Schedule of Accreditation

issued by

United Kingdom Accreditation Service

2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK

10039

Accredited to ISO/IEC 17025:2005

MCS Test Equipment Limited

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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
DC Voltage			
Generation			
	0 V to 330 mV	30 ppm + 2.1 µV	
	330 mV to 3.3 V	20 ppm + 7.0 µV	
	3.3 V to 33 V	20 ppm + 120 µV	
	33 V to 330 V	30 ppm + 1.0 mV	
	330 V to 1020 V	30 ppm + 4.0 mV	
Measurement			
	0 V to 100 mV	10 ppm + 2.1 µV	
	100 mV to 1 V	18 ppm + 7.0 µV	
	1 V to 10 V	25 ppm + 120 µV	
	10 V to 100 V	55 ppm + 1.0 mV	
	100 V to 1000 V	70 ppm + 4.0 mV	
Resistance			
Generation			
	0 Ω to 11 Ω	100 ppm + 6.0 mΩ	
	11 Ω to 33 Ω	100 ppm + 40 mΩ	
	33 Ω to 110 Ω	100 ppm + 40 mΩ	
	110 Ω to 330 Ω	100 ppm + 200 mΩ	
	330 Ω to 1.1 kΩ	100 ppm + 500 mΩ	
	1.1 kΩ to 3.3 kΩ	100 ppm + 700 mΩ	
	3.3 kΩ to 11 kΩ	100 ppm + 500 mΩ	
	11 kΩ to 33 kΩ	100 ppm + 2.0 Ω	
	33 kΩ to 110 kΩ	100 ppm + 20 Ω	
	110 kΩ to 330 kΩ	100 ppm + 5.0 kΩ	
	330 kΩ to 1.1 MΩ	100 ppm + 2.1 kΩ	
	1.1 MΩ to 3.3 MΩ	100 ppm + 6.0 kΩ	
	3.3 MΩ to 11 MΩ	200 ppm + 3.0 kΩ	
	11 MΩ to 33 MΩ	400 ppm + 7.5 kΩ	
	33 MΩ to 110 MΩ	700 ppm + 20 kΩ	
Measurement			
	0 Ω to 100 Ω	150 ppm + 2.1 mΩ	
	100 Ω to 1 kΩ	150 ppm + 690 mΩ	
	1 kΩ to 10 kΩ	150 ppm + 7.0 Ω	
	10 kΩ to 100 kΩ	150 ppm + 120 Ω	
	100 kΩ to 1 MΩ	150 ppm + 1.2 kΩ	
	1 MΩ to 10 MΩ	550 ppm + 12 kΩ	
	10 MΩ to 100 MΩ	0.27 % + 350 kΩ	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
DC Current			
Generation			
	0 A to 330 µA	200 ppm + 30 nA	
	330 µA to 3.3 mA	200 ppm + 70 nA	
	3.3 mA to 33 mA	200 ppm + 300 nA	
	33 mA to 330 mA	200 ppm + 10 µA	
	330 mA to 3.3 A	500 ppm + 140 µA	
	3.3 A to 11 A	700 ppm + 2.0 mA	
Measurement			
	0 A to 20 mA	770 ppm + 2.5 µA	
	20 mA to 100 mA	470 ppm + 95 µA	
	100 mA to 1 A	0.12 % + 500 µA	
	1 A to 3 A	0.14 % + 2.5 mA	
AC Voltage			
Generation			
	10 Hz to 45 Hz		
	33 mV to 330 mV	0.040 % + 27 µV	
	330 mV to 3.3 V	0.050 % + 70 µV	
	3.3 V to 33 V	0.050 % + 3.5 mV	
	45 Hz to 1 kHz		
	30 µV to 33 mV	0.20 % + 8.0 µV	
	33 V to 330 V	0.030 % + 17 mV	
	330 V to 1 kV	0.040 % + 40 mV	
	45 Hz to 10 kHz		
	33 mV to 330 mV	0.020 % + 12 µV	
	330 mV to 3.3 V	0.020 % +130 µV	
	3.3 V to 33 V	0.020 % + 5.0 mV	
	1 kHz to 10 kHz		
	33 V to 330 V	0.030 % + 13 mV	
	10 kHz to 20 kHz		
	33 mV to 330 mV	0.020 % + 12 µV	
	330 mV to 3.3 V	0.030 % +130 µV	
	3.3 V to 33 V	0.040 % + 2.0 mV	
	33 V to 330 V	0.030 % + 27 mV	
	20 kHz to 50 kHz		
	33 mV to 330 mV	0.050 % + 16 µV	
	330 mV to 3.3 V	0.040 % +130 µV	
	3.3 V to 33 V	0.050 % + 2.0 mV	
	33 V to 330 V	0.040 % + 27 mV	
	50 kHz to 100 kHz		
	33 mV to 330 mV	0.10 % + 38 µV	
	330 mV to 3.3 V	0.10 % + 3.5 mV	
	3.3 V to 33 V	0.20 % + 4.0 mV	
	33 V to 330 V	0.30 % + 95 mV	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
AC Voltage (continued)			
Generation (continued)			
