BRITISH STANDARD

BS EN 61000-3-3 : 1995 IEC 1000-3-3 : 1994

Incorporating Amendment No. 1

Electromagnetic compatibility (EMC)

Part 3. Limits

Section 3. Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A

The European Standard EN 61000-3-3 : 1995 has the status of a British Standard

ICS 33.100

BS EN 61000-3-3 : 1995 Issue 2, January 1998

Committees responsible for this British Standard

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Association of Manufacturers of Domestic Electrical Appliances
BEAMA Ltd.
British Lighting Association for the Preparation of Standards (BRITLAPS)
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British Telecommunications plc
Building Automation and Mains Signalling Association (BAMSA) (BEAMA Ltd.)
Electrical Contractors' Association
Electrical Installation Equipment Manufacturers' Association (BEAMA Ltd.)
Electricity Association
ERA Technology Ltd.
Federation of the Electronics Industry
GAMBICA (BEAMA Ltd.)
Heating, Ventilating and Air Conditioning Association
Institution of Electrical Engineers
Lighting Industry Federation Ltd.
Power Supply Manufacturers' Association — PSMA (BEAMA Ltd.)
Professional Lighting and Sound Association
Sound and Communications Industries Federation
Radiocommunications Agency

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Summary of pages

The following table identifies the current issue of each page. Issue 1 indicates that a page has been introduced for the first time by amendment. Subsequent issue numbers indicate an updated page. Double vertical sidelining on replacement pages indicates the most recent changes (amendment, addition, deletion).

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National foreword

This Section of BS EN 61000 has been prepared by Subcommittee GEL/110/8 and is the English language version of EN 61000-3-3 : 1995 *Electromagnetic compatibility (EMC) Part 3: Limits Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A*, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 1000-3-3 : 1994, published by the International Electrotechnical Commission (IEC).

IEC 1000 has been designated a Basic EMC publication for use in the preparation of dedicated product, product family and generic EMC standards.

The foreword of the EN makes reference to the 'date of withdrawal', (dow) of the relevant national standard. In this case the relevant national standard is BS 5406 : Part 3 : 1988 as amended by amendment No 1 : 1992 which will be withdrawn on 2001-01-01.

Cross-references

Publication referred to	Corresponding British Standard
IEC 50 (161) : 1990	BS 4727 *Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms* Part 1 *Terms common to power, telecommunications and electronics* Group 09 : 1991 *Electromagnetic compatibility*
IEC 868 : 1986 + Amendment No 1 : 1990	BS EN 60868 : 1993 *Flickermeter — Functional and design specifications*

Compliance with a British Standard does not of itself confer immunity from legal obligations.

EUROPEAN STANDARD
NORME EUROPÉENNE
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EN 61000-3-3

January 1995

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Supersedes EN 60555-3 : 1987 and its amendment
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Descriptors: Electromagnetic compatibility, disturbances, voltage fluctuation, type of voltage fluctuation, test conditions, assessment, calculation, measurement, flickermeter

English version

Electromagnetic compatibility (EMC)
Part 3: Limits
Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A

(IEC 1000-3-3 : 1994)

Compatibilité électromagnetique (CEM)
Partie 3: Limites
Section 3: Limitation des fluctuations de tension et du flicker dans les réseaux basse tension pour les équipements ayant un courant appelé ≤ 16 A
(CEI 1000-3-3 : 1994)

Elektromagnetische Verträglichkeit (EMV)
Teil 3: Grenzwerte
Hauptabschnitt 3: Grenzwerte für Spannungsschwankungen und Flicker in Niederspannungsnetzen für Geräte mit einem Eingangsstrom ≤ 16 A
(IEC 1000-3-3 : 1994)

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

The text of document 77A(CO)38, future edition 1 of IEC 1000-3-3 : 1994, prepared by SC 77A, Low-frequency phenomena, of IEC TC 77, Electromagnetic compatibility, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61000-3-3 on 1994-03-08.

This European Standard supersedes EN 60555-3 : 1987 + A1 : 1991.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1995-07-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2001-01-01

Annexes designated 'normative' are part of the body of the standard. In this standard, annexes A and ZA are normative. Annex ZA has been added by CENELEC.

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INTRODUCTION

IEC 1000 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 section is a Product Family Standard.

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 3: Limits – Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A

1 Scope

This section of IEC 1000-3 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 section is applicable to electrical and electronic equipment having an input current up to and including 16 A per phase and intended to be connected to public low-voltage distribution systems of between 220 V and 250 V at 50 Hz line to neutral.

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

NOTES

1 The limits in this section are based mainly on the subjective severity of the flicker imposed on the light from 230 V/60 W coiled-coil filament lamps by 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 have not yet been considered.

Special equipment which is not widely used and is designed in such a way that it is unable to comply with the requirements [limits] of this section may be subject to installation restrictions requiring the consent of the supply authority before connection.

2 A guide to the assessment of such equipment is given in technical report IEC 1000-3-5.

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 50(161): 1990, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*

IEC 335-2-7: 1993, *Safety of household and similar electrical appliances – Part 2: Particular requirements for washing machines*

IEC 335-2-11: 1993, *Safety of household and similar electrical appliances – Part 2: Particular requirements for tumbler dryers*

IEC 725: 1981, *Considerations on reference impedances for use in determining the disturbance characteristics of household appliances and similar electrical equipment*

IEC 868: 1986, *Flickermeter – Functional and design specifications*
Amendment No. 1 (1990)

IEC 1000-3-5: 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*

3 Definitions

For the purpose of this section of IEC 1000-3, the following definitions apply.

3.1 **R.M.S. voltage shape, $U(t)$:** The time function of the r.m.s. voltage evaluated stepwise over successive half-periods of the fundamental voltage (see figure 2).

