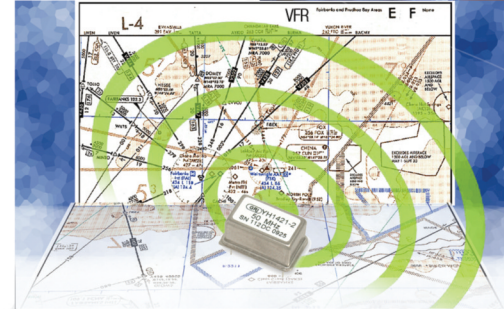




Innovation

Precision

Performance



## About Greenray Industries

Greenray Industries, Inc. is a leading manufacturer of precision crystal oscillators. Since 1961, we have produced innovative, high performance, frequency control solutions for commercial, military, aerospace, communications and instrumentation markets. Greenray's QMS is certified compliant to the requirements of SAE Aerospace Standard AS9100C for Aviation, Space and Defense, which incorporates the requirements of ISO 9001:2008.

Now in to our second half-century of operation, our quartz crystal oscillators are optimized for low phase noise, tight stability and world-leading, ultra-low g-sensitivity performance – and they've attracted the imagination of design engineers working in the military, space, position/location, GPS, picocell, femtocell, and Stratum 3 communications industries.

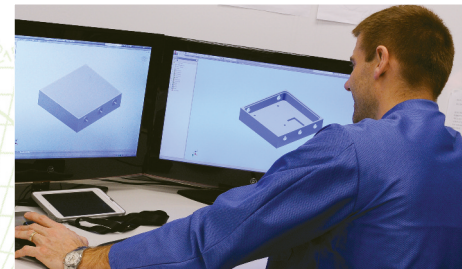
Greenray OCXOs, TCXOs, VCXOs and XOs are designed for demanding applications from 1 Hz to 1 GHz. State-of-the-art design, assembly and test operations enhance our ability to provide superior frequency control components, expert application support, and extraordinary customer service. We offer customers in-house resources others cannot, while establishing new performance standards and fulfilling our goal of redefining frequency control performance. In addition, we can offer one-off, custom and small-volume production assistance.

## Greenray Product Features

- OCXO Frequency Stability to  $\pm 0.005$  ppm
- TCXO Frequency Stability to  $\pm 0.01$  ppm
- VCXO Phase Noise to  $-170$  dBc/Hz
- g-Sensitivity to  $5 \times 10^{-11}/g$
- Temperature range of  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- Sine wave, CMOS, PECL & LVDS outputs
- RoHS Compliant
- Tin Whisker Mitigation

## In-house Electrical & Environmental Test Capabilities

- Aging
- Sine Vibration
- Mechanical Shock
- Acceleration
- Temperature Cycle
- Stabilization Bake
- Thermal Shock
- Fine/Gross Leak
- Random Vibration
- Temperature Test
- Resistance to Solvents
- Solderability



CAD/CAM



Automated Assembly



Manufacturing Expertise

## Aerospace & Defense

Greenray Industries has supported defense and aerospace markets with high performance, precision oscillators for over a half century. Our engineering experience and manufacturing expertise have established Greenray as a key component supplier for a variety of programs, providing cost-efficient, leading-edge solutions and a long-term service commitment.

Today, Greenray oscillators feature various combinations of rugged packaging, ultra-low g-sensitivity and enhanced phase noise performance; many have been engineered to perform reliably in adverse environments, including those of extreme shock, temperature and vibration.

For the military market, Greenray supports critical applications including **smart munitions, missile guidance, airborne communications, airborne instrumentation, portable communications and equipment, radar, satellite communications, telemetry, GPS, jammers, detection and identification.** Our expertise includes designing and manufacturing rugged TCXO and OCXO products that withstand the most severe environmental requirements of military applications including MIL-PRF- 55310, MIL-STD-202, MIL-STD-883, MIL-E-5400, and MIL-M-38510.

