Preliminary

220-625 MHz High Performance Differential (VC) TCXO



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







Electrical Characteristics

Parameter and Conditions	ditions 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	
Stability Over Temperature		-5	ı	+5	PPM	supply voltage and load.	
Supply Voltage	F_vdd	ï	50	-	PPB	±10% Vdd (±5% for Vdd = 1.8V)	
Output Load	F_load	Í	0.1	-	PPM	15 pF ±10% of load	
First year Aging	F_aging	-1.5	_	+1.5	PPM	25°C	
10-year Aging	i _ugiiig	-3.5	-	+3.5	PPM	25°C	
Operating Temperature Range	T_use	-40	_	+85	°C	Industrial	
- Portaining reimperature realinge		-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 $\overline{\text{ST}}$ pin crosses 50% threshold.	
Duty Cycle	DC	45	-	55	%	Contact SiTime for tighter duty cycle	
		LVP	ECL, DC	and AC	Characte	ristics	
		2.97	3.3	3.63	V		
Supply Voltage	Vdd	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	Í	ı	0.1	V		
Control Voltage Input Impedance	Z_vc	100	-	-	kΩ		
Frequency Change Polarity	-	F	Positive slop	e	-		
Control Voltage -3dB Bandwidth	V_BW	_	_	8	kHz		
Current Consumption	ldd	_	_	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	μΑ	For all Vdds, ST = GND, output is Weakly Pulled Down	
Output Disable Leakage Current	l_leak	_	_	1	μА	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	
	T_jitt	-	1.2	1.7	ps	f = 266 MHz, Vdd = 3.3V, 2.5V or 2.5V to 3.3V	
RMS Period Jitter		_	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	

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220-625 MHz High Performance Differential (VC) TCXO



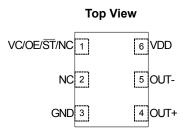
The Smart Timing Choice™

Electrical Characteristics (continued)

Parameter and Conditions	Symbol	Min.	Тур.	Max.	Unit	Condition	
LVDS, DC and AC Characteristics							
	Vdd	2.97	3.3	3.63	V		
Supply Voltage		2.25	2.5	2.75	V		
Supply Voltage		1.71	1.8	1.89	V		
		2.25	_	3.63	V	Operates from 2.25V to 3.63V - XX ordering code	
Current Consumption	ldd	1	47	55	mA	Excluding Load Termination Current, Vdd = 3.3V or 2.5V	
OE Disable Supply Current	I_OE	1	-	35	mA	OE = Low	
Standby Current	I_std	1	-	100	μΑ	For all Vdds, ST = GND, output is Weakly Pulled Down	
Output Disable Leakage Current	l_leak	_	_	1	μА	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	
	T_jitt	-	1.4	1.7	ps	f = 266 MHz, VDD = 3.3V, 2.5V or 2.5V to 3.3V	
RMS Period Jitter		-	1.4	1.7	ps	f = 312.5 MHz, VDD = 3.3V, 2.5V or 2.5V to 3.3V	
		ı	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	Мар		Functionality
	VC/OE/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.
1		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	5 OUT- Outp		Complementary oscillator output.
6	VDD	Power	Power supply voltage.



Note:

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

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



Termination Diagrams

LVPECL:

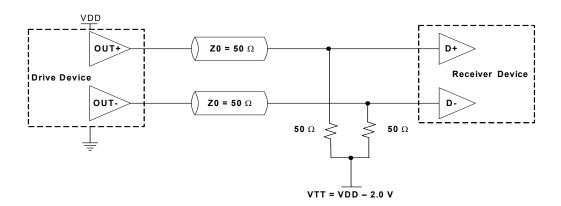


Figure 1. LVPECL Typical Termination

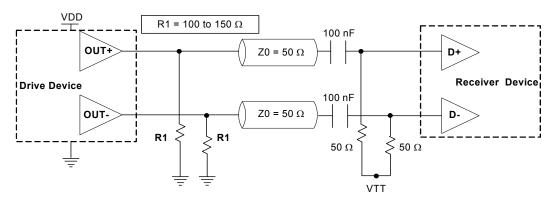


Figure 2. LVPECL AC Coupled Termination

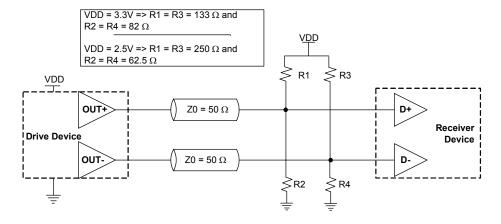


Figure 3. LVPECL with Thevenin Typical Termination

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LVDS:

