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PUBLICATION FONDAMENTALE EN CEM

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

Compatibilité électromagnétique (CEM) – Partie 4-17: Techniques d'essai et de mesure – Essai d'immunité à l'ondulation résiduelle sur entrée de puissance à courant continu

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-17: Testing and measurement techniques – Ripple on d.c. input power port immunity test

FOREWORD

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International Standard IEC 61000-4-17 has been prepared by subcommittee 77A: Low-frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

It forms part 4-17 of IEC 61000. It has the status of a basic EMC publication in accordance with IEC Guide 107.

This consolidated version of IEC 61000-4-17 consists of the first edition (1999) [documents 77A/271/FDIS and 77A/280/RVD], its amendment 1 (2001) [documents 77B/291+293/FDIS and 77B/298+300/RVD] and its amendment 2 (2008) [documents 77A/632/CDV and 77A/652/RVC].

The technical content is therefore identical to the base edition and its amendments and has been prepared for user convenience.

It bears the edition number 1.2.

A vertical line in the margin shows where the base publication has been modified by amendments 1 and 2.

Annex A is for information only.

The committee has decided that the contents of the base publication and its amendments 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- withdrawn,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

This standard is part of the IEC 61000 series, 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 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.

This part is an International Standard which gives test procedures related to ripple on d.c. input power port.

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-17: Testing and measurement techniques – Ripple on d.c. input power port immunity test

1 Scope

This part of IEC 61000 defines test methods for immunity to ripple at the d.c. input power port of electrical or electronic equipment.

This standard is applicable to low-voltage d.c. power ports of equipment supplied by external rectifier systems, or batteries which are being charged.

The object of this standard is to establish a common and reproducible basis for testing, in a laboratory, electrical and electronic equipment when subjected to ripple voltages such as those generated by rectifier systems and/or auxiliary service battery chargers overlaying on d.c. power supply sources.

This standard defines

- test voltage waveform;
- range of test levels;
- test generator;
- test set-up;
- test procedure.

The test described hereafter applies to electrical or electronic equipment and systems. It also applies to modules or subsystems whenever the equipment under test (EUT) rated power is greater than the test generator capacity specified in clause 6.

This test does not apply to equipment connected to battery charger systems incorporating switch mode converters.

This standard does not specify the tests to be applied to particular apparatus or systems. Its main aim is to give a general basic reference to IEC product committees. These product committees (or users or manufacturers of equipment) remain responsible for the appropriate choice of the test and the severity level to be applied to their equipment.

Dedicated test procedures are in use for testing specific categories of electrical or electronic equipment, e.g. equipment connected to d.c. supply network of telephone switching centres; the related product committees should evaluate the relevance and applicability of the test procedure specified in this basic standard.

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 60068-1, *Environmental testing – Part 1: General and guidance*

3 General

Ripple may influence the reliable operation of equipment and systems, powered by d.c. supplies, installed in industrial plants as well in residential and commercial installations.

The ripple disturbance is represented by the voltage derived from a pulsating quantity from which the direct component has been removed.

The main sources of ripple disturbance are rectifier systems used in the external d.c. power networks and battery chargers.

Ripple is therefore a phenomenon continuously present in this type of d.c. power source, and may be accentuated when the battery is recharging after a recovery of the a.c. power line service.

Ripple components may also be produced by equipment absorbing a pulsating current; this is not covered in this standard.

4 Definitions

For the purpose of this part of IEC 61000 the following definitions apply, together with the definitions of IEC 60050(161) [IEV].

4.1
ripple content, alternating component
quantity derived by removing the direct component from a pulsating quantity (see figure 1), [IEV 161-02-25]

4.2
EUT
equipment under test

5 Test levels and waveform

The preferred range of test levels, applicable to the d.c. power supply port of the equipment, are given in table 1.

Table 1 – Test levels

Level	Percentage of the nominal d.c. voltage
1	2
2	5
3	10
4	15
x	x
NOTE "x" is an open level. This level can be given in the product specification. For the duration of the test, see 8.2.	

The test levels are a peak-to-peak voltage expressed as a percentage of the nominal d.c. voltage $U_{d.c}$.

The amplitude of the ripple voltage is represented in figure 1 by the difference $U_{max} - U_{min}$.

The frequency of the ripple is the power frequency or its multiple 2, 3 or 6, as specified by a product committee or according to the EUT manufacturer's specifications or according to the characteristics of the rectifier system (see also clause A.2).

The waveform of the ripple voltage, at the output of the test generator, has a sinusoid-linear character.

