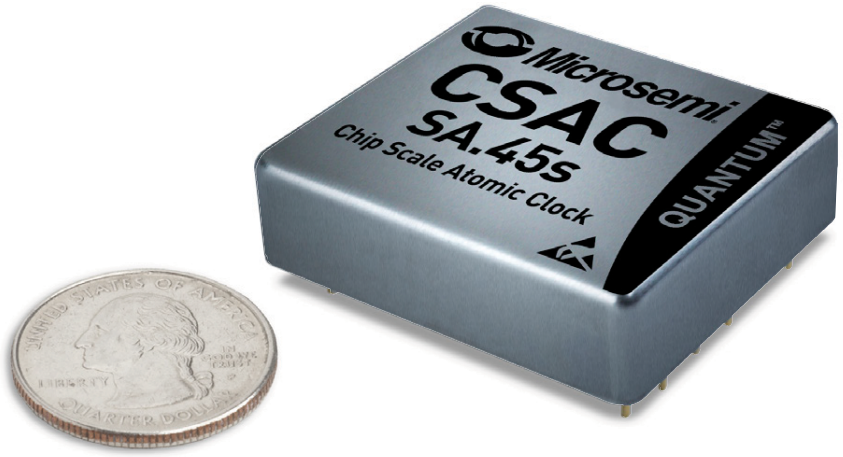
Quantum™ SA.45s CSAC

Chip Scale Atomic Clock



Quantum™

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

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

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 10 MHz and 1 PPS outputs at standard CMOS levels, with short-term stability (Allan Deviation) of $3.0E^{-10}$ @ TAU = 1 sec, typical long-term aging of $<9E^{-10}$/month, and maximum frequency change of $\pm5E^{-10}$ over an operating temperature range of –10 °C to 70 °C.

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

Features

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

Applications*

- GPS receivers
- Backpack radios
- Anti-IED jamming systems
- Autonomous sensor networks
- Unmanned vehicles
- Underwater sensor systems
- Stability for various other communication and transmission applications

*The Chip Scale Atomic Clock is not tested, qualified, and rated for space applications

Quantum™ SA.45s CSAC

Chip Scale Atomic Clock

Options to Meet a Wider Range of Applications

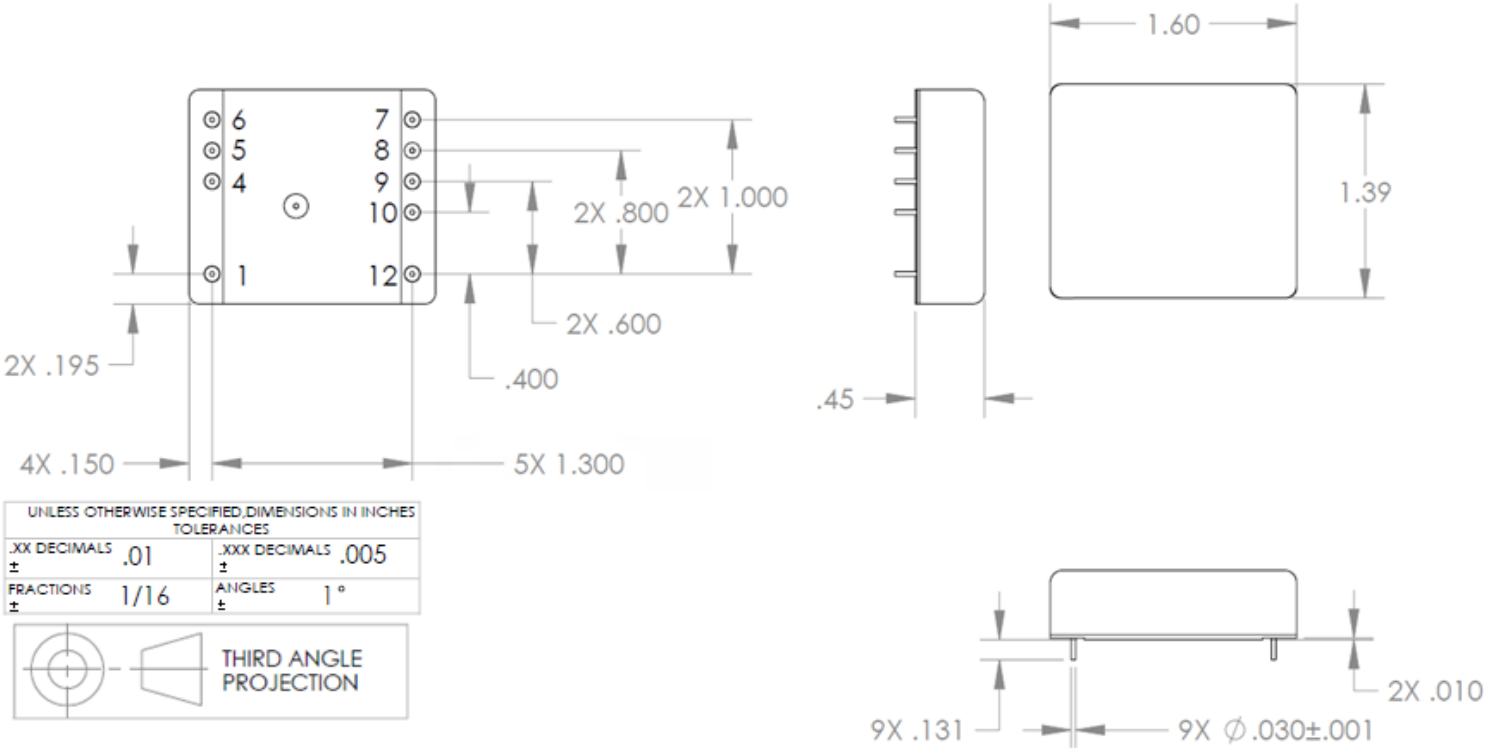
Following are the different SA.45s CSAC options with there output frequencies.

