



# Greenray Quarterly

## ENGINEERING TALK

### Stratum 3 Clocks

In order to ensure error free communications and data transfer in telecommunication networks, it is important to synchronize clocks and timing signals between all of the various pieces of equipment and nodes that are connected to the network. No one likes to experience dropped calls or missing data – this can make for some very unhappy customers. In order to make sure that any equipment that is connected to a telecom network will be able to connect seamlessly, a structured hierarchy of clock accuracy and frequency stability requirements has been established. These clock requirements are defined as various “Stratum” levels.

The most stable clock is called a Primary Reference Source (PRS), defined as Stratum 1. This is a very stable, precisely accurate reference signal generated from an atomic source such as a Cesium clock. This primary reference signal may also be derived from other external timing services such as GPS.

The next stratum level clock is a Stratum 2. These must be accurate to better than 0.016ppm under all conditions including temperature variations and aging for the life of the part, typically 20 years. The 24 hour accuracy must be better than 0.0001ppm. A Stratum 2 clock specification is a very stringent requirement for a quartz crystal based oscillator but it can be met by a very high stability double oven OCXO.

Stratum 3 clocks are common in end user equipment. To be Stratum 3 compliant, the clock must maintain an accuracy of better than  $\pm 4.6$ ppm under all conditions for the life of the part. This includes error sources due to aging (typically for 10 or 20 years), temperature variations and any other disturbances such as supply voltage or load changes. The 24 hour free-running or holdover stability (includes temperature and voltage variations and aging) must be better than  $\pm 0.37$ ppm.

In the past, meeting Stratum 3 specifications over the industrial temperature ranges required the use of an OCXO because of the necessary temperature stability of  $\pm 0.28$ ppm. But the newer compensation techniques that are now available make it possible to meet this with a small, low power TCXO. TCXO’s can now be obtained from Greenray that are designed and specified to meet these Stratum 3 requirements.

The T1238 series of TCXO’s maintain a stability of 0.28ppm peak-to-peak over the industrial range of  $-40^{\circ}$  to  $+85^{\circ}$ C. They also meet the critical  $\pm 4.6$ ppm specification for all conditions for at least 20 years. All of this is accomplished in a small package size of only 5x7mm while drawing a meager 3mA from a +3.3Vdc supply. Contact Greenray Industries to discuss any Stratum 3 or precision TCXO requirement that you have – you might be surprised to find out what is now possible.

#### Inside this issue

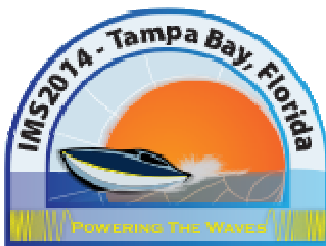
IMS 2014 .....	2
New Hire .....	2
Product Review .....	3
Greenray’s History.....	3
Raytheon Award.....	4
Visit Greenray Links.....	4
Social Media Links .....	4

#### Special points of interest

- Recent hiring of new Engineer
- T1307
- Raytheon Award



Steph Rosenbaum, Sales Engineer speaking with a visitor



## International Microwave Symposium 1-6 June 2014 Tampa Bay, Florida

As one of the premier microwave industry shows, IMS seems to raise the bar with each annual installment. Unlike a lot of technology trade shows, IMS serves up equal parts of marketing sizzle and technical substance, and the 2014 IMS Show certainly had something for everyone, from exciting new technologies and product offerings to tech seminars from some of the best in the industry.

Thanks to everyone that stopped by, friends new and old.



Phil Myer-Greenray Industries

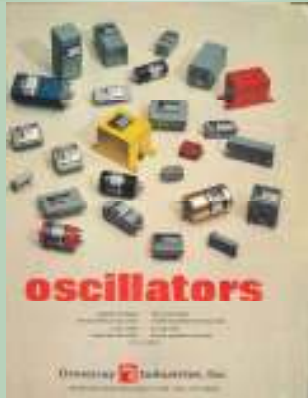
Rich - Adtech Ceramics

Bob Venino - Statek

### Meet Jeff



Greenray would like to announce the recent hiring of Jeff Orner. Hired in May, Jeff is Greenray's new Senior Design Engineer. Jeff holds a BSEET from Penn State University and holds several patents related to RF connector design and a patent application for a directly heated quartz crystal package. He has been in the electronics industry for over 20 years in various roles ranging from temperature controls, to RF connector design and signal integrity, to quartz crystal oscillators and filters. He spent over 10 years in oscillator testing and design primarily in OXCO development in both commercial and Mil/Aero applications. A highlighted example of his work is a 100Mhz Stratum 3 High Stability Double Oven OCXO, which he developed for his Senior Project in completion of his degree at Penn State. In his spare time, Jeff is a licensed amateur radio operator, call sign W3JKO. He also enjoys restoring his 1969 Ford F-100 classic truck and anything outdoors.



#### Greenray's Yesterdays

This is a Greenray Industries brochure from 1969. In 1969 Greenray built only Military oscillators. If you look closely you will see the different colors of the painted units. We had red, yellow, blue, black, green, gray and gold. Today we only build Legacy parts painted in Green or Gray.

## T1238

Greenray's new T1238 series is a Stratum 3 compliant precision TCXO that can be used for Wireline and Wireless Communications including Small Cell, Ethernet and 1588 Synchronization requirements. The T1238 offers superior temperature and long term stability in a small 5x7mm SMT RoHS compliant package. Frequencies are available between 10MHz and 40MHz.



## T1239

Greenray's new T1239 is a tight stability TCXO in a 5x3mm RoHS compliant package, and was specifically designed for wired and wireless communications. This TCXO is available from 10MHz up to 52MHz and is compliant to Stratum 3 requirements, with temperature stability as good as  $\pm 0.1$ ppM. Samples are now available.



## T1307

Greenray Industries offers unparalleled performance under vibration from our T1307 TCXO series. The T1307 utilizes our patented vibration compensation technology to provide exceptional acceleration sensitivity performance ( $\leq 7 \times 10^{-11}$ /g). The improved sensitivity allows the T1307 TCXO to provide much better phase noise (e.g. 30-40dB better for a 10grms random vib) under shock and vibration than typical TCXOs.

Our vibration compensation technology allows Greenray to provide much smaller packaging and more cost efficient parts than typical technology used in the industry. The T1307 is packaged in a very rugged 9x7mm SMT ceramic package with industry standard footprint, and offers temperature stability of 1ppM over -40 to +85C. Frequencies are available from 10MHz to 50MHz with a CMOS or Clipped Sinewave output. Operating voltages are from 2.7 to 5.0VDC, with a maximum current draw of 6mA. The T1307 series is ideal for mobile or airborne applications for commercial or military markets where the user wants the best available performance during exposure to these environments.





## Greenray Receives Raytheon IDS 2013 Excellence Award

On May 24, 2014 Raytheon Integrated Defense Systems Mission Assurance, Quality, Six Sigma and Integrated Supply Chain invited Greenray Industries, Inc. to attend the 2014 Operational Excellence Supplier Conference Wednesday, June 4 the Westin Hotel in Waltham, Mass.

On June 4, 2014 Raytheon Integrated Defense Systems (IDS) Division recognized Greenray Industries for the company's commitment to consistent quality, on-time delivery, safety, and investment to process improvement initiatives with their selection as a 2013 IDS Supplier Excellence Award recipient.



*Award and Banner received from Raytheon*



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## VISIT GREENRAY

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