A sinusoidal-linear characteristic can be described as a part of a sine wave and a line, tangent to the decreasing side of the rectified wave, that intersects the rising edge of the following half-wave; the voltage difference between the peak value of the sine wave and the point of intersection to the following half-wave is the ripple voltage (see figure 1). The decreasing voltage can be assumed as a linear function in the presence of constant current loads. The voltage deviation, in the case of a constant resistor or constant power load, is very small and can be considered acceptable for the purpose of the test.

Deviations from the defined waveform, due to the impedance of the EUT, are allowed during the test. However, care should be taken in order to assess that the deviation from the original waveform is not caused by limitation of the generator. Furthermore, the peak-to-peak value and the frequency of ripple shall be maintained by adjustment in order to maintain the severity of the test.

The graphical representation of the waveform obtained from a single-phase bridge and a three-phase bridge rectifier is shown in figure 1; the difference $U_{max} - U_{min}$ is the percentage of the nominal d.c. voltage and corresponds to the selected test level.

NOTE Information on the phenomenon and on the selection of the test level is given in annex A, clauses A.1 and A.2.

6 Test generator

6.1 Characteristics and performance of the generator

The test generator shall be able to operate in continuous mode with the following main specifications:

– output voltage range:	up to 360 V;
– output voltage change with load: (0 to rated current)	less than 5 %;
– output voltage waveform:	alternating component at power frequency or its multiple, with a sinusoid-linear character, superimposed on the d.c. voltage
– output voltage tolerance:	±10 %
– output current (steady state):	up to 25 A;
– peak output current capability: (maximum allowable duration 5 ms)	+2,5/–0,5 times the steady-state current;
– ripple frequency tolerance:	±1 %.

NOTE The 360 V output voltage value covers the test condition of a 300 V d.c. supply voltage plus a 15 % ripple corresponding to test level 4.

The use of a generator with higher or lower voltage/current capability is allowed provided that the other specifications (waveform, change with load, peak output current/steady-state current ratio, etc.) are preserved. The test generator output power/current capability shall be at least 20 % greater than the EUT power/current ratings.

The generator must be able to produce positive and negative peak current with positive voltage output.

Examples of generators can be found in clause A.3.

Figure A.1 shows a schematic diagram of a generator based on a rectifier system; figure A.2 shows a schematic diagram of a generator based on a programmable power supply with controller.

6.2 Verification of the characteristics of the generator

In order to compare the test results the following characteristics of the generator shall be verified:

– the sinusoid-linear character of the ripple signal shall be maintained at maximum output voltage, with the output connected to a resistive load of 60 Ω;

– the sinusoid-linear character of the ripple signal shall be maintained at maximum current (25 A), with the output connected to a resistive load (e.g. 2,4 Ω at output voltage of 60 V);

– the ripple frequency;

– the peak output current shall meet the requirements of 6.1, when switching the generator output from 0 V to 60 V and driving an uncharged capacitor whose value is at least 1 700 μF.

The verification of a generator with voltage/current capability less than specified in 6.1 shall be made with load conditions reflecting the rated voltage and current.

The measurement uncertainty of the instrumentation (e.g. low-frequency oscilloscope, d.c. voltmeter and a.c. peak-to-peak voltmeter) shall be less than or equal to 2 %.

7 Test set-up

The test shall be performed with the EUT connected to the test generator with the shortest power supply cable as specified by the manufacturer. If no cable length is specified, it shall be the shortest practical length suitable for the connection of the EUT.

8 Test procedure

The test procedure shall include the following:

– verification of the laboratory reference conditions;
– preliminary verification of the correct operation of the equipment;
– execution of the test;
– evaluation of the test results.

8.1 Laboratory reference conditions

In order to minimize the impact of environmental parameters on test results, the tests shall be performed in climatic and electromagnetic reference conditions as specified in 8.1.1 and 8.1.2.

8.1.1 Climatic conditions

Unless otherwise specified by the committee responsible for the generic or product standard, the climatic conditions in the laboratory shall be within any limits specified for the operation of the EUT and the test equipment by their respective manufacturers.

Tests shall not be performed if the relative humidity is so high as to cause condensation on the EUT or the test equipment.

NOTE Where it is considered that there is sufficient evidence to demonstrate that the effects of the phenomenon covered by this standard are influenced by climatic conditions, this should be brought to the attention of the committee responsible for this standard.

8.1.2 Electromagnetic conditions

The electromagnetic conditions of the laboratory shall be such as to guarantee the correct operation of the EUT in order not to influence the test results.

8.2 Execution of the test

The EUT shall be configured for its normal operating conditions. The test shall be performed according to a test plan that shall specify:

– test level;
– duration of the test;
– representative operating conditions of the EUT;
– auxiliary equipment.

The power supply, signal and other functional electrical quantities shall be applied within their rated range. Signal and other functional electrical quantities may be simulated.