



# Improved Performance 5x7mm TB / TVB Model Series

TCXO / VCTCXO

# CONNOR WINFIELD



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## Description:

Connor-Winfield's TBxxx and TVBxxx series are 5x7mm TCXO and VCTCXO products with exceptional frequency stability and low phase noise.



Similar to our Txxx / TVxxx series, these devices are quieter, smoother over temperature and are available at higher frequencies.

Using the latest analog TCXO technology, the TBxxx and TVBxxx series have improved phase noise and frequency stability performance and are available in 4-pad or 10-pad surface mount footprints.

These products are designed for such applications as IEEE 1588 PTP and Synchronous Ethernet.

## Features:

- Frequency Stabilities Available: STRATUM 3  
+/-0.28 ppm (10 to 50 MHz)  
+/-0.50 ppm, +/-1.00 ppm or +/-2.00 ppm (10 to 100 MHz)
- Temperature Ranges Available:  
0 to 85°C, 0 to 70°C, -40 to 85°C or -20 to 70°C
- Packages Available:  
TB - Series: 5 x 7mm - 10 Pad  
TVB - Series: 5 x 7mm - 4 Pad
- 3.3 Vdc Operation
- Output Logic: LVCMOS or Clipped Sinewave
- Fixed Frequency - TCXO
- Voltage Controlled - VCTCXO
- Low Jitter <0.50 ps RMS
- Low Phase Noise
- Tri-State Enable/Disable: (TB - Model Series Only)
- Tape and Reel Packaging
- RoHS Compliant / Lead Free

## Applications:

- IEEE 1588 Applications
- Synchronous Ethernet slave clocks, ITU-T G.8262 EEC options 1 & 2
- Compliant to Stratum 3, GR-1244-CORE & GR-253-CORE
- Wireless Communications
- Small Cells
- Test and Measurement
- GPS Applications

## Standard Frequencies Available \*

\* 10, 12.8, 19.2, 19.44, 20, 25, 40, 50, 52, 54, 80 and 100 MHz  
Available frequencies from the factory for small quantity orders or quick delivery.  
Additional frequencies are available.

\*\* Not all options  
available at  
Digi-Key

## Ordering Information

| TVB                                                                                                     | 5                                                                                                     | 0                                                                                                  | 4                                                                                                                                                                                                                   | -010.0M                                                                                                                                              |
|---------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Type / Package</b><br>TCXO / VCTCXO Series<br><br>TB = 5.0x7.0 mm 10 Pads<br>TVB = 5.0x7.0 mm 4 Pads | <b>Temperature Range</b><br><br>3 = 0 to 85 °C<br>5 = 0 to 70°C<br>6 = -40 to 85°C<br>7 = -20 to 70°C | <b>Frequency Stability</b><br><br>0 = ±0.28 ppm<br>1 = ±0.50 ppm<br>2 = ±1.00 ppm<br>3 = ±2.00 ppm | <b>Features</b><br><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<br>9 = VCTCXO, LVCMOS, 3.3V with reduced pull range | <b>Output Frequency</b><br><br>Frequency Format<br>-xxx.xM Min*<br>-xxx.xxxxxM Max*<br>*Minimum of 1 digit after the decimal point, and Maximum of 6 |

Example: Part Number

TVB504-010.0M = 5x7mm 4 pad package, ±0.28 ppm, 0 to 70°C, 3.3 Vdc, LVCMOS Output, VCTCXO  
 TB715-012.8M = 5x7mm 10 pad package, ±0.50 ppm, -20 to 70°C, 3.3 Vdc, Clipped Sinewave Output, VCTCXO  
 TB522-050.0M = 5x7mm 10 pad package, ±1.0 ppm, 0 to 70°C, 3.3 Vdc, LVCMOS Output, TCXO  
 TVB602-010.0M = 5x7mm 4 pad package, ±0.28 ppm, -40 to 85°C, 3.3 Vdc, LVCMOS Output, TCXO



