

## Electricity and Magnetism, Ukraine, UkrCSM (Ukrmetrteststandard), NSCIM (National Scientific Center - Institute of Metrology)

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 voltage	Thermal converter with amplifier, AC-DC transfer standard	Comparison	0.1	0.5	V	Frequency	10 Hz to 1 MHz	10 to 140	μV/V	2	95%	Yes	<a href="#">Matrix 5.1</a>	Approved on 15 December 2008	UkrCSM/1
AC voltage: AC-DC transfer difference at medium voltage	Thermal converter, AC-DC transfer standard	Comparison	0.5	5	V	Frequency	10 Hz to 1 MHz	4 to 45	μV/V	2	95%	Yes	<a href="#">Matrix 5.1</a>	Approved on 15 December 2008	UkrCSM/2
AC voltage: AC-DC transfer difference at higher voltage	Thermal converter with range resistor, AC-DC transfer standard	Comparison	5	1000	V	Frequency	10 Hz to 1 MHz	6 to 120	μV/V	2	95%	Yes	<a href="#">Matrix 5.1</a>	Approved on 15 December 2008	UkrCSM/3
AC voltage up to 1000 V: sources	Multifunction calibrator	AC-DC transfer standard	0.1	1000	V	Frequency	10 Hz to 1 MHz	20 to 400	μV/V	2	95%	Yes	<a href="#">Matrix 5.2</a>	Approved on 15 December 2008	UkrCSM/4
AC voltage up to 1000 V: meters	AC voltmeter, multimeter, multifunction transfer standard	AC-DC transfer standard	0.1	1000	V	Frequency	10 Hz to 1 MHz	20 to 400	μV/V	2	95%	Yes	<a href="#">Matrix 5.2</a>	Approved on 15 December 2008	UkrCSM/5
High DC voltage: sources	DC kilovolt source	Direct measurement	1	180	kV	Temperature	(20 ± 5) °C	1.2E-03		2	95%	Yes		Approved on 15 December 2008	UkrCSM/6
High DC voltage: meters	DC kilovolt-meter, dedicated set-up for high voltage	Direct measurement	1	180	kV	Temperature	(20 ± 5) °C	3.6E-04		2	95%	Yes		Approved on 15 December 2008	UkrCSM/7
High DC voltage: ratio	High voltage resistive divider, DC high voltage probe	Indirect measurement	1	180	kV	Temperature	(20 ± 5) °C	5.6E-04		2	95%	Yes		Approved on 15 December 2008	UkrCSM/8
High AC voltage: sources	High voltage AC source	Direct measurement	1	220	kV	Frequency	50 Hz	6E-04		2	95%	Yes		Approved on 15 December 2008	UkrCSM/9
High AC voltage: meters	AC high voltage meters, dedicated set-up for high voltage measurements	Indirect measurement	1	220	kV	Frequency	50 Hz	6E-04		2	95%	Yes		Approved on 15 December 2008	UkrCSM/10
High AC voltage ratio: error	High voltage transformer	Comparison by means of a comparator	0	0.01		Frequency	50 Hz	7E-05 to 3E-04		2	95%	Yes		Approved on 15 December 2008	UkrCSM/11
						Voltage	1 kV to 220 kV								

