IEC TS 61000-5-10

Edition 1.0 2017-05

TECHNICAL SPECIFICATION

colour inside

BASIC EMC PUBLICATION

Electromagnetic compatibility (EMC) – Part 5-10: Installation and mitigation guidelines – Guidance on the protection of facilities against HEMP and IEMI

IEC TS 61000-5-10:2017-05(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Technical Specification IEC 61000-5-10 has been prepared by subcommittee 77C: High-power transient phenomena, of IEC technical committee 77: Electromagnetic compatibility.

It forms part 5-10 of IEC 61000. It has the status of a basic EMC publication in accordance with IEC Guide 107.

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

Enquiry draft	Report on voting
77C/260/DTS	77C/262/RVDTS

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

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61000 series, published under the general title *Electromagnetic compatibility (EMC)*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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 the 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).

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 5-10: Installation and mitigation guidelines – Guidance on the protection of facilities against HEMP and IEMI

1 Scope

This part of IEC 61000 provides guidelines to protect commercial facilities from the high-power electromagnetic disturbances of high-altitude electromagnetic pulse (HEMP) and intentional electromagnetic interference (IEMI). These guidelines are developed from the entire body of IEC SC 77C publications.

This document is applicable to both existing facilities and new buildings when the customer has decided that protection of critical electronics from HEMP and IEMI is important to the function of the facility.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC TR 61000-1-3, *Electromagnetic compatibility (EMC) – Part 1-3: General – The effects of high-altitude EMP (HEMP) on civil equipment and systems*

IEC TR 61000-1-5, *Electromagnetic compatibility (EMC) – Part 1-5: General – High power electromagnetic (HPEM) effects on civil systems*

IEC 61000-2-9, *Electromagnetic compatibility (EMC) – Part 2: Environment – Section 9: Description of HEMP environment – Radiated disturbance*

IEC 61000-2-10:1998, *Electromagnetic compatibility (EMC) – Part 2-10: Environment – Description of HEMP environment – Conducted disturbance*

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

IEC 61000-2-13, *Electromagnetic compatibility (EMC) – Part 2-13: Environment – High-power electromagnetic (HPEM) environments – Radiated and conducted*

IEC 61000-4-23:2016, *Electromagnetic compatibility (EMC) – Part 4-23: Testing and measurement techniques – Test methods for protective devices for HEMP and other radiated disturbances*

IEC 61000-4-24, *Electromagnetic compatibility (EMC) – Part 4-24: Testing and measurement techniques – Test methods for protective devices for HEMP conducted disturbance*

IEC 61000-4-25, *Electromagnetic compatibility (EMC) – Part 4-25: Testing and measurement techniques – HEMP immunity test methods for equipment and systems*

IEC TR 61000-4-32, *Electromagnetic compatibility (EMC) – Part 4-32: Testing and measurement techniques – High-altitude electromagnetic pulse (HEMP) simulator compendium*

IEC 61000-4-33, *Electromagnetic compatibility (EMC) – Part 4-33: Testing and measurement techniques – Measurement methods for high-power transient parameters*

IEC TR 61000-4-35, *Electromagnetic compatibility (EMC) – Part 4-35: Testing and measurement techniques –HPEM simulator compendium*

IEC 61000-4-36:2014, *Electromagnetic compatibility (EMC) – Part 4-36: Testing and measurement techniques – IEMI immunity test methods for equipment and systems*

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

IEC TR 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*

IEC 61000-5-5:1996, *Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines – Section 5: Specification of protective devices for HEMP conducted disturbance*

IEC TR 61000-5-6, *Electromagnetic compatibility (EMC) – Part 5-6: Installation and mitigation guidelines – Mitigation of external EM influences*

IEC 61000-5-7:2001, *Electromagnetic compatibility (EMC) – Part 5-7: Installation and mitigation guidelines – Degrees of protection provided by enclosures against electromagnetic disturbances (EM code)*

IEC TS 61000-5-8, *Electromagnetic compatibility (EMC) – Part 5-8: Installation and mitigation guidelines – HEMP protection methods for the distributed infrastructure*

IEC TS 61000-5-9, *Electromagnetic compatibility (EMC) – Part 5-9: Installation and mitigation guidelines – System-level susceptibility assessments for HEMP and HPEM*

IEC 61000-6-6, *Electromagnetic compatibility (EMC) – Part 6-6: Generic standards – HEMP immunity for indoor equipment*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms, definitions and abbreviated terms apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Terms and definitions

3.1.1
attenuation
reduction in magnitude (e.g., as a result of absorption and/or scattering) of an electric or magnetic field or a current or voltage

Note 1 to entry: It is usually expressed in dB.

3.1.2
bandratio
br
ratio of the high and low frequencies between which there is 90 % of the energy

Note 1 to entry: If the spectrum has a large DC content, the lower limit is nominally defined as 1 Hz.

3.1.3
conducted HPEM environment
totality of high-power electromagnetic currents and voltages that are either coupled to or directly injected into cables and wires with voltage levels that typically exceed 1 kV

3.1.4
continuous wave
CW
time waveform that has a fixed frequency and is continuous

3.1.5
coupling
interaction of HEMP/IEMI fields with a system or equipment to produce currents and voltages on system surfaces, cables and wires

3.1.6
E1, E2, E3
terminology for the HEMP electric fields

Note 1 to entry: E1 is early time HEMP electric field, for times less than 1 µs, E2 is intermediate time HEMP electric field, for times between 1 µs and 1 s, and E3 is late time HEMP electric field, for times greater than 1 s.

