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

TEKTRONIX, INC
4570 River Green Parkway Ste 100
Duluth, GA 30096
Catherine Prendiville Phone: 770 813 2269

CALIBRATION

Valid To: March 31, 2024 Certificate Number: 2357.19

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations[1, 9]:

I. Dimensional

Parameter/Equipment	Range	CMC[2, 6] (±)	Comments
Micrometers – Inside, Outside, Depth[3]			
Length	Up to 4 in (4 to 12) in (12 to 48) in	(7.6 + 2.6*L*) µin (25 + 2.6*L*) µin (11 + 3.7*L*) µin	Grade 0 gage blocks & surface plate
Flatness	Up to 1 in	4.9 µin/in	
Parallelism	Up to 1 in	10 µin/in	
Calipers[3]	Up to 4 in (4 to 12) in (12 to 48) in	(58 + 2.8*L*) µin (39 + 7.6*L*) µin (23 + 8.9*L*) µin	Grade 0 gage blocks & surface plate
Indicators[3]	Up to 4 in (4 to 12) in (12 to 48) in Up to 1 in	(14 + 1.0*L*) µin (3.5 + 3.6*L*) µin (6.0 + 3.4*L*) µin 68 µin	Grade 0 gage blocks & surface plate or universal calibrator Starrett 716
Height Gages[3]	Up to 4 in (4 to 12) in (12 to 48) in	(59 + 0.25*L*) µin (53 + 1.8*L*) µin (39 + 2.9*L*) µin	Grade 0 gage blocks & surface plate
Dial Indicator Calibrators[3]	Up to 1 in	11 µin	Grade 0 gage blocks

Parameter/Equipment	Range	CMC[2, 6] (±)	Comments
Rulers & Tape Measures[3]	Up to 400 ft	(14 + 22*L*) µin	Optical comparator
Surface Plate Flatness[3] (Flatness Only)	Up to 157 in diagonal length	(6.6 + 2.0*D*) µin	Mahr leveling system, *D* is for the diagonal length of surface plate in inches
Optical Comparators[3] –			
X/Y – Length	Up to 6 in	(86 + 4.5*L*) µin	Gage blocks
Angle	(0 to 45)°	0.0023°	Angle block set
Magnification	10x 20x	85 µin 86 µin	Magnification checker
Angle Measuring Equipment –Protractors, Levels, Inclinometers[3]	(0 to 360)°	0.012°	Sine plate Grade 0 gage blocks parallel set
Angle – Measure[3]	(0 to 360)°	0.20°	Optical comparator
Electronic Amplifiers[3]	Up to 0.02 in	7.7 µin	Grade 0 gage blocks
Radius Gauges	Up to 12 in	27 µin/in	Optical comparator

II. Dimensional Testing/Calibration[1]

Parameter/Equipment	Range	CMC[2, 6, 8] (±)	Comments
Length[3] – 1D Measure	(0.05 to 4) in (4 to 12) in (12 to 48) in	(66 + 0.25*L*) µin (60 + 1.8*L*) µin (41 + 3.3*L*) µin	Gage blocks, electronic gage amplifier

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Voltage – Generate[3]	(0 to 220) mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V (1 to 120) kV	8.3 µV/V + 0.62 µV 6.7 µV/V + 0.93 µV 6.7 µV/V + 3.1 µV 6.7 µV/V + 6.2 µV 7.4 µV/V + 78 µV 8.9 µV/V + 0.47 mV 0.19 mV/V	Fluke 5720A Ross VD120/34401
DC Voltage – Measure[3]	(0 to 200) mV (0.2 to 2) V (2 to 20) V (20 to 200) V (200 to 1050) V (1 to 120) kV	5.2 µV/V + 93 nV 3.6 µV/V + 0.39 µV 3.6 µV/V + 3.9 µV 5.5 µV/V + 39 µV 5.5 µV/V + 0.49 mV 0.19 mV/V	Fluke 8508A Ross VD120/34401
DC Current – Measure[3]	(0 to 100) nA (0.1 to 1) µA (1 to 10) µA (10 to 200) µA 200 µA to 2 mA (2 to 20) mA (20 to 200) mA 200 mA to 2 A (2 to 20) A (0 to 20) A (1 to 15) A (15 to 100) A	66 µA/A + 31 pA 32 µA/A + 31 pA 16 µA/A + 78 pA 13 µA/A + 0.31 nA 13 µA/A + 3.1 nA 15 µA/A + 31 nA 47 µA/A + 0.62 µA 0.18 mA/A + 12 µA 0.43 mA/A + 0.31 mA 27 µA/A 2.0 mA/A + 7.8 µA 2.1 mA/A + 78 µA	HP 3458A Fluke 8508A Fluke Y5020/8508A Fluke 8508A & Guildline 9211A

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Current – Generate[3]	Up to 220 µA 220 mA to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A (11 to 20.5) A Up to 100 A Up to 150 A (150 to 1025) A	39 µA/A + 5.4 nA 31 µA/A + 6.2 nA 32 µA/A + 39 nA 39 µA/A + 0.62 µA 71 µA/A + 12 µA 0.28 mA/A + 0.37 mA 0.63 mA/A + 0.58 mA 0.70 mA/A 3.9 mA/A + 0.11 mA 3.9 mA/A + 0.39 mA	Fluke 5720A Fluke 5720A/5725A Fluke 5522A Valhalla 2555A 5522A w/ 50 turn coil
DC Resistance – Measure[3]	(0 to 2) Ω (2 to 20) Ω (20 to 200) Ω (0.2 to 2) kΩ (2 to 20) kΩ (2 to 200) kΩ (0.2 to 2) MΩ (2 to 20) MΩ (20 to 200) MΩ (0.2 to 2) GΩ (2 to 20) GΩ	19 µΩ/Ω + 4.0 µΩ 11 µΩ/Ω + 14 µΩ 10 µΩ/Ω + 50 µΩ 8.1 µΩ/Ω + 0.50 mΩ 8.1 µΩ/Ω + 5.0 mΩ 9.6 µΩ/Ω + 50 mΩ 11 µΩ/Ω + 1.0 Ω 35 µΩ/Ω + 10 Ω 98 µΩ/Ω + 1 kΩ 0.49 mΩ/Ω + 0.10 MΩ 1.5 mΩ/Ω + 10 MΩ	Fluke 8508A: True ohms mode Normal mode High voltage mode
DC Resistance[3] – Generate	(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 1.0999 99) 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	38 µΩ/Ω + 0.78 mΩ 28 µΩ/Ω + 1.2 mΩ 24 µΩ/Ω + 1.1 mΩ 24 µΩ/Ω + 1.6 mΩ 23 µΩ/Ω + 1.6 mΩ 24 µΩ/Ω + 16 mΩ 23 µΩ/Ω + 16 mΩ 22 µΩ/Ω + 0.16 Ω 22 µΩ/Ω + 0.16 Ω 25 µΩ/Ω + 1.6 Ω 28 µΩ/Ω + 1.6 Ω 48 µΩ/Ω + 23 Ω 0.11 mΩ/Ω + 39 Ω 0.20 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 5522A

