Revision Record

Revision	DCO	Description	Engineering Approval	Date	QA Approval	Date	Release Date
–		Initial release					5/28/08
A		Updated part numbers	LV RS		CA		1/9/09
B		Edited Part Numbers	LV RS		CA		6/21/09
C		Edited	LV RS		CA		12/2/10
D		Add par. 3.4.2 Logic microcircuits and Radiation characteristics (ECO# 10527)	LV BR		CA		4/2/12
E		Changed par. 3.1.1 split supply and load variation from frequency stability Vs. temperature characteristics, phase noise limits @10Hz and 100 Hz) (ECO# 10548)	LV BR		CA		4/26/12
F		Modified "X" option in P/N generation table; Reformatted doc for clarity	JA RD CH	6/18/2015	CP	4/20/2015	6/18/2015

UNLESS OTHERWISE SPECIFIED
Dimensions are in Inches
Tolerances

Decimal	Fraction	Angular
.xxx ± .005		
.xx ± .02		x° ± 2°
.x ± .1		

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DETAIL PRODUCT SPECIFICATION CONTROL DRAWING

Initial Release	
Prepared	**Date**
Luis Vargas	5/28/2008
Checked	**Date**
Craig Albright	2/10/2009
Engineering Approval	**Date**
Ron Stephens	2/10/2009
Quality Assurance Approval	**Date**
Craig Albright	2/10/2009
Released	**Date**
Alfred Min	2/10/2009

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TITLE

LOW PROFILE, 32 PIN, FLAT PACK, HYBRID CRYSTAL OSCILLATOR, TCXO, CLASS S, STANDARD DESIGN FOR CMOS WAVE UP TO 90MHz, DETAIL SPECIFICATION FOR

DRAWING NO.			REVISION
QPDS-0112			**F**
SCALE	SIZE	CAGE CODE	PAGE
NONE	**A**	**51774**	**1 of 10**

1 PURPOSE

1.1 The purpose of this Detail Specification Control Drawing (SCD) is to describe the specific quality and reliability requirements for a temperature compensated crystal oscillator (TCXO).

2 SCOPE

2.1 This specification establishes the minimum detail requirements for a low profile hybrid, hermetically sealed, Type 3, Class 2 (reference MIL-PRF-55310) TCXO.

3 PART PROTECTION AND SAFETY

3.1 These items are susceptible to breakdown damage resulting from electrostatic discharge. Every precaution shall be taken while handling, installing, and testing the parts to prevent static charge. Care should be exercised to not apply more than rated voltage or current to any terminal/pad during testing.

4 PART NUMBER

4.1 The Q-Tech Part Number shall be as specified in Table 1 herein.

5 APPLICABLE DOCUMENTATION & REFERENCES

5.1 The following documents form a part of this drawing to the extent specified or modified herein.

5.2 Military & Industry

5.2.1 MIL-PRF-55310, Oscillator, Crystal Controlled, General Specification for
5.2.2 MIL-PRF-38534, Microcircuit Manufacturing, General Specification for
5.2.3 MIL-PRF-38535, Integrated Circuits, (Microcircuits) Manufacturing, General Specification for
5.2.4 MIL-PRF-19500, Semiconductor Devices, General Specification for
5.2.5 MIL-STD-202, Test Methods for Electronic and Electrical Component Parts
5.2.6 MIL-STD-883, Test Methods and Procedures for Microelectronics
5.2.7 MIL-STD-1686, Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment

5.3 Application of Documents

5.3.1 Issue of Documents

Document revisions in effect on the date of the customer purchase order form a part of this drawing except as modified herein.

5.3.2 Order of Precedence

In the event of conflict between this document and the references cited herein or other requirements, the precedence in which requirements shall govern, in descending order, is as follows:

a) Applicable Customer Purchase Order
b) Applicable Customer Detail SCD and/or Detail Drawing
c) Applicable Q-Tech Corporation Detail SCD/Drawing
d) Applicable Q-Tech Corporation General SCD

e) Other Specifications, Standards, and Documentation Referenced Above

5.3.3 Customer Purchase Order Special Requirements

Additional special requirements shall be specified in the applicable customer purchase order when additional requirements or modifications are needed for compliance to special programs or product line compliance. Unique identification of the items produced may be required.

