



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: April 30, 2022

Certificate Number: 2357.18

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1, 10</sup>:

I. Dimensional

Parameter/Equipment	Range	CMC <sup>2, 4</sup> (±)	Comments
Micrometers, Depth Gages and Height Gages <sup>3</sup> –			
Length	Up to 12 in (12 to 72) in	(30 + 1.7L) μin (28 + 1.8L) μin	Grade 2 gage blocks and surface plate
Flatness	Up to 1 in	4.8 μin	Optical flats
Gage Blocks	(0.01 to 1) in (1 to 4) in (4 to 14) in	(3.2 + 0.9L) μin (2.5 + 1.8L) μin (9.1 + 2.8L) μin	Grade 00 gage blocks and Labmaster™
Calipers <sup>3</sup>	Up to 4 in (4 to 12) in (12 to 72) in	(58 + 2.3L) μin (67 + 5.4L) μin (110 + 8.0L) μin	Grade 2 gage blocks
Inside Diameter Measuring Instruments	(0.15 to 8) in	(25 + 7L) μin	Comparison to ring gages

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Indicators <sup>3</sup>	Up to 0.05 in (0.05 to 4) in	6.5 μin (60 + 1.3L) μin	Labmaster™ and Grade 2 gage blocks
Pin and Plug Gages	Up to 2 in	(6.7 + 1D) μin	Grade 00 gage blocks and Labmaster™
Precision Rules and Glass Scales	Up to 4 in	120 μin	Nikon MM11 microscope
Rulers and Tape Measures	Up to 36 ft	0.002 in/ft	Video measurement system
Linear Measuring Machines <sup>3</sup>	Up to 2 in (2 to 8) in	(4.4 + 2.0L) μin (11 + 2.1L) μin	Grade 2 gage blocks
Gage Amplifiers	Up to 0.0002 in (0.0002 to 0.0004) in (0.0004 to 0.002) in (0.002 to 0.004) in (0.004 to 0.02) in	10 μin 11 μin 12 μin 14 μin 56 μin	Gage blocks and surface plates
Ring Gages	(0.04 to 14) in	(6.6 + 2.7L) μin	Labmaster™ and Master ring gages
Length Standards	Up to 14 in  (14 to 24) in (24 to 72) in	(16 + 3.2L) μin  (61 + 5.9L) μin (120 + 3.1L) μin	Labmaster™ w/ gage blocks  Gage blocks w/ gage amplifier
Protractors and Levels <sup>3</sup> –  Angle Generation	(0.25 to 160) °  Up to 1000 arc seconds	21 arc seconds  0.36 arc seconds	Sine plate, gage blocks, surface plate  Brunson 470 small angle generator

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
DC Voltage <sup>3</sup> – Generate	0 V	7.6 nV	Copper short
	(0 to 219.999 99) mV (0.22 to 2.199 9999) V (2.2 to 10.999 999) V (11 to 21.999 999) V (22 to 219.999 99) V (220 to 1100) V	6.9 μV/V + 0.40 μV 3.2 μV/V + 0.70 μV 2.4 μV/V + 2.5 μV 2.4 μV/V + 4.0 μV 3.2 μV/V + 40 μV 4.7 μV/V + 0.40 mV	5720A 90-day spec
	1 V 1.018 V 10 V	1.4 μV/V 1.2 μV/V 1.2 μV/V	Fluke 732B
	100 mV to 1000 V <sup>9</sup> 100 mV <sup>9</sup> 100 V <sup>9</sup> 1000 V <sup>9</sup>	1.5 μV/V 1.5 μV/V 1.4 μV/V 1.5 μV/V	Fluke 732B w/720A, 845 AR, 5720A, and 752A
DC Current <sup>3</sup> – Generate (Ohms Law Method)	Zero	1.5 pA	OPEN
	Up to 2 pA	5.3 fA/pA + 12 fA	Keithley 263
	(2 to 20) pA	4.3 fA/pA + 12 fA	
	(20 to 200) pA	2.9 fA/pA + 35 fA	
	(0.2 to 2) nA	0.74 pA/nA + 0.12 pA	
	(2 to 20) nA	0.74 pA/nA + 1.2 pA	
	(20 to 200) nA	0.41 pA/nA + 12 pA	
	(0.2 to 2) μA	0.29 nA/μA + 0.12 nA	
	(2 to 20) μA	0.3 nA/μA + 1.2 nA	
	(20 to 200) μA	0.29 nA/μA + 12 nA	
(0.2 to 2) mA	0.29 μA/mA + 0.12 μA		
(2 to 20) mA	1.7 μA/mA + 1.2 μA		

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
DC Current <sup>3</sup> – Generate (Ohms Law Method) (cont)	(0 to 10) pA (10 to 100) pA (0.1 to 1) nA (1 to 10) nA (10 to 100) nA (0.1 to 1) μA (1 to 10) μA (10 to 100) μA (0.1 to 1) mA (1 to 10) mA <sup>9</sup> (10 to 100) mA <sup>9</sup> (0.1 to 1) A <sup>9</sup> (1 to 10) A <sup>9</sup> (10 to 20) A (20 to 100) A (100 to 300) A (300 to 600) A	0.13 % 0.13 % 920 μA/A 920 μA/A 70 μA/A 55 μA/A 11 μA/A 9.9 μA/A 6.8 μA/A 7.1 μA/A 6.7 μA/A 6.7 μA/A 10 μA/A 35 μA/A 100 μA/A 510 μA/A 0.14 %	Voltage drop method 8508 w/: Keithley 100 GΩ Keithley 10 GΩ Keithley 1 GΩ Keithley 100 MΩ Guildline 10 MΩ Guildline 1 MΩ Guildline 100 kΩ Guidline 9211 shunt  Rubicon shunt
Clamp-On Only	(16.5 to 149.999) A (150 to 1025) A	3.9 mA/A + 0.11 mA 4.0 mA/A + 0.39 mA	5520A w/ coil
DC Current <sup>3</sup> – Measure (Ohms Law Method)	Zero  Up to 1 pA (1 to 10) pA (10 to 100) pA (0.1 to 1) nA (1 to 10) nA (10 to 100) nA (0.1 to 1) μA (0 to 200) μA (0.2 to 2) mA (2 to 20) mA (20 to 200) mA (0.2 to 2) A (2 to 20) A	1.5 pA  13 fA/pA + 8.1 fA 6 fA/pA + 8.1 fA 2 fA/pA + 35 fA 0.6 pA/nA + 230 fA 0.6 pA/nA + 2.3 pA 0.6 pA/nA + 23 pA 0.6 nA/pA + 350 nA 13 μA/A + 0.4 nA 14 μA/A + 4 nA 14 μA/A + 40 nA 48 μA/A + 0.80 μA 0.18 μA/A + 16 μA 0.41 mA/A + 0.40 mA	Fluke 8508, open  Keithley 6340  Fluke 8508A

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
DC Current <sup>3</sup> – Measure (Ohms Law Method) (cont)	(0 to 10) pA (10 to 100) pA (0.1 to 1) nA (1 to 10) nA (10 to 100) nA (0.1 to 1) µA (1 to 10) µA (10 to 100) µA (0.1 to 1) mA (1 to 10) mA <sup>9</sup> (10 to 100) mA <sup>9</sup> (0.1 to 1) A <sup>9</sup> (1 to 10) A <sup>9</sup> (10 to 20) A (20 to 100) A (100 to 300) A (300 to 1000) A	0.13 % 0.13 % 920 µA/A 920 µA/A 70 µA/A 55 µA/A 11 µA/A 9.9 µA/A 6.8 µA/A 7.1 µA/A 6.7 µA/A 6.7 µA/A 10 µA/A 35 µA/A 100 µA/A 510 µA/A 0.14 %	Voltage drop methods 8508 w/: Keithley 100 GΩ Keithley 10 GΩ Keithley 1 GΩ Keithley 100 MΩ Guildline 10MΩ Guildline 1MΩ Guildline 100kΩ Fluke 742A-10k IET SRL-1K Guildline 100Ω Fluke 742A-10 IET SRL 0.1 L&N 0.01Ω Fluke Y5020 Guildline 9211A  Rubicon shunt
DC Power <sup>3</sup> – Generate	0.01 mW to 337 W (0.01 to 3060) W (3060 to 20 910) W (20 to 100) kW	0.24 mW/W 0.17 mW/W 0.56 mW/W 0.29 % + 30 W	5520A  Two phase locked 57XX w/2555 and 9211
DC Voltage <sup>3</sup> – Measure	Zero  (0 to 200) mV (0.2 to 2) V (2 to 20) V (20 to 200) V (200 to 1050) V  1 mV to 1000 V  (1 to 60) kV (60 to 100) kV	7.6 nV  6.0 µV/V + 0.10 µV 3.6 µV/V + 0.40 µV 3.6 µV/V + 4.0 µV 5.5 µV/V + 40 µV 5.5 µV/V + 0.53 mV  1.5 µV/V  0.43 mV/V 6.0 mV/V	Fluke 8508A w/ short  Fluke 8508A   732B w/ 720A, 845AR, 5720A, and 752A  Ross VD60 Hipotronics KVM100

