SiT9120

Standard Frequency Differential Oscillator

Features

- 31 standard frequencies from 25 MHz to 212.5 MHz
- LVPECL and LVDS output signaling types
- 0.6 ps RMS phase jitter (random) over 12 kHz to 20 MHz bandwidth
- Frequency stability as low as ±10 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 x mm
- For any other frequencies between 1 to 625 MHz, refer to SiT9121 and SiT9122 datasheet

Applications

- 10GB Ethernet, SONET, SATA, SAS, Fibre Channel, PCI-Express
- Telecom, networking, instrumentation, storage, server

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Electrical Characteristics

Table 1. Electrical Characteristics

Parameters	Symbol	Min.	Typ.	Max.	Unit	Condition
LVPECL and LVDS, Common Electrical Characteristics						
Supply Voltage	Vdd	2.97	3.3	3.63	V	
		2.25	2.5	2.75	V	
		2.25	–	3.63	V	Termination schemes in Figures 1 and 2 - XX ordering code
Output Frequency Range	f	25	–	212.5	MHz	See list of standard frequencies
Frequency Stability	F_stab	-10	–	+10	ppm	Inclusive of initial tolerance, operating temperature, rated power supply voltage, and load variations
		-20	–	+20	ppm	
		-25	–	+25	ppm	
		-50	–	+50	ppm	
First Year Aging	F_aging1	-2	–	+2	ppm	25°C
10-year Aging	F_aging10	-5	–	+5	ppm	25°C
Operating Temperature Range	T_use	-40	–	+85	°C	Industrial
		-20	–	+70	°C	Extended Commercial
Input Voltage High	VIH	70%	–	–	Vdd	Pin 1, OE or $\overline{ST}$
Input Voltage Low	VIL	–	–	30%	Vdd	Pin 1, OE or $\overline{ST}$
Input Pull-up Impedance	Z_in	–	100	250	kΩ	Pin 1, OE logic high or logic low, or $\overline{ST}$ logic high
		2	–	–	MΩ	Pin 1, $\overline{ST}$ logic low
Start-up Time	T_start	–	6	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						
Current Consumption	Idd	–	61	69	mA	Excluding Load Termination Current, Vdd = 3.3V or 2.5V
OE Disable Supply Current	I_OE	–	–	35	mA	OE = Low
Output Disable Leakage Current	I_leak	–	–	1	µA	OE = Low
Standby Current	I_std	–	–	100	µA	$\overline{ST}$ = Low, for all Vdds
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(a)
Output Low Voltage	VOL	Vdd-1.9	–	Vdd-1.5	V	See Figure 1(a)
Output Differential Voltage Swing	V_Swing	1.2	1.6	2.0	V	See Figure 1(b)
Rise/Fall Time	Tr, Tf	–	300	500	ps	20% to 80%, see Figure 1(a)
OE Enable/Disable Time	T_oe	–	–	115	ns	f = 212.5 MHz - For other frequencies, T_oe = 100ns + 3 period
RMS Period Jitter	T_jitt	–	1.2	1.7	ps	f = 100 MHz, VDD = 3.3V or 2.5V
		–	1.2	1.7	ps	f = 156.25 MHz, VDD = 3.3V or 2.5V
		–	1.2	1.7	ps	f = 212.5 MHz, VDD = 3.3V or 2.5V
RMS Phase Jitter (random)	T_phj	–	0.6	0.85	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdds

Table 1. Electrical Characteristics (continued)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
LVDS, DC and AC Characteristics						
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
Differential Output Voltage	VOD	250	350	450	mV	See Figure 2
Output Disable Leakage Current	I_leak	–	–	1	µA	OE = Low
Standby Current	I_std	–	–	100	µA	$\overline{\text{ST}}$ = Low, for all Vdds
VOD Magnitude Change	ΔVOD	–	–	50	mV	See Figure 2
Offset Voltage	VOS	1.125	1.2	1.375	V	See Figure 2
VOS Magnitude Change	ΔVOS	–	–	50	mV	See Figure 2
Rise/Fall Time	Tr, Tf	–	495	600	ps	20% to 80%, see Figure 2
OE Enable/Disable Time	T_oe	–	–	115	ns	f = 212.5 MHz - For other frequencies, T_oe = 100ns + 3 period
RMS Period Jitter	T_jitt	–	1.2	1.7	ps	f = 100 MHz, VDD = 3.3V or 2.5V
		–	1.2	1.7	ps	f = 156.25 MHz, VDD = 3.3V or 2.5V
		–	1.2	1.7	ps	f = 212.5 MHz, VDD = 3.3V or 2.5V
RMS Phase Jitter (random)	T_phj	–	0.6	0.85	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdds