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Resistance[3] – Generate (cont)	Up to 20 mΩ (>20 to 100) mΩ (>100 to 1010) mΩ (>1.01 to 10.01) Ω (>10.01 to 100.01) Ω (>100.01 to 1000.01) Ω (>1.01 to 10) kΩ (>10 to 100) kΩ (>100 to 1100) kΩ	42 mΩ/Ω + 0.58 mΩ 7.8 mΩ/Ω + 0.58 mΩ 0.88 mΩ/Ω + 0.58 mΩ 0.11 mΩ/Ω + 0.58 mΩ 49 µΩ/Ω + 0.58 mΩ 22 µΩ/Ω + 0.58 mΩ 20 µΩ/Ω 56 µΩ/Ω 14 µΩ/Ω	ESI RS925D
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	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 1.2 Ω 2.2 Ω 20 Ω 38 Ω 0.37 kΩ 0.84 kΩ 12 kΩ	Fluke 5720A
	0.000333 Ω 0.001 Ω 0.01 Ω 0.1 Ω 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ	12 µΩ 2.4 µΩ 0.32 µΩ 28 µΩ 12 µΩ 0.19 mΩ 5.1 mΩ 13 mΩ 0.12 Ω 2.6 Ω 11 Ω 0.54 kΩ	Guildline 9211A L&N 4223B L&N 4222B Guildline 9330-0.1 L&N 4210 Guildline 9330-10 L&N 4030B L&N 4035B L&N 4040B L&N 4045B Guildline 9330-1M Guildline 9330-10M

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Resistance[3] – Generate (cont)	(10 to 100) MΩ (100 to 1000) MΩ (1 to 10) GΩ (10 to 100) GΩ (100 to 1000) GΩ	0.12 % 0.23 % 0.58 % 1.2 % 1.2 %	HRRS-B-7-100k-5kV
DC Power – Generate[3] 33 mV to 1020 V (0.33 to 330) mA (0.33 to 3) A (3 to 20.5) A	 0.01 mW to 337 W (0.01 to 3060) W (3060 to 20 910) W	 0.018 % 0.017 % 0.057 %	 Fluke 5522A

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
Phase – Generate[3] 0° to 360° 50 mV to 120 V	 1:1 to 1 kHz 1:1 to 5 kHz 1:1 to 50 kHz 1:1 to 100 kHz 10:1 to 1 kHz 10:1 to 5 kHz 10:1 to 50 kHz 10:1 to 100 kHz 100:1 to 1 kHz 100:1 to 5 kHz 100:1 to 50 kHz 100:1 to 100 kHz	 6.6 m° 6.6 m° 12 m° 47 m° 6.6 m° 12 m° 18 m° 47 m° 6.6 m° 12 m° 18 m° 47 m°	 Clark-Hess 5500 phase generator
0°, 180° 50 mV to 100 V Bridge A	 100 Hz 10 kHz 50 kHz 200 kHz	 2.2 m° 4.2 m° 4.8 m° 11 m°	 Clark-Hess 5002A-D phase verification bridge
0°, 180° 50 mV to 100 V Bridge B	 100 Hz 1 kHz 10 kHz 50 kHz 200 kHz	 2.4 m° 0.58 m° 4.2 m° 4.4 m° 10 m°	 Clark-Hess 5002A-D phase verification bridge

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
Phase – Generate[3] (cont)			
0°, 180°			
50 mV to 100 V			
Bridge C	100 Hz	2.6 m°	Clark-Hess 5002A-D phase verification bridge
	1 kHz	5.0 m°	
	10 kHz	6.1 m°	
	50 kHz	7.2 m°	
	200 kHz	10 m°	
Bridge D	100 Hz	3.2 m°	
	1 kHz	6.8 m°	
	10 kHz	4.8 m°	
	50 kHz	4.7 m°	
	200 kHz	15 m°	
Phase – Measure[3]			
0° to 360°			
(10 to 20) mV	(5 to 10) Hz	46 m°/Hz	Clarke-Hess 6000
	>10 Hz to 50 kHz	2.4 µ°/Hz	
	(> 50 to 100) kHz	1.3 µ°/Hz	
	(> 100 to 500) kHz	0.70 µ°/Hz	
>20 mV to 350 V	(5 to 10) Hz	23 m°/Hz	
	>10 Hz to 50 kHz	1.3 µ°/Hz	
	(> 50 to 100) kHz	0.76 µ°/Hz	
	(> 100 to 500) kHz	0.36 µ°/Hz	
AC Voltage – Generate[3]			
(0 to 2.2) mV	(10 to 20) Hz	0.53 mV/V + 3.9 µV	Fluke 5720A
	(20 to 40) Hz	0.48 mV/V + 3.9 µV	
	40 Hz to 20 kHz	0.46 mV/V + 3.9 µV	
	(20 to 50) kHz	0.53 mV/V + 3.9 µV	
	(50 to 100) kHz	0.85 mV/V + 4.7 µV	
	(100 to 300) kHz	1.2 mV/V + 9.3 µV	
	(300 to 500) kHz	1.7 mV/V + 19 µV	
	(0.5 to 1) MHz	3.0 mV/V + 19 µV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate[3] (cont)			
(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	0.25 mV/V + 3.9 µV 0.12 mV/V + 3.9 µV 0.11 mV/V + 3.9 µV 0.21 mV/V + 3.9 µV 0.48 mV/V + 4.7 µV 1.0 mV/V + 9.3 µV 1.3 mV/V + 19 µV 2.7 mV/V + 19 µV	Fluke 5720A
(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	0.36 mV/V + 12 µV 93 µV/V + 6.2 µV 80 µV/V + 6.2 µV 0.20 mV/V + 6.2 µV 0.47 mV/V + 16 µV 0.85 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	0.49 mV/V + 39 µV 86 µV/V + 16 µV 42 µV/V + 7.8 µV 71 µV/V + 9.3 µV 0.12 mV/V + 31 µV 0.39 mV/V + 78 µV 0.93 mV/V + 0.19 mV 1.6 mV/V + 0.47 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	0.37 mV/V + 0.39 mV 91 µV/V + 0.16 mV 42 µV/V + 54 µV 71 µV/V + 93 µV 94 µV/V + 0.19 mV 0.25 mV/V + 0.62 mV 0.93 mV/V + 1.9 mV 1.4 mV/V + 3.1 mV	
(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	0.43 mV/V + 3.9 mV 87 µV/V + 1.6 mV 52 µV/V + 0.54 mV 79 µV/V + 0.93 mV 0.14 mV/V + 2.3 mV 0.85 mV/V + 16 mV 4.2 mV/V + 39 mV 7.8 mV/V + 78 mV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate[3] (cont)			
(220 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz	0.28 mV/V + 16 mV 71 µV/V + 3.1 mV	Fluke 5720A
(220 to 1100) V	40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	82 µV/V + 3.1 mV 0.14 mV/V + 4.7 mV 0.49 mV/V + 8.5 mV	Fluke 5720A w/ 5725A
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.49 mV/V + 8.5 mV 1.9 mV/V + 35 mV	
Absolute:			
(0 to 1.1) mV	30 Hz to 500 kHz	6.4 mV/V + 1.6 µV	Fluke 5720A wideband
(1.1 to 3) mV		5.5 mV/V + 2.3 µV	
(3 to 11) mV		5.4 mV/V + 6.2 µV	
(11 to 33) mV		4.7 mV/V + 12 µV	
(33 to 110) mV		4.7 mV/V + 31 µV	
(110 to 330) mV		3.9 mV/V + 78 µV	
(0.33 to 1.1) V		3.9 mV/V + 0.31 mV	
(1.1 to 3.5) V		3.1 mV/V + 0.39 mV	
Flatness:			
Up 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	2.8 mV/V 0.95 mV/V 1.6 mV/V + 2.3 µV 3.4 mV/V + 2.3 µV 5.2 mV/V + 2.3 µV 12 mV/V + 12 µV	
(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	2.6 mV/V 0.88 mV/V 0.88 mV/V + 2.3 µV 1.8 mV/V + 2.3 µV 4.1 mV/V + 2.3 µV 12 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	2.6 mV/V 0.88 mV/V 0.88 mV/V + 2.3 µV 1.7 mV/V + 2.3 µV 3.3 mV/V + 2.3 µV 8.0 mV/V + 2.3 µV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate[3] (cont)			
(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	2.6 mV/V 0.88 mV/V 0.88 mV/V + 2.3 µV 1.7 mV/V + 2.3 µV 3.3 mV/V + 2.3 µV 8.0 mV/V + 2.3 µV	Fluke 5720A wideband
(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	2.5 mV/V 0.85 mV/V 0.85 mV/V + 2.3 µV 1.7 mV/V + 2.3 µV 3.3 mV/V + 2.3 µV 8.0 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	2.5 mV/V 0.82 mV/V 0.82 mV/V + 2.3 µV 1.7 mV/V + 2.3 µV 3.3 mV/V + 2.3 µV 8.0 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	2.4 mV/V 0.82 mV/V 0.82 mV/V + 2.3 µV 1.7 mV/V + 2.3 µV 3.3 mV/V + 2.3 µV 8.0 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 0.82 mV/V 0.82 mV/V + 2.3 µV 1.7 mV/V + 2.3 µV 3.3 mV/V + 2.3 µV 8.0 mV/V + 2.3 µV	
(1 to 50) kV	60 Hz	4.5 mV/V	Ross VD120/34401A