Options	Output Frequency
001	10 MHz
003	16.384 MHz
004	10.24 MHz
006	5 MHz

For other output frequencies please contact Microsemi for details.

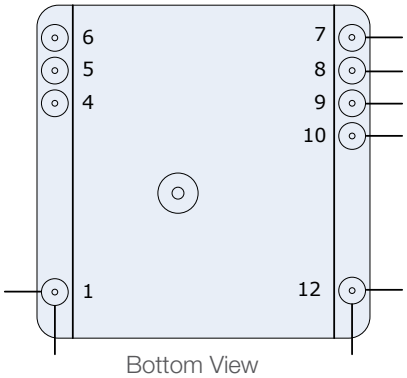
The Chip Scale Atomic Clock is not tested, qualified, and rated for space applications.

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	1 PPS IN
10	1 PPS OUT
11	N/A
12	10 MHz OUT



Bottom View

Quantum™ SA.45s CSAC Option 001

Part number 090-02984-001

Specification

All specifications at 25 °C, V_{CC} = 3.3 VDC unless otherwise specified.

Electrical Specification

RF Output

- Frequency: 10 MHz
- Format: CMOS
- Amplitude: 0 V to V_{CC}
- Load impedance: 1 MΩ
- Quantity: 1

1 PPS 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

1 PPS 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 VDC

Physical Specifications

- Size: 1.6” x 1.39” x 0.45”
- Weight: <35 g
- MTBF: >100,000 hours

Environmental Specification

Operating

- Operating temperature: –10 °C to 70 °C
- Maximum frequency change over operating temp range (max. rate of change 0.5 °C/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 grms
- Humidity: 0 to 95% RH per MIL-STD-810, Method 507.4.

Storage and Transport (non-operating)

- Temperature: –55 °C to 85 °C
- Shock (1 ms half-sine): 1000 g
- Vibration: MIL-STD-810, Method 514.5, Procedure 1, 7.7 grms

Performance Parameters

Stability (Allan Deviation) ADEV

- TAU = 1 sec: 3.0×10^{-10}
- TAU = 10 sec: 1.0×10^{-10}
- TAU = 100 sec: 3.0×10^{-11}
- TAU = 1000 sec: 1.0×10^{-11}

RF Output Phase Noise (SSB)

- 1 Hz: <–50 dBc/Hz
- 10 Hz: <–70 dBc/Hz
- 100 Hz: <–113 dBc/Hz
- 1000 Hz: <–128 dBc/Hz
- 10000 Hz: <–135 dBc/Hz
- 100,000 Hz: <–140 dBc/Hz

