REVIEW ARTICLE

Implementation and automation of the electromagnetic compatibility measurement laboratory to provide services to Aeronautical Command Research Institutes and companies in the aerospace sector

Implementación y automatización del laboratorio de medición de compatibilidad electromagnética para prestar servicios a los Institutos de Investigación de Comando Aeronáutico y a las empresas del sector aeroespacial

Implantação e automatização do laboratório de medições de compatibilidade eletromagnética para prestação de serviços aos Institutos de Pesquisa do Comando da Aeronáutica e empresas do setor aeroespacial

Sérgio Baptista de Oliveira [I]
Carlos do Nascimento Santos [II]

ABSTRACT

This article aims to present the technical tests of electromagnetic compatibility (EMC) in some equipment, minimizing the electromagnetic interference (EMI) in its normal operation for which it was designed, performed in a military laboratory, at a development level, according to the international technical standards. This laboratory, which is innovative for the Aeronautical Command in this type of service provision, was implemented and is in the automation phase. Specific software was developed and has been used to sweep the execution of the frequency range that is repetitive during the process of certain types of testing required by the standard. This laboratory was created to serve mainly space projects and military aviation systems of the Air Force Command, but this service can be extended to other military aerospace institutions, such as research institutes, and can even attend development projects in the civil aerospace field. To demonstrate the technical capacity of this innovative and recently implemented laboratory to provide this type of service at EMC, at a development level and with future expectations for accreditation by INMETRO, some tests were carried out in a military space design system of aeronautics, following all levels and standards established according to a specific international military technical standard.

Keywords: EMC. EMI. Technical standards. Test laboratory. Development.

RESUMEN

Este artículo tiene como objetivo presentar las pruebas técnicas de compatibilidad electromagnética (EMC) en un equipo, minimizando la interferencia electromagnética (EMI) en su funcionamiento normal para el que fue diseñado, realizadas en un laboratorio en el área militar, a nivel de desarrollo, de acuerdo con normas técnicas estandarizadas internacionalmente. Este laboratorio, que es innovador para el Comando de la Fuerza Aérea en este tipo de prestación de servicios, se implementó y está siendo automatizado con el uso de un software específico, desarrollado para escanear la ejecución del rango de frecuencia que es repetitivo durante el proceso de ciertos tipos de pruebas requeridas por la norma. Este laboratorio fue creado para servir principalmente proyectos espaciales y sistemas de aviación militar del Comando de la Fuerza

I. Department of Aerospace Science and Technology (DCTA) – São José dos Campos/SP – Brazil. Major Weapons Specialist of the Brazilian Air Force(FAB). Email: sergiosbo@ifi.cta.br

II. Department of Aerospace Science and Technology (DCTA) – São José dos Campos/SP – Brazil. Doctor Degree in Mechanical Engineering in the Area of Materials by Universidade Estadual Paulista (UNESP). Email: nascimentocns@ifi.cta.br

Received: 11/21/18 Accepted: 07/24/19

Aérea, pero este servicio puede extenderse a otras instituciones aeroespaciales militares, de institutos de investigación, e incluso puede asistir a proyectos de desarrollo en el área aeroespacial civil. Para demostrar la capacidad técnica de este laboratorio innovador e implementado para proporcionar este tipo de servicio en EMC, a nivel de desarrollo y con expectativas futuras para la acreditación por INMETRO, se realizaron pruebas en un sistema de diseño de espacio militar de aeronáutica que sigue todos los niveles y estándares establecido en una norma técnica militar internacional específica, requerida.

Palabras clave: *EMC. EMI. Normas técnicas. Laboratorio de pruebas. Desarrollo.*

RESUMO

O presente artigo tem como objetivo apresentar os ensaios técnicos de compatibilidade eletromagnética (EMC) em um equipamento, minimizando a interferência eletromagnética (EMI) em seu funcionamento normal para o qual foi projetado, executados em laboratório em área militar, em nível de desenvolvimento, segundo normas técnicas padronizadas internacionalmente. Esse laboratório, que é inovador para o Comando da Aeronáutica nesse tipo de prestação de serviços, foi implantado e está em fase de automatização com a utilização de softwares específicos, desenvolvidos para varrer-se a execução da faixa de frequência que é repetitiva durante o processo de determinados tipos de ensaio exigidos pela norma. Esse laboratório foi criado para atender principalmente sistemas de projetos espaciais e da aviação militar do Comando da Aeronáutica, mas esse serviço pode ser estendido a outras instituições militares aeroespaciais, de institutos de pesquisa, podendo inclusive atender projetos de desenvolvimento na área aeroespacial civil. Para demonstrar a capacidade técnica desse laboratório inovador e implantado para prestar esse tipo de serviço em EMC, em nível de desenvolvimento e com expectativas futuras de acreditação pelo INMETRO, foram executados ensaios em um sistema de projeto espacial militar da aeronáutica seguindo todos os níveis e padrões estabelecidos em norma técnica internacional militar específica, exigida.

Palavras-chave: *EMC. EMI. Normas técnicas. Laboratório de ensaios. Desenvolvimento.*

1 INTRODUCTION

All systems with electrical and electronic equipment are susceptible to certain levels of electromagnetic interference noise (EMI) or are also potential generators, so that they may or may not affect their normal operation to which they have been designed. These interferences may be at driven emissions level (EC) or by conducted susceptibilities (CS), at their wiring or at these wire cabling. These signals may also come from the indirect effect of the impact of atmospheric rays on aircraft or on power transmission lines.

Interference stemming from irradiated emissions (RE) or by irradiated susceptibilities (RS) comes from its electronic circuit, or by radio frequency (RF) in all types of telecommunications. Close to airport areas, weather stations, rocket launch, there are radar signals, navigation, communication and telemetry that interfere as high intensity irradiated electromagnetic fields (HIRF).

The electromagnetic environment in which this system is inserted should be analyzed in terms of its electromagnetic compatibility, that is, this system should work properly with no interference and without interfering as a generating source of EMI and other equipment in the area. Depending on how and where it will be used, whether in a military or civilian area the equipment will be developed and certified in laboratories accredited with qualified personnel, where accepted technical standards are applied. In some applications, harmonized standards, developed by international technical committees that meet regularly, studying and promoting updates, are also employed.

World governments have certifying agencies that oversee the production and sale of these different equipment. One of the great effects of the electronic interference in the military area is in the well-known electronic warfare in which actions are involved to prevent or reduce the effective use of the enemy's electromagnetic spectrum, as well as to destroy, neutralize or degrade its combat capability, using electromagnetic energy or weapons that uses the target intentional emission for its equipment guidance, whether on land, sea or air. These electronic attack measures generally include navigation systems, data network communication, voice, links and also by surveillance radar systems, acquisition and (or) monitoring or shooting, and infrared and visual optical systems. Such equipment is designed and must be shielded and not susceptible to these levels of harmful electromagnetic interference signals.

Within the civil area in aviation, maritime, automotive industry or the electronics industry for the different applications, electromagnetic compatibility tests are also necessary and equivalent, but armored levels to these undesirable electromagnetic signals are not so rigorous and high, which would make the final product more expensive. Therefore, specific standards and their accuracy for each area of application are necessary.

During certain types of tests, there are frequency ranges that are swept, step by step, making the process repetitive, which is often tiring and time consuming for the specialist. That was one of the reasons for developing specific automation software due to the assembly with the test equipment and the repetition of the process.