## Absolute Maximum Ratings

| Parameter            | Minimum | Nominal | Maximum   | Units | Notes |
|----------------------|---------|---------|-----------|-------|-------|
| Storage Temperature  | -55     | -       | 95        | °C    |       |
| Supply Voltage (Vcc) | -0.6    | -       | 4.6       | Vdc   |       |
| Input Voltage        | -0.5    | -       | Vcc + 0.6 | Vdc   |       |

## Operating Specifications

| Parameter                                                                                      | Minimum                                                                                 | Nominal  | Maximum   | Units  | Notes        |
|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|----------|-----------|--------|--------------|
| Output Frequency (Fo)                                                                          |                                                                                         |          |           |        |              |
| Models TBx0x, TVBx0x                                                                           | 10                                                                                      | -        | 50        | MHz    |              |
| Models TBx1x, TVBx1x                                                                           | 10                                                                                      | -        | 100       | MHz    |              |
| Models TBx2x, TVBx2x                                                                           | 10                                                                                      | -        | 100       | MHz    |              |
| Models TBx3x, TVBx3x                                                                           | 10                                                                                      | -        | 100       | MHz    |              |
| Operating Temperature Range                                                                    | (See Ordering Information for full part number)                                         |          |           |        |              |
| Models TB3xx, TVB3xx                                                                           | 0                                                                                       | -        | 85        | °C     |              |
| Models TB5xx, TVB5xx                                                                           | 0                                                                                       | -        | 70        | °C     |              |
| Models TB6xx, TVB6xx                                                                           | -40                                                                                     | -        | 85        | °C     |              |
| Models TB7xx, TVB7xx                                                                           | -20                                                                                     | -        | 70        | °C     |              |
| Frequency Calibration @ 25 °C                                                                  | -1.0                                                                                    | -        | 1.0       | ppm    | 1            |
| Frequency Stability (See Ordering Information for full part number) Per STRATUM 3 GR-1244-CORE | Frequency Stability ±0.28 ppm is only available in the frequency range of 10 to 50 MHz. |          |           |        |              |
| Models TBx0x, TVBx0x                                                                           | -0.28                                                                                   | -        | 0.28      | ppm    | 2            |
| Holdover Stability                                                                             | -0.32                                                                                   | -        | 0.32      | ppm    | 3            |
| Constant Temperature Stability                                                                 | -40                                                                                     | -        | 40        | ppb    | Over 24 Hrs. |
| Frequency Stability                                                                            | (See Ordering Information for full part number)                                         |          |           |        |              |
| Models TBx1x, TVBx1x                                                                           | -0.50                                                                                   | -        | 0.50      | ppm    | 2            |
| Models TBx2x, TVBx2x                                                                           | -1.00                                                                                   | -        | 1.00      | ppm    | 2            |
| Models TBx3x, TVBx3x                                                                           | -2.00                                                                                   | -        | 2.00      | ppm    | 2            |
| Frequency vs. Load Stability                                                                   | -0.05                                                                                   | -        | 0.05      | ppm    | ±5%          |
| Frequency vs. Voltage Stability                                                                | -0.05                                                                                   | -        | 0.05      | ppm    | ±5%          |
| Static Temperature Hysteresis                                                                  | -                                                                                       | -        | 0.40      | ppm    | 4            |
| Freq. shift after reflow soldering                                                             | -1.0                                                                                    | -        | 1.0       | ppm    | 5            |
| Long Term Stability                                                                            | -1.0                                                                                    | -        | 1.0       | ppm    | 6            |
| Aging                                                                                          |                                                                                         |          |           |        |              |
| per Life (20 Years)                                                                            | -3.0                                                                                    | -        | 3.0       | ppm    |              |
| per Day                                                                                        | -40                                                                                     | -        | 40        | ppb    |              |
| Total Frequency Tolerance                                                                      | -4.6                                                                                    | -        | 4.6       | ppm    | 7            |
| Supply Voltage (Vcc)                                                                           | 3.135                                                                                   | 3.30     | 3.465     | Vdc    |              |
| Supply Current (Icc)                                                                           |                                                                                         |          |           |        |              |
| LVC MOS (10 to 52 MHz)                                                                         | -                                                                                       | 2.1      | 6.0       | mA     |              |
| LVC MOS (>52 to 100 MHz)                                                                       | -                                                                                       | -        | 12        | mA     |              |
| Clipped Sine (10 to 52 MHz)                                                                    | -                                                                                       | 1.3      | 2.9       | mA     |              |
| Clipped Sine (>52 to 100 MHz)                                                                  | -                                                                                       | -        | 12        | mA     |              |
| Jitter:                                                                                        |                                                                                         |          |           |        |              |
| Period Jitter                                                                                  | -                                                                                       | 3.0      | 5.0       | ps RMS |              |
| Integrated Phase Jitter (12K to Fo/2)                                                          | -                                                                                       | 0.3      | 1.0       | ps RMS | 8            |
| Allan Deviation (1s) Fo=10.0 MHz                                                               | -                                                                                       | 1.0E-10  | -         |        |              |
| Typical SSB Phase Noise                                                                        |                                                                                         |          |           |        |              |
| For Fo                                                                                         | 10.0 MHz                                                                                | 50.0 MHz | 100.0 MHz |        |              |
| @ 10 Hz offset                                                                                 | -103                                                                                    | -90      | -80       | dBc/Hz |              |
| @ 100 Hz offset                                                                                | -128                                                                                    | -120     | -110      | dBc/Hz |              |
| @ 1 KHz offset                                                                                 | -147                                                                                    | -142     | -134      | dBc/Hz |              |
| @ 10 KHz offset                                                                                | -157                                                                                    | -158     | -150      | dBc/Hz |              |
| @ 100 KHz offset                                                                               | -158                                                                                    | -159     | -156      | dBc/Hz |              |
| @ 1 MHz offset                                                                                 | -158                                                                                    | -160     | -157      | dBc/Hz |              |
| Start-Up Time                                                                                  | -                                                                                       | -        | 10        | ms     |              |

