

# INTERNATIONAL STANDARD

# IEC 61000-3-3

Edition 1.2  
2005-10

Edition 1:1994 consolidated with amendments 1:2001 and 2:2005

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## 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 $\leq 16$ A per phase and not subject to conditional connection

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*



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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**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  $\leq 16$  A per phase and not subject to conditional connection**

## FOREWORD

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

This consolidated version of IEC 61000-3-3 is based on the first edition (1994) [documents 77A(BC)38 and 77A(BC)40], its amendment 1 (2001) [documents 77A/326/FDIS and 77A/328/RVD] and its amendment 2 (2005) [documents 77A/493/FDIS and 77A/502/RVD].

It bears the edition number 1.2.

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

Annexes A and B form an integral part of this standard.

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- withdrawn,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

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 sections which are to be published either as International Standards or as Technical Reports.

These standards and reports will be published in chronological order and numbered accordingly.

This part is a Product Family Standard.

The limits in this standard 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. Consequently, if the actual impedance of the supply at the supply terminals of equipment connected within the equipment user's installation exceeds the test impedance, it is possible that supply disturbance exceeding the limits may occur.

## 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 $\leq 16$ A per phase and not subject to conditional connection

#### 1 Scope

This part of IEC 61000 is concerned with the limitation of voltage fluctuations and flicker impressed on the public low-voltage system.

It specifies limits of voltage changes which may be produced by an equipment tested under specified conditions and gives guidance on methods of assessment.

This part of IEC 61000 is applicable to electrical and electronic equipment having an input current equal to or less than 16 A per phase, intended to be connected to public low-voltage distribution systems of between 220 V and 250 V line to neutral at 50 Hz, and not subject to conditional connection.

Equipment which does not comply with the limits of this part of IEC 61000 when tested with the reference impedance  $Z_{ref}$  of 6.4, and which therefore cannot be declared compliant with this part, may be retested or evaluated to show conformity with IEC 61000-3-11. Part 3-11 is applicable to equipment with rated input current  $\leq 75$  A per phase and subject to conditional connection.

The tests according to this part are type tests. Particular test conditions are given in annex A and the test circuit is shown in figure 1.

NOTE The limits in this part of IEC 61000 are based mainly on the subjective severity of flicker imposed on the light from 230 V/60 W coiled-coil filament lamps by fluctuations of the supply voltage. For systems with nominal voltage less than 220 V line to neutral and/or frequency of 60 Hz, the limits and reference circuit values are under consideration.

#### 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):1990, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*



IEC 60335-2-11:1993, *Safety of household and similar electrical appliances – Part 2: Particular requirements for tumbler dryers*

IEC 60725:1981, *Considerations on reference impedances for use in determining the disturbance characteristics of household appliances and similar electrical equipment*

IEC 60868:1986, *Flickermeter – Functional and design specifications*<sup>1)</sup>  
Amendment No. 1 (1990)

IEC 60974-1: *Arc welding equipment – Part 1: Welding power sources*

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

IEC 61000-3-5:1994, *Electromagnetic compatibility (EMC) – Part 3: Limits – Section 5: Limitations of voltage fluctuations and flicker in low-voltage power supply systems for equipment with rated current greater than 16 A*

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  $\leq 75$  A and subject to conditional connection*

### 3 Definitions

For the purpose of this part of IEC 61000-3, the following definitions apply.

#### 3.1

##### **r.m.s. voltage shape, $U(t)$**

the time function of r.m.s. voltage, evaluated as a single value for each successive half period between zero-crossings of the source voltage (see figure 2)

#### 3.2

##### **voltage change characteristic, $\Delta U(t)$**

the time function of the r.m.s. voltage change evaluated as a single value for each successive half period between zero-crossings of the source voltage between time intervals in which the voltage is in a steady-state condition for at least 1 s (see figure 2)

NOTE Since this characteristic is only used for assessments using calculations, the voltage in the steady-state condition is assumed to be constant within the measurement accuracy (see 6.2).

#### 3.3

##### **maximum voltage change characteristic, $\Delta U_{\max}$**

the difference between maximum and minimum r.m.s. values of a voltage change characteristic (see figure 2)

<sup>1)</sup> IEC 60868 will be withdrawn and replaced by IEC 61000-4-15 in 2003. Flickermeters complying with IEC 61000-4-15 may also be used for flicker measurements associated with this part of IEC 61000-3.

