Available at Digi-Key**
www.digikey.com

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

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.

Applications:

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

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 or ±2.00 ppm
- Temperature Ranges Available:
  - 0 to 70°C; 0 to 85°C; -20 to 70°C; -40 to 85°C
- Low Power <6 mA
- Low Jitter <1pS RMS
- Low Phase Noise
- Tape and Reel Packaging
- RoHS Compliant / Lead Free ✓RoHS
- Recommended for new designs

** Not all options available at Digi-Key

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 3 = ±2.00 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.xxxxxxM Max* * Min 1 and Max 6 digits after the decimal point. M = MHz

* See page 4 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

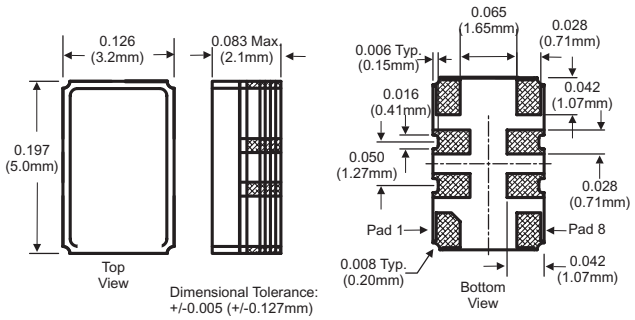
RoHS COMPLIANT

Bulletin	Tx214
Page	1 of 6
Revision	15
Date	10 April 2024

CONNOR WINFIELD

2111 Comprehensive Drive
Aurora, Illinois 60505
Phone: 630-851-4722
Fax: 630-851-5040
www.conwin.com

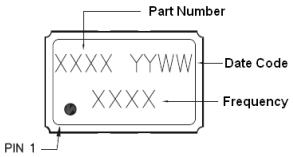
Package Outline for all frequencies other than those mentioned below

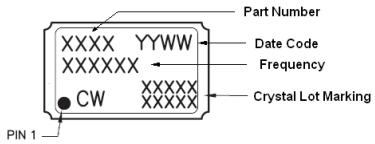


Pad Connections

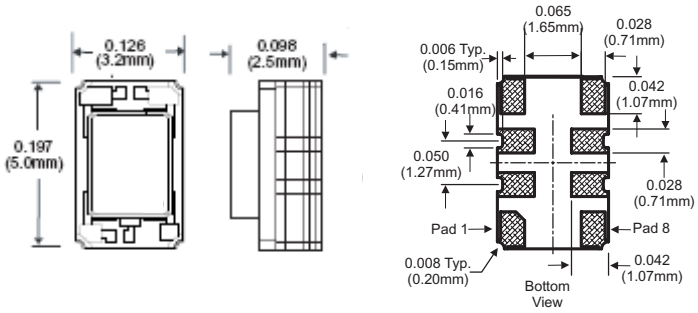
Pad	Connection
1:	Voltage Control or N/C
2:	Do Not Connect
3:	Do Not Connect
4:	Ground
5:	Output
6:	Do Not Connect
7:	Do Not Connect
8:	Supply, Vcc

Marking Configurations

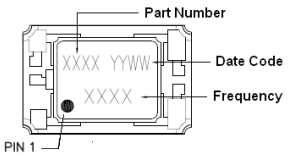


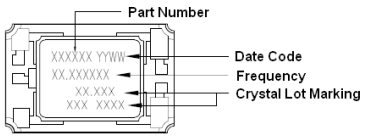


Package Outline for Frequencies (MHz): 10.0, 12.8, 13.0, 14.4, 14.7456, 19.44, 20.0, 24.576, 26.0, 32.0, 33.333333, 38.4, 38.88, 40.0, 48.0, 49.152, and 50

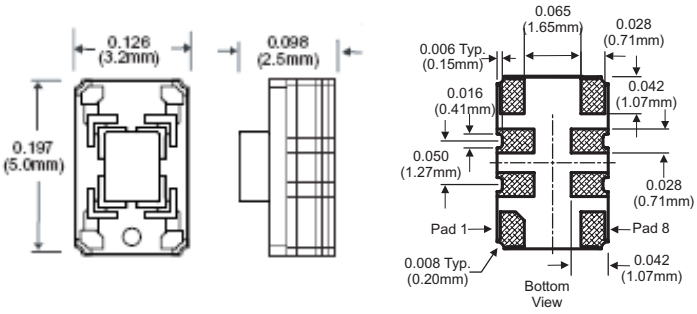


Marking Configurations

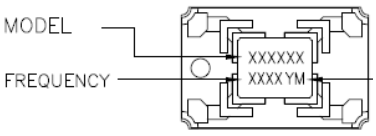




Package Outline for Frequencies (MHz): 25.0, 30.0, 40.0, 50.0



Marking Configurations



2 CHARACTER DATE CODE

Y = Year	M = Month
1 = 2021	A = January
2 = 2022	B = February
3 = 2023	C = March
4 = 2024	D = April
5 = 2025	E = May
6 = 2026	F = June
7 = 2027	G = July
8 = 2028	H = August
9 = 2029	J = September
0 = 2030	K = October
	M = November
	N = December

