BS EN 62586-2:2014

Incorporating corrigendum November 2014

BSI Standards Publication

Power quality measurement in power supply systems

Part 2: Functional tests and uncertainty requirements

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN 62586-2:2014. It is identical to IEC 62586-2:2013, incorporating corrigendum November 2014.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by IEC corrigendum November 2014 is indicated in the text by [AC1) (AC1].

The UK participation in its preparation was entrusted to Technical Committee PEL/85, Measuring equipment for electrical and electromagnetic quantities.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Published by BSI Standards Limited 2014

ISBN 978 0 580 88690 4

ICS 17.220.20

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 July 2014.

Amendments/corrigenda issued since publication

Date	Text affected
30 November 2014	Implementation of IEC corrigendum November 2014

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 62586-2

June 2014

ICS 17.220.20

Incorporating corrigendum November 2014

English Version

Power quality measurement in power supply systems - Part 2: Functional tests and uncertainty requirements (IEC 62586-2:2013)

Mesure de la qualité de l'alimentation dans les réseaux d'alimentation - Partie 2: Essais fonctionnels et exigences d'incertitude
(CEI 62586-2:2013)

Messung der Spannungsqualität in Energieversorgungssystemen - Teil 2: Funktionsprüfungen und Anforderungen an die Messunsicherheit
(IEC 62586-2:2013)

This European Standard was approved by CENELEC on 2014-01-16. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 62586-2:2014 E

Foreword

The text of document 85/461/FDIS, future edition 1 of IEC 62586-2, prepared by IEC/TC 85 "Measuring equipment for electrical and electromagnetic quantities" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62586-2:2014.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2014-12-20
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2017-01-16

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive.

For the relationship with EU Directive see informative Annex ZZ, which is an integral part of this document.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 62586-2:2013 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 60359	NOTE	Harmonized as EN 60359.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When 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

Publication	Year	Title	EN/HD	Year
IEC 61000-2-4	-	Electromagnetic compatibility (EMC) - Part 2-4: Environment - Compatibility levels in industrial plants for low-frequency conducted disturbances	EN 61000-2-4	-
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	EN 61000-4-7	-
IEC 61000-4-15	-	Electromagnetic compatibility (EMC) - Part 4-15: Testing and measurement techniques - Flickermeter - Functional and design specifications	EN 61000-4-15	-
IEC 61000-4-30	2008	Electromagnetic compatibility (EMC) - Part 4-30 : Testing and measurement techniques - Power quality measurement methods	EN 61000-4-30	2009
IEC 62586-1	-	Power quality measurement in power supply systems - Part 1: Power Quality Instruments (PQI)	EN 62586-1	-

Annex ZZ
(informative)

Coverage of Essential Requirements of EU Directives

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers protection requirements of Annex I Article 1 of the EU Directive 2004/108/EC.

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive concerned.

WARNING: Other requirements and other EU Directives may be applicable to the products falling within the scope of this standard.

CONTENTS

INTRODUCTION 9
1 Scope 10
2 Normative references 10
3 Terms, definitions, abbreviations, notations and symbols 10
3.1 General terms and definitions 11
3.2 Terms and definitions related to uncertainty 11
3.3 Notations 12
3.3.1 Functions 12
3.3.2 Symbols and abbreviations 12
3.3.3 Indices 12
4 Requirements 12
4.1 Requirements for products complying with class A 12
4.2 Requirements for products complying with class S 13
5 Functional type tests common requirements 14
5.1 General philosophy for testing 14
5.1.1 Measuring ranges 14
5.1.2 Single "power system influence quantities" 16
5.1.3 Mixed "power system influence quantities" measuring range 17
5.1.4 "External influence quantities" 18
5.1.5 Test criteria 18
5.2 Testing procedure 19
5.2.1 Device under test 19
5.2.2 Testing conditions 19
5.2.3 Testing equipment 19
6 Functional testing procedure for instruments complying with class A according to IEC 61000-4-30 19
6.1 Power frequency 19
6.1.1 General 19
6.1.2 Measurement method 19
6.1.3 Measurement uncertainty and measuring range 20
6.1.4 Measurement evaluation 21
6.1.5 Measurement aggregation 21
6.2 Magnitude of supply voltage 21
6.2.1 Measurement method 21
6.2.2 Measurement uncertainty and measuring range 21
6.2.3 Measurement evaluation 21
6.2.4 Measurement aggregation 22
6.3 Flicker 23
6.4 Supply voltage interruptions, dips and swells 23
6.4.1 General 23
6.4.2 Check dips / interruptions in polyphase system 31
6.4.3 Check swells in polyphase system 33
6.5 Supply voltage unbalance 34
6.5.1 General 34
6.5.2 Measurement method, measurement uncertainty and measuring range 34

6.5.3 Aggregation 35
6.6 Voltage harmonics 35
6.6.1 Measurement method 35
6.6.2 Measurement uncertainty and measuring range 36
6.6.3 Measurement evaluation 37
6.6.4 Measurement aggregation 37
6.7 Voltage inter-harmonics 39
6.7.1 Measurement method 39
6.7.2 Measurement uncertainty and measuring range 39
6.7.3 Measurement evaluation 40
6.7.4 Measurement aggregation 40
6.8 Mains signalling voltages on the supply voltage 42
6.8.1 Measurement method 42
6.8.2 Measurement uncertainty and measuring range 44
6.8.3 Aggregation 45
6.9 Measurement of underdeviation and overdeviation parameters 45
6.9.1 Measurement method 45
6.9.2 Measurement uncertainty and measuring range 47
6.9.3 Measurement evaluation 47
6.9.4 Measurement aggregation 47
6.10 Flagging 49
6.11 Clock uncertainty testing 51
6.12 Variations due to external influence quantities 51
6.12.1 General 51
6.12.2 Influence of temperature 52
6.12.3 Influence of power supply voltage 55
7 Functional testing procedure for instruments complying with class S according to IEC 61000-4-30 56
7.1 Power frequency 56
7.1.1 General 56
7.1.2 Measurement method 56
7.1.3 Measurement uncertainty and measuring range 57
7.1.4 Measurement evaluation 58
7.1.5 Measurement aggregation 58
7.2 Magnitude of the supply voltage 58
7.2.1 Measurement method 58
7.2.2 Measurement uncertainty and measuring range 58
7.2.3 Measurement evaluation 59
7.2.4 Measurement aggregation 59
7.3 Flicker 60
7.4 Supply voltage interruptions, dips and swells 60
7.4.1 General requirements 60
7.4.2 Check dips / interruptions in polyphase system 66
7.4.3 Check swells in polyphase system 68
7.5 Supply voltage unbalance 69
7.5.1 General 69
7.5.2 Measurement method, measurement uncertainty and measuring range 69
7.5.3 Aggregation 70

7.6 Voltage harmonics 70
7.6.1 General 70
7.6.2 Measurement method 70
7.6.3 Measurement method, measurement uncertainty and measuring range 72
7.6.4 Measurement evaluation 73
7.6.5 Measurement aggregation 73
7.7 Voltage inter-harmonics 74
7.8 Mains Signalling Voltages on the supply voltage 75
7.8.1 General 75
7.8.2 Measurement method 75
7.8.3 Measurement uncertainty and measuring range 75
7.8.4 Aggregation 75
7.9 Measurement of underdeviation and overdeviation parameters 75
7.10 Flagging 75
7.11 Clock uncertainty testing 77
7.12 Variations due to external influence quantities 77
7.12.1 General 77
7.12.2 Frequency measurement 78
7.12.3 Influence of temperature 78
7.12.4 Influence of power supply voltage 79
8 Calculation of measurement uncertainty and operating uncertainty 79
Annex A (normative) Intrinsic uncertainty, operating uncertainty, and overall system uncertainty 81
Annex B (normative) Calculation of measurement and operating uncertainty for voltage magnitude and power frequency 83
Annex C (informative) Further test on dips (amplitude and phase angles changes) 86
Annex D (informative) Further tests on dips (polyphase): test procedure 88
Annex E (normative) Gapless measurements of voltage amplitude and harmonics test 92
Annex F (informative) Gapless measurements of voltage amplitude and harmonics 95
Annex G (informative) Testing equipment requirements 103
Annex H (informative) Example of test report 104
Annex I (informative) Mixed influence quantities 105
Bibliography 107

Figure 1 – Overview of test for dips according to test A4.1.1 26
Figure 2 – Detail 1 of waveform for test of dips according to test A4.1.1 27
Figure 3 – Detail 2 of waveform for tests of dips according to A4.1.1 27
Figure 4 – Detail 3 of waveform for tests of dips according to test A4.1.1 27
Figure 5 – Detail 1 of waveform for test of dips according to test A4.1.2 28
Figure 6 – Detail 2 of waveform for tests of dips according to test A4.1.2 28
Figure 7 – Detail 1 of waveform for test of swells according to test A4.1.2 29
Figure 8 – Detail 2 of waveform for tests of swells according to test A4.1.2 29
Figure 9 – Sliding reference voltage test 30
Figure 10 – Sliding reference start up condition 30
Figure 11 – Detail 1 of waveform for test of polyphase dips/interruptions 31

Figure 12 – Detail 2 of waveform for test of polyphase dips/interruptions 32
Figure 13 – Detail 3 of waveform for test of polyphase dips/interruptions 32
Figure 14 – Detail 1 of waveform for test of polyphase swells 33
Figure 15 – Detail 2 of waveform for test of polyphase swells 34
Figure 16 – Flagging test for class A 50
Figure 17 – Clock uncertainty testing 51
Figure 18 – Detail 1 of waveform for test of dips according to test S4.1.2 63
Figure 19 – Detail 2 of waveform for tests of dips according to test S4.1.2 63
Figure 20 – Detail 1 of waveform for test of swells according to test S4.1.2 64
Figure 21 – Detail 2 of waveform for tests of swells according to test S4.1.2 64
Figure 22 – Sliding reference voltage test 65
Figure 23 – Sliding reference start up condition 65
Figure 24 – Detail 1 of waveform for test of polyphase dips/interruptions 66
Figure 25 – Detail 2 of waveform for test of polyphase dips/interruptions 67
Figure 26 – Detail 3 of waveform for test of polyphase dips/interruptions 67
Figure 27 – Detail 1 of waveform for test of polyphase swells 68
Figure 28 – Detail 2 of waveform for test of polyphase swells 69
Figure 29 – Flagging test for class S 76
Figure 30 – Clock uncertainty testing 77
Figure A.1 – Different kinds of uncertainties 81
Figure C.1 – Phase-to-neutral testing on three-phase systems 86
Figure C.2 – Phase-to-phase testing on three-phase systems 86
Figure D.1 – Example for on phase of a typical N cycle injection 89
Figure D.2 – Dip/interruption accuracy (amplitude and timing) test 90
Figure D.3 – Swell accuracy (amplitude and timing) test 91
Figure F.1 – Simulated signal under noisy conditions 95
Figure F.2 – Waveform for checking gapless RMS voltage measurement 96
Figure F.3 – 2,3 Hz Frequency fluctuation 96
Figure F.4 – Spectral leakage effects for a missing sample 97
Figure F.5 – Illustration of QRMS for missing samples 98
Figure F.6 – Detection of a single missing sample 98
Figure F.7 – Q_{RMS} for an ideal signal, sampling error = 300 x 10^{-6} 99
Figure F.8 – Q_{RMS} for an ideal signal, sampling error = 400 x 10^{-6} 99
Figure F.9 – Q_{RMS} for an ideal signal, sampling error = 200 x 10^{-6} 100
Figure F.10 – Q_{RMS} with ideal test signal and perfect sampling frequency synchronization 101
Figure F.11 – Q_{RMS} with 300 x 10^{-6} sampling frequency error and 100 x 10^{-6} modulation frequency error 101
Figure F.12 – Q_{RMS} with a 20/24 cycles sliding window with a output every 10/12 cycles 102
Figure F.13 – Amplitude test for fluctuating component 102

Table 1 – Summary of type tests for Class A 13
Table 2 – Summary of type tests for Class S 14

Table 3 – Testing points for each measured parameter 14
Table 4 – List of single "power system influence quantities" 16
Table 5 – List of mixed "power system influence quantities" 17
Table 6 – Influence of Temperature 18
Table 7 – Influence of auxiliary power supply voltage 18
Table 8 – List of generic test criteria 18
Table 9 – Uncertainty requirements 80
Table C.1 – Tests pattern 87
Table I.1 – Mixed influence quantities test for frequency 105
Table I.2 – Mixed influence quantities test for magnitude of voltage 105
Table I.3 – Mixed influence quantities test for dips and swells 106

INTRODUCTION

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

IEC 62586-2 is a standard specifying 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.

IEC 62586-2 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 standard applies to power quality instruments complying with IEC 62586-1.

This standard may 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 a.c. power supply systems at 50 Hz or 60 Hz.

NOTE 1 It is not the intent of this standard to address user interface or topics unrelated to device measurement performance.

NOTE 2 The standard does not cover postprocessing and interpretation of the data, for example with a dedicated software.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 61000-4-30:2008, *Electromagnetic compatibility (EMC) – Part 4-30: Testing and measurement techniques – Power quality measurement methods*

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

3 Terms, definitions, abbreviations, notations and symbols

For the purposes of this document, the terms and definitions given in IEC 61000-4-30 as well as the following terms and definitions apply.

3.1 General terms and definitions

3.1.1
limit range of operation
extreme conditions that a measuring instrument can withstand without damage and degradation of its metrological characteristics when it is subsequently operated within its rated operating conditions

Note 1 to entry: The measuring instrument should be able to function within the limit range of operation

3.1.2
rated range of operation
range of values of a single influence quantity that forms a part of the rated operating conditions

Note 1 to entry: Uncertainty should be met within the rated range of operation

3.2 Terms and definitions related to uncertainty

3.2.1
intrinsic uncertainty
uncertainty of a measuring instrument when used under reference conditions

Note 1 to entry: In this standard, it is a percentage of the measured value defined in its rated range and with all influence quantities under reference conditions, unless otherwise stated.

[SOURCE: IEC 60359:2001, 3.2.10, modified – Note 1 to entry has been added.]

3.2.2
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 [IEV].

Note 2 to entry: As the calibration diagram depends on the influence quantities, in order to assign the result of a measurement it is necessary to know whether the relevant influence quantities lie within the specified range [IEV].

Note 3 to entry: An influence quantity is said to lie within a range C' to C'' when the results of its measurement satisfy the relationship: $C' \leq V - U < V + U \leq C''$.

[SOURCE: IEC 60359:2001, 3.1.14]

3.2.3
variation
variation due to a single influence quantity
difference between the value measured under reference conditions and any value measured within the rated operating range (for this specific influence quantity)

Note 1 to entry: The other performance characteristics and the other influence quantities should stay within the ranges specified for the reference conditions.

3.2.4
rated operating conditions
set of conditions that must be fulfilled during the measurement in order that a calibration diagram may be valid

Note 1 to entry: Beside the specified measuring range and rated operating ranges for the influence quantities, the conditions may include specified ranges for other performance characteristics and other indications that cannot be expressed as ranges of quantities.

[SOURCE: IEC 60359:2001, 3.3.13]

3.2.5
operating uncertainty
uncertainty under the rated operating conditions

Note 1 to entry: The operating instrumental uncertainty, like the intrinsic one, is not evaluated by the user of the instrument, but is stated by its manufacturer or calibrator. The statement may be expressed by means of an algebraic relation involving the intrinsic instrumental uncertainty and the values of one or several influence quantities, but such a relation is just a convenient means of expressing a set of operating instrumental uncertainties under different operating conditions, not a functional relation to be used for evaluating the propagation of uncertainty inside the instrument.

[SOURCE: IEC 60359:2001, 3.2.11, modified – The word "instrumental" has been removed from both the term and the definition.]

3.2.6
overall system uncertainty
uncertainty including the instrumental uncertainty of all components related to the measurement system (sensors, wires, measuring instrument, etc.) under the rated operating conditions

3.3 Notations

3.3.1 Functions

See functions defined in IEC 61000-4-30:2008.

3.3.2 Symbols and abbreviations

N.R. not requested

N.A. not applicable

3.3.3 Indices

min minimum value

max maximum value

4 Requirements

4.1 Requirements for products complying with class A

Products compliant with class A of IEC 61000-4-30 shall comply with the following requirements:

– Compliance with class A operational uncertainty, based on testing, as defined in Clause 8.
– Compliance with class A functional tests as defined in Clause 6, based on common requirements defined in Clause 5. A summary of those tests is provided in Table 1.

Table 1 – Summary of type tests for Class A

Power system influence quantities	Clause	Measurement method	Measurement uncertainty and measuring range		Measurement evaluation	Measurement aggregation
			Uncertainty under reference conditions	Variations due to influence quantities		
Power frequency	6.1	6.1.2	6.1.3.1	6.1.3.2	6.1.4	N.A.
Magnitude of supply voltage	6.2	6.2.1	6.2.2.1	6.2.2.2	N.A.	6.2.4
Flicker	6.3	See IEC 61000-4-15	See IEC 61000-4-15	N.A.	N.A.	N.A.
Supply voltage interruptions, dips and swells	6.4	6.4	6.4	6.4	N.A.	6.4
Supply voltage unbalance	6.5	6.5	6.5	N.A.	N.A.	N.A.
Voltage harmonics	6.6	6.6.1	6.6.2.1	6.6.2.2	N.A.	6.6.4
Voltage inter-harmonics	6.7	6.7.1	6.7.2.1	6.7.2.2	N.A.	6.7.4
Mains signalling voltage	6.8	6.8	6.8	6.8.2.2	N.A.	6.8
Under-over deviations	6.9	6.9	6.9	6.9	N.A.	6.9
Flagging	6.10	6.10	N.A.	N.A.	N.A.	N.A.
Clock uncertainty testing	6.11	N.A.	6.11	N.A.	N.A.	N.A.
Variations due to external influence quantities	6.12	N.A.	N.A.	6.12	N.A.	N.A.

4.2 Requirements for products complying with class S

The testing procedure for class S instruments is identical to class A instruments, if class A measurement methods are implemented (see Clause 6). However, the measurement range and measuring uncertainty are expected to meet or exceed the performance requirements defined in IEC 61000-4-30 for class S instruments.

Products compliant with class S of IEC 61000-4-30 shall comply with the following requirements:

– Compliance with class S operational uncertainty, based on testing, as defined in Clause 8.
– Compliance with class S functional tests as defined in Clause 7, based on common requirements defined in Clause 5. A summary of those tests is provided in Table 2.

Table 2 – Summary of type tests for Class S

Power System influence quantities	Clause	Measurement method	Measurement uncertainty and measuring range		Measurement evaluation	Measurement aggregation
			Uncertainty under reference conditions	Variations due to influence quantities		
Power frequency	7.1	7.1.2	7.1.3.1	7.1.3.2	7.1.4	N.A.
Magnitude of supply voltage	7.2	7.2.1	7.2.2.1	7.2.2.2	N.A.	7.2.4
Flicker	7.3	N.A.	N.A.	N.A.	N.A.	N.A.
Supply voltage interruptions, dips and swells	7.4	7.4	7.4	7.4	7.4	N.A.
Supply voltage unbalance	7.5	7.5.2	7.5.2	N.A.	N.A.	7.5.3
Voltage harmonics	7.6	7.6.2	7.6.3.1	7.6.3.2	N.A.	7.6.5
Voltage inter-harmonics	7.7	7.7	7.7	7.7	N.A.	7.7
Mains signalling voltage	7.8	7.8.2	7.8.3.1	N.A.	N.A.	N.A.
Under-over deviations	7.9	N.A.	N.A.	N.A.	N.A.	N.A.
Flagging	7.10	N.A.	N.A.	N.A.	N.A.	N.A.
Clock uncertainty testing	7.11	N.A.	N.A.	N.A.	N.A.	N.A.
Variations due to external influence quantities	7.12	N.A.	N.A.	N.A.	N.A.	N.A.

5 Functional type tests common requirements

5.1 General philosophy for testing

5.1.1 Measuring ranges

Table 3 below defines the different testing points that shall be applied according to the test procedures defined in Clause 6, in order to check the uncertainty over the measuring range.

Table 3 – Testing points for each measured parameter

Measured parameter	Class	Testing point P1 [a]	Testing point P2 [a]	Testing point P3 [a]	Testing point P4 [a]	Testing point P5 [a]
Frequency 50 Hz [b] (covers 50 Hz)	A	42,5 Hz	50,05 Hz	57,5 Hz	50 Hz	N.A.
	S	42,5 Hz	50,05 Hz	57,5 Hz	50 Hz	N.A.
Frequency 60 Hz [b] (covers 60 Hz)	A	51 Hz	59,95 Hz	69 Hz	60 Hz	N.A.
	S	51 Hz	59,95 Hz	69 Hz	60 Hz	N.A.
Voltage magnitude	A	10 % U_{din}	45 % U_{din}	80 % U_{din}	115 % U_{din}	150 % U_{din}
	S	20 % U_{din}	45 % U_{din}	70 % U_{din}	95 % U_{din}	120 % U_{din}
Swells [c]	A	Threshold swell- [d]	Threshold swell+ [d]	110 % U_{din}	120 % U_{din}	200 % U_{din}
	S	Threshold swell- [d]	Threshold swell+ [d]	110 % U_{din}	120 % U_{din}	150 % U_{din}

Measured parameter	**Class**	**Testing point P1** [a]	**Testing point P2** [a]	**Testing point P3** [a]	**Testing point P4** [a]	**Testing point P5** [a]
Dips, Interruptions [c]	A	[AC1⟩Threshold dip+⟨AC1] [d]	[AC1⟩Threshold dip- ⟨AC1] [d]	20 % U_{din}	60 % U_{din}	85 % U_{din}
	S	[AC1⟩Threshold dip+⟨AC1] [d]	[AC1⟩Threshold dip- ⟨AC1] [d]	20 % U_{din}	60 % U_{din}	85 % U_{din}
Voltage harmonics [f]	A	Fundamental as specified 5 % on the 2^{nd} harmonic	Fundamental as specified 10 % on the 3^{rd} harmonic	Fundamental as specified 1 % on the 50^{th} harmonic	Fundamental as specified Distortion on all harmonics simultaneously up to the 50^{th} order at 10 % of class 3 compatibility levels from IEC 61000-2-4	Fundamental as specified Distortion on all harmonics simultaneously up to the 50^{th} order at 200 % of class 3 compatibility levels from IEC 61000-2-4
	S	Fundamental as specified 5 % on the 2^{nd} harmonic	Fundamental as specified 10 % on the 3^{rd} harmonic	Fundamental as specified 1 % on the 40^{th} harmonic	Fundamental as specified Distortion on all harmonics simultaneously up to the 40^{th} order at 10 % of class 3 compatibility levels from IEC 61000-2-4	Fundamental as specified Distortion on all harmonics simultaneously up to the 40^{th} order at 100 % of class 3 compatibility levels from IEC 61000-2-4
Voltage interharmonics [f]	A	Fundamental as specified 5 % on the interharmonic at 1,5 × the fundamental frequency	Fundamental as specified 10 % on the interharmonic at 7,5 x the fundamental frequency	Fundamental as specified 1 % on the interharmonic at 49,5 x the fundamental frequency	Fundamental as specified Distortion on 4 selected interharmonics [e] up to the 50^{th} order at 10 % of class 3 compatibility levels from IEC 61000-2-4	Fundamental as specified Distortion on 4 selected interharmonics [e] up to the 50^{th} order at 200 % of class 3 compatibility levels from IEC 61000-2-4
	S	N.A.	N.A.	N.A.	N.A.	N.A.
MsV	A	U_{din} applied at the fundamental frequency, with 0 % U_{din} at the specified carrier frequency	U_{din} applied at the fundamental frequency, with 1 % U_{din} at the specified carrier frequency	U_{din} applied at the fundamental frequency, with 3 % U_{din} at the specified carrier frequency	U_{din} applied at the fundamental frequency, with 9 % U_{din} at the specified carrier frequency	U_{din} applied at the fundamental frequency, with 15 % U_{din} at the specified carrier frequency
	S	N.A.	N.A.	N.A.	N.A.	N.A.

[a] Measured parameters shall be considered individually, e.g. Testing point P1 for frequency, Testing point P2 for flicker, etc.

[b] Instruments intended to work at 50 Hz shall use the figures provided in the line "Frequency 50 Hz". Instruments intended to work at 60 Hz shall use the figures provided in the line "Frequency 60 Hz". Instruments intended to work both at 50 Hz and 60 Hz shall use the figures provided in lines "Frequency 50 Hz" and "Frequency 60 Hz".

[c] see details in Annex C.

[d] Threshold swell+ = Lowest threshold for swells declared by manufacturer + uncertainty of residual voltage measurement + hysteresis

Threshold swell- = Lowest threshold for swells declared by manufacturer – uncertainty of residual voltage measurement – hysteresis

Threshold dip+ = Lowest threshold for dips declared by manufacturer + uncertainty of residual voltage measurement + hysteresis

Threshold dip- = Lowest threshold for dips declared by manufacturer – uncertainty of residual voltage measurement – hysteresis

[e] The manufacturer may select the interharmonics but shall report them in the type test report.

[f] Harmonics and interharmonics phase angles shall not be shifted from the fundamental.

NOTE This table is derived from 6.2 of IEC 61000-4-30:2008.

5.1.2 Single "power system influence quantities"

Table 4 specifies in detail the test points defined for power system influence quantities, consistent with a subset of the requirements of 6.1 of IEC 61000-4-30:2008. It specifies the testing states min, mean and max for each power system influence quantity, and for each performance class. Testing states will have to be considered for each power system influence quantity independently and not as a whole set. These test points are intended to be applied according to the test procedures defined in Clause 6 and Clause 7.

Table 4 – List of single "power system influence quantities"

Power system influence quantities	Class	Testing state S1 [a]	Testing state S2 [a]	Testing state S3 [a]	Testing state S4 [a]
Frequency:	A	42,5 Hz	50 Hz	55,75 Hz	69 Hz
1) for instruments covering both 50 Hz and 60 Hz frequencies	S	42,5 Hz	50 Hz	55,75 Hz	69 Hz
2) for instruments covering only 50 Hz frequency	A	42,5 Hz	50 Hz	57,5 Hz	---
	S	42,5 Hz	50 Hz	57,5 Hz	---
3) for instruments covering only 60 Hz frequency	A	51 Hz	60 Hz	69 Hz	---
	S	51 Hz	60 Hz	69 Hz	---
Voltage magnitude	A	10 % U_{din}	---	200 % U_{din}	---
	S	10 % U_{din}	---	150 % U_{din}	---
Harmonics (in addition to the fundamental signal)	A	[c d] Harmonics: - H3: 10 % U_{din} - H7: 10 % U_{din} - H11: 10 % U_{din} - H15: 4 % U_{din} - H19: 5 % U_{din} - H23: 5 % U_{din}	---	---	---

Power system influence quantities	Class	Testing state S1 [a]	Testing state S2 [a]	Testing state S3 [a]	Testing state S4 [a]
	S	Harmonic H5: 15 % U_{din}, at +90°	---	---	---
Interharmonics [b] (including ranks below fundamental)	A	---	Frequency = 1,5 x fundamental frequency; 9 % of U_{din}	Frequency = 0,5x fundamental frequency; 2,5 % of U_{din}	Distortion applied at two interharmonic frequencies simultaneously: 1) Frequency = 2nd harmonic plus 5 Hz (105Hz at 50Hz, and/or 125Hz at 60Hz), Magnitude = 4 % of U_{din} 2) Frequency = 2nd harmonic plus 10 Hz (110Hz at 50Hz, and/or 130Hz at 60Hz), Magnitude = 6 % of U_{din}
	S	---	Frequency = 1,5 × fundamental frequency; 2,5 % of U_{din}	Frequency = 0,5 × fundamental frequency; 2,5 % of U_{din}	---

[a] Influence quantities shall be considered individually, e.g. Testing State S1 for frequency, Testing State S2 for flicker, etc. Other influence quantities shall stay in reference conditions for testing.

[b] Mains Signalling Voltages may be used like interharmonics for being an influence quantity.

[c] Harmonics shall be shifted by 180° compared to fundamental.

[d] This signal represents a crest factor of 2.

NOTE This table is derived from Table 1 of IEC 61000-4-30:2008.

5.1.3 Mixed "power system influence quantities" measuring range

Table 5 specifies in detail the requirements of 6.2 of IEC 61000-4-30:2008.

Testing states of Table 5 will have to be considered as a whole set including all influence quantities acting together.

Table 5 – List of mixed "power system influence quantities"

Power System influence quantities	Testing state M1 [a]	Testing state M2 [a]	Testing state M3 [a]
Frequency (f_{nom} = 50 Hz and 60 Hz)	$f_{nom} \pm 0,5$ Hz	$f_{nom} - 1$ Hz $\pm$ 0,5 Hz	$f_{nom} + 1$ Hz $\pm$ 0,5 Hz
Voltage magnitude	U_{din} ±1 %	Determined by flicker, unbalance, harmonics, interharmonics (below)	Determined by flicker, unbalance, harmonics, interharmonics (below)
Flicker	$P_{st} < 0,1$	$P_{st} = 1 \pm 0,1$ – rectangular modulation at 39 changes / min	$P_{st} = 4 \pm 0,1$ – rectangular modulation at 110 changes / min
Unbalance	100 % ±0,5 % of U_{din} on all channels. All phase angles 120° (equivalent to u_0 = 0 %, u_2 = 0 %)	73 % ±0,5 % of U_{din} Channel 1 80 % ±0,5 % of U_{din} Channel 2 87 % ±0,5 % of U_{din} Channel 3 all phase angles 120° (equivalent to u_0 = 5,05 %, u_2 = 5,05 %)	152 % ±0,5 % of U_{din} Channel 1 140 % ±0,5 % of U_{din} Channel 2 128 % ±0,5 % of U_{din} Channel 3 all phase angles 120° (equivalent to u_0 = 4,95 %, u_2 = 4,95 %)

Power System influence quantities	Testing state M1 [a]	Testing state M2 [a]	Testing state M3 [a]
Harmonics	0 % to 3 % of U_{din}	10 % ± 3 % of U_{din} 3rd at 0° 5 % ± 3 % of U_{din} 5th at 0° 5 % ± 3 % of U_{din} 29th at 0°	10 % ± 3 % of U_{din} 7th at 180° 5 % ± 3 % of U_{din} 13th at 0° 5 % ± 3 % of U_{din} 25th at 0°
Interharmonics	0 % to 0,5 % of U_{din}	1 % ± 0,5 % of U_{din} at 7,5 f_{nom}	1 % ± 0,5 % of U_{din} at 3,5 f_{nom}

[a] Influence quantities shall be considered all together, with a mix of all influence quantities.

NOTE This table is derived from Table 2 of IEC 61000-4-30:2008.

5.1.4 "External influence quantities"

Table 6 and

Table 7 specify the different testing states related to temperature and power supply voltage.

Table 6 – Influence of Temperature

Influence quantities	Testing state ET1	Testing state ET2	Testing state ET3
Temperature [a]	Minimum temperature of the rated range of operation [b] Bathe time as needed to achieve equilibrium, minimum 1 hour.	Worst case as defined by the manufacturer among the range 0 °C to 45 °C [b] Bathe time as needed to achieve equilibrium, minimum 1 hour.	Maximum temperature of the rated range of operation [b] Bathe time as needed to achieve equilibrium, minimum 1 hour.

[a] Circulating air may be forced in the testing chamber, lowering the impact of product self-heating. If circulating air is forced, then the temperature limit shall be adjusted to take into account the impact of the forced air on the internal temperature of the device under test.

[b] For PQI products, this rated range of operation is specified in Table 1 and Table 2 of IEC 62586-1. Each manufacturer or product standard referring to IEC 62586-2 will have to specify the rated temperature range of operation.

Table 7 – Influence of auxiliary power supply voltage

Influence quantities	Testing state EV1	Testing state EV2
Auxiliary power supply voltage	U_{min} as specified by manufacturer	U_{max} as specified by manufacturer

5.1.5 Test criteria

Table 8 specifies the different generic test criteria used in Clause 6 and Clause 7.

Table 8 – List of generic test criteria

Test criteria N°	Definition
TC10s(unc)	Every 10 s frequency measurement shall be within their specified uncertainty.
TC10s(sam)	Every 10 s frequency measurement shall be the same (within twice the intrinsic uncertainty).
TC(11≤ N ≤13)	Counter number of frequency readings in 2 min: 11≤N≤13
TC10/12(unc)	Every basic 10/12 cycles measurement shall be within their specified uncertainty.
TC150/180(unc)	Every 150/180 cycles aggregation measurement shall be within their specified uncertainty.
TC10/12(unc)-harm	For the harmonic order(s) being tested, every basic 10/12 cycle measurement shall be within the uncertainty specified in IEC 61000-4-7 class I.