Table 2. Pin Description

Pin	Map	Functionality	
1	NC	NA	No Connect; Leave it floating or connect to GND for better heat dissipation
	OE	Input	H or Open: specified frequency output L: output is high impedance
	$\overline{\text{ST}}$	Input	H or Open: specified frequency output L: Device goes to sleep mode. Supply current reduces to I_std.
2	NC	NA	No Connect; Leave it floating or connect to GND for better heat dissipation
3	GND	Power	VDD Power Supply Ground
4	OUT+	Output	Oscillator output
5	OUT-	Output	Complementary oscillator output
6	VDD	Power	Power supply voltage

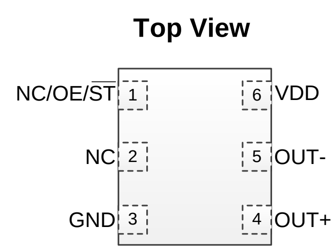


Figure 1. Pin Assignments

Table 3. Absolute Maximum Limits

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 (HBM)	–	2000	V
Soldering Temperature (follow standard Pb free soldering guidelines)	–	260	°C

Table 4. Thermal Consideration[1]

Package	θJA, 4 Layer Board (°C/W)	θJC, Bottom (°C/W)
7050, 6-pin	142	27
5032, 6-pin	97	20
3225, 6-pin	109	20

Note:

1. Refer to JESD51-7 for θJA and θJC definitions, and reference layout used to determine the θJA and θJC values in the above table.

Table 5. Maximum Operating Junction Temperature[2]

Max Operating Temperature (ambient)	Maximum Operating Junction Temperature
70°C	90°C
85°C	105°C

Note:

2. Datasheet specifications are not guaranteed if junction temperature exceeds the maximum operating junction temperature.

Table 6. 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**

Waveform Diagrams

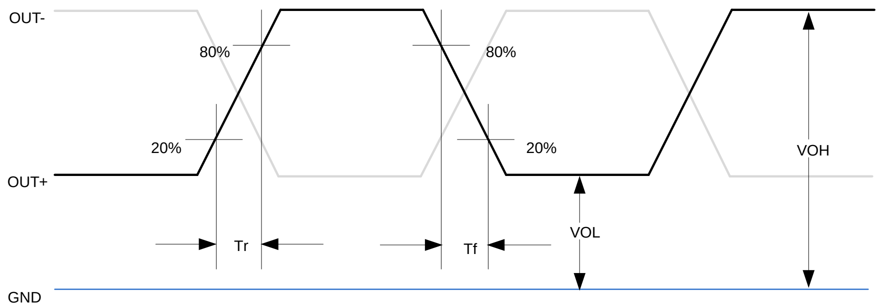


Figure 1(a). LVPECL Voltage Levels per Differential Pin (OUT+/OUT-)

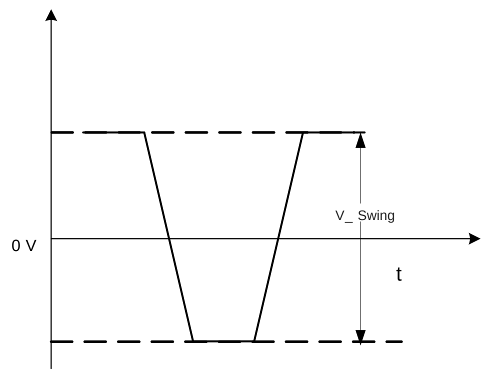


Figure 1(b). LVPECL Voltage Levels Across Differential Pair

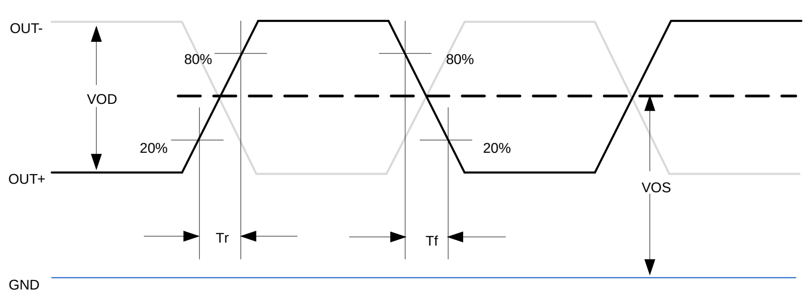


Figure 2. LVDS Voltage Levels per Differential Pin (OUT+/OUT-)

