

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Power quality measurement in power supply systems –
Part 2: Functional tests and uncertainty requirements**

**Mesure de la qualité de l'alimentation dans les réseaux d'alimentation –
Partie 2: Essais fonctionnels et exigences d'incertitude**



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2021 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.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
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

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 It also gives information on projects, replaced and withdrawn publications.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

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

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

IEC online collection - oc.iec.ch

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

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC online collection - oc.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.



IEC 62586-2

Edition 2.1 2021-09
CONSOLIDATED VERSION

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Power quality measurement in power supply systems –
Part 2: Functional tests and uncertainty requirements**

**Mesure de la qualité de l'alimentation dans les réseaux d'alimentation –
Partie 2: Essais fonctionnels et exigences d'incertitude**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 17.220.20

ISBN 978-2-8322-1029-4

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

REDLINE VERSION

VERSION REDLINE



**Power quality measurement in power supply systems –
Part 2: Functional tests and uncertainty requirements**

**Mesure de la qualité de l'alimentation dans les réseaux d'alimentation –
Partie 2: Essais fonctionnels et exigences d'incertitude**

CONTENTS

FOREWORD.....	9
INTRODUCTION.....	11
1 Scope.....	12
2 Normative references.....	12
3 Terms, definitions, abbreviated terms, notations and symbols.....	13
3.1 General terms and definitions.....	13
3.2 Terms and definitions related to uncertainty.....	13
3.3 Notations.....	14
3.3.1 Functions.....	14
3.3.2 Symbols and abbreviated terms.....	14
3.3.3 Indices.....	14
4 Requirements.....	14
4.1 Requirements for products complying with class A.....	14
4.2 Requirements for products complying with class S.....	15
5 Functional type tests common requirements.....	17
5.1 General philosophy for testing.....	17
5.1.1 System topology.....	17
5.1.2 Stabilization time.....	17
5.1.3 Measuring ranges.....	17
5.1.4 Single "power-system influence quantities".....	19
5.1.5 "External influence quantities".....	21
5.1.6 Test criteria.....	21
5.2 Testing procedure.....	22
5.2.1 Device under test.....	22
5.2.2 Testing conditions.....	22
5.2.3 Testing equipment.....	22
6 Functional testing procedure for instruments complying with class A according to IEC 61000-4-30.....	22
6.1 Power frequency.....	22
6.1.1 General.....	22
6.1.2 Measurement method.....	23
6.1.3 Measurement uncertainty and measuring range.....	23
6.1.4 Measurement evaluation.....	24
6.1.5 Measurement aggregation.....	24
6.2 Magnitude of supply voltage.....	24
6.2.1 Measurement method.....	24
6.2.2 Measurement uncertainty and measuring range.....	24
6.2.3 Measurement evaluation.....	25
6.2.4 Measurement aggregation.....	25
6.3 Flicker.....	27
6.4 Supply voltage interruptions, dips and swells.....	27
6.4.1 General.....	27
6.4.2 Check dips / interruptions in polyphase system.....	39
6.4.3 Check swells in polyphase system.....	41
6.5 Supply voltage unbalance.....	42
6.5.1 General.....	42

6.5.2	Measurement method, measurement uncertainty and measuring range	43
6.5.3	Aggregation	43
6.6	Voltage harmonics	43
6.6.1	Measurement method.....	43
6.6.2	Measurement uncertainty and measuring range	44
6.6.3	Measurement evaluation	45
6.6.4	Measurement aggregation	45
6.7	Voltage interharmonics.....	47
6.7.1	Measurement method.....	47
6.7.2	Measurement uncertainty and measuring range	48
6.7.3	Measurement evaluation	49
6.7.4	Measurement aggregation	49
6.8	Mains signalling voltages on the supply voltage	51
6.8.1	Measurement method.....	51
6.8.2	Measurement uncertainty and measuring range	53
6.8.3	Aggregation	54
6.9	Measurement of underdeviation and overdeviation parameters.....	54
6.9.1	Measurement method.....	54
6.9.2	Measurement uncertainty and measuring range	56
6.9.3	Measurement evaluation	57
6.9.4	Measurement aggregation	57
6.10	Flagging.....	60
6.11	Clock uncertainty testing	62
6.12	Variations due to external influence quantities	62
6.12.1	General	62
6.12.2	Influence of temperature	63
6.12.3	Influence of power supply voltage.....	65
6.13	Rapid voltage changes (RVC).....	66
6.13.1	RVC parameters and evaluation	66
6.13.2	General	67
6.13.3	"No RVC" tests	69
6.13.4	"RVC threshold and setup" test	78
6.13.5	"RVC parameters" test	81
6.13.6	"RVC polyphase" tests.....	84
6.13.7	"Voltage is in steady-state condition" tests.....	87
6.14	Magnitude of current	92
6.15	Harmonic current	93
6.16	Interharmonic currents	93
6.17	Current unbalance.....	93
6.17.1	General	93
6.17.2	Measurement method, measurement uncertainty and measuring range	94
7	Functional testing procedure for instruments complying with class S according to IEC 61000-4-30	94
7.1	Power frequency	94
7.1.1	General	94
7.1.2	Measurement method.....	95
7.1.3	Measurement uncertainty and measuring range	95
7.1.4	Measurement evaluation	96
7.1.5	Measurement aggregation	96

