

REV LTR	DESCRIPTION	DATE	APPVD.
-	Orig. Release	10/15/09	JSN
A	Revised per ECN 2012-1	6/18/12	JSN
B	Revised per ECN 2015-1	7/15/14	JSN
C	Revised per ECN 2016-1	10/09/16	JSN

FTOC02 Series
HCMOS/TTL, Sinewave outout OCXO
FOR MILITARY APPLICATIONS
5.0MHz to 300 MHz
(25x 25 mm, DIP, 3.3 V/5V/12V)

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

1. SCOPE: FTOC02 series ,HCMOS/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 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: Dimensions 20x20x12mm

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: 20.0Gms Max.

3.2.3 Reflow Soldering: Hand soldering at 260 °C for 10 seconds ,not reflow compatible.

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 +14.4 VDC
Operating Free-Air Temperature Range	-55°C to + 85 °C
Storage Temperature	-60°C to + 90 °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 to 100 krad. 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 100Krad and is known to be Single Event Latch-up immune for LET of up to 95 Mev-cm²/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 °C and/or +25 °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.

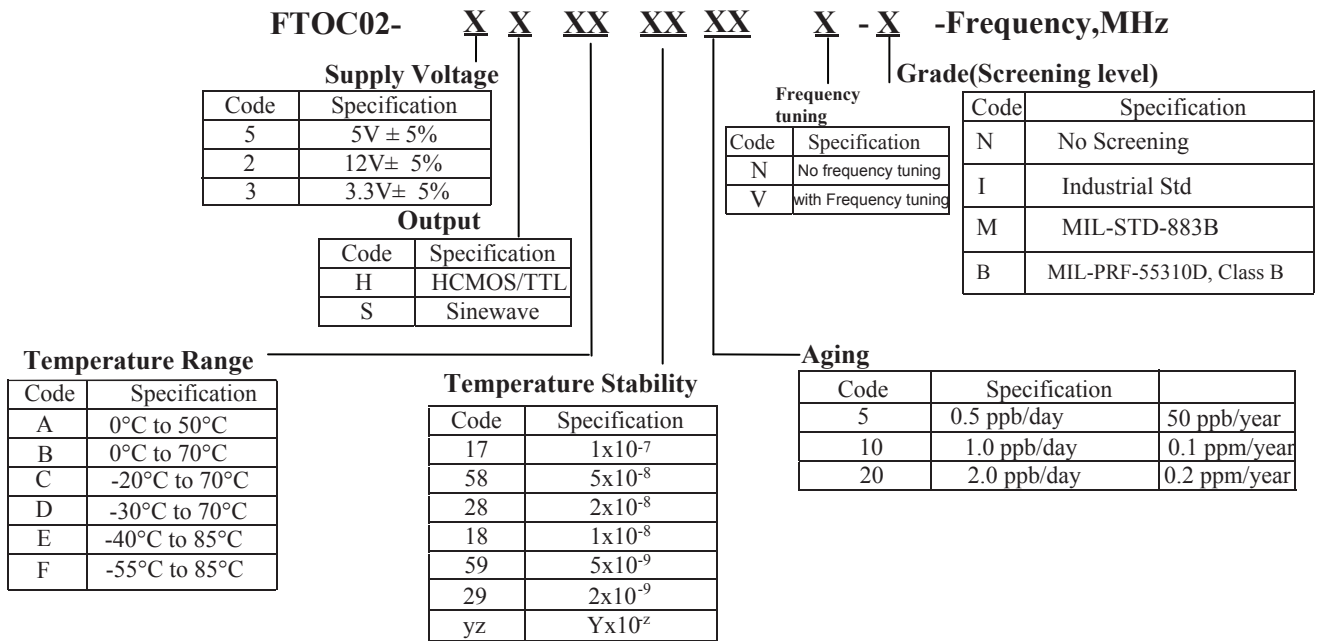
Certificate of Conformance
Summary of Class "S" screening Test Results
PDA Calculations for Non-Destruct Bond Pull and Burn-in
Summary of Elements Lot Traceability
Electrical Tests before and after Burn-in
Group A Inspection Summary
Group B (30 day Aging) Data
Radiographic Inspection Certificate

