Users Manual Model NR3700-Mini

OCXO Reference Module

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1.0 Summary

The signal source is a high performance crystal installed in a temperature controlled oven (OCXO) with a stability 5 ppb/day, 50 ppb/year. The output is a 0.5Vrms sine wave. The NR3700 was designed to be a high performance, low cost 10 MHz OCXO reference in a small package that could be accommodated in almost any application.

The NR3700 can operate from 100 to 260Vac with a separate AC adapter or can be configured to operate from -60 to +60Vdc in three ranges (nominally 12, 24 and 36 volts). The power range must be specified at the time of purchase. The unit is reverse polarity protected and there is complete electrical isolation from the output signal ground and the input power.

To resolve ground loop sub system issues, the unit can also be configured to provide galvanic isolation on the output when operated at 10MHz.

The NR3700 is a high performance 10 MHz reference with a standard phase noise and stability specification that meets or exceeds the requirements of most applications. Novus offers a range of OCXO options to achieve ultra-low phase noise levels as required. To minimize noise and enhance stability, electromagnetic shielding, careful attention to PCB layout, band-gap reference and components with minimal microphonic attributes are used.

The optional internal frequency divider allows the unit to generate 1,10,100,1000, 10K, 100K, 1M and 10 MHz output all tied to the OCXO. The output is 3.3Vdc CMOS 50% duty cycle. Frequency is set at the factory.

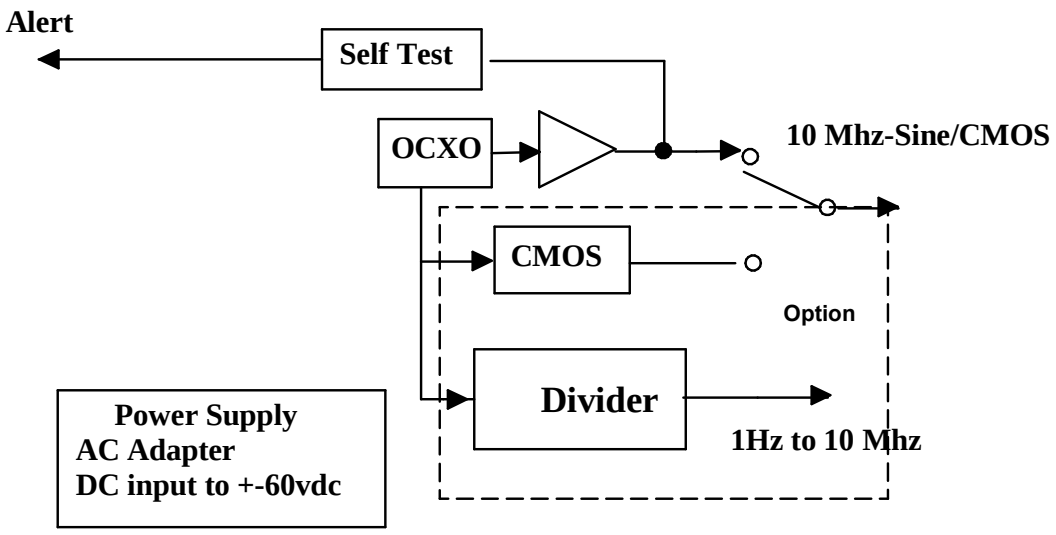
This unit incorporates self-test to monitor key circuitry. If the unit fails self-test, the Alert indicator on the front panel will flash red and the solid state relay will open. The relay is floating and can be easily connected to an alarm panel.

In addition to the signal presence built-in test, there is circuitry to determine if the oven within the OCXO has failed. This is a very subtle failure as there would appear to be a sine wave, but without a functional oven, the temperature stability would be poor. If a failure is detected, the Alert LED will be activated and the status relay will be opened. During the first 15 minutes of operation an Alert may occur as the oven brings the crystal up to temperature. This is normal and will stop after approximately 15 to 30 minutes of operation.

