MODEL FE-5668B

Very High-Performance GPS Disciplined Rubidium Oscillator

STANDARD FEATURES

- Self-Calibrating Using GPS
- Interfaces With GB-GRAM/MPE-S
- Operates In GPS Denied Applications
- 24 Hr Holdover—245 ns rms with environment
- Maintains 1 Hz and RF Without GPS Data
- One sinewave RF Output (select at purchase 5 MHz to 200 MHz)
- One 1 Hz Outputs
- Controlled Over I^2C Bus
- +15 V DC Operation

DESCRIPTION

The FE-5668B is a self-contained module that consists of a high precision 10 MHz rubidium frequency source disciplined by an external 1PPS source. The module can be disciplined to a precision 1PPS input signal (GPS) to compute calibration data to improve its accuracy. In the absence of GPS data, the module maintains the 1 Hz and the RF frequency outputs, enabling continued operation of the system during a GPS denied period. The module is designed to provide low phase noise, stable time interval outputs in the presence of tactical vibration levels. The module supplies one RF output and one1 Hz output. The FE-5668B is controlled with messages over a serial interface (LVTTL, USB, or RS-232). The module is conduction cooled through its base plate and operates from +15Vdc.

DESIGN FEATURES

The FE-5668B 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 Obtain ≤5E-11/g sensitivity to reduce phase noise under vibration
- Direct Synthesis to generate Rb Hyperfine resonance Frequency of ~6.8GHz
- Proprietary time interval counter allows the disciplining loop adjustments to the frequency with a resolution of <1E-15, 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. Photograph of disciplined rubidium oscillator

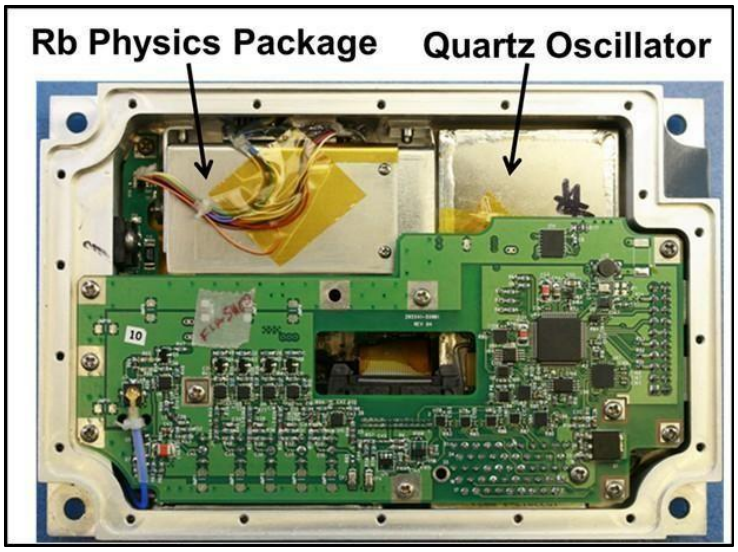

Figure 2. View of Rb oscillator with cover removed

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FE-5668B SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

Frequency

- Frequency accuracy at shipment: <±5.0E-11 (@ +25ºC)
- Frequency control
  - Resolution of <1E-15, and phase adjustment to <0.8ns.
- Frequency retrace <±2.5E-11 (on-off-on: 24h, 48H, 24H at 25ºC)
- Aging
  - Monthly (after 1 month): <±5.0E-11/Month <1.0E-11/Month (option)
  - 10 years: <±1.0E-9

RF Output-select at time of order any frequency between 5 MHz and 200 MHz

- Format: Sinewave
- Amplitude: +10 ± 1.5dBm
- Load impedance: 50 ohm
- Return loss (source and load) > 15 dB

Static Phase Noise (dBC/Hz), 10 MHz

1 Hz	10 Hz	100 Hz	1 kHz	10kHz	2MHz
-110	-140	-150	-155	-155	-155

Spurs: (100Hz to 10kHz offset) , -80 dBc/Hz

Harmonics: -35 dBC

Frequency Stability (Allan Deviation)

Averaging Time (seconds)	Allan deviation
1	1E-11
10	3E-12
100	1E-12
1000	3E-13

1PPS Output: Qty 1 LVCMOS Micro D

- Rise time: <50nS
- Pulse width: <20µS
- Level: >3.3V (15pF Load)
- Jitter: <1ns RMS

Power

- 10 Watts maximum steady state at +25 deg C

ENVIRONMENTAL SPECIFICATIONS

- Temperature
  - Operating: -40ºC to +75ºC baseplate
  - Storage: -55ºC to +85ºC
  - Frequency Sensitivity: <3E-11 (-25ºC to +75ºC)
- Altitude
  - Operating: -200 to 40,000'
  - Non-operating: -200 to 70,000'
- Magnetic sensitivity: dc (±4Gauss): ≤1.0E-11/Gauss
- Relative Humidity (operating): prolonged exposure to relative humidity as high as 100% at all air temperatures up to +120 °F IAW MIL-STD-810F, Method 507.4.