Termination Diagrams

LVPECL

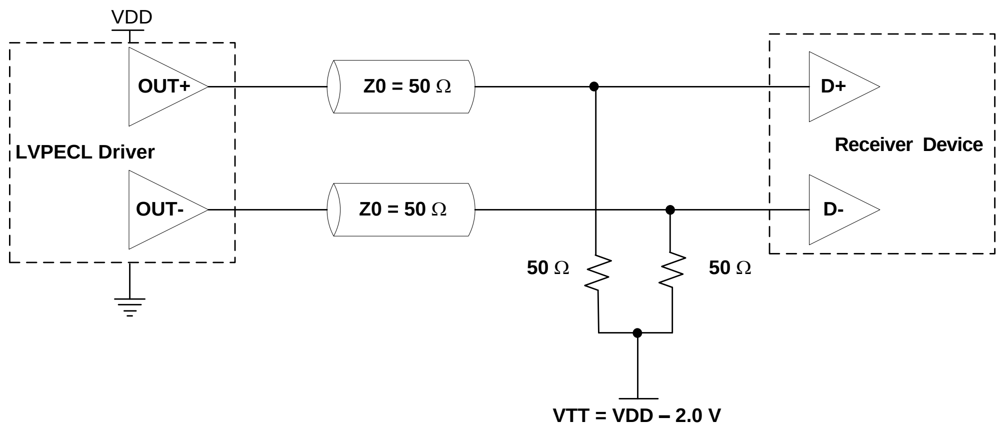


Figure 3. LVPECL Typical Termination

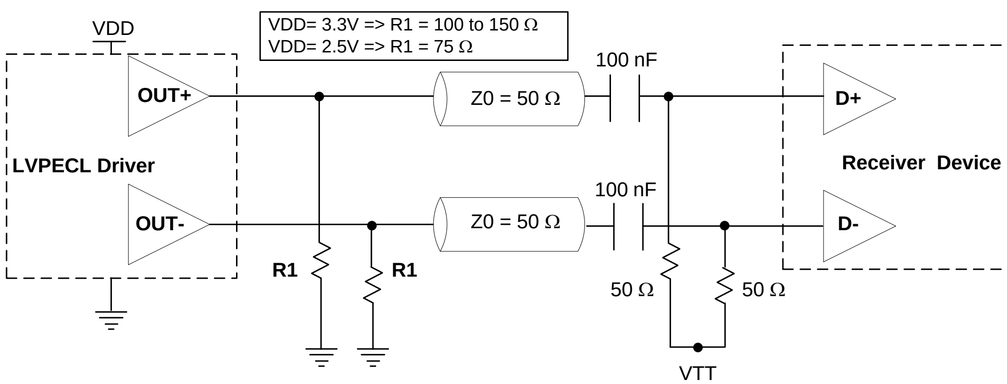


Figure 4. LVPECL AC Coupled Termination

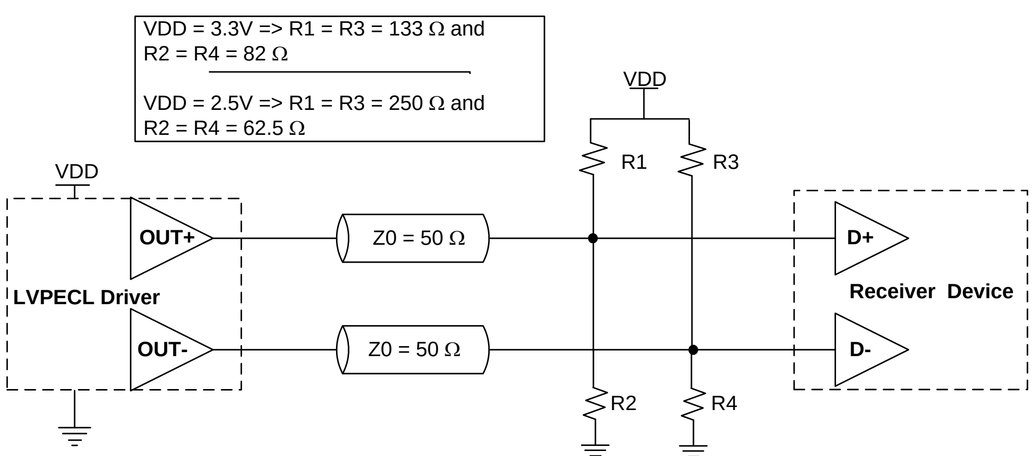


Figure 5. LVPECL with Thevenin Typical Termination

Termination Diagrams (continued)

