SiT5022 Preliminary

220-625 MHz High Performance Differential (VC) TCXO

The Smart Timing Choice™

Features

- Any frequency between 220 MHz and 625 MHz accurate to 6 decimal places
- LVPECL and LVDS output signaling types
- 0.6ps RMS phase jitter (random) over 12 kHz to 20 MHz bandwidth
- Frequency stability as low as ±2.5 PPM
- Industrial and extended commercial temperature ranges
- Industry-standard packages: 3.2 x 2.5, 5.0 x 3.2 and 7.0 x 5.0 mm
- For frequencies lower than 220 MHz, refer to SiT5021 datasheet

Applications

- SATA, SAS, 10GB Ethernet, Fibre Channel, PCI-Express
- Networking, broadband, instrumentation

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Electrical Characteristics

Parameter and Conditions	Symbol	Min.	Typ.	Max.	Unit	Condition
LVPECL and LVDS, Common AC Characteristics						
Output Frequency Range	f	220	–	625	MHz	
Initial Tolerance	F_init	-2	–	2	PPM	At 25°C
Stability Over Temperature	F_stab	-2.5	–	+2.5	PPM	Over operating temperature range at rated nominal power supply voltage and load.
		-5	–	+5	PPM	
Supply Voltage	F_vdd	–	50	–	PPB	±10% Vdd (±5% for Vdd = 1.8V)
Output Load	F_load	–	0.1	–	PPM	15 pF ±10% of load
First year Aging	F_aging	-1.5	–	+1.5	PPM	25°C
10-year Aging		-3.5	–	+3.5	PPM	25°C
Operating Temperature Range	T_use	-40	–	+85	°C	Industrial
		-20	–	+70	°C	Extended Commercial
Start-up Time	T_start	–	–	10	ms	Measured from the time Vdd reaches its rated minimum value.
Resume Time	T_resume	–	6	10	ms	In Standby mode, measured from the time $\overline{ST}$ pin crosses 50% threshold.
Duty Cycle	DC	45	–	55	%	Contact SiTime for tighter duty cycle
LVPECL, DC and AC Characteristics						
Supply Voltage	Vdd	2.97	3.3	3.63	V	
		2.25	2.5	2.75	V	
		2.25	–	3.63	V	Operates from 2.25V to 3.63V - XX ordering code
Pull Range	PR	±12.5, ±25, ±50			PPM	
Upper Control Voltage	VC_U	Vdd-0.1	–	–	V	All Vdds. Voltage at which maximum deviation is guaranteed.
Control Voltage Range	VC_L	–	–	0.1	V	
Control Voltage Input Impedance	Z_vc	100	–	–	kΩ	
Frequency Change Polarity	–	Positive slope			–	
Control Voltage -3dB Bandwidth	V_BW	–	–	8	kHz	
Current Consumption	Idd	–	–	69	mA	Excluding Load Termination Current, Vdd = 3.3V or 2.5V
OE Disable Supply Current	I_OE	–	–	35	mA	OE = Low
Standby Current	I_std	–	–	100	µA	For all Vdds, $\overline{ST}$ = GND, output is Weakly Pulled Down
Output Disable Leakage Current	I_leak	–	–	1	µA	OE = Low
Maximum Output Current	I-driver	–	–	30	mA	Maximum average current drawn from OUT+ or OUT-
Output High Voltage	VOH	Vdd-1.1	–	Vdd-0.7	V	See Figure 1
Output Low Voltage	VOL	Vdd-1.9	–	Vdd-1.5	V	See Figure 1
Output Differential Voltage Swing	V_Swing	1.2	1.6	2.0	V	See Figure 1
Rise/Fall Time	Tr, Tf	–	300	500	ps	20% to 80%
OE Enable/Disable Time	T_oe	–	–	115	ns	f = 625 MHz - For other frequencies, T_oe = 100ns + 3 period
RMS Period Jitter	T_jitt	–	1.2	1.7	ps	f = 266 MHz, Vdd = 3.3V, 2.5V or 2.5V to 3.3V
		–	1.2	1.7	ps	f = 312.5 MHz, Vdd = 3.3V, 2.5V or 2.5V to 3.3V
		–	1.2	1.7	ps	f = 622.08 MHz, Vdd =3.3V, 2.5V or 2.5V to 3.3V
RMS Phase Jitter (random)	T_phj	–	0.6	0.85	ps	f = 312.5 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdds

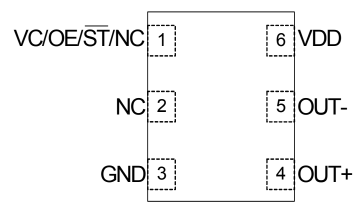
Electrical Characteristics (continued)

Parameter and Conditions	Symbol	Min.	Typ.	Max.	Unit	Condition
LVDS, DC and AC Characteristics						
Supply Voltage	Vdd	2.97	3.3	3.63	V	
		2.25	2.5	2.75	V	
		1.71	1.8	1.89	V	
		2.25	–	3.63	V	Operates from 2.25V to 3.63V - XX ordering code
Current Consumption	Idd	–	47	55	mA	Excluding Load Termination Current, Vdd = 3.3V or 2.5V
OE Disable Supply Current	I_OE	–	–	35	mA	OE = Low
Standby Current	I_std	–	–	100	µA	For all Vdds, $\overline{ST}$ = GND, output is Weakly Pulled Down
Output Disable Leakage Current	I_leak	–	–	1	µA	OE = Low
Differential Output Voltage	VOD	200	350	500	mV	See Figure 4
VOD Magnitude Change	ΔVOD	–	–	50	mV	See Figure 4
Offset Voltage	VOS	1.125	1.2	1.375	V	See Figure 4
VOS Magnitude Change	ΔVOS	–	–	50	mV	See Figure 4
Rise/Fall Time	Tr, Tf	–	495	600	ps	20% to 80%
OE Enable/Disable Time	T_oe	–	–	115	ns	f = 625 MHz - For other frequencies, T_oe = 100ns + 3 period
RMS Period Jitter	T_jitt	–	1.4	1.7	ps	f = 266 MHz, VDD = 3.3V, 2.5V or 2.5V to 3.3V
		–	1.4	1.7	ps	f = 312.5 MHz, VDD = 3.3V, 2.5V or 2.5V to 3.3V
		–	1.2	1.7	ps	f = 622.08 MHz, VDD = 3.3V, 2.5V or 2.5V to 3.3V
RMS Phase Jitter (random)	T_phj	–	0.6	0.85	ps	f = 312.5 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdds

Pin Description

Pin	Map	Functionality	
1	VC/OE/$\overline{ST}$/NC	V control	Voltage control.
		Output Enable	H or Open[1]: specified frequency output. L: output is high impedance. Only output driver is disabled.
		Standby	H or Open[1]: specified frequency output. L: output is low (weak pull down). Device goes to sleep mode. Supply current reduces to I_std.
		NC	No connect (Receiver OFF).
2	NC	NA	Do not connect; Leave it floating.
3	GND	Power	VDD power supply ground.
4	OUT+	Output	Oscillator output.
5	OUT-	Output	Complementary oscillator output.
6	VDD	Power	Power supply voltage.

Top View



Note:
1. A pull-up resistor of <10 kΩ between OE/ $\overline{ST}$ pin and Vdd is recommended in high noise environment when the device operates in OE/$\overline{ST}$ mode.

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

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

Termination Diagrams

LVPECL:

