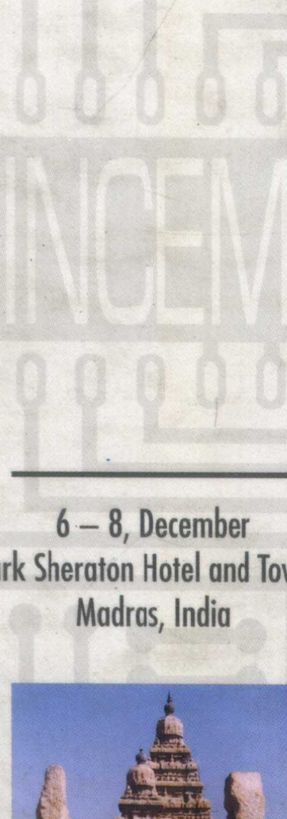
CONFERENCE PROCEEDINGS

15821

1995 International Conference on Electromagnetic Interference and Compatibility (INCEMIC)

Organised by The Society of EMC Engineers (India)

6 – 8, December
Park Sheraton Hotel and Towers
Madras, India



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Chairman's Message

The INCEMIC'95 committee and the Society of EMC Engineers (India) extend a hearty welcome to all the delegates to the fourth International event being held in Madras during December 6-8, 1995. We, in India have come a long way in practicing rigorous EMI testing and EMI control of defence electronic systems as well as industrial products for compliance with EMC regulations. The realisation has bugged our industry captains to put concrete efforts for quality improvement of electronic products to be globally competitive in the post economic liberalisation era. The impact of non-performance of a designed product due to non-compliance of accepted EMC norms and standards without the iron rod legislative sanction in our case, will put our indigenous products out of market. The EMC is a global concern and it is amply proved by European union's EMC directives and other agencies like CISPR, FCC, IEEE etc. Hence, by its nature the practice of EMC requires a continuous awareness programme of what is happening in the contemporary technology. These days 'EMC Science' is accepted and respected as a technical discipline and deserves a rightful recognition in our over crowded under-graduate level of engineering.

The EMC design and standards have proliferated over the years, as governing bodies world-wide have imposed their own set of requirements to ensure that designed electronic equipment functions desirably in its intended environment. EMC standards and specifications are constantly modified/upgraded world over to suit the reality of globalisation of market. It is always prudent to think that it should be a reality now for harmonisation of EMC standards and method of testing on an international level. I strongly believe it is very important to become a party of the unified EMC culture. Our theme during this event "EMI in Communication Systems - European Community EMC Directive" is absolutely perfect, considering the marriage of information technology , consumer electronics and communication systems in today's global market. The fruitful wireless revolution of nineties that will bring about an EM situation along with intelligent computation needs to be looked into in an over all EMC environmental design perspective to avoid information blockage.

The crux of the problem is "Human Resource development and EMC technology educated engineers". Hence, inclusion of a balanced EMC undergraduate course in our engineering curricula is a must. The slogan should be "EMC education for all" especially for those who are involved in a system design life cycle.

MADRAS INCEMIC is all set to discuss most of these problems during the workshop and conference to be attended by galaxy of EMC national and international experts during 4-8 December 1995.

Our committee has worked very hard and put its best. I am very thankful to all my colleagues for that.

I sincerely express my thanks to IEEE, Madras section, Society of EMC Engineers (India), SAMEER - CEM, Madras, Department of Electronics, Govt. of India, and several agencies and various academic institutions for extending their support for the success of fourth INCEMIC'95.

On behalf of INCEMIC '95 Committee a hearty welcome to all the delegates.

