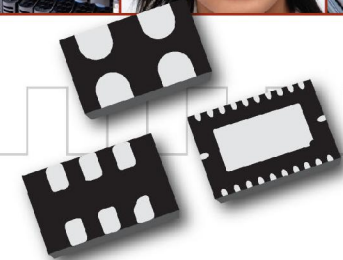




SiTime
Turbo
Webinars

SiTime University Turbo Seminar Series

MEMS Oscillators in Hi-Rel and Industrial Applications



January 28-29, 2013

The Smart Timing Choice™

Agenda



- Why Silicon MEMS for High Temp, High Reliability Applications?
- Overview of High Temp MEMS Oscillators
- Silicon MEMS Advantages and Benefits
- Served Markets

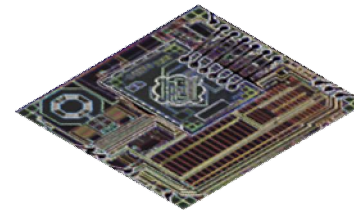
MEMS Timing Technology is Inherently More Robust and Reliable than Quartz



MEMS Resonator



Analog CMOS Die



- Extremely shock & vibration resistant due to small mass
- Hermetically sealed, no contamination
- No Fatigue mechanism over time
- No possibility of breakage under stress

- Best temp sensor expertise
- Best temp compensation
- Best mix-signal design practice

MEMS – Industry's Most Robust and Reliable Oscillator

MEMS Oscillators are Ideal for High Temp, High-Rel Applications



**Widest temp
range options**

**2x better in
stability than
quartz**

**-55 TO +125°C
ULTRA ROBUST**

**35x more
Reliable than
quartz**

**30x better in
robustness than
quartz**



Download Silicon MEMS Reliability and Resilience Turbo Webinar at
<http://www.sitime.com/support/sitime-u/turbo-webinars>

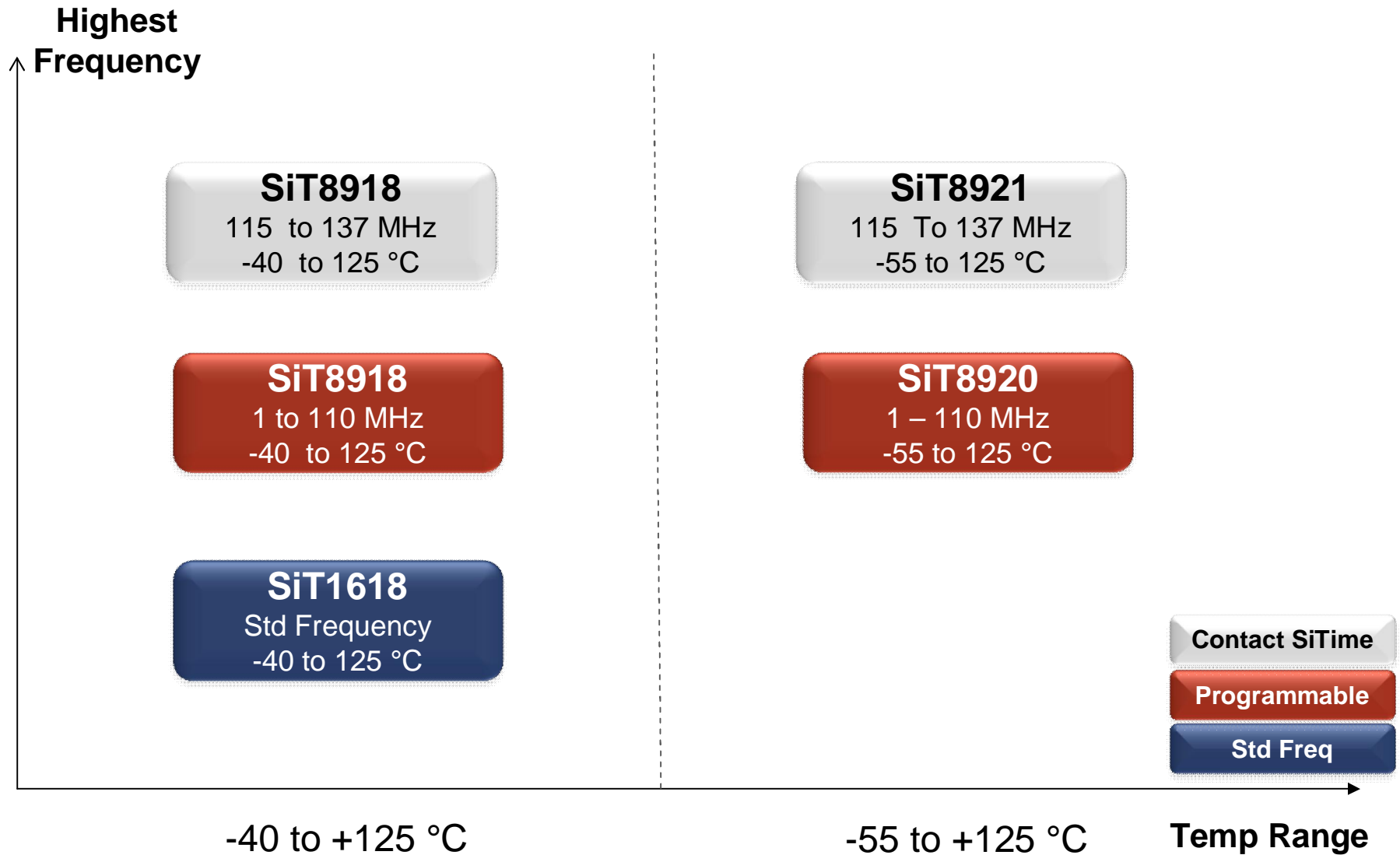
High-Temp Devices Expand Industry's Broadest MEMS Timing Portfolio