Parameter/Equipment	Range	CMC <sup>2, 6</sup> ( $\pm$ )	Comments
DC Resistance <sup>3</sup> – Generate	(0 to 10.9999) $\Omega$	46 $\mu\Omega/\Omega + 0.78 \text{ m}\Omega$	Fluke 5520A
	(11 to 32.9999) $\Omega$	52 $\mu\Omega/\Omega + 1.2 \text{ m}\Omega$	
	(33 to 109.9999) $\Omega$	34 $\mu\Omega/\Omega + 1.1 \text{ m}\Omega$	
	(110 to 329.9999) $\Omega$	29 $\mu\Omega/\Omega + 1.6 \text{ m}\Omega$	
	(0.33 to 1.099 999) $\text{k}\Omega$	27 $\mu\Omega/\Omega + 1.6 \text{ m}\Omega$	
	(1.1 to 3.299 999) $\text{k}\Omega$	28 $\mu\Omega/\Omega + 16 \text{ m}\Omega$	
	(3.3 to 10.999 99) $\text{k}\Omega$	27 $\mu\Omega/\Omega + 16 \text{ m}\Omega$	
	(11 to 32.999 99) $\text{k}\Omega$	29 $\mu\Omega/\Omega + 0.16 \Omega$	
	(33 to 109.9999) $\text{k}\Omega$	27 $\mu\Omega/\Omega + 0.16 \Omega$	
	(110 to 329.9999) $\text{k}\Omega$	25 $\mu\Omega/\Omega + 1.6 \Omega$	
	(0.33 to 1.099 999) $\text{M}\Omega$	26 $\mu\Omega/\Omega + 1.6 \Omega$	
	(1.1 to 3.299 999) $\text{M}\Omega$	49 $\mu\Omega/\Omega + 23 \Omega$	
	(3.3 to 10.999 99) $\text{M}\Omega$	0.11 $\text{m}\Omega/\Omega + 39 \Omega$	
	(11 to 32.999 99) $\text{M}\Omega$	0.20 $\text{m}\Omega/\Omega + 1.9 \text{ k}\Omega$	
	(33 to 109.9999) $\text{M}\Omega$	0.40 $\text{m}\Omega/\Omega + 2.3 \text{ k}\Omega$	
	(110 to 329.9999) $\text{M}\Omega$	2.4 $\text{m}\Omega/\Omega + 78 \text{ k}\Omega$	
	(330 to 1100) $\text{M}\Omega$	12 $\text{m}\Omega/\Omega + 390 \text{ k}\Omega$	Megadek 72-6346-1
(0.1 to 1) $\text{G}\Omega$	2.5 $\text{m}\Omega/\Omega$		
(1 to 10) $\text{G}\Omega$	5.8 $\text{m}\Omega/\Omega$		
	(10 to 100) $\text{G}\Omega$	17 $\text{m}\Omega/\Omega$	IET Labs HRRS-B-3-1G-5 kV
	(0.1 to 1) $\text{T}\Omega$	1.2 %	
	(1 to 10) $\text{M}\Omega$ ; 1M Steps	32 $\mu\Omega/\Omega$	SR1050 1M SR1050 10M
	(10 to 100) $\text{M}\Omega$ ; 10 M Steps	32 $\mu\Omega/\Omega$	
DC Resistance <sup>3</sup> – Generate, Fixed Values	Zero	0.20 $\mu\Omega$	Copper Short
	10 $\mu\Omega$	250 $\mu\Omega/\Omega$	Empro E500050 shunt Rubicon shunt
	100 $\mu\Omega$	120 $\mu\Omega/\Omega$	
	333 $\mu\Omega$	120 $\mu\Omega/\Omega$	Guildline 9211A L&N 0.01 $\Omega$ IET SRL 0.1 Fluke 742A-1 IET SRL 1.9 Fluke 742A-10 Fluke 5720A Guildline 100 $\Omega$ Fluke 5720A IET SRL-1k Fluke 5720A
	1 $\text{m}\Omega$	140 $\mu\Omega/\Omega$	
	0.01 $\Omega$	3.2 $\mu\Omega/\Omega$	
	0.1 $\Omega$	1.9 $\mu\Omega/\Omega$	
	1.0 $\Omega$	2.0 $\mu\Omega/\Omega$	
	1.9 $\Omega$	1.9 $\mu\Omega/\Omega$	
	10 $\Omega$	2.0 $\mu\Omega/\Omega$	
	19 $\Omega$	19 $\mu\Omega/\Omega$	
	100 $\Omega$	4.0 $\mu\Omega/\Omega$	
	190 $\Omega$	8.5 $\mu\Omega/\Omega$	
	1 $\text{k}\Omega$	1.8 $\mu\Omega/\Omega$	
	1.9 $\text{k}\Omega$	7.0 $\mu\Omega/\Omega$	

Parameter/Equipment	Range	CMC <sup>2,6</sup> ( $\pm$ )	Comments
DC Resistance <sup>3</sup> – Generate, Fixed Values (cont)	10 k $\Omega$ 19 k $\Omega$ 100 k $\Omega$ 190 k $\Omega$ 1.0 M $\Omega$ 1.9 M $\Omega$ 10 M $\Omega$ 19 M $\Omega$ 100 M $\Omega$ 1 G $\Omega$ 10 G $\Omega$ 100 G $\Omega$ 1 T $\Omega$ 10 T $\Omega$	1.9 $\mu\Omega/\Omega$ 1.8 $\mu\Omega/\Omega$ 3.1 $\mu\Omega/\Omega$ 8.5 $\mu\Omega/\Omega$ 3.2 $\mu\Omega/\Omega$ 15 $\mu\Omega/\Omega$ 3.3 $\mu\Omega/\Omega$ 5.9 $\mu\Omega/\Omega$ 78 $\mu\Omega/\Omega$ 0.12 m $\Omega/\Omega$ 1.1 m $\Omega/\Omega$ 1.1 m $\Omega/\Omega$ 1.3 m $\Omega/\Omega$ 2.9 m $\Omega/\Omega$	Fluke 742A-10k IET SRL-19k Guildline 100k 5720A Guildline 1M 5720A Guildline 10M IET SRL 19M 5720A Fluke 8508A-7000K Keithley 5155-10 Keithley 5155-11 Keithley 5155-12 Keithley 5155-13
DC Resistance <sup>3</sup> – Measure	(0 to 2) $\Omega$ (2 to 20) $\Omega$ (20 to 200) $\Omega$ (0.2 to 2) k $\Omega$ (2 to 20) k $\Omega$ (20 to 200) k $\Omega$ (0.2 to 2) M $\Omega$ (2 to 20) M $\Omega$ (20 to 200) M $\Omega$ (0.2 to 2) G $\Omega$ (2 to 20) G $\Omega$  (0.1 to 1) m $\Omega$ (1 to 10) m $\Omega$ (1 to 10) $\Omega$ (10 to 100) $\Omega$ (0.1 to 1) k $\Omega$ (1 to 10) k $\Omega$ (10 to 100) k $\Omega$ (0.1 to 1) M $\Omega$ (1 to 10) M $\Omega$	4.1 $\mu\Omega/\Omega$ 8.7 $\mu\Omega/\Omega$ 1.0 $\mu\Omega/\Omega$ 1.1 $\mu\Omega/\Omega$ 1.3 $\mu\Omega/\Omega$ 1.4 $\mu\Omega/\Omega$ 3.6 $\mu\Omega/\Omega$ 4.1 $\mu\Omega/\Omega$ 13 $\mu\Omega/\Omega$ 70 $\mu\Omega/\Omega$ 1100 $\mu\Omega/\Omega$  91 $\mu\Omega/\Omega$ 9.9 $\mu\Omega/\Omega$ 5.5 $\mu\Omega/\Omega$ 5.1 $\mu\Omega/\Omega$ 5.4 $\mu\Omega/\Omega$ 5.4 $\mu\Omega/\Omega$ 6 $\mu\Omega/\Omega$ 6 $\mu\Omega/\Omega$ 6.1 $\mu\Omega/\Omega$	Fluke 8508A opt 1 – transfer method          Fluke 8508, opt 1 – high voltage mode transfer  Fluke 8508A w/ fixed resistors

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
DC Resistance <sup>3</sup> – Measure (cont), (Ohms Law Method)	(0.2 to 2) MΩ (2 to 20) MΩ (20 to 200) MΩ (0.2 to 2) GΩ (2 to 20) GΩ (20 to 200) GΩ (0.2 to 2) TΩ (2 to 20) TΩ	0.0016 MΩ 0.016 MΩ 0.17 MΩ 0.0026 GΩ 0.026 GΩ 0.44 GΩ 0.012 TΩ 0.15 TΩ	Keithley 6517A

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
AC Voltage <sup>3</sup> – Measure & Generate  (Up 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	1.3 mV/V + 1.0 μV 0.58 mV/V + 1.0 μV 0.34 mV/V + 1.0 μV 0.64 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 2.5 mV/V + 6.2 μV	Fluke 5720A w/ 5790A
Wide Band	(1 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.64 mV/V + 0.78 μV 0.84 mV/V + 0.78 μV 1.7 mV/V + 0.78 μV 3.1 mV/V + 0.78 μV 6.0 mV/V + 1.6 μV	Note: uncertainty of wideband is for flatness relative to 1 kHz
(2.2 to 7) 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	0.66 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 1.8 mV/V + 6.2 μV	Fluke 5720A w/ 5790A



Parameter/Range	Frequency	CMC <sup>2,6</sup> ( $\pm$ )	Comments
AC Voltage <sup>3-</sup> Measure & Generate (cont)			
Wide Band	(1 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.60 mV/V + 0.78 $\mu$ V 0.73 mV/V + 0.78 $\mu$ V 1.2 mV/V + 0.78 $\mu$ V 2.2 mV/V + 0.78 $\mu$ V 3.4 mV/V + 0.78 $\mu$ V	Note: uncertainty of wideband is for flatness relative to 1kHz
(7 to 22) mV	(9 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	0.23 mV/V + 1.0 $\mu$ V 0.16 mV/V + 1.0 $\mu$ V 94 $\mu$ V/V + 1.0 $\mu$ V 0.16 mV/V + 1.6 $\mu$ V 0.25 mV/V + 2.5 $\mu$ V 0.65 mV/V + 3.1 $\mu$ V 0.73 mV/V + 6.2 $\mu$ V 1.4 mV/V + 6.2 $\mu$ V	Fluke 5720A w/ 5790A
Wide Band	(1 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	Note: uncertainty of wideband is for flatness relative to 1kHz
(22 to 70) mV	(9 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	0.19 mV/V + 1.0 $\mu$ V 0.10 mV/V + 1.0 $\mu$ V 63 $\mu$ V/V + 1.0 $\mu$ V 0.11 mV/V + 1.6 $\mu$ V 0.22 mV/V + 2.5 $\mu$ V 0.42 mV/V + 3.1 $\mu$ V 0.56 mV/V + 6.2 $\mu$ V 0.90 mV/V + 6.2 $\mu$ V	Fluke 5720A w/ 5790A
Wide Band	(1 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.44 mV/V 0.60 mV/V 1.1 mV/V 2.1 mV/V 3.3 mV/V	