5.3.4 General Specification Control Drawing

Any reference to the "general specification" or "general SCD" refers to the Q-Tech Corporation General Specification Control Drawing cited in the Applicable Documentation and References section, unless otherwise specified.

6 PERFORMANCE REQUIREMENTS

6.1 <u>General Definition</u>

The TCXO is a high reliability signal generator that provides a CMOS output. The TCXO has been designed to operate in a spaceflight environment with an expected lifetime in excess of 15 years. Lifetime is defined as the sum of operational and storage environments

6.2 <u>Electrical Characteristics</u>

The electrical characteristics shall be as specified in Table 3.

6.3 <u>Absolute Maximum Rating</u>

The absolute maximum ratings shall be as specified in Table 2.

6.4 <u>Physical Characteristics</u>

6.4.1 Dimensions

The TCXO outline dimensions and terminal connections shall be as shown in Figure 1 herein.

6.4.2 Weight

The TCXO shall weigh less than or equal to 25 grams.

6.4.3 Materials

The TCXO package body and lead finish shall be gold in accordance with MIL-PRF-38534.

6.5 <u>Design and Construction</u>

The design and construction of the crystal oscillator shall be as specified herein. As a minimum, the oscillators shall meet the design and construction requirements of MIL-PRF-55310, except element evaluation shall be as specified in 6.5.

6.5.1 All piece parts shall be derived from lots that meet the element evaluation requirements of MIL-PRF-38534, Class K, with the following exceptions:

6.5.1.1 Active elements

a) Visual Inspection of Silicon on Sapphire Microcircuits

   Semicircular crack(s) or multiple adjacent cracks, not in the active area, starting and terminating at the edge of the die are acceptable. Attached (chip in place) sapphire is nonconductive material and shall not be considered as foreign material and will be considered as nonconductive material for all inspection criteria.

b) Subgroup 4, Scanning Electron Microscope (SEM) Inspection

The manufacturer may allow the die distributor, at his option, to select two (2) dice from a waffle pack (containing a maximum quantity of 100 die), visually inspect for the worst case metallization of the 2 dice, and take SEM photographs of the worst case.

c) Subgroup 5 Radiation Tests

Subgroup 5 radiation tests are not required unless otherwise specified in the detail purchase order.

6.5.2 Processes

Processes used for manufacturing the TCXO are selected on the basis of their ability to meet the quality requirements for space High Reliability manufacturing. Travelers or Process Cards are used in the manufacturing and testing of all of the TCXO Series, and might be available for customer review. Copies of these Travelers can be provided with the TCXOs at time of shipment if so specified on the purchase order.

6.5.3 Interchangeability

Each TCXO shall be interchangeable without using a special selection process.

6.5.4 Product Marking

Each unit shall be permanently marked with the manufacturer's name or symbol, part number, lot date code number, and serial number. The unit shall be marked with the outline of an equilateral triangle near pin 1 to show that it contains devices which are sensitive to electrostatic discharge.

6.6 Parts Program

Devices delivered to this specification represent the standardized Parts, Materials and Processes (PMP) Program developed, implemented and certified for advanced applications and extended environments.

6.6.1 Quartz Crystal Resonator

The crystal resonator used shall be constructed using a 4-point mount premium synthetic swept Quartz and procured to Q-TECH SCD. (For the Engineering models, non-swept quartz may be used).

6.6.2 Active Devices

Radiation testing is not performed at the oscillator level, but these TCXOs have been acceptable for use in environments up to 100K rads by analysis of the components used. This device is specified to be radiation tolerant to 100 kRad(Si) total ionizing dose (TID). The microcircuit in this part shall use CMOS technology and shall be from a wafer proven to be radiation tolerant to 100kRad(Si) total ionizing dose.

