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

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.

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

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

<table>
<thead>
<tr>
<th>PIN NO.</th>
<th>I.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tune</td>
</tr>
<tr>
<td>2</td>
<td>N/A</td>
</tr>
<tr>
<td>3</td>
<td>N/A</td>
</tr>
<tr>
<td>4</td>
<td>BITE</td>
</tr>
<tr>
<td>5</td>
<td>Tx</td>
</tr>
<tr>
<td>6</td>
<td>Rx</td>
</tr>
<tr>
<td>7</td>
<td>Vcc</td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
</tr>
<tr>
<td>9</td>
<td>1 PPS IN</td>
</tr>
<tr>
<td>10</td>
<td>1 PPS OUT</td>
</tr>
<tr>
<td>11</td>
<td>N/A</td>
</tr>
<tr>
<td>12</td>
<td>10 MHz OUT</td>
</tr>
</tbody>
</table>
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
- Magnetic sensitivity (≤2.0 Gauss): ±9x10⁻¹⁰/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 2.5x10⁻¹⁰
TAU = 10 sec 8x10⁻¹¹
TAU = 100 sec 2.5x10⁻¹¹
TAU = 1000 sec 8x10⁻¹²

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: ±5x10⁻¹¹
- Maximum retrace [48 hrs off]: ±5x10⁻¹⁰
- Aging, monthly*: <9x10⁻¹⁰ typical
- Aging, yearly*: <1x10⁻⁷ typical
- 1 PPS Sync.: ±100 ns

(*After 30 days of continuous operation)

Digital Tuning
- Range: ±2x10⁻⁶
- Resolution: 1x10⁻¹²

Analog Tuning
- Range: ±2.2x10⁻⁶
- Resolution: 1x10⁻¹¹
- 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

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): ±5x10⁻¹⁰
- Frequency change over allowable input voltage range: ±4x10⁻¹⁰

PERFORMANCE PARAMETERS

Stability (Allan Deviation)
- ADEV
  TAU = 1 sec  2.5x10⁻¹⁰
  TAU = 10 sec 8x10⁻¹¹
  TAU = 100 sec 2.5x10⁻¹¹
  TAU = 1000 sec 8x10⁻¹²

RF Output Phase Noise (SSB)
- 1 Hz <-46 dBc/Hz
- 10 Hz <-66 dBc/Hz
- 100 Hz <-110 dBc/Hz
- 1000 Hz <-135 dBc/Hz
- 10,000 Hz <-140 dBc/Hz

Frequency Accuracy
- Maximum offset at shipment: ±5x10⁻¹¹
- Maximum retrace (48 hrs off): ±5x10⁻¹³
- Aging, monthly*: ±9x10⁻¹⁰ typical
- Aging, yearly*: ±1x10⁻⁸ typical
- 1 PPS Sync.: ±100 ns
(*After 30 days of continuous operation)

Digital Tuning
- Range: ±2x10⁻⁴
- Resolution: 1x10⁻¹²

Analog Tuning
- Range: ±2.2x10⁻⁴
- Resolution: 1x10⁻¹¹
- 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)
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]: ±5x10^{-10}
- Frequency change over allowable input voltage range: ±4x10^{-10}

**ENVIROMENTAL SPECIFICATIONS**

**(Continued)**
- Magnetic sensitivity: ±9x10^{-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: 2.5x10^{-10}
  - TAU = 10 sec: 8x10^{-11}
  - TAU = 100 sec: 2.5x10^{-11}
  - TAU = 1000 sec: 8x10^{-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: ±5x10^{-11}
- Maximum retrace (48 hrs off): ±5x10^{-10}
- Aging, monthly*: <9x10^{-10} typical
- Aging, yearly*: <1x10^{-9} typical
- 1 PPS Sync.: ±100 ns
  (*After 30 days of continuous operation)

**Digital Tuning**
- Range: ±2x10^{-8}
- Resolution: 1x10^{-12}

**Analog Tuning**
- Range: ±2.2x10^{-9}
- Resolution: 1x10^{-12}
- 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 Output
- 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: 57600
- 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: ±5x10-10
- Frequency change over allowable input voltage range: ±4x10-10

Stability (Allan Deviation)
ADEV
TAU = 1 sec 2.5x10-10
TAU = 10 sec 8x10-11
TAU = 100 sec 2.5x10-11
TAU = 1000 sec 8x10-12

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: ±5x10-11
- Maximum retrace (48 hrs off): ±5x10-10
- Aging, monthly*: 9x10-10 typical
- Aging, yearly*: 1x10-9 typical
- 1 PPS Sync.: ±100 ns
(*After 30 days of continuous operation)

Digital Tuning
- Range: ±2x10-6
- Resolution: 1x10-12

Analog Tuning
- Range: ±2.2x10-6
- Resolution: 1x10-11
- 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)
Microsemi Corporation (Nasdaq: MSCC) offers a comprehensive portfolio of semiconductor and system solutions for communications, defense & security, aerospace and industrial markets. Products include high-performance and radiation-hardened analog mixed-signal integrated circuits, FPGAs, SoCs and ASICs; power management products; timing and synchronization devices and precise time solutions, setting the world's standard for time; voice processing devices; RF solutions; discrete components; security technologies and scalable anti-tamper products; Ethernet Solutions; Power-over-Ethernet ICs and midspans; as well as custom design capabilities and services. Microsemi is headquartered in Aliso Viejo, Calif., and has approximately 3,600 employees globally. Learn more at www.microsemi.com.

Microsemi makes no warranty, representation, or guarantee regarding the information contained herein or the suitability of its products and services for any particular purpose, nor does Microsemi assume any liability whatsoever arising out of the application or use of any product or circuit. The products sold hereunder and any other products sold by Microsemi have been subject to limited testing and should not be used in conjunction with mission-critical equipment or applications. Any performance specifications are believed to be reliable but are not verified, and Buyer must conduct and complete all performance and other testing of the products, alone and together with, or installed in, any end-products. Buyer shall not rely on any data and performance specifications or parameters provided by Microsemi. It is the Buyer’s responsibility to independently determine suitability of any products and to test and verify the same. The information provided by Microsemi hereunder is provided “as is, where is” and with all faults, and the entire risk associated with such information is entirely with the Buyer. Microsemi does not grant, explicitly or implicitly, to any party any patent rights, licenses, or any other IP rights, whether with regard to such information itself or anything described by such information. Information provided in this document is proprietary to Microsemi, and Microsemi reserves the right to make any changes to the information in this document or to any products and services at any time without notice.