

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

# CONNOR WINFIELD



2111 Comprehensive Drive

Aurora, Illinois 60505

Phone: 630-851-4722

Fax: 630-851-5040

[www.conwin.com](http://www.conwin.com)

US Headquarters:

630-851-4722

European Headquarters:

+353-61-472221

## Description:

The Connor-Winfield 5.0x3.2mm Temperature Compensated Crystal Oscillators and Voltage Controlled Temperature Compensated Crystal Oscillators are designed

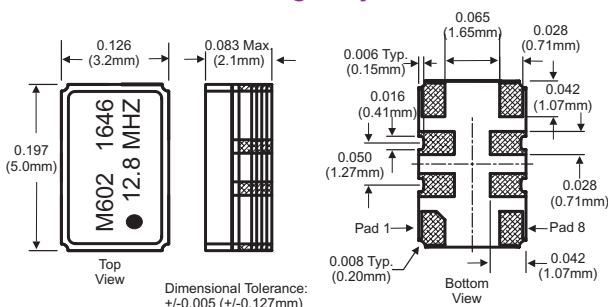
for use in applications requiring tight frequency stability in a small package. Through the use of Analog Temperature Compensation, this device is capable of holding sub 1-ppm stabilities over wide temperature ranges.



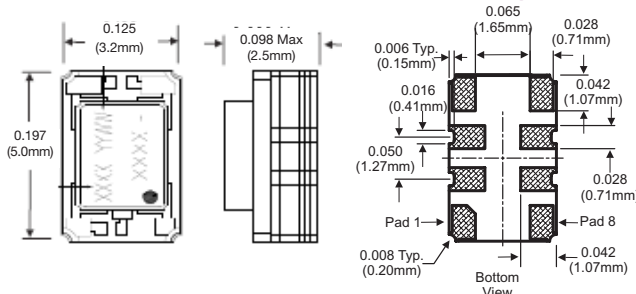
## Features:

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

\* See page 3 for frequency range information on each part number.

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



## 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           | -1.0    | -       | 1.0     | 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                            | -1.0    | -       | 1.0     | ppm    |       |
| Total Frequency Tolerance (20 Years)        | -4.6    | -       | 4.6     | 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 (< 40 MHz) | 1.0     | 1.2     | -       | V     | pk-pk |
| Output Voltage (≥40 MHz)  | 0.8     | 1.0     | -       | 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.



## 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 49.152 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 49.152 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 49.152 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 49.152 MHz |                  |         |                  |       |
| Frequency Stability | ±0.50ppm          |                  |         |                  | 1     |
| Supply Voltage      | 3.3Vdc            |                  |         |                  |       |
| Temperature Range   | 0 to 85°C         |                  |         |                  |       |

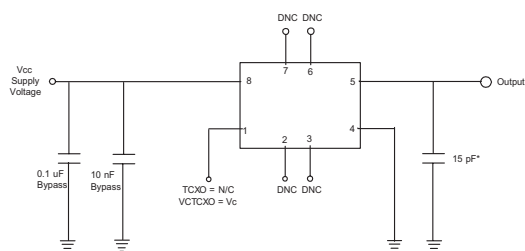
| Model Number        | M522          | M523             | M524    | M525             | Notes |
|---------------------|---------------|------------------|---------|------------------|-------|
| Output Type         | LVC MOS       | Clipped Sinewave | LVC MOS | Clipped Sinewave |       |
| TCXO/VCTCXO         | 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:

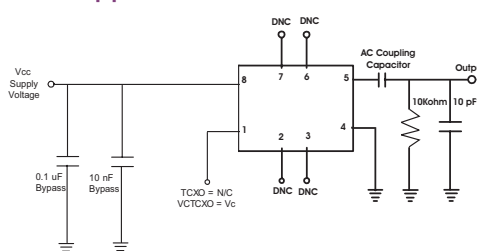
- 1) Frequency stability vs. change in temperature.  $[\pm(F_{max} - F_{min})/2 \cdot F_0]$ .
- 2) Inclusive of frequency stability, supply voltage change (±1%), aging, for 24 hours.

## LVC MOS Test Circuit



DNC = Do Not Connect  
\* NPO Grade Component

## Clipped Sinewave Test Circuit



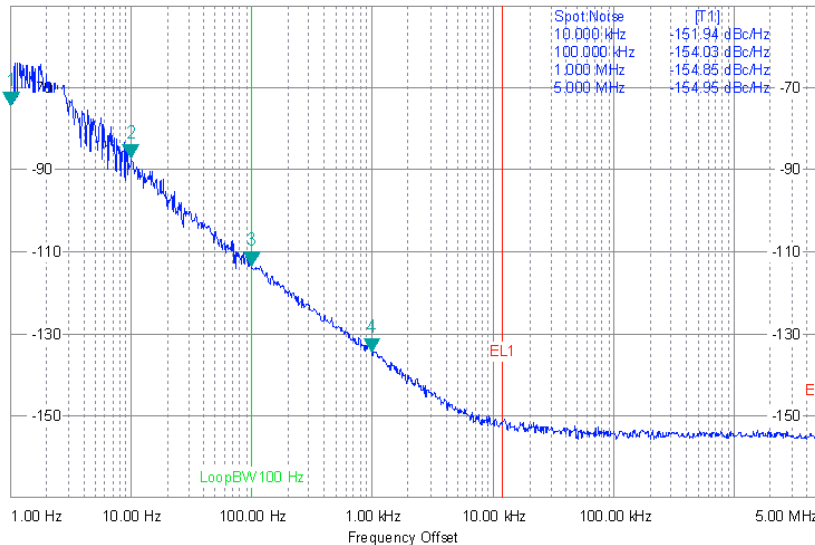
DNC = Do Not Connect  
\* NPO Grade Component

