



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005 & ANSI/NCSL Z540-1-1994

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CALIBRATION

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I. Electromagnetic - DC/Low Frequency

Table with 5 columns: PARAMETER / EQUIPMENT, RANGE, CALIBRATION AND MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)], REFERENCE STANDARD OR EQUIPMENT, METHOD(S). Rows include DC Voltage - Source, DC Voltage - Measure, and DC Current - Source.



PARAMETER / EQUIPMENT	RANGE	CALIBRATION AND MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
DC Current - Measure	Up to 10 mA (10 to 100) mA 100 mA to 1 A (1 to 3) A	500 $\mu$ A/A + 2 $\mu$ A 500 $\mu$ A/A + 5 $\mu$ A 1 mA/A + 100 $\mu$ A 1.2 mA/A + 200 $\mu$ A	Agilent 34401	RT-CTP and OEM-Derived Methods
Resistance - Source	Up to 11 $\Omega$ (11 to 33) $\Omega$ (33 to 110) $\Omega$ (110 to 330) $\Omega$ 330 $\Omega$ to 1.1 k $\Omega$ (1.1 to 3.3) k $\Omega$ (3.3 to 11) k $\Omega$ (11 to 33) k $\Omega$ (33 to 110) k $\Omega$ (110 to 330) k $\Omega$ 330 k $\Omega$ to 1.1 M $\Omega$ (1.1 to 3.3) M $\Omega$ (3.3 to 11) M $\Omega$ (11 to 33) M $\Omega$ (33 to 110) M $\Omega$ (110 to 330) M $\Omega$ 330 M $\Omega$ to 1.1 G $\Omega$	40 $\mu\Omega/\Omega$ + 1 m $\Omega$ 30 $\mu\Omega/\Omega$ + 1.5 m $\Omega$ 28 $\mu\Omega/\Omega$ + 1.4 m $\Omega$ 28 $\mu\Omega/\Omega$ + 2 m $\Omega$ 28 $\mu\Omega/\Omega$ + 2 m $\Omega$ 28 $\mu\Omega/\Omega$ + 20 m $\Omega$ 28 $\mu\Omega/\Omega$ + 20 m $\Omega$ 28 $\mu\Omega/\Omega$ + 200 m $\Omega$ 28 $\mu\Omega/\Omega$ + 200 m $\Omega$ 32 $\mu\Omega/\Omega$ + 2 $\Omega$ 32 $\mu\Omega/\Omega$ + 2 $\Omega$ 60 $\mu\Omega/\Omega$ + 30 $\Omega$ 130 $\mu\Omega/\Omega$ + 50 $\Omega$ 250 $\mu\Omega/\Omega$ + 2.5 k $\Omega$ 500 $\mu\Omega/\Omega$ + 3 k $\Omega$ 3 m $\Omega/\Omega$ + 100 k $\Omega$ 15 m $\Omega/\Omega$ + 500 k $\Omega$	Fluke 5520A	
Resistance - Measure	Up to 100 $\Omega$ 100 $\Omega$ to 1 k $\Omega$ (1 to 10) k $\Omega$ (10 to 100) k $\Omega$ 100 k $\Omega$ to 1 M $\Omega$ (1 to 10) M $\Omega$ (10 to 100) M $\Omega$	100 $\mu\Omega/\Omega$ + 4 m $\Omega$ 100 $\mu\Omega/\Omega$ + 10 m $\Omega$ 100 $\mu\Omega/\Omega$ + 100 m $\Omega$ 100 $\mu\Omega/\Omega$ + 1 $\Omega$ 100 $\mu\Omega/\Omega$ + 10 $\Omega$ 400 $\mu\Omega/\Omega$ + 100 $\Omega$ 8 m $\Omega/\Omega$ + 10 k $\Omega$	Agilent 34401	
AC Voltage - Source	<b>(1 to 33) mV</b> (10 to 45) Hz 45Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	800 $\mu$ V/V + 6 $\mu$ V 150 $\mu$ V/V + 6 $\mu$ V 200 $\mu$ V/V + 6 $\mu$ V 1 mV/V + 6 $\mu$ V 3.5 mV/V + 12 $\mu$ V 8 mV/V + 50 $\mu$ V	Fluke 5520A	