Parameter/Range	Frequency	CMC <sup>2, 6</sup> ( $\pm$ )	Comments
AC Voltage <sup>3</sup> – Measure & Generate (cont)			
(70 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	0.17 mV/V + 1.0 $\mu$ V 75 $\mu$ V/V + 1.0 $\mu$ V 33 $\mu$ V/V + 1.0 $\mu$ V 61 $\mu$ V/V + 1.6 $\mu$ V 0.13 mV/V + 2.5 $\mu$ V 0.21 mV/V + 3.1 $\mu$ V 0.31 mV/V + 6.2 $\mu$ V 0.80 mV/V + 6.2 $\mu$ V	Fluke 5720A w/ 5790A
Wideband	(1 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	Note: uncertainty of wideband is for flatness relative to 1 kHz
(220 to 700) 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	0.17 mV/V + 1.0 $\mu$ V 62 $\mu$ V/V + 1.0 $\mu$ V 28 $\mu$ V/V + 1.0 $\mu$ V 41 $\mu$ V/V + 1.6 $\mu$ V 64 $\mu$ V/V + 2.5 $\mu$ V 0.14 mV/V + 3.1 $\mu$ V 0.23 mV/V + 6.2 $\mu$ V 0.75 mV/V + 6.2 $\mu$ V	
Wide Band	(1 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	(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	0.16 mV/V 55 $\mu$ V/V 20 $\mu$ V/V 36 $\mu$ V/V 56 $\mu$ V/V 0.13 mV/V 0.20 mV/V 0.70 mV/V	Fluke 5720A w/ 5790A

Parameter/Range	Frequency	CMC <sup>2, 6</sup> ( $\pm$ )	Comments
AC Voltage <sup>3</sup> – Measure & Generate (cont)			
Wide Band	(1 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.46 mV/V 0.63 mV/V 1.2 mV/V 2.1 mV/V 3.3 mV/V	Note: uncertainty of wideband is for flatness relative to 1kHz
(2.2 to 7) 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	0.16 mV/V 57 $\mu$ V/V 20 $\mu$ V/V 40 $\mu$ V/V 67 $\mu$ V/V 0.15 mV/V 0.31 mV/V 0.93 mV/V	Fluke 5720A w/ 5790A
Wide Band	(1 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.44 mV/V 0.62 mV/V 1.1 mV/V 2.1 mV/V 3.3 mV/V	
(7 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	0.16 mV/V 56 $\mu$ V/V 24 $\mu$ V/V 44 $\mu$ V/V 69 $\mu$ V/V 0.15 mV/V 0.31 mV/V 0.93 mV/V	

Parameter/Range	Frequency	CMC <sup>2, 6</sup> (±)	Comments
AC Voltage <sup>3</sup> – Measure & Generate (cont)			
Wide Band	(1 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.04 % 0.04 % 0.08 % 0.12 % 0.27 %	Note: uncertainty of wideband is for flatness relative to 1kHz
(22 to 70) 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	0.16 mV/V 57 μV/V 27 μV/V 45 μV/V 74 μV/V 0.16 mV/V 0.32 mV/V 0.93 mV/V	Fluke 5720A w/ 5790A
(70 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	0.16 mV/V 57 μV/V 27 μV/V 45 μV/V 75 μV/V 0.16 mV/V 0.32 mV/V	
(220 to 700) V	(10 to 20) Hz (20 to 40) Hz 40 Hz 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 to 1020) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 30) kHz (50 to 100) kHz	0.16 mV/V 79 μV/V 35 μV/V 0.10 mV/V 0.39 mV/V	

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments	
AC Voltage – Measure and Generate	2 mV	10 Hz	350 µV/V	Fluke 792A and Fluke 8508
		20 Hz	330 µV/V	
		40 Hz	340 µV/V	
		1 kHz	360 µV/V	
		20 kHz	350 µV/V	
		50 kHz	320 µV/V	
		100 kHz	430 µV/V	
		300 kHz	530 µV/V	
		500 kHz	620 µV/V	
		1 MHz	1200 µV/V	
	10 mV	1 kHz	76 µV/V	
		20 kHz	73 µV/V	
	20 mV	10 Hz	120 µV/V	
		20 Hz	78 µV/V	
		40 Hz	61 µV/V	
		1 kHz	64 µV/V	
		20 kHz	62 µV/V	
		50 kHz	81 µV/V	
		100 kHz	140 µV/V	
		300 kHz	220 µV/V	
		500 kHz	320 µV/V	
		1 MHz	420 µV/V	
	30 mV	10 Hz	120 µV/V	
		45 Hz	85 µV/V	
		1 kHz	70 µV/V	
		10 kHz	70 µV/V	
		20 kHz	71 µV/V	
33 mV	45 Hz	81 µV/V		
	10 kHz	69 µV/V		
100 mV	20 Hz	25 µV/V		
	55 Hz	13 µV/V		
	1 kHz	13 µV/V		
	10 kHz	13 µV/V		
	20 kHz	12 µV/V		

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
AC Voltage – Measure & Generate (cont)			
200 mV	10 Hz	26 μV/V	Fluke 792A and Fluke 8508
	20 Hz	20 μV/V	
	40 Hz	11 μV/V	
	1 kHz	10 μV/V	
	20 kHz	10 μV/V	
	50 kHz	20 μV/V	
	100 kHz	40 μV/V	
	300 kHz	75 μV/V	
	500 kHz	110 μV/V	
	1 MHz	180 μV/V	
300 mV	10 Hz	35 μV/V	
500 mV	40 Hz	12 μV/V	
	1 kHz	12 μV/V	
	20 kHz	12 μV/V	
	100 kHz	48 μV/V	
	300 kHz	79 μV/V	
	1 MHz	790 μV/V	
1 V	20 Hz	17 μV/V	
	40 Hz	6.2 μV/V	
	1 kHz	5.7 μV/V	
	20 kHz	13 μV/V	
	100 kHz	14 μV/V	
	300 kHz	21 μV/V	
	1 MHz	48 μV/V	
2 V	10 Hz	26 μV/V	
	20 Hz	25 μV/V	
	40 Hz	6.9 μV/V	
	1 kHz	5.8 μV/V	
	20 kHz	11 μV/V	
	50 kHz	13 μV/V	
	100 kHz	14 μV/V	
	300 kHz	22 μV/V	
	500 kHz	30 μV/V	
	1 MHz	45 μV/V	
3 V	10 Hz	36 μV/V	
10 V	10 Hz	28 μV/V	
	20 Hz	16 μV/V	
	40 Hz	5.3 μV/V	
	1 kHz	5.2 μV/V	

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
AC Voltage – Measure & Generate (cont)			
19 V	1 kHz	6 µV/V	Fluke 792A and Fluke 8508
20 V	10 Hz	26 µV/V	
	20 Hz	15 µV/V	
	40 Hz	6.8 µV/V	
	1 kHz	6.1 µV/V	
	20 kHz	6.3 µV/V	
	50 kHz	7.2 µV/V	
	100 kHz	10 µV/V	
	300 kHz	20 µV/V	
	500 kHz	29 µV/V	
	1 MHz	42 µV/V	
22 V	1 MHz	59 µV/V	
30 V	10 Hz	36 µV/V	
50 V	300 kHz	36 µV/V	
100 V	20 Hz	16 µV/V	
	55 Hz	8.6 µV/V	
	1 kHz	6.1 µV/V	
200 V	10 Hz	37 µV/V	
	20 Hz	15 µV/V	
	40 Hz	8.1 µV/V	
	1 kHz	8.1 µV/V	
	20 kHz	8.6 µV/V	
	50 kHz	12 µV/V	
	100 kHz	18 µV/V	
250 V	15 Hz	57 µV/V	
300 V	50 kHz	20 µV/V	
500 V	50 Hz	14 µV/V	
	1 kHz	14 µV/V	
	30 kHz	20 µV/V	
1000 V	50 Hz	16 µV/V	
	1 kHz	11 µV/V	
	30 kHz	11 µV/V	
(1 to 40) kV	50/60 Hz	4.1 mV/V	Ross YD60 divider w/ meter
(40 to 100) kV	50/60 Hz	14 mV/V	Hipotronics KVM100

Parameter/Range	Frequency	CMC <sup>2,6</sup> ( $\pm$ )	Comments
AC Current <sup>3</sup> – Measure & Generate			
Up to 33 $\mu$ A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz	350 $\mu$ A/A 280 $\mu$ A/A 260 $\mu$ A/A 880 $\mu$ A/A	Fluke 5720A w/ metal film resistors
(33 to 330) $\mu$ A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz	220 $\mu$ A/A 110 $\mu$ A/A 87 $\mu$ A/A 300 $\mu$ A/A	
(0.33 to 5) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz	270 $\mu$ A/A 90 $\mu$ A/A 59 $\mu$ A/A 210 $\mu$ A/A	
(5 to 50) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz	220 $\mu$ A/A 96 $\mu$ A/A 65 $\mu$ A/A 100 $\mu$ A/A	Fluke 5720A w/ 5790A and AC shunts
(50 to 260) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz	220 $\mu$ A/A 97 $\mu$ A/A 67 $\mu$ A/A 110 $\mu$ A/A	
(125 to 650) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz	220 $\mu$ A/A 96 $\mu$ A/A 67 $\mu$ A/A 110 $\mu$ A/A	
(0.5 to 2.6) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz	220 $\mu$ A/A 99 $\mu$ A/A 78 $\mu$ A/A 140 $\mu$ A/A	
(1.25 to 6) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz	220 $\mu$ A/A 110 $\mu$ A/A 97 $\mu$ A/A 190 $\mu$ A/A	
(2.5 to 13) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz	230 $\mu$ A/A 120 $\mu$ A/A 110 $\mu$ A/A 170 $\mu$ A/A	



Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
AC Current <sup>3</sup> – Measure & Generate (cont)			
(5 to 26) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz	250 μA/A 160 μA/A 170 μA/A 210 μA/A	Fluke 5720A w/ 5790A and AC shunts
(26 to 1200) A	Up to 1 kHz	520 μA/A	w/ Weston 327 type 2 current transformer
(Generate Only) (16.5 to 149.999) A	(45 to 65) Hz (65 to 440) Hz	0.31 % 0.81 %	
(150 to 1025) A	(45 to 65) Hz (65 to 440) Hz	0.33 % 0.82 %	Fluke 5520A w/ 5500-coil
AC Resistance <sup>3</sup> – Generate			
10 Ω	DC to 1 MHz (1 to 2) MHz (2 to 3) MHz (3 to 4) MHz (4 to 5) MHz (5 to 10) MHz (10 to 13) MHz	4.1 mΩ 5.1 mΩ 5.1 mΩ 6.1 mΩ 7.1 mΩ 20 mΩ 40 mΩ	Agilent 42030 set
100 Ω	DC to 1 MHz (1 to 2) MHz (2 to 3) MHz (3 to 4) MHz (4 to 5) MHz (5 to 10) MHz (10 to 13) MHz	42 mΩ 42 mΩ 46 mΩ 46 mΩ 44 mΩ 84 mΩ 93 mΩ	
1 kΩ	DC to 3 MHz (3 to 5) MHz (5 to 10) MHz (10 to 13) MHz	0.43 Ω 0.42 Ω 2 Ω 3 Ω	
10 kΩ	DC to 1 MHz	3.3 Ω	
100 kΩ	DC to 1 MHz	46 Ω	

