Type evaluation report

Issued by	:	NMi Certin B.V., accredited by the national accreditation body (RvA), based on the ISO/IEC 17020, with identification number I122 and the ISO/IEC 17025, with identification number L029. RvA is signatory member of both the Multi-Lateral Agreement of the European cooperation for Accreditation (EA) and the Mutual Recognition Arrangement of the International Laboratory Accreditation Cooperation (ILAC). The evaluation results are reported under I122. The test results, including interpretations, are reported under L029.
Applicant	:	Schneider Electric dba Power Measurement Ltd. 2195 Keating Cross Road Saanichton, BC V8M 2A5 Canada
Measuring instrument	:	**Meter embedding IEC 61000-4-30 class S Power Quality functions** Manufacturer : Schneider Electric Type : PowerLogic PM8000 PowerLogic ION7400
Test specifications	:	**IEC 61000-4-30 Edition 3 (2015)** "Electromagnetic Compatibility (EMC) – Part 4-30: Testing and measurement techniques – Power quality measurement methods" **IEC 62586-2 Edition 2 (2017)** "Power quality measurement in power supply systems – Part 2: Functional tests and uncertainty requirements"
Testing period	:	January 2019 up to and including February 2019
Results	:	The measuring instrument complies with the requirements for class *S* of the IEC 61000-4-30, for all performed tests, as reported on the following pages.
Issue date	:	8 March 2019

Performed by: Reviewed by:

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INSPECTION RvA I 122 TESTING RvA L 029

Tests	:	The meters as specified in annex 2 were tested for compliance with the standards as specified on page 1 of this type evaluation report. The performed tests are stated in annex 1. If applicable specific test conditions are stated at each test.
Test locations	:	VSL Thijsseweg 11 2629 JA Delft The Netherlands NMi Certin BV Thijsseweg 11 2629 JA Delft The Netherlands
Other standards relevant for the test	:	- IEC 61000-4-15:2010 "Electromagnetic compatibility (EMC) – Part 4-15: Testing and measurement techniques - Flickermeter - Functional and design specifications" - IEC 61000-4-7:2002 "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 61000-2-4:2002 "Electromagnetic compatibility (EMC) - Part 2-4: Environment - Compatibility levels in industrial plants for low-frequency conducted disturbances" - IEC 62586-1:2017 "Power quality measurement in power supply systems - Part 1: Power quality instruments"
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Annexes	:	The complete type evaluation report consists of the following annexes: annex 1 : performed tests annex 2 : characteristics of the tested meters annex 3 : test data annex 4 : reference equipment and uncertainty
Remark	:	The tests presented in this type evaluation report have been performed under RvA accreditation with reference number L029, in which conformity to ISO/IEC 17025 has been demonstrated The test data as presented in the annex 3 of this type evaluation report is performed under RvA accreditation with reference number L029, in which conformity to ISO/IEC 17025 has been demonstrated. The data as presented in the annexes 1 and 2 gives extra information.

Annex 1: Performed tests

In the following table the performed tests are indicated with the accompanying results, as well as the page number of the appertaining annex where the results are presented.

IEC 62586-2 clause	Tests	Results for class S	Annex 3 page	Remarks
7.1	Power frequency	**P**	1	50 Hz and 60 Hz
7.2	Magnitude of supply voltage	**P**	4	
7.3	Flicker	**P** [2]	9	Class F3: 230 V, 50 Hz 120 V, 60 Hz
7.4	Supply voltage interruptions dips and swells	--- [1]	15	
7.5	Supply voltage unbalance	--- [1]	16	
7.6	Voltage harmonics	--- [1]	17	
7.7	Voltage inter-harmonics	n/a	18	Not implemented
7.8	Mains signalling voltages on the supply voltage	**P** [2]	19	Method 2
7.9	Underdeviation and overdeviation	n/a	19	Not implemented
7.10	Flagging concept	---- [1]	24	
7.11	Clock uncertainty testing	---- [1]	25	
7.12	Variations due to external influence quantities	---- [1]	26	
7.13	Rapid voltage changes (RVC)	n/a	27	Not implemented
7.14	Magnitude of current	**P**	28	
7.15	Harmonic current	**P**	33	
7.16	Interharmonic currents	n/a	43	Not implemented
7.17	Current unbalance	**P**	44	
8	Measurement uncertainty and operating uncertainty	---- [1]	47	

P: Pass. *F:* Fail *n/a*: Not applicable -----*:* Not tested

Two products of the PowerLogic range are evaluated in this type evaluation report.

- PowerLogic PM8000
- PowerLogic ION7400

The PM8000 is identical to the previously tested PM8000 meter, but now evaluated for IEC 61000-4-30 ed.3.

The ION7400 can be considered as a meter of the same base type as the PM8000. It shares identical code base, metrology, power supply and communication design with the PM8000, but offers measurement of more PQ parameters and is intended to cover the "Advanced Utility Metering" segment of the PowerLogic product range. With the ION7400 covering the largest set of parameters, the tests indicated in this table are applied to the ION7400 meter.

Notes:

1 For the tests which are not performed , as indicated in this table, a reference can be made to the previous investigations with the PowerLogic PM8000 meter, as presented in type evaluation report NMi-1520073-01, issued by NMi Certin B.V. The results of these tests can also be applied for the PowerLogic PM8000 and ION7400 meters.

2 PQ parameter not supported by the PM8000.

The measurements are performed at a reference temperature of 23,0 ± 0,5 °C, unless another temperature is stated.

Annex 2: Characteristics

General characteristics	
Model	PowerLogic ION7400 PowerLogic PM8000
Serial number	PowerLogic ION7400: Type No: METSEION7400 Serial No: MR-1901A158-02 Type No: METSEION7400 Serial No: MR-1901A033-02 PowerLogic PM8000: Type No: METSEPM8280 Serial No: ME-1810A813-13 Type No: METSEPM8280 Serial No: ME-1810B503-02
Hardware version	PM8000 : METSEPM82XX ION7400 : METSEION74XX
Firmware version	002.000.xxx or 002.001.xxx
Power supply	90V-415 VAC (+/- 10%), 50/60 Hz 110-415 VDC (+/- 10%)
Ambient temperature:	Rated range of operation : -25 … +70°C
Characteristics relevant for testing	
U_{din} [V]	230 V
I_{nom} [A]	5 A
f_{nom} [Hz]	50 Hz and 60 Hz
Reference channel	U1. If the reference channel loses voltage it (re)synchronizes to the next channel according to a defined priority list.

PowerLogic ION7400

PowerLogic PM8000

Measurement characteristics			
Parameter	EUT Specification		Compliance with IEC 61000-4-30
	Measuring range	Accuracy	
Power Frequency	50 Hz: 42,5 -57,5 Hz 60 Hz: 51 - 69 Hz	±10 mHz	Class S or better
Magnitude of supply voltage	10 – 200% of U_{din}	±0,1 % U_{din}	Class S or better
Flicker	Class F3 0,2 – 10 P_{st}	5 % or 0,05 P_{st} whichever is greater	Class S or better (not implemented for PM8000)
Supply voltage dips and swells	10 – 200% of U_{din}	Amplitude ±0,2 % U_{din} Duration ±1 cycle	Class S or better
Voltage Interruptions	< 10% of U_{din}	Amplitude ±0,02 % U_{din} Duration ±1 cycle	-----
Voltage Unbalance	U_2 : (0,5 – 10)% U_0 : (0,5 – 10)%	±0,3 %	Class S or better
Voltage harmonics	Up to 63th order IEC 61000-2-4 Class 3	IEC 61000-4-7 Class 2	Class S or better
Voltage inter-harmonics	-----	-----	-----
Mains signalling voltage	Up to 3 kHz 0 = 15% U_{din}	1 – 3% Udin, ±0,15 reading 3 – 15% Udin, ±5% reading	Class S (SBM) (not implemented for PM8000)
Clock uncertainty testing	N/A	GPS/PTP/IRIG-B sync : ±1msec Non-sync: ±5 s / 24-h	Class S
Rapid voltage changes	-----	-----	-----
Underdeviation and overdeviation	10 – 200% of U_{din}	±0,1 % U_{din}	NR
Current	I_n = 5(10)A 0,05 = 10 A Crest Factor ≤ 3 Up to 130% of I_n	0,2% of reading	Class S or better
Current harmonics	Up to 63th order 200% of cl.3 IEC 61000-2-4	IEC 61000-4-7 Class 2 Method $I_{sg.h}$	Class S (SBM)
Current interharmonics	-----	-----	-----
Current unbalance	I_2 : (0,5 – 10)% I_0 : (0,5 – 10)%	±0,15 %	Class S (SBM)
The measurement characteristics are specified by the manufacturer. The measurement characteristics are reviewed by NMi for compliance with the range and uncertainty requirements of IEC 61000-4-30.			
----- Not implemented SBM Stated By Manufacturer NR Not Required			

Annex 3: Test data

Tests according to IEC 62586-2 edition 2 (2017):
For easy reference this Annex follows the paragraphs and test numbers of IEC 62586-2.

7.1 Power frequency

EUT Power frequency measurements conforms to Class S requirements	**P**

IEC 62586-2		Requirement	Remarks	Result for class S
Section	Test No.			
7.1.2	S1.1.1	Measurement method - Check that averaging interval is 10 s		**P**
7.1.3.1	S1.2.1 S1.2.2 S1.2.3	Uncertainty under reference conditions		**P**
7.1.3.2	S1.3.1 S1.3.2	Variations due to single influence quantities		**P**
7.1.4	S1.4.1	Measurement evaluation – Reference channel		**P**
7.1.5	-	Measurement aggregation	Aggregation is not required for power frequency.	-----

7.1.1 General

All frequency tests are made on the reference channel, unless otherwise stated.

