Filtering Out of All The ‘Noise’

EMI and RFI “noise” is an elusive and costly problem that may prevent new electronic equipment designs from passing compliance testing.

As processing speeds in electronics continue to rise, and packaging continues to shrink, sensitive internal components are located closer and closer together. Higher clock speeds coupled with increased density of components leads to increasing amounts of electromagnetic interference (EMI) and Radio Frequency Interference (RFI) noise.

Such noise can be detrimental to the performance of communication and computing systems and also cause false triggering and faulty readings in vital sensor circuits, resulting in system failures. Additionally, this noise can make systems incompatible with each other and cause them to be non-compliant with established military and commercial requirements.

EMI Solutions Filter Inserts, which are installed in front of device connectors, are generally considered the lower end of the spectrum in terms of cost and filtering limitations, they are a very practical solution for many applications.
Thus, it has become increasingly important for engineers to address the varying need for EMI/RFI/EMP protection along with that of transient voltages during the design and test phases of a project. Otherwise, they run the risk of failing compliance testing and the accompanying possibility of incurring high costs in redesigning and retesting the electronic systems or components they are developing.

EMI suppression is often handled by filters that are designed to meet the increased performance demands levied during testing from MIL-STD-461, RTCA-DO-160, CISPRE, and CE Mark, etc.

“Current trends in the industry which have caused increased EMI/RFI noise have led to the need for multiple approaches and higher performance filters to provide design and test engineers with new tools to help address this issue. These filters have increased in both their performance and sophistication as well as in the choice of location for these filters,” says Brett Robinson, PhD, Director of Engineering, EMI Solutions, Inc. (Irvine, CA).

Dr. Robinson says that while many of the electronic / mechanical component designers today have strong backgrounds in engineering, the problems that continue to occur due to EMC compatibility layout may be somewhat new to them, or their training can be a bit outdated. They are often unfamiliar with the particulars of the design/test compliance requirement, or are unaware of the exorbitant costs associated with failing compliance testing and resulting redesign costs for their devices.

“We could be talking about thousands to tens of thousands of dollars here,” he says. “Even without failures, it can cost $50K to fully test and certify a device including all environmental and EMI Compliance Testing. Sometimes failing the required test parameters along with the device modifications can easily cost twice that much.”
Filtering approaches

Essentially, there are four ways to address EMI/EMC filtering requirements. Filtering can be designed onto the PCB or in a device during the initial engineering phase. Otherwise, the filtering requirement can be handled by one of three devices after the device has already been designed: (1) filter inserts, which are installed in front of device connectors, (2) filtered connectors, where the filter is contained in the device connector, and (3) filter / Transient Voltage Suppression (TVS) interface modules that are add-ons to an existing device.

Although filter inserts are generally considered the lower end of the spectrum in terms of cost and filtering limitations, they are a very practical solution for many applications.

“The filter insert is a quick and simple solution. It allows to you to simply pop a filter into your existing system and see if simple chip cap level of filtering will solve your EMI issues. If they solve the problem, it won’t cost you a lot,” explains Bob Ydens, President of EMI Solutions Inc. “We have customers who have used filter inserts successfully for 10-12 years. We have other customers who have used these filter inserts to identify the solution to the EMI problems, but then have in turn bought our filtered connectors with the same filtering solution”
The next tier in EMI Filtering is the filter connector, which is a more elegant, higher-performance approach to eliminating EMI/RFI noise. This solution is more expensive than the basic filter insert, but has the ability to include from chip capacitors, like what is in the Filter Inserts, to discoidals, ferrites, TVS components and Pi tubes including a broad range of configurations and mounting arrangements.

Filter modules are add-on components that are attached to an existing device or “box.” These modules can include any filter type, with or without transient voltage protection. Some of the advantages of using filter modules include more sophisticated filtration, avoidance of the need to insert additional PCB design integration into your already functioning fielded unit, and avoidance of the costly time it takes to re-layout and re-test the circuitry.

**Customized solutions**

Customized solutions – including design consulting, troubleshooting, device modification, and pre-certification testing – may be highly appropriate when it comes to choosing the appropriate filtering or product modifications.

Some EMI filtration companies provide design and re-engineering services to expedite any necessary product modifications and keep costs to a minimum. Pre-certification testing is performed in a chamber at their facility so that the customer can evaluate the impacts of changes and modification and achieve a greater confidence that the unit will pass when it goes to the certification test lab.

The pre-certification testing process at EMI Solutions is an iterative, or progressive, process whereby changes and modifications are made incrementally and then tested to determine the results. Additional filtering modifications are then applied until testing in their onsite chamber establishes a solution which meets the customer’s requirements. One of the principal benefits of this approach is that the test lab has the staff and filter technology available on site to implement these modifications very quickly, which is valuable in terms of the time and costs involved.
In some cases the device being tested requires upgrading or modifications simply because
the original design has been outmoded, or the end-user has specified a special application
or environment.

“We were having multiple EMI issues with units being tested in connection with two
government projects,” says John Eckland, Test & Integration Engineer at Curtiss
Wright Controls.

“One of the units is a complex, multi-purpose computer unit. The other one is a high-
capacity, high-throughput Ethernet switch unit. Both have military applications. We had
to switch power supplies on both systems, which caused us to have significant EMI
problems,” Eckland explains. “We were unable to do a redesign on the fly due to time
constrains. So, the only solutions available to us were either to do extensive internal
changes within both units, or to contact EMI Solutions and see if they could develop a
solution that required only limited changes within the units.”

In both cases, the solution required only a modification at the connector to the power
supply, where filter inserts were placed on the power connectors.

“Finding a consulting resource can save a lot of time and money, especially when you’re
in the developmental phase,” says Eckland. In this case, we were provided a very
effective answer to this problem that was done relatively quickly and affordably.”

In another consultant-based case, Gregory Ducote, Engineering Technician at Redstone
Army Arsenal, Alabama, had an EMI problem with a circuit board for a test set that is
used on a M3P 50-caliber machine gun that is attached to the Delta OH58 Kiowa
helicopter. Ducote called on EMI Solutions to find a way to redesign the board and
correct the problem.
“This redesigned test set helps technicians on the ground check the gun out before it is deployed,” explains Ducote. “The technicians will rebuild the gun here at Redstone and then use the test set to test the features of the gun to make sure it is working properly before they send it off. This test set will also help improve the features of the weapon. So, with the assistance of our consultants, we’re helping the soldiers that are still on the ground in Afghanistan or wherever this weapon is used. This will also help us sustain the weapon, and that is a major goal of the Army now – to sustain the equipment they already have.”