Pin-Compatible	Pin-Compatible	Pin-Compatible	Pin-Compatible		Pin-Compatible	Pin-Compatible	
Low Jitter XO 0.3 to 0.5 ps Jitter 10 to 50 PPM	Low Power XO 10 to 50 PPM	High Temp XO up to +125°C 25 to 50 PPM	VCXO 0.5 ps Jitter	DCXO 0.5 ps Jitter	(VC) TCXO 0.5 ps Jitter	Spread Spectrum XO 50 to 100 PPM	Clock Generator 25 to 50 PPM
SiT8208/9 1-220 MHz	SiT1602 3.75-75 MHz Std Freq	SiT1618 7.3728-48 MHz Std Freq -40 to +125°C	SiT3807 1.5-45 MHz Std Freq	SiT3907 1-220 MHz	SiT5000 10-45 MHz 2-5 PPM	SiT9001 1-200 MHz	SiT9104 1-220 MHz
SiT9120^{Diff} 25-212.5 MHz	SiT8008 1-110 MHz 3.5-5 mA	SiT8918 1-110 MHz -40 to +125°C	SiT3808/9 1-220 MHz	SiT3921/2^{Diff} 1-625 MHz	SiT5001/2 1-220 MHz 1-5 PPM	SiT9003 Low Power 1-110 MHz	SiT9105 SE & Diff 1-800 MHz
SiT9121/2^{Diff} 1-625 MHz	SiT8009 115-137 MHz 5-7 mA	SiT8920 1-110 MHz -55 to +125°C	SiT3821/2^{Diff} 1-625 MHz		SiT5003/4 1-220 MHz 0.5 PPM	SiT9002^{Diff} 1-220 MHz	SiT9103^{Diff} 1-800 MHz
SiT9156^{Diff} 156.25 MHz 10/40 GbE	SiT8003XT 0.25mm thin 1-110 MHz				SiT5021/2^{Diff} 1-625 MHz 1-5 PPM		
	SiT8503 200-1000 kHz				SiT5023/4^{Diff} 1-625 MHz 0.5 PPM		

