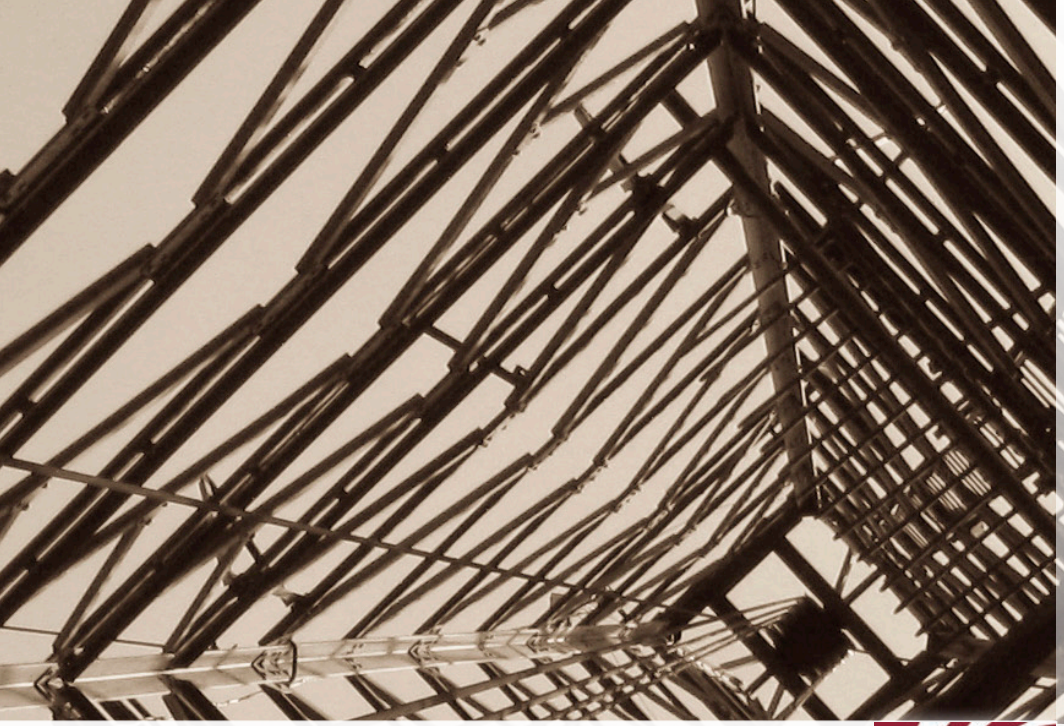

EXTREME ENVIRONMENT | Hi-Reliability
Crystals, Oscillators, VCXOs
and Temperature Sensors

FMI

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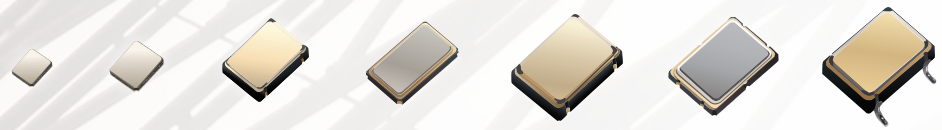


Next Generation in Frequency Control
HIGH TEMPERATURE Solutions

Highest Temperature Ranges
Widest Frequency Ranges
Longest Operational Life
Highest Reliability
Smallest Packages
Lowest Current

FMI is a global leader in the design and manufacturing of high reliability – extreme environment and industrial grade – frequency control and hybrid electronic solutions. Committed to the industry's highest level of service and total customer satisfaction, we help our customers achieve competitive advantages and strategic differentiation in their product applications.

At **FMI**, our foremost commitment is to complete customer satisfaction. This ideal is consistently reflected throughout our superior product performance, QA systems, prompt product delivery and effective customer assistance.

In creating a technology framework for our extreme environment specialization - **FMI** is uniquely situated to provide you with the most efficient solutions and response times.