LVDS

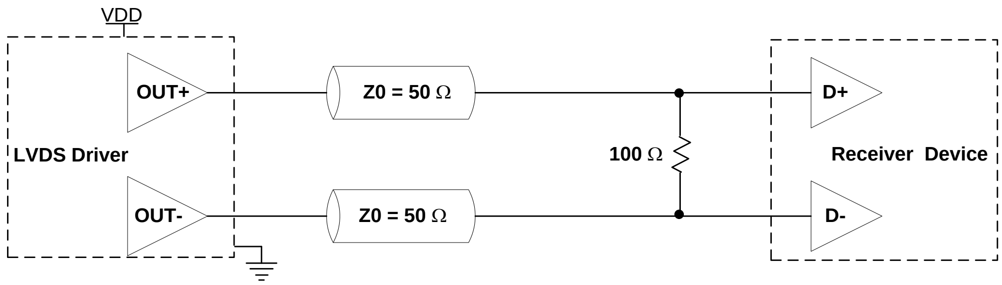
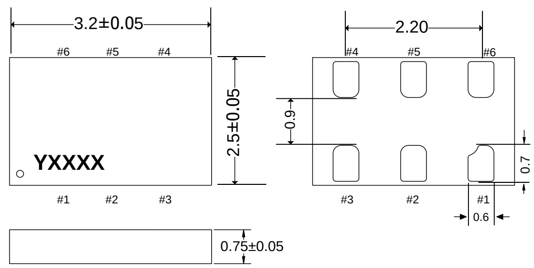
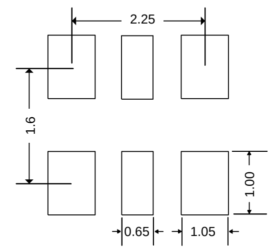
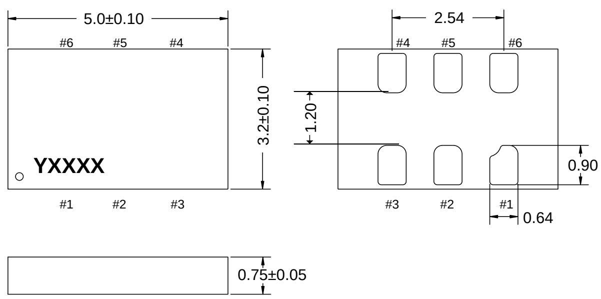
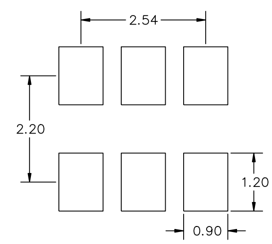
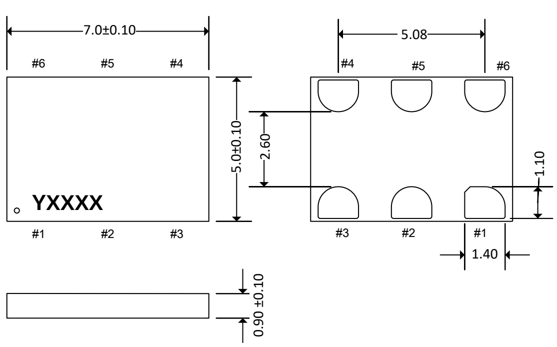
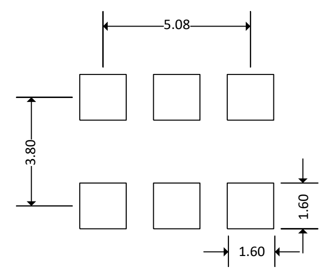


