Why do you need an EMI Filter?

Electromagnetic compatibility (EMC) engineers use the concept of "noise" to describe the unwanted signals that degrade the performance of electronic equipment. In avionic applications, both external and internal sources of EMI noise can jam sensitive navigation and tactical equipment, possibly even disrupting control of the aircraft. An aircraft carrier's massive electronics bay might cause interference that scuttles a take-off or landing. EMI affecting satellite transmissions can cause communication failures on the battleground. For these reasons, EMI is considered a serious problem, and numerous technologies and techniques have been developed to insure electromagnetic compatibility (EMC) in data transmission systems—from shipboard to undersea, from avionics to space, from aircraft carriers to micro unmanned aerial vehicles.

Sources of EMI

Sources of EMI "noise" can be grouped into three categories: 1) Intrinsic noise that arises from random fluctuations within physical systems, such as thermal and shot noise, 2) Man-made noise from motors, switches, power supplies, digital electronics and radio transmitters, and 3) Noise from natural disturbances such as electro-static discharge (ESD), lightning and sunspots.

Intrinsic

Intrinsic noise sources can be very subtle and often go unrecognized. All electrical systems are potential sources of intrinsic noise, including such common devices as portable radios, MP3 players, cell phones and so on. These devices can cause interference simply by being on. This is because electrons within a conducting media or a semiconductor device create current flow when excited by external voltages. When the externally applied voltage stops, electrons continue to move, randomly interacting with other electrons and with the surrounding material. This random electron motion can create noise in conducting media even without current flow.

Man-made

To protect avionics systems from man-made noise, intentional radio frequency (RF) emitters like cell phones, Bluetooth accessories, CB radios, remote-controlled toys, and walkie-talkies are banned outright on commercial airline flights. Laptops, hand held scanners and game players, while not intentional emitters, can produce signals in the 1 MHz range that can affect performance of avionic equipment. Navigation cabling and other critical wiring runs along the fuselage with passengers sitting just a few feet away. Since the thin sheet of dielectric material that forms the interior of the passenger compartment— typically fiberglass—offers no shielding whatsoever; and since commercial passenger jets contain up to 150 miles of electrical wiring that can behave like a giant antenna, it is extremely important for passengers to heed regulations on the use of potentially disruptive electronic equipment.

Obviously, these internal sources of EMI are quite dangerous to aircraft because they are so close to the systems they might affect. But external sources, such as radio and radar transmitters on the ground, or radar from a passing military plane, cockpit avionics are susceptible to multiple sources of EMI including man-made interference from iPhones® and other PEDs can be even more disruptive due to the high power and frequency of such equipment. As if the many external and internal sources of EMI were not enough of a concern, the aluminum airframe itself, in certain circumstances, can act as a resonant cavity in the 1 to 10 MHz range. Behaving much like a satellite dish, the airframe can compound the effects of both internal and external EMI by concentrating man made and naturally-occurring transient signals and broadcasting the interference into nearby equipment. A recently released report from a major aircraft manufacturer illustrates the ongoing concern with passenger-carried portable electronic devices (PED). The number of these devices on commercial airplanes has mushroomed, particularly with the advents of new classes of laptop devices such as the Apple iPad. The use of PEDs produces uncontrolled electromagnetic emissions that have the potential to interfere with avionic systems. While aircraft avionics gear is tested and qualified to rigorous electromagnetic standards PEDs are not subjected to even a fraction of the same testing and qualification regimens for electromagnetic compatibility. As system speeds have increased, the voltage levels of data signals have necessarily decreased, making them much more susceptible to performance degradation by unwanted electronic noise—particularly the combined noise of large numbers of PED's operating within a single aircraft.

The frequency bands used by avionic systems span the electromagnetic spectrum from a few kilohertz to several gigahertz. At the low end, Omega Navigation, which is used to fix aircraft position within a network of ground based transmitters, operates in the frequency range of 10 to 14 KHz. VHF Omnidirectional Range Finders (VOR) are radio beacons used in point to point navigation. They operate from 108 to 118 MHz. Glideslope Systems used during landings operate in the 328 to 335 MHz range. Distance-Measuring Equipment (DME), which gauges the space between the aircraft and ground-based transponders operate at just over 1 GHz. Also in the spectrum above 1 GHz are global positioning, collision avoidance, and cockpit weather radar systems. Personal Electronic Devices (PEDs) operate at frequencies from 10 to 15 KHz for AM radios and up to 400 MHz for laptop computers. When the higher harmonics of these signals are taken into account, the emitted frequencies cover almost the entire range of navigation and communication frequencies used on the aircraft, and PEDs, are just a single class of EMI emitters. When the full spectrum of other radiated and conducted EMI emitters are taken into account, it becomes clear that the entire system of electronic equipment aboard commercial and military aircraft are at risk to EMI.

Naturally

Naturally occurring noise sources such as ESD, lightning or other energy surges also present significant life safety and equipment damage potential. A poorly grounded device can transmit dangerous energy from a transient surge to a technician, user or any other passerby. Sensitive semiconductors and other components can be damaged or destroyed. Solutions to naturally occurring noise include:

- Eliminate static buildup at the source
- Insulate the device properly
- Provide an alternative path for the discharge or surge to bypass the circuit
- Use of EMI Filters with Transient Suppression

In conclusion, it is becoming more and more apparent that EMI/EMC is a growing concern for both the military and commercial industries for all forms of electronic equipment. In response to the increasing demand for low-cost and effective EMI/EMC solutions, WEMS Electronics is here to solve your most challenging requirements and would welcome any opportunity to demonstrate our expertise on your new & upgrade program requirements.

Why use a Filter Connector or Insert?

Filters can be a planned addition to an electronic subsystem or, as frequently occurs, added after a problem has been discovered.

- Easiest and most cost effective permanent EMI/EMP solution – eliminate conducted EMI before it passes into the box
- Helps reduce volume inside the unit as well as conserve circuit board space
- Moves filtering away from sensitive board electronics
- Can easily replace existing non-filtered connectors in existing systems
- Mates with standard Mil-Spec connectors: MIL-DTL-38999, MIL-DTL-26482, MIL-DTL-83723, MIL-DTL-26500, AS50151, MIL-DTL-24308, MIL-DTL-83513, etc.
- Meets military standards and aerospace environmental requirements: EIA-364, MIL-STD-810, MIL-STD-461, DO-160, etc.