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
AC Resistance <sup>3</sup> – Measure			
(0.01 to 100) kΩ (0.1 to 10) MΩ	12 Hz to 100 kHz	0.021 % 0.26 %	IET 1689 – CMC valid at 1 kHz only <sup>8</sup>
0.1 Ω 1.0 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ	(0.1 to 1) MHz	0.53 % 0.34 % 0.11 % 0.05 % 0.05 % 0.10 % 0.16 %	Agilent E4980A
0.1 Ω 1.0 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ	(1 to 2) MHz	0.63 % 0.34 % 0.21 % 0.10 % 0.10 % 0.21 % 0.32 %	
AC Power <sup>3</sup> – Generate			
(0.01 to 0.1) W (0.1 to 890) W (0.89 to 3) kW (3 to 11) kW (11 to 20.5) kW	(0.04 to 1) kHz; PF = 1	0.23 % 0.14 % 0.13 % 0.15 % 0.13 %	Fluke 5520A
(20.5 to 100) kW	(10 to 100) Hz (100 to 400) Hz (0.4 to 1) kHz	0.66 % + 0.15 kW 0.66 % + 0.20 kW 0.67 % + 0.30 kW	Two Fluke 57XX phase locked w/ Valhalla 2555A

Parameter/Range	Frequency	CMC <sup>2, 6</sup> (±)	Comments
AC Level Flatness <sup>3</sup>  0.5, 1V, 3V	10 Hz 100 Hz 10 kHz 30 kHz 100 kHz 300 kHz 1 MHz 3 MHz 8 MHz 10 MHz 20 MHz 30 MHz 50 MHz 70 MHz 80 MHz 100 MHz	0.022 % 0.016 % 0.016 % 0.016 % 0.016 % 0.020 % 0.020 % 0.094 % 0.094 % 0.094 % 0.20 % 0.20 % 0.50 % 1.0 % 1.0 % 1.0 %	Agilent 3458A w/ thermal converters  Reference to 1 kHz
Inductance <sup>3</sup> – Generate  100 Hz to 1 kHz	3 μH 10 μH 100 μH <sup>9</sup>  200 μH <sup>9</sup> 300 μH 500 μH 1 mH 2 mH 5 mH 10 mH 20 mH 100 mH 1 H 5 H 10 H  1 mH to 10 H	81 nH 0.12 μH 0.55 μH  48 nH 0.99 μH 0.12 μH 0.28 μH 0.48 μH 1.2 μH 4.5 μH 4.8 μH 25 μH 0.41 mH 1.5 mH 2.4 mH  0.021 %	Western Elec D-179XXX  GenRad 1482X Western Elec D-179XXX             GenRad 1491-D monitored w/ IET 1689 (CMC valid at 1 kHz only)

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
Inductance <sup>3</sup> – Measure			
100 μH to 10 H <sup>9</sup>	12 Hz to 100 kHz	0.021 %	IET 1689 – CMC valid at 1 kHz only <sup>8</sup>
3 μH	(0.1 to 1) MHz	0.10 %	Agilent E4980A
10 μH		0.05 %	
100 μH <sup>9</sup>		0.05 %	
200 μH		0.06 %	
300 μH		0.07 %	
500 μH		0.06 %	
1 mH		0.07 %	
3 μH	(1 to 2) MHz	0.10 %	
10 μH		0.10 %	
100 μH		0.10 %	
200 μH		0.17 %	
Capacitance <sup>3</sup> – Measure			
(1 to 10) pF	100 Hz to 100 kHz	0.41 %	IET 1689 - CMC valid at 1 kHz only <sup>8</sup>
(10 to 100) pF	12 Hz to 100 kHz	0.05 %	
100 pF to 25 μF		0.02 %	
(25 to 100) μF		0.03 %	
(0.1 to 1) mF		0.21 %	
1 pF	(0.1 to 1) MHz	0.19 %	Agilent E4980A
10 pF		0.11 %	
100 pF		0.05 %	
1 nF		0.05 %	
10 nF		0.10 %	
100 nF		0.15 %	
1 μF		0.41 %	
1 pF	(1 to 2) MHz	0.28 %	
10 pF		0.11 %	
100 pF		0.10 %	
1 nF		0.10 %	
10 nF		0.21 %	
100 nF		0.35 %	
1 μF		0.81 %	
Up to 1.099 99 mF	DC	0.14 mF/F	Fluke 5720A w/ Keysight 3458A
(1.1 to 3.299 99) mF	DC	0.13 mF/F	
(3.3 to 10.9999) mF	DC	0.13 mF/F	
(11 to 32.9999) mF	DC	0.17 mF/F	
(33 to 110) mF	DC	0.33 mF/F	

Parameter/Range	Frequency	CMC <sup>2, 6</sup> (±)	Comments
Capacitance <sup>3</sup> – Generate			
1 pF	100 Hz to 1 MHz	0.40 fF	Agilent 1638XX capacitors
	(1 to 2) MHz	0.45 fF	
	(2 to 3) MHz	0.57 fF	
	(3 to 4) MHz	0.73 fF	
	(4 to 5) MHz	1.5 fF	
	(5 to 10) MHz	2.5 fF	
	(10 to 13) MHz	4.1 fF	
10 pF	100 Hz to 1 MHz	3.5 fF	
	(1 to 3) MHz	3.8 fF	
	(3 to 5) MHz	3.5 fF	
	(5 to 10) MHz	4.1 fF	
	(10 to 13) MHz	4.3 fF	
100 pF	100 Hz to 1 kHz	43 fF	
	1 kHz to 1 MHz	35 fF	
	(1 to 2) MHz	36 fF	
	(2 to 3) MHz	37 fF	
	(3 to 4) MHz	38 fF	
	(4 to 5) MHz	39 fF	
	(5 to 10) MHz	52 fF	
	(10 to 13) MHz	63 fF	
	1 nF	100 Hz to 1 MHz	0.35 pF
(1 to 2) MHz		0.38 pF	
(2 to 3) MHz		0.45 pF	
(3 to 4) MHz		0.56 pF	
(4 to 5) MHz		0.71 pF	
(5 to 10) MHz		1.9 pF	
(10 to 13) MHz		2.8 pF	
10 nF	(100 to 120) Hz	0.62 pF	
	120 Hz to 1 kHz	0.71 pF	
	(1 to 10) kHz	0.71 pF	
	(10 to 100) kHz	0.44 pF	
100 nF	(100 to 120) Hz	7.1 pF	
	120 Hz to 1 kHz	7.1 pF	
	(1 to 10) kHz	7.1 pF	
	(10 to 100) kHz	9.1 pF	
1 μF	(100 to 120) Hz	76 pF	
	120 Hz to 1 kHz	70 pF	
	(1 to 10) kHz	70 pF	
	(10 to 100) kHz	0.58 nF	

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
Capacitance <sup>3</sup> – Generate (cont)			
(1 to 10) μF	50 Hz to 1 kHz	0.081 %	GenRad 1424-A
1 pF to 1 μF	1 kHz	140 μF/F	GenRad 1413
1 μF to 1.4 μF	1 kHz	800 μF/F	Arco SS-32
(0.19 to 1.09) nF	10 Hz to 10 kHz	4.1 pF/nF + 7.8 pF	Fluke 5520A
(1.1 to 3.29) nF	10 Hz to 3 kHz	4.0 pF/nF + 7.8 pF	
(3.3 to 10.09) nF	10 Hz to 1 kHz	2.3 pF/nF + 7.8 pF	
(11 to 109.9) nF	10 Hz to 1 kHz	2.3 pF/nF + 78 pF	
(110 to 329.9) nF	10 Hz to 1 kHz	2.3 pF/nF + 0.23 nF	
(0.33 to 1.09) μF	(10 to 600) Hz	2.3 nF/μF + 0.78 nF	
(1.1 to 3.29) μF	(10 to 300) Hz	2.3 nF/μF + 2.3 nF	
(3.29 to 10.09) μF	(10 to 150) Hz	2.3 nF/μF + 7.8 nF	
(11 to 32.9) μF	(10 to 120) Hz	3.4 nF/μF + 23 nF	
(33 to 109.9) μF	(10 to 80) Hz	3.7 nF/μF + 78 nF	
(110 to 329.9) μF	(10 to 50) Hz	3.5 nF/μF + 0.23 μF	
(0.33 to 1.09) mF	(10 to 20) Hz	3.5 μF/mF + 0.78 μF	
(1.1 to 3.29) mF	DC to 6 Hz	3.5 μF/mF + 2.3 μF	
(3.3 to 10.9) mF	DC to 2 Hz	3.5 μF/mF + 7.8 μF	
(11 to 32.9) mF	DC to 0.6 Hz	5.8 μF/mF + 23 μF	
(33 to 110) mF	DC to 0.2 Hz	8.5 μF/mF + 78 μF	
Phase <sup>3</sup> – Generate			
-180° to 180°	1 mHz to 20 MHz	0.18°	HP 3325A and reference signal
Phase <sup>3</sup> – Measure			
0° to 360°	10 Hz to 225 MHz	0.025°	Agilent 53132A

