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# SA.45s CSAC Options 001 and 003

## Chip-Scale Atomic Clock

## CSAC

Microsemi invented portable atomic timekeeping with the world's first family of miniature and chip scale atomic clocks.

Choose CSAC for best-in-class stability, size, weight, and power consumption.



## 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

With an extremely low power consumption of <120 mW and a volume of <17 cc, the Microsemi SA.45s Chip Scale Atomic Clock (CSAC) brings the accuracy and stability of an atomic clock to portable applications for the first time.

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 long-term 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  $\pm 100$  ns accuracy. It also uses the 1PPS input to discipline its phase and frequency to within 1 ns and  $1.0 \times 10^{-12}$ , respectively.

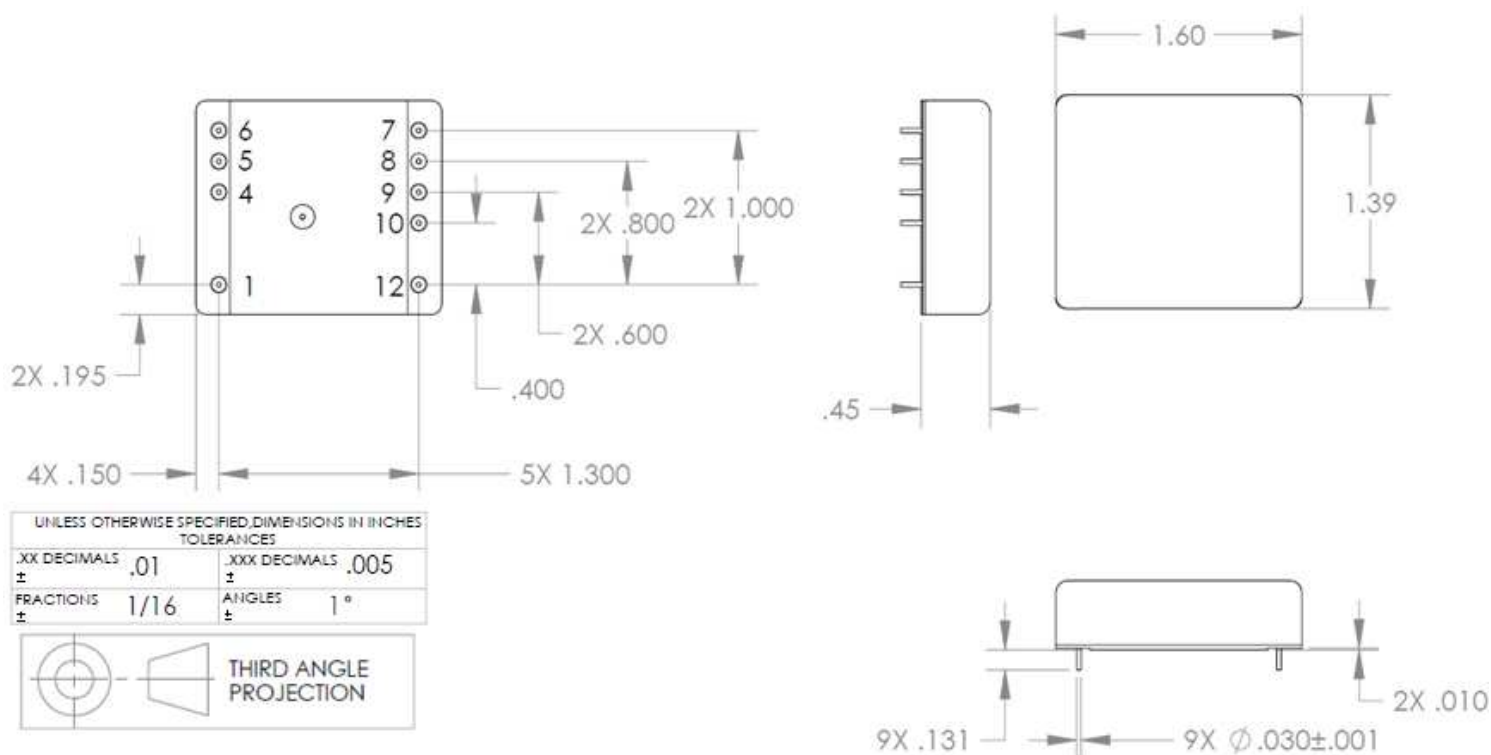
A standard CMOS-level RS-232 serial interface is built in to the SA.45s. This is used to control and calibrate the unit and also to provide a comprehensive set of status monitors. The interface is also used to set and read the CSAC's internal time-of-day clock.

<sup>1</sup>The CSAC is not tested, qualified, or rated for space applications.