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Measure[3]			
(0 to 2.2) mV	(1 to 10) Hz (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 + 3.5 µV 1.3 mV/V + 1.0 µV 0.61 mV/V + 1.0 µV 0.38 mV/V + 1.0 µV 0.66 mV/V + 1.6 µV 0.96 mV/V + 1.9 µV 1.8 mV/V + 3.1 µV 1.9 mV/V + 6.2 µV 3 mV/V + 6.2 µV	HP 3458A, Fluke 8508 or Fluke 5790A
(2.2 to 7) mV	(1 to 10) Hz (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 + 3.5 µV 0.66 mV/V + 1.0 µV 0.30 mV/V + 1.0 µV 0.18 mV/V + 1.0 µV 0.32 mV/V + 1.6 µV 0.47 mV/V + 1.9 µV 0.95 mV/V + 3.1 µV 1 mV/V + 6.2 µV 1.6 mV/V + 6.2 µV	
(7 to 22) mV	(1 to 10) Hz (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 + 4.6 µV 0.24 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 + 1.9 µV 0.66 mV/V + 3.1 µV 0.73 mV/V + 6.2 µV 1.4 mV/V + 6.2 µV	
(22 to 70) mV	(1 to 10) Hz (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 + 4.6 µV 0.15 mV/V + 5.0 µV 0.11 mV/V + 1.2 µV 73 µV/V + 1.2 µV 0.12 mV/V + 1.6 µV 0.25 mV/V + 1.9 µV 0.48 mV/V + 3.1 µV 0.63 mV/V + 6.2 µV 0.95 mV/V + 6.2 µV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Measure[3] (cont)			
(70 to 200) mV	(1 to 10) Hz (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	0.10 mV/V + 46 µV 0.15 mV/V + 5.0 µV 70 µV/V + 1.2 µV 35 µV/V + 1.2 µV 67 µV/V + 1.6 µV 0.15 mV/V + 1.9 µV 0.23 mV/V + 3.1 µV 0.32 mV/V + 6.2 µV 0.81 mV/V + 6.2 µV	HP 3458A, Fluke 8508 or Fluke 5790A
(200 to 700) mV	(1 to 10) Hz (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	0.10 mV/V + 46 µV 0.11 mV/V + 24 µV 69 µV/V + 1.2 µV 28 µV/V + 1.2 µV 45 µV/V + 1.6 µV 65 µV/V + 1.9 µV 0.17 mV/V + 3.1 µV 0.24 mV/V + 6.2 µV 0.76 mV/V + 6.2 µV	
(0.7 to 1) V	(1 to 10) Hz (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	0.10 mV/V + 46 µV 0.11 mV/V + 24 µV 62 µV/V 22 µV/V 42 µV/V 60 µV/V 0.16 mV/V 0.22 mV/V 0.71 mV/V	
(1 to 2) V	(1 to 10) Hz (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	99 µV/V + 0.46 mV 0.11 mV/V + 24 µV 62 µV/V 22 µV/V 42 µV/V 60 µV/V 0.16 mV/V 0.22 mV/V 0.71 mV/V	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Measure[3] (cont)			
(2 to 7) V	(1 to 10) Hz (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	99 µV/V + 0.46 mV 0.13 mV/V + 0.20 mV 57 µV/V 20 µV/V 43 µV/V 64 µV/V 0.17 mV/V 0.32 mV/V 0.96 mV/V	HP 3458A, Fluke 8508 or Fluke 5790A
(7 to 10) V	(1 to 10) Hz (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	99 µV/V + 0.46 mV 0.13 mV/V + 0.20 mV 57 µV/V 24 µV/V 39 µV/V 65 µV/V 0.17 mV/V 0.32 mV/V 0.96 mV/V	
(10 to 20) V	(1 to 10) Hz (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	0.24 mV/V + 4.6 mV 0.13 mV/V + 0.20 mV 57 µV/V 24 µV/V 39 µV/V 65 µV/V 0.17 mV/V 0.32 mV/V 0.96 mV/V	
(20 to 70) V	(1 to 10) Hz (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	0.24 mV/V + 4.6 mV 0.12 mV/V + 2.4 mV 57 µV/V 28 µV/V 54 µV/V 75 µV/V 0.17 mV/V 0.33 mV/V 0.96 mV/V	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Measure[3] (cont)			
(70 to 100) V	(1 to 10) Hz (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	0.24 mV/V + 4.6 mV 0.12 mV/V + 2.4 mV 58 µV/V 28 µV/V 56 µV/V 79 µV/V 0.18 mV/V 0.40 mV/V 8.1 mV/V + 2.4 mV	HP 3458A, Fluke 8508 or Fluke 5790A
(100 to 200) V	(1 to 10) Hz (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	0.47 mV/V + 46 mV 0.12 mV/V + 2.4 mV 58 µV/V 28 µV/V 56 µV/V 79 µV/V 0.18 mV/V 0.40 mV/V 8.1 mV/V + 2.4 mV	
(200 to 700) V	(1 to 10) Hz (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 + 80 mV 0.12 mV/V + 25 mV 80 µV/V 37 µV/V 0.11 mV/V 0.39 mV/V	
(700 to 1000) V	(1 to 10) Hz (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 + 80 mV 0.12 mV/V + 25 mV 80 µV/V 39 µV/V 0.11 mV/V 0.39 mV/V	
(1 to 85) kV	60 Hz	4.5 mV/V	Ross VD120/HP 34401A

Parameter/Equipment	Range	CMC[2, 4, 7] (±)	Comments
Oscilloscopes[3] –			
Amplitude – DC Signal			
Into 50 Ω Load	(0 to 6.0) V	0.19 mV/V + 19 µV	Fluke 9500 w/ 9530 or
Into 1 MΩ Load	(0 to 200) V	0.20 mV/V + 19 µV	9560 head
Amplitude – Square Wave	±1 mV to 6 V_{p-p}		
50 Ω Load	10 Hz to 100 kHz	0.81 mV/V + 7.8 µV	
	±1 mV to 200 V_{p-p}		
1 MΩ Load	10 Hz to 100 kHz	0.80 mV/V + 7.8 µV	
Bandwidth	0.1 Hz to 300 MHz	2.3 %	
	(300 to 550) MHz	2.6 %	
	(550 to 3000) MHz	3.3 %	
	(3000 to 6000) MHz	3.8 %	
	(6 to 18) GHz	3.2 %	83650 generator, splitter,
	(18 to 26.5) GHz	3.8 %	power meter/sensor
	(26.5 to 50) GHz	4.0 %	
Resistance	(40 to 90) Ω	0.80 mΩ/Ω	Fluke 9500 w/ 9560
	(0.8 to 1.2) MΩ	0.81 mΩ/Ω	
Time Markers	180 ps to 55 s	0.29 µs/s	