3.2 **voltage change characteristic, $\Delta U(t)$:** The time function of the change in the r.m.s. voltage between periods when the voltage is in a steady-state condition for at least 1 s (see 4.2.3. and figure 2).

3.3 **maximum voltage change, ΔU_{max}:** The difference between maximum and minimum r.m.s. values of the voltage change characteristics (see figure 2).

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:** A series of voltage changes or a continuous variation of the r.m.s. 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:** A value with a time dimension which describes the flicker impression of a voltage change waveform.

4 Assessment of voltage fluctuations and flicker

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

The basis for flicker evaluation is the voltage change waveform 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, $\Delta \underline{I}$.

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

NOTES

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

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.

3 For single-phase and symmetrical three-phase equipment, the voltage change can be approximated to:

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

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 868.

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

4.2.1 *Flickermeter*

All types of voltage fluctuations may be assessed by direct measurement using a flickermeter which complies with the specification given in IEC 868, and is connected as described in clause 6 of this section. This is the reference method for application of the limits.

4.2.2 *Simulation method*

In the case where the relative voltage change waveform $d(t)$ is known, P_{st} can be evaluated using a computer simulation.

4.2.3 *Analytical method*

For voltage change waveforms of the types shown in figures 5, 6 and 7, the P_{st} value can be evaluated by an analytical method using equations (5) and (6).

NOTES

1 The value of P_{st} obtained using this method is expected to be within ± 10 % of the result which would be obtained by direct measurement (reference method).

2 This method is not recommended if the time duration between the end of one voltage change and the start of the next is less than 1 s.

4.2.3.1 *Description of the analytical method*

Each relative voltage change waveform shall be expressed by a flicker impression time, t_f, in seconds:

$$t_f = 2{,}3\ (F \cdot d_{max})^{3,2} \qquad (5)$$

– the maximum relative voltage change d_{max} is expressed as a percentage of the nominal voltage;

– the shape factor, F, is associated with the shape of the voltage change waveform (see 4.2.3.2).

The sum of the flicker impression times, Σt_f, of all evaluation periods within a total interval of the length T_p, in seconds, is the basis for the P_{st} evaluation. If the total time interval T_p is chosen according to 6.5, it is an "observation period", and:

$$P_{st} = (\Sigma t_f / T_p)^{1/3,2} \qquad (6)$$

4.2.3.2 *Shape factor*

The shape factor, F, converts a relative voltage change waveform $d(t)$ into a flicker equivalent relative step voltage change ($F \cdot d_{max}$).

NOTES

1 The shape factor, F, is equal to 1,0 for step voltage changes.

2 The relative voltage change waveform may be measured directly (see figure 1) or calculated from the r.m.s. current of the equipment under test (see equations (1) to (4)).

The relative voltage change waveform will be obtained from a histogram having successive periods of 10 ms.

The shape factor may be deduced from figures 5, 6 and 7, provided that the relative voltage change waveform matches a characteristic shown in the figures. If the waveforms match, proceed as follows:

- find the maximum relative voltage change d_{max} (according to figure 3); and
- find the time T(ms) appropriate to the voltage change waveform as shown in figures 5, 6 and 7 and, using this value, obtain the required shape factor, F.

3 Extrapolation outside the range of the figures may lead to unacceptable errors.

4.2.4 *Use of $P_{st} = 1$ curve*

In the case of rectangular voltage changes of the same amplitude "d" separated by equal time intervals, the curve of figure 4 may be used to deduce the amplitude corresponding to $P_{st} = 1$ for a particular rate of repetition; this amplitude is called d_{lim}. The P_{st} value corresponding to the voltage change "d" is then given by $P_{st} = d/d_{lim}$.

4.3 *Assessment of long-term flicker value, P_{lt}*

The long-term flicker value P_{lt} is defined in IEC 868, appendix A.2, and shall be applied with the value of $N = 12$ (see 6.5).

It is generally necessary to assess the value of P_{lt} for equipment which is normally operated for more than 30 min at a time.

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 and annex A. Tests made to prove the compliance with the limits are considered to be type tests.

The following limits apply:

- the value of P_{st} shall not be greater than 1,0;
- the value of P_{lt} shall not be greater than 0,65;

- the relative steady-state voltage change, d_c, shall not exceed 3 %;
- the maximum relative voltage change, d_{max}, shall not exceed 4 %;
- the value of $d(t)$ during a voltage change shall not exceed 3 % for more than 200 ms.

If voltage changes are caused by manual switching or occur less frequently than once per hour, the P_{st} and P_{lt} requirements shall not be applicable. The three requirements related to voltage changes shall be applicable with the previously mentioned voltage values, multiplied by a factor of 1,33.

The limits do not apply to emergency switching or emergency interruptions.

6 Test conditions

6.1 *General*

Tests shall not be made on equipment which is unlikely to produce significant voltage fluctuations or flicker.

Tests to prove the compliance of the equipment with the limits shall be made using the test circuit in figure 1.

The test circuit consists of:

- the test supply voltage (see 6.3);
- the reference impedance (see 6.4);
- the equipment under test (see annex A);
- if necessary, a flickermeter (see IEC 868).

The relative voltage change $d(t)$ may be measured directly or derived from the r.m.s. current as described in 4.1. To determine the P_{st} value of the equipment under test, one of the methods described in 4.2 shall be used. In case of doubt, the P_{st} shall be measured using the reference method with a flickermeter.

NOTE – If balanced multiphase equipment is tested, it is acceptable to measure only one of the three line-to-neutral voltages.

6.2 *Measurement accuracy*

The magnitude of the current shall be measured with an accuracy of ±1 % or better. If instead of active and reactive current the phase angle is used, its error shall not exceed ±2°.