## Control Voltage Input Characteristics

| Parameter                   | Minimum        | Nominal | Maximum | Units | Notes |
|-----------------------------|----------------|---------|---------|-------|-------|
| Control Voltage             | 0.3            | 1.65    | 3.0     | V     |       |
| Frequency Pullability       |                |         |         |       |       |
| Pull Range Options 4 and 5: | ±10            | ±12     | -       | ppm   |       |
| Pull Range Option 9:        | ±5             | ±6      | ±8      | ppm   |       |
| Pull Slope (Vc=1.65V)       |                |         |         |       |       |
| Pull Range Options 4 and 5: | -              | 8.00    | -       | ppm/V |       |
| Pull Range Option 9:        | -              | 4.50    | -       | ppm/V |       |
| Control Voltage Slope       | Positive Slope |         |         |       |       |
| Monotonic Linearity         | -              | -       | 5       | %     |       |
| Input Impedance             | 100K           | -       | -       | Ohm   |       |
| Modulation Bandwidth (3dB)  | 10             | -       | -       | KHz   |       |

## OE Enable /Disable Input Characteristics (Pad 8) TB Series only

| Parameter             | Minimum                   | Nominal | Maximum | Units | Notes |
|-----------------------|---------------------------|---------|---------|-------|-------|
| Enable Voltage (High) | 70%Vcc                    | -       | -       | Vdc   | 9     |
| Disable Voltage (Low) | -                         | -       | 30%Vcc  | Vdc   | 9     |
| Function              | Output                    |         |         |       |       |
| Low:                  | Disabled (High Impedance) |         |         |       |       |
| High or Open:         | Enabled                   |         |         |       |       |

## LVC MOS Output Characteristics

| Parameter                             | Minimum | Nominal | Maximum | Units | Notes |
|---------------------------------------|---------|---------|---------|-------|-------|
| Load (CL)                             | -       | 15      | -       | pF    | 10    |
| 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 (Fo<70MHz)   | 45      | 50      | 55      | %     |       |
| Duty Cycle at 50% of Vcc (Fo ≥ 70MHz) | 40      | 45      | 50      | %     |       |
| Rise / Fall Time 10% to 90%           | -       | 4       | 8       | ns    |       |

