IEC 61000-3-12

Edition 2.0 2011-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electromagnetic compatibility (EMC) –
Part 3-12: Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and ≤75 A per phase

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Compatibilité électromagnétique (CEM) –
Partie 3-12: Limites – Limites pour les courants harmoniques produits par les appareils connectés aux réseaux publics basse tension ayant un courant appelé >16 A et ≤75 A par phase

IEC 61000-3-12:2011

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ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 3-12: Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and ≤75 A per phase

INTERPRETATION SHEET

This interpretation sheet has been prepared by subcommittee 77A: Low frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

The text of this interpretation sheet is based on the following documents:

ISH	Report on voting
77A/792/ISH	77A/800/RVD

Full information on the voting for the approval of this interpretation sheet can be found in the report on voting indicated in the above table.

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Interpretation of requirements for equipment with unforeseen low input currents during tests according to IEC 61000-3-12:2011: Electromagnetic compatibility (EMC) – Part 3-12: Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and ≤75 A per phase.

When equipment that has a rated current above 16 A draws a reference current that is less than 16 A under the specified test conditions, the manufacturer may proceed in one of the following ways:

1) Comply with the proportional limits as calculated, choosing the required R_{sce};

2) Comply with the absolute limits given in IEC 61000-3-2:2011, Table 1, using the measurement procedure defined in 4.2.2 in IEC 61000-3-12:2011;

   In that case, the manufacturer shall state in the instruction manual "Equipment complying with IEC 61000-3-12", without having to declare a minimum short circuit power S_{sc}.

3) Change the test conditions to a representative 2,5 min period, as defined in IEC 61000-3-12:2011, Table 1 for long cyclic equipment, and comply with the proportional limits as calculated, choosing the required R_{sce}.

The manufacturer is strongly advised to state in the test report which of these ways was used, so that subsequent tests are carried out with the same procedure.

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ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 3-12: Limits –
Limits for harmonic currents produced
by equipment connected to public low-voltage systems
with input current >16 A and ≤75 A per phase

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International Standard IEC 61000-3-12 has been prepared by subcommittee 77A: Low frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

This second edition cancels and replaces the first edition published in 2004 and constitutes a technical revision.

The significant technical changes with respect to the previous edition are listed below:

– the reference fundamental current I_1 is replaced by the reference current I_{ref} for the calculation of emission limits;

– a new table of current emission limits (Table 5) is added;

– a new annex (Annex A) is added to define test conditions for some types of equipment;

- former Annexes B (Approximate interpolation formulas) and D (Information on the *PWHD* factor) are deleted.

The text of this standard is based on the following documents:

FDIS	Report on voting
77A/740/FDIS	77A/747/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61000 series, published under the general title *Electromagnetic compatibility (EMC)*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability 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.

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The contents of the interpretation sheet 1 of September 2012 have been included in this copy.

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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 the product committees)

Part 4: Testing and measurement techniques

Measurement techniques

Testing techniques

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Part 5: Installation and mitigation guidelines

Installation guidelines

Mitigation methods and devices

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Part 6: Generic standards

Part 9: Miscellaneous

Each part is further subdivided into several parts, published either as International Standards or as technical specifications 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: IEC 61000-6-1).

This International Standard is a Product Family Standard.

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 3-12: Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and ≤75 A per phase

1 Scope

This part of IEC 61000 deals with the limitation of harmonic currents injected into the public supply system. The limits given in this International Standard are applicable to electrical and electronic equipment with a rated input current exceeding 16 A and up to and including 75 A per phase, intended to be connected to public low-voltage a.c. distribution systems of the following types:

- nominal voltage up to 240 V, single-phase, two or three wires;
- nominal voltage up to 690 V, three-phase, three or four wires;
- nominal frequency 50 Hz or 60 Hz.

Other distribution systems are excluded. The limits given in this edition apply to equipment when connected to 230/400 V, 50 Hz systems. See also Clause 5.

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NOTE 1 The limits for the other systems will be added in a future edition of this standard.

