

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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	Solid state voltage standard	Opposition	1.018	1.018	V	Air temperature	20 °C	50	nV	2	95%	No		Approved on 05 March 2010	2
DC voltage sources: single values	Solid state voltage standard	Opposition	10	10	V	Air temperature	20 °C	500	nV	2	95%	No			3
DC voltage sources: single values	Solid state voltage standard	Opposition	1.00E-09	1	V	Temperature	(20, 23) °C	$7E-08U + 10$ nV	nV	2	95%	No		Approved on 17 August 2011	4
DC voltage sources: low values	DC voltage sources, multifunction calibrators: voltage U	Comparison to a reference with a resistive divider	1	2	V	Temperature	(20, 23) °C	$(4E-07U + 65E-09)$, U in V	V	2	95%	No		Approved on 17 August 2011	7
DC voltage sources: low values	DC voltage sources, multifunction calibrators: voltage U	Comparison to a reference with a resistive divider	2	10	V	Temperature	(20, 23) °C	$(6.5E-07U + 65E-08)$, U in V	V	2	95%	No			8
DC voltage sources: intermediate values	DC voltage sources, multifunction calibrators: voltage U	Comparison to a reference with a resistive divider	10	20	V	Temperature	(20, 23) °C	$(6.5E-07U + 65E-08)$, U in V	V	2	95%	No			9
DC voltage sources: intermediate values	DC voltage sources, multifunction calibrators	Comparison to a reference with a resistive divider	20	1100	V	Temperature	(20, 23) °C	1.2	$\mu V/V$	2	95%	Yes			10
DC voltage meters: very low values	Nanovoltmeter, microvoltmeter	Opposition	1.00E-09	1	V	Temperature	(20, 23) °C	$7E-08U + 10$ nV	nV	2	95%	No		Approved on 17 August 2011	4
DC voltage meters: intermediate values	DC voltmeter, multimeter: voltage U	Comparison to a reference with a resistive divider	1	2	V	Temperature	(20, 23) °C	$(4E-07U + 65E-09)$, U in V	V	2	95%	No		Approved on 17 August 2011	10f
DC voltage meters: intermediate values	DC voltmeter, multimeter: voltage U	Comparison to a reference with a resistive divider	2	20	V	Temperature	(20, 23) °C	$(6.5E-07U + 65E-08)$, U in V	V	2	95%	No			10g
DC voltage meters: intermediate values	DC voltmeter, multimeter	Comparison to a reference with a resistive divider	20	1100	V	Temperature	(20, 23) °C	1.2	$\mu V/V$	2	95%	Yes			10h
DC voltage ratios: up to 1100V	Resistive dividers	Step-up method	0.1	0.1		Temperature	(20, 23) °C	11E-09		2	95%	No			11a
						Input voltage	up to 70 V								

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DC voltage ratios: up to 1100V	Resistive dividers	Step-up method	0.2	0.2		Temperature	(20, 23) °C	16E-09		2	95%	No			11b
						Input voltage	up to 70 V								
DC voltage ratios: up to 1100V	Resistive dividers	Step-up method	0.3	0.3		Temperature	(20, 23) °C	23E-09		2	95%	No			11c
						Input voltage	up to 70 V								
DC voltage ratios: up to 1100V	Resistive dividers	Step-up method	0.4	0.4		Temperature	(20, 23) °C	29E-09		2	95%	No			11d
						Input voltage	up to 70 V								
DC voltage ratios: up to 1100V	Resistive dividers	Step-up method	0.5	0.5		Temperature	(20, 23) °C	36E-09		2	95%	No			11e
						Input voltage	up to 70 V								
DC voltage ratios: up to 1100V	Resistive dividers	Step-up method	0.6	0.6		Temperature	(20, 23) °C	42E-09		2	95%	No			11f
						Input voltage	up to 70 V								
DC voltage ratios: up to 1100V	Resistive dividers	Step-up method	0.7	0.7		Temperature	(20, 23) °C	49E-09		2	95%	No			11g
						Input voltage	up to 70 V								
DC voltage ratios: up to 1100V	Resistive dividers	Step-up method	0.8	0.8		Temperature	(20, 23) °C	56E-09		2	95%	No			11h
						Input voltage	up to 70 V								
DC voltage ratios: up to 1100V	Resistive dividers: ratio <i>N</i>	Step-up method	0.9	0.9		Temperature	(20, 23) °C	63E-09		2	95%	No			11i
						Input voltage	up to 70 V								
DC voltage ratios: up to 1100V	Resistive dividers	Step-up method	1.00E-07	1.00E-02		Temperature	(20, 23) °C	8.E-09		2	95%	No			12a
DC voltage ratios: up to 1100V	Resistive dividers: ratio <i>N</i>	Step-up method	1.00E-02	4.00E-02		Temperature	(20, 23) °C	(120E-09 <i>N</i> + 6.8E-09)		2	95%	No			12b
DC voltage ratios: up to 1100V	Resistive dividers: ratio <i>N</i>	Step-up method	4.00E-02	1.00E-01		Temperature	(20, 23) °C	250E-09 <i>N</i>		2	95%	No			12c
DC voltage ratios: up to 1100V	Resistive dividers: ratio <i>N</i>	Step-up method	1.00E-01	1		Temperature	(20, 23) °C	250E-09 <i>N</i>		2	95%	No			12d

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DC resistance standards and sources: low values	Fixed resistor	Current comparator bridge	0.001	100	$\mu\Omega$	Oil bath temperature	(20, 23) °C	1	n Ω	2	95%	No			13
DC resistance standards and sources: low values	Fixed resistor	Current comparator bridge	0.1	1	m Ω	Oil bath temperature	(20, 23) °C	2	n Ω	2	95%	No			14
DC resistance standards and sources: low values	Fixed resistor	Current comparator bridge	1	10	m Ω	Oil bath temperature	(20, 23) °C	1	$\mu\Omega/\Omega$	2	95%	Yes			15
DC resistance standards and sources: low values	Fixed resistor	Current comparator bridge	0.01	1	Ω	Oil bath temperature	(20, 23) °C	0.5	$\mu\Omega/\Omega$	2	95%	Yes			16
DC resistance standards and sources: low values	Fixed resistor	Cryogenic current comparator	1	1	Ω	Oil bath temperature	20 °C	30	n Ω	2	95%	No			18
DC resistance standards and sources: intermediate values	Fixed resistor	Cryogenic current comparator	100	100	Ω	Oil bath temperature	20 °C	1.5	$\mu\Omega$	2	95%	No			19
DC resistance standards and sources: intermediate values	Fixed resistor	Cryogenic current comparator	10000	10000	Ω	Oil bath temperature	20 °C	0.3	m Ω	2	95%	No			20
DC resistance standards and sources: intermediate values	Fixed resistor, resistance box	Current comparator bridge	1	10	Ω	Oil bath temperature	(20, 23) °C	0.3	$\mu\Omega/\Omega$	2	95%	Yes			21
						Resistance	by step of 1 Ω								
DC resistance standards and sources: intermediate values	Fixed resistor, resistance box	Current comparator bridge	10	100	Ω	Oil bath temperature	(20, 23) °C	0.4	$\mu\Omega/\Omega$	2	95%	Yes			22
						Resistance	by step of 10 Ω								
DC resistance standards and sources: intermediate values	Fixed resistor, resistance box	Current comparator bridge	0.1	1	k Ω	Oil bath temperature	(20, 23) °C	0.4	$\mu\Omega/\Omega$	2	95%	Yes			23

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						Resistance	by step of 100 Ω								
DC resistance standards and sources: intermediate values	Fixed resistor, resistance box	Current comparator bridge	1	10	k Ω	Oil bath temperature	(20, 23) $^{\circ}\text{C}$	0.4	$\mu\Omega/\Omega$	2	95%	Yes			24
						Resistance	by step of 1 k Ω								
DC resistance standards and sources: intermediate values	Fixed resistor, resistance box	Thomson bridge	10	100	k Ω	Temperature	(20, 23) $^{\circ}\text{C}$	0.3	$\mu\Omega/\Omega$	2	95%	Yes			25
						Resistance	by step of 10 k Ω								
DC resistance standards and sources: intermediate values	Fixed resistor, resistance box	Thomson bridge	0.1	1	M Ω	Temperature	(20, 23) $^{\circ}\text{C}$	0.3	$\mu\Omega/\Omega$	2	95%	Yes			26
						Resistance	by step of 100 k Ω								
DC resistance standards and sources: intermediate values	Fixed resistor	Current comparator bridge	1	1E+06	Ω	Oil bath temperature	(20, 23) $^{\circ}\text{C}$	0.5	$\mu\Omega/\Omega$	2	95%	Yes			17
DC resistance standards and sources: high values	Fixed resistor, resistance box	Thomson bridge	1	10	M Ω	Temperature	(20, 23) $^{\circ}\text{C}$	0.4	$\mu\Omega/\Omega$	2	95%	Yes			27
						Resistance	by step of 1 M Ω								
DC resistance standards and sources: high values	Fixed resistor, resistance box	Thomson bridge	10	100	M Ω	Temperature	(20, 23) $^{\circ}\text{C}$	0.8	$\mu\Omega/\Omega$	2	95%	Yes			28
						Resistance	by step of 10 M Ω								
DC resistance standards and sources: high values	Fixed resistor	Thomson bridge	1	10	M Ω	Temperature	(20, 23) $^{\circ}\text{C}$	0.8	$\mu\Omega/\Omega$	2	95%	Yes			29
DC resistance standards and sources: high values	Fixed resistor	Thomson bridge	10	100	M Ω	Temperature	(20, 23) $^{\circ}\text{C}$	3	$\mu\Omega/\Omega$	2	95%	Yes			30

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DC resistance standards and sources: high values	Fixed resistor	Guarded Wheatstone bridge	0.1	100	GΩ	Calibration voltage	10 V to 1000 V	33 to 401	μΩ/Ω	2	95%	Yes	Matrix3		32
DC resistance standards and sources: high values	Fixed resistor	Integration bridge	0.0001	1	PΩ	Calibration current	1 fA to 10 nA	3.2E-05 to 3.3E-01	Ω/Ω	2	95%	Yes	Matrix4		36
DC current sources: low values	Generator: current /	Integration bridge	0.001	100	pA	Temperature	(20, 23) °C	(4.7E-05/ + 0.0003), I in pA	pA	2	95%	No		Approved on 22 February 2008	37
DC current sources: low values	Generator: current /	Potential difference between terminals of standard resistance	0.1	100	nA	Temperature	(20, 23) °C	(1.5E-05/ + 3E-05), I in nA	nA	2	95%	No			38
DC current sources: low values	Generator	Potential difference between terminals of standard resistance	0.1	1	μA	Temperature	(20, 23) °C	17	μA/A	2	95%	Yes			39
DC current sources: low values	Generator	Current comparator	0.001	0.1	mA	Temperature	(20, 23) °C	1.5	μA/A	2	95%	Yes			40aa
DC current sources: intermediate values	Generator	Current comparator	0.1	10	mA	Temperature	(20, 23) °C	1.5	μA/A	2	95%	Yes			40ac
DC current sources: intermediate values	Generator	Current comparator	10	100	mA	Temperature	(20, 23) °C	5	μA/A	2	95%	Yes			41a
DC current sources: intermediate values	Generator	Current comparator	0.1	1	A	Temperature	(20, 23) °C	8	μA/A	2	95%	Yes			42a
DC current sources: intermediate values	Generator	Current comparator	1	20	A	Temperature	(20, 23) °C	10	μA/A	2	95%	Yes			43aa
DC current sources: high values	Generator	Current comparator	20	100	A	Temperature	(20, 23) °C	10	μA/A	2	95%	Yes			43ba

