EMC SOCIETY of AUSTRALIA NEWSLETTER

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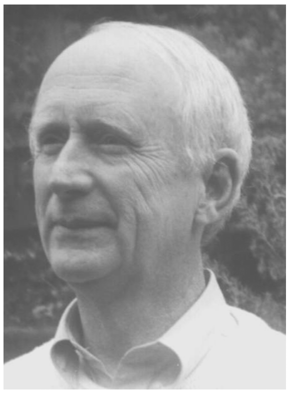
MESSAGE FROM THE CHAIRMAN



"No matching phrases found." "No matches." Such are common responses to a request for information on EMC on the Internet.
How often have I typed "electromagnetic compatibility" into the search facility of an academic site to be met with a nil response, or one of little relevance? Fortunately some of the general search engines available on the Internet provide a better response.

The EMC Society is currently sponsoring a Student Paper competition and has provided application information to academic institutions throughout the country. We await expressions of interest. The level of interest may indicate the level of awareness of EMC in the academic environment where future EMC practitioners and customers are being trained.

EMC in its various aspects is generally not considered mainstream material warranting inclusion in academic courses. Such a situation is likely to remain. Having spent considerable time in the academic environment and designed several tertiary courses from the ground up, I can sympathise with course designers who struggle to include relevant topics in overcrowded courses. Often the course designer is forced to ponder not what can be included in a course, but rather what can be left out. Opportunities to inject material such as EMC into academic courses come by rarely, so we will have to rely on other approaches to educate current and future EMC practitioners.

For most technical professionals in the electrical and electronic industries, EMC is a topic to be addressed when necessary. It is only when faced with an EMI problem or a requirement to meet EMC standards that they go looking for a solution and begin to seek assistance. When assistance is provided by EMC "experts" the solutions are usually understood, but EMI problems are not foreseen and anticipated.

In the meantime new engineers make old mistakes and old engineers make new ones. New buildings are planned and constructed with IT equipment located adjacent to substations, with the consequent disturbance to screen-based equipment from magnetic fields.

In the Defence environment there has traditionally been an awareness of EMC and its consequences and EMC requirements are commonly included in specification and tender documentation. However, there is often pressure to relax or waive requirements because of cost or reluctance of Vendors to supply compliant equipment.

There is clearly a need for at least a minimal EMC awareness in industry so that costly mistakes can be avoided and Government attempts to address topics such as EMC and Radiation Hazards can be successful. There is also a need for more than a minimal competency in the EMC community, and the EMC Society provides a vehicle for establishing and maintaining that competence.

John Hyne, MIEAust., CPEng.

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LETTER FROM THE EDITOR

This issue of the newsletter is the last for the year 2000 and the members of the council report that it was a very successful year for the EMC Society. The Society was pleased to be able to attract two overseas speakers this year for our technical presentation program. Professor Jochen Glimm of PTB Braunschweig, Germany and Keith Armstrong of Cherry Clough Consultants from the UK. In addition our presentations were enhanced by excellent local engineering entrepreneurs Dr Ken Joyner and Lucito Irlandez.

The year 2000 saw the introduction of our student EMC Paper Competition with a prize for the best paper which is currently being adjudicated and the winner will be announced in the next issue of the newsletter.

Do You Believe Mobile Phones Are Safe?

If you are scientist engineer or technician you have the capability and understanding to take a measurement and interpret the results. It does not matter whether you are measuring temperature, pressure, voltage or field strength.

If you are a lay person attitudes and perceptions are entirely different and I state a case in hand to prove my point. An engineer was dispatched to measure the magnetic field strength in an office complex because the operators were suffering interference to their VDU's. The engineer made the statement that he was going to measure the radiation level from the mains. On taking the measurement the field strength meter clearly indicated a rise to a level of about 12mG. The operator seeing the needle movement on the meter immediately stated that she was not prepared to work in an environment where there was so much radiation around. Clearly the operators perception of the meter reading was clearly at odds with the engineer who knows 1000mG is an acceptable level for the general public environment

Our office received a call just recently from a mobile telephone user who wished to find out where he could buy one of those gadgets you attach to the phone to reduce radiation. He was particularly worried that due to the extensive use of his phone his ear was "red" and he believed that this was due to radiation effects of the mobile phone.

Extensive research has been carried out in recent years on the radiation effects of cell phones with no conclusive evidence that health risks exist from such radiation. Similarly studies have been carried out where people live close to power lines to determine whether there have been links to childhood cancer. Once again there have been no conclusive proof of biological effects of exposure to magnetic fields. However the public have always aired their concerns about overhead power lines but do not worry about the fields from the electric blanket on their bed which is more closely coupled to their body.

The truth of the matter is scientists and engineers make statements and they are not big on interpreting the implications of their statements for the general public.

Year 2001

Nominations will be called in November for positions on the council for 2001 and voting will be carried out by mail in the New Year.

I would like to encourage our members to contribute articles of interest for publication in our newsletter. This newsletter is the forum for passing on the knowledge you have gained to others.

I would like to take this opportunity to wish all members and families a happy and joyful festive season and look forward to your continued support in the year 2001.

TECHNICAL PRESENTATION - AUGUST

Mobile Phones – Research, Australian EME Regulations and Compliance Issues

by Dr. Ken Joyner

The August presentation of the EMC Society was given by Dr. Ken Joyner, who is Motorola's director of Electromagnetic Energy (EME) Strategy and Regulatory Affairs, Asia-Pacific. Dr. Joyner spoke on the topic of the hazards of electromagnetic energy to personnel (or HERP as it is sometimes known). Dr. Joyner has a wealth of knowledge and experience on this topic, having studied it for some twenty years or more in Telecom (now Telstra) and Motorola. For those that know Dr. Joyner, the talk promised to be interesting, and it proved to be.

Dr. Ken Joyner receives a gift of gratitude from Mr. Steve Offer

Dr. Joyner presented a mix of historic and contemporary information to educate the audience on the effects of electromagnetic energy on people. He presented research findings describing the place on a mobile phone where the maximum electromagnetic fields are located; surprisingly near the keyboard rather than near the antenna as we all expect. Another surprising research product was the results that showed that the maximum heating caused by the phone was the battery, something most users could attest to in hindsight.

Dr. Joyner described the continuing research being conducted into electromagnetic hazards of mobile phones, as this is the source concerning the public at present. He described how the research is broken into a number of distinct areas such as epidemiological studies (the study of human populations), rodent studies, and specific cases that have arisen. He showed us some excellent pictures of the work to illustrate his message.

The evening was concluded with a video courtesy of Motorola to show the breadth and depth of support for this work in the Telecommunications Industry. The audience enjoyed his presentation, and showed their enthusiasm with a host of probing questions. The EMC Society would like to thank Dr. Joyner for finding time in his busy schedule to make this excellent presentation. The EMC Society would also like to extend an invitation to Dr. Joyner to update us on this important topic after the release of future important results.

TECHNICAL BRIEFS

Effects of Small Changes on Antenna Separation on Antenna Factors and Gain Measurements

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Abstract.- When performing calibrations following the ARP-958 procedure the distance of one meter between two Log-Periodic Dipole Arrays (LPDA) is defined as the distance between the tip of the booms. If instead the separation between the antennas is measured as the distance between the highest frequency element there is a small change in the antenna separation. On this paper we will show that the small change in distance when performing the calibration has little or no effect on the measured results. The higher effect will be mostly on the phase of the field received by the receiving antenna. A series of experimental results using two EMCO 3146 LPDA were performed to confirm the predictions of the theoretical analysis showing 0.6dB/m as the largest change on the AF over the entire range.

I. Introduction

Given two LPDA to perform a calibration following the ARP-958 procedure the antennas are located as shown in Figure 1. The distance between the antennas is 1m. This distance is measured from the tip of the booms [1]. Other standards define the separation of the antennas as being the separation between the highest frequency element in the LPDA.

Hence, depending where the 1m separation is measured from there can be a difference of 2δ from one measurement procedure to the other. The question is, is there a large effect from taking either definition of the distance between antennas? What is the effect of small variations in separation? To see what the effect of performing calibrations when the distance between the antennas is measured as D or D+2□, the radiation from one antenna at those distances must be studied.

II. Theoretical Analysis

To make the analysis easier some assumptions are made. The first assumption is that there is no mutual impedance between both antennas. That is to say that the two antennas are located in each other's far fields. This is not that far fetched since each element is located at least one wavelength from the corresponding element on the other antenna. The second assumption is not easily realizable in practice. We are going to assume that each dipole in the LPDA radiates as if located in free space.
By using this second assumption the following equation is found for the z component of the electric field [2] for the geometry shown in Figure 2.

$$E_z = \frac{-jI_o\eta_o}{4\pi}\left[\frac{e^{-j\beta S_1}}{S_1}+\frac{e^{-j\beta S_2}}{S_2}-2\cos\left(\frac{\beta L}{2}\right)\frac{e^{-j\beta r}}{r}\right] \qquad (1)$$

Equation (1) is valid for the field at any point of space, in both the near and far field and for any length of center fed thin wire antenna. In the LPDA the elements are half-wave dipoles, hence $L=\lambda 2$.

