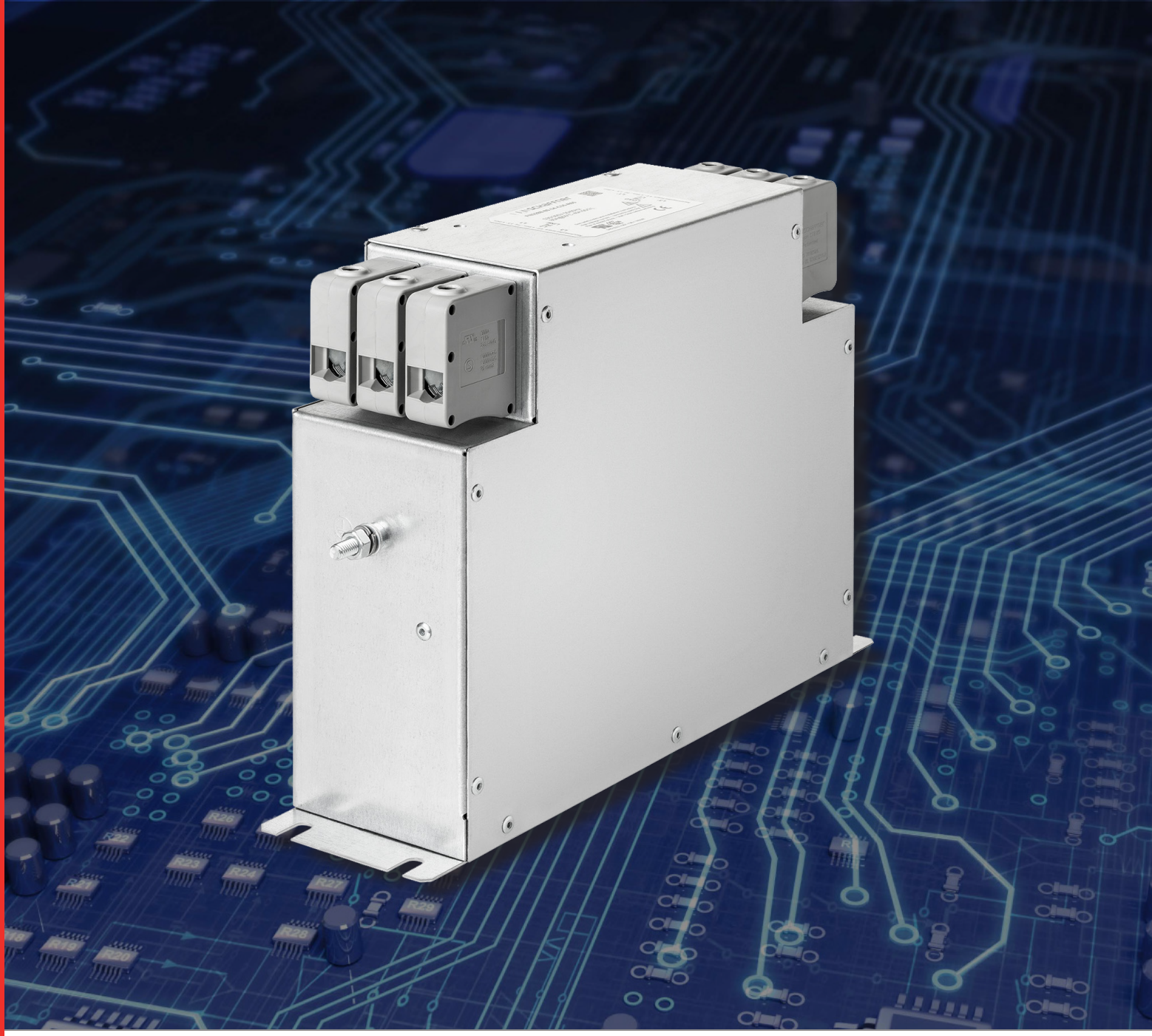

What's New in EMI Filter Designs and Applications, How They Aid EMC Compliance

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INTRODUCTION

Electromagnetic interference (EMI) is becoming a crucial factor as new designs, ranging from industrial to lighting to renewable energy, become more interconnected and employ sophisticated IT and communication systems. There are several design venues with which to suppress interference and minimize unwanted emissions, both preemptively during the design phase and reactionarily in the troubleshooting phase.

