



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

TRADEPORT ELECTRONICS CALIBRATION LABORATORY  
 1750 Steeles Ave. West, Unit 5  
 Concord, Ontario L4K 2L7 CANADA  
 Barry Conway Phone: 905 660 3797

CALIBRATION

Valid To: July 31, 2024

Certificate Number: 2450.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1, 6</sup>:

I. Electrical – DC / Low Frequency

Parameter/Equipment	Range	CMC <sup>2, 5</sup> (±)	Comments
DC Voltage <sup>3</sup> – Generate	(0 to 330) mV	16 µV/V + 1.6 µV	Fluke 5520A
	330 mV to 3.3 V	8.5 µV/V + 9.6 µV	
	(3.3 to 33) V	9.3 µV/V + 180 µV	
	(33 to 330) V	14 µV/V + 1 mV	
	(330 to 1000) V	14 µV/V + 3.4 mV	
	(0 to 220) mV	8.0 µV/V + 0.68 µV	Fluke 5700A
	220 mV to 2.2 V	7.0 µV/V + 1.4 µV	
	(2.2 to 11) V	7.0 µV/V + 6.5 µV	
	(11 to 22) V	7.0 µV/V + 12 µV	
	(22 to 220) V	8.0 µV/V + 140 µV	
	(220 to 1100) V	9.0 µV/V + 1.5 mV	
	(0 to 0.202) V	15 µV/V + 2.7 µV	Transmille 4010
	(0.202 to 2.02) V	9.0 µV/V + 2.6 µV	
	(2.02 to 20.2) V	8.0 µV/V + 0.16 mV	
	(20.2 to 220) V	12 µV/V + 0.31 mV	
	(200 to 1025) V	12 µV/V + 9.0 mV	
(> 1 to 10) kV	0.58 % + 25 V	Pintek HVC-801	
(10 to 20) kV	0.58 % + 26 V		
(20 to 30) kV	0.58 % + 27 V		
(30 to 40) kV	0.58 % + 30 V		

Parameter/Equipment	Range	CMC <sup>2, 4, 5</sup> ( $\pm$ )	Comments
DC Voltage <sup>3</sup> – Measure	(0 to 100) mV (0 to 1) V (0 to 10) V (0 to 100) V (0 to 1000) V	11 $\mu$ V/V + 1.0 $\mu$ V 10 $\mu$ V/V + 1.0 $\mu$ V 10 $\mu$ V/V + 2.1 $\mu$ V 12 $\mu$ V/V + 34 $\mu$ V 24 $\mu$ V/V + 0.13 mV	Agilent 3458A
	100 V to 15 kV	3.9 %	Tektronix P6015A with 1 M $\Omega$ impedance oscilloscope
	(0.5 to 6) kV (> 6 to 10) kV	0.035 % + 0.58 V 0.035 % + 5.8 V	Vitrek 4700
	(> 10 to 40) kV (40 to 70) kV (70 to 100) kV	0.058 % + 5.8 V 0.058 % + 58 V 0.058 % + 0.12 kV	Vitrek 4700 & Vitrek HVL-100 probe
DC Current <sup>3</sup> – Generate	(0 to 330) $\mu$ A 330 $\mu$ A to 3.3 mA (3.3 to 33) mA (33 to 330) mA 330 mA to 1.1 A	120 $\mu$ A/A + 16 nA 78 $\mu$ A/A + 52 nA 78 $\mu$ A/A + 0.37 $\mu$ A 78 $\mu$ A/A + 7.0 $\mu$ A 0.016 % + 52 $\mu$ A	Fluke 5520A
	(1.1 to 3) A (3 to 11) A (11 to 20.5) A	0.029 % + 0.19 mA 0.039 % + 0.74 mA 0.078 % + 2.4 mA	
	(> 20 to 50) A (50 to 100) A (100 to 500) A (500 to 1000) A	0.19 % + 0.20 A 0.20 % + 0.40 A 0.20 % + 1.0 A 0.21 % + 1.8 A	Fluke 5520A & Fluke 5500A/COIL
	(> 20 to 120) A	0.01 % + 0.13 A	APM SPS40VDC1000W
	(0 to 220) $\mu$ A 220 $\mu$ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A	50 $\mu$ A/A + 10 nA 50 $\mu$ A/A + 22 nA 50 $\mu$ A/A + 0.25 $\mu$ A 60 $\mu$ A/A + 1.8 $\mu$ A 80 $\mu$ A/A + 59 $\mu$ A	Fluke 5700A

