SiT3373

220 MHz to 725 MHz Ultra-low Jitter Differential VCXO

Features

- Any frequency between 220.000001 MHz and 725 MHz accurate to 6 decimal places
- Widest pull range options: ±25, ±50, ±80, ±100, ±150, ±200, ±400, ±800, ±1600, ±3200 ppm
- 0.235 ps RMS phase jitter (typ) over 12 kHz to 20 MHz bandwidth
- Wide temperature range support from -40°C to 105°C
- Industry-standard packages: 7.0 x 5.0 mm, 5.0 x 3.2 mm, 3.2 x 2.5 mm packages
- For frequencies 1 MHz to 220 MHz, refer to SiT3372

Applications

- Cable Modem Termination System (CMTS), Video, Broadcasting System, Audio, Industrial Sensors, Remote Radio Head (RRH)
- SATA, SAS, 10GB Ethernet, Fibre Channel, PCI-Express
- Optical Transport Network (OTN)

Electrical Characteristics

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

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.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Frequency Range						
Output Frequency Range	f	220.000001	–	725	MHz	Accurate to 6 decimal places
Frequency Stability						
Frequency Stability	F_stab	-15	–	+15	ppm	Inclusive of initial tolerance, operating temperature, rated power supply voltage, load variations, and first year aging at 25°C. Contact SiTime for ±15 ppm.
		-25	–	+25	ppm	Inclusive of initial tolerance, operating temperature, rated power supply voltage, load variations, and first year aging at 25°C.
		-35	–	+35	ppm	
		-50	–	+50	ppm	
Temperature Range						
Operating Temperature Range	T_use	-20	–	+70	°C	Extended Commercial
		-40	–	+85	°C	Industrial.
		-40	–	+95	°C	
		-40	–	+105	°C	Extended Industrial
Supply Voltage						
Supply Voltage	Vdd	2.97	3.30	3.63	V	
		2.70	3.00	3.30	V	
		2.52	2.80	3.08	V	
		2.25	2.50	2.75	V	
Voltage Control Characteristics						
Pull Range	PR	±25, ±50, ±80, ±100, ±150, ±200, ±400, ±800, ±1600, ±3200ppm			ppm	See the APR (Absolute Pull Range) Table 11. Contact SiTime for custom pull range options.
Upper Control Voltage	VC_U	90%	–	–	Vdd	Voltage at which maximum frequency deviation is guaranteed
Lower Control Voltage	VC_L	–	–	10%	Vdd	Voltage at which minimum frequency deviation is guaranteed
Control Voltage Input Impedance	VC_z	–	10	–	MΩ	
Control Voltage Input Bandwidth	V_c	–	10	–	kHz	Contact SiTime for other input bandwidth options
Pull Range Linearity	Lin	–	–	1.0	%	
Frequency Change Polarity	–	Positive Slope			–	
Input Characteristics						
Input Voltage High	VIH	70%	–	–	Vdd	Pin 2, OE
Input Voltage Low	VIL	–	–	30%	Vdd	Pin 2, OE
Input Pull-up Impedance	Z_in	–	100	-	kΩ	Pin 2, OE logic high or logic low
Output Characteristics						
Duty Cycle	DC	45	–	55	%	
Startup and OE Timing						
Start-up Time	T_start	–	–	3.0	ms	Measured from the time Vdd reaches its rated minimum value.
OE Enable/Disable Time	T_oe	–	–	3.8	µs	f = 322.265625 MHz. Measured from the time OE pin reaches rated VIH and VIL to the time clock pins reach 90% of swing and high-Z. See Figure 7 and Figure 8

