



BSI Standards Publication

Electromagnetic compatibility (EMC)

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

National foreword

This British Standard is the UK implementation of EN IEC 61000-4-30:2025. It is identical to IEC 61000-4-30:2025. It supersedes BS EN 61000-4-30:2015+A1:2021, which will be withdrawn on 31 December 2028.

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Compatibilité électromagnétique (CEM) - Partie 4-30: Techniques d'essai et de mesure - Méthodes de mesure de la qualité de l'alimentation (IEC 61000-4-30:2025)

Elektromagnetische Verträglichkeit (EMV) - Teil 4-30: Prüf- und Messverfahren - Verfahren zur Messung der Spannungsqualität (IEC 61000-4-30:2025)

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 77A/1253/FDIS, future edition 4 of IEC 61000-4-30, prepared by SC 77A "EMC - Low frequency phenomena" of IEC/TC 77 "Electromagnetic compatibility" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61000-4-30:2025.

The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2026-12-31 level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the (dow) 2028-12-31 document have to be withdrawn

This document supersedes EN 61000-4-30:2015 and all of its amendments and corrigenda (if any).

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Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

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In the official version, for Bibliography, the following notes have to be added for the standard indicated:

IEC 62586-1	NOTE	Approved as EN 62586-1
IEC 61000-2-2:2002	NOTE	Approved as EN 61000-2-2:2002 (not modified)
IEC 61000-2-12	NOTE	Approved as EN 61000-2-12
IEC 61000-4-4:2012	NOTE	Approved as EN 61000-4-4:2012 (not modified)
IEC 61000-4-19	NOTE	Approved as EN 61000-4-19
IEC 61000-6-3:2020	NOTE	Approved as EN IEC 61000-6-3:2021 (not modified)
IEC 61010-1	NOTE	Approved as EN 61010-1
IEC 61010-2-030	NOTE	Approved as EN IEC 61010-2-030
IEC 61010-2-032	NOTE	Approved as EN IEC 61010-2-032
IEC 61557-12:2018	NOTE	Approved as EN IEC 61557-12:2022 (not modified)
IEC 61869-2:2012	NOTE	Approved as EN 61869-2:2012 (not modified)
IEC 61869-3:2011	NOTE	Approved as EN 61869-3:2011 (not modified)
IEC 62428:2008	NOTE	Approved as EN 62428:2008 (not modified)
CISPR 16-1-1:2019	NOTE	Approved as EN IEC 55016-1-1:2019 (not modified)
CISPR 16-2-1:2014	NOTE	Approved as EN 55016-2-1:2014 (not modified)

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050-161	1990	International Electrotechnical Vocabulary. Chapter 161: Electromagnetic compatibility	-	-
+ A9	2019		-	-
IEC 61000-2-4	2024	Electromagnetic compatibility (EMC) - Part 2-4: Environment - Compatibility levels in power distribution systems in industrial locations for low-frequency conducted disturbances	EN IEC 61000-2-4	2024
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	EN 61000-4-7	2002
+ A1	2008		+ A1	2009
IEC 61000-4-15	2010	Electromagnetic compatibility (EMC) - Part 4-15: Testing and measurement techniques - Flickermeter - Functional and design specifications	EN 61000-4-15	2011
IEC 62586-2	-	Power quality measurement in power supply systems - Part 2: Functional tests and uncertainty requirements	EN 62586-2	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**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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IEC 61000 4-30 has been prepared by subcommittee 77A: EMC – Low- frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility. It is an International Standard.

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

This fourth edition cancels and replaces the third edition published in 2015. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) IEC 61000-4-30:2015/AMD1:2021 and IEC 61000-4-30:2015/COR1:2016 were included.
- b) The measurement method for rapid voltage changes (RVC) has been corrected and extended.
- c) The measurement method for voltage events has been updated and extended.
- d) Annex C was divided into 2 parts:
 - 1) Annex C: The measurement method from IEC 61000-4-7:2002 and IEC 61000-4-7:2002/AMD1:2008, Annex B for conducted emissions in the 2 kHz to 9 kHz range has been separated.
 - 2) Annex D: A new measurement method for conducted emissions in the 9 kHz to 150 kHz range has been added.
- e) Annex D (underdeviation and overdeviation parameters) was removed.
- f) Annex E (Class B) was removed.

The text of this International Standard is based on the following documents:

Draft	Report on voting
77A/1253/FDIS	77A/1268/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in 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 document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

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).

1 Scope

This part of IEC 61000-4 defines the methods for measurement and interpretation of results for power quality parameters in AC power supply systems with a declared fundamental frequency of 50 Hz or 60 Hz.

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

This document covers two classes of measurement methods (Class A and Class S). The classes of measurement are specified in Clause 4.

NOTE 1 In this document, "A" stands for "advanced" and "S" stands for "surveys".

Measurement of parameters covered by this document is limited to conducted phenomena in power systems. The power quality parameters considered in this document 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, rapid voltage changes, mains communicating system (MCS) voltages, magnitude of current, harmonic currents, interharmonic currents and current unbalance.

Emissions in the 2 kHz to 150 kHz range are considered in Annex C and Annex D.

Depending on the purpose of the measurement, all or a subset of the phenomena on this list can be measured.

NOTE 2 Test methods for verifying compliance with this document can be found in IEC 62586-2.