## Clipped Sinewave Output Characteristics

| Parameter                  | Minimum | Nominal | Maximum | Units | Notes |
|----------------------------|---------|---------|---------|-------|-------|
| Load (RC)                  |         |         |         |       | 11    |
| Output Load Resistance     | -       | 10K     | -       | Ohm   | 12    |
| Output Load Capacitance    | -       | 10      | -       | pF    |       |
| 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  |       |

## Package Characteristics

|                                      |                                                                              |
|--------------------------------------|------------------------------------------------------------------------------|
| Package                              | Hermetically sealed ceramic package with grounded metal cover                |
| Moisture Sensitivity Level           | MSL-1                                                                        |
| Pad Termination Material and Plating | 0.5-1.0um [20-40 micro-inches] Gold over 1.27um [50micro-inches] min Nickel. |

## Environmental Characteristics

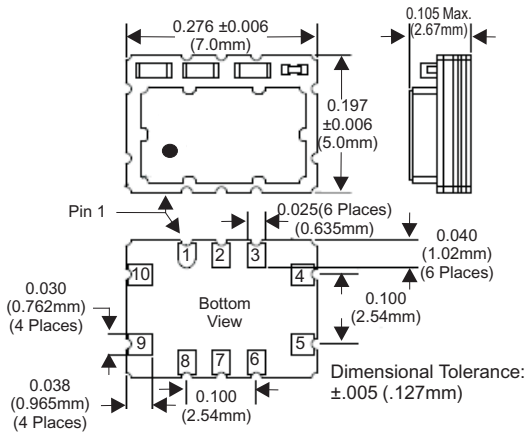
|                    |                                                                   |
|--------------------|-------------------------------------------------------------------|
| Vibration:         | Vibration per Mil Std 883E Method 2007.3 Test Condition A.        |
| Shock:             | Mechanical Shock per Mil Std 883E Method 2002.4 Test Condition B. |
| Soldering Process: | RoHS compliant lead free. See soldering profile on page 6.        |
| Solderability:     | Solderability per Mil Std 883E Method 2003                        |

### Notes:

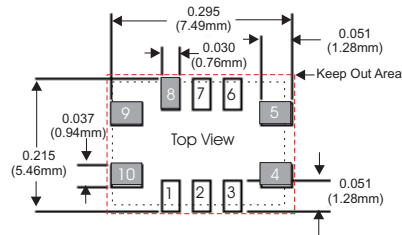
- Initial calibration @ 25°C. ±2°C, for VCTCXO's Vc = 1.65V. Specifications at time of shipment
- Frequency stability vs. change in temperature.  $[\pm(F_{max}-F_{min})/(2 \cdot F_0)]$ . For VCTCXO, Vc = 1.65Vdc
- Inclusive of frequency stability, supply voltage change (±1%), aging, for 24 hours. Per STRATUM 3 GR-1244-CORE.
- Frequency change after reciprocal temperature ramped over the operating range. Frequency measured before and after at 25°C
- Two consecutive solder reflows after 1 hour recovery @ 25°C.
- Frequency drift over 1 year @ 25°C.
- 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.
- For Fo<40MHz, BW=12kHz to Fo/2, for Fo>40MHz, BW=12kHz to 20MHz
- Output is active with Pad 8 not connected. Leave Pad 8 open if disable function is not required. When disabled, output stage is off but oscillator and compensation circuits are still powered (current consumption <3 mA)
- Attention: To achieve optimal frequency stability, and in some cases to meet the specification stated on this data sheet, 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 20 ppb per pF load difference.
- Load components are required for proper operation of the device.
- Output is AC coupled.

|          |                    |
|----------|--------------------|
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| Revision | <b>13</b>          |
| Date     | <b>28 May 2025</b> |

