

Electricity and Magnetism, Singapore, SPRING Singapore (Standards, Productivity and Innovation Board)

Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty							
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
DC voltage sources: single values	Standard cell, solid state voltage standard	Comparison with standard	1	1.018	V	Voltage	1 V, 1.018 V	0.02	μV	2	95%	No		Approved on 18 October 2004	1
DC voltage sources: single values	Standard cell, solid state voltage standard	Comparison with standard	10	10	V			0.07	μV	2	95%	No		Approved on 18 October 2004	2
DC voltage sources: low values (≤ 10 V)	Solid state voltage standard, DC voltage source, multifunction calibrator	Comparison with standard	0.1	10	V			0.4	μV	2	95%	No		Approved on 18 October 2004	3
DC voltage sources: intermediate values (> 10 V to 1000 V)	DC voltage source, multifunction calibrator	Comparison with standard	10	1000	V			1.5	$\mu\text{V/V}$	2	95%	Yes		Approved on 18 October 2004	4
DC voltage meters: intermediate values (> 1 mV to 1100 V)	DC voltmeter, multimeter, multifunction transfer standard	Comparison with standard	0.1	10	V			0.4	μV	2	95%	No		Approved on 18 October 2004	5
DC voltage meters: intermediate values (> 1 mV to 1100 V)	DC voltmeter, multimeter, multifunction transfer standard	Comparison with standard	10	1000	V			2	$\mu\text{V/V}$	2	95%	Yes		Approved on 18 October 2004	6
DC resistance standards and sources: low values ($\leq 1 \Omega$)	Fixed resistor, resistance box	Direct current comparator bridge	0.1	0.1	$\text{m}\Omega$	Oil bath temperature	25 °C	15	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	7
DC resistance standards and sources: low values ($\leq 1 \Omega$)	Fixed resistor, resistance box	Direct current comparator bridge	1	1	$\text{m}\Omega$	Oil bath temperature	25 °C	4	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	8

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DC resistance standards and sources: low values ($\leq 1 \Omega$)	Fixed resistor, resistance box	Direct current comparator bridge	10	10	m Ω	Oil bath temperature	25 °C	2.5	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	9
DC resistance standards and sources: low values ($\leq 1 \Omega$)	Fixed resistor, resistance box	Direct current comparator bridge	100	100	m Ω	Oil bath temperature	25 °C	1	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	10
DC resistance standards and sources: low values ($\leq 1 \Omega$)	Fixed resistor, resistance box	Direct current comparator bridge	1	1	Ω	Oil bath temperature	25 °C	0.6	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	11
DC resistance standards and sources: intermediate values ($> 1 \Omega$ to 1 M Ω)	Fixed resistor, resistance box	Direct current comparator bridge	10	10	Ω	Oil bath temperature	25 °C	1	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	12
DC resistance standards and sources: intermediate values ($> 1 \Omega$ to 1 M Ω)	Fixed resistor, resistance box	Direct current comparator bridge	100	100	Ω	Oil bath temperature	25 °C	1	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	13
DC resistance standards and sources: intermediate values ($> 1 \Omega$ to 1 M Ω)	Fixed resistor, resistance box	Direct current comparator bridge	1	1	k Ω	Oil bath temperature	25 °C	1.6	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	14
DC resistance standards and sources: intermediate values ($> 1 \Omega$ to 1 M Ω)	Fixed resistor, resistance box	Direct current comparator bridge	10	10	k Ω	Oil bath temperature	25 °C	1.3	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	15