Test criteria N°	Definition
TC150/180(unc)-harm	For the harmonic order(s) being tested, every 150/180-cycle aggregation measurement shall be within the uncertainty specified in IEC 61000-4-7 class I.
TC10-min(unc)-harm	For the harmonic order(s) being tested, every 10-min aggregation measurement shall be within the uncertainty specified in IEC 61000-4-7 class I.
TC150/180(unc)-thd	The total harmonic distortion is calculated according to the definition for subgroup total harmonic distortion (THDS) in IEC 61000-4-7.
TC10/12(unc)-interharm	For the interharmonic order(s) being tested, every basic 10/12 cycle measurement shall be within the uncertainty specified in IEC 61000-4-7 class I.
TC150/180(unc)-interharm	For the interharmonic order(s) being tested, every 150/180-cycle aggregation measurement shall be within the uncertainty specified in IEC 61000-4-7 class I.
TC10-min(unc)-interharm	For the interharmonic order(s) being tested, every 10-min aggregation measurement shall be within the uncertainty specified in IEC 61000-4-7 class I.
NOTE The manufacturer may proceed with several repetitions of the same test in sequence, to ensure that results are repeatable.	

5.2 Testing procedure

5.2.1 Device under test

The device under test shall be representative of the device in production.

5.2.2 Testing conditions

Reference conditions for testing defined in the related product standard shall apply unless otherwise specified. For PQI products, these reference conditions are specified in IEC 62586-1.

5.2.3 Testing equipment

Testing equipment and its calibration date shall be specified in the test report and in the certificate.

For Class A testing, an external synchronisation device shall be used.

NOTE Some guidance is provided in Annex G.

6 Functional testing procedure for instruments complying with class A according to IEC 61000-4-30

6.1 Power frequency

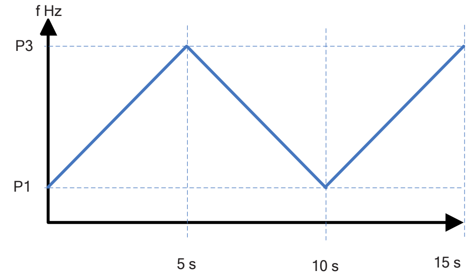
6.1.1 General

Frequency measurement shall be made on the reference channel.

6.1.2 Measurement method

Each test shall last at least 2 min.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A1.1.1	Check that averaging interval is 10 s	Loop (see scheme below): P1-P3 triangle Duration: 5 s P3-P1 triangle Duration: 5 s	Count the number of frequency readings in 2 min (N)	TC10s(sam) TC(11≤ N ≤13)



6.1.3 Measurement uncertainty and measuring range

6.1.3.1 Uncertainty under reference conditions

Each test shall last at least 1 min.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A1.2.1	Check measuring range	P1 for Frequency [a]	---	TC10s(unc)
A1.2.2	Check measuring range	P2 for Frequency [a]	---	TC10s(unc)
A1.2.3	Check measuring range	P3 for Frequency [a]	---	TC10s(unc)

[a] Instruments intended to work at 50 Hz shall use the figures provided in the line “Frequency 50 Hz”. Instruments intended to work at 60 Hz shall use the figures provided in the line “Frequency 60 Hz”. Instruments intended to work both at 50 Hz and 60 Hz shall use the figures provided both lines “Frequency 50 Hz” and “Frequency 60 Hz”.

6.1.3.2 Variations due to single influence quantities

Each test shall last at least 1 min.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A1.3.1	Measure influence of voltage magnitude on measurement uncertainty (for further calculations as required in Clause 8).	P2 for Frequency [a b]	S1 for voltage magnitude.	TC10s(unc)
A1.3.2	Measure influence of harmonics on measurement uncertainty (for further calculations as required in Clause 8).	P2 for Frequency [a b]	S1 for Harmonics	TC10s(unc)

[a] Instruments intended to work at 50 Hz shall use the figures provided the line “Frequency 50 Hz”. Instruments intended to work at 60 Hz shall use the figures provided in the line “Frequency 60 Hz”. Instruments intended to work both at 50 Hz and 60 Hz shall use the figures provided both in lines “Frequency 50 Hz” and “Frequency 60 Hz”.

[b] Frequency measurement is made on the reference channel.

6.1.4 Measurement evaluation

N°	Target of the test	Test
A1.4.1	Reference channel	It shall be checked that the frequency measurement is made on the reference channel.

6.1.5 Measurement aggregation

Aggregation is not required for power frequency.

6.2 Magnitude of supply voltage

6.2.1 Measurement method

Each test shall last at least 1 s.

N°	Target of the test	Test
A2.1.1	Check gapless and non-overlapping measurement	A test shall be achieved according to the requirements of Annex E.
NOTE The following tests are not listed here because they are covered by other tests: check true RMS measurement (covered by other tests), check basic accuracy of 10/12 cycles measurement (covered by other tests)		

6.2.2 Measurement uncertainty and measuring range

6.2.2.1 Uncertainty under reference conditions

Each test shall last at least 1 s.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A2.2.1	Check measuring range	P1 for Voltage magnitude	---	TC10/12(unc)
A2.2.2	Check measuring range	P3 for Voltage magnitude	---	TC10/12(unc)
A2.2.3	Check measuring range	P5 for Voltage magnitude	---	TC10/12(unc)

6.2.2.2 Variations due to single influence quantities

Each test shall last at least 1 s.

N°	Target of the test	Testing points according Table 3	Complementary test conditions according to Table 4	Test criterion (if test is applicable)
A2.3.1	Measure influence of frequency on measurement uncertainty (for further calculations as required in 8).	P3 for Voltage magnitude	S1 for Frequency	---
			S3 for Frequency	---
			S4 for Frequency	---
A2.3.2	Measure influence of harmonics on measurement uncertainty (for further calculations as required in 8).	P3 for Voltage magnitude	S1 for Harmonics	TC10/12(unc) on ch1 compared to a reference voltage

6.2.3 Measurement evaluation

Not applicable.

6.2.4 Measurement aggregation

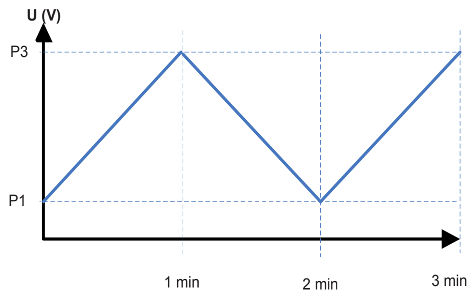
6.2.4.1 10/12 cycles with 10 min synchronisation

Each test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A2.4.1	Check aggregation overlap 1	P3 for Voltage magnitude	f = 59,99 Hz (covering 60 Hz) or f = 49,99 Hz (covering 50 Hz)" Test duration = 11 min	Test the time tag, and the sequence number of blocks for proper re-synchronization to the 10-min tick as specified in IEC 61000-4-30.
10 minute tick should occur in the middle of the 10/12 cycle time interval number 3000. NOTE 59,99 Hz = (2999,5/600) × 12; 49,99 Hz = (2999,5/600) × 10				

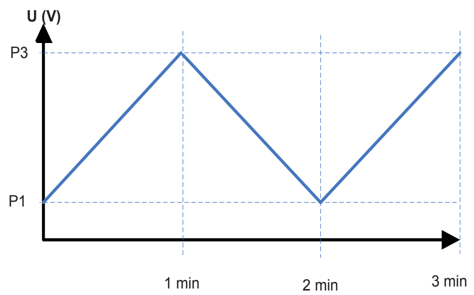
6.2.4.2 150/180 cycles aggregation with 10 min synchronisation

Each test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A2.5.1	Check aggregation overlap 2	Loop (see scheme below): – voltage changing linearly from P1 to P3 for 1 min duration, then – linearly from P3 to P1 for 1 min duration	f = 50,125 Hz (covering 50 Hz) and/or 60,15 Hz (covering 60 Hz) depending on manufacturer selection.	Test the aggregation of 10/12 cycles data into 150/180 cycles interval relative to the 10-min tick as specified in IEC 61000-4-30.
		 NOTE 1 The time on X axis is not necessarily synchronised on the 10-min tick		
10 min tick should occur in the middle of the 150/180 cycle time interval number 201. NOTE 2 50,125 Hz = (200,5 / 600) × 150; 60,15 Hz = (200,5 / 600) × 180				

6.2.4.3 10 min aggregation

Each test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.

<table>
<tr><th>N°</th><th>Target of the test</th><th>Testing points according to Table 3</th><th>Complementary test conditions according to Table 4</th><th>Test criterion</th></tr>
<tr><td rowspan="2">A2.6.1</td><td rowspan="2">Check 10-min aggregation</td><td>Loop (see scheme below):
– voltage changing linearly from P1 to P3 for 1 min duration, then
– linearly from P3 to P1 for 1 min duration</td><td>S2 for Frequency</td><td rowspan="2">Test the aggregation of 10/12 cycles data into 10 min interval relative to the 10-min tick as specified in IEC 61000-4-30.</td></tr>
<tr><td colspan="2">

NOTE The time on X axis is not necessarily synchronised on the 10-min tick</td></tr>
</table>

6.2.4.4 2-h aggregation

<table>
<tr><th>N°</th><th>Target of the test</th><th>Testing points according to Table 3</th><th>Complementary test conditions</th><th>Test criterion (if test is applicable)</th></tr>
<tr><td>A2.7.1</td><td>Check 2h aggregation</td><td colspan="3">It shall be checked that the 2-h aggregated value is provided by the equipment under test.</td></tr>
</table>

6.3 Flicker

Test shall be performed according to IEC 61000-4-15 testing requirements.

6.4 Supply voltage interruptions, dips and swells

6.4.1 General

NOTE Further guidance for testing is provided in Annex C and Annex D.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A4.1.1	Check U_{rms}(1/2) are independently synchronized on each channel on zero crossing.	P4 for Frequency [a] for at least 15 s [d] . Voltage step should be made on zero crossing.	This test does not require synchronized generator. – At T1, inject 0 % U_{din} interruption of duration 2 cycles followed by a step at 90 % U_{din} and of 2 cycles, then a steady state at 94 % U_{din} on channel 1 – At T1+10cycles + 1/3 cycle, apply the same profile on channel 2. – At T1+20cycles – 1/3 cycle, apply the same profile on channel 3. See Figure 1 and Figure 2.	– Check, for each channel, that the sequence of *U*rms(1/2) in the instrument complies to the sequence defined in Figure 4. – Check time tag of *U*rms(1/2) (N+1) on channel 1: T1 + ½ cycle. – Check that time tag of *U*rms(1/2) (N+1) on channel2 is T1+10,5cycles± 1/2cycle – Check that time tag of *U*rms(1/2) (N+1) on channel3 is T1+20,5cycles± 1/2cycle.
A4.1.2	Check amplitude and duration accuracy requirement [d]	P5 for Swells. [b] P4 for Frequency [a] — P3 for Dips/Int. [b] P4 for Frequency [a]	This test does not require synchronized generator. The change of signal amplitude to create dips/swells/interruption will be simultaneous in time. Test shall be achieved with the following durations: 1; 1,5; 2,5; 10; 30 and 150 cycles. See Figure 5, Figure 6, Figure 7 and Figure 8	Check that all durations and amplitudes reported on the dips/ swells/ interruption measurements are complying with IEC 61000-4-30 5.4.5.1 (amplitude accuracy requirement) and 5.4.5.2 (duration accuracy requirement) The expected duration results are Injected duration ± 0,5 cycles, see Figure 5 and Figure 6 where the expected duration is 3 cycles ± 0,5 cycles. The expected amplitude results are Injected Px amplitude ± 0,2 % U_{din} (Px being P5 or P3).
A4.1.3	Check threshold	P2 for swells [b c] P4 for Frequency [a] — P1 for swells [b c] P4 for Frequency [a] — P2 for Dips/Int. [b c] P4 for Frequency [a] — P1 for Dips/Int. [b c] P4 for Frequency [a]	This test does not require synchronized generator. The change of signal amplitude to create dips/swells/interruption will be simultaneous in time. Test shall be achieved with the following duration: 2,5 cycles.	Check the duration accuracy complies with IEC 61000-4-30 5.4.5.2 The expected duration result is 2,5 cycles ± 0,5 cycles.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A4.1.4	Check influence of mains frequency.	P1 for Frequency [a] [AC1) P3 for Dips/Int. (AC1] [b] P3 for Frequency [a] P2 for Dips/Int. [b]	This test does not require synchronized generator. The change of signal amplitude to create dips/swells/interruption will be simultaneous in time. Test shall be achieved with the following durations: 2 and 30 cycles.	Check the duration accuracy complies with IEC 61000-4-30 5.4.5.2 The expected duration result is respectively 2 and 30 cycles ± 0,5 cycles.
A4.1.5	Check dips / interruptions / swells in a polyphase system	A test shall be achieved according to the requirements of 6.4.2 and 6.4.3.		
A4.1.6	Check sliding voltage reference – Steady state operation [e]	1) configuration: select sliding reference voltage, dip threshold set to 90 %U_{sr}, hysteresis=2 % U_{din}. 2) Inject steady state voltage at U_{din} for at least 5 min. Then decrease voltage amplitude by to 95 % U_{din} for 5 min. Then 87 % U_{din} for 5 min.	See Figure 9	No dip should be detected.
		3) Inject dip of 5 cycles duration at 50 % U_{din}.		Verify that instrument is detecting a dip at 57,5 % of U_{ref}. NOTE 57,5 % = 50/87 × 100 %
A4.1.7	Check sliding voltage reference – Sliding reference start up condition [e]	1) configuration: select sliding reference voltage, dip threshold set to 90 % U_{din}, hysteresis = 2 % U_{din}. 2) Turn on the instrument with 0V injected at the voltage inputs.	See Figure 10	The instrument shall detect an interruption start.
		3) After 5 min + instrument boot up time, inject voltage = U_{din} NOTE 2 The purpose is to check that the sliding reference voltage is built from an initial value of U_{din}, not refreshed until the voltage is applied.		Verify that the instrument has detected an end of interruption

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)

[a] Instruments intended to work at 50 Hz shall use the figures provided line “Frequency 50 Hz”. Instruments intended to work at 60 Hz shall use the figures provided in line “Frequency 60 Hz”. Instruments intended to work both at 50 Hz and 60 Hz shall use the figures provided both in line “Frequency 50 Hz” and in line “Frequency 60 Hz”.

[b] Test points P1, P2, P3, P4 and P5 as described in Table 3 and in IEC 61000-4-30 table C.1.

[c] Test point P1 must not be identified as a dip/swell, and testing point P2 must be identified as a dip/swell.

[d] Recommended values for threshold dip is 90 % U_{din}, for swell threshold is 110 % U_{din}, Hysteresis =2 %.

[e] The use of sliding reference voltage is optional. This test is applicable only if the manufacturer implements sliding reference voltage.

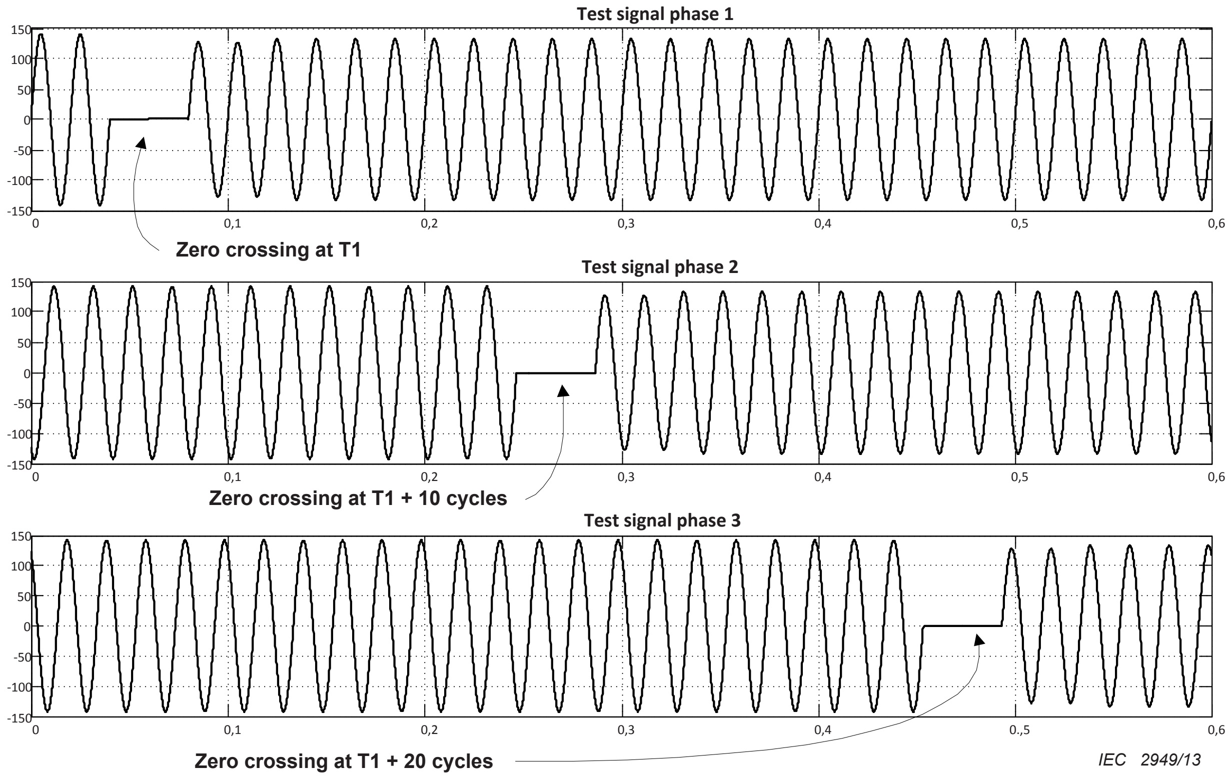


Figure 1 – Overview of test for dips according to test A4.1.1

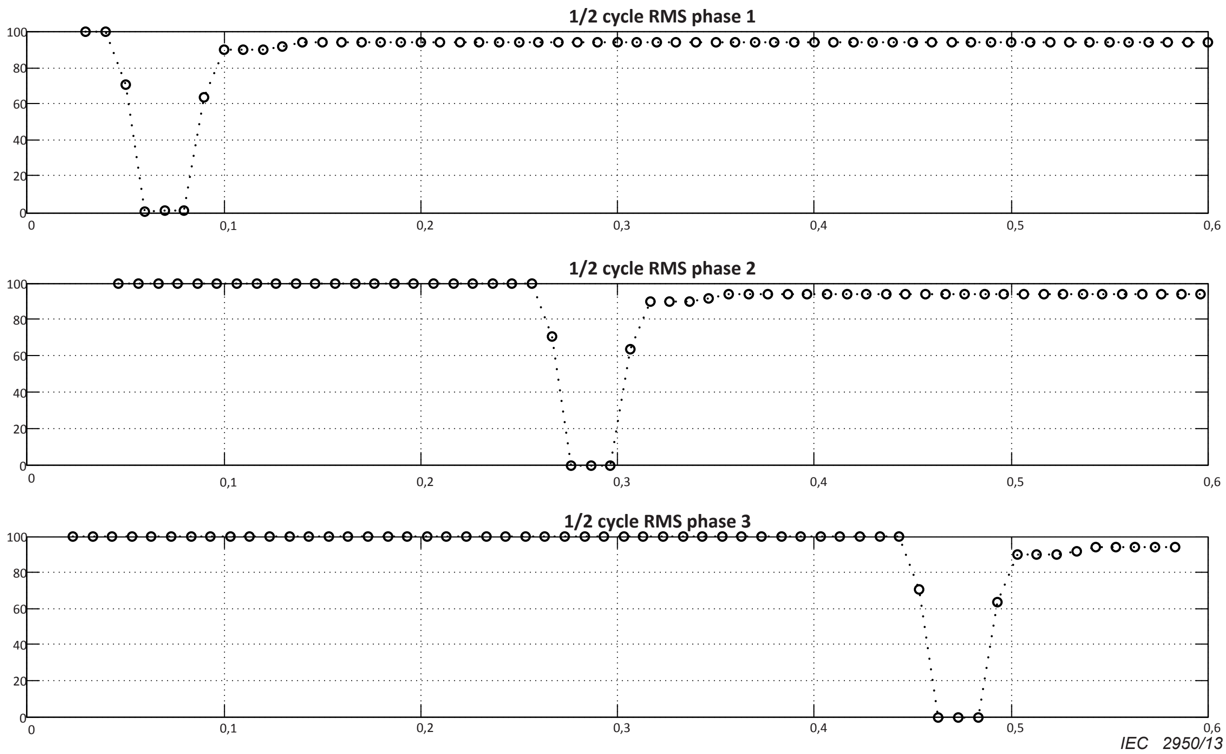


Figure 2 – Detail 1 of waveform for test of dips according to test A4.1.1

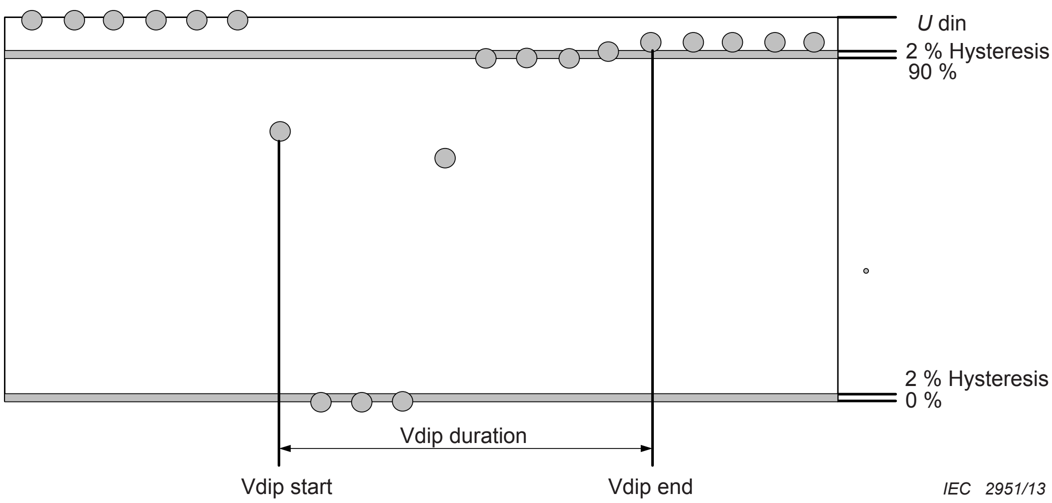


Figure 3 – Detail 2 of waveform for tests of dips according to A4.1.1

*U*rms(1/2) N	*U*rms(1/2) N+1	*U*rms(1/2) N+2	*U*rms(1/2) N+3	*U*rms(1/2) N+4	*U*rms(1/2) N+5	*U*rms(1/2) N+6	*U*rms(1/2) N+7
100	70	0	0	0	64	90	90

*U*rms(1/2) N+8	*U*rms(1/2) N+9	*U*rms(1/2) N+10	*U*rms(1/2) N+11	*U*rms(1/2) N+12	*U*rms(1/2) N+13	*U*rms(1/2) N+14	*U*rms(1/2) N+15
90	92	94	94	94	94	94	94

Figure 4 – Detail 3 of waveform for tests of dips according to test A4.1.1

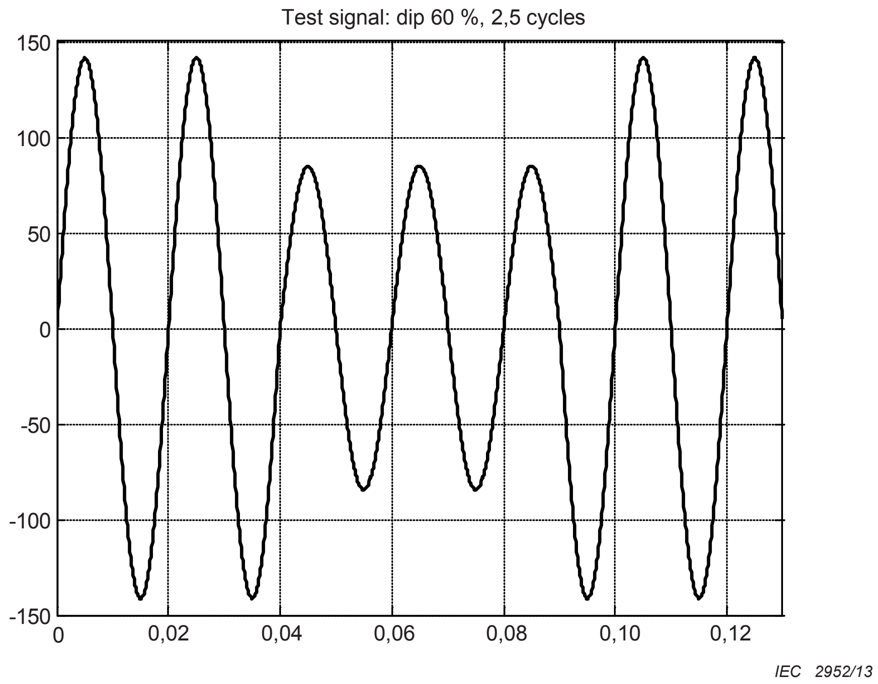


Figure 5 – Detail 1 of waveform for test of dips according to test A4.1.2

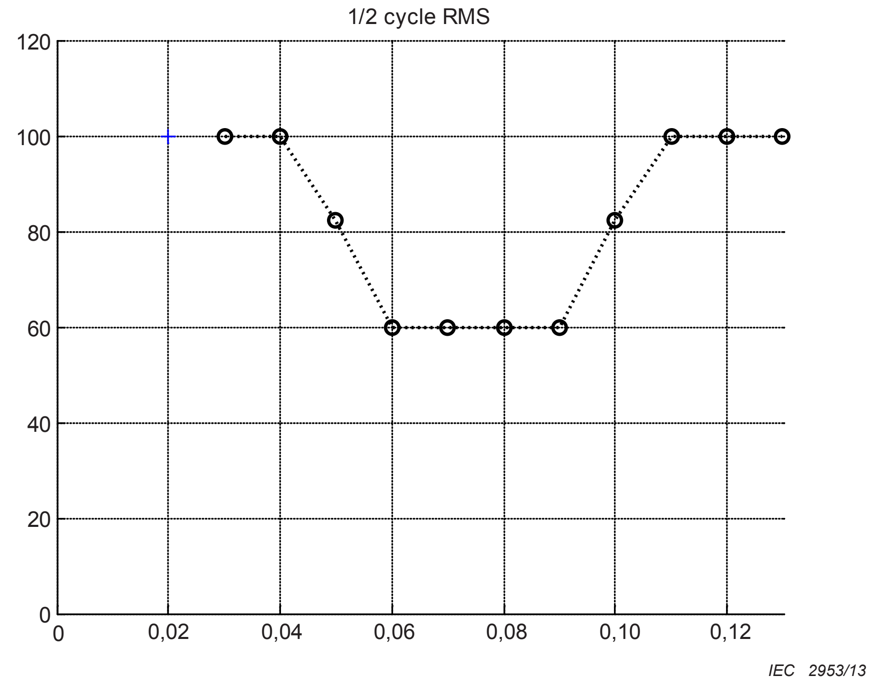


Figure 6 – Detail 2 of waveform for tests of dips according to test A4.1.2

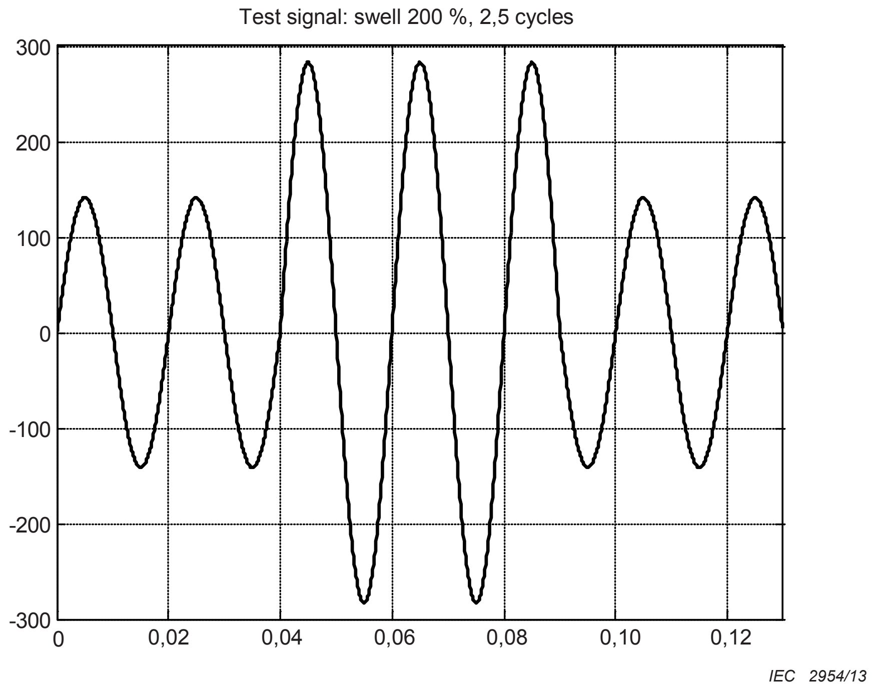


Figure 7 – Detail 1 of waveform for test of swells according to test A4.1.2

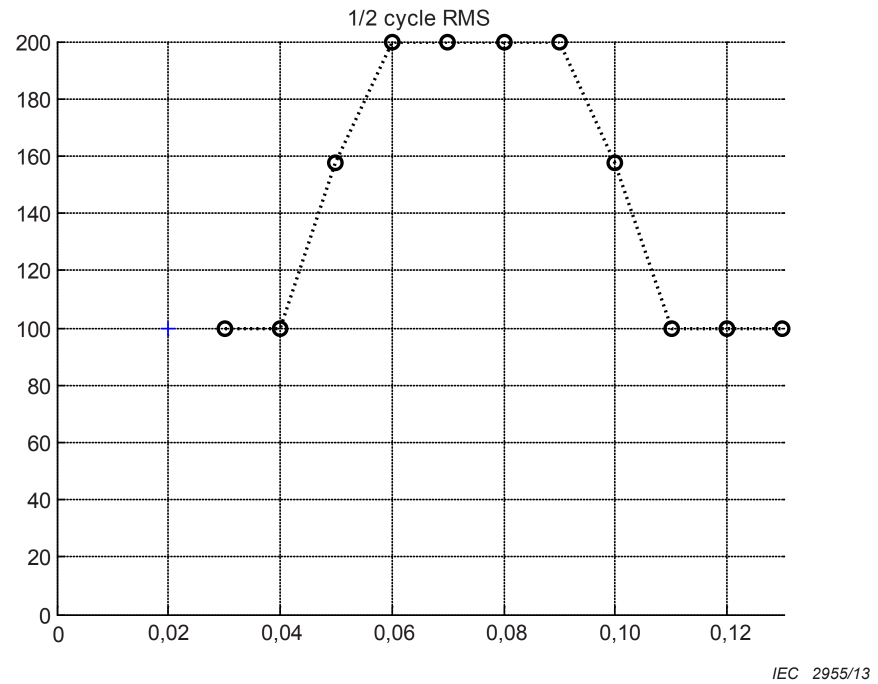


Figure 8 – Detail 2 of waveform for tests of swells according to test A4.1.2

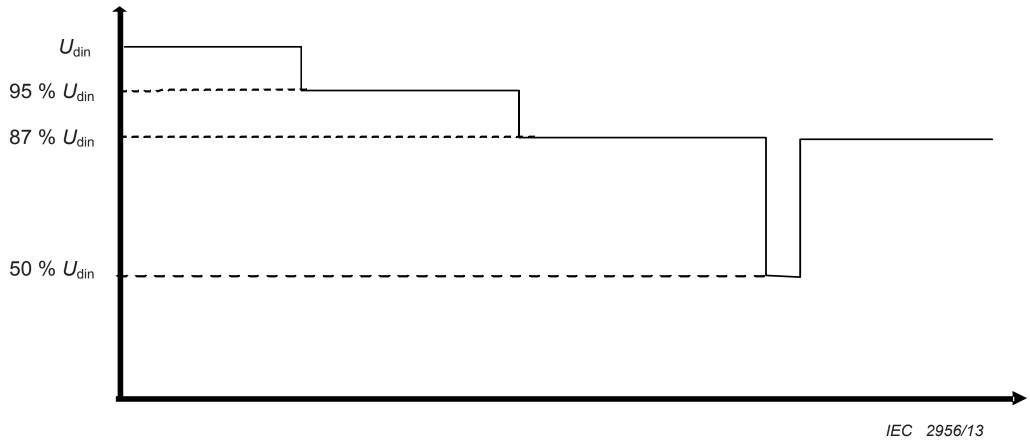


Figure 9 – Sliding reference voltage test

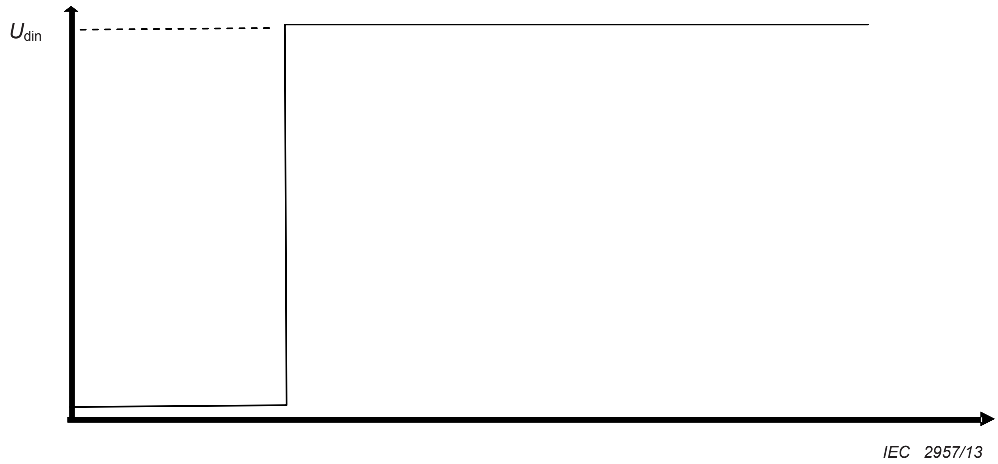
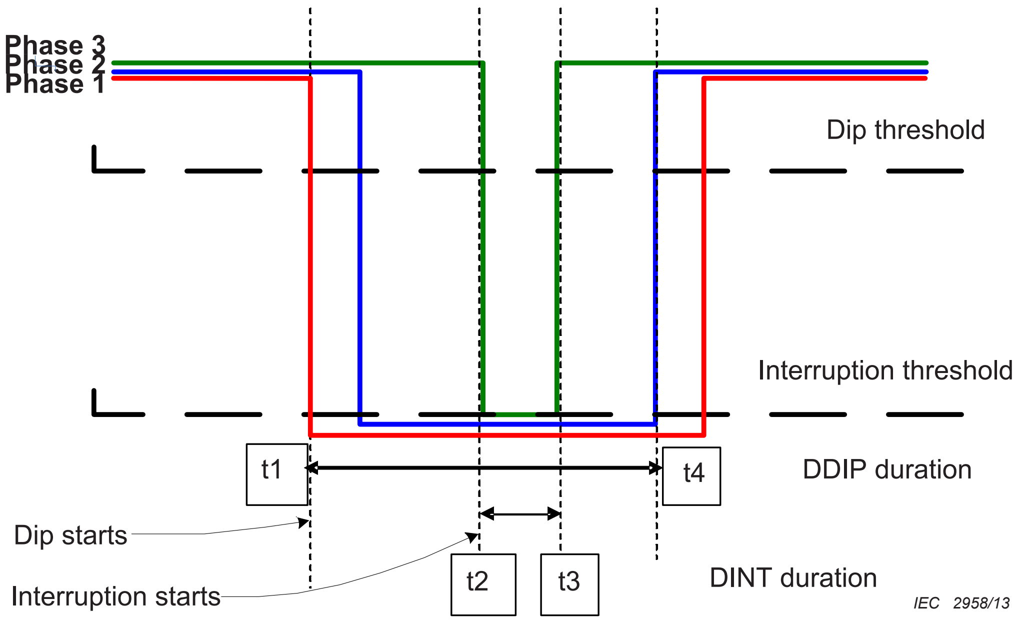