NOTE 3 The effects of transducers inserted between the power system and the instrument are acknowledged but not addressed in detail in this document. Guidance about effects of transducers can be found IEC TR 61869-103.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-161:1990, *International Electrotechnical Vocabulary (IEV) - Part 161: Electromagnetic compatibility*

IEC 60050-161:1990/AMD9:2019

IEC 61000-2-4:2024, *Electromagnetic compatibility (EMC) - Part 2-4: Environment - Compatibility levels in power distribution systems in industrial locations for low-frequency conducted disturbances*

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*

IEC 61000-4-7:2002/AMD1:2008

IEC 61000-4-15:2010, *Electromagnetic compatibility (EMC) - Part 4-15: Testing and measurement techniques - Flickermeter - Functional and design specifications*

IEC 62586-2, *Power quality measurement in power supply systems - Part 2: Functional tests and uncertainty requirements*

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1.1

channel

individual measurement path through an instrument

Note 1 to entry: "Channel" and "phase" are not the same. A voltage channel is by definition the difference in potential between two conductors. Phase refers to a single conductor. On polyphase systems, a channel can be between any two phases, or between any phase and neutral, or between any phase and earth, or between neutral and earth.

3.1.2

declared input voltage

U_{din}

value obtained from the declared supply voltage by a transducer ratio

Note 1 to entry: This quantity can be expressed as a phase-to-phase or as a phase-to-neutral value.

3.1.3

declared supply voltage

U_{c}

nominal voltage U_{n} of the system

Note 1 to entry: If by agreement between the supplier and the customer a voltage different from the nominal voltage is applied to the terminals, then this voltage is the declared supply voltage U_{c} .

3.1.4

dip threshold

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

3.1.5

flagged data

for any measurement time interval in which interruptions, dips or swells occur, marked measurement results of all other parameters made during this time interval

Note 1 to entry: For some applications, this 'marked' or 'flagged' data can be excluded from further analysis, for example. See 4.8 for further explanation.

3.1.6

flicker

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

[SOURCE: IEC 60050-161:1990, 161-08-13]

3.1.6.1 **P_{st}**

short-term flicker severity

Note 1 to entry: Unless otherwise specified, the P_{st} evaluation time is 10 min. For the purpose of power quality surveys and studies, other time intervals may be used, and should be defined in the index. For example a 1 min interval should be written as $P_{st,1m}$.

[SOURCE: IEC 61000-4-15:2010, 3.2]

3.1.6.2 **P_{lt}**

long-term flicker severity

$$P_{lt} = \sqrt[3]{\frac{\sum_{i=1}^N P_{st_i}^3}{N}}$$

where P_{st_i} ($i = 1, 2, 3, \dots$) are consecutive readings of the short-term severity P_{st}

Note 1 to entry: Unless otherwise specified, P_{lt} is calculated over discrete T_{long} periods. Each time a T_{long} period has expired, a new P_{lt} calculation is started.

[SOURCE: IEC 61000-4-15:2010, 3.2]

3.1.7**fundamental component**

component whose frequency is the fundamental frequency

3.1.8**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

Note 1 to entry: In case of any remaining risk of ambiguity, the fundamental frequency can be derived from the number of poles and speed of rotation of the synchronous generator(s) feeding the system.

3.1.9**harmonic component**

any of the components having a harmonic frequency

Note 1 to entry: Its value is normally expressed as an RMS value. For brevity, such component may be referred to simply as a harmonic.

[SOURCE: IEC 61000-2-2:2002, 3.2.4, modified – the second part of the definition has been made into a note.]

3.1.10**harmonic frequency**

frequency which is an integer multiple of the fundamental frequency

Note 1 to entry: The ratio of the harmonic frequency to the fundamental frequency is the harmonic order (recommended notation: h).

[SOURCE: IEC 61000-2-2:2002, 3.2.3, modified – the second part of the definition has been made into a note.]

3.1.11**hysteresis**

difference in magnitude between the start and end thresholds

Note 1 to entry: This definition of hysteresis is relevant to PQ measurement parameters and is different from the IEC 60050 definition which is relevant to iron core saturation.

Note 2 to entry: 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.

3.1.12**influence quantity**

quantity which is not the subject of the measurement and whose change affects the relationship between the indication and the result of the measurement

Note 1 to entry: Influence quantities can originate from the measured system, the measuring equipment or the environment.

[SOURCE: IEC 60050-311:2001, 311-06-01, modified – Notes 1 and 3 have been removed.]

3.1.13**interharmonic component**

spectral component with a frequency between two consecutive harmonic frequencies

Note 1 to entry: The definition is derived from IEC 61000-4-7.

Note 2 to entry: Its value is normally expressed as an RMS value. For brevity, such a component can be referred to simply as an interharmonic.

3.1.14**interharmonic frequency**

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

Note 1 to entry: By extension from harmonic order, the interharmonic order is the ratio of an interharmonic frequency to the fundamental frequency. This ratio is not an integer (recommended notation m).

Note 2 to entry: In the case where $m < 1$ the term subharmonic frequency can be used.

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

3.1.15**interruption**

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

3.1.16**interruption threshold**

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

3.1.17**mains communicating system****MCS**

electrical system using mains power lines to transmit information signals, either on the power supply system or within installations of network users

Note 1 to entry: MCS is also called "ripple control signal" in certain applications.

3.1.18**maximum permissible measurement error****maximum permissible error****limit of error****MPE**

extreme value of measurement error, with respect to a known reference quantity value, permitted by specifications or regulations for a given measurement, measuring instrument, or measuring system

Note 1 to entry: Usually, the term "maximum permissible errors" or "limits of error" is used where there are two extreme values.

Note 2 to entry: For the application of this document, "specifications or regulations" means: the provisions contained in this document and the relevant product standards.

