



FE-5667B

High-Performance Rubidium Oscillator

STANDARD FEATURES

- Self-Calibrating Using External 1PPS Input
- Conformal coating of PWBs per IPC-CC-830, Type XY, Parylene
- Operates In GPS Denied Applications
- Maintains 1 Hz and 10 MHz Without External 1 PPS Input
- One 10 MHz Outputs
- Six 1 Hz Outputs
- Controlled Over RS-232 port
- +12 V DC Operation

DESCRIPTION

The FE-5667B is a self-contained module that installs in your system. The module consists of a high precision 10 MHz rubidium frequency source disciplined by an external 1PPS input source. The module is self-calibrating, using the 1PPS input to compute calibration data to improve its accuracy on the subsequent Power ON operation. In the absence of external 1PPS input, the module maintains the 1 Hz and the 10 MHz frequency outputs, enabling continued operation of the system. The module is designed to provide low phase noise, stable time interval outputs in the presence of tactical vibration levels. The module supplies one (1) 10 MHz and six (6) 1 Hz outputs. Your system can control the module with messages over RS-232 port. The module is conduction cooled through its base plate and operates from +12Vdc.

DESIGN FEATURES

The FE-5667B is designed for use in harsh environments. The key updates to the electronics which make possible significant improvement to the performance generally obtained for this class of oscillator are listed below:

- Active Acceleration Compensation to reduce phase noise under vibration
- Direct Synthesis to generate Rb Hyperfine resonance Frequency of ~6.8GHz to eliminate step recovery diode which limited frequency stability in the past
- Proprietary time interval counter allows the disciplining loop adjustments to the frequency with a resolution of <1E-14, and phase adjustment to <0.8ns.
- Adjustments are made via external commands to the direct digital synthesizer.

Package Outline-Pin out available from factory

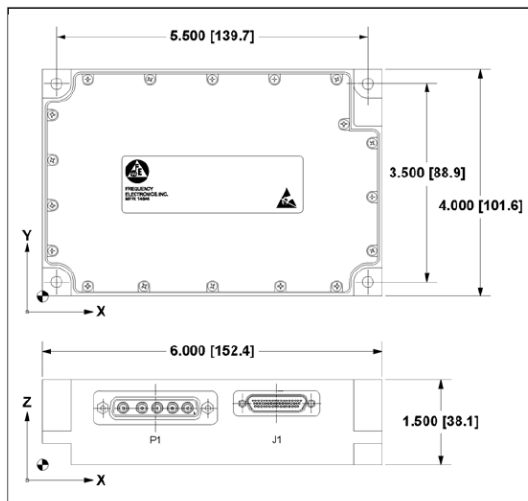


Figure 1. Outline drawing of Rb oscillator.
Dimensions are in inches [millimeters]. Weight: <1.82lbs



Figure 2. Photograph of disciplined rubidium oscillator



FE-5667B SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

FREQUENCY

- Frequency accuracy at shipment: $\leq \pm 5.0 \text{E-}11$ (@ +25°C)
- Frequency control
 - Resolution of $< 1 \text{E-}14$, and phase adjustment to $< 0.8 \text{ns}$.
- Frequency retrace $\leq \pm 2.5 \text{E-}11$ (on-off-on: 24h, 48H, 24H at 25°C)
- Aging
 - $< 2.0 \text{E-}11$ /Month
 - 20 years: $\leq \pm 5.02 \text{E-}9$

RF Output-10MHz-Short circuit protected

- 10 MHz output can be enabled/disabled via RS-232
- Format: Sinewave- Qty: 1
- Amplitude: $+7.6 \pm 1.0 \text{dBm}$
- Load impedance: 50 ohm@10MHz
- Return loss at 10MHz (source and load)
 - $> 15 \text{dB}$
- Phase Noise under Operating Vibration (Profile below)

1Hz	10 Hz	100 Hz	1kHz	10kHz	
-102	-132	-142	-152	-152	

Note : 20 dBc/Hz out of spec from 100Hz to 150Hz is acceptable.

- Spurs
 - $< -85 \text{dBc}$ H
- armonics:

20 MHz	30 MHz	40 MHz
-37	-50	-56

Short-Term Stability

1 second $< 4 \text{E-}11$

10 second $< 1.26 \text{E-}11$

100 second $< 4 \text{E-}12$

g-sensitivity to meet phase noise under vibration requirement

- Connector: Positronics P/N CBM5W5MO500S

Inserts P/N MRT4201D

Mates with P/N

CMB5W5F000E2S Contacts P/N

FS4101D-15

Note: Prefer SMA connector for 10MHz

1PPS Output: Qty 4 EIA/TIA-644 LVDS

Qty 2 EIA/TIA-422

- 1 Hz outputs can be individually enable/disable via the RS-232

• Rise time: $< 50 \text{nS}$

• Pulse width: $< 20 \mu\text{S}$

• Level: $> 4.5 \text{V}$ (15pF Load)

