

INTERNATIONAL STANDARD

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

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



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CONTENTS

FOREWORD.....	7
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	80
Annex A (normative)	Intrinsic uncertainty, operating uncertainty, and overall system uncertainty	82
Annex B (normative)	Calculation of measurement and operating uncertainty for voltage magnitude and power frequency	84
Annex C (informative)	Further test on dips (amplitude and phase angles changes)	87
Annex D (informative)	Further tests on dips (polyphase): test procedure	89
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	82
Figure C.1 – Phase-to-neutral testing on three-phase systems	87
Figure C.2 – Phase-to-phase testing on three-phase systems	87
Figure D.1 – Example for on phase of a typical N cycle injection	90
Figure D.2 – Dip/interruption accuracy (amplitude and timing) test	91
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 – QRMS for an ideal signal, sampling error = 300×10^{-6}	99
Figure F.8 – QRMS for an ideal signal, sampling error = 400×10^{-6}	99
Figure F.9 – QRMS for an ideal signal, sampling error = 200×10^{-6}	100
Figure F.10 – QRMS with ideal test signal and perfect sampling frequency synchronization	101
Figure F.11 – QRMS with 300×10^{-6} sampling frequency error and 100×10^{-6} modulation frequency error	101
Figure F.12 – QRMS 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	81
Table C.1 – Tests pattern	88
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

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POWER QUALITY MEASUREMENT IN POWER SUPPLY SYSTEMS –**Part 2: Functional tests and uncertainty requirements**

FOREWORD

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

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

FDIS	Report on voting
85/461/FDIS	85/467/RVD

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

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

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

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

The contents of the corrigendum of November 2014 have been included in this copy.

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Withdrawn

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.

Withdrawn

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	Threshold dip+ ^d	Threshold dip- ^d	20 % U_{din}	60 % U_{din}	85 % U_{din}
	S	Threshold dip+ ^d	Threshold dip- ^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 x 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 = 2 nd harmonic plus 5 Hz (105Hz at 50Hz, and/or 125Hz at 60Hz), Magnitude = 4 % of U_{din} 2) Frequency = 2 nd harmonic plus 10 Hz (110Hz at 50Hz, and/or 130Hz at 60Hz), Magnitude = 6 % of U_{din}
	S	---	Frequency = 1,5 x fundamental frequency; 2,5 % of U_{din}	Frequency = 0,5 x 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	$U_{din} \pm 1$ %	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 % $\pm 0,5$ % of U_{din} on all channels. All phase angles 120° (equivalent to $u_0 = 0$ %, $u_2 = 0$ %)	73 % $\pm 0,5$ % of U_{din} Channel 1 80 % $\pm 0,5$ % of U_{din} Channel 2 87 % $\pm 0,5$ % of U_{din} Channel 3 all phase angles 120° (equivalent to $u_0 = 5,05$ %, $u_2 = 5,05$ %)	152 % $\pm 0,5$ % of U_{din} Channel 1 140 % $\pm 0,5$ % of U_{din} Channel 2 128 % $\pm 0,5$ % 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 % $\pm$ 3 % of U_{din} 3 rd at 0° 5 % $\pm$ 3 % of U_{din} 5 th at 0° 5 % $\pm$ 3 % of U_{din} 29 th at 0°	10 % $\pm$ 3 % of U_{din} 7 th at 180° 5 % $\pm$ 3 % of U_{din} 13 th at 0° 5 % $\pm$ 3 % of U_{din} 25 th at 0°
Interharmonics	0 % to 0,5 % of U_{din}	1 % $\pm$ 0,5 % of U_{din} at 7,5 f_{nom}	1 % $\pm$ 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

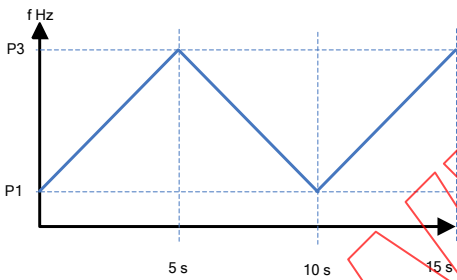
6.1 Power frequency

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

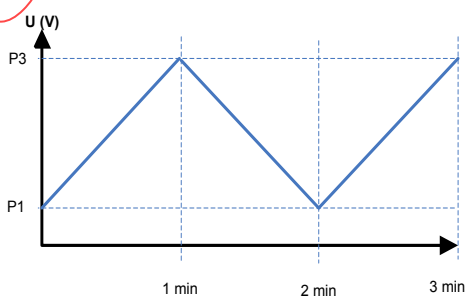
6.2.4.1 10/12 cycles with 10 min synchronisation