[SOURCE: ISO/IEC Guide 99:2007, 4.26, modified – note 2 deleted and new note 2 added.]

3.1.19**base maximum permissible error****base MPE**

extreme value permitted for the error of indication of a product implementing the measurement methods of this document, when the measured power quality parameter is varied within the rated operating conditions, and when specific power-system influence quantities, specified in product standards, are varied within the specified influence quantity range, and when the product is otherwise operated at reference conditions

Note 1 to entry: For the application of this document, the relevant power-system influence quantities are power frequency, magnitude of supply voltage, magnitude of current, harmonics and interharmonics.

[SOURCE: OIML R 46-1/R46-2:2012, 2.2.19, modified – definition and notes have been modified.]

3.1.20**maximum swell magnitude voltage** **$U_{\max}$**

maximum value of $U_{\text{rms}(\frac{1}{2})}$ recorded during a voltage swell

Note 1 to entry: The maximum swell magnitude voltage is expressed as a value in volts, or as a percentage or per unit value of the declared input voltage.

3.1.21**nominal voltage** **U_n**

voltage by which a power supply system is designated or identified

3.1.22**power quality**

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

Note 1 to entry: These parameters might, in some cases, relate to the compatibility between electricity supplied on a network and the loads connected to that network.

3.1.23**RMS value (for a time-dependent quantity)
root-mean-square value (for a time-dependent quantity)
effective value**

for a time-dependent quantity, positive square root of the mean value of the square of the quantity taken over a given time interval

Note 1 to entry: The root-mean-square value of a periodic quantity is usually taken over an integration interval the range of which is the period multiplied by a natural number.

Note 2 to entry: For a sinusoidal quantity $a(t) = \hat{A} \cdot \cos(\omega t + \vartheta_0)$, the root-mean-square value is $A_{\text{eff}} = \hat{A} / \sqrt{2}$.

Note 3 to entry: The root-mean-square value of a quantity may be denoted by adding one of the subscripts eff or rms to the symbol of the quantity.

Note 4 to entry: In electrical technology, the root-mean-square values of electric current $i(t)$ and voltage $u(t)$ are usually denoted I and U , respectively.

Note 5 to entry: The abbreviation RMS was formerly denoted as r.m.s. or rms, but these notations are now deprecated.

[SOURCE: IEC 60050-103:2009/AMD1:2017, 103-02-03]

3.1.24**RMS voltage refreshed each half-cycle**

$U_{\text{rms}(\frac{1}{2})}$

value of the RMS voltage measured over 1 cycle, commencing at a fundamental zero crossing, and refreshed each half-cycle

Note 1 to entry: This technique is independent for each channel and will produce RMS values at successive times on different channels for polyphase systems.

Note 2 to entry: This value is used only for voltage dip, voltage swell, interruption, and RVC detection and evaluation, in Class A or Class S.

Note 3 to entry: This RMS voltage value can be a phase-to-phase value or a phase-to-neutral value.

3.1.25**RMS current refreshed each half-cycle**

$I_{\text{rms}(\frac{1}{2})}$

value of the RMS current measured over 1 cycle, commencing at a fundamental zero crossing on an associated voltage channel, and refreshed each half-cycle

Note 1 to entry: For guidance, the associated voltage channel might be the corresponding phase-to-neutral channel on single-phase or star networks. If there is no corresponding voltage channel, for example on delta network currents, or earth current or neutral current measurements, then the reference channel (see 5.2.3) used for frequency measurements might be used.

3.1.26**RMS voltage refreshed each cycle**

$U_{\text{rms}(1)}$

value of the RMS voltage measured over 1 cycle and refreshed each cycle

Note 1 to entry: In contrast to $U_{\text{rms}(\frac{1}{2})}$, this technique does not define when a cycle commences.

Note 2 to entry: This value is used only in Class S, and is used for voltage dip, voltage swell, interruption, and rapid voltage changes (RVC) detection and evaluation.

Note 3 to entry: This RMS voltage value can be a phase-to-phase value or a phase-to-neutral value.

3.1.27**range of influence quantities**

range of values of a single influence quantity

3.1.28**rapid voltage change****RVC**

quick transition in RMS voltage occurring between two steady-state conditions, and during which the RMS voltage does not exceed the dip/swell thresholds

3.1.29**reference channel**

one of the voltage measurement channels designated for the frequency measurement in polyphase measurements

Note 1 to entry: In the case of a single-phase measurement, the voltage measuring channel is also the reference channel.

3.1.30**residual voltage** **U_{res}**

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

Note 1 to entry: The residual voltage is expressed as a value in volts, or as a percentage or per unit value of the declared input voltage.

3.1.31**sliding reference voltage** **U_{sr}**

voltage magnitude averaged over 1 min, representing the voltage preceding a voltage dip or swell

Note 1 to entry: It is precisely defined in 5.5.1.2.

Note 2 to entry: The sliding reference voltage can be used to determine the voltage change during a dip or a swell, typically for medium-voltage or high-voltage systems.

3.1.32**surge**

transient voltage wave propagating along a line or a circuit and characterized by a rapid increase followed by a slower decrease of the voltage

[SOURCE: IEC 60050-161:1990, 161-08-11]

3.1.33**swell threshold**

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

3.1.34**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 1 to entry: Aggregation in this document always refers to time aggregation.

3.1.35**transient**, adjective and noun

pertaining to a phenomenon or quantity which passes from one steady state to another consecutive steady state

Note 1 to entry: The term "transient" is also used as a noun to mean a transient phenomenon or quantity.

