

Description

The SiT3372 is a 1 MHz to 220 MHz differential MEMS VCXO engineered for low-jitter applications. Utilizing SiTime's unique DualMEMS[™] temperature sensing and TurboCompensation[™] technology, the SiT3372 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 SiT3372 can be factory programmed for any combination of frequency, stability, voltage, output signaling, and pull range. 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 pullable 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 frequencies 220.000001 MHz to 725 MHz, refer to SiT3373)
- Widest pull range options: ±25, ±50, ±80, ±100, ±150, ±200, ±400, ±800, ±1600, ±3200 ppm
- 0.225 ps RMS phase jitter (typ) over 12 kHz to 20 MHz bandwidth
- Frequency stability as low as ±15 ppm
- 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

Applications

- Cable Modem Termination System (CMTS), Video, Broadcasting System, Audio, Industrial Sensors, Remote Radio Head (RRH)
- SATA, SAS, 10/40/100/400 Gbps Ethernet, Fibre Channel, PCI-Express



Block Diagram

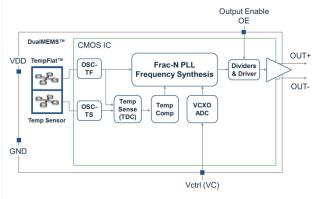


Figure 1. SiT3372 Block Diagram

3.2 x 2.5 mm Package Pinout

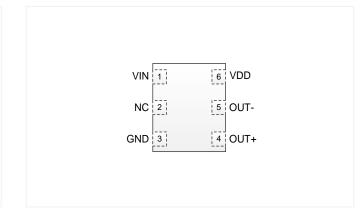
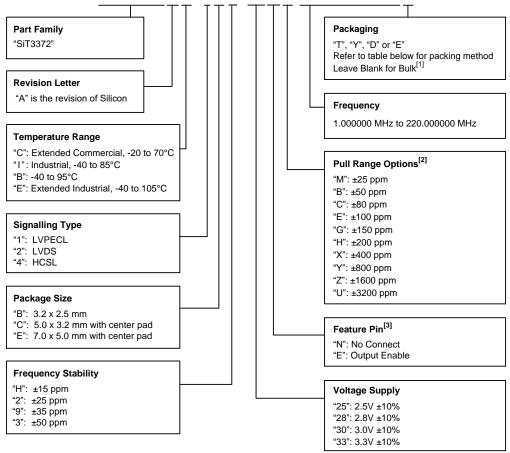


Figure 2. Pin Assignments (Top view) (Refer to Table 6 for Pin Descriptions)



Ordering Information

SiT3372AC-1B2-33NH122.123456T



Notes:

1. Bulk is available for sampling only.

2. Contact SiTime for custom pull range options.

3. "E": Output Enable function is only available in 7.0 x 5.0 mm and 5.0 x 3.2 mm packages.

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	Т	Y	-	-



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Electrical Characteristics

Table 2. 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 shown in the termination diagrams. Typical values are at 25°C and nominal supply voltage.

		<u> </u>	1				
Parameter	Symbol	Min.	Тур.	Max.	Unit	Condition	
	1		1	Frequency	Range	1	
Output Frequency Range	f	1	-	220	MHz	Accurate to 6 decimal places	
			-	Frequency S	Stability	T	
Frequency Stability	F_stab	-15	-	+15	ppm	Inclusive of initial tolerance, operating temperature, rated power	
		-25	-	+25	ppm	supply voltage, load variations, and first year aging at 25 °C, with VIN voltage at Vdd/2.	
		-35	-	+35	ppm	± 15 ppm is only guaranteed for pull range up to ± 100 ppm.	
		-50	-	+50	ppm		
			1	Femperature	e Range	1	
Operating Temperature Range	T_use	-20	-	+70	°C	Extended Commercial	
		-40	-	+85	°C	Industrial	
		-40	-	+95	°C		
		-40	-	+105	°C	Extended Industrial	
	_			Supply Vo	oltage		
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		
			Voltag	e Control C	haracteristi	cs	
Pull Range	PR		0, ±80, ±10 400, ±800		ppm	See the APR (Absolute Pull Range) Table 11. Contact SiTime for custom pull range options	
Upper Control Voltage	VC U	90%	±3200	_	Vdd	Voltage at which maximum frequency deviation is guaranteed	
Lower Control Voltage	VC_U VC_L			_ 10%	Vdd Vdd	Voltage at which minimum frequency deviation is guaranteed	
Control Voltage Input Impedance	VC_L VC_z	-	- 10	-	MΩ	Voltage at which minimum requency deviation is guaranteed	
Control Voltage Input Impedance		-	10	_	kHz	Contact SiTima for other input bandwidth antions	
• I	V_c	_	10	- 1.0	кпz %	Contact SiTime for other input bandwidth options	
Pull Range Linearity Frequency Change Polarity	Lin _	– Positive	- Slope	1.0	%		
Frequency change Folanty	-	FUSILIVE		put Charac			
Input Voltage High	VIH	70%	- In	put Charac	Vdd	Pin 2, OE	
Input Voltage Low	VIL	70%	_	- 30%	Vdd Vdd	Pin 2, OE Pin 2, OE	
	Z in	_	- 100	30%	νdd kΩ		
Input Pull-up Impedance	۲_۱۱۱	-		- Itput Chara		Pin 2, OE logic high or logic low	
Duty Cyclo	DC	45	- 01	55	%		
Duty Cycle		40					
Startur Time	Tatart			artup and C		Management from the time V/dd reaches its rated at initiation with	
Startup Time OE Enable/Disable Time	T_start T_oe	-	-	3.0 3.8	ms µs	Measured from the time Vdd reaches its rated minimum value 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 9 and Figure 10	



