

SiT9366

1 MHz to 220 MHz Ultra-low Jitter Differential Oscillator



Description

The [SiT9366](#) is a 1 MHz to 220 MHz differential MEMS XO engineered for low-jitter applications. Utilizing SiTime's unique DualMEMS™ temperature sensing and TurboCompensation™ technology, the SiT9366 delivers exceptional dynamic performance by providing resistance to airflow, thermal gradients, shock and vibration. This device also integrates multiple on-chip regulators to filter power supply noise, eliminating the need for a dedicated external LDO.

The SiT9366 can be factory programmed for any combination of frequency, stability, voltage, and output signaling. Programmability enables designers to optimize clock configurations while eliminating long lead times and customization costs associated with quartz devices where each frequency is custom built.

The wide frequency range and programmability makes this device ideal for telecom, networking, and industrial applications that require a variety of frequencies and operate in noisy environments.

Refer to [Manufacturing Notes](#) for proper reflow profile, tape and reel dimension, and other manufacturing related information.

Features

- Any frequency between 1 MHz and 220 MHz accurate to 6 decimal places
(For additional frequencies, refer to [SiT9367](#) and [SiT9365](#) datasheets)
- LVPECL, Low-swing LVPECL, LVDS and HCSL output signaling
- 0.1 ps RMS phase jitter (random) for Ethernet applications
- Frequency stability as low ± 10 ppm
- Wide temperature ranges from -40°C to 105°C
- Industry-standard packages: $7.0 \times 5.0 \text{ mm}^2$, $5.0 \times 3.2 \text{ mm}^2$, $3.2 \times 2.5 \text{ mm}^2$ packages

Applications

- 10/40/100 Gbps Ethernet, SONET, SATA, SAS, Fibre Channel
- Telecom, networking, instrumentation, storage, servers