[SOURCE: IEC 60050-161:1990/AMD9:2019, 161-02-01]

3.1.36**Coordinated Universal Time
UTC**

time-scale maintained by the *Bureau International des Poids et Mesures* (BIPM) and the International Earth Rotation and Reference Systems Service (IERS), which forms the basis of a coordinated dissemination of standard frequencies and time signals

it corresponds exactly in rate with international atomic time, but differs from it by an integer number of seconds. The UTC scale is adjusted by the insertion or deletion of seconds (positive or negative leap seconds) to ensure approximate agreement with UT1

[SOURCE: Recommendation ITU-R TF.686-3:2013]

3.1.37**voltage dip**

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

Note 1 to entry: Interruptions are a special case of a voltage dip. Post-processing can be used to distinguish between voltage dips and interruptions.

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

3.1.38**voltage swell**

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

3.1.39**voltage unbalance**

condition in a polyphase system in which the RMS values of the phase voltages (fundamental component), or the phase angles between consecutive phase voltages, are not all equal

Note 1 to entry: 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 to entry: In this document, voltage unbalance is considered in relation to three-phase systems.

[SOURCE: IEC 60050-161:1990, 161-08-09, modified – the notes have been added.]

3.2 Abbreviated terms

ADC	Analogue to digital converter
DFT	Discrete Fourier transform
FIR	Finite impulse response
IF	Intermediate frequency (of a heterodyne receiver)
IIR	Infinite impulse response
RC	Resistor-capacitor (circuit)
S/s	Samples per second

4 General

4.1 Classes of measurement

For each parameter measured, two classes, A and S, are defined in this document. 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 can 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 maximum permissible measurement error for that parameter.

NOTE Class A measurements produce matching results only if the user-selected parameters (thresholds, hysteresis, etc.) match.

– 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 much lower. Some surveys can assess power quality parameters of several measurement sites on a network; other surveys assess power quality parameters at a single site over a period of time, or at locations within a building or even within a single large piece of equipment.

Users shall select the class that they require, based on their application(s). For troubleshooting applications, depending on the type of problem either Class A or Class S methods can be selected by the user.

The influence quantities, which can degrade the performance of the instrument, should be described in the technical documentation.

An instrument can measure some or all of the parameters identified in this document, and preferably uses the same class for all parameters. For guidance, see IEC 62586-1.

The technical documentation shall contain information about 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.

4.2 Organization of the measurements

The electrical quantity to be measured can 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.

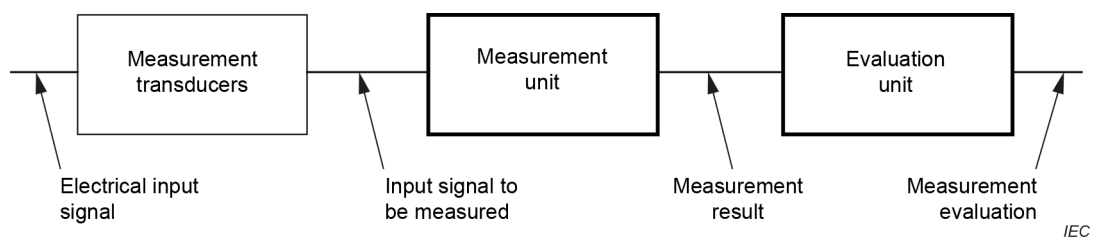


Figure 1 – Measurement chain

An "instrument" can include the whole measurement chain (see Figure 1). In this document, the normative part does not consider any possible measurement transducers external to the instrument and their associated measurement error, but Clause A.2 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 can be necessary to measure voltages between phase conductors and neutral (phase-to-neutral), or between phase conductors (phase-to-phase), or between phase conductors or neutral and earth (phase-to-earth, neutral-to-earth). It is not the purpose of this document to impose the choice of the electrical values to be measured. Moreover, except for the measurement of voltage unbalance and current unbalance, which are intrinsically polyphase, the measurement methods specified in this document are such that independent results can be produced on each measurement channel.

NOTE 1 Phase-to-phase instantaneous values can be measured directly or can be derived from instantaneous phase-to-neutral measured values or from phase-to-earth measured values.

NOTE 2 Some of the measurement methods defined in this document use the declared input voltage U_{din} as a reference value. Depending on whether the measurement is performed between phase conductors or between phase conductors and the neutral conductor, the value of U_{din} is converted to match the measurand configuration.

Current measurements can be performed on each conductor of supply systems, including the neutral conductor and the protective earth conductor (see 5.13).

4.4 Measurement aggregation over time intervals

– Class A

The basic measurement time interval for parameter magnitudes (supply voltage, current, harmonics, interharmonics and unbalance) shall be a 10-cycle time interval for a 50 Hz power system or a 12-cycle time interval for a 60 Hz power system.

The 10/12-cycle measurement shall be resynchronized at every Universal Time Coordinated (UTC) 10 min tick. See Figure 2.

The 10/12-cycle values are then aggregated over 3 additional intervals:

- 150/180-cycle interval (150 cycles for 50 Hz power systems or 180 cycles for 60 Hz power systems),
- 10 min interval,
- 2 h interval for P_{It} flicker.

NOTE 1 A 2 h aggregation interval is optional for all parameters, except for flicker measurements which require a 2 h aggregation interval for P_{It} . This 2 h aggregation interval can be useful in some applications and can be necessary for assessing compliance with some national or international standards.

NOTE 2 Clause B.1 and Clause B.2 discuss some applications of these aggregation time intervals.

– Class S

Same time intervals as Class A.

Aggregated values shall be tagged with the UTC time at the conclusion of the respective aggregation interval (e.g. 01:10:00,040). For aggregation intervals of 10 min and longer, the time stamp can be rounded to the nearest second (e.g. 01:10:00,000).