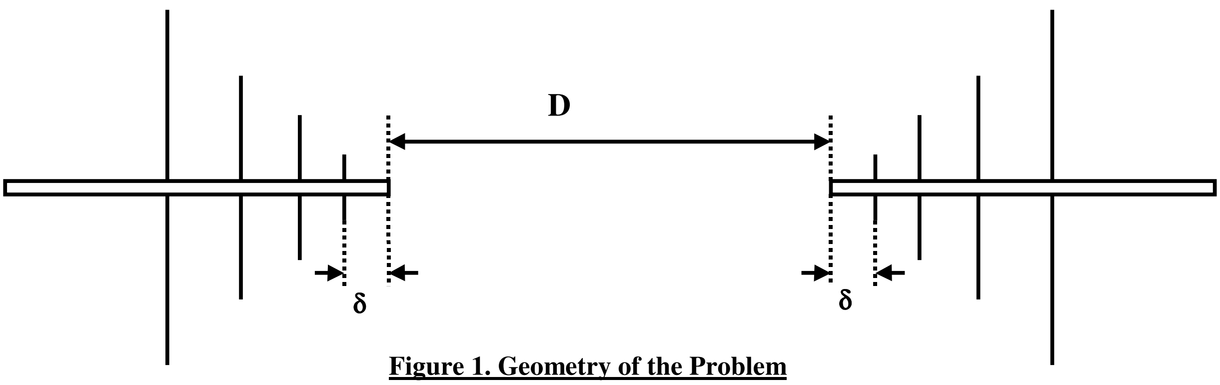


Figure 1. Geometry of the Problem

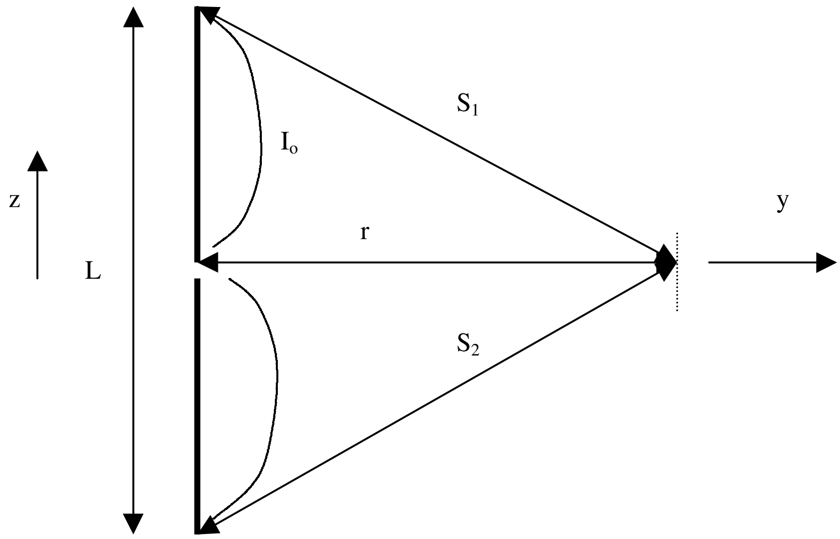


Figure 2. Dipole radiating in free space.

Given the value of L, since $\beta=2\pi/\lambda$, the last term in equation (1) reduces to,

$$2\cos\left(\frac{\beta L}{2}\right) = 2\cos\left(\frac{\frac{2\pi}{\lambda}\frac{\lambda}{2}}{2}\right) = 2\cos\left(\frac{\pi}{2}\right) = 0 \qquad (2)$$

Hence, (1) becomes,

$$E_z = \frac{-jI_o\eta_o}{4\pi}\left[\frac{e^{-j\beta S_1}}{S_1} + \frac{e^{-j\beta S_2}}{S_2}\right] \qquad (3)$$

Since the observation point is on the z=0 plane then $S_1=S_2$ then the equation becomes:

$$E_z = \frac{-jI_o\eta_o}{4\pi}\left[\frac{2e^{-j\beta S_1}}{S_1}\right] \qquad (4)$$

Which can be rewritten in terms of r=D and L as:

$$E_z = \frac{-jI_o\eta_o e^{-j\beta\sqrt{\left(\frac{L}{2}\right)^2 + D^2}}}{2\pi\sqrt{\left(\frac{L}{2}\right)^2 + D^2}} \qquad (5)$$

For the case that we are studying D>>L/2, so (5) becomes

$$E_z = \frac{-jI_o\eta_o e^{-j\beta D}}{2\pi D} \qquad (6)$$

From equation (6) two equations may be written showing the difference in the fields detected at a distance D and at a distance $D+2\delta$ from the radiating antenna.

$$E_{z1} = \frac{-jI_o\eta_o e^{-j\frac{2\pi}{\lambda}D}}{2\pi D}$$
$$E_{z2} = \frac{-jI_o\eta_o e^{-j\frac{2\pi}{\lambda}(D+2\delta)}}{2\pi(D+2\delta)} \qquad (7)$$

Let us now compare the two equations in (7) to estimate the difference between the two types of measurements. If we separate the magnitude and the phase the following equations are found for the magnitude:

$$|E_{z1}| = \frac{I_o \eta_o}{2\pi D}$$
$$|E_{z2}| = \frac{I_o \eta_o}{2\pi (D + 2\delta)} \quad (8)$$

Since D>>2δ then it is true that D+2δ≈D. using this it can be said that:

$$|E_{z1}| \approx |E_{z2}| \quad (9)$$

So there appears to be a negligible effect on the magnitude. Let us now turn our attention to the phase. The phase of the fields is given by the following equations

$$\angle^{E_{z1}} = e^{-j\frac{\pi}{2}} e^{-j\frac{2\pi}{\lambda}D}$$
$$\angle^{E_{z2}} = e^{-j\frac{\pi}{2}} e^{-j\frac{2\pi}{\lambda}D} e^{-j\frac{2\pi}{\lambda}2\delta} \quad (10)$$

Hence, there is, as it should have been expected a phase difference of

$$e^{-j\frac{2\pi}{\lambda}2\delta} \quad (11)$$

For the EMCO 3146 antenna that we are using 2δ=6cm which is 2λ at 1GHz, for that case (11) becomes 1. For the lower frequencies where 2δ<<δ as is the case in 2δ=0.01λ then, the phase difference can be approximated as

$$e^{-j\frac{2\pi}{\lambda}(0.01\lambda)} = e^{-j0.02\pi} \approx e^{-j0} = 1 \quad (12)$$

In between these cases there may be points where the phase difference is π rad or any other number giving larger phase differences. These phase differences will not be apparent when looking at magnitude results.

III. Experimental Results

The derivations above assume that the dipoles on the array radiate in free space. This is not really the case in practice. A series of calibrations using two EMCO 3146A antennas where performed following the ARP-958 procedure. A total of 20 measurements where performed. Ten trials measuring the separation distance from tip to tip and another ten trials measuring the separation distance from element to element. The large number of trials was done to be sure that no variation existed from trial to trial.

Figure 3 shows the antenna factor vs. frequency for both measurement set ups.

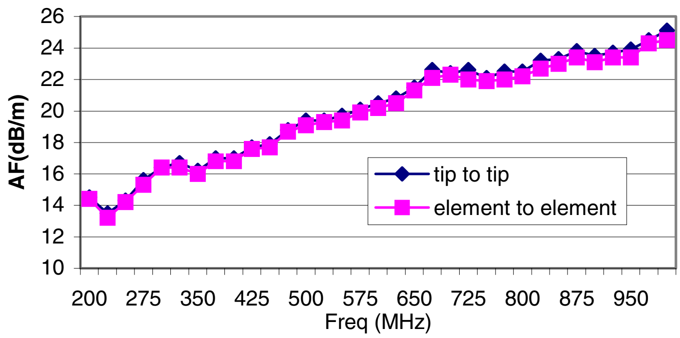


Figure 3. comparison of AF for tip to tip and element to element separation

As we see there is almost no effect from the small change in distance between the antennas when the 1m separation is taken from different points.

Figure 4 shows the difference on the antenna factors plotted in figure 3.

There appears to be a certain ripple to the difference in AF. This ripple seems to be periodic and it could be related to the periodicity of the phase error. It is also larger at the higher frequencies where the small 2δ change accounts for a larger phase difference.
The difference is still very small and could be ignored since at its maxima it is only 0.6dB/m.

