

Application Note

Low Power OCXO



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Low Power OCXO

Overview of the OCXO

Abstract

There are many hurdles to overcome during any new program development phase, one being the selection of components. This paper outlines and highlights applications in search of high stability, low power, low noise, and environmentally rugged precision oscillators. Other considerations include overall budget as well as component package size/volume.

Demand

In the world of wireless communication, transmit frequencies are continually being pushed higher and higher to accommodate the need for ever increasing bandwidth. Likewise, overall power consumption is being driven lower as systems historically associated with large platforms and fixed sites are being installed on smaller mobile platforms such as land vehicles, handheld mobile test equipment, and mobile Satellite Communication links. This evolution however does not reduce a system's requirement for frequency stability/accuracy along with noise performance generated by its local reference oscillator. As some wireless communication architectures become more complex and gravitate to mobile functionality (re. deployed on a mobile platform or vehicle), the need for synchronization and quick lock time is becoming more critical. (Traditionally GPS acquisition and network authentication are considered lengthy processes)

Challenges

The challenge for designers, who deal with system timing and synchronization, is to select timing devices that comply with stringent frequency accuracy and drift requirements associated with both fixed networks and mobile platforms; in other words, oscillators that can provide fast turn-on frequency accuracy (to nominal F_0) to shorten system acquisition time. In addition, features like; high stability, low power consumption, low noise, and low acceleration-sensitivity shall allow continuous and uninterrupted operation that can be disrupted by variations due to environmental conditions or interferences. CTS's Low Power Oven Controlled Crystal Oscillators (LPOCXO) product family is designed to meet these stringent application requirements. In such systems; Clock Oscillators (XO) and Temperature Compensated Crystal Oscillators (TCXO) cannot achieve the stability, precision and phase noise performance under vibration of an OCXO.



CTS Low Power OCXO Features

Ultra-low power consumption, to 65mW
 Low phase noise, to -170 dBc/Hz @ 10kHz
 Low G-sensitivity, to 0.3 ppb/G
 Fast warm-up, <60 seconds typical
 Low aging rates, to 0.2 ppb/day

5 to 300MHz frequency range
 Small size, 15x15mm
 High shock resistance (1000G)
 Temperature stability to ± 5 ppb, -40/+85°C

Low Power OCXO Applications

Military

Mobile Communication systems may be subjected to severe shock and vibration conditions (in excess of 500 G shock and 20 G vibration) as they are integrated into mobile, tactical vehicle platforms. Frequency stability is of considerable concern for these systems which must remain reliably stable under demanding conditions. CTS LPOCXO options include low G-sensitivity (0.3 ppb/G), low phase noise (-170 dBc/Hz) and high shock and vibration resilient platforms (up to 1000G shock, 30G sine vibration) well suited for these harsh environments.



Ocean Bottom Seismic

OBS nodes used for off-shore oil and natural gas exploration are deployed on the ocean floor in both shallow and deep water. Deployment durations may range from days to months. Because each node is continuously powered with a Lithium-Ion battery while deployed, low power consumption, along with a low aging rates, are key requirements of a precision timing device. The LPOCXO offers steady state power consumption as low as 65mW vs. conventional OCXOs at 750mW. Aging rates as low as 0.2 ppb/day.



Satellite Communication (SATCOM)

In any satellite link, a high quality, low noise oscillator is key in reducing connectivity noise and establishing stable, high bandwidth communication links. CTS's Low Power OCXO provides phase noise floor down to -170 dBc/Hz (at $F_0=10\text{M-Hz}$). Its small size and low power are prime attributes suited for mobile field SATCOM applications.



Low Power OCXO

Medical

In a medical imaging system such as MRI, a stable, low noise radio frequency source is necessary to create the high-resolution images hospitals require. With a noise floor at -170 dBc/Hz coupled with low power consumption, CTS LPOCXOs are ideally suited frequency sources for high resolution imaging.