Parameter/Equipment	Range	CMC <sup>2, 5</sup> (±)	Comments
DC Current <sup>3</sup> – Generate (cont)	(0 to 202) $\mu$ A (0.2 to 2.02) mA (2 to 20.2) mA (20 to 202) mA  (0.2 to 2.02) A (2 to 20.2) A (20.2 to 30) A  (> 20 to 50) A (50 to 100) A (100 to 500) A (500 to 1000) A	0.01 % + 12 nA 0.050 % + 79 nA 0.050 % + 0.37 $\mu$ A 0.05% + 3.7 $\mu$ A  0.013 % + 60 $\mu$ A 0.030 % + 1.4 mA 0.050 % + 1.5 mA  0.25 % + 0.20 A 0.25 % + 0.40 A 0.25 % + 1.0 A 0.25 % + 1.8 A	Transmille 4010       Transmille 4010 & Fluke 5500A/COIL
DC Current <sup>3</sup> – Measure	(0 to 100) $\mu$ A 100 $\mu$ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A  (1 to 3) A (3 to 10) A  (10 to 20) A	25 $\mu$ A/A + 2.1 nA 25 $\mu$ A/A + 17 nA 25 $\mu$ A/A + 0.17 $\mu$ A 40 $\mu$ A/A + 2.4 $\mu$ A 120 $\mu$ A/A + 50 $\mu$ A  0.016 % + 4.4 mA 0.039 % + 4.4 mA  0.21 % + 9.7 mA	Agilent 3458A     Fluke 8846A  Agilent 3458A & 50 A/50 mV current shunt
Resistance <sup>3</sup> – Generate	(0 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 $\Omega$	31 $\mu\Omega/\Omega$ + 0.79 m $\Omega$ 23 $\mu\Omega/\Omega$ + 1.2 m $\Omega$ 22 $\mu\Omega/\Omega$ + 1.5 m $\Omega$ 22 $\mu\Omega/\Omega$ + 0.024 $\Omega$ 22 $\mu\Omega/\Omega$ + 0.0059 $\Omega$ 22 $\mu\Omega/\Omega$ + 0.030 $\Omega$ 22 $\mu\Omega/\Omega$ + 0.083 $\Omega$ 22 $\mu\Omega/\Omega$ + 0.30 $\Omega$ 22 $\mu\Omega/\Omega$ + 0.90 $\Omega$ 25 $\mu\Omega/\Omega$ + 2.7 $\Omega$ 25 $\mu\Omega/\Omega$ + 8.4 $\Omega$ 47 $\mu\Omega/\Omega$ + 48 $\Omega$ 0.010 % + 200 $\Omega$ 0.019 % + 2.7 k $\Omega$ 0.039 % + 9.4 k $\Omega$ 0.23 % + 110 k $\Omega$ 1.2 % + 1.3 M $\Omega$	Fluke 5520A

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Resistance <sup>3</sup> – Generate (cont)	(0 to 100) Ω	0.010 % + 50 mΩ	Transmille 4010
	(100 to 330) Ω	0.010 % + 50 mΩ	
	330 Ω to 1.1 kΩ	0.010 % + 51 mΩ	
	(1.1 to 3.3) kΩ	0.010 % + 94 mΩ	
	(3.3 to 10) kΩ	0.010 % + 0.14 Ω	
	(10 to 33) kΩ	0.010 % + 0.82 Ω	
	(33 to 100) kΩ	0.010 % + 1.4 Ω	
	(100 to 330) kΩ	0.010 % + 43 Ω	
	330 kΩ to 1 MΩ	0.010 % + 53 Ω	
	(1 to 3.3) MΩ	0.010 % + 0.17 kΩ	
	(3.3 to 10) MΩ	0.010 % + 0.30 kΩ	
	(10 to 33) MΩ	0.010 % + 9.3 kΩ	
	(33 to 100) MΩ	0.050 % + 0.10 MΩ	
	(100 to 330) MΩ	1.0 % + 0.21 MΩ	
	330 MΩ to 1.0 GΩ	2.0 % + 0.70 MΩ	
	Resistance – Generate, (2-wire and 4-wire) Fixed Points	0 Ω	
1 Ω		120 μΩ	
1.9 Ω		220 μΩ	
10 Ω		370 μΩ	
19 Ω		720 μΩ	
100 Ω		2.0 mΩ	
190 Ω		3.0 mΩ	
1 kΩ		16 mΩ	
1.9 kΩ		32 mΩ	
10 kΩ		120 mΩ	
19 kΩ		290 mΩ	
100 kΩ		1.7 Ω	
190 kΩ		2.7 Ω	
1 MΩ		25 Ω	
1.9 MΩ		51 Ω	
10 MΩ		490 Ω	
19 MΩ		1.7 kΩ	
100 MΩ		16 kΩ	
0.001 Ω		0.15 μΩ	KAENAHO B CCCP fixed value resistor
0.01 Ω	0.94 μΩ		
0.1 Ω	16 μΩ		
1 Ω	0.16 mΩ		
10 Ω	0.73 mΩ		
100 Ω	14 mΩ		
1 kΩ	87 mΩ		
10 kΩ	1.0 Ω		
100 kΩ	23 Ω		

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Resistance <sup>3</sup> – Measure (2-Wire and 4-Wire)	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	18 μΩ/Ω + 0.11 mΩ 15 μΩ/Ω + 1.0 mΩ 13 μΩ/Ω + 7.5 mΩ 13 μΩ/Ω + 75 mΩ 13 μΩ/Ω + 0.75 Ω 18 μΩ/Ω + 8.3 Ω 53 μΩ/Ω + 0.20 kΩ 0.050 % + 0.24 kΩ 0.50 % + 0.24 MΩ	Agilent 3458A

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Voltage <sup>3</sup> – Generate			
(1 to 33) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.062 % + 5.0 μV 0.012 % + 5.0 μV 0.016 % + 5.6 μV 0.078 % + 7.7 μV 0.27 % + 12 μV 0.62 % + 45 μV	Fluke 5520A
(33 to 330) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.023 % + 25 μV 0.011 % + 11 μV 0.012 % + 11 μV 0.027 % + 33 μV 0.062 % + 35 μV 0.16 % + 93 μV	
330 mV to 3.3 V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.023 % + 150 μV 0.012 % + 100 μV 0.015 % + 100 μV 0.023 % + 120 μV 0.054 % + 220 μV 0.19 % + 1.0 mV	
(3.3 to 33) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.023 % + 3.4 mV 0.012 % + 1.0 mV 0.019 % + 1.1 mV 0.027 % + 1.5 mV 0.070 % + 2.6 mV	

Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments
AC Voltage <sup>3</sup> – Generate (cont)			
(33 to 330) V	45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.015 % + 12 mV 0.016 % + 13 mV 0.019 % + 14 mV 0.023 % + 31 mV 0.16 % + 49 mV	Fluke 5520A
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.023 % + 54 mV 0.019 % + 32 mV 0.023 % + 35 mV	
(1 to 2.2) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.055 % + 4.5 μV 0.021 % + 4.5 μV 0.011 % + 4.5 μV 0.037 % + 4.5 μV 0.085 % + 7.0 μV 0.11 % + 13 μV 0.17 % + 25 μV 0.34 % + 25 μV	Fluke 5700A
(2.2 to 22) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.055 % + 5.1 μV 0.021 % + 5.2 μV 0.011 % + 4.2 μV 0.037 % + 5.1 μV 0.085 % + 7.0 μV 0.11 % + 12 μV 0.17 % + 25 μV 0.34 % + 25 μV	
(22 to 220) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.055 % + 13 μV 0.021 % + 8.0 μV 0.011 % + 8.0 μV 0.037 % + 8.0 μV 0.085 % + 25 μV 0.11 % + 25 μV 0.17 % + 35 μV 0.34 % + 80 μV	
(0.22 to 2.2) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.050 % + 130 μV 0.016 % + 55 μV 0.0080 % + 41 μV 0.012 % + 83 μV 0.025 % + 140 μV 0.043 % + 280 μV 0.11 % + 530 μV 0.22 % + 1.6 mV	

Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments
AC Voltage <sup>3</sup> – Generate (cont)			
(2.2 to 22) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.050 % + 1.3 mV 0.016 % + 560 μV 0.008 % + 440 μV 0.012 % + 860 μV 0.025 % + 1.3 mV 0.050 % + 3.3 mV 0.13 % + 7.5 mV 0.27 % + 20 mV	Fluke 5700A
(22 to 220) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.050 % + 13 mV 0.016 % + 5.8 mV 0.0080 % + 5.1 mV 0.022 % + 12 mV 0.050 % + 17 mV	
(220 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz	0.040 % + 95 mV 0.0080 % + 94 mV	
(0 to 202) mV	(10 to 45) Hz 45 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz (100 to 500) kHz	0.080 % + 31 μV 0.016 % + 31 μV 0.020 % + 44 μV 0.10 % + 0.15 mV 0.40 % + 0.17 mV	Transmille 4010
(0.2 to 2.02) V	(10 to 45) Hz 45 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz 100 kHz to 1 MHz	0.050 % + 0.28 mV 0.016 % + 0.25 mV 0.021 % + 0.45 mV 0.065 % + 1.3 mV 0.30 % + 3.3 mV	
(2 to 20.2) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 100) kHz	0.050 % + 2.6 mV 0.016 % + 2.2 mV 0.021 % + 2.2 mV 0.060 % + 7.2 mV	
(20 to 202) V	(30 Hz to 45) Hz 45 Hz to 1 kHz (1 to 10) kHz (10 to 40) kHz (40 to 100) kHz	0.050 % + 28 mV 0.015 % + 23 mV 0.020 % + 80 mV 0.030 % + 0.14 V 0.20 % + 0.15 V	
(200 to 1020) V	30 Hz to 45 Hz 45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz	0.055 % + 0.23 V 0.020 % + 0.13 V 0.025 % + 0.17 V 0.030 % + 0.25 V	

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Voltage <sup>3</sup> – Measure			
(1 to 10) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.30 μV/V + 4.1 μV 0.20 μV/V + 3.0 μV 0.30 μV/V + 3.1 μV 1.0 μV/V + 3.1 μV 5.0 μV/V + 9.1 μV 40 μV/V + 66 μV 40 μV/V + 66 μV	Agilent 3458A
(10 to 100) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz (2 to 4) MHz (4 to 6) MHz (6 to 8) MHz (8 to 10) MHz	72 nV/V + 7.0 μV 72 nV/V + 6.1 μV 0.14 μV/V + 8.1 μV 0.30 μV/V + 8.1 μV 0.80 μV/V + 37 μV 3.0 μV/V + 70 μV 10 μV/V + 70 μV 15 μV/V + 91 μV 40 μV/V + 0.72 mV 40 μV/V + 0.77 mV 40 μV/V + 0.77 mV 0.015 % + 2.3 mV	
100 mV to 1V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz (2 to 4) MHz (4 to 6) MHz (6 to 8) MHz (8 to 10) MHz	72 nV/V + 64 μV 72 nV/V + 54 μV 0.014 % + 72 μV 0.030 % + 0.13 mV 0.080 % + 0.21 mV 0.30 % + 0.61 mV 1.0 % + 1.7 mV 1.5 % + 1.8 mV 4.0 % + 7.2 mV 4.0 % + 7.7 mV 4.0 % + 7.7 mV 15 % + 25 mV	
(1 to 10) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	72 μV/V + 0.71 mV 72 μV/V + 0.54 mV 0.014 % + 0.71 mV 0.030 % + 1.3 mV 0.080 % + 1.6 mV 0.30 % + 5.2 mV 1.0 % + 16 mV	
(10 to 100) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.020 % + 9.3 mV 0.020 % + 8.6 mV 0.020 % + 12 mV 0.035 % + 14 mV 0.12 % + 34 mV	



