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Calibration laboratory No. 2202 accredited by the Czech Accreditation Institute according ISO/IEC 17025:2017

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CERTIFICATE OF CALIBRATION

6011-KL-L1123-22

This certificate is consistent with the capabilities that are included in Appendix C of the MRA drawn up by the International Committee for Weights and Measures (CIPM). Under the MRA, all participating institutes recognize the validity of each other's calibration and measurement certificates for the quantities, ranges and measurement uncertainties specified in Appendix C (for details see www.bipm.org).

Date of issue: November 28, 2022

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User:

Measuring instrument: Multifunction calibrator
Manufacturer: MEATEST
Type: M-142
Serial number: 541671

The results of the calibration have been obtained following the procedures reported in this Certificate and are reported only to the calibrated measuring instrument, the date, place and conditions of the calibration.

Date of calibration: November 21 to November 25, 2022

Calibrated by:

Head of department:

Michal Marek

Jiří Streit



Jiří Streit

Metrological traceability:	Measurements are traceable to (inter)national standards.
Measurement standards used:	Reference multimeter Fluke 8508A, S/N 328370412, Cert. of Cal. 6011-KL-E0005-22. Current shunt ČMI, S/N CMI/20A/3/14, Cert. of Cal. 6011-KL-E0011-20. LCR meter Keysight E4980A, S/N MY46312534, Cert. of Cal. 6011-KL-E0017-21. Power analyzer Applied Precision 3961E, S/N 1092080151, Cert. of Cal. 6011-KL-E0049-21. Counter Pendulum CNT-81, S/N SM783671, Cert. of Cal. 6011-KL-E0032-22. Multifunction calibrator Fluke 5720A, S/N 7465206, Cert. of Cal. 6011-KL-E0002-22. AC Measurement Standard Fluke 5790A, S/N 9170033, Cert. of Cal. 6011-KL-E0053-21
Calibration procedure:	Calibrated instrument has been compared with standards listed above. The current ranges 20 A were calibrated by measurement the drop of voltage on current shunt ČMI. The calibration has been made according to the Calibrating Procedure No. 611-MP-C042, 611-MP-C097, 611-MP-C098, 611-MP-C130 and 611-MP-C030. The calibrator was zeroed before calibration by function AUTOCAL.
Place of calibration:	Czech metrology institute, Regional Inspectorate Brno, Okružní 31, 638 00 Brno
Ambient conditions:	<i>The average ambient conditions during the measurement were as follows:</i> Air temperature: $23.0^{\circ}\text{C} \pm 0.7^{\circ}\text{C}$ Relative humidity: $45\% \pm 15\%$
Measurement results:	The measurement results are given in the Tables of results. The instrument has not been adjusted and was calibrated after manufacturer maintenance. The results marked "!!!" are out of specification reported by manufacturer. The 1-year specification are reported in the table of results. The measurement uncertainty is not included in calculation of % of specification. Only functions and ranges reported in this Certificate of Calibration were calibrated.

The standard uncertainty of measurement has been determined in accordance with JCGM 100:2008 document. The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k corresponding to a coverage probability of approximately 95 %, which for normal distribution corresponds to a coverage factor $k = 2$.

The uncertainties reported in the table of results are valid after rounding up to two valid numbers.

Note: *Set value* is the value set on the calibrator.
Measured value is the value measured on the output terminals of the calibrator.
Difference is calculated as Measured value - Set Value

Tables of results:

DC Voltage

Range	Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
20 mV	0.000 00 mV	-0.000 51 mV	-0.51 μ V	$\pm 6.00 \mu$ V	-9%	0.53 μ V
	10.000 00 mV	9.998 22 mV	-1.78 μ V	$\pm 6.50 \mu$ V	-27%	0.34 μ V
	-10.000 00 mV	-10.001 89 mV	-1.89 μ V	$\pm 6.50 \mu$ V	-29%	0.27 μ V
	19.000 00 mV	18.998 38 mV	-1.62 μ V	$\pm 6.95 \mu$ V	-23%	0.44 μ V
	-19.000 00 mV	-19.001 56 mV	-1.56 μ V	$\pm 6.95 \mu$ V	-22%	0.45 μ V
200 mV	20.000 1 mV	19.999 93 mV	-0.17 μ V	$\pm 8.3 \mu$ V	-2%	0.46 μ V
	-20.000 1 mV	-19.999 38 mV	0.72 μ V	$\pm 8.3 \mu$ V	9%	0.45 μ V
	100.000 0 mV	99.999 03 mV	-0.97 μ V	$\pm 9.5 \mu$ V	-10%	0.64 μ V
	-100.000 0 mV	-99.998 83 mV	1.17 μ V	$\pm 9.5 \mu$ V	12%	0.64 μ V
	190.000 0 mV	189.998 60 mV	-1.40 μ V	$\pm 10.9 \mu$ V	-13%	1.19 μ V
2 V	-190.000 0 mV	-189.998 36 mV	1.64 μ V	$\pm 10.9 \mu$ V	15%	1.19 μ V
	0.200 001 V	0.200 003 4 V	2.4 μ V	$\pm 12 \mu$ V	20%	1.3 μ V
	-0.200 001 V	-0.199 998 2 V	2.8 μ V	$\pm 12 \mu$ V	23%	1.3 μ V
	1.000 000 V	1.000 002 1 V	2.1 μ V	$\pm 22 \mu$ V	10%	4.1 μ V
	-1.000 000 V	-0.999 999 4 V	0.6 μ V	$\pm 22 \mu$ V	3%	4.1 μ V
20 V	1.900 000 V	1.900 003 5 V	3.5 μ V	$\pm 33 \mu$ V	11%	7.3 μ V
	-1.900 000 V	-1.900 004 6 V	-4.6 μ V	$\pm 33 \mu$ V	-14%	7.3 μ V
	2.000 01 V	1.999 994 V	-16 μ V	$\pm 70 \mu$ V	-23%	12 μ V
	4.000 00 V	3.999 983 V	-17 μ V	$\pm 90 \mu$ V	-19%	18 μ V
	6.000 00 V	5.999 985 V	-15 μ V	$\pm 110 \mu$ V	-14%	25 μ V
	8.000 00 V	8.000 003 V	3 μ V	$\pm 130 \mu$ V	2%	31 μ V
	10.000 00 V	10.000 007 V	7 μ V	$\pm 150 \mu$ V	5%	37 μ V
	12.000 00 V	12.000 013 V	13 μ V	$\pm 170 \mu$ V	8%	43 μ V
	14.000 00 V	14.000 022 V	22 μ V	$\pm 190 \mu$ V	12%	50 μ V
	16.000 00 V	16.000 041 V	41 μ V	$\pm 210 \mu$ V	20%	56 μ V
	18.000 00 V	18.000 049 V	49 μ V	$\pm 230 \mu$ V	21%	62 μ V
	19.000 00 V	19.000 053 V	53 μ V	$\pm 240 \mu$ V	22%	65 μ V
	-2.000 01 V	-2.000 014 V	-4 μ V	$\pm 70 \mu$ V	-6%	13 μ V
	-4.000 00 V	-3.999 990 V	10 μ V	$\pm 90 \mu$ V	11%	19 μ V
	-6.000 00 V	-5.999 980 V	20 μ V	$\pm 110 \mu$ V	18%	25 μ V
	-8.000 00 V	-8.000 007 V	-7 μ V	$\pm 130 \mu$ V	-5%	31 μ V
	-10.000 00 V	-10.000 002 V	-2 μ V	$\pm 150 \mu$ V	-1%	37 μ V
	-12.000 00 V	-12.000 000 V	0 μ V	$\pm 170 \mu$ V	0%	43 μ V
	-14.000 00 V	-14.000 000 V	0 μ V	$\pm 190 \mu$ V	0%	50 μ V
	-16.000 00 V	-16.000 032 V	-32 μ V	$\pm 210 \mu$ V	-15%	56 μ V
	-18.000 00 V	-18.000 038 V	-38 μ V	$\pm 230 \mu$ V	-17%	62 μ V
	-19.000 00 V	-19.000 041 V	-41 μ V	$\pm 240 \mu$ V	-17%	65 μ V
240 V	20.000 1 V	19.999 92 V	-0.18 mV	$\pm 0.8 \text{ mV}$	-23%	0.16 mV
	-20.000 1 V	-20.000 15 V	-0.05 mV	$\pm 0.8 \text{ mV}$	-6%	0.15 mV
	100.000 0 V	99.999 72 V	-0.28 mV	$\pm 2.0 \text{ mV}$	-14%	0.51 mV
	-100.000 0 V	-99.999 32 V	0.68 mV	$\pm 2.0 \text{ mV}$	34%	0.51 mV
	190.000 0 V	189.999 21 V	-0.79 mV	$\pm 3.4 \text{ mV}$	-23%	0.92 mV
	-190.000 0 V	-189.998 66 V	1.34 mV	$\pm 3.4 \text{ mV}$	39%	0.92 mV
	240.000 0 V	239.998 2 V	-1.8 mV	$\pm 4.1 \text{ mV}$	-44%	2.3 mV
	-240.000 0 V	-239.998 7 V	1.3 mV	$\pm 4.1 \text{ mV}$	32%	2.3 mV
1000 V	250.000 V	250.001 0 V	1.0 mV	$\pm 33 \text{ mV}$	3%	2.3 mV
	-250.000 V	-250.000 1 V	-0.1 mV	$\pm 33 \text{ mV}$	0%	2.3 mV
	1000.000 V	1000.005 7 V	5.7 mV	$\pm 70 \text{ mV}$	8%	5.7 mV
	-1000.000 V	-999.993 3 V	6.7 mV	$\pm 70 \text{ mV}$	10%	5.9 mV