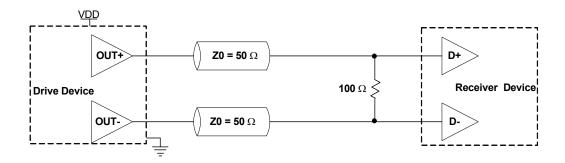
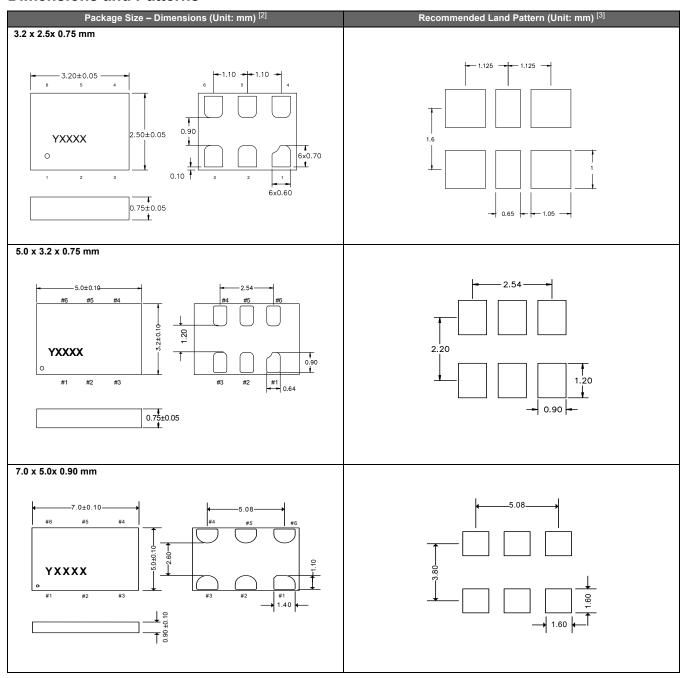


Figure 4. LVDS Single Termination (Load Terminated)

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Dimensions and Patterns



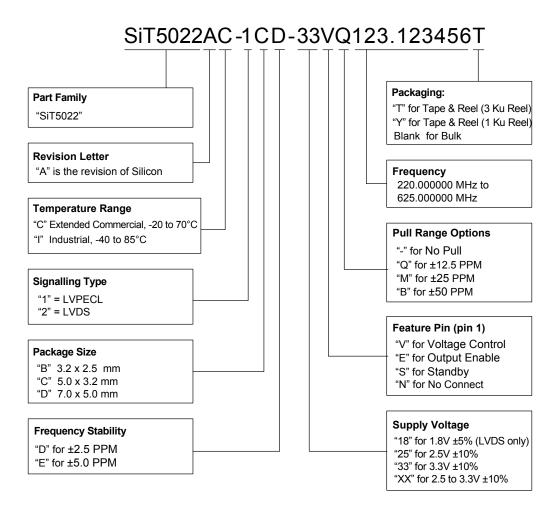
- 2. Top Marking: Y denotes manufacturing origin and XXXX denotes manufacturing lot number. The value of "Y" will depend on the assembly location of the device.

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

220-625 MHz High Performance Differential (VC) TCXO



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

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Supplemental Information

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Silicon MEMS Outperforms Quartz

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

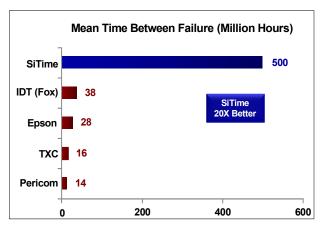


Figure 1. Reliability Comparison^[1]

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

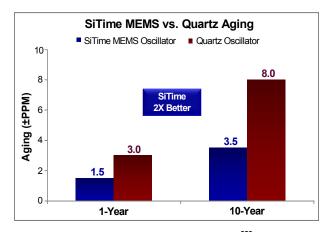


Figure 2. Aging Comparison^[2]

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

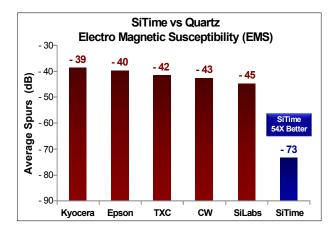


Figure 3. Electro Magnetic Susceptibility (EMS)[3]

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

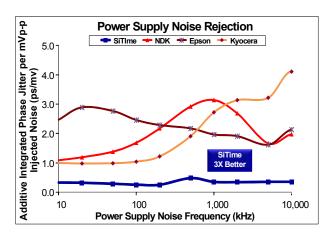


Figure 4. Power Supply Noise Rejection^[4]

Silicon MEMS Outperforms Quartz



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 guartz
- Center-anchored MEMS resonator is the most robust design

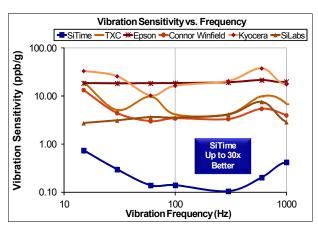


Figure 5. Vibration Robustness^[5]

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
 - \bullet 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.

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 guartz
- Center-anchored MEMS resonator is the most robust design

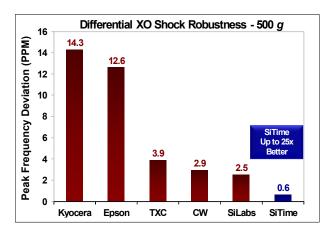


Figure 6. Shock Robustness^[6]

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