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Incorporating corrigendum November 2014



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Power quality measurement in power supply systems

Part 2: Functional tests and
uncertainty requirements

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National foreword

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

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

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English Version

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

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

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

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Europäisches Komitee für Elektrotechnische Normung

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Foreword

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

The following dates are fixed:

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publication of an identical national
standard or by endorsement
- latest date by which the national (dow) 2017-01-16
standards conflicting with the
document have to be withdrawn

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

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

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

Endorsement notice

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

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

IEC 60359	NOTE	Harmonized as EN 60359.
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Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61000-2-4	-	Electromagnetic compatibility (EMC) - Part 2-4: Environment - Compatibility levels in industrial plants for low-frequency conducted disturbances	EN 61000-2-4	-
IEC 61000-4-7	-	Electromagnetic compatibility (EMC) - Part 4-7: Testing and measurement techniques - General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto	EN 61000-4-7	-
IEC 61000-4-15	-	Electromagnetic compatibility (EMC) - Part 4-15: Testing and measurement techniques - Flickermeter - Functional and design specifications	EN 61000-4-15	-
IEC 61000-4-30	2008	Electromagnetic compatibility (EMC) - Part 4-30 : Testing and measurement techniques - Power quality measurement methods	EN 61000-4-30	2009
IEC 62586-1	-	Power quality measurement in power supply systems - Part 1: Power Quality Instruments (PQI)	EN 62586-1	-

Annex ZZ (informative)

Coverage of Essential Requirements of EU Directives

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

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

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

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INTRODUCTION

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

IEC 62586-2 is a standard specifying functional and uncertainty tests intended to verify the compliance of a product to class A and class S measurement methods defined in IEC 61000-4-30.

IEC 62586-2 therefore complements IEC 61000-4-30.

POWER QUALITY MEASUREMENT IN POWER SUPPLY SYSTEMS –

Part 2: Functional tests and uncertainty requirements

1 Scope

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

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

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

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

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

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

2 Normative references

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

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

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

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

IEC 61000-4-30:2008, *Electromagnetic compatibility (EMC) – Part 4-30: Testing and measurement techniques – Power quality measurement methods*

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

3 Terms, definitions, abbreviations, notations and symbols

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

3.1 General terms and definitions

3.1.1

limit range of operation

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

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

3.1.2

rated range of operation

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

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

3.2 Terms and definitions related to uncertainty

3.2.1

intrinsic uncertainty

uncertainty of a measuring instrument when used under reference conditions

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

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

3.2.2

influence quantity

quantity which is not the subject of the measurement and whose change affects the relationship between the indication and the result of the measurement

Note 1 to entry: Influence quantities can originate from the measured system, the measuring equipment or the environment [IEV].

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

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

[SOURCE: IEC 60359:2001, 3.1.14]

3.2.3

variation

variation due to a single influence quantity

difference between the value measured under reference conditions and any value measured within the rated operating range (for this specific influence quantity)

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

3.2.4

rated operating conditions

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

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

[SOURCE: IEC 60359:2001, 3.3.13]

