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









Electrical Characteristics

Table 1. Electrical Characteristics

Parameters	Symbol	Min.	Тур.	Max.	Unit	Condition	
		LVPECL	and LVDS	S, Commo	n Electrica	al 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,	
		-20	-	+20	ppm	rated power supply voltage, and load variations	
		-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	ī	+70	°C	Extended Commercial	
Input Voltage High	VIH	70%	-	-	Vdd	Pin 1, OE or ST	
Input Voltage Low	VIL	-	ı	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 \$\overline{ST}\$ logic high	
		2	ı	_	МΩ	Pin 1, ST logic low	
Start-up Time	T_start	1	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 A	C Charac	teristics	
Current Consumption	ldd	-	61	69	mA	Excluding Load Termination Current, Vdd = 3.3V or 2.5V	
OE Disable Supply Current	I_OE	-	ı	35	mA	OE = Low	
Output Disable Leakage Current	l_leak	-	-	1	μΑ	OE = Low	
Standby Current	I_std	-	Ī	100	μΑ	ST = Low, for all Vdds	
Maximum Output Current	I_driver	-	ı	30	mA	Maximum average current drawn from OUT+ or OUT-	
Output High Voltage	VOH	Vdd-1.1	I	Vdd-0.7	٧	See Figure 1(a)	
Output Low Voltage	VOL	Vdd-1.9	1	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.	Тур.	Max.	Unit	Condition
			LVDS, [OC and AC	Characte	eristics
Current Consumption	Idd	_	47	55	mA	Excluding Load Termination Current, Vdd = 3.3V or 2.5V
OE Disable Supply Current	I_OE	-	ı	35	mA	OE = Low
Differential Output Voltage	VOD	250	350	450	mV	See Figure 2
Output Disable Leakage Current	I_leak	-	-	1	μΑ	OE = Low
Standby Current	I_std	-	-	100	μΑ	\overline{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	ı	0.6	0.85	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdds

Table 2. Pin Description

Pin	Мар	Functionality					
	NC	NA	No Connect; Leave it floating or connect to GND for better heat dissipation				
1	OE	Input	H or Open: specified frequency output L: output is high impedance				
	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				

Top View

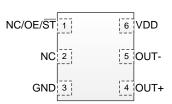


Figure 1. Pin Assignments



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:

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

<u> </u>					
Parameter	Condition/Test Method				
Mechanical Shock	MIL-STD-883F, Method2002				
Mechanical Vibration	MIL-STD-883F, Method2007				
Temperature Cycle	JESD22, Method A104				
Solderability	MIL-STD-883F, Method2003				
Moisture Sensitivity Level	MSL1 @ 260°C				

^{1.} Refer to JESD51-7 for θ JA and θ JC definitions, and reference layout used to determine the θ JA and θ JC values in the above table.



Waveform Diagrams

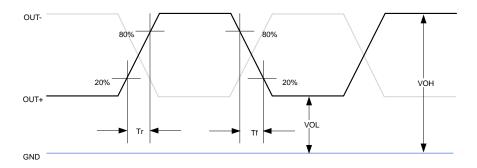


Figure 1(a). LVPECL Voltage Levels per Differential Pin (OUT+/OUT-)

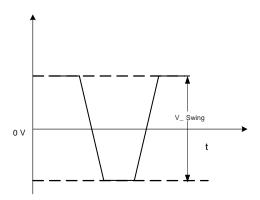


Figure 1(b). LVPECL Voltage Levels Across Differential Pair

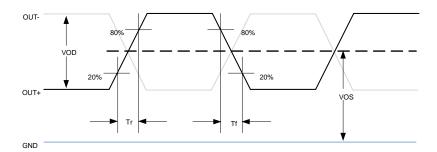


Figure 2. LVDS Voltage Levels per Differential Pin (OUT+/OUT-)



Termination Diagrams

LVPECL

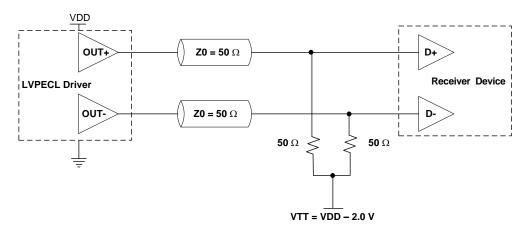


Figure 3. LVPECL Typical Termination

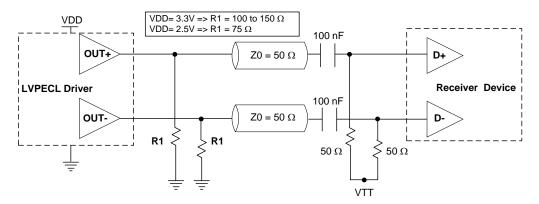


Figure 4. LVPECL AC Coupled Termination

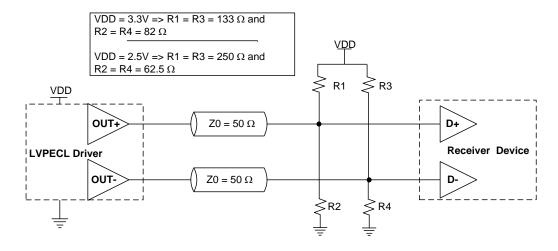


Figure 5. LVPECL with Thevenin Typical Termination



Termination Diagrams (continued)

