

Schedule of Accreditation

issued by

United Kingdom Accreditation Service

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

 <p>0452</p> <p>Accredited to ISO/IEC 17025:2017</p>	Eurofins E&E ETC Limited	
	Issue No: 033 Issue date: 01 June 2020	
	Caddsdwn Industrial Estate Clovelly Road Bideford Devon EX39 3DX	Contact: Steve Campion Tel: +44 (0)1237 423388 Fax: +44 (0)1237 423434 E-Mail: info@etcal.co.uk Website: www.etcal.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
<p>Address Caddsdwn Industrial Estate Clovelly Road Bideford Devon EX39 3DX</p> <p>Local contact Steve Campion Tel: +44 (0)1237 423388 Fax: +44 (0)1237 423434 E-Mail: info@etcal.co.uk</p>	Electrical dc and lf Electrical rf Antennas	Bideford

Site activities performed away from the locations listed above:

Location details	Activity	Location code
<p>Customers' sites or premises</p> <p>The customers' site or premises must be suitable for the nature of the particular calibrations undertaken and will be the subject of contract review arrangements between the laboratory and the customer</p>	<p>Local contact Steve Campion Tel: +44 (0)1237 423388 Fax: +44 (0)1237 423434 E-Mail: info@etcal.co.uk</p> <p>Electrical dc and lf Electrical rf</p>	Site



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DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	Location code
DC RESISTANCE				
Measurement	<i>At 10 A:</i> 100 $\mu\Omega$ to 1 m Ω 1 m Ω to 10 m Ω <i>At 1 A:</i> 10 m Ω to 100 m Ω 100 m Ω to 1 Ω <i>From 10 V to 1 kV:</i> 200 M Ω to 2 G Ω 2 G Ω to 20 G Ω 20 G Ω to 200 G Ω 200 G Ω to 2 T Ω <i>From 1 kV to 5 kV:</i> 200 M Ω to 2 G Ω 2 G Ω to 20 G Ω 20 G Ω to 200 G Ω 200 G Ω to 2 T Ω	130 ppm 42 ppm 37 ppm 33 ppm 0.031 % 0.037 % 0.042 % 0.12 % 0.15 % 0.15 % 0.16 % 0.19 %	<div style="border-left: 1px solid black; border-right: 1px solid black; border-top: 1px solid black; border-bottom: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> Other test currents may be used but with increased uncertainties. </div> Using voltage and current method. Using voltage and current method.	Bideford
Measurement and generation	0 Ω to 1 Ω 1 Ω to 20 Ω 20 Ω to 200 Ω 200 Ω to 2 k Ω 2 k Ω to 20 k Ω 20 k Ω to 200 k Ω 200 k Ω to 2 M Ω 2 M Ω to 20 M Ω 20 M Ω to 200 M Ω	15 $\mu\Omega$ 15 ppm 10 ppm 10 ppm 10 ppm 15 ppm 19 ppm 21 ppm 190 ppm		



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DC RESISTANCE (continued)				
Generation	100 $\mu\Omega$ to 2 m Ω 2 m Ω to 20 m Ω 20 m Ω to 200 m Ω 200 m Ω to 1 Ω 10 Ω 100 Ω 1 k Ω 10 k Ω 100 k Ω 1 M Ω 10 M Ω 100 M Ω <i>From 10 V to 1 kV:</i> 200 M Ω to 2 G Ω 2 G Ω to 20 G Ω 20 G Ω to 200 G Ω 200 G Ω to 2 T Ω <i>From 1 kV to 5 kV:</i> 200 M Ω to 2 G Ω 2 G Ω to 20 G Ω 20 G Ω to 200 G Ω 200 G Ω to 2 T Ω	160 ppm 45 ppm 42 ppm 37 ppm 6.7 ppm 6.4 ppm 6.4 ppm 6.5 ppm 6.7 ppm 14 ppm 15 ppm 150 ppm 0.031 % 0.037 % 0.042 % 0.12 % 0.15 % 0.15 % 0.16 % 0.19 %	Application of known resistance values for the calibration of resistance measuring instruments.	Bideford
DC VOLTAGE				
Generation	0 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1000 V 1 kV to 30 kV	14 ppm + 0.12 μ V 6.6 ppm 6.3 ppm 6.7 ppm 7.2 ppm 0.14 %	Application of known DC voltages for the calibration of voltage measuring instruments.	
Measurement	0 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1000 V 1 kV to 40 kV	18 ppm + 0.16 μ V 8.6 ppm 8.4 ppm 9.0 ppm 9.7 ppm 0.14 %		



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DC CURRENT Generation	10 pA to 200 pA 200 pA to 2 nA 2 nA to 20 nA 20 nA to 200 nA 200 nA to 2 μ A 2 μ A to 20 μ A 20 μ A to 200 μ A 200 μ A to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 1 A 1 A to 20 A 20 A to 100 A	0.056 % 0.034 % 0.029 % 0.023 % 0.019 % 0.014 % 11 ppm 11 ppm 12 ppm 14 ppm 22 ppm 46 ppm 0.15 %	Application of known DC currents for the calibration of current measuring instruments.	Bideford
Current clamp calibration	0 A to 20 A 0 A to 1000 A 1000 A to 5000 A	0.25 % 0.34 % 0.36 %	Using multi-turn coils: Single turn 10 or 50 turns 10 or 50 turns	
Measurement	10 pA to 200 pA 200 pA to 2 nA 2 nA to 20 nA 20 nA to 200 nA 200 nA to 2 μ A 2 μ A to 20 μ A 20 μ A to 200 μ A 200 μ A to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 1 A 1 A to 20 A 20 A to 100 A 100 A to 250 A 250 A to 1000 A	0.056 % 0.038 % 0.034 % 0.027 % 0.023 % 0.019 % 14 ppm 14 ppm 16 ppm 27 ppm 39 ppm 46 ppm 0.15 % 0.17 % 0.31 %		
AC VOLTAGE	100 mHz to 10 Hz V_{rms} 2.5 mV to 707 V V_{pk} 1000 V maximum	0.15 % + 5.0 μ V		
Generation Specific Values	10 Hz to 30 Hz 1 V 10 V 100 V	75 ppm 75 ppm 78 ppm	Application of known AC voltages for the calibration of voltage measuring instruments.	
	30 Hz to 300 Hz 10 mV 100 mV 1 V 10 V 100 V 1000 V	300 ppm 140 ppm 73 ppm 73 ppm 78 ppm 84 ppm	40 Hz minimum	



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Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	Location code
AC VOLTAGE (continued) Generation (continued) Specific Values	<p><i>300 Hz to 1 kHz</i></p> <p>10 mV 100 mV 1 V 10 V 100 V 1000 V</p> <p><i>1 kHz to 10 kHz</i></p> <p>10 mV 100 mV 1 V 10 V 100 V 1000 V</p> <p><i>10 kHz to 30 kHz</i></p> <p>10 mV 100 mV 1 V 10 V 100 V 1000 V</p> <p><i>30 kHz to 100 kHz</i></p> <p>10 mV 100 mV 1 V 10 V 100 V 700 V</p> <p><i>100 kHz to 300 kHz</i></p> <p>1 V 10 V</p> <p><i>300 kHz to 1 MHz</i></p> <p>1 V 10 V</p>	<p>300 ppm 120 ppm 70 ppm 70 ppm 75 ppm 84 ppm</p> <p>310 ppm 130 ppm 76 ppm 76 ppm 81ppm 95 ppm</p> <p>370 ppm 220 ppm 130 ppm 130 ppm 130 ppm 170 ppm</p> <p>460 ppm 360 ppm 140 ppm 150 ppm 170 ppm 470 ppm</p> <p>710 ppm 710 ppm</p> <p>0.12 % 0.13 %</p>		Bideford
Other Values	<p><i>10 Hz to 30 Hz</i></p> <p>200 mV to 2 V 2 V to 20 V 20 V to 200 V</p>	<p>190 ppm to 83 ppm 190 ppm to 83 ppm 190 ppm to 85 ppm</p>		



