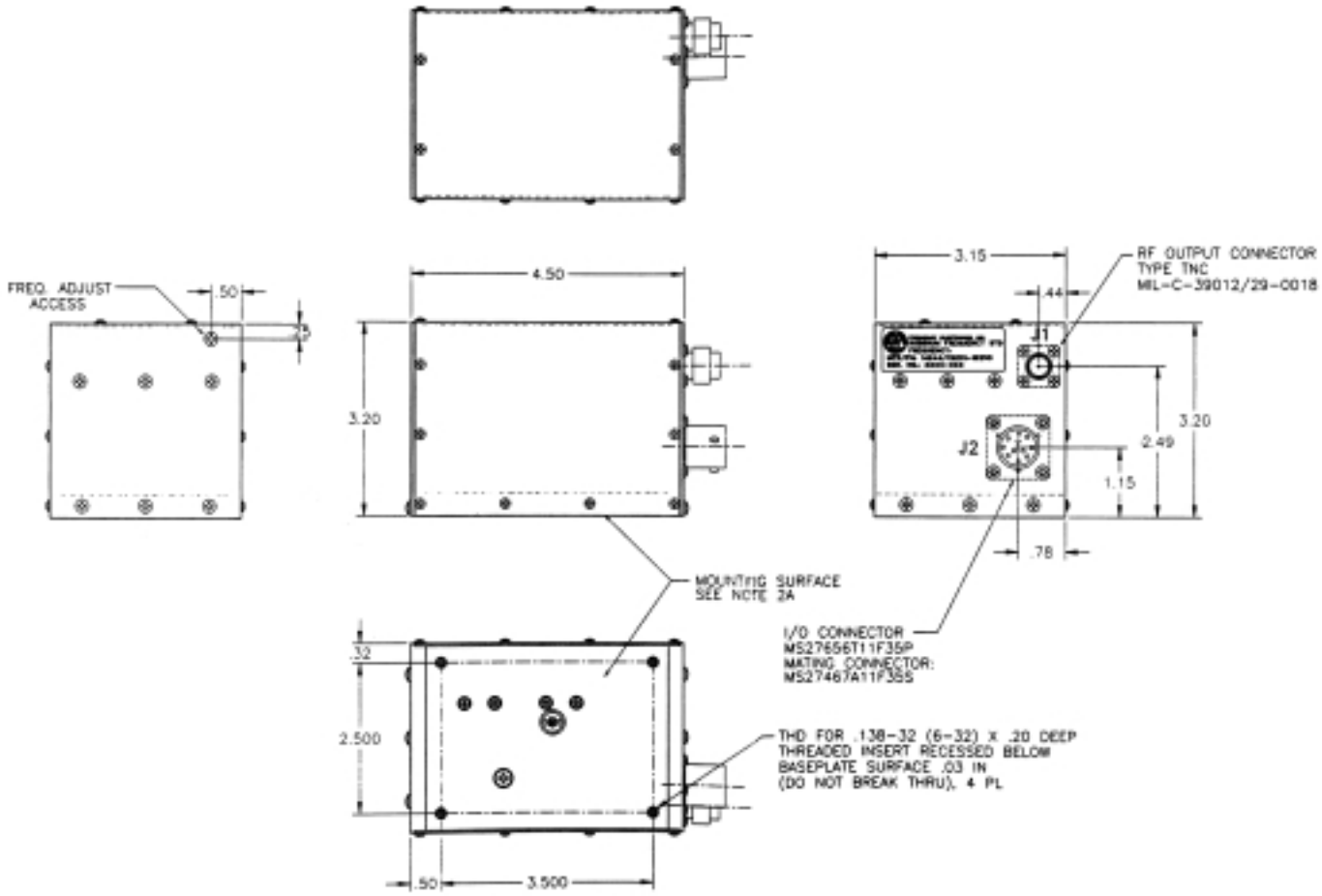
OUTLINE DRAWING



FEIC Has a Full Line of Commercial Rubidium Frequency Standards.