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DC current meters: low values	Ammeter	Current comparator	0.001	0.1	mA	Temperature	(20, 23) °C	1.5	μA/A	2	95%	Yes			40ab
DC current meters: intermediate values	Ammeter	Current comparator	0.1	10	mA	Temperature	(20, 23) °C	1.5	μA/A	2	95%	Yes			40ad
DC current meters: intermediate values	Ammeter	Current comparator	10	100	mA	Temperature	(20, 23) °C	5	μA/A	2	95%	Yes			41b
DC current meters: intermediate values	Ammeter	Current comparator	0.1	1	A	Temperature	(20, 23) °C	8	μA/A	2	95%	Yes			42b
DC current meters: intermediate values	Ammeter	Current comparator	1	20	A	Temperature	(20, 23) °C	10	μA/A	2	95%	Yes			43ab
DC current meters: high values	Ammeter	Current comparator	20	100	A	Temperature	(20, 23) °C	10	μA/A	2	95%	Yes			43bb
AC resistance: modulus	Fixed resistor	Calculable resistor	1000	1000	Ω	Frequency	20 Hz	1	mΩ	2	95%	No			45
AC resistance: argument	Fixed resistor	Calculable resistor	-20	20	mrاد	Frequency	20 Hz	1	mrاد	2	95%	No			46
						Resistance	1000 Ω								
AC resistance: modulus	Fixed resistor	Calculable resistor	1000	1000	Ω	Frequency	20 kHz	1.3	mΩ	2	95%	No			47
AC resistance: argument	Fixed resistor	Calculable resistor	-20	20	mrاد	Frequency	20 kHz	1.3	mrاد	2	95%	No			48
						Resistance	1000 Ω								
AC resistance: modulus	Fixed resistor	RC Bridge	0.01	5E+06	Ω	Frequency	20 Hz to 20 kHz	5E-04 to 5.5E-02	Ω/Ω	2	95%	Yes	Matrix15		47a
AC resistance: argument	Fixed resistor	RC Bridge	-20	20	mrاد	Frequency	20 Hz to 20 kHz	0.03 to 7.2	mrاد	2	95%	No	Matrix16		48a
						Resistance	10 mΩ to 5 kΩ								
AC resistance: argument	Fixed resistor	RC Bridge	-20	20	mrاد	Frequency	20 Hz to 100 Hz	45	μrad	2	95%	No			48b
						Resistance	5 kΩ to 10 kΩ								
AC resistance: argument	Fixed resistor	RC Bridge	-20	20	mrاد	Frequency	20 Hz to 100 Hz	(3.7E-03R), R in Ω	μrad	2	95%	No			48c
						Resistance R	10 kΩ to 5 MΩ								
AC resistance: argument	Fixed resistor	RC Bridge	-20	20	mrاد	Frequency	20 Hz to 100 Hz	(3.8E-02R), R in Ω	μrad	2	95%	No			48d

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						Resistance R	5 k Ω to 5 M Ω								
AC resistance: argument	Fixed resistor	RC Bridge	-20	20	mrad	Frequency	20 Hz to 100 Hz	(1.9E-01R), R in Ω	μ rad	2	95%	No			48e
						Resistance R	5 k Ω to 1 M Ω								
AC resistance: argument	Fixed resistor	RC Bridge	-20	20	mrad	Frequency	20 Hz to 100 Hz	(3.8E-01R), R in Ω	μ rad	2	95%	No			48f
						Resistance R	5 k Ω to 500 k Ω								
AC resistance: argument	Fixed resistor	RC Bridge	-20	20	mrad	Frequency	20 Hz to 100 Hz	(7.5E-01R), R in Ω	μ rad	2	95%	No			48g
						Resistance R	5 k Ω to 100 k Ω								
Capacitance: low loss capacitors	Standard capacitor	Two or four terminal-pair bridge	10	10	pF	Temperature	20 °C	0.2	μ F/F	2	95%	Yes			53
						Angular frequency	2500 rad/s, 5000 rad/s and 10000 rad/s								
Capacitance: low loss capacitors	Standard capacitor	Two or four terminal-pair bridge	100	100	pF	Temperature	20 °C	0.2	μ F/F	2	95%	Yes			54
						Angular frequency	2500 rad/s, 5000 rad/s and 10000 rad/s								
Capacitance: low loss capacitors	Standard capacitor	Two or four terminal-pair bridge	1000	1000	pF	Temperature	20 °C	0.2	μ F/F	2	95%	Yes			55
						Angular frequency	2500 rad/s, 5000 rad/s and 10000 rad/s								
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Direct comparison	10	10	pF	Frequency f	20 Hz to 935 Hz	(-1.4E-02f +19), f in Hz	μ F/F	2	95%	Yes			56
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Direct comparison	10	10	pF	Frequency f	935 Hz to 10 kHz	(1.4E-03f + 4.6), f in Hz	μ F/F	2	95%	Yes			57
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Direct comparison	100	100	pF	Frequency f	20 Hz to 1100 Hz	(-1.2E-02f + 19), f in Hz	μ F/F	2	95%	Yes			58
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Direct comparison	100	100	pF	Frequency f	1100 Hz to 10 kHz	(1.5E-03f + 4), f in Hz	μ F/F	2	95%	Yes			59

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Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Direct comparison	1	1	nF	Frequency f	20 Hz to 1070 Hz	$(-1.2E-02f + 19)$, f in Hz	$\mu\text{F}/\text{F}$	2	95%	Yes			60
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Direct comparison	1	1	nF	Frequency f	1070 Hz to 10 kHz	$(1.4E-03f + 4.6)$, f in Hz	$\mu\text{F}/\text{F}$	2	95%	Yes			61
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box. Capacitance C	Transformer bridge	0	1	nF	Frequency f	20 Hz to 100 Hz	$(2.4E-05C + 1.5E-06)$, C in nF	nF	2	95%	No			62
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box. Capacitance C	Transformer bridge	0	1	nF	Frequency f	100 Hz to 3 kHz	$(1.8E-05C + 0.1E-06)$, C in nF	nF	2	95%	No			63
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box. Capacitance C	Transformer bridge	0	1	nF	Frequency f	3 kHz to 5 kHz	$(3.3E-05C + 0.1E-06)$, C in nF	nF	2	95%	No			63a
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box. Capacitance C	Transformer bridge	0	1	nF	Frequency f	5 kHz to 7 kHz	$(6E-05C + 0.1E-06)$, C in nF	nF	2	95%	No			63b
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box. Capacitance C	Transformer bridge	0	1	nF	Frequency f	7 kHz to 10 kHz	$(1.2E-04C + 0.1E-06)$, C in nF	nF	2	95%	No			63c
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Transformer bridge	0.001	1	μF	Frequency f	20 Hz to 1 kHz	$(-1.4E-02f + 40)$, f in Hz	$\mu\text{F}/\text{F}$	2	95%	Yes			64
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Transformer bridge	0.001	1	μF	Frequency f	1 kHz to 5 kHz	$(6.7E-03f + 20)$, f in Hz	$\mu\text{F}/\text{F}$	2	95%	Yes			64a

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Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Transformer bridge	0.001	1	μF	Frequency f	5 kHz to 10 kHz	$(9.4E-03f + 6.7)$, f in Hz	μF/F	2	95%	Yes			65
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Transformer bridge	1	10	μF	Frequency f	20 Hz to 1 kHz	$(-1.1E-02f + 50)$, f in Hz	μF/F	2	95%	Yes			66
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Transformer bridge	1	10	μF	Frequency f	1 kHz to 5 kHz	$(2.8E-02f + 10)$, f in Hz	μF/F	2	95%	Yes			66a
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Transformer bridge	1	10	μF	Frequency f	5 kHz to 10 kHz	$(6.4E-02f - 170)$, f in Hz	μF/F	2	95%	Yes			67
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Transformer bridge	10	100	μF	Frequency f	20 Hz to 1 kHz	$(-1.1E-02f + 50)$, f in Hz	μF/F	2	95%	Yes			68
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Transformer bridge	10	100	μF	Frequency f	1 kHz to 5 kHz	$(4.7E-03f + 40)$, f in Hz	μF/F	2	95%	Yes			68a
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Transformer bridge	10	100	μF	Frequency f	5 kHz to 10 kHz	$(1.2E-02f + 1.5)$, f in Hz	μF/F	2	95%	Yes			69
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Transformer bridge	0.1	1	mF	Frequency f	20 Hz to 1 kHz	$(-1.10E-02f + 120)$, f in Hz	μF/F	2	95%	Yes			70
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Transformer bridge	0.1	1	mF	Frequency f	1 kHz to 5 kHz	$(9.4E-02f + 15)$, f in Hz	μF/F	2	95%	Yes			70a
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Transformer bridge	0.1	1	mF	Frequency f	5 kHz to 10 kHz	$(4.2E-02f + 68)$, f in Hz	μF/F	2	95%	Yes			71
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Resonance method	1	1	pF	Frequency	1 MHz	0.3	mF/F	2	95%	Yes			72

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Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Resonance method	10	10	pF	Frequency	1 MHz	0.3	mF/F	2	95%	Yes			73
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Resonance method	100	100	pF	Frequency	1 MHz	0.3	mF/F	2	95%	Yes			74
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Resonance method	1	1	nF	Frequency	1 MHz	0.6	mF/F	2	95%	Yes			75
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Resonance method	0.1	10	pF	Frequency	1 MHz	0.5	mF/F	2	95%	Yes			76
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Resonance method	10	100	pF	Frequency	1 MHz	0.6	mF/F	2	95%	Yes			77
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Resonance method	0.1	1	nF	Frequency	1 MHz	0.8	mF/F	2	95%	Yes			78
Capacitance: dissipation factor for dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box	Comparison	0	0.01		Capacitance	1 fF to 1 μ F	5E-05		2	95%	No			79
						Frequency	20 Hz to 1 kHz								
Capacitance: dissipation factor for dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box: $\tan\delta$	Comparison	0.01	0.1		Capacitance	1 fF to 1 μ F	$(4 \tan\delta + 1.3) \times 10^{-4}$		2	95%	No			80
						Frequency	20 Hz to 1 kHz								
Capacitance: dissipation factor for dielectric capacitors	Fixed capacitor, variable capacitor, capacitance box: $\tan\delta$	Comparison	0.1	1		Capacitance	1 fF to 1 μ F	$(4 \tan\delta + 5.2) \times 10^{-4}$		2	95%	No			81
						Frequency	20 Hz to 1 kHz								
Inductance: self inductance, low values	Fixed inductor, variable inductor, inductance box: L	Modified Maxwell bridge	0.01	1	mH	Frequency	40 Hz to 120 Hz	$(5.8E-04L + 12E-06)$, L in mH	mH	2	95%	No			83

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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
Inductance: self inductance, low values	Fixed inductor, variable inductor, inductance box: L	Modified Maxwell bridge	0.01	1	mH	Frequency	120 Hz to 10 kHz	$(5.1E-04L + 12E-06)$, L in mH	mH	2	95%	No			83a
Inductance: self inductance, intermediate values	Fixed inductor, variable inductor, inductance box	Modified Maxwell bridge	0.001	1	H	Frequency	40 Hz to 400 Hz	0.16	mH/H	2	95%	Yes			84
Inductance: self inductance, intermediate values	Fixed inductor, variable inductor, inductance box	Modified Maxwell bridge	0.001	1	H	Frequency	400 Hz to 1 kHz	0.25	mH/H	2	95%	Yes			84a
Inductance: self inductance, intermediate values	Fixed inductor, variable inductor, inductance box	Modified Maxwell bridge	0.001	1	H	Frequency	1 kHz to 2 kHz	0.36	mH/H	2	95%	Yes			84b
Inductance: self inductance, intermediate values	Fixed inductor, variable inductor, inductance box	Modified Maxwell bridge	0.001	0.5	H	Frequency	2 kHz to 5 kHz	0.56	mH/H	2	95%	Yes			84d
Inductance: self inductance, intermediate values	Fixed inductor, variable inductor, inductance box	Modified Maxwell bridge	0.5	1	H	Frequency	2 kHz to 5 kHz	1	mH/H	2	95%	Yes			84e
Inductance: self inductance, intermediate values	Fixed inductor, variable inductor, inductance box	Modified Maxwell bridge	0.001	0.1	H	Frequency	5 kHz to 10 kHz	0.66	mH/H	2	95%	Yes			85
Inductance: self inductance, high values	Fixed inductor, variable inductor, inductance box	Modified Maxwell bridge	1	10	H	Frequency	40 Hz to 400 Hz	0.16	mH/H	2	95%	Yes			84g
Inductance: self inductance, high values	Fixed inductor, variable inductor, inductance box	Modified Maxwell bridge	1	5	H	Frequency	400 Hz to 1 kHz	0.25	mH/H	2	95%	Yes			84f
Inductance: self inductance, high values	Fixed inductor, variable inductor, inductance box	Modified Maxwell bridge	5	10	H	Frequency	400 Hz to 1 kHz	0.42	mH/H	2	95%	Yes			84ab
Inductance: self inductance, high values	Fixed inductor, variable inductor, inductance box	Modified Maxwell bridge	1	2	H	Frequency	1 kHz to 2 kHz	0.36	mH/H	2	95%	Yes			84bc
Inductance: self inductance, high values	Fixed inductor, variable inductor, inductance box	Modified Maxwell bridge	2	5	H	Frequency	1 kHz to 2 kHz	0.78	mH/H	2	95%	Yes			84c

