



## Low Phase Noise Floor Frequency Control for Stratum 3E

The series 139 oven-controlled crystal oscillator (OCXO) from CTS Corporation offers the highly stable and tightly controlled performance, emblematic of quartz-based OCXOs, in combination with excellent phase noise performance that minimizes signal fluctuations and prevents degrading accuracy. Striking the perfect balance between performance and cost-effectiveness, the series 139 OCXO is the ideal internal timing reference for applications that require timing stability and performance to the levels of Stratum 3E. To boot, the series is small of size and comes with options for mounting, voltage and operating temperature.

### Keeping SONET/SDH Networks in Sync

Standardized data transmitting protocols such as Synchronous Optical Network (SONET) and Synchronous Digital Hierarchy (SDH) allow multiple digital signals such as voice, video or data to be *multiplexed* (i.e., *combined*) and transmitted over long distances synchronously. This requires all network elements to operate in tight unison which is achieved by using a common clock reference with the necessary precision and stability to meet Stratum 1 standards. Throughout the network, however, *local timing references*, set to the common timing source, are required, as they will keep the individual devices in sync in case the connection to the common clock is lost. Without local timing references, the network timing would quickly fall about during any signal holdover, resulting in errors and loss of data. Stratum 3E is the accuracy, stability and holdover standard for local timing sources in SONET and SDH networks, and that standard can be achieved by for instance a quartz-based *oven-controlled crystal oscillator* (OCXO). While not as accurate as atomic clocks or a GPS, an OCXO is more than capable of maintaining timing in downstream network equipment, even during extended holdover periods. At the same time, they are not nearly as costly as Cesium- and Rubidium-based clocks, making them a good fit for applications that require Stratum 3E performances.



The series 139 low phase noise OCXO from CTS.

## The Series 139 Oven-Controlled Crystal Oscillator (OCXO)

### How does the series 139 OCXO work?

The series 139 OCXO is a quartz-based clock oscillator that utilizes an internal oven to tightly control the temperature of its quartz resonator. As the quartz crystal is piezoelectric, it can be made to vibrate at specified frequencies when exposed to an electric field, thus providing a stable frequency output that can be used as a timing reference. However, the frequency of the quartz crystal is temperature-sensitive, meaning that changes in ambient temperature can cause the frequency to drift.

An OCXO circumvents this issue by hermetically sealing the quartz crystal within an internal oven, keeping the crystals at temperatures optimal for their required frequency output. When the ambient temperature changes, the oven will compensate for that change accordingly, thus maintaining an internal temperature of within 1°C of its set point over an entire -40 to 85°C ambient temperature range. This feature makes OCXOs the most stable and accurate of all available quartz-based timing devices, enabling operation to the Stratum 3E standard of stability and precision.

Additionally, thermally stabilizing the quartz crystal resonator in the internal oven will help lower the *phase noise* that can occur during operation. With fewer temperature fluctuations, the oscillator will consequently experience fewer short-term phase shifts, resulting in less phase noise to degrade the quality of the signal. Low phase noise generation is also an important criterion to the Stratum 3E standard and one of the deciding factors that separate it from its less stringent Stratum 3 counterpart.

### What does the series 139 OCXO offer?

The series 139 OCXO from CTS is specifically designed to meet the operational demands of the Stratum 3E standard. It can be calibrated to one of nine standard frequencies ranging from 10 to 30.72 MHz, but upon request, custom frequencies from 10 to 40MHz can be accommodated as well.

In terms of stability, the series 139 OCXO offers true Stratum 3E performance of 10 ppb peak-to-peak over its entire operating temperature range. It can also be customized to match applications that can do with a narrower temperature range or a greater stability drift.

What truly sets the series 139 OCXO apart, however, is its excellent phase noise performance. The thermally stabilized quartz resonator, the high mechanical quality factor of CTS' meticulously cut crystals as well as oscillator circuitry amplifiers and buffers all contribute to a typical phase noise floor of -170 dBc/Hz.

To accommodate unique system architectures and maximize design freedom, the series 139 can be acquired either as a surface mount solution or in a DIL through-hole package. Both versions are small of size and come with options for supply voltage (3.3 or 5.0 V<sub>DC</sub>).