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Calibration of Thermocouple Indicators <sup>3</sup>			
Type B	(600 to 1820) °C	0.092 °C	Keysight 3458, Fluke 5720A, thermal reference probe, and ice point
Type C	(0 to 2316) °C	0.092 °C	
Type E	(-250 to 1000) °C	0.091 °C	
Type J	(-210 to 1200) °C	0.092 °C	
Type K	(-200 to 1372) °C	0.092 °C	
Type R	(0 to 1767) °C	0.24 °C	
Type S	(0 to 1767) °C	0.24 °C	
Type T	(-250 to 400) °C	0.14 °C	
Type U	(-200 to 600) °C	0.14 °C	
Type N	(-200 to -100) °C	0.31 °C	Fluke 5520A
	(-100 to -25) °C	0.17 °C	
	(-25 to 120) °C	0.15 °C	
	(120 to 410) °C	0.14 °C	
	(410 to 1300) °C	0.21 °C	
Electrical calibration of RTDs –			
Pt 385, 100 Ω	(-200 to 0) °C	0.06 °C	Fluke 5520A
	(0 to 100) °C	0.08 °C	
	(100 to 400) °C	0.10 °C	
	(400 to 630) °C	0.12 °C	
	(630 to 800) °C	0.23 °C	
Pt 385, 200 Ω	(-200 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 260) °C	0.06 °C	
	(260 to 400) °C	0.08 °C	
	(400 to 600) °C	0.09 °C	
	(600 to 630) °C	0.11 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical calibration of RTDs – (cont)			
Pt 385, 1 kΩ	(-200 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 600) °C (600 to 630) °C	0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.08 °C 0.23 °C	Fluke 5520A
PtNi 385, 120 Ω	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.08 °C 0.09 °C 0.14 °C	
Pt 3916, 100 Ω	(-200 to -190) °C (-190 °C to 0) °C (0 °C to 100) °C (100 °C to 260) °C (260 °C to 300) °C (300 °C to 400) °C (400 °C to 600) °C (600 °C to 630) °C	0.25 °C 0.05 °C 0.06 °C 0.07 °C 0.08 °C 0.09 °C 0.11 °C 0.23 °C	
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	0.05 °C 0.06 °C 0.07 °C 0.09 °C 0.10 °C 0.13 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.30 °C	



Parameter/Equipment	Range	CMC <sup>2,6</sup> ( $\pm$ )	Comments
Oscilloscopes <sup>3</sup>			
DC Signal			
Into 50 $\Omega$ Load	(0 to 6.6) V	1.9 mV/V + 31 $\mu$ V	Fluke 5520A/SC1100
Into 1 M $\Omega$ Load	(0 to 130) V	0.39 mV/V + 31 $\mu$ V	
Amplitude Square Wave			
10 Hz to 10 kHz			
Into 50 $\Omega$ Load	1 mV to 6.6 V	1.6 mV/V + 31 $\mu$ V	
Into 1 M $\Omega$ Load	1 mV to 130 V <sub>p-p</sub>	0.78 mV/V + 31 $\mu$ V	
Leveled Sine Wave Flatness			
5 mV to 5.5 V	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	1.5 % + 78 $\mu$ V 1.8 % + 78 $\mu$ V 3.4 % + 78 $\mu$ V	Note: uncertainty of flatness is relative to 50 kHz
Leveled Sine Wave Flatness			
Up to 3.5 V	>1 kHz to 100 MHz (>0.1 to 2.4) GHz (>2.4 to 8) GHz (>8 to 12.4) GHz (>12.4 to 18) GHz (>18 to 26.5) GHz	0.61 % 0.82 % 1.3 % 1.3 % 1.7 % 2.1 %	Fluke 96270A Note: uncertainty of flatness is relative to 100 kHz. VSWR = 1.0
Time Mark			
Into 50 $\Omega$	1 ns to 20 ms 20 ms to 5 s	2.1 $\mu$ s/s (19 + 39 <i>t</i> ) $\mu$ s/s	Fluke 5520A
Frequency	1 kHz to 10 MHz	2.5 $\mu$ s/s	<i>t</i> is the time in seconds
Rise Time – Generate	Positive Side $\geq$ 16 ps Negative Side $\geq$ 16 ps	11 ps 12 ps	Tektronix 067-1338-00
Rise Time – Measure	6 ps to 1 $\mu$ s	10 ps	Tektronix SD-32

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> (±)	Comments
Distortion <sup>3</sup> – Measure  (0 to 100) % Distortion	20 Hz to 20 kHz (20 to 100) kHz	1.3 dB 2.4 dB	HP 8903B

### III. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC <sup>2, 6</sup> (±)	Comments
RF Power <sup>3</sup> – Generate  (16 to 20) dBm	(0.2 to 100) kHz (0.1 to 125) MHz	0.023 dB 0.045 dB	Fluke 96270A – leveling head output
(3 to 16) dBm	(0.2 to 100) kHz (0.1 to 150) MHz (0.25 to 1.4) GHz	0.023 dB 0.043 dB 0.16 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 0.047 dB 0.16 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 0.047 dB 0.16 dB 0.24 dB 0.40 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 0.083 dB 0.31 dB 0.41 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	0.56 dB 0.41 dB 0.82 dB 0.80 dB	
(-124 to -84) dBm	(10 to 100) MHz (0.1 to 1.4) GHz	0.60 dB 1.4 dB	

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> ( $\pm$ )	Comments
RF Power <sup>3</sup> – Generate (cont)  (-120 to 24) dBm	Up to 100 MHz (0.1 to 1) GHz (1 to 2.4) GHz (2.4 to 8) GHz (8 to 12) GHz (12 to 18) GHz (18 to 22) GHz (22 to 26.5) GHz	0.43 % 0.57 % 0.70 % 0.88 % 1.0 % 1.2 % 1.6 % 2.5 %	Fluke 96270A – characterized microwave output w/ splitter
RF Power <sup>3</sup> – Measure  (-30 to 23) dBm	100 kHz to 100 MHz 100 MHz to 2.0 GHz (2.0 to 12.0) GHz (12.0 to 18.0) GHz (18.0 to 26.5) GHz (26.5 to 40.0) GHz	0.060 dB 0.064 dB 0.082 dB 0.10 dB 0.12 dB 0.16 dB	NRP-Z55, VSWR = 1.15
(-20 to 30) dBm	(0.05 to 12) GHz (12 to 18) GHz (18 to 26.5) GHz	1.8 % 2.0 % 2.3 %	HP 8902A, 11722A, 11793A, and 11792A
(-70 to -20) dBm	50 MHz to 2 GHz (2 to 8) GHz (8 to 18) GHz (18 to 26.5) GHz	2.9 % 3.0 % 4.2 % 5.0 %	HP 8902A w/ 8485D
(-140 to -60) dBm	9 kHz to 2.9 GHz (2.9 to 6.46) GHz (6.46 to 13.2) GHz (13.2 to 26.5) GHz	3.0 dB 3.6 dB 4.1 dB 5.2 dB	HP 8563E
1 mW reference	50 MHz	0.68 %	HP 478A-H76 w/ 432A and 3458A

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
RF Attenuation <sup>3</sup> – Measure			
(0 to 10) dB (10 to 20) dB (20 to 30) dB (30 to 40) dB (40 to 50) dB (50 to 60) dB (60 to 70) dB (70 to 80) dB (80 to 90) dB (90 to 100) dB (100 to 110) dB (110 to 120) dB	100 kHz to 1.3 GHz	0.064 dB 0.067 dB 0.069 dB 0.082 dB 0.10 dB 0.10 dB 0.11 dB 0.11 dB 0.14 dB 0.14 dB 0.15 dB 0.18 dB	HP 8902A w/ 11722A
(0 to 10) dB (10 to 20) dB (20 to 30) dB (30 to 40) dB (40 to 50) dB (50 to 60) dB (60 to 70) dB (70 to 80) dB (80 to 85) dB	(1.3 to 26.5) GHz	0.064 dB 0.067 dB 0.080 dB 0.082 dB 0.10 dB 0.10 dB 0.11 dB 0.11 dB 0.14 dB	HP 8902A w/ 11722A, 11792A and 11793A
RF Attenuation <sup>3</sup> – Generate (Relative)			
100 kHz to 128 MHz	(0 to 55) dB (55 to 64) dB (64 to 74) dB (74 to 100) dB (100 to 120) dB	0.019 dB 0.026 dB 0.043 dB 0.061 dB 0.23 dB	Fluke 96270A
DC to 18 GHz	(0 to 10) dB, 1 dB steps 10 dB 20 dB 30 dB 40 dB 50 dB 60 dB 70 dB 80 dB 90 dB 100 dB 110 dB	0.023 dB 0.053 dB 0.074 dB 0.11 dB 0.13 dB 0.15 dB 0.19 dB 0.22 dB 0.24 dB 0.26 dB 0.31 dB 0.37 dB	HP 8494B and 8496B w/ 8902A, 11722A, 11792A and 11793A

Parameter/Equipment	Range	CMC <sup>2,5,6</sup> (±)	Comments
Frequency Modulation <sup>3</sup> – Generate			
Pk Deviation < 12.5 kHz Rate: < 100 kHz Rate: ≤ 200 kHz	(11 to 13.5) MHz (11 to 13.5) MHz	0.39 % 0.38 %	HP 11715A w/ 3335A
Pk Deviation < 100 kHz Rate: < 100 kHz Rate: ≤ 200 kHz	(88 to 108) MHz (88 to 108) MHz	0.38 % 0.38 %	
Pk Deviation < 400 kHz Rate: < 100 kHz Rate: ≤ 200 kHz	(352 to 432) MHz (352 to 432) MHz	0.38 % 0.53 %	
Pk Deviation < 40 kHz Rate: (0.02 to 10) kHz	(0.25 to 10) MHz	2.3 % + 1 digit	Agilent 836X0 w/ HP 8902A and 11793A
Pk Deviation < 400 kHz Rate: (0.02 to 200) kHz	(0.01 to 1.3) GHz	5.8 % + 1 digit	
Pk Deviation < 400 kHz Rate: (0.05 to 100) kHz	(0.01 to 1.3) GHz	1.2 % + 1 digit	
Pk Deviation < 400 kHz Rate: (0.02 to 200) kHz	(1.3 to 26.5) GHz	5.8 % + 1 digit	
Pk Deviation < 400 kHz Rate: (0.05 to 100) kHz	(1.3 to 26.5) GHz	1.2 % + 1 digit	
Amplitude Modulation <sup>3</sup> – Generate			
Rate: (0.05 to 50) kHz Depth: (0 to 99) %	(11 to 13.5) MHz	0.20 %	HP 11715A w/ 3335A
Rate: (0.02 to 100) kHz Depth: (0 to 99) %	(12 to 13.5) MHz	0.33 %	