In this article we aim to present the electromagnetic compatibility tests performed in aerospace equipment, with defense technology, in an implemented laboratory, in the automation phase to meet the needs of the Aeronautics Command.

2 BIBLIOGRAPHIC REVIEW

In this article the main applicability will be for the military field of the air force and aerospace and the main technical standard will be the military standard MIL - STD-461, Revision G.

In electromagnetic compatibility tests, according to the main military or civilian technical standards are divided into conducted emissions (EC), or conducted susceptibilities (CS), or irradiated emissions (RE), or irradiated susceptibilities (RS). In these types of tests, Line Impedance Stabilization Network (LISN) is used as one of the power supply line functions in alternating or continuous electric current of the equipment under testing (ESE) to ensure that there is no interference in these signals.

2.1 Conducted emission test CE102

This test is used to verify the noisy conducted electromagnetic emissions that arise through the electrical power supply cables of the equipment under test (ESE). According to MIL-STD-46 the frequency range specified for the assay is 10 kHz to 10 MHz. It should include return cables and those that are sources of other equipment and were not part of the ESE, but have influence on it.

Established and adjusted by the standards, the acceptable limits of interference that the ESE equipment must withstand, the laboratory test setup is set up and ESE operation is constantly monitored in order to assess whether it will work properly within the specified frequency range and limits.

2.2 Susceptibility-driven essay CS101

According to MIL-STD-461 the frequency range specified for the test is 30 Hz to 150 kHz. This test is used to verify ESE capacity to withstand noisy signals coupled to low-frequency power supply cables. It is applicable to alternating current equipment and subsystems, limited to electric current less lower than or equal to 30 amperes per phase and direct current input feed conductors, not including returns.

If the ESE is operated with direct current (DC), or alternated current (AC), this assay is normally applicable over the range of 30 Hz to 150 kHz. If the ESE is operated with alternating current, this assay is applicable from the second harmonic of the ESE power frequency extending up to 150 kHz.

Established by the standard of the acceptable limits of interference noise that the ESE equipment must withstand, the laboratory test setup is set up and this signal is applied to the ESE, which is constantly monitored, to assess whether it will work properly within the specific frequency range.

2.3 Susceptibility-driven essay CS114

According to MIL-STD-461, the frequency range specified for the test is 10 kHz to 200 MHz. This test procedure is used to verify ESE capacity to withstand noisy signals, coupled to the interconnection and power supply cables of this equipment in this range frequency.

Established by the standard, the acceptable limits of interference noise that ESE equipment must withstand, the laboratory test setup is set up and this signal is applied to ESE, which is constantly monitored to assess whether it will work properly within the specified frequency range.

2.4 Susceptibility-driven essay CS115

In this assay noisy pulsed signals are injected into the power cables or ESE data signals. This test procedure is used to verify ESE capacity to withstand impulse of these noisy signals coupled to power supply cables of energy, data, or grounded systems of the interconnection cables. The pulse level used for the test is specified according to MIL-STD-461.

Once this level is established, the laboratory test setup is set up and this signal is applied to ESE, which is constantly monitored to assess whether it will work properly.

2.5 Susceptibility-driven essay CS116

In this assay, according to MIL-STD-461, it is worked the injection of a noisy signal of sine transient pulsed current dampened in the frequency range from 10 kHz to 100 MHz. This signal is injected into the power supply cables or in ESE data signals.

Established by the standard this level of signal, the assay is set up in laboratory and this signal is applied to ESE, which is monitored all the time, to check its capability of withstanding signals coupled to the power supply cables of energy, data or grounded systems of the interconnection cables, that is, ESE should work properly in the presence of these transient pulses of signals within the specified frequency range.

2.6 Irradiated emission assay RE102

This test, according to MIL- STD-461, is used to verify the irradiated emissions of electric fields from ESE, as well as its subsystems and associated wiring that may interfere with other equipment installed in this space.

This assay is performed in an anechoic chamber and normally applicable over the frequency range from 10 kHz to 18 GHz. Above 30 MHz the vertical and horizontal polarizations of the antennas are applied. Depending on the frequency range, an antenna with its own characteristics should be used. They are known as the ROD antenna, to sweep the 9 kHz to 30 MHz range, BICONILOG antenna, to sweep the range from 26 MHz to 6 GHz, and DOUBLE RIDGE HORN antenna, to sweep the range from 750 MHz to 18 GHz.

The antennas are positioned one meter away from ESE and at a height of 1.20 m from the ground, according to the standard. The intensity of the electric field radiated by the ESE is monitored in the specified frequency range and its limit is compared to the one which is specified by the standard. The result of this monitoring is represented in a graph with the measured and irradiated limits of ESE and the one specified by the standard.

2.7 Irradiated emission assay RS103

This assay, according to MIL-STD-461, is used to check ESE capacity to withstand radiated emissions of electric field interference on it, as well as its subsystems and associated wiring coming from other equipment installed in this neighborhood, or from other sources in this environment.

This assay can be performed in anechoic or reverberation chamber. The electric field intensity is 20 Volts per meter for space projects and 200 Volts per meter for military aviation, according to the standard. This requirement is normally applicable over the frequency range from 10 kHz to 18 GHz. Above 30 MHz the vertical and horizontal polarizations of the antennas are applied.

This test is similar to RE102 only that now the ESE, its wiring and subsystems are being irradiated by the electric field emitted by the antennas. Depending on the frequency range, an antenna with its own characteristics should be used. They are known as ROD antenna, to sweep the range from 9 kHz to 30 MHz, BICONILOG antenna, to sweep the range from 26 MHz to 6 GHz, and DOUBLE RIDGE HORN antenna, to sweep the range from 750 MHz to 18 GHz.

The antennas are positioned one meter away from ESE, or its wirings, and at a height of 1.20 m from the ground, according to the standard.

The limit for electric field intensity is adjusted to the standard for applicability in air force or aerospace projects. During the test, an electric field sensor is constantly positioned as close as possible to ESE, its wirings and subsystems to check the intensity of the radiated electric field on this setup. The assay, according to its complexity, can be repeated several times, in which the positions of the sensor and antennas are varied to sweep all the critical points of this assembly system, as specified in standard.

3 METHODOLOGY

The main objective of this technical methodology is to demonstrate the laboratory capacity to perform this type of EMC assay, with prospects for extending this service provision, at the development level, but with future expectations of accreditation.

To demonstrate the EMC compatibility tests in this DCTA/IFI laboratory, a certain system that composes an aerospace vehicle of the DCTA/IAE was used, preserving some technical details due to the secrecy of the military technology involved, as well as the assembly to rehearse it.

This system has one or more ESE appliances, composed of its wiring, cabling, connectors and subsystems. Both the configuration of the layout of this system and the equipment for the test and the assembly table are standards that follow the rule. The EMC test table used in the laboratory follows standard according to MIL-STD-461, with copper sheet earth plan and grounding connections in external laboratory earth mesh designed for this purpose. The non-conductive part used under the conductive table is an insulating styrofoam plate. The test laboratory equipment represented in the figures and used in each type of test are broken down and/or represented by letters A, B, C, D, E, F, or G. The others, non-discriminated are only part of the test bench, should be used according to the type of test.