- LVCMOS Output
- Differential Output

High Temp (125 °C) MEMS Oscillators



Unique Features and Value Propositions



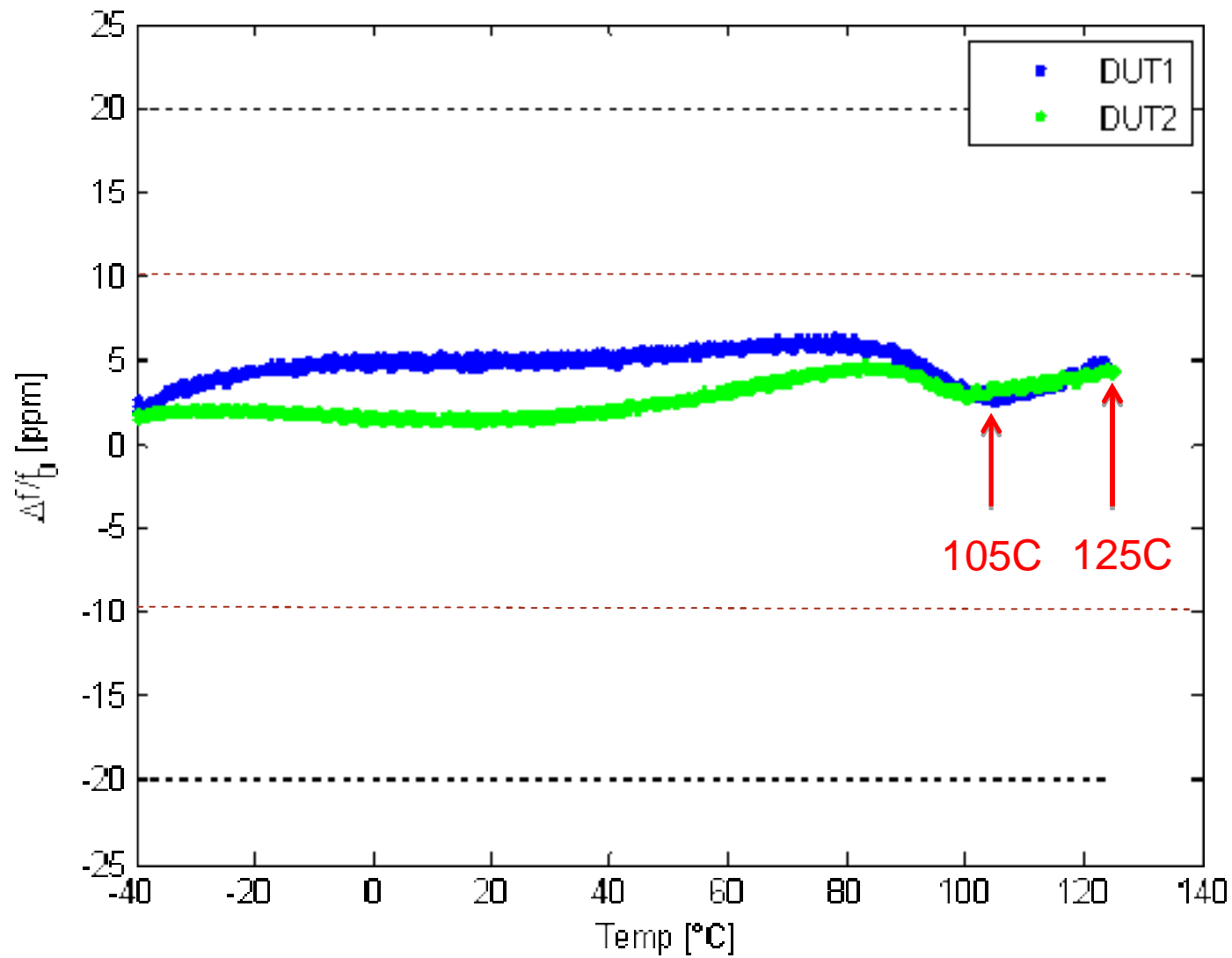
- **Extensive and flexible features: high frequency, low voltage and ultra small packages**
- **Excellent stability as low as ± 25 PPM from -55 to 125 °C**
- **Rise/fall time control for EMI reduction or driving multiple loads**
- **Industry-best low G-sensitivity of 0.1 PPB/G**
- **Unmatched resistance of shock (50kG) and vibration (70G)**
- **Superior immunity to external EMS**
- **35x better reliability (500M Hours of MTBF)**

Highly Flexible Feature Set Enables Best System Solutions



Frequency	1MHz	6 Decimals of Accuracy			110 MHz
Stability	±25 PPM				±50 PPM
Temperature	Military	Automotive		Extended Industrial	
SoftEdge™ Rise/Fall Time	1 ns	2 ns	4 ns	6ns	
Voltage	1.8V	2.5V	2.8V	3.0V	3.3V
Package	2.0 x 1.6	2.5 x 2.0	3.2 x 2.5	5.0 x 3.2	7.0 x 5.0 mm

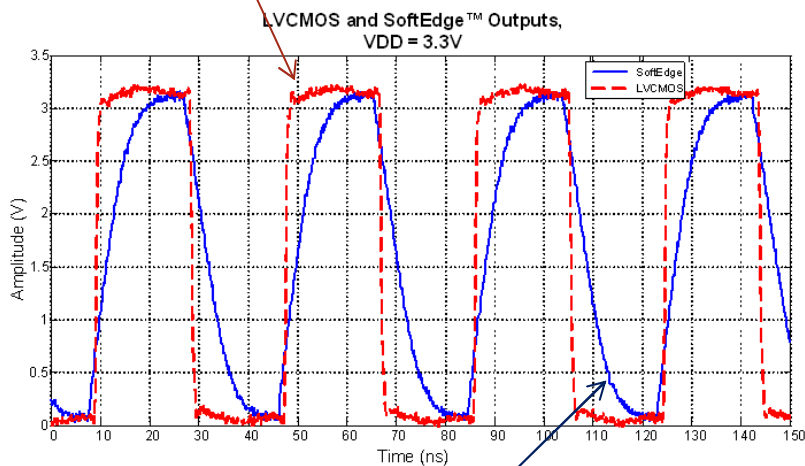
Industry Best Stability- ± 5 PPM at Automotive Temp Demonstrated



