


Schedule of Accreditation

issued by

United Kingdom Accreditation Service

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

 <p>UKAS CALIBRATION 10039</p> <p>Accredited to ISO/IEC 17025:2017</p>	<p>MCS Test Equipment Limited</p> <p>Issue No: 007 Issue date: 08 April 2022</p>	
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<p>Calibration performed at the above address only</p>		

Calibration and Measurement Capability (CMC)

Measured Quantity Instrument or Gauge	Range	Expanded Measurement Uncertainty ($k = 2$)	Remarks
<p>Values and uncertainties listed below are applicable for the calibration of both measurement instruments and for instruments with an output. the method used is by direct comparison unless otherwise stated in the remarks column</p>			
ELECTRICAL			
DC Voltage			
Generation	0 V to 330 mV 330 mV to 3.3 V 3.3 V to 33 V 33 V to 330 V 330 V to 1020 V	15 μ V/V + 3.2 μ V 10 μ V/V + 15 μ V 10 μ V/V + 180 μ V 15 μ V/V + 2.4 mV 15 μ V/V + 8.1 mV	These values can be generated for the calibration of measuring instruments
Measurement	0 V to 100 mV 100 mV to 1 V 1 V to 10 V 10 V to 100 V 100 V to 1000 V	15 μ V/V + 0.78 μ V 15 μ V/V + 350 μ V 15 μ V/V + 2.5 mV 25 μ V/V + 45 mV 25 μ V/V + 0.5 V	Outputs of instruments within these values can be measured to the listed uncertainties
Resistance			
Generation	0 Ω to 11 Ω 11 Ω to 33 Ω 33 Ω to 110 Ω 110 Ω to 330 Ω 330 Ω to 1.1 k Ω	45 $\mu\Omega/\Omega$ + 5.6 m Ω 35 $\mu\Omega/\Omega$ + 3.1 m Ω 30 $\mu\Omega/\Omega$ + 3.7 m Ω 30 $\mu\Omega/\Omega$ + 3.7 m Ω 30 $\mu\Omega/\Omega$ + 470 m Ω	These values can be generated for the calibration of measuring instruments
	1.1 k Ω to 3.3 k Ω 3.3 k Ω to 11 k Ω 11 k Ω to 33 k Ω 33 k Ω to 110 k Ω 110 k Ω to 330 k Ω	30 $\mu\Omega/\Omega$ + 670 m Ω 30 $\mu\Omega/\Omega$ + 430 m Ω 30 $\mu\Omega/\Omega$ + 1.8 Ω 30 $\mu\Omega/\Omega$ + 1.7 Ω 35 $\mu\Omega/\Omega$ + 6.2 Ω	
	330 k Ω to 1.1 M Ω 1.1 M Ω to 3.3 M Ω 3.3 M Ω to 11 M Ω 11 M Ω to 33 M Ω 33 M Ω to 110 M Ω	35 $\mu\Omega/\Omega$ + 2.0 k Ω 65 $\mu\Omega/\Omega$ + 5.7 k Ω 150 $\mu\Omega/\Omega$ + 3.1 k Ω 280 $\mu\Omega/\Omega$ + 17 k Ω 550 $\mu\Omega/\Omega$ + 80 k Ω	



