SA.45s Space CSAC
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"
- Radiation-tolerant: 20 krad
- SEL, SEU tested to 64 MeV-cm^2/mg (contact factory for details)
- 10 MHz CMOS-compatible output
- 1PPS output and 1PPS input for synchronization
- RS-232 interface for monitoring and control
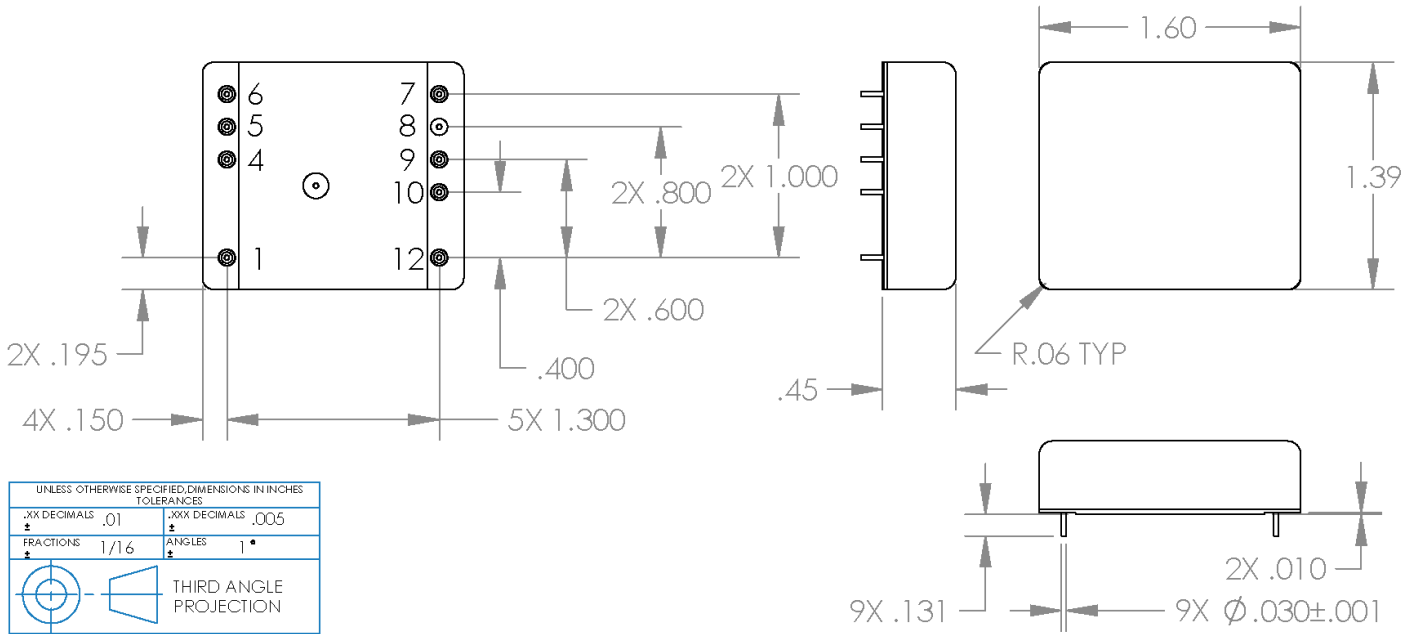- Short-term stability (Allan Deviation) of 3.0×10^{-10} at TAU = 1 sec

Applications

- Satellite timing and frequency control
- Satellite clock reference
- Assured position, navigation, and timing (PNT)
- Atomic clock accuracy
- Satellite cross-linking

The Microsemi SA.45s Commercial Space Chip-Scale Atomic Clock's (CSAC) potential for low size, weight, and power (SWaP), and high timing performance at relatively low cost makes it very attractive for low Earth orbit (LEO) applications. In addition to being a stand-alone atomic clock with a 10 MHz output, the CSAC also has a 1PPS output and can be disciplined with a 1PPS input. The Space CSAC retains this functionality and is a timing module that can be disciplined with a GPS-derived 1PPS input.

The SA.45s provides 10 MHz and 1PPS outputs at standard CMOS levels, with short-term stability (Allan Deviation) of 3.0×10^{-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.

A standard CMOS-level RS-232 serial interface is built into the SA.45s. This is used to control and calibrate the unit and 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

UNLESS OTHERWISE SPECIFIED, DIMENSIONS IN INCHES	
TOLERANCES	
.XX DECIMALS ± .01	.XXX DECIMALS ± .005
FRACTIONS ± 1/16	ANGLES ± 1°

THIRD ANGLE PROJECTION

Pin Description

Pin Number	ID
1	Tune
2	N/A
3	N/A
4	BITE
5	Tx
6	Rx
7	V_{CC}
8	GND
9	1 PPS IN
10	1 PPS OUT
11	N/A
12	10 MHz OUT

Bottom View
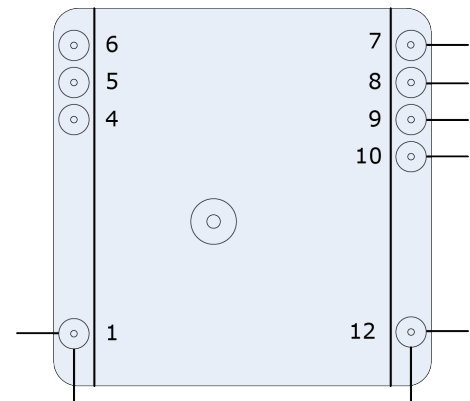
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Specifications[1]

Electrical

RF Output

- Frequency   10 MHz
- 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
- 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   RS232
- 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}

Environmental

- Operating temperature   −10 °C to 70 °C
- Maximum frequency change over operating temp range (maximum rate of change 0.5 °C per minute) $\pm5 \times 10^{-10}$
- Magnetic sensitivity (≤2.0 Gauss) $\pm9 \times 10^{-11}$/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: $\pm2.2 \times 10^{-8}$ Resolution: 1×10^{-11} Input: 0 V–2.5 V into 100 kΩ
- Digital tuning   Range: $\pm1 \times 10^{-6}$ Resolution: 1×10^{-12}

Phase Noise (SSB)

Frequency	CSAC
1 Hz	<−50 dBc/Hz
10 Hz	<−70 dBc/Hz
100 Hz	<−113 dBc/Hz
1 kHz	<−128 dBc/Hz
10 kHz	<−135 dBc/Hz
100 kHz	<−140 dBc/Hz

Frequency Accuracy

- Maximum offset at shipment $\pm5 \times 10^{-11}$
- Maximum retrace (48 hrs off) $\pm5 \times 10^{-10}$
- 1 PPS sync   ±100 ns

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

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}

Radiation Tolerance

Type	SA.45s
TID	20 krad, $<5 \times 10^{-10}$ frequency offset change
SEL, SEU	Tested to 64 MeV-cm^2/mg (contact factory for details)

Physical

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

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
090-02984-007	Space chip-scale atomic clock	10 MHz

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Microsemi](#):
  [090-02984-007](#)