6.6.2.1 CMOS Microcircuit Usage

For output frequencies below 14MHz, the output microcircuit shall be 54AC74, see DSCC SMD 5962-88520. For frequencies greater than or equal to 14MHz, the CMOS microcircuit shall be 54AC00, see DSCC SMD 5962-87549. These microcircuits are specified to be Single Event Latchup Free for LET up to 93 MeV-cm^2/mg. For QT822 devices above 70MHz, the manufacturer shall be National Semiconductor Corporation, otherwise the manufacturer shall be ST Microelectronics Corporation.

6.6.3 Prohibited Materials

Materials containing more than 97% tin and materials containing measurable amounts (by common nondestructive test methods) of selenium, cadmium, or mercury shall not be used as plating, coating or base materials in the construction of parts or components. Zinc is only acceptable as an alloying element and alloys containing zinc must be covered by suitable protective plating (e.g. nickel plating). Inert oxides of the above materials are allowed.

6.7 Traceability Requirements

Material, element and process traceability requirements shall be as specified by MIL-PRF-38534 for Class K hybrids.

6.8 Data

6.8.1 Design Documentation

When required by the purchase order, design, topography, process and flow charts for all assembly/inspection and test operation for devices to be supplied under this specification on the initial procurement shall be established and shall be available in-plant for review by the procuring activity upon request. This design documentation shall be sufficient to depict the physical and electrical construction of the devices supplied under the specification and shall be traceable to the specific parts, drawings or part type numbers to which it applies, and to the production lot(s) and inspection lot codes under which devices are manufactured and tested so that revisions can be identified.

6.8.2 Technical Data Package

When required by the purchase order, the following design documentation and information is deliverable 30 days prior to the start of production. The Technical Data Package shall consist of the following:

a) Assembly drawing(s).
b) All electrical schematics and drawings *not considered proprietary*.
c) The assembly and screening travelers to be used on-line to manufacture the devices supplied to this specification.
d) Parts and materials list.
e) Element evaluation data confirming compliance with MIL-PRF-38534, Class K, and Prohibited Materials paragraph 3.4.3

6.9 Test Report

6.10 A test report is supplied with each shipment of oscillators and includes the following information, as a minimum:

a) A Certificate of Conformance to all specifications and purchase order requirements. As a minimum, the Certificate of Conformance shall include the following information:
    1) Purchase order number.
    2) Applicable part number.
    3) Manufacturers lot number.
    4) Lot date code.
b) Parts and materials traceability information.

c) Certificate of crystal sweeping.
d) Manufacturing lot traveler.
e) Screening attributes and variables data as applicable.
f) Quality conformance inspection attributes and variables data as applicable.
g) Radiographic inspection negatives.

6.11 Engineering Models

Engineering Models are fit, form, and function representative of Flight Models and of commercial construction using commercial parts of same generic type as Flight Models. Completed oscillators are not screened.

Table 1 – Part Number

Series	Supply Voltage	Duty Cycle	Temperature Range (°C)	Stability Over Temperature	External Tuning	Level	Frequency (MHz)
QT82	1: 5V	A: 60/40	N: 0 to +50	±1 ppm	R: External Resistor	E: Eng. Model	3 to 90
	2: 3.3V	T: 45/55	P: 0 to+70	±1 ppm	V: External Voltage	M: Flight Model	
			Q: 0 to +70	±2 ppm	X: No Tuning 1/		
			R: 0 to +70	±5 ppm			
			U: -20 to +70	±1 ppm			
			V: -20 to +70	±2 ppm			
			W: -20 to +70	±5 ppm			
			X: -40 to +85	±4 ppm			
			Y: -40 to +85	±5 ppm			
			Z: -40 to +85	±10 ppm			
			A: 0 to +50	± 0.5 ppm			
			G: 0 to+70	± 0.5 ppm			
			H: -30 to +70	±2 ppm			
			K: -30 to +70	±4 ppm			

1/ No Tuning option "X" available only with Temperature Stability codes R, W, Y and Z.