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Resistance (continued) Measurement	0 Ω to 100 Ω 100 Ω to 1 k Ω 1 k Ω to 10 k Ω 10 k Ω to 100 k Ω 100 k Ω to 1 M Ω 1 M Ω to 10 M Ω 10 M Ω to 100 M Ω	140 $\mu\Omega/\Omega$ + 2.0 m Ω 140 $\mu\Omega/\Omega$ + 600 m Ω 140 $\mu\Omega/\Omega$ + 6.0 Ω 140 $\mu\Omega/\Omega$ + 100 Ω 140 $\mu\Omega/\Omega$ + 1.0 k Ω 500 $\mu\Omega/\Omega$ + 10 k Ω 0.24 % + 300 k Ω	Outputs of instruments within these values can be measured to the listed uncertainties
DC Current Generation	0 A to 330 μ A 330 μ A to 3.3 mA 3.3 mA to 33 mA 33 mA to 330 mA 330 mA to 3.3 A 3.3 A to 11 A	100 μ A/A + 20 nA 70 μ A/A + 90 nA 100 μ A/A + 800 nA 75 μ A/A + 10 μ A 250 μ A/A + 255 μ A 300 μ A/A + 1.0 mA	These values can be generated for the calibration of measuring instruments
Measurement	0 A to 20 mA 20 mA to 100 mA 100 mA to 1 A 1 A to 3 A	250 μ A/A + 2.0 μ A 250 μ A/A + 45 μ A 0.04 % + 200 μ A 0.06 % + 0.40 mA	Outputs of instruments within these values can be measured to the listed uncertainties
AC Voltage Generation	<i>10 Hz to 45 Hz</i> 33 mV to 330 mV 330 mV to 3.3 V 3.3 V to 33 V <i>45 Hz to 1 kHz</i> 30 μ V to 33 mV 33 V to 330 V 330 V to 1 kV <i>45 Hz to 10 kHz</i> 33 mV to 330 mV 330 mV to 3.3 V 3.3 V to 33 V <i>1 kHz to 10 kHz</i> 33 V to 330 V	0.020 % + 15 μ V 0.020 % + 110 μ V 0.020 % + 1.3 mV 0.010 % + 6.0 μ V 0.015 % + 12 mV 0.020 % + 30 mV 0.015 % + 15 μ V 0.015 % + 140 μ V 0.035 % + 1.5 mV 0.015 % + 11 mV	These values can be generated for the calibration of measuring instruments



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Measured Quantity Instrument or Gauge	Range	Expanded Measurement Uncertainty ($k = 2$)	Remarks
AC Voltage (continued)	<p><i>10 kHz to 20 kHz</i> 33 mV to 330 mV 330 mV to 3.3 V 3.3 V to 33 V 33 V to 330 V</p> <p><i>20 kHz to 50 kHz</i> 33 mV to 330 mV 330 mV to 3.3 V 3.3 V to 33 V 33 V to 330 V</p> <p><i>50 kHz to 100 kHz</i> 33 mV to 330 mV 330 mV to 3.3 V 3.3 V to 33 V 33 V to 330 V</p> <p><i>100 kHz to 500 kHz</i> 33 mV to 330 mV 330 mV to 3.3 V</p>	<p>0.015 % + 11 μV 0.015 % + 100 μV 0.020 % + 1.1 mV 0.020 % + 10 mV</p> <p>0.020 % + 11 μV 0.020 % + 100 μV 0.025 % + 1.0 mV 0.020 % + 10 mV</p> <p>0.050 % + 30 μV 0.050 % + 0.15 mV 0.060 % + 2.0 mV 0.15 % + 50 mV</p> <p>0.15 % + 60 μV 0.20 % + 0.55 mV</p>	<p>These values can be generated for the calibration of measuring instruments</p>
VRMS Measurement	<p><i>10 Hz to 20 kHz</i> 10 mV to 100 mV 100 mV to 1 V 1 V to 10 V 10 V to 100 V</p> <p><i>10 Hz to 1 kHz</i> 100 V to 750 V</p> <p><i>20 kHz to 50 kHz</i> 10 mV to 100 mV 100 mV to 1 V 1 V to 10 V 10 V to 100 V</p> <p><i>50 kHz to 100 kHz</i> 100 mV to 1 V 1 V to 10 V</p> <p><i>100 kHz to 300 kHz</i> 1 V to 10 V</p>	<p>0.10 % + 35 μV 0.10 % + 110 μV 0.10 % + 12 mV 0.10 % + 35 mV</p> <p>0.10 % + 87 mV</p> <p>0.20 % + 65 μV 0.20 % + 525 μV 0.20 % + 5.5mV 0.20 % + 60 mV</p> <p>0.85 % + 870 μV 0.95 % + 9.0 mV</p> <p>6.0 % + 55 mV</p>	<p>Outputs of instruments within these values can be measured to the listed uncertainties</p>



