

Schedule of Accreditation

issued by

United Kingdom Accreditation Service

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

 <p>UKAS CALIBRATION</p> <p>0324</p> <p>Accredited to ISO/IEC 17025:2017</p>	<p>Transmille Ltd</p> <p>Issue No: 041 Issue date: 17 December 2021</p>	
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<p>Calibration performed at the above address only</p>		

DETAIL OF ACCREDITATION

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 measurements instruments and for instruments with an output. the method used is by direct comparison unless otherwise stated in the remarks column.</p>			
ELECTRICAL			
DC Resistance range values	0 Ω to 1 m Ω 1 m Ω to 10 m Ω 10 m Ω to 100 m Ω 100 m Ω to 1 Ω 1 Ω to 10 Ω 10 Ω to 100 Ω 100 Ω to 1k Ω 1k Ω to 10k Ω 10k Ω to 100k Ω 100 k Ω to 1 M Ω 1 M Ω to 10 M Ω 10 M Ω to 100 M Ω 100 M Ω to 1 G Ω 1 G Ω to 10 G Ω 10 G Ω to 100 G Ω 100 G Ω to 1 T Ω	850 p Ω 0.85 $\mu\Omega/\Omega$ 0.80 $\mu\Omega/\Omega$ 0.60 $\mu\Omega/\Omega$ 0.50 $\mu\Omega/\Omega$ 0.70 $\mu\Omega/\Omega$ 0.65 $\mu\Omega/\Omega$ 0.36 $\mu\Omega/\Omega$ 0.45 $\mu\Omega/\Omega$ 14 $\mu\Omega/\Omega + 2.2 \Omega$ 20 $\mu\Omega/\Omega + 90 \Omega$ 510 $\mu\Omega/\Omega + 1.5 k\Omega$ 0.58 % + 20 k Ω 0.41 % 1.6 % 0.58 % + 21 k Ω	Ratio technique. These CMC's are for 4 terminal resistors suitable for oil immersion / placing In an air bath at 20 °C. The CMC may increase for other types
Specific Values	1 Ω 10k Ω 1M Ω 10M Ω 100M Ω 1G Ω 10G Ω 100G Ω 1T Ω	310 n Ω 2.8 m Ω 4.8 Ω 110 Ω 3.55 k Ω 140 k Ω 28 M Ω 520 M Ω 7.6 G Ω	



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DC Voltage ranges	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	440 nV 490 nV 1.5 μ V/V +440 nV 1.6 μ V/V 1.8 μ V/V 2.0 μ V/V	
DC Voltage specific values	100 mV 1V 10 V 100 V 1 kV	300 nV 1.1 μ V 6.5 μ V 110 μ V 1.2 mV	
High Voltage	1 kV to 5 kV 5 kV to 40 kV	0.20 % + 5.0 V 0.25 % + 10 V	
DC Current	0 A to 10nA 10 nA to 100 nA 100 nA to 1 μ A 1 μ A to 10 μ A 10 μ A to 100 μ A 100 μ A to 1 mA 1.0 mA to 10 mA 10 mA to 100 mA 100 mA to 1 A 1 A to 10 A 10 A to 30 A 30 A to 100 A 10 A to 1500 A	0.30 % + 1 pA 40 μ A/A + 28 pA 21 μ A/A + 29 pA 15 μ A/A + 33 pA 4.3 μ A/A + 100 pA 4.5 μ A/A + 950 pA 3.6 μ A/A + 22 nA 4.4 μ A/A + 100 nA 7.6 μ A/A + 700 nA 53 μ AA + 5.0 μ A 60 μ A/A 190 μ A/A 0.23 % + 1.3 A	For the calibration of clamp-on ammeters



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**AC Voltage
Specific values**

The CMC's shown relate to voltages and frequencies that lie within 10% of the specified values. For intermediate frequencies the CMC is the greatest of the adjacent uncertainties. The CMCs are in $\mu V/V$ of the nominal voltage

