Schedule of Accreditation

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Accredited to ISO/IEC 17025:2005

Agilent Technologies UK Limited

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Calibration performed by the Organisations at the locations specified below

The Calibration and Measurement Capabilities (CMCs) presented in this Schedule represent the smallest uncertainties for which the laboratory is accredited and are obtained at the Winnersh facility. Measurement systems are also available at the locations listed below and include some or all of the quantities included in this Schedule. Customers' equipment will be calibrated at a location with a capability appropriate for that particular type of equipment. The assigned uncertainties will be such as to properly demonstrate the performance of the equipment and may be greater than the CMCs stated in this Schedule. Where more than one location is able to calibrate a specific item of equipment, the quoted uncertainties will normally be identical.

Laboratory locations:

Location details		Activity
Address Agilent Technologies UK Limited 610 Wharfedale Road Winnersh Triangle Wokingham Berkshire RG41 5TP	**Local contact** Contact Centre Tel: +44 (0) 118 927 6201 E-mail: **contactcentre_UK@agilent.com**	Calibration DC and LF electrical quantities RF and Microwave electrical quantities
Address Agilent Technologies Sales & Services GmbH & Co. KG Servicezentrum Herrenberger Straße 130 71034 Böblingen Germany	**Local contact** Contact Centre Tel: +49 (0) 7031 464 6333 E-mail: **contactcenter_germany@agilent.com**	Calibration DC and LF electrical quantities RF and Microwave electrical quantities
Customers' sites or premises Calibrations may be performed in an air-conditioned vehicle taken to the customers' sites or in suitable areas within the customers' premises. The customers' premises must be appropriate for the nature of the particular calibrations undertaken and will be the subject of contract review arrangements between the laboratory and the customer.	**Local contact** Contact Centre Tel: +44 (0) 118 927 6201 E-mail: **contactcentre_UK@agilent.com**	Calibration DC and LF electrical quantities RF and Microwave electrical quantities

DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location
DC RESISTANCE				
Specific Values	100 µΩ 1 mΩ 10 mΩ 100 mΩ 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 GΩ	280 ppm 25 ppm 14 ppm 5.0 ppm 2.0 ppm 1.5 ppm 1.5 ppm 1.5 ppm 0.30 ppm 2.4 ppm 5.7 ppm 6.8 ppm 48 ppm 270 ppm	Measurement of resistors with negligible power dissipation. The CMCs up to 10 MΩ are obtained at 20 °C in a temperature controlled oil bath.	
Other Values	0 Ω	10 µΩ	Sourcing only, relative to a reference established using a low thermal emf, 4-terminal short circuit.	**See Page 1**
	10 µΩ to 100 µΩ 100 µΩ to 1 mΩ 1 mΩ to 10 mΩ 10 mΩ to 100 mΩ 0.1 Ω to 1 Ω 1 Ω to 10 Ω 10 Ω to 100 Ω 100 Ω to 1 kΩ 1 kΩ to 10 kΩ 10 kΩ to 120 kΩ 120 kΩ to 1.1 MΩ 1.2 MΩ to 12 MΩ 12 MΩ to 120 MΩ 120 MΩ to 1.2 GΩ	650 ppm 60 ppm 60 ppm 9.0 ppm 6.5 ppm 6.5 ppm 2.0 ppm 2.0 ppm 1.6 ppm 11 ppm + 74 mΩ 15 ppm + 2.4 Ω 53 ppm + 110 Ω 500 ppm + 3.9 kΩ 0.50 % + 300 kΩ		
	10 GΩ 100 GΩ 1 TΩ 10 TΩ	0.10 % 0.10 % 0.10 % 0.20 %	Calibration of resistance measuring equipment and standard resistors at test voltages of 100V, 250V and 500 V.	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location
DC VOLTAGE				
Specific Values	1 V to 1.1 V 10 V	1.2 µV 0.80 ppm	Standard cells and solid-state reference standards can be measured on a fully automated system.	
	10 mV 0.1 V 1 V 10 V 100 V 1 kV	23 ppm 2.5 ppm 0.80 ppm 0.80 ppm 0.80 ppm 1.0 ppm		
Other Values	0 V *	0.10 µV	Generation	
	0 V to 10 µV *	0.16 µV	Measurement	
	* With respect to a reference established using a low thermal emf short circuit			
	1 µV to 1 V 1 V to 10 V 10 V to 100 V 100 V to 1000 V	0.60 ppm + 0.43 µV 1.3 ppm 3.5 ppm 4.0 ppm		**See Page 1**
DC CURRENT	0 A	1.0 pA	For calibration of precision digital multimeters (open circuit input).	
	100 nA to 1 µA 1 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 10 A 10 A to 100 A	27 pA 27 ppm to 13 ppm 7.0 ppm to 4.0 ppm 7.0 ppm to 4.0 ppm 7.0 ppm to 4.0 ppm 7.0 ppm to 4.0 ppm 34 ppm to 15 ppm 300 ppm to 47 ppm 370 ppm to 570 ppm		
	100 A to 200 A	570 ppm	Measurement only	
AC VOLTAGE Three reference standards are available for dissemination of AC voltage measurement traceability, each with different frequency ranges, voltage ranges and CMCs. For clarity, each system is described separately in this Schedule; these capabilities are listed on the following five pages.				

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location
AC VOLTAGE Specific Values (System 1)				See Page 1

Voltage	*Calibration and Measurement Capability* in ppm of value for specific values of AC voltages at the frequencies shown									
	10 Hz	*40 Hz*	*1 kHz*	*30 kHz*	*50 kHz*	*100 kHz*	*200 kHz*	*500 kHz*	*700 kHz*	*1 MHz*
100 mV			46	52	54	54		290		750
300 mV	43	38	38	39	40	41	220	170	540	450
1 V	41	32	30	32	33	34	41	110	150	440
3 V	52	39	39	39	40	40	140	160	390	390
10 V	48	32	32	32	33	33	34	130	160	390
20 V								120	360	360
30 V	44	41	32	32	34	37	83			
100 V	48	41	36	36	37	38				

	10 Hz	*40 Hz*	*1 kHz*	*30 kHz*	*50 kHz*	*100 kHz*
300 V		48	48	48	48	48
500 V						190
700 V					150	
1000 V	44	44	44	44		

Other values (System 1)

Voltage range	*Calibration and Measurement Capability* in ppm of value for other values of AC voltages over the frequency ranges shown				
	10 Hz to 100 Hz	*100 Hz to 30 kHz*	*30 kHz to 200 kHz*	*200 kHz to 500 kHz*	*500 kHz to 1 MHz*
1 mV to 3.3 mV	1300	1100	1600	2900	5900
3.3 mV to 11 mV	410	260	580	1700	4000
11 mV to 33 mV	320	200	420	1300	3000
33 mV to 110 mV	250	120	230	690	1900
	10 Hz to 40 Hz	*40 Hz to 30 kHz*	*30 kHz to 200 kHz*	*200 kHz to 500 kHz*	*500 kHz to 1 MHz*
0.1 V to 0.33 V	42	42	85	350	900
0.33 V to 1.1 V	39	39	82	350	900
1.1 V to 3.3 V	39	39	82	350	890
3.3 V to 11 V	39	39	82	350	890
	10 Hz to 40 Hz	*40 Hz to 30 kHz*	*30 kHz to 100 kHz*	*100 kHz to 500 kHz*	*500 kHz to 1 MHz*
10 V to 30 V	48	40	82		
10 V to 20 V				350	900
30 V to 110 V	48	40	84		
	10 Hz to 40 Hz		*40 Hz to 20 kHz*	*20 kHz to 100 kHz*	
100 V to 330 V	57		57	140	
300 V to 1.1 kV	57		63	200	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	Location
AC VOLTAGE (continued) Specific Values (System 2)				See Page 1