While sold primarily as a 10MHz reference, the NR3700 can be configured with a custom crystal to 50MHz.

A low cost, high performance reference in a versatile package.

2.0 Block Diagram

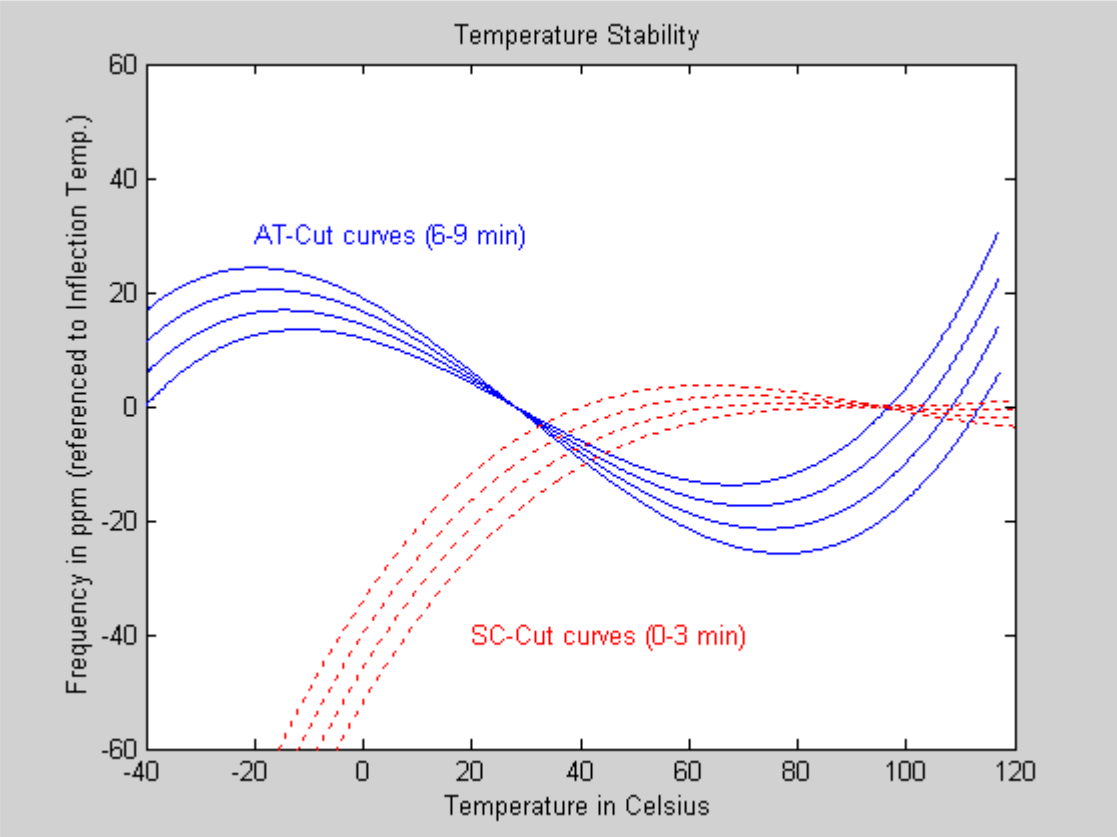


3.0 Crystal

Novus crystal based frequency reference products are based upon either TCXO or OCXO technology. Temperature compensated crystal oscillators will normally use a AT cut crystal and electronically compensate the device with temperature. An OCXO device uses a SC (stress compensated) crystal and the part is held at a fix temperature to minimize temperature drift.

The TCXO implementation results in a temperature stable reference in the single digit parts per million. An OCXO device affords a reference that is almost 2 orders of magnitude more stable than the TCXO.