NOTE 3 In some circumstances, it can be useful to use local time, which can differ from UTC by a fixed offset, or an offset that can vary based on time of year. This type of time stamp often includes both a time and a date. This type of time stamp can be referred to as "absolute time".

4.5 Measurement aggregation algorithm

4.5.1 Requirements

Aggregations shall be performed using the square root of the arithmetic mean of the squared input values.

For flicker measurements, a different aggregation algorithm is used (see IEC 61000-4-15).

4.5.2 150/180-cycle aggregation

– Class A

The data for the 150/180-cycle time interval shall be aggregated without gap from fifteen 10/12-cycle time intervals.

The 150/180-cycle time interval is resynchronized at the UTC 10 min tick as shown in Figure 2.

When a 10 min tick occurs, a new 150/180-cycle time interval begins, and the pending 150/180-cycle time interval also continues until it is completed. This can create an overlap between these two 150/180-cycle intervals (overlap 2 in Figure 2).

– Class S

The data for the 150/180-cycle time interval shall be aggregated from 10/12-cycle time intervals. Resynchronization at the UTC 10 min tick is permitted but not mandatory (see Figure 3).

Gaps are permitted but not mandatory for harmonics, interharmonics, MCS voltage and unbalance. A minimum of three 10/12-cycle values shall be used within each 150/180-cycle time interval, i.e. at least one 10/12-cycle value shall be used every 50/60 cycles (see Figure 4). For all other parameters, the data for the 150/180-cycle time interval shall be aggregated without gaps from fifteen 10/12-cycle time intervals.

4.5.3 10 min aggregation

– Class A

The data for the 10 min time interval shall be aggregated from 10/12-cycle time intervals.

Each 10 min interval shall begin on a UTC 10 min tick. The 10 min tick is also used to resynchronize the 10/12-cycle intervals and the 150/180-cycle intervals. See Figure 2.

The final 10/12-cycle interval in a 10 min aggregation period will typically overlap in time with the UTC 10 min clock tick. Any overlapping 10/12-cycle interval (overlap 1 in Figure 2) is included in the aggregation of the previous 10 min interval.

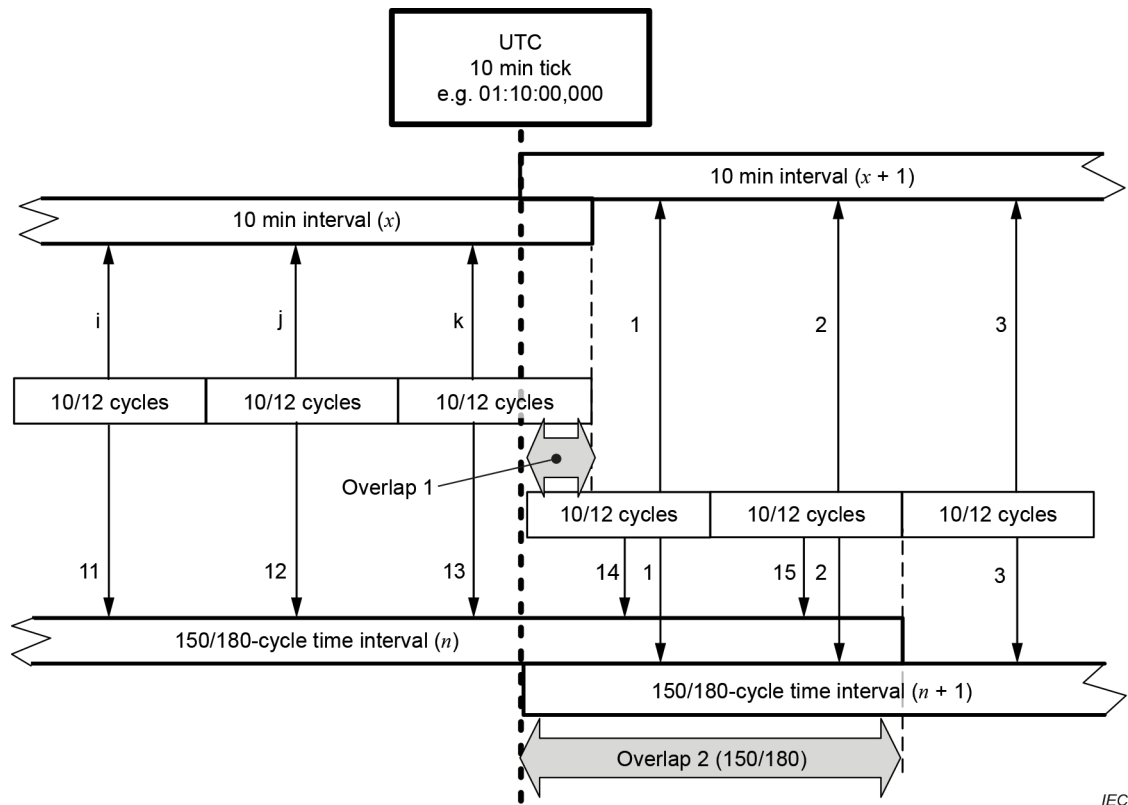


Figure 2 – Synchronization of aggregation intervals for Class A

– Class S

The 10 min aggregation method used for Class S shall be either the Class A method, or the following simplified method:

The data for the 10 min time interval shall be aggregated from 10/12-cycle time intervals. There is no resynchronization on the UTC 10 min tick. The 10 min intervals are free-running.

There will be no overlap, as illustrated in Figure 3 and Figure 4.

