EndRun TECHNOLOGIES
"Smarter Timing Solutions"

Tycho *GPS Frequency Reference*

Ultra-Precise Time and Frequency Standard

The Tycho GPS Frequency Reference is a high-performance and cost-effective unit designed specifically for time and frequency applications. The Tycho includes 1 PPS and IRIG-B as outputs and a standard network port supports many protocols including TELNET, FTP and DHCP. The highly-integrated solid state design yields a conservative MTBF of 225,000 hours, giving many years of trouble-free service. The unit can be remotely managed via SNMP, SSH, TELNET, or via a local console on the RS-232 serial port. A quartz oscillator upgrade is available to improve holdover and short-term stability.

FEATURES

- Timing Accuracy: < 20 Nanoseconds RMS to GPS Time
- Frequency Accuracy: $< 1 \times 10^{-13}$
- 1 PPS Output
- IRIG-B Timecode Output
- Network Port with Telnet, FTP, SNMP, SSH
- Oscillator Upgrade Option
- Low-Phase-Noise Output Option
- Pulse Rates and DC-Level-Shift Timecode Options
- Static or Dynamic Modes of Operation

GPS Timing and Frequency Control

Utilizing a Global Positioning System (GPS) receiver with advanced algorithms, the Tycho GPS Frequency Reference uses the GPS transmissions to precisely synchronize itself to <20 nanoseconds RMS to GPS Time. The frequency of the internal oscillator is disciplined to match the frequency of the UTC timescale to parts in 10^{14} level-of-accuracy over 24-hour observation intervals. The time and frequency outputs are coherent after initial GPS synchronization, and synchronization is maintained via 20-bit DAC frequency control, rather than phase stepping, to provide the ultimate in short-term stability.

Standard Features

In addition to sourcing a precision 1 PPS timing reference this unit provides a user-selectable timecode output. Choices are IRIG-B, NASA-36 or 2137. The Tycho can be managed via the network port or an RS-232 port.

Secure Network Interface

An ethernet port is provided as a standard feature of the Tycho Frequency Reference with a wide variety of network protocols including TELNET, FTP, DHCP, SSH and SNMP with Enterprise MIB. The incorporation of SNMP v3 and SSH provides the ultimate in network security and allows the safe performance of monitoring and maintenance activities. Security-conscious users can also disable any of the risky protocols such as Telnet. In addition, access via SSH, SNMP and Telnet can be restricted to specific hosts.

Two-Year Warranty

The Tycho is backed by a full two-year warranty against defects in material and workmanship. Free technical support and software upgrades are available for life.

Money-Back Guarantee

If your standard Tycho does not meet your time and frequency needs for any reason, simply return it within 60 days for a full refund less shipping fees. See www.endruntechnologies.com/guarantee.htm for more information.

A clean and reliable solid-state design.

Tycho GPS Frequency Reference
Specifications

GPS RECEIVER:
- L1 Band - 1575.42 MHz.
- 8 Channels, C/A Code.

ANTENNA:
- TNC jack on rear panel, Z_{in} = 50Ω.
- Integral +35 dB gain LNA and filter for out-of-band interference rejection.
- Operation over -40° to +85°C temperature extremes.
- Mounting via 18" long, ¾" PVC pipe with clamps.
- 50' low-loss RG-59 downlead cable is standard. Other lengths are optional.

LOCAL OSCILLATOR:
- TCXO: $2.5x10^{-6}$ over -20° to 70° C,
  < 10 ms holdover at 24 hours, 5° C max delta.
- MS-OCXO (option): $4x10^{-9}$ over 0° to 70° C,
  < 100 us holdover at 24 hours, 5° C max delta.

TIME TO LOCK:
- < 5 minutes, typical (TCXO). < 10 minutes, typical (MS-OCXO).

1 PPS CHARACTERISTICS:
- 1 PPS: Positive TTL pulse into 50Ω or optional RS-422 levels.
- User-Selectable Width: 20 us, 1 ms, 100 ms, 500 ms.
- User Calibration: +/- 500 us, 1 ns resolution.
- Stability: TDEV < 10 ns @ $\tau < 10^5$ secs, $\sigma_y(\tau) < 1x10^{-13}$ @ $\tau=10^5$ secs.
- Accuracy: < 20 nanoseconds RMS to GPS Time when locked.
  <10 nanoseconds RMS to GPS Time with 10-Nanosecond Calibration Option.
  <100* ns to UTC when locked.
  *Constraints in the official GPS spec prohibit claiming an accuracy to UTC better than 100 ns.

