

## Features

- AEC-Q100 with extended temperature range (-40°C to 105°C)
- Any frequency between 1 MHz and 220 MHz, accurate to 6 decimal places. For frequency between 220 and 725 MHz, see [SiT9387](#)
- LVPECL, LVDS and HCSL output signaling types
- 0.23 ps RMS (typ) phase jitter (random, 12 kHz to 20 MHz)
- Frequency stability as low as  $\pm 25$  ppm – contact [SiTime](#)
- Industry-standard packages: 3.2 x 2.5, 7.0 x 5.0 mm  
Contact [SiTime](#) for 5.0 x 3.2 mm package

## Applications

- Automotive, and other high reliability electronics
- Infotainment systems, collision detection devices and in-vehicle 10/40/100 Gbps Ethernet

## Electrical Characteristics

All Min and Max limits in the Electrical Characteristics tables are specified over temperature and rated operating voltage with standard output termination show in the termination diagrams. Typical values are at 25°C and nominal supply voltage.

**Table 1. Electrical Characteristics — Common to LVPECL, LVDS and HCSL**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
<b>Frequency Range</b>						
Output Frequency Range	f	1	–	220	MHz	Accurate to 6 decimal places
<b>Frequency Stability</b>						
Frequency Stability		-25	–	+25	ppm	Inclusive of initial tolerance, operating temperature, rated power supply voltage and load variations. Contact <a href="#">SiTime</a> for $\pm 25$ ppm.
		-50	–	+50	ppm	Inclusive of initial tolerance, operating temperature, rated power supply voltage and load variations.
First Year Aging	F_1y	–	$\pm 1$	–	ppm	At 25°C
<b>Temperature Range</b>						
Operating Temperature Range	T_use	-40	–	+85	°C	Industrial
		-40	–	+105	°C	Extended Industrial
<b>Supply Voltage</b>						
Supply Voltage	Vdd	2.97	3.3	3.63	V	
		2.7	3.0	3.3	V	
		2.52	2.8	3.08	V	
		2.25	2.5	2.75	V	
<b>Input Characteristics</b>						
Input Voltage High	V <sub>IH</sub>	70%	–	–	Vdd	Pin 1, OE
Input Voltage Low	V <sub>IL</sub>	–	–	30%	Vdd	Pin 1, OE
Input Pull-up Impedance	Z <sub>in</sub>	–	100	–	k $\Omega$	Pin 1, OE logic high or logic low
<b>Output Characteristics</b>						
Duty Cycle	DC	45	–	55	%	
<b>Startup and OE Timing</b>						
Start-up Time	T <sub>start</sub>	–	–	3.0	ms	Measured from the time Vdd reaches its rated minimum value.
OE Enable/Disable Time	T <sub>oe</sub>	–	–	3.8	$\mu$ s	f = 156.25 MHz.

Table 2. Electrical Characteristics – LVPECL

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
<b>Current Consumption</b>						
Current Consumption	I <sub>dd</sub>	–	–	89	mA	Excluding Load Termination Current, V <sub>dd</sub> = 3.3V or 2.5V
OE Disable Supply Current	I <sub>OE</sub>	–	–	58	mA	OE = Low
Output Disable Leakage Current	I <sub>leak</sub>	–	0.15	–	μA	OE = Low
Maximum Output Current	I <sub>driver</sub>	–	–	32	mA	Maximum average current drawn from OUT+ or OUT-
<b>Output Characteristics</b>						
Output High Voltage	VOH	V <sub>dd</sub> -1.1	–	V <sub>dd</sub> -0.7	V	See Figure 2
Output Low Voltage	VOL	V <sub>dd</sub> -1.9	–	V <sub>dd</sub> -1.5	V	See Figure 2
Output Differential Voltage Swing	V <sub>Swing</sub>	1.2	1.6	2.0	V	See Figure 3
Rise/Fall Time	T <sub>r</sub> , T <sub>f</sub>	–	225	–	ps	20% to 80%, see Figure 2
<b>Jitter</b>						
RMS Phase Jitter (random)	T <sub>phj</sub>	–	0.220	–	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V <sub>dd</sub> levels, includes spurs, 7.0 x 5.0 mm package.
		–	0.225	–	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V <sub>dd</sub> levels, includes spurs, 3.2 x 2.5 mm package.
		–	0.1	–	ps	f = 156.25, IEEE802.3-2005 10GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz, includes spurs, all V <sub>dd</sub> levels.
RMS Period Jitter <sup>[1]</sup>	T <sub>jitt</sub>	–	1.0	–	ps	f = 100, 156.25 or 212.5 MHz, V <sub>dd</sub> = 3.3V or 2.5V