Parameter/Equipment	Range	CMC[2, 4, 7] (±)	Comments
AC Current – Generate[3]			
(0 to 220) µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.38 mA/A + 16 nA 0.17 mA/A + 10 nA 0.12 mA/A + 8.0 nA 0.28 mA/A + 12 nA 1.0 mA/A + 65 nA	Fluke 5720A/5725A
(0.22 to 2.2) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.34 mA/A + 40 nA 0.19 mA/A + 35 nA 0.15 mA/A + 35 nA 0.22 mA/A + 0.11µA 1.0 mA/A + 0.65 µA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.34 mA/A + 0.40 µA 0.17 mA/A + 0.35 µA 0.12 mA/A + 0.35 µA 0.20 mA/A + 0.55 µA 1.0 mA/A + 5.0 µA	
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.35 mA/A + 4 µA 0.17 mA/A + 3.5 µA 0.12 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 kHz (1 to 5) kHz (5 to 10) kHz	0.27 mA/A + 35 µA 0.41 mA/A + 80 µA 6.0 mA/A + 0.16 mA	
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.38 mA/A + 0.17 mA 0.76 mA/A + 0.38 mA 2.9 mA/A + 0.75 mA	Fluke 5720A/5725A
(11 to 20.5) A	(45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	0.98 mA/A + 3.9 mA 1.2 mA/A + 3.9 mA 23 mA/A + 3.9 mA	Fluke 5522A
(20 to 100) A	(10 to 100) Hz (100 to 400) Hz 400 Hz to 1 kHz	0.29 % 0.46 % 0.69 %	Fluke 5720A w/ Valhalla 2555A
Clamp On Only: Toroidal			
(16.5 to 150) A	(45 to 65) Hz (65 to 440) Hz	0.42 % 0.85 %	Fluke 5522A w/ coil
(150 to 1025) A	(45 to 65) Hz (65 to 440) Hz	0.38 % 0.84 %	
Non-Toroidal			
(16.5 to 150) A	(45 to 65) Hz (65 to 440) Hz	0.77 % 1.2 %	
(150 to 1025) A	(45 to 65) Hz (65 to 440) Hz	1.2 % 1.6 %	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Current – Measure[3]			
(0 to <200) µA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.79 mA/A + 20 nA 0.51 mA/A + 20 nA 0.66 mA/A + 20 nA 3.3 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 0.36 mA/A + 0.20 µA 0.69 mA/A + 0.20 µA 3.5 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 0.30 mA/A + 2.0 µA 0.65 mA/A + 2.0 µA 5.1 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 0.31 mA/A + 20 µA 0.93 mA/A + 20 µA	
(0.2 to < 2) A	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.59 mA/A + 0.20 mA 0.68 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	0.81 mA/A + 2.0 mA 2.0 mA/A + 2.0 mA	
(1 to 20) A	55 Hz to 1 kHz (1 to 5) kHz	0.12 mA/A 0.15 mA/A	Fluke Y5020/8508A
(20 to 100) A	60 Hz	6.8 µA/A	HP 3458A & L&N 4361
(0 to 200) A (0.2 to 2) kA (2 to 20) kA	60 Hz 60 Hz 60 Hz	0.12 mA/A 0.14 mA/A 0.15 mA/A	HP 3458A & Aya PS-Flex

Parameter/Equipment	Range	CMC[2, 4, 7] (±)	Comments
AC Power[3] – Generate, PF = (0 to 1)			
(10 to 45) Hz			
(33 to 329.99) mV			
(3.3 to 8.999) mA	(0.1089 to 2.9696) mW	0.14 %	Fluke 5522A
(9 to 32.999) mA	(0.297 to 10.8893) mW	0.15 %	
(33 to 89.99) mA	(1.089 to 29.6958) mW	0.039 %	
(90 to 329.99) mA	(2.97 to 108.8934) mW	0.040 %	
(330 to 899.9) mA	(10.89 to 296.958) mW	0.049 %	
(0.9 to 2.1999) A	(29.7 to 725.945) mW	0.052 %	
(2.2 to 4.4999) A	(72.6 to 1484.922) mW	0.069 %	
(4.5 to 20.5) A	148.5 mW to 6.7648 W	0.12 %	
330 mV to 1020 V			
(3.3 to 8.999) mA	1.089 mW to 9.179 W	0.15 %	
(9 to 32.999) mA	2.97 mW to 33.659 W	0.15 %	
(33 to 89.99) mA	10.89 mW to 91.7898 W	0.044 %	
(90 to 329.99) mA	(0.0297 to 336.5898) W	0.044 %	
(330 to 899.9) mA	(0.1089 to 917.898) W	0.053 %	
(0.9 to 2.1999) A	(0.297 to 2243.898) W	0.055 %	
(2.2 to 4.4999) A	(0.726 to 4589.898) W	0.072 %	
(4.5 to 20.5) A	1.485 W to 20.91 kW	0.12 %	
(45 to 65) Hz			
(**33 to 329.999**) **mV**			
(3.3 to 8.999) mA	(0.109 to 3.0) mW	0.23 %	
(9 to 32.999) mA	(0.297 to 10.89) mW	0.14 %	
(33 to 89.99) mA	(1.09 to 29.7) mW	0.11 %	
(90 to 329.99) mA	(3.0 to 108.9) mW	0.13 %	
(330 to 899.9) mA	(10.9 to 297) mW	0.10 %	
(0.9 to 2.1999) A	(29.7 to 726) mW	0.10 %	
(2.2 to 4.4999) A	72.6 mW to 1.5 W	0.11 %	
(4.5 to 20.5) A	148.5 mW to 6.8 W	0.10 %	
330 mV to 1020 V			
(3.3 to 8.999) mA	1.09 mW to 9.2 W	0.34 %	
(9 to 32.999) mA	2.97 mW to 33.6 W	0.062 %	
(33 to 89.99) mA	10.9 mW to 91.8 W	0.094 %	
(90 to 329.99) mA	29.7 mW to 336.6 W	0.062 %	
(330 to 899.9) mA	108.9 mW to 918 W	0.086 %	
(0.9 to 2.1999) A	297 mW to 2244 W	0.071 %	
(2.2 to 4.4999) A	72.6 mW to 4590 W	0.098 %	
(4.5 to 20.5) A	(1.49 to 20 910) W	0.081 %	

Parameter/Equipment	Range	CMC[2, 4, 7] (±)	Comments
AC Power[3] – Generate, PF = (0 to 1) (cont)			
65 Hz to 1 kHz			
(33 to 329.99) mV			
(3.3 to 8.999) mA	(0.109 to 3.0) mW	0.040 %	Fluke 5522A
(9 to 32.999) mA	(0.297 to 10.89) mW	0.040 %	
(33 to 89.99) mA	(1.09 to 29.7) mW	0.044 %	
(90 to 329.99) mA	(3.0 to 108.9) mW	0.039 %	
(330 to 899.9) mA	(10.9 to 297) mW	0.54 %	
(0.9 to 2.1999) A	(29.7 to 726) mW	0.052 %	
(2.2 to 4.4999) A	72.6 mW to 1.5 W	0.098 %	
(4.5 to 20.5) A	148.5 mW to 6.8 W	0.14 %	
330 mV to 1020 V			
(3.3 to 8.999) mA	1.089 mW to 9.179 W	0.15 %	
(9 to 32.999) mA	2.97 mW to 33.659 W	0.15 %	
(33 to 89.99) mA	10.89 mW to 91.7898 W	0.044 %	
(90 to 329.99) mA	(0.0297 to 336.5898) W	0.044 %	
(330 to 899.9) mA	(0.1089 to 917.898) W	0.053 %	
(0.9 to 2.1999) A	(0.297 to 2243.898) W	0.055 %	
(2.2 to 4.4999) A	(0.726 to 4589.898) W	0.072 %	
(4.5 to 20.5) A	1.485 W to 20.91 kW	0.12 %	
(45 to 65) Hz			
(33 to 329.999) mV			
(3.3 to 8.999) mA	(0.109 to 3.0) mW	0.23 %	
(9 to 32.999) mA	(0.297 to 10.89) mW	0.14 %	
(33 to 89.99) mA	(1.09 to 29.7) mW	0.11 %	
(90 to 329.99) mA	(3.0 to 108.9) mW	0.13 %	
(330 to 899.9) mA	(10.9 to 297) mW	0.10 %	
(0.9 to 2.1999) A	(29.7 to 726) mW	0.10 %	
(2.2 to 4.4999) A	72.6 mW to 1.5 W	0.11 %	
(4.5 to 20.5) A	148.5 mW to 6.8 W	0.10 %	
330 mV to 1020 V			
(3.3 to 8.999) mA	1.09 mW to 9.2 W	0.34 %	
(9 to 32.999) mA	2.97 mW to 33.6 W	0.062 %	
(33 to 89.99) mA	10.9 mW to 91.8 W	0.094 %	
(90 to 329.99) mA	29.7 mW to 336.6 W	0.062 %	
(330 to 899.9) mA	108.9 mW to 918 W	0.086 %	
(0.9 to 2.1999) A	297 mW to 2244 W	0.071 %	
(2.2 to 4.4999) A	72.6 mW to 4590 W	0.098 %	
(4.5 to 20.5) A	(1.49 W to 20 910) W	0.081 %	

