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INTERNATIONAL STANDARD

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BASIC EMC PUBLICATION

PUBLICATION FONDAMENTALE EN CEM

Electromagnetic compatibility (EMC) –
Part 4-30: Testing and measurement techniques – Power quality measurement methods

Compatibilité électromagnétique (CEM) –
Partie 4-30: Techniques d'essai et de mesure – Méthodes de mesure de la qualité de l'alimentation

IEC 61000-4-30:2008

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ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-30: Testing and measurement techniques – Power quality measurement methods

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61000-4-30 has been prepared by subcommittee 77A: Low-frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

This standard forms part 4-30 of IEC 61000. It has the status of a basic EMC publication in accordance with IEC Guide 107.

This second edition cancels and replaces the first edition published in 2003. This edition includes the following significant technical changes with respect to the previous edition.

– Adjustments, clarifications, and corrections to class A and class B measurement methods.
– A new category, class S, intended for survey instruments, has been added.
– A new Annex C gives guidance on instruments.

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

FDIS	Report on voting
77A/660/FDIS	77A/666/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, 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 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 the 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 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 completed by a second number identifying the subdivision (example: IEC 61000-6-1).

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-30: Testing and measurement techniques – Power quality measurement methods

1 Scope

This part of IEC 61000-4 defines the methods for measurement and interpretation of results for power quality parameters in 50/60 Hz a.c. power supply systems.

Measurement methods are described for each relevant parameter in terms that give reliable and repeatable results, regardless of the method's implementation. This standard addresses measurement methods for *in situ* measurements.

Measurement of parameters covered by this standard is limited to voltage phenomena that can be conducted in a power system. The power quality parameters considered in this standard are power frequency, magnitude of the supply voltage, flicker, supply voltage dips and swells, voltage interruptions, transient voltages, supply voltage unbalance, voltage harmonics and interharmonics, mains signalling on the supply voltage and rapid voltage changes. Depending on the purpose of the measurement, all or a subset of the phenomena on this list may be measured.

NOTE 1 Information about current parameters may be found in A.3 and A.5.

This standard gives measurement methods and appropriate performance requirements, but does not set thresholds.

The effects of transducers inserted between the power system and the instrument are acknowledged but not addressed in detail in this standard. Precautions on installing monitors on live circuits are addressed.

NOTE 2 Some guidance about effects of transducers may be found in IEC 61557-12.

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

IEC 61000-2-2:2002, *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 61000-3-8, *Electromagnetic compatibility (EMC) – Part 3: Limits – Section 8: Signalling on low-voltage electrical installations – Emission levels, frequency bands and electromagnetic disturbance levels*

IEC 61000-4-4:2004, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-7:2002, *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*

Amendment 1 (2008)

IEC 61000-4-15, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 15: Flickermeter – Functional and design specifications*

IEC 61180 (all parts), *High-voltage test techniques for low voltage equipment*

3 Terms and definitions

For the purpose of this document, the definitions of IEC 60050-161, as well as the following, apply.

3.1
channel
individual measurement path through an instrument

NOTE "Channel" and "phase" are not the same. A voltage channel is by definition the difference in potential between 2 conductors. Phase refers to a single conductor. On polyphase systems, a channel may be between 2 phases, or between a phase and neutral, or between a phase and earth, or between neutral and earth.

3.2
Coordinated Universal Time
UTC
time scale which forms the basis of a coordinated radio dissemination of standard frequencies and time signals. It corresponds exactly in rate with international atomic time, but differs from it by an integral number of seconds.

NOTE 1 Coordinated universal time is established by the International Bureau of Weights and Measures (BIPM) and the International Earth Rotation Service (IERS).

NOTE 2 The UTC scale is adjusted by the insertion or deletion of seconds, so called positive or negative leap seconds, to ensure approximate agreement with UT1.

[IEV 713-05-20]

3.3
declared input voltage
U_{din}
value obtained from the declared supply voltage by a transducer ratio

3.4
declared supply voltage
U_c
declared supply voltage U_c is normally the nominal voltage U_n of the system. If, by agreement between the supplier and the customer, a voltage different from the nominal voltage is applied to the terminal, then this voltage is the declared supply voltage U_c

3.5
dip threshold
voltage magnitude specified for the purpose of detecting the start and the end of a voltage dip

3.6
flagged data
data that has been marked to indicate that its measurement or its aggregation may have been affected by interruptions, dips, or swells

NOTE Flagging enables other methods that may prevent a single event from being counted as several different types of events. Flagging is supplemental information about a measurement or aggregation. Flagged data is not removed from the data set. In some applications, flagged data may be excluded from further analysis but in other applications, the fact that data was flagged may be unimportant. The user, application, regulation, or other standards determine the use of flagged data. See 4.7 for further explanation.