## TB Series Package Outline



## TB Series Suggested Pad Layout

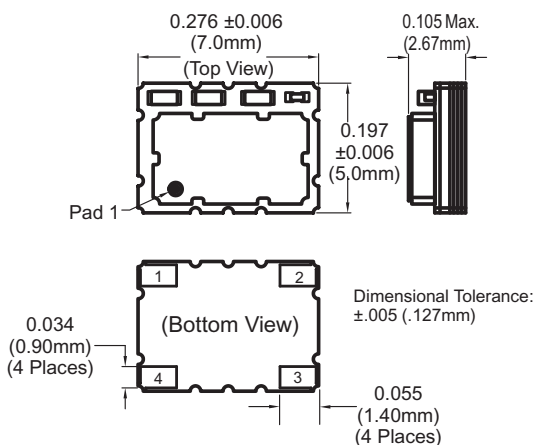


\* Do not route any traces in the keep out area. It is recommended the next layer under the keep out area is to be ground plane.

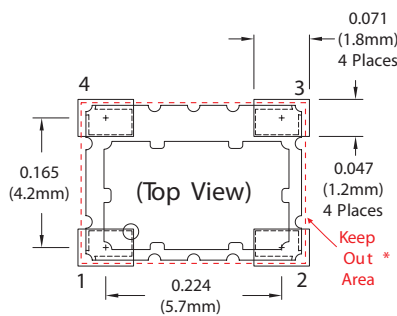
## TB Series Pad Connections

|     |                                          |
|-----|------------------------------------------|
| 1:  | Do Not Connect                           |
| 2:  | Do Not Connect                           |
| 3:  | Do Not Connect                           |
| 4:  | Ground                                   |
| 5:  | Output                                   |
| 6:  | Do Not Connect                           |
| 7:  | Do Not Connect                           |
| 8:  | Enable / Disable (OE)                    |
| 9:  | Supply Voltage (Vcc)                     |
| 10: | VTCXO: Control Voltage (Vc)<br>TCXO: N/C |

## TVB Series Package Outline



## TVB Series Suggested Pad Layout



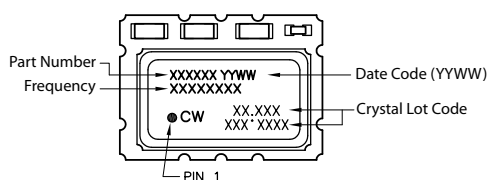
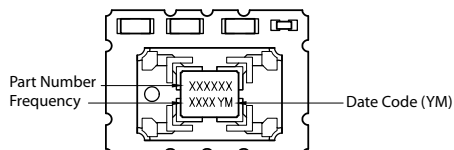
\* Do not route any traces in the keep out area. It is recommended the next layer under the keep out area is to be ground plane.

## TVB Series Pad Connections

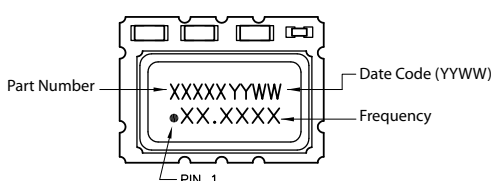
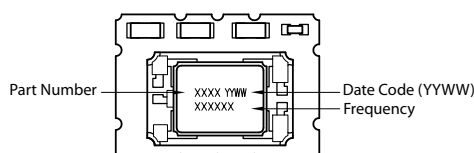
|    |                                           |
|----|-------------------------------------------|
| 1: | VCTCXO: Voltage Control (Vc)<br>TCXO: N/C |
| 2: | Ground                                    |
| 3: | Output                                    |
| 4: | Supply (Vcc)                              |

### Marking Information

The following are examples of possible marking configurations

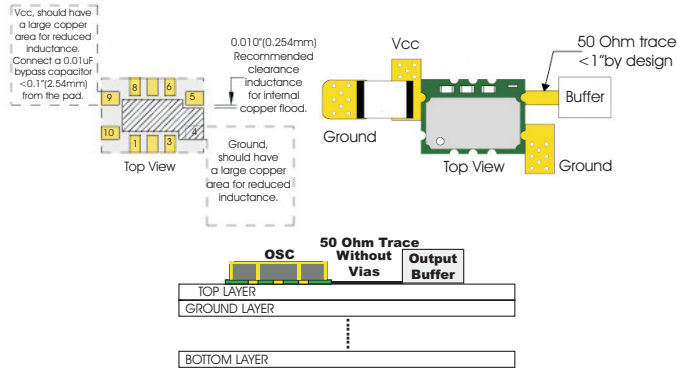


| 2 CHARACTER DATE CODE |               |
|-----------------------|---------------|
| Y = Year              | M = Month     |
| 1 = 2021              | A = January   |
| 2 = 2022              | B = February  |
| 3 = 2023              | C = March     |
| 4 = 2024              | D = April     |
| 5 = 2025              | 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  |