## Notes:

1. Measured according to JESD65B

Table 3. Electrical Characteristics – LVDS

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
<b>Current Consumption</b>						
Current Consumption	I <sub>dd</sub>	–	–	79	mA	Excluding Load Termination Current, V <sub>dd</sub> = 3.3V or 2.5V
OE Disable Supply Current	I <sub>OE</sub>	–	–	58	mA	OE = Low
Output Disable Leakage Current	I <sub>leak</sub>	–	0.15	–	μA	OE = Low
<b>Output Characteristics</b>						
Differential Output Voltage	VOD	250	–	455	mV	See Figure 4
VOD Magnitude Change	ΔVOD	–	–	50	mV	See Figure 4
Offset Voltage	VOS	1.125	–	1.375	V	See Figure 4
VOS Magnitude Change	ΔVOS	–	–	50	mV	See Figure 4
Rise/Fall Time	T <sub>r</sub> , T <sub>f</sub>	–	400	–	ps	Measured with 2 pF capacitive loading to GND, 20% to 80%, see Figure 4
<b>Jitter</b>						
RMS Phase Jitter (random)	T <sub>phj</sub>	–	0.215	–	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V <sub>dd</sub> levels, includes spurs, 7.0 x 5.0 mm package.
		–	0.235	–	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V <sub>dd</sub> levels, includes spurs, 3.2 x 2.5 mm package.
		–	0.1	–	ps	f = 156.25, IEEE802.3-2005 10GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz, includes spurs, all V <sub>dd</sub> levels.
RMS Period Jitter <sup>[2]</sup>	T <sub>jitt</sub>	–	1.0	–	ps	f = 100, 156.25 or 212.5 MHz, V <sub>dd</sub> = 3.3V or 2.5V

## Notes:

2. Measured according to JESD65B

Table 4. Electrical Characteristics – HCSL

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
<b>Current Consumption</b>						
Current Consumption	I <sub>dd</sub>	–	–	89	mA	Excluding Load Termination Current, V <sub>dd</sub> = 3.3V or 2.5V
OE Disable Supply Current	I <sub>OE</sub>	–	–	58	mA	OE = Low
Output Disable Leakage Current	I <sub>leak</sub>	–	0.15	–	μA	OE = Low
Maximum Output Current	I <sub>driver</sub>	–	–	35	mA	Maximum average current drawn from OUT+ or OUT-
<b>Output Characteristics</b>						
Output High Voltage	V <sub>OH</sub>	0.60	–	0.90	V	See Figure 2
Output Low Voltage	V <sub>OL</sub>	-0.05	–	0.08	V	See Figure 2
Output Differential Voltage Swing	V <sub>Swing</sub>	1.2	1.4	1.80	V	See Figure 3
Rise/Fall Time	T <sub>r</sub> , T <sub>f</sub>	–	360		ps	Measured with 2 pF capacitive loading to GND, 20% to 80%, see Figure 2
<b>Jitter</b>						
RMS Phase Jitter (random)	T <sub>phj</sub>	–	0.220		ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V <sub>dd</sub> levels, includes spurs, 7.0 x 5.0 mm package.
		–	0.230		ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V <sub>dd</sub> levels, includes spurs, 3.2 x 2.5 mm package.
		–	0.1	–	ps	f = 156.25, IEEE802.3-2005 10GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz, includes spurs, all V <sub>dd</sub> levels.
RMS Period Jitter <sup>[3]</sup>	T <sub>jitt</sub>	–	1.0		ps	f = 100, 156.25 or 212.5 MHz, V <sub>dd</sub> = 3.3V or 2.5V