DC Current

Range	Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
200 μ A	0.000 0 μ A	0.000 2 μ A	0.2 nA	± 20.0 nA	1%	0.6 nA
	10.000 0 μ A	9.999 7 μ A	-0.3 nA	± 25.0 nA	-1%	0.9 nA
	-10.000 0 μ A	-9.999 5 μ A	0.5 nA	± 25.0 nA	2%	0.9 nA
	100.000 0 μ A	99.996 8 μ A	-3.2 nA	± 70.0 nA	-5%	4.0 nA
	-100.000 0 μ A	-99.997 5 μ A	2.5 nA	± 70.0 nA	4%	4.0 nA
	190.000 0 μ A	189.995 2 μ A	-4.8 nA	± 115.0 nA	-4%	7.3 nA
	-190.000 0 μ A	-189.996 6 μ A	3.4 nA	± 115.0 nA	3%	7.3 nA
2 mA	0.200 001 mA	0.200 006 mA	5 nA	± 140 nA	4%	5 nA
	-0.200 001 mA	-0.199 982 mA	19 nA	± 140 nA	14%	5 nA
	1.000 000 mA	0.999 974 mA	-26 nA	± 300 nA	-9%	18 nA
	-1.000 000 mA	-0.999 961 mA	39 nA	± 300 nA	13%	18 nA
	1.900 000 mA	1.899 953 mA	-47 nA	± 480 nA	-10%	32 nA
	-1.900 000 mA	-1.899 950 mA	50 nA	± 480 nA	10%	32 nA
20 mA	2.000 01 mA	2.000 07 mA	0.06 μ A	± 0.80 μ A	8%	0.05 μ A
	-2.000 01 mA	-1.999 83 mA	0.18 μ A	± 0.80 μ A	23%	0.05 μ A
	10.000 00 mA	9.999 85 mA	-0.15 μ A	± 1.60 μ A	-9%	0.18 μ A
	-10.000 00 mA	-9.999 67 mA	0.33 μ A	± 1.60 μ A	21%	0.18 μ A
	19.000 00 mA	18.999 72 mA	-0.28 μ A	± 2.50 μ A	-11%	0.32 μ A
	-19.000 00 mA	-18.999 59 mA	0.41 μ A	± 2.50 μ A	16%	0.32 μ A
200 mA	20.000 1 mA	20.001 2 mA	1.1 μ A	± 8.0 μ A	14%	1.1 μ A
	-20.000 1 mA	-19.998 2 mA	1.9 μ A	± 8.0 μ A	24%	1.1 μ A
	40.000 0 mA	40.001 0 mA	1.0 μ A	± 10.0 μ A	10%	1.7 μ A
	-40.000 0 mA	-39.997 3 mA	2.7 μ A	± 10.0 μ A	27%	1.7 μ A
	60.000 0 mA	60.000 9 mA	0.9 μ A	± 12.0 μ A	8%	2.3 μ A
	-60.000 0 mA	-59.996 5 mA	3.5 μ A	± 12.0 μ A	29%	2.3 μ A
	80.000 0 mA	80.000 6 mA	0.6 μ A	± 14.0 μ A	4%	3.0 μ A
	-80.000 0 mA	-79.995 7 mA	4.3 μ A	± 14.0 μ A	31%	3.0 μ A
	100.000 0 mA	100.000 4 mA	0.4 μ A	± 16.0 μ A	3%	3.6 μ A
	-100.000 0 mA	-99.994 9 mA	5.1 μ A	± 16.0 μ A	32%	3.6 μ A
	120.000 0 mA	120.000 2 mA	0.2 μ A	± 18.0 μ A	1%	4.2 μ A
	-120.000 0 mA	-119.994 1 mA	5.9 μ A	± 18.0 μ A	33%	4.2 μ A
	140.000 0 mA	140.000 2 mA	0.2 μ A	± 20.0 μ A	1%	4.9 μ A
	-140.000 0 mA	-139.993 1 mA	6.9 μ A	± 20.0 μ A	35%	4.9 μ A
	160.000 0 mA	160.000 0 mA	0.0 μ A	± 22.0 μ A	0%	5.5 μ A
	-160.000 0 mA	-159.992 4 mA	7.6 μ A	± 22.0 μ A	35%	5.5 μ A
	180.000 0 mA	179.999 9 mA	-0.1 μ A	± 24.0 μ A	0%	6.2 μ A
	-180.000 0 mA	-179.991 4 mA	8.6 μ A	± 24.0 μ A	36%	6.2 μ A
	190.000 0 mA	189.999 7 mA	-0.3 μ A	± 25.0 μ A	-1%	6.5 μ A
	-190.000 0 mA	-189.991 2 mA	8.8 μ A	± 25.0 μ A	35%	6.5 μ A
2 A	0.200 001 A	0.200 063 A	62 μ A	± 130 μ A	48%	18 μ A
	-0.200 001 A	-0.199 950 A	51 μ A	± 130 μ A	39%	19 μ A
	1.000 000 A	1.000 018 A	18 μ A	± 250 μ A	7%	59 μ A
	-1.000 000 A	-0.999 947 A	53 μ A	± 250 μ A	21%	59 μ A
	1.900 000 A	1.900 015 A	15 μ A	± 385 μ A	4%	105 μ A
	-1.900 000 A	-1.899 970 A	30 μ A	± 385 μ A	8%	105 μ A
20 A	2.000 01 A	2.000 19 A	0.18 mA	± 2.40 mA	8%	0.20 mA
	-2.000 01 A	-2.000 01 A	0.00 mA	± 2.40 mA	0%	0.20 mA
	10.000 00 A	9.999 31 A	-0.69 mA	± 4.00 mA	-17%	0.80 mA
	-10.000 00 A	-9.999 11 A	0.89 mA	± 4.00 mA	22%	0.80 mA
	19.000 00 A	18.998 35 A	-1.65 mA	± 5.80 mA	-28%	1.49 mA
	-19.000 00 A	-18.999 64 A	0.36 mA	± 5.80 mA	6%	1.50 mA