Voltage	*Calibration and Measurement Capability* in ppm of value for specific values of AC voltages at the frequencies shown											
	10 Hz	*20 Hz*	*40 Hz*	*500 Hz*	*1 kHz*	*10 kHz*	*20 kHz*	*50 kHz*	*100 kHz*	*200 kHz*	*500 kHz*	*1 MHz*
2 mV	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1800	3300
6 mV	270	190	170	170	170	170	170	170	180	320	640	2100
20 mV	220	150	130	130	130	130	130	130	140	230	500	1600
60 mV	160	93	89	89	88	89	89	93	110	190	380	1100
100 mV	150	70	55	51	51	51	51	51	84	180	340	1100
200 mV	140	70	52	48	48	49	49	68	78	160	330	1100
600 mV	140	58	41	41	41	41	42	42	68	140	310	1100
1 V	140	56	36	36	36	36	36	37	63	130	280	970
2 V	140	56	36	36	36	36	36	37	63	130	280	970
6 V	140	57	36	36	36	36	36	39	74	170	400	1300
10 V	140	57	37	36	36	36	36	39	74	170	400	1300
20 V	140	57	38	37	37	37	37	40	76	170	400	1300
60 V	140	59	47	43	43	43	43	44	93			
100 V	140	60	47	43	43	43	43	50	93			
200 V	150	60	47	43	43	43	43	50	100			
600 V	150	81	56	50	50	50	50	130	500			
1000 V	150	81	58	51	51	51	54	130	510			

Other values (System 2)

Voltage range	*Calibration and Measurement Capability* in (ppm of value + µV) for other values of AC voltages over the frequency ranges shown							
	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 300 kHz*	*300 kHz to 500 kHz*	*500 kHz to 1 MHz*
0.6 mV to 2.2 mV	380 + 7.5	310 + 3.6	290 + 2.4	310 + 2.8	320 + 3.1	460 + 4.3	880 + 8.6	2700 + 12
2.2 mV to 7 mV	260 + 7.5	180 + 3.6	160 + 2.4	170 + 2.8	180 + 3.1	320 + 4.3	600 + 8.6	2100 + 12
7 mV to 22 mV	210 + 7.5	140 + 3.6	120 + 2.4	130 + 2.8	130 + 3.1	230 + 4.3	480 + 8.6	1600 + 12
22 mV to 70 mV	150 + 7.0	82 + 3.7	71 + 2.5	79 + 2.8	96 + 3.1	180 + 4.3	350 + 8.6	1100 + 12
70 mV to 220 mV	140 + 7.0	67 + 3.7	51 + 2.5	47 + 2.8	82 + 3.1	160 + 4.3	340 + 8.6	1100 + 12
220 mV to 700 mV	140 + 7.0	62 + 3.7	39 + 2.5	38 + 2.8	69 + 3.1	150 + 4.3	310 + 8.6	1100 + 12

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location
AC VOLTAGE (continued) Other values (System 2, continued)				

Voltage range	*Calibration and Measurement Capability* in ppm of value for other values of AC voltages over the frequency ranges shown							
	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 300 kHz*	*300 kHz to 500 kHz*	*500 kHz to 1 MHz*
0.7 V to 2.2 V	140	56	36	37	63	130	280	970
2.2 V to 7 V	140	57	36	39	74	170	400	1300
7 V to 22 V	140	57	38	40	76	170	400	1300
22 V to 70 V	140	58	43	44	91			
70 V to 220 V	150	60	47	50	100			
220 V to 700 V	150	81	56	130	500			
700 V to 1000 V	150	81	58	130	510			

See Page 1

AC VOLTAGE (continued)

Specific Values (System 3)

Voltage	*Calibration and Measurement Capability* in ppm of value for specific values of AC voltages at the frequencies shown										
	10 Hz	*20 Hz*	*100 Hz*	*1 kHz*	*10 kHz*	*20 kHz*	*50 kHz*	*100 kHz*	*300 kHz*	*500 kHz*	*1 MHz*
2 mV	1200	1200	1200	1200	1200	1200	1200	1200	1200	1800	3600
6 mV	140	110	110	110	110	110	110	130	270	560	2100
10 mV				72		110					
20 mV	120	88	74	74	74	74	86	120	230	500	1600
60 mV	140	88	72	68	73	76	95	150	290	510	1200
100 mV				46		47					
200 mV	91	48	42	43	42	42	56	110	200	320	970
600 mV	84	55	40	40	40	40	45	62	180	290	950
1 V	120	51	35	36	36	36	39	58	150	260	920
2 V	82	45	35	35	35	35	38	58	170	260	920
6 V	83	45	36	35	35	35	43	69	190	390	1200
20 V	82	46	36	36	36	36	39	70	190	390	1200
60 V	83	48	39	39	39	39	49	74	180		
200 V	91	49	41	39	39	39	45	77			
600 V			43	40	40	42	120	490			
1000 V			43	41	41	41					

Other values (System 3)

Voltage range	*Calibration and Measurement Capability* in (ppm of value + μV) for other values of AC voltages over the frequency ranges shown							
	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 300 kHz*	*300 kHz to 500 kHz*	*500 kHz to 1 MHz*
0.6 mV to 2.2 mV	230 + 7.5	200 + 3.6	190 + 2.4	200 + 2.8	230 + 3.1	410 + 4.3	830 + 8.6	3000 + 12
2.2 mV to 7 mV	130 + 7.5	87 + 3.6	85 + 2.4	89 + 2.8	120 + 3.1	260 + 4.3	540 + 8.6	2100 + 12
7 mV to 22 mV	110 + 7.5	77 + 3.6	60 + 2.4	74 + 2.8	110 + 3.1	230 + 4.3	480 + 8.6	1600 + 12
22 mV to 70 mV	130 + 7.0	72 + 3.7	59 + 2.5	80 + 2.8	150 + 3.1	290 + 4.3	490 + 8.6	1100 + 12
70 mV to 220 mV	120 + 7.0	49 + 3.7	32 + 2.5	37 + 2.8	59 + 3.1	150 + 4.3	310 + 8.6	970 + 12
220 mV to 700 mV	76 + 7.0	52 + 3.7	32 + 2.5	39 + 2.8	61 + 3.1	170 + 4.3	300 + 8.6	940 + 12

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location
				See Page 1

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location

AC VOLTAGE (continued)

Other values (System 3, continued)

Voltage range	*Calibration and Measurement Capability* in ppm of value for other values of AC voltages over the frequency ranges shown							
	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 300 kHz*	*300 kHz to 500 kHz*	*500 kHz to 1 MHz*
0.7 V to 2.2 V	82	45	35	38	58	170	260	920
2.2 V to 7 V	83	45	36	43	72	190	390	1200
7 V to 22 V	82	46	36	39	70	190	390	1200
22 V to 70 V	83	48	39	49	80			
70 V to 220 V	91	49	41	45	77			
220 V to 700 V			43	120	490			
700 V to 1000 V			43					

Voltage range	*Calibration and Measurement Capability* in (% of value + µV) for other values of AC voltages over the frequency ranges shown				
	500 kHz to 1.2 MHz	*1.2 MHz to 2 MHz*	*2 MHz to 10 MHz*	*10 MHz to 20 MHz*	*20 MHz to 30 MHz*
0.6 mV to 2.2 mV	0.21 + 1.0	0.21 + 1.0	0.28 + 1.0	0.43 + 1.0	0.87 + 2.0
2.2 mV to 7 mV	0.12 + 1.0	0.12 + 1.0	0.16 + 1.0	0.27 + 1.0	0.50 + 1.0
7 mV to 22 mV	0.11 + 0	0.11 + 0	0.15 + 0	0.26 + 0	0.50 + 0
22 mV to 70 mV	0.080 + 0	0.080 + 0	0.14 + 0	0.24 + 0	0.48 + 0
70 mV to 220 mV	0.080 + 0	0.080 + 0	0.14 + 0	0.24 + 0	0.47 + 0
220 mV to 700 mV	0.080 + 0	0.080 + 0	0.14 + 0	0.24 + 0	0.47 + 0
700 mV to 2.2 V	0.080 + 0	0.080 + 0	0.14 + 0	0.24 + 0	0.47 + 0
2.2 V to 7 V	0.080 + 0	0.080 + 0	0.14 + 0	0.24 + 0	0.48 + 0

