Field of Measurement	Parameter and Range of Measurement	Calibration Measurement Uncertainty (±)	Standard/Test Method Technique/Equipment
1. Electrical	**Generating Instrument DC Resistance**		
	0.1 mΩ to 100 mΩ	3.0 μΩ/Ω	In-house Method: CP-E1045 by comparison technique using DCC Resistance Bridge and Extender (1:1 to 1000:1 ratio)
	> 100 mΩ to 100 Ω	1.8 μΩ/Ω	
	> 100 Ω to 100 kΩ	1.0 μΩ/Ω	
	> 100 kΩ to 10 MΩ	1.5 μΩ/Ω	
	> 10 MΩ to 100 MΩ	5.0 μΩ/Ω	
	> 100 MΩ to 1 GΩ	20 μΩ/Ω	
	>1 MΩ to 100 MΩ	50 μΩ/Ω	In-house Method CP-E1002 based on Ohm's Law with constant current and varied test voltage of 10 V to 1kV
	> 100 MΩ to 1 GΩ	0.10 mΩ/Ω	
	> 1 GΩ to 10 GΩ	0.15 mΩ/Ω	
	> 10 GΩ to 100 GΩ	0.20 mΩ/Ω	
	1 mΩ	20 μΩ/Ω	In-house Method CP-E1001 by comparison to reference resistance standard by 1:1 substitution technique
	10 mΩ	10 μΩ/Ω	
	100 mΩ to 1 Ω	5.0 μΩ/Ω	
	>1 Ω to 10 Ω	3.5 μΩ/Ω	
	>10 Ω to 100 Ω	3.0 μΩ/Ω	
	>100 Ω to 100 kΩ	3.0 μΩ/Ω	In-house Method CP-E1003 by comparison to reference resistance standard by 1:1 substitution technique
	1 mΩ to 10 mΩ	7.0 μΩ/Ω	In-house Method CP-E1004 by comparison to reference resistance standard by 1:1 substitution technique
	100 mΩ	14 μΩ/Ω	
	0.1 mΩ to 1 mΩ	85 μΩ/Ω	In-house method: CP-E1014 by applied current and measure voltage across resistance Ohm's law
	>1 mΩ to 10 mΩ	30 μΩ/Ω	
	>10 mΩ to 1 kΩ	25 μΩ/Ω	
	0 Ω to 2 Ω	20 μΩ/Ω	In-house method: CP-E1015
	> 2 Ω to 2 MΩ	11 μΩ/Ω	By direct measurement
	> 2 MΩ to 20 MΩ	18 μΩ/Ω	
	> 20 MΩ to 200 MΩ	75 μΩ/Ω	
	> 200 MΩ to 2 GΩ	0.24 mΩ/Ω	
	> 2 GΩ to 20 GΩ	1.2 mΩ/Ω	
	> 20 GΩ to 100 GΩ	7.0 mΩ/Ω	

Field of Measurement	Parameter and Range of Measurement	Calibration Measurement Uncertainty (±)	Standard/Test Method Technique/Equipment
1. Electrical (Cont.)	**Generating Instrument** **DC Voltage**		
	10 V	0.50 μV/V	In-house Method CP-E1008 by difference voltage measurement,
	1.018 V 1V	1.0 μV/V 1.1 μV/V	comparison to reference voltage standards
	10 V, 100 V, 1000 V	1.0 μV/V	In-house Method CP-E1010 by direct measurement, comparison
	0 mV to 10 mV	0.5 μV	
	> 10 mV to 100 mV	0.50 μV or 3.0 μV/V*	to reference voltage standards
	>100 mV to 1050 V	2.0 μV/V	*whichever is greater
	1 kV to 10 kV	0.15 mV/V	In-house Method CP-E1037 using high voltage divider
	0 mV to 200 mV	6.0 μV/V	In-house Method CP-E1032
	>200 mV to 2 V	4.0 μV/V	by direct measurement using
	>2 V to 20 V	4.0 μV/V	dc voltage standards
	>20 V to 200 V	5.0 μV/V	
	>200 V to 1050 V	6.0 μV/V	
	DC Current		In-house Method CP-E1012
	1 nA to <10 nA	0.20 mA/A	by direct measurement at
	> 10 nA to <100 nA	0.10 mA/A	1nA to 1 μA and measurement
	> 0.1 μA to <1 μA	50 μA/A	voltage across shunt
	1 μA	20 μA/A	(Ohm's Law) at 1 μA to 20 A
	> 1 μA to 2.2 A	10 μA/A	
	> 2.2 A to 20 A	20 μA/A	
	0 mA to 200 mA	20 μA/A	In-house Method CP-E1036
	> 200 mA to 2 A	70 μA/A	by direct measurement or
	> 2 A to 20 A	0.10 mA/A	substitution method
	Generating instrument **AC voltage**		In-house method: CP-E1027
