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EMISSION AND IMMUNITY STANDARDS FOR PROFESSIONAL-USER AUDIO, VIDEO, AUDIO-VISUAL AND ASSOCIATED LIGHTING-CONTROL EQUIPMENT; THE WORK OF BSI PANEL COMMITTEE EEL/32/-/3

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1. INTRODUCTION

This paper describes the background to the work of BSI Panel Committee EEL/32/-/3 since its setting up in March 1991, to conduct a feasibility study on EMC emission and immunity standards for professional-user audio, video and lighting equipment, and summarises the work done so far, with a discussion of some of the problems encountered.

2. EMC DIRECTIVES AND THE ASSOCIATED STANDARDS

The 'EMC Directive' with which we are concerned is officially referenced 'Directive 89/336/EEC', and it may come as a surprise to learn that it is the SECOND EMC Directive to be introduced by the European Community. The first Directive was introduced on 4 November 1976, and its defects well foretold the problems which are being experienced now. Its scope was roughly based on that of an international EMC emission standard, CISPR14, approximately equivalent to BS800, which was itself seriously out of date in respect of its application to the equipment with which we are concerned here. CISPR14 basically applies to household electrical equipment (there being so much more of this than of any other sort) which is very likely to cause interference because it includes contacts at which sparking may occur. As an example of the problem with this Directive, mains-operated 'record players' were included on the assumption that, even in the late 1970s, they used commutator motors! Unfortunately, the term 'record players' was interpreted to include cassette recorders, which DID include commutator motors, but of minute power compared with those that the standard was concerned with. It was therefore necessary, under the Directive, to include a statement in the instruction book of each cassette recorder: 'This apparatus complies with Directive 76/336/EEC'. It will be appreciated how much meaning this conveyed to the purchaser.

This 1976 Directive not only included the legal text, but also the whole technical text, comprising both the acceptance limits and the methods of measurement to be used. This procedure was

Proceedings of the Institute of Acoustics

EMC STANDARDS FOR AUDIO, VIDEO AND LIGHTING EQUIPMENT FOR PROFESSIONAL USE

subsequently found to be impossibly unwieldy, and in 1985 a 'New Approach' was introduced by resolution of the Council of Ministers. New Approach Directives are confined to statements of the scope, the 'essential requirements' and methods of satisfying them, attestation, transitional arrangements, and legal matters. Here, we are concerned with the method of satisfying the requirements, and this is normally by demonstrating compliance with one or more relevant standards. However, to allow for unforeseen circumstances, it is also permitted to demonstrate compliance with the 'essential requirements' themselves. The second EMC Directive, 89/336/EEC, is of this type, but is so all-embracing that many of the standards to which it should appeal either do not yet exist or are in the process of extensive revision.

3. STANDARDS-MAKING BODIES

It is necessary to explain some of the structure of the international standards-making process in order to make clear the import of numerous references in the text of this paper.

At the top of the tree is the International Electrotechnical Commission. (At the same level is the International Organization for Standardization (ISO).) The members of this body are the national standards authorities of the member states. Under the aegis of the IEC is the Comité International Spécial des Perturbations Radioélectriques (CISPR), which admits as members governmental and quasi-governmental regulatory authorities as well as national standards bodies. CISPR has seven sub-committees, labelled A to G. Sub-committee A is concerned with measuring apparatus and methods, while the others are concerned with various product families.

Unfortunately, the European Community set up its own standards-making bodies, which are described as 'regional' rather than international. These are CENELEC, paralleling IEC, and CEN, paralleling ISO. Obviously, a damaging power struggle was bound to result, and it is by no means yet resolved. However, largely due to the UK insistence on the international nature of the electronics industry, there is an agreement in principle that CENELEC should co-operate closely with the IEC, and should not adopt regional standards with needless differences. Opinions, of course, vary as to what is 'needless'.

CISPR standards are almost entirely concerned with emission, and its effects on radio communication in the broad sense. The first sector of the electrical industry to consider EMC was that concerned with industrial control systems, no doubt to combat expensive, and perhaps dangerous, system malfunctions.

Proceedings of the Institute of Acoustics

EMC STANDARDS FOR AUDIO, VIDEO AND LIGHTING EQUIPMENT FOR PROFESSIONAL USE

This sector is dealt with by IEC Technical Committee TC65, which has sub-committees SC65A, SC65B and SC65C. SC65A has produced the IEC801 series of standards (BS6667). These deal with immunity, rather than emission, and extend the concept of EM stimuli beyond radiated or conducted r.f. energy, to include such phenomena as electrostatic discharge and electrical fast transients on power supply, signal and control cables. The standards were prepared some time ago, and are now being extensively revised. The test methods that they include have proved applicable to equipment well outside the field of industrial control systems, which has led to difficulties which are still unresolved. There is no onus on SC65A to take into account the views of those who wish to apply the IEC801 standards to other sorts of equipment. Yet it would be very wasteful for every product committee to produce its own version of IEC801.

