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# IEC 61000-4-30 Edition 2 Power Quality Measurement Methods Compliance Report

ISKRA SISTEMI  
MC774

$U_{\text{din}}$ : 230 V, 50/60 Hz



*June 2013 – July 2013*

**Summary of Results**  
**ISKRA SISTEMI MC774**  
**IEC 61000-4-30 compliance**  
**when equipped with the following accessories or options:**  
**Compatible GPS receiver or NTP server**

Table 1: Summary of Results  
 at 230 V L-N  $U_{din}$  (equivalent to 400 L-L  $V_{rms}$ ), 50/60 Hz

61000-4-30 Section	Power Quality Parameter	Class A Compliance	Class S Compliance	Class B Compliance	Remarks
5.1	Power frequency	Yes	Yes	Yes	
5.2	Magnitude of the supply voltage	Yes	Yes	Yes	
5.3	Flicker	Yes	Yes	(N/A)	
5.4	Supply voltage dips and swells	Yes	Yes	Yes	
5.5	Voltage interruptions	Yes	Yes	Yes	
5.7	Supply voltage unbalance	Yes	Yes	Yes	
5.8	Voltage harmonics	Yes	Yes	Yes	
5.9	Voltage interharmonics	Yes	Yes	Yes	
5.10	Mains signaling voltage	Yes	Yes	Yes	
5.12	Underdeviation and overdeviation	Yes	(N/A)	(N/A)	
4.4	Measurement aggregation intervals	Yes	Yes	Yes	
4.6	Time-clock uncertainty	Yes	Yes	Yes	Tested using NTP server
4.7	Flagging	Yes	Yes	(N/A)	
6.1	Transient influence quantities	Yes	(N/A)	(N/A)	

(N/A) – Not Applicable. There is no requirement in the Standard.

Signed: 

Alex McEachern  
 President, Power Standards Lab  
 30 July 2013

Signed: 

Thomas Pua  
 Test Engineer, Power Standards Lab  
 30 July 2013

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## Equipment under Test

EUT Manufacturer: ISKRA SISTEMI  
EUT Model: MC774  
EUT S/N: MC015976, MC015975  
EUT Firmware version: MC774 .FL2: 1.0.1  
EUT Software version: Quality Meter Logger v.1.0.0.5 (5/23/2013)  
MiQen2.1 v.0.1.0.10 (5/14/2013)  
Operating mode: Wye/Star

Accessories included in test:

Required from Client:

- Two samples of EUT, with all necessary accessories, manuals in English, specifications, etc. PSL provides electric power signals only. Client must provide all other supplies, signals, materials, support equipment, antennas, etc.
- A designated technical contact who can answer technical questions in English and give detailed guidance on the use of the EUT.
  - Technical contact(s): Janez Humar  
janez.humar@iskra-mis.si
- Selection of parameters to be evaluated, expected class for each parameter, and expected range of  $U_{din}$  for each parameter. Select from the following list:
  - Frequency
  - magnitude of supply voltage
  - flicker Pst
  - voltage dip and swell depth
  - voltage dip and swell duration
  - voltage interruption duration
  - voltage unbalance (or positive, negative, and zero sequence)
  - voltage harmonic amplitude
  - voltage interharmonic amplitude
  - Mains Signaling
  - Underdeviation and Overdeviation
- Immediate visible viewing of all values of parameters to be evaluated. Unless other arrangements are made, EUT will be evaluated on readings shown on user interface, and not on internally stored data.



Photo 1: Equipment Under Test (EUT)

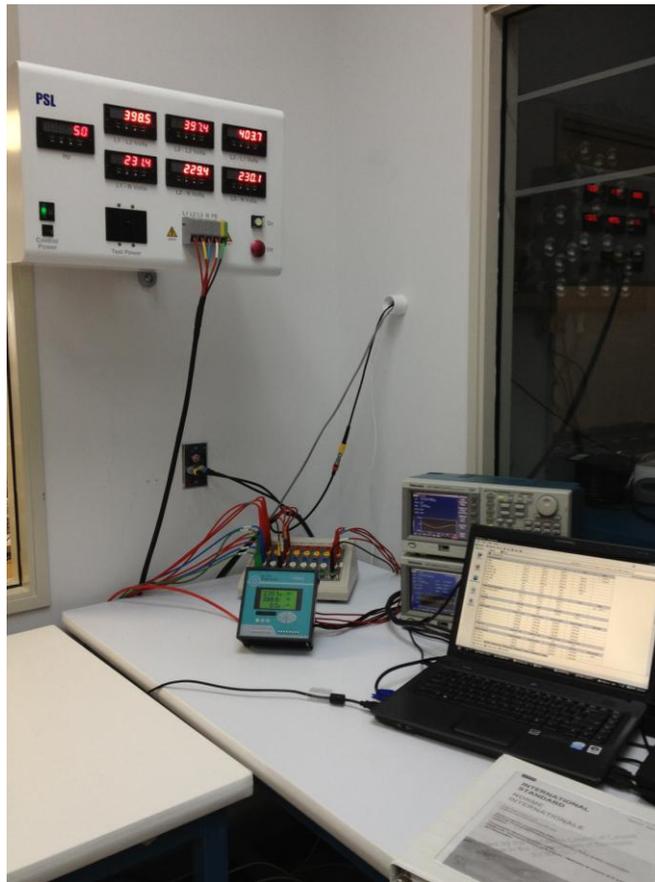
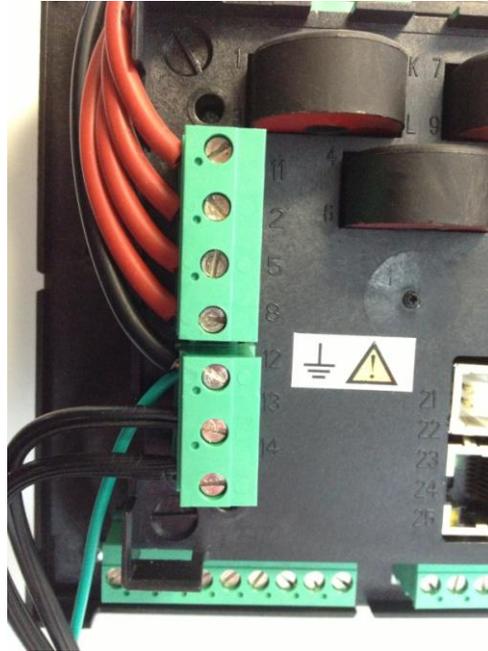
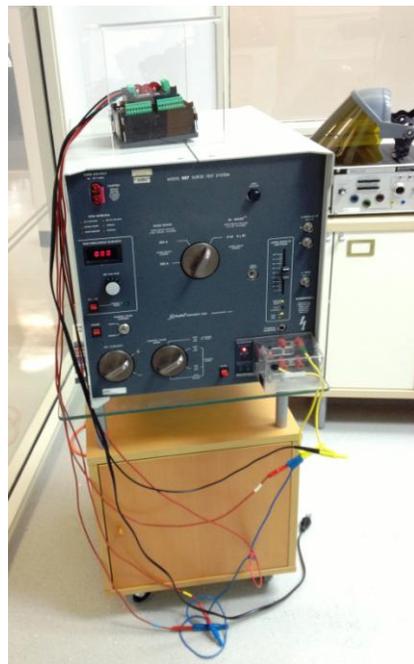


Photo 2: EUT in Test Environment



*Photo 3: EUT sense connections*



*Photo 4: EUT – 6kV Surge Test*

## Test standard

IEC 61000-4-30 ed.2.0 2008-10 © IEC:2008

## Other required standards

61000-4-30 cites values and requirements from the following standards:

IEC 61000-4-15 ed.2.0 2010-08 © IEC:2010 (Flickermeter)

IEC 61000-4-7 ed.2.0 2002-08 © IEC:2002 (harmonics and interharmonics)

IEC 61000-2-4 ed 1.0 1994-02 © IEC:2002 (compatibility levels)

## Test parameters

Test location: Power Standards Lab, Alameda, California, U.S.A.

Test dates: March 2011 – April 2011

Supervising engineer: A. McEachern

Other participants: J. Correa, T. Pua

## Basic EUT specifications for test

Rated maximum RMS input voltage: For 61000-4-30 purposes, this EUT is only rated for  $U_{din} = 230V$ , 50/60 Hz. This is equivalent to max RMS = 345V, 50/60 Hz

Maximum 61000-4-30  $U_{din}$ : 230V L-N for Class A<sup>1</sup>

$U_{din}$  selected by PSL for this report:  **$U_{din} = 230 V_{rms}$  at  $F_{nom} = 50/60 Hz$**

Rated operating temperature range: -10 – +55°C

Rated storing temperature range: -40 – +70°C

Rated frequency range: 16 – 400 Hz

Reference channel<sup>2</sup>: Channel 1 Voltage

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<sup>1</sup> See IEC 61000-4-30, 6.1, Table 1, line 2 “Voltage magnitude (steady-state)”. For Class A, maximum  $U_{din}$  is 66.7% of rated max input voltage.

<sup>2</sup> See IEC 61000-4-30, 3.24

## 5.1 Power Frequency

### Summary of 5.1 Power Frequency Conformance Results

<b>Power frequency measurements conform to Class A requirements</b>	<b>Yes</b>
<b>Power frequency measurements conform to Class S requirements</b>	<b>Yes</b>
<b>Power frequency measurements conform to Class B requirements</b>	<b>Yes</b>

Table 5.1 Class A – Summary of Power Frequency Results

	<b>61000-4-30 section</b>	<b>Power frequency requirement</b>	<b>EUT conforms to Class A</b>	<b>Remarks</b>
Engineering review	Table 1 Line 1	EUT specifications meet required range for frequency	Yes	User manual, page 145
PSL Test 5.1(a)	¶5.1.2, Paragraph 1, Sentence 1	General accuracy	Yes	Pass
PSL Test 5.1.1(b)	¶5.1.1, Paragraph 1, Sentence 1	10-second interval	Yes	Pass
PSL Test 5.1.1(c)	¶5.1.1, Paragraph 2, Sentence 2	Synchronized to an absolute 10-second clock	Yes	Pass
PSL Test 5.1.1(d)	¶5.1.1, Paragraph 1, Sentence 4	Harmonics and interharmonics are attenuated	Yes	Pass
PSL Test 5.1.2(a)	¶6.2.1	Verify accuracy over range of influence quantities	Yes	Pass

Table 5.1 Class S – Summary of Power Frequency Results

	<b>61000-4-30 section</b>	<b>Power frequency requirement</b>	<b>EUT conforms to Class S</b>	<b>Remarks</b>
Engineering review	Table 1 Line 1	EUT specifications meet required range for frequency	Yes	User manual, page 145
PSL Test 5.1(a)	¶5.1.2, Paragraph 1, Sentence 1	General accuracy	Yes	Pass
PSL Test 5.1.1(b)	¶5.1.1, Paragraph 1, Sentence 1	10-second interval	Yes	Pass
PSL Test 5.1.1(c)	¶5.1.1, Paragraph 2, Sentence 2	Synchronized to an absolute 10-second clock	Yes	Pass
PSL Test 5.1.1(d)	¶5.1.1, Paragraph 1, Sentence 4	Harmonics and interharmonics are attenuated	Yes	Pass
PSL Test 5.1.2(a)	¶6.2.1	Verify accuracy over range of influence quantities	Yes	Pass

**Table 5.1 Class B – Summary of Power Frequency Results**

	<b>61000-4-30 section</b>	<b>Power frequency requirement</b>	<b>EUT conforms to Class B</b>	<b>Remarks</b>
Engineering review	Table 2 Line 1	EUT specifications meet required range for frequency	Yes	User manual, page 145
PSL Test 5.1(a)	¶5.1.2, Paragraph 2, Sentence 1	General accuracy	Yes	Pass
Engineering review	¶5.1.2, Paragraph 2, Sentence 1	Manufacturer shall specify frequency uncertainty	Yes	Pass
Engineering review	¶5.1.3, Paragraph 2, Sentence 1	Manufacturer shall indicate process used for frequency measurement	Yes	Pass

## PSL Test Suite 5.1: Frequency

### PSL Test 5.1(a) – Simple steady-state frequency measurement

*Purpose of test: Verifies general steady-state frequency accuracy. Verifies that we know how to make frequency measurements with the EUT. Test is single-phase, applied to EUT reference channel. Voltage is sinusoidal, approx  $V_{din}$ .*

Table 5.1(a)

Applied frequency Hz	Voltage applied $V_{rms}$	Ambient temperature °C	EUT frequency reading Hz	Error Hz <sup>1</sup>	Remarks
50.0000	230 V	22 °C	50.000	0.00	Pass
60.0000	230 V	22 °C	60.000	0.00	Pass
43.0000	230 V	22 °C	43.000	0.00	Pass
68.5000	230 V	22 °C	68.500	0.00	Pass
55.0000	230 V	22 °C	55.000	0.00	Pass

<sup>1</sup> Rounded to closest 0.001 Hz. Includes error of EUT plus error of PSL test equipment: ±0.0001 Hz

