STORM™ POWER COMPONENTS

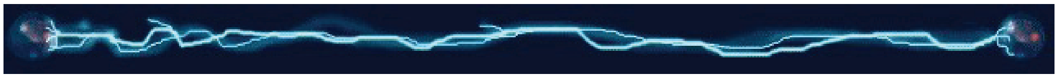
Applications Note

Understanding Key Techniques to Integrate and Optimize EMI Shielding and Filtering into Busbars

Integrating shielding and filtering into busbars is an important aspect of electrical system design, particularly in applications where electromagnetic interference (EMI) and electrical noise need to be minimized. EMI is radiated or conducted energy that adversely affects circuit performance, and thus disrupts a device's electromagnetic compatibility (EMC).

This Applications Note provides a brief overview of why shielding and filtering are important, along with a detailed look at some of the specific methodologies for integrating EMI management into busbars.

Shielding is primarily concerned with blocking or containing electromagnetic fields, while filtering is focused on selectively attenuating or eliminating specific frequencies or ranges of electrical noise or unwanted signals.

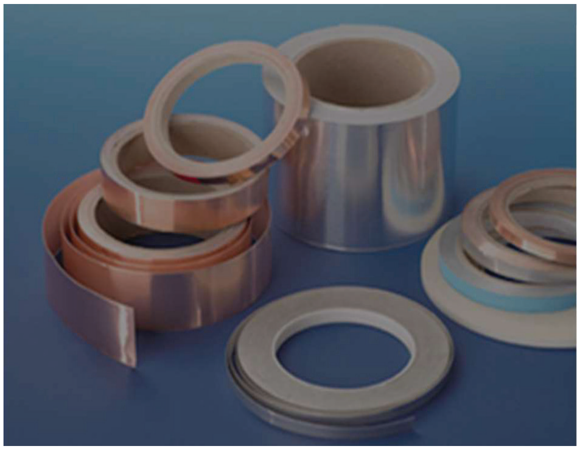


Filtering

- **Purpose:** Filtering aims to reduce or eliminate unwanted electrical noise, interference, or disturbances present within a signal or power path. It focuses on improving the quality and integrity of the desired signals or power while suppressing undesirable frequencies.
- **Mechanism:** Filtering components, such as capacitors, inductors, and filters, are used to introduce impedance or resonance at specific frequencies. This impedance selectively attenuates or blocks unwanted frequencies while allowing desired frequencies to pass through.

Shielding

- **Purpose:** Shielding is designed to prevent the transmission or reception of electromagnetic radiation. It aims to block external interference from reaching sensitive components or to contain and minimize the emission of electromagnetic radiation from the source.
- **Mechanism:** Shielding works by utilizing conductive materials, such as metal enclosures, shields, or coatings, that create a conductive barrier. This barrier reflects, absorbs, or diverts the electromagnetic fields, reducing their impact on the protected area or component.



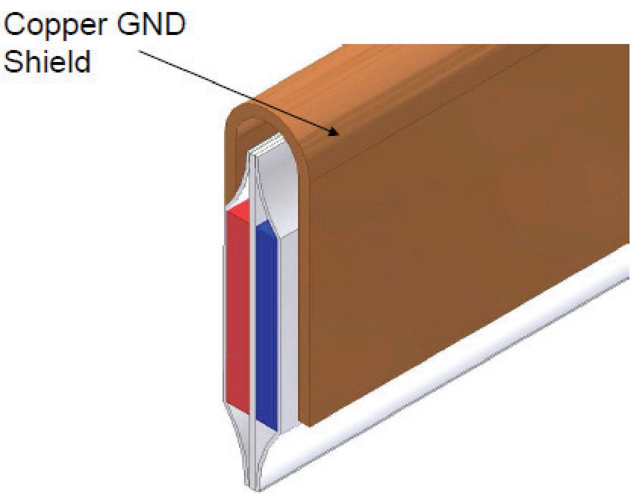
Key Design Techniques include:

The following sections address these methodologies for integrating EMI management into busbars.