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 = $(2999,5/600) \times 12$; 49,99 Hz = $(2999,5/600) \times 10$				

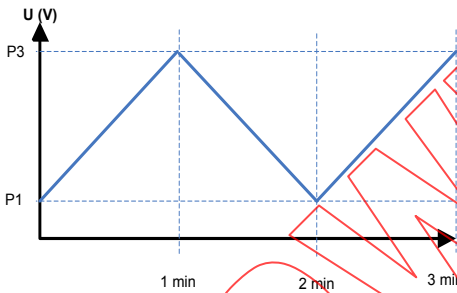
6.2.4.2 150/180 cycles aggregation with 10 min synchronisation

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	$f = 50,125 \text{ Hz}$ (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 $50,125 \text{ Hz} = (200,5 / 600) \times 150$; $60,15 \text{ Hz} = (200,5 / 600) \times 180$				

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.

N°	Target of the test	Testing points according to Table 3	Complementary test conditions according to Table 4	Test criterion
A2.6.1	Check 10-min aggregation	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	S2 for Frequency	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.
		 NOTE The time on X axis is not necessarily synchronised on the 10-min tick		

6.2.4.4 2-h aggregation

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

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	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).
		P3 for Dips/Int. ^b P4 for Frequency ^a		
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 P3 for Dips/Int. ^b P3 for Frequency ^a P3 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 $\pm 0,5$ 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. 3) Inject dip of 5 cycles duration at $50\% U_{din}$	See Figure 9	No dip should be detected. Verify that instrument is detecting a dip at $57,5\%$ of U_{ref} . NOTE $57,5\% = 50/87 \times 100\%$
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. 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.	See Figure 10	The instrument shall detect an interruption start. 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.			