Frequency Accuracy

- Maximum offset at shipment: $\pm 5 \times 10^{-11}$
- Maximum retrace (48 hrs off): $\pm 5 \times 10^{-10}$
- Aging, monthly*: $<9 \times 10^{-10}$ typical**
- Aging, yearly*: $<1 \times 10^{-8}$ typical**
- 1 PPS Sync.: ±100 ns

(*After 30 days of continuous operation)

Digital Tuning

- Range: $\pm 2 \times 10^{-8}$
- Resolution: 1×10^{-12}

Analog Tuning

- Range: $\pm 2.2 \times 10^{-8}$
- Resolution: 1×10^{-11}
- Input: 0-2.5 V into 100 kΩ

Warm-up Time

<180 s

Solder

Hand solder using 63/37 Tin/Lead Solder with maximum soldering tip of 329 °C (625 °F)

** 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.

Quantum™ SA.45s CSAC Option 003

Part number 090-02984-003

Specification

All specifications at 25 °C, V_{cc} = 3.3 VDC unless otherwise specified.

Electrical Specification

RF Output

- Frequency: 16.384 MHz
- Format: CMOS
- Amplitude: 0 V to V_{cc}
- Load impedance: 1 MΩ
- Quantity: 1

1 PPS Output

- Rise/fall time (10%-90%) at load capacitance 10 pF: <10 ns
- Pulse width: 97.656 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

1 PPS 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 VDC

Physical Specifications

- Size: 1.6” x 1.39” x 0.45”
- Weight: <35 g
- MTBF: >100,000 hours

Environmental Specification

Operating

- Operating temperature: –10 °C to 70 °C
- Maximum frequency change over operating temp range (max. rate of change 0.5 °C/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 grms
- Humidity: 0 to 95% RH per MIL-STD-810, Method 507.4.

Storage and Transport (non-operating)

- Temperature: –55 °C to 85 °C
- Shock (1 ms half-sine): 1000 g
- Vibration: MIL-STD-810, Method 514.5, Procedure 1, 7.7 grms

Performance Parameters

Stability (Allan Deviation) ADEV

- TAU = 1 sec: 3.0×10^{-10}
- TAU = 10 sec: 1.0×10^{-10}
- TAU = 100 sec: 3.0×10^{-11}
- TAU = 1000 sec: 1.0×10^{-11}

RF Output Phase Noise (SSB)

- 1 Hz: <–46 dBc/Hz
- 10 Hz: <–66 dBc/Hz
- 100 Hz: <–110 dBc/Hz
- 1000 Hz: <–128 dBc/Hz
- 10000 Hz: <–135 dBc/Hz
- 100,000 Hz: <–140 dBc/Hz

Frequency Accuracy

- Maximum offset at shipment: $\pm 5 \times 10^{-11}$
- Maximum retrace (48 hrs off): $\pm 5 \times 10^{-10}$
- Aging, monthly*: <9×10^{-10} typical**
- Aging, yearly*: <1×10^{-8} typical**
- 1 PPS Sync.: ±100 ns

(*After 30 days of continuous operation)

Digital Tuning

- Range: $\pm 2 \times 10^{-8}$
- Resolution: 1×10^{-12}

Analog Tuning

- Range: $\pm 2.2 \times 10^{-8}$
- Resolution: 1×10^{-11}
- Input: 0-2.5 V into 100 kΩ

Warm-up Time

<180 s

Solder

Hand solder using 63/37 Tin/Lead Solder with maximum soldering tip of 329 °C (625 °F)

** 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.

Quantum™ SA.45s CSAC Option 004

Part number 090-02984-004

Specification

All specifications at 25 °C, V_{cc} = 3.3 VDC unless otherwise specified.

Electrical Specification

RF Output

- Frequency: 10.24 MHz
- Format: CMOS
- Amplitude: 0 V to V_{cc}
- Load impedance: 1 MΩ
- Quantity: 1

1 PPS 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

1 PPS 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 Vcc
- 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 VDC

Physical Specifications

- Size: 1.6” x 1.39” x 0.45”
- Weight: <35 g
- MTBF: >100,000 hours

Environmental Specification

Operating

- Operating temperature: –10 °C to 70 °C
- Maximum frequency change over operating temp range (max. rate of change 0.5 °C/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 grms
- Humidity: 0 to 95% RH per MIL-STD-810, Method 507.4.

