Strand Lighting

FACT sheet

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THE EMC DIRECTIVE - A STRAND BRIEFING

The EMC Directive - in a Nutshell

Recognising the rapidly growing use and reliance on electronic products in the EEC, the European Community has acted to eliminate Electromagnetic Compatibility (EMC) related technical barriers to trade, protect the electromagnetic environment for radio and telecommunication, and maintain adequate quality of operation of products in the face of expected electromagnetic disturbance. The Directive sets general requirements on electromagnetic emission and immunity, relying on published standards for detail specifications. These are now mostly published, with Generic Standards covering the areas where there are no Product Standards. An amending Directive extended the transitional period for compliance with the EMC standards to 31st December 1995 in all EEC countries. As a result of national laws transposing the Directive in member states, compliance will then become obligatory on manufacturers and users taking equipment new into service. The standards are technically challenging, requiring investment in expertise and resource, but are necessary and desirable to maintain the quality of product service and European Community lifestyle now expected.

Introduction

Modern civilisation has developed a remarkable dependency on electricity, much of it consisting of electronics in such items as radios, TVs and communication devices and the many microprocessors in modern domestic and professional electronic equipment. However, it is an unfortunate consequence that virtually all electrical and electronic apparatus emits extraneous electromagnetic phenomena which is not part of the intended function. This is generally experienced as radio frequency interference. Similarly most electronic apparatus is susceptible to some degree to external electromagnetic phenomena, such as nearby radio signals or (electro-)static discharges.

Examples abound such as the interference experienced on radios and TVs from poorly suppressed domestic electrical appliances, or the computer which "crashes" due to interference on its mains supply. Whilst many problems are merely irritating, they can become life threatening if for example the interference disrupts emergency service communications. More hazardous examples are reported car ABS braking systems that self operated at speed on an autobahn when passing a powerful radio transmitter, and when electronic interference caused a computer controlled crane to drop its load prematurely, a fatality was caused.

Thus, there is need to regulate both the generation of interference and susceptibility to it to prevent the modern equivalent of the Tower of Babel - hence EMC: Electro-Magnetic Compatibility. This is generally defined to mean the ability of a piece of equipment to function satisfactorily in its electromagnetic environment (ie. be immune to an acceptable level of electromagnetic disturbances) without introducing intolerable extra electromagnetic disturbances to anything else in that environment (ie. not cause interference to other equipment).

Historical Development

The consideration of the overall impact of EMC may be a modern vogue, but its main elements are not. Even Marconi appreciated the need to control the frequency emissions of his early transmitters so that multiple channels could be

used without interference. This problem receives international consideration with the formulation in 1934 of CISPR (Comité International Special des Perturbations Radioelectriques), now a sub-committee of the IEC (International Electrotechnical Commission). Since those early years CISPR has developed a well-researched set of Radio Frequency Interference standards covering motor vehicles, household appliances, RF and Information Technology equipment and Fluorescent Luminaires. The immunity problems were recognised much later with the IEC Industrial Process Control group devising in the 1980s the IEC 801 series of standards for electrostatic discharge, RF fields and impulses.

Valuable as standards are, they lack any teeth without laws to enforce them. Amongst the earliest were the UK and Germany with respectively the "Wireless Telegraphy Act 1949" and the "High Frequency Law" also of 1949. Whilst both required a general curtailment of interfering radiation, the specifics were in the subsequent regulations. In Germany very broad ranging limits were set on RF, IT and domestic appliances, often more onerous than in other countries together with a licensing regime. The UK like most countries relied on a complaints driven approach until in 1976 the first EEC Directives on domestic appliance RFI (76/889/EEC) and fluorescent luminaire RFI (76/890/EEC) were translated into national legislation. This also served to bring the relevant German limits into line with the rest of Europe. Whilst these have been updated (to follow EN55014 and EN55015 respectively), they are ultimately replaced by the EMC Directive.

In the USA in the early 1980s the interference potential of computers was appreciated, which led to an extension of the FCC (Federal Communications Commission) Regulations to govern "Computing Devices" emissions (docket 20780, Part 15,J). This has recently been enhanced in October 1992 (Section 15, B) to cover a much broader range of "unintended radiators", though fortunately only still demanding certification for computing devices and TV games etc.