ESE system is normally operated by the designer, during laboratory testing, as if it were operating under normal conditions in his space vehicle, so that he can analyze its normal operability within these EMI limits acceptable by the standard. The standards and the equipment which are used in the laboratory, are constantly being updated.

Technical documents of internal procedures for the execution of these types of tests are kept in the DCTA/IFI Laboratory which strictly follow what is determined by the standard, specify the adjustment phases of the equipment and test ESE system and its wiring, which are constantly evaluated and, if necessary, a new revision is issued. The result data presented by the laboratory, depending on the type of test, can be provided in graphs or tables, but only the designer can declare whether or not the system worked properly.

3.1 Conducted emission assay CE102

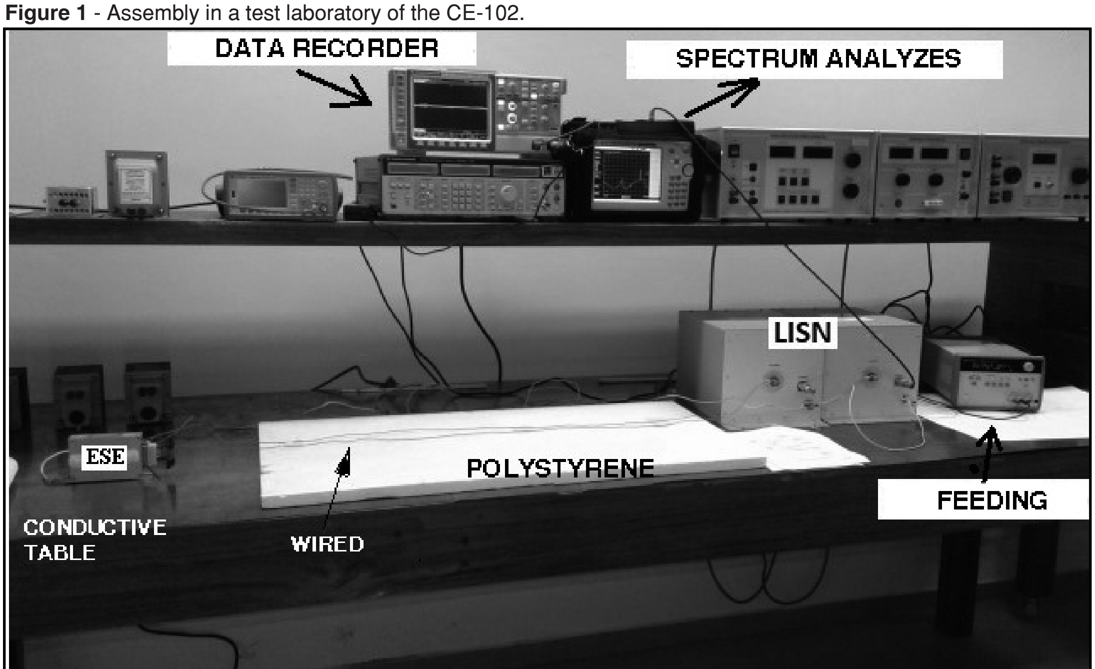
For this type of test, the first phase is called calibration, according to the standard in which only the equipment checking and adjustment is made, without ESE, according to the levels specified in this standard by sweeping the frequency range from 10 kHz to 10 MHz. The second phase, in which the equipment is already adjusted and using ESE, is the test whereby this type of emission is observed. The representative assembly for this laboratory test is described in Figure 1 and the equipment used in the test is described.

This test verified the electromagnetic emission signals conducted by means of ESE power supply cables, that is, it evaluated the signal that interferes with this equipment in relation to the limit acceptable by the standard and that was adjusted in the first phase. It also included return cables and the ones that are sources of other equipment that are not part of ESE, but should be influence it. ESE, LISN and equipment are arranged in the conductive part of the test table. The wiring is under insulating material in this case, styrofoam.

Figure 2 shows the measured result of the noisy signal level (signal amplitude in microvolt decibels - dBuV) in ESE, compared to the limit established by the standard in the specified frequency range.

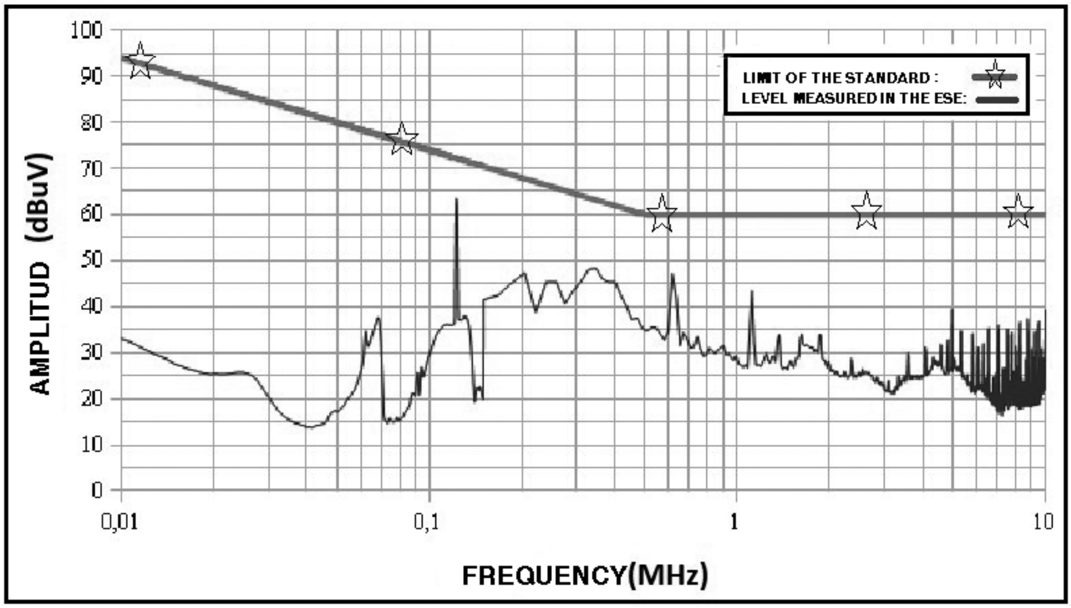
The distances of wiring, equipment and ESE system, in general follow the standards of the rule, but are not indicated in the assembly of Figure 1.

Figure 1 - Assembly in a test laboratory of the CE-102.



Source: Electromagnetic testing laboratory DCTA/IFI/CMA.

Figure 2 - Result model obtained from the emission test conducted on the ESE.

