INTERNATIONAL STANDARD

IEC 61000-3-3

Edition 1.1
2002-03

Edition 1:1994 consolidated with amendment 1:2001

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

*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 ≤16 A per phase and not subject to conditional connection

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
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5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
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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 6000-3-3 is based on the first edition (1994) [documents 77A(BC)38 and 77A(BC)40] and its amendment 1 (2001) [documents 77A/326/FDIS and 77A/328/RVD].

It bears the edition number 1.1.

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

This first edition of IEC 61000-3-3 cancels and replaces IEC 60555-3, published in 1982, and amendment 1 (1990).

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 2005. 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 ≤16 A per phase and not subject to conditional connection

1 Scope

This part of IEC 61000-3 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 ≤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 normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of the IEC and the ISO maintain registers of currently valid International Standards.

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* [1)]
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 ≤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 ≤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, ΔU_{max}
the difference between maximum and minimum r.m.s. values of a voltage change characteristic (see figure 2)

1) 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, ΔU_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 ΔU 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 ΔU 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. ΔI_p and ΔI_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:

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

where

ΔI_p and ΔI_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