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AC VOLTAGE (continued) Generation (continued) Other Values	<p><i>30 Hz to 300 Hz</i> 2 mV to 5 mV 5 mV to 10 mV 10 mV to 50 mV 50 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1000 V</p> <p><i>300 Hz to 1 kHz</i> 2 mV to 5 mV 5 mV to 10 mV 10 mV to 50 mV 50 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1000 V</p> <p><i>1 kHz to 10 kHz</i> 2 mV to 5 mV 5 mV to 10 mV 10 mV to 50 mV 50 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1000 V</p> <p><i>10 kHz to 30 kHz</i> 2 mV to 5 mV 5 mV to 10 mV 10 mV to 50 mV 50 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1000 V</p> <p><i>30 kHz to 100 kHz</i> 2 mV to 5 mV 5 mV to 10 mV 10 mV to 50 mV 50 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 700 V</p>	<p>2900 ppm to 1200 ppm 1200 ppm to 650 ppm 650 ppm to 200 ppm 200 ppm to 160 ppm 140 ppm to 77 ppm 140 ppm to 77 ppm 140 ppm to 81 ppm 100 ppm to 87 ppm</p> <p>2900 ppm to 1200 ppm 1200 ppm to 650 ppm 650 ppm to 190 ppm 190 ppm to 140 ppm 91 ppm to 71 ppm 91 ppm to 71 ppm 94 ppm to 76 ppm 100 ppm to 87 ppm</p> <p>2900 ppm to 1200 ppm 1200 ppm to 660 ppm 660 ppm to 200 ppm 200 ppm to 150 ppm 96 ppm to 77 ppm 96 ppm to 77 ppm 99 ppm to 82 ppm 110 ppm to 98 ppm</p> <p>2900 ppm to 1200 ppm 1200 ppm to 690 ppm 690 ppm to 270 ppm 270 ppm to 230 ppm 140 ppm to 130 ppm 140 ppm to 130 ppm 180 ppm to 140 ppm 180 ppm to 170 ppm</p> <p>2900 ppm to 1200 ppm 1200 ppm to 740 ppm 740 ppm to 390 ppm 390 ppm to 370 ppm 180 ppm to 140 ppm 190 ppm to 160 ppm 240 ppm to 170 ppm 480 ppm to 470 ppm</p>	40 Hz minimum	Bideford



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AC VOLTAGE (continued) Generation (continued) Other Values	100 kHz to 300 kHz 200 mV to 2 V 2 V to 20 V	840 ppm to 730 ppm 840 ppm to 730 ppm		Bideford
	300 kHz to 1 MHz 200 mV to 2 V 2 V to 20 V	0.26 % to 0.13 % 0.27 % to 0.14 %		
	At 50 Hz 1 kV to 7 kV	0.30 %		
Measurement Specific Values	10 Hz to 30 Hz 1 V 10 V 100 V	99 ppm 99 ppm 100 ppm		
	30 Hz to 300 Hz 10 mV 100 mV 1 V 10 V 100 V 1000 V	320 ppm 150 ppm 98 ppm 98 ppm 100 ppm 110 ppm	40 Hz minimum	
	300 Hz to 1 kHz 10 mV 100 mV 1 V 10 V 100 V 1000 V	310 ppm 140 ppm 95 ppm 95 ppm 99 ppm 110 ppm		
	1 kHz to 10 kHz 10 mV 100 mV 1 V 10 V 100 V 1000 V	320 ppm 150 ppm 110 ppm 110 ppm 110 ppm 120 ppm		
	10 kHz to 30 kHz 10 mV 100 mV 1 V 10 V 100 V 1000 V	400 ppm 260 ppm 190 ppm 190 ppm 190 ppm 220 ppm		
	30 kHz to 100 kHz 10 mV 100 mV 1 V 10 V 100 V 700 V	500 ppm 410 ppm 230 ppm 240 ppm 50 ppm 500 ppm		



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AC VOLTAGE (continued) Measurement (continued) Specific Values	30 kHz to 100 kHz 10 mV 100 mV 1 V 10 V 100 V 700 V	500 ppm 410 ppm 230 ppm 240 ppm 50 ppm 500 ppm		Bideford
	100 kHz to 300 kHz 1 V 10 V	930 ppm 930 ppm		
	300 kHz to 1 MHz 1 V 10 V	0.14 % 0.15 %		
Measurement; other values	10 Hz to 30 Hz 200 mV to 2 V 2 V to 20 V 20 V to 200 V	150 ppm to 100 ppm 150 ppm to 100 ppm 150 ppm to 100 ppm		
	30 Hz to 300 Hz 2 mV to 5 mV 5 mV to 10 mV 10 mV to 50 mV 50 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1000 V	2300 ppm to 980 ppm 980 ppm to 560 ppm 560 ppm to 180 ppm 180 ppm to 160 ppm 150 ppm to 100 ppm 150 ppm to 100 ppm 150 ppm to 100 ppm 120 ppm to 110 ppm		
	300 Hz to 1 kHz 2 mV to 5 mV 5 mV to 10 mV 10 mV to 50 mV 50 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1000 V	1200 ppm to 560 ppm 560 ppm to 380 ppm 380 ppm to 140 ppm 140 ppm to 140 ppm 150 ppm to 98 ppm 150 ppm to 98 ppm 150 ppm to 100 ppm 120 ppm to 110 ppm		
	1 kHz to 10 kHz 2 mV to 5 mV 5 mV to 10 mV 10 mV to 50 mV 50 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1000 V	2300 ppm to 980 ppm 980 ppm to 560 ppm 560 ppm to 180 ppm 180 ppm to 160 ppm 160 ppm to 110 ppm 160 ppm to 110 ppm 160 ppm to 110 ppm 140 ppm to 130 ppm	40 Hz minimum	



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AC CURRENT Generation	<p>1 kV to 4 kV, 60 Hz to 1 kHz</p> <p><i>10 Hz to 300 Hz</i> 10 μA to 200 μA 200 μA to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 1 A 1 A to 10 A</p> <p><i>300 Hz to 1 kHz</i> 10 μA to 200 μA 200 μA to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 1 A 1 A to 10 A</p>	<p>1.0 %</p> <p>190 ppm 170 ppm 170 ppm 170 ppm 220 ppm 290 ppm</p> <p>170 ppm 150 ppm 150 ppm 150 ppm 180 ppm 260 ppm</p>	Application of known AC currents for the calibration of current measuring instruments.	



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AC CURRENT (continued) Generation (continued)	1 kHz to 5 kHz 10 µA to 200 µA 200 µA to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 1 A 1 A to 10 A	240 ppm 210 ppm 190 ppm 200 ppm 350 ppm 500 ppm		
Current clamp calibration	10 Hz to 5 kHz 100 µA to 1 A	0.28 %	Using multi-turn coils: Single turn	
	30 Hz to 5 kHz 1 A to 10 A	0.31 %	Single turn	
	30 Hz to 100 Hz 3.2 A to 500 A	0.66 %	10 or 50 turns	
	100 Hz to 440 Hz 3.2 A to 500 A	1.8 %	10 or 50 turns	
Measurement	10 Hz to 300 Hz 10 µA to 200 µA 200 µA to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 1 A 1 A to 10 A	230 ppm 210 ppm 210 ppm 210 ppm 250 ppm 290 ppm		Bidford
	300 Hz to 1 kHz 10 µA to 200 µA 200 µA to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 1 A 1 A to 10 A	210 ppm 200 ppm 190 ppm 190 ppm 220 ppm 260 ppm		
	1 kHz to 5 kHz 10 µA to 200 µA 200 µA to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 1 A 1 A to 10 A	270 ppm 240 ppm 220 ppm 230 ppm 370 ppm 400 ppm		