Figure 10 – Sliding reference start up condition

6.4.2 Check dips / interruptions in polyphase system

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A4.2.1	Check that dips and interruptions are properly detected in a polyphase system, by applying a single test with a 3 phase non synchronous disturbance that contains both a dip and an interruption	P4 for frequency for at least 15 s. Dip threshold = 90 % U_{din}, hysteresis = 2 % U_{din} Interruption threshold = 10 % U_{din}, hysteresis =2 % U_{din} Voltage steps should be made on zero crossing for each phase.	This test does not require a synchronized generator. - Begin the test with all three phases set to U_{din} - At t1 (synchronized to zero crossing on phase 1), inject 0 % U_{din} on phase 1 - At t1+1cycle (synchronized to zero crossing on phase 2), inject 0 % U_{din} on phase 2 - At t2 (synchronized to zero crossing on phase 3), inject 0 % U_{din} on phase 3 - At t3 (synchronized to zero crossing on phase 3), inject 100 % U_{din} on phase 3 - At t3+1cycle (synchronized to zero crossing on phase 2), inject 100 % U_{din} on phase 2 - At t4 (synchronized to zero crossing on phase 1), inject 100 % U_{din} on phase 1 See Figure 11, Figure 12 and Figure 13	- For each channel, check that the sequence of *U*rms(1/2) in the instrument complies to the sequence defined in Figure 9. - Check that the polyphase dip duration is correctly reported as 6,5 cycles (within the timing accuracy defined in IEC 61000-4-30). - Check that the polyphase interruption duration is correctly reported as 1,5 cycles (within the timing accuracy defined in IEC 61000-4-30). - Check that the remaining voltage for the dip measurement is correctly reported as 0 % U_{din} (within the magnitude accuracy defined in IEC 61000-4-30).



NOTE The figure is not drawn to scale.

Figure 11 – Detail 1 of waveform for test of polyphase dips/interruptions

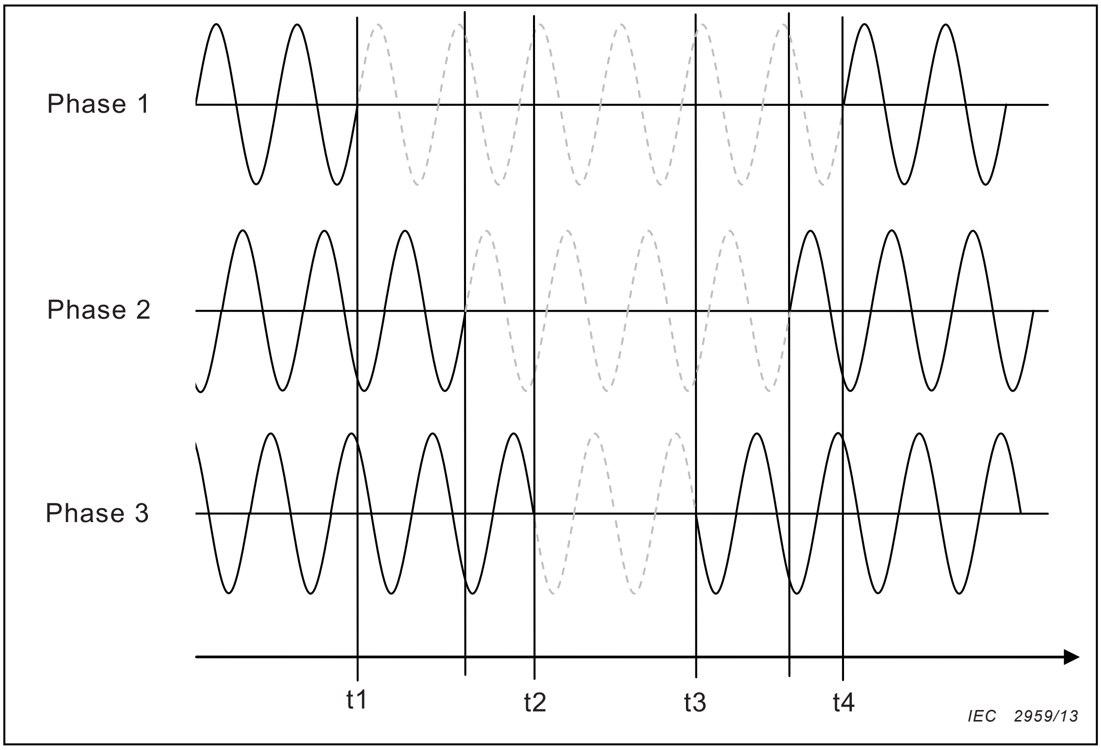


Figure 12 – Detail 2 of waveform for test of polyphase dips/interruptions

	*U*rms(1/2) N	*U*rms(1/2) N+1 (start of dip)	*U*rms(1/2) N+2	*U*rms(1/2) N+3	*U*rms(1/2) N+4	*U*rms(1/2) N+5	*U*rms(1/2) N+6 (start of interrupt.)	*U*rms(1/2) N+7
Phase 1	100	70	0	0	0	0	0	0
Phase 2	100	100	100	70	0	0	0	0
Phase 3	100	100	100	100	100	70	0	0

	*U*rms(1/2) N+8	*U*rms(1/2) N+9 (end of interrupt.)	*U*rms(1/2) N+10	*U*rms(1/2) N+11	*U*rms(1/2) N+12	*U*rms(1/2) N+13	*U*rms(1/2) N+14 (end of dip)	*U*rms(1/2) N+15
Phase 1	0	0	0	0	0	70	100	100
Phase 2	0	0	0	70	100	100	100	100
Phase 3	0	70	100	100	100	100	100	100

Figure 13 – Detail 3 of waveform for test of polyphase dips/interruptions

6.4.3 Check swells in polyphase system

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A4.3.1.	Check that swells are properly detected in a polyphase system by applying a single test with a 3 phase non synchronous swell injection	P4 for frequency for at least 15 s. Swell threshold = 110 % U_{din}, hysteresis = 2 % U_{din} Voltage steps shall be made on zero crossing for each phase.	This test does not require a synchronized generator. – Begin the test with all three phases set to U_{din} – At t1 (synchronized to zero crossing on phase 1), inject 130 % U_{din} on phase 1 – At t1+1cycle (synchronized to zero crossing on phase 2), inject 130 % U_{din} on phase 2 – At t1+2cycles (synchronized to zero crossing on phase 3), inject 150 % U_{din} on phase 3 – At t1+4cycles (synchronized to zero crossings on phase 1 and phase 3), inject 100 % U_{din} on both phase 1 and phase 3 – At t3 (synchronized to zero crossing on phase 2), inject 100 % U_{din} on phase 2 See Figure 14 and Figure 15	– for each channel, check that the sequence of *U*rms(1/2) in the instrument complies to the sequence defined in Figure 15 – Check that the polyphase swell duration is correctly reported as 6,5 cycles (within the timing accuracy defined in IEC 61000-4-30). – Check that the polyphase swell amplitude is correctly reported as 150 % U_{din} (within the magnitude accuracy defined in IEC 61000-4-30).

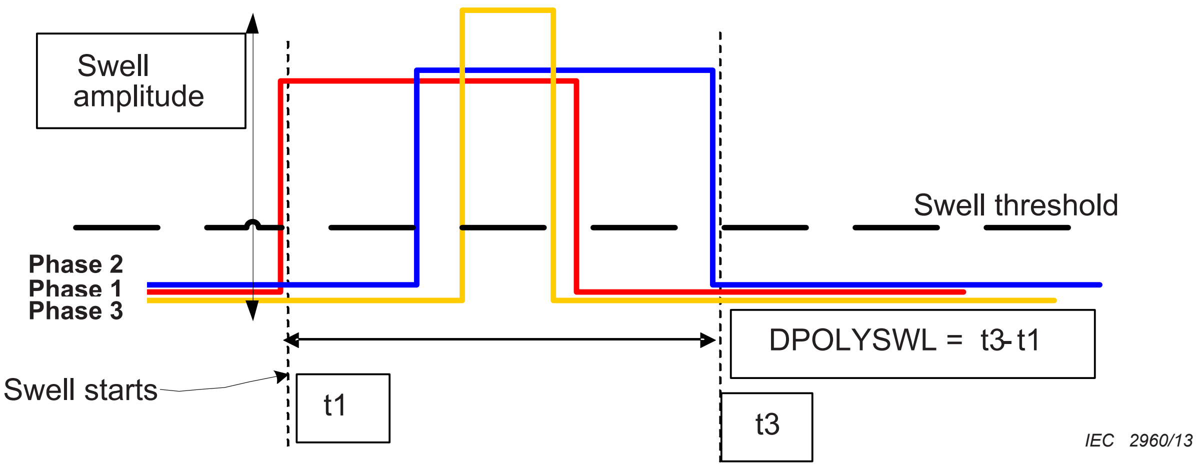


Figure 14 – Detail 1 of waveform for test of polyphase swells

	*U*rms(1/2) N	*U*rms(1/2) N+1 (start of swell)	*U*rms(1/2) N+2	*U*rms(1/2) N+3	*U*rms(1/2) N+4	*U*rms(1/2) N+5	*U*rms(1/2) N+6	*U*rms(1/2) N+7
Phase 1	100	116	130	130	130	130	130	130
Phase 2	100	100	100	116	130	130	130	130
Phase 3	100	100	100	100	100	127	150	150

	*U*rms(1/2) N+8	*U*rms(1/2) N+9	*U*rms(1/2) N+10	*U*rms(1/2) N+11	*U*rms(1/2) N+12	*U*rms(1/2) N+13	*U*rms(1/2) N+14 (end of swell)	*U*rms(1/2) N+15
Phase 1	130	116	100	100	100	100	100	100
Phase 2	130	130	130	130	130	116	100	100
Phase 3	150	127	100	100	100	100	100	100

Figure 15 – Detail 2 of waveform for test of polyphase swells

6.5 Supply voltage unbalance

6.5.1 General

Use a 3 channel AC power source that meets or exceeds the following stability ratings under the reference conditions: voltage ±0,05 %

NOTE Reference conditions for PQI are defined in IEC 62586-1.

6.5.2 Measurement method, measurement uncertainty and measuring range

N°	Target of the test	Testing conditions	Complementary test conditions	Test criterion (if test is applicable)
A5.1.1	Check accuracy of unbalance measurement	Connect a 3 channel AC power source and adjust Channel 1 (L1 to N) to 100 % of U_{din} Channel 2 (L2 to N) to 100 % of U_{din} Channel 3 (L3 to N) to 100 % of U_{din}	---	check if u0 and u2 is between 0 % and 0,15 %
A5.1.2	Check accuracy of unbalance measurement	Connect the 3 channel AC power source and adjust Channel 1 (L1 to N) to 73 % of U_{din} Channel 2 (L2 to N) to 80 % of U_{din} Channel 3 (L3 to N) to 87 % of U_{din}	---	check if u0 and u2 is between 4,9 % and 5,2 %

N°	Target of the test	Testing conditions	Complementary test conditions	Test criterion (if test is applicable)
A5.1.3	Check accuracy of unbalance measurement	Connect the 3 channel AC power source and adjust Channel 1 (L1 to N) to 152 % of U_{din} Channel 2 (L2 to N) to 140 % of U_{din} Channel 3 (L3 to N) to 128 % of U_{din}	---	check if u0 and u2 is between 4,8 % and 5,1 %
A5.1.4	Check accuracy of unbalance measurement with phase displacement with a 4 wires system.	Connect a 3 channel AC power source and adjust Channel 1 (L1 to N) to 100 % of U_{din} , 0° Channel 2 (L2 to N) to 90 % of U_{din} , -122° Channel 3 (L3 to N) to 100 % of U_{din} , +118°	---	check if u0 = 2,47 % ± 0,15 % and u2 = 4,52 % ± 0,15 %

6.5.3 Aggregation

It shall be verified that the aggregated values are provided by the equipment under test. An accuracy test of the aggregated values is not required.

6.6 Voltage harmonics

6.6.1 Measurement method

Each test shall last at least 10 seconds.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A6.1.1	Check that the 10/12-cycle measurement intervals are gapless and non-overlapping	A test shall be achieved according to the requirements of Annex E		
A6.1.2	Check that the 10/12-cycle measurements use the harmonic subgroup measurement (*U*sg.n) from IEC 61000-4-7	Apply reference conditions, plus P1 for harmonics (verify basic subgroup measurement)	---	TC10/12(unc)-harm for the 2^{nd} harmonic (2^{nd} harmonic is present at 5 %)
		Apply reference conditions, plus P1 for interharmonics)	---	TC10/12(unc)-harm for the 2^{nd} harmonic (no significant content detected)
		Apply reference conditions, plus S4 for interharmonics	---	TC10/12(unc)-harm for the 2^{nd} harmonic (2^{nd} harmonic is present at 4 %)
A6.1.3	Check that measurements are made at least up to the 50^{th} order	---	---	Verify that at least 50 harmonics are provided by the device
A6.1.4	If total harmonic distortion is calculated, check that it is the subgroup total harmonic distortion (THDS) from IEC 61000-4-7	Apply reference conditions plus P5 for harmonics	---	TC150/180(unc)-thd (significant distortion detected)
		Apply reference conditions plus P5 for interharmonics	---	TC150/180(unc)-thd (no significant distortion detected)

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A6.1.5	Check that a crest factor of at least 2 is supported by the device	Apply reference conditions plus S1 for harmonics (crest factor of 2)	---	TC150/180(unc)-harm for all 50 harmonics
A6.1.6	[AC1) Check that a properly designed antialiasing filter is used on the device, providing (in combination with oversampling) an attenuation exceeding 50 dB for any frequency producing an alias below or up to the 50th harmonic. (AC1]	Apply reference conditions plus 10 % of U_{din} at 75,0 × the fundamental frequency [a]	---	TC150/180(unc)-harm for all 50 harmonics (no aliasing detected)
		Apply reference conditions plus 10 % of U_{din} at 150,0 × the fundamental frequency [a]	---	TC150/180(unc)-harm for all 50 harmonics (no aliasing detected)
		Apply reference conditions plus 10 % of U_{din} at 501,0 × the fundamental frequency [a]	---	TC150/180(unc)-harm for all 50 harmonics (no aliasing detected)

[a] Only three mandatory anti-aliasing test points are defined here to simplify the minimum testing requirement. However, depending on the sampling rate and filter characteristics of the device under test, other spectral content may be required to properly evaluate the operation of an anti-aliasing filter. The test lab applying this procedure may additionally choose to apply a set of broad spectrum signals as a more exhaustive test of the anti-aliasing filter, using a network analyzer or other similar equipment.

6.6.2 Measurement uncertainty and measuring range

6.6.2.1 Uncertainty under reference conditions

Each test shall last at least 10 s.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A6.2.1	Check measuring uncertainty – single even harmonic	Reference conditions plus P1 for harmonics	---	TC150/180(unc)-harm for applicable harmonics
A6.2.2	Check measuring uncertainty – single odd harmonic	Reference conditions plus P2 for harmonics	---	TC150/180(unc)-harm for applicable harmonics
A6.2.3	Check measuring uncertainty – single high harmonic	Reference conditions plus P3 for harmonics	---	TC150/180(unc)-harm for applicable harmonics
A6.2.4	Check measuring range – low end	Reference conditions plus P4 for harmonics	---	TC150/180(unc)-harm for applicable harmonics
A6.2.5	Check measuring range – high end	Reference conditions plus P5 for harmonics	---	TC150/180(unc)-harm for applicable harmonics

NOTE The 150/180-cycle values are selected for these tests for ease of data extraction, as it will be necessary to extract measurement data for all 50 harmonics, and this is easier to do in a 3-s window than a shorter one.

6.6.2.2 Variations due to single influence quantities

Each test shall last at least 10 s.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions according to Table 4	Test criterion (if test is applicable)
A6.3.1	Check influence of frequency on measurement uncertainty	Reference conditions plus P1 for harmonics (lowest harmonic order)	S1 for frequency (lowest frequency)	TC150/180(unc)-harm for all 50 harmonics
		Reference conditions plus P3 for harmonics (highest harmonic order)	S3 or S4for frequency (highest frequency)	TC150/180(unc)-harm for all 50 harmonics
A6.3.2	Check influence of voltage magnitude on measurement uncertainty	Reference conditions plus P2 for harmonics	S1 for voltage magnitude (lowest voltage)	TC150/180(unc)-harm for all 50 harmonics
		Reference conditions plus P2 for harmonics	S3 for voltage magnitude (highest voltage)	TC150/180(unc)-harm for all 50 harmonics
NOTE The 150/180-cycle values are selected for these tests for ease of data extraction, as it will be necessary to extract measurement data for all 50 harmonics, and this is easier to do in a 3-s window than a shorter one.				

6.6.3 Measurement evaluation

Not applicable.

6.6.4 Measurement aggregation

6.6.4.1 10/12 cycles with 10 min synchronization

Each test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A6.4.1	Check aggregation overlap 1	Reference conditions plus P2 for harmonics	f = 49,99 Hz or 59,99 Hz Test duration = 11 min	Test the time tag, and the sequence number of blocks for the 3rd harmonic.
10 min tick should occur in the middle of the 10/12 cycle time interval number 3000. NOTE 59,99 Hz = (2999,5/600) × 12; 49,99 Hz = (2999,5/600) × 10				

6.6.4.2 150/180 cycle aggregation with 10 min synchronization

Each test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A6.5.1	Check aggregation overlap 2	Maintain reference conditions (including a constant fundamental component), and add varying harmonic content as described: – Start at P2 for harmonics – Ramp the harmonic content down by 1 %/s until it reaches 0 % – Ramp the harmonic content up by 1 %/s until it reaches P2 – Repeat	f = 50,125 Hz (covering 50 Hz) or 60,15 Hz (covering 60 Hz) depending on manufacturer selection.	TC150/180(unc)-harm for the 3rd harmonic, with correct aggregation of the 10/12-cycle values for each of the two overlapping 150/180-cycle aggregation intervals
10 min tick should occur in the middle of the 150/180 cycle time interval number 201. NOTE 50,125 Hz = (200,5/600) × 150; 60,15 Hz = (200,5/600) × 180				

6.6.4.3 10 min aggregation

Each test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A6.6.1	Check 10-min aggregation	Maintain reference conditions (including a constant fundamental component), and add varying harmonic content as described: – Start at P2 for harmonics – Ramp the harmonic content down by 1 %/s until it reaches 0 % – Ramp the harmonic content up by 1 %/s until it reaches P2 – Repeat	f = 49,99 Hz or 59,99 Hz Test duration = 11 min	TC10-min(unc)-harm for the third harmonic, with correct aggregation of the 10/12-cycle values based on the block sequence numbers
10 min tick should occur in the middle of the 10/12 cycle time interval number 3000. NOTE 59,99 Hz = (2999,5/600) × 12; 49,99 Hz = (2999,5/600) × 10				

6.6.4.4 2 h aggregation

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A6.7.1	Check 2-hour aggregation	It shall be checked that the 2 h aggregated value is provided by the equipment under test.		

6.7 Voltage inter-harmonics

6.7.1 Measurement method

Each test shall last at least 10 s.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A7.1.1	Check that the 10/12-cycle measurement intervals are gapless and non-overlapping	A test shall be achieved according to the requirements of Annex E		
A7.1.2	Check that the 10/12-cycle measurements use the interharmonic subgroup measurement (Uisg.h) from IEC 61000-4-7	Apply reference conditions, plus P1 for harmonics	---	TC10/12(unc)-interharm for the two interharmonics surrounding the 2^{nd} harmonic (no significant content on either interharmonic)
		Apply reference conditions, plus P1 for interharmonics	---	TC10/12(unc)-interharm for the interharmonic between the fundamental and the 2^{nd} harmonic (interharmonic is present)
A7.1.3	Check that measurements are made at least up to the 50^{th} order	---	---	Verify that at least 50 interharmonics are provided by the device

6.7.2 Measurement uncertainty and measuring range

6.7.2.1 Uncertainty under reference conditions

Each test shall last at least 10 s.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A7.2.1	Check measuring uncertainty – no interharmonics	Reference conditions	---	TC150/180(unc)-interharm for all 50 interharmonics
A7.2.2	Check measuring uncertainty – single low order interharmonic	P1 for interharmonics	---	TC150/180(unc)-interharm for all 50 interharmonics
A7.2.3	Check measuring uncertainty – single medium order interharmonic	P2 for interharmonics	---	TC150/180(unc)-interharm for all 50 interharmonics
A7.2.4	Check measuring uncertainty – single high order interharmonic	P3 for interharmonics	---	TC150/180(unc)-interharm for all 50 interharmonics
A7.2.5	Check measuring range – low end	P4 for interharmonics	---	TC150/180(unc)-interharm for all 50 interharmonics
A7.2.6	Check measuring range – high end	P5 for interharmonics	---	TC150/180(unc)-interharm for all 50 interharmonics
The 150/180-cycle values are selected for these tests for ease of data extraction, as it will be necessary to extract measurement data for all 50 interharmonics, and this is easier to do in a 3 s window than a shorter one.				

6.7.2.2 Variations due to single influence quantities

Each test shall last at least 10 s.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions according to Table 4	Test criterion
A7.3.1	Check influence of frequency on measurement uncertainty	P1 for interharmonics (lowest interharmonic order	S1 for frequency (lowest frequency)	TC150/180(unc)-interharm for all 50 interharmonics
		P3 for interharmonics (highest interharmonic order)	S4 for frequency (highest frequency)	TC150/180(unc)-interharm for all 50 interharmonics
A7.3.2	Check influence of voltage magnitude on measurement uncertainty	P2 for interharmonics	S1 for voltage magnitude (lowest voltage)	TC150/180(unc)-interharm for all 50 interharmonics
		P2 for interharmonics	S3 for voltage magnitude (highest voltage)	TC150/180(unc)-interharm for all 50 interharmonics
The 150/180-cycle values are selected for these tests for ease of data extraction, as it will be necessary to extract measurement data for all 50 interharmonics, and this is easier to do in a 3-s window than a shorter one.				

6.7.3 Measurement evaluation

Not applicable.

6.7.4 Measurement aggregation

6.7.4.1 10/12 cycles with 10 min synchronization

Each test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A7.4.1	Check aggregation overlap 1	P2 for interharmonics	f = 49,99 Hz or 59,99 Hz Test duration = 11 min	Test the time tag, and the sequence number of blocks for the interharmonic at 7,5xthe fundamental frequency.
10 min tick should occur in the middle of the 10/12 cycle time interval number 3000. NOTE 59,99 Hz = (2999,5 / 600) × 12; 49,99 Hz = (2999,5 / 600) × 10				

6.7.4.2 150/180 cycle aggregation with 10 min synchronization

Each test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A7.5.1	Check aggregation overlap 2	Maintain reference conditions (including a constant fundamental component), and add varying interharmonic content as described: – Start at P2 for interharmonics	f = 50,125 Hz (covering 50 Hz) or 60,15 Hz (covering 60 Hz) depending on manufacturer selection.	TC150/180(unc)-interharm for the interharmonic at 7,5xthe fundamental frequency, with correct aggregation of the 10/12-cycle values for each of the two overlapping

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
		– Ramp the interharmonic content down by 1 %/s until it reaches 0 % – Ramp the interharmonic content up by 1 %/s until it reaches P2 – Repeat		150/180-cycle aggregation intervals
10 min tick should occur in the middle of the 150/180 cycle time interval number 201. NOTE 50,125 Hz = (200,5 / 600) × 150; 60,15 Hz = (200,5 / 600) × 180				

6.7.4.3 10 min aggregation

Each test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A7.6.1	Check 10-min aggregation	Maintain reference conditions (including a constant fundamental component), and add varying interharmonic content as described: – Start at P2 for interharmonics – Ramp the interharmonic content down by 1 %/s until it reaches 0 % – Ramp the interharmonic content up by 1 %/s until it reaches P2 – Repeat	f = 49,99 or 59,99 Hz Test duration = 11 min	TC10-min(unc)-interharm for the interharmonic at 7,5 × the fundamental frequency, with correct aggregation of t TC150/180(unc)-interharm for all 50 interharmonics he 10/12-cycle values based on the block sequence numbers
10 min tick should occur in the middle of the 10/12 cycle time interval number 3000. NOTE 59,99 Hz = (2999,5 / 600) × 12; 49,99 Hz = (2999,5 / 600) × 10				

6.7.4.4 2 h aggregation

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A7.7.1	Check 2-hour aggregation	It shall be checked that the 2 h aggregated value is provided by the equipment under test.		

6.8 Mains signalling voltages on the supply voltage

6.8.1 Measurement method

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A8.1.1	Verify that the user can specify the carrier frequency to monitor, up to 3 kHz	---	---	Product allows the user to configure monitored carrier frequencies up to 3 kHz
A8.1.2	Verify that the user can specify the detection threshold (above 0,3 % U_{din}) and length of recording period (up to 120s)	---	---	Product allows the user to configure detection threshold and recording period as specified
A8.1.3	If method 1[a] is implemented, verify proper implementation	Configure the product to monitor a carrier frequency of 1 060 Hz. Apply the following test points for mains signalling, each of which apply two interharmonic frequencies simultaneously on the same signal under reference conditions.	---	---
		1060 Hz bin only (should count toward MsV): P3 at 1 060 Hz	---	TC10/12(unc), where the expected value is the RMS voltage for the component at 1060Hz only
		Two adjacent bins (should not count toward MsV): P3 at 1 055 Hz, and P3 at 1 065 Hz	---	TC10/12(unc), where the expected value is the RMS voltage for the component at 1060Hz only
A8.1.4	If method 2[b] is implemented, verify proper implementation	Configure the product to monitor a carrier frequency of 316,67 Hz. Apply the following test points for mains signalling, each of which apply two interharmonic frequencies simultaneously on the same signal under reference conditions.	---	---
		Middle two bins (should both count toward MsV): P3 at 315 Hz and P3 at 320 Hz	---	TC10/12(unc), where the expected value is the root of the sum of squares for the four bins closest to the monitored frequency only: 310 Hz 315 Hz 320 Hz 325 Hz

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
		Outer two bins (should both count toward MsV): P3 at 310 Hz and P3 at 325 Hz	---	TC10/12(unc), where the expected value is the root of the sum of squares for the four bins closest to the monitored frequency only: 310 Hz 315 Hz 320 Hz 325 Hz
		Two bins adjacent to the calculation range (should not count toward MsV): P3 at 305 Hz and P3 at 330 Hz	---	TC10/12(unc), where the expected value is the root of the sum of squares for the four bins closest to the monitored frequency only: 310 Hz 315 Hz 320 Hz 325 Hz
A8.1.5	If method 1[a] and method 2[b] are both implemented, and the manufacturer claims to dynamically select the method based on the user-specified frequency (IEC 61000-4-30 calls this the “preferred” approach), verify that the product uses the appropriate method	Same tests as 8.1.3 and 8.1.4, but applied sequentially without manual intervention (other than specifying the carrier frequency)	---	Product passes both 8.1.3 and 8.1.4 without manual intervention
A8.1.6	Verify that the product indicates when a signal exceeds the detection threshold	Configure the product to use a detection threshold of 0,5 %, and to monitor a carrier frequency of 316,67 Hz, then apply the two tests below.	---	---
		a) Apply P1 for mains signalling (carrier frequency of 316,67 Hz).	---	The product does <u>not</u> indicate that the signal has exceeded the detection threshold
		b) Apply P2 for Mains Signalling (carrier frequency of 316,67 Hz).	---	The product <u>does</u> indicate that the signal has exceeded the detection threshold
A8.1.7	Verify that the product can record the 10/12-cycle signal voltage values during the recording period following the detection, to give the maximum level of the signal voltage during this time.	Configure the product to use a recording period of 120 s, and then apply the same test as 8.1.6 b).	---	The maximum level of the signal voltage during the 120 s recording period can be determined from the recorded 10/12-cycle values.

[a] “Method 1” refers to the method based on “the corresponding 10/12-cycle RMS value interharmonic bin”.

[b] “Method 2” refers to the method based on “the root of the sum of the squares of the 4 nearest 10/12-cycle RMS value interharmonic bins”.