		Frequency (kHz)											
		0.01	0.023	0.04	0.206	1	10	20	50	100	200	500	1000
Voltage (V)	0.002	2600	1900	1900	1900	1900	2000	1900	1900	2250	2950	5000	6000
	0.01	400	350	350	350	350	350	350	370	590	820	1400	1700
	0.02	330	220	180	175	175	175	180	240	500	750	1300	1500
	0.1	240	110	60	60	60	60	60	120	170	520	690	690
	0.2	230	95	48	48	48	48	48	115	175	500	700	700
	0.3	255	94	60	60	60	60	60	60	120	175	535	700
	0.5	260	94	60	60	60	60	60	115	120	520	700	700
	0.7	230	82	36	32	32	32	32	53	70	160	500	630
	1	220	71	38	23	23	23	23	49	60	130	500	520
	2	220	75	35	23	23	23	23	50	60	135	495	500
	5	220	72	32	20	20	20	20	48	60	140	500	
	10	220	71	38	28	28	28	28	49	60	140	500	
	20	220	70	35	26	26	26	26	50	60	140	140	
	50	220	72	34	30	30	30	30	60	78			
	100			39	39	39	39	39	77	83			
	200			38	38	38	38	38	70	85			
	500			50	50	50	50	52	78				
1000			36	36	36	36	36	72					

Other values	1mV to 2.2mV 10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	1.8 mV/V + 2.1 μV 700 $\mu V/V$ + 2.3 μV 400 $\mu V/V$ + 2.3 μV 800 $\mu V/V$ + 3 μV 1.2 mV/V + 3.5 μV 2.5 mV/V + 5 μV 2.5 mV/V + 10 μV 3.5 mV/V + 10 μV	
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AC Voltages Range values – continued	2.2 mV to 7 mV		
	10 Hz to 20 Hz	600 μ V/V + 4.8 μ V	
	20 Hz to 40 Hz	400 μ V/V + 2 μ V	
	40 Hz to 20 kHz	220 μ V/V + 2.2 μ V	
	20 kHz to 50 kHz	400 μ V/V + 3 μ V	
	50 kHz to 100 kHz	630 μ V/V + 3.5 μ V	
	100 kHz to 300kHz	1.35 mV/V + 5 μ V	
	300 kHz to 500 kHz	1.5 mV/V + 10 μ V	
	500 kHz to 1 MHz	2.6 mV/V + 10 μ V	
	7 mV to 22 mV		
	10 Hz to 20 Hz	330 μ V/V + 2 μ V	
	20 Hz to 40 Hz	220 μ V/V + 2 μ V	
	40 Hz to 20 kHz	120 μ V/V + 2.2 μ V	
	20 kHz to 50 kHz	230 μ V/V + 2.9 μ V	
	50 kHz to 100 kHz	350 μ V/V + 3.3 μ V	
	100 kHz to 300kHz	940 μ V/V + 4.5 μ V	
	300 kHz to 500 kHz	1 mV/V + 10 μ V	
	500 kHz to 1 MHz	1.95 mV/V + 10 μ V	
	22 mV to 70 mV		
	10 Hz to 20 Hz	290 μ V/V + 1.8 μ V	
20 Hz to 40 Hz	150 μ V/V + 1.8 μ V		
40 Hz to 20 kHz	70 μ V/V + 2.3 μ V		
20 kHz to 50 kHz	150 μ V/V + 2.6 μ V		
50 kHz to 100 kHz	300 μ V/V + 3.1 μ V		
100 kHz to 300kHz	580 μ V/V + 5.4 μ V		
300 kHz to 500 kHz	780 μ V/V + 9 μ V		
500 kHz to 1 MHz	1.28 mV/V + 9 μ V		
70 mV to 220 mV			
10 Hz to 20 Hz	240 μ V/V + 2.2 μ V		
20 Hz to 40 Hz	95 μ V/V + 2.2 μ V		
40 Hz to 20 kHz	45 μ V/V + 2.2 μ V		
20 kHz to 50 kHz	80 μ V/V + 2.5 μ V		
50 kHz to 100 kHz	185 μ V/V + 3.3 μ V		
100 kHz to 300kHz	285 μ V/V + 5.3 μ V		
300 kHz to 500 kHz	465 μ V/V + 8 μ V		
500 kHz to 1 MHz	1.15 mV/V + 10 μ V		
220 mV to 700 mV			
10 Hz to 20 Hz	240 μ V/V + 2.2 μ V		
20 Hz to 40 Hz	87 μ V/V + 2.2 μ V		
40 Hz to 20 kHz	38 μ V/V + 1.7 μ V		
20 kHz to 50 kHz	59 μ V/V + 3.1 μ V		
50 kHz to 100 kHz	90 μ V/V + 4 μ V		
100 kHz to 300kHz	210 μ V/V + 4 μ V		
300 kHz to 500 kHz	340 μ V/V + 12 μ V		
500 kHz to 1 MHz	1.12 mV/V + 6 μ V		