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DC resistance standards and sources: intermediate values (> 1 Ω to 1 M Ω)	Fixed resistor, resistance box	Direct current comparator bridge	100	100	k Ω	Oil bath temperature	25 $^{\circ}$ C	2	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	16
DC resistance standards and sources: intermediate values (> 1 Ω to 1 M Ω)	Fixed resistor, resistance box	Direct current comparator bridge	1	1	M Ω			6	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	17
DC resistance standards and sources: high values (> 1 M Ω)	Fixed resistor, three terminal resistor, resistance box	Modified Wheatstone bridge	10	10	M Ω			12	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	18
DC resistance standards and sources: high values (> 1 M Ω)	Fixed resistor, three terminal resistor, resistance box	Modified Wheatstone bridge	100	100	M Ω			20	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	19
DC resistance standards and sources: high values (> 1 M Ω)	Fixed resistor, three terminal resistor, resistance box	Modified Wheatstone bridge	1	1	G Ω			50	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	20
DC resistance standards and sources: high values (> 1 M Ω)	Fixed resistor, three terminal resistor, resistance box	Modified Wheatstone bridge	10	10	G Ω			110	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	21
DC resistance standards and sources: high values (> 1 M Ω)	Fixed resistor, three terminal resistor, resistance box	Modified Wheatstone bridge	100	100	G Ω			700	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	22
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Direct current comparator bridge	0.1	0.1	m Ω			15	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	23

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Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Direct current comparator bridge	1	1	m Ω			4	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	24
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Direct current comparator bridge	10	10	m Ω			2.5	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	25
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Direct current comparator bridge	100	100	m Ω			1	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	26
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Direct current comparator bridge	1	1	Ω			0.6	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	27
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Direct current comparator bridge	10	10	Ω			1	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	28
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Direct current comparator bridge	100	100	Ω			1	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	29
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Direct current comparator bridge	1	1	k Ω			1.6	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	30
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Direct current comparator bridge	10	10	k Ω			1.3	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	31

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Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Direct current comparator bridge	100	100	k Ω			2	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	32
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Direct current comparator bridge	1	1	M Ω			6	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	33
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Modified Wheatstone bridge	10	10	M Ω			12	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	34
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Modified Wheatstone bridge	100	100	M Ω			20	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	35
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Modified Wheatstone bridge	1	1	G Ω			50	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	36
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Modified Wheatstone bridge	10	10	G Ω			110	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	37
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Modified Wheatstone bridge	100	100	G Ω			700	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	38
DC resistance meters: low values (<= 1 Ω)	Resistance meter, multimeter, multifunction transfer standard	Direct measurement	0.1	0.1	m Ω			15	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	39

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Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
DC resistance meters: low values ($\leq 1 \Omega$)	Resistance meter, multimeter, multifunction transfer standard	Direct measurement	1	1	m Ω			4	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	40
DC resistance meters: low values ($\leq 1 \Omega$)	Resistance meter, multimeter, multifunction transfer standard	Direct measurement	10	10	m Ω			2.5	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	41
DC resistance meters: low values ($\leq 1 \Omega$)	Resistance meter, multimeter, multifunction transfer standard	Direct measurement	100	100	m Ω			1	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	42
DC resistance meters: low values ($\leq 1 \Omega$)	Resistance meter, multimeter, multifunction transfer standard	Direct measurement	1	1	Ω			0.6	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	43
DC resistance meters: intermediate values ($> 1 \Omega$ to 1 G Ω)	Resistance meter, multimeter, multifunction transfer standard	Direct measurement	10	10	Ω			1	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	44
DC resistance meters: intermediate values ($> 1 \Omega$ to 1 G Ω)	Resistance meter, multimeter, multifunction transfer standard	Direct measurement	100	100	Ω			1	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	45
DC resistance meters: intermediate values ($> 1 \Omega$ to 1 G Ω)	Resistance meter, multimeter, multifunction transfer standard	Direct measurement	1	1	k Ω			1.6	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	46
DC resistance meters: intermediate values ($> 1 \Omega$ to 1 G Ω)	Resistance meter, multimeter, multifunction transfer standard	Direct measurement	10	10	k Ω			1.3	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	47