	@ 10 Hz to 10 kHz		by direct measuring using
	1 mV to 2 mV	1.0 μV/V	AC-DC thermal transfer
	> 2 mV to 20 mV	1.0 μV or 70 μV/V*	standard
	> 20 mV to 200 mV	70 μV/V	* whichever is greater
	@ 10 Hz to 10 kHz		In-house method: CP-E1021
	1 mV to 2 mV	1.1 μV/V	by direct measuring using
	> 2 mV to 20 mV	1.8 μV or 0.13 mV/V*	AC-DC thermal transfer
	> 20 mV to 200 mV	70 μV/V	standard
	@ > 10 kHz to 1 MHz		* whichever is greater
	1 mV to 2 mV	1.3 μV/V	
	> 2 mV to 5 mV	1.5 μV or 0.45 mV/V*	
	@ > 10 kHz to 100 kHz		
	> 5 mV to 20 mV	1.5 μV or 0.10 mV/V*	
	> 20 mV to 200 mV	70 μV/V	
	@ > 100 kHz to 500 kHz		
	> 5 mV to 20 mV	0.26 mV/V	
	> 20 mV to 200 mV	0.16 mV/V	

Field of Measurement	Parameter and Range of Measurement	Calibration Measurement Uncertainty (±)	Standard/Test Method Technique/Equipment
1. Electrical (Cont.)	**Generating instrument AC voltage (cont.)**		
	@ > 500 kHz to 1 MHz		
	> 5 mV to 20 mV	0.26 mV/V	
	> 20 mV to 200 mV	0.18 mV/V	
	@ 10 Hz to 500 kHz		
	> 0.20 V to 0.50 V	80 µV/V	
	> 0.50 V to 20 V	70 µV/V	
	@ > 500 kHz to 1 MHz		In-house method: CP-E1021 by direct measuring using AC-DC thermal transfer standard
	> 0.20 V to 0.50 V	0.15 mV/V	
	> 0.50 V to 20 V	0.10 mV/V	
	@ 10 Hz to 300 kHz		
	> 20 V to 30 V	70 µV/V	
	@ 10 Hz to 100 kHz		
	> 30 V to 1 000 V	70 µV/V	
	@ 50 Hz to 60 Hz		In-house method: CP-E1030 by direct measuring using high voltage probe
	> 1 kV to 6.6 kV	0.50 mV/V	
	@ 10 Hz to 10 kHz		In-house method: CP-E1044 by direct measuring using AC voltmeter *whichever is greater
	1 mV to 2 mV	1.1 µV/V	
	@ > 10 kHz to 1 MHz		
	1 mV to 2 mV	1.3 µV/V	
	@ 10 Hz to 10 kHz		
	> 2 mV to 20 mV	1.0 µV or 70 µV/V*	
	@ > 10 kHz to 1 MHz		
	> 2 mV to 5 mV	1.5 µV or 0.45 mV/V*	
	@ > 10 kHz to 100 kHz		
	> 5 mV to 20 mV	1.5 µV or 0.10 mV/V*	
	@ > 100 kHz to 1 MHz		
	> 5 mV to 20 mV V	0.26 mV/	
	@ > 10 Hz to 100 kHz		
	> 20 mV to 200 mV	70 µV/ V	
	@ > 100 kHz to 1 MHz		
	> 20 mV to 500 mV	0.17 mV/V	
	@ 10 Hz to 500 kHz		
	> 0.20 V to 0.50 V	80 µV/V	
	@ 10 Hz to 500 kHz		
	> 0.50 V to 20 V	70 µV/V	
	@ > 500 kHz to 1 MHz		
	> 0.50 V to 20 V	0.10 mV/V	
	@ 10 Hz to 300 kHz		
	> 20 V to 30 V	70 µV/V	
	@ 10 Hz to 100 kHz		
	> 30 V to 1 000 V	70 µV/V	
	AC current		In-house method: CP-E1005 by using AC current shunt standards with thermal voltage converter
	@ 10 Hz to 10 kHz		
	5 mA to 20 A	0.15 mA/A	
	@ 10 Hz to 1 kHz		In-house method: CP-E1058 by using AC resistance standard Ohm's law
	10 µA to 5 mA	0.20 mA/A	
	@ > 1 kHz to 5 kHz		
	10 µA to 5 mA	0.30 mA/A	In-house method: CP-E1018 by direct measurement with AC current meter or substitution technique
	@ > 5 kHz to 10 kHz		
	10 µA to 5 mA	0.50 mA/A	
	@ 10 Hz to 10 kHz		
	5 mA to 20 mA	0.15 mA/A	

Field of Measurement	Parameter and Range of Measurement	Calibration Measurement Uncertainty (±)	Standard/Test Method Technique/Equipment
1. Electrical (Cont.)	**Generating instrument**		
	DC power		In-house method: CP-E1025