## Notes:

- Measured according to JESD65B

Table 5. Pin Description

Pin	Map	Functionality	
1	OE/NC	Output Enable (OE)	H <sup>[4]</sup> : specified frequency output L: output is high impedance
		Non Connect (NC)	H or L or Open: No effect on output frequency or other device functions
2	NC	NA	No Connect; Leave it floating or connect to GND for better heat dissipation
3	GND	Power	V <sub>dd</sub> Power Supply Ground
4	OUT+	Output	Oscillator output
5	OUT-	Output	Complementary oscillator output
6	V <sub>dd</sub>	Power	Power supply voltage <sup>[5]</sup>

## Notes:

- In OE mode, a pull-up resistor of 10 kΩ or less is recommended if pin 1 is not externally driven.
- A capacitor of value 0.1 μF or higher between V<sub>dd</sub> and GND is required. An additional 10 μF capacitor between V<sub>dd</sub> and GND is required for the best phase jitter performance

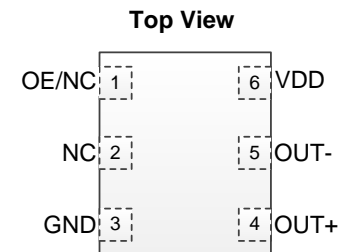


Figure 1. Pin Assignments

**Table 6. Absolute Maximum Ratings**

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
Vdd	-0.5	4.0	V
VIH		Vdd + 0.3V	V
VIL	-0.3		V
Storage Temperature	-65	150	°C
Maximum Junction Temperature		130	°C
Soldering Temperature (follow standard Pb-free soldering guidelines)		260	°C

**Table 7. Thermal Considerations<sup>[6]</sup>**

Package	$\theta_{JA}$ , 4 Layer Board (°C/W)	$\theta_{JC}$ , Bottom (°C/W)
3225, 6-pin	80	30
7050, 6-pin	52	19

**Notes:**

6. Refer to JE5D51 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 8. Maximum Operating Junction Temperature<sup>[7]</sup>**

Max Operating Temperature (ambient)	Maximum Operating Junction Temperature
70°C	95°C
85°C	110°C
105°C	-

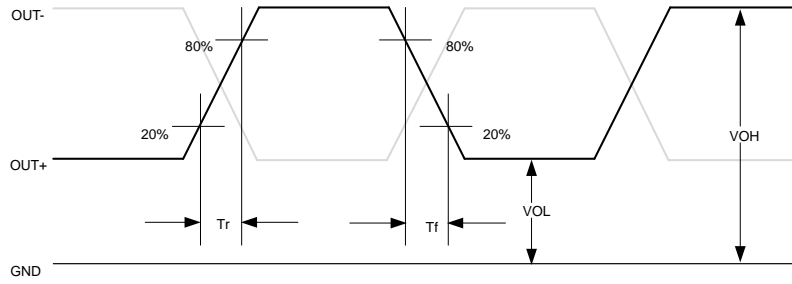
**Notes:**

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

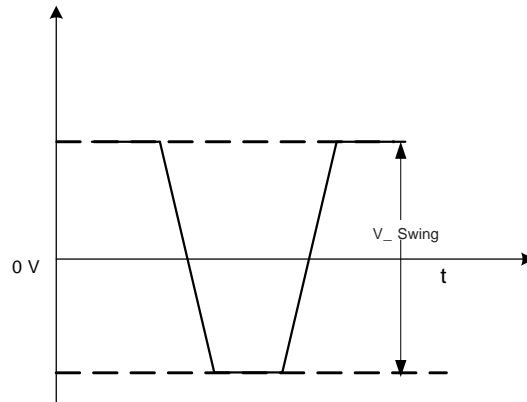
**Table 9. Environmental Compliance**

Parameter	Test Conditions	Value	Unit
Mechanical Shock Resistance	MIL-STD-883F, Method 2002	10,000	<i>g</i>
Mechanical Vibration Resistance	MIL-STD-883F, Method 2007	70	<i>g</i>
Soldering Temperature (follow standard Pb free soldering guidelines)	MIL-STD-883F, Method 2003	260	°C
Moisture Sensitivity Level	MSL1 @ 260°C		
Electrostatic Discharge (HBM)	HBM, JESD22-A114	2,000	V
Charge-Device Model ESD Protection	JESD220C101	750	V
Latch-up Tolerance	JESD78 Compliant		