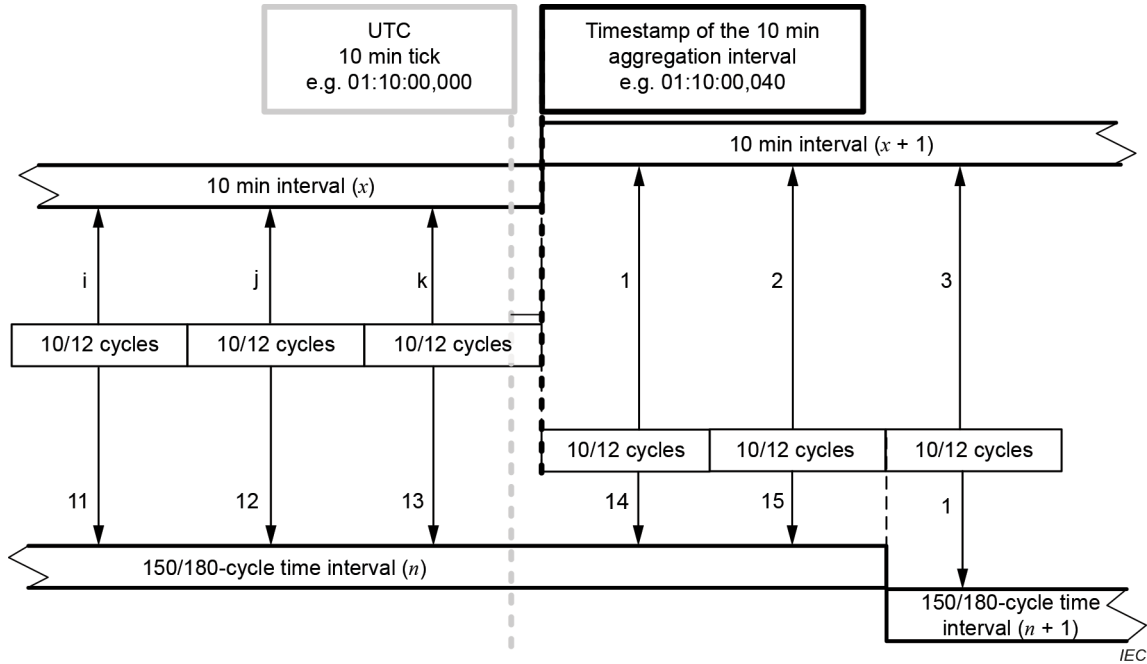


Figure 3 – Synchronization of aggregation intervals for Class S: parameters for which gaps are not permitted

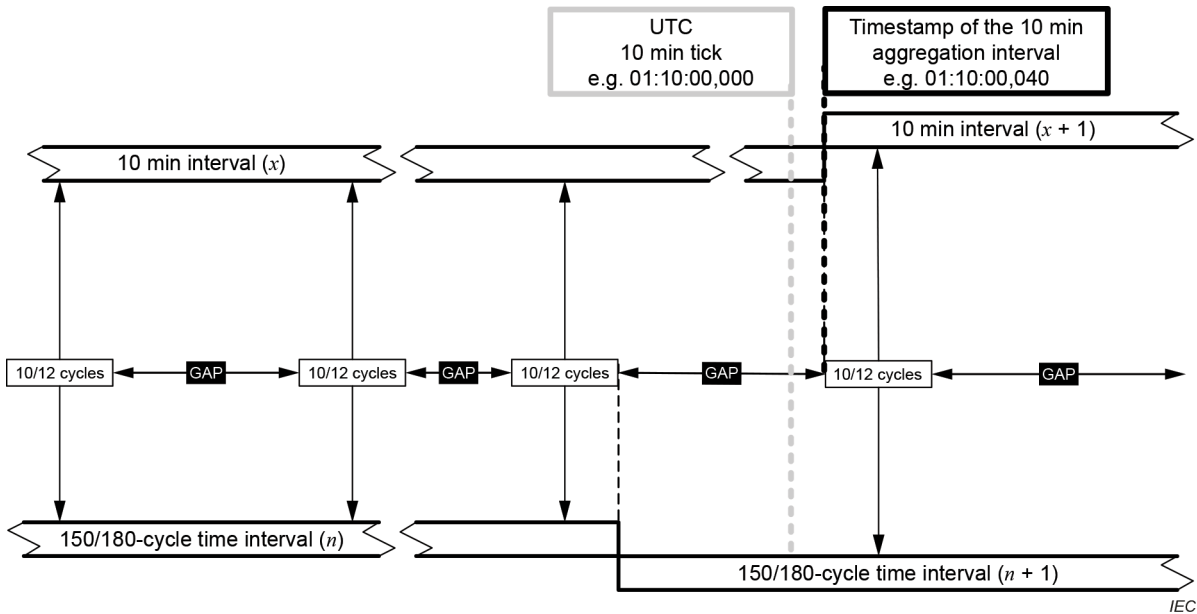


Figure 4 – Synchronization of aggregation intervals for Class S: parameters for which gaps are permitted (see 4.5.2)

4.5.4 2 h aggregation

- Class A

The data for the 2 h interval shall be aggregated from twelve 10 min intervals. The 2 h intervals shall be gapless and not overlapping. 2 h intervals commence on even numbered UTC hour ticks.

NOTE As an option to provide a more frequent update rate, sliding 2 h intervals could also be provided by an instrument at the end of each hour or at the end of 10 min intervals.

- Class S

Same as Class A.