See Page 1

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location
AC CURRENT				
Specific Values	*From 10 Hz to 5 kHz:*			
	10 µA	0.087 %	Voltage/resistance method	
	100 µA	0.033 %		
	1 mA	0.033 %		
	10 mA	0.033 %		
	100 mA	0.033 %		
	From 20 Hz to 10 kHz:			
	10 mA	0.011 %	Thermal transfer method	
	100 mA	0.011 %		
	1 A	0.015 %		
	10 A	0.025 %		
Other Values	9 µA to 220 µA			
	10 Hz to 20 Hz	410 ppm + 16 nA		
	20 Hz to 40 Hz	370 ppm + 10 nA		
	40 Hz to 1 kHz	350 ppm + 8.0 nA		
	1 kHz to 5 kHz	430 ppm + 12 nA		
	220 µA to 2.2 mA			
	10 Hz to 20 Hz	410 ppm + 40 nA		
	20 Hz to 40 Hz	370 ppm + 35 nA		
	40 Hz to 1 kHz	350 ppm + 35 nA		
	1 kHz to 5 kHz	390 ppm + 110 nA		
	2.2 mA to 22 mA			
	10 Hz to 20 Hz	270 ppm + 400 nA		
	20 Hz to 40 Hz	190 ppm + 350 nA		
	40 Hz to 1 kHz	160 ppm + 350 nA		
	1 kHz to 5 kHz	230 ppm + 550 nA		
	5 kHz to 10 kHz	0.11 % + 5.0 µA		
	22 mA to 220 mA			
	10 Hz to 20 Hz	250 ppm + 4.0 µA		
	20 Hz to 40 Hz	190 ppm + 4.0 µA		
	40 Hz to 1 kHz	160 ppm + 3.0 µA		
	1 kHz to 5 kHz	230 ppm + 4.0 µA		
	5 kHz to 10 kHz	0.11 % + 10 µA		
	220 mA to 2.2 A			
	20 Hz to 1 kHz	300 ppm + 35 µA		
	1 kHz to 5 kHz	470 ppm + 80 µA		
	5 kHz to 10 kHz	0.70 % + 160 µA		
	2.2 A to 11 A			
	40 Hz to 1 kHz	520 ppm + 0.17 mA		
	1 kHz to 5 kHz	980 ppm + 0.38 mA		
	5 kHz to 10 kHz	0.36 % + 0.75 mA		

See Page 1

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location
AC RESISTANCE				
Specific Values	1 Ω		For the calibration of meters and standards with 4-terminal pair BNC connectors. Other configurations can be calibrated but the uncertainties may be increased.	See Page 1
	5 Hz to 100 kHz	0.17 %		
	100 kHz to 1 MHz	0.23 %		
	10 Ω			
	5 Hz to 1 MHz	0.14 %		
	1 MHz to 13 MHz	2.1 %		
	100 Ω			
	5 Hz to 1 MHz	0.16 %		
	100 kHz, 500 kHz and 1 MHz	0.14 %		
	3 MHz	0.33 %		
	5 MHz	0.33 %		
	10 MHz	0.33 %		
	1 MHz to 10 MHz	0.38 %		
	10 MHz to <13 MHz	0.41 %		
	At 13 MHz	0.37 %		
	1 kΩ			
	5 Hz to 1 MHz	0.24 %		
	100 kHz, 500 kHz and 1 MHz	0.21 %		
	3 MHz	0.32 %		
	5 MHz	0.32 %		
	10 MHz	0.33 %		
	13 MHz	0.34 %		
	1 MHz to 13 MHz	0.38 %		
	10 kΩ			
	5 Hz to 1 MHz	0.24 %		
	100 kHz	0.21 %		
	500 kHz	0.21 %		
	1 MHz	0.21 %		
	100 kΩ			
	5 Hz to 500 kHz	0.35 %		
	100 kHz	0.33 %		
	500 kHz	0.33 %		
	1 MHz	0.39 %		
	500 kHz to 1 MHz	0.41 %		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location
CAPACITANCE				
Specific Values	1 pF		For the calibration of meters and standards with 4-terminal pair BNC connectors. Other configurations can be calibrated but the uncertainties may be increased.	**See Page 1**
	5 Hz to 1 kHz	0.040 %		
	1 kHz to 1 MHz	0.38 %		
	1 MHz to 13 MHz	1.3 %		
	10 pF			
	5 Hz to 1 kHz	0.030 %		
	1 kHz	0.026 %		
	1 kHz to 1 MHz	0.070 %		
	1 MHz to 13 MHz	0.21 %		
	100 pF			
	5 Hz to 1 kHz	0.23 %		
	1 kHz	0.024 %		
	1 kHz to 1 MHz	0.050 %		
	1 MHz to 13 MHz	0.19 %		
	1000 pF			
	5 Hz to 1 kHz	0.25 %		
	1 kHz	0.023 %		
	1 kHz to 1 MHz	0.04 %		
	3 MHz	0.51 %		
	5 MHz	0.51 %		
	10 MHz	0.52 %		
	13 MHz	0.53 %		
	1 MHz to 13 MHz	0.60 %		
	10 nF			
	120 Hz	0.040 %		
	1 kHz	0.035 %		
	10 kHz	0.060 %		
	100 kHz	0.16 %		
	100 nF			
	120 Hz	0.040 %		
	1 kHz	0.030 %		
	10 kHz	0.10 %		
	100 kHz	0.29 %		
	1 µF			
	120 Hz	0.060 %		
	1 kHz	0.030 %		
	10 kHz	0.080 %		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location
DISSIPATION FACTOR	D (tan δ) values between 0 and 0.01 at the following nominal values of capacitance: 1 pF *5 Hz to 1 MHz* *1 MHz to 13 MHz* 10 pF *5 Hz to 1 MHz* *1 MHz to 13 MHz* 100 pF *5 Hz to 1 kHz* *1 kHz to 1 MHz* *1 MHz to 13 MHz* 1000 pF *5 Hz to 1 kHz* *1 kHz to 1 MHz* *1 MHz to 13 MHz* 10 nF *1 kHz* 100 nF *1 kHz* 1 µF *1 kHz*	 0.00040 0.0012 0.00020 0.0012 0.0027 0.00040 0.0012 0.0028 0.00020 0.0011 0.00020 0.00030 0.00050	For the calibration of meters and standards with 4-terminal pair BNC connectors. Other configurations can be calibrated but the uncertainties may be increased.	**See Page 1**
DISTORTION	*From 20 Hz to 20 kHz:* 0 % to 0.05 % 0.05 % to 10 % *From 20 Hz to 50 kHz:* 0 % to 0.1 % 0.1 % to 10 % *From 50 kHz to 100 kHz:* 0 % to 0.18 % 0.18 % to 10 %	 0.0070 % absolute 14 % of reading 0.027 % absolute 27 % of reading 0.050 % absolute 27 % of reading		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location
FREQUENCY				
Specific Values	1 MHz, 5 MHz and 10 MHz	1.0×10^{-12}		
Other Values	0.1 Hz to 500 MHz 500 MHz to 1 GHz 1 GHz to 2 GHz 2 GHz to 40 GHz	6.0 in 10^{11} + 0.020 nHz 2.0 in 10^{9} 1.0 in 10^{9} 5.0 in 10^{10}		
TIME INTERVAL	10 ns to 10 s	35 ps to 0.12 ns		
PULSE CHARACTERISTICS				
Amplitude	- 500 mV to + 500 mV	0.10 % + 2.0 mV	Higher amplitude pulses (up to 10 V) can be measured with increased uncertainty.	
Time interval (including rise and fall time)	20 ps to 1 μs	0.10 % + 10 ps		
AMPLITUDE MODULATION				
For the calibration of signal sources and modulation meters between 10% and 90% modulation depth.	Carrier: *0.15 MHz to 10 MHz* Modulation: *20 Hz to 400 Hz* *400 Hz to 10 kHz* *10 kHz to 100 kHz* Carrier: *10 MHz to 26.5 GHz* Modulation: *20 Hz to 400 Hz* *400 Hz to 10 kHz* *10 kHz to 100 kHz*	(% of reading) 1.5 % to 3.0 % 1.3 % to 2.9 % 2.1 % to 3.4 % (% of reading) 1.1 % to 2.8 % 0.80 % to 2.7 % 1.8 % to 3.1 %	The uncertainties are with respect to the modulation depth and are appropriate for signals with harmonic distortion not exceeding - 40 dBc. The uncertainties may be increased for higher levels of distortion at modulation depths less than 30%.	**See Page 1**
FREQUENCY MODULATION				
For the calibration of signal sources and modulation meters at frequency deviations between 1 kHz and 320 kHz.	Carrier: *10 MHz to 26.5 GHz* Modulation: *20 Hz to 100 kHz*	 2.0 %		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location
RF POWER				See Page 1
Reference sources				
Output power	1 mW *50 MHz*	 0.22 %	For sources with female type-N connectors	
Source reflection coefficient	0 to 0.1	0.012	Where the output reflection phase is known to be 0° ± 40° or 180° ± 40°.	
For the calibration of sources and receivers.	*2 MHz to 26.5 GHz:* 0 dBm to - 50 dBm - 50 dBm to - 90 dBm - 90 dBm to - 127 dBm	 0.15 dB 0.25 dB 0.35 dB	For EMC receivers the results may also be presented in terms of dBµV in a 50 Ω system.	

