

Electricity and Magnetism, Slovakia, SMU (Slovensky Metrologicky Ustav)

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		Expanded Uncertainty					Uncertainty Matrix	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?		
DC voltage sources: single values	DC voltage solid state standards	Direct method	1	1	V	Laboratory pressure	atmospheric pressure	200	nV	2	95%	No		2
DC voltage sources: single values	DC voltage solid state standards	Direct method	10	10	V	Laboratory pressure	atmospheric pressure	200	nV	2	95%	No		1
DC voltage sources: single values	Standard Weston cells	Direct method	1.018	1.018	V	Laboratory temperature	20 °C	200	nV	2	95%	No		3
DC voltage sources: low values	Digital voltmeters and calibrators	Direct method	0.01	10	V	Laboratory temperature	20 °C	500	nV	2	95%	No		4a
DC voltage sources: low values	Multifunction calibrator	Comparison with reference standard	100	100	mV			7	μV/V	2	95%	Yes		5
DC voltage sources: low values	Multifunction calibrator	Comparison with reference standard	1	1	V			4	μV/V	2	95%	Yes		6
DC voltage sources: low values	Multifunction calibrator	Comparison with reference standard	10	10	V			0.6	μV/V	2	95%	Yes		7
DC voltage sources: intermediate values	Multifunction calibrator	Comparison with reference standard	100	100	V			4	μV/V	2	95%	Yes		8
DC voltage sources: intermediate values	Multifunction calibrator	Comparison with reference standard	1000	1000	V			4	μV/V	2	95%	Yes		9
DC voltage meters: intermediate values	Digital voltmeters and calibrators	Direct method	0.01	10	V	Laboratory temperature	20 °C	500	nV	2	95%	No		4b
DC voltage meters: intermediate values	Digital multimeter	Direct measurement	10	10	V			0.6	μV/V	2	95%	Yes		10

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DC voltage meters: intermediate values	Digital multimeter	Resistive divider and DC voltage standard	100	100	V			4	$\mu\text{V/V}$	2	95%	Yes		11
DC voltage meters: intermediate values	Digital multimeter	Resistive divider and DC voltage standard	1000	1000	V			4	$\mu\text{V/V}$	2	95%	Yes		12
DC voltage meters: intermediate values	Digital multimeter	Direct with calibrator	100	100	mV			8	$\mu\text{V/V}$	2	95%	Yes		13
DC voltage meters: intermediate values	Digital multimeter	Direct with calibrator	1	1	V			4	$\mu\text{V/V}$	2	95%	Yes		14
DC voltage meters: intermediate values	Digital multimeter	Direct with calibrator	10	10	V			1.5	$\mu\text{V/V}$	2	95%	Yes		15
DC voltage meters: intermediate values	Digital multimeter	Direct with calibrator	100	100	V			4	$\mu\text{V/V}$	2	95%	Yes		16
DC voltage meters: intermediate values	Digital multimeter	Direct with calibrator	1	1	kV			4	$\mu\text{V/V}$	2	95%	Yes		17
DC resistance standards and sources: low values	Fixed resistor, resistance boxes	DCC bridge	0.01	0.1	$\text{m}\Omega$	Power	10 mW	30	$\mu\Omega/\Omega$	2	95%	Yes		18
DC resistance standards and sources: low values	Fixed resistor, resistance boxes	DCC bridge	0.1	1	$\text{m}\Omega$	Power	10 mW	10	$\mu\Omega/\Omega$	2	95%	Yes		19
DC resistance standards and sources: low values	Fixed resistor, resistance boxes	DCC bridge	1	10	$\text{m}\Omega$	Power	10 mW	5	$\mu\Omega/\Omega$	2	95%	Yes		20

