To Shield or Not to Shield - Part 1

In power and RF circuits, radiative and conductive electromagnetic emissions and susceptibility can be a significant element of the design, build and test stages of product development. Whether you encounter drawing requirements to meet EMC standards such as FCC Part 15 or the IEC 61000 series or you are just trying to be proactive against excessive noise, crosstalk and resonances, there are several component options to choose from to minimize radiative EMI. Radiative paths of EMI are unintentional couplings between a source and target typically through air or a lossy medium. In contrast, conductive paths are directly through the cables, connectors, PCB traces, and components. Shielding is a very common and effective practice to solve radiative EMI issues. Many components, including inductors, can be manufactured in either a shielded or unshielded configuration.

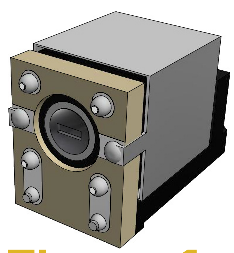

Figure 1

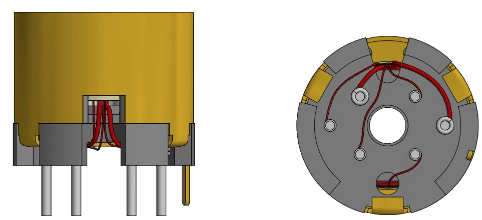

Figure 2

Shielding effectiveness can be specified in terms of the reduction in magnetic and/or electric field strength caused by the shield, the physical barrier. The electromagnetic (EM) waves striking the properly designed shield (optimum materials and geometry, and minimized leakage/apertures) are either reflected or absorbed, resulting in attenuated EMI induced into the circuit. Electric field shields are typically made from thin, conductive, low-resistance metals such as plated brass or copper, being mindful that some thickening of the shield is necessary for lower frequencies, due to the skin depth effect. Grounding to the chassis or enclosure, if possible, can prove to be effective to divert this noise away from the desired power and signal paths. GCG offers many solutions within this family of shields (see Figures 1 and 2 for real world examples). They work well, typically, for high-frequency SMPS, fast digital and RF/microwave modulation formats, and when external AND internal noise and couplings in miniaturized circuits can become troublesome.

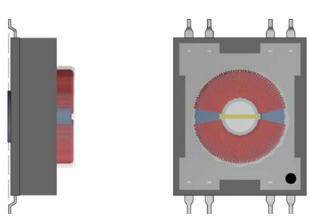

Figure 3

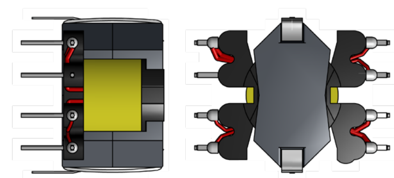

Figure 4

Magnetic field shielding (see Figures 3 and 4) is a relatively more common option for inductors and transformers, due to the open loop, antenna-like magnetic flux lines produced from solenoid chokes and inductors, as some examples. Toroids and paired cores, such as EFD- and pot types to name a few, lend to closing those magnetic loops, effectively creating maximal or even partial shielding and containment of EMI radiation via low-reluctance paths. In addition, high-permeability soft magnetic (Mumetal®, Permalloy®, etc.) housings can be added to magnetic and air-core components. At Gowanda, our proven processes and materials can overmold RF and Power ferrite cores with shielding material or with nonmagnetic compound (unshielded) in the same-sized package (click on the Series SMRF1812S link below). Another successful design involves ferrite cylinders added before overmolding (click on the Series SMRF3013S link below).

As with all electronic components, benefits and tradeoffs should be examined concerning design parameters such as: cost, inductance, efficiency, inertial mass, EM interference & noise levels, size, weight, and so on, depending on your requirements.

SMRF1812S Inductor Series: http://www.gowanda.com/catalog/standard/smrf1812s-detail.html

SMRF3013S Inductor Series: http://www.gowanda.com/catalog/standard/smrf3013s-detail.html

In Part 2, we will provide more design and circuit fix tips and options for shielding your components, with practical results comparing shielding vs. not shielding.

IN CONCLUSION

Shielding is a common and effective method to solve radiative EMI issues with inductors. Shielding can be accomplished by utilizing physical barriers made of specific metal or magnetic materials. As with all electronic components, cost/performance tradeoffs should be evaluated when deciding to shield or not to shield.

If you have any questions about this Technical Tip, suggestions for future Technical Tips, or need assistance with our standard or custom products, please contact us.

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