Table 2. Electrical Characteristics – LVPECL Specific

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Current Consumption						
Current Consumption	Idd	–	–	97	mA	Excluding Load Termination Current, Vdd = 3.3V or 2.5V
OE Disable Supply Current	I_OE	–	–	63	mA	OE = Low
Output Disable Leakage Current	I_leak	–	0.15	–	µA	OE = Low
Maximum Output Current	I_driver	–	–	32	mA	Maximum average current drawn from OUT+ or OUT-
Output Characteristics						
Output High Voltage	VOH	Vdd-1.15	–	Vdd-0.7	V	See Figure 3
Output Low Voltage	VOL	Vdd-1.9	–	Vdd-1.5	V	See Figure 3
Output Differential Voltage Swing	V_Swing	1.2	1.6	2.0	V	See Figure 4
Rise/Fall Time	Tr, Tf	–	225	290	ps	20% to 80%, see Figure 4
Jitter – 7.0 x 5.0 mm Package						
RMS Period Jitter[1]	T_jitt	–	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3V or 2.5V, Pull Range = 100 ppm.
RMS Phase Jitter (random)	T_phj		0.220	0.270	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs, pull range = 100 ppm. Temperature ranges -20 to 70ºC and -40 to 85ºC.
		–	0.220	0.300	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs, pull range = 100 ppm. Temperature ranges -40 to 95 ºC and -40 to 105ºC
		–	0.1	–	ps	f = 156.25 or 322.265625 MHz, IEEE802.3-2005 10GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz, all Vdd levels.
Jitter – 5.0 x 3.2 mm and 3.2 x 2.5 mm Packages						
RMS Period Jitter[1]	T_jitt	–	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3V or 2.5V, Pull Range = 100 ppm.
RMS Phase Jitter (random)	T_phj		0.225	0.282	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs, pull range = 100 ppm. Temperature ranges -20 to 70ºC and -40 to 85ºC.
		–	0.225	0.315	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs, pull range = 100 ppm. Temperature ranges -40 to 95 ºC and -40 to 105ºC
		–	0.1	–	ps	f = 156.25 or 322.265625 MHz, IEEE802.3-2005 10GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz, all Vdd levels.

Notes:
1. Measured according to JESD65B

Table 3. Electrical Characteristics – LVDS Specific

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Current Consumption						
Current Consumption	Idd	–	–	89	mA	Excluding Load Termination Current, Vdd = 3.3V or 2.5V
OE Disable Supply Current	I_OE	–	–	67	mA	OE = Low
Output Disable Leakage Current	I_leak	–	0.15	–	µA	OE = Low
Output Characteristics						
Differential Output Voltage	VOD	250	–	450	mV	See Figure 5
VOD Magnitude Change	ΔVOD	–	–	50	mV	See Figure 5
Offset Voltage	VOS	1.125	–	1.375	V	See Figure 5
VOS Magnitude Change	ΔVOS	–	–	50	mV	See Figure 5
Rise/Fall Time	Tr, Tf	–	370	470	ps	Measured with 2 pF capacitive loading to GND, 20% to 80%, see Figure 6
Jitter – 7.0 x 5.0 mm package						
RMS Period Jitter[2]	T_jitt	–	0.92	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3V or 2.5V, Pull Range = 100 ppm.
RMS Phase Jitter (random)	T_phj	–	0.215	0.265	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs, pull range = 100 ppm. Temperature ranges -20 to 70ºC and -40 to 85ºC.
		–	0.215	0.280	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs, pull range = 100 ppm. Temperature ranges -40 to 95 ºC and -40 to 105ºC
		–	0.1	–	ps	f = 156.25 or 322.265625 MHz, IEEE802.3-2005 10GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz, includes spurs, all Vdd levels.
Jitter – 5.0 x 3.2 mm and 3.2 x 2.5 mm packages						
RMS Period Jitter[2]	T_jitt	–	0.92	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3V or 2.5V, Pull Range = 100 ppm.
RMS Phase Jitter (random)	T_phj	–	0.235	0.282	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs, pull range = 100 ppm. Temperature ranges -20 to 70ºC and -40 to 85ºC.
		–	0.235	0.310	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs, pull range = 100 ppm. Temperature ranges -40 to 95 ºC and -40 to 105ºC
		–	0.1	–	ps	f = 156.25 or 322.265625 MHz, IEEE802.3-2005 10GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz, includes spurs, all Vdd levels.