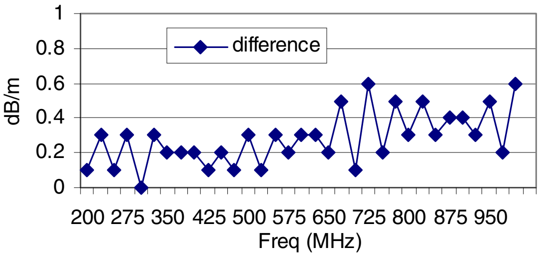


Figure 4. Difference in antenna factors from the two measurement set ups

Conclusion

Although the theoretical analysis of the problem is based on free space dipoles it correctly predicts the very small effect on the AF that the different ways of measuring the separation distance between the antennas has. The Experimental results where clear that, very small effects (0.3dB/m in average over the whole range of frequencies) are to be expected between calibrations conducted at 1 meter when the distance between the antennas is measured in slightly different ways. It is safe to say that for most practical purposes there is no difference on the AF measurements that can be obtained when measuring the distance between the antennas from the tips of the booms or from the highest frequency element.

Acknowledgement

The author would like to thank Ron Bethel, Senior Calibration Laboratory Technician and Lee Thompson, Calibration Laboratory Technician of ETS for performing the experiments that yielded the measured data.

References

[1] SAE, *Surface Vehicle Electromagnetic Compatibility (EMC) Standards Manual,* Society of Automotive Engineers, Inc.: Warrendale, PA, 1999

[2] Kraus, J. *Antennas.* 2nd Ed. McGraw-Hill: Boston, MA. 1988

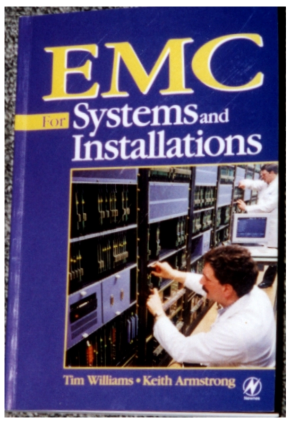
Biographical sketch.

Dr. Vicente Rodriguez-Pereyra, attended the University of Mississippi where he received the B.S., M.S. and Ph.D. degrees in Electrical Engineering/Electromagnetics in 1994, 1996 and 1999 respectively. In 1994 he joined the department of Electrical Engineering at the University of Mississippi as a research assistant working on cross-talk reduction and applications of the FDTD technique in electromagnetics. From August 1999 to May 2000 he was Visiting Assistant Professor of Electrical Engineering and Computer Science at Texas A&M University-Kingsville, Kingsville, TX, USA. In May 2000 he joined ETS as a RF/Electromagnetics Engineer. Dr. Rodriguez is co-author of more than 10 publications. He is a member of IEEE, and several of its technical societies; ACES; the Mississippi Academy of Sciences; and several honor societies, including Sigma Xi. Dr. Rodriguez is a registered E.I.T. in the states of Texas and Mississippi

BOOK REVIEW

EMC For Systems and Installations

Authors: Tim Williams and Keith Armstrong



The first three chapters deal with the need for EMC, the EMC Directives requirements in terms of systems and installations and the management aspects of EMC. The remaining chapters deal mainly with technical aspects to ensure or maintain compatibility.

Subjects covered in Chapters 4 to 7 include coupling, earthing and bonding, cabinets, cubicles and chambers and lastly cabling. Chapters 8 and 9 deal with filtering lightning and surge protection whilst chapter 10 deals with testing.

The author's approach is thoroughly practical and the introduction sets up the quality of the information that flows on through all the chapters.

This book is highly recommended for engineers who work in fields related to EMC. It can also serve as a useful reference for undergraduate and graduate students in electrical and electronic engineering who have an interest in EMC. The material covered in this book make it essential reading for product managers and suppliers.

INDUSTRIAL BRIEFS

SAR Measurements On Mobile Phones With Hands Free Kits for Australian Consumers' Association (Choice)

There have recently been media reports questioning the benefit of hands free kits in reducing the exposure of the head to Electromagnetic Radiation (EMR). The Australian Consumers Association (Choice) commissioned independent testing of mobile phones with and without hands free kits. Specific Absorption Rate (SAR) measurements were performed by EMC Technologies, an independent laboratory accredited for SAR measurements on mobile phones. The tests were performed with the "State-of-the-Art" Dosimetric Assessment System (DASY3) developed by the Swiss Federal Institute of Technology (ETH). The DASY3 is also known as the Kuster System.

Methodology

Specific Absorption Rate is defined as the rate of absorption of Electromagnetic Energy per unit mass of biological tissue. The measured SAR for each mobile phone quantifies the energy that will be absorbed by the part of the body exposed to the EMR, with and without the hands free kit (microphone and earpiece) in use. A Generic Twin Phantom filled with tissue simulating liquid, was used to simulate the human torso. The methodology used in this testing was generally in accordance with the mandatory human exposure standard specified by the Australian Communications Authority for mobile and cordless phones. SAR requirements are specified only for the head.

Baseline SAR measurements were first performed on three mobile phones (two 900 MHz GSM and one 835 MHz AMPS) transmitting at full power in the standard left and right ear Touch Positions. The second part of the testing evaluated the performance of the hands free adapters in reducing SAR inside the head. The hands free kits, (microphone and earpiece) were attached and the cable taped along the length of the phone and its antenna to represent worst case coupling of the EMR to the cable. SAR measurements were then performed inside the phantom at the ear position, first with the phone placed 70 cm away from the body (to simulate hand held use), and then with the phone mounted at the flat section of the phantom (to simulate waist or pocket-worn position). The third part of the tests evaluated the SAR performance of the three phones at the waist/pocket position.

Results

Both GSM phones complied with the Australian and New Zealand SAR limits when tested under normal conditions at the ear position. The New Zealand AMPS phone complied with the New Zealand limit but did not comply with the Australian limit.

The hands free kits reduced the SAR inside the head by worst case margins of 92% for the two GSM phones and 92% for the AMPS phone. The SAR reduction at the head was achieved for both hand held and body worn positions for each phone. A further reduction will be achieved when the hands free kit cable is arranged in a manner, consistent with normal use, away from the phone antenna.

The SAR of the New Zealand AMPS phone at the waist position (in hands free mode), exceeded the New Zealand (and Australian) SAR limits. It should be noted that no international standard currently exists for measuring SAR in the hip/waist.

Conclusions

The use of hands free kits with mobile phones greatly reduces exposure to the head, however, wearing the phone on the waist or in the pocket, places it, and the antenna in closer contact to the body and is likely to increase actual exposure. The exposure limits are unlikely to be exceeded when the phone is operated with hands free kit fitted and the phone held in the hand. A copy of the report including detailed procedures, photographs and SAR plots is available from the Choice website at *www.choice.com.au*

COMPANY ACQUISITION

The Laird Group PLC, a United Kingdom corporation, announced on August 7, 2000 that it had reached an agreement to acquire Instrument Specialties Company, Inc., a leading supplier of electromagnetic interference (EMI) shielding products to the electronics and telecommunications industries. The acquisition, which is expected to immediately enhance Laird's worldwide EMI position, is subject to the approval of the Laird Group's shareholders and the completion is expected to be on August 29, 2000.

The combination of I/S and Laird's existing fast growing EMI business, APM, Inc., will create the leading global supplier of shielding products to the rapidly growing worldwide electronics industries. As President of I/S, I'm extremely excited about the merger/acquisition and I am confident that the merged companies will create a significant presence in the worldwide EMI/RFI marketplace. The combination of the two companies will accelerate our existing rapid growth and continue to present associates from both I/S and APM with unlimited potential for personal growth opportunities. The combined companies will be over $200 million in fiscal 2001. Both I/S and APM operate facilities in North America, Europe, and throughout Asia. The Laird Group Chairman Nigel Keen commenting on the acquisition said:

"The acquisition of Instrument Specialties represents major strategic advance of the Group building on the success of its existing EMI shielding activities and creating a leading international supply position in a rapidly growing market."

INTERVIEW

Embracing A New Outlook For The Future Of EMC

The chairman of CISPR shares his views on how and why the criteria for EMC of the last century is not sufficient for the new one.

Peter J. Kerry

Q. Why do you believe that the EMC criteria of the last century are not sufficient for the future?

A. CISPR has its origins in the 1930s when the major concern was the protection of AM radio broadcast services. This early work has served us well, and has successfully evolved to cope with the protection of FM radio and traditional (television broadcasting services. However, the more recent technological developments are in a different category. In particular, digital radio and television services need different protection criteria, and new standards need to be developed to account for these changes.
Equally important, digital technology uses switching rates in the radio frequency range, which leads to new compatibility issues that will need to be considered. For example, the challenge of ensuring that high-speed data networks are protected from amateur radio transmissions has been highlighted in a recent European Telecommunications Standards Institute (ETSI) report.
In addition, the frequency range of radio services needing protection is increasing. Testing at frequencies above 1 GHz can be time consuming, and the open-area test site (OATS) was not designed for this. A further difficulty is that the radio spectrum is being used more intensively; consequently, it is becoming difficult to find quiet areas for the traditional OATS emission measurements. Hence, there is a need for the development of new measuring techniques.