Series 139 Low Phase Noise OCXO						
Output	Frequency Range (MHz)	Frequency Stability (ppb)	Package (mm) (L x W x H)	Phase Noise Floor (dBc/Hz)	Voltage (V <sub>DC</sub> )	Operating Temperature Range (°C)
HCMOS	10-40	±10, ±20, ±50, 10 pk-pk	20.32x12.7x11.0	-170	3.3, 5.0	-40 to 85
			SMD 20.32x12.7x9.3 Through Hole			



## Ideal Applications for the Series 139 Oven-Controlled Crystal Oscillator (OCXO)

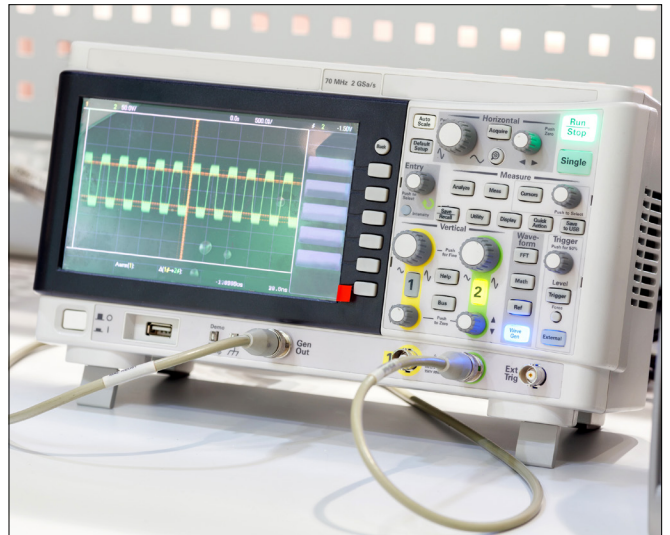
### SONET, SDH and Packet-Based Networks

The series 139 OCXO from CTS is the ideal choice of frequency control for SONET, SDH and packet-based network element that require local timing references that meet the Stratum 3E standard of stability, accuracy and phase noise performance. This could include add/drop multiplexers (ADMs), digital cross-connect systems (DCS), synchronization supply units (SSUs) and other downstream equipment that need to be synced to the network's master clock while also requiring timing redundancy in case of connection loss and extended periods of holdover. To these applications, the series 139 OCXO will provide a stable, accurate and durable means of localized frequency control that will reduce the detrimental effects of phase noise interference for a clearer signal.



### Test and Measurement Equipment

The series 139 low phase noise OCXO will improve performance in precision test equipment used in labs and manufacturing, such as signal generators, frequency counters and spectrum analyzers. It delivers ultra-stable timing with minimal jitter, enabling accurate measurements and clean signal generation. Essential for applications like high-speed serial interface testing, RF component characterization and oscillator validation, the series 139 will ensure reliable and repeatable results in production and experimental environments where timing and frequency accuracy are critical.



### Radar and Radio Frequency Systems

A low phase noise OCXO, like the series 139, are a vital component in radar and similar RF systems, where signal clarity and timing precision directly impact performance. In radar, it will ensure stable reference frequencies for accurate target detection, reduced clutter and sharper resolution. Low phase noise minimizes signal distortion and improves dynamic range, which is crucial for tracking fast-moving or distant objects. These oscillators also support reliable operation in e.g., avionics and surveillance systems, where frequency stability and low jitter are essential for processing weak or rapidly changing signals.



## About CTS Corporation

CTS is a leading designer and manufacturer of products that Sense, Connect, and Move. We manufacture sensors, actuators and electronic components in North America, Europe and Asia, and provide solutions to OEMs in the aerospace & defense, medical, industrial, communications, information technology and transportation industries.

Frequency controls products from CTS combine the impeccable product quality of a well-established and renowned western electronics manufacturer with highly competitive price points and short lead times. The series 139 oven-controlled crystal oscillator is a ready-made, yet highly accurate solution with the flexibility of implementation to fit a broad spectrum of applications across various industries and markets. It can be acquired via the CTS website or through CTS' global network of product distributors and shipped to anywhere in the world in a matter of days.

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