Notes:
2. Measured according to JESD65B

Table 4. Electrical Characteristics – HCSL – Specific

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Current Consumption						
Current Consumption	Idd	–	–	102	mA	Excluding Load Termination Current, Vdd = 3.3V or 2.5V
OE Disable Supply Current	I_OE	–	–	67	mA	OE = Low
Output Disable Leakage Current	I_leak	–	0.15	–	µA	OE = Low
Maximum Output Current	I_driver	–	–	36	mA	Maximum average current drawn from OUT+ or OUT-
Output Characteristics						
Output High Voltage	VOH	0.6	–	0.90	V	See Figure 3
Output Low Voltage	VOL	-0.05	–	0.08	V	See Figure 3
Output Differential Voltage Swing	V_Swing	1.2	1.4	1.8	V	See Figure 4
Rise/Fall Time	Tr, Tf	–	360	470	ps	Measured with 2 pF capacitive loading to GND, 20% to 80%, see Figure 4
Jitter – 7.0 x 5.0 mm package						
RMS Period Jitter[3]	T_jitt	–	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3V or 2.5V, Pull Range = 100 ppm.
RMS Phase Jitter (random)	T_phj	–	0.215	0.265	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs, Pull Range = 100 ppm.
		–	0.215	0.282	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs, pull range = 100 ppm. Temperature ranges -20 to 70ºC and -40 to 85ºC.
		–	0.1	–	ps	f = 156.25 or 322.265625 MHz, IEEE802.3-2005 10GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz, includes spurs, all Vdd levels.
Jitter – 5.0 x 3.2 mm and 3.2 x 2.5 mm packages						
RMS Period Jitter[3]	T_jitt	–	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3V or 2.5V, Pull Range = 100 ppm.
RMS Phase Jitter (random)	T_phj		0.235	0.282	0.215	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs, pull range = 100 ppm. Temperature ranges -20 to 70ºC and -40 to 85ºC.
			0.235	0.305	0.215	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs, pull range = 100 ppm. Temperature ranges -40 to 95 ºC and -40 to 105ºC
			0.1	–	0.1	f = 156.25 or 322.265625 MHz, IEEE802.3-2005 10GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz, includes spurs, all Vdd levels.

Notes:
3. Measure according to JESD65B.

Table 5. Pin Description

Pin	Symbol	Functionality	
1	VIN	Input	Control Voltage
2	NC/OE	No Connect (NC)	No Connect: Leave floating or connect to GND for better heat dissipation. NC for all 3.2 x 2.5 mm package options.
		Output Enable (OE)	H[4,5]: specified frequency output L: output is high impedance. Only output driver is disabled. OE function only available on 7050 package. Pin 2 on 3225 package is NC.
3	GND	Power	Vdd Power Supply Ground
4	OUT+	Output	Oscillator output
5	OUT-	Output	Complementary oscillator output
6	Vdd	Power	Power supply voltage[6]

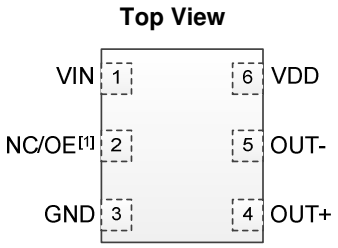


Figure 1. Pin Assignments (7.0 x 5.0 mm and 5.0 x 3.2 mm packages)

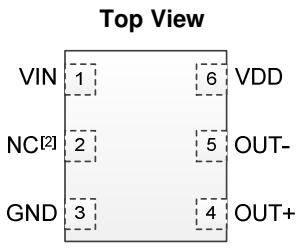


Figure 2. Pin Assignments (3.2 x 2.5 mm package)

Notes:

4. A pull-up resistor of 10 kΩ or less is recommended if pin 1 is not externally driven.
5. OE mode is only available in the 7050 and 5032 packages. 3225 package is NC.
6. 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.

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	ºC
Maximum Junction Temperature		130	ºC
Soldering Temperature (follow standard Pb-free soldering guidelines)		260	ºC

Table 7. Thermal Considerations[7]

Package	θ_{JA}, 4 Layer Board (°C/W)	θ_{JC}, Bottom (°C/W)
3225, 6-pin	80	30
5032, 6-pin	TBD	TBD
7050, 6-pin	52	19

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

Table 8. Maximum Operating Junction Temperature[8]

Max Operating Temperature (ambient)	Maximum Operating Junction Temperature
70°C	95°C
85°C	110°C
95°C	120°C
105°C	130°C

Notes:
8. 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	*g*
Mechanical Vibration Resistance	**MIL-STD-883F, Method 2007**	70	*g*
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

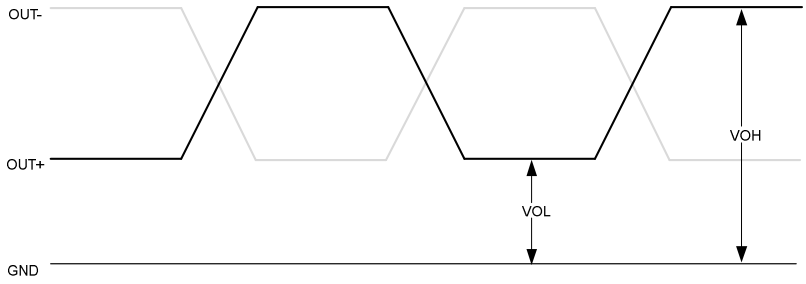


Figure 3. LVPECL/HCSL Voltage Levels per Differential Pin (OUT+/OUT-)