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High AC voltage ratio: phase displacement	High voltage transformer	Comparison by means of a comparator	15E-06	0.058	rad	Frequency	50 Hz	1.7E-04 to 7.5E-04	rad	2	95%	Yes		Approved on 15 December 2008	UkrCSM/12
						Voltage	1 kV to 220 kV								
High AC current ratio: error	Current transformer	Comparison by means of a comparator	0	0.05		Frequency	50 Hz	6E-05 to 8E-05		2	95%	Yes		Approved on 15 December 2008	UkrCSM/13
						Primary current	0.5 A to 10000 A								
						Secondary current	0.5 A, 1 A, 2 A, 2.5 A, 5 A								
High AC current ratio: phase displacement	Current transformer	Comparison by means of a comparator	3E-05	0.058	rad	Frequency	50 Hz	1E-04 to 1E-03	rad	2	95%	Yes		Approved on 15 December 2008	UkrCSM/14
						Primary current	0.5 A to 10000 A								
						Secondary current	0.5 A, 1 A, 2 A, 2.5 A, 5 A								
Capacitance: low loss capacitors	Standard capacitor	Transformer bridge	10	10	pF	Frequency	1 kHz, 1.592 kHz	1	μF/F	2	95%	Yes		Approved on 28 July 2010	UkrCSM/15
Capacitance: low loss capacitors	Standard capacitor	Transformer bridge	100	100	pF	Frequency	1 kHz, 1.592 kHz	1	μF/F	2	95%	Yes		Approved on 28 July 2010	UkrCSM/16
Capacitance: low loss capacitors	Standard capacitor	Transformer bridge	1	1000	pF	Frequency	1 kHz, 1.592 kHz	12	μF/F	2	95%	Yes		Approved on 28 July 2010	UkrCSM/17
Capacitance: dielectric capacitors	Standard capacitor	Transformer bridge	1	10	nF	Frequency	1 kHz, 1.592 kHz	14	μF/F	2	95%	Yes		Approved on 28 July 2010	UkrCSM/18
Capacitance: dissipation factor for low loss capacitors	Standard capacitor	Transformer bridge	1E-05	0.01		Capacitance	10 pF, 100 pF	8E-05		2	95%	No		Approved on 28 July 2010	UkrCSM/19
						Frequency	1 kHz								
Capacitance: meter	Capacitance bridge, LCR meter	Comparison to capacitance standard	1	1000	pF	Frequency	1 kHz, 1.592 kHz	12	μF/F	2	95%	No		Approved on 28 July 2010	UkrCSM/20
Capacitance: meter	Capacitance bridge, LCR meter	Comparison to capacitance standard	1	10	nF	Frequency	1 kHz, 1.592 kHz	14	μF/F	2	95%	No		Approved on 28 July 2010	UkrCSM/21

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Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty Matrix	Comments	NMI Service Identifier
Inductance: self inductance, low values	Fixed inductance, inductance box	Transformer bridge	1	1000	μH	Frequency	1 kHz	10	mH/H	2	95%	Yes		Approved on 28 July 2010	UkrCSM/22
Inductance: self inductance, intermediate values	Fixed inductance, inductance box	Transformer bridge	1	1000	mH	Frequency	1 kHz	10	mH/H	2	95%	Yes		Approved on 28 July 2010	UkrCSM/23
Inductance: self inductance, high values	Fixed inductance, inductance box	Transformer bridge	1	10	H	Frequency	1 kHz	10	mH/H	2	95%	Yes		Approved on 28 July 2010	UkrCSM/24
Inductance: meter	LCR meter	Comparison to inductance standard	1	1E+07	μH	Frequency	1 kHz	10	mH/H	2	95%	Yes		Approved on 28 July 2010	UkrCSM/25
Inductance: quality factor	Q standard	Transformer bridge	100	1000		Frequency	1 kHz	100		2	95%	No		Approved on 28 July 2010	UkrCSM/26
						Inductance	0.001 mH to 10 mH								
AC power and energy: single phase ( $f \leq 400$ Hz), active power	Power meter, power converter, wattmeter	Direct measurement	1	6000	W	Voltage	10 V to 600 V	30 to 50	μW/VA	2	95%	Yes	<a href="#">Matrix 7.1</a>	Approved on 28 July 2010	UkrCSM/27
						Current	0.1 A to 10 A								
						Frequency	40 Hz to 70 Hz								
						Power factor	1 to 0.5, inductive or capacitive								
AC power and energy: three phase ( $f \leq 400$ Hz), active power	Power meter, power converter, wattmeter	Direct measurement	1	10392	W	Voltage	10 V to 600 V	30 to 50	μW/VA	2	95%	Yes	<a href="#">Matrix 7.1</a>	Approved on 28 July 2010	UkrCSM/28
						Current	0.1 A to 10 A								
						Frequency	40 Hz to 70 Hz								
						Power factor	1 to 0.5, inductive or capacitive								
AC power and energy: single phase ( $f \leq 400$ Hz), reactive power	Power meter, power comparator	Direct measurement	1	6000	var	Voltage	10 V to 600 V	60 to 80	μvar/VA	2	95%	Yes	<a href="#">Matrix 7.2</a>	Approved on 28 July 2010	UkrCSM/29