Parameter/Range	Frequency	CMC <sup>2, 4, 5</sup> (±)	Comments
AC Voltage <sup>3</sup> – Measure (cont)			
(10 to 100) V	(100 to 300) kHz 300 kHz to 1 MHz	0.40 % + 35 mV 1.5 % + 35 mV	Agilent 3458A
(100 to 700) V	(1 to 50) Hz 50 Hz to 1 kHz (1 to 10) kHz	0.040 % + 87 mV 0.040 % + 80 mV 0.060 % + 80 mV	
100 V to 15 kV	60 Hz	3.9 %	Tektronix P6015A with 1MΩ impedance oscilloscope
(0.5 to 5) kV (> 5 to 10) kV	60 Hz	0.14 % + 0.60 V 0.14 % + 29 V	Vitrek 4700
(> 10 to 20) kV (20 to 50) kV (50 to 70) kV	60 Hz	0.14 % + 29 V 0.14 % + 58 V 0.14 % + 0.12 kV	Vitrek 4700 + Vitrek HVL-100 Probe
100 V to 1 kV	400 Hz	0.46 % + 0.13 V	Vitrek 4700
AC Current <sup>3</sup> – Generate			
(29 to 330) μA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.16 % + 0.11 μA 0.12 % + 0.10 μA 0.097 % + 0.11 μA 0.23 % + 0.16 μA 0.62 % + 0.22 μA 1.2 % + 0.41 μA	Fluke 5520A
(0.33 to 3.3) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.16 % + 0.49 μA 0.097 % + 0.42 μA 0.078 % + 0.41 μA 0.16 % + 0.51 μA 0.39 % + 0.93 μA 0.78 % + 2.8 μA	

Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments	
AC Current <sup>3</sup> – Generate (cont)	(3.3 to 33) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.14 % + 4.5 μA 0.070 % + 4.3 μA 0.031 % + 4.1 μA 0.062 % + 5.0 μA 0.16 % + 9.0 μA 0.31 % + 21 μA	Fluke 5520A
	(0 to 220) μA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.070 % + 28 nA 0.035 % + 24 nA 0.014 % + 21 nA 0.060 % + 42 nA 0.16 % + 82 nA	Fluke 5700A
	220 μA to 2.2 mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.070 % + 140 nA 0.035 % + 170 nA 0.014 % + 140 nA 0.060 % + 420 nA 0.16 % + 810 nA	
	(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.070 % + 1.5 μA 0.035 % + 1.4 μA 0.014 % + 1.4 μA 0.060 % + 4.3 μA 0.16 % + 8.1 μA	
	(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.070 % + 1.4 μA 0.035 % + 1.4 μA 0.014 % + 1.4 μA 0.060 % + 42 μA 0.16 % + 81 μA	
	220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.065 % + 140 μA 0.075 % + 160 μA 0.85 % + 210 μA	
	(33 to 330) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.14 % + 47 μA 0.070 % + 45 μA 0.031 % + 42 μA 0.078 % + 62 μA 0.16 % + 120 μA 0.31 % + 310 μA	Fluke 5520A
	(0.33 to 1.1) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.14 % + 0.14 mA 0.039 % + 0.13 mA 0.47 % + 0.80 mA 2.0 % + 3.9 mA	

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Current <sup>3</sup> – Generate (cont)			
(1.1 to 3) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.14 % + 1.1 mA 0.046 % + 1.0 mA 0.47 % + 1.5 mA 2.0 % + 4.4 mA	Fluke 5520A
(3 to 11) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.047 % + 3.1 mA 0.078 % + 3.1 mA 0.23 % + 4.0 mA	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.093 % + 6.3 mA 0.12 % + 6.1 mA 0.23 % + 7.5 mA	
(> 20 to 50) A	(50 to 100) Hz (100 to 400) Hz	0.23 % + 0.12 A 0.62 % + 0.12 A	Fluke 5520A & Fluke 5500A/coil
(50 to 100) A	(50 to 100) Hz (100 to 400) Hz	0.23 % + 0.21 A 0.62 % + 0.21 A	
(100 to 500) A	(50 to 100) Hz (100 to 400) Hz	0.23 % + 1.1 A 0.62 % + 1.1 A	
(500 to 1000) A	(50 to 100) Hz (100 to 400) Hz	0.24 % + 2.1 A 0.63 % + 1.9 A	
(20 to 202) μA	(10 to 45) Hz 45 Hz to 1 kHz (1 to 10) kHz (10 to 30) kHz	0.20 % + 0.30 μA 0.070 % + 0.23 μA 0.80 % + 0.77 μA 1.6 % + 0.83 μA	Transmille 4010
(0.2 to 2.02) mA	(10 to 45) Hz 45 Hz to 1 kHz (1 to 10) kHz (10 to 30) kHz	0.20 % + 0.63 μA 0.060 % + 0.62 μA 0.50 % + 3.3 μA 1.0 % + 6.6 μA	
(2 to 20.2) mA	(10 to 45) Hz 45 Hz to 1 kHz (1 to 10) kHz (10 to 30) kHz	0.20 % + 4.0 μA 0.040 % + 3.4 μA 0.25 % + 4.2 μA 0.50 % + 5.0 μA	
(20 to 202) mA	(10 to 45) Hz 45 Hz to 1 kHz (1 to 10) kHz (10 to 30) kHz	0.20 % + 58 μA 0.040 % + 54 μA 0.50 % + 70 μA 0.70 % + 0.22 mA	