The relative voltage change "d" shall be determined with a total accuracy better than ±8 % with reference to the maximum value d_{max}. The total impedance of the circuit, excluding the appliance under test, but including the internal impedance of the supply source, shall be equal to the reference impedance. The stability and tolerance of this total impedance shall be adequate to ensure that the overall accuracy of ±8 % is achieved during the whole assessment procedure.

NOTE – The following method is not recommended where the measured values are close to the limits.

When the source impedance is not well defined, for example where the source impedance is subject to unpredictable variations, an impedance having resistance and inductance equal to the reference impedance may be connected between the supply and the terminals of the equipment under test. Measurements can then be made of the voltages at the source side of the reference impedance and at the equipment terminals. In that case, the maximum relative voltage change, d_{max}, measured at the supply terminals shall be less than 20 % of the maximum value d_{max} measured at the equipment terminals.

6.3 *Test supply voltage*

The test supply voltage (open-circuit voltage) shall be the rated voltage of the equipment. If a voltage range is stipulated for the equipment, the test voltage shall be 230 V single-phase or 400 V three-phase. The test voltage shall be maintained within ± 2 % of the nominal value. The frequency shall be 50 Hz ± 0,5 %.

The percentage total harmonic distortion of the supply voltage shall be less than 3 %.

Fluctuations of the test supply voltage during a test may be neglected if the P_{st} value is less than 0,4. This condition shall be verified before and after each test.

6.4 *Reference impedance*

For equipment under test the reference impedance, Z_{ref} , according to IEC 725, is a conventional impedance used in the calculation and measurement of the relative voltage change "*d*", and the P_{st} and P_{lt} values.

The impedance values of the various elements are given in figure 1.

6.5 *Observation period*

The observation period, T_p, for the assessment of flicker values by flicker measurement, flicker simulation, or analytical method shall be:

- for P_{st}, T_p = 10 min;
- for P_{lt}, T_p = 2 h.

The observation period shall include that part of the whole operation cycle in which the equipment under test produces the most unfavourable sequence of voltage changes.

For the assessment of P_{st}, the cycle of operation shall be repeated continuously, unless stated otherwise in annex A. The minimum time to restart the equipment shall be included in this observation period when testing equipment that stops automatically at the end of a cycle of operation which lasts for less than the observation period.

For P_{lt} assessment, the cycle of operation shall not be repeated, unless stated otherwise in annex A, when testing equipment with a cycle of operation of less than 2 h and which is not normally used continuously.

NOTE – For example, in the case of equipment with a cycle of operation lasting 45 min, five consecutive P_{st} values will be measured during a total period of 50 min, and the remaining seven P_{st} values in the 2 h observation period will be deemed to be zero.

6.6 *General test conditions*

The test conditions for the measurement of voltage fluctuations and flicker are given below. For equipment not mentioned in annex A, controls or automatic programmes shall be set to produce the most unfavourable sequence of voltage changes, using only those combinations of controls and programmes which are mentioned by the manufacturer in the instruction manual, or are otherwise likely to be used. Particular test conditions for equipment not included in annex A are under consideration.

The equipment shall be tested in the condition in which it is supplied by the manufacturer. Preliminary operation of motor drives may be needed before the tests to ensure that results corresponding to those of normal use are obtained.

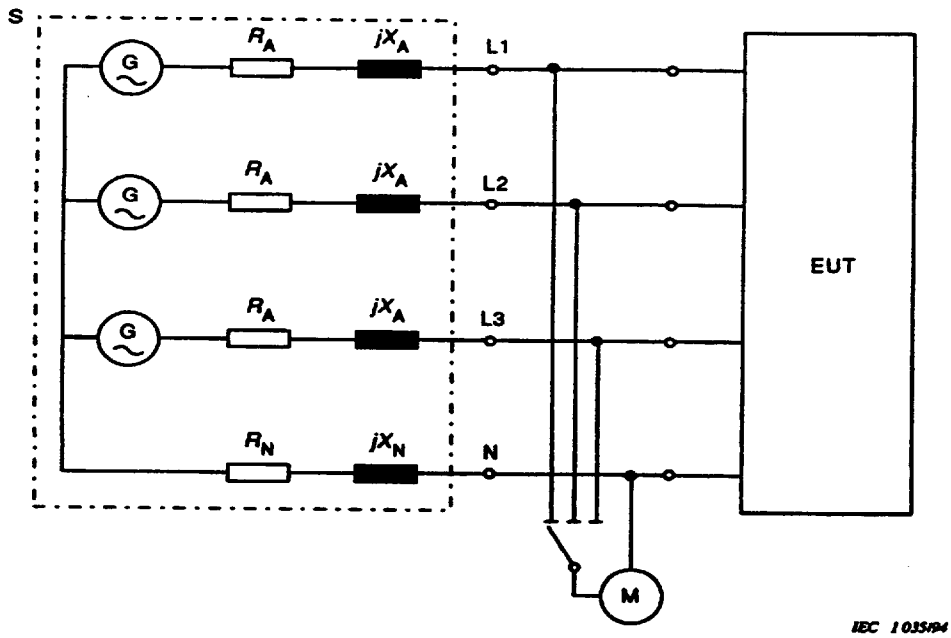
For motors, locked-rotor measurements may be used to determine the largest r.m.s. voltage change, d_{max}, occurring during motor starting.

For equipment having several separately controlled circuits, the following conditions apply:

- each circuit shall be considered as a single item of equipment if it is intended to be used independently, provided that the controls are not designed to switch at the same instant;
- if the control of separate circuits are designed to switch simultaneously, the group of circuits so controlled are considered as a single item of equipment.