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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
AC voltage: AC/DC transfer difference at low voltages	AC-DC transfer standard	Step down procedure	0.01	0.5	V	Frequency	10 Hz, 20 Hz, 40 Hz, 400 Hz and 1 kHz, 4 kHz, 5 kHz, 10 kHz, 20 kHz, 50 kHz, 100 kHz	10 to 90	μV/V	2	95%	Yes	Matrix30	Approved on 05 March 2010	101
AC voltage: AC/DC transfer difference at low voltages	Thermal converter	Comparison	0.2	0.2	V	Frequency	10 Hz	15E-05	V/V	2	95%	Yes			101a
AC voltage: AC/DC transfer difference at low voltages	Thermal converter	Comparison	0.2	0.2	V	Frequency	20 Hz, 40 Hz, 500 Hz and 1 kHz, 10 kHz, 20 kHz, 50kHz, 100 kHz	5E-05	V/V	2	95%	Yes			101c
AC voltage: AC/DC transfer difference at low voltages	Thermal converter	Direct comparison	0.5	0.5	V	Frequency	10 Hz, 20 Hz, 40 Hz, 500 Hz and 1 kHz, 10 kHz, 20 kHz, 50 kHz, 100 kHz	2E-05	V/V	2	95%	Yes			101b
AC voltage: AC/DC transfer difference at medium voltages	Thermal converter	Step-up procedure	0.5	5	V	Frequency	10 Hz, 20 Hz, 40 Hz, 400 Hz, and 1 kHz, 4 kHz, 5 kHz, 10 kHz, 20 kHz, 50 kHz, 100 kHz	5 to 10	μV/V	2	95%	Yes	Matrix1	Approved on 05 March 2010	100.1
AC voltage: AC/DC transfer difference at higher voltages	Thermal converter	Step-up procedure	5	1000	V	Frequency	10 Hz, 20 Hz, 40 Hz, 400 Hz, and 1 kHz, 4 kHz, 5 kHz, 10 kHz, 20 kHz, 50 kHz, 100 kHz	10 to 70	μV/V	2	95%	Yes	Matrix1	Approved on 05 March 2010	100.2
AC voltage up to 1000 V: sources	Multifunction calibrator: voltage U	Sampling + algorithm	1	100	mV	Frequency	< 5 Hz	$(1E-05U + 2E-03)$, U in mV	mV	2	95%	No			106a
AC voltage up to 1000 V: sources	Multifunction calibrator: voltage U	Sampling + algorithm	0.1	10	V	Frequency	< 5 Hz	16	μV/V	2	95%	Yes		Approved on 22 February 2008	107a
AC voltage up to 1000 V: sources	Multifunction calibrator: voltage U	Sampling + algorithm	1	100	mV	Frequency	5 Hz to 10 Hz	$(4E-05U + 2E-03)$, U in mV	mV	2	95%	No			108a

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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
AC voltage up to 1000 V: sources	Multifunction calibrator: voltage U	Sampling + algorithm	0.1	10	V	Frequency	5 Hz to 10 Hz	40	$\mu\text{V/V}$	2	95%	Yes		Approved on 22 February 2008	109a
AC voltage up to 1000 V: sources	Multifunction calibrator	Direct comparison	0.2	1000	V	Fixed voltages	0.2 V to 1000 V	20 to 160	$\mu\text{V/V}$	2	95%	Yes	Matrix27		115c
						Fixed frequencies	10 Hz to 100 kHz								
AC voltage up to 1000 V: sources	Multifunction calibrator: voltage U	Comparison to a thermal transfer with an inductive divider	0.01	200	mV	Frequency range	10 Hz to 1 kHz	$(3.4\text{E-}05U + 3.5\text{E-}03)$, U in mV	mV	2	95%	No			116a
AC voltage up to 1000 V: sources	Multifunction calibrator: voltage U	Comparison to a thermal transfer with an inductive divider	0.01	200	mV	Frequency range	1 kHz to 10 kHz	$(3.4\text{E-}05U + 7\text{E-}03)$, U in mV	mV	2	95%	No			117a
AC voltage up to 1000 V: sources	Multifunction calibrator: voltage U	Comparison to a thermal transfer with an inductive divider	1	200	mV	Frequency range	10 kHz to 100 kHz	$(1\text{E-}04U + 12\text{E-}03)$, U in mV	mV	2	95%	No			118a
AC voltage up to 1000 V: sources	Multifunction calibrator	Direct comparison	0.2	1000	V	Voltage range	0.2 V to 1000 V	35 to 260	$\mu\text{V/V}$	2	95%	Yes	Matrix28		123c
						Frequency range	10 Hz to 100 kHz								
AC voltage up to 1000 V: meters	AC voltmeter, multimeter, multifunction transfer standards: voltage U	Sampling + algorithm	1	100	mV	Frequency	< 5 Hz	$(1\text{E-}05U + 2\text{E-}03)$, U in mV	mV	2	95%	No			106b
AC voltage up to 1000 V: meters	AC voltmeter, multimeter, multifunction transfer standards	Sampling + algorithm	0.1	10	V	Frequency	< 5 Hz	16	$\mu\text{V/V}$	2	95%	Yes		Approved on 22 February 2008	107b
AC voltage up to 1000 V: meters	AC voltmeter, multimeter, multifunction transfer standards: voltage U	Sampling + algorithm	1	100	mV	Frequency	5 Hz to 10 Hz	$(4\text{E-}05U + 2\text{E-}03)$, U in mV	mV	2	95%	No			108b
AC voltage up to 1000 V: meters	AC voltmeter, multimeter, multifunction transfer standards	Sampling + algorithm	0.1	10	V	Frequency	5 Hz to 10 Hz	40	$\mu\text{V/V}$	2	95%	Yes		Approved on 22 February 2008	109b

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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
AC voltage up to 1000 V: meters	AC voltmeter, multimeter, multifunction transfer standards	Direct comparison	0.2	1000	V	Fixed voltages	0.2 V to 1000 V	20 to 160	$\mu\text{V/V}$	2	95%	Yes	Matrix27		115d
						Fixed frequencies	10 Hz to 100 kHz								
AC voltage up to 1000 V: meters	AC voltmeter, multimeter, multifunction transfer standards: voltage U	Comparison to a thermal transfer with an inductive divider	0.01	200	mV	Frequency range	10 Hz to 1 kHz	$(3.4\text{E-}05U + 3.5\text{E-}03)$, U in mV	mV	2	95%	No			116b
AC voltage up to 1000 V: meters	AC voltmeter, multimeter, multifunction transfer standards: voltage U	Comparison to a thermal transfer with an inductive divider	0.01	200	mV	Frequency range	1kHz to 10 kHz	$(3.4\text{E-}05U + 7\text{E-}03)$, U in mV	mV	2	95%	No			117b
AC voltage up to 1000 V: meters	AC voltmeter, multimeter, multifunction transfer standards: voltage U	Comparison to a thermal transfer with an inductive divider	1	200	mV	Frequency range	10 kHz to 100 kHz	$(1\text{E-}04U + 12\text{E-}03)$, U in mV	mV	2	95%	No			118b
AC voltage up to 1000 V: meters	AC voltmeter, multimeter, multifunction transfer standards	Direct comparison	0.2	1000	V	Voltage range	0.2 V to 1000 V	35 to 260	$\mu\text{V/V}$	2	95%	Yes	Matrix28		123d
						Frequency range	10 Hz to 100 kHz								
AC voltage ratio: real and imaginary components	Inductive voltage dividers, voltage transformers, AC bridge standards	Step-up method	1E-03	0.9		Frequency	40 Hz to 10 kHz	2.2E-08 to 2.4E-07		2	95%	No	Matrix5		129
						Input voltage	< 1000 V								
AC voltage ratio: attenuation	Asymmetric artificial lines (75 Ω)	Comparison to a reference divider	0	10	dB	Frequency	1 kHz	5E-06 to 1E-05	dB	2	95%	No			130a
AC voltage ratio: attenuation	Asymmetric artificial lines (75 Ω)	Comparison to a reference divider	10	20	dB	Frequency	1 kHz	1E-05 to 2.7E-05	dB	2	95%	No			131a
AC voltage ratio: attenuation	Asymmetric artificial lines (75 Ω)	Comparison to a reference divider	20	30	dB	Frequency	1 kHz	2.7E-05 to 7.9E-05	dB	2	95%	No			132a

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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
AC voltage ratio: attenuation	Asymmetric artificial lines (75 Ω)	Comparison to a reference divider	30	40	dB	Frequency	1 kHz	7.9E-05 to 1.3E-04	dB	2	95%	No			133a
AC voltage ratio: attenuation	Asymmetric artificial lines (75 Ω)	Comparison to a reference divider	40	50	dB	Frequency	1 kHz	1.3E-04 to 7.6E-04	dB	2	95%	No			134a
AC voltage ratio: attenuation	Asymmetric artificial lines (75 Ω)	Comparison to a reference divider	50	60	dB	Frequency	1 kHz	7.6E-04 to 2.4E-03	dB	2	95%	No			135a
AC voltage ratio: attenuation	Asymmetric artificial lines (75 Ω)	Comparison to a reference divider	60	70	dB	Frequency	1 kHz	2.4E-03 to 7.6E-03	dB	2	95%	No			136a
AC voltage ratio: attenuation	Asymmetric artificial lines (75 Ω)	Comparison to a reference divider	70	80	dB	Frequency	1 kHz	7.6E-03 to 2.4E-02	dB	2	95%	No			137a
AC voltage ratio: attenuation	Asymmetric artificial lines (75 Ω)	Comparison to a reference divider	80	90	dB	Frequency	1 kHz	2.4E-02 to 7.6E-02	dB	2	95%	No			138a
AC voltage ratio: attenuation	Asymmetric artificial lines (75 Ω)	Comparison to a reference divider	90	100	dB	Frequency	1 kHz	7.6E-02 to 2.4E-01	dB	2	95%	No			139a
AC voltage ratio: attenuation	Symmetric artificial lines (600 Ω)	Comparison to a reference divider	0	10	dB	Frequency	1 kHz	1E-05 to 2E-05	dB	2	95%	No			143a
AC voltage ratio: attenuation	Symmetric artificial lines (600 Ω)	Comparison to a reference divider	10	20	dB	Frequency	1 kHz	2E-05 to 5.4E-05	dB	2	95%	No			144a
AC voltage ratio: attenuation	Symmetric artificial lines (600 Ω)	Comparison to a reference divider	20	30	dB	Frequency	1 kHz	5.4E-05 to 1.6E-04	dB	2	95%	No			145a
AC voltage ratio: attenuation	Symmetric artificial lines (600 Ω)	Comparison to a reference divider	30	40	dB	Frequency	1 kHz	1.6E-04 to 2.6E-04	dB	2	95%	No			146a
AC voltage ratio: attenuation	Symmetric artificial lines (600 Ω)	Comparison to a reference divider	40	50	dB	Frequency	1 kHz	2.6E-04 to 1.6E-03	dB	2	95%	No			147a
AC voltage ratio: attenuation	Symmetric artificial lines (600 Ω)	Comparison to a reference divider	50	60	dB	Frequency	1 kHz	1.6E-03 to 4.8E-03	dB	2	95%	No			148a
AC voltage ratio: attenuation	Symmetric artificial lines (600 Ω)	Comparison to a reference divider	60	70	dB	Frequency	1 kHz	4.8E-03 to 1.6E-02	dB	2	95%	No			149a
AC voltage ratio: attenuation	Symmetric artificial lines (600 Ω)	Comparison to a reference divider	70	80	dB	Frequency	1 kHz	1.6E-02 to 4.8E-02	dB	2	95%	No			150a

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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
AC voltage ratio: attenuation	Symmetric artificial lines (600 Ω)	Comparison to a reference divider	80	90	dB	Frequency	1 kHz	4.8E-02 to 1.6E-01	dB	2	95%	No			151a
AC voltage ratio: attenuation	Symmetric artificial lines (600 Ω)	Comparison to a reference divider	90	100	dB	Frequency	1 kHz	1.6E-01 to 4.8E-01	dB	2	95%	No			152a
AC current: AC/DC transfer difference	Thermal converter plus shunt	Step-up procedure	0.0025	20	A	Frequency	10 Hz to 20 kHz	30 to 160	μA/A	2	95%	Yes	Matrix2	Approved on 05 March 2010	167.1
AC current: AC/DC transfer difference	Thermal converter	Comparison	2.5	2.5	mA	Frequency	10 Hz to 20 kHz	42	μA/A	2	95%	Yes			168
AC current up to 100 A: sources	Multifunction calibrator, transconductance amplifier	Voltage measurement at the terminal of a resistance	0.001	10	μA	Frequency range	20 Hz to 2 kHz	430	μA/A	2	95%	Yes			172a
AC current up to 100 A: sources	Multifunction calibrator, transconductance amplifier	Voltage measurement at the terminal of a resistance	0.01	5	mA	Frequency range	20 Hz to 2 kHz	100	μA/A	2	95%	Yes			173a
AC current up to 100 A: sources	Multifunction calibrator, transconductance amplifier	Comparison to a thermal transfer standard	0.0025	1	A	Frequency range	10 Hz to 20 kHz	100	μA/A	2	95%	Yes			174a
AC current up to 100 A: sources	Multifunction calibrator, transconductance amplifier	Comparison to a thermal transfer standard	1	20	A	Frequency range	10 Hz to 20 Hz	200	μA/A	2	95%	Yes			175a
AC current up to 100 A: sources	Multifunction calibrator, transconductance amplifier	Comparison to a thermal transfer standard	1	20	A	Frequency range	20 Hz to 5 kHz	140	μA/A	2	95%	Yes			176a
AC current up to 100 A: sources	Multifunction calibrator, transconductance amplifier	Comparison to a thermal transfer standard	1	20	A	Frequency range	5 kHz to 20 kHz	200	μA/A	2	95%	Yes			177a
AC current up to 100 A: meters	AC ammeter, multimeter, multifunction transfer standard	Voltage measurement at the terminal of a resistance	0.001	10	μA	Frequency range	20 Hz to 2 kHz	430	μA/A	2	95%	Yes			172b
AC current up to 100 A: meters	AC ammeter, multimeter, multifunction transfer standard	Voltage measurement at the terminal of a resistance	0.01	5	mA	Frequency range	20 Hz to 2 kHz	100	μA/A	2	95%	Yes			173b

