



IEC 61000-4-30

Edition 4.0 2025-10

# INTERNATIONAL STANDARD

---

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



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2025 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Secretariat  
3, rue de Varembé  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

### About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

### About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

#### IEC publications search -

[webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

#### IEC Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [sales@iec.ch](mailto:sales@iec.ch).

#### IEC Products & Services Portal - [products.iec.ch](http://products.iec.ch)

Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD .....	6
INTRODUCTION .....	8
1 Scope .....	9
2 Normative references .....	9
3 Terms, definitions, and abbreviated terms .....	10
3.1 Terms and definitions .....	10
3.2 Abbreviated terms .....	16
4 General .....	17
4.1 Classes of measurement .....	17
4.2 Organization of the measurements .....	17
4.3 Electrical values to be measured .....	18
4.4 Measurement aggregation over time intervals .....	18
4.5 Measurement aggregation algorithm .....	19
4.5.1 Requirements .....	19
4.5.2 150/180-cycle aggregation .....	19
4.5.3 10 min aggregation .....	19
4.5.4 2 h aggregation .....	22
4.6 Maximum permissible error of the time clock .....	22
4.7 Maximum permissible errors of power quality parameters .....	22
4.8 Flagging concept .....	22
5 Power quality parameters .....	23
5.1 General .....	23
5.2 Power frequency .....	23
5.2.1 Measurement method .....	23
5.2.2 Maximum permissible measurement error and measuring range .....	23
5.2.3 Measurement evaluation .....	24
5.2.4 Aggregation .....	24
5.3 Magnitude of the supply voltage .....	24
5.3.1 Measurement method .....	24
5.3.2 Maximum permissible measurement error and measuring range .....	24
5.3.3 Measurement evaluation .....	24
5.3.4 Aggregation .....	24
5.4 Flicker .....	24
5.4.1 Measurement method .....	24
5.4.2 Maximum permissible measurement error and measuring range .....	25
5.4.3 Measurement evaluation .....	25
5.4.4 Aggregation .....	25
5.5 Supply voltage dip and swell events .....	25
5.5.1 Measurement method .....	25
5.5.2 Voltage dips on single-phase systems .....	26
5.5.3 Voltage swells on single-phase systems .....	27
5.5.4 Voltage dip and swell events on polyphase systems .....	28
5.5.5 Maximum permissible measurement error .....	30
5.5.6 Aggregation .....	31
5.6 Supply voltage interruptions .....	31
5.6.1 Measurement method .....	31

5.6.2	Detection and evaluation.....	31
5.6.3	Maximum permissible measurement error.....	32
5.6.4	Aggregation.....	32
5.7	Transient voltages .....	32
5.8	Supply voltage unbalance .....	32
5.8.1	Measurement method .....	32
5.8.2	Maximum permissible measurement error and measuring range.....	33
5.8.3	Measurement evaluation .....	33
5.8.4	Aggregation.....	33
5.9	Voltage harmonics .....	34
5.9.1	Measurement method .....	34
5.9.2	Maximum permissible measurement error and measuring range.....	34
5.9.3	Measurement evaluation .....	35
5.9.4	Aggregation.....	35
5.10	Voltage interharmonics .....	35
5.10.1	Measurement method .....	35
5.10.2	Maximum permissible measurement error and measuring range.....	35
5.10.3	Evaluation .....	35
5.10.4	Aggregation.....	35
5.11	MCS voltage on the supply voltage .....	36
5.11.1	Measurement method .....	36
5.11.2	Maximum permissible measurement error and measuring range.....	36
5.11.3	Aggregation.....	36
5.12	Rapid voltage changes (RVC) .....	36
5.12.1	General.....	36
5.12.2	RVC event detection.....	37
5.12.3	RVC event evaluation .....	39
5.12.4	Examples of RVC event evaluation .....	41
5.12.5	Maximum permissible measurement error.....	41
5.12.6	Aggregation.....	42
5.13	Current .....	42
5.13.1	General.....	42
5.13.2	Magnitude of current.....	42
5.13.3	Current recording .....	43
5.13.4	Harmonic currents.....	43
5.13.5	Interharmonic currents .....	44
5.13.6	Current unbalance.....	44
6	Performance verification.....	44
Annex A (informative) Power quality measurements – Issues and guidelines .....		47
A.1	General .....	47
A.2	Installation precautions.....	47
A.2.1	General.....	47
A.2.2	Test leads .....	47
A.2.3	Guarding of live parts .....	48
A.2.4	Monitor placement.....	48
A.2.5	Earthing .....	49
A.2.6	Interference .....	49
A.3	Transducers .....	49

