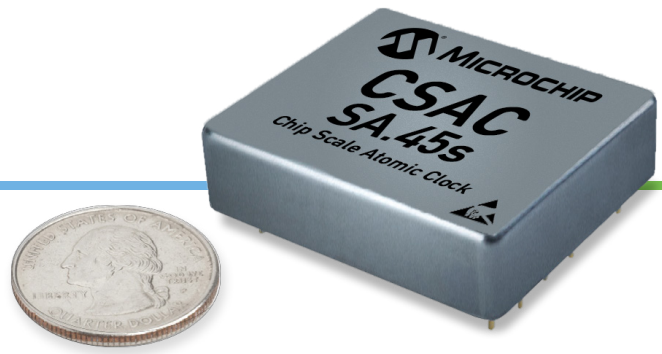


# SA.45s CSAC and RoHS CSAC

## 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  $3.0 \times 10^{-10}$  at  $\tau = 1$  sec
- Applications<sup>1</sup>
- 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

<sup>1</sup>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  $3.0 \times 10^{-10}$  at  $\tau = 1$  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  $-10^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

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  $\pm 100$  ns accuracy. It also use the 1PPS input to discipline its phase and frequency to within 1 ns and  $1.0 \times 10^{-12}$ , 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<sup>1</sup>

### Electrical

RF Outputs	
Frequency	10 MHz (option 001) 16.384 MHz (option 003)
Format	CMOS
Amplitude	0 V to VCC
Load Impedance	1 M $\Omega$
Quantity	1
1PPS Output	
Rise/fall Time (10%–90%) at Load Capacitance 10 pF	<10 ns
Pulse Width	100 $\mu$ s (Option 001) 97.656 $\mu$ s (Option 003)
Level	0 V to VCC
Logic High (VOH) Min	2.80 V
Logic Low (VOL) Max	0.30 V
Load Impedance	1 M $\Omega$
Quantity	1
1PPS Input	
Format	Rising edge
Low Level	<0.5 V
High Level	2.5 V to VCC
Load Impedance	1 M $\Omega$
Quantity	1
Serial Communications	
Protocol	RS-232
Format	CMOS 0 V to VCC
Tx/Rx Impedance	1 M $\Omega$
Baud Rate	57600
Built-In Test Equipment (BITE) Output	
Format	CMOS 0 V to VCC
Load Impedance	1 M $\Omega$
Logic	0= Normal operation 1= Alarm
Power Input	
Operating	<120 mW
Warmup	<140 mW
Input Voltage (VCC)	3.3 $\pm$ 0.1 VDC

<sup>1</sup>At input voltage V<sub>CC</sub> = 3.3 V<sub>DC</sub> 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 ( $\leq 2.0$ 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 grms 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 grms 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: $1 \times 10^{-11}$ Input: 0 V–2.5 V into 100 k $\Omega$
Digital Tuning	Range: $\pm 1 \times 10^{-6}$ Resolution: $1 \times 10^{-12}$

## 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	$\pm 100$ ns	

## Aging

Type <sup>2</sup>	SA.45s
Monthly	$< 9 \times 10^{-10}$
Yearly	$< 1 \times 10^{-8}$

<sup>2</sup>After 30 days of continuous operation.

## Short-Term Stability (Allan Deviation)

Type	SA.45s
$\tau = 1$ s	$3 \times 10^{-10}$
$\tau = 10$ s	$1 \times 10^{-10}$
$\tau = 100$ s	$3 \times 10^{-11}$
$\tau = 1000$ s	$1 \times 10^{-11}$

## 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