Table 3. Electrical Characteristics – LVPECL Specific

Parameter	Symbol	Min.	Тур.	Max.	Unit	Condition
				Irrent Cons	umption	
Current Consumption	ldd	-	78	92	mA	Excluding Load Termination Current, Vdd = 3.3V or 2.5V
OE Disable Supply Current	I_OE	-	53	61	mA	OE = Low
Output Disable Leakage Current	I_leak	-	0.15	-	μA	OE = Low
Maximum Output Current	I_driver	-	-	33	mA	Maximum average current drawn from OUT+ or OUT-
	•		Ou	tput Chara	cteristics	·
Output High Voltage	VOH	Vdd-1.15	-	Vdd-0.7	V	See Figure 5
Output Low Voltage	VOL	Vdd-2.0	-	Vdd-1.5	V	See Figure 5
Output Differential Voltage Swing	V_Swing	1.2	1.6	2.0	V	See Figure 6
Rise/Fall Time	Tr, Tf	-	225	290	ps	20% to 80%, see Figure 6
			Jitter	– 7.0 x 5.0 r	nm packag	je
RMS Period Jitter ^[4]	T_jitt	-	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 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 Vdd levels, includes spurs, pull range = \pm 100 ppm. 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, pull range = \pm 100 ppm. Temperature ranges -40 to 95 °C and -40 to 105 °C
		-	0.1	-	ps	f = 156.25 MHz, IEEE802.3-2005 10 GbE 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 mi	m package
RMS Period Jitter ^[4]	T_jitt	-	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3V or 2.5V
RMS Phase Jitter (random)	T_phj	-	0.225	0.275	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs, pull range = \pm 100 ppm. 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, pull range = \pm 100 ppm. Temperature ranges -40 to 95 °C and -40 to 105 °C
		-	0.1	-	ps	f = 156.25 MHz, IEEE802.3-2005 10 GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz, includes spurs, all Vdd levels

Notes: 4. Measured according to JESD65B.

Table 4. Electrical Characteristics – LVDS

Parameter	Symbol	Min.	Тур.	Max.	Unit	Condition			
			Cı	urrent Cons	sumption				
Current Consumption	Idd	-	73	84	mA	Excluding Load Termination Current, Vdd = 3.3V or 2.5V			
OE Disable Supply Current	I_OE	-	55	62	mA	OE = Low			
Output Disable Leakage Current	I_leak	-	0.15	-	μΑ	OE = Low			
	Output Characteristics								
Differential Output Voltage	VOD	250	-	450	mV	See Figure 7			
Delta VOD	ΔVOD	I	-	50	mV	See Figure 7			
Offset Voltage	VOS	1.125	-	1.375	V	See Figure 7			
Delta VOS	ΔVOS	-	-	50	mV	See Figure 7			
Rise/Fall Time	Tr, Tf	-	400	470	ps	Measured with 2 pF capacitive loading to GND, 20% to 80%, see Figure 8			
			Jitter	– 7.0 x 5.0	mm packag	ge			
RMS Period Jitter ^[5]	T_jitt	I	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 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 Vdd levels, includes spurs, pull range = ± 100 ppm. 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, pull range = ± 100 ppm. Temperature ranges -40 to 95 °C and -40 to 105 °C			
		-	0.1	-	ps	f = 156.25 MHz, IEEE802.3-2005 10 GbE 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 mi	m package			
RMS Period Jitter ^[5]	T_jitt	-	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3V or 2.5V			
RMS Phase Jitter (random)	T_phj	Ι	0.235	0.275	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs, pull range = \pm 100 ppm. 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, pull range = ± 100 ppm. Temperature ranges -40 to 95 °C and -40 to 105 °C			
		-	0.1	-	ps	f = 156.25 MHz, IEEE802.3-2005 10 GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz, includes spurs, all Vdd levels			

Notes: 5. Measured according to JESD65B.