	100 kHz to 500 kHz		
	33 mV to 330 mV	0.30 % + 5.0 mV	
	330 mV to 3.3 V	0.30 % + 35 mV	
Measurement			
	10 Hz to 20 kHz		
	10 mV to 100 mV	0.10 % + 37 µV	
	100 mV to 1 V	0.10 % + 110 µV	
	1 V to 10 V	0.10 % + 12 mV	
	10 V to 100 V	0.10 % + 37 mV	
	10 Hz to 1 kHz		
	100 V to 750 V	0.10 % + 88 mV	
	20 kHz to 50 kHz		
	10 mV to 100 mV	0.20 % + 72 µV	
	100 mV to 1 V	0.20 % + 600 µV	
	1 V to 10 V	0.20 % + 6.5 mV	
	10 V to 100 V	0.20 % + 65 mV	
	50 kHz to 100 kHz		
	100 mV to 1 V	1.0 % + 990 µV	
	1 V to 10 V	0.95 % + 9.5 mV	
	100 kHz to 300 kHz		
	1 V to 10 V	6.2 % + 65 mV	
AC Current			
Generation			
	45 Hz to 1 kHz		
	30 µA to 3.3 mA	0.20 % + 800 nA	
	3.3 mA to 33 mA	0.070 % + 4.5 µA	
	33 mA to 330 mA	0.070 % + 5.5 mA	
	330 mA to 1.1 A	0.080 % + 16 mA	
	1.1 A to 3.3 A	0.80 % + 80 mA	
	1 kHz to 5 kHz		
	30 µA to 3.3 mA	0.35 % + 3.5 µA	
	3.3 mA to 33 mA	0.15 % + 8.0 µA	
	33 mA to 330 mA	0.20 % + 150 µA	
	330 mA to 1.1 A	1.0 % + 5.5 mA	
	1.1 A to 3.3 A	1.0 % + 45 mA	
	5 kHz to 10 kHz		
	30 µA to 3.3 mA	0.80 % + 3.5 µA	
	3.3 mA to 33 mA	0.35 % + 8.5 µA	
	33 mA to 330 mA	0.35 % + 2.1 mA	
	330 mA to 1.1 A	4.0 % + 15 mA	
	1.1 A to 3.3 A	4.0 % + 70 mA	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
AC Current (continued)			
Generation (continued)			
	10 kHz to 30 kHz		
	30 µA to 3.3 mA	1.6 % + 4.5 µA	
	3.3 mA to 33 mA	0.65 % + 9.5 µA	
	33 mA to 330 mA	0.65 % + 350 µA	
	3.3 A to 11 A		
	45 Hz to 100 Hz	0.10 % + 3.0 mA	
	100 Hz to 1 kHz	2.0 % + 3.0 mA	
	1 kHz to 5 kHz	5.0 % + 3.0 mA	
Measurement			
	10 Hz to 3 kHz		
	100 mA to 1 A	0.040 % + 27 mA	
	1 A to 3 A	0.050 %+ 70 mA	
	3 kHz to 5 kHz		
	1 A to 3 A	0.30 % + 210 mA	
Capacitance			
Sourcing by simulation			
	1.1 nF to 3.3 nF	0.60 % + 25 pF	
	3.3 nF to 11 nF	0.30 % + 40 pF	
	11 nF to 33 nF	0.30 % + 160 pF	
	33 nF to 110 nF	0.30 % + 370 pF	
	110 nF to 330 nF	0.30 % + 1.0 nF	
	330 nF to 1.1 µF	0.30 % + 750 pF	
	1.1 µF to 3.3 µF	0.30 % + 11 nF	
	3.3 µF to 11 µF	0.30 % + 40 pF	
	11 µF to 33 µF	0.50 % + 150 pF	
	33 µF to 110 µF	0.55 % + 600 nF	
	110 µF to 330 µF	0.55 % + 2.5 µF	
	330 µF to 1.1 mF	0.55 % + 8.5 µF	
	1.1 mF to 3.3 mF	0.55 % + 4.5 µF	
	3.3 mF to 11 mF	0.55 % + 60 µF	
	11 mF to 33 mF	0.90 % + 500 µF	
Frequency			
	10 MHz	6.0 in 10^{12}	
	1 Hz to 10 Hz	22 ppm	
	10 Hz to 100 Hz	14 ppm	
	100 Hz to 1 kHz	150 ppm	
	1 kHz to 10 kHz	3.8 in 10^{8}	
	10 kHz to 100 kHz	3.5 in 10^{9}	
	100 kHz to 160 MHz	1.0 in 10^{10}	
	160 MHz to 1.3 GHz	3.0 in 10^{10}	
	1.3 GHz to 10 GHz	7.5 in 10^{10}	
	10 GHz to 18 GHz	1.4 in 10^{9}	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
RF Measurements			
Power			
	9 kHz to 6 GHz		
Ranges	200 pW to 40 µW	3.0 %	
	20 nW to 4 mW	2.7 %	
	2 µW to 200 mW	2.8 %	
	10 MHz to 18 GHz		
	2 nW to 40 µW	9.5 %	
	200 nW to 40 mW	4.5 %	
	2 µW to 2 W	5.0 %	
Calibration Factor			
	0 % to 100 %		
	9 kHz 18 GHz	2.0 %	
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.