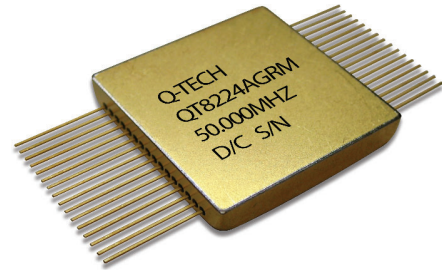


## Description

The Q-Tech 8220 Series Space-Qualified, 300kRad(Si) Tolerant Hybrid Oscillator is a Class 2 Hybrids per MIL-PRF-55310. This multiple CMOS output TCXO is hermetically sealed in a square-inch 32-pin Flatpack and allows for up to four (4) CMOS outputs. This oscillator can also operate over a variety of voltages and temperature ranges.

## Features

- Made in the USA
- Hermetically sealed packages
- 3.3V, 5.0V Supply Voltages available
- Temperature ranges from -40° to +85°C
- Screened and Quality Conformance Inspection to MIL-PRF-55310
- Up to 4 CMOS Outputs
- Up to 300kRad(Si) Total Dose Tolerant
- Low phase noise & jitter



## EAR Destination Control Statement

This Product and related technical data are subject to the EAR as promulgated and implemented by the U.S. Department of Commerce Bureau of Industry and Security. This product and related technical data are controlled under Export Control Classification Number (ECCN) 9A515.e.1 of the Commerce Control List (CCL), and may not be exported, re-exported, or re-transferred outside of the U.S. or released or disclosed to Foreign Persons, as defined by the EAR, without first complying with all applicable U.S. Export Regulations.

## Ordering Information

For non-standard requirements, email Q-Tech Corporation at [Sales@Q-Tech.com](mailto:Sales@Q-Tech.com)

Specifications subject to change without prior notice.

Sample Part Number: QT8224AGRM - 50.000000 MHz

QT8	2	2	4	A	G	R	M	-	50.000000MHz
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Part Series Designation

Supply Voltage & Logic

**1** = 5.0V, CMOS

**2** = 3.3V, CMOS

Package Type (\*)

**2** = 32-Pin Flatpack

Number of Outputs

**1** = 1 CMOS Output

**2** = 2 CMOS Outputs

**3** = 3 CMOS Outputs

**4** = 4 CMOS Outputs

Duty Cycle

**A** = 60/40%

**T** = 45/55%

Frequency vs. Temperature Code

**A** = ± 0.5 ppm at 0°C to +50°C

**N** = ± 1.0 ppm at 0°C to +50°C

**P** = ± 1.0 ppm at 0°C to +70°C

**Q** = ± 2.0 ppm at 0°C to +70°C

**R** = ± 5.0 ppm at 0°C to +70°C

**U** = ± 1.0 ppm at -20°C to +70°C

**V** = ± 2.0 ppm at -20°C to +70°C

**U** = ± 1.0 ppm at -20°C to +70°C

**V** = ± 2.0 ppm at -20°C to +70°C

**W** = ± 5.0 ppm at -20°C to +70°C

**H** = ± 2.0 ppm at -30°C to +70°C

**K** = ± 4.0 ppm at -30°C to +70°C

**X** = ± 4.0 ppm at -40°C to +85°C

**Y** = ± 5.0 ppm at -40°C to +85°C

**Z** = ± 10.0 ppm at -40°C to +85°C

Frequency Stability is referenced to the midpoint between minimum and maximum frequency value over the temperature range.

Frequency Stability vs. temperature codes may not be available at all frequencies.

