The Engineer's Application Overview: EMI Shielding

EMI issues affecting the high quality performance of electronic devices are becoming more challenging to address as devices run at higher frequencies and their components must fit into more crowded spaces. Problems with radiated EMI can force teams to delay product launches, scrap prototypes, and run through multiple board spins as they experiment with different measures to suppress emissions. Traditionally, engineers have used bulky shielding in their enclosures and tricks in the PCB layout like via fences and copper pour to combat EMI. Oftentimes, designers must compromise on form factor, functionality, or both due to lack of flexible solutions to suppress EMI and ultimately pass EMC testing.

Today, advanced materials companies are offering cost-effective, flexible solutions that can suppress emissions from a product and help a new design pass EMC testing. This whitepaper will serve as an introduction to some of the foundational concepts of EMI shielding, as well as several different types of shielding solutions designers can implement.

As a leader in the electronic and thermal materials space, Laird offers multiple solutions that can be customized to your board, enclosure, and application. With standard and customizable form factors, Laird's broad range of products can be tailored to any application, offering ultra-high noise suppression out to GHz frequencies.

Laird's EMI Shielding Materials

Shielding materials need to satisfy multiple requirements beyond high attenuation over a broad bandwidth. While this is certainly the initial consideration when evaluating an EMI shielding solution, other requirements may dictate the final material system being selected. In addition to high shielding effectiveness, some shielding materials must also be multi-functional. These materials may be implemented in a high temperature environment, in an enclosure with movable elements, or in a tight space requiring a low profile solution.

Laird Performance Materials' EMI shielding materials target and suppress EMI with flexible solutions implemented on the PCB and in the enclosure. These solutions can be adapted to fit form factor and functional requirements, often without requiring modifications to the enclosure. These board-level and enclosure-level solutions fall into three areas: flexible conductive elastomer materials, surface-mount metal shielding, and metallic gaskets for fittings, mating surfaces, and flanges.

Fingerstock Metal EMI Shielding Gaskets

When high-frequency EMI is detected from mating surfaces, doors, or movable elements in an enclosure, metal gaskets can provide compact, cost-effective solutions. Laird's shielding gasket solutions can provide shielding effectiveness up to 110 dB and out to 10 GHz. As metal materials, these options combine structural rigidity and ease of application with low-profile form factors and customizable lengths.

- **Tape-mounted gaskets:** These gaskets use a non-conductive self-adhesive backing to ensure a tight fit along the length of an enclosure or mating surface. The pressure-sensitive adhesive makes these gaskets useful whenever a welded gasket or a clip-on gasket are infeasible.

- **Clip-on and edge-mount gaskets:** These are an ideal alternative when adhesive-mounted gaskets are problematic, such as in high temperature environments. These gaskets are simple to install and can be clipped onto flanges on doors and lids, or onto the edge of an add-in card to suppress cavity emission from the board edge.
- **Slot, track, and rail gaskets:** These products are useful on straight mating surfaces with movable components or sliding surfaces. This ensures high shielding from the opening of the enclosure, functioning as both a shielding solution and a grounding contact between two surfaces.

Foam and Elastomer Gaskets

Some EMI shielding materials need to be placed in tight-fiiting or oddly-shaped locations where metal shielding is unwieldy, too large, or too difficult to apply. Foam-based and elastomer-based materials are ideal for sealing mating surfaces on a metal enclosure with a conductive filler material. Laird offers these materials in a range of shapes and thicknesses:

- **Fabric-over-foam:** These materials use an elastic foam covered with a metalized fabric, making them ideal for filling gaps at a mating surface requiring a solution with low compression force. The broadband shielding effectiveness of these materials typically exceeds 100 dB.
- **Conductive elastomers:** These materials are an electrically conductive alternative to silicone gaskets that can withstand specific environmental factors, such as heat or noxious gases. These materials are also useful as conductive fillers between mating surfaces with low compression force.

Surface-mount Shielding

These board-level EMI solutions come in standard and custom form factors. These shielding options can be mounted directly on a PCB as a standard SMD component, providing shielding along six surfaces. Laird offers one-piece and two-piece shielding options in standardized sizes to fit a range of integrated circuits packages or groups of discrete components. These solutions also allow varying levels of ventilation, which may be critical on high-speed electronic components. Although this solution requires some planning during the board layout phase, it's an effective low-profile solution for EMI suppression that rarely requires modifications to the device enclosure.

