

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 x 5.0 mm², 5.0 x 3.2 mm², 3.2 x 2.5 mm² packages

Applications

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



Block Diagram

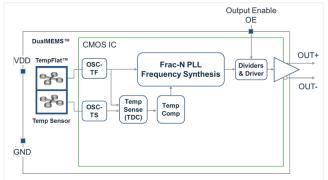


Figure 1. SiT9366 Block Diagram

Package Pinout

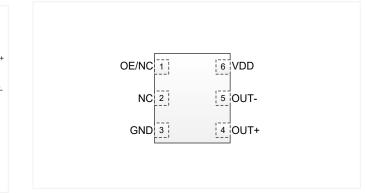
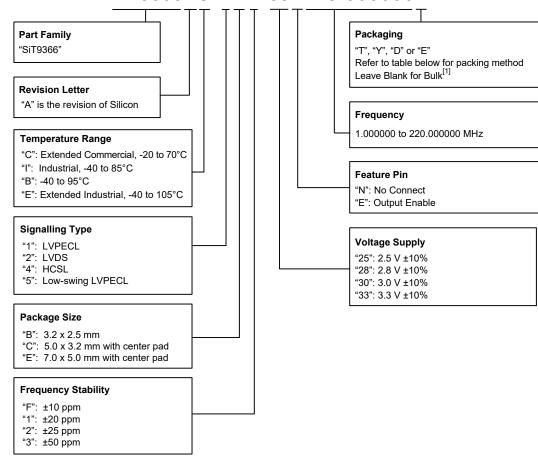


Figure 2. Pin Assignments (Top view) (Refer to Table 6 for Pin Descriptions)



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	_	_	_	—	Т	Y
5.0 x 3.2			Т	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.	Тур.	Max.	Unit	Condition
				Frequency Ra	nge	
Output Frequency Range	f	1	-	220.000001	MHz	Accurate to 6 decimal places
				Frequency Stal	oility	
Frequency Stability	F_stab	-10	-	+10	ppm	Inclusive of initial tolerance, operating temperature, rated power
		-20	-	+20	ppm	supply voltage and load variations
		-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 Ra	ange	
Operating Temperature Range	T_use	-20	-	+70	°C	Extended Commercial
		-40	-	+85	°C	Industrial
		-40	-	+95	°C	
		-40	-	+105	°C	Extended Industrial
				Supply Volta	ge	
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	
			1	Input Character	istics	1
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
-	1		(Output Characte	ristics	
Duty Cycle	DC	45	-	55	%	
	1		;	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.	Тур.	Max.	Unit	Condition
		•	Curr	ent Consum	otion	
Current Consumption	ldd	-	-	89	mA	Excluding Load Termination Current, Vdd = 3.3 V or 2.5 V
OE Disable Supply Current	I_OE	-	-	58	mA	OE = Low
Output Disable Leakage Current	l_leak	-	0.15	-	μΑ	OE = Low
Maximum Output Current	I_driver	-	-	32	mA	Maximum average current drawn from OUT+ or OUT-
	_	-	Output Cha	racteristics f	for LVPEC	CL
Output High Voltage	VOH	Vdd-1.1	-	Vdd-0.7	V	See Figure 4
Output Low Voltage	VOL	Vdd-1.9	-	Vdd-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	Tr, Tf	-	225	290	ps	20% to 80%, See Figure 5
		Outp	ut Character	istics for Lo	w-swing l	LVPECL
Output High Voltage	VOH	Vdd-1.2	-	Vdd-0.75	V	See Figure 4
Output Low Voltage	VOL	Vdd-1.8	-	Vdd-1.25	V	See Figure 4
Output Differential Voltage	V_Swing	0.4	1	1.2	V	Output frequency 1 to 220 MHz, See Figure 5
Swing		0.4	1	1.6	V	Output frequency greater than 220 MHz, See Figure 5
Rise/Fall Time	Tr, Tf	-	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, Vdd = 3.3 V or 2.5 V
RMS Phase Jitter (random)	T_phj	-	0.225	0.270	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd 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 Vdd 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 Vdd levels.
		Jitte	er – 5.0 x 3.2	and 3.2 x 2.	5 mm Pac	ckages
RMS Period Jitter ^[2]	T_jitt	-	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3 V or 2.5 V
RMS Phase Jitter (random)		-	0.225	0.275	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd 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 Vdd 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 Vdd levels.

