# SPIRAL INDUCTOR NOTES

## SPIRAL INDUCTORS

Spiral inductors are used extensively in microwave circuit resonant elements and as a choke in power supplies. When used as a choke, a low Q is generally desirable to obtain a broadband characteristic. To obtain a high self-resonance, the conductor width is reduced and capacitance between turns is minimized by conductor geometry. Values for chokes are usually not too critical as long as self-resonant frequency is high. Tuned circuits frequently require adjustment of the inductance value. This is accomplished at a modest tooling cost. e.g. The outside turn can be constructed with sufficient width to allow a wire bond position which will bypass some of the winding. Coils can also be fabricated with shorting bars which may be trimmed by use of a laser to vary the inductance.

## SPIRAL INDUCTORS VS. WOUND INDUCTORS

Spiral inductors generally have somewhat lower Q and SRF compared to wound inductors, but are manufactured with processes which makes them much more uniform. The contacts are wire bonded compared to welded leads which are more difficult to position. Spiral inductors may be mounted on an insulating ground post to reduce capacitance to the ground plane and increase SRF. Orientation is not optional with spirals as they are Thin Film deposited with their axis perpendicular to the ground plane. Spirals are easier to install and save labor in assembly.

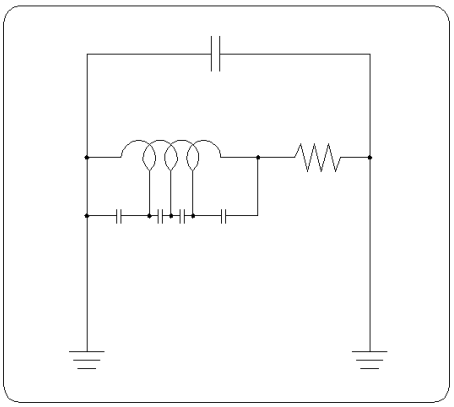
There are several different inductance geometries which may be used depending on circuit requirements. The most common type features contacts on the top surface for thermosonic gold wire bonding. Single layer devices have a center contact and an edge contact. A minor disadvantage of this geometry is that the gold leads to the center contact can vary in length and cause a small change in value from one circuit to another. Most customers, designers, and engineers, prefer edge contacts to provide short and consistent interconnections with the gold bonding wire. Edge contacts are accomplished by bridging with a wirebond.

## SUBSTRATE TYPES

Alumina and Quartz are the two basic materials utilized for the substrate base of spiral inductors. Alumina (99.6%) is a strong material and is relatively inexpensive. It has a fairly high dielectric constant of approximately 10. Quartz is more fragile, smoother and much more expensive, but has a dielectric constant of 4.0. This characteristic permits much higher self-resonant frequencies when produced on quartz Alumina and Quartz are the most common materials although thin film processing occasionally uses other materials. (e.g.beryllia, etc.).

## EQUIVALENT CIRCUITS

The equivalent circuit of the spiral inductor includes a parallel input capacitance to ground and capacitance from input to output terminals. In addition, there is coupling or capacitance between turns. An equivalent ideal inductor series with a resistor is connected from input to output. The resultant circuit yields many resonances. The first is usually a parallel resonance. The next is a series resonance, then another parallel resonance followed by another series resonance, etc. When inductors are used as chokes the first series resonance is usually the most important. When inductors are used as tuned circuits, the first parallel resonance is usually the most important. Microwave engineers frequently use inductors beyond the first self-resonance.



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