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Current <sup>3</sup> – Generate (cont)			
(0.2 to 2.02) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 30) kHz	0.20 % + 0.41 mA 0.060 % + 0.49 mA 0.50 % + 0.60 mA 0.60 % + 1.1 mA	Transmille 4010
(2 to 30.0) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.080 % + 5.6 mA 0.30 % + 6.6 mA 0.60 % + 6.6 mA 3.0 % + 6.8 mA	
(> 20 to 50) A	(50 to 100) Hz (100 to 400) Hz	0.29 % + 0.11 A 0.79 % + 0.11 A	Transmille 4010 & Fluke 5500A/coil
(50 to 100) A	(50 to 100) Hz (100 to 400) Hz	0.29 % + 0.20 A 0.79 % + 0.20 A	
(100 to 500) A	(50 to 100) Hz (100 to 400) Hz	0.30 % + 1.0 A 0.80 % + 1.0 A	
(500 to 1000) A	(50 to 100) Hz (100 to 400) Hz	0.41 % + 2.0 A 0.85 % + 1.8 A	

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Current <sup>3</sup> – Measure			
(10 to 100) μA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 10) kHz	0.40 % + 44 nA 0.15 % + 44 nA 0.061 % + 44 nA 0.061 % + 44 nA 0.061 % + 44 nA	Agilent 3458A
100 μA to 1 mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 10) kHz	0.40 % + 0.23 μA 0.15 % + 0.23 μA 0.061 % + 0.23 μA 0.031 % + 0.23 μA 0.061 % + 0.23 μA	
(1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 10) kHz	0.40 % + 2.8 μA 0.15 % + 2.8 μA 0.061 % + 2.8 μA 0.031 % + 2.8 μA 0.061 % + 2.8 μA	
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 10) kHz	0.40 % + 28 μA 0.15 % + 28 μA 0.061 % + 28 μA 0.031 % + 28 μA 0.061 % + 28 μA	
100 mA to 1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 10) kHz	0.40 % + 0.29 mA 0.18 % + 0.29 mA 0.081 % + 0.29 mA 0.11 % + 0.29 mA 0.31 % + 0.29 mA	
(1 to 3) A	10 Hz to 1 kHz (1 to 5) kHz	0.14 % + 3.8 mA 2.3 % + 4.5 mA	Fluke 8846A
(3 to 10) A	10 Hz to 1 kHz (1 to 5) kHz	0.14 % + 9.4 mA 2.3 % + 9.7 mA	
(10 to 20) A	10 Hz to 400 Hz 400 Hz to 1 kHz	0.23 % + 18 mA 0.23 % + 38 mA	Agilent 3458A & 50A/50mV current shunt

Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments
Capacitance <sup>3</sup> – Generate			
(0.19 to 0.4) nF	10 Hz to 10 kHz	0.39 % + 0.0079 nF	Fluke 5520A
(0.4 to 1.1) nF	10 Hz to 10 kHz	0.39 % + 0.0080 nF	
(1.1 to 3.3) nF	10 Hz to 3 kHz	0.39 % + 0.0085 nF	
(3.3 to 11) nF	10 Hz to 1 kHz	0.19 % + 0.012 nF	
(11 to 33) nF	10 Hz to 1 kHz	0.19 % + 0.080 nF	
(33 to 110) nF	10 Hz to 1 kHz	0.19 % + 0.10 nF	
(110 to 330) nF	10 Hz to 1 kHz	0.19 % + 0.32 nF	
(0.33 to 1.1) μF	(10 to 600) Hz	0.19 % + 1.1 nF	
(1.1 to 3.3) μF	(10 to 300) Hz	0.19 % + 3.0 nF	
(3.3 to 11) μF	(10 to 150) Hz	0.19 % + 12 nF	
(11 to 33) μF	(10 to 120) Hz	0.31 % + 23 nF	
(33 to 110) μF	(10 to 80) Hz	0.35 % + 150 nF	
(110 to 330) μF	Up to 50 Hz	0.35 % + 420 nF	
(0.33 to 1.1) mF	Up to 20 Hz	0.35 % + 1.1 μF	
(1.1 to 3.3) mF	Up to 6 Hz	0.35 % + 2.5 μF	
(3.3 to 11) mF	Up to 2 Hz	0.35 % + 9.5 μF	
(11 to 33) mF	Up to 0.6 Hz	0.58 % + 25 μF	
(33 to 110) mF	Up to 0.2 Hz	0.85 % + 81 μF	
(0.95 to 9.5) μF	1 kHz	0.70 % + 1.0 nF	Transmille 4010
(9.5 to 95) μF		0.70 % + 6.0 nF	
95 μF to 0.95mF		0.70 % + 5.3 nF	
(0.95 to 9.5) mF		0.70 % + 6.0 μF	
(9.5 to 100) mF		0.70 % + 24 μF	
Fixed Points Capacitance			
1 nF	1 kHz	0.25 % + 0.61 pF	
2 nF		0.25 % + 42 pF	
5 nF		0.25 % + 32 pF	
10 nF		0.25 % + 6.0 pF	
100nF		0.25 % + 60 pF	
1 μF		0.40 % + 0.60 μF	
10 μF		0.60 % + 0.60 μF	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of Thermocouple Indicating Systems <sup>3</sup> –			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.34 °C 0.27 °C 0.24 °C 0.26 °C	Fluke 5520A
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.23 °C 0.20 °C 0.24 °C 0.39 °C 0.65 °C	
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.39 °C 0.13 °C 0.11 °C 0.14 °C 0.17 °C	
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.21 °C 0.13 °C 0.11 °C 0.13 °C 0.18 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.26 °C 0.14 °C 0.13 °C 0.20 °C 0.31 °C	
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.29 °C 0.20 °C 0.14 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.31 °C 0.17 °C 0.15 °C 0.14 °C 0.21 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.44 °C 0.27 °C 0.26 °C 0.31 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of Thermocouple Indicating Systems <sup>3</sup> – (cont)			
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.36 °C 0.28 °C 0.29 °C 0.36 °C	Fluke 5520A
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.49 °C 0.19 °C 0.13 °C 0.11 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.43 °C 0.21 °C	
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.44 °C 0.34 °C 0.30 °C 0.33 °C	Transmille 4010
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.30 °C 0.26 °C 0.31 °C 0.50 °C 0.84 °C	
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.50 °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 1200) °C	0.27 °C 0.16 °C 0.17 °C 0.17 °C 0.23 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1370) °C	0.33 °C 0.18 °C 0.16 °C 0.26 °C 0.40 °C	