3.2.5

operating uncertainty

uncertainty under the rated operating conditions

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

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

3.2.6

overall system uncertainty

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

3.3 Notations

3.3.1 Functions

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

3.3.2 Symbols and abbreviations

N.R. not requested

N.A. not applicable

3.3.3 Indices

min minimum value

max maximum value

4 Requirements

4.1 Requirements for products complying with class A

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

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

Table 1 – Summary of type tests for Class A

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

4.2 Requirements for products complying with class S

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

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

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

Table 2 – Summary of type tests for Class S

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

5 Functional type tests common requirements

5.1 General philosophy for testing

5.1.1 Measuring ranges

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

Table 3 – Testing points for each measured parameter

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

Measured parameter	Class	Testing point P1 ^a	Testing point P2 ^a	Testing point P3 ^a	Testing point P4 ^a	Testing point P5 ^a
Dips, Interruptions ^c	A	$\left[\overline{AC_1} \right]$ Threshold dip+ $\left[\overline{AC_1} \right]$ ^d	$\left[\overline{AC_1} \right]$ Threshold dip- $\left[\overline{AC_1} \right]$ ^d	20 % U_{din}	60 % U_{din}	85 % U_{din}
	S	$\left[\overline{AC_1} \right]$ Threshold dip+ $\left[\overline{AC_1} \right]$ ^d	$\left[\overline{AC_1} \right]$ Threshold dip- $\left[\overline{AC_1} \right]$ ^d	20 % U_{din}	60 % U_{din}	85 % U_{din}
Voltage harmonics ^f	A	Fundamental as specified 5 % on the 2 nd harmonic	Fundamental as specified 10 % on the 3 rd harmonic	Fundamental as specified 1 % on the 50 th harmonic	Fundamental as specified Distortion on all harmonics simultaneously up to the 50 th order at 10 % of class 3 compatibility levels from IEC 61000-2-4	Fundamental as specified Distortion on all harmonics simultaneously up to the 50 th order at 200 % of class 3 compatibility levels from IEC 61000-2-4
	S	Fundamental as specified 5 % on the 2 nd harmonic	Fundamental as specified 10 % on the 3 rd harmonic	Fundamental as specified 1 % on the 40 th harmonic	Fundamental as specified Distortion on all harmonics simultaneously up to the 40 th order at 10 % of class 3 compatibility levels from IEC 61000-2-4	Fundamental as specified Distortion on all harmonics simultaneously up to the 40 th order at 100 % of class 3 compatibility levels from IEC 61000-2-4
Voltage interharmonics ^f	A	Fundamental as specified 5 % on the interharmonic at 1,5 × the fundamental frequency	Fundamental as specified 10 % on the interharmonic at 7,5 × 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, 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.

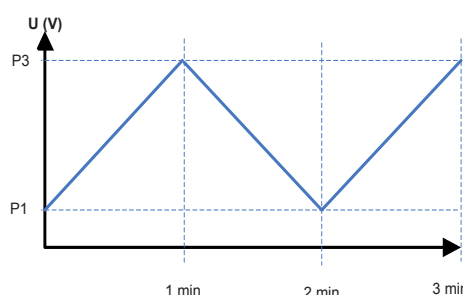
10 minute tick should occur in the middle of the 10/12 cycle time interval number 3000.

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 Hz (covering 50 Hz) and/or 60,15 Hz (covering 60 Hz) depending on manufacturer selection.	Test the aggregation of 10/12 cycles data into 150/180 cycles interval relative to the 10-min tick as specified in IEC 61000-4-30.



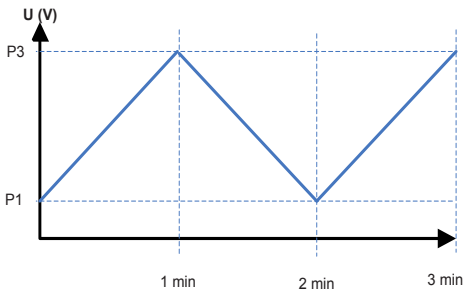
NOTE 1 The time on X axis is not necessarily synchronised on the 10-min tick

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

NOTE 2 50,125 Hz = $(200,5 / 600) \times 150$; 60,15 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	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.
		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		

N°	Target of the test	Testing points according to Table 3	Complementary test conditions	Test criterion (if test is applicable)
A4.1.4	Check influence of mains frequency.	P1 for Frequency ^a AC1 P3 for Dips/Int. AC1 ^b P3 for Frequency ^a P2 for Dips/Int. ^b	This test does not require synchronized generator. The change of signal amplitude to create dips/swells/interruption will be simultaneous in time. Test shall be achieved with the following durations: 2 and 30 cycles.	Check the duration accuracy complies with IEC 61000-4-30 5.4.5.2 The expected duration result is respectively 2 and 30 cycles $\pm 0,5$ 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.	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

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.			

