SiT1604
Oscillator for Security and Surveillance Applications

The Smart Timing Choice™

Features

- 36 standard frequencies between 3.57 MHz and 80 MHz
- 100% pin-to-pin drop-in replacement to quartz-based XO
- Excellent total frequency stability as low as ±20 PPM
- Low power consumption of 3.6 mA typical
- Standby mode for longer battery life
- Fast startup time of 5 ms
- LVCMOS/HCMOS compatible output
- Industry-standard packages: 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
- Pb-free, RoHS and REACH compliant

Applications

- Ideal for DVR, CCTV, IP CAM, security, cameras

Electrical Characteristics[1, 2]

Parameter and Conditions	Symbol	Min.	Typ.	Max.	Unit	Condition
Frequency Range						
Output Frequency Range	f	(*Refer to the frequency list page 6*)			MHz	36 standard frequencies between 3.57 MHz and 80 MHz
Frequency Stability and Aging						
Frequency Stability	F_stab	-20	–	+20	PPM	Inclusive of Initial tolerance at 25°C, 1st year aging at 25°C, and variations over operating temperature, rated power supply voltage and load.
		-25	–	+25	PPM	
Operating Temperature Range						
Operating Temperature Range	T_use	-20	–	+70	°C	Extended Commercial
		-40	–	+85	°C	Industrial
Supply Voltage and Current Consumption						
Supply Voltage	Vdd	1.62	1.8	1.98	V	Contact SiTime for 1.5V support
		2.25	2.5	2.75	V	
		2.52	2.8	3.08	V	
		2.7	3.0	3.3	V	
		2.97	3.3	3.63	V	
		2.25	–	3.63	V	
Current Consumption	Idd	–	3.8	4.5	mA	No load condition, f = 20 MHz, Vdd = 2.8V to 3.3V
		–	3.6	4.2	mA	No load condition, f = 20 MHz, Vdd = 2.5V
		–	3.4	3.9	mA	No load condition, f = 20 MHz, Vdd = 1.8V
OE Disable Current	I_OD	–	–	4	mA	Vdd = 2.5V to 3.3V, OE = GND, output is Weakly Pulled Down
		–	–	3.8	mA	Vdd = 1.8 V. OE = GND, output is Weakly Pulled Down
Standby Current	I_std	–	2.6	4.3	µA	$\overline{ST}$ = GND, Vdd = 2.8V to 3.3V, Output is Weakly Pulled Down
		–	1.4	2.5	µA	$\overline{ST}$ = GND, Vdd = 2.5V, Output is Weakly Pulled Down
		–	0.6	1.3	µA	$\overline{ST}$ = GND, Vdd = 1.8V, Output is Weakly Pulled Down
LVCMOS Output Characteristics						
Duty Cycle	DC	45	–	55	%	All Vdds
Rise/Fall Time	Tr, Tf	–	1	2	ns	Vdd = 2.5V, 2.8V, 3.0V or 3.3V, 20% - 80%
		–	1.3	2.5	ns	Vdd =1.8V, 20% - 80%
		–	–	2	ns	Vdd = 2.25V - 3.63V, 20% - 80%
Output High Voltage	VOH	90%	–	–	Vdd	IOH = -4 mA (Vdd = 3.0V or 3.3V) IOH = -3 mA (Vdd = 2.8V and Vdd = 2.5V) IOH = -2 mA (Vdd = 1.8V)
Output Low Voltage	VOL	–	–	10%	Vdd	IOL = 4 mA (Vdd = 3.0V or 3.3V) IOL = 3 mA (Vdd = 2.8V and Vdd = 2.5V) IOL = 2 mA (Vdd = 1.8V)
Input Characteristics						
Input High Voltage	VIH	70%	–	–	Vdd	Pin 1, OE or $\overline{ST}$
Input Low Voltage	VIL	–	–	30%	Vdd	Pin 1, OE or $\overline{ST}$
Input Pull-up Impedence	Z_in	–	87	100	kΩ	Pin 1, OE logic high or logic low, or $\overline{ST}$ logic high
		2	–	–	MΩ	Pin 1, $\overline{ST}$ logic low

Notes:
1. All electrical specifications in the above table are specified with 15 pF output load and for all Vdd(s) unless otherwise stated.
2. Contact SiTime for custom drive strength to drive higher or multiple load, or SoftEdge™ option for EMI reduction.