6.8.2 Measurement uncertainty and measuring range

6.8.2.1 Uncertainty under reference conditions

Each test shall last at least 1 s.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A8.2.1	Verify measurement uncertainty for a carrier frequency of 316,67 Hz	P2 for mains signalling (carrier frequency of 316,67 Hz)	---	TC10/12(unc) for the chosen method
		P3 for mains signalling (carrier frequency of 316,67 Hz)	---	TC10/12(unc) for the chosen method
		P4 for mains signalling (carrier frequency of 316,67 Hz)	---	TC10/12(unc) for the chosen method
		P5 for mains signalling (carrier frequency of 316,67 Hz)	---	TC10/12(unc) for the chosen method
A8.2.2	Verify measurement uncertainty for a carrier frequency of 1 060 Hz	P2 for mains signalling (carrier frequency of 1 060 Hz)	---	TC10/12(unc) for the chosen method
		P3 for mains signalling (carrier frequency of 1 060 Hz)	---	TC10/12(unc) for the chosen method
		P4 for mains signalling (carrier frequency of 1 060 Hz)	---	TC10/12(unc) for the chosen method
		P5 for mains signalling (carrier frequency of 1 060 Hz)	---	TC10/12(unc) for the chosen method
A8.2.3	Verify measurement uncertainty for a carrier frequency of 2 975 Hz	P2 for mains signalling (carrier frequency of 2 975 Hz)	---	TC10/12(unc) for the chosen method
		P3 for mains signalling (carrier frequency of 2 975 Hz)	---	TC10/12(unc) for the chosen method
		P4 for mains signalling (carrier frequency of 2 975 Hz)	---	TC10/12(unc) for the chosen method
		P5 for mains signalling (carrier frequency of 2 975 Hz)	---	TC10/12(unc) for the chosen method

6.8.2.2 Variations due to single influence quantities

Each test shall last at least 1 s.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions according to Table 4	Test criterion (if test is applicable)
A8.3.1	Check influence of frequency on measurement uncertainty	P3 for mains signalling (carrier frequency of 2 975 Hz)	S1 for Frequency	TC10/12(unc) for the chosen method
		P3 for mains signalling (carrier frequency of 1 060 Hz)	S3 for Frequency	TC10/12(unc) for the chosen method
		P3 for mains signalling (carrier frequency of 316,67 Hz)	S4 for Frequency	TC10/12(unc) for the chosen method

N°	Target of the test	Testing points according to Table 3	Complementary test conditions according to Table 4	Test criterion (if test is applicable)
A8.3.2	Check influence of voltage magnitude on measurement uncertainty	P3 for mains signalling (carrier frequency of 316,67 Hz)	S1 for Voltage magnitude	TC10/12(unc) for the chosen method
		P3 for mains signalling (carrier frequency of 316,67 Hz)	S3 for Voltage magnitude	TC10/12(unc) for the chosen method
A8.3.4	Check influence of harmonics on measurement uncertainty	P3 for mains signalling (carrier frequency of 316,67 Hz)	S1 for Harmonics	TC10/12(unc) for the chosen method
		P3 for mains signalling (carrier frequency of 1 060 Hz)	S1 for Harmonics	TC10/12(unc) for the chosen method

6.8.2.3 Measurement evaluation

Not applicable.

6.8.3 Aggregation

Not applicable.

6.9 Measurement of underdeviation and overdeviation parameters

6.9.1 Measurement method

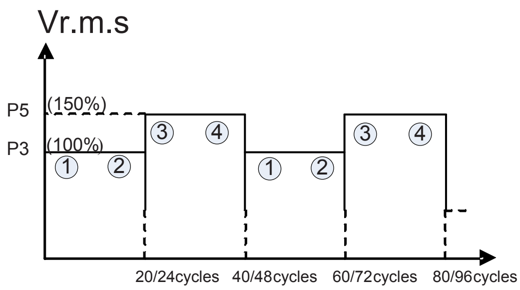
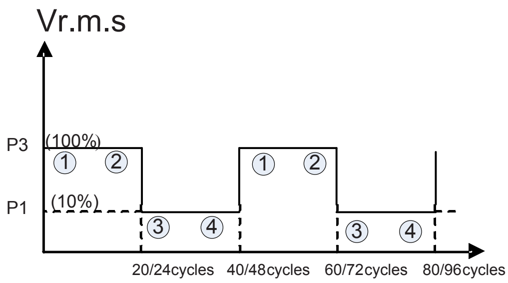
Tests for the measurement method are specified in the table below for 10/12-cycle values only (aggregation is specified in a later section).

IEC 61000-4-30:2008 describes the measurement method for $U_{\text{rms-under,i}}$ and $U_{\text{rms-over,i}}$ based on the 10/12-cycle RMS value $U_{\text{rms-200ms,i}}$, where *i* denotes the specific 10/12-cycle interval. However, the underdeviation (U_{under}) and overdeviation (U_{over}) are only described within the aggregation section. The table below assumes that U_{under} and U_{over} may also be calculated for every 10/12-cycle interval, using the same formula from the aggregation section to aggregate a single 10/12-cycle value.

For the 10/12-cycle interval, a device shall make available at least one of U_{under} and $U_{\text{rms-under}}$, and at least one of U_{over} and $U_{\text{rms-over}}$. All of the values that are made available shall comply with the requirements stated below.

Each test shall last at least 1 s.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A9.1.1	Steady-state test – check for proper calculation of $U_{\text{rms-under}}$, U_{under}, $U_{\text{rms-over}}$ and U_{over} when $U_{\text{rms-200ms}} > U_{\text{din}}$	P5 for magnitude of supply voltage (voltage is 150 % of U_{din})	---	For every 10/12-cycle value: $U_{\text{rms-under}} = U_{\text{din}}$ U_{under} = 0 % $U_{\text{rms-over}} = U_{\text{rms-200ms}}$ $U_{\text{over}} = (U_{\text{rms-over}} – U_{\text{din}}) / U_{\text{din}}$ [approx 50 %]

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A9.1.2	Steady-state test – check for proper calculation of $U_{rms-under}$, U_{under}, $U_{rms-over}$ and U_{over} when $U_{rms-200ms} = U_{din}$	Reference conditions (magnitude of supply voltage is $U_{din} \pm 1$ %)	---	For every 10/12-cycle value: $U_{rms-under} = U_{din}$ or $U_{rms-200ms}$, whichever is lower $U_{under} = (U_{din} - U_{rms-under}) / U_{din}$ [approx 0 %] $U_{rms-over} = U_{din}$ or $U_{rms-200ms}$, whichever is higher $U_{over} = (U_{rms-over} - U_{din}) / U_{din}$ [approx 0 %]
A9.1.3	Steady-state test – check for proper calculation of $U_{rms-under}$, U_{under}, $U_{rms-over}$ and U_{over} when $U_{rms-200ms} < U_{din}$	P1 for magnitude of supply voltage (voltage is 10 % of U_{din})	---	For every 10/12-cycle value: $U_{rms-under} = U_{rms-200ms}$ (the magnitude of supply voltage) $U_{under} = (U_{din} - U_{rms-under}) / U_{din}$ [approx 90 %] $U_{rms-over} = U_{din}$ U_{over} = 0 %
A9.1.4	Non-steady-state test – check that all 10/12-cycle values are calculated without gaps			Sequence of expected values: 10/12-cycle values will repeat in groups of four states: 1. U_{under}= 0 % 2. U_{under}= 0 % 3. U_{under} = 50 % 4. U_{under}= 50 % NOTE Those values can deviate depending on 10/12 cycles synchronisation accuracy.
A9.1.5	Non-steady-state test – check that all 10/12-cycle values are calculated without gaps			Sequence of expected values: 10/12-cycle values will repeat in groups of four states: 1. $U_{under=}$ 0 % 2. U_{under}= 0 % 3. U_{under}= 90 % 4. U_{under}= 90 % NOTE Those values can deviate depending on 10/12 cycles synchronisation accuracy.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A9.1.6	Verify number of values produced	N/A	---	On single-phase systems, 1 value is provided for each of $U_{rms\text{-}under}$ and $U_{rms\text{-}over}$. On 3-phase 3-wire systems, 3 values are provided for each of $U_{rms\text{-}under}$ and $U_{rms\text{-}over}$. On 3-phase 4-wire systems, either 6 values or 3 values are provided for each of $U_{rms\text{-}under}$ and $U_{rms\text{-}over}$.

6.9.2 Measurement uncertainty and measuring range

6.9.2.1 General

For underdeviation and overdeviation, the calculated values are dependent on the underlying 10/12-cycle RMS values, as specified for the magnitude of supply voltage. The relevant tests in 6.2.4.1 are considered necessary and sufficient to verify the measurement uncertainty and measuring range, as described below.

6.9.2.2 Uncertainty under reference conditions

Covered by 6.2.4.1.

It is sufficient to verify that the underlying 10/12-cycle calculations for magnitude of supply voltage meet the relevant accuracy and range requirements.

6.9.2.3 Variations due to single influence quantities

Covered by 6.2.4.1.

It is sufficient to verify that the underlying 10/12-cycle calculations for magnitude of supply voltage meet the relevant accuracy and range requirements.

6.9.3 Measurement evaluation

Not applicable.

6.9.4 Measurement aggregation

6.9.4.1 General

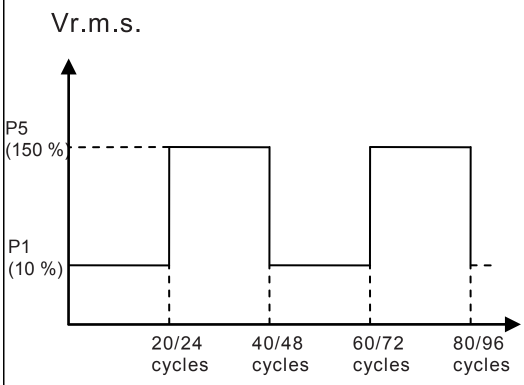
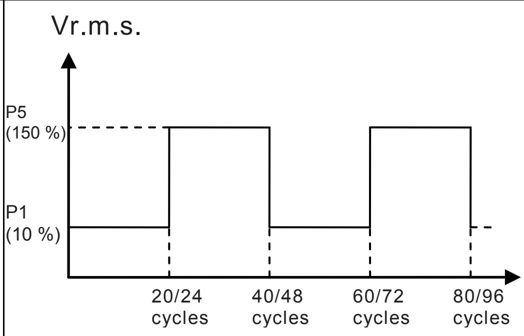
In IEC 61000-4-30:2008, Equations (6) and (7) specify the aggregation method for underdeviation and overdeviation in a slightly different manner than for other parameters. The following tests are intended to verify that these aggregation methods are implemented properly.

6.9.4.2 10/12 cycles with 10 min synchronisation

Covered by 6.2.2.

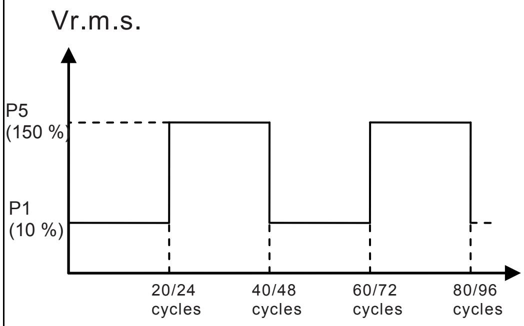
It is sufficient to verify that the underlying 10/12-cycle calculations for magnitude of supply voltage are properly synchronized at the 10-min tick.

6.9.4.3 150/180 cycles aggregation with 10 min synchronisation

<table>
<tr><th>N°</th><th>Target of the test</th><th>Testing points according to Table 3</th><th>Complementary test conditions</th><th>Test criterion (if test is applicable)</th></tr>
<tr><td>A9.2.1</td><td>Verify proper aggregation of U_{under} and U_{over} for the 150/180-cycle interval (according to equations 6 and 7 from IEC 61000-4-30:2008):
$$U_{under} = \frac{U_{din} - \sqrt{\frac{\sum_{i=1}^{n} U^2_{rms-under,i}}{n}}}{U_{din}} \quad [\%]$$
$$U_{over} = \frac{\sqrt{\frac{\sum_{i=1}^{n} U^2_{rms-over,i}}{n}} - U_{din}}{U_{din}} \quad [\%]$$</td><td colspan="2">
Frequency = 50 Hz / 60 Hz (or both when applicable)
Test shall last at least 10 s.</td><td>The 10/12-cycle RMS values will repeat in groups of four, as per 9.1.3.
These 10/12-cycle RMS values shall be recorded, and synchronized with the associated 150/180-cycle values for U_{under} and U_{over}.
The 150/180-cycle values must be consistent with the theoretical values derived from the 10/12-cycle RMS values, using Equations 6 and 7.</td></tr>
<tr><td>A9.2.2</td><td>Verify that the 150/180-cycle aggregations for U_{under} and U_{over} are re-synchronized at the 10-min tick</td><td colspan="2">
Frequency = 50,125 Hz / 60,15 Hz (or both when applicable)
Test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.</td><td>The 10/12-cycle RMS values will repeat in groups of four, as per 9.1.3.
These 10/12-cycle RMS values shall be recorded, and synchronized with the associated 150/180-cycle values for U_{under} and U_{over}.
The final 150/180-cycle value in one 10-min interval and the first (re-synchronized) 150/180-cycle value in the next 10-min interval shall both be consistent with the theoretical values derived from the 10/12-cycle RMS values, using equations 6 and 7.</td></tr>
<tr><td colspan="5">10 min tick should occur in the middle of the 150/180 cycle time interval number 201.
NOTE 50,125 Hz = (200,5 / 600) × 150; 60,15 Hz = (200,5 / 600) × 180.</td></tr>
</table>

6.9.4.4 10-min aggregation

Each test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A9.3.1	Verify proper aggregation of *U*under and *U*over for the 10-min interval (according to Equations 6 and 7 from IEC 61000-4-30:2008): $$U_{under} = \frac{U_{din} - \sqrt{\frac{\sum_{i=1}^{n} U^2_{rms-under,i}}{n}}}{U_{din}} \quad [\%]$$ $$U_{over} = \frac{\sqrt{\frac{\sum_{i=1}^{n} U^2_{rms-over,i}}{n}} - U_{din}}{U_{din}} \quad [\%]$$	 Frequency = 50 Hz / 60 Hz (or both when applicable) Test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.		The 10/12-cycle RMS values will repeat in groups of four, as per 9.1.3. These 10/12-cycle RMS values shall be recorded for the entire 10-min interval, and lined up with the associated 10-min values for U_{under} and U_{over}. The 10-min values must be consistent with the theoretical values derived from the 10/12-cycle RMS values, using equations 6 and 7.

6.9.4.5 2 h aggregation

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A9.4.1	Check 2-hour aggregation	It shall be checked that the 2 h aggregated value is provided by the equipment under test.		

6.10 Flagging

N°	Target of the test	Testing points	Test criterion (if test is applicable)
A10.1.1	Check flagging is not set when flagging conditions are not met	This test shall include at least 1 complete 2 h interval. NOTE This test can be combined with another test that does not include flagging conditions.	Check there is no flagging in all aggregated intervals.
A10.1.2	Flagging in polyphase system caused by voltage dip For Plt flicker	Dip: 70 % of U_{din}, 1 channel, L2, Duration: 100 ms This test shall include at least 1 complete 2 h interval.	Each of the parameters listed below is flagged within each of the corresponding measurement intervals that contain the dip/swell/interruption (as illustrated in Figure 18): – Flicker (2-hour Plt) NOTE For reasons of efficiency, this test only examines the flagging of flicker (2-hour Plt values), even though other 2-hour values are also expected to be flagged.”
A10.1.3	Flagging in polyphase system caused by voltage dip [a]	Dip: 70 % of U_{din}, 1 channel, L2, Duration: 100 ms	Each of the parameters listed below is flagged within each of the corresponding measurement intervals that contain the dip/swell/interruption (as illustrated in Figure 16): – Power frequency (10-second) – Voltage magnitude (10/12-cycle, 150/180-cycle, 10-min) – Flicker (10-min Pst) – Supply voltage unbalance (10/12-cycle, 150/180-cycle, 10-min) – Voltage harmonics (10/12-cycle, 150/180-
A10.1.4	Flagging in polyphase system caused by voltage	Swell: 120 % of U_{din}, 2 channels, L1+L3, Duration:	

N°	Target of the test	Testing points	Test criterion (if test is applicable)
	swell [a]	100 ms	cycle, 10-min)
A10.1.5	Flagging in polyphase system caused by voltage interruption [a]	Interruption: 0 % of U_{din}, 3 channels, L1+L2+L3, Duration: 100 ms	– Voltage interharmonics (10/12-cycle, 150/180-cycle, 10-min) – Mains signalling (10/12-cycle) – Underdeviation and overdeviation (10/12-cycle, 150/180-cycle, 10-min)”

The 100 ms dip / swell / interruption must begin and end within the same 10/12-cycle interval, and within the same 10 s interval for frequency.

[a] For instruments using the polyphase approach for data flagging, the flag is applied to all measured phases. For instruments using the channel by channel approach, the flag is applied only to the phase(s) containing the dip / swell / interruption event. The polyphase approach and the channel by channel approach is defined in IEC 62586-1.

NOTE See explanation in Figure 16.

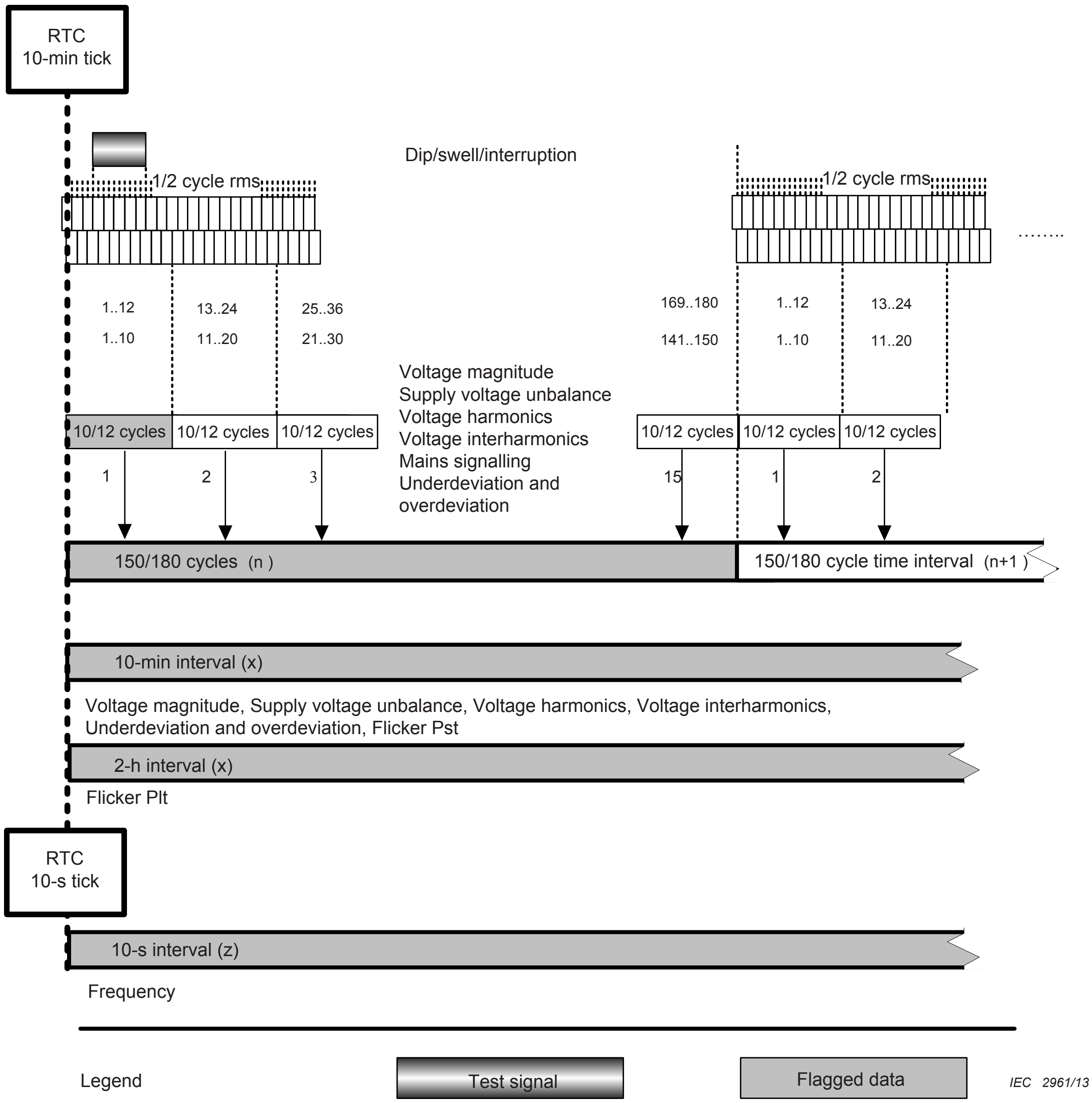


Figure 16 – Flagging test for class A

6.11 Clock uncertainty testing

<table>
<tr><th>N°</th><th>Target of the test</th><th>Testing points according to Table 3</th><th>Complementary test conditions</th><th>Test criterion (if test is applicable)</th></tr>
<tr><td>A11.1.1</td><td>Check clock uncertainty</td><td colspan="3">1) Verify that instrument is operating with clock synchronization (check device status).
2) Inject a fixed duration interruption with a synchronized signal generator and note start time of interruption T1start.
3) Verify the instrument has detected an interruption and note the measured start time (reading) T1start_mes. Check the accuracy of T1start_mes, it shall be T1start ± 1 cycle.
4) Disconnect or disable the synchronization and leave the instrument measuring for at least 24 h.
NOTE During that time, the device is available to be used for any test not requiring synchronization.
5) Inject a fixed duration interruption with a synchronized signal generator and note start time of interruption T2start.
6) Verify the instrument has detected an interruption and note the measured start time (reading) T2start_mes
7) Verify the clock uncertainty:
Modulus(T2start-T2start_mes) < (T2start-T1start)x1/(3600x24)
See Figure 17.</td></tr>
<tr><td colspan="5">NOTE 1 The injected interruption 2) and 5) will have an arbitrary duration (e.g. 1 s).
NOTE 2 T1start_mes and T2start_mes have a resolution of ± 20 ms.</td></tr>
</table>

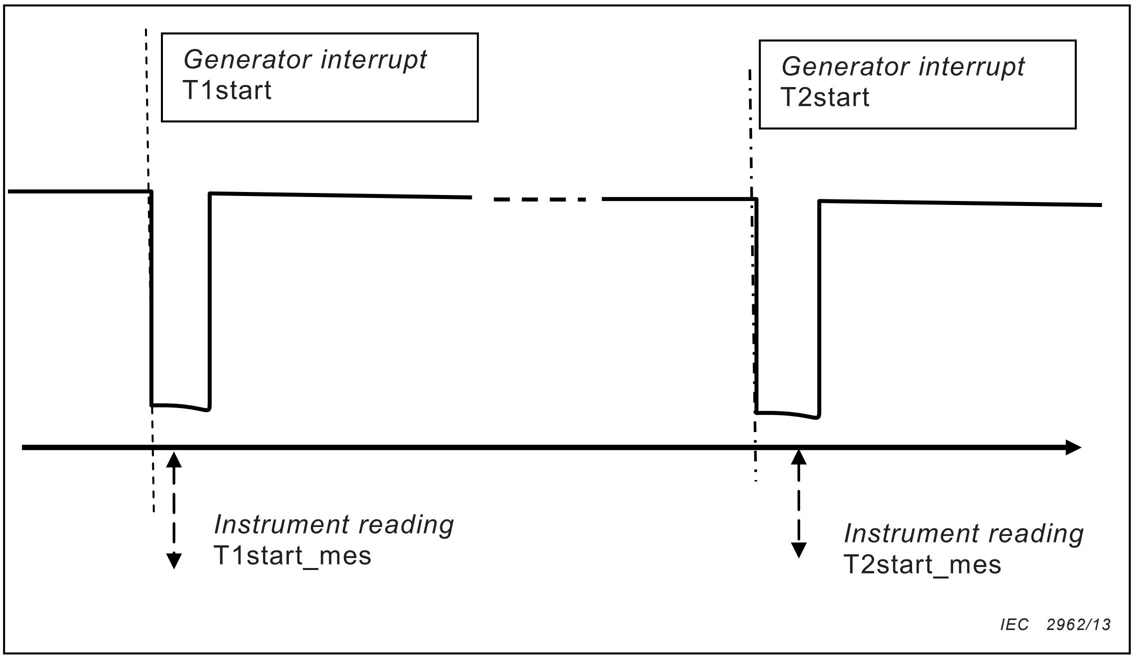


Figure 17 – Clock uncertainty testing

6.12 Variations due to external influence quantities

6.12.1 General

The variations shall only be checked for frequency measurement and for voltage measurement.

6.12.2 Influence of temperature

Each test shall last at least 1 min.

N°	Target of the test	Testing points according Table 3	Complementary test conditions according to Table 6	Test criterion (if test is applicable)
A12.1.1	Check the influence of low temperature	P1 for Frequency [a]	ET1	Measurement value will be used for further calculation Check each 10 s measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)
		P2 for Frequency [a]	ET1	Measurement value will be used for further calculation Check each 10 s measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)
		P3 for Frequency [a]	ET1	Measurement value will be used for further calculation Check each 10 s measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)
		P1 for Voltage magnitude	ET1	Measurement value will be used for further calculation Check each 10/12 cycles measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)
		P3 for Voltage magnitude	ET1	Measurement value will be used for further calculation Check each 10/12 cycles measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)
		P5 for Voltage magnitude	ET1	Measurement value will be used for further calculation Check each 10/12 cycles measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)
		Clock uncertainty (check drift on a 8 h duration)	ET1	Less than 333 ms
A12.1.2	Check the influence of worst case temperature	P1 for Frequency [a]	ET2	Measurement value will be used for further calculation Check each 10 s measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)

N°	Target of the test	Testing points according Table 3	Complementary test conditions according to Table 6	Test criterion (if test is applicable)
		P2 for Frequency [a]	ET2	Measurement value will be used for further calculation Check each 10 s measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)
		P3 for Frequency [a]	ET2	Measurement value will be used for further calculation Check each 10 s measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)
		P1 for Voltage magnitude	ET2	Measurement value will be used for further calculation Check each 10/12 cycles measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)
		P3 for Voltage magnitude	ET2	Measurement value will be used for further calculation Check each 10/12 cycles measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)
		P5 for Voltage magnitude	ET2	Measurement value will be used for further calculation Check each 10/12 cycles measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)
		Clock uncertainty (check drift on a 8 h duration)	ET2	Less than 333 ms
A12.1.3	Check the influence of high temperature	P1 for Frequency [a]	ET3	Measurement value will be used for further calculation Check each 10 s measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)
		P2 for Frequency [a]	ET3	Measurement value will be used for further calculation Check each 10 s measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)

N°	Target of the test	Testing points according Table 3	Complementary test conditions according to Table 6	Test criterion (if test is applicable)
		P3 for Frequency [a]	ET3	Measurement value will be used for further calculation Check each 10 s measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)
		P1 for Voltage magnitude	ET3	Measurement value will be used for further calculation Check each 10/12 cycles measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)
		P3 for Voltage magnitude	ET3	Measurement value will be used for further calculation Check each 10/12 cycles measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)
		P5 for Voltage magnitude	ET3	Measurement value will be used for further calculation Check each 10/12 cycles measurement complies with the limits (e.g. Figure 2 of IEC 62586-1)
		Clock uncertainty (check drift on a 8 h duration)	ET3	Less than 333 ms

[a] Instruments intended to work at 50 Hz shall use the figures provided in the line “Frequency 50 Hz”. Instruments intended to work at 60 Hz shall use the figures provided in the line “Frequency 60 Hz”. Instruments intended to work both at 50 Hz and 60 Hz shall use the figures provided both in lines “Frequency 50 Hz” and “Frequency 60 Hz”.

6.12.3 Influence of power supply voltage

N°	Target of the test	Testing points according Table 3	Complementary test conditions according to Table 6	Test criterion (if test is applicable)
A12.2.1	Check influence of low power supply voltage	P1 for Frequency [a]	EV1	Measurement value will be used for further calculation Check each 10 s measurement complies with the limits
		P2 for Frequency [a]	EV1	Measurement value will be used for further calculation Check each 10 s measurement complies with the limits
		P3 for Frequency [a]	EV1	Measurement value will be used for further calculation Check each 10 s measurement complies with the limits
		P1 for Voltage magnitude	EV1	Measurement value will be used for further calculation Check each 10/12 cycles measurement complies with the limits
		P3 for Voltage magnitude	EV1	Measurement value will be used for further calculation Check each 10/12 cycles measurement complies with the limits
		P5 for Voltage magnitude	EV1	Measurement value will be used for further calculation Check each 10/12 cycles measurement complies with the limits
A12.2.2	Check influence of high power supply voltage	P1 for Frequency [a]	EV2	Measurement value will be used for further calculation Check each 10 s measurement complies with the limits
		P2 for Frequency [a]	EV2	Measurement value will be used for further calculation Check each 10 s measurement complies with the limits

N°	Target of the test	Testing points according Table 3	Complementary test conditions according to Table 6	Test criterion (if test is applicable)
		P3 for Frequency [a]	EV2	Measurement value will be used for further calculation Check each 10 s measurement complies with the limits
		P1 for Voltage magnitude	EV2	Measurement value will be used for further calculation Check each 10/12 cycles measurement complies with the limits
		P3 for Voltage magnitude	EV2	Measurement value will be used for further calculation Check each 10/12 cycles measurement complies with the limits
		P5 for Voltage magnitude	EV2	Measurement value will be used for further calculation Check each 10/12 cycles measurement complies with the limits

[a] Instruments intended to work at 50 Hz shall use the figures provided in the line “Frequency 50 Hz”. Instruments intended to work at 60 Hz shall use the figures provided in the line “Frequency 60 Hz”. Instruments intended to work both at 50 Hz and 60 Hz shall use the figures provided both in lines “Frequency 50 Hz” and “Frequency 60 Hz”.

7 Functional testing procedure for instruments complying with class S according to IEC 61000-4-30

7.1 Power frequency

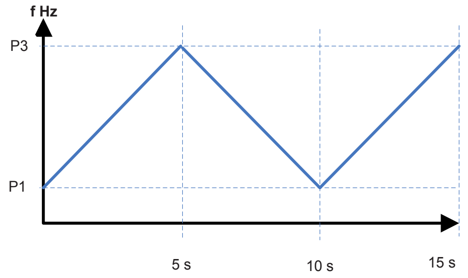
7.1.1 General

Frequency measurement shall be made on the reference channel.

7.1.2 Measurement method

The testing procedure is identical to the one defined for ‘Class A’.

Each test shall last at least 2 min.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
S1.1.1	Check that averaging interval is 10 s	Loop (see scheme below): P1-P3 triangle Duration: 5 s P3-P1 triangle Duration: 5 s	Count the number of frequency readings in 2 min (N)	TC10s(sam) TC(11≤ N ≤13)
				

7.1.3 Measurement uncertainty and measuring range

7.1.3.1 Uncertainty under reference conditions

The testing procedure is identical to the one defined for ‘Class A’.

Each test shall last at least 1 min.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
S1.2.1	Check measuring range	P1 for Frequency [a]	---	TC10s(unc)
S1.2.2	Check measuring range	P2 for Frequency [a]	---	TC10s(unc)
S1.2.3	Check measuring range	P3 for Frequency [a]	---	TC10s(unc)

[a] Instruments intended to work at 50 Hz shall use the figures provided line “Frequency 50 Hz”. Instruments intended to work at 60 Hz shall use the figures provided in line “Frequency 60 Hz”. Instruments intended to work both at 50 Hz and 60 Hz shall use the figures provided both in line “Frequency 50 Hz” and in line “Frequency 60 Hz”.

7.1.3.2 Variations due to single influence quantities

The testing procedure is identical to the one defined for ‘Class A’.

Each test shall last at least 1 min.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
S1.3.1	Measure influence of voltage magnitude on measurement uncertainty (for further calculations as required in 8).	P2 for Frequency [a] [b]	S1 for voltage magnitude.	TC10s(unc)
S1.3.2	Measure influence of harmonics on measurement uncertainty (for further calculations as required in 8).	P2 for Frequency [a] [b]	S1 for Harmonics	TC10s(unc)

[a] Instruments intended to work at 50 Hz shall use the figures provided line “Frequency 50 Hz”. Instruments intended to work at 60 Hz shall use the figures provided in line “Frequency 60 Hz”. Instruments intended to work both at 50 Hz and 60 Hz shall use the figures provided both in line “Frequency 50 Hz” and in line “Frequency 60 Hz”.

[b] Frequency measurement is made on the reference channel.

7.1.4 Measurement evaluation

N°	Target of the test	Test
S1.4.1	Reference channel	It shall be checked that the frequency measurement is made on the reference channel

7.1.5 Measurement aggregation

Aggregation is not required for power frequency

7.2 Magnitude of the supply voltage

7.2.1 Measurement method

The testing procedure is identical to the one defined for 'Class A'.

Each test shall last at least 1 s.