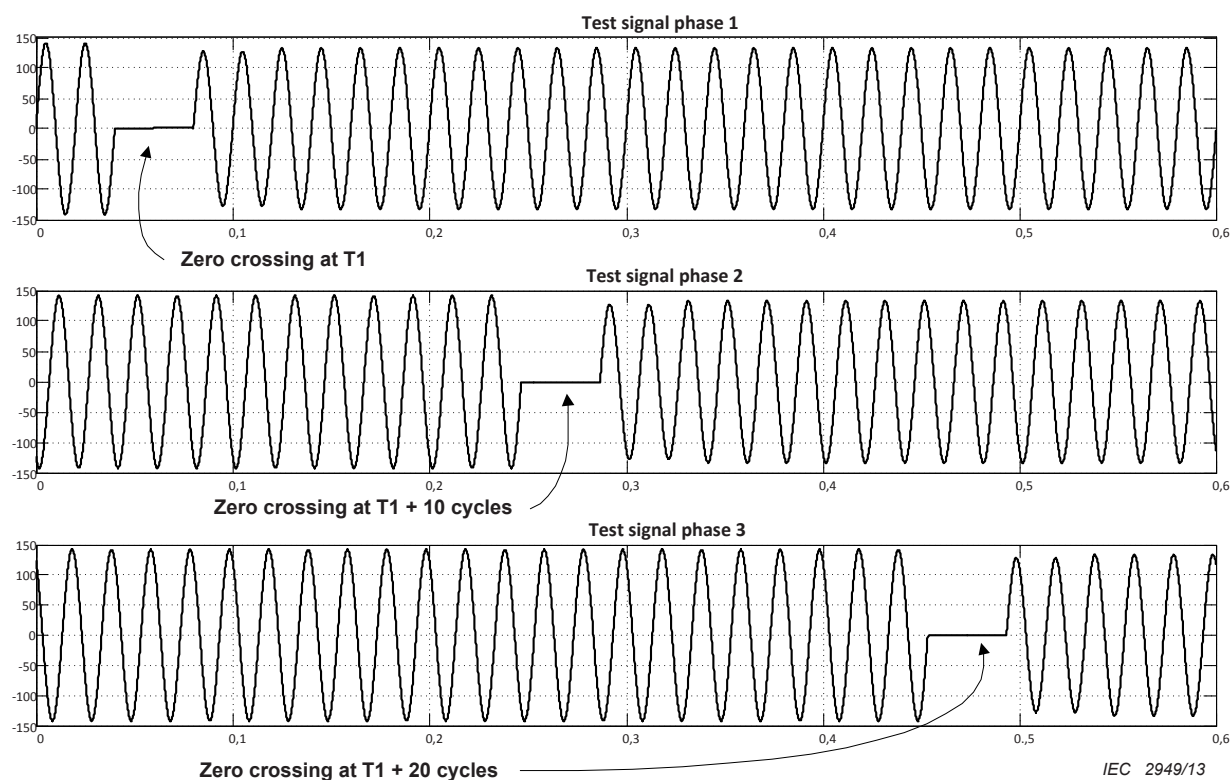


Figure 1 – Overview of test for dips according to test A4.1.1

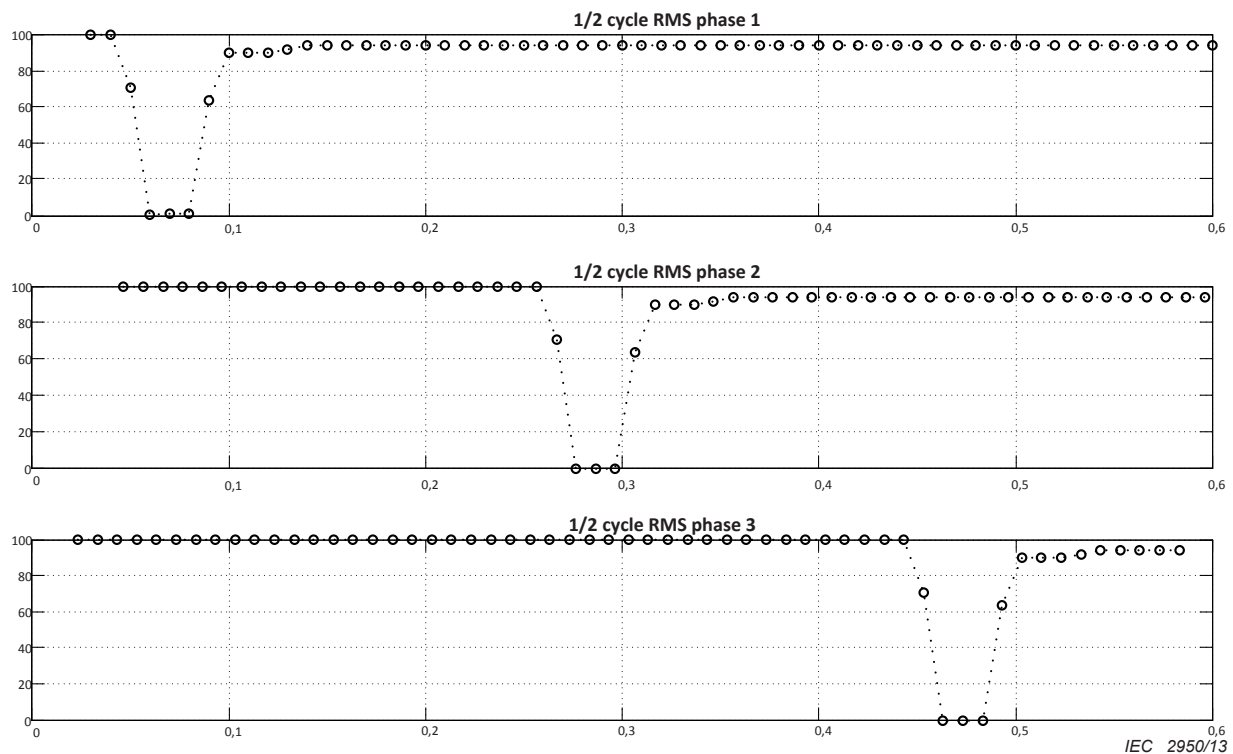


Figure 2 – Detail 1 of waveform for test of dips according to test A4.1.1