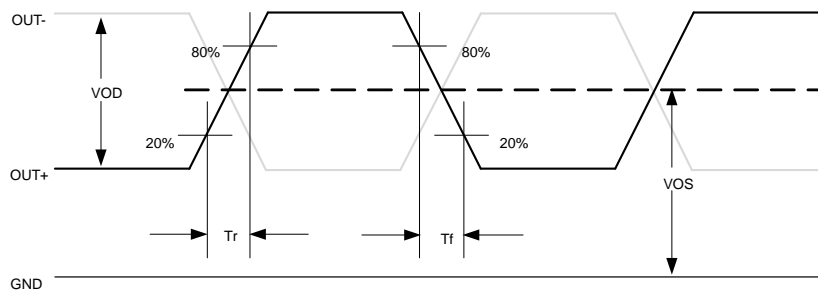
## Waveform Diagrams



**Figure 2. LVPECL/HCSL Voltage Levels per Differential Pin (OUT+/OUT-)**



**Figure 3. LVPECL/HCSL Voltage Levels across Differential Pair**



**Figure 4. LVDS Voltage Levels per Differential Pin (OUT+/OUT-)**

## Termination Diagrams

LVPECL:

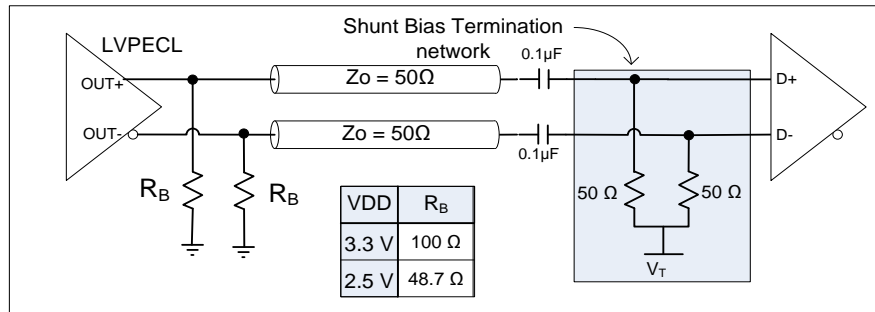


Figure 5. LVPECL with AC-coupled termination

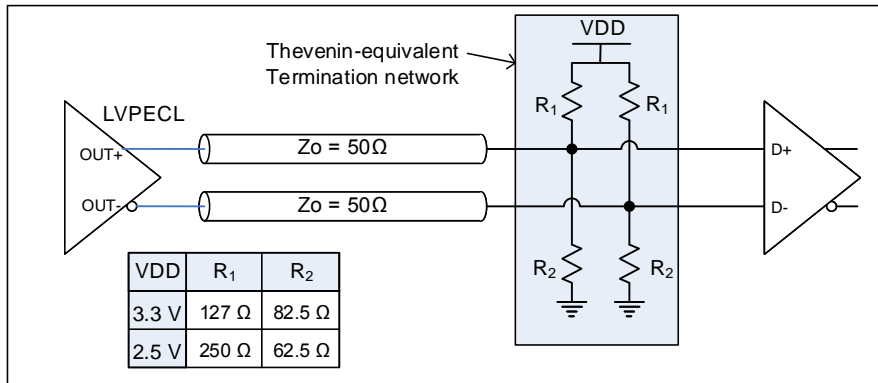


Figure 6. LVPECL DC-coupled load termination with Thevenin equivalent network

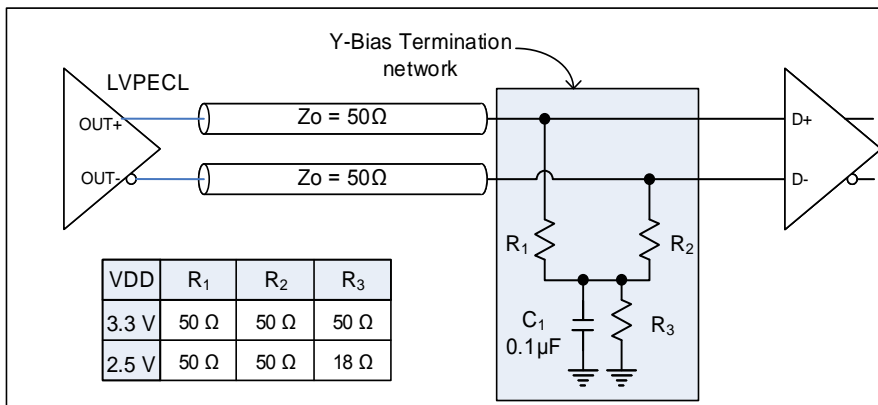


