IEC TR 61000-4-1

Edition 1.0 2016-04

TECHNICAL REPORT

BASIC EMC PUBLICATION

Electromagnetic compatibility (EMC) – Part 4-1: Testing and measurement techniques – Overview of the IEC 61000-4 series

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-1: Testing and measurement techniques – Overview of the IEC 61000-4 series

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. 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".

IEC TR 61000-4-1, which is a technical report, has been prepared by IEC technical committee 77: Electromagnetic compatibility.

This Technical Report forms Part 4-1 of IEC 61000. It has the status of a basic EMC publication in accordance with IEC Guide 107.

This first edition as a Technical Report cancels and replaces the third edition of the International Standard published in 2006. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) updates the text to include reference to the latest publications of the IEC 61000-4 series;
b) gives more detailed assignment between applicable immunity tests and the electromagnetic environment in which equipment is intended to be used.

The text of this standard is based on the following documents:

Enquiry draft	Report on voting
77/498/DTR	77/508/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 publication 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 publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

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

INTRODUCTION

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

Part 1: General

General consideration (introduction, fundamental principles)

Definitions, terminology

Part 2: Environment

Description of the environment

Classification of the environment

Compatibility levels

Part 3: Limits

Emission limits

Immunity test levels (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, 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 completed by a second number identifying the subdivision (example: 61000-6-1).

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-1: Testing and measurement techniques – Overview of the IEC 61000-4 series

1 Scope and object

This part of IEC 61000 gives information and guidance on the EMC basic standards and other basic EMC documents published in the IEC 61000-4 series. Those basic standards describe mainly immunity tests to be considered and applied for electric and electronic equipment, including systems.

The object of this part of IEC 61000 is to give assistance to the technical committees of IEC or other bodies, users and manufacturers in

- considering the immunity test methods applicable to their products;
- determining the immunity test methods relevant for the electromagnetic environment in which their products are intended to be used;
- specifying the ports of their products being subjected to the relevant immunity test methods.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-161, *International Electrotechnical Vocabulary (IEV) – Part 161: Electromagnetic compatibility* (available at <http:www.electropedia.org>)

IEC TR 61000-1-1, *Electromagnetic compatibility (EMC) – Part 1: General – Section 1: Application and interpretation of fundamental definitions and terms*

IEC TR 61000-2-5, *Electromagnetic compatibility (EMC) – Part 2-5: Environment – Description and classification of electromagnetic environments*

IEC 61000-3-2, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤16 A per phase)*

IEC 61000-3-3, *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤16 A per phase and not subject to conditional connection*

IEC TR 61000-3-4, *Electromagnetic compatibility (EMC) – Part 3-4: Limits – Limitation of emission of harmonic currents in low-voltage power supply systems for equipment with rated current greater than 16 A*

IEC TS 61000-3-5, *Electromagnetic compatibility (EMC) – Part 3-5: Limits – Limitation of voltage fluctuations and flicker in low-voltage power supply systems for equipment with rated current greater than 75 A*

IEC TR 61000-3-6, *Electromagnetic compatibility (EMC) – Part 3-6: Limits –Assessment of emission limits for the connection of distorting installations to MV, HV and EHV power systems*

IEC 61000-3-11, *Electromagnetic compatibility (EMC) – Part 3-11: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems – Equipment with rated current ≤75 A and subject to conditional connection*

IEC 61000-3-12, *Electromagnetic compatibility (EMC) – Part 3-12: Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and ≤75 A per phase*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

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

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

IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-7, *Electromagnetic compatibility (EMC) – Part 4-7: Testing and measurement techniques – General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-9, *Electromagnetic compatibility (EMC) – Part 4-9: Testing and measurement techniques – Pulse magnetic field immunity test*

IEC 61000-4-10, *Electromagnetic compatibility (EMC) – Part 4-10: Testing and measurement techniques – Damped oscillatory magnetic field immunity test*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

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

IEC 61000-4-13, *Electromagnetic compatibility (EMC) – Part 4-13: Testing and measurement techniques – Harmonics and interharmonics including mains signalling at a.c. power port, low frequency immunity tests*