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of Thermocouple Indicating Systems <sup>3</sup> – (cont)			
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.37 °C 0.26 °C 0.17 °C	Transmille 4010
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.40 °C 0.22 °C 0.19 °C 0.18 °C 0.27 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.57 °C 0.35 °C 0.33 °C 0.40 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.47 °C 0.36 °C 0.37 °C 0.46 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.63 °C 0.24 °C 0.16 °C 0.14 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.56 °C 0.27 °C	
Electrical Simulation of RTD Indicators & Indicating Systems <sup>3</sup> –			
Pt 385, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C (400 to 630) °C	0.040 °C 0.040 °C 0.050 °C 0.070 °C 0.080 °C 0.090 °C 0.18 °C 0.090 °C	Fluke 5520A

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of RTD Indicators & Indicating Systems <sup>3</sup> – (cont)			
Pt 3926, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C	0.040 °C 0.040 °C 0.060 °C 0.070 °C 0.080 °C	Fluke 5520A
Pt 3916, 100 Ω	(-200 to -190) °C (-190 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	0.19 °C 0.030 °C 0.040 °C 0.050 °C 0.050 °C 0.060 °C 0.070 °C 0.080 °C 0.18 °C	
Pt 385, 200 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	0.030 °C 0.030 °C 0.030 °C 0.040 °C 0.090 °C 0.10 °C 0.11 °C 0.12 °C	
Pt 385, 500 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	0.030 °C 0.040 °C 0.040 °C 0.050 °C 0.060 °C 0.060 °C 0.070 °C 0.090 °C	
Pt 385, 1000 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	0.020 °C 0.020 °C 0.030 °C 0.040 °C 0.050 °C 0.050 °C 0.050 °C 0.18 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of RTD Indicators & Indicating Systems <sup>3</sup> - (cont)			
PtNi 385, 120 Ω	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.060 °C 0.060 °C 0.11 °C	Fluke 5520A
Cu 427, 10 Ω	(-100 to 260) °C	0.23 °C	
Pt 25, 25 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.50 °C 0.50 °C 0.60 °C 0.60 °C 0.60 °C 0.60 °C 0.60 °C	Transmille 4010
Pt 100, 100 Ω	(-200 to -80) °C (80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.13 °C 0.13 °C 0.55 °C 0.55 °C 0.55 °C 0.55 °C 0.55 °C	
Pt 250, 250 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 800) °C	0.25 °C 0.25 °C 0.30 °C 0.30 °C 0.30 °C 0.30 °C 0.30 °C	
Pt 25, 500 Ω	(-200 to -80) °C (80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.10 °C 0.10 °C 0.90 °C 0.90 °C 0.90 °C 0.90 °C 0.90 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of RTD Indicators & Indicating Systems <sup>3</sup> – (cont)			
Pt 100, 1000 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 800) °C	0.080 °C 0.080 °C 0.45 °C 0.45 °C 0.45 °C 0.45 °C 0.45 °C	Transmille 4010
Fixed Point Temperature (4 Wire)			
(-100 to 800) °C	-100 °C 0 °C 30 °C 60 °C 100 °C 200 °C 400 °C 800 °C	0.011 °C 0.002 °C 0.004 °C 0.008 °C 0.011 °C 0.022 °C 0.041 °C 0.08 °C	

Parameter/Equipment	Range	CMC <sup>2, 5</sup> (±)	Comments	
Oscilloscope <sup>3</sup> –				
Square Wave Amplitude: 50 Ω Load 1 MΩ Load	V <sub>p-p</sub> 1 mV to 6.6 V V <sub>p-p</sub> 1 mV to 130 V ≤ 1 kHz > 1 kHz	0.19 % of output + 39 μV 0.08 % of output + 39 μV 0.08 % of output + 39 μV	Fluke 5520A with SC-1100 option	
DC Signal Output: 50 Ω Load 1 MΩ Load	V <sub>dc</sub> (0 to 6.6) V V <sub>dc</sub> (0 to 130) V	0.19 % of output + 5.9 μV 0.040 % of output + 8.0 μV		
Leveled Sine Wave Amplitude: 5 mV <sub>p-p</sub> to 5.5 V <sub>p-p</sub>	50 kHz reference 50 KHz to 100 MHz (100 to 300) MHz	1.6 % of output + 250 μV 2.8 % of output + 400 μV 3.1 % of output + 660 μV		
5 mV <sub>p-p</sub> to 3.5 V <sub>p-p</sub>	(300 to 600) MHz (600 to 1100) MHz	4.7 % of output + 660 μV 5.5 % of output + 250 μV		
Flatness: Relative to 50 kHz 5 mV <sub>p-p</sub> to 5.5 V <sub>p-p</sub>	50 kHz reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	1.5 % of output + 240 μV 2.0 % of output + 240 μV 4.0 % of output + 240 μV 5.0 % of output + 240 μV		
Time Marker: 50 Ω Load	5 s to 50 ms (20 to 1.0) ms (50 to 20) ns 10 ns (5 to 1) ns	8.1 μs/s 8.1 μs/s 8.1 μs/s 5.8 μs/s 5.8 μs/s		
Edge-Rise Time	1 kHz to 10 MHz	≤ 300 ps		
Square Wave Amplitude: 1 MΩ Load	V <sub>p-p</sub> 1 mV to 300 V at 1 kHz	0.25 % of output + 38 μV		Transmille 4010 with SCP 600 option
DC Signal Output: 1 MΩ Load	V <sub>dc</sub> (0 to 300) V	0.01 % of output + 0.84 μV		