PARAMETER / EQUIPMENT	RANGE	CALIBRATION AND MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
AC Voltage - Source (cont.)	<p><b>(33 to 330) mV</b>            (10 to 45) Hz            45Hz to 10kHz            (10 to 20) kHz            (20 to 50) kHz            (50 to 100) kHz            (100 to 500) kHz</p> <p><b>330 mV to 3.3 V</b>            (10 to 45) Hz            45Hz to 10kHz            (10 to 20) kHz            (20 to 50) kHz            (50 to 100) kHz            (100 to 500) kHz</p> <p><b>(3.3 to 33) V</b>            (10 to 45) Hz            45Hz to 10kHz            (10 to 20) kHz            (20 to 50) kHz            (50 to 100) kHz</p> <p><b>(33 to 330) V</b>            45Hz to 1kHz            (1 to 10) kHz            (10 to 20) kHz            (20 to 50) kHz            (50 to 100) kHz</p> <p><b>330 V to 1.02 kV</b>            45Hz to 1kHz            (1 to 5) kHz            (5 to 10) kHz</p>	<p>300 μV/V + 8 μV            145 μV/V + 8 μV            160 μV/V + 8 μV            350 μV/V + 8 μV            800 μV/V + 32 μV            2 mV/V + 70 μV</p> <p>300 μV/V + 50 μV            150 μV/V + 60 μV            190 μV/V + 60 μV            300 μV/V + 50 μV            700 μV/V + 125 μV            2.4 mV/V + 600 μV</p> <p>300 μV/V + 650 μV            150 μV/V + 600 μV            240 μV/V + 600 μV            350 μV/V + 600 μV            900 μV/V + 1.6 mV</p> <p>190 μV/V + 2 mV            200 μV/V + 6 mV            250 μV/V + 6 mV            300 μV/V + 6 mV            2 mV/V + 5 mV</p> <p>300 μV/V + 10 mV            250 μV/V + 10 mV            300 μV/V + 10 mV</p>	Fluke 5520A	RT-CTP and OEM-Derived Methods
AC Voltage - Measure	<p><b>(1 to 5) mV</b>            (3 to 5) Hz            (5 to 10) Hz            10 Hz to 20 kHz            (20 to 50) kHz            (50 to 100) kHz            (100 to 300) kHz</p>	<p>10 mV/V + 140 μV            3.5 mV/V + 140 μV            600 μV/V + 140 μV            1.2 mV/V + 140 μV            6 mV/V + 80 μV            40 mV/V + 500 μV</p>	Agilent 34401	

PARAMETER / EQUIPMENT	RANGE	CALIBRATION AND MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
AC Voltage - Measure (cont.)	<p><b>(5 to 120) mV</b>  (3 to 5) Hz  (5 to 10) Hz  10 Hz to 20 kHz  (20 to 50) kHz  (50 to 100) kHz  (100 to 300) kHz</p> <p><b>120 mV to 120 V</b>  (3 to 5) Hz  (5 to 10) Hz  10 Hz to 20 kHz  20 to 50) kHz  (50 to 100) kHz  (100 to 300) kHz</p> <p><b>(120 to 750) V</b>  (3 to 5) Hz  (5 to 10) Hz  10 Hz to 20 kHz  20 to 50) kHz  (50 to 100) kHz</p>	<p>10 mV/V + 40 μV  3.5 mV/V + 40 μV  600 μV/V + 40 μV  1.2 mV/V + 40 μV  6 mV/V + 80 μV  40 mV/V + 500 μV</p> <p>10 mV/V + 300 μV/V  3.5 mV/V + 300 μV/V  600 μV/V + 300 μV/V  1.2 mV/V + 400 μV/V  6 mV/V + 800 μV/V  40 mV/V + 5 mV/V</p> <p>10 mV/V + 300 μV/V  3.5 mV/V + 300 μV/V  600 μV/V + 300 μV/V  1.2 mV/V + 400 μV/V  6 mV/V + 800 μV/V</p>	Agilent 34401	RT-CTP and OEM-Derived Methods
AC Current - Source	<p><b>(29 to 330) μA</b>  (10 to 20) Hz  (20 to 45) Hz  45 Hz to 1kHz  (1 to 5) kHz  (5 to 10) kHz  (10 to 30) kHz</p> <p><b>330 μA to 3.3 mA</b>  (10 to 20) Hz  (20 to 45) Hz  45Hz to 1kHz  (1 to 5) kHz  (5 to 10) kHz  (10 to 30) kHz</p> <p><b>(3.3 to 33) mA</b>  (10 to 20) Hz  (20 to 45) Hz  45Hz to 1kHz  (1 to 5) kHz  (5 to 10) kHz  (10 to 30) kHz</p>	<p>2 mA/A + 100 nA  1.5 mA/A + 100 nA  1.25 mA/A + 100 nA  3 mA/A + 150 nA  8 mA/A + 200 nA  16. mA/A + 400 nA</p> <p>2 mA/A+ 150 nA  1.25 mA/A + 150 nA  1 mA/A +150 nA  2 mA/A + 200 nA  5 mA/A + 300 nA  10 mA/A + 600 nA</p> <p>1.8 mA/A + 2 μA  900 μA/A + 2 μA  400 μA/A + 2 μA  800 μA/A + 2 μA  2 mA/A + 3 μA  4 mA/A + 4 μA</p>	Fluke 5520A	

