

Ceramic Resonator terms and application notes

GENERAL DESCRIPTION

Why ceramic resonators? Ceramic resonators stand between quartz crystal oscillators and LC/RC oscillators in regard to accuracy. They are considerably smaller, require no adjustments, with improved start-up time and low in cost.

Package: Ceramic resonators come with standard, single-in-line package (ZTA, ZTB and ZTT), or 3-leads with built-in capacitors (ZTTS, ZTTCV).

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 crystal by an applied electric field.

Frequency Range: The available frequency range varies from 190 kHz to 50 MHz.

Frequency Stability: The maximum allowable frequency deviation compared to the measured frequency at 25° C over the temperature window, i.e., -20°C to +80°C. The typical stability is $\pm 0.3\%$ ($\pm 3000\text{ppm}$).

Frequency Tolerance: The allowable deviation from the nominal frequency at room temperature. Frequency tolerance is expressed in percentage, typical $\pm 0.5\%$ or in parts per millions (ppm), $\pm 5000\text{ppm}$.

Resonant Impedance: The value of impedance the crystal exhibits in the operating resonant circuit.

Aging: The relative frequency change over a certain period of time. This rate of change of frequency is normally exponential in character. Typically, aging is $\pm 0.5\%$ over 10 years.

Load Capacitance: Load capacitance (C_L) is the amount of capacitance that the oscillator exhibits when looking into the circuit through the two resonator terminals. Load capacitance is expressed in a pair of C_1 and C_2 with the default values given in table.

Equivalent Circuit: Its equivalent circuit is similar to the quartz crystal equivalent circuit, i.e., consists of a series L_1 , C_1 , R_1 circuit shunting with a parallel C_0 capacitance. A standard ZTAS-MG-4.00MHz has its typical parameters as follows: $L_1 - 330\mu\text{H}$, $C_1 - 5\text{pF}$, $C_0 - 40\text{pF}$, and $Q \sim 900$.

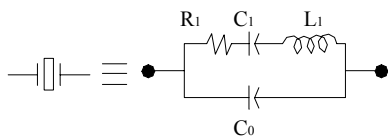


Figure 1

TEST CIRCUITS FOR CERAMIC RESONATORS

Ceramic resonators: with built-in capacitors: It consists of a CMOS inverter with a feedback resistor R_f (figure 2). The feedback resistor allows oscillation

to start when power is initially applied. Its value is generally $1\text{ M}\Omega$. The values of C_1 and C_2 are given in the table or specified by customer.

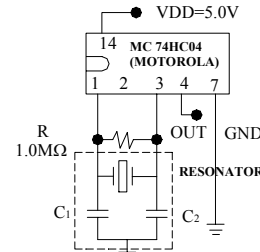


Fig. 2 Test circuit

APPLICATIONS

Ceramic resonators are used mainly as a source of clock signals for many microprocessors, where tight frequency stability is not a primary concern. Ceramic resonators are low in cost and are built-in with capacitance for space savings. Ceramic resonators are mainly used in consumer electronics applications (TV, VCR, games, radios) and household appliances.

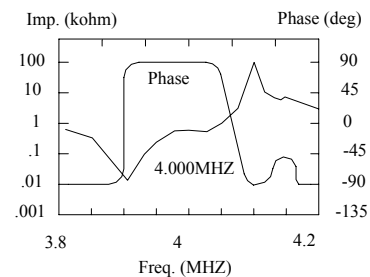


Fig. 3 Impedance vs. phase of a 4.000 MHz ceramic resonator.

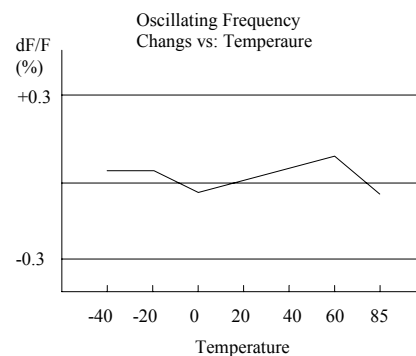


Fig. 4 Typical curve of frequency vs. temperature