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AC Voltages Range values – continued	700 mV to 2.2 V		
	10 Hz to 20 Hz	230 μ V/V + 4 μ V	
	20 Hz to 40 Hz	78 μ V/V	
	40 Hz to 20 kHz	28 μ V/V + 0.4 μ V	
	20 kHz to 50 kHz	55 μ V/V	
	50 kHz to 100 kHz	83 μ V/V	
	100 kHz to 300kHz	185 μ V/V + 3 μ V	
	300 kHz to 500 kHz	300 μ V/V	
	500 kHz to 1 MHz	1.05 mV/V	
	2.2 V to 7 V		
	10 Hz to 20 Hz	230 μ V/V + 4 μ V	
	20 Hz to 40 Hz	77 μ V/V + 6 μ V	
	40 Hz to 20 kHz	28 μ V/V + 4 μ V	
	20 kHz to 50 kHz	55 μ V/V + 5 μ V	
	50 kHz to 100 kHz	94 μ V/V + 3 μ V	
	100 kHz to 300kHz	215 μ V/V + 7 μ V	
	300 kHz to 500 kHz	460 μ V/V	
	500 kHz to 1 MHz	1.4 mV/V	
	7 V to 22 V		
	10 Hz to 20 Hz	230 μ V/V + 40 μ V	
20 Hz to 40 Hz	77 μ V/V + 6 μ V		
40 Hz to 20 kHz	28 μ V/V + 4 μ V		
20 kHz to 50 kHz	55 μ V/V + 5 μ V		
50 kHz to 100 kHz	96 μ V/V		
100 kHz to 300kHz	220 μ V/V		
300 kHz to 500 kHz	460 μ V/V		
500 kHz to 1 MHz	1.4 mV/V		
22 V to 70 V			
10 Hz to 20 Hz	230 μ V/V		
20 Hz to 40 Hz	78 μ V/V		
40 Hz to 20 kHz	31 μ V/V + 38 μ V		
20 kHz to 50 kHz	56 μ V/V		
50 kHz to 100 kHz	96 μ V/V		
70 V to 220 V			
10 Hz to 20 Hz	230 μ V/V		
20 Hz to 40 Hz	78 μ V/V		
40 Hz to 20 kHz	36 μ V/V		
20 kHz to 50 kHz	82 μ V/V		
50 kHz to 100 kHz	115 μ V/V		
220 V to 700 V			
10 Hz to 20 Hz	232 μ V/V		
20 Hz to 40 Hz	115 μ V/V		
40 Hz to 20 kHz	50 μ V/V		
20 kHz to 50 kHz	158 μ V/V		
50 kHz to 100 kHz	560 μ V/V + 7 mV		



