TECHNICAL INTRODUCTION MFR.

TIM#2860336

Q-TECH CORPORATION

10150 Jefferson Blvd, Culver City, CA 90232 USA

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Q-TECH Corporation

High Reliability Crystal Oscillators

10150 Jefferson Blvd, Culver City, CA 90232 USA

Company History

- Q-Tech Corporation founded in 1972
- Focused exclusively on providing high reliability crystal oscillators
- Providing oscillators for Space **since 1985**
- More products QPL qualified to MIL-PRF-55310 than any other supplier (Level S and Level B)
- M55310 / ISO 9001 / AS 9100 Registered
- Contributed to the first government specifications for hybrid crystal oscillators: MIL-O-55310, TO-5 package

MICROMINIATURE CRYSTAL OSCILLATORS
TYPE MCO-F

DESCRIPTION

The MCO-F is a crystal controlled oscillator totally contained within a TO-5 package. The unit has been designed with an AT cut quartz crystal and thin film circuitry for high stability and reliability. A three point mounting arrangement is used in mounting the quartz crystal blank, resulting in a unit able to withstand the most extreme environmental conditions without failure.

FREQUENCY RANGE

Frequency Range - 7 MHz to 25MHz

NOMINAL FREQUENCY TOLERANCE AVAILABLE

Standard:	± 0.005 %	-55°C to +105°C
Special:	± 0.0035%	-55°C to +105°C
	± 0.0025%	-55°C to +105°C
	± 0.002 %	-40°C to + 90°C

Frequency Stability - Long term aging 5 parts in 10^{-6}/30 days to 5 parts in 10^{-7}/30 days.*

Stability vs Input - 1 X 10^{-6} for 10% change

Stability vs Load - 1 X 10^{-7} for 20% change

Wave Form - Sinusoidal

Output Voltage - .35 volts RMS (min.) into 5K load (5.0 V.D.C. input)

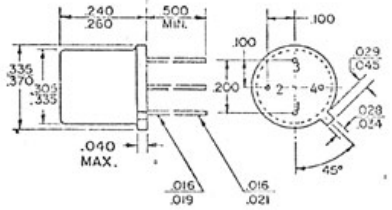
Input Voltage - 2.0 to 10.0 volts

STATE-OF-THE-ART DEVELOPMENT

MCO-F OSCILLATOR CONNECTIONS

1. Crystal T.P.
2. Vcc
3. Common
4. Output

TO-5 Case Outline
(TO-77)



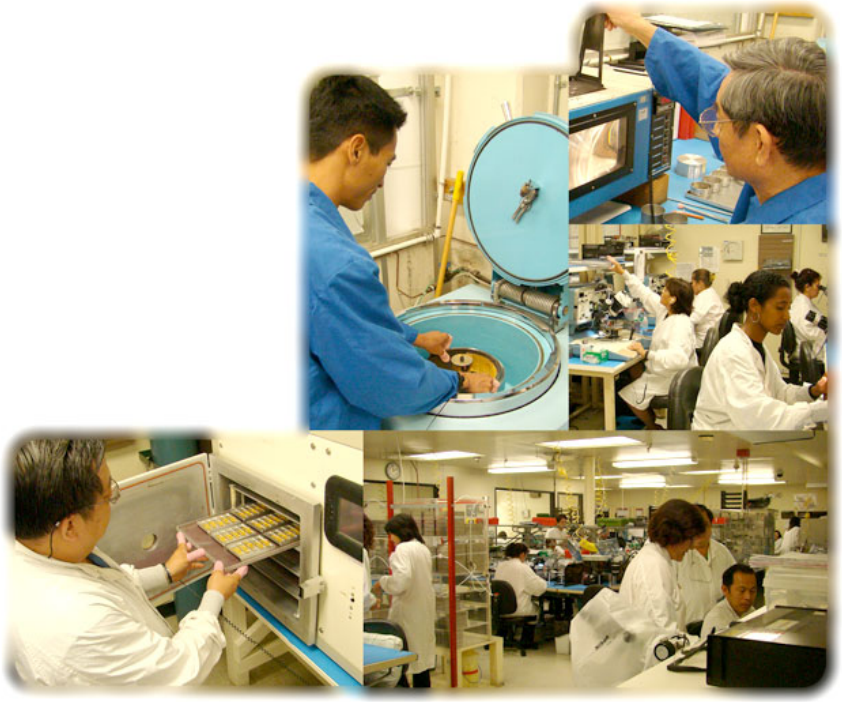
*Dependent on package, frequency, temperature and operating levels. Improved stability available on special orders.

Note: Consult TRW Crystal Plant application engineering for special applications.

Workmanship and Quality Standards - TRW standard crystal products are manufactured to comply with the latest military specifications. Special products may be ordered with additional specifications or special applications.