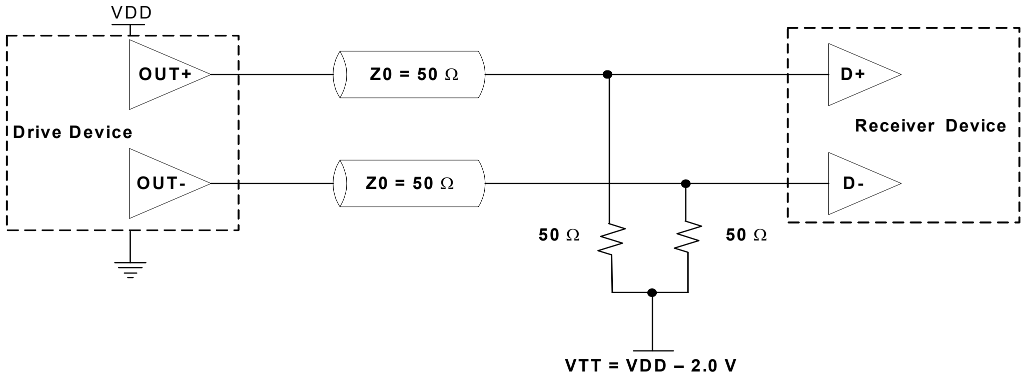


Figure 1. LVPECL Typical Termination

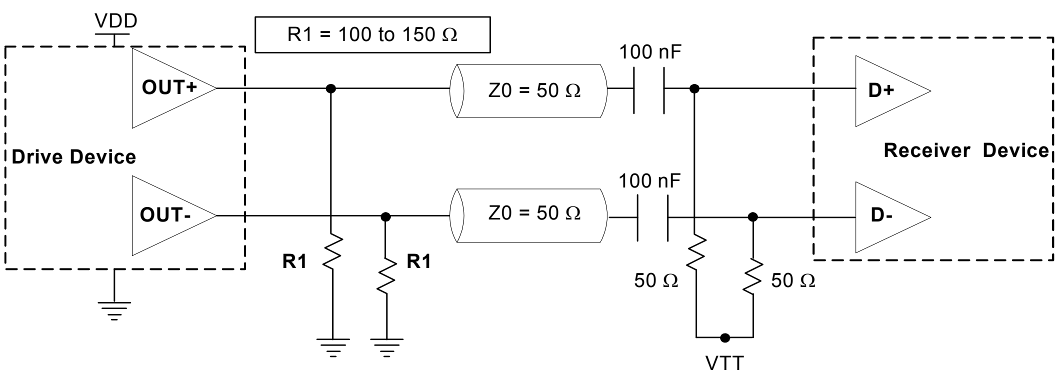


Figure 2. LVPECL AC Coupled Termination

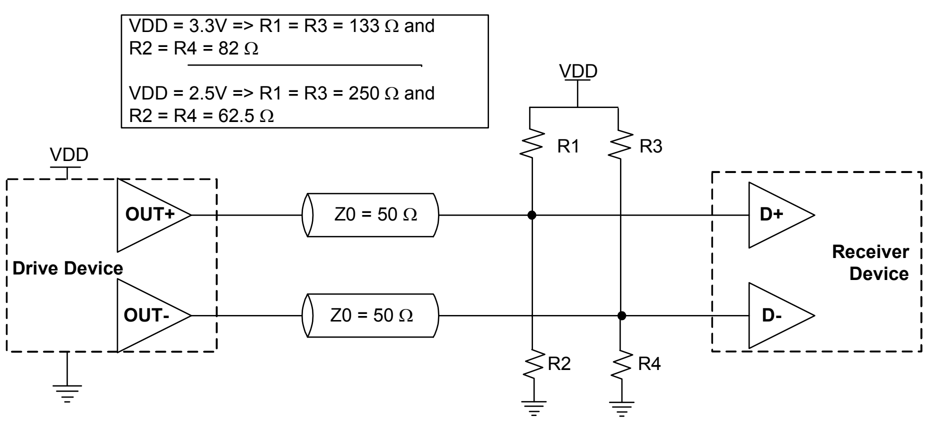


Figure 3. LVPECL with Thevenin Typical Termination

LVDS:

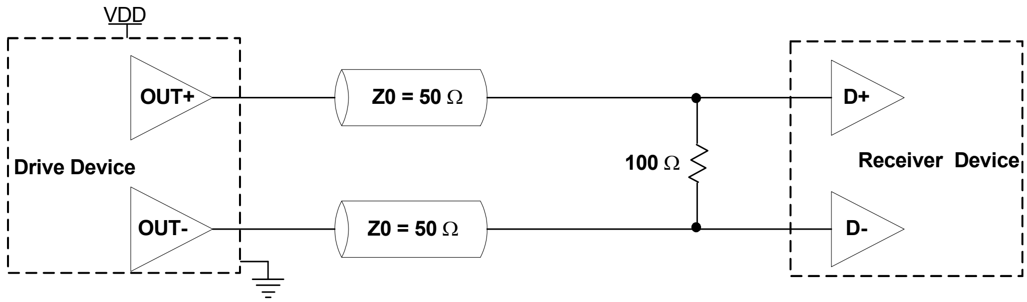


Figure 4. LVDS Single Termination (Load Terminated)