For control systems regulating part of a load only, the voltage fluctuations produced by each variable part of the load alone shall be considered.

Detailed type test conditions for some equipment are given in annex A.



EUT equipment under test

M measuring equipment

S supply source consisting of the supply voltage generator G and reference impedance Z with the elements:

R_A = 0,24 Ω; jX_A = 0,15 Ω at 50 Hz;

R_N = 0,16 Ω; jX_N = 0,10 Ω at 50 Hz.

The elements include the actual generator impedance.

When the source impedance is not well defined, see 6.2.

G voltage source in accordance with 6.3.

NOTE – In general, three-phase loads are balanced, and R_N and X_N can be neglected, as there is no current in the neutral wire.

Figure 1 – Reference network for single-phase and three-phase supplies derived from a three-phase, four-wire supply

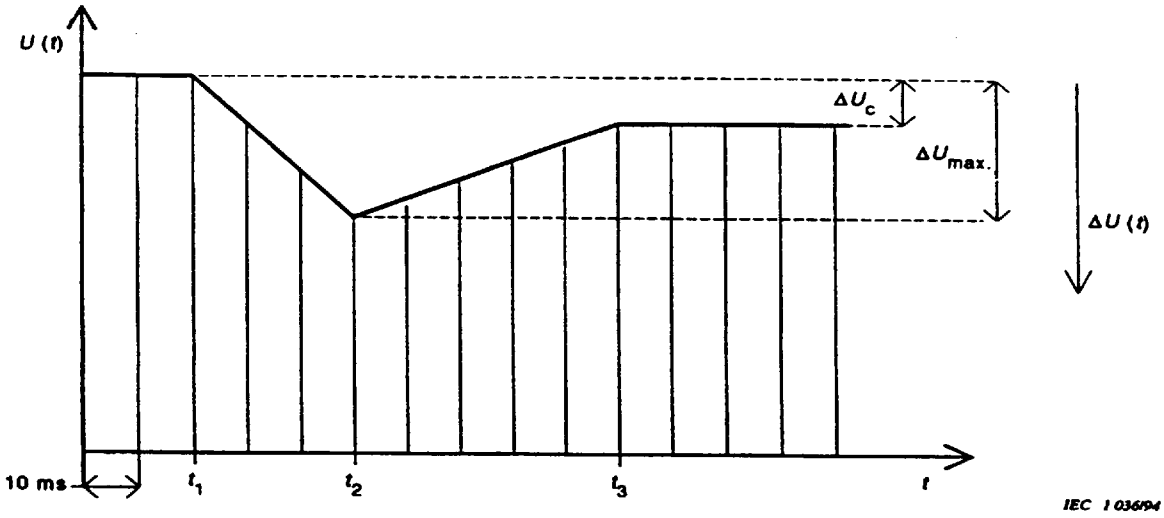


Figure 2 – Histogram evaluation of $U(t)$

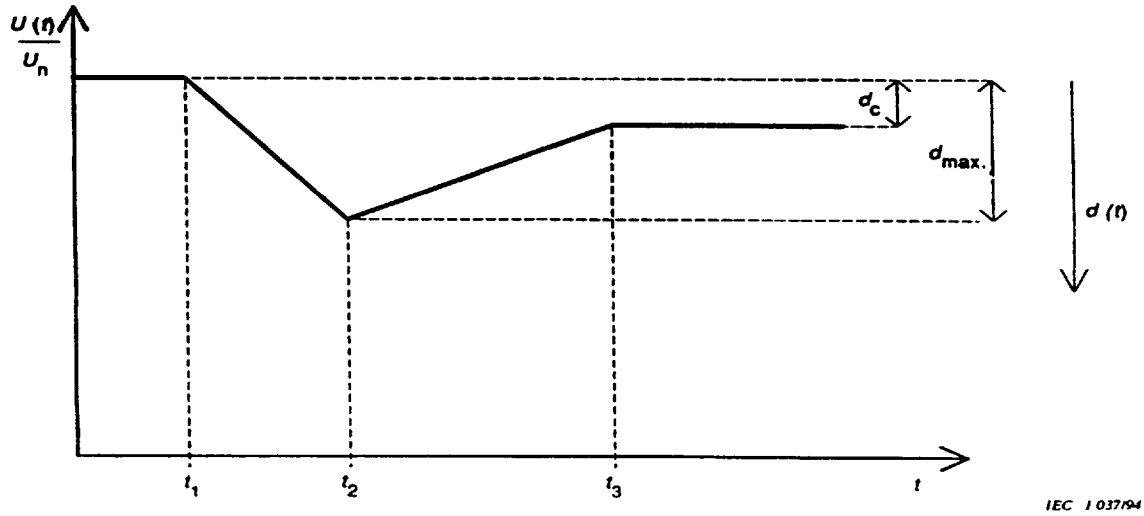
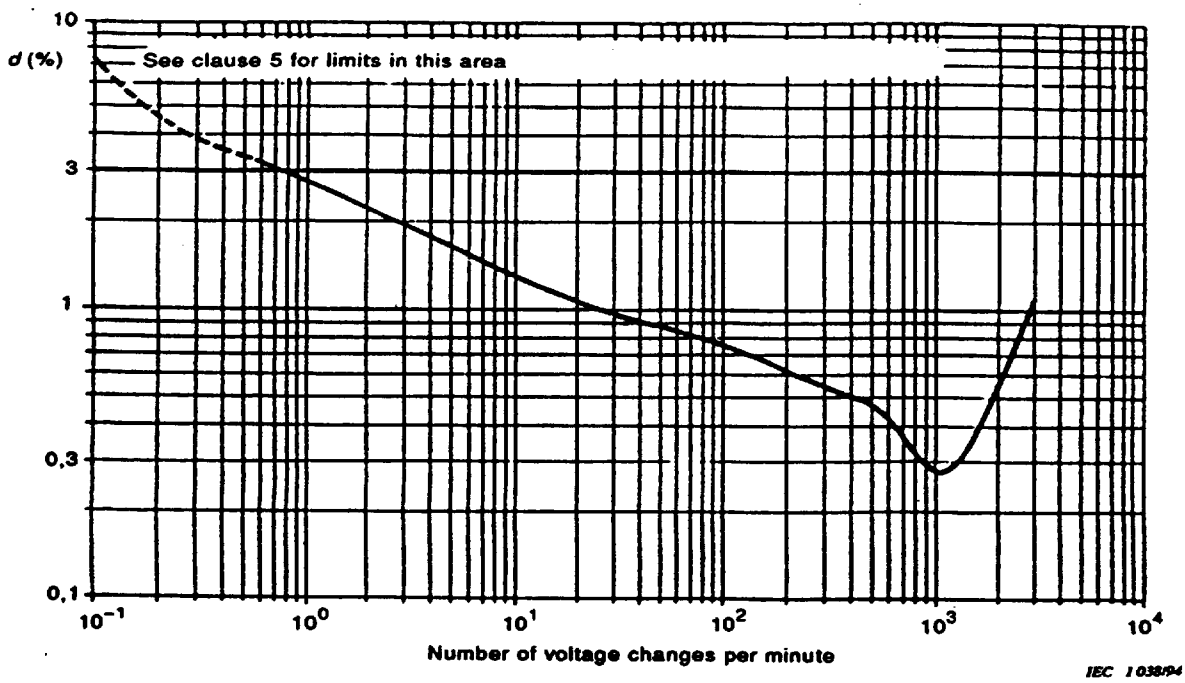


