


# Schedule of Accreditation

issued by

## United Kingdom Accreditation Service

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

 <b>0654</b> Accredited to ISO/IEC 17025:2017	<b>Calibration, Maintenance and Repair Ltd</b>	
	Issue No: 041    Issue date: 24 October 2022	
	11 Frensham Road Norwich NR3 2BT	Contact: Mr P K Clark Tel: +44 (0)1603 279557 Fax: +44 (0)1603 278008 E-Mail: support@cmrcalibrate.co.uk Website: www.cmrcalibrate.co.uk

**Calibration performed by the Organisation at the locations specified**

### Locations covered by the organisation and their relevant activities

#### Laboratory locations:

Location details	Activity	Location code
<b>Address</b> 11 Frensham Road Norwich NR3 2BT	<b>Local contact:</b> Mr P K Clark Tel: +44 (0)1603 279557	Electrical Calibration Accelerometer calibration A
<b>Address</b> 5 Octavian Way, Team Valley Trading Est Gateshead NE11 0HZ	<b>Local contact:</b> Mr John Fryer Tel: +44 (0)191 4875951	Electrical Calibration Pressure Calibration B



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Calibration and Measurement Capability (CMC)

Measured Quantity Instrument or Gauge	Range	Expanded Measurement Uncertainty ( $k = 2$ )	Remarks	Location Code
Values and uncertainties listed below are applicable for the calibration of both measuring instruments and for instruments with an output. The method used is by direct comparison against laboratory references unless otherwise stated in the remarks column.				
<b>ELECTRICAL MEASUREMENTS</b>			Calibrations are performed as a direct comparison against a reference standard	A
<b>DC VOLTAGE</b>				
Generation	0 mV to 10 mV 10 mV to 100 mV 100 mV to 1 V 1 V to 10 V 10 V to 100 V 100 V to 1100 V	0.55 $\mu$ V 1.4 $\mu$ V 6.6 $\mu$ V 44 $\mu$ V 630 $\mu$ V 8.0 mV	For the calibration of measuring instruments	
Measurement	0 mV to 10 mV 10 mV to 100 mV 100 mV to 1 V 1 V to 10 V 10 V to 100 V 100 V to 1 kV	1.0 $\mu$ V 2.0 $\mu$ V 10 $\mu$ V 98 $\mu$ V 1.3 mV 14 mV	For instruments with a voltage output	
<b>DC RESISTANCE</b>				A
Sourcing - Spot Values	1 $\Omega$ 1.9 $\Omega$ 10 $\Omega$ 19 $\Omega$ 100 $\Omega$  190 $\Omega$ 1 k $\Omega$ 1.9 k $\Omega$ 10 k $\Omega$ 19 k $\Omega$  100 k $\Omega$ 190 k $\Omega$ 1 M $\Omega$ 1.9 M $\Omega$  10 M $\Omega$ 19 M $\Omega$ 100 M $\Omega$	110 $\mu$ $\Omega$ 210 $\mu$ $\Omega$ 270 $\mu$ $\Omega$ 540 $\mu$ $\Omega$ 1.2 m $\Omega$  2.5 m $\Omega$ 8.7 m $\Omega$ 17 m $\Omega$ 81 m $\Omega$ 170 m $\Omega$  1.1 $\Omega$ 2.4 $\Omega$ 16 $\Omega$ 48 $\Omega$  460 $\Omega$ 1.1 k $\Omega$ 12 k $\Omega$	For the calibration of measuring instruments	



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<b>DC RESISTANCE</b> (continued)				A
Sourcing - Range values	0Ω to 10 Ω 10 Ω to 100 Ω 100 Ω to 1 kΩ  1 kΩ to 10 kΩ 10 kΩ to 100 kΩ  100 kΩ to 1 MΩ 1 MΩ to 10 MΩ 10 MΩ to 33 MΩ  33 MΩ to 110 MΩ 110 MΩ to 330 MΩ 330 MΩ to 1.1 GΩ	2.0 mΩ 5.0 mΩ 31 mΩ  310 mΩ 3.0 Ω  37 Ω 2.0 kΩ 11 kΩ  60 kΩ 1.0 MΩ 17 MΩ	For the calibration of measuring instruments	
Measurement	0 Ω to 10 Ω 10 Ω to 100 Ω 100 Ω to 1 kΩ 1 kΩ to 10 kΩ 10 kΩ to 100 kΩ  100 kΩ to 1 MΩ 1 MΩ to 10 GΩ 10 GΩ to 1 TΩ	250 μΩ 2.0 mΩ 14 mΩ 140 mΩ 1.0 Ω  22 Ω 0.71 % 1.0 %	For instruments with a resistance output	
<b>DC CURRENT</b>				A
Generation	0 μA to 10 μA 10 μA to 100 μA 100 μA to 1 mA 1 mA to 10 mA 10 mA to 100 mA  100 mA to 1 A 1 A to 3 A 3 A to 5 A 5 A to 10 A 10 A to 20 A  16 A to 160 A 160 A to 1000 A	7.4 nA 12 nA 49 nA 450 nA 6.0 μA  110 μA 1.0 mA 4.0 mA 6.0 mA 12 mA  25 mA 580 mA	For the calibration of measuring instruments          Current clamp calibration using a multi turn coil	



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<b>DC CURRENT</b> (continued)				A
Measurement	0 $\mu$ A to 10 $\mu$ A 10 $\mu$ A to 100 $\mu$ A 100 $\mu$ A to 1 mA 1 mA to 10 mA  10 mA to 100 mA 100 mA to 1 A 1 A to 2 A 2 A to 10 A	2.0 nA 4.0 nA 34 nA 340 nA  5.0 $\mu$ A 150 $\mu$ A 2.4 mA 25 mA	For instruments which generate current	
<b>AC VOLTAGE</b>				A
Generation	1 Hz to 10 Hz 10 $\mu$ V to 10 mV 10 mV to 100 mV 100 mV to 1 V 1 V to 7 V  <b>10 <math>\mu</math>V to 2.2 mV</b> 10 Hz to 20 Hz 20 Hz to 40 Hz 40Hz to 500 Hz 500 Hz to 1 kHz 1 kHz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz  <b>2.2 mV to 22 mV</b> 10 Hz to 20 Hz 20 Hz to 40 Hz 40Hz to 500 Hz 500 Hz to 1 kHz 1 kHz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	60 $\mu$ V 270 $\mu$ V 1.9 mV 9.2 mV  5.3 $\mu$ V 4.9 $\mu$ V 4.9 $\mu$ V 4.9 $\mu$ V 4.9 $\mu$ V 4.9 $\mu$ V 5.2 $\mu$ V 7.1 $\mu$ V 14 $\mu$ V 27 $\mu$ V 30 $\mu$ V  11 $\mu$ V 7.1 $\mu$ V 6.9 $\mu$ V 6.9 $\mu$ V 6.9 $\mu$ V 6.9 $\mu$ V 10 $\mu$ V 19 $\mu$ V 38 $\mu$ V 59 $\mu$ V 92 $\mu$ V	For the calibration of measuring instruments	