N°	Target of the test	Test
S2.1.1	Check gapless and non-overlapping measurement	A test shall be achieved according to the requirements of Annex E.
NOTE The following tests are not listed here because they are covered by other tests: Check true RMS measurement (covered by other tests), Check basic accuracy of 10/12 cycles measurement (covered by other tests)		

7.2.2 Measurement uncertainty and measuring range

7.2.2.1 Uncertainty under reference conditions

The testing procedure is identical to the one defined for 'Class A'.

Each test shall last at least 1 s.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
S2.2.1	Check measuring range	P1 for Voltage magnitude	---	TC10/12(unc)
S2.2.2	Check measuring range	P3 for Voltage magnitude	---	TC10/12(unc)
S2.2.3	Check measuring range	P5 for Voltage magnitude	---	TC10/12(unc)

7.2.2.2 Variations due to single influence quantities

The testing procedure is identical to the one defined for 'Class A'.

Each test shall last at least 1 s.

N°	Target of the test	Testing points according Table 3	Complementary test conditions according to Table 4	Test criterion (if test is applicable)
S2.3.1	Measure influence of frequency on measurement uncertainty (for further calculations as required in 8).	P3 for Voltage magnitude	S1 for Frequency	TC10/12(unc)
			S3 for Frequency	TC10/12(unc)
			S4 for Frequency	TC10/12(unc)
S2.3.2	Measure influence of harmonics on measurement uncertainty (for further calculations as required in 8).	P3 for Voltage magnitude	S1 for Harmonics	TC10/12(unc) on ch1 compared to a reference voltage

7.2.3 Measurement evaluation

Not applicable.

7.2.4 Measurement aggregation

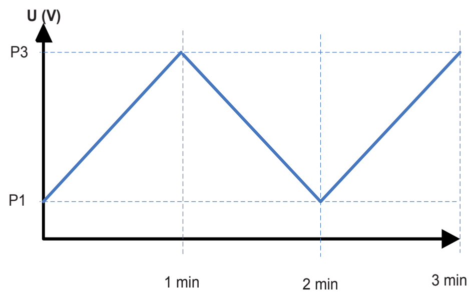
7.2.4.1 10/12 cycles with 10 min synchronisation

Not required for Class S.

Class S requires gapless and non-overlapping 10/12 cycles blocks (test S2.1.1), there is no further requirement on 10 min synchronization.

7.2.4.2 150/180 cycles aggregation with 10 min synchronisation

Each test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.

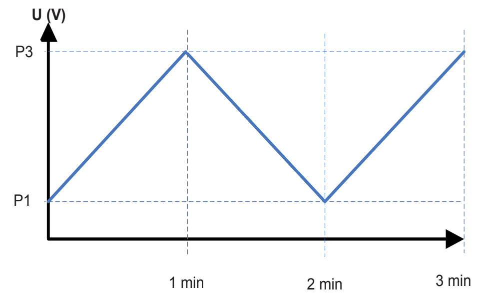
N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
S2.5.1	Check gapless implementation	Loop (see scheme below): – Voltage changing linearly from P1 to P3 for 1min duration, then – linearly from P3 to P1 for 1min duration	f = 50,125 Hz (covering 50 Hz) and/or 60,15 Hz (covering 60 Hz) depending on manufacturer selection.	Check 150/180 cycles aggregation comply with IEC 61000-4-30
				

10 min tick should occur in the middle of the 150/180 cycle time interval number 201.

NOTE 50,125 Hz = (200,5 / 600) × 150; 60,15 Hz = (200,5 / 600) × 180

7.2.4.3 10-min aggregation

Each test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions according to Table 4	Test criterion
S2.6.1	Check 10-min aggregation	Loop (see scheme below): – Voltage changing linearly from P1 to P3 for 1min duration, then – linearly from P3 to P1 for 1min duration	S2 for Frequency	Check 10 min aggregation comply with IEC 61000-4-30
				

7.2.4.4 2-h aggregation

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
S2.7.1	Check 2-h aggregation	It shall be checked that the 2-h aggregated value is provided by the equipment under test.		

7.3 Flicker

Tests shall be performed according to IEC 61000-4-15 testing requirements.

7.4 Supply voltage interruptions, dips and swells

NOTE Further guidance for testing is provided in Annex C and Annex D.

7.4.1 General requirements

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
S4.1.1	Verify that the appropriate U_{rms} (1) or U_{rms} (1/2) are used. If U_{rms} (1/2) is used, check U_{rms} (1/2) are independently synchronized on each channel on zero crossing.	P4 for Frequency [a] for at least 15 s [d] . Voltage step should be made on zero crossing.	This test does not require synchronized generator. - At T1, inject 0% U_{din} interruption of duration 2 cycles followed by a step at 90% U_{din} and of 2 cycles, then a steady state at 94% *UV* on channel 1 - At T1+10cycles + 1/3 cycle, apply the same profile on channel 2. -At T1+20cycles – 1/3 cycle, apply the same	For U_{rms} (1) implementation, verify that the U_{rms} (1) sequence contains at least one value on each phase that has the amplitude of the interruption injected (within the magnitude accuracy defined in IEC 61000-4-30). For U_{rms} (1/2), - Check, for each

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
			profile on channel 3. See Figure 1 and Figure 2.	channel, that the sequence of U_{rms} (1/2) in the instrument complies to the sequence defined in Figure 4. - Check time tag of U_{rms} (1/2) (N+1) on channel 1: T1 + ½ cycle. - Check that time tag of U_{rms} (1/2) (N+1) on channel2 is T1+10,5cycles ± 1/2cycle - Check that time tag of U_{rms} (1/2) (N+1) on channel3 is T1+20,5cycles ± 1/2cycle.
S4.1.2	Check amplitude and duration accuracy requirement [d]	P5 for swells. [b] P4 for Frequency [a] --- P3 for Dips/Int. [b] P4 for Frequency [a]	This test does not require synchronized generator. The signal change in amplitude to create. dips/swells/interruption will be simultaneous in time. Test shall be achieved with the following durations: 1; 1,5; 2,5; 10; 30 and 150 cycles. NOTE For U_{rms} (1) test points 1 and 1,5 are excluded See Figure 18 and Figure 20 for signal injection details, see Figure 19, and Figure 21 for expected sequence of U_{rms} (1/2). For U_{rms} (1) implementations the expected sequence is dependent on the alignment of the U_{rms} window ,which may not be synchronized with zero crossings.	Check that all durations and amplitudes reported on the dips/ swells/ interruption measurements are complying with IEC 61000-4-30, 5.4.5.1 (amplitude accuracy requirement) and 5.4.5.2 (duration accuracy requirement)
S4.1.3	Check threshold	P2 for swells [b c] P4 for Frequency [a] --- P1 for swells [b c] P4 for Frequency [a] --- P2 for Dips/Int. [b c] P4 for Frequency [a] --- P1 for Dips/Int. [b c] P4 for Frequency [a]	This test does not require synchronized generator. The signal change in amplitude to create dips/swells/interruption will be simultaneous in time. Test shall be achieved with the following duration: 2,5 cycles.	Check the duration accuracy complies with IEC 61000-4-30, 5.4.5.2
S4.1.4	Check influence of mains frequency.	P1 for Frequency [a] P2 for Dips/Int. [b]	This test does not require a synchronized	Check the duration accuracy complies

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
		P3 for Frequency [a] P2 for Dips/Int. [b]	generator. The signal change in amplitude to create dips/swells/interruption will be simultaneous in time. Test shall be achieved with the following durations: 2 and 30 cycles.	with IEC 61000-4-30, 5.4.5.2
S4.1.5	Check dips / interruptions / swells in a polyphase system	A test shall be achieved according to the requirements of 7.4.2 and 7.4.3.		
S4.1.6	Check sliding voltage reference – Steady state state operation	1) configuration: select sliding reference voltage, dip threshold set to 90 %Usr, hysteresis=2 % U_{din}. 2) Inject steady state voltage at U_{din} for at least 5 min. Then decrease voltage amplitude by to 95 % U_{din} for 5 min. Then 87 % U_{din} for 5 min.	See Figure 22.	No dip should be detected.
		3) Inject dip of 5 cycles duration at 50 % U_{din}.		Verify that instrument is detecting a dip at (57,5) %U_{ref}. NOTE 1 57,5 % = 50/87 × 100 %
S4.1.7	Check sliding voltage reference – Sliding reference start up condition	1) configuration: select sliding reference voltage, dip threshold set to 90 % U_{din}, hysteresis = 2 % U_{din}. 2) Turn on the instrument with 0V injected at the voltage inputs.	See Figure 23	The instrument shall detect an interruption start.
		3) After 5 min + instrument boot up time, inject voltage = U_{din} NOTE 2 The purpose is to check that the sliding reference voltage is built from an initial value of U_{din}, not refreshed until the voltage is applied.		Verify that the instrument has detected an end of interruption

[a] Instruments intended to work at 50 Hz shall use the figures provided line "Frequency 50 Hz". Instruments intended to work at 60 Hz shall use the figures provided in line "Frequency 60 Hz". Instruments intended to work both at 50 Hz and 60 Hz shall use the figures provided both in line "Frequency 50 Hz" and in line "Frequency 60 Hz".

[b] Test points P1, P2, P3, P4 and P5 as described in Table 3 and in IEC 61000-4-30 table C.1.

[c] Test point P1 must not be identified as a dip/swell, and testing points P2 must be identified as a dip/swell.

[d] Recommended values for threshold dip is 90 % U_{din}, for swell threshold is 110 %U_{din}, Hysteresis =2 %.

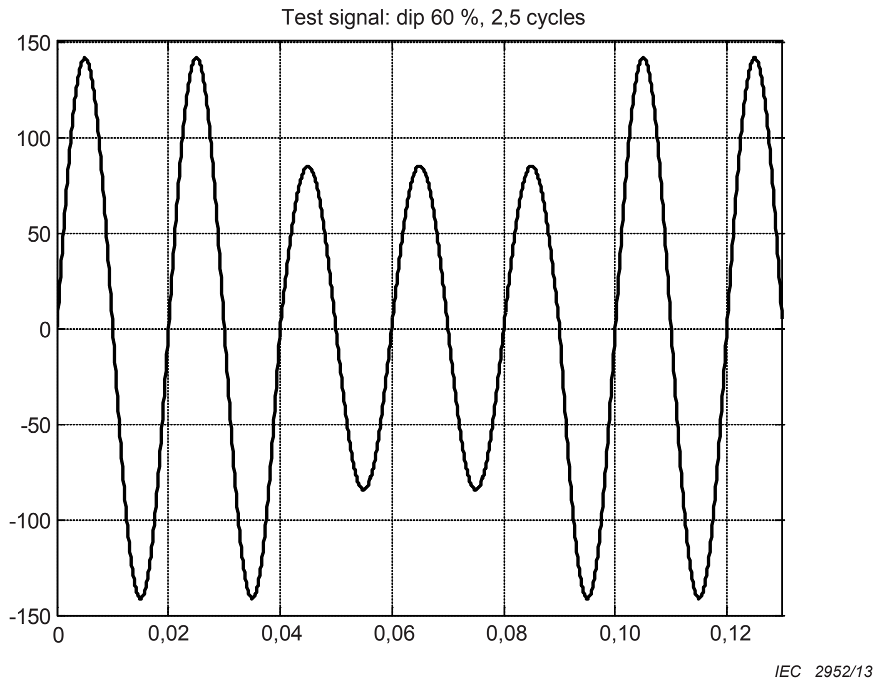


Figure 18 – Detail 1 of waveform for test of dips according to test S4.1.2

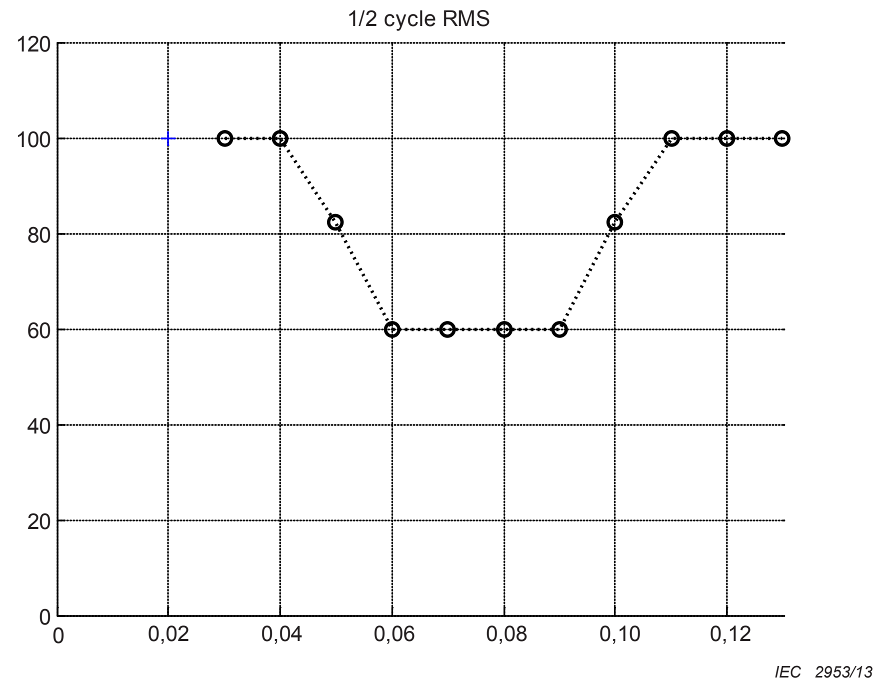


Figure 19 – Detail 2 of waveform for tests of dips according to test S4.1.2

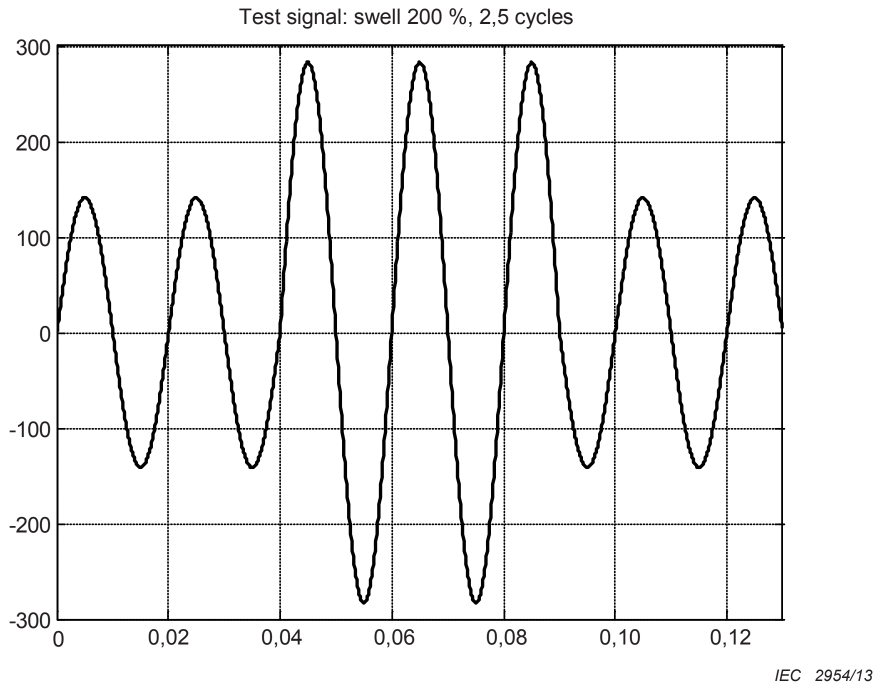


Figure 20 – Detail 1 of waveform for test of swells according to test S4.1.2

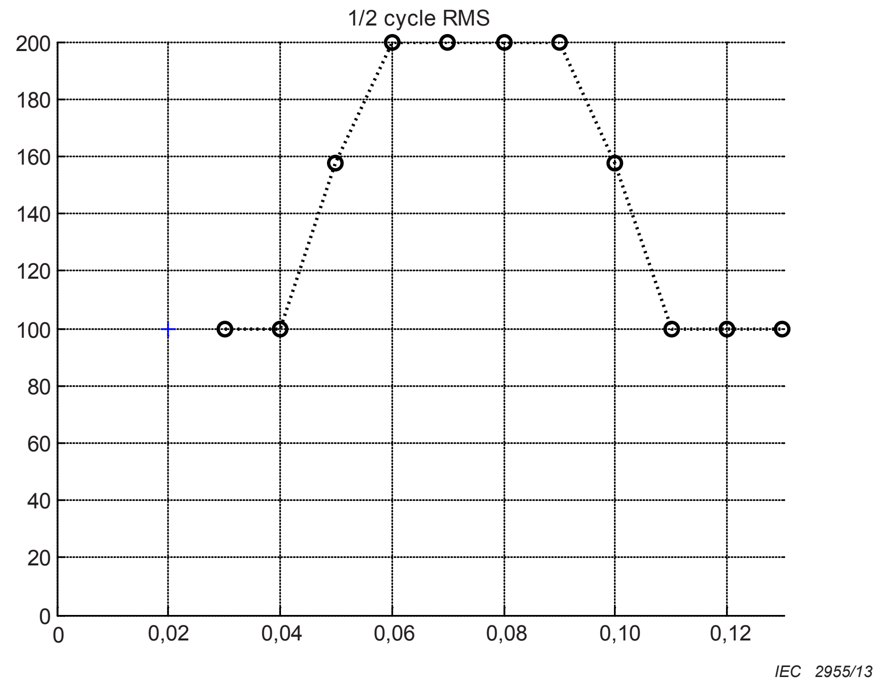


Figure 21 – Detail 2 of waveform for tests of swells according to test S4.1.2

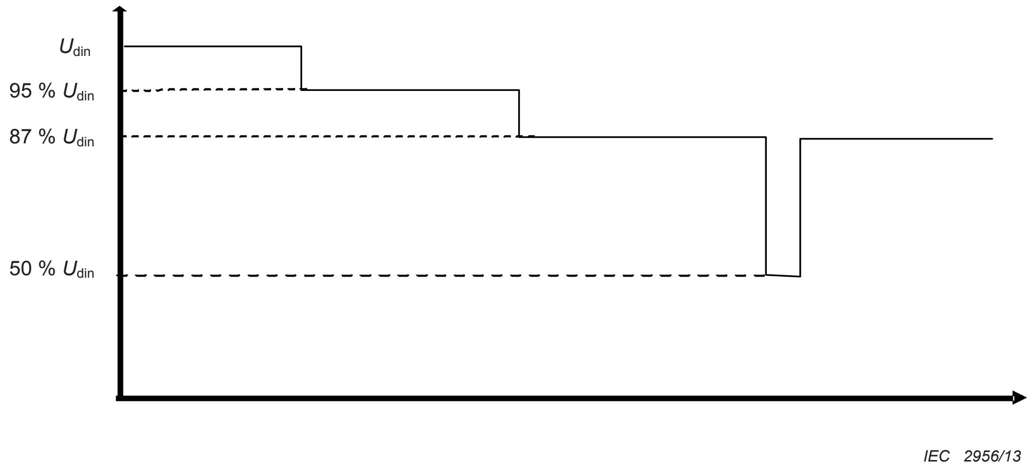


Figure 22 – Sliding reference voltage test

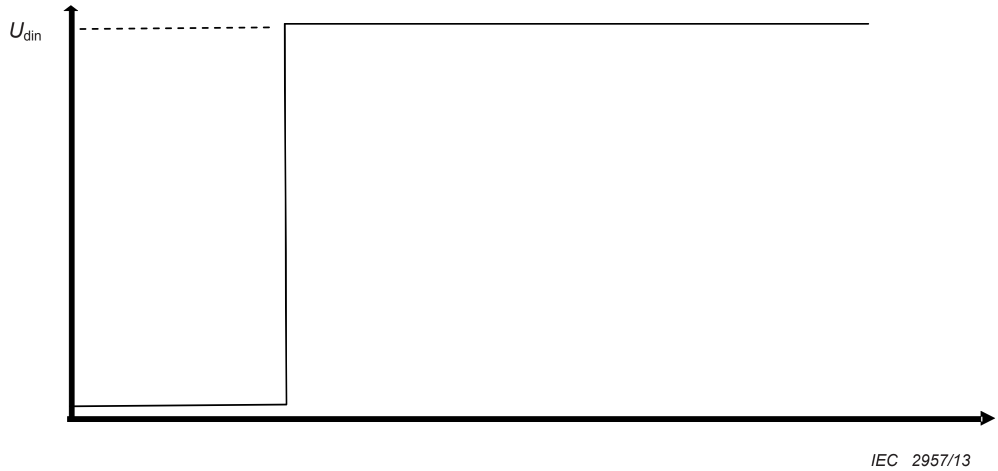
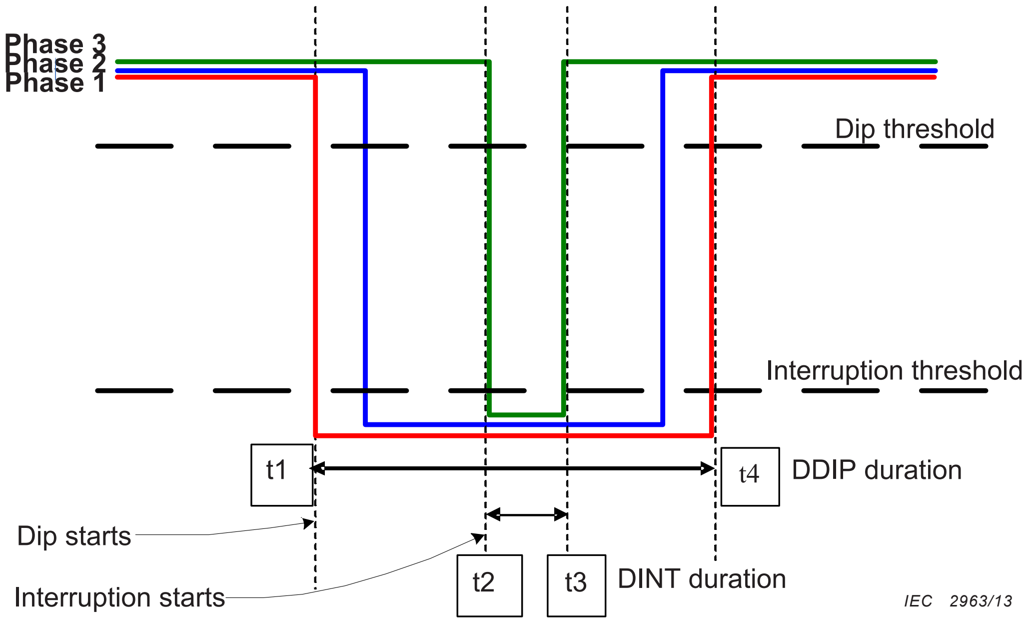


Figure 23 – Sliding reference start up condition

7.4.2 Check dips / interruptions in polyphase system

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
S4.2.1	Check that dips and interruptions are properly detected in a polyphase system, by applying a single test with a 3 phase non synchronous disturbance that contains both a dip and an interruption	P4 for frequency for at least 15 s. Dip threshold = 90 % U_{din}, hysteresis =2 % U_{din} Interruption threshold = 10 % U_{din}, hysteresis =2 % U_{din} Voltage steps should be made on zero crossing for each phase.	This test does not require a synchronized generator. – Begin the test with all three phases set to U_{din} – At t1 (synchronized to zero crossing on phase 1), inject 0 % U_{din} on phase 1 – At t1+1cycle (synchronized to zero crossing on phase 2), inject 0 % U_{din} on phase 2 – At t2 (synchronized to zero crossing on phase 3), inject 0 % U_{din} on phase 3 – At t3 (synchronized to zero crossing on phase 3), inject 100 % U_{din} on phase 3 – At t3+1cycle (synchronized to zero crossing on phase 2), inject 100 % U_{din} on phase 2 – At t4 (synchronized to zero crossing on phase 1), inject 100 % U_{din} on phase 1 See Figure 24, Figure 25 and Figure 26.	– If U_{rms} (1/2) is implemented , check for each channel, that the sequence of U_{rms} (1/2) in the instrument complies to the sequence defined in Figure 26 – Check that the polyphase dip duration is correctly reported as 6,5 cycles (within the timing accuracy defined in IEC 61000-4-30). – Check that the polyphase interruption duration is correctly reported as 1,5 cycles (within the timing accuracy defined in IEC 61000-4-30). – Check that the remaining voltage for the dip measurement is correctly reported as 0 % U_{din} (within the magnitude accuracy defined in IEC 61000-4-30).



NOTE The figure is not drawn to scale

Figure 24 – Detail 1 of waveform for test of polyphase dips/interruptions

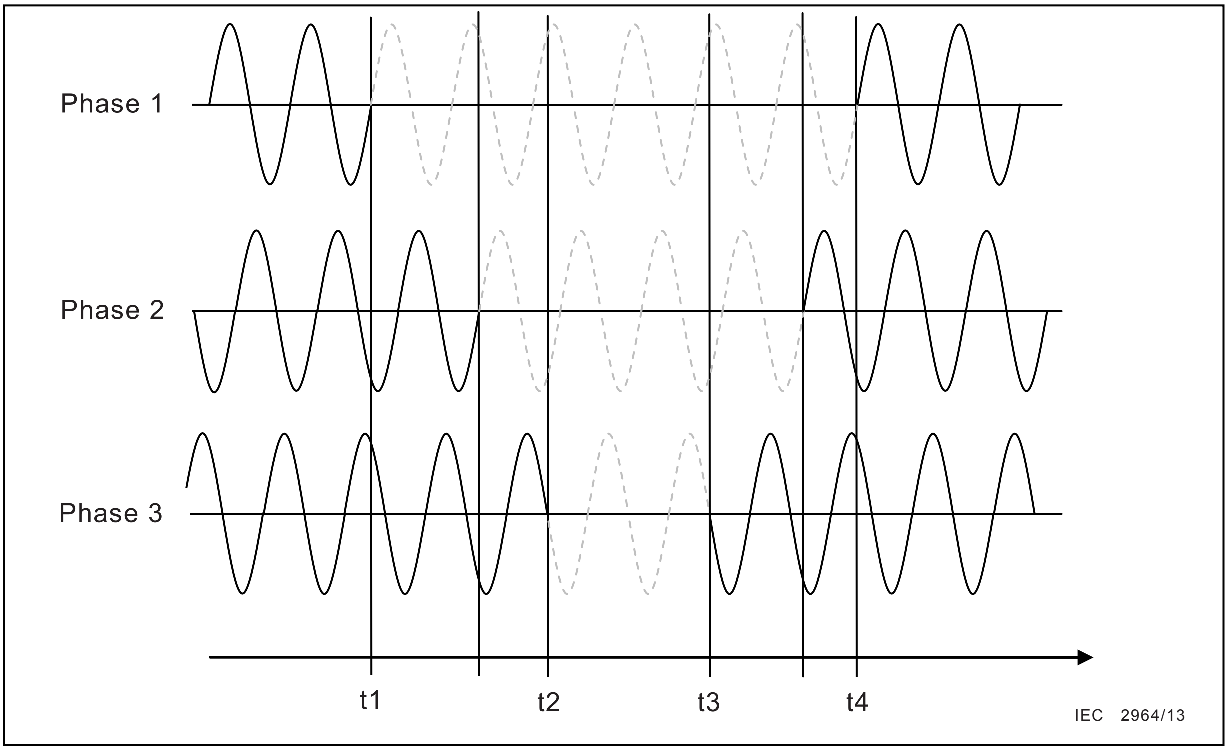


Figure 25 – Detail 2 of waveform for test of polyphase dips/interruptions

	U_{rms}(1/2) N	U_{rms}(1/2 N+1 (start of dip)	U_{rms}(1/2 N+2	U_{rms}(1/2 N+3	U_{rms}(1/2 N+4	U_{rms}(1/2 N+5	U_{rms}(1/2 N+6 (start of interrupt.)	U_{rms}(1/2 N+7
Phase 1	100	70	0	0	0	0	0	0
Phase 2	100	100	100	70	0	0	0	0
Phase 3	100	100	100	100	100	70	0	0

	U_{rms}(1/2 N+8	U_{rms}(1/2) N+9 (end of interrupt.)	U_{rms}(1/2 N+10	U_{rms}(1/2 N+11	U_{rms}(1/2 N+12	U_{rms}(1/2 N+13	U_{rms}(1/2 N+14 (end of dip)	U_{rms}(1/2 N+15
Phase 1	0	0	0	0	0	70	100	100
Phase 2	0	0	0	70	100	100	100	100
Phase 3	0	70	100	100	100	100	100	100

Figure 26 – Detail 3 of waveform for test of polyphase dips/interruptions

7.4.3 Check swells in polyphase system

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
S4.3.1.	Check that swells are properly detected in a polyphase system, by applying a single test with a 3 phase non synchronous swell injection	P4 for frequency for at least 15 s. Swell threshold = 110 % U_{din}, hysteresis = 2 % U_{din} Voltage steps should be made on zero crossing for each phase.	This test does not require a synchronized generator. – Begin the test with all three phases set to U_{din} – At t1 (synchronized to zero crossing on phase 1), inject 130 % U_{din} on phase 1 – At t1+1cycle (synchronized to zero crossing on phase 2), inject 130 % U_{din} on phase 2 – At t1+2cycles (synchronized to zero crossing on phase 3), inject 130 % U_{din} on phase 3 – At t1+4cycles (synchronized to zero crossings on phase 1 and phase 3), inject 100 % U_{din} on both phase 1 and phase 3 – At t3 (synchronized to zero crossing on phase 2), inject 100 % U_{din} on phase 2 See Figure 27 and Figure 28	– If Urms(1/2) is implemented , check for each channel, that the sequence of *U*rms(1/2) in the instrument complies to the sequence defined in Figure 28 – Check that the polyphase swell duration is correctly reported as 6,5 cycles (within the timing accuracy defined in IEC 61000-4-30). – Check that the polyphase swell amplitude is correctly reported as 130 % U_{din} (within the magnitude accuracy defined in IEC 61000-4-30).

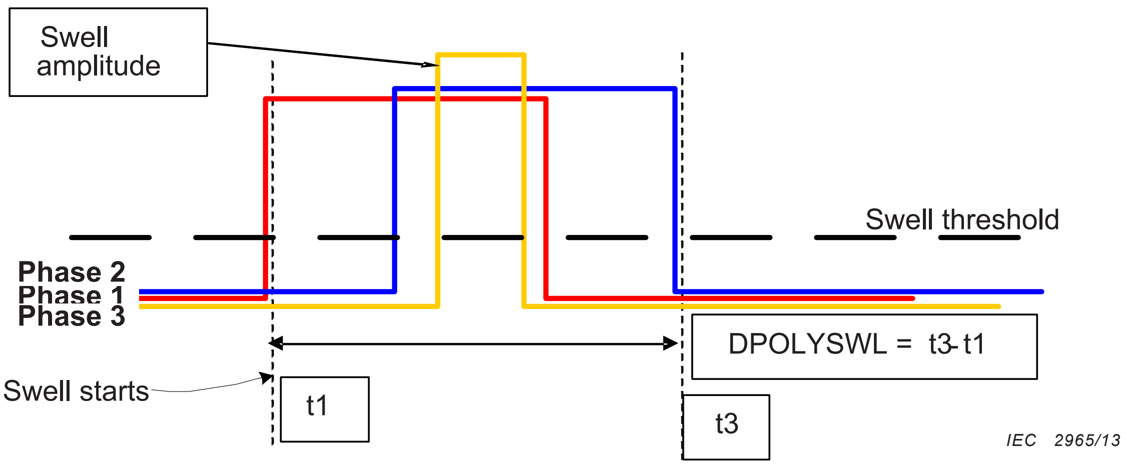


Figure 27 – Detail 1 of waveform for test of polyphase swells

	U_{rms} (1/2) N	U_{rms} (1/2 N+1 (start of swell)	U_{rms} (1/2 N+2	U_{rms} (1/2 N+3	U_{rms} (1/2 N+4	U_{rms} (1/2 N+5	U_{rms} (1/2 N+6	U_{rms} (1/2 N+7
Phase 1	100	116	130	130	130	130	130	130
Phase 2	100	100	100	116	130	130	130	130
Phase 3	100	100	100	100	100	116	130	130

	U_{rms} (1/2 N+8	U_{rms} (1/2 N+9	U_{rms} (1/2 N+10	U_{rms} (1/2 N+11	U_{rms} (1/2 N+12	U_{rms} (1/2 N+13	U_{rms} (1/2 N+14 (end of swell)	U_{rms} (1/2 N+15
Phase 1	130	116	100	100	100	100	100	100
Phase 2	130	130	130	130	130	116	100	100
Phase 3	130	116	100	100	100	100	100	100

Figure 28 – Detail 2 of waveform for test of polyphase swells

7.5 Supply voltage unbalance

7.5.1 General

This test is identical to the one defined for ‘Class A’, except on the accuracy performance requirement. The assessment of zero sequence component (u0) is optional.

