TECHNICAL REPORT

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BASIC EMC PUBLICATION

Electromagnetic compatibility (EMC) –

Part 5-6:
Installation and mitigation guidelines –
Mitigation of external EM influences

Compatibilité électromagnétique (CEM) –

Partie 5-6:
Guides d'installation et d'atténuation –
Atténuation des influences électromagnétiques externes

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 5-6: Installation and mitigation guidelines – Mitigation of external EM influences

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example “state of the art”.

Technical reports do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful by the maintenance team.

IEC 61000-5-6, which is a technical report, has been prepared by subcommittee 77C: High power transient phenomena, of IEC technical committee 77: Electromagnetic compatibility. It has the status of a basic EMC publication in accordance with IEC Guide 107.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
77C/110/CDV	77C/122/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This document, which is purely informative, is not to be regarded as an International Standard.

The committee has decided that the contents of this publication will remain unchanged until 2007. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this technical report may be issued at a later date.

INTRODUCTION

IEC 61000 is published in separate parts according to the following structure:

Part 1: General
- General considerations (introduction, fundamental principles)
- Definitions, terminology

Part 2: Environment
- Description of the environment
- Classification of the environment
- Compatibility levels

Part 3: Limits
- Emission limits
- Immunity limits (in so far as they do not fall under the responsibility of product committees)

Part 4: Testing and measurement techniques
- Measurement techniques
- Testing techniques

Part 5: Installation and mitigation guidelines
- Installation guidelines
- Mitigation methods and devices

Part 6: Generic standards

Part 9: Miscellaneous

Each part is further subdivided into several parts published either as International Standards or as technical specifications or technical reports, some of which have already been published as sections. Others will be published with the part number followed by a dash and a second number identifying the subdivision (example: IEC 61000-6-1).

This part of IEC 61000 gives guidelines for the mitigation of external electromagnetic influences.

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 5-6: Installation and mitigation guidelines – Mitigation of external EM influences

1 Scope and general considerations

1.1 Scope

This part of IEC 61000 covers guidelines for the mitigation of external electromagnetic influences impinging upon a facility, aimed at ensuring electromagnetic compatibility (EMC) among electrical and electronic apparatus or systems. These influences include lightning, RF transmitters, power-line and telecom transients, high-altitude electromagnetic pulse (HEMP) and other high-power electromagnetic transients. More particularly, this technical report is concerned with the arrangement of shielding and screening against radiated disturbances, and with mitigation of conducted disturbances. These arrangements include appropriate electromagnetic barriers for industrial, commercial, and residential installations.

The concept of barriers installed for mitigating potentially penetrating and unwanted electromagnetic noise is applicable even when there is no designed-in electromagnetic shield. The enclosure through which power and signal (communications, control, etc.) cables must enter or exit may be considered as a potential electromagnetic barrier that will provide some level of protection. The concept of enclosure can be understood as the perimeter walls of a building, the walls of a single room, or the housing of an apparatus, with protection installed at all points of electromagnetic penetration into the enclosure.

This technical report is intended for use by installers, manufacturers and users of sensitive electrical or electronic installations or systems, and of equipment with emission levels that could degrade the overall electromagnetic (EM) environment. It applies primarily to new installations but, where economically feasible, it may be applied to extensions or modifications to existing facilities. While the technical principles are applicable to individual equipment or apparatus, such application is not included in the scope of this technical report.

1.2 General considerations

1.2.1 Elementary interference control

In its simplest form, the interference problem consists of a source of disturbance, a victim and the medium between the two. Interference control consists of suppressing the disturbance source, strengthening the victim, or impeding the source-victim interaction through the medium. When the source is not controllable (for example, lightning, portable transmitters, HEMP, etc.), and the inherent strength of the victim is dictated by other considerations (for example, circuit density and operating power), interference control is relegated to the intervening medium. Furthermore, for interference control oriented toward victim protection, control measures tend to be applied fairly close to the susceptible circuits (at the system or subsystem levels).

Increasing the separation between them, enclosing one or the other in a shield or orthogonalizing them (for example, rejecting common-mode interference on differential-mode signalling lines) can reduce the interaction between source and victim. All three techniques can be combined to form a closed electromagnetic barrier between the source and the victim. For sources outside the system, the barrier may be applied at the system level. For sources inside the system, electromagnetic compatibility requires two barriers: one at the source to control emissions, and one at the victim to control susceptibility. This concept is illustrated in figure 1. In this technical report, we will concentrate on sources outside the system.