Portable Test Equipment

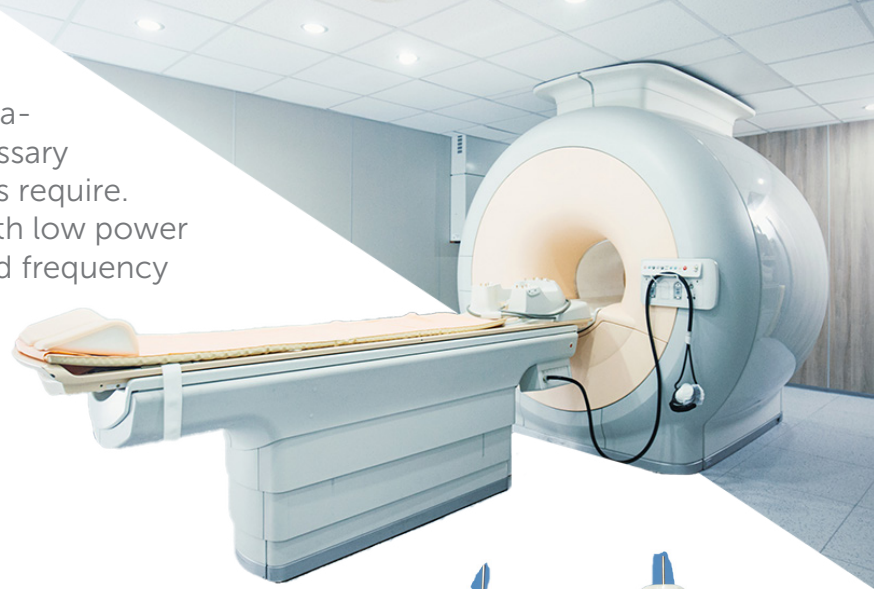
For portable test equipment applications, stability and oscillator noise factor are important attributes of a reference oscillator. Likewise, fast instrument readiness is essential. Along with extremely low power consumption, Low Power OCXOs provide significantly faster warm-up stabilization time compared to conventional OCXOs. Warm-up time for conventional OCXOs may range from 3 minutes to 7 minutes; the LPOCXO, typically <60 seconds. (see warm-up plot below)

GPS Holdover

For communications systems where GPS synchronization is a necessity, OCXOs are used not only to clean-up short term noise of GPS signals, but also act as a backup signal reference source in the event of a loss of the GPS. CTS's Low Power OCXO can provide $<10\mu\text{s}$ of holdover phase error over 24 hours.

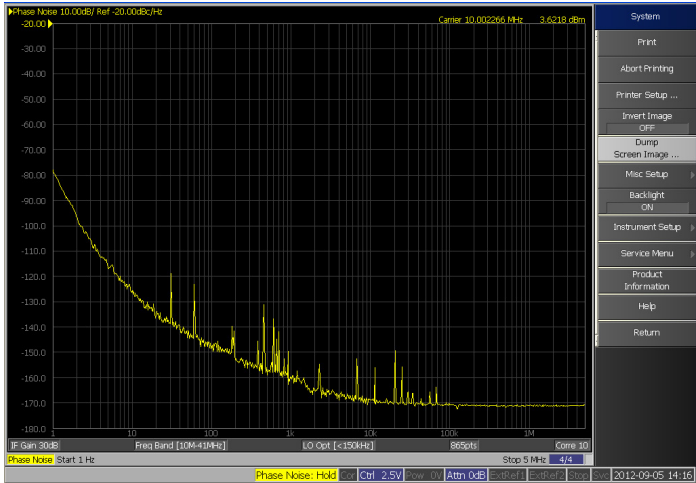
Commercial Airborne WiFi

For inflight broadband satellite based WiFi offered by commercial air carriers, system satellite links must be clean of any flicker noise and reliably maintain system operation despite changes in altitude or induced vibration. These links require a stable, low noise reference source with low susceptibility to ambient aircraft vibration. CTS's LPOCXO provides acceleration sensitivity down to 0.3 ppb/G from 0 to 2000Hz vibration range. (see plot on next page)