	1 mW to 20 kW (1 mA x 1 V to 20 A x 1 kV)	40 µW/W + 0.10 µW	by direct measurement with DC voltage and current standards
	Phase		In-house method: CP-E2040
	0 ° to 360 ° 50 mV to 100 V		zero balance measurement by phase bridge
	Voltage ratio 1:1		
	@ 5 Hz to 50 kHz	0.0050 °	
	@ > 50 kHz to 100 kHz	0.020 °	
	Voltage ratio > 1:1 to 1:100		
	@ 5 Hz to 1 kHz	0.005 0 °	
	@ > 1 kHz to 50 kHz	0.010 °	
	@ > 50 kHz to 100 kHz	0.020 °	
	50 mV to 100 V		In-house method: CP-E2037
	Voltage ratio 1:1		by direct measurement or
	@ 5 Hz to 6.25 kHz	0.020 °	transfer measurement
	@ > 6.25 kHz to 50 kHz	0.030 °	
	@ > 50 kHz to 100 kHz	0.040 °	
	Voltage ratio > 1:1 to 1:100		
	@ 5 Hz to 50 kHz	0.030 °	
	@ > 50 kHz to 100 kHz	0.050 °	
	Capacitance		In-house method: CP-E1007
	@ 1 kHz		by comparison using
	1 pF	15 µF/F	transformer arm radio
	10 pF, 100 pF	5.0 µF/F	technique or substitution
	> 1 pF to 1 000 pF	15 µF/F	technique using capacitance
	> 1 nF to 100 nF	25 µF/F	bridge
	> 0.1 µF to 10 µF	60 µF/F	
	@ 1 kHz		In-house method: CP-E1017
	1 pF to < 10 pF	0.15 mF/F	by direct measurement using
	10 pF to 1 µF	0.12 mF/F	capacitance bridge
	1 pF to 20 pF	14 mF/F	In-house method: CP-E1020
	> 20 pF to 100 pF	5.2 mF/F	by direct measurement using
	> 100 pF to 1 nF	3.4 mF/F	LCR meter
	> 1 nF to 50 nF	1.5 mF/F	
	> 50 nF to 10 µF	1.0 mF/F	
	Frequency		
	0.1 Hz to 1 Hz	5.0×10^{-3}	In-house method: CP-E1054
	> 1 Hz to 10 Hz	1.0×10^{-4}	by direct measurement using
	> 10 Hz to 100 Hz	5.0×10^{-6}	frequency counter
	> 100 Hz to 1 kHz	1.0×10^{-7}	
	> 1 kHz to 10 kHz	5.0×10^{-9}	
	> 10 kHz to 100 kHz	2.0×10^{-10}	
	> 100 kHz to 225 MHz	8.5×10^{-11}	
	> 225 MHz to 18 GHz	5.0×10^{-10}	
	100 kHz, 1 MHz, 5 MHz, 10 MHz	1.0×10^{-11}	In-house method: CP-E1053 by comparison technique (Phase difference)

Field of Measurement	Parameter and Range of Measurement	Calibration Measurement Uncertainty (±)	Standard/Test Method Technique/Equipment
1. Electrical (Cont.)	**Generating Instrument**		
	Temperature simulator		EURAMET cg-11 and
	Resistance thermometer		EN 60751
	-200 °C to 850 °C	0.004 0 °C	
	Thermocouple		EURAMET cg-11 and
	Type S		ASTM E 230
	-40 °C to 50 °C	0.32 °C	
	> 50 °C to 1 767 °C	0.20 °C	
	Type R		
	-40 °C to 50 °C	0.32 °C	
	> 50 °C to 1 767 °C	0.20 °C	
	Type K		
	-200 °C to 0 °C	0.10 °C	
	> 0 °C to 1 372 °C	0.050 °C	
	Type J		
	-210 °C to 50 °C	0.090 °C	
	> 0 °C to 1 200 °C	0.050 °C	
	Type T		
	-250 °C to 0 °C	0.25 °C	
	> 0 °C to 400 °C	0.050 °C	
	Type E		
	-250 °C to 0 °C	0.16 °C	
	> 0 °C to 1 000 °C	0.050 °C	
	Type N		EURAMET cg-11 and
	-200 °C to 0 °C	0.12 °C	EN 60751
	> 0 °C to 1 300 °C	0.050 °C	
	Type B		
	0 °C to 150 °C	1.0 °C	
	> 150 °C to 400 °C	0.40 °C	
	> 400 °C to 1 820 °C	0.25 °C	
	Measuring instrument		
	DC resistance		In-house method: CP-E1039
	0.1 mΩ to 1 mΩ	20 μΩ/Ω	by direct measurement
	> 1 mΩ to 100 mΩ	10 μΩ/Ω	based on EURAMET cg-15
	> 100 mΩ to 10 MΩ	5.0 μΩ/Ω	
	> 10 MΩ to 100 MΩ	10 μΩ/Ω	
	> 100 MΩ to 1 GΩ	60 μΩ/Ω	
	DC voltage		In-house method: CP-E1033