CALIBRATION OF RF POWER SOURCES

The following *Calibration and Measurement Capability* is for the calibration 75 Ω RF power sources fitted with Type N coaxial connectors. The uncertainties are for the measurement of sources with an output VSWR of 1.2:1 or less and with connectors that are in good condition. Instruments with a higher VSWR, fitted with different connectors to those shown, or which have connectors that are in poor condition will be assigned larger uncertainties.

75 Ω Type N coaxial system	1 µW to 100 µW	100 µW to 10 mW	10 mW to 100 mW	Using Model 8483A sensor
100 kHz to 300 kHz	4.7 % + 92 nW	4.7 %	4.7 % + 0.0004P^2	P = measured power in mW
300 kHz to 2 GHz	2.8 % + 92 nW	2.8 %	2.8 % + 0.0004P^2	P = measured power in mW
2 GHz to 3 GHz	4.0 % + 92 nW	4.0 %	4.0 % + 0.0004P^2	P = measured power in mW

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	Location
CALIBRATION OF RF POWER SOURCES (continued) The following *Calibration and Measurement Capability* is for the calibration of 50 Ω RF power sources fitted with Type N or APC-3.5 coaxial connectors. The uncertainties are for the measurement of sources with an output VSWR of 1.2:1 or less and with connectors that are in good condition. Instruments with a higher VSWR, fitted with different connectors to those shown, or which have connectors that are in poor condition will be assigned larger uncertainties.				
50 Ω Type N coaxial system	1 µW to 100 µW	100 µW to 10 mW	10 mW to 100 mW	Using Model 8481A sensor
10 MHz to 50 MHz *50 MHz to 2 GHz* *2 GHz to 12 GHz* *12 GHz to 18 GHz*	2.9 % + 92 nW 2.1 % + 92 nW 2.6 % + 92 nW 3.5 % + 92 nW	2.9 % 2.1 % 2.6 % 3.5 %	2.9 % + 0.0004P^2 2.1 % + 0.0004P^2 2.6 % + 0.0004P^2 3.5 % + 0.0004P^2	P = measured power in mW P = measured power in mW P = measured power in mW P = measured power in mW
50 Ω Type N coaxial system	1 µW to 100 µW	100 µW to 10 mW	10 mW to 100 mW	Using Model 8482A sensor
100 kHz to 300 kHz *300 kHz to 2 GHz* *2 GHz to 4.2 GHz*	3.5 % + 92 nW 2.2 % + 92 nW 2.7 % + 92 nW	3.5 % 2.2 % 2.7 %	3.5 % + 0.0004P^2 2.2 % + 0.0004P^2 2.7 % + 0.0004P^2	P = measured power in mW P = measured power in mW P = measured power in mW
50 Ω Type N coaxial system	100 pW to 10 nW	10 nW to 1 µW	1 µW to 10 µW	Using Model 8481D sensor
10 MHz to 30 MHz *30 MHz to 4 GHz* *4 GHz to 18 GHz*	3.2 % + 9.2 pW 2.7 % + 9.2 pW 4.5 % + 9.2 pW	3.2 % 2.7 % 4.5 %	3.2 % + 0.0014$P^{1.9}$ 2.7 % + 0.0014$P^{1.9}$ 4.5 % + 0.0014$P^{1.9}$	P = measured power in µW P = measured power in µW P = measured power in µW
50 Ω Type N coaxial system	100 µW to 10 mW	10 mW to 700 mW	700 mW to 3 W	Using Model 8481H sensor
10 MHz to 8 GHz *8 GHz to 12 GHz* *12 GHz to 18 GHz*	2.9 % + 9.2 µW 3.1 % + 9.2 µW 3.8 % + 9.2 µW	2.9 % 3.1 % 3.8 %	2.9 % + 0.04$P^{1.4}$ 3.1 % + 0.04$P^{1.4}$ 3.8 % + 0.04$P^{1.4}$	P = measured power in W P = measured power in W P = measured power in W
50 Ω Type N coaxial system	100 µW to 10 mW	10 mW to 700 mW	700 mW to 3 W	Using Model 8482H sensor
100 kHz to 4.2 GHz	2.8 % + 9.2 µW	2.8 %	2.8 % + 0.04$P^{1.4}$	P = measured power in W
50 Ω APC-3.5 coaxial system	1 µW to 100 µW	100 µW to 10 mW	10 mW to 100 mW	Using Model 8485A sensor
50 MHz to 2 GHz *2 GHz to 12 GHz* *12 GHz to 18 GHz* *18 GHz to 26.5 GHz*	2.1 % + 92 nW 2.7 % + 92 nW 3.2 % + 92 nW 3.9 % + 92 nW	2.1 % 2.7 % 3.2 % 3.9 %	2.1 % + 0.0004P^2 2.7 % + 0.0004P^2 3.2 % + 0.0004P^2 3.9 % + 0.0004P^2	P = measured power in mW P = measured power in mW P = measured power in mW P = measured power in mW

