

# Precision Sub-Miniature 5.0x3.2mm TCXO / VCTCXO Designed for Telecom Applications

# CONNOR WINFIELD



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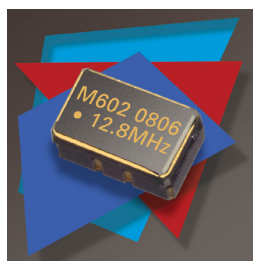
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## Description:

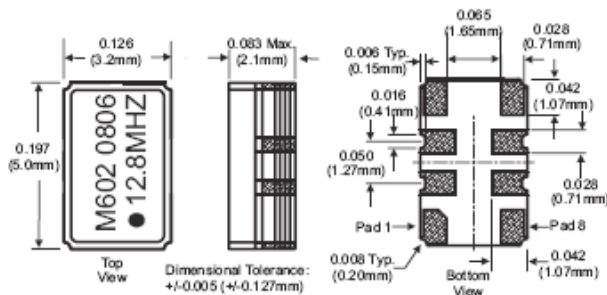
The Connor-Winfield 5.0x3.2mm Temperature Compensated Crystal Oscillators and Voltage Controlled Temperature Compensated Crystal Oscillators are designed for use in applications requiring tight frequency stability in a small package. Through the use of Analog Temperature Compensation, this device is capable of holding sub 1-ppm stabilities over wide temperature ranges.



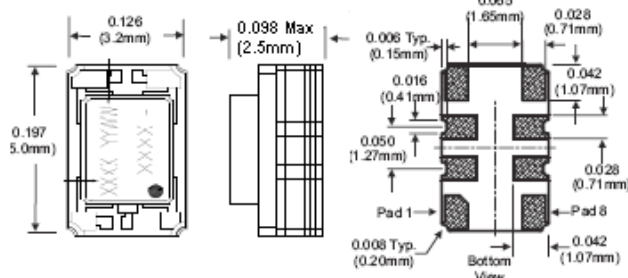
## Features:

- 3.3V Operation
- LVCMOS or clipped Sinewave Output Logic
- Sub-Miniature 5.0x3.2mm SMT Package
- Frequency Stabilities Available: **✓ STRATUM 3**  
±0.28 ppm with Stratum 3 Holdover  
±0.50 ppm or ±1.00 ppm
- Temperature Ranges Available:  
0 to 70°C; 0 to 85°C; -20 to 70°C; -40 to 85°C
- Low Power <10mA
- Low Jitter <1pS RMS
- Low Phase Noise
- Tape and Reel Packaging
- RoHS Compliant / Lead Free **✓ RoHS**
- Recommended for new designs

## Package Layout



## Alternate Package Layout for Select Frequencies



## Applications:

- STRATUM 3 Applications
- GPS Receivers
- Instrumentation
- Femtocells
- FTTH, FTTC

## Pad Connections

Pad	Connection
1:	Voltage Control or N/C
2:	Do Not Connect
3:	Do Not Connect
4:	Ground
5:	Output
6:	Do Not Connect
7:	Do Not Connect
8:	Supply, Vcc

## Ordering Information

M	6	0	2	012.8M
Type: Precision TCXO VCTCXO 3.2x5.0mm	Temperature Range 3 = 0 to 85°C 5 = 0 to 70°C 6 = -40 to 85°C 7 = -20 to 70°C	Frequency Stability 0 = ±0.28 ppm 1 = ±0.50 ppm 2 = ±1.00 ppm	Features 2 = TCXO, LVCMOS, 3.3 Vdc 3 = TCXO, Clipped Sinewave, 3.3 Vdc 4 = VCTCXO, LVCMOS, 3.3 Vdc 5 = VCTCXO, Clipped Sinewave, 3.3 Vdc	Output Frequency Frequency Format -xxx.xM Min* -xxx.xxxxxM Max* *Amount of numbers after the decimal point. M = MHz