7.1.2 Measurement method

Purpose of the test : Check that averaging interval for frequency measurement is 10 s.
Method : A single-phase sinusoidal signal with a linear modulated frequency between P1 and P3 is applied to the EUT reference channel. The number of frequency readings in two minutes is counted and it is verified that the individual frequency readings give the correct value.

Test criteria	Description
TC10s(sam)	Every 10 s frequency measurement shall be within their specified uncertainty.
TC(11≤ N ≤13)	Counter of frequency readings in 2 min: 11 ≤ N ≤13

IEC 62586-2 Test No.	Test points [Hz]	Number of frequency readings [N]	Result TC(11≤N≤13)	EUT frequency reading Max / Min [Hz]	Allowed deviation [Hz]	Result TC10s(sam)
S1.1.1	P1–P3 Triangle 5 s 42,500 – 57,500 P3-P1 Triangle 5 s 57,500 – 42,500	N = 12	**P**	49,99 50,00	0,10	**P**

7.1.3 Measurement uncertainty and measuring range

7.1.3.1 Uncertainty under reference conditions

Purpose of the test : Check measuring range.
Method : A single-phase sinusoidal signal of U_{din} with a steady state frequency is applied to the EUT reference channel. It is verified that the frequency error is less than the required uncertainty.
Remark : The instrument is intended to work both at 50 Hz and 60 Hz, therefore the test points for "Frequency 50 Hz" and "Frequency 60 Hz" are applied.

Test criteria	Description
TC10s(sam)	Every 10 s frequency measurement shall be within their specified uncertainty.

IEC 62586-2 Test No.	Applied test points for Frequency [Hz]		EUT reading [Hz]	EUT error [Hz]	Allowed error [Hz]	Result TC10s(unc)
S1.2.1	Frequency 50 Hz	P1 = 42,500	42,500	0,000	0,050	**P**
S1.2.2		P2 = 50,050	50,049	-0,001	0,050	**P**
S1.2.3		P3 = 57,500	57,500	0,000	0,050	**P**
S1.2.1	Frequency 60 Hz	P1 = 51,000	51,001	0,001	0,050	**P**
S1.2.2		P2 = 59,950	59,950	0,000	0,050	**P**
S1.2.3		P3 = 69,000	69,000	0,000	0,050	**P**

7.1.3.2 Variation due to single influence quantities

Purpose of the test : Measure influence of voltage magnitude and harmonics on measurement uncertainty
Method : Single-phase signals with low amplitude and with distorted voltages are applied to the EUT reference channel. The frequency reading is verified to be within the required uncertainty.
Remark : The instrument is intended to work both at 50 Hz and 60 Hz, therefore the test points for "Frequency 50 Hz" and "Frequency 60 Hz" are applied.

Test criteria	**Description**
TC10s(unc)	Every 10 s frequency measurement shall be within their specified uncertainty.

IEC 62586-2 Test No.	Applied test points for influence quantities		Applied frequency [Hz]	EUT reading [Hz]	EUT error [Hz]	Allowed error [Hz]	Result TC10s(unc)
S1.3.1	Frequency 50 Hz	S1 for voltage magnitude 10 % of U_{din}	50,050	50,050	0,000	0,050	**P**
S1.3.2		S1 for harmonics H1:100 % H3: 10 % 180° H7: 10 % 180° H11: 10 % 180° H15: 4 % 180° H19: 5 % 180° H23: 5 % 180°	50,050	50,050	0,000	0,050	**P**
S1.3.1	Frequency 60 Hz	S1 for voltage magnitude 10 % of U_{din}	59,950	50,950	0,000	0,050	**P**
S1.3.2		S1 for harmonics H1:100 % H3: 10 % 180° H7: 10 % 180° H11: 10 % 180° H15: 4 % 180° H19: 5 % 180° H23: 5 % 180°	59,950	50,950	0,000	0,050	**P**

7.1.4 Measurement evaluation

Purpose of the test : Verify that frequency measurements are performed on the reference channel.
Method : It is verified that the reference channel as mentioned by the manufacturer is indeed the channel on which the frequency measurements are performed.

IEC 62586-2 Test No.	EUT reference channel	Remarks	Result
S1.4.1	Dynamic	The EUT successfully switches reference channels when the reference channel is disconnected	**P**

7.2 Magnitude of the voltage magnitude

EUT Voltage Magnitude measurements conforms to Class S requirements	**P**

IEC 62586-2		Requirement	Remarks	Result for class S
Section	Test No.			
7.2.1	S2.1.1	Measurements method		**P**
7.2.2.1	S2.2.1 S2.2.2 S2.2.3	Uncertainty under reference conditions		**P**
7.2.2.2	S2.3.1 S2.3.2	Variation due to single influence quantities		**P**
7.2.4.1	S2.4.1	10/12 cycles with 10 min synchronization	Not required for Class S	**P**
7.2.4.2	S2.5.1	150/180 cycles aggregation with 10 min synchronization		**P**
7.2.4.3	S2.6.1	10 minute aggregation		**P**
7.2.4.4	S2.7.1	2-hour aggregation		**P**

7.2.1 Measurements method

Purpose of the test : Check gapless and non-overlapping measurement.
Method : The test is made according to the requirements of IEC 62586-2 Annex F

The following test signal is applied to the EUT:

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

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

The 10/12 cycles RMS values build a sequence $U_{rms}(0)$... $U_{rms}(99)$. From this sequence, the following quantities are calculated:

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

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

IEC 62586-2 Test No.	Quantity	Requirement	EUT	Result
S2.1.1	Q_{rms}	$Q_{rms} > 20$	$3{,}4 \cdot 10^4$	**P**
	$A(46) / V_1$	4,5 % < $A(46) / V_1$ < 5,5 %	4,85 %	**P**
	timestamp	Timestamp($U(100)$) - Timestamp($U(0)$) = 20 s ± 6 ms	20,000 s	**P**

7.2.2 Measurement uncertainty and measurement range

7.2.2.1 Uncertainty under reference conditions

Purpose of the test : Check measuring range.
Method : Steady state sinusoidal waveforms are applied to the EUT. The difference between the reference meter and the EUT reading is verified to be less than the required uncertainty.

Test criteria	**Description**
TC10/12(unc)	Every basic 10/12-cycle measurement shall be within its specified uncertainty.

IEC 62586-2 Test No.	Testing points voltage magnitude	Channel	REF reading [% of U_{din}]	EUT reading [% of U_{din}]	EUT error [% of U_{din}]	Allowed error [% of U_{din}]	Result TC10/12(unc)
S2.2.1	P1 = 20% U_{din}	V_1 V_2 V_3	20,00 20,00 20,00	20,01 20,01 20,00	0,01 0,01 0,00	0,50	**P**
S2.2.2	P3 = 70% U_{din}	V_1 V_2 V_3	70,00 70,01 69,99	70,03 70,04 70,02	0,03 0,03 0,03	0,50	**P**
S2.2.3	P5 = 120% U_{din}	V_1 V_2 V_3	120,01 120,02 120,00	120,05 120,07 120,04	0,04 0,05 0,04	0,50	**P**

7.2.2.2 Variation due to single influence quantities

Purpose of the test : Measure influence of frequency and harmonics on measurement uncertainty.
Method : Single-phase signals with different frequencies and harmonics is applied to the EUT reference channel. The results are verified to be within the required RMS uncertainty.

Test criteria	**Description**
TC10/12(unc)	Every basic 10/12-cycle measurement shall be within its specified uncertainty.

IEC 62586-2 Test No.	Testing points voltage magnitude	Complementary test condition	REF reading [% of U_{din}]	EUT reading [% of U_{din}]	EUT error [% of U_{din}]	Allowed error [% of U_{din}]	Result TC10/12(unc)
S2.3.1	P3 for voltage magnitude 70% U_{din} (50 Hz)	S1 for Frequency 42,500 Hz	70,00	70,03	0,03	0,50	**P**
		S3 for Frequency 57,500 Hz	70,00	70,03	0,03	0,50	**P**
	P3 for voltage magnitude 70% U_{din} (60 Hz)	S1 for Frequency 51,000 Hz	69,99	70,02	0,03	0,50	**P**
		S3 for Frequency 69,000 Hz	70,00	70,03	0,03	0,50	**P**
S2.3.2	P3 for voltage magnitude 70% U_{din}	S1 for Harmonics H1: 100 % H3: 10 % 180° H7: 10 % 180° H11: 10 % 180° H15: 4 % 180° H19: 5 % 180° H23: 5 % 180°	71,27	71,29	0,03	0,50	**P**

7.2.3 Measurement evaluation

Not applicable.

7.2.4 Measurement aggregation

7.2.4.1 10/12 cycles with 10 min synchronization

Class S requires gapless and non-overlapping 10/12-cycle blocks (test S2.1.1). There is no further requirement for 10 min synchronization. Although not required for class S, the following test is applied:

Target of the test : Check aggregation overlap 1
Method : A single phase voltage is applied at 80 % of U_{din}. The fundamental frequency 49,990 Hz is chosen such that the 10 minute time tag occurs during 10/12 cycle sequence block number 3000. The time tags of the last 10/12 cycles are reviewed and the sequence number of blocks are verified to be properly resynchronized to the 10 minute tick.

Test criteria
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.

IEC 62586-2 Test No.	Complementary test condition	Influence quantity	Time tags of blocks	Remarks	Result
S2.4.1	f = 49,990 Hz Test duration = 11 min	P3 for voltage 70% U_{din} = 184 V	08:39:59.730 08:39:59.930 08:40:00.130 08:40:00.200 08:40:00.400	EUT correctly synchronizes at the 10 minute tick	**P**

7.2.4.2 150/180 cycles aggregation with 10 min synchronization

Target of the test : Check aggregation overlap 2.
Method : A single phase signal with a carrier wave frequency of 50,125 Hz is applied which linearly ramps from 20 % of U_{din} to 70 % of U_{din} in 1 minute, then linearly back to 20 % of U_{din} in 1 minute. The aggregation of the 10/12 cycles data into 150/180 cycle interval relative to 10 minute tick is verified to comply.

