มาตรฐานผลิตภัณฑ์อุตสาหกรรม

THAI INDUSTRIAL STANDARD

มอก. 1451 – 2552

IEC 61000 – 4 – 1(2006)

ความเข้ากันได้ทางแม่เหล็กไฟฟ้า

เล่ม 4 เทคนิคการทดสอบและการวัด

ส่วนที่ 1 ภาพโดยรวมของการทดสอบภูมิคุ้มกัน

ELECTROMAGNETIC COMPATIBILITY (EMC)

PART 4 : TESTING AND MEASUREMENT TECHNIQUES

SECTION 1 : OVERVIEW OF IMMUNITY TESTS

สำนักงานมาตรฐานผลิตภัณฑ์อุตสาหกรรม

กระทรวงอุตสาหกรรม

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สำนักงานมาตรฐานผลิตภัณฑ์อุตสาหกรรม
กระทรวงอุตสาหกรรม ถนนพระรามที่ 6 กรุงเทพฯ 10400
โทรศัพท์ 02 202 3300

ประกาศในราชกิจจานุเบกษา ฉบับประกาศและงานทั่วไป เล่ม 126 ตอนพิเศษ 185ง
วันที่ 25 ธันวาคม พุทธศักราช 2552

ภาพโดยรวมของการทดสอบภูมิคุ้มกัน ได้ประกาศใช้ครั้งแรกโดยรับ IEC 1000-4-1(1992-12) Electromagnetic compatibility (EMC) - Part4: Testing and measurement techniques - Section1: Overview of immunity tests มาใช้ในระดับเหมือนกันทุกประการ (Identical) โดยใช้ IEC ฉบับภาษาอังกฤษเป็นหลัก โดยประกาศในราชกิจจานุเบกษา ฉบับประกาศทั่วไป เล่มที่ 115 ตอนที่ 28ง วันที่ 7 เมษายน พุทธศักราช 2541

เนื่องจาก IEC ได้แก้ไขปรับปรุงมาตรฐาน IEC 1000-4-1(1992-12) เป็น IEC 61000-4-1(2006) จึงได้ยกเลิกมาตรฐานเดิมและกำหนดมาตรฐานใหม่โดยรับ IEC 61000-4-1(2006) Electromagnetic Compatibility (EMC) - Part4-1: Testing and measurement techniques -Overview of immunity series มาใช้ในระดับเหมือนกันทุกประการโดยใช้มาตรฐาน IEC ฉบับภาษาอังกฤษเป็นหลัก

คณะกรรมการมาตรฐานผลิตภัณฑ์อุตสาหกรรมได้พิจารณามาตรฐานนี้แล้ว เห็นสมควรเสนอรัฐมนตรีประกาศตามมาตรา 15 แห่งพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม พ.ศ. 2511

ประกาศกระทรวงอุตสาหกรรม

ฉบับที่ 4071 (พ.ศ. 2552)

ออกตามความในพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม

พ.ศ. 2511

เรื่อง ยกเลิกและกำหนดมาตรฐานผลิตภัณฑ์อุตสาหกรรม

ความเข้ากันได้ทางแม่เหล็กไฟฟ้า

เล่ม 4 เทคนิคการทดสอบและการวัด

ส่วนที่ 1 ภาพโดยรวมของการทดสอบภูมิคุ้มกัน

โดยที่เป็นการสมควรปรับปรุงมาตรฐานผลิตภัณฑ์อุตสาหกรรม ความเข้ากันได้ทางแม่เหล็กไฟฟ้า เล่ม 4 เทคนิคการทดสอบและการวัด ส่วนที่ 1 ภาพโดยรวมของการทดสอบภูมิคุ้มกัน มาตรฐานเลขที่ มอก.1451-2540

