

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
- LVC MOS/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



EXPRESS
SAMPLES



GREEN
SOLUTIONS



QUARTZ
FREE

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 | ST = GND, Vdd = 2.8V to 3.3V, Output is Weakly Pulled Down |
| | | – | 1.4 | 2.5 | µA | ST = GND, Vdd = 2.5V, Output is Weakly Pulled Down |
| | | – | 0.6 | 1.3 | µA | ST = GND, Vdd = 1.8V, Output is Weakly Pulled Down |
| LVC MOS 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 ST |
| Input Low Voltage | VIL | – | – | 30% | Vdd | Pin 1, OE or ST |
| Input Pull-up Impedance | Z_in | – | 87 | 100 | kΩ | Pin 1, OE logic high or logic low, or ST logic high |
| | | 2 | – | – | MΩ | Pin 1, 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)

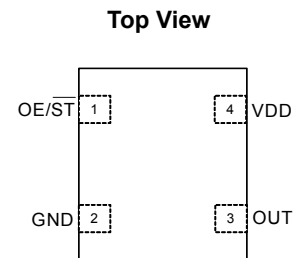
| Parameter and Conditions | Symbol | Min. | Typ. | Max. | Unit | Condition |
|----------------------------------|----------|------|------|------|------|--|
| Startup and Resume Timing | | | | | | |
| Startup Time | T_start | – | – | 5 | ms | Measured from the time Vdd reaches its rated minimum value |
| 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:

- All electrical specifications in the above table are specified with 15 pF output load and for all Vdd(s) unless otherwise stated.
- 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/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] |



Notes:

- A pull-up resistor of <math><10\text{ k}\Omega</math> between OE/ST pin and Vdd is recommended in high noise environment.
- 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 | θ_{JA} , 4 Layer Board (°C/W) | θ_{JA} , 2 Layer Board (°C/W) | θ_{JC} , 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

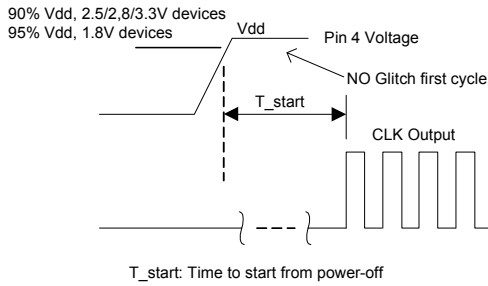


Figure 1. Startup Timing (OE/ST Mode)

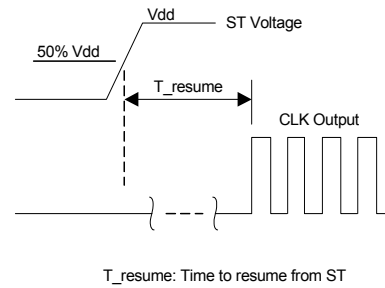


Figure 2. Standby Resume Timing (ST Mode Only)

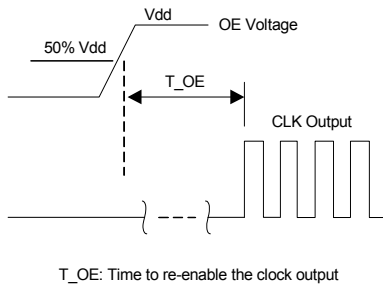


Figure 3. OE Enable Timing (OE Mode Only)

