

# SiT9201

## Single-Chip, One-Output Clock Generator



### Features

- Any frequency between 1 MHz and 110 MHz accurate to 6 decimal places
- Operating temperature from -40°C to 85°C. Refer to [SiT2018](#) for -40°C to 85°C option and [SiT2020](#) for -55°C to 125°C option
- Excellent total frequency stability as low as ±20 ppm
- Low power consumption of 3.6 mA typical
- Fast startup time of 5 ms
- LVC MOS/HCMOS compatible output
- 5-pin SOT23-5: 2.9mm x 2.8mm
- Pb-free, RoHS and REACH compliant
- For AEC-Q100 one-output clock generators, refer to [SiT2024](#) and [SiT2025](#)

### Applications

- Industrial, medical, automotive, avionics and other high temperature applications
- Industrial sensors, PLC, motor servo, outdoor networking equipment, medical video cam, asset tracking systems, etc.



## Electrical Specifications

Table 1. Electrical Characteristics<sup>[1, 2]</sup>

Parameters	Symbol	Min.	Typ.	Max.	Unit	Condition
<b>Frequency Range</b>						
Output Frequency Range	f	1	–	110	MHz	
<b>Frequency Stability and Aging</b>						
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 (15 pF ± 10%).
		-25	–	+25	ppm	
		-50	–	+50	ppm	
<b>Operating Temperature Range</b>						
Operating Temperature Range (ambient)	T_use	-20	–	+70	°C	Extended Commercial
		-40	–	+85	°C	Industrial
<b>Supply Voltage and Current Consumption</b>						
Supply Voltage	Vdd	1.62	1.8	1.98	V	
		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, 3.0V or 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	–	–	4.3	mA	Vdd = 2.5V to 3.3V, OE = Low, output in high Z state.
		–	–	4.1	mA	Vdd = 1.8V, OE = Low, output in high Z state.
Standby Current	I_std	–	2.6	4.3	µA	Vdd = 2.8V to 3.3V, $\overline{ST}$ = Low, Output is Weakly Pulled Down
		–	1.4	2.5	µA	Vdd = 2.5V, $\overline{ST}$ = Low, Output is Weakly Pulled Down
		–	0.6	1.3	µA	Vdd = 1.8V, $\overline{ST}$ = Low, Output is Weakly Pulled Down
<b>LVC MOS Output Characteristics</b>						
Duty Cycle	DC	45	–	55	%	All Vdds
Rise/Fall Time	Tr, Tf	–	1.0	2.0	ns	Vdd = 2.5V, 2.8V, 3.0V or 3.3V, 20% - 80%
		–	1.3	2.5	ns	Vdd = 1.8V, 20% - 80%
		–	1.0	2.0	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 or 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 or 2.5V) IOL = 2 mA (Vdd = 1.8V)

**Table 1. Electrical Characteristics<sup>[1, 2]</sup> (continued)**

Parameters	Symbol	Min.	Typ.	Max.	Unit	Condition
<b>Input Characteristics</b>						
Input High Voltage	V <sub>IH</sub>	70%	–	–	V <sub>dd</sub>	Pin 3, OE or $\overline{ST}$
Input Low Voltage	V <sub>IL</sub>	–	–	30%	V <sub>dd</sub>	Pin 3, OE or $\overline{ST}$
Input Pull-up Impedance	Z <sub>in</sub>	50	87	150	k $\Omega$	Pin 3, OE logic high or logic low, or $\overline{ST}$ logic high
		2	–	–	M $\Omega$	Pin 3, $\overline{ST}$ logic low
<b>Startup and Resume Timing</b>						
Startup Time	T <sub>start</sub>	–	–	5	ms	Measured from the time V <sub>dd</sub> reaches 90% of final value
Enable/Disable Time	T <sub>oe</sub>	–	–	130	ns	f = 110 MHz. For other frequencies, T <sub>oe</sub> = 100 ns + 3 * clock periods
Resume Time	T <sub>resume</sub>	–	–	5	ms	Measured from the time ST pin crosses 50% threshold
<b>Jitter</b>						
RMS Period Jitter	T <sub>jitt</sub>	–	1.76	3	ps	f = 75 MHz, V <sub>dd</sub> = 2.5V, 2.8V, 3.0V or 3.3V
		–	1.78	3	ps	f = 75 MHz, V <sub>dd</sub> = 1.8V
Peak-to-peak Period Jitter	T <sub>pk</sub>	–	12	20	ps	f = 75 MHz, V <sub>dd</sub> = 2.5V, 2.8V, 3.0V or 3.3V
		–	14	25	ps	f = 75 MHz, V <sub>dd</sub> = 1.8V
RMS Phase Jitter (random)	T <sub>phj</sub>	–	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 V<sub>dd</sub>(s) unless otherwise stated.
- The typical value of any parameter in the Electrical Characteristics table is specified for the nominal value of the highest voltage option for that parameter and at 25°C temperature.

