

Newton4th ISO17025

Calibration

UKAS Laboratory no.7949



Compliance to IEC Harmonics and Flicker Measurement

Harmonics:

IEC61000-3-2 (2014) and IEC61000-3-12 (2011)
in accordance with IEC61000-4-7 (2009)

Flicker:

IEC61000-3-3 (2013) and IEC61000-3-11 (2000)
in accordance with IEC61000-4-15 (2010)



Introduction

There are many companies that provide Harmonic and Flicker measurement instrumentation, with most of these companies claiming to provide fully compliant measurement functions.

However, given the complexity of this measurement application combined with the continually developing criteria that defines a compliant measurement product, how can a customer be confident that a product being offered to them is truly compliant?

A certificate of conformance vs Accredited Calibration

Manufactures may offer a wide range of documents to support an argument that their product will meet the requirements of a measurement standard. This includes type testing, reference measurements and certificates of conformance. While these forms of testing may have value in illustrating the nominal level of measurement ability for certain measurement functions, the ideal solution is an 'accredited certificate of calibration' including all of the required measurements defined in the associated standard.

An accredited calibration is supplied only by a laboratory that has been awarded and continually maintains standards, processes and procedures in accordance with internationally agreed levels. Most countries have an organisation that is responsible for managing this process and in the UK; the associated organisation is the United Kingdom Accreditation Service, UKAS.

UKAS is responsible for awarding and auditing the accreditation of all ISO17025 laboratories including for example, the National Physical Laboratory and of course, Newtons4th Ltd. The calibration that can be carried out by any laboratory and the uncertainty associated with that calibration is defined within a document called the 'Schedule of Accreditation'. The prevailing schedule of accreditation for any laboratory is available directly from the UKAS website. A link to the Newtons4th schedule of accreditation is available on the ISO17025 page of our website.

Why accept less?

In the world of metrology, it is stated that you can only believe what you can prove. In other words, a supplier can claim what they like but unless their claim can be supported by an accredited calibration, it may be meaningless.

Until now, there has been no ISO17025 accredited laboratory with a Schedule of Accreditation that includes all of the latest tests defined for IEC61000 Harmonics and Flicker measurement instrumentation. Newtons4th UKAS Laboratory no.7949 is the first and presently the only laboratory with this facility.

While harmonic calibration is offered by a number of laboratories, the UKAS accredited laboratory at N4L is presently the only facility with a schedule that includes all the tests defined within Annex C of the IEC61000-4-15 standard. This standard defines the test protocol for a fully compliant flicker meter in accordance with IEC61000-3-3 and IEC61000-3-11. We follow with a copy of Annex C with colour coding of ALL sections then a copy of our UKAS accredited IEC61000 calibration certificate with corresponding colour coded sections that illustrate full compliance with ALL required tests.

Annex C (informative)

Sample protocols for type testing

Manufacturer:
Serial number:

Instrument:
Firmware version:

CERTIFICATE OF CALIBRATION

UKAS IEC61000 Calibration



Certificate No: **166-04860180821**
 Date of Issue: 18th August 2021

Approved Signature:

Name: M Wade 
 Title: Operations Manager

Customer Name and Address:

| Product | Model | Serial No | Calibration Date | Condition |
|--------------------------|----------|-----------|------------------------------|------------|
| Precision Power Analyser | 5531(HC) | 166-04860 | 18 th August 2021 | Acceptable |

Calibration Comments:

All pre-adjustment tests passed.

Calibration Type

IEC61000-3-2:(2014), IEC61000-3-2:(2018) IEC61000-3-3:(2013), IEC61000-3-11:(2000), IEC61000-3-12 (2011), IEC61000-4-7:(2002) + AMD1:(2008), IEC61000-4-15(2010)

| Equipment Used | Model | Serial No | Calibration Due |
|---------------------------------|-------|-----------|------------------------------|
| Fluke Electrical Power Standard | 6105A | 176162845 | 22 nd March 2022 |
| Precision AC Source | N4A03 | 91J-11145 | 17 th August 2022 |

Method of Calibration

The results of this calibration report were obtained by applying voltage and current sinusoidal signals (or multiple sinusoidal signals where applicable) from a traceable calibrated source.

Conditions of Calibration

Temperature: 23°C ±5°C (18°C - 28°C)
 Humidity Band: 20% - 85%

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. (Calibration control is in accordance with ISO17025)
 Calibration relates exclusively to the product(s) defined above without customer supplied leads unless defined otherwise

CERTIFICATE OF CALIBRATION

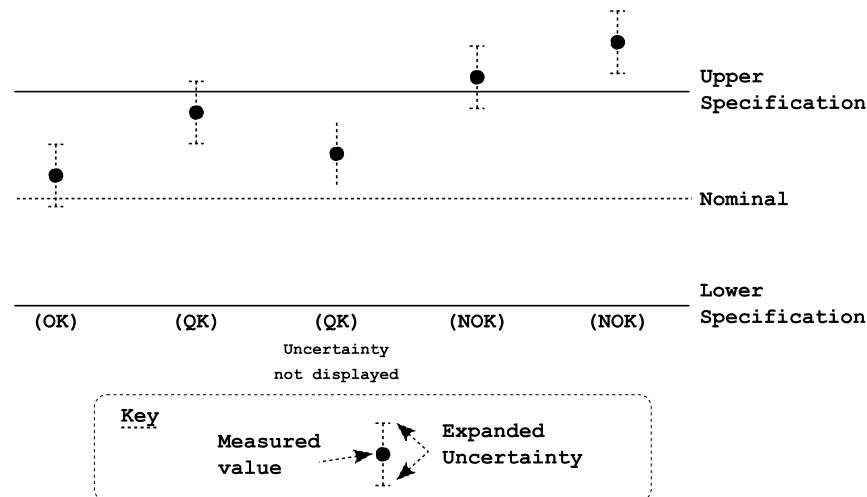
UKAS IEC61000 Calibration



Compliance with specification

A statement of compliance, indicating the performance of the instrument or system against its specification, is reported for each test line in the certificate. Compliance is determined by accounting for the expanded measurement of uncertainty as follows:

| Statement | Explanation |
|--------------------------------------|--|
| OK | The margin between the measured value and the stated specification is greater than the expanded measurement uncertainty; the measurement is within the specification limits by at least the reported confidence level and therefore the instrument can be stated to comply with the specification. |
| QK (Uncertainty shown) | The margin between the measured value and the stated specification is less than the expanded measurement uncertainty, therefore it is not possible to state compliance with the reported confidence level, but the measurement is still more likely than not to be compliant. |
| QK (Uncertainty not shown) | Where no uncertainty is shown the measurement is beyond the scope of our UKAS accreditation but has been included as an indicative measurement for completeness. |
| NOK | The measurement is outside of the stated specification and is therefore non-compliant. |



A complete summary is created at the end of each script, summing the number tests that have passed or qualified pass (OK or QK) or failed (NOK).

Multiphase measurement

Where multiple instrument phases or channels have been calibrated to a common reference, the measurements may be recorded on a single line in the report. All measurement values are listed in the certificate but for conciseness, only the deviation of the greatest magnitude is included when multiple phases are measured.

Additional comments

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service (UKAS). It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory (NPL) or other recognised national metrology institutes. This certificate may not be reproduced other than in full except with the prior written approval of the issuing laboratory.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$ to give a level of confidence of approximately 95%.

Where no uncertainty is shown the measurement is beyond the scope of UKAS accreditation but has been included as an indicative measurement for completeness.

CERTIFICATE OF CALIBRATION

Certificate No: **166-04860180821**
 Date of Issue: 18th August 2021

UKAS IEC61000 Calibration



18 Aug 2021 05:31 Script file: KinetiQ PPA5500-HC calibration v2.14
 Automatic Calibration Environment release ACE v2.168
 NEWTONS4TH,PPA5531,166-04860,2.185
 Fluke,6105A,176162845,4.14
 NEWTONS4TH,ACC-IV,91K-09999,1.60

Summary report

Verify all voltage ranges

| [----- applied -----] | | | phase 1 | phase 2 | phase 3 | [----- voltage -----] | | | |
|-----------------------|-------|----|----------|----------|----------|-----------------------|----------|-------------------------------|------------------------------------|
| | | | range | | | dev spec uncert | | | |
| QK: | 55.00 | Hz | 100.00mV | 500.00mA | 1 | 99.955mV | 99.946mV | 99.971mV <-0.05%> [5.12%] { } | |
| QK: | 55.00 | Hz | 500.00mV | 500.00mA | 2 | 499.85mV | 499.82mV | 499.84mV <-0.04%> [1.09%] { } | |
| OK: | 55.00 | Hz | 2.0000 | V | 500.00mA | 3 | 2.0002 | 1.9998 | 2.0001 V <+0.01%> [0.32%] {0.018%} |
| OK: | 400.0 | Hz | 2.0000 | V | 500.00mA | 3 | 2.0003 | 1.9996 | 2.0001 V <-0.02%> [0.32%] {0.020%} |
| OK: | 850.0 | Hz | 2.0000 | V | 500.00mA | 3 | 2.0004 | 1.9993 | 2.0000 V <-0.03%> [0.32%] {0.020%} |
| OK: | 55.00 | Hz | 6.3000 | V | 500.00mA | 4 | 6.3003 | 6.2994 | 6.2997 V <-0.01%> [0.15%] {0.012%} |
| OK: | 400.0 | Hz | 6.3000 | V | 500.00mA | 4 | 6.3006 | 6.2996 | 6.2999 V <+0.01%> [0.15%] {0.013%} |
| OK: | 850.0 | Hz | 6.3000 | V | 500.00mA | 4 | 6.3008 | 6.2998 | 6.3001 V <+0.01%> [0.15%] {0.013%} |
| OK: | 55.00 | Hz | 20.000 | V | 500.00mA | 5 | 19.999 | 20.000 | 19.999 V <-0.01%> [0.09%] {0.009%} |
| OK: | 400.0 | Hz | 20.000 | V | 500.00mA | 5 | 20.001 | 20.001 | 20.000 V <+0.01%> [0.09%] {0.011%} |
| OK: | 850.0 | Hz | 20.000 | V | 500.00mA | 5 | 20.001 | 20.001 | 20.000 V <+0.01%> [0.10%] {0.011%} |
| OK: | 55.00 | Hz | 63.000 | V | 500.00mA | 6 | 62.998 | 62.996 | 62.996 V <-0.01%> [0.08%] {0.009%} |
| OK: | 400.0 | Hz | 63.000 | V | 500.00mA | 6 | 63.003 | 63.001 | 63.002 V <+0.00%> [0.08%] {0.010%} |
| OK: | 850.0 | Hz | 63.000 | V | 500.00mA | 6 | 63.003 | 63.001 | 63.001 V <+0.00%> [0.08%] {0.010%} |
| OK: | 55.00 | Hz | 200.00 | V | 500.00mA | 7 | 199.97 | 199.98 | 199.97 V <-0.02%> [0.07%] {0.011%} |
| OK: | 400.0 | Hz | 200.00 | V | 500.00mA | 7 | 200.00 | 200.00 | 199.99 V <-0.00%> [0.07%] {0.011%} |
| OK: | 850.0 | Hz | 200.00 | V | 500.00mA | 7 | 200.00 | 200.00 | 199.99 V <-0.00%> [0.07%] {0.011%} |
| OK: | 55.00 | Hz | 630.00 | V | 500.00mA | 8 | 629.97 | 630.00 | 629.95 V <-0.01%> [0.07%] {0.010%} |
| OK: | 400.0 | Hz | 630.00 | V | 500.00mA | 8 | 629.96 | 630.03 | 629.93 V <-0.01%> [0.07%] {0.010%} |
| OK: | 850.0 | Hz | 630.00 | V | 500.00mA | 8 | 629.93 | 630.05 | 629.88 V <-0.02%> [0.07%] {0.010%} |
| OK: | 55.00 | Hz | 975.00 | V | 500.00mA | 9 | 975.08 | 975.09 | 975.06 V <+0.01%> [0.13%] {0.011%} |
| OK: | 400.0 | Hz | 975.00 | V | 500.00mA | 9 | 975.02 | 975.04 | 975.01 V <+0.00%> [0.13%] {0.011%} |
| OK: | 850.0 | Hz | 975.00 | V | 500.00mA | 9 | 974.98 | 975.01 | 974.97 V <-0.00%> [0.13%] {0.011%} |

Verify all current ranges

| [----- applied -----] | | | phase 1 | phase 2 | phase 3 | [----- current -----] | | | | |
|-----------------------|-------|----|---------|---------|----------|-----------------------|----------|----------|------------------------------------|------------------------------------|
| | | | range | | | dev spec uncert | | | | |
| OK: | 55.00 | Hz | 20.000 | V | 50.000mA | 1 | 50.001mA | 49.999mA | 49.997mA <-0.01%> [2.09%] {0.019%} | |
| OK: | 400.0 | Hz | 20.000 | V | 50.000mA | 1 | 49.997mA | 49.996mA | 49.994mA <-0.01%> [2.09%] {0.019%} | |
| OK: | 850.0 | Hz | 20.000 | V | 50.000mA | 1 | 50.005mA | 49.992mA | 49.986mA <-0.03%> [2.09%] {0.019%} | |
| OK: | 55.00 | Hz | 20.000 | V | 180.00mA | 2 | 180.00mA | 179.97mA | 180.00mA <-0.02%> [0.63%] {0.013%} | |
| OK: | 400.0 | Hz | 20.000 | V | 180.00mA | 2 | 180.01mA | 179.99mA | 180.01mA <+0.01%> [0.63%] {0.014%} | |
| OK: | 850.0 | Hz | 20.000 | V | 180.00mA | 2 | 180.04mA | 180.01mA | 180.03mA <+0.02%> [0.63%] {0.014%} | |
| OK: | 55.00 | Hz | 20.000 | V | 630.00mA | 3 | 629.99mA | 629.97mA | 629.98mA <-0.00%> [0.23%] {0.011%} | |
| OK: | 400.0 | Hz | 20.000 | V | 630.00mA | 3 | 630.02mA | 630.01mA | 630.03mA <+0.00%> [0.23%] {0.013%} | |
| OK: | 850.0 | Hz | 20.000 | V | 630.00mA | 3 | 630.08mA | 630.07mA | 630.07mA <+0.01%> [0.23%] {0.013%} | |
| OK: | 55.00 | Hz | 20.000 | V | 2.0000 | A | 4 | 1.9998 | 1.9997 | 1.9997 A <-0.01%> [0.12%] {0.011%} |
| OK: | 400.0 | Hz | 20.000 | V | 2.0000 | A | 4 | 1.9998 | 1.9998 | 1.9998 A <-0.01%> [0.12%] {0.013%} |
| OK: | 850.0 | Hz | 20.000 | V | 2.0000 | A | 4 | 1.9999 | 1.9999 | 1.9999 A <-0.00%> [0.12%] {0.013%} |
| OK: | 55.00 | Hz | 20.000 | V | 6.3000 | A | 5 | 6.3000 | 6.2998 | 6.2998 A <-0.00%> [0.09%] {0.012%} |
| OK: | 400.0 | Hz | 20.000 | V | 6.3000 | A | 5 | 6.2995 | 6.2998 | 6.2998 A <-0.01%> [0.09%] {0.014%} |
| OK: | 850.0 | Hz | 20.000 | V | 6.3000 | A | 5 | 6.2994 | 6.2997 | 6.2996 A <-0.01%> [0.09%] {0.014%} |
| OK: | 55.00 | Hz | 20.000 | V | 20.000 | A | 6 | 20.001 | 19.999 | 20.000 A <+0.01%> [0.07%] {0.011%} |
| OK: | 400.0 | Hz | 20.000 | V | 20.000 | A | 6 | 19.998 | 19.999 | 19.999 A <-0.01%> [0.07%] {0.013%} |

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UKAS IEC61000 Calibration



OK: 850.0 Hz 20.000 V 20.000 A 6 19.998 A 19.998 A 19.997 A <-0.02%> [0.08%] {0.013%}
 OK: 55.00 Hz 20.000 V 48.000 A 7 47.994 A 47.990 A 47.993 A <-0.02%> [0.09%] {0.011%}
 OK: 400.0 Hz 20.000 V 48.000 A 7 48.008 A 48.010 A 48.009 A <+0.02%> [0.09%] {0.017%}
 OK: 850.0 Hz 20.000 V 48.000 A 7 48.008 A 48.012 A 48.008 A <+0.03%> [0.09%] {0.017%}
 OK: 55.00 Hz 20.000 V 48.000 A 8 48.001 A 47.996 A 48.003 A <-0.01%> [0.25%] {0.011%}
 OK: 400.0 Hz 20.000 V 48.000 A 8 48.016 A 48.018 A 48.016 A <+0.04%> [0.25%] {0.017%}
 OK: 850.0 Hz 20.000 V 48.000 A 8 48.021 A 48.020 A 48.022 A <+0.05%> [0.25%] {0.017%}
 OK: 55.00 Hz 20.000 V 48.000 A 9 48.005 A 47.997 A 48.009 A <+0.02%> [0.80%] {0.011%}
 OK: 400.0 Hz 20.000 V 48.000 A 9 48.022 A 48.027 A 48.019 A <+0.06%> [0.81%] {0.017%}
 OK: 850.0 Hz 20.000 V 48.000 A 9 48.036 A 48.035 A 48.041 A <+0.09%> [0.81%] {0.017%}

Phase tests

[----- applied -----] phase 1 phase 2 phase 3 [----- phase -----]
 ranges dev spec uncert
 OK: 55.00 Hz 220.00 V 10.000 A +0.000° 7 6 -0.001° +0.001° +0.000° <+0.001°> [0.011°] {0.003°}
 OK: 55.00 Hz 220.00 V 10.000 A +30.00° 7 6 +30.00° +30.00° +30.00° <-0.001°> [0.011°] {0.003°}
 OK: 55.00 Hz 220.00 V 10.000 A +60.00° 7 6 +60.00° +60.00° +60.00° <-0.002°> [0.011°] {0.003°}
 OK: 55.00 Hz 220.00 V 10.000 A +90.00° 7 6 +90.00° +90.00° +90.00° <-0.002°> [0.011°] {0.003°}

Verify power measurement at 220V 20A at 40-850Hz

[----- applied -----] [---- phase 1 ----] [---- phase 2 ----] [---- phase 3 ----] [----- VA -----] [----- W -----]
 ranges dev spec uncert dev spec uncert
 OK: 40.00 Hz 4.4000kVA 4.4000kW +0.000° 7 6 4.4002kVA 4.4001kW 4.4000kVA 4.3999kW 4.3998kVA 4.3997kW <+0.01%> [0.14%] {0.016%} <-0.01%> [0.07%] {0.016%}
 OK: 55.00 Hz 4.4000kVA 4.4000kW +0.000° 7 6 4.4002kVA 4.4000kW 4.4000kVA 4.3999kW 4.3996kVA 4.3997kW <-0.01%> [0.14%] {0.013%} <-0.01%> [0.07%] {0.013%}
 OK: 150.0 Hz 4.4000kVA 4.4000kW +0.000° 7 6 4.3998kVA 4.3997kW 4.4000kVA 4.3996kVA 4.3996kVA <-0.01%> [0.14%] {0.016%} <-0.01%> [0.07%] {0.016%}
 OK: 400.0 Hz 4.4000kVA 4.4000kW +0.000° 7 6 4.3994kVA 4.3992kW 4.3996kVA 4.3994kW 4.3990kVA 4.3990kW <-0.02%> [0.14%] {0.016%} <-0.02%> [0.07%] {0.016%}
 OK: 850.0 Hz 4.4000kVA 4.4000kW +0.000° 7 6 4.3986kVA 4.3985kW 4.3984kVA 4.3983kW 4.3977kVA 4.3977kW <-0.05%> [0.14%] {0.016%} <-0.05%> [0.08%] {0.016%}

Verify power measurement at different phase angles at 220V 15A

[----- applied -----] [---- phase 1 ----] [---- phase 2 ----] [---- phase 3 ----] [----- VA -----] [----- W -----]
 ranges dev spec uncert dev spec uncert
 OK: 55.00 Hz 3.3000kVA 3.3000kW +0.000° 7 6 3.3000kVA 3.2998kW 3.2997kVA 3.2996kW 3.2996kVA 3.2997kW <-0.01%> [0.16%] {0.013%} <-0.01%> [0.08%] {0.013%}
 OK: 55.00 Hz 3.3000kVA 2.8579kW -30.00° 7 6 3.2999kVA 2.8577kW 3.2997kVA 2.8576kW 3.2996kVA 2.8576kW <-0.01%> [0.16%] {0.013%} <-0.01%> [0.09%] {0.013%}
 OK: 55.00 Hz 3.3000kVA 2.3335kW +45.00° 7 6 3.3000kVA 2.3335kW 3.2997kVA 2.3332kW 3.2998kVA 2.3333kW <-0.01%> [0.16%] {0.013%} <-0.01%> [0.10%] {0.014%}
 OK: 55.00 Hz 3.3000kVA 1.6500kW -60.00° 7 6 3.2999kVA 1.6498kW 3.2996kVA 1.6498kW 3.2996kVA 1.6498kW <-0.01%> [0.16%] {0.013%} <-0.01%> [0.14%] {0.015%}

All 72 tests passed

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 It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory (NPL)
 or other recognised national metrology institutes.

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The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$ to give a level of confidence of approximately 95%.

Where no uncertainty is shown the measurement is beyond the scope of UKAS accreditation but has been included as an indicative measurement for completeness.

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UKAS IEC61000 Calibration



Harmonics & Flicker

18 Aug 2021 14:19 Script file: KinetiQ PPA5500 IEC61000 50Hz tests v2.06
 Automatic Calibration Environment release ACE v2.168
 NEWTONS4TH,PPA5531,166-04860,2.185
 Fluke,6105A,176162845,4.14
 NEWTONS4TH,ACC-IV,91K-09999,1.60

Result log

Verify response to Harmonics at Class A limit with 230V 2.3A 50Hz

| | applied | measured harmonic | dev | spec | uncert |
|---------|----------|-------------------|---------|---------|--------------------------|
| OK: H01 | 50.00 Hz | 2.300 A | 2.300 A | 2.299 A | <-0.03%> [5.00%] {0.16%} |
| OK: H02 | 100.0 Hz | 1.080 A | 1.079 A | 1.079 A | <-0.13%> [5.00%] {0.17%} |
| OK: H03 | 150.0 Hz | 2.300 A | 2.299 A | 2.299 A | <-0.05%> [5.00%] {0.16%} |
| OK: H04 | 200.0 Hz | 430.0mA | 430.1mA | 430.2mA | <+0.06%> [5.00%] {0.18%} |
| OK: H05 | 250.0 Hz | 1.140 A | 1.140 A | 1.140 A | <+0.02%> [5.00%] {0.17%} |
| OK: H06 | 300.0 Hz | 300.0mA | 300.2mA | 300.3mA | <+0.11%> [5.00%] {0.19%} |
| OK: H07 | 350.0 Hz | 770.0mA | 769.8mA | 769.5mA | <-0.06%> [5.00%] {0.17%} |
| OK: H08 | 400.0 Hz | 230.0mA | 230.2mA | 229.9mA | <+0.08%> [5.00%] {0.20%} |
| OK: H09 | 450.0 Hz | 400.0mA | 400.0mA | 400.1mA | <+0.06%> [5.00%] {0.18%} |
| OK: H10 | 500.0 Hz | 184.0mA | 184.0mA | 183.9mA | <-0.13%> [5.00%] {0.21%} |
| OK: H11 | 550.0 Hz | 330.0mA | 329.8mA | 330.0mA | <-0.07%> [5.00%] {0.19%} |
| OK: H12 | 600.0 Hz | 153.3mA | 153.2mA | 153.2mA | <-0.08%> [5.00%] {0.23%} |
| OK: H13 | 650.0 Hz | 210.0mA | 209.8mA | 210.1mA | <-0.07%> [5.00%] {0.21%} |
| OK: H14 | 700.0 Hz | 131.4mA | 131.4mA | 131.4mA | <-0.20%> [5.00%] {0.24%} |
| OK: H15 | 750.0 Hz | 150.0mA | 149.9mA | 149.9mA | <-0.07%> [5.00%] {0.23%} |
| OK: H16 | 800.0 Hz | 115.0mA | 115.0mA | 115.0mA | <+0.04%> [5.00%] {0.25%} |
| OK: H17 | 850.0 Hz | 132.4mA | 132.1mA | 132.3mA | <-0.21%> [5.00%] {0.55%} |
| OK: H18 | 900.0 Hz | 102.2mA | 102.2mA | 102.1mA | <-0.13%> [5.00%] {0.57%} |
| OK: H19 | 950.0 Hz | 118.4mA | 118.4mA | 118.1mA | <-0.24%> [5.00%] {0.55%} |
| OK: H20 | 1.000kHz | 92.00mA | 91.88mA | 92.03mA | <+0.21%> [5.00%] {0.58%} |
| OK: H21 | 1.050kHz | 107.1mA | 107.0mA | 107.2mA | <-0.11%> [5.00%] {0.56%} |
| OK: H22 | 1.100kHz | 83.60mA | 83.51mA | 83.45mA | <-0.18%> [5.00%] {0.59%} |
| OK: H23 | 1.150kHz | 97.80mA | 97.77mA | 97.86mA | <+0.06%> [5.00%] {0.57%} |
| OK: H24 | 1.200kHz | 76.70mA | 76.55mA | 76.69mA | <-0.19%> [5.00%] {0.60%} |
| OK: H25 | 1.250kHz | 90.00mA | 89.94mA | 90.07mA | <+0.08%> [5.00%] {0.58%} |
| OK: H26 | 1.300kHz | 78.00mA | 77.91mA | 77.84mA | <-0.20%> [5.00%] {0.60%} |
| OK: H27 | 1.350kHz | 83.30mA | 83.27mA | 83.40mA | <+0.12%> [5.00%] {0.59%} |
| OK: H28 | 1.400kHz | 65.70mA | 65.60mA | 65.77mA | <-0.16%> [5.25%] {0.62%} |
| OK: H29 | 1.450kHz | 77.60mA | 77.50mA | 77.49mA | <-0.14%> [5.00%] {0.60%} |
| OK: H30 | 1.500kHz | 61.30mA | 61.29mA | 61.20mA | <-0.16%> [5.63%] {0.63%} |
| OK: H31 | 1.550kHz | 72.60mA | 72.44mA | 72.58mA | <-0.21%> [5.00%] {0.61%} |
| OK: H32 | 1.600kHz | 57.50mA | 57.38mA | 57.41mA | <-0.21%> [6.00%] {0.64%} |
| OK: H33 | 1.650kHz | 68.20mA | 67.93mA | 68.18mA | <-0.39%> [5.06%] {0.62%} |
| OK: H34 | 1.700kHz | 54.10mA | 54.01mA | 54.07mA | <-0.24%> [6.38%] {0.65%} |
| OK: H35 | 1.750kHz | 64.30mA | 64.04mA | 64.07mA | <-0.40%> [5.37%] {0.63%} |
| OK: H36 | 1.800kHz | 51.10mA | 50.95mA | 51.05mA | <-0.30%> [6.75%] {0.67%} |
| OK: H37 | 1.850kHz | 60.80mA | 60.71mA | 60.76mA | <-0.15%> [5.67%] {0.63%} |
| OK: H38 | 1.900kHz | 48.40mA | 48.35mA | 48.29mA | <-0.23%> [7.13%] {0.68%} |
| OK: H39 | 1.950kHz | 57.70mA | 57.50mA | 57.55mA | <-0.34%> [5.98%] {0.64%} |
| OK: H40 | 2.000kHz | 46.00mA | 45.87mA | 45.99mA | <-0.27%> [7.50%] {0.69%} |

CERTIFICATE OF CALIBRATION

Certificate No: **166-04860180821**
 Date of Issue: 18th August 2021

UKAS IEC61000 Calibration



Verify response to sine/square modulation

| Applied | Measured Pinst max | Dev | Spec | Uncert |
|-----------------------------------|---------------------------------|------------------|---------|--------|
| OK: 50.00Hz 230.0 V 0.5000 Hz sin | 2.3250% 1.000 0.998 0.990 0.998 | <-0.97%> [8.00%] | {0.37%} | |
| OK: 50.00Hz 230.0 V 0.5000 Hz squ | 0.5090% 1.000 1.003 1.002 1.004 | <+0.37%> [8.00%] | {0.39%} | |
| OK: 50.00Hz 230.0 V 1.5000 Hz sin | 1.0670% 1.000 0.998 0.991 0.997 | <-0.93%> [8.00%] | {0.37%} | |
| OK: 50.00Hz 230.0 V 3.5000 Hz squ | 0.3420% 1.000 0.998 0.991 0.997 | <-0.85%> [8.00%] | {0.39%} | |
| OK: 50.00Hz 230.0 V 8.8000 Hz sin | 0.2500% 1.000 1.003 1.005 1.007 | <+0.73%> [8.00%] | {0.37%} | |
| OK: 50.00Hz 230.0 V 8.8000 Hz squ | 0.1960% 1.000 1.013 1.003 1.009 | <+1.29%> [8.00%] | {0.39%} | |
| OK: 50.00Hz 230.0 V 18.000 Hz squ | 0.4460% 1.000 0.996 0.994 0.996 | <-0.62%> [8.00%] | {0.39%} | |
| OK: 50.00Hz 230.0 V 20.000 Hz sin | 0.7040% 1.000 1.006 1.005 1.006 | <+0.62%> [8.00%] | {0.37%} | |
| OK: 50.00Hz 230.0 V 21.500 Hz squ | 0.5920% 1.000 1.001 1.002 0.997 | <-0.34%> [8.00%] | {0.39%} | |
| OK: 50.00Hz 230.0 V 25.000 Hz sin | 1.0370% 1.000 0.996 0.998 0.994 | <-0.55%> [8.00%] | {0.37%} | |
| OK: 50.00Hz 230.0 V 25.000 Hz squ | 0.7640% 1.000 0.996 0.997 0.995 | <-0.48%> [8.00%] | {0.39%} | |
| OK: 50.00Hz 230.0 V 28.000 Hz squ | 0.9150% 1.000 1.004 0.996 0.998 | <+0.43%> [8.00%] | {0.39%} | |
| OK: 50.00Hz 230.0 V 30.500 Hz squ | 0.8470% 1.000 1.003 1.002 1.005 | <+0.49%> [8.00%] | {1.05%} | |
| OK: 50.00Hz 230.0 V 33.333 Hz sin | 2.1280% 1.000 0.992 0.994 0.992 | <-0.83%> [8.00%] | {0.37%} | |
| OK: 50.00Hz 230.0 V 33.333 Hz squ | 1.6710% 1.000 0.992 0.992 0.992 | <-0.79%> [8.00%] | {0.39%} | |

Verify PST = 1 measurement at 50Hz to IEC61000-3-3:2013

| Applied | Measured Pst | Dev | Spec | Uncert |
|-------------------------------------|---------------------------------|------------------|---------|--------|
| OK: 50.00Hz 230.0 V 1.0000 cpm squ | 2.7240% 1.000 0.994 0.993 0.992 | <-0.77%> [5.00%] | {0.25%} | |
| OK: 50.00Hz 230.0 V 2.0000 cpm squ | 2.2110% 1.000 0.997 0.997 0.996 | <-0.42%> [5.00%] | {0.25%} | |
| OK: 50.00Hz 230.0 V 7.0000 cpm squ | 1.4590% 1.000 1.002 1.002 1.001 | <+0.22%> [5.00%] | {0.25%} | |
| OK: 50.00Hz 230.0 V 39.000 cpm squ | 0.9060% 1.000 1.008 1.007 1.007 | <+0.75%> [5.00%] | {0.25%} | |
| OK: 50.00Hz 230.0 V 110.00 cpm squ | 0.7250% 1.000 1.000 1.000 0.999 | <-0.08%> [5.00%] | {0.25%} | |
| OK: 50.00Hz 230.0 V 1620.00 cpm squ | 0.4020% 1.000 0.999 0.999 0.999 | <-0.11%> [5.00%] | {0.25%} | |
| OK: 50.00Hz 230.0 V 4000.00 cpm squ | 2.3430% 1.000 1.003 1.003 1.003 | <+0.32%> [5.00%] | {0.25%} | |

Verify PST = 1 measurement at 50Hz to IEC61000-4-15:2011

| Applied | Measured Pst | Dev | Spec | Uncert |
|-------------------------------------|---------------------------------|------------------|---------|--------|
| OK: 50.00Hz 230.0 V 1.0000 cpm squ | 2.7150% 1.000 0.987 0.989 0.986 | <-1.44%> [5.00%] | {0.25%} | |
| OK: 50.00Hz 230.0 V 2.0000 cpm squ | 2.1910% 1.000 0.990 0.991 0.989 | <-1.11%> [5.00%] | {0.25%} | |
| OK: 50.00Hz 230.0 V 7.0000 cpm squ | 1.4500% 1.000 0.996 0.995 0.995 | <-0.51%> [5.00%] | {0.25%} | |
| OK: 50.00Hz 230.0 V 39.000 cpm squ | 0.8940% 1.000 0.995 0.995 0.994 | <-0.57%> [5.00%] | {0.25%} | |
| OK: 50.00Hz 230.0 V 110.00 cpm squ | 0.7220% 1.000 0.996 0.997 0.996 | <-0.40%> [5.00%] | {0.25%} | |
| OK: 50.00Hz 230.0 V 1620.00 cpm squ | 0.4070% 1.000 1.003 1.003 1.003 | <+0.32%> [5.00%] | {0.25%} | |
| OK: 50.00Hz 230.0 V 4000.00 cpm squ | 2.3430% 1.000 1.003 1.003 1.003 | <+0.32%> [5.00%] | {0.25%} | |

Verify PST range measurement

| Applied | Measured Pst | Dev | Spec | Uncert |
|-------------------------------------|---------------------------------|------------------|---------|--------|
| OK: 50.00Hz 230.0 V 1620.00 cpm squ | 0.1017% 0.250 0.251 0.251 0.251 | <+0.52%> [5.00%] | {0.25%} | |
| OK: 50.00Hz 230.0 V 1620.00 cpm squ | 2.0350% 5.000 4.984 4.984 4.984 | <-0.33%> [5.00%] | {0.25%} | |

Verify frequency changes test

| Applied | Measured Pinst max | Dev | Spec | Uncert |
|---------------------|-----------------------------------|------------------|---------|--------|
| OK: 50.00Hz 230.0 V | PERFREQCH 1.000 1.006 1.005 1.004 | <+0.61%> [8.00%] | {1.50%} | |

CERTIFICATE OF CALIBRATION

UKAS IEC61000 Calibration



Verify distorted voltage with multiple zero crossings test
[----- applied -----] [----- measured Pinst max -----]
dev spec uncert
OK: 50.00Hz 230.0 V DVMULTIZC 1.000 1.005 1.011 <+1.08%> [8.00%] {1.12%}

Verify input bandwidth
[----- applied -----] [----- measured Pinst max -----]
dev spec uncert
OK: 50.00Hz 230.0 V HSIDEBAND 4.000k 1.000 0.965 0.965 0.969 <-3.54%> [8.00%] {1.30%}

Verify phase jumps test
[----- applied -----] [----- measured Pst -----]
dev spec uncert
OK: 50.00Hz 230.0 V PHASEJUMP +30.00 0.913 0.907 0.907 0.907 <-0.67%> [5.00%] {1.00%}
OK: 50.00Hz 230.0 V PHASEJUMP -30.00 0.913 0.918 0.918 0.918 <+0.57%> [5.00%] {1.00%}
OK: 50.00Hz 230.0 V PHASEJUMP +45.00 1.060 1.045 1.045 1.045 <-1.44%> [5.00%] {1.00%}
OK: 50.00Hz 230.0 V PHASEJUMP -45.00 1.060 1.066 1.067 1.065 <+0.63%> [5.00%] {1.00%}

Verify duty cycle test
[----- applied -----] [----- measured Pst -----]
dev spec uncert
OK: 50.00Hz 230.0 V DUTYCYCLE 1.000 0.994 0.994 0.994 <-0.65%> [5.00%] {1.00%}

All 79 tests passed

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service (UKAS). It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory (NPL) or other recognised national metrology institutes. This certificate may not be reproduced other than in full except with the prior written approval of the issuing laboratory.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$ to give a level of confidence of approximately 95%.

Where no uncertainty is shown the measurement is beyond the scope of UKAS accreditation but has been included as an indicative measurement for completeness.

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UKAS IEC61000 Calibration



IEC61000 d(t) test

19 Aug 2021 05:20 Script file: KinetiQ PPA5500 IEC61000 d(t) test v2.00
 Automatic Calibration Environment release ACE v2.168
 NEWTONS4TH,PPA5531,166-04860,2.185

Result log

Verify d(t) test waveforms at 230V 50Hz

| ----- applied ----- | ----- measured ----- | dev | spec | uncert |
|---------------------------------|----------------------|------------------|---------|--------|
| OK: 50.00Hz 230.0 V +2.00% dc | +2.01% +2.00% +2.00% | <+0.25%> [5.00%] | {0.75%} | |
| OK: 50.00Hz 230.0 V +4.00% dmax | +3.96% +3.96% +3.97% | <-1.00%> [5.00%] | {0.37%} | |
| OK: 50.00Hz 230.0 V 500ms tmax | 500ms 500ms 500ms | | | |
| OK: 50.00Hz 230.0 V +1.00% dc | +1.00% +1.01% +1.01% | <+1.38%> [5.00%] | {1.50%} | |
| OK: 50.00Hz 230.0 V +5.00% dmax | +5.04% +5.04% +5.03% | <+0.84%> [5.00%] | {0.30%} | |
| OK: 50.00Hz 230.0 V 600ms tmax | 600ms 600ms 600ms | | | |

Verify d(t) test waveforms at 100V 50Hz

| ----- applied ----- | ----- measured ----- | dev | spec | uncert |
|---------------------------------|----------------------|------------------|---------|--------|
| OK: 50.00Hz 100.0 V +2.00% dc | +2.01% +2.02% +2.00% | <+1.24%> [5.00%] | {0.75%} | |
| OK: 50.00Hz 100.0 V +4.00% dmax | +3.93% +4.09% +3.94% | <+2.37%> [5.00%] | {0.37%} | |
| OK: 50.00Hz 100.0 V 500ms tmax | 500ms 500ms 500ms | | | |
| OK: 50.00Hz 100.0 V +1.00% dc | +1.00% +1.03% +1.03% | <+2.75%> [5.00%] | {1.50%} | |
| OK: 50.00Hz 100.0 V +5.00% dmax | +5.03% +5.05% +5.03% | <+0.92%> [5.00%] | {0.30%} | |
| OK: 50.00Hz 100.0 V 600ms tmax | 600ms 600ms 600ms | | | |

All 12 tests passed

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service (UKAS).

It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory (NPL) or other recognised national metrology institutes. This certificate may not be reproduced other than in full~ except with the prior written approval of the issuing laboratory.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$ to give a level of confidence of approximately 95%.

For clarity all values have been normalised appropriately.