



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017,  
ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540.3-2006

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CALIBRATION

Valid To: June 30, 2024

Certificate Number: 2357.21

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1,7</sup>:

I. Dimensional

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Calipers – Inside & Outside <sup>3</sup>	Up to 4 in (4 to 12) in (12 to 48) in	(58 + 0.51L) μin (70 + 0.38L) μin (15 + 4.9L) μin	Gage blocks
Micrometers – Inside, Outside, & Depth <sup>3</sup>	Up to 4 in (4 to 12) in (12 to 48) in	(8.0 + 7.7L) μin (39 + 3.8L) μin (69 + 15L) μin	Gage blocks
Pin & Plug Gages	Up to 6.0 in	(6.1 + 1.5L) μin	Pratt & Whitney Universal Lab Master™
Length Indicators & Transducers <sup>3</sup>	Up to 4 in  (4 to 12) in	(4.9 + 2.0L) μin  (7.3 + 3.1L) μin	Pratt & Whitney Universal Lab Master™
Flatness <sup>3</sup>	Up to 1 in	6.1 μin	Optical flats

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Height Gages	(0.05 to 4) in (4 to 12) in (12 to 48) in	(58 + 0.76L) μin (57 + 1.3L) μin (36 + 3L) μin	Gage blocks

## II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
DC Voltage – Generate <sup>3</sup>	0 V	0.10 μV	Copper short
	(0 to 219.999 999) mV	11 μV/V + 0.39 μV	Fluke 5720A opt 003, Fluke 5725A
	(0.22 to 2.199 999) V	4.9 μV/V + 0.62 μV	
	(2.2 to 10.999 999) V	3.3 μV/V + 2.3 μV	
	(11 to 21.999 999) V	3.3 μV/V + 3.9 μV	
	(22 to 219.999 999) V (220 to 1100) V	4.9 μV/V + 39 μV 6.4 μV/V + 0.39 mV	
Fixed Point	10 V 1.018 V	1.6 μV/V 9.4 μV/V	Fluke 732B
DC Voltage – Measure <sup>3</sup>	0 V	0.10 μV	Copper short
	(0 to 200) mV	6 μV/V + 93 nV	Fluke 8508A opt 001
	(0.2 to 2) V	3.6 μV/V + 0.39 μV	
	(2 to 20) V	3.6 μV/V + 3.9 μV	
	(20 to 200) V	5.5 μV/V + 39 μV	
	(200 to 1050) V	5.5 μV/V + 0.49 mV	
	Up to 6 kV	1.2 mV/V	Ross VD120-6.2Y w/ 34401A

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
DC Current – Generate <sup>3</sup>	(0 to 219.9999) $\mu$ A (0.22 to 2.199 999) mA (2.2 to 21.999 99) mA (22 to 219.9999) mA (0.22 to 2.199 999) A (2.2 to 11) A	39 $\mu$ A/A + 5.4 nA 32 $\mu$ A/A + 6.2 nA 42 $\mu$ A/A + 39 nA 48 $\mu$ A/A + 0.62 $\mu$ A 76 $\mu$ A/A + 12 $\mu$ A 0.28 mA/A + 0.37 mA	Fluke 5720A opt 003, Fluke 5725A
Clamp-On Only	(11 to 20.5) A  (16.5 to 54.995) A (55 to 149.9995) A (150 to 549.995) A (550 to 1025) A	0.81 mA/A + 0.58 mA  0.48 mA/A + 0.031 mA 6.4 mA/A + 0.031 mA 1.2 mA/A + 0.39 mA 2.3 mA/A + 0.58 mA	Fluke 5520A  Fluke 5520A w/ coil
DC Current – Generate <sup>3</sup> (Ohm’s Law Method)	Up to 2 pA (2 to 20) pA (20 to 200) pA (0.2 to 2) nA (2 to 20) nA (20 to 200) nA (0.2 to 2) $\mu$ A (2 to 20) $\mu$ A (20 to 200) $\mu$ A (0.2 to 2) mA (2 to 20) mA	5.3 fA/pA + 12 fA 4.3 fA/pA + 12 fA 2.9 fA/pA + 35 fA 0.74 pA/nA + 120 fA 0.74 pA/nA + 1.2 pA 0.41 pA/nA + 12 pA 0.29 nA/ $\mu$ A + 120 pA 0.30 nA/ $\mu$ A + 1.2 nA 0.29 nA/ $\mu$ A + 12 nA 0.29 $\mu$ A/mA + 120 nA 1.7 $\mu$ A/mA + 1.2 $\mu$ A	Keithley 263
DC Power – Generate <sup>3</sup>  33 mV to 1020 V (0.33 to 329.9) mA (0.33 A to 2.9999) A (2.9999 A to 20.5) A	0.01 mW to 337 W (337 to 3060) W (3060 to 20 910) W	0.18 mW/W 0.18 mW/W 0.57 mW/W	Fluke 5520A
DC Current – Measure <sup>3</sup>	(0 to 200) $\mu$ A (0.2 to 2) mA (2 to 20) mA (20 to 200) mA (0.2 to 2) A (2 to 20) A	13 $\mu$ A/A + 0.31 nA 13 $\mu$ A/A + 3.1 nA 14 $\mu$ A/A + 31 nA 48 $\mu$ A/A + 0.62 $\mu$ A 0.18 mA/A + 12 $\mu$ A 0.43 mA/A + 0.31 mA	Fluke 8508A opt 001

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Resistance – Generate <sup>3</sup>	(10 to 120) Ω 100 Ω to 1.2 kΩ (1 to 12) kΩ (10 to 120) kΩ 100 kΩ to 1.2 MΩ	6.3 μΩ/Ω 7.9 μΩ/Ω 7.5 μΩ/Ω 6.9 μΩ/Ω 3.0 μΩ/Ω	ESI SR1010-10 ESI SR1010-100 ESI SR1010-1K ESI SR1010-10K ESI SR1010-100K
	(0 to 10.9999) Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω (0.33 to 1.099 999) kΩ (1.1 to 3.299 999) kΩ (3.3 to 10.999 99) kΩ (11 to 32.999 99) kΩ (33 to 109.9999) kΩ (110 to 329.9999) kΩ (0.33 to 1.099 999) MΩ (1.1 to 3.299 999) MΩ (3.3 to 10.999 99) MΩ (11 to 32.999 99) MΩ (33 to 109.9999) MΩ (110 to 329.9999) MΩ (330 to 1100) MΩ	33 μΩ/Ω + 0.78 mΩ 24 μΩ/Ω + 1.2 mΩ 22 μΩ/Ω + 1.1 mΩ 23 μΩ/Ω + 1.6 mΩ 22 μΩ/Ω + 1.6 mΩ 23 μΩ/Ω + 16 mΩ 23 μΩ/Ω + 16 mΩ 23 μΩ/Ω + 0.16 Ω 23 μΩ/Ω + 0.16 Ω 26 μΩ/Ω + 1.6 Ω 26 μΩ/Ω + 1.6 Ω 48 μΩ/Ω + 23 Ω 0.10 mΩ/Ω + 39 Ω 0.21 mΩ/Ω + 1.9 kΩ 0.40 mΩ/Ω + 2.3 kΩ 2.4 mΩ/Ω + 78 kΩ 12 mΩ/Ω + 0.39 MΩ	Fluke 5520A
Fixed Points	1 mΩ 10 mΩ 0.1 Ω	8.3 nΩ 0.19 μΩ 3.4 μΩ	L&N 4223-B L&N 4222-B L&N 4221-B
	1.0 Ω 10.0 kΩ 100 Ω 1.0 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ	6.3 μΩ 72 μΩ 0.49 mΩ 4.9 mΩ 35 mΩ 0.49 Ω 6.7 Ω 78 Ω	Fluke 742A-1 Fluke 742A-10 Fluke 742A-100 Fluke 742A-1K Fluke 742A-10K Fluke 742A-100k Fluke 742A-1M Fluke 742A-10M
10 MΩ steps	100 MΩ 1 GΩ 10 GΩ 100 GΩ	2.8 kΩ 0.65 MΩ 9.7 MΩ 0.11 GΩ	Guildline 9336-100M 9336-1G 9336-10G 9336-100G
	(10 to 110) MΩ	0.0038 %	IET Labs HATS-Y-10M

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Resistance – Generate <sup>3</sup> (cont), Fixed Points	1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	0.11 mΩ 0.16 mΩ 0.21 mΩ 0.41 mΩ 0.96 mΩ 1.8 mΩ 8.6 mΩ 16 mΩ 80 mΩ 0.15 Ω 1.2 Ω 2.2 Ω 20 Ω 38 Ω 0.37 kΩ 0.84 kΩ 12 kΩ	Fluke 5720A
Resistance – Measure <sup>3</sup>	Up to 2 Ω (2 to 20) Ω (20 to 200) Ω 200 Ω to 2 kΩ (2 to 20) kΩ (20 to 200) kΩ 200 kΩ to 2 MΩ (2 to 20) MΩ (20 to 200) MΩ 200 MΩ to 2 GΩ (2 to 20) GΩ	20 μΩ/Ω + 4.0 μΩ 12 μΩ/Ω + 14 μΩ 10 μΩ/Ω + 50 μΩ 8.2 μΩ/Ω + 0.50 mΩ 8.1 μΩ/Ω + 5.0 mΩ 8.4 μΩ/Ω + 50 mΩ 10 μΩ/Ω + 1.0 Ω 21 μΩ/Ω + 10 Ω 68 μΩ/Ω + 1.0 kΩ 0.19 mΩ/Ω + 100 kΩ 1.5 mΩ/Ω + 10 MΩ	Fluke 8508A opt 001 True ohms mode  Normal mode  High voltage mode