AC Voltage

Range	Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
20 mV	10.000 00 mV; 45 Hz	10.008 4 mV	8.4 μ V	$\pm 50.0 \mu$ V	17%	8.7 μ V
	10.000 00 mV; 400 Hz	10.008 2 mV	8.2 μ V	$\pm 50.0 \mu$ V	16%	8.7 μ V
	10.000 00 mV; 1 kHz	10.009 2 mV	9.2 μ V	$\pm 50.0 \mu$ V	18%	8.7 μ V
	10.000 00 mV; 10 kHz	10.020 3 mV	20.3 μ V	$\pm 50.0 \mu$ V	41%	8.7 μ V
	10.000 00 mV; 50 kHz	9.998 1 mV	-1.9 μ V	$\pm 60.0 \mu$ V	-3%	11.3 μ V
	10.000 00 mV; 100 kHz	9.995 5 mV	-4.5 μ V	$\pm 140.0 \mu$ V	-3%	14.1 μ V
	19.000 00 mV; 45 Hz	19.004 4 mV	4.4 μ V	$\pm 68.0 \mu$ V	6%	13.3 μ V
	19.000 00 mV; 400 Hz	19.004 5 mV	4.5 μ V	$\pm 68.0 \mu$ V	7%	13.3 μ V
	19.000 00 mV; 1 kHz	19.006 4 mV	6.4 μ V	$\pm 68.0 \mu$ V	9%	13.3 μ V
	19.000 00 mV; 10 kHz	19.027 9 mV	27.9 μ V	$\pm 68.0 \mu$ V	41%	13.3 μ V
	19.000 00 mV; 50 kHz	18.986 0 mV	-14.0 μ V	$\pm 78.0 \mu$ V	-18%	15.6 μ V
	19.000 00 mV; 100 kHz	18.998 2 mV	-1.8 μ V	$\pm 230.0 \mu$ V	-1%	19.6 μ V
200 mV	20.000 1 mV; 45 Hz	20.003 4 mV	3.3 μ V	$\pm 100 \mu$ V	3%	9.4 μ V
	100.000 0 mV; 45 Hz	99.999 7 mV	-0.3 μ V	$\pm 180 \mu$ V	0%	26.6 μ V
	100.000 0 mV; 400 Hz	99.993 1 mV	-6.9 μ V	$\pm 180 \mu$ V	-4%	26.6 μ V
	100.000 0 mV; 1 kHz	99.987 8 mV	-12.2 μ V	$\pm 180 \mu$ V	-7%	26.6 μ V
	100.000 0 mV; 10 kHz	99.978 8 mV	-21.2 μ V	$\pm 180 \mu$ V	-12%	26.6 μ V
	100.000 0 mV; 50 kHz	99.938 6 mV	-61.4 μ V	$\pm 270 \mu$ V	-23%	33.3 μ V
	100.000 0 mV; 100 kHz	100.132 7 mV	132.7 μ V	$\pm 420 \mu$ V	32%	59.6 μ V
	190.000 0 mV; 45 Hz	189.997 9 mV	-2.1 μ V	$\pm 270 \mu$ V	-1%	50.5 μ V
	190.000 0 mV; 400 Hz	189.986 9 mV	-13.1 μ V	$\pm 270 \mu$ V	-5%	50.5 μ V
	190.000 0 mV; 1 kHz	189.979 0 mV	-21.0 μ V	$\pm 270 \mu$ V	-8%	50.5 μ V
	190.000 0 mV; 10 kHz	189.967 4 mV	-32.6 μ V	$\pm 270 \mu$ V	-12%	50.5 μ V
	190.000 0 mV; 50 kHz	189.907 9 mV	-92.1 μ V	$\pm 405 \mu$ V	-23%	63.2 μ V
2 V	0.200 001 V; 45 Hz	0.200 005 V	4 μ V	$\pm 136 \mu$ V	3%	22 μ V
	1.000 000 V; 45 Hz	0.999 988 V	-12 μ V	$\pm 280 \mu$ V	-4%	60 μ V
	1.000 000 V; 400 Hz	1.000 003 V	3 μ V	$\pm 280 \mu$ V	1%	60 μ V
	1.000 000 V; 1 kHz	0.999 974 V	-26 μ V	$\pm 280 \mu$ V	-9%	60 μ V
	1.000 000 V; 10 kHz	0.999 948 V	-52 μ V	$\pm 280 \mu$ V	-19%	60 μ V
	1.000 000 V; 50 kHz	0.999 739 V	-261 μ V	$\pm 700 \mu$ V	-37%	102 μ V
	1.000 000 V; 100 kHz	0.999 443 V	-557 μ V	$\pm 3000 \mu$ V	-19%	205 μ V
	1.900 000 V; 45 Hz	1.899 966 V	-34 μ V	$\pm 442 \mu$ V	-8%	115 μ V
	1.900 000 V; 400 Hz	1.900 009 V	9 μ V	$\pm 442 \mu$ V	2%	115 μ V
	1.900 000 V; 1 kHz	1.899 979 V	-21 μ V	$\pm 442 \mu$ V	-5%	115 μ V
	1.900 000 V; 10 kHz	1.899 977 V	-23 μ V	$\pm 442 \mu$ V	-5%	115 μ V
	1.900 000 V; 50 kHz	1.899 775 V	-225 μ V	$\pm 1150 \mu$ V	-20%	194 μ V
20 V	2.000 01 V; 45 Hz	2.000 17 V	0.16 mV	± 1.36 mV	12%	0.19 mV
	2.000 01 V; 400 Hz	2.000 08 V	0.07 mV	± 1.36 mV	5%	0.19 mV
	2.000 01 V; 1 kHz	1.999 81 V	-0.20 mV	± 1.36 mV	-15%	0.19 mV
	2.000 01 V; 10 kHz	1.999 58 V	-0.43 mV	± 1.36 mV	-32%	0.19 mV
	2.000 01 V; 50 kHz	1.998 75 V	-1.26 mV	± 7.00 mV	-18%	0.52 mV
	2.000 01 V; 100 kHz	1.996 28 V	-3.73 mV	± 14.00 mV	-27%	1.02 mV
	5.000 00 V; 45 Hz	5.000 08 V	0.08 mV	± 1.90 mV	4%	0.28 mV
	5.000 00 V; 400 Hz	5.000 04 V	0.04 mV	± 1.90 mV	2%	0.28 mV
	5.000 00 V; 1 kHz	4.999 74 V	-0.26 mV	± 1.90 mV	-14%	0.28 mV
	5.000 00 V; 10 kHz	4.999 46 V	-0.54 mV	± 1.90 mV	-28%	0.28 mV
	5.000 00 V; 50 kHz	4.997 64 V	-2.36 mV	± 8.50 mV	-28%	0.78 mV
	5.000 00 V; 100 kHz	4.993 33 V	-6.67 mV	± 20.00 mV	-33%	1.66 mV

AC Voltage - continue

Range	Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
20 V	10.000 00 V; 45 Hz	9.999 87 V	-0.13 mV	±2.80 mV	-5%	0.60 mV
	10.000 00 V; 400 Hz	9.999 96 V	-0.04 mV	±2.80 mV	-1%	0.60 mV
	10.000 00 V; 1 kHz	9.999 66 V	-0.34 mV	±2.80 mV	-12%	0.60 mV
	10.000 00 V; 10 kHz	9.999 59 V	-0.41 mV	±2.80 mV	-15%	0.60 mV
	10.000 00 V; 50 kHz	9.998 25 V	-1.75 mV	±11.00 mV	-16%	1.64 mV
	10.000 00 V; 100 kHz	9.994 51 V	-5.49 mV	±30.00 mV	-18%	3.35 mV
	15.000 00 V; 45 Hz	14.999 66 V	-0.34 mV	±3.70 mV	-9%	0.89 mV
	15.000 00 V; 400 Hz	14.999 86 V	-0.14 mV	±3.70 mV	-4%	0.89 mV
	15.000 00 V; 1 kHz	14.999 55 V	-0.45 mV	±3.70 mV	-12%	0.89 mV
	15.000 00 V; 10 kHz	14.999 78 V	-0.22 mV	±3.70 mV	-6%	0.89 mV
	15.000 00 V; 50 kHz	14.999 34 V	-0.66 mV	±13.50 mV	-5%	2.46 mV
	15.000 00 V; 100 kHz	14.995 49 V	-4.51 mV	±40.00 mV	-11%	5.03 mV
	19.000 00 V; 45 Hz	18.999 51 V	-0.49 mV	±4.42 mV	-11%	1.13 mV
	19.000 00 V; 400 Hz	18.999 80 V	-0.20 mV	±4.42 mV	-5%	1.13 mV
	19.000 00 V; 1 kHz	18.999 49 V	-0.51 mV	±4.42 mV	-12%	1.13 mV
	19.000 00 V; 10 kHz	18.999 91 V	-0.09 mV	±4.42 mV	-2%	1.13 mV
	19.000 00 V; 50 kHz	19.000 41 V	0.41 mV	±15.50 mV	3%	3.12 mV
	19.000 00 V; 100 kHz	18.997 52 V	-2.48 mV	±48.00 mV	-5%	6.37 mV
240 V	20.000 1 V; 45 Hz	20.010 1 V	10.0 mV	±13.6 mV	74%	1.2 mV
	100.000 0 V; 45 Hz	100.003 3 V	3.3 mV	±28.0 mV	12%	6.7 mV
	100.000 0 V; 400 Hz	100.004 5 V	4.5 mV	±28.0 mV	16%	6.7 mV
	100.000 0 V; 1 kHz	100.000 8 V	0.8 mV	±28.0 mV	3%	6.7 mV
	100.000 0 V; 10 kHz	99.997 6 V	-2.4 mV	±28.0 mV	-9%	6.7 mV
	190.000 0 V; 45 Hz	189.996 5 V	-3.5 mV	±44.2 mV	-8%	12.7 mV
	190.000 0 V; 400 Hz	189.999 7 V	-0.3 mV	±44.2 mV	-1%	12.7 mV
	190.000 0 V; 1 kHz	189.997 1 V	-2.9 mV	±44.2 mV	-7%	12.7 mV
	190.000 0 V; 10 kHz	189.999 5 V	-0.5 mV	±44.2 mV	-1%	12.7 mV
	240.000 0 V; 45 Hz	239.996 V	-4.0 mV	±53.2 mV	-8%	19 mV
	240.000 0 V; 400 Hz	240.001 V	1.0 mV	±53.2 mV	2%	19 mV
	240.000 0 V; 1 kHz	239.999 V	-1.0 mV	±53.2 mV	-2%	19 mV
1000 V	250.000 V; 45 Hz	250.035 V	35 mV	±275 mV	13%	45 mV
	1000.000 V; 45 Hz	1000.091 V	91 mV	±500 mV	18%	122 mV
	1000.000 V; 400 Hz	1000.104 V	104 mV	±500 mV	21%	98 mV
	1000.000 V; 1 kHz	1000.247 V	247 mV	±500 mV	49%	98 mV

