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 3.0×10^{-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

[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 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 3.0×10^{-10} at τ = 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 ±100 ns accuracy. It also uses 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.

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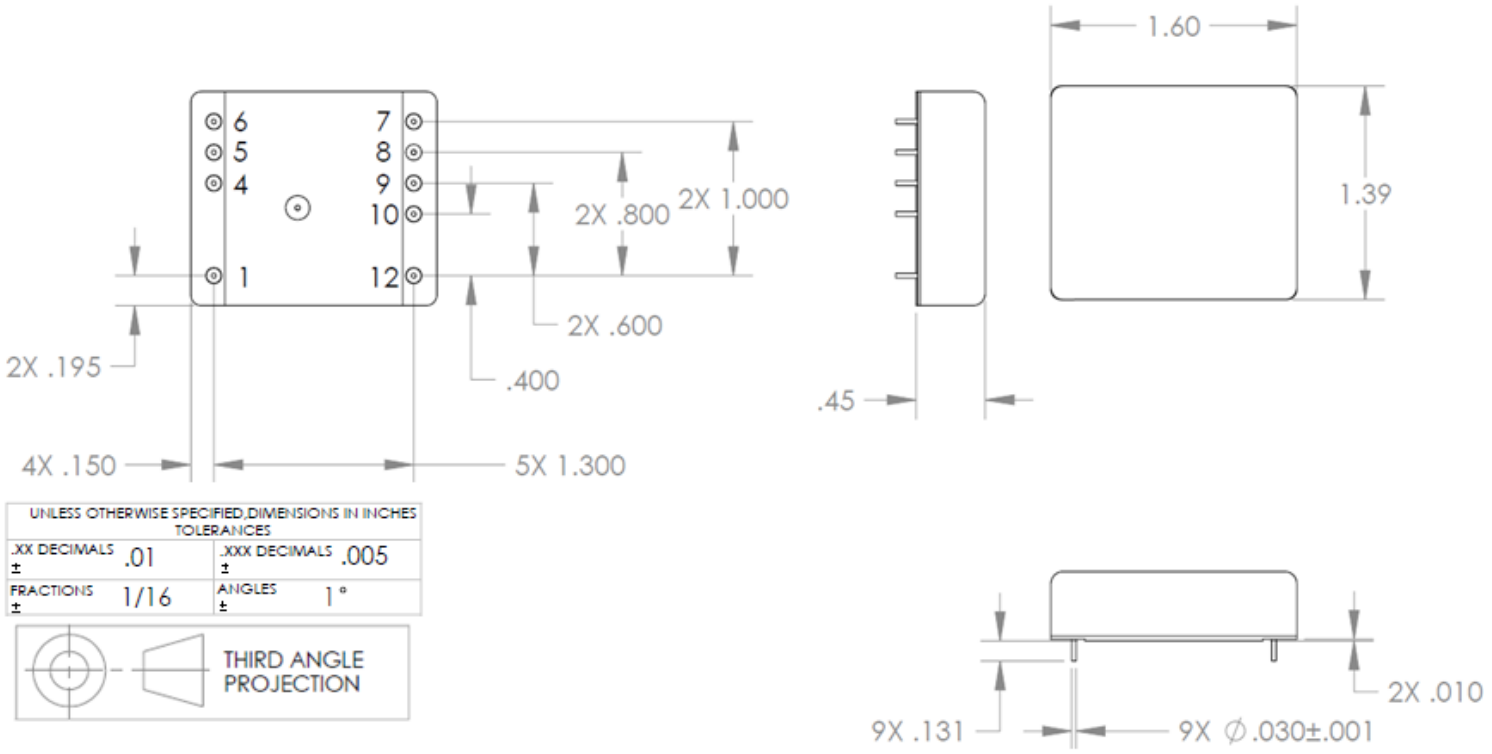
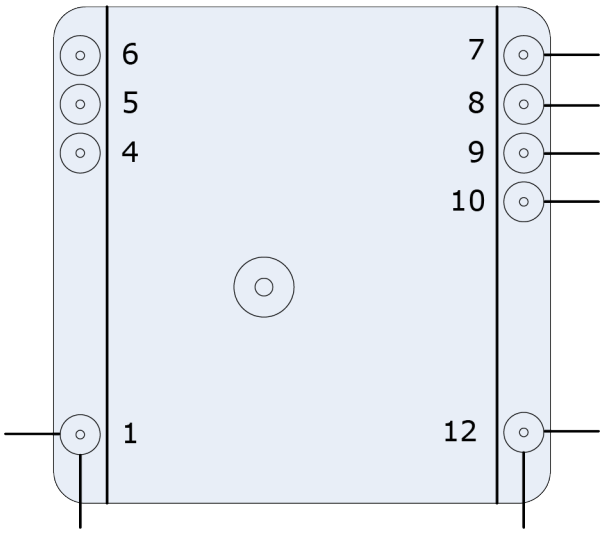
Mechanical Interface



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



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Specifications[1]

Electrical

RF Output

- 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}
- Input 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

- 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-810, Method 514.5, Procedure 1, 7.7 g_{rms}
- 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_{rms}
- Shock (1 ms half-sine): 1000 g

Performance Parameters

- 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	<–110 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): $\pm 5 \times 10^{-10}$
- 1PPS sync: ±100 ns

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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
$\tau = 1$ s	3×10^{-10}
$\tau = 10$ s	1×10^{-10}
$\tau = 100$ s	3×10^{-11}
$\tau = 1000$ s	1×10^{-11}

Physical

- Weight <35 g (<1.23 oz)
- Size 1.6" × 1.39" × 0.45"
- MTBF >100,000 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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