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Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
DC resistance meters: intermediate values (> 1 Ω to 1 G Ω)	Resistance meter, multimeter, multifunction transfer standard	Direct measurement	100	100	k Ω			2	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	48
DC resistance meters: intermediate values (> 1 Ω to 1 G Ω)	Resistance meter, multimeter, multifunction transfer standard	Direct measurement	1	1	M Ω			6	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	49
DC resistance meters: intermediate values (> 1 Ω to 1 G Ω)	Resistance meter, multimeter, multifunction transfer standard	Direct measurement	10	10	M Ω			12	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	50
DC resistance meters: intermediate values (> 1 Ω to 1 G Ω)	Resistance meter, multimeter, multifunction transfer standard	Direct measurement	100	100	M Ω			20	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	51
DC resistance meters: intermediate values (> 1 Ω to 1 G Ω)	Resistance meter, multimeter, multifunction transfer standard	Direct measurement	1	1	G Ω			50	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	52
DC resistance meters: high values (> 1 G Ω)	Resistance meter, multimeter, multifunction transfer standard	Direct measurement	10	10	G Ω			110	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	53
DC resistance meters: high values (> 1 G Ω)	Resistance meter, multimeter, multifunction transfer standard	Direct measurement	100	100	G Ω			700	$\mu\Omega/\Omega$	2	95%	Yes		Approved on 18 October 2004	54
DC current sources: low values (\leq 0.1 mA)	Current generator, multifunction calibrator	Comparison with voltage drop across shunt	0.1	0.1	mA			7	$\mu A/A$	2	95%	Yes		Approved on 18 October 2004	55

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DC current sources: intermediate values (> 0.1 mA to 20 A)	Current generator, multifunction calibrator	Comparison with voltage drop across shunt	0.1	20	mA	Current	0.2 mA, 1 mA, 2 mA, 10 mA, 20 mA	7	μA/A	2	95%	Yes		Approved on 18 October 2004	56
DC current sources: intermediate values (> 0.1 mA to 20 A)	Current generator, multifunction calibrator	Comparison with voltage drop across shunt	0.1	10	A	Current	0.1 A, 0.2 A, 1 A, 2 A, 5 A, 10 A	10	μA/A	2	95%	Yes		Approved on 18 October 2004	57
DC current meters: low values (<= 0.1 mA)	Multimeter, ammeter	Comparison with voltage drop across shunt	0.1	0.1	mA			7	μA/A	2	95%	Yes		Approved on 18 October 2004	58
DC current meters: intermediate values (> 0.1 mA to 20 A)	Multimeter, ammeter	Comparison with voltage drop across shunt	0.1	20	mA	Current	0.2 mA, 1 mA, 2 mA, 10 mA, 20 mA	7	μA/A	2	95%	Yes		Approved on 18 October 2004	59
DC current meters intermediate values (> 0.1 mA to 20 A)	Multimeter, ammeter	Comparison with voltage drop across shunt	0.1	10	A	Current	0.1 A, 0.2 A, 1 A, 2 A, 5 A, 10 A	10	μA/A	2	95%	Yes		Approved on 18 October 2004	60
Capacitance: low loss capacitor	Standard capacitor (sealed, dry-nitrogen or fused silica dielectric)	AC ratio bridge, comparison with standard	1	1	nF	Frequency	1 kHz, 1.592 kHz	8	μF/F	2	95%	Yes		Approved on 18 October 2004	61
Capacitance: low loss capacitor	Standard capacitor (sealed, dry-nitrogen or fused silica dielectric)	AC ratio bridge, comparison with standard	100	100	pF	Frequency	1 kHz, 1.592 kHz	10	μF/F	2	95%	Yes		Approved on 18 October 2004	62
Capacitance: low loss capacitor	Standard capacitor (sealed, dry-nitrogen or fused silica dielectric)	AC ratio bridge, comparison with standard	10	10	pF	Frequency	1 kHz, 1.592 kHz	12	μF/F	2	95%	Yes		Approved on 18 October 2004	63