อาศัยอำนาจตามความในมาตรา 15 แห่งพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม พ.ศ. 2511 รัฐมนตรีว่าการกระทรวงอุตสาหกรรมออกประกาศยกเลิกประกาศกระทรวงอุตสาหกรรม ฉบับที่ 2344 (พ.ศ.2541) ออกตามความในพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม พ.ศ. 2511 เรื่อง กำหนดมาตรฐานผลิตภัณฑ์อุตสาหกรรม ความเข้ากันได้ทางแม่เหล็กไฟฟ้า เล่ม 4 เทคนิคการทดสอบและการวัด ส่วนที่ 1 ภาพโดยรวมของการทดสอบภูมิคุ้มกัน ลงวันที่ 28 มกราคม พ.ศ. 2541 และออกประกาศกำหนดมาตรฐาน ผลิตภัณฑ์อุตสาหกรรม ความเข้ากันได้ทางแม่เหล็กไฟฟ้า เล่ม 4 เทคนิคการทดสอบและการวัด ส่วนที่ 1 ภาพโดยรวมของการทดสอบภูมิคุ้มกัน มาตรฐานเลขที่ มอก.1451-2552 ขึ้นใหม่ ดังมีรายละเอียดต่อท้ายประกาศนี้

ทั้งนี้ให้มีผลตั้งแต่วันถัดจากวันที่ประกาศในราชกิจจานุเบกษา เป็นต้นไป

ประกาศ ณ วันที่ 1 กันยายน พ.ศ. 2552

ชาญชัย ชัยรุ่งเรือง

รัฐมนตรีว่าการกระทรวงอุตสาหกรรม

มาตรฐานผลิตภัณฑ์อุตสาหกรรม
ความเข้ากันได้ทางแม่เหล็กไฟฟ้า
เล่ม 4 เทคนิคการทดสอบและการวัด
ส่วนที่ 1 ภาพโดยรวมของการทดสอบภูมิคุ้มกัน

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้กำหนดขึ้นโดยการรับ IEC 61000-4-1(2006) Electromagnetic Compatibility (EMC) - Part 4-1: Testing and measurement techniques -Overview of IEC 61000-4 series มาใช้ในระดับเหมือนกันทุกประการ (identical) โดยใช้ IEC ฉบับภาษาอังกฤษเป็นหลัก

มาตรฐานผลิตภัณฑ์นี้ครอบคลุมถึงการทดสอบและเทคนิคการวัดสำหรับบริภัณฑ์ไฟฟ้าและอิเล็กทรอนิกส์ (เครื่องมือและระบบ) ในสภาวะแวดล้อมแม่เหล็กไฟฟ้า

วัตถุประสงค์ของมาตรฐานนี้ เพื่อเป็นสิ่งอ้างอิงในการนำไปใช้ สำหรับคณะกรรมการเทคนิคของ IEC หรือขององค์กรอื่น ผู้ใช้ ผู้ผลิตบริภัณฑ์ไฟฟ้าและอิเล็กทรอนิกส์ตามมาตรฐาน EMC ซึ่งอยู่ภายใต้ IEC 61000-4 series ที่มีเนื้อหาเกี่ยวกับเทคนิคการการทดสอบและการวัด รวมทั้งยังเป็นการแนะนำทั่วไปที่เกี่ยวกับทางเลือกในการทดสอบต่าง ๆที่เกี่ยวข้อง

รายละเอียดให้เป็นไปตาม IEC 61000-4-1(2006)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-1: Testing and measurement techniques – Overview of 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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9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61000-4-1 has been prepared by IEC technical committee 77: Electromagnetic compatibility.

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

This third edition cancels and replaces the second edition, published in 2000. It constitutes a technical revision. Changes introduced in this third edition are for the purpose of updating the text to include reference to the latest publications of the IEC 61000-4 series.

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

FDIS	Report on voting
77/319/FDIS	77/324/RVD

Full information on the voting for the approval of this standard 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.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site 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.

INTRODUCTION

The IEC 61000 series 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 IEC 61000-4 series

1 Scope and object

This part of IEC 61000 covers testing and measuring techniques for electric and electronic equipment (apparatus and systems) in its electromagnetic environment.

The object of this part is to give applicability assistance to the technical committees of IEC or other bodies, users and manufacturers of electrical and electronic equipment on EMC standards within the IEC 61000-4 series on testing and measurement techniques and to provide general recommendations concerning the choice of relevant tests.