External Tuning Options

**R** = External Resistor

**V** = External Voltage

**X** = No Tuning (only available with Temperature Codes: R, W, Y, and Z)

Model Level

**B** = BreadBoard Model

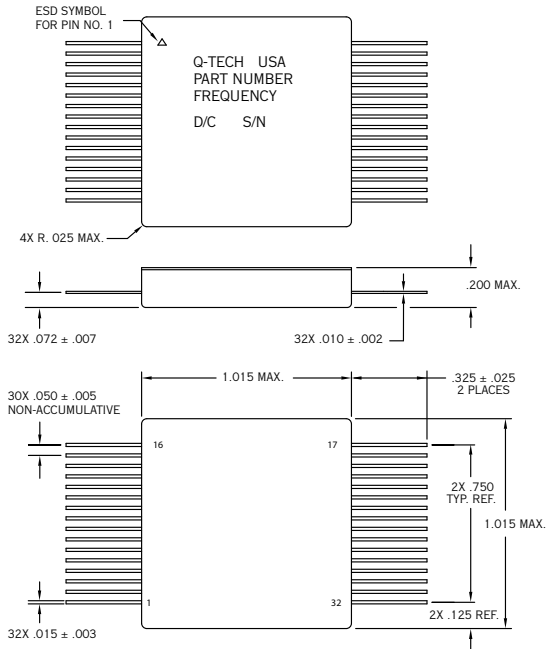
**E** = Engineering Model

**M** = Flight Model

Output Frequency (20 MHz to 100 MHz)

## Other Options Available

- Hot solder dip Sn60/Pb40 per MIL-PRF-55310

**Figure 1 - Package Outline**  
*Dimensions are in inches (mm.)*
*Flatpack (32-Pin)*

*Flatpack (32-Pin) Pin-Out Table*

Pin No.	Function
1-3	NC
4	Ext. Freq. Adjust (If Applicable)
5	GND/CASE
6-9	NC
10	RF Output 1
11	Supply Voltage
12	RF Output 2
13	Supply Voltage
14	RF Output 3
15	RF Output 4
16-32	NC

## 1. PURPOSE

- 1.1 The purpose of this Data Sheet (QPDS) is to describe the specific quality and reliability requirements for a 4 CMOS output, space qualified 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 Ordering Information (Page 2).

## 5. APPLICABLE DOCUMENTATION & REFERENCES

*The following documents form a part of this data sheet to the extent specified or modified herein:*

### 5.2 Military & Industry

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

### 5.3 Q-Tech

Form F1221, Definitions for Hybrid Product Development Levels

### 5.4 Application of Documents

#### 5.4.1 Issue of Documents

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

#### 5.4.2 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

#### 5.4.3 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.

## 6. Requirements

### 6.1 General Definition

The temperature compensated crystal oscillator (TCXO) is a high reliability signal generator that provides a sine-wave or 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 Electrical Characteristics

The electrical characteristics shall be as specified in Table II and Table III.

### 6.3 Absolute Maximum Rating

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

### 6.4 Physical Characteristics

#### 6.4.1 Dimensions

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

#### 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 Design and Construction

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 6.5.1.

#### 6.5.1 Element Evaluation

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 wafer 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 detailed 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 TCXOs. Copies of these travelers can be provided with the TCXOs at the 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. See part marking on figure 1 of this data sheet.

## 6.6 Parts Program

Devices delivered to this data sheet 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 mounted, premium synthetic swept Quartz and procured to Q-Tech's SCD. (For the Breadboard and Engineering models, non-swept quartz may be used. See Q-Tech Form F1221, Definitions for Hybrid Product Development Levels).

### 6.6.2 CMOS Active Devices

Radiation testing is not performed at the oscillator level, but these TCXOs have been acceptable for use in environments up to by analysis of the components used. The microcircuit in this part shall use CMOS technology and shall be from a wafer proven to be radiation tolerant to 300 kRad(Si) total ionizing dose for frequencies up to 70MHz. For frequencies above 70MHz, the device shall be from a wafer proven to be radiation tolerant to 100 kRad(Si) total ionizing dose.

### 6.6.2.1 CMOS Microcircuit Usage

For frequencies less than or equal to 70MHz, 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<sup>2</sup>/mg. The manufacturer shall be ST Microelectronics Corporation. For frequencies above 70 MHz, the manufacturer shall be Texas Instruments, and this microcircuit is specified to be single event latch-up free for LET up to 85 MeV-cm<sup>2</sup>/mg.

### 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 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.

## 6.9 Test Report

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) Manufacturer's 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.

#### **6.10 Non-Flight Oscillators**

Unless otherwise specified in the data sheet, the general requirements for non-flight hardware (Breadboard and Engineering models) shall be defined in F1221 - Definitions for Hybrid Product Development Levels.

#### **6.11 Screening**

Screening tests shall be in accordance with Table IV.

#### **6.12 Quality Conformance Inspection (QCI)**

Quality conformance inspection shall be performed as specified herein. All records shall be traceable to the lot number and unit serial number. Samples used for Group A that pass all tests may be delivered on contract.