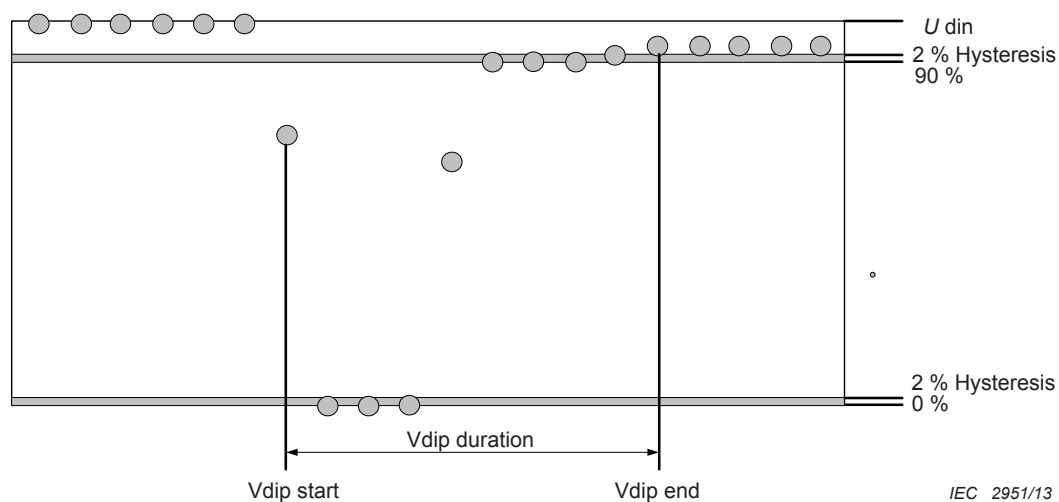


Figure 3 – Detail 2 of waveform for tests of dips according to A4.1.1

$U_{rms}(1/2)$ 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

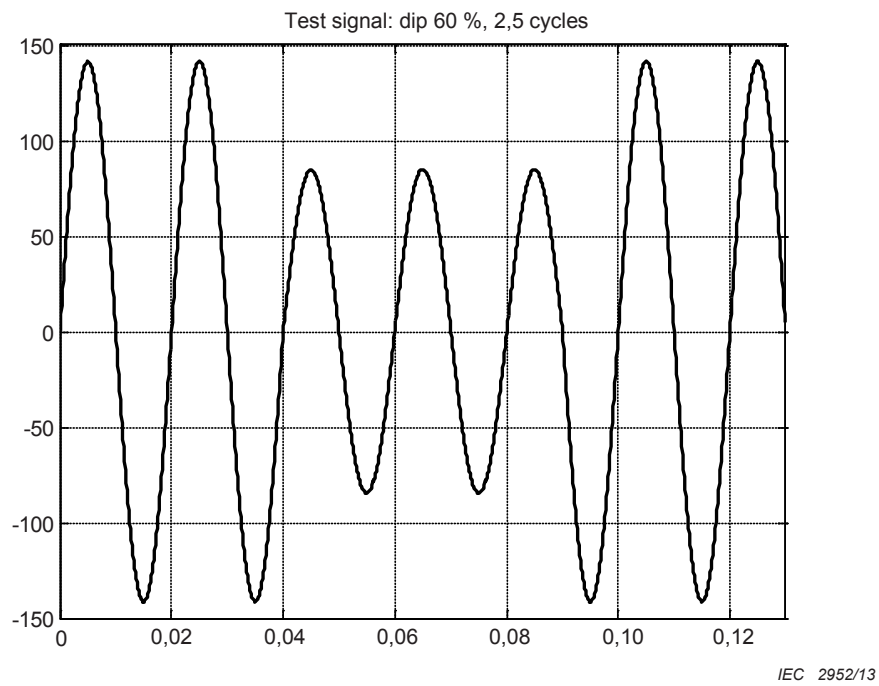