IEC 61000-4-14, *Electromagnetic compatibility (EMC) – Part 4-14: Testing and measurement techniques – Voltage fluctuation immunity test for equipment with input current not exceeding 16 A per phase*

IEC 61000-4-15, *Electromagnetic compatibility (EMC) – Part 4-15: Testing and measurement techniques – Flickermeter – Functional and design specifications* [1]

IEC 61000-4-16, *Electromagnetic compatibility (EMC) – Part 4-16: Testing and measurement techniques – Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz*

IEC 61000-4-17, *Electromagnetic compatibility (EMC) – Part 4-17: Testing and measurement techniques – Ripple on d.c. input power port immunity test*

IEC 61000-4-18, *Electromagnetic Compatibility (EMC) – Part 4-18: Testing and measurement techniques – Damped oscillatory wave immunity test*

IEC 61000-4-19, *Electromagnetic Compatibility (EMC) – Part 4-19: Testing and measurement techniques – Test for immunity to conducted, differential mode disturbances and signalling in the frequency range 2 kHz to 150 kHz at a.c. power ports*

IEC 61000-4-20, *Electromagnetic compatibility (EMC) – Part 4-20: Testing and measurement techniques – Emission and immunity testing in transverse electromagnetic (TEM) waveguides*

IEC 61000-4-21, *Electromagnetic compatibility (EMC) – Part 4-21: Testing and measurement techniques – Reverberation chamber test methods*

IEC 61000-4-22, *Electromagnetic compatibility (EMC) – Part 4-22: Testing and measurement techniques – Radiated emissions and immunity measurements in fully anechoic rooms (FARs)*

IEC 61000-4-23, *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 61000-4-27, *Electromagnetic compatibility (EMC) – Part 4-27: Testing and measurement techniques – Unbalance, immunity test for equipment with input current not exceeding 16 A per phase*

IEC 61000-4-28, *Electromagnetic compatibility (EMC) – Part 4-28: Testing and measurement techniques – Variation of power frequency, immunity test for equipment with input current not exceeding 16 A per phase*

IEC 61000-4-29, *Electromagnetic compatibility (EMC) – Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests*

IEC 61000-4-30, *Electromagnetic compatibility (EMC) – Part 4-30: Testing and measurement techniques –Power quality measurement methods*

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

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[1] Revision of IEC 60868.

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

IEC 61000-4-34, *Electromagnetic compatibility (EMC) – Part 4-34: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current more than 16 A per phase*

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

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

IEC TR 61000-4-38, *Electromagnetic compatibility (EMC) – Part 4-38: Testing and measurement techniques – Test, verification and calibration protocol for voltage fluctuation and flicker compliance test systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-161, as well as the following apply.

NOTE Additional definitions related to EMC and to relevant phenomena are given in other IEC and CISPR publications.

3.1
electromagnetic environment
totality of electromagnetic phenomena existing at a given location

Note 1 to entry: In general, this totality is time-dependent and its description may need a statistical approach.

Note 2 to entry: It is very important not to confuse the electromagnetic environment and the location itself.

[SOURCE: IEC 60050-161:1990, 161-01-01, modified – a note 2 has been added.]

3.2
residential location
location which exists as an area of land designated for the construction of domestic dwellings, and is characterized by the fact that equipment is directly connected to a low-voltage public mains network or connected to a dedicated DC source which is intended to interface between the equipment and the low-voltage mains network

EXAMPLE Examples of residential locations are houses, apartments, and farm buildings used for living (see IEC TR 61000-2-5 for further information).

Note 1 to entry: The function of a domestic dwelling is to provide a place for one or more people to live. A dwelling can be a single, separate building (as in a detached house) or a separate section of a larger building (as in an apartment in an apartment block).

Note 2 to entry: The connection between location and electromagnetic environment is given in 3.1.