Our unique and unmatched application design history (1986 to present, with a dedicated focus on the future) specifically targets the expanding systems applications for electronic frequency control products used in Oil & Gas Exploration, Geothermal Energy Generation, and Advanced Avionics Engine Sensor & Control.

At **FMI**, we continue to push the technology envelope for compelling Extreme Environment products, thereby enabling us to respond to your ever evolving needs.

Extreme Environment Products for Oil | Gas | Geothermal

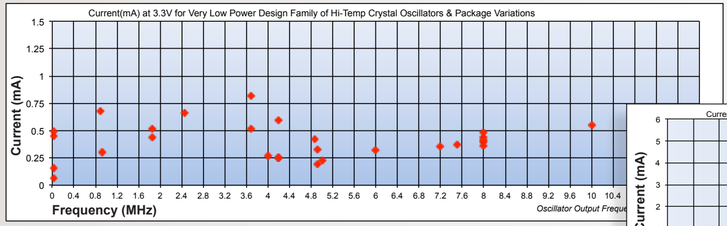
We are proactive in planning new solutions for the next generation down-hole, geothermal, and other extreme environment system applications.

FMI has delivered various extreme environment solutions to NASA and the U.S. DOE including resonators for 500ºC and crystal oscillator for 300ºC operation.

Capabilities & Features

- Targeting both New System Designs and Legacy Replacements
- Complies to Operating Conditions Beyond Industry Standards
- Solutions for New Jet Engine Controllers and Sensors at Higher Temperatures
- Smallest Available Product Footprints
- Best Performance with the Lowest Power Consumption
- Voltage Options: 1.2V, 1.5V, 1.8V, 2.5V, 3.3V, 5V

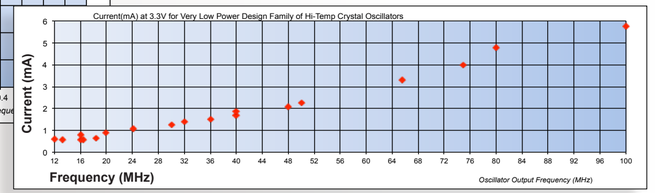
Hi-Temp Oscillators



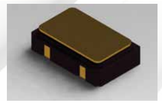
mwd applications critical

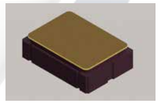
LOW CURRENT

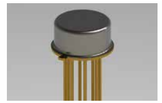
Low power oscillator products are available in various packages and over a wide frequency range.

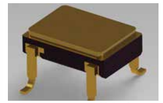



3.2x2.5 mm SMD


5x3.2 mm SMD

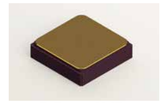

5x7 mm SMD

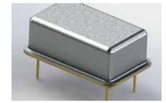

TO-5 LP

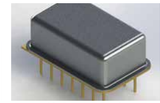

5x7 mm Gull Wing

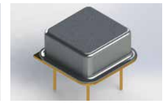

5x7 mm J-Lead

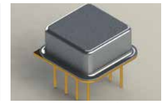

5x7 mmStraight Lead


7x7 mm SMD


Full DIP 4 Pin


Full DIP 14 Pin


Half DIP 4 Pin


Half DIP 8 Pin

- Oscillator Temperature Range: -180ºC to +325ºC, Crystals to +500ºC
- High Shock and Vibration
- Fixed, Variable, & Multiple Frequency
- Low Phase Jitter
- Optimal Frequency Stability vs. Temperature Options
- Established Reliability: Unparalleled Design, Reliability, & Customer Service
- Fast Turn Around for Hi-Reliability Prototypes
- Best Optimized Frequency Stability vs. Temperature Range Options
- Industry Standard Packages and I/O Connections
- DC to 500 MHz

