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

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**	**NMI Service Identifier**	**Comments**
DC voltage sources: single values	DC voltage solid state standards, standard Weston cells	Direct method	1	10	V	Fixed voltage	1 V, 1.018 V, 10 V	200	nV	2	95%	No	Matrix111	2	Approved on 06 August 2013
DC voltage sources: low values	Digital voltmeters and calibrators	Direct method, comparison with reference standard	0.01	10	V	Laboratory temperature	20 °C	0.6 to 50	μV/V	2	95%	Yes	Matrix112	4a	Approved on 06 August 2013
DC voltage sources: intermediate values	Multifunction calibrator	Comparison with reference standard	100	1000	V	Fixed voltage	100 V, 1000 V	4	μV/V	2	95%	Yes	Matrix113	8	Approved on 06 August 2013
DC voltage meters: intermediate values	Digital voltmeters and calibrators	Direct method	0.01	1000	V	Laboratory temperature	20 °C	0.6 to 50	μV/V	2	95%	Yes	Matrix122	4b	Approved on 06 August 2013
DC resistance standards and sources: low values	Fixed resistor, resistance boxes	DCC bridge	0.01	1000	mΩ	Power	10 mW	1.2 to 30	μΩ/Ω	2	95%	Yes	Matrix211	18	Approved on 06 August 2013
DC resistance standards and sources: low values	Fixed resistor, resistance boxes	DCC bridge	1	1	Ω	Power	10 mW	1	μΩ/Ω	2	95%	Yes	Matrix211	23	Approved on 06 August 2013
DC resistance standards and sources: intermediate values	Fixed resistor, resistance boxes	DCC bridge	10	10	kΩ	Power	10 mW	1.2	μΩ/Ω	2	95%	Yes	Matrix211	24	Approved on 06 August 2013
DC resistance standards and sources: intermediate values	Fixed resistor, resistance boxes	DCC bridge	1	10000	Ω	Power	10 mW	1.2 to 1.8	μΩ/Ω	2	95%	Yes	Matrix211	25	Approved on 06 August 2013
DC resistance standards and sources: intermediate values	Fixed resistor, resistance boxes	Resistance ratio bridge	10	1000	kΩ	Voltage	< 12 V	3 to 5	μΩ/Ω	2	95%	Yes	Matrix211	27	Approved on 06 August 2013

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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**	**NMI Service Identifier**	**Comments**
DC resistance standards and sources: high values	Fixed resistor, three terminal resistor, resistance boxes	High resistance ratio bridge	0.001	1000	GΩ	Voltage	10 V to 100 V	8 to 1000	μΩ/Ω	2	95%	Yes	Matrix213	29	Approved on 06 August 2013
DC resistance standards and sources: standards for high current	Fixed resistor, DC shunt	DCC bridge	0.01	100	mΩ	Current	1 A to 100 A	50	μΩ/Ω	2	95%	Yes		35	Approved on 06 August 2013
DC resistance standards and sources: multiple ranges	Multifunction calibrator	DCC bridge, resistance ratio bridge	0.001	10000	kΩ	Power	10 mW	8	μΩ/Ω	2	95%	Yes		36	Approved on 06 August 2013
DC resistance standards and sources: temperature coefficients	Fixed resistor	DCC bridge, resistance ratio bridge	0.5	50	(μΩ/Ω)/K	Temperature	18 °C to 25 °C	1 to 5	(μΩ/Ω)/K	2	95%	No		37	Approved on 06 August 2013
						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	Approved on 06 August 2013
						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	Approved on 06 August 2013
						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	Approved on 06 August 2013
						Voltage	10 V to 100 V								