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AC HARMONICS AND DISTORTION				
NOTE				
<p>The total harmonic distortion of a repetitive waveform (THD) is often defined as the ratio of the RMS values of the harmonics with reference to that of the fundamental. This is referred to herein as THD_F.</p> <p>Certain types of distortion analyser use a broad band voltmeter in conjunction with a notch filter. The total signal (including harmonics) is used as a "100 % reference"; the notch filter is then used to remove the fundamental and the residue is displayed as the "THD". This is referred to herein as THD_R, the subscript R referring to the RMS value of the reference voltage.</p> <p>It should be noted that THD_R cannot exceed 100 % as the total signal is used as the reference, whereas THD_F can have any value. At relatively low values, the two converge, e.g. if $THD_F = 10 %$ then $THD_R = 9.5 %$. At higher values of THD the differences between the two can be very significant indeed.</p> <p>For this reason, the capabilities described below distinguish clearly between the two definitions.</p>				
Generation of Harmonic Distortion, THD_R and THD_F	THD_R 0.006 % to 100 % THD_F 0.006 % to 1000 % 30 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	0.62 % to 5.7 % 0.85 % to 5.8 % 1.7 % to 6.4 %	Fundamental: 3 mV to 300 V, 30 Hz to 20 kHz. Harmonic(s): 3 μ V to 300 V. Not all combinations of voltage and frequency may be available.	Bideford
Measurement of Harmonic Distortion, THD_R and THD_F	THD_R 0.00032 % to 100 % THD_F 0.00032 % to 1000 % 30 Hz to 100 kHz	0.73 % to 1.8 %	Fundamental: 3 mV to 300 V, 30 Hz to 20 kHz. Harmonic(s): 3 μ V to 300 V	
Harmonic Amplitude Measurement and Generation	3 μ V to 300 V 30 Hz to 100 kHz	0.90 % to 1.7 %		
Flicker Measurement and Generation	In accordance with EN61000-4-15	0.37 %		



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CAPACITANCE Measurement and generation	<i>At 100 Hz:</i> 100 pF to 190 pF 190 pF to 350 pF 350 pF to 1 nF 1 nF to 1 μ F 1 μ F to 100 μ F	0.60 % 0.26 % 0.17 % 0.080 % 0.10 %	Using standard capacitors and LCR meter.	Bideford
	<i>At 1 kHz:</i> 10 pF to 15 pF 15 pF to 25 pF 25 pF to 100 pF 100 pF to 1 μ F 1 μ F to 100 μ F	0.62 % 0.32 % 0.24 % 0.080 % 0.10 %		
INDUCTANCE Measurement and Generation	<i>At 100 Hz:</i> 100 μ H to 250 μ H 250 μ H to 600 μ H 600 μ H to 1 mH 1 mH to 100 mH 100 mH to 1 H	0.59 % 0.25 % 0.15 % 0.11 % 0.27 %	Using standard inductors and LCR meter.	Bideford
	<i>At 1 kHz:</i> 10 μ H to 25 μ H 25 μ H to 60 μ H 60 μ H to 100 μ H 100 μ H to 150 μ H 150 μ H to 1 H	0.59 % 0.25 % 0.14 % 0.14 % 0.092 %		
	<i>At 10 kHz:</i> 10 μ H to 20 μ H 20 μ H to 1 mH 1 mH to 10 mH 10 mH to 100 mH	0.14 % 0.099 % 0.092 % 0.13 %		



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FREQUENCY MEASUREMENT Specific Value	10 MHz	1 in 10^{10}	Can be expressed as average periodic time (1/f) for repetitive waveforms.	Bideford
Other Values	1 Hz to 1 GHz 1 GHz to 40 GHz	14 in 10^9 1.5 in 10^9		
TIME INTERVAL	100 ps to 1 ns 1 ns to 10 ns 10 ns to 100 ns 100 ns to 1 μ s 1 μ s to 100 μ s 100 μ s to 10^5 s	2.2 % 220 ppm 22 ppm 14 ppm 14 ppm 15 in 10^9 + 400 ps	Repetitive and Single Event	
PULSE TRANSITION TIME				
Measurement	150 ps to 500 ps 500 ps to 10 s	1.3 % 0.91 %	Using fast rise oscilloscope; for the calibration of Waveform Generators	
Generation	500 ps to 10 s	1.6 %	Using fast rise pulse generator; for the calibration of oscilloscopes and other measurement devices	
ELECTRICAL SIMULATION OF TEMPERATURE				
Measurement and Generation				
Thermocouple Simulation			By millivolt injection; excluding cold junction compensation	
Type K	-270 °C to +1372 °C	0.12 °C to 0.30 °C		
Type J	-210 °C to +1200 °C	0.12 °C to 0.23 °C		
Type E	-270 °C to +1000 °C	0.12 °C to 0.22 °C		
Type N	-270 °C to +1300 °C	0.12 °C to 0.27 °C		
Type T	-270 °C to +400 °C	0.12 °C to 0.22 °C		
Type S	0 °C to 1768 °C	0.18 °C to 0.29 °C		
Type R	0 °C to 1768 °C	0.17 °C to 0.28 °C		
Type B	0 °C to 1820 °C	0.19 °C to 0.34 °C		
Thermocouple CJC	Ambient (23 °C)	0.13 °C		
PRT Simulation	-200 °C to 0 °C 0 °C to 400 °C 400 °C to 850 °C	0.027 °C to 0.049 °C 0.049 °C to 0.12 °C 0.12 °C to 0.21 °C	By application of equivalent DC resistance values.	



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RF POWER				Bideford		
<p>The CMCs below are for the measurement of RF Power in 50 Ω coaxial systems expressed in terms of % of the linearly expressed value for the stated frequency and power ranges. The capabilities are for the measurement of sources, such as signal generators and synthesisers.</p> <p align="center">Type N coaxial systems</p>						
Frequency range	-60 dBm to -50 dBm	-50 dBm to -40 dBm	-40 dBm to -20 dBm			
9 kHz to 10 MHz	1.6 %	1.5 %	1.2 %			
Frequency range	-62 dBm to -55 dBm	-55 dBm to -20 dBm	-20 dBm to +20 dBm		+20 dBm to +44 dBm	+44 dBm to +55 dBm
9 kHz to 10 MHz			1.3 %		2.2 %	2.7 %
10 MHz to 50 MHz	1.4 %	1.3 %	1.3 %		2.2 %	2.7 %
50 MHz to 1 GHz	1.5 %	1.4 %	1.3 %		2.0 %	2.3 %
1 GHz to 5 GHz	1.6 %	1.5 %	1.3 %		2.0 %	3.3 %
5 GHz to 10 GHz	2.0 %	1.9 %	1.4 %		2.1 %	3.8 %
10 GHz to 12.5 GHz	2.1 %	2.0 %	1.5 %		2.6 %	5.6 %
12.5 GHz to 15 GHz	2.1 %	2.0 %	1.5 %		2.7 %	
15 GHz to 18 GHz	2.3 %	2.3 %	1.6 %		2.7 %	
3.5 mm coaxial systems						
Frequency range	-62 dBm to -55 dBm	-55 dBm to -20 dBm	-20 dBm to +20 dBm			
50 MHz to 1 GHz	1.6 %	1.5 %	1.4 %			
1 GHz to 5 GHz	1.6 %	1.5 %	1.4 %			
5 GHz to 10 GHz	1.7 %	1.6 %	1.5 %			
10 GHz to 15 GHz	2.0 %	1.9 %	1.6 %			
15 GHz to 20 GHz	2.6 %	2.5 %	2.0 %			
20 GHz to 26.5 GHz	3.4 %	3.3 %	2.3 %			
2.92 mm coaxial systems						
Frequency range	-62 dBm to -55 dBm	-55 dBm to -20 dBm	-20 dBm to +20 dBm			
50 MHz to 1 GHz	1.7 %	1.7 %	1.4 %			
1 GHz to 5 GHz	1.8 %	1.7 %	1.5 %			
5 GHz to 10 GHz	1.9 %	1.9 %	1.7 %			
10 GHz to 15 GHz	2.1 %	2.0 %	1.7 %			
15 GHz to 20 GHz	2.4 %	2.4 %	2.0 %			
20 GHz to 25 GHz	2.5 %	2.5 %	2.0 %			
25 GHz to 30 GHz	3.1 %	3.1 %	2.3 %			
30 GHz to 35 GHz	3.7 %	3.7 %	2.3 %			
35 GHz to 40 GHz	4.8 %	4.8 %	2.3 %			



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Calibration performed by the Organisation at the locations specified