	0.1 V	3.0 μV/V	by comparison to DC voltage
	1 V, 10 V, 100 V, 1 000 V	1.5 μV/V	standard
	0 mV to 10 mV	0.50 μV/V	* whichever is greater
	> 10 mV to 100 mV	0.50 μV/V or 3.0 μV/V*	
	> 100 mV to 1.05 kV	2.0 μV/V	
	> 1 kV to 10 kV	0.15 mV/V	In-house method: CP-E1038 by using high voltage divider

Field of Measurement	Parameter and Range of Measurement	Calibration Measurement Uncertainty (±)	Standard/Test Method Technique/Equipment
1. Electrical (Cont.)	**Measuring instrument**		
	DC voltage		In-house method: CP-E1031
	0 mV to 220 mV	6.0 µV/V + 0.15 µV	by direct measurement
	> 220 mV to 2.2 V	2.2 µV/V + 0.15 µV	based on EURAMET cg-15
	> 2.2 V to 22 V	1.8 µV/V + 1.0 µV	
	> 22 V to 220 V	2.7 µV/V + 10 µV	
	> 220 V to 1 050 V	2.7 µV/V + 0.10 mV	
	DC current		In-house method: CP-E1013
	1 nA to 10 nA 0.20 mA/A		by direct measurement
	> 10 nA to 100 nA 0.10 mA/A		current standard flown
	> 0.1 µA to 1 µA 50 µA/A		through standard shunt
	> 1 µA to 2 A 10 µA/A		
	> 2 A to 20 A 20 µA/A		
	> 10 µA to 220 µA	8.0 µA/A + 0.10 nA	In-house method: CP-E1035
	> 220 µA to 2.2 mA	8.0 µA/A + 0.25 nA	by direct measurement
	> 2.2 mA to 22 mA	8.0 µA/A + 2.5 nA	or substitution method
	> 22 mA to 2.2 A	15 µA/A	based on EURAMET cg-15
	> 2.2 A to 11 A	20 µA/A	
	> 11 A to 20 A	60 µA/A	
	AC voltage		In-house method: CP-E1035
	@ 10 Hz to 10 kHz		by direct measurement
	1 mV to 2 mV	1.0 µV/V	or substitution method
	> 2 mV to 200 mV	1.0 µV/V or 75 µV/V*	based on EURAMET cg-15
	@ > 10 kHz to 1 MHz		*whichever is greater
	1 mV to 2 mV	1.3 µV/V	
	> 2 mV to 5 mV	1.5 µV/V or 0.46 mV/V*	
	@> 10 kHz to 100 kHz		In-house method: CP-E1035
	> 5 mV to 20 mV	0.20 mV/V	by direct measurement
	> 20 mV to 200 mV	0.10 mV/V	or substitution method
	@ > 100 kHz to 500 kHz		based on EURAMET cg-15
	> 5 mV to 20 mV V	0.30 mV/	
	> 20 mV to 200 mV	0.20 mV/V	
	@ > 10 Hz to 500 kHz		
	> 0.2 V to 0.5 V	90 µV/V	
	> 0.5 V to 20 V	70 µV/V	
	@ > 500 kHz to 1 MHz		
	> 0.2 V to 0.5 V	0.20 mV/V	
	> 0.5 V to 20 V	0.10 mV/V	
	@ 10 Hz to 300 kHz		
	> 20 V to 30 V	70 µV/V	
	@ 10 Hz to 100 kHz		
	> 30 V to 750 V	70 µV/V	
	@ 10 Hz to 30 kHz		
	> 750 V to 1 kV	70 µV/V	
			In-house method: CP-E1029
	@ 50 Hz to 60 Hz		
	> 1 kV to 6.6 kV	0.50 mV/V	by direct measurement
			high voltage source
	AC current		In-house method: CP-E1019
	@ 10 Hz to 1 kHz		by direct measurement
	10 µA to 5 mA	0.20 mA/A	or substitution method
	@ > 1 kHz to 5 kHz		
	10 µA to 5 mA	0.30 mA/A	
	@ > 5 kHz to 10 kHz		
	10 µA to 5 mA	0.50 mA/A	
	@ 10 Hz to 10 kHz		
	> 5 mA to 20 A	0.15 mA/A	

Field of Measurement	Parameter and Range of Measurement	Calibration Measurement Uncertainty (±)	Standard/Test Method Technique/Equipment
1. Electrical (Cont.)	**Measuring instrument** **AC current (Cont)** @ 10 Hz to 10 kHz > 5 mA to 20 A	 0.15 mA/A	 In-house method: CP-E1006 by against AC current standard shunt with thermal voltage converter