For instance, take simulation tools to predict EMI issues, which require engineers to obtain data for multiple components and then conduct simulations. However, this mandates skilled and dedicated engineering teams, and no simulation model is perfect amid unpredictable design changes.

Likewise, while current probes attached to oscilloscopes or spectrum analyzers can efficiently locate emissions to suppress interference, they can also increase the reception sensitivity. As for metal shields installed on the transmission path to suppress noise, the use of shields generally increases the cost and weight of the device.

Add the increasingly shorter design cycles and cost constraints to the above design practices, and discrete EMI mitigation solutions emerge as a viable option for design, troubleshooting and retrofit phases. Off-the-shelf EMI filters are highly versatile, and they can serve a wide range of applications. Moreover, they can be customized for specific EMI suppression requirements during the design or troubleshooting stages.

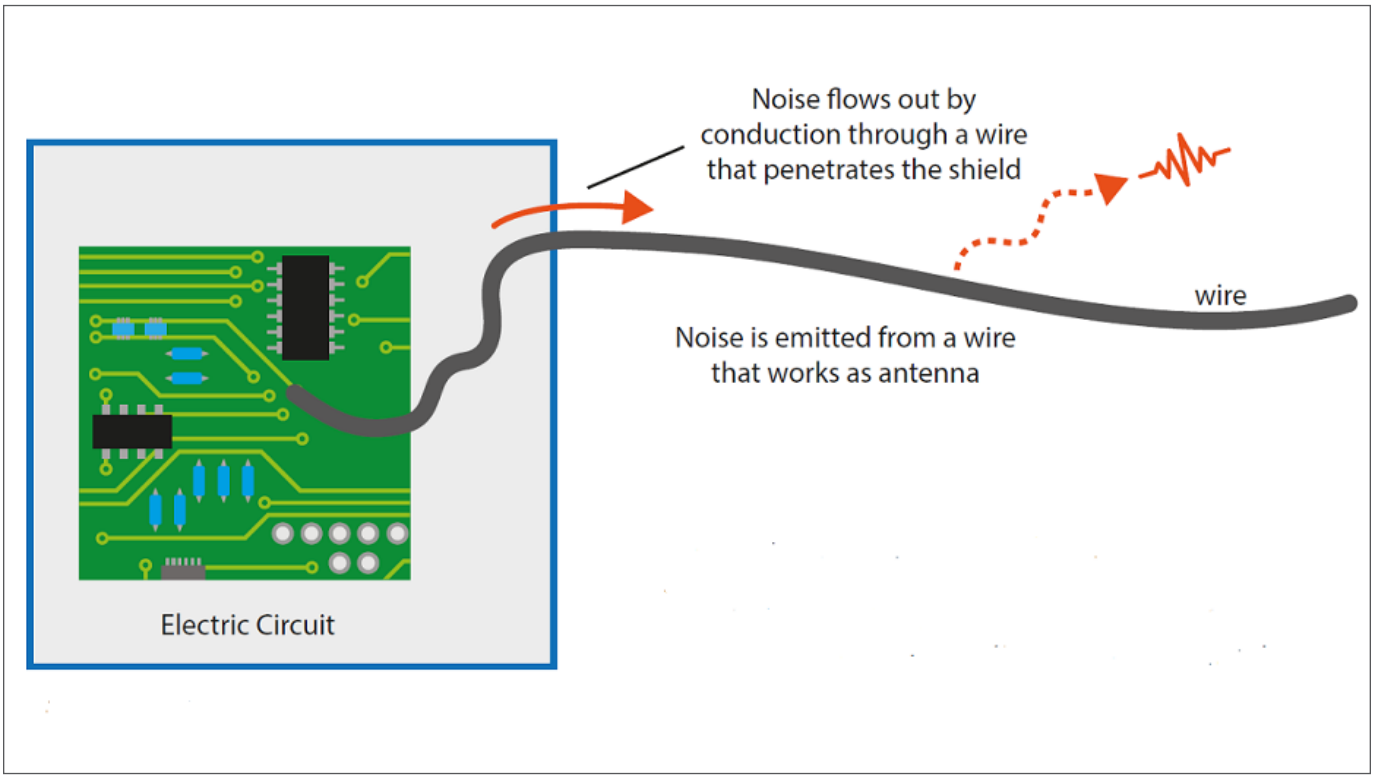

Figure 1: EMI filters enable designers to mitigate conducted and radiated emissions. Image source: Schaffner

