

Features

- 32.7707 ±20 ppm all-inclusive frequency stability
- World's smallest TCXO Footprint: 1.2 mm²
 - 1.5 x 0.8 mm CSP
 - No external bypass capacitor required
- Improved stability reduces system power with fewer network timekeeping updates
- Ultra-low power: 4.5 µA (33 kHz)
- Supply voltage: 1.8V ±10%
- Operating temperature ranges: -20°C to +70°C, -40°C to +85°C
- Pb-free, RoHS and REACH compliant

Applications

- Smart watches, health and wellness monitors
- Ultra-accurate RTC reference clock
- ULP input devices
- Proprietary wireless

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WARRANTY



Electrical Characteristics

Conditions: Min/Max limits are over temperature, Vdd = 1.8V ±10%, unless otherwise stated. Typicals are at 25°C and Vdd = 1.8V.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Frequency and Stability						
Output Frequency	F _{out}		32.7707		kHz	
Total Frequency Stability ^[1]	F _{stab}	-5		5	ppm	All inclusive, Stability code: E
		-20		20	ppm	All inclusive, Stability code: 1
Allan Deviation	AD		0.010	0.1	ppm	1 second averaging time
Jitter Performance						
8-Interval Period Jitter	PJ		20.3		ns _{p-p}	Cycles = 10,000
Supply Voltage and Current Consumption						
Operating Supply Voltage	V _{dd}	1.62	1.8	1.98	V	
Supply Current			4.5		µA	F _{OUT} = 33 kHz
Start-up Time at Power-up	t _{start}			300	ms	Measured when supply reaches 90% of final V _{dd} to the first output pulse.
Operating Temperature Range						
Operating Temperature Range	Op_Temp	-20		70	°C	"C" ordering code
		-40		85	°C	"I" ordering code
LVC MOS Output						
Output Rise/Fall Time	t _r , t _f			50	ns	10-90% (V _{dd}), 15 pF Load
Output Clock Duty Cycle	DC	45		55	%	
Output Voltage High	VOH	90%			V _{dd}	I _{OH} = -1 µA, 15 pF Load
Output Voltage Low	VOL			10%	V _{dd}	I _{OL} = 1 µA, 15 pF Load

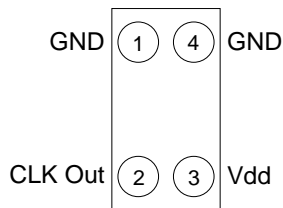
Note:

1. Inclusive of initial tolerance, over temp stability, 3x reflow, V_{dd} range, aging, and load. Tested with Agilent 53132A frequency counter. Due to the low operating frequency, the gate time must be ≥100 ms to ensure an accurate frequency measurement.

Pin Configuration

CSP Pin	Symbol	I/O	Functionality
1	GND	Ground	Connect to ground.
2	CLK Out	OUT	Oscillator clock output.
3	Vdd	Power Supply	1.8V ±10% power supply. Under normal operating conditions, Vdd does not require external bypass/decoupling capacitor(s). CS00096 includes on-chip filtering capacitance.
4	GND	Power Supply Ground	Connect to ground.

CSP Package (Top View)



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.

Parameters	Test Conditions	Value	Unit
Continuous Power Supply Voltage Range (Vdd)		-0.5 to 3.63	V
Short Duration Maximum Power Supply Voltage (Vdd)	<30 seconds	4.0	V
Continuous Maximum Operating Temperature Range		105	°C
Short Duration Maximum Operating Temperature Range	≤ 30 minutes	125	°C
Human Body Model (HBM) ESD Protection	JESD22-A114	2000	V
Charge-Device Model (CDM) ESD Protection	JESD22-C101	750	V
Machine Model (MM) ESD Protection	JESD22-A115	300	V
Latch-up Tolerance	JESD78 Compliant		
Mechanical Shock Resistance	Mil 883, Method 2002	10,000	g
Mechanical Vibration Resistance	Mil 883, Method 2007	70	g
1508 CSP Junction Temperature		150	°C
Storage Temperature		-65 to 150	°C

