# EMI Shielding Materials Improve Reliability for Electronics

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Electronic product designers are often asked to add more features and redesign for lighter, smaller formats. Therefore, signal integrity, durability, and long-term reliability are key factors in ensuring the high performance that consumers have come to expect. Two components that can directly affect the overall performance of electronics are EMI shielding and cable construction.

EMI Shielding

Making electronic products smaller while adding new features increases the complexity of printed circuit board (PCB) designs, resulting in the need for high-performance EMI shielding materials. While most engineers are familiar with strategies that reduce EMI issues at the board level, solutions become more difficult, and in some cases more costly, as new features are added in smaller housings. You can eliminate last-minute EMI issues that often occur during validation testing by considering shielding options at the outset of the design process — options that include thermoformed board-level shields, construction of the product housing, and shield materials used in grounding pads and gaskets (Figure 1).

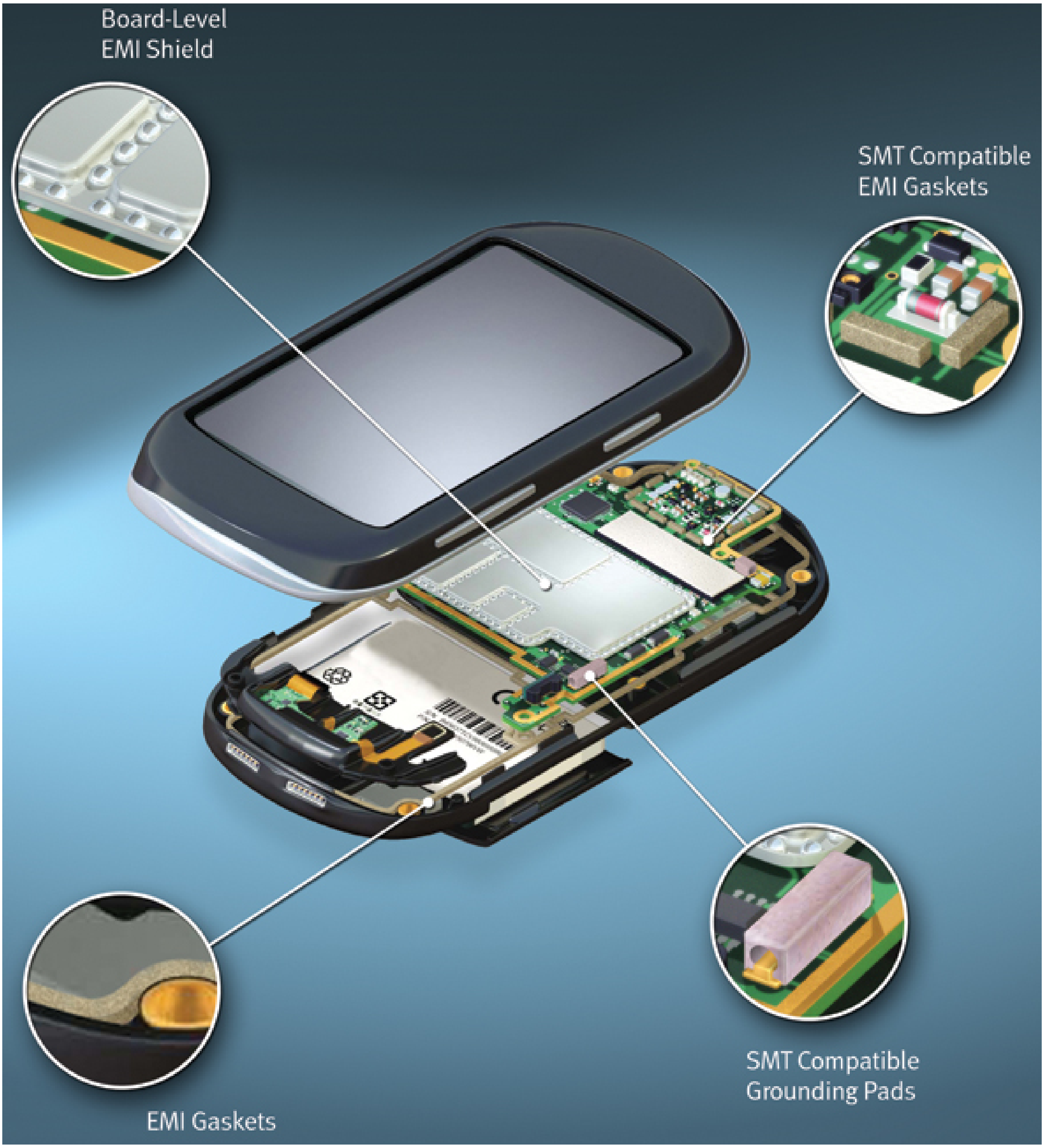


**Figure 1. Assessing shielding options at the beginning of the design process can eliminate last-minute EMI issues.**

Traditional design methodology places noisy components as far away from sensitive electronics as possible, which means that design is controlled by the shape of shielding cans. This design method can increase the overall size and weight of the product. Using thermoformed board-level shields increases design flexibility because you can design the PCB based on circuit and component function without being limited by your EMI needs. Thermoformed shields can be shaped to fit any board, regardless of its geometry. For example, the size of a PCB that requires six shielding cans can be significantly reduced by using a single board-level shield. These shields also minimize the space needed to shield individual areas. Unlike traditional cans that require separate ground traces for each cavity, thermoformed shields require only a single row of solder spheres to connect adjacent cavities to the ground plane. Thermoformed shields allow more flexibility in board layout because noisy components can be placed close together, reducing the overall size.

When selecting an EMI shielding material, the best choice depends on the materials used for the product’s housing as well as the performance of the shielding material. The type and thickness of the housing material can have a significant impact on EMI materials. For example, protective coatings on metallic components (such as chromate used over aluminum) add a nonconductive layer that can cause EMI issues by preventing the enclosure from engaging with a shielding gasket. In this case, a gasket material that can pierce the coating, such as metallized foam, can improve shielding performance. The mechanical strength of the housing construction can also affect EMI performance. For example, a flexible plated-plastic enclosure may result in slot antennas because electromagnetic energy can radiate through the gaps if the EMI material does not compress and recover at the same rate the flexible enclosure.

Validation testing of the final design often highlights EMI-related system failures that did not occur during component testing. As components are combined into subsystems or into the final product, slot antennas that were not previously detected can cause EMI testing failure. Adding a peel-and-stick shielding material in the housing’s seams or at critical grounding points on the PCB is an effective alternative to prevent time-consuming redesign.