##### **6.12.1 Oscillator Group A Inspection**

Group A testing shall be in accordance with Table V. Group A inspection shall be performed on units that have passed all Screening tests. All electrical performance tests of this specification shall be performed during Group A with the exception of any tests performed as part of the final electrical testing during 100% Screening.

##### **6.12.2 Oscillator Group B Inspection**

Group B inspection shall be performed in accordance with Table VI.

##### **6.12.3 Oscillator Group C Inspection**

Group C inspection shall be performed in accordance with Table VII.

#### **6.13 Destructive Physical Analysis (DPA)**

A DPA may be performed on a lot of devices in accordance with MIL-STD-883, Method 5009. The DPA shall be performed by the customer.



**Table I - Maximum Ratings**

Parameter	Symbol	Minimum	Maximum	Units
Supply Voltage	$V_s$	0	+6.0	Volts (V)
Operating Temperature Range	$T_c$	-55	+125	°C
Storage Temperature	$T_{STG}$	-65	+125	°C
Lead Solder Temperature/Time	N/A	-	+250/10	°C/sec.
Package Thermal Resistance	$\Theta_{J_c}$	-	50	°C/W

**Table II - Electrical Performance Characteristics**

Parameter	Symbol	Test Condition	Limits			
			Min.	Typ.	Max.	Unit
Frequency, nominal	$f_o$	3.3V	20.000	-	100.000	MHz
		5.0V	20.000	-	100.000	MHz
Supply Voltage, nominal	$V_s$	-	3.135	3.3	3.465	V
			4.75	5.0	5.25	V
Input Current	$I_s$	Nominal $V_s$ , No Load	-	-	60	mA
Frequency/Temperature Stability	$\Delta f/f_c (T_a)$	-	See Temperature Codes on Page 2			
Frequency Adjustment Range	$\Delta f/f_o$	-	±3.0	-	-	ppm
Frequency/Voltage Stability	$\Delta f/f_c (V_s)$	±5% $V_s$ at 25°C	-	-	± 0.5	ppm
Frequency/Load Stability	$\Delta f/f_c (\text{Load})$	Load ±5%, $V_s$ Nominal @ +25°C	-	-	± 0.1	ppm
Load	-	-	-	15	-	pF
Output Voltage, High	$V_{OH}$	-	90% Vcc	-	-	V
Output Voltage, Low	$V_{OL}$	-	-	-	10% Vcc	V
Output Waveform	-	-	SQUARE			-
Output Rise Time	$T_r$	10% to 90% of $V_s$	-	-	5	ns
Output Fall Time	$T_f$	90% to 10% of $V_s$	-	-	5	ns
Duty Cycle	DC	Code A	60/40			%
Aging, Max. (Note 1)	$\Delta f/f_o$	Over 18 Years	-	-	± 4	ppm
Frequency Stability vs. Vacuum	$\Delta f/f_o$	Guaranteed by Design, Not tested	-	-	± 0.2	ppm
Short Term Stability	$\Delta f/dc (\Delta t)$	$\Delta t = 1s$ (Allan Deviation)	-	-	0.001	ppm
Phase Noise @ Frequency Offset	$\epsilon (\Delta f)$	10Hz 100 Hz 1 kHz 10 kHz 100 kHz	-	-	-70 -100 -130 -136 -146	dBc/Hz

**Note 1:** Consult with factory for better Aging performance.

**Table III - Screening Tests**

Test Description	Standard	Method	Condition	Comments
Non-destructive Bond Pull	MIL-STD-883	2023	-	2.4 grams pull
Internal Visual	MIL-STD-883	2017	K	Class S
Stabilization Bake	MIL-STD-883	1008	B, 48 Hours at +150°C	
Thermal Shock	MIL-STD-883	1011	A	
Temperature Cycling	MIL-STD-883	1010	B	
Constant Acceleration	MIL-STD-883	2001	A (5,000g, Y1 Axis only)	
Particle Impact Noise Detection (PIND)	MIL-STD-883	2020	A	
Electrical Test (CMOS)	Frequency, $V_{OH}$ , $V_{OL}$ , $T_r$ , $T_f$ , DC, Input Current @ +25°C			
Burn-in	MIL-STD-883	1015	+125°C for 240 Hours	Note 1
Seal Test, Fine Leak	MIL-STD-883	1014	A1 or B1	Note 2
Seal Test, Gross Leak	MIL-STD-883	1014	C or B2	Note 2
Electrical Test (CMOS)	Frequency, $V_{OH}$ , $V_{OL}$ , $T_r$ , $T_f$ , DC, Input Current @ +25°C and Temperature Extremes Listed on Electrical Specification			
Percent Defective Allowance (PDA)	MIL-PRF-55310	-	Level S	PDA
Radiographic Inspection	MIL-STD-883	2012		Class S
External Visual	MIL-STD-883	2009		