Use a 3 channel AC power source that meets or exceeds the following stability ratings under the reference conditions: voltage ±0,05 %

NOTE Reference conditions for PQI are defined in IEC 62586-1

7.5.2 Measurement method, measurement uncertainty and measuring range

N°	Target of the test	Testing conditions	Complementary test conditions	Test criterion (if test is applicable)
S5.1.1	Check accuracy of unbalance measurement	Connect a 3 channel AC power source and adjust Channel 1 (L1 to N) to 100 % of U_{din} Channel 2 (L2 to N) to 100 % of U_{din} Channel 3 (L3 to N) to 100 % of U_{din}	---	check if u2 is between 0 % and 0,3 % check if u0 is between 0 % and 0,3 %, if evaluated
S5.1.2	Check accuracy of unbalance measurement	Connect the 3 channel AC power source and adjust Channel 1 (L1 to N) to 73 % of U_{din} Channel 2 (L2 to N) to 80 % of U_{din} Channel 3 (L3 to N) to 87 % of U_{din}	---	check if u2 is between 4,75 % and 5,35 % check if u0 is between 4,75 % and 5,35 %, if evaluated
S5.1.3	Check accuracy of unbalance measurement	Connect the 3 channel AC power source and adjust Channel 1 (L1 to N) to 152 % of U_{din}	---	check if u2 is between 4,65 % and 5,25 % check if u0 is between 4,65 % and

N°	Target of the test	Testing conditions	Complementary test conditions	Test criterion (if test is applicable)
		Channel 2 (L2 to N) to 140 % of U_{din} Channel 3 (L3 to N) to 128 % of U_{din}		5,25 %, if evaluated
S5.1.4	Check accuracy of unbalance measurement with phase displacement with a 4 wires system.	Connect a 3 channel AC power source and adjust Channel 1 (L1 to N) to 100 % of U_{din} , 0° Channel 2 (L2 to N) to 90 % of U_{din} , -122° Channel 3 (L3 to N) to 100 % of U_{din} , +118°	---	Check if u2 is between 4,22 % and 4,82 % check if u0 is between 2,17 % and 2,77 %, if evaluated

7.5.3 Aggregation

It shall be verified that the aggregated values are provided by the equipment under test. An accuracy test of the aggregated values is not required.

7.6 Voltage harmonics

7.6.1 General

The manufacturer shall specify if the implementation of aggregation uses gapless or gapped 10/12 cycle data intervals.

– Gapless implementation will be tested with test S6.1.1.
– Gapped implementation will be tested with test S6.1.2.

The manufacturer shall specify if the implementation of 10/12 cycles data uses groups (Ug.h)or subgroups of harmonics (Usg.h).

– Subgroup implementation will be tested with test S6.1.3.
– Group implementation will be tested with test S6.1.4.

7.6.2 Measurement method

Each test shall last at least 10 s.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
S6.1.1	If the manufacturer has implemented a gapless measurement method: Check that the 10/12-cycle measurement intervals are gapless and non-overlapping	A test shall be achieved according to the requirements of Annex E		
S6.1.2	If the manufacturer has implemented a gapped measurement method: Check that at least one 10/12-cycle value is calculated every 50/60 cycles	Apply reference conditions (including a constant fundamental component), and add varying voltage harmonic content as described: – Start at P2 for harmonics (10 % on the 3rd harmonic) – Ramp the harmonic content down by	S2 for Frequency (50/60Hz)	Test the time tag, the sequence number and the voltage magnitude of the 10/12-cycle blocks for the 3rd harmonic. Verify that: – 10/12-cycle intervals are consistently provided at a

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
		1 %/s until it reaches 0 % – Ramp the harmonic content up by 1 %/s until it reaches P2 – Repeat Apply this test signal for a minimum of 10 min (to ensure that larger gaps are not seen during 10-min aggregation calculations).		minimum rate of one per second throughout the test – The 10/12-cycle intervals show at least 10 unique values between 0 % and 10 % for every ramping period – The sequence of 10/12-cycle intervals show values that repeat every 20 s
S6.1.3	If the manufacturer has implemented harmonic subgroup measurement (Usg,h): Check that the 10/12-cycle measurements use the harmonic subgroup measurement (Usg.h) from IEC 61000-4-7	Apply reference conditions, plus P1 for harmonics (verify basic subgroup measurement)	---	TC10/12(unc)-harm for the 2^{nd} harmonic (2^{nd} harmonic is present at 5 %)
		Apply reference conditions, plus P1 for interharmonics (eliminate incorrect use of Ug,h)	---	TC10/12(unc)-harm for the 2^{nd} harmonic (no significant content detected)
		Apply reference conditions, plus S4 for interharmonics (eliminate incorrect use of Ug)	---	TC10/12(unc)-harm for the 2^{nd} harmonic (2^{nd} harmonic is present at 4 %)
S6.1.4	If the manufacturer has implemented harmonic group measurement (Ug,h): Check that the 10/12-cycle measurements use harmonic group measurement (Ug,h) from IEC 61000-4-7.	Apply reference conditions, plus P1 for harmonics (verify basic group measurement)	---	TC10/12(unc)-harm for the 2^{nd} harmonic (2^{nd} harmonic is present at 5 %)
		Apply reference conditions, plus S4 for interharmonics (eliminate incorrect use of Ug or Usg,h)	---	TC10/12(unc)-harm for the 2^{nd} harmonic (2^{nd} harmonic is present at approximately 7,2 %)
S6.1.5	Check that measurements are made at least up to the 40^{th} order	---	---	Verify that at least 40 harmonics are provided by the device
S6.1.6	If total harmonic distortion is calculated, and if the manufacturer has implemented harmonic subgroup measurement (Usg,h): Check that it is the subgroup total harmonic distortion (THDS) from IEC 61000-4-7	Apply reference conditions plus P5 for harmonics	---	TC150/180(unc)-thd (significant distortion detected)
		Apply reference conditions plus P5 for interharmonics	---	TC150/180(unc)-thd (no significant distortion detected)
S6.1.7	Check that a crest factor of at least 2 is supported by the device	Apply reference conditions plus S1 for harmonics (crest factor of 2)	---	TC150/180(unc)-harm for all 40 harmonics
S6.1.8	Check that a properly designed anti-aliasing filter is used on the device, providing (in combination with oversampling) attenuation of all frequencies above the 40^{th}	[a] Apply reference conditions plus 10 % of U_{din} at 75,0 × the fundamental frequency	---	TC150/180(unc)-harm for all 40 harmonics (no aliasing detected)
		Apply reference	---	TC150/180(unc)-

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
	harmonic exceeding 50 dB [b]	conditions plus 10 % of U_{din} at 150,0 × the fundamental frequency		harm for all 40 harmonics (no aliasing detected)
		Apply reference conditions plus 10 % of U_{din} at 501,0 × the fundamental frequency	---	TC150/180(unc)-harm for all 40 harmonics (no aliasing detected)
[a] Only three mandatory anti-aliasing test points are defined here to simplify the minimum testing requirement. However, depending on the sampling rate and filter characteristics of the device under test, other spectral content may be required to properly evaluate the operation of an anti-aliasing filter. The test lab applying this procedure may additionally choose to apply a set of broad spectrum signals as a more exhaustive test of the anti-aliasing filter, using a network analyzer or other similar equipment. [b] This test only applies if the manufacturer has chosen to implement the optional anti-aliasing filter.				

7.6.3 Measurement method, measurement uncertainty and measuring range

7.6.3.1 Measurement uncertainty and measuring range

Each test shall last at least 10 s.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
S6.2.1	Check measuring uncertainty – single even harmonic	Reference conditions plus P1 for harmonics	---	TC150/180(unc)-harm for applicable harmonics
S6.2.2	Check measuring uncertainty – single odd harmonic	Reference conditions plus P2 for harmonics	---	TC150/180(unc)-harm for applicable harmonics
S6.2.3	Check measuring uncertainty – single high harmonic	Reference conditions plus P3 for harmonics	---	TC150/180(unc)-harm for applicable harmonics
S6.2.4	Check measuring range – minimum harmonic magnitudes	Reference conditions plus P4 for harmonics	---	TC150/180(unc)-harm for applicable harmonics
S6.2.5	Check measuring range – maximum harmonic magnitudes	Reference conditions plus P5 for harmonics	---	TC150/180(unc)-harm for applicable harmonics
The 150/180-cycle values are selected for these tests for ease of data extraction, as it will be necessary to extract measurement data for all 50 harmonics, and this is easier to do in a 3 s window than a shorter one.				

7.6.3.2 Variations due to single influence quantities

Each test shall last at least 10 s.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions according to Table 4	Test criterion (if test is applicable)
S6.3.1	Check influence of frequency on measurement uncertainty	Reference conditions plus P1 for harmonics (lowest harmonic order)	S1 for frequency (lowest frequency)	TC150/180(unc)-harm for all 40 harmonics
		Reference conditions plus P3 for harmonics (highest harmonic order)	S4 for frequency (highest frequency)	TC150/180(unc)-harm for all 40 harmonics
S6.3.2	Check influence of voltage magnitude on measurement uncertainty	Reference conditions plus P2 for harmonics	S1 for voltage magnitude (lowest voltage)	TC150/180(unc)-harm for all 40 harmonics

N°	Target of the test	Testing points according to Table 3	Complementary test conditions according to Table 4	Test criterion (if test is applicable)
		Reference conditions plus P2 for harmonics	S3 for voltage magnitude (highest voltage)	TC150/180(unc)-harm for all 40 harmonics
The 150/180-cycle values are selected for these tests for ease of data extraction, as it will be necessary to extract measurement data for all 40 harmonics, and this is easier to do in a 3 s window than a shorter one.				

7.6.4 Measurement evaluation

Not applicable.

7.6.5 Measurement aggregation

7.6.5.1 10/12 cycles with 10 min synchronization

Each test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
S6.4.1	Check aggregation overlap 1	Reference conditions plus P2 for harmonics	f = 49,99 or 59,99 Hz Test duration = 11 min	Test the time tag, and the sequence number of blocks for the 3rd harmonic. Resynchronization with the 10 min tick is permitted but not required.
10 min tick should occur in the middle of the 10/12 cycle time interval number 3000. NOTE 59,99 Hz = (2999,5 / 600) × 12; 49,99 Hz = (2999,5 / 600) × 10				

7.6.5.2 150/180 cycle aggregation with 10 min synchronization

Each test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
S6.5.1	If the manufacturer has implemented a gapless measurement method: Check gapless 150/180-cycle aggregation	Maintain reference conditions (including a constant fundamental component), and add varying harmonic content as described: – Start at P2 for harmonics – Ramp the harmonic content down by 1 %/s until it reaches 0 % – Ramp the harmonic content up by 1 %/s until it reaches P2 – Repeat	f = 50,125 Hz (covering 50 Hz) or 60,15 Hz (covering 60 Hz) depending on manufacturer selection.	TC150/180(unc)-harm for the 3rd harmonic, with correct aggregation of all of the gapless 10/12-cycle values. Resynchronization with the 10 min tick is permitted but not required.
S6.5.2	If the manufacturer has implemented a gapped measurement method: Check that a minimum of	Maintain reference conditions (including a constant fundamental component), and add varying harmonic	f = 50,125 Hz (covering 50 Hz) or 60,15 Hz (covering 60 Hz) depending on manufacturer selection.	TC150/180(unc)-harm for the 3rd harmonic, with correct aggregation of all of the reported

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
	three 10/12-cycle values is used in each 150/180-cycle interval	content as described: – Start at P2 for harmonics – Ramp the harmonic content down by 1 %/s until it reaches 0 % – Ramp the harmonic content up by 1 %/s until it reaches P2 – Repeat		10/12-cycle values (it is already proven in Test 6.1.2 that at least three values are reported every 150/180-cycle interval). Resynchronization with the 10 min tick is permitted but not required.
10 min tick should occur in the middle of the 150/180 cycle time interval number 201. NOTE 50,125 Hz = (200,5 / 600) × 150; 60,15 Hz = (200,5 / 600) × 180				

7.6.5.3 10 min aggregation

Each test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
S6.6.1	Check 10 min aggregation	Maintain reference conditions (including a constant fundamental component), and add varying harmonic content as described: – Start at P2 for harmonics – Ramp the harmonic content down by 1 %/s until it reaches 0 % – Ramp the harmonic content up by 1 %/s until it reaches P2 – Repeat	f = 49,99 or 59,99 Hz Test duration = 11 min	TC10-min(unc)-harm for the 3rd harmonic, with correct aggregation of the 10/12-cycle values based on the block sequence numbers
NOTE 10 min tick should occur in the middle of the 10/12 cycle time interval number 3000. NOTE 59,99 Hz = (2999,5 / 600) × 12; 49,99 Hz = (2999,5 / 600) × 10				

7.6.5.4 2 h aggregation

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
S6.7.1	Check 2-hour aggregation	It shall be checked that the 2 h aggregated value is provided by the equipment under test.		

7.7 Voltage inter-harmonics

If the manufacturer implements interharmonics, then he shall specify the method and the accuracy performance. The test will verify the availability of the data and its accuracy according to the manufacturer specification.

7.8 Mains Signalling Voltages on the supply voltage

7.8.1 General

If the manufacturer implements mains signalling voltage, then he shall specify the method and the accuracy performance. The test will verify the availability of the data and its accuracy according to the manufacturer specification.

7.8.2 Measurement method

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
S8.1.1	Verify that the user can specify the carrier frequency to monitor, according to the manufacturer specification.	---	---	Product allows the user to configure monitored carrier frequencies according to the manufacturer specification.

7.8.3 Measurement uncertainty and measuring range

7.8.3.1 Uncertainty under reference conditions

Not applicable.

7.8.3.2 Measurement evaluation

Not applicable.

7.8.4 Aggregation

Not applicable.

7.9 Measurement of underdeviation and overdeviation parameters

Not required for class S instruments.

7.10 Flagging

The tests requirements are identical to those defined for 'Class A', for the applicable parameters.

N°	Target of the test	Testing points	Test criterion (if test is applicable)
S10.1.1	Flagging in polyphase system caused by voltage dip For Plt flicker	Dip: 70 % of U_{din}, 1 channel, L2, Duration: 100 ms	Each of the parameters listed below is flagged within each of the corresponding measurement intervals that contain the dip/swell/interruption (as illustrated in Figure 18): – Flicker (2-h Plt)
S10.1.2	Flagging in polyphase system caused by voltage dip [a]	Dip: 70 % of U_{din}, 1 channel, L2, Duration: 100 ms	Each of the parameters listed below is flagged within each of the corresponding measurement intervals that contain the dip/swell/interruption (as illustrated in Figure 18): – Power frequency (10-s) – Voltage magnitude (10/12-cycle, 150/180-cycle, 10-min) – Flicker (10-min Pst) – Supply voltage unbalance (10/12-cycle, 150/180-cycle, 10-min) – Voltage harmonics (10/12-cycle, 150/180-
S10.1.3	Flagging in polyphase system	Swell: 120 % of U_{din},	

N°	Target of the test	Testing points	Test criterion (if test is applicable)
	caused by voltage swell [a]	2 channels, L1+L3, Duration: 100 ms	cycle, 10-min) – Voltage interharmonics (10/12-cycle, 150/180-cycle, 10-min) – Mains signalling (10/12-cycle) – Underdeviation and overdeviation (10/12-cycle, 150/180-cycle, 10-min)”
S10.1.4	Flagging in polyphase system caused by voltage interruption [a]	Interruption: 0 % of U_{din}, 3 channels, L1+L2+L3, Duration: 100 ms	

The 100ms dip / swell / interruption must begin and end within the same 10/12-cycle interval, and within the same 10-second interval for frequency.

The test should last 6 h, because three 2-h aggregations should be evaluated.

[a] For instruments using the polyphase approach according to IEC 62586-1, the flag is applied to all measured phases. For instruments using the channel by channel approach according to IEC 62586-1, the flag is applied only to the phase(s) containing the dip / swell / interruption event.

NOTE See explanation in Figure 29 below.

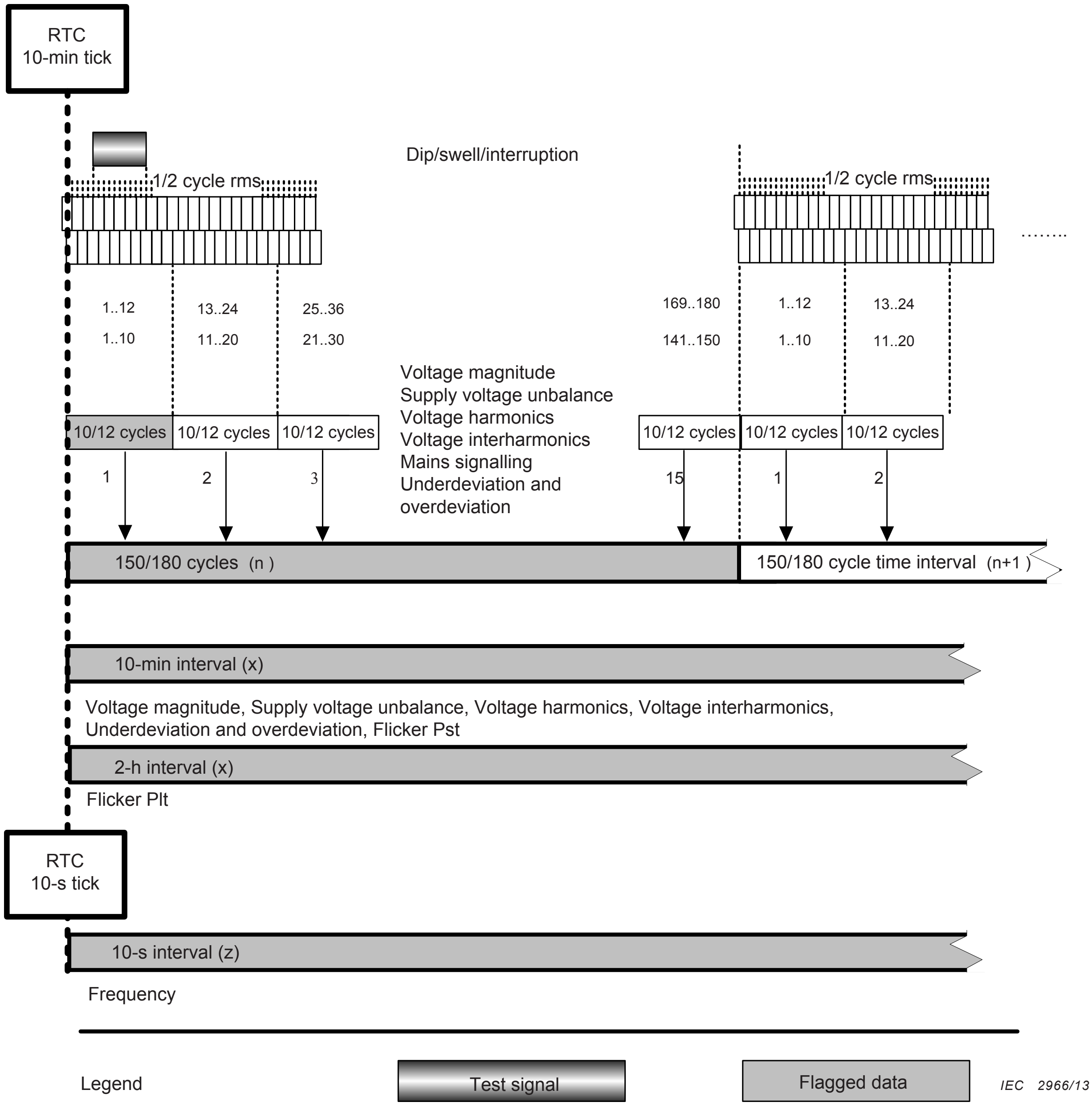


Figure 29 – Flagging test for class S

7.11 Clock uncertainty testing

The test requirements are identical to those defined for 'Class A', except for the maximum drift allowed.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
S11.1.1	Check clock uncertainty	1) Verify that instrument is operating with clock synchronization (check device status). 2) Inject a fixed duration interruption with a synchronized signal generator and note the start time of interruption T1start. 3) Verify the instrument has detected an interruption and note the measured start time (reading) T1start_mes. Check the accuracy of T1 start_mes shall be T1start ± 1 cycle. 4) Disconnect or disable the synchronization and leave the instrument measuring for at least 24 h. NOTE 1 During that time, the device is available to be used for test not requiring synchronization. 5) Inject a fixed duration interruption with a synchronized signal generator and note the start time of interruption T2start. 6) Verify the instrument has detected an interruption and note the measured start time (reading) T2start_mes 7) Verify the clock uncertainty: Modulus(T2start-T2start_mes) < (T2start-T1start)*5/(3600*24) See Figure 30.		
NOTE 2 The injected interruption 2) and 5) will have an arbitrary duration (e.g. 1 s). NOTE 3 T1start_mes and T2start_mes have a resolution of ± 20ms.				

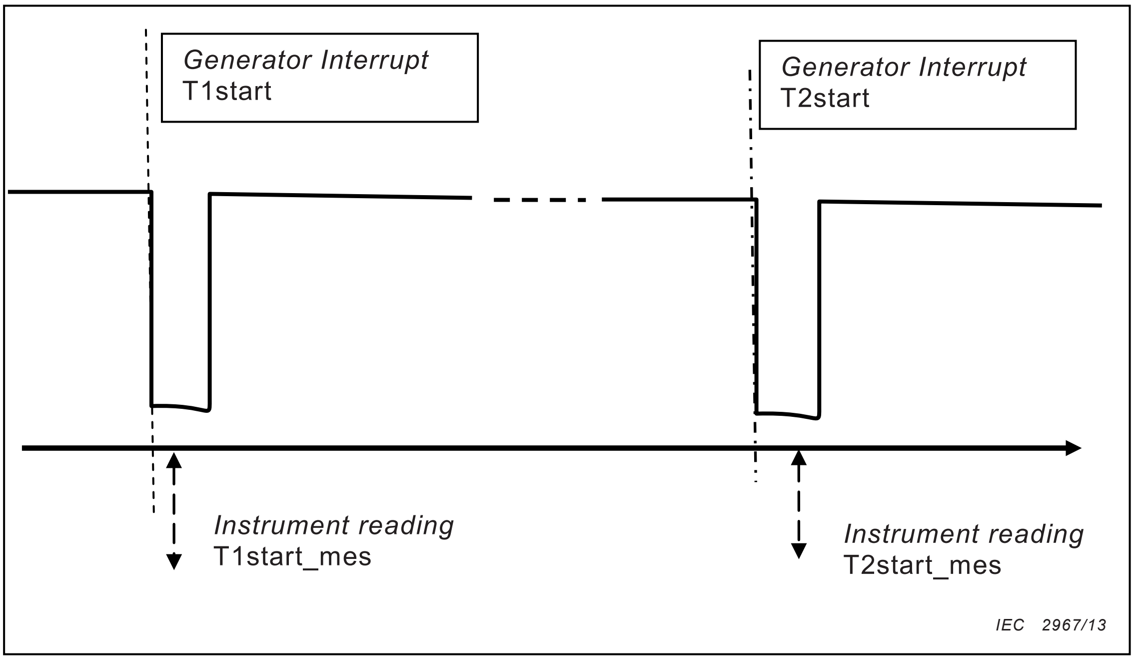


Figure 30 – Clock uncertainty testing

7.12 Variations due to external influence quantities

7.12.1 General

The test requirements are identical to those defined for 'Class A'.

The variations shall only be checked for frequency measurement and for voltage measurement.

7.12.2 Frequency measurement

Each test shall last at least 1 min.

7.12.3 Influence of temperature

Each test shall last at least 1 min.

N°	Target of the test	Testing points according Table 3	Complementary test conditions according to Table 6	Test criterion (if test is applicable)
S12.1.1	Check influence of low temperature	P1 for Frequency [a]	ET1	[AC1⟩ For “Clock uncertainty (check drift on a 8 h duration)”: Less than 333 ms. For other tests on frequency: Measurement value will be used for further calculation. Check each 10 s measurement complies with the limits (e.g. Figure 2 of IEC 62586-1). For other tests on voltage magnitude: Check each 10/12 cycles measurement complies with the limits. ⟨AC1]
		P2 for Frequency [a]	ET1	
		P3 for Frequency [a]	ET1	
		P1 for Voltage magnitude	ET1	
		P3 for Voltage magnitude	ET1	
		P5 for Voltage magnitude	ET1	
		Clock uncertainty (check drift on a 8 h duration)	ET1	
S12.1.2	Check influence of worst case temperature	P1 for Frequency [a]	ET2	
		P2 for Frequency [a]	ET2	
		P3 for Frequency [a]	ET2	
		P1 for Voltage magnitude	ET2	
		P3 for Voltage magnitude	ET2	
		P5 for Voltage magnitude	ET2	
		Clock uncertainty (check drift on a 8 h duration)	ET2	
S12.1.3	Check influence of high temperature	P1 for Frequency [a]	ET3	
		P2 for Frequency [a]	ET3	
		P3 for Frequency [a]	ET3	
		P1 for Voltage magnitude	ET3	

N°	Target of the test	Testing points according Table 3	Complementary test conditions according to Table 6	Test criterion (if test is applicable)
		P3 for Voltage magnitude	ET3	
		P5 for Voltage magnitude	ET3	
		Clock uncertainty (check drift on a 8 h duration)	ET3	

[a] Instruments intended to work at 50 Hz shall use the figures provided line “Frequency 50 Hz”. Instruments intended to work at 60 Hz shall use the figures provided in line “Frequency 60 Hz”. Instruments intended to work both at 50 Hz and 60 Hz shall use the figures provided both in line “Frequency 50 Hz” and in line “Frequency 60 Hz”.

7.12.4 Influence of power supply voltage

N°	Target of the test	Testing points according Table 3	Complementary test conditions according to Table 6	Test criterion (if test is applicable)
S12.2.1	Check influence of low power supply voltage	P1 for Frequency [a]	EV1	[AC1) For tests on frequency: Measurement value will be used for further calculation. Check each 10 s measurement complies with the limits. For tests on voltage magnitude: Measurement value will be used for further calculation. Check each 10/12 cycles measurement complies with the limits. (AC1]
		P2 for Frequency [a]	EV1	
		P3 for Frequency [a]	EV1	
		P1 for Voltage magnitude	EV1	
		P3 for Voltage magnitude	EV1	
		P5 for Voltage magnitude	EV1	
S12.2.2	Check influence of high power supply voltage	P1 for Frequency [a]	EV2	
		P2 for Frequency [a]	EV2	
		P3 for Frequency [a]	EV2	
		P1 for Voltage magnitude	EV2	
		P3 for Voltage magnitude	EV2	
		P5 for Voltage magnitude	EV2	

[a] Instruments intended to work at 50 Hz shall use the figures provided line “Frequency 50 Hz”. Instruments intended to work at 60 Hz shall use the figures provided in line “Frequency 60 Hz”. Instruments intended to work both at 50 Hz and 60 Hz shall use the figures provided both in line “Frequency 50 Hz” and in line “Frequency 60 Hz”.

8 Calculation of measurement uncertainty and operating uncertainty

Measurement uncertainty and operating uncertainty are defined in Annex A.

Measurement and Operating uncertainty of magnitude of supply voltage, and Measurement and operating uncertainty of frequency shall be calculated taking into account uncertainty test results on:

– intrinsic uncertainty
– variations due to influence quantities

Measurement and Operating uncertainty for voltage magnitude and for frequency, as calculated in Annex B, shall not exceed the limits given Table 9.

Table 9 – Uncertainty requirements

Requirement according to calculation defined in Annex B	For devices complying with class A as defined in IEC 61000-4-30		For devices complying with class S as defined in IEC 61000-4-30	
	Maximum operating uncertainty for magnitude of supply voltage	Maximum operating uncertainty for frequency at 50Hz and 60 Hz	Maximum operating uncertainty for magnitude of supply voltage	Maximum operating uncertainty for frequency at 50Hz and 60 Hz
Calculation 1	± 0,1 % of U_{din} [a]	± 10 mHz [b]	± 0,5 % of U_{din} [c]	± 50 mHz [d]
Calculation 2 [i] (within temperature range 0 °C to +45°C)	± 0,2 % of U_{din} [e]	± 20 mHz [f]	± 1,0 % of U_{din} [g]	± 100 mHz [h]
Calculation 3 [j] (outside 0 °C to +45°C and within rated range of operation)	± 0,3 % of U_{din} [e]	± 30 mHz [f]	± 1,5 % of U_{din} [g]	± 150 mHz [h]

[a] For this calculation, intrinsic uncertainty will be defined as the worst uncertainty calculated in 6.2.2.1, variations will be defined as the worst uncertainties calculated in each of the tests specified in 6.2.2.2.

[b] For this calculation, intrinsic uncertainty will be defined as the worst uncertainty calculated in 6.1.3.1, variations will be defined as the worst uncertainties calculated in each of the tests specified in 6.1.3.2.

[c] For this calculation, intrinsic uncertainty will be defined as the worst uncertainty calculated in 7.2.2.1, variations will be defined as the worst uncertainties calculated in each of the tests specified in 7.2.2.2.

[d] For this calculation, intrinsic uncertainty will be defined as the worst uncertainty calculated in 7.1.3.1, variations will be defined as the worst uncertainties calculated in each of the tests specified in 7.1.3.2.

[e] For this calculation, intrinsic uncertainty will be defined as the worst uncertainty calculated in 6.2.2.1, variations will be defined as the worst uncertainties calculated in each of the tests specified in 6.2.2.2, 6.12.2 and 6.12.3

[f] For this calculation, intrinsic uncertainty will be defined as the worst uncertainty calculated in 6.1.3.1, variations will be defined as the worst uncertainties calculated in each of the tests specified in 6.1.3.2, 6.12.2 and 6.12.3

[g] For this calculation, intrinsic uncertainty will be defined as the worst uncertainty calculated in 7.2.2.1, variations will be defined as the worst uncertainties calculated in each of the tests specified in 7.2.2.2, 7.12.3 and 7.12.4

[h] For this calculation, intrinsic uncertainty will be defined as the worst uncertainty calculated in 7.1.3.1, variations will be defined as the worst uncertainties calculated in each of the tests specified in 7.1.3.2, 7.12.3 and 7.12.4

[i] For products complying with IEC 62586-1, this test is applicable to PQI-x-FI1, -FI2, -FO, -PI and -PO.

[j] For products complying with IEC 62586-1, this test is applicable to PQI-x-FI1, -FO and -PO but is not applicable to PQI-x-FI2 or -PI.

Annex A
(normative)

Intrinsic uncertainty, operating uncertainty, and overall system uncertainty

A.1 General

Figure A.1 below gives the different kind of uncertainties.

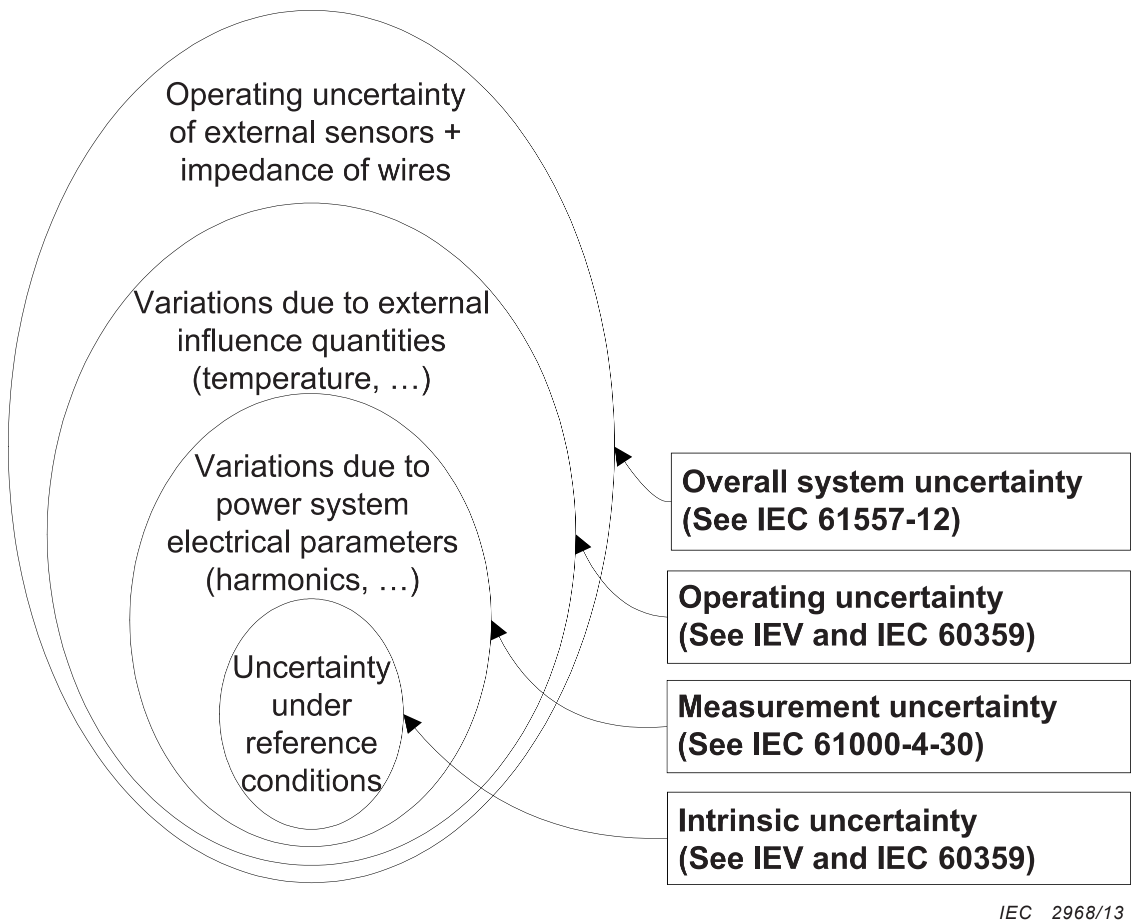


Figure A.1 – Different kinds of uncertainties

A.2 Measurement uncertainty

This is the uncertainty as defined in IEC 61000-4-30.