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Capacitance: dielectric capacitor	Fixed capacitor, variable capacitor, capacitance box	AC ratio bridge, comparison with standard	1	1	nF	Frequency	1 kHz, 1.592 kHz	8	μF/F	2	95%	Yes		Approved on 18 October 2004	64
Capacitance: dielectric capacitor	Fixed capacitor, variable capacitor, capacitance box	AC ratio bridge, comparison with standard	100	100	pF	Frequency	1 kHz, 1.592 kHz	10	μF/F	2	95%	Yes		Approved on 18 October 2004	65
Capacitance: dielectric capacitor	Fixed capacitor, variable capacitor, capacitance box	AC ratio bridge, comparison with standard	10	10	pF	Frequency	1 kHz, 1.592 kHz	12	μF/F	2	95%	Yes		Approved on 18 October 2004	66
Capacitance: meters	Capacitance bridge, LCR meter, capacitance meter	AC ratio bridge, comparison with standard	1	1	nF	Frequency	1 kHz, 1.592 kHz	8	μF/F	2	95%	Yes		Approved on 18 October 2004	67
Capacitance: meters	Capacitance bridge, LCR meter, capacitance meter	AC ratio bridge, comparison with standard	100	100	pF	Frequency	1 kHz, 1.592 kHz	10	μF/F	2	95%	Yes		Approved on 18 October 2004	68
Capacitance: meters	Capacitance bridge, LCR meter, capacitance meter	AC ratio bridge, comparison with standard	10	10	pF	Frequency	1 kHz, 1.592 kHz	12	μF/F	2	95%	Yes		Approved on 18 October 2004	69
Inductance: self inductance, low values (< 1 mH)	Fixed inductor, variable inductor, inductance box	AC ratio bridge, comparison with standard	100	100	μH	Frequency	100 Hz, 1 kHz	200	μH/H	2	95%	Yes		Approved on 18 October 2004	70
Inductance: self inductance, intermediate values (>= 1 mH to 1 H)	Fixed inductor, variable inductor, inductance box	AC ratio bridge, comparison with standard	1	1	mH	Frequency	100 Hz, 1 kHz	200	μH/H	2	95%	Yes		Approved on 18 October 2004	71

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Inductance: self inductance, intermediate values (≥ 1 mH to 1 H)	Fixed inductor, variable inductor, inductance box	AC ratio bridge, comparison with standard	10	10	mH	Frequency	100 Hz, 1 kHz	200	μ H/H	2	95%	Yes		Approved on 18 October 2004	72	
Inductance: self inductance, intermediate values (≥ 1 mH to 1 H)	Fixed inductor, variable inductor, inductance box	AC ratio bridge, comparison with standard	100	100	mH	Frequency	100 Hz, 1 kHz	200	μ H/H	2	95%	Yes		Approved on 18 October 2004	73	
Inductance: self inductance, intermediate values (≥ 1 mH to 1 H)	Fixed inductor, variable inductor, inductance box	AC ratio bridge, comparison with standard	1	1	H	Frequency	100 Hz, 1 kHz	200	μ H/H	2	95%	Yes		Approved on 18 October 2004	74	
Inductance: self inductance, high values (> 1 H)	Fixed inductor, variable inductor, inductance box	AC ratio bridge, comparison with standard	10	10	H	Frequency	100 Hz, 1 kHz	200	μ H/H	2	95%	Yes		Approved on 18 October 2004	75	
Inductance: meters	LCR meter	AC ratio bridge, comparison with standard	100	100	μ H	Frequency	100 Hz, 1 kHz	200	μ H/H	2	95%	Yes		Approved on 18 October 2004	76	
Inductance: meters	LCR meter	AC ratio bridge, comparison with standard	1	1	mH	Frequency	100 Hz, 1 kHz	200	μ H/H	2	95%	Yes		Approved on 18 October 2004	77	
Inductance: meters	LCR meter	AC ratio bridge, comparison with standard	10	10	mH	Frequency	100 Hz, 1 kHz	200	μ H/H	2	95%	Yes		Approved on 18 October 2004	78	
Inductance: meters	LCR meter	AC ratio bridge, comparison with standard	100	100	mH	Frequency	100 Hz, 1 kHz	200	μ H/H	2	95%	Yes		Approved on 18 October 2004	79	