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	Location code	
RF POWER (continued)					
The CMCs below are for the measurement of RF Power in 50 Ω coaxial systems expressed in terms of % of the linearly expressed value for the stated frequency and power ranges. The capabilities are for the measurement of sources, such as signal generators and synthesisers.					
2.4 mm coaxial systems					
Frequency range	-62 dBm to -55 dBm	-55 dBm to -20 dBm	-20 dBm to +20 dBm	Bidford	
50 MHz to 1 GHz	1.7 %	1.6 %	1.4 %		
1 GHz to 5 GHz	1.8 %	1.7 %	1.4 %		
5 GHz to 10 GHz	1.9 %	1.8 %	1.6 %		
10 GHz to 15 GHz	2.0 %	2.0 %	1.7 %		
15 GHz to 20 GHz	2.4 %	2.3 %	2.0 %		
20 GHz to 25 GHz	2.6 %	2.6 %	2.0 %		
25 GHz to 30 GHz	2.9 %	2.9 %	2.1 %		
30 GHz to 35 GHz	3.2 %	3.1 %	2.3 %		
35 GHz to 40 GHz	3.8 %	3.7 %	2.7 %		
Specific value	1 mW, 50 MHz Type N coaxial systems 3.5 mm coaxial systems 2.92 mm coaxial systems 2.4 mm coaxial systems	0.65 % 0.69 % 0.80 % 0.69 %	For the measurement of sources, including the calibrator output of RF power meters.	Bidford	
The CMCs below are for the generation of RF Power in 50 Ω coaxial systems expressed in terms of % of the linearly expressed value for the stated frequency and power ranges. The capabilities are for the calibration of receivers, spectrum analysers and similar items.					
Type N coaxial systems					
Frequency range	-70 dBm to -50 dBm	-50 dBm to -20 dBm	-20 dBm to +20 dBm		
9 kHz to 10 MHz	1.5 %	1.3 %	1.3 %	Bidford	
10 MHz to 50 MHz	1.5 %	1.3 %	1.3 %		
50 MHz to 1 GHz	1.5 %	1.3 %	1.3 %		
1 GHz to 5 GHz	1.5 %	1.4 %	1.3 %		
5 GHz to 10 GHz	1.7 %	1.5 %	1.4 %		
10 GHz to 15 GHz	1.7 %	1.5 %	1.4 %		
15 GHz to 18 GHz	2.2 %	1.7 %	1.6 %		
Frequency range	+20 dBm to +34 dBm	+20 dBm to +47 dBm	+47 dBm to +55 dBm	Bidford	
9 kHz to 10 MHz		2.1 %	4.7 %		
10 MHz to 50 MHz		2.1 %	4.7 %		
50 MHz to 1 GHz		2.1 %	4.7 %		
1 GHz to 3 GHz	2.4 %				



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RF POWER (continued)				Bideford
The CMCs below are for the generation of RF Power in 50 Ω coaxial systems expressed in terms of % of the linearly expressed value for the stated frequency and power ranges. The capabilities are for the calibration of receivers, spectrum analysers and similar items.				
3.5 mm coaxial systems				
Frequency range	-70 dBm to -50 dBm	-50 dBm to -20 dBm	-20 dBm to +14 dBm	
50 MHz to 1 GHz	1.7 %	1.4 %	1.4 %	
1 GHz to 5 GHz	1.6 %	1.5 %	1.4 %	
5 GHz to 10 GHz	1.7 %	1.6 %	1.5 %	
10 GHz to 15 GHz	2.0 %	1.9 %	1.9 %	
15 GHz to 20 GHz	2.5 %	2.4 %	2.2 %	
20 GHz to 26.5 GHz	2.9 %	2.9 %	2.4 %	
2.92 mm coaxial systems				
Frequency range	-70 dBm to -50 dBm	-50 dBm to -20 dBm	-20 dBm to +14 dBm	
50 MHz to 1 GHz	1.7 %	1.5 %	1.4 %	
1 GHz to 5 GHz	1.7 %	1.6 %	1.5 %	
5 GHz to 10 GHz	1.9 %	1.8 %	1.7 %	
10 GHz to 15 GHz	2.0 %	1.9 %	1.8 %	
15 GHz to 20 GHz	2.4 %	2.3 %	2.4 %	
20 GHz to 25 GHz	2.5 %	2.3 %	2.5 %	
25 GHz to 30 GHz	2.9 %	2.8 %	3.0 %	
30 GHz to 35 GHz	3.3 %	3.3 %	3.1 %	
35 GHz to 40 GHz	3.6 %	3.5 %	3.4 %	
2.4 mm coaxial systems				
Frequency range	-70 dBm to -50 dBm	-50 dBm to -20 dBm	-20 dBm to +14 dBm	
50 MHz to 1 GHz	1.6 %	1.4 %	1.4 %	
1 GHz to 5 GHz	1.7 %	1.5 %	1.6 %	
5 GHz to 10 GHz	1.8 %	1.6 %	1.7 %	
10 GHz to 15 GHz	1.9 %	1.8 %	1.8 %	
15 GHz to 20 GHz	2.3 %	2.2 %	2.2 %	
20 GHz to 25 GHz	2.6 %	2.4 %	2.7 %	
25 GHz to 30 GHz	2.9 %	2.8 %	2.9 %	
30 GHz to 35 GHz	3.1 %	3.0 %	3.0 %	
35 GHz to 40 GHz	4.0 %	3.9 %	4.1 %	



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Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)		Remarks	Location code
		Nominal level 0 dBm	Nominal level -30 dBm		
RF CALIBRATION FACTOR	Type N 50 Ω coaxial systems	Nominal level 0 dBm	Nominal level -30 dBm	For calibration of RF power sensors by comparison with standard sensors.	Bideford
	9 kHz to 10 MHz	0.59 %	0.63 %		
	10 MHz to 50 MHz	0.59 %	0.62 %		
	50 MHz to 1 GHz	0.70 %	0.73 %		
	1 GHz to 5 GHz	0.73 %	0.82 %		
	5 GHz to 10 GHz	0.81 %	1.3 %		
	10 GHz to 15 GHz	0.96 %	1.3 %		
	15 GHz to 18 GHz	1.1 %	1.5 %		
	3.5 mm 50 Ω coaxial systems	Nominal level 0 dBm	Nominal level -30 dBm		
	50 MHz to 1 GHz	0.74 %	0.84 %		
	1 GHz to 5 GHz	0.82 %	0.92 %		
	5 GHz to 10 GHz	0.99 %	1.1 %		
	10 GHz to 15 GHz	1.4 %	1.5 %		
	15 GHz to 20 GHz	1.9 %	2.2 %		
	20 GHz to 26.5 GHz	2.5 %	3.1 %		
	2.92 mm 50 Ω coaxial systems	Nominal level 0 dBm	Nominal level -30 dBm		
	50 MHz to 1 GHz	0.78 %	1.1 %		
	1 GHz to 5 GHz	0.94 %	1.2 %		
	5 GHz to 10 GHz	1.3 %	1.4 %		
	10 GHz to 15 GHz	1.5 %	1.6 %		
15 GHz to 20 GHz	2.1 %	2.0 %			
20 GHz to 25 GHz	2.3 %	2.1 %			
25 GHz to 30 GHz	2.7 %	2.7 %			
30 GHz to 35 GHz	3.2 %	3.4 %			
35 GHz to 40 GHz	3.2 %	4.6 %			
2.4 mm 50 Ω coaxial systems	Nominal level 0 dBm	Nominal level -30 dBm			
50 MHz to 1 GHz	0.72 %	0.88 %			
1 GHz to 5 GHz	0.89 %	0.98 %			
5 GHz to 10 GHz	1.1 %	1.2 %			
10 GHz to 15 GHz	1.3 %	1.4 %			
15 GHz to 20 GHz	1.8 %	1.8 %			
20 GHz to 25 GHz	2.1 %	2.1 %			
25 GHz to 30 GHz	2.6 %	2.5 %			
30 GHz to 35 GHz	2.8 %	2.8 %			
35 GHz to 40 GHz	3.2 %	3.4 %			