Test criteria
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.

IEC 62586-2 Test No.	Complementary test condition	Influenced quantity	10/12 cycle to 150/180 cycle aggregation is correct	150/180 synchronization to 10 minute boundary is correct	Result
S2.5.1	f = 50,125	U_{din} Linear ramp	Yes	Yes	**P**

7.2.4.3 10 minute aggregation

Target of the test : Check 10-min aggregation.

Method : A single phase voltage is applied which linearly ramps from 20 % of U_{din} to 70 % of U_{din} in 1 minute, then linearly back to 10 % of U_{din} in 1 minute. It is verified that the aggregation of 10/12 cycles data into 10 minute tick interval is correctly implemented.

Test criteria
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.

IEC 62586-2 Test No.	Applied Frequency	Influenced quantity	Calculated 10 minute aggregated value [% of U_{din}]	Measured 10 minute aggregated value [% of U_{din}]	Result
S2.6.1	50,000 Hz	U_{din} Linear ramp	49,338	49,338	**P**

7.2.4.4 2-hour aggregation

Target of the test : Check 2h aggregation.

Method : It should be verified that a 2 hour aggregated value is provided for magnitude at every even-numbered 2 hour RTC interval.

IEC 62586-2 Test No.	2-hour aggregation implemented?	New 2-hour value at even-numbered hours?	Result
S2.7.1	Yes	Yes	**P**

7.3 Flicker

EUT Flicker measurements conforms to Class S requirements	**P**

Section	IEC 61000-4-15 2011	Requirement	Value used for test	Remarks	Result for class F3
7.3.1	6.2	Sinusoidal voltage changes Table 1a and 1b	$P_{inst.max}$		**P**
7.3.2	6.2	Rectangular voltage changes Table 2a and 2b	$P_{inst.max}$		**P**
7.3.3	6.3	P_{st} = 1 accuracy Table 5	P_{st}		**P**
7.3.4	6.4	Combined frequency and voltage changes	$P_{inst.max}$	Only applicable for Flickermeter class F1	n.a.[1]
7.3.5	6.5	Distorted voltage with multiple zero crossings	$P_{inst.max}$	Only applicable for Flickermeter class F1	n.a.[1]
7.3.6	6.6	Bandwidth test using harmonics and inter-harmonic side band modulation	$P_{inst.max}$	Only applicable for Flickermeter class F1	n.a.[1]
7.3.7	6.7	Phase jumps	P_{st}	Only applicable for Flickermeter class F1	n.a.[1]
7.3.8	6.8	Rectangular voltage changes with 20 % duty cycle	P_{st}	Only applicable for Flickermeter class F1	n.a.[1]
7.3.9	6.3	Flicker accuracy over measuring range K = 0,2 K = 10	P_{st}		**P**
7.3.10	---	P_{lt} aggregation is correctly implemented	P_{lt}		**P**

[1] IEC 61000-4-15 Class F3 applies as minimum requirement for a Class S device.

7.3.1 Sinusoidal response

Target of the test : Test the response characteristic of the filters and scaling parameters for sinusoidal modulations.

Method : *IEC 61000-4-15 section 6.2*
Flicker signals according to Table 1 of IEC 61000-4-15 are applied to the EUT. Each test takes at least 10 minutes and contains two consecutive RTC ticks. The applied signals are sinusoidal modulated sine waves at U_{din} with the fundamental frequency. The applied sinusoidal modulation is dependent on the specified frequency and U_{din}. The results are verified to be $P_{inst,max}$ = 1,00 ± 0,16 .

IEC 61000-4-15	Modulation frequency [Hz]	Applied sinusoidal modulation [%]	EUT measured [$P_{inst,max}$]	Target [$P_{inst,max}$]	Result
§ 6.2 Table 1a 120V / 60 Hz	0,5 Hz	2,453	1,00	1,00 ± 0,16	**P**
	1,5 Hz	1,126	1,00	1,00 ± 0,16	**P**
	8,8 Hz	0,321	1,03	1,00 ± 0,16	**P**
	20 Hz	0,977	1,00	1,00 ± 0,16	**P**
	33,3 Hz	2,570	0,99	1,00 ± 0,16	**P**
	40,0 Hz	4,393	0,99	1,00 ± 0,16	**P**
§ 6.2 Table 1b 230V / 50 Hz	0,5 Hz	2,325	1,01	1,00 ± 0,16	**P**
	1,5 Hz	1,067	1,01	1,00 ± 0,16	**P**
	8,8 Hz	0,250	1,03	1,00 ± 0,16	**P**
	20,0 Hz	0,704	1,00	1,00 ± 0,16	**P**
	25,0 Hz	1,037	1,00	1,00 ± 0,16	**P**
	33,3 Hz	2,128	0,99	1,00 ± 0,16	**P**

7.3.2 Rectangular response

Target of the test : Tests the response characteristic of the filters and scaling parameters for rectangular modulations.

Method : *IEC 61000-4-15 section 6.2*
Flicker signals according to Table 2 of IEC 61000-4-15 are applied to the EUT. Each test takes at least 10 minutes and contains two consecutive RTC ticks. The applied signals are rectangular modulated sine waves at U_{din} with the fundamental frequency. The applied rectangular modulation is dependent on the specified frequency and U_{din}. The results are verified to be $P_{inst.max}$ = 1,00 ± 0,16.

IEC 61000-4-15	Modulation frequency [Hz]	Applied rectangular modulation [%]	EUT measured [$P_{inst,max}$]	Target [$P_{inst,max}$]	Result
§ 6.2 Table 2a 120 V / 60 Hz	0,5 Hz	0,598	1,01	1,00 ± 0,16	**P**
	3,5 Hz	0,408	1,02	1,00 ± 0,16	**P**
	8,8 Hz	0,252	1,03	1,00 ± 0,16	**P**
	18,0 Hz	0,626	1,01	1,00 ± 0,16	**P**
	22,0 Hz	0,851	1,01	1,00 ± 0,16	**P**
	25,5 Hz	1,072	1,01	1,00 ± 0,16	**P**
	33,3 Hz	1,823	1,00	1,00 ± 0,16	**P**
	37,0 Hz	1,304	1,02	1,00 ± 0,16	**P**
	40,0 Hz	33,451	0,99	1,00 ± 0,16	**P**
§ 6.2 Table 2b 230 V / 50 Hz	0,5 Hz	0,509	1,01	1,00 ± 0,16	**P**
	3,5 Hz	0,342	1,02	1,00 ± 0,16	**P**
	8,8 Hz	0,196	1,03	1,00 ± 0,16	**P**
	18,0 Hz	0,446	1,01	1,00 ± 0,16	**P**
	21,5 Hz	0,592	1,00	1,00 ± 0,16	**P**
	25,0 Hz	0,764	0,99	1,00 ± 0,16	**P**
	28,0 Hz	0,915	1,00	1,00 ± 0,16	**P**
	30,5 Hz	0,847	1,00	1,00 ± 0,16	**P**
	33,3 Hz	1,671	0,98	1,00 ± 0,16	**P**

7.3.3 P_{st} = 1 accuracy

Target of the test : Verify that the stated flicker accuracy complies at P_{st} = 1.

Method : *IEC 61000-4-15 section 6.3*
Flicker signals according to Table 5 of IEC 61000-4-15 are applied to the EUT. Each test takes at least 10 minutes and contains two consecutive RTC ticks. The applied signals are rectangular modulated sine waves at U_{din} with the fundamental frequency. The applied rectangular modulation is dependent on the specified frequency and U_{din}. The results are verified to be P_{st} = (1,00 ± 0,10).

IEC 61000-4-15	Changes per minute	Applied rectangular modulation [%]	EUT measured [P_{st}]	Target [P_{st}]	Result
§ 6.3 Table 5 120 V / 60 Hz	1	3,181	0,99	1,00 ± 0,10	**P**
	2	2,564	1,00	1,00 ± 0,10	**P**
	7	1,694	1,00	1,00 ± 0,10	**P**
	39	1,040	1,00	1,00 ± 0,10	**P**
	110	0,844	1,00	1,00 ± 0,10	**P**
	1620	0,548	1,00	1,00 ± 0,10	**P**
	4800	4,837	0,99	1,00 ± 0,10	**P**
§ 6.3 Table 5 230 V / 50 Hz	1	2,715	0,99	1,00 ± 0,10	**P**
	2	2,191	1,00	1,00 ± 0,10	**P**
	7	1,450	1,00	1,00 ± 0,10	**P**
	39	0,894	1,00	1,00 ± 0,10	**P**
	110	0,722	1,00	1,00 ± 0,10	**P**
	1620	0,407	1,00	1,00 ± 0,10	**P**
	4000	2,343	0,99	1,00 ± 0,10	**P**

7.3.4 Combined frequency and voltage changes

N.A. for a Class S device.

7.3.5 Distorted voltage with multiple zero crossings

N.A. for a Class S device.

7.3.6 Bandwidth test using harmonic and inter-harmonic side band modulation

N.A. for a Class S device.

7.3.8 Rectangular voltage changes with 20 % duty cycle

N.A. for a Class S device.

7.3.9 Flicker accuracy over measuring range

Target of the test : Verify that the stated flicker accuracy complies over the minimum required flicker range.

Method : The flicker accuracy will be tested at the required minimum ranges. The applied flicker signals are rectangular modulated sine waves at U_{din} with the fundamental frequency. The applied rectangular modulation is dependent on the specified frequency and U_{din}. The results are verified to be within ±10 % of the expected P_{st} or 0,10, whichever is greater.