Comparison of an AT versus a SC cut crystal

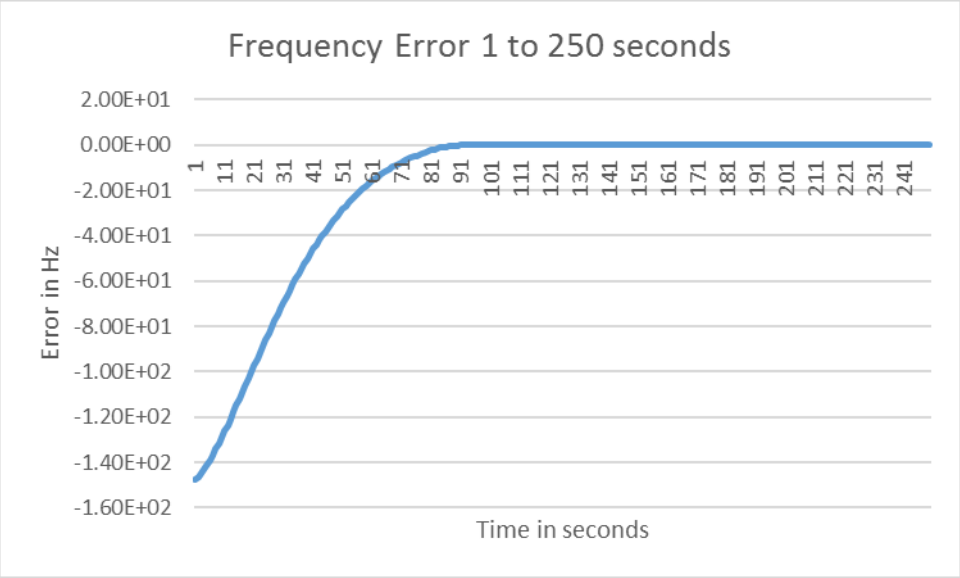


Over a broad temperature range, an AT performs very well and much easier to compensate electronically. It is also a simpler crystal to manufacture than a SC cut device. For applications where a stability of a few ppm is acceptable, a TCXO can be a cost effective alternative.

The SC cut results in a much higher Q device and achieves much lower phase noise than the AT cut. The device is also more sensitive to pressure and temperature variation is mounted in temperature controlled hermetic chamber.

OCXO oven temperature is in the range of 90 C. The devices heat-up and become stable within ~ 5 minutes.

OCXO Frequency Error from cold start

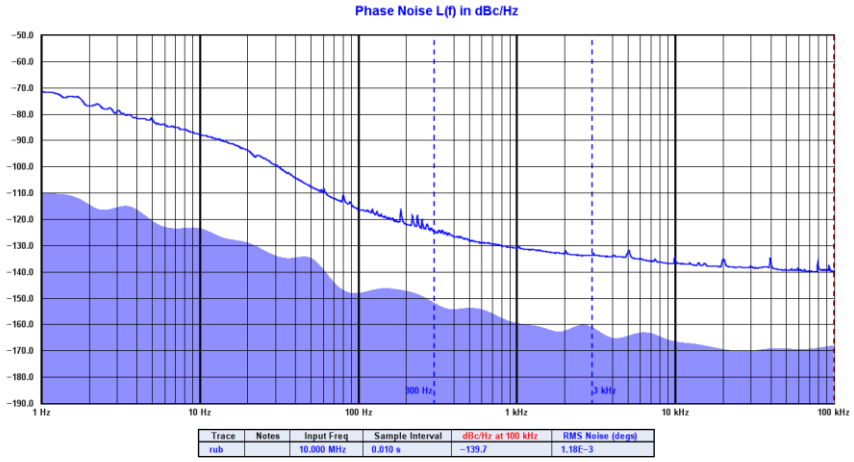


Typical OCXO

Another alternative for a frequency reference is an atomic reference. These devices use a change in atomic state of an isotope of Cesium or Rubidium for stability. Instead of a stability of ±50 ppb/year for a typical OCXO- stability of ±1 ppb/year is very common.