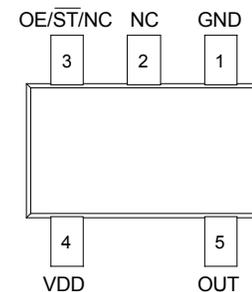
**Table 2. Pin Description**

Pin	Symbol		Functionality
1	GND	Power	Electrical ground <sup>[3]</sup>
2	NC	No Connect	No connect
3	OE/ $\overline{ST}$ /NC	Output Enable	H <sup>[4]</sup> : specified frequency output L: output is high impedance. Only output driver is disabled.
		Standby	H or Open <sup>[4]</sup> : specified frequency output L: output is low (weak pull down). Device goes to sleep mode. Supply current reduces to I <sub>std</sub> .
		No Connect	Any voltage between 0 and V <sub>dd</sub> or Open <sup>[4]</sup> : Specified frequency output. Pin 3 has no function.
4	VDD	Power	Power supply voltage <sup>[3]</sup>
5	OUT	Output	Oscillator output

**Notes:**

- A capacitor of value 0.1  $\mu$ F or higher between V<sub>dd</sub> and GND is required.
- In OE or  $\overline{ST}$  mode, a pull-up resistor of 10 k $\Omega$  or less is recommended if pin 3 is not externally driven. If pin 3 needs to be left floating, use the NC option.

**Top View**



**Figure 1. Pin Assignments**

**Table 3. Absolute Maximum Limits**

Attempted operation outside the absolute maximum ratings 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 <sup>[5]</sup>	–	150	°C

Note:

5. Exceeding this temperature for extended period of time may damage the device.

**Table 4. Thermal Consideration<sup>[6]</sup>**

Package	$\theta_{JA}$ , 4 Layer Board (°C/W)	$\theta_{JC}$ , Bottom (°C/W)
SOT23-5	421	175

Note:

6. Refer to JESD51 for  $\theta_{JA}$  and  $\theta_{JC}$  definitions, and reference layout used to determine the  $\theta_{JA}$  and  $\theta_{JC}$  values in the above table.

**Table 5. Maximum Operating Junction Temperature<sup>[7]</sup>**

Max Operating Temperature (ambient)	Maximum Operating Junction Temperature
70°C	80°C
85°C	95°C

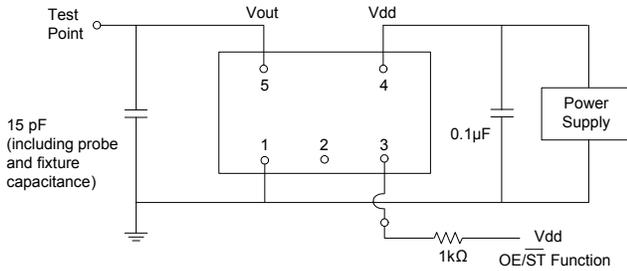
Note:

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

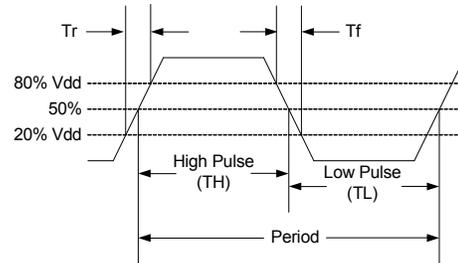
**Table 6. Environmental Compliance**

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

### Test Circuit and Waveform<sup>[8]</sup>



**Figure 2. Test Circuit**

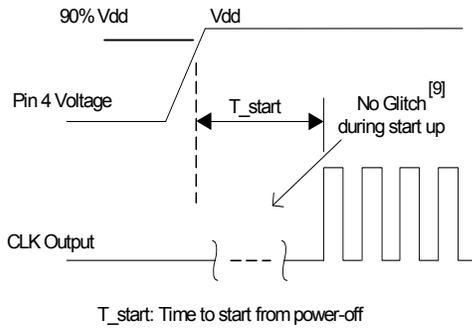


**Figure 3. Output Waveform**

**Note:**

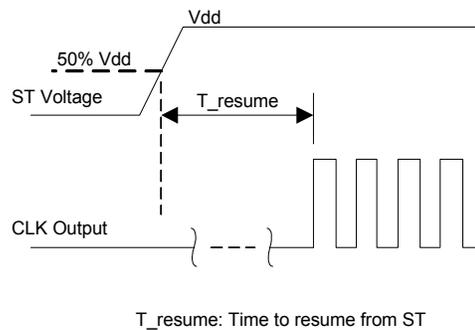
8. Duty Cycle is computed as  $Duty\ Cycle = TH/Period$ .

### Timing Diagrams



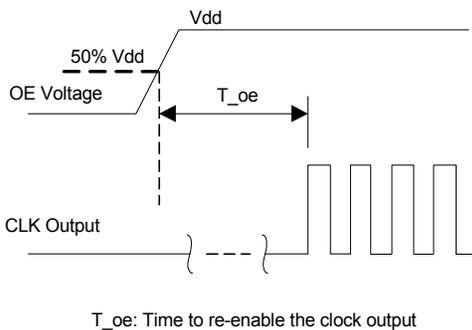
$T_{start}$ : Time to start from power-off