LVDS

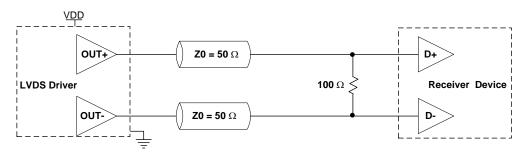
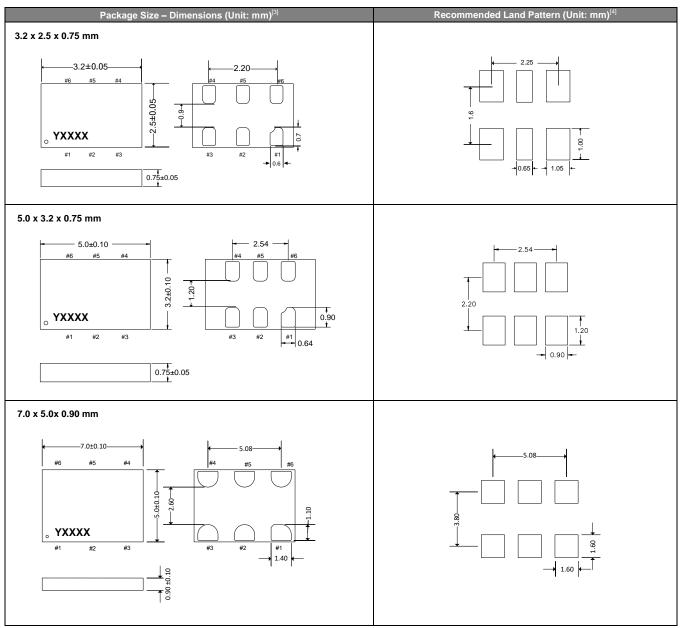


Figure 6. LVDS Single Termination (Load Terminated)



Dimensions and Patterns



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

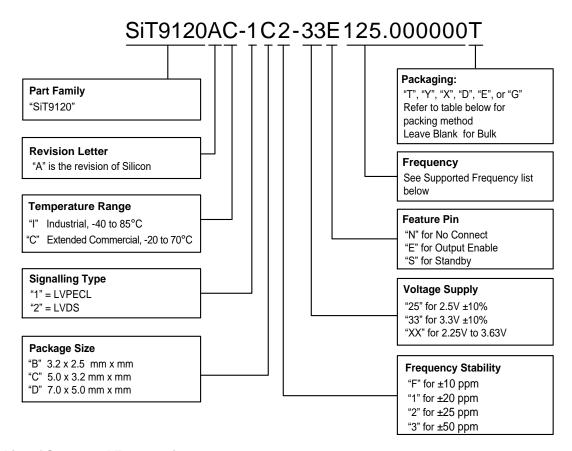


Table 7. List of Supported Frequencies

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	-	-	-	-	-	-	Т	Υ	Х
5.0 x 3.2 mm	_	-	-	Т	Y	Х	-	_	_
3.2 x 2.5 mm	D	Е	G	Т	Y	Х	_	_	_



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

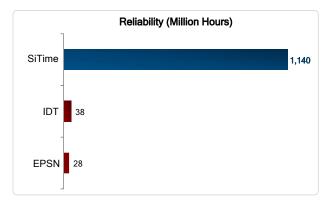


Figure 1. Reliability Comparison[1]

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

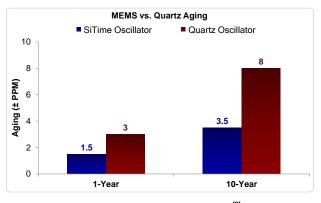


Figure 2. Aging Comparison[2]

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

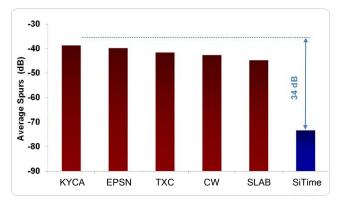


Figure 3. Electro Magnetic Susceptibility (EMS)[3]

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

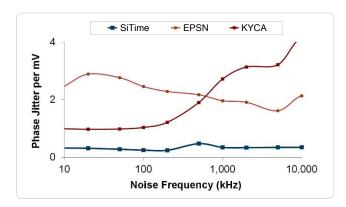


Figure 4. Power Supply Noise Rejection[4]



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

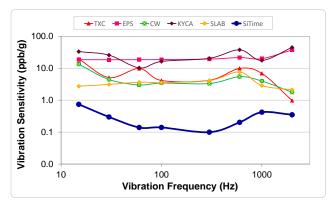


Figure 5. Vibration Robustness^[5]

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

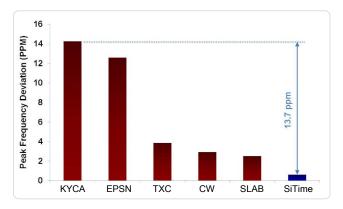


Figure 6. Shock Robustness^[6]

Silicon MEMS Outperforms Quartz



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, 3 rd Overtone
CW	Conner Winfield	P123-156.25M	Quartz, 3 rd Overtone
KYCA	AVX Kyocera	KC7050T156.250P30E00	Quartz, SAW
SLAB	SiLab	590AB-BDG	Quartz, 3 rd 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:

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SiT9120Al-2C3-25E100.000000 SIT9120Al-2C2-25E200.000000 SIT9120Al-2C2-25E125 SIT9120Al-2C2-
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