A further example is the use of the quasi-peak (QP) detector for emission measurements. It was developed to simulate the audible impact of interference to AM broadcast services. We are now in an age of automatic testing, where not only are QP measurements slowing the process, but AM broadcasting is now only a small part of the services we need to protect. There is a need to review the use of the QP detector, not only for the benefit of radio users, but also to try to reduce the cost burden to industry. These are the major issues that indicate that while our predecessors have done good work that has stood the test of time, now is a time to look afresh at what is really needed for the coming years.

Q. What do you view as the most significant milestone in the history of EMC?

A. The banning of the spark transmitter was probably the first significant step in improving EMC; however, the impact of the EMC Directive has been much wider than this.
One of the driving factors behind the EMC Directive was the removal of technical barriers to trade within the European Union so that there were common requirements throughout the member countries. This has created a very large trading block with common EMC requirements, Many other countries have done something similar. Consequently, the IEC standards for EMC are increasingly being used for regulatory purposes throughout the world.

The EMC Directive was also unique in recognizing that immunity requirements were as important as emission. I recognize that this was a controversial decision, but it has raised the profile of EMC immunity and should reduce the number of interference complaints being recorded. Interference complaints are attributable most often either to poor immunity performance or to poor installation quality. While the immunity issue has been addressed, the issue of installation quality is one of the major challenges yet to be resolved.

The time available to develop the necessary standards for the directive was limited, and in order to meet the deadlines, the four generic standards were developed. These now serve as reference standards against which new EMC standards are compared, changing the focus from "what the product can easily meet" to "what is needed to protect radio services and the power network."

Q. How can industry designers' take into account the new and evolving radio services?

A. This question occupied my mind for a long time when I first took over as chair of CISPR. CISPR is unique in the International Electrotechnical Commission (IEC) in that it comprises not only national committees, but also key radio organizations such as the International Telecommunication Union Radiocommunication Sector (ITU-R), Civil Aviation Authority (CAA), European Broadcasting Union (EBU), and more recently ETSI. However, the CISPR structure was ineffective in allowing these organizations to be heard, and they had long ceased shouting when I came on the scene. Consequently the standards being developed were not taking into account new radio services.
My solution was to establish a new CISPR subcommittee (CISPR/H) or "limits" committee. CISPR/H provides a focus point for the radio interests. They provide input on radio parameters, and EMC standards are registered on a database. This process should facilitate the setting of EMC limits as a two-way process. This will not happen overnight, and there is a lot of catching up to be done. Openness and cooperation in designing new radio services and the setting of EMC limits is the only way we can operate in what is becoming an increasingly congested radio spectrum.

Q. How do you see industry reducing the number of EMC standards?

A. I do foresee a reduction in the number of EMC standards over the longer term, and there are several reasons for this, Technology convergence is one of the factors. The classic example is the new generation of televisions that have e-mail and Internet facilities, Currently manufacturers are testing these to four standards: CISPR 13) 20,22, and 24. This being costly and time consuming, something better is needed. CISPR is proposing to develop a new standard for such products. Some may see this as an increase in the number of standards, but for the many companies involved in producing multimedia products. This will be seen as a reduction long overdue.

The other factor pointing to the reduction in the number of standards is the change of focus from the ever-increasing number of products to that of the environment in which the product will be used. One has to ask the question, 'If one is trying to protect radio services, is there a reason for two products in the same room to have different EMC requirements?' While reasons for differences can be justified in some cases, the general answer is obviously, 'No'. It is for this reason that the generic standards are being used as reference standards. While these may not be well known in the EMC community, their immediate derivatives; CISPR 11 and CISPR 22, are the most widely used emission standards.

Within CISPR, one of our tasks is helping the various product committees apply CISPR limits to their products. Currently this involves duplicating parts of CISPR documents in other standards. In the longer term, I envisage product standards evolving into 'application guides' for the generic standards. With wider use of electronic publishing and hyperlinks, the number of standards will eventually fall. In the interim, keeping track of the many different EMC standards will continue to be a major task.

Q. How high -and why- should EMC testing be required to go?

A. The simple answer is: high enough! In reality, there is a need to balance the protection of radio services with the cost of testing. It has to be recognized that because the cost of testing escalates rapidly with frequency, unnecessary testing should be avoided. I would like to see not only all standards having limits up to the 18/22 GHz region, but also testing requirements being limited to what is appropriate for the product. While clock speed is often seen as a marketing issue, many manufacturers are beginning to realize the EMC advantages of keeping clock speed low. I would not like to see such manufacturers subjected to unnecessary testing. The debate over how to arrive at this balance really has yet to begin, so comments will be welcome.

Q. Why do alternative solutions require reviewing the fundamental concepts of EMC?

A. EMC is a big subject, so I will restrict my remarks to the subject of radio-frequency emissions. The basic question to be addressed is, 'What is radio interference?' Traditionally it has been something that can be heard or seen. Similarly some would regard it as interference only if it is significant enough to warrant a report to the authorities. Many consider the reduction in interference complaints reported in many countries a result of the emission limits being excessively stringent. My view is that there are many reasons for such reductions, and that some types of interference may never result in complaints. Cell phones, for instance, search for a vacant channel, and thereby automatically avoid those channels with interference. It may take considerable time before such interference is recognized. Similarly, digital services are immune to interference until it passes a threshold level. This may not be the fault of any individual piece of apparatus, but rather a collective problem.
These considerations are different from those that were used to derive the limits in current EMC standards. I believe that there is a need to review the fundamental concepts for EMC to account for the different world we are now in.

Q. Are current limits realistic?

A. This is probably the most difficult question, and there are no easy answers. First we have to decide: 'What is interference?' And, as we've just discussed, this question is far from simple to answer.
A further difficulty is that EMC and radio engineers tend to talk in different units with different criteria. As has often been said, the "80/80 rule" is no good if you are one of the "20/20." Realistic limits will not be achieved without the radio and EMC interests talking together to arrive at a common understanding of the problems. As I mentioned earlier, it was for this reason that I recommended the setting up of CISPR/H. The subcommittee has a major task ahead, but it is in everybody's interest to contribute to the subcommittee's success.

Peter J. Kerry has been with the Radiocommunications Agency and its predecessors for some 30 years. During this period, he has been involved with a wide range of radio systems. For the past decade, he has been responsible for EMC standardization and is currently the chairman of the international EMC standardization committee (CISPR). The Radiocommunications Agency is an executive agency of the UK's Department of Trade and Industry and is responsible for the radio spectrum in the UK. Kerry spoke with senior editor Sherrie Steward about his perspectives on EMC and the new challenges for CISPR and the industry.

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FROM THE U.S.A.

Risk Of Electromagnetic Interference With Medical Telemetry Systems

Currently in the USA, most wireless medical telemetry systems (WTMS) operate as secondary users in commercial broadcast TV bands. As secondary users WMTS must accept interference from and not cause interference with primary licensed users. Typically if there is interference from a primary user the medical telemetry system will be unusable.

The only effective solution is for hospital to use medical telemetry systems which operate in a new WMTS band.

History

This problem of interference with medical telemetry systems initially gained much attention when systems at two hospitals in Texas were disrupted by DTV transmissions from a local TV station. FDA issued a public health advisory on March 20, 1998, (that can be found at http://www.fda.gov/cdrh/dtvalert.html) which was followed by a joint FDA/FCC statement on March 28, 1998, describing the potential for interference between DTV and medical telemetry and offering temporary solutions. As a result, the FDA, FCC, and the American Hospital Association (AHA) began work toward developing permanent solutions to this potential problem. This work ultimately led to the FCC proposing the WMTS frequency bands.

The Wireless Medical Telemetry Service (WMTS)

On June 8, 2000 the FCC commissioners adopted a Report and Order that amends 47 C.F.R. Parts 2, 15, 90 and 95 to establish the new Wireless Medical Telemetry Service (WMTS). (The Report and Order can be found at http://www.fcc.gov/Bureaus/Engineering_Technology/Orders/2000/fcc00211.doc.) The frequency bands 608-614 MHz (TV channel 37), 1395-1400 MHz, and 1429-1432 MHz, have been allocated to the WMTS for use on a primary basis. The 608-614 MHz band will be shared on a co-primary basis with radio astronomy and operations. The 1395-1400 MHz frequency band has been allocated to WMTS. However, there are 17 government sites that are authorised to continue to use that band on a fully protected basis until January 1, 2009. Also, there are 14 government sites authorised to use the 1429-1432 MHz band until January 1, 2004. A listing of these sites and their locations is included in the appendices of the FCC Report and Order. The FCC will also designate one or more frequency co-ordinators, whose tasks will be to maintain a database of WMTS transmitters and notify users of potential frequency conflicts.