**Figure 4. Startup Timing (OE/ST Mode)**



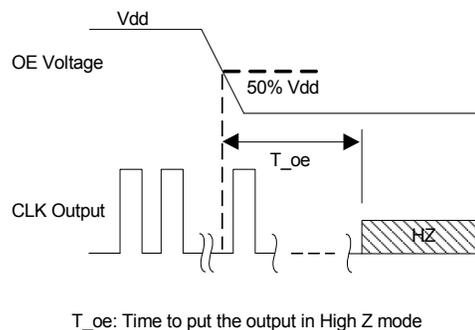
$T_{resume}$ : Time to resume from ST

**Figure 5. Standby Resume Timing (ST Mode Only)**



$T_{oe}$ : Time to re-enable the clock output

**Figure 6. OE Enable Timing (OE Mode Only)**



$T_{oe}$ : Time to put the output in High Z mode

**Figure 7. OE Disable Timing (OE Mode Only)**

**Note:**

9. SiT9201 has "no runt" pulses and "no glitch" output during startup or resume.

Performance Plots<sup>[10]</sup>

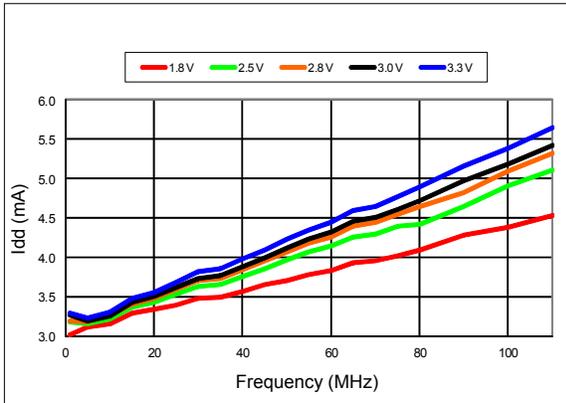


Figure 8. Idd vs Frequency

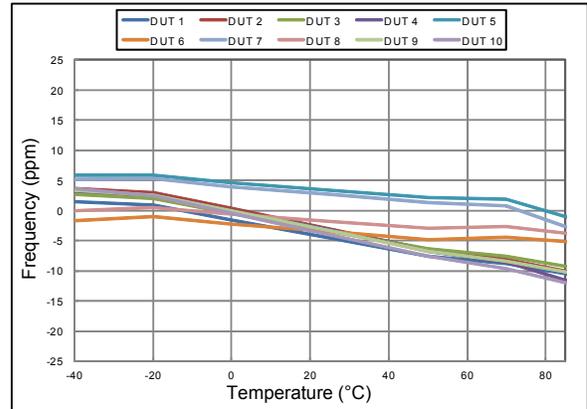


Figure 9. Frequency vs Temperature

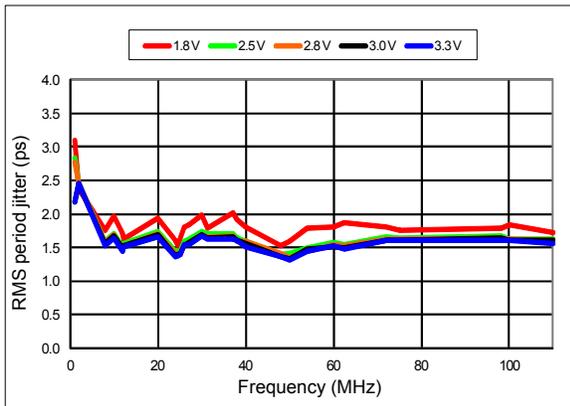


Figure 10. RMS Period Jitter vs Frequency

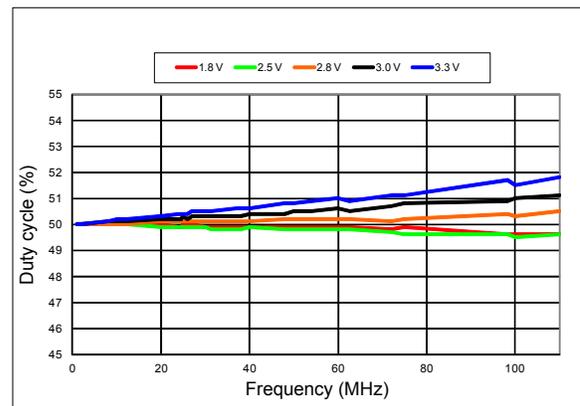


Figure 11. Duty Cycle vs Frequency

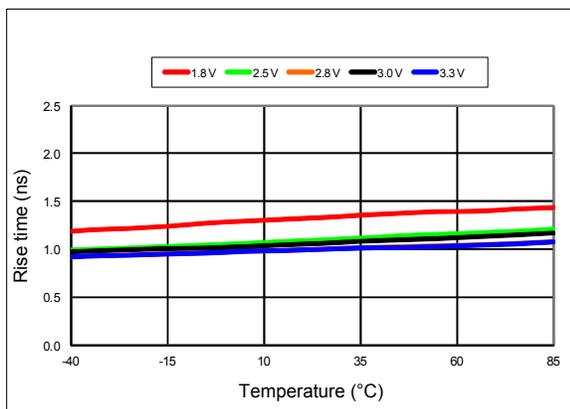


Figure 12. 20%-80% Rise Time vs Temperature

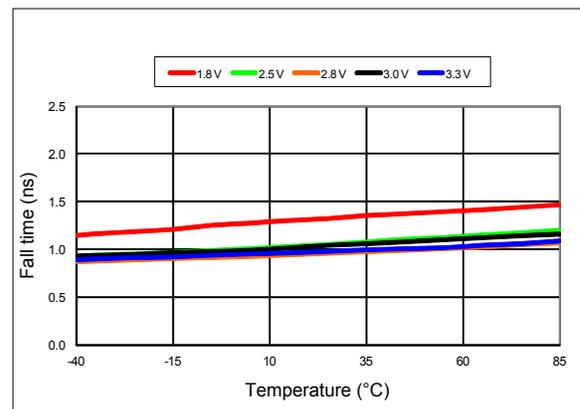
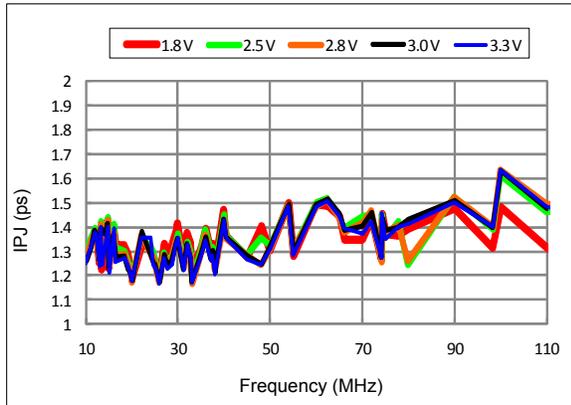
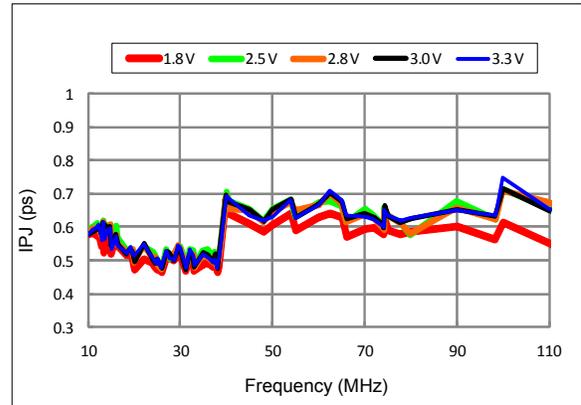


Figure 13. 20%-80% Fall Time vs Temperature

**Performance Plots<sup>[10]</sup>**



**Figure 14. RMS Integrated Phase Jitter Random (12 kHz to 20 MHz) vs Frequency<sup>[11]</sup>**



**Figure 15. RMS Integrated Phase Jitter Random (900 kHz to 7.5 MHz) vs Frequency<sup>[11]</sup>**

**Notes:**

- 10. All plots are measured with 15 pF load at room temperature, unless otherwise stated.
- 11. Phase noise plots are measured with Agilent E5052B signal source analyzer. Integration range is up to 5 MHz for carrier frequencies up to 40 MHz.