\* Models M602, M604, M612 and M614 are available with the frequency range limited to 6.4 MHz to 26 MHz

Example:

M602-012.8M = 3.2x5mm, TCXO, LVCMOS,

3.3Vdc, -40° to 85°C, ±0.28ppm, Output Frequency 12.8MHz

To order an M602 with an output frequency of: 6.4MHz = M602-006.4M

Consult the factory for available frequencies



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### Absolute Maximum Ratings

Parameter	Minimum	Nominal	Maximum	Units	Notes
Storage Temperature	-55	-	85	°C	
Supply Voltage (Vcc)	-0.5	-	6.0	Vdc	
Input Voltage (Vc)	-0.5	-	Vcc + 0.5	Vdc	

### Operating Specifications

Parameter	Minimum	Nominal	Maximum	Units	Notes
TCXO Frequency Calibration @ 25°C	-1.00	-	1.00	ppm	1
Supply Voltage Variation. (Vcc±5%)	-0.2	-	0.2	ppm	
Load Coefficient, ±5%	-0.2	-	0.2	ppm	
Static Temperature Hysteresis	-0.4	-	0.4	ppm	2
Aging First Year	-1.00	-	1.00	ppm	
Total Frequency Tolerance (20 Years)	-4.60	-	4.60	ppm	3
Supply Voltage (Vcc)	3.135	3.3	3.465	Vdc	4
Supply Current (Icc)	-	6	10	mA	
Period Jitter	-	3	5	ps rms	
Integrated Phase Jitter (BW=12kHz to 20MHz)	-	0.3	1.0	ps rms	
SSB Phase Noise at 10Hz offset	-	-90	-70	dBc/Hz	
SSB Phase Noise at 100Hz offset	-	-115	-100	dBc/Hz	
SSB Phase Noise at 1KHz offset	-	-135	-130	dBc/Hz	
SSB Phase Noise at >10KHz offset	-	-152	-145	dBc/Hz	
SSB Phase Noise at >100KHz offset	-	-154	-150	dBc/Hz	
Start Up Time	-	-	10	ms	

### Input Characteristics for Voltage Control (Pad 1)

Parameter	Minimum	Nominal	Maximum	Units	Notes
Control Voltage Range (Vcc = 3.3V) (Vc)	0.3	1.65	3.0	Vdc	
Frequency Tuning measured @ 25°C	±10	-	-	ppm	5
Linearity	±5	-	-	%	
Slope	Positive	-	-		
Input Impedance	100K	-	-	Ohms	
Modulation Bandwidth (3dB)	10	-	-	KHz	

### LVC MOS Output Characteristics

Parameter	Minimum	Nominal	Maximum	Units	Notes
LOAD	-	15	-	pF	6
Voltage (High) (Voh)	90% Vcc	-	-	Vdc	
(Low) (Vol)	-	-	10% Vcc	Vdc	
Current (High) (Ioh)	-	-	-4	mA	
(Low) (Iol)	4	-	-	mA	
Duty Cycle at 50% of Vcc	45	50	55	%	
Rise / Fall Time 10% to 90%	-	-	8	ns	

### Clipped Sinewave Output Characteristics

Parameter	Minimum	Nominal	Maximum	Units	Notes
LOAD	-	-	-		7
Output Load Resistance	-	10K	-	Ohms	6
Output Load Capacitance	-	10	-	pF	6
Output Voltage	1.00	-	-	V pk-pk	
Output Impedance	-	200	-	Ohms	