### PSL Test 5.1.1(b) – Verify 10-second averaging interval for frequency measurement

*Purpose of test: Verifies “The frequency reading shall be obtained every 10-s.” Test is single-phase, applied to EUT reference channel. Because this test does not require precision frequency measurements from the EUT, temperature and voltage are non-critical. Voltage is proprietary series of sinusoidal waveforms, approx  $U_{din}$ . Ambient temperature approx 21°C.*

Table 5.1.1(b)

Applied waveform	Applied frequency	Remarks	Result
PSL511b1.csv	Varying	Verifies that frequency averaging interval is an integer multiple of 10 seconds.	Pass
PSL511b2.csv	Varying	Verifies that frequency averaging interval is shorter than 20 seconds.	Pass

**PSL Test 5.1.1(c) – Verify 10-second averaging interval for frequency measurement begins on absolute 10-s time clock**

*Purpose of test: Verifies “Each 10-s interval shall begin on an absolute 10-s time clock...” Test is single-phase, applied to EUT reference channel. Because this test does not require precision frequency measurements from the EUT, temperature and voltage are non-critical. Proprietary voltage waveform is sinusoidal, varying frequency synchronized to absolute time. Amplitude approx  $U_{din}$ . Ambient temperature approx 21°C.*

*NOTE: This test is performed only if EUT conforms to Class A requirements in PSL Test 5.1.1(b).*

Table 5.1.1(c)

Applied waveform	Applied frequency	Remarks	Result
PSL511c1.csv	Varying	Verifying that frequency averaging interval is synchronized to an absolute 10-second clock	Pass

**PSL Test 5.1.1(d) – Verify harmonics do not affect frequency measurement**

*Purpose of test: Verifies “Before each assessment, harmonics and interharmonics shall be attenuated to minimize the effects of multiple zero-crossings.” Test is single-phase, applied to EUT reference channel. Non-standard fundamental frequency is used to detect snap-to-standard-frequency algorithms. Temperature and voltage are non-critical. Proprietary voltage waveforms are non-sinusoidal, RMS value is approx  $U_{din}$ . Ambient temperature approx 21°C.*

Table 5.1.1(d)

Applied waveform	Applied fundamental frequency Hz	EUT frequency reading Hz	Remarks	Result
PSL511d1.csv	55.137	55.137	Additional zero-crossings: Low-amplitude high-frequency	Pass
PSL511d2.csv	55.137	55.137	Additional zero-crossings: high-amplitude high-frequency	Pass
PSL511d3.csv	55.137	55.137	Additional zero-crossings: low-amplitude low-frequency	Pass
PSL511d4.csv	55.137	55.137	Additional zero-crossings: high-amplitude low-frequency	Pass

**PSL Test 5.1.2(a) – Verify frequency uncertainty over range of influence quantities**

*Purpose of test: Verifies frequency measurement according to Table 2, IEC 61000-4-30, Section 6.2. “Over the range of influence quantities, and under the conditions described in 6.1, the measurement uncertainty...” Checks frequency measurements with distorted voltages, flicker, and other influence quantities. Voltage is non-sinusoidal, RMS value varies. Ambient temperature approx 21°C.*

*NOTE: This test is performed only if EUT conforms to Class A requirements in PSL Test 5.1.1(b).*

Table 5.1.2(a)

Applied waveform	Applied fundamental frequency Hz	Applied waveform definition	EUT frequency reading Hz	Error / Remarks
PSL512a1.csv	42.500	Table 2 Testing State 1	42.500	Pass
PSL512a2.csv	46.250	Table 2 Testing State 1	46.250	Pass
PSL512a3.csv	50.000	Table 2 Testing State 1	50.000	Pass
PSL512a4.csv	53.750	Table 2 Testing State 1	53.750	Pass
PSL512a5.csv	57.500	Table 2 Testing State 1	57.500	Pass
PSL512a6.csv	42.500	Table 2 Testing State 2	42.500	Pass
PSL512a7.csv	46.250	Table 2 Testing State 2	46.250	Pass
PSL512a8.csv	50.000	Table 2 Testing State 2	50.000	Pass
PSL512a9.csv	53.750	Table 2 Testing State 2	53.750	Pass
PSL512a10.csv	57.500	Table 2 Testing State 2	57.500	Pass
PSL512a11.csv	42.500	Table 2 Testing State 3	42.499	Pass
PSL512a12.csv	46.250	Table 2 Testing State 3	46.250	Pass
PSL512a13.csv	50.000	Table 2 Testing State 3	50.000	Pass
PSL512a14.csv	53.750	Table 2 Testing State 3	53.750	Pass
PSL512a15.csv	57.500	Table 2 Testing State 3	57.500	Pass

NOTE: For Testing State 3, and only for Testing State 3,  $U_{din}$  is set to  $170 V_{rms}$  due to limitations in PSL's power amplifier. This corresponds to a worst-case voltage of approximately  $306 V_{rms}$  L-N, and  $530 V_{rms}$  L-L.

## 5.2 Magnitude of the Supply Voltage

### Summary of 5.2 Magnitude of the Supply Voltage Conformance Results

<b>Magnitude of the supply voltage measurements conform to Class A requirements</b>	<b>Yes</b>
<b>Magnitude of the supply voltage measurements conform to Class S requirements</b>	<b>Yes</b>
<b>Magnitude of the supply voltage measurements conform to Class B requirements</b>	<b>Yes</b>

Table 5.2 Class A – Summary of Magnitude of the Supply Voltage Results

	<b>61000-4-30 section</b>	<b>Magnitude of the supply voltage requirement</b>	<b>EUT conforms to Class A</b>	<b>Remarks</b>
Engineering review	Table 1 Line 2	EUT specifications meet required range for voltage magnitude	Yes	User manual, page 143
PSL Test 5.2.1 (a)	none	Simple voltage magnitude measurement	Yes	Pass
PSL Test 5.2.1 (b)	¶5.2.1, Paragraph 1, Sentence 1	True RMS	Yes	Pass
PSL Test 5.2.1(c)	¶5.2.1, Paragraph 1, Sentence 1	10/12-cycle RMS interval	Yes	Pass
PSL Test 5.2.1(d)	¶5.2.1, Paragraph 1, Sentence 1	Contiguous non-overlapping intervals	Yes	Pass
Engineering review	¶5.2.2, Paragraph 1, Sentence 1	$\pm 0,1\%$ of $U_{din}$ uncertainty according to specifications	Yes	Pass
PSL Test 5.2.2(b)	¶6.2.1	$\pm 0,1\%$ of $U_{din}$ uncertainty over range of influence quantities	Yes	Pass
PSL Test 5.2.3(a)	¶5.2.3, Paragraph 1, Sentence 1	Aggregation conforming to ¶4.5 shall be used	Yes	Pass

Table 5.2 Class S – Summary of Magnitude of the Supply Voltage Results

	61000-4-30 section	Magnitude of the supply voltage requirement	EUT conforms to Class S	Remarks
Engineering review	Table 1 Line 2	EUT specifications meet required range for voltage magnitude	Yes	User manual, page 143
PSL Test 5.2.1 (a)	none	Simple voltage magnitude measurement	Yes	Pass
PSL Test 5.2.1 (b)	¶5.2.1, Paragraph 1, Sentence 1	True RMS	Yes	Pass
PSL Test 5.2.1(c)	¶5.2.1, Paragraph 1, Sentence 1	10/12-cycle RMS interval	Yes	Pass
PSL Test 5.2.1(d)	¶5.2.1, Paragraph 1, Sentence 1	Contiguous non-overlapping intervals	Yes	Pass
Engineering review	¶5.2.2, Paragraph 1, Sentence 1	$\pm 0,5\%$ of $U_{din}$ uncertainty according to specifications	Yes	Pass
PSL Test 5.2.2(b)	¶6.2.1	$\pm 0,5\%$ of $U_{din}$ uncertainty over range of influence quantities	Yes	Pass
PSL Test 5.2.3(a)	¶5.2.3, Paragraph 1, Sentence 1	Aggregation conforming to ¶4.5 shall be used	Yes	Pass

Table 5.2 Class B – Summary of Magnitude of the Supply Voltage Results

	61000-4-30 section	Magnitude of the supply voltage requirement	EUT conforms to Class B	Remarks
Engineering review	Table 2 Line 2	EUT specifications meet required range for voltage magnitude	Yes	User manual, page 143
PSL Test 5.2.1 (a)	none	Simple voltage magnitude measurement	Yes	Pass
PSL Test 5.2.1(b)	¶5.2.1, Paragraph 2, Sentence 1	True RMS	Yes	Pass
Engineering review	¶5.2.1, Paragraph 2, Sentence 1	Manufacturer shall specify the RMS period	Yes	Pass
Engineering review	¶5.2.2, Paragraph 2, Sentence 1	Manufacturer shall specify the uncertainty, which shall not exceed $\pm 1\%$ of $U_{din}$	Yes	Pass
PSL Test 5.2.2(b)	¶5.2.2 and ¶6.1	$\pm 1\%$ of $U_{din}$ uncertainty	Yes	Pass
PSL Test 5.2.3(a)	¶5.2.3, Paragraph 2, Sentence 1	Manufacturer shall specify the aggregation process	Yes	Pass

## PSL Test Suite 5.2: Magnitude of the Supply

### PSL Test 5.2.1(a) – Simple voltage magnitude measurement

*Purpose of test: Verifies general steady-state RMS magnitude accuracy. Verifies that we know how to make magnitude measurements with the EUT. Test is single-phase, applied to EUT reference channel. Voltage is sinusoidal.*

Table 5.2.1(a)

Applied frequency Hz	Applied $V_{rms}$	Ambient temperature °C	EUT voltage reading $V_{rms}$	Error $V_{rms}$ <sup>1</sup>	Remarks
50.0000	230.10	22 °C	230.2	0.04	Pass
60.0000	230.81	22 °C	230.9	0.04	Pass

<sup>1</sup> Rounded to closest 0.01 Volts. Includes error of EUT plus error of PSL test equipment: ±0.01  $V_{rms}$

### PSL Test 5.2.1(b) – Verify true RMS measurements

*Purpose of test: Verifies “The measurement shall be the r.m.s. value ....” Test is single-phase, applied to EUT reference channel. Voltage is proprietary series of non-sinusoidal waveforms, approx  $U_{din}$ . Ambient temperature approx 21°C.*

Table 5.2.1(b)

Applied waveform	Applied $V_{rms}$ , frequency	EUT voltage reading $V_{rms}$	Remarks	Result
PSL521b1.csv	245.44 $V_{rms}$ , 50Hz	245.5 $V_{rms}$ , 50.000Hz	Verifies that EUT is using <u>true</u> RMS measurement method	Pass
PSL521b2.csv	246.27 $V_{rms}$ , 60.00Hz	246.4 $V_{rms}$ , 60.000Hz	Verifies that EUT is using <u>true</u> RMS measurement method	Pass

### PSL Test 5.2.1(c) – Verify 10/12 cycle RMS interval

*Purpose of test: Verifies “The measurement shall be ... over a 10-cycle time interval for 50 Hz power system or 12-cycle time interval for 60 Hz power system.” Test is single-phase, applied to EUT reference channel. Proprietary voltage waveform is sinusoidal, varying amplitude. Amplitude ranges around  $U_{din}$ . Ambient temperature approx 21°C.*

*NOTE: This test is performed only if EUT conforms to Class A requirements in PSL Test 5.2.1(b).*

Table 5.2.1(c)

Applied waveform	Applied $V_{rms}$ , frequency	Remarks	Result
PSL521c1.csv	Varying, 50 Hz	Verifies that EUT is measuring RMS voltage over an integer multiple of 10 cycles	Pass
PSL521c2.csv	Varying, 50 Hz	Verifies that EUT is measuring RMS voltage over fewer than 20 cycles	Pass
PSL521c3.csv	Varying, 60 Hz	Verifies that EUT is measuring RMS voltage over an integer multiple of 12 cycles	Pass Note: Frequency needs to be changed from MiQen Software under Power supply quality section
PSL521c4.csv	Varying, 60 Hz	Verifies that EUT is measuring RMS voltage over fewer than 24 cycles	Pass Note: Frequency needs to be changed from MiQen Software under Power supply quality section

**PSL Test 5.2.1(d) – Verify contiguous non-overlapping RMS intervals**

*Purpose of test: Verifies “Every 10/12-cycle interval shall be contiguous with, and not overlap, adjacent 10/12 cycle intervals.” Test is single-phase, applied to EUT reference channel. Proprietary voltage waveforms are sinusoidal, varying amplitude. Amplitude ranges around  $U_{din}$ . Ambient temperature approx 21°C.*

*NOTE: This test is performed only if EUT conforms to Class A requirements in PSL Test 5.2.1(c).*

Table 5.2.1(d)

Applied waveform	Applied $V_{rms}$ , frequency	Remarks	Result
PSL521d1.csv	Varying, 50 Hz	Verifies that EUT is measuring RMS voltage over contiguous 10-cycle intervals	Pass
PSL521d2.csv	Varying, 50 Hz	Verifies that EUT is measuring RMS voltage over non-overlapping 10-cycle intervals	Pass