A.3.1	General.....	49
A.3.2	Signal levels.....	50
A.3.3	Frequency response of transducers .....	51
A.3.4	Transducers for measuring transients.....	51
A.4	Transient voltages and currents.....	52
A.4.1	General.....	52
A.4.2	Frequency and amplitude characteristics of AC mains transients.....	52
A.4.3	Transient voltage detection .....	53
A.4.4	Transient voltage evaluation.....	54
A.4.5	Effect of surge protective devices on transient measurements .....	54
A.5	Voltage dip characteristics .....	54
A.5.1	General.....	54
A.5.2	Rapidly updated RMS values.....	55
A.5.3	Phase angle/point-on-wave .....	55
A.5.4	Voltage dip unbalance .....	55
A.5.5	Phase shift during voltage dip.....	56
A.5.6	Missing voltage.....	56
A.5.7	Distortion during voltage dip.....	56
A.5.8	Other characteristics and references .....	56
Annex B (informative)	Power quality measurement – Guidance for applications.....	57
B.1	Contractual applications of power quality measurements.....	57
B.1.1	General.....	57
B.1.2	General considerations .....	57
B.1.3	Specific considerations .....	58
B.2	Statistical survey applications .....	61
B.2.1	General.....	61
B.2.2	Considerations.....	61
B.2.3	Power quality indices.....	62
B.2.4	Monitoring objectives.....	62
B.2.5	Economic aspects of power quality surveys .....	62
B.3	Locations and types of surveys .....	63
B.3.1	Monitoring locations .....	63
B.3.2	Pre-monitoring site surveys.....	64
B.3.3	Customer side site survey .....	64
B.3.4	Network side survey .....	64
B.4	Connections and quantities to measure.....	64
B.4.1	Equipment connection options .....	64
B.4.2	Priorities: quantities to measure.....	65
B.4.3	Current monitoring .....	65
B.5	Selecting the monitoring thresholds and monitoring period .....	66
B.5.1	Monitoring thresholds .....	66
B.5.2	Monitoring period .....	66
B.6	Statistical analysis of the measured data.....	67
B.6.1	General.....	67
B.6.2	Indices .....	67
B.7	Trouble-shooting applications.....	67
B.7.1	General.....	67
B.7.2	Power quality signatures .....	67

B.7.3	Waveform data format .....	68
Annex C (informative)	Functional design and specification for measurements in the 2 kHz to 9 kHz range for Class A and Class S equipment.....	69
C.1	General .....	69
C.2	Voltage disturbances in the 2 kHz to 9 kHz range.....	69
C.2.1	Measurement method .....	69
C.2.2	Maximum permissible measurement error .....	69
C.2.3	Aggregation.....	70
Annex D (informative)	Functional design and specifications for measurements in the 9 kHz to 150 kHz range .....	71
D.1	General .....	71
D.2	Background.....	71
D.3	Comparability requirements .....	72
D.4	Method overview.....	72
D.5	Signal input stage .....	74
D.5.1	General.....	74
D.5.2	Input filtering .....	74
D.5.3	Frequency response .....	74
D.5.4	Transducer compensation .....	74
D.5.5	Measuring range .....	75
D.5.6	Overload detection .....	75
D.6	Fourier transform stage .....	76
D.6.1	General.....	76
D.6.2	DFT window design .....	77
D.6.3	Application of the DFT .....	79
D.6.4	Selectivity and power bandwidth.....	80
D.7	Detector stage .....	80
D.7.1	General.....	80
D.7.2	RMS detector.....	81
D.7.3	Peak detector .....	81
D.7.4	Quasi-peak detector .....	81
D.7.5	Average detector.....	83
D.7.6	RMS-average detector .....	83
D.8	Indicator stage.....	84
D.9	Adjustment of time constants .....	86
D.10	Accuracy requirements .....	87
D.10.1	General.....	87
D.10.2	Accuracy requirements for measuring steady-state sinusoidal signals.....	87
D.10.3	Accuracy requirements for measuring impulsive signals .....	87
D.11	Aggregation.....	91
D.11.1	General.....	91
D.11.2	Aggregation time intervals.....	91
D.11.3	Aggregation methods.....	91
D.12	Integration of signal levels over frequency .....	92
Bibliography .....	93	
Figure 1 – Measurement chain .....	17	
Figure 2 – Synchronization of aggregation intervals for Class A.....	20	

Figure 3 – Synchronization of aggregation intervals for Class S: parameters for which gaps are not permitted .....	21
Figure 4 – Synchronization of aggregation intervals for Class S: parameters for which gaps are permitted (see 4.5.2) .....	21
Figure 5 – Example of the MPE of a supply voltage unbalance measurement.....	33
Figure 6 – RVC event: example of a change in RMS voltage that results in an RVC event....	41
Figure 7 – Not an RVC event: example of a change in RMS voltage that does not result in an RVC event because the dip threshold is exceeded.....	41
Figure A.1 – Frequency spectrum of typical representative transient test waveforms .....	53
Figure D.1 – Block diagram of the 9 kHz to 150 kHz measurement method.....	73
Figure D.2 – Quasi-peak detector equivalent circuit.....	81
Figure D.3 – Indicator response to a 160 ms impulse pulse width when represented by a 2 <sup>nd</sup> order Linkwitz-Riley low-pass filter tuned to the frequency $f_C = 0,9947$ Hz .....	86
Figure D.4 – Impulses with an amplitude of 5,51 V and a width of 2,45 $\mu$ s to assess instrument compliance at 100 Hz.....	90
Table 1 – Summary of requirements (see subclauses for actual requirements).....	45
Table D.1 – Band A IF filter impulse response zero-crossing times .....	78
Table D.2 – Adjusted time constants for the quasi-peak detector .....	86
Table D.3 – Sinusoidal signal accuracy requirements from 9 kHz to 150 kHz .....	87
Table D.4 – Impulsive signal accuracy requirements from 9 kHz to 150 kHz.....	88
Table D.5 – Reference quasi-peak response to spectrally flat impulses .....	89

## 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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

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](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://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](http://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*