- Lowest Power Consumption
- Proven Long Operating Life over the Entire Operating Conditions
- Crystals, Oscillators, VCXOs, Temperature Sensors
- High Pressure Tolerant to 7,000 PSI
- Maximum Use of Established Reliability Components
- Rugged Design & Construction Optimized for Severe Environments
- Robust Manufacturing & Assembly Techniques
- Very Rugged Crystal Design and Mechanical Assembly
- Long Term Performance & Life Test Under Extreme Conditions
- Surface Mount and Thru-Hole Package Options

Package Style vs. Supply V vs. Frequency Range Offered

Package Style	*Supply Voltage*	*Frequency Range*
3.2x2.5 SMD	1.2V to 5V	32.768 KHz
5x3.2 SMD	1.2V to 5V	300 KHz to 100 MHz
5x7 (SMD & Leaded)	1.2V to 5V	300 KHz to 100 MHz
7x7 SMD	1.2V to 5V	300 KHz to 100 MHz
Half DIP	1.2V to 15V	10 KHz to 100 MHz
Full DIP	1.2V to 15V	0.1 Hz to 100 MHz
TO-5 LP	1.2V to 15V	300 KHz to 100 MHz

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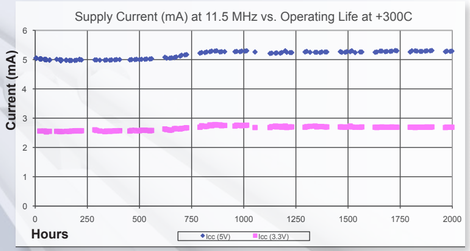
OPERATING LIFE

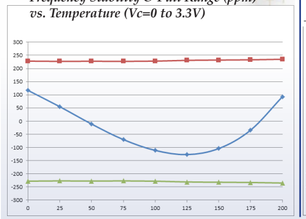
FMI continues to set new reliability milestones based on real test data. Our technology and capabilities offer outstanding solutions at elevated temperatures (up to +325°C). This performance leads to longer operating life, lower aging, lower power consumption & superior reliability at lower operating temperatures.



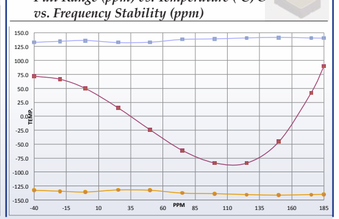
completion applications critical

HI-TEMP VCXOs

Half-DIP, 32.768 MHz VCXO
Frequency Stability & Pull Range (ppm)
vs. Temperature (Vc=0 to 3.3V)



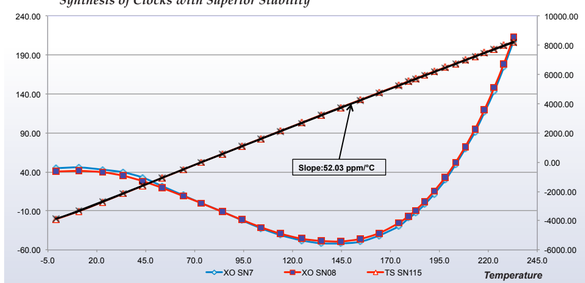
5x7 mm, 32 MHz SMD VCXO
Pull Range (ppm) vs. Temperature (°C) &
vs. Frequency Stability (ppm)



High temperature voltage controlled crystal oscillator products are available in various packages, voltages and temperature ranges.

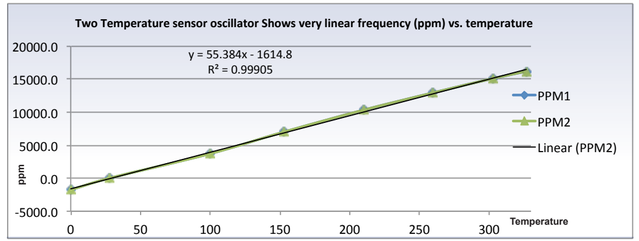
MATCHED PAIR

Combining Stability Performance & Temperature Accuracy with High Reliability Long Operating Life Enables Digital Synthesis of Clocks with Superior Stability



TEMP SENSORS

Real Test Results of 8 units showing consistant performance of high linearity temperature sensors to +325°C



ALL FMI Designs have Extensive Life Testing

Offering both standard and custom solutions, our team of engineers is ready and able for any challenge. Contact FMI for all your Frequency Control Product needs.