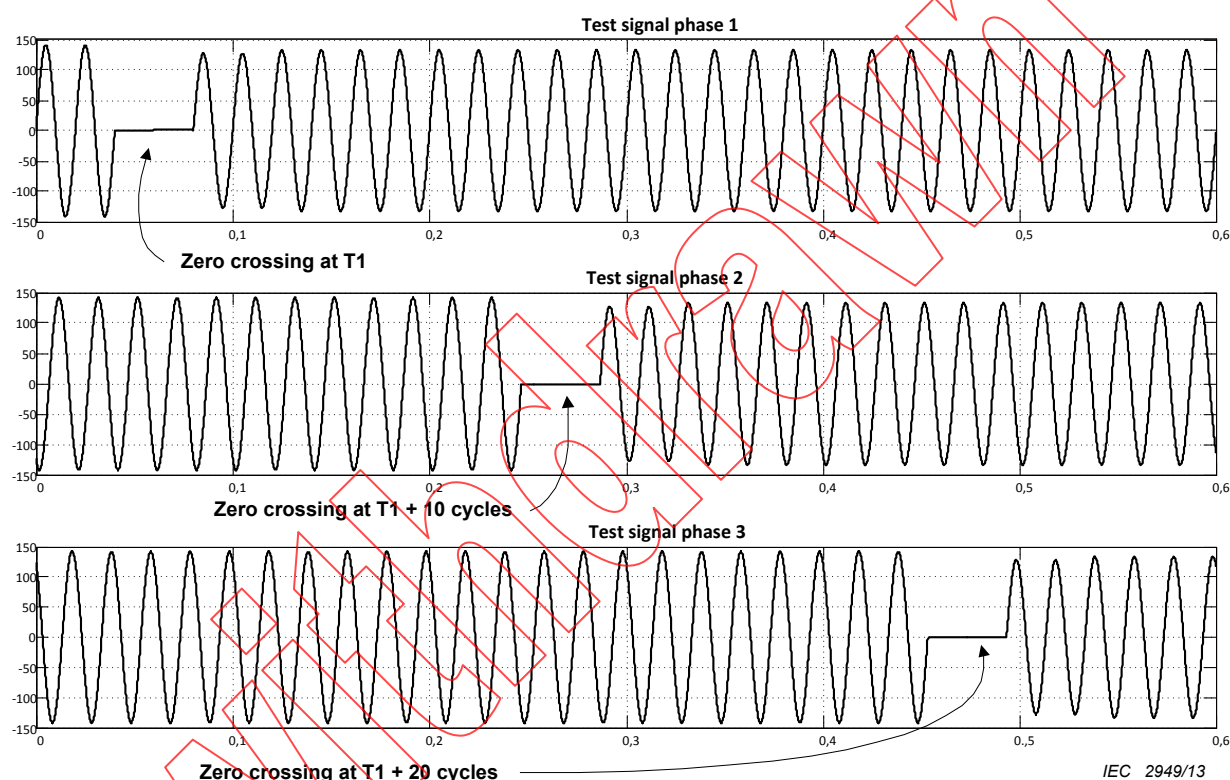


Figure 1 – Overview of test for dips according to test A4.1.1

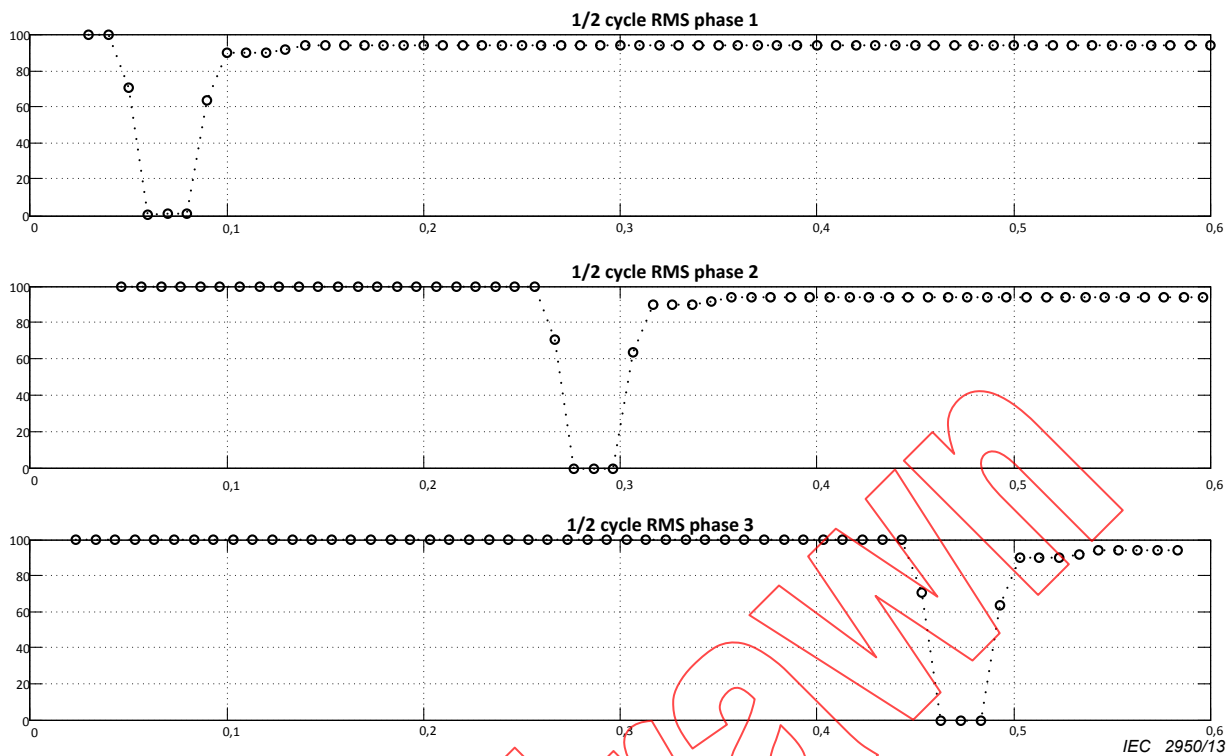


Figure 2 – Detail 1 of waveform for test of dips according to test A4.1.1

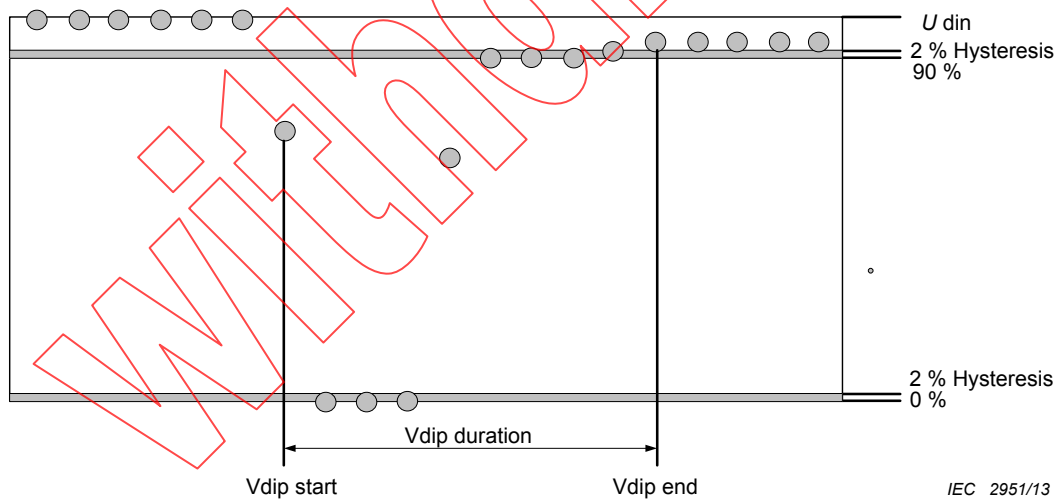