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Table 5. Electrical Characteristics – HCSL

Parameter	Symbol	Min.	Тур.	Max.	Unit	Condition		
			Cı	urrent Cons	sumption			
Current Consumption	Idd	-	83	97	mA	Excluding Load Termination Current, Vdd = 3.3V or 2.5V		
OE Disable Supply Current	I_OE	-	55	62	mA	OE = Low		
Output Disable Leakage Current	I_leak	-	0.15	-	μA	OE = Low		
	Output Characteristics							
Output High Voltage	VOH	0.60	-	0.90	V	See Figure 5		
Output Low Voltage	VOL	-0.05	-	0.08	V	See Figure 5		
Output Differential Voltage Swing	V_Swing	1.2	1.4	1.80	V	See Figure 6		
Rise/Fall Time	Tr, Tf	-	360	495	ps	Measured with 2 pF capacitive loading to GND, 20% to 80%, See Figure $_{\rm 6}$		
			Jitter	– 7.0 x 5.0 i	mm packag	ge		
RMS Period Jitter ^[6]	T_jitt	Ι	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 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 Vdd levels, includes spurs, pull range = ± 100 ppm. 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, pull range = ± 100 ppm. Temperature ranges -40 to 95 °C and -40 to 105 °C		
		-	0.1	-	ps	f = 156.25 MHz, IEEE802.3-2005 10 GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz, includes spurs, all Vdd levels		
		Jitter	– 5.0 x 3.	2 mm and 3	3.2 x 2.5 mi	m package		
RMS Period Jitter ^[6]	T_jitt	I	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 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 Vdd levels, includes spurs, pull range = ± 100 ppm. 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, pull range = ± 100 ppm. Temperature ranges -40 to 95 °C and -40 to 105 °C		
		-	0.1	-	ps	f = 156.25 MHz, IEEE802.3-2005 10 GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz, includes spurs, all Vdd levels		

Notes: 6. Measured according to JESD65B.

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Table 6. Pin Description

Pin	Symbol	Functionality					
1	VIN	Input	Control Voltage				
		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.				
2	2 NC/OE Output Enable (OE)	H ^[7,8] : 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 ^[9]				





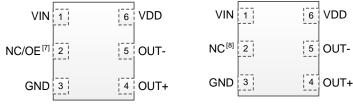


Figure 3. Pin Assignments (7.0 x 5.0 mm and 5.0 x 3.2 mm packages)

Figure 4. Pin Assignments (3.2 x 2.5 mm package)

Notes:

7. A pull-up resistor of 10 $k\Omega$ or less is recommended if pin 1 is not externally driven.

- 8. OE mode is only available in the 7050 and 5032 packages. 3225 package is NC.
- 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.



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
Continuous Power Supply Voltage Range (Vdd)	-0.5	4.0	V
Input Voltage, Maximum (any input pin)		Vdd + 0.3V	V
Input Voltage, Minimum (any input pin)	-0.3		V
Storage Temperature	-65	150	°C
Maximum Junction Temperature		145	°C
Soldering Temperature (follow standard Pb-free soldering guidelines)		260	°C

Table 8. Thermal Considerations^[10]

Package	$ heta_{ extsf{JA}}$, 4 Layer Board (°C/W)	θ _{JC} , Bottom (°C/W)
3225, 6-pin	80	30
5032, 6-pin	53[11]	20
7050, 6-pin	52 ^[11]	19

Notes:

10. 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.