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 °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 Part Numbering Example:



Freq. Vs Temp Availability

Temp (°C)	50: ±0.5ppb	19: ±1ppb	29: ±2.0ppb	39: ±3.0ppb	59: ±5.0ppb	18: ±10ppb	28: ±20ppb	58: ±20ppb
A: 0°C to +50°C	♦	♦	♦	♦	♦	♦	♦	♦
B: 0°C to +70°C		♦	♦	♦	♦	♦	♦	♦
C: -20°C to +70°C			o	♦	♦	♦	♦	♦
D: -30°C to +70°C				o	♦	♦	♦	♦
E: -40°C to +85°C					♦	♦	♦	♦
F: -55°C to +85°C						♦	♦	♦

o Contact Factory
♦ available

* No frequency control option – on customer require

P/N Example: FT0C02-5SE1810VB-100.000MHz

100.000 MHz, Class “B” OCXO, +/- 10 ppb overall Frequency stability over an operating temperature range of -40 °C to +85 °C, 5.0V,Sinewave output . Aging :1.0 ppb/day, 0.1 ppm/year.Frequency tuning.

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:

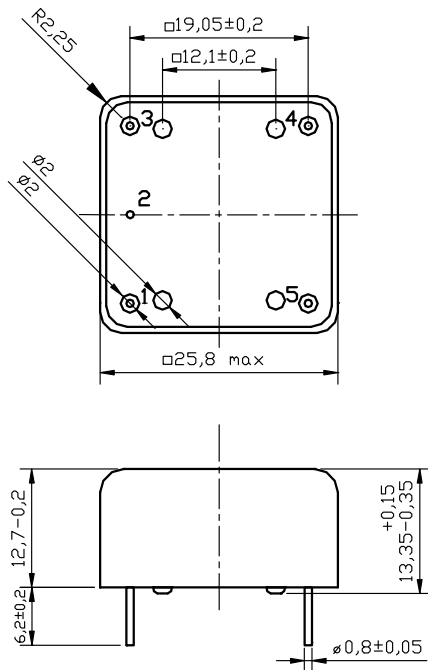
Active and Passive Elements are as per MIL-PRF-55310, Class B. Microcircuit die is similar to the one used in Class B, but is not from radiation tested wafer lot.

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

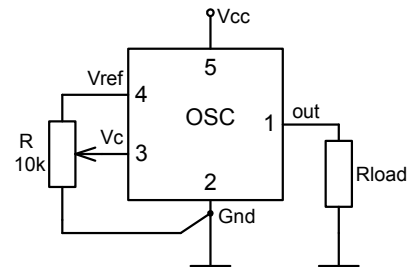
Prototypes may use and industrial and commercial grade elements and are not screened. Quality Conformance inspection is not applicable.

Package dimensions and Connections

Physical Dimensions



Pin Connections



Pin	Signal
1	RF Out
2	GND
3	Electrical tuning *
4	Reference voltage
5	+V Supply

* No frequency control option – on customer require. Pin 3 and pin 4 may be not connected for no frequency tuning.

Features

- MIL-PRF-55310D Class B Available
- Wide operating temperature (-55 °C to +85°C)
- Very Low Phase Noise(-175 dBc/Hz, TYP, floor for 10MHz)
- Small sizes packaging (20x20x10mm)
- High Stability :up to $\pm 1 \times 10^{-9}$ for -40 °C to +85°C
- Low Aging (5×10^{-10} /day, 5×10^{-8} /year)
- SC-cut crystal
- Sine Wave or HCMOS/TTL output
- 5 MHz to 300 MHz Frequencies Available

