TECHNICAL BRIEF

Quartz stability over time [aging]

Quartz is a single crystal piezoelectric material suitable for use on accelerometers, transducers, sensors, and frequency control devices. Quartz possesses large electromechanical coupling coefficients, has high mechanical and chemical stability, is non pyroelectric [excellent for thermal transients], and has very low acoustic losses [high Q factor]. In piezoelectric accelerometers, it can be utilized, as a high-temperature transducer up to 250 °C, such as in accelerometers for jet aircraft. Its alpha-beta temperature transition is 573 °C, but when built into a sensor, like an accelerometer, the piezoelectric element is under stress, and could form "twin" transformations on the material. Therefore, it is limited in applications with temperatures up to 250 °C.

Quartz is a preferred material for accelerometers [instead of ferroelectric piezoceramics, like PZT types], when stability over temperature and over time [aging], are important design considerations. Quartz is a single crystal, with single domain polarization and orientation, with very high coercive field [higher than breakdown electric field]; therefore it will maintain the sensitivity piezoelectric output over time. Ferroelectric piezoceramics are multi-domain and will age considerably after poling, in comparison with quartz.

There are no known mechanisms that will produce aging on quartz, in ideal conditions, meaning that any aging will be related to the parts that are contact with the sensitive elements used to fabricate the accelerometer. Corrosion or other changes [mechanical or chemical] on the materials of the electrodes, seismic masses, support, and housing could produce deviations in sensitivity over time. Excelling accelerometer manufacturers, like Dytran by HBK, will foresee these effects and apply best practices to compensate for them.

A quartz accelerometer under high mechanical stresses [exceeding the performance specification] could develop "twins" on the crystal structure, and this effect might lead to a lower sensitivity on the accelerometer over time. It could be interpreted as aging by the user, but in reality it is a degradation of the sensor unit. Small differences in sensitivities of quartz accelerometers over years, are usually within the uncertainty of the calibration for the accelerometer.

In conclusion, quartz, as a piezoelectric crystal in accelerometers, is a great material of choice when the thermal stability and long-term stability of the sensitivity are the primary design considerations for the application.

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