Electrical Characteristics[1, 2] (continued)

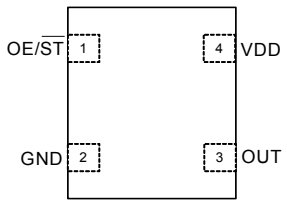
Parameter and Conditions	Symbol	Min.	Typ.	Max.	Unit	Condition
Startup and Resume Timing						
Startup Time	T_start	–	–	5	ms	Measured from the time Vdd reaches its rated minimum value
Enable/Disable Time	T_oe	–	–	130	ns	f = 110 MHz. For other frequencies, T_oe = 100 ns + 3 * cycles
Resume Time	T_resume	–	–	5	ms	Measured from the time ST pin crosses 50% threshold
Startup Time	T_start	–	–	5	ms	Measured from the time Vdd reaches its rated minimum value
Jitter						
RMS Period Jitter	T_jitt	–	1.76	3	ps	f = 75 MHz, Vdd = 2.5V, 2.8V, 3.0V or 3.3V
		–	1.78	3	ps	f = 75 MHz, Vdd = 1.8V
RMS Phase Jitter (random)	T_phj	–	0.5	0.9	ps	f = 75 MHz, Integration bandwidth = 900 kHz to 7.5 MHz
		–	1.3	2	ps	f = 75 MHz, Integration bandwidth = 12 kHz to 20 MHz

Notes:
1. All electrical specifications in the above table are specified with 15 pF output load and for all Vdd(s) unless otherwise stated.
2. Contact SiTime for custom drive strength to drive higher or multiple load, or SoftEdge™ option for EMI reduction.

Pin Description

Pin	Symbol		Functionality
1	OE/ $\overline{ST}$	Output Enable	H or Open[3]: specified frequency output L: output is high impedance. Only output driver is disabled.
		Standby	H or Open[3]: specified frequency output L: output is low (weak pull down). Device goes to sleep mode. Supply current reduces to I_std.
2	GND	Power	Electrical ground[4]
3	OUT	Output	Oscillator output
4	VDD	Power	Power supply voltage[4]

Top View



Notes:
3. A pull-up resistor of <10 kΩ between OE/ $\overline{ST}$ pin and Vdd is recommended in high noise environment.
4. A capacitor value of 0.1 µF between Vdd and GND is recommended.

Absolute Maximum

Attempted operation outside the absolute maximum ratings of the part may cause permanent damage to the part. Actual performance of the IC is only guaranteed within the operational specifications, not at absolute maximum ratings.

Parameter	Min.	Max.	Unit
Storage Temperature	-65	150	°C
VDD	-0.5	4	V
Electrostatic Discharge	–	2000	V
Soldering Temperature (follow standard Pb free soldering guidelines)	–	260	°C
Junction Temperature	–	150	°C

Thermal Consideration

Package	θJA, 4 Layer Board (°C/W)	θJA, 2 Layer Board (°C/W)	θJC, Bottom (°C/W)
7050	191	263	30
5032	97	199	24
3225	109	212	27
2520	117	222	26
2016	124	227	26

Environmental Compliance

Parameter	Condition/Test Method
Mechanical Shock	**MIL-STD-883F, Method 2002**
Mechanical Vibration	**MIL-STD-883F, Method 2007**
Temperature Cycle	**JESD22, Method A104**
Solderability	**MIL-STD-883F, Method 2003**
Moisture Sensitivity Level	**MSL1 @ 260°C**

Timing Diagram

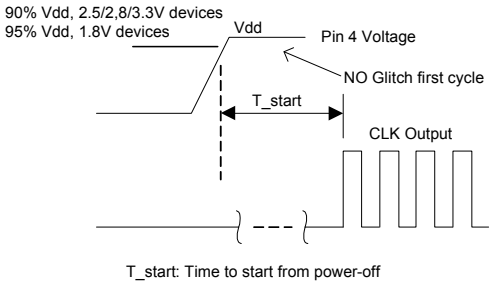


Figure 1. Startup Timing (OE/$\overline{ST}$ Mode)