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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	Comments	NMI Service Identifier
						Current	0.1 A to 10 A								
						Frequency	40 Hz to 70 Hz								
						Sine phi	1 i/c to 0.5, inductive or capacitive								
AC power and energy: three phase ( $f \leq 400$ Hz), reactive power	Power meter, power comparator	Direct measurement	1	10392	var	Voltage	10 V to 600 V	60 to 80	$\mu\text{var}/\text{VA}$	2	95%	Yes	<a href="#">Matrix 7.2</a>	Approved on 28 July 2010	UkrCSM/30
						Current	0.1 A to 10 A								
						Frequency	40 Hz to 70 Hz								
						Sine phi	1 i/c to 0.5, inductive or capacitive						-		
AC power and energy: single phase ( $f \leq 400$ Hz), active energy	Energy meter	Direct measurement	0.025	6E+06	Ws	Voltage	10 V to 500 V	85	$\mu\text{Wh}/\text{VA h}$	2	95%	Yes		Approved on 28 July 2010	UkrCSM/31
						Current	0.01 A to 120 A								
						Frequency	40 Hz to 70 Hz								
						Power factor	1 to 0.25, inductive or capacitive								
						Measurement time	1 s to 100 s								
AC power and energy: three phase ( $f \leq 400$ Hz), active energy	Energy meter	Direct measurement	0	10E+06	Ws	Voltage	10 V to 500 V	85	$\mu\text{Wh}/\text{VA h}$	2	95%	Yes		Approved on 28 July 2010	UkrCSM/32
						Current	0.01 A to 120 A								
						Frequency	40 Hz to 70 Hz								
						Power factor	1 to 0.25, inductive or capacitive								
						Measurement time	1 s to 100 s								
AC power and energy: single phase ( $f \leq 400$ Hz), reactive energy	Energy meter	Direct measurement	0.025	6E+06	vars	Voltage	10 V to 500 V	140	$\mu\text{varh}/\text{V Ah}$	2	95%	Yes		Approved on 28 July 2010	UkrCSM/33

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Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty Matrix	Comments	NMI Service Identifier
						Current	0.01 A to 120 A								
						Frequency	40 Hz to 70 Hz								
						Sine phi	1 i/c to 0.25, inductive or capacitive								
						Measurement time	1 s to 100 s								
AC power and energy: three phase ( $f \leq 400$ Hz), reactive energy	Energy meter	Direct measurement	0	10E+06	vars	Voltage	10 V to 500 V	140	$\mu\text{varh}/\text{V Ah}$	2	95%	Yes		Approved on 28 July 2010	UkrCSM/34
						Current	0.01 A to 120 A								
						Frequency	40 Hz to 70 Hz								
						Sine phi	1 i/c to 0.25, inductive or capacitive								
						Measurement time	1 s to 100 s								
DC resistance standards and sources: low values	Fixed resistor	Bridge by substitution and resistance ratio set	1E-03	1E-01	$\Omega$	Temperature	19.5 °C to 20.5 °C	2 to 3	$\mu\Omega/\Omega$	2	95%	Yes	<a href="#">Matrix 2A</a>	Approved on 28 April 2010	NSCIM/4
DC resistance standards and sources: intermediate values	Fixed resistor	Bridge by substitution, Hamon transfer	1	1E+06	$\Omega$	Temperature	19.5 °C to 20.5 °C	200 to 1600	$\text{n}\Omega/\Omega$	2	95%	Yes	<a href="#">Matrix 2B</a>	Approved on 28 April 2010	NSCIM/5
DC resistance standards and sources: high values	Fixed resistor	Bridge by substitution, Hamon transfer	1E+07	1E+09	$\Omega$	Temperature	19.5 °C to 20.5 °C	10 to 60	$\mu\Omega/\Omega$	2	95%	Yes	<a href="#">Matrix 2C</a>	Approved on 28 April 2010	NSCIM/6
Magnetic fields below 50 kHz: DC magnetic flux density	Magnetic inductance meter	Nuclear magnetic resonance	0.05	2	T			4E-06	T/T	2	95%	Yes		Approved on 28 April 2010	NSCIM/7
Radio frequency power: absolute power on coaxial line	Power meter, power source	Direct comparison, comparison with comparator	1E-03	1E-02	W	Frequency	0.03 GHz to 18.0 GHz	1.1E-02	W/W	2	95%	Yes		Approved on 28 April 2010	NSCIM/8
						Connector type	III GOST R13317								

