Microsemi
Power Matters.™

DATASHEET

Quantum™ SA.45s CSAC

Chip Scale Atomic Clock

Key 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 2.5E-10@ TAU =1 sec

Applications*

- Underwater sensor systems
- GPS receivers
- Backpack radios
- Anti-IED jamming systems
- Autonomous sensor networks
- Unmanned vehicles

*The Chip Scale Atomic Clock is not tested, qualified, and 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 10 MHz and 1 PPS outputs at standard CMOS levels, with short-term stability (Allan Deviation) of 2.5E-10 @ TAU =1 sec, long-term aging of <9E-10/month, and maximum frequency change of 5E-10 over an operating temperature range of -10°C to +35°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. The CSAC can 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.

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 (SWAP).

Quantum™ SA.45s CSAC

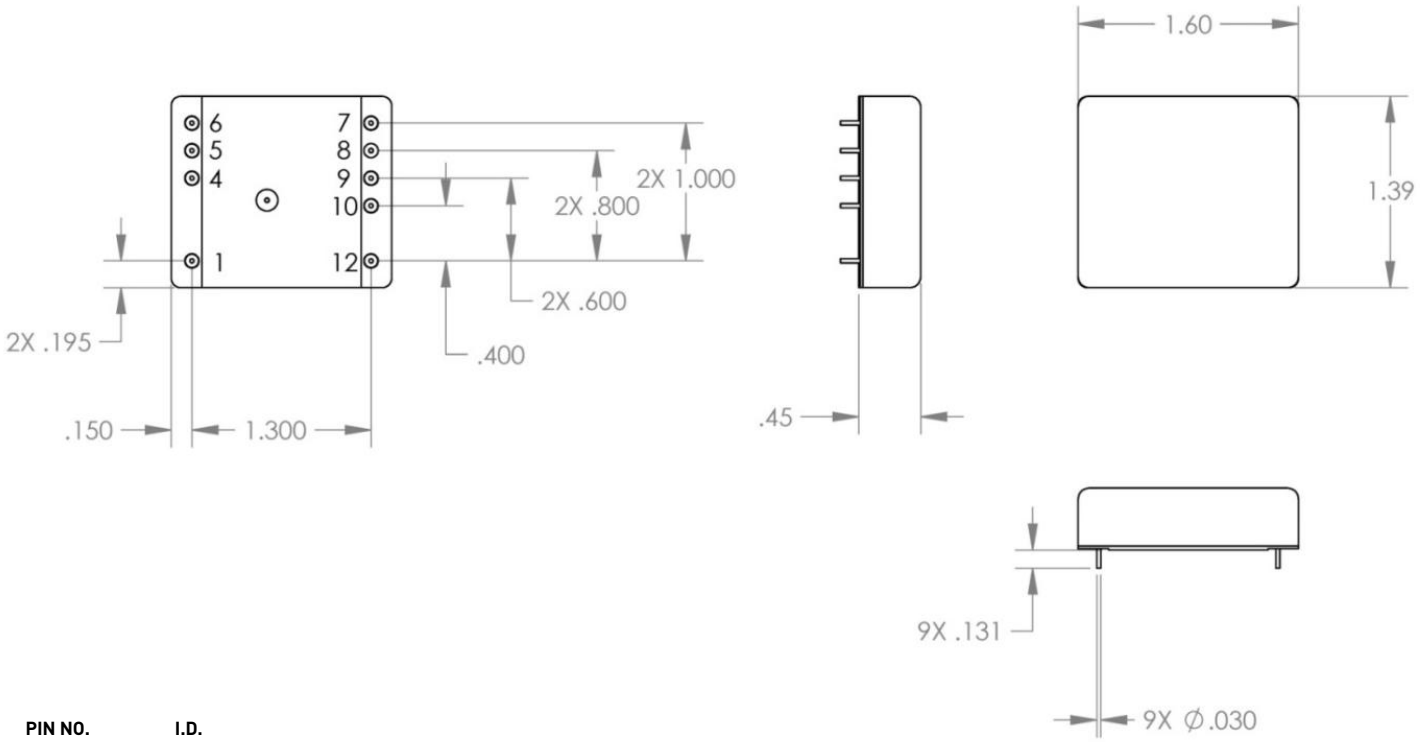
Options to Meet a Wider Range of Applications

The standard SA.45s CSAC option 001 provides an output frequency of 10MHz. However, other output frequencies are available: option 003 provides 16.384 MHz, and option 004 provides 10.24 MHz and option 006 provides a 5 MHz output.

