

# SiT8225

## 0.3 ps Jitter Oscillator for Networking



### Features

- 25 MHz, 25.001200 MHz and 25.000625 MHz for Ethernet applications
- 100% pin-to-pin drop-in replacement to quartz-based oscillators
- Ultra low phase jitter: 0.3 ps
- Frequency stability as low as  $\pm 10$  PPM
- Industrial or extended commercial temperature range
- LVCMOS/LVTTL compatible output
- Standby or output enable modes
- Standard 4-pin packages: 2.5 x 2.0, 3.2 x 2.5, 5.0 x 3.2, 7.0 x 5.0 mm<sup>2</sup>
- Outstanding silicon reliability of 2 FIT or 500 million hour MTBF
- Pb-free, RoHS and REACH compliant
- Ultra short lead time

### Applications

- SATA, SAS, Ethernet, 10Gb Ethernet, XAUI
- Computing, storage, networking, telecom, industrial control



EXPRESS  
SAMPLES



GREEN  
SOLUTIONS



QUARTZ  
FREE

### Electrical Characteristics

| Parameter                   | Symbol   | Min.                            | Typ. | Max. | Unit | Condition                                                                                                               |
|-----------------------------|----------|---------------------------------|------|------|------|-------------------------------------------------------------------------------------------------------------------------|
| Output Frequency Range      | f        | 25.000000, 25.001200, 25.000625 |      |      | MHz  |                                                                                                                         |
| Frequency Stability         | F_stab   | -10                             | —    | +10  | PPM  | Inclusive of Initial tolerance at 25 °C, and variations over operating temperature, rated power supply voltage and load |
|                             |          | -20                             | —    | +20  | PPM  |                                                                                                                         |
|                             |          | -25                             | —    | +25  | PPM  |                                                                                                                         |
|                             |          | -50                             | —    | +50  | PPM  |                                                                                                                         |
| Operating Temperature Range | T_use    | -20                             | —    | +70  | °C   | Extended Commercial                                                                                                     |
|                             |          | -40                             | —    | +85  | °C   | Industrial                                                                                                              |
| Supply Voltage              | Vdd      | 1.71                            | 1.8  | 1.89 | V    | Supply voltages between 2.5V and 3.3V can be supported. Contact SiTime for additional information.                      |
|                             |          | 2.25                            | 2.5  | 2.75 | V    |                                                                                                                         |
|                             |          | 2.52                            | 2.8  | 3.08 | V    |                                                                                                                         |
|                             |          | 2.97                            | 3.3  | 3.63 | V    |                                                                                                                         |
| Current Consumption         | Idd      | —                               | 31   | 33   | mA   | No load condition, Vdd = 2.5V, 2.8V or 3.3V                                                                             |
|                             |          | —                               | 29   | 31   | mA   | No load condition, Vdd = 1.8V                                                                                           |
| OE Disable Current          | I_OD     | —                               | —    | 31   | mA   | Vdd = 2.5V, 2.8V or 3.3V, OE = GND, output is Weakly Pulled                                                             |
|                             |          | —                               | —    | 30   | mA   | Vdd = 1.8 V. OE = GND, output is Weakly Pulled Down                                                                     |
| Standby Current             | I_std    | —                               | —    | 70   | μA   | Vdd = 2.5V, 2.8V or 3.3V, ST = GND, output is Weakly Pulled                                                             |
|                             |          | —                               | —    | 10   | μA   | Vdd = 1.8 V. ST = GND, output is Weakly Pulled Down                                                                     |
| Duty Cycle                  | DC       | 45                              | —    | 55   | %    |                                                                                                                         |
| Rise/Fall Time              | Tr, Tf   | —                               | 1.2  | 2    | ns   | 15 pF load, 10% - 90% Vdd                                                                                               |
|                             |          | —                               | 2.2  | —    | ns   | 30 pF load, 10% - 90% Vdd                                                                                               |
|                             |          | —                               | 3.4  | —    | ns   | 45 pF load, 10% - 90% Vdd                                                                                               |
| Output Voltage High         | VOH      | 90%                             | —    | —    | Vdd  | IOH = -6 mA, IOL = 6 mA, (Vdd = 3.3V, 2.8V, 2.5V)                                                                       |
| Output Voltage Low          | VOL      | —                               | —    | 10%  | Vdd  | IOH = -3 mA, IOL = 3 mA, (Vdd = 1.8V)                                                                                   |
| Input Voltage High          | VIH      | 70%                             | —    | —    | Vdd  | Pin 1, OE or ST                                                                                                         |
| Input Voltage Low           | VIL      | —                               | —    | 30%  | Vdd  | Pin 1, OE or ST                                                                                                         |
| Input Pull-up Impedance     | Z_in     | —                               | 100  | 250  | kΩ   | Pin 1, OE logic high or logic low, or ST logic high                                                                     |
|                             |          | 2                               | —    | —    | MΩ   | Pin 1, ST logic low                                                                                                     |
| Startup Time                | T_start  | —                               | 7    | 10   | ms   | Measured from the time Vdd reaches its rated minimum value                                                              |
| OE Enable/Disable Time      | T_oe     | —                               | —    | 150  | ns   |                                                                                                                         |
| Resume Time                 | T_resume | —                               | 6    | 10   | ms   | In standby mode, measured from the time ST pin crosses 50% threshold. Refer to Figure 5.                                |
| RMS Period Jitter           | T_jitt   | —                               | 1.5  | 2    | ps   | Vdd = 2.5V, 2.8V or 3.3V                                                                                                |
|                             |          | —                               | 2    | 3    | ps   | Vdd = 1.8V                                                                                                              |
| RMS Phase Jitter (random)   | T_phj    | —                               | 0.25 | 0.3  | ps   | IEEE802.3-2005 10GbE jitter measurement specifications                                                                  |
| First year Aging            | F_aging  | -1.5                            | —    | +1.5 | PPM  | 25°C                                                                                                                    |
| 10-year Aging               |          | -5                              | —    | +5   | PPM  | 25°C                                                                                                                    |

