TM-4M TIME & FREQUENCY SYSTEM

Spectrum has evolved its highly successful Intelligent Reference/TM-4™ into another innovative product. The TM-4M Time & Frequency System incorporates all of the versatility and functions of the TM-4 and supports mission-critical applications with a built-in uninterruptible power supply.

All of the standard features included in the TM-4 are available, including our phase coherent optimized architecture, Event Time Tag, Programmed Output Pulse, and NMEA-0183 message subset. All optional TM-4 features, such as IRIG time code, NTP output and PL tone generator are also available.

The TM-4M Time & Frequency System features a larger, easier to use form-factor. It was designed for mobile applications that require uninterruptible power, and for applications that require multiple front panel connections. Momentary power outages or accidents wonít disrupt vital tests or destabilize reference applications.

The rechargeable battery/UPS allows the TM-4M to be taken into locations where there is no source of power for up to ten hours of normal operation. It also allows the TM-4M to maintain its timing synchronization while being transported, by holding up power until the unit can again be connected to mains power. For example, the TM-4M can be synchronized to GPS, disconnected from mains power and the GPS antenna, moved to a location without GPS availability and operated in holdover mode. This can be done without loss of precise time or synchronization, because power is always maintained via the built-in UPS. The integrated charger quickly charges the internal SLA battery when depleted and maintains the battery at peak capacity when the unit is not in use.

The six BNC jacks on the front panel are user-assignable to output any signal the user chooses. The TM-4M is half-rack sized, and two units may be operated in tandem and occupy only 1U of rack space. An optional adapter kit is available to rack-mount a single TM-4M.

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Specifications: TM-4M TIME & FREQUENCY SYSTEM

PHYSICAL

HEIGHT:	1.75 in.	(45 mm)
WIDTH:	8.37 in.	(213 mm)
DEPTH:	Case: 9.50 in.	(241 mm)
	Overall: 10.625 in.	(270 mm)
WEIGHT:	4.50 lbs.	(2.04 kg)

ENVIRONMENTAL

OPERATING TEMPERATURE: -20 to +70°C

STORAGE TEMPERATURE: -40 to +85°C

HUMIDITY: Up to 95% R.H., non-condensing

POWER

SUPPLY VOLTAGE: 90 to 264 VAC, 47-63 Hz

POWER CONNECTOR: Rear panel IEC-320, optional MS3112E14-5P on front panel.

UPS BATTERY: Rechargeable SLA, 2.9 Ah

Optional MS3112E14-5P AC power connector

PERFORMANCE (GPS)

RECEIVER TYPE: Twelve parallel channel, code + carrier tracking, CA code, L1 carrier

TIME TO FIRST FIX (typical):

Hot Start: <25 seconds (valid almanac, time, date, position & ephemeris)
Warm Start: <50 seconds (valid almanac, time, date & position)
Cold Start: <200 seconds (no information)

POSITION UPDATE RATE: Once per second

POSITION ACCURACY: Less than15m SEP

PERFORMANCE (TIME)

1 PPS OUTPUT: (Referenced to UTC)

PPS Accuracy: 5 ns RMS
Accuracy while coasting: Generated from primary frequency output

COMMUNICATION

NMEA and SERIAL TIME MESSAGES, NTP

Connector: BNC
Characteristics: RS-232C, 1200-19200 bps. ASCII date and time of next 1PPS epoch. NMEA-0183 messages $GPZDA, $GPRMC and $GPGGA. Optional Type-11 NTP output. Optional data rates of 38.4, 57.6, and 115.2 kbps.

SERIAL CONTROL I/O

Connector: DB-9 female
Characteristics: RS-232C, 9600 bps, simple ASCII command set.

TM-4M shown with optional rack adapter

PERFORMANCE (FREQUENCY)

PRIMARY FREQUENCY: 10 MHz. Other primary frequencies optional. Meets MTIE requirement for Stratum-1 primary clock source.