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DC resistance standards and sources: low values	Fixed resistor, resistance boxes	DCC bridge	10	100	m Ω	Power	10 mW	2	$\mu\Omega/\Omega$	2	95%	Yes		21
DC resistance standards and sources: low values	Fixed resistor, resistance boxes	DCC bridge	0.1	1	Ω	Power	10 mW	1.2	$\mu\Omega/\Omega$	2	95%	Yes		22
DC resistance standards and sources: low values	Fixed resistor, resistance boxes	DCC bridge	1	1	Ω	Power	10 mW	1	$\mu\Omega/\Omega$	2	95%	Yes		23
DC resistance standards and sources: intermediate values	Fixed resistor, resistance boxes	DCC bridge	10	10	k Ω	Power	10 mW	1.2	$\mu\Omega/\Omega$	2	95%	Yes		24
DC resistance standards and sources: intermediate values	Fixed resistor, resistance boxes	DCC bridge	1	100	Ω	Power	10 mW	1.2	$\mu\Omega/\Omega$	2	95%	Yes		25
DC resistance standards and sources: intermediate values	Fixed resistor, resistance boxes	DCC bridge	100	10000	Ω	Power	10 mW	1.8	$\mu\Omega/\Omega$	2	95%	Yes		26
DC resistance standards and sources: intermediate values	Fixed resistor, resistance boxes	Resistance ratio bridge	10	100	k Ω	Voltage	< 12 V	3	$\mu\Omega/\Omega$	2	95%	Yes		27
DC resistance standards and sources: intermediate values	Fixed resistor, resistance boxes	Resistance ratio bridge	0.1	1	M Ω	Voltage	< 12 V	5	$\mu\Omega/\Omega$	2	95%	Yes		28

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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?		
DC resistance standards and sources: high values	Fixed resistor, three terminal resistor, resistance boxes	High resistance ratio bridge	1	10	M Ω	Voltage	10 V to 100 V	8	$\mu\Omega/\Omega$	2	95%	Yes		29
DC resistance standards and sources: high values	Fixed resistor, three terminal resistor, resistance boxes	High resistance ratio bridge	10	100	M Ω	Voltage	10 V to 100 V	15	$\mu\Omega/\Omega$	2	95%	Yes		30
DC resistance standards and sources: high values	Fixed resistor, three terminal resistor, resistance boxes	High resistance ratio bridge	0.1	1	G Ω	Voltage	10 V to 100 V	30	$\mu\Omega/\Omega$	2	95%	Yes		31
DC resistance standards and sources: high values	Fixed resistor, three terminal resistor, resistance boxes	High resistance ratio bridge	1	10	G Ω	Voltage	10 V to 100 V	100	$\mu\Omega/\Omega$	2	95%	Yes		32
DC resistance standards and sources: high values	Fixed resistor, three terminal resistor, resistance boxes	High resistance ratio bridge	10	100	G Ω	Voltage	40 V to 100 V	300	$\mu\Omega/\Omega$	2	95%	Yes		33
DC resistance standards and sources: high values	Fixed resistor, three terminal resistor, resistance boxes	High resistance ratio bridge	0.1	1	T Ω	Voltage	40 V to 100 V	1000	$\mu\Omega/\Omega$	2	95%	Yes		34
DC resistance standards and sources: standards for high current	Fixed resistor, DC shunt	DCC bridge	0.01	100	m Ω	Current	1 A to 100 A	50	$\mu\Omega/\Omega$	2	95%	Yes		35
DC resistance standards and sources: multiple ranges	Multifunction calibrator	DCC bridge, resistance ratio bridge	0.001	10000	k Ω	Power	10 mW	8	$\mu\Omega/\Omega$	2	95%	Yes		36
DC resistance standards and sources: temperature coefficients	Fixed resistor	DCC bridge, resistance ratio bridge	0.5	50	$\mu\Omega/\Omega/K$	Temperature	18 °C to 25 °C	1 to 5	$\mu\Omega/\Omega/K$	2	95%	No		37

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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?		
						Resistance	0.1 mΩ to 100 kΩ							
DC resistance meters: low values	Microohmmeter, multimeter, transfer standards, resistance bridge	Direct measurement standards resistor or direct comparison	0.0001	1	Ω	Resistance	decadic values	100 to 2	μΩ/Ω	2	95%	Yes		38
						Power	10 mW							
DC resistance meters: intermediate values	Ohmmeter, multimeter, multifunction transfer standard, resistance bridge	Direct measurement standards resistor or direct comparison	1	1E+06	Ω	Resistance	decadic values	2 to 15	μΩ/Ω	2	95%	Yes		39
						Power	10 mW							
DC resistance meters: intermediate values	Multimeter, multifunction transfer standard, teraohmmeter, resistance bridge	Direct measurement standards resistor or direct comparison	1E+06	1E+09	Ω	Resistance	decadic values	15 to 150	μΩ/Ω	2	95%	Yes		40a
						Voltage	10 V to 100 V							
DC resistance meters: high values	Multimeter, multifunction transfer standard, teraohmmeter, resistance bridge	Direct measurement standards resistor or direct comparison	1E+09	1E+12	Ω	Resistance	decadic values	150 to 5000	μΩ/Ω	2	95%	Yes		40b
						Voltage	10 V to 100 V							
DC current sources: low values	Multifunction calibrator	Shunt and multimeter, voltage drop across resistor	20	100	μA			5.7	μA/A	2	95%	Yes		41a
DC current sources: intermediate values	Multifunction calibrator	Shunt and multimeter, voltage drop across resistor	0.1	200	mA			5.7	μA/A	2	95%	Yes		42
DC current sources: intermediate values	Multifunction calibrator	Shunt and multimeter, voltage drop across resistor	0.2	2	A			7.3	μA/A	2	95%	Yes		45