#### Note:

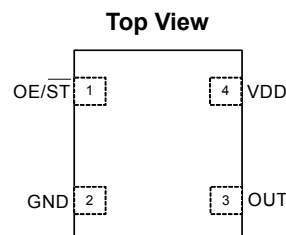
1. All electrical specifications in the above table are specified with 15 pF output load and for all Vdd(s) unless otherwise stated.
2. Contact SiTime for custom drive strength to drive higher or multiple load, or SoftEdge™ option for EMI reduction.

# SiT8225

## 0.3 ps Jitter Oscillator for Networking

### Pin Configuration

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



**Note:**

3. A pull-up resistor of <10 k $\Omega$  between OE/  $\overline{\text{ST}}$  pin and Vdd is recommended in high noise environment

### 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   |

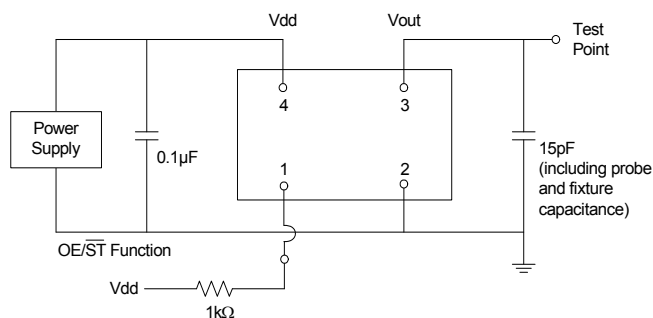
### Thermal Consideration

| Package | $\theta_{\text{JA}}$ , 4 Layer Board (°C/W) | $\theta_{\text{JA}}$ , 2 Layer Board (°C/W) | $\theta_{\text{JC}}$ , Bottom (°C/W) |
|---------|---------------------------------------------|---------------------------------------------|--------------------------------------|
| 7050    | 191                                         | 263                                         | 30                                   |
| 5032    | 97                                          | 199                                         | 24                                   |
| 3225    | 109                                         | 212                                         | 27                                   |
| 2520    | 117                                         | 222                                         | 26                                   |

