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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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POWER QUALITY MEASUREMENT IN POWER SUPPLY SYSTEMS –

Part 2: Functional tests and uncertainty requirements

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

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

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

This second edition constitutes a technical revision.

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

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

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

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

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INTRODUCTION

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

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

This document therefore complements IEC 61000-4-30.

POWER QUALITY MEASUREMENT IN POWER SUPPLY SYSTEMS –

Part 2: Functional tests and uncertainty requirements

1 Scope

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

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

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

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

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

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

2 Normative references

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

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

IEC 61000-4-7, *Electromagnetic compatibility (EMC) – Part 4-7: Testing and measurement techniques – General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto*

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

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

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

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

3 Terms, definitions, abbreviated terms, notations and symbols

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

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

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

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 document, 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 shall 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 condition

3.2.7

nominal value of current input I_n

full scale RMS value specified by the manufacturer as defined in IEC 61000-4-30

3.3 Notations

3.3.1 Functions

See the functions defined in IEC 61000-4-30:2015.

3.3.2 Symbols and abbreviated terms

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 interharmonics	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.
Rapid voltage changes	6.13	6.13.2 6.13.3 6.13.4 6.13.5 6.13.6 6.13.7	N.A.	N.A.	N.A.	N.A.
Magnitude of current	6.14	6.2.1	6.2.2.1	6.2.2.2	N.A.	N.A.
Harmonic current	6.15	6.6.1	6.6.2.1	6.6.2.2	N.A.	6.6.4
Interharmonic currents	6.16	6.7.1	6.7.2.1	6.7.2.2	N.A.	6.7.4
Current unbalance	6.17	6.17.2	6.17.2	N.A.	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 interharmonics	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.
Rapid voltage changes	7.13	6.13.2.1, 6.13.3, 6.13.4, 6.13.5, 6.13.6, 6.13.7	N.A.	N.A.	N.A.	N.A.
Magnitude of current	7.14	7.2.1	7.2.2.1	7.2.2.2	N.A.	N.A.
Harmonic currents	7.15	7.6.2	7.6.3.1	7.6.3.2	N.A.	7.6.5
Interharmonic currents	7.16	7.7	7.7	7.7	N.A.	7.7
Current unbalance	7.17	7.17.2	7.17.2	N.A.	N.A.	N.A.

5 Functional type tests common requirements

5.1 General philosophy for testing

5.1.1 System topology

In case of measuring devices for three phase systems, the test shall be based on a 4-wire topology whenever influence quantities address voltage dips, swells, and unbalance (see 6.4.2, 6.4.3, 6.5, 7.4.2, 7.4.3 and 7.5)

5.1.2 Stabilization time

The time duration specified for each test in this document does not include the stabilization time of both the test equipment and the device under test.

5.1.3 Measuring ranges

Table 3 below defines the different testing points that shall be applied according to the test procedures defined in Clause 6 and Clause 7 for checking 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 or S	42,5 Hz	50,05 Hz	57,5 Hz	50 Hz	N.A.
Frequency 60 Hz ^b (covers 60 Hz)	A or 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}
Magnitude of current	A or S	10 % I_n	45 % I_n	80 % I_n	100 % I_n	N.A.
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}
Dips ^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}
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
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 × the fundamental frequency	Fundamental as specified 1 % on the interharmonic at 49,5 × 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.
- ^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 D.
- ^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 Clause 6 of IEC 61000-4-30:2015.

5.1.4 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.

NOTE Requirements of 6.1 were removed in IEC 61000-4-30:2015

Table 4 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 50 Hz ^e (covers 50 Hz)	A or S	42,5 Hz		50 Hz	57,5 Hz	N.A.
Frequency 60 Hz ^e (covers 60 Hz)	A or S	51 Hz		60 Hz	69 Hz	N.A.
Voltage magnitude	A	10 % U_{din}		N.A.	200 % U_{din}	N.A.
	S	10 % U_{din}		N.A.	150 % U_{din}	N.A.
Magnitude of current	A or S	10 % I_n		N.A.	100 % I_n	N.A.
Harmonics (in addition to the specified fundamental signal)	A or S	^c % fundamental signal H1: 100% H3: 10% 180° H7: 10% 180° H11: 10% 180° H15: 4% 180° H19: 5% 180° H23: 5% 180°	^d % fundamental signal H1: 100% H3: 60% 180° H5: 55% 0° H7: 50% 180° H9: 41% 0°	N.A.	N.A.	N.A.
Interharmonics ^b (including ranks below fundamental)	A	N.A.		Frequency = 1,5 × fundamental frequency; 9 % of U_{din}	Frequency = 0,5 × fundamental frequency; 2,5 % of U_{din}	Distortion applied at two interharmonic frequencies simultaneously: 1) Frequency = 2 nd harmonic plus 5 Hz (105 Hz at 50 Hz, and/or 125 Hz at 60 Hz), Magnitude = 4 % of U_{din} 2) Frequency = 2 nd harmonic plus 10 Hz (110 Hz at 50 Hz, and/or 130 Hz at 60 Hz), Magnitude = 6 % of U_{din}
	S	N.A.		Frequency = 1,5 × fundamental frequency; 2,5 % of U_{din}	Frequency = 0,5 × fundamental frequency; 2,5 % of U_{din}	N.A.

^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 signaling voltages may be used like interharmonics as an influence quantity.

^c This signal represents a crest factor of 2 and applies to voltage signals.

^d This signal represents a crest factor of 3 and applies to current signals.

^e 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".

5.1.5 "External influence quantities"

Table 5 and Table 6 specify the different testing states related to temperature and power supply voltage.

Table 5 – 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 h.	Worst case as defined by the manufacturer in the range 0 °C to 45 °C. ^b Bathe time as needed to achieve equilibrium, minimum 1 h.	Maximum temperature of the rated range of operation. ^b Bathe time as needed to achieve equilibrium, minimum 1 h.
^a Circulating air may be forced into 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. If the user of the standard makes such accommodations, the user shall provide sufficient details of this accommodation so that the test can be reproduced. ^b For PQI products, this rated range of operation is specified in IEC 62586-1. Each manufacturer or product standard referring to IEC 62586-2 will have to specify the rated temperature range of operation.			

Table 6 – 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

5.1.6 Test criteria

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

Table 7 – List of generic test criteria

Test criteria No.	Definition
TC10s(unc)	Every 10 s frequency measurement shall be within its specified uncertainty.
TC10s(sam)	Every 10 s frequency measurement shall be the same (within twice the intrinsic uncertainty).
TC(11 ≤ N ≤ 13)	Counter of frequency readings in 2 min: 11 ≤ N ≤ 13
TC10/12(unc)	Every basic 10/12-cycle measurement shall be within its specified uncertainty.
TC150/180(unc)	Every 150/180-cycle aggregation measurement shall be within its 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.
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 interharmonics 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 interharmonics 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 interharmonics order(s) being tested, every 10 min aggregation measurement shall be within the uncertainty specified in IEC 61000-4-7 class I.
The manufacturer may proceed with several repetitions of the same test in sequence to ensure that the 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 H.

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.

No.	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 graph 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($11 \leq N \leq 13$)

6.1.3 Measurement uncertainty and measuring range

6.1.3.1 Uncertainty under reference conditions

Each test shall last at least 1 min.

No.	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	N.A.	TC10s(unc)
A1.2.2	Check measuring range	P2 for frequency ^a	N.A.	TC10s(unc)
A1.2.3	Check measuring range	P3 for frequency ^a	N.A.	TC10s(unc)
^a Instruments intended to work at 50 Hz shall use the figures provided in the line "Frequency 50 Hz" in Table 3. Instruments intended to work at 60 Hz shall use the figures provided in the line "Frequency 60 Hz" in Table 3. 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.

No.	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 in the line "Frequency 50 Hz" in Table 3. Instruments intended to work at 60 Hz shall use the figures provided in the line "Frequency 60 Hz" in Table 3. 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

No.	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 20 s.

