



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Isotech North America
158 Brentwood Drive, Unit 4
Colchester, VT 05446

Fulfills the requirements of

ISO/IEC 17025:2017

In the field of

CALIBRATION

This certificate is valid only when accompanied by a current scope of accreditation document.
The current scope of accreditation can be verified at www.anab.org.

A handwritten signature in black ink, appearing to read 'R. Douglas Leonard Jr.', is positioned above a horizontal line.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 17 July 2023

Certificate Number: AC-2691.01



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory
quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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CALIBRATION

Valid to: **July 17, 2023**

Certificate Number: **AC-2691.01**

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source Fixed Values	1.018 V 10.000 V	2.6 μ V 25 μ V	Transmille 3000ZR Zener Voltage Standard
DC Voltage – Source	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1 000) V	6.6 μ V/V + 1.4 μ V 5.3 μ V/V + 1.6 μ V 4.8 μ V/V + 11 μ V 7.3 μ V/V + 15 μ V 8.3 μ V/V + 1.3 mV	Transmille 4010 Reference Calibrator
DC Voltage – Measure	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100 V to 1 kV	2.8 μ V/V + 0.8 μ V 4.7 μ V/V + 0.9 μ V 5.3 μ V/V + 7.5 μ V 7.3 μ V/V + 15 μ V 7.2 μ V/V + 1.4 mV	Transmille 8091 Multimeter
DC Current – Source	(0 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A (1 to 10) A (10 to 30) A	5.6 μ A/A + 0.28 nA 5.9 μ A/A + 2.5 nA 6.3 μ A/A + 32 nA 18 μ A/A + 0.36 μ A 87 μ A/A + 7.0 μ A 210 μ A/A + 210 μ A 290 μ A/A + 510 μ A	Transmille 4010 Reference Calibrator
DC Current Source For Clamp Meters	(10 to 1 500) A	0.46 % of reading + 0.42 A	Transmille 4010 Reference Calibrator, Transmille EA002 Coil