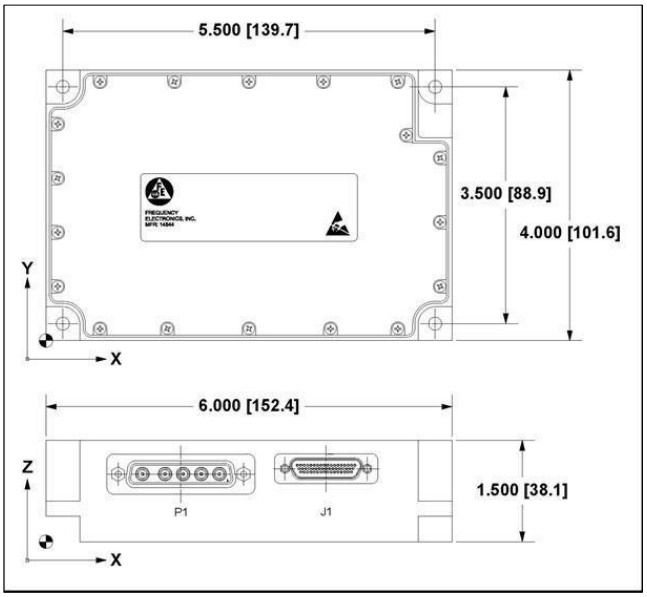

Figure 3. Outline drawing of Rb oscillator.

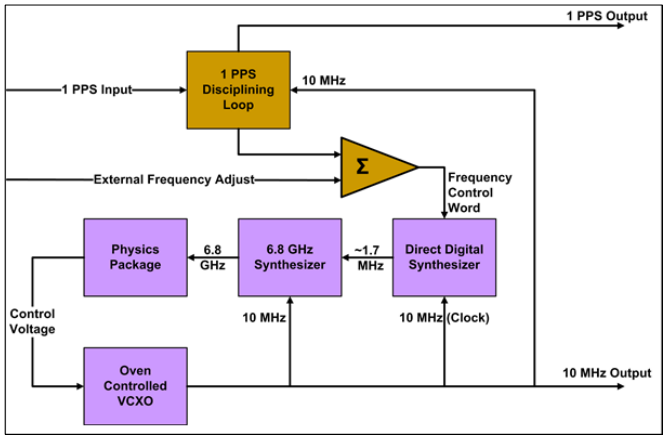

Figure 4. Block diagram of Rb oscillator

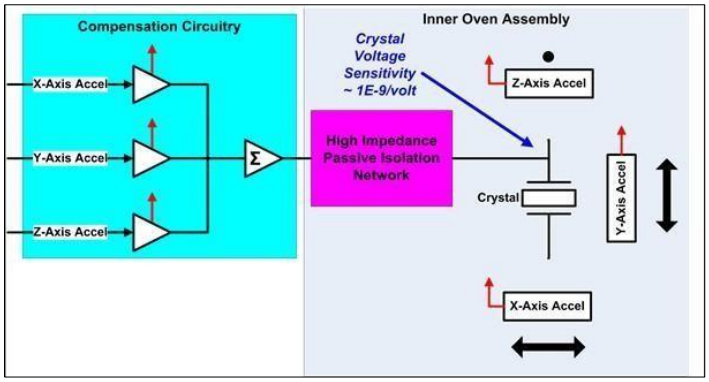

Figure 5. Block diagram of acceleration compensation circuitry

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PERFORMANCE CHARACTERISTICS

Short Term Frequency Stability

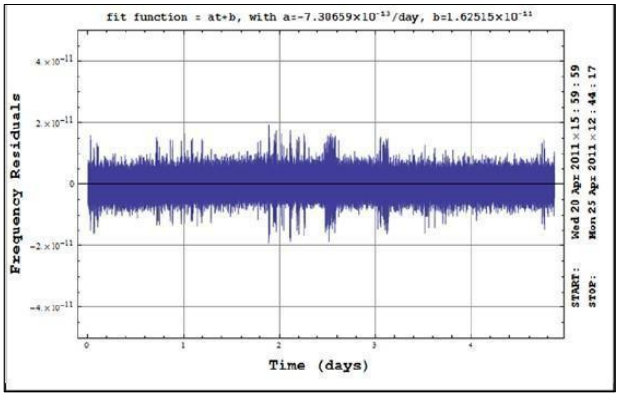

Figure 6. Frequency stability of ***un-disciplined*** Rb oscillator over a 5 day time period, at constant temperature (25°C), a linear drift of -7.3X 10^{-13}/day has been removed form the data.