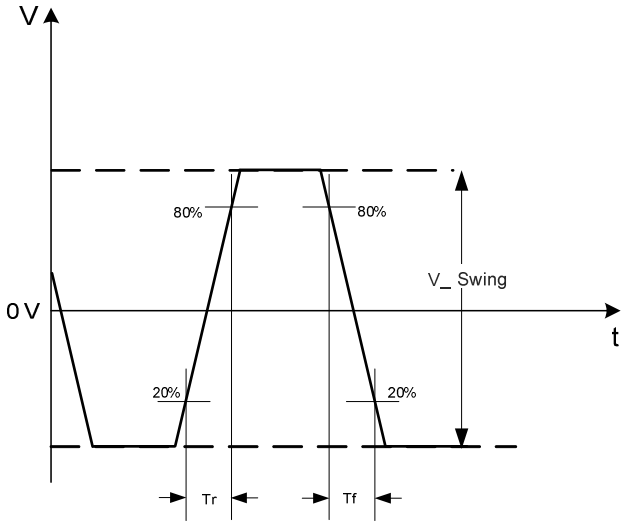


Figure 4. LVPECL/HCSL Voltage Levels across Differential Pair

Waveform Diagrams (continued)

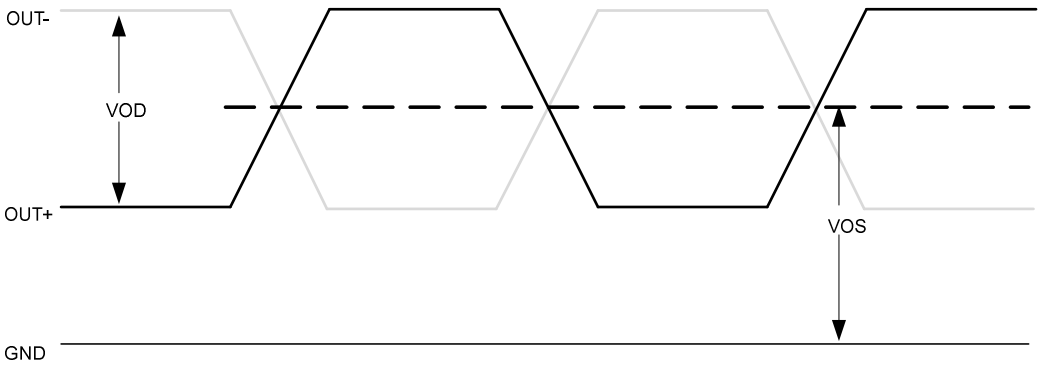


Figure 5. LVDS Voltage Levels per Differential Pin (OUT+/OUT-)