Frequency (mode HF, $a = 0$ dB)

Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
10.000 00 kHz	9.999 844 kHz	-0.156 Hz	±0.50 Hz	-31%	0.005 Hz
10.000 00 MHz	9.999 843 MHz	-157 Hz	±500 Hz	-31%	5 Hz

Frequency (mode PWM POS, $U = 1$ V, PWM = 50%)

Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
10.000 00 kHz	9.999 845 kHz	-0.155 Hz	±0.50 Hz	-31%	0.005 Hz

AC Current

Range	Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
200 μ A	100.000 0 μ A; 45 Hz	99.991 8 μ A	-8.2 nA	± 170.0 nA	-5%	41.2 nA
	100.000 0 μ A; 400 Hz	99.997 8 μ A	-2.2 nA	± 170.0 nA	-1%	41.2 nA
	100.000 0 μ A; 1 kHz	99.991 4 μ A	-8.6 nA	± 170.0 nA	-5%	41.2 nA
	100.000 0 μ A; 5 kHz	99.954 8 μ A	-45.2 nA	± 520.0 nA	-9%	46.8 nA
	190.000 0 μ A; 45 Hz	189.982 8 μ A	-17.2 nA	± 305.0 nA	-6%	62.5 nA
	190.000 0 μ A; 400 Hz	189.995 7 μ A	-4.3 nA	± 305.0 nA	-1%	62.5 nA
	190.000 0 μ A; 1 kHz	189.988 3 μ A	-11.7 nA	± 305.0 nA	-4%	62.5 nA
	190.000 0 μ A; 5 kHz	189.924 1 μ A	-75.9 nA	± 790.0 nA	-10%	71.8 nA
	1.000 000 mA; 45 Hz	0.999 921 mA	-79 nA	± 900 nA	-9%	229 nA
	1.000 000 mA; 400 Hz	0.999 977 mA	-23 nA	± 900 nA	-3%	229 nA
	1.000 000 mA; 1 kHz	0.999 912 mA	-88 nA	± 900 nA	-10%	229 nA
	1.000 000 mA; 5 kHz	0.999 410 mA	-590 nA	± 3000 nA	-20%	467 nA
	1.900 000 mA; 45 Hz	1.899 871 mA	-129 nA	± 1530 nA	-8%	346 nA
	1.900 000 mA; 400 Hz	1.899 999 mA	-1 nA	± 1530 nA	0%	346 nA
	1.900 000 mA; 1 kHz	1.899 915 mA	-85 nA	± 1530 nA	-6%	346 nA
	1.900 000 mA; 5 kHz	1.899 009 mA	-991 nA	± 4800 nA	-21%	714 nA
20 mA	2.000 01 mA; 45 Hz	1.999 56 mA	-0.45 μ A	± 2.00 μ A	-23%	1.00 μ A
	2.000 01 mA; 400 Hz	1.999 60 mA	-0.41 μ A	± 2.00 μ A	-21%	1.00 μ A
	2.000 01 mA; 1 kHz	1.999 27 mA	-0.74 μ A	± 2.00 μ A	-37%	1.00 μ A
	2.000 01 mA; 5 kHz	1.998 21 mA	-1.80 μ A	± 14.00 μ A	-13%	2.51 μ A
	5.000 00 mA; 45 Hz	4.999 42 mA	-0.58 μ A	± 3.50 μ A	-17%	1.31 μ A
	5.000 00 mA; 400 Hz	4.999 64 mA	-0.36 μ A	± 3.50 μ A	-10%	1.31 μ A
	5.000 00 mA; 1 kHz	4.999 26 mA	-0.74 μ A	± 3.50 μ A	-21%	1.31 μ A
	5.000 00 mA; 5 kHz	4.996 74 mA	-3.26 μ A	± 20.00 μ A	-16%	3.30 μ A
	10.000 00 mA; 45 Hz	9.999 21 mA	-0.79 μ A	± 6.00 μ A	-13%	1.83 μ A
	10.000 00 mA; 400 Hz	9.999 78 mA	-0.22 μ A	± 6.00 μ A	-4%	1.83 μ A
	10.000 00 mA; 1 kHz	9.999 19 mA	-0.81 μ A	± 6.00 μ A	-14%	1.83 μ A
	10.000 00 mA; 5 kHz	9.994 30 mA	-5.70 μ A	± 30.00 μ A	-19%	4.65 μ A
	15.000 00 mA; 45 Hz	14.999 00 mA	-1.00 μ A	± 8.50 μ A	-12%	2.34 μ A
	15.000 00 mA; 400 Hz	14.999 93 mA	-0.07 μ A	± 8.50 μ A	-1%	2.34 μ A
	15.000 00 mA; 1 kHz	14.999 29 mA	-0.71 μ A	± 8.50 μ A	-8%	2.34 μ A
	15.000 00 mA; 5 kHz	14.992 16 mA	-7.84 μ A	± 40.00 μ A	-20%	6.00 μ A
	19.000 00 mA; 45 Hz	18.998 83 mA	-1.17 μ A	± 10.50 μ A	-11%	2.76 μ A
	19.000 00 mA; 400 Hz	19.000 13 mA	0.13 μ A	± 10.50 μ A	1%	2.76 μ A
	19.000 00 mA; 1 kHz	18.999 41 mA	-0.59 μ A	± 10.50 μ A	-6%	2.76 μ A
	19.000 00 mA; 5 kHz	18.990 66 mA	-9.34 μ A	± 48.00 μ A	-19%	7.10 μ A
200 mA	20.000 1 mA; 45 Hz	19.998 2 mA	-1.9 μ A	± 20.0 μ A	-10%	10.0 μ A
	100.000 0 mA; 45 Hz	99.989 7 mA	-10.3 μ A	± 60.0 μ A	-17%	18.3 μ A
	100.000 0 mA; 400 Hz	99.995 4 mA	-4.6 μ A	± 60.0 μ A	-8%	18.3 μ A
	100.000 0 mA; 1 kHz	99.988 2 mA	-11.8 μ A	± 60.0 μ A	-20%	18.3 μ A
	100.000 0 mA; 5 kHz	99.935 8 mA	-64.2 μ A	± 300.0 μ A	-21%	46.5 μ A
	190.000 0 mA; 45 Hz	189.978 9 mA	-21.1 μ A	± 105.0 μ A	-20%	27.6 μ A
	190.000 0 mA; 400 Hz	189.990 7 mA	-9.3 μ A	± 105.0 μ A	-9%	27.6 μ A
	190.000 0 mA; 1 kHz	189.981 2 mA	-18.8 μ A	± 105.0 μ A	-18%	27.6 μ A
	190.000 0 mA; 5 kHz	189.888 2 mA	-111.8 μ A	± 480.0 μ A	-23%	71.0 μ A