Starting two years from the effective date of the final rules on WMTS, the FCC will not approve new medical telemetry equipment that operated in the TV or PLMRS bands. There is no cutoff on the sale or use of equipment approved before that date to operate in the TV and PLMRS bands. However, the FCC will begin accepting high-power land mobile applications for the 450-460 MHz band January 29, 2001. They will begin accepting high-power land mobile applications for the 460-470 MHz band within three years. At the same time, TV broadcasters have deadlines by which they are required by the FCC to begin testing and transmitting in their allocated DTV channel. These actions will continue to increase the risk of interference to medical telemetry systems operating in the TV and PLMRS bands. For these reasons, the FDA and the FCC strongly encourage medical telemetry users to migrate out of the TV and PLMRS bands and into the WMTS as soon as reasonable.

In Australia

There have been reported instances of DTV interference with medical telemetry devices which were operating as unlicensed systems. The technical result of this was that the medical telemetry device could not be used satisfactorily.

FROM EUROPE

Voltage Fluctuations and Flicker

Phil Carter wrote an article some years ago which probably spearheaded the publicity that the standard attracted and which paved the way for its significant rewrite. Here he addresses some of the similar controversy surrounding the sister Standard on Flicker. He asks how the IEC and CENELEC systems allow these standards to be effectively Hijacked by vested interest and expand their scope to include parameters never considered in the original versions.

New amendments to EN 61000.3.3 introduce instruction on how to measure Peak Inrush Current, the majority of manufacturers and test houses however, did not even know this was a requirement of the standard. In fact, of some forty witnessed tests in accredited laboratories, only two had made the interpretation that the moment of switch on was included in the test cycle. **This can only be an indication of how unclear the standard is.** This article seeks to clarify the situation now and to comment on the evolution of the standard from its more humble beginning. It also argues that while concentrating on the worst standard in history, the now infamous Harmonics Standard EN61000-3-2 our eye was taken off the ball and now we are faced with a new monster.

Over 25 years ago it was already known that lights of rapidly varying intensity could cause a feeling of nausea, and worse even induce epileptic behaviour with variations of sufficient intensity and at particular frequency. It was on this basis then that a standard was developed to 'protect us' from the possibility of these voltage changes on the mains supply. This standard was originally based around the somewhat subjective view of a group of people looking at a light bulb and deciding at what rate the bulb could 'Flicker' before it might lead to these feelings. Following a mathematical frenzy by a couple of Professors and a big investment in University research funding, the flicker standard was born. This standard, IEC 555-3 introduced the Flicker meter, several new definitions, a more than adequate supply of horrendous mathematical formulae and the proposed ability to make measurements of subjective levels. This was the first standard applying limits for Flicker and Voltage Fluctuations and the scope of the standard applied to all household goods, such as those typically covered by CISPR 14.

To understand why some of the confusion exists, lets consider some of the text which appears in both the original IEC 555 –3 and in its successor IEC 61000-3-3:

In the scope of IEC 555 –3 the following note is provided for guidance

1 The limits in this section are based mainly on the subjective severity of the flicker imposed on the light from 230 V/60 W coiled-coil filament lamps by fluctuations of the supply voltage. For systems with nominal voltages less than 220 V, line to neutral and/or frequency of 60 Hz, the limits and reference circuit values have not yet been considered.

From the original standard we have the following statement under the heading of:

6. Test Conditions

6.1 General

Tests **shall** not be made on equipment which is unlikely to produce significant voltage fluctuations or flicker.

What does that statement really mean? Look at the actual definitions included in section 3 of the standard:

3.5 voltage fluctuation: A series of voltage changes or a continuous variation of the r.m.s. voltage.

3.6 flicker: Impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time.

It is important to remember that all the statements above are repeated in the EN61000-3-3:1995 document, it seems reasonable then to consider that the intended protection and measurement requirements are meant to be similar.

There was a new parameter introduced in 61000-3-3 called $\mathbf{D_{max}}$ but it was not considered as an addition to the requirement as none of the previous statements had been altered. What this was supposed to mean, other than a measurement of the maximum Voltage change observed during the measurement period is not clear, but it certainly was not something that the test community saw as a major change of requirement. As the scope of the standard still maintained, the main intent was still to consider the subjective severity of Flicker. Does this suggest that the result of a single event such as switching the EUT on should be included in the measurement?

It is hardly surprising that most test laboratories have not considered the moment of switch on as part of the test when the user prompt from most of the software controlled test systems tell the operator to switch on the EUT before commencing with the measurements!

So there we have it, a new amendment which has been approved at international levels and we are assured only after full consultation with all the relevant trade bodies. It was, we are told properly represented on the committees by a balanced representation of industry. It is also claimed that it does not represent any significant change to the requirement of the existing standard. This latter claim is made on the reasoning that the current standard required the inclusion of the moment of switch on anyway.

We have already seen that most of the laboratories did not come to that same conclusion and therefore most test results presented to all those manufacturers who have diligently tried to address this standard in anticipation of its legal mandate in January 2001, are in fact missing this now critical result. Where does that leave them, the amendment now even refers to Peak inrush current and an annex even defines the method of measurement. This includes multiple measurements to account for the variability of the switch and requires the taking of 24 separate readings appropriately spaced in time and then discarding the first and last and taking an average of the rest. The test is not strictly peak inrush but the inrush current measured in a half cycle, (10mS).

This in itself brings up a number of questions in the behaviour of Equipments when switched on, the standard tells us we may need to make locked rotor tests on motors to establish the inrush current, however a locked rotor may not behave anything like the starting rotor current over the first half cycle. Other significant variations involve the operating temperature of the motor at restart etc.

For many items of equipment the inrush currents quoted will present a significant design limitation and will require the inclusion of ‘soft start’ circuitry. There is some relaxation for equipment fitted with manual switching or delayed start.

For many manufacturers Flicker was never an issue, as the voltage changes during normal operation did not constitute levels that could have any noticeable effect. With the amendment now defining Inrush requirements and benefiting equipment with delayed start it is clear we have moved away from the standard being mainly based on the subjective severity of the flicker imposed on the light, to now being based mainly on how we can minimise the stress on the power generation system when equipment restarts after power outages.
Lets just repeat this in another way, the original standard was designed to protect us from the problems that may be caused by flicker and to the voltage fluctuations that may cause them. The new standard with these amendments now also covers all the steady state equipment below 16 amps that may draw more than the now specified inrush current. This represents a significant increase in the types of equipment that now must be considered. Was this major change in direction mandated by CENELEC and the IEC or are the committees now so powerful that they can change direction and introduce new requirements without proper cost analysis of the impact against any advantages such standards will have?

I also ask the question why did the standard evolve in what can only be described as a devious way with paragraphs added in successive versions that were so confusing that the majority of the users did not arrive at the conclusion the committee desired until some 5 years later and only then when the amendment hit the streets.

Finally then to put some dimension to what the amendment and new limits mean the following are extracts from the amendment, I have added in brackets some indication of what that means in current terms.

> “the maximum relative voltage change dmax, shall not exceed:
> a) 4% without additional conditions. **(20 Amps)**
>
> b) 6% for equipment with automatic switching more frequently than twice per day and has a delayed restart (the delay being not less than a few tens of seconds) or
> manual restart after a power supply interruption. **(30 Amps)**

NOTE - The cycling frequency will be further limited by the Pst and Plt limit. For example: a dmax of 6% producing a rectangular voltage change characteristic twice per hour will give a Plt of about 0,65.

> c) 7% for equipment which **(35 Amps)**
> - is attended whilst in use (For example: hair dryers, vacuum cleaners, kitchen equipment such as mixers, garden equipment such as lawn mowers, portable tools such as electric drills.) or
> - is switched on automatically or is intended to be switched on manually no more than twice per day and has a delayed restart (the delay being not less than a few tens of seconds) or manual restart after a power supply interruption.
> In the case of equipment incorporating multiple loads, the b) and c) limits shall be applicable only to delayed loads; for all loads which are energised immediately on restoration of supply after a power supply interruption the limits given in a) shall be applied.”

The calculations of the current limits are only approximate and are based on the following table.

As stated previously the actual current is calculated from the voltage change as measured during the 10mS half cycle and therefore will not directly correlate with the figure calculated above.

	Complex		Ohms
Impedance	0.4	0.25	0.472
			Volts
Voltage	240	4.00%	9.6
	240	6.00%	14.4
	240	7.00%	16.8
			Current
		a)	20.35
		b)	30.53
		c)	35.62

I have been told by members of the committee responsible for this change that this did not need to be considered a major change as it was all within the current scope of the standard. It will be interesting for some of those manufacturers who have been complying with the IEC/EN 60555 requirements for many years, to now find that they fail against a standard that they had previously been assured has not changed its scope. Even more interesting then that an even more recent amendment currently going through the system is to change the scope to include "Voltage changes", it seems clear then that the policy now is to sneak in all the big changes under an umbrella of minor corrections and clarifications, and then later to bring the scope into line.

