Precise Time and Frequency Standards

Low Noise Rubidium Oscillator Module, 10MHz

SMA Female Connectors

RMRO Series (Miniature Rubidium Oscillator

Applications

- *Where sizes are restricted this 'breakthrough' low noise rubidium oscillator will enable new applications*
- *Extended holdover for CDMA, WiMAX and LTE base stations*
- *Higher stability and low phase noise communication and surveillance applications*
- *Compact designs and portable and mobile applications*
- *Production Test Reference for instrumentation*
- *Microwave Test Bench or Test solution*

Feature

- *Sine wave or CMOS/TTL output*
- *100 x less drift than OCXOs*
- *Lower power consumption*
- *Compatible with 50Ω or 75Ω load*
- *-115dBc/Hz@1Hz Phase noise*
- *$5x10^{-11}$ Accuracy*
- *Short term stability $2x10^{-12}$/s@100s*

RMRO-10M-Sf-LN-c5 Low Noise Rubidium Oscillator Module is a sub miniature atomic clock combined with 'active noise filter' technology. This rubidium oscillator has 100x less drift than OCXO's. With short term stability of $2x10^{-12}$/s @ 100s this rubidium oscillator provides significant improvement in performance over other rubidium components

Order Examples: RMRO-10M-Sf-LN-A-3-c5

Description: (Low Noise Rubidium Oscillator Module, 10MHz, SMA Female Connectors, Frequency Stability A, Phase Noise option 3)

Additional options Frequency Stability A or B Phase Noise option 1 / 2 Or 3 (see Table below)

Specifications				
Output		10MHz		
Level		+7dBm (±2dBm) into 50 Ohms, 0.5Vrms (Specify for 75Ω load)		
Connector		SMA		
Frequency Stability Allan Deviation		**Option A**	**Option B**	
	1s	$\leq 2x10^{-12}$	$\leq 7x10^{-13}$	
	10s	$\leq 5\ x10^{-12}$	$\leq 1x10^{-12}$	
	100s	$\leq 7\ x10^{-12}$	$\leq 2x10^{-12}$	
Phase Noise(SSB)		**Option 1**	**Option 2**	**Option 3**
	1 Hz	-110dBc/Hz	-113dBc/Hz	-115dBc/Hz
	10Hz	-135dBc/Hz	-138dBc/Hz	-140dBc/Hz
	100Hz	-145dBc/Hz	-152dBc/Hz	-154dBc/Hz
	1kHz	-155dBc/Hz	-155dBc/Hz	-155dBc/Hz
	10kHz	-158dBc/Hz	-158dBc/Hz	-160dBc/Hz
Harmonics		<-30dBc		
Spurious	100 KHz BW	<100dBc		
Aging(After 30 days)		$\leq 5x10^{-12}$ /day $\leq 5x10^{-11}$ /month $\leq 5x10^{-10}$ /Year		