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
Capacitance – Measure <sup>3</sup>  12 Hz to 100 kHz	(0.1 to 10) pF (10 to 100) pF 100 pF to 25 μF (25 to 100) μF (0.1 to 1) mF	4.7 mF/F 4.7 mF/F 0.25 mF/F 0.26 mF/F 2.6 mF/F	Genrad 1689M Digibridge – CMC valid at 1 kHz only

Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments
Capacitance – Generate <sup>3</sup>			
(220 to 399.9) pF	10 Hz to 10 kHz	6.2 mF/F + 7.8 pF	Fluke 5520A
(0.4 to 1.0999) nF	10 Hz to 10 kHz	4.3 mF/F + 7.8 pF	
(1.1 to 3.2999) nF	10 Hz to 3 kHz	4.1 mF/F + 7.8 pF	
(3.3 to 10.9999) nF	(0.01 to 1) kHz	2.1 mF/F + 7.8 pF	
(11 to 32.9999) nF	(0.01 to 1) kHz	2.1 mF/F + 78 pF	
(33 to 109.999) nF	(0.01 to 1) kHz	2.1 mF/F + 78 pF	
(110 to 329.999) nF	(0.01 to 1) kHz	2.1 mF/F + 0.23 nF	
(0.33 to 1.099 99) μF	(10 to 600) Hz	2.1 mF/F + 0.78 nF	
(1.1 to 3.299 99) μF	(10 to 300) Hz	2 mF/F + 2.3 nF	
(3.3 to 10.9999) μF	(10 to 150) Hz	2.2 mF/F + 7.8 nF	
(11 to 32.9999) μF	(10 to 120) Hz	3.2 mF/F + 23 nF	
(33 to 109.999) μF	(10 to 80) Hz	3.7 mF/F + 78 nF	
(110 to 329.999) μF	(0 to 50) Hz	3.7 mF/F + 0.23 μF	
(0.33 to 1.099 99) mF	(0 to 20) Hz	3.7 mF/F + 0.78 μF	
(1.1 to 3.299 99) mF	(0 to 6) Hz	3.5 mF/F + 2.3 μF	
(3.3 to 10.9999) mF	(0 to 2) Hz	3.5 mF/F + 7.8 μF	
(11 to 32.9999) mF	(0 to 0.6) Hz	5.8 mF/F + 23 μF	
(33 to 110) mF	(0 to 0.2) Hz	8.5 mF/F + 78 μF	
Fixed Values			
100 pF	1 kHz	2.4 fF	Genrad 1404-B
1 nF	1 kHz	24 fF	Genrad 1404-A

Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments
AC Voltage – Generate <sup>3</sup>			
(0.2 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 (0.5 to 1) MHz	1.1 mV/V + 3.9 μV 0.86 mV/V + 3.9 μV 0.86 mV/V + 3.9 μV 1.4 mV/V + 3.9 μV 2.0 mV/V + 4.7 μV 3.5 mV/V + 9.3 μV 4.9 mV/V + 19 μV 6.6 mV/V + 19 μV	Fluke 5720A opt 003, Fluke 5725A
(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 (0.5 to 1) MHz	0.32 mV/V + 3.9 μV 0.18 mV/V + 3.9 μV 0.16 mV/V + 3.9 μV 0.31 mV/V + 3.9 μV 0.58 mV/V + 4.7 μV 1.3 mV/V + 9.3 μV 1.7 mV/V + 19 μV 3.1 mV/V + 19 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 (0.5 to 1) MHz	0.37 mV/V + 12 μV 96 μV/V + 6.2 μV 85 μV/V + 6.2 μV 0.20 mV/V + 6.2 μV 0.47 mV/V + 16 μV 0.86 mV/V + 19 μV 1.3 mV/V + 23 μV 2.6 mV/V + 47 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 (0.5 to 1) MHz	0.50 mV/V + 39 μV 90 μV/V + 16 μV 50 μV/V + 7.8 μV 76 μV/V + 9.3 μV 0.13 mV/V + 31 μV 0.41 mV/V + 78 μV 0.94 mV/V + 0.19 mV 1.6 mV/V + 0.31 mV	
(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 (0.5 to 1) MHz	0.38 mV/V + 0.39 mV 0.09 mV/V + 0.16 mV 47 μV/V + 54 μV 82 μV/V + 93 μV 0.11 mV/V + 0.19 mV 0.29 mV/V + 0.62 mV 0.98 mV/V + 1.9 mV 1.7 mV/V + 3.1 mV	

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Voltage – Generate <sup>3</sup> (cont)			
(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 (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.45 mV/V + 3.9 mV 90 μV/V + 1.6 mV 57 μV/V + 0.54 mV 82 μV/V + 0.93 mV 0.15 mV/V + 2.3 mV 0.95 mV/V + 16 mV 4.2 mV/V + 39 mV 8.6 mV/V + 78 mV	Fluke 5720A opt 003, Fluke 5725A
(220 to 1000) V	(15 to 50) Hz 50 Hz to 1 kHz	0.28 mV/V + 16 mV 77 μV/V + 3.1 mV	
(220 to 1000) V	40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	80 μV/V + 3.1 mV 0.13 mV/V + 4.7 mV 0.49 mV/V + 8.5 mV	Fluke 5700A Fluke 5725A
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.47 mV/V + 8.5 mV 1.8 mV/V + 35 mV	
Leveled Output (0.3 to 1.1) mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.4 mV/V 0.98 mV/V 2.2 mV/V + 2.3 μV 3.7 mV/V + 2.3 μV 5.5 mV/V + 2.3 μV 13 mV/V + 12 μV	Fluke 5720A opt 003
(1.1 to 3) mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.4 mV/V 0.94 mV/V 1.3 mV/V + 2.3 μV 2.2 mV/V + 2.3 μV 4.9 mV/V + 2.3 μV 13 mV/V + 2.3 μV	
(3 to 11) mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.4 mV/V 0.94 mV/V 1.1 mV/V + 2.3 μV 2.0 mV/V + 2.3 μV 3.9 mV/V + 2.3 μV 8.6 mV/V + 2.3 μV	



Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Voltage – Generate <sup>3</sup> (cont)			
Leveled Output (11 to 33) mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.4 mV/V 0.91 mV/V 1.0 mV/V + 2.3 μV 2.0 mV/V + 2.3 μV 3.8 mV/V + 2.3 μV 8.5 mV/V + 2.3 μV	Fluke 5720A opt 003
(33 to 110) mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.4 mV/V 0.87 mV/V 1.0 mV/V + 2.3 μV 2.0 mV/V + 2.3 μV 3.8 mV/V + 2.3 μV 8.1 mV/V + 2.3 μV	
(110 to 330) mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.3 mV/V 0.84 mV/V 1.0 mV/V + 2.3 μV 2.0 mV/V + 2.3 μV 3.8 mV/V + 2.3 μV 8.5 mV/V + 2.3 μV	
330 mV to 1.1 V	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.3 mV/V 0.84 mV/V 1.0 mV/V + 2.3 μV 2.0 mV/V + 2.3 μV 3.8 mV/V + 2.3 μV 8.5 mV/V + 2.3 μV	
(1.1 to 3.5) V	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.3 mV/V 0.84 mV/V 1.0 mV/V + 2.3 μV 2.0 mV/V + 2.3 μV 3.8 mV/V + 2.3 μV 8.5 mV/V + 2.3 μV	