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Phil is Director of aCEmark europe ltd, a Company which provides consulting and training in the EMC and Laboratory accreditation/Quality systems business. He has been the main EMC Assessor for UKAS, (United Kingdom Accreditation Service) for many years, Phil is also a Lead Assessor for the Irish National Accreditation Board (NAB) and for Norwegian Accreditation (Justervesenet). He also regularly visits many other EMC test laboratories around the world.

Following an article published a few years ago on the ambiguities and interpretation problems of Specifications and particularly the Harmonic emissions standard. Phil was involved in the Working group which drafted the basis for amendment A14 to the EN 61000-3-2 harmonic emissions. www.acemark.com

EMC 2000 WASHINGTON D.C.

The EMC 2000 Symposium was held in Washington, and again there was a record number of attendees and exhibitors. This together with the depth and content of technical papers from all the world makes this EMC show a "must see" for the EMC enthusiast.

The theme of this years symposium was " A spectrum of Challenges for the Next Millennium" and clearly, this was one of the best attended EMC shows ever with well over the 2500 people of last year. The number of exhibitors was around 200. The setting was the Washington Hilton, (the hotel where Ronald Reagan was shot). The excellent conference facilities greatly facilitated the presentation of papers. There was great interest in all the reverberation chamber papers.

There is a much greater use of reverberation chambers for doing emission and immunity testing of various systems and components. This is particularly the case in the automotive and aerospace industry for the manufacturers of the assemblies as well as for the sub assembly suppliers. System users are greatly interested because of the capacity of a reverberation chamber to test large systems. A large percentage of papers were about radiated emissions, OATS or test chambers as well as fully lined absorber chambers. Printed circuit board issues also were of great interest with papers, practical demonstrations and poster reflecting the popularity of the topic.

EMC is expanding as more industry groups recognise the importance of EMC as a key risk area, which must be addressed in system, assembly and sub assembly design. This year Transport was represented as a group, and there was even more interest in EMC for medical devices this year.

As a global symposium, with papers from all over the world, the efforts of the work that has gone into MRAs is clearly emerging, as more barriers slowly come down. This is the good side of globalisation which most people do not see.

Dr Franz Schlagenhaufer from the University of Western Australia was also in attendance as was Kevin Fynn from Curtin University. Overall Australia was well represented this year, however, there was clearly an absence of regulators and qualifiers. Maybe in the future……?

Kingsley McRae

EMC NOTEBOOK

Cable Coupling – The Twisted Pair

Many EMC problems arise due to cable coupling techniques particularly in the use of shielded or screened cables and coaxial cables. The immediate thought that jumps to mind when structuring layouts is to use screened cables to eliminate radiation. However this is not always the solution as generally cable screens should be bonded to local earths at both ends and this in itself can give rise to significant earth loop currents and hence radiation. A common mode current path exists between the outer conductor (screen) and earth and this is because the screen of a coaxial cable carries the return current of the signal in the centre conductor.

The twisted-pair is quite often the simple solution to reduce emissions and immunity problems caused by common mode currents of coaxial cables. To those of us who still remember the "old valve" days you will recall that the filaments of the valves were usually heated by a 6V, 50 Hz source. To eliminate the 50 Hz interference in the "super-het" the filaments of each valve were wired in parallel using twisted pair coupling from a 6V secondary on the power transformer.

The twisted pair ensures that the signal and its return are closely coupled in an adjacent conductor pair. The magnetic field coupling with the pair is continually changing orientation and hence the coupling from each successive half twist will cancel from the previous one. The electric field coupling is more balanced to each half of the pair than if the pair was untwisted. Tight twisting of the pair gives rise to small areas of each half twist influenced by field variation and provides better balance. The twisted pair cable is particularly effective at LF and wideband EMC.

NEWS FROM ACA

EMR Compliance Self-Assessment Trial

The ACA is conducting a voluntary trial of materials for self-assessing electromagnetic radiation (EMR) compliance. The materials will allow licensees of certain radiocommunications transmitters to self-assess compliance of their transmitter against the limits in the Radiocommunications (Electromagnetic Radiation-Human Exposure) Standard 1999 (as amended from time to time).

Although the standard currently applies only to transmitter installations supporting cellular mobile telecommunications services, all radiocommunications transmitters will be subject to the standard by the end of 2001.When the regulatory arrangements are fully in place, the ACA intends to allow some licensees to determine whether their installations comply with the standard, subject to audit by the ACA. In anticipation of these changes, the ACA is making the self-assessment materials available to licensees to trial on a voluntary basis, before the full implementation of the EMR regulatory arrangements.

The trial will assess the effectiveness of the self-help guidelines by obtaining feedback from the licensees, which will enable the ACA to fine-tune the materials. The trial will also provide licensees with the opportunity to bring their installation into compliance before the arrangements are fully implemented.

Based on sound engineering practice, the self-assessment materials include charts and graphs that will allow trialing for the following radiocommunications services:

* low power TV and radio broadcast;
* paging;
* land mobile; and
* fixed links.

There are also materials designed for amateur radiocommunications operators. The materials are designed to assist licensees to make a simple assessment of whether their transmitting facilities comply with the EMR Standard.

The self-assessment materials will be available for trial between I September and 31 December 2000. Licensees using the materials will be requested to return an evaluation questionnaire to the ACA. Participants may also be offered a free validation of their assessment through measurement by the ACA.

Licensees wishing to take part in the trial may use an application form on the ACA website at:
www.aca.gov.au/standards/emr.htm
or contact the ACA on telephone: (02) 6256 5552.

CALENDAR OF EVENTS

2000

November 15 - 18 EMC 2000 Shanghai International Exhibition on EMC, Shanghai Mart, China
Info: Worldwide Exhibition Services Co., Ltd, Mr. Yimin Xu
Room 2706, Nanzheng Building, 580 Nanjing Road, Shanghai 200041
Phone: +86 21 52340 646 Fax: +86 21 5234 0649 weszhou@online.sh.cn

December 12 - 14 EMC Asia, 2000
Taipei Tourism Bureau
Taipei, Taiwan

December 14 - 15 EMC 2000, National Conference on Electromagnetic Compatibility
Hotel Grand Days, Chenmai, India
Contact R.Gaveson
Phone 44 235 0747 sameercern@vsne.com

2001

February 20 – 22 EMC Zurich'01, Swiss Federal Institute of Technology, Zurich, Switzerland
Info: Dr. Herbet Kramer
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March 13 - 15 EMV 2001, Exhibition Centre, Augsburg, Germany
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May 13 – 17 2001 International Symposium on Electromagnetic Theory
Victoria Canada

July 8 – 13 2001 IEEE AP-S URSIO
International Symposium
Boston, MA

July 18 – 22 PIERS'01
Osaka, Japan

August 13 – 17 2001 IEEE EMCS Symposium on Electromagnetic Capability
Palais de Congres, Montreal, Canada
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AMENDMENT 1 BRINGS IMPROVEMENTS TO CISPR 11

Daniel Hoolihan

Amendment 1 to CISPR 11:1997 was released by the International Electrotechnical Commission (IEC) in May 1999. CISPR 11 ("Industrial, Scientific, and Medical (ISM) Radio -Frequency Equipment-Electromagnetic Disturbance Characteristics-Limits and Methods of Measurement") is the most widely used document for measuring electromagnetic emissions from medical devices. It and its Amendment 1 were developed by technical experts from around the world serving on Subcommittee B of CISPR, the International Special Committee on Radio Interference. The amendment makes several major changes in the document, along with some minor ones. It adds lighting apparatus for ISM equipment to the scope of the standard, and it changes a required antenna distance for radiated emissions for a key class of ISM equipment. Because CISPR documents take the form of recommendations, the new amendment has no impact on regulations around the world until countries adopt its provisions into their laws and directives.

This article itemizes key constituents of CISPR 11, Amendment 1.

Change in Scope

Amendment 1 has added requirements for ISM lighting apparatus operating in the protected frequency bands of 915 MHz, 2.45 GHz, and 5.8GHz. (The 915MHz frequency is only permitted in Region 2 as defined by the International Telecommunications Union Radio Regulations.) Note: All other types of lighting apparatus are covered in CISPR 15, "Limits and Methods of Measurement of Radio Disturbance Characteristics of Electrical Lighting and Similar Equipment."

Normative References

To the "Normative References" section another standard was added: IEC 60705: 1999, "Household Microwave Ovens- Methods for Measuring Performance."