Block Diagram

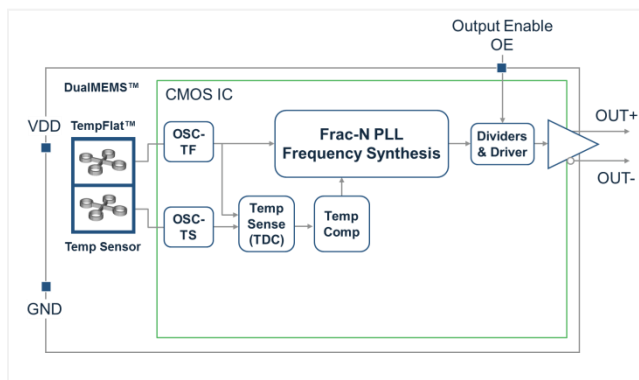


Figure 1. SiT9366 Block Diagram

Package Pinout

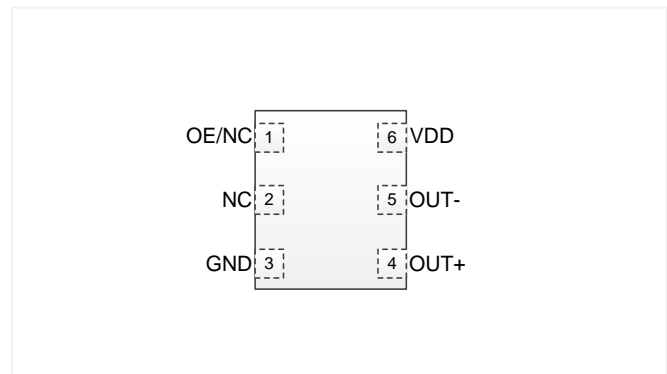
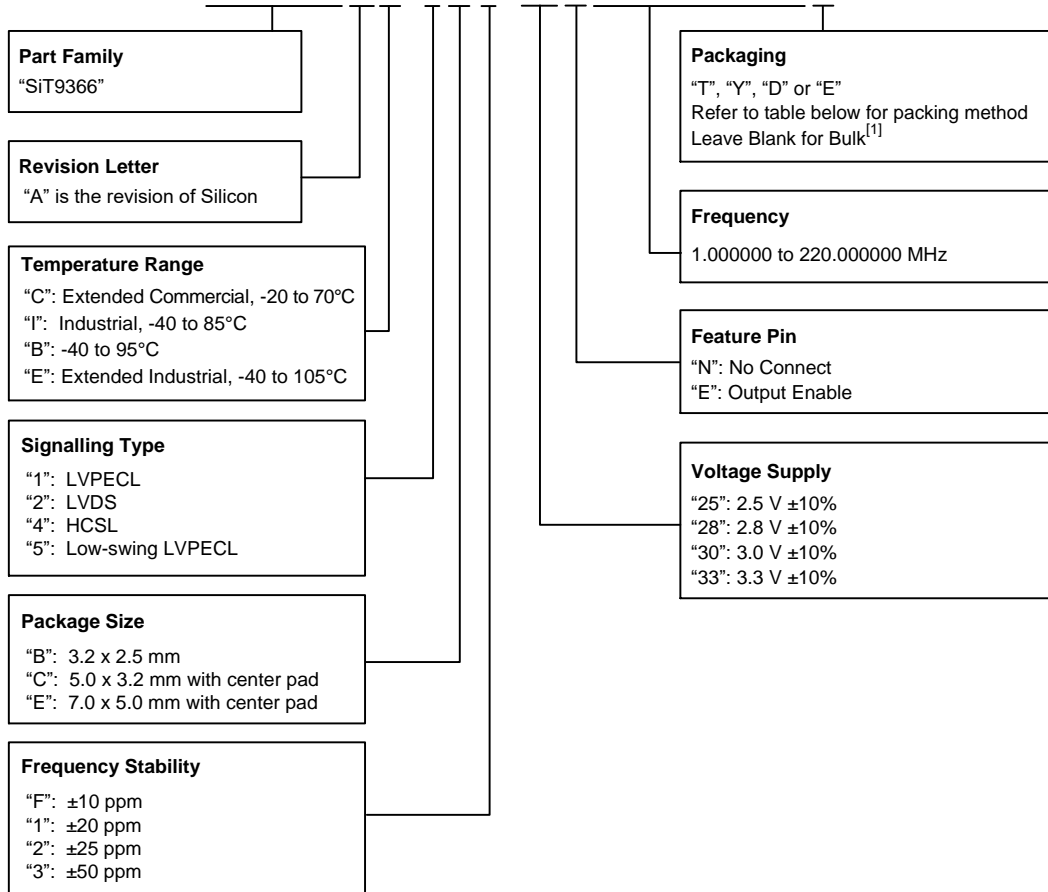


Figure 2. Pin Assignments (Top view)
(Refer to [Table 6](#) for Pin Descriptions)

Ordering Information

SiT9366AC-1B2-33E125.000000T



Notes:

1. Bulk is available for sampling only

Table 1. 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			—	—

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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 2. Electrical Characteristics – Common to LVPECL, Low-swing LVPECL, LVDS and HCSL (All temperature ranges)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Frequency Range						
Output Frequency Range	f	1	–	220.000001	MHz	Accurate to 6 decimal places
Frequency Stability						
Frequency Stability	F_stab	-10	–	+10	ppm	Inclusive of initial tolerance, operating temperature, rated power supply voltage and load variations
		-20	–	+20	ppm	
		-25	–	+25	ppm	
		-50	–	+50	ppm	
First Year Aging	F_1y	-0.7	±0.4	+0.7	ppm	At 85°C
5 Year Aging	F_5y	-1.1	±0.7	+1.1	ppm	At 85°C
10 Year Aging	F_10y	-1.3	±0.8	+1.3	ppm	At 85°C
20 Year Aging	F_20y	-1.5	±1.0	+1.5	ppm	At 85°C
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	
Input Characteristics						
Input Voltage High	VIH	70%	–	–	Vdd	Pin 1, OE
Input Voltage Low	VIL	–	–	30%	Vdd	Pin 1, OE
Input Pull-up Impedance	Z_in	–	100	-	kΩ	Pin 1, OE logic high or logic low
Output Characteristics						
Duty Cycle	DC	45	–	55	%	
Startup and OE Timing						
Startup 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 = 156.25 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 8 and Figure 9 .