3.3
commercial, public and light-industrial location
location which exists as areas of the city centre, offices, public transport systems (road/train/underground), and modern business centres containing a concentration of office automation equipment (PCs, fax machines, photocopiers, telephones, etc.), and is characterized by the fact that equipment is directly connected to a low-voltage public mains network or connected to a dedicated DC source which is intended to interface between the equipment and the low-voltage mains network

EXAMPLE Examples of commercial, public or light-industrial locations are (see IEC TR 61000-2-5 for further information):

– retail outlets, for example shops, supermarkets;
– business premises, for example offices, banks, hotels, data centers;
– areas of public entertainment, for example cinemas, public bars, dance halls;
– places of worship, for example temples, churches, mosques, synagogues;
– outdoor locations, for example petrol stations, car parks, amusement and sports centers;
– general public locations, for example park, amusement facilities, public offices;
– hospitals, educational institutions, for example schools, universities, colleges;
– public traffic area, railway stations, and public areas of an airport;
– light-industrial locations, for example workshops, laboratories, service centers.

Note 1 to entry: The connection between location and electromagnetic environment is given in 3.1.

3.4
industrial location
location characterized by a separate power network, supplied from a high- or medium-voltage transformer, dedicated for the supply of the installation

EXAMPLE Examples of industrial locations are metalworking, pulp and paper, chemical plants, car production, farm building, high voltage (HV) areas of airports.

Note 1 to entry: Industrial locations can generally be described by the existence of an installation with one or more of the following characteristics:

– items of equipment installed and connected together and working simultaneously;
– significant amount of electrical power is generated, transmitted and/or consumed;
– frequent switching of heavy inductive or capacitive loads;
– high currents and associated magnetic fields;
– presence of industrial, high power scientific and medical (ISM) equipment (for example, welding machines)

The electromagnetic environment at an industrial location is predominantly produced by the equipment and installation present at the location. There are types of industrial locations where some of the electromagnetic phenomena appear in a more severe degree than in other installations.

Note 2 to entry: Industrial locations can be further distinguished, for example into general, process, heavy or power industrial locations (see IEC TR 61000-2-5 for further information).

Note 3 to entry: The connection between location and electromagnetic environment is given in 3.1.

4 General

Electronic components and equipment are sensitive to electromagnetic disturbances (i.e. conducted and radiated electromagnetic disturbances and electrostatic discharge). The tremendous expansion in the use of electronic components and equipment continuously increases the number of cases and probability of malfunctioning or damage, etc., which can arise from electromagnetic disturbances.

IEC TR 61000-2-5 provides a description of the various electromagnetic environments that electronic components and systems can be exposed to. However, IEC TR 61000-2-5 does not provide a link to all the immunity test standards of the IEC 61000-4 series.

Product committees, users and manufacturers of equipment remain responsible for the appropriate choice of the immunity tests from the IEC 61000-4 series and the test level to be applied to their equipment.

To enhance the task of coordination and standardization, product committees, users and manufacturers should consider the recommendations given in this document in parallel to the environmental descriptions given in IEC TR 61000-2-5.

5 Structure of the IEC 61000-4 series

The structure of documents within the IEC 61000-4 series follows the guidance given in IEC Guide 107. For the basic immunity test standards of the series, that structure is as follows:

1) Scope
2) Normative references
3) Terms and definitions
4) General
5) Test levels/limits
6) Test equipment
7) Test set-up
8) Test procedures
9) Evaluation of test results
10) Test report

There are documents within the IEC 61000-4 series, which are not basic immunity test standards (for example IEC 61000-4-7). They are documents related to measurement (instrumentation and procedures), which do not necessarily follow the above-mentioned structure.

6 Applicability of tests

Tests can be applied to equipment for many reasons, for example

- design tests during development;
- type tests;
- acceptance tests;
- production tests.

Equipment should be subjected to all tests necessary to provide the required reliability, but, for economic reasons, the number of tests may be limited to a reasonable minimum. It is acceptable that the number of tests for acceptance or production testing is reduced in comparison with type tests.

The selection of the tests to be applied to a particular equipment depends on several factors, such as

– types of disturbances affecting the equipment;
– environmental conditions;
– required reliability and behaviour;
– economic constraints;
– equipment characteristics.