Parameter/Equipment	Range	CMC <sup>2,4,5</sup> (±)	Comments
AC Power – Generate <sup>3</sup> PF = (0 to 1)			
(10 to 45) Hz	(33 to 329.99) mV:		Fluke 5522A
(0.1089 to 2.9696) mW	(3.3 to 8.999) mA	0.15 %	
(0.297 to 10.8893) mW	(9 to 32.999) mA	0.15 %	
(1.089 to 29.6958) mW	(33 to 89.99) mA	0.040 %	
(2.97 to 108.8934) mW	(90 to 329.99) mA	0.040 %	
(10.89 to 296.958) mW	(330 to 899.9) mA	0.049 %	
(29.7 to 725.945) mW	(0.9 to 2.1999) A	0.052 %	
(72.6 to 1484.922) mW	(2.2 to 4.4999) A	0.064 %	
148.5 mW to 6.7648 W	(4.5 to 20.5) A	0.11 %	
	330 mV to 1020 V:		
1.089 mW to 9.179 W	(3.3 to 8.999) mA	0.15 %	
2.97 mW to 33.659 W	(9 to 32.999) mA	0.15 %	
10.89 mW to 91.7898 W	(33 to 89.99) mA	0.044 %	
(0.0297 to 336.5898) W	(90 to 329.99) mA	0.044 %	
(0.1089 to 917.898) W	(330 to 899.9) mA	0.053 %	
(0.297 to 2243.898) W	(0.9 to 2.1999) mA	0.056 %	
(0.726 to 4589.898) W	(2.2 to 4.4999) A	0.067 %	
1.485 W to 20.91 kW	(4.5 to 20.5) A	0.12 %	
(45 to 65) Hz	(33 to 329.999) mV:		
(0.109 to 3.0) mW	(3.3 to 8.999) mA	0.23 %	
(0.297 to 10.89) mW	(9 to 32.999) mA	0.14 %	
(1.09 to 29.7) mW	(33 to 89.99) mA	0.11 %	
(3.0 to 108.9) mW	(90 to 329.99) mA	0.13 %	
(10.9 to 297) mW	(330 to 899.9) mA	0.10 %	
(29.7 to 726) mW	(0.9 to 2.1999) A	0.10 %	
72.6 mW to 1.5 W	(2.2 to 4.4999) A	0.11 %	
148.5 mW to 6.8 W	(4.5 to 20.5) A	0.10 %	
	330 mV to 1020 V:		
1.09 mW to 9.2 W	(3.3 to 8.999) mA	0.34 %	
2.97 mW to 33.6 W	(9 to 32.999) mA	0.062 %	
10.9 mW to 91.8 W	(33 to 89.99) mA	0.094 %	
29.7 mW to 336.6 W	(90 to 329.99) mA	0.062 %	
108.9 mW to 918 W	(330 to 899.9) mA	0.086 %	
297 mW to 2244 W	(0.9 to 2.1999) A	0.071 %	
72.6 mW to 4590 W	(2.2 to 4.4999) A	0.094 %	
(1.49 to 20 910) W	(4.5 to 20.5) A	0.077 %	

Parameter/Range	Frequency	CMC <sup>2,4,5</sup> (±)	Comments
AC Power – Generate <sup>3</sup> PF = (0 to 1)			
65 Hz to 1 kHz	(33 to 329.99) mV:		Fluke 5522A
(0.109 to 3.0) mW	(3.3 to 8.999) mA	0.040 %	
(0.297 to 10.89) mW	(9 to 32.999) mA	0.040 %	
(1.09 to 29.7) mW	(33 to 89.99) mA	0.042 %	
(3.0 to 108.9) mW	(90 to 329.99) mA	0.039 %	
(10.9 to 297) mW	(330 to 899.9) mA	0.54 %	
(29.7 to 726) mW	(0.9 to 2.1999) A	0.053 %	
72.6 mW to 1.5 W	(2.2 to 4.4999) A	0.094 %	
148.5 mW to 6.8 W	(4.5 to 20.5) A	0.14 %	
	330 mV to 1020 V:		
1.089 mW to 9.179 W	(3.3 to 8.999) mA	0.043 %	
2.97 mW to 33.659 W	(9 to 32.999) mA	0.043 %	
10.89 mW to 91.7898 W	(33 to 89.99) mA	0.045 %	
(0.0297 to 336.5898) W	(90 to 329.99) mA	0.042 %	
(0.0189 to 917.898) W	(330 to 899.9) mA	0.54 %	
(0.297 to 2243.898) W	(0.9 to 2.1999) A	0.055 %	
(0.726 to 4589.898) W	(2.2 to 4.4999) A	0.095 %	
1.485 W to 20.91 kW	(4.5 to 20.5) A	0.14 %	
(1 to 5) kHz	(33 to 329.99) mW:		
(0.1089 to 2.9696) mW	(3.3 to 8.999) mA	0.13 %	
(0.297 to 10.8893) mW	(9 to 32.999) mA	0.13 %	
(1.089 to 29.6958) mW	(33 to 89.99) mA	0.15 %	
(2.97 to 108.8934) mW	(90 to 329.99) mA	0.15 %	
(10.89 to 296.958) mW	(330 to 899.9) mA	0.55 %	
(29.7 to 725.945) mW	(0.9 to 2.1999) A	0.50 %	
(72.6 to 1484.922) mW	(2.2 to 4.4999) A	0.15 %	
148.5 mW to 6.7648 W	(4.5 to 20.5) A	0.18 %	
	330 mV to 1020 V:		
1.089 mW to 9.179 W	(3.3 to 8.999) mA	0.14 %	
2.97 mW to 33.659 W	(9 to 32.999) mA	0.14 %	
10.89 mW to 91.7898 W	(33 to 89.99) mA	0.15 %	
(0.0297 to 336.5898) W	(90 to 329.99) mA	0.15 %	
(0.1089 to 917.898) W	(330 to 899.9) mA	0.55 %	
(0.297 to 2243.898) W	(0.9 to 2.1999) A	0.51 %	
(0.726 to 4589.898) W	(2.2 to 4.4999) A	0.15 %	
1.485 W to 20.91 kW	(4.5 to 20.5) A	0.18 %	

Parameter/Range	Frequency	CMC <sup>2,4,5</sup> (±)	Comments
AC Power – Generate <sup>3</sup> PF = (0 to 1) (cont)			
(5 to 10) kHz (0.1089 to 2.9696) mW (0.297 to 10.8893) mW (1.089 to 29.6958) mW (2.97 to 108.8934) mW (10.89 to 296.958) mW (29.7 to 725.945) mW (72.6 to 989.9667) mW	(33 to 329.99) mV: (3.3 to 8.999) mA (9 to 32.999) mA (33 to 89.99) mA (90 to 329.99) mA (330 to 899.9) mA (0.9 to 2.1999) A (2.2 to 2.999 99) A	0.47 % 0.47 % 0.48 % 0.47 % 0.69 % 0.66 % 0.66 %	Fluke 5522A
1.089 mW to 9.179 W 2.97 mW to 33.659 W 10.89 mW to 91.7898 W 29.7 mW to 336.5898 W (0.1089 to 917.898) W (0.297 to 2243.898) W (0.726 to 3059.9898) W	330 mV to 1020 V: (3.3 to 8.999) mA (9 to 32.999) mA (33 to 89.99) mA (90 to 329.99) mA (330 to 899.9) mA (0.9 to 2.1999) A (2.2 to 2.999 99) A	0.46 % 0.47 % 0.47 % 0.48 % 0.47 % 0.69 % 0.66 %	
(10 to 30) kHz (0.1089 to 2.9696) mW (0.297 to 10.8893) mW (1.089 to 29.6958) mW (2.97 to 108.8934) mW	(33 to 329.99) mV: (3.3 to 8.999) mA (9 to 32.999) mA (33 to 89.99) mA (90 to 329.99) mA	1.8 % 1.8 % 1.8 % 1.8 %	
1.089 mW to 9.179 W 2.97 mW to 33.659 W 10.89 mW to 91.7898 W 29.7 mW to 336.5898 W	330 mV to 1020 V: (3.3 to 8.999) mA (9 to 32.999) mA (33 to 89.99) mA (90 to 329.99) mA	1.8 % 1.8 % 1.8 % 1.8 %	
AC Voltage – Measure <sup>3</sup> (0 to 200) mV	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz (0.1 to 2) kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.62 mV/V + 16 μV 0.15 mV/V + 5.0 μV 0.11 mV/V + 5.0 μV 0.11 mV/V + 2.0 μV 0.13 mV/V + 5.0 μV 0.31 mV/V + 10 μV 0.68 mV/V + 24 μV	Fluke 8508A

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Voltage – Measure <sup>3</sup> (cont)			
(0.2 to 2) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz (0.1 to 2) kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz	0.93 mV/V + 0.14 mV 0.11 mV/V + 24 μV 0.14 mV/V + 24 μV 74 μV/V + 24 μV 0.11 mV/V + 24 μV 0.21 mV/V + 50 μV 0.54 mV/V + 0.24 mV 2.4 mV/V + 2.4 mV 8.1 mV/V + 24 mV	Fluke 8508A
(2 to 20) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz (0.1 to 2) kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz	0.65 mV/V + 1.4 mV 0.13 mV/V + 0.20 mV 90 μV/V + 0.20 mV 75 μV/V + 0.20 mV 0.11 mV/V + 0.20 mV 0.20 mV/V + 0.50 mV 0.51 mV/V + 2.4 mV 2.3 mV/V + 24 mV 8.1 mV/V + 0.24 V	
(20 to 200) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz (0.1 to 2) kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz	0.80 mV/V + 14 mV 0.12 mV/V + 2.4 mV 0.10 mV/V + 2.4 mV 78 μV/V + 2.4 mV 0.11 mV/V + 2.4 mV 0.20 mV/V + 5.0 mV 0.52 mV/V + 24 mV 2.3 mV/V + 0.24 V 8.1 mV/V + 2.4 V	
(20 to 1050) V	(1 to 10) Hz (10 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.16 mV/V + 80 mV 0.12 mV/V + 25 mV 0.15 mV/V + 25 mV 0.37 mV/V + 50 mV 0.62 mV/V + 0.25 V	
Up to 6 kV	60 Hz	5.9 mV/V	Ross VD120-6.2Y w/34401A
Up to 85 kV	60 Hz	5.9 mV/V	Fluke 8508A