SoftEdge™ Rise/Fall Time Control to Reduce EMI

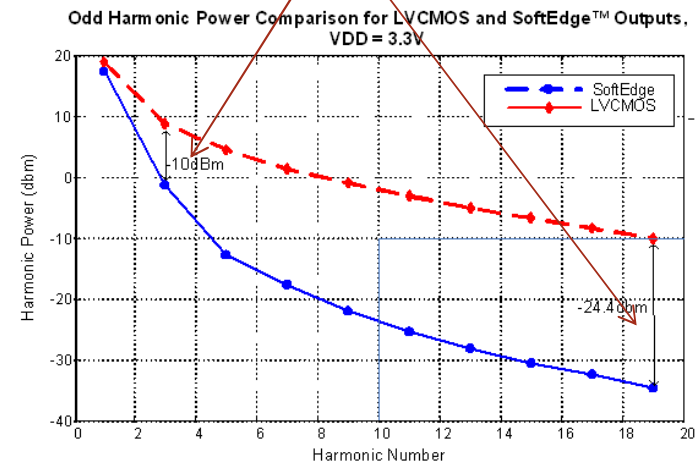


Standard Rise/fall time



SoftEdge Rise/fall time

Up to 24 dBm EMI Reduction w SoftEdge™



- Multiple rise/fall time options are available on any given device
- Appnote: <http://www.sitime.com/support2/documents/AN10022-rise-and-fall-time-rev1.1.pdf>

Silicon MEMS Delivers Most Robust and Reliable High-Temp Oscillators



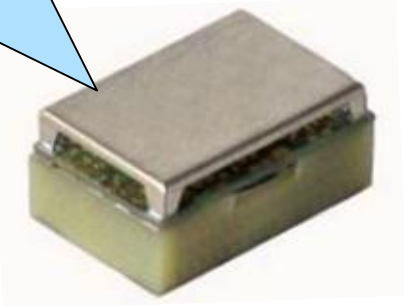
	SiTime MEMS XO	Quartz XO
Core technology	All-Silicon MEMS	Pullable Crystals
Product coverage	Any combination of voltage, frequency, package	Limited options for 1.8V, small package, stability
Frequency stability over-temp	±25 PPM - 55 to 125 °C	±40 PPM - 55 to 125 °C
Vibration sensitivity	0.1 PP/G	0.5 PPB/G
Long term reliability (MTBF)	500 Million Hours	<50 Million Hours
Rise/fall time control	1 – 6 ns	Not Available

SiTime Delivers 0.1ppb/g Performance in a Plastic Package



- Putting 0.1ppb/g sensitivity in perspective
- Quartz requires very specialized packaging to achieve low G-sensitivity performance.
- All SiTime parts are highly resistant to shock and vibration in a standard plastic package—no special packaging requirements!

Quartz Low G-Sensitivity Solution



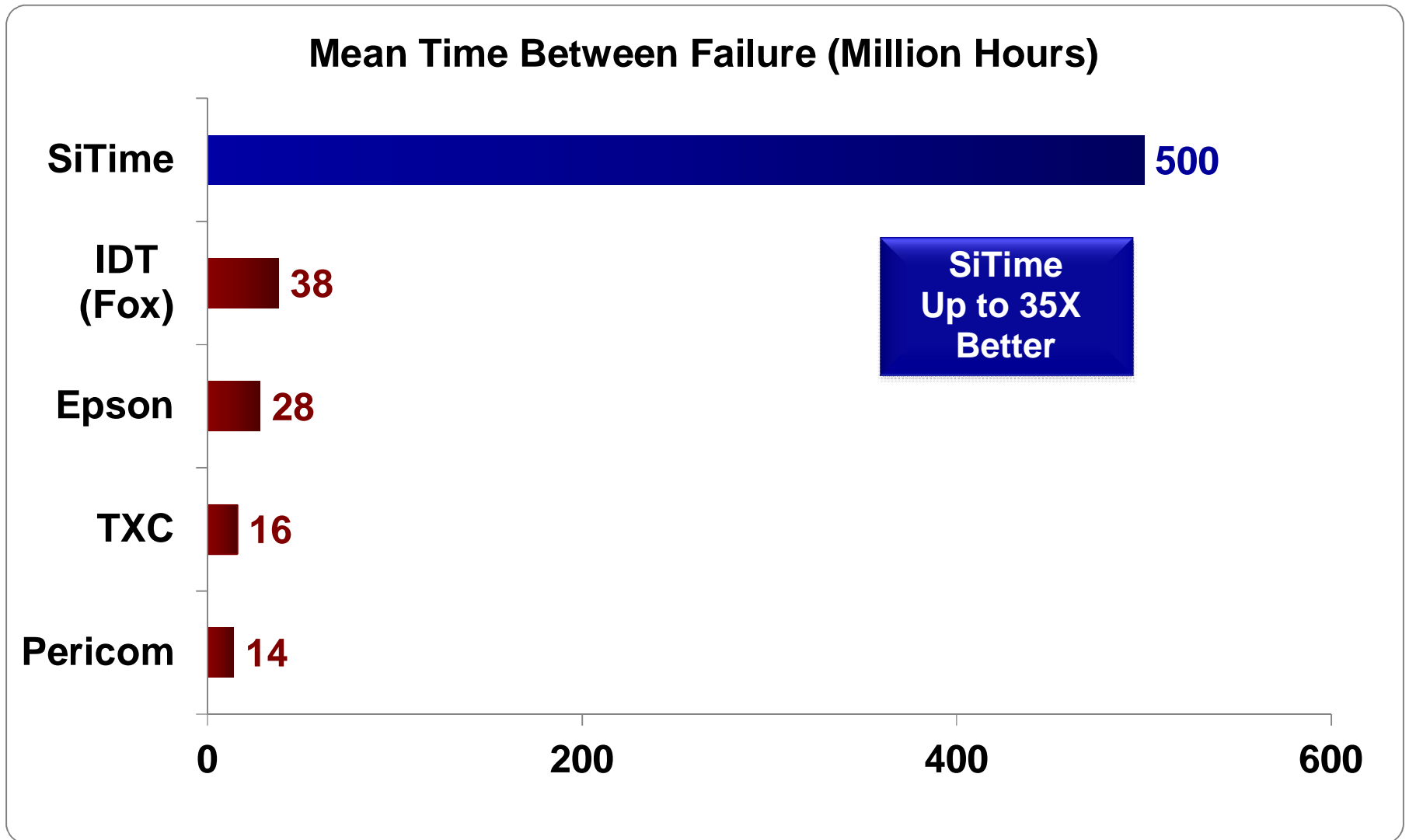
**Quartz 0.5 ppb/g device
9 x 14 x 6.2 mm**

