CERAMIC RESONATORS

Why Ceramic Resonators? Ceramic resonators stand between quartz crystals and LC/RC oscillators in regard to accuracy. They offer low cost and high reliability timing devices with improved start-up time to quartz crystals.

Package styles: Abracon offers a wide variety of package styles for ceramic resonators. They come with two or three terminals leaded type or surface-mount type.

Properties: The oscillation of ceramic resonators is dependent upon mechanical resonance associated with their piezoelectric crystal structure. These materials (usually Barium Titanate or Lead-Zirconium Titanate) have large dipole movement, which causes the distortion or growth of the wafer by an applied electric field.

Oscillation mode: The ceramic resonator oscillates in thickness-shear vibration mode for Fundamental frequencies (typical less or equal than 8MHz) and thickness-longitudinal vibration mode for third-overtone mode (above 8MHz to 50MHz).

Frequency range: The available frequency range varies from 182kHz to 50MHz.

Frequency tolerance at 25°C: The maximum allowable frequency deviation from the nominal frequency at room temperature. Frequency tolerance is expressed in percent. Typical frequency tolerance is ± 0.5% max. Frequency tolerance can be controlled tighter on built-in capacitance type.

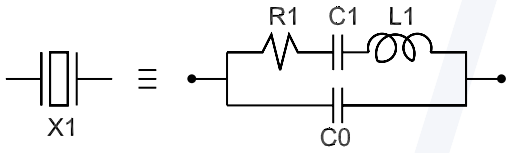
Frequency stability: The maximum allowable deviation compared to the measured frequency at 25°C over the temperature window, i.e. –20°C to +80°C or –40°C to +125°C. Standard frequency stability is ± 0.3%.

Resonant Impedance: The net impedance of the ceramic resonator at resonant frequency. Ceramic resonators have superior resonant impedance than quartz crystal, which offer much better start-up time.

Aging: The relative frequency change over 10 years period. The aging is ± 0.3% max. over 10 years.

Load capacitance CL: Since ceramic resonators have very large parallel resonance area and frequency is very sensitive to load capacitance, exact value of load capacitance must be specified. This process is usually been done through IC matching and characterization. Please contact Abracon for details.

Equivalent circuit: The equivalent circuit of the ceramic resonator is similar to the quartz crystal, but motional parameters are very different.
See figure 1 below:
For 4MHz: L1 = 385µH, C1 = 4.4pF, C0 = 36.3pF, R1 = 8 , Q = 1134, F = 228kHz.



Manufacturing Process: Material Mixing – Calcination – Milling – Spray Dry Seving – Pressing – Sintering – Printing – Sintering – Poling – Slicing – Sputtering – Dicing – Wire forming – Soldering – Lead frame insert – Wax coating – Epoxy coating – Epoxy curing – Inspection – Packaging – Shipping.

Why do ceramic resonators have lower cost than quartz crystals?: Because ceramic resonators have high mass production rate, small size, no need for adjustment.

IC characterization for ceramic resonators: Due to ceramic resonators' properties, IC matching must be studied and performed to satisfy oscillation conditions. The following possible causes may occur if IC matching was not performed:

-In-circuit oscillation frequency off tolerance limit.
-Not-start-up or start-up at an unwanted frequency.
-Stop oscillating or oscillating off limits over temperature.
-Oscillation at overtone mode.
-Poor aging due to over power driving.

Also, there is possibility between frequency correlation between test jig and customer IC. The circuits below show an example between IC characterization of a TMP87P808M and correlation of in-house test jig using CD4069UBE.