With regard to the variety of equipment and environmental conditions to be considered, it is difficult to indicate exact rules concerning the selection of tests. This selection is primarily the responsibility of the product committees concerned (based on their experience). In special cases, this can be fixed by agreement between the manufacturer and the user. In all cases, knowledge of the electromagnetic environment (see the IEC 61000-2 series, especially IEC TR 61000-2-5) and awareness of the statistical aspects explained in IEC 61000-1-1 are helpful.

If there is an existing applicable generic, product family or dedicated product standard, these standards have the following priority (see IEC Guide 107):

a) dedicated product standard;

b) product family standard;

c) generic standard.

If it is considered that none of these standards is applicable to a particular type of equipment, the following short explanation of each basic immunity test standard within the IEC 61000-4 series may be helpful to decide on tests applicable for this type of equipment.

- **IEC 61000-4-2** *(Electrostatic discharge immunity test)*

  In general, the electrostatic discharge test is applicable to all equipment which is used in an environment where electrostatic discharges may occur. Direct and indirect discharges shall be considered. Exclusions may include equipment limited for use in ESD-controlled environmental conditions and non-electrical or non-electronic products.

- **IEC 61000-4-3** *(Radiated, radio-frequency, electromagnetic field immunity test)*

  In general, the radiated immunity test is applicable to all products where radio-frequency fields are present. Exclusions may include equipment limited for use in electromagnetic-controlled conditions or low electromagnetic field environment and non-electrical or non-electronic products.

- **IEC 61000-4-4** *(Electrical fast transient/burst immunity test)*

  In general, the fast transient test is applicable to products which are connected to mains or have cables (signal or control) in close proximity to power supply cables (AC or DC).

- **IEC 61000-4-5** *(Surge immunity test)*

  The surge test is applicable to products which are connected to networks leaving the building or mains in general.

- **IEC 61000-4-6** *(Immunity to conducted disturbances, induced by radio-frequency fields)*

  In general, the conducted immunity test is applicable to products where radio-frequency fields are present and which are connected to mains or other networks (signal or control lines).

- **IEC 61000-4-8** *(Power frequency magnetic field immunity test)*

  In general, this test should be limited to products which are susceptible to magnetic fields (for example Hall effect devices, CRTs and special products to be installed in high magnetic field environments). Exclusions include equipment which is intended for use in a low magnetic field environment.

- **IEC 61000-4-9** *(Pulse magnetic field immunity test)*

  This test is mainly applicable to products to be installed in electrical plants (for example telecontrol centres in close proximity to switchgear).

- **IEC 61000-4-10** *(Damped oscillatory magnetic field immunity test)*

  This test is mainly applicable to products to be installed in high-voltage substations.

- **IEC 61000-4-11** *(Voltage dips, short interruptions and voltage variations immunity tests)*

  This document defines the test methods to evaluate the immunity of equipment connected to the LV system, to voltage dips, short interruptions and voltage variations. This test is applicable to equipment with a rated input current not exceeding 16 A per phase, connected to AC mains.

- **IEC 61000-4-12** *(Ring wave immunity test)*

  The ring wave test is applicable to equipment with connections to low-voltage power, control and signal lines and which is used in power plants and high voltage substations.

- **IEC 61000-4-13** *(Harmonics and interharmonics including mains signalling at a.c. power port, low-frequency immunity tests)*

This test may be applied to equipment sensitive to precise zero crossing in time on the a.c. mains or to specific harmonic components.

- **IEC 61000-4-14** *(Voltage fluctuation immunity test for equipment with input current not exceeding 16 A per phase)*

  In general, voltage fluctuations have an amplitude not exceeding 10 %; therefore, most equipment is not disturbed by voltage fluctuations. However, this test may be applicable to equipment intended to be installed at locations where the mains have larger fluctuations.

- **IEC 61000-4-16** *(Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz)*

  This test is applicable for equipment with long lines in large installations (for example industrial plants). This document defines the test method to evaluate the immunity of an equipment to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz.