4.6 Maximum permissible error of the time clock

Time clock is defined relative to Universal Time Coordinated (UTC), which is continuously incrementing and available world-wide.

NOTE 1 The time clock can move forward or backward under certain circumstances, such as daylight savings time, external synchronization updates, etc. When the clock moves forward in time, there can be gaps in the data. When the clock moves backwards in time, data can overlap in time.

- Class A

The maximum permissible error of the time clock shall not exceed ± 20 ms for 50 Hz or $\pm 16,7$ ms for 60 Hz, regardless of the total time interval.

NOTE 2 The above durations correspond to 1 cycle at the nominal frequency of the respective power systems.

NOTE 3 This performance can be achieved, for example, through a synchronization procedure applied periodically during a measurement campaign, or through a GPS receiver, or through reception of transmitted radio timing signals or by using network timing signals.

When synchronization by an external time signal becomes unavailable, the base MPE of the time clock shall not exceed ± 1 s per 24 h period; however, this exception does not eliminate the requirement for compliance with the first part of this paragraph.

NOTE 4 This performance is important to ensure that two instruments using Class A methods produce the same 10 min aggregation results when connected to the same signal.

- Class S

The base MPE of the time clock shall not exceed ± 5 s per 24 h period.

4.7 Maximum permissible errors of power quality parameters

The base MPEs (and MPEs where applicable) of power quality parameters given in Clause 5 for each power quality parameter shall apply under the conditions described in Clause 6.

4.8 Flagging concept

During a dip, swell, or interruption, the measurement algorithm for other parameters (for example, frequency measurement) might produce an unreliable value. The flagging concept avoids counting a single event more than once in different parameters (for example, counting a single dip as both a dip and a frequency variation), and indicates that an aggregated value might be unreliable.

Flagging is only triggered by supply voltage dip/swell events and interruptions. The detection of supply voltage dip/swell events is dependent on the thresholds selected by the user, and this selection will influence which data are "flagged".

The flagging concept is applicable for Class A and Class S during measurement of power frequency, voltage magnitude, flicker, supply voltage unbalance, voltage harmonics, voltage interharmonics, and MCS voltage parameters.

If during a given time interval any value is flagged, the aggregated value which includes that value shall also be flagged. The flagged value shall be stored and also included in the aggregation process. For example, if during a given time interval any value is flagged, then the aggregated value that includes this value shall also be flagged and stored.

The flag on the aggregated value should differentiate the cause of the flag and can include multiple causes if it includes values that have been flagged due to different causes. For example, a 10 min value of the voltage, wherein both a dip and a swell occurred should be flagged as being caused by both a dip and a swell.

NOTE Information about other types of flagging, or data marking, can be found in IEC 62586-1.

5 Power quality parameters

5.1 General

Unless a different method for time stamping is specified for individual power quality parameters, in all cases where time stamping of measured values is required, the measured values shall be tagged with the UTC time at the conclusion of the respective measurement interval.

5.2 Power frequency

5.2.1 Measurement method

– Class A

The frequency reading shall be obtained every 10 s. As it is not necessary for the power frequency to be exactly 50 Hz or 60 Hz within the 10 s UTC interval, it is not necessary for the number of cycles to be an integer number. The fundamental frequency output is the ratio of the number of integer cycles counted during the 10 s UTC interval, divided by the cumulative duration of the integer cycles.

When a zero-crossing method is used for frequency calculation, then before assessment, harmonics and interharmonics shall be attenuated to minimize the effects of multiple zero crossings.

The measurement time intervals shall be non-overlapping. Individual cycles that overlap the 10 s UTC tick are discarded. Each 10 s interval shall begin on an absolute 10 s UTC tick, with a maximum permissible measurement error as defined in 4.6.

Other techniques that provide equivalent results, such as convolution, are acceptable.

NOTE For some applications, the use of time intervals shorter than 10 s can be useful, such as 10/12 cycles (wind turbines), 1 s (national standards), etc.

– Class S

Same as Class A.

5.2.2 Maximum permissible measurement error and measuring range

– Class A

The base MPE shall not exceed ± 10 mHz over the measuring ranges 42,5 Hz to 57,5 Hz (50 Hz power system), respectively 51 Hz to 69 Hz (60 Hz power system).

– Class S

The base MPE shall not exceed ± 50 mHz over the measuring ranges 42,5 Hz to 57,5 Hz (50 Hz power system), respectively 51 Hz to 69 Hz (60 Hz power system).

5.2.3 Measurement evaluation

– Class A

The frequency measurement shall be made on the reference channel.

Information shall be given in the technical documentation about the behaviour of frequency measurement whenever the reference channel loses voltage.

– Class S

Same as Class A.

5.2.4 Aggregation

Aggregation is not mandatory.

5.3 Magnitude of the supply voltage**5.3.1 Measurement method**

– Class A

The measurement shall be the RMS value of the voltage magnitude over a 10-cycle time interval for a 50 Hz power system or a 12-cycle time interval for a 60 Hz power system. Every 10/12-cycle interval shall be contiguous, and not overlapping with adjacent 10/12-cycle intervals except as shown in overlap 1 in Figure 2.

NOTE 1 This specific measurement method is used for quasi-stationary signals and is not used for the detection and measurement of disturbances: dips, swells, voltage interruptions and transients.

NOTE 2 The RMS value includes, by definition, harmonics, interharmonics, MCS voltage, etc.

– Class S

Same as Class A.

The –3 dB measurement bandwidth should be declared in the technical documentation. It should include at least the frequency components up to and including the 50th harmonic of the power frequency.