• Jitter: $< 1 \text{ns}$ RMS

• Connector: Tyco P/N MCK-N1-P-51S-RT1

Mates with P/N MCK-C2-RM-51PSN

Prefer High density DE-15 connector

PERFORMANCE PARAMETERS

Rubidium Lock

Time to lock: $< 6 \text{min}$

Warm-up Frequency (No disciplining input signal) Time to $< 2.0 \text{E-}10$: $< 10 \text{min}$ over temperature

Magnetic Field Sensitivity-5X Better Performance

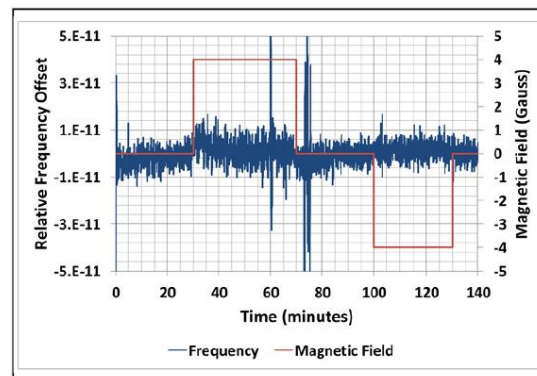


Figure 9. Magnetic field sensitivity of Rb oscillator, **un-disciplined**. Frequency change is shown of the left axis, corresponding magnetic field on the right axis.



FE-5667B SPECIFICATIONS

Operation

States of Operation

- Startup
 - Initialize
 - Power on Self Test
 - Warm-up
- Operation
 - Unaided
 - Frequency adjustment
 - Auto-Calibration
 - Built-In-Test (See operating Instructions for status messages)
 - Power On Self Test
 - Continuous BIT
 - Initiated BITS

Logical Interfaces

- RS-232 Communication to control, request FE-5667B Status, and adjust Frequency Output of the FE-5667B with resolution $<1E-14$.

FE-5667B TOD to User

- 1 Hz Outputs
 - Four (4) 1 Hz timing signals per EIA/TIA-644 LVDS, ICD-GPS-153C
 - One (1) 1 Hz timing signal per EIA/TIA-422 for external timing user, ICD-GPS-153C
- The FE-5667B provides a 1Hz interface to the user processor, via EIA/TIA-422.

Output Synchronization

- 1Hz to 10MHz $<30ns$
- 1 Hz Output to Output skew $<0.6ns$
- Phase alignment- 1Hz to 10 MHz $<30ns$
- Phase Lock- 1Hz to 10MHz, $\pm 1Hz$ in one second
- Re-Synchronization- 1Hz to 1PPS $<30ns$ in 60 sec.

Maintenance Interface

- A maintenance Interface capable of Software and Firmware upgrades while the FE-5667A is installed
- The Maintenance Interface is bi-directional and conforms to EIA/TIA-232

ENVIRONMENTAL & PHYSICAL SPECIFICATIONS

- Temperature
 - Operating: $-40^{\circ}C$ to $+82^{\circ}C$
 - baseplate Storage: $-55^{\circ}C$ to $+85^{\circ}C$
- Sensitivity: $<3E-11$ ($-25^{\circ}C$ to $+75^{\circ}C$)
- Altitude
 - Operating: -1312 to 40,000'
 - Non-operating: -1312 to 70,000'
- Magnetic sensitivity: dc ($\pm 4Gauss$)
 $\leq 1.0E-11/Gauss$
- RH (operating): prolonged exposure to relative humidity as high as 100% at all air temperatures up to $+120^{\circ}F$ IAW MIL-STD-810F, Method 507.4.
- Operating Vibration: As specified in Figure below.
- EMI/EMC: Compliant to MIL HDBK-461E, RE102. Figure RE102-4 (Navy mobile and Army limit) from 1 MHz to 1 GHz relaxed by 20 dB.
- MTBF: MIL-HDBK-217F, Notice 1 and Notice 2, Ground Mobile environments 55,000 hours
- Conformal coating of PWBs per IPC-CC-830, Type XY, Parylene

Power

- Max input (Amps) @ $12V \pm 0.6V$: $\leq 3.3A$ over temperature, 2.5A SS at $-32^{\circ}C$
- Voltage sensitivity: $0.72E-11/V$ (over input voltage range)
- Input voltage range: $+12VDC \pm 0.6 Vdc$
- Regulation: $\pm 5\%$
- Ripple: 100mv p-p, dc-20MHz
- Overvoltage limit: $+15vdc$

Operating Vibration Profile