SiTime Standard MEMS XO



**SiTime 0.1 ppb/g Device
2.0 x 1.6 x 0.75 mm**

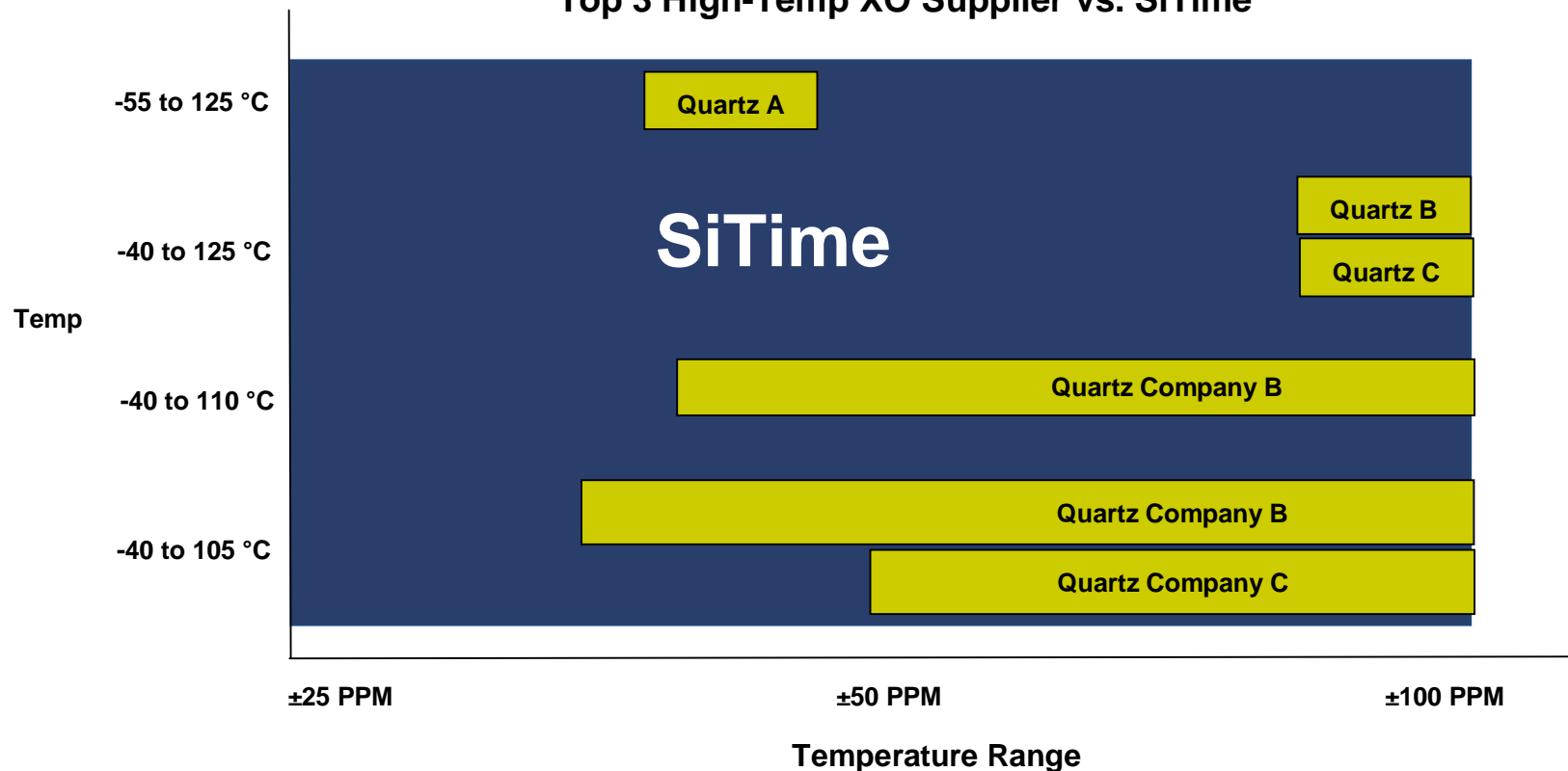
SiTime is Up to 35X Better Reliability Than Quartz