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RF VOLTAGE	200 μ V to 1 mV		50 Ω systems only	Bidford
	9 kHz to 100 kHz	1.1 %	Derived from RF Power measurements.	
	100 kHz to 1 MHz	1.1 %		
	1 MHz to 100 MHz	1.1 %		
	100 MHz to 1 GHz	1.4 %		
	1 GHz to 1.5 GHz	2.1 %		
	1 mV to 10 mV			
	9 kHz to 100 kHz	0.96 %		
	100 kHz to 1 MHz	0.96 %		
	1 MHz to 100 MHz	0.96 %		
	100 MHz to 1 GHz	1.3 %		
	1 GHz to 1.5 GHz	2.1 %		
10 mV to 1 V				
9 kHz to 20 kHz	0.80 %			
20 kHz to 1 MHz	0.80 %			
1 MHz to 100 MHz	0.80 %			
100 MHz to 1 GHz	1.2 %			
1 GHz to 1.5 GHz	2.1 %			
1 V to 10 V				
9 kHz to 20 kHz	0.74 %			
20 kHz to 1 MHz	0.99 %			
1 MHz to 100 MHz	0.99 %			
100 MHz to 1 GHz	1.7 %			
1 GHz to 1.5 GHz	2.8 %			
VOLTAGE REFLECTION COEFFICIENT	5 MHz to 1 GHz		50 Ω systems only. Reflection bridge method.	Bidford
	0.00 to 0.05	0.016		
	0.05 to 0.1	0.019		
	0.1 to 0.2	0.030		
	0.2 to 0.7	0.090		
	0.7 to 1.0	0.16		
	1 GHz to 2 GHz			
	0.00 to 0.05	0.022		
	0.05 to 0.1	0.023		
	0.1 to 0.2	0.029		
	0.2 to 0.7	0.077		
	0.7 to 1.0	0.11		
2 GHz to 5 GHz				
0.00 to 0.05	0.021			
0.05 to 0.1	0.034			
0.1 to 0.2	0.065			
0.2 to 0.7	0.22			
0.7 to 1.0	0.32			



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VOLTAGE REFLECTION COEFFICIENT (continued)	<i>5 GHz to 10 GHz</i> 0.00 to 0.05 0.05 to 0.1 0.1 to 0.2 0.2 to 0.7 0.7 to 1.0 <i>10 GHz to 15 GHz</i> 0.00 to 0.05 0.05 to 0.1 0.1 to 0.2 0.2 to 0.7 0.7 to 1.0 <i>15 GHz to 18 GHz</i> 0.00 to 0.05 0.05 to 0.1 0.1 to 0.2 0.2 to 0.7 0.7 to 1.0	0.026 0.028 0.038 0.11 0.14 0.033 0.035 0.042 0.093 0.13 0.035 0.038 0.050 0.13 0.18		Bideford
LF VECTOR NETWORK ANALYSIS			<p>This section of the Schedule presents the CMCs for a vector network analysis system. Measurements are made as complex quantities. Transmission magnitude capabilities are expressed in dB terms and reflection magnitude is expressed in terms of voltage reflection coefficient (VRC). These may also be reported in terms of voltage standing wave ratio (VSWR), return loss (dB) or Impedance magnitude and phase. Measurements are made in a 50 Ω coaxial system using an Agilent E5061B network analyser with appropriate test port leads in a 10 Hz bandwidth.</p>	
N Type 50 Ω system Reflection magnitude	VRC 0 to 0.1 <i>1 kHz to 50 kHz</i> <i>50 kHz to 100 kHz</i> <i>100 kHz to 200 kHz</i> <i>200 kHz to 500 kHz</i> <i>500 kHz to 1 MHz</i> <i>1 MHz to 100 MHz</i> <i>100 MHz to 500 MHz</i> <i>500 MHz to 2 GHz</i> <i>2 GHz to 3 GHz</i>	0.0020 to 0.0022 0.0021 to 0.0037 0.0036 to 0.0054 0.0054 to 0.0061 0.0022 to 0.0061 0.0020 to 0.0022 0.0020 to 0.0031 0.0025 to 0.0043 0.0022 to 0.0057		



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Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	Location code
Reflection magnitude (continued)	VRC 0.1 to 0.5 1 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 200 kHz 200 kHz to 500 kHz 500 kHz to 1 MHz 1 MHz to 100 MHz 100 MHz to 500 MHz 500 MHz to 2 GHz 2 GHz to 3 GHz	0.0020 to 0.0031 0.0021 to 0.0038 0.0036 to 0.0053 0.0053 to 0.0060 0.0022 to 0.0060 0.0019 to 0.0060 0.0020 to 0.0044 0.0022 to 0.017 0.0040 to 0.017		Bideford
	VRC 0.5 to 1.0 1 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 200 kHz 200 kHz to 500 kHz 500 kHz to 1 MHz 1 MHz to 100 MHz 100 MHz to 500 MHz 500 MHz to 2 GHz 2 GHz to 3 GHz	0.0024 to 0.0049 0.0024 to 0.0050 0.0024 to 0.0048 0.0024 to 0.0053 0.0024 to 0.0054 0.0024 to 0.0051 0.0025 to 0.0056 0.0038 to 0.041 0.012 to 0.041		
Reflection phase	VRC 0.004 to 0 1 kHz to 3 GHz	180°		Bideford
	VRC 0.001 to 0.004 1 kHz to 3 GHz	106° to 180°		
	VRC 0.01 to 0.001 1 kHz to 3 GHz	10.7° to 32.1°		
	VRC 1 to 0.01 1 kHz to 3 GHz	0.14° to 3.8°		
Transmission magnitude	Attenuation 0 dB to 20 dB 1 kHz to 2 GHz 2 GHz to 3 GHz	0.0020 to 0.051 0.028 to 0.090		Bideford
	20 dB to 70 dB 1 kHz to 3 GHz	0.047 to 0.13		
Transmission phase	0° to ± 180°			Bideford
	Attenuation 0 dB to 70 dB 1 kHz to 3 GHz	0.003° to 0.89°		



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Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks
AUTOMATIC NETWORK ANALYSER SYSTEM; VOLTAGE TRANSMISSION COEFFICIENT MAGNITUDE AND PHASE: The CMCs are for 50Ω coaxial systems fitted with Type N, 3.5 mm, 2.92 mm or 2.4 mm connectors over the frequency ranges as specified below. The CMCs are presented in dB terms for magnitude and in degrees for phase.			

Type N systems	0 dB to 40 dB	40 dB to 50 dB	50 dB to 60 dB	60 dB to 70 dB	Location Code: Bideford
10 MHz to 100 MHz Magnitude Phase	0.085 to 0.11 0.36 to 0.48	0.090 to 0.22 0.41 to 1.4	0.092 to 0.64 0.43 to 4.2	0.11 to 2.0 0.57 to 13	
100 MHz to 1 GHz Magnitude Phase	0.085 to 0.11 0.36 to 0.48	0.090 to 0.22 0.41 to 0.48	0.090 to 0.11 0.42 to 0.57	0.090 to 0.21 0.45 to 1.3	
1 GHz to 12 GHz Magnitude Phase	0.085 to 0.090 0.45 to 1.5	0.090 to 0.090 0.48 to 1.5	0.090 to 0.090 0.48 to 1.5	0.090 to 0.091 0.48 to 1.5	
12 GHz to 18 GHz Magnitude Phase	0.085 to 0.090 1.5 to 2.0	0.090 to 0.090 1.5 to 2.0	0.090 to 0.090 1.5 to 2.0	0.090 to 0.090 1.5 to 2.0	
3.5 mm systems	0 dB to 40 dB (50 dB)	40 dB (50 dB) to 60 dB	60 dB to 70 dB		
50 MHz to 1 GHz Magnitude Phase	0.085 to 0.091 0.36 to 0.55	0.090 to 0.20 0.42 to 1.2	0.090 to 0.56 0.45 to 3.7		
1 GHz to 12 GHz Magnitude Phase	0.085 to 0.090 0.45 to 1.5	0.090 to 0.090 0.48 to 1.5	0.090 to 0.091 0.49 to 1.5		
12 GHz to 26.5 GHz Magnitude Phase	0.085 to 0.090 1.5 to 2.8	0.090 to 0.090 1.5 to 2.8	0.090 to 0.090 1.5 to 2.8		
2.92 mm systems	0 dB to 40 dB (50 dB)	40 dB (50 dB) to 60 dB	60 dB to 70 dB		
50 MHz to 100 MHz Magnitude Phase	0.057 to 0.066 0.36 to 0.42	0.063 to 0.19 0.41 to 1.2	0.064 to 0.56 0.57 to 3.7		
100 MHz to 26.5 GHz Magnitude Phase	0.057 to 0.063 0.36 to 1.9	0.063 to 0.064 0.41 to 1.9	0.063 to 0.066 0.44 to 1.9		
26.5 GHz to 40 GHz Magnitude Phase	0.057 to 0.063 1.9 to 2.6	0.063 to 0.064 1.9 to 2.6	0.063 to 0.071 1.9 to 2.6		
2.4 mm systems	0 dB to 40 dB (50 dB)	40 dB (50 dB) to 60 dB	60 dB to 70 dB		
50 MHz to 1 GHz Magnitude Phase	0.057 to 0.066 0.36 to 0.55	0.063 to 0.19 0.42 to 1.2	0.064 to 0.56 0.44 to 3.7		
1 GHz to 5 GHz Magnitude Phase	0.057 to 0.063 0.41 to 0.66	0.063 to 0.064 0.45 to 0.67	0.064 to 0.066 0.45 to 0.67		
5 GHz to 26.5 GHz Magnitude Phase	0.057 to 0.063 0.64 to 1.9	0.063 to 0.064 0.66 to 1.9	0.063 to 0.070 0.67 to 1.9		
26.5 GHz to 40 GHz Magnitude Phase	0.057 to 0.063 1.9 to 2.6	0.063 to 0.064 1.9 to 2.6	0.063 to 0.071 1.9 to 2.6		