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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
AC current up to 100 A: meters	AC ammeter, multimeter, multifunction transfer standard	Comparison to a thermal transfer standard	0.0025	1	A	Frequency range	10 Hz to 20 kHz	100	μA/A	2	95%	Yes			174b
AC current up to 100 A: meters	AC ammeter, multimeter, multifunction transfer standard	Comparison to a thermal transfer standard	1	20	A	Frequency range	10 Hz to 20 Hz	200	μA/A	2	95%	Yes			175b
AC current up to 100 A: meters	AC ammeter, multimeter, multifunction transfer standard	Comparison to a thermal transfer standard	1	20	A	Frequency range	20 Hz to 5 kHz	140	μA/A	2	95%	Yes			176b
AC current up to 100 A: meters	AC ammeter, multimeter, multifunction transfer standard	Comparison to a thermal transfer standard	1	20	A	Frequency range	5 kHz to 20 kHz	200	μA/A	2	95%	Yes			177b
AC power and energy: single phase ($f \leq 400$ Hz), apparent power	Power meter, power converter, wattmeter	Direct comparison	0	6000	VA	Voltage	60 V to 600 V	50	μVA/VA	2	95%	Yes		Approved on 05 March 2010	178a
						Current	0.05 A to 10 A								
						Frequency	45 Hz to 65 Hz								
AC power and energy: single phase ($f \leq 400$ Hz), active power	Power meter, power converter, power comparator	Direct comparison	0	1200	W	Voltage	120 V and 240 V	40	μW/VA	2	95%	Yes		Approved on 05 March 2010	178f
						Current	1 A, 2 A and 5 A								
						Power factor	1 to 0, inductive or capacitive								
						Frequency	45 Hz to 65 Hz								
AC power and energy: single phase ($f \leq 400$ Hz), active power	Power meter, power converter, power comparator	Direct comparison	0	6000	W	Voltage	60 V to 600 V	50	μW/VA	2	95%	Yes		Approved on 05 March 2010	178g
						Current	0.05 A to 10 A								
						Power factor	1 to 0, inductive or capacitive								
						Frequency	45 Hz to 65 Hz								

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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
AC power and energy: single phase ($f \leq 400$ Hz), reactive power	Power meter, power converter, power comparator	Direct comparison	0	6000	var	Voltage	60 V to 600 V	50	$\mu\text{var}/\text{VA}$	2	95%	Yes		Approved on 17 August 2011	178h
						Current	0.05 A to 10 A								
						$\sin \phi$	- 1 to 1, inductive or capacitive								
AC power and energy: single phase ($f \leq 400$ Hz), apparent power	Power meter, power converter, wattmeter	Direct comparison	0	1200	VA	Voltage	120 V to 240 V	40	$\mu\text{VA}/\text{VA}$	2	95%	Yes		Approved on 05 March 2010	178b
						Current	1 A, 2 A and 5 A								
						Frequency	45 Hz to 65 Hz								
AC power and energy: single phase ($f \leq 400$ Hz), active power	Power meter, power converter, wattmeter	Direct comparison	0	60000	W	Voltage	60 V to 600 V	70	$\mu\text{W}/\text{W}$	2	95%	Yes		Approved on 05 March 2010	178c
						Current	10 A to 100 A								
						$\cos \phi$	1 to 0, inductive or capacitive								
AC power and energy: single phase ($f \leq 400$ Hz), reactive power	Power meter, power converter, wattmeter	Direct comparison	0	60000	var	Voltage	60 V to 600 V	70	$\mu\text{var}/\text{VA}$	2	95%	Yes		Approved on 17 August 2011	178i
						Current	10 A to 100 A								
						$\sin \phi$	- 1 to 1, inductive or capacitive								
AC power and energy: single phase ($f \leq 400$ Hz), apparent power	Power meter, power converter, wattmeter	Direct comparison	0	60000	VA	Voltage	60 V to 600 V	70	$\mu\text{VA}/\text{VA}$	2	95%	Yes		Approved on 05 March 2010	178d
						Current	10 A to 100 A								
						Frequency	45 Hz to 65 Hz								

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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
AC power and energy: single phase ($f \leq 400$ Hz), active energy	Power meter, energy meter, power converter, wattmeter, watt-hour meters	Direct comparison	15	4.8E+06	Ws	Voltage	60 V to 480 V	150	$\mu\text{Ws}/\text{VAs}$	2	95%	Yes		Approved on 17 August 2011	178e
						Current	50 mA to 100 A								
						Time	10 s to 100 s								
						$\cos \phi$	0.5 to 1, inductive or capacitive								
					Frequency	45 Hz to 65 Hz									
AC power and energy: single phase ($f \leq 400$ Hz), reactive energy	Power meter, energy meter, power converter, wattmeter, watt-hour meters	Direct comparison	15	4.8E+06	var	Voltage	60 V to 480 V	150	$\mu\text{var}/\text{VA}$	2	95%	Yes		Approved on 17 August 2011	178j
						Current	50 mA to 100 A								
						Time	10 s to 100 s								
						$\sin \phi$	-1 to -0.5 and 0.5 to 1, inductive or capacitive								
					Frequency	45 Hz to 65 Hz									
High DC voltage: high voltage meters	DC kilovoltmeter, dedicated set-up for high voltage	Comparison to a voltmeter with a resistive divider	2	50	kV	Temperature	23 °C	10	$\mu\text{V}/\text{V}$	2	95%	Yes			182
High DC voltage: high voltage meters	DC kilovoltmeter, dedicated set-up for high voltage	Comparison to a voltmeter with a resistive divider	50	250	kV	Temperature	23 °C	40	$\mu\text{V}/\text{V}$	2	95%	Yes			183
						Relative humidity	< 60%								
High voltage impedance: capacitance	Compressed gas capacitor, capacitor for high voltage	Comparison	100	500	pF	Frequency	40 Hz to 60 Hz	50	$\mu\text{F}/\text{F}$	2	95%	Yes			184
						Voltage	< 100 kV								
High voltage impedance: capacitance	Compressed gas capacitor, capacitor for high voltage	Comparison	500	1000	pF	Frequency	40 Hz to 60 Hz	50	$\mu\text{F}/\text{F}$	2	95%	Yes			185
						Voltage	< 25 kV								
High voltage impedance: capacitance	Compressed gas capacitor, capacitor for high voltage	Comparison	1	2.5	nF	Frequency	40 Hz to 60 Hz	100	$\mu\text{F}/\text{F}$	2	95%	Yes			186
						Voltage	< 20 kV								

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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
High voltage impedance: capacitance	Compressed gas capacitor, capacitor for high voltage	Comparison	2.5	25	nF	Frequency	40 Hz to 60 Hz	100	μF/F	2	95%	Yes			187
						Voltage	< 2 kV								
High voltage impedance: capacitance and dissipation factor	Compressed gas capacitor, capacitor for high voltage: dissipation factor <i>D</i>	Comparison	1.00E-05	1.00E-02		Frequency	40 Hz to 60 Hz	(2E-05 + 0.01 <i>D</i>)		2	95%	No			187a
AC high voltage: ratio error	High voltage transformer	Step-up procedure	1.00E-05	1		Voltage	1 kV to 250 kV	100E-06		2	95%	No			189
						Frequency	50 Hz								
AC high voltage: ratio: phase displacement	High voltage transformer	Comparison bridge	0	2	crad	Voltage	1 kV to 250 kV	0.01	crad	2	95%	No			189a
						Frequency	50 Hz								
High AC current: meters	Dedicated measurement set-up, current transducer	Direct comparison	0.01	30	kA	Frequency	40 Hz to 70 Hz	0.14	mA/A	2	95%	Yes			195
High AC current: ratio error	Current transformer, current transformer bridge	Comparison	1.00E-05	1		Current	1 A to 30000 A	100E-06		2	95%	No			196
						Frequency	50 Hz								
High AC current: ratio: phase displacement	Current transformer, current transformer bridge	Comparison	0	2	crad	Current	1 A to 30000 A	0.01	crad	2	95%	No			196a
						Frequency	50 Hz								
High DC current: sources	Generator, ammeter	Current comparator	100	1000	A	Temperature	(20, 23) °C	10	μA/A	2	95%	Yes			43ca
High DC current: sources	Generator, ammeter	Current comparator	1	10	kA			50	μA/A	2	95%	Yes			44a
High DC current: meters	Generator, ammeter	Current comparator	100	1000	A	Temperature	(20, 23) °C	10	μA/A	2	95%	Yes			43cb
High DC current: meters	Generator, ammeter	Current comparator	1	10	kA			50	μA/A	2	95%	Yes			44b
Electric charge: meters	Charge meter	Charge of capacitor	1	10	pC	Fequency	DC	230	μC/C	2	95%	Yes			197

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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
Electric charge: meters	Charge meter	Charge of capacitor	10	20000	pC	Frequency	DC	150	μC/C	2	95%	Yes			198
Electric charge: meters	Charge meter	Intensity of current during a fixed time	20	10000	nC	Frequency	DC	540	μC/C	2	95%	Yes			199
Electric charge: meters	Charge meter	Charge of capacitor	1	10	pC	Frequency	10 Hz to 20 Hz	480	μC/C	2	95%	Yes			200
Electric charge: meters	Charge meter	Charge of capacitor	10	20000	pC	Frequency	10 Hz to 20 Hz	450	μC/C	2	95%	Yes			201
Electric charge: meters	Charge meter	Charge of capacitor	1	10	pC	Frequency	20 Hz to 10 kHz	400	μC/C	2	95%	Yes			202
Electric charge: meters	Charge meter	Charge of capacitor	10	20000	pC	Frequency	20 Hz to 10 kHz	360	μC/C	2	95%	Yes			203
Electric charge: meters	Charge meter	Charge of capacitor	1	10	pC	Frequency	10 kHz to 100 kHz	410	μC/C	2	95%	Yes			204
Electric charge: meters	Charge meter	Charge of capacitor	10	20000	pC	Frequency	10 kHz to 100 kHz	380	μC/C	2	95%	Yes			205
Electric charge: meters	Charge meter	Intensity of current during a fixed time	0.1	100	mAs	Frequency	DC	40	μAs/As	2	95%	Yes			206
Electric charge: meters	Charge meter	Intensity of current during a fixed time	100	200	mAs	Frequency	DC	25	μAs/As	2	95%	Yes			207
Electric charge: meters	Charge meter: charge Q	Intensity of current during a fixed time	200	2000	mAs	Frequency	DC	(1.5E-03Q + 0.4), Q in mAs	mAs	2	95%	No			208
Electric charge: meters	Charge meter: charge Q	Intensity of current during a fixed time	2	20	As	Frequency	DC	(2.1E-03Q + 0.004), Q in As	As	2	95%	No			209
Electric charge: meters	Charge meter: charge Q	Intensity of current during a fixed time	20	100	As	Frequency	DC	2.3	mAs/As	2	95%	Yes			210
Electric charge: meters	Charge amplifier	Charge of capacitor	1	20000	pC	Frequency	10 Hz to 20 Hz	0.97	mC/C	2	95%	Yes			211
Electric charge: meters	Charge amplifier	Charge of capacitor	1	20000	pC	Frequency	20 Hz to 10 kHz	8.8	mC/C	2	95%	Yes			212
Electric charge: meters	Charge amplifier	Charge of capacitor	1	20000	pC	Frequency	10 kHz to 100 kHz	0.93	mC/C	2	95%	Yes			213
Phase angle: sources	Phase shifted signal generators	Comparison to a reference phase meter	0	2π	rad	Voltage	10 mV to 8 V	1.8E-05 to 5.1E-05	rad	2	95%	No	Matrix 31	Approved on 05 March 2010	214
						Frequency	20 Hz to 1 kHz								
Phase angle: sources	Phase shifted signal generators	Comparison to a reference phase meter	0	2π	rad	Voltage	10 mV to 8 V	4.9E-05 to 1.8E-04	rad	2	95%	No	Matrix 31	Approved on 05 March 2010	215
						Frequency	1 kHz to 20 kHz								