	Phase 0 ° to 360 ° Voltage ratio 1:1 @ 5 Hz to 6.25 kHz @ > 6.25 kHz to 50 kHz @ > 50 kHz to 100 kHz Voltage ratio > 1:1 to 1:100 @ 5 Hz to 1 kHz @ > 1 kHz to 6.25 kHz @ > 6.25 kHz to 50 kHz @ > 50 kHz to 100 kHz	 0.020 ° 0.030 ° 0.050 ° 0.025 ° 0.030 ° 0.035 ° 0.065 °	 In-house method: CP-E2038 by direct measurement of phase standards
	DC power (1 mA x 1 V to 20 A x 1 kV) 0 mW to 20 kW	 40 µW/W + 0.10 µW	 In-house method: CP-E1024 by direct measurement of DC power standards
	AC power @ 10 Hz to 1 kHz Power factor = 1 (1 mA x 1 V to 10 A x 1 kV) 1 mW to 10 kW @ 10 Hz to 65 Hz (1 mA x 1 V to 10 A x 1 kV) Power factor ≥ 0.94 to < 1 1 mW to 10 kW Power factor ≥ 0.77 to < 0.94 1 mW to 10 kW Power factor ≥ 0.5 to < 0.77 1 mW to 10 kW @ > 65 Hz to 500 Hz (1 mA x 1 V to 10 A x 1 kV) Power factor ≥ 0.94 to < 1 1 mW to 10 kW Power factor ≥ 0.77 to < 0.94 1 mW to 10 kW Power factor ≥ 0.5 to < 0.77 1 mW to 10 kW @ > 500 Hz to 1 kHz (1 mA x 1 V to 10 A x 1 kV) Power factor ≥ 0.94 to < 1 1 mW to 10 kW Power factor ≥ 0.77 to < 0.94 1 mW to 10 kW Power factor ≥ 0.5 to < 0.77 1 mW to 10 kW	 0.50 mW/W 1.0 mW/W 2.0 mW/W 5.0 mW/W 2.0 mW/W 5.0 mW/W 10 mW/W 5.0 mW/W 10 mW/W 20 mW/W	 In-house method: CP-E1023 by direct measurement of AC voltage, current and phase standards
	Capacitance @ 1 kHz 10 pF to 10 µF	 0.15 mF/F	 In-house method: CP-E1042 by direct measurement of capacitance standards

Field of Measurement	Parameter and Range of Measurement	Calibration Measurement Uncertainty (±)	Standard/Test Method Technique/Equipment
1. Electrical (Cont.)	**Measuring instrument**		
	Frequency		In-house method: CP-E1062 by direct measurement of frequency standards
	0.1 Hz	5.0×10^{-6}	
	> 0.1 Hz to 1 Hz	7.0×10^{-6}	
	> 1 Hz to 10 Hz	3.0×10^{-6}	
	> 10 Hz to 100 Hz	5.0×10^{-8}	
	> 100 Hz to 1 kHz	7.0×10^{-9}	
	> 1 kHz to 10 kHz	5.0×10^{-9}	
	> 10 kHz to 18 GHz	5.0×10^{-10}	
	AC-DC transfer voltage standard		In-house method: CP-E1051 by direct comparison to AC and DC voltage standards
	@ 10 Hz		
	0.25 V to 200 V	75 µV/V	
	@ 20 Hz to 100 kHz		
	0.25 V to 200 V	50 µV/V	
	@ > 100 kHz to 300 kHz		
	0.25 V to 30 V	0.10 mV/V	
	@ > 300 kHz to 500 kHz		
	0.25 V to 20 V	0.15 mV/V	
	@ > 500 kHz to 1 MHz		
	0.25 V to 20 V	0.20 mV/V	
	@ 40 Hz to 30 kHz		
	> 200 V to 1 000 V	75 µV/V	
	Temperature indicator		EURAMET cg-11 and ASTM E 230
	Resistance thermometer		
	-200 °C to 850 °C	0.004 0 °C	
	Thermocouple		
	Type S		
	-40 °C to 50 °C	0.32 °C	
		0.20 °C	
	> 50 °C to 1 767 °C		
	Type R		
	-40 °C to 50 °C	0.32 °C	
	> 50 °C to 1 767 °C	0.20 °C	
	Type K		
	-200 °C to 0 °C	0.10 °C	
	> 0 °C to 1 372 °C	0.050 °C	
	Type J		
	-210 °C to 50 °C	0.090 °C	
	> 0 °C to 1 200 °C	0.050 °C	
	Type T		
	-250 °C to 0 °C	0.25 °C	
	> 0 °C to 400 °C	0.050 °C	
	Type E		
	-250 °C to 0 °C	0.16 °C	
	> 0 °C to 1 000 °C	0.050 °C	
	Type N		
	-200 °C to 0 °C	0.12 °C	
	> 0 °C to 1 300 °C	0.050 °C	
	Type B		
	0 °C to 150 °C	1.0 °C	
	> 150 °C to 400 °C	0.40 °C	
	> 400 °C to 1 820 °C	0.25 °C	

