Maximizing EMI and Surge Protection in Medical and Aerospace Electronic Systems

As the aircraft industry strives for robust protection from lightning induced transients, EMI, ESD and voltage surge for its sophisticated state of the art electronic systems and medical equipment manufacturers look to eliminate the effects of EMI in imaging and diagnostic equipment, the role of interconnect device capabilities at providing this protection to internal systems becomes imperative. The interconnect system can serve as the gatekeeper into these costly systems that are highly susceptible to voltage spikes or electromagnetic interference.

While traditional methods of EMI and surge protection include mounting additional devices to the circuit board, such solutions are costly, less effective, and do not conform to the increasing space constraints of portable equipment. Protection is most effective when it is at the interface to the system, placed within the connector. In most of today's applications, protection includes capacitive filtering of the device to maximize the surge protection to the system.

Because of the labor-intensive and costly traditional methods of EMI and surge protection — such as physically attaching a device to the side of each contact within the connector and grounding it to the connector shell or attaching a pre-tested JANTX certified device with leads to the contact via circuit boards or other similar techniques, the other end being connected to the shell — connector

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manufacturers are developing new solutions for shielding and filtering inside the connectors themselves to protect signal integrity.

In aircraft applications, fragile ceramic planar array block capacitors are being replaced with state-of-the-art flexible circuits where individual chip capacitors are surface-mounted on a pad adjacent to the feed-through contact. Since the feed-through contacts are not soldered directly to the capacitor, stress points that are impacted by thermal shock and vibration have been virtually eliminated. The resulting design is a robust filter connector that meets 1000 cycles of thermal shock and provides superior mechanical performance and improved reliability. Such CoF (Chip-on-Flex) filter connectors provide standard filtering capabilities including individual isolated pin filtering of high-frequency noise, built-in ground plane barriers in the connector inserts, and filtering at the face of system boxes.

These filter connectors often utilize off-the-shelf chip capacitors that are mounted on flex circuits to provide the required filtering. TVSS (transient voltage surge suppression) protection can be accomplished utilizing the CoF technology by simply surface-mounting devices on one of the flex layers or adding a separate layer with the TVSS devices. A filter connector design with chip capacitors mounted on the flex circuit affords system designers a number of benefits as compared to traditional surge, EMI, and EMP methods of protecting the overall system, such as the need for far less PC board space, thus conforming to increased real estate constraints. The filter connector has a ground plane so it provides further protection by acting as a form of shielding – at the system or box level, if a ground plane isn’t present, there is an open window or opportunity

for electromagnetic interference; and in general, the system is much more robust than alternative electromagnetic solutions.

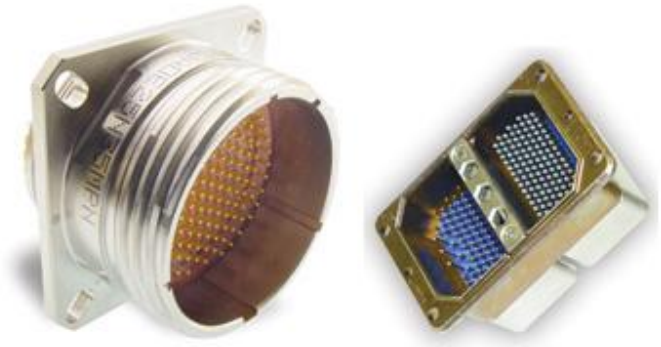

Image 1a & 1b: ITT's Chip-on-Flex filter connector provides EMI and surge protection in aircraft electronic systems.

Yet, the necessity of EMI and surge protection isn't limited to aircraft electronic systems. In medical equipment, including X-ray machines and ultrasound equipment, as well as implantable devices such as pacemakers, electromagnetic interference can distort images and signal noise can negatively affect the operation of equipment that must work flawlessly at all times. The same connector technologies used in military and aerospace applications for EMI/RFI requirements are critical for diagnostic equipment. As such, filter connectors play a critical role in managing and controlling the effects of EMI and RFI on system performance.

The filter-design approach described above with off-the-shelf chip capacitors and flexible circuits offers the system designer complete flexibility in defining or changing individual circuit capacitance, ground, and electro-magnetic interference, and pulse performance during the design and development phase. EMI is further reduced through the capacitance value of the connector. Connectors with capacitance values ranging to 50,000pF significantly reduce signal noise traveling through the device, thus directly affecting the performance of

the end unit.

Image 2: The Breakaway connector from ITT incorporates a spring probe/pin pad contact system.

Filtering effects can be further enhanced through an advanced contact system, such as the spring probe pin/pad design. The spring probe/pin pad contact system is comprised of the spring probe pin in the plug connector configuration and can be implemented across multiple sizes. Some manufacturers utilize an internal clip mechanism to ensure uninterrupted contact with the contact itself. This spring probe design helps reduce electrical resistance while addressing misalignment issues, making the contact system much more forgiving.

A spring probe system houses individual touch pad contact areas which enables an effective electrical engagement point of contact. Further, the individual touch pad contacts incorporate no crevices for contaminants to accumulate, which is critical for portable field use.

Superior EMI-suppression filter connectors, along with advanced contact systems such as the spring probe/pin pad design, offer robust solutions to the challenge of eliminating EMI and surge in high reliability medical and aerospace electronic equipment. With connector manufacturers introducing new designs, including filtering inside the connectors themselves and the use of off-the-shelf chip capacitors and flex circuits to protect signal integrity, system designers are provided with a much less costly, less labor-intensive, highly effective and more reliable solution to EMI and surge requirements than traditional methods previously available.

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