**PSL Test 5.2.2(a) – Verify required accuracy specification – magnitude of supply voltage measurements**

*Purpose of test: Verifies “...the measurement uncertainty shall not exceed  $\pm 0,1\%$  of  $U_{din}$ .” For this test, we examine the published specifications to determine if they meet this requirement. Note that  $U_{din}$  never exceeds 50% of EUT full scale.*

Table 5.2.2(a)

Published accuracy specification	Translated specification to percent of $U_{din}$	Remarks	Result
$\pm 0.1\% U_{din}$	$\pm 0.1\% U_{din}$		Pass

**PSL Test 5.2.2(b) – Verify magnitude of supply voltage uncertainty over range of influence quantities**

*Purpose of test: Verifies magnitude of supply measurement according to Table 2, IEC 61000-4-30, Section 6.2 . “Over the range of influence quantities, and under the conditions described in 6.1, the measurement uncertainty...” Checks voltage magnitude measurements with distorted voltages, flicker, and other influence quantities. Voltage is non-sinusoidal, RMS value varies. Ambient temperature approx 21°C. NOTE: Unbalance influence quantity does not apply. NOTE: This test is performed only if EUT conforms to Class A requirements in PSL Test 5.2.2(a).*

Table 5.2.2(b) with  $U_{din} = 230\text{ V}$

Applied waveform	Applied RMS voltage % $U_{din}$	Applied waveform definition	Reference meter reading RMS volts	EUT 10-cycle reading RMS volts	Error / Remarks
PSL522b1.csv	10%	Table 2 Testing State 1	22.85V	22.85V	Pass
PSL522b2.csv	45%	Table 2 Testing State 1	103.12V	103.1V	Pass
PSL522b3.csv	80%	Table 2 Testing State 1	183.86V	183.9V	Pass
PSL522b4.csv	115%	Table 2 Testing State 1	264.76V	264.8V	Pass
PSL522b5.csv	150%	Table 2 Testing State 1	345.84V	346.0V	Pass
PSL522b6.csv	10%	Table 2 Testing State 2	36.98V	36.9V	Pass
PSL522b7.csv	45%	Table 2 Testing State 2	107.00V	106.95V	Pass
PSL522b8.csv	80%	Table 2 Testing State 2	185.96V	185.85V	Pass
PSL522b9.csv	115%	Table 2 Testing State 2	266.12V	266.2V	Pass
PSL522b10.csv	150%	Table 2 Testing State 2	346.80V	346.85V	Pass
PSL522b11.csv	10%	Table 2 Testing State 3	27.58V	27.5V	Pass
PSL522b12.csv	45%	Table 2 Testing State 3	79.24V	79.2V	Pass
PSL522b13.csv	80%	Table 2 Testing State 3	137.48V	137.5V	Pass
PSL522b14.csv	115%	Table 2 Testing State 3	196.67V	196.7V	Pass
PSL522b15.csv	150%	Table 2 Testing State 3	256.19V	256.3V	Pass

NOTE: For Testing State 3, and only for Testing State 3,  $U_{din}$  is set to  $170\text{ V}_{rms}$  due to limitations in PSL’s power amplifier. This corresponds to a worst-case voltage of approximately  $306\text{ V}_{rms}$  L-N, and  $530\text{ V}_{rms}$  L-L.

**PSL Test 5.2.3(a) – Verify aggregation method –magnitude of supply voltage measurements**

*Purpose of test: Verifies “Aggregation intervals as described in 4.5 shall be used.” For this test, we examine the published specifications to determine if they meet this requirement. Note that  $U_{din}$  never exceeds 50% of EUT full scale.*

Table 5.2.3(a)

Aggregation interval	Verification	Remarks	Result
150/180 cycle interval	PSL523a1.csv		Pass
10 minute interval, absolute 10-min boundary	PSL523a2.csv		Pass
2-hour interval	PSL523a3.csv		Pass

## 5.3 Flicker

### Summary of 5.3 Flicker Conformance Results

<b>Flicker measurements conform to Class A requirements</b>	<b>Yes</b>
<b>Flicker measurements conform to Class S requirements</b>	<b>Yes</b>
<b>(Class B does not apply to Flicker measurements)</b>	<b>-</b>

*Per IEC 61000-4-30 5.3.1, all tests were performed with reference to IEC 61000-4-15 (Ed 2)*

Lamp response specification for this series of tests: 230 V, 50/60 Hz

Table 5.3 Class A – Summary of Flicker Results

	<b>61000-4-30 section</b>	<b>Flicker requirement</b>	<b>EUT conforms to Class A</b>	<b>Remarks</b>
Engineering review	¶5.3.3, and IEC61000-4-15, ¶3.6.6, ¶3.6.7	Verify Pst, Plt, Pinst values are available	Yes	Pass
Engineering review	Table 1 Line 3	EUT specifications meet required range for flicker	Yes	User manual, page 143
PSL Test 5.3(a)	IEC 61000-4-15, ¶5, Table 5, Line 4	Simple Pst flicker measurement	Yes	Pass
PSL Test 5.3(b)	IEC 61000-4-15, ¶5, Table 5	Test specification with Pst = 1, rectangular	Yes	Pass
PSL Test 5.3(c)	IEC 61000-4-15, ¶5, Sentence 5	Test specification with Pst = 4 and 20, rectangular	Yes	Pass
PSL Test 5.3(d)	IEC 61000-4-15, ¶4.10.2	Plt aggregation	Yes	Pass
PSL Test 5.3(e)	IEC 61000-4-30 ¶6.2	Measurement uncertainty over range of influence quantities	Yes	Pass

Note: IEC 61000-4-15 Ed. 2 is referenced in the table above, due to IEC 61000-4-30 ¶ 5.3.1.

**Table 5.3 Class S – Summary of Flicker Results**

	<b>61000-4-30 section</b>	<b>Flicker requirement</b>	<b>EUT conforms to Class S</b>	<b>Remarks</b>
Engineering review	¶5.3.3, and IEC61000-4-15, ¶3.6.6, ¶3.6.7	Verify Pst, Plt, Pinst values are available	Yes	Pass
Engineering review	Table 1 Line 3	EUT specifications meet required range for flicker	Yes	User manual, page 143
PSL Test 5.3(a)	IEC 61000-4-15, ¶5, Table 5, Line 4	Simple Pst flicker measurement	Yes	Pass
PSL Test 5.3(b)	IEC 61000-4-15, ¶5, Table 5	Test specification with Pst = 1, rectangular	Yes	Pass
PSL Test 5.3(c)	IEC 61000-4-15, ¶5, Sentence 5	Test specification with Pst = 4 and 20, rectangular	Yes	Pass
PSL Test 5.3(d)	IEC 61000-4-15, ¶4.10.2	Plt aggregation	Yes	Pass
PSL Test 5.3(e)	IEC 61000-4-30 ¶6.2	Measurement uncertainty over range of influence quantities	Yes	Pass

Note: IEC 61000-4-15 Ed. 2 is referenced in the table above, due to IEC 61000-4-30 ¶ 5.3.1.

(There is no Class B for Flicker.)

## PSL Test Suite 5.3: Flicker

### PSL Test 5.3(a) – Simple flicker measurement

*Purpose of test: Verifies general steady-state flicker accuracy. Verifies that we know how to make flicker measurements with the EUT. Test is single-phase, applied to EUT reference channel. Voltage is sinusoidal, with varying amplitude.*

Table 5.3(a)

Applied waveform	Pst value applied	EUT measured Pst	Remarks
PSL53a1.csv	0.04	0.04	Pass
PSL53a2.csv	0.99	0.96	Pass

### PSL Test 5.3(b) – Verify flicker Pst=1.0 accuracy

*Purpose of test: Verifies the measured value of Pst according to Table 5 of IEC 61000-4-15. Applied waveforms are sinusoidal, Vdin nominal, 50/60 Hz. Rectangular modulation. Pass/fail criteria is ±5% of Pst reading.*

Table 5.3(b)

Applied waveform	Applied Pst	EUT Pst reading	Remarks	Result
PSL53b1.csv	1.00	1.02	1 change per minute	Pass
PSL53b2.csv	1.00	1.03	2 changes per minute.	Pass
PSL53b3.csv	1.00	1.03	7 changes per minute.	Pass
PSL53b4.csv	1.00	1.02	39 changes per minute.	Pass
PSL53b5.csv	1.00	1.00	110 changes per minute.	Pass
PSL53b6.csv	1.00	0.99	1620 changes per minute.	Pass
PSL53b7.csv	1.00	0.96	4000 changes per minute. This test only applies to 50 Hz.	Pass
PSL53b8.csv	-	-	4800 changes per minute. N/A because this particular test only applies to 60 Hz.	-

NOTE: For all flicker measurement verification, the applied Pst is determined by measuring the two applied RMS voltages with the reference meter, and relying on the signal generators for the modulation (flicker) frequency, which is set with a resolution of 0.002 Hz.

**PSL Test 5.3(c) – Verify flicker Pst=0.2 through Pst=10.0 accuracy**

*Purpose of test: Verifies the measured value of Pst according to paragraphs following Table 5 of IEC 61000-4-15. Applied waveforms are sinusoidal, V<sub>din</sub> nominal, 50/60 Hz. Rectangular modulation, 7 changes per minute. Max Pst=10 is chosen based on IEC 61000-4-30 Section 5.3.2. Pass/fail criteria is  $\pm 5\%$  of reading, based on 61000-4-15, Section 5, paragraph 3.*

Table 5.3(c)

Applied waveform	Applied Pst	EUT Pst reading	Remarks	Result
PSL53c1.csv	0.20	0.2		Pass
PSL53c2.csv	3.00	3.1		Pass
PSL53c3.csv	5.98	6.19		Pass
PSL53c4.csv	9.94	10.21		Pass

**PSL Test 5.3(d) – Verify flicker Plt aggregation**

*Purpose of test: Verifies the aggregation value of Plt according to 4.10.2 of IEC 61000-4-15. Applied waveforms are sinusoidal, Vdin nominal, 50/60 Hz.*

Table 5.3(d)

Applied waveform	Applied Plt	EUT Plt reading	Remarks	Result
PSL53d1.csv	0.982	1.00		Pass

**PSL Test 5.3(e) – Verify flicker uncertainty over range of influence quantities**

*Purpose of test: Verifies flicker measurement according to Table 2, IEC 61000-4-30, Section 6.2 . “Over the range of influence quantities, and under the conditions described in 6.1, the measurement uncertainty...” Checks flicker measurements with distorted voltages, and other influence quantities. Voltage is non-sinusoidal, RMS value varies. Ambient temperature approx 21°C.*

*NOTE: This test is performed only if EUT conforms to Class A requirements in PSL Test 5.3(a) through 5.3(d). All Applied Pst Flicker values are tested at 39 changes per minute, as multiples of Line 4 of Table 5 of 61000-4-15.*

Table 5.3(e)

Applied waveform	Applied Pst flicker	Applied flicker definition	EUT Pst flicker	Error / Remarks
PSL53e1.csv	0.20	Table 2 Testing State 1	0.20	Pass
PSL53e2.csv	2.50	Table 2 Testing State 1	2.55	Pass
PSL53e3.csv	4.99	Table 2 Testing State 1	5.10	Pass
PSL53e4.csv	7.48	Table 2 Testing State 1	7.70	Pass
PSL53e5.csv	9.97	Table 2 Testing State 1	10.20	Pass
PSL53e6.csv	0.21	Table 2 Testing State 2	0.21	Pass
PSL53e7.csv	2.51	Table 2 Testing State 2	2.55	Pass
PSL53e8.csv	5.01	Table 2 Testing State 2	5.10	Pass
PSL53e9.csv	7.52	Table 2 Testing State 2	7.70	Pass
PSL53e10.csv	10.01	Table 2 Testing State 2	10.20	Pass
PSL53e11.csv	0.242	Table 2 Testing State 3	0.24	Pass
PSL53e12.csv	2.55	Table 2 Testing State 3	2.59	Pass
PSL53e13.csv	4.96	Table 2 Testing State 3	5.10	Pass
PSL53e14.csv	6.93	Table 2 Testing State 3	7.15	Pass
PSL53e15.csv	9.78	Table 2 Testing State 3	10.01	Pass

\*Pass, based on combined uncertainties of EUT and PSL’s waveform generator

## 5.4 Supply Voltage Dips and Swells

### Summary of 5.4 Supply Voltage Dips and Swells Conformance Results

<b>Supply voltage dip and swell measurements conform to Class A requirements</b>	<b>Yes</b>
<b>Supply voltage dip and swell measurements conform to Class S requirements</b>	<b>Yes</b>
<b>Supply voltage dip and swell measurements conform to Class B requirements</b>	<b>Yes</b>