2 Normative references

The following referenced documents are indispensable for the application 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 60050(161), *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*

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

IEC 61000-2-5, *Electromagnetic Compatibility (EMC) – Part 2: Environment – 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/TS 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/TR 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 16 A*

IEC 61000-3-6, *Electromagnetic compatibility (EMC) – Part 3: Limits – Section 6: Assessment of emission limits for distorting loads in MV and HV 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 test*

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

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 immunity test*

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[1] Revision of IEC 60868.

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 – Oscillatory wave immunity test*

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 61000-4-23, *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: Testing and measurement techniques – Section 24: 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*

IEC 61000-4-28, *Electromagnetic compatibility (EMC) – Part 4-28: Testing and measurement techniques – Variation of power frequency, immunity test*

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 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 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*

3 Terms and definitions

For the purposes of this document, the definitions in IEC 60050(161) apply.

4 General

In the past, electromechanical devices and systems were generally not sensitive to electromagnetic disturbances (i.e. conducted and radiated electromagnetic disturbances and electrostatic discharge). The electronic components and equipment now in use are much more sensitive to these disturbances, particularly to "high-frequency" and "transient" phenomena. The tremendous expansion in the use of electronic components and equipment has increased the danger and importance of malfunctioning, damage, etc. which can arise from electric and electromagnetic disturbances.

The product committees (or 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. However, to enhance the task of coordination and standardization, the product committees or users and manufacturers should consider the recommendations given in this standard.

5 Structure of the IEC 61000-4 series standards

The structure of standards within the IEC 61000-4 series in general follows the guidance given in IEC Guide 107. For the basic testing 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 standards within the IEC 61000-4 series, which are not basic testing standards (for example IEC 61000-4-7). They are standards related to measurement (instrumentation and procedures), which do not necessarily follow the above-mentioned structure.

6 Selection 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 committee 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 (the IEC 61000-2 series, especially IEC 61000-2-5) and awareness of the statistical aspects explained in IEC 61000-1-1 will be helpful.

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

- dedicated product standard;
- product family standard;
- generic standard.

If it is considered that these standards are not applicable to a particular type of equipment, the following short explanation of each part of the IEC 61000-4 series may be helpful. A summary is also given in Tables 1 and 2.

- **Test according to 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 electronic products.

- **Test according to 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 electronic products..

- **Test according to 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 mains.

- **Test according to 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.

- **Test according to IEC 61000-4-6** *(Immunity test 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 61000-4-7** *(General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto)*

  This technical report defines the measurement method of harmonics and interharmonics. It compares the characteristics of an analogue measuring equipment and of a digital measuring equipment. It provides also the accuracy awaited and the test set-up. It is applicable to voltage or current measurements in the d.c. frequency range up to 2 500 Hz, especially with regard to the emission requirements according to IEC 61000-3-2, IEC 61000-3-4, IEC 61000-3-6, IEC 61000-3-12 and IEC 61000-4-30.

- **Test according to 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, CRT 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.

- **Test according to 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).

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

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

- **Test according to IEC 61000-4-11** *(Voltage dips, short interruptions and voltage variations immunity test)*

  This document defines the test methods to evaluate the immunity of an 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 less than 16 A per phase, connected to a.c. mains. The standard describes also different levels of tests, four performance criteria, the operating condition when the equipment is tested and the test set-up. It is a basic standard which can be used as a tool for the product committees which are defining their own EMC immunity standard.

- **Test according to IEC 61000-4-12** *(Oscillatory wave immunity test)*

  The ring wave test is applicable to equipment connected to a.c. mains in certain countries (for example the mains network in the USA). The damped oscillatory wave test is applicable to equipment used in power plants and high-voltage substations (for example static relays).

- **Test according to IEC 61000-4-13** *(Harmonics, 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.

- **Test according to IEC 61000-4-14** *(Voltage fluctuation immunity test)*

  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.

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

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

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

  This test shall only be used for very special equipment 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. The standard describes also different levels of tests, four performance criteria, the operating condition when the equipment is tested and the test set-up. It is a basic standard which can be used as a tool for the product committees which are defining their own EMC immunity standard.