No.	Target of the test	Test
A2.1.1	Check gapless and non-overlapping measurement	A test shall be carried out according to the requirements of Annex F.
NOTE The following tests are not listed here because they are covered by other tests: checking true RMS measurement (covered by other tests), checking basic accuracy of 10/12-cycle 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.

No.	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	N.A.	TC10/12(unc)
A2.2.2	Check measuring range	P3 for voltage magnitude	N.A.	TC10/12(unc)
A2.2.3	Check measuring range	P5 for voltage magnitude	N.A.	TC10/12(unc)

6.2.2.2 Variations due to single influence quantities

Each test shall last at least 1 s.

No.	Target of the test	Testing points according to 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 ~~Clause~~ 8).	P3 for voltage magnitude	S1 for frequency S3 for frequency	~~N.A.~~ TC10/12(unc) ~~N.A.~~
A2.3.2	Measure influence of harmonics on measurement uncertainty (for further calculations as required in ~~Clause~~ 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

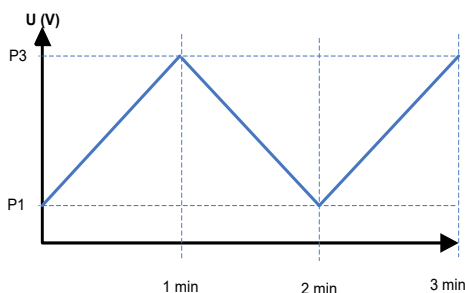
Each test shall last at least 11 min, and shall contain at least two consecutive RTC 10 min ticks.

No.	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criteria (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 min tick should occur during the 10/12-cycle time interval number 3 000.				
NOTE $59,99$ Hz = $(2\,999,5 / 600) \times 12$; $49,99$ Hz = $(2\,999,4 / 600) \times 10$				

6.2.4.2 150/180-cycle- aggregation with 10 min synchronisation

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

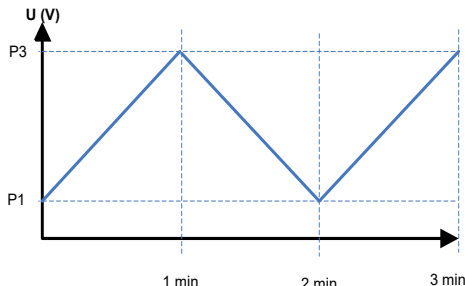
No.	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A2.5.1	Check aggregation overlap 2	Loop (see graph below): – voltage changing linearly from P1 to P3 for 1 min in duration, then – linearly from P3 to P1 for 1 min in duration.	$f = 50,125 \text{ Hz}$ (covering 50 Hz) and/or $60,15 \text{ Hz}$ (covering 60 Hz) depending on manufacturer selection.	Test the aggregation of 10/12-cycle data into 150/180-cycle interval relative to the 10 min tick as specified in IEC 61000-4-30.
10 min tick should occur in the middle of the 150/180-cycle time interval number 201. NOTE 2 $50,125 \text{ Hz} = (200,5 / 600) \times 150$; $60,15 \text{ Hz} = (200,5 / 600) \times 180$				



NOTE 1 The time on the x -axis is not necessarily synchronised on the 10 min tick

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.

No.	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 graph below): – voltage changing linearly from P1 to P3 for 1 min in duration, then – linearly from P3 to P1 for 1 min in duration.	S2 for frequency	Test the aggregation of 10/12-cycle 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

When applicable, the test shall be carried out according to the table below:

No.	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A2.7.1	Check 2-h 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