Part Number Examples

QT822AURM-50.000000 would be a Flight Model version HF TCXO, 32 pin SMD Flat-Pack, CMOS 3.3 volts, 40/60 symmetry, stability ±1 ppm over -20 to +70°C, @ 50 MHz with external tuning via external resistor.

QT822AURE-50.000000 would be an Engineering Model version HF TCXO, 32 pin SMD Flat-Pack, CMOS 3.3 volts, 40/60 symmetry, stability ±1 ppm over -20 to +70°C, @ 50 MHz with external tuning via external resistor.

Table 2 – Absolute Maximum Ratings

PARAMETER	SYMBOL	MIN	MAX	UNITS
Supply Voltage	Vs	0	6	Volts
Operating Temperature Range	Tc	-55	125	°C
Storage Temperature Range	Tstg	-62	125	°C
Lead solder temperature/time			250/10	°C/seconds
Package thermal resistance	θjc		50	°C/W

Table 3 – Electrical Performance Characteristics

ELECTRICAL PARAMETER	SYMBOL	CONDITIONS	LIMITS			UNITS
			MIN	NOM	MAX	
Frequency Nom.	fo	Per Table 1	Per Table 1			MHz
Supply voltage, Nom.	Vs	Per Table 1	-5%		+5%	V
Input Current	Is	Nominal Vs, No Load			50	mA
Frequency/Temperature Stability	Δf/fc (Ta)	Per Table 1	Per Table 1			ppm
Frequency Adjustment Range	Δf/fo	Per Table 1	±3			ppm
Frequency/Vs	Δf/fc (Vs)	±5 % Vs @ +25°C			±1.2	ppm
Load				15		pF
Output Voltage, High	V_{OH}		V_{CC} x 0.9			V
Output Voltage, Low	V_{OL}				V_{CC} x 0.1	V
Output Waveform			Squarewave			N/A
Output Risetime	T_R	10% to 90% of Vs			5	nS
Output Falltime	T_F	90% to 10% of Vs			5	nS
Duty Cycle	DC		Per Table 1			%
Frequency/Load Stability	Δf/fc (Load)	Load ±5%, Vs Nom. @ +25°C			±0.3	ppm
Aging, Max	Δf/fo	Over 10 Years (First Year ≤ 1 ppm)			±5	ppm
Frequency Stability vs Vacuum	Δf/fo	Guaranteed by Design, Not Tested			±0.2	ppm
Short Term Stability	Δf/fc(Δt)	Δt=1 Second (Allan Deviation)			0.001	ppm
Phase Noise @ Frequency Offset	£ (Δf)	Δf=10Hz Δf=100Hz Δf=1kHz Δf=10kHz Δf=100kHz			-70 -100 -130 -140 -140	dBc/Hz dBc/Hz dBc/Hz dBc/Hz dBc/Hz

Table 4 – Screening Flow (Performed on a 100% Basis)

Operation	Description
Nondestructive Wire Bond Pull	100%, MIL-STD-883, Method 2023 (2.4 grams)
Internal Visual	MIL-STD-883, Methods 2017 and 2032, Condition K (Class S) During Time Interval Between Final Internal Visual Inspection and Preparation for Sealing, Hybrid Crystal Oscillators Shall be Stored in a Dry, Controlled Environment as Defined in MIL-STD-883, Method 2017, or in a Vacuum Bake Oven
Stabilization Bake	MIL-STD-883, Method 1008, Condition B: 48 Hours Minimum @ +150°C
Thermal Shock	MI-STD 883, Method 1011, Condition A
Temperature Cycling	MI-STD 883, Method 1010, Condition B
Constant Acceleration	MIL-STD-883, Method 2001, Condition A (5000gs, Y1 Axis only)
PIND	MIL-STD-883, Method 2020, Condition B, 5 passes[1]
Electrical Test	Frequency, V_{OH}, V_{OL}, T_R, T_F, DC, Input Current @ +25°C
Burn-In (Powered with Load)	+125°C for 240 Hours
Seal Test (Fine and Gross)	Fine Leak – MIL-STD-883, Method 1014, Condition A1 <u>or</u> B1 Gross Leak – MIL-STD-883, Method 1014, Condition C <u>or</u> B2
Electrical Test	Frequency, V_{OH}, V_{OL}, T_R, T_F, DC, Input Current @ +25°C and Temperature Extremes Listed on Electrical Specification
Radiographic	MIL-STD-883, Method 2012, Class S
External Visual	MIL-STD-883, Method 2009