Extreme Environment **OSCILLATOR** Product Highlights

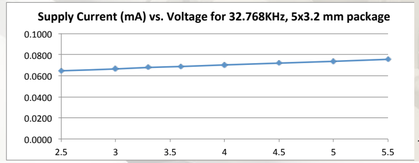
- **Extended Operating Life Crystal Oscillators, Half-DIP, >8000 Hours at +280°C**
- **5x7mm SMD Low-power at 32.768 kHz with ±75 ppm Frequency Stability from -40 to +210°C**
- **Extreme Low-Power XO at 32.768 kHz, 5x7mm SMD, 60µA at +3.3V; -40 to +185°C, ±110 ppm**
- **5x7mm SMD Delivering Stability of ±60 ppm from 0 to +240°C (38 MHz, +3.3V)**
- **Super Low-Aging XO, half-DIP, -3.5 ppm over 3500 hours at +175°C;**
- **5x7mm SMD XO (1.00 MHz) with Very Long Operating Life; 1 Year at +240°C**
- **5x7 mm SMD XO with High Ambient Pressure Tolerance; >7000 psi**
- **High Temperature Voltage Controlled Crystal Oscillator, to 66 MHz**
- **Low Jitter XO for High Temperature Applications to 100 MHz**

Driver Solutions for Crystals, Resonators and Sensors

FMI offers a variety of crystal resonator and sensor driver circuit solutions for customer applications where an efficient driver circuit is utilized in place of more complex circuits. The drivers can be used in applications such as temperature sensing, pressure sensing and general purpose time-base reference.

Smaller footprint, reduced cost, higher reliability and lower power are among the most common performance attributes of the driver products. Standard footprints and platforms are: SMD 5x7, SMD 5X3.2, TO-5, Half DIP (4 or 8 pin). Operating temperatures are supported to +325°C.

Low Power Real Time Clock

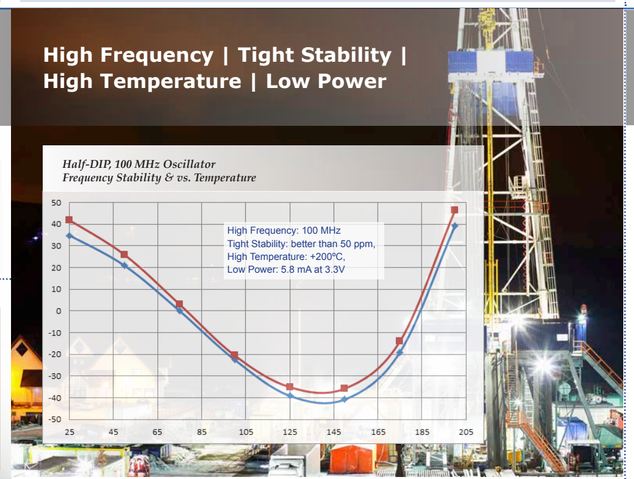


FMI offers the most accurate timing solutions that optimize

- *lowest power*
- *best accuracy*
- *smallest package*

for high temperature applications

High Frequency | Tight Stability | High Temperature | Low Power



FMI Standard Hi-Temp | Hi-Rel Screening Plan

HI-TEMP SCREENING

Screening	*Method*
Non-Destruct Bond Pull	MIL-STD-883, Method 2023
Internal Visual	MIL-STD-883, Method 2017, Class H; Method 2032, Class H
Stabilization (Vacuum) Bake	MIL-STD-883, Method 1008, Condition C, 150°C, 24 hours min
Seal: Gross leak	MIL-STD-202, Method 112, Condition D
Pre Burn-in Electrical Test	Functional Test Only
Marking & Serialization	MIL-STD-1285
Burn-in	Energized oscillator (nominal supply voltage) is tested at +140°C for 48 hours min
Electrical Test	Nominal Vcc & Extremes and Nominal Temp and Extremes
External Visual & Mechanical	MIL-STD-883, Method 2009.10