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Measure	1 pA to 10 nA	0.54 % of reading + 13 pA	Transmille 8091 Multimeter, AC-DC Current Shunts
	(10 to 100) nA	0.19 % of reading + 22 pA	
	100 nA to 1 μ A	0.02 % of reading + 33 pA	
	(1 to 10) μ A	38 μ A/A + 120 pA	
	(10 to 100) μ A	9.1 μ A/A + 470 pA	
	(100 to 200) μ A	9.1 μ A/A + 4.7 nA	
	200 μ A to 1 mA	14 μ A/A	
	(1 to 2) mA	11 μ A/A + 51 nA	
	(2 to 10) mA	13 μ A/A	
	(10 to 20) mA	35 μ A/A + 0.7 μ A	
	20 to 100 mA	19 μ A/A	
	(100 to 200) mA	0.17 mA/A + 15 μ A	
	200 mA to 1 A	30 μ A/A	
	(1 to 2) A	26 μ A/A	
2 to 5) A	20 μ A/A		
(5 to 30) A	69 μ A/A		
AC Voltage – Source	(0 to 100) mV		Transmille 4010 Reference Calibrator
	(10 to 45) Hz	640 μ V/V + 12 μ V	
	45 Hz to 1 kHz	130 μ V/V + 12 μ V	
	(1 to 20) kHz	170 μ V/V + 18 μ V	
	(20 to 50) kHz	980 μ V/V + 25 μ V	
	(50 to 100) kHz	1.3 mV/V + 25 μ V	
	(100 to 300) kHz	4.6 mV/V + 59 μ V	
	(300 to 500) kHz	12 mV/V + 65 μ V	
	(100 to 300) mV		
	(10 to 23) Hz	780 μ V/V + 89 μ V	
	(23 to 45) Hz	480 μ V/V + 100 μ V	
	45 to 1 kHz	160 μ V/V + 70 μ V	
	(1 to 20) kHz	170 μ V/V + 100 μ V	
	(20 to 100) kHz	730 μ V/V + 170 μ V	
	(100 to 200) kHz	2.6 mV/V + 260 μ V	
	(200 to 500) kHz	2.7 mV/V + 260 μ V	
	300 mV to 1 V		
	(10 to 23) Hz	510 μ V/V + 100 μ V	
	(23 to 45) Hz	470 μ V/V + 110 μ V	
	45 Hz to 1 kHz	150 μ V/V + 75 μ V	
(1 to 20) kHz	170 μ V/V + 110 μ V		
(20 to 100) kHz	620 μ V/V + 170 μ V		
(100 to 200) kHz	2.6 mV/V + 260 μ V		
(200 to 500) kHz	2.7 mV/V + 260 μ V		
500 kHz to 1 MHz	2.8 mV/V + 250 μ V		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source	(1 to 3) V		Transmille 4010 Reference Calibrator
	(10 to 23) Hz	490 $\mu\text{V/V}$ + 910 μV	
	(23 to 45) Hz	450 $\mu\text{V/V}$ + 930 μV	
	45 Hz to 1 kHz	140 $\mu\text{V/V}$ + 580 μV	
	(1 to 20) kHz	170 $\mu\text{V/V}$ + 0.93 mV	
	(20 to 100) kHz	550 $\mu\text{V/V}$ + 1.7 mV	
	(3 to 10) V		
	(10 to 23) Hz	500 $\mu\text{V/V}$ + 880 μV	
	(23 to 45) Hz	450 $\mu\text{V/V}$ + 920 μV	
	45 Hz to 1 kHz	140 $\mu\text{V/V}$ + 580 μV	
	(1 to 20) kHz	170 $\mu\text{V/V}$ + 920 μV	
	(20 to 100) kHz	560 $\mu\text{V/V}$ + 1.7 mV	
	(10 to 30) V		
	(30 to 45) Hz	450 $\mu\text{V/V}$ + 12 mV	
	45 Hz to 1 kHz	140 $\mu\text{V/V}$ + 7 mV	
	(1 to 10) kHz	170 $\mu\text{V/V}$ + 9.3 mV	
	(10 to 20) kHz	250 $\mu\text{V/V}$ + 17 mV	
	(20 to 40) kHz	260 $\mu\text{V/V}$ + 17 mV	
	(40 to 100) kHz	2.1 mV/V + 29 mV	
	(30 to 100) V		
	(30 to 45) Hz	450 $\mu\text{V/V}$ + 12 mV	
	45 Hz to 1 kHz	140 $\mu\text{V/V}$ + 7.9 mV	
	(1 to 10) kHz	170 $\mu\text{V/V}$ + 10 mV	
	(10 to 20) kHz	250 $\mu\text{V/V}$ + 18 mV	
(20 to 40) kHz	280 $\mu\text{V/V}$ + 17 mV		
(40 to 100) kHz	2.1 mV/V + 29 mV		
(100 to 300) V			
(30 to 45) Hz	520 $\mu\text{V/V}$ + 120 mV		
45 Hz to 1 kHz	160 $\mu\text{V/V}$ + 36 mV		
(1 to 10) kHz	210 $\mu\text{V/V}$ + 70 mV		
300 V to 1 kV			
(30 to 45) Hz	520 $\mu\text{V/V}$ + 120 mV		
45 Hz to 1 kHz	170 $\mu\text{V/V}$ + 35 mV		
(1 to 10) kHz	220 $\mu\text{V/V}$ + 70 mV		
(10 to 20) kHz	270 $\mu\text{V/V}$ + 120 mV		

