SA.45s CSAC and RoHS CSAC Options 001 and 003

Chip-Scale Atomic Clock

Features

- Power consumption <120 mW
- Less than 17 cc volume, 1.6" × 1.39" × 0.45"
- 10 MHz CMOS-compatible output
- 1PPS output and 1PPS input for synchronization
- RS-232 interface for monitoring and control
- Short term stability (Allan Deviation) of 3.0×10^{-10} at τ =1 sec

Applications[1]

- GPS receivers
- Backpack radios
- Anti-IED jamming systems
- Autonomous sensor networks
- Unmanned vehicles
- Underwater sensor systems
- Stability for various other communication and transmission applications
- RoHS-Compliant CSAC
  - RoHS 2 (Directive 2011/65/EU)
  - Wide storage temperature: 100 °C

[1]The CSAC is not tested, qualified, or rated for space applications.

With an extremely low power consumption of <120 mW and a volume of <17 cc, the Microchip SA.45s Chip Scale Atomic Clock (CSAC) brings the accuracy and stability of an atomic clock to portable applications for the first time. The CSAC is also available in a RoHS-compliant form.

The SA.45s provides RF and 1PPS outputs at standard CMOS levels, with short-term stability (Allan Deviation) of 3.0×10^{-10} at τ = 1 sec, typical longterm aging of $<9 \times 10^{-10}$/month, and maximum frequency change of $\pm 5 \times 10^{-10}$ over an operating temperature range of –10 °C to 70 °C.

The SA.45s CSAC accepts a 1PPS input that may be used to synchronize the unit's 1PPS output to an external reference clock with ±100 ns accuracy. It also use the 1PPS input to discipline its phase and frequency to within 1 ns and 1.0×10^{-12}, respectively.

A standard CMOS-level RS-232 serial interface is built in to the SA.45s. This is used to control and calibrate the unit and also to provide a comprehensive set of status monitors. The interface is also used to set and read the CSAC's internal time-of-day clock.

Specifications[1]

Electrical

RF Outputs	
Frequency	10 MHz (option 001) 16.384 MHz (option 003)
Format	CMOS
Amplitude	0 V to V_{CC}
Load Impedance	1 MΩ
Quantity	1
1PPS Output	
Rise/fall Time (10%–90%) at Load Capacitance 10 pF	<10 ns
Pulse Width	100 µs (Option 001) 97.656 µs (Option 003)
Level	0 V to V_{CC}
Logic High (V_{OH}) Min	2.80 V
Logic Low (V_{OL}) Max	0.30 V
Load Impedance	1 MΩ
Quantity	1
1PPS Input	
Format	Rising edge
Low Level	<0.5 V
High Level	2.5 V to V_{CC}
Load Impedance	1 MΩ
Quantity	1
Serial Communications	
Protocol	RS-232
Format	CMOS 0 V to V_{CC}
Tx/Rx Impedance	1 MΩ
Baud Rate	57600
Built-In Test Equipment (BITE) Output	
Format	CMOS 0 V to V_{CC}
Load Impedance	1 MΩ
Logic	0= Normal operation 1= Alarm
Power Input	
Operating	<120 mW
Warmup	<140 mW
Input Voltage (V_{CC})	3.3 ± 0.1 V_{DC}

[1]At input voltage V_{CC} = 3.3 V_{DC} and ambient temperature = 25 °C, unless otherwise specified.

Environmental

Specification	Details
Operating Temperature	–10 °C to 70 °C
Maximum Frequency Change over Operating Temp Range (Maximum Rate of Change 0.5 °C per Minute)	$\pm 5 \times 10^{-10}$
Frequency Change Over Allowable Input Voltage Range	$\pm 4 \times 10^{-10}$
Magnetic sensitivity (≤2.0 Gauss)	$\pm 9 \times 10^{-11}$/Gauss
Radiated Emissions	Compliant to FCC part 15, Class B, when mounted properly onto host PCB
Vibration	Maintains lock under MIL-STD-810G, Operational, 7.7 g_{rms} per Figure 514.7E-1. Category 24
Humidity	0%–95% RH per MIL-STD-810, Method 507.4
Storage and Transport (Non-operating)	
Temperature	–55 °C to 85 °C
Temperature (RoHS-Compliant)	–55 °C to 100 °C
Vibration	MIL-STD-810G, 7.7 g_{rms} per Figure 514.7E-1. Category 24
Shock	MIL-STD-202-213A, Condition E, 1000 g

Performance Parameters

Specification	Details
Warm-up Time	<180 s
Analog Tuning	Range: $\pm 2.2 \times 10^{-8}$ Resolution: 1×10^{-11} Input: 0 V–2.5 V into 100 kΩ
Digital Tuning	Range: $\pm 1 \times 10^{-6}$ Resolution: 1×10^{-12}

Phase Noise (SSB)

Frequency	Option 001	Option 003
1 Hz	<–50 dBc/Hz	<–46 dBc/Hz
10 Hz	<–70 dBc/Hz	<–66 dBc/Hz
100 Hz	<–113 dBc/Hz	<–104 dBc/Hz
1 kHz	<–128 dBc/Hz	<–128 dBc/Hz
10 kHz	<–135 dBc/Hz	<–135 dBc/Hz
100 kHz	<–140 dBc/Hz	<–140 dBc/Hz
Frequency Accuracy		
Maximum Offset at Shipment	$\pm 5 \times 10^{-11}$	
Maximum Retrace (48 hrs Off)	$\pm 5 \times 10^{-10}$	
1 PPS Sync	±100 ns	

Aging

Type[2]	SA.45s[3]
Monthly	$<9 \times 10^{-10}$
Yearly	$<1 \times 10^{-8}$

[2]After 30 days of continuous operation.

[3]All CSAC units are tested for aging specs as per the datasheet and meet the specs at the time of shipment. However, continuous operation of CSAC over extended period of time may yield unpredictable aging performance, resulting in failure to meet the aging specs and may not be suitable for certain applications.

Short-Term Stability (Allan Deviation)

Type	SA.45s
τ = 1 s	3×10^{-10}
τ = 10 s	1×10^{-10}
τ = 100 s	3×10^{-11}
τ = 1000 s	1×10^{-11}

Physical

Type	SA.45s
Weight	<35 g (<1.23 oz)
Size	1.6" × 1.39" × 0.45"
MTBF	>100,000 hours
RoHS	RoHS 2 (Directive 2011/65/EU)

Solder

Type	Details
Standard	Hand solder using 63/37 tin/lead solder with maximum soldering tip of 329 °C (625 °F)
RoHS-Compliant	Hand solder using 96.5/3/0.5 tin/silver/copper with maximum solder tip temperature of 370 °C (698 °F) and a dwell time of <5 s.

Ordering Information

Part Number	Description	Output Frequency
090-02984-001	Chip-scale atomic clock option 001	10 MHz
090-02984-003	Chip-scale atomic clock option 003	16.384 MHz
090-03240-001	RoHS-compliant chip-scale atomic clock option 001	10 MHz
090-03240-003	RoHS-compliant chip-scale atomic clock option 003	16.384 MHz