

REV LTR	DESCRIPTION	DATE	APPVD.
-	Orig. Release	9/21/08	FRK
A	Revised per ECN 2012-1	2/18/12	FRK
B	Revised per ECN 2015-1	01/12/15	FRK
C	Revised per ECN 2016-2	9/18/16	FRK

FTVC1 Series

Sinewave output ultra low phase noise VCXO

FOR SPACE APPLICATIONS

10M Hz to 260 MHz

(17 x 14 mm, SMD, 3.3 V /5.0V)

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

1. SCOPE: FTVC1series, 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: Metal cover and PCB base, 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: 1.50 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-tech P/N and date code

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

Supply Voltage	-0.5 to +5.5 VDC
Operating Free-Air Temperature Range	-40°C to +85 °C
Storage Temperature	-55°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 +85 °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:

FTVC1 -	0	D	D	S /	100
Voltage	Temperature range	Absolute pull range (APR)	Screening Level	Frequency	
A=+3.3V 0=+5.0V	A= 0°C to +70°C B=-20°C to +70° C C=-20°C to +70° C D=-40°C to +85°C	D= ± 10ppm E= ± 20ppm F= ± 30ppm G= ± 50ppm H= ± 100ppm	N = No Screening I = Industrial Std M = MIL-STD-883 B = MIL-PRF-55310D Class B S = MIL-PRF-55310D Class S		MHz

P/N Example: FTVC1-0DDS - 100.000 MHz = 100.000 MHz, Class "S" Oscillator, ± 10 PPM (APR) operating temperature range of -40°C to +85 °C, 5.0V

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

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

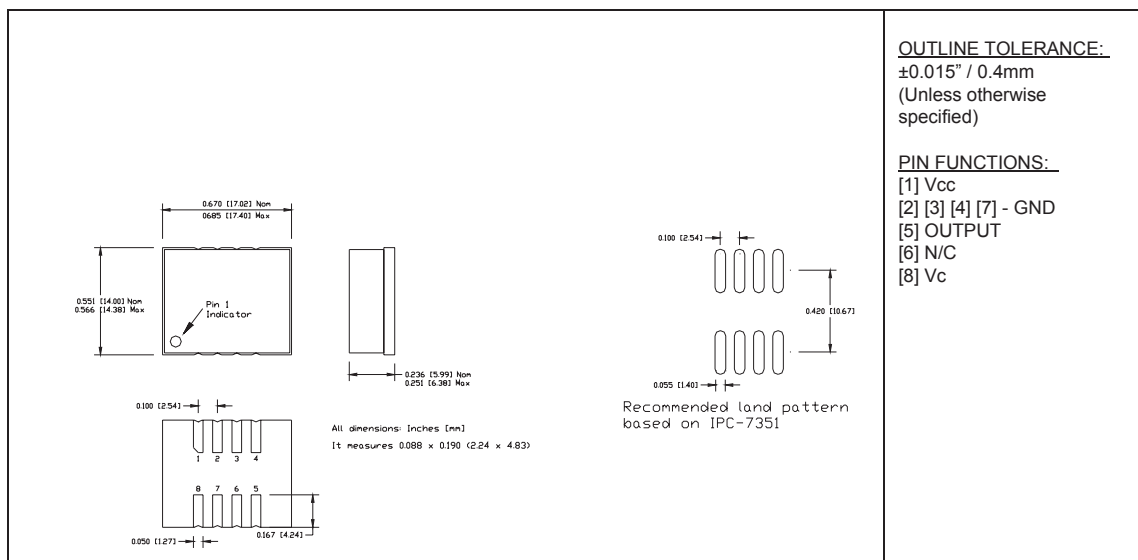
Active and Passive Elements are as per MIL-PRF-55310, Class B. Microcircuit die is similar to the one used in Model Class S but is not from radiation tested wafer lot.