PARAMETER / EQUIPMENT	RANGE	CALIBRATION AND MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
AC Current - Source (cont.)	<b>(33 to 330) mA</b> (10 to 20) Hz (20 to 45) Hz 45Hz to 1kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz <b>330 mA to 1.1 A</b> (10 to 45) Hz 45Hz to 1kHz (1 to 5) kHz (5 to 10) kHz <b>(1.1 to 3) A</b> (10 to 45) Hz 45Hz to 1kHz (1 to 5) kHz (5 to 10) kHz <b>(3 to 11) A</b> (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz <b>(11 to 20.5) A</b> (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	1.8 mA/A + 20 µA 900 µA/A + 20 µA 400 µA/A + 20 µA 1 mA/A + 50 µA 2 mA/A + 100 µA 4 mA/A + 200 µA  1.8 mA/A + 100 µA 500 µA/A + 100 µA 6 mA/A + 1 mA 25 mA/A + 5 mA  1.8 mA/A + 100 µA 600 µA/A + 100 µA 6 mA/A + 1 mA 25 mA/A + 5 mA  600 µA/A + 2 mA 1 mA/A + 2 mA 30 mA/A + 2 mA  1.2 mA/A + 5 mA 1.5 mA/A + 5 mA 30 mA/A + 5 mA	Fluke 5520A	RT-CTP and OEM-Derived Methods
AC Current - Measure	<b>100 mA to 1.2 A</b> (3 to 5) Hz (5 to 10) Hz 10 Hz to 5 kHz <b>(1.2 to 3) A</b> (3 to 5) Hz (5 to 10) Hz 10 Hz to 5 kHz	10 mA/A + 400 µA 3 mA/A + 400 µA 1 mA/A + 400 µA  11 mA/A + 600 µA 3.5 mA/A + 600 µA 1.5 mA/A + 600 µA	Agilent 34401	
Frequency - Source	0.01 Hz to 2 MHz	2.5 µHz/Hz ± 5 µHz	Fluke 5520A	

PARAMETER / EQUIPMENT	RANGE	CALIBRATION AND MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Capacitance - Source	(190 to 400) pF 400 nF to 1.1pF (1.1 to 33) nF (3.3 to 11) nF (11 to 33) nF (33 to 110) nF (110 to 330) nF 330 nF to 1.1 μF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF (110 to 330) μF 330 μF to 1.1 mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	5 mF/F + 10 pF 5 mF/F + 10 pF 5 mF/F + 10 pF 2.5 mF/F + 100 pF 2.5 mF/F + 100 pF 2.5 mF/F + 100 pF 2.5 mF/F + 300 pF 2.5 mF/F + 1 nF 2.5 mF/F + 3 nF 2.5 mF/F + 10 nF 4 mF/F + 30 nF 4.5 mF/F + 100 nF 4.5 mF/F + 300 nF 4.5 mF/F + 1 μF 4.5 mF/F + 3 μF 4.5 mF/F + 10 μF 7.5 mF/F + 30 μF 11 mF/F + 100 μF	Fluke 5520A	RT-CTP and OEM-Derived Methods
Electrical Simulation of Thermocouples				
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1 000) °C	0.5 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °C		
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1 200) °C	0.27 °C 0.16 °C 0.14 °C 0.17 °C 0.23 °C		
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1 000) °C (1 000 to 1 372) °C	0.33 °C 0.18 °C 0.16 °C 0.26 °C 0.4 °C		

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Electrical Simulation of Thermocouples (cont.)  Type R Type S  Type T	(0 to 250) °C (250 to 400) °C (400 to 1 000) °C (1 000 to 1 767) °C  (0 to 250) °C (250 to 1 000) °C (1 000 to 1 400) °C (1 400 to 1 767) °C  (-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.57 °C 0.35 °C 0.33 °C 0.4 °C  0.47 °C 0.36 °C 0.37 °C 0.46 °C  0.63 °C 0.24 °C 0.16 °C 0.14 °C		