Figure 6. LVDS Single Termination (Load Terminated)

Dimensions and Patterns

Package Size – Dimensions (Unit: mm)[3]	Recommended Land Pattern (Unit: mm)[4]
3.2 x 2.5 x 0.75 mm 	
5.0 x 3.2 x 0.75 mm 	
7.0 x 5.0x 0.90 mm 	

Notes:

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

Ordering Information

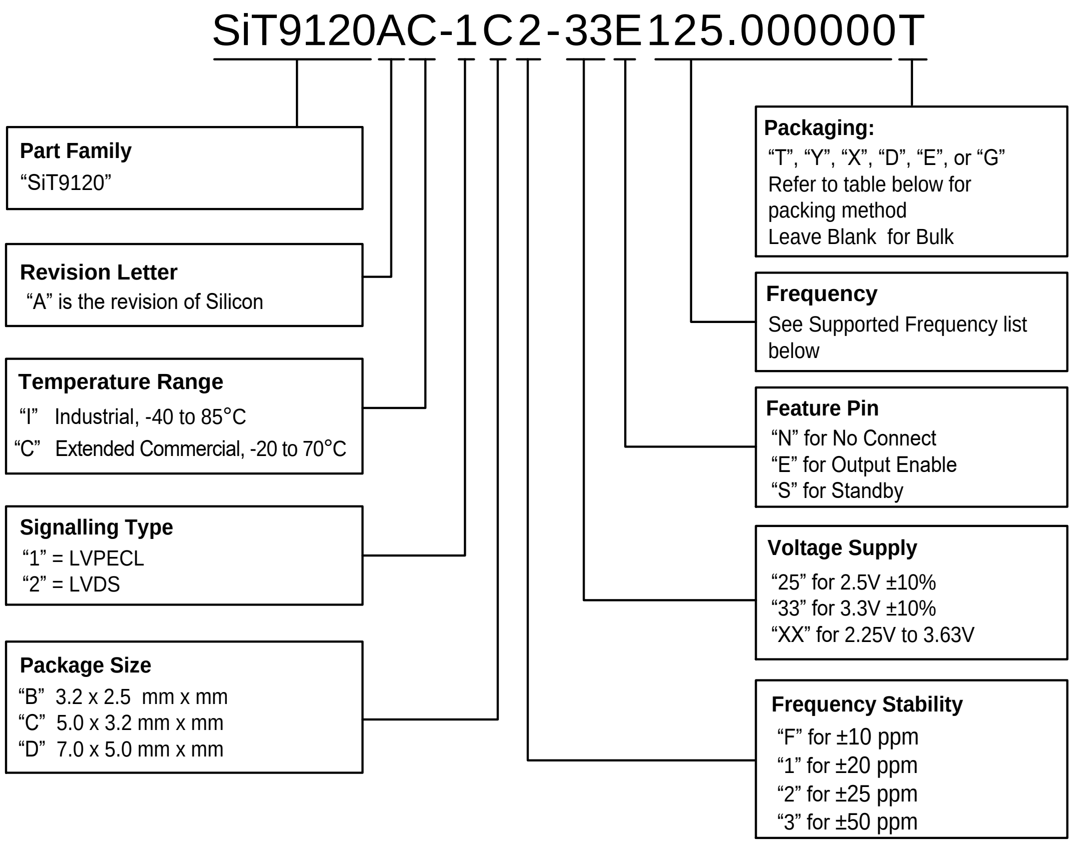


Table 7. List of Supported Frequencies

25.000000 MHz	50.000000 MHz	74.175824 MHz	74.250000 MHz	75.000000 MHz	98.304000 MHz	100.000000 MHz	106.250000 MHz
125.000000 MHz	133.000000 MHz	133.300000 MHz	133.330000 MHz	133.333000 MHz	133.333300 MHz	133.333330 MHz	133.333333 MHz
148.351648 MHz	148.500000 MHz	150.000000 MHz	155.520000 MHz	156.250000 MHz	161.132800 MHz	166.000000 MHz	166.600000 MHz
166.660000 MHz	166.666000 MHz	166.666600 MHz	166.666660 MHz	166.666666 MHz	200.000000 MHz	212.500000 MHz	