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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
Phase angle: sources	Phase shifted signal generators	Comparison to a reference phase meter	0	2π	rad	Voltage	8 V to 1000 V	2.3E-05 to 2.3E-04	rad	2	95%	No	Matrix 31	Approved on 05 March 2010	216
						Frequency	20 Hz to 20 kHz								
Phase angle: meters	Phase meters	Comparison to a reference phase meter	0	2π	rad	Voltage	10 mV to 8 V	1.8E-05 to 5.1E-05	rad	2	95%	No	Matrix 31	Approved on 05 March 2010	217
						Frequency	20 Hz to 1 kHz								
Phase angle: meters	Phase meters	Comparison to a reference phase meter	0	2π	rad	Voltage	10 mV to 8 V	4.9E-05 to 1.8E-04	rad	2	95%	No	Matrix 31	Approved on 05 March 2010	218
						Frequency	1 kHz to 20 kHz								
Phase angle: meters	Phase meters	Comparison to a reference phase meter	0	2π	rad	Voltage	8 V to 1000 V	2.3E-05 to 2.3E-04	rad	2	95%	No	Matrix 31	Approved on 05 March 2010	219
						Frequency	20 Hz to 20 kHz								
Magnetic fields below 50 kHz: DC magnetic flux	Flux meter: flux ϕ	Flux created by an inductor	100	200	μWb			$(7\text{E}-04\phi + 4\text{E}-02)$, ϕ in μWb	μWb	2	95%	No			223
Magnetic fields below 50 kHz: DC magnetic flux	Flux meter: flux ϕ	Flux created by an inductor	0.2	2	mWb			$(7\text{E}-04\phi + 6\text{E}-04)$, ϕ in mWb	mWb	2	95%	No			224
Magnetic fields below 50 kHz: DC magnetic flux	Flux meter: flux ϕ	Flux created by an inductor	2	20	mWb			$(7\text{E}-04\phi + 25\text{E}-03)$, ϕ in mWb	mWb	2	95%	No			225
Magnetic fields below 50 kHz: DC magnetic flux density	Gaussmeter: flux density B	Coil	200	530	μT			$(3.4\text{E}-03B + 0.7)$, B in μT	μT	2	95%	No			219
Magnetic fields below 50 kHz: DC magnetic flux density	Gaussmeter: flux density B	Coil	0.53	5.3	mT			$(3.4\text{E}-03B + 2.3\text{E}-03)$, B in mT	mT	2	95%	No			220
Magnetic fields below 50 kHz: DC magnetic flux density	Gaussmeter: flux density B	Coil	5.3	15	mT			$(3.4\text{E}-03B + 2\text{E}-02)$, B in mT	mT	2	95%	No			221
Magnetic fields below 50 kHz: DC magnetic flux density	Gaussmeter: flux density B	NMR gaussmeter electromagnet	0.015	1.2	T			$(1.6\text{E}-04B + 1\text{E}-03)$, B in mT	mT	2	95%	No			222

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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
Electromagnetic fields above 50 kHz: power flux density	Field probe	Known field in AC	0.1	1	mW/cm ²	Frequency	1 GHz to 18 GHz	120	1E-03	2	95%	Yes			226
Electromagnetic fields above 50 kHz: power flux density	Field probe	Known field in AC	1	100	mW/cm ²	Frequency	1 GHz to 18 GHz	80	1E-03	2	95%	Yes			227
RF power: absolute power on coaxials	Power meter, power source	Power transfer	1	1	mW	Frequency	50 MHz	3.6	mW/W	2	95%	Yes			228
RF power: absolute power on coaxials	Power meter, power source	Power transfer with attenuator	1.00E-05	100	W	Frequency	500 kHz to 40 GHz	4 to 96	mW/W	2	95%	Yes	Matrix17		229
RF power: absolute power on waveguides	Power meter, power source	Power transfer with attenuator	1.00E-05	100	W	Frequency	8.2 GHz to 40 GHz	4 to 80	mW/W	2	95%	Yes	Matrix18		239
RF power: absolute power on waveguides	Power meter, power source	Power transfer with attenuator	0.1	5	mW	Frequency	42 GHz to 48 GHz, 60 GHz to 64 GHz	22 to 28	mW/W	2	95%	Yes	Matrix18		246
RF power: absolute power on waveguides	Power meter, power source	Power transfer with attenuator	1.00E-05	5	W	Frequency	93.5 GHz to 95 GHz	28 to 34	mW/W	2	95%	Yes	Matrix18		247
RF power: calibration factor on coaxials	50 Ω thermistor	Single six-port	0.9	1		Frequency	1GHz to 18 GHz	0.006		2	95%	No			248
						Type N and PC 7 connectors									
RF power: calibration factor on coaxials	Power sensor: factor K	Power transfer	0.8	1		Frequency	0.05 MHz to 40 GHz	0.9E-02 to 2.2E-02		2	95%	Yes	Matrix19a		249
						Power	1 nW to 100 W								
RF power: effective efficiency on coaxials	50 Ω thermistor	Microcalorimeter	0.9	1		Frequency	0.5 MHz to 18 GHz	0.002 to 0.0026		2	95%	No			265
						Type N and PC 7 connectors									
RF power: effective efficiency on coaxials	75 Ω thermistor	Microcalorimeter	0.9	1		Frequency	100 kHz to 1 GHz	0.002		2	95%	No			266

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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 waveguides	Power sensor	Power transfer	0.8	1		Frequency	8 GHz to 40 GHz	1.1E-02 to 2.5E-02		2	95%	Yes	Matrix19b		255
						Power	100 nW to 100 W								
RF power: calibration factor on waveguides	Power sensor	Power transfer	0.8	1		Frequency	42 GHz to 48 GHz, 60 GHz to 64 GHz	2.2E-02 to 2.8E-02		2	95%	Yes	Matrix19b		261
						Power	100 μW to 5 mW								
RF power: calibration factor on waveguides	Power sensor	Power transfer	0.8	1		Frequency	93.5 GHz to 95 GHz	2.8E-02 to 3.4E-02		2	95%	Yes	Matrix19b		262
						Power	100 nW to 5 W								
RF power: effective efficiency on waveguides	Thermistor	Microcalorimeter	0.9	1		Frequency	8.2 GHz to 12.4 GHz	0.0026		2	95%	No			267
RF power: effective efficiency on waveguides	Thermistor	Microcalorimeter	0.9	1		Frequency	12.4 GHz to 18 GHz	0.0026		2	95%	No			268
RF power: effective efficiency on waveguides	Thermistor	Microcalorimeter	0.9	1		Frequency	18 GHz to 26.5 GHz	0.0046		2	95%	No			269
RF power: effective efficiency on waveguides	Thermistor	Microcalorimeter	0.9	1		Frequency	26.5 GHz to 40 GHz	0.008		2	95%	No			270
RF power: effective efficiency on waveguides	Thermistor	Microcalorimeter	0.8	1		Frequency	42 GHz to 48 GHz	0.01		2	95%	No			271
RF power: effective efficiency on waveguides	Thermistor	Microcalorimeter	0.8	1		Frequency	60 GHz to 64 GHz	0.01		2	95%	No			272
RF power: effective efficiency on waveguides	Thermistor	Microcalorimeter	0.8	1		Frequency	93 GHz to 96 GHz	0.014		2	95%	No			273

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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
Scalar RF reflection coefficient: on waveguides, magnitude	Waveguide termination	Tuned reflectometer on waveguide	0.001	0.5		Frequency	8.2 GHz to 40 GHz	5.5E-04 to 3.2E-02		2	95%	No	Matrix29		294
Scalar RF reflection coefficient: on waveguides, magnitude	Waveguide termination	Tuned reflectometer on waveguide	0.001	0.5		Frequency	93.5 GHz to 95 GHz	3E-03 to 3.7E-02		2	95%	No	Matrix29		297
Scalar RF attenuation: on coaxials, magnitude	Passive device, fixed attenuator	Power variation	0	20	dB	Frequency	500 kHz to 18 GHz	0.005	dB	2	95%	No	Matrix20		276
Scalar RF attenuation: on coaxials, magnitude	Passive device, fixed attenuator	Direct substitution	20	60	dB	Frequency	500 kHz to 5 MHz	0.03	dB	2	95%	No	Matrix20		277
Scalar RF attenuation: on coaxials, magnitude	Passive device, fixed attenuator	Substitution at 30 MHz	20	100	dB	Frequency	5 MHz to 18 GHz	0.04 to 0.070	dB	2	95%	No	Matrix20		278
Scalar RF attenuation: on coaxials, magnitude	Passive device, step attenuator	Power variation	0	20	dB	Frequency	500 kHz to 26.5 GHz	0.006	dB	2	95%	No	Matrix21		279
Scalar RF attenuation: on coaxials, magnitude	Passive device, step attenuator	Direct substitution	30	60	dB	Frequency	500 kHz to 5 MHz	0.03 to 0.14	dB	2	95%	No	Matrix21		280
Scalar RF attenuation: on coaxials, magnitude	Passive device, step attenuator	Substitution at 30 MHz	30	100	dB	Frequency	5 MHz to 26.5 GHz	0.06 to 0.08	dB	2	95%	No	Matrix21		282
Scalar RF attenuation: on coaxials, magnitude	Passive device, WBCO attenuator	Power variation	0	20	dB	Frequency	30 MHz	0.005 to 0.007	dB	2	95%	No			283
Scalar RF attenuation: on coaxials, magnitude	Passive device, WBCO attenuator	Direct substitution	30	100	dB	Frequency	30 MHz	0.013 to 0.062	dB	2	95%	No			284
Scalar RF attenuation: on waveguides, magnitude	Passive device, fixed attenuator	Power variation	0	20	dB	Frequency	8.2 GHz to 40 GHz and 93.5 GHz to 95 GHz	0.005	dB	2	95%	No	Matrix22a		285

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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
Scalar RF attenuation: on waveguides, magnitude	Passive device, fixed attenuator	Substitution at 30 MHz	30	100	dB	Frequency	8.2 GHz to 26.5 GHz	0.035 to 0.11	dB	2	95%	No	Matrix22a		286
Scalar RF attenuation: on waveguides, magnitude	Passive device, fixed attenuator	Direct substitution	30	60	dB	Frequency	8.2 GHz to 40 GHz, 93.5 GHz to 95 GHz	0.035 to 0.14	dB	2	95%	No	Matrix22a		287
Scalar RF attenuation: on waveguides, magnitude	Passive device, rotary vane attenuator	Power variation	0	20	dB	Frequency	8.2 GHz to 40 GHz, 93.5 GHz to 95 GHz	0.013 to 0.015	dB	2	95%	No	Matrix22b		288
Scalar RF attenuation: on waveguides, magnitude	Passive device, rotary vane attenuator	Substitution at 30 MHz	20	70	dB	Frequency	8.2 GHz to 26.5 GHz	0.03 to 0.12	dB	2	95%	No	Matrix22b		289
Scalar RF attenuation: on waveguides, magnitude	Passive device, rotary vane attenuator	Direct substitution	20	60	dB	Frequency	26.5 GHz to 40 GHz, 93.5 GHz to 95 GHz	0.05 to 0.13	dB	2	95%	No	Matrix22b		290
Scattering parameters: reflection coefficient (S_{ij}) on coaxials, real and imaginary	Passive device	Dual six-port	-1	1		Frequency	0.1 GHz to 40 GHz	0.004 to 0.02		2	95%	No	Matrix22c		292
Scattering parameters: transmission coefficient (S_{ij}) on coaxials, real and imaginary	Passive device	Dual six-port	-1	1		Frequency	0.1 GHz to 40 GHz	1.6E-03 to 4.1E-03		2	95%	No	Matrix22d		274
RF noise: noise temperature in coaxials	Coaxial noise source	Dicke radiometer	1000	100000	K	Frequency	0.01 GHz to 8.2 GHz	51 to 7171	K	2	95%	No			299
						PC7 and type N connectors									
RF noise: excess noise ratio in waveguides	Noise source	Dicke radiometer	3.9	25.4	dB	Frequency	8.2 GHz to 12.4 GHz	0.04	dB	2	95%	No			300

