IEC 61000-3-11

Edition 2.0 2017-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

Compatibilité électromagnétique (CEM) – Partie 3-11: Limites – Limitation des variations de tension, des fluctuations de tension et du papillotement dans les réseaux publics d'alimentation basse tension – Équipements ayant un courant assigné ≤75 A et soumis à un raccordement conditionnel

IEC 61000-3-11:2017-04(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 33.100.10

ISBN 978-2-8322-4163-9

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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

FOREWORD

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International Standard IEC 61000-3-11 has been prepared by sub-committee 77A: EMC – Low-frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

This second edition cancels and replaces the first edition published in 2000. This edition constitutes a technical revision.

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

a) addition of a new Annex A which explains the limitations and effectiveness of IEC 61000-3-11 regarding the connection of multiple items of similar equipment at the same location in the supply network.

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The text of this International Standard is based on the following documents:

CDV	Report on voting
77A/929/CDV	77A/947/RVC

Full information on the voting for the approval of this International Standard 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, 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

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INTRODUCTION

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

Part 1: General

General considerations (introduction, fundamental principles)

Definitions, terminology

Part 2: Environment

Description of the environment

Classification of the environment

Compatibility levels

Part 3: Limits

Emission limits

Immunity limits (in so far as they do not fall under the responsibility of product committees)

Part 4: Testing and measurement techniques

Measurement techniques

Testing techniques

Part 5: Installation and mitigation guidelines

Installation guidelines

Mitigation methods and devices

Part 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 (example: 61000-3-11).

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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

1 Scope

This part of IEC 61000 is concerned with the emission of voltage changes, voltage fluctuations and flicker produced by equipment and impressed on the public low-voltage supply system.

It specifies the limits of voltage changes produced by equipment tested under specified conditions.

This document is primarily applicable to electrical and electronic equipment having a rated input current from 16 A up to and including 75 A, which is intended to be connected to public low-voltage distribution systems having nominal system voltages of between 220 V and 250 V, line-to-neutral at 50 Hz, and which is subject to conditional connection.

This document is also applicable to equipment within the scope of IEC 61000-3-3 that does not meet the limits when tested or evaluated with reference impedance Z_{ref} and is therefore subject to conditional connection. Equipment which meets the requirements of IEC 61000-3-3 is excluded from this part of IEC 61000.

Equipment tests made in accordance with this document are type tests.

NOTE 1 The flicker limits specified in this document, being the same as those in IEC 61000-3-3, are based on the subjective severity of the flicker imposed on the light from 230 V/60 W coiled-coil filament lamps when subjected to fluctuations of the supply voltage. For systems with nominal voltages less than 220 V, line-to-neutral and/or frequency of 60 Hz, the limits and reference circuit values are under consideration.

NOTE 2 The limits in this document relate to the voltage changes experienced by consumers connected at the interface between the public supply low-voltage network and the equipment user's installation. Therefore, it cannot be guaranteed that the users of equipment compliant with this standard will not experience supply disturbance within their own installation due to the operation of this equipment alone, as the impedance at the point of connection of the equipment to the supply within the installation can have an impedance greater than the maximum permissible impedance as determined by the procedures in this document.

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 60050-161, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility* (available at www.electropedia.org)

IEC TR 60725, *Consideration of reference impedances and public supply network impedances for use in determining the disturbance characteristics of electrical equipment having a rated current ≤75 A per phase*

IEC 61000-3-3:2013, *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*

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3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-161, IEC 61000-3-3 and the following apply.

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

3.1
reference impedance
Z_{ref}
conventional impedance specified in IEC 61000-3-3, with a value in accordance with IEC TR 60725, and used in the calculation and measurement of relative voltage change d, and of P_{st} and P_{lt} values

Note 1 to entry: The resistive and reactive components of Z_{ref} are given in Figure B.2.