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	(0 to 100) mV		Transmille 8091 Multimeter
	(10 to 40) Hz	360 μ V/V + 11 μ V	
	40 Hz to 1 kHz	110 μ V/V + 10 μ V	
	(1 to 20) kHz	140 μ V/V + 14 μ V	
	(20 to 50) kHz	510 μ V/V + 18 μ V	
	(50 to 100) kHz	940 μ V/V + 18 μ V	
	(100 to 300) kHz	3.8 mV/V + 48 μ V	
	(300 to 500) kHz	12 mV/V + 55 μ V	
	(100 to 300) mV		
	(10 to 23) Hz	760 μ V/V + 4.6 μ V	
	(23 to 40) Hz	320 μ V/V + 6.7 μ V	
	40 Hz to 1 kHz	98 μ V/V + 7.2 μ V	
	(1 to 20) kHz	110 μ V/V + 12 μ V	
	(20 to 100) kHz	640 μ V/V + 13 μ V	
	100 kHz to 1 MHz	2 mV/V + 43 μ V	
	300 mV to 1 V		
	(10 to 23) Hz	280 μ V/V + 62 μ V	
	(23 to 40) Hz	190 μ V/V + 73 μ V	
	40 kHz to 1 kHz	72 μ V/V + 53 μ V	
	(1 to 20) kHz	88 μ V/V + 74 μ V	
	(20 to 100) kHz	290 μ V/V + 110 μ V	
	100 kHz to 1 MHz	1.6 mV/V + 140 μ V	
	(1 to 3) V		
	(10 to 23) Hz	290 μ V/V + 51 μ V	
	(23 to 40) Hz	200 μ V/V + 69 μ V	
	40 Hz to 1 kHz	85 μ V/V + 45 μ V	
	(1 to 20) kHz	120 μ V/V + 82 μ V	
	(20 to 100) kHz	290 μ V/V + 110 μ V	
100 kHz to 1 MHz	1.6 mV/V + 130 μ V		
(3 to 10) V			
(10 to 23) Hz	290 μ V/V + 500 μ V		
(23 to 40) Hz	200 μ V/V + 600 μ V		
40 Hz to 1 kHz	79 μ V/V + 390 μ V		
(1 to 20) kHz	93 μ V/V + 610 μ V		
(20 to 100) kHz	280 μ V/V + 1.1 mV		
(100 to 200) kHz	1.2 mV/V + 1.7 mV		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	(10 to 30) V		Transmille 8091 Multimeter
	(10 to 23) Hz	290 $\mu\text{V/V}$ + 430 μV	
	(23 to 40) Hz	200 $\mu\text{V/V}$ + 580 μV	
	40 Hz to 1 kHz	80 $\mu\text{V/V}$ + 370 μV	
	(1 to 20) kHz	94 $\mu\text{V/V}$ + 580 μV	
	(20 to 100) kHz	260 $\mu\text{V/V}$ + 1.1 mV	
	(30 to 100) V		
	(10 to 40) Hz	190 $\mu\text{V/V}$ + 8.3 mV	
	40 Hz to 1 kHz	67 $\mu\text{V/V}$ + 5.9 mV	
	(1 to 20) kHz	77 $\mu\text{V/V}$ + 7.4 mV	
	(20 to 50) kHz	170 $\mu\text{V/V}$ + 11 mV	
	(50 to 100) kHz	710 $\mu\text{V/V}$ + 19 mV	
	(100 to 300) V		
	(10 to 40) Hz	190 $\mu\text{V/V}$ + 7.8 mV	
	40 Hz to 1 kHz	76 $\mu\text{V/V}$ + 5.0 mV	
(1 to 10) kHz	76 $\mu\text{V/V}$ + 63 mV		
(10 to 40) kHz	140 $\mu\text{V/V}$ + 110 mV		
AC Voltage – Measure	300 V to 1 kV		5790B AC Measurement Standard
	40 Hz to 1 kHz	93 $\mu\text{V/V}$ + 21 mV	
	(1 to 10) kHz	110 $\mu\text{V/V}$ + 44 mV	
	(2.2 to 7) mV		
	(10 to 20) Hz	1.8 mV/V + 1.9 μV	
	(20 to 40) Hz	430 $\mu\text{V/V}$ + 1.9 μV	
	40 Hz to 20 kHz	430 $\mu\text{V/V}$ + 1.9 μV	
	(20 to 50) kHz	910 $\mu\text{V/V}$ + 2.6 μV	
	(50 to 100) kHz	1.3 mV/V + 3.1 μV	
	(100 to 300) kHz	2.6 mV/V + 4.8 μV	
	(300 to 500) kHz	3 mV/V + 9.3 μV	
	(500 to 1 000) kHz	5.8 mV/V + 9.3 μV	
	(2.2 to 7) mV		
	(10 to 20) Hz	964 $\mu\text{V/V}$ + 1.7 μV	
	(20 to 40) Hz	409 $\mu\text{V/V}$ + 1.8 μV	
40 Hz to 20 kHz	229 $\mu\text{V/V}$ + 1.8 μV		
(20 to 50) kHz	462 $\mu\text{V/V}$ + 2.5 μV		
(50 to 100) kHz	695 $\mu\text{V/V}$ + 3.1 μV		
(100 to 300) kHz	1.4 mV/V + 4.7 μV		
(300 to 500) kHz	1.6 mV/V + 9.3 μV		
(500 to 1 000) kHz	4.2 mV/V + 9.3 μV		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	(7 to 22) mV		5790B AC Measurement Standard
	(10 to 20) Hz	330 $\mu\text{V/V} + 1.7 \mu\text{V}$	
	(20 to 40) Hz	220 $\mu\text{V/V} + 1.8 \mu\text{V}$	
	40 Hz to 20 kHz	120 $\mu\text{V/V} + 1.8 \mu\text{V}$	
	(20 to 50) kHz	240 $\mu\text{V/V} + 2.5 \mu\text{V}$	
	(50 to 100) kHz	360 $\mu\text{V/V} + 3 \mu\text{V}$	
	(100 to 300) kHz	960 $\mu\text{V/V} + 4.6 \mu\text{V}$	
	(300 to 500) kHz	1.2 mV/V + 9.2 μV	
	(500 to 1 000) kHz	3 mV/V + 9.2 μV	
	(22 to 70) mV		
	(10 to 20) Hz	290 $\mu\text{V/V} + 1.8 \mu\text{V}$	
	(20 to 40) Hz	150 $\mu\text{V/V} + 1.9 \mu\text{V}$	
	40 Hz to 20 kHz	80 $\mu\text{V/V} + 1.9 \mu\text{V}$	
	(20 to 50) kHz	160 $\mu\text{V/V} + 2.4 \mu\text{V}$	
	(50 to 100) kHz	310 $\mu\text{V/V} + 2.9 \mu\text{V}$	
	(100 to 300) kHz	630 $\mu\text{V/V} + 4.6 \mu\text{V}$	
	(300 to 500) kHz	820 $\mu\text{V/V} + 9 \mu\text{V}$	
	(500 to 1 000) kHz	1.5 mV/V + 9.1 μV	
	(70 to 220) mV		
	(10 to 20) Hz	250 $\mu\text{V/V} + 1.8 \mu\text{V}$	
	(20 to 40) Hz	100 $\mu\text{V/V} + 1.8 \mu\text{V}$	
	40 Hz to 20 kHz	50 $\mu\text{V/V} + 1.9 \mu\text{V}$	
	(20 to 50) kHz	90 $\mu\text{V/V} + 2.4 \mu\text{V}$	
	(50 to 100) kHz	190 $\mu\text{V/V} + 2.9 \mu\text{V}$	
	(100 to 300) kHz	330 $\mu\text{V/V} + 4.5 \mu\text{V}$	
	(300 to 500) kHz	480 $\mu\text{V/V} + 9.0 \mu\text{V}$	
	(500 to 1 000) kHz	1.4 mV/V + 9.1 μV	
	(220 to 700) mV		
(10Hz to 20) Hz	240 $\mu\text{V/V} + 2.1 \mu\text{V}$		
(20Hz to 40) Hz	90 $\mu\text{V/V} + 2.7 \mu\text{V}$		
40 Hz to 20 kHz	40 $\mu\text{V/V} + 3.5 \mu\text{V}$		
(20z to 50) kHz	60 $\mu\text{V/V} + 3.6 \mu\text{V}$		
(50 to 100) kHz	100 $\mu\text{V/V} + 3.7 \mu\text{V}$		
(100 to 300) kHz	250 $\mu\text{V/V} + 4.9 \mu\text{V}$		
(300 to 500) kHz	400 $\mu\text{V/V} + 9.4 \mu\text{V}$		
(500 to 1 000) kHz	1.4 mV/V + 9.3 μV		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	700 mV to 2.2 V		5790B AC Measurement Standard
	(10 to 20) Hz	230 μ V/V	
	(20 to 40) Hz	80 μ V/V	
	40 Hz to 20 kHz	34 μ V/V	
	(20 to 50) kHz	61 μ V/V	
	(50 to 100) kHz	91 μ V/V	
	(100 to 300) kHz	240 μ V/V	
	(300 to 500) kHz	360 μ V/V	
	(500 to 1 000) kHz	1.4 mV/V	
	(2.2 to 7) V		
	(10 to 20) Hz	230 μ V/V	
	(20 to 40) Hz	80 μ V/V	
	40 Hz to 20 kHz	32 μ V/V	
	(20 to 50) kHz	61 μ V/V	
	(50 to 100) kHz	100 μ V/V	
	(100 to 300) kHz	260 μ V/V	
	(300 to 500) kHz	540 μ V/V	
	(500 to 1 000) kHz	1.7 mV/V	
	(7 to 22) V		
	(10 to 20) Hz	230 μ V/V	
	(20 to 40) Hz	81 μ V/V	
	40 Hz to 20 kHz	36 μ V/V	
	(20 to 50) kHz	62 μ V/V	
	(50 to 100) kHz	99 μ V/V	
(100 to 300) kHz	260 μ V/V		
(300 to 500) kHz	540 μ V/V		
(500 to 1 000) kHz	1.7 mV/V		
(22 to 70) V			
(10 to 20) Hz	230 μ V/V		
(20 to 40) Hz	81 μ V/V		
40 Hz to 20 kHz	43 μ V/V		
(20 to 50) kHz	71 μ V/V		
(50 to 100) kHz	130 μ V/V		
(100 to 300) kHz	260 μ V/V		
(300 to 500) kHz	590 μ V/V		
(500 to 1 000) kHz	1.7 mV/V		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	(70 to 220) V		5790B AC Measurement Standard
	(10 to 20) Hz	230 μ V/V	
	(20 to 40) Hz	85 μ V/V	
	40 Hz to 20 kHz	45 μ V/V	
	(20 to 50) kHz	90 μ V/V	
	(50 to 100) kHz	130 μ V/V	
	(100 to 300) kHz	300 μ V/V	
	(300 to 500) kHz	810 μ V/V	
	(220 to 700) V		
	(10 to 20) Hz	230 μ V/V	
	(20 to 40) Hz	130 μ V/V	
	40 Hz to 20 kHz	55 μ V/V	
	(20 to 50) kHz	170 μ V/V	
	(50 to 100) kHz	980 μ V/V	
	(700 to 1 000) V		
(10 to 20) Hz	230 μ V/V		
(20 to 40) Hz	130 μ V/V		
40 Hz to 20 kHz	53 μ V/V		
(20 to 50) kHz	170 μ V/V		
(50 to 100) kHz	980 μ V/V		
AC Current – Source	(1 to 100) μ A		Transmille 4010 Reference Calibrator
	10 Hz to 45 Hz	1.7 mA/A + 0.15 μ A	
	45 Hz to 1 kHz	520 μ A/A + 0.09 μ A	
	1 kHz to 10 kHz	8.4 mA/A + 0.12 μ A	
	100 μ A to 1 mA		
	10 Hz to 45 Hz	1.6 mA/A + 0.15 μ A	
	45 Hz to 1 kHz	430 μ A/A + 0.12 μ A	
	1 kHz to 10 kHz	4.3 mA/A + 0.17 μ A	
	10 kHz to 30 kHz	8.4 mA/A + 0.35 μ A	
	1 mA to 10 mA		
	10 Hz to 45 Hz	1.6 mA/A + 1.8 μ A	
	45 Hz to 1 kHz	380 μ A/A + 1.2 μ A	
	1 kHz to 10 kHz	2.3 mA/A + 1.7 μ A	
	10 kHz to 30 kHz	4.3 mA/A + 2.3 μ A	
	10 mA to 100 mA		
10 Hz to 45 Hz	1.6 mA/A + 18 μ A		
45 Hz to 1 kHz	380 μ A/A + 12 μ A		
1 kHz to 10 kHz	4.2 mA/A + 23 μ A		
10 kHz to 30 kHz	5.2 mA/A + 120 μ A		