Table 5.4 Class A – Summary of Dips and Swells Results

	61000-4-30 section	Dip/Swell requirement	EUT conforms to Class A	Remarks
PSL Test 5.4 (a)	none	Simple single-phase voltage dip measurement	Yes	Pass
PSL Test 5.4 (b)	none	Simple three-phase voltage dip measurement	Yes	Pass
PSL Test 5.4.1(a)	¶3.2.2	$U_{rms(1/2)}$ values are RMS values measured over a single cycle	Yes	Pass
PSL Test 5.4.1(b)	¶3.2.2	$U_{rms(1/2)}$ values are synchronized to zero crossings	Yes	Pass
PSL Test 5.4.1(c)	¶3.2.2	$U_{rms(1/2)}$ values are refreshed every ½ cycle	Yes	Pass
PSL Test 5.4.1(d)	¶3.2.2	$U_{rms(1/2)}$ values – each channel independently synchronized	Yes	Pass
PSL Test 5.4.2(a)	¶5.4.2.1	Verify dip hysteresis voltage	Yes	Pass
PSL Test 5.4.2(b)	¶5.4.2.2	Verify polyphase dip evaluation - magnitude	Yes	Pass
PSL Test 5.4.2(c)	¶5.4.2.2	Verify polyphase dip evaluation - duration	Yes	Pass
PSL Test 5.4.3(a)	¶5.4.3.1	Verify swell hysteresis voltage	Yes	Pass
PSL Test 5.4.3(b)	¶5.4.3.2	Verify polyphase swell evaluation - magnitude	Yes	Pass
PSL Test 5.4.3(c)	¶5.4.3.2	Verify polyphase swell evaluation - duration	Yes	Pass
PSL Test 5.4.4(a)	¶5.4.4	Verify sliding reference voltage value calculation	Yes	Pass
PSL Test 5.4.3(b)	¶5.4.4	Verify sliding reference voltage calculation excludes flagged values	Yes	Pass
Engineering review	¶5.4.5.1	Verify residual voltage magnitude meets required uncertainty in EUT specifications	Yes	User manual, page 144
PSL Test 5.4.5.1(b)	¶5.4.5.1	Verify residual voltage magnitude meets required uncertainty – measured performance	Yes	Pass

Table 5.4 Class S – Summary of Dips and Swells Results

	61000-4-30 section	Dip/Swell requirement	EUT conforms to Class S	Remarks
PSL Test 5.4 (a)	none	Simple single-phase voltage dip measurement	Yes	Pass
PSL Test 5.4 (b)	none	Simple three-phase voltage dip measurement	Yes	Pass
PSL Test 5.4.1(a)	¶3.2.2	Manufacturer shall specify $U_{rms(1/2)}$ or $U_{rms(1)}$	Yes	Pass
PSL Test 5.4.2(a)	¶5.4.2.1	Verify dip hysteresis voltage	Yes	Pass
PSL Test 5.4.2(b)	¶5.4.2.2	Verify polyphase dip evaluation - magnitude	Yes	Pass
PSL Test 5.4.2(c)	¶5.4.2.2	Verify polyphase dip evaluation - duration	Yes	Pass
PSL Test 5.4.3(a)	¶5.4.3.1	Verify swell hysteresis voltage	Yes	Pass
PSL Test 5.4.3(b)	¶5.4.3.2	Verify polyphase swell evaluation - magnitude	Yes	Pass
PSL Test 5.4.3(c)	¶5.4.3.2	Verify polyphase swell evaluation - duration	Yes	Pass
PSL Test 5.4.4(a)	¶5.4.4	Verify sliding reference voltage value calculation	Yes	Pass
PSL Test 5.4.3(b)	¶5.4.4	Verify sliding reference voltage calculation excludes flagged values	Yes	Pass
Engineering review	¶5.4.5.1	Verify residual voltage magnitude meets required uncertainty in EUT specifications	Yes	User manual, page 144
PSL Test 5.4.5.1(b)	¶5.4.5.1	Verify residual voltage magnitude meets required uncertainty – measured performance	Yes	Pass

Table 5.4 Class B – Summary of Magnitude of the Dips and Swells Results

	61000-4-30 section	Dip / Swell requirement	EUT conforms to Class B	Remarks
Engineering review	¶5.4.5.1	Verify residual voltage magnitude meets required uncertainty in EUT specifications	Yes	Pass
PSL Test 5.4.5.1(b)	¶5.4.5.1	Verify residual voltage magnitude meets required uncertainty – measured performance	Yes	Pass
PSL Test 5.4.2(c)	¶5.4.2.2	Verify polyphase dip evaluation - duration	Yes	Pass

For detailed results, see the following pages.

## PSL Test Suite 5.4: Supply voltage dips and swells

### PSL Test 5.4(a) – Simple voltage dip measurement – single-phase system

*Purpose of test: Verifies general dip measurements. Verifies that we can set the dip/swell thresholds and hysteresis. Verifies that we know how to make single-phase voltage dip measurements, including depth and duration, with the EUT. Test is single-phase, applied to EUT reference channel. Voltage is sinusoidal, at  $U_{din}$  nominal.*

Table 5.4(a)

Applied waveform	Applied depth	Applied duration	EUT depth reading	EUT duration reading	Remarks
PSL54a.csv	~40% $U_{din}$	0.030 seconds	41.02%	0.030 seconds	Pass

### PSL Test 5.4(b) – Simple voltage dip measurement – three-phase system

*Purpose of test: Verifies general dip measurements. Verifies that we know how to make three-phase voltage dip measurements, including depth and duration, with the EUT. Test is three-phase. Voltage is sinusoidal, at  $U_{din}$  nominal.*

Table 5.4(b)

Applied waveform	Applied depth	Applied duration	EUT depth reading	EUT duration reading	Remarks
PSL54b.csv	~40% $U_{din}$ on all three channels	1 cycle	41.07%	0.030 seconds	Pass

### PSL Test 5.4.1(a) – Verify $U_{rms(1/2)}$ measurements – measured over 1 cycle

*Purpose of test: Verifies “...the value of r.m.s. voltage measured over 1 cycle....” Test is single-phase, applied to reference channel. Voltage is approx  $U_{din}$ .*

Table 5.4.1(a)

Applied waveform	Applied depth	EUT depth reading	Remarks	Result
PSL541a1.csv	~40%	40.96%	Verifies that EUT is using <u>true</u> RMS measurement method	Pass
PSL541a2.csv	~50%	50.67%	Verifies that EUT is using single-cycle RMS	Pass

**PSL Test 5.4.1(b) – Verify  $U_{rms(1/2)}$  measurements – synchronized to zero-crossing**

*Purpose of test: Verifies “...the value of r.m.s. voltage measured over 1 cycle, commencing at a fundamental zero-crossing....” Test is single-phase, applied to reference channel. Voltage is approx  $U_{din}$ .*

Table 5.4.1(b)

Applied waveform	Applied depth	EUT depth reading	Remarks	Result
PSL541b1.csv	~50%	49.58%	Verifies that EUT is updating r.m.s. value synchronized to zero-crossings. Same waveform as PSL541a2.csv	Pass

**PSL Test 5.4.1(c) – Verify  $U_{rms(1/2)}$  measurements – refreshed every half-cycle**

*Purpose of test: Verifies “...the value of r.m.s. voltage measured over 1 cycle...refreshed every half-cycle.” Test is single-phase, applied to reference channel. Voltage is approx  $U_{din}$ .*

Table 5.4.1(c)

Applied waveform	Applied depth	EUT depth reading	Remarks	Result
PSL541c1.csv	~50%	49.58%	Verifies that EUT is updating r.m.s. value synchronized to zero-crossings. Same waveform as PSL541a2.csv	Pass

**PSL Test 5.4.1(d) – Verify  $U_{rms(1/2)}$  measurements – each channel independently synchronized**

*Purpose of test: Verifies “This technique is independent for each channel, and will produce r.m.s. values at successive times on different channels on polyphase systems.” Test is three-phase. Voltage is approx  $U_{din}$ .*

Table 5.4.1(d)

Applied waveform	Applied depth	EUT depth reading	Remarks	Result
PSL541d1.csv	~50%	50.70%	Verifies that EUT is independently synchronizing each channel	Pass

**PSL Test 5.4.1(e) – Verify that EUT reports the smallest  $U_{rms(1/2)}$  value as the depth of the dip.**

*Purpose of test: Test is single-phase. Voltage is approx  $U_{din}$ .*

Table 5.4.1(e)

Applied waveform	Applied depth	EUT depth reading	Remarks	Result
PSL541e.csv	~40%	41.03%	Verifies that EUT reports the correct minimum value	Pass

**PSL Test 5.4.2(a) – Verify voltage dip hysteresis voltage**

*Purpose of test: Verifies “On single-phase systems a voltage dip begins when the  $U_{rms(1/2)}$  voltage falls below a threshold, and ends when the  $U_{rms(1/2)}$  voltage is equal to or above the dip threshold plus the hysteresis voltage.” Test is single-phase, applied to reference channel. Voltage is approx  $U_{din}$ . EUT Dip threshold set to 80%, EUT Hysteresis is set to 4%.*

Table 5.4.2(a)

Applied waveform	Applied duration	EUT duration reading	Remarks	Result
PSL542a1.csv	0.120 seconds	0.110 seconds	Verifies that EUT is using hysteresis properly	Pass

**PSL Test 5.4.2(b) – Verify polyphase dip evaluation - magnitude**

*Purpose of test: Verifies “The residual voltage is the lowest  $U_{rms(1/2)}$  value measured on any channel during the voltage dip.” Test is three-phase. Voltage is approx  $U_{din}$ .*

Table 5.4.2(b)

Applied waveform	Applied depth	EUT depth reading	Remarks	Result
PSL542b1.csv	~70%, ~40%, ~80%	39.79%	Verifies that EUT is evaluating the depth of three-phase dips correctly.	Pass

**PSL Test 5.4.2(c) – Verify polyphase dip evaluation - duration**

*Purpose of test: Verifies “On polyphase systems a voltage dip begins when the  $U_{rms(1/2)}$  voltage of one or more channels falls below a threshold, and ends when the  $U_{rms(1/2)}$  voltage of all channels is equal to or above the dip threshold plus the hysteresis voltage.” Test is three-phase. Voltage is approx  $U_{din}$ .*

Table 5.4.2(c)

Applied waveform	Applied duration	EUT duration reading	Remarks	Result
PSL542c.csv	0.215 seconds	0.193 seconds	Verifies that EUT is evaluating beginning and conclusion of three-phase dips correctly.	Pass*

\*In PSL’s engineering judgment, this test is a pass due to combined uncertainties of EUT and reference equipment

**PSL Test 5.4.3(a) – Verify voltage swell hysteresis voltage**

*Purpose of test: Verifies “On single-phase systems a voltage swell begins when the  $U_{rms(1/2)}$  voltage rises above a threshold, and ends when the  $U_{rms(1/2)}$  voltage is equal to or less than the swell threshold minus the hysteresis voltage.” Test is single-phase, applied to reference channel. Voltage is approx  $U_{din}$ . EUT Swell threshold set to 110%, EUT Hysteresis is set to 5%.*

Table 5.4.3(a)

Applied waveform	Applied duration	EUT duration reading	Remarks	Result
PSL543a1.csv	0.120 seconds	0.110 seconds	Verifies that EUT is using hysteresis properly	Pass

**PSL Test 5.4.3(b) – Verify polyphase swell evaluation - magnitude**

*Purpose of test: Verifies “The maximum swell magnitude voltage is the largest  $U_{rms(1/2)}$  value measured on any channel during the voltage swell.” Test is three-phase.*

Table 5.4.3(b)

Applied waveform	Applied maximum	EUT maximum reading	Remarks	Result
PSL543b1.csv	~115%, ~120%, ~112%	120.07%	Verifies that EUT is evaluating the magnitude of three-phase swells correctly.	Pass

**PSL Test 5.4.3(c) – Verify polyphase swell evaluation - duration**

*Purpose of test: Verifies “On polyphase systems a voltage swell begins when the  $U_{rms(1/2)}$  voltage of one or more channels rises above a threshold, and ends when the  $U_{rms(1/2)}$  voltage of all channels is equal to or below the swell threshold minus the hysteresis voltage.” Test is three-phase. Voltage is approx 109-112%  $U_{din}$ .*

Table 5.4.3(c)

Applied waveform	Applied duration	EUT duration reading	Remarks	Result
PSL543c1.csv	0.200 seconds	0.203 seconds	Verifies that EUT is evaluating beginning and conclusion of three-phase swells correctly.	Pass

**PSL Test 5.4.4(a) – (Optional) Verify sliding voltage reference – value calculation**

*Purpose of test: Verifies method given in 5.4.4 for calculating sliding reference voltage, including filter. Voltage is approx  $U_{din}$ .*

Table 5.4.4(a)

Applied waveform	Applied sliding reference voltage value	EUT sliding reference voltage value	Remarks	Result
PSL544a1.csv			Verifies that EUT is calculating sliding reference voltage correctly	Optional – not required

**PSL Test 5.4.4(b) – (Optional) Verify sliding voltage reference – exclude flagged values**

*Purpose of test: Verifies that the flagged values are excluded from sliding voltage reference calculations. Test is single-phase. Voltage is approx  $U_{din}$ .*

Table 5.4.4(b)

