Schedule of Accreditation

issued by

United Kingdom Accreditation Service

21 - 47 High Street, Feltham, Middlesex, TW13 4UN, UK

0147

Accredited to ISO/IEC 17025:2005

Agilent Technologies UK Limited

Issue No: 036 **Issue date:** 3 October 2008

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Calibration performed by the Organisations at the locations specified below

The locations covered by the organisation and their relevant activities are shown on Page 2 of this Schedule of Accreditation. Links to the relevant parts of the schedule for each type of calibration performed are included below.

Measured Quantity Instrument or Gauge	United Kingdom	Site Calibration	Germany
AC Current	▶	▶	
AC Resistance	▶		
AC Voltage	▶	▶	▶
Amplitude Modulation	▶	▶	
Capacitance	▶		
CISPR16 Pulse Response	▶		
Complex VRC / VTC (*iPIMMS*)	▶		
DC Current	▶	▶	▶
DC Resistance	▶	▶	▶
DC Voltage	▶	▶	▶
Directivity	▶		
Dissipation Factor	▶		
Distortion	▶		
Frequency	▶	▶	▶
Frequency Modulation	▶	▶	
Impedance (LISN calibration)	▶		
Pulse Characteristics	▶		
RF Attenuation	▶		
RF Calibration Factor	▶	▶	▶
RF Power	▶	▶	
RF Voltage	▶	▶	▶
Time Interval	▶	▶	
VRC/VSWR	▶	▶	▶

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Calibration performed by the Organisation at the locations specified

Laboratory locations:

Location details		Activity	Location code
Address Service Solutions Unit 610 Wharfedale Road Winnersh Triangle Wokingham Berkshire RG41 5TP	**Local contact** Test & Measurement Contact Centre. Tel: +44 (0) 7004 666666 Fax: +44 (0) 7004 444555 E-mail: contactcenter_UK@agilent.com	Calibration DC and LF electrical quantities RF and Microwave electrical quantities	United Kingdom
Agilent Technologies Sales & Services GmbH & Co. KG Servicezentrum Herrenberger Straße 130 71034 Böblingen Germany	**Local contact** Mr Wolfgang Trester Tel: +49 (0) 7031 464 6569 Fax: +49 (0) 7031 464 6565 E-mail: wolfgang_trester@agilent.com	Calibration DC and LF electrical quantities RF and Microwave electrical quantities	Germany

Activities performed away from the locations listed above:

Location details		Activity	Location code
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** Test & Measurement Contact Centre. Tel: +44 (0) 7004 666666 Fax: +44 (0) 7004 444555 E-mail: contactcenter_UK@agilent.com	Calibration DC and LF electrical quantities RF and Microwave electrical quantities	Site calibration

DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code
DC RESISTANCE				United Kingdom
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	220 ppm 25 ppm 14 ppm 6.1 ppm 2.4 ppm 2.4 ppm 1.6 ppm 1.6 ppm 0.4 ppm 2.4 ppm 5.7 ppm 6.8 ppm 48 ppm 270 ppm	Measurement of resistors with negligible power dissipation. The best measurement capabilities 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.	
	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	610 ppm 580 ppm 60 ppm 9.2 ppm 6.7 ppm 6.7 ppm 2.2 ppm 2.2 ppm 2.2 ppm 11 ppm + 74 mΩ 15 ppm + 2.4 Ω 53 ppm + 110 Ω 500 ppm + 3.9 kΩ 0.5% + 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	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code
DC VOLTAGE				United Kingdom
Specific Values	1 V to 1.1 V 10 V	1.2 µV 0.8 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 0.8 ppm 0.8 ppm 0.8 ppm 1.0 ppm		
Other Values	0 V *	0.1 µV	Generation	
	0 to 10 V * * With respect to a reference established using a low thermal emf short circuit	0.16 µV	Measurement	
	Up to 0.21 V 0.21 V to 2.1 V 2.1 V to 100 V 100 V to 1 kV	1.8 ppm + 0.3 µV 1.4 ppm + 0.3 µV 3.7 ppm 5.0 ppm		
DC CURRENT	0 A	1 pA	Appropriate to 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 ppm to 4 ppm 7 ppm to 4 ppm 7 ppm to 4 ppm 7 ppm to 4 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	

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Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code
AC VOLTAGE		*10 Hz to 100 kHz* / *100 kHz to 1 MHz*		United Kingdom
	1 mV	0.21% / 0.31%	Ratio step-down method	
	10 mV	0.02% / 0.10%		
	100 mV	0.01% / 0.07%		

Voltage	Best Measurement Capability in ppm for specific values of AC voltages at the frequencies shown								
	10 Hz	*40 Hz*	*1 kHz*	*10 kHz*	*30 kHz*	*50 kHz*	*100 kHz*	*500 kHz*	*1 MHz*
100 mV		50	50	56	50	50	50	200	1000
300 mV		30	30		35	35	35	160	400
1 V	40	30	30	37	30	40	40	150	440
2 V		31	31	37		49	96	440	
3 V	55	40	40		40	40	40	160	390
10 V	50	30	30	120	30	35	35	160	390
20 V								120	360
30 V	45	30	30		30	35	35		
100 V	50	40	35	130	35	35	40		

	10 Hz	*45 Hz*	*1 kHz*	*10 kHz*	*20 kHz*	*33 kHz*	*50 kHz*	*100 kHz*
300 V		50	50	50	50	60	60	80
500 V								200
700 V							150	
1000 V		45	45	45	45	65		

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code
AC VOLTAGE (cont'd)				United Kingdom