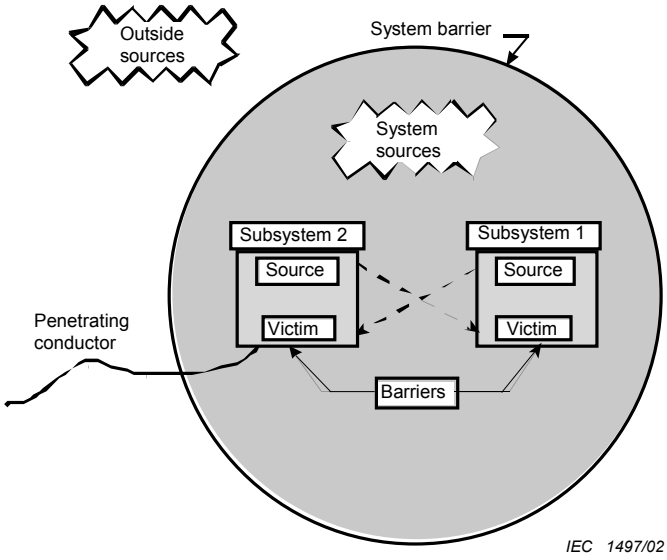

Figure 1 – System barrier topology

1.2.2 Shields and interfaces

Shields are used for attenuating the direct coupling of radiated electromagnetic disturbances from the external environment onto the internal electronics circuits and, conversely, to limit the radiation of disturbances from the internal circuits to the exterior, thus contributing to the electromagnetic compatibility (EMC) of the installation. The shields considered in this document are electromagnetically closed structures. Any form of electromagnetically open structure is not recommended for achieving a fully compliant installation. Some examples of structure shielding applications include

– telecom facilities, such as relay stations, multipurpose radio installations;
– TV and broadcasting studios;
– test rooms and laboratories (telecom, metrology, high-voltage engineering);
– metrology facilities in educational institutions;
– diagnostic and therapy rooms in medical facilities;
– computer rooms for business and industry.

Interface protection devices are used for mitigating the propagation of conducted electromagnetic disturbances from the environment into the internal electronics and may, conversely, limit the emission of disturbances from the internal electronics into the environment. This assumes that bi-directional protection devices are applied. Thus, when installed in conjunction with a shield, these devices contribute to achieving electromagnetic compatibility for the installation. Protection devices that will be discussed in this technical report include filters, decoupling devices and surge-protective devices (SPDs).

The filters considered in this document are limited to low-voltage passive circuits for high-frequency disturbances that are part of an installation. Filters and other interface devices incorporated in individual apparatus are not included within the scope of this document. Low-frequency filters, such as those used to mitigate power-line harmonics, are also not included in the scope of this document.

A complete installation can include the interconnection of several properly shielded cabinets with screened cables. However, the selection of such cables and proper bonding of the cable screens is not within the scope of this publication, but is addressed in IEC 61000-5-2.

The installation of filters and other mitigation means, including shields, is predicated on the existence of a properly designed earthing system, as described in IEC 61000-5-2.

The recommendations presented in this technical report address the EMC concerns of the installation. The safety aspects of any installation are of prime importance but while not ignored, are not within the scope of this technical report. Reference to safety issues may be found in IEC 60364-1, IEC 60364-5-54, and IEC 60364-5-548. The efficient transportation of power within the installation is a prime function of any facility, but is also excluded from the scope of this technical report. Nevertheless, these two issues are taken into consideration in the recommendations concerning EMC. These two issues can be implemented concurrently for enhanced EMC of the installed sensitive apparatus or systems without conflict by applying the recommended practices presented in this technical report and the relevant safety requirements such as those of IEC 60364. As each installation is unique, it is the responsibility of the designer and the installer to select and abide by the relevant recommendations most appropriate to a particular installation. It is important to note that the recommendations presented in this technical report do not seek to preclude existing installation practices, when they have been shown to perform satisfactorily. Special mitigation methods might not be necessary when the installed equipment satisfy applicable emission and immunity standards.

1.2.3 Summary

Clauses 1-3 provide general information concerning the scope, references and definitions applicable to this publication.

