

Schedule of Accreditation

issued by

United Kingdom Accreditation Service

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

 <p>0324</p> <p>Accredited to ISO/IEC 17025:2005</p>	<h3>Transmille Ltd</h3> <p>Issue No: 035 Issue date: 08 January 2018</p>	
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<p>Calibration performed at the above address only</p>		

DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks
ELECTRICAL			
DC Resistance Specific values	1 m Ω 10 m Ω 100 m Ω 1 Ω 10 Ω 100 Ω 1 k Ω 10 k Ω 100 k Ω 1 M Ω 10 M Ω 100 M Ω 1 G Ω 10 G Ω 100 G Ω 1T Ω	260 n Ω 76 n Ω 890 $\mu\Omega$ 2.4 $\mu\Omega$ 28 $\mu\Omega$ 160 $\mu\Omega$ 1.2 m Ω 7.0 m Ω 150 m Ω 4.6 Ω 110 Ω 1.5 k Ω 140 k Ω 35 M Ω 550 M Ω 7.8 G Ω	
Other values	0 Ω to 1 Ω 1 Ω to 10 Ω 10 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 100 M Ω to 1 G Ω 1 G Ω to 10 G Ω 10 G Ω to 100 G Ω	16 ppm + 60 $\mu\Omega$ 16 ppm + 84 $\mu\Omega$ 14 ppm + 600 $\mu\Omega$ 12 ppm + 600 $\mu\Omega$ 12 ppm + 6.0 m Ω 12 ppm + 60 m Ω 18 ppm + 2.4 Ω 60 ppm + 130 Ω 580 ppm + 1.7 k Ω 0.58 % + 20 k Ω 0.41 % 1.6 %	
DC Voltage ranges	0 mV to 10 mV 10 mV to 100 mV 100 mV to 1 V 1 V to 100V 100 V to 1 kV	440 nV 480 nV 1.5 ppm + 440 nV 1.5 ppm 1.5 ppm	



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DC Voltage set points	1V 10 V 100 V 1 kV	1.0 μ V 7.0 μ V 100 μ V 1.0 mV	
High Voltage	1 kV to 5 kV 5 kV to 40 kV	0.20 % + 5.0 V 0.25 % + 10 V	
DC Current	1 pA 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	0.3 % + 1 pA 40 ppm + 28 pA 21 ppm + 29 pA 15 ppm + 33 pA 4.3 ppm + 100 pA 4.5 ppm + 950 pA 3.6 ppm + 22 nA 4.4 ppm + 100 nA 7.6 ppm + 700 nA 53 ppm + 5 μ A 60 ppm 190 ppm 0.23 % + 1.3 A	For the calibration of clamp-on ammeters
AC Voltage			
Specific values	10 mV 10 Hz 20 Hz 40 Hz 206 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 20 mV 10 Hz 20 Hz 40 Hz 206 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz	3.9 μ V 3.4 μ V 3.4 μ V 3.4 μ V 3.4 μ V 3.4 μ V 3.4 μ V 3.7 μ V 5.9 μ V 8.2 μ V 14 μ V 6.6 μ V 4.3 μ V 3.5 μ V 3.5 μ V 3.5 μ V 3.5 μ V 3.5 μ V 3.5 μ V 4.8 μ V 10 μ V 15 μ V 11 μ V	



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AC Voltage Specific values (continued)	100 mV		
	10 Hz	24 μ V	
	23 Hz	11 μ V	
	40 Hz	6.0 μ V	
	206 Hz	6.0 μ V	
	1 kHz	6.0 μ V	
	10 kHz	6.0 μ V	
	20 kHz	6.0 μ V	
	50 kHz	12 μ V	
	100 kHz	17 μ V	
	200 kHz	52 μ V	
	500 kHz	69 μ V	
	1 MHz	69 μ V	
	200 mV		
	10 Hz	140 μ V	
	23 Hz	19 μ V	
	40 Hz	9.5 μ V	
	206 Hz	9.5 μ V	
	1 kHz	9.5 μ V	
	10 kHz	9.5 μ V	
	20 kHz	9.5 μ V	
	50 kHz	23 μ V	
	100 kHz	35 μ V	
	200 kHz	100 μ V	
	500 kHz	140 μ V	
	1 MHz	140 μ V	
	300 mV		
	10 Hz	76 μ V	
	23 Hz	28 μ V	
	40 Hz	18 μ V	
	206 Hz	18 μ V	
	1 kHz	18 μ V	
	10 kHz	18 μ V	
	20 kHz	18 μ V	
	50 kHz	35 μ V	
	100 kHz	52 μ V	
	200 kHz	160 μ V	
	500 kHz	210 μ V	
	1 MHz	210 μ V	
	500 mV		
	10 Hz	130 μ V	
	23 Hz	47 μ V	
	40 Hz	29 μ V	
	206 Hz	29 μ V	
	1 kHz	30 μ V	
	10 kHz	30 μ V	
	20 kHz	30 μ V	
	50 kHz	58 μ V	
100 kHz	87 μ V		
200 kHz	260 μ V		
500 kHz	350 μ V		
1 MHz	350 μ V		