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

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

- **Test according to 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.

- **Test according to IEC 61000-4-21** *(Reverberation chambers)*

  This standard specifies equipment and test procedures for testing to radiated electromagnetic fields in reverberation chambers.

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

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

- **Test according to 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 HEMP protective devices

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

  This standard specifies the basic HEMP test methods and levels appropriate for radiated and conducted immunity testing. It is applicable for equipment and systems intended to survive a HEMP.

- **Test according to IEC 61000-4-27** *(Unbalance immunity test)*

  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.

- **Test according to IEC 61000-4-28** *(Variation of power frequency, immunity test)*

  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).

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

  In general, this test is applicable for d.c. input power ports.

- **Test according to IEC 61000-4-30** *(Measurements of power quality parameters)*

  This standard gives clarification on the measurement of power quality parameters.

- **Test according to IEC 61000-4-32** *(HEMP simulator compendium)*

  This technical report provides information on the world wide availability and applicability of large scale HEMP simulators.

- **Test according to 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

- **Test according to 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 test is applicable to equipment with a rated input current greater than 16 A per phase, connected to a.c. mains.

A guide to the applicability of the various standards 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.

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 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 environmental conditions in which the test was performed, for example, shielded enclosure;
- any specific conditions necessary to enable the test to be performed;
- performance level defined by the manufacturer, requestor or purchaser;
- performance criterion specified in the generic, product or product-family standard;
- 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 the purchaser);
- any specific conditions of use, for example cable length or type, shielding or grounding, or EUT operating conditions, which are required to achieve compliance.

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

Basic standard	Description	Applicability [a]		
		Residential, commercial and light industrial	Industrial area	Special (e.g. power plant)
61000-4-2	ESD	g.a.	g.a.	g.a.
61000-4-3	Radiated electromagnetic field	g.a.	g.a.	g.a.
61000-4-4	EFT/Burst	g.a.	g.a.	g.a.
61000-4-5	Surge	g.a.	g.a.	g.a.
61000-4-6	Conducted disturbances by RF fields	g.a.	g.a.	g.a.
61000-4-7	General guide on harmonics and interharmonics measurements and instrumentation	n.i.s.	n.i.s.	n.i.s.
61000-4-8	50/60 Hz magnetic field	may	may	g.a.
61000-4-9	Pulse magnetic field	g.n.a.	g.n.a.	g.a.
61000-4-10	Damped oscillatory magnetic field	g.n.a.	g.n.a.	g.a.
61000-4-11	Voltage dips and short interruptions	g.a.	g.a.	g.a.
61000-4-12	Oscillatory waves "ring wave"	may	may	may
61000-4-13	Harmonics, interharmonics, main signalling	may	may	may
61000-4-14	Voltage fluctuations	may	may	may
61000-4-15	Flickermeter	n.i.s.	n.i.s.	n.i.s.
61000-4-16	Conducted common mode disturbances in the range of 0 Hz to 150 kHz	g.n.a.	may	g.n.a.
61000-4-17	Ripple on DC power supply	g.n.a.	may	g.n.a.
61000-4-18	Oscillatory waves immunity test	g.n.a.	may	may
61000-4-19	Free			
61000-4-20	TEM waveguides	**b**	**b**	**b**
61000-4-21	Reverberation chambers	**b**	**b**	**b**
61000-4-22	Free			
61000-4-23	Test methods for protective device; HEMP radiated disturbance	g.n.a.	g.n.a.	g.n.a.
61000-4-24	Test methods for protective device; HEMP conducted disturbance	g.n.a.	g.n.a.	g.n.a.
61000-4-25	Test methods for equipment and systems; HEMP	g.n.a.	g.n.a.	g.n.a.
61000-4-27	Unbalance in three-phase mains	may	may	may
61000-4-28	Variation of power frequency	g.n.a.	g.n.a.	g.n.a.