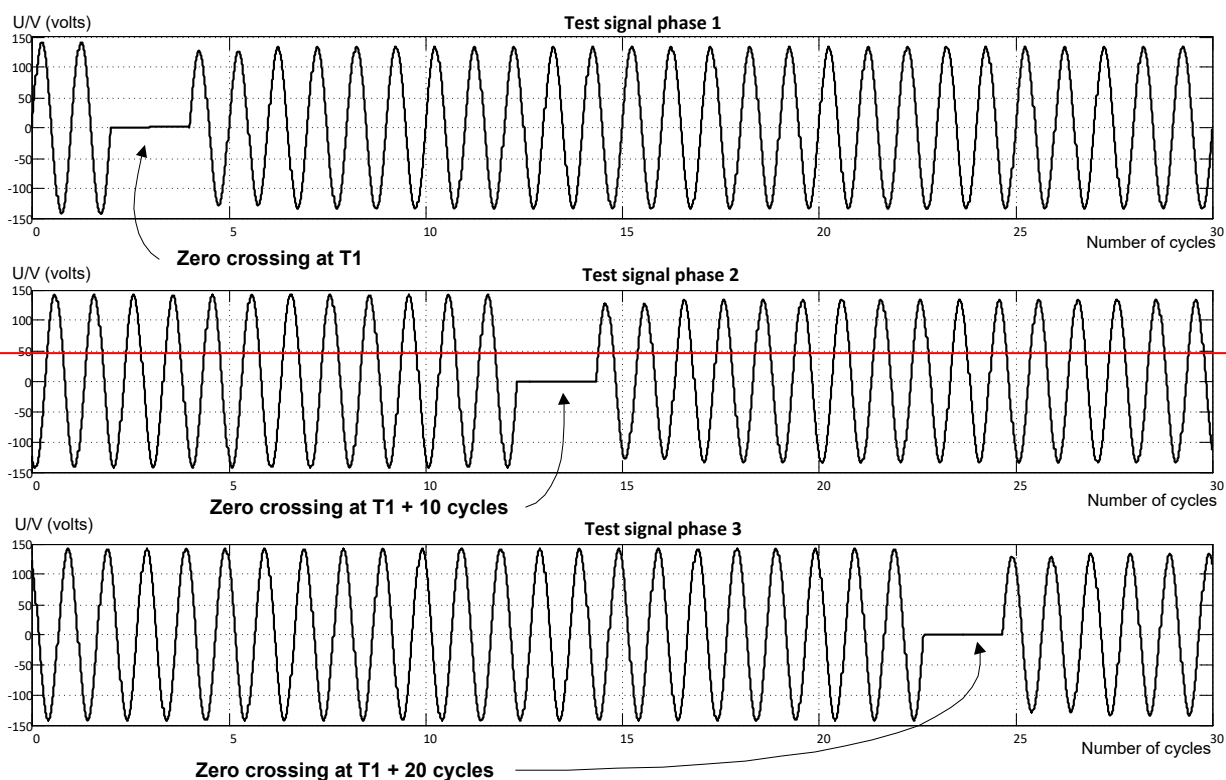
6.4.1 General

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

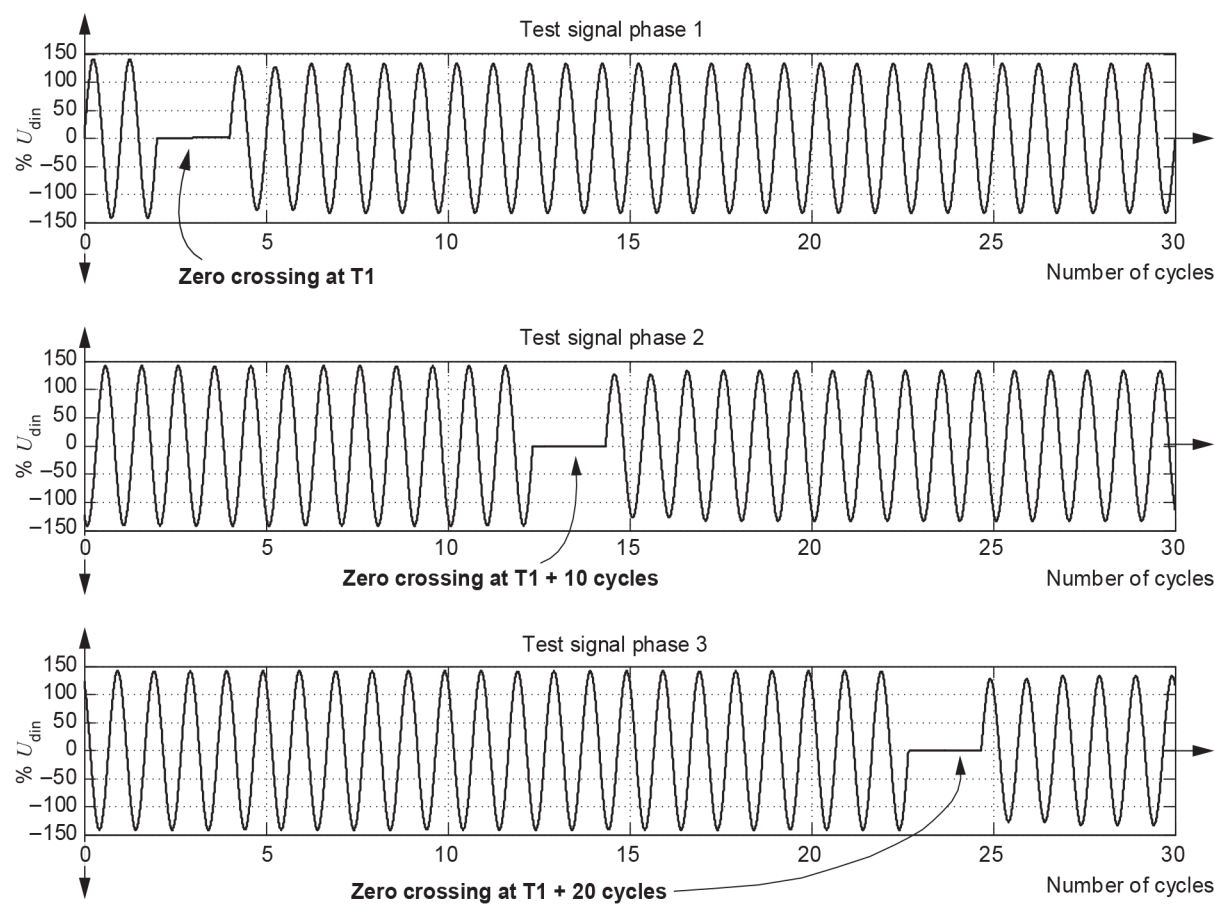
No.	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criteria (if test is applicable)
A4.1.1	Check $U_{rms(\frac{1}{2})}$ are independently synchronized on each channel on zero crossing.	P4 for frequency ^a for at least 15 s ^d . Voltage step should be made on zero crossing.	This test does not require a 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 $U_{rms(\frac{1}{2})}$ in the instrument complies to the sequence defined in Figure 4. – Check time tag of $U_{rms(\frac{1}{2})}$ (N + 1) on channel 1: T1 + ½ cycle. – Check that time tag of $U_{rms(\frac{1}{2})}$ (N + 1) on channel2 is T1 + 10,5 cycles ± ½ cycle – Check that time tag of $U_{rms(\frac{1}{2})}$ (N + 1) on channel 3 is T1 + 20,5 cycles ± ½ cycle.
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 a 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 comply with 5.4.5.1 (amplitude accuracy requirement) of IEC 61000-4-30:2015 and 5.4.5.2 (duration accuracy requirement). The expected duration results are Injected duration ± 1 cycle, see Figure 5 and Figure 6 where the expected duration is 3 cycles ± 1 cycle. The expected amplitude results are injected testing point P_x amplitude ± 0,2 % U_{din} (P_x 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 a synchronized generator. The change of signal amplitude to create dips/swells/interruptions will be simultaneous in time. Test shall be carried out with the following duration: 2,5 cycles.	Check the duration accuracy complies with IEC 61000-4-30:2015, 5.4.5.2. The expected duration result is 2,5 cycles ± 1 cycle.

No.	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criteria (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 5.4.5.2 of IEC 61000-4-30:2015 The expected duration result is respectively 2 and 30 cycles ± 1 cycle.
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 % = $50/87 \times 100$ %
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.	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.

- ^a Instruments intended to work at 50 Hz shall use the figures provided in line "Frequency 50 Hz" in Table 3. Instruments intended to work at 60 Hz shall use the figures provided in line "Frequency 60 Hz" in Table 3. Instruments intended to work both at 50 Hz and 60 Hz shall use the figures provided both in the line "Frequency 50 Hz" and in the line "Frequency 60 Hz".
- ^b Test points P1, P2, P3, P4 and P5 as described in Table 3.
- ^c Test point P1 shall not be identified as a dip/swell, and testing point P2 shall be identified as a dip/swell.
- ^d Recommended value for threshold dip is 90 % U_{din} , for swell threshold, 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.