3.1.7
electromagnetic compatibility
EMC
ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

[SOURCE: IEC 60050-161:1990, 161-01-07]

3.1.8
electromagnetic disturbance
any electromagnetic phenomenon which may degrade the performance of a device, equipment or system

[SOURCE: IEC 60050-161:1990, 161-01-05, modified – the last part of the definition has been deleted.]

3.1.9
electromagnetic interference
EMI
degradation of the performance of a device, transmission channel or system caused by an electromagnetic disturbance

Note 1 to entry: Disturbance and interference are respectively cause and effect.

[SOURCE: IEC 60050-161:1990, 161-01-06, modified – in the definition "equipment" has been replaced by "device" and a new note has been added.]

3.1.10
shield
electromagnetic shield
electrically continuous housing for a facility, area, or component used to attenuate incident electric and magnetic fields by both absorption and reflection

3.1.11
(electromagnetic) susceptibility
inability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance

Note 1 to entry: Susceptibility is a lack of immunity.

[SOURCE: IEC 60050-161:1990, 161-01-21]

3.1.12
equipment
modules, devices, apparatuses, subsystems, complete systems and installations

3.1.13
equipment under test
EUT
particular equipment being subjected to the test

3.1.14
high-altitude electromagnetic pulse
HEMP
electromagnetic pulse produced by a nuclear explosion outside the earth's atmosphere

Note 1 to entry: This typically occurs above an altitude of 30 km.

3.1.15
high-power microwaves
HPM
narrowband signals, nominally with peak power in a pulse, in excess of 100 MW at the source

Note 1 to entry: This is a historical definition that depended on the strength of the source. The interest in this document is mainly on the EM field incident on an electronic system.

3.1.16
hyperband signal
signal or waveform with a pbw (see 3.1.21) value between 163,4 % and 200 % or a bandratio > 10

3.1.17
hypoband signal
narrowband signal or waveform with a pbw of < 1 % or a bandratio < 1,01

3.1.18
installation
combination of apparatuses, components and systems assembled and/or erected (individually) in a given area

Note 1 à l'article: For physical reasons (e.g. long distances between individual items) it is in many cases not possible to test an installation as a unit.

3.1.19
intentional electromagnetic interference
IEMI
intentional malicious generation of electromagnetic energy introducing noise or signals into electric and electronic systems, thus disrupting, confusing or damaging these systems for terrorist or criminal purposes

3.1.20
mesoband signal
signal or waveform with a pbw value between 1 % and 100 % or a bandratio between 1,01 and 3

3.1.21
percentage bandwidth
pbw
bandwidth of a waveform expressed as a percentage of the centre frequency of that waveform

Note 1 to entry: The pbw has a maximum value of 200 % when the centre frequency is the mean of the high and low frequencies. The pbw does not apply to signals with a large DC content (e.g., E1 HEMP) for which the bandratio decades term is used.

3.1.22
port of entry
PoE
physical location (point) on an electromagnetic barrier, where EM energy may enter or exit a topological volume, unless an adequate PoE protective device is provided

Note 1 to entry: A PoE is not limited to a geometrical point.

Note 2 to entry: PoEs are classified as aperture PoEs or conductive PoEs according to the type of penetration. They are also classified as architectural, mechanical, structural or electrical PoEs according to the functions they serve.

3.1.23
pulse
transient waveform that usually rises to a peak value and then decays, or a similar waveform that is an envelope of an oscillating waveform

3.1.24
pulse width
time interval between the points on the leading and trailing edges of a pulse at which the instantaneous value is 50 % of the peak pulse amplitude, unless otherwise stated

3.1.25
radiated HPEM environment
totality of high-power electromagnetic fields with peak electric field levels that typically exceed 100 V/m

3.1.26
rise time (of a pulse)
time interval between the instants in which the instantaneous amplitude of a pulse first reaches specified lower and upper limits, namely 10 % and 90 % of the peak pulse amplitude, unless otherwise stated

[SOURCE: IEC 60050-161:1990, 161-02-05, modified – the note has been incorporated into the definition

3.1.27
source impedance
impedance presented by a source of energy to the input terminals of a device or network

3.1.28
sub-hyperband signal
signal or waveform with a pbw value between 100 % and 163,4 % or a bandratio between 3 and 10

3.1.28
system
combination of apparatuses and/or active components constituting a single functional unit and intended to be installed and operated to perform (a) specific task(s)

3.1.29
transient, adj. and noun
pertaining to or designating a phenomenon or a quantity which varies between two consecutive steady states during a time interval which is short compared with the time-scale of interest

Note 1 to entry: A transient can be a unidirectional impulse of either polarity or a damped oscillatory wave with the first peak occurring in either polarity.

[SOURCE: IEC 60050-161:1990, 161-02-01, modified – a note has been added.]

3.1.30
waveguide below cutoff
WBC
a waveguide which severely attenuates the electromagnetic fields at frequencies below the cutoff frequency

3.2 Abbreviated terms

CW	Continuous wave
DS	Damped sinusoid
EMI	Electromagnetic interference
ESD	Electrostatic discharge
EUT	Equipment under test
HEMP	High-altitude electromagnetic pulse
HIRF	High-intensity radiated fields
HPEM	High-power electromagnetic
HPM	High-power microwave
LV	Low voltage
MOV	Metal oxide varistor
MV	Medium voltage
PoE	Port of entry
SE	Shielding effectiveness
SPD	Surge protective device
VPD	Vertically polarized dipole
WBC	Waveguide below cutoff

4 General

IEC SC 77C has developed a wide variety of high-altitude electromagnetic pulse (HEMP) and intentional electromagnetic interference (IEMI) protection reports and standards, and the growth of these publications has been organic, responding to the needs of industry. In addition, some of the standards are being revised to be more specific and useful to industry. IEC SC 77C publications are currently found in many parts of the IEC 61000 series including: