Equipment's modification for compliance with radiated emissions for certification according to CISPR normative.

Soluções para equipamentos com emissões radiadas acima dos valores prescritos nas normas CISPR

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Resumo: Este é um estudo de emissões radiadas por equipamentos eletrônicos. Dois equipamentos são testados e seus respectivos resultados foram apresentados, onde foi constatado valores de emissões maiores do que os desejados. Modificações foram realizadas nestes aparelhos e novos testes foram feitos. Novos resultados são apresentados, e estes novos resultados estão dentro das faixas desejadas.

Palavras-chave: Testes de Compatibilidade, Ferrites, EMI, Blindagem

Abstract: This is a study of radiated emissions generated by electronic equipment. Two different equipments were tested and their respective results presented, where it was observed that their emissions' values were worse than desired. After some modifications, and a second batch of tests, better results were achieved.

Keywords: Compliance tests, ferrites, filters, EMI, shielding.

1. INTRODUCTION

Electromagnetic Interference (EMI) is a disturbance that affects an electrical circuit due to electromagnetic conduction or electromagnetic radiation emitted from an external source, and that source could be an electric or electronic equipment. Because of that, products that require electric power to operate could have the influence of EMI from another equipment. They could be themselves producing it, creating problems to other units close to them. It is necessary to verify if products have emissions above the appropriate limits and if they are effectively immune to it.

Experimentally it can be verified that the interference between equipment could occur in two different ways, by conducted induction and radiated induction. This study is only for the radiated interference. In this case, it can also be in two different ways, differential mode and common mode. Some of the energy will propagate as the differential mode (forward on one cable, back on another), and the rest as the common mode (along all of the cables simultaneously and back via an unknown "ground" return). [1]

Cables are a source of EMI that cause significant problems in complying with

Electromagnetic Compatibility (EMC) regulations, and even can jeopardize signal integrity. Ferrite cores or flexible absorbing materials on cables are used to suppress common mode radiated from cables. [1]

Filter circuits are used in a wide variety of applications. These filters can be active or passive. Usually they are electric circuits with capacitors, inductors and resistors. Low pass filters are those that allow low frequency signal to pass and block the ones with higher frequency. Generally, a major part of electronic equipments employ anti-aliasing low pass filters in their signal conditioning stages. In a higher frequency band, mostly passive components are used. [2]

Cable shielding was also developed to solve problems with EMI radiated interference. The type of shielding that is used for this type of interference is the braided shielding. The braided wire works because the surface area of the braid is significantly greater than solid wire or stranded wire. Since the skin effect applies to high frequency interference, the greater surface area of the braid can facilitate in reducing the effect of high frequency EMI. Braids are effective for controlling both immunity and emissions. When the interference is less than 100 MHZ within the shield, the braid will represent a large inductive path preventing the coupling in an unintended circuit. [5]

With those technics described, employed together or apart, One can control susceptibility and radiation of EMI of electronic equipment. If the unit tested has its sensitivity to EMI higher then desired, or its emissions are above the regulation values, those methods could decrease the emissions. This will assure that the equipment is suitable for operation with other different equipment nearby without interfering with their operation.

This paper is about radiated emissions. Its main objective is to compare radiated emissions before and after changes to the equipments, adding ferrite cores, changing low pass filters by adding resistors in series, and applying braided shielding to cables. The results are positive, proving that the described methods are effective for all equipments that could present this kind of problems.

2. TESTING METHOD AND CHANGES MADE TO THE EQUIPMENT

The electromagnetic compatibility tests were done in semi-anechoic chamber in IPT (Instituto de Pesquisas Tecnológicas do Estado de São Paulo). They followed the specifications of CISPR 11[3] normative e CISPR 22[4] normative.

For both equipments, the first test was done before any changes from the shelf units. The first test results for both were worse than desired. For the first equipment, the results were above desired in several frequencies although it was above regulatory values only for about 50 MHz and for values between 200 and 700 MHz.

Some changes were made to the cables. A ferrite core was added close to the power supply and it was shortened considerably. The aim was to add a magnetic resistance to the circuit. This will decrease the effect of the inducted current for the frequency were the larger emissions. The chosen core was the one designed for maximum attenuation at the frequency desired.

Low pass filters were employed. In some cases complete filters were used, and others only resistors in series, changing the cut off frequency. This filters let lower frequency pass and block those larger than 50MHz, which were the ones with results higher than desired in the test.

Cables were also replaced by different ones, with braided shielding. Even with all the changes described, the equipment still had emissions above desired. With the shielding in the internal cables, finally the values were under the limit, making the operation possible in the presence of other equipment.

Following the same procedure, the second equipment was also tested without any changes, and it presented results that have higher emissions than allowed.

The first step was to increase the resistance in series with the circuit, changing the frequency for the low pass filter. Installing a ferrite core complete the changes and brought the results to acceptable values.

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3. RESULTS

For the first equipment, before the changes, the result is on Figure 1. Many of the frequencies are above the limits prescribed by CISPR11. Particularly the frequencies between 40 MHz and 50 MHz, and above MHz.

After the mentioned changes, the result is on Figure 2. The emissions' results are a lot better, and there was no change on the equipment functionality. The results agree well with CISPR 11 imposed limits.

For the second equipment, the radiated results are presented on Figure 3. Figure 4 shows better results, after the changes. On that case only one frequency was above the limit, at 200 MHz, and it got to acceptable values.