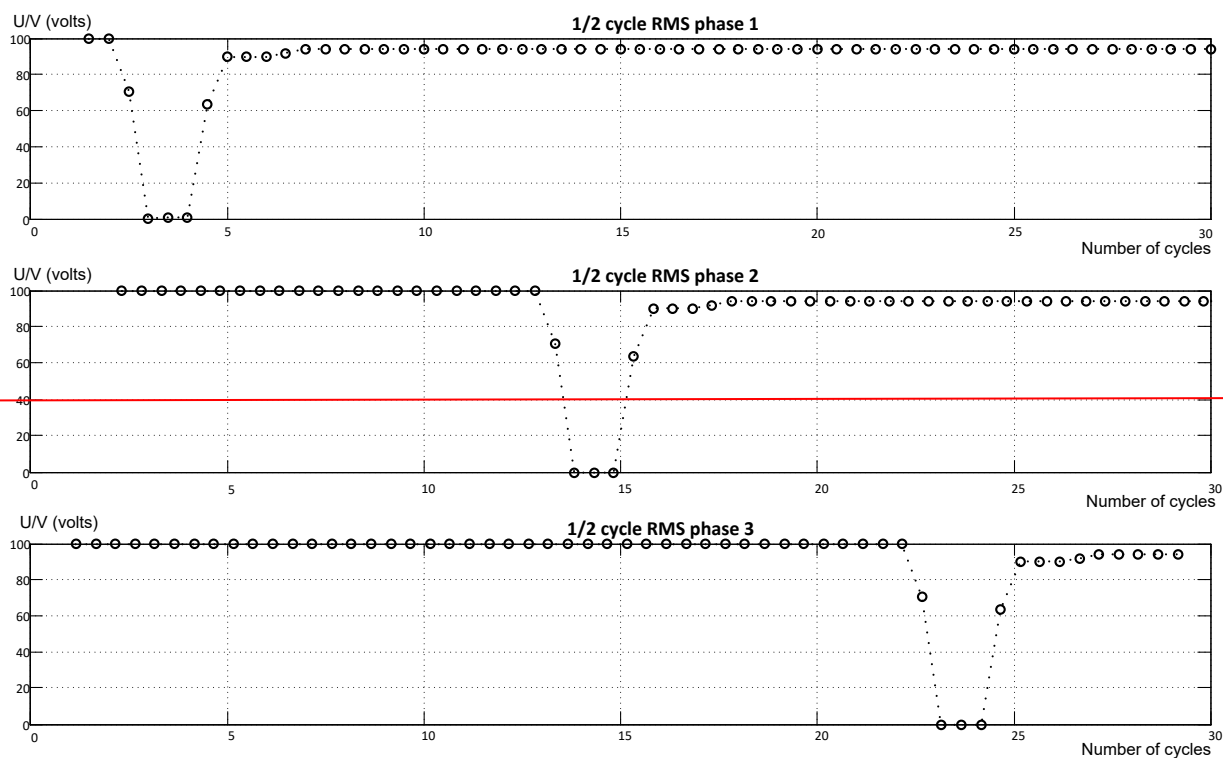


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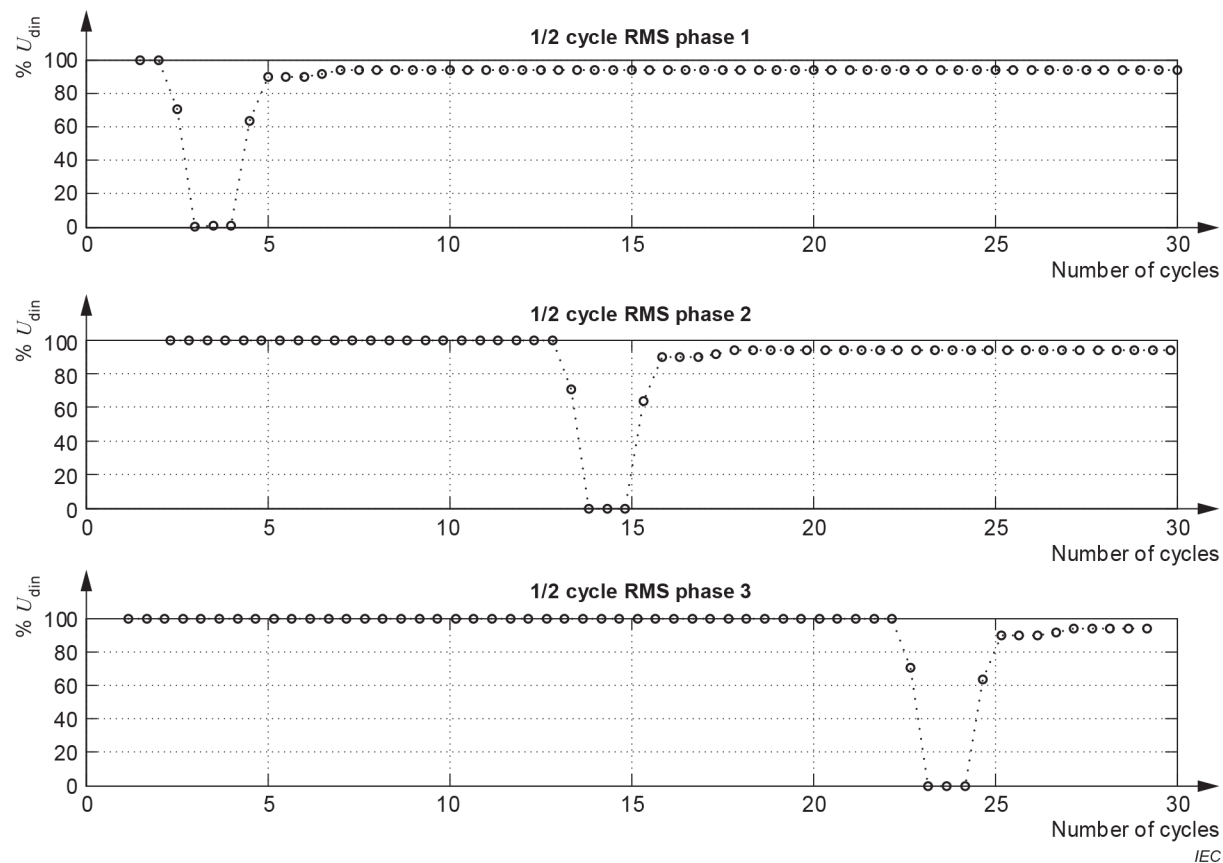


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Figure 1 – Overview of test for dips according to test A4.1.1



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

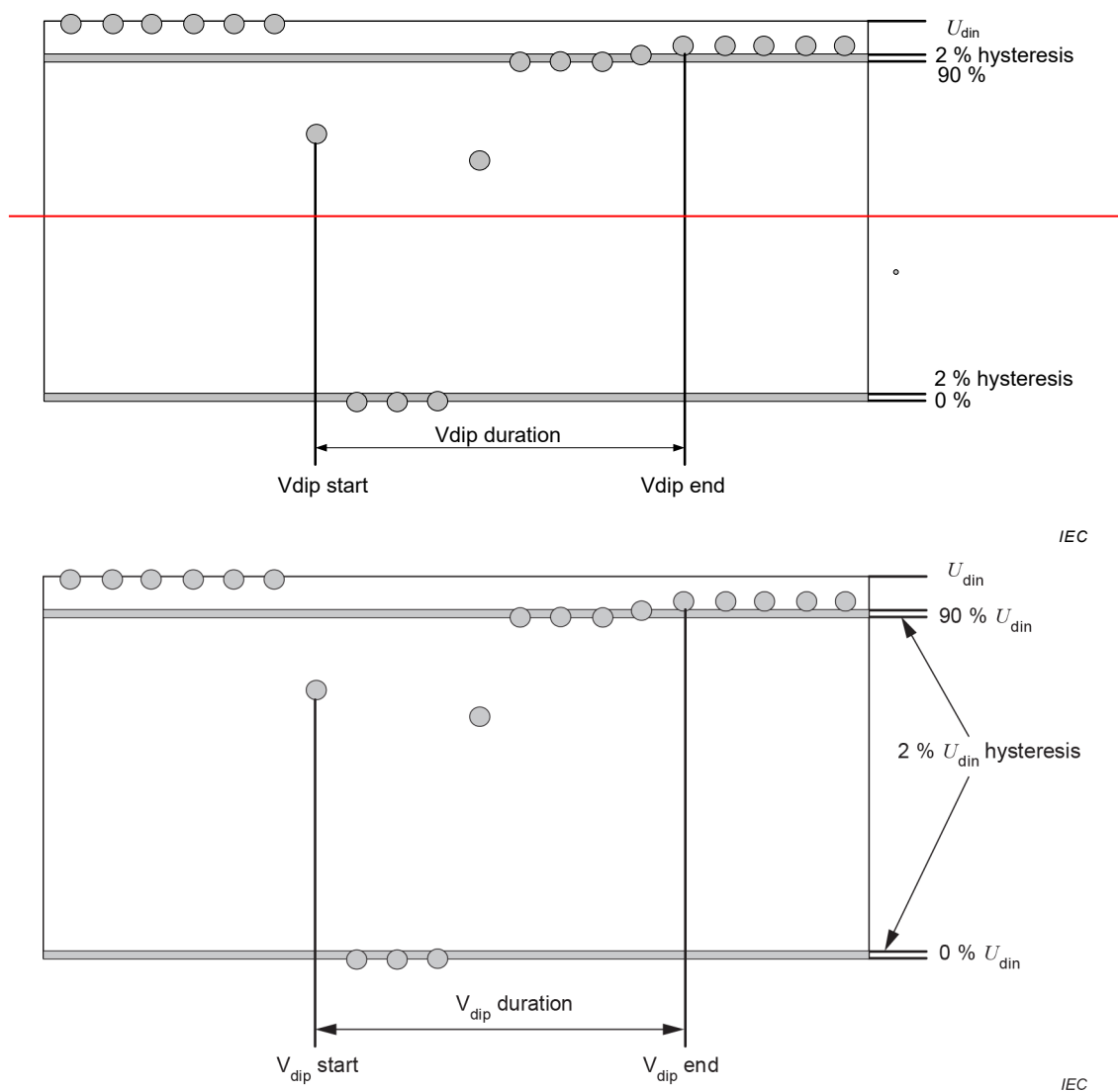


Figure 3 – Detail 2 of waveform for tests of dips according to A4.1.1

$U_{rms(\frac{1}{2})}$ N	$U_{rms(\frac{1}{2})}$ $N + 1$	$U_{rms(\frac{1}{2})}$ $N + 2$	$U_{rms(\frac{1}{2})}$ $N + 3$	$U_{rms(\frac{1}{2})}$ $N + 4$	$U_{rms(\frac{1}{2})}$ $N + 5$	$U_{rms(\frac{1}{2})}$ $N + 6$	$U_{rms(\frac{1}{2})}$ $N + 7$
100 % U_{din}	70,7 % U_{din}	0 % U_{din}	0 % U_{din}	0 % U_{din}	63,6 % U_{din}	90 % U_{din}	90 % U_{din}