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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**	**NMI Service Identifier**	**Comments**
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	Approved on 06 August 2013
						Voltage	10 V to 100 V								
DC current sources: low values	Multifunction calibrator	Shunt and multimeter, voltage drop accross resistor	0.02	0.1	mA			5.7	μA/A	2	95%	Yes	Matrix311	41a	Approved on 06 August 2013
DC current sources: intermediate values	Multifunction calibrator	Shunt and multimeter, voltage drop accross resistor	0.0001	20	A			5.7 to 7.3	μA/A	2	95%	Yes	Matrix311	42	Approved on 06 August 2013
DC current meters: low values	Digital multimeter	Calibrator, shunt and multimeter, voltage drop accross resistor	0.02	0.1	mA			5.7	μA/A	2	95%	Yes	Matrix311	47a	Approved on 06 August 2013
DC current meters: intermediate values	Digital multimeter	Calibrator, shunt and multimeter, voltage drop accross resistor	0.0001	20	A			5.7 to 7.3	μA/A	2	95%	Yes	Matrix311	48	Approved on 06 August 2013
AC resistance: real component	Fixed resistor, resistance boxes	Comparison with AC ratio bridge	1	10000	Ω	Frequency	50 Hz to 1600 Hz	2 to 5	μΩ/Ω	2	95%	Yes	Matrix411	53	Approved on 06 August 2013
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	Approved on 06 August 2013
Capacitance: low loss capacitors	Standard capacitor (air, fused silica)	Comparison with transformer bridge	0.01	10000	nF	Frequency	1 kHz	10 to 300	μF/F	2	95%	Yes	Matrix421	58	Approved on 06 August 2013
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	Matrix422	64	Approved on 06 August 2013
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	Matrix521	65	Approved on 06 August 2013
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	Matrix521	75	Approved on 06 August 2013

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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**	**NMI Service Identifier**	**Comments**
AC current up to 100 A: sources	Multifunction calibrator	AC-DC transfer standard and shunt	0.02	2	A	Frequency	50 Hz	120	µA/A	2	95%	Yes		85	Approved on 06 August 2013
AC current up to 100 A: meters	Digital multimeter	Calibrator AC-DC transfer standard and shunt	0.02	2	A	Frequency	50 Hz	120	µA/A	2	95%	Yes		87	Approved on 06 August 2013
AC power and energy: single phase (*f* <= 400 Hz), active power	Power meter, power converter, wattmeter	Direct comparison with reference standard	1.25	30000	W	Power factor	1, 0.5 (inductive or capacitive)	80 to 120, depending on power factor	µW/VA	2	95%	Yes		89b	Approved on 06 August 2013
						Voltage	50 V to 300 V								
						Current	0.05 A to 100 A								
						Frequency	45 Hz to 65 Hz								
AC power and energy: single phase (*f* <= 400 Hz), active energy	Energy meter	Direct comparison with reference standard	12.5	3E+06	Ws	Power factor	1, 0.5 (inductive or capacitive)	80 to 120, depending on power factor	µWh/VAh	2	95%	Yes		89a	Approved on 06 August 2013
						Voltage	50 V to 300 V								
						Current	0.05 A to 100 A								
						Frequency	45 Hz to 65 Hz								
						Time	10 s to 100 s								
AC power and energy: three phase, active power	Power meter	Direct comparison with reference standard	7.5	90000	W	Power factor	1, 0.5 (inductive or capacitive)	120 to 160, depending on power factor	µW/VA	2	95%	Yes		90b	Approved on 06 August 2013
						Voltage	50 V to 300 V								
						Current	0.1 A to 100 A								
						Frequency	45 Hz to 65 Hz								
AC power and energy: three phase, active energy	Energy meter	Direct comparison with reference standard	75	9E+06	Ws	Power factor	1, 0.5 (inductive or capacitive)	120 to 160, depending on power factor	µWh/VAh	2	95%	Yes		90a	Approved on 06 August 2013
						Voltage	50 V to 300 V								
						Current	0.1 A to 100 A								
						Frequency	45 Hz to 65 Hz								
						Time	10 s to 100 s								
RF power: absolute power on coaxials	Power meters	Power sensors	0.01	1000	mW	Frequency	10 MHz to 18 GHz	16 to 25	mW/W	2	95%	Yes	Matrix1111	91	Approved on 06 August 2013