G.K. Deb
Honorary Chairman,
INCEMIC'95

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INCEMIC '95

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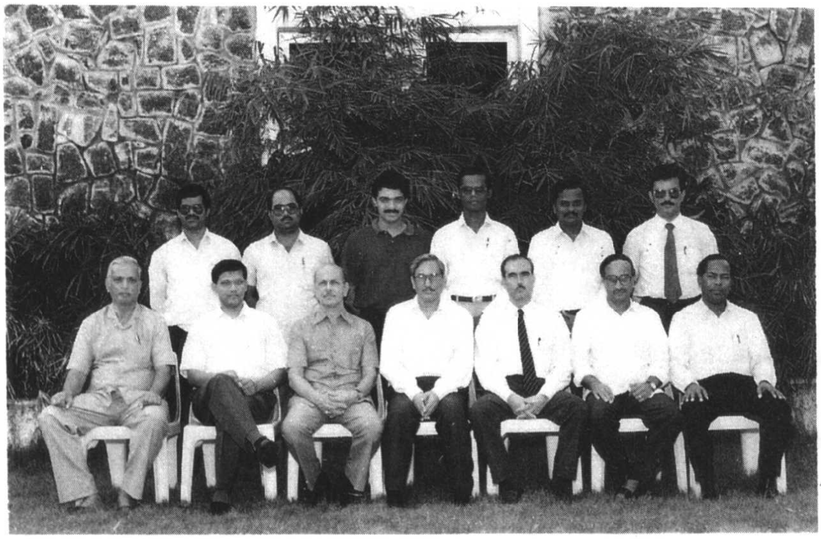

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SAMEER, Madras.

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THE EFFECT OF NEW EUROPEAN NORMS ON THE WORLD EMC MARKET

Michael Norton, President
KeyTek Instrument Corporation

Introduction

The European Union has issued an EMC Directive requiring virtually all electrical and electronic products be tested for EMC compliance. This Directive will have an economic effect on manufacturers world-wide and influence standards development at international, national and corporate levels. Although the test requirements are driven by actual events involving public safety, the standards themselves now only require minimum levels of testing. As the EMC field grows and expands, standards need to evolve and become more realistic.

Driving Forces

As electronic products evolve, there is a continuing requirement for more capability in smaller packages. This requires smaller and faster electronic devices, which by their nature become more sensitive to the effects of electromagnetic fields in the environment, and become a source of unwanted electromagnetic radiation themselves.

Today, we have an unprecedented increase in use of portable cellular telephones, each of which produces electromagnetic fields intentionally, and each of which is a potential source of interference to nearby electronic circuits and systems. Add these to the numbers of existing radio transmitters, plus all the *un*intentional radiators, such as your personal computer and the microprocessor controlling your automobiles engine, and it becomes easy to see that there will be an increasing compatibility problem.

In recent years, a number of incidents involving EMC safety have been reported in the media, including:

- An aircraft navigation system was being blocked by radiation from a lap-top computer. The pilot of the jetliner documented that when a passenger in first class turned off a lap-top computer, the malfunctioning navigation instruments recovered completely. All airlines now prohibit the use of electronic products during taxi, takeoff, and landing.

- An electric wheelchair went out of control and seriously injured a handicapped person. The ability of electromagnetic radiation to cause an electric wheelchair to become uncontrollable was documented by the U.S. FDA in lab experiments.

- In one hospital, a cellular telephone caused the incubators to fail in an incubation ward. In another hospital, a drug infusion machine malfunctioned, also caused by a cellular telephone being used in the immediate vicinity. These incidents have led to a ban on the use of cellular telephones in many hospitals

There are many other documented cases, as well as a number of incidents where EMC is suspected of being the cause of failures in electronically controlled machines. Electronic pacemakers seemed to be relatively immune, but new anecdotal evidence exists regarding malfunctions being attributed to EMC.

The EMC Directive

The EMC Directive requires all electrical and electronic products be tested for both immunity to EMI and for unwanted emissions. It applies to all electrical and electronic products being shipped ***into*** the EU (European Union), or across borders ***within*** the EU. Compliance with the Directive is effective beginning January 1, 1996. (When the directive was first issued, there was concern that this would be a trade barrier; however, it is now clear that all European manufacturers must also meet the requirements of the Directive if they are to ship products across borders.)

To meet the Directive, one must determine which product or product family standards apply, and then perform the basic EMC tests that it specifies. If no product standard, or product family standard exists for a particular product, the Generic Standards for immunity and emissions apply.

One frequent question is, "Isn't there a grandfather clause for products already being shipped into Europe?", and the answer is firmly, no. The original date for mandatory compliance was to be then end of 1992; however, it quickly became clear that manufacturers could not comply in such a short period of time (the directive was issued in 1989). As a result of industry pressure, the mandatory date was moved off until January 1, 1996.

