RUBIDIUM ATOMIC FREQUENCY STANDARD FE-5650A SERIES

Low Cost Atomic Standard... the Perfect Replacement for Precision Quartz.

Low Phase Noise for Communications and Timing Systems

ACTUAL SIZE

FEATURES

- Extremely small: 3 x 3 x 1.4 in.
- Digitally Programmable to 1 x 10^{-13}
- Frequency: 1 Hz to 20 MHz and 50.255+MHz
- Fast Warm Up: <4 min
- Fast warm up: < 5 min
- Stability over temperature 3 x 10^{-10}
- Stability: 1.4 x $10^{-11}/\sqrt{t}$
  2 x 10^{-11} /day
  2 x 10^{-9} /year

FEI Communications, Inc.
A Subsidiary of Frequency Electronics, Inc.
55 Charles Lindbergh Blvd., Mitchel Field, NY 11553
TEL: 516-794-4500 • FAX: 516-794-4340
Visit us at: www.freqelec.com

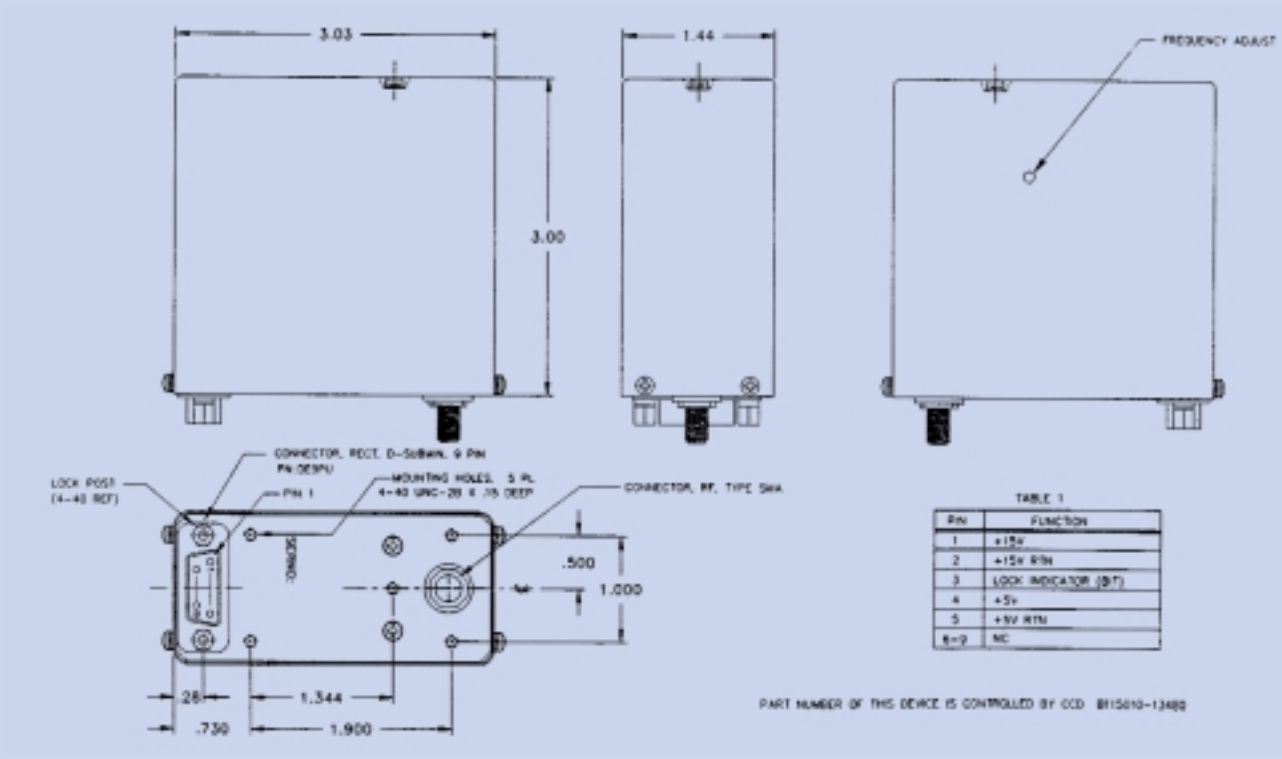
OPTIONS BY TYPE

OPTION NO.	OUTPUT FREQUENCY
01	50.255055 MHz Sine Wave
03	5 MHz
04	15 MHz
05	13MHz
06	2.048 MHz
07	10.23 MHz
08	Customer Frequency
	TEMPERATURE RANGE
36-44	Consult Factory
OPTION NO.	**INPUT VOLTAGE**
20	15 VDC Input Only
24	24 VDC Input (FE5650)
25	22 VDC to 32 VDC Input
34	15 & 5 VDC Input (FE5660)
46	Reverse Voltage Protection