Figure 7. LVPECL with Y-Bias termination

Termination Diagrams (Continued)

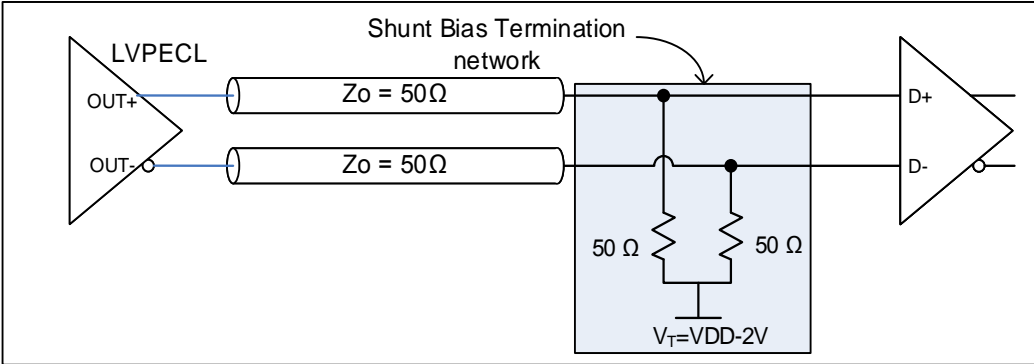


Figure 8. LVPECL with DC-coupled parallel shunt load termination

Termination Diagrams (Continued)

LVDS:

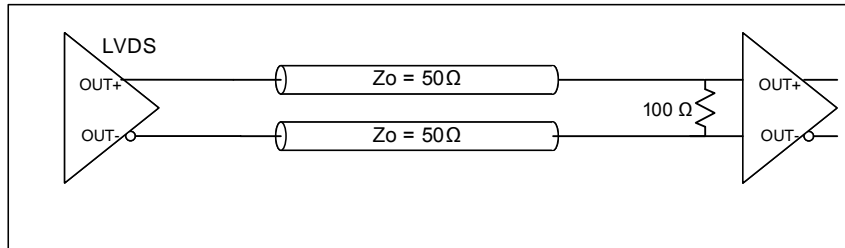


Figure 9. LVDS single DC termination at the load

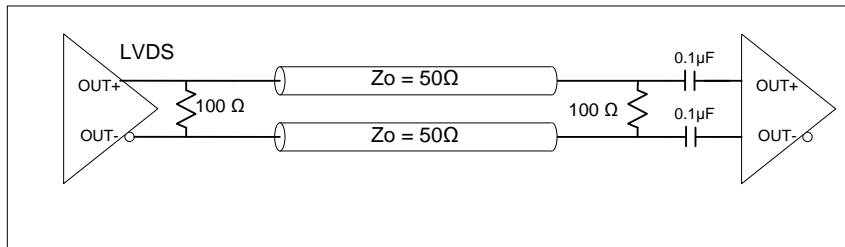


Figure 10. LVDS double AC termination with capacitor close to the load

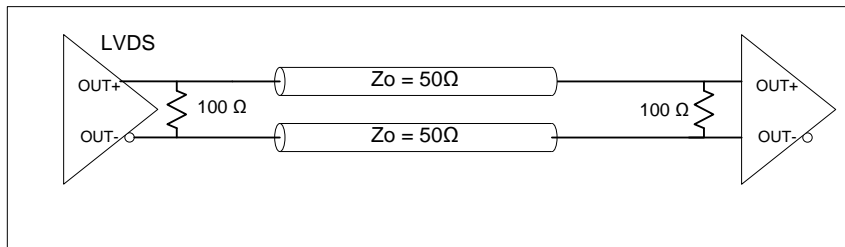


Figure 11. LVDS double DC termination



Termination Diagrams (Continued)