Solid Company

- Financially strong, **<u>woman owned small business</u>** with 180 employees
- Facilities in Culver City, CA 32,000 sq ft including 7,000 sq ft in clean rooms
- Experienced long term employees
- Annual sales $35 Million
- USML Registration # M17677
- Steady growth rate
- Made in USA



Markets Served

Spacecraft Electronics

QPL Clocks for Commercial Avionics

Military: All Areas

Oil Industry Down-Hole Electronics

High Temperature Applications

Space Products History

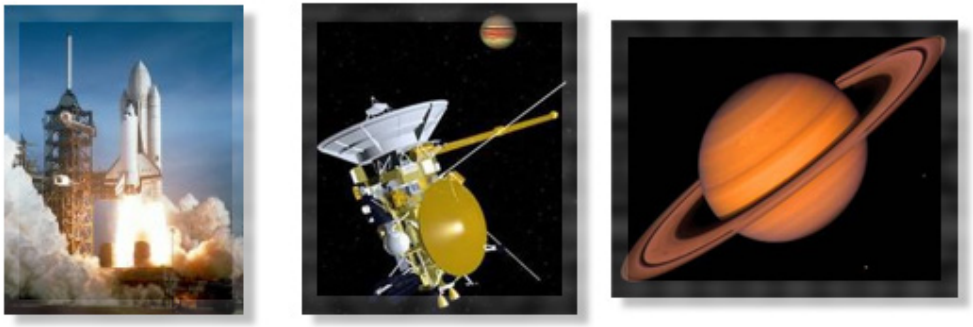
- **1985** – Entered the Space Applications Market and received our first order for the MILSTAR program.
- **1986 & 1987** – Received the TRW "Supplier of the Year Award".
- **1994** – Became the major supplier of hybrid crystal oscillators to virtually every satellite manufacturer in the USA.
- **1997** – Produced our first Space level VCXO.
- **1999** – Received the JPL award for our contribution to Cassini program.
- **2002** – Produced our first Space level TCXO.
- **2004** – Received our first NGST “Gold Supplier Award”.
- **2006** – Received our second NGST “Gold Supplier Award”.
- **2007** – Released “catalogue” part numbers for “standard” Space level product.
- **2007** – Received our third NGST “Gold Supplier Award”
- **2008** – Launched QT800 Series TCXOs to 350 MHz
- **2009** – Launched Class B+ small, 7 x 9 mm space clocks up to 360 MHz.
- **2010** – Launched QT700 Series VCXOs to 350 MHz
- **2011** – Launched Low Phase Noise Space OCXO

Space Customers

RAYTHEON	SAAB ERICSSON SPACE AB	SEAKR ENGINEERING, INC
JET PROPULSION LABORATORY	TESAT SPACECOM	FUJI ELECTRONICS
BAE SYSTEMS	BALL AEROSPACE	ADCOLE CORPORATION
N-T SPACE	SPACE SYSTEMS/LORAL	EMS TECHNOLOGIES CANADA
HONEYWELL INT'L, INC.	MAXWELL TECHNOLOGIES	SAIC
QSS GROUP, INC	SOUTHWEST RESEARCH INSTITUTE	ALCATEL
EADS ASTRIUM SAS	ISRO SATELLITE CENTRE	MOTOROLA
ALTER TECHNOLOGY GROUP	DIGITAL GLOBE, INC	BOSCH
AEROFLEX	BROAD REACH	SANDIA NATIONAL LABORATORIES
GENERAL DYNAMICS	THALES ALENIA SPACE	BEI SENSORS SENSORS AND SYSTEMS CO.
TOP-REL	TECHNOLOGICA	RUAG
THE AEROSPACE CORP	EDO	HAMILTON SUNSTRAND
BOEING SPACE SYSTEMS	ORBITAL SCIENCES	CINCINNATI ELECTRONICS
ITT CORPORATION	ASSURANCE TECHNOLOGY	MITSUBISHI SPACE
LOCKHEED MARTIN	BFI-OPTILAS S.A.	UNISYS
NORTHROP GRUMMAN	COMDEV	BALL AEROSPACE
SURREY SATELITE	SPAR	L3 NARDA
SPACE MICRO	Spur	L3 TELEMETRY

Our Partners in Space

NASA, JPL, ESA (European Space Agency), JAXA (Japanese Space Agency) & ISRO (Gov't of India Dept of Space)



Cassini Mission to Saturn

SPACE CRYSTAL OSCILLATORS

- CLASS 2, LEVEL S, HYBRID CONSTRUCTION
- XO, VCXO, TCXO with long Space History and Heritage since 1985.
- OCXO introduction since 2011 and Production starts Mid-2012 for Engineering models and Flight models for major US customers.
- SAW Space Oscillators in progress with first Engineering model 1GHz shipped to customer.