AC Current - continue

Range	Applied value		Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
2 A	0.200 001 A;	45 Hz	0.199 956 A	-45 μ A	$\pm 200 \mu$ A	-23%	96 μ A
	1.000 000 A;	45 Hz	0.999 809 A	-191 μ A	$\pm 600 \mu$ A	-32%	242 μ A
	1.000 000 A;	400 Hz	0.999 883 A	-117 μ A	$\pm 600 \mu$ A	-20%	242 μ A
	1.000 000 A;	1 kHz	0.999 870 A	-130 μ A	$\pm 600 \mu$ A	-22%	242 μ A
	1.900 000 A;	45 Hz	1.899 695 A	-305 μ A	$\pm 1050 \mu$ A	-29%	407 μ A
	1.900 000 A;	400 Hz	1.899 858 A	-142 μ A	$\pm 1050 \mu$ A	-14%	407 μ A
	1.900 000 A;	1 kHz	1.899 850 A	-150 μ A	$\pm 1050 \mu$ A	-14%	407 μ A
20 A	2.000 01 A;	45 Hz	1.999 42 A	-0.59 mA	± 8.00 mA	-7%	1.45 mA
	10.000 00 A;	45 Hz	9.998 38 A	-1.62 mA	± 16.00 mA	-10%	4.08 mA
	10.000 00 A;	400 Hz	9.999 81 A	-0.19 mA	± 16.00 mA	-1%	4.08 mA
	10.000 00 A;	1 kHz	10.000 51 A	0.51 mA	± 16.00 mA	3%	4.08 mA
	19.000 00 A;	45 Hz	18.997 25 A	-2.75 mA	± 25.00 mA	-11%	7.04 mA
	19.000 00 A;	400 Hz	19.001 69 A	1.69 mA	± 25.00 mA	7%	7.05 mA
	19.000 00 A;	1 kHz	19.002 92 A	2.92 mA	± 25.00 mA	12%	7.05 mA



Resistance (4-wire - output AUX, used adapter opt.70)

Range	Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
10 Ω	0.00 Ω	-0.000 5 Ω	-0.5 m Ω	± 5 m Ω	-10%	0.1 m Ω
	1.00 Ω	0.999 5 Ω	-0.5 m Ω	± 5 m Ω	-10%	0.1 m Ω
	10.00 Ω	10.000 3 Ω	0.3 m Ω	± 8 m Ω	4%	0.2 m Ω
33 Ω	30.00 Ω	30.002 5 Ω	2.5 m Ω	± 10 m Ω	25%	0.3 m Ω
100 Ω	100.00 Ω	100.002 2 Ω	2.2 m Ω	± 15 m Ω	15%	0.8 m Ω
330 Ω	190.00 Ω	190.003 Ω	3 m Ω	± 24 m Ω	13%	2 m Ω
	300.00 Ω	300.012 Ω	12 m Ω	± 35 m Ω	34%	3 m Ω
1 k Ω	1.000 0 k Ω	1.000 017 k Ω	17 m Ω	± 100 m Ω	17%	8 m Ω
3.3 k Ω	1.900 0 k Ω	1.900 019 k Ω	19 m Ω	± 190 m Ω	10%	14 m Ω
	3.000 0 k Ω	3.000 08 k Ω	0.08 Ω	± 0.30 Ω	27%	0.03 Ω
10 k Ω	10.000 k Ω	10.000 21 k Ω	0.21 Ω	± 1.0 Ω	21%	0.08 Ω
33 k Ω	19.000 k Ω	19.000 51 k Ω	0.51 Ω	± 1.9 Ω	27%	0.15 Ω
	30.000 k Ω	30.001 1 k Ω	1.1 Ω	± 3.0 Ω	37%	0.3 Ω
100 k Ω	100.00 k Ω	100.002 8 k Ω	2.8 Ω	± 10 Ω	28%	0.8 Ω
330 k Ω	190.00 k Ω	190.008 7 k Ω	8.7 Ω	± 19 Ω	46%	1.5 Ω
	300.00 k Ω	300.015 0 k Ω	15.0 Ω	± 30 Ω	50%	3 Ω
1 M Ω	1.000 0 M Ω	1.000 07 M Ω	0.07 k Ω	± 0.10 k Ω	70%	0.01 k Ω
3.3 M Ω	1.900 0 M Ω	1.900 13 M Ω	0.13 k Ω	± 0.38 k Ω	34%	0.02 k Ω
	3.000 0 M Ω	3.000 2 M Ω	0.2 k Ω	± 0.60 k Ω	33%	0.1 k Ω
10 M Ω	10.000 M Ω	10.002 4 M Ω	2.4 k Ω	± 5 k Ω	48%	0.2 k Ω
33 M Ω	19.000 M Ω	19.001 5 M Ω	1.5 k Ω	± 19 k Ω	8%	0.3 k Ω
	30.000 M Ω	30.000 3 M Ω	0.3 k Ω	± 30 k Ω	1%	11.0 k Ω

Resistance (2-wire - output Hi and Lo)

Range	Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
10 Ω	0.00 Ω	-0.001 6 Ω	-1.6 m Ω	± 25 m Ω	-6%	0.1 m Ω
	1.00 Ω	0.997 8 Ω	-2.2 m Ω	± 25 m Ω	-9%	0.1 m Ω
	10.00 Ω	9.998 6 Ω	-1.4 m Ω	± 28 m Ω	-5%	0.2 m Ω
33 Ω	30.00 Ω	30.001 3 Ω	1.3 m Ω	± 30 m Ω	4%	0.3 m Ω
100 Ω	100.00 Ω	100.000 7 Ω	0.7 m Ω	± 35 m Ω	2%	0.8 m Ω
300 Ω	190.00 Ω	190.000 Ω	0 m Ω	± 44 m Ω	0%	2 m Ω
	300.00 Ω	300.003 Ω	3 m Ω	± 55 m Ω	5%	3 m Ω
1 k Ω	1.000 0 k Ω	1.000 015 k Ω	15 m Ω	± 120 m Ω	13%	8 m Ω
3.3 k Ω	1.900 0 k Ω	1.900 025 k Ω	25 m Ω	± 210 m Ω	12%	14 m Ω
	3.000 0 k Ω	3.000 01 k Ω	0.01 Ω	± 0.32 Ω	3%	0.03 Ω
10 k Ω	10.000 k Ω	10.000 16 k Ω	0.16 Ω	± 1.0 Ω	16%	0.08 Ω
33 k Ω	19.000 k Ω	19.000 29 k Ω	0.29 Ω	± 1.9 Ω	15%	0.15 Ω
	30.000 k Ω	30.001 0 k Ω	1.0 Ω	± 3.0 Ω	33%	0.3 Ω
100 k Ω	100.00 k Ω	100.001 3 k Ω	1.3 Ω	± 10 Ω	13%	0.8 Ω
330 k Ω	190.00 k Ω	190.008 0 k Ω	8.0 Ω	± 19 Ω	42%	1.4 Ω
	300.00 k Ω	300.014 3 k Ω	14.3 Ω	± 30 Ω	48%	306 Ω
1 M Ω	1.000 0 M Ω	1.000 06 M Ω	0.06 k Ω	± 0.10 k Ω	60%	0.01 k Ω
3.3 M Ω	1.900 0 M Ω	1.900 14 M Ω	0.14 k Ω	± 0.38 k Ω	37%	0.02 k Ω
	3.000 0 M Ω	3.000 3 M Ω	0.3 k Ω	± 0.60 k Ω	50%	0.1 k Ω
10 M Ω	10.000 M Ω	10.002 5 M Ω	2.5 k Ω	± 5.0 k Ω	50%	0.2 k Ω
33 M Ω	19.000 M Ω	19.003 0 M Ω	3.0 k Ω	± 19.0 k Ω	16%	0.3 k Ω
	30.000 M Ω	30.004 0 M Ω	4.0 k Ω	± 30.0 k Ω	13%	11.0 k Ω
100 M Ω	100.00 M Ω	100.014 2 M Ω	14.2 k Ω	± 200 k Ω	7%	13.8 k Ω
1000 M Ω	190.00 M Ω	190.371 9 M Ω	371.9 k Ω	± 950 k Ω	39%	31.0 k Ω
	999.00 M Ω	1000.702 2 M Ω	1702.2 k Ω	± 4995 k Ω	34%	100.3 k Ω

Capacitance ($f = 300 \text{ Hz}$, $U_{\text{meas}} = 1.00 \text{ V}$, 2-wire, GND OFF)