Applied waveform	Applied sliding reference voltage value	EUT sliding reference voltage value	Remarks	Result
PSL544b1.csv			Verifies that EUT is excluding flagged values from the sliding reference voltage calculation.	Optional – not required

**PSL Test 5.4.5.1(a) – Verify residual voltage and swell voltage magnitude uncertainty – specifications**

*Purpose of test: Verifies that the specifications of the EUT meet the requirements of 5.4.5.1, i.e.  $\pm 0,2\%$  of  $U_{din}$ .*

Table 5.4.5.1(a)

EUT dip/swell specified accuracy	Remarks	Result
$\pm 0,2\%$ of $U_{din}$	Manual, page 144	Pass

**PSL Test 5.4.5.1(b) – Verify residual voltage and swell voltage magnitude uncertainty – measured performance**

*Purpose of test: Verifies that the measured voltage dip and swell values are within the requirements, i.e.  $\pm 0,2\%$  of  $U_{din}$ . Test is single-phase. Voltage is percent of  $U_{din}$ .*

Table 5.4.5.1(b)

Applied waveform	Applied dip or swell	EUT reading	Remarks	Result
PSL5451b1.csv	183.7V	79.77%	Voltage dip accuracy test	Pass
PSL5451b2.csv	160.6V	69.76%	Voltage dip accuracy test	Pass
PSL5451b3.csv	91.5V	39.66%	Voltage dip accuracy test	Pass
PSL5451b4.csv	264.9V	115.32%	Voltage swell accuracy test	Pass
PSL5451b5.csv	284.9V	123.91%	Voltage swell accuracy test	Pass
PSL5451b6.csv	304.4V	132.46%	Voltage swell accuracy test	Pass

## 5.5 Voltage Interruptions

### Summary of 5.5 Voltage Interruptions Conformance Results

Voltage interruption measurements conform to Class A requirements	Yes
Voltage interruptions measurements conform to Class S requirements	Yes
Voltage interruptions measurements conform to Class B requirements	Yes

Table 5.5 Class A – Summary of Voltage Interruption Results

	61000-4-30 section	Voltage interruption requirement	EUT conforms to Class A	Remarks
PSL Test 5.5.1(a)	¶5.5.1	Verify that $U_{rms(1/2)}$ values are used for voltage interruption measurements	Yes	Pass
PSL Test 5.5.2(a)	¶5.5.2	Verify polyphase interruption duration evaluation	Yes	Pass
PSL Test 5.5.2(b)	¶5.5.2	Verify interruption threshold hysteresis	Yes	Pass

Table 5.5 Class S – Summary of Voltage Interruption Results

	61000-4-30 section	Voltage interruption requirement	EUT conforms to Class S	Remarks
PSL Test 5.5.1(a)	¶5.5.1	Verify that $U_{rms(1/2)}$ or $U_{rms(1)}$ values are used for voltage interruption measurements	Yes	Pass
PSL Test 5.5.2(a)	¶5.5.2	Verify polyphase interruption duration evaluation	Yes	Pass
PSL Test 5.5.2(b)	¶5.5.2	Verify interruption threshold hysteresis	Yes	Pass

Table 5.5 Class B – Summary of Voltage Interruption Results

	61000-4-30 section	Voltage interruption requirement	EUT conforms to Class B	Remarks
PSL Test 5.5.2(a)	¶5.5.2	Verify polyphase interruption duration evaluation	Yes	Pass

For detailed results, see the following pages.

**PSL Test 5.5.1(a) – Verify  $U_{rms(1/2)}$  measurements are used for voltage interruption measurements**

*Purpose of test: Verifies “The basic measurement of a voltage interruption shall be the  $U_{rms(1/2)}$  on each measurement channel.” Test is single-phase, applied to reference channel. Voltage is approx  $U_{din}$ .*

Table 5.5.1(a)

Applied waveform	Applied signal	EUT interruption duration	Remarks	Result
PSL551a1.csv	0.100 seconds at 0 volts	0.08 seconds	Verifies that EUT is using $U_{rms(1/2)}$ for interruption measurements	Pass

**PSL Test 5.5.2(a) – Verify polyphase interruption duration evaluation**

*Purpose of test: Verifies “On polyphase systems, an interruption begins when  $U_{rms(1/2)}$  of all channels fall below the voltage interruption threshold and ends when the  $U_{rms(1/2)}$  of any one channel rises above the voltage interruption threshold plus the hysteresis.” Voltage is approx  $U_{din}$ .*

Table 5.5.2(a)

Applied waveform	Applied signal	EUT interruption duration	Remarks	Result
PSL552a1.csv	2.5 seconds at 0 volts	2.474 seconds	Verifies that EUT is correctly determining the beginning and end of an interruption on polyphase systems.	Pass

**PSL Test 5.5.2(b) – Verify interruption hysteresis voltage**

*Purpose of test: Verifies “On single-phase systems a voltage interruption begins when the  $U_{rms(1/2)}$  voltage falls below the voltage interruption threshold, and ends when the  $U_{rms(1/2)}$  voltage is equal to or greater than the voltage interruption threshold plus the hysteresis.” Test is single-phase, applied to reference channel. Voltage is approx  $U_{din}$ .*

Table 5.5.2(b)

Applied waveform	Applied signal	EUT interruption duration	Remarks	Result
PSL552b1.csv	0.2 seconds at 0 volts followed by 0.2 seconds at 5% $U_{din}$	0.380 seconds	Verifies that EUT is using hysteresis properly	Pass

## 5.7 Supply Voltage Unbalance

### Summary of 5.7 Supply Voltage Unbalance Conformance Results

<b>Supply voltage unbalance measurements conform to Class A requirements</b>	<b>Yes</b>
<b>Supply voltage unbalance measurements conform to Class S requirements</b>	<b>Yes</b>
<b>Supply voltage unbalance measurements conform to Class B requirements</b>	<b>Yes</b>

Table 5.7 Class A – Summary of Unbalance Results

	<b>61000-4-30 section</b>	<b>Unbalance requirement</b>	<b>EUT conforms to Class A</b>	<b>Remarks</b>
Engineering review	¶5.7.1	Verify negative-sequence-unbalance $u_2$ and zero-sequence-unbalance $u_0$ are available.	Yes	Pass
Engineering review	Table 1 Line 5	EUT specifications meet required range for voltage unbalance	Yes	Pass
PSL Test 5.7.1(a)	¶5.7.1	Verify unbalance measurement method – symmetrical components	Yes	Pass
PSL Test 5.7.2(a)	¶5.7.2	Verify unbalance measurement uncertainty	Yes	Pass
PSL Test 5.7.3(a)	¶5.7.3	Verify unbalance measurement aggregation	Yes	Pass

Table 5.7 Class S – Summary of Unbalance Results

	<b>61000-4-30 section</b>	<b>Unbalance requirement</b>	<b>EUT conforms to Class S</b>	<b>Remarks</b>
Engineering review	¶5.7.1	Verify negative-sequence-unbalance $u_2$ is available.	Yes	Pass
Engineering review	Table 1 Line 5	EUT specifications meet required range for voltage unbalance	Yes	Pass
PSL Test 5.7.1(a)	¶5.7.1	Verify unbalance measurement method – symmetrical components	Yes	Pass
PSL Test 5.7.2(a)	¶5.7.2	Verify unbalance measurement uncertainty	Yes	Pass
PSL Test 5.7.3(a)	¶5.7.3	Verify unbalance measurement aggregation	Yes	Pass

**Table 5.7 Class B – Summary of Unbalance Results**

	<b>61000-4-30 section</b>	<b>Unbalance requirement</b>	<b>EUT conforms to Class B</b>	<b>Remarks</b>
Engineering review	Table 2 Line 3	EUT specifications meet required range for unbalance	Yes	Pass
Engineering review	¶5.7.1	The manufacturer shall specify method for calculating unbalance	Yes	Pass
Engineering review	¶5.7.2	The manufacturer shall specify unbalance uncertainty	Yes	Pass
PSL Test 5.7.2(a)	¶5.7.2	Verify unbalance measurement uncertainty	Yes	Pass
Engineering review	¶5.7.3	The manufacturer shall specify unbalance aggregation method	Yes	Pass

**PSL Test 5.7.1(a) – Verify unbalance measurement method**

*Purpose of test: Verifies “The supply voltage unbalance is evaluated using the method of symmetrical components” and other requirements in 5.7.1. Voltage is approx  $U_{din}$ .*

Table 5.7.1(a)

Applied waveform	Applied negative sequence unbalance $U_2$	Applied zero sequence unbalance $U_0$	EUT measured $U_2$	EUT measured $U_0$	Remarks	Result
PSL571a1.csv	9.5%	10.2%	9.49%	10.17%	Simple unbalance, sinusoidal waveforms	Pass
PSL571a2.csv	0.6%	0.2%	0.58	0.22	Differing non-sinusoidal waveforms with balanced fundamental, to verify that the EUT is using only the fundamental (i.e. symmetrical component evaluation)	Pass
PSL571a3.csv	9.2%	10.6%	9.17%	10.56%	Sinusoidal waveforms with equal fundamental but angles not equal to 120°, to verify that the EUT is using symmetrical component evaluation	Pass
PSL571a4.csv	varies	varies	varies	varies	Verifies that the measurement of unbalance is over a 10/12 cycle interval	Pass

**PSL Test 5.7.2(a) – Verify unbalance measurement uncertainty**

*Purpose of test: Verifies the uncertainty requirements in 5.7.2. Voltage is approx  $U_{din}$ .*

Table 5.7.2(a)

Applied waveform	Applied negative sequence	Applied zero sequence	EUT negative sequence	EUT zero sequence	Remarks	Result
PSL572a1.csv	0.4%	2.5%	0.37%	2.49%		Pass
PSL572a2.csv	0.5%	5.0%	0.48%	4.96%		Pass
PSL572a3.csv	3.0%	0.6%	2.96%	0.54%		Pass
PSL572a4.csv	5.4%	1.1%	5.39%	1.04%		Pass
PSL572a5.csv	3.1%	6.5%	3.12%	6.5%		Pass
PSL572a6.csv	4.1%	5.5%	4.06%	5.53%		Pass
PSL572a7.csv	0.5%	0.2%	0.52%	0.16%	Range of Inf Qty's	Pass
PSL572a8.csv	0.8%	1.4%	0.79%	1.36%	Range of Inf Qty's	Pass
PSL572a9.csv	2.0%	2.6%	2.01%	2.56%	Range of Inf Qty's	Pass
PSL572a10.csv	3.7%	4.1%	3.73%	4.07%	Range of Inf Qty's	Pass
PSL572a11.csv	4.6%	5.1%	4.59%	5.11%	Range of Inf Qty's	Pass

**PSL Test 5.7.3(a) – Verify unbalance measurement aggregation**

*Purpose of test: Verifies the unbalance measurement aggregation. Voltage is approx  $U_{din}$ .*

Table 5.7.3(a)

Applied waveform	Applied negative sequence	Applied zero sequence	Remarks	Result
PSL573a1.csv	varies	varies		Pass

## 5.8 Voltage Harmonics

### Summary of 5.8 Voltage Harmonics Results

<b>Voltage harmonic measurements conform to Class A requirements</b>	<b>Yes</b>
<b>Voltage harmonic measurements conform to Class S requirements</b>	<b>Yes</b>
<b>Voltage harmonic measurements conform to Class B requirements</b>	<b>Yes</b>

Per IEC 61000-4-30 5.8, all tests were performed with reference to IEC 61000-4-7:2002.

Table 5.8 Class A – Summary of Voltage Harmonics Results

	¶	Voltage harmonic requirement	EUT conforms to Class A	Remarks
Engineering review	IEC 61000-4-7, ¶1, Note 3	EUT specifications meet required range for harmonic order	Yes	User manual, page 124
Engineering review	Table 1 Line 5	EUT specifications meet required amplitude range for voltage harmonics	Yes	User manual, page 144
Engineering review	IEC 61000-4-7, Table 1, Line 1 of Class 1	EUT specifications meet required accuracy for voltage harmonics	Yes	User manual, page 144
Engineering review	IEC 61000-4-7, ¶8	Operating conditions and errors caused by temperature, humidity, EUT supply voltage, common mode, static discharges, radiated EMF	Yes	Pass
PSL Test 5.8(a)	IEC 61000-4-7, ¶5.3 paragraph 2	Verify suitable anti-alias filter	Yes	Pass
PSL Test 5.8(b)	IEC 61000-4-7, ¶4.4.1 paragraph 3	Verify suitable PLL (or equivalent) performance	Yes	Pass
PSL Test 5.8(c)	IEC 61000-4-7, ¶4.4.1	Verify 10/12 cycle window	Yes	Pass
PSL Test 5.8(d)	IEC 61000-4-30, ¶5.8	Verify gapless measurements and $G_{sgn}$ implementation	Yes	Pass
PSL Test 5.8(e)	IEC 61000-4-7, ¶5.3, Table 1, Line 1	Verify single harmonic accuracy at $\geq 1\%$	Yes	Pass
PSL Test 5.8(f)	IEC 61000-4-7, ¶5.3, Table 1, Line 1	Verify single harmonic accuracy at $< 1\%$	Yes	Pass
PSL Test 5.8(g)	IEC 61000-4-30, ¶5.8	Verify harmonics aggregation	Yes	Pass
PSL Test 5.8(h)	IEC 61000-4-30, ¶6.1, ¶6.2, ¶5.8 61000-2-4 Table 2, 61000-4-7 Table 1	Verify accuracy over range of influence quantities	Yes	Pass

Note: IEC 61000-4-7:2002 is referenced in the table above, due to IEC 61000-4-30 ¶ 5.8.