IEC 61000-4-15	Range K-value	Changes per minute	Applied rectangular modulation [%]	EUT measured [P_{st}]	Target [P_{st}]	Result
§ 6.3 Table 5 120 V / 60 Hz	K = 0,4	1	0,6362	0,40	0,40 ± 0,10	**P**
		7	0,3388	0,40	0,40 ± 0,10	**P**
		1620	0,1096	0,40	0,40 ± 0,10	**P**
	K = 4,0	1	31,810	3,97	4,0 ± 0,4	**P**
		7	16,940	4,00	4,0 ± 0,4	**P**
		1620	5,480	4,00	4,0 ± 0,4	**P**
§ 6.3 Table 5 230 V / 50 Hz	K = 0,4	1	0,5430	0,40	0,40 ± 0,10	**P**
		7	0,2900	0,40	0,40 ± 0,10	**P**
		1620	0,0814	0,40	0,40 ± 0,10	**P**
	K = 4,0	1	27,150	3,99	4,0 ± 0,4	**P**
		7	14,500	4,01	4,0 ± 0,4	**P**
		1620	4,070	3,99	4,0 ± 0,4	**P**

7.3.10 P_{lt} calculation

Target of the test : Verify the calculation of P_{lt}.

Method : The applied flicker signal is a rectangular modulated sine wave at U_{din} with the fundamental frequency. Two levels of modulation depths (at 7 changes per minute) are applied consecutively after 10 minutes, continuing for at least 2 hours. The applied modulation levels result in a P_{lt} value of 1,04 (P_{st} = 0,8 for 1 hour and 1,2 for 1 hour). The results are verified to be ± 10 % of the expected P_{lt} value.

IEC 61000-4-15	Changes Per minute	Applied rectangular modulation [%]	EUT measured [P_{lt}]	Target [P_{lt}]	Result
120 V	7	1,3552 2,0328	1,037	1,040 ± 0,104	**P**
230 V	7	1,1600 1,7400	1,057	1,040 ± 0,104	**P**

7.4 Supply voltage interruptions, dips and swells

Supply voltage interruptions, dips and swells conforms to Class S requirements	-----

IEC 62586-2		Requirement	Remarks	Result for class S
Section	Test No.			
7.4.1	S4.1.1	$U_{rms(½)}$ are independently synchronized on each channel on zero crossing		-----
	S4.1.2	Amplitude and duration accuracy – dips		-----
	S4.1.3	Amplitude and duration accuracy - swells		-----
	S4.1.4	Thresholds		-----
	S4.1.5	Dip / Interruptions / Swells in polyphase system	The test is achieved according to the requirements of 7.4.2 and 7.4.3	N/A
	S4.1.6	Sliding voltage reference – steady state operation		-----
	S4.1.7	Sliding voltage reference – startup condition		-----
7.4.2	S4.2.1	Dips / Interruptions in polyphase systems		-----
7.4.3	S4.3.1	Swells in polyphase system		-----

7.5 Supply voltage unbalance

EUT Unbalance measurements conforms to Class S requirements	-----

IEC 62586-2		Requirement	Remarks	Result for class S
Section	Test No.			
7.5.2	S5.1.1	accuracy of unbalance measurement		-----
	S5.1.2	accuracy of unbalance measurement		-----
	S5.1.3	accuracy of unbalance measurement		-----
	S5.1.4	Accuracy of unbalance during phase displacement		-----

7.6 Voltage harmonics

EUT Voltage harmonics measurements conforms to Class S requirements	-----

IEC 62586-2		Requirement	Remarks	Result for class S
Section	Test No.			
7.6.1	S6.1.1	10/12-cycle measurement intervals are gapless and non-overlapping		-----
	S6.1.2	10/12-cycle measurement intervals are gapped and non-overlapping		-----
	S6.1.3	10/12-cycle measurements use the harmonic subgroup measurement		-----
	S6.1.4	10/12-cycle measurements use the harmonic group easurement		-----
	S6.1.5	Measurements are made at least up to the 50th order		-----
	S6.1.6	THD		-----
	S6.1.7	A crest factor of at least 2 is supported by the device		-----
	S6.1.8	A properly designed anti-aliasing filter is used on the device		-----
7.6.2.1	S6.2.1	Check measuring uncertainty – single even harmonic		-----
	S6.2.2	Check measuring uncertainty – single odd harmonic		-----
	S6.2.3	Check measuring uncertainty – single high harmonic		-----
	S6.2.4	Check measuring range – low end		-----
	S6.2.5	Check measuring range – high end		-----
7.6.2.2	S6.3.1	Check influence of frequency on measurement uncertainty		-----
	S6.3.2	Check influence of voltage magnitude on measurement uncertainty		-----
7.6.4.1	S6.4.1	10/12 cycles with 10 min synchronization		-----
7.6.4.2	S6.5.1	150/180-cycle aggregation with 10 min synchronization		-----
7.6.4.3	S6.6.1	10 min aggregation		-----
7.6.4.4	S6.7.1	2-h aggregation		-----

7.7 Voltage interharmonics

EUT interharmonics measurements conforms to Class S requirements	-----

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

Interharmonics are not implemented.

7.8 Mains signalling voltage on the supply voltage

EUT mains signaling voltages measurements conforms to Class S requirements	**P**

IEC 62586-2 Section	IEC 62586-2 Test No.	Requirement	Remark	Result for class S
7.8.2	S8.1.1	Verify that the user can specify the carrier frequency to monitor, up to 3 kHz.		**P**
7.8.2 additional class A test cases	A8.1.2	Verify that the user can specify the detection threshold (above 0,3 % U_{din}) and length of recording period (up to 120s)		**P**
	A8.1.3	If method 1[a] is implemented, verify proper implementation.	Not implemented.	N/A
	A8.1.4	If method 2[b] is implemented, verify proper implementation.		**P**
	A8.1.5	If method 1[a] and method 2[b] are both implemented, and the manufacturer claims to dynamically select the method based on the user-specified frequency.	Only Method 2 is implemented.	N/A
	A8.1.6	Verify that the product indicates when a signal exceeds the detection threshold.		**P**
	A8.1.7	Verify that the product can record the 10/12-cycle signal voltage values during the recording period following the detection, to give the maximum level of the signal voltage during this time.		**P**

7.8.1 General

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

Based on specified method additional Class A test cases are applied.

7.8.2.(1) Carrier frequency

Purpose of the test : Verify that the user can specify the carrier frequency to monitor, up to 3 kHz

Method : The EUT should be verified to allow for setting the mains signaling carrier to frequencies up to 3 kHz.

IEC 62586-2 Test No.	Test criterium	Result	Remarks	Result
S8.1.1	Carrier frequency can be set up to 3 kHz	Yes		**P**

7.8.2.(2) Threshold and length of recording period

Purpose of the test : Verify that the user can specify the detection threshold (above 0,3 % U_{din}) and length of recording period (up to 120s).

Method : The EUT should be verified to allow for setting the mains signaling threshold to 0.3 % and the recording length up to 120 seconds.

IEC 62586-2 Test No.	Test criterium	Result	Remarks	Result
A8.1.2	Threshold can be set to 0,3 % of U_{din}	Yes		**P**
	Recording can be set to 120 seconds	Yes		**P**

7.8.2.(3) Proper implementation of measurement method

Purpose of the test : Verify proper implementation

Method : Two methods of measuring the mains signaling voltages can be implemented by the manufacturer:
Method 1: Refers to the method based on the corresponding 10/12-cycle RMS value interharmonic bin.
Method 2: Refers to the method based on the root of the sum of the squares of the 4 nearest 10/12-cycle RMS value interharmonic bins.

A single-phase signal at U_{din} with the fundamental frequency in combination with an interharmonic of 3 % of U_{din} is applied to the EUT. The EUT is verified to give the expected RMS voltage for the mains signaling voltage within the required uncertainty of 0,15 % of U_{din}.

Remark : The manufacturer has implemented method 2.

IEC 62586-2 Test No.	Applied Mains Signaling	Criteria	Expected MSV [% of U_{din}]	EUT reading [% of U_{din}]	EUT error [% of U_{din}]	Allowed error [% of U_{din}]	Result
A8.1.3 (Method 1)	1060 Hz	Should count to MsV	3,00	-	-	0,15	-----
	1055 Hz 1065 Hz	Should not count to MsV	0	-	-	0,15	-----
A8.1.4 (Method 2)	315 Hz 320 Hz	Should count to MsV	4,24	4,24	0,00	0,15	**P**
	310 Hz 325 Hz	Should count to MsV	4,24	4,24	0,00	0,15	**P**
	305 Hz 330 Hz	Should not count to MsV	0	No MsV detected	-	0,15	**P**
A8.1.5	A8.1.3 and A8.1.4 are passed without manual intervention						-----

7.8.2.(4) Detection threshold

Purpose of the test : Verify that the product indicates when a signal exceeds the detection threshold

Method : The EUT will be set to use a detection threshold of 0,5 % and to monitor a carrier frequency of 316,67 Hz. A single phase signal with the fundamental frequency is applied to the EUT at U_{din}.

IEC 62586-2 Test No.	Applied Mains Signaling	Test criteria	Results	Result
A8.1.6	0 % of U_{din} at 316,67 Hz	The product does not indicate that the signal has exceeded the detection threshold	No MsV detected	**P**
	1 % of U_{din} at 316,67 Hz	The product does indicate that the signal has exceeded the detection threshold	MsV detected	**P**

7.8.2.(5) Ability to record 10/12-cycle signal voltage values

Purpose of the test : Verify that the product can record the 10/12-cycle signal voltage values during the recording period following the detection, to give the maximum level of the signal voltage during this time.

Method : The EUT will be set to use a detection threshold of 0,5 % and to monitor a carrier frequency of 316,67 Hz. A single phase signal with the fundamental frequency is applied to the EUT at U_{din}.

IEC 62586-2 Test No.	Applied Mains Signaling	Test criteria	Results	Result
A8.1.7	1 % of U_{din} at 316,67 Hz	The maximum level of the signal voltage should be determined by the EUT	Yes, the maximum value is correctly displayed	**P**

7.8.3 Measurement uncertainty and measuring range

7.8.3.1 Measurement evaluation

Not applicable.