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AC Voltages Range values – continued	700 V to 1000 V 10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	200 μ V/V + 20 mV 100 μ V/V + 10 mV 45 μ V/V 135 μ V/V + 16 mV 580 μ V/V	
AC High Voltage	1 kV to 5 kV 50 Hz 5 kV to 28 kV 50 Hz	0.45 % + 5.0 V 0.80 % + 10 V	
AC Current	25 μ A to 100 μ A 40 Hz to 1 kHz	100 μ A μ A/A + 2 nA	
	100 μ A to 1 mA 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 10 kHz 10kHz to 30 kHz	250 μ A/A + 10 nA 105 μ A/A + 15 nA 170 μ A/A + 12 nA 620 μ A/A + 10 nA	
	1 mA to 10 mA 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 10 kHz 10kHz to 30 kHz	270 μ A/A + 330 nA 100 μ A/A + 220 nA 170 μ A/A + 275 nA 880 μ A/A + 120 nA	
	10 mA to 20 mA 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 10 kHz 10kHz to 30 kHz	220 μ A/A + 800 nA 100 μ A/A + 400 nA 165 μ A/A + 500 nA 635 μ A/A + 300 nA	
	20 mA to 50 mA 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 10 kHz 10kHz to 30 kHz	220 μ A/A + 1.6 μ A 100 μ A/A + 0.8 μ A 170 μ A/A + 1.2 μ A 600 μ A/A	
	50 mA to 100 mA 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 10 kHz 10kHz to 30 kHz	220 μ A/A + 4 μ A 100 μ A/A + 2 μ A 170 μ A/A + 2.5 μ A 350 μ A/A + 2.5 μ A	
	100 mA to 200 mA 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 10 kHz 10kHz to 30 kHz	220 μ A/A + 9 μ A 90 μ A/A + 7 μ A 165 μ A/A + 6 μ A 355 μ A/A + 5 μ A	



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AC Current – continued	200 mA to 500 mA <i>10 Hz to 40 Hz</i> <i>40 Hz to 1 kHz</i> <i>1 kHz to 10 kHz</i> <i>10kHz to 30 kHz</i> 500 mA to 1 A <i>10 Hz to 40 Hz</i> <i>40 Hz to 1 kHz</i> <i>1 kHz to 10 kHz</i> <i>10kHz to 30 kHz</i> 1 A to 2 A <i>10 Hz to 40 Hz</i> <i>40 Hz to 1 kHz</i> <i>1 kHz to 10 kHz</i> <i>10kHz to 30 kHz</i> 2 A to 10 A <i>10 Hz to 40 Hz</i> <i>40 Hz to 1 kHz</i> <i>1 kHz to 10 kHz</i> 10 A to 30 A <i>10 Hz to 40 Hz</i> <i>40 Hz to 1 kHz</i> <i>1 kHz to 10 kHz</i>	220 μ A/A + 25 μ A 110 μ A/A + 10 μ A 170 μ A/A + 25 μ A 360 μ A/A + 20 μ A 240 μ A/A + 20 μ A 100 μ A/A + 20 μ A 170 μ A/A + 25 μ A 360 μ A/A + 20 μ A 240 μ A/A + 60 μ A 100 μ A/A + 40 μ A 170 μ A/A + 50 μ A 360 μ A/A + 50 μ A 270 μ A/A 110 μ A/A 180 μ A/A 260 μ A/A 150 μ A/A 200 μ A/A	
AC Current simulation	50 Hz 10 A to 1500 A	0.25 % + 1.3 A	For the calibration of clamp-on ammeters
Loop impedance	At 50 Hz: 0.2 Ω to 0.6 Ω 0.6 Ω to 1.6 Ω 5.5 Ω to 100 Ω 1 k Ω	22 m Ω 24 m Ω 42 m Ω 5.8 Ω	Nominal values for the calibration of earth loop testers
Inductance			
Specific Values	1 kHz 10 μ H 100 μ H 1 mH 10 mH 100 mH 1 H	17 nH 29 nH 330 nH 3.2 μ H 29 μ H 270 μ H	Specific values are those that fall within 1 % of the stated values.
Other values	10 μ H to 100 μ H 100 μ H to 1 mH 1 mH to 10 mH 10 mH to 100 mH 100 mH to 1 H	0.81 % 0.49 % 0.34 % + 1.0 μ H 0.31 % + 10 μ H 0.30 % + 100 μ H	