$U_{rms(\frac{1}{2})}$ $N + 8$	$U_{rms(\frac{1}{2})}$ $N + 9$	$U_{rms(\frac{1}{2})}$ $N + 10$	$U_{rms(\frac{1}{2})}$ $N + 11$	$U_{rms(\frac{1}{2})}$ $N + 12$	$U_{rms(\frac{1}{2})}$ $N + 13$	$U_{rms(\frac{1}{2})}$ $N + 14$	$U_{rms(\frac{1}{2})}$ $N + 15$
90 % U_{din}	92 % U_{din}	94 % U_{din}	94 % U_{din}	94 % U_{din}	94 % U_{din}	94 % U_{din}	94 % U_{din}

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

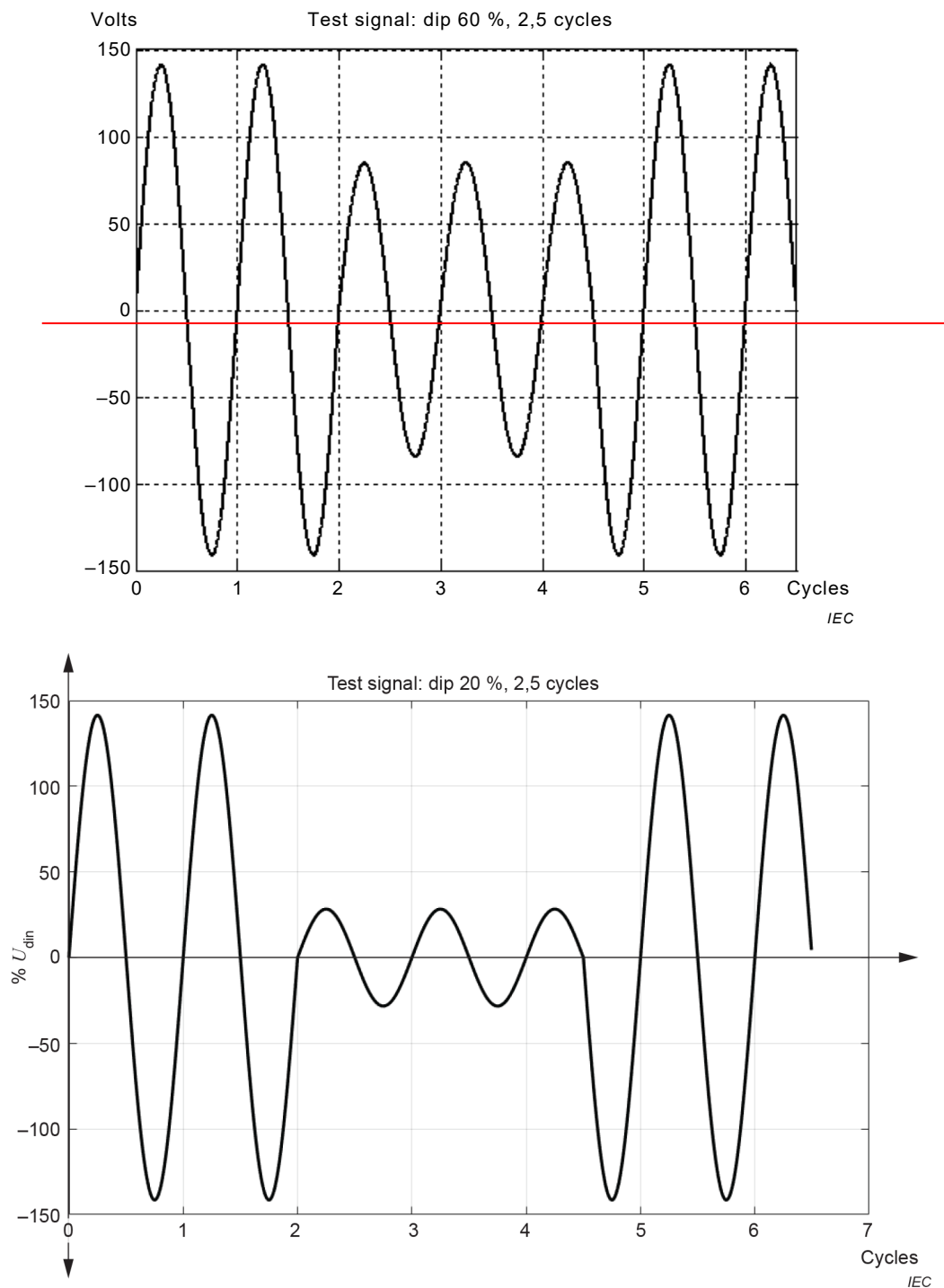


Figure 5 – Detail 1 of waveform for test of dips according to test A4.1.2

