REV LTR	DESCRIPTION	DATE	APPVD.
-	Orig. Release	01/16/10	JSN
A	Revised per ECN 2012-1	11/09/12	JSN
B	Revised per ECN 2014-1	03/26/14	JSN
C	Revised per ECN 2016-2	10/21/16	JSN

FTTC16 Series

CMOS/Clipped sinewave Output TCXO/VCTCXO

FOR SPACE APPLICATIONS

6.0MHz to 100 MHz

(7x5 mm, 3.3 V)

(Refer to Page 5 for Models with Reduced Screening & QCI)

1. SCOPE: FTTC16 series, CMOS/Sinewave output, high reliability hybrid microcircuit crystal oscillators are designed, produced and tested by Frequency Technology, Inc. as MIL-PRF-55310, Class "S" equivalent devices for use in advanced military, avionics and space applications. These devices are of hybrid microcircuit technology conforming to MIL-PRF-55310, Type 1, Class 2 oscillators.

2. APPLICABLE DOCUMENTS:

MIL-PRF-55310E	Oscillator, Crystal Controlled, General Specifications for
MIL-PRF-38534G	Hybrid Microcircuits, General Specifications for
MIL-STD-883E	Test Methods and Procedures for Microelectronics

3. REQUIREMENTS:

3.1 General: The individual item requirements shall be as specified herein.

3.2 Package: Ceramic, 90% Min. AL_2O_3. Thermal Resistance, θ_{JC}: 50 °C / Watt.

3.2.1 Termination Finish: 1.3 μm minimum gold plate over 2.0 μm minimum nickel plate. Hot Solder tinning with Sn60/Pb40 solder per MIL-PRF-55310 is optional at an additional cost.

3.2.2 Weight: 0. 3 Gms Max.

3.2.3 Reflow Soldering: Reflow soldering at 260 °C for 10 seconds shall not degrade the performance.

3.3 Hermeticity: Resistance welded, hermetically sealed, leak rate of $1(10)^{-8}$ atm-cc/s Max.

3.4. Marking: As a minimum, the parts shall be marked with Fre-techP/N and date code

3.5 Absolute Maximum Ratings: Unless otherwise specified, absolute maximum ratings shall be as follows:

Supply Voltage	-0.5 to +6.0 VDC
Operating Free-Air Temperature Range	-40°C to +85 °C
Storage Temperature	-55°C to +105°C

3.6 Electrical Characteristics: See Table I

3.6.1 Total Dose Radiation: Hybrid Microcircuit Crystal Oscillators shall be capable of meeting the electrical characteristics of Para. 3.6 after being exposed to total ionizing dose radiation of 100 krads as per MIL-STD-883, method 1019.

3.7 Hybrid Elements:

3.7.1 Quartz Crystals: High grade cultured quartz crystal shall be used. As an option, Fre-tech will use premium Q swept quartz crystal at an additional charge, refer to part numbering example in paragraph 6 to specify swept quartz crystal. Crystal element evaluation shall be in accordance with MIL-PRF-55310.

3.7.2 Crystal Mounting: Crystal element shall be mounted at 4 points in such a manner as to provide adequate ruggedness and performance under extreme environments specified herein.

3.7.3 Passive Elements: Established Reliability (ER) QPL components, failure level R minimum shall be used or element lot evaluation shall be as per MIL-PRF-55310, class S, or MIL-PRF-38534, Appendix C, Class K as applicable.

3.7.4 Microcircuit die shall be from lots that have passed the element evaluation per MIL-PRF-55310, Appendix B, Level S, except testing per Subgroup 5 is omitted. Subgroup 5 testing is circuit configuration dependent, therefore, it is more effectively performed at the oscillator level as explained in Paragraph 3.7.4 herein.

3.7.5 For Output Frequency up to 90 MHz, microcircuit die used in the oscillator shall be from NSC/FC 54ACT family and must be from wafer lot that has been successfully tested in the oscillator for ionizing radiation of up to100 krads Fre-tech has also performed SET & SEL testing on the microcircuit die. Test reports are available on request. For output frequencies above 90 MHz, the microcircuit die shall be from 0,8 µm BiCMOS Si family and must be from wafer lots that have been successfully tested in the oscillator for ionizing radiation of up to 100Krads and is known to be Single Event Latch-up immune for LET of up to 95 Mev-cm^2/mg.