Voltage range	Best Measurement Capability in % 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	0.15	0.13	0.19	0.35	0.70
3.3 mv to 10 mV	0.048	0.030	0.069	0.20	0.47
10 mV to 33 mV	0.038	0.023	0.050	0.15	0.36
33 mV to 100 mV	0.029	0.014	0.027	0.080	0.21
	Best Measurement Capability in ppm for other values of AC voltages over the frequency ranges shown				
	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	50	50	90	370	960
0.3 V to 1.1 V	50	50	90	360	960
1 V to 3.3 V	60	50	90	360	940
3 V to 11 V	60	45	90	360	940
10 V to 33 V *20 V max.* *≥ 500 kHz*	60	50	90	350	860
30 V to 110 V *100 kHz max.* *≥ 100 V*	60	50	90		
	10 Hz to 40 Hz	*40 Hz to 20 kHz*	*20 kHz to 100 kHz*		
100 V to 330 V	65	65	140		
300 V to 1.1 kV *700 V max.* *≥ 50 kHz*	65	80	220		

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	0.027%	
Other Values	10 µA to 110 µA		
	20 Hz to 1 kHz	0.4% to 0.1%	
	100 µA to 110 mA		
	20 Hz to 100 Hz	0.4% to 0.1%	
	100 Hz to 5 kHz	0.23% to 0.05%	

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code
AC CURRENT (cont'd)				
Other values				
	100 mA to 1.05 A			
	20 Hz to 100 Hz	0.40% to 0.10%		
	100 Hz to 5 kHz	0.30% to 0.12%		
	1.05 A to 11 A			
	40 Hz to 1 kHz	0.23% to 0.12%		
	1 kHz to 5 kHz	0.32% to 0.17%		
	5 kHz to 10 kHz	0.89% to 0.34%		
AC RESISTANCE				
Specific Values	1 Ω		Appropriate to the calibration of meters and standards with 4-terminal pair BNC connectors. Other configurations can be calibrated but the uncertainties may be increased.	United Kingdom
	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	Best Measurement Capability Expressed as an Expanded Uncertainty (k=2)	Remarks	Location Code
AC RESISTANCE (cont'd)				United Kingdom
Other Values	1 Ω to 100 MΩ *20 Hz to 1 MHz*	0.11%	The uncertainty varies in a complex manner. This is the lowest possible uncertainty within the stated range. The maximum frequency for resistance measurement above 100 kΩ is limited to f_{max} (kHz) = $10^5/R$ (kΩ).	
IMPEDANCE				
For calibration of Line Impedance Stabilisation Networks.	1 Ω to 200 Ω *20 Hz to 30 MHz*	5%		
CAPACITANCE				
Specific Values	1 pF *5 Hz to 1 kHz* *1 kHz to 1 MHz* *1 MHz to 13 MHz*	 0.04% 0.38% 1.3%	For the calibration of meters and standards with 4-terminal pair BNC connectors. Other configurations can be calibrated but the uncertainties may be increased.	
	10 pF *5 Hz to 1 kHz* *1 kHz* *1 kHz to 1 MHz* *1 MHz to 13 MHz*	 0.03% 0.026% 0.07% 0.21%		
	100 pF *5 Hz to 1 kHz* *1 kHz* *1 kHz to 1 MHz* *1 MHz to 13 MHz*	 0.23% 0.024% 0.05% 0.19%		
	1000 pF *5 Hz to 1 kHz* *1 kHz* *1 kHz to 1 MHz* *3 MHz* *5 MHz* *10 MHz* *13 MHz* *1 MHz to 13 MHz*	 0.25% 0.023% 0.04% 0.51% 0.51% 0.52% 0.53% 0.60%		
	10 nF *120 Hz* *1 kHz* *10 kHz* *100 kHz*	 0.04% 0.035% 0.06% 0.16%		

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code
CAPACITANCE (cont'd)				United Kingdom
Specific Values	100 nF			
	120 Hz	0.04%		
	1 kHz	0.03%		
	10 kHz	0.10%		
	100 kHz	0.29%		
	1 µF			
	120 Hz	0.06%		
	1 kHz	0.03%		
	10 kHz	0.08%		
Other Values *Measurement only*	1 pF to 1 mF (D < 0.1) *20 Hz to 1 MHz*	0.15%	The uncertainty varies in a complex manner. This is the lowest possible uncertainty in the stated range. The maximum frequency for capacitance measurement above 100 nF is limited according to f_{max} (kHz) = 10^{-4}/C (F).	
DISSIPATION FACTOR	D (tan δ) values between 0 and 0.01 at the following nominal values of capacitance:		For the calibration of meters and standards with 4-terminal pair BNC connectors. Other configurations can be calibrated but the uncertainties may be increased.	
	1 pF			
	5 Hz to 1 MHz	0.0004		
	1 MHz to 13 MHz	0.0012		
	10 pF			
	5 Hz to 1 MHz	0.0002		
	1 MHz to 13 MHz	0.0012		
	100 pF			
	5 Hz to 1 kHz	0.0027		
	1 kHz to 1 MHz	0.0004		
	1 MHz to 13 MHz	0.0012		
	1000 pF			
	5 Hz to 1 kHz	0.0028		
	1 kHz to 1 MHz	0.0002		
	1 MHz to 13 MHz	0.0011		
	10 nF			
	1 kHz	0.0002		
	100 nF			
	1 kHz	0.0003		
	1 µF			
	1 kHz	0.0005		

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code
FREQUENCY				United Kingdom
Specific Values	1 MHz, 5 MHz and 10 MHz	1×10^{-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 in 10^{11} + 0.02 nHz 2 in 10^{9} 1 in 10^{9} 5 in 10^{10}		
TIME INTERVAL	10 ns to 10 s	35 ps to 0.12 ns		
PULSE CHARACTERISTICS				
Amplitude	-500 mV to +500 mV	0.1% + 2 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	0.1% + 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% 1.3% to 2.9% 2.1% to 3.4% (% of reading) 1.1% to 2.8% 0.8% 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%.	
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%		

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code
DISTORTION				United Kingdom
	From 20 Hz to 20 kHz: < 0.05% 0.05% to 10%	 0.007% absolute 13.5% of reading		
	From 20 Hz to 50 kHz: < 0.1% 0.1% to 10%	 0.027% absolute 26.8% of reading		
	From 50 kHz to 100 kHz: < 0.18% 0.18% to 10%	 0.05% absolute 26.8% of reading		
RF POWER				
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°.	
Waveguide 22 sources	0.2 µW to 100 mW *26.5 GHz to 40 GHz*	 2% to 4.7%		
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 *Best Measurement Capability* is for the calibration 75 Ω RF power sources fitted with Type N coaxial connectors. The uncertainties are for the measurement of perfectly matched sources 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.