Clause 4 provides an overview and introduction of the general approach to applying EMC concepts in the design of installations through the use of appropriate interface protection devices.

Clause 5 provides information on the application of shields to mitigate the coupling of radiated disturbances and to create a boundary between different zones of disturbance levels.

Clause 6 provides information on the application of filters as interface protection devices that can be inserted in power and signal cables entering the shield or enclosure.

Clause 7 provides information on the application of decoupling devices as interface protection devices that can be inserted in power cables or applied to signal cables entering the shield or enclosure.

Clause 8 provides information on the application of SPDs as interface protection devices that can be inserted in power or signal cables entering the shield or enclosure.

It is emphasized that this technical report does not discuss in detail the internal design of these mitigation means. However, some knowledge of their fundamental characteristics, as well as some information on the EM disturbance environment, is necessary to make an appropriate selection of measures and to install them in a way that will not make them ineffective.

2 Reference documents

IEC 60050(161), *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electro-magnetic compatibility*

IEC 60050(195), *International Electrotechnical Vocabulary (IEV) – Chapter 195: Earthing and protection against electric shock*

IEC 60050(300), Part 312, *International Electrotechnical Vocabulary (IEV) – Electrical and electronic measurements and measuring instruments – Part 312: General terms relating to electrical measurements*

IEC 60335-1, *Household and similar electrical appliances – Safety – Part 1: General requirements*

IEC 60364-1, *Electrical installations of buildings – Part 1: Fundamental principles, assessment of general characteristics, definitions*

IEC 60364-5-54, *Electrical installations of buildings – Part 5: Selection and erection of electrical equipment – Chapter 54: Earthing arrangements and protective conductors*

IEC 60364-5-548, *Electrical installations of buildings – Part 5: Selection and erection of electrical equipment – Section 548: Earthing arrangements and equipotential bonding for information technology installations*

IEC 60939-1, *Complete filter units for radio frequency suppression – Part 1: Generic specification*

IEC 60939-2, *Complete filter units for radio frequency suppression – Part 2: Sectional specification. Selection of methods for test and general requirements*

IEC/TR2 61000-2-5, *Electromagnetic compatibility – Part 2: Environment – Section 5: Classification of electromagnetic environments*. Basic EMC publication

IEC 61000-2-11, *Electromagnetic compatibility – Part 2-11: Environment – Classification of HEMP environments*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 4: Electrical fast transient/burst immunity test*. Basic EMC publication

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-12, *Electromagnetic compatibility (EMC) – Part 4-12: Testing and measurement techniques – Oscillatory waves immunity test*

IEC/TR 61000-5-1, *Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines – Section 1: General considerations*. Basic EMC publication

IEC/TR 61000-5-2, *Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines – Section 2: Earthing and cabling*

IEC/TR 61000-5-3, *Electromagnetic compatibility (EMC) – Part 5-3: Installation and mitigation guidelines – HEMP protection concepts*

IEC/TR2 61000-5-4, *Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines – Section 4: Immunity to HEMP – Specifications for protective devices against HEMP radiated disturbance*. Basic EMC publication

IEC 61000-5-5, *Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines – Section 5: Specification of protective devices for HEMP conducted disturbance.* Basic EMC publication

IEC 61000-5-7, *Electromagnetic compatibility (EMC) – Part 5-7: Installation and mitigation guidelines – Degrees of protection provided by enclosures against electromagnetic disturbances (EM code)*

IEC 61024-1, *Protection of structures against lightning – Part 1: General principles*

IEC 61312-1, *Protection against lightning electromagnetic impulse (LEMP) – Part 1 – General principles*

IEC/TS 61312-2, *Protection against lightning electromagnetic impulse (LEMP) – Part 2: Shielding of structures, bonding inside structures and earthing*

IEC/TS 61312-3, *Protection against lightning electromagnetic impulse (LEMP) – Part 3: Requirements of surge protective devices (SPDs)*

IEC 61312-4, *Protection against lightning electromagnetic impulse (LEMP) – Part 4: Protection of equipment in existing structures*

IEC/TR 62066, *General basic information regarding surge overvoltages and surge protection in low-voltage a.c. power systems*[1]

CISPR 17, *Methods of measurement of the suppression characteristics of passive radio interference filters and suppression components*

[1] To be published