PARAMETER / EQUIPMENT	RANGE	CALIBRATION AND MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Electrical Simulation of RTDs			Fluke 5520A	RT-CTP and OEM-Derived Methods
Pt 385, 100 Ω	(-200 to -80) °C	0.05 °C		
	(-80 to 0) °C	0.05 °C		
	(0 to 100) °C	0.07 °C		
	(100 to 300) °C	0.09 °C		
	(300 to 400) °C	0.1 °C		
	(400 to 630) °C	0.12 °C		
Pt 3926, 100 Ω	(630 to 800) °C	0.23 °C		
	(-200 to -80) °C	0.05 °C		
	(-80 to 0) °C	0.05 °C		
	(0 to 100) °C	0.07 °C		
	(100 to 300) °C	0.09 °C		
	(300 to 400) °C	0.1 °C		
	(400 to 630) °C	0.12 °C		
Pt 3916, 100 Ω	(-200 to -190) °C	0.25 °C		
	(-190 to -80) °C	0.04 °C		
	(-80 to 0) °C	0.05 °C		
	(0 to 100) °C	0.06 °C		
	(100 to 260) °C	0.07 °C		
	(260 to 300) °C	0.08 °C		
	(300 to 400) °C	0.09 °C		
	(400 to 600) °C	0.1 °C		
	(600 to 630) °C	0.23 °C		
Pt 385, 200 Ω	(-200 to -80) °C	0.04 °C		
	(-80 to 0) °C	0.04 °C		
	(0 to 100) °C	0.04 °C		
	(100 to 260) °C	0.05 °C		
	(260 to 300) °C	0.12 °C		
	(300 to 400) °C	0.13 °C		
	(400 to 600) °C	0.14 °C		
	(600 to 630) °C	0.16 °C		
Pt 385, 500 Ω	(-200 to -80) °C	0.04 °C		
	(-80 to 0) °C	0.05 °C		
	(0 to 100) °C	0.05 °C		
	(100 to 260) °C	0.06 °C		
	(260 to 300) °C	0.08 °C		
	(300 to 400) °C	0.08 °C		
	(400 to 600) °C	0.09 °C		
	(600 to 630) °C	0.11 °C		

PARAMETER / EQUIPMENT	RANGE	CALIBRATION AND MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Electrical Simulation of RTDs (cont.) Pt 385, 1 000 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.03 °C 0.03 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.07 °C 0.23 °C	Fluke 5520A	RT-CTP and OEM-Derived Methods
PtNi 385, 120 Ω (Ni 120)	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.08 °C 0.08 °C 0.14 °C		
Cu 427, 10 Ω	(-100 to 260) °C	0.3 °C		
<b>Oscilloscopes</b> Squarewave Signal 50 Ω load @ 1 kHz 1 MΩ load @1 kHz	1 mV to 6.6 V p-p 1 mV to 130 V p-p	2.9 mV/V + 40 μV 1 mV/V + 40 μV	Fluke 5520A SC1100	
Leveled Sine Wave (50 kHz ref)	[5 mV to 5.5 V] p-p	51 mV/V + 100 μV		
Pulse Generator Width	(4 to 45) ns (45 to 500) ns	58 ms/s + 500 ps 58 ms/s + 4 ns		
Period	200 ns to 20 ms	58 ms/s + 200 ns		
Time Marker -- Source & Period 50 Ω load	1 ns to 5 s	6.4 μs/s		
Wave Generator 50 MΩ load 1 MΩ load	1.8 mV p-p to 2.5 V p-p 1.8 mV p-p to 55 V p-p	34.6 mV/V + 100 μV 34.6 mV/V + 100 μV		
Input Impedance	(50 to 60) Ω	1.2 mΩ/Ω		

## II. Optical Radiation

PARAMETER / EQUIPMENT	RANGE	CALIBRATION AND MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Optical Power - Measure (800 to 1650) nm	(+11 to -70) dBm	0.14 dBm/dBm	JDSU MOPM-B1PMH	OEM-Derived Methods
Optical Power - Source 1310 nm, 1550 nm	(0 to -60) dB	0.005 dB/dB	JDSU MWL1310A MWL1550A	
Optical Attenuation (1260 to 1650) nm	(0 to 70) dB	0.09 dB/dB	JDSU MOVA-A2SS1	

**Notes:**

1. Calibration and Measurement Capabilities (Expanded Uncertainties) are based on approximately a 95% confidence interval, using a coverage of  $k=2$  and do not include possible contributors to uncertainty caused by a "best available" unit under test.
2. This laboratory is an in-house calibration laboratory that also offers calibrations to outside organizations.
3. The use of  $t$  signifies Time in seconds.
4. This scope is part of and must be included with the Certificate of Accreditation No. AC – 1310.



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Vice President