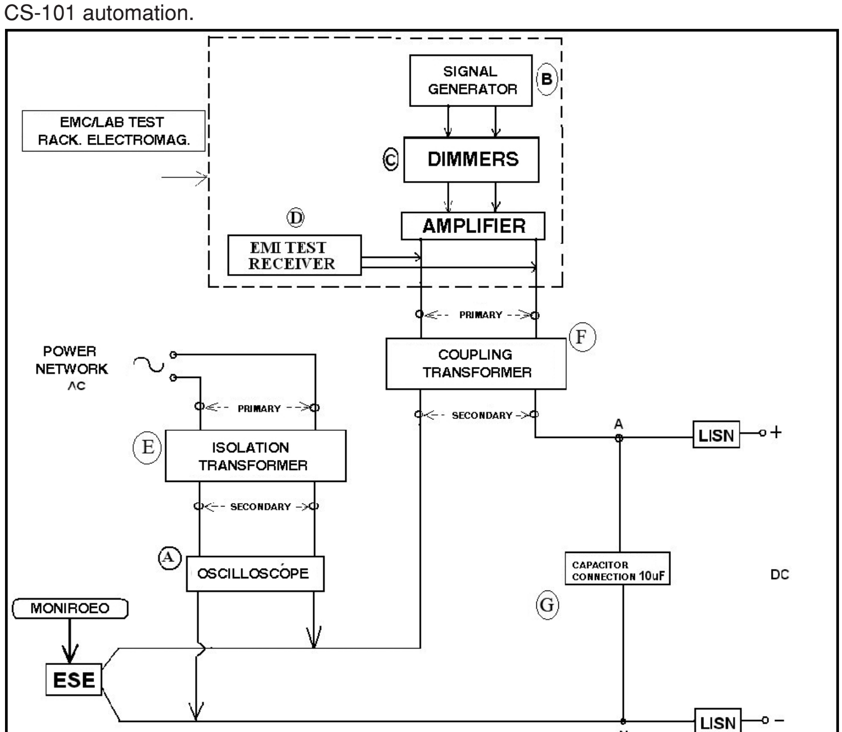


Source: Electromagnetic testing laboratory DCTA/IFI/CMA.

3.2 Susceptibility-driven assay CS101

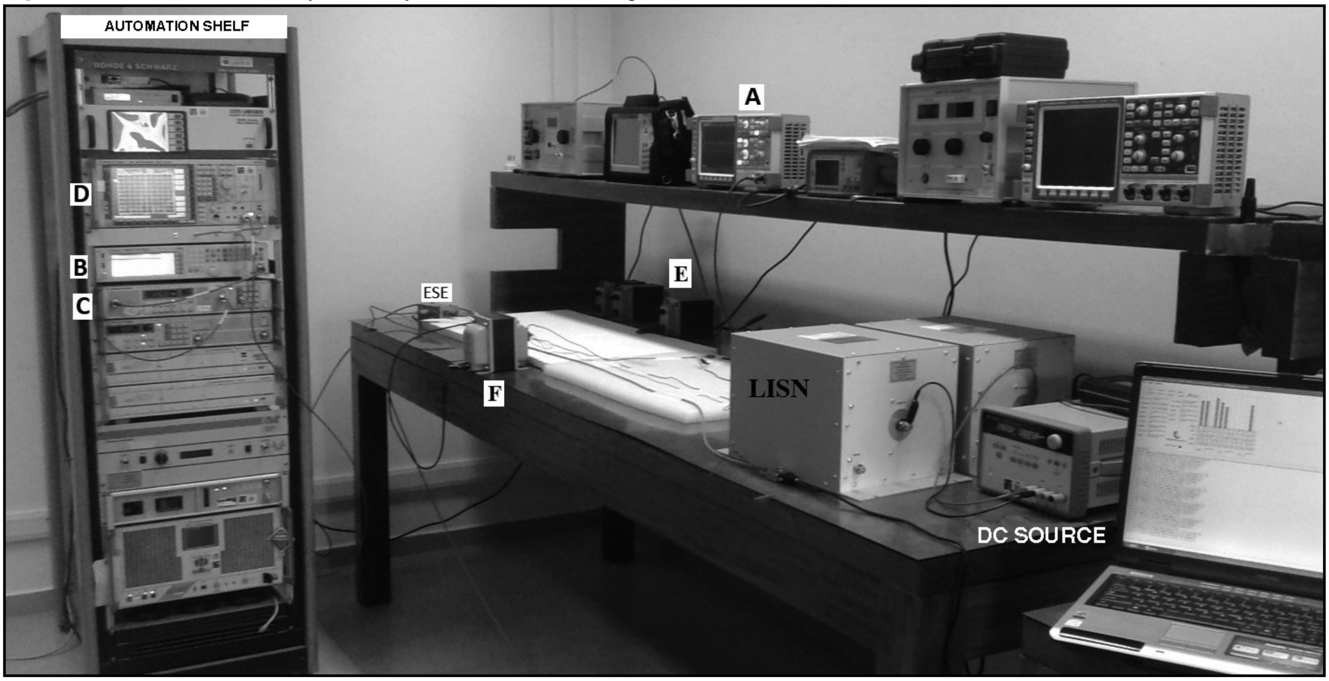
For this type of test, the first phase is called calibration, according to the standard in which only the equipment checking and adjustment are made, without ESE, according to the specified levels in the standard by sweeping the frequency range from 30 Hz to 150 kHz. The second phase, in which the adjusted equipment and ESE are used, is the test in which this type of susceptibility conducted will be observed. In this case, this signal level is scanned on ESE power supply cables in the frequency range of the first phase. The representation and assembly for this laboratory rack-automation test are described in Figures 3 and 4.

Figure 3 - Diagram of the assembly scheme with portable laboratory Rack for testing with CS-101 automation.



Source: Electromagnetic testing laboratory DCTA/IFI/CMA.

Figure 4 - CS-101 test laboratory assembly with ESE and its wiring.



Source: Electromagnetic testing laboratory DCTA/IFI/CMA with the automation rack.

The IFI laboratory has developed a portable automation rack, where the necessary equipment for these types of assays are assembled and integrated. The equipment operates automatically, controlled and programmed by software to perform each type of test according to the standard. The test wirings interconnect ESE and LISN. The equipment used for this type of test is represented by the letters A, B, C, D, E, F and G respectively. Capacitor G, which does not appear in Figure 4, is connected to the positive feeding phase of ESE being coupled to LISN output. The amplifier is coupled to the output of the signal generator in the automation rack.

The others are just on the bench and will be used according to the type of test. ESE, LISN and equipment are arranged in the conductive part of the test table. The wiring is under insulating material, styrofoam. The distances of cabling, equipment and ESE system follow the standards, but they are not indicated in Figure 4.

During the test, the system operation is constantly monitored, and any anomaly or not is recorded by the designer.