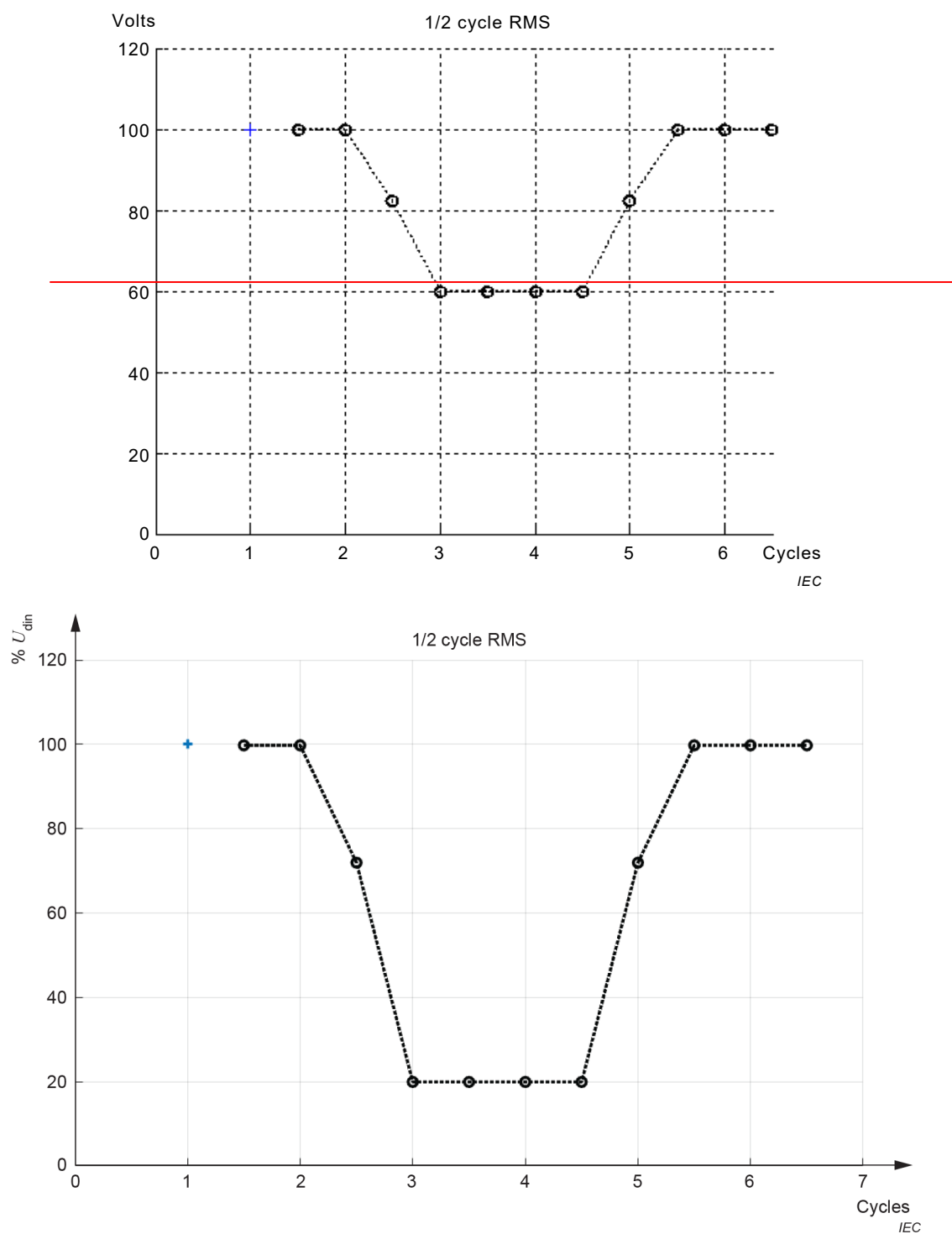


Figure 6 – Detail 2 of waveform for tests of dips according to test A4.1.2

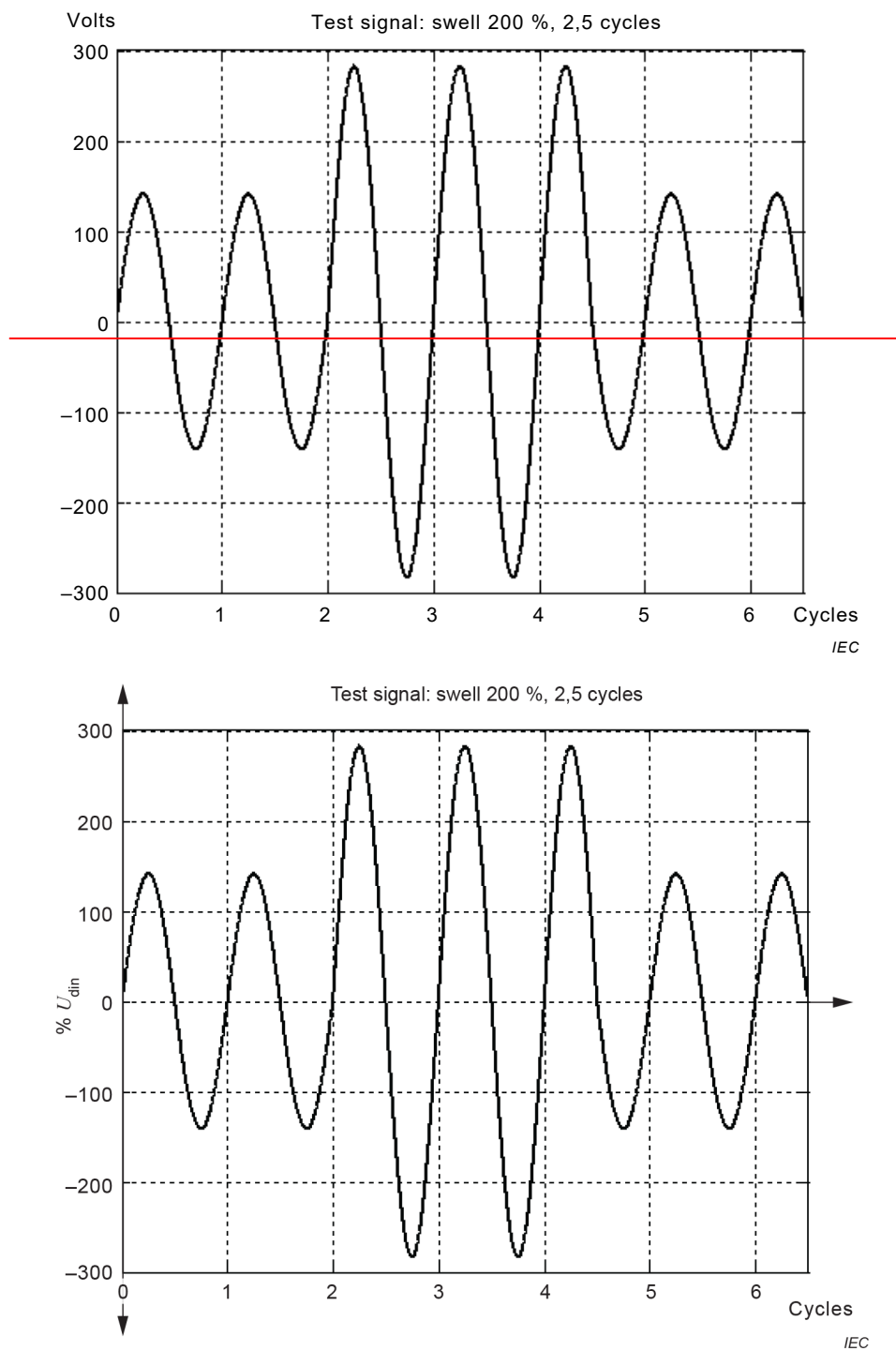


Figure 7 – Detail 1 of waveform for test of swells according to test A4.1.2

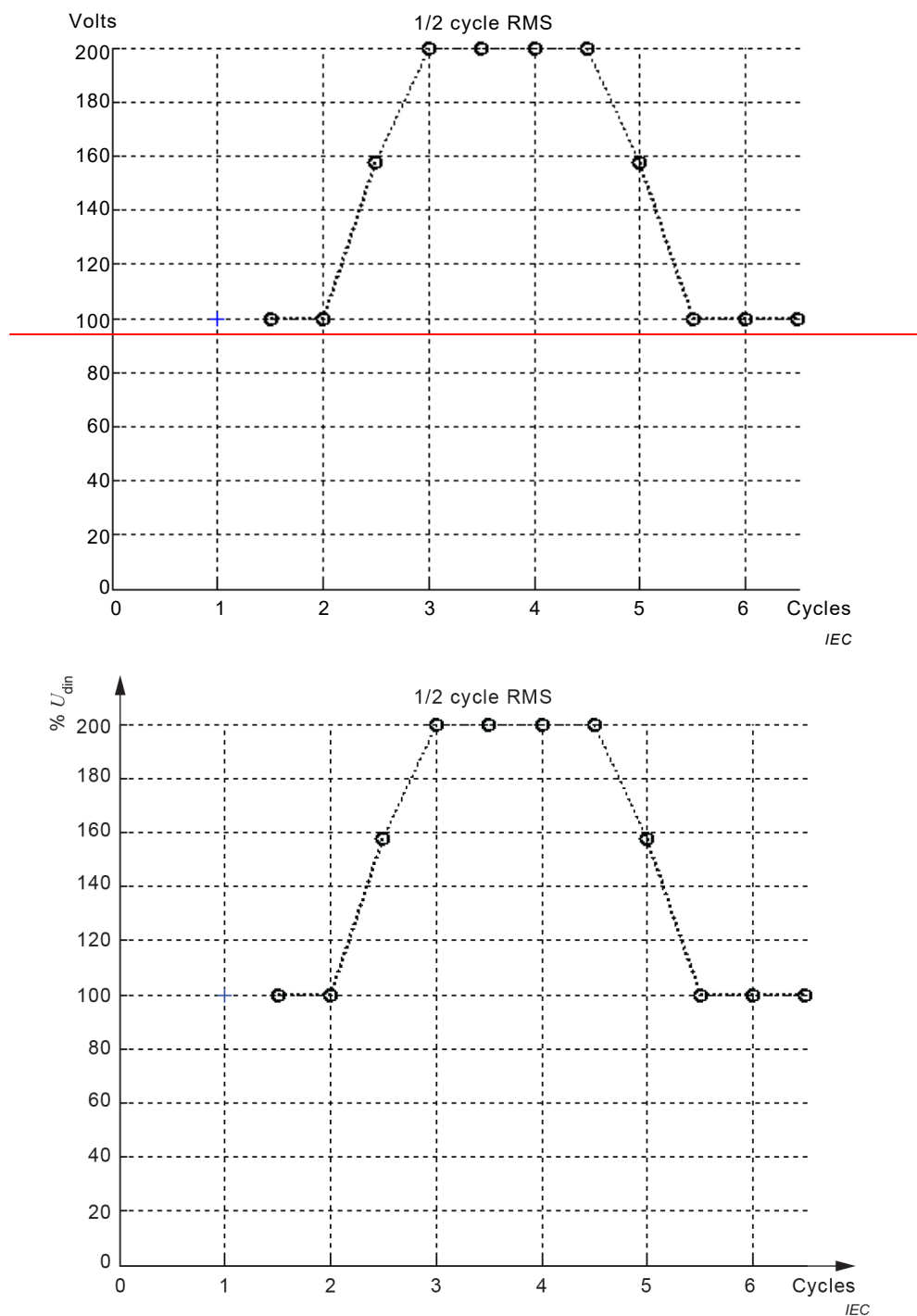


Figure 8 – Detail 2 of waveform for tests of swells according to test A4.1.2

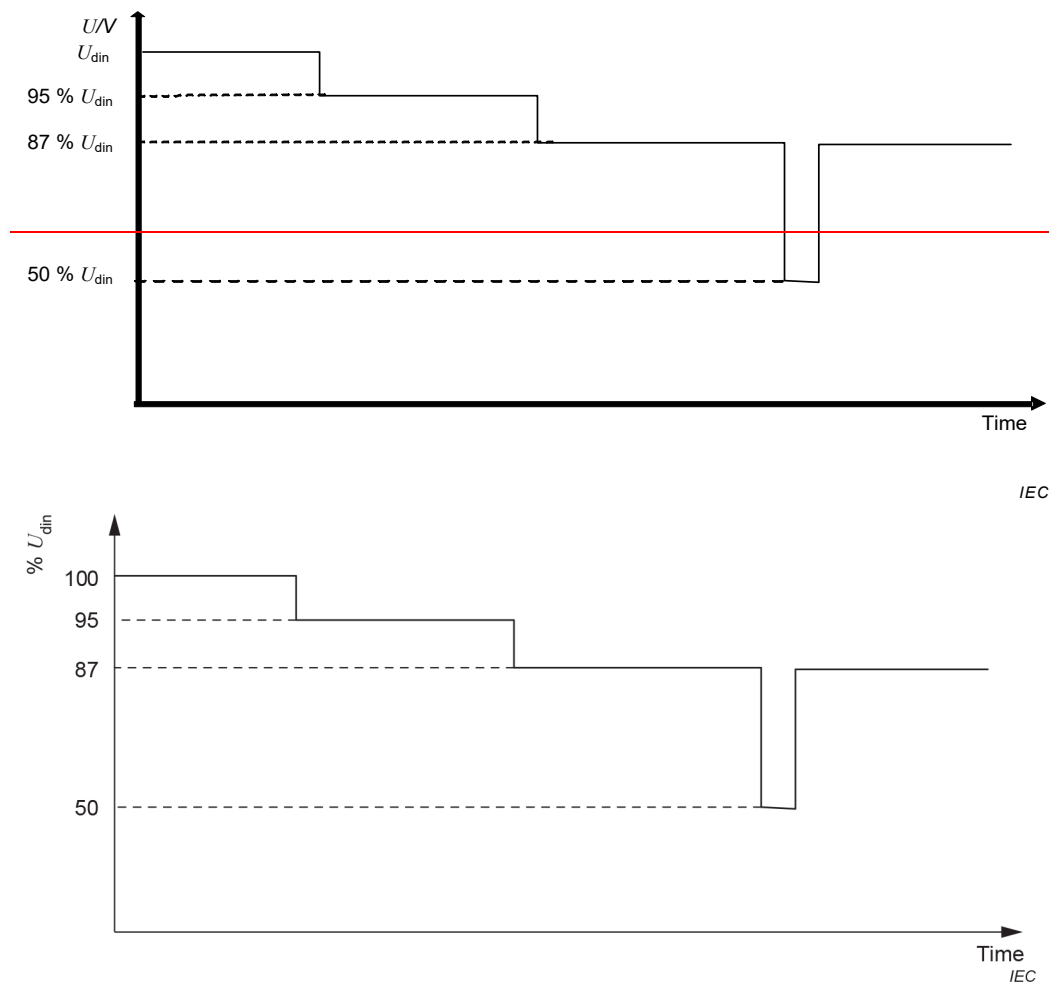


Figure 9 – Sliding reference voltage test

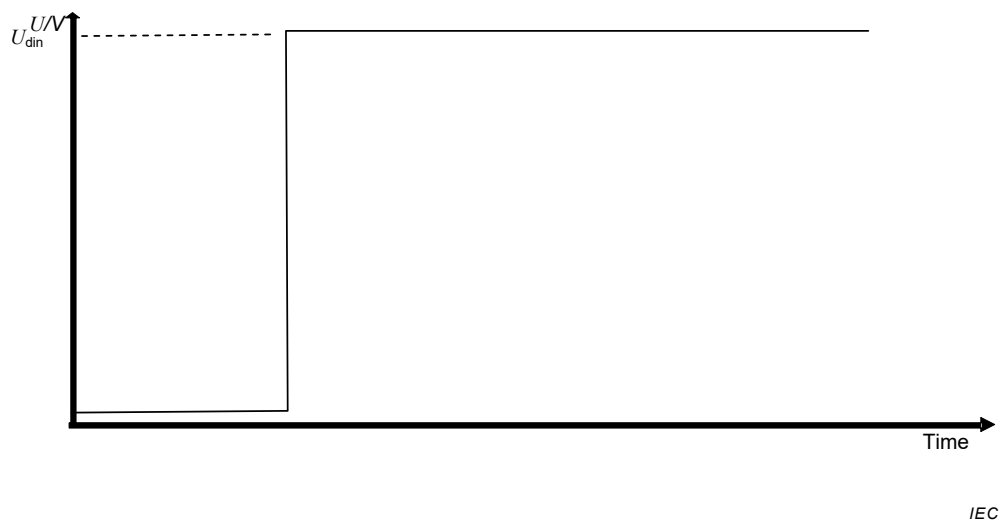