Table 8. Ordering Codes for Supported Tape & Reel Packing Method

Device Size	8 mm T&R (3ku)	8 mm T&R (1ku)	8 mm T&R (250u)	12 mm T&R (3ku)	12 mm T&R (1ku)	12 mm T&R (250u)	16 mm T&R (3ku)	16 mm T&R (1ku)	16 mm T&R (250u)
7.0 x 5.0 mm	–	–	–	–	–	–	T	Y	X
5.0 x 3.2 mm	–	–	–	T	Y	X	–	–	–
3.2 x 2.5 mm	D	E	G	T	Y	X	–	–	–

Table 9. Revision History

Revisions	Release Date	Change Summary
1.01	02/20/2013	Original
1.02	11/23/2013	Added input specifications, LVPECL/LVDS waveforms, packaging T&R options
1.03	02/06/2014	Added 8mm T&R option
1.04	03/03/2014	Added ±10 ppm
1.05	07/23/2014	Include Thermal Consideration Table
1.06	10/03/2014	Modified Thermal Consideration values
1.07	01/09/2017	Included Maximum Operating Junction Temperature Table Added Thermal Consideration Notes to Table Updated logo and company address, other page layout changes
1.08	06/25/2019	Added No Connect feature to Pin 1

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Supplemental Information

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

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 EpiSeal™ process, which eliminates foreign particles and improves long term aging and reliability
- World-class MEMS and CMOS design expertise

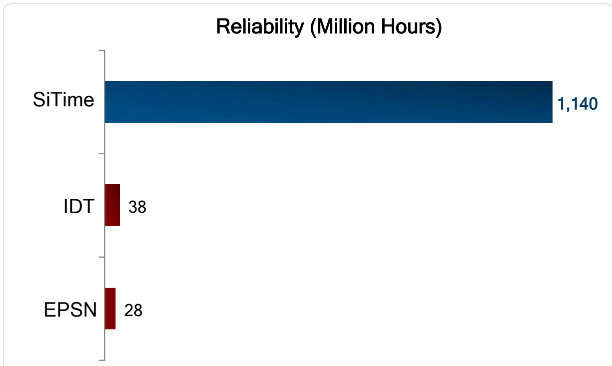

Figure 1. Reliability Comparison[1]

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 EpiSeal™ process, which eliminates foreign particles and improves long term aging and reliability
- Inherently better immunity of electrostatically driven MEMS resonator

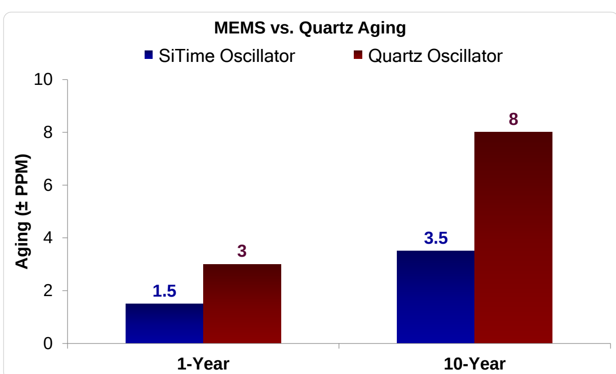

Figure 2. Aging Comparison[2]

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

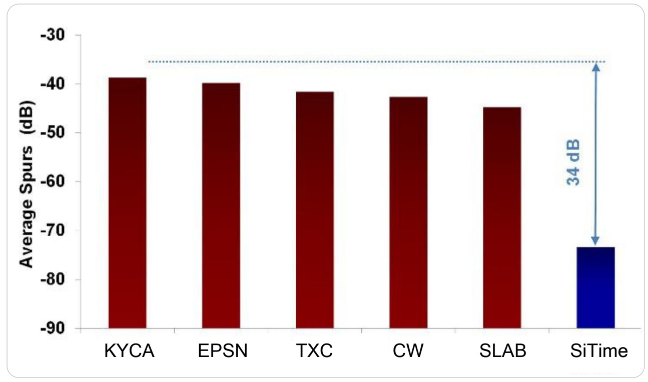

Figure 3. Electro Magnetic Susceptibility (EMS)[3]

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
- MEMS resonator is paired with advanced analog CMOS IC