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Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks
AUTOMATIC NETWORK ANALYSER SYSTEM		Location Code: Bideford	
VOLTAGE REFLECTION COEFFICIENT MAGNITUDE: The CMCs are for 50Ω coaxial systems fitted with Type N, 3.5 mm, 2.92 mm or 2.4 mm connectors over the frequency ranges as specified below. The CMCs are presented in VRC terms.			

Connector type	Frequency	VRC range 0.0 to 0.2		VRC range 0.2 to 1.0	
Type N	10 MHz to 1 GHz	0.0061	to 0.0062	0.0062	to 0.012
	1 GHz to 12 GHz	0.0061	to 0.0078	0.0062	to 0.017
	12 GHz to 18 GHz	0.0077	to 0.0078	0.0077	to 0.018
3.5 mm	50 MHz to 1 GHz	0.00050	to 0.0010	0.00080	to 0.0015
	1 GHz to 12 GHz	0.00080	to 0.0020	0.0010	to 0.0028
	12 GHz to 26.5 GHz	0.0019	to 0.0024	0.0019	to 0.0037
2.92 mm	50 MHz to 1 GHz	0.0072	to 0.0073	0.0075	to 0.019
	1 GHz to 26.5 GHz	0.0072	to 0.018	0.0075	to 0.029
	26.5 GHz to 40 GHz	0.012	to 0.015	0.011	to 0.029
2.4 mm	50 MHz to 1 GHz	0.0019	to 0.0023	0.0020	to 0.0045
	1 GHz to 26.5 GHz	0.0023	to 0.0031	0.0023	to 0.0069
	26.5 GHz to 40 GHz	0.0031	to 0.0037	0.0031	to 0.0084

VOLTAGE REFLECTION COEFFICIENT PHASE, 0° to ±180°			Location Code: Bideford
Type N systems			
VRC 0.0000 to 0.0003	10 MHz to 1 GHz 1 GHz to 12 GHz 12 GHz to 18 GHz	175° to 180° 175° to 180° 180°	
VRC 0.0003 to 0.0005	10 MHz to 1 GHz 1 GHz to 12 GHz 12 GHz to 18 GHz	87° to 175° 87° to 180° 109° to 180°	
VRC 0.0005 to 0.001	10 MHz to 1 GHz 1 GHz to 12 GHz 12 GHz to 18 GHz	70° to 87° 70° to 110° 87° to 110°	
VRC 0.001 to 0.01	10 MHz to 1 GHz 1 GHz to 12 GHz 12 GHz to 18 GHz	35° to 70° 35° to 88° 44° to 88°	
VRC 0.01 to 0.1	10 MHz to 1 GHz 1 GHz to 12 GHz 12 GHz to 18 GHz	3.5° to 35° 3.4° to 44° 4.4° to 44°	



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VOLTAGE REFLECTION COEFFICIENT PHASE, 0° to ±180° (continued)				
Type N systems (continued)				
VRC 0.1 to 1	10 MHz to 1 GHz 1 GHz to 12 GHz 12 GHz to 18 GHz	0.69° to 3.5° 0.69° to 4.4° 1.0° to 4.4°		Bideford
3.5 mm systems				
VRC 0.0000 to 0.0001	50 MHz to 1 GHz 1 GHz to 12 GHz 12 GHz to 26.5 GHz	103° to 180° 138° to 180° 180°		
VRC 0.0001 to 0.0005	50 MHz to 1 GHz 1 GHz to 12 GHz 12 GHz to 26.5 GHz	32° to 139° 49° to 180° 105° to 180°		
VRC 0.0005 to 0.001	50 MHz to 1 GHz 1 GHz to 12 GHz 12 GHz to 26.5 GHz	32° to 49° 49° to 105° 105° to 106°		
VRC 0.001 to 0.01	50 MHz to 1 GHz 1 GHz to 12 GHz 12 GHz to 26.5 GHz	2.7° to 49° 4.6° to 105° 10° to 131°		
VRC 0.01 to 0.1	50 MHz to 1 GHz 1 GHz to 12 GHz 12 GHz to 26.5 GHz	0.30° to 4.6° 0.48° to 10° 1.0° to 10°		
VRC 0.1 to 1	50 MHz to 1 GHz 1 GHz to 12 GHz 12 GHz to 26.5 GHz	0.083° to 0.28° 0.083° to 0.53° 0.16° to 0.66°		
2.92 mm systems				
VRC 0.000 to 0.003	50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 26.5 GHz 26.5 GHz to 40 GHz	137° to 180° 136° to 180° 180° 180°		
VRC 0.003 to 0.004	50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 26.5 GHz 26.5 GHz to 40 GHz	103° to 137° 103° to 180° 145° to 180° 175° to 180°		
VRC 0.004 to 0.005	50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 26.5 GHz 26.5 GHz to 40 GHz	82° to 103° 82° to 145° 116° to 177° 140° to 177°		
VRC 0.005 to 0.01	50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 26.5 GHz 26.5 GHz to 40 GHz	41° to 82° 41° to 116° 58° to 142° 70° to 142°		



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Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	Location code
VOLTAGE REFLECTION COEFFICIENT PHASE, 0° to ±180° (continued) 2.92 mm systems (continued)				
VRC 0.01 to 0.1	50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 26.5 GHz 26.5 GHz to 40 GHz	4.1° to 41° 4.1° to 58° 5.8° to 71° 7.0° to 71°		Bideford
VRC 0.1 to 1	50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 26.5 GHz 26.5 GHz to 40 GHz	1.1° to 4.1° 1.1° to 5.8° 1.2° to 7.0° 1.6° to 7.0°		
2.4 mm systems				
VRC 0.000 to 0.001	50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 26.5 GHz 26.5 GHz to 40 GHz	107° to 180° 130° to 180° 170° to 180° 176° to 180°		
VRC 0.001 to 0.002	50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 26.5 GHz 26.5 GHz to 40 GHz	53° to 130° 64° to 177° 84° to 176° 87° to 180°		
VRC 0.002 to 0.003	50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 26.5 GHz 26.5 GHz to 40 GHz	35° to 64° 43° to 88° 56° to 86° 58° to 107°		
VRC 0.003 to 0.004	50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 26.5 GHz 26.5 GHz to 40 GHz	27° to 43° 32° to 58° 42° to 58° 44° to 71°		
VRC 0.004 to 0.005	50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 26.5 GHz 26.5 GHz to 40 GHz	21° to 32° 25° to 44° 33° to 44° 35° to 53°		
VRC 0.005 to 0.01	50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 26.5 GHz 26.5 GHz to 40 GHz	10° to 25° 13° to 35° 17° to 35° 17° to 43°		
VRC 0.01 to 0.1	50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 26.5 GHz 26.5 GHz to 40 GHz	1.0° to 13° 1.3° to 17° 1.7° to 17° 2.1° to 21°		
VRC 0.1 to 1	50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 26.5 GHz 26.5 GHz to 40 GHz	0.25° to 1.3° 0.25° to 1.8° 0.36° to 1.7° 0.38° to 2.1°		