Field of Measurement	Parameter and Range of Measurement	Calibration Measurement Uncertainty (±)	Standard/Test Method Technique/Equipment
1. Electrical (Cont.)	**Generating instrument**		
	DC resistance		In-house method: CP-E3010
	0 Ω to 100 Ω	0.17 mΩ/Ω + 0.58 mΩ	by direct measurement
	> 100 Ω to 1 MΩ	0.13 mΩ/Ω	using digital ohmmeter
	> 1 MΩ to 10 MΩ	0.48 mΩ/Ω	
	> 10 MΩ to 100 MΩ	10 mΩ/Ω	
	DC voltage		In-house method: CP-E3001
	0 mV to 100 mV	0.11 mV/V + 3.5 µV	by direct measurement
	> 100 mV to 1 000 mV	56 µV/V + 3.5 µV	using digital voltmeter
	> 1 V to 10 V	48 µV/V	
	> 10 V to 100 V	61 µV/V	
	> 100 V to 1 000 V	65 µV/V	
	DC current		In-house method: CP-E3004
	0 µA to 500 µA	1.5 mA/A + 0.26 µA	by direct measurement
	> 0.5 mA to 5 mA	1.5 mA/A + 0.27 µA	using digital ammeter
	> 5 mA to 10 mA	0.81 mA/A	
	> 10 mA to 100 mA	0.65 mA/A	
	> 100 mA to 1 000 mA	1.3 mA/A	
	> 1 A to 3 A	1.6 mA/A	
	> 3 A to 10 A	3.7 mA/A	
	> 1 A to 3 A	0.50 mA/A	In-house method: CP-E3004
	> 3 A to 5 A	0.22 mA/A	by measure voltage across
	> 5 A to 55 A	0.14 mA/A	shunt, then calculate the
	> 55 A to 70 A	0.20 mA/A	current according to Ohm's law
	1 000 A, 2 000 A, 3 000 A	0.50 mA/A	In-house method: CP-E3003
	200 A to 500 A	10 mA/A	by measure voltage across
	> 500 A to 3 000 A	6.0 mA/A	shunt, then calculate the current according to Ohm's law
	AC voltage		In-house method: CP-E3006
	@ 10 Hz to 20 kHz		by direct measurement
	1 mV to 10 mV	5.5 mV/V	using AC voltmeter
	> 10 mV to 100 mV	1.4 mV/V	
	> 0.1 V to 100 V	1.1 mV/V	
	> 100 V to 200 V	2.0 mV/V	
	> 200 V to 750 V	1.1 mV/V	
	@ > 20 kHz to 50 kHz		
	1 mV to 10 mV	7.5 mV/V	
	> 10 mV to 100 mV	2.7 mV/V	
	> 0.1 V to 100 V	2.0 mV/V	
	> 100 V to 200 V	3.6 mV/V	
	> 200 V to 750 V	2.0 mV/V	
	@ > 50 kHz to 100 kHz		
	1 mV to 10 mV	17 mV/V	
	> 10 mV to 100 mV	8.8 mV/V	
	> 0.1 V to 100 V	8.0 mV/V	
	> 100 V to 200 V	11 mV/V	
	> 200 V to 750 V	8.0 mV/V	
	@ > 100 kHz to 300 kHz		
	1 mV to 10 mV	0.24 V/V	
	> 10 mV to 100 mV	0.12 V/V	
	> 0.1 V to 100 V	53 mV/V	
	> 100 V to 200 V	69 mV/V	

Field of Measurement	Parameter and Range of Measurement	Calibration Measurement Uncertainty (±)	Standard/Test Method Technique/Equipment
1. Electrical (Cont.)	**Generating instrument** **AC current** @ 20 Hz to 45 Hz 50 µA to 500 µA > 0.5 mA to 400 mA @ > 45 Hz to 10 kHz 50 µA to 500 µA > 0.5 mA to 5 mA > 5 mA to 50 mA @ > 45 Hz to 1 kHz > 50 mA to 400 mA @ > 1 kHz to 10 kHz > 50 mA to 400 mA @ 10 Hz to 5 kHz > 0.1 A to 1 A > 1 A to 3 A @ > 5 kHz to 10 kHz > 0.1 A to 1 A @ 20 Hz to 45 Hz > 1 A to 10 A @ > 45 Hz to 1 kHz > 1 A to 10 A @ > 1 kHz to 10 kHz > 1 A to 10 A @ 50 Hz to 60 Hz 200 A to 3 000 A **Measuring instrument** **DC resistance** 0 Ω to < 11 Ω 11 Ω to < 33 Ω 33 Ω to < 110 Ω 110 Ω to < 330 Ω 330 Ω to < 1.1 kΩ 1.1 kΩ to < 3.3 kΩ 3.3 kΩ to < 11 kΩ 11 kΩ to < 33 kΩ 33 kΩ to < 110 kΩ 110 kΩ to < 330 kΩ 330 kΩ to < 1.1 MΩ 1.1 MΩ to < 3.3 MΩ 3.3 MΩ to < 11 MΩ 11 MΩ to < 33 MΩ 33 MΩ to < 110 MΩ 110 MΩ to < 330 MΩ 330 MΩ to 1 100 MΩ 0 Ω to 100 Ω > 100 Ω to 