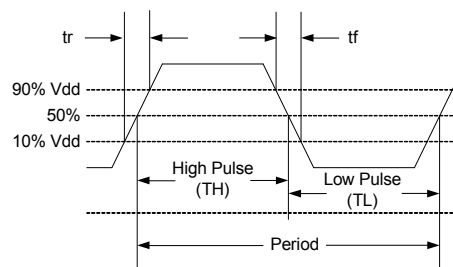
### Environmental Compliance

| 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              |

### Test Circuit and Waveform



**Figure 1. Test Circuit**

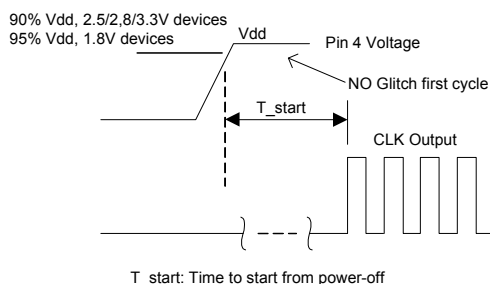


**Figure 2. Waveform**

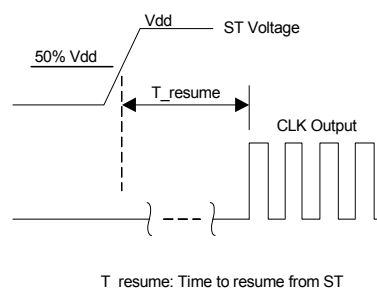
**Note:**

4. Duty Cycle is computed as  $\text{Duty Cycle} = \text{TH}/\text{Period}$ .
5. SiT8225 supports the configurable duty cycle feature. For custom duty cycle at any given frequency, contact [SiTime](http://www.sitime.com).

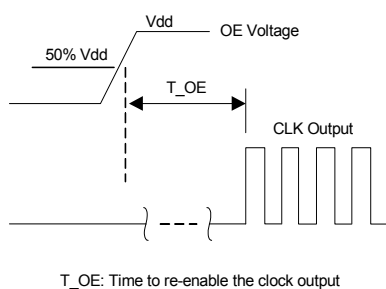
### Timing Diagram



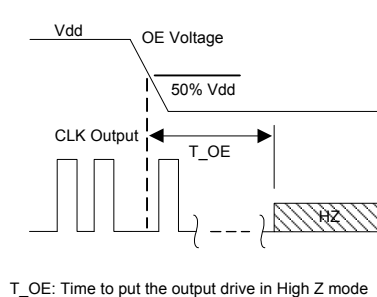
**Figure 3. Startup Timing (OE/ST Mode)**



**Figure 4. Standby Resume Timing (ST Mode Only)**



**Figure 5. OE Enable Timing (OE Mode Only)**



**Figure 6. OE Disable Timing (OE Mode Only)**

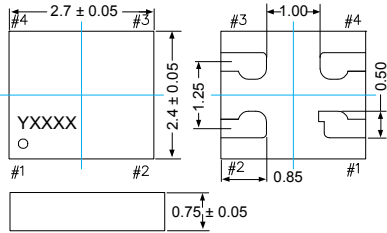
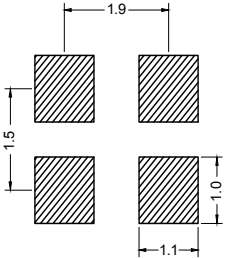
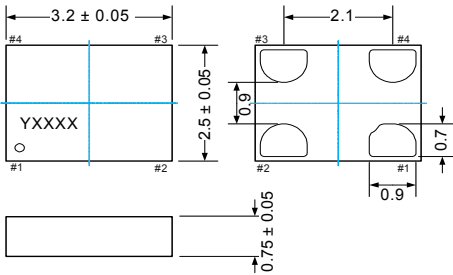
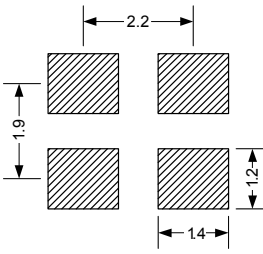
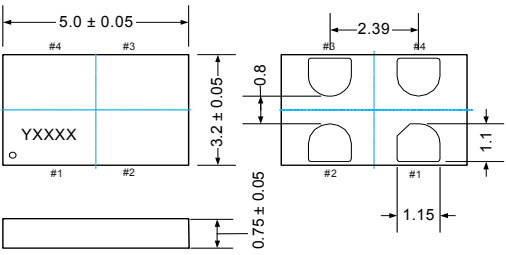
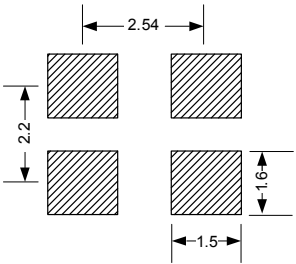
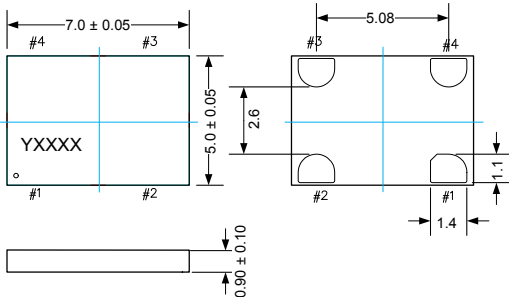
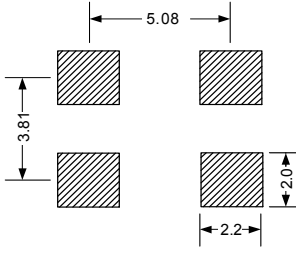
**Note:**

6. SiT8225 supports NO RUNT pulses and No glitches during startup or resume.
7. SiT8225 supports gated output which is accurate within rated frequency stability from the first cycle.