Limits of Electromagnetic Disturbance

The limits for ISM lighting devices within the expanded scope of the document are the same as those for Class B, Group 2 ISM equipment. These limits are given in Tables I and II, for conducted energy and electromagnetic radiated disturbances, respectively.

Class B Equipment Limits dB (μv)		
Frequency Band (MHz)	Groups 1 and 2	
	Quasi Peak	Average
0.15 – 0.50	66 Decreasing linearly with logarithm of frequency to 56	56 Decreasing linearly with logarithm of frequency to 46
0.50 - 5	56	46
5 - 30	60	50
Note: Care should be taken to comply with leakage current requirements.		

Table 1. Mains terminal disturbance, voltage limits for Class B equipment measured on a test site.[1]

Frequency Band (MHz)	Quasi-Peak Electric Field 10-m Measurement Distance dB (μv)	Quasi-Peak Magnetic Field 3-m Measurement Distance dB (μA/m)
0.15 - 30	-	39 Decreasing linearly with logarithm of frequency to 3
30 – 80.872	30	-
80.872-81.848	50	-
81.848-134.786	30	-
134.786-136.414	50	-
136.414-230	30	-
230-1000	37	-

Table II. Electromagnetic radiation disturbance limits for Group 2, Class B equipment measured on a test site[1]

A major change in testing requirements pertains to Class A, Group 1 equipment as shown in Table III. When tested on an open-area test site (OATS), this class of equipment shall now be measured at a 10-m antenna distance for radiated emissions rather than the previous 30-m distance. This has a tremendous impact on testing laboratories that have been having trouble making 30-m measurements because of high ambient signal levels. Also, many labs that have gone to 10-m absorber-lined chambers can now make this measurement at the 10-m distance inside their protected environment.

Frequency Band (MHz)	Measured on a Test Site		Measured In Situ
	Group 1, Class A (10-m measurement distance) dB(μV/m)	Group 1, Class B (10-m measurement distance) dB(μV/m)	Group 1, Class A (Limits with measuring distance 30m from exterior wall outside the building in which the equipment is situated) dB(μV/m)
0.15 – 30	Under consideration	Under Consideration	Under Consideration
30 – 230	40	30	30
230 – 1000	47	37	37

Table III. Electromagnetic radiation disturbance limits for Group 1 equipment.[1]

In addition, table 5 of CISPR 11 has been changed by the amendment to reflect antenna distances of 10 m rather than30 m. However, in the case of any dispute, Class A, Group 2 equipment shall be measured at a distance of 30 m.

1-18 GHz Frequency Band

Amendment 1 introduces significant changes in the requirements of CISPR 11 for the frequency range from 1 to 18 GHz. In the 1997 standard, limits were under consideration everywhere within this range except for the narrow frequency band of 11.7-12.7 GHz. For Group 1 ISM equipment, limits are still under consideration (radiated disturbance limits for Group 1 ISM equipment are intended to be identical to the limits currently under consideration for information technology equipment (ITE) above 1 GHz), and with respect to Group 2 ISM equipment, limits are under consideration for Class A equipment. However, a more complicated scenario applies to Class B, Group 2 equipment.

Limits are under consideration for Class B ISM equipment operating at frequencies below 400 MHz. When finalized, these limits will be introduced together with the following conditional testing clause: "If, in the band from 400 MHz to 1 GHz, all emissions are below the Class B limits and the fifth harmonic of the highest internally generated source is lower than 1 GHz (i.e., the highest source is less than 200 MHz), no testing above 1 GHz is required." For Class B, Group 2 ISM equipment operating above 400MHz, the limits are specified in new tables 8, 9 and 10 of the amendment. It is also necessary to use a new decision tree, which appears as figure 5 of the amendment (see Tables IV-VI and Figure 1).

Frequency Band (GHz)	Field Strength at a Measurement Distance of 3 m dB(µV/m)
1 – 2.4	70
2.5 – 5.725	70
5.785 – 18	70
Note 1: For the protection of radio services, competent national authorities may require lower limits. Note 2: Peak measurements with a resolution bandwidth of 1 MHz and a video signal bandwidth equal to or higher than 1 MHz	

Table IV. electromagnetic radiation disturbance peak limits for Group0 2, Class B ISM equipment producing CW-type disturbances and operating at frequencies above 400 MHz.[1]

Frequency Band (GHz)	Field Strength at a Measurement Distance of 3 m dB(µV/m)
1 – 2.3	92
2.3 – 2.4	110
2.5 – 5.725	92
5.875 – 11.7	92
11.7 – 12.7	73
12.7 – 18	92
Note 1: for the protection of radio services, competent national authorities may require lower limits	
Note 2: Peak measurements with a resolution bandwidth of 1 MHz and a video signal bandwidth equal to or higher than 1 MHz Note 3: Limits in this table were derived considering fluctuation sources such as magnetron-driven microwave ovens.	

Table V. Electromagnetic radiation disturbance peak limits for Group 2, Class B ISM equipment producing fluctuating disturbances other than CW and operating at frequencies above 400 MHz.[1]

Measuring Instrument

Specific details relating to the measuring instrument have been replaced by a note in the amendment. The note simply refers the user to the latest characteristics of a spectrum analyzer as defined in CISPR 16-1, "Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods."

Antennas

This section contains some substituted new words, which read: "For measurements at frequencies above 1 GHz, the antenna used shall be as specified in CISPR 16-1."'

Microwave Cooking Appliances

With the amendment, words have been added to this clause and new words substituted for old. The dimensions of the container are referenced to the new standard IEC 60705, and the material of construction may be glass or plastic or some other nonconductive substance.

Specific measurement instructions have been added for peak measurements above 1GHz. The amendment states that "measurements shall be made with the azimuth of the Equipment Under Test (EUT) varying every 30° (starting position perpendicular to the front door). At each of these 12 positions, a maximum hold shall be made for a period of 20 seconds. Then, at the position where the maximum occurred, a maximum hold for a period of 2 minutes shall be made, and the result compared with the relevant limit."

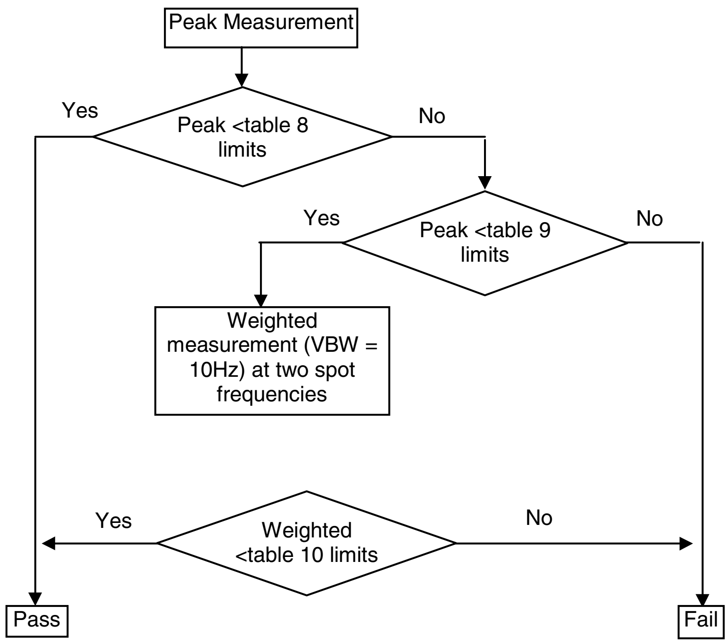
Radiation Measurements (9 kHz to 1 GHz)
In the original paragraph 7.1.3, the wording suggested that measurements could be made at distances closer to the EUT than specified, but that the limit could not be changed; that is, the limit stayed the same even though the tester was closer to the EUT and the field strength was stronger. Amendment 1 explicitly permits measurements at the closer distance (because of high ambient noise levels or for other reasons), requiring that the test report record the distance and the circumstances of the measurement. Importantly, the new language allows an inverse proportionality factor of 20 dB per decade to be employed to normalize the measured data to the specified distance for determining compliance of the product under test. The amendment cautions that "care should be taken in measuring a large test unit at 3 meters at a frequency near 30 MHz due to near-field effects."'

Receiving Antenna (1-18 GHz)
An added note says that "the distance between the receiving antenna and the EUT shall be 3 meters."

Validation and Calibration of the Test site (1-18 GHz)
The amendment substitutes new words here to make reference to CISPR 16- 2, "Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods," and to specify that "test sites validated for field measurements between 30 MHz and 1 GHz may be used for measurements above 1 GHz, provided that absorbing material is placed on the ground between the EUT and the receiving antenna."

Measuring Procedure (1-18GHz)
In this area Amendment 1 adds the following recommendation: "The general measuring procedure above 1 GHz specified in CISPR 16-2 should be consulted for guidance."
The amendment also adds this language to Clause 8.4: "Peak measurements above 1 GHz (see table 8 or table 9) shall be the result of a maximum hold on the spectrum analyzer. Weighted measurements above 1 GHz (see table 10) shall be the result of a maximum hold and shall be performed with the spectrum analyzer in logarithmic mode (values displayed in decibels)."