7.8.3.2 Measurement evaluation

Not applicable.

7.8.4 Aggregation

Not applicable.

7.9 Measurement of underdeviation and overdeviation parameters

EUT under- and overdeviation measurements conforms to Class S requirements	-----

Not required for class S instruments.

7.10 Flagging

EUT flagging conforms to Class S requirements	-----

IEC 62586-2		Requirement	Remark	Result for class S
Section	Test No.			
7.10	S10.1.1	Check flagging is not set when flagging conditions are not met.		-----
	S10.1.2	Flagging in polyphase system caused by voltage dip For P_{lt} flicker.		-----
	S10.1.3	Flagging in polyphase system caused by voltage dip a.		-----
	S10.1.4	Flagging in polyphase system caused by voltage swell a.		-----
	S10.1.5	Flagging in polyphase system caused by voltage swell a.		-----

7.11 Clock uncertainty testing

EUT real time clock conforms to Class S requirements	-----

IEC 62586-2		Requirement	Remarks	Result for class S
Section	Test No.			
7.11	S11.1.1	Check clock uncertainty		-----

7.12 Variation due to external influence quantities

EUT measurements conforms to Class S requirements	-----

IEC 62586-2		Requirement	Remarks	Result for class S
Section	Test No.			
7.12.1	S12.1.1	Check the influence of low temperature		-----
	S12.1.2	Check the influence of worst case temperature		-----
	S12.1.3	Check the influence of high temperature		-----
	IEC 62586-1 paragraph 6.4.4	Temperature drift within the rated range of operation for ambient air temperature		-----
7.12.2	S12.2.1	Check influence of low power supply voltage		-----
	S12.2.2	Check influence of high power supply voltage		-----
	-----	Error shift due to influence of supply voltage		-----

7.13 Rapid Voltage Changes (RVC)

EUT RVC measurements conforms to Class S requirements	-----

IEC 62586-2		Requirement	Remarks	Result for class S
Section	Test No.			
7.13.3	S13.1.1	No RVC events are detected if the voltage magnitude changes too slowly.		-----
	S13.1.2	No RVC event will be detected if the voltage magnitude changes less than the threshold.		-----
	S13.1.3	If a dip/swell is detected during an RVC event, including the disabled 100/120 half cycles, then the RVC event would be discarded and recorded as a dip/swell.		-----
7.13.4	S13.2.1	To verify that mentioned RVC setup values are valid.		-----
7.13.5	S13.3.1	To verify that mentioned RVC parameters are valid.		-----
7.13.6	S13.4.1	In a polyphase system, RVC detection depends on the combined VSS (voltage-is-steady-state) logic signal.		-----
7.13.7	S13.5.1	If the second RVC event starts before the VSS (voltage-is-steady-state) logic signal changes to true, only one RVC event will be detected.		-----
	S13.5.2	The second RVC event starts after the VS (voltage-is-steady-state) logic signal changes to true, two RVC events shall be detected.		-----

7.14 Magnitude of the current

EUT Current Magnitude measurements conforms to Class S requirements	**P**

IEC 62586-2		Requirement	Remarks	Result for class S
Section	Test No.			
7.14.1	S14.1.1	Measurements method		**P**
7.14.2.1	S14.2.1 S14.2.2 S14.2.3	Uncertainty under reference conditions		**P**
7.14.2.2	S14.3.1 S14.3.2	Variation due to single influence quantities		**P**
7.14.4.1	S14.4.1	10/12 cycles with 10 min synchronization		**P**
7.14.4.2	S14.5.1	150/180 cycles aggregation with 10 min synchronization		**P**
7.14.4.3	S14.6.1	10 minute aggregation		**P**
7.14.4.4	S14.7.1	2-hour aggregation		**P**

7.14.1 Measurement method

Purpose of the test : Check gapless and non-overlapping measurement.
Method : The test is made according to the requirements of IEC 62586-2 Annex F.

The following test signal is applied to the EUT:

$$s_{rms}(t) = I_1\sqrt{2}\cos(2\pi f_1 t + \varphi_1)\cdot(1 + A_m\cos(2\pi f_m t + \varphi_m)$$

	Value	Accuracy
Fundamental frequency (f_1)	50 Hz or 60 Hz	$50 \cdot 10^{-6}$
Amplitude of fundamental component (I_1)	I_n	0,5 %
Modulating frequency (f_m)	2,3 Hz	$100 \cdot 10^{-6}$
Modulating amplitude (A_m)	0,1	1 %
Phases (φ_1, φ_m)	N.R.	N.R.

The 10/12 cycles RMS values build a sequence $U_{rms}(0)$… $U_{rms}(99)$. From this sequence, the following quantities are calculated:

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

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

IEC 62586-2 Test No.	Quantity	Requirement	EUT	Result
S14.1.1	Q_{rms}	$Q_{rms} > 20$	$3{,}1 \cdot 10^4$	**P**
	$A(46) / I_1$	4,5 % < $A(46) / I_1$ < 5,5 %	4,85 %	**P**
	timestamp	Timestamp(U(100)) - Timestamp(U(0)) = 20 s ± 6 ms	20,000 s	**P**

7.14.2 Measurement uncertainty and measurement range

7.14.2.1 Uncertainty under reference conditions

Purpose of the test : Check measuring range.
Method : Single-phase, steady state sinusoidal waveforms are applied to the EUT. The difference between the reference meter and the EUT reading is verified to be less than the required uncertainty.

Test criteria	Description
TC10/12(unc)	Every basic 10/12-cycle measurement shall be within its specified uncertainty.

IEC 62586-2 Test No.	Applied current [% of I_{nom}]	Channel	REF reading [A]	EUT reading [A]	EUT error [% of reading]	Allowed error [% of reading]	Result TC10/12(unc)
S14.2.1	10	I_1 I_2 I_3	0,500 0,500 0,500	0,500 0,500 0,499	0,0 0,0 0,0	2,0	**P**
S14.2.2	45	I_1 I_2 I_3	2,251 2,252 2,248	2,251 2,251 2,247	0,0 -0,1 0,0	2,0	**P**
S14.2.3	80	I_1 I_2 I_3	4,001 4,004 3,997	4,001 4,001 3,997	0,0 -0,1 0,0	2,0	**P**
S14.2.4	100	I_1 I_2 I_3	5,001 5,005 4,998	5,001 5,002 4,997	0,0 -0,1 0,0	2,0	**P**

7.14.2.2 Variation due to single influence quantities

Purpose of the test : Measure influence of frequency and harmonics on measurement uncertainty.
Method : Single-phase, steady state sinusoidal waveforms are applied to the EUT. The difference between the reference meter and the EUT reading is verified to be less than the required uncertainty.

Test criteria	Description
TC10/12(unc)	Every basic 10/12-cycle measurement shall be within its specified uncertainty.

IEC 62586-2 Test No.	Influence quantity	Applied current [% of I_{nom}]	REF reading [A]	EUT reading [A]	EUT error [% of reading]	Allowed error [% of reading]	Result TC10/12(unc)
S14.3.1 (50 Hz)	Frequency 42,500 Hz	80	4,002	4,001	0,0	2,0	**P**
	Frequency 57,500 Hz	80	4,002	4,002	0,0	2,0	**P**
S14.3.1 (60 Hz)	Frequency 51,000 Hz	80	4,002	4,001	0,0	2,0	**P**
	Frequency 69,000 Hz	80	4,001	4,001	0,0	2,0	**P**
S14.3.2	H3: 60% 180° H5: 55% 0° H7: 50% 180° H9: 41% 0°	80	5,018	5,020	0,0	2,0	**P**

7.14.3 Measurement evaluation

Not applicable.

7.14.4 Measurement aggregation

6.14.4.1 10/12 cycles with 10 min synchronization

Target of the test : Check aggregation overlap 1

Method : A single phase current is applied at 80 % of I_{nom}. The fundamental frequency 49,990 Hz is chosen such that the 10 minute time tag occurs during 10/12 cycle sequence block number 3000. The time tags of the last 10/12 cycles are reviewed and the sequence number of blocks are verified to be properly resynchronized to the 10 minute tick.

Test criteria
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.

IEC 62586-2 Test No.	Complementary test condition	Influence quantity	Time tags of blocks	Remarks	Result
S14.4.1	f = 49,990 Hz Test duration = 11 min	P3 for current 80 % I_{nom}	08:39:59.730 08:39:59.930 08:40:00.130 08:40:00.200 08:40:00.400	EUT correctly synchronizes at the 10 minute tick.	**P**

7.14.4.2 150/180 cycles aggregation with 10 min synchronization

Target of the test : Check aggregation overlap 2.

Method : A single phase signal with a carrier wave frequency of 50,125 Hz is applied which linearly ramps from 10 % of I_{nom} to 80 % of I_{nom} in 1 minute, then linearly back to 10 % of I_{nom} in 1 minute. The aggregation of the 10/12 cycles data into 150/180 cycle interval relative to 10 minute tick is verified to comply.

Test criteria
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.

IEC 62586-2 Test No.	Complementary test condition	Influenced quantity	10/12 cycle to 150/180 cycle aggregation is correct	150/180 synchronization to 10 minute boundary is correct	Result
S14.5.1	f = 50,125 Hz	I_{nom} Linear ramp	Yes	Yes	**P**

7.14.4.3 10 minute aggregation

Target of the test : Check 10-min aggregation.

Method : A single phase current is applied which linearly ramps from 10 % of I_{nom} to 80 % of I_{nom} in 1 minute, then linearly back to 10 % of I_{nom} in 1 minute. It is verified that the aggregation of 10/12 cycles data into 10 minute tick interval is correctly implemented.

Test criteria
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.

IEC 62586-2 Test No.	Applied frequency	Influenced quantity	Calculated 10 minute aggregated value [% of I_{nom}]	Measured 10 minute aggregated value [% of I_{nom}]	Result
S14.6.1	50,000 Hz	I_{nom} Linear ramp	39,485	39,485	**P**

7.14.4.4 2-hour aggregation

Target of the test : Check 2h aggregation.