Parameter/Equipment	Range	CMC[2, 4, 7] (±)	Comments
AC Power[3] – Generate, PF = (0 to 1) (cont)			
65 Hz to 1 kHz			
(33 to 329.99) mV			
(3.3 to 8.999) mA	(0.109 to 3.0) mW	0.040 %	Fluke 5522A
(9 to 32.999) mA	(0.297 to 10.89) mW	0.040 %	
(33 to 89.99) mA	(1.09 to 29.7) mW	0.044 %	
(90 to 329.99) mA	(3.0 to 108.9) mW	0.039 %	
(330 to 899.9) mA	(10.9 to 297) mW	0.54 %	
(0.9 to 2.1999) A	(29.7 to 726) mW	0.052 %	
(2.2 to 4.4999) A	72.6 mW to 1.5 W	0.098 %	
(4.5 to 20.5) A	148.5 mW to 6.8 W	0.14 %	
(10 to 45) Hz			
330 mV to 1020 V			
(3.3 to 8.999) mA	1.089 mW to 9.179 W	0.15 %	
(9 to 32.999) mA	2.97 mW to 33.659 W	0.15 %	
(33 to 89.99) mA	10.89 mW to 91.7898 W	0.044 %	
(90 to 329.99) mA	(0.0297 to 336.5898) W	0.044 %	
(330 to 899.9) mA	(0.1089 to 917.898) W	0.053 %	
(0.9 to 2.1999) A	(0.297 to 2243.898) W	0.055 %	
(2.2 to 4.4999) A	(0.726 to 4589.898) W	0.072 %	
(4.5 to 20.5) A	1.485 W to 20.91 kW	0.12 %	
(45 to 65) Hz			
(33 to 329.999) mV			
(3.3 to 8.999) mA	(0.109 to 3.0) mW	0.23 %	
(9 to 32.999) mA	(0.297 to 10.89) mW	0.14 %	
(33 to 89.99) mA	(1.09 to 29.7) mW	0.11 %	
(90 to 329.99) mA	(3.0 to 108.9) mW	0.13 %	
(330 to 899.9) mA	(10.9 to 297) mW	0.10 %	
(0.9 to 2.1999) A	(29.7 to 726) mW	0.10 %	
(2.2 to 4.4999) A	72.6 mW to 1.5 W	0.11 %	
(4.5 to 20.5) A	148.5 mW to 6.8 W	0.10 %	
330 mV to 1020 V			
(3.3 to 8.999) mA	1.09 mW to 9.2 W	0.34 %	
(9 to 32.999) mA	2.97 mW to 33.6 W	0.062 %	
(33 to 89.99) mA	10.9 mW to 91.8 W	0.094 %	
(90 to 329.99) mA	29.7 mW to 336.6 W	0.062 %	
(330 to 899.9) mA	108.9 mW to 918 W	0.086 %	
(0.9 to 2.1999) A	297 mW to 2244 W	0.071 %	
(2.2 to 4.4999) A	72.6 mW to 4590 W	0.098 %	
(4.5 to 20.5) A	(1.49 W to 20 910) W	0.081 %	

Parameter/Range	Frequency	CMC[2, 4, 7] (±)	Comments
AC Power[3] – Generate, PF = (0 to 1) (cont)			
65 Hz to 1 kHz			
(33 to 329.99) mV			
(3.3 to 8.999) mA	(0.109 to 3.0) mW	0.040 %	Fluke 5522A
(9 to 32.999) mA	(0.297 to 10.89) mW	0.040 %	
(33 to 89.99) mA	(1.09 to 29.7) mW	0.044 %	
(90 to 329.99) mA	(3.0 to 108.9) mW	0.039 %	
(330 to 899.9) mA	(10.9 to 297) mW	0.54 %	
(0.9 to 2.1999) A	(29.7 to 726) mW	0.052 %	
(2.2 to 4.4999) A	72.6 mW to 1.5 W	0.098 %	
(4.5 to 20.5) A	148.5 mW to 6.8 W	0.14 %	
330 mV to 1020 V			
(3.3 to 8.999) mA	1.089 mW to 9.179 W	0.043 %	
(9 to 32.999) mA	2.97 mW to 33.659 W	0.043 %	
(33 to 89.99) mA	10.89 mW to 91.7898 W	0.047 %	
(90 to 329.99) mA	(0.0297 to 336.5898) W	0.042 %	
(330 to 899.9) mA	(0.1089 to 917.898) W	0.54 %	
(0.9 to 2.1999) A	(0.297 to 2243.898) W	0.054 %	
(2.2 to 4.4999) A	(0.726 to 4589.898) W	0.099 %	
(4.5 to 20.5) A	1.485 W to 20.91 kW	0.14 %	
(1 to 5) kHz			
(33 to 329.99) mV			
(3.3 to 8.999) mA	(0.1089 to 2.9696) mW	0.13 %	
(9 to 32.999) mA	(0.297 to 10.8893) mW	0.13 %	
(33 to 89.99) mA	(1.089 to 29.6958) mW	0.15 %	
(90 to 329.99) mA	(2.97 to 108.8934) mW	0.15 %	
(330 to 899.9) mA	(10.89 to 296.958) mW	0.55 %	
(0.9 to 2.1999) A	(29.7 to 725.945) mW	0.50 %	
(2.2 to 4.4999) A	(72.6 to 1484.922) mW	0.16 %	
(4.5 to 20.5) A	148.5 mW to 6.7648 W	0.18 %	
330 mV to 1020 V			
(3.3 to 8.999) mA	1.089 mW to 9.179 W	0.13 %	
(9 to 32.999) mA	2.97 mW to 33.659 W	0.14 %	
(33 to 89.99) mA	10.89 mW to 91.7898 W	0.15 %	
(90 to 329.99) mA	(0.0297 to 336.5898) W	0.15 %	
(330 to 899.9) mA	(0.1089 to 917.898) W	0.55 %	
(0.9 to 2.1999) A	(0.297 to 2243.898) W	0.51 %	
(2.2 to 4.4999) A	(0.726 to 4589.898) W	0.16 %	
(4.5 to 20.5) A	1.485 W to 20.91 kW	0.18 %	