- Wrapping w/Copper Stamping or Conductive PSA Foil
- Potting w/Conductive Epoxy
- Die Cutting Conductive Fabric
- Machining Barriers and Conductive Gaskets
- Laminating W/Interleaved Grounds

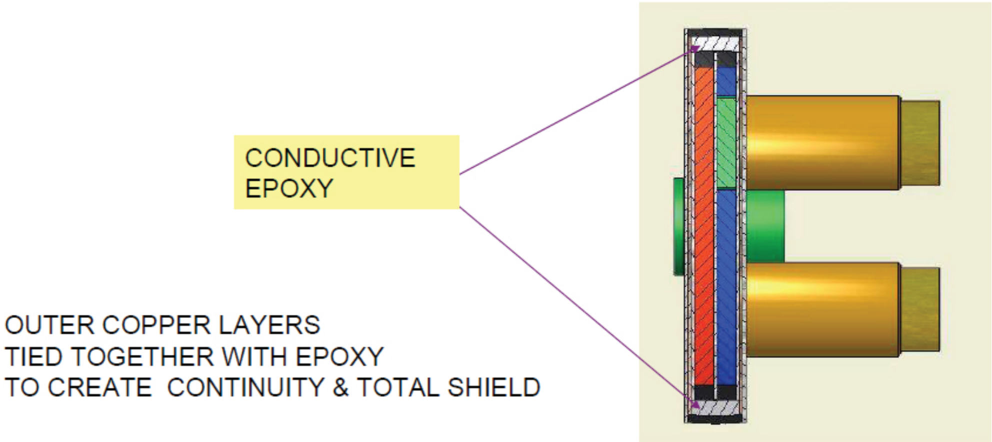
Wrapping with Copper Stamping or Conductive PSA Foil

This technique involves wrapping the busbar with either a copper stamping or pressure-sensitive adhesive (PSA) conductive foil to shield it from EMI impacts. Benefits are straightforward application, adaptability for a wide range of busbar form factors, and relatively low cost.



Potting with Conductive Epoxy

Using specially formulated conductive epoxy as an edge fill provides another very effective method fore electrically connecting the outer copper layers to form an EMI shield. Benefits include flexibility for use in a variety of busbar designs and efficient application with proven dispensing methods.



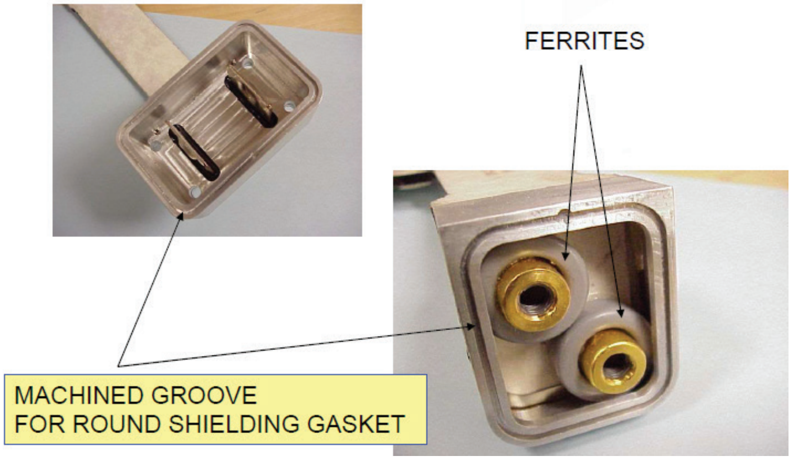
Die Cutting Conductive Fabric

Another approach involves wrapping portions of the busbar with electrically conductive fabric, which can be helpful with shielding complex busbar designs that may not be appropriate for copper wrapping or epoxy.

Conductive fabric is flexible and can be cut, sewn, stretched and manipulated in ways that hard metals cannot. However, it can require some additional expense due to the material cost and the secondary operations for preparing and applying the fabric.