See Page 1

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	Location
CALIBRATION OF RF POWER SOURCES (continued) The following *Calibration and Measurement Capability* is for the calibration of 50 Ω RF power sources fitted with APC-2.4 or APC-3.5 coaxial connectors. The uncertainties are for the measurement of sources with an output VSWR of 1.2:1 or less (50 MHz to 26.5 GHz) or 1.6:1 or less (26.5 GHz to 50 GHz), with connectors that are in good condition. Instruments that are not well matched, fitted with different connectors to those shown, or which have connectors that are in poor condition will be assigned larger uncertainties.				
50 Ω APC-3.5 coaxial system	100 pW to 10 nW	10 nW to 1 µW	1 µW to 10 µW	Using Model 8485D sensor
50 MHz to 4 GHz	2.7 % + 9.2 pW	2.7 %	2.7 % + 0.0014$P^{1.9}$	P = measured power in µW
4 GHz to 12 GHz	3.1 % + 9.2 pW	3.1 %	3.1 % + 0.0014$P^{1.9}$	P = measured power in µW
12 GHz to 18 GHz	3.6 % + 9.2 pW	3.6 %	3.6 % + 0.0014$P^{1.9}$	P = measured power in µW
18 GHz to 26.5 GHz	4.2 % + 9.2 pW	4.2 %	4.2 % + 0.0014$P^{1.9}$	P = measured power in µW
50 Ω APC-2.4 coaxial system	1 µW to 100 µW	100 µW to 10 mW	10 mW to 100 mW	Using Model 8487A sensor
50 MHz to 2 GHz	2.5 % + 92 nW	2.5 %	2.5 % + 0.0004P^2	P = measured power in mW
2 GHz to 12.4 GHz	3.0 % + 92 nW	3.0 %	3.0 % + 0.0004P^2	P = measured power in mW
12.4 GHz to 18 GHz	3.3 % + 92 nW	3.3 %	3.3 % + 0.0004P^2	P = measured power in mW
18 GHz to 26 GHz	3.8 % + 92 nW	3.8 %	3.8 % + 0.0004P^2	P = measured power in mW
26 GHz to 40 GHz	6.2 % + 92 nW	6.2 %	6.2 % + 0.0004P^2	P = measured power in mW
40 GHz to 50 GHz	8.9 % + 92 nW	8.9 %	8.9 % + 0.0004P^2	P = measured power in mW
50 Ω APC-2.4 coaxial system	100 pW to 10 nW	10 nW to 1 µW	1 µW to 10 µW	Using Model 8487D sensor
50 MHz to 2 GHz	3.7 % + 9.2 pW	3.7 %	3.7 % + 0.0014$P^{1.9}$	P = measured power in µW
2 GHz to 12.4 GHz	4.1 % + 9.2 pW	4.1 %	4.1 % + 0.0014$P^{1.9}$	P = measured power in µW
12.4 GHz to 18 GHz	4.5 % + 9.2 pW	4.5 %	4.5 % + 0.0014$P^{1.9}$	P = measured power in µW
18 GHz to 26 GHz	5.0 % + 9.2 pW	5.0 %	5.0 % + 0.0014$P^{1.9}$	P = measured power in µW
26 GHz to 34 GHz	7.2 % + 9.2 pW	7.2 %	7.2 % + 0.0014$P^{1.9}$	P = measured power in µW
34 GHz to 40 GHz	9.4 % + 9.2 pW	9.4 %	9.4 % + 0.0014$P^{1.9}$	P = measured power in µW
40 GHz to 50 GHz	12 % + 9.2 pW	12 %	12 % + 0.0014$P^{1.9}$	P = measured power in µW

See Page 1

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location
CALIBRATION FACTOR RF Power Sensors				See Page 1

The table overleaf shows the *Calibration and Measurement Capability* in % calibration factor for the various RF power sensors listed below. These are examples and are not intended to be restrictive; other sensors of similar frequency range, power range etc. may also be calibrated.

The uncertainties are for devices with values of voltage reflection coefficient (VRC) that typically do not exceed 0.01. The uncertainties will be increased for devices with significantly greater VRC.

The uncertainties apply to a measurement procedure that includes an evaluation of the connector repeatability of the device being calibrated. An alternative measurement procedure is available based on a single measurement of the device and generic data for the connector repeatability. This alternative procedure will normally be used, unless requested otherwise by the customer, and the reported uncertainty will be larger.

Column	Sensor type	Impedance	Connector	Maximum power	Frequency range	Example type
A	Thermocouple	50 Ω	Type N	100 mW	10 MHz to 18 GHz	8481A
B	Thermocouple	50 Ω	Type N	3 W	10 MHz to 18 GHz	8481H
C	Thermocouple	50 Ω	Type N	100 mW	100 kHz to 4.2 GHz	8482A
D	Thermocouple	50 Ω	Type N	3 W	100 kHz to 4.2 GHz	8482H
E	Thermocouple	75 Ω	Type N	100 mW	100 kHz to 3 GHz	8483A
F	Diode	50 Ω	Type N	10 µW	10 MHz to 18 GHz	8481D
G	Thermocouple	50 Ω	3.5 mm	100 mW	10 MHz to 26.5 GHz	8485A
H	Diode	50 Ω	3.5 mm	10 µW	10 MHz to 26.5 GHz	8485D
I	Thermistor Mount	50 Ω	Type N	10 mW	10 MHz to 18 GHz	8478B
J	Thermistor Mount	50 Ω	Type N	10 mW	1 MHz to 1 GHz	478A-H55
K	Thermocouple	50 Ω	Type N	100 mW	100 kHz to 2.6 GHz	11722A
L	Thermocouple	50 Ω	Type N	100 mW	10 MHz to 18 GHz	11792A opt. 001
M	Thermocouple	50 Ω	Type N	100 mW	10 MHz to 26.5 GHz	11792A
N	Diode	50 Ω	Type N	320 mW	9 kHz to 6 GHz	E9304A

Calibration and Measurement Capability in % calibration factor for the power sensor types described on Page 14

Frequency	A	B	C	D	E	F	G	H	I	J	K	L	M	N
9 kHz														0.67
30 kHz														0.67
50 kHz														0.67
100 kHz			0.72	1.5	2.2						0.73			0.67
300 kHz			0.62	1.4	1.2						0.62			0.67
500 kHz			0.61	1.4							0.62			0.67
1 MHz			0.61	1.4	1.1					0.59	0.61			0.67
3 MHz			0.61	1.4	1.0					0.58	0.61			0.67
5 MHz			0.61	1.4						0.58	0.61			0.67
10 MHz	0.64	1.55	0.57	1.4	1.0	0.75	0.88	0.88	0.55	0.55	0.57	0.63	0.88	0.75
20 MHz					1.3									
30 MHz	0.58	1.4	0.57	1.4	1.0	0.67	0.67	0.68	0.47	0.55	0.57	0.58	0.67	0.76
50 MHz	0.49	1.4	0.48	1.4	0.85	0.50	0.52	0.53	0.46	0.42	0.49	0.49	0.52	0.48
75 MHz					1.3									
100 MHz	0.58	1.4	0.57	1.4	1.1	0.66	0.64	0.66	0.46	0.58	0.57	0.57	0.64	0.63
125 MHz					1.4									
150 MHz					1.4									
200 MHz					1.4									
300 MHz	0.68	1.5	0.67	1.5	1.1	0.74	0.64	0.66	0.58	0.58	0.67	0.68	0.64	0.63
400 MHz					1.4									
500 MHz	0.68	1.5	0.67	1.5	1.4	0.75	0.65	0.66	0.58	0.76	0.68			0.63
600 MHz					1.4									
700 MHz					1.4									
800 MHz	0.51	1.4			1.4	0.74				0.69				0.63
900 MHz					1.4									
1 GHz	0.68	1.5	0.67	1.5	1.1	0.75	0.65	0.66	0.58	0.77	0.68	0.68	0.65	0.63
1.2 GHz	0.68	1.5				0.75								0.63
1.5 GHz	0.68	1.5	0.68	1.5	1.7	0.75	0.74	0.75	0.59		0.68	0.68	0.74	0.63
2 GHz	0.69	1.5	0.68	1.5	1.1	0.76	0.75	0.76	0.60		0.68	0.68	0.75	0.64
2.5 GHz			0.68	1.5	2.0									
2.6 GHz			0.68	1.5							0.69			
3 GHz	0.69	1.5	0.69	1.5	2.1	0.77	0.79	0.80	0.61			0.68	0.79	0.66
3.5 GHz			0.70	1.5										
3.7 GHz			0.70	1.5										
4 GHz	0.69	1.5	0.71	1.5		0.77	0.79	0.80	0.63			0.68	0.79	0.66
4.2 GHz			0.76	1.5										
5 GHz	0.73	1.5				0.81	0.79	0.80	0.73			0.72	0.79	0.67
6 GHz	0.72	1.5				0.83	0.91	0.92	0.72			0.72	0.91	0.68
7 GHz	0.73	1.5				0.85	0.94	0.95	0.73			0.72	0.94	
8 GHz	0.73	1.5				0.89	0.99	0.99	0.80			0.73	0.99	
9 GHz	0.81	1.5				0.97	1.1	1.1	0.89			0.81	1.1	
10 GHz	0.82	1.5				1.1	1.1	1.1	0.92			0.82	1.1	
11 GHz	0.82	1.5				1.2	1.2	1.2	0.99			0.82	1.2	
12 GHz	0.83	1.5				1.1	1.2	1.2	1.00			0.82	1.2	
12.4 GHz	0.87	1.6				1.1	1.3	1.3	0.99					
13 GHz	0.87	1.6				1.0	1.3	1.3	0.93			0.86	1.3	
14 GHz	0.87	1.6				0.93	1.3	1.3	0.87			0.87	1.3	
15 GHz	0.89	1.6				1.0	1.3	1.3	0.87			0.88	1.3	
16 GHz	0.98	1.6				1.3	1.4	1.4	1.0			0.98	1.4	
17 GHz	1.3	1.8				1.7	1.4	1.4	1.4			1.2	1.4	
18 GHz	1.7	2.1				2.2	1.4	1.4	1.9			1.6	1.4	
18.5 GHz							1.6	1.7					1.6	
19 GHz to 21.5 GHz in 0.5 GHz steps							1.7	1.7					1.7	
22 GHz							1.6	1.7					1.6	
22.5 GHz							1.7	1.8					1.7	
23 GHz to 25.5 GHz in 0.5 GHz steps							1.8	1.9					1.8	
26 GHz and 26.5 GHz							1.9	1.9					1.9	