3.7.6 Workmanship, Rework and Process controls shall be in accordance with the requirements of MIL-PRF-55310.

3.7.7 Lot Traceability: Production lot for these oscillators shall be homogenous. Each element used in the production lot shall be traceable to a single lot. Swept quartz shall be traceable to the quartz bar, and its applicable processing details.

4. Quality Assurance Provisions: The quality assurance provisions shall be per MIL-PRF-55310, except as specified herein.

4.1 100% Screening: The 100% screening shall be performed as per Table II. PDA requirements for nondestructive bond pull and burn-in shall be as specified below.

4.2 PDA for Nondestruct Bond Pull: Unless otherwise specified, PDA shall be 2% of total number of wires or 1 wire whichever is greater.

4.3 PDA for Burn-in: Unless otherwise specified, PDA for burn-in shall be 2% or 1 oscillator whichever is greater and shall be applicable to +23 ^{o}C and/or +25 ^{o}C static tests only. In addition Delta Calculation shall be performed after Burn-in and shall count for PDA. All measured values for Delta Calculation shall be recorded. Parts that exceed the specified delta limits shall be rejected and be counted for PDA. Delta Calculation shall be performed at 3.3 VDC for the following parameters:

Input Current	10% change Maximum
Output High Level	10% change Maximum
Output Low Level	0.1V change Maximum

4.4 Group A inspection shall be in accordance with MIL-PRF-55310 for product level S.

4.5 Group B inspection (30 day aging) shall be in accordance with MIL-PRF-55310 for product level S. In order to expedite delivery, by customer request, the aging test can be ended after 15 days if the amount of frequency aging is less than 50% of the 30 day specification limit.

4.6 Oscillators shall be capable of meeting group C inspection per MIL-PRF-55310. Generic group C inspection data on similar parts may be used to satisfy this requirement. When specified by the Customer, Fre-tech will perform Group C testing at an additional charge.

4.7 Inspection and Test Data: Unless otherwise specified in the purchase order, the following Inspection and test data documentation shall be supplied with the parts.

Certificate of Conformance
Summary of Class “S” screening Test Results
PDA Calculations for Non-Destruct Bond Pull and Burn-in
Summary of Elements Lot Traceability
Electrical Tests before and after Burn-in
Group A Inspection Summary
Group B (30 day Aging) Data
Radiographic Inspection Certificate

4.8 The following test and inspection options are available at customer request.

Customer Source Inspection for Pre-Cap and Final
Group C Inspection per MIL-PRF-55310 on 4 or 8 units
DPA (Destructive Physical Analysis)
Life Test per MIL-STD-883, Method 1005, 1000 Hrs. at +125 ^{o}C
MIL-PRF-38534, Group B Inspection
MIL-PRF-38534, Group C Inspection

5.0 Preservation, Packaging and Packing: The oscillators shall be clean, dry and packaged in a manner to provide adequate protection against electrostatic discharge, corrosion, deterioration and physical damage during shipment.

6.0

HOW TO ORDER

FTTC16 – 10 D H T v / 50

10 — Frequency/ Temperature Stability
- 3= ± 0.3ppm *
- 5= ± 0.5ppm
- 10= ± 1.0ppm
- 15= ± 1.5ppm
- 20= ± 2.0ppm
- 25= ± 2.5ppm
- 30= ± 3.0ppm
- 50= ± 5.0ppm

* Note: ± 0.3ppm only for 6.4MHz to 50MHz

D — Temperature
- A= 0°C to +50°C
- B= -20°C to +70°C
- C= -30°C to +70°C
- D= -40°C to +85°C

H — Output Logic
- H= HCMOS/TTL
- S = Clipped Sinewave

T — Pull range(for VCTCXO)
- T= TCXO
- V= VCTCXO

v — Grade(Screening Level)
- N=No Screening
- I= Industrial Std
- M= MIL-STD-883
- B= MIL-PRF-55310,level B
- S= MIL-PRF-55310,level S
- V= MIL-PRF-55310,level S ,50krad(Si) total dose
- R= MIL-PRF-55310,level S ,100krad(Si) total dose