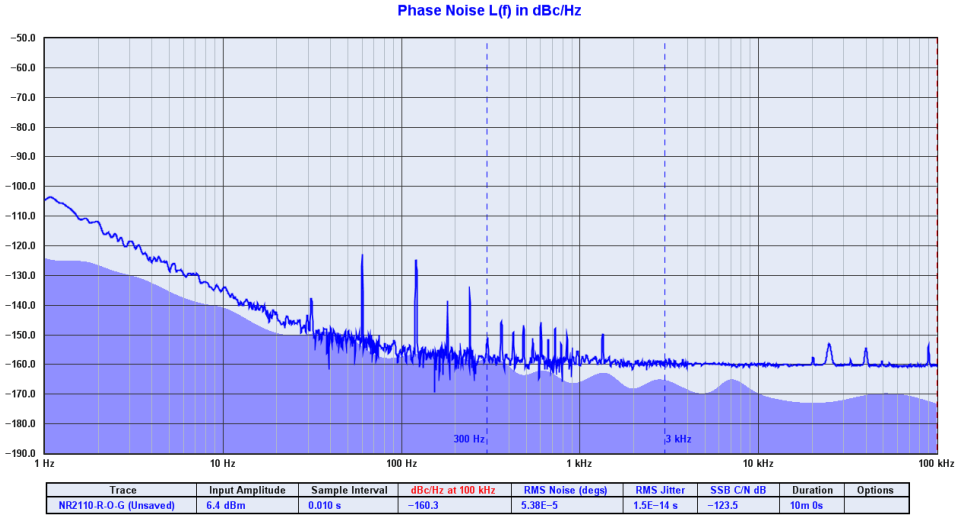
Atomic sources are very complex and while a very stable source, phase noise performance may not be acceptable for many applications.

Typical phase noise performance for a Rubidium source



For applications requiring the stability of an atomic source but also requiring low phase noise a low phase noise OCXO is disciplined to an atomic source. The phase noise for the NR2310-RO has phase noise improved by well over 20 dB by this technique.

Typical Phase Noise Performance-Rubidium with OCXO

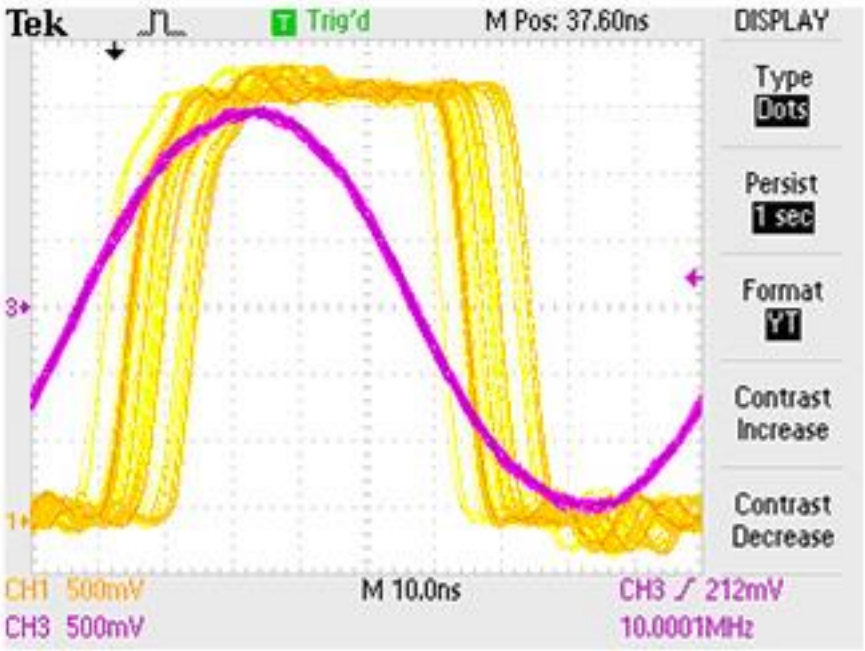


When the stability of an atomic or crystal source is not sufficient a GNSS disciplined source is an option. A GNSS receiver is installed and timing information from the GNSS

is used to discipline the timing device. Timing accuracy to a few ppb is readily achievable.