Location: See Page 1

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location
RF VOLTAGE				
Thermal voltage converter calibration	0.15 V to 3 V *1 MHz to 3 MHz* *3 MHz to 30 MHz* *30 MHz to 60 MHz* *60 MHz to 100 MHz*	 0.059 % 0.13 % 0.24 % 0.43 %	Calibration of 50 Ω TVCs with BNC connectors. The uncertainty may be increased for other connector types.	**See Page 1**
Calibration of voltmeters and sources	0.25 V to 5 V *(10 MHz max. for 3V to 5V)* *20 Hz to 1 MHz* *1 MHz to 10 MHz* *10 MHz to 30 MHz* *30 MHz to 60 MHz* *60 MHz to 80 MHz* *80 MHz to 100 MHz*	Generation / Measurement 0.15 % / 0.32 % 0.31 % / 0.39 % 0.31 % / 0.59 % 0.50 % / 0.70 % 0.82 % / 0.89 % 0.82 % / 1.3 %		
	5 V to 10 V *20 Hz to 3 MHz* *3 MHz to 10 MHz*	 0.16 % / 0.16 % 0.26 % / 0.26 %		
RF ATTENUATION				
Specific Values	Incremental attenuation 10 dB 20 dB 30 dB 40 dB 50 dB 60 dB 70 dB 80 dB 90 dB 100 dB 110 dB 120 dB	30 MHz and 50 MHz / 60 MHz [1] 0.0020 dB / 0.011 dB 0.0020 dB / 0.011 dB 0.0030 dB / 0.011 dB 0.0030 dB / 0.012 dB 0.0040 dB / 0.012 dB 0.0040 dB / 0.013 dB 0.0050 dB / 0.013 dB 0.0050 dB / 0.013 dB 0.0050 dB / 0.014 dB 0.0050 dB / 0.014 dB 0.0060 dB / 0.020 dB 0.0060 dB / -	For the calibration of spectrum analysers, receivers, network analysers, signal generators etc. [1] Includes step attenuators	
Other Values	*300 kHz to 6 GHz:* 0 dB to 40 dB 40 dB to 50 dB 50 dB to 60 dB 60 dB to 70 dB 70 dB to 75 dB 0 dB to 90 dB *50 MHz to 26.5 GHz*	 0.030 dB to 0.080 dB 0.040 dB to 0.13 dB 0.080 dB to 0.32 dB 0.20 dB to 0.95 dB 0.93 dB to 1.7 dB See table on the following page	The uncertainties stated are for two-port 50 Ω devices fitted with APC7, Type-N or APC3.5 connectors that have input and output VRC of less than 0.1.The uncertainties may be increased for higher values of VRC.	

The following table gives the *Calibration and Measurement Capability* in dB for ranges of measured attenuation using a modified version of a Vector Network Analyser Model 8510C. The uncertainties are for two-port 50 Ω devices fitted with APC-7, Type N or APC-3.5 connectors that have input and output VRC of less than 0.1. The uncertainties may be increased for higher values of VRC.

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	Location
				See Page 1

Frequency GHz	Uncertainty in measured attenuation (dB) for the ranges shown								
	0 dB to 10 dB	10 dB to 20 dB	20 dB to 30 dB	30 dB to 40 dB	40 dB to 50 dB	50 dB to 60 dB	60 dB to 70 dB	70 dB to 80 dB	80 dB to 90 dB
0.05	0.050	0.050	0.050	0.050	0.050	0.060	0.11	0.32	1.0
0.1	0.050	0.050	0.050	0.050	0.050	0.060	0.11	0.33	1.0
0.3	0.050	0.050	0.050	0.050	0.050	0.060	0.11	0.33	1.0
1	0.050	0.050	0.050	0.050	0.050	0.060	0.11	0.33	1.0
1.5	0.050	0.050	0.050	0.050	0.050	0.060	0.12	0.34	1.1
2	0.050	0.050	0.050	0.050	0.060	0.060	0.12	0.36	1.1
3	0.050	0.050	0.050	0.050	0.060	0.070	0.13	0.39	1.2
4	0.050	0.050	0.050	0.050	0.060	0.070	0.14	0.42	1.3
5	0.050	0.050	0.050	0.060	0.060	0.070	0.15	0.45	1.4
6	0.050	0.050	0.050	0.060	0.060	0.080	0.16	0.49	1.5
7	0.050	0.050	0.060	0.060	0.060	0.080	0.18	0.53	1.6
8	0.050	0.060	0.060	0.060	0.060	0.080	0.19	0.58	1.7
9	0.060	0.060	0.060	0.060	0.070	0.090	0.21	0.63	1.9
10	0.060	0.060	0.060	0.060	0.070	0.090	0.23	0.69	2.1
11	0.060	0.060	0.060	0.060	0.070	0.10	0.25	0.75	2.2
12	0.060	0.060	0.060	0.070	0.070	0.10	0.27	0.81	2.4
13	0.060	0.060	0.060	0.070	0.070	0.11	0.29	0.89	2.6
14	0.060	0.060	0.070	0.070	0.080	0.12	0.32	0.97	2.9
15	0.060	0.060	0.070	0.070	0.080	0.13	0.35	1.1	3.1
16	0.060	0.070	0.070	0.070	0.080	0.14	0.38	1.2	3.3
17	0.070	0.070	0.070	0.070	0.090	0.15	0.42	1.3	3.6
18	0.070	0.070	0.070	0.080	0.090	0.16	0.45	1.4	3.9
19	0.070	0.070	0.070	0.080	0.090	0.17	0.49	1.5	4.2
20	0.070	0.070	0.070	0.080	0.10	0.19	0.54	1.6	4.6
21	0.070	0.070	0.080	0.080	0.10	0.20	0.59	1.8	4.9
22	0.070	0.070	0.080	0.080	0.10	0.22	0.64	1.9	5.3
23	0.070	0.080	0.080	0.080	0.11	0.24	0.70	2.1	5.7
24	0.070	0.080	0.080	0.090	0.11	0.26	0.76	2.2	6.1
25	0.080	0.080	0.080	0.090	0.12	0.28	0.82	2.4	6.5
26	0.080	0.080	0.080	0.090	0.13	0.30	0.90	2.6	7.0
26.5	0.080	0.080	0.080	0.090	0.13	0.32	0.94	2.7	7.2