Allan Deviation

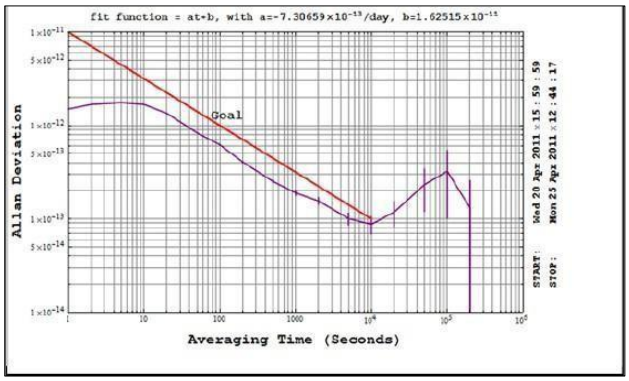

Figure 7. Allan deviation of ***un-disciplined*** Rb oscillator, from frequency data plotted in figure 3. Performance at τ=1 second reflects the quartz oscillator noise, while the τ=10 to 10,000 second performance reflects the Rb loop white frequency noise.

Frequency vs. Temperature

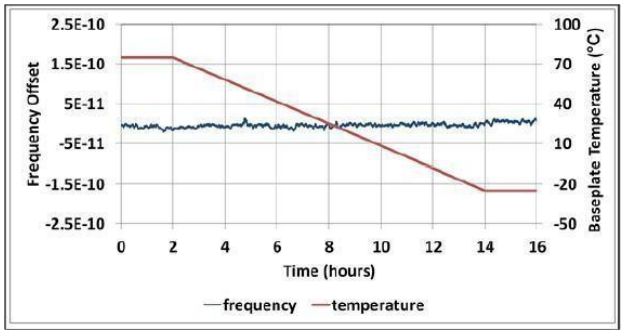

Figure 8. Frequency vs. temperature of Rb oscillator from +75°C to -25°C

Holdover-An order of magnitude improvement

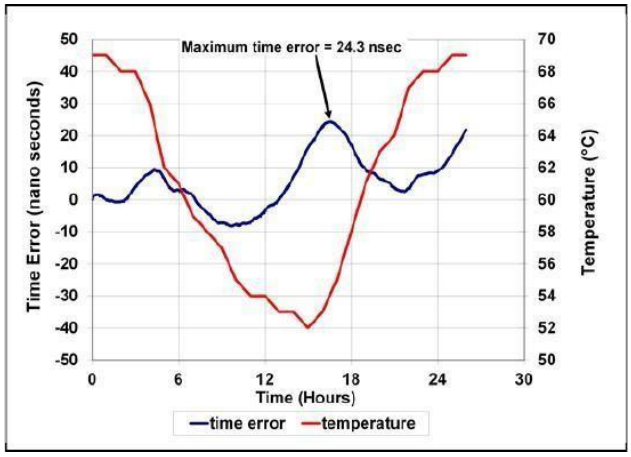

Figure 9. "Holdover" test to determine accumulation of time error while the Rb oscillator is ***un-disciplined***. Time error accumulated over 24 hours is shown. Unit was subjected to a diurnal variation of ~17°C, simulating a worst case condition, during this test.

Fast Warm-up-1PPS <10ns and f_o<10^{11} @ 15 min.

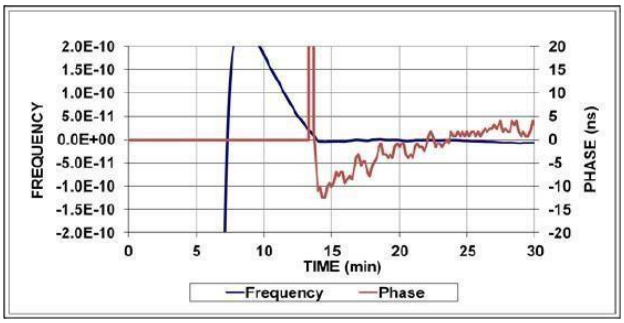

Figure 10. Warm-up of Rb oscillator at -40°C with 1 PPS input. Test performed ***with*** disciplining input signal.

Magnetic Field Sensitivity

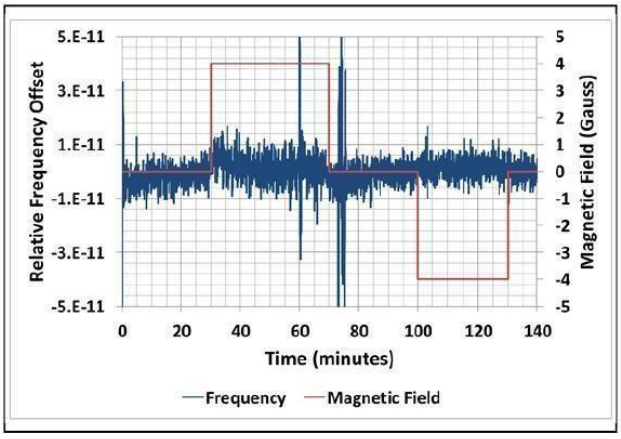

Figure 11. Magnetic field sensitivity of Rb oscillator, ***un-disciplined***. Frequency change is shown of the left axis, corresponding magnetic field on the right axis.

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