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Voltage – Measure <sup>3</sup> (cont)			
(0 to 2.2) mV	(10 to 20) Hz (20 to 40) Hz (0.040 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.50 to 1.0) MHz	1.3 mV/V + 1.0 μV 0.58 mV/V + 1.0 μV 0.34 mV/V + 1.0 μV 0.63 mV/V + 1.6 μV 0.94 mV/V + 2.5 μV 1.8 mV/V + 3.1 μV 1.9 mV/V + 6.2 μV 2.7 mV/V + 6.2 μV	Fluke 5790A
(2.2 to 7) mV	(10 to 20) Hz (20 to 40) Hz (0.040 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.50 to 1.0) MHz	0.66 mV/V + 1.0 μV 0.29 mV/V + 1.0 μV 0.17 mV/V + 1.0 μV 0.31 mV/V + 1.6 μV 0.47 mV/V + 2.5 μV 0.95 mV/V + 3.1 μV 1.0 mV/V + 6.2 μV 1.6 mV/V + 6.2 μV	
(7 to 22) mV	(10 to 20) Hz (20 to 40) Hz (0.040 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.50 to 1.0) MHz	0.23 mV/V + 1.0 μV 0.16 mV/V + 1.0 μV 94 μV/V + 1.0 μV 0.17 mV/V + 1.6 μV 0.25 mV/V + 2.5 μV 0.65 mV/V + 3.1 μV 0.73 mV/V + 6.2 μV 1.4 mV/V + 6.2 μV	
(22 to 70) mV	(10 to 20) Hz (20 to 40) Hz (0.040 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.50 to 1.0) MHz	0.19 mV/V + 1.2 μV 0.10 mV/V + 1.2 μV 60 μV/V + 1.2 μV 0.11 mV/V + 1.6 μV 0.22 mV/V + 2.5 μV 0.42 mV/V + 3.1 μV 0.56 mV/V + 6.2 μV 0.90 mV/V + 6.2 μV	
(70 to 220) mV	(10 to 20) Hz (20 to 40) Hz (0.040 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.50 to 1.0) MHz	0.17 mV/V + 1.2 μV 72 μV/V + 1.2 μV 33 μV/V + 1.2 μV 59 μV/V + 1.6 μV 0.13 mV/V + 2.5 μV 0.21 mV/V + 3.1 μV 0.31 mV/V + 6.2 μV 0.80 mV/V + 6.2 μV	

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Voltage – Measure <sup>3</sup> (cont)			
(220 to 700) mV	(10 to 20) Hz (20 to 40) Hz (0.040 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.50 to 1.0) MHz	0.16 mV/V + 1.2 μV 62 μV/V + 1.2 μV 27 μV/V + 1.2 μV 40 μV/V + 1.6 μV 63 μV/V + 2.5 μV 0.14 mV/V + 3.1 μV 0.23 mV/V + 6.2 μV 0.75 mV/V + 6.2 μV	Fluke 5790A
(0.70 to 2.2) V	(10 to 20) Hz (20 to 40) Hz (0.040 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.50 to 1.0) MHz	0.16 mV/V 55 μV/V 20 μV/V 36 μV/V 56 μV/V 0.13 mV/V 0.20 mV/V 0.70 mV/V	
(2.2 to 7.0) V	(10 to 20) Hz (20 to 40) Hz (0.040 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.50 to 1.0) MHz	0.16 mV/V 56 μV/V 20 μV/V 39 μV/V 65 μV/V 0.15 mV/V 0.31 mV/V 0.93 mV/V	
(7.0 to 22) V	(10 to 20) Hz (20 to 40) Hz (0.040 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.50 to 1.0) MHz	0.16 mV/V 56 μV/V 23 μV/V 42 μV/V 67 μV/V 0.15 mV/V 0.31 mV/V 0.93 mV/V	

Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments
AC Voltage – Measure <sup>3</sup> (cont)			
(22 to 70) V	(10 to 20) Hz (20 to 40) Hz (0.040 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.50 to 1.0) MHz	0.16 mV/V 56 µV/V 26 µV/V 45 µV/V 74 µV/V 0.16 mV/V 0.32 mV/V 0.93 mV/V	Fluke 5790A
(70 to 220) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz	0.16 mV/V 57 µV/V 26 µV/V 54 µV/V 78 µV/V 0.16 mV/V 0.39 mV/V	
(220 to 700) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.16 mV/V 78 µV/V 34 µV/V 0.10 mV/V 0.39 mV/V	
700 V to 1 kV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.16 mV/V 79 µV/V 35 µV/V 0.10 mV/V 0.39 mV/V	
AC Voltage Flatness – Measure <sup>3</sup>			
Up to 3 V	(0.1 to 10) kHz (> 10 to 30) kHz (> 30 to 300) kHz (> 0.3 to 1) MHz (> 1 to 10) MHz (> 10 to 20) MHz (> 20 to 30) MHz (> 30 to 50) MHz (> 50 to 70) MHz (> 70 to 80) MHz (> 80 to 100) MHz	0.12 % 0.23 % 0.29 % 0.58 % 0.70 % 0.72 % 1.7 % 2.6 % 3.5 % 3.9 % 4.7 %	Ballantine 1395B-3 w/ Agilent 3458A



Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments
AC Voltage Flatness – Measure <sup>3</sup> (cont)			
Up to 0.5 V	10 Hz (> 10 to 100) Hz (> 0.1 to 1) kHz (> 1 to 30) kHz (> 30 to 300) kHz (> 0.30 to 8) MHz (> 8 to 20) MHz (> 20 to 30) MHz (> 30 to 50) MHz (> 50 to 70) MHz (> 70 to 80) MHz (> 80 to 100) MHz	0.20 % 0.036 % 0.035 % 0.058 % 0.10 % 0.21 % 0.70 % 1.7 % 2.5 % 3.4 % 3.8 % 4.6 %	Agilent 11051A w/ Agilent 3458A
AC Voltage Flatness – Measure <sup>3</sup>			
(0 to 2.2) mV	(0.50 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	1 mV/V + 0.78 μV 0.97 mV/V + 0.78 μV 1.6 mV/V + 0.78 μV 2.9 mV/V + 0.78 μV 5.8 mV/V + 1.6 μV	Fluke 5790A, opt 003, wideband input
(2.2 to 7) mV	(0.50 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.58 mV/V + 0.78 μV 0.71 mV/V + 0.78 μV 1.1 mV/V + 0.78 μV 2.2 mV/V + 0.78 μV 3.4 mV/V + 0.78 μV	
(7 to 22) mV	(0.50 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.58 mV/V 0.72 mV/V 1.1 mV/V 2.2 mV/V 3.4 mV/V	

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Voltage Flatness – Measure <sup>3</sup> (cont)			
(22 to 70) mV	(0.50 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.45 mV/V 0.60 mV/V 1.1 mV/V 2.1 mV/V 3.3 mV/V	Fluke 5790A, opt 003, wideband input
(70 to 220) mV	(0.50 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.43 mV/V 0.60 mV/V 1.1 mV/V 2.1 mV/V 3.3 mV/V	
(220 to 700) mV	(0.50 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.43 mV/V 0.60 mV/V 1.1 mV/V 2.1 mV/V 3.2 mV/V	
(0.7 to 2.2) V	(0.50 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.43 mV/V 0.59 mV/V 1.1 mV/V 2.1 mV/V 3.2 mV/V	
(2.2 to 7) V	(0.50 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.43 mV/V 0.59 mV/V 1.1 mV/V 2.1 mV/V 2.7 mV/V	

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Current – Generate <sup>3</sup>			
(9 to 219.999) µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1.0 kHz (1.0 to 5.0) kHz (5.0 to 10) kHz	0.48 mA/A + 16 nA 0.28 mA/A + 10 nA 0.25 mA/A + 8.0 nA 0.36 mA/A + 12 nA 1.1 mA/A + 65 nA	Fluke 5720A
(0.22 to 2.199 99) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1.0 kHz (1.0 to 5.0) kHz (5.0 to 10) kHz	0.43 mA/A + 40 nA 0.21 mA/A + 35 nA 0.18 mA/A + 35 nA 0.24 mA/A + 0.11 µA 1.0 mA/A + 0.65 µA	
(2.2 to 21.9999) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1.0 kHz (1.0 to 5.0) kHz (5.0 to 10) kHz	0.42 mA/A + 0.40 µA 0.21 mA/A + 0.35 µA 0.14 mA/A + 0.35 µA 0.21 mA/A + 0.55 µA 1.0 mA/A + 5.0 µA	
(22 to 219.999) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1.0 kHz (1 to 5) kHz (5 to 10) kHz	0.42 mA/A + 4.0 µA 0.19 mA/A + 3.5 µA 0.13 mA/A + 2.5 µA 0.20 mA/A + 3.5 µA 1.0 mA/A + 10 µA	
(0.22 to 2.2) A	20 Hz to 1.0 kHz (1 to 5) kHz (5 to 10) kHz	0.33 mA/A + 35 µA 0.45 mA/A + 80 µA 6.3 mA/A + 0.16 mA	
(2.2 to 11) A	40 Hz to 1.0 kHz (1 to 5) kHz (5 to 10) kHz	0.41 mA/A + 0.17 mA 0.76 mA/A + 0.38 mA 2.9 mA/A + 0.75 mA	
(29 to 329.99) µA	(10 to 30) kHz	12 mA/A + 0.31 µA	
(0.33 to 3.2999) mA	(10 to 30) kHz	7.8 mA/A + 0.47 µA	
(3.3 to 32.999) mA	(10 to 30) kHz	3.5 mA/A + 3.1 µA	
(33 to 329.99) mA	(10 to 30) kHz	3.2 mA/A + 0.16 mA	