FEI Communications, Inc.
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RUBIDIUM ATOMIC FREQUENCY STANDARDS

FE-5600M SERIES

FEATURES

- FAST WARM-UP
- MIL-E-5400 CLASS II
- LIGHTWEIGHT-SMALL-RUGGED
- RAW AIRCRAFT POWER OPERATION
- MODULAR CONSTRUCTION

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TECHNICAL CHARACTERISTICS

ELECTRICAL

@ 25°C (unless otherwise specified)

FREQUENCY: 10 MHz

SETTABILITY (Frequency): $\pm 1 \times 10^{-11}$

ADJUSTMENT RANGE: 3×10^{-9}

LONG TERM STABILITY: 4×10^{-11}/mo.
2×10^{-10}/year

SHORT-TERM STABILITY:

AVERAGING TIME (SEC):	f/f
10^{0}	1.4×10^{-11}
10^{1}	4.4×10^{-12}
10^{2}	1.4×10^{-12}

SSB PHASE NOISE:

OFFSET FROM SIGNAL: 10MHz
Phase noise (1 Hz BW)

Hz	dBc
10^{1}	90
10^{2}	125
10^{3}	145

WARM-UP TIME: <4 min. to 5×10^{-10} @ 25°C
<10 min. to 5×10^{-10} @ -55°C

RETRACE: 1×10^{-11} when measured at the same temperature, power off <24 hrs.

OUTPUT VOLTAGE: 0.5 VRMS into 50 ohms

HARMONIC DISTORTION: -30dB

NON- HARMONICALLY RELATED OUTPUT: -60dB

VOLTAGE VARIATION: $<1 \times 10^{-11}$ for input voltage range

POWER CONSUMPTION:

	25°C	-55°C
During Warm-Up:	45 watts max	45 watts max
After Warm-Up:	15 watts max	20 watts max

VOLTAGE REQUIRED: MIL-STD-704, 22 TO 32 Vdc

ENVIRONMENTAL

TEMPERATURE

Operating: -55°C to +71°C baseplate frequency change $<\pm 3 \times 10^{-10}$

Non-Operating: -62°C to +95°C

HUMIDITY: MIL-STD-810, Method 507.1, Proc. 1

TEMPERATURE SHOCK: MIL-E-5400, Class II except 71°C baseplate 0-40°F and Class I curve A>40,000 ft.

MAGNETIC FIELD: 2×10^{-11} per Gauss (worst case orientation)

PRESSURE: 1×10^{-13}/m bar

ACCELERATION: $<2 \times 10^{-9}$/g

VIBRATION: Random-MIL-STD-810 Method 514.2 (5 g rms)
Sine - MIL-STD-810 Method 514.2,Proc. VIII (Curve W)

SHOCK

Bench: MIL-STD-810, Method 516.2, Half sinewave 20g peak, 11 millisec duration

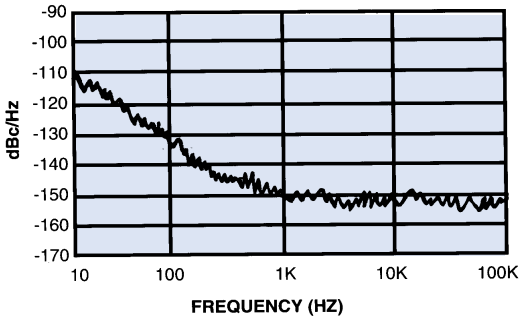
OPERATIONAL: MIL-STD-810, Method 516.2, Proc. 1

EMC/EMI: MIL-STD-462

WEIGHT: <2.5 pounds

SIZE: 3.25” x 3.25” x 4.5”