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source	100 mA to 1 A 10 Hz to 45 Hz 45 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz 10 kHz to 30 kHz (1 to 30) A 10 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	1.6 mA/A + 180 μA 420 μA/A + 130 μA 4.2 mA/A + 230 μA 15 mA/A + 580 μA 25 mA/A + 2.9 mA 1.6 mA/A + 2.3 mA 410 μA/A + 2.1 mA 4.2 mA/A + 2.6 mA 5.2 mA/A + 2.6 mA 29 mA/A + 3 mA	Transmille 4010 Reference Calibrator
AC Current Source For Clamp Meters	(10 to 1500) A @60 Hz	0.46 % of reading + 0.42 A	Transmille 4010 Reference Calibrator, Transmille EA002 Coil
AC Current – Measure	(0 to 100) μA (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz (100 to 200) μA (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz 10 kHz to 30 kHz 200 μA to 1 mA (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz (10 to 30) kHz (1 to 2) mA (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz 10 kHz to 30 kHz (2 to 10) mA (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz (10 to 30) kHz	490 μA/A + 0.16 μA 97 μA/A + 0.13 μA 190 μA/A + 0.2 μA 580 μA/A + 0.16 μA 140 μA/A + 0.13 μA 2.9 mA/A + 0.15 μA 1.6 mA/A + 120 μA 270 μA/A 140 μA/A 140 μA/A 690 μA/A 600 μA/A + 0.2 μA 170 μA/A + 0.24 μA 1.5 mA/A + 0.28 μA 3 mA/A + 0.37 μA 270 μA/A 130 μA/A 130 μA/A 560 μA/A	Transmille 8091 Multimeter, AC-DC Current Shunts

