The Increasing Threat of Electromagnetic Interference

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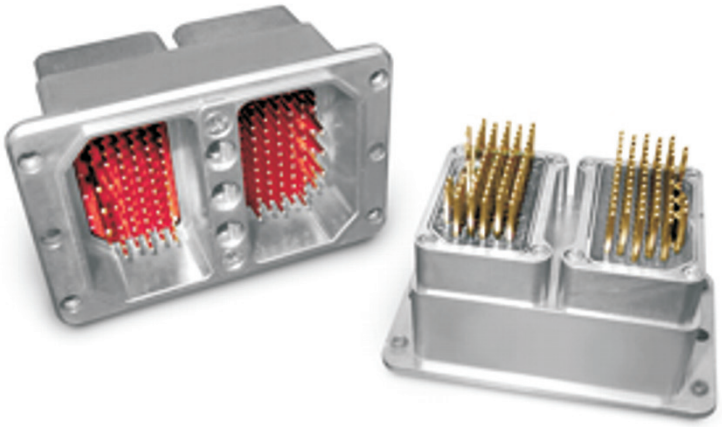
Electromagnetic interference (EMI), also called radio-frequency interference (RFI), is a disturbance generated by unwanted electrical signals. These unwanted signals can come from other electronic components or devices in the operating environment, or they may occur naturally, such as during lightning strikes. They can have harmful effects on equipment, reducing the performance of the equipment or even stopping it from functioning properly. EMI/RFI is a particular problem when it occurs in critical applications, including communication and military flight control systems, medical applications, and telecommunications.



Design engineers need a way to filter out the unwanted electrical signal, so it doesn't harm additional components. In order to protect modern electronic systems from the abundance of EMI sources in today's environments, a combination of approaches is implemented: shielding, filtering, and reduction of EMI at the source (if possible).

Design concepts for EMI filter connectors

Sophisticated filter connector technology addresses EMI/RFI filtering and transient protection to meet demanding high-intensity radiated field (HIRF) requirements. EMI filter connectors use multi-layer ceramic capacitor arrays together with inductive materials to realize robust, high-performance low-pass filter networks. Where required, protection can be provided against high energy transients from direct lightning strikes, standard EMP, high-altitude EMP (HEMP), non-nuclear EMP (NNEMP), and EMI.

Types of EMI filter capacitor technologies

Tubular capacitors

Tubular capacitors were the first to be incorporated into EMI filters. They still have a significant market share but are being phased out. The capacitor takes the form of a cylinder with axial leads. Downsides of tubular capacitors are that they are not available in higher capacitance values, they can fail quickly in extreme shock and vibration environments, and they cannot withstand higher voltages due to wall thickness.

Chip capacitors

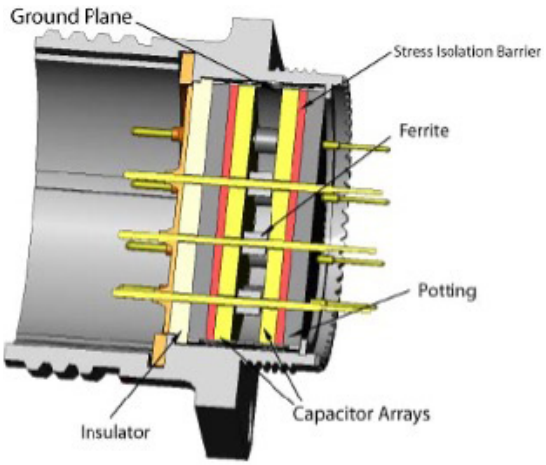
Chip capacitors are cost-effective and easy to source. They mount on the surface of the PCB and can be removed and replaced inexpensively to modify the capacitor value. Compared to tubular capacitors, chip capacitors have a much greater range of capacitance values and are less susceptible to shock and vibration. Their resonance frequency of 120 MHz may be problematic for some applications.

Planar capacitor array

The planar capacitor array is the best technology to use in high shock and vibration environments because it has the lowest failure rate. It offers no resonance frequency and can handle up to 1000 VDC working voltage. This capacitor is constructed out of a ceramic disk. The disk can contain different capacitor values for each pin, unfiltered (feed through) pins, and ground pins.

Advantages of EMI filter connectors

EMI filter connectors provide a plug-and-go solution. They are the most space-efficient way to package EMI/RFI and EMP transient protection. A single capacitor array can provide multiple capacitance values. The connector shell protects the capacitor array and diodes from environmental, mechanical, and thermal damage. Transient voltage suppressors integrated into the connector offer EMP transient protection to sensitive circuitry. Modular design techniques reduce the overall package size and improve maintainability. System weight is reduced by integrating the filters and diodes into the connector. Monolithic capacitor arrays are the most reliable method of EMI/RFI filtering. EMI filter connectors are tested and documented using automatic test equipment.



Transient protection using surface mount technology diodes

Transients are temporary spikes or surges in voltage that can impact components or circuits to the point of failure. Where required, transient suppression can be combined with EMI/RFI filtering to provide maximum protection. These solutions can be embedded within the filter connector shell by utilizing surface mount technology (SMT) diodes. The incorporation of SMT diodes offers space and weight savings to a varying degree, depending on connector application requirements.

Advantages of surface mount technology diodes

SMT diodes offer a significant reduction in board space and connector weight, low incremental surge resistance, fast response time (typically less than 1.0 ps) and low Zener diode impedance values. They have better thermal conductivity for high power dissipation requirements, increased flexibility in design limits, increased mean time between failures (MTBF) and improved shock and vibration resistance.

EMI/RFI and transients can have a significant impact on system performance and longevity. Reducing and removing their effects is a key component of system design. By incorporating signal conditioning into the interconnect solution, this can be done with multiple advantages, such as space and weight savings. In particular, planar capacitor arrays and SMT diodes are an innovative, robust, and high-performance way to tackle the challenges of EMI.

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