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Inductance: meters	LCR meter	AC ratio bridge, comparison with standard	1	1	H	Frequency	100 Hz, 1 kHz	200	μH/H	2	95%	Yes		Approved on 18 October 2004	80	
Inductance: meters	LCR meter	AC ratio bridge, comparison with standard	10	10	H	Frequency	100 Hz, 1 kHz	200	μH/H	2	95%	Yes		Approved on 18 October 2004	81	
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converter with amplifier, micropotentiometer, AC/DC transfer standard	AC/DC difference	10	200	mV	Frequency	10 Hz to 1 MHz	25 to 450	μV/V	2	95%	Yes	Matrix 1	Approved on 18 October 2004	82	
AC/DC voltage transfer: AC/DC transfer difference at medium voltages (0.5 V to 5 V)	Thermal converter (directly connected), AC/DC transfer standard	AC/DC difference	0.6	2	V	Frequency	10 Hz to 1 MHz	10 to 110	μV/V	2	95%	Yes	Matrix 1	Approved on 18 October 2004	83	
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converter with range extender, AC/DC transfer standard	AC/DC difference	6	1000	V	Frequency	10 Hz to 1 MHz	8 to 77	μV/V	2	95%	Yes	Matrix 1	Approved on 18 October 2004	84	
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC difference	0.01	1000	V	Frequency	10 Hz to 1 MHz	8 to 450	μV/V	2	95%	Yes	Matrix 2	Approved on 18 October 2004	85	
AC voltage up to 1000 V: meters	AC voltmeter, multimeter, multifunction transfer standard	AC/DC difference	0.01	1000	V	Frequency	10 Hz to 1 MHz	8 to 450	μV/V	2	95%	Yes	Matrix 3	Approved on 18 October 2004	86	
AC current up to 100 A: source	Multifunction calibrator, transconductance amplifier	AC/DC difference	0.0001	10	A	Frequency	10 Hz to 10 kHz	77 to 304	μA/A	2	95%	Yes	Matrix 4	Approved on 18 October 2004	87	

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AC current up to 100 A: meter	Multimeter, ammeter, multifunction transfer standard	AC/DC difference	0.0001	10	A	Frequency	10 Hz to 10 kHz	77 to 304	μA/A	2	95%	Yes	Matrix 5	Approved on 18 October 2004	88	
AC power and energy: single phase power ($f \leq 400$ Hz)	Power converter, power meter, wattmeter, energy meter	Comparison with standard	0.01	1200	W	Frequency	40 Hz to 400 Hz	50	μW/W	2	95%	Yes		Approved on 18 October 2004	89	
						Voltage	120 V, 240 V									
						Current	0.5 A to 5 A									
						Power factor	0 to 1									
DC high voltage: sources	DC kilovolt source	Comparison with reference divider	1	5	kV			76	μV/V	2	95%	Yes		Approved on 18 October 2004	90	
DC high voltage: sources	DC kilovolt source	Comparison with reference divider	5	100	kV			40	μV/V	2	95%	Yes		Approved on 18 October 2004	91	
DC high voltage: meters	DC kilovoltmeter, dedicated set-up for high voltage	Comparison with reference divider	1	5	kV			76	μV/V	2	95%	Yes		Approved on 18 October 2004	92	
DC high voltage: meters	DC kilovoltmeter, dedicated set-up for high voltage	Comparison with reference divider	5	100	kV			40	μV/V	2	95%	Yes		Approved on 18 October 2004	93	
AC high voltage: sources	High voltage AC source	Comparison with reference ratio transformer	1	100	kV	Frequency	50 Hz	800	μV/V	2	95%	Yes		Approved on 18 October 2004	94	

