NEL FREQUENCY CONTROLS
Powered By ABRACON

Ultra-Low Phase Noise 100 MHz TCXO with Low G-Sensitivity

Acceleration Sensitivity Of Crystal Oscillators

- Acceleration sensitivity is also referred to as "g-sensitivity" or Greek letter gamma, Γ
- Quartz Crystal Resonator is a main source of frequency shift versus acceleration, but other oscillator components may contribute
- Resonator's sensitivity is influenced by
  - – Mounting structure
  - – Material properties
  - – Orientation
  - – Isolation
- Γ is a vector; $\Gamma_{total} = \sqrt{\Gamma_x{}^2 + \Gamma_y{}^2 + \Gamma_z{}^2}$
- Applications requiring oscillators with low g-sensitivity:
  - – Aircraft (civilian and military)
  - – UAV
  - – Communications
  - – GPS
  - – Science and Metrology
- Sine vibration produces spectral lines at $\pm f_v$ (vibration frequency) from the carrier
  £(fv) = 20log(Γxaf_0/2f_v)
- Random vibration contributes to phase noise as £(f) = 20log(ΓxAf0/2f), where
  A = √ 2(PSD) PSD = Power Spectral Density
- Phase Noise under vibration is determined by the acceleration sensitivity at higher levels of vibration and not on phase noise in static conditions.
- Acceleration sensitivity test methods:
  - – 2-g tipover test. Only practical for high precision OCXO
  - – Testing phase noise under random vibration in the range and calculating gamma per: $\Gamma = \left(\frac{f_v}{f_0}\right)\sqrt{\frac{2}{\left(\sqrt{2PSD}\right)(f_v)}10^{\left(\frac{\mathcal{L}(f_v)}{20}\right)}}$
  - – This is the method used by NEL. We apply random vibration 1.8 g RMS in the frequency range 20 Hz to 300 Hz (0.013 g2/Hz). Phase noise is tested while vibrating in 3 different axis. Γ for each axis is calculated per above

    formula, and total gamma then $\Gamma_{total} = \sqrt{\Gamma_x{}^2 + \Gamma_y{}^2 + \Gamma_z{}^2}$
  - – Testing side band level under sine vibration (high end spectrum analyzer is needed) and calculating gamma per: $\Gamma = \frac{2f_v}{a_{peak} f_0} 10^{\mathcal{L}\left(\frac{f_v}{20}\right)}$