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> (±)	Comments
Amplitude Modulation <sup>3</sup> – Generate (cont)			
Rate: (0.05 to 10) kHz Depth: (5 to 99) %	(0.15 to 10) MHz	2.4 % + 1 digit	Agilent 836X0 w/ HP 8902A and 11793A
Rate: (0.02 to 10) kHz Depth: (0 to 99) %	(0.15 to 10) MHz	3.5 % + 1 digit	
Rate: (0.05 to 10) kHz Depth: (5 to 99) %	(0.01 to 1.3) GHz	1.2 % + 1 digit	
Rate: (0.02 to 10) kHz Depth: (0 to 99) %	(0.01 to 1.3) GHz	3.5 % + 1 digit	
Rate: (0.05 to 10) kHz Depth: (5 to 99) %	(1.3 to 26.5) GHz	1.8 % + 1 digit	
Rate: (0.02 to 10) kHz Depth: (0 to 99) %	(1.3 to 26.5) GHz	3.5 % + 1 digit	
Frequency Modulation <sup>3</sup> – Measure			
Pk Deviation < 40 kHz Rate: (0.02 to 10) kHz	(0.25 to 10) MHz	2.3 % + 1 digit	HP 8902A w/ 11793A
Pk Deviation < 400 kHz Rate: (0.02 to 200) kHz	(0.01 to 1.3) GHz	5.8 % + 1 digit	
Pk Deviation < 400 kHz Rate: (0.05 to 100) kHz	(0.01 to 1.3) GHz	1.2 % + 1 digit	
Pk Deviation < 400 kHz Rate: (0.02 to 200) kHz	(1.3 to 26.5) GHz	5.8 % + 1 digit	
Pk Deviation < 400 kHz Rate: (0.05 to 100) kHz	(1.3 to 26.5) GHz	1.2 % + 1 digit	

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> ( $\pm$ )	Comments
Amplitude Modulation <sup>3</sup> – Measure			
Rate: (0.05 to 10) kHz Depth: (5 to 99) %	(0.15 to 10) MHz	2.4 % + 1 digit	HP 8902A w/ 11793A
Rate: (0.02 to 10) kHz Depth: (0 to 99) %	(0.15 to 10) MHz	3.5 % + 1 digit	
Rate: (0.05 to 10) kHz Depth: (5 to 99) %	(0.01 to 1.3) GHz	1.2 % + 1 digit	
Rate: (0.02 to 10) kHz Depth: (0 to 99) %	(0.01 to 1.3) GHz	3.5 % + 1 digit	
Rate: (0.05 to 10) kHz Depth: (5 to 99) %	(1.3 to 26.5) GHz	1.8 % + 1 digit	
Rate: (0.02 to 10) kHz Depth: (0 to 99) %	(1.3 to 26.5) GHz	3.5 % + 1 digit	
Phase Modulation <sup>3</sup> – Measure			
Rate: 200 Hz to 10 kHz	$f_c$ (0.15 to 10) MHz	3.5 % + 1 digit	HP 8902A
Rate: 200 Hz to 20 kHz	$f_c$ (0.01 to 26.5) GHz	3.5 % + 1 digit	HP 8902A w/ 11793A

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> (±)	Comments
Phase Noise <sup>3</sup> – Measure			
(5 to 250) MHz	1 Hz Offset 10 Hz Offset 100 Hz Offset 1 kHz Offset 10 kHz Offset 100 kHz Offset	3.5 dB 2.9 dB 2.7 dB 2.7 dB 2.5 dB 2.7 dB	HP 3048A w/ Fluke 96270A
(250 to 500) MHz	1 Hz Offset 10 Hz Offset 100 Hz Offset 1 kHz Offset 10 kHz Offset 100 kHz Offset	7.7 dB 3.7 dB 3.2 dB 2.6 dB 2.7 dB 2.4 dB	
(0.5 to 1) GHz	1 Hz Offset 10 Hz Offset 100 Hz Offset 1 kHz Offset 10 kHz Offset 100 kHz Offset	4.6 dB 3.1 dB 3.4 dB 2.8 dB 2.5 dB 2.5 dB	
(1 to 2) GHz	1 Hz Offset 10 Hz Offset 100 Hz Offset 1 kHz Offset 10 kHz Offset 100 kHz Offset	3.6 dB 3.6 dB 3.1 dB 2.6 dB 2.5 dB 2.5 dB	
(2 to 3.2) GHz	1 Hz Offset 10 Hz Offset 100 Hz Offset 1 kHz Offset 10 kHz Offset 100 kHz Offset	9.2 dB 11 dB 3.5 dB 2.9 dB 2.5 dB 3.0 dB	



Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> (±)	Comments	
Phase Noise <sup>3</sup> – Measure (cont)	(3.2 to 10) GHz	1 Hz Offset	13 dB	HP 3048A w/ Fluke 96270A
		10 Hz Offset	13 dB	
		100 Hz Offset	3.5 dB	
		1 kHz Offset	3.0 dB	
		10 kHz Offset	2.6 dB	
		100 kHz Offset	2.5 dB	
	(10 to 18) GHz	1 Hz Offset	7.6 dB	
		10 Hz Offset	12 dB	
		100 Hz Offset	3.1 dB	
		1 kHz Offset	2.7 dB	
		10 kHz Offset	5.5 dB	
		100 kHz Offset	2.5 dB	

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments	
Power Sensor <sup>3</sup> – Calibration Factors	(-10 to 20) dBm	(0.01 to 0.05) GHz	1.5 %	% = % of assigned calibration factor  Fluke 96270A – characterized microwave output w/ splitter VSWR = 1.0 Reference power sensors – HP 8481A  Reference power sensors – HP8481D
		(0.05 to 2) GHz	1.5 %	
		(2 to 4) GHz	1.7 %	
		(4 to 6) GHz	1.8 %	
		(6 to 8) GHz	1.9 %	
		(8 to 12) GHz	1.9 %	
		(12 to 13) GHz	2.2 %	
		(13 to 14) GHz	2.2 %	
		(14 to <18) GHz	2.2 %	
		18 GHz	2 %	
		(-70 to -20) dBm	(10 to 30) MHz	
	30 MHz to 4 GHz		2.0 %	
	(4 to 6) GHz		2.1 %	
	(6 to 8) GHz		2.1 %	
	(8 to 10) GHz		2.1 %	
	(10 to 12) GHz		2.3 %	
	(12 to 14) GHz		2.4 %	
	(14 to 15) GHz		2.4 %	
	(15 to 18) GHz	2.5 %		

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> ( $\pm$ )	Comments
Power Sensor <sup>3</sup> – Calibration Factors (cont)			
(-30 to 20) dBm	(100 to 500) kHz 500 kHz to 1 MHz (1 to 2) MHz (2 to 50) MHz (50 to 100) MHz (0.1 to 2) GHz (2 to 4) GHz (4 to 4.2) GHz	1.7 % 1.7 % 1.5 % 1.5 % 1.4 % 1.5 % 1.9 % 1.9 %	Fluke 96270A – characterized microwave output w/ splitter VSWR = 1.0 Reference power sensors – HP 8482A
(-30 to 20) dBm	50 MHz to 12 GHz (12 to 18) GHz (18 to 26.5) GHz	2.4 % 2.9 % 3.4 %	Reference power sensors – HP 8485A
Transmission Magnitude – Into 50 $\Omega$ , (S12, S21)			
(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	0.048 dB 0.037 dB 0.059 dB 0.07 dB 0.28 dB	HP 8722ES w/ 85052D
(10 to 0) dB (0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB	(2 to 8) GHz	0.06 dB 0.056 dB 0.079 dB 0.082 dB 0.094 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	0.071 dB 0.062 dB 0.088 dB 0.11 dB 0.095 dB	
(10 to 0) dB (0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB	(20 to 26.5) GHz	0.15 dB 0.14 dB 0.15 dB 0.15 dB 0.20 dB	

Parameter/Range	Frequency	CMC <sup>2, 6</sup> (±)	Comments
Reflection Coefficient – Into 50 Ω, (S11, S22)			
(0 to 1)	30 kHz to 1.2 GHz	0.004 ρ	HP 8753D
(0 to 0.5)	50 MHz to 20 GHz (20 to 26.5) GHz	0.016 ρ 0.021 ρ	HP 8722ES w/ 85052D
(0.5 to 0.75)	50 MHz to 20 GHz (20 to 26.5) GHz	0.013 ρ 0.021 ρ	
(0.75 to 1)	50 MHz to 20 GHz (20 to 26.5) GHz	0.017 ρ 0.030 ρ	

#### IV. Mechanical

Parameter/Equipment	Range	CMC <sup>2, 5, 11</sup> (±)	Comments
Pressure <sup>3</sup> – Measure and Measuring Equipment			
Pneumatic	(0 to 1) in·H <sub>2</sub> O (1 to 35) in·H <sub>2</sub> O	0.00017 in·H <sub>2</sub> O 0.01 %	Ruska 7250LP PK 654- WC
	(0 to 15) psia (-15 to 15) psia Up to 75 psia (75 to 150) psia Up to 300 psia (300 to 600) psia Up to 1500 psia	0.0021 psia 0.012 % 0.0089 psia 0.013 % 0.042 psia 0.012 % 0.18 psia	Mensor CPC6050
Hydraulic	(1500 to 3000) psia (1 to 30) kpsig	0.012 % 0.010 %	DHI PG7202



Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> ( $\pm$ )	Comments	
Force Gages and Load Cells <sup>3</sup>	(0 to 100) lb	0.012 lb	Class F weights	
	(100 to 500) lb	0.082 lb		
	(500 to 1000) lb	0.13 lb		
		(20 to 500) lbf	0.018 %	Interface gold 1600 series load cells w/ GSSYS software
		(500 to 1000) lbf	0.018 %	
		(1000 to 5000) lbf	0.018 %	
		(5000 to 10 000) lbf	0.018 %	
		(10 000 to 25 000) lbf	0.018 %	
(25 000 to 50 000) lbf		0.021 %		
(50 000 to 100 000) lbf	0.017 %			
Tachometers –				
Contact	(55 to 40 000) rpm	0.018 %	General dynamics H8224 and frequency counter	
Non-Contact	(0.01 to 600 000) fpm	0.0019 %	LED w/ frequency generator	