Table 3. Electrical Characteristics – LVPECL, Low-swing LVPECL

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Current Consumption						
Current Consumption	I _{dd}	–	–	89	mA	Excluding Load Termination Current, V _{dd} = 3.3V or 2.5V
OE Disable Supply Current	I _{OE}	–	–	58	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 for LVPECL						
Output High Voltage	VOH	V _{dd} -1.1	–	V _{dd} -0.7	V	See Figure 4
Output Low Voltage	VOL	V _{dd} -1.9	–	V _{dd} -1.5	V	See Figure 4
Output Differential Voltage Swing	V _{Swing}	1.2	1.6	2.0	V	See Figure 5
Rise/Fall Time	T _r , T _f	–	225	290	ps	20% to 80%, See Figure 5
Output Characteristics for Low-swing LVPECL						
Output High Voltage	VOH	V _{dd} -1.2	–	V _{dd} -0.75	V	See Figure 4
Output Low Voltage	VOL	V _{dd} -1.8	–	V _{dd} -1.25	V	See Figure 4
Output Differential Voltage Swing	V _{Swing}	0.4	1	1.2	V	Output frequency 1 to 220 MHz, See Figure 5
		0.4	1	1.6	V	Output frequency greater than 220 MHz, See Figure 5
Rise/Fall Time	T _r , T _f	–	225	290	ps	20% to 80%. See Figure 5
Jitter – 7.0 x 5.0 mm Package						
RMS Period Jitter ^[2]	T _{jitt}	–	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, V _{dd} = 3.3V or 2.5V
RMS Phase Jitter (random)	T _{phj}	–	0.225	0.270	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V _{dd} levels, includes spurs. Temperature ranges -20 to 70°C and -40 to 85°C
		–	0.225	0.300	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V _{dd} levels, includes spurs. Temperature ranges -40 to 95°C and -40 to 105°C
		–	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 V _{dd} levels.
Jitter – 5.0 x 3.2 and 3.2 x 2.5 mm Packages						
RMS Period Jitter ^[2]	T _{jitt}	–	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, V _{dd} = 3.3V or 2.5V
RMS Phase Jitter (random)		–	0.225	0.275	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V _{dd} levels, includes spurs. Temperature ranges -20 to 70°C and -40 to 85°C
		–	0.225	0.340	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V _{dd} levels, includes spurs. Temperature ranges -40 to 95°C and -40 to 105°C
		–	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 V _{dd} levels.

Notes:

- Measured according to JESD65B

Table 4. Electrical Characteristics – LVDS

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Current Consumption						
Current Consumption	I _{dd}	–	–	79	mA	Excluding Load Termination Current, V _{dd} = 3.3V or 2.5V
OE Disable Supply Current	I _{OE}	–	–	58	mA	OE = Low
Output Disable Leakage Current	I _{leak}	–	0.15	–	μA	OE = Low
Output Characteristics						
Differential Output Voltage	V _{OD}	300	–	450	mV	See Figure 6
Delta VOD	ΔV _{OD}	–	–	50	mV	See Figure 6
Offset Voltage	V _{OS}	1.125	–	1.375	V	See Figure 6
Delta VOS	ΔV _{OS}	–	–	50	mV	See Figure 6
Rise/Fall Time	T _r , T _f	–	400	470	ps	Measured with 2 pF capacitive loading to GND, 20% to 80%, see Figure 7
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, V _{dd} = 3.3V or 2.5V
RMS Phase Jitter (random)	T _{phj}	–	0.215	0.265	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V _{dd} levels, includes spurs. Temperature ranges -20 to 70°C and -40 to 85°C
		–	0.215	0.300	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V _{dd} levels, includes spurs. Temperature ranges -40 to 95°C and -40 to 105°C
		–	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 V _{dd} levels.
Jitter – 5.0 x 3.2 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, V _{dd} = 3.3V or 2.5V
RMS Phase Jitter (random)	T _{phj}	–	0.235	0.275	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V _{dd} levels, includes spurs. Temperature ranges -20 to 70°C and -40 to 85°C
		–	0.235	0.320	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V _{dd} levels, includes spurs. Temperature ranges -40 to 95°C and -40 to 105°C
		–	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 V _{dd} levels.