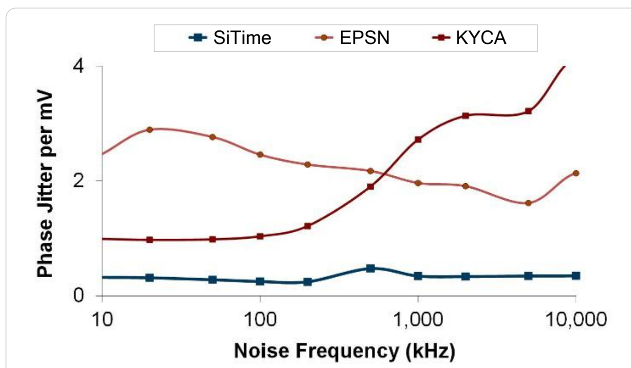

Figure 4. Power Supply Noise Rejection[4]

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

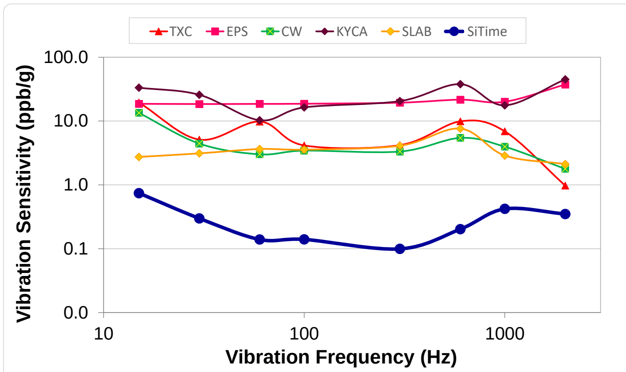

Figure 5. Vibration Robustness[5]

Figure labels:

- TXC = TXC
- Epson = EPSN
- Connor Winfield = CW
- Kyocera = KYCA
- SiLabs = SLAB
- SiTime = EpiSeal MEMS

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

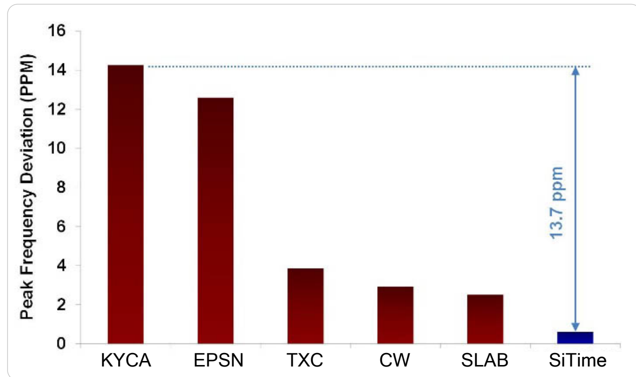

Figure 6. Shock Robustness[6]

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:

Label	Manufacturer	Part Number	Technology
EpiSeal MEMS	SiTime	SiT9120AC-1D2-33E156.250000	MEMS + PLL
EPSN	Epson	EG-2102CA156.2500M-PHPAL3	Quartz, SAW
TXC	TXC	BB-156.250MBE-T	Quartz, 3rd Overtone
CW	Conner Winfield	P123-156.25M	Quartz, 3rd Overtone
KYCA	AVX Kyocera	KC7050T156.250P30E00	Quartz, SAW
SLAB	SiLab	590AB-BDG	Quartz, 3rd Overtone + PLL

4. 50 mV pk-pk Sinusoidal voltage.

   Devices used in this test:

Label	Manufacturer	Part Number	Technology
EpiSeal MEMS	SiTime	SiT8208AI-33-33E-25.000000	MEMS + PLL
NDK	NDK	NZ2523SB-25.6M	Quartz
KYCA	AVX Kyocera	KC2016B25M0C1GE00	Quartz
EPSN	Epson	SG-310SCF-25M0-MB3	Quartz

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 customer. Please contact productsupport@sitime.com.