3.2
interface point
interface between a public supply network and a user's installation

3.3
conditional connection
connection of equipment which requires the user's supply at the interface point to have an impedance lower than the reference impedance Z_{ref} in order that the equipment emissions comply with the limits in this document

Note 1 to entry: Meeting the voltage change limits is not the only condition for connection; emission limits for other phenomena such as harmonics, may also have to be satisfied.

3.4
service current capacity
current per phase which can be taken continuously by the user at the interface point without exceeding the plant ratings used by the supply authority in the design of its system

Note 1 to entry: In practice the service current capacity is the rating of the main service fuse or overcurrent protection setting of the circuit breaker at the interface point. In cases where supply authorities declare supply capacities in volt-amperes (VA), the current per phase may be deduced for single-phase supplies by dividing the volt-amperes by the declared phase voltage, and for three-phase supplies by dividing it by √3 times the declared line voltage.

4 Requirements

The assessment of voltage changes and flicker shall be conducted in accordance with the methods specified in IEC 61000-3-3.

If equipment with a rated current above 16 A complies with the requirements of IEC 61000-3-3 and therefore is not subject to conditional connection, it may be declared so by the manufacturer in documentation made available to users before purchase.

Equipment which does not meet the limits of IEC 61000-3-3, when tested or evaluated with reference impedance Z_{ref}, is subject to conditional connection, and the manufacturer shall either:

a) determine the maximum permissible system impedance Z_{max} at the interface point of the user's supply in accordance with 6.3, declare Z_{max} in the equipment instruction manual

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and instruct the user to determine in consultation with the supply authority, if necessary, that the equipment is connected only to a supply of that impedance or less, or

b) test the equipment in accordance with 6.4 and declare in the equipment instruction manual that the equipment is intended for use only in premises having a service current capacity ≥ 100 A per phase, supplied from a distribution network having a nominal voltage of 400/230 V, and instruct the user to determine in consultation with the supply authority, if necessary, that the service current capacity at the interface point is sufficient for the equipment.

The equipment shall be clearly marked as being suitable for use only in premises having a service current capacity equal to or greater than 100 A per phase.

NOTE 1 In the case of option a), restrictions to connection can be imposed by the supply authority on the use of equipment if the actual system impedance at the interface point on the user's premises, Z_{act} , exceeds Z_{max}.

NOTE 2 In the case of option b), a new symbol (IEC 60417-5855) is available for the purpose of marking equipment.

NOTE 3 For options a) and b), if the supply capacity and/or the actual system impedance Z_{act} have been declared to, or measured by, the user, this information can be used to assess the suitability of equipment without reference to the supply authority.

5 Limits

The limits shall be applicable to voltage fluctuations and flicker at the supply terminals of the equipment under test, measured or calculated according to Clause 4 under test conditions described in Clause 6. Tests made to prove compliance with the limits are considered to be type tests.

The following limits apply:

a) the value of the short-term flicker indicator, P_{st} shall not be greater than 1,0;

b) the value of the long-term flicker indicator, P_{lt} shall not be greater than 0,65;

c) T_{max}, the accumulated time of $d(t)$ with a deviation exceeding 3,3 % during a voltage change, shall not exceed 500 ms;

d) the maximum relative steady-state voltage change, d_c, shall not exceed 3,3 %;

e) the maximum relative voltage change, d_{max}, shall not exceed:

1) 4 % without additional conditions;

2) 6 % for equipment which is

– switched manually, or

– switched automatically more than twice per day and having a delayed restart (the delay being not less than a few tens of seconds), or manual restart after a power supply interruption;

NOTE The cycling frequency will be further limited by the P_{st} and P_{lt} limit. For example: a d_{max} of 6 % producing a rectangular voltage change characteristic twice per hour will give a P_{lt} of about 0,65.

3) 7 % for equipment which is

– attended whilst in use (for example, industrial machinery such as milling equipment and lathes); or

– switched on automatically, or is intended to be switched on manually, no more than twice per day and has a delayed restart (the delay being not less than a few tens of seconds) or manual restart after a power supply interruption.