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DC current sources: intermediate values	Transconductance amplifier	Shunt and multimeter, voltage drop across resistor	2	20	A			6.1	μA/A	2	95%	Yes		46
DC current meters: low values	Digital multimeter	Calibrator, shunt and multimeter, voltage drop across resistor	20	100	μA			5.7	μA/A	2	95%	Yes		47a
DC current meters: intermediate values	Digital multimeter	Calibrator, shunt and multimeter, voltage drop across resistor	0.1	200	mA			5.7	μA/A	2	95%	Yes		48
DC current meters: intermediate values	Digital multimeter	Calibrator, shunt and multimeter, voltage drop across resistor	0.2	2	A			7.3	μA/A	2	95%	Yes		51
DC current meters: intermediate values	Digital multimeter	Calibrator, shunt and multimeter, voltage drop across resistor	2	20	A			6.1	μA/A	2	95%	Yes		52
AC resistance: real component	Fixed resistor, resistance boxes	Comparison with AC ratio bridge	1	10	Ω	Frequency	50 Hz to 1600 Hz	4	μΩ/Ω	2	95%	Yes		53
AC resistance: real component	Fixed resistor, resistance boxes	Comparison with AC ratio bridge	10	100	Ω	Frequency	50 Hz to 1600 Hz	2	μΩ/Ω	2	95%	Yes		54
AC resistance: real component	Fixed resistor, resistance boxes	Comparison with AC ratio bridge	100	1000	Ω	Frequency	50 Hz to 1600 Hz	3	μΩ/Ω	2	95%	Yes		55
AC resistance: real component	Fixed resistor, resistance boxes	Comparison with AC ratio bridge	1	10	kΩ	Frequency	50 Hz to 1600 Hz	5	μΩ/Ω	2	95%	Yes		56
Capacitance: low loss capacitors	Standard capacitor (air, fused silica)	Comparison with transformer bridge	10	10	pF	Frequency	1 kHz	5	μF/F	2	95%	Yes		57
Capacitance: low loss capacitors	Standard capacitor (air, fused silica)	Comparison with transformer bridge	10	100	pF	Frequency	1 kHz	10	μF/F	2	95%	Yes		58
Capacitance: low loss capacitors	Standard capacitor (air, fused silica)	Comparison with transformer bridge	1	1	nF	Frequency	1 kHz	20	μF/F	2	95%	Yes		59
Capacitance: low loss capacitors	Standard capacitor (air, fused silica)	Comparison with transformer bridge	10	10	nF	Frequency	1 kHz	40	μF/F	2	95%	Yes		60

