RTCA DO-160C: A General Overview

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INTRODUCTION

On December 4, 1989 the Radio Technical Commission for Aeronautics (RTCA) introduced DO-160C. The specification, more stringent than a previous DO-160B version, is intended "to provide a laboratory means of determining the performance characteristics of airborne equipment in environmental conditions representative of those which may be encountered in airborne operation of the equipment." The modifications to the specification were deemed necessary to ensure the operational integrity of all critical systems on today's modern equipment.

Only minor procedural changes were made to Sections 16 thru 19 of DO-160C. This article will concentrate on Sections 20 through 22 since these sections were revised in terms of both procedure and levels. In all of the testing, the Equipment Under Test (EUT) should be set up and operating as close as possible to the final operating configuration aboard the aircraft.

SECTION 20 - RF SUSCEPTIBILITY

The purpose of these tests is to determine if the EUT will operate correctly when its cable bundles are exposed to inductively coupled RF signals (conducted susceptibility) or to radiated RF fields (radiated susceptibility).

The first procedure requires the cable bundles of the EUT to be subjected to RF signals in the frequency range 10 kHz to 400 MHz. The RF signal levels used in this section are based on experimental data that showed the induced current on a cable immersed in an electric field. The electric field strengths were updated to a maximum of 200 volts/m, which is currently the most severe threat level agreed upon by commercial and government organizations. Figure 1 details the conducted susceptibility test levels.

The new DO-160C specification will ensure the operational integrity of all critical systems on today's modern equipment.

The conducted susceptibility test procedure requires calibration of the injection probe for each category. The calibration curve indicates the amount of forward power required to generate the required current, shown in Figure 1, into a 50-ohm impedance calibration circuit. The calibration curve is then used in conjunction with the maximum induced cable bundle current allowed for the category. The maximum induced cable current shall not exceed 1 amp for the 200 V/m Category Y; 500 mA for the 100 V/m Category W; 250 mA for the 50 V/m Category V; 100 mA for the 20 V/m Category U; and 25 mA for the 5 V/m Category T, when injected with the forward power necessary to produce the levels given in Figure 1.

The conducted susceptibility test is performed by slowly scanning the frequency range from 10 kHz to 400 MHz at the forward power amplitude and monitoring the induced cable bundle current to ensure that the maximum current level or the forward power level is not exceeded.

The second test procedure re-

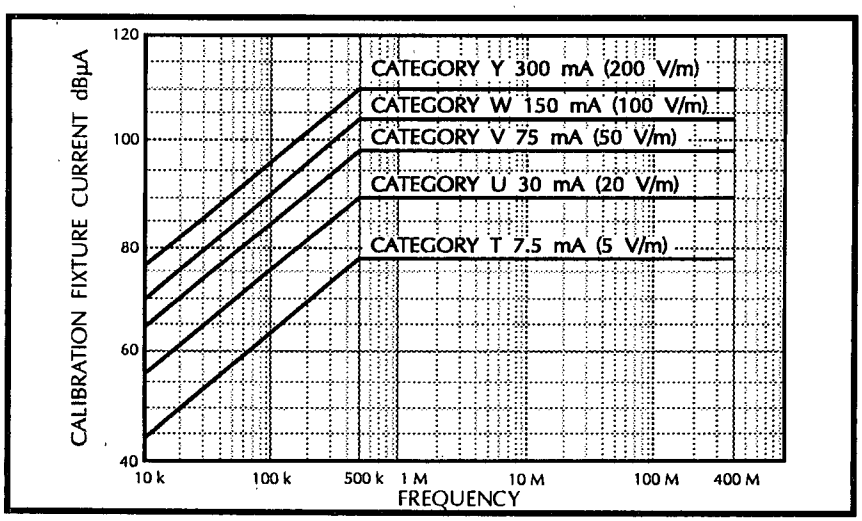

FIGURE 1. *Conducted Susceptibility Test Levels.*

quires the EUT to be subjected to antenna-generated RF fields, in the frequency range from 30 MHz to a maximum of 18 GHz, with a maximum field strength of 200 V/m. This is a major change from DO-160B, which required a maximum field strength of 126 dBμV/m, which corresponds to 2 V/m in a frequency range from 118 MHz to 136 MHz and 1 V/m over the rest of the frequency range up to 1.215 GHz.