### Programmable Drive Strength

The SiT9201 includes a programmable drive strength feature to provide a simple, flexible tool to optimize the clock rise/fall time for specific applications. Benefits from the programmable drive strength feature are:

- Improves system radiated electromagnetic interference (EMI) by slowing down the clock rise/fall time.
- Improves the downstream clock receiver's (RX) jitter by decreasing (speeding up) the clock rise/fall time.
- Ability to drive large capacitive loads while maintaining full swing with sharp edge rates.

For more detailed information about rise/fall time control and drive strength selection, see the SiTime Application Notes section: <http://www.sitime.com/support/application-notes>.

### EMI Reduction by Slowing Rise/Fall Time

Figure 16 shows the harmonic power reduction as the rise/fall times are increased (slowed down). The rise/fall times are expressed as a ratio of the clock period. For the ratio of 0.05, the signal is very close to a square wave. For the ratio of 0.45, the rise/fall times are very close to near-triangular waveform. These results, for example, show that the 11th clock harmonic can be reduced by 35 dB if the rise/fall edge is increased from 5% of the period to 45% of the period.

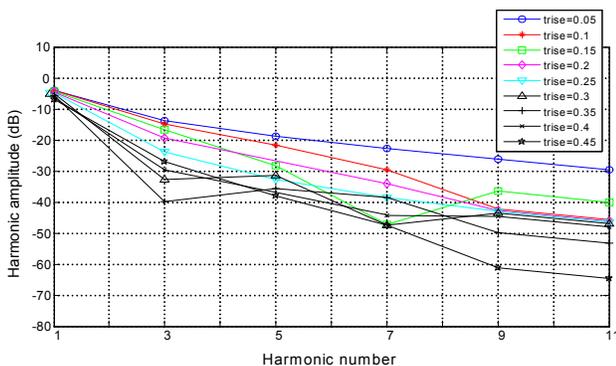


Figure 16. Harmonic EMI reduction as a Function of Slower Rise/Fall Time

### Jitter Reduction with Faster Rise/Fall Time

Power supply noise can be a source of jitter for the downstream chipset. One way to reduce this jitter is to speed up the rise/fall time of the input clock. Some chipsets may also require faster rise/fall time in order to reduce their sensitivity to this type of jitter. Refer to the Rise/Fall Time Tables (Table 7 to Table 11) to determine the proper drive strength.