7.2	Magnitude of the supply voltage	96
7.2.1	Measurement method.....	96
7.2.2	Measurement uncertainty and measuring range	96
7.2.3	Measurement evaluation	97
7.2.4	Measurement aggregation	97
7.3	Flicker	99
7.4	Supply voltage interruptions, dips and swells	99
7.4.1	General requirements.....	99
7.4.2	Check dips / interruptions in polyphase system.....	105
7.4.3	Check swells in polyphase system.....	107
7.5	Supply voltage unbalance.....	108
7.5.1	General	108
7.5.2	Measurement method, measurement uncertainty and measuring range	109
7.5.3	Aggregation	109
7.6	Voltage harmonics	109
7.6.1	General	109
7.6.2	Measurement method.....	110
7.6.3	Measurement method, measurement uncertainty and measuring range	111
7.6.4	Measurement evaluation	112
7.6.5	Measurement aggregation	112
7.7	Voltage interharmonics.....	114
7.8	Mains signalling voltages on the supply voltage	114
7.8.1	General	114
7.8.2	Measurement method.....	115
7.8.3	Measurement uncertainty and measuring range	115
7.8.4	Aggregation	115
7.9	Measurement of underdeviation and overdeviation parameters.....	115
7.10	Flagging.....	115
7.11	Clock uncertainty testing	117
7.12	Variations due to external influence quantities	118
7.12.1	General	118
7.12.2	Influence of temperature	119
7.12.3	Influence of power supply voltage.....	121
7.13	Rapid voltage changes	122
7.14	Magnitude of current	122
7.15	Harmonic current	122
7.16	Interharmonic currents	122
7.17	Current unbalance.....	122
7.17.1	General	122
7.17.2	Measurement method, measurement uncertainty and measuring range	123
8	Calculation of measurement uncertainty and operating uncertainty	124
Annex A (normative)	Intrinsic uncertainty and operating uncertainty,.....	126
A.1	General.....	126
A.2	Measurement uncertainty	126
A.3	Operating uncertainty	127
Annex B (informative)	Overall system uncertainty	128
Annex C (normative)	Calculation of measurement and operating uncertainty for voltage magnitude and power frequency.....	129

C.1	Selection of test points to verify operating uncertainty and uncertainty under reference conditions	129
C.2	Class A calculation examples	129
C.2.1	General	129
C.2.2	Parameter: magnitude of supply voltage, $U_{din} = 230$ V, 50/60Hz, rated range of temperature -25 °C to $+55$ °C	129
C.2.3	Parameter: power frequency 50/60 Hz, rated range of temperature -25 °C to $+55$ °C	130
Annex D (informative)	Further test on dips (amplitude and phase angles changes)	132
D.1	Phase-to-phase or phase-to-neutral testing	132
D.2	Test method	132
Annex E (informative)	Further tests on dips (polyphase): test procedure	134
E.1	General	134
E.2	Phase voltage dips and interruptions	135
E.3	Phase swells	135
Annex F (normative)	Gapless measurements of voltage amplitude and harmonics test	137
F.1	Purpose of the test	137
F.2	Test set up	137
F.3	Voltage amplitude	137
F.3.1	Test signal	137
F.3.2	Result evaluation	137
F.4	Harmonics	138
F.4.1	Test signal	138
F.4.2	Result evaluation	138
F.5	Inter-harmonics	139
F.5.1	Test signal	139
F.5.2	Result evaluation	139
Annex G (informative)	Gapless measurements of voltage amplitude and harmonics	140
Annex H (informative)	Testing equipment recommendations	149
H.1	Testing range	149
H.2	Uncertainty and stability of source and reference meter	149
H.2.1	Uncertainty of source and reference meter	149
H.2.2	Stability of the source	150
H.3	Time synchronisation	150
H.4	Power quality functions of source and reference meter	150
H.5	Traceability	151
Annex I (informative)	Recommendations related to a declaration of conformity (DoC) and a test report	152
I.1	Definitions	152
I.2	Recommendations	152
I.3	Example of IEC 62586-1 declaration of conformity	152
I.4	Example of IEC 62586-2 declaration	154
I.4.1	General	154
I.4.2	Recommendation for IEC 62586-2 test report	155
I.4.3	Recommendation for IEC 62586-2 test summary	156
I.4.4	Recommendation for IEC 62586-2 test equipment information	156
I.4.5	Recommendation for IEC 62586-2 tested functions	156
Bibliography	157