Notes:

- Measured according to JESD65B

Table 5. Electrical Characteristics – HCSL

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Current Consumption						
Current Consumption	I _{dd}	–	–	89	mA	Excluding Load Termination Current, V _{dd} = 3.3V or 2.5V
OE Disable Supply Current	I _{OE}	–	–	58	mA	OE = Low
Output Disable Leakage Current	I _{leak}	–	0.15	–	μA	OE = Low
Maximum Output Current	I _{driver}	–	–	35	mA	Maximum average current drawn from OUT+ or OUT-
Output Characteristics						
Output High Voltage	VOH	0.60	–	0.90	V	See Figure 4
Output Low Voltage	VOL	-0.05	–	0.08	V	See Figure 4
Output Differential Voltage Swing	V _{Swing}	1.2	1.4	1.80	V	See Figure 5
Rise/Fall Time	Tr, Tf	–	360	465	ps	Measured with 2 pF capacitive loading to GND, 20% to 80%, see Figure 5
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, V _{dd} = 3.3V or 2.5V
RMS Phase Jitter (random)	T _{phj}	–	0.220	0.270	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V _{dd} levels, includes spurs. Temperature ranges -20 to 70°C and -40 to 85°C
		–	0.220	0.300	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V _{dd} levels, includes spurs. Temperature ranges -40 to 95°C and -40 to 105°C
		–	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 V _{dd} levels.
Jitter – 5.0 x 3.2 and 3.2 x 2.5 mm Packages						
RMS Period Jitter ^[4]	T _{jitt}	–	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, V _{dd} = 3.3V or 2.5V
RMS Phase Jitter (random)	T _{phj}	–	0.230	0.275	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V _{dd} levels, includes spurs. Temperature ranges -20 to 70°C and -40 to 85°C
		–	0.230	0.340	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V _{dd} levels, includes spurs. Temperature ranges -40 to 95°C and -40 to 105°C
		–	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 V _{dd} levels.

Notes:

4. Measured according to JESD65B

Table 6. Pin Description

Pin	Map	Functionality	
1	OE/NC	Output Enable (OE)	H ^[5] : 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 _{dd} Power Supply Ground
4	OUT+	Output	Oscillator output
5	OUT-	Output	Complementary oscillator output
6	V _{dd}	Power	Power supply voltage ^[6]

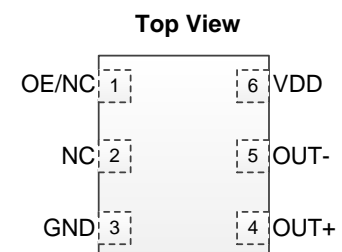


Figure 3. Pin Assignments

Notes:

5. In OE mode, a pull-up resistor of 10 kΩ or less is recommended if pin 1 is not externally driven.
6. A capacitor of value 0.1 μF or higher between V_{DD} and GND is required. An additional 10 μF capacitor between V_{DD} and GND is required for the best phase jitter performance.