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<p>Values and uncertainties listed below are applicable for the calibration of both measuring instruments and for instruments with an output. The method used is by direct comparison against laboratory references unless otherwise stated in the remarks column.</p>				
<b>AC VOLTAGE</b> (continued)  Generation (continued)	<b>22 mV to 220 mV</b> 10 Hz to 20 Hz 20 Hz to 40 Hz 40Hz to 500 Hz 500 Hz to 1 kHz 1 kHz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz  <b>220 mV to 2.2 V</b> 10 Hz to 20 Hz 20 Hz to 40 Hz 40Hz to 500 Hz 500 Hz to 1 kHz 1 kHz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz  <b>2.2 V to 22 V</b> 10 Hz to 20 Hz 20 Hz to 40 Hz 40Hz to 500 Hz 500 Hz to 1 kHz 1 kHz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz  <b>22 V to 220 V</b> 10 Hz to 20 Hz 20 Hz to 40 Hz 40Hz to 500 Hz 500 Hz to 1 kHz 1 kHz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	76 $\mu$ V 31 $\mu$ V 23 $\mu$ V 23 $\mu$ V 23 $\mu$ V 23 $\mu$ V 39 $\mu$ V 99 $\mu$ V 190 $\mu$ V 380 $\mu$ V 740 $\mu$ V  660 $\mu$ V 250 $\mu$ V 120 $\mu$ V 120 $\mu$ V 120 $\mu$ V 120 $\mu$ V 180 $\mu$ V 250 $\mu$ V 950 $\mu$ V 2.8 mV 4.7 mV  6.6 mV 2.5 mV 1.1 mV 1.1 mV 1.1 mV 1.1 mV 1.8 mV 2.3 mV 7.2 mV 28 mV 42 mV  66 mV 25 mV 14 mV 14 mV 14 mV 14 mV 22 mV 41 mV	For measuring instruments	A



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<b>AC VOLTAGE (continued)</b>				A
Generation (continued)	<b>220 V to 1100 V</b> <i>55 Hz to 1 kHz</i>	110 mV	For measuring instruments	
	<b>220 V to 500 V</b> <i>50 Hz to 10 kHz</i>	180 mV		
	<b>500 V to 750 V</b> <i>50 Hz to 10 kHz</i>	260 mV		
	<b>750 V to 1 kV</b> <i>50 Hz to 10 kHz</i>	350 mV		
Measurement	<b>30 <math>\mu</math>V to 10 mV</b> <i>1 Hz to 40 Hz</i> <i>40 Hz to 1kHz</i> <i>1 kHz to 20 kHz</i> <i>20 kHz to 50 kHz</i> <i>50 kHz to 100 kHz</i> <i>100 kHz to 1 MHz</i>	8.0 $\mu$ V 5.0 $\mu$ V 6.0 $\mu$ V 13 $\mu$ V 60 $\mu$ V 160 $\mu$ V	For instruments with a voltage output	
	<b>10 mV to 100 mV</b> <i>1 Hz to 40 Hz</i> <i>40 Hz to 1kHz</i> <i>1kHz to 20 kHz</i> <i>20 kHz to 50 kHz</i> <i>50 kHz to 100 kHz</i> <i>100 kHz to 300 kHz</i> <i>300 kHz to 1 MHz</i>	15 $\mu$ V 13 $\mu$ V 20 $\mu$ V 38 $\mu$ V 100 $\mu$ V 360 $\mu$ V 2.3 mV		
	<b>100mV to 1V</b> <i>1 Hz to 40 Hz</i> <i>40 Hz to 1kHz</i> <i>1kHz to 20 kHz</i> <i>20 kHz to 50 kHz</i> <i>50 kHz to 100 kHz</i> <i>100 kHz to 300 kHz</i> <i>300 kHz to 1 MHz</i>	140 $\mu$ V 120 $\mu$ V 200 $\mu$ V 390 $\mu$ V 970 $\mu$ V 3.6 mV 24 mV		
	<b>1 V to 10 V</b> <i>1 Hz to 40 Hz</i> <i>40 Hz to 1 kHz</i> <i>1kHz to 20 kHz</i> <i>20 kHz to 50 kHz</i> <i>50 kHz to 100 kHz</i> <i>100 kHz to 300 kHz</i> <i>300 kHz to 1 MHz</i>	2.0 mV 1.0 mV 2.0 mV 4.0 mV 10 mV 36 mV 240 mV		



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<b>AC VOLTAGE (continued)</b>  Measurement (continued)	<b>10V to 100V</b> 1 Hz to 40 Hz 40 Hz to 1kHz 1kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100kHz to 300 kHz	38 mV 36 mV 37 mV 51 mV 150 mV 480 mV	For instruments with a voltage output.	A
<b>AC CURRENT</b>  Generation	<b>100V to 1 kV</b> 1 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	520 mV 490 mV 720 mV 1.4 V 3.5 V		A
	<b>10 µA to 220 µA</b> 55 Hz to 400 Hz 400 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	38 nA 38 nA 88 nA 360 nA	For the calibration measuring instruments	
	<b>220 µA to 2.2 mA</b> 55 Hz to 400 Hz 400 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	320 nA 320 nA 660 nA 3.6 µA		
	<b>2.2 mA to 22 mA</b> 55 Hz to 400 Hz 400 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	29 µA 29 µA 55 µA 290 µA		
	<b>22 mA to 220 mA</b> 55 Hz to 400 Hz 400 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	3.0 µA 3.0 µA 5.7 µA 34 µA		
	<b>220 mA to 2.2 A</b> 55 Hz to 400 Hz 400 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	660 µA 660 µA 1.3 mA 18 mA		
	<b>10 Hz to 1 kHz</b> 2 A to 3 A 3 A to 5 A 5 A to 10 A	7.0 mA 9.0 mA 14 mA		



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<b>AC CURRENT</b> (continued)				A
Generation (continued)	<b>10 Hz to 100 Hz</b> 10 A to 32 A 16 A to 160 A 160 A to 1000 A	9.0 mA 35 mA 580 mA	Calibration of current clamps using a multi turn coil	
Measurement	<b>20 nA to 10 <math>\mu</math>A</b> 20 Hz to 45 kHz 45 Hz to 1 kHz	23 nA 14 nA	For instruments which generate current	
	<b>10 <math>\mu</math>A to 100 <math>\mu</math>A</b> 20 Hz to 45 kHz 45 Hz to 1 kHz	210 nA 110 nA		
	<b>100 <math>\mu</math>A to 1 mA</b> 20 Hz to 45 kHz 45 Hz to 20 kHz 20 kHz to 50 kHz	2.0 $\mu$ A 1.0 $\mu$ A 5.0 $\mu$ A		
	<b>1 mA to 10 mA</b> 20 Hz to 45 kHz 45 Hz to 20 kHz 20 kHz to 50 kHz	20 $\mu$ A 9.0 $\mu$ A 51 $\mu$ A		
	<b>10 mA to 100 mA</b> 20Hz to 45Hz 45Hz to 20kHz 20kHz to 50kHz	200 $\mu$ A 95 $\mu$ A 510 $\mu$ A		
	<b>100 mA to 1 A</b> 20Hz to 45Hz 45Hz to 20kHz 20kHz to 50kHz	2.0 mA 1.0 mA 12 mA		
<b>FREQUENCY</b>				A
Generation	0.5 Hz to 5.4 GHz	2.1 in $10^9$	For the calibration of measuring instruments May be reported as events per unit time	
	1 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 27 GHz	35 $\mu$ Hz 0.40 Hz 0.24 $\mu$ Hz/Hz	For instruments outputting frequency	
Generation	0.5 Hz to 5.4 GHz 5.4 GHz to 20 GHz	2.1 in $10^9$ 4.0 MHz	For the calibration of measuring instruments May be reported as events per unit time	