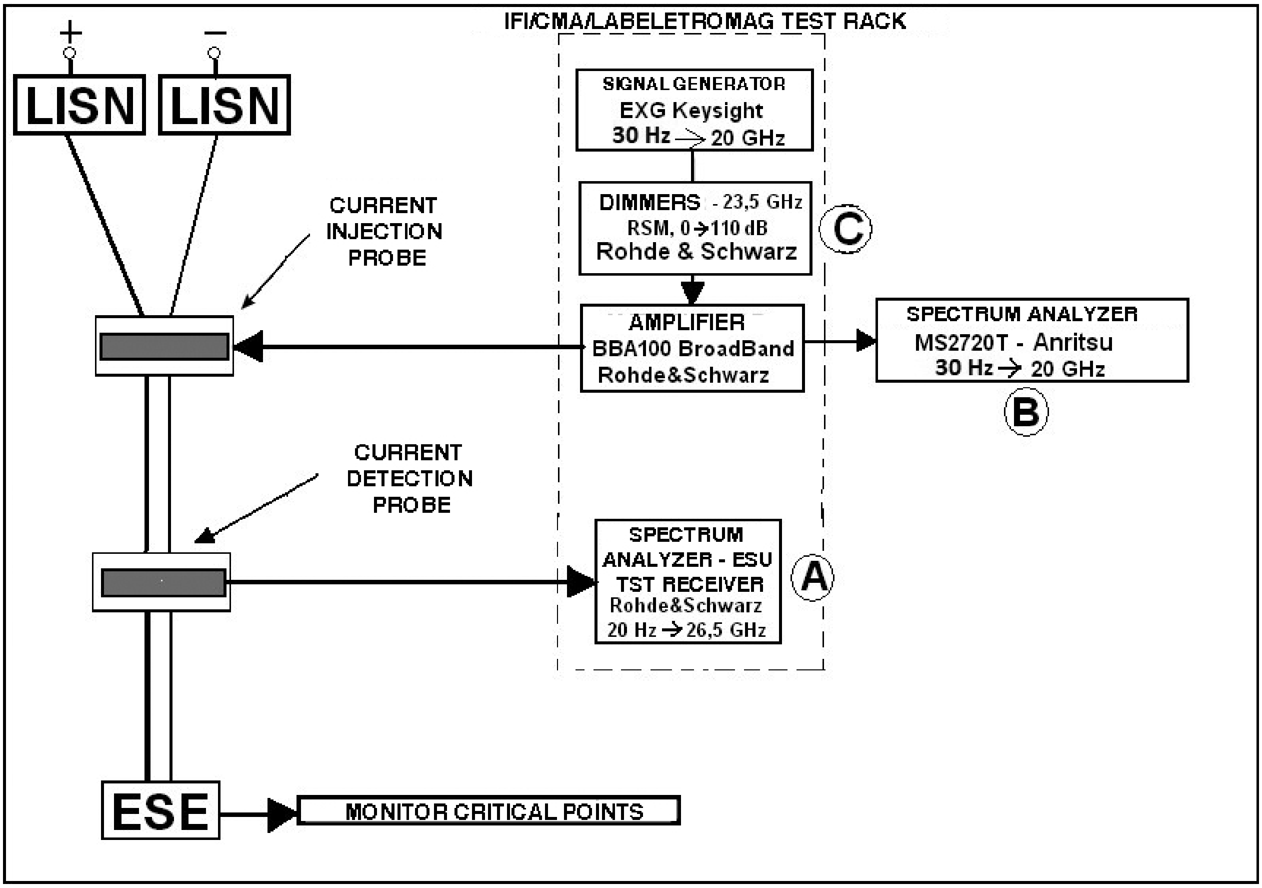
3.3 Susceptibility-driven assay CS114

For this type of test, the first phase is called calibration, according to the standard for FAB and Space project design characteristics, in which only the equipment checking and adjustment, without ESE, is done, according to the levels specified in this standard, by scanning the frequency range from 10 kHz to 200 MHz. The second phase, in which the adjusted equipment and ESE are used, is the test in which this type of susceptibility conducted is observed. The assemblies for the automated test with laboratory rack are described in Figures 5 and 6. The test wiring is connecting ESE and LISN. In this assay, equipment A and B are used as signal receivers.

After adjusting the test equipment, this signal level is scanned on ESE power and interconnect cables in the specified frequency range. In the assay, ESE capacity to withstand noisy signals coupled to its interconnection and power supply cables was verified.

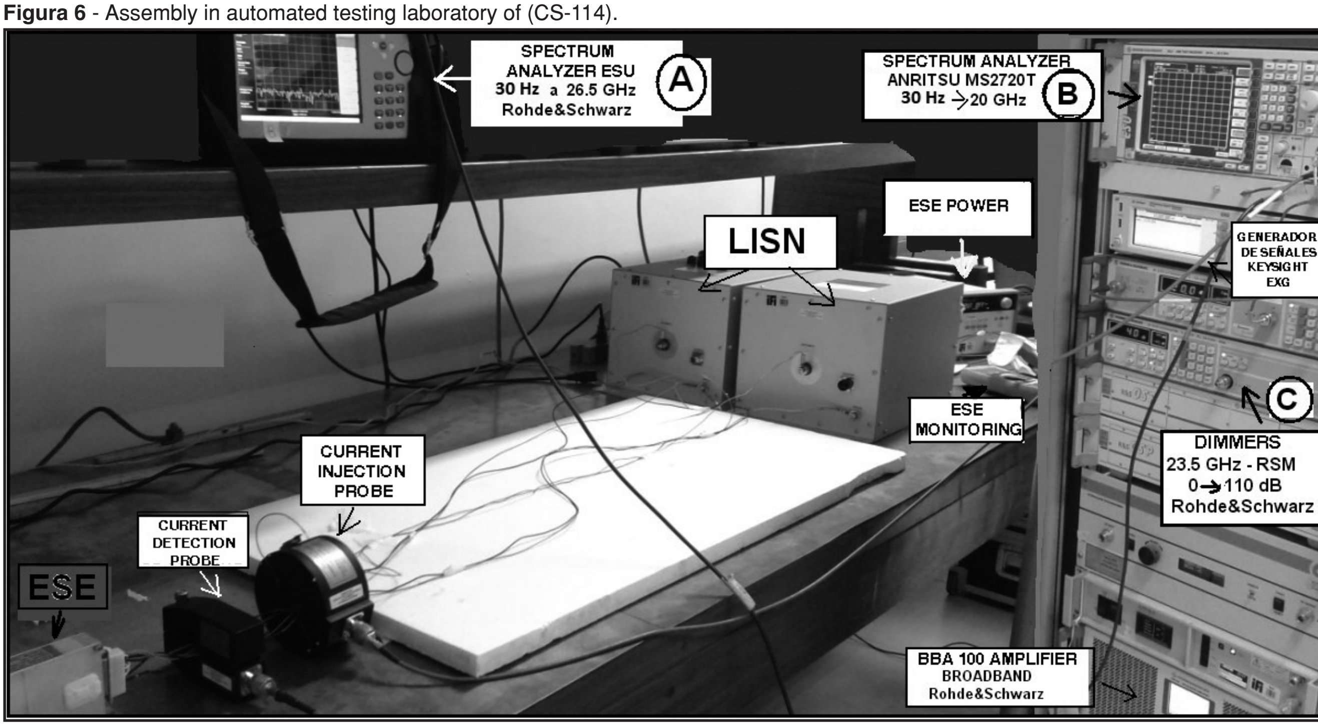
During the test, the operation of the system is constantly monitored, and any anomaly or not is recorded by the designer.

Figure 5 - Laboratory assembly diagram for automated testing of (CS-114).



Source: Electromagnetic testing laboratory DCTA/IFI/CMA.

Figura 6 - Assembly in automated testing laboratory of (CS-114).



Source: Electromagnetic testing laboratory DCTA/IFI/CMA.

3.4 Susceptibility-driven assay CS115

For this type of test, the first phase is called calibration, according to signal levels by the standard, in which only the equipment verification and adjustment are made, without ESE. In the second phase, in which the equipment is adjusted, pulsed signals are injected into the power cables or data signals of ESE, where this type of susceptibility conducted will be observed. The assembly for the test is described in Figure 7. Equipment A is the signal injection probe, B is the measuring probe, C is a signal attenuator not to damage the oscilloscope, and D are the spacers of 5 cm. The test wiring is connecting ESE and LISN. The other non-discriminated equipment is just on the bench and is ESE power signal.