Parameter/Equipment	Range	CMC[2, 4, 7] (±)	Comments
AC Power[3] – Generate, PF = (0 to 1) (cont)			
(5 to 10) kHz			
(33 to 329.99) mV			
(3.3 to 8.999) mA	(0.1089 to 2.9696) mW	0.47 %	Fluke 5522A
(9 to 32.999) mA	(0.297 to 10.8893) mW	0.47 %	
(33 to 89.99) mA	(1.089 to 29.6958) mW	0.48 %	
(90 to 329.99) mA	(2.97 to 108.8934) mW	0.47 %	
(330 to 899.9) mA	(10.89 to 296.958) mW	0.69 %	
(0.9 to 2.1999) A	(29.7 to 725.945) mW	0.66 %	
(2.2 to 2.99999) A	(72.6 to 989.9667) mW	0.66 %	
330 mV to 1020 V			
(3.3 to 8.999) mA	1.089 mW to 9.179 W	0.46 %	
(9 to 32.999) mA	2.97 mW to 33.659 W	0.47 %	
(33 to 89.99) mA	10.89 mW to 91.7898 W	0.47 %	
(90 to 329.99) mA	29.7 mW to 336.5898 W	0.48 %	
(330 to 899.9) mA	(0.1089 to 917.898) W	0.47 %	
(0.9 to 2.1999) A	(0.297 to 2243.898) W	0.69 %	
(2.2 to 2.99999) A	(0.726 to 3059.9898) W	0.66 %	
(10 to 30) kHz			
(33 to 329.99) mV			
(3.3 to 8.999) mA	(0.1089 to 2.9696) mW	1.8 %	
(9 to 32.999) mA	(0.297 to 10.8893) mW	1.8 %	
(33 to 89.99) mA	(1.089 to 29.6958) mW	1.8 %	
(90 to 329.99) mA	(2.97 to 108.8934) mW	1.8 %	
330 mV to 1020 V			
(3.3 to 8.999) mA	1.089 mW to 9.179 W	1.8 %	
(9 to 32.999) mA	2.97 mW to 33.659 W	1.8 %	
(33 to 89.99) mA	10.89 mW to 91.7898 W	1.8 %	
(90 to 329.99) mA	29.7 mW to 336.5898 W	1.8 %	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Resistance[3] – 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	3.2 mΩ 5.2 mΩ 6.2 mΩ 7.2 mΩ 10 mΩ 41 mΩ 61 mΩ	HP 42030A resistor set
100 Ω	DC to 1 MHz (1 to 2) MHz (2 to 4) MHz (4 to 5) MHz (5 to 10) MHz (10 to 13) MHz	32 mΩ 43 mΩ 55 mΩ 55 mΩ 0.20 Ω 0.31 Ω	
1 kΩ	DC to 3 MHz (3 to 5) MHz (5 to 10) MHz (10 to 13) MHz	0.34 Ω 0.57 Ω 2.0 Ω 3.0 Ω	
10 kΩ 100 kΩ	DC to 1 MHz DC to 1 MHz	3.5 Ω 48 Ω	
25 Ω	1 kHz 500 kHz, 1 MHz	0.46 mΩ 0.46 mΩ	Quad Tech 7000-09 calibration kit
374 Ω	1 kHz 500 kHz, 1 MHz	7.1 mΩ 7.1 mΩ	
5.97 kΩ	1 kHz 250 kHz, 500 kHz, 1 MHz	89 mΩ 0.59 Ω	
95.3 kΩ	1 kHz (25, 50) kHz	1.2 Ω 6.2 Ω	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Resistance[3] – Measure			
10 mΩ to 100 Ω	(20 to 50) Hz (50 to 125) Hz (125 to 1000) Hz (1 to 12.5) kHz (12.5 to 48) kHz (48 to 96) kHz 96 kHz to 1 MHz	3.3 mΩ/Ω 1.3 mΩ/Ω 0.96 mΩ/Ω 1.5 mΩ/Ω 1.5 mΩ/Ω 1.5 mΩ/Ω 1.8 mΩ/Ω	Agilent 4284A
>100 Ω to 100 kΩ	(20 to 50) Hz (50 to 125) Hz (125 to 1000) Hz (1 to 12.5) kHz (12.5 to 48) kHz (48 to 96) kHz 96 kHz to 1 MHz	3.2 mΩ/Ω 1.3 mΩ/Ω 0.94 mΩ/Ω 1.5 mΩ/Ω 1.5 mΩ/Ω 1.5 mΩ/Ω 1.2 mΩ/Ω	
AC Voltage Ratio[3] –			
(0 to 1.111111) Up to 100 V	50 Hz to 1 kHz (>1 to 10) kHz	$(0.38 \cdot 10^{-6})$ ratio $(0.38 \cdot 10^{-6})$ ratio x F^2	Tegam M1011A w/ NA 2250 & voltage source F is for frequency in kHz

Parameter/Range	Frequency	CMC[2, 4, 7] (±)	Comments
AC Level Flatness – Measure[3]			
Into 50 Ω, 0.5 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 %	HP 3458A w/ 50 Ω thermal voltage converters
1 V, 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 % 0.71 % 1.8 % 2.8 % 3.6 % 3.9 % 4.8 %	
Into 75 Ω, 1 V	10 Hz (>0.01 to 1) kHz (>1 to 10) kHz (>10 to 100) kHz (>100 to 300) kHz (>0.30 to 1) MHz (>1 to 8) MHz (>8 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	0.20 % 0.036 % 0.036 % 0.058 % 0.10 % 0.11 % 0.21 % 0.22 % 0.13 % 0.17 % 0.26 % 0.45 % 0.51 % 0.75 %	