Figure 3 – Relative voltage change characteristic



NOTE – 1 200 voltage changes per minute give 10 Hz flicker.

Figure 4 – Curve for P_{st}=1 for rectangular equidistant voltage changes

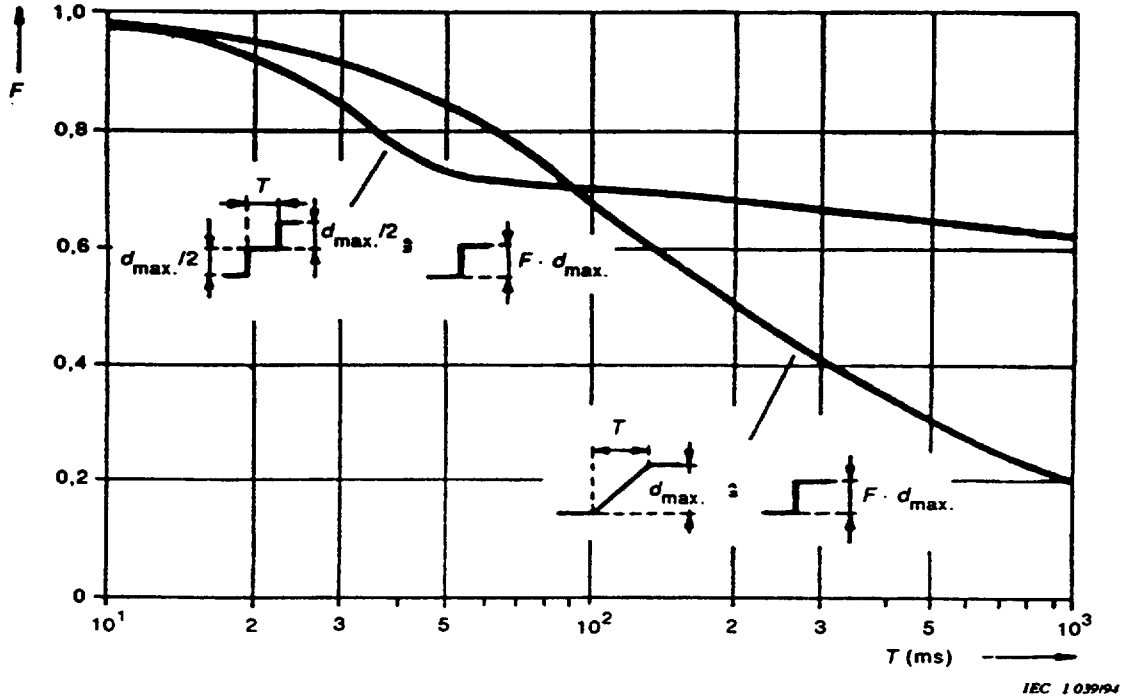


Figure 5 – Shape factors *F* for double-step and ramp-voltage characteristics

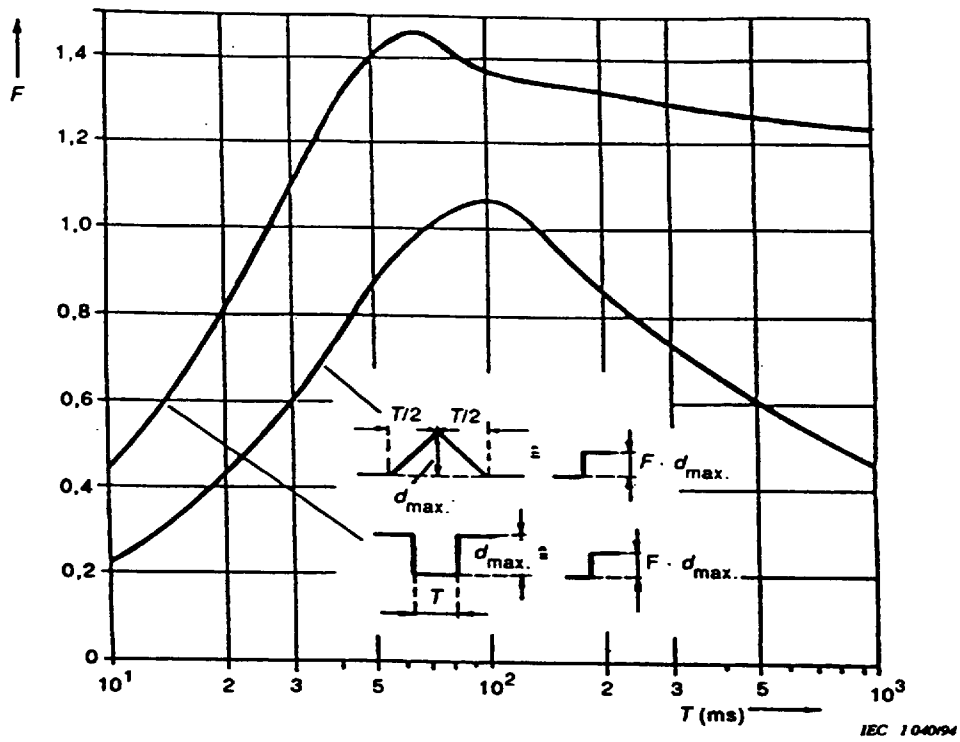
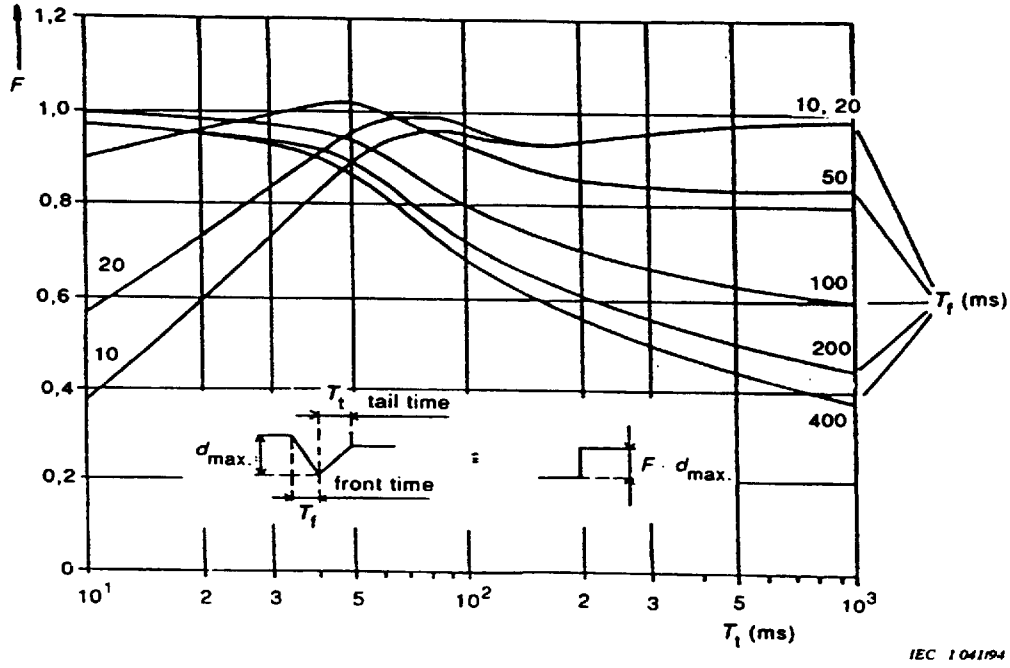


Figure 6 – Shape factors *F* for rectangular and triangular voltage characteristics



NOTE – $T_1 = t_3 - t_2$, $T_f = t_2 - t_1$ (see figure 3).

Figure 7 – Shape factor *F* for motor-start voltage characteristics having various front times

Annex A
(normative)

Application of limits and type test conditions for specific equipment

A.1 Test conditions for cookers

For cookers designed for use in domestic premises, the evaluation of P_{lt} shall not be required.

The tests of P_{st} shall be performed at steady-state temperature conditions, unless stated otherwise.

Each heater shall be tested separately as follows.

A.1.1 *Hotplates*

Hotplates shall be tested using standard saucepans with diameter, height and water quantity as follows:

Diameter of the hotplate (mm)	Height of the pot (mm)	Quantity of water (g)
145	about 140	1 000 ± 50
180	about 140	1 500 ± 50
220	about 120	2 000 ± 50

Possible losses by evaporation have to be compensated for during the time of measurement.

In all of the following tests the hotplate shall comply with the limits given in clause 5.

a) Boiling temperature range: set the control to the position where the water just boils. The test is made five times and the mean value of the test results calculated.

b) Frying temperature range: fill the pot, without a lid, with silicone oil to 1,5 times the quantity of water shown in the table. Set the control to a temperature of 180 °C measured by a thermocouple in the geometric centre of the oil.

c) Total range of power settings: the total power range shall be checked continuously during a 10 min observation period. If control switches have discrete stages, test all stages up to a maximum of 20 stages. If there are no discrete stages, divide the total range into 10 equally spaced steps. The measurements shall then be made starting at the highest power stage.

A.1.2 *Baking ovens*

The oven shall be tested empty with the door closed. Adjust the control so that a thermocouple fixed in the geometric centre measures a mean temperature of 220 °C for conventional ovens and 200 °C for hot air oven.

A.1.3 *Grills*

The grill shall be tested empty with the door closed, if not otherwise stated by the manufacturer. If a control is available it shall be set to the lowest, the medium and the highest setting for grilling operation; and the worst result recorded.