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure	(10 to 30) mA (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz (10 to 30) kHz	600 μ A/A + 3.3 μ A 160 μ A/A + 2.1 μ A 710 μ A/A + 2.1 μ A 1.5 mA/A + 2.2 μ A	Transmille 8091 Multimeter, AC-DC Current Shunts
AC Current – Measure	(20 to 100) mA (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz (10 to 30) kHz (100 to 200) mA (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz (10 to 30) kHz 200 mA to 1 A (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz (10 to 30) kHz (1 to 2) A (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz (10 to 30) kHz (2 to 5) A (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz (10 to 30) kHz (5 to 30) A (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz (10 to 100) kHz	510 μ A/A 130 μ A/A 140 μ A/A 140 μ A/A 600 μ A/A + 19 μ A 160 μ A /A + 23 μ A 1.5 mA/A + 22 μ A 1.6 mA/A + 120 μ A 540 μ A/A 250 μ A/A 290 μ A/A 410 μ A/A 500 μ A/A 139 μ A/A 220 μ A/A 416 μ A/A 450 μ A/A 151 μ A/A 138 μ A/A 175 μ A/A 516 μ A/A 160 μ A/A 216 μ A/A 446 μ A/A	Transmille 8091 Multimeter, AC-DC Current Shunts
Resistance – Source Fixed Values	1 Ω 5 Ω 10 Ω 15 Ω 25 Ω	2.4 $\mu\Omega/\Omega$ 0.76 $\mu\Omega/\Omega$ 1.2 $\mu\Omega/\Omega$ 1.2 $\mu\Omega/\Omega$ 1.2 $\mu\Omega/\Omega$	Transmille 3000RS Transmille 3000HR & Fixed Temp Controlled Resistors