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Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	Location code
RF ATTENUATION Tuned receiver method	0 dB to 30 dB 9 kHz to 100 kHz 100 kHz to 10 MHz 10 MHz to 50 MHz 50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 10 GHz 10 GHz to 15 GHz 15 GHz to 18 GHz 30 dB to 60 dB 9 kHz to 100 kHz 100 kHz to 10 MHz 10 MHz to 50 MHz 50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 10 GHz 10 GHz to 15 GHz 15 GHz to 18 GHz 60 dB to 70 dB 9 kHz to 100 kHz 100 kHz to 10 MHz 10 MHz to 50 MHz 50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 10 GHz 10 GHz to 15 GHz 15 GHz to 18 GHz 70 dB to 80 dB 9 kHz to 100 kHz 100 kHz to 10 MHz 10 MHz to 50 MHz 50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 10 GHz 10 GHz to 15 GHz 15 GHz to 18 GHz 80 dB to 90 dB 9 kHz to 100 kHz 100 kHz to 10 MHz 10 MHz to 50 MHz 50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 10 GHz 10 GHz to 15 GHz 15 GHz to 18 GHz	0.032 dB 0.032 dB 0.032 dB 0.051 dB 0.055 dB 0.087 dB 0.12 dB 0.13 dB 0.045 dB 0.045 dB 0.045 dB 0.072 dB 0.079 dB 0.12 dB 0.16 dB 0.18 dB 0.055 dB 0.055 dB 0.055 dB 0.088 dB 0.097 dB 0.14 dB 0.20 dB 0.22 dB 0.080 dB 0.056 dB 0.056 dB 0.088 dB 0.097 dB 0.15 dB 0.20 dB 0.22 dB 0.13 dB 0.067 dB 0.063 dB 0.093 dB 0.10 dB 0.15 dB 0.23 dB 0.24 dB	50 Ω systems only	Bideford



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RF ATTENUATION (continued) Tuned receiver method (continued)	90 dB to 100 dB 9 kHz to 100 kHz 100 kHz to 10 MHz 10 MHz to 50 MHz 50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 10 GHz 10 GHz to 15 GHz 15 GHz to 18 GHz	0.29 dB 0.14 dB 0.12 dB 0.15 dB 0.16 dB 0.22 dB 0.35 dB 0.37 dB	50 Ω systems only	Bideford
	100 dB to 110 dB 9 kHz to 100 kHz 100 kHz to 10 MHz 10 MHz to 50 MHz 50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 10 GHz 10 GHz to 15 GHz 15 GHz to 18 GHz	0.67 dB 0.48 dB 0.33 dB 0.34 dB 0.36 dB 0.39 dB 0.76 dB 1.3 dB		
Power meter method	0 dB to 25 dB 9 kHz to 20 kHz 20 kHz to 1 MHz 1 MHz to 10 MHz 10 MHz to 50 MHz 50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 10 GHz 10 GHz to 15 GHz 15 GHz to 18 GHz	0.050 dB 0.029 dB 0.025 dB 0.032 dB 0.030 dB 0.033 dB 0.046 dB 0.060 dB 0.061 dB		
	25 dB to 60 dB 9 kHz to 20 kHz 20 kHz to 1 MHz 1 MHz to 10 MHz 10 MHz to 50 MHz 50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 10 GHz 10 GHz to 15 GHz 15 GHz to 18 GHz	0.053 dB 0.035 dB 0.032 dB 0.032 dB 0.031 dB 0.035 dB 0.054 dB 0.078 dB 0.078 dB		



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RF ATTENUATION (continued) Power meter method (continued)	60 dB to 70 dB 9 kHz to 20 kHz 20 kHz to 1 MHz 1 MHz to 10 MHz 10 MHz to 50 MHz 50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 10 GHz 10 GHz to 15 GHz 15 GHz to 18 GHz	0.24 dB 0.23 dB 0.23 dB 0.12 dB 0.12 dB 0.12 dB 0.13 dB 0.14 dB 0.14 dB	50 Ω systems only	Bideford
FREQUENCY MODULATION	0 Hz to 5 kHz 5 kHz to 20 kHz 20 kHz to 100 kHz 100 kHz to 700 kHz	0.10 kHz 0.11 kHz 0.50 kHz 3.4 kHz	Using modulation meter. Carrier frequency range: 50 kHz to 1 GHz Modulation frequency range: 10 Hz to 200 kHz or 1/5 of carrier frequency (Distortion <0.5 %)	
AMPLITUDE MODULATION	0 %AM to 20 %AM 20 %AM to 50 %AM 50 %AM to 80 %AM 80 %AM to 95 %AM	0.16 %AM 0.32 %AM 0.53 %AM 1.1 %AM	Using modulation meter. Carrier frequency range: 50 kHz to 1 GHz Modulation frequency range: 30 Hz to 100 kHz or 1/5 of carrier frequency (Distortion <0.5 %)	
RF INTERMODULATION PRODUCTS	0 dB to -80 dB 10 kHz to 110 MHz 110 MHz to 18 GHz	0.94 dB 1.9 dB	Spectrum analyser method.	



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ELECTROSTATIC VOLTAGE	0.1 kV to 30 kV	0.69 %	Field meters for measuring charged surfaces	Bideford
HIGH IMPEDANCE CONTACT VOLTAGE	0.1 kV to 30 kV	0.61 %	Electrostatic voltmeter and other high resistance voltmeters for measuring charged surfaces	
ELECTROSTATIC DISCHARGE GENERATORS				
Air discharge voltage	0.5 kV to 30 kV	0.73 %	EN61000-4-2:2009 EN61000-4-2:1995 ISO10605:2008 EN61340-3-1:2007 MIL-STD-331C:2005 Corr 1:2009 (Personnel) EIA/JES22-A114-B June 2000 EIA/JES22-A115-A October 1997 The measurement bandwidth is the lowest specified by the associated standard.	
Pulse transition time	500 ps to 50 ns	2.2 %		
Peak current	0.1 A to 30 A	3.7 %		
Decay current	0.1 A to 30 A	5.0 %		
BURST TRANSIENT GENERATOR CHARACTERISTICS				
Peak voltage	0.1 kV to 5 kV	2.6 %	For the calibration of Electrical Fast Transient generators and CDNs to 61000-4-4	
Rise time	3.5 ns to 50 s	0.91 %		
Pulse width	10 ns to 100 ns	0.91 %		
Repetition Frequency	1 kHz to 1 MHz	0.91 %		
Burst duration	100 μ s to 100 ms	0.91 %		
Burst period	1 ms to 1 s	0.14 %		
SURGE PULSE CHARACTERISTICS				
Voltage	0.25 kV to 6.6 kV	2.1 %	For the calibration of surge generators to 61000-4-5	
Current	0.2 kA to 3.3 kA	2.8 %		
Impedance	1 Ω to 100 Ω	4.6 %		
Front/Rise Time	0.1 μ s to 50 μ s	0.91 %		
Pulse Duration	1.0 μ s to 1.0 ms	0.91 %		
Phase	0° to 360°	0.5° to 3.3°		