Annex A
This annex presents examples of equipment with their appropriate classifications. Amendment 1 adds microwave lighting apparatus to the list.



Conclusion
The first amendment to CISPR 11:1997 contributes some important clarifications to that document. It adds certain lighting devices to the scope of the standard. It has changed antenna measurement distances for an important class of products, allowing EMC testing laboratories to make measurements at a 10-m distance, either inside an absorber-lined chamber or on an OATS, instead of at 30 m. And it modifies measurements between 1 and 18 GHz in order to reflect changes in test equipment and field experiences with products operating in that range. Overall, the changes are an obvious improvement on the 1997 version of CISPR11.

Frequency Band (GHz)	Field Strength at a Measurement Distance of 3 m dB(µV/m)
1 – 2.4	60
2.5 – 5.725	60
5.875 – 18	60
Note 1: For the protection of radio services, competent national authorities may require lower limits Note 2: Weighted measurements with a resolution bandwidth of 1 MHz and a video bandwidth of 10Hz. Note 3: To check the limits of this table, measurements need only be performed around two center frequencies. The highest emission in the 1005 – 2395 MHz band and the highest peak emission in the 2505 to 17,995 MHz band (outside the band 5720 – 5880 MHz). At these two center frequencies, measurements are performed with a span of 10 MHz on the spectrum analyser.	

Table VI. Electromagnetic radiation disturbance weighted limits for Group 2, Class B ISM equipment operating at frequencies above 400 MHz.[1]

Regulated Equipment Defined by Category
Group 1 ISM equipment is equipment containing intentionally generated and/or used conductively coupled radio-frequency energy that is necessary for the internal functioning of the equipment itself.
Group2 ISM equipment is equipment in which radio-frequency energy is intentionally generated and/or used in the form of electromagnetic radiation for the treatment of material, as well as spark-erosion equipment.

Within each group:
Class A equipment is equipment suitable for use in all establishments other than domestic and those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.
Class B equipment is equipment suitable for use in domestic establishments and in establishments directly connected to a low-voltage power supply network that supplies buildings used for domestic purposes.

References

1. The tables from CISPR II (1999-08) Ed 3.1 Consolidated Edition are reproduced here with the permission of IEC (Geneva). All IEC publications are available from *http://www.iec.ch* or any IEC National Committee. IEC takes no responsibility for and will not assume liability for damages resulting from the reader's misinterpretation of the referenced material due to its placement and context in this publication.

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CISPR 15

Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment.
The latest issue (CISPR 15 Ed. 6.0) adds requirements for independent starters and igniters for fluorescent and other discharge lamps. Requirements for lighting equipment which operates in one of the four ISM frequency bands are deleted from CISPR 15. Together with all other ISM equipment these kinds of devices are now covered by CISPR 11. For the measuring method with the large loop antenna, reference is now made to CISPR 16.

IEC 61000-4-20

Electromagnetic Compatibility Part 4-10: Testing and Measurement Techniques – Emission and Immunity Testing in Transverse Electromagnetic (TEM) Waveguides.
An amendment to this IEC 61000-4-20 will allow emission measurements of small objects, but only if the correlation to an OATS is shown. The standard will contain general information on the new test procedures and all types of TEM waveguides are covered in these procedures.

AS 62040.2

DR00248 CP Uninterruptible power systems (UPS) Part 2: Electromagnetic Compatibility (EMC) requirements has been issued in draft for comment. This standard has been reproduced from and is identical to IEC 62040.2: 1999.

CURRENT AUSTRALIAN/NEW ZEALAND STANDARDS

*	AS/NZS	1044:1995	Household motor operated and thermal appliances, electric tools and similar appliances
*	AS/NZS	1053:1999	Sound and TV receivers and associated equipment
*	AS/NZS	2064:1997	Industrial, scientific and medical radio frequency equipment
	AS/NZS	2344:1997	Overhead a.c. power lines and high voltage equipment (0.15 to 1000 MHz)
	AS	2362.7-1990	Automatic fire detection and alarm systems
*	AS/NZS	2557:1992	Vehicles, motor boats and spark-ignited engine driven devices
	AS/NZS	3200.1.2:1995	Medical electrical equipment – General requirements for safety and EMC
	AS	2772.2-1998	Radio frequency radiation, Pt 2. Principals and Methods of measurement.
	AS	4428.0-1997	Fire detection, warning, control and intercom systems
*	AS/NZS	3548:1995	Information technology equipment
*	AS/NZS	3652 (Int):1998	Arc welding equipment
*	AS/NZS	4051:1998	Lighting and similar equipment
*	AS/NZS	4251.1:1999	Generic emission standard Residential, commercial and light industry
	AS/NZS	4417.1:1996	Marking of electrical goods to indicate compliance, general rules
	AS/NZS	4417.3:1996	Specific requirements for EMC regulatory applications
	AS/NZS	4448:1997	Protection of receivers on board vehicles
	AS/NZS	61000.3.2	Limits for harmonic emissions (current equal to or less than 16A)
	AS/NZS	61000.3.3:1998	Voltage fluctuations and flicker (current equal to or less than 16A)
	AS/NZS	61000.3.5:1998	Voltage fluctuations and flicker (current greater than 16A)
	AS/NZS	1088.9:1995	Hearing Aids, Immunity requirements
**	AS/NZS	4053:1997	Sound and TV receivers and associated equipment (Immunity)
**	AS/NZS	4252.1:1994	Residential, commercial and light industry (Immunity)
	AS/NZS	1052.1:1995	Radio disturbance and immunity measuring apparatus and methods
	AS	60870.2.1:1998	Telecontrol equipment and systems operating conditions, power supply
	AS	4168.2:1994	Programmable controllers, equipment requirements and tests
	AS/NZS	3947.1:1998	Low voltage switch-gear and control gear
	AS	1284.5:1992	Electricity metering, general purpose watt hour meters
	AS	1284.6:1992	Electricity metering ripple control receivers for tariff and local control
	AS/NZS	61000.4.7:1999	General guide on harmonics and interharmonics for power supplies and connected equipment
	AS/NZS	4251.2:1999	Generic emission standard Industrial environments
	AS/NZS	1052.2:1999	Radio disturbances and immunity measuring apparatus and methods
	AS/NZS	61000.2.3:1999	Radiated and non-network frequency-related conducted phenomena
	AS/NZS	61000.2.5:1999	Classification of electromagnetic environments
	AS/NZS	61000.4.1:1999	Overview of immunity tests
	\	61000.4.5:1999	Surge immunity test
	AS/NZS	61000.4.6:1999	Immunity to conducted disturbances, induced by radio frequency fields

Emission Standards
The Radio Frequency (RF) emission standards are intended to reduce the levels of intended emissions from electrical and electronic goods to an acceptable level.

*** Introduced** on a mandatory basis from 1 January 1997 and are the first standards to be phased in by the ACA as part of the EMC framework. The subsequent ACA Radiocommunications (Electromagnetic compatibility) Standard 1998 issued on 11th November 1998 designates which AS/NZS standards currently apply. Updates of the relevant EMC framework standards are listed above, together with other published standards with EMC tests.

**** Immunity Standards**
Immunity standards are not currently mandatory under the EMC framework. The basic strategy of the EMC framework is to provide for management of both emissions and susceptibility over time. The role of immunity standards is to establish a basic level of protection for products that are susceptible to interference effects. The ACA has advised that it will reconvene a working group to consider extending the EMF framework to cover immunity standards and systems and installations. ACA staff members are preparing a discussion paper on these issues and have requested input on the application of immunity standards and how EMC standards might be applied to systems and installations.

NEW MEMBERS

For those who have not yet joined our EMC Society we would ask you to fill in our membership application form and encourage your colleagues to follow suit. If you have applied for membership but not yet received an invoice from IEAust, would you please fill in and submit a new application form.

MAILBOX

We invite all our members and readers to participate in our quarterly newsletter. In order to produce a better newsletter and provide our readers with the information and items of interest looked for, we welcome your comment, advice and criticism. Particularly, we would look forward to receiving technical articles, amusing anecdotes and items of general interest to the EMC community.

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The EMC Society offers corporate Membership to organisations who may wish to nominate up to three people for membership. It also provides an important source of funding to the Society and we would like to take this opportunity to recognise the 2000 corporate Members.

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The EMC Society would like to express gratitude to Advantec, Department of Defence, Rittal, Robert Bosch, and Tenix for their support in 2000.

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The IEAust Electromagnetic Compatibility Society is grateful for the assistance given by the firms listed and invites application for Institutional Listings from other firms interested in the electromagnetic compatibility field.

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