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	3.1% + 92 nW	3.1%	3.1% + 0.0004P^2	P = measured power in mW
300 kHz to 2 GHz	2.5% + 92 nW	2.5%	2.5% + 0.0004P^2	P = measured power in mW

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (k=2)	Remarks	Location Code
The following *Best 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 perfectly matched sources 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 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 2 GHz *2 GHz to 12 GHz* *12 GHz to 18 GHz*	2.0% + 92 nW 2.0% + 92 nW 3.0% + 92 nW	2.0% 2.6% 3.0%	2.0% + 0.0004P^2 2.6% + 0.0004P^2 3.0% + 0.0004P^2	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 4.2 GHz	2.2% + 92 nW	2.2%	2.0% + 0.0004P^2	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 4 GHz *4 GHz to 18 GHz*	3.3% + 9.2 pW 3.8% + 9.2 pW	3.3% 3.8%	3.3% + 0.0014$P^{1.9}$ 3.8% + 0.0014$P^{1.9}$	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 2 GHz *2 GHz to 12 GHz* *12 GHz to 18 GHz*	2.7% + 9.2 µW 3.1% + 9.2 µW 3.5% + 9.2 µW	2.7% 3.1% 3.5%	2.7% + 0.04$P^{1.4}$ 3.1% + 0.04$P^{1.4}$ 3.5% + 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 4 GHz *4 GHz to 12 GHz* *12 GHz to 18 GHz* *18 GHz to 26.5 GHz*	2.0% + 92 nW 2.7% + 92 nW 3.4% + 92 nW 3.8% + 92 nW	2.0% 2.7% 3.4% 3.8%	2.0% + 0.0004P^2 2.7% + 0.0004P^2 3.4% + 0.0004P^2 3.8% + 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 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 *4 GHz to 12 GHz* *12 GHz to 18 GHz* *18 GHz to 26.5 GHz*	3.3% + 9.2 pW 3.6% + 9.2 pW 4.1% + 9.2 pW 4.5% + 9.2 pW	3.3% 3.6% 4.1% 4.5%	3.3% + 0.0014$P^{1.9}$ 3.6% + 0.0014$P^{1.9}$ 4.1% + 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 P = measured power in µW

United Kingdom

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code
CALIBRATION FACTOR RF Power Sensors				United Kingdom

The table overleaf shows the *Best Measurement Capability* in % 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) not exceeding 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. Where this procedure is used, 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

Calibration Factor - *Best Measurement Capability* in % for the power sensor types described on Page 13

Frequency	A	B	C	D	E	F	G	H	I	J	K	L	M
100 kHz			0.62	2.1	2.5						1.9		
300 kHz			0.43	1.9	1.3						1.6		
500 kHz			0.41	1.8							1.6		
1 MHz			0.39	1.8	1.0					0.6	1.6		
3 MHz			0.39	1.8	1.0					0.6	1.5		
5 MHz			0.39	1.8							1.5		
10 MHz	0.39	1.9	0.39	1.8	1.0	2.2	0.80	2.3	1.2	0.6	1.5	1.7	2.8
30 MHz	0.39	1.8	0.39	1.8	1.0	2.1	0.48	2.1	0.6	0.6	1.5	1.6	1.7
50 MHz									0.6	0.6			
100 MHz	0.40	1.8	0.40	1.8	1.0	2.1	0.47	2.1	0.6	0.6	1.6	1.6	1.6
200 MHz	0.48		0.48										
300 MHz	0.48	1.8	0.48	1.8	1.0	2.1	0.48	2.1	0.6	0.6	1.6	1.6	1.6
500 MHz	0.48	1.8	0.48	1.8	1.0	2.1			0.6	0.6	1.6	1.6	
650 MHz	0.48		0.48										
800 MHz	0.48		0.48										
1 GHz	0.47	1.8	0.47	1.8	1.3	2.1	0.48	2.1	0.7	0.9	1.6	1.6	1.6
1.5 GHz	0.59	1.9	0.59	1.9	1.6	2.2	0.65	2.1	0.7		1.6	1.6	1.6
1.8 GHz	0.61		0.61										
2 GHz	0.59	1.9	0.59	1.9	1.6	2.2	0.65	2.1	0.9		1.7	1.7	1.6
2.5 GHz	0.61		0.61		1.7								
2.6 GHz	0.62		0.62	2.0							1.7		
3 GHz	0.64	2.0	0.64	2.0	1.9	2.2	0.65	2.2	1.0			1.7	1.8
3.5 GHz	0.71		0.71										
3.7 GHz	0.74		0.74										
4 GHz	0.48	2.0	0.48	2.0		2.3	0.66	2.3	1.1			1.7	1.8
4.2 GHz	0.69		0.69	2.0									
5 GHz	0.57	2.0				2.3	0.66	2.3	1.2			1.8	1.8
6 GHz	0.57	2.2				2.4	0.84	2.4	1.5			2.0	2.0
7 GHz	0.57	2.2				2.4	0.84	2.4	1.5			2.0	2.0
8 GHz	0.57	2.3				2.5	0.94	2.4	1.4			2.0	2.0
9 GHz	0.67	2.1				2.4	1.2	2.4	1.2			1.9	2.0
10 GHz	0.67	2.2				2.4	1.2	2.4	1.3			1.9	2.0
11 GHz	0.68	2.2				2.4	1.2	2.5	1.3			1.9	2.1
12 GHz	0.66	2.1				2.4	1.2	2.4	1.2			1.9	2.0
13 GHz	0.66	2.2				2.5	1.2	2.5	1.4			2.0	2.2
14 GHz	0.66	2.2				2.5	1.2	2.5	1.4			2.0	2.2
15 GHz	0.76	2.2				2.5	1.2	2.5	1.5			2.0	2.3
16 GHz	0.80	2.2				2.5	1.3	2.5	1.5			2.0	2.3
17 GHz	0.93	2.3				2.5	1.3	2.6	1.6			2.1	2.3
18 GHz	1.04	2.3				2.5	1.3	2.9	1.8			2.1	2.6
18.5 GHz							1.8	2.9					2.6
19 GHz							1.6	2.9					2.6
19.5 GHz							1.7	2.9					2.6
20 GHz							1.7	2.9					2.6
20.5 GHz							1.8	2.9					2.5
21 GHz							1.8	2.9					2.5
21.5 GHz							1.9	2.9					2.5
22 GHz							1.9	2.9					2.5
22.5 GHz							2.0	2.9					2.5
23 GHz							1.8	2.9					2.5
23.5 GHz							1.8	2.9					2.5
24 GHz							1.7	2.9					2.6
24.5 GHz							1.7	2.9					2.6
25 GHz							1.6	2.9					2.6
25.5 GHz							1.7	2.9					2.6
26 GHz							1.6	2.9					2.7
26.5 GHz							1.6	3.0					2.7