CONNOR WINFIELD

2111 Comprehensive Drive
Aurora, Illinois 60505
Phone: 630-851-4722
Fax: 630-851-5040
www.conwin.com

Absolute Maximum Ratings

Parameter	Minimum	Nominal	Maximum	Units	Notes
Storage Temperature	-55	-	85	°C	
Supply Voltage (Vcc)	-0.6	-	4.6	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) LVCMOS	-	2.1	6.0	mA	
Clipped Sinewave	-	1.3	2.9	mA	
Period Jitter	-	3	5	ps rms	
Integrated Phase Jitter (BW=12kHz to 20MHz)	-	0.3	1.0	ps rms	
SSB Phase Noise (Fo=10 MHz)					
at 10Hz offset	-	-96	-80	dBc/Hz	
at 100Hz offset	-	-121	-110	dBc/Hz	
at 1KHz offset	-	-143	-130	dBc/Hz	
at >10KHz offset	-	-156	-150	dBc/Hz	
at >100KHz offset	-	-157	-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	

LVCMOS 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
Clipped Sine Output	-	-	-		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.*

CONNOR WINFIELD

2111 Comprehensive Drive
Aurora, Illinois 60505
Phone: 630-851-4722
Fax: 630-851-5040
www.conwin.com

Model Specifications

Model Number	M502	M503	M504	M505	Notes
Output Type	LVCMOS	Clipped Sinewave	LVCMOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 50.0 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	LVCMOS	Clipped Sinewave	LVCMOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 50.0 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	LVCMOS	Clipped Sinewave	LVCMOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 50.0 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	LVCMOS	Clipped Sinewave	LVCMOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 50.0 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	LVCMOS	Clipped Sinewave	LVCMOS	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	LVCMOS	Clipped Sinewave	LVCMOS	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				

Model Number	M532	M533	M534	M535	Notes
Output Type	LVCMOS	Clipped Sinewave	LVCMOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 52 MHz				
Frequency Stability	±2.00ppm				1
Supply Voltage	3.3Vdc				
Temperature Range	0 to 70°C				

Model Number	M332	M333	M334	M335	Notes
Output Type	LVCMOS	Clipped Sinewave	LVCMOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 52 MHz				
Frequency Stability	±2.00ppm				1
Supply Voltage	3.3Vdc				
Temperature Range	0 to 85°C				

Model Specifications

Model Number	M702	M703	M704	M705	Notes
Output Type	LVCMOS	Clipped Sinewave	LVCMOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 50.0 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	LVCMOS	Clipped Sinewave	LVCMOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 50.0 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	LVCMOS	Clipped Sinewave	LVCMOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 50.0 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	LVCMOS	Clipped Sinewave	LVCMOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 50.0 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	LVCMOS	Clipped Sinewave	LVCMOS	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	LVCMOS	Clipped Sinewave	LVCMOS	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				

Model Number	M732	M733	M734	M735	Notes
Output Type	LVCMOS	Clipped Sinewave	LVCMOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 52 MHz				
Frequency Stability	±2.00ppm				1
Supply Voltage	3.3Vdc				
Temperature Range	-20 to 70°C				

Model Number	M632	M633	M634	M635	Notes
Output Type	LVCMOS	Clipped Sinewave	LVCMOS	Clipped Sinewave	
TCXO/VCTCXO	TCXO	TCXO	VCTCXO	VCTCXO	
Frequency Range	6.4 to 52 MHz				
Frequency Stability	±2.00ppm				1
Supply Voltage	3.3Vdc				
Temperature Range	-40 to 85°C				

Notes:
1) Frequency stability vs. change in temperature. [±(Fmax - Fmin)/2.Fo].
2) Inclusive of frequency stability, supply voltage change (±1%), aging, for 24 hours.

