INTELLIGENT REFERENCE/TM-4D™

PRECISE TIME & FREQUENCY REFERENCE WITH MULTIPLE DIGITAL AND ANALOG OUTPUTS

The Intelligent Reference/TM-4D™ breaks new ground for time and frequency references. For the first time, you can generate and distribute both analog and digital signals to multiple instruments and locations with just one product– and it all fits in a single rack space. It's three instruments in one– an Intelligent Reference/TM-4™ precise time and frequency reference, a digital signal distribution amplifier and an analog distribution amplifier– and it eliminates the need for multiple boxes!

The TM-4D incorporates our market-proven TM-4/OEM™ and vastly increases its capabilities. It takes the single primary frequency output of the TM-4 and expands it to as many as 12 analog outputs. Similarly, the digital signals generated by the internal TM-4 may be distributed to as many as 24 outputs. Even more exciting, you can optionally supply external signals and distribute them along with or in place of any of the internally-generated signals.

The Intelligent Reference/TM-4D™ is incredibly versatile. The analog section is divided into two banks which can operate either independently or slaved together. The digital section is divided into four banks which may also operate independently or slaved. You can distribute internally generated and optional externally supplied signals in any combination you choose.

We've also built upon the capabilities of the internal TM-4/OEM™ to make the new TM-4D even more useful. Because the internal reference is available with an IRIG serial time code output, the Intelligent Reference/TM-4D™ is an ideal distributed serial time code generator. There's even an option to incorporate two additional frequency synthesizers that can generate custom analog or digital signals up to 125 MHz. Combined with the optional synthesizer capability that's built into the internal TM-4, that means you can have up to three additional custom signals, all locked to the GPS-disciplined primary reference frequency.

The Intelligent Reference/TM-4D™ is so versatile, it might be the only reference you'll ever need.

Spectrum INSTRUMENTS, INC.

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Specifications: INTELLIGENT REFERENCE/TM-4D™

PHYSICAL (TM-4D)

HEIGHT:	1.72 in.	(44 mm)
WIDTH:	Front panel: 18.95 in.	(481 mm)
	Rear case: 17.7 in.	(449 mm)
DEPTH:	Case: 8.375 in.	(213 mm)
	Overall: 9.00 in	(229 mm)
WEIGHT:	6.75 lbs.	(3.07 kg)

ENVIRONMENTAL (TM-4D)

OPERATING TEMPERATURE: -20 to +70°C

STORAGE TEMPERATURE: -40 to +85°C

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

ENVIRONMENTAL (ANTENNA)

OPERATING TEMPERATURE: -45 to +85°C
HUMIDITY: water resistant, all weather

POWER

INPUT SUPPLY VOLTAGE: 12 to 35 VDC, 24 VDC nominal

INPUT CONNECTOR: 2.5mm coaxial

POWER CONSUMPTION: 3.4 watts after warm-up. Low-power option available.

ANTENNA POWER OUT: 5 VDC, 20 mA

GPS BACKUP: Rechargeable lithium battery

OSCILLATORS

STANDARD FREQUENCY: 10 MHz
HIGH-PERFORMANCE OCXO: standard
TCVCXO: optional
OPTIONAL FREQUENCIES: 5, 12.8, 13 MHz
• consult factory for additional oscillator options

PERFORMANCE (GPS)

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

TIME TO FIRST FIX (typical):
Hot Start: <15 seconds (valid almanac, time, date, position & ephemeris)
Warm Start: <40 seconds (valid almanac, time, date & position)
Cold Start: <60 seconds (no information)

POSITION UPDATE RATE: Once per second, nominal

POSITION ACCURACY: Less than15m SEP

PERFORMANCE (TIME)

1 PPS OUTPUT: (Referenced to UTC)

Accuracy: 25ns RMS
Accuracy while coasting: Same as primary frequency output

PERFORMANCE (FREQUENCY)

PRIMARY FREQUENCY: 10 MHz. 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

16 buffered digital outputs
• distribute as many as four different signals to any combination of four digital output banks

8 isolated analog outputs
• distribute up to two different signals to either or both analog output banks

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
• Spectrum-format serial time message
• NMEA messages $GPZDA, $GPRMC and $GPGGA

User Time Bias
• compensation for antenna cable length and system delays
• absolute timing accuracy and synchronization with other system components

OPTIONS

• External signal inputs, front and/or rear, BNC
• IRIG and/or NASA-36 serial time code
• NTP output
• Filtered timing pulse
• Three GPS-corrected PLL frequency synthesizers
• 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
• Customized user software

AVAILABLE OUTPUTS

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
Polarity: Positive
Pulse Width: 1 ms nominal

PROGRAMMED OUTPUT PULSE
Pulse Width: User-selectable, 1 μsec - 250 ms
Polarity: Selectable

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 base-band IRIG and/or NASA-36, custom outputs 1 - 3

OPTIONAL FILTERED TIMING PULSE
Frequency: Virtually any frequency up to 100 kHz, such as 25 Hz, 216.66 Hz, etc. Factory set.
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 desired, up to 125 MHz. Factory set.
Rise/Fall Time: 2 ns, maximum

OPTIONAL AUXILIARY FREQUENCY OUTPUT
Frequency: GPS-locked, VCXO-derived. Divide or multiply possible. Factory set.

ANALOG: Characteristics as noted.

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

OPTIONAL SECONDARY SINE WAVE OUTPUT
Identical to or independent of primary output

OPTIONAL IRIG/NASA-36 TIME CODE OUTPUT
Output Level: 2.7 V_{pp} into 600Ω
Modulation Level: 3.3:1

OPTIONAL PLL FREQUENCY SYNTHESIZER
Frequency: Virtually any frequency desired, up to 125 MHz. Factory set.
Signal: Same characteristics as primary frequency

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

COMMUNICATION

SERIAL TIME MESSAGE/NMEA MESSAGES/NTP
Connector: DB-15HD female
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

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