United Kingdom

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code
RF VOLTAGE Specific Values				United kingdom

The table below shows the *Best Measurement Capability* in % for the calibration of thermal voltage converters fitted with BNC male connectors. The capability is for 50 Ω, 75 Ω and 600 Ω converters, subject to the following frequency constraints:

0.5 V, 75 Ω converters can be calibrated up to a maximum frequency of 30 MHz.
3 V, 600 Ω converters can be calibrated up to a maximum frequency of 10 MHz.

Intermediate frequencies may be calibrated but the uncertainty will be at least equal to the larger uncertainty of the two adjacent frequency points

Frequency	Nominal voltage of thermal converter				
	0.5 V	1 V	3 V	5 V	10 V
	50 Ω or 75 Ω	*50 Ω or 75 Ω*	*50 Ω or 600 Ω*	*600 Ω*	
100 Hz	0.11	0.11	0.11		
10 kHz	0.11	0.11	0.11		
100 kHz	0.11	0.11	0.11		0.12
500 kHz	0.12	0.11	0.11		0.12
700 kHz					0.12
1 MHz	0.12	0.12	0.12	0.07	0.12
3 MHz				0.08	0.12
5 MHz	0.22	0.22	0.22	0.17	0.22
7 MHz	0.22	0.22	0.22	0.17	0.22
10 MHz	0.23	0.22	0.22	0.17	0.22
20 MHz	0.24	0.23	0.23		
30 MHz	0.25	0.24	0.24		
40 MHz	0.36	0.35	0.35		
50 MHz	0.38	0.36	0.36		
60 MHz	0.40	0.37	0.37		
70 MHz	0.60	0.57	0.57		
80 MHz	0.62	0.58	0.58		
90 MHz	0.64	0.59	0.59		
100 MHz	0.66	0.60	0.60		

Other Values		Generation	Measurement	Remarks
	0.25 V to 5 V *(10MHz max. for 3V to 5V)*			For calibration of RF voltmeters and measurement of RF sources, using thermal voltage converters.
	20 Hz to 1 MHz	0.15%	0.32%	
	1 MHz to 10 MHz	0.31%	0.39%	
	10 MHz to 30 MHz	0.31%	0.59%	
	30 MHz to 60 MHz	0.50%	0.70%	
	60 MHz to 80 MHz	0.82%	0.89%	
	80 MHz to 100 MHz	0.82%	1.3%	
	5 V to 10 V			
	20 Hz to 3 MHz	0.16%	0.16%	
	3 MHz to 10 MHz	0.26%	0.26%	

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (k=2)	Remarks	Location Code
RF ATTENUATION				United kingdom
Specific Values For the calibration of spectrum analysers, receivers, network analysers, signal generators etc.	*60 MHz:* 10, 20, 30 dB 40, 50, 60, 70 dB 80, 90, 100, 110 dB *3 MHz:* 2, 4, 6, 8 and 10 dB 20 and 30 dB 40 dB 50 dB 60 dB 70 and 80 dB *10 MHz:* 38 dB 58 dB 98 dB *40 MHz:* 38 dB 58 dB 98 dB *80 MHz:* 30 dB 58 dB 98 dB	 0.005 dB 0.006 dB 0.006 dB 0.013 dB 0.014 dB 0.015 dB 0.016 dB 0.017 dB 0.018 dB 0.015 dB 0.016 dB 0.023 dB 0.015 dB 0.017 dB 0.023 dB 0.016 dB 0.017 dB 0.023 dB	All values are relative to a nominal level of 0 dBm. The uncertainties apply at the stated frequencies. Measurements can also be made at intermediate frequencies within the range, with increased uncertainty.	
Other Values (50 Ω coaxial system)	*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*	 0.03 dB to 0.08 dB 0.04 dB to 0.13 dB 0.08 dB to 0.32 dB 0.20 dB to 0.95 dB 0.93 dB to 1.7 dB See table on 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.	

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code
				United Kingdom

The following table gives the Best 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.