Notes:

2. Measured according to JESD65B.



Parameter	Symbol	Min.	Тур.	Max.	Unit	Condition
			Curre	ent Consum	ption	
Current Consumption	ldd	I	-	79	mA	Excluding Load Termination Current, Vdd = 3.3 V or 2.5 V
OE Disable Supply Current	I_OE	-	-	58	mA	OE = Low
Output Disable Leakage Current	l_leak	-	0.15	-	μA	OE = Low
			Outpu	ut Character	istics	
Differential Output Voltage	VOD	300	-	450	mV	See Figure 6
Delta VOD	Δνοd	-	-	50	mV	See Figure 6
Offset Voltage	VOS	1.125	-	1.375	V	See Figure 6
Delta VOS	ΔVOS	-	-	50	mV	See Figure 6
Rise/Fall Time	Tr, Tf	-	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	I	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3 V or 2.5 V
RMS Phase Jitter (random)	T_phj	-	0.215	0.265	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd 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 Vdd 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 Vdd levels.
		Jitte	er – 5.0 x 3.2	and 3.2 x 2.	5 mm Pac	skages
RMS Period Jitter ^[3]	T_jitt	I	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3 V or 2.5 V
RMS Phase Jitter (random)	T_phj	_	0.235	0.275	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd 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 Vdd 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 Vdd levels.

Notes: 3. Measured according to JESD65B.

SiTime



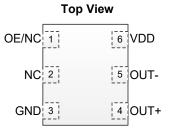
Parameter	Symbol	Min.	Тур.	Max.	Unit	Condition
			Curre	ent Consum	ption	
Current Consumption	ldd	-	-	89	mA	Excluding Load Termination Current, Vdd = 3.3 V or 2.5 V
OE Disable Supply Current	I_OE	-	-	58	mA	OE = Low
Output Disable Leakage Current	l_leak	-	0.15	-	μA	OE = Low
Maximum Output Current	I_driver	-	-	35	mA	Maximum average current drawn from OUT+ or OUT-
			Outpu	ut Characteri	istics	
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, Vdd = 3.3 V or 2.5 V
RMS Phase Jitter (random)	T_phj	-	0.220	0.270	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd 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 Vdd 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 Vdd levels.
		Jitte	er – 5.0 x 3.2	and 3.2 x 2.	5 mm Pac	skages
RMS Period Jitter ^[4]	T_jitt	-	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3 V or 2.5 V
RMS Phase Jitter (random)	T_phj	-	0.230	0.275	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd 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 Vdd 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 Vdd levels.

Notes:

4. Measured according to JESD65B.

Table 6. Pin Description

Pin	Мар	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	Vdd Power Supply Ground		
4	OUT+	Output	Oscillator output		
5	OUT-	Output	Complementary oscillator output		
6	Vdd	Power	Power supply voltage ^[6]		



Time



Notes:

5. In OE mode, a pull-up resistor of 10 k Ω or less is recommended if pin 1 is not externally driven.

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 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	$ heta_{JA}$, 4 Layer Board (°C/W)	$ heta_{ t 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 C	ompliant	



Waveform Diagrams

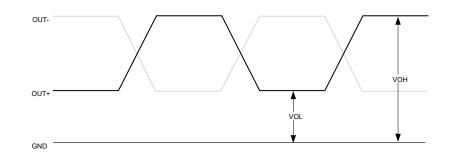


Figure 4. LVPECL, Low-swing LVPECL, and HCSL Voltage Levels per Differential Pin (i.e. OUT+, or OUT-)