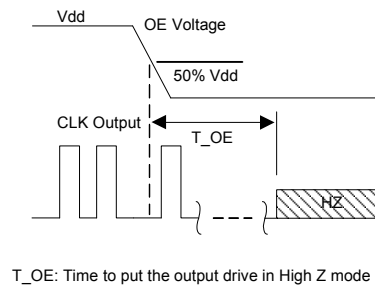
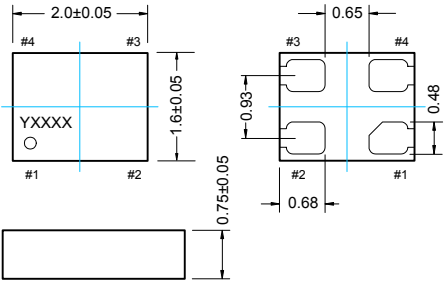
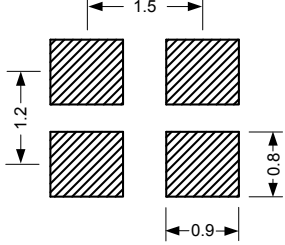
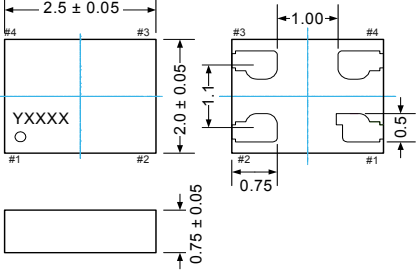
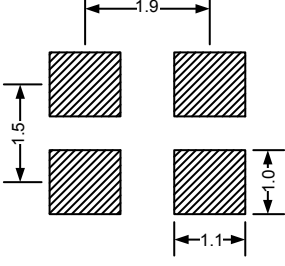
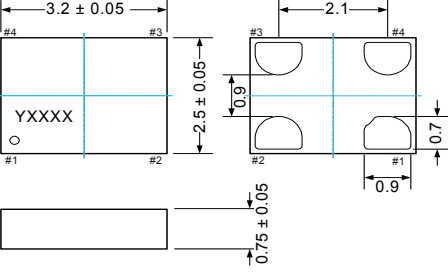
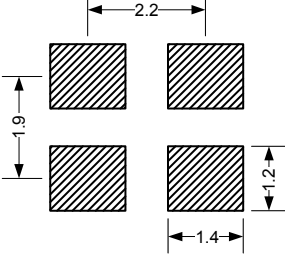
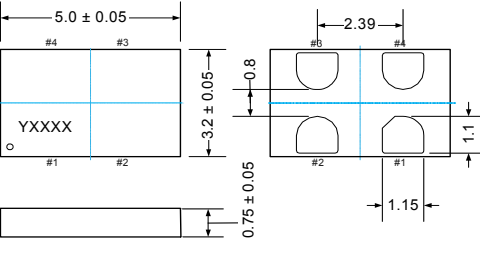
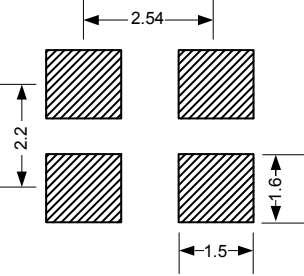


Figure 4. OE Disable Timing (OE Mode Only)

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.

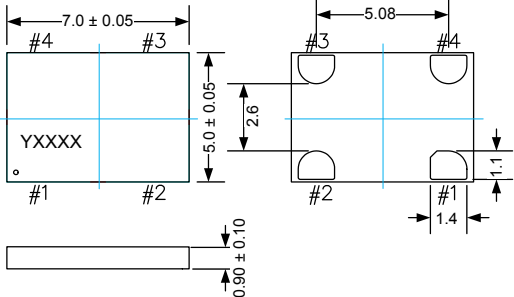
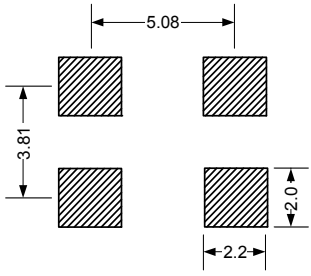
Dimensions and Patterns