Storage and Transport (non-operating)

- Temperature: –55 °C to 85 °C
- Shock (1 ms half-sine): 1000 g
- Vibration: MIL-STD-810,Method 514.5, Procedure 1, 7.7 grms

Performance Parameters

Stability (Allan Deviation) ADEV

- TAU = 1 sec: 3.0×10^{-10}
- TAU = 10 sec: 1.0×10^{-10}
- TAU = 100 sec: 3.0×10^{-11}
- TAU = 1000 sec: 1.0×10^{-11}

RF Output Phase Noise (SSB)

- 1 Hz: <–50 dBc/Hz
- 10 Hz: <–70 dBc/Hz
- 100 Hz: <–113 dBc/Hz
- 1000 Hz: <–128 dBc/Hz
- 10000 Hz: <–135 dBc/Hz
- 100,000 Hz: <–140 dBc/Hz

Frequency Accuracy

- Maximum offset at shipment: $\pm 5 \times 10^{-11}$
- Maximum retrace (48 hrs off): $\pm 5 \times 10^{-10}$
- Aging, monthly*: $<9 \times 10^{-10}$ typical**
- Aging, yearly*: $<1 \times 10^{-8}$ typical**
- 1 PPS Sync.: ±100 ns

(*After 30 days of continuous operation)

Digital Tuning

- Range: $\pm 2 \times 10^{-8}$
- Resolution: 1×10^{-12}

Analog Tuning

- Range: $\pm 2.2 \times 10^{-8}$
- Resolution: 1×10^{-11}
- Input: 0-2.5 V into 100 kΩ

Warm-up Time

<180 s

Solder

Hand solder using 63/37 Tin/Lead Solder with maximum soldering tip of 329 °C (625 °F)

** 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.

Quantum™ SA.45s CSAC Option 006

Part number 090-02984-006

Specification

All specifications at 25 °C, V_{CC} = 3.3 VDC unless otherwise specified.

Electrical Specification

RF Output

- Frequency: 5 MHz
- Format: CMOS
- Amplitude: 0 V to V_{CC}
- Load impedance: 1 MΩ
- Quantity: 1

1 PPS 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

1 PPS 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 VDC

Physical Specifications

- Size: 1.6” x 1.39” x 0.45”
- Weight: <35 g
- MTBF: >100,000 hours

Environmental Specification

Operating

- Operating temperature: –10 °C to 70 °C
- Maximum frequency change over operating temp range (max. rate of change 0.5 °C/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 grms
- Humidity: 0 to 95% RH per MIL-STD-810, Method 507.4.

Storage and Transport (non-operating)

- Temperature: –55 °C to 85 °C
- Shock (1 ms half-sine): 1000 g
- Vibration: MIL-STD-810,Method 514.5, Procedure 1, 7.7 grms

Performance Parameters

Stability (Allan Deviation) ADEV

- TAU = 1 sec: 3.0×10^{-10}
- TAU = 10 sec: 1.0×10^{-10}
- TAU = 100 sec: 3.0×10^{-11}
- TAU = 1000 sec: 1.0×10^{-11}

RF Output Phase Noise (SSB)

- 1 Hz: <–53 dBc/Hz
- 10 Hz: <–73 dBc/Hz
- 100 Hz: <–116 dBc/Hz
- 1000 Hz: <–131 dBc/Hz
- 10000 Hz: <–138 dBc/Hz
- 100,000 Hz: <–140 dBc/Hz

Frequency Accuracy

- Maximum offset at shipment: $\pm 5 \times 10^{-11}$
- Maximum retrace (48 hrs off): $\pm 5 \times 10^{-10}$
- Aging, monthly*: $<9 \times 10^{-10}$ typical**
- Aging, yearly*: $<1 \times 10^{-8}$ typical**
- 1 PPS Sync.: ±100 ns

(*After 30 days of continuous operation)

** 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.

Quantum™ SA.45s CSAC Option 006 cont.

Part number 090-02984-006

Digital Tuning

- Range ±2x10^{-8}
- Resolution 1x10^{-12}

Analog Tuning

- Range ±2.2x10^{-8}
- Resolution 1x10^{-11}
- Input 0-2.5 V into 100 kΩ

Warm-up Time

<180 s

Solder

Hand solder using 63/37 Tin/Lead Solder with maximum soldering tip of 329 °C (625 °F)

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