TABLE I – Electrical Characteristics

Parameter	Sym.	Conditions	Value			Unit	Note
			Min.	Typ.	Max.		
Frequency range	f_0		5		300	MHz	Fundamental operation <150MHz
RF output							
HCMOS (TTL) option	Load		10		15	kOhm pF	
	H-level voltage	V_H	3.9			V	For 5V or 12V
	L-level voltage	V_L			0.4	V	
	Duty cycle		45		55	%	
Sine-wave option	Rise/Fall time				10	ns	for 10 MHz operational frequency
	Level	L	+5	+8	+10	dBm	
	Load	R_L		50		Ohm	
	Harmonics level				-25	dBc	
Sub-harmonics level		Operational frequency <150 MHz Operational frequency >150 MHz		none	-40	dBc	Frequency multiplier used
Power supply							
Voltage	V_{cc}		3.14 4.75 11.4	3.3 5.0 12.0	3.47 5.25 12.6	V V V	
Power consumption		Warm-up state Steady state, +25°C		3.2 1.0	3.5 1.2	W W	
Warm-up time	t_{up}	to $\Delta f/f=1e-7$, at +25°C			180	s	ref. to frequency after 30 min.
Frequency control*							
Control voltage range	V_c	$V_{cc}=5$ or 12 V $V_{cc}=3.3$ V	0 0		4.3 2.8	V V	Positive tuning slope (standard option)
Tuning range			± 0.5	± 1		ppm	
Reference voltage	V_{ref}	$V_{cc}=5$ or 12 V $V_{cc}=3.3$ V	4.19 2.73	4.3 2.8	4.41 2.87	V V	
Frequency stability							
vs. temperature		-30°C to +70°C, ref 25°C		± 10		ppb	See chart below
vs. supply voltage		ref Vcc typ.		± 1		ppb	
vs. acceleration		Worst direction			± 1	ppb/G	
SSB Phase noise		1 Hz		-95/60		dBc/Hz	for 10/100MHz operational frequency
		10 Hz		-125/95			
		100 Hz		-145/125			
		1 kHz		-155/153			
		10 kHz		-165/165			
Allan variance		1 s		10		e-12	
Aging	per day	after 30 days of operation			± 0.5	ppb	Standard option (see how to order)
	first year				± 50	ppb	
	for 20 years				± 0.5	ppm	
Environmental, mechanical conditions.							
Operating temperature range		-30°C to +70°C Standard Other options - see chart below.					
Storage temperature range		-60°C to +90°C					
Humidity		Hermetically sealed					
Mechanical shock		Per MIL-STD-202, 30G half sine pulse, 11ms					
Vibration		Per MIL-STD-202, 5G swept sine 10 to 500 Hz					
Soldering conditions		Hand solder only-not reflow compatible, 260°C 10s					

* No frequency control option – on customer requirement

Contact Fre-tech Engineering for any other special requirements.

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

Test - Inspection	Test Method – Condition
Nondestructive Bond Pull	Not available
Internal Visual	MIL-STD-883, Method 2017, Level S
Stabilization Bake (Prior to Seal) <u>1/</u>	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	Not available
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. Input Current Output Frequency Output Voltage Levels Output Rise & Fall Times Output Duty Cycle	Nominal Supply Voltage, Specified load, +23 °C 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. Input Current Output Frequency Output Voltage Levels Output Rise & Fall Times Output Duty Cycle	Nominal and Extreme Supply Voltages, Specified load, +23 °C and operating temperature extremes, 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	Not available
Internal Visual	MIL-STD-883, Method 2017, Level B
Stabilization Bake (Prior to Seal) <u>1/</u>	MIL-STD-883, Method 1008, Condition C (+150 °C), 24 hours minimum
Temperature Cycling	MIL-STD-883, Method 1010, Condition B
Constant Acceleration	Not available
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: Input Current Output Frequency Output Voltage Levels Output Rise & Fall Times Output Duty Cycle	Nominal Supply Voltage, Specified load, +23 °C Verify all parameters 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, 160 Hours Minimum
Electrical Tests: Input Current Output Frequency Output Voltage Levels Output Rise & Fall Times Output Duty Cycle	Nominal Supply Voltage, Specified load, +23 °C and verify frequency at temperature extremes. 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.