#### V. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2, 5, 11</sup> ( $\pm$ )	Comments
Temperature <sup>3</sup> – Measuring Equipment	(-197 to 0) °C	0.12 °C	Fluke 5626 PRT w/ Hart 1560 blackstack and temperature sources
	(0 to 20) °C	0.060 °C	
	(20 to 220) °C	0.080 °C	
	(220 to 660) °C	0.10 °C	
Temperature <sup>3</sup> – Measure	(-197 to 0) °C	0.07 °C	Fluke 5626 PRT w/ Hart 1560 blackstack and temperature sources
	(0 to 20) °C	0.06 °C	
	(20 to 220) °C	0.08 °C	
	(220 to 660) °C	0.10 °C	
Relative Humidity <sup>3</sup> – Measuring Equipment and Measure	(10 to 80) %	1.1 %	Humidity probe and humidity chambers

Parameter/Equipment	Range	CMC <sup>2, 5, 11</sup> (±)	Comments
Infrared Temperature – Measuring Equipment <sup>3</sup>	(-30 to -20) °C	1.9 °C	Hart 9133
	(-20 to 35) °C	0.93 °C	
	(35 to 100) °C	1.3 °C	Fluke 4181
	(100 to 200) °C	2.7 °C	
	(200 to 350) °C	4.6 °C	
	(350 to 500) °C	6.8 °C	
	(500 to 982) °C	1.2 % + 1 °C	Omega BB-4A

## VI. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2, 4, 11</sup> (±)	Comments
Stopwatches/Timers <sup>3</sup>	1 s to 24 hr	0.039 s/day	Helmut Klein 4500 Tinometer
Frequency – Generate <sup>3</sup>	10 MHz	0.11 Hz + 0.6R	HP 3325B w/ GPS
	DC to 1 kHz	0.12 mHz/Hz	Agilent 83630 w/ GPS
	(0.1 to 20) MHz	0.6 nHz/Hz	
	10 MHz to 26.5 GHz	64 pHz/Hz	
	(0.2 to 26.5) GHz	11 nHz/Hz	
Frequency – Measure	DC to 1 kHz	0.01 mHz/Hz	5313X w/ GPS
	(1 to 1000) kHz	0.29 nHz/Hz	
	(1 to 225) MHz	38 pHz/Hz	
	(0.2 to 26.5) GHz	1.2 nHz/Hz	5351B w/ GPS

Satellite Facility  
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 Austin, TX 78754  
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I. Dimensional

Parameter/Equipment	Range	CMC <sup>2, 4</sup> (±)	Comments
Micrometers, Depth Gages and Height Gages –			
Length	Up to 12 in (12 to 72) in	(30 + 1.7L) μin (28 + 1.8L) μin	Grade 2 gage blocks and surface plate
Flatness	Up to 1 in	5.8 μin	Optical flats
Calipers <sup>3</sup>	Up to 4 in (4 to 12) in (12 to 48) in	(58 + 2.3L) μin (67 + 5.4L) μin (110 + 8.0L) μin	Grade 2 gage blocks
Indicators	Up to 1 in	41 μin	Pratt & Whitney Model C

II. Electrical – DC/Low Frequency

Parameter/Range	Frequency	CMC <sup>2, 6</sup> (±)	Comments
AC Current – Generate <sup>3</sup>			
(29 to 329.99) 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	1.6 nA/μA + 78 nA 1.2 nA/μA + 78 nA 0.98 nA/μA + 78 nA 2.3 nA/μA + 0.12 μA 6.2 nA/μA + 0.16 μA 12 nA/μA + 0.31 μA	Fluke 5520A

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
AC Current – Generate <sup>3</sup> (cont)			
(0.33 to 3.2999) 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	1.6 μA/mA + 0.12 μA 1.0 μA/mA + 0.12 μA 0.79 μA/mA + 0.12 μA 1.6 μA/mA + 0.16 μA 4.0 μA/mA + 0.23 μA 7.8 μA/mA + 0.47 μA	Fluke 5520A
(3.3 to 32.999) 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	1.4 μA/mA + 1.6 μA 0.71 μA/mA + 1.6 μA 0.35 μA/mA + 1.6 μA 0.64 μA/mA + 1.6 μA 1.6 μA/mA + 2.3 μA 3.5 μA/mA + 3.1 μA	
(33 to 329.99) 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	1.5 μA/mA + 16 μA 0.71 μA/mA + 16 μA 0.34 μA/mA + 16 μA 0.79 μA/mA + 39 μA 1.6 μA/mA + 78 μA 3.2 μA/mA + 0.16 mA	
(0.33 to 1.099 99) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	1.4 mA/A + 0.078 mA 0.41 mA/A + 0.078 mA 4.7 mA/A + 0.78 mA 19 mA/A + 3.9 mA	
(1.1 to 2.999 99) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	1.4 mA/A + 78 μA 0.56 mA/A + 78 μA 4.7 mA/A + 0.78 mA 19 mA/A + 3.9 mA	
(3 to 10.9999) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.52 mA/A + 1.6 mA 0.81 mA/A + 1.6 mA 23 mA/A + 1.6 mA	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.96 mA/A + 3.9 mA 1.2 mA/A + 3.9 mA 23 mA/A + 3.9 mA	



Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
AC Voltage – Generate <sup>3</sup>			
(1.0 to 32.999) 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	0.63 mV/V + 4.7 μV 0.15 mV/V + 4.7 μV 0.19 mV/V + 4.7 μV 0.80 mV/V + 4.7 μV 2.7 mV/V + 9.3 μV 6.2 mV/V + 39 μV	Fluke 5520A
(33 to 329.999) 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	0.23 mV/V + 6.2 μV 0.12 mV/V + 6.2 μV 0.13 mV/V + 6.2 μV 0.28 mV/V + 6.2 μV 0.63 mV/V + 25 μV 1.6 mV/V + 54 μV	
(0.33 to 3.299 99) 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	0.23 mV/V + 39 μV 0.12 mV/V + 47 μV 0.15 mV/V + 47 μV 0.24 mV/V + 39 μV 0.55 mV/V + 97 μV 1.9 mV/V + 0.47 mV	
(3.3 to 32.9999) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.23 mV/V + 0.50 mV 0.12 mV/V + 0.47 mV 0.19 mV/V + 0.47 mV 0.27 mV/V + 0.47 mV 0.7 mV/V + 1.2 mV	
(33 to 329.999) V	45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.15 mV/V + 1.6 mV 0.16 mV/V + 4.7 mV 0.44 mV/V + 4.7 mV 0.25 mV/V + 4.7 mV 1.6 mV/V + 39 mV	
330 V to 1020 V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.23 mV/V + 7.8 mV 0.20 mV/V + 7.8 mV 0.23 mV/V + 7.8 mV	

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
AC Voltage – Generate <sup>3</sup> (cont)			
(33 to 329.999) 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	0.23 mV/V + 6.2 μV 0.12 mV/V + 6.2 μV 0.13 mV/V + 6.2 μV 0.28 mV/V + 6.2 μV 0.63 mV/V + 25 μV 1.6 mV/V + 54 μV	Fluke 5522A
(0.33 to 3.299 99) 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	0.23 mV/V + 39 μV 0.12 mV/V + 47 μV 0.15 mV/V + 47 μV 0.24 mV/V + 39 μV 0.55 mV/V + 97 μV 1.9 mV/V + 0.47 mV	
(3.3 to 32.9999) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.23 mV/V + 0.50 mV 0.12 mV/V + 0.47 mV 0.19 mV/V + 0.47 mV 0.27 mV/V + 0.47 mV 0.7 mV/V + 1.2 mV	
(33 to 329.999) V	45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.15 mV/V + 1.6 mV 0.16 mV/V + 4.7 mV 0.44 mV/V + 4.7 mV 0.25 mV/V + 4.7 mV 1.6 mV/V + 39 mV	
330 V to 1020 V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.23 mV/V + 7.8 mV 0.20 mV/V + 7.8 mV 0.23 mV/V + 7.8 mV	
Capacitance – Generate <sup>3</sup>			
(220 to 399.9) pF (0.4 to 1.0999) nF (1.1 to 3.2999) nF (3.3 to 10.9999) nF (11 to 32.9999) nF (33 to 109.999) nF (110 to 329.999) nF (0.33 to 1.099 99) μF (1.1 to 3.299 99) μF (3.3 to 10.9999) μF (11 to 32.9999) μF (33 to 109.999) μF (110 to 329.999) μF	10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (DC to 50) Hz	5.6 fF/pF + 7.8 pF 4.3 pF/nF + 7.8 pF 4.1 pF/nF + 7.8 pF 2.0 pF/nF + 7.8 pF 2.0 pF/nF + 78 pF 2.0 pF/nF + 78 pF 2.1 pF/nF + 0.23 nF 2.0 nF/μF + 0.78 nF 2.0 nF/μF + 2.3 nF 2.1 nF/μF + 7.8 nF 3.2 nF/μF + 23 nF 3.7 nF/μF + 78 nF 3.7 nF/μF + 0.23 μF	Fluke 5522A

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
Capacitance – Generate <sup>3</sup> (cont)			
(0.33 to 1.099 99) mF	(DC to 20) Hz	3.7 μF/mF + 0.78 μF	Fluke 5522A
(1.1 to 3.299 99) mF	(DC to 6) Hz	3.5 μF/mF + 2.3 μF	
(3.3 to 10.9999) mF	(DC to 2) Hz	3.5 μF/mF + 7.8 μF	
(11 to 32.9999) mF	(DC to 0.6) Hz	5.8 μF/mF + 23 μF	
(33 to 110) mF	(DC to 0.2) Hz	8.5 μF/mF + 78 μF	

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
DC Current – Generate <sup>3</sup>	(0 to 329.999) μA (0 to 3.299 99) mA (0 to 32.9999) mA (0 to 329.999) mA (0 to 1.099 99) A (1.1 to 2.999 99) A (0 to 10.9999) A (11 to 20.5) A	120 μA/A + 16 nA 78 μA/A + 39 nA 78 μA/A + 0.19 μA 80 μA/A + 1.9 μA 0.16 mA/A + 31 μA 0.3 mA/A + 31 μA 0.39 mA/A + 0.39 mA 0.78 mA/A + 0.58 mA	Fluke 5520A
DC Voltage – Generate <sup>3</sup>	(0 to 329.9999) mV (0 to 3.299 999) V (0 to 32.999 99) V (30 to 329.9999) V (100 to 1000.000) V	18 μV/V + 0.78 μV 12 μV/V + 1.6 μV 12 μV/V + 16 μV 16 μV/V + 0.12 mV 16 μV/V + 1.2 mV	Fluke 5520A
DC Resistance- Generate <sup>3</sup>	(0 to 10.9999) Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω (0.33 to 1.0999 99) 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