#### Notes:

- 1) TCXO: Initial calibration @ 25°C. Specifications at time of shipment after 48 hours of operation.
- 2) Frequency change after reciprocal temperature ramped over the operating range. Frequency measured before and after at 25°C.
- 3) Inclusive of calibration @ 25°C, frequency vs. change in temperature, change in supply voltage (±5%), load change (±5%), reflow soldering process and 20 years aging.
- 4) For best in application performance, careful selection of an external power source is critical. Select an external regulator that meets or exceeds to the following specifications regarding voltage regulation tolerance, initial accuracy, temperature coefficient, voltage noise, and low voltage noise density. Factory Test Conditions: Initial Accuracy ±2mv, Noise (0.1Hz to 10KHz) 15uV p-p, Voltage Noise Density = 50nV/ (Square root Hz), Temperature Coefficient <5ppm°C.
- 5) Additional pull ranges are available; please contact the factory for additional information.
- 6) Attention: To achieve optimal frequency stability, and in some cases to meet the specification stated on this datasheet, it is required that the circuit connected to this TCXO output must have the equivalent input capacitance that is specified by the nominal load capacitance. Deviations from the nominal load capacitance will have a graduated effect on the stability of approximately 20ppb per pF load difference.
- 7) Output is DC coupled.

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## Model Specifications

Model Number	M502	M503	M504	M505	Notes
Output Type	LVC MOS	Clipped Sinewave	LVC MOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 40 MHz				
Frequency Stability	±0.28ppm				1
Supply Voltage	3.3Vdc				
Temperature Range	0 to 70°C				
Holdover Stability	±0.32ppm				2

Model Number	M302	M303	M304	M305	Notes
Output Type	LVC MOS	Clipped Sinewave	LVC MOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 40 MHz				
Frequency Stability	±0.28ppm				1
Supply Voltage	3.3Vdc				
Temperature Range	0 to 85°C				
Holdover Stability	±0.32ppm				2

Model Number	M512	M513	M514	M515	Notes
Output Type	LVC MOS	Clipped Sinewave	LVC MOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 40 MHz				
Frequency Stability	±0.50ppm				1
Supply Voltage	3.3Vdc				
Temperature Range	0 to 70°C				

Model Number	M312	M313	M314	M315	Notes
Output Type	LVC MOS	Clipped Sinewave	LVC MOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 40 MHz				
Frequency Stability	±0.50ppm				1
Supply Voltage	3.3Vdc				
Temperature Range	0 to 85°C				

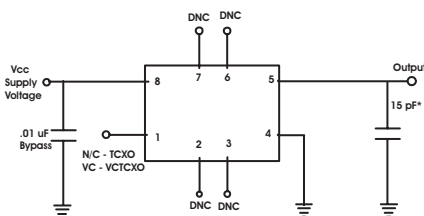
Model Number	M522	M523	M524	M525	Notes
Output Type	LVC MOS	Clipped Sinewave	LVC MOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 52 MHz				
Frequency Stability	±1.00ppm				1
Supply Voltage	3.3Vdc				
Temperature Range	0 to 70°C				

Model Number	M322	M323	M324	M325	Notes
Output Type	LVC MOS	Clipped Sinewave	LVC MOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 52 MHz				
Frequency Stability	±1.00ppm				1
Supply Voltage	3.3Vdc				
Temperature Range	0 to 85°C				

**Notes:**

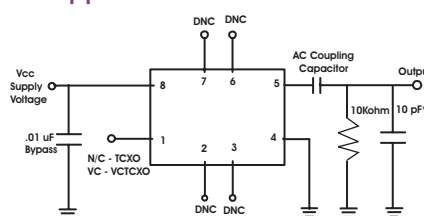
- 1) Frequency stability vs. change in temperature.  $[\pm(F_{max} - F_{min})/2 \cdot F_0]$ .
- 2) Inclusive of frequency stability, supply voltage change (±1%), aging, for 24 hours.