Figure 3 – Detail 2 of waveform for tests of dips according to A4.1.1

$U_{rms}(1/2)$ 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

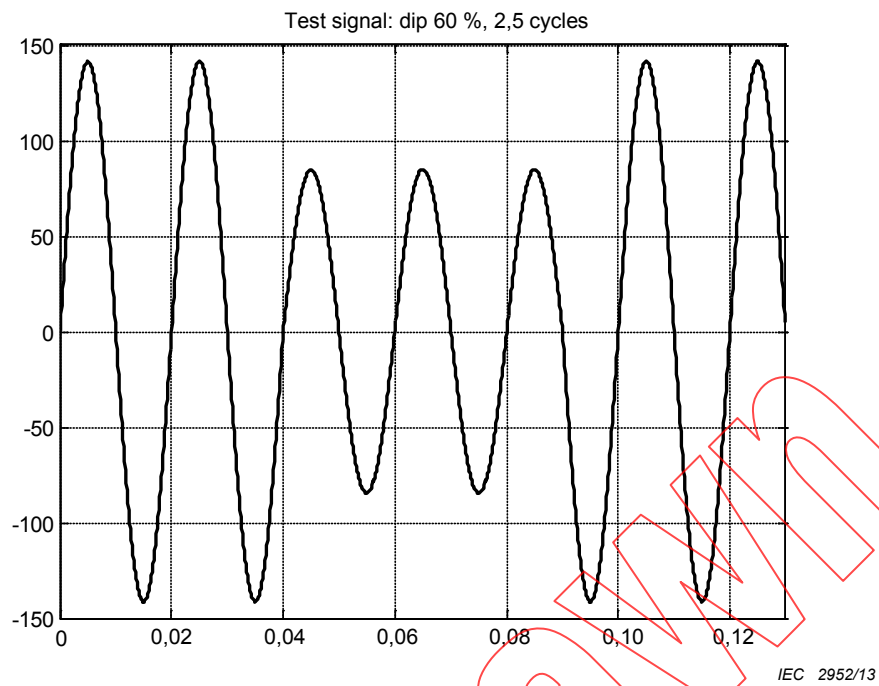


Figure 5 – Detail 1 of waveform for test of dips according to test A4.1.2