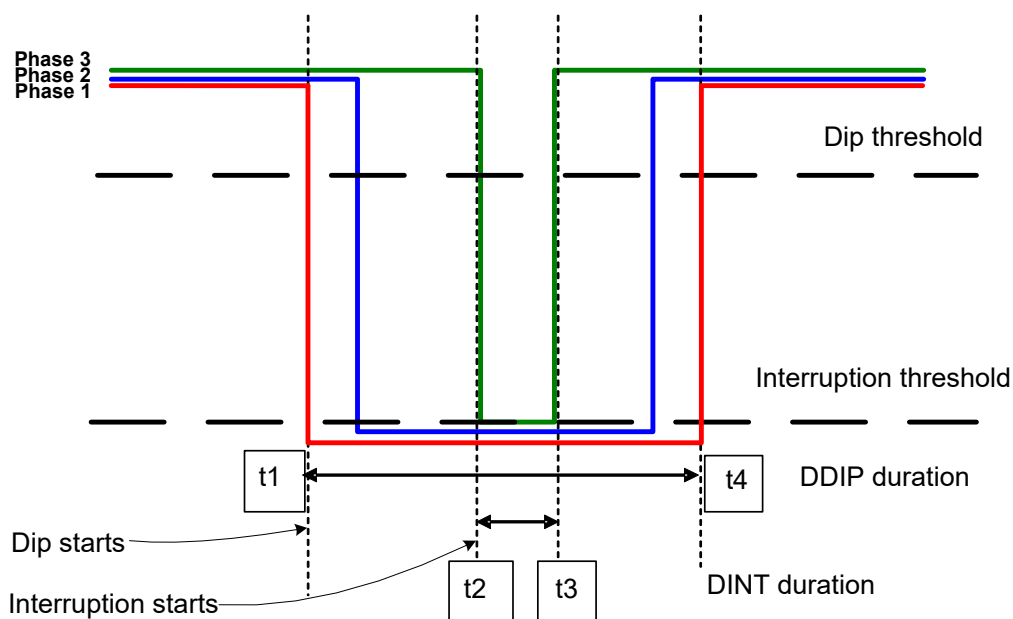


Figure 10 – Sliding reference start up condition

6.4.2 Check dips / interruptions in polyphase system

No.	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criteria (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 $U_{rms(\frac{1}{2})}$ in the instrument complies to the sequence defined in Figure 13. – 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).



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NOTE The figure is not drawn to scale.