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source Fixed Values	30 Ω	1.2 μΩ/Ω	Transmille 3000RS Transmille 3000HR & Fixed Temp Controlled Resistors
	50 Ω	1.8 μΩ/Ω	
	62.5 Ω	0.65 μΩ/Ω	
	75 Ω	0.65 μΩ/Ω	
	100 Ω	0.65 μΩ/Ω	
	150 Ω	0.65 μΩ/Ω	
	200 Ω	0.65 μΩ/Ω	
	250 Ω	0.65 μΩ/Ω	
	300 Ω	0.65 μΩ/Ω	
	350 Ω	0.65 μΩ/Ω	
	400 Ω	0.65 μΩ/Ω	
	500 Ω	3.5 μΩ/Ω	
	1 kΩ	2.9 μΩ/Ω	
	10 kΩ	1.7 μΩ/Ω	
	20 kΩ	1.4 μΩ/Ω	
	100 kΩ	1.9 μΩ/Ω	
	300 kΩ	3.1 μΩ/Ω	
	400 kΩ	2 μΩ/Ω	
	1 MΩ	1.9 μΩ/Ω	
10 MΩ	5.6 μΩ/Ω		
100 MΩ	120 μΩ/Ω		
1 GΩ	250 μΩ/Ω		
10 GΩ	580 μΩ/Ω		
100 GΩ	5.2 mΩ/Ω		
Resistance – Source Variable Ranges	(0 to 100) Ω	110 μΩ/Ω + 59 mΩ	Transmille 4010 Reference Calibrator
	(100 to 330) Ω	120 μΩ/Ω + 59 mΩ	
	0.33 Ω to 1 kΩ	87 μΩ/Ω + 120 mΩ	
	(1 to 3.3) kΩ	110 μΩ/Ω + 100 mΩ	
	(3.3 to 10) kΩ	66 μΩ/Ω + 1 Ω	
	(10 to 33) kΩ	100 μΩ/Ω + 640 mΩ	
	(33 to 100) kΩ	63 μΩ/Ω + 10 Ω	
	(100 to 330) kΩ	110 μΩ/Ω + 6.0 Ω	
	330 kΩ to 1 MΩ	64 μΩ/Ω + 100 Ω	
	(1 to 3.3) MΩ	160 μΩ/Ω + 47 Ω	
(3.3 to 10) MΩ	82 μΩ/Ω + 1 kΩ		
(10 to 33) MΩ	690 μΩ/Ω + 1.3 kΩ		
Resistance – Source Variable Ranges	(33 to 100) MΩ	710 μΩ/Ω + 110 kΩ	Transmille 4010 Reference Calibrator
	(100 to 330) MΩ	13 mΩ/Ω + 100 kΩ	
	330 MΩ to 1 GΩ	24 mΩ/Ω + 560 kΩ	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Measure	(0 to 1) Ω (1 to 10) Ω (10 to 100) Ω 100 Ω to 1 k Ω (1 to 10) k Ω (10 to 100) k Ω	16 $\mu\Omega/\Omega$ + 9.0 $\mu\Omega$ 9.9 $\mu\Omega/\Omega$ + 64 $\mu\Omega$ 11 $\mu\Omega/\Omega$ + 540 $\mu\Omega$ 6.3 $\mu\Omega/\Omega$ + 5.4 m Ω 7.9 $\mu\Omega/\Omega$ + 53 m Ω 8.8 $\mu\Omega/\Omega$ + 530 m Ω	Transmille 8091 Multimeter
Resistance – Measure	100 k Ω to 1 M Ω (1 to 10) M Ω (10 to 100) M Ω 100 M Ω to 1 G Ω (1 to 10) G Ω 10 G Ω to 100 G Ω 100 G Ω to 1 T Ω	11 $\mu\Omega/\Omega$ + 5.7 Ω 19 $\mu\Omega/\Omega$ + 110 Ω 130 $\mu\Omega/\Omega$ + 4.7 k Ω 460 $\mu\Omega/\Omega$ + 29 k Ω 5 m Ω/Ω + 37 k Ω 27 m Ω/Ω + 68 k Ω 27 m Ω/Ω + 0.68 M Ω	Transmille 8091 Multimeter
Capacitance – Source Fixed Values	1 nF 2 nF 5 nF 10 nF 100 nF 1 μ F 10 μ F	0.06 % of reading	Transmille 4010 Reference Calibrator w/ GW Instek LCR 819
Capacitance – Source	0.95 μ F to 100 mF	0.7 % of reading	Transmille 4010 Reference Calibrator
Capacitance-Measure	10 pF to 1 F	0.06 % of reading	GW Instek LCR 819 LCR Meter
Inductance – Source Fixed Values	1 mH 10 mH 19 mH 29 mH 50 mH 100 mH 1 H 10 H	0.06 % of reading	Transmille 4010 Reference Calibrator w/ GW Instek LCR 819 LCR Meter
Inductance Measure	1 mH to 10 H	0.06 % of reading	GW Instek LCR 819 LCR Meter
Phase – Single Phase Power (0 to 1 000) V, (0 to 30) A 40 Hz to 60 Hz	(-180 to 180) $^{\circ}$	0.12 $^{\circ}$	Transmille 8091 Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices	Type J		Transmille 4010 Reference Calibrator W/ EA001A
	(-210 to -100) °C	0.31 °C	
	(-100 to -30) °C	0.23 °C	
	(-30 to 150) °C	0.22 °C	
	(120 to 760) °C	0.25 °C	
	(760 to 1 200) °C	0.28 °C	
	Type K		
	(-200 to -100) °C	0.34 °C	
	(-100 to -25) °C	0.25 °C	
	(-25 to 120) °C	0.23 °C	
	(120 to 1 000) °C	0.29 °C	
	(1 000 to 1 372) °C	0.33 °C	
	Type T		
	(-250 to -150) °C	0.64 °C	
	(-150 to 0) °C	0.23 °C	
	(0 to 120) °C	0.22 °C	
	(120 to 400) °C	0.23 °C	
	Type R		
	(0 to 250) °C	0.83 °C	
	(250 to 1 000) °C	0.49 °C	
	(1 000 to 1 760) °C	0.55 °C	
	Type S		
	(0 to 250) °C	0.83 °C	
	(250 to 1 000) °C	0.49 °C	
(1 000 to 1 760) °C	0.55 °C		
Type B			
(600 to 800) °C	0.76 °C		
(800 to 1 000) °C	0.69 °C		
(1 000 to 1 550) °C	0.58 °C		
(1 550 to 1 820) °C	0.59 °C		
Type N			
(-200 to -100) °C	0.47 °C		
(-100 to -25) °C	0.29 °C		
(-25 to 120) °C	0.26 °C		
(120 to 410) °C	0.26 °C		
(410 to 1 300) °C	0.32 °C		

