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"
- Aging <3.0E-10/month
- 10 MHz CMOS-compatible output
- 1 PPS output and 1 PPS input for synchronization
- Hermetically sealed
- 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

With an extremely low power consumption of <120 mW and a volume of <17 cc, the Symmetricom® 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 < 3E-10/month, and maximum frequency change of 5E-10 over an operating temperature range of -10°C to +70°C. The unit can also be ordered with a wider temperature range (Option 002) of -40°C to +85°C, with slightly higher power consumption and a wider maximum frequency change over temperature.

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™

Symmetricom 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.

Quantum™ SA.45s CSAC

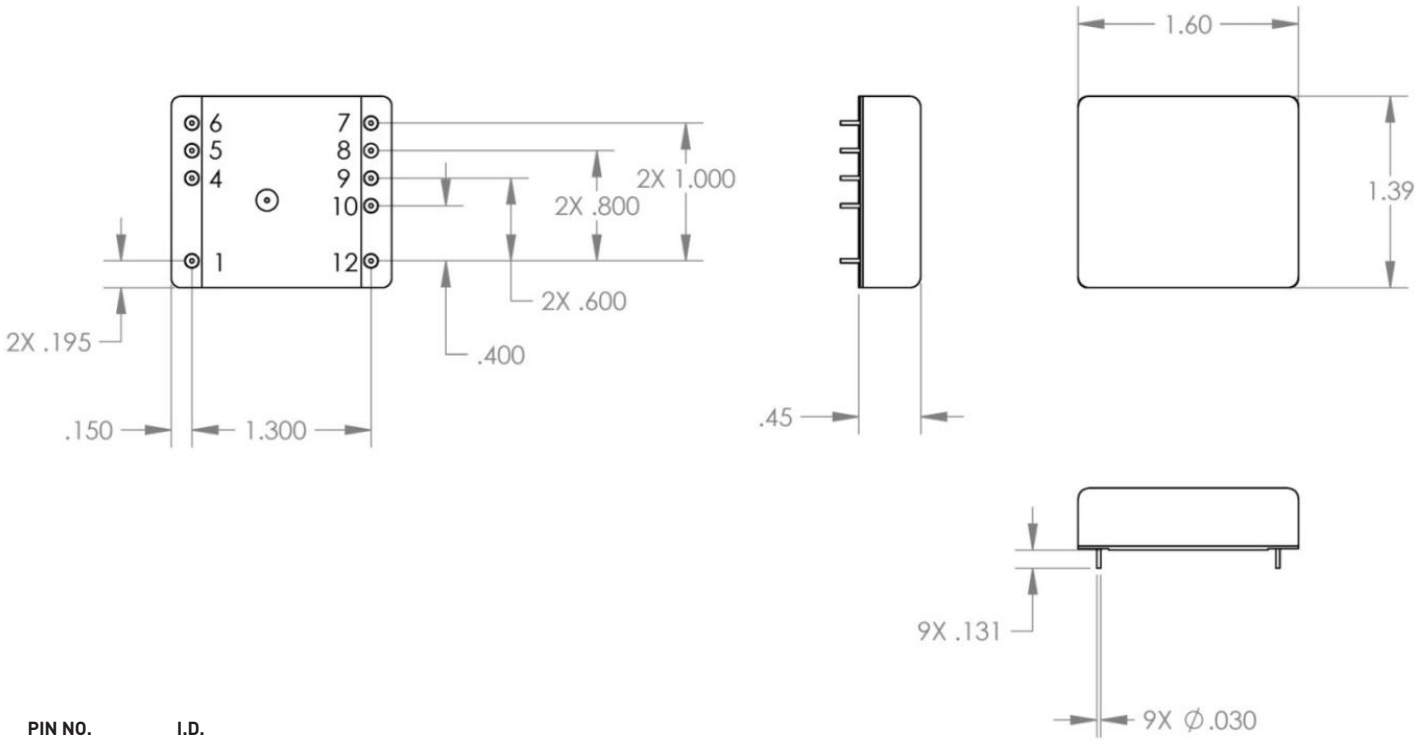
Options to Meet a Wider Range of Applications

The standard SA.45s CSAC (options 001 and 002) 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.

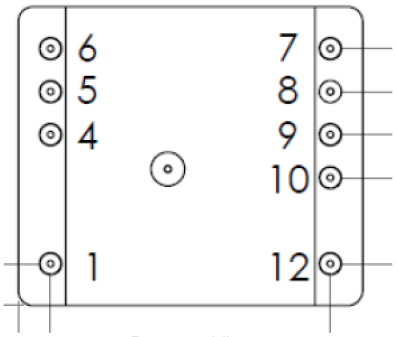
For other output frequencies please contact Symmetricom for details.

Customers wanting tighter ADEV specifications contact Symmetricom for details.