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AC high voltage: meters	AC high voltage meter, dedicated set-up for high voltage measurements (resistive and capacitive dividers)	Comparison with reference ratio transformer	1	100	kV	Frequency	50 Hz	800	$\mu V/V$	2	95%	Yes		Approved on 18 October 2004	95
RF power: absolute power on coaxial	Power meter and source, type N	Power meter with sensors	0.001	100	mW	Frequency	100 kHz to 4.2 GHz	2.4	%	2	95%	Yes		Approved on 18 October 2004	96
RF power: absolute power on coaxial	Power meter and source, type N and 7 mm	Power meter with sensors	0.001	100	mW	Frequency	10 MHz to 18 GHz	3.5	%	2	95%	Yes		Approved on 18 October 2004	97
RF power: absolute power on coaxial	Power meter and source, type N	Power meter with sensors	0.0001	10	μW	Frequency	10 MHz to 18 GHz	4	%	2	95%	Yes		Approved on 18 October 2004	98
RF power: absolute power on coaxial	Power meter and source, 3.5 mm	Power meter with sensors	0.001	100	mW	Frequency	50 MHz to 26.5 GHz	5	%	2	95%	Yes		Approved on 18 October 2004	99
RF power: calibration factor on coaxial	Thermistor mounts, type N	DC substitution (power splitter system)	0.9	1		Power level	1 mW	1.9	%	2	95%	Yes		Approved on 18 October 2004	100
						Frequency	100 kHz to 300 kHz								
RF power: calibration factor on coaxial	Thermistor mounts, type N	DC substitution (power splitter system)	0.9	1		Power level	1 mW	1.1	%	2	95%	Yes		Approved on 18 October 2004	101

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty							Comments	NMI Service Identifier
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix			
						Frequency	500 kHz to 100 MHz									
RF power: calibration factor on coaxial	Power sensors, type N	DC substitution (power splitter system)	0.9	1		Power level	1 mW to 10 mW	4	%	2	95%	Yes		Approved on 18 October 2004	102	
						Frequency	100 kHz to 100 MHz									
RF power: calibration factor on coaxial	Thermistor mounts, type N	DC substitution	0.9	1		Power level	10 mW	0.5	%	2	95%	Yes		Approved on 18 October 2004	103	
						Frequency	50 MHz to 18 GHz									
RF power: calibration factor on coaxial	Power sensors, type N	DC substitution (power splitter system)	0.9	1		Power level	1 mW to 10 mW	1	%	2	95%	Yes		Approved on 18 October 2004	104	
						Frequency	50 MHz to 18 GHz									
RF power: calibration factor on coaxial	Thermistor mounts and power sensors, 7 mm	DC substitution	0.9	1		Power level	1 mW to 10 mW	2.9	%	2	95%	Yes		Approved on 18 October 2004	105	
						Frequency	10 MHz to 18 GHz									
RF power: calibration factor on coaxial	Thermistor mounts, 3.5 mm	DC substitution	0.9	1		Power level	1 mW	2	%	2	95%	Yes		Approved on 18 October 2004	106	
						Frequency	50 MHz to 26.5 GHz									

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty							
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
RF power: calibration factor on coaxial	Power sensors, 3.5 mm	DC substitution (power splitter system)	0.9	1		Power level	1 mW	4	%	2	95%	Yes		Approved on 18 October 2004	107
						Frequency	50 MHz to 26.5 GHz								
RF power: calibration factor on waveguide	Thermistor mounts, waveguide	DC substitution	0.9	1		Power level	1 mW	3	%	2	95%	Yes		Approved on 18 October 2004	108
						Frequency	8.2 GHz to 12.4 GHz								
RF power: calibration factor on waveguide	Thermistor mounts, waveguide	DC substitution	0.9	1		Power level	1 mW	5	%	2	95%	Yes		Approved on 18 October 2004	109
						Frequency	12.4 GHz to 18 GHz								
Scattering parameters: reflection coefficient on coaxial: magnitude	Passive device: type N	Network analyzer	0	1		Frequency	5 Hz to 500 MHz	0.03		2	95%	No		Approved on 18 October 2004	110
						Angle	-180 ° to 180 °								
Scattering parameters: reflection coefficient on coaxial: magnitude	Passive device: type N, 7mm	Network analyzer	0	1		Frequency	0.045 GHz to 18 GHz	0.015		2	95%	No		Approved on 18 October 2004	111
						Angle	-180 ° to 180 °								