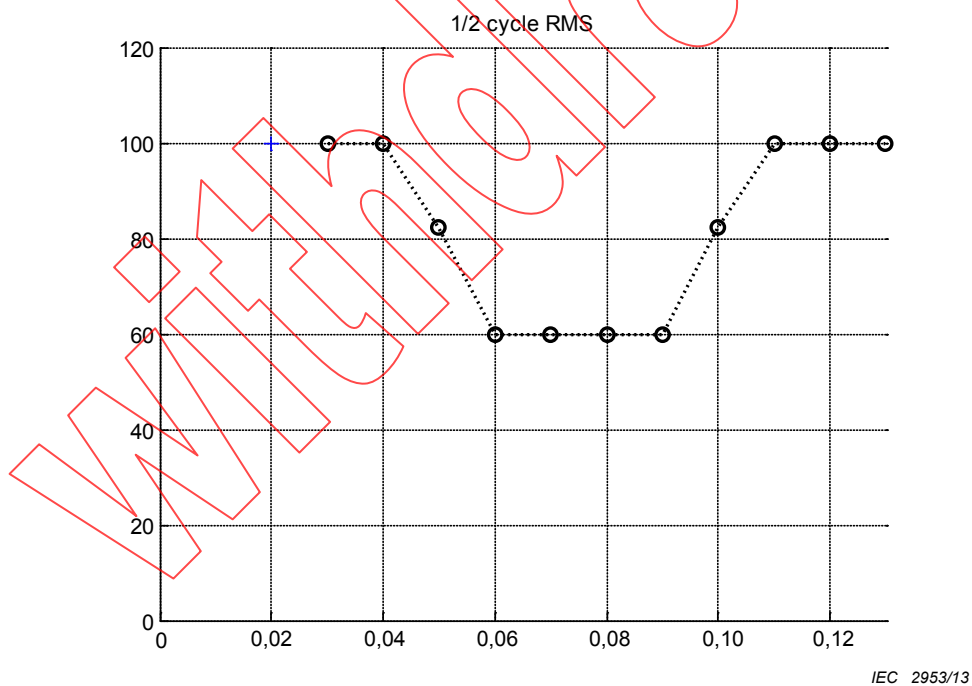


Figure 6 – Detail 2 of waveform for tests of dips according to test A4.1.2

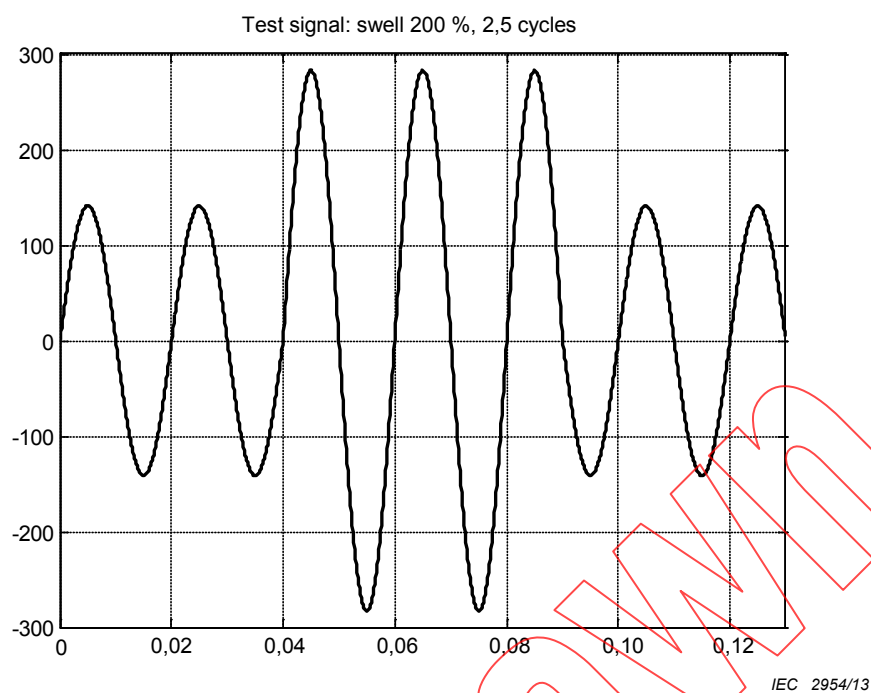


Figure 7 – Detail 1 of waveform for test of swells according to test A4.1.2