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 Options 001 and 002

Part numbers 090-00218-001 and 090-00218-002

Specifications

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

ELECTRICAL SPECIFICATIONS

	-001	-002
RF Output		
- Frequency:	10 MHz	10 MHz
- Format:	CMOS	CMOS
- Amplitude:	0V to Vcc	0V to Vcc
- Load impedance:	1 MΩ	1 MΩ
- Quantity:	1	1
1 PPS Output		
- Rise/fall time (10%-90%) at load capacitance 10pF:	<10 ns	<10 ns
- Pulse width:	100 µs	100 µs
- Level:	0V to Vcc	0V to Vcc
- Logic High (VoH) min:	2.80 V	2.80 V
- Logic Low (VoL) max:	0.30 V	0.30 V
- Load impedance:	1 MΩ	1 MΩ
- Quantity:	1	1
1 PPS Input		
- Format:	Rising edge	Rising edge
- Low level:	<0.5 V	<0.5 V
- High level	2.5 V to Vcc	2.5 V to Vcc
- Input impedance:	1 MΩ	1 MΩ
- Quantity:	1	1
Serial Communications		
- Protocol:	RS232	RS232
- Format:	CMOS 0V to Vcc	CMOS 0V to Vcc
- Tx/Rx impedance:	1 MΩ	1 MΩ
- Baud rate:	57600	57600
Built-in Test Equipment (BITE) output		
- Format:	CMOS 0V to Vcc	CMOS 0V to Vcc
- Load impedance:	1 MΩ	1 MΩ
- Logic:	0 = Normal operation 1 = Alarm	0 = Normal operation 1 = Alarm
Power Input		
- Operating:	<120 mW	<125 mW
- Warmup:	<140 mW	<140 mW
- Input voltage (Vcc):	3.3 ± 0.1 VDC	3.3 ± 0.1 VDC

PHYSICAL SPECIFICATIONS

- Size:	1.6" x 1.39" x 0.45"	1.6" x 1.39" x 0.45"
- Weight:	<35 g	<35 g
- MTBF:	>100,000 hours	>50,000 hours

ENVIRONMENTAL SPECIFICATIONS

Operating:		
- Operating temperature:	-10°C to +70°C	-40°C to +85°C
- Maximum frequency change over operating temp range (max. rate of change 0.5 °C/minute):	$\pm 5 \times 10^{-10}$	$\pm 1 \times 10^{-9}$
- Frequency change over allowable input voltage range:	$\pm 4 \times 10^{-10}$	$\pm 4 \times 10^{-10}$

ENVIRONMENTAL SPECIFICATIONS *(Continued)*

	-001	-002
- Magnetic sensitivity (≤2.0 Gauss):	$\pm 9 \times 10^{-11}$/Gauss	$\pm 9 \times 10^{-11}$/Gauss
- Radiated emissions.	Compliant to FCC part 15, Class B, when mounted properly onto host PCB.	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	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.	0 to 95% RH per MIL-STD-810, Method 507.4
Storage and Transport (non-operating):		
- Temperature:	- 55°C to +90°C	- 55°C to +90°C
- Shock (1 ms half-sine):	1000 g	1000 g
- Vibration:	MIL-STD-810, Method 514.5, Procedure 1, 7.7 grms	MIL-STD-810, Method 514.5, Procedure 1, 7.7 grms

PERFORMANCE PARAMETERS

Stability (Allan Deviation)

ADEV		
TAU = 1 sec	2.5×10^{-10}	2.5×10^{-10}
TAU = 10 sec	8×10^{-11}	8×10^{-11}
TAU = 100 sec	2.5×10^{-11}	2.5×10^{-11}
TAU = 1000 sec	8×10^{-12}	8×10^{-12}
RF Output Phase Noise (SSB)		
1 Hz	<-50 dBc/Hz	<-50 dBc/Hz
10 Hz	<-70 dBc/Hz	<-70 dBc/Hz
100 Hz	<-113 dBc/Hz	<-113 dBc/Hz
1000 Hz	<-128 dBc/Hz	<-128 dBc/Hz
10000 Hz	<-135 dBc/Hz	<-135 dBc/Hz
100,000 Hz	<-140 dBc/Hz	<-140 dBc/Hz
Frequency Accuracy		
- Maximum offset at shipment:	$\pm 5 \times 10^{-11}$	$\pm 5 \times 10^{-11}$
- Maximum retrace (48 hrs off):	$\pm 5 \times 10^{-11}$	$\pm 5 \times 10^{-11}$
- Aging, monthly*:	$<3 \times 10^{-10}$	$<3 \times 10^{-10}$
- Aging, yearly*:	$<1 \times 10^{-9}$	$<1 \times 10^{-9}$
- 1 PPS Sync.:	±100 ns	±100 ns

*(*After 30 days of continuous operation)*

Digital Tuning		
- Range:	$\pm 2 \times 10^{-8}$	$\pm 2 \times 10^{-8}$
- Resolution:	1×10^{-12}	1×10^{-12}
Analog Tuning		
- Range:	$\pm 2.2 \times 10^{-8}$	$\pm 2.2 \times 10^{-8}$
- Resolution:	1×10^{-11}	1×10^{-11}
- Input:	0-2.5V into 100 kΩ	0-2.5V into 100 kΩ
Warm-up Time	<130 s	<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 =3.3VDC 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 +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:	$\pm 4 \times 10^{-10}$

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 +90°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):	$\pm 5 \times 10^{-11}$
- Aging, monthly*:	$<3 \times 10^{-10}$
- Aging, yearly*:	$<1 \times 10^{-9}$
- 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 <130 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 =3.3VDC 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 +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:	$\pm 4 \times 10^{-10}$

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 +90°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):	$\pm 5 \times 10^{-11}$
- Aging, monthly*:	$<3 \times 10^{-10}$
- Aging, yearly*:	$<1 \times 10^{-9}$
- 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 <130 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 =3.3VDC 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 +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:	$\pm 4 \times 10^{-10}$

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 +90°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):	$\pm 5 \times 10^{-11}$
- Aging, monthly*:	$<3 \times 10^{-10}$
- Aging, yearly*:	$<1 \times 10^{-9}$
- 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 <130 s

Solder

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

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