50 — Frequency MHz

P/N Example: FTTC16 -10DHTV - 50.000 MHz = 50.000 MHz, Class "V" Oscillator, ± 1 PPM Overall Frequency Accuracy over an operating temperature range of -40 °C to +85 °C, 3.3V,HCMOS output,TCXO

NOTE: Besides **Class R and Class V,** the following additional models are available for applications that can accommodate reduced level of screening and quality conformance inspection:

Class S : **Class S** is same as **Class R and ClassV** except as follows:

Group A inspection is per MIL-PRF-55310, Class B
Group B inspection (30 day aging) per MIL-PRF-55310 is not applicable

Class B : **Class B** uses the same design and elements as **Class S** except as follows:

100% screening is as per Table III herein
PDA for Burn-in is 10% or 1 unit whichever is greater
Delta measurements of paragraph 4.3 are not applicable
Group A inspection is as per MIL-PRF-55310, Class B
Group B inspection (30 day aging) per MIL-PRF-55310 is not applicable

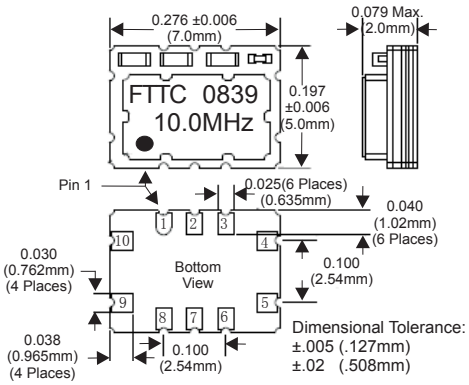
Class M : **Class M** is same as **Class B** except as follows:

Active and Passive Elements are as per MIL-PRF-55310, Class B. Microcircuit die is similar to the one used in Class B but is not from radiation tested wafer lot.

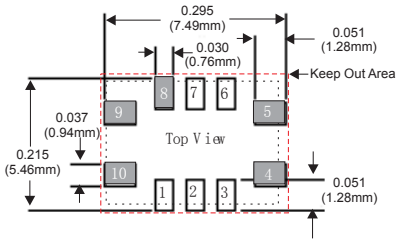
Class I/N : **Class I and Class N** is a form, fit and function equivalent prototype of **Class R to Calss M**

Prototypes may use and industrial and commercial grade elements and are not screened. Quality Conformance inspection is not applicable.

Package & Dimensions :



Recommended Land Patter



Pin 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	N/C or Tri-state Enable / Disable
9	Supply, Vcc
10	N/C (TCXO) or Voltage Control (VCTCXO)

Electrical Specifications

Electrical Performance for the CMOS Output Option

Parameter		Symbol	Min	Typical	Maximum	Units
Frequency		f_O	6.000		100.000	MHz
Supply Voltage				3.3V±5%		V_{DC}
Maximum Supply Voltage					7	V_{DC}
Supply Current	V_{DD} =3.3v	I_{DD}			25.0	mA
Output Level [2] Logic High Logic Low		 V_{OH} V_{OL}	 0.9*V_{DD}		 0.1*V_{DD}	 V V
Rise and Fall Time[3]		t_R/t_F			10	ns
Output Load				15pf		
Duty Cycle, @ 50%					45/55	%
Control Voltage Impedance		Z_{Vc}	100			Kohm
Control Voltage to reach pull			0.3	1.65	3.0	V
Pull Range *Ordering option, see last page*		TPR		±5, ±8, ±10		ppm
Temperature Stability *Ordering option, see last page.*				±0.5 to ±5.0		ppm
Initial Accuracy, "No Adjust" option[4]					±1.0	ppm
Power Supply Stability					±0.3	ppm
Load Stability					±0.3	ppm
Aging					±1.0	ppm/year
Operating temperature *Ordering option, see last page*				0/55, -10/60, -20/70, -30/80, -40/85		°C
Phase Noise, 10/100MHz 10 Hz offset 100 Hz offset 1 kHz offset 10 kHz offset 100 kHz offset				 -98/-60 -125/-91 -143/-119 -154/-142 -155/-153		dBc/Hz
Start-up time					10	ms

1. A 0.01uF and a 0.1uF capacitor should be located as close to the supply as possible (to ground) is recommended.
2. Output is DC coupled.
3. Rise and Fall time is measured at 20/80% levels
4. Initial Accuracy is +/-2.0ppm after 2 IR reflows.