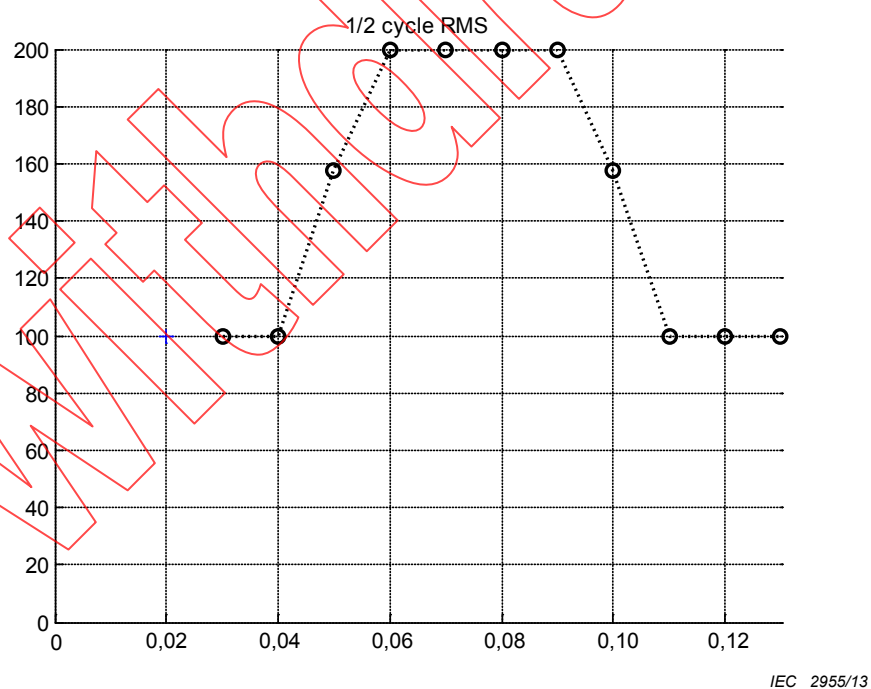


Figure 8 – Detail 2 of waveform for tests of swells according to test A4.1.2

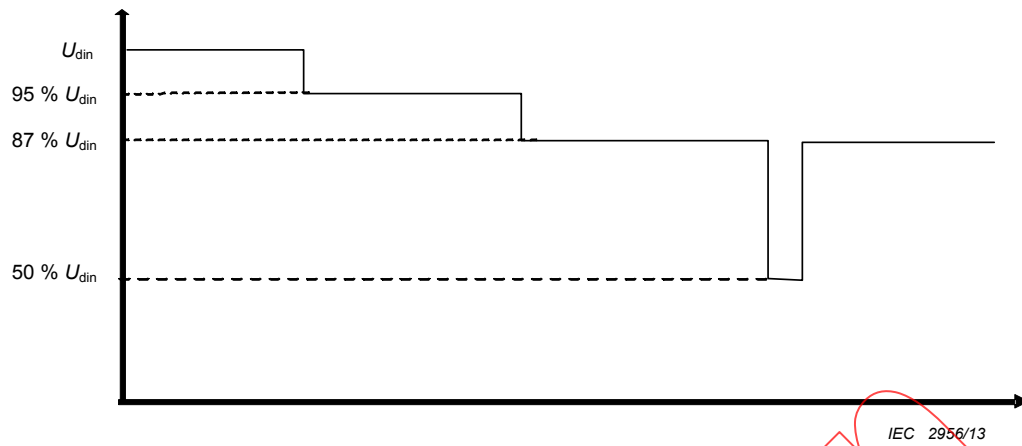


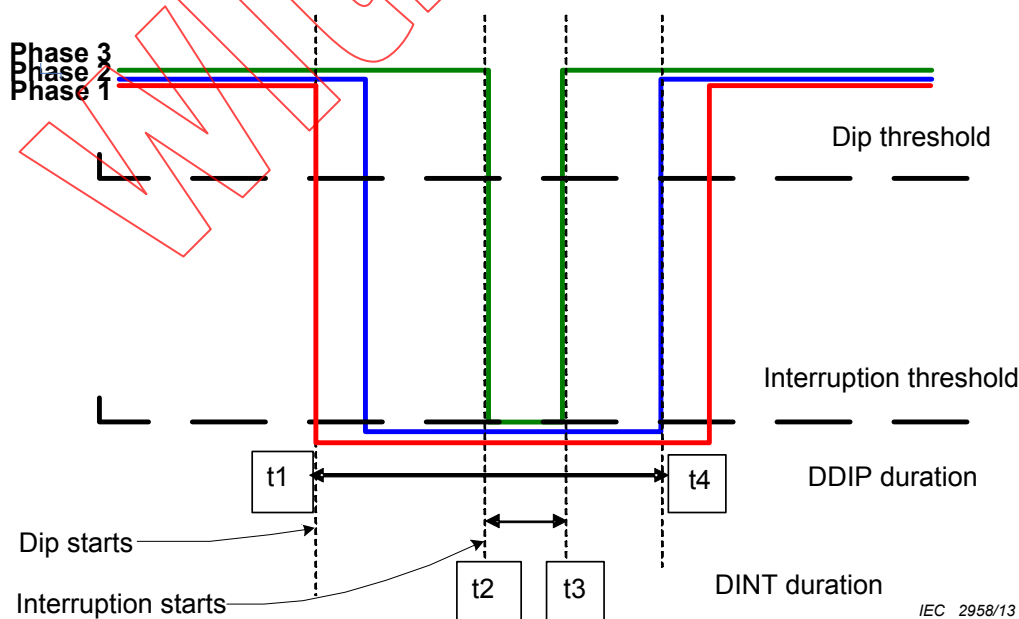
Figure 9 – Sliding reference voltage test