**Note 1:** Burn-in shall be under the specified load and nominal voltage conditions.

**Note 2:** Conditions A1 and C are used if B1 and B2 are not purchased.

### Table IV - Group A Inspection

Group A Inspection, in the sequence shown below, shall be performed on units that have passed the screening tests. All electrical performance tests of this specification shall be performed during Group A with the exception of any tests performed as part of the final electrical testing during 100 percent screening.

Test Description	Test Condition
Frequency/Temperature Stability	V <sub>s</sub> nominal, Over specified operating temperature extremes.
Input Current	
Output Voltage, High (CMOS)	
Output Voltage, Low (CMOS)	
Output Waveform (CMOS)	
Duty Cycle (CMOS)	
Output Rise and Fall Time (CMOS)	
Phase Noise	V <sub>c, nom.</sub> , +25°C
Frequency Adjustment Range	
External Visual	MIL-STD-883, Method 2009

### Table V - Group B Inspection

Subgroup	Test Description	Test Condition
1	Frequency Aging ( <b>Note 1</b> )	MIL-PRF-55310, Para. 3.6.34.2
2	Hermetic Seal ( <b>Note 2</b> )	Fine Leak: MIL-STD-883, Method 1014, Condition A1 or B1 Gross Leak: MIL-STD, Method 1014, Condition C or B2
3	Electrical (Functional) ( <b>Note 2</b> )	V <sub>s</sub> nominal, +25°C

**Note 1:** Long term aging projections are performed per MIL-0-55310.

**Note 2:** Shall be performed after completion of frequency aging and before parts are shipped.

**Note 3:** Conditions A1 and C are used if B1 and B2 are not purchased.

**Table VI - Group C Inspection**

Subgroup	Test Description	Condition	Quantity (Accept No.)
1	Sinusoidal Vibration (Non-Operating)	MIL-STD-202, Method 204, Condition G	8 (0)
	Shock (Non-Operating)	MIL-STD-202, Method 213, Condition I	
	Random Vibration (Non-Operating)	MIL-STD-883, Method 2026, Condition I-J	
2	Thermal Shock	MIL-STD-202, Method 107, Condition B	2 (0) (Level S) or 4 (0) (Level B) <b>(Note 4)</b>
	Ambient Pressure (Non-Operating)	MIL-PRF-55310, Paragraph 4.8.46.1	
	Ambient Pressure (Operating)	MIL-STD-202, Method 105, Condition C	
	Storage Temperature	MIL-PRF-55310, Paragraph 4.8.47	
3	Resistance to Solder Heat	MIL-STD-202, Method 210, Condition C	2 (0)
	Moisture Resistance	MIL-STD-202, Method 106	
	Salt Atmosphere	MIL-STD-883, Method 1009, Condition A	
4	Terminal Strength (Leaded Packages)	MIL-STD-202, Method 211, Condition A and C	2 (0)
	Resistance to Solvents	MIL-STD-202, Method 215	
5	End Point Electricals	<b>Note 3</b>	2 (0) (Level S) <b>(Note 4)</b>
	Life Test	MIL-STD-883, Method 1005 (1,000 hours at +125°C) (Note 5)	
	End Point Electricals	<b>Note 3</b>	

**Note 1:** Eight (8) samples shall be selected from inspection lots which have passed quality conformance inspection. Group C may be completed with a minimum sample size of four (4) units as specified by the qualifying activity.

**Note 2:** All test conditions are in accordance with MIL-PRF-55310.

**Note 3:** Measure current, frequency, and output waveform at +23°C and temperature extremes. Frequency after life test shall be within ±10 ppm of pre-life frequency.

**Note 4:** When specified on the purchase order, Subgroup 2 shall be tested on 2 units and Subgroup 5 (Life Test) is not required.

**Revision Log**

DCO	Revision	Revision Summary	Page(s) Affected	Date
6541	-	Initial Release	All	09/27/24