Improve Your Knowledgment

EME, EMI E EMC

- Part 2: **HIRF** -

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

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In the flash MSC 01, we said that the EMI sources that most concern, ie those that can cause serious problems in the operation of aircraft equipment and so in the safety of the aircraft, are the transmitters of HIRF (High Intensity Radiated Fields) and the atmospheric electrical discharge, more known by the term Lightning. But this MSC will treat only of HIRF. The next MSC about the electromagnetic theme will treat of Lightning.

Like Lightning, HIRF is an external aggression. But there are also internal aggressions, such as that produced by 400HZ power supplies and the aggressions resulting from transients from turns the on-board equipment on and off.

Minimizing the problem of interference from sources in the interior of the aircraft, although it is not so simple, it is much easier that circumvent the electromagnetic interference from HIRF, simply because we do not have any action on such sources.

In terms of power of HIRF transmitters, we can have low power sources, such as the 3W of a Walkie Talkie, up to 10 MW peak powers of radar.

On the other hand, the frequency spectrum of these equipment goes from 60 Hz (transmission lines) to some tens of GHz (radars).

There are reception services operating in frequencies ranges that overlap to the ranges of others transmission services or in frequencies which are harmonics of these transmission frequencies. Anyway, it's a mess of electromagnetic waves traveling in the space in which we live that may or may not bring dangers, especially when our lives depend on equipment susceptible to this attack.

The miniaturization of digital electronic devices has allowed a great technological advance, but the bias electrical voltages[1] on these devices, operating on active circuits can be as low as two volts. This fact raises the concern with HIRF, which can easily produce inductions higher than two volts in these circuits and with sufficient duration to change the state of an active digital electronic circuit, such as flight control computers, which could lead them to behave on an undesirable way.

Another technological advance has appeared in the area of material, making arise lightweight materials, such as the well-known composite material, reducing the weight of the airframe. Unfortunately, this material is simply hollow to electromagnetic radiation.

A feature very used to minimize the effects of HIRF is the shielding, technique that consists in engage the cables within an aircraft with a continuous malleable metal cover, connected in its extremes to points of the metallic structure of the aircraft (null reference voltage).

The technique of shielding can also be very useful to prevent conductor cables of electrical and electronic systems become a path of discharges from materials with electrostatic charge, culminating in an inadvertent operation of critical devices. The human being itself can be a dangerous source of electrostatic charge (just see those people who feel a shock when they touch a conductive material). It is perfectly known that the human body can reach a electrical static load of 50,000V (Ref. (4)).

[1] DC voltages that enable semiconductor devices to perform active functions like amplification, modulation and others.

But the metallic shielding can be with their finished days. Recently, scientists from University of Virginia, United States, have created a plastic conductor of electricity, which works just as well as the metals for shielding against electromagnetic interference, with the advantage of being lighter.

The new material combines the best feature of the metals, ie excellent electrical conductivity, has a good thermal conductivity, is malleable, has the lightness of the plastic, is corrosion-free and is cheaper than the structures of metallic shielding. The component that gives the electrical conductivity of this material are called carbon nanotubes, which curiously only participate with a composition of one or two percent.

The HIRF spectrum that couples with aircraft wiring and electrical systems-electronics can be summarized in three basic ranges:

- ***Frequencies below 1 MHz*** *– the coupling induced is inefficient, not causing concerns;*
- ***Frequencies between 1 and 400 MHz*** *– the coupling induced is worrying because the wiring begins to act as a receiving antenna.*
- ***Frequencies above 400 MHz*** *- the incident energy can be coupled directly with the equipment, through their openings and joints, as well as with the cables connected to them with dimensions equal to or greater than one quarter of the wavelength of the incident radiation.*

References:

(1) SPITZER, Cary R. Digital Avionics Systems: Principles and Practice. 2. Ed. New York (USA): McGraw-Hill, 1993. 277p.

(2) FEDERAL AVIATION ADMINISTRATION: High-Intensity Radiated Fields (HIRF) Risk Analysis. NTSI, Virginia (USA), 1999.

(3) DUFF, William G. Fundamentals of Electromagnetic Compatibility. Vol. 1. Interference Control Technologies, Inc. Virginia (USA), 1988.

(4) DEPARTMENT OF DEFENSE OF THE UNITED STATES OF AMERICA (USA DOD), System Engineering Design Guide for Army Materiel (MIL-HDBK-764(MI)). Washington (USA), 1990, p. 10-98.

See Part 3 soon, which will focus on Lightning.