It should be noted that enforcement of this directive is a matter of criminal law in each member state. Penalties for non-compliance range from shipping restrictions, to fines of hundreds of thousands of U.S. dollars.

Effects of the EMC Directive

The Directive is having an immediate effect on standards development world-wide. New IEC standards are being written to cover areas where standards didn't exist, national standards around the world are being "harmonized" with the European Norms, and even at the corporate level, in-house test standards are being modified to be in line with the mandatory European Norms.

Markets everywhere are already being affected in both positive and negative ways. Complying with many new standards can be a major investment for the manufacturer. The manufacturer has some choices, the major one being whether to perform all or some of the tests in-house, or to send products to outside test facilities. Each has its own set of trade-offs, including the cost of purchasing test equipment vs. the daily cost of using a test facility, the availability of equipment vs. the lead times at test facilities[1], and the number of products to be tested.

As with all product costs, the cost of compliance to the EMC Directive will eventually be borne by the consumer. The investments made by the manufacturer to comply with mandatory regulations, must be recovered.

One positive effect of the Directive will be that products will be hardened to some minimum degree, against Electromagnetic Interference (EMI). This could result in a reduction of field failures and returns.

The EMC Test Standards

It is important to understand the requirement for standards, but even more important to understand what they do NOT accomplish. There has been so much emphasis on meeting the standards in order to comply with the regulations that reality sometimes gets lost.

There are always two levels to EMC testing: the requirements for compliance, and the manufacturers requirement for minimum field failures and problems related to EMC.

Immunity of a product to EMC related events is a balance between the costs to harden equipment, and the cost of failure or upset due to EMC. In some fields such as aircraft electronics, medical devices, and control systems at processing plants, no failure can be tolerated; therefore, a large amount of cost is added in redundant circuits and hardening of the electronics for EMC. Other products, such as consumer electronics and appliances, don't justify the costs or effort required to achieve high levels of immunity. International standards, such as those produced by the IEC, are an attempt to set down some minimum test requirements that everyone can perform. The tests are meant to be repeatable, although it is a continuing struggle to make them so (especially with high frequency phenomena). Tests are also meant to assure compliance at levels that can be achieved with a moderate to low amount of effort and cost -- not always possible when some tests require test chambers or sites costing hundreds of thousands of dollars.

The biggest problem with testing to the European Norms is that it promotes a false sense of security and implies that compliance will make a product immune to real world EMC. This just isn't the case. Don't forget that the standards are meant to provide a *minimum* level of compliance, and must be both repeatable and achievable by most manufacturers.

Although the standards sometimes seem to be written out of context with reality, reality is always in the background. Basic investigative work is ongoing in many areas, especially in areas where the fastest EMC related events occur: ESD (Electrostatic Discharge). New technologies are being investigated to measure and characterize real current impulses. The results of these investigations may result in a better understanding of how to protect sensitive electronic devices and circuits in a more cost effective

[1] As of mid 1995, some test facilities had already gone to multiple shifts, and even with that, were quoting 2-3 month lead times.

way. In addition, basic investigative work is ongoing in all other areas of EMC with the same potential benefits.

The Future

The EMC market is growing very fast and should continue to do so for the immediate future. Always thought to be a "niche" market, EMC is something all manufacturers must now learn to deal with.[2] Once they begin to comply with mandatory regulations, the positive effects of fewer field problems and better quality products may begin to take over as the driving force. Competitive pressures will take over where the standards leave off and some customers will demand higher levels of immunity than are required by simple compliance.

Although one could argue that EMC test standards have been around for a long time, they are really still in their infancy, especially the immunity standards. In some cases, no immunity standards existed at the time the EMC Directive was issued, in other cases, existing standards were in need of considerable revision before they could be included as European Norms. In the rush to get standards in place before the mandatory dates for compliance, some standards were adopted prematurely, and will need considerable improvement before the objective of repeatability will be achieved.

Now that there is a library of "Basic EMC Standards"[3] written by the IEC, new work is underway to update, revise, improve, and modify them all. IEC standards are dynamic in the sense that they must be reviewed periodically, and each time they are reviewed, new discoveries or technologies will demand that changes be made.