5.3.2 Maximum permissible measurement error and measuring range

– Class A

The base MPE shall not exceed $\pm 0,1$ % of U_{din} , over the range of 10 % to 150 % of U_{din} .

– Class S

The base MPE shall not exceed $\pm 0,5$ % of U_{din} , over the range of 20 % to 120 % of U_{din} .

5.3.3 Measurement evaluation

No requirements.

5.3.4 Aggregation

Aggregation shall be performed in accordance with 4.4 and 4.5.

5.4 Flicker**5.4.1 Measurement method**

– Class A

IEC 61000-4-15 Class F1 applies as the minimum requirement.

– Class S

IEC 61000-4-15 Class F3 applies as the minimum requirement.

5.4.2 Maximum permissible measurement error and measuring range

- Class A

See IEC 61000-4-15. Under the conditions described in Clause 6, the accuracy requirements of IEC 61000-4-15 shall be met over the measuring range of $0,2 P_{st}$ to $10,0 P_{st}$.

- Class S

See IEC 61000-4-15. Under the conditions described in Clause 6, twice the accuracy requirements of IEC 61000-4-15 shall be met over the measuring range of $0,4 P_{st}$ to $4,0 P_{st}$.

5.4.3 Measurement evaluation

- Class A

IEC 61000-4-15 applies.

The 10 min time interval for P_{st} shall commence on a UTC 10 min tick, and shall be tagged with the time at the conclusion of the interval (see 4.5.3).

Voltage dips, swells, and interruptions shall cause P_{st} and P_{lt} output values (see IEC 61000-4-15) to be flagged.

- Class S

Same as Class A.

5.4.4 Aggregation

- Class A

Aggregation shall be performed according to IEC 61000-4-15.

- Class S

Same as Class A.

5.5 Supply voltage dip and swell events

5.5.1 Measurement method

5.5.1.1 Basic RMS voltage measurement

- Class A

The basic measurement U_{rms} of voltage dip and swell events shall be the $U_{rms(1/2)}$ on each measurement channel (see 3.1.24).

- Class S

The basic measurement U_{rms} of voltage dip and swell events shall be either the $U_{rms(1/2)}$ on each measurement channel (see 3.1.24) or the $U_{rms(1)}$ on each measurement channel (see 3.1.26). The basic measurement U_{rms} used, shall be specified in the technical documentation.

The cycle duration for U_{rms} depends on the frequency. The frequency might be determined by the last non-flagged power frequency measurement (see 4.8 and 5.2), or by any other method that complies with the maximum permissible measurement error requirements of Clause 6.

NOTE 1 The U_{rms} value includes, by definition, harmonics, interharmonics, MCS voltage, etc.

The –3 dB measurement bandwidth should be declared in the technical documentation. It should include at least the frequency components up to and including the 50th harmonic of the power frequency.

NOTE 2 It is important to avoid loss of data when voltage dip or swell events, or both, occur in a rapid sequence (for example, three events in 1 s, with up to 1 min between sequences, can occur when a recloser operates into a sustained fault). If, during a rapid burst, the event characteristics cannot be recorded, then a count of events can be useful.

5.5.1.2 Calculation of a sliding reference voltage

The sliding reference voltage implementation is optional, not mandatory. If a sliding reference is chosen for voltage dip and swell event detection, it shall be calculated using a first-order filter with a 1 min time constant. This filter is given by:

$$U_{sr(n)} = 0,9967 \cdot U_{sr(n-1)} + 0,0033 \cdot U_{(10/12)rms} \quad (1)$$

where

- $U_{sr(n)}$ is the present value of the sliding reference voltage;
- $U_{sr(n-1)}$ is the previous value of the sliding reference voltage; and
- $U_{(10/12)rms}$ is the most recent 10/12-cycle RMS value.

When the measurement is started, the initial value of the sliding reference voltage is set to the declared input voltage. The sliding reference voltage is updated every 10/12 cycles. In a polyphase system, if a 10/12-cycle value is flagged on any channel, the sliding reference voltage on all channels is not updated and the previous values are used.

NOTE The sliding voltage reference U_{sr} is generally not used in LV systems. See IEC TR 61000-2-8 for further information and advice.

5.5.2 Voltage dips on single-phase systems

5.5.2.1 Voltage dip detection

The dip threshold is a percentage of either U_{din} or the sliding voltage reference U_{sr} (see 5.5.1.2). If the sliding voltage reference is supported, the user shall choose the type of reference voltage in use.

The dip threshold and the hysteresis voltage are set by the user according to the application.

A voltage dip begins when the U_{rms} voltage falls below the dip threshold and ends when the U_{rms} voltage is equal to or above the dip threshold plus the hysteresis voltage.

5.5.2.2 Voltage dip evaluation

A voltage dip is characterized by the residual voltage or depth, and the duration:

- The residual voltage U_{res} of a voltage dip is the lowest U_{rms} value measured during the dip.
- The depth is the difference between the reference voltage (either U_{din} or U_{sr}) and the residual voltage U_{res} . It is generally expressed as a percentage of the reference voltage.
- The duration of a voltage dip is the time difference between the end time of the dip and the start time of the dip.

If the sliding reference voltage is used and the depth is recorded, then the value of the reference voltage used for the calculation of the depth shall also be recorded.

The start time of a dip shall be time stamped with the time of the end of the U_{rms} that initiated the event, and the end time of the dip shall be time stamped with the time of the end of the U_{rms} that ended the event as defined by the threshold plus the hysteresis voltage.

NOTE 1 Either $U_{rms(\%)}$ or $U_{rms(1)}$ is selected for U_{rms} depending on Class A or Class S, see 5.5.1.1.