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	0.05	0.05	0.05	0.05	0.05	0.06	0.11	0.32	1.0
0.1	0.05	0.05	0.05	0.05	0.05	0.06	0.11	0.33	1.0
0.3	0.05	0.05	0.05	0.05	0.05	0.06	0.11	0.33	1.0
1	0.05	0.05	0.05	0.05	0.05	0.06	0.11	0.33	1.0
1.5	0.05	0.05	0.05	0.05	0.05	0.06	0.12	0.34	1.1
2	0.05	0.05	0.05	0.05	0.06	0.06	0.12	0.36	1.1
3	0.05	0.05	0.05	0.05	0.06	0.07	0.13	0.39	1.2
4	0.05	0.05	0.05	0.05	0.06	0.07	0.14	0.42	1.3
5	0.05	0.05	0.05	0.06	0.06	0.07	0.15	0.45	1.4
6	0.05	0.05	0.05	0.06	0.06	0.08	0.16	0.49	1.5
7	0.05	0.05	0.06	0.06	0.06	0.08	0.18	0.53	1.6
8	0.05	0.06	0.06	0.06	0.06	0.08	0.19	0.58	1.7
9	0.06	0.06	0.06	0.06	0.07	0.09	0.21	0.63	1.9
10	0.06	0.06	0.06	0.06	0.07	0.09	0.23	0.69	2.1
11	0.06	0.06	0.06	0.06	0.07	0.10	0.25	0.75	2.2
12	0.06	0.06	0.06	0.07	0.07	0.10	0.27	0.81	2.4
13	0.06	0.06	0.06	0.07	0.07	0.11	0.29	0.89	2.6
14	0.06	0.06	0.07	0.07	0.08	0.12	0.32	0.97	2.9
15	0.06	0.06	0.07	0.07	0.08	0.13	0.35	1.1	3.1
16	0.06	0.07	0.07	0.07	0.08	0.14	0.38	1.2	3.3
17	0.07	0.07	0.07	0.07	0.09	0.15	0.42	1.3	3.6
18	0.07	0.07	0.07	0.08	0.09	0.16	0.45	1.4	3.9
19	0.07	0.07	0.07	0.08	0.09	0.17	0.49	1.5	4.2
20	0.07	0.07	0.07	0.08	0.10	0.19	0.54	1.6	4.6
21	0.07	0.07	0.08	0.08	0.10	0.20	0.59	1.8	4.9
22	0.07	0.07	0.08	0.08	0.10	0.22	0.64	1.9	5.3
23	0.07	0.08	0.08	0.08	0.11	0.24	0.70	2.1	5.7
24	0.07	0.08	0.08	0.09	0.11	0.26	0.76	2.2	6.1
25	0.08	0.08	0.08	0.09	0.12	0.28	0.82	2.4	6.5
26	0.08	0.08	0.08	0.09	0.13	0.30	0.90	2.6	7.0
26.5	0.08	0.08	0.08	0.09	0.13	0.32	0.94	2.7	7.2

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code
DIRECTIVITY of VRC bridges				United Kingdom
The capability described below is for the measurement of directivity on 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 0.006		
Type N connectors	16 dB to 50 dB *0.1 MHz to 2 GHz* *2 GHz to 18 GHz*	 0.017 to 0.006 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 0.006 0.018 to 0.008 0.019 to 0.008		
7 mm connectors	16 dB to 50 dB *10 MHz to 18 GHz*	 0.017 to 0.004		
2.4 mm connectors	16 dB to 50 dB *10 MHz to 4 GHz* *4 GHz to 20 GHz* *20 GHz to 36 GHz* *36 GHz to 40 GHz* *40 GHz to 50 GHz*	 0.019 to 0.009 0.019 to 0.010 0.021 to 0.013 0.023 to 0.016 0.026 to 0.020		

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (k=2)	Remarks	Location Code
CISPR16 Pulse Response	Nominal level / *PRF*			
	64 dBµV / *100 Hz*	0.55 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.	
	63 dBµV / *60 Hz*	0.55 dB		
	56 dBµV / *10 Hz*	0.55 dB		
	52.5 dBµV / *5 Hz*	0.55 dB		
	47 dBµV / *2 Hz*	0.55 dB		
	43 dBµV / *1 Hz*	0.55 dB		
	53.5 dBµV / *20 Hz*	0.55 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.	
	50 dBµV / *10 Hz*	0.55 dB		
	39.5 dBµV / *2 Hz*	0.55 dB		
	37.5 dBµV / *1 Hz*	0.55 dB		
	51 dBµV / *20 Hz*	0.55 dB	For "Band C" (30 MHz to 1 GHz) with120 kHz IF bandwidth. With respect to a reference established at nominal 60 dBµV at 100 Hz pulse repetition frequency.	United Kingdom
	46 dBµV / *10 Hz*	0.55 dB		
	34 dBµV / *2 Hz*	0.55 dB		
	31.5 dBµV / *1 Hz*	0.70 dB		
VOLTAGE REFLECTION COEFFICIENT				
50 Ω coaxial system	*100 kHz to 300 kHz:*		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 appropriate units.	
	0 to 0.1	0.03 to 0.04		
	0.1 to1.0	0.04 to 0.11		
	300 kHz to 6 GHz:			
	0 to 0.2	0.005 to 0.01		
	0.2 to 0.4	0.007 to 0.015		
	0.4 to 0.6	0.011 to 0.023		
	0.6 to 0.8	0.018 to 0.033		
	0.8 to 1.0	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	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code

Frequency GHz	Uncertainty in Voltage Reflection Coefficient Magnitude for the ranges shown									
	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	0.007	0.007	0.007	0.007	0.008	0.009	0.010	0.012	0.016	0.021
0.1	0.007	0.007	0.007	0.007	0.008	0.009	0.010	0.012	0.016	0.021
0.3	0.007	0.007	0.007	0.007	0.008	0.009	0.010	0.012	0.016	0.021
1	0.007	0.007	0.007	0.008	0.008	0.009	0.010	0.012	0.016	0.022
1.5	0.008	0.008	0.008	0.008	0.008	0.009	0.010	0.013	0.016	0.022
2	0.008	0.008	0.008	0.008	0.009	0.009	0.011	0.013	0.017	0.023
3	0.008	0.008	0.008	0.009	0.009	0.010	0.011	0.014	0.018	0.023
4	0.009	0.009	0.009	0.009	0.009	0.010	0.012	0.014	0.018	0.024
5	0.009	0.009	0.009	0.009	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