NOTE 2 Equipment with a rated input current exceeding 75 A per phase should be considered in the harmonic current requirements for installations. See IEC/TR 61000-3-6 and future IEC/TR 61000-3-14.

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This standard applies to equipment intended to be connected to low-voltage systems interfacing with the public supply at the low-voltage level. It does not apply to equipment intended to be connected only to private low-voltage systems interfacing with the public supply only at the medium- or high-voltage level.

NOTE 3 The scope of this standard is limited to equipment connected to public low voltage systems because emissions from equipment installed in private low voltage systems can be controlled in aggregate at the MV point of common coupling using procedures defined in IEC/TR 61000-3-6 and/or by means of contractual agreements between the distribution network operator and the customer. It is expected that operators of private systems will manage the EMC environment in a manner that ensures compliance with the provisions given in IEC/TR 61000-3-6 and/or the contractual agreements.

NOTE 4 If the equipment is intended to be connected only to private systems, the manufacturer should make this very clear in the product documentation.

NOTE 5 Professional equipment with input current ≤16 A per phase and that does not comply with the requirements and limits of standard IEC 61000-3-2 may be permitted to be connected to certain types of low voltage supplies, in the same way as equipment with input current >16 A per phase and that does not comply with the requirements and limits of the present standard (see Annex C).

NOTE 6 The limits in this standard are not applicable to stand-alone harmonic filters.

This standard defines:

a) requirements and emission limits for equipment;

b) methods for type tests and simulations.

Tests according to this International Standard are type tests of complete pieces of equipment.

Conformity with this standard can also be determined by validated simulations.

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 60038, *IEC standard voltages*

IEC 60050(161):1990, *International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility*
Amendment 1 (1997)
Amendment 2 (1998)

IEC 61000-2-2, *Electromagnetic compatibility (EMC) – Part 2-2: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*

IEC 61000-2-4, *Electromagnetic compatibility (EMC) – Part 2-4: Environment – Compatibility levels in industrial plants for low-frequency conducted disturbances*

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

IEC 61000-4-7, *Electromagnetic compatibility (EMC) – Part 4-7: Testing and measurement techniques – General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto*

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3 Terms and definitions

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For the purposes of this document, the definitions given in IEC 60050(161) and the following definitions apply.

3.1
total harmonic current
THC
total r.m.s. value of the harmonic current components of orders 2 to 40

$$THC = \sqrt{\sum_{h=2}^{40} I_h^2}$$

3.2
partial weighted harmonic current
PWHC
total r.m.s. value of a selected group of higher order harmonic current components (in this International Standard from order 14 to order 40), weighted with the harmonic order h

$$PWHC = \sqrt{\sum_{h=14}^{40} h \cdot I_h{}^2}$$

NOTE The partial weighted harmonic current is employed in order to ensure that the effects of the higher order harmonic currents on the results are reduced sufficiently and individual limits need not be specified.

3.3
point of common coupling
PCC
point in the public system which is closest to the customer concerned and to which other customers are or may be connected

3.4
single-phase equipment
equipment connected between one line conductor and the neutral conductor

NOTE This includes equipment in which separate loads are connected from one or more line conductors to the neutral conductor

3.5
interphase equipment
equipment connected between two line conductors (phases)

NOTE The neutral conductor is not used as a current-carrying conductor under normal operating conditions.

3.6
three-phase equipment
equipment connected to the three line conductors

NOTE 1 The neutral conductor is not used as a current-carrying conductor under normal operating conditions.

NOTE 2 Equipment intended to be connected to all three phases and to the neutral and where the neutral conductor is used as a current-carrying conductor, is considered as three separate single-phase items.