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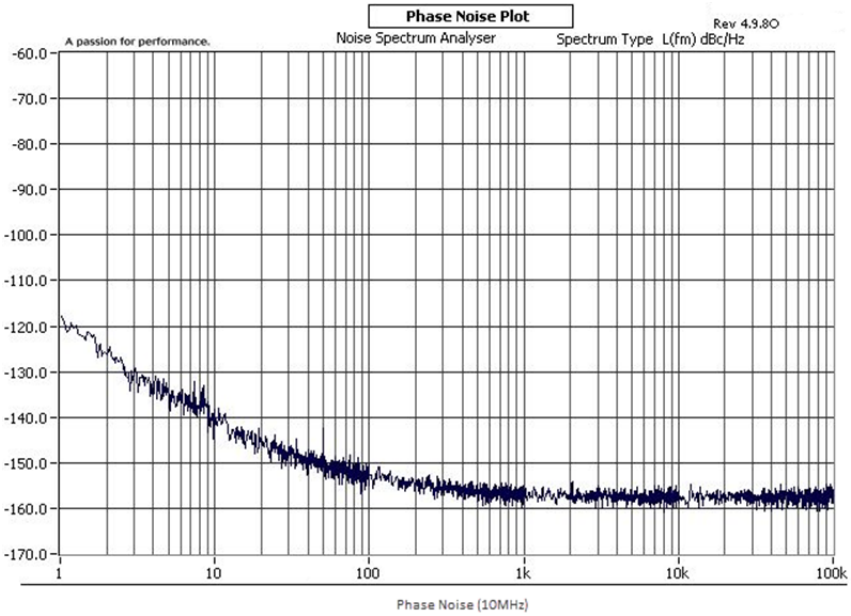
Frequency accuracy		
Accuracy at shipping @ 25°C		5×10^{-11}
Frequency Retrace		$\pm 3 \times 10^{-11}$ After 1 hours of continues operation
Start Up (Warm) Time		<5 minutes, time to lock <6 minutes to 1x10-9 at room temperature 25°C
Frequency Adjustment	Mechanical	$\pm 2 \times 10^{-09}$
	Electrical	$\pm 5 \times 10^{-09}$
	(Optional) Control Voltage	0 ~ 5Vdc
Power Supply		+12VDC to +15 VDC
Power Consumption @ 25°C		Warm Up: 22W max Stabilized: 6W
Temperature	Operating	-20 to +60°C Extended range available: -40 to +60°C
	Storage	-40 to +85°C
Temp stability		$<3 \times 10^{-9}$ over operating temperature range (-20 to +60°C)
Relative humidity		94% non-condensing
Magnetic Field	Sensitivity	$\pm 5 \times 10^{-12}$ Gauss $\pm 2 \times 10^{-11}$
	Atmospheric Pressure (mbar)	1×10^{-13} per mbar
Approx. MTBF Stationary		100,000 hours
Mechanical		
Dimension	without cover	L 101 x W 60.5 x H 34mm
	with cover	L 101 x W 60.5 x H 37mm
Approx. Weight		315 grams
Data output & monitoring		RS232, 9600 baud rate



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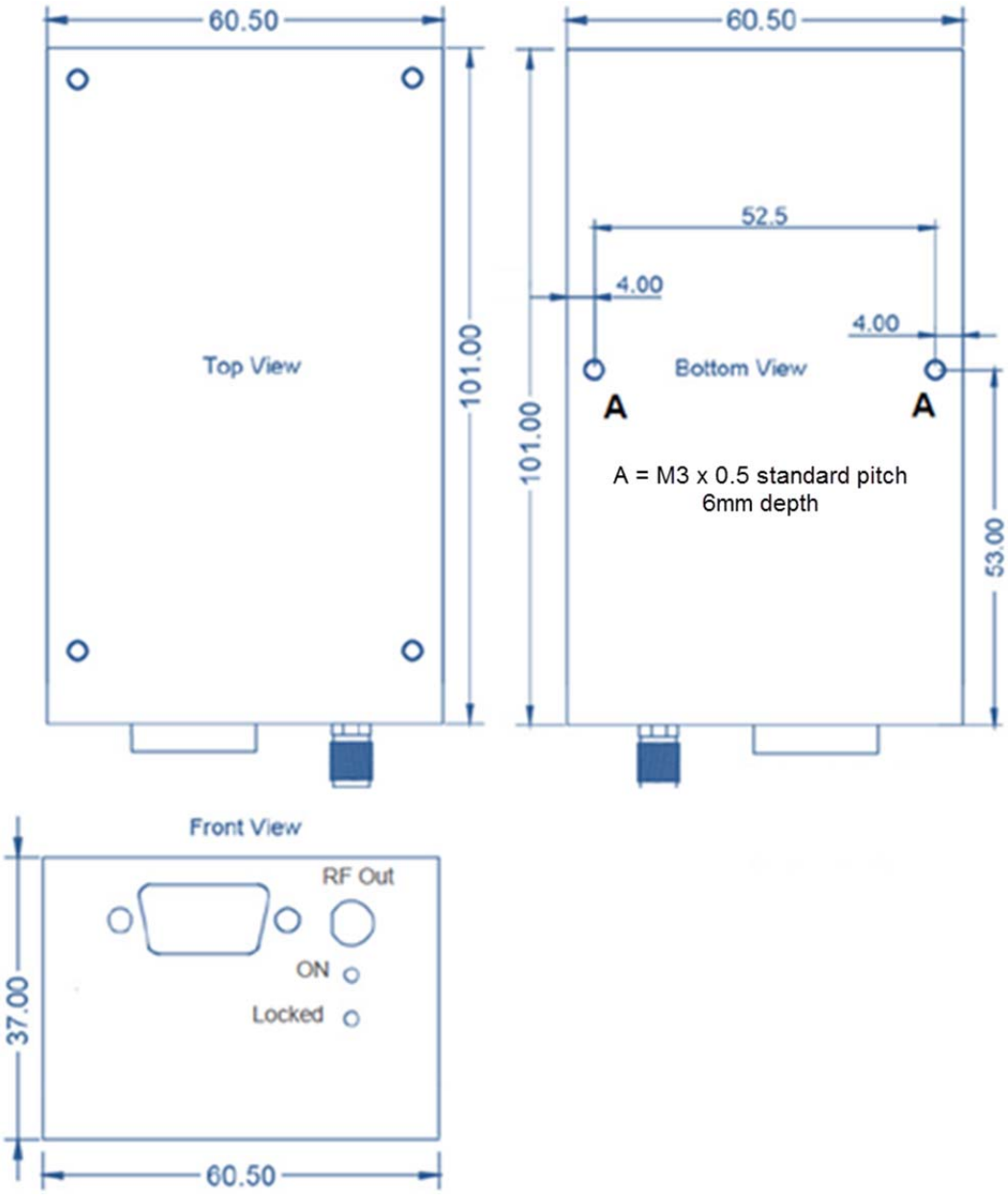
Rubidium Oscillator with Cover - Mechanical drawing