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<b>TIME and FREQUENCY</b>				A
Elapsed time			Mechanical timers / stop watches	
Single event	10 s to 12 hrs	0.23 s		
Revolutions Per Minute	60 RPM to 1000 RPM 1000 RPM to 30000 RPM 30000 RPM to 96000 RPM	0.37 RPM 1.6 RPM 23 RPM		
<b>CAPACITANCE</b>				A
Measurement For capacitance sources	<b>1 kHz</b> 0.1 pF to 1 pF 1 pF to 10 pF 10 pF to 100 pF 100 pF to 1000 pF	0.030 pF 0.035 pF 0.10 pF 1.2 pF	For capacitance sources	
	<b>1 MHz</b> 0.1 pF to 1 pF 1 pF to 10 pF 10 pF to 100 pF 100 pF to 1000 pF	0.0050 pF 0.030 pF 0.90 pF 8.0 pF		
Simulated For capacitance meters	<b>10 Hz to 10 kHz</b> 220 pF to 400 pF 400 pF to 1.1 nF	13 pF 16 pF		
	<b>10 Hz to 3 kHz</b> 1.1 nF to 3.3 nF	27 pF		
	<b>10 Hz to 1 kHz</b> 3.3 nF to 11 nF 11 nF to 33 nF	39 pF 180 pF		
	<b>10 Hz to 1 kHz</b> 33 nF to 110 nF 110 nF to 330 nF	380 pF 1.0 nF		
	<b>10 Hz to 600 Hz</b> 330 nF to 1.1 µF	5.0 nF		
	<b>10 Hz to 300 Hz</b> 1.1 µF to 3.3 µF	12 nF		
	<b>10 Hz to 150 Hz</b> 3.3 µF to 11 µF	39 nF		
	<b>10 Hz to 120 Hz</b> 11 µF to 33 µF	140 nF		
	<b>10 Hz to 80 Hz</b> 33 µF to 110 µF	610 nF		



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<b>CAPACITANCE</b> (continued)				A
For capacitance meters	<b>0 Hz to 50 Hz</b> 110 $\mu$ F to 330 $\mu$ F	2.0 $\mu$ F		
	<b>0 Hz to 20 Hz</b> 330 $\mu$ F to 1.1 mF	6.0 $\mu$ F		
	<b>0 Hz to 6 Hz</b> 1.1 mF to 3.3 mF	2.0 $\mu$ F		
	<b>0 Hz to 2 Hz</b> 3.3 mF to 11 mF	60 $\mu$ F		
	<b>0 Hz to 0.6 Hz</b> 11 mF to 33 mF	280 $\mu$ F		
	<b>0 Hz to 0.2 Hz</b> 33 mF to 110 mF	1.0 mF		
<b>CALIBRATION OF INSULATION TESTERS</b>				A
Insulation Resistance	100 k $\Omega$ to 1 M $\Omega$ 1 M $\Omega$ to 10 M $\Omega$ 10 M $\Omega$ to 100 M $\Omega$ 100 M $\Omega$ to 1 G $\Omega$	2.0 k $\Omega$ 32 k $\Omega$ 510 k $\Omega$ 7.0 M $\Omega$	Up to 1350 V	
Insulation test voltage Nominal	50 V 100 V 250 V 500 V 1 kV	1.0 V 2.0 V 3.0 V 4.0 V 7.0 V	The test voltage will normally be measured with a 1 mA load.	
Continuity Resistance	0 $\Omega$ to 1 $\Omega$ 1 $\Omega$ to 50 $\Omega$ 50 $\Omega$ to 100 $\Omega$ 100 $\Omega$ to 200 $\Omega$	58 m $\Omega$ 100 m $\Omega$ 120 m $\Omega$ 140 m $\Omega$		



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<b>Temperature indicators, calibration by electrical simulation</b>				A
Type k thermocouple	-200 °C to +1372 °C	0.73 °C	Including reference junction compensation	
Type T thermocouple	-250 °C to +400 °C	0.65 °C	Including reference junction compensation	
Type N thermocouple	-200 °C to +1300 °C	0.46 °C	Including reference junction compensation	
Type S thermocouple	0 °C to 1767 °C	0.77 °C	Including reference junction compensation	
Type J thermocouple	-210 °C to +1200 °C	0.23 °C	Including reference junction compensation	
Type E thermocouple	-250 °C to +1000 °C	0.26 °C	Including reference junction compensation	
Resistance thermometer (Pt 100)	-200°C to +800°C	0.05°C		
<b>Calibration of Oscilloscopes</b>				A
Voltage deflection	0 V to 6 V 11 V to 130 V	0.33 % 0.22 %	Into 50 Ω Into 1 MΩ	
Edge verification - Amplitude	4.5 mV to 2.27 V 1 kHz, 10 kHz & 100 kHz	2.7 %		
Time markers	100 ns to 20 ms 20 ms to 50 ms	83 ns 250 μs		
Rise time	1 kHz to 2 MHz 2 MHz to 10 MHz	300 ps 350 ps		
Bandwidth Level flatness 50 kHz ref Nominal 3 V	To 100 MHz To 300 MHz To 600 MHz To 1.1 GHz	3.3 % 5.4 % 8.5 % 9.5 %	CMC is with respect to relative amplitude of level flatness this will be quoted in frequency terms when stating bandwidth uncertainty as it will vary from device to device.	