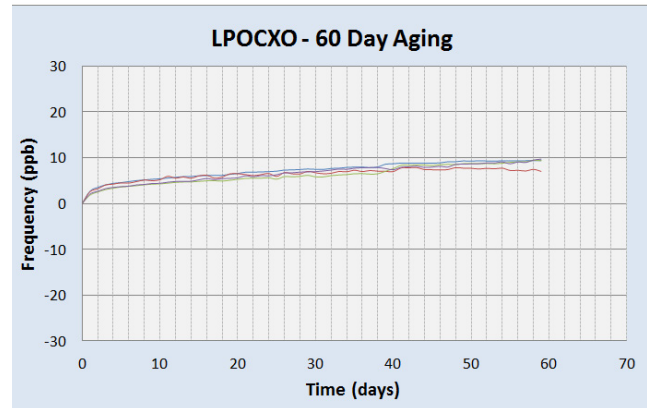


CTS Low Power OCXO Performance

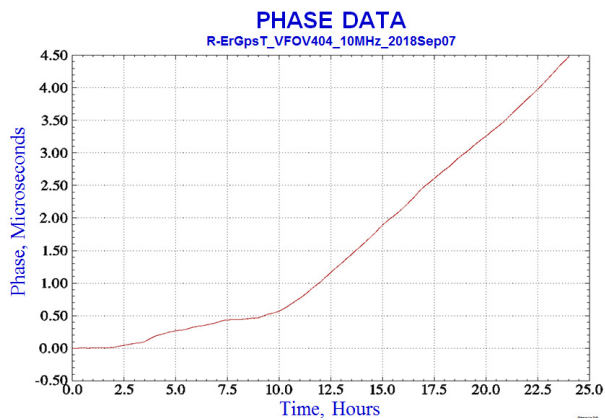
Phase Noise Performance



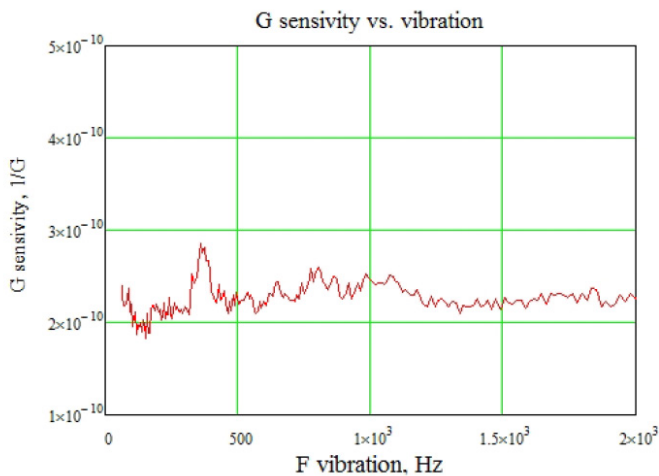
Aging (10 MHz)



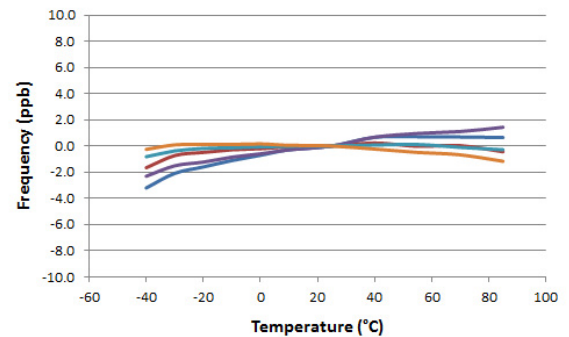
Typical Holdover Phase Error



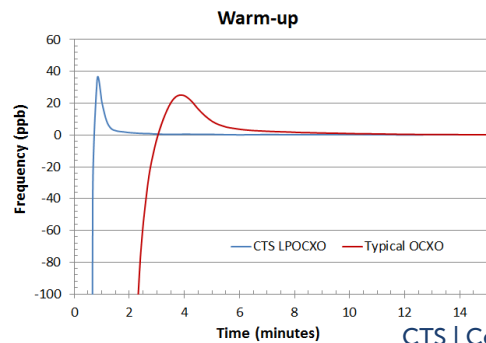
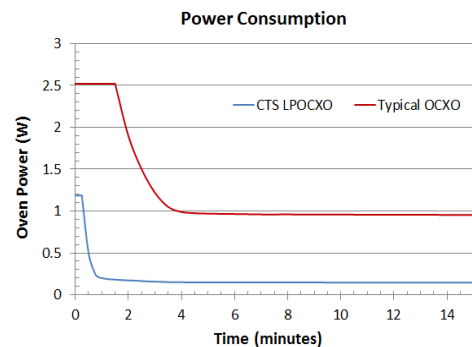
Acceleration Sensitivity (Model 148, 10MHz)



Frequency vs. Temperature



Warm-Up Characteristics



Conclusion

Specific applications within multiple key industry segments such as; military communication, mobile test equipment, off-shore gas and oil exploration, airborne broadband systems, satellite datalinks and high definition imaging require precision and low noise reference signals to perform accurately. In such systems operating might involve exposure to rigorous environmental conditions such as extreme temperatures, shock and vibrations. In other cases, battery powered operation and ultra-low noise performance are key attributes. CTS's Low Power OCXO and its unique set of performance attributes is well suited for most requirements where high stability, low power, ultra-low noise, low aging, and low susceptibility to stringent mechanical stress environments are needed.



CTS Low Power OCXO Models: 144, 148, VFOV404, VFOV405, VFOV406, and VFOV504

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