Table 1 (*continued*)

Basic standard	Description	Applicability [a]		
		Residential, commercial and light industrial	Industrial area	Special (e.g. power plant)
61000-4-29	Voltage dips, interruptions and voltage variations on DC power ports	may	may	may
61000-4-30	Measurement of power quality parameters	n.i.s.	n.i.s.	n.i.s.
61000-4-32	HEMP simulator compendium	n.i.s.	n.i.s.	n.i.s.
61000-4-33	Measurement methods for high power transient parameters	n.i.s.	n.i.s.	n.i.s.
61000-4-34	Voltage dips and interruption	g.a.	g.a.	g.a.

[a] Applicability explanation:

n.i.s. = not an immunity standard

g.a. = generally applicable except in special cases

g.n.a. = generally not applicable except in special cases

may = may be applicable in certain circumstances.

[b] Test method which is subject to restrictions given in the basic standard.

Table 2 – Applicability of immunity tests based on EUT ports

Basic standard	Description	Applicability [a]				
		AC power	DC power	En-closure	Signal data	Earth
61000-4-2	ESD	—	g.n.a.	g.a.	g.n.a.	g.n.a.
61000-4-3	Radiated electromagnetic field	g.n.a.	g.n.a.	g.a.	g.n.a.	g.n.a.
61000-4-4	EFT/Burst	g.a.	g.a.	__	g.a.	g.a.
61000-4-5	Surge	g.a.	may	__	may	may
61000-4-6	Conducted disturbances by RF fields	g.a.	g.a.	__	g.a.	g.a.
61000-4-7	General guide on harmonics and interharmonics measurements and instrumentation	n.i.s.	n.i.s.	n.i.s.	n.i.s.	n.i.s.
61000-4-8	50/60 Hz magnetic field	—	—	may	—	—
61000-4-9	Pulse magnetic field	—	—	may	—	—
61000-4-10	Oscillatory magnetic field	—	—	may	—	—
61000-4-11	Voltage dips and interruption	g.a.	—	—	—	—
61000-4-12	Oscillatory waves "ring wave"	may	g.n.a.	—	may	g.n.a.
61000-4-13	Harmonics, interharmonics, mains signalling	may	—	—	may	—
61000-4-14	Voltage fluctuations	g.n.a.	—	—	—	—
61000-4-15	Flickermeter	n.i.s.	n.i.s.	n.i.s.	n.i.s.	n.i.s.
61000-4-16	Conducted disturbances in the range 0 Hz to 150 kHz	g.n.a.	g.n.a.	—	g.n.a.	—
61000-4-17	Ripple on DC power supply	—	may	—	—	—
61000-4-18	Oszillatory waves immunity test	may	may		may	may
61000-4-19	Free					
61000-4-20	TEM waveguides	—	—	—	—	—
61000-4-21	Reverberation chambers	—	—	—	—	—
61000-4-22	Free					
61000-4-23	Test methods for protective device; HEMP radiated disturbance	g.n.a.	g.n.a.	g.n.a.	g.n.a.	g.n.a.
61000-4-24	Test methods for protective device; HEMP conducted disturbance	g.n.a.	g.n.a.	g.n.a.	g.n.a.	g.n.a.
61000-4-25	Test methods for equipment and systems; HEMP	g.n.a.	g.n.a.	g.n.a.	g.n.a.	g.n.a.
61000-4-27	Unbalance in three-phase mains	may	—	—	—	—
61000-4-28	Variation of power frequency	g.n.a.	—	—	—	—
61000-4-29	Voltage dips, interruptions and voltage variations on DC power ports	—	may	—	—	—
61000-4-30	Measurement of power quality parameters	n.i.s.	n.i.s.	n.i.s.	n.i.s.	n.i.s.
61000-4-32	HEMP simulator compendium	n.i.s.	n.i.s.	n.i.s.	n.i.s.	n.i.s.
61000-4-33	Measurement methods for high power transient parameters	n.i.s.	n.i.s.	n.i.s.	n.i.s.	n.i.s.
61000-4-34	Voltage dips and interruption	g.a.	—	—	—	—

[a] Applicability explanation:
n.i.s. = not an immunity standard
g.a. = generally applicable except in special cases
g.n.a. = generally not applicable except in special cases
may = may be applicable in certain circumstances.

(–) means not applicable.