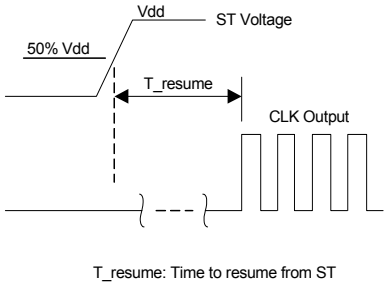


Figure 2. Standby Resume Timing ($\overline{ST}$ Mode Only)

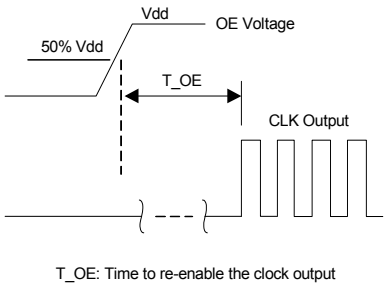


Figure 3. OE Enable Timing (OE Mode Only)

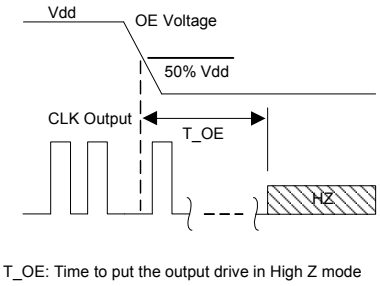
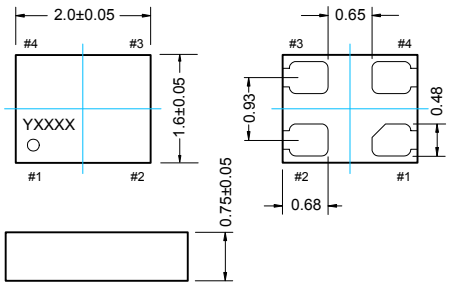
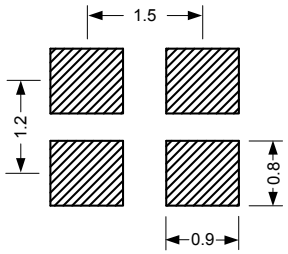
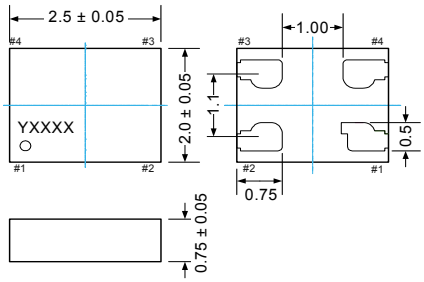
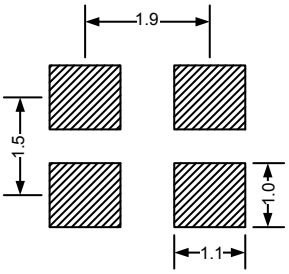
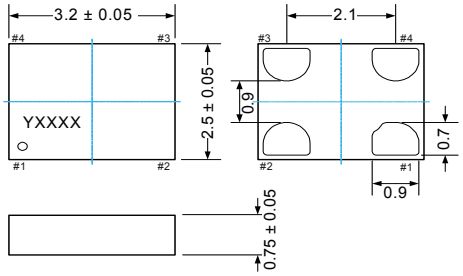
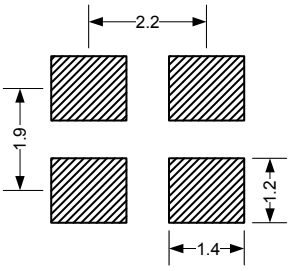
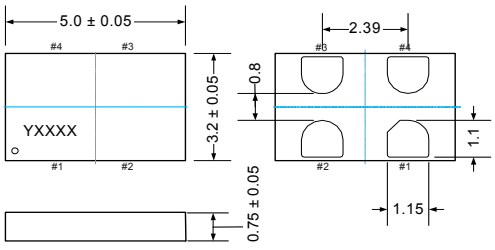
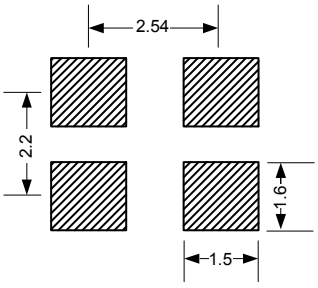


Figure 4. OE Disable Timing (OE Mode Only)