3.7
balanced three-phase equipment
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three-phase equipment connected to the three line conductors of a three-phase supply and in which the three line or phase currents are designed to be identical in amplitude and waveshape, each being displaced from the other two by one-third of a fundamental period

3.8
unbalanced three-phase equipment
three-phase equipment connected to the three line conductors of a three-phase supply and in which the three line or phase currents are not designed to be identical in amplitude or waveshape, or the displacement between any two is other than one-third of a fundamental period

3.9
hybrid equipment
combination of a balanced three-phase load and one or more loads connected between phase and neutral or between phases

3.10
short-circuit power
S_{sc}
value of the three-phase short-circuit power calculated from the nominal interphase system voltage $U_{nominal}$ and the line impedance Z of the system at the PCC:

$$S_{sc} = U^2_{nominal} / Z$$

where Z is the system impedance at the power frequency

3.11
rated apparent power of the equipment
S_{equ}
value calculated from the rated current I_{equ} of the piece of equipment stated by the manufacturer and the rated voltage U_p (single phase) or U_i (interphase) as follows:

a) $S_{equ} = U_p\ I_{equ}$ for single-phase equipment and the single-phase part of hybrid equipment;

b) $S_{equ} = U_i\ I_{equ}$ for interphase equipment;

c) $S_{equ} = \sqrt{3}\ U_i\ I_{equ}$ for balanced three-phase equipment and the three-phase part of hybrid equipment;

d) $S_{equ} = \sqrt{3}\ U_i\ I_{equ\ max}$ for unbalanced three-phase equipment, where $I_{equ\ max}$ is the maximum of the r.m.s. currents flowing in any one of the three phases

NOTE In the case of a voltage range, U_p or U_i is a nominal system voltage according to IEC 60038 (for example: 120 V or 230 V for single-phase or 400 V line-to-line for three-phase).

3.12
reference current
$\boldsymbol{I_{ref}}$
value of the r.m.s. input current of the equipment determined according to 4.1 and used to establish emission limits

3.13
rated current of the equipment
$\boldsymbol{I_{equ}}$
input current of the piece of equipment as declared by the manufacturer and marked as such on the rating plate of the piece of equipment or stated in the product documents

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3.14
short-circuit ratio
$\boldsymbol{R_{sce}}$
characteristic value of a piece of equipment defined as follows:

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a) $R_{sce} = S_{sc} / (3\ S_{equ})$ for single-phase equipment and the single-phase part of hybrid equipment;

b) $R_{sce} = S_{sc} / (2\ S_{equ})$ for interphase equipment;

c) $R_{sce} = S_{sc} / S_{equ}$ for all three-phase equipment and the three-phase part of hybrid equipment

NOTE 1 R_{sce} may be related directly to basic known quantities by means of the equations:

$R_{sce} = U/(\sqrt{3} \times Z \times I_{equ})$ for single-phase equipment and the single phase part of hybrid equipment;

$R_{sce} = U/(2 \times Z \times I_{equ})$ for interphase equipment;

$R_{sce} = U/(\sqrt{3} \times Z \times I_{equ})$ for balanced three-phase equipment and the three-phase part of hybrid equipment;

$R_{sce} = U/(\sqrt{3} \times Z \times I_{equ\ max})$ for unbalanced three-phase equipment

where $U = U_{nominal}$, and is assumed to be equal to U_i or $\sqrt{3} \times U_p$, whichever is relevant.

NOTE 2 R_{sce} is not the same as R_{sc}, as defined in IEC 61000-2-6.

NOTE 3 For hybrid equipment, the method of calculating a single R_{sce} value is given in 5.2.

3.15
stand-by mode
non-operational, low power consumption mode (usually indicated in some way on the equipment) that can persist for an indefinite time

NOTE This mode is sometimes termed sleep mode.

3.16
phase angle of I_5 related to the fundamental phase-to-neutral voltage U_{p1}
phase angle of the 5th harmonic current determined as described in Figures 1 and 2

3.17
professional equipment
equipment for use in trades, professions, or industries and which is not intended for sale to the general public

NOTE The designation is specified by the manufacturer.