Parameter/Range	Frequency	CMC[2, 4, 7] (±)	Comments
AC Level Flatness – Measure[3] (cont)			
3 V	10 Hz (>10 to 100) Hz (>0.1 to 10) kHz (>10 to 30) kHz (>30 to 100) kHz (>100 to 300) kHz (>0.3 to 1) MHz (>1 to 3) MHz (>3 to 8) MHz (>8 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	0.015 % 0.0075 % 0.0076 % 0.0082% 0.047 % 0.010 % 0.034 % 0.051 % 0.085 % 0.088 % 0.099 % 0.15 % 0.23 % 0.35 % 0.39 % 0.62 %	HP 3458A w/ 75 Ω thermal voltage converters
(0 to 2.2) mV	(0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.65 mV/V + 0.78 µV 0.91 mV/V + 0.78 µV 1.4 mV/V + 0.78 µV 2.5 mV/V + 0.78 µV 5.6 mV/V + 1.6 µV	Fluke 5790A wideband input
(2.2 to 7) mV	(0.5 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 0.58 mV/V + 0.78 µV 0.88 mV/V + 0.78 µV 1.5 mV/V + 0.78 µV 3.2 mV/V + 0.78 µV	
(7 to 22) mV	(0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.57 mV/V 0.58 mV/V 0.87 mV/V 1.5 mV/V 3.1 mV/V	
(22 to 70) mV	(0.5 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 0.43 mV/V 0.85 mV/V 1.3 mV/V 3.0 mV/V	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Level Flatness – Measure[3] (cont)			
(70 to 220) mV	(0.5 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 0.42 mV/V 0.84 mV/V 1.3 mV/V 3.0 mV/V	Fluke 5790A wideband input
(220 to 700) mV	(0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.42 mV/V 0.42 mV/V 0.83 mV/V 1.3 mV/V 3.0 mV/V	
(0.7 to 2.2) V	(0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.42 mV/V 0.42 mV/V 0.83 mV/V 1.3 mV/V 3.0 mV/V	
(2.2 to 7) V	(0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.42 mV/V 0.42 mV/V 0.83 mV/V 1.3 mV/V 3.0 mV/V	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
Capacitance – Generate[3]			
Up to 10 pF	1 kHz	6.9 µF/F	Andeen Hagerling 2500A
(>10 to 100) pF	1 kHz	6.0 µF/F	
(>100 to 1000) pF	1 kHz	6.5 µF/F	
(220 to 399.9) pF	10 Hz to 10 kHz	5.0 mF/F + 7.8 pF	Fluke 5520A
(0.4 to 1.1) nF	10 Hz to 10 kHz	4.2 mF/F + 7.8 pF	
(1.1 to 3.3) nF	10 Hz to 3 kHz	4.1 mF/F + 7.8 pF	
(3.3 to 11) nF	10 Hz to 1 kHz	2.4 mF/F + 7.8 pF	
(11 to 33) nF	10 Hz to 1 kHz	2.4 mF/F + 78 pF	
(33 to 110) nF	10 Hz to 1 kHz	2.4 mF/F + 78 pF	
(110 to 330) nF	10 Hz to 1 kHz	2.3 mF/F + 0.23 nF	
(0.33 to 1.1) µF	(10 to 600) Hz	2.4 mF/F + 0.78 nF	
(1.1 to 3.3) µF	(10 to 300) Hz	2.3 mF/F + 2.3 nF	
(3.29 to 11) µF	(10 to 150) Hz	2.4 mF/F + 7.8 nF	
(11 to 33) µF	(10 to 120) Hz	3.4 mF/F + 23 nF	
(33 to 110) µF	(10 to 80) Hz	3.5 mF/F + 78 nF	
(110 to 330) µF	(10 to 50) Hz	3.5 mF/F + 0.23 µF	
(0.33 to 1.1) mF	(10 to 20) Hz	3.5 mF/F + 0.78 µF	
(1.1 to 3.3) mF	(0 to 6) Hz	3.5 mF/F + 2.3 µF	
(3.3 to 11) mF	(0 to 2) Hz	3.5 mF/F + 7.8 µF	
(11 to 33) 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	100 Hz to 10 kHz	2.4 fF	GenRad 1404-B
1000 pF	100 Hz to 10 kHz	24 fF	GenRad 1404-A
1 pF	(0.1 to 1) kHz	0.39 fF	HP 1638XX standard capacitors
	1 kHz to 1 MHz	0.40 fF	
	(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	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
Capacitance – Generate[3] (cont)			
Fixed Values			
10 pF	100 Hz to 1 kHz 1 kHz 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	3.5 fF 3.5 fF 3.8 fF 3.8 fF 3.5 fF 3.5 fF 4.1 fF 4.3 fF	HP 1638XX standard capacitors
100 pF	100 Hz to 1 kHz 1 kHz 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	43 fF 35 fF 36 fF 37 fF 38 fF 39 fF 52 fF 64 fF	
1000 pF	100 Hz to 1 kHz 1 kHz 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	0.35 pF 0.35 pF 0.38 pF 0.45 pF 0.56 pF 0.72 pF 2.0 pF 3.0 pF	
10 nF	(100 to 120) Hz 120 Hz to 1 kHz (1 to 10) kHz (10 to 100) kHz	0.62 pF 0.71 pF 0.71 pF 0.73 pF	
100 nF	(100 to 120) Hz 120 Hz to 1 kHz (1 to 10) kHz (10 to 100) kHz	7.1 pF 7.1 pF 7.1 pF 9.1 pF	
1 µF	(100 to 120) Hz 120 Hz to 1 kHz (1 to 10) kHz (10 to 100) kHz	76 pF 70 pF 70 pF 0.58 nF	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
Capacitance[3] – Generate (cont)			
0.0001 µF	DC to 1 kHz	0.69 pF	Arco SS-32 (CMC valid at 1 kHz only)
0.0002 µF	DC to 1 kHz	0.25 pF	
0.0003 µF	DC to 1 kHz	0.29 pF	
0.0004 µF	DC to 1 kHz	0.32 pF	
0.0005 µF	DC to 1 kHz	0.37 pF	
0.0006 µF	DC to 1 kHz	0.39 pF	
0.0007 µF	DC to 1 kHz	0.44 pF	
0.0008 µF	DC to 1 kHz	0.27 pF	
0.0009 µF	DC to 1 kHz	0.36 pF	
0.001 µF	DC to 1 kHz	1.4 pF	
0.002 µF	DC to 1 kHz	1.5 pF	
0.003 µF	DC to 1 kHz	2.2 pF	
0.004 µF	DC to 1 kHz	2.5 pF	
0.005 µF	DC to 1 kHz	3.2 pF	
0.006 µF	DC to 1 kHz	4.2 pF	
0.007 µF	DC to 1 kHz	4.9 pF	
0.008 µF	DC to 1 kHz	5.2 pF	
0.009 µF	DC to 1 kHz	7.0 pF	
0.01 µF	DC to 1 kHz	6.9 pF	
0.02 µF	DC to 1 kHz	9.9 pF	
0.03 µF	DC to 1 kHz	16 pF	
0.04 µF	DC to 1 kHz	20 pF	
0.05 µF	DC to 1 kHz	24 pF	
0.06 µF	DC to 1 kHz	30 pF	
0.07 µF	DC to 1 kHz	41 pF	
0.08 µF	DC to 1 kHz	46 pF	
0.09 µF	DC to 1 kHz	49 pF	
0.1 µF	DC to 1 kHz	83 pF	
0.2 µF	DC to 1 kHz	0.13 nF	
0.3 µF	DC to 1 kHz	0.19 nF	
0.4 µF	DC to 1 kHz	0.28 nF	
0.5 µF	DC to 1 kHz	0.43 nF	
1.4 µF*	DC to 1 kHz	0.76 nF	*Combined (0.5 + 0.4 + 0.3 + 0.2) µF

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
Capacitance[3] – Measure			
Up to 10 pF	1 kHz	6.9 µF/F	Andeen Hagerling 2500A
(>10 to 100) pF	1 kHz	6.0 µF/F	
(>100 to 1000) pF	1 kHz	6.5 µF/F	
1 nF to 1 mF	12 Hz to 100 kHz	0.045 % + 0.58 pF	GenRad 1689 – CMC Valid at 1 kHz only
Up to 10 pF	(>0.1 to 1) MHz	2.9 mF/F	Agilent 4284A
(10 to 100) pF	(>0.1 to 1) MHz	1.4 mF/F	
(100 to 1000) pF	(>0.1 to 1) MHz	2.1 mF/F	
Up to 1 mF	DC	0.14 mF/F	Fluke 5720A and Agilent 3458A
(1 to 3.3) mF	DC	0.13 mF/F	
(3.3 to 11) mF	DC	0.14 mF/F	
(11 to 33) mF	DC	0.17 mF/F	
(33 to 110) mF	DC	0.33 mF/F	
Inductance – Generate[3]			
100 µH	(0.1 to 1) kHz	0.31 µH	GenRad 1482
1 mH	(0.1 to 1) kHz	0.29 µH	
2 mH	(0.1 to 1) kHz	0.94 µH	
10 mH	(0.1 to 1) kHz	5.2 µH	
100 mH	(0.1 to 1) kHz	40 µH	
1 H	(0.1 to 1) kHz	0.77 mH	
10 H	(0.1 to 1) kHz	83 mH	
Inductance – Measure[3]			
100 µH to 10 H	12 Hz to 100 kHz	0.68 mH/H	GenRad 1689 – CMC valid at 1 kHz only
10 nH to 1 µH	50 Hz to 1 MHz	1.2 mH/H	Agilent 4284A
(1 to 100) µH	100 Hz to 1 MHz	0.62 mH/H	
100 µH to 10 mH	30 kHz to 1 MHz	1.2 mH/H	
(1 to 10) mH	100 Hz to 30 kHz	0.62 mH/H	
10 mH to 1 H	100 Hz to 1 MHz	1.2 mH/H	
(1 to 10) H	1 kHz to 1 MHz	1.2 mH/H	