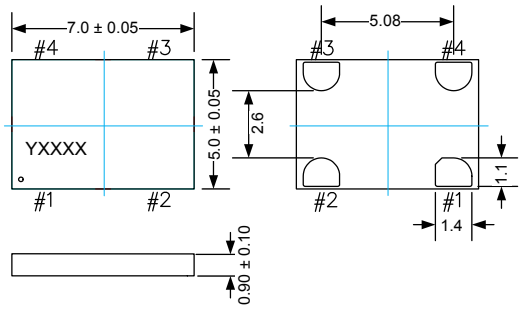
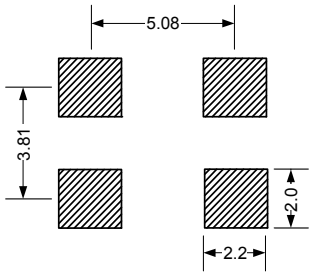
Notes:
5. SiT1604 supports no runt pulses and no glitches during startup or resume.
6. SiT1604 supports gated output which is accurate within rated frequency stability from the first cycle.

Dimensions and Patterns

Package Size – Dimensions (Unit: mm)[7]	Recommended Land Pattern (Unit: mm)[8]
2.0 x 1.6 x 0.75 mm 	
2.5 x 2.0 x 0.75 mm 	
3.2 x 2.5 x 0.75 mm 	
5.0 x 3.2 x 0.75 mm 	

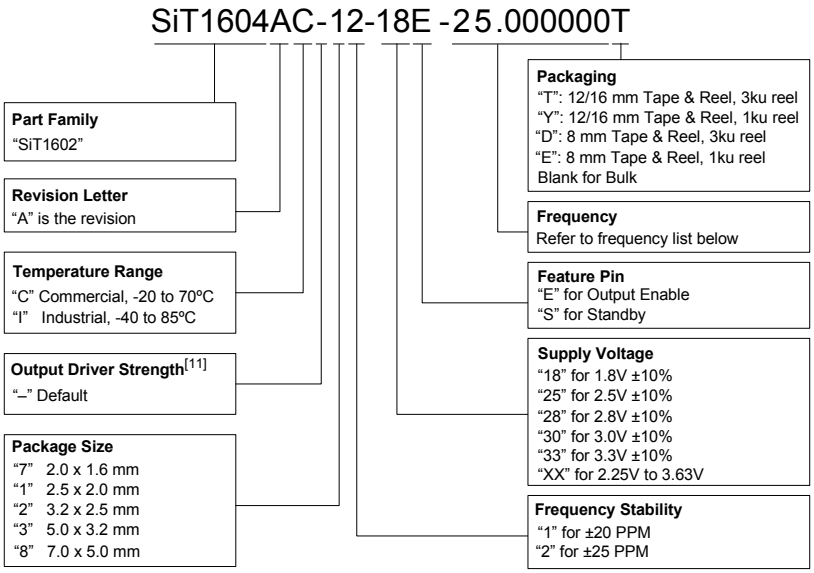
Notes:
7. Top marking: Y denotes manufacturing origin and XXXX denotes manufacturing lot number. The value of "Y" will depend on the assembly location of the device.
8. A capacitor of value 0.1 µF between Vdd and GND is recommended.

Dimensions and Patterns

Package Size – Dimensions (Unit: mm)[9]	Recommended Land Pattern (Unit: mm)[10]
7.0 x 5.0 x 0.90 mm 	

Notes:
9. Top marking: Y denotes manufacturing origin and XXXX denotes manufacturing lot number. The value of "Y" will depend on the assembly location of the device.
10. A capacitor of value 0.1 µF between Vdd and GND is recommended.

Ordering Information



Note:
11. Contact SiTime for custom drive strength to drive higher or multiple load, or SoftEdge™ option for EMI reduction.

Supported Frequencies[12]

3.57 MHz	4.096 MHz	8.192 MHz	10 MHz	11.0592 MHz	11.2896 MHz	12 MHz	12.288 MHz	14.318 MHz
14.31818 MHz	20 MHz	22.5792 MHz	24 MHz	24.576 MHz	25 MHz	26 MHz	27 MHz	28.375 MHz
28.6363 MHz	28.63636 MHz	30 MHz	33 MHz	36 MHz	37.125 MHz	38.4 MHz	48 MHz	50 MHz
54 MHz	58 MHz	60 MHz	65 MHz	66 MHz	72 MHz	74.250 MHz	75 MHz	80 MHz

Note:
12. Contact SiTime for frequencies that are not listed in the above table.

