

Acceleration, Vibration, Radiation...
It's A Jungle Up Here.



Greenray Industries, Inc.

Frequency Control Solutions
2025

Greenray offers a variety of rugged TCXOs designed for space applications.

Utilizing precision thermistor networks for temperature compensation, the passive networks are essentially immune from radiation effects up to a TID (Total Ionizing Dose) of tens of Mrad(Si). Active semiconductor devices are then selected to withstand the radiation levels experienced in the target environment. These TCXO models employ Greenray's patented vibration compensation technology to achieve acceleration sensitivity levels as low as $7 \times 10^{-11}/g$ and to ensure that low phase noise levels are maintained even under significant levels of random vibration.

The reliability of components in the harsh radiation environment of space is characterized by the TID together with radiation from Single Event Effects (SEEs) and high energy particles that may strike the device. Radiation exposure is a function of the spacecraft's orbit, the mission duration and the amount of shielding around the device. The number and magnitude of solar flares that may be experienced must also be taken into account.

There are also extreme hot and cold temperature excursions in space. In order to ensure the reliability of oscillators in this environment, some Greenray space products have a temperature range of -55°C to $+125^{\circ}\text{C}$, with electrical parameters tested and guaranteed over those conditions.

Satellites in Low Earth Orbit (LEO) are expected to withstand a total ionizing dose of around 30 to 50 krad (Si). GRI models designed specifically for this environment include the T1254 and the T1283.

Systems that will operate in MEO and GEO orbits – or during deep space missions – require a higher level of radiation tolerance of at least 100 krad (Si). Greenray models T1276, T1277, T1354 and T139 are designed for this environment.

T1254



30 krad (Si) TID
Frequency: 10 to 100 MHz
Rugged, hermetically sealed, 20.3 x 12.7 mm package
Ultra-low acceleration sensitivity to < 0.07 ppb/g
Stability: ± 1.0 ppm (-20°C to $+70^{\circ}\text{C}$)
 $+3.3$ VDC or $+5$ VDC supply
Square wave CMOS output

T1283



50 krad (Si) TID
Frequency: 40 to 100 MHz
Rugged, hermetically sealed, 25.4 x 25.4 mm package
Ultra-low acceleration sensitivity to < 0.07 ppb/g
Excellent phase noise performance under high shock/high vibration conditions
EFC for precise tuning or phase locking apps
 $+3.3$ VDC or $+5$ VDC Supply
Square wave CMOS output

T1276



200 krad (Si) TID
Frequency: 2.5 to 120 MHz
Rugged, hermetically sealed, 34.8 x 20.2 mm
24-Pin DIP package
Ultra-low acceleration sensitivity to < 0.07 ppb/g
Wide temperature range: -55°C to $+125^{\circ}\text{C}$
SEL and SET free to 100 MeV cm^2/mg
 $+3.3$ VDC or $+5$ VDC supply
CMOS output
MIL-PRF-55310 Level B or Level S Screening

T1277



200 krad (Si) TID
Frequency: 10 to 100 MHz
Rugged, hermetically sealed, 34.8 x 20.2 mm
24-Pin DIP package
Ultra-low acceleration sensitivity to < 0.07 ppb/g
Wide temperature range: -55°C to $+125^{\circ}\text{C}$
SEL and SET free to 100 MeV cm^2/mg
 $+3.3$ VDC or $+5$ VDC supply
Sinewave output
MIL-PRF-55310 Level B or S Screening