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location
SPECTRUM ANALYSIS Calibration of the spectral content, including harmonic distortion, of signal sources in a 50 Ω coaxial system.	0 dBc to - 50 dBc *10 Hz to 3 GHz* *3 GHz to 20 GHz* *20 GHz to 40 GHz* *40 GHz to 50 GHz* - 50 dBc to - 90 dBc *10 Hz to 3 GHz* *3 GHz to 20 GHz* *20 GHz to 40 GHz* *40 GHz to 50 GHz* - 90 dBc to -150 dBc *10 Hz to 3 GHz* *3 GHz to 6.6 GHz* *6.6 GHz to 22 GHz* *22 GHz to 26.5 GHz* *26.5 GHz to 31.1 GHz* *31.1 GHz to 50 GHz*	 1.4 dB 1.8 dB 2.0 dB 2.3 dB 1.8 dB 2.1 dB 2.3 dB 2.5 dB 4.0 dB 4.3 dB 4.6 dB 5.0 dB 4.5 dB 5.0 dB		See Page 1
DIRECTIVITY of VRC bridges				
The capability described below is for the measurement of directivity of 50 Ω VRC bridges and similar devices. The uncertainties are given in linear quantities (VRC) where the range applies to the range of measured directivity. The values and uncertainties may be reported in terms of return loss (dB), calculated from the linear values and uncertainties.				
BNC connectors	16 dB to 50 dB *0.1 MHz to 110 MHz*	 0.017 to 0.0060		
Type N connectors	16 dB to 50 dB *0.1 MHz to 2 GHz* *2 GHz to 18 GHz*	 0.017 to 0.0060 0.019 to 0.010		
3.5 mm connectors	16 dB to 50 dB *10 MHz to 3 GHz* *3 GHz to 18 GHz* *18 GHz to 26.5 GHz*	 0.018 to 0.0060 0.018 to 0.0080 0.019 to 0.0080		
7 mm connectors	16 dB to 50 dB *10 MHz to 18 GHz*	 0.017 to 0.0040		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location
DIRECTIVITY of VRC bridges (continued)				
2.4 mm connectors	16 dB to 50 dB			
	10 MHz to 4 GHz	0.019 to 0.0090		
	4 GHz to 20 GHz	0.019 to 0.010		
	20 GHz to 36 GHz	0.021 to 0.013		
	36 GHz to 40 GHz	0.023 to 0.016		
	40 GHz to 50 GHz	0.026 to 0.020		
CISPR16 PULSE RESPONSE	*PRF*			
Quasi-peak detector response	*100 Hz, 60 Hz, 10 Hz, 5 Hz, 2 Hz, 1 Hz and isolated.*	0.10 dB	For "Band A" (9 kHz to 150 kHz) with 200 Hz IF bandwidth. With respect to a reference established at nominal 60 dBµV at 25 Hz pulse repetition frequency.	
	20 Hz, 10 Hz, 2 Hz, 1 Hz and isolated.	0.11 dB	For "Band B" (150 kHz to 30 MHz) with 9 kHz IF bandwidth. With respect to a reference established at nominal 60 dBµV at 100 Hz pulse repetition frequency.	
	20 Hz, 10 Hz, 2 Hz, 1 Hz and isolated.	0.26 dB	For "Band C" (150 kHz to 300 MHz) with 120 kHz IF bandwidth. With respect to a reference established at nominal 60 dBµV at 100 Hz pulse repetition frequency.	
	20 Hz, 10 Hz, 2 Hz, 1 Hz and isolated.	0.26 dB	For "Band D" (300 MHz to 1 GHz) with 120 kHz IF bandwidth. With respect to a reference established at nominal 60 dBµV at 100 Hz pulse repetition frequency.	
Quasi-peak to Peak detector relative response ratio	*25 Hz*	0.10 dB	Band A	
	100 Hz	0.10 dB	Band B	
	100 Hz	0.10 dB	Bands C and D	
Quasi-peak to Average detector relative response ratio	*25 Hz*	0.10 dB	Band A	
	500 Hz	0.10 dB	Band B	
	5 kHz	0.10 dB	Bands C and D	
Quasi-peak absolute amplitude	*25 Hz*	0.40 dB	Band A	
	100 Hz	0.40 dB	Band B	
	100 Hz	0.60 dB	Bands C and D	

See Page 1

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ($k = 2$)	Remarks	Location
VSWR				
75 Ω coaxial system	1.0 to 1.2 *100 kHz to 500 kHz* *500 kHz to 10 MHz* *10 MHz to 40 MHz* *40 MHz to 2 GHz*	 0.060 to 0.17 0.060 to 0.10 0.070 to 0.12 0.070 to 0.11	For devices fitted with 75 Ω Type N connectors.	
	1.2 to 2.0 *100 kHz to 500 kHz* *500 kHz to 10 MHz* *10 MHz to 40 MHz* *40 MHz to 2 GHz*	 0.17 to 0.47 0.10 to 0.32 0.12 to 0.36 0.11 to 0.33	For devices fitted with 75 Ω Type N connectors.	
VOLTAGE REFLECTION COEFFICIENT				
50 Ω coaxial system	*100 kHz to 300 kHz:* 0 to 0.1 0.1 to1.0	 0.030 to 0.040 0.040 to 0.11	The uncertainties are for a one-port or two-port device with greater than 25 dB transmission loss and 50 Ω Type-N, APC7 (to 18 GHz) or APC3.5 connectors. The uncertainties may be increased for other connector types or for devices with transmission loss less than 25 dB. The results may also be expressed in terms of VSWR or Return Loss (dB), with uncertainties stated in the corresponding units.	**See Page 1**
	300 kHz to 6 GHz: 0 to 0.2 0.2 to 0.4 0.4 to 0.6 0.6 to 0.8 0.8 to 1.0	 0.0050 to 0.010 0.0070 to 0.015 0.011 to 0.023 0.018 to 0.033 0.027 to 0.047		
	50 MHz to 26.5 GHz: 0 to 1.0	See table on following page		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location