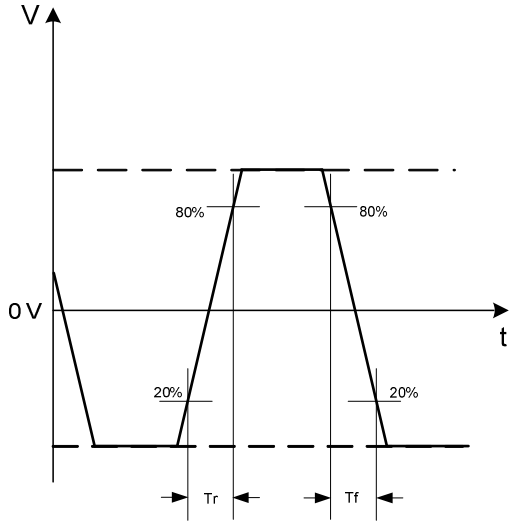


Figure 6. LVDS Differential Waveform

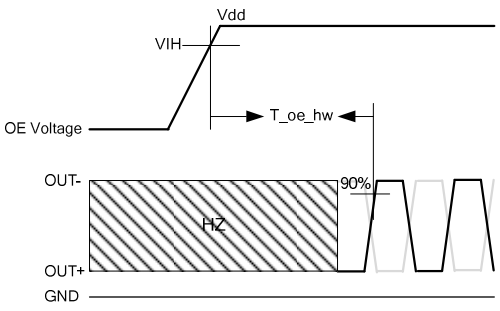


Figure 7. Hardware OE Enable Timing

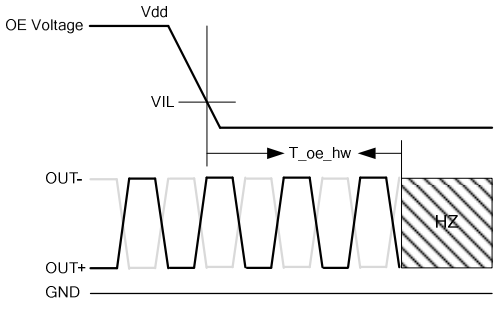


Figure 8. Hardware OE Disable Timing

Termination Diagrams

LVPECL:

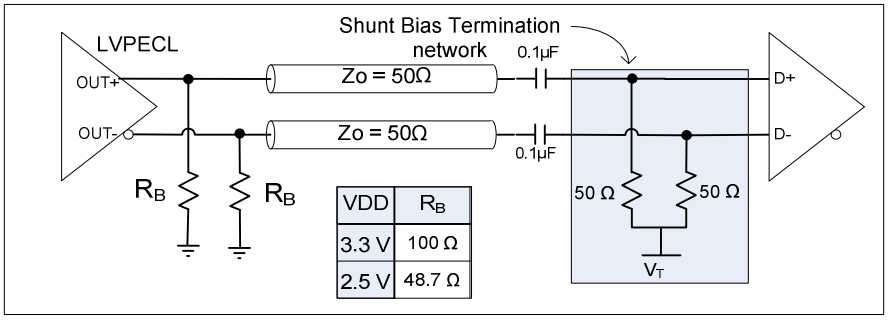


Figure 9. LVPECL with AC-coupled termination

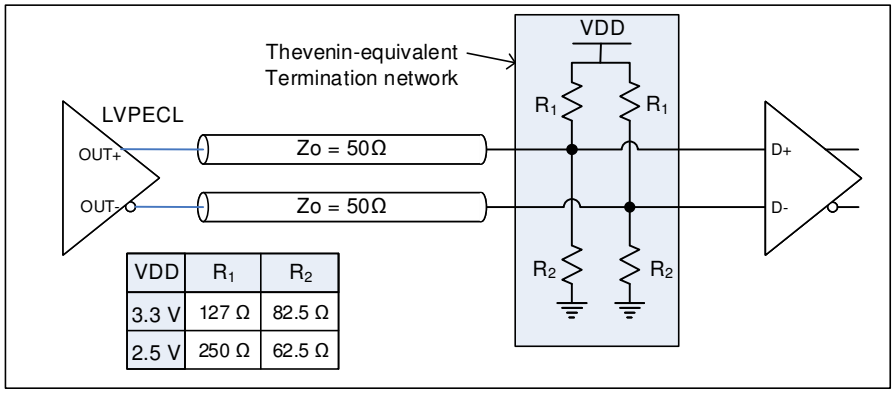


Figure 10. LVPECL DC-coupled load termination with Thevenin equivalent network

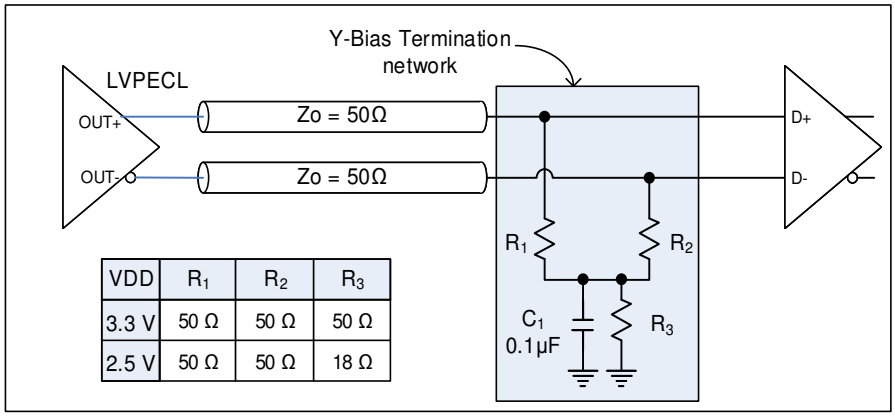


Figure 11. LVPECL with Y-Bias termination

Termination Diagrams (continued)