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* 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*	 0.06 to 0.17 0.06 to 0.10 0.07 to 0.12 0.07 to 0.11 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. For devices fitted with 75 Ω Type N connectors.	United Kingdom

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (k=2)	Remarks	Location Code
Internet Primary Impedance Measurement System (*i*PIMMS) *i*PIMMS is an Internet-enabled measurement service supplied and maintained by the UK's National Physical Laboratory. Measurements are performed using a Microwave Network Analyser connected via the Internet to the NPL *i*PIMMS server. **NOTES** For the linear voltage reflection and transmission coefficient measurands (i.e. complex-valued *S*-parameters) described in this section of the schedule, the Best 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.				**United Kingdom**
***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: $0 \le \|VRC\| \le 1$	0.002 to 0.007	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: $0 \le \|VRC\| \le 1$	0.006 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	0.000005 to 0.00005 0.00015 to 0.0005 0.0015 to 0.005	For devices fitted with 7mm or Type-N connectors only.	

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code
***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 0.09° to 0.28°	For devices fitted with 7mm or Type-N connectors only.	**United Kingdom**
	Attenuation at 50 dB	0.014 dB to 0.14 dB 0.09° 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.	
	$\lvert VTC \rvert = 0$ $\lvert VTC \rvert = 0.1$ $\lvert VTC \rvert = 1$	0.000005 to 0.00010 0.00015 to 0.0005 0.0015 to 0.005		
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°		

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code
DC RESISTANCE				**Site calibration**
Measurement	1 Ω to 110 Ω 110 Ω to 110 kΩ 110 kΩ to 1.1 MΩ 1.1 MΩ to 11 MΩ 11 MΩ to 110 MΩ	90 ppm to 30 ppm 30 ppm 60 ppm to 30 ppm 810 ppm to 185 ppm 0.15% to 0.09%		
Generation	0 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ	1 mΩ 30 ppm 15 ppm 15 ppm 15 ppm 15 ppm 35 ppm 55 ppm 130 ppm		
DC VOLTAGE				
Measurement	0 to 1000 V	15 ppm + 2 µV		
Generation	0 to 1000 V	10 ppm + 2 µV		
DC CURRENT				
Measurement	10 µA to 110 µA 110 µA to 11 mA 11 mA to 110 mA 110 mA to 1.05 A	230 ppm to 80 ppm 170 ppm to 70 ppm 230 ppm to 130 ppm 380 ppm to 210 ppm		
Generation	0.1 µA to 200 µA 0.2 mA to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 2 A	90 ppm + 2 nA 40 ppm +10 nA 40 ppm + 100 nA 40 ppm + 1 µA 90 ppm + 2 µA		
AC VOLTAGE Measurement	1 mV to 11 mV *20 Hz to 40 Hz* *40 Hz to 50 kHz* *50 kHz to 100 kHz* 11 mV to 11 V *20 Hz to 50 kHz* *50 kHz to 100 kHz* 11 V to 110 V *20 Hz to 50 kHz* *50 kHz to 100 kHz* 110 V to 700 V *20 Hz to 20 kHz* *20 kHz to 50 kHz* *50 kHz to 100 kHz*	 0.7% 0.3% 0.7% 0.05% to 0.02% 0.1% 0.06% to 0.03% 0.14% 0.08% to 0.05% 0.14% 0.32%		

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (k=2)	Remarks	Location Code
AC VOLTAGE (cont'd)				**Site calibration**
Generation	0.1 mV to 2 mV			
	20 Hz to 100 kHz	0.25% + 5 µV		
	2 mV to 200 mV			
	20 Hz to 100 kHz	0.1% + 5 µV		
	200 mV to 20 V			
	20 Hz to 100 kHz	0.07% to 0.02%		
	100 kHz to 300 kHz	0.05% to 0.3%		
	300 kHz to 1 MHz	0.5% to 3.5%		
	20 V to 200 V			
	20 Hz to 30 kHz	0.05% to 0.02%		
	30 kHz to 100 kHz	0.08% to 0.025%		
	200 V to 1000 V			
	45 Hz to 30 kHz	0.06% to 0.04%		
	200 V to 750 V			
	30 kHz to 100 kHz	0.25% to 0.15%		
AC CURRENT				
Measurement	10 µA to 110 mA			
	45 Hz to 5 kHz	0.26% to 0.5%		
	110 mA to 1.05 A			
	45 Hz to 5 kHz	0.12%		
Generation	10 µA to 1A			
	20 Hz to 5 kHz	0.15% to 0.03%		
FREQUENCY				
Measurement	0.01 Hz to 100 MHz	2 in 10^{10} to 4 in 10^{9}		
	100 MHz to 26.5 GHz	1 in 10^{10} + 1 Hz		
Generation	0.01 Hz to 26.5 GHz	1 in 10^{10}		
TIME INTERVAL	10 ns to 10 s	35 ps to 0.12 ns		
RF VOLTAGE	0.25 V to 1 V			
	100 kHz to 15 MHz	0.13%		
	15 MHz to 35 MHz	0.3%		
	35 MHz to 55 MHz	0.5%		
	55 MHz to 100 MHz	1.1%		
	1.5 V to 3 V			
	100 kHz to 15 MHz	0.13%		
	15 MHz to 35 MHz	0.3%		
	35 MHz to 55 MHz	0.5%		
	55 MHz to 100 MHz	2.1%		