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<b>ACCELEROMETRY</b>				A
Accelerometer calibration Charge	Sensitivity range: 0.3 pC/g to 1000 pC/g (0.03 pC/ms <sup>2</sup> to 100 pC/m <sup>2</sup> )  1 Hz to 2 Hz 2 Hz to 5 Hz 5 Hz to 5 kHz 5 kHz to 10 kHz	3.0 % 1.2 % 0.80 % 0.90 %	Uncertainties for accelerometry sensitivity calibrations at ambient temperature applies for masses up to 40 grams.  Nominal acceleration ms <sup>-2</sup> : 2 Hz: 0.10 3 Hz: 0.20 4 Hz to 10 kHz: 0.31 to 1.0	
Devices with integral electronics	Sensitivity range: 0.04 pC/g to 0.3 pC/g (0.004 pC/ms <sup>2</sup> to 0.03 pC/ms <sup>2</sup> )  20 Hz to 10 kHz	3.0 %	Nominal acceleration 0.31 ms <sup>-2</sup> to 1.0 ms <sup>-2</sup> .	
Voltage (mV/ms <sup>2</sup> )	0.03 mV/ms <sup>2</sup> to 1000 mV/ms <sup>2</sup> 1 Hz to 2 Hz 2 Hz to 5 Hz 5 Hz to 5 kHz 5 kHz to 10 kHz	2.0 % 0.83 % 0.86 % 0.90 %	Nominal acceleration ms <sup>-2</sup> : 1 Hz: 0.10 3 Hz: 0.20 4 Hz to 10 kHz: 0.31 to 1.0	
Resistive/Capacitive	0.004 mV/ms <sup>2</sup> to 0.03 mV/ms <sup>2</sup> 20 Hz to 10 kHz  0.01 mV/ms <sup>2</sup> to 100 mV/ms <sup>2</sup> 1 Hz to 2 Hz 2 Hz to 5 Hz 5 Hz to 5 kHz 5 kHz to 10 kHz	3.0 %  2.0 % 0.83 % 0.86 % 0.90 %	Nominal acceleration ms <sup>-2</sup> : 1 Hz: 0.10 3 Hz: 0.20 4 Hz to 10 kHz: 0.31 to 1.0	
<b>Vibration</b>	10 Hz to 5 kHz		Reference to transfer standard Accelerometer	
Acceleration	0.1g to 10 g	0.40 %		
Velocity	3 mm/s to 2000 mm/s	0.40 %		
Displacement	0.2µm to 100 mm	0.40 %		
Velocity transducers	5 Hz to 10 kHz 1.5 mm/s to 3000 mm/s	0.90 %		
Transducer at any temperature from -60 °C to +180 °C:	0.03 mV/ms <sup>2</sup> to 1000 mV/ms <sup>2</sup>  20 Hz to 630 Hz	3.0 %	At a nominal 1 g <sub>n</sub>  This uncertainty applies for masses up to 60 grams, larger masses can be calibrated but at greater uncertainties.	



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<b>ACCELEROMETRY</b> (continued)				A
Transducer at any temperature from -60 °C to +180 °C:	0.03 mV/ms <sup>2</sup> to 1000 mV/ms <sup>2</sup> 20 Hz to 630 Hz	3.0 %	At a nominal 1 g <sub>n</sub> This uncertainty applies for masses up to 60 grams, larger masses can be calibrated but at greater uncertainties  Note indicated outputs on Bench Calibrators for acceleration are normally indicated in "g".	
Portable calibrators	Frequency 160 Hz 1 ms <sup>2</sup> nominal	1.5 %		
Bench Calibrators				
Acceleration	10mV to 10V, 5 Hz to 10KHz Up to 25g	2.4 %		
Velocity	10mV to 10V, 10 Hz to 1KHz Up to 1000 m/sec pk	2.4 %		
Displacement	10 mV to 10V, 10 Hz to 250 Hz Up to 10 mm pk to pk	2.4 %		
<b>DISTORTION THD</b>	20 Hz to 20 kHz 10 mV to 750 V 0 % to 1 % 1 % to 100 %	0.20 % distortion 0.47 % distortion	Bandpass filter between 20 Hz and 50 kHz	



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**Calibration, Maintenance and Repair Ltd**  
**Issue No: 041    Issue date: 24 October 2022**

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<p><b>ACCELERATION TRANSDUCERS - SHOCK CALIBRATION</b></p> <p><u>Piezoelectric and Piezoresistive and voltage types</u></p> <p>Transducer at nominal 23 °C</p> <p>Vibration meters and analysers</p> <p>Shock and Impulse hammers</p> <p>Spring hammers</p> <p>Impact Energy Imparted from Spring Operated Impact Test Apparatus - as specified in BS EN 60068-2-75:1997 and IEC 60068-2-75 1997</p>	<p>Sensitivity 0.001 pC/ms<sup>2</sup> to 100 pC/ms<sup>2</sup> 0.001 mV/ms<sup>2</sup> to 10 mV/ms<sup>2</sup> Within the range of: 4 ms<sup>2</sup> to 1000 ms<sup>2</sup></p> <p>Frequency 10 Hz to 1 kHz Range 0.1 ms<sup>2</sup> to 1 ms<sup>2</sup></p> <p>Half Sine Wave Frequency 500 Hz to 20 kHz Applied Force 0.2 N to 450 N</p> <p>0.1 Joule to 1.0 Joule</p>	<p>3.0 %</p> <p>2.0 %</p> <p>4.0 %</p> <p>0.015 Joule</p>	<p>Calibration of charge sensitivity by comparison with a reference (precision grade) transducer The transducer to be calibrated must have a mass of no more than 40 grams.</p> <p>Calibrations can be given in Joule or Newton Meter units.</p>	A



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<b>Gateshead Laboratory</b>				
<b>ELECTRICAL</b>				B
DC VOLTAGE Generation	0 mV to 100 mV 100 mV to 220 mV 0.22 V to 0.5 V 0.5 to 1 V 1 V to 2.2 V 2.2 V to 5 V 5 V to 11 V 11 V to 22 V 22 V to 50 V 50 V to 100 V 100 V to 220 V 220 V to 500 V 500 V to 1100 V	9.3 $\mu$ V 10 $\mu$ V 4.9 $\mu$ V 9.4 $\mu$ V 20 $\mu$ V 47 $\mu$ V 0.10 mV 0.20 mV 0.54 mV 1.0 mV 2.3 mV 6.5 mV 14 mV		B
Measurement	0 mV 0 mV to 50 mV 50 mV to 100 mV 100 mV to 500 mV 500 mV to 1 V 1 V to 2 V 2 V to 5 V 5 V to 10 V 10 V to 20 V 20 V to 50 V 50 V to 100 V  100 V to 200 V 200 V to 500 V 500 V to 1050 V	0.62 $\mu$ V 0.82 $\mu$ V 1.1 $\mu$ V 2.0 $\mu$ V 3.5 $\mu$ V 7.0 $\mu$ V 17 $\mu$ V 34 $\mu$ V/68 $\mu$ V 270 $\mu$ V 0.51 mV  1.0 mV 2.7 mV 5.4 mV		B
DC RESISTANCE Sourcing - Spot Values	0 $\Omega$ 1 $\Omega$ 1.9 $\Omega$ 10 $\Omega$ 19 $\Omega$ 100 $\Omega$ 190 $\Omega$ 1 k $\Omega$ 1.9 k $\Omega$ 10 k $\Omega$ 19 k $\Omega$ 100 k $\Omega$ 190 k $\Omega$ 1 M $\Omega$ 1.9 M $\Omega$ 10 M $\Omega$ 19 M $\Omega$ 100 M $\Omega$	58 $\mu$ $\Omega$ 0.13 m $\Omega$ 0.24 m $\Omega$ 0.38 m $\Omega$ 0.68 m $\Omega$ 2.3 m $\Omega$ 4.4 m $\Omega$ 17 m $\Omega$ 33 m $\Omega$ 0.16 $\Omega$ 0.31 $\Omega$ 1.8 $\Omega$ 3.5 $\Omega$ 27 $\Omega$ 53 $\Omega$ 0.53 k $\Omega$ 1.2 k $\Omega$ 15 k $\Omega$		B