## Greenray Specialized MIL Capabilities

- Testing and processing to MIL-PRF-55310
- Screening to MIL-PRF-55310
- Established reliability construction
- IPC-A-610 & J-STD-001 trained operators
- In-house qualification testing
- Reliability calculations per MIL-HBK-217
- Phase Noise vs. Vibration Testing for Random and Sine Vibration
- High Shock test to 50,000g
- Vibration test to >50g RMS



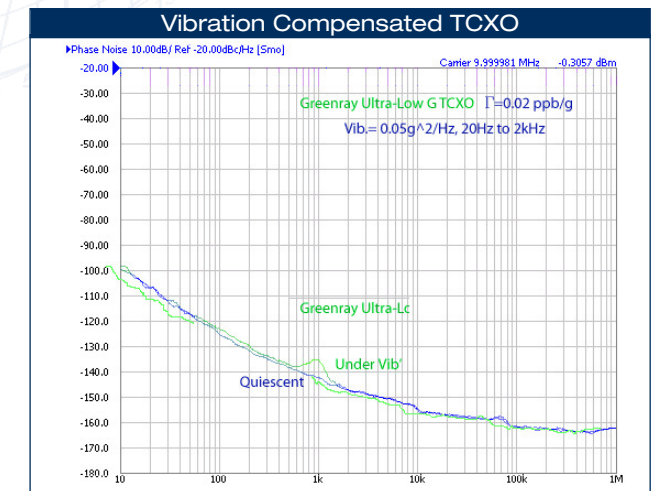
Avionics

## Communications & Instrumentation

Greenray Industries offers specialized products for commercial applications including Stratum3 compliant TCXOs suitable for wireline and wireless, small cell, Ethernet and 1588 synchronization requirements. Our TCXOs feature superior temperature and long-term stability in compact, ROHS compliant packages.

We offer ruggedized TCXOs for GNSS/GPS applications that require tight stability, excellent low micro-jump performance and the best performance under shock available today.

Greenray VCXOs feature very low noise for PLL applications to support instrumentation and SATCOM market needs, with phase noise of  $-170$  dBc/Hz and compact, cost-efficient SMD packages.



Communications, SATCOM

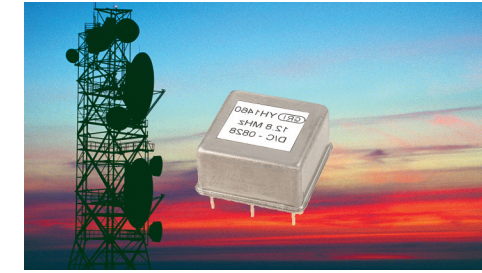
## OCXOs

Greenray precision oscillators offer exceptional frequency stability, vibration, shock, and acceleration sensitivity performance.

Like our TCXOs, Greenray OCXOs are optimized for low phase noise, tight stability over temperature, and long-term performance and reliability. Preferred for demanding communications, military, and aerospace applications, Greenray OCXOs deliver performance and reliability for wired and wireless communications, instrumentation and Base Station applications, and technologies like Stratum 3e.



Mobile Communications



SATCOM, Base Stations

Model Number	Frequency Range (MHz)	Input Voltage (Vdc)	Best Stability (ppm)	Output Signal	Input Power (Turn On - @Idle)	Package (mm), Type
YH1420	10 to 100	3.3 or 5	±0.1	CMOS/Sine	3W to 1W	20.3 x 12.7, DIP
YH1440	10 to 100	3.3 or 5	±0.1	CMOS/Sine	5W to 1.5W	25.4 x 22.1, SMD
YH1460	10 to 120	3.3 to 15	±0.01	CMOS/Sine	5W to 1.5W	25.4 x 25.4, Thru-Hole
YH1300	10 to 50	3.3 or 5	±0.2	CMOS	3W to 1W	20.3 x 12.7, DIP
YH1310	10 to 40	5 to 15	±0.005	Sine	5W to 2W	35.6 x 25.4, Thru-Hole
YH1320	10 to 120	5 to 15	±0.005	Sine	5W to 2W	50.8 x 50.8, Thru-Hole
YH1322	10 to 120	5 to 15	±0.01	Sine	5W to 2W	50.8 x 50.8, SMA Connector