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
AC Current – Generate <sup>3</sup> (cont)			
(11 to 20.5) A	(45 to 100) Hz (0.10 to 1.0) kHz (1.0 to 5.0) kHz	0.96 mA/A + 3.9 mA 1.2 mA/A + 3.9 mA 23 mA/A + 3.9 mA	Fluke 5520A
Toroidal Type Clamps (16.5 to 149.999) A	(45 to 65) Hz (65 to 440) Hz	0.39 % 0.84 %	
(150 to 1025) A	(45 to 65) Hz (65 to 440) Hz	0.38 % 0.84 %	
Non-Toroidal Type Clamps (16.5 to 149.999) A	(45 to 65) Hz (65 to 440) Hz	0.77 % 1.2 %	Fluke 5520A w/ 5500A coil
(150 to 1025) A	(45 to 65) Hz (65 to 440) Hz	1.2 % 1.6 %	
AC Current – Measure <sup>3</sup>			
(5 to 26) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz	0.023 % 0.010 % 0.0049 % 0.0090 %	Holt HCS-1, Fluke 5720A, & 5790A
(50 to 260) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz	0.023 % 0.011 % 0.0052 % 0.0095 %	
(125 to 650) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz	0.023 % 0.011 % 0.0052 % 0.0099 %	
(0.5 to 2.6) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz	0.024 % 0.012 % 0.0082 % 0.014 %	

Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments
AC Current – Measure <sup>3</sup> (cont)			
(1.25 to 6.5) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz	0.024 % 0.013 % 0.0089 % 0.019 %	Holt HCS-1, Fluke 5720A, & 5790A
(2.5 to 13) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz	0.025 % 0.014 % 0.011 % 0.016 %	
(5 to 26) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz	0.028 % 0.019 % 0.017 % 0.022 %	
(9 to 200) µA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.78 mA/A + 20 nA 0.52 mA/A + 20 nA 0.65 mA/A + 20 nA 3.1 mA/A + 20 nA	Fluke 8508A
(0.2 to 2) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.61 mA/A + 0.20 µA 0.35 mA/A + 0.20 µA 0.63 mA/A + 0.20 µA 3.2 mA/A + 0.20 µA	
(2 to 20) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.59 mA/A + 2.0 µA 0.31 mA/A + 2.0 µA 0.63 mA/A + 2.0 µA 5.0 mA/A + 2.0 µA	
(20 to 200) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.61 mA/A + 20 µA 0.3 mA/A + 20 µA 0.9 mA/A + 20 µA	
(0.2 to 2) A	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.58 mA/A + 0.20 mA 0.85 mA/A + 0.20 mA 2.4 mA/A + 0.20 mA	
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.77 mA/A + 2.0 mA 2.1 mA/A + 2.0 mA	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of Thermocouple Indicators <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/SC1100
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.24 °C 0.21 °C 0.25 °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 0.13 °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	0.25 °C 0.13 °C 0.12 °C 0.14 °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 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	0.45 °C 0.28 °C 0.26 °C 0.32 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of Thermocouple Indicators <sup>3</sup> – (cont)			
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.38 °C 0.28 °C 0.29 °C 0.36 °C	Fluke 5520A/SC1100
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.50 °C 0.19 °C 0.13 °C 0.11 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.44 °C 0.21 °C	
Electrical Simulation of RTDs <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	0.085 °C 0.12 °C 0.12 °C 0.11 °C 0.097 °C 0.11 °C 0.20 °C	Fluke 5520A
Pt 3926 (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	0.064 °C 0.076 °C 0.075 °C 0.089 °C 0.095 °C 0.17 °C	
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	0.21 °C 0.060 °C 0.068 °C 0.070 °C 0.077 °C 0.084 °C 0.090 °C 0.13 °C 0.19 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of RTDs <sup>3</sup> (cont) –			
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	0.041 °C 0.043 °C 0.044 °C 0.051 °C 0.098 °C 0.11 °C 0.11 °C 0.13 °C	Fluke 5520A
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	0.036 °C 0.043 °C 0.044 °C 0.051 °C 0.066 °C 0.066 °C 0.073 °C 0.088 °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	0.029 °C 0.029 °C 0.036 °C 0.042 °C 0.050 °C 0.18 °C 0.057 °C 0.18 °C	
PtNi 120 (120 Ω)	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.081 °C 0.11 °C 0.11 °C	
Cu 427 (10 Ω)	(-100 to 260) °C	0.69 °C	



Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments
Inductance – Generate <sup>3</sup> , Fixed Points  100 µH 1 mH 10 mH 100 mH 1 H 10 H	(0.1 to 1.0) kHz	0.46 µH 1.3 µH 12 µH 0.17 mH 1.3 mH 7.6 mH	Genrad 1482-B Genrad 1482-E Genrad 1481-D Genrad 1482-L Genrad 1482-P Genrad 1482-T
Inductance – Measure <sup>3</sup>  100 µH to 10 H	12 Hz to 100 kHz	0.28 mH/H	Genrad 1689M Digibridge – CMC valid at 1 kHz only
AC Phase – Generate <sup>3</sup>  (0 to 360)° 1:1  10:1  100:1	1 Hz to 1 kHz (1 to 6.25) kHz (6.25 to 50) kHz (50 to 100) kHz 1 Hz to 1 kHz (1 to 6.25) kHz (6.25 to 50) kHz (50 to 100) kHz 1 Hz to 1 kHz (1 to 6.25) kHz (6.25 to 50) kHz (50 to 100) kHz	0.014° 0.027° 0.046° 0.10° 0.012° 0.016° 0.022° 0.049° 0.014° 0.017° 0.019° 0.050°	Clarke-Hess 5500-2
AC Phase – Measure <sup>3</sup>  (0 to 360)° 100 mV to 120 V rms	10 Hz to 1 kHz (1 to 10) kHz (10 to 100) kHz	0.058° 0.058° 0.062°	Krohn-Hite 6610

Parameter/Equipment	Range	CMC <sup>2, 5</sup> (±)	Comments
Oscilloscope <sup>3</sup> –			
Amplitude – DC Signal Into 50 Ω Load Into 1 MΩ Load	(0 to 6.6) V (0 to 130) V	2.0 mV/V + 24 μV 0.37 mV/V + 24 μV	Fluke 5520A/SC1100
Amplitude – Square Wave 50 Ω Load	±1 mV to 6.6 V <sub>p-p</sub> 10 Hz to 10 kHz	2.0 mV/V + 24 μV	
1 MΩ Load	±1 mV to 130 V <sub>p-p</sub> 10 Hz to 1 kHz	0.78 mV/V + 24 μV	
Rise Time	>300 ps	16 ps	
Bandwidth 5 mV to 5.5 V <sub>p-p</sub>	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz 600 MHz to 1.1 GHz	2.9 % + 78 μV 3.1 % + 78 μV 4.1 % + 78 μV 4.7 % + 78 μV	
(0.005 to 3.5) V <sub>p-p</sub>	(1.1 to 18) GHz (18 to 26.5) GHz	3.0 % 4.7 %	Power meter, signal generator, power sensor, Splitter
Time Marker into 50 Ω Load – Generate	5 s to 50 ms 20 ms to 1 ns Non-Cardinal Points	7.8 ms/s + 0.0019 % 2.0 μs/s 39 μs/s	Fluke 5520A/SC1100
Distortion – Measure <sup>3</sup>			
20 Hz to 100 kHz, Fundamental Frequency			
(0 to -99) dB (0 to -99) dB	20 Hz to 20 kHz (20 to 100) kHz	1.3 dB 2.3 dB	HP 8903B
Rise/Fall Time – Measure <sup>3</sup>			
Transition Time	(25 to 50) ps (50 to 200) ps (75 to 125) ps (200 to 500) ps	10 ps 10 ps 9.7 ps 13 ps	Keysight 86100A w/83483A

III. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
RF Power – Measure <sup>3</sup>			
(-30 to +30) dBm (-70 to -30) dBm	3 Hz to 100 kHz	0.021 dB 0.072 dB	Fluke 8508A
(+10 to +20) dBm (-10 to +10) dBm (-20 to -10) dBm	100 kHz to 4.2 GHz	0.14 dB 0.051 dB 0.061 dB	Keysight E441X w/ Keysight 8482A
(+10 to +20) dBm (-10 to +10) dBm (-20 to -10) dBm	(4.2 to 18) GHz	0.14 dB 0.050 dB 0.065 dB	Keysight 8481A
(+10 to +20) dBm (-10 to +10) dBm (-20 to -10) dBm	(18 to 26.5) GHz	0.16 dB 0.10 dB 0.10 dB	Keysight 8485A
(+10 to +20) dBm (-10 to +10) dBm (-20 to -10) dBm	(26.5 to 50) GHz	0.17 dB 0.12 dB 0.12 dB	Keysight 8487A
(-30 to -20) dBm (-70 to -30) dBm	10 MHz to 18 GHz	0.070 dB 0.050 dB	Keysight 8481D
(-30 to -20) dBm (-70 to -30) dBm	(18 to 26.5) GHz	0.11 dB 0.071 dB	Keysight 8485D
(-30 to -20) dBm (-70 to -30) dBm	(26.5 to 50) GHz	0.11 dB 0.071 dB	Keysight 8487D
(+20 to +30) dBm (+20 to +30) dBm (+20 to +30) dBm (+20 to +30) dBm	100 kHz to 4.2 GHz (4.2 to 18) GHz (18 to 26.5) GHz (26.5 to 50) GHz	0.15 dB 0.17 dB 0.19 dB 0.22 dB	Keysight E441X w/Keysight 8482A, 8481A, 8485A, 8487A, & 10 dB attenuator

Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments
RF Power – Generate <sup>3</sup>			
(16 to 24) dBm	(0.2 to 100) kHz (0.1 to 125) MHz	0.023 dB 0.049 dB	Fluke 96270A/LL/FF w/leveling head
(3 to 16) dBm	(0.2 to 100) kHz (0.1 to 150) MHz (0.25 to 1.4) GHz	0.023 dB 0.050 dB 0.20 dB	
(-7 to 3) dBm	(0.2 to 100) kHz (0.1 to 300) MHz (0.3 to 1.4) GHz (1.4 to 4.0) GHz	0.024 dB 0.052 dB 0.17 dB 0.26 dB	
(-47 to -17) dBm	(0.2 to 100) kHz (0.1 to 300) MHz (0.3 to 1.4) GHz (1.4 to 3.5) GHz (3.5 to 4.0) GHz	0.024 dB 0.052 dB 0.17 dB 0.26 dB 0.41 dB	
(-66 to -47) dBm	(0.1 to 10) MHz (10 to 300) MHz (0.3 to 1.4) GHz (1.4 to 4) GHz	0.16 dB 0.089 dB 0.33 dB 0.44 dB	
(-85 to -66) dBm	(0.1 to 10) MHz (10 to 150) MHz (0.15 to 1.5) GHz (1.5 to 4) GHz	0.40 dB 0.10 dB 0.42 dB 0.80 dB	
(-124 to -84) dBm	(10 to 100) MHz (0.1 to 1.4) GHz	0.62 dB 1.5 dB	
	RF Power Generate (Microwave Output)		Fluke 96270A/LL/FF w/microwave head
	Up to 100 MHz	0.43 %	
	(0.1 to 1) GHz	0.57 %	
	(1 to 2.4) GHz	0.70 %	
	(2.4 to 8) GHz	0.88 %	
	(8 to 12) GHz	1.0 %	
	(12 to 18) GHz	1.2 %	
	(18 to 22) GHz	1.6 %	
	(22 to 26.5) GHz	2.5 %	

Parameter/Range	Frequency	CMC <sup>2, 4, 5</sup> (±)	Comments
Phase Modulation <sup>3</sup> – Measure/Carrier Frequency:			
150 kHz to 10 MHz	200 Hz to 10 kHz	3.5 % + 1 LSD	HP 8902A
10 MHz to 26.5 GHz	200 Hz to 20 kHz	3.5 % + 1 LSD	
RF Attenuation – Tuned RF Power Measure <sup>3</sup>			
(0 to -10) dB	100 kHz to 10 MHz	0.018 dB	Rohde & Schwarz FSMR50
(-10 to -20) dB		0.024 dB	
(-20 to -30) dB		0.029 dB	
(-30 to -40) dB		0.035 dB	
(-40 to -50) dB		0.041 dB	
(-50 to -60) dB		0.047 dB	
(-60 to -70) dB		0.052 dB	
(-70 to -80) dB		0.058 dB	
(-80 to -90) dB		0.064 dB	
(-90 to -95) dB		0.071 dB	
(-95 to -100) dB		0.075 dB	
(-100 to -105) dB		0.086 dB	
(-105 to -110) dB		0.094 dB	
(-110 to -115) dB		0.13 dB	
(-115 to -120) dB		0.21 dB	
(-120 to -125) dB		0.27 dB	
(0 to -5) dB	10 MHz to 22 GHz	0.018 dB	
(-5 to -10) dB		0.019 dB	
(-10 to -20) dB		0.024 dB	
(-20 to -30) dB		0.029 dB	
(-30 to -40) dB		0.035 dB	
(-40 to -50) dB		0.041 dB	
(-50 to -60) dB		0.047 dB	
(-60 to -70) dB		0.053 dB	
(-70 to -80) dB		0.059 dB	
(-80 to -85) dB		0.065 dB	
(-85 to -90) dB		0.068 dB	
(-90 to -100) dB		0.074 dB	
(-100 to -105) dB		0.082 dB	
(-105 to -110) dB		0.092 dB	
(-110 to -115) dB		0.094 dB	
(-115 to -120) dB		0.22 dB	
(-120 to -130) dB		0.47 dB	
(-130 to -135) dB		1.3 dB	

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
RF Attenuation – Tuned RF Power Measure <sup>3</sup> (cont)			
(0 to -5) dB	(22 to 26.5) GHz	0.22 dB	Rohde & Schwarz FSMR50
(-5 to -10) dB		0.28 dB	
(-10 to -15) dB		0.35 dB	
(-15 to -20) dB		0.34 dB	
(-20 to -25) dB		0.30 dB	
(-25 to -30) dB		0.21 dB	
(-30 to -35) dB		0.31 dB	
(-35 to -40) dB		0.26 dB	
(-40 to -45) dB		0.35 dB	
(-45 to -50) dB		0.41 dB	
(-50 to -55) dB		0.35 dB	
(-55 to -60) dB		0.32 dB	
(-60 to -65) dB		0.51 dB	
(-65 to -70) dB		0.38 dB	
(-70 to -75) dB		0.23 dB	
(-75 to -80) dB		0.27 dB	
(-80 to -85) dB		0.34 dB	
(-85 to -90) dB		0.31 dB	
(-90 to -95) dB		0.30 dB	
(-95 to -100) dB		0.27 dB	
(-100 to -105) dB	0.27 dB		
(-105 to -110) dB	0.31 dB		
(-110 to -115) dB	0.45 dB		
(-115 to -120) dB	0.31 dB		
(-120 to -130) dB	2.9 dB		
(-130 to -135) dB	1.3 dB		
(0 to -5) dB	(26.5 to 40) GHz	0.26 dB	
(-5 to -20) dB		0.25 dB	
(-20 to -25) dB		0.39 dB	
(-25 to -30) dB		0.29 dB	
(-30 to -35) dB		0.22 dB	
(-35 to -40) dB		0.44 dB	
(-40 to -45) dB		0.31 dB	
(-45 to -50) dB		0.45 dB	
(-50 to -55) dB		0.61 dB	
(-55 to -60) dB		0.41 dB	
(-60 to -65) dB		0.51 dB	
(-65 to -70) dB		0.41 dB	
(-70 to -75) dB		0.29 dB	
(-75 to -80) dB		0.41 dB	
(-80 to -85) dB		0.42 dB	
(-85 to -90) dB	0.41 dB		
(-90 to -95) dB	0.42 dB		

Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments
RF Attenuation – Tuned RF Power Measure <sup>3</sup> (cont)			
(-95 to -100) dB (-100 to -105) dB (-105 to -110) dB (-110 to -115) dB (-115 to -120) dB (-120 to -125) dB	(26.5 to 40) GHz	0.40 dB 0.38 dB 0.47 dB 0.55 dB 0.18 dB 0.26 dB	Rohde & Schwarz FSMR50
(0 to -5) dB (-5 to -10) dB (-10 to -15) dB (-15 to -20) dB (-20 to -25) dB (-25 to -30) dB (-30 to -35) dB (-35 to -40) dB (-40 to -45) dB (-45 to -50) dB (-50 to -55) dB (-55 to -65) dB (-65 to -70) dB (-70 to -75) dB (-75 to -80) dB (-80 to -85) dB (-85 to -90) dB (-90 to -95) dB (-95 to -100) dB (-100 to -105) dB (-105 to -110) dB (-110 to -115) dB	(40 to 50) GHz	0.36 dB 0.31 dB 0.45 dB 0.44 dB 0.50 dB 0.52 dB 0.51 dB 0.55 dB 0.43 dB 0.49 dB 0.30 dB 0.36 dB 0.44 dB 0.35 dB 0.42 dB 0.36 dB 0.41 dB 0.37 dB 0.38 dB 0.39 dB 0.37 dB 0.35 dB	
Reflection Coefficient Magnitude – Measure			
$0 < \Gamma \leq 0.2$	50 MHz to 2 GHz (2 to 8) GHz (8 to 20) GHz (20 to 40) GHz	0.0081 ρ 0.0083 ρ 0.0083 ρ 0.013 ρ	HP 8722D w/ 85056A cal kit