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DC RESISTANCE (continued)				B
Sourcing - Range values	0 $\Omega$ to 11 $\Omega$ 11 $\Omega$ to 33 $\Omega$ 33 $\Omega$ to 110 $\Omega$ 110 $\Omega$ to 330 $\Omega$ 330 $\Omega$ to 1.1 k $\Omega$  1.1 k $\Omega$ to 3.3 k $\Omega$ 3.3 k $\Omega$ to 11 k $\Omega$ 11 k $\Omega$ to 33 k $\Omega$ 33 k $\Omega$ to 110 k $\Omega$  110 k $\Omega$ to 330 k $\Omega$ 330 k $\Omega$ to 1.1 M $\Omega$ 1.1 M $\Omega$ to 3.3 M $\Omega$ 3.3 M $\Omega$ to 11 M $\Omega$ 11 M $\Omega$ to 33 M $\Omega$  33 M $\Omega$ to 110 M $\Omega$ 110 M $\Omega$ to 330 M $\Omega$ 330 M $\Omega$ to 1.1 G $\Omega$	0.79 m $\Omega$ 1.5 m $\Omega$ 3.9 m $\Omega$ 11 m $\Omega$ 36 m $\Omega$  110 m $\Omega$ 130 m $\Omega$ 1.1 $\Omega$ 3.6 $\Omega$  13 $\Omega$ 43 $\Omega$ 240 $\Omega$ 1.7 k $\Omega$ 9.6 k $\Omega$  65 k $\Omega$ 1.1 M $\Omega$ 19 M $\Omega$		
Measurement	0 $\Omega$ 0 $\Omega$ to 0.5 $\Omega$ 0.5 $\Omega$ to 1 $\Omega$ 1 $\Omega$ to 2 $\Omega$ 2 $\Omega$ to 5 $\Omega$ 5 $\Omega$ to 10 $\Omega$ 10 $\Omega$ to 20 $\Omega$ 20 $\Omega$ to 50 $\Omega$ 50 $\Omega$ to 100 $\Omega$ 100 $\Omega$ to 200 $\Omega$ 0.2 k $\Omega$ to 0.5 k $\Omega$ 0.5 k $\Omega$ to 1 k $\Omega$ 1 k $\Omega$ to 2 k $\Omega$ 2 k $\Omega$ to 5 k $\Omega$ 5 k $\Omega$ to 10 k $\Omega$ 10 k $\Omega$ to 20 k $\Omega$ 20 k $\Omega$ to 50 k $\Omega$ 50 k $\Omega$ to 100 k $\Omega$ 100 k $\Omega$ to 200 k $\Omega$ 0.2 M $\Omega$ to 0.5 M $\Omega$ 0.5 M $\Omega$ to 1 M $\Omega$ 1 M $\Omega$ to 2 M $\Omega$ 2 M $\Omega$ to 5 M $\Omega$ 5 M $\Omega$ to 10 M $\Omega$ 10 M $\Omega$ to 20 M $\Omega$ 20 M $\Omega$ to 50 M $\Omega$ 50 M $\Omega$ to 100 M $\Omega$ 100 M $\Omega$ to 1 G $\Omega$ 1 G $\Omega$ to 10 G $\Omega$	7.4 $\mu\Omega$ 13 $\mu\Omega$ 21 $\mu\Omega$ 41 $\mu\Omega$ 88 $\mu\Omega$ 0.13 m $\Omega$ 0.24 m $\Omega$ 0.56 m $\Omega$ 1.1 m $\Omega$ 2.1 m $\Omega$ 5.5 m $\Omega$ 11 m $\Omega$ 21 m $\Omega$ 56 m $\Omega$ 0.11 $\Omega$ 0.21 $\Omega$ 0.58 $\Omega$ 1.1 $\Omega$ 2.2 $\Omega$ 7.6 $\Omega$ 13 $\Omega$ 26 $\Omega$ 0.17 k $\Omega$ 0.25 k $\Omega$ 0.51 k $\Omega$ 14 k $\Omega$ 18 k $\Omega$ 0.30 M $\Omega$ 19 M $\Omega$		







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AC VOLTAGE				B
Generation	<b>220 V to 500 V</b> 50Hz 50 Hz to 500 Hz 500Hz to 1 kHz	57 mV 57 mV 57 mV		
	<b>500 V to 1100 V</b> 50 Hz 50 Hz to 500Hz 500 Hz to 1 kHz	0.12 V 0.12 V 0.12 V		
Measurement	<b>1 mV to 5 mV</b> 10 Hz to 2 kHz 2 kHz to 10 kHz. 10 kHz to 30 kHz 30 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 1 MHz	2.5 $\mu$ V 2.8 $\mu$ V 3.0 $\mu$ V 17 $\mu$ V 58 $\mu$ V 0.12 mV		
	<b>5 mV to 10 mV</b> 10 Hz 10 Hz to 2 kHz 2 kHz to 10 kHz. 10 kHz to 30 kHz 30 kHz to 60 kHz 60 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 1 MHz	2.5 $\mu$ V 3.8 $\mu$ V 4.6 $\mu$ V 4.8 $\mu$ V 36 $\mu$ V 35 $\mu$ V 0.12 mV 0.23 mV		
	<b>10 mV to 50 mV</b> 10Hz 10 Hz to 2 kHz 2 kHz to 10 kHz. 10 kHz to 30 kHz 30 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 1 MHz 1 MHz to 2 MHz 2 MHz to 4 MHz 4 MHz to 6 MHz 6 MHz to 8 MHz 8 MHz to 10 MHz	6.0 $\mu$ V 5.7 $\mu$ V 7.9 $\mu$ V 14 $\mu$ V 31 $\mu$ V 0.13 mV 0.65 mV 1.1 mV 2.6 mV 5.0 mV 5.0 mV 9.3 mV		



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AC VOLTAGE (continued) Measurement (continued)	<p><b>50 mV to 100 mV</b>            10 Hz to 2 kHz            2 kHz to 10 kHz.            10 kHz to 30 kHz            30 kHz to 60 kHz            60 kHz to 100 kHz            100 kHz to 300 kHz            300 kHz to 1 MHz            1 MHz to 2 MHz            2 MHz to 4 MHz            4 MHz to 8 MHz            8 MHz to 10 MHz</p> <p><b>0.1 V to 0.5 V</b>            10Hz            10 Hz to 2 kHz            2 kHz to 10 kHz            10 kHz to 30 kHz            30 kHz to 100 kHz            100 kHz to 300 kHz            300 kHz to 1 MHz            1 MHz to 2 MHz            2 MHz to 4 MHz            4 MHz to 8MHz            8 MHz to 10 MHz</p> <p><b>0.5 V to 1 V</b>            10Hz            10 Hz to 2 kHz            2 kHz to 10 kHz.            10 kHz to 30 kHz            30 kHz to 60 kHz            60 kHz to 100 kHz            100 kHz to 300 kHz            300 kHz to 1 MHz            1 MHz to 2 MHz            2 MHz to 4 MHz            4 MHz to 8 MHz            8 MHz to 10 MHz</p> <p><b>1 V to 5 V</b>            10Hz            10 Hz to 2 kHz            2 kHz to 10 kHz.            10 kHz to 30 kHz            30 kHz to 100 kHz            100 kHz to 300 kHz            300 kHz to 1 MHz            1 MHz to 2 MHz            2 MHz to 4 MHz            4 MHz to 8 MHz            8 MHz to 10 MHz</p>	<p>11 <math>\mu</math>V            15 <math>\mu</math>V            27 <math>\mu</math>V            62 <math>\mu</math>V            67 <math>\mu</math>V            0.25 mV            1.3 mV            1.9 mV            4.9 mV            10 mV            19 mV</p> <p>52 <math>\mu</math>V            48 <math>\mu</math>V            73 <math>\mu</math>V            0.13 mV            0.31 mV            1.3 mV            5.9 mV            11 mV            26 mV            49 mV            90 mV</p> <p>92 <math>\mu</math>V            90 <math>\mu</math>V            0.14 mV            0.27 mV            0.61 mV            0.67 mV            2.5 mV            12 mV            18 mV            48 mV            0.10 V            0.18 V</p> <p>0.54 mV            0.48 mV            0.73 mV            1.3 mV            3.1 mV            13 mV            59 mV            0.10 V            0.26 V            0.49 V            0.90 V</p>		B