EMI Filters: What's New

EMI filters aren't something new; what's different is a new crop of applications like factory automation, LED lighting, and solar panels that are stimulating new design structures for EMI filters. These EMI filters are exploring new combinations of capacitor and inductor content to boost attenuation characteristics, and thus enhance the overall performance of interference mitigation.

First and foremost, EMI filters are offering higher EMI attenuation performance in smaller filter footprints, and that saves board space as well as allows engineers to incorporate filters during PCB layout spins. Additionally, a significant footprint reduction is bolstered by connection terminals integrated into the filter cubical, which effectively shields the filter no matter how it's mounted.

EMI filters in smaller form factors can be used as chassis mount filters, and it's critical for engineering teams either aiming to accelerate design turnaround or work with limited development resources. The compact size also minimizes power loss which in turn, helps maximize power efficiency.

Leakage current is a critical attribute in some industries and filters are therefore designed to accommodate this requirement. They come in various options allowing the user to choose an acceptable leakage current. The design of these low leakage filters may also be adjusted to maintain high performance characteristics.

Figure 2: The book-style FN 3287 and FN 3288 filters facilitate space-saving installations next to inverters, converters, and power drives with leakage currents ranging from 12 mA to 0.1 mA. Image source: Schaffner

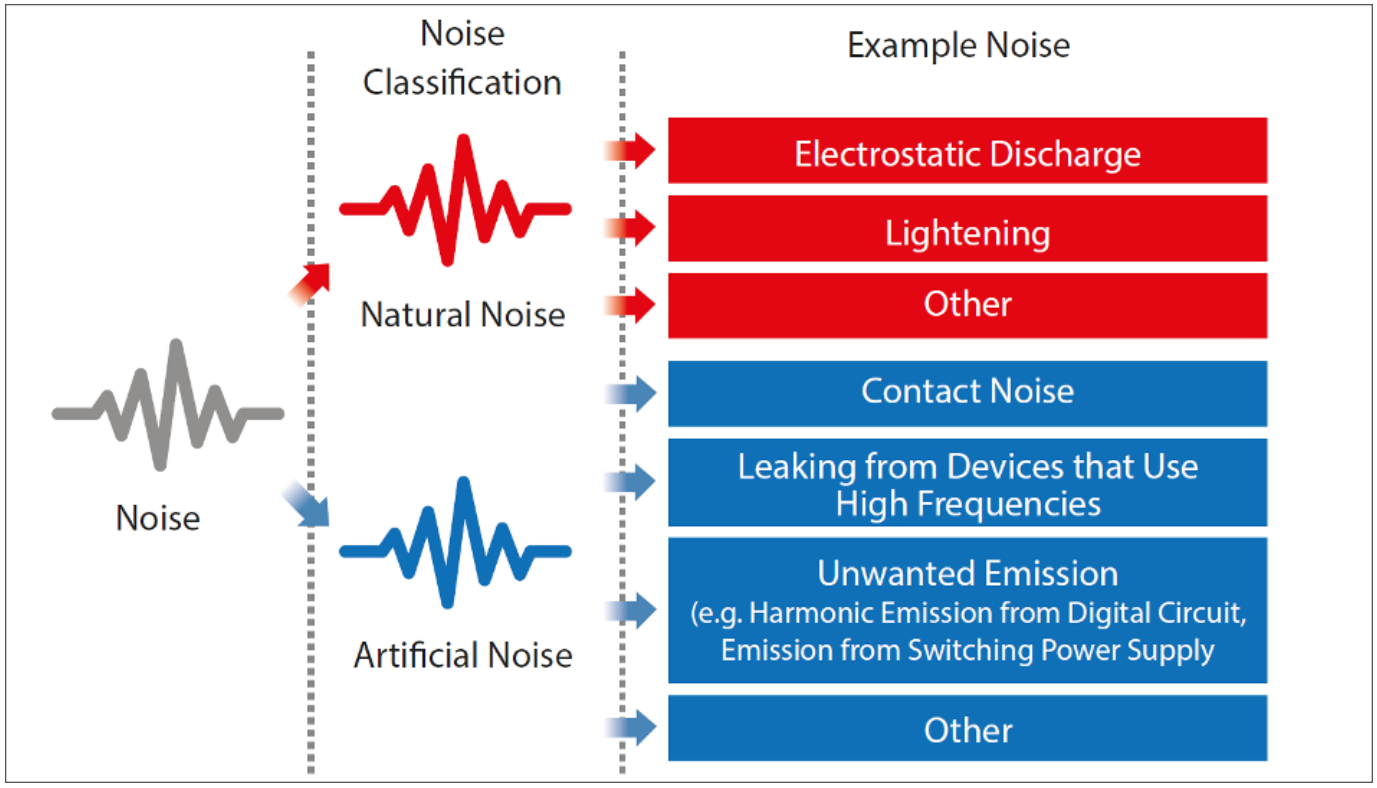

Figure 3: A more detailed description of noise and immunity issues that designers confront while preparing for EMC compliance. Image source: Schaffner

Simplifying EMC Compliance

EMC compliance keeps electronic devices from interfering with each other which is crucial for highly regulated industries such as medical, renewable energy systems, and domestic and industrial lighting.

However, engineers usually leave this gatekeeper between product design and market launch untouched until the testing phase. As a result, it often becomes a last-minute headache for system and production engineers. Again, discrete filters optimized for rigorous EMC compliance come to the rescue should engineers catch EMI issues in the compliance stage.

It's worth mentioning that the majority of EMI emissions are unintentional, and they commonly originate from common-mode currents, crosstalk coupling to I/O traces, and power planes. So, if the original design doesn't work, EMI filters can be incorporated into the product for rapid redesign and testing, and thus save time as well as lab visits.