[1] PIND testing shall be performed using five (5) independent passes and all failures found at the end of each pass are rejected. The survivors of the last pass are acceptable.

Table 5 – Group A Inspection (Performed on a 100% Basis)

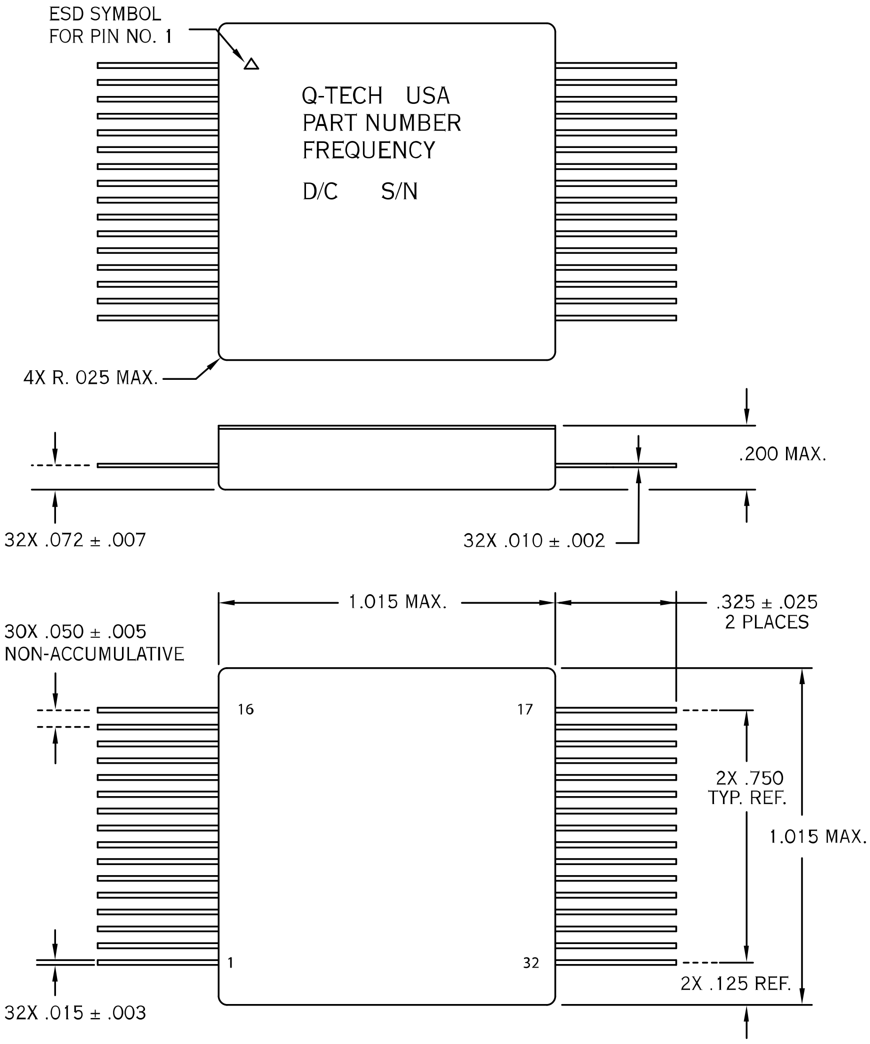
Test Description	Condition
Frequency/Temperature Stability	Vs nominal, Over specified operating temperature
Input Current	
Output Voltage, High	
Output Voltage, Low	
Output Waveform	
Output Risetime	
Output Falltime	
Duty Cycle	
Frequency Adjustment Range	Vs nominal, 25°C
Phase Noise	
External Visual	MIL-STD-883, Method 2009