**Table 5.8 Class S – Summary of Voltage Harmonics Results**

	¶	Voltage harmonic requirement	EUT conforms to Class S	Remarks
Engineering review	IEC 61000-4-7, ¶1, Note 3	EUT specifications meet required range for harmonic order	Yes	User manual, page 124
Engineering review	Table 1 Line 5	EUT specifications meet required amplitude range for voltage harmonics	Yes	User manual, page 144
Engineering review	IEC 61000-4-7, Table 1, Line 1 of Class 1	EUT specifications meet required accuracy for voltage harmonics	Yes	User manual, page 144
Engineering review	IEC 61000-4-7, ¶8	Operating conditions and errors caused by temperature, humidity, EUT supply voltage, common mode, static discharges, radiated EMF	Yes	Pass
PSL Test 5.8(b)	IEC 61000-4-7, ¶4.4.1 paragraph 3	Verify suitable PLL (or equivalent) performance	Yes	Pass
PSL Test 5.8(c)	IEC 61000-4-7, ¶4.4.1	Verify 10/12 cycle window	Yes	Pass
PSL Test 5.8(e)	IEC 61000-4-7, ¶5.3, Table 1, Line 1	Verify single harmonic accuracy at $\geq 1\%$	Yes	Pass
PSL Test 5.8(f)	IEC 61000-4-7, ¶5.3, Table 1, Line 1	Verify single harmonic accuracy at $< 1\%$	Yes	Pass
PSL Test 5.8(g)	IEC 61000-4-30, ¶5.8	Verify harmonics aggregation	Yes	Pass
PSL Test 5.8(h)	IEC 61000-4-30, ¶6.1, ¶6.2, ¶5.8 61000-2-4 Table 2, 61000-4-7 Table 1	Verify accuracy over range of influence quantities	Yes	Pass

Note: IEC 61000-4-7:2002 is referenced in the table above, due to IEC 61000-4-30 ¶ 5.8.

**Table 5.8 Class B – Summary of Voltage Harmonics Results**

	¶	Voltage harmonic requirement	EUT conforms to Class B	Remarks
Engineering review	IEC 61000-4-30, ¶5.8	Manufacturer specifies uncertainty and aggregation methods	Yes	Pass
Engineering review	IEC 61000-4-30, Table 2 Line 4	EUT specifications meet required range for voltage harmonics	Yes	Pass
PSL Test 5.8(e)	IEC 61000-4-30, ¶5.8	Verify single harmonic accuracy at $\geq 1\%$	Yes	Pass
PSL Test 5.8(h)	IEC 61000-4-30, 6.1 Table 2	Verify harmonic accuracy, <u>Testing State 1 only</u>	Yes	Pass

**PSL Test 5.8(a) – Verify suitable anti-alias filter**

*Purpose of test: Verifies the requirement in 61000-4-7,5.3, “An anti-aliasing low-pass filter, with a negative -3 dB frequency above the measuring range, shall be provided. The attenuation in the stop-band shall exceed 50 dB.” Single-phase test. Voltage is approx  $U_{din}$ , 50 Hz nominal, with harmonics above the measured range.*

Table 5.8(a)

Applied waveform	Remarks	Result
PSL58a1.csv	Checks for alias signal reflected into passband near upper end of passband	Pass
PSL58a2.csv	Checks for alias signal reflected into passband well above upper end of passband	Pass

**PSL Test 5.8(b) – Verify suitable PLL (or equivalent) performance**

*Purpose of test: Verifies the requirement in 61000-4-7, 4.4.1, “Instruments including a phase locked loop or other synchronization means shall meet the requirements for accuracy and synchronization for measuring any signal frequency within a range of at least  $\pm 5\%$  of the nominal system frequency.” Single-phase test. Voltage is approx  $U_{din}$ .*

Table 5.8(b)

Applied waveform	Remarks	Result
PSL58b1.csv	Verify proper 5 <sup>th</sup> harmonic measurement at 95% of nominal frequency	Pass
PSL58b2.csv	Triangular frequency modulation, slewing at 1 Hz per second, 50 Hz $\pm 5\%$ , while observing the stability of the 5 <sup>th</sup> harmonic measurement	Pass
PSL58b3.csv	Triangular frequency modulation, slewing at 0.5 Hz per second, 60 Hz $\pm 5\%$ , while observing the stability of the 5 <sup>th</sup> harmonic measurement	Pass

**PSL Test 5.8(c) – Verify 10/12 cycle window**

*Purpose of test: Verifies the requirement in 61000-4-7, 4.4.1, “The time window shall be synchronized with each group of 10 or 12 cycles.” Single-phase test. Voltage is approx  $U_{din}$ , 50 Hz nominal.*

Table 5.8(c)

Applied waveform	Remarks	Result
PSL58c.csv	Verifies 10 cycle windows at 50 Hz	Pass

**PSL Test 5.8(d) – Verify gapless window and  $G_{sgn}$  implementation**

*Purpose of test: Verifies requirement for “...gapless harmonic subgroup measurement...” Single-phase test. Voltage is approx  $U_{din}$ , 50 Hz nominal.*

Table 5.8(d)

Applied waveform	Remarks	Result
PSL58d1a.csv	Verifies gapless windows at 50 Hz – part 1	Pass
PSL58d1b.csv	Verifies gapless windows at 50 Hz – part 2 – must pass both parts to confirm gapless harmonics measurements	Pass
PSL58d2.csv	Verifies $G_{sgn}$ implementation – 7.1 harmonic at 50 Hz	Pass
PSL58d3.csv	Verifies $G_{sgn}$ implementation – 2.9 harmonic at 50 Hz	Pass

**PSL Test 5.8(e) – Verify single harmonic uncertainty –  $U_m \geq 1\%$**

*Purpose of test: Verifies the uncertainty requirements of 61000-4-7 Table 1, line 1. RMS voltage is approx  $U_{din}$ . Single-phase on reference channel. Harmonic orders and amplitudes based on twice the values in IEC 61000-2-4 Class 3. (per line 5 of Table 1 and line 4 of Table 2 in IEC 61000-4-3). All percentages are percent of  $U_{din}$ . Requirement is  $\pm 5\%$  of  $U_m$ .*

Table 5.8(e)

Applied waveform	Applied harmonic	EUT measured harmonic	Remarks	Result
PSL58e1.csv	9.5%	21.89		Pass
PSL58e2.csv	10.5%	24.14		Pass
PSL58e3.csv	14.4%	33.18		Pass
PSL58e4.csv	16.4%	37.73		Pass

**PSL Test 5.8(f) – Verify single harmonic uncertainty –  $U_m < 1\%$**

*Purpose of test: Verifies the uncertainty requirements of 61000-4-7 Table 1, line 2. RMS voltage is approx  $U_{din}$ . Single-phase on reference channel. Requirement is  $\pm 0.05\%$  of  $U_{din}$ .*

Table 5.8(f)

Applied waveform	Applied harmonic	EUT measured harmonic	Remarks	Result
PSL58f1.csv	0.9%	2.11		Pass
PSL58f2.csv	0.5%	1.17		Pass

**PSL Test 5.8(g) – Verify voltage harmonic aggregation**

*Purpose of test: Verifies “Aggregation will be performed according to 4.5.” RMS voltage is approx  $U_{din}$ . Single-phase on reference channel.*

Table 5.8(g)

Applied waveform	Applied harmonic	EUT measured harmonic	Remarks	Result
PSL58g1.csv	Varies	Varies		Pass

**PSL Test 5.8(h) – Verify voltage harmonics uncertainty over range of influence quantities**

*Purpose of test: Verifies voltage harmonics uncertainty according to Table 2, IEC 61000-4-30, Section 6.2, using twice the values of Class 3 in IEC 61000-2-4 Table 2 ( per IEC 61000-4-30 Table 1 Line 5) with uncertainty requirements specified in IEC 61000-4-7, Table 1, Class I (per IEC 61000-4-30 5.8 paragraph 1). “Over the range of influence quantities, and under the conditions described in 6.1, the measurement uncertainty...” Checks harmonics measurements with unbalance, flicker, and other influence quantities. Voltage is non-sinusoidal, RMS value varies. Requirement is ±5% of reading for signals greater than 1% of  $U_{din}$  (and ±0.05% of  $U_{din}$  for smaller signals). Results are measured on the first channel (usually L1-N), but signals are applied to all three phases.*

*NOTE: This test is performed only if EUT conforms to Class A requirements in PSL Test 5.8(a)-5.8(g).*

*NOTE: Table 5.8(h) uses the 17<sup>th</sup> harmonic. Table 5.8(i) uses the 2<sup>nd</sup> harmonic.*

Table 5.8(h) – 17<sup>th</sup> harmonic

Applied waveform	Testing state	Applied harmonic amplitude	EUT harmonic amplitude	Remarks	Result
PSL58h1.csv	Table 2 Testing State 1	0.0V	0.03		Pass
PSL58h2.csv	Table 2 Testing State 1	4.9V	4.93		Pass
PSL58h3.csv	Table 2 Testing State 1	9.9V	9.88		Pass
PSL58h4.csv	Table 2 Testing State 1	14.8V	14.82		Pass
PSL58h5.csv	Table 2 Testing State 1	19.7V	19.76		Pass
PSL58h6.csv	Table 2 Testing State 2	0.0V	0.02		Pass
PSL58h7.csv	Table 2 Testing State 2	4.9V	4.93		Pass
PSL58h8.csv	Table 2 Testing State 2	9.8V	9.88		Pass
PSL58h9.csv	Table 2 Testing State 2	14.7V	14.82		Pass
PSL58h10.csv	Table 2 Testing State 2	19.6V	19.76		Pass
PSL58h11.csv	Table 2 Testing State 3	0.0V	0.03	Note: for Testing State 3, $U_{din}$ is reconfigured 170 Vrms.	Pass
PSL58h12.csv	Table 2 Testing State 3	3.6V	3.64		Pass
PSL58h13.csv	Table 2 Testing State 3	7.3V	7.31		Pass
PSL58h14.csv	Table 2 Testing State 3	10.87V	10.86V		Pass
PSL58h15.csv	Table 2 Testing State 3	14.475V	14.48V		Pass

Table 5.8(i) – 2<sup>nd</sup> harmonic

Applied Waveform	Testing state	Applied harmonic amplitude	EUT harmonic amplitude	Remarks	Result
PSL58h1.csv	Table 2 Testing State 1	0.58V	.55V		Pass
PSL58h2.csv	Table 2 Testing State 1	3.51V	3.52V		Pass
PSL58h3.csv	Table 2 Testing State 1	7.0V	6.98V		Pass
PSL58h4.csv	Table 2 Testing State 1	10.48V	10.46V		Pass
PSL58h5.csv	Table 2 Testing State 1	13.98V	13.95V		Pass
PSL58h6.csv	Table 2 Testing State 2	0.42V	.43V		Pass
PSL58h7.csv	Table 2 Testing State 2	3.49V	3.52V		Pass
PSL58h8.csv	Table 2 Testing State 2	6.92V	6.94V		Pass
PSL58h9.csv	Table 2 Testing State 2	10.41V	10.42V		Pass
PSL58h10.csv	Table 2 Testing State 2	13.9V	13.9V		Pass
PSL58h11.csv	Table 2 Testing State 3	0.59V	.57V	Note: for Testing State 3, U <sub>din</sub> is reconfigured 170 Vrms.	Pass
PSL58h12.csv	Table 2 Testing State 3	2.62V	2.63V		Pass
PSL58h13.csv	Table 2 Testing State 3	5.2V	5.18V		Pass
PSL58h14.csv	Table 2 Testing State 3	7.75V	7.78V		Pass
PSL58h15.csv	Table 2 Testing State 3	10.31V	10.32V		Pass

## 5.9 Voltage Interharmonics

### Summary of 5.9 Voltage Interharmonics Results

<b>Voltage interharmonic measurements conform to Class A requirements</b>	<b>Yes</b>
<b>Voltage interharmonic measurements conform to Class S requirements</b>	<b>Yes</b>
<b>Voltage interharmonic measurements conform to Class B requirements</b>	<b>Yes</b>

Table 5.9 Class A – Summary of Voltage Interharmonics Results

	<b>61000-4-30 section</b>	<b>Voltage interharmonic requirement</b>	<b>EUT conforms to Class A</b>	<b>Remarks</b>
Engineering review	IEC 61000-4-30 Table 1 Line 6	EUT specifications meet required range for voltage interharmonics	Yes	User manual, page 144
Engineering review	IEC 61000-4-30, ¶5.9	Verify interharmonics aggregation	Yes	Pass
PSL Test 5.9(a)	IEC 61000-4-30, ¶5.9	Verify C <sub>isg,n</sub> implementation	Yes	Pass
PSL Test 5.9(b)	IEC 61000-4-30, ¶5.9	Verify single interharmonic accuracy at ≥ 1%	Yes	Pass
PSL Test 5.9(c)	IEC 61000-4-30, ¶6.1, ¶6.2, ¶5.9 61000-2-4 Table 6, 61000-4-7 Table 1	Verify accuracy over range of influence quantities	Yes	Pass

Note: IEC 61000-4-7:2002 is referenced in the table above, due to IEC 61000-4-30 ¶ 5.9.