Meanwhile, the electricity supply authorities have required the IEC to set up a Technical Committee, TC77, with the title 'Electromagnetic compatibility between electrical equipment, including networks'. This Committee has two sub-committees, SC77A, which deals with equipment connected to the public low-voltage mains supply, and SC77B, which deals with equipment intended only for connection to industrial and other non-public networks. Since a very great deal of electronic equipment is connected to the public mains supply, we are faced with the situation that standards for the performance of our equipment are being made by power-system engineers who, with the best will in the world, are not familiar with it in sufficient detail and have no responsibility for the economic consequences of their decisions. The electronics industry in general, and our branches in particular, are not sufficiently represented on IEC TC77 or its sub-committees. Nevertheless, IEC TC77 has been given a major role in producing EMC standards, in the IEC1000 series, and some, at least, of the IEC801 series will appear as parts of IEC1000. This has already resulted in conflict between TC77, TC65 and CISPR. Granted that international technical negotiations are often very difficult, a policy of 'management by disaster' seems to be the order of the day.

4. TYPES OF STANDARD

In the midst of all this high-level chaos, individual committee members are struggling to avoid clashes and prevent problems. One essential move is to try to produce a structure for the work to be done, and the CENELEC committee CLC/TC110 has produced some good work in this area, in the shape of a 'Guide to product committees for the application of basic and generic EMC standards'.

Proceedings of the Institute of Acoustics

EMC STANDARDS FOR AUDIO, VIDEO AND LIGHTING EQUIPMENT FOR PROFESSIONAL USE

Basic EMC standards give general conditions and methods of measurement, together, where appropriate, with preferred values for immunity levels.

Generic EMC standards give requirements for ALL products intended to be used in a given 'electromagnetic environment', for which product standards, or product-family standards, do not exist.

Three points here are worthy of note: there is an assumption that a useful description of an 'electromagnetic environment' can be written, and a further assumption that products are confined to their intended environment. Also, EMC standards come in pairs, one for emission and one for immunity.

Product standards apply to particular products. In our field, product diversity is too great for product standards to be practicable. Product-family standards apply to all products within a defined industry sector, except for any specifically excluded.

Generic, product and product-family standards draw on the methods of measurement given in basic standards, together with an appropriate choice of immunity levels. Detailed changes to the methods may be included if essential. Product standards (which hereinafter imply also product-family standards unless otherwise stated) are also required to specify those characteristics of the product which should be investigated for impairment if compatibility is inadequate.

5. FORMATION OF PANEL COMMITTEE EEL/32/-/3

The author became aware of the importance of the then projected new Directive in 1988, and made contact with the Department of Trade and Industry (DTI), which was handling the UK government negotiations with the Commission. Comments were regularly submitted to the DTI on matters of concern. When the first pair of draft generic standards prepared by CLC/TC110, prEN50081-1 and prEN50082-1, were published as British Standard Drafts for Public Comment in June 1990, more intensive activity was begun, prompted by a full appraisal of the disastrous consequences for the professional-user audio and video electronics industry if these generic standards were to be applied, as they would be in the absence of any relevant product standards.

It was discovered at once that the drafts referred for vital information to other documents which were not available to the general public, or even to BSI committee members. In some

Proceedings of the Institute of Acoustics

EMC STANDARDS FOR AUDIO, VIDEO AND LIGHTING EQUIPMENT FOR PROFESSIONAL USE

cases, the references were so poor as to prevent identification of the document concerned. As a result of strongly-worded comments to BSI, CLC/TC110 was persuaded to restrict the requirements to those where the relevant standards were already published, and to include projected future requirements in an annex, so that informed comments could be made on these before they were introduced.

At the same time, increased efforts were made to goad an apathetic industry into taking the matter seriously. BSI agreed to host an industry-wide meeting on the subject if sufficient people would attend, and, with the valuable assistance of Mr. A. Mornington-West, a meeting was arranged in London on 28 January 1991. At this meeting, the DTI representative announced that an extended transitional period for the enforcement of the Directive had been negotiated, subject to ratification. It was generally agreed that this transitional period was only barely long enough to allow the necessary standards to be published and for industry to carry out testing and, where necessary, redesign of products.

It was further agreed to set up a BSI Panel committee to conduct a feasibility study into the preparation of product family standards for professional-user audio and video products (studio and entertainment lighting being added subsequently). Within BSI, EMC is dealt with under the aegis of the General Electrotechnical Standards Policy Committee GEL/-, but the audio and video industry committees come within the area of the Electronic Equipment Standards Policy Committee EEL/-. It was finally agreed that the Panel should report to Technical Committee EEL/32, and the author, as Chairman of EEL/32 and a member of GEL/110 and two of its sub-committees, took the Chair of the Panel. The Panel first met on 26 March 1991, and has met on four further occasions since then.