The EMC Directive

It can be seen that the RFI side of EMC has been a recognised concern for many years. However the many national EMC emission incompatibilities acted as barriers to EC trade, and the little but growing regulatory concern for EMC immunity was perceived as a problem. The 1985 EEC "Single European Act" set a target by 31st December 1992 of eliminating all tariff and non-tariff (eg. technical) barriers to trade in the European Community, and consequently spawned a plethora of harmonising Directives. Recognising the current disparity in national laws and the growing dependence of the infra-structure on electronic equipment, a Directive was issued both harmonising current requirements and radically extending them to cover all electrical/electronic equipment for emission and immunity.

The EMC Directive (89/336/EEC) has, in common with the other "New Approach" Directives aimed at securing the Single Market, a simple structure setting general aims. These are enshrined in the two essential requirements (Article 4) "that the apparatus shall be so constructed that:

a) the electromagnetic disturbance it generates does not exceed a level allowing radio and telecommunications equipment and other apparatus to operate as intended;

b) the apparatus has an adequate level of intrinsic immunity of electromagnetic disturbance to enable it to operate as intended."

Compliance

The preferred means of actually complying with the Directive is by conforming with recognised standards which meet the "essential requirements", meaning they have been recognised by the EC and published in the Official Journal of the European Community. Here the manufacturer may self assess (eg. test) the product to the standards and if compliant, declare conformity with the Directive and market the product. Should adequate standards not exist, perhaps due to an intended specialised use, then an independent Competent Body (ie. a test house) must prepare a Technical File and certificate of conformity that the product meets the essential requirements before it is placed on the market. A Technical File must be prepared for any Telecommunication or Radio communication product. Should the manufacturer not be in the EC then the importer is responsible for compliance. "Grey" imports are caught also as there is an equal duty on users to only take into service (ie. use for the first time) compliant product.

Once the product is determined to be in conformity, then the product shall be marked with the CE Mark and date, which acts as a visible declaration of conformity by the manufacturer. It must then be accepted by the other EC Member States as declaring full compliance with all the New Approach Directives unless a State has reason to

believe otherwise, and the product allowed to be placed on the Market. This thus achieves the elimination of technical barriers in the "Single Market".

Though the Directive was issued in 1989 with intended national completions by 31st December 1992, there were initially insufficient standards developed to fully assess conformity. As a result, the European Standards body CENELEC was charged with developing a broad range of suitable Standards in a very short time, in fact so short as to be impracticable both to complete and for manufacturers to comply with. In response to these concerns, an amending EEC Directive 92/31/EEC was issued in April 1992 extending the original 1 year transitional period to 4 years to expire on 31st December 1995, though this still now leaves remarkably little time to comply.

A further complexity is caused by the fact that an EC Directive is only binding on Member Governments, who must each enact national legislation before it becomes obligatory in that State. To date six of the twelve EC States have enacted legislation (UK, France, Germany, Denmark, Italy and Portugal), with essentially identical technical requirements but differing enforcement. Germany for example intends to continue its tradition of actively policing conformity, with penalties of up to 100,000DM, whilst the UK will rely on complaints driven enforcement though Trading Standards Officers with a maximum penalty of £5,000 (or 3 months!) Regardless in all States conformity is certain to be required by 1st January 1996 and an infringement warranting product withdrawal in any one State will be broadcast to all other States for consideration. Thus the largest commercial threat of proven non-conformity is that of product being impounded or withdrawn from the whole market and users being denied use of equipment already bought.

EMC Standards

Clearly competent standards are the key to compliance, since whilst the Technical File route is available, most manufacturers would prefer for economy and development efficiency to have clear technical goals. Recognising the impossibility of generating perhaps thousands of individual product EMC Standards, CENELEC chose to initially generate a set of Generic Standards for all products intended for a particular environment (eg. Residential or Industrial), where there are no competent EMC Product Standards. The logic of this is that it is the severity of the surrounding EM Environment that limits the acceptable emissions and immunity rather than the precise nature of the product.

So far Generic Standards have been set for one environment: Residential, Commercial and Light Industrial (EN50081-1 for emission and EN50082-1 for immunity) and in draft for Industrial (prEN50081-2 for emission and prEN50082-2 for immunity). The "Industrial" category is principally separated from "Light Industrial" by not being connected directly to the Public Low Voltage (220-240V) Mains. Unfortunately it is not having a smooth passage in CENELEC with adoption unlikely before 1994.