A.1.4 *Baking oven/grill combinations*

The oven/grill combination shall be tested empty with the door closed. Adjust the control so that a thermocouple fixed in the geometric centre measures a mean temperature of 250 °C, or that available temperature closest to this value.

A.1.5 *Microwave ovens*

The microwave oven or the microwave function of a combination oven shall be tested at the lowest, the medium and a third stage which is the highest adjustable power less than or equal to 90 % of the maximum power. Load the oven with a glass bowl containing 1 000 ± 50 g of water.

A.2 Test conditions for lighting equipment

Lighting equipment shall be tested with a lamp of that power for which the equipment is rated. If lighting equipment includes more than one lamp, all lamps shall be in use.

P_{st} and P_{lt} are only evaluated for lighting equipment which is likely to produce flicker, for example, disco lighting.

A.3 Test conditions for washing machines

The washing machine shall be tested in a complete laundry programme at 60 °C filled as specified for normal operation in IEC 335-2-7.

Neglect simultaneous switching of heater and motor in the evaluation of d_c, d_{max} and $d(t)$.

P_{st} and P_{lt} shall be evaluated.

A.4 Test conditions for tumbler dryers

The tumbler dryer shall be filled with 50 % of the load as specified for normal operation in IEC 335-2-11.

If a control of the drying degree is available, the test shall be performed at the maximum and minimum settings.

P_{st} and P_{lt} shall be evaluated.

A.5 Test conditions for refrigerators

Refrigerators shall operate continuously with the door closed. Adjust the thermostat to the mid-value of the adjusting range. The cabinet shall be empty and not heated. The measurement shall be made after a steady state has been reached. P_{st} and P_{lt} shall not be evaluated.

A.6 Test conditions for copying machines, laser printers and similar appliances

The appliance shall be tested for P_{st} at the maximum rate of copying. The original to be copied/printed is white blank paper and the copy paper shall have a weight of 80 g/m^2 if not otherwise stated by the manufacturer.

Obtain the P_{lt} value in the stand-by mode.

A.7 Test conditions for vacuum cleaners

For vacuum cleaners, P_{st} and P_{lt} shall not be evaluated.

A.8 Test conditions for food mixers

For food mixers, P_{st} and P_{lt} shall not be evaluated.

A.9 Test conditions for portable tools

For portable tools, P_{lt} shall not be evaluated. For portable tools without heating elements, P_{st} shall not be evaluated. For portable tools with heating elements, P_{st} shall be evaluated as follows.

Switch on the tool and allow to operate continuously for 10 min, or until it switches off automatically, in which case 6.5 applies.

A.10 Test conditions for hairdryers

For hand-held hairdryers, P_{lt} shall not be evaluated. To evaluate P_{st}, switch on the hairdryer and allow to operate continuously for 10 min or until it switches off automatically, in which case 6.5 applies.

For hairdryers incorporating a power range, check the total power range continuously during a 10 min observation period. If control switches have discrete stages all stages shall be tested up to a maximum of 20 stages. If there are no discrete stages, divide the total range into 10 equally spaced steps. The measurements shall then be made, starting with the highest power stage.

A.11 Test conditions for consumer electronics products

For consumer electronics products, only the measurement of d_{max} is made.

A.12 Test conditions for direct water heaters

For direct water heaters without electronic controls, evaluate d_c only by switching the heater on and off (sequence 0 – P_{max} – 0).

For direct water heaters with electronic controls, the output temperature of the water has to be chosen so that by means of the variation of water flow-rate all electric power consumption rates between P_{min} and P_{max} may be produced. P_{max} is defined as the maximum power which can be chosen, and $P_{min} > 0$ is defined as the minimum power which can be chosen.

NOTE – For some appliances, the maximum power P_{max} which can be chosen may be less than the rated power.

The set temperature value shall be kept unchanged during the total test.

Starting from the water flow-rate demand for maximum power consumption, P_{max}, reduce the rate of flow in 20 approximately equal steps to minimum power consumption, P_{min}.

Then, in another 20 approximately equal steps, increase the water flow-rate again to power consumption P_{max}. For each of these 40 stages the $P_{st,i}$ value shall be evaluated; the measurements start when the steady state is reached, that is about 30 s after changing the water flow-rate.

NOTE – It may be sufficient to calculate $P_{st,i}$ value on the base of a measurement period of only 1 min.

Additionally, the flicker $P_{st,z}$ caused by switching the heater on and off has to be measured within a 10 min interval. In this interval, the power consumption has to be changed twice in the quickest possible way between the stages $P = 0$ and $P = P_{max}$ (sequence 0 – P_{max} – 0 – P_{max} – 0).

The duty cycle of the heater shall be 50 % that is P_{max} during 5 min.

Evaluate the resultant P_{st} values by:

$$P_{st} = \left(P_{st,z}^{3} + \frac{1}{40} \sum_{i=1}^{i=40} (P_{st,i})^3 \right)^{\frac{1}{3}}$$

and compare against the limit value in clause 5.

P_{lt} shall not be evaluated.

Annex ZA (normative)

Other international publications quoted in this standard with the references of the relevant European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

NOTE. When the international publication has been modified by CENELEC common modifications, indicated by (mod), the relevant EN/HD applies.