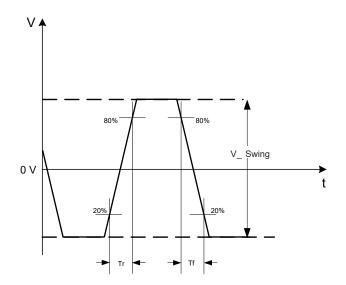


Figure 5. LVPECL, Low-swing LVPECL, and HCSL Voltage Levels Across Differential Pair (i.e. OUT+ minus OUT-)



Waveform Diagrams (continued)

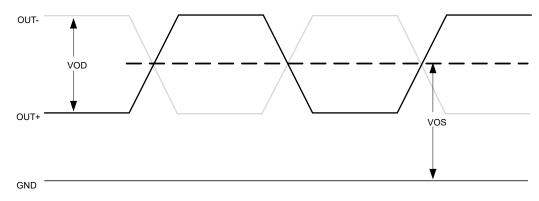
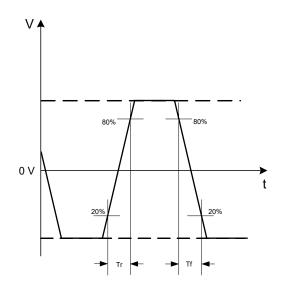
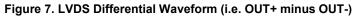
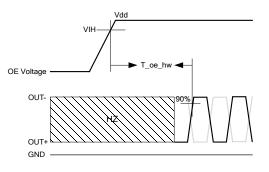


Figure 6. LVDS Voltage Levels per Differential Pin (i.e. OUT+, or OUT-)

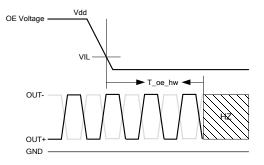


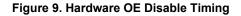


Timing Diagrams





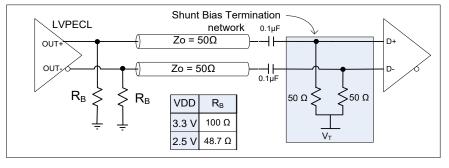






Termination Diagrams

LVPECL and Low-swing LVPECL





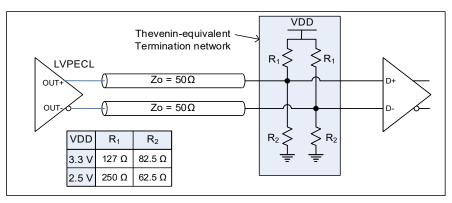


Figure 11. LVPECL and Low-swing LVPECL DC-coupled Load Termination with Thevenin Equivalent Network

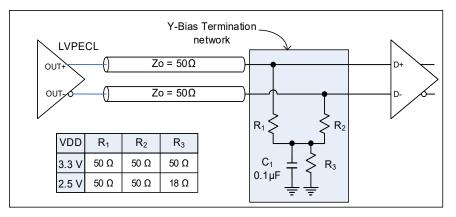


Figure 12. LVPECL and Low-swing LVPECL with Y-Bias Termination

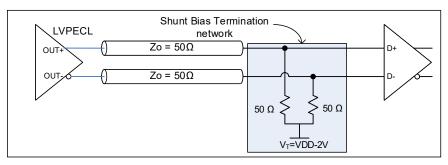
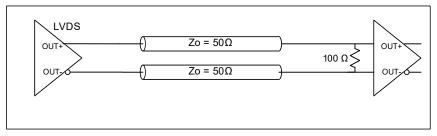


Figure 13. LVPECL and Low-swing LVPECL with DC-coupled Parallel Shunt Load Termination



Termination Diagrams (continued)