3.7
flicker
impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time

[IEV 161-08-13]

3.8
fundamental component
component whose frequency is the fundamental frequency

[IEV 101-14-49, modified]

3.9
fundamental frequency
frequency in the spectrum obtained from a Fourier transform of a time function, to which all the frequencies of the spectrum are referred

[IEV 101-14-50, modified]

NOTE In case of any remaining risk of ambiguity, the fundamental frequency may be derived from the number of poles and speed of rotation of the synchronous generator(s) feeding the system.

3.10
harmonic component
any of the components having a harmonic frequency

[IEC 61000-2-2:2002, 3.2.4, modified]

NOTE Its value is normally expressed as an r.m.s. value. For brevity, such component may be referred to simply as a harmonic.

3.11
harmonic frequency
frequency which is an integer multiple of the fundamental frequency

NOTE The ratio of the harmonic frequency to the fundamental frequency is the *harmonic order* (notation: *h)*.

3.12
hysteresis
difference in magnitude between the start and end thresholds

NOTE 1 This definition of hysteresis is relevant to Power Quality (PQ) measurement parameters and is different from the IEV definition which is relevant to iron core saturation.

NOTE 2 The purpose of hysteresis in the context of PQ measurements is to avoid counting multiple events when the magnitude of the parameter oscillates about the threshold level.

3.13
influence quantity
any quantity which may affect the working performance of a measuring equipment

[IEV 311-06-01, modified]

NOTE This quantity is generally external to the measurement equipment.

3.14
interharmonic component
component having an interharmonic frequency

[IEC 61000-2-2:2002, 3.2.6]

NOTE Its value is normally expressed as an r.m.s. value. For brevity, such a component may be referred to simply as an *interharmonic*.

3.15
interharmonic frequency
any frequency which is not an integer multiple of the fundamental frequency

[IEC 61000-2-2:2002, 3.2.5]

3.16
interruption
reduction of the voltage at a point in the electrical system below the interruption threshold

3.17
interruption threshold
voltage magnitude specified for the purpose of detecting the start and the end of a voltage interruption

3.18
measurement uncertainty
parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand

[IEV 311-01-02]

3.19
nominal voltage
U_n
voltage by which a system is designated or identified

3.20
overdeviation
absolute value of the difference between the measured value and the nominal value of a parameter, only when the measured value of the parameter is greater than the nominal value

3.21
power quality
characteristics of the electricity at a given point on an electrical system, evaluated against a set of reference technical parameters

NOTE These parameters might, in some cases, relate to the compatibility between electricity supplied on a network and the loads connected to that network.

3.22
Real-Time Clock
RTC
local timekeeping device used for implementing certain methods in this standard.

NOTE The relationship between the real-time clock and UTC is defined in 4.6.

3.23
r.m.s. (root-mean-square) value
square root of the arithmetic mean of the squares of the instantaneous values of a quantity taken over a specified time interval and a specified bandwidth

[IEV 101-14-16, modified]

3.24
r.m.s. voltage refreshed each half-cycle
$U_{rms(1/2)}$
value of the r.m.s. voltage measured over 1 cycle, commencing at a fundamental zero crossing, and refreshed each half-cycle

NOTE 1 This technique is independent for each channel and will produce r.m.s. values at successive times on different channels for polyphase systems.

NOTE 2 This value is used only for voltage dip, voltage swell and interruption detection and evaluation, in Class A.

NOTE 3 This r.m.s. voltage value may be a phase-to-phase value or a phase-to-neutral value.

3.25
r.m.s. voltage refreshed each cycle
$U_{rms(1)}$
value of the r.m.s. voltage measured over 1 cycle and refreshed each cycle

NOTE 1 In contrast to $U_{rms(1/2)}$, this technique does not define when a cycle commences.

NOTE 2 This value is used only for voltage dip, voltage swell and interruption detection and evaluation, in Class S.

NOTE 3 This r.m.s. voltage value can be a phase-to-phase value or a phase-to-neutral value.

3.26
range of influence quantities
range of values of a single influence quantity

3.27
reference channel
one of the voltage measurement channels designated as the reference channel for polyphase measurements

3.28
residual voltage
U_{res}
minimum value of $U_{rms(1/2)}$ or $U_{rms(1)}$ recorded during a voltage dip or interruption

NOTE The residual voltage is expressed as a value in volts, or as a percentage or per unit value of U_{din}. $U_{rms(1/2)}$ is used for Class A. Either $U_{rms(1/2)}$ or $U_{rms(1)}$ may be used for Class S. See 5.4.1.

3.29
sliding reference voltage
U_{sr}
voltage magnitude averaged over a specified time interval, representing the voltage preceding a voltage-change type of event (e.g. voltage dips and swells, rapid voltage changes)

3.30
swell threshold
voltage magnitude specified for the purpose of detecting the start and the end of a swell

3.31
time aggregation
combination of several sequential values of a given parameter (each determined over identical time intervals) to provide a value for a longer time interval

NOTE Aggregation in this standard always refers to time aggregation.