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (k=2)	Remarks	Location Code
AMPLITUDE MODULATION	Modulation Depths between 10% and 90%		For the calibration of sources and modulation meters.	Site calibration
	Carrier: *0.15 MHz to 10 MHz* Modulation:		The uncertainty is with respect to the modulation depth for signals of total harmonic distortion less than –40 dBc.	
	20 Hz to 400 Hz	1.5% to 3.0% of reading		
	400 Hz to 10 kHz	1.3% to 2.9% of reading		
	10 kHz to 100 kHz	2.1% to 3.4% of reading	The uncertainty may be increased for higher levels of distortion at modulation depths less than 30%.	
	Carrier: *10 MHz to 26.5 GHz* Modulation:			
	20 Hz to 400 Hz	1.1% to 2.8% of reading		
	400 Hz to 10 kHz	0.8% to 2.7% of reading		
	10 kHz to 100 kHz	1.8% to 3.1% of reading		
FREQUENCY MODULATION	Frequency Deviations between 1 kHz and 320 kHz		For the calibration of sources and modulation meters.	
	Carrier: *10 MHz to 26.5 GHz* Modulation:			
	20 Hz to 100 kHz	2.0%		
DISTORTION	*20 Hz to 20 kHz:*		For the calibration of modulation oscillators fitted to RF and microwave sources.	
	<0.05%	0.007% absolute		
	0.05% to 10%	13.5% of reading		
	20 kHz to 50 kHz:			
	<0.1%	0.027% absolute		
	0.1% to 10%	26.8% of reading		
	50 Hz to 100 kHz:			
	<0.18%	0.05% absolute		
	0.18% to 10%	26.8% of reading		
RF POWER				
Measurement				
Reference Sources	1 mW *50 MHz*	0.7%	For sources with female Type N connectors.	
50 Ω system	10 nW to 1 W *100 kHz to 26.5 GHz*	2% to 7%	Type N or APC -3.5 connectors.	
75 Ω system	0.2 µW to 100 mW *100 kHz to 2.0 GHz*	2% to 5%	Precision Type N connectors.	
Receiver and signal source calibration	*2 MHz to 26.5 GHz:*			
	0 dBm to -50 dBm	0.15 dB		
	-50 dBm to -90 dBm	0.25 dB		
	-90 dBm to -127 dBm	0.35 dB		

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (k=2)	Remarks	Location Code
CALIBRATION FACTOR				**Site calibration**
50 Ω system	100 kHz	1.5%	The uncertainties are for Power Sensors and Thermistor Mounts fitted with either precision male Type N or APC 3.5 mm connectors. Other connector types will be assigned larger uncertainties. The calibration method is based upon one set of measurements being performed with the uncertainty evaluation using a generic value for Type A uncertainties.	
	300 kHz	0.9%		
	500 kHz	0.8%		
	1 MHz to 300 MHz	0.6%		
	400 MHz to 1.0 GHz	0.7%		
	1.5 GHz	0.8%		
	2 GHz	0.9%		
	3 GHz	1.0%		
	4 GHz and 5 GHz	1.1%		
	6 GHz	1.2%		
	7 GHz and 8 GHz	1.5%		
	9 GHz	1.6%		
	10 GHz to 12 GHz	1.7%		
	13 GHz	1.8%		
	14 GHz	1.9%		
	15 GHz	2.0%		
	16 GHz and 17 GHz	2.1%		
	18 GHz	2.3%		
	18.5 GHz to 24.5 GHz	2.7%		
	25 GHz	2.8%		
	25.5 GHz	3.1%		
	26 GHz and 26.5 GHz	3.2%		
75 Ω system	100 kHz	2.9%	The uncertainties are for Power Sensors fitted with either precision male Type N connectors. The calibration method is based upon one set of measurements being performed with the uncertainty evaluation using a generic value for Type A uncertainties.	
	300 kHz	1.6%		
	1 MHz to 100 MHz	1.4%		
	125 MHz to 150 MHz	1.5%		
	300 MHz	1.6%		
	500 MHz	1.7%		
	1.0 GHz	2.2%		
	1.5 GHz	2.6%		
	2.0 GHz	3.0%		
VOLTAGE REFLECTION COEFFICIENT				
50 Ω system	*100 kHz to 26.5 GHz:*			
	0.0 to 0.1	0.01 to 0.04	For devices fitted with male APC 3.5 or precision Type N male connectors	
	0.1 to 0.2	0.02 to 0.05		
	0.2 to 0.3	0.03 to 0.06		
	0.3 to 1.0	0.03 to 0.12		
VSWR				
75 Ω system	*100 kHz to 2.0 GHz:*			
	1.0 to 1.2	0.06 to 0.17	For devices fitted with precision Type N male connectors.	
	1.2 to 1.5	0.12 to 0.27		
	1.5 to 2.0	0.19 to 0.48		

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code
DC VOLTAGE				Germany
Specific value	10 V	0.46 ppm	For calibration of 10 V DC references	
Other values	1 µV to 1 V 1 V to 10 V 10 V to 100 V 100 V to 1000 V	0.7 ppm + 0.26 µV 1.5 ppm 3.5 ppm 3.5 ppm		
DC CURRENT				
Specific values	1 µA 10 µA and 100 µA 1 mA and 10 mA 100 mA and 1 A 10 A 100 A	19 ppm 14 ppm 9.5 ppm 9.5 ppm 15 ppm 51 ppm		
Other values	0.1 µA to 1 µA 1 µA to 100 µA 100 µA to 1 A 1 A to 10 A 10 A to 100 A	45 ppm 43 ppm 12 ppm 43 ppm 65 ppm		
DC RESISTANCE	1 mΩ to 100 mΩ 100 mΩ to 100 Ω 100 Ω to 100 kΩ 100 kΩ to 1 MΩ 1 MΩ to 10 MΩ At 10 MΩ 10 MΩ to 100 MΩ At 100 MΩ 100 MΩ to 1 GΩ 1 GΩ to 10 GΩ	12 ppm 3.0 ppm 3.3 ppm 3.9 ppm 13 ppm 4.8 ppm 18 ppm 13 ppm 130 ppm 480 ppm		