Figure 1 – Overview of test for dips according to test A4.1.1	31
Figure 2 – Detail 1 of waveform for test of dips according to test A4.1.1	32
Figure 3 – Detail 2 of waveform for tests of dips according to A4.1.1	33
Figure 4 – Detail 3 of waveform for tests of dips according to test A4.1.1	33
Figure 5 – Detail 1 of waveform for test of dips according to test A4.1.2	34
Figure 6 – Detail 2 of waveform for tests of dips according to test A4.1.2	35
Figure 7 – Detail 1 of waveform for test of swells according to test A4.1.2	36
Figure 8 – Detail 2 of waveform for tests of swells according to test A4.1.2	37
Figure 9 – Sliding reference voltage test	38
Figure 10 – Sliding reference start up condition	38
Figure 11 – Detail 1 of waveform for test of polyphase dips/interruptions	40
Figure 12 – Detail 2 of waveform for test of polyphase dips/interruptions	40
Figure 13 – Detail 3 of waveform for test of polyphase dips/interruptions	41
Figure 14 – Detail 1 of waveform for test of polyphase swells	42
Figure 15 – Detail 2 of waveform for test of polyphase swells	42
Figure 16 – Flagging test for class A	61
Figure 17 – Clock uncertainty testing	62
Figure 18 – Example of RVC event	67
Figure 19 – Test A13.1.1 waveform	70
Figure 20 – Test A13.1.1 waveform with RVC limits and arithmetic mean at 50 Hz	71
Figure 21 – Test A13.1.2 waveform	73
Figure 22 – Test A13.1.2 waveform with RVC limits and arithmetic means at 50 Hz	74
Figure 23 – Test A13.1.3 waveform	76
Figure 24 – Test A13.1.3 waveform with RVC limits and arithmetic mean at 50 Hz	77
Figure 25 – Test A13.2.1 waveform	79
Figure 26 – Test A13.2.1 waveform with RVC limits and arithmetic mean at 50 Hz	80
Figure 27 – Test A13.3.1 waveform	82
Figure 28 – Test A13.3.1 waveform with RVC limits and arithmetic mean at 50 Hz	83
Figure 29 – Test A13.4.1 waveform at 50 Hz	85
Figure 47 – Test A13.4.1 waveform with RVC limits and VSS at 50 Hz	86
Figure 30 – Test A13.5.1 waveform	88
Figure 31 – Test A13.5.1 waveform with RVC limits and arithmetic mean at 50 Hz	89
Figure 32 – Test A13.5.2 waveform	91
Figure 33 – Test A13.5.2 waveform with RVC limits and arithmetic mean at 50 Hz	92
Figure 34 – Detail 1 of waveform for test of dips according to test S4.1.2	102
Figure 35 – Detail 2 of waveform for tests of dips according to test S4.1.2	102
Figure 36 – Detail 1 of waveform for test of swells according to test S4.1.2	103
Figure 37 – Detail 2 of waveform for tests of swells according to test S4.1.2	103
Figure 38 – Sliding reference voltage test	104
Figure 39 – Sliding reference start-up condition	104
Figure 40 – Detail 1 of waveform for test of polyphase dips/interruptions	106
Figure 41 – Detail 2 of waveform for test of polyphase dips/interruptions	106
Figure 42 – Detail 3 of waveform for test of polyphase dips/interruptions	107