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

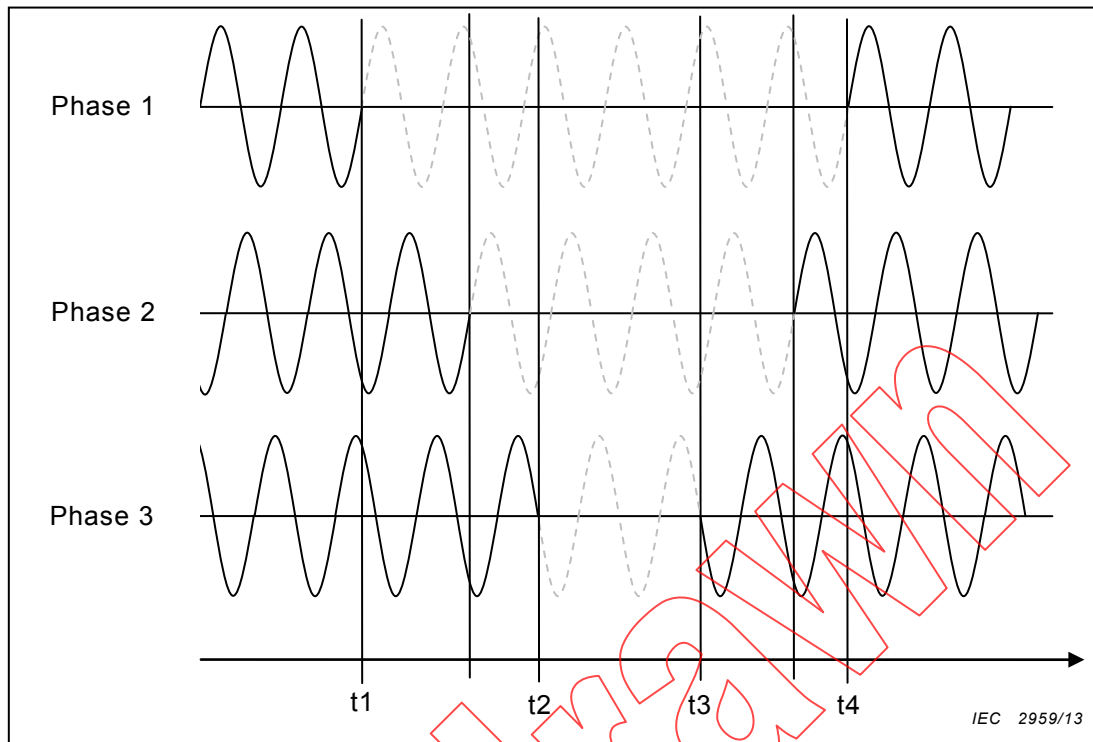


Figure 12 – Detail 2 of waveform for test of polyphase dips/interruptions

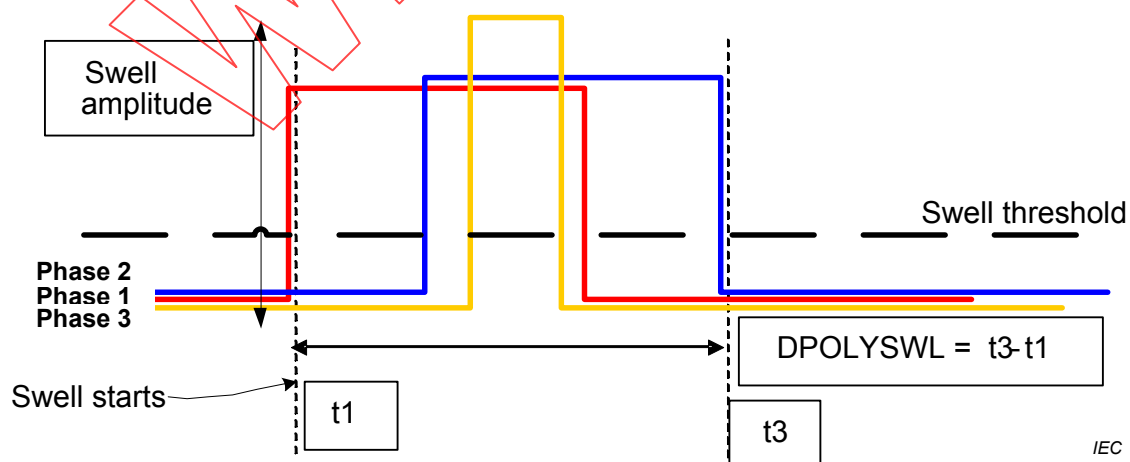
	$U_{rms}(1/2)$ N	$U_{rms}(1/2)$ N+1 (start of dip)	$U_{rms}(1/2)$ N+2	$U_{rms}(1/2)$ N+3	$U_{rms}(1/2)$ N+4	$U_{rms}(1/2)$ N+5	$U_{rms}(1/2)$ N+6 (start of interrupt.)	$U_{rms}(1/2)$ N+7
Phase 1	100	70	0	0	0	0	0	0
Phase 2	100	100	100	70	0	0	0	0
Phase 3	100	100	100	100	100	70	0	0

	$U_{rms}(1/2)$ 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 t_1 (synchronized to zero crossing on phase 1), inject $130 \% U_{din}$ on phase 1 – At $t_1+1\text{cycle}$ (synchronized to zero crossing on phase 2), inject $130 \% U_{din}$ on phase 2 – At $t_1+2\text{cycles}$ (synchronized to zero crossing on phase 3), inject $150 \% U_{din}$ on phase 3 – At $t_1+4\text{cycles}$ (synchronized to zero crossings on phase 1 and phase 3), inject $100 \% U_{din}$ on both phase 1 and phase 3 – At t_3 (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).