Final Electrical Test

a) Input current, output frequency, output waveform, are tested at +23°C ±2°C
b) Frequency stability is tested over the specified temperature range; at both extremes and at +25°C at a minimum of 5 temperature increments
note: Recording of test data is by lot # and then serial #

note: other screening levels and custom test plans available.

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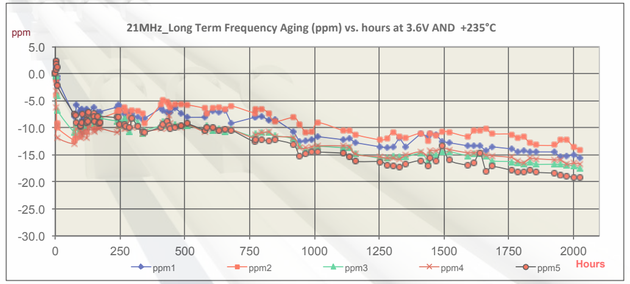
Oscillators | VCXOs | Sensors

HI-TEMPERATURE LONG-TERM AGING

FMI continues to set the standard and surpass long-term frequency drift performance milestones



FMI Standard Hi-Temp | Long Term Stability

Aging measurements were done over more than 2000 hours of testing at +235°C. Despite the short term temperature fluctuations, the long term pattern clearly points to these trends. The results indicate that most of the dominant aging mechanism has been addressed. Changes in the first day of the test are due to the thermal settlement of the setup at +235C.

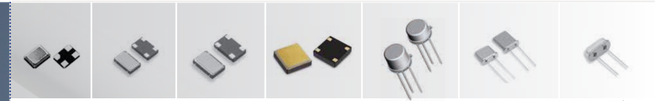
Crystals

FMI

Hi-Temp Crystals

Extreme Environment **CRYSTAL** Product Highlights

- SMD Packages, Operating Temperature Established to +240°C
- SMD Packages with Optimized Crystal Cut, ±60 ppm, 0 to +200°C, to 150 MHz
- SMD Package Super Compliant Mounting for Very High Shock & Vibration
- TO-5 Low-profile Package (0.175"/4.4mm) from 3.6 MHz
- HC-49/U Hi-Rel Package from 1.8 MHz (lowest in the industry)
- Highly Tunable Crystals (>2000 ppm) that facilitates any wide tuning range or data recovery and can be used for capacitive pressure sensing to +350°C
- Extremely Linear Temperature Sensor Crystals that Operate to +350°C



3.2x2.5 mm | *5x3.2 mm* | *5x7 mm* | *7x7 mm* | *TO-5* | *UM-5, UM-1* | *HC-49/US*

CRYSTAL PACKAGE STYLE vs. FREQUENCY RANGE OFFERED

Package Style	*Frequency Range*
3.2x2.5 SMD	15 MHz to 150 MHz
5x3.2 SMD	12 MHz to 150 MHz
5x7 (SMD & Leaded)	8 MHz to 150 MHz
7x7 SMD	3.6864 MHz to 150 MHz
HC-49/U	1.8 MHz to 150 MHz
HC-49/US	3.5 MHz to 150 MHz
UM-1	3.6864 MHz to 150 MHz
UM-5	10 MHz to 150 MHz
TO-5 Low-profile	3.6864 MHz to 150 MHz

Quality

Quality Assurance Program

Our dedication to customer satisfaction is the backbone of our quality program.