Ordering Codes for Supported Tape & Reel Packing Method[13]

Device Size	8 mm T&R (3ku)	8 mm T&R (1ku)	12 mm T&R (3ku)	12 mm T&R (1ku)	16 mm T&R (3ku)	16 mm T&R (1ku)
2.0 x 1.6 mm	D	E	–	–	–	–
2.5 x 2.0 mm	D	E	–	–	–	–
3.2 x 2.5 mm	D	E	–	–	–	–
5.0 x 3.2 mm	–	–	T	Y	–	–
7.0 x 5.0 mm	–	–	–	–	T	Y

Note:
13. For "–", contact SiTime for availability.

Additional Information

Document	Description	Download Link
Manufacturing Notes	Tape & Reel dimension, reflow profile and other manufacturing related info	http://www.sitime.com/component/docman/doc_download/85-manufacturing-notes-for-sitime-oscillators
Qualification Reports	RoHS report, reliability reports, composition reports	http://www.sitime.com/support/quality-and-reliability
Performance Reports	Additional performance data such as phase noise, current consumption and jitter for selected frequencies	http://www.sitime.com/support/performance-measurement-report
Termination Techniques	Termination design recommendations	http://www.sitime.com/support/application-notes
Layout Techniques	Layout recommendations	http://www.sitime.com/support/application-notes

Supplemental Information

The Supplemental Information section is not part of the datasheet and is for informational purposes only.

Silicon MEMS Outperforms Quartz

Silicon MEMS Outperforms Quartz

The Smart Timing Choice™

Best Reliability

Silicon is inherently more reliable than quartz. Unlike quartz suppliers, SiTime has in-house MEMS and analog CMOS expertise, which allows SiTime to develop the most reliable products. Figure 1 shows a comparison with quartz technology.

Why is SiTime Best in Class:

- SiTime's MEMS resonators are vacuum sealed using an advanced Epi-Seal™ process, which eliminates foreign particles and improves long term aging and reliability
- World-class MEMS and CMOS design expertise

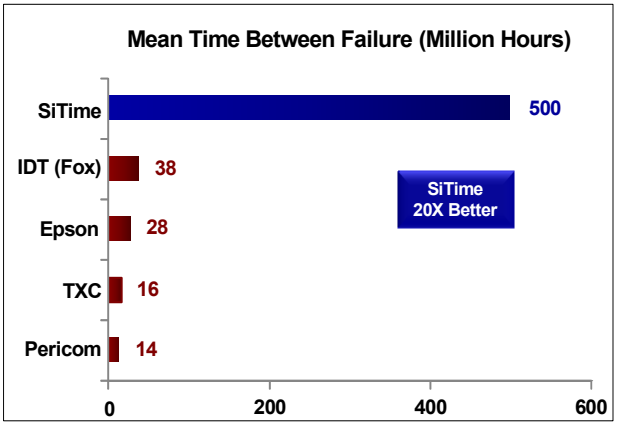


Figure 1. Reliability Comparison[1]

Best Aging

Unlike quartz, MEMS oscillators have excellent long term aging performance which is why every new SiTime product specifies 10-year aging. A comparison is shown in Figure 2.

Why is SiTime Best in Class:

- SiTime's MEMS resonators are vacuum sealed using an advanced Epi-Seal™ process, which eliminates foreign particles and improves long term aging and reliability
- Inherently better immunity of electrostatically driven MEMS resonator

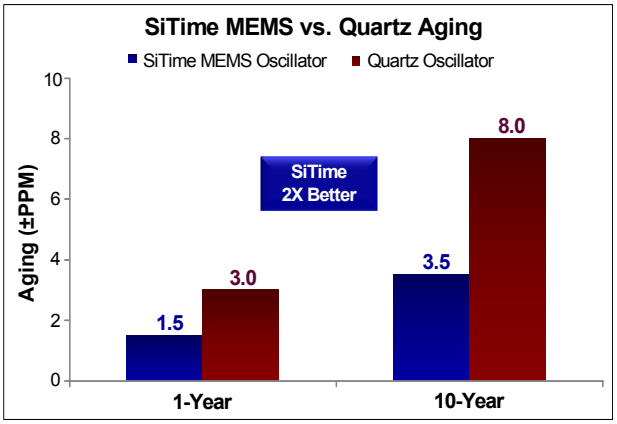


Figure 2. Aging Comparison[2]

Best Electro Magnetic Susceptibility (EMS)

SiTime's oscillators in plastic packages are up to 54 times more immune to external electromagnetic fields than quartz oscillators as shown in Figure 3.