Range	Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
1 nF	0.900 0 nF	0.901 69 nF	1.69 pF	$\pm 19.5 \text{ pF}$	9%	0.50 pF
3.3 nF	3.000 nF	2.997 5 nF	-2.5 pF	$\pm 20.0 \text{ pF}$	-13%	1.5 pF
10 nF	10.000 nF	9.987 4 nF	-12.6 pF	$\pm 50 \text{ pF}$	-25%	5.0 pF
33 nF	30.00 nF	30.032 nF	0.032 nF	$\pm 0.15 \text{ nF}$	21%	0.015 nF
100 nF	100.00 nF	100.061 nF	0.061 nF	$\pm 0.50 \text{ nF}$	12%	0.050 nF
330 nF	0.300 0 μF	0.299 93 μF	-0.07 nF	$\pm 3.0 \text{ nF}$	-2%	0.15 nF
1 μF	1.000 0 μF	1.000 25 μF	0.25 nF	$\pm 10.0 \text{ nF}$	3%	0.50 nF
3.3 μF	3.000 μF	3.002 1 μF	2.1 nF	$\pm 45 \text{ nF}$	5%	1.5 μF
10 μF	10.000 μF	10.053 1 μF	53.1 nF	$\pm 150 \text{ nF}$	35%	5.0 μF
100 μF	50.00 μF	50.461 μF	0.461 μF	$\pm 1.0 \text{ } \mu\text{F}$	46%	0.038 μF
	80.00 μF	80.283 μF	0.283 μF	$\pm 1.6 \text{ } \mu\text{F}$	18%	0.060 μF
	100.00 μF	99.541 μF	-0.459 μF	$\pm 2.0 \text{ } \mu\text{F}$	-23%	0.075 μF

Capacitance ($f = 1 \text{ kHz}$, $U_{\text{meas}} = 1.00 \text{ V}$, 2-wire, GND OFF)

Range	Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
1 nF	0.900 0 nF	0.899 96 nF	-0.04 pF	$\pm 19.5 \text{ pF}$	0%	1.35 pF
3.3 nF	3.000 nF	3.002 3 nF	2.3 pF	$\pm 20 \text{ pF}$	12%	4.5 pF
10 nF	10.000 nF	10.007 5 nF	7.5 pF	$\pm 50 \text{ pF}$	15%	11.0 pF
33 nF	30.00 nF	30.099 nF	0.099 nF	$\pm 0.15 \text{ nF}$	66%	0.033 nF

Simulation of RTD - type Pt385 (ITS 90, $R_0 = 100 \text{ } \Omega$)

Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
-200.0 $^{\circ}\text{C}$	-200.00 $^{\circ}\text{C}$	0.00 $^{\circ}\text{C}$	$\pm 0.04 \text{ }^{\circ}\text{C}$	0%	0.02 $^{\circ}\text{C}$
-25.0 $^{\circ}\text{C}$	-24.98 $^{\circ}\text{C}$	0.02 $^{\circ}\text{C}$	$\pm 0.09 \text{ }^{\circ}\text{C}$	22%	0.02 $^{\circ}\text{C}$
0.0 $^{\circ}\text{C}$	0.03 $^{\circ}\text{C}$	0.03 $^{\circ}\text{C}$	$\pm 0.04 \text{ }^{\circ}\text{C}$	75%	0.02 $^{\circ}\text{C}$
25.0 $^{\circ}\text{C}$	25.02 $^{\circ}\text{C}$	0.02 $^{\circ}\text{C}$	$\pm 0.04 \text{ }^{\circ}\text{C}$	50%	0.02 $^{\circ}\text{C}$
50.0 $^{\circ}\text{C}$	50.01 $^{\circ}\text{C}$	0.01 $^{\circ}\text{C}$	$\pm 0.05 \text{ }^{\circ}\text{C}$	20%	0.02 $^{\circ}\text{C}$
100.0 $^{\circ}\text{C}$	100.01 $^{\circ}\text{C}$	0.01 $^{\circ}\text{C}$	$\pm 0.05 \text{ }^{\circ}\text{C}$	20%	0.03 $^{\circ}\text{C}$
500.0 $^{\circ}\text{C}$	500.02 $^{\circ}\text{C}$	0.02 $^{\circ}\text{C}$	$\pm 0.13 \text{ }^{\circ}\text{C}$	15%	0.07 $^{\circ}\text{C}$
850.0 $^{\circ}\text{C}$	849.99 $^{\circ}\text{C}$	-0.01 $^{\circ}\text{C}$	$\pm 0.20 \text{ }^{\circ}\text{C}$	-5%	0.10 $^{\circ}\text{C}$

DC Power

	Applied value	Measured value	Difference	Spec.	% of spec.	Expanded uncertainty
1.00 V; 10.00 mW; 10.00 mA;	10.000 00 mW	9.999 73 mW	-0.27 μ W	$\pm 7.1 \mu$ W	-4%	0.28 μ W
1.00 V; 100.000 0 mW; 100.0 mA;	100.000 0 mW	99.998 5 mW	-1.5 μ W	$\pm 61.0 \mu$ W	-2%	4.1 μ W
1.00 V; 1.000 000 W; 1.00 A;	1.000 000 W	0.999 761 W	-0.239 mW	± 0.61 mW	-39%	0.115 mW
1.00 V; 10.000 00 W; 10.00 A;	10.000 00 W	9.997 32 W	-2.68 mW	± 6.1 mW	-44%	1.16 mW
240.00 V; 2.400 000 W; 10.00 mA;	2.400 000 W	2.399 910 W	-0.090 mW	± 1.704 mW	-5%	0.068 mW
240.00 V; 2400.000 W; 10.00 A;	2400.000 W	2399.126 W	-0.874 W	± 1.464 W	-60%	0.277 W

AC Power

$U_{SET} = 230.000$ V; $f_{SET} = 50.0$ Hz

Power factor		Applied value	Measured value	Difference	Spec.	% of spec.	Expanded uncertainty
$\cos \varphi = 1$	0.10 A;	23.000 00 W	23.002 0 W	2.0 mW	± 17.25 mW	12%	10.0 mW
	2.00 A;	460.000 0 W	460.115 W	115 mW	± 327 mW	35%	92 mW
	10.00 A;	2300.000 W	2300.60 W	0.60 W	± 1.73 W	35%	0.47 W
$\cos \varphi = 0.5LA$	0.10 A;	11.500 00 W	11.493 6 W	-6.4 mW	± 52.9 mW	-12%	2.4 mW
	2.00 A;	230.000 0 W	229.954 W	-46 mW	± 1058 mW	-4%	47 mW
	10.00 A;	1150.000 W	1149.74 W	-0.26 W	± 5.29 W	-5%	0.31 W
$\cos \varphi = 0.25LA$	0.10 A;	5.750 00 W	5.745 64 W	-4.36 mW	± 57.50 mW	-8%	1.49 mW
	2.00 A;	115.000 0 W	114.893 W	-107 mW	± 1150 mW	-9%	26 mW
	10.00 A;	575.000 W	574.91 W	-0.09 W	± 5.75 W	-2%	0.58 W
$\cos \varphi = 0.5LE$	0.10 A;	11.500 00 W	11.506 9 W	6.9 mW	± 52.9 mW	13%	2.6 mW
	2.00 A;	230.000 0 W	230.117 W	117 mW	± 1058 mW	11%	48 mW
	10.00 A;	1150.000 W	1150.46 W	0.46 W	± 5.29 W	9%	0.52 W

Simulation of TC - type J (ITS 90, RJ = 0°C)

Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
-200.0 °C	-200.02 °C	-0.02 °C	±0.6 °C	-3%	0.04 °C
-25.0 °C	-24.99 °C	0.01 °C	±0.2 °C	5%	0.04 °C
0.0 °C	0.02 °C	0.02 °C	±0.2 °C	10%	0.04 °C
25.0 °C	25.03 °C	0.03 °C	±0.2 °C	15%	0.04 °C
50.0 °C	50.00 °C	0.00 °C	±0.2 °C	0%	0.04 °C
100.0 °C	100.00 °C	0.00 °C	±0.2 °C	0%	0.04 °C
500.0 °C	500.00 °C	0.00 °C	±0.4 °C	0%	0.04 °C
1000.0 °C	999.98 °C	-0.02 °C	±0.4 °C	-5%	0.04 °C
1200.0 °C	1199.99 °C	-0.01 °C	±0.4 °C	-3%	0.04 °C

Simulation of TC - type K (ITS 90, RJ = 0°C)

Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
-200.0 °C	-200.03 °C	-0.03 °C	±0.8 °C	-4%	0.06 °C
-25.0 °C	-24.98 °C	0.02 °C	±0.3 °C	7%	0.05 °C
0.0 °C	0.03 °C	0.03 °C	±0.3 °C	10%	0.05 °C
25.0 °C	25.03 °C	0.03 °C	±0.3 °C	10%	0.05 °C
50.0 °C	50.01 °C	0.01 °C	±0.3 °C	3%	0.05 °C
100.0 °C	99.99 °C	-0.01 °C	±0.3 °C	-3%	0.05 °C
500.0 °C	499.99 °C	-0.01 °C	±0.5 °C	-2%	0.06 °C
1000.0 °C	1000.01 °C	0.01 °C	±0.6 °C	2%	0.06 °C
1370.0 °C	1370.01 °C	0.01 °C	±0.7 °C	1%	0.06 °C