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment	
Electrical Simulation of Thermocouple Indicating Devices	Type E		Transmille 4010 Reference Calibrator W/ EA001A	
		(-250 to -100) °C		0.54 °C
		(-100 to -25) °C		0.23 °C
		(-25 to 350) °C		0.22 °C
		(350 to 650) °C		0.24 °C
		(650 to 1 000) °C		0.26 °C
	Type L			
		(-200 to -100) °C		0.4 °C
		(-100 to 800) °C		0.39 °C
		(800 to 900) °C		0.4 °C
	Type U			
		(-200 to 0) °C		0.47 °C
		(0 to 600) °C		0.37 °C
Type C				
	(0 to 150) °C	0.37 °C		
	(150 to 650) °C	0.34 °C		
	(650 to 1 000) °C	0.38 °C		
	(1 000 to 18 00) °C	0.51 °C		
	(1 800 to 2 316) °C	0.71 °C		
Electrical Simulation of RTD/PRT Indicating Devices (Fixed Values)	Pt 100 Sensors		Transmille 4010 Reference Calibrator	
		-100 °C		0.023 °C
		0 °C		0.02 °C
		30 °C		0.021 °C
		60 °C		0.021 °C
		100 °C		0.023 °C
		200 °C		0.029 °C
		400 °C		0.045 °C
	800 °C	0.083 °C		
Electrical Simulation of RTD/PRT Indicating Devices (Variable Ranges)	Pt 100 Sensors		Transmille 4010 Reference Calibrator	
		(-200 to 100) °C		0.03 °C
		(400 to 630) °C		0.19 °C
	(630 to 800) °C	0.26 °C		