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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	Comments	NMI Service Identifier
Radio frequency power: calibration factor and effective efficiency on coaxial line	Thermistor, barretter	Direct comparison, comparison with comparator	8E-01	1		Frequency	0.03 GHz to 18.0 GHz	1.1E-02	W/W	2	95%	Yes		Approved on 28 April 2010	NSCIM/9
						Connector type	III GOST R13317								
Radio frequency power: absolute power in waveguide	Power meter, power source	Direct comparison, comparison with comparator	1E-03	1E-02	W	Frequency	37.5 GHz to 178.6 GHz	1.1E-02 to 1.5E-02	W/W	2	95%	Yes	<a href="#">Matrix 11A</a>	Approved on 28 April 2010	NSCIM/10
Radio frequency power: calibration factor and effective efficiency in waveguide	Thermistor, barretter	Direct comparison, comparison with comparator	6E-01	1		Frequency	37.5 GHz to 178.6 GHz	1.1E-02 to 1.5E-02	W/W	2	95%	Yes	<a href="#">Matrix 11A</a>	Approved on 28 April 2010	NSCIM/11
Signal and pulse characteristics: modulation, AM	Signal generator, modulation meter	Comparison with comparator, direct measurement	0.1	100	%	Carrier frequency	0.01 MHz to 500 MHz	(0.002M + 0.05), M AM coefficient	% (unit of M)	2	95%	No		Approved on 28 April 2010	NSCIM/12
						Modulation frequency	0.02 kHz to 200 kHz								
Signal and pulse characteristics: modulation, FM	Signal generator, modulation meter	Comparison with comparator	1E+02	1E+06	Hz	Carrier frequency	0.1 MHz to 10 GHz	(0.0025df + 10), df frequency deviation	Hz	2	95%	No		Approved on 28 April 2010	NSCIM/14
						Modulation frequency	0.02 kHz to 200 kHz								
Signal and pulse characteristics: distortion and harmonic content	Reference standard, signal generator, distortion meter	Direct comparison, direct measurement	3E-03	1E+02	%	Frequency	0.01 kHz to 200 kHz	0.01 K <sub>H</sub> , K <sub>H</sub> coefficient of harmonic content	% (unit of K <sub>H</sub> )	2	95%	No		Approved on 28 April 2010	NSCIM/15

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Quantity	Instrument or artifact	Instrument Type or Method	Minimum value	Maximum value	units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Uncertainty Matrix	Comments	NMI Service Identifier
RF voltage and current: RF-DC difference	Thermal voltage converter	Comparison with reference	0.1	3	V	Frequency	30 MHz to 100 MHz	1 to 5	mV/V	2	95%	Yes		Approved on 28 April 2010	NSCIM/18
RF voltage and current: RF-DC difference	Thermal voltage converter	Comparison with reference	0.1	3	V	Frequency	100 MHz to 300 MHz	2 to 10	mV/V	2	95%	Yes		Approved on 28 April 2010	NSCIM/19
RF voltage and current: RF-DC difference	Thermal voltage converter	Comparison with reference	0.1	3	V	Frequency	300 MHz to 600 MHz	3 to 12	mV/V	2	95%	Yes		Approved on 28 April 2010	NSCIM/20
RF voltage and current: RF-DC difference	Thermal voltage converter	Comparison with reference	0.1	3	V	Frequency	600 MHz to 1000 MHz	4 to 16	mV/V	2	95%	Yes		Approved on 28 April 2010	NSCIM/21
RF voltage and current: RF voltage meters	RF voltmeter	Direct measurement	0.1	3	V	Frequency	30 MHz to 100 MHz	2 to 6	mV/V	2	95%	Yes		Approved on 28 April 2010	NSCIM/22
RF voltage and current: RF voltage meters	RF voltmeter	Direct measurement	0.1	3	V	Frequency	100 MHz to 300 MHz	2 to 12	mV/V	2	95%	Yes		Approved on 28 April 2010	NSCIM/23
RF voltage and current: RF voltage meters	RF voltmeter	Direct measurement	0.1	3	V	Frequency	300 MHz to 600 MHz	3 to 15	mV/V	2	95%	Yes		Approved on 28 April 2010	NSCIM/24
RF voltage and current: RF voltage meters	RF voltmeter	Direct measurement	0.1	3	V	Frequency	600 MHz to 1000 MHz	4 to 20	mV/V	2	95%	Yes		Approved on 28 April 2010	NSCIM/25

**Electricity and Magnetism, Ukraine, UkrCSM**

**Uncertainty table: Matrix 5.1**

AC-DC voltage transfer: AC-DC transfer difference

	10 Hz	20 Hz	30 Hz to 300 Hz	400 Hz to 10 kHz	20 kHz to 30 kHz	50 kHz	70 kHz	100 kHz	200 kHz to 300 kHz	500 kHz	700 kHz to 800 kHz	1 MHz
100 mV / 200 mV	42	35	25	22	25	30	30	32	85	100	120	140
300 mV / 500 mV	20	18	15	10	12	15	15	15	20	25	40	55
1 V / 2 V	12	10	8	4	4	5	5	6	15	15	35	45
3 V / 4 V	14	12	8	4	6	6	6	6	12	15	30	40
10 V	16	12	8	6	6	6	7	8	15	20	30	50
20 V	25	20	15	10	10	12	15	15	20	30	40	55
30 V	25	20	16	12	12	15	20	25	-	-	-	-
100 V	40	32	25	15	12	15	20	35	-	-	-	-
300 V	-	35	30	25	25	25	30	40	-	-	-	-
500 V	-	45	30	25	25	35	50	75	-	-	-	-
1000 V	-	60	40	30	50	80	120	-	-	-	-	-