Simulation of TC - type S (ITS 90, RJ = 0°C)

Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
-50.0 °C	-50.37 °C	-0.37 °C	±2.8 °C	-13%	0.16 °C
-25.0 °C	-24.92 °C	0.08 °C	±2.5 °C	3%	0.16 °C
0.0 °C	0.19 °C	0.19 °C	±2.1 °C	9%	0.16 °C
25.0 °C	25.20 °C	0.20 °C	±1.9 °C	11%	0.16 °C
50.0 °C	50.04 °C	0.04 °C	±1.8 °C	2%	0.16 °C
100.0 °C	99.97 °C	-0.03 °C	±1.6 °C	-2%	0.16 °C
500.0 °C	499.91 °C	-0.09 °C	±1.3 °C	-7%	0.16 °C
1000.0 °C	999.95 °C	-0.05 °C	±1.3 °C	-4%	0.16 °C
1200.0 °C	1199.99 °C	-0.01 °C	±1.3 °C	-1%	0.16 °C
1500.0 °C	1499.98 °C	-0.02 °C	±1.4 °C	-1%	0.16 °C
1750.0 °C	1749.93 °C	-0.07 °C	±1.7 °C	-4%	0.16 °C

Simulation of TC - type B (ITS 90, RJ = 0°C)

Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
400.0 °C	399.74 °C	-0.26 °C	±2.9 °C	-9%	0.14 °C
600.0 °C	599.78 °C	-0.22 °C	±2.0 °C	-11%	0.14 °C
800.0 °C	799.86 °C	-0.14 °C	±1.7 °C	-8%	0.14 °C
1000.0 °C	999.81 °C	-0.19 °C	±1.4 °C	-14%	0.14 °C
1200.0 °C	1199.82 °C	-0.18 °C	±1.3 °C	-14%	0.14 °C
1500.0 °C	1499.87 °C	-0.13 °C	±1.3 °C	-10%	0.14 °C
1800.0 °C	1799.86 °C	-0.14 °C	±1.4 °C	-10%	0.14 °C

Simulation of TC - type R (ITS 90, RJ = 0°C)

Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
-50.0 °C	-50.37 °C	-0.37 °C	±3.0 °C	-12%	0.16 °C
-25.0 °C	-25.02 °C	-0.02 °C	±2.6 °C	-1%	0.17 °C
0.0 °C	0.09 °C	0.09 °C	±2.1 °C	4%	0.16 °C
25.0 °C	25.10 °C	0.10 °C	±1.9 °C	5%	0.16 °C
50.0 °C	49.87 °C	-0.13 °C	±1.7 °C	-8%	0.16 °C
100.0 °C	99.84 °C	-0.16 °C	±1.5 °C	-11%	0.16 °C
500.0 °C	499.90 °C	-0.10 °C	±1.2 °C	-8%	0.16 °C
1000.0 °C	999.95 °C	-0.05 °C	±1.1 °C	-5%	0.16 °C
1200.0 °C	1199.96 °C	-0.04 °C	±1.2 °C	-3%	0.16 °C
1500.0 °C	1500.00 °C	0.00 °C	±1.3 °C	0%	0.16 °C
1750.0 °C	1749.96 °C	-0.04 °C	±1.6 °C	-3%	0.16 °C

Simulation of TC - type T (ITS 90, RJ = 0°C)

Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
-200.0 °C	-200.11 °C	-0.11 °C	±0.8 °C	-14%	0.05 °C
-25.0 °C	-24.98 °C	0.02 °C	±0.3 °C	7%	0.05 °C
0.0 °C	0.02 °C	0.02 °C	±0.3 °C	7%	0.05 °C
25.0 °C	25.03 °C	0.03 °C	±0.3 °C	10%	0.05 °C
50.0 °C	50.01 °C	0.01 °C	±0.3 °C	3%	0.05 °C
100.0 °C	100.00 °C	0.00 °C	±0.3 °C	0%	0.05 °C
400.0 °C	400.00 °C	0.00 °C	±0.3 °C	0%	0.05 °C

Simulation of TC - type E (ITS 90, RJ = 0°C)

Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
-200.0 °C	-200.07 °C	-0.07 °C	±0.6 °C	-12%	0.05 °C
-25.0 °C	-24.97 °C	0.03 °C	±0.2 °C	15%	0.05 °C
0.0 °C	0.02 °C	0.02 °C	±0.2 °C	10%	0.05 °C
25.0 °C	25.03 °C	0.03 °C	±0.2 °C	15%	0.05 °C
50.0 °C	50.01 °C	0.01 °C	±0.2 °C	5%	0.05 °C
100.0 °C	100.00 °C	0.00 °C	±0.2 °C	0%	0.05 °C
500.0 °C	499.99 °C	-0.01 °C	±0.3 °C	-3%	0.05 °C
1000.0 °C	1000.00 °C	0.00 °C	±0.3 °C	0%	0.05 °C

Simulation of TC - type N (ITS 90, RJ = 0°C)

Applied value	Measured value	Difference	Spec.	Percent of spec.	Expanded uncertainty
-200.0 °C	-200.10 °C	-0.10 °C	±1.2 °C	-8%	0.05 °C
-25.0 °C	-24.98 °C	0.02 °C	±0.5 °C	4%	0.05 °C
0.0 °C	0.03 °C	0.03 °C	±0.4 °C	8%	0.05 °C
25.0 °C	25.03 °C	0.03 °C	±0.4 °C	8%	0.05 °C
50.0 °C	50.01 °C	0.01 °C	±0.4 °C	3%	0.05 °C
100.0 °C	99.99 °C	-0.01 °C	±0.4 °C	-3%	0.05 °C
500.0 °C	500.03 °C	0.03 °C	±0.5 °C	6%	0.05 °C
1000.0 °C	1000.00 °C	0.00 °C	±0.6 °C	0%	0.05 °C
1300.0 °C	1299.99 °C	-0.01 °C	±0.6 °C	-2%	0.05 °C

Multimeter:

DC Voltage- mVDC: cable opt.80

Range	Applied value	Indicated value	Difference	Spec.	Percent of spec.	Expanded uncertainty
20 mV	0.000 00 mV	-0.004 9 mV	-4.9 μ V	$\pm 7.0 \mu$ V	-70%	0.2 μ V
	10.000 00 mV	9.995 9 mV	-4.1 μ V	$\pm 9.0 \mu$ V	-46%	0.4 μ V
	-10.000 00 mV	-10.001 9 mV	-1.9 μ V	$\pm 9.0 \mu$ V	-21%	0.4 μ V
200 mV	100.000 00 mV	99.999 mV	-1 μ V	$\pm 27 \mu$ V	-4%	1 μ V
	-100.000 00 mV	-100.017 mV	-17 μ V	$\pm 27 \mu$ V	-63%	1 μ V
2 V	1.000 000 0 V	0.999 97 V	-0.03 mV	± 0.21 mV	-14%	0.02 mV
	-1.000 000 0 V	-0.999 98 V	0.02 mV	± 0.21 mV	10%	0.02 mV
	1.900 000 0 V	1.900 02 V	0.02 mV	± 0.39 mV	5%	0.02 mV
	-1.900 000 0 V	-1.900 01 V	-0.01 mV	± 0.39 mV	-3%	0.02 mV

DC Voltage: cable opt.40

Range	Applied value	Indicated value	Difference	Spec.	Percent of spec.	Expanded uncertainty
10 V	0.000 000 V	0.000 0 V	0.0 mV	± 0.3 mV	0%	0.1 mV
	2.000 000 V	1.999 7 V	-0.3 mV	± 0.5 mV	-60%	0.1 mV
	-2.000 000 V	-2.000 0 V	0.0 mV	± 0.5 mV	0%	0.1 mV
	5.000 000 V	4.999 8 V	-0.2 mV	± 0.8 mV	-25%	0.1 mV
	-5.000 000 V	-5.000 4 V	-0.4 mV	± 0.8 mV	-50%	0.1 mV
	10.000 000 V	10.000 0 V	0.0 mV	± 1.3 mV	0%	0.1 mV
	-10.000 000 V	-10.000 2 V	-0.2 mV	± 1.3 mV	-15%	0.1 mV
	15.000 000 V	15.000 2 V	0.2 mV	± 0.8 mV	25%	0.1 mV
	-15.000 000 V	-15.000 1 V	-0.1 mV	± 0.8 mV	-13%	0.1 mV
	20.000 000 V	20.000 4 V	0.4 mV	± 1.3 mV	31%	0.1 mV
	-20.000 000 V	-20.001 0 V	-1.0 mV	± 1.3 mV	-77%	0.1 mV

