# Quantum™ SA.45s CSAC

## Chip Scale Atomic Clock

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.

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).
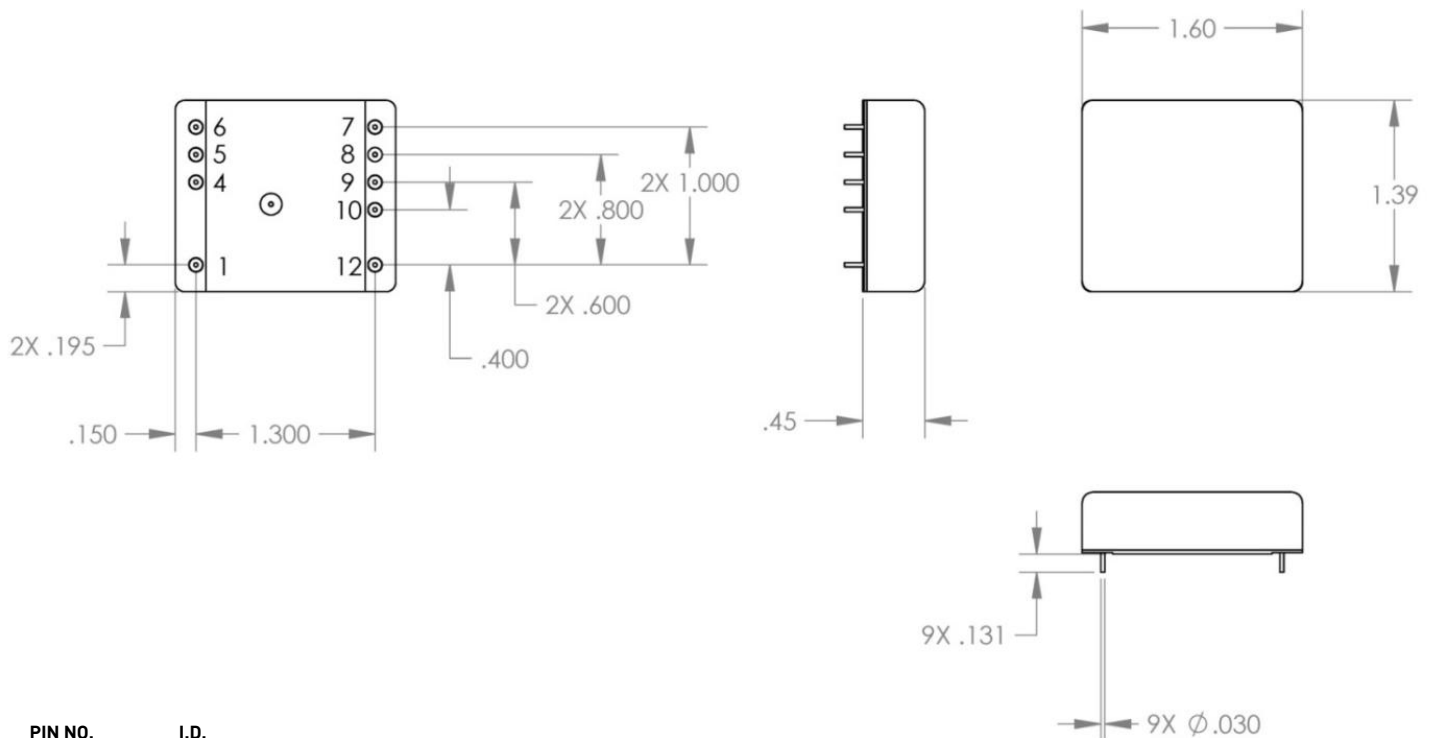
# Quantum™ SA.45s CSAC

## 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.

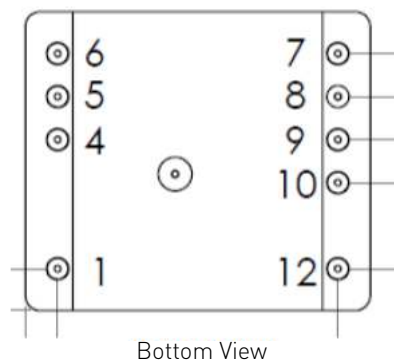For other output frequencies please contact Microsemi for details.