SiTime Bolsters 2x Better Stability that Improve System Margin



Frequency Stability Over-temperature
Top 3 High-Temp XO Supplier vs. SiTime

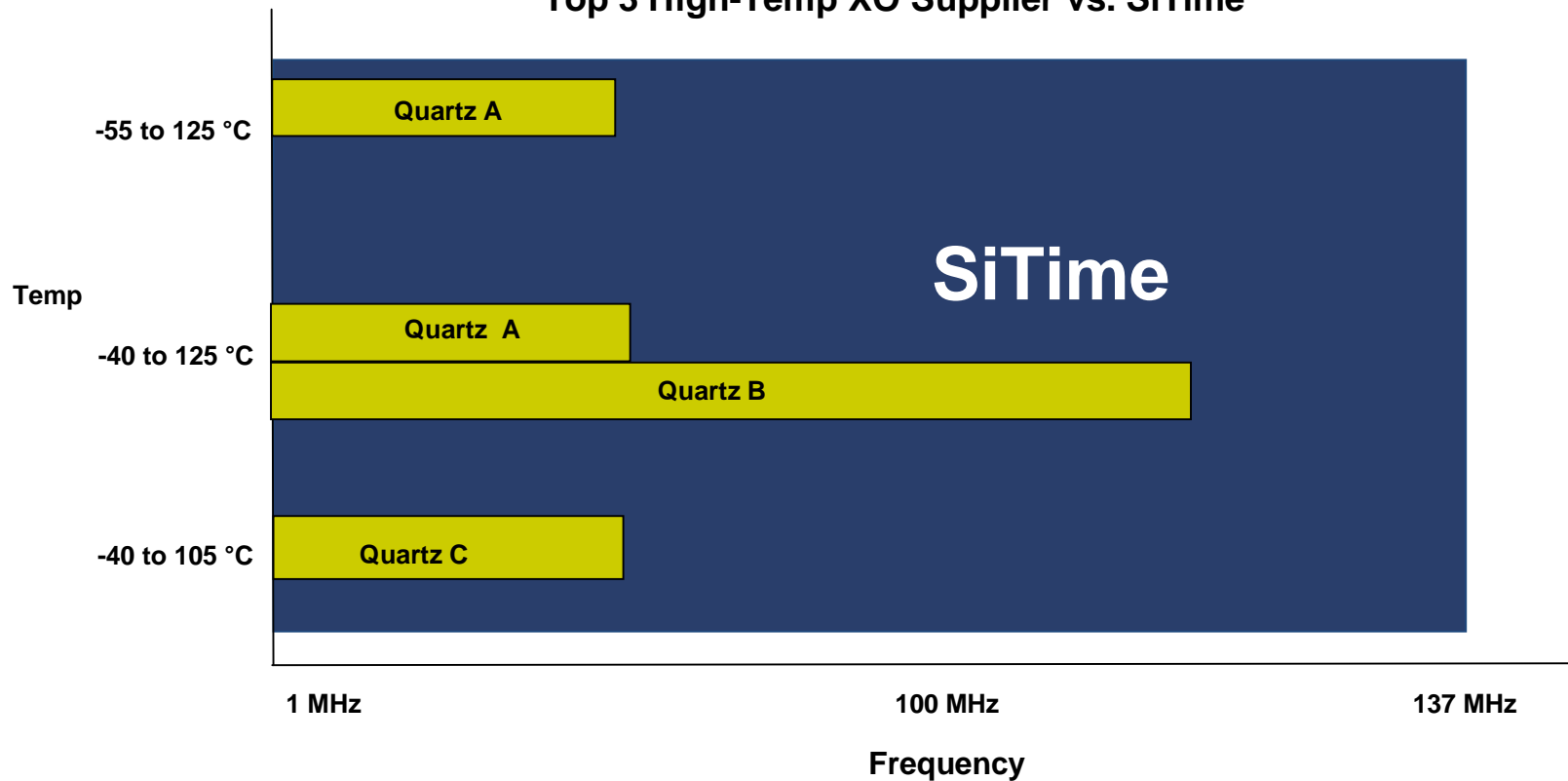


SiT8920 Feature Highlights
Any frequency from 1 to 137 MHz
±25 PPM frequency stability (low stability options available, contact SiTime)
1.8V or 2.5 – 3.3V
In ultra small 2.0x1.6 mm packages, in additional to 4 other industry standard packages

