

SPECIAL ASPECTS OF AIRCRAFT WIRING SHIELDING

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Shielding is one of the most reliable and popular ways to avoid electromagnetic interference (EMI) exposure to wiring. This, of course, increases the reliability, but there is no need to use the shield on all wires of the aircraft, and it also has some disadvantages and extra costs. Therefore, with the aim of the correct choice of wire (shielded or not) electrical wire interconnection system (EWIS) designers need to conduct an appropriate analysis of the transmitted data, its frequency, power, etc.

It is known that EMI can be the reason for malfunctions of aircraft's equipment and in particular of avionics equipment. Lightning, solar flares, electrostatic discharge and high-intensity radiated fields (HIRF) from radars and various types of transmitters or communication equipment – all of these can be the reason for EMI on aircraft. Moreover, there are cases when EMI causes aviation accidents, so it is important to consider its influence in all aircraft design and certification.

Those wires and harnesses play one of the key roles in avionics. As they are quite vulnerable to EMI, many standards have been developed to describe methods for protecting aviation wires. Among such standards, we can mention MIL-STD-461, Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment. One of the main ways mentioned in these regulations is the use of shielded wires. Nevertheless, not every system needs to be shielded and the use of a shield must be reasonably and correctly analysed by designers of an EWIS.

As mentioned above, shielding is the main way to reduce EMI in cables. The signal or power wires are surrounded by it. From Figure 1 it is clear that the shield may not transmit noise inside the wire or may absorb it from the inside and conduct it to the ground. In both cases, the EMI does not reach the conductors. A small amount of energy still passes through the shield, but it no longer poses such a danger to the signals in the wires.

Conductivity, material thickness, frequency and amplitude of the electromagnetic field will affect the shielding efficiency. It is worth

mentioning that the shield has such disadvantages as weight, prone to corrosion and high rigidity.

There are several basic approaches to reduce or protect electromagnetic emission from a device and to its sensitivity. These options are: to shield the signal

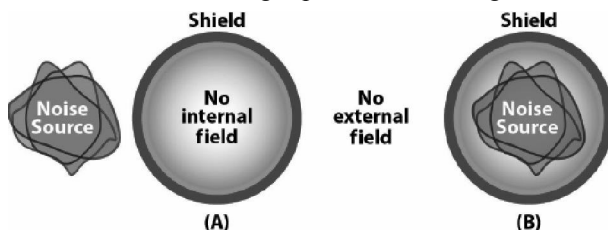


Fig.1. A - shielding noise from the outside; B - shielding noise from the inside

wires (Fig.1, A – when signal wires are sensitive to noise), to shield the power wires (Fig.1, B – when power wires are the source of noise) or to shield them both.

First of all, signal cables that send low voltage signals (usually less than 10 V) and have a high data rate are sensitive to the negative effects of EMI. Therefore, it is important to protect the integrity of the signals in these cables so that the transmitted data is more reliable.

Of particular importance is the question of whether the individual wires/pairs / twisted pairs inside the multi-conductor cable should be shielded. It depends on the data rate, because the higher the frequency, the more EMI they generate and the more they perceive EMI. Thus, the outer shield may be a common shield of the wire, and the inner shield in this case is selected to shield the frequencies that are likely to carry the inner wires.

Therefore, one of the pros is that in the case of shielding signal cables, the data of each system is protected from EMI. Besides, the advantages include the availability of different options for the desired shielded cable.

The next possible option is to protect the power wires. This method is considered to be simpler than the previous one, as the percentage of power wires on the aircraft is much lower than the percentage of signal wires.

Currently, systems that gain control equipment are often used. They have advantages in power and control. However, pulse-width modulation and energy generation with the frequency used in them are an additional source of EMI.

That is why shielding power wires will reduce EMI and noise in electronic equipment throughout the aircraft. Moreover, the shield itself can create additional protection for cables by weaving a shield.

Another option is to shield both types of wires, but it is worth remembering that the presence of the shield – is extra weight. This option, of course, significantly increases the reliability, but at the same time complicates the overall operation of the wires and the aircraft.

Therefore, we can conclude that in modern aircraft designs of shielding to protect the wiring from EMI is an important and difficult point. Properly analysed use of shielded wiring will ensure a balance of reliability at a high level and a minimum of additional shield weight.

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