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Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Measure	(-200 °C to 156) °C (156 to 660) °C (660 to 1 100) °C (1 100 to 1 300) °C	5 mK 8 mK 0.4 °C 0.6 °C	Precision Thermometers with SPRT and Primary TC
Temperature - Thermometers and Probes by comparison	(-80 to 30) °C 0 °C (30 to 300) °C (300 to 650) °C (650 to 1 100) °C (1 100 to 1 200) °C	7.6 mK 5 mK 14 mK 61 mK 0.53 °C 0.6 °C	Comparison in liquid baths & dry wells with Reference measurement systems
Temperature – SPRT/PRT Calibration by Fixed Points	-195.798 °C -38.8344 °C 0.01 °C 29.7646 °C 156.598 °C 231.928 °C 419.527 °C 660.323 °C	3.7 mK 1.8 mK 0.7 mK 1.3 mK 2.7 mK 2.7 mK 2.9 mK 6.5 mK	Liquid N ₂ comparison Mercury cell Water triple point cell Gallium cell Indium cell Tin cell Zinc cell Aluminum cell
Infrared (IR) Thermometers / Pyrometers	50 °C 150 °C 300 °C 450 °C 550 °C 600 °C 700 °C 800 °C 900 °C 1 000 °C 1 100 °C 1 200 °C	0.30° C 0.64 °C 1.1 °C 2 °C 2.2 °C 2.7 °C 3.2 °C 3.3 °C 3.3 °C 3.9 °C 4.5 °C 4.9 °C	Blackbody Sources (Cavity) $\epsilon = (0.95 \text{ to } 1.0)$, $\lambda = (8 \text{ to } 14) \text{ um}$

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Measure	(1 to 100) Hz 100 Hz to 1 GHz	0.015 μ Hz/Hz+ 1.2 μ Hz 0.026 μ Hz/Hz	Transmille 8600 GPS Frequency Standard

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source	(1 to 100) Hz 100 Hz to 1 GHz	0.015 μ Hz/Hz+ 1.2 μ Hz 0.026 μ Hz/Hz	Transmille 8600 GPS Frequency Standard

Calibration and Measurement Capability (CMC) is expressed in terms of the measurement parameter, measurement range, expanded uncertainty of measurement and reference standard, method, and/or equipment. The expanded uncertainty of measurement is expressed as the standard uncertainty of the measurement multiplied by a coverage factor of 2 ($k=2$), corresponding to a confidence level of approximately 95%.

Notes:

1. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2691.01.



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