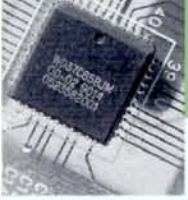

Choosing the right inductor

An application's requirements dictate part selection

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Not all inductors are created equal. There is a natural tradeoff between performance, size, and cost that must be considered when selecting an inductor for a design. As a result, manufacturers produce many series of similar inductors, allowing engineers to select a component well suited for their designs.

Know your application

Choice is all about options. In the case of inductors, knowing the options enables an engineer to choose a component that not only satisfies a circuit electronically, but also improves its overall performance.

The two most common applications for inductors are in the fields of RF and power electronics. Most inductor manufacturers recognize this division and have tailored their datasheets to provide an engineer with the electrical parameters required to design their part into an RF or power circuit.

RF designs

For RF electronics, the main factors considered are the component's quality (Q) factor and its self-resonant frequency (SRF). Additionally, an inductor's tolerance should be considered.

The Q factor describes a ratio of an inductor's reactance to effective resistance. This value is frequency dependent, and therefore the test frequency is often specified.

Specifically, Q affects the sharpness of a resonant filter and the center frequency of an LC circuit. Because a high value of Q is preferred, datasheets specify a minimum Q value.

SRF simply describes the frequency at which an inductor quits working as an inductor. For RF designs, an SRF should be chosen with a minimum value that exceeds the operating frequency of one's circuit.

Power inductors

Power inductor parameters generally are focused on the device's current parameters: incremental current and maximum current. Incremental current describes the current at which inductance is decreased—normally by 5%—due to

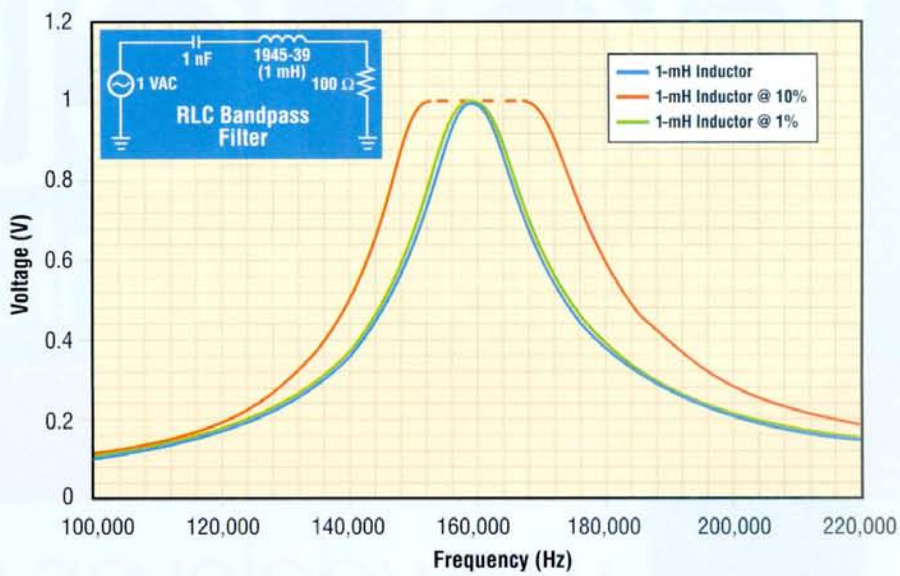

Fig. 1. A simulated RLC bandpass filter shows the maximum range of frequency shifting using a 10%-tolerance inductor (red), a 1-% tolerance inductor (green), and the ideal 1-mH inductor (blue).

saturation. Saturation can be altered with different core materials and shapes.

The maximum current expresses the current at which the device will exceed the specified temperature rise. Under some situations, this may result in device failure.

Other factors to consider

After selecting an inductor with a desired electrical performance, a simple part search often results in a variety of different series to choose from. The parameters that make these remaining parts different present an engineer with an array of often-overlooked design aspects that can be used to improve their overall circuit. Some such parameters are tolerance, device dimensions, shielding, and whether the part is RoHS compliant.

Tolerance percentages inform an engineer that the part they are using could have an inductance value different from what is listed in the datasheet by a certain percent. For example, a 1.0-mH device with a 10% tolerance may have an actual value ranging from 1.1 to 0.9 mH.

If you are designing an RF device, this change in inductance can cause an unwanted shift in frequency selection. By using a 1% part, an engineer can minimize this shift and expect a 1.0-mH part to have a value of 1.01 to 0.99 mH, resulting in a much more accurate frequency selection (see *Fig. 1*).

The reduction of size is a general trend seen in the electronics industry today. As a result, for many applications, board space has become prime real estate.

Under these circumstances, using a smaller inductor can provide much needed room for larger components that are too expensive to scale down—and thus can help lower the cost of the overall board. Shielded components reduce the magnetic coupling between components in a space-constrained design.

The reduction of coupling allows shielded inductors to be placed closer together without having an adverse effect on the performance of the circuit. This can be exploited to reduce overall board space. Additionally, the use of shielded parts reduces the circuit's electromagnetic interference.

A very modern device parameter to consider is whether or not the device is RoHS compliant. RoHS is a European Union directive aimed at reducing hazardous substances that have been found to be harmful to both humans and the environment.

The selection of an RoHS inductor may be critical depending on location and type of product being manufactured. The guidelines for RoHS compliance are described in Directive 2002/95/EC of the European Parliament and of the Council. ■