# SiT8225

## 0.3 ps Jitter Oscillator for Networking

### Dimensions and Patterns

| Package Size – Dimensions (Unit: mm) <sup>[8]</sup>                                                                                                               | Recommended Land Pattern (Unit: mm) <sup>[9]</sup>                                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <p><b>2.7 x 2.4 x 0.75 mm (100% compatible with 2.5 x 2.0 mm footprint)</b></p>  |   |
| <p><b>3.2 x 2.5 x 0.75 mm</b></p>                                               |    |
| <p><b>5.0 x 3.2 x 0.75 mm</b></p>                                              |  |
| <p><b>7.0 x 5.0 x 0.90 mm</b></p>                                              |  |

#### Notes:

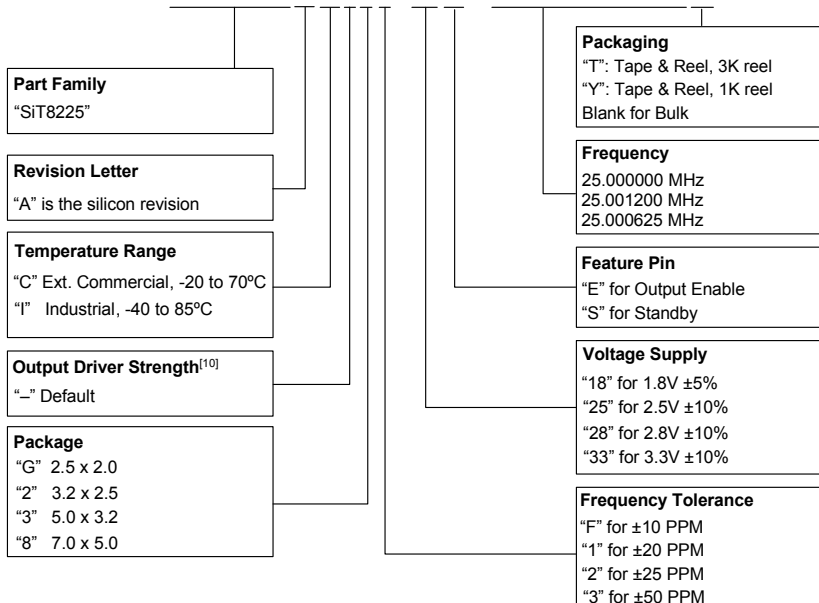
8. Top marking: Y denotes manufacturing origin and XXXX denotes manufacturing lot number. The value of "Y" will depend on the assembly location of the device.
9. A capacitor of value 0.1  $\mu$ F between Vdd and GND is recommended.

# SiT8225

## 0.3 ps Jitter Oscillator for Networking

### Ordering Information

SiT8225AC-23-25E -25.000625T



**Note:**

10. Contact [SiTime](#) for custom drive strength to drive higher or multiple load, or SoftEdge<sup>™</sup> option for EMI reduction.