### Specification Parameters

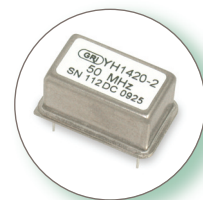
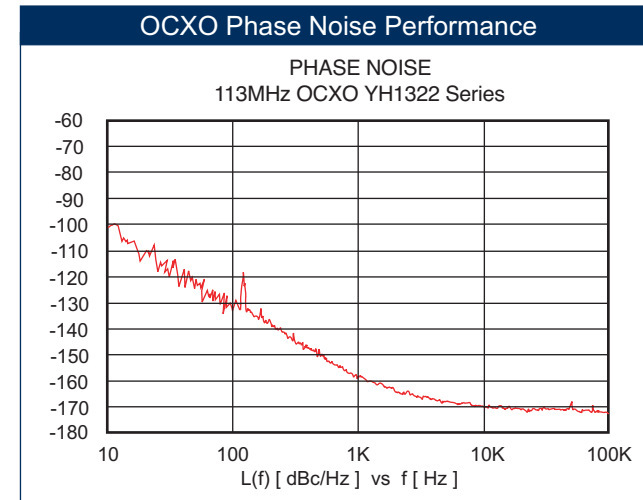
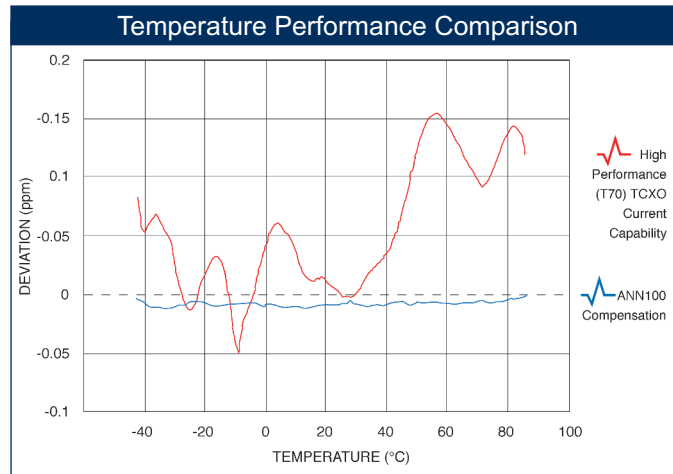
In order to help you get the best solutions for your particular application, please refer to the following Specifications Codes when speaking with the factory or your sales representative. Use of these Codes for Stability and Temperature Range facilitates the order process, and can help reduce lead time for your order. Additional options are available.

Output Signal	Output Code	g-Sensitivity	g-Sens Code
CMOS	C	Standard	SD
Sine	S	Low g-SensOption	LG
PECL	PE		
LVDS	DS		

Ordering Example					
Model	Temp/Stability	Output	g-Sens	Vs	Frequency
T52	N17	C	LG	3.3	10 MHz

Frequency Stability v. Temp (ppm)	Stability Code
±0.001	19
±0.01	18
±0.1	17
±1.0	16
±1.5	156
±2.0	26

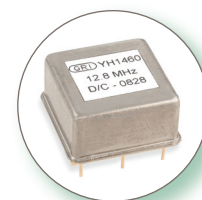
Temperature Range °C	Temperature Code
0 to +50	B
-30 to +70	D
0 to +60	F
-10 to +60	G
-10 to +50	H
0 to +70	K
-10 to +70	L
-20 to +60	M
-20 to +70	N
-25 to +70	O
-30 to +80	P
-35 to +85	Q
-40 to +60	R
-40 to +70	S
-40 to +85	T
-55 to +85	U
-55 to +95	V
-55 to +105	W
-55 to +125	X



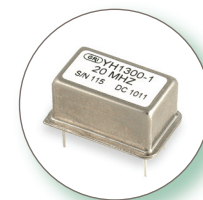
YH1420



YH1440



YH1460



YH1300



YH1310



YH1320



YH1322

## TCXOs

Greenray's TCXO products are designed for wired and wireless communications, instrumentation, aerospace, position/location, including GPS, as well as military applications. Our TCXOs feature temperature stability performance of 1ppm or less and are available from 1Hz to 1GHz.

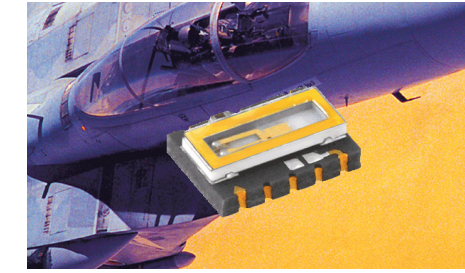
Greenray offers Stratum 3 compliant TCXOs for wireline and wireless communications, including small cell, Ethernet and 1588 synchronization requirements. Greenray T1238 and T1239 Series TCXOs offer superior temperature stability performance and long-term stability in compact, SMD, RoHS-compliant packages.