Method : It should be verified that a 2 hour aggregated value is provided for magnitude at every even-numbered 2 hour RTC interval.

IEC 62586-2 Test No.	2-hour aggregation implemented?	New 2-hour value at even-numbered hours?	Result
S14.7.1	Yes	Yes	**P**

7.15 Harmonic current

EUT harmonics measurements conforms to Class S requirements	**P**

IEC 62586-2 Section	Test No.	Requirement	Remarks	Result for class S
7.15.1	S15.1.1	10/12-cycle measurement intervals are gapless and non-overlapping		**P**
	S15.1.2	10/12-cycle measurement intervals are gapped and non-overlapping	Not applicable for gapless implementation	N/A
	S15.1.3	10/12-cycle measurements use the harmonic subgroup measurement		**P**
	S15.1.4	10/12-cycle measurements use the harmonic group measurement	Not applicable for subgroup implementation	N/A
	S15.1.5	Measurements are made at least up to the 50th order		**P**
	S15.1.6	THD		**P**
	S15.1.7	A crest factor of at least 2 is supported by the device		**P**
7.15.2	S15.2.1	Check measuring uncertainty – single even harmonic		**P**
	S15.2.2	Check measuring uncertainty – single odd harmonic		**P**
	S15.2.3	Check measuring uncertainty – single high harmonic		**P**
	S15.2.4	Check measuring range – low end		**P**
	S15.2.5	Check measuring range – high end		**P**
7.15.3	S15.3.1	Check influence of frequency on measurement uncertainty		**P**
	S15.3.2	Check influence of current magnitude on measurement uncertainty		**P**
7.15.4.1	S15.4.1	10/12 cycles with 10 min synchronization		**P**
7.15.4.2	S15.5.1	150/180-cycle aggregation with 10 min synchronization		**P**
7.15.4.3	S15.6.1	10 min aggregation		**P**
7.15.4.4	S15.7.1	2-h aggregation		**P**

7.15.1 Measurement method

7.15.1.(1) 10/12-cycle measurement intervals are gapless and non-overlapping

Purpose of the test : Check that the 10/12-cycle measurement intervals are gapless and non-overlapping
Method : IEC 62586-2 test S15.1.1 (Annex F).

The following test signal is applied to the EUT:

$$s_H(t) = I_1\sqrt{2}\cos(2\pi f_1 t + \varphi_1) + (1 + A_m\cos(2\pi f_m t + \varphi_m)) \cdot I_M\sqrt{2}\cos(2\pi M f_1 t + \varphi_M)$$

	Value	Accuracy
Fundamental frequency (f_1)	50 Hz or 60 Hz	$50 \cdot 10^{-6}$
Amplitude of fundamental component (I_1)	I_n	0,5 %
Modulating frequency (f_m)	2,3 Hz	$100 \cdot 10^{-6}$
Modulating amplitude (A_m)	0,1	1 %
Harmonic number (M)	Any value	N.R.
Amplitude of harmonic component(I_M)	0,1	1 %
Phases ($\varphi_1, \varphi_m, \varphi_M$)	N.R.	N.R.

The 10/12 cycles harmonic for harmonic number N build a sequence $H_{rms}(0)$… $H_{rms}(99)$. From this sequence, the following quantities are calculated:

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

$$Q_H(M) = \sqrt{\frac{B(46,M)^2}{B(45,M)^2 + B(47,M)^2}}$$

During this test the harmonic number (M) was 3.

IEC 62586-2 Test No.	Quantity	Requirement	EUT	Result
S15.1.1	Q_H(M)	Q_H(M)> 20	$2{,}2 \cdot 10^4$	**P**
	B(46,M) / I_M	13,5 % < B(46,M) / I_M< 16,5 %	14,51 %	**P**
	Timestamp	Timestamp(H(100,M)) - Timestamp(H(0,M)) = 20 s ± 6 ms	20,000 s	**P**

7.15.1.(2) 10/12-cycle measurement intervals are gapped

Purpose of the test : Verify that at least one 10/12-cycle value is calculated every 50/60 cycles.

Method : Single-phase signals of I_n are applied to the EUT. Harmonics are added to the signals in order to verify that the EUT is correctly grouping harmonic content.

IEC 62586-2 Test No.	Applied harmonics [% of I_n]		Result	Result TC10/12 (unc)-harm
S15.1.2	3rd harmonics ramp	The EUT provides at at least one measurement per second	-	nt
		The EUT presents at least 10 unique values between 0 % and 10 % and repeats these every 20 seconds.	-	nt

7.15.1.(3) 10/12-cycle measurements use the harmonic subgroup measurement

Purpose of the test : Verify that harmonic subgrouped values ($I_{sg,h}$) as defined in IEC 61000-4-7 are used for harmonic results.

Method : Single-phase signals of I_n are applied to the EUT. Harmonics are added to the signals in order to verify that the EUT is correctly grouping harmonic content.

Test criteria	**Description**
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.

IEC 62586-2 Test No.	Applied frequency [Hz]	Applied amplitude [% of I_n]	REF indicated 2nd harmonic [% of I_n]	EUT indicated 2nd harmonic [% of I_n]	EUT error [% of I_n]	Allowed error [% of I_n]	Result TC10/12 (unc)-harm
S15.1.3	$2 \cdot f$	5	5,04	5,04	0,00	1,0	**P**
	$1{,}5 \cdot f$	5	0,04	0,04	0,00	1,0	**P**
	$2 \cdot f$ + 5 Hz $2 \cdot f$ + 10 Hz	4 6	4,00	4,00	0,00	1,0	**P**

7.15.1.(4) 10/12-cycle measurements use the harmonic group measurement

Purpose of the test : Check that the 10/12-cycle measurements use the harmonic group measurement ($I_{g,n}$). from IEC 61000-4-7

Method : Single-phase signals of I_n are applied to the EUT. Harmonics are added to the signals in order to verify that the EUT is correctly grouping harmonic content.

Test criteria	**Description**
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.

IEC 62586-2 Test No.	Applied frequency [Hz]	Applied amplitude [% of I_n]	Reference 2nd harmonic [% of I_n]	EUT indicated 2nd harmonic [% of I_n]	EUT error [% of I_n]	Allowed error [% of I_n]	Result TC10/12 (unc)-harm
S15.1.4	$2 \cdot f$	5	-	-	-	0,50	nt
	$2 \cdot f$ + 5 Hz $2 \cdot f$ + 10 Hz	5	-	-	-	0,72	nt

7.15.1.(5) Measurements are made at least up to the 50th order

Purpose of the test : Check that measurements are made at least up to the 50th order
Method : The EUT measurements are verified to contain harmonics up to the 50th order

IEC 62586-2 Test No	Harmonics up to the 50th are available	Result
S15.1.5	Yes	**P**

7.15.1.(6) THD

Purpose of the test : If total harmonic distortion is calculated, check that it is the subgroup total harmonic distortion (THDS) from IEC 61000-4-7
Method : A single-phase sinusoidal signal of I_n with multiple harmonics is applied to the EUT and a reference meter. If the EUT measures THD, the difference between the EUT and the reference meter should be less than the required uncertainty. The harmonic content in the applied signal is equal to the high end range of the EUT. The EUT is verified to detect no significant distortion when only interharmonics are applied.

Test criteria	**Description**
TC150/180(unc)-thd	The total harmoic distortion is calculated according to the definition for subgroup total harmonic distortion (THDS) in IEC 61000-4-7.

IEC 62586-2 Test No.	Applied	Applied THD	REF THD	EUT THD	Result TC150/180 (unc)-thd
S15.1.6	Harmonics	17,220 %	16,391 %	16,399 %	**P**
	Interharmonics	0 %	0,093 %	0,111 %	**P**

7.15.1.(7) Crest factor

Purpose of the test : Check that a crest factor of at least 3 is supported by the device.

Method : A single-phase signal of I_n is applied to the EUT. Harmonics are added to the signal in order to verify that the EUT can support waveforms with a crest factor of 3. The readings should be within the allowed uncertainty for harmonics.

Test criteria	Description
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.

IEC 62586-2 Test No.	Applied harmonic	Amplitude [% of I_n]	Reference reading [% of I_n]	EUT reading [% of I_n]	EUT error [% of I_n]	Allowed error [% of I_n]	Result TC150/180 (unc)-harm
S15.1.7	3rd	60,0 (180°)	60,0	60,0	0,00	6,0	**P**
	5th	55,0 (0°)	55,0	55,0	0,00	5,5	**P**
	7th	50,0 (180°)	50,0	50,0	0,00	5,0	**P**
	9th	41,0 (0°)	40,9	41,0	0,01	4,1	**P**

7.15.2 Measurement uncertainty and measuring range

7.15.2.1(.1) Uncertainty under reference conditions

Purpose of the test : Check measuring uncertainty
- single even harmonic (A15.2.1)
- single odd harmonic (A15.2.2)
- single high harmonic (A15.2.3).

Method : A single-phase sinusoidal signal of I_n with a steady state harmonic is applied to the EUT and a reference meter. The difference between the EUT and the reference meter are verified to be less than the required uncertainty.

Test criteria	Description
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.

IEC 62586-2 Test No.	Applied harmonic	Amplitude [% of I_n]	REF reading [% of I_n]	EUT reading [% of I_n]	EUT error [% of I_n]	Allowed error [% of I_n]	Result TC150/180 (unc)-harm
S15.2.1	2	5	5,04	5,04	0,00	1,0	**P**
S15.2.2	3	10	9,99	10,01	0,02	1,0	**P**
S15.2.3	40	1	0,98	0,98	0,00	1,0	**P**

7.15.2.1(.2) Uncertainty under reference conditions

Purpose of the test : Check measuring range
– Low end (A15.2.4)
- High end (A15.2.5).