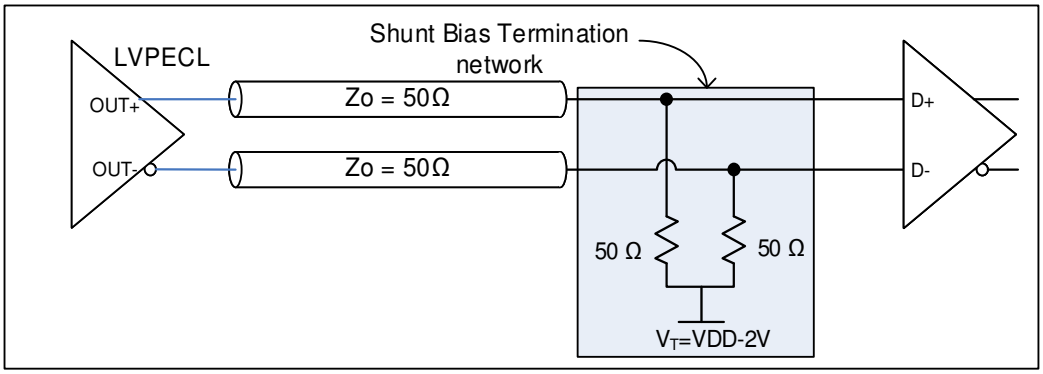


Figure 12. LVPECL with DC-coupled parallel shunt load termination

Termination Diagrams (continued)

LVDS:

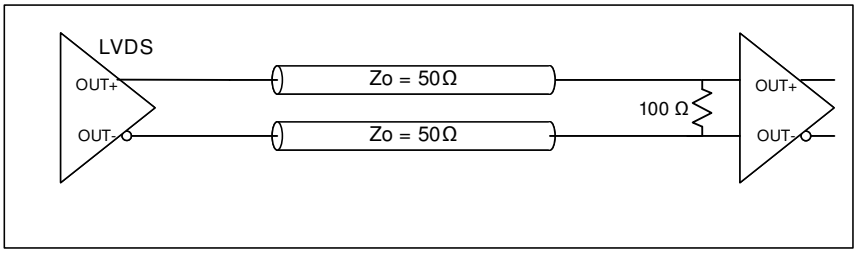


Figure 13. LVDS single DC termination at the load

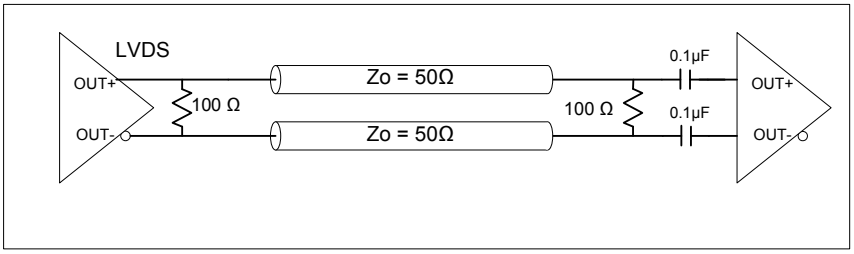


Figure 14. LVDS double AC termination with capacitor close to the load

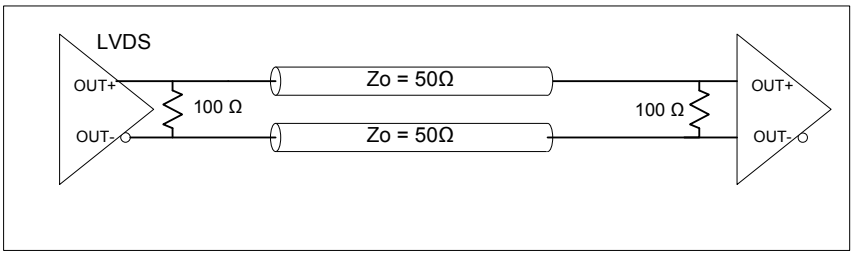


Figure 15. LVDS double DC termination

Termination Diagrams (continued)

HCSL:

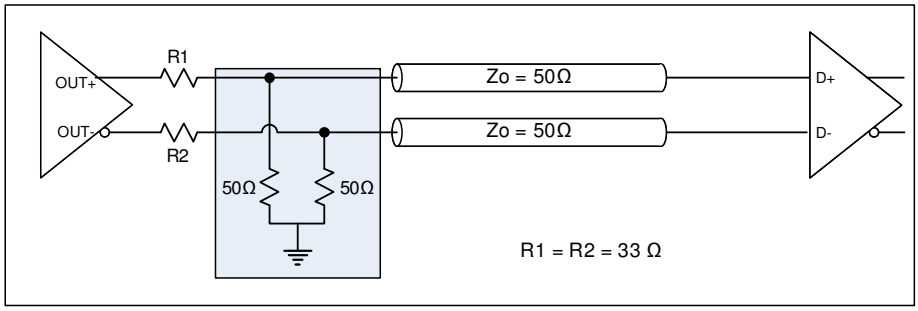
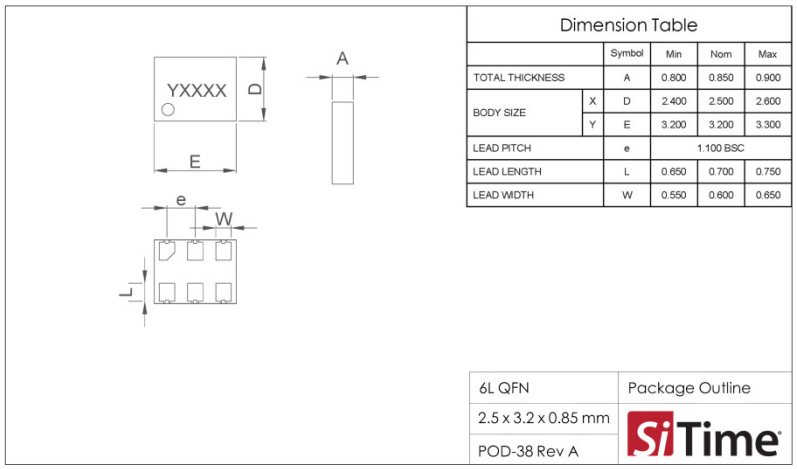


Figure 16. HCSL interface termination

Dimensions and Patterns

Package Size – Dimensions (Unit: mm)[9]	Recommended Land Pattern (Unit: mm)[10]

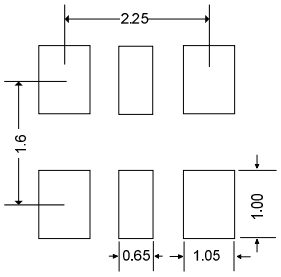
3.2 x 2.5 x 0.85 mm



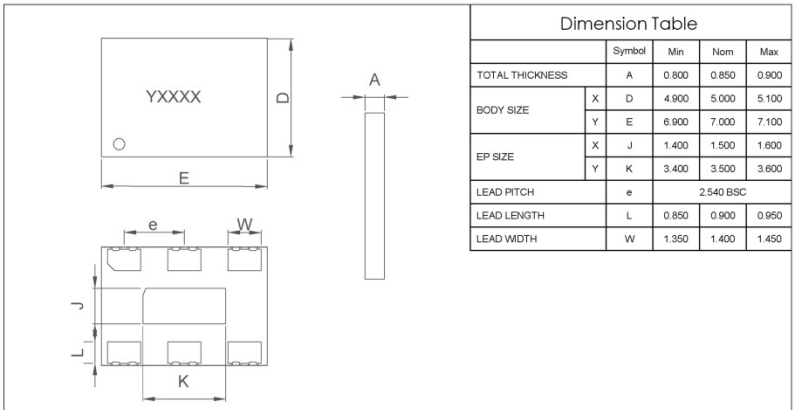
Dimension Table					
		Symbol	Min	Nom	Max
TOTAL THICKNESS		A	0.800	0.850	0.900
BODY SIZE	X	D	2.400	2.500	2.600
	Y	E	3.200	3.200	3.300
LEAD PITCH		e	1.100 BSC		
LEAD LENGTH		L	0.650	0.700	0.750
LEAD WIDTH		W	0.550	0.600	0.650

6L QFN	Package Outline
2.5 x 3.2 x 0.85 mm	SiTime
POD-38 Rev A	

3.2 x 2.5 x 0.85 mm



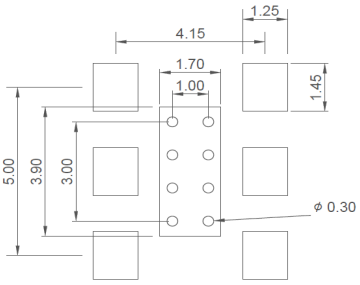
7.0 x 5.0 x 0.85 mm[11]