### LVC MOS Test Circuit



DNC = Do Not Connect  
\* NPO Grade Component

### Clipped Sinewave Test Circuit



DNC = Do Not Connect  
\* NPO Grade Component

## Model Specifications

Model Number	M702	M703	M704	M705	Notes
Output Type	LVC MOS	Clipped Sinewave	LVC MOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 40 MHz				
Frequency Stability	±0.28ppm				1
Supply Voltage	3.3Vdc				
Temperature Range	-20 to 70°C				
Holdover Stability	±0.32ppm				2

Model Number	M602	M603	M604	M605	Notes
Output Type	LVC MOS	Clipped Sinewave	LVC MOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 26 MHz	6.4 to 40 MHz	6.4 to 26 MHz	6.4 to 40 MHz	
Frequency Stability	±0.28ppm				1
Supply Voltage	3.3Vdc				
Temperature Range	-40 to 85°C				
Holdover Stability	±0.32ppm				2

Model Number	M712	M713	M714	M715	Notes
Output Type	LVC MOS	Clipped Sinewave	LVC MOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 40 MHz				
Frequency Stability	±0.50ppm				1
Supply Voltage	3.3Vdc				
Temperature Range	-20 to 70°C				

Model Number	M612	M613	M614	M615	Notes
Output Type	LVC MOS	Clipped Sinewave	LVC MOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 26 MHz	6.4 to 40 MHz	6.4 to 26 MHz	6.4 to 40 MHz	
Frequency Stability	±0.50ppm				1
Supply Voltage	3.3Vdc				
Temperature Range	-40 to 85°C				

Model Number	M722	M723	M724	M725	Notes
Output Type	LVC MOS	Clipped Sinewave	LVC MOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 52 MHz				
Frequency Stability	±1.00ppm				1
Supply Voltage	3.3Vdc				
Temperature Range	-20 to 70°C				

Model Number	M622	M623	M624	M625	Notes
Output Type	LVC MOS	Clipped Sinewave	LVC MOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 52 MHz				
Frequency Stability	±1.00ppm				1
Supply Voltage	3.3Vdc				
Temperature Range	-40 to 85°C				