1 MΩ > 1 MΩ to 100 MΩ > 100 MΩ to 100 GΩ	 13 mA/A 12 mA/A 7.5 mA/A 7.2 mA/A 7.5 mA/A 7.1 mA/A 18 mA/A 1.7 mA/A 2.5 mA/A 40 mA/A 18 mA/A 10 mA/A 36 mA/A 35 mA/A 0.17 mΩ/Ω 95 µΩ/Ω 72 µΩ/Ω 44 µΩ/Ω 68 µΩ/Ω 45 µΩ/Ω 68 µΩ/Ω 44 µΩ/Ω 64 µΩ/Ω 65 µΩ/Ω 74 µΩ/Ω 92 µΩ/Ω 0.18 mΩ/Ω 0.44 mΩ/Ω 0.82 mΩ/Ω 4.0 mΩ/Ω 19 mΩ/Ω 0.13 mΩ/Ω + 2.0 mΩ 0.13 mΩ/Ω 0.36 mΩ/Ω 1.2 mΩ/Ω	In-house method: CP-E3008 by direct measurement using digital ammeter In-house method: CP-E3003 by measure voltage across shunt, then calculate the current according to Ohm's law In-house method: CP-E3011 by direct measurement against multi-function calibrator based on EURAMET cg-15 In-house method: CP-E3011 by direct measurement against decade resistance standard based on EURAMET cg-15

Field of Measurement	Parameter and Range of Measurement	Calibration Measurement Uncertainty (±)	Standard/Test Method Technique/Equipment
1. Electrical (Cont.)	**Measuring instrument**		
	DC voltage		In-house method: CP-E3002 by direct measurement against multi-function calibrator based on EURAMET cg-15
	0 mV to < 330 mV	2.4 µV/V + 3.7 µV	
	330 mV to < 3.3 V	14 µV/V	
	3.3 V to < 33 V	15 µV/V	
	33 V to < 330 V	22 µV/V	
	330 V to 1 000 V	23 µV/V	
	DC current		In-house method: CP-E3005 by direct measurement against multi-function calibrator based on EURAMET cg-15
	0 µA to < 330 µA	0.18 mA/A + 24 nA	
	330 µA to < 3.3 mA	0.12 mA/A + 82 nA	
	3.3 mA to < 33 mA	0.13 mA/A	
	33 mA to < 330 mA	0.13 mA/A	
	330 mA to < 1.1 A	0.28 mA/A	
	1.1 A to < 3 A	0.46 mA/A	
	3 A to < 11 A	0.65 mA/A	
	11 A to 20.5 A	1.2 mA/A	
	AC voltage		In-house method: CP-E3007 by direct measurement against multi-function calibrator based on EURAMET cg-15
	@ 10 Hz to 45 Hz		
	1 mV to < 33 mV	0.94 mV/V + 7.5 µV	
	33 mV to < 330 mV	0.35 mV/V + 11 µV	
	0.33 V to < 3.3 V	0.37 mV/V	
	3.3 V to < 33 V	0.38 mV/V	
	@ > 45 Hz to 10 kHz		
	1 mV to < 33 mV	0.41 mV/V + 7.5 µV	
	33 mV to < 330 mV	0.41 mV/V + 11 µV	
	0.33 V to < 3.3 V	0.20 mV/V	
		0.20 mV/V	
	3.3 V to < 33 V		
	@ > 10 kHz to 20 kHz		
	1 mV to < 33 mV	0.77 mV/V + 7.5 µV	
	33 mV to < 330 mV	0.75 mV/V + 11 µV	
	0.33 V to < 3.3 V	0.25 mV/V	
	3.3 V to < 33 V	0.30 mV/V	
	@ > 20 kHz to 50 kHz		
	1 mV to < 33 mV	2.2 mV/V + 7.5 µV	
	33 mV to < 330 mV	1.9 mV/V + 11 µV	
	0.33 V to < 3.3 V	0.37 mV/V	
	3.3 V to < 33 V	0.43 mV/V	
	@ > 50 kHz to 100 kHz		
	1 mV to < 33 mV	5.5 mV/V + 15 µV	
	33 mV to < 330 mV	3.8 mV/V + 38 µV	
	0.33 V to < 3.3 V	0.87 mV/V	
	3.3 V to < 33 V	1.1 mV/V	
	@ > 100 kHz to 500 kHz		
	1 mV to < 33 mV	20 mV/V + 60 µV	
	33 mV to < 330 mV	18 mV/V + 83 µV	
	0.33 V to < 3.3 V	3.0 mV/V	
	@ 45 Hz to 1 kHz		
	33 V to < 330 V	0.23 mV/V	
	330 V to < 1 000 V	0.37 mV/V	
	@ > 1 kHz to 10 kHz		
	33 V to < 330 V	0.26 mV/V	
	@ > 1 kHz to 5 kHz		
	330 V to < 1 000 V	0.31 mV/V	

Field of Measurement	Parameter and Range of Measurement	Calibration Measurement Uncertainty (±)	Standard/Test Method Technique/Equipment
