

**In certain oscillator applications, more than others, it is necessary to control modes of operation.** These modes of operation can be undesirable like harmonic, resonant, and spurious modes, or they can be standard modes like fundamental, third overtone, fifth overtone, etc.

Undesired modes generally have a higher frequency than desired modes within a few hundred kHz. When working with pullable crystals it is necessary to deposit large electrodes on the surface of the blank to allow for pullability. This is a common cause of promoting spurs and can result in a crystal oscillating on a spurious mode. Undesirable modes are usually specified in resistance or the ratio of resistance of the undesired mode to that of the desired mode over a frequency bandwidth. A separation of 3dB between desired modes and undesired modes is usually adequate to avoid operation in a spurious mode.

Listed below are two methods for controlling fundamental modes in third overtone circuits:

**The inductor-less third overtone circuit** (diagram A) is similar to a fundamental mode circuit except the feedback resistor value should be made much smaller than normal, typically the value will fluctuate between 2kW and 6kW. Because of the resistor value, the component of inductive admittance is greater than the admittance of the load capacitance at the fundamental frequency, thus preventing oscillation. Meanwhile, the inductive admittance at the overtone is less than the admittance of the load capacitance therefore enabling oscillation at third-overtone.

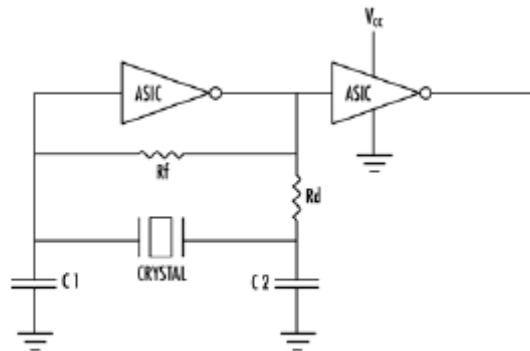


DIAGRAM A

The tuning tank L/C overtone circuit (diagram B) requires an additional inductor and capacitor to select the 3rd-Overtone mode, while suppressing or rejecting the fundamental mode. You will need to choose inductance and capacitance values to satisfy the following 3 conditions:

1. The Lc/Cc section forms a series resonant circuit at a frequency below the fundamental frequency, which makes the circuit look inductive at the fundamental frequency. This condition does not favor oscillation at fundamental mode.
2. The Lc/Cc and C2 components form a parallel resonant circuit at a frequency about half-way between the fundamental and 3rd-Overtone frequencies. This condition makes the circuit capacitive at the third overtone frequency and favors oscillation at the third overtone mode.
3. Locating the Lc tank at the output of the inverter is ideal because it helps to clean up all unwanted modes before signal goes through the crystal.

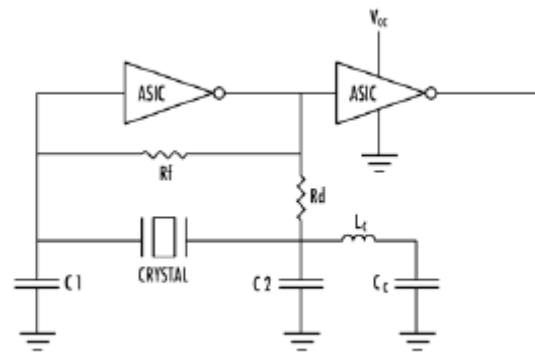


DIAGRAM B