Table 7. 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 8. Thermal Considerations^[7]

Package	θ_{JA} , 4 Layer Board (°C/W)	θ_{JC} , Bottom (°C/W)
3225, 6-pin	80	30
5032, 6-pin	53	20
7050, 6-pin	52	19

Notes:

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

Table 9. 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 10. 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

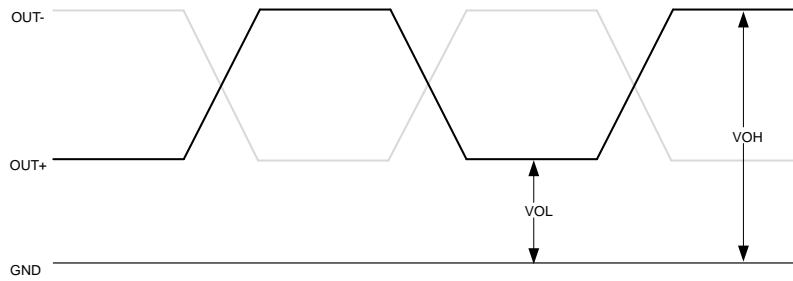


Figure 4. LVPECL, Low-swing LVPECL, and HCSL Voltage Levels per Differential Pin (i.e. OUT+, or OUT-)

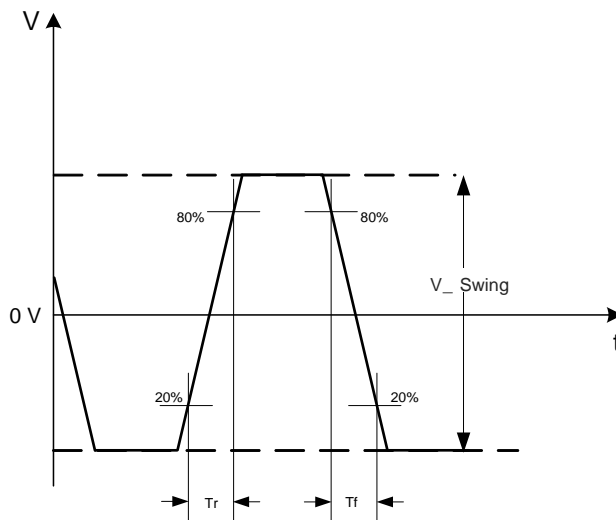


Figure 5. LVPECL, Low-swing LVPECL, and HCSL Voltage Levels Across Differential Pair (i.e. OUT+ minus OUT-)

Waveform Diagrams (continued)

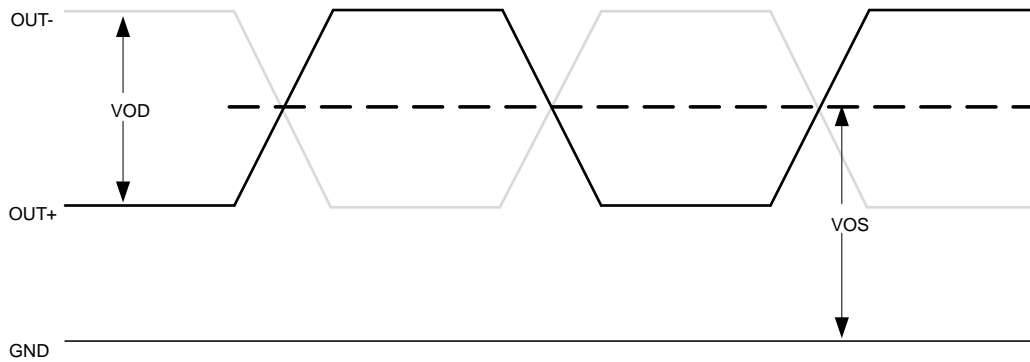


Figure 6. LVDS Voltage Levels per Differential Pin (i.e. OUT+, or OUT-)