The GNSS is used to provide timing for a DDS (direct digital waveform synthesizer). While the DDS has outstanding long-term accuracy, the short-term stability very poor due to the nature of the timing source. A GNSS timing source has considerable short-term instability due to the numerous radio effects-multi-path, signal weakness etc. In order to develop a stable reference, the GNSS timing waveform is used to discipline a low noise source with a Kalman filter. A good example of the improved jitter performance of a Kalman filter is shown below:

Kalman Filter Performance:



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Typical acceptance testing data for the NR3620-Cal GNSS Locked Reference

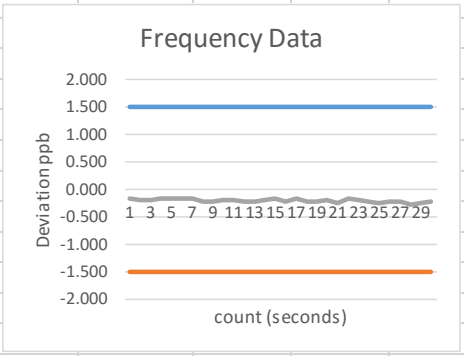
Novus- Reference Group
201 N Forest Ave Suite 225
Independence, MO 64050
866 984 6887

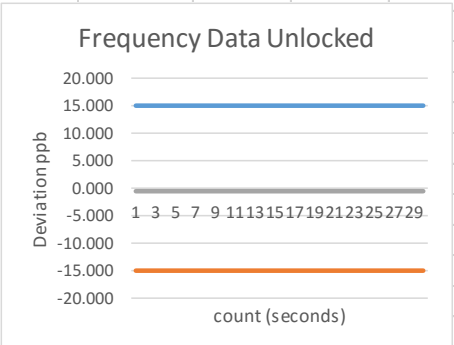
Date	1/12/2015		Model	NR3620-CAL
Tech	DS		Serial	03150565

Output amplitude	
Hi Limit	1.25
Measurenment Hi	1.00
Measurement Low	0.99
Low limit	0.8

Frequency Specification	Limit ±15ppb

Equipment	Model	Cal Exp Date
Frequency Counter	Agilent 53230a	9/8/2015





	Actual			
	Frequency Locked		Frequency Unlocked	
Count (second)	Frequency	Actual - Deviation (ppb)	Frequency Unlocked	Actual - Deviation (ppb) Unlocked
1	9999999.998	-0.174	9999999.995	-0.545
2	9999999.998	-0.198	9999999.994	-0.563
3	9999999.998	-0.198	9999999.995	-0.543
4	9999999.998	-0.176	9999999.995	-0.538
5	9999999.998	-0.163	9999999.994	-0.554
6	9999999.998	-0.173	9999999.995	-0.546
7	9999999.998	-0.176	9999999.994	-0.564
8	9999999.998	-0.223	9999999.995	-0.521
9	9999999.998	-0.230	9999999.994	-0.552
10	9999999.998	-0.193	9999999.994	-0.556
11	9999999.998	-0.212	9999999.995	-0.530
12	9999999.998	-0.217	9999999.995	-0.529
13	9999999.998	-0.220	9999999.995	-0.507
14	9999999.998	-0.200	9999999.995	-0.526
15	9999999.998	-0.177	9999999.994	-0.553
16	9999999.998	-0.226	9999999.994	-0.563
17	9999999.998	-0.178	9999999.995	-0.527
18	9999999.998	-0.223	9999999.994	-0.565
19	9999999.998	-0.225	9999999.995	-0.537
20	9999999.998	-0.206	9999999.994	-0.568
21	9999999.998	-0.245	9999999.995	-0.524
22	9999999.998	-0.184	9999999.995	-0.526
23	9999999.998	-0.213	9999999.995	-0.546
24	9999999.998	-0.223	9999999.994	-0.551
25	9999999.997	-0.255	9999999.995	-0.502
26	9999999.998	-0.232	9999999.995	-0.549
27	9999999.998	-0.238	9999999.994	-0.587
28	9999999.997	-0.277	9999999.994	-0.568
29	9999999.997	-0.254	9999999.995	-0.516
30	9999999.998	-0.219	9999999.994	-0.561

4.0 Typical Phase Noise

10MHz Sine- Primary Output

Offset Frequency (Hz)	Typical (dBc / Hz)
10	-104
100	-135
1K	-145
10K	-149

There are optional phase noise performance and stability levels available – contact factory for details.