# SA.45s CSAC Options 001 and 003

## Chip-Scale Atomic Clock

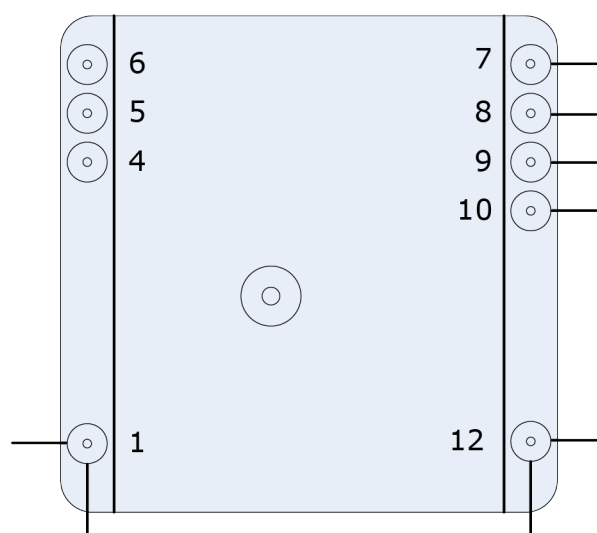
### Mechanical Interface



### Pin Description

Pin Number	I.D.
1	Tune
2	N/A
3	N/A
4	BITE
5	Tx
6	Rx
7	Vcc
8	GND
9	1PPS IN
10	1PPS OUT
11	N/A
12	RF OUT

### Bottom View





# SA.45s CSAC Options 001 and 003

## Chip-Scale Atomic Clock

### Specifications<sup>1</sup>

#### Electrical

##### RF Output

- Frequency 10 MHz (option 001)  
16.384 MHz (option 003)
- Format CMOS
- Amplitude 0 V to V<sub>CC</sub>
- Load impedance 1 MΩ
- Quantity 1

##### 1PPS Output

- Rise/fall time (<math>10\%–90\%</math>) at load capacitance 10 pF <math><10</math> ns
- Pulse width 100 μs (Option 001)  
97.656 μs (Option 003)
- Level 0 V to V<sub>CC</sub>
- Logic high (V<sub>OH</sub>) min 2.80 V
- Logic low (V<sub>OL</sub>) max 0.30 V
- Load impedance 1 MΩ
- Quantity 1

##### 1PPS Input

- Format Rising edge
- Low level <math><0.5</math> V
- High level 2.5 V to V<sub>CC</sub>
- Input impedance 1 MΩ
- Quantity 1

##### Serial Communications

- Protocol RS-232
- Format CMOS 0 V to V<sub>CC</sub>
- Tx/Rx impedance 1 MΩ
- Baud rate 57600

##### Built-in Test Equipment (BITE) Output

- Format CMOS 0 V to V<sub>CC</sub>
- Load impedance 1 MΩ
- Logic 0 = Normal operation  
1 = Alarm

##### Power Input

- Operating <math><120</math> mW
- Warmup <math><140</math> mW
- Input voltage (V<sub>CC</sub>) 3.3 ± 0.1 V<sub>DC</sub>

#### Environmental

- 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 (<math>\leq 2.0</math> Gauss)  $\pm 9 \times 10^{-11}/\text{Gauss}$
- Radiated emissions Compliant to FCC part 15, Class B, when mounted properly onto host PCB
- Vibration Maintains lock under MIL-STD-810, Method 514.5, Procedure 1, 7.7 g<sub>rms</sub>
- Humidity 0%–95% RH per MIL-STD-810, Method 507.4

#### Storage and Transport (Non-operating)

- Temperature –55 °C to 85 °C
- Vibration MIL-STD-810, Method 514.5, Procedure 1, 7.7 g<sub>rms</sub>
- Shock (1 ms half-sine) 1000 g

#### Performance Parameters

- Warm-up time <math><180</math> s
- Analog tuning Range:  $\pm 2.2 \times 10^{-8}$   
Resolution:  $1 \times 10^{-11}$   
Input: 0 V–2.5 V into 100 kΩ
- Digital tuning Range:  $\pm 1 \times 10^{-6}$   
Resolution:  $1 \times 10^{-12}$

#### Phase Noise (SSB)

Frequency	Option 001	Option 003
1 Hz	<math>\leq -50</math> dBc/Hz	<math>\leq -46</math> dBc/Hz
10 Hz	<math>\leq -70</math> dBc/Hz	<math>\leq -66</math> dBc/Hz
100 Hz	<math>\leq -113</math> dBc/Hz	<math>\leq -110</math> dBc/Hz
1 kHz	<math>\leq -128</math> dBc/Hz	<math>\leq -128</math> dBc/Hz
10 kHz	<math>\leq -135</math> dBc/Hz	<math>\leq -135</math> dBc/Hz
100 kHz	<math>\leq -140</math> dBc/Hz	<math>\leq -140</math> dBc/Hz

#### Frequency Accuracy

- Maximum offset at shipment  $\pm 5 \times 10^{-11}$
- Maximum retrace (48 hrs off)  $\pm 5 \times 10^{-10}$
- 1PPS sync  $\pm 100</math> ns$

<sup>1</sup>At input voltage V<sub>CC</sub> = 3.3 V<sub>DC</sub> and ambient temperature = 25 °C, unless otherwise specified.

# SA.45s CSAC Options 001 and 003

## Chip-Scale Atomic Clock

### Aging

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

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

<sup>3</sup>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
$\tau = 1 \text{ s}$	$3 \times 10^{-10}$
$\tau = 10 \text{ s}$	$1 \times 10^{-10}$
$\tau = 100 \text{ s}$	$3 \times 10^{-11}$
$\tau = 1000 \text{ s}$	$1 \times 10^{-11}$

### Physical

- Weight  $<35 \text{ g}$  ( $<1.23 \text{ oz}$ )
- Size  $1.6" \times 1.39" \times 0.45"$
- MTBF  $>100,000 \text{ hours}$

**Note:** RoHS-compliant versions of CSAC are available with base part number 090-03240-xxx.

### Solder

Hand solder using 63/37 tin/lead solder with maximum soldering tip of 329 °C (625 °F).

### 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



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