Dimensions and Patterns

<table>
<tr><th>Package Size – Dimensions (Unit: mm) [2]</th><th>Recommended Land Pattern (Unit: mm) [3]</th></tr>
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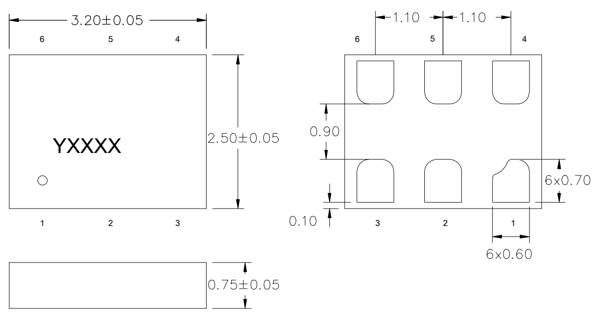
3.2 x 2.5x 0.75 mm



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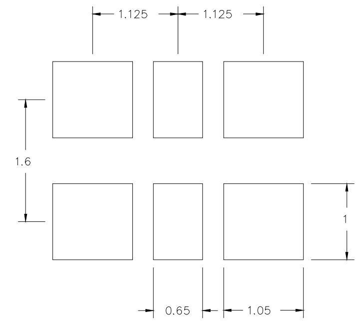

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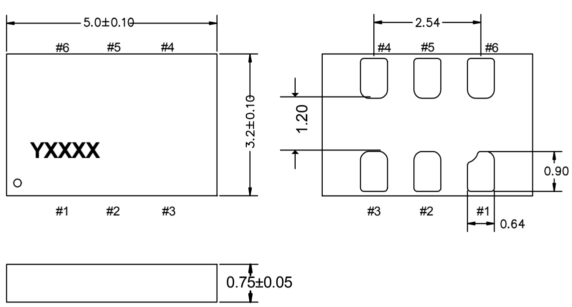
5.0 x 3.2 x 0.75 mm



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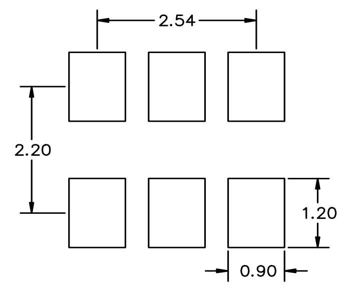

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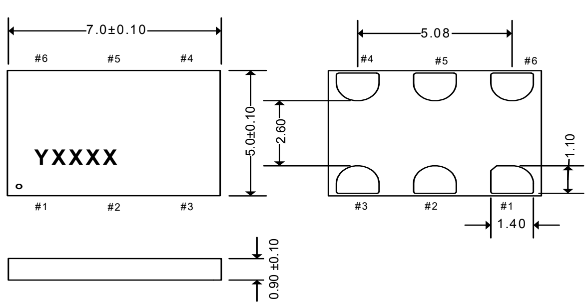
7.0 x 5.0x 0.90 mm