IEC publication	Date	Title	EN/HD	Date
50(161)	1990	*International Electrotechnical Vocabulary (IEV) — Chapter 161: Electromagnetic compatibility*	—	—
335-2-7	1993*	*Safety of household and similar electrical appliances* *Part 2: Particular requirements for washing machines*	—	—
335-2-11	1993*	*Safety of household and similar electrical appliances* *Part 2: Particular requirements for tumbler dryers*	—	—
725	1981	*Considerations on reference impedances for use in determining the disturbance characteristics of household appliances and similar electrical equipment*	—	—
868 A1	1986 1990	*Flickermeter — Functional and design specifications*	EN 60868	1993
1000-3-5	1994	*Electromagnetic compatibility (EMC)* *Part 3: Limits — Section 5: Limitation of voltage fluctuations and flicker in low-voltage power supply systems for equipment with rated current greater than 16 A*	—	—

*IEC 335-2-7 : 1984, mod., is harmonized as EN 60335-2-7 : 1990
IEC 335-2-11 : 1984, mod., is harmonized as EN 60335-2-11 : 1989

List of references

See national foreword.

BS EN 61000-3-3 : 1995 IEC 1000-3-3 : 1994

Issue 2, January 1998

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AMD 9789

Amendment No. 1
published and effective from 15 January 1998
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Electromagnetic compatibility (EMC)

Part 3. Limits

Section 3.3 Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A

Instructions for replacement of pages

Where only one of the two pages on each sheet has been updated, the other page has been reprinted.

Front cover and inside front cover	Replace the pages
a and b	Insert the pages immediately after the inside front cover
i and ii	Replace the pages
1 and 2	Replace the pages
Inside back cover and back cover	Replace the pages

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BRITISH STANDARD

BS EN
61000-3-3 : 1995
IEC 1000-3-3 :
1994

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Electromagnetic compatibility (EMC)

Part 3. Limits

Section 3. Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A

The European Standard EN 61000-3-3 : 1995 has the status of a British Standard

ICS 33.100

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by Technical Committee GEL/110, Electromagnetic compatibility, to Subcommittee GEL/110/8, Electromagnetic compatibility — Low frequency disturbances, upon which the following bodies were represented:

Association of Control Manufacturers — TACMA (BEAMA Ltd.)
Association of Manufacturers of Domestic Electrical Appliances
BEAMA Ltd.
British Lighting Association for the Preparation of Standards (BRITLAPS)
British Radio and Electronic Equipment Manufacturers' Association
British Telecommunications plc
Building Automation and Mains Signalling Association (BAMSA) (BEAMA Ltd.)
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Institution of Electrical Engineers
Lighting Industry Federation Ltd.
Power Supply Manufacturers' Association — PSMA (BEAMA Ltd.)
Professional Lighting and Sound Association
Sound and Communications Industries Federation
Radiocommunications Agency

This British Standard, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on
15 August 1995

The following BSI references relate to the work on this standard:
Committee reference GEL/110/8
Draft for comment 90/28296 DC

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Amendments issued since publication

Amd. No.	Date	Text affected
9789	January 1998	Indicated by a double sideline in the margin

Summary of pages

The following table identifies the current issue of each page. Issue 1 indicates that a page has been introduced for the first time by amendment. Subsequent issue numbers indicate an updated page. Double vertical sidelining on replacement pages indicates the most recent changes (amendment, addition, deletion).

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b	blank	Inside back cover	original
i	original	Back cover	2
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Contents

National foreword

This Section of BS EN 61000 has been prepared by Subcommittee GEL/110/8 and is the English language version of EN 61000-3-3 : 1995 *Electromagnetic compatibility (EMC) Part 3: Limits Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A*, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 1000-3-3 : 1994, published by the International Electrotechnical Commission (IEC).

IEC 1000 has been designated a Basic EMC publication for use in the preparation of dedicated product, product family and generic EMC standards.

The foreword of the EN makes reference to the 'date of withdrawal', (dow) of the relevant national standard. In this case the relevant national standard is BS 5406 : Part 3 : 1988 as amended by amendment No 1 : 1992 which will be withdrawn on 2001-01-01.

Cross-references

Publication referred to	Corresponding British Standard
IEC 50 (161) : 1990	BS 4727 *Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms* Part 1 *Terms common to power, telecommunications and electronics* Group 09 : 1991 *Electromagnetic compatibility*
IEC 868 : 1986 + Amendment No 1 : 1990	BS EN 60868 : 1993 *Flickermeter — Functional and design specifications*

Compliance with a British Standard does not of itself confer immunity from legal obligations.

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 61000-3-3

January 1995

ICS 29.240.00

Supersedes EN 60555-3 : 1987 and its amendment (includes corrigendum July 1997)

Descriptors: Electromagnetic compatibility, disturbances, voltage fluctuation, type of voltage fluctuation, test conditions, assessment, calculation, measurement, flickermeter

English version

Electromagnetic compatibility (EMC)
Part 3: Limits
Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A

(IEC 1000-3-3 : 1994)

Compatibilité électromagnetique (CEM)
Partie 3: Limites
Section 3: Limitation des fluctuations de tension et du flicker dans les réseaux basse tension pour les équipements ayant un courant appelé ≤ 16 A
(CEI 1000-3-3 : 1994)

Elektromagnetische Verträglichkeit (EMV)
Teil 3: Grenzwerte
Hauptabschnitt 3: Grenzwerte für Spannungsschwankungen und Flicker in Niederspannungsnetzen für Geräte mit einem Eingangsstrom ≤ 16 A
(IEC 1000-3-3 : 1994)

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Ref. No. EN 61000-3-3 : 1995 E

Foreword

The text of document 77A(CO)38, future edition 1 of IEC 1000-3-3 : 1994, prepared by SC 77A, Low-frequency phenomena, of IEC TC 77, Electromagnetic compatibility, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61000-3-3 on 1994-03-08.

This European Standard supersedes EN 60555-3 : 1987 + A1 : 1991.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1995-07-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2001-01-01

Annexes designated 'normative' are part of the body of the standard. In this standard, annexes A and ZA are normative. Annex ZA has been added by CENELEC.

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