The Generic Standards

Professional Lighting and Lighting Control Equipment are currently principally governed by the Generic Standards EN50081-1 and EN50082-1 (which explicitly include "areas of public entertainment"). These in turn refer to individual (basic) emission and immunity standards drawn from existing CENELEC and IEC standards. It is beyond the scope of this article to explain the detailed technicalities of the standards, since those responsible for their application must study current copies of the Standards, and have adequate technical competence in their application and access to the necessary test equipment.

In outline these requirements are:

Emission EN50081-1:

For each of these tests the emissions must not exceed the levels given below.

Radiated

EN55022	Class B
30MHz-230MHz	30db db (uV/m) @ 10m
230-1000MHz	37db db (uV/m) @ 10m

(Measured using a special receiver/aerial system on an open test site for all orientations of the equipment)

AC Mains Low Frequency

EN60555-2 Limits of Harmonics between 0-2KHz.
EN60555-3 Limits of voltage fluctuations between 0-2KHz.
(Both these standards currently apply only to Household Appliances.)

AC Mains Conducted

EN55022	Class B
0.15-0.5MHz,	66-56db (uV, Quasi-Peak)

	56-46db	(uV, Average)
0.5-5MHz	56db	(uV, Quasi-Peak)
	46db	(uV, Average)
5-30MHz	60db	(uV, Quasi-Peak)
	50db	(uV, Average)

(Measured on all poles of the mains supply using a special receiver and Line Impedance Simulator.)

AC Mains Conducted

EN55014 - Discontinuous Interference
(Measured like EN55022 but assessing the effects of repetitive "clicks" caused by switching or the like.)

Extra Standards requirement for Dimmers beyond EN50081-1:

AC Load Terminals (Dimmers)

EN55014

0.15-0.5MHz	80db	(uV, Quasi-Peak)
	70db	(uV, Average)
0.5 -30 MHz	74db	(uV, Quasi-Peak)
	64db	(uV, Average)

Immunity : EN50082-1

For each of these tests, the equipment must be immune to performance criterion A (no reduction in performance below specification), or B (no loss of data or reduction in specification after tests but specified reduction during test) or C (any reduction during test but resettable without damage after test).

Electrostatic Discharge

IEC 801-2 (1984), Criterion B
8KV, air discharge, 10 - per point.
(Measured using an "ESD Gun" on all user accessible conductive points and an underneath earth plane.

RF Field

IEC 801-3 (1984) Criterion A
27-500MHz. 3V/m unmodulated.
(Measured by exposing to a swept uniform RF field for all orientations of the equipment.)

Transients on AC Mains

1.0Kv (peak), 5/50nS (rise/fall),
5KHz repetition rate pulses for at least
1 minute (Measured using special pulse generator connected via capacitors to all poles of mains).

Transients on Signals

IEC 801-4 (1988), Criterion B
0.5Kv (peak) 5/50nS (rise/fall).
5KHz rate repetition pulses for at least
1 minute. (Measured using a special pulse generator coupled by a capacitative clamp into any signal cables allowed to be over 3m long.)

EN50082-1 also contains an informative annexe of another eight immunity standards that are still in development! However only standards on immunity to mains dips and variations are likely to be introduced in the next few years, as this is clearly an important missing aspect.

Whilst the Generic standards clearly cover the Directive's "essential requirements" on most equipment, certain products may have further recognised phenomena requiring control. In this case if it is within the scope of a further recognised standard, it should be applied, otherwise the Technical File route is necessary. Since lighting dimmers can generate substantial interference on their outputs, then the product standard EN55014 which includes "semiconductor regulating controls" in its scope must be applied to these products. This is in fact just a continuation of previous mandatory requirements under EC Directive 76/889/EEC. It has the same limits as EN55022 (Class B) for the AC Mains input, but higher levels for the Mains outputs as shown in the tables above.