SiTime Offers Superior Frequency Coverage to Meet any Application Needs



Frequency Coverage
Top 3 High-Temp XO Supplier vs. SiTime



SiT8920 Feature Highlights

Any frequency from 1 to 137 MHz

±25 PPM frequency stability (low stability options available, contact SiTime)

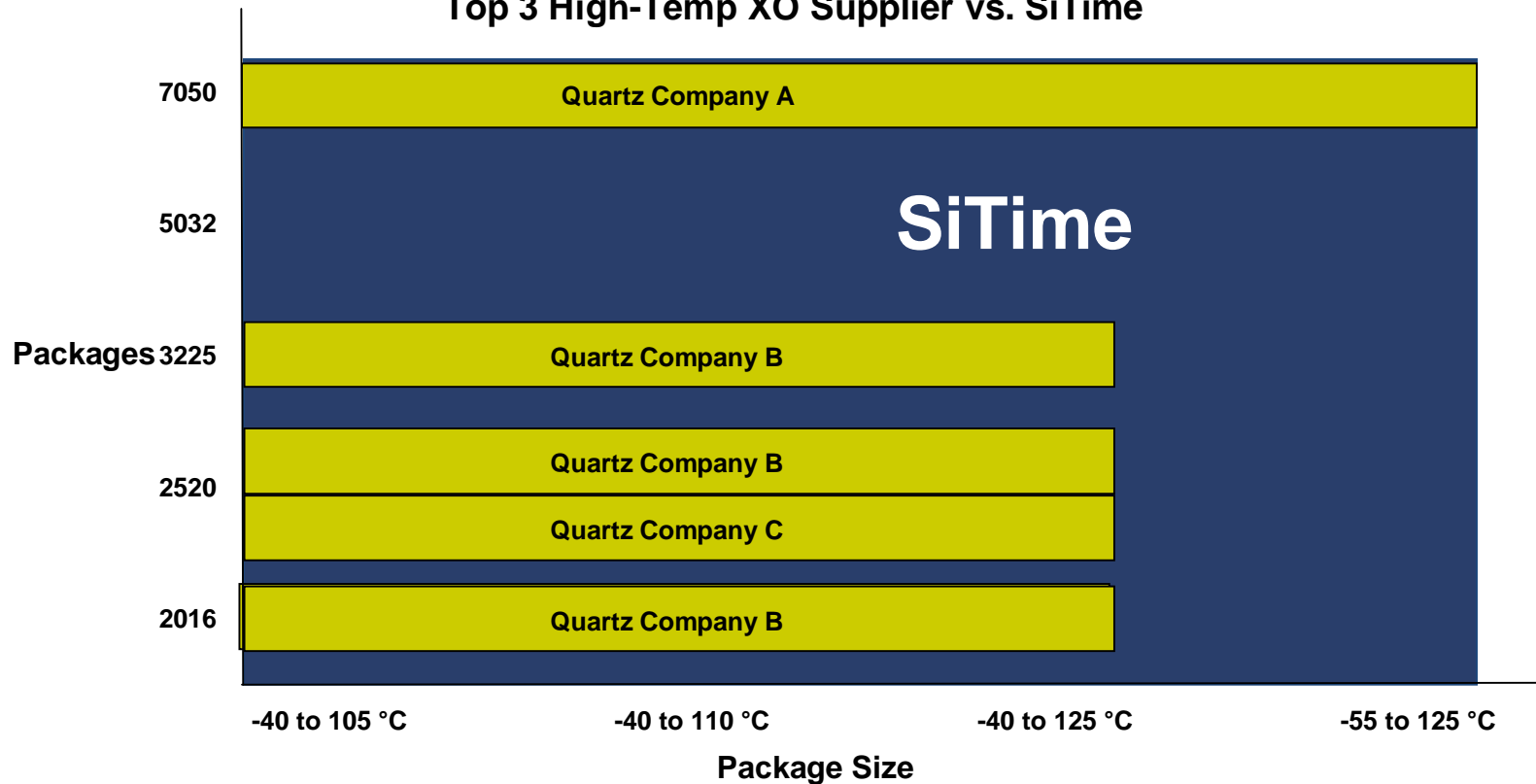
1.8V or 2.5 – 3.3V

In ultra small 2.0x1.6 mm packages, in addition to 4 other industry standard packages

SiTime Features Ultra Small Package for Miniaturization of High Temp Systems



Package vs. Operating Temperature
Top 3 High-Temp XO Supplier vs. SiTime



SiT8920 Feature Highlights

Any frequency from 1 to 137 MHz

±25 PPM frequency stability (low stability options available, contact SiTime)

1.8V or 2.5 – 3.3V

In ultra small 2.0x1.6 mm packages, in addition to 4 other industry standard packages