Table 5.9 Class S – Summary of Voltage Interharmonics Results

	<b>61000-4-30 Section</b>	<b>Voltage interharmonic Requirement</b>	<b>EUT conforms to Class S</b>	<b>Remarks</b>
Engineering review	IEC 61000-4-30, ¶5.9	Manufacturer specifies uncertainty and aggregation methods	Yes	User manual, page 144
Engineering review	IEC 61000-4-30, Table 2 Line 5	EUT specifications meet required range for voltage interharmonics	Yes	Pass
PSL Test 5.9(c)	IEC 61000-4-30, 6.1 Table 2	Verify interharmonic accuracy, Testing State 1 only	Yes	Pass

Table 5.9 Class B – Summary of Voltage Interharmonics Results

	<b>61000-4-30 Section</b>	<b>Voltage interharmonic Requirement</b>	<b>EUT conforms to Class B</b>	<b>Remarks</b>
Engineering review	IEC 61000-4-30, ¶5.9	Manufacturer specifies uncertainty and aggregation methods	Yes	User manual, page 144
Engineering review	IEC 61000-4-30, Table 2 Line 5	EUT specifications meet required range for voltage interharmonics	Yes	Pass
PSL Test 5.9(c)	IEC 61000-4-30, 6.1 Table 2	Verify interharmonic accuracy, Testing State 1 only	Yes	Pass

**PSL Test 5.9(a) – Verify  $C_{isg,n}$  implementation**

*Purpose of test: Verifies the implementation requirements in 61000-4-30 Edition 1 Corrigendum Item 5.9. RMS voltage is approx  $U_{din}$ . Single-phase on reference channel. Requirements for  $C_{isg,n}$  method can be found in IEC 61000-4-7, equations A3 and A4, and in Figure 6, and in Section 5.6.*

Table 5.9(a)

Applied waveform	Applied interharmonic	EUT measured interharmonic	Remarks	Result
PSL59a1.csv	23.5V	23.53V		Pass
PSL59a2.csv	42.4V	42.41V		Pass

**PSL Test 5.9(b) – Verify single interharmonic uncertainty**

*Purpose of test: Verifies the uncertainty requirements of 61000-4-7 Table 1, line 1. RMS voltage is approx  $U_{din}$ . Single-phase on reference channel. Interharmonic amplitudes based on twice the values in IEC 61000-2-4 Table 6 Class 3, per line 6 of Table 1 and line 5 of Table 2 in IEC 61000-4-30. Interharmonic frequency is selected based on test. All percents are percent  $U_{din}$ .*

Table 5.9(b)

Applied waveform	Applied interharmonic	EUT measured interharmonic	Remarks	Result
PSL59b1.csv	7.8V	7.81		Pass
PSL59b2.csv	9.8V	9.78		Pass
PSL59b3.csv	10.8V	10.92		Pass
PSL59b4.csv	11.8V	11.77		Pass

### PSL Test 5.9(c) – Verify voltage interharmonics uncertainty over range of influence quantities

*Purpose of test: Verifies voltage interharmonics uncertainty according to Table 2, IEC 61000-4-30, Section 6.2, using twice the values of Class 3 in IEC 61000-2-4 Table 6 ( per IEC 61000-4-30 Table 1 Line 6) with uncertainty requirements specified in IEC 61000-4-7, Table 1, Class I (per IEC 61000-4-30 5.9 paragraph 1). “Over the range of influence quantities, and under the conditions described in 6.1, the measurement uncertainty...” Checks interharmonics measurements with unbalance, flicker, and other influence quantities. Voltage is non-sinusoidal, RMS value varies. Unless otherwise noted, all tests were performed with 5.5<sup>th</sup> harmonic. Requirement is  $\pm 5\%$  of reading for signals greater than 1% of  $U_{din}$  (and  $\pm 0.05\%$  of  $U_{din}$  for smaller signals). Results are measured on the first channel (usually L1-N), but signals are applied to all three phases.*

*NOTE: This test is performed only if EUT conforms to Class A requirements in PSL Test 5.9(a).*

Table 5.9(c)

Applied waveform	Testing state	Applied interharmonic level	EUT measured interharmonic	Comments	Result
PSL59c1.csv	Table 2 Testing State 1	0.0V	.01V		Pass
PSL59c2.csv	Table 2 Testing State 1	2.91V	2.93V		Pass
PSL59c3.csv	Table 2 Testing State 1	5.88V	5.86V		Pass
PSL59c4.csv	Table 2 Testing State 1	8.8V	8.79V		Pass
PSL59c5.csv	Table 2 Testing State 1	11.71V	11.72V		Pass
PSL59c6.csv	Table 2 Testing State 2	0.01V	.01V		Pass
PSL59c7.csv	Table 2 Testing State 2	2.91V	2.92V		Pass
PSL59c8.csv	Table 2 Testing State 2	5.82V	5.89V		Pass
PSL59c9.csv	Table 2 Testing State 2	8.78V	8.78V		Pass
PSL59c10.csv	Table 2 Testing State 2	11.69V	11.71V		Pass
PSL59c11.csv	Table 2 Testing State 3	0.01V	.01V	Note: for Testing State 3, $U_{din}$ is reconfigured 170 Vrms.	Pass
PSL59c12.csv	Table 2 Testing State 3	2.15V	2.16V		Pass
PSL59c13.csv	Table 2 Testing State 3	4.31V	4.33V		Pass
PSL59c14.csv	Table 2 Testing State 3	6.48V	6.49V		Pass
PSL59c15.csv	Table 2 Testing State 3	8.62V	8.66V		Pass

## 5.10 Mains Signaling Voltage on the Supply Voltage

### Summary of 5.10 Mains Signaling Voltage Conformance Results

<b>Mains signaling voltage measurements conform to Class A requirements</b>	<b>Yes</b>
<b>Mains signaling voltage measurements conform to Class S requirements</b>	<b>Yes</b>
<b>Mains signaling voltage measurements conform to Class B requirements</b>	<b>Yes</b>

Table 5.10 Class A – Summary of Mains Signaling Voltage Results

	<b>61000-4-30 section</b>	<b>Mains signaling voltage requirement</b>	<b>EUT conforms to Class A</b>	<b>Remarks</b>
Engineering review	¶5.10	Determine EUT's interpretation of value of mains signaling voltage	Yes	Pass
Engineering review	¶5.10.1	User-selected detection threshold	Yes	Pass
Engineering review	¶5.10.1	User-selected length of recording period	Yes	Pass
PSL Test 5.10(a)	¶5.10.1	Verify functionality of mains signaling voltage recording	Yes	Pass
PSL Test 5.10(b)	¶5.10.2	Verify uncertainty of mains signaling voltage recording	Yes	Pass

Table 5.10 Class S – Summary of Mains Signaling Voltage Results

	<b>61000-4-30 section</b>	<b>Mains signaling voltage requirement</b>	<b>EUT conforms to Class S</b>	<b>Remarks</b>
Engineering review	¶5.10	Determine EUT's interpretation of value of mains signaling voltage	Yes	Pass
Engineering review	¶5.10.1	User-selected detection threshold	Yes	Pass
Engineering review	¶5.10.1	User-selected length of recording period	Yes	Pass

Table 5.10 Class B – Summary of Mains Signaling Voltage Results

	<b>61000-4-30 section</b>	<b>Mains signaling voltage requirement</b>	<b>EUT conforms to Class B</b>	<b>Remarks</b>
Engineering review	¶5.10	Determine EUT's interpretation of value of mains signaling voltage	Yes	Pass
Engineering review	¶5.10.1	User-selected detection threshold	Yes	Pass
Engineering review	¶5.10.1	User-selected length of recording period	Yes	Pass

**PSL Test 5.10(a) – Verify mains signaling voltage measurement**

*Purpose of test: Verifies the parameters of mains signaling voltage can be set, per 5.10. Verifies that we can read the value. RMS voltage is approx  $U_{din}$ . Single-phase on reference channel.*

Table 5.10(a)

Applied waveform	Applied mains signal	EUT measured mains signal	Remarks	Result
Engineering review	(none)		Verify that user can specify the required interharmonic(s) to be used for mains signaling voltage measurements	Pass
Engineering review	(none)		Verify that user can set a mains signaling voltage threshold, above 0,3% $U_{din}$	Pass
Engineering review	(none)		Verify that user can set a length of recording period, up to 120 seconds	Pass
PSL510a1.csv	10.181V	10.17V	Verify that we can detect and measure mains signaling voltage (uses second standard method)	Pass
PSL510a2.csv	10% 3 <sup>rd</sup> 4.5% 3.1 <sup>st</sup>	No event recorded	Verify that first standard method is also implemented, and that the correct method is selected based on mains signal frequency	Meter uses second method

**PSL Test 5.10(b) – Verify uncertainty of mains signaling voltage measurement**

*Purpose of test: Verifies the measurement uncertainty requirements per 5.10.2 and 6.2.*

*RMS voltage is approx  $U_{din}$ . Single-phase on reference channel. Limit is 5% of reading.*

*Applied mains signaling frequency for this test is 316.67 Hz.*

Table 5.10(b)

Applied waveform	Applied mains signal	EUT measured mains signal	Remarks	Result
PSL510b1.csv	0	0	Testing State 1 No signal should be reported because the 0.1% threshold has not been exceeded.	Pass
PSL510b2.csv	8.496	8.49	Testing State 1	Pass
PSL510b3.csv	17.026	16.95	Testing State 1	Pass
PSL510b4.csv	25.625	25.42	Testing State 1	Pass
PSL510b5.csv	34.12	33.88	Testing State 1	Pass
PSL510b6.csv	0	0	Testing State 2 No signal should be reported because the 0.1% threshold has not been exceeded.	Pass
PSL510b7.csv	6.079	6.19	Testing State 2	Pass
PSL510b8.csv	12.21	12.37	Testing State 2	Pass
PSL510b9.csv	18.348	18.56	Testing State 2	Pass
PSL510210.csv	24.475	24.75	Testing State 2	Pass
PSL510b11.csv	0	0	Testing State 3 Note: $U_{din}$ changed to 170 $V_{rms}$ for this testing state	Pass
PSL510b12.csv	9.551	9.43	Testing State 3	Pass
PSL510b13.csv	18.946	18.63	Testing State 3	Pass
PSL510b14.csv	28.467	28.18	Testing State 3	Pass
PSL510b15.csv	37.827	36.96	Testing State 3	Pass

## 5.12 Underdeviation and Overdeviation Parameters

### Summary of 5.12 Underdeviation and Overdeviation Conformance Results

<b>Underdeviation and overdeviation measurements conform to Class A requirements</b>	<b>Yes</b>
<b>(Class S does not apply to underdeviation and overdeviation measurements)</b>	<b>-</b>
<b>(Class B does not apply to underdeviation and overdeviation measurements)</b>	<b>-</b>

Table 5.12 Class A – Summary of Underdeviation / Overdeviation Results

	<b>61000-4-30 section</b>	<b>Under / over deviation requirement</b>	<b>EUT conforms to class A</b>	<b>Remarks</b>
PSL Test 5.12(a)	¶5.12	Verify 10/12 cycle RMS value is used	Yes	Pass
PSL Test 5.12(b)	¶5.12	Verify calculation and separation of under/over deviation	Yes	Pass
PSL Test 5.12(c)	¶5.12	Verify aggregation intervals	Yes	Pass
PSL Test 5.12(d)	¶5.12	Verify 3 values for 3-wire systems, and 6 values for 4-wire systems	Yes	Pass

There is no Class S or Class B for underdeviation and overdeviation.