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AC VOLTAGE (continued) Measurement (continued)	<p><b>5 V to 10 V</b> 10Hz 10 Hz to 2 kHz 2 kHz to 10 kHz. 10 kHz to 30 kHz 30 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 1 MHz 1 MHz to 2 MHz 2 MHz to 4 MHz 4 MHz to 8 MHz 8 MHz to 10 MHz</p> <p><b>10 V to 50 V</b> 10Hz 10 Hz to 2 kHz 2 kHz to 10 kHz. 10 kHz to 30 kHz 30 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 1 MHz</p> <p><b>50 V to 100 V</b> 10 Hz to 2 kHz 2 kHz to 10 kHz. 10 kHz to 30 kHz 30 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 1 MHz</p> <p><b>100 V to 500 V</b> 40 Hz to 10 kHz 10 kHz to 30 kHz 30 kHz to 100 kHz</p> <p><b>500 V to 1000 V</b> 40 Hz to 10 kHz 10 kHz to 30 kHz 30 kHz to 100 kHz</p>	<p>0.93 mV 0.90 mV 1.4 mV 2.7 mV 6.1 mV 24 mV 0.12 V 0.18 V 0.48 V 1.0 V 1.8 V</p> <p>5.8 mV 5.6 mV 6.7 mV 13 mV 35 mV 0.22 V 0.86 V</p> <p>11 mV 13 mV 27 mV 68 mV 0.43 V 1.4 V</p> <p>73 mV 0.14V 0.36V</p> <p>0.13 V 0.27 V 0.69 V</p>		B



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AC CURRENT Generation	<b>10 <math>\mu</math>A to 50 <math>\mu</math>A</b> 20 Hz to 40 Hz 40 to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz  <b>50 <math>\mu</math>A to 100 <math>\mu</math>A</b> 20 Hz to 40 Hz 40 to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz  <b>100 <math>\mu</math>A to 220 <math>\mu</math>A</b> 20 Hz to 40 Hz 40 to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz  <b>0.22 mA to 0.5 mA</b> 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz  <b>0.5 mA to 1 mA</b> 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz  <b>1 mA to 2.2 mA</b> 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz  <b>2.2 mA to 5 mA</b> 20 Hz to 40 Hz 40 to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz  <b>5 mA to 10 mA</b> 20 Hz to 40 Hz 40 to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz  <b>10 mA to 22 mA</b> 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	38 nA 26 nA 71 nA 0.16 $\mu$ A  57 nA 30 nA 0.10 $\mu$ A 0.24 $\mu$ A  0.11 $\mu$ A 48 nA 0.19 $\mu$ A 0.47 $\mu$ A  48 nA 47 nA 0.58 $\mu$ A 1.2 $\mu$ A  0.49 $\mu$ A 0.19 $\mu$ A 1.0 $\mu$ A 2.4 $\mu$ A  1.1 $\mu$ A 0.41 $\mu$ A 1.9 $\mu$ A 4.7 $\mu$ A  2.5 $\mu$ A 1.0 $\mu$ A 7.0 $\mu$ A 16 $\mu$ A  4.9 $\mu$ A 1.9 $\mu$ A 10 $\mu$ A 24 $\mu$ A  11 $\mu$ A 4.1 $\mu$ A 19 $\mu$ A 47 $\mu$ A		B



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AC CURRENT (continued) Generation (continued)	<b>22 mA to 50 mA</b> 20 Hz to 40 Hz 40 to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz  <b>50 mA to 100 mA</b> 20 Hz to 40 Hz 40 to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz  <b>100 mA to 220 mA</b> 20 Hz to 40 Hz 40 to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz  <b>0.22 A to 0.5 A</b> 20 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz  <b>0.5 A to 1 A</b> 20 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz  <b>1 A to 2.2 A</b> 20 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz  <b>2.2 A to 3 A</b> 10 Hz to 45 Hz 45 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz  <b>3 A to 11 A</b> 45 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 5 kHz  <b>11 A to 20.5 A</b> 45 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 5 kHz  <b>45 Hz to 1 kHz</b> 11 A to 30 A	25 $\mu$ A 11 $\mu$ A 70 $\mu$ A 0.16 mA  49 $\mu$ A 21 $\mu$ A 99 $\mu$ A 0.24 mA  0.11 mA 46 $\mu$ A 0.19 mA 0.47 mA  0.44 mA 0.50 mA 0.62 mA  0.87 mA 0.99 mA 1.2 mA  1.9 mA 2.2 mA 2.6 mA  6.4 mA 2.3 mA 22 mA 92 mA  11 mA 16 mA 0.38 mA  36 mA 42 mA 720 mA  110 mA	Calibration of current clamps using a multi turn coil	



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AC CURRENT (continued) Generation (continued)	<b>30 A to 110 A</b> 45 Hz to 100 Hz 100 Hz to 1 kHz	430 mA 450 mA		B
	<b>110 A to 150 A</b> 45 Hz to 1 kHz	610 mA		
	<b>150 A to 550 A</b> 45 Hz to 100 Hz 100 Hz to 1 kHz	2.1 A 2.3 A		
	<b>550 A to 1025 A</b> 45 Hz to 100 Hz 100 Hz to 1 kHz	4.1 A 4.6 A		
Measurement	<b>0 <math>\mu</math>A to 5 <math>\mu</math>A</b> 10 Hz to 55 Hz 55 Hz to 10 kHz	12 nA 25 nA		
	<b>5 <math>\mu</math>A to 10 <math>\mu</math>A</b> 10 Hz to 55 Hz 55 Hz to 10 kHz	24 nA 34 nA		
	<b>10 <math>\mu</math>A to 20 <math>\mu</math>A</b> 10 Hz to 55 Hz 55 Hz to 10 kHz	47 nA 52 nA		
	<b>20 <math>\mu</math>A to 50 <math>\mu</math>A</b> 10 Hz to 2 kHz. 2 kHz to 10 kHz 10 kHz to 20 kHz 20 kHz to 30 kHz	19 nA 32 nA 46 nA 51 nA		
	<b>50 <math>\mu</math>A to 100 <math>\mu</math>A</b> 10 Hz to 2 kHz. 2 kHz to 10 kHz 10 kHz to 20 kHz 20 kHz to 30 kHz	34 nA 62 nA 87 nA 90 nA		
	<b>100 <math>\mu</math>A to 200 <math>\mu</math>A</b> 10 Hz to 2 kHz. 2 kHz to 10 kHz 10 kHz to 30 kHz	66 nA 0.12 $\mu$ A 0.17 $\mu$ A		
	<b>0.2 mA to 0.5 mA</b> 10Hz to 2 kHz. 2 kHz to 10 kHz 10 kHz to 30 kHz	0.18 $\mu$ A 0.32 $\mu$ A 0.43 $\mu$ A		
	<b>0.5 mA to 1 mA</b> 10 Hz to 2 kHz. 2 kHz to 10 kHz 10 kHz to 30 kHz	0.33 $\mu$ A 0.62 $\mu$ A 0.86 $\mu$ A		