Frequency	Calibration and Measurement Capability in Voltage Reflection Coefficient Magnitude for the ranges shown									
GHz	0 to 0.1	0.1 to 0.2	0.2 to 0.3	0.3 to 0.4	0.4 to 0.5	0.5 to 0.6	0.6 to 0.7	0.7 to 0.8	0.8 to 0.9	0.9 to 1.0
0.05	0.0070	0.0070	0.0070	0.0070	0.0080	0.0090	0.010	0.012	0.016	0.021
0.1	0.0070	0.0070	0.0070	0.0070	0.0080	0.0090	0.010	0.012	0.016	0.021
0.3	0.0070	0.0070	0.0070	0.0070	0.0080	0.0090	0.010	0.012	0.016	0.021
1	0.0070	0.0070	0.0070	0.0080	0.0080	0.0090	0.010	0.012	0.016	0.022
1.5	0.0080	0.0080	0.0080	0.0080	0.0080	0.0090	0.010	0.013	0.016	0.022
2	0.0080	0.0080	0.0080	0.0080	0.0090	0.0090	0.011	0.013	0.017	0.023
3	0.0080	0.0080	0.0080	0.0090	0.0090	0.010	0.011	0.014	0.018	0.023
4	0.0090	0.0090	0.0090	0.0090	0.0090	0.010	0.012	0.014	0.018	0.024
5	0.0090	0.0090	0.0090	0.0090	0.010	0.011	0.012	0.015	0.019	0.025
6	0.010	0.010	0.010	0.010	0.010	0.011	0.013	0.015	0.019	0.026
7	0.010	0.010	0.010	0.010	0.011	0.012	0.013	0.016	0.020	0.026
8	0.010	0.010	0.010	0.011	0.011	0.012	0.014	0.016	0.021	0.027
9	0.011	0.011	0.011	0.011	0.011	0.012	0.014	0.017	0.021	0.028
10	0.011	0.011	0.011	0.011	0.012	0.013	0.015	0.017	0.022	0.028
11	0.012	0.012	0.012	0.012	0.012	0.013	0.015	0.018	0.022	0.029
12	0.012	0.012	0.012	0.012	0.013	0.014	0.015	0.018	0.023	0.030
13	0.012	0.012	0.012	0.013	0.013	0.014	0.016	0.019	0.024	0.031
14	0.013	0.013	0.013	0.013	0.014	0.015	0.016	0.019	0.024	0.031
15	0.013	0.013	0.013	0.013	0.014	0.015	0.017	0.020	0.025	0.032
16	0.014	0.014	0.014	0.014	0.014	0.015	0.017	0.020	0.025	0.033
17	0.014	0.014	0.014	0.014	0.015	0.016	0.018	0.021	0.026	0.033
18	0.014	0.014	0.014	0.015	0.015	0.016	0.018	0.022	0.027	0.034
19	0.014	0.014	0.014	0.015	0.015	0.016	0.018	0.022	0.027	0.035
20	0.014	0.014	0.015	0.015	0.015	0.016	0.018	0.022	0.027	0.035
21	0.014	0.014	0.015	0.015	0.015	0.016	0.018	0.022	0.027	0.035
22	0.014	0.014	0.015	0.015	0.015	0.016	0.019	0.022	0.027	0.036
23	0.014	0.014	0.015	0.015	0.015	0.017	0.019	0.022	0.028	0.036
24	0.015	0.015	0.015	0.015	0.015	0.017	0.019	0.022	0.028	0.036
25	0.015	0.015	0.015	0.015	0.015	0.017	0.019	0.022	0.028	0.037
26	0.015	0.015	0.015	0.015	0.015	0.017	0.019	0.023	0.028	0.037
26.5	0.015	0.015	0.015	0.015	0.015	0.017	0.019	0.023	0.028	0.037

See Page 1

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location
Industry Primary Impedance Measurement System (*i*PIMMS) *i*PIMMS is a measurement tool supplied and maintained by the UK's National Physical Laboratory. Measurements are performed using a Microwave Network Analyser with enhancements and corrections being applied via NPL software. **NOTES** For the linear voltage reflection and transmission coefficient measurands (i.e. complex-valued *S*-parameters) described in this section of the schedule, the *Calibration and Measurement Capability* is shown as an interval of values, where a selected value within the interval represents an expanded uncertainty at a level of confidence of approximately 95%. Furthermore, a selected value within the interval will represent the uncertainty applied equally and simultaneously to *both* the Real and Imaginary parts of the *S*-parameter. The uncertainty value therefore defines a circular region of uncertainty, in the appropriate *S*-parameter plane, centred on the measured, quoted, mean value with a radius equal to the stated expanded uncertainty. For Voltage Reflection Coefficients (VRCs), the stated uncertainty is assumed here to be independent of the nominal |VRC|, so a single interval is presented applicable for all |VRC| in the range $0 \le |VRC| \le 1$. For Voltage Transmission Coefficients (VTCs), the stated uncertainty is dependent on the nominal |VTC|, so uncertainty intervals are presented for selected, representative, values of |VTC| in the range $0 \le |VTC| \le 1$. The measured values and uncertainties may also be reported as dB, VSWR, or VRC, with the angle reported in degrees or radians. Typical examples are presented in this schedule for clarification purposes.				**See Page 1**
***i*PIMMS** **LINEAR COMPLEX VOLTAGE REFLECTION COEFFICIENT (VRC) IN 50 Ω COAXIAL LINE**	45 MHz to 18 GHz: $-1 \le Re(VRC) \le +1$ $-1 \le Im(VRC) \le +1$ constrained by: $0 \le \|VRC\| \le 1$	0.0020 to 0.0070	For devices fitted with 7mm or Type-N connectors only.	
	45 MHz to 26.5 GHz: $-1 \le Re(VRC) \le +1$ $-1 \le Im(VRC) \le +1$ constrained by: $0 \le \|VRC\| \le 1$	0.0060 to 0.012	For devices fitted with 3.5mm connectors.	
***i*PIMMS** **LINEAR COMPLEX VOLTAGE TRANSMISSION COEFFICIENT (VTC) IN 50 Ω COAXIAL LINE**	45 MHz to 18 GHz: $-1 \le Re(VTC) \le +1$ $-1 \le Im(VTC) \le +1$ constrained by: $0 \le \|VTC\| \le 1$			
	|VTC| = 0 |VTC| = 0.1 |VTC| = 1	0.0000050 to 0.000050 0.00015 to 0.00050 0.0015 to 0.0050	For devices fitted with 7mm or Type-N connectors only.	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location
***i*PIMMS**				
LINEAR COMPLEX VOLTAGE TRANSMISSION COEFFICIENT (VTC) IN 50 Ω COAXIAL LINE				
Typical examples expressed in terms of attenuation and transmission phase	Attenuation from 0 dB to 40 dB	0.013 dB to 0.043 dB 0.090° to 0.28°	For devices fitted with 7mm or Type-N connectors only.	See Page 1
	Attenuation at 50 dB	0.014 dB to 0.14 dB 0.090° to 0.91°		
	Attenuation at 60 dB	0.043 dB to 0.42 dB 0.29° to 2.9°		
	Attenuation at 70 dB	0.14 dB to 1.3 dB 0.91° to 9.1°		
	Attenuation at 80 dB	0.42 dB to 3.5 dB 2.9° to 30°		
	45 MHz to 26.5 GHz: $-1 \leq Re(VTC) \leq +1$ $-1 \leq Im(VTC) \leq +1$ constrained by: $0 \leq \lvert VTC \rvert \leq 1$		For devices fitted with 3.5mm connectors.	
	$\lvert VTC \rvert = 0$ $\lvert VTC \rvert = 0.1$ $\lvert VTC \rvert = 1$	0.0000050 to 0.00010 0.00015 to 0.00050 0.0015 to 0.0050		
Typical examples expressed in terms of attenuation and transmission phase	Attenuation from 0 dB to 30 dB	0.013 dB to 0.043 dB 0.09° to 0.29°	For devices fitted with 3.5mm connectors	
	Attenuation at 40 dB	0.014 dB to 0.086 dB 0.09° to 0.57°		
	Attenuation at 50 dB	0.014 dB to 0.27 dB 0.09° to 1.8°		
	Attenuation at 60 dB	0.043 dB to 0.83 dB 0.29° to 5.7°		
	Attenuation at 70 dB	0.14 dB to 2.4 dB 0.91° to 18°		
	Attenuation at 80 dB	0.42 dB to 6.0 dB 2.9° to 90°		

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 µV:

Over the range 100 mV to 1 V, the CMC is 0.0025 %·V + 5.0 µV, 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 + ($0.12 \cdot 10^{-6} \cdot p \cdot 10^{-6}$) + 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 $1.5 \cdot 0.01 \cdot i$, where i is the instrument indication.

--- END OF SCHEDULE ---