DC Current: Cable opt.40

Range	Applied value	Indicated value	Difference	Spec.	Percent of spec.	Expanded uncertainty
25 mA	0.000 00 mA	0.000 2 mA	0.2 μ A	$\pm 0.3 \mu$ A	67%	0.1 μ A
	5.000 00 mA	4.999 8 mA	-0.2 μ A	$\pm 1.1 \mu$ A	-18%	0.2 μ A
	-5.000 00 mA	-4.999 7 mA	0.3 μ A	$\pm 1.1 \mu$ A	27%	0.1 μ A
	10.000 00 mA	9.999 5 mA	-0.5 μ A	$\pm 1.8 \mu$ A	-28%	0.2 μ A
	-10.000 00 mA	-9.999 6 mA	0.4 μ A	$\pm 1.8 \mu$ A	22%	0.2 μ A
	15.000 00 mA	14.999 8 mA	-0.2 μ A	$\pm 2.6 \mu$ A	-8%	0.3 μ A
	-15.000 00 mA	-14.999 9 mA	0.1 μ A	$\pm 2.6 \mu$ A	4%	0.3 μ A
	19.000 00 mA	18.999 7 mA	-0.3 μ A	$\pm 3.2 \mu$ A	-9%	0.4 μ A
	-19.000 00 mA	-19.000 2 mA	-0.2 μ A	$\pm 3.2 \mu$ A	-6%	0.4 μ A
	24.000 00 mA	23.999 9 mA	-0.1 μ A	$\pm 3.9 \mu$ A	-3%	0.9 μ A
	-24.000 00 mA	-24.000 0 mA	0.0 μ A	$\pm 3.9 \mu$ A	0%	0.9 μ A

Multimeter:

Resistance: 4-wire, cable opt.60

Range	Applied value	Indicated value	Difference	Spec.	Percent of spec.	Expanded uncertainty
20 Ω	0.000 000 Ω	0.000 Ω	0 m Ω	± 10 m Ω	0%	1 m Ω
	9.999 283 Ω	9.998 Ω	-1 m Ω	± 12 m Ω	-8%	1 m Ω
200 Ω	99.996 53 Ω	99.985 Ω	-12 m Ω	± 30 m Ω	-40%	1 m Ω
2 k Ω	1000.002 0 Ω	999.98 Ω	-0.02 Ω	± 0.21 Ω	-10%	0.01 Ω
	1899.998 3 Ω	1900.00 Ω	0.00 Ω	± 0.21 Ω	0%	0.01 Ω

Frequency: cable opt. 40, $U_{rms} = 1$ V, sine

Range	Applied value	Indicated value	Difference	Spec.	Percent of spec.	Expanded uncertainty
15 kHz	1.000 000 kHz	1.000 02 kHz	0.02 Hz	± 0.05 Hz	40%	0.01 Hz



Temperature measurement -TC type J (ITS 90, RJ = 0°C)

cable opt.80

Applied value	Equivalent value	Indicated value	Difference	Spec.	Percent of spec.	Expanded uncertainty
-200.0 °C	-7.890 48 mV	-200.09 °C	-0.09 °C	± 0.8 °C	-11%	0.05 °C
0.0 °C	0.000 00 mV	-0.07 °C	-0.07 °C	± 0.4 °C	-18%	0.04 °C
100.0 °C	5.268 92 mV	99.97 °C	-0.03 °C	± 0.4 °C	-8%	0.04 °C
1199.0 °C	69.495 93 mV	1198.97 °C	-0.03 °C	± 0.6 °C	-5%	0.04 °C

Temperature measurement -TC type K (ITS 90, RJ = 0°C)

cable opt.80

Applied value	Equivalent value	Indicated value	Difference	Spec.	Percent of spec.	Expanded uncertainty
-199.0 °C	-5.876 05 mV	-199.15 °C	-0.15 °C	± 0.8 °C	-19%	0.07 °C
0.0 °C	0.000 00 mV	-0.09 °C	-0.09 °C	± 0.4 °C	-23%	0.05 °C
100.0 °C	4.096 23 mV	99.98 °C	-0.02 °C	± 0.4 °C	-5%	0.05 °C
1370.0 °C	54.818 57 mV	1369.94 °C	-0.06 °C	± 0.8 °C	-8%	0.06 °C

Temperature measurement -TC type S (ITS 90, RJ = 0°C)

cable opt.80

Applied value	Equivalent value	Indicated value	Difference	Spec.	Percent of spec.	Expanded uncertainty
-48.0 °C	-0.227 58 mV	-48.82 °C	-0.82 °C	± 2.0 °C	-41%	0.20 °C
0.0 °C	0.000 00 mV	-0.69 °C	-0.69 °C	± 1.6 °C	-43%	0.17 °C
100.0 °C	0.645 91 mV	99.89 °C	-0.11 °C	± 1.6 °C	-7%	0.18 °C
1750.0 °C	18.503 26 mV	1749.61 °C	-0.39 °C	± 1.3 °C	-30%	0.17 °C

Temperature measurement -TC type R (ITS 90, RJ = 0°C)

cable opt.80

Applied value	Equivalent value	Indicated value	Difference	Spec.	Percent of spec.	Expanded uncertainty
-47.0 °C	-0.215 20 mV	-48.15 °C	-1.15 °C	± 2.5 °C	-46%	0.22 °C
0.0 °C	0.000 00 mV	-0.79 °C	-0.79 °C	± 1.5 °C	-53%	0.18 °C
100.0 °C	0.647 40 mV	99.99 °C	-0.01 °C	± 1.5 °C	-1%	0.18 °C
1750.0 °C	20.877 03 mV	1749.68 °C	-0.32 °C	± 1.2 °C	-27%	0.13 °C

Temperature measurement -TC type T (ITS 90, RJ = 0°C)

cable opt.80

Applied value	Equivalent value	Indicated value	Difference	Spec.	Percent of spec.	Expanded uncertainty
-199.0 °C	-5.587 15 mV	-199.18 °C	-0.18 °C	± 0.8 °C	-23%	0.07 °C
0.0 °C	0.000 00 mV	-0.11 °C	-0.11 °C	± 0.4 °C	-28%	0.05 °C
100.0 °C	4.278 52 mV	99.95 °C	-0.05 °C	± 0.4 °C	-13%	0.04 °C
400.0 °C	20.871 97 mV	399.93 °C	-0.07 °C	± 0.4 °C	-18%	0.03 °C

Temperature measurement -TC type E (ITS 90, RJ = 0°C) cable opt.80

Applied value	Equivalent value	Indicated value	Difference	Spec.	Percent of spec.	Expanded uncertainty
-200.0 °C	-8.824 58 mV	-200.00 °C	0.00 °C	± 1.1 °C	0%	0.04 °C
0.0 °C	0.000 00 mV	-0.07 °C	-0.07 °C	± 0.4 °C	-18%	0.04 °C
100.0 °C	6.318 93 mV	99.93 °C	-0.07 °C	± 0.4 °C	-18%	0.03 °C
999.0 °C	76.297 67 mV	998.96 °C	-0.04 °C	± 0.5 °C	-8%	0.03 °C

Temperature measurement -TC type N (ITS 90, RJ = 0°C) cable opt.80

Applied value	Equivalent value	Indicated value	Difference	Spec.	Percent of spec.	Expanded uncertainty
-199.0 °C	-3.980 38 mV	-199.34 °C	-0.34 °C	± 0.9 °C	-38%	0.10 °C
0.0 °C	0.000 00 mV	-0.18 °C	-0.18 °C	± 0.5 °C	-36%	0.08 °C
100.0 °C	2.774 12 mV	99.89 °C	-0.11 °C	± 0.5 °C	-22%	0.07 °C
1299.0 °C	47.476 75 mV	1298.88 °C	-0.12 °C	± 0.8 °C	-15%	0.06 °C

Temperature measurement -TC type B (ITS 90, RJ = 0°C) cable opt.80

Applied value	Equivalent value	Indicated value	Difference	Spec.	Percent of spec.	Expanded uncertainty
402.0 °C	0.794 68 mV	401.34 °C	-0.66 °C	± 2.0 °C	-33%	0.21 °C
1000.0 °C	4.834 34 mV	999.71 °C	-0.29 °C	± 1.2 °C	-24%	0.14 °C
1800.0 °C	13.591 30 mV	1799.73 °C	-0.27 °C	± 1.1 °C	-25%	0.15 °C

End of Certificate of Calibration.