Summary of Unique Features and Benefits



Features

Benefits

Best-in-class Stability
±25 PPM from -55 to 125 °C

- Improve system stability in harsh and/or outdoor environments

Industry-best low G-sensitivity
0.1 PPB/G in 2.0x1.6 mm package

- Vibration resistance systems
- Carrier drop-test compliance

35x better reliability than quartz
500M Hours of MTBF

- Longer product life
- Fewer product failures

Rise/fall time Control (SoftEdge)
1 ns to 6 ns

- EMI reduction
- Avoiding system level interferences

Extensive Configurability
1.8-3.3V, 1-110MHz, 3 temp range

- Significantly more design options
- Consolidation of supplier base

SiT1618 Standard Frequency, Automotive Temp MEMS XO

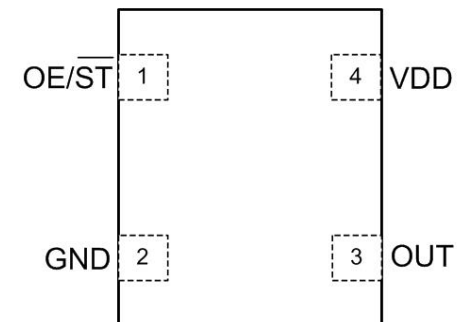


Frequency Range	Frequency Stability	Supply Voltage	Packages	Temp. Range	Active Current (typical)	Startup Time	Output Load	Signaling Type
7.3728 - 75MHz	± 25PPM ± 50PPM	1.8 V 2.5 – 3.3V	2016 2520 3225 5032 7050	--40 to +125 °C -40 to +105 °C	3.6 mA (no load)	5 ms	15pF	LVC MOS

- 33 standard automotive XTAL frequencies from 7.3728 MHz to 48 MHz
- 0.1 PPB/G G-sensitivity
- Excellent over-temp stability
- Package as small as 2016
- Excellent phase jitter more resistant to external EMI
- Regulated input voltage, up to 10% tolerance for 1.8V



4-pin
2016/2520/3225
5032/7050



SiT8918 Programmable, Automotive Temp MEMS XO

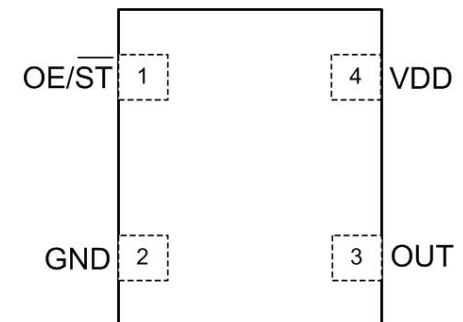


Frequency Range	Frequency Stability	Supply Voltage	Packages	Temp. Range	Active Current (typical)	Startup Time	Output Load	Signaling Type
1 - 110 MHz	± 20 PPM ± 25 PPM ± 50 PPM	1.8 V 2.5 – 3.3V	2016 2520 3225 5032 7050	-40 to +125 °C -40 to +105 °C	3.6 mA (no load)	5 ms	15pF	LVC MOS

- Any frequency from 1-110 MHz accurate to 6 decimal places
- ±25 PPM stability up to 125 °C (contact SiTime for better stability)
- Package as small as 2016
- 01. ppb/g vibration sensitivity
- Excellent jitter for digital applications
- Faster startup time with gated output



4-pin
2016/2520/3225
5032/7050



SiT8918 Military Temp MEMS XO

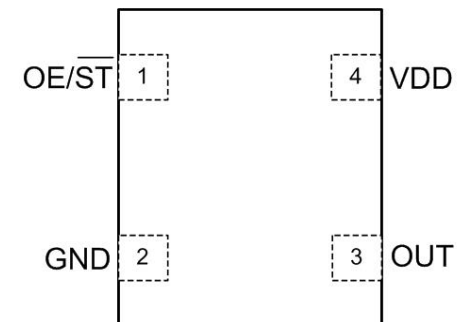


Frequency Range	Frequency Stability	Supply Voltage	Packages	Temp. Range	Active Current (typical)	Startup Time	Output Load	Signaling Type
1 - 110 MHz	± 20 PPM ± 25 PPM ± 50 PPM	1.8 V 2.5 – 3.3V	2016 2520 3225 5032 7050	-55 to +125 °C	3.6 mA (no load)	5 ms	15pF	LVC MOS

- Any frequency from 1-110 MHz accurate to 6 decimal places
- ±25 PPM stability from -55 to 125 °C (contact SiTime for better stability)
- 01. ppb/g vibration sensitivity
- Industry best survivability (50kG shock & 70G vibration)
- Package as small as 2016
- Faster startup time with gated output



4-pin
2016/2520/3225
5032/7050



Contact Information



- **For Questions, contact SiTime Technical Support**
Technicalsupport@sitime.com
- **For *Turbo Webinar* pdf Downloads on SiTime's Web Site**
www.sitime.com/support/sitime-u/turbo-webinars
 - All new webinars will be posted within 1-week
 - For a list of part numbers used for each test, contact SiTime Technical Support at the email address listed above.
- **For SiTime High-Temp oscillator datasheets and other info, visit**
<http://www.sitime.com/products/high-temp-oscillators>