1. Electrical (Cont.)	**Measuring instrument** **AC voltage** @ > 5 kHz to 10 kHz 330 V to < 1 000 V @ > 10 kHz to 20 kHz 33 V to < 330 V @ > 20 kHz to 50 kHz 33 V to < 330 V @ > 50 kHz to 100 kHz 33 V to < 330 V	 0.37 mV/V 0.32 mV/V 0.38 mV/V 2.5 mV/V	In-house method: CP-E3007 by direct measurement against multi-function calibrator based on EURAMET cg-15
	AC current @ 10 Hz to 20 Hz 29 µA to < 330 µA 0.33 mA to < 3.3 mA 3.3 mA to < 33 mA 33 mA to < 330 mA @ > 20 Hz to 45 Hz 29 µA to < 330 µA 0.33 mA to < 3.3 mA 3.3 mA to < 33 mA 33 mA to < 330 mA @ 10 Hz to 45 Hz 0.33 A to < 1.1 A @ > 45 Hz to 1 kHz 29 µA to < 330 µA 0.33 mA to < 3.3 mA 3.3 mA to < 33 mA 33 mA to < 330 mA 0.33 A to < 1.1 A 1.1 A to < 3 A @ 45 Hz to 100 Hz 3 A to < 11 A 11 A to < 20 A @ > 100 Hz to 1 kHz 3 A to < 11 A 11 A to < 20 A @ > 1 kHz to 5 kHz 29 µA to < 330 µA 0.33 mA to < 3.3 mA 3.3 mA to < 33 mA 33 mA to < 330 mA 0.33 A to < 1.1 A 1.1 A to < 3 A 3 A to < 11 A 11 A to < 20 A	 2.4 mA/A + 0.12 µA 2.4 mA/A + 0.19 µA 2.1 mA/A + 2.4 µA 2.1 mA/A + 24 µA 1.8 mA/A + 0.12 µA 1.5 mA/A + 0.19 µA 1.1 mA/A + 2.4 µA 1.1 mA/A + 24 µA 2.1 mA/A + 0.13 mA 1.5 mA/A + 0.12 µA 1.2 mA/A + 0.19 µA 0.48 mA/A + 2.4 µA 0.48 mA/A + 24 µA 0.60 mA/A + 0.13 mA 0.71 mA/A + 0.13 mA 0.71 mA/A + 2.5 mA 1.4 mA/A + 6.0 mA 1.2 mA/A + 2.5 mA 1.8 mA/A + 6.0 mA 3.5 mA/A + 0.18 µA 2.4 mA/A + 0.24 µA 0.95 mA/A + 2.4 µA 1.2 mA/A + 59 µA 7.1 mA/A + 1.2 mA 7.1 mA/A + 1.2 mA 35 mA/A + 2.5 mA 35 mA/A + 6.0 mA	In-house method: CP-E3009 by direct measurement against multi-function calibrator based on EURAMET cg-15
	Frequency **Amplitude (into 50 Ω)** 50 mVp-p to 10 Vp-p 0.1 Hz to 15 MHz	 26 µHz/Hz	In-house method: CP-E3012 by direct measurement of frequency standards

Field of Measurement	Parameter and Range of Measurement	Calibration Measurement Uncertainty (±)	Standard/Test Method Technique/Equipment
1. Electrical (Cont.)	**Measuring instrument** **Temperature indicator** **Resistance thermometer**		EURAMET cg-1**1**
	-200 °C to -100 °C	0.029 °C	
	> -100 °C to 0 °C	0.042 °C	
	> 0 °C to 200 °C	0.071 °C	
	> 200 °C to 400 °C	0.11 °C	
	> 400 °C to 600 °C	0.14 °C	
	> 600 °C to 850 °C	0.19 °C	
	Thermocouple (with conjunction compensation)		
	Type B		
	600 °C to 800 °C	0.60 °C	
	> 800 °C to 1 000 °C	0.45 °C	
	> 1 000 °C to 1 820 °C	0.42 °C	
	Type R		
	0 °C to 300 °C	0.74 °C	
	> 300 °C to 1 000 °C	0.44 °C	
	> 1 000 °C to 1 767 °C	0.49 °C	
	Type S		
	0 °C to 300 °C	0.64 °C	
	> 300 °C to 1 400 °C	0.47 °C	
	> 1 400 °C to 1 767 °C	0.56 °C	
	Type E		
	-250 °C to < -100 °C	0.60 °C	
	-100 °C to 600 °C	0.21 °C	
	> 600 °C to 1 000 °C	0.26 °C	
	Type J		
	-210 °C to 0 °C	0.35 °C	
		0.22 °C	
	> 0 °C to 700 °C		
	> 700 °C to 1 200 °C	0.28 °C	
	Type K		
	-200 °C to <-100 °C	0.41 °C	
	-100 °C to 1 000 °C	0.32 °C	
	> 1 000 °C to 1 372 °C	0.48 °C	
	Type N		
	-200 °C to < 0 °C	0.50 °C	
	0 °C to 400 °C	0.25 °C	
	> 400 °C to 1 300 °C	0.33 °C	
	Type T		
	-250 °C to -200 °C	0.78 °C	
	> -200 °C to 0 °C	0.30 °C	
	> 0 °C to 400 °C	0.21 °C	