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Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	Location code
LISN MEASUREMENT				Bideford
<p>This section of the Schedule presents the CMCs for the measurement of complex impedance of a Line Impedance Stabilisation Network (LISN) using a vector network analysis system. Measurements are made as complex quantities. Reflection magnitude is expressed in terms of Impedance with Magnitude and Phase. Measurements are made in a 50 Ω coaxial system using an Agilent E5061B network analyser with appropriate test port leads in a 10 Hz bandwidth. Actual uncertainties are calculated dynamically during the measurement and may be larger than indicated below.</p>				
N Type 50 Ω system				
Impedance Magnitude	Magnitude 0 Ω to 150 Ω			
	1kHz to 9kHz	0.30 Ω		
	9 kHz to 150 kHz	0.30 Ω		
	150 kHz to 30 MHz	1.0 Ω		
	30 MHz to 300 MHz	3.0 Ω		
	300MHz to 400MHz	5.0 Ω		
Impedance Phase	Phase 0° to 180°			
	9kHz to 108MHz	1.0°		
Voltage Division	1kHz to 400MHz	0.25 dB		
Isolation	9 kHz to 108 MHz			
	Up to 60 dB	1.0 dB		
	>60 dB	5.0 dB		
CDN MEASUREMENT				
<p>This section of the Schedule presents the CMCs for the measurement of complex impedance of a CDN using a vector network analysis system. Measurements are made as complex quantities. Reflection magnitude is expressed in terms of Impedance with Magnitude and Phase. Measurements are made in a 50 Ω coaxial system using an Agilent E5061B network analyser with appropriate test port leads in a 10 Hz bandwidth. Actual uncertainties are calculated dynamically during the measurement and may be larger than indicated below.</p>				
Impedance Magnitude	Magnitude 50 Ω to 250 Ω			
	150 kHz to 80 MHz	1.0 %		
	80 MHz to 230 MHz	2.0 %		
	230 MHz to 300 MHz	3.0 %		
Impedance Phase	Phase 0° to 180°			
	150 kHz to 300 MHz	5.0°		
Coupling Factor	150 kHz to 300 MHz	0.39 dB		
Isolation	150 kHz to 300 MHz			
	0 dB to 60 dB	1.0 dB		
	>60 dB	5.0 dB		



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Spectral Intensity	50 dB μ V/MHz to 150 dB μ V/MHz 9 kHz to 10 MHz 10 MHz to 50 MHz 50 MHz to 1 GHz	0.44 dB 0.41 dB 0.41 dB	For the calibration of Impulse Generators	Bideford	
Impulse Measurement					
Detector Pulse Measurements	9 kHz to 10 MHz 10 MHz to 50 MHz 50 MHz to 1 GHz	0.55 dB 0.53 dB 0.55 dB	Absolute and relative CISPR detector response to pulses and response to varying repetition rates		
Detector response to narrowband interference	Band A to D	0.096 dB	Average and RMS CISPR detector response to any drifting narrow band interference		
VOLTAGE DIPS, SHORT INTERRUPTIONS VOLTAGE VARIATIONS GENERATORS					
Dip RMS Voltage	1 V to 500 V	0.58 % + 50 mV	For the calibration of Voltage Dips and Interrupts generators to EN61000-4-11		
Voltage Variations	1 V to 500 V	1.5 %			
Transition rise and fall time	0.1 μ s to 1.0 s	0.91 %			
Interruptions Overshoot Voltage	25 % to 100 %	2.8 %			
Phase Angle	0° to 360°	2.9°			
Dip Variations timing	10 μ s to 30.0 s	0.91 %			
Peak Inrush Current	1 A to 1000 A	2.9 %			
DAMPED OSCILLATORY GENERATORS					
Voltage	100 V to 6.6 kV Frequency \leq 1 MHz Frequency 1 MHz to 50 MHz	2.1 % 2.9 %	For the calibration of Damped Oscillatory Wave Generators in accordance with EN 61000-4-10, EN 61000-4-12, EN 61000-4-18, ANSI C37.90.1		
Ring Wave Current	1 A to 400 A	2.8 %			
DOW Current	1 A to 150 A	3.6 %			
Impedance	5 Ω to 500 Ω	4.6 %			
Rise time	1 ns to 10 μ s	0.91 %			
Frequency	10 kHz to 100 MHz	0.91 %			
Repetition Rate	100 μ s to 1 s	0.91 %			
Burst Duration	1 ms to 5 s	0.91 %			
Phase	0° to 360°	3.3°			
Burst Period	1 ms to 1 s	0.14 %			



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ANTENNA MEASUREMENTS				
Monopole Antenna Antenna Factor	20 Hz to 30 MHz 30 MHz to 100 MHz	1.4 dB/m 1.6 dB/m	Equivalent capacitance method.	Bideford
Antenna Factor and Apparent Gain			Best capability using the three antenna method or by comparison with similar antennas using the standard antenna method.	
Biconical and Broad Band Dipoles	20 MHz to 300 MHz 300 MHz to 1.0 GHz	1.5 dB (1.8 dB at 1 m) 1.5 dB (1.8 dB at 1 m)	Measurement distances 10 m, 3.0 m and 1.0 m.	
Log Periodic	80 MHz to 18.0 GHz	1.5 dB (1.6 dB at 1 m)	Measurement distances 3.0 m and 1.0 m; calculated results for 10 m and for Free Space.	
Bilog and hybrid antennas	20 MHz to 18.0 GHz	1.5 dB (1.8 dB at 1 m)	Measurement distances 3.0 m and 1.0 m; calculated results for 10 m and for Free Space.	
Horn Antennas	200 MHz to 1.0 GHz 1.0 GHz to 18.0 GHz	1.5 dB 1.5 dB	Horn measurement at 3 m and 1.0 m.	
Voltage Reflection Coefficient	18 GHz to 26.5 GHz 30 MHz to 1 GHz 1 GHz to 18 GHz	1.5 dB 0.090 0.129		



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Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	Location code		
BURST TRANSIENT GENERATOR CHARACTERISTICS						
Peak voltage	0.1 kV to 5 kV	2.6 %	For the calibration of Electrical Fast Transient generators, Coupling Clamps and CDNs to EN 61000-4-4			
Rise time	3.5 ns to 50 s	0.91 %				
Pulse width	10 ns to 100 ns	0.91 %				
Repetition Frequency	1 kHz to 1 MHz	0.91 %				
Burst duration	100 μ s to 100 ms	0.91 %				
Burst period	1 ms to 1 s	0.14 %				
SURGE PULSE CHARACTERISTICS						
Voltage	0.25 kV to 6.6 kV	2.1 %			For the calibration of Surge generators and coupling Networks to EN 61000-4-5	
Current	0.2 kA to 3.3 kA	2.8 %				
Impedance	1 Ω to 100 Ω	4.6 %				
Front/Rise Time	0.1 μ s to 50 μ s	0.91 %				
Pulse Duration	1.0 μ s to 1.0 ms	0.91 %				
Phase	0° to 360°	0.5° to 3.3°				
VOLTAGE DIPS, SHORT INTERRUPTIONS, VOLTAGE VARIATIONS GENERATORS						
Dip RMS Voltage	1 V to 500 V	0.58 % + 50 mV	For the calibration of Voltage Dips and Interrupts generators in accordance with EN 61000-4-11	Site		
Voltage Variations	1 V to 500 V	1.5 %				
Transition rise and fall time	0.1 μ s to 1.0 s	0.91 %				
Interruptions Overshoot Voltage	25 % to 100 %	2.8 %				
Phase Angle	0° to 360°	2.9°				
Dip Variations timing	10 μ s to 30.0 s	0.91 %				
Peak Inrush Current	1 A to 1000 A	2.9 %				
DAMPED OSCILLATORY GENERATORS						
Voltage	100 V to 6.6 kV <i>Frequency ≤ 1 MHz</i> <i>Frequency 1 MHz to 50 MHz</i>	2.1 % 2.9 %	For the calibration of Damped Oscillatory Wave Generators in accordance with EN 61000-4-10, EN 61000-4-12, EN 61000-4-18, ANSI C37.90.1			
Ringwave Current	1 A to 400 A	2.8 %				
DOW Current	1 A to 150 A	3.6 %				
Impedance	5 Ω to 500 Ω	4.6 %				
Rise time	1 ns to 10 μ s	0.91 %				
Frequency	10 kHz to 100 MHz	0.91 %				
Repetition Rate	100 μ s to 1 s	0.91 %				
Burst Duration	1 ms to 5 s	0.91 %				
Phase	0° to 360°	3.3°				
Burst Period	1 ms to 1 s	0.14 %				
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 are shown below. It should be noted that these expressions are *not* mathematical formulae but are instead written in a commonly used shorthand for expressing uncertainties - therefore, for purposes of clarity, an indication of how they are to be interpreted is also provided 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.