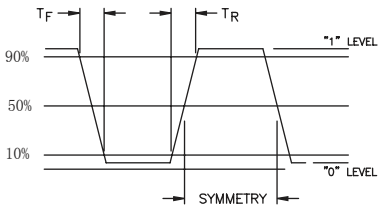
FTTC16 Series High Reliability 5x7mm Package TCXO/VCTCXO

Electrical Performance for the Clipped Sine Wave Output Option

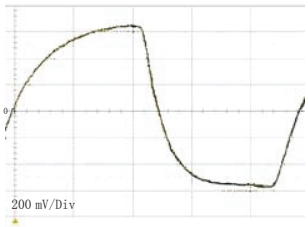
Parameter	Symbol	Min	Typical	Maximum	Units
Frequency	f_O	6.000		100.000	MHz
Typical Supply Voltage[1] *Ordering option, see last page*			3.3		V
Supply Current 10.00 MHz to < 52.00 MHz 52.00 MHz to < 100.00 MHz	I_{DD}			10.0 20.0	mA
Output Level [2]	Vpk to pk	0.8			V
Output Load Resistance			10K		Ohm
Output Load Capacitance			10		pF
Output Impedance			200		Ohm
Control Voltage to reach pull		0.3	1.65	3.0	V
Pull Range *Ordering option, see last page*	TPR		±5, ±8, ±10		ppm
Temperature Stability *Ordering option, see last page.*			±0.5 to ±5.0		ppm
Initial Accuracy, "No Adjust" option[3]				±1.0	ppm
Power Supply Stability				±0.3	ppm
Load Stability				±0.3	ppm
Aging				±1.0	ppm/year
Operating temperature *Ordering option, see last page*			0/55, -10/60, -20/70, -30/80, -40/85		°C
Phase Noise, 10.00/100.00MHz 10 Hz offset 100 Hz offset 1 kHz offset 10 kHz offset 100 kHz offset			 -98/-60 -125/-91 -143/-119 -151/-142 -152/-153		dBc/Hz
Start-up time				10	ms

1. A 0.01uF and a 0.1uF capacitor should be located as close to the supply as possible (to ground) is recommended.
2. Output is AC coupled.
3. Initial Accuracy is +/-2.0ppm after 2 IR reflows.

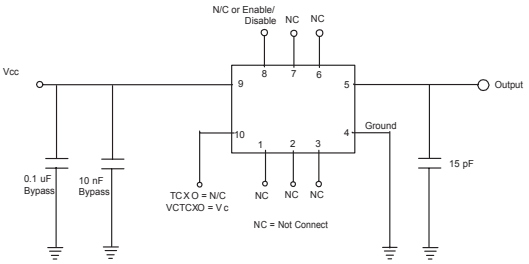
CMOS Output



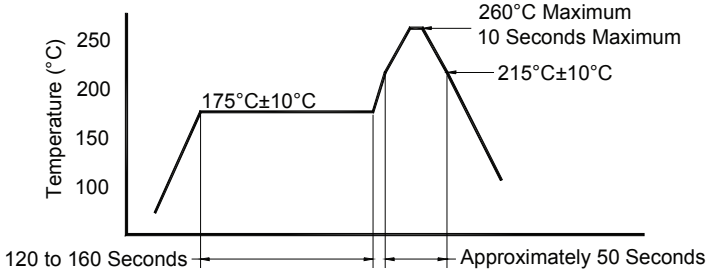
Clipped Sinewave Output



Test circuit for CMOS Output



Reflow Cycle (typical for lead free processing)



Allowed rate of temperature change
Maximum 4°C per second

Test circuit for Clipped Sinewave

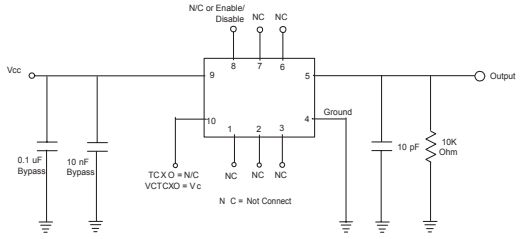


Table II - Class R/V/S , Screening (100%)