IEC 2960/13

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 $\pm 0,05$ %

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 u_0 and u_2 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 u_0 and u_2 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 u_0 and u_2 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} , $+118^\circ$	---	check if $u_0 = 2,47 \% \pm 0,15 \%$ and $u_2 = 4,52 \% \pm 0,15 \%$

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	Check that a properly designed anti-aliasing 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.	Apply reference conditions plus 10 % of U_{din} at $75,0 \times$ the fundamental frequency ^a	---	TC150/180(unc)-harm for all 50 harmonics (no aliasing detected)
		Apply reference conditions plus 10 % of U_{din} at $150,0 \times$ the fundamental frequency ^a	---	TC150/180(unc)-harm for all 50 harmonics (no aliasing detected)
		Apply reference conditions plus 10 % of U_{din} at $501,0 \times$ 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 3 rd harmonic.
10 min tick should occur in the middle of the 10/12 cycle time interval number 3000.				
NOTE 59,99 Hz = $(2999,5/600) \times 12$; 49,99 Hz = $(2999,5/600) \times 10$				

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 3 rd 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 = $(200,5/600) \times 150$; 60,15 Hz = $(200,5/600) \times 180$				

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 = $(2999,5/600) \times 12$; 49,99 Hz = $(2999,5/600) \times 10$				

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 = $(2999,5 / 600) \times 12$; 49,99 Hz = $(2999,5 / 600) \times 10$				

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 = $(200,5 / 600) \times 150$; 60,15 Hz = $(200,5 / 600) \times 180$				

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 = $(2999,5 / 600) \times 12$; 49,99 Hz = $(2999,5 / 600) \times 10$				

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

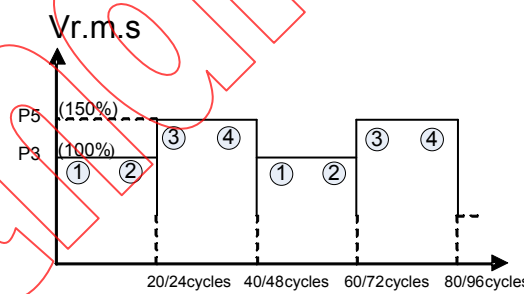
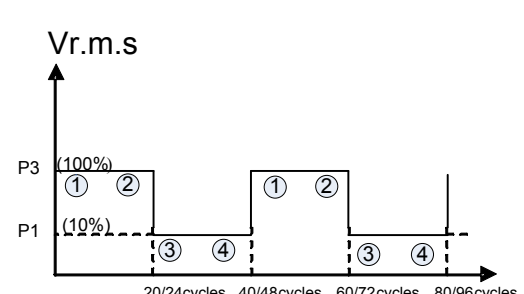
Tests for the measurement method are specified in the table below for 10/12-cycle values only (aggregation is specified in a later section).

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: $U_{\text{rms-under}} = U_{\text{din}}$ $U_{\text{under}} = 0 \%$ $U_{\text{rms-over}} = U_{\text{rms-200ms}}$ $U_{\text{over}} = (U_{\text{rms-over}} - U_{\text{din}}) / U_{\text{din}}$ [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 $U_{rms-under}$, $U_{rms-over}$ 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 <u>lower</u> $U_{under} = (U_{din} - U_{rms-under}) / U_{din}$ [approx 0 %] $U_{rms-over} = U_{din}$ or $U_{rms-200ms}$, whichever is <u>higher</u> $U_{over} = (U_{rms-over} - U_{din}) / U_{din}$ [approx 0 %]
A9.1.3	Steady-state test – check for proper calculation of $U_{rms-under}$, $U_{rms-over}$ 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 $U_{\text{rms-under}}$ and $U_{\text{rms-over}}$. On 3-phase 3-wire systems, 3 values are provided for each of $U_{\text{rms-under}}$ and $U_{\text{rms-over}}$. On 3-phase 4-wire systems, either 6 values or 3 values are provided for each of $U_{\text{rms-under}}$ and $U_{\text{rms-over}}$.

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

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A9.2.1	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): $U_{\text{under}} = \frac{U_{\text{din}} - \sqrt{\frac{\sum_{i=1}^n U_{\text{rms-under},i}^2}{n}}}{U_{\text{din}}} [\%]$ $U_{\text{over}} = \frac{\sqrt{\frac{\sum_{i=1}^n U_{\text{rms-over},i}^2}{n}} - U_{\text{din}}}{U_{\text{din}}} [\%]$	Vr.m.s. Frequency = 50 Hz / 60 Hz (or both when applicable) Test shall last at least 10 s.		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.
A9.2.2	Verify that the 150/180-cycle aggregations for U_{under} and U_{over} are re-synchronized at the 10-min tick	Vr.m.s. 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.		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.
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.				

6.9.4.4 10-min aggregation

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