TIMECODE CHARACTERISTICS:
- Signal: Amplitude-modulated (AM), 3:1 ratio, 1 kHz carrier.
- Drive: 1 Vrms into 50Ω.
- User-Selectable Format: IRIG-B120 (IEEE-1344), IRIG-B122, IRIG-B123, NASA-36, or 2137.

NETWORK I/O:
- Rear-panel RJ-45 jack.
- AMD PC-Net Fast III 10/100Base-T Ethernet.

SUPPORTED NETWORK PROTOCOLS:
- SSH server with "secure copy" utility, SCP.
- SNMP v1, v2c, v3 with Enterprise MIB.
- TELNET client/server.
- FTP and DHCP clients.
- TIME and DAYTIME server.
- SYSLOG.
- IPv4, IPv6 and IPv4/IPv6 Hybrid.

SERIAL PORT I/O:
- RS-232 serial I/O on rear-panel 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: Green LED pulses to indicate lock status.
- Network LED: Amber LED indicates network activity.
- Alarm LED: Red LED indicates a serious fault condition.

FIRMWARE UPGRADES:
- Software is field-upgradeable and provided free-of-charge.

POWER:
- 90-264 VAC, 47-63 Hz, 0.5A Max. @ 120 VAC.
- 110-370 VDC, 0.5A Max. @ 120 VDC.
- 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: 2.5" high x 3.5" diameter.

ENVIRONMENTAL:
- Temperature: 0° to +50° C.
- Humidity: 0 to 95%, non-condensing.

COMPLIANCE:
- CE, FCC.

OPTIONS:
- Medium-Stability OCXO, 5&10 MHz Low-Phase-Noise Outputs, 10 MPPS, 1 MHz, Alarm, DC-Shift Timecode, User-Selectable Pulse Rate Outputs, -48 Vdc Input, 10-Nanosecond Calibration, Additional RS-232 Serial Port. More options available - call us with your requirements.

LOW PHASE NOISE CHARACTERISTICS - (option):
- Quantity: 4 or 8 outputs on rear-panel BNC connectors.
- Frequency: 5 or 10 MHz.
- Output Level @ 50Ω: +13 dBm, +/- 2 dBm.
- Harmonics @ 50Ω: < -45 dBc.
- Channel-Channel Isolation: > +75 dB.
- Phase Noise dBc/Hz (with MS-OCXO) @ 10 MHz:

1 Hz	-95 dBc
10 Hz	-120 dBc
100 Hz	-135 dBc
1 kHz	-145 dBc
10 kHz	-145 dBc
100 kHz	-145 dBc

PULSE RATE CHARACTERISTICS - (option):
- Pulse: TTL squarewave into 50Ω.
- User-Selectable Rates: 1, 10, 100, 1K, 10K, 100K, 1M, 5M, 10M PPS or DC-Shift Timecode.
- Accuracy: $< 10^{-13}$ to UTC for 24-hour averaging times when locked.
- Stability (Allan Deviation):

Tau in Secs	TCXO	MS-OCXO
1	$1x10^{-9}$	$3x10^{-12}$
10	$4x10^{-10}$	$4x10^{-12}$
100	$5x10^{-11}$	$5.5x10^{-12}$
1000	$7x10^{-12}$	$5x10^{-12}$
10000	$1x10^{-12}$	$1x10^{-12}$
100000	$1x10^{-13}$	$1x10^{-13}$

DC-SHIFT TIMECODE CHARACTERISTICS - (option):
- Signal: TTL squarewave into 50Ω.
- User-Selectable Formats: IRIG-B000, IRIG-B002, IRIG-B003

ALARM CHARACTERISTICS - (option):
- Open Collector, 40V Max, 100 mA Max Saturation Current.
- High impedance after signal loss or at major hardware fault.

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Data subject to change.