It is possible that someday the standards will reflect both reality and the current state of technology, but it isn't likely to be soon. What is certain is that for manufacturers in the EMC business, growth is assured for some time to come; for manufacturers of electronic products, improved quality and safety will benefit us all.

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[2] Although compliance with the EMC Directive becomes mandatory on January 1, 1996, many manufacturers still haven't begun to deal with it.
[3] The IEC 1000-4-X Series standards are considered to be "Basic Immunity Standards".

OPTIMUM PLACEMENT OF D.C. BLOCKS IN ULTRA BROAD BAND M.W. RECEIVERS

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ABSTRACT

Ultra broad band M.W. Receivers are used in some Airborne systems. Antennas covering Multioctave frequencies are mounted at convenient locations on the aircraft. The Receivers are kept as close to the antennas as possible. Video outputs from these receivers are carried to signal processor units located at different places in the aircraft. Single point grounding is many times used to avoid loop currents interfering with genuine signals. In such systems single point grounding calls for isolation of some of the hardware from the aircraft. Inner/Outer D.C. blocks help in isolating microwave hardware. This paper discusses, as a case study, the optimum placement of D.C. blocks in ultrabroad band microwave receivers.

INTRODUCTION

Single point grounding is many times used to avoid loop currents from different ground returns interfering with genuine signals in system applications.

Practical implementation of single point grounding is very difficult in airborne systems. With many subsystems located at different places of the aircraft, single point grounding is more difficult since the aircraft body is the main return point for systems installed on it. Ultra broad band microwave receivers are used in some airborne systems. In these systems, antennas covering multioctave frequencies are mounted at convenient locations on the aircraft causing minimum distortion to their radiation patterns. The associated receivers are located close to these antennas to reduce RF losses. Direct detection techniques are some times used for signal processing for achieving high probability of intercept. The video signal strength detected is of the order of millivolts at the tangential signal sensitivity level and is required to be carried by long lengths of video cables to signal processor units located at the electronic bay of the aircraft. When the antennas, receivers and signal processor units located at different locations in the aircraft are returned to ground at their respective locations, loop currents are circulated among video cables. The loop currents need not be restricted to the sub units of the receivers above, but caused by many other electrical systems of the aircraft. These loop currents induce large interference voltages in the video cables of the microwaves receivers, and are as such detrimental to weak video signals of these receivers and the signals get corrupted.

To overcome this problem, floating of the antennas and RF receivers from the aircraft body is a possible solution but difficult to implement. Alternately, the signal processing units can be isolated from the receivers by using INNER/OUTER DC block at RF level just before detectors. This technique is easy to implement since only video circuits are to be isolated from the ground before they are returned to ground at single point at the processor level. However, in one of our applications, it was observed that ground noise was exorbitantly high, when INNER/OUTER DC block was introduced in a broad-band microwave receiver. It took considerable diagnostic efforts to identify that the increase in ground noise is due to introduction of the DC block. Circuit analysis indicated that the equivalent inductance of the DC return in the microwave detector coupled to the capacitance of the DC block was causing unwarranted oscillations, thereby increasing the ground noise level of the system.

OBSERVATIONS

The block diagram of the receiver system is shown in Fig.1. When this receiver was evaluated for its charactristics, the base line noise (which was 400 mv) far exceeded the actual noise (100-120 mv) level of the detector log video amplifier. This called for detailed analysis of the designed RF Receiver.

ANALYSIS

As shown in Fig.1, the INNER/OUTER DC block is placed in between the RF amplifier and the detector log video amplifier. The equivalent circuit of this configuration is shown in Fig.2

From this circuit, it can be seen that the series capacitance of the DC block along with the shunt inductance of the DC return at the input of the detector forms a series resonant circuit giving rise to oscillations. The value of this capacitance is about 50 PF and the self inductance of the DC return is about 7.0 uh. Thus the resonant frequency is around 8.0 MHz. This oscillation frequency is in the video bandwidth of the log video amplifier causing the enhancement of the noise floor.

SOLUTION

To avoid the oscillations causing the enhanced floor noise of the receiver, it is necessary to shift the position of the DC block in the receiver. The final block diagram of the receiver giving the optimum placement of the DC block is shown in Fig.3. When once the receiver was reconfigured to this modified design, the noise level came down to that of the log video amplifier level (i.e. to 120 mv level).

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