Table 6 – Group B Inspection (Performed on a 100% Basis)
(Shall be Performed After Completion of Frequency Aging and Before Parts are Shipped)

Subgroup	Test Description	Condition
1	Frequency Aging	MIL-PRF-55310, Para 3.6.34.2
2	Hermetic Seal	Fine Leak – MIL-STD-883, Method 1014, Condition A1 <u>or</u> B1 Gross Leak – MIL-STD-883, Method 1014, Condition C <u>or</u> B2
3	Electrical (Functional)	Vs nominal, 25°C

Table 7 – Group C Inspection
(Samples from Subgroup 1 May be Divided and Used for Subgroups 3 and 4 Inspections)

Subgroup	Test Description	Condition	Quantity
1	Vibration (Random)	MIL-STD-202, Method 214 Condition I-K: 46Grms for 3 Minutes in Each Plane.	4 Parts (0 Failures)
	Shock	MIL-STD-202, Method 213 Condition F: 1500g, 0.5ms Half-Sine Pulse, 3 Blows Each Direction of Three Axes (18 Shocks Total)	
	Electrical Test	Frequency, Waveform, Input Current @ +25°C and Temperature Extremes Listed on Electrical Specification	
	Hermetic Seal	Fine Leak – MIL-STD-883, Method 1014, Condition A1 <u>or</u> B1 Gross Leak – MIL-STD-883, Method 1014, Condition C <u>or</u> B2	
	Electrical Test	Frequency, Waveform, Input Current @ +25°C and Temperature Extremes Listed on Electrical Specification	
	Temperature Cycling	MIL-STD 883, Method 1010, Condition B: 100 Cycles	
	Electrical Test	Frequency, Waveform, Input Current @ +25°C and Temperature Extremes Listed on Electrical Specification	
	Ambient Pressure (Non-Operating)	MIL-STD-202, Method 105, Condition C	
	Electrical Test	Frequency, Waveform, Input Current @ +25°C and Temperature Extremes Listed on Electrical Specification	
	Storage Temperature	Low Temperature of -55°C (+0, -5) High Temperature of +150°C (+5,-0)	
	Hermetic Seal	Fine Leak – MIL-STD-883, Method 1014, Condition A1 <u>or</u> B1 Gross Leak – MIL-STD-883, Method 1014, Condition C <u>or</u> B2	
	Electrical Test	Frequency, Waveform, Input Current @ +25°C and Temperature Extremes Listed on Electrical Specification	
3	Resistance to Soldering Heat	MIL-STD-202, Method 210, Condition B	1 Parts (0 Failures)
	Hermetic Seal	Fine Leak – MIL-STD-883, Method 1014, Condition A1 <u>or</u> B1 Gross Leak – MIL-STD-883, Method 1014, Condition C <u>or</u> B2	
	Moisture Resistance	MIL-STD-202, Method 106	
4	Terminal Strength (Lead Integrity)	MIL-STD-202, Method 211, Condition B	1 Parts (0 Failures)
	Visual Inspection		
	Hermetic Seal	Fine Leak – MIL-STD-883,Method 1014, Condition A1 <u>or</u> B1 Gross Leak – MIL-STD-883, Method 1014, Condition C <u>or</u> B2	
	Resistance To Solvents	MI-STD 202 Method 215	



NOTES

- Dimensions are in inches.
- Lead numbers are for reference only and are not marked on the unit.
- A triangle symbol is marked on the corner of the package to indicate Pin 1
- All pins with NC function may not be connected as external tie or connections (pins may be connected internally).

PIN NO.	DESIGNATION
1 - 3	NC
4	External Frequency Adjustment (if applicable)
5	Ground/Case
6 – 10	NC
11	Supply Voltage
12	RF Output
13	Supply Voltage
14 – 32	NC

Figure 1 – Package Dimensions and Terminal Connections