11. Value for θ_{JA} assumes the center pad is soldered down.

Table 9. Maximum Operating Junction Temperature^[12]

Max Operating Temperature (ambient)	Maximum Operating Junction Temperature: 3225 Package	Maximum Operating Junction Temperature: 5032, 7050 Packages
70°C	105°C	95°C
85°C	130°C	110°C
95°C	130°C	120°C
105°C	145°C	130°C

Notes:

12. 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

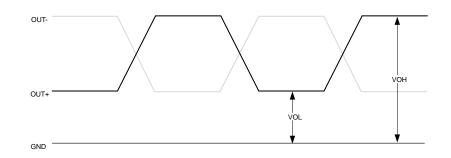


Figure 5. LVPECL, HCSL Voltage Levels per Differential Pin (i.e. OUT+, or OUT-)

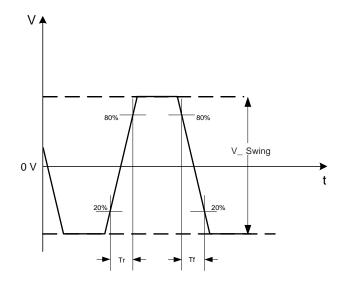


Figure 6. LVPECL, HCSL Voltage Levels across Differential Pair (i.e. OUT+ minus OUT-)



Waveform Diagrams (continued)

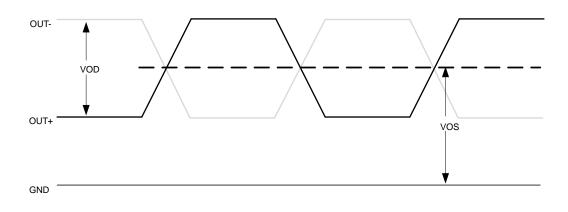


Figure 7. LVDS Voltage Levels per Differential Pin (OUT+, or OUT-)

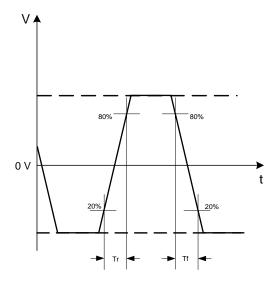
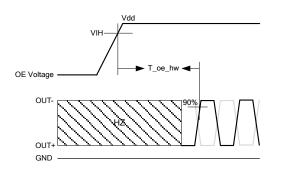


Figure 8. LVDS Differential Waveform (i.e. OUT+ minus OUT-)





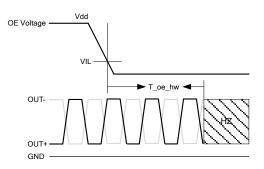


Figure 10. Hardware OE Disable Timing



Termination Diagrams

LVPECL

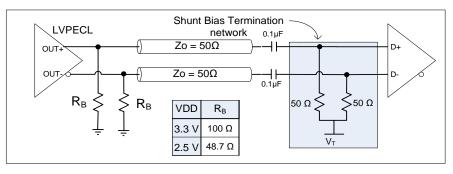


Figure 11. LVPECL with AC-coupled termination

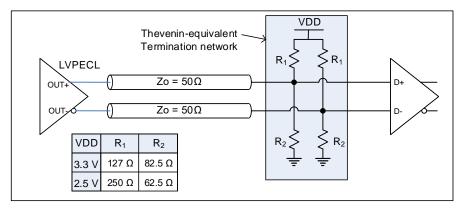


Figure 12. LVPECL DC-coupled load termination with Thevenin equivalent network

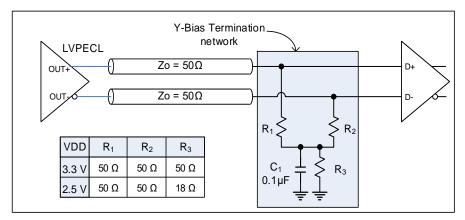


Figure 13. LVPECL with Y-Bias termination



Termination Diagrams (continued)

LVPECL (continued)

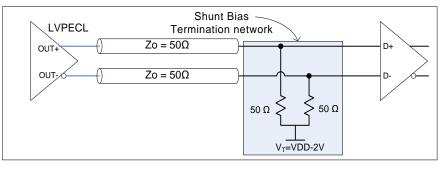


Figure 14. LVPECL with DC-coupled parallel shunt load termination



Termination Diagrams (continued)

LVDS

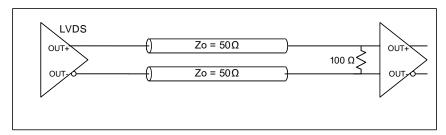


Figure 15. LVDS single DC termination at the load

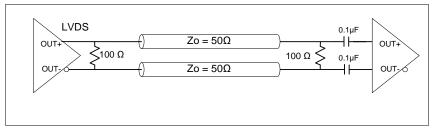


Figure 16. LVDS double AC termination with capacitor close to the load

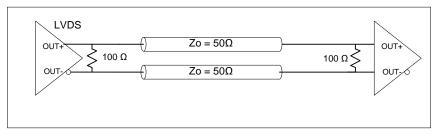


Figure 17. LVDS double DC termination



Termination Diagrams (continued)