Units: mm
Not to Scale

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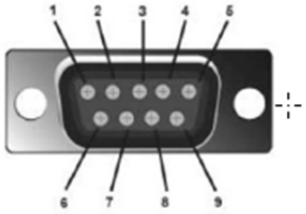
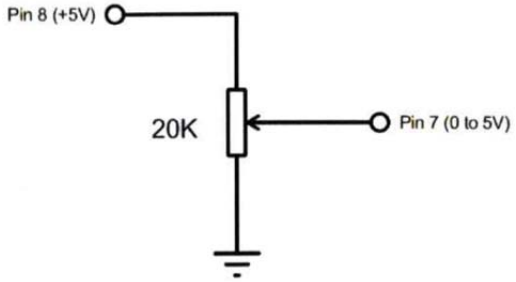
Pin Connections



Pin	Function	Description
1	Lock Status	OFF: locked, ON: not locked
2	RXD	Serial data receive
3	TXD	Serial data transmit
4	Power Supply	Input power supply between +12~15V
5	GND	Ground
6	GND	Ground
7	Frequency adjustment	Apply 0-5 volt to adjust the frequency
8	Voltage reference	+5V supply voltage to be used for frequency adjustment
9	Not used	Not used



RS232 Control Codes

RS232 control codes (all values following command or returned from the microcontroller are hexadecimal)

* = backed up in EEPROM

UA **User adjust**

UA? returns user parameters

aa bbbb

aa *is bandwidth control: bits set:*

bit0,1, 2: *bandwidth (0 to 7)*
bit3 to 6: *not used*
bit7: *controlled oscillator negative slope*

* *bbbb* *is clock registers 3 and 4 (elapsed time)*

UABaa write new bandwidth control byte

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OS **Overall Status**

OS? returns overall status bytes:

aa bb cccc dd ee ff gg hhhh

*	*aa*	*is test status byte:*	*bits set::*	*bit0,1,2:*	*bits 0 to 2 DAC output select*
				bit3:	*no integrator update*
				bit4:	*no proportional term*
				bit5:	*AGC off*
				bit6:	*not used*
				bit7:	*inhibit state control*
		bits 2,1,0:	*000*	*no test output, fine tune DAC used for tuning*	
			001	*sub sampled I*	
			010	*sub sampled Q*	
			011	*PLL Integrator upper 16 bits*	
			100	*Phase result*	
			101	*I sample (filtered)*	
			110	*Q sample (filtered)*	
			111	*reference CH6 (filtered)*	
	bb	*is lock status byte:*	*bits set*	*bit0 to 2:*	*State control, states 0 to 7*
				bit3:	*set to normalise tuning DACs (cleared automatically)*
				bit4:	*OCXO warmed up*
				bit5:	*Loop locked*
				bit6:	*narrow range phase detector in use*
				bit7:	*set to inhibit auto load of PLL gain parameters*
	cccc	*is PLL control:*	*bits set*	*bit0,1,2,3*	*subsample rate*
				bit4, 5, 6, 7	*exp filter order*
				bit8, 9, 10, 11	*integrator gain*
				bit12, 13, 14, 15	*proportional gain*
*	*dd*	*is quadrature delay line setting*			
*	*ee*	*is tune voltage span (FFh min,00h max) 0 to 5.8V (FFh), and 0 to 10V (00h):*			
	ff	*is Q amp AGC setting*			
	gg	*is I amp AGC setting*			
	hhhh	*is OCXO current*			