6. PROGRESS OF WORK

It was agreed to base the work on the texts of the generic standards, as far as possible. Under the CENELEC rules, it is not permissible for the Panel to draft standards, but it is permissible to carry out a feasibility study. Naturally, the results of the study may be recorded as draft documents, which CENELEC could then adopt as draft standards. Such activity is officially notified to CENELEC under what is known as the 'Vilamoura Procedure', and this is under way at present.

The emission standard has, as expected, proved much easier to deal with than the immunity standard. However, there is at least one matter which is still unresolved in respect of

Proceedings of the Institute of Acoustics

EMC STANDARDS FOR AUDIO, VIDEO AND LIGHTING EQUIPMENT FOR PROFESSIONAL USE

emission, and can be traced back to a possible defect in the Directive itself. EC product safety Directives recognise that certain products have to pose a safety hazard in order to fulfil their purpose. Examples are soldering irons and electric power tools. However, the EMC Directive does not recognise that any apparatus, other than a radio transmitter, may have to radiate electric and/or magnetic fields in order to do its job. A specific example is the bulk eraser for magnetic recording tape. The generic emission standard poses no limits for magnetic (or electric) field emissions from enclosures, yet the positioning of a bulk eraser close to an audio or video mixer or recorder could result in serious compatibility problems. In the absence of appropriate treatment of this issue in the Directive, it is difficult to see how to handle it in the product-family standard.

Another matter has proved easier to resolve. The generic standard does contain requirements for r.f. emission from the enclosure of equipment in the frequency range 30 MHz to 1 GHz. Because the generic standard applies to the residential environment as well as to commercial and light industrial environments, the severe limits generally known as 'Class B' have been imposed. This is a basic flaw in the concept of this generic standard, which will continue to cause difficulty for years to come. The Panel has decided to adopt the 'Class A' limits, because the products concerned are not intended to be used in the residential environment. The problem is that even the Class B limits are not severe enough to allow the unrestricted use of the product in the vicinity of radio microphones. A further complication is that there is no uniformity of the frequency allocations for radio microphones within Europe, so there is no possibility of simply imposing more severe limits over a narrow frequency band. Instead, the Panel has agreed to add an informative annex indicating the limits which may need to be imposed on equipment required to work close to radio microphones, with the advice that such requirements should be imposed contractually between purchaser and supplier. It is neither economically viable, or necessary, for these very severe limits to be imposed on all equipment.

There is another very important matter concerned with emission. IEC555 (BS5406) is, at present, concerned with disturbances, such as voltage dips and surges, which household electrical equipment may cause on the supply mains. At present, therefore, the standard does not apply to professional-user electronic equipment. However, the standard is under revision by IEC SC77A, and it is intended to extend its scope to cover all electrical and electronic equipment. In particular, IEC555-2 deals with the generation of currents at harmonics of the supply frequency by non-linear loads, such as d.c. power

Proceedings of the Institute of Acoustics

EMC STANDARDS FOR AUDIO, VIDEO AND LIGHTING EQUIPMENT FOR PROFESSIONAL USE

supplies. New requirements are being put forward by the power system interests, that take no account of the actual harmonic-generation characteristics of real d.c. power supply circuits, and which are very difficult, in some cases impossible, to meet with conventional circuits. There has been an evident intent to suggest, in error, that all equipment will soon use switch-mode power supplies, which can be modified (at a cost) to reduce harmonic current generation. Because the apathetic electronics industry has had no effective voice in IEC SC77A, the enormous difference in complexity and design time between a conventional power supply and a switch-mode supply, and the serious problems of eliminating enclosure and supply-line emission from switch-mode supplies, have not been pointed out, let alone the problems of using, for example, a switch-mode power supply to feed a sensitive radio receiver. Further information on this subject will be given in a following paper.

The draft immunity standard follows the generic standard closely, in respect of immunity to r.f. fields, electrostatic discharge and fast transients, the methods of measurement being taken from the published Parts 2, 3 and 4 of IEC801. However, these standards themselves are under revision, so the industry is being presented with moving targets, while at the same time it is trying to collect information on what design measures are necessary in order to ensure compliance. There is also a very large number of extra requirements, derived from the informative annex of the generic standard, which are only awaiting the publication of the relevant standard to be transferred to the mandatory part of the standard. One country is already pressing for this to be done without observing the normal time-scale, thus opening the possibility of equipment becoming unacceptable overnight.

It is clear that the Panel has a considerable amount of further work to do, provided it is not prevented by CENELEC procedures. If it does not complete its work properly, the whole industry sector in Europe will have cause to regret.

7. SUMMARY

The situation in which BSI Panel Committee was set up, and the environment in which it operates, have been described. Then followed an account of the work done so far, with some discussion of the more intractable problems which have occurred.