| Package Size – Dimensions (Unit: mm) ^[7] | Recommended Land Pattern (Unit: mm) ^[8] |
|--|---|
| <p>2.0 x 1.6 x 0.75 mm</p>  <p>Top view dimensions: 2.0 ± 0.05 mm (width), 1.6 ± 0.05 mm (height). Pin locations: #1, #2, #3, #4. Marking: YXXXX. Bottom view dimensions: 0.75 ± 0.05 mm (height), 0.68 mm (pin pitch), 0.65 mm (pin width), 0.93 mm (pin offset), 0.48 mm (pin height).</p> <p>Recommended Land Pattern: 1.5 mm (width), 1.2 mm (height), 0.9 mm (pitch), 0.8 mm (height).</p> |  <p>Land pattern dimensions: 1.5 mm (width), 1.2 mm (height), 0.9 mm (pitch), 0.8 mm (height).</p> |
| <p>2.5 x 2.0 x 0.75 mm</p>  <p>Top view dimensions: 2.5 ± 0.05 mm (width), 2.0 ± 0.05 mm (height). Pin locations: #1, #2, #3, #4. Marking: YXXXX. Bottom view dimensions: 0.75 mm (height), 1.1 mm (pin pitch), 1.00 mm (pin width), 0.75 mm (pin offset), 0.5 mm (pin height).</p> <p>Recommended Land Pattern: 1.9 mm (width), 1.5 mm (height), 1.1 mm (pitch), 1.0 mm (height).</p> |  <p>Land pattern dimensions: 1.9 mm (width), 1.5 mm (height), 1.1 mm (pitch), 1.0 mm (height).</p> |
| <p>3.2 x 2.5 x 0.75 mm</p>  <p>Top view dimensions: 3.2 ± 0.05 mm (width), 2.5 ± 0.05 mm (height). Pin locations: #1, #2, #3, #4. Marking: YXXXX. Bottom view dimensions: 0.75 ± 0.05 mm (height), 0.9 mm (pin pitch), 2.1 mm (pin width), 0.9 mm (pin offset), 0.7 mm (pin height).</p> <p>Recommended Land Pattern: 2.2 mm (width), 1.9 mm (height), 1.4 mm (pitch), 1.2 mm (height).</p> |  <p>Land pattern dimensions: 2.2 mm (width), 1.9 mm (height), 1.4 mm (pitch), 1.2 mm (height).</p> |
| <p>5.0 x 3.2 x 0.75 mm</p>  <p>Top view dimensions: 5.0 ± 0.05 mm (width), 3.2 ± 0.05 mm (height). Pin locations: #1, #2, #3, #4. Marking: YXXXX. Bottom view dimensions: 0.75 ± 0.05 mm (height), 1.15 mm (pin pitch), 2.39 mm (pin width), 1.1 mm (pin offset), 0.8 mm (pin height).</p> <p>Recommended Land Pattern: 2.54 mm (width), 2.2 mm (height), 1.5 mm (pitch), 1.6 mm (height).</p> |  <p>Land pattern dimensions: 2.54 mm (width), 2.2 mm (height), 1.5 mm (pitch), 1.6 mm (height).</p> |

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

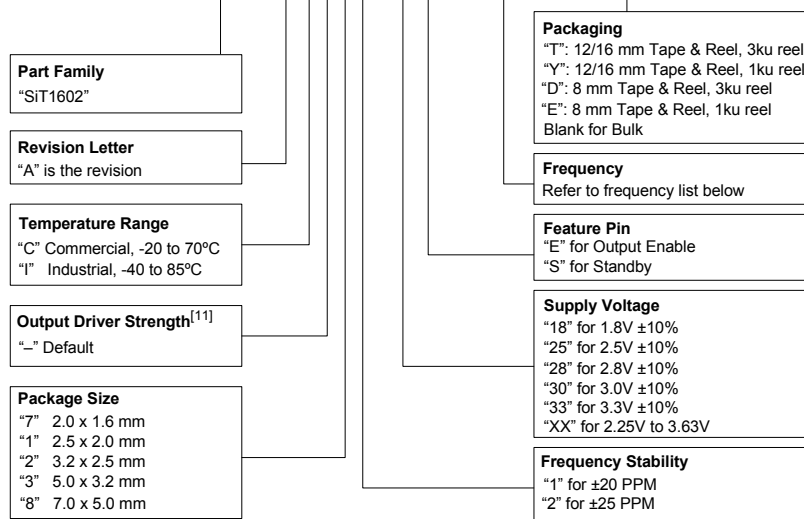
| Package Size – Dimensions (Unit: mm) ^[9] | Recommended Land Pattern (Unit: mm) ^[10] |
|--|--|
| <p>7.0 x 5.0 x 0.90 mm</p>  |  |

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 μ F between Vdd and GND is recommended.

Ordering Information

SiT1604AC-12-18E -25.00000T



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 |

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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

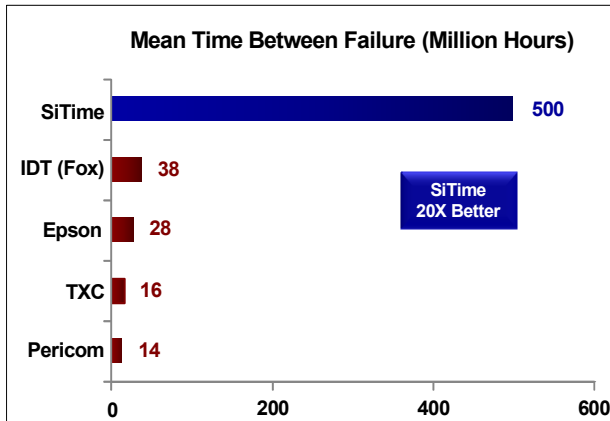


Figure 1. Reliability Comparison^[1]