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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 noise: excess noise ratio in waveguides	Noise source	Dicke radiometer	3.9	25.4	dB	Frequency	12.4 GHz to 18 GHz	0.04	dB	2	95%	No			301
RF noise: excess noise ratio in waveguides	Noise source	Dicke radiometer	3.9	25.4	dB	Frequency	18 GHz to 26.5 GHz	0.04	dB	2	95%	No			302
RF noise: excess noise ratio in waveguides	Noise source	Dicke radiometer	3.9	25.4	dB	Frequency	26.5 GHz to 40 GHz	0.04	dB	2	95%	No			303
Antenna properties: antenna factor	Antenna dipole	Standard site method on OATS	5	45	dB(1/m)	Frequency	30 MHz to 1000 MHz	1	dB	2	95%	No			304
Antenna properties: antenna factor	Loop antenna	Standard antenna method	-45	35	dB(1/Ωm)	Frequency	9 kHz to 30 MHz	1.2 to 1.3	dB	2	95%	No			305
Antenna properties: antenna gain	Horn antenna	Standard site method in AC	10	25	dB	Frequency	1 GHz to 40 GHz	0.24 to 0.65	dB	2	95%	No			306
RF voltage: RF/DC transfer difference	Thermal voltage convertors	Thermal transposition with thermal convertors	0.5	50	V	Frequency	100 kHz to 50 MHz	20 to 2500	μV/V	2	95%	Yes	Matrix23	Approved on 05 March 2010	307a
						Relative difference	0 to 0.02								
RF voltage: RF/DC transfer difference	Thermal voltage convertors	Thermal transposition with thermal convertors	0.5	50	V	Frequency	20 MHz to 50 MHz	0.65 to 2.5	mV/V	2	95%	Yes	Matrix23	Approved on 05 March 2010	307b
						Relative difference	0 to 0.02								
RF voltage: RF/DC transfer difference	Thermal voltage convertors	Thermal transposition with thermal convertors	50	200	V	Frequency	100 kHz to 50 MHz	1.2 to 2.3	mV/V	2	95%	Yes	Matrix 23b	Approved on 05 March 2010	307c
						Relative difference	0 to 0.02								
RF voltage: RF voltage meters	RF voltmeter	Thermal transposition with attenuators	25E-06	32E-06	V	Frequency	9 kHz to 30 MHz	8	μV	2	95%	No		Approved on 17 August 2011	369a
RF voltage: RF voltage meters	RF voltmeter	Thermal transposition with attenuators	32E-06	10	V	Frequency	9 kHz to 50 MHz	0.003 to 0.072	V/V	2	95%	Yes	Matrix26	Approved on 17 August 2011	369b

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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 voltage meters	RF voltmeters and RF generators	Thermal transposition with thermal convertors	0.25	200	V	Frequency	100 kHz to 50 MHz	0.43 to 2.4	mV/V	2	95%	Yes	Matrix24		375	
RF voltage: RF voltage meters	RF voltmeters and RF generators	Comparison to a HF power measurement	1.00E-05	10	V	Frequency	50 MHz to 2 GHz	9.5 to 89	mV/V	2	95%	Yes	Matrix25		384	
Lumped impedance: quality factor	Q meter: factor Q	Resonance method	100	300		Frequency	0.1 MHz to 50 MHz	0.02Q to 0.034Q		2	95%	No			298	
						Inductance	200 nH to 20 mH									
RF noise: phase noise	Oscillators, 2 port devices	Phase detector	-140	0	dBc/Hz	Carrier frequency	5 MHz to 500 MHz	2	dB	2	95%	No		Approved on 22 September 2006. Service provided by the LNE-LTFB	75	
						Offset frequency	1 Hz									
						DUT power	> 0 dBm									
RF noise: phase noise	Oscillators, 2 port devices	Phase detector	-150	0	dBc/Hz	Carrier frequency	5 MHz to 500 MHz	2	dB	2	95%	No		Approved on 22 September 2006. Service provided by the LNE-LTFB	76	
						Offset frequency	10 Hz									
						DUT power	> 0 dBm									
RF noise: phase noise	Oscillators, 2 port devices	Phase detector	-160	0	dBc/Hz	Carrier frequency	5 MHz to 500 MHz	2	dB	2	95%	No		Approved on 22 September 2006. Service provided by the LNE-LTFB	77	
						Offset frequency	100 Hz									
						DUT power	> 0 dBm									
RF noise: phase noise	Oscillators, 2 port devices	Phase detector	-170	0	dBc/Hz	Carrier frequency	5 MHz to 500 MHz	2	dB	2	95%	No		Approved on 22 September 2006. Service provided by the LNE-LTFB	78	
						Offset frequency	1 kHz									
						DUT power	> 0 dBm									

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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 noise: phase noise	Oscillators, 2 port devices	Phase detector	-172	0	dBc/Hz	Carrier frequency	5 MHz to 500 MHz	2	dB	2	95%	No		Approved on 22 September 2006. Service provided by the LNE-LTFB	79
						Offset frequency	10 kHz								
						DUT power	> 0 dBm								
RF noise: phase noise	Oscillators, 2 port devices	Phase detector	-172	0	dBc/Hz	Carrier frequency	5 MHz to 500 MHz	2	dB	2	95%	No		Approved on 22 September 2006. Service provided by the LNE-LTFB	80
						Offset frequency	100 kHz								
						DUT power	> 0 dBm								
RF noise: phase noise	Oscillators, 2 port devices	Phase detector	-130	0	dBc/Hz	Carrier frequency	0.5 GHz to 18 GHz	2	dB	2	95%	No		Approved on 22 September 2006. Service provided by the LNE-LTFB	81
						Offset frequency	1 Hz								
						DUT power	> 0 dBm								
RF noise: phase noise	Oscillators, 2 port devices	Phase detector	-140	0	dBc/Hz	Carrier frequency	0.5 GHz to 18 GHz	2	dB	2	95%	No		Approved on 22 September 2006. Service provided by the LNE-LTFB	82
						Offset frequency	10 Hz								
						DUT power	> 0 dBm								
RF noise: phase noise	Oscillators, 2 port devices	Phase detector	-150	0	dBc/Hz	Carrier frequency	0.5 GHz to 18 GHz	2	dB	2	95%	No		Approved on 22 September 2006. Service provided by the LNE-LTFB	83
						Offset frequency	100 Hz								
						DUT power	> 0 dBm								
RF noise: phase noise	Oscillators, 2 port devices	Phase detector	-160	0	dBc/Hz	Carrier frequency	0.5 GHz to 18 GHz	2	dB	2	95%	No		Approved on 22 September 2006. Service provided by the LNE-LTFB	84
						Offset frequency	1 kHz								

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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
						DUT power	> 0 dBm								
RF noise: phase noise	Oscillators, 2 port devices	Phase detector	-170	0	dBc/Hz	Carrier frequency	0.5 GHz to 18 GHz	2	dB	2	95%	No		Approved on 22 September 2006. Service provided by the LNE-LTFB	85
						Offset frequency	10 kHz								
						DUT power	> 0 dBm								
RF noise: phase noise	Oscillators, 2 port devices	Phase detector	-170	0	dBc/Hz	Carrier frequency	0.5 GHz to 18 GHz	2	dB	2	95%	No		Approved on 22 September 2006. Service provided by the LNE-LTFB	86
						Offset frequency	100 kHz								
						DUT power	> 0 dBm								
Pulsed high voltage and current: lightning impulse voltage parameters	Lightning impulse voltage measurement systems: peak value	Comparison under high voltage with a reference measuring system comprising a shielded resistive divider	1	420	kV	Front time	0.8 μ s to 1.6 μ s	5	mV/V	2	95%	Yes		Approved on 15 December 2006 According to CEI 60060-1	
Pulsed high voltage and current: lightning impulse voltage parameters	Lightning impulse voltage measurement systems: peak value	Comparison under high voltage with a reference measuring system comprising a shielded resistive divider	1	420	kV	Time to chopping	0.4 μ s to 1.6 μ s	30	mV/V	2	95%	Yes		Approved on 15 December 2006 According to CEI 60060-1	
Pulsed high voltage and current: lightning impulse time parameters (front time)	Lightning impulse voltage measurement systems: front time	Comparison under high voltage to a reference measuring system comprising a shielded resistive divider	0.8	1.6	μ s	Voltage	1 kV to 420 kV	25	ms/s	2	95%	Yes		Approved on 15 December 2006 According to CEI 60060-1	

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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
Pulsed high voltage and current: lightning impulse time parameters	Lightning impulse voltage measurement systems: time to half value	Comparison under high voltage with a reference measuring system comprising a shielded resistive divider	40	60	µs	Voltage	1 kV to 420 kV	10	ms/s	2	95%	Yes		Approved on 15 December 2006 According to CEI 60060-1	
Pulsed high voltage and current: lightning impulse time parameters	Lightning impulse voltage measurement systems: time to chopping	Comparison under high voltage with a reference measuring system comprising a shielded resistive divider	0.4	1.6	µs	Voltage	1 kV to 420 kV	50	ms/s	2	95%	Yes		Approved on 15 December 2006 According to CEI 60060-1	
Electric discharge: apparent charge (according to IEC 60270)	Partial discharge calibrator	Numerical integration of voltage	1	10000	pC			(0.025Q + 0.1), Q in pC	pC	2	95%	No		Approved on 22 February 2008	310
Electric discharge: response - crest value (according to IEC 61000-4-2)	Electrostatic discharge generator	Measurement of voltage through current-sensing transducer	1	40	A			50	mA/A	2	95%	Yes		Approved on 22 February 2008	311
Electric discharge: response - time parameters (according to IEC 61000-4-2)	Electrostatic discharge generator	Measurement of voltage through current-sensing transducer	0.5	2	ns	Current	1 A to 40 A	0.05	ns	2	95%	No		Approved on 22 February 2008	312

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)**uncertainties table: Matrix1**

AC voltage: AC/DC transfer difference at medium voltages, LNE Internal Identifier: 100.1

AC voltage: AC/DC transfer difference at higher voltages, LNE Internal Identifier: 100.2

	10 Hz	20 Hz	40 Hz	400 Hz	1 kHz	4 kHz	5 kHz	10 kHz	20 kHz	50 kHz	100 kHz
0.5 V	10	10	10	10	10	10	10	10	10	10	10
1 V	10	10	5	5	5	5	5	5	5	10	10
2 V	10	10	5	5	5	5	5	5	5	10	10
3 V	10	10	5	5	5	5	5	5	5	10	10
5 V	10	10	10	10	10	10	10	10	10	10	10
10 V	10	10	10	10	10	10	10	10	10	10	10
20 V	10	10	10	10	10	10	10	10	10	10	10
30 V	13	13	13	13	13	13	13	13	13	13	13
50 V	13	13	13	13	13	13	13	13	13	13	13
100 V	15	15	15	15	15	15	15	15	15	15	15
200 V	20	20	20	20	20	20	20	20	20	25	25
300 V	25	25	20	20	20	20	20	25	25	30	30
500 V	30	30	20	20	20	20	20	30	30	50	50
1000 V	55	55	25	25	25	25	25	50	50	70	70

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

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)**uncertainties table: Matrix2**

AC Current: AC/DC current transfer, LNE Internal Identifier: 167.1

	10 Hz	20 Hz	40 Hz	400 Hz	1 kHz	4 kHz	5 kHz	10 kHz	20 kHz
2.5 mA	40	40	30	30	30	30	30	30	30
5 mA	40	40	30	30	30	30	30	30	30
10 mA	40	40	30	30	30	30	30	30	30
25 mA	40	40	30	30	30	30	30	30	30
50 mA	60	60	40	40	40	40	40	40	40
100 mA	60	60	45	45	45	45	45	45	45
250 mA	60	60	55	55	55	55	55	55	55
500 mA	60	60	60	60	60	60	60	60	60
1 A	140	140	80	80	80	80	80	80	80
2.5 A	140	140	80	80	80	80	80	80	80
5 A	140	140	85	80	80	80	80	85	85
10 A	160	160	100	100	100	100	100	100	100
20 A	160	160	125	100	100	100	100	120	120

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

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)

uncertainties table: Matrix3

DC resistance standards and sources: high values, LNE Internal Identifier: 32

	10 V	20 V	30 V	40 V	50 V	60 V	70 V	80 V	90 V	100 V	200 V	300 V	400 V	500 V	600 V	700 V	800 V	900 V	1000 V	
100 MΩ to 10 GΩ	52	39	36	35	34	34	34	34	33	33	33	33	33	33	33	33	33	33	33	33
10 GΩ to 100 GΩ	401	203	137	105	87	74	66	60	55	52	39	36	35	34	34	34	34	33	33	33

The expanded uncertainties given in this table are expressed in $\mu\Omega/\Omega$

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)

uncertainties table: Matrix4

DC resistance standards and sources: high values, LNE Internal Identifier: 36

	1 fA	2 fA	3 fA	4 fA	5 fA	6 fA	7 fA	8 fA	9 fA	10 fA	20 fA	30 fA	40 fA	50 fA	60 fA
100 GΩ to 1 TΩ	3.3E-01	1.7E-01	1.1E-01	8.3E-02	6.6E-02	5.5E-02	4.7E-02	4.1E-02	3.7E-02	3.3E-02	1.7E-02	1.1E-02	8.3E-03	6.6E-03	5.5E-03
1 TΩ to 10 TΩ	3.3E-01	1.7E-01	1.1E-01	8.3E-02	6.6E-02	5.5E-02	4.7E-02	4.1E-02	3.7E-02	3.3E-02	1.7E-02	1.1E-02	8.3E-03	6.6E-03	5.5E-03
10 TΩ to 100 TΩ	3.3E-01	1.7E-01	1.1E-01	8.3E-02	6.6E-02	5.5E-02	4.7E-02	4.1E-02	3.7E-02	3.3E-02	1.7E-02	1.1E-02	8.3E-03	6.6E-03	5.5E-03
100 TΩ to 1 PΩ	3.3E-01	1.7E-01	1.1E-01	8.3E-02	6.6E-02	5.5E-02	4.8E-02	4.2E-02	3.7E-02	3.3E-02	1.7E-02	1.2E-02	9.4E-03	8.0E-03	7.1E-03