**3.4****steady-state voltage change,  $\Delta U_c$** 

the difference between two adjacent steady-state voltages separated by at least one voltage change characteristic (see figure 2)

NOTE Definitions 3.2 to 3.4 relate to absolute phase-to-neutral voltages. The ratios of these magnitudes to the phase-to-neutral value of the nominal voltage ( $U_n$ ) of the reference network in figure 1 are called:

- relative voltage change characteristic:  $d(t)$  (definition 3.2);
- maximum relative voltage change:  $d_{\max}$  (definition 3.3);
- relative steady-state voltage change:  $d_c$  (definition 3.4).

These definitions are explained by the example in figure 3.

**3.5****voltage fluctuation**

series of changes of r.m.s. voltage evaluated as a single value for each successive half-period between zero-crossings of the source voltage

**3.6****flicker**

impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time. [IEV 161-08-13]

**3.7****short-term flicker indicator,  $P_{st}$** 

the flicker severity evaluated over a short period (in minutes);  $P_{st} = 1$  is the conventional threshold of irritability

**3.8****long-term flicker indicator,  $P_{lt}$** 

the flicker severity evaluated over a long period (a few hours) using successive  $P_{st}$  values

**3.9****flickermeter:**

an instrument designed to measure any quantity representative of flicker

NOTE Measurements are normally  $P_{st}$  and  $P_{lt}$ . [IEV 161-08-14]

**3.10****flicker impression time,  $t_f$** 

value with a time dimension which describes the flicker impression of a voltage change characteristic

**3.11****conditional connection**

connection of equipment requiring 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 part.

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

**3.12****interface point**

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

## 4 Assessment of voltage changes, voltage fluctuations and flicker

### 4.1 Assessment of a relative voltage change, "d"

The basis for flicker evaluation is the voltage change characteristic at the terminals of the equipment under test, that is the difference  $\Delta U$  of any two successive values of the phase-to-neutral voltages  $U(t_1)$  and  $U(t_2)$ :

$$\Delta U = U(t_1) - U(t_2) \quad (1)$$

The r.m.s. values  $U(t_1)$ ,  $U(t_2)$  of the voltage shall be measured or calculated. When deducing r.m.s. values from oscillographic waveform, account should be taken of any waveform distortion that may be present. The voltage change  $\Delta U$  is due to the change of the voltage drop across the complex reference impedance  $\underline{Z}$ , caused by the complex fundamental input current change,  $\Delta \underline{I}$ , of the equipment under test.  $\Delta I_p$  and  $\Delta I_q$  are the active and reactive parts respectively of the current change,  $\Delta \underline{I}$ .

$$\Delta \underline{I} = \Delta I_p - j \cdot \Delta I_q = \underline{I}(t_1) - \underline{I}(t_2) \quad (2)$$

NOTE 1  $I_q$  is positive for lagging currents and negative for leading currents.

NOTE 2 If the harmonic distortion of the currents  $\underline{I}(t_1)$  and  $\underline{I}(t_2)$  is less than 10 %, the total r.m.s. value may be applied instead of the r.m.s. values of their fundamental currents.

NOTE 3 For single-phase and symmetrical three-phase equipment the voltage change can, provided X is positive (inductive), be approximated to:

$$\Delta U = |\Delta I_p \cdot R + \Delta I_q \cdot X| \quad (3)$$

where

$\Delta I_p$  and  $\Delta I_q$  are the active and reactive parts respectively of the current change  $\Delta \underline{I}$ ;

R and X are the elements of the complex reference impedance  $\underline{Z}$  (see figure 1).

The relative voltage change is given by:

$$"d" = \Delta U / U_n \quad (4)$$

### 4.2 Assessment of the short-term flicker value, $P_{st}$

The short-term flicker value  $P_{st}$  is defined in amendment 1 to IEC 60868.

Table 1 shows alternative methods for evaluating  $P_{st}$ , due to voltage fluctuations of different types:

**Table 1 – Assessment method**

Types of voltage fluctuations	Methods of evaluation $P_{st}$
All voltage fluctuataions (on-line evaluation)	Direct measurement
All voltage fluctuations where $U(t)$ is defined	Simulation Direct measurement
Voltage change characteristics according to figures 5 to 7 with an occurrence rate less than 1 per second	Analytical method Simulation Direct measurement
Rectangular voltage change at equal intervals	Use of the $P_{st} = 1$ curve of figure 4