The test procedure is now similar to the procedure required by MIL-STD-461C. An antenna is used to produce the electric field required, and an electric field sensor is placed near the EUT and its cable bundle. The frequency range is slowly scanned while monitoring the field sensors to ensure that the required field strength is being reached at all frequencies.

SECTION 21 - EMISSION OF RF ENERGY

The purpose of these tests is to ensure that the EUT does not emit undesired RF noise, neither conducted nor radiated. The conducted emission test procedure requires data to be collected for both narrowband (dBμA) and broadband (dBμA/MHz) interference signals. The measurements shall be taken in the frequency range from 15 kHz to 30 MHz using a clamp or current probe, line impedance stabilization network (LISN) and an interference measuring device. Because the impedance of the power to test laboratories vary, LISNs are used so test results have repeatability from one test laboratory to another.

The conducted emission limits are grouped into Categories A and Z or Category B equipment, then into narrow and broadband limits, and finally into power lines and interconnecting cables, with the limits for power lines being the more stringent of the two limits. See Figure 2 for the narrowband limit for Categories A and Z.

The radiated emission limit covers the frequency range from 15 kHz to 1.215 GHz with both narrowband and broadband measurements being taken in this range. The RTCA recommends three antennas to cover this frequency range: a rod antenna from 15 kHz to 25 MHz; a dipole antenna from 25 MHz to 1000 MHz; and a horn antenna from 1 GHz to 1.215 GHz. The limit is again classified into Categories A and Z or Category B and then narrowband and broadband limit.

SECTION 22 - LIGHTNING INDUCED TRANSIENTS SUSCEPTIBILITY

The purpose of this section is to determine whether an EUT is able to withstand the induced effects of a lightning strike. The EUT must withstand four waveforms. The first is the long wave test, then the short wave, and finally damped sinusoidal waveforms with frequencies of 1.0 and 10.0 MHz. The short wave and damped sinusoidal waveforms (both 1 and 10 MHz) are induced onto the cable bundles of the EUT. The long wave and the high short circuit current levels of Category M are difficult to induce on the cables of the EUT. Therefore, the direct injection method is used to perform this test.

The levels of these waveforms are determined by the EUT category, which is based on the placement of the EUT and its interconnecting cables on the aircraft. The levels for the long and short wave vary from 125 volts open circuit and 25 amps short circuit for Category J, to 1600 volts open circuit and 320 amps short circuit for Category M (the most stringent category). For the damped sinusoidal waveform, the levels vary from 250 volts open circuit and 10 amps short circuit for Category J, to 3200 volts open circuit and 128 amps short circuit for Category M.

CONCLUSION

In DO-160C, the RTCA has developed a specification that is more comprehensive than DO-160B. Manufacturers of aircraft subsystems are now required to test to levels that are closer to the actual environment that might be encountered by the modern aircraft.

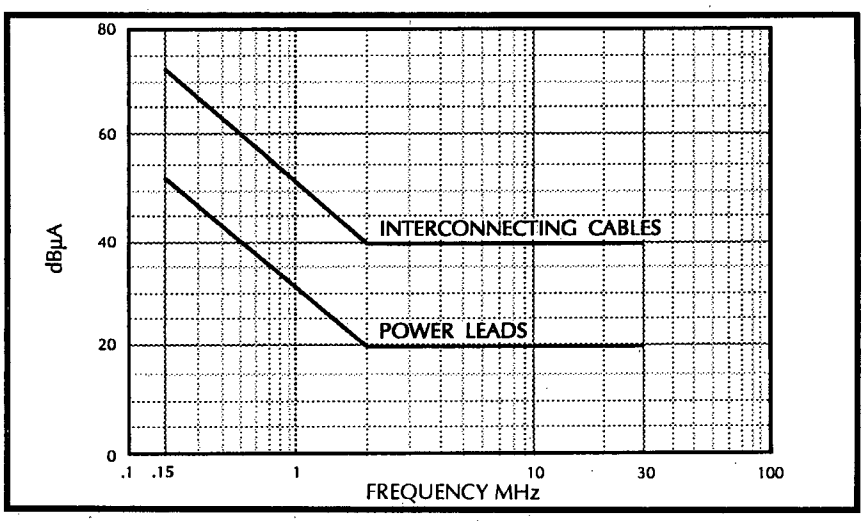

FIGURE 2. *Conducted Emission Test Levels for Categories A and Z.*

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