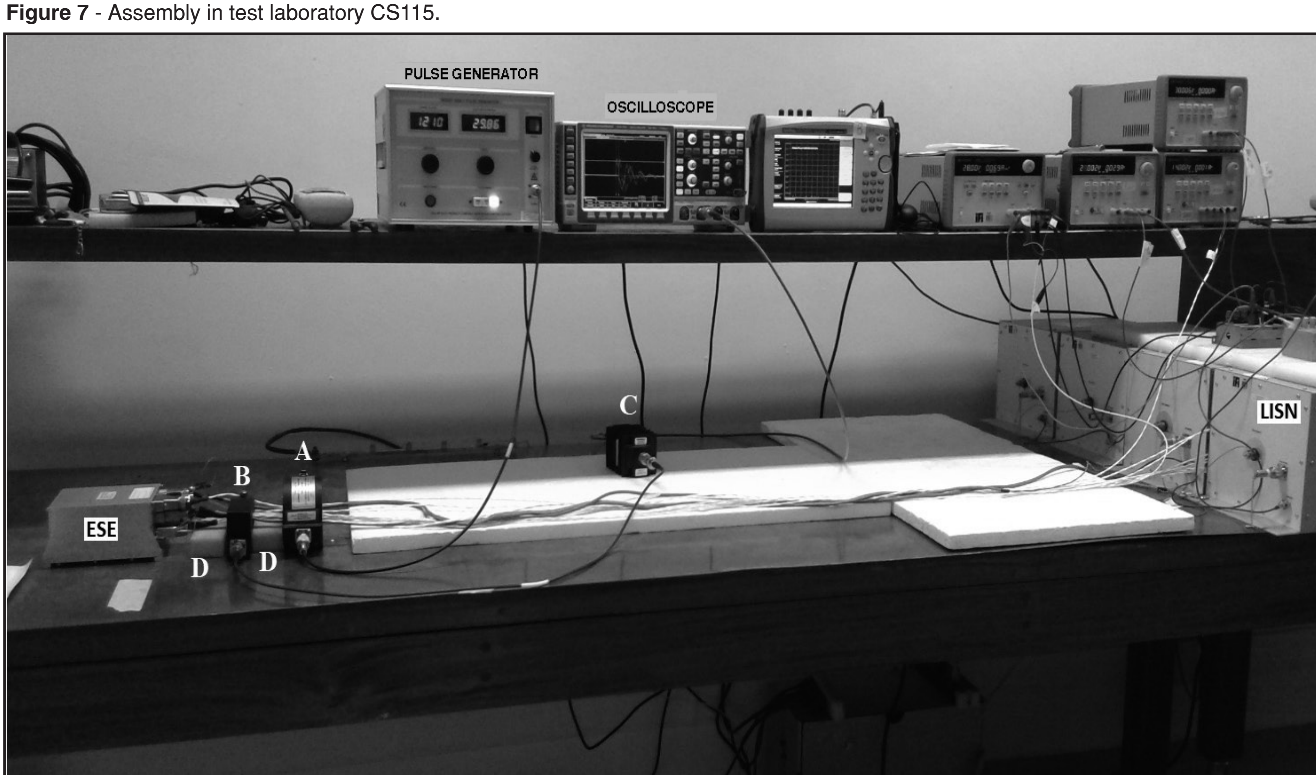
The test verifies ESE capacity to withstand impulse interference signals coupled to its power supply cables of energy, data or grounded systems of its interconnection cables. During the test, the system operation is constantly monitored, and it is recorded whether there is any anomaly, or not, by the designer.

3.5 Susceptibility-driven assay CS116

For this type of test, the first phase is called calibration, according to signal levels by the standard, in which only the equipment verification and adjustment are made, without ESE. In the second phase, in which the equipment is adjusted, this signal of sine pulsed current is injected, in the frequency range from 10 kHz to 100 MHz, into the power supply cables or data signals from ESE where this type of susceptibility conducted will be observed. The laboratory assembly for the test is described in Figure 8. The test wiring is connecting ESE and LISN. The 5 cm spacers are represented by A, equipment B is the measuring probe, and C is the signal injection probe. The other non-discriminated equipment is just on the bench. It's not part of this test.

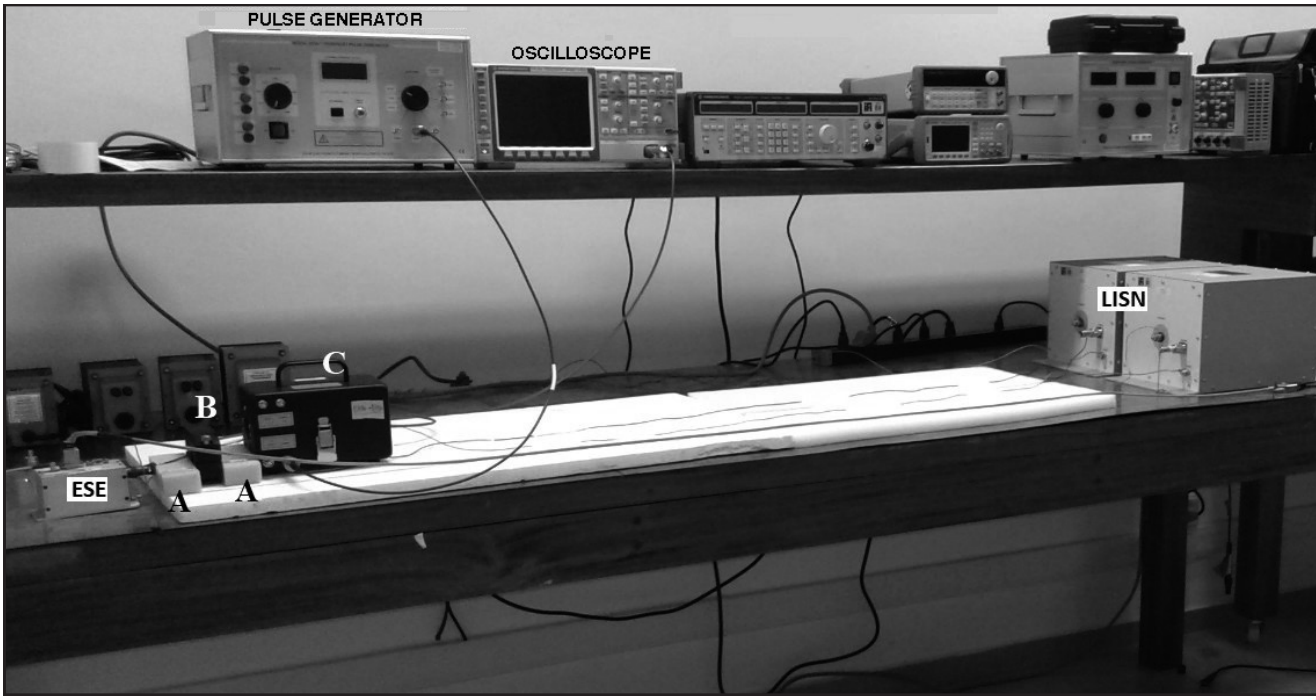
The test verifies ESE capacity to withstand interference signals coupled to its power supply cables or data signals in the specified frequency range. During the test, the system operation is constantly monitored, and it is recorded whether there is any anomaly, or not, by the designer.

Figure 7 - Assembly in test laboratory CS115.



Source : Electromagnetic testing laboratory DCTA/IFI/CMA.

Figure 8 - Assembly in test laboratory CS-116.