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

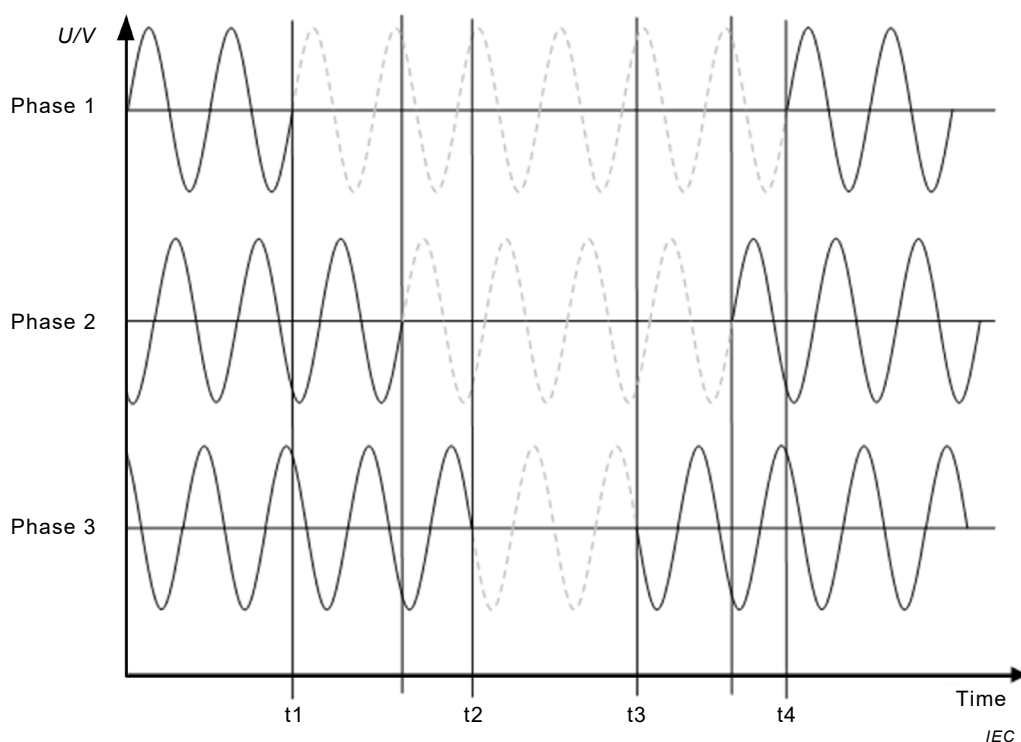


Figure 12 – Detail 2 of waveform for test of polyphase dips/interruptions

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

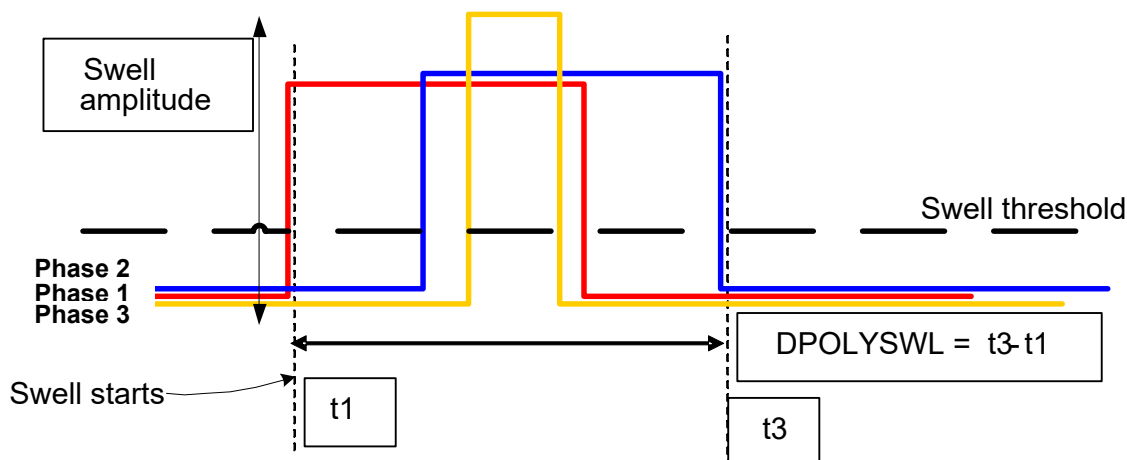
	$U_{rms(\frac{1}{2})}$ $N + 8$	$U_{rms(\frac{1}{2})}$ $N + 9$ (end of interrupt.)	$U_{rms(\frac{1}{2})}$ $N + 10$	$U_{rms(\frac{1}{2})}$ $N + 11$	$U_{rms(\frac{1}{2})}$ $N + 12$	$U_{rms(\frac{1}{2})}$ $N + 13$	$U_{rms(\frac{1}{2})}$ $N + 14$ (end of dip)	$U_{rms(\frac{1}{2})}$ $N + 15$
Phase 1	0 %	0 %	0 %	0 %	0 %	70,7 %	100 %	100 %
Phase 2	0 %	0 %	0 %	70,7 %	100 %	100 %	100 %	100 %
Phase 3	0 %	70,7 %	100 %	100 %	100 %	100 %	100 %	100 %

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

6.4.3 Check swells in polyphase system

No.	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criteria (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 $U_{rms(\frac{1}{2})}$ in the instrument complies with 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).



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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 %	127,5 %	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 %	127,5 %	100 %	100 %	100 %	100 %	100 %	100 %

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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

No.	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}	N.A.	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}	N.A.	Check if u_0 and u_2 is between 4,9 % and 5,2 %
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}	N.A.	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-wire 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} , $+118^\circ$	N.A.	Check if $u_2 = 2,47 \% \pm 0,15 \%$ and $u_0 = 4,52 \% \pm 0,15 \%$

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 s.

No.	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 carried out according to the requirements of Annex F		
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)	N.A.	TC10/12(unc)-harm for the 2 nd harmonic (2 nd harmonic is present at 5 %)
		Apply reference conditions, plus P1 for interharmonics)	N.A.	TC10/12(unc)-harm for the 2 nd harmonic (no significant content detected)
		Apply reference conditions, plus S4 for interharmonics	N.A.	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	N.A.	N.A.	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	N.A.	TC150/180(unc)-thd (significant distortion detected)
		Apply reference conditions plus P5 for interharmonics	N.A.	TC150/180(unc)-thd (no significant distortion detected)
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)	N.A.	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 50 th harmonic.	Apply reference conditions plus 10 % of U_{din} at 75,0 × the fundamental frequency ^a	N.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	N.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	N.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 analyser 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.

No.	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	N.A.	TC150/180(unc)-harm for applicable harmonics
A6.2.2	Check measuring uncertainty – single odd harmonic	Reference conditions plus P2 for harmonics	N.A.	TC150/180(unc)-harm for applicable harmonics
A6.2.3	Check measuring uncertainty – single high harmonic	Reference conditions plus P3 for harmonics	N.A.	TC150/180(unc)-harm for applicable harmonics
A6.2.4	Check measuring range – low end	Reference conditions plus P4 for harmonics	N.A.	TC150/180(unc)-harm for applicable harmonics
A6.2.5	Check measuring range – high end	Reference conditions plus P5 for harmonics	N.A.	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.

No.	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 for 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 bound)	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.

No.	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.	$f = 49,99 \text{ Hz}$ or $59,99 \text{ Hz}$ Test duration = 11 min	Test the time tag, and the sequence number of blocks for the 3 rd harmonic.
10 min tick should occur during the 10/12-cycle time interval number 3 000.				
NOTE $59,99 \text{ Hz} = (2\,999,5 / 600) \times 12$; $49,99 \text{ Hz} = (2\,999,4 / 600) \times 10$				

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.

No.	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.	$f = 50,125 \text{ Hz}$ (covering 50 Hz) or $60,15 \text{ Hz}$ (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 $50,125 \text{ Hz} = (200,5 / 600) \times 150$; $60,15 \text{ Hz} = (200,5 / 600) \times 180$				

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.