Method : A single-phase sinusoidal signal of In with multiple harmonics is applied to the EUT and a reference meter. The difference between the EUT and the reference meter are verified to be less than the required uncertainty. The harmonic content in the applied signal is equal to the minimum required range values.

Test criteria	Description
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.

Measuring range – low end (A15.2.4)

IEC 62586-2 Test No.	Applied harmonic	Applied amplitude [% of I_n]	Reference reading [% of I_n]	EUT reading [% of I_n]	EUT error [% of I_n]	Allowed error [% of I_n]	Result TC150/180 (unc)-harm
S15.2.4	1	100,000	100,00	100,00	0,00	-	**P**
	2	0,300	0,34	0,34	0,00	1,0	**P**
	3	0,600	0,59	0,60	0,01	1,0	**P**
	4	0,150	0,18	0,18	0,00	1,0	**P**
	5	0,800	0,79	0,80	0,01	1,0	**P**
	6	0,100	0,11	0,12	0,01	1,0	**P**
	7	0,700	0,71	0,72	0,01	1,0	**P**
	8	0,100	0,10	0,10	0,00	1,0	**P**
	9	0,250	0,26	0,26	0,00	1,0	**P**
	10	0,100	0,11	0,10	-0,01	1,0	**P**
	11	0,500	0,50	0,50	0,00	1,0	**P**
	12	0,100	0,11	0,10	-0,01	1,0	**P**
	13	0,450	0,45	0,44	-0,01	1,0	**P**
	14	0,100	0,10	0,10	0,00	1,0	**P**
	15	0,200	0,20	0,20	0,00	1,0	**P**
	16	0,100	0,10	0,10	0,00	1,0	**P**
	17	0,400	0,39	0,40	0,01	1,0	**P**
	18	0,100	0,10	0,10	0,00	1,0	**P**
	19	0,353	0,34	0,34	0,00	1,0	**P**
	20	0,100	0,11	0,10	-0,01	1,0	**P**
	21	0,175	0,17	0,18	0,01	1,0	**P**
	22	0,100	0,10	0,10	0,00	1,0	**P**
	23	0,283	0,27	0,28	0,01	1,0	**P**
	24	0,100	0,10	0,10	0,00	1,0	**P**
	25	0,256	0,26	0,26	0,00	1,0	**P**
	26	0,100	0,10	0,10	0,00	1,0	**P**
	27	0,100	0,10	0,10	0,00	1,0	**P**
	28	0,100	0,10	0,10	0,00	1,0	**P**
	29	0,214	0,20	0,20	0,00	1,0	**P**
	30	0,100	0,10	0,10	0,00	1,0	**P**
	31	0,197	0,19	0,20	0,01	1,0	**P**
	32	0,100	0,10	0,10	0,00	1,0	**P**
	33	0,100	0,10	0,10	0,00	1,0	**P**
	34	0,100	0,10	0,10	0,00	1,0	**P**
	35	0,169	0,17	0,16	-0,01	1,0	**P**
	36	0,100	0,10	0,10	0,00	1,0	**P**
	37	0,157	0,16	0,16	0,00	1,0	**P**
	38	0,100	0,10	0,10	0,00	1,0	**P**
	39	0,100	0,10	0,10	0,00	1,0	**P**
	40	0,100	0,10	0,10	0,00	1,0	**P**

Measuring range – High end (A15.2.5)

IEC 62586-2 Test No.	Applied harmonic	Applied amplitude [% of I_n]	Reference reading [% of I_n]	EUT reading [% of I_n]	EUT error [% of I_n]	Allowed error [% of I_n]	Result TC150/180 (unc)-harm
S15.2.5	1	100	100,00	100,00	0,00	-	**P**
	2	3,00	3,01	3,00	-0,01	1,0	**P**
	3	6,00	6,00	6,00	0,00	1,0	**P**
	4	1,50	1,01	1,01	0,00	1,0	**P**
	5	8,00	7,99	7,99	0,01	1,0	**P**
	6	1,00	1,01	1,01	0,01	1,0	**P**
	7	7,00	6,99	7,00	0,01	1,0	**P**
	8	1,00	1,00	0,99	-0,01	1,0	**P**
	9	2,50	1,99	1,99	-0,01	1,0	**P**
	10	1,00	1,00	0,99	0,00	1,0	**P**
	11	5,00	4,99	4,99	0,00	1,0	**P**
	12	1,00	1,00	0,99	0,00	1,0	**P**
	13	4,50	3,99	4,00	0,00	1,0	**P**
	14	1,00	1,00	0,99	-0,01	1,0	**P**
	15	2,00	1,99	1,99	0,00	1,0	**P**
	16	1,00	1,00	0,99	-0,01	1,0	**P**
	17	4,00	3,98	3,97	-0,01	1,0	**P**
	18	1,00	1,00	0,99	-0,01	1,0	**P**
	19	3,55	2,98	2,98	0,00	1,0	**P**
	20	1,00	1,00	0,99	-0,01	1,0	**P**
	21	1,75	0,99	0,99	0,00	1,0	**P**
	22	1,00	1,00	0,99	0,00	1,0	**P**
	23	2,85	1,98	1,99	0,00	1,0	**P**
	24	1,00	1,00	0,99	0,00	1,0	**P**
	25	2,55	1,98	1,99	0,01	1,0	**P**
	26	1,00	1,00	0,99	0,00	1,0	**P**
	27	1,00	0,99	0,99	0,01	1,0	**P**
	28	1,00	0,99	0,99	0,00	1,0	**P**
	29	2,15	1,98	1,97	-0,01	1,0	**P**
	30	1,00	1,00	0,99	0,00	1,0	**P**
	31	1,95	0,99	0,99	0,01	1,0	**P**
	32	1,00	1,00	0,99	0,00	1,0	**P**
	33	1,00	0,98	0,97	-0,01	1,0	**P**
	34	1,00	0,99	0,99	0,00	1,0	**P**
	35	1,70	0,98	0,99	0,01	1,0	**P**
	36	1,00	0,99	0,99	0,00	1,0	**P**
	37	1,55	0,98	0,97	-0,01	1,0	**P**
	38	1,00	0,99	0,99	0,00	1,0	**P**
	39	1,00	0,98	0,97	-0,01	1,0	**P**
	40	1,00	0,99	0,99	0,00	1,0	**P**

7.15.2.2 Variations due to single influence quantities

Purpose of the test : Check influence of frequency and current on measurement uncertainty.

Method : A single-phase sinusoidal signal is applied to the EUT and a reference meter. Various influence quantities are being adjusted in order to verify that these do not affect the measurement method. The difference between the EUT and the reference meter are verified to be less than the required uncertainty.

Test criteria	**Description**
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.

IEC 62586-2 Test No.	Influence quantity	Applied harmonic	Amplitude [% of I_n]	REF reading [% of I_n]	EUT reading [% of I_n]	EUT error [% of I_n]	Allowed error [% of I_n]	Result TC150/180 (unc)-harm
S15.3.1 (50 Hz)	Frequency 42,500 Hz	2	5	5,01	5,01	0,00	1,0	**P**
	Frequency 57,500 Hz	50	1	0,98	0,98	0,00	1,0	**P**
S15.3.1 (60 Hz)	Frequency 51,000 Hz	2	5	5,01	5,01	0,00	1,0	**P**
	Frequency 69,000 Hz	50	1	0,97	0,97	0,00	1,0	**P**
S15.3.2	Magnitude 10 % of I_n	3	10	10,06	10,08	0,02	1,0	**P**
	Magnitude 100 % of I_n	3	10	10,00	10,02	0,02	1,0	**P**

7.15.3 Measurement evaluation

Not applicable

7.15.4 Measurement aggregation

7.15.4.1 10/12 cycles with 10 min synchronization

Purpose of the test : Check aggregation overlap 1.

Method : A single phase current is applied at I_{nom} with a 3rd harmonic of 10 % of I_{nom}. The fundamental frequency is such chosen that the 10 minute time tag occurs during 10/12 cycle sequence block number 3000. The time tags of the last 10/12 cycles are reviewed and the sequence number of blocks are verified to be proper resynchronized to the 10 minute tick.

Test criteria
Test the time tag, and the sequence number of blocks for the 3rd harmonic.

IEC 62586-2 Test No.	Applied Frequency	Influenced quantity	Time tags of blocks	Remarks	Result
S15.4.1	49,990 Hz	3rd harmonic 10 % of I_{nom}	16:19:59.723 16:19:59.923 16:20:00.123 16:20:00.203 16:20:00.403	EUT correctly synchronizes at the 10 minute tick	**P**

7.15.4.2 150/180-cycle aggregation with 10 min synchronization

Purpose of the test : Check aggregation overlap 2.

Method : A single phase current with a carrier wave frequency of 50,125 Hz is applied. A 3rd harmonic is added which linearly ramps from 10 % of I_{nom} to 0 % of I_{nom} in 10 seconds, then linearly back to 10 % of I_{nom} in 10 seconds. The aggregation of the 10/12 cycles data into 150/180 cycle interval relative to 10 minute tick is verified to comply.

Test criteria
TC150/180(unc)-harm for the 3rd harmonic, with correct aggregation of the 10/12-cycle values for each of the two overlapping 150/180-cycle aggregation intervals

IEC 62586-2 Test No.	Applied Frequency	Influenced quantity	10/12 cycle to 150/180 cycle aggregation is correct	150/180 synchronization to 10 minute boundary is correct	Result
S15.5.1	50,125 Hz	3rd harmonic Linear ramp	Yes	EUT correctly synchronizes at the 10 minute tick	**P**

7.15.4.3 10 min aggregation

Purpose of the test : Check 10 min aggregation.

Method : A single phase current is applied at I_{nom} with a 3rd harmonic which linearly ramps from 10 % of I_{nom} to 0 % of I_{nom} in 10 seconds, then linearly back to 10 % of I_{nom} in 10 seconds. The frequency of the carrier wave is such chosen that the 10 minute time tag occurs during 10/12 cycle sequence block number 3000. It is verified that the aggregation of 10/12 cycles data into 10 minute tick interval is correctly implemented.