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Measured Quantity Instrument or Gauge	Range	Expanded Measurement Uncertainty ($k = 2$)	Remarks
AC Power Unity PF to 0.25 PF	45 Hz to 65 Hz 10 mV to 1 kV 3.3 mA to 20.5 A	0.50 %	
Capacitance Sourcing by simulation	1.1 nF to 3.3 nF 3.3 nF to 11 nF 11 nF to 33 nF 33 nF to 110 nF 110 nF to 330 nF 330 nF to 1.1 μ F 1.1 μ F to 3.3 μ F 3.3 μ F to 11 μ F 11 μ F to 33 μ F 33 μ F to 110 μ F 110 μ F to 330 μ F 330 μ F to 1.1 mF 1.1 mF to 3.3 mF 3.3 mF to 11 mF 11 mF to 33 mF	0.65 % + 10 pF 0.35 % + 12 pF 0.35 % + 85 pF 0.35 % + 115 pF 0.35 % + 0.45 nF 0.35 % + 1.5 nF 0.35 % + 3.5 nF 0.35 % + 12 nF 0.55 % + 50 nF 0.60 % + 165 nF 0.60 % + 0.25 μ F 0.60 % + 0.85 μ F 0.60 % + 2.5 μ F 0.60 % + 8.5 μ F 1.1 % + 25 μ F	These values can be simulated for the calibration of measuring instruments



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Measured Quantity Instrument or Gauge	Range	Expanded Measurement Uncertainty ($k = 2$)	Remarks
Oscilloscope Calibration			
Vertical deflection as a Voltage	0 V to 25 mV 25 mV to 110 mV 110 mV to 2.2 V 2.2 V to 11 V 11 V to 130 V	0.040 % + 31 μ V 0.040 % + 31 μ V 0.040 % + 120 μ V 0.040 % + 200 μ V 0.040 % + 2.0 mV	Into 1 M Ω
Square wave peak to peak	0 V to 25 mV 25 mV to 110 mV 110 mV to 2.2 V 2.2 V to 6 V	0.19 % + 31 μ V 0.19 % + 33 μ V 0.19 % + 31 μ V 0.19 % + 31 mV	Into 50 Ω
Sine wave level flatness referenced to set point	Ref set point 5 mV to 5.5 V 50 kHz to 300 MHz 100 kHz to 600 MHz	62 μ V 220 μ V 32 mV 33 mV	Into 50 Ω
Rise time	250 ps 5 mV to 2.5 V peak	3.9 % 3.9 %	
Resistance	40 Ω to 60 Ω 500 k Ω to 1.5 M Ω	80 ps	
Time markers	2 ns to 20 ns 20 ns to 100 ns 100 ns to 1 s 1 s to 5 s	0.080 % + 10 m Ω 0.080 % + 100 m Ω	
Capacitance	5 pF to 50 pF	5.0 fs 130 fs 13 ps 10 ms	



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Measured Quantity Instrument or Gauge	Range	Expanded Measurement Uncertainty ($k = 2$)	Remarks
Insulation Testers			
Continuity	0 Ω to 100 m Ω 100 m Ω to 500 m Ω 0.5 Ω to 1 Ω 1 Ω to 5 Ω 5 Ω to 200 Ω 200 Ω to 10 k Ω	4.5 m Ω 6.5 m Ω 8.0 m Ω 25 m Ω 0.80 Ω 8.0 Ω	
High Resistance	10 k Ω to 1 M Ω 1 M Ω to 10 M Ω 10 M Ω to 1 G Ω 1 G Ω to 10 G Ω	0.20 % 0.30 % 0.65 % 1.0 %	Uncertainty Increases by 0.10 % per 200 V above 500 V
Test Voltage Measurement	0 V to 2 kV DC 10 k Ω to 1 M Ω 1 M Ω to 10 G Ω	0.8 % + 2.6 V 0.8 % + 4.5 V	
Line / Loop Impedance Testers			
Resistance Nominal values	25 m Ω 50 m Ω 100 m Ω 330 m Ω 500 m Ω 1 Ω 1.8 Ω 5 Ω 10 Ω 18 Ω 50 Ω 100 Ω 180 Ω 500 Ω 1 k Ω 1.8 k Ω 0.05 A 0.5 A 3.2 A 10 A 20 A	4.0 m Ω 4.5 m Ω 4.0 m Ω 5.5 m Ω 6.5 m Ω 8.0 m Ω 15.5 m Ω 25 m Ω 50 m Ω 80 m Ω 0.25 Ω 0.40 Ω 0.80 Ω 2.0 Ω 4.0 Ω 8.0 Ω 1.2 % + 2.0 mA 1.2 % + 11 mA 1.2 % + 55 mA 1.2 % + 0.16 A 1.2 % + 0.30 A	Outputs of instruments within these values can be measured to the listed uncertainties