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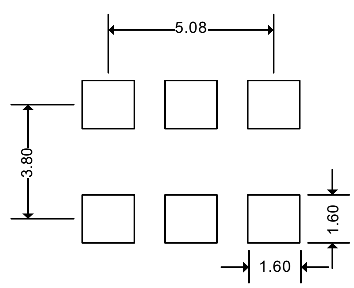
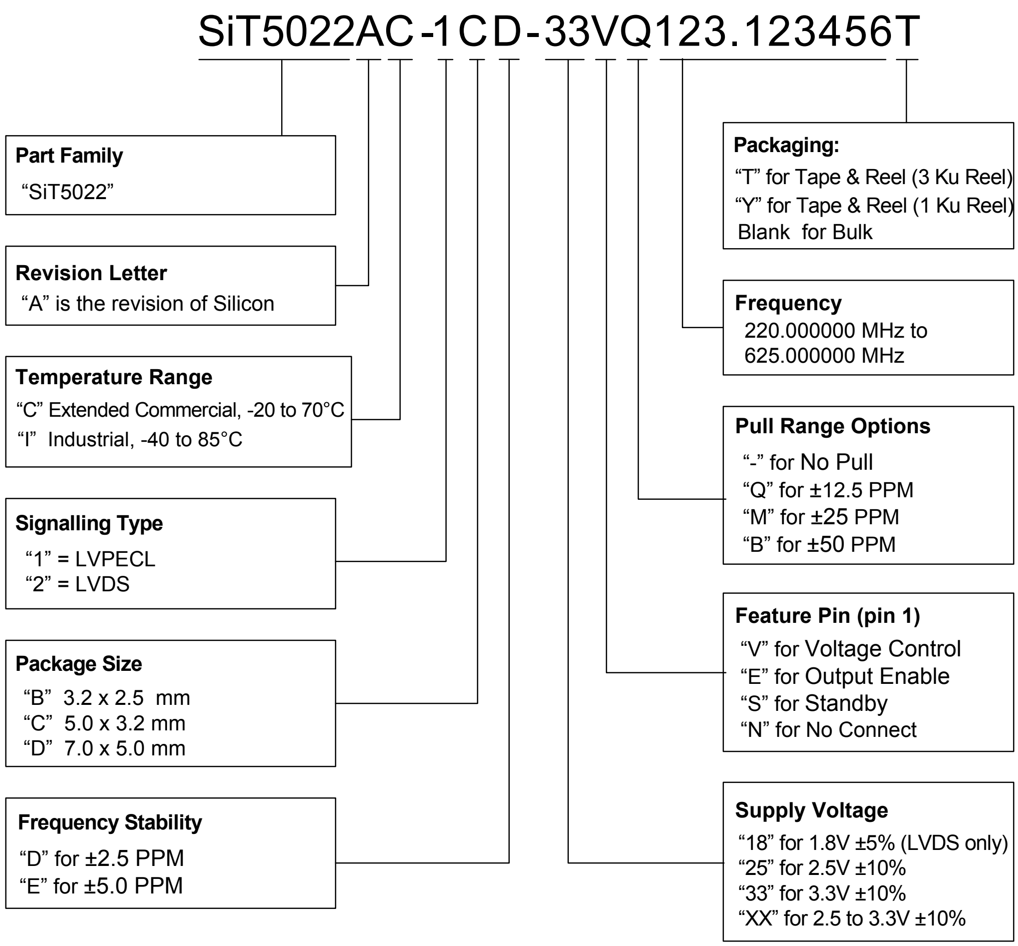


</td></tr>
</table>

Notes:

2. 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.
3. A capacitor of value 0.1 µF between Vdd and GND is recommended.

Ordering Information



Frequencies Not Supported

Range 1: From 251.000001 MHz to 263.999999 MHz
Range 2: From 314.000001 MHz to 422.999999 MHz
Range 3: From 502.000001 MHz to 527.999999 MHz

Supplemental Information

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

Silicon MEMS Outperforms Quartz

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SiTime
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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

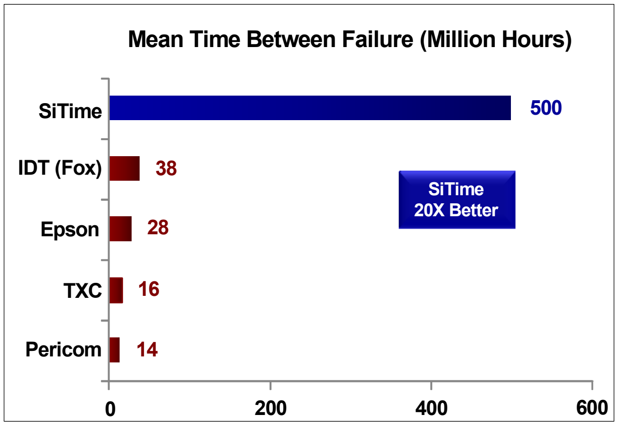

Figure 1. Reliability Comparison[1]

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

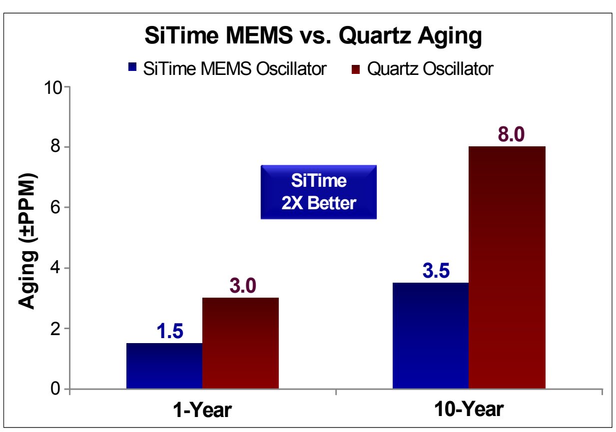

Figure 2. Aging Comparison[2]