In the case of equipment incorporating multiple subsystems, limits 2) and 3) shall only apply if there is delayed or manual restart after a power supply interruption; for all equipment with automatic switching which is energised immediately on restoration of supply after a power supply interruption, limits 1) shall apply; for all equipment with manual switching, limits 2) or 3) shall apply, depending on the rate of switching.

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P_{st} and P_{lt} requirements shall not be applicable to voltage changes caused by manual switching.

The limits shall not be applicable to emergency switching or emergency interruptions.

6 Test, measurement and evaluation procedures

6.1 Overview

Except where specified otherwise in this document, the general test conditions, measurement and evaluation procedures specified in IEC 61000-3-3 shall apply. For equipment that meets the conditions specified in 6.2.1 the test impedance in 6.2.1 shall be used.

An overview in the form of a flow chart showing the evaluation and test procedures used in the assessment of equipment and leading to connection is given in Annex B (see Figure B.1).

In the calculations described in the following subclauses 6.2 to 6.4 the modulus values of complex impedances shall be used.

In order to evaluate equipment and determine the maximum permissible system impedance from a type test, some auxiliary quantities are necessary. These auxiliary quantities have been given suffixes to facilitate their application in formulae and calculations; see Table 1.

The test conditions specified in IEC 61000-3-3:2013, Annex A, shall be applicable to equipment rated ≤ 16 A. For equipment rated > 16 A the general test conditions specified in IEC 61000-3-3 shall apply.

Table 1 – Suffixes and their applications

Suffix	Representing	Application
sys	System	Z_{sys} is the modulus of the impedance of the system to which the equipment may be connected in order to meet a particular limit. A number after the subscript identifies a particular calculation.
ref	Reference	Z_{ref} is the reference impedance.
act	Actual	Z_{act} is the modulus of the actual impedance of the supply existing at the interface point.
max	Maximum	Z_{max} is the modulus of the maximum value of the supply impedance at which equipment meets all the limits of this document.
test	Test or measurement	Z_{test} is the modulus of the test circuit impedance at which the emission test is performed and d_{ctest}, $d_{max\ test}$, $P_{st\ test}$ and $P_{lt\ test}$ are measured values.

6.2 Test and measurement procedures

6.2.1 Test impedance Z_{test}

The test impedance Z_{test} may be lower than Z_{ref}, particularly for equipment having a rated input current > 16 A. To find the optimal test impedance, two conditions shall be met:

1) the steady-state voltage drop (d_c) caused by the equipment shall be within the range 2 % to 9 % of the test supply voltage;
2) the ratio of inductive to resistive components of Z_{test} given by X_{test}/R_{test} shall be within the range 0,5 to 0,75 (i.e. similar to the ratio of the components of Z_{ref}).

NOTE The 2 % to 9 % condition ensures that the relative current changes of the equipment in the real network situation will be nearly the same as those during the test.

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6.2.2 Test of equipment against Z_{test}

The test shall be made with the test circuit specified in Figure B.2, except that the impedance Z_{ref} is replaced with Z_{test}. Four values $d_{c\ test}$, $d_{max\ test}$, $P_{st\ test}$ and $P_{lt\ test}$ shall be measured. The definitions of d_c, d_{max}, P_{st}, and P_{lt} are given in IEC 61000-3-3.

6.2.3 Evaluation against Z_{ref}

If Z_{test} is not equal to Z_{ref}, the measured values shall be recalculated using the following formulae:

$$d_c = d_{c\ test} \cdot \frac{Z_{ref}}{Z_{test}}$$

$$d_{max} = d_{max\ test} \cdot \frac{Z_{ref}}{Z_{test}}$$

$$P_{st} = P_{st\ test} \cdot \frac{Z_{ref}}{Z_{test}}$$

$$P_{lt} = P_{lt\ test} \cdot \frac{Z_{ref}}{Z_{test}}$$

The values d_c, d_{max}, P_{st}, P_{lt} are similar to those which would be obtained by measurements using Z_{ref} because the conditions placed on Z_{test} in 6.2.1 ensure that Z_{test} and Z_{ref} have approximately the same X/R ratio and that the measured voltage, P_{st} and P_{lt} values can be converted to equivalent values with reasonable accuracy by multiplying them by the ratio $\frac{Z_{ref}}{Z_{test}}$.

