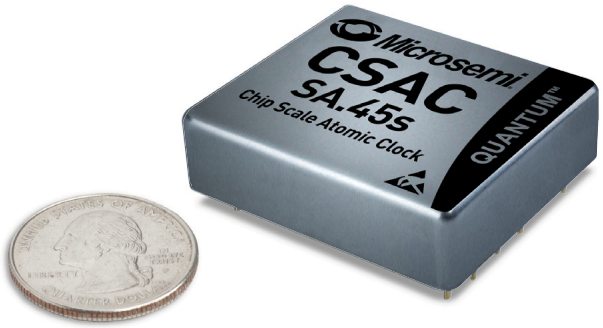
# Quantum™ SA.45s CSAC Frequently Asked Questions

## 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.

## SA.45s CSAC Hardware

**Q:** Can output frequencies other than 10 MHz be provided?

**A:** Yes, other frequencies can be implemented, but not all. However, they require a special frequency crystal, and some engineering work on the units and test system. Consequently, first time orders for special frequencies will have an NRE charge and will require a minimum order quantity, which will depend on the frequency being requested, as the crystal suppliers have different MOQs for different frequencies. We can accommodate most frequencies up to 32 MHz.

**Q:** Have we seen any activity dips on our TCXO?

**A:** Atomic clocks do not show activity dips because the TCXO is locked to the atoms in the physics package.

**Q:** Have we seen any frequency jump behavior that was not corrected by the cesium feedback loop?

**A:** Traditional Rb oscillators are known to show occasional and unpredictable frequency jumps at the parts in the $1.0E^{-10}$ level, which have never been completely understood. To date, we have not seen any such jumps on the SA.3xm Rubidium series, or on the SA.45s CSAC.

**Q:** Is the SA.45s CSAC sensitive to magnetic fields?

**A:** Yes, this sensitivity is specified on the data sheet as $<9E^{-11}$/gauss, in fields of ±2.0 gauss. Just like conventional Rb sources, the SA.45s CSAC has one sensitive axis and two axes that show negligible effects. However, due to its size, the SA.45s is somewhat more vulnerable to magnetic fields (conventional Rbs show an effect of ~$5E^{-11}$/gauss). The SA.45s CSAC has two layers of mu-metal shielding to reduce magnetic effects.

**Q:** How sensitive is the SA.45s CSAC to power supply voltage/noise?

**A:** The output frequency will change by no more than $4.0E^{-10}$ as the supply voltage varies over its allowable range (3.2 V to 3.4 V).

**Q:** What material is used in the SA.45s housing?

**A:** The entire housing—cover and baseplate—is made of mu-metal.

**Q:** The SA.45s contains cesium in its physics package. Does that mean the unit must be shipped as hazardous material?

**A:** No, because Microsemi has secured exemptions from "hazmat" shipping regulations due to the amount of cesium in the physics package being very small. We have certification from IATA stating that the product can be shipped to international destinations (outside of the U.S.) without hazmat restrictions, and similar certification from the U.S. Department of Transportation (DoT) stating the same for shipments inside of the U.S.

**Q:** Does Microsemi have drawings of the package outline that can be accessed by customers?

**A:** Yes, these drawings are available as a pdf file.

**Q:** Does Microsemi have a 3D model of the unit that can be used with Solid Works?

**A:** Yes, we can provide an .SLDPRT file that has a 3D mass model of the SA.45s CSAC.

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**Q:** For soldering purposes, what is the composition of the SA.45s CSAC leads?

**A:** The lead material is 52 Alloy with a plating of 200 µinches (minimum) of tin plate (MIL-T-10727) over 100 µinches nickel (QQ-N-290).

**Q:** What are the soldering guidelines for the SA.45s CSAC?

**A:** The unit should be hand-soldered. Specific guidelines are shown on the data sheet.

**Q:** Is the SA.45s CSAC hermetic?

**A:** No. The physics package is hermetic, but the PCBA is not hermetically sealed.

**Q:** Can the SA.45s CSAC be operated in a vaccum?

**A:** Yes. When the unit is hermetically sealed, the operation is at normal atmospheric pressure. The pressure difference is not great enough to affect the physics package hermeticity, so there should be no operational effect, assuming that the baseplate is properly heatsunk.

**Q:** How rugged is the SA.45s CSAC?

**A:** The SA.45s is one of our best-performing atomic clocks under shock and vibration. A whitepaper describing the tests, along with the results, can be downloaded from the Microsemi website.

**Q:** Does the SA.45s have a jitter specification? What is it?

**A:** The SA.45s does not specify jitter because this specification is very easy to misinterpret. However, the unit does specify phase noise, and jitter can be calculated from phase noise. Using the CSAC's phase noise specification, and calculating over a bandwidth from 1 Hz to 1 MHz, the calculated jitter of the CSAC is 78 ps.

**Q:** How does the PCB in the SA.45s CSAC mount to the bottom housing?

**A:** The PCB is soldered to the pins of the lower housing, and there is a pin in the lower housing that connects through the PCB as well.

**Q:** Is the SA.45s CSAC RoHS-compliant?

**A:** CSAC is 5/6 compliant, as it makes use of lead in solder. This product is excluded from the Restrictive Substance Requirements of the RoHS Directive under Category 9 (Industrial Monitoring and Control instruments) as defined by 2011/65/EU Annex 1.