**PSL Test 5.12(a) – Verify overdeviation measurement uses 10/12 cycle RMS**

*Purpose of test: Verifies that EUT correctly uses 10/12 cycle RMS for calculating deviation parameters. RMS voltage is approx  $U_{din}$ . Single-phase on reference channel.*

Table 5.12(a)

Applied waveform	Applied deviation	EUT measured overdeviation	EUT measured underdeviation	Remarks	Result
PSL512a1.csv	Varying			Verifies that 10/12 cycle RMS values are used. Similar to PSL521c2.csv	Pass* 10/12 cycles data found via Modbus Registers: 12859 – Under L1 12860 – Under L2 12861 – Under L3 12862 – Over L1 12863 – Over L2 12864 – Over L3

**PSL Test 5.12(b) – Verify overdeviation and underdeviation measurement**

*Purpose of test: Verifies that EUT correctly categorizes underdeviation and overdeviation parameters. RMS voltage is approx  $U_{din}$ . Single-phase on reference channel.*

Table 5.12(b)

Applied waveform	Applied deviation	EUT measured overdeviation	EUT measured underdeviation	Remarks	Result
PSL512b1.csv	19.61% $U_{din}$ underdeviation	0%	19.69%	Checks both that underdeviation is calculated correctly, and that underdeviation does not affect overdeviation.	Pass
PSL512b1.csv	10% $U_{din}$ overdeviation	10.06%	0%	Checks both that overdeviation is calculated correctly, and that overdeviation does not affect underdeviation.	Pass

**PSL Test 5.12(c) – Verify deviation aggregation intervals**

*Purpose of test: Verifies that EUT correctly aggregates deviation parameters. RMS voltage is approx  $U_{din}$ . Single-phase on reference channel.*

Table 5.12(c)

Applied waveform	Applied deviation	EUT measured overdeviation	EUT measured underdeviation	Remarks	Result
PSL512c1.csv	Varying			Verifies aggregation intervals	Pass

**PSL Test 5.12(d) – Verify number of deviation parameters for three-phase systems**  
*Purpose of test: Verifies that EUT correctly produces pairs of deviation parameters for three-phase systems. RMS voltage is approx  $U_{din}$ .*

Table 5.12(d)

<b>Applied waveform</b>	<b>Test</b>	<b>Remarks</b>	<b>Result</b>
As required	Engineering review	Verifies 3 pairs of deviation parameters for 3-wire systems	Pass
As required	Engineering review	Verifies 3 or 6 pairs of deviation parameters for 4-wire systems	Pass

## 4.4 Measurement Aggregation Time Intervals

### Summary of 4.4 Measurement Aggregation Time Intervals

<b>Measurement aggregation conforms to Class A requirements</b>	<b>Yes</b>
<b>Measurement aggregation conforms to Class S requirements</b>	<b>Yes</b>
<b>Measurement aggregation conforms to Class B requirements</b>	<b>Yes</b>

*Results in this section are based on engineering review and tests as necessary.*

Table 4.4 Class A – Summary of Aggregation Interval Results

	<b>61000-4-30 section</b>	<b>Aggregation interval requirement</b>	<b>EUT conforms to Class A</b>	<b>Remarks</b>
PSL44a1.csv	¶4.4	3-second interval based on cycles	Yes	Pass
Engineering review	¶4.4	10-minute interval based on time clock	Yes	Pass
PSL44a1.csv	¶4.4	10/12 cycle measurements re-synchronized at 10-minute RTC tick	Yes	Pass
Engineering review	¶4.4	Time stamp of 10-minute intervals occurs at the <u>end</u> of the interval.	Yes	Pass
Engineering review	¶4.4	2-hour interval based on time clock	Yes	Pass

Table 4.4 Class S – Summary of Aggregation Interval Results

	<b>61000-4-30 section</b>	<b>Aggregation interval requirement</b>	<b>EUT conforms to Class S</b>	<b>Remarks</b>
PSL44a1.csv	¶4.4	3-second interval based on cycles	Yes	Pass
Engineering review	¶4.4	10-minute interval based on time clock	Yes	Pass
PSL44a1.csv	¶4.4	10/12 cycle are re-synchronized according to Figure 3 and 4	Yes	Pass
Engineering review	¶4.4	Time stamp of 10-minute intervals occurs at the <u>end</u> of the interval.	Yes	Pass
Engineering review	¶4.4	2-hour interval based on time clock	Yes	Pass

Table 4.4 Class B – Summary of Aggregation Interval Results

	<b>61000-4-30 section</b>	<b>Mains signaling voltage requirement</b>	<b>EUT conforms to Class B</b>	<b>Remarks</b>
Engineering review	¶4.4	Manufacturer shall indicate the method, number, and duration of aggregation time intervals	Yes	Pass

## 4.6 Time Clock Uncertainty

### Summary of 4.6 Time Clock Uncertainty

<b>Time clock uncertainty conforms to Class A requirements</b>	<b>Yes</b>
<b>Time clock uncertainty conforms to Class S requirements</b>	<b>Yes</b>
<b>Time clock uncertainty conforms to Class B requirements</b>	<b>Yes</b>

*Results in this section are based on engineering review and tests as necessary.*

Table 4.6 Class A – Summary of Time Clock Uncertainty Results

	<b>61000-4-30 section</b>	<b>Time clock uncertainty requirement</b>	<b>EUT conforms to Class A</b>	<b>Remarks</b>
Engineering review	¶4.6 (Note 1 applies)	Max uncertainty of one period over any very long length of time	Yes	Tested using NTP server
Engineering review	¶4.6 (Note 2 applies)	Max uncertainty of 1 second per 24 hours if sync becomes lost	Yes	Pass

Table 4.6 Class S – Summary of Time Clock Uncertainty Results

	<b>61000-4-30 section</b>	<b>Time clock uncertainty requirement</b>	<b>EUT conforms to Class S</b>	<b>Remarks</b>
Engineering review	¶4.6 (Note 1 applies)	Max uncertainty of 5 second per 24 hours if sync becomes lost	Yes	Pass

Table 4.6 Class B – Summary of Time Clock Uncertainty Results

	<b>61000-4-30 section</b>	<b>Time clock uncertainty requirement</b>	<b>EUT conforms to Class B</b>	<b>Remarks</b>
Engineering review	¶4.6	Manufacturer shall specify the method to determine 10-min intervals	Yes	Pass

## 4.7 Flagging

### Summary of 4.7 Flagging

<b>Flagging conforms to Class A requirements</b>	<b>Yes</b>
<b>Flagging conforms to Class S requirements</b>	<b>Yes</b>
<b>(Class B does not apply to Flagging)</b>	<b>-</b>

Table 4.4 Class A – Summary of Flagging Results

	<b>61000-4-30 section</b>	<b>Flagging requirement</b>	<b>EUT conforms to class A</b>	<b>Remarks</b>
PSL Test 4.7(a)	¶4.7	Flagging of appropriate aggregated parameters based on dips, swells, and interruptions	Pass	Only individual phases flagged
PSL Test 4.7(a)	¶4.7	If any interval is flagged, the aggregated intervals are also flagged.	Pass	

Table 4.4 Class S – Summary of Flagging Results

	<b>61000-4-30 section</b>	<b>Flagging requirement</b>	<b>EUT conforms to class S</b>	<b>Remarks</b>
PSL Test 4.7(a)	¶4.7	Flagging of appropriate aggregated parameters based on dips, swells, and interruptions	Pass	Only individual phases flagged
PSL Test 4.7(a)	¶4.7	If any interval is flagged, the aggregated intervals are also flagged.	Pass	

Flagging does not apply to Class B.

**PSL Test 4.7(a) – Flagging**

*Purpose of test: Verifies that EUT correctly meets the flagging requirements of 4.7. Engineering review using voltage dips, swells, and interruptions to trigger flagging.*

Table 4.7(a)

	<b>Test</b>	<b>Remarks</b>	<b>Result</b>
Engineering review	Power frequency measurements flagged		Pass
Engineering review	Voltage magnitude measurements flagged		Pass
Engineering review	Flicker measurements flagged		Pass
Engineering review	Unbalance measurements flagged		Pass
Engineering review	Harmonics measurements flagged		Pass
Engineering review	Interharmonics measurements flagged		Pass
Engineering review	Mains signaling measurements flagged		Pass
Engineering review	Over- and underdeviation measurements flagged		Pass
Engineering review	If any interval is flagged, the aggregated intervals are also flagged		Pass

## 6.1 Range of Influence Quantities

### Summary of 6.1 Range of Influence Quantities

<b>Uncertainty over the range of influence quantities conforms to Class A requirements</b>	<b>Yes</b>
<b>Uncertainty over the range of influence quantities conforms to Class S requirements</b>	<b>Yes</b>
<b>Uncertainty over the range of influence quantities conforms to Class B requirements</b>	<b>Yes</b>

Note: For Section 6.1, PSL tests the non-aggregated results of parameter measurements. For this reason, in Testing State 3, we use Pst=0 to 0,1 (not 4±0,1).

Table 6.1 Class A – Summary of Range of Influence Quantities Results

	<b>61000-4-30 section</b>	<b>Power quality parameter</b>	<b>EUT conforms to class A</b>	<b>Remarks</b>
PSL Test 5.1.2(a)	¶6.1, ¶6.2, and ¶5.1.2 paragraph 1	Power frequency	Pass	See Section 5.1 of this report
PSL Test 5.2.2(a)	¶6.1, ¶6.2, and ¶5.2.2 paragraph 1	Magnitude of the supply voltage	Pass	See Section 5.2 of this report
PSL Test 5.3(g)	¶6.1, ¶6.2	Flicker	Pass	See Section 5.3 of this report
N/A	N/A	Supply voltage dips and swells	Pass	Section 6.2 applies to pseudo steady-state parameters
N/A	N/A	Voltage interruptions	Pass	Section 6.2 applies to pseudo steady-state parameters
PSL Test 5.7.2(a)	¶6.1, ¶6.2, and ¶5.7.2	Supply voltage unbalance	Pass	Section 5.7.2 only requires Testing State 1 of Section 6.2. See Section 5.7 of this report
PSL Test 5.8(h)	¶6.1, ¶6.2, and ¶5.8, 61000-2-4 Table 2, 61000-4-7 Table 1	Voltage harmonics	Pass	See Section 5.8 of this report
PSL Test 5.9(b)	¶6.1, ¶6.2, and ¶5.9	Voltage interharmonics	Pass	See Section 5.9 of this report
PSL Test 5.10(b)	¶6.1, ¶6.2, and ¶5.10	Mains signaling voltage	Pass	See Section 5.10 of this report

NOTE: The “transient” set of tests in this section is performed after all other testing has been completed, due to the possibilities of damaging the EUT.

Table 6.1 supplemental Class A – Summary of Transient Results

	<b>61000-4-30 section</b>	<b>Influence quantity</b>	<b>EUT conforms to class A</b>	<b>Remarks</b>
PSL Test 6.1(a)	Table 1 Line 8	6kV transient	Yes	Pass
PSL Test 6.1(b)	Table 1 Line 9	4kV fast transients	Yes	Pass

**PSL Test 6.1(a) – Verify parameter measurements with 6kV transients as influence quantities**

*Purpose of test: Verifies that EUT correctly measures parameters when “transient voltages according to IEC 61180 – 6 kV peak” are applied.*

Table 6.1(a)

Influence quantity	Parameter	Applied value of parameter	EUT measured value of parameter	Remarks	Result
IEC 61180 – 6 kV peak	-	-	-	Verifies that EUT tolerates 6 kV impulse	Pass
IEC 61180 – 6 kV peak	Power frequency	100 kHz		6 kV transient applied to input channel terminals	Pass
IEC 61180 – 6 kV peak	Magnitude of supply voltage	6 kV open circuit		6 kV transient applied 3 times with positive polarity, 3 times with negative polarity	Pass
None applied	All other parameters			Based on engineering judgment, re-test parameters after transient has been applied	Pass

**PSL Test 6.1(b) – Verify parameter measurements with fast transients as influence quantities**

*Purpose of test: Verifies that EUT correctly measures parameters when “Fast transients – 4 kV peak” are applied.*

Table 6.1(b)

Influence quantity	Parameter	Applied value of parameter	EUT measured value of parameter	Remarks	Result
Fast transient 4 kV peak	-	-	-	Verification that EUT tolerates 4 kV impulse	Pass
Fast transient 4 kV peak	Power frequency				Pass
Fast transient 4 kV peak	Magnitude of supply voltage	4 kV			Pass
None applied	All other parameters			Based on engineering judgment, re-test parameters after transient has been applied	Pass

Transients are not an Influence Quantity for Class S or Class B.

## PSL Instruments and Facilities used for this Test

### PSL Instruments

Description	Manufacturer	Model number	Serial number	NIST trace	Remarks
Arbitrary waveform gen(s)	Tektronix	AFG3022	AFG3022C010634, AFG3022C010614	N/A	Used for signal generation
High-voltage amplifier	Pacific Power	390-GCT	0652	N/A	Used for signal generation
Reference meter(s)	Fluke	8508A	947854898	Simco cert# 4040525	
Waveform inspection	Tektronix	TDS3014	B017593	N/A	Used for verification only
Surge generator	Keytek	587	8804247	N/A	Trace not required
EFT generator	Schaffner	NSG200D NSG222	125 416	N/A	Trace not required
Voltage angle and harmonic measurements	PSL	CEATI T054700- 5130	SP4029	1006-001	

### PSL Facilities

Description	Remarks
PSL Calibration Lab	Used as required
PSL High-voltage Test Area	Used as required for surge and transient tests. Also, High-voltage amplifier is located here, and is operated remotely from the Instrument Test Area
PSL 3-phase 15-amp Instrument Test Area	Principal test location

### PSL Software / Waveform Library

Description	Revision level
PSL 61000-4-30 Compliance Verification Software + Library	1.2.3