Measurement uncertainty shall include intrinsic uncertainty under reference conditions and the maximum variation value due to relevant single influence quantities.

A.3 Operating uncertainty

Operating uncertainty shall include intrinsic uncertainty under reference conditions, the maximum variation value due to relevant single influence quantities and the maximum variation value due to relevant external influence quantities.

$$\text{Operating uncertainty} = \left|\text{Intrinsic uncertainty}\right| + 1{,}15 \times \sqrt{\sum_{i=1}^{N}(\text{variation due to single influence quantity})^2 + \sum_{i=1}^{M}(\text{variation due to external influence quantity})^2}$$

where

N is the number of relevant single influence quantities and

M is the number of relevant external influence quantities.

A.4 Overall system uncertainty

Overall system uncertainty shall include operating uncertainty, uncertainty due to impedance of wires and uncertainty due to sensors.

The formula given below is a simplified approach:

$$\text{Overall system uncertainty} = 1{,}15 \times \sqrt{(\text{PQI operating uncertainty})^2 + \sum_{i=1}^{N}(\text{sensor uncertainty} + \text{wirings uncertainty})^2}$$

where

N is the number of kind of external sensors (voltage or current).

NOTE N = 1 when only a current (or voltage) sensor is used, N = 2 when a current sensor and a voltage sensor are used.

Annex B
(normative)

Calculation of measurement and operating uncertainty for voltage magnitude and power frequency

B.1 Selection of test points to verify operating uncertainty and uncertainty under reference conditions

For each relevant power quality parameter, the manufacturer shall identify the test points having the greatest uncertainty under reference conditions and the test points for single influence quantities having the greatest variation to be used for the calculation according to this Annex B.

To verify compliance to this standard, it is sufficient that external test laboratories and/or facilities (third-party test labs) have verified the manufacturer identified test points and the associated calculations for uncertainty.

Aggregations shall be tested separately.

NOTE In case of doubt the manufacturer can present the whole summary of type tests to the test house.

B.2 Class A calculation examples

B.2.1 General

The following clauses specified both for the magnitude of supply voltage and for frequency are based on Table 9. For each, the 3 steps of calculation are necessary to assess uncertainties.

B.2.2 Parameter: Magnitude of Supply Voltage, U_{din} = 230 V, 50/60Hz, rated range of Temperature –25°C to + 55°C

B.2.2.1 Calculation 1 to determine the measurement uncertainty according to IEC 61000-4-30

Test voltage levels P1, P3, and P5 according to Table 3 of this standard under reference conditions.

- Select the highest intrinsic uncertainty, e.g. measured at test point P5 = 0,092 V (0,04 % of U_{din})
- Use P3 for further determination of influences caused by frequency and Harmonics
- Test influence of frequency on U_{din} at test points S1, S3, and S4 according to Table 4 of this standard and select the highest variation e.g. measured at test point S4 = 0,069 V (0,03 % of U_{din})
- Test influence of Harmonics on U_{din} at test point S1 according to Table 4 of this standard and use the variation for calculation = 0,046 V (0,02 % of U_{din})

$$\text{Measurement uncertainty} = 0{,}092 + 1{,}15\sqrt{0{,}069^2 + 0{,}046^2} \quad [\text{V}]$$

= 0,187 [V] (0,08 % of U_{din} meaning that measurement uncertainty is within 0,1 % of U_{din})

B.2.2.2 Calculation 2 to determine the operating uncertainty within temperature range 0...+ 45°C, taking in account a possible influence caused by the Power supply

- Select the highest intrinsic uncertainty e.g. measured at test point P5 = 0,092 V (0,04 % of U_{din})
- Test influence of temperature at test point ET2 according to Table 6 of this standard and use the variation caused by ET2 for further calculation = 0,23 V(0,1 % of U_{din})
- Test influence of Power supply at test points EV1 and EV2 according to Table 7 of this standard: result no variation

$$\text{Operating uncertainty} = 0{,}092 + 1{,}15\sqrt{0{,}069^2 + 0{,}046^2 + 0{,}23^2} \quad [\text{V}]$$

= 0,372 [V] (0,16 % of U_{din} meaning that measurement uncertainty is within 0,2 % of U_{din})

B.2.2.3 Calculation 3 to determine the operating uncertainty outside a temperature range of 0....+ 45°C, taking in account a possible influence caused by the Power supply

- Select the highest intrinsic uncertainty e.g. measured at test point P5 = 0,092 V (0,04 % of U_{din})
- Test influence of temperature at test points ET1 and ET3 according to Table 6 of this standard and use the greatest variation for further calculation = 0,46 V (0,2 % of U_{din})
- Take the values for the influence of Power supply at test points EV1 and EV2 from Calculation 2

$$\text{Operating uncertainty} = 0{,}092 + 1{,}15\sqrt{0{,}069^2 + 0{,}046^2 + 0{,}46^2} \quad [\text{V}]$$

= 0,629 [V] (0,27 % of U_{din} meaning that measurement uncertainty is within 0,3 % of U_{din})

B.2.3 Parameter: Power Frequency 50/60 Hz, rated range of Temperature –25° to +55°C

B.2.3.1 Calculation 1 to determine the measurement uncertainty according to IEC 61000-4-30

Test frequency levels P1, P2, P3 and P4 according to Table 3 of this standard under reference conditions.

- Select the greatest intrinsic uncertainty e.g. measured at test point P4 = 4 mHz
- Use P2 for further determination of influences caused by voltage magnitude and Harmonics
- Test influence of voltage magnitude at test point S1 according to Table 4 of this standard is 3 mHz
- Test influence of Harmonics at test point S1 according to Table 4 of this standard is 2 mHz

$$\text{Measurement uncertainty} = 4 + 1{,}15\sqrt{3^2 + 3^2} \quad [\text{mHz}]$$

$$= 8{,}146\ (< \pm 10) \quad [\text{mHz}]$$

B.2.3.2 Calculation 2 to determine the operating uncertainty within temperature range 0...+ 45°C, taking in account a possible influence caused by the Power supply

- Select the greatest intrinsic uncertainty e.g. measured at test point P4 = 4 mHz
- Test influence of temperature at test point ET2 according to Table 6 of this standard and use the variation of ET2 for further calculation = 5mHz
- Test influence of Power supply at test points EV1 and EV2 according to Table 7 of this standard: result no variation

$$\text{Operating uncertainty} = 4 + 1{,}15\sqrt{3^2 + 2^2 + 5^2} \quad \text{[mHz]}$$

$$= 11{,}09\ (< \pm 20) \quad \text{[mHz]}$$

B.2.3.3 Calculation 3 to determine the operating uncertainty outside a temperature range of 0....+ 45°C, taking in account a possible influence caused by the Power supply

- Select the greatest intrinsic uncertainty e.g. measured at test point P4 = 4 mHz
- Test influence of temperature at test points ET1 and ET3 according to Table 6 of this standard and use the greatest variation for further calculation = 15 mHz
- Take the values for the influence of Power supply at test points EV1 and EV2 from Calculation 2

$$\text{Operating uncertainty} = 4 + 1{,}15\sqrt{3^2 + 2^2 + 15^2} \quad \text{[mHz]}$$

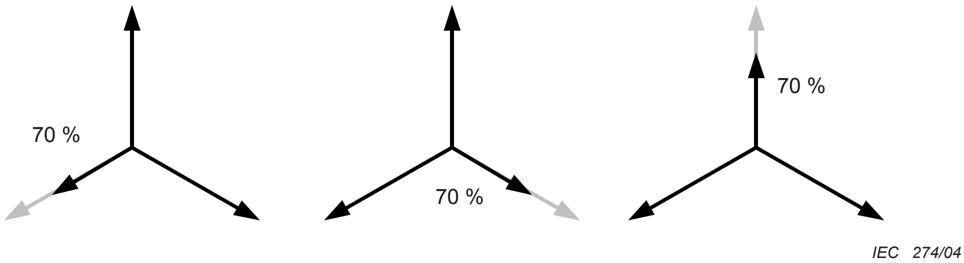
$$= 21{,}74\ (< \pm 30) \quad \text{[mHz]}$$

Annex C
(informative)

Further test on dips (amplitude and phase angles changes)

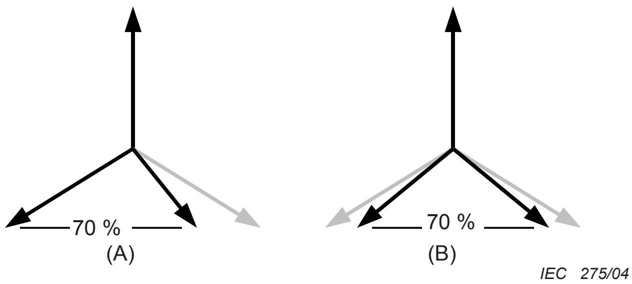
C.1 Phase-to-phase or phase-to-neutral testing

Phase-to-neutral testing (see Figure C.1) and phase-to-neutral testing (see Figure C.2) on three-phase systems:



NOTE Phase-to-neutral testing on three-phase systems is performed one phase at a time.

Figure C.1 – Phase-to-neutral testing on three-phase systems



NOTE Phase-to-phase testing on three-phase phase systems is also performed one phase at a time. Both (A) and (B) show a 70 % dip. (A) is preferred, but (B) is also acceptable.

Figure C.2 – Phase-to-phase testing on three-phase systems

C.2 Test method

Objective:

To ensure the correct measurement of parameters by the instrument during fault conditions that may typically occur at installation sites e.g. radial feeders, where measurement devices may be exposed to multiple reclosures.

Successful outcomes:

- Instrument measures parameters in accordance with IEC 61000-4-30
- Number of events are correctly identified/counted
- Instrument maintains functionality throughout the test.

The tests shall be performed according to Table C.1:

Table C.1 – Tests pattern

Time (s)	Red Phase (%)	White Phase (%)	Blue Phase (%)	Dip Events	Interruption Events
0	100	100	100		
1	100	100	100		
2	100	100	100		
3	100	100	100		
4	100	100	0	Start Dip 1	
5	100	100	0	Dip 1	
6	100	100	0	Dip 1	
7	0	100	0	Dip 1	
8	0	100	0	Dip 1	
9	0	100	0	Dip 1	
10	100	100	100	End Dip 1	
11	100	0	100	Start Dip 2	
12	100	0	100	Dip 2	
13	100	0	100	Dip 2	
14	0	0	100	Dip 2	
15	0	0	100	Dip 2	
16	0	0	100	Dip 2	
17	100	100	100	End Dip 2	
18	100	100	0	Start Dip 3	
19	100	100	0	Dip 3	
20	100	100	0	Dip 3	
21	0	100	0	Dip 3	
22	0	100	0	Dip 3	
23	0	100	0	Dip 3	
24	100	100	100	End Dip 3	
25	100	0	100	Start Dip 4	
26	100	0	100	Dip 4	
27	100	0	100	Dip 4	
28	0	0	100	Dip 4	
29	0	0	100	Dip 4	
30	0	0	100	Dip 4	
31	100	100	100	End Dip 4	
32	100	100	0	Start Dip 5	
33	100	0	0	Dip 5	
34	100	0	0	Dip 5	
35	0	0	0	Dip 5	Start Int 1
36	0	0	0	Dip 5	Int 1
37	0	0	0	Dip 5	Int 1
38	100	0	100	Dip 5	End Int 1
39	100	100	100	End Dip 5	
40	100	100	100		

Annex D
(informative)

Further tests on dips (polyphase): test procedure

D.1 General

a) Prerequisites:

The equipment under test should be properly calibrated (amplitude accuracy) and its clock shall be properly synchronized.

The manufacturer shall provide the necessary companion tools to allow access to the dips / swells / interruption (DSI) information required to perform the IEC 61000-4-30 test protocol.

The 'DSI' test requires to verify the time tags, duration and remaining voltage or depth (dips or interruptions) and/or amplitude (for swells), expressed as a percentage of U_{din} or in primary voltage units (for example V or kV).

b) Test protocol:

The 'DSI' test will be used for each of the declared U_{din} declared by the manufacturer, and for each of the mains frequencies supported.

c) General:

Injection 3 phase waveform with a steady state pre-fault and post-fault of minimum 30 s at U_{din} Pre-fault and post-fault sections will be 'pure' (nominally single-frequency) sine waves $f(t) = U_{din} \sin(2\pi f_{req}\, t + \varphi)$ with a maximum distortion of 2 %.

φ will be chosen so that zero crossing occurs at a reference time t_{REF} programmed in the injection test equipment.

The fault will start at signal zero crossing (t_{REF}) and will terminate at zero crossing, independently for each of the 3 phases. Therefore t_{REF_P2} for phase 2, will be delayed by 120° compared to $t_{REF.}$

The injected fault duration will last an integer number of cycles (example Figure D.1). The duration will be according to the tests RMS injections described below.

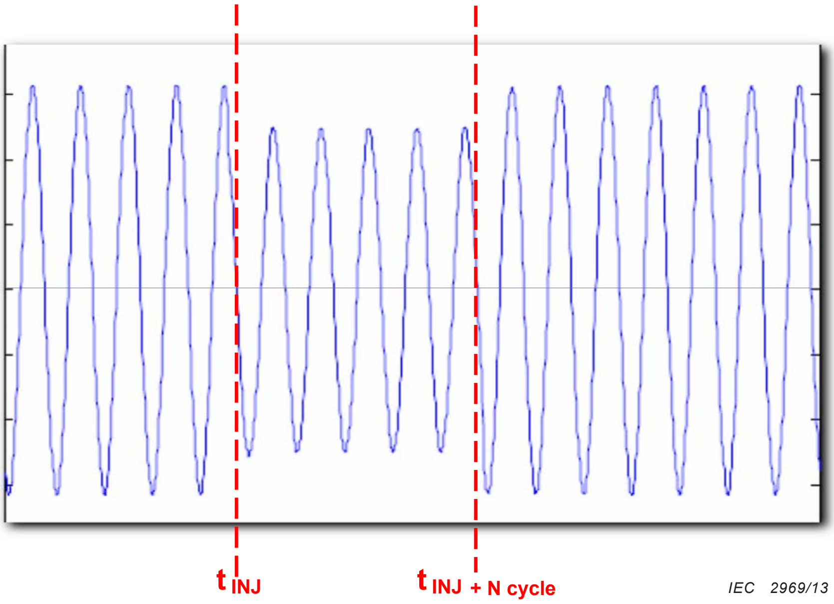
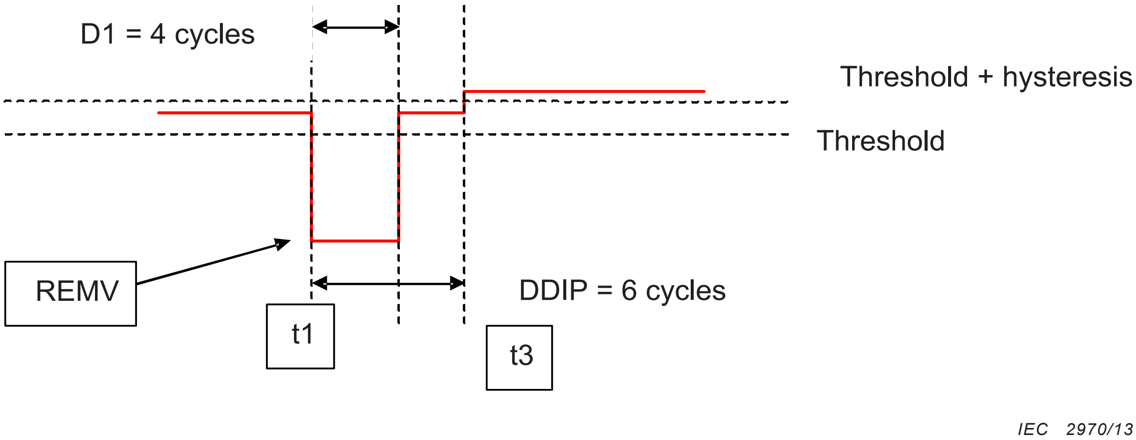


Figure D.1 – Example for on phase of a typical N cycle injection

D.2 Phase voltage dips and interruptions

Dip/interruption accuracy (amplitude and timing) test:

- One test for each of the following remaining voltages REMV: 85, 60, 40, 15 % U_{din}.
- Thresholds will be set above the remaining voltage tested and hysteresis is 2 % U_{din}.
- 3 phase synchronous waveforms, injection reference at t_{INJ} according to Figure D.2 below:



What parameter to check	Name	Expected result
Time tag for beginning of dip	t1	t1 (absolute UTC time tag).+ 1cycle (see latest issue of time tagging the $U_{rms1/2}$ window)
Time tag for end of dip:	t3	t1+ 7 cycles (absolute UTC time tag).
Dip duration	DDIP	t3-t1 = 6 cycles
Remaining voltage	REMV	within accuracy defined in IEC 61000-4-30

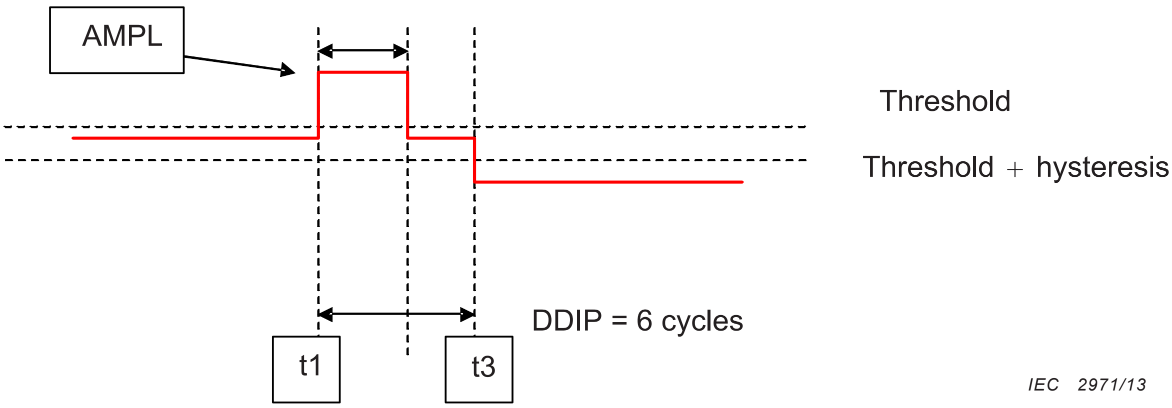
NOTE The number of cycles (4 , 6) are arbitrary values

Figure D.2 – Dip/interruption accuracy (amplitude and timing) test

D.3 Phase swells

Swell accuracy (amplitude and timing) test:

- Thresholds will be below the remaining voltage tested and hysteresis is 2 % U_{din}.
- 3 phase synchronous waveforms, injection reference at t_{INJ} according to Figure D.3 below:



Expected results:

What parameter to check	Name	Expected result
Time tag for beginning of swell: t1	t1	t_{INJ} (absolute UTC time tag).+ 1cycle (see latest issue of time tagging the $U_{rms1/2}$ window)
Time tag for end of swell: t3	t3	t_{INJ}+ 7 cycles (absolute UTC time tag).
Swell duration: DSWL	DSWL	t3-t1 = 6 cycles
Swell amplitude	AMPL	within accuracy defined in IEC 61000-4-30

NOTE The number of cycles (4 , 6) are arbitrary values.

Figure D.3 – Swell accuracy (amplitude and timing) test

Annex E
(normative)

Gapless measurements of voltage amplitude and harmonics test

E.1 Purpose of the test

The purpose of this test is to check the exact duration of the 10/12 cycles basic time window and also the gapless and non-overlapping implementation of the measurements.

E.2 Test set up

The test shall not be done over a 10 min boundary or it would cause an eventual overlap condition due to the aggregation algorithm.

The test shall be conducted with an U_{din} value giving the best signal to noise ratio. The manufacturer shall indicate what is the optimal U_{din} value for this test.

The EUT shall provide every 10/12 cycles RMS value and harmonics value with timestamp with a history depth of at least 100 values.

NOTE 1 The EUT could either provide a log file or output the data continuously on a communication port, or any other mean that can achieve the required history depth.

NOTE 2 For class S device, only RMS values are required, because harmonic measurements are allowed to be with gap.

NOTE 3 The test can be run separately for harmonics and voltage magnitude if the device is not able to produce 10/12 cycles value at the same time for harmonics and voltage magnitude.

E.3 Voltage amplitude

E.3.1 Test signal

The following test signal shall be applied to the EUT:

$$s_{RMS}(t) = V_1\sqrt{2}\cos\left(2\pi f_1 t + \varphi_1\right)\cdot\left(1 + A_m\cos\left(2\pi f_m t + \varphi_m\right)\right)$$

The following requirements apply to the test signal:

	Value	Accuracy
Fundamental frequency (f_1)	50 Hz or 60 Hz	50×10^{-6}
Amplitude of fundamental component (V_1)	U_{din}	0,5 %
Modulating frequency (f_m)	2,3 Hz	100×10^{-6}
Modulating amplitude (A_m)	0,1	1 %
Phases (φ_1 , φ_m)	N.R.	N.R.

E.3.2 Result evaluation

The 10/12 cycles RMS values build a sequence $U_{rms}(0)\ldots U_{rms}(99)$. From this sequence, the following quantities shall be computed:

$$\text{[AC1]}\ A(\mathrm{N}) = \left\| \frac{1}{50\sqrt{2}} \sum_{k=0}^{99} U_{\mathrm{RMS}}(\mathrm{k}) e^{\frac{j2\pi \mathrm{Nk}}{100}} \right\| \quad , \mathrm{N} = 45, 46, 47\ \text{[/AC1]}$$

NOTE Double bar means complex modulus

$$Q_{\mathrm{rms}} = \sqrt{\frac{A(46)^2}{A(45)^2 + A(47)^2}}$$

The following requirements shall be met:

– $Q_{\mathrm{rms}} > 20$
– $4{,}5\ \% < A(46)/V_1 < 5{,}5\ \%$
– timestamp(U(99)) – timestamp(U(0)) = 20 s ± 6 ms

E.4 Harmonics

E.4.1 Test signal

The following test signal shall be applied to the EUT:

$$s_{\mathrm{H}}(\mathrm{t}) = \mathrm{V}_1\sqrt{2}\cos(2\pi f_1 \mathrm{t} + \varphi_1) + (1 + A_{\mathrm{m}}\cos(2\pi f_{\mathrm{m}}\mathrm{t} + \varphi_{\mathrm{m}})) \cdot \mathrm{V}_{\mathrm{N}}\sqrt{2}\cos(2\pi \mathrm{N} f_1 \mathrm{t} + \varphi_{\mathrm{N}})$$

The following requirements apply to the test signal:

	Value	**Accuracy**
Fundamental frequency (f_1)	50 Hz or 60 Hz	50×10^{-6}
Amplitude of fundamental component (V_1)	U_{din}	0,5 %
Modulating frequency (f_m)	2,3Hz	100×10^{-6}
Modulating amplitude (A_m)	0,3	1 %
Harmonic number (N)	Any value	N.R.
Amplitude of harmonic component (V_N)	$0{,}1 \times U_{\mathrm{din}}$	1 %
Phases (φ_1 , φ_m , φ_N)	N.R.	N.R.

E.4.2 Result evaluation

The 10/12 cycles harmonic values for harmonic number N build a sequence H(0)…H(99). From this sequence, the following quantities shall be computed:

$$\text{[AC1]}\ B(\mathrm{N}) = \left\| \frac{1}{50\sqrt{2}} \sum_{k=0}^{99} \mathrm{H}(\mathrm{k}) e^{\frac{j2\pi \mathrm{Nk}}{100}} \right\| \quad , \mathrm{N} = 45, 46, 47\ \text{[/AC1]}$$

NOTE Double bar means complex modulus

$$Q_{\mathrm{H}} = \sqrt{\frac{B(46)^2}{B(45)^2 + B(47)^2}}$$

The following requirements shall be met:

- $Q_H > 20$
- 13,5 % $<$ B(46)/ V_N $<$ 16,5 %
- timestamp(H(100)) – timestamp(H(0)) = 20 s ± 6 ms

NOTE See Annex F for explanation about the method.

Annex F
(informative)

Gapless measurements of voltage amplitude and harmonics

Identification of incorrect implementation of the gapless and non-overlapping measurements of 10/12 cycles RMS values and harmonics is a difficult task when trying to detect small gaps or overlap, or filtering effects (for example, using a sliding window longer than 10/12 cycles with an output every 10/12 cycles).

The following results are based on simulation, with the following simulation conditions (see Figure F.1):

– Sampling frequency: 10 240 Hz (first well suited frequency for harmonic analysis: 2048 pts for 200 ms).
– Noise: Gaussian white noise at 0,01 × U_{din} RMS. For steady state distortion free signal, this noise level produces 200 ms RMS value in the range U_{din} ±0,1 % U_{din}. This noise level simulates a device just at the limit of the allowed intrinsic uncertainty.

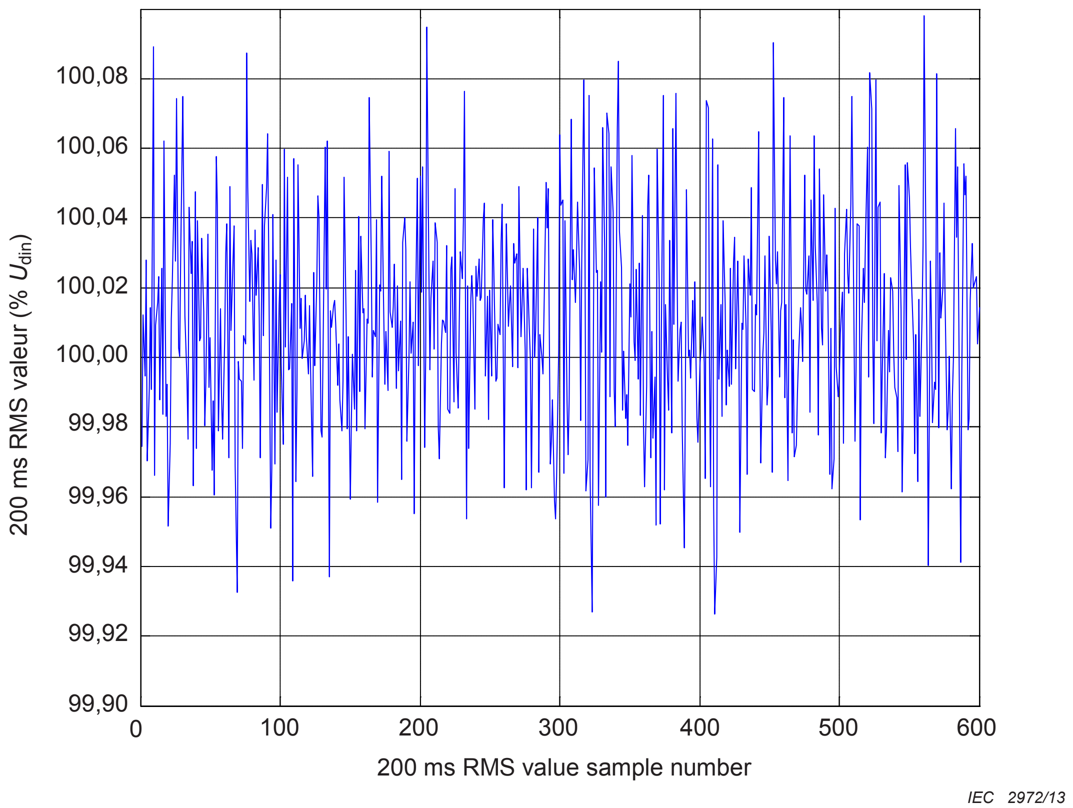


Figure F.1 – Simulated signal under noisy conditions

The signal used for checking gapless RMS voltage measurement is a fluctuating fundamental signal with following settings:

– Sine modulation
– Fundamental amplitude: 100 % of U_{din}
– ±10 % modulation depth
– Modulating frequency: 2,3 Hz

With the above settings, the 10/12 cycles RMS values give this kind of waveform, illustrated in Figure F.2:

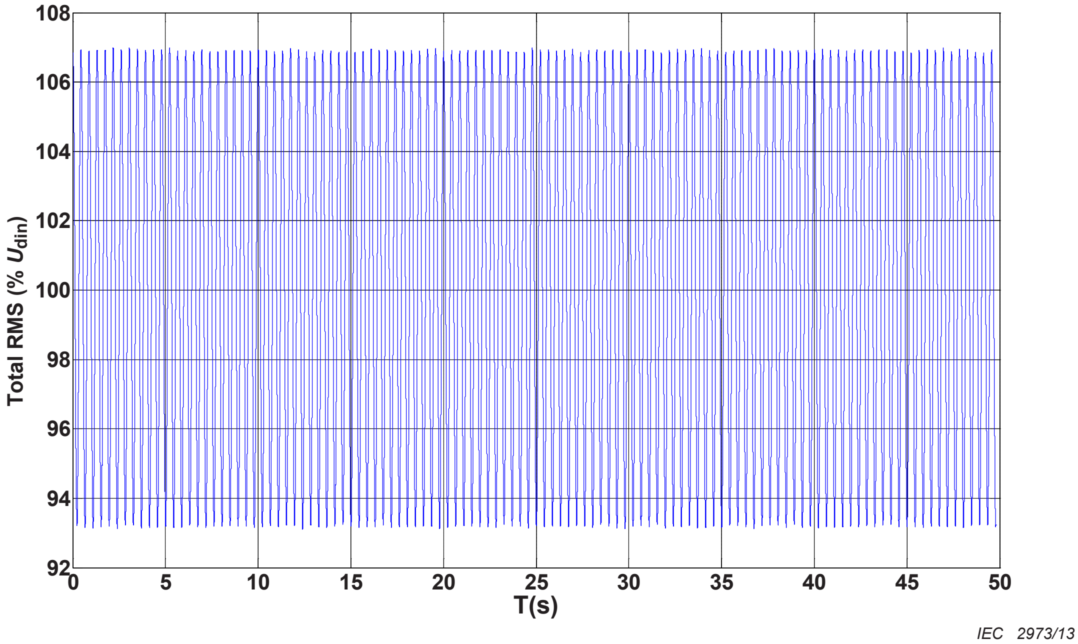


Figure F.2 – Waveform for checking gapless RMS voltage measurement

For the simulation of a theoretical ideal design, the frequency of the fluctuation is exactly 2,3 Hz. Using an FFT analysis, it is quite easy to detect gaps: the spectrum in Figure F.3 is obtained with a 100 pts rectangular analysis window:

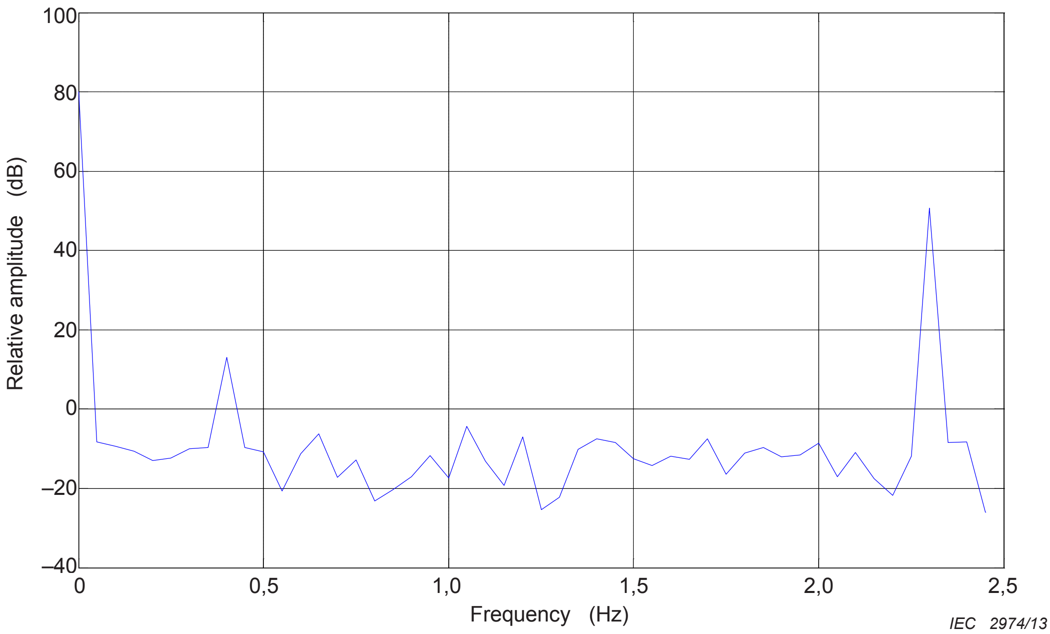


Figure F.3 – 2,3 Hz Frequency fluctuation

If there is only a missing sample between two measurements, the spectral leakage effects become visible as shown in the following figure: in blue, the spectrum with gapless measurement, in red, the spectrum with just one missing sample (ca 100 µs…) between measurements, see Figure F.4:

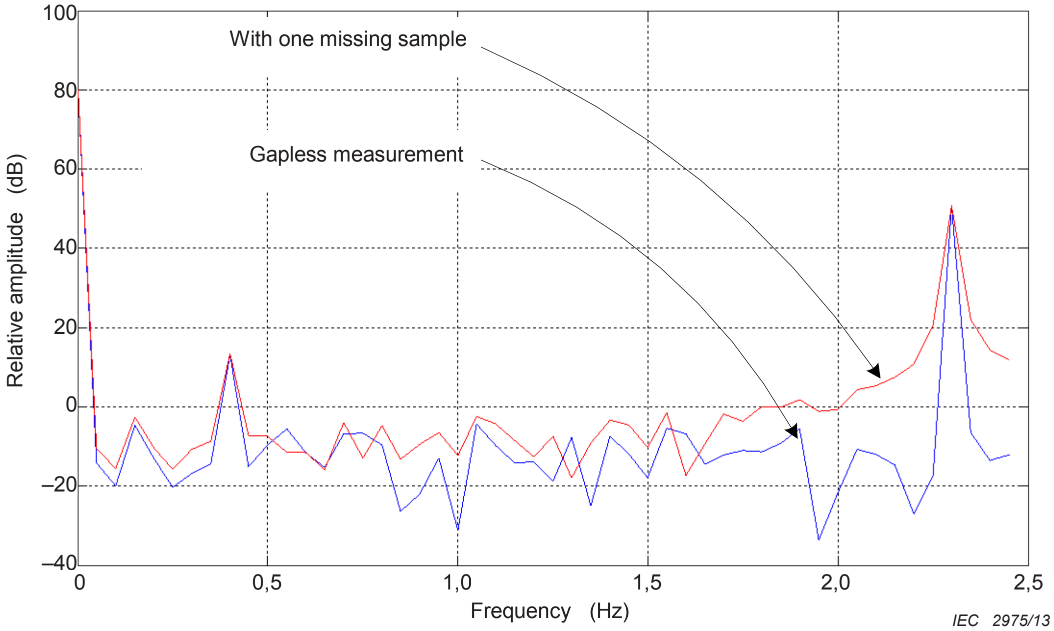


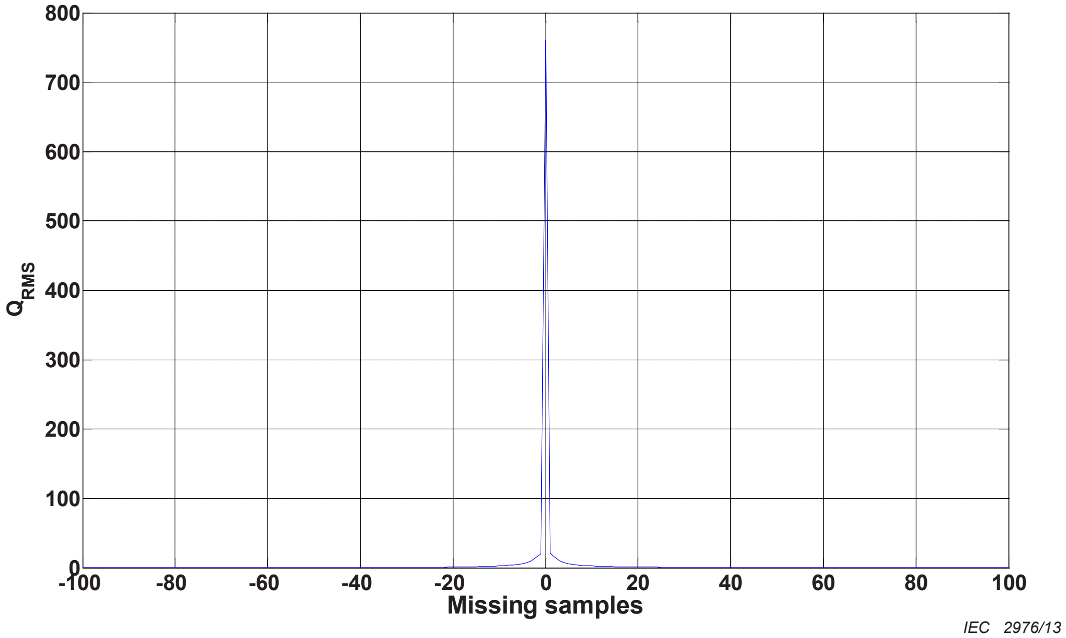
Figure F.4 – Spectral leakage effects for a missing sample

As an indication for the gap (or overlap) between two measurements, we can use the following equation:

$$Q = \sqrt{\frac{A(\mathrm{n})^2}{A(\mathrm{n}-1)^2 + A(\mathrm{n}+1)^2}}$$

where n is the FFT bin corresponding to the modulating frequency and *A*(n) the corresponding amplitude (in our case, with an analysis window of 100 RMS values and a modulating frequency of 2,3 Hz, n=46, assuming the DC component as an index of 0).

Figure F.5 shows that this indicator has a very high value for exact gapless measurements and decreases very quickly even with small gaps between consecutive measurements (negative missing samples means overlap between consecutive measurements):



NOTE Q_{RMS} and Q_H are defined in Annex E .

Figure F.5 – Illustration of QRMS for missing samples

If we take a closer look to the range [-5, 5], we can see that it is possible to detect even just one missing sample, see Figure F.6:

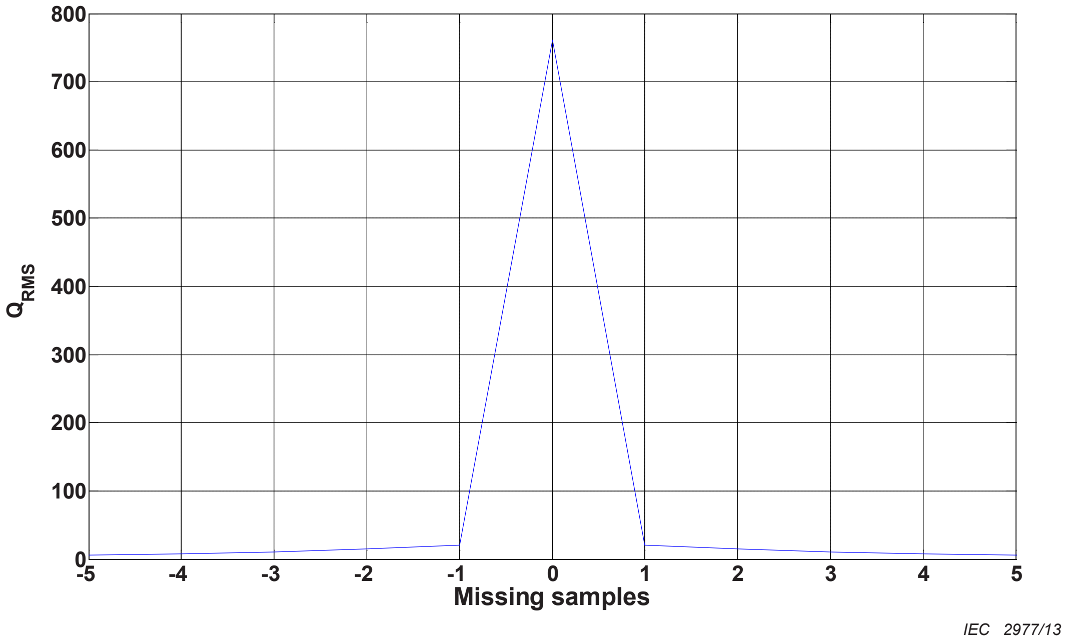
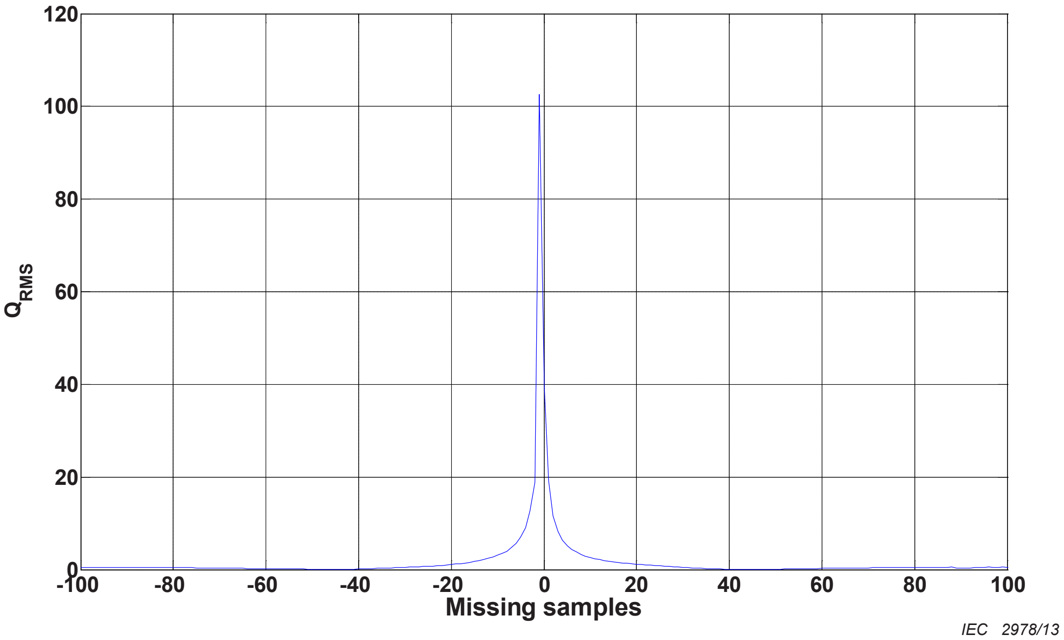


Figure F.6 – Detection of a single missing sample

NOTE Q_{RMS} and Q_H are defined in Annex E .

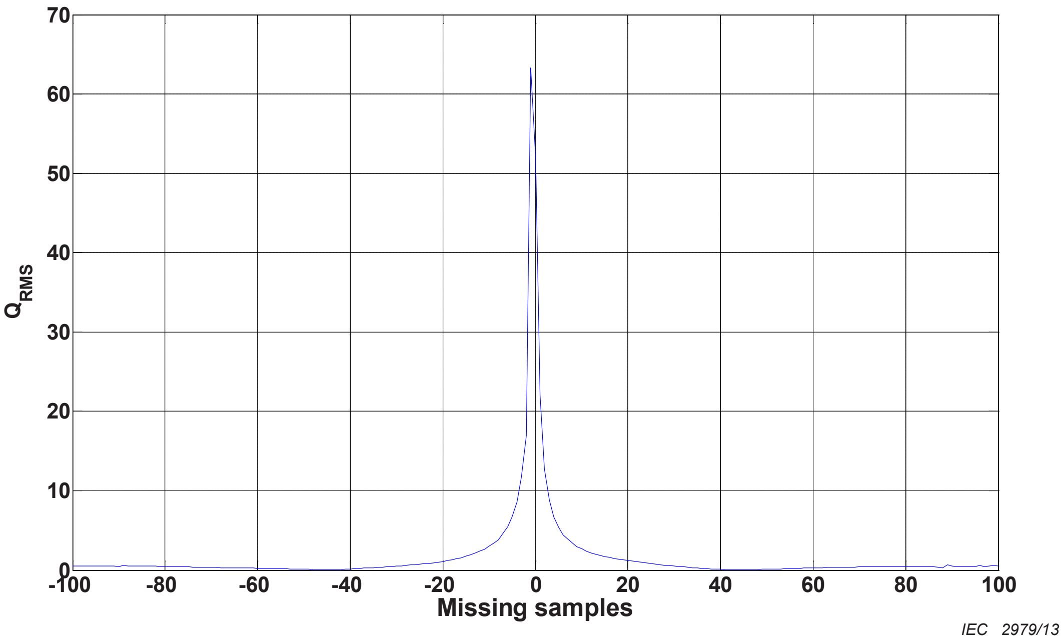
These results are valid for an ideal signal, i.e. with 0 % deviation on the fundamental frequency as well as the modulating frequency and also with perfectly synchronized sampling. IEC 61000-4-7 tolerates a deviation of 300×10^{-6} of the synchronisation of the 10/12 cycles time window. Should an ideal signal be assumed which is sampled with a sampling frequency error of $^{-}300 \times 10^{-6}$, the results are shown in Figure F.7:



NOTE Q_{RMS} and Q_H are defined in Annex E.

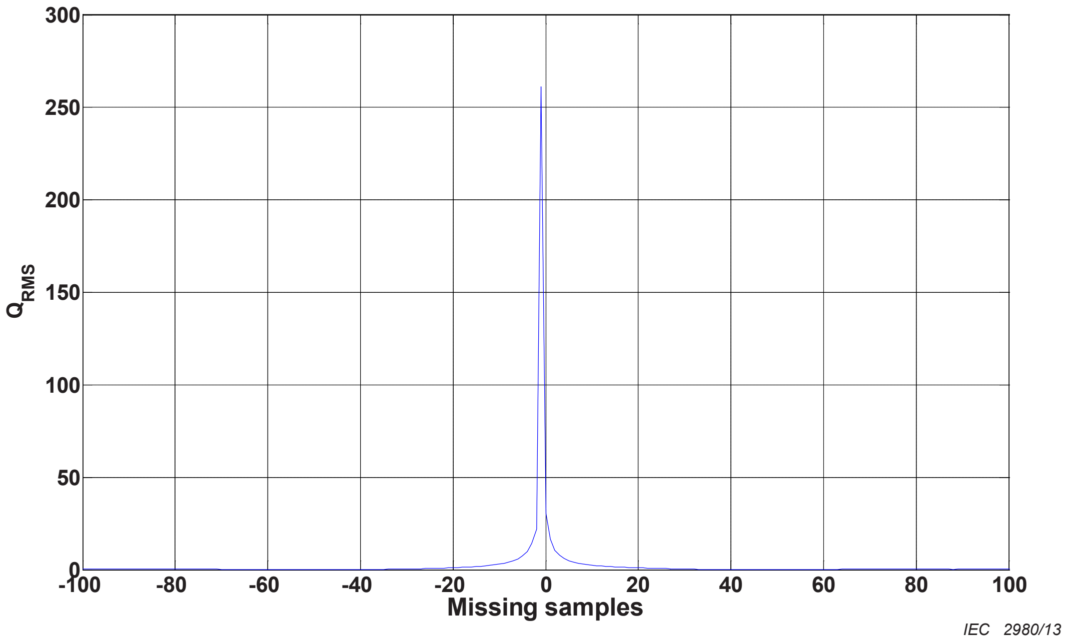
Figure F.7 – Q_{RMS} for an ideal signal, sampling error = 300 x 10^{-6}

If we add $\pm 100 \times 10^{-6}$ deviation on the modulating frequency, the results are shown in Figure F.8 and Figure F.9:



NOTE Q_{RMS} and Q_H are defined in Annex E.

Figure F.8 – Q_{RMS} for an ideal signal, sampling error = 400 x 10^{-6}



NOTE Q_{RMS} and Q_H are defined in Annex E.

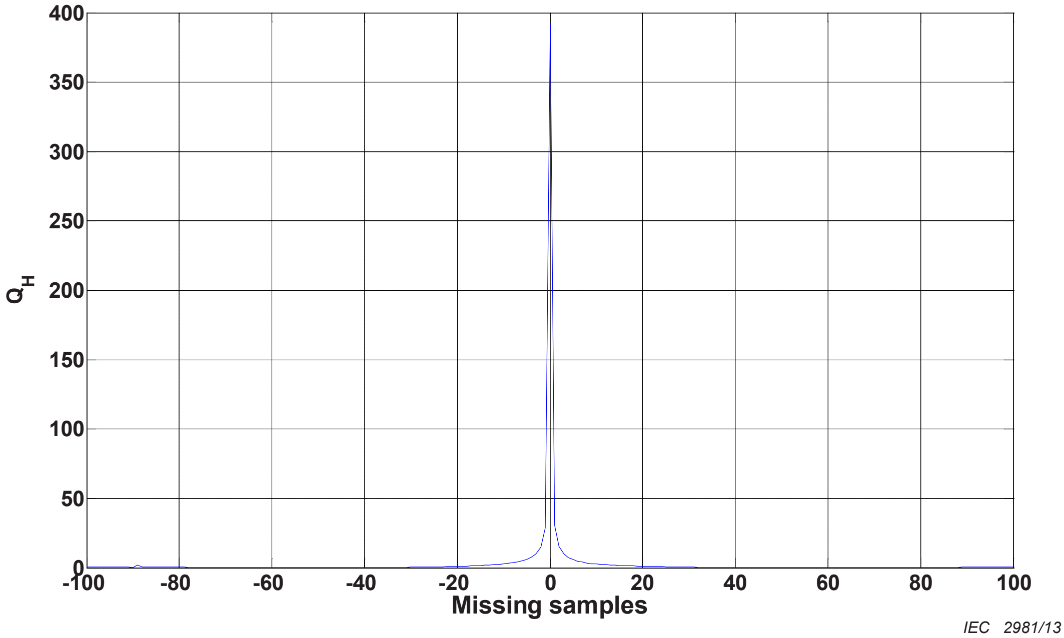
Figure F.9 – Q_{RMS} for an ideal signal, sampling error = 200 x 10^{-6}

The value of QRMS with perfect design could be as low as 30. In order to keep some safety margin, we chose a limit value of 20 for QRMS. Under certain conditions, we may declare conform a device that has a gap or overlap of 1 or 2 samples, but this risk is very low.

For harmonics, the same considerations apply. With the following settings:

– Fluctuating harmonic settings (example)
– Sine modulation
– 5^{th} harmonic
– Harmonic amplitude: 10 % of U_{din}
– ±30 % modulation depth
– Modulating frequency: 2,3Hz

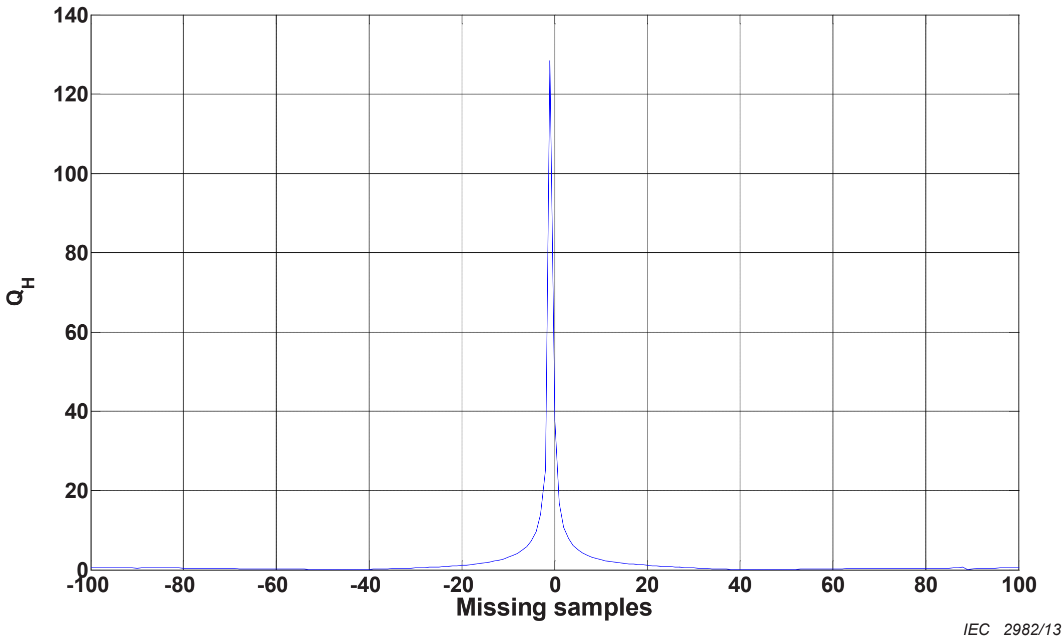
Figure F.10 shows the result with an ideal test signal and perfect sampling frequency synchronization:



NOTE Q_{RMS} and Q_H are defined in Annex E.

Figure F.10 – Q_{RMS} with ideal test signal and perfect sampling frequency synchronization

Figure F.11 shows the result with 300 × 10^{-6} sampling frequency error and 100 x 10^{-6} modulation frequency error:

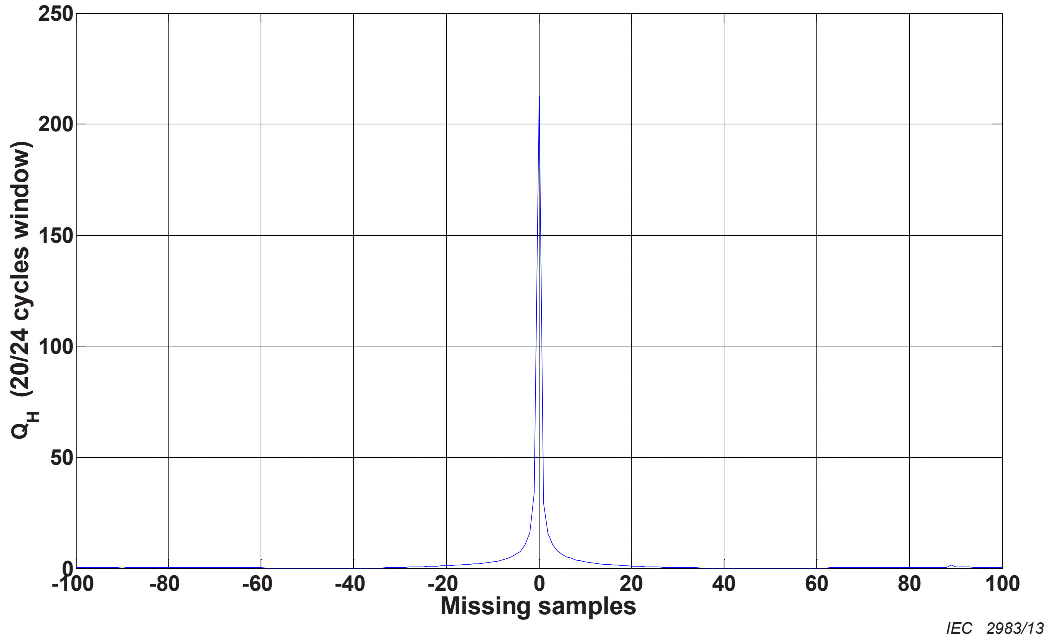


NOTE $Q_{RMS\ and}$ Q_H are defined in Annex E.

Figure F.11 – Q_{RMS} with 300 x 10^{-6} sampling frequency error and 100 x 10^{-6} modulation frequency error

The limit QH > 20 is valid for the harmonic test.

This indicator is not enough to detect filtering effects: the following Figure F.12 shows the results obtained with a 20/24 cycles sliding window with a value output every 10/12 cycles:



NOTE $Q_{RMS\ and}$ Q_H are defined in Annex E.

Figure F.12 – Q_{RMS} with a 20/24 cycles sliding window with a output every 10/12 cycles

To detect this kind of wrong design, we need to add a test on the amplitude of the fluctuating component:

Figure F.13 shows in blue the correct implementation, and shows in red the wrong one.

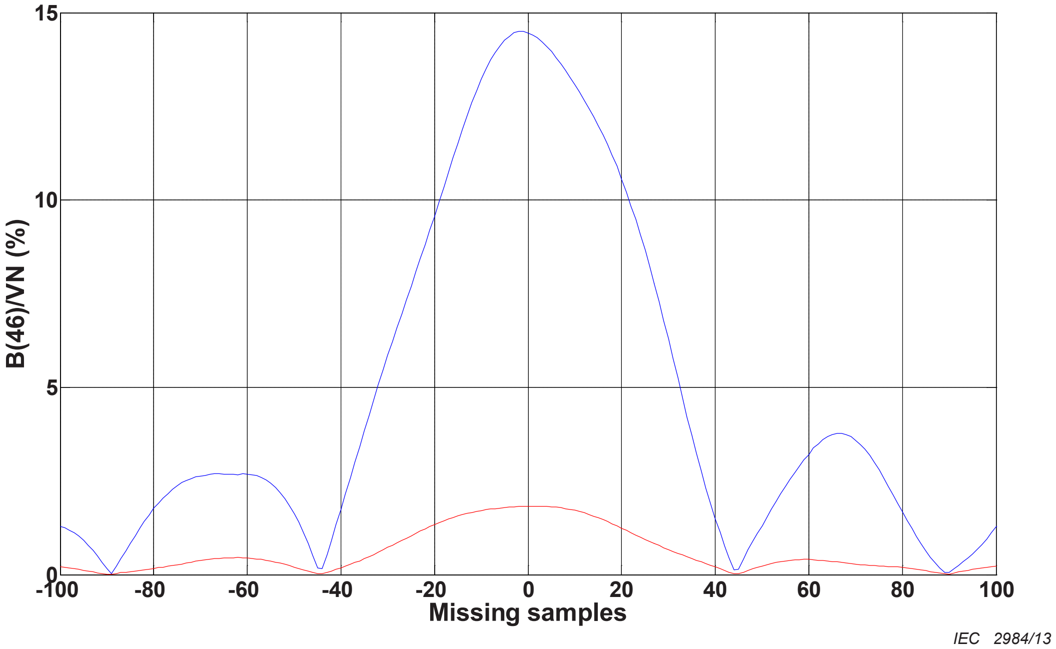


Figure F.13 – Amplitude test for fluctuating component

This condition on the value of A(46) for 10/12 cycles RMS value and B(46) for harmonics is a good way to detect this kind of filtering effects.

Annex G
(informative)

Testing equipment requirements

For compliance testing, the testing equipment should support the range of 200 % U_{din}.

NOTE 1 For pre-compliance testing, arbitrary waveform generator can be used to inject after the attenuator.

The stability and uncertainty of the source and reference meter should be carefully considered, and should be at least 5 times the one of the measured parameter.

For some class A tests, the testing equipment needs a time synchronisation with a sufficiently accurate time source.

NOTE 2 An alternative solution would be to use a non-synchronized testing equipment along with a synchronized reference meter, at least twice more accurate than the equipment under test.

Annex H
(informative)

Example of test report

Certification Laboratory: YYY Laboratory Inc., City, Country
Manufacturer: XXX Instruments Ltd., City, Country

Model Number(s): ZZZ-1
Firmware version: x.xx

This Certificate applies:

– for values of U_{din} between xxx V and xxx V, at xx Hz.
– For a rated range of operation [xx°C – xx °C]
– For a range of power supply xxV to xxV

The instrument designated above complies with IEC 62586-2.

The following 61000-4-30:2008 measurement methods have been tested:

Parameter	Class A	Class S	Implemented	Comment
Aggregation	Yes	Yes	Yes	
Power frequency	Yes	Yes	Yes	
Magnitude of the supply voltage	---	---	Yes	
Flicker	---	---	Yes	
Supply voltage dips and swells	---	Yes	Yes	
Supply voltage interruptions	Yes	Yes	Yes	
Supply voltage unbalance	---	---	Yes	
Voltage harmonics	---	---	Yes	
Voltage inter-harmonics	---	---	---	
Mains signalling voltage	---	---	Yes	
Under/over deviation	Yes	Yes	Yes	

Annex I
(informative)

Mixed influence quantities

I.1 Variations due to mixed influence quantities for frequency

Each test shall last at least 1 min (see Table I.1).

Table I.1 – Mixed influence quantities test for frequency

N°	Target of the test	Testing points according Table 3	Complementary test conditions according to Table 5	Test criterion (if test is applicable)
1.4.1	Check influence of mixed power system influence quantities	P1 for Frequency [a]	M1	Measurement needs to comply with IEC 61000-4-30 requirement about measurement uncertainty
			M2	
			M3	
1.4.2	Check influence of mixed power system influence quantities	P2 for Frequency [a]	M1	
			M2	
			M3	
1.4.3	Check influence of mixed power system influence quantities	P3 for Frequency [a]	M1	
			M2	
			M3	
1.4.4	Check influence of mixed power system influence quantities	P4 for Frequency [a]	M1	
			M2	
			M3	

[a] Instruments intended to work at 50 Hz shall use the figures provided line “Frequency 50 Hz”. Instruments intended to work at 60 Hz shall use the figures provided in line “Frequency 60 Hz”. Instruments intended to work both at 50 Hz and 60 Hz shall use the figures provided both in line “Frequency 50 Hz” and in line “Frequency 60 Hz”.

I.2 Variations due to mixed influence quantities for magnitude of voltage

Each test shall last at least 1 s (see Table I.2).

Table I.2 – Mixed influence quantities test for magnitude of voltage

N°	Target of the test	Testing points according Table 3	Complementary test conditions according to Table 5	Test criterion (if test is applicable)
2.4.1	Check influence of mixed power system influence quantities	P1 for Voltage magnitude	M1	Measurement needs to comply with IEC 61000-4-30 requirement about measurement uncertainty
			M2	
			M3	
2.4.2	Check influence of mixed power system influence quantities	P2 for Voltage magnitude	M1	
			M2	
			M3	
2.4.3	Check influence of mixed power system influence quantities	P3 for Voltage magnitude	M1	
			M2	
			M3	
2.4.4	Check influence of mixed	P4 for Voltage	M1	

N°	Target of the test	Testing points according Table 3	Complementary test conditions according to Table 5	Test criterion (if test is applicable)
	power system influence quantities	magnitude	M2	
			M3	
2.4.5	Check influence of mixed power system influence quantities	P5 for Voltage magnitude	M1	
			M2	
			M3	

I.3 Variations due to mixed influence quantities for dips and swells

Each test shall last at least 1 s (see Table I.3).

Table I.3 – Mixed influence quantities test for dips and swells

N°	Target of the test	Testing points according Table 3	Complementary test conditions according to Table 5	Test criterion (if test is applicable)
4.4.1	Check influence of mixed power system influence quantities	P1 for Dips / Interruptions / Swells	M1	Measurement needs to comply with IEC 61000-4-30 requirement about measurement uncertainty
			M2	
			M3	
4.4.2	Check influence of mixed power system influence quantities	P2 for Dips / Interruptions / Swells	M1	
			M2	
			M3	
4.4.3	Check influence of mixed power system influence quantities	P3 for Dips / Interruptions / Swells	M1	
			M2	
			M3	
4.4.4	Check influence of mixed power system influence quantities	P4 for Dips / Interruptions / Swells	M1	
			M2	
			M3	
4.4.5	Check influence of mixed power system influence quantities	P5 for Dips / Interruptions / Swells	M1	
			M2	
			M3	

I.4 Variations due to mixed influence quantities for under and over deviations

Covered by 6.2.2

It is sufficient to verify that the underlying 10/12-cycle calculations for magnitude of supply voltage meet the relevant accuracy and range requirements.

Bibliography

IEC 60359, *Electrical and electronic measurement equipment – Expression of performance*

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

bsi.

...making excellence a habit.™