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Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	
AC Voltage Specific values (continued)	700 mV			
	10 Hz	160 μ V		
	23 Hz	57 μ V		
	40 Hz	25 μ V		
	206 Hz	21 μ V		
	1 kHz	21 μ V		
	10 kHz	22 μ V		
	20 kHz	22 μ V		
	50 kHz	22 μ V		
	100 kHz	22 μ V		
	200 kHz	22 μ V		
	500 kHz	22 μ V		
	1 MHz	22 μ V		
	1 V			
	10 Hz	220 μ V		
	23 Hz	71 μ V		
	40 Hz	38 μ V		
	206 Hz	23 μ V		
	1 kHz	23 μ V		
	10 kHz	23 μ V		
	20 kHz	23 μ V		
	50 kHz	49 μ V		
	100 kHz	60 μ V		
	200 kHz	130 μ V		
	500 kHz	500 μ V		
	1 MHz	520 μ V		
	2 V			
	10 Hz	440 μ V		
	23 Hz	140 μ V		
	40 Hz	69 μ V		
	206 Hz	45 μ V		
	1 kHz	45 μ V		
	10 kHz	45 μ V		
	20 kHz	45 μ V		
	50 kHz	100 μ V		
	100 kHz	120 μ V		
	200 kHz	270 μ V		
	500 kHz	990 μ V		
	1 MHz	1.0 mV		
	2 V			
	10 Hz	1.1 mV		
	23 Hz	360 μ V		
	40 Hz	160 μ V		
	206 Hz	96 μ V		
	1 kHz	96 μ V		
	10 kHz	96 μ V		
	20 kHz	96 μ V		
	50 kHz	240 μ V		
100 kHz	300 μ V			
200 kHz	700 μ V			
500 kHz	2.5 mV			



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AC Voltage Specific values (continued)	10 V		
	10 Hz	2.2 mV	
	23 Hz	710 μ V	
	40 Hz	380 μ V	
	206 Hz	280 μ V	
	1 kHz	280 μ V	
	10 kHz	280 μ V	
	20 kHz	280 μ V	
	50 kHz	490 μ V	
	100 kHz	600 μ V	
	200 kHz	1.4 mV	
	500 kHz	5.0 mV	
	20 V		
	10 Hz	4.4 mV	
	23 Hz	1.4 mV	
	40 Hz	660 μ V	
	206 Hz	470 μ V	
	1 kHz	470 μ V	
	10 kHz	470 μ V	
	20 kHz	470 μ V	
	50 kHz	980 μ V	
	100 kHz	1.2 mV	
	200 kHz	2.8 mV	
	500 kHz	2.8 mV	
	50 V		
	10 Hz	11 mV	
	23 Hz	3.6 mV	
	40 Hz	1.7 mV	
	206 Hz	1.5 mV	
	1 kHz	1.5 mV	
	10 kHz	1.5 mV	
	20 kHz	1.5 mV	
	50 kHz	3.0 mV	
	100 kHz	3.9 mV	
	100 V		
	40 Hz	3.9 mV	
	206 Hz	3.9 mV	
	1 kHz	3.9 mV	
	10 kHz	3.9 mV	
	20 kHz	3.9 mV	
	50 kHz	7.7 mV	
	100 kHz	8.3 mV	
	200 V		
	40 Hz	7.2 mV	
206 Hz	7.2 mV		
1 kHz	7.2 mV		
10 kHz	7.4 mV		
20 kHz	7.4 mV		
50 kHz	14 mV		
100 kHz	17 mV		