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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**	**NMI Service Identifier**	**Comments**
						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	Approved on 06 August 2013
						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	Matrix1172a	94a	Approved on 06 August 2013
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	Approved on 06 August 2013
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	Approved on 06 August 2013
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	Matrix1172a	94b	Approved on 06 August 2013
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	Approved on 06 August 2013
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	Approved on 06 August 2013

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Matrix111

	Expanded uncertainty / nV
1 V	200
1.018 V	200
10 V	200

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Matrix112

	Expanded uncertainty / μV	Method of measurement	Reference standard used in calibration
10 mV to 10 V	0.5	Direct method	JAVS
100 mV	7*U*	Comparison with reference standard	Digital multimeter
1 V	4*U*	Comparison with reference standard	10 V reference and resistive divider
10 V	0.6*U*	Comparison with reference standard	10 V reference

Voltage *U* is in volt

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Matrix113

	Expanded uncertainty / (μV/V)
100 V	4
1000 V	4

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Matrix122

	Expanded uncertainty / μV	Method of measurement	Reference standard used in calibration
10 mV to 10 V	0.5	Direct method	JAVS
10 V	0.6*U*	Direct measurement	DC voltage standard
100 V	4*U*	Resistive divider and DC voltage standard	Resistive divider plus DC standard
1000 V	4*U*	Resistive divider and DC voltage standard	Resistive divider plus DC standard
0.1 V	*8U*	Direct with calibrator	Calibrator
1 V	4*U*	Direct with calibrator	Calibrator
10 V	1.5*U*	Direct with calibrator	Calibrator
100 V	4*U*	Direct with calibrator	Calibrator
1000 V	4*U*	Direct with calibrator	Calibrator

Voltage *U* is in volt

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Matrix211

	Expanded uncertainty / (μΩ/Ω)
0.01 mΩ to 0.1 mΩ	30
0.1 mΩ to 1 mΩ	10
1 mΩ to 10 mΩ	5
10 mΩ to 100 mΩ	2
0.1 Ω to 1 Ω	1.2
1 Ω	1
10000 Ω	1.2
1 Ω to 100 Ω	1.2
100 Ω to 10000 Ω	1.8
10 kΩ to 100 kΩ	3
0.1 MΩ to 1 MΩ	5

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Matrix213

	10 V to 100 V	40 V to 100 V
1 MΩ to 10 MΩ	8	-
10 MΩ to 100 MΩ	15	-
0.1 GΩ to 1 GΩ	30	-
1 GΩ to 10 GΩ	100	-
10 GΩ to 100 GΩ	-	300
0.1 TΩ to 1 TΩ	-	1000

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

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Matrix311

	Expanded uncertainty / (μA/A)
0.02 mA to 0.1 mA	5.7
0.1 mA to 200 mA	5.7
0.2 A to 2 A	7.3
2 A to 20 A	6.1

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Matrix411

	Expanded uncertainty / (μΩ/Ω)
1 Ω to 10 Ω	4
10 Ω to 100 Ω	2
100 Ω to 1000 Ω	3
1 kΩ to 10 kΩ	5

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Matrix421

	Expanded uncertainty / (μF/F)
10 pF, 100 pF	10
1 nF	20
10 nF	40
100 nF	60
1000 nF	120
10000 nF	300

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Matrix422

	Expanded uncertainty / (μF/F)
1 pF, 10 pF	10
1 nF	20
10 nF	50
100 nF	100
1000 nF	250
10000 nF	500

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Matrix521

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

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

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Matrix1172a

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

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

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

Matrix1111

	Expanded uncertainty / (mW/W)
0.01 mW to 1 mW	25
1 mW to 1000 mW	16