HCSL

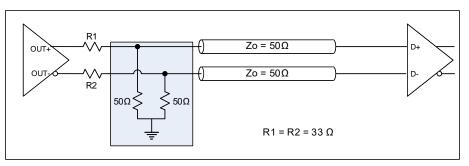
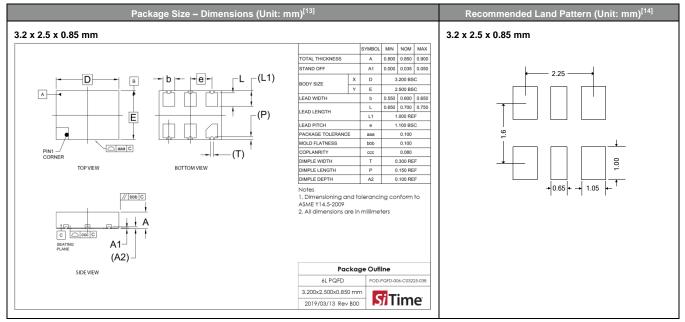


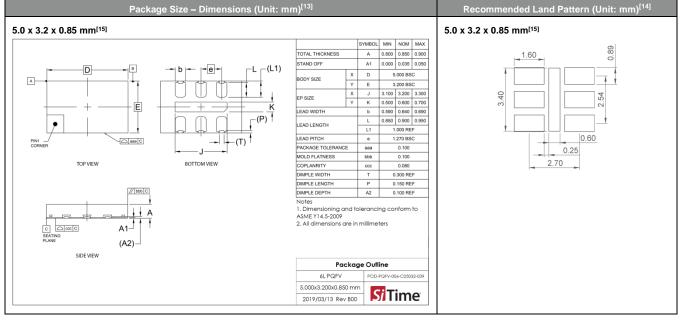
Figure 18. HCSL interface termination



Dimensions and Patterns — 3.2 x 2.5 mm



Dimensions and Patterns — 5.0 x 3.2 mm

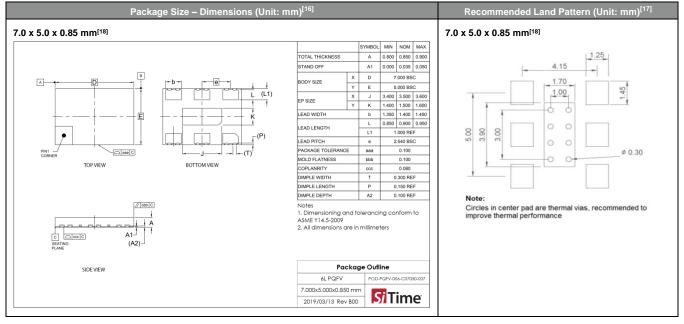


Notes:

- 13. 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.
- 14. 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.
- 15. The center pad is internally connected to the GND pin. 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 mm



Notes:

16. 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.

- 17. 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.
- The center pad is internally connected to the GND pin. Soldering down the center pad to the GND is recommended for best thermal dissipation, but is optional.



Table 11. APR Table

Absolute pull range (APR) = Nominal pull range (PR) - frequency stability (F_stab)-aging^[19]

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

Note: 19. Aging includes solder down shift and 20-year aging.

Additional Information

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.	-	
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	
Time Machine II	MEMS oscillator programmer	http://www.sitime.com/support/time-machine-oscillator-programmer	
Manufacturing Notes	Tape & Reel dimension, reflow profile and other manufacturing related info	https://www.sitime.com/support/resource-library?filter=531	
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	AN10029 Termination design recommendations	http://www.sitime.com/support/application-notes	
Layout Techniques	AN10006 Layout recommendations	http://www.sitime.com/support/application-notes	
Evaluation Boards	SiT6085EB, SiT6086EB and SiT6097EB for Differential Oscillators	https://www.sitime.com/support/user-guides	



Revision History

Table 13. Revision History

Revision	Release Date	Change Summary
1.0	10/13/2017	Initial release
1.03	05/10/2018	Updated the Part Ordering info with added 5.0 x 3.2 mm package
1.04	10/29/2018	±15 ppm option
1.05	06/07/2020	Formatting updates Corrected typos Updated package Dimensions Drawings Updated Table 8 Thermal Considerations for 5032 package Added Evaluation Boards SiT6085EB reference in Additional Information Rearranged layout, added Description, Block Diagram and TOC Added HTS classification code Clarified ±15 ppm pull range up to ±100 ppm Modified maximum junction temperatures Removed I_driver HCSL specification as not applicable

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