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RCD Testers			
Timing	10 ms to 5 s	0.02 % + 2.7 ms	
Current			
0.5 x I and 1 x I Mode	3 mA to 30 mA 30 mA to 300 mA 300 mA to 3000 mA	0.80 % + 60 μ A 0.80 % + 0.60 mA 0.80 % + 6.0 mA	
1.4 x I and 2 x I Mode	3 mA to 30 mA 30 mA to 300 mA 300 mA to 1500 mA	1.6 % + 60 μ A 1.6 % + 0.60 mA 1.6 % + 6.0 mA	
5 x I Mode	3 mA to 30 mA 30 mA to 300 mA 300 mA to 600 mA	4.0 % + 60 μ A 4.0 % + 0.60 mA 4.0 % + 6.0 mA	
Leakage Testers			
Current			
Passive/Differential/Substitute Modes	0.1 mA to 30 mA	0.30 % + 2 μ A (ac + dc) rms	
Active Mode	0.1 mA to 30 mA	0.30 % + 1.3 μ A (ac + dc) rms	
Touch Voltage	250 V Range	5.0 % + 3.0 V	
Portable Appliance Testers			
Earth / Ground Bond Resistance. Nominal values At 50 Hz to 60 Hz	25 m Ω 50 m Ω 100 m Ω 330 m Ω 500 m Ω 1 Ω 1.8 Ω 5 Ω 10 Ω 18 Ω 50 Ω 100 Ω 180 Ω 500 Ω 1 k Ω 1.8 k Ω	4.0 m Ω 4.5 m Ω 4.0 m Ω 5.5 m Ω 6.5 m Ω 8.0 m Ω 16 m Ω 25 m Ω 47 m Ω 80 m Ω 0.25 Ω 0.40 Ω 0.80 Ω 2.0 Ω 4.0 Ω 8.0 Ω	



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Earth / Ground Bonding Current At 50 Hz to 60 Hz	0.05 A	1.2 % + 1.7 mA	
	0.5 A	1.2 % + 11 mA	
	3.2 A	1.2 % + 55 mA	
Insulation Resistance	10 A	1.2 % + 0.12 A	Uncertainty Increases by 0.10 % per 200 V above 500 V
	20 A	1.2 % + 0.28 A	
	10 kΩ to 1 MΩ	0.16 %	
	1 MΩ to 10 MΩ	0.27 %	
Test Voltage	10 MΩ to 1 GΩ	0.62 %	
	1 GΩ to 10 GΩ	0.95 %	
	0 V to 2 kV DC	0.80 % + 2.6 V	
	10 kΩ to 1 MΩ	0.80 % + 4.5 V	
Continuity	1 MΩ to 10 GΩ	0.80 % + 4.5 V	
	100 mΩ to 500 mΩ	6.5 mΩ	
	0.5 Ω to 1 Ω	8.0 mΩ	
	1 Ω to 5 Ω	25 mΩ	
	5 Ω to 200 Ω	0.78 Ω	
HIPOT/HV TESTERS	200 Ω to 10 kΩ	7.8 Ω	
HVDC Voltage	0.1 kV to 1.0 kV	0.23 % + 4.5 V	
HVAC Peak Voltage	50 Hz to 60 Hz 0.1 kV to 1.0 kV	0.40 % + 4 V	
DC Leakage Current	0 A to 300 μA	0.23 % + 0.20 μA	
	0.3 mA to 3 mA	0.16 % + 1.3 μA	
	3 mA to 30 mA	0.16 % + 12 μA	
	30 mA to 300 mA	0.16 % + 120 μA	
AC Leakage Current	20 Hz to 400 Hz	0.23 % + 0.34 μA	
	0 A to 300 μA	0.16 % + 1.5 μA	
	0.3 mA to 3 mA	0.16 % + 18 μA	
	3 mA to 30 mA	0.16 % + 130 μA	
	30 mA to 300 mA	0.16 % + 130 μA	