Provided that the conditions for d_c and d_{max} are met with Z_{test}, T_{max} shall be deemed to be satisfied.

6.3 Evaluation and declaration by the manufacturer of the maximum permissible system impedance

6.3.1 Comparison of calculated and measured emission values with Clause 5 limits to enable a declaration of compliance with IEC 61000-3-3

If all values calculated according to 6.2.3, or measured in accordance with IEC 61000-3-3, are less than or equal to the limits in Clause 5, the manufacturer may declare that "the product meets the technical requirements of IEC 61000-3-3".

6.3.2 Calculation of the maximum permissible system impedance

The following evaluation procedure shall be applied if the equipment emissions cannot meet the technical requirements of IEC 61000-3-3 and therefore the equipment cannot be declared compliant by the manufacturer in accordance with 6.3.1. In such a case the equipment shall only be connected to a supply having a system impedance lower than Z_{ref}.

To calculate the lower system impedance, Z_{sys}, the values of d_c, d_{max}, P_{st} and P_{lt} calculated according to 6.2.3 shall be used in the following formulae.

$$Z_{sys1} = Z_{ref} \cdot \frac{(\text{the } d_{max} \text{ limit given in Clause 5 appropriate to the EUT})}{d_{max}}$$

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$$Z_{\text{sys2}} = Z_{\text{ref}} \cdot \frac{3{,}3\ \%}{d_{\text{c}}}$$

$$Z_{\text{sys3}} = Z_{\text{ref}} \cdot \left(\frac{1}{P_{\text{st}}}\right)^{\frac{3}{2}}$$

$$Z_{\text{sys4}} = Z_{\text{ref}} \cdot \left(\frac{0{,}65}{P_{\text{lt}}}\right)^{\frac{3}{2}}$$

The minimum of the four calculated values of Z_{sys} is the maximum permissible system impedance, $Z_{\text{max,}}$ which the manufacturer shall declare in accordance with Clause 4.

In consideration of voltage changes caused by manual switching, it is only required to calculate Z_{sys1} and Z_{sys2}; Z_{max} is the minimum of the two values.

See annex A for further information.

If the evaluation in accordance with 6.2.3 results in a d_{max} value which exceeds 3,3 % and a recording of $d(t)$ is not available, additional tests will be required to properly evaluate T_{max}. The measurement $d(t)$ shall be multiplied by the ratio $Z_{\text{max}}/\ Z_{\text{test}}$ prior to evaluating the requirements for T_{max}. Alternatively, the threshold definitions may be multiplied by the ratio $Z_{\text{test}}/\ Z_{\text{max}}$ for the T_{max} determination.

6.4 Evaluation and declaration by the manufacturer of the minimum permissible service current capacity

For single-phase equipment intended to be connected to public low-voltage distribution systems having a nominal voltage of 230 V line to neutral by means of a single or three-phase service having a service current supply capacity ≥100 A per phase, the test impedance, Z_{test}, shall be set in complex terms at 0,25 + j 0,25 Ω; see Figure B.2.

For three-phase equipment intended to be connected to public low-voltage distribution systems having a nominal voltage of 400 V line to line by means of a three-phase service having a service current capacity ≥100 A per phase, the test impedance, Z_{test}, shall be set in complex terms at 0,15 + j 0,15 Ω for each line, and 0,1 + j 0,1 Ω for the neutral; see Figure B.2.

Equipment tested against the test impedances specified in the previous paragraphs of 6.4 shall meet the limits given in Clause 5.

The manufacturer shall declare the minimum service current capacity in accordance with Clause 4, item b).

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