1. **Aging**: The change in frequency over time, usually expressed as a maximum value in parts per million per year (ppm/year). Aging is often calculated for the first year, and then projected for a longer period.

2. **Drive Level:** The amount of power dissipated in the crystal due to the driving or excitation current, expressed in milliwatts or microwatts. Drive level should be kept to a safe minimum to ensure proper start-up. Excessive drive levels can lead to long-term frequency drift or crystal fracture.

3. **Equivalent Series Resistance (ESR):** The crystal impedance value exhibits within the oscillation circuit.

4. **Frequency Stability:** The maximum permitted frequency deviation from ambient temperature across the operating temperature range. Frequency stability is measured in parts per million (ppm) and is influenced by factors like crystal cutting type, cutting angle, cutting angle tolerance, operating mode, package style, and the mechanical dimensions of the quartz blank.

5. **Frequency Tolerance:** The maximum allowed frequency deviation from a specified nominal frequency at ambient room temperature, expressed in parts per million (ppm).

6. **Load Capacitance:** The capacitance the oscillator presents when looking into the circuit through the two crystal terminals. Load capacitance must be specified when the crystal operates in parallel mode.

7. **Motional Capacitance:** The capacitance of the nominal arm in the equivalent circuit. Motional Capacitance (C1) arises from the elasticity of the quartz blank.

8. **Operating Mode:** The mode in which the quartz crystal operates, either its fundamental mode or a harmonic mode. The fundamental mode is generally preferred. Odd harmonics, such as the 3rd, 5th, 7th, etc., are considered overtone modes.

9. **Nominal Frequency:** The specified center frequency of the crystal, measured in Hertz (Hz). Quartz crystals are typically specified in kHz or MHz.

10. **Pullability:** When a crystal operates at parallel resonance, it appears inductive in the circuit. Changes in reactance lead to corresponding frequency changes, affecting the crystal's pullability. The frequency difference between the series resonant frequency (Fs) and the anti-resonant frequency (Fa) depends on the crystal's C0/C1 ratio and the load capacitance (CL).

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11. **Series Resonance vs. Parallel Resonance:**

    - **Series Resonance:** The crystal appears resistive in the circuit. Load capacitance specification is not required in this mode.
    - **Parallel Resonance:** The crystal appears inductive in the circuit. The crystal's equivalent circuit can be simplified to a series resistance with reactance. The frequency difference between the anti-resonant frequency and series resonance depends on the crystal's C0/C1 ratio and inductance (L1). Load capacitance must be specified in this mode.

12. **Shunt Capacitance:** The static capacitance between the electrodes (Ce) combined with holder capacitance (Ch):

    $$C0 = Ce + Ch$$

    Ch varies between 0.6pF to 0.8pF depending on the mounting method.

13. **Spurious Responses:** Unwanted resonances, typically above the operating mode, specified in dB max. or as a multiple of the main mode's ESR value. The frequency range is usually specified within a few hundred kilohertz.

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Check out our website at https://suntsu.com/ or contact us by phone at (949) 783-7300.

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