Figure 5 – Detail 1 of waveform for test of dips according to test A4.1.2

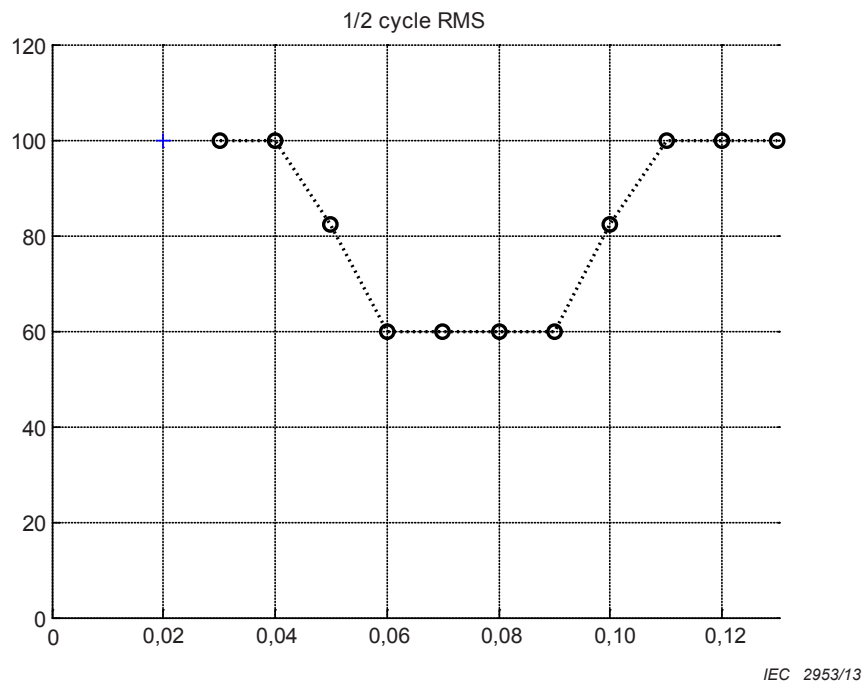


Figure 6 – Detail 2 of waveform for tests of dips according to test A4.1.2

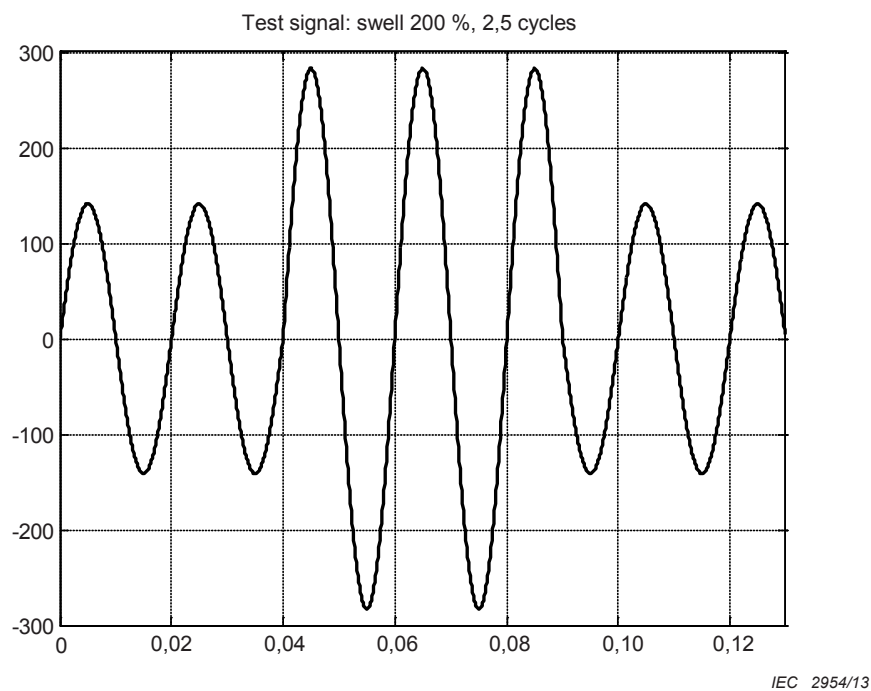