Developing Standards

Luminaires in general are expected to eventually be covered by EN55015, when it is extended from an emission limit only for fluorescent luminaires to become a complete EMC Product Standard for all luminaires. This may occur in 1994-5 as CISPR 15, its IEC precedent, now already covers all luminaires for emission in its 1992 edition just adopted into EN55015, and is actively in further development regarding immunity. There are also complete product EMC Standards for Radio and TV equipment (EN55020) and standards completing development for Information Technology equipment and many other products. There are currently 271 IEC standards existing or in development that have some EMC content!

A further area of significant interest is a UK led initiative to develop and obtain CENELEC adoption of a complete EMC Product Standard for Professional Audio, Visual and Audio-Visual Equipment. The initial proposals included "professional Lighting Control" in the scope: however fresh representation and study recognised that these products were competently covered by ex-

isting Generic and Product EMC Standards and deleted them from the scope. Recently this question has been resurrected in CENELEC but with no definitive conclusion as yet. When this standard is accepted in CENELEC and adopted by the European Commission, it will replace the Generic Standards for the products finally in its scope.

Strand Lighting's Response

Strand's products have for many years recognised the need for general EMC compliance and all European dimmers have conformed to the relevant EC Directives and thus EN55014 for many years. In the 1980s the importance of adequate EMC Immunity as a measure of quality was fully accepted and in-house standards set for new products. These still considerably exceed the new Generic Immunity Standards providing even better assurance of trouble-free operation.

On the publication of the EMC Directive Strand recognised the obligations and free trade opportunities that conformity provides and set a policy that European new and re-worked products would comply with the new Standards when available rather than when mandatory. Since some products will thus comply well before the end of the transitional period, these provide the customer with the advantages of the Directive early and make the transition a more achievable task across the many products affected.

In common with most manufacturers it has been recognised that designing in EMC compliance is much more cost effective than trying to add it on afterwards. Trying to suppress a particular problem that should be controlled at source by just "bolting on" extra filters can be expensive and is frequently ineffective as the problem just moves to another place. Whilst good filters are an important part of the EMC Engineer's armoury, without the ability to properly measure the total effect on emission and immunity, it is easy to be misled as to the nett benefit. All this requires considerable and continuing investment in test equipment, expertise and development since proper compliance can only be obtained by competent design, experienced assessment and if in any doubt (as there usually is), full testing.

Conclusion

The EMC Directive sets a new landmark for the European Community in that not only is it the most complex and far reaching Directive, for the first time for electrical and electronic equipment it requires standards for quality (immunity) and the protection of the environment (emissions). The ultimate benefit of these "Good Neighbour" requirements must be borne in mind both by suppliers struggling with the new technical demands and customers faced with a choice of compliant or (perhaps cheaper but soon to be illegal) non-compliant products. If we consider our dramatic growth in dependency on electronics in the last 20 years and project that forward another 20 years, there is no doubt that by then we shall all be very grateful for these steps to protect the Electromagnetic Environment.

Further Reading:

i) "Council Directive 89/336/EEC" (the EMC Directive)
Official Journal of the European Communities,
L139/14-26, 23.5.89.

ii) "Council Directive 92/31/EEC" (amending EMC Directive).
Official Journal of the European Communities,
L126/11, 12.5.92.

iii) "The Guide to the EMC Directive 89/336/EEC"
Chris Marshnan, EPA Press, 1992.

iv) "The Single Market, Electromagnetic Compatibility"
DTI, May 1992.

v) "The Electromagnetic Compatibility Regulations 1992"
SI 2372, HMSO.

vi) "Gesetz über die elektromagnetische Verträglichkeit von Geräten - EMVG (EMC Law); Germany, 9th November 1992.

vii) "Explanatory Document on Council Directive 89/336/EEC".
EEC document 111/4060/91/EN - Rev 1, November '91.

viii) Standards: EN50081-1 (1991), EN50082-1 (1991), EN55014 (1987), EN55022 (1987), EN60555-2 (1988), IEC801-2 (1984), IEC801-3 (1984), IEC 801-4 (1988). BSI, dates as above.

The above information is provided in good faith and believed accurate at the time of writing. However no liability can be assumed for any error or omission. In particular anyone needing to satisfy the Standards and Regulations mentioned

must obtain complete up-to-date details and advice on the requirements and satisfy themselves that they are in conformance.

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6th May 1993. (David Bertenshaw is Corporate R&D Director of Strand Lighting Ltd in London.)