SCREENING AND QUALITY CONFORMANCE INSPECTION METHODS

- There are three General Specifications that govern the Hybrid Crystal Oscillators:
  - **MIL-PRF-55310** Crystal Oscillators, General Specification For
  - **MIL-PRF-38534** Hybrid Microcircuits, General Specification For
  - **EEE-INST-002** Instructions for EEE Parts Selection, Screening, Qualification and Derating, Section C4 Crystal Oscillators
- Q-Tech adopted the screening method adopting the best of the two MIL-PRF-55310 and MIL-PRF-38534 since we build Class 2, Hybrid Crystal Oscillators.
- Q-Tech also has product codes with screening and Quality Conformance Inspection in compliance with MIL-PRF-55310, Class 2, Level S, or with NASA EEE-INST-002, Level I that NASA approved to all Space flight missions.
- Q-Tech also adopted screening and QCI options from customers, e.g. the number of cycles in thermal shock or temperature cycles in Group C, or test condition levels of Random Vibration and Mechanical shock.

Q-Tech's High Stability Space Grade Oven Controlled Crystal Oscillator (OCXO)

➢ A high-precision and high reliability signal generator that provides **Sine wave** or **HCMOS** output. The OCXO is designed to be used in Aerospace applications.

➢ It is designed to withstand radiation level up to 100kRad(Si), high shock and vibration, very low phase noise, fast warm-up time, and low g-Sensitivity: SC-Cut Crystal utilized in the design guarantees 1PPB/g or better. The reliable construction of this design qualifies it for stringent environmental applications.

Packages: 50.8mm x 50.8mm x 40mm
50.8mm x 25.4mm x 19.08mm

Option with Output power: Up to +10dBm, Noise floor to -175dBc/Hz

Sample part number

QT4107SDM-55.000MHz

Q	T	4	1	0	7	S	D	M	-	55.000MHz

Supply Voltage:
3 = +3.3V
5 = +5.0V
6 = +12.0V
7 = +15.0V

Logic:
C = HCMOS
S = Sine Wave

Output Frequency

Screening Option:
Blank = EM
M = Per MIL-PRF-55310, Level S

Frequency vs. Temperature Code:

G =	± 100PPB	at	-20°C to	+70°C
H =	± 10PPB	at	-20°C to	+70°C
J =	± 200PPB	at	-40°C to	+85°C
D =	± 20PPB	at	-40°C to	+85°C

Specifications:

Package Size	2" x 2" x 2.5"	
Frequency	1MHz to 125MHz	
Supply Voltage	3.3 to 15Vdc	
Aging	1PPB / day 1.5PPM / 15 years	
G-Sensitivity max.	1PPB/G	
Warm-up Time	@+25°C to ±100PPB (2hours ref.)	
Phase Noise	1Hz	-70dBc/Hz
	10Hz	-102dBc/Hz
	100Hz	-132dBc/Hz
	1kHz	-148dBc/Hz
	10kHz	-155dBc/Hz
	100kHz	-155dBc/Hz

Electrical Characteristics Space OCXO

(Specifications custom tailored to applications)

Parameters	Conditions	Requirements	
Output Frequency Range (Fo)		**1MHz — 125MHz**	
Supply Voltage (Vdd)	±5.0%	+3.3Vdc, +5Vdc, +12Vdc and +15Vdc	
Initial Tolerance	@+25ºC	±0.2ppm	
Temperature Range		See Option Codes	
Frequency Stability vs. Temperature		See Option Codes	
Frequency Stability vs. Voltage Variation	Over Temperature Range	±10PPB	
Frequency Stability vs. Load Variation	±5.0% Load Variation	±20PPB	
Warm-up Power max.	@-40ºC	4.8W	
Steady State Power max.	@+25ºC	2.7W	
Warm-up Time	@+25ºC to ±100PPB (2 hours ref.)	10 min.	
Output Waveform		**Sine Wave**	**HCMOS**
Output Power (See note 1)		+3.0±1.0dBm	
Output Power Stability (See note 2)	Over Temperature Range	±1.0dBm	
Duty Cycle	Over Temperature Range		50%±5.0%
Output Load		50Ω	10kΩ//15pF
Harmonics	Over Temperature Range	-35dBc	
Spurious (See note 3)	Over Temperature Range	-90dBc	
Aging	Per Day	1PPB	
	15 years	1.5PPM	
G-Sensitivity max.		1PPB/G	
Phase Noise for 50MHz OCXO (typ.)	1Hz	-70dBc/Hz	
	10Hz	-102dBc/Hz	
	100Hz	-132dBc/Hz	
	1kHz	-148dBc/Hz	
	10kHz	-155dBc/Hz	
	100kHz	-155dBc/Hz	

Low Noise Custom Design Space OCXO 100MHz