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

## Mechanical Interface



Bottom View

| 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 |

# 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 | $2.5 \times 10^{-10}$ |
| TAU = 10 sec | $8 \times 10^{-11}$ |
| TAU = 100 sec | $2.5 \times 10^{-11}$ |
| TAU = 1000 sec | $8 \times 10^{-12}$ |

**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: $1 \times 10^{-12}$

**Analog Tuning**
- Range: $\pm 2.2 \times 10^{-8}$
- Resolution: $1 \times 10^{-11}$
- 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)

![Microsemi — Power Matters.™]

# 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<br>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 | $2.5 \times 10^{-10}$ |
| TAU = 10 sec | $8 \times 10^{-11}$ |
| TAU = 100 sec | $2.5 \times 10^{-11}$ |
| TAU = 1000 sec | $8 \times 10^{-12}$ |

**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: | $1 \times 10^{-12}$ |

**Analog Tuning**

| | |
|---|---|
| - Range: | $\pm 2.2 \times 10^{-8}$ |
| - Resolution: | $1 \times 10^{-11}$ |
| - 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): | $\pm5\times10^{-10}$ |
| - Frequency change over allowable input voltage range: | $\pm4\times10^{-10}$ |

### ENVIRONMENTAL SPECIFICATIONS (Continued)

| | |
|---|---|
| - Magnetic sensitivity (≤2.0 Gauss): | $\pm9\times10^{-11}$/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 | $2.5\times10^{-10}$ |
| TAU = 10 sec | $8\times10^{-11}$ |
| TAU = 100 sec | $2.5\times10^{-11}$ |
| TAU = 1000 sec | $8\times10^{-12}$ |

**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: | $\pm5\times10^{-11}$ |
| - Maximum retrace (48 hrs off): | $\pm5\times10^{-10}$ |
| - Aging, monthly*: | $<9\times10^{-10}$ typical |
| - Aging, yearly*: | $<1\times10^{-8}$ typical |
| - 1 PPS Sync.: | ±100 ns |

(*After 30 days of continuous operation)

**Digital Tuning**

| | |
|---|---|
| - Range: | $\pm2\times10^{-8}$ |
| - Resolution: | $1\times10^{-12}$ |

**Analog Tuning**

| | |
|---|---|
| - Range: | $\pm2.2\times10^{-8}$ |
| - Resolution: | $1\times10^{-11}$ |
| - 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): | $\pm5\times10^{-10}$ |
| - Frequency change over allowable input voltage range: | $\pm4\times10^{-10}$ |

### ENVIRONMENTAL SPECIFICATIONS (Continued)

| | |
|---|---|
| - Magnetic sensitivity (≤2.0 Gauss): | $\pm9\times10^{-11}$/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 | $2.5\times10^{-10}$ |
| TAU = 10 sec | $8\times10^{-11}$ |
| TAU = 100 sec | $2.5\times10^{-11}$ |
| TAU = 1000 sec | $8\times10^{-12}$ |

#### 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: | $\pm5\times10^{-11}$ |
| - Maximum retrace (48 hrs off): | $\pm5\times10^{-10}$ |
| - Aging, monthly*: | $<9\times10^{-10}$ typical |
| - Aging, yearly*: | $<1\times10^{-8}$ typical |
| - 1 PPS Sync.: | ±100 ns |

(*After 30 days of continuous operation)

#### Digital Tuning

| | |
|---|---|
| - Range: | $\pm2\times10^{-8}$ |
| - Resolution: | $1\times10^{-12}$ |

#### Analog Tuning

| | |
|---|---|
| - Range: | $\pm2.2\times10^{-8}$ |
| - Resolution: | $1\times10^{-11}$ |
| - 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.**

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