- **IEC 61000-4-17** *(Ripple on d.c. input power port immunity test)*

  This test applies to equipment connected to DC distribution systems with external batteries charged during the operation of the equipment.

- **IEC 61000-4-18** *(Damped oscillatory wave immunity test)*

  The damped oscillatory wave test is applicable to equipment used in power plants and high-voltage substations (for example static relays).

- **IEC 61000-4-19** *(Test for immunity to conducted, differential mode disturbances and signalling in the frequency range 2 kHz to 150 kHz at a.c. power ports)*

  This test is intended to demonstrate the immunity of equipment connected to a.c. mains when subjected to conducted, differential mode disturbances such as those originating from power electronics and power line communication systems (PLC).

- **IEC 61000-4-20** *(Emission and immunity testing in transverse electromagnetic (TEM) waveguides)*

  This standard specifies equipment and test procedures for testing to radiated electromagnetic fields in TEM cells as an alternative to testing according to IEC 61000-4-3.

- **IEC 61000-4-21** *(Reverberation chamber test methods)*

  This standard specifies equipment and test procedures for testing to radiated electromagnetic fields in reverberation chambers as an alternative to testing according to IEC 61000-4-3.

- **IEC 61000-4-22** *(Radiated emissions and immunity measurements in fully anechoic rooms (FARs))*

  This standard specifies equipment and test procedures for testing to radiated electromagnetic fields in fully anechoic rooms as an alternative to testing according IEC 61000-4-3.

- **IEC 61000-4-23** *(Test methods for protective devices for HEMP and other radiated disturbances)*

  This standard covers testing of protective elements designed to reduce the level of radiated electromagnetic fields from HEMP and other high power transients.

- **IEC 61000-4-24** *(Test methods for protective devices for HEMP conducted disturbance)*

  This standard covers testing of voltage breakdown and voltage-limiting characteristics of high-altitude electromagnetic pulse protective devices.

- **IEC 61000-4-25** *(HEMP immunity test methods for equipment and systems)*

  This standard specifies the basic high-altitude electromagnetic pulse (HEMP) test methods and levels appropriate for radiated and conducted immunity testing. It is applicable for equipment and systems intended to survive a HEMP.

- **IEC 61000-4-27** *(Unbalance, immunity test for equipment with input current not exceeding 16 A per phase)*

  This test may be applicable to three-phase equipment with a rated input current up to 16 A per phase, connected to a three-phase a.c. mains. However, this test is not applicable to equipment taking three-phase power but using it in a single-phase manner.

- **IEC 61000-4-28** *(Variation of power frequency, immunity test for equipment with input current not exceeding 16 A per phase)*

  In general, the test for variation of the power frequency is not applicable. However, it may apply to equipment intended to be installed at locations where the power frequency has large variations (for example equipment connected to an emergency power supply).

- **IEC 61000-4-29** *(Voltage dips, interruptions and voltage variations on d.c. input power port immunity tests)*

  This document defines the test methods to evaluate the immunity of equipment connected to the DC supply system, to voltage dips, short interruptions and voltage variations.

- **IEC 61000-4-31** *(AC mains ports broadband conducted immunity test)*[2]

  This part of IEC 61000 relates to the conducted immunity of electrical and electronic equipment to electromagnetic disturbances coming from intended and/or unintended broadband signal sources in the frequency range 150 kHz up to 80 MHz. The object of this standard is to establish a common reference to evaluate the functional immunity of electrical and electronic equipment when subjected to conducted disturbances caused by intended and/or unintended broadband signal sources (such as power line telecommunication systems) on AC mains ports.

- **IEC 61000-4-34** (*Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current more than 16 A per phase)*

  This document defines the test methods to evaluate the immunity of equipment connected to the LV system, to voltage dips, short interruptions and voltage variations. This test is applicable to equipment with a rated input current of more than 16 A per phase, connected to AC mains.

- **IEC 61000-4-36** (*IEMI immunity test methods for equipment and systems)*

  This standard provides methods to determine test levels for the assessment of the immunity of equipment and systems to intentional electromagnetic interference (IEMI) sources. It introduces the general IEMI problem, IEMI source parameters, and the derivation of test limits and it also identifies practical test methods.