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RF MEASUREMENTS			All RF measurements are for a well matched 50 Ω source or load unless otherwise stated.
Voltage Reflection Coefficient	1.0 to 0.1 <i>10 MHz to 6 GHz</i> <i>6 GHz to 15 GHz</i> <i>15 GHz to 18 GHz</i>	0.020 0.030 0.040	Uncertainties apply to precision connectors.
Frequency Generation			May be reported as time (1/f) for repetitive events.
Specific Value Measurement	10 MHz	6.0 in 10^{12}	GPS Time and frequency Reference Receiver
Specific Value	10 MHz	6.9 in 10^{12}	
Other Values	1 Hz to 10 Hz 10 Hz to 1 MHz 1 MHz to 100 MHz 100 MHz to 350 MHz 160 MHz to 1.3 GHz 1.3 GHz to 10 GHz 10 GHz to 18 GHz 18 GHz to 26.5 GHz	6.2 in 10^6 6.0 in 10^6 1.0 in 10^5 2.7 in 10^5 3.0 in 10^{10} 7.5 in 10^{10} 1.4 in 10^9 4.7 in 10^9	
Power I mW reference	1 mW at 50 MHz	0.004 mW	
Ranges	<i>9 kHz to 6 GHz</i> 200 pW to 40 μ W 20 nW to 4 mW 2 μ W to 200 mW <i>10 MHz to 18 GHz</i> 2 nW to 40 μ W 200 nW to 40 mW 2 μ W to 2 W	1.5 % 1.4 % 1.4 % 5.3 % 2.2 % 2.4 %	
Attenuation	0 dB to 90 dB <i>50 MHz to 18 GHz</i>	0.10 dB	
Calibration Factor	75 % to 110 % 9 kHz 18 GHz	2.0 % (Cal Factor)	



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RF MEASUREMENTS Continued			
Amplitude Modulation (AM)	<i>10 Hz to 10 kHz</i> 150 kHz to 10 MHz	2.4 % of reading	
	<i>50 Hz to 50 kHz</i> 10 MHz to 1300 MHz	1.4 % of reading	
AM Distortion	<i>10 Hz to 50 kHz</i> 150 kHz to 1300 MHz	0.50 %	
Frequency Modulation (FM)	<i>20 Hz to 10 kHz</i> 250 kHz to 10 MHz	2.4 % + 40 Hz	Frequency Modulation - Carrier frequency range 10 MHz to 1300 MHz Modulation frequency range 10 Hz to 100 kHz
	<i>50 Hz to 100 kHz</i> 10 MHz to 1300 MHz	1.2 % + 17 Hz	
FM Distortion	<i>20 Hz to 100 kHz</i> 150 kHz to 1300 MHz	0.20 %	
Harmonic Content	Carrier Frequency 1 MHz to 13 GHz Harmonic Frequency 2 MHz to 26 GHz	0.62 dB	Maximum CW amplitude +15 dBm; minimum harmonic level -80 dBc
END			



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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 measurement uncertainty 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 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 measurement uncertainty is calculated according to the procedures given in the GUM 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 measurement uncertainty in certificates issued under its accreditation.

Expression of CMCs - symbols and units

It should be noted that the percentage symbol (%) represents the number 0.01. In cases where the measurement uncertainty is stated as a percentage, this is to be interpreted as meaning percentage of the measurand.

Thus, for example, a measurement uncertainty of 1.5 % means $1.5 \times 0.01 \times q$, where q is the quantity value.

The notation $Q[a, b]$ stands for the root-sum-square of the terms between brackets: $Q[a, b] = [a^2 + b^2]^{1/2}$