

EME, EMI and EMC

- Part 1: Generalities -

*Berquó, Jolan Eduardo – Electronic Eng.
Certificador de Produto Aeroespacial (DCTA/IFI)
Representante Governamental da Garantia da Qualidade – (pelo DCTA/IFI)
jberquo@dcabr.org.br*

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The most common acronyms in the electromagnetic world of an aircraft are EME, EMI and EMC. The first two letters are the same in the three acronyms and come from the adjective “Electromagnetic”.

The acronym EME corresponds to the term Electromagnetic Environment, which designates the environment of electromagnetic energy inside the aircraft. This environment can be created by aircraft equipment or by external sources such as lightning, or transmitters installed in other aircraft or on the ground. The energy emitted by other aircraft or ground transmitters belongs to the group known as HIRF (High Intensity Radiated Fields).

Whatever the source, the big problem is that this spurious energy has the same nature as the energy processed by the equipment inside the aircraft. As such, this environment (EME) is a threat to the proper operation of systems which depend on these equipment. And the more severe is the failure condition due to the impact of such energy, the greater is the threat.

However, not all electromagnetic energy present inside or outside the aircraft (but interacting with it) is spurious, i.e., interferes on the normal operation of equipment. When this interference occurs, it is particularly called Electromagnetic Interference, the “popular” EMI.

EMI is then a kind of environmental pollution, more specifically an electrical or electromagnetic pollution.

There are many sources of EMI, from a simple electric shaver, which produces noise for example into a television, to radio frequency transmitters that can induce interference into a pacemaker, and could even lead to the death of

its host, or into a flight control computer of an aircraft, causing it to produce unwanted commands that could cause a catastrophic accident.

Examples of sources of EMI: radio transmitters (broadcast, communications, navigation and radar), receivers, oscillators, motors, transients produced by switching, fluorescent lamps, engine ignition and relays, electric heaters, computers and peripherals, electrostatic discharge, electrical alternating fields (400 Hz), and natural sources: lightning and galactic noise.

But the EMI sources of most concern, i.e., that can cause serious problems in the operation of the equipment of an aircraft, are the electromagnetic wave transmitters of high intensity and the atmospheric electrical discharge, known as “lightning”. These high intensity fields form the group called High Intensity Radiated Fields (High Intensity Radiated Fields), better known by its initials HIRF. Just in the United States and Western Europe there are over 500,000 sources contributing to the EME.

The acronym EMC, in turn, corresponds to the term “electromagnetic compatibility” (EMC). EMC refers to the skill or ability of an equipment or system of being compatible with the environment where it is installed, operating without interfering in the operation of other equipment and without suffering interference of those equipment.

Both in the civilian and military applications, equipment must pass several environmental tests. For civil applications, equipment must undergo a battery of these tests, defined according to the category assigned to them, including those from EMI, for their TSO

(Technical Standard Order) approval. These tests are prescribed in the RTCA DO-160 document.

For military applications, the most important documents aimed at EMI/EMC are those so-called "460 Family of Standards". They are: MIL-STD-461, which establishes the requirements that avionics equipment must meet regarding EMI; MIL-STD-462, which gives the techniques of the laboratory tests to verify compliance with the requirements of 461; MIL-STD-463, which provides the definition of various terms used in EMI/EMC, and MIL-STD-464 (formerly 6051), which just refers to EMC.

EMI tests are performed in laboratories¹, using the so-called shielded anechoic chambers, while EMC tests are performed, almost entirely, on the aircraft where the equipment operate, since it is exactly the environment that we are interested in when checking the electromagnetic compatibility among these devices.

References:

- (1) Ferrara, John M. Avionics: A Practical User's and Buyer's Guide to Avionics - Volume 1. USA: Air and Space Co., 1989. 275p.*
- (2) Spitzer, Cary R. Digital Avionics Systems: Principles and Practice. 2. Ed New York (USA): McGraw-Hill, 1993. 277p.*
- (3) FEDERAL AVIATION ADMINISTRATION: High-Intensity Radiated Fields (HIRF) Risk Analysis. NTSL, Virginia (USA), 1999.*

¹ An example of EMI testing laboratory in Brazil is the LIT ("Laboratório de Integração e Testes" or in English: Testing and Integration Laboratory), installed at INPE ("Instituto Nacional de Pesquisas Espaciais" or in English something like National Institute for Space Research), located in Sao Jose dos Campos (SP).