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code
AC VOLTAGE	1 mV to 10 mV			Germany
	1 Hz to 1 kHz	280 ppm		
	10 mV to 7 V			
	1 Hz to 100 Hz	35 ppm	Using fast DC sampling technique	
	100 Hz to 500 Hz	51 ppm		
	500 Hz to 1 kHz	81 ppm		
	7 V to 700 V			
	1 Hz to 100 Hz	45 ppm		
	0.5 V to 3 V			
	40 Hz to 100 kHz	30 ppm		
	100 kHz to 200 kHz	43 ppm		
	200 kHz to 500 kHz	170 ppm		
	500 kHz to 1 MHz	330 ppm		
	5 V to 10 V			
	40 Hz to 50 kHz	30 ppm		
	50 kHz to 200 kHz	43 ppm		
	200 kHz to 500 kHz	170 ppm		
	500 kHz to 1 MHz	330 ppm		
	15 V to 30 V			
	40 Hz to 50 kHz	31 ppm	Using thermal transfer technique	
	50 kHz to 200 kHz	44 ppm		
	200 kHz to 500 kHz	170 ppm		
	500 kHz to 1 MHz	330 ppm		
	50 V to 100 V			
	40 Hz to 20 kHz	28 ppm		
	20 kHz to 100 kHz	32 ppm		
	150 V to 300 V			
	40 Hz to 20 kHz	29 ppm		
	20 kHz to 50 kHz	35 ppm		
	50 kHz to 100 kHz	55 ppm		
	500 V to 1000 V			
	40 Hz to 30 kHz	35 ppm		
RF VOLTAGE (Thermal voltage converter calibration)	0.15 V to 3 V			
	1 MHz to 3 MHz	0.059%	Calibration of TVCs with BNC connectors < 100 MHz or GR874 connectors < 50 MHz The uncertainty may be increased with other connector types.	
	3 MHz to 30 MHz	0.10%		
	30 MHz to 60 MHz	0.24%		
	60 MHz to 100 MHz	0.43%		

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (*k*=2)	Remarks	Location Code
RF POWER				Germany
Calibration factor				
50 Ω Power Sensors with Type N connectors	- 25 dBm to + 10 dBm	3.0 %		
	100 kHz to 300 kHz	3.0 %	|Γ| < 0.15	
	300 kHz to 10 MHz	2.1 %	|Γ| < 0.10	
	10 MHz to 1 GHz	1.6 %	|Γ| < 0.04	
1 GHz steps:	*1 GHz to 5 GHz*	2.0 %	|Γ| < 0.05	
1 GHz steps:	*5 GHz to 9 GHz*	2.6 %	|Γ| < 0.06	
1 GHz steps:	*9 GHz to 13 GHz*	3.0 %	|Γ| < 0.07	
1 GHz steps:	*13 GHz to 16 GHz*	3.7 %	|Γ| < 0.09	
1 GHz steps:	*16 GHz to 18 GHz*	4.7 %	|Γ| < 0.09	
50 Ω Power Sensors with APC3.5 connectors	- 25 dBm to + 10 dBm			
	50 MHz to 1 GHz	1.5 %	|Γ| < 0.04	
1 GHz steps:	*1 GHz to 5 GHz*	2.0 %	|Γ| < 0.05	
1 GHz steps:	*5 GHz to 9 GHz*	2.6 %	|Γ| < 0.06	
1 GHz steps:	*9 GHz to 13 GHz*	3.1 %	|Γ| < 0.07	
1 GHz steps:	*13 GHz to 18 GHz*	3.7 %	|Γ| < 0.09	
1 GHz steps:	*18 GHz to 26.5 GHz*	4.6 %	|Γ| < 0.10	
VOLTAGE REFLECTION COEFFICIENT |Γ|				
For devices fitted with 50 Ω Type N connectors	*100 kHz to 1 MHz:*			
	0.01 to 0.048	0.050		
	0.048 to 0.13	0.060		
	0.13 to 0.2	0.070		
	0.2 to 0.25	0.075		
	1 MHz to 10 MHz:			
	0.01 to 0.048	0.020		
	0.048 to 0.13	0.030		
	0.13 to 0.2	0.040		
	0.2 to 0.25	0.045		
	10 MHz to 8.4 GHz:			
	0.01 to 0.048	0.030		
	0.048 to 0.13	0.035		
	0.13 to 0.2	0.040		
	0.2 to 0.25	0.045		

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (k=2)	Remarks	Location Code
VOLTAGE REFLECTION COEFFICIENT |Γ| (continued)				Germany
For devices fitted with 50 Ω Type N connectors	*8.4 GHz to 12.4 GHz:*			
	0.01 to 0.048	0.030		
	0.048 to 0.13	0.035		
	0.13 to 0.2	0.045		
	0.2 to 0.25	0.050		
	12 GHz to 18 GHz:			
	0.01 to 0.048	0.035		
	0.048 to 0.13	0.045		
	0.13 to 0.2	0.055		
	0.2 to 0.25	0.060		
For devices fitted with 50 Ω APC3.5 connectors	*10 MHz to 8.4 GHz:*			
	0.01 to 0.048	0.020		
	0.048 to 0.13	0.025		
	0.13 to 0.2	0.030		
	0.2 to 0.25	0.040		
	8.4 GHz to 20 GHz:			
	0.01 to 0.048	0.025		
	0.048 to 0.13	0.030		
	0.13 to 0.2	0.040		
	0.2 to 0.25	0.050		
	20 GHz to 26.5 GHz:			
	0.01 to 0.048	0.030		
	0.048 to 0.13	0.040		
	0.13 to 0.2	0.055		
	0.2 to 0.25	0.070		
FREQUENCY				
Specific values	100 kHz, 1 MHz and 10 MHz	2.3 in 10^{11}	The *Best Measurement Capability* is for a measurement period not less than 8 hours.	
Other values	0.1 mHz to 5 GHz	$2 \cdot \sqrt{\left(1.2 \cdot 10^{-11}\right)^2 + u_T^2}$	u_T is the trigger uncertainty and will depend on the slew rate and noise levels associated with the signal being measured. It may be particularly significant at low frequencies.	