Test criteria
TC10min(unc)-harm for the 3rd harmonic, with correct aggregation of the 10/12-cycle values based on the block sequence numbers.

IEC 62586-2 Test No.	Applied Frequency	Influenced quantity	Calculated 10 minute aggregated value [% of I_{nom}]	Measured 10 minute aggregated value [% of I_{nom}]	Result
S15.6.1	49,990 Hz	3rd harmonic Linear ramp	5,761	5,761	**P**

7.15.4.4 2-h aggregation

Purpose of the test : Check 2-h aggregation

Method : It should be verified that a 2 hour aggregated value is provided for harmonics at every even-numbered 2 hour RTC interval.

IEC 62586-2 Test No.	2-hour aggregation implemented?	New 2-hour value at even-numbered hours?	Result
S15.7.1	Yes	Yes	**P**

7.16 Interharmonic currents

EUT interharmonics measurements conforms to Class S requirements	-----

Interharmonics are not implemented.

When interharmonics are implemented for a class S device, the manufacturer shall specify the method and the accuracy performance. The test will verify the availability of the data and its accuracy according to the manufacturer 's specification.

7.17 Current unbalance

EUT Unbalance measurements conforms to Class S requirements	**P**

IEC 62586-2		Requirement	Remarks	Result for class S
Section	Test No.			
7.17.2	S17.1.1	Unbalance accuracy during small unbalanced currents		**P**
	S17.1.2	Unbalance accuracy during unbalanced currents		**P**
	S17.1.3	Unbalance accuracy during phase displacement		**P**
	S17.1.4	Unbalance accuracy during during low currents		**P**
	S17.1.5	Unbalance accuracy during unbalance and phase displacement		**P**

7.17.2 Measurement method, measurement uncertainty and measuring range

7.17.2.(1) Measurement uncertainty during small unbalanced currents

Purpose of the test : Verify the general accuracy of i_2 and i_0 in the case of small unbalanced signals.

Method : A polyphase unbalanced signal is applied to the EUT. The expected i_0 and i_2 are verified to be 0,10 %.

IEC 62586-2 Test No.	Applied current	Quantity	REF reading [%]	EUT reading [%]	Target [%]	Result
S17.1.1	I_1: 100,2 %; 0,0° I_2: 99,9 %; -120,0° I_3: 99,9 %; 120,0°	i_0	0,10	0,11	0 % < i_0 < 0,55 %	**P**
		i_2	0,10	0,10	0 % < i_2 < 0,55 %	**P**

7.17.2.(2) Measurement uncertainty during unbalanced currents

Purpose of the test : Verify the general accuracy of i_2 and i_0 in the case of unbalanced signals.

Method : A polyphase unbalanced signal is applied to the EUT. The expected i_0 and i_2 are verified to be 5,00 %.

IEC 62586-2 Test No.	Applied current	Quantity	REF reading [%]	EUT reading [%]	Target [%]	Result
S17.1.2	I_1: 110,0 %; 0,0° I_2: 95,0 %; -120,0° I_3: 95,0 %; 120,0°	i_0	5,00	5,00	4,60 % < i_0 < 5,50 %	**P**
		i_2	4,98	5,00	4,60 % < i_0 < 5,50 %	**P**

7.17.2.(3) Unbalance accuracy during phase displacement

Purpose of the test : Verify the general accuracy of i_2 and i_0 during phase displacement.

Method : A polyphase signal is applied to the EUT at 100 % of I_n at all three phases. The phase of L2 and L3 are displaced. The expected i_0 and i_2 are verified to be 17,79 %.

IEC 62586-2 Test No.	Applied current	Quantity	REF reading [%]	EUT reading [%]	Target [%]	Result
S17.1.3	I_1: 100,0 %; 0,0° I_2: 100,0 %; -150,0° I_3: 100,0 %; 90,0°	i_0	17,80	17,76	17,30 % < i_0 < 18,30 %	**P**
		i_2	17,80	17,81	17,30 % < i_0 < 18,30 %	**P**

7.17.2.(4) Measurement uncertainty during low currents

Purpose of the test : Verify the general accuracy of i_2 and i_0 in the case of low current signals.

Method : A polyphase unbalanced signal is applied to the EUT. The expected i_0 and i_2 are verified to be 5,00 %.

IEC 62586-2 Test No.	Applied current	Quantity	REF reading [%]	EUT reading [%]	Target [%]	Result
S17.1.4	I_1: 55,0 %; 0,0° I_2: 47,5 %; -120,0° I_3: 47,5 %; 120,0°	i_0	5,03	5,03	4,50 % < i_0 < 5,50 %	**P**
		i_2	5,02	5,03	4,50 % < i_0 < 5,50 %	**P**

7.17.2.(5) Measurement uncertainty during low currents

Purpose of the test : Verify the general accuracy of i_2 and i_0 during both unbalance and phase displacement

Method : A polyphase unbalanced signal with a phase displacement at L2 and L3 is applied to the EUT. The expected i_0 and i_2 are verified to be 2,00 % and 3,00 % respectively.

IEC 62586-2 Test No.	Applied current	Quantity	REF reading [%]	EUT reading [%]	Target [%]	Result
S17.1.5	I_1: 105,0 %; 0,0° I_2: 97,5 %; -120,5° I_3: 97,5 %; 120,5°	i_0	2,01	2,02	1,50 % < i_0 < 2,50 %	**P**
		i_2	2,98	2,99	2,50 % < i_0 < 3,50 %	**P**

8 Measurement uncertainty and operating uncertainty

EUT measurement uncertainty and operating uncertainty to Class S requirements	-----

IEC 62586-2		Requirement	Remarks	Result for class S
Section	Requirement			
8	Calculation 1	Measurement uncertainty		-----
	Calculation 2	Operating uncertainty *(within the range 0°C to +45°C)*		-----
	Calculation 3	Operating uncertainty *(outside the range 0°C to +45°C and within the rated range of operation)*		-----

Annex 4: Reference equipment and uncertainty

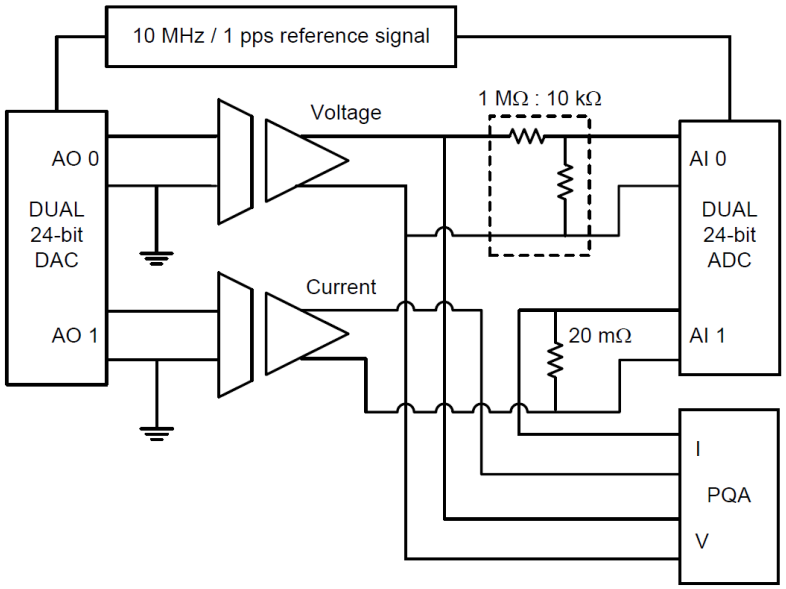
Reference equipment used for the test

PQ reference system (used for testing IEC 62586-2)

Description	Manufacturer	Type	Serial No.
Digitizer	National Instruments	PXI-4461 (3x)	1742EB2 185072 185072
Voltage divider	VSL	-	ML1502019
Shunt	SIQ	MU-1A (3x)	15003 15004 15005
Shunt	SIQ	MU-5A (3x)	15006 15007 17007
Shunt	SIQ	MU-20A (3x)	15009 15010 15011

The test results have been obtained using a power quality reference system that consists of a source to generate the test signals and a meter that simultaneously measures the generated signals. The meter is a combination of current shunts with digitizers and voltage dividers with digitizers for determining the current and voltage signals, respectively. The meter is calibrated every year under RvA accreditation with reference number K999 and traceable to primary and/or (inter)nationally accepted measurement standards.

Schematic overview of the calibration system. In reality, it is a 3-phase system.



Uncertainty

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, which provides a confidence level of approximately 95%.

Measurand	Nominal value	Frequency	Uncertainty (k=2)	Remarks
Frequency	40 Hz – 70 Hz	n.a.	0,000 01 Hz	
Voltage	(0 – 500) V	50 Hz / 60 Hz	(0,02 – 0,06) V	
Voltage fluctuations (flicker)	(0,01 – 10) %	50 Hz / 60 Hz	(0,001 – 0,003) %	10 mHz – 40 Hz modulation; P_{st} 0,2 to 10 (IEC 61000-4-15)
Voltage unbalance	(0 – 100) %	50 Hz / 60 Hz	0,03 %	
Harmonics / interharmonics voltage	(0.1 – 250) V	(40 – 5000) Hz	(0,01 – 0.03) V	
THD	(0,01 – 1000) %	(40 – 5000) Hz	(0,001 – 0,02) %	Voltage or current
Timebase	1 s – 1 week	50 Hz / 60 Hz	5 ms	Time stamp difference
Current	10 mA – 20 A	50 Hz / 60 Hz	(0,1 – 2) mA	
Harmonics / interharmonics current	1 mA – 20 A	(40 – 5000) Hz	(0,1 – 2) mA	
THD	(0,01 – 1000) %	(40 – 5000) Hz	(0,001 – 0,02) %	Voltage or current