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AC CURRENT (continued) Measurement (continued)	<b>1 mA to 2 mA</b> 10 Hz to 2 kHz. 2 kHz to 10 kHz 10 kHz to 30 kHz  <b>2 mA to 5 mA</b> 10 Hz to 2 kHz. 2 kHz to 10 kHz 10 kHz to 30 kHz  <b>5 mA to 10 mA</b> 10 Hz to 2 kHz. 2 kHz to 10 kHz 10 kHz to 30 kHz  <b>10 mA to 20 mA</b> 10 Hz to 2 kHz. 2 kHz to 10 kHz 10 kHz to 30 kHz  <b>20 mA to 50 mA</b> 10 Hz to 2 kHz. 2 kHz to 10 kHz 10 kHz to 30 kHz  <b>50 mA to 100 mA</b> 10 Hz to 2 kHz. 2 kHz to 10 kHz 10 kHz to 30 kHz  <b>100 mA to 200 mA</b> 10 Hz to 2 kHz. 2 kHz to 10 kHz 10 kHz to 30 kHz  <b>0.2 A to 0.5 A</b> 10 Hz to 2 kHz. 2 kHz to 10 kHz 10 kHz to 30 kHz  <b>0.5 A to 1 A</b> 10 Hz to 2 kHz. 2 kHz to 10 kHz 10 kHz to 30 kHz  <b>1 A to 2 A</b> 10 Hz to 2 kHz. 2 kHz to 10 kHz 10 kHz to 30 kHz  <b>2 A to 5 A</b> 10 Hz to 10 kHz	0.66 $\mu$ A 1.2 $\mu$ A 1.7 $\mu$ A  1.8 $\mu$ A 3.2 $\mu$ A 4.4 $\mu$ A  3.3 $\mu$ A 6.2 $\mu$ A 8.6 $\mu$ A  6.6 $\mu$ A 12 $\mu$ A 17 $\mu$ A  18 $\mu$ A 31 $\mu$ A 44 $\mu$ A  33 $\mu$ A 61 $\mu$ A 86 $\mu$ A  66 $\mu$ A 0.12 mA 0.17 mA  0.22 mA 0.35 mA 0.47 mA  0.37 mA 0.65 mA 0.92 mA  0.73 mA 1.3 mA 1.8 mA  4.9 mA		B





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AC CURRENT (continued) Measurement (continued)	<b>5 A to 10 A</b> <i>10 Hz to 10 kHz</i>  <b>10 A to 20 A</b> <i>10 Hz to 10 kHz</i>  <b>20 A to 30 A</b> <i>10 Hz to 2 kHz</i> <i>2 kHz to 10 kHz</i>	10 mA  19 mA  24 mA 32 mA		B
FREQUENCY				B
Generation	10 MHz	3.2 in 10 <sup>9</sup>	Reference	
Measurement	10 Hz to 100 kHz 100 kHz to 1 MHz 1 MHz to 10 MHz 10 MHz to 50 MHz 50 MHz to 600 MHz 600 MHz to 6 GHz	16 mHz 170 mHz 1.7 Hz 17 Hz 4.8 Hz 35 Hz		
Generation	1 Hz to 10 Hz 10 Hz to 100 Hz 100 Hz to 20 MHz	2.3 µHz/Hz 1.2 µHz/Hz 0.012 µHz/Hz	May be reported as events per unit time	
Elapsed time			Mechanical timers / stop watches	
Single event	1 s to 12 hrs	0.10 s		
Revolutions Per Minute Simulation	6 RPM to 600 RPM 600 RPM to 6000 RPM 6000 RPM to 120000 RPM	0.064 RPM 0.065 RPM 0.066 RPM	Optical	
CAPACITANCE				B
Simulated generation	<b>1 kHz</b> 220 pF to 400 pF 400 pF to 1.1 nF 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	14 pF 18 pF 31 pF 44 pF 110 pF 330 pF 990 pF		



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issued by  
**United Kingdom Accreditation Service**  
2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK

**Calibration, Maintenance and Repair Ltd**  
**Issue No: 041    Issue date: 24 October 2022**

**Calibration performed by the Organisation at the locations specified**

Measured Quantity Instrument or Gauge	Range	Expanded Measurement Uncertainty ( $k = 2$ )	Remarks	Location Code
Values and uncertainties listed below are applicable for the calibration of both measuring instruments and for instruments with an output. The method used is by direct comparison against laboratory references unless otherwise stated in the remarks column.				
CAPACITANCE (continued) Simulated generation (continued)	<b>100 Hz</b> 0.33 $\mu$ F to 1.1 $\mu$ F 1.1 $\mu$ F to 3.3 $\mu$ F 3.3 $\mu$ F to 11 $\mu$ F 11 $\mu$ F to 33 $\mu$ F 33 $\mu$ F to 110 $\mu$ F 110 $\mu$ F to 330 $\mu$ F 330 $\mu$ F to 1.1 mF 1.1 mF to 3.3 mF 3.3 mF to 11 mF 11 mF to 33 mF 33 mF to 110 mF	4.4 nF 13 nF 44 nF 190 nF 700 nF 2.1 $\mu$ F 7.0 $\mu$ F 21 $\mu$ F 70 $\mu$ F 320 $\mu$ F 1.5 mF		B
Measurement	0 to 0.5 nF 0.5 nF to 1 nF 1 nF to 2 nF 2 nF to 5 nF 5 nF to 10 nF 10 nF to 20 nF 20 nF to 50 nF 50 nF to 100 nF 100 nF to 200 nF 0.2 $\mu$ F to 0.5 $\mu$ F 0.5 $\mu$ F to 1 $\mu$ F 1 $\mu$ F to 2 $\mu$ F 2 $\mu$ F to 5 $\mu$ F 5 $\mu$ F to 10 $\mu$ F 10 $\mu$ F to 20 $\mu$ F 20 $\mu$ F to 50 $\mu$ F 50 $\mu$ F to 100 $\mu$ F 100 $\mu$ F to 200 $\mu$ F 0.2 mF to 0.5 mF 0.5 mF to 1 mF 1 mF to 2 mF 2 mF to 5 mF 5 mF to 10 mF 10 mF to 20 mF 20 mF to 50 mF 50 mF to 100 mF 100 mF to 200 mF	2.4 pF 3.0 pF 5.2 pF 5.7 pF 10 pF 20 pF 32 pF 58 pF 0.12 nF 0.27 nF 0.50 nF 1.1 nF 2.8 nF 5.0 nF 10 nF 45 nF 76 nF 0.15 $\mu$ F 0.61 $\mu$ F 0.87 $\mu$ F 1.5 $\mu$ F 4.4 $\mu$ F 8.4 $\mu$ F 17 $\mu$ F 45 $\mu$ F 85 $\mu$ F 0.17 mF		