5.0 Input / Output Connectors

5.1 Power

Power: Phoenix Contact P/N 1840382.

1- Ground
2- 10 to 15 Vdc @ 1.0 amp
3- Floating solid state relay contact (self-test)
4- Floating self-test relay contact

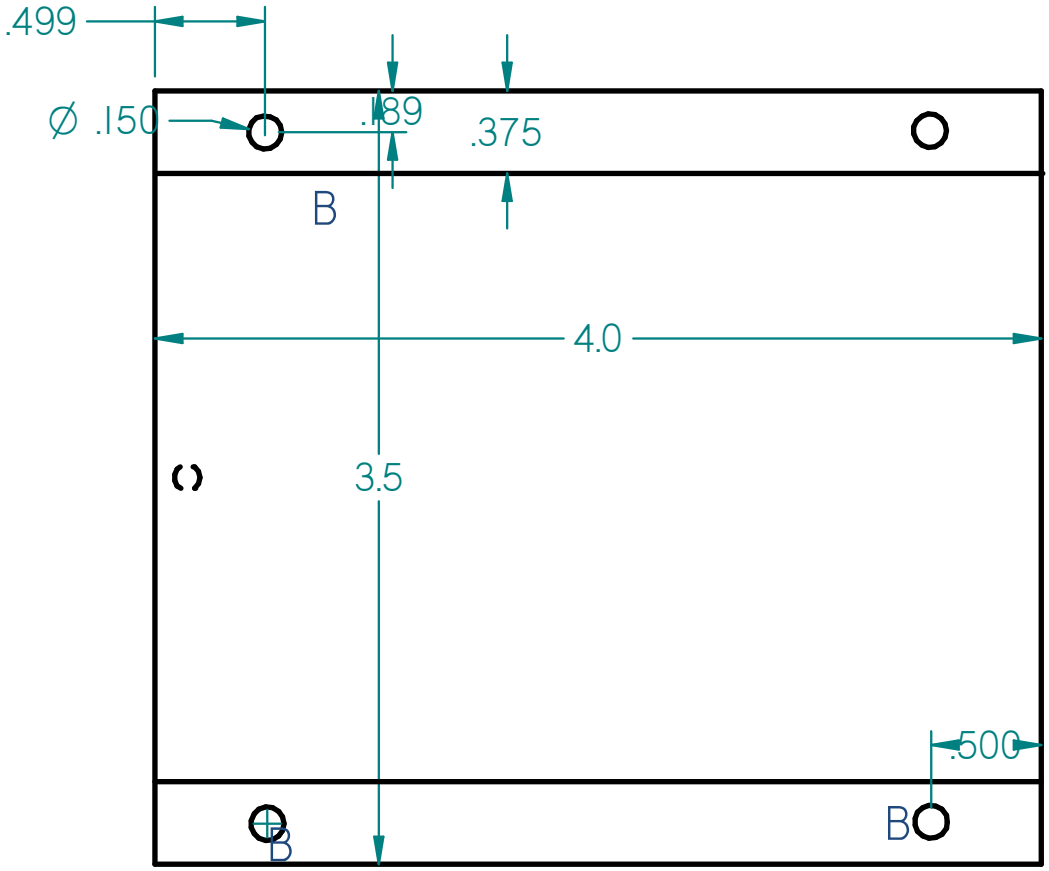
Self-test relay max voltage is ±100Vdc and 50 ma

There is also a standard AC power adapter connector that is threaded to prevent accidental power interruption. In this case the power adapter is simply plugged in and the threaded collar engaged. Connector 1 is not to be used for power when using an AC power adapter.