**Q:** The SA.45s CSAC data sheet only shows an Allan Deviation specification of 1000 seconds. What happens for larger values of tau?

**A:** The ADEV continues to improve (but with a shallower slope than what is seen up to 1000 seconds) up to about 20,000 seconds. After that, the ADEV starts to increase due to aging effects.

## SA.45s CSAC Software

**Q:** Can the frequency be adjusted (steered) by the !F command while the SA.45s CSAC is in "holdover" of discipline mode (external 1 PPS removed but unit is still in discipline mode)?

**A:** Yes. The way the SA.45s CSAC works is that the tuning at any time is the sum (factory cal + steer + discipline + analog tuning). You can change any one setting independent of the others. The Latch command can be sent at any time to add the last three terms to the factory calculation and reset to 0.

**Q:** What does the SA.45s CSAC clock do if it is in disciplined mode but not receiving a 1 PPS IN? What if the 1 PPS IN is intermittent (i.e. with poor GPS reception)? Could the clock be left in this mode during deployments, or will the user have to change modes?

**A:** If the SA.45s CSAC is in disciplining mode, it will steer to 1 PPS when available. Should the 1 PPS disappear, the SA.45s CSAC will hold its last frequency (as described in the User Guide). When the 1 PPS reappears, the SA.45s CSAC will begin to discipline back to that signal, and it will do so "gracefully," with no sudden changes in phase or frequency. The only exception to this is if outage is lengthy and there is a significant wander/drift of phase during that time, in which case the SA.45s CSAC will steer aggressively to recover when the 1 PPS reappears.

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**Q:** It would be more convenient for us to run at 9600 baud. Is it possible to change the SA.45s CSAC's baud rate, or purchase a SA.45s CSAC with a different baud rate?

**A:** There is no command interface/software provision to change the baud rate.

**Q:** Is it possible to retrieve the value of the non-volatile calibration?

**A:** This value is not customer-accessible.

## SA.45 CSAC Developer's Kit

**Q:** What are the contents of the Developer's Kit?

**A:** The Developer's kit contains:

- A PC board with a socket for the CSAC, and various other components that make it easy to access the various pins of the CSAC.
- An external power supply to power the PCBA and the CSAC.
- An RS-232 cable to connect your PC to the PCBA.
- Miscellaneous hardware for mounting the PCBA.

**Q:** Is the external power supply in the Developer's Kit compatible with 220 V AC?

**A:** Yes, the Developer's Kit is compatible with 220 V AC.

**Q:** Is there an alternative to the recommended socket, Tyco P/N 4-5332070?

**A:** Yes, we have also used Mil-Max P/N 0305-0-15-15- 47-27-10-0, which is available from Digikey.

**Q:** What is the temperature range of the demo board in the Developer's Kit?

**A:** It is the same, both operating and non-operating, as the SA.45s CSAC itself.

**Q:** What is the "mounting hardware" referred to in the contents of the Developer's Kit?

**A:** The PCB is mounted on an aluminum plate and held in place with screws. The plate and screws are the mounting hardware.

**Q:** Can a SA.45s CSAC in the socket of the demo board be subjected to vibration?

**A:** No, the socket is not at all vibration-proof. The SA.45s CSAC would need to be glued into the socket or soldered to a PCB.

**Q:** Can the Developer's Kit be used with a SA.45s CSAC that is operating at a special frequency of 10.24 MHz instead of the standard 10 MHz?

**A:** Yes, this will work without any modifications to the Developer's Kit.

## SA.45s CSAC Sales and Ordering

**Q:** What is the licensing status of the SA.45s CSAC?

**A:** The SA.45s CSAC has an Export Commodity Control Number (ECCN) of EAR99. This means it is not ITAR-controlled and does not require a special license to ship to most nations. The SA.45s CSAC's classification is less restrictive than Microsemi's 5071 Cs standard. The SA.45s CSAC classification is controlled by the Bureau of Industrial Security (BIS) within the US Department of Commerce.

**Q:** What data is supplied with the SA.45s CSAC when it is shipped?

**A:** No data comes with standard production units, as this helps us keep our costs low.

**Q:** What is the warranty on the SA.45s CSAC?

**A:** The product comes with a one-year warranty.

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**Q:** Any advice for disciplining to a GPS?

**A:** If trouble disciplining, user can try a larger 1 PPS phase threshold or shorter time constant, Tau. Once the CSAC is disciplined, these values can be tailored to optimize performance. See the User Guide for more details.

**Q:** What are the different options available with thee SA.45s CSAC?

**A:** The following options are available with the SA.45s CSAC.

| Part Number | Description |
|---|---|
| 090-02984-001 (Option -001) | Operates from –10 °C to 70 °C, with an output frequency of 10 MHz, ADEV = $3E^{-10}$ (tau = 1 sec) |
| 090-02984-001 (Option -003) | Operates from –10 °C to 70 °C, with an output frequency of 16.384 MHz, ADEV = $3E^{-10}$ (tau = 1 sec) |
| 090-02984-001 (Option -004) | Operates from –10 °C to 70 °C, with an output frequency of 10.24 MHz, ADEV = $3E^{-10}$ (tau = 1 sec) |
| 090-02984-001 (Option -006) | Operates from –10 °C to 70 °C, with an output frequency of 5 MHz, ADEV = $3E^{-10}$ (tau = 1 sec) |


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