- **MIL-PRF-55310 Class B (QPL Certified)**
- **ISO 9001:2008 (Certified & Registered)**
- **MIL-STD-790 (Certified)**
- **MIL-PRF-3098 (Compliant)**
- **MIL-STD-883**
- **MIL-PRF-38534**
- **MIL-STD-202**
- **ESD: JESD625-A**

We are committed to providing the best product performance & quality, consistent on-time delivery, and quality customer support. These are integral to our quest for total customer satisfaction.

ENVIRONMENTAL COMPLIANCE

Environmental	Specification	Method	Condition	
Vibration – Sine	MIL-STD-202G	Method 204D	Condition G	30g, 10 to 2 kHz Sine
Vibration – Random	MIL-STD-202G	Method 214A	Condition 1	30g rms, 10 to 2 kHz Random
Shock	MIL-STD-202G	Method 213B	Condition F	Modified to: 2500g, 0.5 ms
Seal Test	MIL-STD-883H	Method 1014	Condition A2	Fine Leak
Seal Test	MIL-STD-883H	Method 1014	Condition C	Gross Leak
Temperature Cycling	MIL-STD-883H	Method 1010	Condition B	10 Cycles Minimum
Constant Acceleration	MIL-STD-883H	Method 2001	Condition A	5000g, Y1 Axis

Space & Avionics

FMI

Space | Radiation Tolerant Solutions

Extreme Environment Space Product Highlights

- Wide Frequency Range
- Extreme Low and High Temperature Ranges
- Radiation Tolerant from 10 krad TID
- Maximum Use of Established Reliability Components
- Industry Standard Package & Pin Connections
- Industry Standard Operating Voltages & Output Logics
- Industry Leading Screening Work Flows & Options
- Rugged Design & Construction Optimized for Severe Environments
- Very Rugged Crystal Design and Mechanical Assembly
- Long Term Performance & Life Test Under Extreme Conditions
- Active Components: ACMOS, SOI-CMOS, HT-SOI-CMOS, & Bipolar Devices
- Optional Hi-Q or Swept Quartz Crystals

FMI Extreme Environment Products

Avionics Solutions

Extreme Environment MIL-Grade Product Highlights

- Targeting both New System Designs and Legacy Replacements
- Complies to Operating Conditions Beyond Industry Standards
- Solutions for new Jet Engine Controllers and Sensors at Higher Operating Temperatures
- Smallest Available Product Footprints
- Lowest Available Power Consumption
- Established Reliability
- Fixed, Variable, & Multiple Frequency
- Low Phase Jitter
- Wide Operating Temperature Range | Tight Stability
- DC to 500 MHz

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QPL per MIL-PRF-55310 | ISO 9001:2008 | MIL-STD-790

Pb RoHS compliant

FMI offers innovative and efficient solutions that have been developed exclusively for Extreme Environment applications:

- Oil & Gas Exploration Systems & Tools
  Geothermal | Monitoring Systems
- Space Based Electronic Systems
- Aircraft Engine | Avionics
- Other Military & Industrial Subsystems
- Automotive
- Industrial Sensor Applications

Welcome to the new age of Extreme Environment Electronics. FMI offers you the most rugged and advanced frequency control solutions while enhancing product performance in the most demanding environmental conditions.

FMI

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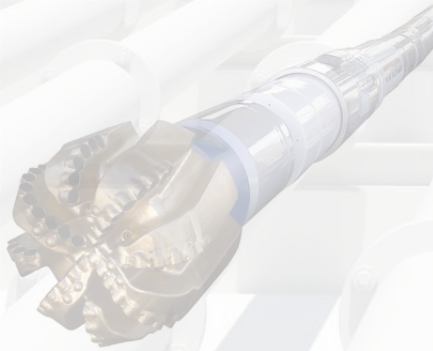

FREQUENCY MANAGEMENT | International

World Class Manufacturing and First Class Customer Service

Located within easy reach from 3 major airports, our headquarters is located in Huntington Beach, CA with more than 16000 SF operating space for manufacturing and test equipment, clean room, and administration.