### High Output Load Capability

The rise/fall time of the input clock varies as a function of the actual capacitive load the clock drives. At any given drive strength, the rise/fall time becomes slower as the output load increases. As an example, for a 3.3V SiT9201 device with default drive strength setting, the typical rise/fall time is 1 ns for 15 pF output load. The typical rise/fall time slows down to 2.6 ns when the output load increases to 45 pF. One can choose to speed up the rise/fall time to 1.83 ns by then increasing the drive strength setting on the SiT9201.

The SiT9201 can support up to 60 pF in maximum capacitive loads with drive strength settings. Refer to the Rise/Fall Time Tables (Table 7 to 11) to determine the proper drive strength for the desired combination of output load vs. rise/fall time.

### SiT9201 Drive Strength Selection

Tables 7 through 11 define the rise/fall time for a given capacitive load and supply voltage.

1. Select the table that matches the SiT9201 nominal supply voltage (1.8V, 2.5V, 2.8V, 3.0V, 3.3V).
2. Select the capacitive load column that matches the application requirement (5 pF to 60 pF)
3. Under the capacitive load column, select the desired rise/fall times.
4. The left-most column represents the part number code for the corresponding drive strength.
5. Add the drive strength code to the part number for ordering purposes.

### Calculating Maximum Frequency

Based on the rise and fall time data given in Tables 7 through 11, the maximum frequency the oscillator can operate with guaranteed full swing of the output voltage over temperature can be calculated as the following:

$$\text{Max Frequency} = \frac{1}{5 \times \text{Trf}_{20/80}}$$

where  $\text{Trf}_{20/80}$  is the typical value for 20%-80% rise/fall time.

### Example 1

Calculate  $f_{\text{MAX}}$  for the following condition:

- Vdd = 1.8V (Table 7)
- Capacitive Load: 30 pF
- Desired Tr/f time = 3 ns (rise/fall time part number code = E)

Part number for the above example:

SiT9201AIES2-18E-66.666660



Drive strength code is inserted here. Default setting is “-”

### Rise/Fall Time (20% to 80%) vs C<sub>LOAD</sub> Tables

Table 7. V<sub>dd</sub> = 1.8V Rise/Fall Times for Specific C<sub>LOAD</sub>

Rise/Fall Time Typ (ns)					
Drive Strength \ C <sub>LOAD</sub>	5 pF	15 pF	30 pF	45 pF	60 pF
L	6.16	11.61	22.00	31.27	39.91
A	3.19	6.35	11.00	16.01	21.52
R	2.11	4.31	7.65	10.77	14.47
B	1.65	3.23	5.79	8.18	11.08
T	0.93	1.91	3.32	4.66	6.48
E	0.78	1.66	2.94	4.09	5.74
U	0.70	1.48	2.64	3.68	5.09
F or "-": default	0.65	1.30	2.40	3.35	4.56

Table 8. V<sub>dd</sub> = 2.5V Rise/Fall Times for Specific C<sub>LOAD</sub>

Rise/Fall Time Typ (ns)					
Drive Strength \ C <sub>LOAD</sub>	5 pF	15 pF	30 pF	45 pF	60 pF
L	4.13	8.25	12.82	21.45	27.79
A	2.11	4.27	7.64	11.20	14.49
R	1.45	2.81	5.16	7.65	9.88
B	1.09	2.20	3.88	5.86	7.57
T	0.62	1.28	2.27	3.51	4.45
E or "-": default	0.54	1.00	2.01	3.10	4.01
U	0.43	0.96	1.81	2.79	3.65
F	0.34	0.88	1.64	2.54	3.32

Table 9. V<sub>dd</sub> = 2.8V Rise/Fall Times for Specific C<sub>LOAD</sub>

Rise/Fall Time Typ (ns)					
Drive Strength \ C <sub>LOAD</sub>	5 pF	15 pF	30 pF	45 pF	60 pF
L	3.77	7.54	12.28	19.57	25.27
A	1.94	3.90	7.03	10.24	13.34
R	1.29	2.57	4.72	7.01	9.06
B	0.97	2.00	3.54	5.43	6.93
T	0.55	1.12	2.08	3.22	4.08
E or "-": default	0.44	1.00	1.83	2.82	3.67
U	0.34	0.88	1.64	2.52	3.30
F	0.29	0.81	1.48	2.29	2.99

Table 10. V<sub>dd</sub> = 3.0V Rise/Fall Times for Specific C<sub>LOAD</sub>

Rise/Fall Time Typ (ns)					
Drive Strength \ C <sub>LOAD</sub>	5 pF	15 pF	30 pF	45 pF	60 pF
L	3.60	7.21	11.97	18.74	24.30
A	1.84	3.71	6.72	9.86	12.68
R	1.22	2.46	4.54	6.76	8.62
B	0.89	1.92	3.39	5.20	6.64
T or "-": default	0.51	1.00	1.97	3.07	3.90
E	0.38	0.92	1.72	2.71	3.51
U	0.30	0.83	1.55	2.40	3.13
F	0.27	0.76	1.39	2.16	2.85

