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Application Note

RF Chip Inductor Applications

December 2011

RF chip inductors are an integral part of many tuning and filtering circuits and are mainly used in the RF circuits in electronics systems. With a small footprint and rugged construction, they provide a cost-effective solution for densely packed PC board designs that are found in RF and wireless communication, computers, telecommunications and automotive electronics applications.

Offered in small sizes with high Q values, monolithic construction provides stable, low-loss inductance over broad frequencies. RF chip inductors also offer inductance tolerance rated at + 10% of the specified frequency. The rated operating current is based on the maximum sustained current applied, while maintaining the specified minimum inductance (L).

Now that the operational frequencies of electronic products are higher and higher, and the products that incorporate RF circuits into board-level designs are more and more popular like cell phones, the application of RF chip inductors has seen a wide and rapid growth.

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RF Chip Inductor Applications

RF chip inductors are an integral part of many tuning and filtering circuits. The chip inductors reduce or eliminate electromagnetic interference (EMI) noise on the printed circuit board (PCB). Mainly used in the RF circuits in electronics systems, they are available in small sizes with high Q values. Monolithic construction also provides stable, low-loss inductance over broad frequencies. The reduced footprint accommodates the ever-increasing reduction in current form factors and board-level systems.

Chip Inductor Types

There are three (3) types of RF chip inductors that are based on the material and structure feature:

- Multilayer chip inductor
- Wire wound chip inductor
- Thin film chip inductors

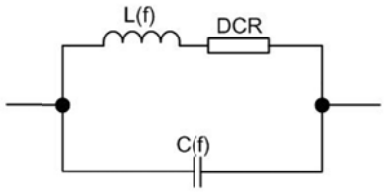
The multilayer and wire wound chip inductors have two (2) types of ferrite and ceramic chip inductors with almost the same manufacture process. All of them possess RF Inductor Parameters that include: L-inductance, DCR-DC resistance, rated current, Q factor and SRF.

Self-Resonant Frequency (SRF)

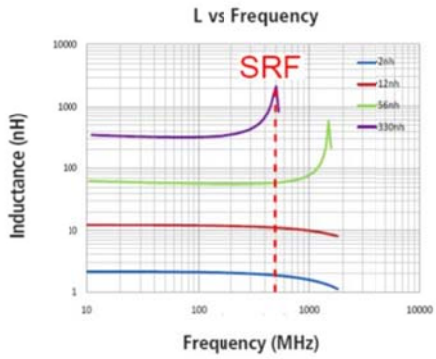
The inductor's Self-Resonant Frequency (SRF) is the frequency where the inductor and parasitic capacitor among coil windings resonates as shown in equivalent circuit below. The higher the SRF, the higher the inductor's effective operational frequency range.

$$\mathrm{SRF}=\frac{1}{2\pi\sqrt{LC}}$$

The operation frequency selected for the inductor should be lower than the SRF. Generally speaking, the large inductance has a low SRF since the stray C is increased with the wire wound number.



Equivalent Circuit



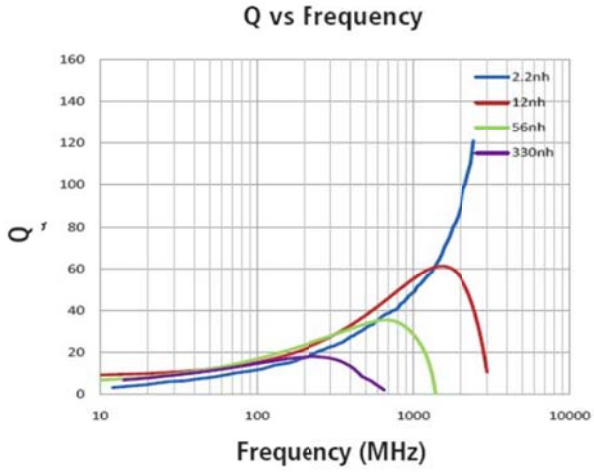
Laird Technologies Ceramic Inductor 0603 Characteristic

Q Factor

The Q factor is defined as the following formula, where *R* is its internal electrical resistance and *ωL* is capacitive or inductive reactance at resonance:

$$Q = \frac{\omega L}{R}$$

The high Q factor inductors have better performance for narrow band filtering, amplifier, and oscillator application. The Q factor is the function of the frequency. Below details the Laird Technologies 603 ceramic chip inductors Q versus the frequency curve.



Laird Technologies Ceramic Inductor 0603 Characteristic

RF Chip Inductors Features Table

	Multilayer		Wire Wound		Thin Film
	Ferrite	Ceramic	Ferrite	Ceramic	
Features	Low SRF; low Q	High SRF; high Q	High L, low SRF, high current	High SRF; low L; high Q	Low L, high accuracy; high Q; low temp coefficient;
Applications	Power line; RF choke	Impedance matching; oscillator; signal filtering	Power line; RF choke	Impedance matching; oscillator signal filtering	Impedance matching; oscillator; signal filtering

RF Chip Inductor Application

RF chip inductors mainly have four (4) applications including frequency filter, RF choke, oscillator and impedance matching circuits. They are widely used in the RF equipment like cell phones, base stations, satellite receivers, WLANs, set top boxes, GPS and CATV, etc.

Summary

As electronics systems continue to be designed and produced with slimmer profiles, implementation of small form factor board-level EMI suppression components is more vital than ever. RF chip inductor monolithic construction provides stable, low-loss inductance over broad frequencies. Laird Technologies can provide a series of RF chip inductors, including multilayer chip inductors, wire wound chip inductors and thin film chip inductors, which are widely utilized in the electronics market. The inductors offer inductance tolerance rated at + 10% of the specified frequency and incorporate small footprint and rugged construction that accommodates today's electronics applications.

About Laird Technologies, Inc.

Laird Technologies designs and manufactures customized, performance-critical products for wireless and other advanced electronics applications.

The company is a global market leader in the design and supply of electromagnetic interference (EMI) shielding, thermal management products, specialty metal products, signal integrity components, and antenna solutions, as well as radio frequency (RF) modules and wireless remote controls and systems.

Custom products are supplied to all sectors of the electronics industry including the handset, telecommunications, data transfer and information technology, automotive, aerospace, defense, consumer, medical, mining, railroad and industrial markets.

Laird Technologies, a unit of Laird PLC, employs over 12,000 employees in more than 49 facilities located in 16 countries.

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