Besides conducted emissions, EMI filters can also help counter radiated emissions and fast transients. The new EMI filters offer enhanced screening features and higher attenuation levels that allow them to go beyond conducted emissions.

Once past the EMC compliance phase, the installation of EMI suppression filters add a level of protection (immunity) to a device that can avoid a variety of operational disruption. That's a vital consideration in factory automation systems which typically rely on operations without human supervision.

Here, in the post-EMC compliance scenarios, engineers can save costs and time spent in tracking emission and immunity issues, which leads to either replacing faulty components or installing a new system. The following section will briefly touch upon a new generation of applications that demand greater efficiency and reliability, and they must often comply with FCC, CE, and other EMC certifications.

A New Breed of Applications

There are LED lighting and renewable energy generation and storage systems that could create interference effecting nearby electronic devices or themselves. Their remote location also reinforces the need for EMI filter integration during the design phase. Otherwise, EMI testing and probing can bring a considerable cost and resource overhead.

Compact EMI filters can be easily integrated into renewable energy devices like power supply, battery chargers, and solar panels. There are EMI filters that support AC and DC power systems and are optimized for photovoltaic, power conversion, energy storage, and motor control systems.

Figure 4: EMI filter suppliers can customize the suppression devices to serve unique application needs. Image source: Schaffner

What's important to know is that EMC/EMI issues are unique to product design and installations. There are several types of EMI filters to counter these issues (Figure 4). So, engineers must carefully review the important factors like EMI signal strength, current ratings, and time-domain characteristics while selecting an EMI mitigation filter.

Furthermore, during the filter selection, engineers can obtain the EMI characteristics data from the filter supplier and load this data to conduct simulations. That will allow them to analyze noise filter characteristics for any desired frequency and then choose an optimum filter solution.

Conclusion

EMI filters, highly versatile suppression devices, offer optimal value when designed into an electronic device during the early design and prototyping phase. It's one of the quickest and most cost-effective ways to reduce conducted emissions and confront immunity problems. And EMI filters can be rapidly customized to unique applications such as factory automation, LED lighting, medical equipment, and renewable energy systems.

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