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

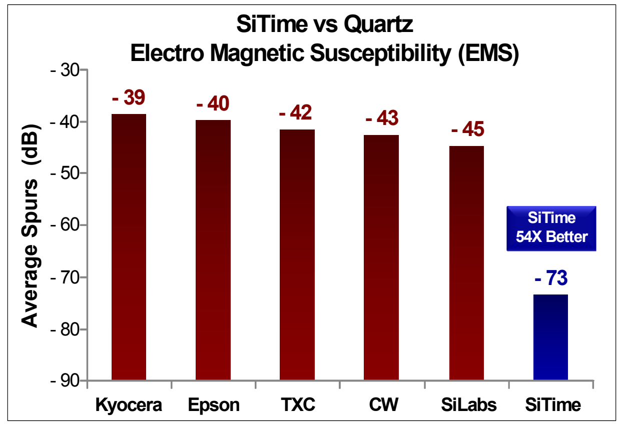

Figure 3. Electro Magnetic Susceptibility (EMS)[3]

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

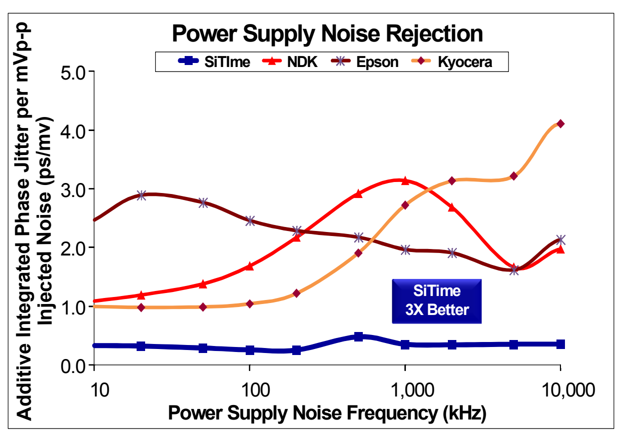

Figure 4. Power Supply Noise Rejection[4]

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

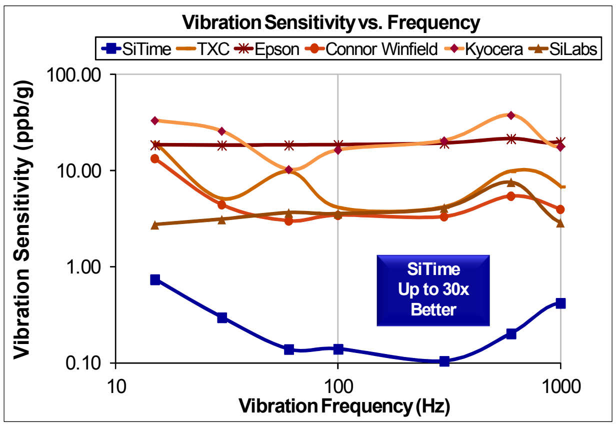

Figure 5. Vibration Robustness[5]

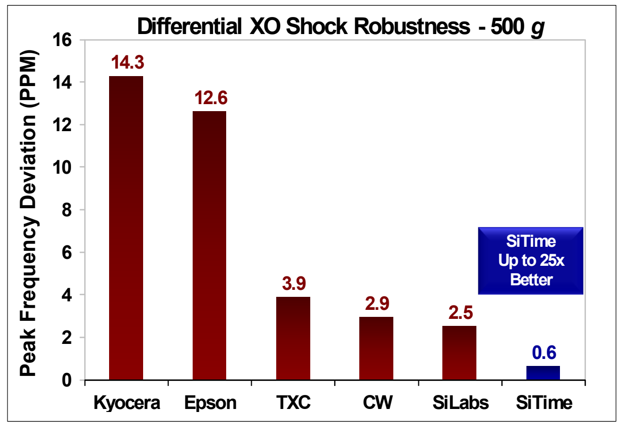

Figure 6. Shock Robustness[6]

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

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