LONG-TERM STABILITY: $1x10^{-12}$ after 24 hours of tracking. (Δt=24 hours)

SHORT-TERM STABILITY: $1x10^{-11}$ (Δt=1 second)

ACCURACY WHILE COASTING: $5x10^{-10}$ per day after 3 days of locked operation, standard OCXO

PHASE NOISE, 1 HZ BANDWIDTH:

10 Hz: < -124 dBc
100 Hz: < -139 dBc
1 kHz: < -149 dBc
10 kHz: < -151 dBc
100 kHz: < -155 dBc

HARMONIC OUTPUTS: < -50 dBc

SPURIOUS OUTPUTS: < -70 dBc

STANDARD FEATURES

6 independent front-panel outputs
- user-selectable outputs eliminate the need for special cables

Uninterruptible power supply
- built-in rechargeable sealed lead-acid battery allows for up to 10 hours of operation without AC and prevents catastrophic loss of power

Intelligent charging
- charging circuit keeps the internal battery at peak capacity and will not overcharge

Real-time sawtooth PPS correction
- reduces PPS jitter to less than ±5 ns

User-selectable filtered PPS output
- improves PPS jitter performance further to ±2.5 ns by deriving it from the primary reference frequency, after lock

Optimized architecture for phase-coherency
- very high unit-to-unit consistency
- ideal for simulcast and TDoA applications

Programmed Output Pulse (POP)
- user programmable, precise output pulses
- one-shot and repeat modes

Event Time Tag (ETT)
- snapshot date and time of external signal event
- 4 ms latency between events
- up to 30 events per second

NMEA and ASCII time messages
- user-selectable message format on separate RS-232 serial channel

User Time Bias
- compensates for antenna cable length and system delays
- sets absolute timing accuracy and synchronization with other system components

Two TM-4Ms shown in 1U rack configuration

OPTIONS

- Single or two units in 1U rack space
- IRIG and/or NASA-36 serial time code
- NTP output
- Filtered timing pulse
- GPS-corrected auxiliary frequency output
- Coherent CTCSS (PL) tone generator
- Secondary sine wave output (x2)
- Higher baud rates for serial time messages
- Substitute other frequency for primary output
- Custom multiplexer and/or other outputs
- Custom functions
- Rack handles for 1/2 width rack mount

AVAILABLE OUTPUTS

All signals are generated by the internal Intelligent Reference/TM-4™. For complete details, refer to the specification sheet or user manual for the TM-4.

DIGITAL: TTL levels into 50Ω. Accuracy same as primary frequency. Rising edge on time where applicable. Rise time 10ns (max), except as noted.

- **1 PPS OUTPUT**
- **PROGRAMMED OUTPUT PULSE**
- **MULTIPLEXER OUTPUTS**

MUX 1: 1,10,100 kHz, 1,5,10 MHz, PPS, baseband IRIG (optional)
MUX 2: 10 MHz, Mux 1 mirror, PPS, optional baseband IRIG and/or NASA-36, custom outputs 1 - 3

OPTIONAL FILTERED TIMING PULSE

Frequency: Virtually any frequency up to 100 kHz
Output: Positive pulse, 10 μsec width, nominal
Characteristics: Coherent with primary frequency output. Leading edge synchronized with average value of PPS from GPS receiver. Very low jitter.

OPTIONAL PLL FREQUENCY SYNTHESIZER

Frequency: Virtually any frequency to 125 MHz
Rise/Fall Time: 2 ns, maximum

OPTIONAL AUXILIARY FREQUENCY OUTPUT

Frequency: GPS-locked, VCXO-derived

ANALOG: Characteristics as noted.

PRIMARY FREQUENCY OUTPUT

Signal: High spectral-purity sine wave, +10 dBm into 50Ω, ±2dB

OPTIONAL SECONDARY SINE WAVE OUTPUT

Characteristic: Identical to or independent of primary reference output

OPTIONAL IRIG/NASA-36 TIME CODE OUTPUT

Output Level: 2.7 V_{ptp} into 600Ω
Modulation Level: 3.3:1

OPTIONAL CTCSS (PL) TONE GENERATOR (x2)

Frequency: Selectable from predetermined standard tone frequencies of 67.0 Hz to 250.3 Hz

HARDWARE FAULT ALARM OUTPUT

Open collector with software message

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