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SiTime:

SIT9120AI-2C1-25E156.250000X SIT9120AI-2C2-25E200.000000X SiT9120AI-2D3-33E156.250000X SiT9120AI-2C3-25E100.000000X SIT9120AI-2CF-25E200.000000X SIT9120AI-2D3-33E200.000000X SIT9120AI-2C2-33E100.0000X SIT9120AI-2C3-33E100.000000X SIT9120AI-2C3-33E125.000000X SIT9120AI-2C2-25E125.000000X SiT9120AI-2C3-33E200.000000X SIT9120AI-2CF-25E100.000000X SiT9120AI-2B3-XXE100.000000G SIT9120AI-2C1-25E200.000000X SIT9120AI-2D3-25E200.000000X SiT9120AI-2C2-33E100.000000X SiT9120AC-1D3-33E25.000000X SiT9120AI-2BF-25E25.000000G SIT9120AI-2BF-33E125.000000G SiT9120AI-2B1-33E100.000000E SiT9120AI-2B1-33E50.000000E SiT9120AI-2DF-25E125.000000X SiT9120AC-2C3-33E25.000000X SIT9120AI-2D3-33E100.000000X SiT9120AI-2C2-25S125.000000X SIT9120AI-2C2-33E200.000000X SiT9120AC-1D2-33E50.000000X SiT9120AC-2D3-25E156.250000X SiT9120AC-2D3-33E106.250000X SiT9120AC-1D3-33E200.000000X SiT9120AI-1D2-33E125.000000X SiT9120AI-1D2-33E150.000000X SiT9120AC-2C2-25E100.000000X SiT9120AC-1C3-25E156.250000X SiT9120AI-2C2-33E125.000000X SiT9120AI-2C2-33E148.500000X SiT9120AI-1C2-33E150.000000X SIT9120AC-1B2-25E100.000000x SIT9120AC-1B2-25E125.000000x SIT9120AC-1B2-33E100.000000x SIT9120AC-1B2-33E125.000000x SIT9120AC-1B2-33E133.333000x SIT9120AC-1B2-33E156.250000x SIT9120AC-2B1-XXE50.000000x SIT9120AC-2B3-25E150.000000x SIT9120AC-2C2-25E150.000000x SIT9120AC-2C2-33E125.000000x SIT9120AC-2D2-33E100.000000x SIT9120AC-2D3-33E166.666666x SIT9120AI-1B2-33E155.520000x SIT9120AI-1C3-33E133.333000x SIT9120AI-1C3-33E150.000000x SIT9120AI-1D3-33E156.250000x SIT9120AI-2B2-25E50.000000x SIT9120AI-2B2-33E156.250000x SIT9120AI-2B2-XXE100.000000x SIT9120AI-2B3-25E125.000000x SIT9120AI-2B3-XXE100.000000x SIT9120AI-2C2-33E156.250000x SIT9120AI-2C3-25E212.500000x SIT9120AC-1B3-25E100.000000x SiT9120AI-2BF-33E100.000000G SiT9120AI-2BF-33E100.000000Y SiT9120AI-2DF-33E125.000000Y SiT9120AI-2BF-25E156.250000G SiT9120AI-2BF-33E100.000000E SiT9120AI-2BF-33E106.250000G SiT9120AI-2BF-33E25.000000G SiT9120AI-2DF-33E125.000000X SiT9120AI-2DF-33E200.000000X SiT9120AC-2BF-33E100.000000Y SiT9120AI-2BF-33E100.000000T SiT9120AC-2BF-25E200.000000E SiT9120AC-2BF-33E100.000000D SiT9120AI-2BF-25E25.000000D SiT9120AI-2BF-XXE200.000000G SiT9120AI-2B1-33E50.000000G SiT9120AI-2B2-25E148.500000Y SiT9120AI-2B3-25E125.000000Y SiT9120AI-2C1-33E125.000000T SiT9120AI-2C2-25E125.000000Y SiT9120AI-1C2-25E125.000000Y SiT9120AI-2C2-33E100.000000Y SiT9120AI-2C2-33E100.000000T SiT9120AI-2C2-33E125.000000Y SiT9120AI-2C2-33E156.250000Y SiT9120AI-2C2-33E200.000000Y SiT9120AI-2C2-33E200.000000T SiT9120AI-1C2-33S50.000000Y SiT9120AI-2C3-25E100.000000Y SiT9120AI-2C3-33E100.000000Y

SiT9120AI-2C3-33E125.000000Y SiT9120AI-2C3-33E212.500000Y SiT9120AI-2C3-33E212.500000T SiT9120AI-2D1-33E106.250000X SiT9120AI-2D2-XXE100.000000Y SiT9120AI-2D2-XXE156.250000Y SiT9120AI-2D2-25E125.000000Y SiT9120AI-2D2-25E156.250000Y SiT9120AI-2D2-25E156.250000X