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<b>CALIBRATION OF INSULATION TESTERS</b>				B
Insulation Resistance	100 k $\Omega$ to 1 M $\Omega$ 1 M $\Omega$ to 10 M $\Omega$ 10 M $\Omega$ to 100 M $\Omega$ 100 M $\Omega$ to 1 G $\Omega$	2.0 k $\Omega$ 32 k $\Omega$ 510 k $\Omega$ 7.0 M $\Omega$	Up to 1350 V	
Insulation test voltage Nominal	50 V 100 V 250 V 500 V 1 kV	1.0 V 2.0 V 3.0 V 4.0 V 7.0 V	The test voltage will normally be measured with a 1 mA load.	
Continuity Resistance	0 $\Omega$ to 1 $\Omega$ 1 $\Omega$ to 50 $\Omega$ 50 $\Omega$ to 100 $\Omega$ 100 $\Omega$ to 200 $\Omega$	58 m $\Omega$ 100 m $\Omega$ 120 m $\Omega$ 140 m $\Omega$		
Temperature indicators, calibration by electrical simulation				B
Type E thermocouple	-250 $^{\circ}$ C to -100 $^{\circ}$ C -100 $^{\circ}$ C to -25 $^{\circ}$ C -25 $^{\circ}$ C to +350 $^{\circ}$ C 350 $^{\circ}$ C to 650 $^{\circ}$ C 650 $^{\circ}$ C to 1000 $^{\circ}$ C	0.62 $^{\circ}$ C 0.20 $^{\circ}$ C 0.18 $^{\circ}$ C 0.20 $^{\circ}$ C 0.26 $^{\circ}$ C	Including reference junction compensation	
Type J thermocouple	-210 $^{\circ}$ C to -100 $^{\circ}$ C -100 $^{\circ}$ C to -30 $^{\circ}$ C -30 $^{\circ}$ C to +150 $^{\circ}$ C 150 $^{\circ}$ C to 760 $^{\circ}$ C 760 $^{\circ}$ C to 1200 $^{\circ}$ C	0.34 $^{\circ}$ C 0.23 $^{\circ}$ C 0.18 $^{\circ}$ C 0.21 $^{\circ}$ C 0.28 $^{\circ}$ C	Including reference junction compensation	
Type k thermocouple	-200 $^{\circ}$ C to -100 $^{\circ}$ C -100 $^{\circ}$ C to -25 $^{\circ}$ C -25 $^{\circ}$ C to +120 $^{\circ}$ C 120 $^{\circ}$ C to 1000 $^{\circ}$ C 1000 $^{\circ}$ C to 1370 $^{\circ}$ C	0.41 $^{\circ}$ C 0.23 $^{\circ}$ C 0.21 $^{\circ}$ C 0.31 $^{\circ}$ C 0.47 $^{\circ}$ C	Including reference junction compensation	



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Temperature indicators, calibration by electrical simulation (continued)				B
Type N thermocouple	-200 °C to -100 °C -100 °C to -25 °C -25 °C to +120 °C 120 °C to 410 °C 410 °C to 1300 °C	0.48 °C 0.28 °C 0.25 °C 0.23 °C 0.33 °C	Including reference junction compensation	
Type R thermocouple	0 °C to 250 °C 250 °C to 400 °C 400 °C to 1000 °C 1000 °C to 1767 °C	0.76 °C 0.46 °C 0.43 °C 0.50 °C	Including reference junction compensation	
Type S thermocouple	0 °C to 250 °C 250 °C to 1000 °C 1000 °C to 1400 °C 1400 °C to 1767 °C	0.66 °C 0.48 °C 0.47 °C 0.57 °C	Including reference junction compensation	
Type T thermocouple	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.80 °C 0.30 °C 0.21 °C 0.18 °C	Including reference junction compensation	
Resistance thermometer				
Pt 100 Generation: simulation	-200 °C to -80 °C -80 °C to 0 °C 0 °C to 100 °C 100 °C to 300 °C 300 °C to 400 °C 400 °C to 630 °C 630 °C to 800 °C	0.058 °C 0.058 °C 0.081 °C 0.10 °C 0.12 °C 0.14 °C 0.27 °C		
Pt100 Measure: simulation	-200 °C to 0 °C 0 °C to 850 °C	0.0069 °C 0.020 °C		



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Measured Quantity Instrument or Gauge	Range	Expanded Measurement Uncertainty ( $k = 2$ )	Remarks	Location Code
Values and uncertainties listed below are applicable for the calibration of both measuring instruments and for instruments with an output. The method used is by direct comparison against laboratory references unless otherwise stated in the remarks column.				
Calibration of Oscilloscopes				B
Voltage deflection	1 mV to 25 mV 25 mV to 110 mV 110 mV to 2.2 V 2.2 V to 6 V	0.29 % + 76 $\mu$ V 0.29 % + 250 $\mu$ V 0.29 % + 3.6 mV 0.29 % + 9.0 mV	Into 50 $\Omega$	
	1 mV 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	0.12 % + 61 $\mu$ V 0.12 % + 68 $\mu$ V 0.12 % + 800 $\mu$ V 0.12 % + 4.0 mV 0.12 % + 40 mV	Into 1 M $\Omega$	
Time markers	2 ns to 500 ns 500 ns to 500 $\mu$ s 500 $\mu$ s to 50 ms 50 ms to 5 s	0.082 % + 0.20 ps 0.082 % + 0.50 ns 0.058 % + 50 ns 0.59 % + 0.25 ms		
<b>PRESSURE</b>				B
Pneumatic Pressure (gauge)			Methods consistent with EURAMET CG17. Absolute pressures can be generated within these gauge pressure ranges. This will attract an additional uncertainty of 10 Pa.	
Calibration of pressure indicating instruments and gauges	- 95 kPa to -10 kPa -10 kPa to -1.5 kPa 1.5 kPa to 10 kPa 10 kPa to 20 kPa 20 kPa to 2.5 MPa 2.5 MPa to 14 MPa	0.0087 % 0.0084 % + 0.42 Pa 0.0062 % + 0.42 Pa 0.0066 % 0.0060 % 0.0079 %	Sensors with an electrical output can be calibrated	
Hydraulic Pressure (gauge)				
Calibration of pressure indicating instruments and gauges	0.6 MPa to 6 MPa 6 MPa to 120 MPa	0.011 % 0.010 %		
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:  $Q[a, b] = [a^2 + b^2]^{1/2}$