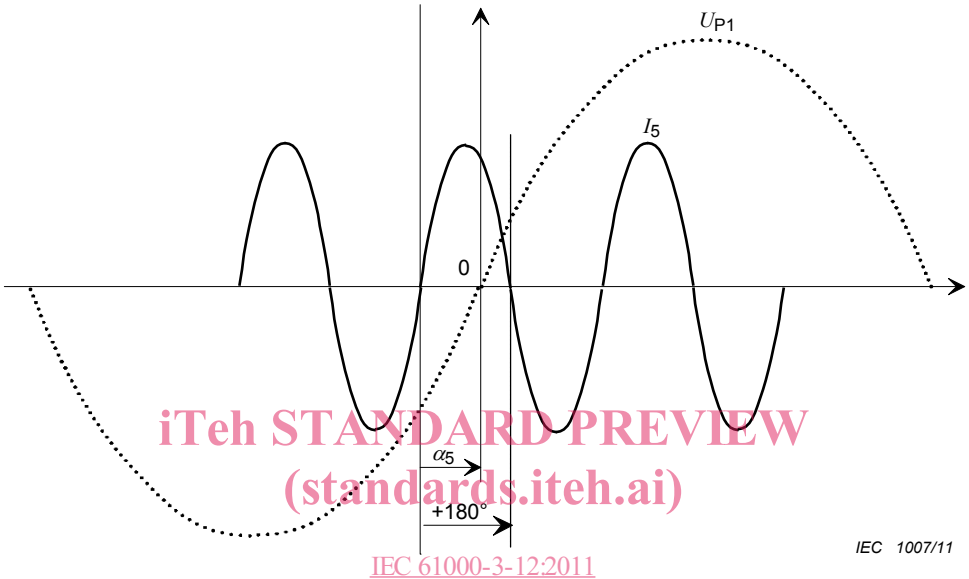

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Figure 1 – Definition of the 5th harmonic current phase angle (I_5 leads U_{p1}, $\alpha_5 > 0$)

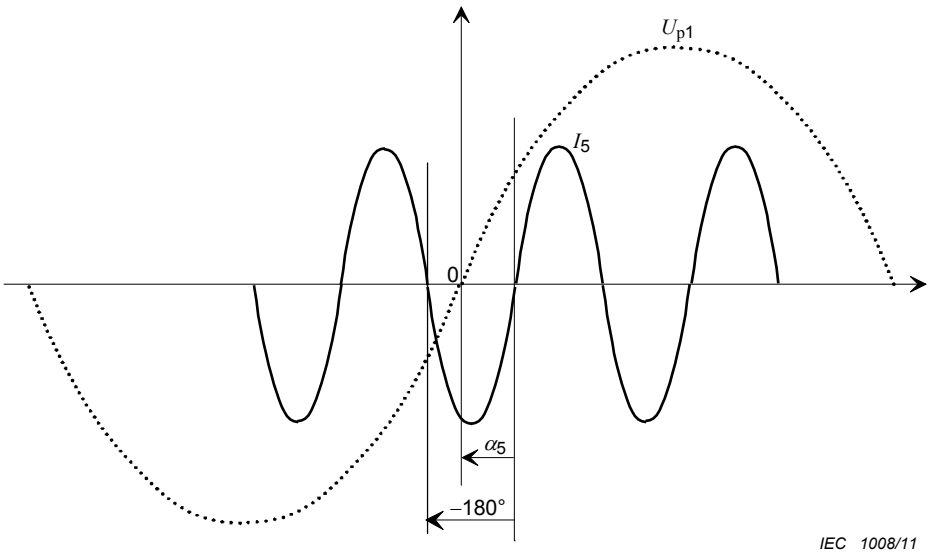

Figure 2 – Definition of the 5th harmonic current phase angle (I_5 lags U_{p1}, $\alpha_5 < 0$)

4 Measurement conditions

4.1 Determination of the reference current

The average r.m.s. input current shall be measured using the averaging method defined in 4.2.2 for harmonic currents. Except for dimmers, the measurement shall be made under the conditions specified in 7.4. For dimmers, the average r.m.s. input current shall be determined with the dimmer set to its maximum conduction angle.

The manufacturer may specify any value of r.m.s. current which is within ± 10 % of the actual measured value and use it as the reference current for the original manufacturer's conformity assessment test. The measured and specified values of current, as defined in this clause, shall be documented in the test report.