### Additional Information

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

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# Supplemental Information

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

# Silicon MEMS Outperforms Quartz

## 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

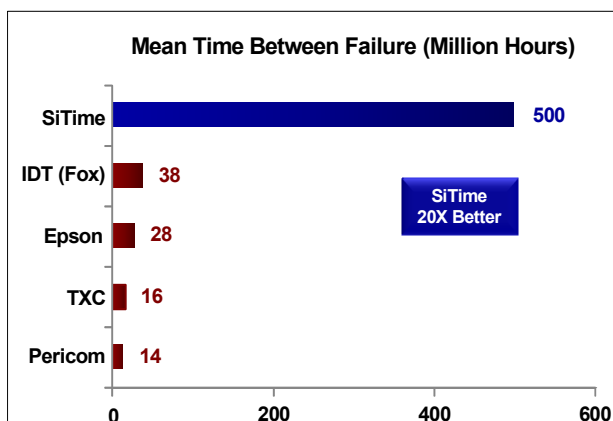


Figure 1. Reliability Comparison<sup>[1]</sup>

## 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

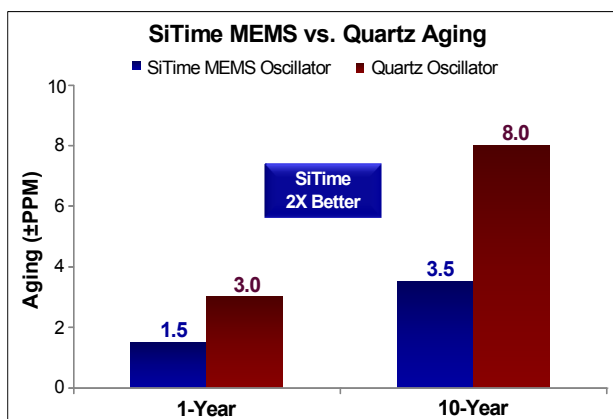


Figure 2. Aging Comparison<sup>[2]</sup>

## 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

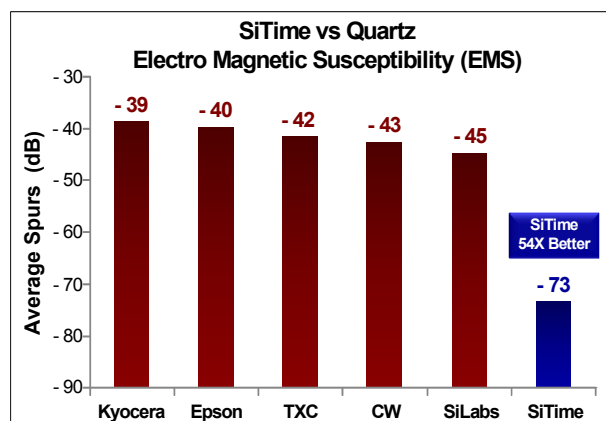


Figure 3. Electro Magnetic Susceptibility (EMS)<sup>[3]</sup>

## 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

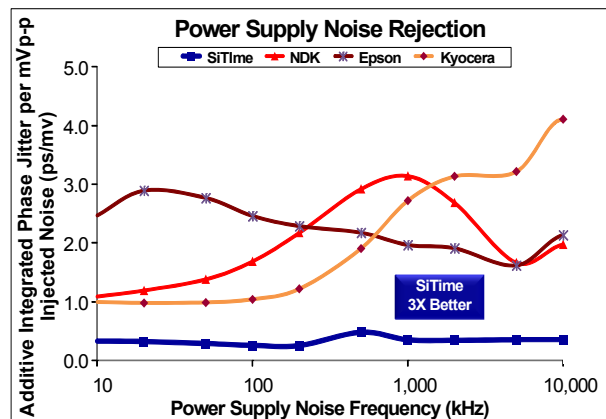


Figure 4. Power Supply Noise Rejection<sup>[4]</sup>

## 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

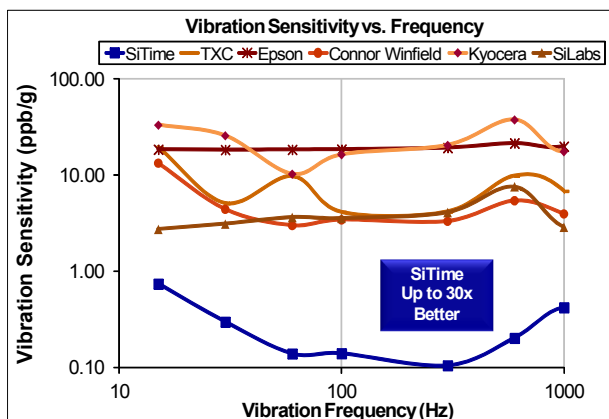


Figure 5. Vibration Robustness<sup>[5]</sup>

## 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

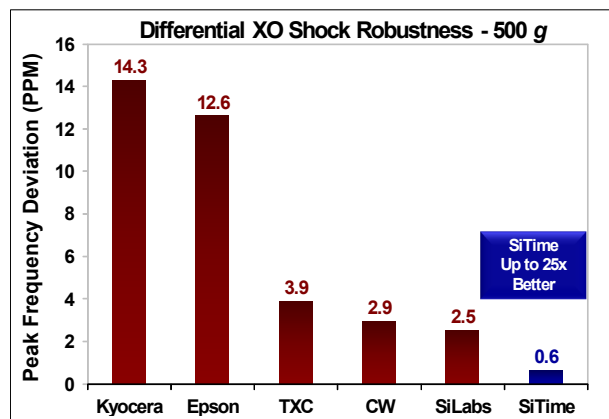


Figure 6. Shock Robustness<sup>[6]</sup>

### 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
4. 50 mV pk-pk Sinusoidal voltage.
 

**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
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  $\mu$ s 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](mailto:productsupport@sitime.com).

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The Smart Timing Choice™

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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?

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City / State or Province / Postal Code / Country \_\_\_\_\_

Telephone \_\_\_\_\_

Application \_\_\_\_\_

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