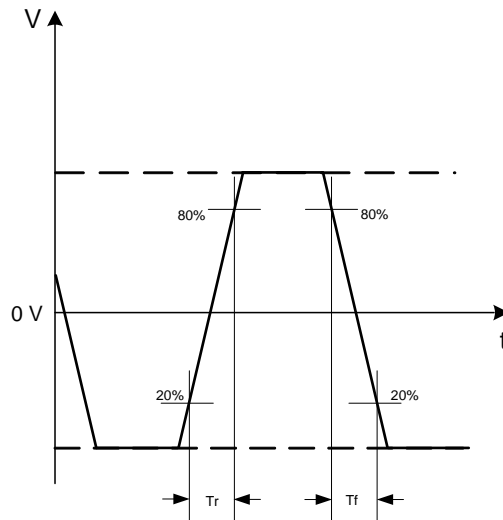


Figure 7. LVDS Differential Waveform (i.e. OUT+ minus OUT-)

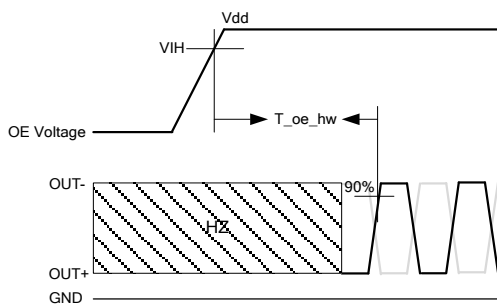


Figure 8. Hardware OE Enable Timing

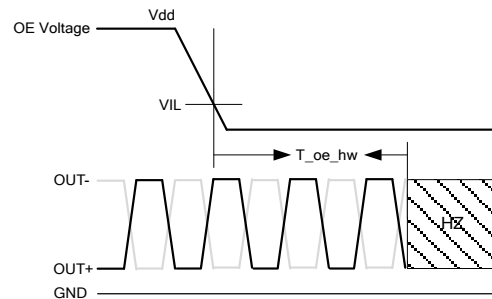


Figure 9. Hardware OE Disable Timing

Termination Diagrams

LVPECL and Low-swing LVPECL

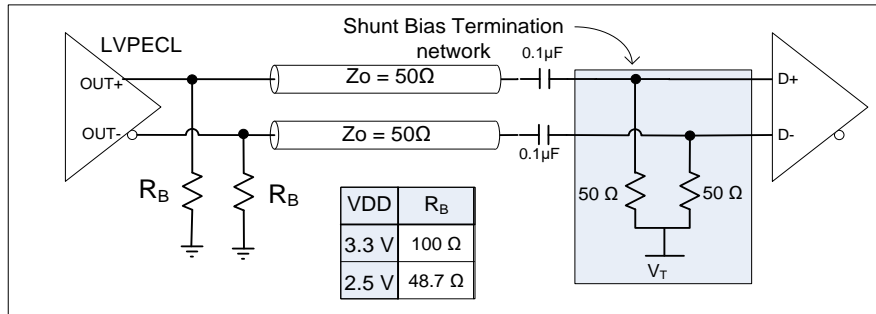


Figure 10. LVPECL and Low-swing LVPECL with AC-coupled Termination

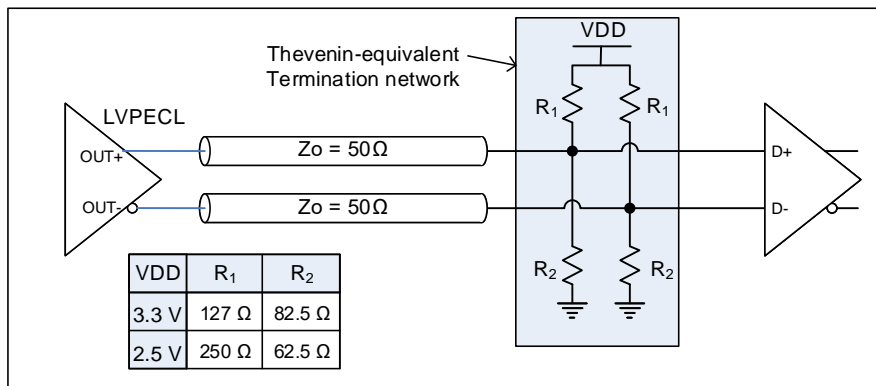


Figure 11. LVPECL and Low-swing LVPECL DC-coupled Load Termination with Thevenin Equivalent Network