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



**Electricity and Magnetism, Ukraine, UkrCSM**

**Uncertainty table: Matrix 5.2**

AC voltage up to 1000 V: sources and meters

	10 Hz	20 Hz	30 Hz to 300 Hz	400 Hz to 10 kHz	20 kHz to 30 kHz	50 kHz	70 kHz	100 kHz	200 kHz to 300 kHz	500 kHz	700 kHz to 800 kHz	1 MHz
100 mV / 200 mV	60	55	55	50	50	50	50	60	80	300	360	400
300 mV / 500 mV	30	30	25	25	30	30	30	45	70	250	350	400
1 V / 2 V	30	25	25	20	20	20	20	30	70	250	350	400
3 V / 4 V	25	20	20	20	20	20	20	20	50	250	350	400
10 V	30	20	20	20	20	20	20	20	50	250	300	400
20 V	30	20	20	20	20	20	20	25	50	200	300	400
30 V	25	30	25	20	20	25	30	30	-	-	-	-
100 V	50	40	35	35	35	40	45	50	-	-	-	-
300 V		45	45	50	50	50	60	70	-	-	-	-
500 V		55	55	60	60	60	70	100	-	-	-	-
1000 V		70	70	70	80	120	160	-	-	-	-	-

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

**Electricity and Magnetism, Ukraine, UkrCSM**

**Uncertainty table: Matrix 7.1**

AC power and energy: single phase and three phase ( $f \leq 400$  Hz), active power

	Expanded uncertainty
1	30
0.5	50

The first column of the table indicates the value of the power factor

The expanded uncertainty given in this table are expressed in  $\mu\text{W}/\text{VA}$

**Electricity and Magnetism, Ukraine, UkrCSM**

**Uncertainty table: Matrix 7.2**

AC power and energy: single phase and three phase ( $f \leq 400$  Hz), reactive power

	Expanded uncertainty
1	60
0.5	80

The first column of the table indicates the value of the power factor

The expanded uncertainty given in this table are expressed in  $\mu\text{var}/\text{VA}$

**Electricity and Magnetism, Ukraine, NSCIM**

**Uncertainty table: Matrix 2A**

DC resistance standards and sources: low values

	Expanded uncertainty
1E-03 $\Omega$	3 $\mu\Omega/\Omega$
1E-02 $\Omega$	2.5 $\mu\Omega/\Omega$
1E-01 $\Omega$	2 $\mu\Omega/\Omega$

**Electricity and Magnetism, Ukraine, NSCIM**

**Uncertainty table: Matrix 2B**

DC resistance standards and sources: intermediate values

	Expanded uncertainty
1 $\Omega$	200 n $\Omega$ / $\Omega$
1E+01 $\Omega$	224 n $\Omega$ / $\Omega$
1E+02 $\Omega$	400 n $\Omega$ / $\Omega$
1E+03 $\Omega$	565 n $\Omega$ / $\Omega$
1E+04 $\Omega$	692 n $\Omega$ / $\Omega$
1E+05 $\Omega$	800 n $\Omega$ / $\Omega$
1E+06 $\Omega$	1600 n $\Omega$ / $\Omega$

**Electricity and Magnetism, Ukraine, NSCIM**

**Uncertainty table: Matrix 2C**

DC resistance standards and sources: high values

	Expanded uncertainty
1E+07 $\Omega$	10 $\mu\Omega/\Omega$
1E+08 $\Omega$	25 $\mu\Omega/\Omega$
1E+09 $\Omega$	60 $\mu\Omega/\Omega$

**Electricity and Magnetism, Ukraine, NSCIM**

**Uncertainty table: Matrix 11A**

Radio frequency power: absolute power in waveguide

Radio frequency power: calibration factor and effective efficiency in waveguide

Frequency range and Connector type	Expanded uncertainty
37.5 GHz to 53.57 GHz Connector type GOST R13317 (5.2x2.6 mm)	1.1E-02
53.57 GHz to 78.3 GHz Connector type GOST R13317 (3.6x1.8 mm)	1.1E-02
78.3 GHz to 118.1 GHz Connector type GOST R13317 (2.4x1.2 mm)	1.5E-02
118.1 GHz to 178.6 GHz Connector type GOST R13317(1.6x0.8 mm)	1.5E-02

The expanded uncertainty given in this table are expressed in W/W