Typical Phase Noise vs. Frequency



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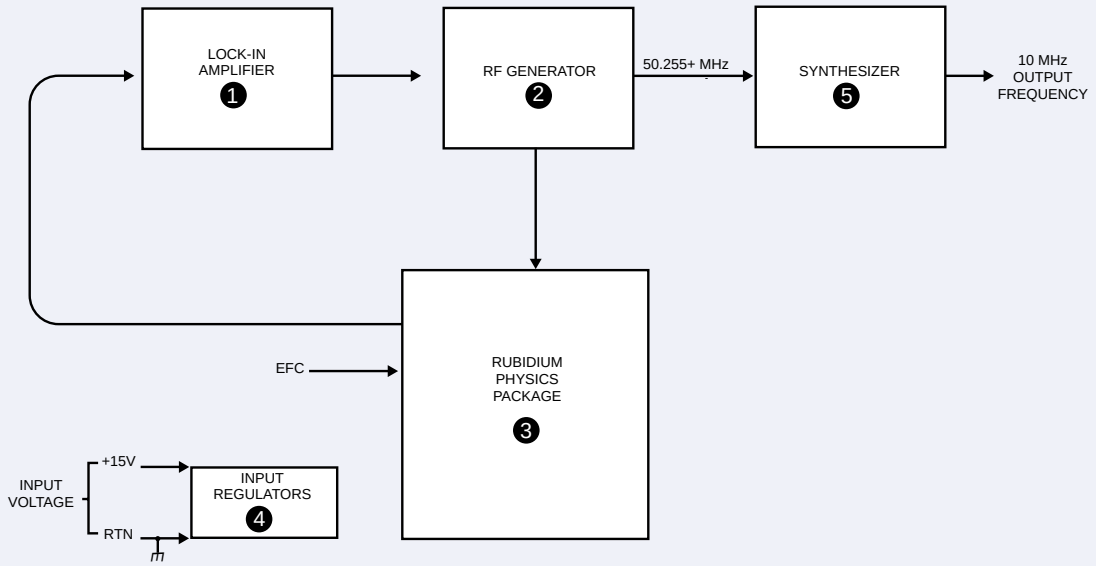

FUNCTION DESCRIPTION

The RFS uses the property of atomic resonance in a Rubidium Physics Package to control the output frequency of a 50.255+ MHz Voltage Controlled Crystal Oscillator (VCXO) via a Frequency Lock Loop (FLL). The FLL functional blocks consist of an RF Generator, Lock-in Amplifier and the Rubidium Physics Package. Frequency locking of the VCXO is accomplished by operating the Rubidium Physics Package as a frequency discriminator, i.e., departures of a frequency derived from an input signal (50.255+ MHz from the VCXO) from a defined center frequency (Rubidium atomic resonance) produce a DC output signal (control voltage). Once the FLL has been established, the system generates a loop-locked indication which can be monitored on pin 3. Depending on the option selected, the 50.255+ MHz VCXO output is used as the clock input for the DDS within the Synthesizer, the Digital Programmable Synthesizer or Buffer Amplifier.

The Rubidium Physics Package utilizes the ground-state hyperfine transition of the Rubidium atom, at approximately 6.8+ GHz. In order to use this atomic transition, the Rubidium Physics Package incorporates a Rubidium cell, Rubidium lamp, and servo electronics. The VCXO is locked to the Rubidium atomic resonance at 6.8+ GHz. The VCXO frequency of 50.255+ MHz is an exact sub-multiple (x136) of the atomic resonance frequency at 6.8+ GHz.

The error signal is generated in the physics package. Light from the Rubidium lamp, produced by an excited plasma discharge, is filtered and passed through the Rubidium resonance cell where it interacts with Rubidium atoms in the vapor. After passing through the resonance cell, this light is incident upon a photocell. When the applied microwave frequency is equal to 6.8+ GHz, the Rubidium atoms are resonated by the microwave field in the cavity; this causes the light reaching the photocell to decrease. The decrease in light, when the microwave frequency is equal to the sharply defined Rubidium frequency, is then converted electronically to an error signal with phase and amplitude information that is used to steer the VCXO via its control voltage and keep it on frequency at 50.255+ MHz.

The input frequency is provided from a digitally Programmable Synthesizer.

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