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Capacitance: low loss capacitors	Standard capacitor (air, fused silica)	Comparison with transformer bridge	100	100	nF	Frequency	1 kHz	60	μF/F	2	95%	Yes		61
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor	Comparison with transformer bridge	1	1	μF	Frequency	1 kHz	120	μF/F	2	95%	Yes		62
Capacitance: dielectric capacitors	Fixed capacitor, variable capacitor	Comparison with transformer bridge	10	10	μF	Frequency	1 kHz	300	μF/F	2	95%	Yes		63
Capacitance: dielectric capacitors	Variable capacitor, capacitance box	Comparison with transformer bridge	0.001	10000	nF	Frequency	1 kHz	10 to 500	μF/F	2	95%	Yes		64
AC voltage up to 1000 V: sources	Multifunction calibrator	Comparison with reference standard	0.5	1000	V	Frequency	40 Hz to 40 kHz	120 to 480	μV/V	2	95%	Yes	Matrix 1	65
AC voltage up to 1000 V: meters	Digital multimeter	Comparison with reference standard	0.5	1000	V	Frequency	40 Hz to 40 kHz	120 to 480	μV/V	2	95%	Yes	Matrix 1	75
AC current up to 100 A: sources	Multifunction calibrator	AC/DC transfer standard and shunt	20	200	mA	Frequency	50 Hz	120	μA/A	2	95%	Yes		85
AC current up to 100 A: sources	Multifunction calibrator	AC/DC transfer standard and shunt	0.2	2	A	Frequency	50 Hz	120	μA/A	2	95%	Yes		86
AC current up to 100 A: meters	Digital multimeter	Calibrator AC/DC transfer standard and shunt	20	200	mA	Frequency	50 Hz	120	μA/A	2	95%	Yes		87
AC current up to 100 A: meters	Digital multimeter	Calibrator AC/DC transfer standard and shunt	0.2	2	A	Frequency	50 Hz	120	μA/A	2	95%	Yes		88
AC power and energy: single phase (f ≤ 400 Hz), active power	Power meter	Direct comparison with reference standard	12.5	1100	W	Power factor	1, 0.5 (inductive or capacitive)	(120 to 160), depending on power factor	μW/W	2	95%	Yes		89
						Voltage	50 V to 220 V							

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						Current	0.5 A to 5 A							
						Frequency	50 Hz							
AC power and energy: single phase ($f \leq 400$ Hz), active energy	Energy meter	Direct comparison with reference standard	125	11000	Ws	Power factor	1, 0.5 (inductive or capacitive)	(120 to 160), depending on power factor	$\mu\text{Wh}/\text{Wh}$	2	95%	Yes		90
						Voltage	50 V to 220 V							
						Current	0.5 A to 5 A							
						Frequency	50 Hz							
						Time	10 s							
RF power: absolute power on coaxials	Power meters	Power sensors	10	1000	μW	Frequency	10 MHz to 18 GHz	25	mW/W	2	95%	Yes		91
						Coaxial line	50 Ω							
						Connector	N							
RF power: absolute power on coaxials	Power meters	Power sensors	1	1000	mW	Frequency	10 MHz to 18 GHz	16	mW/W	2	95%	Yes		92
						Coaxial line	50 Ω							
						Connector	N							
RF power: absolute power on waveguides	Power meters	Power sensors	1	10	mW	Frequency	8.2 GHz to 12.4 GHz	8.5	mW/W	2	95%	Yes		93
						Waveguide	WR-90							
RF voltage sources	RF generators	RF/DC transfer	0.2	30	V	Frequency	0.05 MHz to 50 MHz	0.2 to 10	mV/V	2	95%	Yes	Matrix 2	94a
RF voltage sources	RF generators	Bolometer method	0.1	1	V	Frequency	20 MHz to 1000 MHz	4 to 16	mV/V	2	95%	Yes		97a
RF voltage sources	RF generators	Attenuation of RF voltage	1	1E+05	μV	Frequency	0.1 MHz to 1000 MHz	20 to 100	mV/V	2	95%	Yes		98a
RF voltage meters	RF voltmeters	RF/DC transfer	0.2	30	V	Frequency	0.05 MHz to 50 MHz	0.2 to 10	mV/V	2	95%	Yes	Matrix 2	94b
RF voltage meters	RF voltmeters	Bolometer method	0.1	1	V	Frequency	20 MHz to 1000 MHz	4 to 16	mV/V	2	95%	Yes		97b
RF voltage meters	RF voltmeter	Attenuation of RF voltage	1	1E+05	μV	Frequency	0.1 MHz to 1000 MHz	20 to 100	mV/V	2	95%	Yes		98b

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Uncertainty matrix: Matrix 1

AC voltage up to 1000 V: sources and meters. Internal identifiers: 65 and 75

	40 Hz	1 kHz	10 kHz	20 kHz	40 kHz
0.5 V/ 500 V	120	120	120	120	120
500 V/1000 V	240	240	240	240	480

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

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Uncertainty matrix: Matrix 2

RF voltage sources and meters. Internal identifiers: 94a and 94b

	0.05 MHz	1 MHz	10 MHz	20 MHz	30 MHz	50 MHz
0.2 V/2 V	0.2	0.5	1	1.5	2	5
2 V/30 V	2	2	3	4	5	10

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