Source: Electromagnetic testing laboratory DCTA/IFI/CMA.

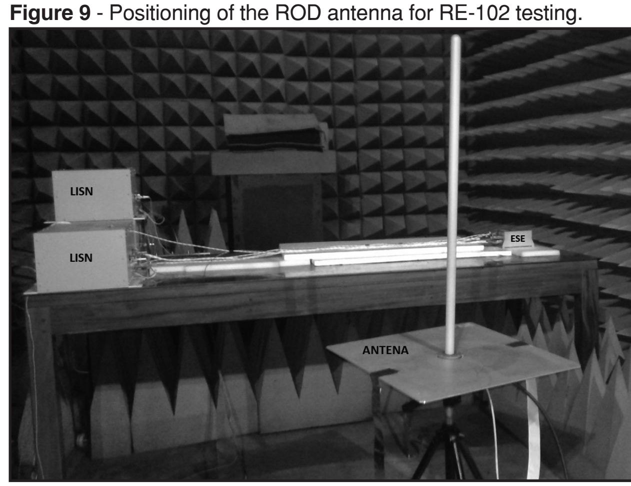
3.6 Irradiated emission assay RE102

In the first phase of this type of test, called calibration by the standard, adjustment and verification of the equipment and the antennas are made, according to limits of electric field intensity (amplitude in microvolt decibels per meter - dBuV/m) acceptable by the standard. In this phase, the ROD, BICONILOG and DOUBLE RIDGE HORN antennas are positioned, according to its frequency range between 10 kHz to 18 GHZ, one meter away from ESE or its cabling and ground height of 1.20 m.

In the second phase of the test, when ESE equipment is working normally, the intensity of electric field irradiated in dBuV/m is used by this system consisting of ESE and its wiring. These emission levels produce the effects of noisy signals and must be between the limits established in the standard and adjusted in the first phase. Depending on the complexity of this system and the size of its wiring, this test can be repeated several times until it covers the entire angle of antenna coverage. The configurations of the assemblies for the laboratory assay are described in Figure 9, from 10 kHz to 30 MHz, figure 10, from 30 MHz to 200 MHz, and figure 11, from 200 MHz to 18 GHz, respectively. The test wirings connect ESE and LISN and are on the styrofoam.

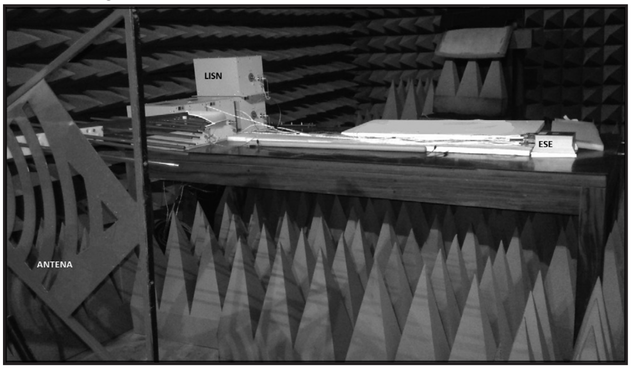
This type of test was carried out inside the anechoic chamber of the IFI laboratory that has EMI absorbers, precisely to ensure that the electromagnetic signals present in this setup, are only those coming from the ESE system plus the wiring are measured by the antennas inside. The other equipment that is part of the antenna measurement system is arranged on the outside of the camera and is set up according to the IFI portable automation rack, as shown in Figure 4. During the test, ESE operation is constantly monitored and the frequency bands established are swept. Part of the result of the measurement of irradiated emission levels of ESE, compared to the levels acceptable by the standard, is presented in Figure 12. The frequency range presented is between 1GHz and 18 GHz in horizontal polarization with the level of signal amplitude irradiated electric field, in dBuV/m.

Figure 9 - Positioning of the ROD antenna for RE-102 testing.



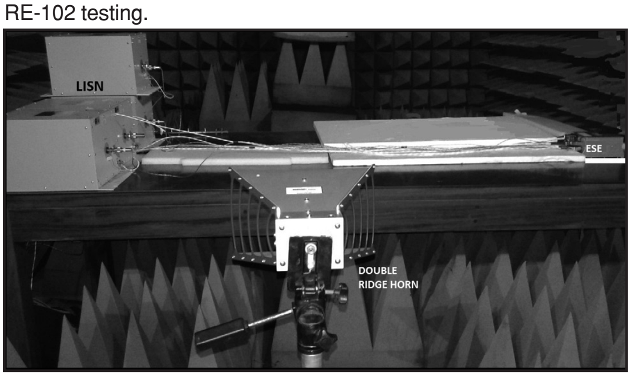
Source: Electromagnetic testing laboratory DCTA/IFI/CMA.

Figure 10 - Positioning of the BICONILOG antenna for RE-102 testing.



Source: Electromagnetic testing laboratory DCTA/IFI/CMA.

Figure 11 - Positioning of the DOUBLE RIDGE HORN antenna for RE-102 testing.



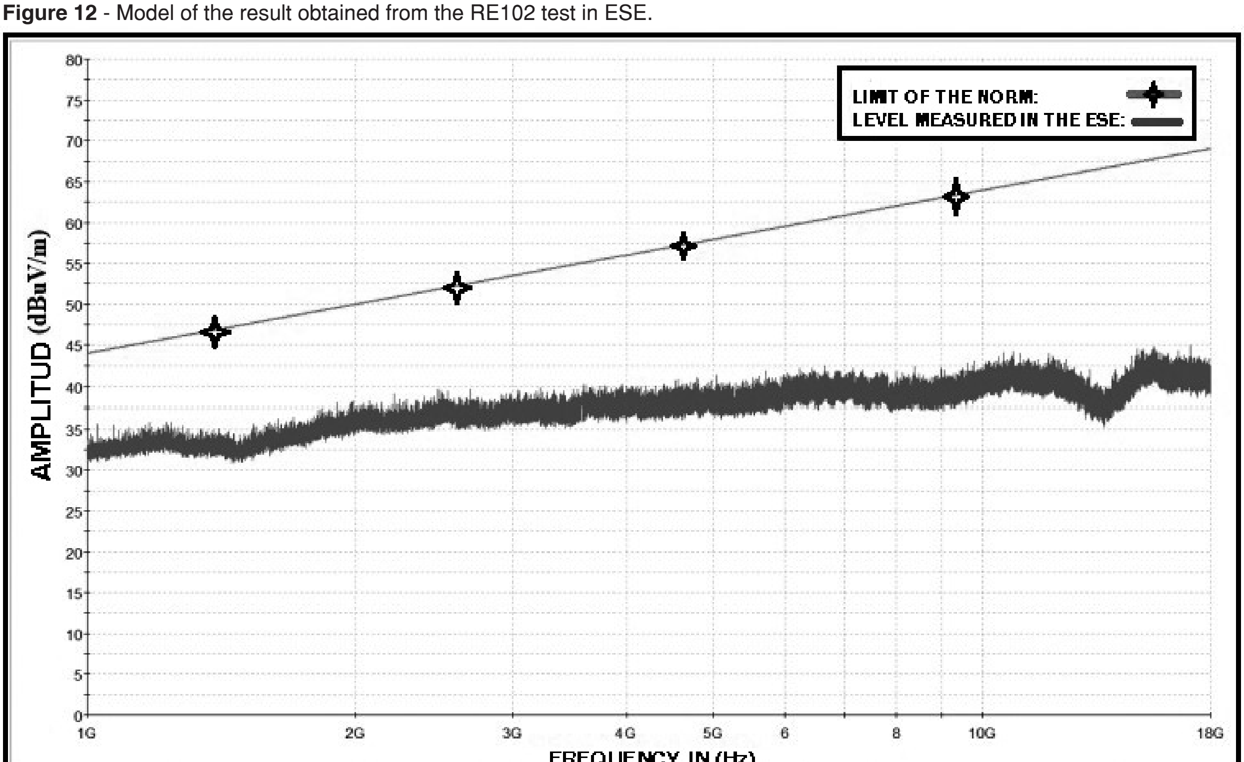
Source: Electromagnetic testing laboratory DCTA/IFI/CMA.

