APPLICATION NOTE

Glossary of Terms for Coaxial Resonators and Coaxial Inductors

Coaxial resonator — A component in which standing waves are established in a ceramic coaxial line, short-circuited or open-circuited at the end, and remote from the drive. These resonators can be either a 1/4 or 1/2 wave-length type.

Coupling — The method by which a dielectric resonator is electromagnetically connected to the external environment.

Cylindrical resonator — A disc type resonator with a centered hole used for ease-of-mounting and improved mode separation.

Dielectric constant (εR) — The ratio of electric displacement in a medium which would be produced in free space by the same field.

Dielectric Resonator (DR) — An unmetallized dielectric ceramic that functions similarly to a mechanical resonant cavity at microwave frequencies, but has a greatly reduced size because of its high dielectric constant.

Dielectric Resonator Oscillator (DRO) — In this type of oscillator, a dielectric resonator is used as a frequency-determining element for a microwave oscillator to achieve high stability.

Direct Broadcast Satellite (DBS) — A satellite broadcast system that operates in the range of 10 GHz to 40 GHz in different world locations.

Disc resonator — A solid cylindrical ceramic body with a height to diameter ratio of approximately 0.4.

Global Positioning System (GPS) — A satellite system for determining accurate location. GPS used in land, sea, air, commercial, and military applications.

Loss tangent ($\tan\delta$) — The reciprocal of the dielectric resonator's Quality Factor (Q).

Quality factor (Q) = ($1/\tan\delta$) — The figure of merit for assessing the performance or quality of a resonator, the Quality Factor (Q) is a measure of energy loss or dissipation per cycle as compared to the energy stored in the fields inside the resonator. The Q is defined by:

$$Q = 2\pi \times \frac{\text{Maximum Energy Stored}}{\text{Average Energy Dissipated per Cycle}}$$

Where $\pi = 3.14159$

Unloaded Q (Q_O) — Q_O is the value of Q that is obtained when only the incidental dissipation of the system elements is present. Q_O is defined by the following equation:

$$\frac{1}{Q_O} = \frac{1}{Q_C} + \frac{1}{Q_D} + \frac{1}{Q_R}$$

Where:
Q_C = Q of conductor
Q_D = Q of dielectric
Q_R = Radiation Q factor

Loaded Q (Q_L) — Q_L is the value of Q that is obtained when the system is coupled to an external device that dissipates energy. Q_L is defined by the following equation:

$$\frac{1}{Q_L} = \frac{1}{Q_C} + \frac{1}{Q_D} + \frac{1}{Q_R} + \frac{1}{Q_{EXT}}$$

Where:
Q_C = Q of conductor
Q_D = Q of dielectric
Q_R = Radiation Q factor
Q_{EXT} = Q of the first (or last) filter resonator when terminated by the external load (usually 50 Ω).

Resonant frequency (f_0) of dielectric resonator — The frequency in which the dielectric resonator can store the electromagnetic signal for long time periods compared to the period of the frequency being applied.

Spurious mode — Output from a dielectric resonator caused by a signal or signals having frequencies other than the preferred resonant frequency. The presence of higher resonant modes close to the resonant frequency of the principle mode interferes with filter or oscillator performance.

Temperature coefficient of dielectric constant (τF) — The change of the dielectric constant of the resonator as a function of temperature.

Temperature coefficient of resonant frequency τF (ppm/°C) — The shift in the resonant frequency of the dielectric resonator due to the linear expansion of the material, plus the change in its dielectric constant as a function of temperature.

Thermal coefficient of expansion — The linear expansion of a dielectric resonator in all directions with temperature.

Tuning device — A mechanical mechanism used to adjust the resonant frequency of the dielectric resonator up to 5% by perturbing the external electromagnetic fields.

Television Receive Only (TVRO) — A satellite broadcast system that operates in the 3.7 GHz to 4.2 GHz range. TVRO is used in North and South America.