Schedule of Accreditation

issued by

United Kingdom Accreditation Service

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7949

Accredited to ISO/IEC 17025: 2017

Newtons4th Ltd

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Calibration performed at the above address only

DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
CALIBRATION OF AC POWER ANALYSERS			With the exception of calorimetric measurements, the AC Power Analyser capabilities are achieved by a phantom load technique, whereby independent signals (voltage or current) are applied to each channel of the power analyser. The phase and amplitude of these signals, and of their harmonics, are varied to produce the required stimulus. Suitably modulated signals are used for flicker measurements.
Voltage sine amplitude	1 V to 23 V *16 Hz to 45 Hz* *45 Hz to 65 Hz* *65 Hz to 850 Hz* 23 V to 45 V *16 Hz to 45 Hz* *45 Hz to 65 Hz* *65 Hz to 850 Hz* 45 V to 90 V *16 Hz to 45 Hz* *45 Hz to 65 Hz* *65 Hz to 850 Hz* 90 V to 180 V *16 Hz to 45 Hz* *45 Hz to 65 Hz* *65 Hz to 850 Hz* 180 V to 215 V *16 Hz to 850 Hz* *45 Hz to 65 Hz* *65 Hz to 850 Hz* 215 V to 246 V *16 Hz to 45 Hz* *45 Hz to 65 Hz* *65 Hz to 850 Hz* 246 V to 360 V *16 Hz to 850 Hz* *45 Hz to 65 Hz* *65 Hz to 850 Hz*	 90 ppm + 0.20 mV 79 ppm + 0.20 mV 90 ppm + 0.20 mV 86 ppm + 0.40 mV 74 ppm + 0.40 mV 86 ppm + 0.40 mV 85 ppm + 0.80 mV 73 ppm + 0.80 mV 85 ppm + 0.80 mV 90 ppm + 1.6 mV 80 ppm + 1.6 mV 90 ppm + 1.6 mV 87 ppm + 3.2 mV 87 ppm + 3.2 mV 87 ppm + 3.2 mV 87 ppm + 3.2 mV 75 ppm 87 ppm + 3.2 mV 87 ppm + 3.2 mV 87 ppm + 3.2 mV 87 ppm + 3.2 mV	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
Voltage sine amplitude (continued)	360 V to 425 V		
	16 Hz to 45 Hz	86 ppm + 5.8 mV	
	45 Hz to 65 Hz	85 ppm	
	65 Hz to 850 Hz	86 ppm + 5.8 mV	
	425 V to 490 V		
	16 Hz to 45 Hz	86 ppm + 5.8 mV	
	45 Hz to 65 Hz	75 ppm	
	65 Hz to 850 Hz	86 ppm + 5.8 mV	
	490 V to 650 V		
	16 Hz to 45 Hz	86 ppm + 5.8 mV	
	45 Hz to 65 Hz	85 ppm	
	65 Hz to 850 Hz	86 ppm + 5.8 mV	
	650 V to 1008 V		
	16 Hz to 45 Hz	90 ppm + 10 mV	
	45 Hz to 65 Hz	90 ppm + 10 mV	
	65 Hz to 850 Hz	90 ppm + 10 mV	
Voltage harmonic amplitude	0 V to 6.9 V Total rms 1 V to 23 V		
	16 Hz to 850 Hz	600 ppm + 1.0 mV	
	850 Hz to 6 kHz	1300 ppm + 1.0 mV	
	0 V to 13.5 V Total rms 23 V to 45 V		
	16 Hz to 850 Hz	600 ppm + 2.0 mV	
	850 Hz to 6 kHz	1300 ppm + 2.0 mV	
	0 V to 27 V Total rms 45 V to 90 V		
	16 Hz to 850 Hz	600 ppm + 2.2 mV	
	850 Hz to 6 kHz	1300 ppm + 2.2 mV	
	0 V to 54 V Total rms 90 V to 180 V		
	16 Hz to 850 Hz	600 ppm + 4.4 mV	
	850 Hz to 6 kHz	1300 ppm + 4.4 mV	
	0 V to 108 V Total rms 180 V to 360 V		
	16 Hz to 850 Hz	600 ppm + 12 mV	
	850 Hz to 6 kHz	1300 ppm + 12 mV	
	0 V to 195 V Total rms 360 V to 650 V		
	16 Hz to 850 Hz	600 ppm + 22 mV	
	850 Hz to 6 kHz	1300 ppm + 22 mV	
	0 V to 302 V Total rms 650 V to 1008 V		
	16 Hz to 850 Hz	600 ppm + 33 mV	
	850 Hz to 6 kHz	1300 ppm + 33 mV	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
Current sine amplitude	100 mA to 250 mA		
	16 Hz to 45 Hz	108 ppm + 5.0 µA	
	45 Hz to 65 Hz	101 ppm + 2.5 µA	
	65 Hz to 850 Hz	108 ppm + 5.0 µA	
	250 mA to 500 mA		
	16 Hz to 45 Hz	85 ppm + 10 µA	
	45 Hz to 65 Hz	75 ppm + 5.0 µA	
	65 Hz to 850 Hz	85 ppm + 10 µA	
	0.5 A to 1 A		
	16 Hz to 45 Hz	89 ppm + 20 µA	
	45 Hz to 65 Hz	80 ppm + 10 µA	
	65 Hz to 850 Hz	89 ppm + 20 µA	
	1 A to 2 A		
	16 Hz to 45 Hz	89 ppm + 40 µA	
	45 Hz to 65 Hz	80 ppm + 20 µA	
	65 Hz to 850 Hz	89 ppm + 40 µA	
	2 A to 5 A		
	16 Hz to 45 Hz	88 ppm + 100 µA	
	45 Hz to 65 Hz	78 ppm + 50 µA	
	65 Hz to 850 Hz	88 ppm + 100 µA	
	5 A to 10 A		
	16 Hz to 45 Hz	92 ppm + 200 µA	
	45 Hz to 65 Hz	82 ppm + 100 µA	
	65 Hz to 850 Hz	92 ppm + 200 µA	
	10 A to 21 A		
	16 Hz to 45 Hz	95 ppm + 400 µA	
	45 Hz to 65 Hz	82 ppm + 200 µA	
	65 Hz to 850 Hz	95 ppm + 400 µA	
	21 A to 48 A		
	16 Hz to 45 Hz	142 ppm + 1.0 mA	
	45 Hz to 65 Hz	93 ppm + 0.50 mA	
	65 Hz to 850 Hz	142 ppm + 1.0 mA	
Current harmonic amplitude	Harmonic 0 A to 75 mA Total rms 100 mA to 250 mA		
	16 Hz to 850 Hz	610 ppm + 5.0 µA	
	850 Hz to 6 kHz	1800 ppm + 5.0 µA	
	Harmonic 0 A to 150 mA Total rms 250 mA to 500 mA		
	16 Hz to 850 Hz	610 ppm + 10 µA	
	850 Hz to 6 kHz	1800 ppm + 10 µA	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
Current harmonic amplitude (continued)	Harmonic 0 A to 300 mA Total rms 500 mA to 1 A *16 Hz to 850 Hz* *850 Hz to 6 kHz*	 610 ppm + 20 µA 1800 ppm + 20 µA	
	Harmonic 0 A to 600 mA Total rms 1 A to 2 A *16 Hz to 850 Hz* *850 Hz to 6 kHz*	 610 ppm + 40 µA 1800 ppm + 40 µA	
	Harmonic 0 mA to 1.5 A Total rms 2 A to 5 A *16 Hz to 850 Hz* *850 Hz to 6 kHz*	 610 ppm + 100 µA 1800 ppm + 100 µA	
	Harmonic 0 A to 3 A Total rms 5 A to 10 A *16 Hz to 850 Hz* *850 Hz to 6 kHz*	 610 ppm + 200 µA 1800 ppm + 200 µA	
	Harmonic 0 A to 6 A Total rms 10 A to 21 A *16 Hz to 850 Hz* *850 Hz to 6 kHz*	 610 ppm + 400 µA 1800 ppm + 400 µA	
	Harmonic 0 A to 15 A Total rms 21 A to 50 A *16 Hz to 850 Hz* *850 Hz to 6 kHz*	 610 ppm + 1.0 mA 1800 ppm + 1.0 mA	
Current to voltage phase angle	-180° to +180° *16 Hz to 45 Hz* *45 Hz to 65 Hz* *65 Hz to 69 Hz* *69 Hz to 180 Hz* *180 Hz to 450 Hz* *450 Hz to 850 Hz*	 3.1 m° 2.4 m° 3.2 m° 7.1 m° 18 m° 33 m°	
Apparent power (VA product)	100 mVA to 48.4 kVA *16 Hz to 850 Hz*	 The RSS summation of the uncertainties for voltage and current.	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
AC Power	Harmonic 0 W to 48.4 kW *16 Hz to 850 Hz*	The RSS summation of the uncertainties for voltage, current and cos(φ).	For power factors between 0 and unity, leading or lagging. The uncertainties at low power factors may be stated in absolute terms or as a fraction of the VA product. NOTE: For typical input voltages of 115 V and 230 V, the minimum power at unity p.f. is 5.5 W and 11 W respectively. Lower powers for these voltages can be obtained by using lower power factors.
Current harmonic amplitude to IEC61000-4-7	Harmonic 0 A to 75 mA Total rms 100 mA to 250 mA *16 Hz to 850 Hz* *850 Hz to 6 kHz*	 0.16 % + 5.0 µA 0.47 % + 5.0 µA	
	Harmonic 0 A to 150 mA Total rms 250 mA to 500 mA *16 Hz to 850 Hz* *850 Hz to 6 kHz*	 0.16 % + 10 µA 0.47 % + 10 µA	
	Harmonic 0 A to 300 mA Total rms 500 mA to 1 A *16 Hz to 850 Hz* *850 Hz to 6 kHz*	 0.16 % + 20 µA 0.47 % + 20 µA	
	Harmonic 0 A to 600 mA Total rms 1 A to 2 A *16 Hz to 850 Hz* *850 Hz to 6 kHz*	 0.16 % + 40 µA 0.47 % + 40 µA	
	Harmonic 0 mA to 1.5 A Total rms 2 A to 5 A *16 Hz to 850 Hz* *850 Hz to 6 kHz*	 0.16 % + 100 µA 0.47 % + 100 µA	
	Harmonic 0 A to 3 A Total rms 5 A to 10 A *16 Hz to 850 Hz* *850 Hz to 6 kHz*	 0.16 % + 200 µA 0.47 % + 200 µA	
	Harmonic 0 A to 6 A Total rms 10 A to 21 A *16 Hz to 850 Hz* *850 Hz to 6 kHz*	 0.16 % + 400 µA 0.47 % + 400 µA	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
Flicker to IEC61000-4-15	Pinst (sinusoidal modulation) Pinst (rectangular modulation) f_{mod} 0.5 Hz to 30 Hz f_{mod} 30.5Hz f_{mod} 31 Hz to 33.33 Hz Pst	0.36 % 0.39 % 1.0 % 0.39 % 0.25 %	
	d_c and d_{max} 0 % to 5 %	0.015 % of steady state	With respect to a nominal steady state of 100 V to 230 V at 50 Hz.
	T_{max}	Half cycle count	This is a counting function and therefore there is no associated uncertainty. The results may also be reported as time corresponding to the nominal frequency (1/2f).
	Frequency changes Distorted voltage with multiple zero crossings Harmonics with sidebands Phase jumps Rectangular changes with duty cycle	1.5 % 1.1 % 1.3 % 1.0 % 1.0 %	
Wideband Power Measurement	*45 Hz to 2 MHz* 1 W to 2 W 2 W to 5 W	 0.28 % 0.21 %	Measured using bespoke calorimeter
CALIBRATION OF IMPEDANCE NETWORKS	*16 Hz to 850 Hz:*		Impedances are derived from the voltage and current signals described in Page 1.
Resistance	33 mΩ to 400 Ω	0.48 % to 0.10 %	Phase angle 0° to ±85°
Reactance	33 mΩ to 400 Ω	0.48 % to 0.10 %	Phase angle ±5° to ±90°

END

Appendix - Calibration and Measurement Capabilities

Introduction

The definitive statement of the accreditation status of a calibration laboratory is the Accreditation Certificate and the associated Schedule of Accreditation. This Schedule of Accreditation is a critical document, as it defines the measurement capabilities, ranges and boundaries of the calibration activities for which the organisation holds accreditation.

Calibration and Measurement Capabilities (CMCs)

The capabilities provided by accredited calibration laboratories are described by the Calibration and Measurement Capability (CMC), which expresses the lowest uncertainty of measurement that can be achieved during a calibration. If a particular device under calibration itself contributes significantly to the uncertainty (for example, if it has limited resolution or exhibits significant non-repeatability) then the uncertainty quoted on a calibration certificate will be increased to account for such factors. The CIPM-ILAC definition of the CMC is as follows:

A CMC is a calibration and measurement capability available to customers under normal conditions:
(a) as published in the BIPM key comparison database (KCDB) of the CIPM MRA; or
(b) as described in the laboratory's scope of accreditation granted by a signatory to the ILAC Arrangement.

The CMC is normally used to describe the uncertainty that appears in an accredited calibration laboratory's schedule of accreditation and is the uncertainty for which the laboratory has been accredited using the procedure that was the subject of assessment. The CMC is calculated according to the procedures given in M3003 and is normally stated as an expanded uncertainty at a coverage probability of 95 %, which usually requires the use of a coverage factor of $k = 2$. An accredited laboratory is not permitted to quote an uncertainty that is smaller than the published CMC in certificates issued under its accreditation.

The CMC may be described using various methods in the Schedule of Accreditation:

As a single value that is valid throughout the range.
As an explicit function of the measurand or of a parameter (see below).
As a range of values. The range is stated such that the customer can make a reasonable estimate of the likely uncertainty at any point within the range.
As a matrix or table where the CMCs depend on the values of the measurand and a further quantity.
In graphical form, providing there is sufficient resolution on each axis to obtain at least two significant figures for the CMC.

Expression of CMCs - symbols and units

In general, only units of the SI and those units recognised for use with the SI are used to express the values of quantities and of the associated CMCs. Nevertheless, other commonly used units may be used where considered appropriate for the intended audience. For example, the term "ppm" (part per million) is frequently used by manufacturers of test and measurement equipment to specify the performance of their products. Terms like this may be used in Schedules of Accreditation where they are in common use and understood by the users of such equipment, providing their use does not introduce any ambiguity in the capability that is being described.

When the CMC is expressed as an explicit function of the measurand or of a parameter, this often comprises a relative term (e.g., percentage) and an absolute term, i.e. one expressed in the same units as those of the measurand. This form of expression is used to describe the capability that can be achieved over a range of values. Some examples are shown below. It should be noted that these expressions are *not* mathematical formulae but are instead written in a commonly used shorthand for expressing uncertainties - therefore, for purposes of clarity, an indication of how they are to be interpreted is also provided below.

DC voltage, 100 mV to 1 V: 0.0025 % + 5.0 µV

Over the range 100 mV to 1 V, the CMC is 0.0025 %·V + 5.0 µV, where V is the measured voltage.

Hydraulic pressure, 0.5 MPa to 140 MPa: 0.0036 % + 0.12 ppm/MPa + 4.0 Pa

Over the range 0.5 MPa to 140 MPa, the CMC is $0.0036\ \%\cdot p + (0.12\cdot 10^{-6}\cdot p\cdot 10^{-6}) + 4.0$ Pa, where p is the measured pressure in Pa.

It should be noted that the percentage symbol (%) simply represents the number 0.01. In cases where the CMC is stated only as a percentage, this is to be interpreted as meaning percentage of the measured value or indication.

Thus, for example, a CMC of 1.5 % means $1.5 \cdot 0.01 \cdot i$, where i is the instrument indication.