- **IEC 61000-4-39** (*Radiated fields in close proximity– Immunity test)*[3]

  This part of IEC 61000 is applicable to the immunity requirements of electrical and electronic equipment to radiated electromagnetic energy from intended radio-frequency (RF) transmitters, for example mobile phones or RFID transmitters, used in close proximity to other equipment. It establishes test levels and the required test procedures. The applicable frequency range is 9 kHz to 6 GHz. The object of this standard is to establish a common reference for evaluating the additional immunity requirements of electrical and electronic equipment that is exposed to radiated, RF electromagnetic fields from sources at close distances.

A guide to the applicability of the above listed test standards for equipment intended to be used in a selected electromagnetic environment is given in Table 1. When any of the standards listed in Table 1 is applied, the corresponding entry in Table 2 gives a guide to the selection of the EUT ports to be tested.

The IEC 61000-4 series also contains the following documents which are not basic immunity test standards:

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2 Under consideration.

3 Under consideration.

- **IEC 61000-4-7** (*General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto*)

  This standard defines the measurement method of harmonics and interharmonics. It provides also the accuracy expected and the test set-up. It is applicable to voltage or current measurements in the frequency range DC up to 9 kHz, especially with regard to the emission requirements according to IEC 61000-3-2, IEC TR 61000-3-4, IEC TR 61000-3-6, IEC 61000-3-12 and with regard to IEC 61000-4-30.

- **IEC 61000-4-15** (*Flickermeter – Functional and design specifications*)

  This is a specification for a flickermeter, intended to indicate correct flicker perception levels for all practical voltage fluctuation waveforms, especially with regard to the emission requirements according to IEC 61000-3-3, IEC TS 61000-3-5 and IEC 61000-3-11.

- **IEC 61000-4-30** (*Power quality measurement methods*)

  This standard defines methods for the measurement of power quality parameters in 50/60 Hz AC power supply systems.

- **IEC TR 61000-4-32** *(High-altitude electromagnetic pulse (HEMP) simulator compendium)*

  This technical report provides information about existing system-level high-altitude EMP (HEMP) simulators and their applicability as test facilities and validation tools for satisfying IEC SC 77C immunity test requirements in accordance with the IEC SC 77C series of publications. This report provides the first detailed listing of large HEMP simulators throughout the world.

- **IEC 61000-4-33** *(Measurement methods for high-power transient parameters)*

  This standard provides a basic description of the methods and means of measuring responses from high power transient electromagnetic radiated and conducted disturbances.

- **IEC TR 61000-4-35** *(HPEM simulator compendium)*

  This technical report provides information about existing system-level high power electromagnetic (HPEM) radiated simulators and their applicability as test facilities and validation tools for satisfying immunity test requirements in accordance with the IEC SC 77C series of publications. This report includes HPEM simulators producing both narrowband and wideband waveforms representing radiated high power electric fields (peak fields greater than 100 V/m).

- **IEC TR 61000-4-37** *(Calibration and verification protocol for harmonic emission compliance test systems)*

  This technical report defines a test protocol for harmonic analysis systems designed according to the IEC 61000-4-7 standard, and is intended to evaluate products according to IEC 61000-3-2 and/or IEC 61000-3-12.

- **IEC TR 61000-4-38** (*Test, verification and calibration protocol for voltage fluctuation and flicker compliance test systems*)

  This technical report defines a test protocol for flicker test systems designed to perform compliance tests in accordance with IEC 61000-3-3 and IEC 61000-3-11.