Figure 43 – Detail 1 of waveform for test of polyphase swells	108
Figure 44 – Detail 2 of waveform for test of polyphase swells	108
Figure 45 – Flagging test for class S	117
Figure 46 – Clock uncertainty testing.....	118
Figure A.1 – Different kinds of uncertainties	126
Figure D.1 – Phase-to-neutral testing on three-phase systems.....	132
Figure D.2 – Phase-to-phase testing on three-phase systems	132
Figure E.1 – Example for one phase of a typical N cycle injection	134
Figure E.2 – Dip/interruption accuracy (amplitude and timing) test	135
Figure E.3 – Swell accuracy (amplitude and timing) test	136
Figure G.1 – Simulated signal under noisy conditions	140
Figure G.2 – Waveform for checking gapless RMS voltage measurement.....	141
Figure G.3 – 2,3 Hz frequency fluctuation.....	141
Figure G.4 – Spectral leakage effects for a missing sample	142
Figure G.5 – Illustration of Q_{RMS} for missing samples.....	143
Figure G.6 – Detection of a single missing sample.....	143
Figure G.7 – Q_{RMS} for an ideal signal, sampling error = -300×10^{-6}	144
Figure G.8 – Q_{RMS} for an ideal signal, sampling error = 400×10^{-6}	144
Figure G.9 – Q_{RMS} for an ideal signal, sampling error = 200×10^{-6}	145
Figure G.10 – $Q_H(5)$ with ideal test signal and perfect sampling frequency synchronization	146
Figure G.11 – $Q_H(5)$ with 300×10^{-6} sampling frequency error and 100×10^{-6} modulation frequency error	146
Figure G.12 – Q_{RMS} with a 20/24-cycle sliding window with an output every 10/12 cycles.....	147
Figure G.13 – Amplitude test for fluctuating component	147
Table 1 – Summary of type tests for class A	15
Table 2 – Summary of type tests for class S	16
Table 3 – Testing points for each measured parameter.....	18
Table 4 – List of single "power-system influence quantities".....	20
Table 5 – Influence of temperature.....	21
Table 6 – Influence of auxiliary power supply voltage	21
Table 7 – List of generic test criteria.....	22
Table 8 – Specification of test A13.1.1	69
Table 9 – Specification of test A13.1.2	72
Table 10 – Specification of test A13.1.3	75
Table 11 – Specification of test A13.2.1	78
Table 12 – Specification of test A13.3.1	81
Table 13 – Specification of test A13.4.1	84
Table 14 – Specification of test A13.5.1	87
Table 15 – Specification of test A13.5.2	90
Table 16 – Uncertainty requirements	125
Table D.1 – Tests pattern.....	133

Table H.1 – Testing range.....	149
Table H.2 – Uncertainty of source and reference meter.....	150
Table H.3 – Stability of source	150
Table I.1 – Example of a DoC related to compliance with IEC 62586-1.....	153
Table I.2 – Example of DoC related to compliance with IEC 62586-2.....	155

INTERNATIONAL ELECTROTECHNICAL COMMISSION

POWER QUALITY MEASUREMENT IN POWER SUPPLY SYSTEMS –

Part 2: Functional tests and uncertainty requirements

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) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 62586-2 edition 2.1 contains the second edition (2017-03) [documents 85/525/CDV and 85/571/RVC], its corrigendum 1 (2018-06) and its amendment 1 (2021-09) [documents 85/770/FDIS and 85/795/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

International Standard IEC 62586-2 has been prepared by IEC technical committee 85: Measuring equipment for electrical and electromagnetic quantities.

This second edition constitutes a technical revision.

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

- a) test procedures for RVC and current have been added;
- b) mistakes have been fixed.

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

A list of all parts of the IEC 62586 series, published under the general title *Power quality measurement in power supply systems*, can be found on the IEC website.

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under 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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Power quality is more and more important worldwide in power supply systems and is generally assessed by power quality instruments.

This part of IEC 62586 specifies functional and uncertainty tests intended to verify the compliance of a product to class A and class S measurement methods defined in IEC 61000-4-30.

This document therefore complements IEC 61000-4-30.

POWER QUALITY MEASUREMENT IN POWER SUPPLY SYSTEMS –

Part 2: Functional tests and uncertainty requirements

1 Scope

This part of IEC 62586 specifies functional tests and uncertainty requirements for instruments whose functions include measuring, recording, and possibly monitoring power quality parameters in power supply systems, and whose measuring methods (class A or class S) are defined in IEC 61000-4-30.

This document applies to power quality instruments complying with IEC 62586-1.

This document can also be referred to by other product standards (e.g. digital fault recorders, revenue meters, MV or HV protection relays) specifying devices embedding class A or class S power quality functions according to IEC 61000-4-30.

These requirements are applicable in single-, dual- (split phase) and 3-phase AC power supply systems at 50 Hz or 60 Hz.

It is not the intent of this document to address user interface or topics unrelated to device measurement performance.

The document does not cover post-processing and interpretation of the data, for example with dedicated software.

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

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*

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

IEC 61000-4-30:2015, *Electromagnetic compatibility (EMC) – Part 4-30: Testing and measurement techniques – Power quality measurement methods*

IEC 62586-1:2013, *Power quality measurement in power supply systems – Part 1: Power quality instruments (PQI)*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*