3.32
underdeviation
the absolute value of the difference between the measured value and the nominal value of a parameter, only when the value of the parameter is lower than the nominal value

3.33
voltage dip
temporary reduction of the voltage magnitude at a point in the electrical system below a threshold

NOTE 1 Interruptions are a special case of a voltage dip. Post-processing may be used to distinguish between voltage dips and interruptions.

NOTE 2 A voltage dip is also referred to as sag. The two terms are considered interchangeable; however, this standard will only use the term voltage dip.

3.34
voltage swell
temporary increase of the voltage magnitude at a point in the electrical system above a threshold

3.35
voltage unbalance
condition in a polyphase system in which the r.m.s. values of the line voltages (fundamental component), and/or the phase angles between consecutive line voltages, are not all equal

[IEV 161-08-09, modified]

NOTE 1 The degree of the inequality is usually expressed as the ratios of the negative- and zero-sequence components to the positive-sequence component.

NOTE 2 In this standard, voltage unbalance is considered in relation to 3-phase systems.

4 General

4.1 Classes of measurement methods

For each parameter measured, three classes (A, S and B) are defined. For each class, measurement methods and appropriate performance requirements are included.

– **Class A**

This class is used where precise measurements are necessary, for example, for contractual applications that may require resolving disputes, verifying compliance with standards, etc. Any measurements of a parameter carried out with two different instruments complying with the requirements of Class A, when measuring the same signals, will produce matching results within the specified uncertainty for that parameter.

– **Class S**

This class is used for statistical applications such as surveys or power quality assessment, possibly with a limited subset of parameters. Although it uses equivalent intervals of measurement as class A, the class S processing requirements are lower.

– **Class B**

This class is defined in order to avoid making many existing instruments designs obsolete.

NOTE Class B methods are not recommended for new designs. Readers are advised that Class B may be removed in a future Edition of this standard.

For each class, the range of influencing factors that shall be complied with is specified in Clause 6. Users shall select the class that they require, based on their application(s).

NOTE 1 The instrument manufacturer should declare influence quantities which are not expressly given and which may degrade performance of the instrument. Guidance can be found, for example, in IEC 61557-12.

NOTE 2 An instrument may measure some or all of the parameters identified in this standard, and preferably uses the same class for all parameters.

NOTE 3 The instrument manufacturer should declare which parameters are measured, which class is used for each parameter, the range of U_{din} for which each class is fulfilled, and all the necessary requirements and accessories (synchronization, probes, calibration period, temperature ranges, etc.) to meet each class.

NOTE 4 In this standard, “A” stands for “Advanced”, and “S” stands for “Surveys”. (“B” or “Basic” methods are not recommended for new designs, because Class B may be removed in a future Edition of this standard.)

4.2 Organization of the measurements

The electrical quantity to be measured may be either directly accessible, as is generally the case in low-voltage systems, or accessible via measurement transducers.

The whole measurement chain is shown in Figure 1.

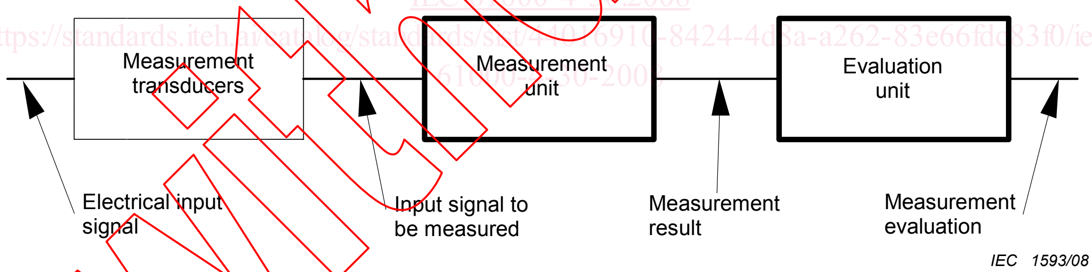

Figure 1 – Measurement chain

An instrument may include the whole measurement chain (see Figure 1). In this standard, the normative part does not consider the measurement transducers external to the instrument and their associated uncertainty, but Clause A.3 gives guidance.

4.3 Electrical values to be measured

Measurements can be performed on single-phase or polyphase supply systems. Depending on the context, it may be necessary to measure voltages between phase conductors and neutral (line-to-neutral) or between phase conductors (line-to-line) or between phase conductors or neutral and earth (phase-to-earth, neutral-to-earth). It is not the purpose of this standard to impose the choice of the electrical values to be measured. Moreover, except for the measurement of voltage unbalance, which is intrinsically polyphase, the measurement methods specified in this standard are such that independent results can be produced on each measurement channel.

Phase-to-phase instantaneous values can be measured directly or derived from instantaneous phase-to-neutral measured values.