Table 1 – Applicability of immunity tests based on location (environment)

Basic standard or technical report	Description	Applicability [a]						
		Resi-dential	Com-mer-cial/ public	Light-indus-trial	Industrial			
					General	Heavy	Power	Process
61000-4-2	ESD	H	H	H	H	H	H	H
61000-4-3	Radiated electromagnetic field	H	H	H	H	H	H	H
61000-4-4	EFT/burst	H	H	H	H	H	H	H
61000-4-5	Surge	H	H	H	H	H	H	H

Basic standard or technical report	Description	Applicability [a]						
		Resi-dential	Com-mer-cial/ public	Light-indus-trial	Industrial			
					General	Heavy	Power	Process
61000-4-6	Conducted disturbances by RF field	H	H	H	H	H	H	H
61000-4-8	50/60 Hz magnetic field	S	S	S	S	S	S	S
61000-4-9	Pulse magnetic field	S	S	S	S	S	R	S
61000-4-10	Oscillatory magnetic field	S	S	S	S	S	R	S
61000-4-11	Voltage dips and interruption	H	H	H	H	H	H	H
61000-4-12	Ring wave	S	S	S	S	S	S	S
61000-4-13	Harmonics, interharmonics including mains signalilng	S	S	S	S	S	S	S
61000-4-14	Voltage fluctuations	S	S	S	S	S	S	S
61000-4-16	Conducted disturbances in the range of 0 Hz to 150 kHz	S	S	S	S	S	R	S
61000-4-17	Ripple on DC power supply	S	S	S	S	S	S	S
61000-4-18	Damped oscillatory wave	S	S	S	S	S	R	S
61000-4-19	Conducted, differential mode disturbances and signalling in the frequency range 2 kHz to 150 kHz	R	R	R	S	S	S	S
61000-4-20	TEM cells	[c]	[c]	[c]	[c]	[c]	[c]	[c]
61000-4-21	Reverberation chambers	[c]	[c]	[c]	[c]	[c]	[c]	[c]
61000-4-22	Fully anechoic rooms (FARs)	[c]	[c]	[c]	[c]	[c]	[c]	[c]
61000-4-23	Test methods for protective device; HEMP radiated disturbance	S	S	S	S	S	S	S
61000-4-24	Test methods for protective device; HEMP conducted disturbance	S	S	S	S	S	S	S
61000-4-25	HEMP immunity test methods for equipment and systems	S	S	S	S	S	S	S
61000-4-27	Unbalance in three-phase mains	S	S	S	S	S	S	S
61000-4-28	Variation of power frequency	S	S	S	S	S	S	S
61000-4-29	Voltage dips, interruptions and voltage variations on DC power ports	S	S	S	R	R	H	R
61000-4-31[b]	AC mains port broadband conducted disturbances	R	R	R	S	S	S	S
61000-4-32	HEMP simulator compendium	S	S	S	S	S	S	S
61000-4-34	Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current more than 16 A per phase	H	H	H	H	H	H	H
61000-4-36	IEMI immunity test methods for equipment and systems	S	S	S	S	S	S	S
61000-4-39[b]	Radiated fields in close proximity	R[d]	R[d]	R[d]	R[d]	R[d]	R[d]	R[d]

[a] Applicability explanation:
H = highly recommended
R = recommended
S = special case

[b] The document is under consideration.

[c] The decision about test sites and methods where radiated immunity tests (alternative to IEC 61000-4-3) should be applied is subject to the product committee.

[d] This test is highly recommended for safety critical devices with a high probability of mobile transmitters in close proximity.