*Consult factory

OPTION NO.	OUTPUT STABILITY
28	4×10^{-12}/day, 5×10^{-10}/year
29	2×10^{-10}/year after 1 year (4×10^{-11}/month)
31	Allan Dev = $5 \times 10^{-12}/\sqrt{t}$
32	f vs. T = $\pm 1 \times 10^{-10}$
	OUTPUT
02	RS232 control*
09	Square Wave
11	RS32 Wideband Output*
12	Analog Tuning
16	-80 dHc Spurious for ± 5 MHz
19	LED Monitor
21	1.0 Vrms Output
26	LOCK=TTL High
30	Analog Tuning:0 to 10v
35	$7E^{-9}$ C-Fld Adj
	OTHER
14	Horizon. Heat sink
15	Vert. Heat Sink
18	Conformally Coated
22	MIL environment (foamed)

OUTLINE DRAWING



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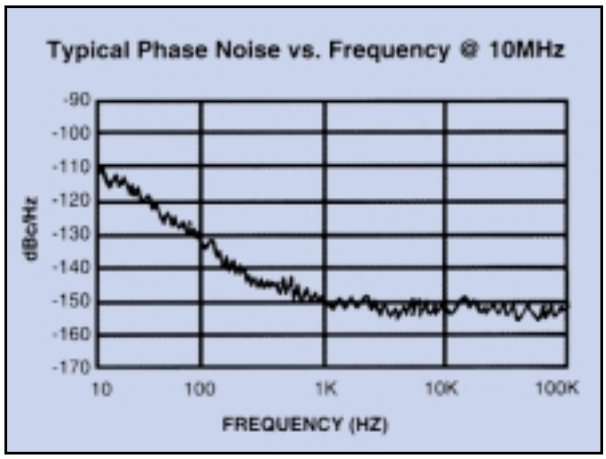
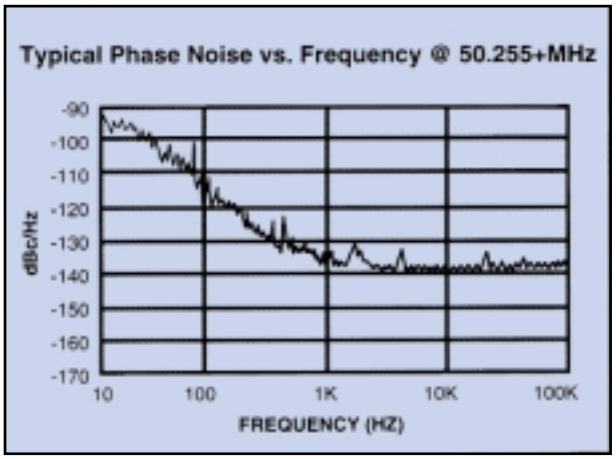
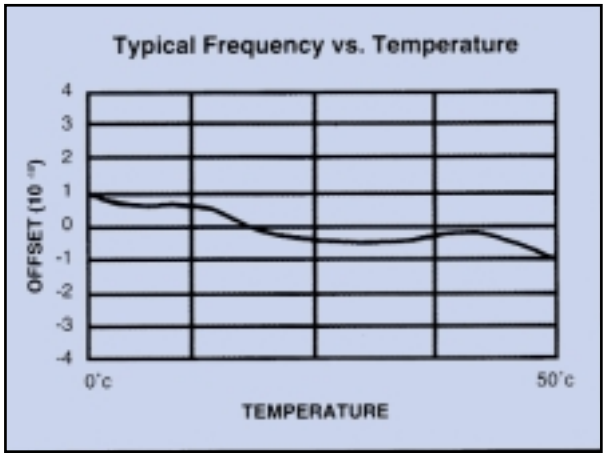
TECHNICAL CHARACTERISTICS

MODEL	FE-5650A	FE-5650A-1
FREQUENCY	10 MHz*	50.255055 MHz
OUTPUT	0.5V rms into 50 Ωsine**	0.5V rms into 50 Ω sine
SETTABILITY	1 X 10^{-11} (range 2 X 10^{-7})	———————-
	"C" field potentiometer and 0 to 5V fine tune voltage:	
	1 X 10^{-11}	1 X 10^{-11}
	(Range: 2 x 10^{-9})	(Range: 2 x 10^{-9})
	Internal DDS switches	External-customer
	Steps: 1.2 x 10^{-9}	synthesizer if
	Range: 2 x 10^{-7}	required***
POWER	8 Watts (steady state) @ 25°C	8 Watts (steady state) @ 25°C
	32 Watts peak	32 Watts peak
WARM UP TIME	<4 min. to lock @ 25°C	<4 min. to lock @ 25°C
STABILITY		
ALLAN VARIANCE	1.4 x $10^{-11}/\sqrt{t}$	1.4 x $10^{-11}/\sqrt{t}$
DRIFT	2 x 10^{-9}/year	2 x 10^{-9}/year
	2 x 10^{-11}/day	2 x 10^{-11}/day
RETRACE	5 x 10^{-11}	5 x 10^{-11}
INPUT VOLTAGE SENSITIVITY	2 x 10^{-11}/15 to 16V	2 x 10^{-11}/15 to 16V
FREQUENCY VS. TEMPERATURE	±3 x 10^{-10}(-5 to +50°C)	±3 x 10^{-10} (-5 to +50°C)
PHASE NOISE (@10 MHz)	@ 10Hz:-100dBc	-90dBc
	@100 Hz:-125 dBc	-110 dBc
	@1000 Hz:-145 dBc	-130 dBc
SPURS	60 dBc	60dBc
HARMONICS	30 dBc	30dBc
WEIGHT	12 oz.	12oz.
	338 grams	338 grams
POWER SUPPLY		
INPUT VOLTAGE	15 to 18V @ 500mA	15 to 18V@500mA
	5V+ 0.25V @ 100mA	Not Required
RIPPLE INPUT	15V:<0.1 Vrms	15V:<0.1 Vrms
	5V:<0.020Vrms	Not Required
SIZE	1.44 x 3.03 x 3.00 in.	1.44 x 3.03 x 3.00 in.
	37 x 77 x 76mm	37 x 77 x 76mm







