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Crystal FAQ

How do I calculate the value of the load capacitors used in my parallel resonant oscillator circuit?

The crystal load capacitance is the sum of all the circuit and stray capacitance seen from the crystal terminals. If the crystal frequency is to be adjustable, a physical capacitor or varactor will be placed in series with the crystal and will be included as part of the overall load capacitance. If the load capacitance values are too small, manufacturing difficulties arise, because the crystal frequency becomes very sensitive to small variations in the circuit. Reasonable values of load capacitance can be recommended by the crystal manufacturer.

What happens if I operate a crystal outside of its specified temperature range?

At temperatures outside of the specified range the crystal frequency will shift at an increasingly rapid rate. The crystal is optimized for best frequency stability within the specified temperature range.

What is the difference between a fundamental and an overtone crystal?

Thickness-shear crystal such as the AT-cut will resonate on the odd harmonics of the fundamental frequency. As the specified crystal frequency is increased, the quartz wafer becomes thinner and more difficult to process. Therefore, the maximum fundamental frequency of a crystal is limited by manufacturing and cost limits. Higher frequencies can be obtained by operating on one of the harmonic or overtone frequencies although the oscillator circuit will be more complex as it must prevent the crystal from operating at its fundamental frequency. An overtone crystal will be considerably higher in impedance than a fundamental crystal at the same frequency.

How do I know if I need a fundamental or an overtone crystal?

In the higher frequency ranges the overtone crystal will be more economical. However, if a low impedance crystal is needed, for example in a VCXO or a filter, a fundamental mode crystal may be needed.

What is an activity dip and do I need to worry about them?

An activity dip is a sharp increase in the equivalent series resistance of the crystal that can occur at a specific temperature. It normally is present over a very narrow temperature range. This can be a problem in an oscillator as it may cause the oscillation to die or prevent the oscillator from starting at that temperature. Activity dips can be eliminated by proper design of the crystal.