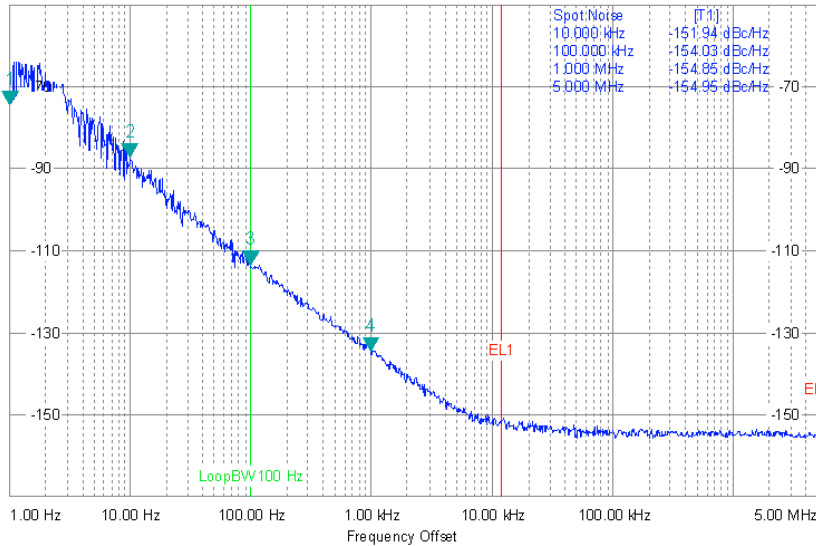


## Environmental Characteristics

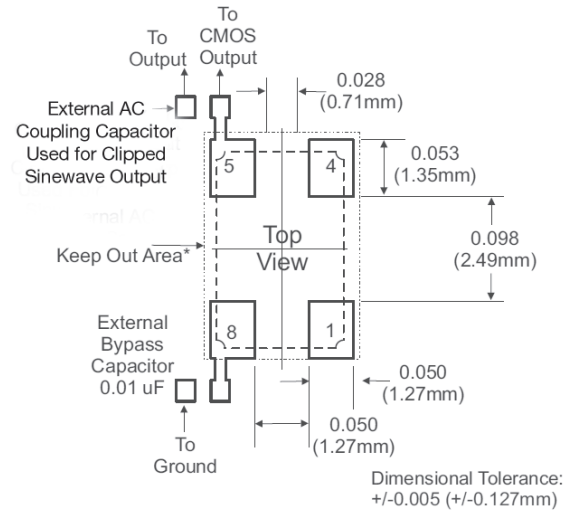
Vibration:	Vibration per Mil Std 883E Method 2007.3 Test Condition A
Shock:	Mechanical Shock per Mil Std 883E Method 2002.4 Test Condition B.
Soldering:	SMD product suitable for Convection Reflow soldering. Peak temperature 260°C Maximum time above 220°C, 60 seconds.
Solderability	Solderability per Mil Std 883E Method 2003

## Typical Phase Noise

M602-020.0M Typical Phase Noise (dBc/Hz)

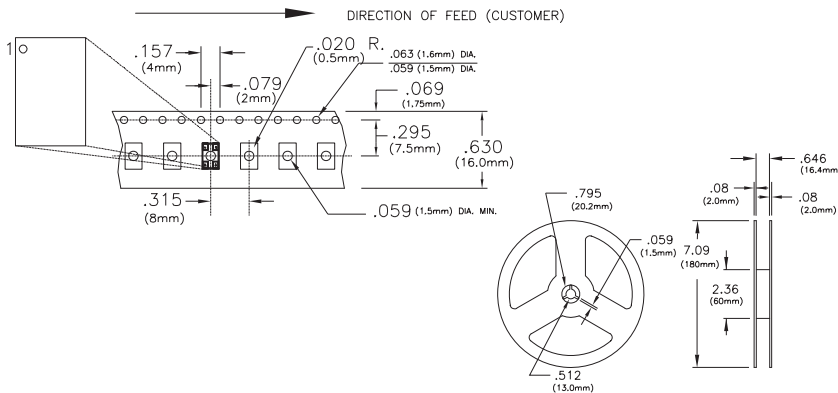


## Suggested Pad Layout

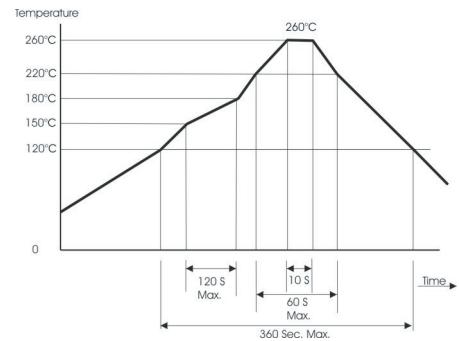


\* Do not route any traces in the keep out area. It is recommended that the next layer under the keep out area is to be ground plane.

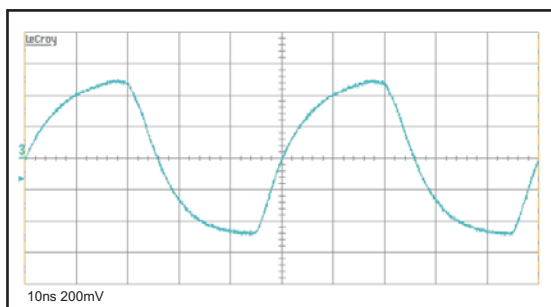
## Tape and Reel Specifications



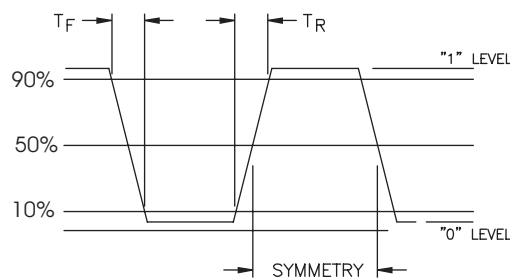
## Solder Profile



## Clipped Sinewave Output Waveform



## LVC MOS Output Waveform



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