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Calibration 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 5522A
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 1 000) °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 1 200) °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 1 300) °C	0.31 °C 0.17 °C 0.15 °C 0.14 °C 0.21 °C	

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> ( $\pm$ )	Comments
Electrical Calibration of Thermocouple Indicators <sup>3</sup> (cont)			Fluke 5522A
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	
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	
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	
Oscilloscope –			Fluke 552XA SC1100
Voltage – DC 50 $\Omega$ 1 M $\Omega$	(0 to 6.6) V (0 to 130) V	1.9 mV/V + 24 $\mu$ V 0.37 mV/V + 24 $\mu$ V	
Squarewave @ 1 kHz 50 $\Omega$ 1 M $\Omega$	1 mV to 6.6 V 1 mV to 130 V	1.9 mV/V + 24 $\mu$ V 0.78 mV/V + 24 $\mu$ V	
Bandwidth <sup>3</sup>	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	3.0 % + 78 $\mu$ V 3.4 % + 78 $\mu$ V 4.3 % + 78 $\mu$ V 4.9 % + 78 $\mu$ V	
Time Marker	50 ms to 5 s 1 ns to 20 ms Non-Cardinal Points	7.8 ms/s + 0.0019 % 6.2 $\mu$ s/s 39 $\mu$ s/s	

Parameter/Equipment	Range	CMC <sup>2,6</sup> ( $\pm$ )	Comments
Oscilloscope – (cont)			
Rise Time – Generate Transition Time w/Rep Rate <2 MHz	(200 to 300) ps Actual Value from Calibration Report	19 ps	Fluke 552XA SC1100
Transition Time w/Rep Rate (2 to 10) MHz	(250 to 350) ps Actual Value from Calibration Report	19 ps	
Input Resistance – Measure	(40 to 90) $\Omega$ (0.6 to 1.5) M $\Omega$	0.79 m $\Omega/\Omega$ 0.79 m $\Omega/\Omega$	
DC Voltage – Measure <sup>3</sup>	(0 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1100) V	5.9 $\mu\text{V}/\text{V} + 0.23 \mu\text{V}$ 3.5 $\mu\text{V}/\text{V} + 0.23 \mu\text{V}$ 3.4 $\mu\text{V}/\text{V} + 0.39 \mu\text{V}$ 4.9 $\mu\text{V}/\text{V} + 23 \mu\text{V}$ 5.0 $\mu\text{V}/\text{V} + 78 \mu\text{V}$	HP 3458A OPT 002
DC Resistance – Measure <sup>3</sup>	Up to 10 $\Omega$ (10 to 100) $\Omega$ (0.1 to 1) k $\Omega$ (1 to 10) k $\Omega$ (10 to 100) k $\Omega$ (0.1 to 1) M $\Omega$ (1 to 10) M $\Omega$ (10 to 100) M $\Omega$ (0.1 to 1) G $\Omega$	15 $\mu\Omega/\Omega + 50 \mu\Omega$ 12 $\mu\Omega/\Omega + 0.50 \text{m}\Omega$ 10 $\mu\Omega/\Omega + 0.50 \text{m}\Omega$ 10 $\mu\Omega/\Omega + 5.0 \text{m}\Omega$ 11 $\mu\Omega/\Omega + 50 \text{m}\Omega$ 16 $\mu\Omega/\Omega + 2.0 \Omega$ 51 $\mu\Omega/\Omega + 100 \Omega$ 0.51 m $\Omega/\Omega + 1.0 \text{k}\Omega$ 5.6 m $\Omega/\Omega + 10 \text{k}\Omega$	HP 3458A
DC Current – Measure <sup>3</sup>	(0 to 100) nA (0.1 to 1) $\mu\text{A}$ (1 to 10) $\mu\text{A}$ (10 to 100) $\mu\text{A}$ (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A  (1 to 20) A	67 $\mu\text{A}/\text{A} + 40 \text{pA}$ 34 $\mu\text{A}/\text{A} + 40 \text{pA}$ 20 $\mu\text{A}/\text{A} + 0.10 \text{nA}$ 22 $\mu\text{A}/\text{A} + 0.80 \text{nA}$ 23 $\mu\text{A}/\text{A} + 5.0 \text{nA}$ 22 $\mu\text{A}/\text{A} + 50 \text{nA}$ 42 $\mu\text{A}/\text{A} + 500 \text{nA}$ 110 $\mu\text{A}/\text{A} + 10 \mu\text{A}$  56 $\mu\text{A}/\text{A}$	HP 3458A         Y5020 w/3458A

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
AC Voltage – Measure <sup>3</sup>			
Up 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 kHz to 1 MHz	0.43 μV/mV + 3.0 μV 0.22 μV/mV + 1.1 μV 0.32 μV/mV + 1.1 μV 1.0 μV/mV + 1.1 μV 5.0 μV/mV + 1.1 μV 40 μV/mV + 5.0 μV	HP 3458A, synchronous sub-sampled mode
(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 (0.3 to 1) MHz	0.30 μV/mV + 4.0 μV 0.10 μV/mV + 2.0 μV 0.15 μV/mV + 2.0 μV 0.32 μV/mV + 2.0 μV 0.81 μV/mV + 2.0 μV 3.0 μV/mV + 10 μV 10 μV/mV + 10 μV	
(0.1 to 1) 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 (0.3 to 1) MHz	0.28 mV/V + 40 μV 87 μV/V + 20 μV 0.15 mV/V + 20 μV 0.32 mV/V + 20 μV 0.81 mV/V + 20 μV 3.0 mV/V + 0.10 mV 10 mV/V + 0.10 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 (0.3 to 1) MHz	0.28 mV/V + 0.40 mV 86 μV/V + 0.20 mV 0.15 mV/V + 0.20 mV 0.32 mV/V + 0.20 mV 0.81 mV/V + 0.20 mV 3.0 mV/V + 1.0 mV 10 mV/V + 1.0 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 (100 to 300) kHz (0.3 to 1) MHz	0.34 mV/V + 4.0 mV 0.21 mV/V + 2.0 mV 0.21 mV/V + 2.0 mV 0.37 mV/V + 2.0 mV 1.2 mV/V + 2.0 mV 4.0 mV/V + 10 mV 15 mV/V + 10 mV	
(100 to 700) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.49 mV/V + 40 mV 0.40 mV/V + 20 mV 0.60 mV/V + 20 mV 1.2 mV/V + 20 mV 3.0 mV/V + 20 mV	

Parameter/Range	Frequency	CMC <sup>2,6</sup> (±)	Comments
AC Current – Measure <sup>3</sup>			
(10 to 100) µA	(10 to 20) Hz (20 to 45) Hz (45 to 5) kHz	3.1 nA/µA + 23 nA 1.2 nA/µA + 23 nA 0.49 nA/µA + 23 nA	HP 3458A
(0.1 to 1) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz	3.1 µA/mA + 0.16 µA 1.2 µA/mA + 0.16 µA 0.52 µA/mA + 0.16 µA 0.28 µA/mA + 0.16 µA	
(1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz	3.1 µA/mA + 1.6 µA 1.2 µA/mA + 1.6 µA 0.49 µA/mA + 1.6 µA 0.28 µA/mA + 1.6 µA	
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz	3.1 µA/mA + 16 µA 1.2 µA/mA + 16 µA 0.49 µA/mA + 16 µA 0.28 µA/mA + 16 µA	
(0.1 to 1) A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz	3.1 mA/A + 0.16 mA 1.3 mA/A + 0.16 mA 0.69 mA/A + 0.16 mA 0.83 mA/A + 0.16 mA	
(1 to 20) A	55 Hz to 1 kHz (1 to 5) kHz	0.42 mA/A 0.92 mA/A	Y5020 w/ 3458A

### III. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2,11</sup> (±)	Comments
Frequency – Measure	0.001 Hz to 1 kHz (1 to 1000) kHz (1 to 225) MHz	0.22 mHz/Hz 1.8 µHz/Hz 0.18 µHz/Hz	HP 53132A
Frequency – Measuring Equipment	0.1 Hz to 80 MHz	0.11 µHz/Hz	HP 33250A w/ 53132A

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



- <sup>2</sup> Calibration and Measurement Capability Uncertainty 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 of 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 CMC of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device, to the environment and to influences from the circumstances of the specific calibration.
- <sup>3</sup> Field calibration service is available for this calibration and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. Please note the uncertainties achievable on a customer's site can normally be expected to be larger than the Calibration and Measurement Capability Uncertainty (CMC) that the accredited laboratory has been assigned 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 uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the calibration uncertainty being larger than the BMC.
- <sup>4</sup> In the statement of CMC,  $L$  is the numerical value of the nominal length of the device measured in inches;  $D$  is the diameter of the device in inches;  $R$  is the resolution of the unit under test.
- <sup>5</sup> In the statement of CMC, percentages are to be read as percent of reading unless otherwise noted.
- <sup>6</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 value in the ranges indicated. CMC's 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>7</sup> Vector error magnitude and phase error are for modulation types: MSK, GMSK, BPSK, DQPSK,  $\Pi/4$ DQPSK, 8PSK, 16QAM, 32QAM, 64QAM, 128QAM, and 256QAM unless otherwise stated.
- <sup>8</sup> CMC uncertainties at frequencies other than 1 kHz are calculated using the 1689 Limits of Error Calculation Tool ([www.ietlabs.com](http://www.ietlabs.com))
- <sup>9</sup> The CMC uncertainty claim is smaller than that of the expanded CMC uncertainty claim by NIST as listed in the BIPM KCDB. A2LA has evaluated the laboratory CMC uncertainty claim and has verified this information to be correct and appropriate.
- <sup>10</sup> This scope meets A2LA's *P112 Flexible Scope Policy*.
- <sup>11</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.**

*Irving, TX*

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/NCSL 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 22<sup>nd</sup> day of January 2020.

A blue ink signature of the Vice President of Accreditation Services.

Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 2357.18  
Valid to April 30, 2022

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