T1354



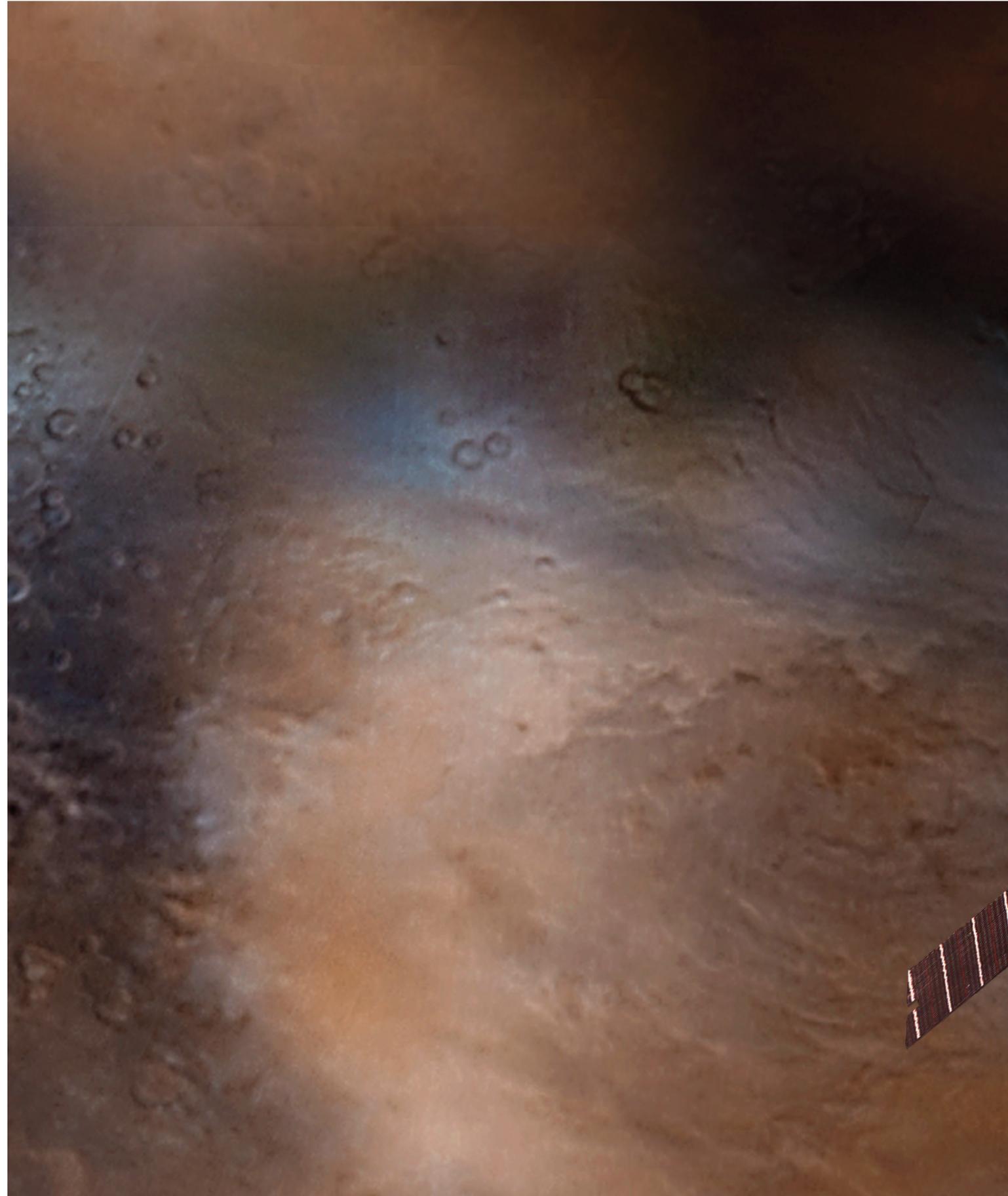
Frequency: 20 to 100 MHz
100 krad (Si) TID
Rugged, hermetically sealed, 20.3 x 12.7mm
14-Pin DIP package
Stability: ± 1.0 ppm (-20°C to $+70^{\circ}\text{C}$)
Ultra-low acceleration sensitivity to < 0.07 ppb/g
 $+3.3$ VDC or $+5$ VDC supply
Sinewave output

T139



Frequency: 20 to 100MHz
300 krad (Si) TID
Rugged, hermetically sealed, 38.1 x 38.1 mm package
Wide temperature range: -55°C to $+125^{\circ}\text{C}$
SEL and SET free to 100 MeV cm^2/mg
Ultra-low acceleration sensitivity to < 0.07 ppb/g
 $+5$ VDC supply
Low Phase Noise CMOS output
MIL-PRF-55310 Level B or Level S Screening

Since 1961, Greenray Industries has been a preferred provider of precision quartz crystal oscillators to the world's leading military, defense and industrial manufacturers. Visit us online at www.greenrayindustries.com or call 717.766.0223 and speak with a frequency control expert today.



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