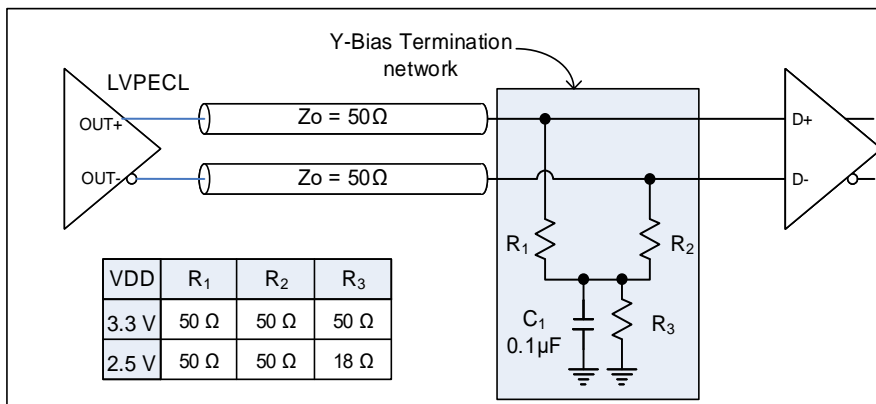


Figure 12. LVPECL and Low-swing LVPECL with Y-Bias Termination

Termination Diagrams (continued)

LVPECL and Low-swing LVPECL (continued)

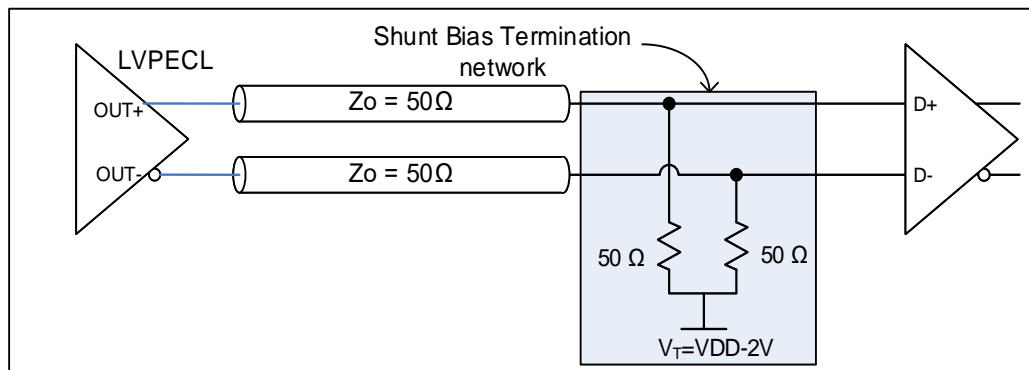


Figure 13. LVPECL and Low-swing LVPECL with DC-coupled Parallel Shunt Load Termination

Termination Diagrams (continued)