Dimension Table					
		Symbol	Min	Nom	Max
TOTAL THICKNESS		A	0.800	0.850	0.900
BODY SIZE	X	D	4.900	5.000	5.100
	Y	E	6.900	7.000	7.100
EP SIZE	X	J	1.400	1.500	1.600
	Y	K	3.400	3.500	3.600
LEAD PITCH		e	2.540 BSC		
LEAD LENGTH		L	0.850	0.900	0.950
LEAD WIDTH		W	1.350	1.400	1.450

6L QFN	Package Outline
5.0 x 7.0 x 0.85 mm	SiTime
POD-37 Rev A	

7.0 x 5.0 x 0.85 mm[11]



Note:
Circles in center pad are thermal vias, recommended to improve thermal performance

Notes:

9. 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.
10. 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
11. 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

SiT3373AC-1B2-33NH220.123456T

Part Family
"SiT3373"

Revision Letter
"A" is the revision of Silicon

Temperature Range
"C": Extended Commercial, -20 to 70°C
"I": Industrial, -40 to 85°C
"B": -40 to 95°C
"E": Extended Industrial, -40 to 105°C

Signalling Type
"1": LVPECL
"2": LVDS
"4": HCSL

Package Size
"B": 3.2 x 2.5 mm
"C": 5.0 x 3.2 mm with center pad
"E": 7.0 x 5.0 mm with center pad

Frequency Stability
"H": ±15 ppm[12]
"2": ±25 ppm
"9": ±35 ppm
"3": ±50 ppm

Packaging
"T", "Y", "D" or "E"
Refer to table below for packing method
Leave Blank for Bulk[13]

Frequency
220.000001 MHz to 725.000000 MHz

Pull Range Options[14]
"M": ±25 ppm
"B": ±50 ppm
"C": ±80 ppm
"E": ±100 ppm
"G": ±150 ppm
"H": ±200 ppm
"X": ±400 ppm
"Y": ±800 ppm
"Z": ±1600 ppm
"U": ±3200 ppm

Feature Pin[15]
"N": No Connect
"E": Output Enable

Voltage Supply
"25": 2.5 V ±10%
"28": 2.8 V ±10%
"30": 3.0 V ±10%
"33": 3.3 V ±10%

Notes:
12. Contact SiTime for ±15 ppm
13. Bulk is available for sampling only
14. Contact SiTime for custom pull range options
15. "E": Output Enable function is only available in 7.0 x 5.0 mm and 5.0 x 3.2 mm packages

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
5.0 x 3.2	—	—	T	Y	—	—
3.2 x 2.5	D	E	T	Y	—	—

Table 11. APR Table

Absolute pull range (APR) = Nominal pull range (PR) - frequency stability (F_stab) - aging [16]

Nominal Pull Range	Frequency Stability			
	± 15	± 25	± 35	±50
	APR (ppm)			
± 25	± 5	—	—	—
± 50	± 30	± 20	± 10	—
± 80	± 60	± 50	± 40	± 25
± 100	± 80	± 70	± 60	± 45
± 150	± 130	± 120	± 110	± 95
± 200	± 180	± 170	± 160	± 145
± 400	± 380	± 370	± 360	± 345
± 800	± 780	± 770	± 760	± 745
± 1600	± 1580	± 1570	± 1560	± 1545
± 3200	± 3180	± 3170	± 3160	± 3145

Note:
16. Aging includes solder down shift and 20-year aging.

Table 12. 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.	—
Manufacturing Notes	Tape & Reel dimension, reflow profile and other manufacturing related info	http://www.sitime.com/manufacturing-notes
Qualification Reports	RoHS report, reliability reports, composition reports	http://www.sitime.com/support/quality-and-reliability
Performance Reports	Additional performance data such as phase noise, current consumption and jitter for selected frequencies	http://www.sitime.com/support/performance-measurement-report
Termination Techniques	Termination design recommendations	http://www.sitime.com/support/application-notes
Layout Techniques	Layout recommendations	http://www.sitime.com/support/application-notes

Table 13. Revision History

Revision	Release Date	Change Summary
1.0	10/13/2017	Initial release
1.01	02/02/2018	Corrected ppm ordering codes. Corrected minor formatting errors. Added Additional Information table. Added Extended Industrial temperature range (-40 ºC – 95ºC and -40 ºC – 105ºC)
1.03	05/10/2018	Updated the Part Ordering info with added 5.0 x 3.2 mm package

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