**Cable Reliability**

Cable assemblies used with an electronic device can dramatically affect its performance, but they are often the last component considered during the design process. Cable reliability is based on both durability and signal integrity, and the ideal cable system should last the life of the device in any environment. Therefore, it is essential to identify potential factors that can affect the electrical performance of the cables (Figure 2).

Many of today’s electronic products are used in environments that require unique materials and mechanical properties to ensure reliable cable performance, so you need to evaluate the electrical, mechanical, and environmental stress that the cable will encounter. Electrical performance is probably the foremost consideration, and many factors can potentially compromise signal integrity — EMI, crosstalk, attenuation, and voltage standing wave ratio (VSWR) for example. Mechanical stress occurs when cables are exposed to random, rolling, and torsion types of motion, such as in automation applications or high-performance test equipment that is used in the field. Environmental stress results from exposure to such physical issues as extreme temperatures and pressures, radiation, chemicals, and friction. Application-specific constraints are unique to the device’s application, such as aerospace where cables need to be as light and small as possible to minimize mass during take-off. Electrical performance is generally reliable when there are not other factors; however, as you add stress, it can be compromised because electrical performance is interwoven with mechanical and environmental performance, with each having a direct impact on the other (Figure 2).

**Figure 2. Electrical, mechanical, and environmental stress can significantly compromise cable performance in applications such as defense and aerospace, cleanrooms, or hand-held test equipment.**

When selecting a cable, you should evaluate its insulation and jacket materials. Dielectric materials affect the signal integrity as well as the cable’s robustness, and insulation materials affect maximum voltage and resistance to abrasion. Jacket materials must survive the external factors (temperature, friction, liquids, and gases, for example) to protect the conductors inside the cable. Because these materials all have unique properties, some are more appropriate than others for specific applications. For example, fluoropolymers and enhanced fluoropolymers such as FEP, PFA, PTFE, and engineered PTFE are excellent for applications when the cost of system failure is high.

Finally, before selecting a cable, you should ensure that sufficient testing has been done to verify that the cable will survive in your application. Selecting a manufacturer with extensive expertise in a variety of cable materials, environments, and industries ensures that the cable will function reliably. At a minimum, the manufacturer should understand your application and can provide sufficient data to ensure that the cable will not be compromised. It may be necessary for the manufacturer to develop tests that evaluate electrical performance while simulating mechanical and environmental stress similar to that in your application.

**Summary**

As electronic products continue to get more sophisticated, the reliability of both EMI shielding materials and cable assemblies has a direct impact on a product’s performance. Selecting the right EMI shielding materials during the design process can maximize signal performance within the product itself. To ensure long-term reliability for the life of the product, you should also select high-performance cable assemblies engineered specifically to handle the conditions in which the device will be used.

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