Schedule of Accreditation

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Accredited to ISO/IEC 17025:2005

Seaward Electronic 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
ELECTRICAL CALIBRATION			
DC VOLTAGE			
Generation	0 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1000 V	31 ppm + 3.7 µV 32 ppm + 4.8 µV 26 ppm + 45 µV 31 ppm + 0.46 mV 31 ppm + 4.6 mV	
Measurement	0 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1000 V	44 ppm +2.9 µV 14 ppm + 1.2 µV 12 ppm + 4.3 µV 18 ppm + 46 µV 18 ppm + 0.23 mV	
DC RESISTANCE			
Generation	10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 GΩ	6.9 mΩ 12 mΩ 94 mΩ 0.94 Ω 9.4 Ω 0.16 kΩ 4.6 kΩ 0.59 MΩ 14 MΩ	Nominal values obtained from a multi-function calibrator for calibration of multimeters, resistance meters etc.
	100 µΩ 1 mΩ 10 mΩ 100 mΩ 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ	20 ppm 15 ppm 8.0 ppm 7.6 ppm 6.9 ppm 6.6 ppm 13 ppm 7.7 ppm 10 ppm 6.5 ppm 7.9 ppm	Standard resistors available for calibration of resistance bridges, long-scale multimeters etc.

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (*k*=2)	Remarks
DC RESISTANCE (continued)			
Measurement	1 mΩ	47 ppm	Calibration of standard resistors
	10 mΩ	24 ppm	
	100 mΩ	10 ppm	
	1 Ω	8.9 ppm	
	10 Ω	9.2 ppm	
	100 Ω	12 ppm	
	1 kΩ	9.2 ppm	
	10 kΩ	11 ppm	
	100 kΩ	9.1 ppm	
	1 MΩ	8.9 ppm	
	100 µΩ to 2 mΩ	46 ppm + 0.012 µΩ	Calibration of standard resistors, decade resistance boxes etc.
	2 mΩ to 20 mΩ	22 ppm + 0.12 µΩ	
	20 mΩ to 200 mΩ	9.9 ppm + 0.12 µΩ	
	200 mΩ to 2 Ω	8.9 ppm + 0.46 µΩ	
	2 Ω to 20 Ω	9.2 ppm + 4.6 µΩ	
	20 Ω to 200 Ω	12 ppm + 46 µΩ	
	200 Ω to 2 kΩ	9.2 ppm + 0.46 mΩ	
	2 kΩ to 20 kΩ	11 ppm + 6.9 mΩ	
	20 kΩ to 200 kΩ	9.0 ppm + 69 mΩ	
	200 kΩ to 2 MΩ	8.9 ppm + 0.12 Ω	
	2 MΩ to 20 MΩ	36 ppm + 860 Ω	
	20 MΩ to 200 MΩ	0.035 % + 65 kΩ	
	200 MΩ to 2 GΩ	0.23 % + 200 kΩ	
High resistance/high voltage Measurement	0.1 MΩ to 1 MΩ	0.060 %	The applied voltages will be in the range 10 V to 1000 V DC
	1 MΩ to 10 MΩ	0.059 %	
	10 MΩ to 100 MΩ	0.061 %	
	100 MΩ to 1 GΩ	0.053 %	
	1 GΩ to 10 GΩ	0.054 %	
	10 GΩ to 100 GΩ	0.072 %	
	100 GΩ to 1 TΩ	0.25 %	
	1 MΩ to 10 MΩ	0.32 %	The applied voltages will be in the range 1 kV to 5 kV DC
	10 MΩ to 100 MΩ	0.31 %	
	100 MΩ to 1 GΩ	0.31 %	
	1 GΩ to 10 GΩ	0.31 %	
	10 GΩ to 100 GΩ	0.37 %	
	100 GΩ to 1 TΩ	0.44 %	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
AC VOLTAGE			
Measurement	20 mV to 200 mV		
	45 Hz to 55 Hz	0.012 % + 45 µV	
	55 Hz to 1 kHz	0.012 % + 61 µV	
	200 mV to 2 V		
	45 Hz to 100 Hz	92 ppm + 0.35 mV	
	100 Hz to 1 kHz	70 ppm + 0.35 mV	
	1 kHz to 2 kHz	74 ppm + 0.49 mV	
	2 kHz to 10 kHz	92 ppm + 1.1 mV	
	2 V to 20 V		
	45 Hz to 100 Hz	93 ppm + 3.2 mV	
	100 Hz to 2 kHz	77 ppm + 1.6 mV	
	2 kHz to 10 kHz	93 ppm + 4.7 mV	
	20 V to 200 V		
	45 Hz to 100 Hz	92 ppm + 33 mV	
	100 Hz to 1 kHz	72 ppm + 33 mV	
	200 V to 1000 V		
	45 Hz to 100 Hz	94 ppm + 0.27V	
	100 Hz to 1 kHz	93 ppm + 0.78V	
Generation	20 mV to 200 mV		
	45 Hz to 1 kHz	0.040 % + 43 µV	
	1 kHz to 10 kHz	0.083 % + 54 µV	
	200 mV to 2 V		
	45 Hz to 1 kHz	0.037 % + 0.11 mV	
	1 kHz to 10 kHz	0.074 % + 0.16 mV	
	2 V to 20 V		
	45 Hz to 1 kHz	0.035 % + 1.0 mV	
	1 kHz to 10 kHz	0.064 % + 1.6 mV	
	20 V to 200 V		
	45 Hz to 1 kHz	0.037 % + 8.7 mV	
	1 kHz to 10 kHz	0.085 % + 46 mV	
	200 V to 1000 V		Minimum frequency 46 Hz above 700 V
	45 Hz to 1 kHz	0.037 % + 87 mV	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
DC CURRENT			
Generation	0 μA to 200 μA	94 ppm + 37 nA	
	200 μA to 2 mA	83 ppm + 68 nA	
	2 mA to 20 mA	57 ppm + 0.69 μA	
	20 mA to 200 mA	120 ppm + 3.6 μA	
	200 mA to 2 A	0.015 % + 40 μA	
	2 A to 10 A	0.035 % + 0.49 mA	
	10 A to 20 A	0.035 % + 0.79 mA	
Calibration of clamp-on ammeters using multi-turn coil	20 A to 100 A	0.55 % + 0.48 A	Hall effect clamps
	100 A to 1000 A	0.33 % + 46 mA	Wound clamps
Measurement	0 μA to 200 μA	29 ppm + 25 nA	
	200 μA to 2 mA	29 ppm + 0.11 μA	
	2 mA to 20 mA	29 ppm + 1.0 μA	
	20 mA to 200 mA	58 ppm + 14 μA	
	200 mA to 2 A	170 ppm + 0.33 mA	
AC CURRENT			
Generation	*45 Hz to 500 Hz:*		
	20 μA to 200 μA	0.12 % + 0.50 μA	
	200 μA to 2 mA	0.087 % + 0.61 μA	
	2 mA to 20 mA	0.086 % + 4.6 μA	
	20 mA to 200 mA	0.086 % + 46 μA	
	200 mA to 2 A	0.098 % + 0.46 mA	
	45 Hz to 100 Hz:		
	2 A to 20 A	0.060 % + 2.9 mA	
Calibration of clamp-on ammeters using multi-turn coil	*40 Hz to 60 Hz:*		
	20 A to 1000 A	0.55 % + 0.48 A	Hall effect clamps
	20 A to 1000 A	0.33 % + 46 mA	Wound clamps
Measurement	*50 Hz to 200 Hz:*		
	2 μA to 200 μA	0.024 % + 330 nA	
	200 μA to 2 mA	0.026 % + 1.8 μA	
	2 mA to 20 mA	0.024 % + 35 μA	
	20 mA to 200 mA	0.024 % + 180 μA	
	200 mA to 2 A	0.059 % + 1.7 mA	
FREQUENCY	1 Hz to 10 Hz	11 ppm + (0.62 mHz to 1.3 mHz)	
	10 Hz to 100 Hz	11 ppm + 1.3 mHz	
	100 Hz to 1 kHz	11 ppm + (1.3 mHz to 1.2 mHz)	
	1 kHz to 10 kHz	11 ppm + 1.2 mHz	
	10 kHz to 100 kHz	11 ppm + (1.2 mHz to 1.3 mHz)	
	100 kHz to 1 MHz	11 ppm + (1.3 mHz to 5.9 mHz)	
	1 MHz to 10 MHz	11 ppm + (5.9 mHz to 58 mHz)	
	10 MHz to 100 MHz	11 ppm + (58 mHz to 0.58 Hz)	
	100 MHz to 1 GHz	11 ppm + (0.58 Hz to 5.8 Hz)	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
Calibration of Portable Appliance Testers			
Earth Bond	*At 50 Hz:*		
	0.05 Ω	1.2 %	
	0.09 Ω	0.67 %	
	0.1 Ω	0.62 %	
	0.115 Ω	0.54 %	
	0.2 Ω	0.34 %	
	0.33 Ω	0.30 %	
	0.45 Ω	0.28 %	
	0.5 Ω	0.24 %	
	0.575 Ω	0.25 %	
	1.0 Ω	0.20 %	
	3.3 Ω	0.29 %	
	5.0 Ω	0.24 %	
	10 Ω	0.19 %	
	15 Ω	0.18 %	
	18 Ω	0.18 %	
Insulation Resistance	*At DC:*		
	0.25 MΩ	0.25 %	
	0.5 MΩ	0.13 %	
	1.0 MΩ	0.077 %	
	2.0 MΩ	0.060 %	
	4.0 MΩ	0.062 %	
	5.0 MΩ	0.066 %	
	6.0 MΩ	0.052 %	
	10 MΩ	0.051 %	
	15 MΩ	0.068 %	
	18 MΩ	0.064 %	
	50 MΩ	0.083 %	
	90 MΩ	0.12 %	
Insulation Resistance Test Voltage	100 V	0.094 %	
	250 V	0.073 %	
	500 V	0.13 %	
	1000 V	0.11 %	
Leakage Current	*DC:*		
	0 μA to 320 μA	0.12 % + 0.051 μA	
	320 μA to 3.2 mA	0.069 % + 0.23 μA	
	3 mA to 32 mA	0.11 % + 2.3 μA	
	50 Hz to 60 Hz:		
	0 mA to 1.6 mA	0.29 % + 0.40 μA	
	1.6 mA to 16 mA	0.35 % + 3.8 μA	
	16 mA to 20 mA	0.35 % + 39 μA	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
Calibration of Portable Appliance Testers (continued)			
Flash Test	*DC, 50 Hz and 60 Hz:*		These capabilities also apply to flash testers and high voltage meters.
	Current (0 mA to 32 mA)	See *Leakage Current* above	
	Voltage *(AC, 50 Hz and 60 Hz)*		
	1 kV	12 V	
	1.5 kV	13 V	
	2 kV	17 V	
	3 kV	21 V	
	4 kV	28 V	
	5 kV	35 V	
	Voltage *(DC)*		
	1 kV	10 V	
	2 kV	12 V	
	3 kV	13 V	
	4 kV	14 V	
	5 kV	20 V	
	6 kV	32 V	
Load Test	*At 50 Hz:*		
	1 kVA and 3 kVA nominal	1.5 % + 0.015 kVA	
Calibration of RCD Testers			
Trip Current	*At 50 Hz:*		
	10 mA to 100 mA	1.4 % + 0.083 mA	
	100 mA to 2 A	1.4 % + 0.83 mA	
Trip Time	20 ms to 100 ms	0.96 ms	
	100 ms to 400 ms	1.5 ms	
	400 ms to 700 ms	4.8 ms	
	700 ms to 900 ms	8.5 ms	
Calibration of Loop Testers			
Loop impedance	*At 50 Hz:*		
	0.5 Ω to 1 kΩ	(0.60 % to 0.80 %) + 4.6 mΩ	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
CALIBRATION OF SEAWARD PV100/PV150 SOLAR INSTALLATION METERS			The accreditation for calibration of these instruments includes the expression of opinions relating to the effects of storage periods of up to six months on the calibration validity.
Insulation Resistance	0.5 MΩ 1 MΩ 10 MΩ 90 MΩ 190 MΩ	10 kΩ 10 kΩ 100 kΩ 100 kΩ 1.0 MΩ	At 500 V DC
	0.25 MΩ 90 MΩ	10 kΩ 1.0 MΩ	At 250 V DC
	1 MΩ 90 MΩ	10 kΩ 1.0 MΩ	At 1000 V DC
Insulation Voltage	250 V 500 V	1.0 V 1.0 V	Into 1 mA load Into 1 mA load
Continuity Resistance	0.67 Ω 1.2 Ω 10.5 Ω 100 Ω 190 Ω	10 mΩ 10 mΩ 100 mΩ 1.0 Ω 1.0 Ω	
Current clamp input	100 mV (10 A simulation) 199 mV (20 A simulation) 500 mV (50 A simulation)	100 mA 100 mA 100 mA	Simulation of current clamp at 100 A/V
RPE Voltage	110 V 240 V 420 V	1.0 V 1.0 V 1.0 V	
Open circuit panel voltage	10.9 V 49.9 V 202 V 440 V 640 V 900 V	100 mV 100 mV 1.0 V 1.0 V 1.0 V 1.0 V	DC voltage
Short circuit current	0.97 A 2.7 A 8 A	10 mA 20 mA 50 mA	DC Current

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
CALIBRATION OF DEFIBRILLATOR TESTERS			
Energy	20 J to 70 J 70 J to 100 J 100 J to 360 J	1.5 % to 1.3 % 1.3 % to 1.2 % 1.2 %	
CALIBRATION OF TEMPERATURE INDICATORS			By electrical simulation
PT100 indicators	- 125 °C to 0 °C 0 °C to 130 °C 130 °C to 266 °C 266 °C to 408 °C 408 °C to 558 °C 558 °C to 715 °C 715 °C to 883 °C	0.0025 °C to 0.0047 °C 0.0047 °C to 0.0070 °C 0.0070 °C to 0.0096 °C 0.0096 °C to 0.012 °C 0.012 °C to 0.015 °C 0.015 °C to 0.018 °C 0.018 °C to 0.021 °C	
PT25 indicators	5 °C to 408 °C 408 °C to 883 °C	0.0056 °C to 0.013 °C 0.013 °C to 0.024 °C	
Type K thermocouple indicators	- 190 °C to - 154 °C - 154 °C to - 115 °C - 115 °C to - 82 °C - 82 °C to - 53 °C - 53 °C to - 26 °C - 26 °C to 0 °C 0 °C to 25 °C 25 °C to 122 °C 122 °C to 246 °C 246 °C to 1370 °C	0.26 °C to 0.20 °C 0.20 °C to 0.17 °C 0.17 °C to 0.16 °C 0.16 °C 0.15 °C 0.15 °C 0.15 °C 0.15 °C to 0.14 °C 0.14 °C to 0.16 °C 0.16 °C	
PRESSURE CALIBRATION			
Gas Pressure, Gauge	- 85 kPa to 0.0 kPa 0.0 kPa to 50 kPa 50 kPa to 1.0 MPa 1.0 MPa to 2.0 MPa	1.0 kPa 24 Pa 1.1 kPa 1.0 kPa	

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, and an indication of how they are to be interpreted, are shown below.

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

Over the range 100 mV to 1 V, the CMC is $0.0025\ \% \cdot V + 5.0\ \mu V$, 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.