Figure 7 – Detail 1 of waveform for test of swells according to test A4.1.2

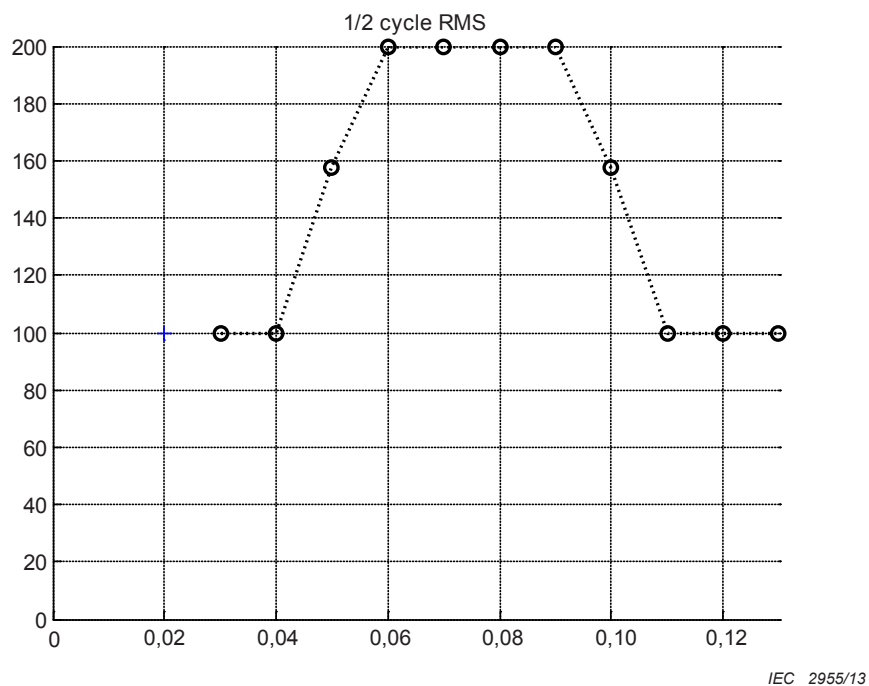


Figure 8 – Detail 2 of waveform for tests of swells according to test A4.1.2

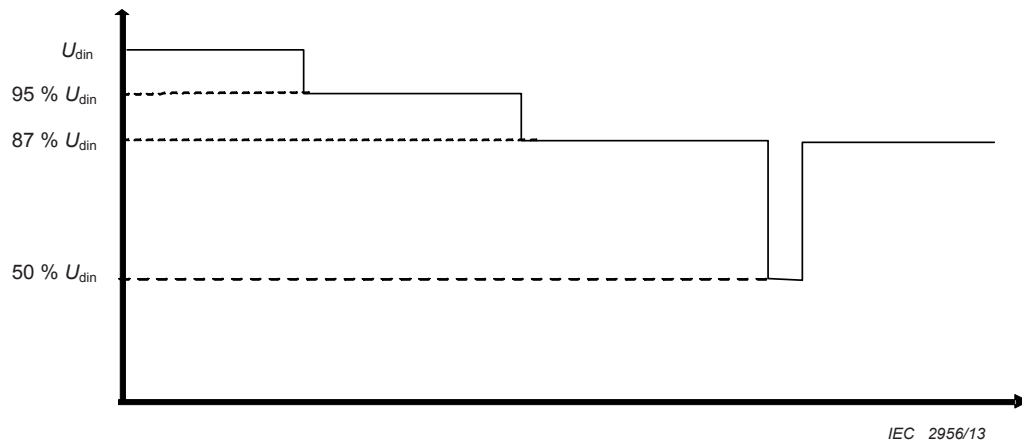