Why is SiTime Best in Class:

- Internal differential architecture for best common mode noise rejection
- Electrostatically driven MEMS resonator is more immune to EMS

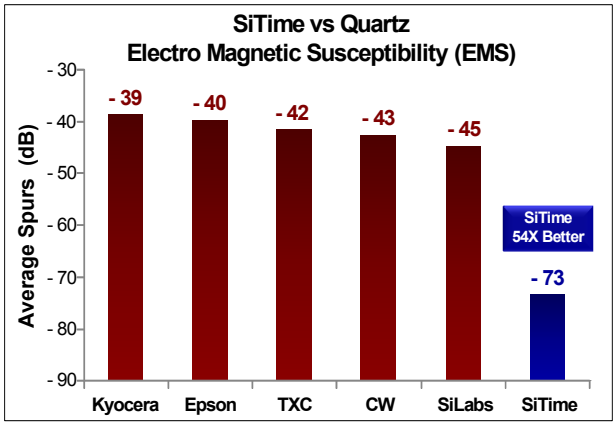


Figure 3. Electro Magnetic Susceptibility (EMS)[3]

Best Power Supply Noise Rejection

SiTime's MEMS oscillators are more resilient against noise on the power supply. A comparison is shown in Figure 4.

Why is SiTime Best in Class:

- On-chip regulators and internal differential architecture for common mode noise rejection
- Best analog CMOS design expertise

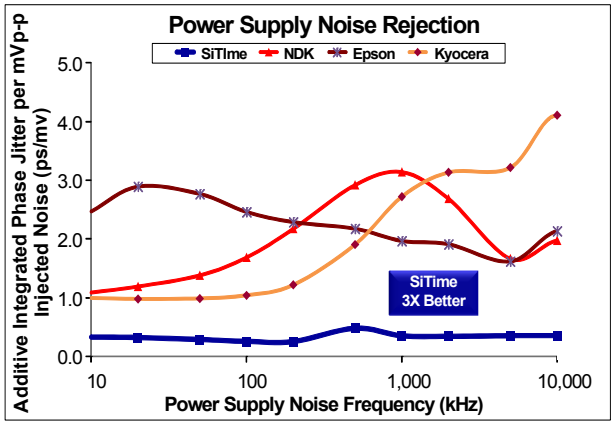


Figure 4. Power Supply Noise Rejection[4]

Silicon MEMS Outperforms Quartz

The Smart Timing Choice™

Best Vibration Robustness

High-vibration environments are all around us. All electronics, from handheld devices to enterprise servers and storage systems are subject to vibration. Figure 5 shows a comparison of vibration robustness.

Why is SiTime Best in Class:

- The moving mass of SiTime's MEMS resonators is up to 3000 times smaller than quartz
- Center-anchored MEMS resonator is the most robust design

Best Shock Robustness

SiTime's oscillators can withstand at least 50,000 *g* shock. They all maintain their electrical performance in operation during shock events. A comparison with quartz devices is shown in Figure 6.

Why is SiTime Best in Class:

- The moving mass of SiTime's MEMS resonators is up to 3000 times smaller than quartz
- Center-anchored MEMS resonator is the most robust design

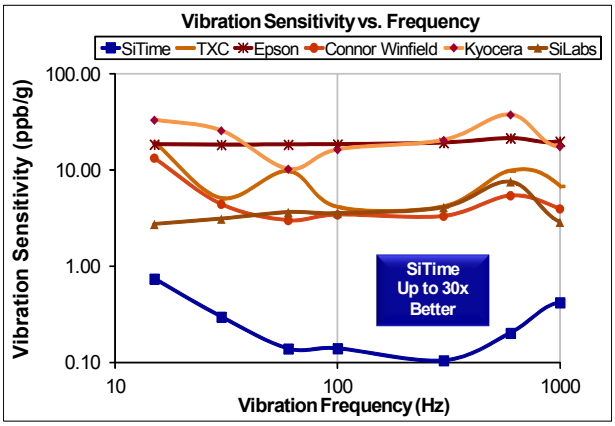


Figure 5. Vibration Robustness[5]

