

Crystal terms and application notes

The same crystal with frequency at third-overtone mode will have much less pulling because its motional capacitance C_1' is approximately 1/9 of C_1 at fundamental.

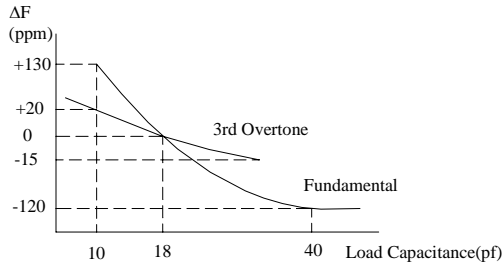


Fig. 7 Change of load capacitance and pullability

Frequency pullability of a fundamental 20 MHz crystal vs. its 3rd overtone crystal. The oscillating mass of the quartz crystal corresponds to the motional inductance L_1 while the elasticity of the oscillating body is represented by the motional capacitance C_1 .

$$C_1 \text{ (pF)} = 0.22 \times A \text{ (m}^2) \times F \text{ (Hz)} / 1670$$

Where A = area of the electrode
F = resonant Frequency

OVERTONE CRYSTAL

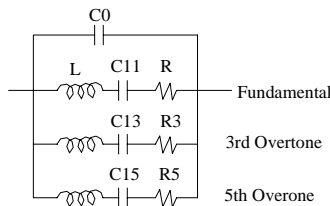


Figure 8

The C_1 value can be changed for a particular resonant frequency by varying the electrode area. The range of variation of the electrode area depends on the diameter of the quartz element.

FORMULAS

$$R_s = \text{Series Resistance} = \frac{2\pi frL_1}{Q}$$

$$C_1 = \text{Motional Capacitance} = \frac{2\Delta f}{fr} (C_0 + C_1)$$

$$L_1 = \text{Motional Inductance} = \frac{1}{4\pi^3 fr^3 C_1}$$

$$C_0 = \text{Shunt Capacitance} = \frac{frC_1}{2\Delta f} - C_1$$

$$F_r = \text{(Series) Frequency} = \frac{1}{2\pi\sqrt{L_1C_1}}$$

$$Q = \text{Quality Factor} = \frac{2\pi frL_1}{R_1} = \frac{1}{2\pi C_1 frR_1}$$

$$\Delta f = \text{Change in Frequency} = \frac{frC_1}{2(C_0 + C_1)}$$

(Series to Parallel)

$$C_L = \text{Load Capacitance} = \frac{frC_1}{2\Delta f} - C_0$$

APPLICATION NOTES

Selecting a crystal for a micro controller

1.0 Purpose:

This application note describes the selection of a crystal used with any type of micro controller that accepts a parallel mode, AT or BT cut crystal, fundamental or third-overtone mode.

2.0 Functionality and comparability:

Unless otherwise specified in the micro controller data sheet, this application note can be used as a general guidance in the selection of a crystal which can be used with many leading manufacturers of micro controllers.

3.0 Circuit description:

Most micro controllers include an inverter design with a positive feedback resistor (typical 1 MΩ) with an optional series resistor with value varied from 10Ω to 1kΩ (see figure 9).

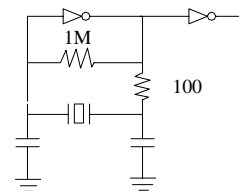


Figure 9