Figure 9 – Sliding reference voltage test

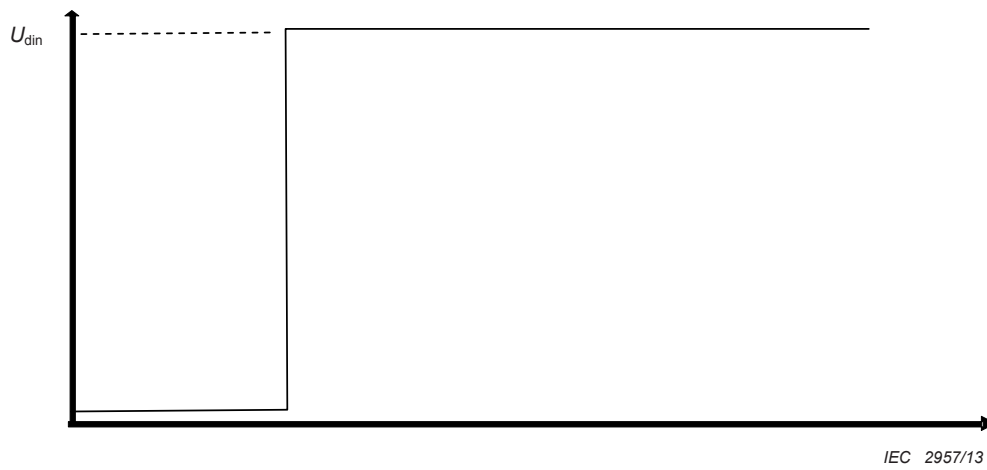
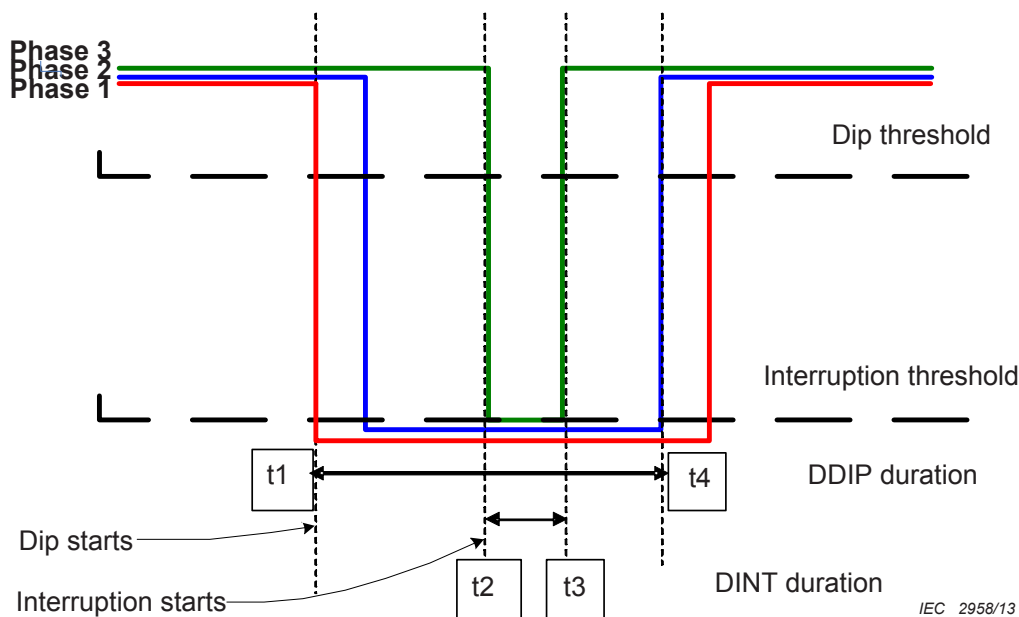


Figure 10 – Sliding reference start up condition

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