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

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

Package & Dimensions :

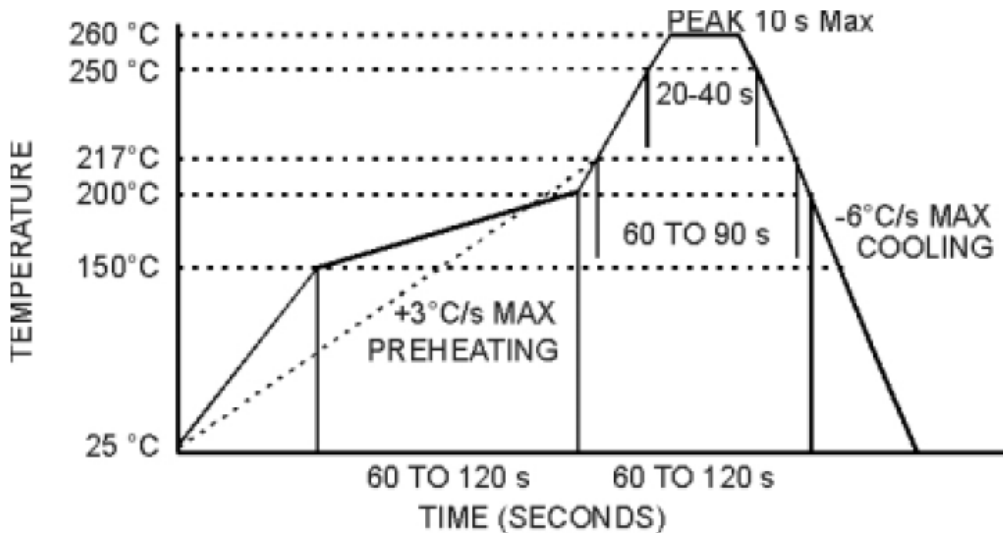
PIN CONNECTIONS



Typical Phase Noise at 100 MHz



Reflow Cycle (typical for lead free processing)



The device may be reflowed once. Reflowing upside down is not allowed. NO CLEAN assembly is recommended.

TABLE I – Electrical Characteristics

Parameter	Symbol	Value	Unit
Operating Temperature Range	To	-40 to +85	°C
Storage Temperature Range	Tst	-50 to +90	°C
Supply Voltage	Vcc	-0.5 to 5.5	V
Control Voltage	Vc	-0.5 to 5.5	V

Parameter	Symb	Conditions, Note	MIN	TYP	MAX	Unit	
Nominal Frequency	Fo		10		260	MHz	
Supply Voltage	Vcc	Code 0 Code A	4.75 3.135	5.0 3.3	5.25 3.465	V	
Supply current	Icc	No load, Vcc=3.3V 100MHz		60	160	mA	
Output Logic Type				Sine			
Load		Internally AC coupled	45	50	55	Ohm	
Harmonic	Ph				-25	dBc	
Sub-Harmonics			None				
Output Power	Po	Into 50 ohm,5V 3.3V	4 3	10 7		dBm	
Jitter	Integrated, RMS	J	Integrated from Phase Noise, 12 KHz to 20 MHz RMS		0.1	0.15	ps
			100Hz to 80KHz,RMS			0.5	ns
			50 KHz to 80 MHz		0.2		ps
	Wavecrest characterized	J	Random period,		2.5		ps
			Accumul., pk-to-pk		17		ps
			Determin.		0		ps
Phase Noise	£ (Δ f)	100 MHz, 3.3V APR 32 ppm or less	@ 10 Hz @100 Hz @1 KHz @10KHz @100KHz @>1MHz	-85 -115 -145 -168 -171 -172	-80 -110 -140 -166 -169 -170	dBc/Hz	
Frequency Stability, usually not specified – unless necessary, APR is specified to incorporate stability	Δ F/F	Overall, including temperature, aging 10 years, shock and vibration @Vc=Vcc/2; APR 50 ppm, or less	±20	±30		ppm	
Control Voltage Range	Vc		0V		Vcc	V	
Setability	Vcs	Vc to set the F at Fo; T, Vcc, load –nominal, as shipped	0.4 Vcc	0.5 Vcc	0.6 Vcc	V	
Absolute Pull Range	APR	Over all conditions, see part # creation	10, 20, 32, 50, 100			ppm	
Input impedance	Zin	@ Fmod < 100 KHz	50			KOhm	
Modulation Bandwidth		At Vc = Vcc/2, -3dB	20			KHz	

Note 1. All parameters, unless otherwise specified, are at nominal conditions, ie: T=25°C, Nominal Vcc & Nominal Load.

Table II - Class 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) ^{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,for crystal)	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	MIL-STD-883, Method 2001, Condition A Y ₁ axis only (5000 G)
Seal (Fine and Gross Leak,for crystal)	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.