Our TCXOs are available in a variety of configurations including miniature DIP, ceramic, SMD, MIL-spec, and industry-standard sizes. More options are available – contact the factory for options not listed here.

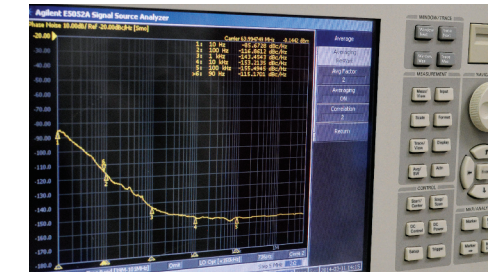
Greenray TCXOs feature innovative, state-of-the-art packaging to complement their outstanding performance attributes, while stringent materials, test & assembly, and quality assurance protocols satisfy the rigorous requirements of defense contractors and commercial customers alike.



Mobile/Remote Communications



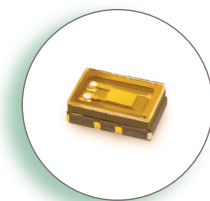
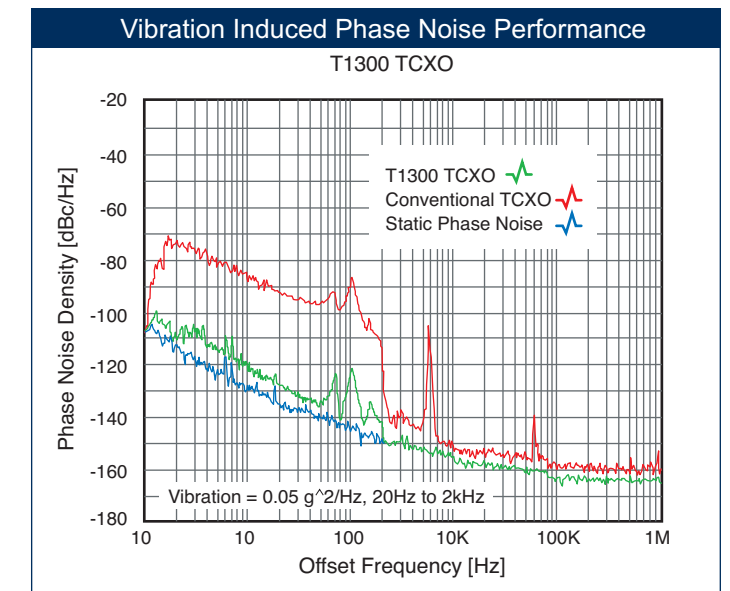
Smart Munitions



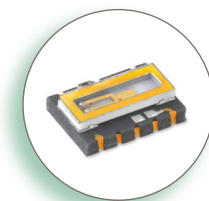
Instrumentation

Model Number	Frequency Range (MHz)	Input Voltage (Vdc)	Best Stability (ppm)	Output Signal	Input Current (mA)	g-Sensitivity ("lg" = Low g-Sens Option; shown if avail.)	Package (mm), Type
T52	10 to 50	2.7 to 5	±0.1	CMOS/Sine	2 to 6	to $7 \times 10^{-10}/g$	3 x 5, SMD
T70	10 to 50	2.7 to 5	±0.1	CMOS/Sine	2 to 6	to $7 \times 10^{-10}/g$	5 x 7, SMD
T75	10 to 50	2.7 to 5	±0.3	CMOS/Sine	2 to 6	to $7 \times 10^{-10}/g$	5 x 7, SMD
T120	10 to 100	3.3 to 5	±0.5	CMOS	30	to $7 \times 10^{-10}/g$	17.8 x 22.9, SMD
T121	50 to 100	3.3 to 5	±0.3	Sine	25	to $7 \times 10^{-10}/g$	17.3 x 17.3, SMD
T1215	10 to 50	3.0 to 5	±0.3	CMOS/Sine/PECL/LVDS	75	to $7 \times 10^{-10}/g$	7 x 9, SMD
T1238	10 to 40	2.7 to 5	±0.1	CMOS/Sine	2 to 6	std	5 x 7, SMD
T1239	10 to 40	2.7 to 5	±0.1	CMOS/Sine	2 to 6	std	3 x 5, SMD
T1300	10 to 50	3.3 to 5	±0.1	CMOS	20	to $7 \times 10^{-11}/g$	12.7 x 22.3, DIP
T1307	10 to 50	3.3 to 5	±0.5	CMOS/Sine	5	to $7 \times 10^{-11}/g$	7 x 9, SMD
ZT600	10 to 500	3.3 to 5	±0.3	CMOS/Sine	25	std	25.4 x 29.2, SMD
ZT610	10 to 100	5	±0.5	CMOS	25	to $7 \times 10^{-10}/g$	12.7 x 22.3, DIP
T1220	10 to 50	3 to 5	±0.01	CMOS/Sine	25	to $7 \times 10^{-10}/g$	12.7 x 22.3, DIP