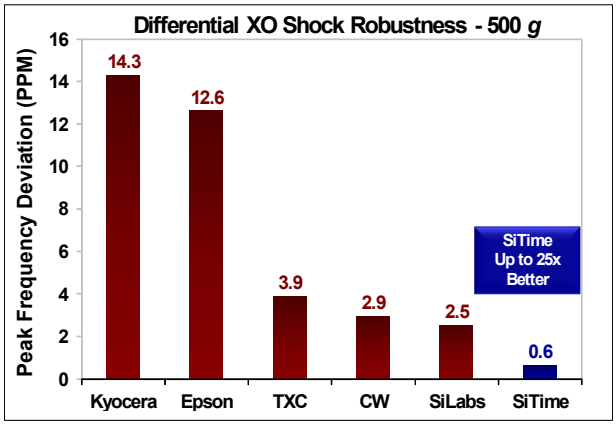


Figure 6. Shock Robustness[6]

Notes:

1. Data Source: Reliability documents of named companies.
2. Data source: SiTime and quartz oscillator devices datasheets.
3. Test conditions for Electro Magnetic Susceptibility (EMS):
   - According to IEC EN61000-4.3 (Electromagnetic compatibility standard)
   - Field strength: 3V/m
   - Radiated signal modulation: AM 1 kHz at 80% depth
   - Carrier frequency scan: 80 MHz – 1 GHz in 1% steps
   - Antenna polarization: Vertical
   - DUT position: Center aligned to antenna

   Devices used in this test:
   SiTime, SiT9120AC-1D2-33E156.250000 - MEMS based - 156.25 MHz
   Epson, EG-2102CA 156.2500M-PHPAL3 - SAW based - 156.25 MHz
   TXC, BB-156.250MBE-T - 3rd Overtone quartz based - 156.25 MHz
   Kyocera, KC7050T156.250P30E00 - SAW based - 156.25 MHz
   Connor Winfield (CW), P123-156.25M - 3rd overtone quartz based - 156.25 MHz
   SiLabs, Si590AB-BDG - 3rd overtone quartz based - 156.25 MHz
4. 50 mV pk-pk Sinusoidal voltage.
   Devices used in this test:
   SiTime, SiT8208AI-33-33E-25.000000, MEMS based - 25 MHz
   NDK, NZ2523SB-25.6M - quartz based - 25.6 MHz
   Kyocera, KC2016B25M0C1GE00 - quartz based - 25 MHz
   Epson, SG-310SCF-25M0-MB3 - quartz based - 25 MHz
5. **Devices used in this test:** same as EMS test stated in Note 3.
6. Test conditions for shock test:
   - MIL-STD-883F Method 2002
   - Condition A: half sine wave shock pulse, 500-g, 1ms
   - Continuous frequency measurement in 100 µs gate time for 10 seconds

   Devices used in this test: same as EMS test stated in Note 3
7. Additional data, including setup and detailed results, is available upon request to qualified customers. Please contact productsupport@sitime.com.

Document Feedback Form

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SiTime values your input in improving our documentation. Click here for our online feedback form or fill out and email the form below to productsupport@sitime.com.

1. Does the Electrical Characteristics table provide complete information? ◯ Yes ◯ No

If No, what parameters are missing?

_____

2. Is the organization of this document easy to follow? ◯ Yes ◯ No

If "No," please suggest improvements that we can make:

_____

3. Is there any application specific information that you would like to see in this document? (Check all that apply)

☐ EMI ☐ Termination recommendations ☐ Shock and vibration performance ☐ Other

If "Other," please specify:

_____

4. Are there any errors in this document? ◯ Yes ◯ No

If "Yes", please specify (what and where):

_____

5. Do you have additional recommendations for this document?

_____

Name _____

Title _____

Company _____

Address _____

City / State or Province / Postal Code / Country _____

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Application _____

Would you like a reply? ◯ Yes ◯ No

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