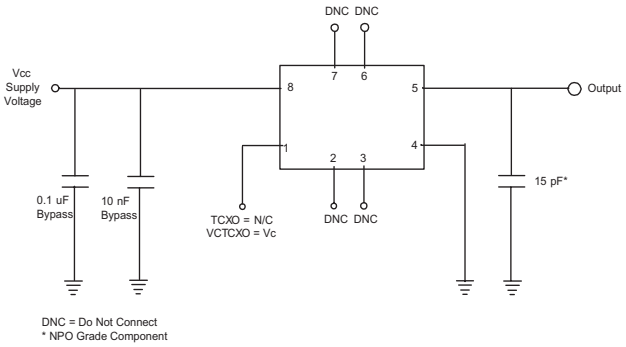
CONNOR WINFIELD

2111 Comprehensive Drive
Aurora, Illinois 60505
Phone: 630-851-4722
Fax: 630-851-5040
www.conwin.com

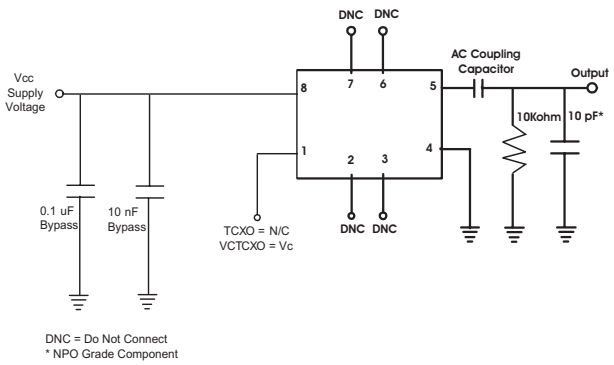
Environmental Characteristics

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 on page 6.
Solderability:	Solderability per Mil Std 883E Method 2003
Package Terminations:	0.5 to 1.0um (20 to 40 micro-inches) Gold over minimum of 2.0um (80 micro-inches) Nickel.
Moisture Sensitivity Level:	MSL-1