HCSL:

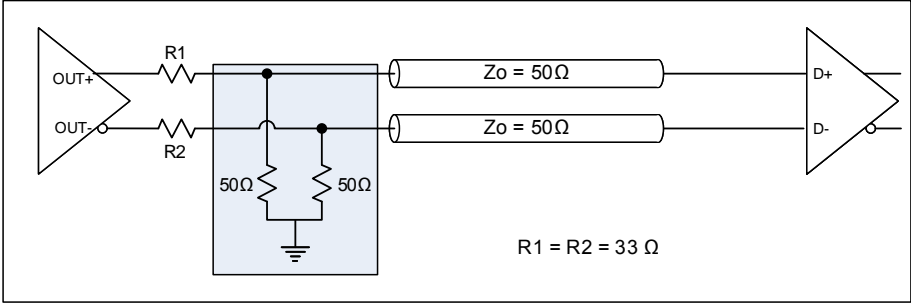


Figure 12. HCSL interface termination

### Dimensions and Patterns

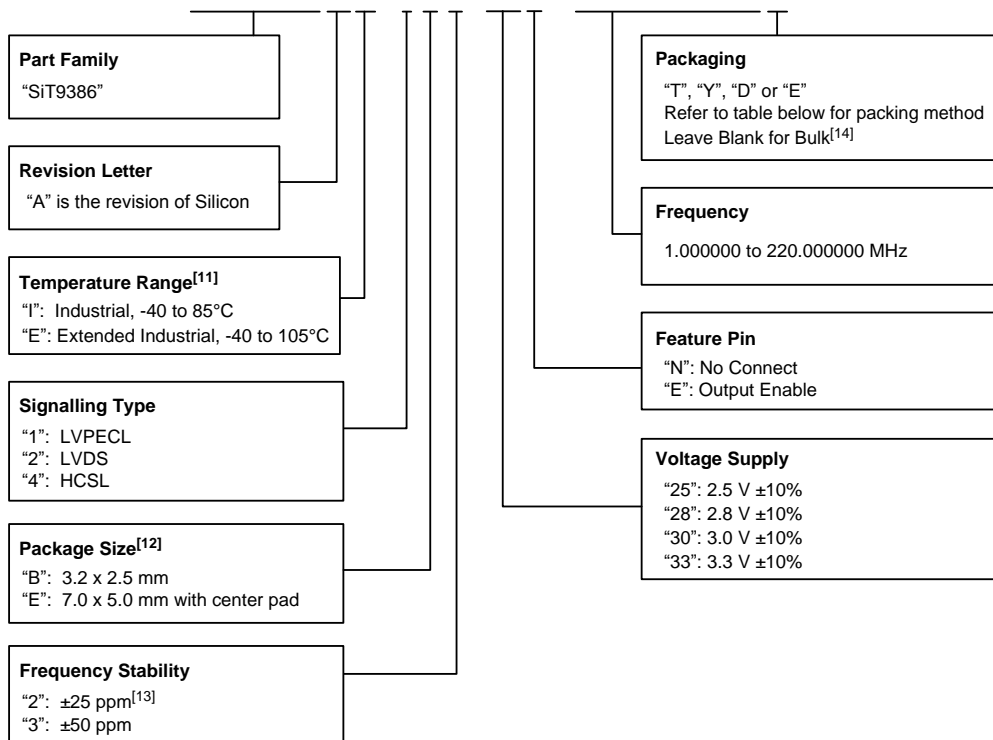
Package Size – Dimensions (Unit: mm) <sup>[8]</sup>	Recommended Land Pattern (Unit: mm) <sup>[9]</sup>																																																				
<p><b>3.2 x 2.5 x 0.85 mm</b></p> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p style="text-align: center;">Dimension Table</p> <table border="1"> <thead> <tr> <th></th> <th>Symbol</th> <th>Min</th> <th>Nom</th> <th>Max</th> </tr> </thead> <tbody> <tr> <td>TOTAL THICKNESS</td> <td>A</td> <td>0.800</td> <td>0.850</td> <td>0.900</td> </tr> <tr> <td rowspan="2">BODY SIZE</td> <td>X</td> <td>D</td> <td>2.400</td> <td>2.500</td> <td>2.600</td> </tr> <tr> <td>Y</td> <td>E</td> <td>3.200</td> <td>3.200</td> <td>3.300</td> </tr> <tr> <td>LEAD PITCH</td> <td>e</td> <td colspan="3">1.100 BSC</td> </tr> <tr> <td>LEAD LENGTH</td> <td>L</td> <td>0.650</td> <td>0.700</td> <td>0.750</td> </tr> <tr> <td>LEAD WIDTH</td> <td>W</td> <td>0.550</td> <td>0.600</td> <td>0.650</td> </tr> </tbody> </table> </div> <div style="width: 50%;"> </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="width: 45%;"> <table border="1"> <tr> <td>6L QFN</td> <td>Package Outline</td> </tr> <tr> <td>2.5 x 3.2 x 0.85 mm</td> <td rowspan="2" style="text-align: center;"></td> </tr> <tr> <td>POD-38 Rev A</td> </tr> </table> </div> <div style="width: 50%;"></div> </div>		Symbol	Min	Nom	Max	TOTAL THICKNESS	A	0.800	0.850	0.900	BODY SIZE	X	D	2.400	2.500	2.600	Y	E	3.200	3.200	3.300	LEAD PITCH	e	1.100 BSC			LEAD LENGTH	L	0.650	0.700	0.750	LEAD WIDTH	W	0.550	0.600	0.650	6L QFN	Package Outline	2.5 x 3.2 x 0.85 mm		POD-38 Rev A	<p><b>3.2 x 2.5 x 0.85 mm</b></p>											
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**Notes:**