	70 fA	80 fA	90 fA	100 fA	200 fA	300 fA	400 fA	500 fA	600 fA	700 fA	800 fA	900 fA	1 pA	2 pA	3 pA
100 GΩ to 1 TΩ	4.7E-03	4.1E-03	3.7E-03	3.3E-03	1.7E-03	1.1E-03	8.3E-04	6.6E-04	5.5E-04	4.7E-04	4.2E-04	3.7E-04	3.3E-04	1.7E-04	1.1E-04
1 TΩ to 10 TΩ	4.7E-03	4.1E-03	3.7E-03	3.3E-03	1.7E-03	1.1E-03	8.3E-04	6.7E-04	5.6E-04	4.8E-04	4.2E-04	3.7E-04	3.4E-04	1.8E-04	1.3E-04
10 TΩ to 100 TΩ	4.8E-03	4.2E-03	3.7E-03	3.3E-03	1.7E-03	1.2E-03	9.4E-04	8.0E-04	7.1E-04	6.5E-04	6.1E-04	5.8E-04	5.6E-04	4.8E-04	4.6E-04
100 TΩ to 1 PΩ	6.5E-03	6.1E-03	5.8E-03	5.6E-03	4.8E-03	4.6E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03

	4 pA	5 pA	6 pA	7 pA	8 pA	9 pA	10 pA	20 pA	30 pA	40 pA	50 pA	60 pA	70 pA	80 pA	90 pA	100 pA to 10 nA
100 GΩ to 1 TΩ	8.9E-05	7.3E-05	6.4E-05	5.7E-05	5.2E-05	4.9E-05	4.6E-05	3.6E-05	3.3E-05	3.3E-05	3.2E-05	3.2E-05	3.2E-05	3.2E-05	3.2E-05	3.2E-05
1 TΩ to 10 TΩ	1.0E-04	9.2E-05	8.4E-05	7.9E-05	7.6E-05	7.3E-05	7.1E-05	6.5E-05	6.4E-05	6.4E-05	6.4E-05	6.3E-05	6.3E-05	6.3E-05	6.3E-05	6.3E-05
10 TΩ to 100 TΩ	4.5E-04	4.5E-04	4.5E-04	4.5E-04	4.5E-04	4.5E-04	4.5E-04	4.5E-04	4.5E-04	4.5E-04	4.5E-04	4.5E-04	4.5E-04	4.5E-04	4.5E-04	4.5E-04
100 TΩ to 1 PΩ	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03	4.5E-03

The expanded uncertainties given in this table are expressed in Ω/Ω

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)**uncertainties table: Matrix5**

AC voltage ratio: real and imaginary components, LNE Internal Identifier: 129

	40 Hz to 400 Hz	400 Hz to 1 kHz	1 kHz to 2 kHz	2 kHz to 10 kHz
0.001	4.20E-08	2.20E-08	2.20E-08	6.60E-08
0.002	7.40E-08	3.80E-08	3.80E-08	9.00E-08
0.003	9.60E-08	5.00E-08	5.00E-08	1.10E-07
0.004	1.20E-07	5.60E-08	5.60E-08	1.30E-07
0.005	1.20E-07	5.80E-08	5.80E-08	1.30E-07
0.006	1.20E-07	5.60E-08	5.60E-08	1.30E-07
0.007	9.60E-08	5.00E-08	5.00E-08	1.10E-07
0.008	7.40E-08	3.80E-08	3.80E-08	9.00E-08
0.009	4.20E-08	2.20E-08	2.20E-08	6.60E-08
0.01	4.20E-08	2.20E-08	2.20E-08	6.60E-08
0.02	7.40E-08	3.80E-08	3.80E-08	9.00E-08
0.03	9.60E-08	5.00E-08	5.00E-08	1.10E-07
0.04	1.20E-07	5.60E-08	5.60E-08	1.30E-07
0.05	1.20E-07	5.80E-08	5.80E-08	1.30E-07
0.06	1.20E-07	5.60E-08	5.60E-08	1.30E-07
0.07	9.60E-08	5.00E-08	5.00E-08	1.10E-07
0.08	7.40E-08	3.80E-08	3.80E-08	9.00E-08
0.09	4.20E-08	2.20E-08	2.20E-08	6.60E-08
0.1	4.20E-08	2.20E-08	2.80E-08	2.00E-07
0.2	7.40E-08	3.80E-08	4.20E-08	2.20E-07
0.3	9.60E-08	5.00E-08	5.20E-08	2.20E-07
0.4	1.20E-07	5.60E-08	5.80E-08	2.20E-07
0.5	1.20E-07	5.80E-08	6.00E-08	2.40E-07
0.6	1.20E-07	5.60E-08	5.80E-08	2.20E-07
0.7	9.60E-08	5.00E-08	5.20E-08	2.20E-07
0.8	7.40E-08	3.80E-08	4.20E-08	2.20E-07
0.9	4.20E-08	2.20E-08	2.80E-08	2.00E-07

The expanded uncertainties given in this table are dimensionless

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)**uncertainties table: Matrix15**

AC resistance: modulus, LNE Internal Identifier: 47a

	20 Hz to 100 Hz	100 Hz to 1 kHz	1kHz to 5 kHz	5 kHz to 10 kHz	10 kHz to 20 kHz
10 m Ω to 10 k Ω	5.0E-04	5.0E-04	5.0E-04	5.0E-04	5.0E-04
10 k Ω to 50 k Ω	5.0E-04	5.0E-04	5.0E-04	7.5E-04	2.5E-03
50 k Ω to 100 k Ω	5.0E-04	5.0E-04	7.5E-04	2.5E-03	1.0E-02
100 k Ω to 500 k Ω	5.0E-04	7.5E-04	1.5E-02	5.5E-02	-
500 k Ω to 1 M Ω	5.0E-04	2.5E-03	5.5E-02	-	-
1 M Ω to 5 M Ω	7.5E-04	5.5E-02	-	-	-

The expanded uncertainties given in this table are expressed in Ω/Ω

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)

uncertainties table: Matrix16

AC resistance: argument, LNE Internal Identifier: 48a

	20 Hz to 100 Hz	100 Hz to 1 kHz	1kHz to 5 kHz	5kHz to 10 kHz	10 kHz to 20 kHz
10 mΩ to 5 Ω	0.03	0.105	0.7	2	7.2
5 Ω to 1 kΩ	0.03	0.105	0.5	1	2.2
1 kΩ to 5 kΩ	0.03	0.205	1.1	2.1	4.1

The expanded uncertainties given in this table are expressed in mrad

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)**uncertainties table: Matrix17**

RF power: absolute power on coaxials, LNE Internal Identifier: 229

	1 mW	10 μ W to 100 μ W	100 μ W to 10 mW	10 mW to 1 W	1 W to 10 W	10 W to 50 W
50 MHz	4	5	4	30	30	30
500 kHz to 10 MHz	4	-	4	-	-	-
10 MHz to 1 GHz	4	5	4	30	30	30
1 GHz to 12 GHz	4	5	4	30	70	70
12 GHz to 18 GHz	4	5	4	60	70	70
18 GHz to 26 GHz	40	40	4	50	50	-
26 GHz to 40 GHz	96	96	4	80	80	-

The expanded uncertainties given in this table are expressed in mW/W

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)

uncertainties table: Matrix18

RF power: absolute power on waveguides, LNE Internal Identifier: 239

RF power: absolute power on waveguides, LNE Internal Identifier: 246

RF power: absolute power on waveguides, LNE Internal Identifier: 247

	10 μ W to 100 μ W	100 μ W to 1 mW	1 mW to 5 mW	5 mW to 10 mW	10 mW to 5 W	5 W to 100 W
8.2 GHz to 18 GHz	13	4	4	4	50	50
18 GHz to 26 GHz	9	9	9	9	55	55
26 GHz to 40 GHz	6	6	6	6	80	80
42 GHz to 48 GHz	-	28	22	-	-	-
60 GHz to 64 GHz	-	28	23	-	-	-
93.5 GHz to 95 GHz	34	29	28	34	34	-

The expanded uncertainties given in this table are expressed in mW/W

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)**uncertainties table: Matrix19a**

RF power: calibration factor on coaxials, LNE Internal Identifier: 249

	1 nW	10 nW	0.1 μ W	1 μ W	10 μ W	100 μ W	300 μ W	1 mW	3 mW	5 mW	10 mW	100 mW	1 W	5 W	10 W	100 W
0.5 MHz to 500 MHz	1.5E-02	1.4E-02	1.3E-02	1.2E-02	1.2E-02	1.9E-02	1.1E-02	1.0E-02	9.0E-03	9.0E-03	9.0E-03	1.9E-02	1.2E-02	1.3E-02	1.3E-02	1.3E-02
500 MHz to 8 GHz	1.6E-02	1.5E-02	1.4E-02	1.4E-02	1.3E-02	2.0E-02	1.3E-02	1.1E-02	1.1E-02	1.1E-02	1.1E-02	2.0E-02	1.4E-02	1.4E-02	1.4E-02	1.4E-02
8 GHz to 18 GHz	1.6E-02	1.5E-02	1.4E-02	1.4E-02	1.3E-02	2.0E-02	1.3E-02	1.1E-02	1.1E-02	1.1E-02	1.1E-02	2.0E-02	1.3E-02	1.4E-02	1.4E-02	1.4E-02
18 GHz to 26.5 GHz	2.1E-02	2.1E-02	2.0E-02	2.0E-02	2.0E-02	2.4E-02	1.9E-02	1.9E-02	1.9E-02	1.8E-02	1.8E-02	2.5E-02	2.0E-02	2.0E-02	2.0E-02	2.0E-02
26.5 GHz to 40 GHz	2.2E-02	2.1E-02	2.1E-02	2.0E-02	2.0E-02	2.5E-02	2.0E-02	1.9E-02	1.9E-02	1.9E-02	1.9E-02	2.5E-02	2.0E-02	2.0E-02	2.0E-02	2.1E-02

The uncertainties are given for PC7 or N Type connectors up to 18 GHz. PC3.5 from 18 GHz to 26.5 GHz and K from 26.5 GHz to 40 GHz

The expanded uncertainties given in this table are dimensionless

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)

uncertainties table: Matrix19b

RF power: calibration factor on waveguides, LNE Internal Identifier: 255

RF power: calibration factor on waveguides, LNE Internal Identifier: 261

RF power: calibration factor on waveguides, LNE Internal Identifier: 262

	0.1 μ W	1 μ W	10 μ W	100 μ W	300 μ W	1 mW	3 mW	5 mW	10 mW	100 mW	1 W	5 W	10 W	100 W
8 GHz to 18 GHz	1.4E-02	1.4E-02	1.3E-02	2.0E-02	1.3E-02	1.1E-02	1.1E-02	1.1E-02	1.1E-02	2.0E-02	1.3E-02	1.4E-02	1.4E-02	1.4E-02
18 GHz to 26.5 GHz	2.0E-02	2.0E-02	2.0E-02	2.4E-02	1.9E-02	1.9E-02	1.9E-02	1.8E-02	1.8E-02	2.5E-02	2.0E-02	2.0E-02	2.0E-02	2.0E-02
26.5 GHz to 40 GHz	2.1E-02	2.0E-02	2.0E-02	2.5E-02	2.0E-02	1.9E-02	1.9E-02	1.9E-02	1.9E-02	2.5E-02	2.0E-02	2.0E-02	2.0E-02	2.1E-02
42 GHz to 48 GHz	-	-	-	2.8E-02	2.3E-02	2.2E-02	2.2E-02	2.2E-02	-	-	-	-	-	-
60 GHz to 64 GHz	-	-	-	2.8E-02	2.3E-02	2.3E-02	2.3E-02	2.2E-02	-	-	-	-	-	-
93.5 GHz to 95 GHz	2.9E-02	2.9E-02	2.9E-02	3.4E-02	2.9E-02	2.8E-02	2.8E-02	2.8E-02	3.4E-02	3.4E-02	2.9E-02	2.9E-02	-	-

The expanded uncertainties given in this table are dimensionless

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)

uncertainties table: Matrix20

Scalar RF attenuation: on coaxials, magnitude, LNE Internal Identifier: 276

Scalar RF attenuation: on coaxials, magnitude, LNE Internal Identifier: 277

Scalar RF attenuation: on coaxials, magnitude, LNE Internal Identifier: 278

	0 dB to 20 dB	20 dB to 60 dB	60 dB to 80 dB	80 dB to 100 dB
0.5 MHz to 5 MHz	0.005	0.030	-	-
5 MHz to 18 GHz	0.005	0.040	0.060	0.070

The expanded uncertainties given in this table are expressed in dB

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)

uncertainties table: Matrix21

Scalar RF attenuation: on coaxials, magnitude, LNE Internal Identifier: 279

Scalar RF attenuation: on coaxials, magnitude, LNE Internal Identifier: 280

Scalar RF attenuation: on coaxials, magnitude, LNE Internal Identifier: 282

	0 dB to 20 dB	20 dB to 50 dB	50 dB to 60 dB	60 dB to 80 dB	80 dB to 100 dB
0.5 MHz to 5 MHz	0.006	0.030	0.140	-	-
5 MHz to 26 GHz	0.006	0.060	0.060	0.053	0.074