LVDS





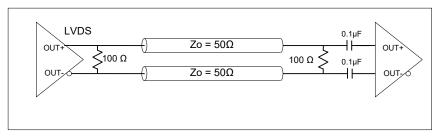


Figure 15. LVDS Double AC Termination with Capacitor Close to the Load

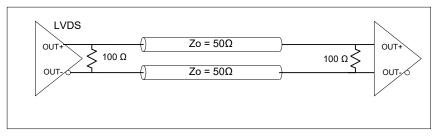


Figure 16. LVDS Double DC Termination

HCSL

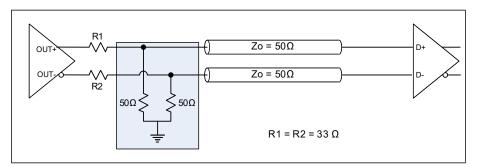
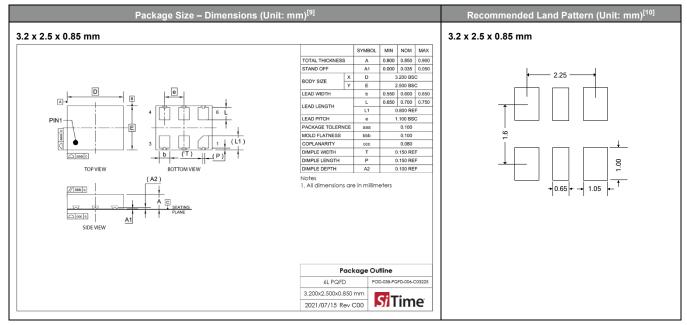


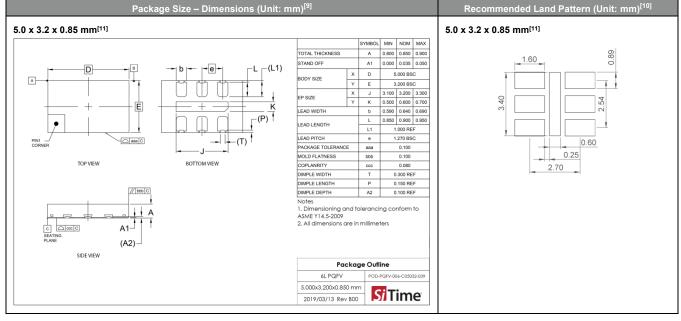
Figure 17. HCSL Interface Termination



Dimensions and Patterns — 3.2 x 2.5 mm²



Dimensions and Patterns — 5.0 x 3.2 mm²

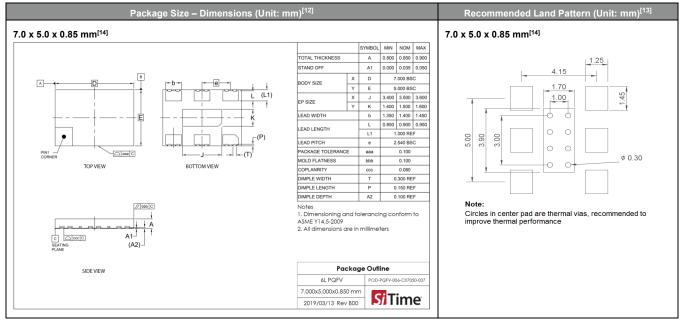


Notes:

- 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.



Dimensions and Patterns — 7.0 x 5.0 mm²



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 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.

14. The center pad has no electrical function. Soldering down the center pad to the GND is recommended for best thermal dissipation, but is optional.



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.	https://www.sitime.com/part-number-generator
Manufacturing Notes	Tape & Reel dimension, reflow profile and other manufacturing related info	https://www.sitime.com/sites/default/files/gated/Manufacturing-Notes-for-SiTime-Products.pdf
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	6-Sep-2017	Final release
1.04	17-Apr-2018	Added 5032 package Added -40 to 95°C and -40 to 105°C temperature ranges Corrected minor errors Added Additional Information Table.
1.05	1-Oct-2018	Updated Ordering Information and performed minor edits Fixed formatting Updated 3225 package drawing to POD 38 RevA
1.06	25-Oct-2018	Removed "Contact SiTime" for ±10 ppm
1.07	17-Aug-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
1.08	9-Mar-2021	Updated L1 and Dimple Width package dimensions for 3.2 x 2.5 mm package Updated trademarks, hyperlinks and changed rev table date format
1.09	20-Jul-2021	

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