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty							
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
Scattering parameters: reflection coefficient on coaxial: magnitude	Passive device: 3.5 mm	Network analyzer	0	1		Frequency	0.045 GHz to 26.5 GHz	0.015		2	95%	No		Approved on 18 October 2004	112
						Angle	-180 ° to 180 °								
Scattering parameters: transmission coefficient on coaxial: magnitude	Passive device: type N	Network analyzer	0.003	1		Frequency	5 Hz to 500 MHz	0.023		2	95%	Yes		Approved on 18 October 2004	113
						Angle	-180 ° to 180 °								
Scattering parameters: transmission coefficient on coaxial: magnitude	Passive device: type N, 7mm	Network analyzer	0.003	1		Frequency	0.045 GHz to 18 GHz	0.023		2	95%	Yes		Approved on 18 October 2004	114
						Angle	-180 ° to 180 °								
Scattering parameters: transmission coefficient on coaxial: magnitude	Passive device: 3.5 mm	Network analyzer	0.003	1		Frequency	0.045 GHz to 26.5 GHz	0.072		2	95%	Yes		Approved on 18 October 2004	115
						Angle	-180 ° to 180 °								
Signal and pulse characteristics: distortion and harmonic content	Function generator, AC calibrator	Direct measurement	0.005	30	%THD	Frequency	10 Hz to 100 kHz	20	%	2	95%	Yes		Approved on 18 October 2004	116
RF voltage: RF/DC difference	Thermal voltage converter	Comparison	4	4	V	Frequency	200 kHz to 10 MHz	30	μV/V	2	95%	Yes		Approved on 18 October 2004	117

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty							
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty matrix	Comments	NMI Service Identifier
RF voltage: RF/DC difference	Thermal voltage converter	Comparison	4	4	V	Frequency	20 MHz to 100 MHz	2000	$\mu\text{V/V}$	2	95%	Yes		Approved on 18 October 2004	118
RF voltage: RF/DC difference	Thermal voltage converter	Comparison	0.5	10	V	Frequency	300 kHz to 10 MHz	300	$\mu\text{V/V}$	2	95%	Yes		Approved on 18 October 2004	119
RF voltage: RF/DC difference	Thermal voltage converter	Comparison	0.5	10	V	Frequency	20 MHz to 100 MHz	4000	$\mu\text{V/V}$	2	95%	Yes		Approved on 18 October 2004	120

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AC/DC voltage transfer uncertainty matrix: Matrix 1

Internal NMI service identifier: 82, 83 and 84

	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
10 mV	60	44	41	40	44	141	190	450
20 mV	60	44	41	40	44	141	190	450
60 mV	30	28	25	29	40	140	180	450
100 mV	30	28	25	29	40	140	180	450
200 mV	30	28	25	29	40	140	180	450
0.6 V	16	10	10	12	15	35	54	110
1 V	16	10	10	12	15	35	54	110
2 V	16	10	10	12	15	35	54	110
6 V	15	10	8	8	8	15	18	43
10 V	15	10	8	8	8	15	18	43
19 V / 20 V	15	10	8	8	8	15	18	43
60 V	13	8	10	14	25	29	-	-
100 V	13	8	10	14	25	29	-	-
200 V	13	8	10	14	25	29	-	-
300 V	-	-	13	44	77	-	-	-
600 V	-	-	13	44	77	-	-	-
700 V	-	-	13	44	77	-	-	-
1000 V	-	-	13	44	77	-	-	-

The expanded uncertainties given in this table are expressed in $\mu\text{V/V}$.