Table 11. V<sub>dd</sub> = 3.3V Rise/Fall Times for Specific C<sub>LOAD</sub>

Rise/Fall Time Typ (ns)					
Drive Strength \ C <sub>LOAD</sub>	5 pF	15 pF	30 pF	45 pF	60 pF
L	3.39	6.88	11.63	17.56	23.59
A	1.74	3.50	6.38	8.98	12.19
R	1.16	2.33	4.29	6.04	8.34
B	0.81	1.82	3.22	4.52	6.33
T or "-": default	0.46	1.00	1.86	2.60	3.84
E	0.33	0.87	1.64	2.30	3.35
U	0.28	0.79	1.46	2.05	2.93
F	0.25	0.72	1.31	1.83	2.61

# SiT9201

## Single-Chip, One-Output Clock Generator

### Pin 3 Configuration Options (OE, $\overline{ST}$ , or NC)

Pin 3 of the SiT9201 can be factory-programmed to support three modes: Output Enable (OE), standby ( $\overline{ST}$ ) or No Connect (NC).

#### Output Enable (OE) Mode

In the OE mode, applying logic Low to the OE pin only disables the output driver and puts it in Hi-Z mode. The core of the device continues to operate normally. Power consumption is reduced due to the inactivity of the output. When the OE pin is pulled High, the output is typically enabled in  $<1\mu\text{s}$ .

#### Standby ( $\overline{ST}$ ) Mode

In the  $\overline{ST}$  mode, a device enters into the standby mode when Pin 3 pulled Low. All internal circuits of the device are turned off. The current is reduced to a standby current, typically in the range of a few  $\mu\text{A}$ . When  $\overline{ST}$  is pulled High, the device goes through the “resume” process, which can take up to 5 ms.

#### No Connect (NC) Mode

In the NC mode, the device always operates in its normal mode and outputs the specified frequency regardless of the logic level on pin 3.

Table 12 below summarizes the key relevant parameters in the operation of the device in OE,  $\overline{ST}$ , or NC mode.

**Table 12. OE vs.  $\overline{ST}$  vs. NC**

	OE	$\overline{ST}$	NC
Active current 20 MHz (max, 1.8V)	4.2 mA	4.2 mA	4.2 mA
OE disable current (max, 1.8V)	4.1 mA	N/A	N/A
Standby current (typical 1.8V)	N/A	0.6 $\mu\text{A}$	N/A
OE enable time at 110 MHz (max)	130 ns	N/A	N/A
Resume time from standby (max, all frequency)	N/A	5 ms	N/A
Output driver in OE disable/standby mode	High Z	weak pull-down	N/A

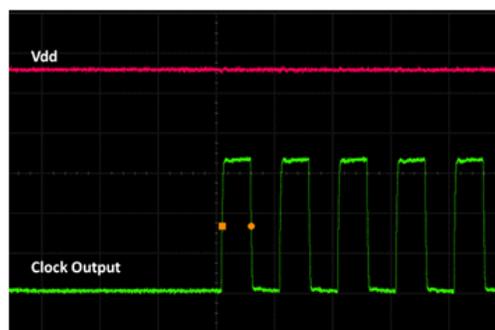
#### Output on Startup and Resume

The SiT9201 comes with gated output. Its clock output is accurate to the rated frequency stability within the first pulse from initial device startup or resume from the standby mode.

In addition, the SiT9201 supports “no runt” pulses, and “no glitch” output during startup or resume as shown in the waveform captures in Figure 17 and Figure 18.

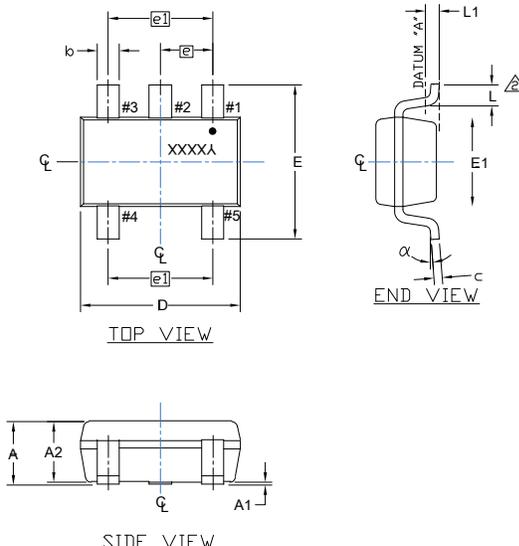
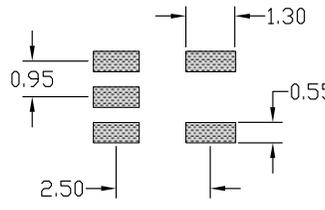


**Figure 17. Startup Waveform vs. Vdd**



**Figure 18. Startup Waveform vs. Vdd (Zoomed-in View of Figure 17)**

### Dimensions and Patterns

Package Size – Dimensions (Unit: mm) <sup>[12]</sup>	Recommended Land Pattern (Unit: mm) <sup>[13]</sup>
<p><b>2.90 x 2.80 mm SOT23-5</b></p>  <p><b>TOP VIEW</b></p> <p><b>END VIEW</b></p> <p><b>SIDE VIEW</b></p>	