If a standard one-piece or two-piece enclosure will not work within existing layout requirements, Laird offers custom solutions that can be fabbed to customer specifications. These custom surface-mount shielding options are available in a range of shapes, sizes, plating options, and substrate materials. Both custom and standard solution options typically provide up to 40 dB shielding effectiveness at approximately 1 GHz. This is sufficient to suppress radiated EMI from noisy clocks, switching regulators, and many digital components.

Grounding Contacts

These materials are designed to provide a ground path back to a metal enclosure or other grounding point in a system. Although these components follow a simple concept, they help ensure a consistent reference potential can be enforced throughout the system. Laird's grounding contacts are surface-mounted materials that can pass through reflow soldering on an SMT line. These materials fall into two categories:

- **Surface-mounted foam:** This board-level conductive foam material consists of a silicone core with a platinum film outer layer.
- **Metal grounding contacts:** These surface-mount contacts are available in a variety of materials, making them useful in a range of temperatures.

This simple, low-cost solution can be used to target conducted and radiated EMI that originates from inconsistent grounding in specific circuits or components. The specific shielding effectiveness varies depending on the EMI problem being targeted.

Comparison of Laird's Shielding Solutions

Laird's broad range of products gives designers access to multiple form factors, shielding effectiveness values, and attenu-

ation in various frequency ranges. Best of all, these solutions can be targeted at specific EMI problems. The following table summarizes these capabilities and how these EMI shielding materials are implemented.

	Type of Shielding	Implementation	SE/frequency
Surface-Mount Shielding	Board-level	Surface mounted directly to the board to provide shielding for specific components and circuits	- Up to 48 dB/200 MHz (H-field) - Up to 60 dB/2 GHz (Plane wave)
Foam and Metal Grounding Contacts	Board-level	Connects ground on the board to another ground in the system (e.g., chassis)	Varies depending on number of contacts used on PCB
Metal Gaskets	Enclosure-level or board-level (clip-on)	Attaches to flanges, lids, board edge, or tracks	- Up to ~70 dB/200 MHz (H-field) - Up to ~110 dB/2 GH (Plane wave)
Foam and Elastomer Gaskets	Enclosure-level	Applied at mating surfaces requiring low compression force	- Exceeds 100 dB/Up to 2 GH (Plane wave, broadband)

Each of these solutions targets a different pain point in EMI shielding or suppression. Designers can mix-and-match these materials as needed to address specific frequencies with high-attenuation options, both at the board level and enclosure level.

Beyond EMI Shielding With Multi-functional Solutions

There is no single shielding solution that is ideal for every EMI problem, and designers need flexible material options when EMI becomes a serious problem. Laird is a major innovator in this area thanks to its broad range of EMI shielding materials. With flexible solutions targeting board-level and enclosure-level EMI problems, designers can combine multiple options to craft a custom solution for their products.

At Laird, a "multi-functional" has a wide-ranging definition. Often, it refers to Laird products now successfully mitigating both EMI and excessive heating. When a device suffers from both EMI and heat dissipation challenges - and space is severly restricted - Laird's increasing number of multi-functional products help resolve both issues using a single process design. Laird can provide custom EMI shielding solutions for customers who have unique design needs, or for whom an off-the-shelf solution may be infeasible. Such custom solutions can provide EMI suppression from multiple noise sources in unique form factors, as well as a path for heat dissipation. Using state-of-the-art design and modeling technologies, Laird's engineering team can provide a rapid prototype and help ease the transition to medium and high volume production for a custom solution.

Because modern electronics are complex and deployed in diverse environments, designers may find a need to reduce EMI, reduce heat loads, remain stable in harsh environments, and quickly implement a custom solution. Laird's advanced materials provide these advantages and many more, giving designers broadband shielding options that can be implemented at scale. Laird offers a range of shielding products and custom components that can aid thermal management and EMI mitigation. Contact Laird today to find the best materials for your product.