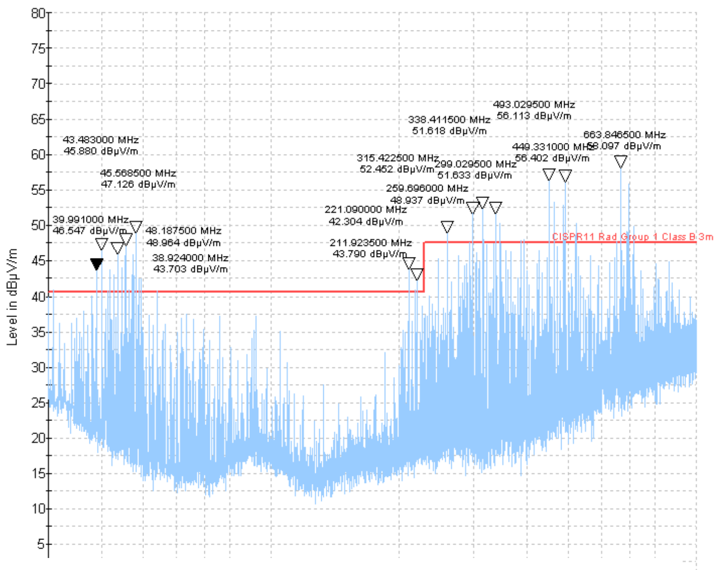

Figure 1: Radiated emissions, first equipment1, before the modifications.

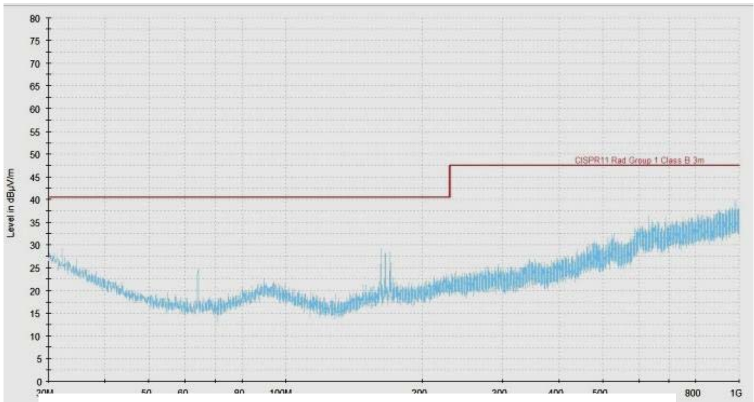

Figure 2: Radiated emissions, first equipment 1, after the modifications.

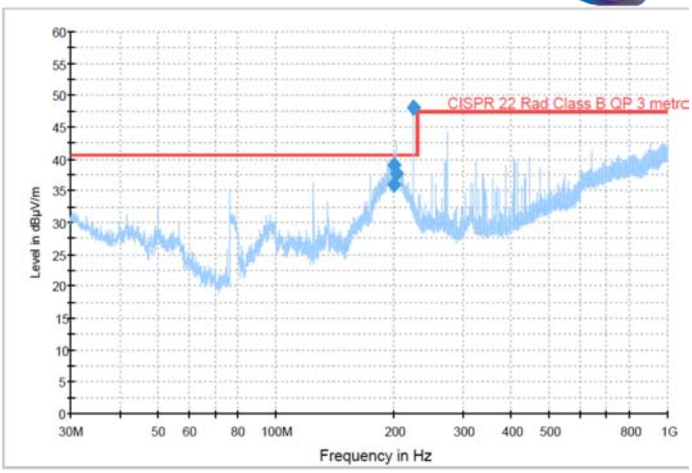

Figure 2: Radiated emissions, first equipment 2, before the modifications.

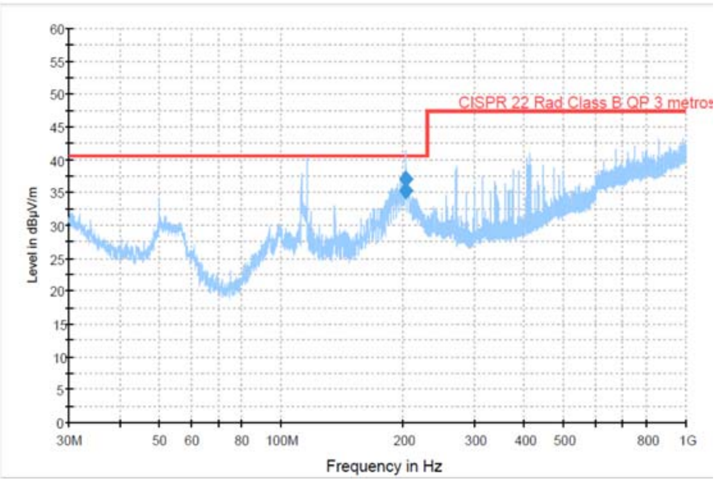

Figure 4: Radiated emissions, first equipment 2, after the modifications.

4. DISCUSSION

Both equipments were designed well for their functionalities, but were not suited to CISPR11 and CISPR22 normative, for electromagnetic emissions. The initial tests showed that. After the described modifications were made, adding resistors, shielding and ferrites got the results to what it is prescribed.

These results are seen on the shown graphs, and it can be observed that the results are below the limits prescribed.

Any type of electronic equipment could be modified following the same rules, using the same method described.

5. CONCLUSION

There are several ways to correct the electromagnetic emissions that are above the limits established by the normative.

It is demonstrated by the examples described in this article, the methods were successful, making it possible for the two equipments tested here to be certified.

If applied the described method, an association of them could be used for any electronic equipment, for any field of application.

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