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
Reflection Coefficient Magnitude – Measure (cont)			
0.2 < $\Gamma$ ≤ 0.4	50 MHz to 2 GHz (2 to 8) GHz (8 to 20) GHz (20 to 40) GHz	0.0083 $\rho$ 0.0086 $\rho$ 0.0086 $\rho$ 0.013 $\rho$	HP 8722D w/ 85056A cal kit
0.4 < $\Gamma$ ≤ 0.6	50 MHz to 2 GHz (2 to 8) GHz (8 to 20) GHz (20 to 40) GHz	0.0089 $\rho$ 0.0096 $\rho$ 0.0096 $\rho$ 0.015 $\rho$	
0.6 < $\Gamma$ ≤ 0.8	50 MHz to 2 GHz (2 to 8) GHz (8 to 20) GHz (20 to 40) GHz	0.010 $\rho$ 0.012 $\rho$ 0.012 $\rho$ 0.019 $\rho$	
0.8 < $\Gamma$ ≤ 1.0	50 MHz to 2 GHz (2 to 8) GHz (8 to 20) GHz (20 to 40) GHz	0.012 $\rho$ 0.015 $\rho$ 0.015 $\rho$ 0.026 $\rho$	
Transmission Coefficient – Magnitude – Measure			
(10 to 0) dB (0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB	50 MHz to 2 GHz	0.041 dB 0.044 dB 0.078 dB 0.18 dB 0.50 dB	HP 8722D w/ 85056A cal kit
(10 to 0) dB (0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to 40) dB	(2 to 8) GHz	0.055 dB 0.059 dB 0.073 dB 0.076 dB 0.095 dB	
(10 to 0) dB (0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB	(8 to 20) GHz	0.064 dB 0.062 dB 0.087 dB 0.084 dB 0.11 dB	



Parameter/Range	Frequency	CMC <sup>2, 4, 5</sup> ( $\pm$ )	Comments
Transmission Coefficient – Magnitude – Measure (cont)  (10 to 0) dB (0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB	(20 to 40) GHz	0.12 dB 0.12 dB 0.14 dB 0.14 dB 0.19 dB	HP 8722D w/ 85056A cal kit
Power Reference – Measure <sup>3</sup>	1 mW @ 50 MHz	0.33 %	Agilent 478-H76, HP 432, 3458A
Amplitude Modulation – Generate & Measure <sup>3</sup>  Rate: 50 Hz to 10 kHz Rate: 50 Hz to 50 kHz Rate: 50 Hz to 50 kHz  Rate: 20 Hz to 10 kHz Rate: 20 Hz to 100 kHz Rate: 20 Hz to 100 kHz	150 kHz to 10 MHz 10 MHz to 1.3 GHz (1.3 to 26.5) GHz  150 kHz to 10 MHz 10 MHz to 1.3 GHz (1.3 to 26.5) GHz	2.3 % + 1 LSD 1.2 % + 1 LSD 1.8 % + 1 LSD  3.5 % + 1 LSD 3.5 % + 1 LSD 3.5 % + 1 LSD	HP 8902A
Frequency Modulation – Generate & Measure <sup>3</sup>  $\leq$ 40 kHz Peak Rate: 20 Hz to 10 kHz  $\leq$ 400 kHz Peak Rate: 50 Hz to 100 kHz  Rate: 20 Hz to 200 kHz  Rate: 50 Hz to 100 kHz Rate: 20 Hz to 200 kHz	250 kHz to 10 MHz  10 MHz to 1.3 GHz  10 MHz to 1.3 GHz  (1.3 to 26.5) GHz	2.3 % + 1 LSD  1.2 % + 1 LSD  5.8 % + 1 LSD  1.2 % + 1 LSD 5.8 % + 1 LSD	HP 8902A

Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments
Phase Noise – Generate & Measure <sup>3</sup>			
Carrier Frequency: (1 to 10) MHz	Carrier Freq. Offset: $\leq 1$ Hz Offset $\leq 10$ Hz Offset $\leq 100$ Hz Offset $\leq 1$ kHz Offset $\leq 10$ kHz Offset $\leq 100$ kHz Offset $\leq 1$ MHz Offset	2.7 dBc 2.5 dBc 1.6 dBc 1.6 dBc 1.6 dBc 1.6 dBc 4.0 dBc	Rohde & Schwarz FSWP50
(10 to 100) MHz	$\leq 1$ Hz Offset $\leq 10$ Hz Offset $\leq 100$ Hz Offset $\leq 1$ kHz Offset $\leq 10$ kHz Offset $\leq 100$ kHz Offset $\leq 1$ MHz Offset $\leq 10$ MHz Offset $> 10$ MHz Offset	3.7 dBc 2.8 dBc 1.6 dBc 1.6 dBc 1.6 dBc 1.6 dBc 2.7 dBc 3.3 dBc 4.0 dBc	
(0.1 to 1) GHz	$\leq 1$ Hz Offset $\leq 10$ Hz Offset $\leq 100$ Hz Offset $\leq 1$ kHz Offset $\leq 10$ kHz Offset $\leq 100$ kHz Offset $\leq 1$ MHz Offset $\leq 10$ MHz Offset $> 10$ MHz Offset	3.2 dBc 2.4 dBc 1.7 dBc 1.6 dBc 1.6 dBc 1.6 dBc 3.9 dBc 4.0 dBc 4.0 dBc	
(1 to 3) GHz	$\leq 1$ Hz Offset $\leq 10$ Hz Offset $\leq 100$ Hz Offset $\leq 1$ kHz Offset $\leq 10$ kHz Offset $\leq 100$ kHz Offset $\leq 1$ MHz Offset $\leq 10$ MHz Offset $> 10$ MHz Offset	4.2 dBc 2.0 dBc 1.6 dBc 1.6 dBc 1.6 dBc 1.6 dBc 3.8 dBc 4.4 dBc 4.1 dBc	
(3 to 7) GHz	$\leq 1$ Hz Offset $\leq 10$ Hz Offset $\leq 100$ Hz Offset $\leq 1$ kHz Offset $\leq 10$ kHz Offset $\leq 100$ kHz Offset $\leq 1$ MHz Offset $\leq 10$ MHz Offset $> 10$ MHz Offset	4.4 dBc 2.6 dBc 1.7 dBc 1.6 dBc 1.6 dBc 1.6 dBc 3.3 dBc 3.9 dBc 4.6 dBc	



Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
Phase Noise – Generate & Measure <sup>3</sup> (cont)			
Carrier Frequency: (7 to 10) GHz	Carrier Freq. Offset: ≤ 1 Hz Offset ≤ 10 Hz Offset ≤ 100 Hz Offset ≤ 1 kHz Offset ≤ 10 kHz Offset ≤ 100 kHz Offset ≤ 1 MHz Offset ≤ 10 MHz Offset > 10 MHz Offset	4.4 dBc 2.7 dBc 1.8 dBc 1.6 dBc 1.6 dBc 1.6 dBc 3.5 dBc 3.3 dBc 4.6 dBc	Rohde & Schwarz FSWP50
(10 to 16) GHz	≤ 1 Hz Offset ≤ 10 Hz Offset ≤ 100 Hz Offset ≤ 1 kHz Offset ≤ 10 kHz Offset ≤ 100 kHz Offset ≤ 1 MHz Offset ≤ 10 MHz Offset > 10 MHz Offset	3.2 dBc 2.7 dBc 1.7 dBc 1.6 dBc 1.6 dBc 1.6 dBc 3.3 dBc 4.1 dBc 4.0 dBc	
(16 to 26) GHz	≤ 1 Hz Offset ≤ 10 Hz Offset ≤ 100 Hz Offset ≤ 1 kHz Offset ≤ 10 kHz Offset ≤ 100 kHz Offset ≤ 1 MHz Offset ≤ 10 MHz Offset > 10 MHz Offset	4.1 dBc 2.7 dBc 1.7 dBc 1.6 dBc 1.6 dBc 1.6 dBc 3.6 dBc 4.2 dBc 4.0 dBc	
(26 to 50) GHz	≤ 1 Hz Offset ≤ 10 Hz Offset ≤ 100 Hz Offset ≤ 1 kHz Offset ≤ 10 kHz Offset ≤ 100 kHz Offset ≤ 1 MHz Offset ≤ 10 MHz Offset > 10 MHz Offset	4.1 dBc 2.0 dBc 1.8 dBc 1.6 dBc 1.6 dBc 1.6 dBc 3.7 dBc 3.6 dBc 4.4 dBc	