System Block Diagram

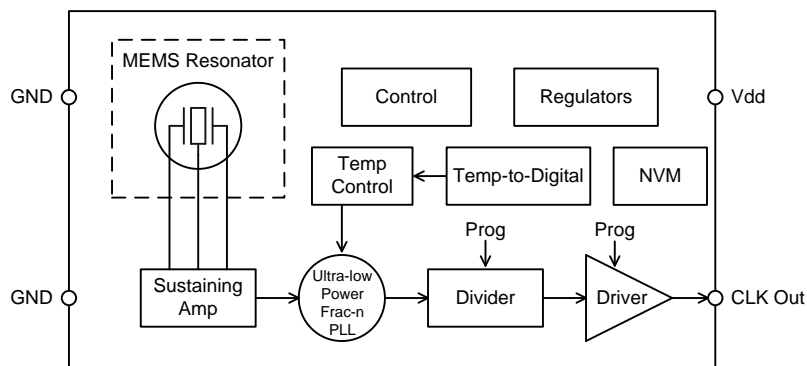


Figure 1. CS00096 Block Diagram

Description

CS00096 is an ultra-small and ultra-low power Factory programmable TCXO with an output frequency range between 1 Hz to 1 MHz. The CS00096 is programmed to 32.7707 kHz. SiTime’s silicon MEMS technology enables the first 1 Hz - 1 MHz TCXO in the world’s smallest footprint and chip-scale packaging (CSP). Typical supply current is 4.5 μ A (33 kHz) under no load condition.

SiTime’s MEMS oscillator consists of a MEMS resonator and a programmable analog circuit. CS00096 MEMS resonator is built with SiTime’s unique MEMS First™ process. A key manufacturing step is EpiSeal™ during which the MEMS resonator is annealed with temperatures over 1000°C. EpiSeal creates an extremely strong, clean, vacuum chamber that encapsulates the MEMS resonator and ensures the best performance and reliability. During EpiSeal, a poly silicon cap is grown on top of the resonator cavity, which eliminates the need for additional cap wafers or other exotic packaging. As a result, SiTime’s MEMS resonator die can be used like any other semiconductor die. One unique result of SiTime’s MEMS First and EpiSeal manufacturing processes is the capability to integrate SiTime’s MEMS die with a SOC, ASIC, microprocessor or analog die within a package to eliminate external timing components and provide a highly integrated, smaller, cheaper solution to the customer.

TCXO Frequency Stability

CS00096 is factory calibrated (trimmed) over multiple temperature points to guarantee extremely tight stability over temperature. Unlike quartz crystals that have a classic tuning fork parabola temperature curve with a 25°C turnover point and a 0.04 -0.06 ppm/°C² temperature coefficient, the CS00096 temperature coefficient is calibrated and corrected over temperature with an active temperature correction circuit. The result is a 32 kHz TCXO with extremely tight frequency variation over the -40°C to +85°C temperature range.

When measuring the output frequency of CS00096 with a frequency counter, it is important to make sure the counter’s gate time is \geq 100 ms. Shorter gate times may lead to inaccurate measurements.

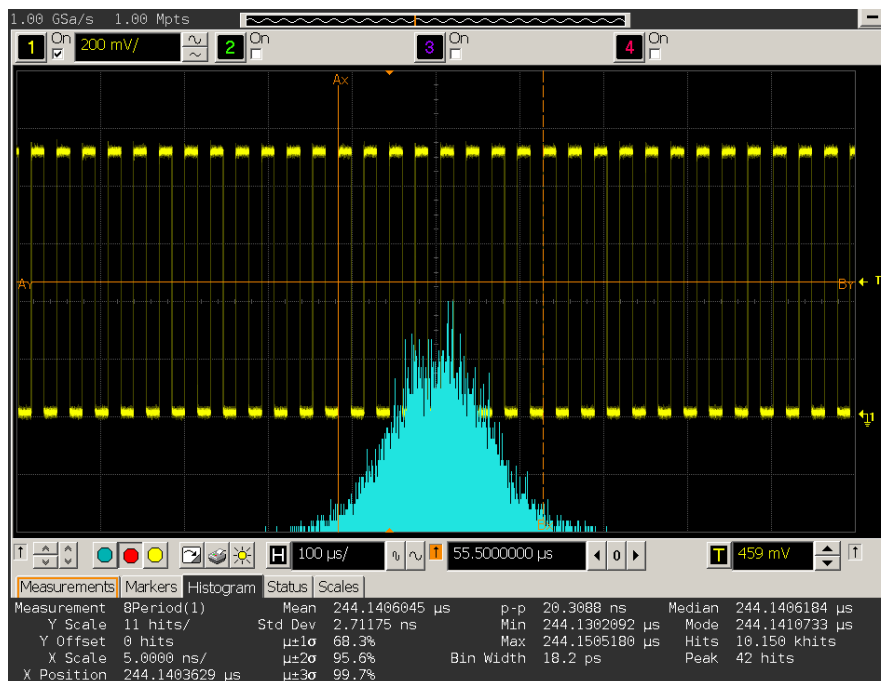
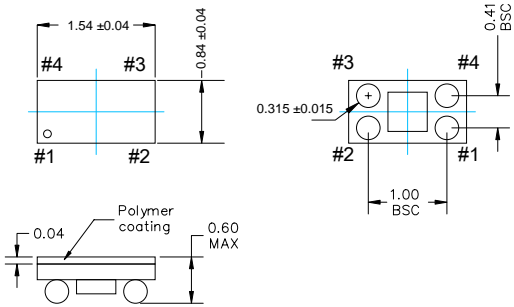
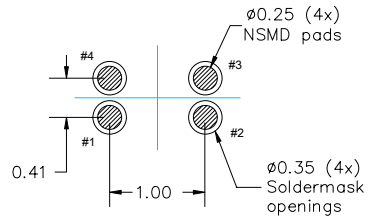