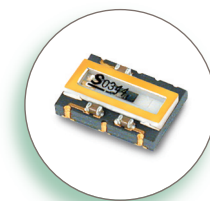
Note: Contact Factory for High Shock/Vibration Options & Availability



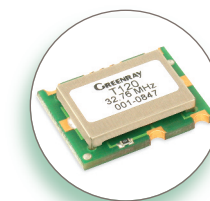
T52



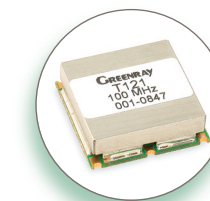
T70



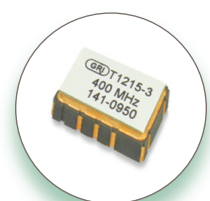
T75



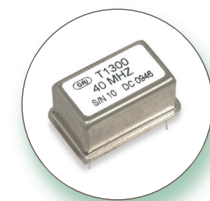
T120



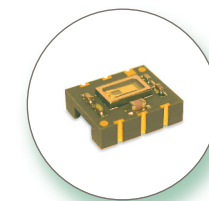
T121



T1215



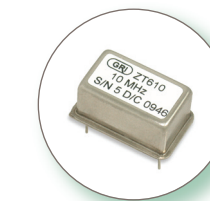
T1300



T1307



T600



ZT610



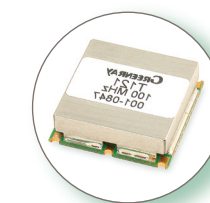
T1220

## VCXOs

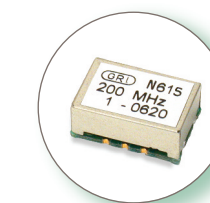
Greenray VCXOs are often specified when low phase noise, tight precision and precise adjustment of the operating frequency are required. E-mail [technical@greenrayindustries.com](mailto:technical@greenrayindustries.com) if you need assistance selecting a VCXO appropriate to your specific needs, or call the plant for additional information.

Model Number	Frequency Range (MHz)	Input Voltage (Vdc)	Best Stability (ppm)	Output Signal	Input Current (mA)	g-Sensitivity ("lg" = Low g-Sens Option; shown if avail.)	Package (mm), Type
ZN260	50 to 100	3	±15.0	CMOS	35	to $7 \times 10^{-11}/g$	17.43 x 17.43, SMD
N615	50 to 125	3 or 5	±15.0	CMOS/Sine	25	to $5 \times 10^{-9}/g$	9 x 14, SMD

Note: Frequency Adjust is Available on All TCXOs and VCXOs with External Voltage



ZN260



N615

## Quartz Precision for Industry. And Defense.



Greenray Industries, Headquarters, Mechanicsburg, PA



Statek Corporation, Orange, CA



AdTech Ceramics, Chattanooga, TN

### Solutions<sup>3</sup>

Greenray is unique in its ability to draw on the specialized resources of sister companies Statek Corporation ([www.statek.com](http://www.statek.com)) and Advanced Technical Ceramics ([www.adtechceramics.com](http://www.adtechceramics.com)). They provide high performance, miniature crystals and innovative, hermetic packaging for products like our T70 Series TCXOs. Working together for customers, we're able to offer state-of-the-art design, engineering and manufacturing solutions – that's **SOLUTIONS<sup>3</sup>**.

To learn more about how you can benefit from this unique set of resources, call your Greenray technical representative or visit [www.greenrayindustries.com](http://www.greenrayindustries.com).



frequency control solutions



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