8. 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.
9. A capacitor of value 0.1 μF or higher between Vdd and GND is required. An additional 10 μF capacitor between Vdd and GND is required for the best phase jitter performance
10. The center pad has no electrical function. Soldering down the center pad to the GND is recommended for best thermal dissipation, but is optional.

## Ordering Information

### SiT9386AC-1B2-33E123.456789T



**Notes:**

11. Contact [SiTime](#) for higher temperature range options.
12. Contact [SiTime](#) for 5.0 x 3.2 mm package.
13. Contact [SiTime](#) for ±25 ppm option.
14. Bulk is available for sampling only.

**Table 10. Ordering Codes for Supported Tape & Reel Packing Method**

Device Size (mm x mm)	8 mm T&R (3ku)	8 mm T&R (1ku)	12 mm T&R (3ku)	12 mm T&R (1ku)	16 mm T&R (3ku)	16 mm T&R (1ku)
7.0 x 5.0	—	—	—	—	T	Y
3.2 x 2.5	D	E	T	Y	—	—

Table 11. Additional Information

Document	Description	Download Link
ECCN #: EAR99	Five character designation used on the commerce Control List (CCL) to identify dual use items for export control purposes.	—
Part number Generator	Tool used to create the part number based on desired features.	—
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/243-manufacturing-notes-for-sitime-oscillators">http://www.sitime.com/component/docman/doc_download/243-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>

Table 12. Revision History

Revision	Release Date	Change Summary
0.1	03/11/2017	Initial draft
0.87	11/06/2017	Updated package drawings Corrected tape/reel ordering information Updated Electrical Characteristics based on characterization Included max numbers for IPJ Added additional information table Corrected formatting issues Increased temperature range from 95°C to 105°C Removed ±10 ppm options for automotive and industrial temperature ranges Changed ±20 ppm to "contact SiTime" Updated termination diagrams Lower mechanical shock from 20,000 to 10,000 g
0.90	11/24/2017	Ordering information updates and page layout changes

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