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AC voltage (sources) uncertainty matrix: Matrix 2

Internal NMI service identifier: 85

	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
10 mV	60	44	41	40	44	141	190	450
20 mV	60	44	41	40	44	141	190	450
60 mV	30	28	25	29	40	140	180	450
100 mV	30	28	25	29	40	140	180	450
200 mV	30	28	25	29	40	140	180	450
0.6 V	16	10	10	12	15	35	54	110
1 V	16	10	10	12	15	35	54	110
2 V	16	10	10	12	15	35	54	110
6 V	15	10	8	8	8	15	18	43
10 V	15	10	8	8	8	15	18	43
19 V / 20 V	15	10	8	8	8	15	18	43
60 V	13	8	10	14	25	29	-	-
100 V	13	8	10	14	25	29	-	-
200 V	13	8	10	14	25	29	-	-
300 V	-	-	13	44	77	-	-	-
600 V	-	-	13	44	77	-	-	-
700 V	-	-	13	44	77	-	-	-
1000 V	-	-	13	44	77	-	-	-

The expanded uncertainties given in this table are expressed in $\mu\text{V/V}$.

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AC voltage (meters) uncertainty matrix: Matrix 3

Internal NMI service identifier: 86

	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
10 mV	60	44	41	40	44	141	190	450
20 mV	60	44	41	40	44	141	190	450
60 mV	30	28	25	29	40	140	180	450
100 mV	30	28	25	29	40	140	180	450
200 mV	30	28	25	29	40	140	180	450
0.6 V	16	10	10	12	15	35	54	110
1 V	16	10	10	12	15	35	54	110
2 V	16	10	10	12	15	35	54	110
6 V	15	10	8	8	8	15	18	43
10 V	15	10	8	8	8	15	18	43
19 V / 20 V	15	10	8	8	8	15	18	43
60 V	13	8	10	14	25	29	-	-
100 V	13	8	10	14	25	29	-	-
200 V	13	8	10	14	25	29	-	-
300 V	-	-	13	44	77	-	-	-
600 V	-	-	13	44	77	-	-	-
700 V	-	-	13	44	77	-	-	-
1000 V	-	-	13	44	77	-	-	-

The expanded uncertainties given in this table are expressed in $\mu\text{V/V}$.

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AC current (sources) uncertainty matrix: Matrix 4

Internal NMI service identifier: 87

	10 Hz	20 Hz	40 Hz	1 kHz	5 kHz	10 kHz
0.1 mA	304	107	77	77	97	294
0.2 mA	304	107	77	77	97	294
1 mA	304	107	77	77	97	294
2 mA	304	107	77	77	97	294
10 mA	229	-	229	229	229	229
20 mA	229	-	229	229	229	229
100 mA	229	-	229	229	229	229
200 mA	229	-	229	229	229	229
1 A	-	-	228	228	228	228
2 A	-	-	228	228	228	228
10 A	-	-	250	250	250	250

The expanded uncertainties given in this table are expressed in $\mu\text{A}/\text{A}$.

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AC current (meters) uncertainty matrix: Matrix 5

Internal NMI service identifier: 88

	10 Hz	20 Hz	40 Hz	1 kHz	5 kHz	10 kHz
0.1 mA	304	107	77	77	97	294
0.2 mA	304	107	77	77	97	294
1 mA	304	107	77	77	97	294
2 mA	304	107	77	77	97	294
10 mA	229	-	229	229	229	229
20 mA	229	-	229	229	229	229
100 mA	229	-	229	229	229	229
200 mA	229	-	229	229	229	229
1 A	-	-	228	228	228	228
2 A	-	-	228	228	228	228
10 A	-	-	250	250	250	250

The expanded uncertainties given in this table are expressed in $\mu\text{A}/\text{A}$.