3.7 Irradiated susceptibility assay RS103

In the first phase of this type of test, called calibration by the standard, only adjustments and verification of the equipment and the antennas are made, according to limits of electric field intensity (amplitude in microvolt decibels per meter - dBuV/m) acceptable by the standard. In this phase, the ROD, BICONILOG and DOUBLE RIDGE HORN antennas are positioned, according to its frequency range between 10 kHz to 18 GHZ, one meter away from the ESE or its cabling and ground height of 1.20 m.

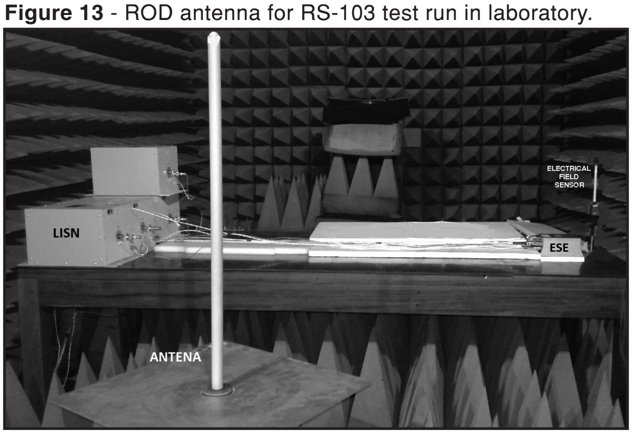
This test is similar to RE102, however, only now the antennas radiate a noisy electric field signal, initially adjusted over ESE system and wiring. This signal is constantly monitored by an electric field intensity sensor, positioned as close as possible to this system. The electric field intensity is 20 Volts per meter, specified in standard for space projects. The configurations of the assemblies for the laboratory test are described in Figure 13, from 10 kHz to 30 MHz, figure 14 from 30 MHz to 200 MHz, and figure 15, from 200 MHz to 18 GHz, respectively.

Figure 12 - Model of the result obtained from the RE102 test in ESE.



Source: Electromagnetic testing laboratory DCTA/IFI/CMA.

Figure 13 - ROD antenna for RS-103 test run in laboratory.

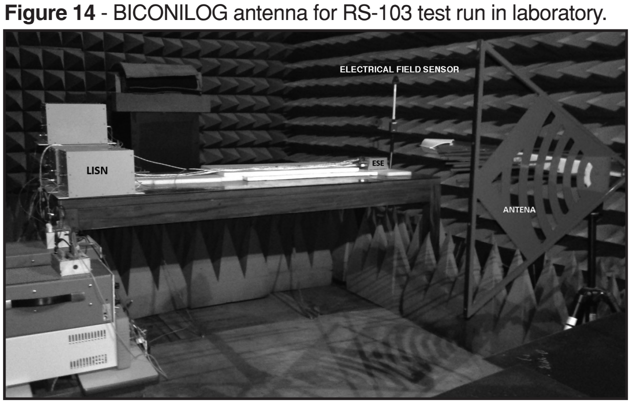


Source: Electromagnetic testing laboratory DCTA/IFI/CMA.

This type of test was carried out inside the anechoic chamber of the IFI laboratory, in which there are EMI absorbers precisely to ensure that the electromagnetic signals, in this case the electric field, generated and irradiated on this assembly of ESE system plus wiring, are only those coming from the antennas inside. The other equipment that is part of the signal generation system for the antennas and signal measurement of the electric field sensor, was arranged on the outside of the camera and was set up according to the IFI portable automation rack, as shown in Figure 4.

During the test, the system operation is constantly monitored, and any anomaly or not is recorded by the designer.

Figure 14 - BICONILOG antenna for RS-103 test run in laboratory.



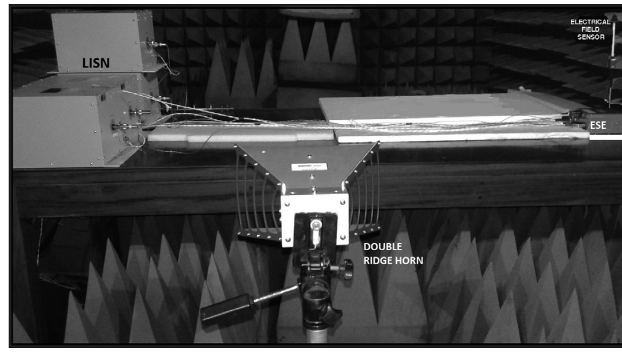
Source: Electromagnetic testing laboratory DCTA/IFI/CMA.

4 CONCLUSION

This article presents EMC electromagnetic compatibility tests in a system developed in the aerospace area of defense technology of the Aeronautics Command, for the Aerospace Institute, IAE, mainly taking as reference the technical requirement MIL-STD-461 of American standard, with its revision G.

The Laboratory of Electromagnetic Tests (Labeletromag) of the Division of Metrological Reliability, CMA, at the

Figura 15 - DOUBLE RIDGE HORN antenna for RS-103 test, run in laboratory.



Source: Electromagnetic testing laboratory DCTA/IFI/CMA.

Institute of Industrial Promotion and Coordination, IFI, of the Department of Aerospace Science and Technology DCTA, in São José dos Campos(SP), is deployed, in the automation phase, but already performs these types of technical-specialized EMC testing services on conducted emissions or susceptibilities, (CE) and (CS), and radiated emissions or susceptibilities, (RE) and (RS), at product development level, to meet projects in the aerospace area of defense technology of the Air Force Command.

Service that can be extended to other military institutions of the Ministry of Defense, civil industries in the aerospace sector, educational and research establishments. This type of innovative service, in this area in the IFI and for the Air Force Command, has already performed tests for a Navy weapons project and has the Army also in partnership. The laboratory has provided a partnership, at the development level, for EMBRAER military or civil aviation projects, since its development and certification tests are carried out almost entirely abroad. The norm followed by civil aviation, the main one being the RTCA/DO-160, Revision G, through sections 18 to 23, can be mostly performed in this laboratory. In Brazil the main laboratory that has been able to meet this type of service has been the National Institute of Space Research (INPE) but, with the great demand for its services by the national automobile industry, the wait for the execution of the tests ends up compromised by other sectors of the military or civil aerospace areas of research and development.

This type of technical service offered is of great importance for autonomy and development of the country, since much of this service is performed abroad. The laboratory also has a reverberation chamber in operation, to perform tests of irradiated susceptibility, being the only one in the country. With the implementation of Labeletromag in the IFI, an alternative has been offered to meet this service demand in Brazil.

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