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AC Voltage Specific values (continued)	500 V 40 Hz 206 Hz 1 kHz 10 kHz 20 kHz 50 kHz	25 mV 25 mV 25 mV 25 mV 26 mV 39 mV	
	1 kV 40 Hz 206 Hz 1 kHz 10 kHz 20 kHz 50 kHz	36 mV 36 mV 36 mV 36 mV 36 mV 72 mV	
Other values 10 count devices	10 mV to 100 mV 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz	220 ppm + 7 μ V 100 ppm + 6 μ V 140 ppm + 6 μ V 330 ppm + 6 μ V 910 ppm + 6 μ V 0.35 % + 12 μ V 1.2 % + 30 μ V	
	100 mV to 1 V 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 1 MHz	210 ppm + 40 μ V 85 ppm + 25 μ V 160 ppm + 30 μ V 345 ppm + 25 μ V 920 ppm + 30 μ V 0.35 % + 120 μ V 1.2 % + 100 μ V	
	1 V to 10 V 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 1 MHz	210 ppm + 400 μ V 90 ppm + 220 μ V 170 ppm + 220 μ V 345 ppm + 250 μ V 920 ppm + 300 μ V 0.35 % + 1.1 mV 1.2 % + 1.0 mV	
	10 V to 100 V 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	240 ppm + 2.2 mV 420 ppm + 2.2 mV 920 ppm + 20 mV	
	100 V to 1 kV 40 Hz to 1 kHz 1 kHz to 20 kHz	470 ppm + 22 mV 700 ppm + 22 mV	



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AC Voltages Range values continued 300 count devices	100 mV to 300mV 10 Hz to 23 Hz 23 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 200 kHz 200 kHz to 500 kHz	695 ppm + 2 μ V 100 ppm + 2 μ V 80 ppm + 2 μ V 500 ppm + 2uV 800 ppm		
	300 mV to 1V 10 Hz to 23 Hz 23 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 200 kHz 200 kHz to 500 kHz 500 kHz to 1 MHz	225 ppm 60 ppm 50 ppm 160 ppm 635 ppm 0.11 %		
	1 V to 3 V 10 Hz to 23 Hz 23 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 200 kHz 200 kHz to 500 kHz 500 kHz to 1 MHz	225 ppm 75 ppm 60 ppm 140 ppm 635 ppm 0.11 %		
	3 V to 10 V 10 Hz to 23 Hz 23 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 200 kHz	225 ppm 80 ppm 55 ppm 170 ppm		
	10 V to 30 V 10 Hz to 23 Hz 23 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 200 kHz	225 ppm 80 ppm 50 ppm 130 ppm		
	30 V to 100 V 40 Hz to 20 kHz 20 kHz to 100 kHz	55 ppm 130 ppm		
	100 V to 300 V 40 Hz to 20 kHz 20 kHz to 100 kHz	55 ppm 150 ppm		
	300 V to 1000 V 40 Hz to 20 kHz	65 ppm		
	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	



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Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks
AC Current	25 μ A to 100 μ A 40 Hz to 1 kHz	100 ppm + 2 nA	
	100 μ A to 1 mA 40 Hz to 1 kHz	100 ppm + 22 nA	
	1 mA to 10 mA 40 Hz to 1 kHz	100 ppm + 220 nA	
	10 mA to 100 mA 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 10 kHz 10 kHz to 30 kHz	220 ppm + 4 μ A 100 ppm + 2 μ A 165 ppm + 2.5 μ A 345 ppm + 2.5 μ A	
	100 mA to 1 A 23 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 10 kHz	220 ppm + 40 μ A 100 ppm + 22 μ A 165 ppm + 25 μ A	
	1 A to 10 A 40 Hz to 1 kHz	370 ppm + 100 μ A	
	10 A to 30 A 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 10 kHz	260 ppm + 100 μ A 150 ppm 200 ppm + 100 μ 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: 0.6 Ω to 1.6 Ω 5.5 Ω to 100 Ω 1 k Ω	24 m Ω 42 m Ω 5.8 m 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	14 nH 29 nH 330 nH 3.2 μ H 29 μ H 260 μ H	Specific values are those that fall within 1 % of the stated values.



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Capacitance Specific Values, three-terminal	1 kHz 10 pF 100 pF 1 nF	26 fF 27 fF 280 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	2.9 pF 29 pF 280 pF	
Other Values	1 kHz 10 pF to 10 μF	0.050 % + 0.20 pF	
Frequency Measurement	10 mHz to 1 GHz	0.24 ppm	The CMC is for an average frequency measured or generated over a 10-minute period. The uncertainties will be increased for shorter periods.
Generation	1 Hz to 10 MHz	0.21 ppm	
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 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	
N	-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	0.55 °C 0.35 °C 0.32 °C 0.31 °C 0.38 °C	
R	0 °C to 250 °C 250 °C to 1000 °C 1000 °C to 1760 °C	1.0 °C 0.65 °C 0.72 °C	



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Temperature simulation (Continued)			Including Reference Junction Compensation	
Thermocouple type				
S	0 °C to 250 °C 250 °C to 1000 °C 1000 °C to 1760 °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 650 °C 650 °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		
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 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 μ V:

Over the range 100 mV to 1 V, the CMC is 0.0025 % · V + 5.0 μ 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 % · p + (0.12 · 10⁻⁶ · p · 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 · 0.01 · i, where i is the instrument indication.