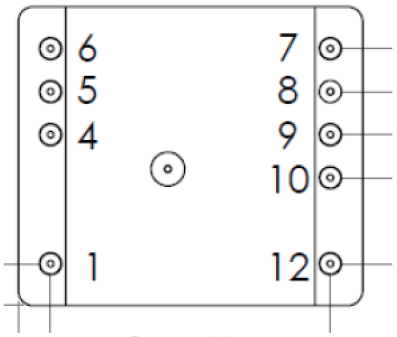
For other output frequencies please contact Microsemi for details.

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

Mechanical Interface



PIN NO.	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 090-00218-001

Specifications

All specifications at 25°C, Vcc =3.3V DC unless otherwise specified

ELECTRICAL SPECIFICATIONS

RF Output

- Frequency:	10 MHz
- Format:	CMOS
- Amplitude:	0V to Vcc
- Load impedance:	1 MΩ
- Quantity:	1

1 PPS Output

- Rise/fall time (10%-90%) at load capacitance 10pF:	<10 ns
- Pulse width:	100 µs
- Level:	0V to Vcc
- Logic High (VoH) min:	2.80 V
- Logic Low (VoL) 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 Vcc
- Input impedance:	1 MΩ
- Quantity:	1

Serial Communications

- Protocol:	RS232
- Format:	CMOS 0V to Vcc
- Tx/Rx impedance:	1 MΩ
- Baud rate:	57600

Built-in Test Equipment (BITE) output

- Format:	CMOS 0V to Vcc
- Load impedance:	1 MΩ
- Logic:	0 = Normal operation 1 = Alarm

Power Input

- Operating:	<120 mW
- Warmup:	<140 mW
- Input voltage (Vcc):	3.3 ± 0.1 VDC

PHYSICAL SPECIFICATIONS

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

ENVIRONMENTAL SPECIFICATIONS

Operating:

- Operating temperature:	-10°C to +35°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:	$\pm 4 \times 10^{-10}$

ENVIRONMENTAL SPECIFICATIONS (Continued)

- 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 +40°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	2.5×10^{-10}
TAU = 10 sec	8×10^{-11}
TAU = 100 sec	2.5×10^{-11}
TAU = 1000 sec	8×10^{-12}

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:	0-2.5V 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)

Quantum™ SA.45s CSAC Option 003

Part number 090-00218-003

Specifications

All specifications at 25°C, Vcc =3.3V DC unless otherwise specified

ELECTRICAL SPECIFICATIONS

RF Output

- Frequency:	16.384 MHz
- Format:	CMOS
- Amplitude:	0V to Vcc
- Load impedance:	1 MΩ
- Quantity:	1

1 PPS Output

- Rise/fall time (10%-90%) at load capacitance 10pF:	<10 ns
- Pulse width:	97.656 µs
- Level:	0V to Vcc
- Logic High (VOH) min:	2.80 V
- Logic Low (VOL) 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 Vcc
- Input impedance:	1 MΩ
- Quantity:	1

Serial Communications

- Protocol:	RS-232
- Format:	CMOS 0V to Vcc
- Tx/Rx impedance:	1 MΩ
- Baud rate:	57600

Built-in Test Equipment (BITE) output

- Format:	CMOS 0V to Vcc
- Load impedance:	1 MΩ
- Logic:	0 = Normal operation 1 = Alarm

Power Input

- Operating:	<120 mW
- Warmup:	<140 mW
- Input Voltage (Vcc):	3.3 ± 0.1 VDC

PHYSICAL SPECIFICATIONS

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

ENVIRONMENTAL SPECIFICATIONS

Operating:

- Operating temperature:	-10°C to +35°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:	$\pm 4 \times 10^{-10}$

ENVIRONMENTAL SPECIFICATIONS (Continued)

- 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 +40°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	2.5×10^{-10}
TAU = 10 sec	8×10^{-11}
TAU = 100 sec	2.5×10^{-11}
TAU = 1000 sec	8×10^{-12}

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*:	$<9 \times 10^{-10}$ 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:	0-2.5V 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)

Quantum™ SA.45s CSAC Option 004

Part number 090-00218-004

Specifications

All specifications at 25°C, Vcc =3.3V DC unless otherwise specified

ELECTRICAL SPECIFICATIONS

RF Output

- Frequency:	10.24 MHz
- Format:	CMOS
- Amplitude:	0V to Vcc
- Load impedance:	1 MΩ
- Quantity:	1

1 PPS Output

- Rise/fall time (10%-90%) at load capacitance 10pF:	<10 ns
- Pulse width:	100 µs
- Level:	0V to Vcc
- Logic High (VOH) min:	2.80 V
- Logic Low (VOL) 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 Vcc
- Input impedance:	1 MΩ
- Quantity:	1

Serial Communications

- Protocol:	RS-232
- Format:	CMOS 0V to Vcc
- Tx/Rx impedance:	1 MΩ
- Baud rate:	57600

Built-in Test Equipment (BITE) output

- Format:	CMOS 0V to Vcc
- Load impedance:	1 MΩ
- Logic:	0 = Normal operation 1 = Alarm

Power Input

- Operating:	<120 mW
- Warmup:	<140 mW
- Input Voltage (Vcc):	3.3 ± 0.1 VDC

PHYSICAL SPECIFICATIONS

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

ENVIRONMENTAL SPECIFICATIONS

Operating:

- Operating temperature:	-10°C to +35°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:	$\pm 4 \times 10^{-10}$

ENVIRONMENTAL SPECIFICATIONS (Continued)

- 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 +40°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	2.5×10^{-10}
TAU = 10 sec	8×10^{-11}
TAU = 100 sec	2.5×10^{-11}
TAU = 1000 sec	8×10^{-12}

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:	0-2.5V 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)

Quantum™ SA.45s CSAC Option 006

Part number 090-00218-006

Specifications

All specifications at 25°C, Vcc =3.3V DC unless otherwise specified

ELECTRICAL SPECIFICATIONS

RF Outptut

- Frequency:	5 MHz
- Format:	CMOS
- Amplitude:	0V to Vcc
- Load impedance:	1 MΩ
- Quantity:	1

1 PPS Output

- Rise/fall time (10%-90%) at load capacitance 10pF:	<10 ns
- Pulse width:	100 µs
- Level:	0V to Vcc
- Logic High (VOH) min:	2.80 V
- Logic Low (VOL) 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 Vcc
- Input impedance:	1 MΩ
- Quantity:	1

Serial Communications

- Protocol:	RS-232
- Format:	CMOS 0V to Vcc
- Tx/Rx impedance:	1 MΩ
- Baud rate:	57600

Built-in Test Equipment (BITE) output

- Format:	CMOS 0V to Vcc
- Load impedance:	1 MΩ
- Logic:	0 = Normal operation 1 = Alarm

Power Input

- Operating:	<120 mW
- Warmup:	<140 mW
- Input Voltage (Vcc):	3.3 ± 0.1 VDC

PHYSICAL SPECIFICATIONS

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

ENVIRONMENTAL SPECIFICATIONS

Operating:

- Operating temperature:	-10°C to +35°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:	$\pm 4 \times 10^{-10}$

ENVIRONMENTAL SPECIFICATIONS (Continued)

- 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 +40°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	2.5×10^{-10}
TAU = 10 sec	8×10^{-11}
TAU = 100 sec	2.5×10^{-11}
TAU = 1000 sec	8×10^{-12}

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)

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:	0-2.5V 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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