**Notes:**

- 12. 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.
- 13. A capacitor value of 0.1  $\mu$ F between Vdd and GND is required

**Table 13. Dimension Table**

Symbol	Min.	Nom.	Max.
A	0.90	1.27	1.45
A1	0.00	0.07	0.15
A2	0.90	1.2	1.30
b	0.30	0.35	0.50
c	0.14	0.153	0.20
D	2.90		
E	2.80		
E1	1.60		
e	0.95		
e1	1.90		
L	0.30	0.38	0.55
L1	0.25		
a	0°	–	8°

# SiT9201

## Single-Chip, One-Output Clock Generator

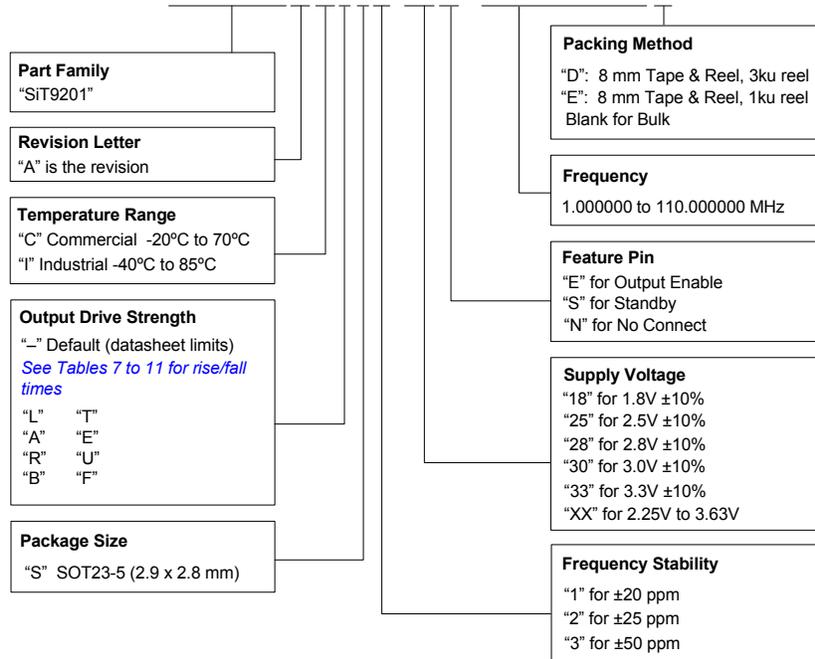


The Smart Timing Choice™

### Ordering Information

The Part No. Guide is for reference only. To customize and build an exact part number, use the SiTime [Part Number Generator](#).

SiT9201AI-S2-18E -25.000025D



**Table 14. Additional Information**

Document	Description	Download Link
Time Machine II	MEMS oscillator programmer	<a href="http://www.sitime.com/support/time-machine-oscillator-programmer">http://www.sitime.com/support/time-machine-oscillator-programmer</a>
Field Programmable Oscillators	Devices that can be programmable in the field by Time Machine II	<a href="http://www.sitime.com/products/field-programmable-oscillators">http://www.sitime.com/products/field-programmable-oscillators</a>
Manufacturing Notes	Tape & Reel dimension, reflow profile and other manufacturing related info	<a href="http://www.sitime.com/component/docman/doc_download/85-manufacturing-notes-for-sitime-oscillators">http://www.sitime.com/component/docman/doc_download/85-manufacturing-notes-for-sitime-oscillators</a>
Qualification Reports	RoHS report, reliability reports, composition reports	<a href="http://www.sitime.com/support/quality-and-reliability">http://www.sitime.com/support/quality-and-reliability</a>
Performance Reports	Additional performance data such as phase noise, current consumption and jitter for selected frequencies	<a href="http://www.sitime.com/support/performance-measurement-report">http://www.sitime.com/support/performance-measurement-report</a>
Termination Techniques	Termination design recommendations	<a href="http://www.sitime.com/support/application-notes">http://www.sitime.com/support/application-notes</a>
Layout Techniques	Layout recommendations	<a href="http://www.sitime.com/support/application-notes">http://www.sitime.com/support/application-notes</a>

## Revision History

**Table 15. Datasheet Version and Change Log**

Version	Release Date	Change Summary
0.92	5/30/13	Initial Release Date
0.95	1/30/14	<ul style="list-style-type: none"> <li>• Updated icons with LifeTime Warranty</li> <li>• Added peak-to-peak jitter in the EC table</li> <li>• Added maximum operating junction temperature table</li> <li>• Updated test circuit</li> <li>• Added additional performance plot</li> <li>• Added description on programmable drive strength</li> <li>• Added section on OE/ST/NC description</li> </ul>
1.0	10/16/14	<ul style="list-style-type: none"> <li>• Added height dimension in the package drawing</li> <li>• Minor correction of the top mark drawing in Figure 1</li> </ul>