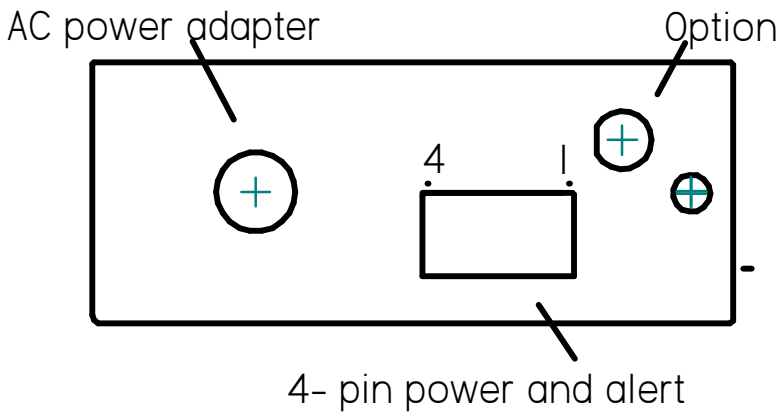
5.2 Signal Output:

The 10 MHz signal output is provided through a front panel BNC, 50Ω.

6.0 Mechanical



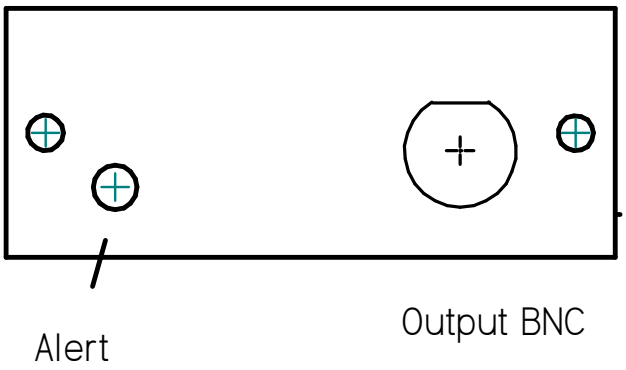
Rear Panel



1 +Vdc pwr
2 -Vdc pwr
3 alert relay
4 alert relay

A wall adapter can be electrically connected thru either connector
Euro style connector mates with Phoenix Contact PN 1840382 (Digi-key #277-2418-ND) (mate provided with unit)

Front Panel



7.0 Alert - LED – Relay

There are a number of critical circuits in the unit. These are monitored and a failure of any of these will initiate an ALERT condition. The ALERT LED goes from green to red and the solid state ALERT relay will open. The normal operating state is the relay contacts will be closed.

Self-test relay max voltage is ±100 Vdc and 50 ma

8.0 Technical Specifications

8.1 Technical specifications

Output	10 MHz, 0.4 Vrms ±0.1, into 50 Ohms	
Ship Frequency Accuracy	±20 ppb (24 hours)	
First Year Frequency Stability	±50 ppb	
Temp Stability	±10 ppb	
Yearly Aging	±50ppb	
Alert Relay	Solid state- isolated- ±100Vdc 28 ohm On, 50 ma	
Power Requirements	Standard configuration is 12Vdc (9 to 15Vdc) Options- ±24Vdc (20 to 30Vdc), ±48vdc (40 to 60Vdc) AC Adapter available 100 to 240Vac, 50/60Hz	
Connectors		
	4-pin Power Connector, power in, status relay connector – Phoenix Contact PN 1840382 Digi-key #277-2418-ND. (mate provided with unit)	
	Optional output transformer- 200 volt isolation for frequencies over 100KHz	

8.2 Environmental and Mechanical

Operating temperature	0 to 50C non-condensing (extended temperature range available)	
Storage temperature	-40 to 70C	
Width	3.5 inches (with flange)	
Depth	4 inches (exclusive of connectors)	
Height	1.2 inches	
Weight	~8 oz	

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