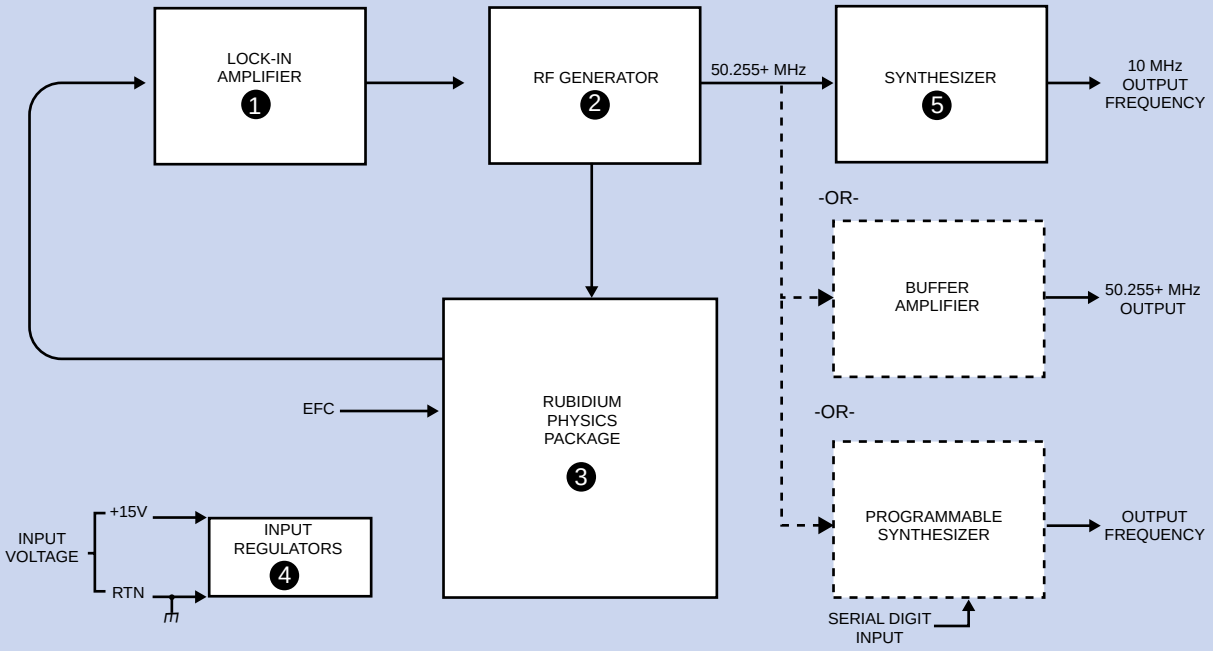
* Frequency Electronics' Model FE-5650A Commercial Rb Standard can be factory set at any frequency from 1 Hz to 20 MHz.

** 1 Hz to 10 MHz sq. wave, TTL Comp., 5 MHz to 20 MHz sine wave.

***Nominal Frequency ± 5 x 10^{-8}

The FE-5650A features an extremely small size unit for usage in a multitude of equipments. Additional features include low power consumption, fast warm up time, outstanding accuracy, low phase noise and low spurious. The FE-5680A is a reliable and versatile atomic standard which provides consistent, high quality performance over a wide range of applications and environmental conditions.

RUBIDIUM FREQUENCY STANDARD MODEL FE-5650A SERIES



FUNCTIONAL 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 consists 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 or 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 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 equals 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.

Output frequencies for Options 02, 10 & 11 are provided by the Digital Programmable Synthesizer. Option 02 is an RS232 remote digitally controlled output with a frequency range of 2×10^{-7} at a resolution of 3×10^{-12}. Option 10 offers a stepped approximation to a sine wave with wideband digital tuning. The output characteristics of Option 11 are essentially the same as those for option 10 with the exception that the output resolution is programmable in steps of 2.7×10^{-12} Hz.

Option 12 is remote analog voltage-controlled output frequency with a range of 2×10^{-9} and an input voltage range from 0 to 5 volts.