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

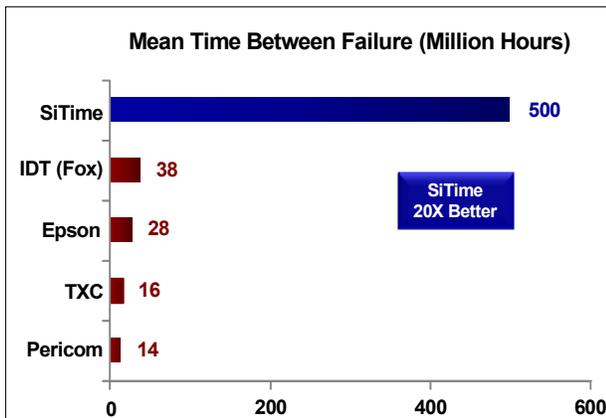


Figure 1. Reliability Comparison<sup>[1]</sup>

## 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

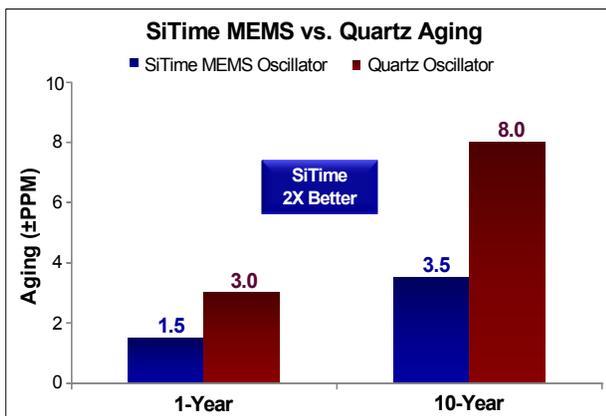


Figure 2. Aging Comparison<sup>[2]</sup>

## 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

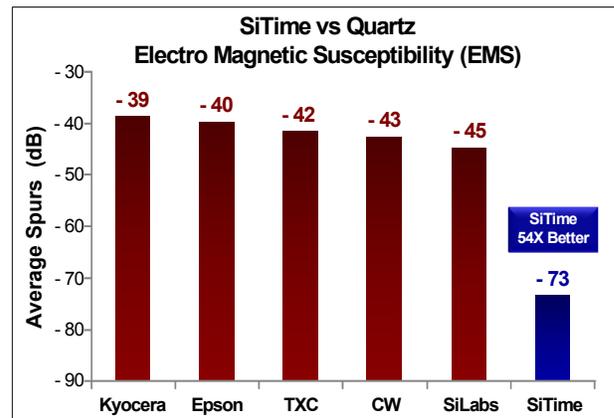


Figure 3. Electro Magnetic Susceptibility (EMS)<sup>[3]</sup>

## 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

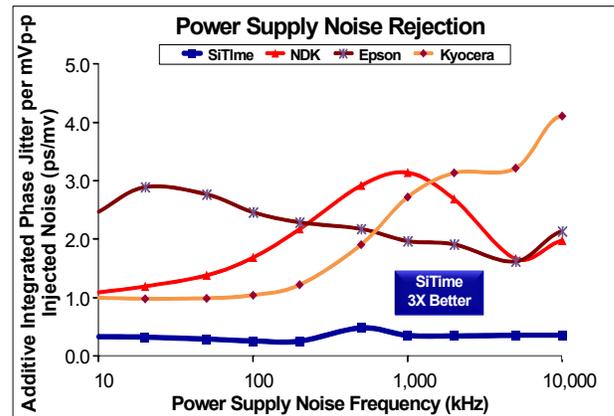


Figure 4. Power Supply Noise Rejection<sup>[4]</sup>

## 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

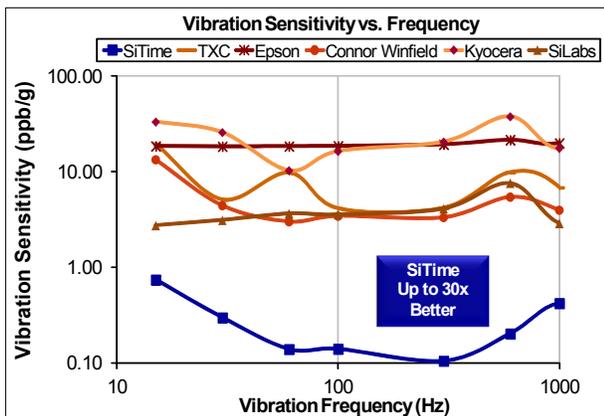


Figure 5. Vibration Robustness<sup>[5]</sup>

## 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

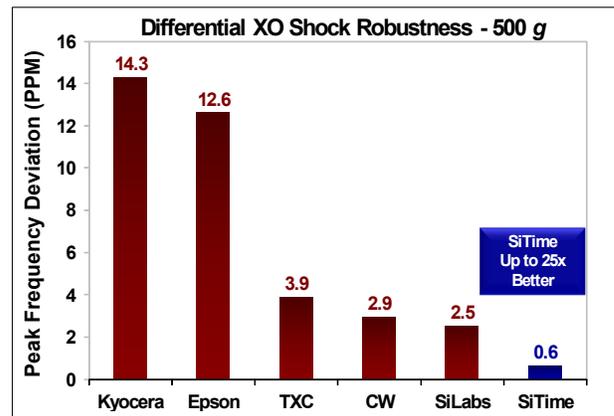


Figure 6. Shock Robustness<sup>[6]</sup>

### 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](mailto:productsupport@sitime.com).

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