Parameter/Equipment	Range	CMC <sup>2, 5</sup> (±)	Comments
Oscilloscope <sup>3</sup> – (cont)			
Leveled Sine Wave Amplitude: 600 mV <sub>p</sub>	50 kHz reference (> 5 to 600) MHz	0.26 % of output + 69 μV 0.26 % of output + 69 μV	Transmille 4010 with SCP 600 option
Timebase: 50 Ω Load	(5 to 1) s (500 to 1) ms (500 to 100) μs (50 to 1) μs (500 to 2) ns	0.010% + 0.58 ms 0.010 % + 58 μs 0.010% + 5.8 μs 0.010 % + 0.58 ns 0.010 % + 0.58 ps	
Edge-Rise Time	1 kHz	≤ 1.5 ns	

Parameter/Range	Frequency	CMC <sup>2, 4, 5</sup> (±)	Comments
Phase – Measuring Equipment <sup>3</sup>	(10 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.093° 0.20° 0.39° 2.0° 3.9° 7.8°	Fluke 5520A
	(40 to 60) Hz (60 to 100) Hz (100 to 400) Hz	0.11° 0.26° 0.50°	Transmille 4010
DC Power <sup>3</sup> –			
	33 mV to 1020 V	330 μA to 330 mA > 330 mA to 3 A (> 3 to 20) A	0.018 % 0.041 % 0.078 %
200 mV to 1000 V	(0.2 to 20) mA > 20 mA to 2 A (> 2 to 30) A	0.030 % 0.014 % 0.031 %	Transmille 4010

Parameter/Range	Frequency	CMC <sup>2, 4, 5</sup> (±)	Comments
AC Power <sup>3</sup> –  PF = 1 33 mV to 1020 V			
(3 to 9) mA (> 9 to 33) mA (> 33 to 90) mA (> 90 to 330) mA > 330 mA to 0.9 A (> 0.9 to 2.2) A (> 2.2 to 4.5) A (> 4.5 to 20.5) A	(10 to 65) Hz	0.062 % 0.041 % 0.063 % 0.042 % 0.047 % 0.066 % 0.11 % 0.10 %	Fluke 5520A
(3 to 9) mA (> 9 to 33) mA (> 33 to 90) mA (> 90 to 330) mA > 330 mA to 0.9 A (> 0.9 to 2.2) A (> 2.2 to 4.5) A (> 4.5 to 20.5) A	(65 to 500) Hz	0.049 % 0.046 % 0.049 % 0.074 % 0.055 % 0.069 % 0.11 % 0.12 %	
(> 3 to 9) mA (> 9 to 33) mA (> 33 to 90) mA (> 90 to 330) mA > 330 mA to 0.9 A (> 0.9 to 2.2) A (> 2.2 to 4.5) A (> 4.5 to 20.5) A	500 Hz to 1 kHz	0.045 % 0.041 % 0.045 % 0.041 % 0.047 % 0.065 % 0.11 % 0.12 %	
(> 3 to 9) mA (> 9 to 33) mA (> 33 to 90) mA (> 90 to 330) mA > 330 mA to 0.9 A (> 0.9 to 2.2) A	(1 to 5) kHz	0.10 % 0.068 % 0.10 % 0.084 % 0.47 % 0.47 %	
(> 3 to 9) mA (> 9 to 33) mA (> 33 to 90) mA (> 90 to 330) mA > 330 mA to 0.9 A (> 0.9 to 2.2) A	(5 to 10) kHz	0.18 % 0.16 % 0.18 % 0.16 % 2.0 % 2.2 %	

Parameter/Range	Frequency	CMC <sup>2, 4, 5</sup> (±)	Comments
AC Power <sup>3</sup> – (cont)			
PF = 1 200 mV to 1000 V			
(0.2 to 20) mA > 20 mA to 2 A (> 2 to 30) A	(40 to 60) Hz	0.21 % 0.21 % 0.20 %	Transmille 4010
(0.2 to 20) mA > 20 mA to 2 A (> 2 to 30) A	(> 60 to 100) Hz	0.079 % 0.088 % 0.10 %	
(0.2 to 20) mA > 20 mA to 2 A (> 2 to 30) A	(> 100 to 400) Hz	0.079 % 0.088 % 0.31 %	

## II. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments
RF Absolute Power – Measure			
(20 to 44) dBm	10 MHz to 4 GHz	0.73 dB	30 dB attenuator with HP8482B
(-30 to 20) dBm	0.1 MHz to 4 GHz	0.16 dB	HP437B & HP 8482A
(-20 to -70) dBm	10 MHz to 8 GHz	0.11 dB	HP437B & HP8481D
	(> 8 to 10) GHz	0.13 dB	HP437B & HP8481D
	(> 10 to 14) GHz	0.14 dB	HP437B & HP8481D
	(> 14 to 18) GHz	0.16 dB	HP437B & HP8481D
(10 to -10) dBm	10 MHz to 8 GHz	0.13 dB	HP437B & HP8481A
	(> 8 to 10) GHz	0.17 dB	HP437B & HP8481A
	(> 10 to 14) GHz	0.17 dB	HP437B & HP8481A
	(> 14 to 18) GHz	0.21 dB	HP437B & HP8481A