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
Digital Modulation – Generate & Measure <sup>3</sup>  Carrier: 2 MHz to 26.5 GHz  Error Vector Magnitude for Modulation Types: MSK, GMSK, BPSK, DQPSK, $\pi/4$ DQPSK, 8PSK, 16QAM & 32QAM  Phase Error for Modulation Types: MSK, GMSK, BPSK, DQPSK, $\pi/4$ DQPSK, 8PSK, 16QAM & 32QAM  Carrier: 2 MHz to 26.5 GHz  Error Vector Magnitude for FSK Modulation  Phase Error for FSK Modulation  Error Vector Magnitude for Modulation Types: QPSK & OQPSK  Phase Error for Modulation Types: QPSK & OQPSK	Mod Frequency Span: 1 Hz to 100 kHz (0.1 to 1) MHz (1 to 2650) MHz  Mod Frequency Span: 1 Hz to 100 kHz (0.1 to 1) MHz (1 to 2650) MHz  Mod Frequency: 3.2 kHz 1.152 kHz  Mod Frequency: 3.2 kHz 1.152 kHz  Mod Frequency: 2.6 MHz  Mod Frequency: 2.6 MHz	0.32 % 0.53 % 1.1 %  0.18° 0.36° 0.60°  0.53 % 1.6 %  15 Hz 3.0 kHz  1.1 %  0.60°	Agilent E4438C w/ Agilent 89441A
Pulse Modulation – Generate <sup>3</sup>  10 MHz to 31.8 GHz	(-10 to 7) dBm	1.5 dB	Agilent E8257D

IV. Mechanical

Parameter/Equipment	Range	CMC <sup>2, 4, 8</sup> (±)	Comments
Pressure – Measure & Measuring Equipment <sup>3</sup>	(0 to 17) psia (>17 to 1500) psia (>1500 to 3000) psia	0.12 % 0.012 % FS 0.012 %	Mensor CPC6050
Mass	Up to 1 mg (1 to 2) mg (2 to 5) mg (5 to 10) mg (10 to 20) mg (20 to 100) mg (100 to 200) mg (200 to 500) mg (0.5 to 1) g (1 to 2) g (2 to 3) g (3 to 5) g (5 to 10) g (10 to 50) g (50 to 100) g (100 to 200) g (200 to 300) g (300 to 500) g (0.5 to 1) kg (1 to 2) kg (2 to 3) kg (3 to 5) kg (5 to 10) kg (10 to 20) kg (20 to 26) kg	6.0 µg 6.3 µg 6.0 µg 7.7 µg 24 µg 10 µg 7.1 µg 5.8 µg 25 µg 30 µg 51 µg 16 µg 0.19 mg 0.23 mg 0.51 mg 0.65 mg 1.3 mg 1.1 mg 0.96 mg 2.6 mg 29 mg 32 mg 36 mg 47 mg 42 mg	Master weights
Fixed Points	1 mg 2 mg 3 mg 5 mg 10 mg 20 mg 30 mg 50 mg 100 mg 200 mg 300 mg 500 mg	3.5 µg 3.4 µg 6.0 µg 3.5 µg 3.4 µg 3.0 µg 5.6 µg 2.8 µg 2.8 µg 2.9 µg 5.3 µg 3.2 µg	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Mass (cont), Fixed Points	1 g 2 g 3 g 5 g 10 g 20 g 30 g 50 g 100 g 200 g 300 g 500 g 1000 g 2000 g 3000 g 5000 g 10 000 g 20 000 g 25 000 g	3.9 µg 5.1 µg 8.3 µg 7.0 µg 13 µg 23 µg 34 µg 44 µg 85 µg 0.31 mg 0.35 mg 0.41 mg 0.83 mg 2.4 mg 4.4 mg 6.7 mg 11 mg 22 mg 30 mg	Master weights
Scales & Balances <sup>3</sup>	(0 to 5) mg (5 to 10) mg (10 to 50) mg (50 to 100) mg (100 to 500) mg (0.5 to 1) g (1 to 5) g (5 to 10) g (10 to 100) g (100 to 200) g (200 to 500) g (500 to 1000) g (1 to 2) kg (2 to 5) kg (5 to 10) kg (10 to 20) kg (20 to 25) kg  (0.25 to 0.5) lb (0.5 to 10) lb (10 to 25) lb (25 to 50) lb (50 to 100) lb (100 to 250) lb (250 to 500) lb	23 µg 17 µg 23 µg 17 µg 24 µg 18 µg 80 µg 71 µg 0.20 mg 0.66 mg 2.1 mg 3.9 mg 7.6 mg 18 mg 33 mg 42 mg 84 mg  58 mg 0.58 g 1.3 g 26 g 27 g 27 g 28 g	Master weights

Parameter/Equipment	Range	CMC <sup>2, 4, 8</sup> (±)	Comments
Torque – Measure <sup>3</sup>	(5 to 50) ozf·in (15 to 200) ozf·in	0.61 % 0.32 %	CDI 2000-04-02 CDI 2000-05-02
	(5 to 50) lbf·in (40 to 400) lbf·in (100 to 1000) lbf·in (20 to 250) lbf·ft	0.32 % 0.31 % 0.48 % 0.43 %	DT950 w/ TTPM-41 4 in 1 transducer
	(60 to 600) lbf·ft (200 to 2000) lbf·ft (15 to 150) lbf·in	0.65 % 0.45 % 0.33 %	CDI 2000-12-02 CDI 2000-14-02 CDI 2000-65-02
Torque – Measuring Equipment	(2 to 220) ozf·in (4 to 110) lbf·in (9 to 275) lbf·ft (275 to 2000) lbf·ft	0.012 % 0.021 % 0.028 % 0.022 %	Class F weights w/ 2.5 in wheel 5 in wheel 10 in wheel 40 in torque arm
Air Velocity – Measuring Equipment <sup>6</sup>	(400 to 1000) fpm (>1000 to 2000) fpm (>2000 to 4000) fpm	2.2 % + 1.0 fpm 2.1 % + 1.0 fpm 2.2 % + 1.0 fpm	Omega HHF142, stopwatch
Accelerometers	(5 to <7) Hz (7 to <100) Hz (100 to <160) Hz (160 to <500) Hz (500 to <3000) Hz (3 to <5) kHz (5 to <8) kHz (8 to 15) kHz	1.6 % 1.4 % 0.92 % 1.2 % 1.6 % 2.1 % 2.5 % 3.8 %	PCB/Modal shop 9155 shaker w/ standard accelerometers

## V. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2, 8</sup> (±)	Comments
Temperature – Measuring Equipment	(-45 to 0) °C (0 to 100) °C (100 to 230) °C (230 to 300) °C	0.038 °C 0.038 °C 0.038 °C 0.046 °C	SPRT w/ baths
Temperature – Measure <sup>3</sup>	(-200 to -40) °C (-40 to 100.0) °C (100.0 to 300) °C (300 to 420) °C (420 to 550) °C (550 to 660) °C	0.036 °C 0.036 °C 0.036 °C 0.044 °C 0.073 °C 0.073 °C	SPRT
Relative Humidity – Measuring Equipment	(10 to 14.7) % RH (14.7 to 49) % RH (49 to 73.5) % RH (73.5 to 95) % RH	0.51 % RH 0.54 % RH 0.55 % RH 0.59 % RH	Thunder Scientific 2500
Relative Humidity – Measure <sup>3</sup>	(11 to 89) % RH (90 to 95) % RH	1.3 % RH 2.4 % RH	Vaisala

## VI. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2, 8</sup> (±)	Comments
Frequency – Measure <sup>3</sup>	0.001 Hz to 1 kHz (1 to 1000) kHz (1 to 225) MHz (0.225 to 12.4) GHz	0.12 mHz/Hz 0.30 nHz/Hz 0.12 nHz/Hz 0.12 nHz/Hz	Microsemi S650 GPS w/ Agilent 5313xA
	(100 to 500) MHz (0.5 to 46) GHz	2.9 nHz/Hz 0.063 nHz/Hz	Microsemi S650 GPS w/ Agilent 5352B
	10 MHz	0.013 mHz	Microsemi S650 GPS w/ Keysight 53203A



Parameter/Equipment	Range	CMC <sup>2, 4, 8</sup> ( $\pm$ )	Comments
Frequency – Measuring Equipment <sup>3</sup>	10 MHz	5.8 mHz + 0.6R	Datum GPS
	(0.001 to 1) kHz 1 kHz to 50 MHz	0.66 $\mu$ Hz/Hz 0.59 nHz/Hz	Datum GPS w/ Agilent 33250A
	10 MHz to 46 GHz	0.58 nHz/Hz	Datum GPS w/Agilent 83650A
Non-Contact Tachometer <sup>3</sup>	Up to 100 000 RPM	23 nRPM/RPM	Datum GPS w/ Agilent 33250A
Stopwatches & Timers <sup>3</sup>	(0.0 to 86 400) s	0.039 s/day	Timometer 4500

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

<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's 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's.

<sup>4</sup> In the statement of CMC,  $L$  is the numerical value of the nominal length of the device measured in inches.  $R$  is the numerical value of the resolution of the device measured in inches.  $LSD$  is the least significant digit. Percent is percent of reading unless marked otherwise.

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

<sup>6</sup> The contributions from the "best existing device" are not included in the CMC claim.

<sup>7</sup> This scope meets A2LA's *P112 Flexible Scope Policy*.

<sup>8</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.



## Accredited Laboratory

A2LA has accredited

**TEKTRONIX, INC.**

*Timonium, MD*

for technical competence in the field of

### Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and the requirements of ANSI/NCSLI Z540.3-2006 and R205 – Specific Requirements: Calibration Laboratory Accreditation Program. 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*).



Presented this 12<sup>th</sup> day of July 2022.

A blue ink signature of the Vice President of Accreditation Services, written over a horizontal line.

Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 2357.21  
Valid to June 30, 2024

*For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.*