LVDS

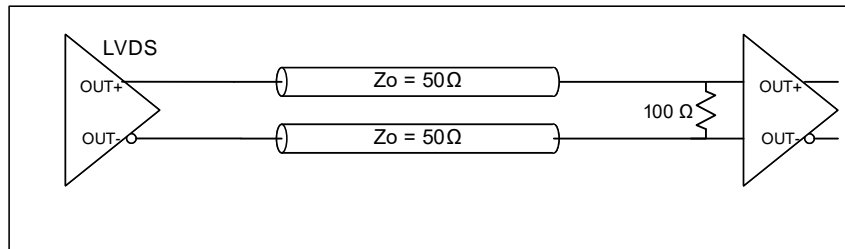


Figure 14. LVDS single DC Termination at the Load

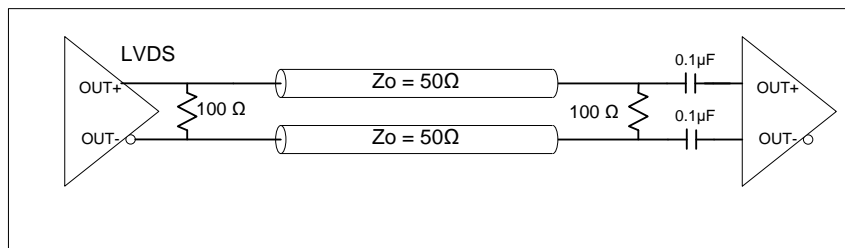


Figure 15. LVDS Double AC Termination with Capacitor Close to the Load

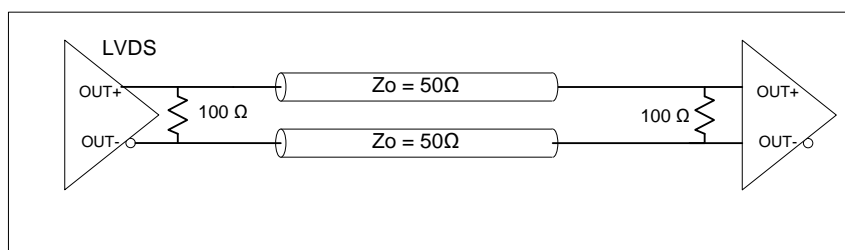


Figure 16. LVDS Double DC Termination

Termination Diagrams (continued)

HCSL

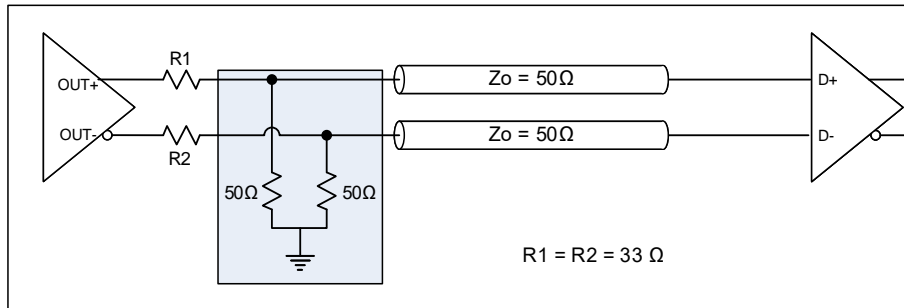


Figure 17. HCSL Interface Termination

Dimensions and Patterns — 3.2 x 2.5 mm²

Package Size – Dimensions (Unit: mm) ^[9]	Recommended Land Pattern (Unit: mm) ^[10]																																																																																									
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Dimensions and Patterns — 5.0 x 3.2 mm²

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Dimensions and Patterns — 7.0 x 5.0 mm²

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Additional Information

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.	—
HTS Classification Code: 8542.39.0000	A Harmonized Tariff Schedule (HTS) code developed by the World Customs Organization to classify/define internationally traded goods.	—
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
Evaluation Boards	SiT6085/6EB rev. 3.0, SiT6085EB rev.3.1 and SiT6097EB rev. 2.0 Evaluation Boards for Differential Oscillators User Manual	https://www.sitime.com/support/user-guides

Revision History

Table 12. Revision History

Revision	Release Date	Change Summary
1.0	09/06/2017	Final release
1.04	04/17/2018	Added 5032 package Added -40 to 95C and -40 to 105C temperature ranges Corrected minor errors Added Additional Information Table.
1.05	10/01/2018	Updated Ordering Information and performed minor edits Fixed formatting Updated 3225 package drawing to POD 38 RevA
1.06	10/25/2018	Removed "Contact SiTime" for ± 10 ppm
1.07	08/17/2019	Updated package Dimensions Drawings Updated Table 8 Thermal Considerations for 5032 package Updated Table 2 specification for First Year Aging Added 5, 10, and 20 year aging specs Added Evaluation Boards SiT6085EB reference in Additional Information Rearranged layout, added Description, Block Diagram and TOC Tightened LVDS minimum VOD specification Added HTS code Added low-swing LVPECL package code and specifications

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