## Environmental Characteristics

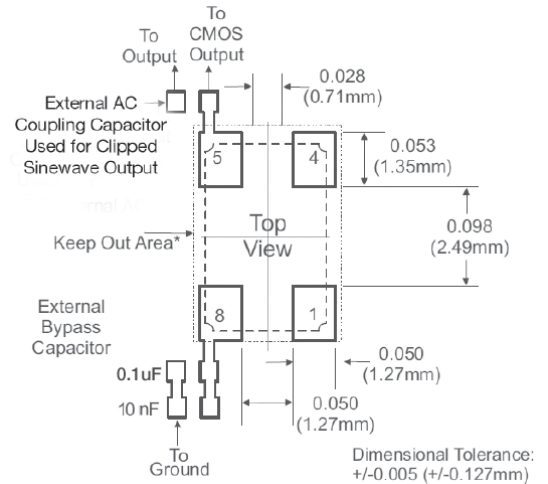
|                |                                                                   |
|----------------|-------------------------------------------------------------------|
| Vibration:     | Vibration per Mil Std 883E Method 2007.3 Test Condition A         |
| Shock:         | Mechanical Shock per Mil Std 883E Method 2002.4 Test Condition B. |
| Soldering:     | RoHS compliant lead free. See soldering profile below.            |
| Solderability: | Solderability per Mil Std 883E Method 2003                        |

## Typical Phase Noise

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

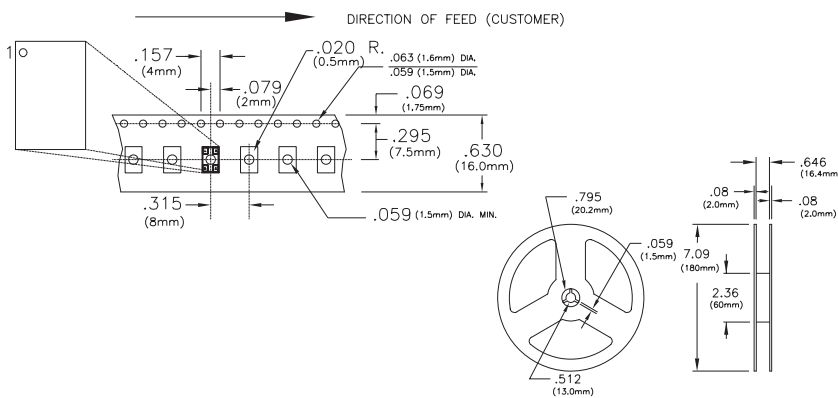


## Suggested Pad Layout

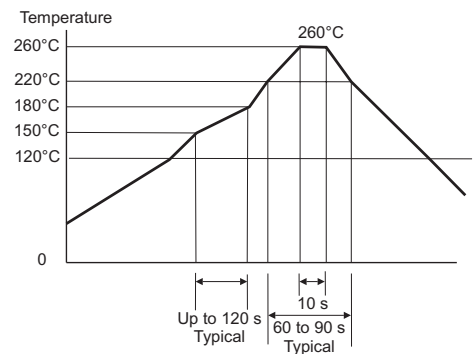


\* Do not route any traces in the keep out area. It is recommended that the next layer under the keep out area is to be ground plane.

## Tape and Reel Specifications

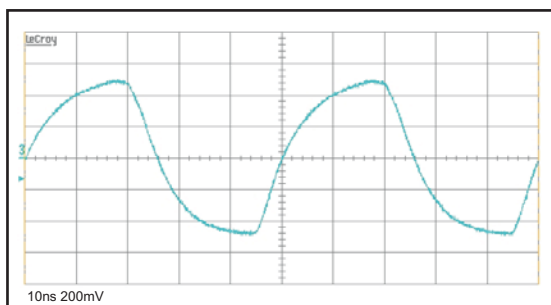


## Solder Profile

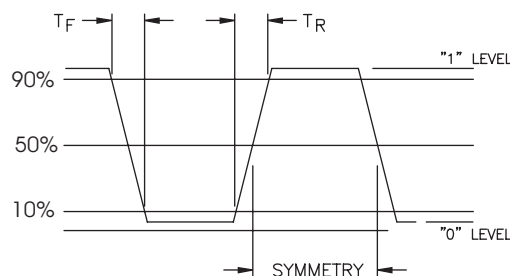


Meets IPC/JEDEC J-STD-020C

## Clipped Sinewave Output Waveform



## LVC MOS Output Waveform



Bulletin **Tx214**  
Page **4 of 4**  
Revision **09**  
Date **16 Nov 2016**