For emission tests other than the original manufacturer's conformity assessment test, the value of the reference current shall be determined as follows. If the value of the average r.m.s. input current found by measurement during these emission tests, measured according to the terms of this clause, is not less than 90 % nor greater than 110 % of the value of current specified by the manufacturer in the test report (see 4.2.6), the reference current is equal to the specified value. If the new measured value is outside of this tolerance band around the specified value, the reference current is equal to the new measured value.

4.2 Harmonic current measurement

4.2.1 General

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The harmonic current limits for equipment as specified apply to line currents for all types of power connections and load.

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4.2.2 Measurement procedure

The measurement of harmonic currents shall be performed as follows:

- for each harmonic order, measure the 1,5 s smoothed r.m.s. harmonic current in each Discrete Fourier Transform (DFT) time window as defined in IEC 61000-4-7;
- for each harmonic order, calculate the arithmetic average of the measured values from the DFT time windows, over the entire test observation period as defined in 4.2.7.

Test conditions for the measurement or calculation of harmonic currents are given in Clause 7.

4.2.3 Repeatability

The repeatability of the average value for the individual harmonic currents over the entire test observation period shall be better than ± 5 % of the applicable limit, when the following conditions are met:

- the same equipment under test (EUT) (not another of the same type, however similar);
- identical test conditions;
- the same test system;
- identical climatic conditions, if relevant.

NOTE This repeatability requirement serves the purpose of defining the necessary test observation period, see 4.2.7. It is not intended to serve as a pass/fail criterion for the assessment of compliance with the requirements of this standard.

4.2.4 Starting and stopping

When a piece of equipment is brought into operation or is taken out of operation, manually or automatically, harmonic currents are not taken into account for the first 10 s, or until the equipment is fully in or out of operation, whichever is longer, following the switching event.

The equipment under test shall not be in stand-by mode (see 3.15) for more than 10 % of any observation period.

4.2.5 Application of limits

The average value for the individual harmonic currents, taken over the entire test observation period shall be less than or equal to the applicable limits in Tables 2 to 5.

For each harmonic order, all 1,5 s smoothed r.m.s. harmonic current values, as defined in 4.2.2, shall be less than or equal to 150 % of the applicable limits.

For the calculation of THC and $PWHC$, individual harmonic currents below 1 % of the reference current are disregarded.

4.2.6 Test report

The test report may be based on information supplied by the manufacturer to a testing facility, or be a document recording details of the manufacturer's own tests. It shall include all relevant information for the test conditions, the test observation period and the determination of the reference current showing compliance with the present standard.

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The test report shall include:

IEC 61000-3-12:2011
https://standards.iteh.ai/catalog/standards/sist/58a61792-071a-4fc5-861c-d71e78527502/iec-61000-3-12-2011

- the values of the input current measured and specified by the manufacturer for the determination of the reference current I_{ref}, according to 4.1;
- the short circuit ratio used for calculation or test;
- the required minimum short circuit ratio;
- and a statement about the table applied (i.e. about the type of equipment).

4.2.7 Test observation period

Observation periods (T_{obs}) for four different types of equipment behavior are considered and described in Table 1.

Table 1 – Values of the observation period

Type of equipment behavior	Observation period
Quasi-stationary	T_{obs} of sufficient duration to meet the requirements for repeatability in 4.2.3.
Short cyclic ($T_{cycle} \leq$ 2,5 min)	$T_{obs} \geq$ 10 cycles (reference method) or T_{obs} of sufficient duration or synchronization to meet the requirements for repeatability in 4.2.3. [a]
Random	T_{obs} of sufficient duration to meet the requirements for repeatability in 4.2.3.
Long cyclic (T_{cycle} > 2,5 min)	Full equipment program cycle (reference method) or a representative 2,5 min period considered by the manufacturer as the operating period with the highest THC.

[a] By synchronization is meant that the total observation period is sufficiently close to including an exact integral number of equipment cycles in such a way that the requirements for repeatability in 4.2.3 are met.

4.3 Equipment consisting of several self-contained items

Where individual self-contained items of equipment (possibly, but not necessarily, of different manufacture) are assembled in a rack or case, compliance with the present standard shall be