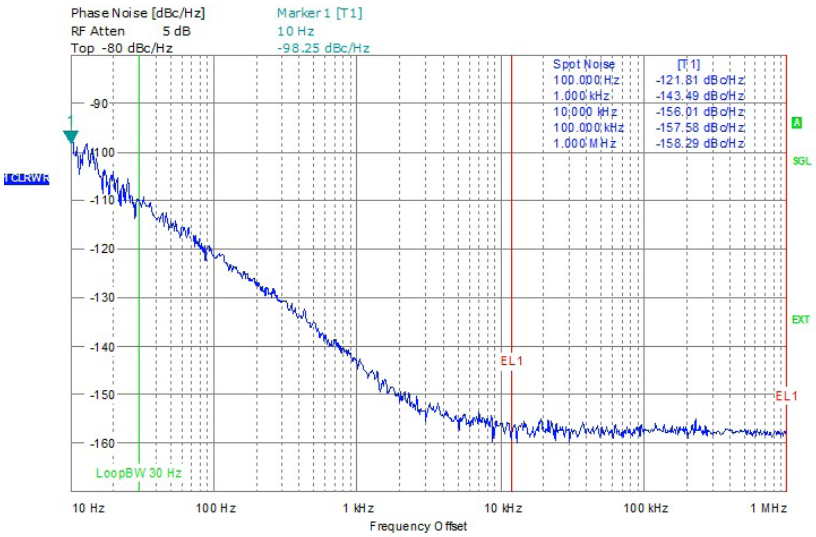
LVCMOS Test Circuit



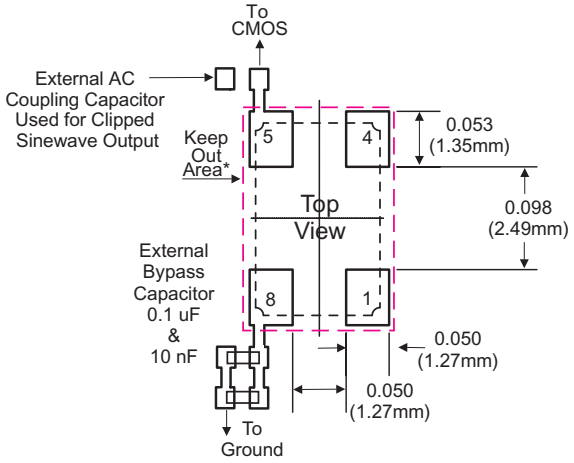
Clipped Sinewave Test Circuit



Typical Phase Noise for M602-010.0M



Suggested Pad Layout



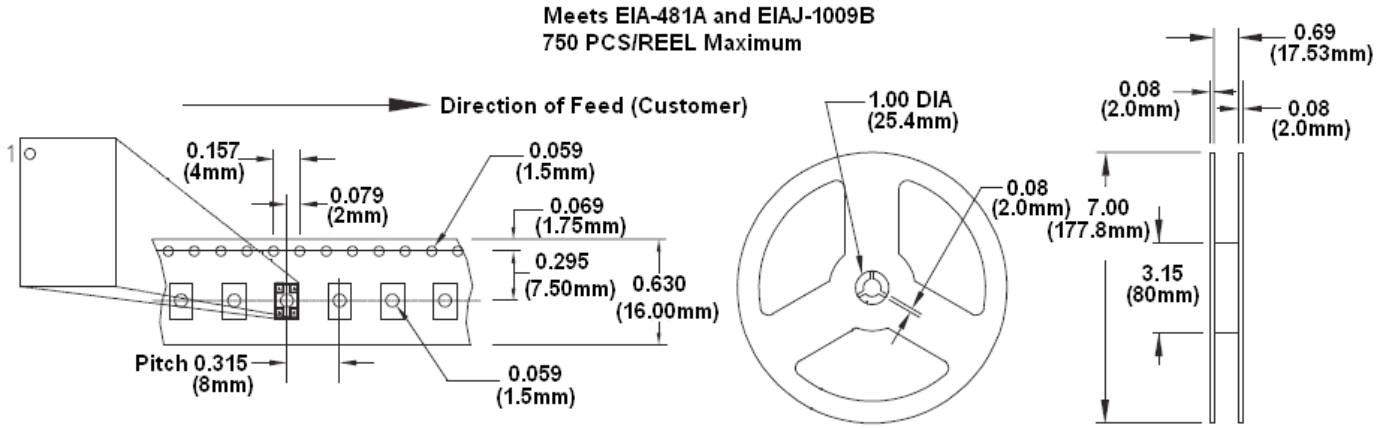
* Do not route any traces in the keep out area. It is recommended that the next layer under the keep out area is to be ground plane.

Bulletin	Tx214
Page	5 of 6
Revision	15
Date	10 April 2024

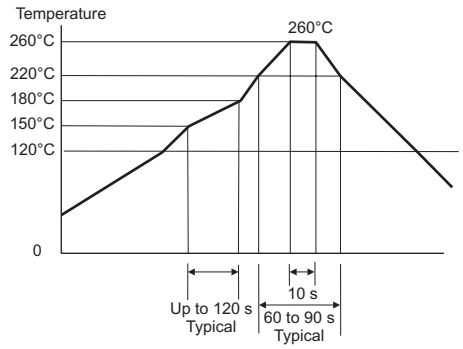
CONNOR WINFIELD

2111 Comprehensive Drive
Aurora, Illinois 60505
Phone: 630-851-4722
Fax: 630-851-5040
www.conwin.com

Tape and Reel Specifications

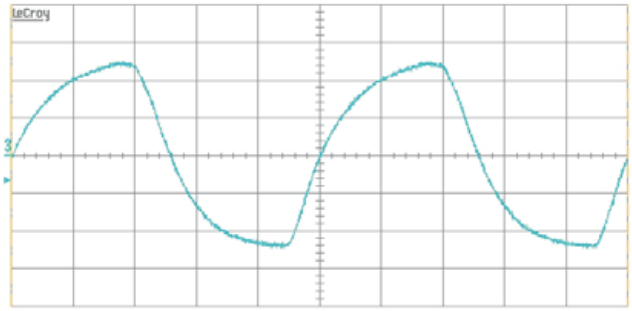


Solder Profile



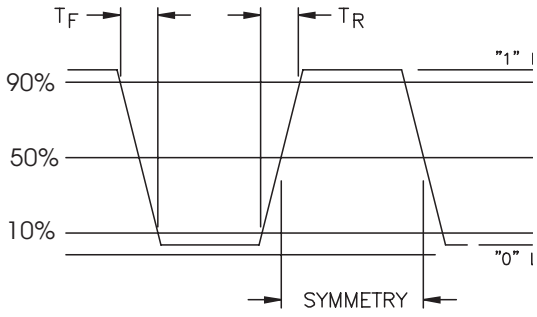
Meets IPC/JEDEC J-STD-020C

Clipped Sinewave Output Waveform



10ns 200mV

LVCMOS Output Waveform



Bulletin	Tx214
Page	6 of 6
Revision	15
Date	10 April 2024