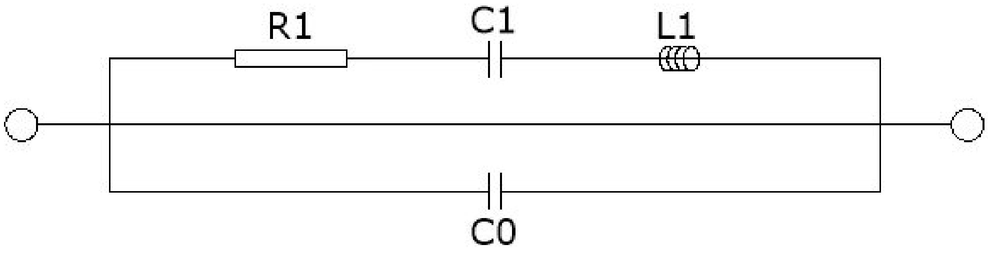
The equivalent circuit of a quartz crystal can be represented as follows:



This circuit consists of L1 (motional inductance), C1 (motional capacitance), and C0 (shunt capacitance). While all parameters can be adjusted through design, they are interconnected, meaning a change to one will affect the others.

- **L1 (Motional Inductance):** This is determined by the mass of quartz in motion. Lower frequencies (thicker and larger quartz wafers) typically have inductance values in the range of a few henries, while higher frequencies (thinner and smaller wafers) have values in the millihenry range. L1 and C1 are connected through Thomson's formula:

$$L1 = 1 / (4\pi^2 fs^2 C1)$$

If needed, it's best if the customer specifies L1. C1 will then be calculated using the above formula.

- **C1 (Motional Capacitance):** This depends on the quartz's stiffness (which is constant), the size of the metallization (electrode) on the crystal's face, and the wafer's thickness and shape. At lower frequencies, the wafer may need to be shaped (contoured or beveled) for better performance. For fundamental mode crystals, C1 typically ranges from approximately 0.005pF to 0.030pF. Generally, if a fundamental design is used for an overtone, C1 is divided by the square of the overtone number (e.g., for the 3rd overtone, C1 is 1/9 of the fundamental value).
- **C0 (Shunt Capacitance):** This is partly due to the wafer's thickness. It's the measured capacitance when the crystal isn't vibrating and typically ranges from 1pF to 7pF. The specific value is usually chosen for compatibility with the oscillator circuit.

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

Suntsu Electronics, Inc.
142 TECHNOLOGY DR., SUITE 150
IRVINE, CA 92618

Call: +1-949-783-7300 | Fax: +1-949-783-7301