### III. Mechanical

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Pressure <sup>3</sup> – Generate and Measure	Pneumatic		
	(-14 to 0) PSI	0.025 % + 0.73 PSI	Druck DPI610
	(0 to 300) PSI	0.025 % + 0.73 PSI	
	Hydraulic	(0 to 2000) PSI	0.02 % + 0.34 PSI
(> 2000 to 10 000) PSI		0.1 % + 0.69 PSI	

### IV. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2, 7</sup> (±)	Comments
Frequency & Period – Measuring Equipment	10 MHz	0.035 mHz	Brandywine Communication GPS time/frequency system
	(0.01 to 119.99) Hz	3.0 pHz/Hz + 5.8 mHz	Fluke 5520A
	(120.0 to 1199.9) Hz	3.0 pHz/Hz + 58 mHz	(With 10 MHz GPS external clock)
	(1.200 to 11.999) kHz	3.0 pHz/Hz + 0.58 Hz	
	(12.00 to 119.99) kHz	3.0 pHz/Hz + 5.8 Hz	
	(120.0 to 1199.9) kHz	3.0 pHz/Hz + 58 Hz	
	(1.200 to 2.000) MHz	3.0 pHz/Hz + 0.58 kHz	
	(0.05 to 100) MHz	3.0 pHz/Hz + 5.8 kHz	
	(100 to 300) MHz	3.0 pHz/Hz + 5.8 kHz	
	(300 to 600) MHz	3.0 pHz/Hz + 5.8 kHz	
(600 to 1100) MHz	3.0 pHz/Hz + 58 kHz		

V. EMC

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
ESD Simulators –			EN 61000-4-2
Contact Voltage (Positive & Negative)	(2 to 8) kV ± 5 % (10 to 30) kV ± 5 %	0.35 % 4.4 %	Tektronix DPO7254 with Noiseken Target 06- 00067A, Noiseken Attenuator 00-00010A, Tektronix attenuator 011- 0053-03, Tektronix probe P6015A, Brandenburg HV meter 139D
Rise/Fall Time	(0.6 to 1) ns	1.2 %	
Peak Current	(7.5 to 30) A ± 15 %	2.3 %	
30 ns Current	(4 to 16) A ± 30 %	2.2 %	
60 ns Current	(2 to 8) A ± 30 %	3.0 %	
EFT/Burst Generator <sup>3</sup> – 50 Ω / 1 kΩ Load; 100 kHz / 5 kHz			
Voltage (Positive & Negative)	(0.25 to 4.4) kV	4.3 %	Tektronix DPO7254 with Noiseken attenuators AT- 810 & AT-811
Rise/Fall Time	5 ns ± 30 %	3.6 %	
Burst Duration	50 ns ± 30 %	3.6 %	
Impulse Duration 5 kHz 100 kHz	20 ms ± 20 % 1 ms ± 20 %	3.7 % 3.7 %	
Burst Period (5/100) kHz	300 ms ± 20 %	3.7 %	
Repetition Cycle 5 kHz 100 kHz	200 μs ± 20 % 10 μs ± 20 %	3.7 % 3.7 %	

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Surge Generator <sup>3</sup> –			EN 61000-4-5
Open Circuit – Voltage (Positive & Negative)	(0.5 to 4.4) kV	2.6 %	Tektronix DPO7254 with Pintek DP-100, Pearson 110A, Tektronix 011-0060-02
Rise/Fall Time	1.2 μs	2.7 %	
Duration	50 μs	2.6 %	
Short Circuit – Current (Positive & Negative)	(41.67 to 2200) A	1.3 %	
Front Time	8 μs	1.3 %	
Duration	20 μs	1.3 %	
Ring Wave Generator <sup>3</sup> –			
Open Circuit – Voltage (Positive & Negative)	(0.5 to 4) kV	5.9 %	Tektronix DPO7254 with Pintek DP-100, Pearson 110A, Tektronix 011-0060-02
Rise/Fall Time	1 μs	6.0 %	
Duration	10 μs	6.0 %	
Short Circuit – Current (Positive * Negative)	(200 & 500) A	5.8 %	
Rise/Fall Time	8 μs	6.0 %	

Parameter/Equipment	Range	CMC <sup>2, 4</sup> (±)	Comments
PQT <sup>3</sup> – Testing Voltage at 220 V With no Loading –			EN 61000-4-11
Dip Voltage	(0 to 70) %	2.7 %	Tektronix DPO7254 with Pintek DP-100
Duration (1 to 100) cycles	16.6 ms to 1.666 s	2.6 %	
Phase Angle	(0 to 360) <sup>o</sup>	2.7 %	
Rise/Fall Time	2 cycles, 30 <sup>o</sup>	2.7 %	

<sup>1</sup> This laboratory offers commercial and field calibration services.

<sup>2</sup> Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of  $k = 2$ . The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

<sup>3</sup> Field calibration service is available for this calibration. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.

<sup>4</sup> Unless otherwise noted, in the statement of CMC, percent refers to percent of reading.

<sup>5</sup> The measurands stated are generated using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure the measurand in the ranges indicated. CMC are expressed as either a specific value that covers the full range or as a fraction/percent of the reading plus a fixed floor specification.

<sup>6</sup> This scope meets A2LA's *P112 Flexible Scope Policy*.

<sup>7</sup> The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.