Table 2 – Applicability of immunity tests based on EUT ports

Basic standard or technical report	Description	Applicability [a]				
		Encl-osure	AC power	DC power	Signal data	Earth
61000-4-2	ESD	H	-	-	-	-
61000-4-3	Radiated electromagnetic field	H	-	-	-	-
61000-4-4	EFT/burst	-	H	H	H	H
61000-4-5	Surge	-	H	H	H	S
61000-4-6	Conducted disturbances by RF field	-	H	H	H	H
61000-4-8	50/60 Hz magnetic field	S	-	-	-	-
61000-4-9	Pulse magnetic field	R	-	-	-	-
61000-4-10	Damped oscillatory magnetic field	R	-	-	-	-
61000-4-11	Voltage dips, short interruptions and voltage variations	-	H	-	-	-
61000-4-12	Ring wave	-	S	S	S	S
61000-4-13	Harmonics, interharmonics including mains signalilng	-	S	-	-	-
61000-4-14	Voltage fluctuations	-	S	-	-	-
61000-4-16	Conducted, common mode disturbances in the range of 0 Hz to 150 kHz	-	R	R	R	-
61000-4-17	Ripple on DC input power port	-	-	R	-	-
61000-4-18	Damped oscillatory wave	-	R [c]	S [c]	S [c]	S [c]
61000-4-19	Conducted, differential mode disturbances and signalling in the frequency range 2 kHz to 150 kHz	-	R	-	-	-
61000-4-20	TEM waveguides	S [d]	-	-	-	-
61000-4-21	Reverberation chambers	S [d]	-	-	-	-
61000-4-22	Fully anechoic rooms (FARs)	S [d]	-	-	-	-
61000-4-23	Test methods for protective device; HEMP and other radiated disturbances	S	S	S	S	S
61000-4-24	Test methods for protective device; HEMP conducted disturbance	-	S	S	S	S
61000-4-25	HEMP immunity test methods for equipment and systems	S	S	S	S	S
61000-4-27	Unbalance in three-phase mains	-	R	-	-	-
61000-4-28	Variation of power frequency	-	R	-	-	-
61000-4-29	Voltage dips, interruptions and voltage variations on DC power ports	-	-	R	-	-
61000-4-31 [b]	AC mains port broadband conducted disturbances	-	R	-	-	-
61000-4-34	Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current more than 16 A per phase	-	H	-	-	-
61000-4-36	IEMI for equipment and systems	S	S	S	S	S
61000-4-39 [b]	Radiated fields in close proximity	R [e]	-	-	-	-

[a] Applicability explanation:

H = highly recommended

R = recommended

S = special case

(–) means not applicable.

[b] The document is under consideration.

[c] Applicable to equipment installed in high voltage and medium voltage (HV/MV) substations, in gas insulated switchgear(GIS) substations and in air insulated switchgear(AIS) substations or in any installation due to HEMP phenomena.

[d] The decision about test sites and methods where radiated immunity tests (alternative to IEC 61000-4-3) should be applied is subject to the product committee.

[e] Applicable to equipment that may be exposed to radiated electromagnetic energy from intended radio-frequency (RF) transmitters, for example mobile phones or RFID transmitters, used in “close proximity” to other equipment. “Close proximity” generally refers to separation between the source and victim equipment of less than or equal to 200 mm.

7 Test report

The test report shall contain all the information necessary to reproduce the test. In particular, the following shall be recorded:

- identification of the EUT (including hardware and software versions) and any associated equipment, for example, brand name, product type, serial number;
- identification of the test equipment, for example, brand name, product type, serial number;
- any special installation conditions in which the test was performed, for example, shielded enclosure, use of cabinets;
- environmental conditions (e.g. temperature, humidity);
- operation mode(s) of the EUT;
- description of the test set-up;
- any specific conditions necessary to enable the test to be performed;
- performance level defined by the manufacturer (or third party);
- performance criterion as specified in the generic, product or product-family standard;
- test results including any effects on the EUT observed during or after the application of the test disturbance, and the duration for which these effects persist;
- the rationale for the pass/fail decision (based on the performance criterion specified in the generic, product or product-family standard, or agreed between the manufacturer and third party);
- any specific conditions of use, for example cable length or type, shielding or grounding, or EUT operating conditions, which are required to achieve compliance.

Bibliography

IEC 61000-4-31, *Electromagnetic compatibility (EMC) – Part 4-31: Testing and measurement techniques – AC mains ports broadband conducted immunity test*

IEC TR 61000-4-37, *Electromagnetic compatibility (EMC) – Part 4-37: Testing and measurement techniques – Calibration and verification protocol for harmonic emission compliance test systems*

IEC 61000-4-39, *Electromagnetic compatibility (EMC) – Part 4-39: Testing and measurement techniques – Radiated fields in close proximity – Immunity test*

IEC Guide 107:2014, *Electromagnetic compatibility – Guide to the drafting of electromagnetic compatibility publications*

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