OSTaa	write new test status byte
OSLbb	write new lock status byte
OSGcccc	Write new PLL control
OSDdd	Write new quadrature setting
OSSee	Write new tuning span
OSQff	Write new Q amp AGC byte
OSIgg	Write new I amp AGC byte

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PL **Phase lock loop**

	PL?	returns current status of PLL
	aaaa bbbb cccccccc dddd eeee	
	aaaa	*last value of I sample(filtered) , 2s complement, 16 bit*
	bbbb	*last value of Q sample(filtered), 2s complement 16 bit*
*	*cccccccc*	*last value of PLL integrator (32 bit integer)*
	dddd	*Coarse tune DAC 16 bit integer*
	eeee	*Fine tune DAC 16 bit integer*
	PLIcccccccc	write new PLL integrator
	PLCdddd	write new coarse tune DAC
	PLFeeee	write new fine tune DAC
	PL+	enter command PL? into repeat stack

PD **Phase detector**

PD?	returns phase detector parameters
aaaa bbbb cccc dddd eeee	
aaaa	*Last phase result, 2s complement*
bbbb	*Last mod[I] +mod[Q]*
cccc	*2.5V reference (filtered)*
dddd	*mod (phase result) (filtered) lsb=0.763ps*
eeee	*mod(freq offset) (filtered) lsb = 5.82E-15*
PD+	write PD? to command repeat stack

EU **EEPROM update (backed up values)**

SR **Software Reset**

ER **EEPROM read**

ERCaabb	returns bb bytes from starting address aa as ASCII characters
ERNaabb	returns bb bytes from starting address aa as hexadecimal numbers (character pairs)

EW **EEPROM write**

EWCaabbcccccc------c
writes bb characters to starting address aa. Correct number of characters must be included in string

EWNaabbcccc------c
Writes bb bytes to starting address aa. Character pairs cc etc. are interpreted as hexadecimal numbers.

RI **Repeat Interval**

RI?	returns command repeat interval
aa	
aa	*8 bit command repeat interval multiplier. Range 1 to 255. Command repeat interval is 50ms x aa*
RI0aa	write new command repeat interval
RID	cancel command repeat and clear command repeat stack

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Operating Procedure

Introduction

The basic module contains two principal internal units:
1) A Rubidium Atomic Frequency Standard.
2) An Oven Controlled Crystal Oscillator used to provide a clean low noise output.
3) The Associated External Power Supply.

Additionally 2 indicators are available to monitor the status of the instrument. These are: Rubidium Unlocked and Power.

Getting Started

Check that the appropriate supply voltage is being used. Connect the external supply to the unit either via JP1 P2 +Vdc / P3 GND or JP2 P1 +Vdc / P2 GND.

The 'ON' indicator LED will come on and it will remain on. The 'UNLOCKED' indicator will initially come on.

The 10 MHz output is available from the SMA socket on the side of the module.

The units' warm time is approximately 5 minutes. Frequency stabilization time is up to 15 minutes depending on the detailed specification of the particular Rubidium fitted. Once the rubidium has locked the 'UNLOCKED' indicator LED will turn off and will remain off as long as the instrument is performing correctly.

Cleaning Instructions

To ensure long and trouble free operation, keep the unit free from dust and use care with liquids around the unit.

Be careful not to spill liquids onto the unit. If the unit does get wet, tum the power off immediately and let the unit dry completely before turning it on again.

Never spray cleaner directly onto the unit or let liquid run into any pan of it. Never use harsh or caustic products to clean the unit.

Additional Notes

1) The preferred heat path for the 6W of heat generation:
The internal modules are not touching the enclosure which means heat will convect and radiate from the enclosure/body in all directions.
The heat dissipation from RMRO-10M-Sf-LN-c5 body is slow and around +40°C to +50°C.

2) Use of magnetic shielding material from fans:
RMRO-10M-Sf-LN-c5 will operate normally as long as the ambient temperature (surrounding the RMRO-10M-Sf-LN-c5) does not exceed +60°C. If the shielding material is metal then the heat will dissipate slowly and in this case it should not cause any problems.

3) Magnetic susceptibility is very much depends on the level of Magnetic Field strength. The RMRO-10M-Sf-LN-c5 has two layers of shielding which make this module very resilient to EMI
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