Test - Inspection	Test Method – Condition
Nondestructive Bond Pull	MIL-STD-883, Method 2023
Internal Visual	MIL-STD-883, Method 2017, Level S
Stabilization Bake (Prior to Seal) 1/	MIL-STD-883, Method 1008, Condition C (+150 °C), 48 hours minimum
Thermal Shock	MIL-STD-883, Method 1011, Condition A
Temperature Cycling	MIL-STD-883, Method 1010, Condition B
Constant Acceleration	MIL-STD-883, Method 2001, Condition A Y_1 axis only (5000 G)
Seal (Fine and Gross Leak)	MIL-PRF-55310, Para. 4.8.2.2.2
Particle Impact Noise Detection (PIND)	MIL-STD-883, Method 2020, Condition A
Radiographic Inspection	MIL-STD-883, Method 2012, Class S
Electrical Tests: Record all measurements.	Nominal Supply Voltage, Specified load, +23 °C
Input Current Output Frequency Output Voltage Levels Output Rise & Fall Times Output Duty Cycle	MIL-PRF-55310, Para. 4.8.5 MIL-PRF-55310, Para. 4.8.6 MIL-PRF-55310, Para. 4.8.21.3 MIL-PRF-55310, Para. 4.8.22 MIL-PRF-55310, Para. 4.8.23
Burn-in (load)	+125 °C, Nominal Supply Voltage and Burn-in load, 320 Hours Minimum
Electrical Tests: Record all measurements.	Nominal and Extreme Supply Voltages, Specified load, +23 °C and operating temperature extremes,
Input Current Output Frequency Output Voltage Levels Output Rise & Fall Times Output Duty Cycle	MIL-PRF-55310, Para. 4.8.5 MIL-PRF-55310, Para. 4.8.6 MIL-PRF-55310, Para. 4.8.21.3 MIL-PRF-55310, Para. 4.8.22 MIL-PRF-55310, Para. 4.8.23

1/ Vacuum bake and maintain oscillators in dry nitrogen per MIL-PRF-55310.

Table III - Class B/M Screening (100%)

Test - Inspection	Test Method – Condition
Nondestructive Bond Pull	MIL-STD-883, Method 2023
Internal Visual	MIL-STD-883, Method 2017, Level B
Stabilization Bake (Prior to Seal) 1/	MIL-STD-883, Method 1008, Condition C (+150 °C), 24 hours minimum
Temperature Cycling	MIL-STD-883, Method 1010, Condition B
Constant Acceleration	MIL-STD-883, Method 2001, Condition A Y_1 axis only (5000 G)
Seal (Fine and Gross Leak)	MIL-PRF-55310, Para. 4.8.2.2.2
Particle Impact Noise Detection (PIND)	MIL-STD-883, Method 2020, Condition A
Electrical Tests:	Nominal Supply Voltage, Specified load, +23 °C Verify all parameters
Input Current	MIL-PRF-55310, Para. 4.8.5
Output Frequency	MIL-PRF-55310, Para. 4.8.6
Output Voltage Levels	MIL-PRF-55310, Para. 4.8.21.3
Output Rise & Fall Times	MIL-PRF-55310, Para. 4.8.22
Output Duty Cycle	MIL-PRF-55310, Para. 4.8.23
Burn-in (load)	+125 °C, Nominal Supply Voltage and Burn-in load, 160 Hours Minimum
Electrical Tests:	Nominal Supply Voltage, Specified load, +23 °C and verify frequency at temperature extremes.
Input Current	MIL-PRF-55310, Para. 4.8.5
Output Frequency	MIL-PRF-55310, Para. 4.8.6
Output Voltage Levels	MIL-PRF-55310, Para. 4.8.21.3
Output Rise & Fall Times	MIL-PRF-55310, Para. 4.8.22
Output Duty Cycle	MIL-PRF-55310, Para. 4.8.23

1/ Vacuum bake and maintain oscillators in dry nitrogen per MIL-PRF-55310.