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

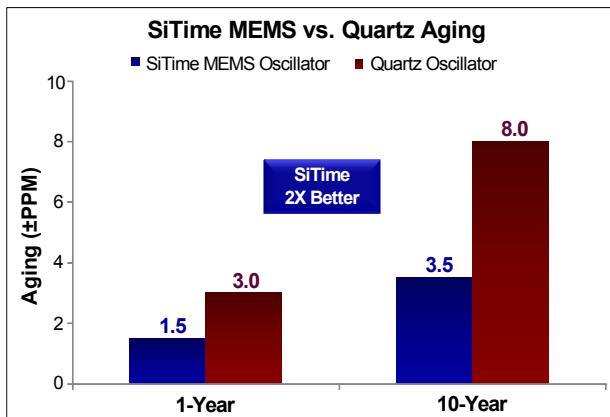


Figure 2. Aging Comparison^[2]

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

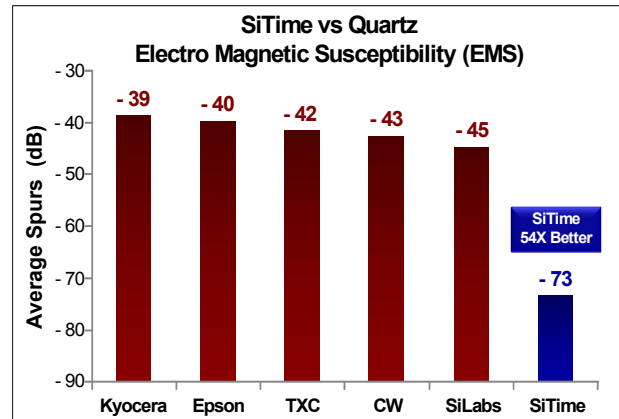


Figure 3. Electro Magnetic Susceptibility (EMS)^[3]

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

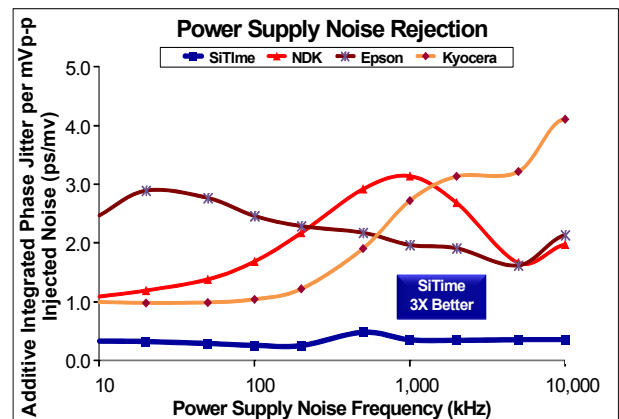


Figure 4. Power Supply Noise Rejection^[4]

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

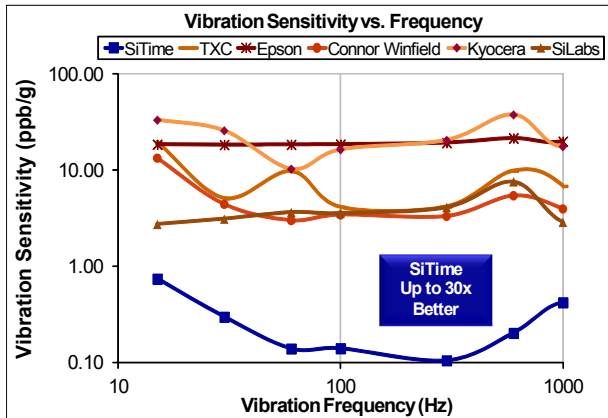


Figure 5. Vibration Robustness^[5]

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

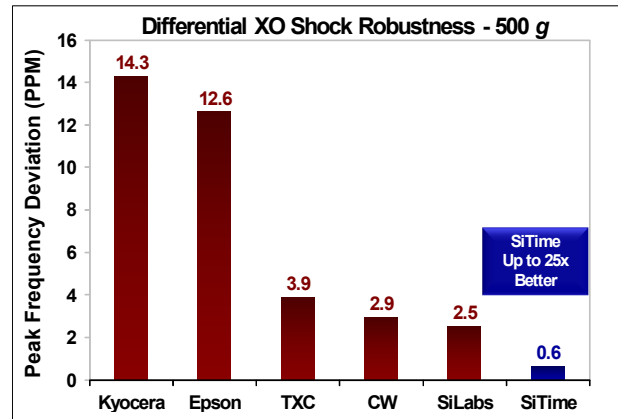


Figure 6. Shock Robustness^[6]

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, KC2016B25MOC1GE00 - 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



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.

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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

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