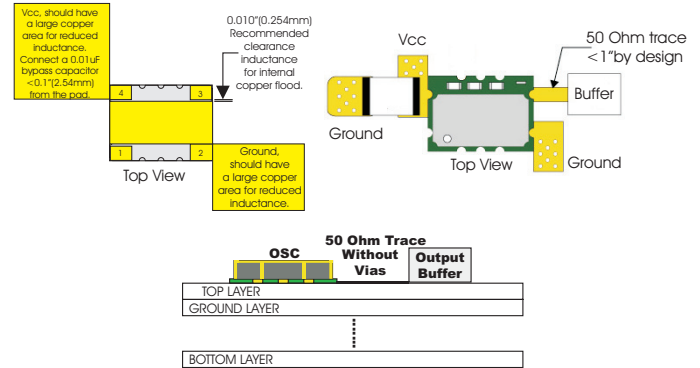


|          |                    |
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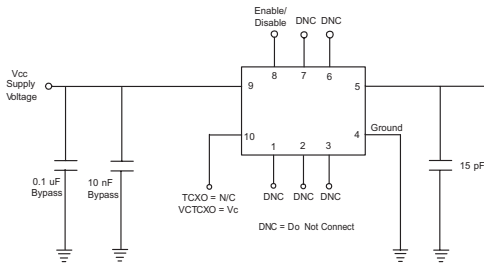
## TB Series Design Recommendations



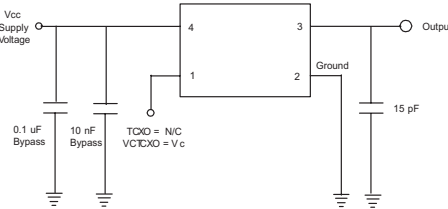
## TVB Series Design Recommendations



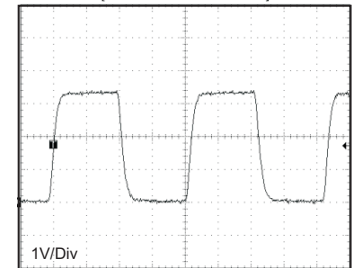
## TB Series LVCMOS Test Circuit



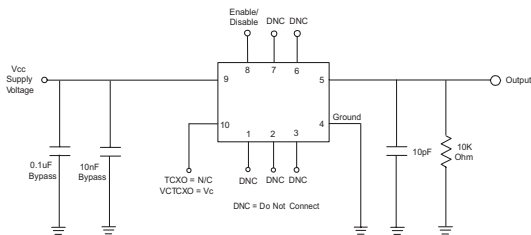
## TVB Series LVCMOS Test Circuit



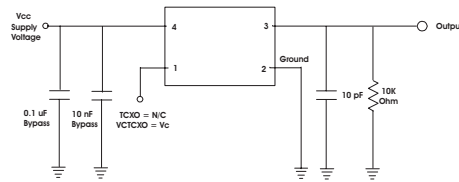
## LVCMOS Output Waveform



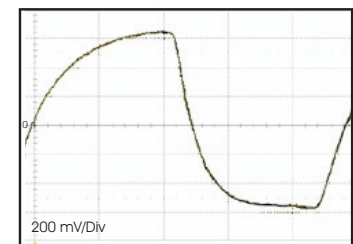
## TB Series Clipped Sinewave Test Circuit



## TVB Series Clipped Sinewave Test Circuit



## Clipped Sinewave Output Waveform



Note: The clipped sinewave output is AC coupled