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Capacitance Specific Values, three-terminal	1 kHz 10 pF 100 pF 1 nF	16 fF 18 fF 180 fF	Specific values are those that fall within 1 % of the stated values
Specific Values, two- and three-terminal	1 kHz 10 nF 100 nF 1 μF	2.1 pF 20 pF 190 pF	
Other Values	1 kHz 10 pF to 10 μF	0.050 % + 0.20 pF	
Frequency			The 10 MHz claim is for an average frequency over a 10-minute period. Uncertainties will be increased for shorter periods. Range values may be reported as 1/f for electronically triggered repetitive events.
Reference	10 MHz	2.2 in 10 ¹⁰	
	10 mHz to 1 GHz	2.4 in 10 ⁸	
Time Interval	20 ms to 900 ms	390 μs	For the calibration of RCD testers
Phase Measurement Voltage : Current	40 Hz to 60 Hz -180 ° to 180°	130 m°	Voltage range: 1 V to 500 V
Temperature by electrical simulation			
Reference junction measurements	Ambient 18 °C to 28 °C	0.12 °C	
Including Reference Junction Compensation			
Thermocouple type			
K	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 1000 °C 1000 °C to 1370 °C	0.41 °C 0.31 °C 0.29 °C 0.35 °C 0.40 °C	
J	-210 °C to -100 °C -100 °C to -30 °C -30 °C to 150 °C 150 °C to 760 °C 760 °C to 1200 °C	0.37 °C 0.28 °C 0.30 °C 0.30 °C 0.34 °C	



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Temperature by electrical simulation Including reference junction compensation Continued			
Thermocouple type			
N	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 410 °C	0.56 °C 0.35 °C 0.32 °C 0.31 °C	
R	410 °C to 1300 °C 0 °C to 250 °C 250 °C to 1000 °C 1000 °C to 1760 °C	0.38 °C 1.0 °C 0.65 °C 0.72 °C	
S	0 °C to 250 °C 250 °C to 1000 °C 1000 °C to 1700 °C	0.99 °C 0.62 °C 0.68 °C	
T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.74 °C 0.28 °C 0.28 °C 0.29 °C	
B	600 °C to 800 °C 800 °C to 1000 °C 1000 °C to 1550 °C 1550 °C to 1820 °C	2.0 °C 2.0 °C 1.9 °C 1.9 °C	
E	-250 °C to -100 °C -100 °C to -25 °C -25 °C to 350 °C 350 °C to 1000 °C	0.63 °C 0.28 °C 0.29 °C 0.31 °C	
L	-200 °C to -100 °C -100 °C to 800 °C 800 °C to 900 °C	0.47 °C 0.43 °C 0.44 °C	
U	-200 °C to 0 °C 0 °C to 600 °C	0.55 °C 0.43 °C	
C	0 °C to 150 °C 150 °C to 650 °C 650 °C to 1000 °C 1000 °C to 1800 °C 1800 °C to 2316 °C	0.44 °C 0.40 °C 0.45 °C 0.60 °C 0.83 °C	



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Excluding Reference Junction Compensation			
Thermocouple type			
K	-270 °C to -200 °C -200 °C to 1372 °C	0.66 °C 0.050 °C	
J	-210 °C to 1200 °C	0.050 °C	
N	-270 °C to -200 °C -200 °C to 1300 °C	0.16 °C 0.080 °C	
R	0 °C to 1760 °C	0.12 °C	
S	0 °C to 1760 °C	0.12 °C	
T	-250 °C to -200 °C -200 °C to 400 °C	0.17 °C 0.050 °C	
B	600 °C to 1820 °C	0.11 °C	
E	-270 °C to -200 °C -200 °C to 1000 °C	0.32 °C 0.040 °C	
L	-200 °C to 900 °C	0.040 °C	
U	-200 °C to 600 °C	0.050 °C	
C	0 °C to 2316 °C	0.060 °C	
Resistance Thermometer PT 100	-100 °C to 800 °C	0.020 °C	
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: $Q[a, b] = [a^2 + b^2]^{1/2}$