The expanded uncertainties given in this table are expressed in dB

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)

uncertainties table: Matrix22a

Scalar RF attenuation: on waveguides, magnitude, LNE Internal Identifier: 285

Scalar RF attenuation: on waveguides, magnitude, LNE Internal Identifier: 286

Scalar RF attenuation: on waveguides, magnitude, LNE Internal Identifier: 287

	0 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	90 dB to 100 dB
8.2 GHz to 26 GHz	0.005	0.035	0.035	0.035	0.035	0.090	0.100	0.110
26 GHz to 40 GHz	0.005	0.080	0.100	0.120	0.140	-	-	-
93.5 GHz to 95 GHz	0.005	0.080	0.100	0.120	0.140	-	-	-

The expanded uncertainties given in this table are expressed in dB

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)

uncertainties table: Matrix22b

Scalar RF attenuation: on waveguides, magnitude, LNE Internal Identifier: 288

Scalar RF attenuation: on waveguides, magnitude, LNE Internal Identifier: 289

Scalar RF attenuation: on waveguides, magnitude, LNE Internal Identifier: 290

	0 dB to 3 dB	3 dB to 6 dB	6 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
8.2 GHz to 26 GHz	0.013	0.013	0.014	0.015	0.03	0.05	0.08	0.11	0.12
26 GHz to 40 GHz	0.013	0.013	0.014	0.015	0.05	0.06	0.12	0.13	-
93.5 GHz to 95 GHz	0.013	0.013	0.014	0.015	0.05	0.06	0.12	0.13	-

The expanded uncertainties given in this table are expressed in dB

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)

uncertainties table: Matrix22c

Scattering parameters: reflection coefficient (Sii) on coaxials, LNE Internal Identifier:292

	0 to 0.01	0.01 to 1
100 MHz to 1 GHz	4.0E-03	1.0E-02
1 GHz to 18 GHz	7.0E-03	2.0E-02
18 GHz to 40 GHz	8.0E-03	2.0E-02

Uncertainties are given for PC7 and N type connectors up to 18 GHz and for K connectors up to 40 GHz

The expanded uncertainties given in this table are dimensionless

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)

uncertainties table: Matrix22d

Scattering parameters: transmission coefficient (Sij) on coaxials, LNE Internal Identifier: 274

	0 to 0.1	0.1 to 1
100 MHz to 1 GHz	1.6E-03	3.7E-03
1 GHz to 18 GHz	1.6E-03	4.1E-03
18 GHz to 40 GHz	1.6E-03	4.1E-03

Uncertainties are given for PC7 and N type connectors up to 18 GHz and for K connectors up to 40 GHz

The expanded uncertainties given in this table are dimensionless

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)**uncertainties table: Matrix23**

RF voltage: RF/DC transfer difference, LNE Internal Identifiers: 307a and 307b

	0.1 MHz	0.5 MHz	1 MHz	2 MHz	5 MHz	10 MHz	20 MHz	30 MHz	50 MHz
0.5 V	20	200	200	200	300	300	600	700	2000
1 V	20	200	200	200	200	300	400	600	2000
2.5 V	20	150	150	150	200	300	400	600	2000
5 V	20	150	150	150	150	200	300	600	2000
10 V	20	200	200	200	200	300	500	650	2000
20 V	20	200	200	200	200	300	500	800	2000
50 V	20	200	200	200	300	400	650	1100	2500

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

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)

uncertainties table: Matrix23b

RF voltage: RF/DC transfer difference, LNE Internal Identifier: 307c

	0.1 MHz	0.5 MHz	1 MHz	2 MHz	5 MHz	10 MHz	20 MHz	30 MHz	50 MHz
50 V	1.2	1.2	1.2	1.2	1.2	1.2	1.2	2.3	2.3
100 V	1.2	1.2	1.2	1.2	1.2	1.2	1.2	2.3	2.3
200 V	1.3	1.3	1.3	1.3	1.3	1.3	2.3	2.3	2.3

The expanded uncertainties given in this table are expressed in mV/V

uncertainties table: Matrix24

RF voltage: RF voltage meters, LNE Internal Identifier: 375

	100 kHz to 10 MHz	10 MHz to 20 MHz	20 MHz to 30 MHz	30 MHz to 50 MHz
250 mV to 500 mV	0.67	0.7	0.75	0.94
0.5 V to 1.25 V	0.56	0.61	0.63	0.94
1.25 V to 2.5 V	0.43	0.48	0.52	0.69
2.5 V to 5 V	0.46	0.47	0.53	0.72
5 V to 10 V	0.67	0.73	0.74	0.93
10 V to 20 V	0.85	0.92	0.92	1.1
20 V to 50 V	1.3	1.3	1.3	2.3
50 V to 100 V	1.4	1.4	1.4	2.3
100 V to 200 V	1.4	1.4	2.4	-

The expanded uncertainties given in this table are expressed in mV/V

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)**uncertainties table: Matrix25**

RF voltage: RF voltage meters, LNE Internal Identifier: 384

	10 μ V to 200 μ V	200 μ V to 10 mV	10 mV to 200 mV	200 mV to 700 mV	700 mV to 2 V	2V to 10 V
50 MHz	37	21	12	9.5	12	21
100 MHz	37	21	12	9.5	12	21
300 MHz	37	21	12	9.5	12	21
500 MHz	37	21	12	9.5	12	21
700MHz	37	21	12	9.5	12	21
1000 MHz	37	21	12	9.5	12	21
1.5 GHz, 2 GHz	38	23	15	13	15	23
50 MHz to 1 GHz	55	46	43	42	43	46
1 GHz to 2 GHz	89	84	82	81	82	84

The expanded uncertainties given in this table are expressed in mV/V

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)

uncertainties table: Matrix26

RF voltage: RF voltage meters, LNE Internal Identifier: 369b

	32 μ V to 100 μ V	100 μ V to 320 μ V	320 μ V to 1 mV	1 mV to 3.2 mV	3.2 mV to 10 mV	10 mV to 32 mV	32 mV to 0.1 V	0.1 V to 1 V	1 V to 10 V
100 kHz to 5 MHz	0.071	0.047	0.018	0.012	0.007	0.005	0.005	0.004	0.003
5 MHz to 20 MHz	0.071	0.047	0.018	0.012	0.009	0.007	0.005	0.005	0.005
20 MHz to 50 MHz	0.072	0.048	0.021	0.016	0.013	0.012	0.010	0.010	0.010

The expanded uncertainties given in this table are expressed in V/V

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)**uncertainties table: Matrix27**

AC voltage up to 1000 V: sources, LNE Internal Identifier: 115c

AC voltage up to 1000 V: meters, LNE Internal Identifier: 115d

	10 Hz	20 Hz	40 Hz	500 Hz	1 kHz	10 kHz	20 kHz	50 kHz	100 kHz
0.2 V	160	60	60	60	60	60	60	60	60
0.5 V	30	30	30	30	30	30	30	30	30
1 V	30	30	30	30	30	30	30	30	30
2 V	20	20	20	20	20	20	20	20	20
3 V	30	30	30	30	30	30	30	30	30
5 V	20	20	20	20	20	20	20	20	20
10 V	30	30	30	30	30	30	30	30	30
20 V	20	20	20	20	20	20	20	20	20
30 V	34	34	34	34	34	34	34	34	34
50 V	24	24	24	24	24	24	24	24	24
100 V	34	34	34	34	34	34	34	34	34
200 V	30	30	30	30	30	30	30	30	30
300 V	51	43	43	43	43	43	43	43	43
500 V	49	37	37	37	37	37	37	54	54
1000 V	53	53	33	33	33	53	53	82	82

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

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)

uncertainties table: Matrix28

AC voltage up to 1000 V: sources, LNE Internal Identifier: 123c

AC voltage up to 1000 V: meters, LNE Internal Identifier: 123d

	10 Hz to 20 Hz	20 Hz to 40 Hz	40 Hz to 500 Hz	500 Hz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz
0.2 V to 0.5 V	260	90	71	62	62	64
0.5 V to 1 V	160	42	40	35	37	43
1 V to 100 V	160	58	40	35	37	43
100 V to 200 V	160	67	40	35	37	43
200 V to 300 V	160	80	45	45	49	51
300 V to 500 V	82	61	45	45	59	61
500 V to 1000 V	140	82	45	60	92	120

The expanded uncertainties given in this table are expressed in $\mu V/V$

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)

uncertainties table: Matrix29

Scalar RF reflection coefficient: on waveguides, magnitude, LNE Internal Identifier: 294

Scalar RF reflection coefficient: on waveguides, magnitude, LNE Internal Identifier: 297

	0.001	0.003	0.01	0.03	0.1	0.3	0.5
8.2 GHz to 18 GHz	0.00071	0.00065	0.00083	0.0019	0.0061	0.019	0.031
18 GHz to 26.5 GHz	0.00055	0.00063	0.00086	0.0034	0.0065	0.02	0.032
26.5 GHz to 40 GHz	0.00055	0.0008	0.00096	0.0034	0.0065	0.02	0.032
93.5 GHz to 95 GHz	0.003	0.003	0.0031	0.0046	0.0079	0.022	0.037

The expanded uncertainties given in this table are dimensionless

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)**uncertainties table: Matrix30**

AC voltage: AC/DC transfer difference at low voltages: LNE Internal Identifier 101

	10 Hz	20 Hz	40 Hz	400 Hz	1 kHz	4 kHz	5 kHz	10 kHz	20 kHz	50 kHz	100 kHz
0.01 V	90	80	70	60	60	60	60	60	60	80	80
0.02 V	70	60	50	45	45	45	45	45	45	60	60
0.03 V	65	55	45	40	40	40	40	40	40	50	50
0.05 V	60	50	40	30	30	30	30	30	30	40	40
0.1 V	40	30	15	15	15	15	15	15	15	15	25
0.2 V	30	20	15	10	10	10	10	10	10	15	15
0.3 V	25	15	10	10	10	10	10	10	10	15	15
0.5 V	10	10	10	10	10	10	10	10	10	10	10

The expanded uncertainties given in this table are expressed in $\mu V/V$

Electricity and Magnetism, France, LNE (Laboratoire national de métrologie et d'essais)**uncertainties table: Matrix31**

Phase angles: sources and meters: LNE Internal Identifiers 214, 215, 216, 217, 218 and 219

	0.02 kHz	0.04 kHz	0.06 kHz	0.08 kHz	0.1 kHz	0.2 kHz	0.4 kHz	0.6 kHz	0.8 kHz	1 kHz	2 kHz	4 kHz	6 kHz	8 kHz	10 kHz	20 kHz
0.01 V	18	18	20	20	20	23	30	37	44	51	65	86	102	116	130	179
0.02 V	18	18	20	20	20	23	30	37	44	51	65	86	102	116	130	179
0.04 V	18	18	20	20	20	23	30	37	44	51	65	86	102	116	130	179
0.06 V	18	18	20	20	20	23	30	37	44	51	65	86	102	116	130	179
0.08 V	18	18	20	20	20	23	30	37	44	51	65	86	102	116	130	179
0.1 V	18	18	20	20	20	23	30	37	44	51	65	86	102	116	130	179
0.2 V	18	18	20	20	20	23	30	37	44	51	65	86	102	116	130	177
0.4 V	18	18	20	20	20	23	30	37	44	51	65	86	102	116	130	172
0.6 V	18	18	20	20	20	23	30	37	44	51	65	76	76	76	76	76
0.8 V	18	18	20	20	20	23	30	37	44	51	65	74	74	74	74	74
1 V	18	18	20	20	20	23	30	37	44	51	65	86	102	116	128	128
2 V	18	18	20	20	20	23	30	37	44	51	65	86	90	90	90	90
4 V	18	18	20	20	20	23	30	37	44	51	65	77	77	77	77	77
6 V	18	18	20	20	20	23	30	37	44	51	51	51	51	51	51	51
8 V	18	18	20	20	20	23	30	37	44	49	49	49	49	49	49	49
10 V	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116	116
20 V	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72
40 V	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
60 V	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51
70 V	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51
80 V	23	23	24	24	24	27	33	40	46	53	67	87	103	117	130	179
100 V	23	23	24	24	24	27	33	40	46	53	67	87	103	117	130	179
200 V	34	34	35	35	35	37	41	47	52	58	71	91	106	119	133	181
400 V	73	73	74	74	74	75	77	80	84	87	96	111	124	136	148	192
600 V	143	143	143	143	143	144	145	147	148	151	156	166	174	183	192	228
800 V	143	143	143	143	143	144	145	147	148	151	156	166	174	183	192	228
1000 V	143	143	143	143	143	144	145	147	148	151	156	166	174	183	192	228

The expanded uncertainties given in this table are expressed in μrad