Figure 2. 8-Period Jitter Plot, F_{OUT} = 32.7707 kHz, T_A = 25 °C

Dimensions and Patterns

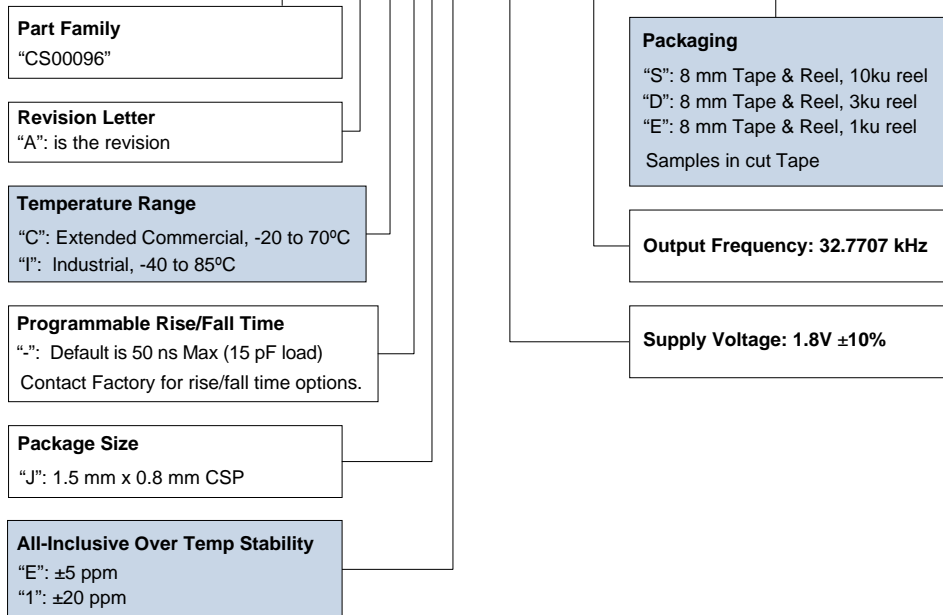
Package Size – Dimensions (Unit: mm)	Recommended Land Pattern (Unit: mm)
<p>1.55 x 0.85 mm CSP</p> 	 <p>(soldermask openings shown with heavy dashed line)</p> <p>Recommended 4-mil (0.1mm) stencil thickness</p>

Manufacturing Guidelines

- 1) No Ultrasonic or Megasonic cleaning: Do not subject CS00096 to an ultrasonic or megasonic cleaning environment. Permanent damage or long term reliability issues may occur.
- 2) Applying board-level underfill and overmold is acceptable and will not impact the reliability of the device.
- 3) Reflow profile, per JESD22-A113D.
- 4) For additional manufacturing guidelines and marking/tape-reel instructions, click on the following link:
http://www.sitime.com/component/docman/doc_download/243-manufacturing-notes-for-sitime-oscillators

Ordering Information

CS00096A**C**-J**1**-18E-0032.7707**S**



Revision History

Version	Release Date	Change Summary
0.25	12/15/15	Initial Release
0.90	1/4/16	Changed pin 1 connection.

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