Machining Barriers

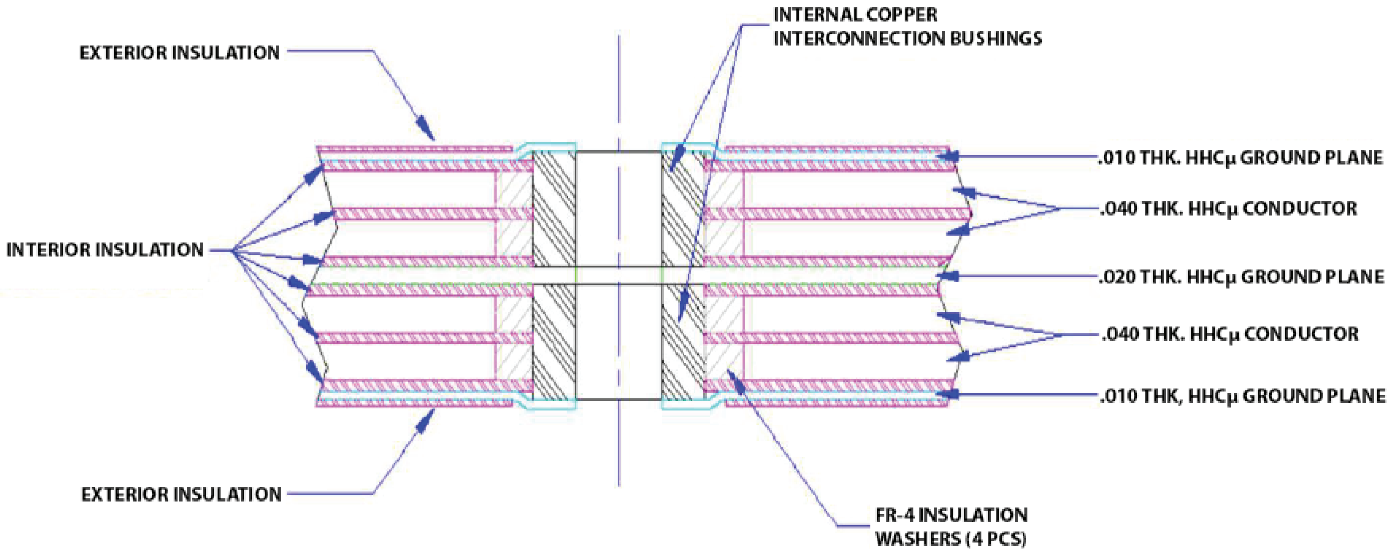
For some specific shielding requirements, it can be useful to design custom machined EMI barriers. For example, machined aluminum shields can be tailored to provide robust targeted EMI protection for focused EMI risk areas in the busbar design, such as enabling conductive ferrite gasketing around connectors for filtering specific frequency ranges.



While machined barriers can be very effective for specialized situations, because of the added cost, this technique needs to be carefully considered in the early design phase to assure it is the best choice.

Interleaved Grounds

In applications where holistic EMI management across the entire busbar is critical, an effective design approach is to embed multiple interleaved ground planes that are connected via internal copper bushings. When fastened together, the ground planes form an effective Faraday cage. Using this technique in laminated busbars provides an excellent end-to-end EMI shielding solution.



Summary

As described in this App Note, integration of shielding and filtering into busbar designs can take a variety of forms, ranging from relatively simple techniques, such as wrapping with copper stamping or PSA foil, to more complex holistic EMI management such as interleaved grounds within laminated busbars.

In order to achieve the best balance of EMI mitigation and cost containment, it is important to work closely with experienced busbar design partners, starting with the initial conceptual assessments all the way through prototypes, testing and full production ramp up. Your busbar design partner should be able to guide the process and offer best practices with regard to these key areas:

Grounding and Bonding: Proper grounding and bonding techniques are crucial for effective EMI shielding and filtering in busbars. Ensuring a low-impedance path to ground and proper connection of shielding components, such as enclosures and gaskets, helps in diverting and dissipating unwanted noise and interference.

Physical Layout: The physical layout of the busbar system should consider minimizing the loop areas and distances between busbars and sensitive components to reduce the coupling of electromagnetic fields.

Component Placement: Strategic placement of shielding components, filters, and grounding connections within the busbar system is crucial for optimal noise suppression. Consideration should be given to the proximity of filters to noise sources and the routing of shielded cables or conductive traces.

Material Selection: Choosing appropriate materials for busbars and shielding components is important to achieve desired electrical and electromagnetic characteristics. Conductive materials with high conductivity and low resistivity are typically preferred.

It is important to note that the specific techniques and approaches for integrating shielding and filtering into busbars can vary depending on the application, system requirements, and regulatory standards.

Consulting with experts that can provide vertical integration and end-to-end design-to-production support, including testing and quality control, is critical for achieving cost-effective EMI management compliance along with highly scalable and consistent volume manufacturing.