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Rise Time – Generate[3]	Nominal: 25 ps	16 ps	Fluke 9500B w/ 9560
Rise Time – Measure[3]	Nominal: 16.8 ps	5.2 ps	Tektronix 80E04 w/ CSA8200
Thermocouple Indicators[3] –			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.35 °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 0.66 °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 0.12 °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 0.14 °C 0.12 °C 0.14 °C 0.19 °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 0.15 °C 0.13 °C 0.21 °C 0.31 °C	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Thermocouple Indicators[3] –			
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.29 °C 0.21 °C 0.14 °C	Fluke 5522A
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.32 °C 0.18 °C 0.15 °C 0.15 °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	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.38 °C 0.29 °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 0.12 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.44 °C 0.22 °C	
Electrical Calibration of RTDs[3] –			
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 5522A
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	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Electrical Calibration of RTDs[3] –			
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	Fluke 5522A
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	
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 385, 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	

IV. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC[2, 4, 7] (±)	Comments
RF Power – Generate & Measure[3]			
(-30 to +30) dBm (-70 to -30) dBm	3 Hz to 100 kHz	0.060 dB 0.091 dB	HP 33250A/Fluke 8508A HP E44XXB & signal generator w/ keysight power sensor:
(-10 to +20) dBm (-20 to -10) dBm	100 kHz to 4.2 GHz	0.084 dB 0.086 dB	8482A
(-10 to +20) dBm (-20 to -10) dBm	(4.2 to 18) GHz	0.096 dB 0.10 dB	8481A
(-20 to +20) dBm	(18 to 26.5) GHz	0.19 dB	8485A
(-20 to +20) dBm	(26.5 to 50) GHz	0.19 dB	8487A
(-70 to -20) dBm	10 MHz to 18 GHz (18 to 26.5) GHz (26.5 to 50) GHz	0.10 dB 0.14 dB 0.21 dB	8481D 8485D 8487D
(+20 to +24) dBm	128 MHz to 18 GHz (18 to 26.5) GHz	0.22 dB 0.26 dB	8481A 8485A
1 mW Power Meter Reference	50 MHz	0.22 %	HP 435B K06 w/ HP 432A & DMM
	50 MHz	2.8 µW	HP 435B K06 w/HP 432A & 8482A power sensor

Parameter/Range	Frequency	CMC[2, 4, 7] (±)	Comments
RF Power – Generate[3]			
(-56 to 27) dBm	DC to 5 MHz (>5 to 20) MHz	0.20 dB 0.37 dB	Tektronix AFG2021
(16 to 24) dBm	(0.2 to 100) kHz (0.1 to 125) MHz	0.023 dB 0.047 dB	Fluke 96270A/LL/FF w/leveling head
(13 to 16) dBm	(0.2 to 100) kHz (0.1 to 150) MHz (0.25 to 1.4) GHz	0.023 dB 0.045 dB 0.16 dB	
(-7 to 13) 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 0.050 dB 0.17 dB 0.27 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 0.050 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 0.088 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 (10.6 to 4) GHz	0.40 dB 0.10 dB 0.42 dB 0.80 dB	
(-124 to -95) dBm	(10 to 100) MHz (0.1 to 1.4) GHz	0.62 dB 1.4 dB	
(-4 to +24) dBm	Microwave Output Up to 100 MHz (0.1 to 1) GHz	 0.43 % 0.57 %	

Parameter/Range	Frequency	CMC[2, 4, 7] (±)	Comments
RF Power – Generate[3] (cont)			
(-4 to +24) dBm	Microwave Output (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	 0.70 % 0.88 % 1.0 % 1.2 % 1.6 % 2.5 %	Fluke 96270A/LL/FF w/leveling head
RF Attenuation – Tuned RF Power Measure[3]			
(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 -95) dB (-95 to -100) dB (-100 to -105) dB (-105 to -110) dB (-110 to -115) dB (-115 to -120) dB (-120 to -125) dB	100 kHz to 10 MHz	0.018 dB 0.024 dB 0.029 dB 0.035 dB 0.041 dB 0.047 dB 0.052 dB 0.058 dB 0.064 dB 0.071 dB 0.075 dB 0.086 dB 0.094 dB 0.13 dB 0.21 dB 0.27 dB	Rohde and Schwarz FSMR50
(0 to -5) dB (-5 to -10) dB (-10 to -20) dB (-20 to -30) dB	10 MHz to 22 GHz	0.018 dB 0.019 dB 0.024 dB 0.029 dB	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
RF Attenuation – Tuned RF Power Measure[3] (cont)			
(-30 to -40) dB	10 MHz to 22 GHz	0.035 dB	Rohde & Schwarz FSMR50
(-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	
(0 to -5) dB	(22 to 26.5) GHz	0.22 dB	
(-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	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
RF Attenuation – Tuned RF Power Measure[3] (cont)			
(-120 to -130) dB	(22 to 26.5) GHz	2.9 dB	Rohde & Schwarz FSMR50
(-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	
(-10 to -15) dB		0.25 dB	
(-15 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	
(-95 to -100) dB		0.40 dB	
(-100 to -105) dB		0.38 dB	
(-105 to -110) dB		0.47 dB	
(-110 to -115) dB		0.55 dB	
(-115 to -120) dB		0.18 dB	
(-120 to -125) dB		0.26 dB	
(0 to -5) dB	(40 to 50) GHz	0.36 dB	
(-5 to -10) dB		0.31 dB	
(-10 to -15) dB		0.45 dB	
(-15 to -20) dB		0.44 dB	
(-20 to -25) dB		0.50 dB	
(-25 to -30) dB		0.52 dB	
(-30 to -35) dB		0.51 dB	
(-35 to -40) dB		0.55 dB	
(-40 to -45) dB		0.43 dB	
(-45 to -50) dB		0.49 dB	
(-50 to -55) dB		0.30 dB	
(-55 to -65) dB		0.36 dB	

Parameter/Range	Frequency	CMC[2, 4, 7] (±)	Comments
Frequency Modulation – Generate/Measure[3]			
Rate: 10 Hz to 10 kHz Dev: ≤50 kHz peak	(0.1 to 10) MHz	1.2 %	Rohde & Schwarz FSMR 50
Rate: 10 Hz to 100 kHz Dev: ≤500 kHz peak	(0.01 to 50) GHz	1.2 %	
Rate: (100 to 200) kHz Dev: ≤500 kHz peak	(0.01 to 50) GHz	3.5 %	
Frequency Modulation – Generate[3]			
Rate: DC to 100 kHz Rate: (100 to 200) kHz Dev.: ≤12.5 kHz peak	(11 to 13.5) MHz	0.44 % 0.43 %	HP 11715A
Rate: DC to 100 kHz Rate: (100 to 200) kHz Dev.: ≤100 kHz peak	(88 to 108) MHz	0.43 % 0.43 %	
Rate: DC to 100 kHz Rate: (100 to 200) kHz Dev.: ≤400 kHz peak	(352 to 432) MHz	0.43 % 0.56 %	
Amplitude Modulation – Generate/Measure[3]			
Rate: 10 Hz to 10 kHz Depth: (5 to 99) %	(0.1 to 10) MHz	1.5 %	HP 83650B monitored by Rohde & Schwarz FSMR 50
Rate: 10 Hz to 50 kHz Depth: (5 to 99) %	(0.01 to 50) GHz	1.0 %	
Rate: (50 to 100) kHz Depth: (5 to 99) %	(0.01 to 50) GHz	1.5 %	
Rate: (90 to 150) Hz Depth: (5 to 99) %	(0.01 to 50) GHz	0.42 %	

Parameter/Range	Frequency	CMC[2, 4, 7] (±)	Comments
Phase Modulation – Measure[3]			
Rate: 50 Hz to 10 kHz	200 kHz to 10 MHz	1.0 %	Rohde & Schwarz FSMR 50
Rate: 50 Hz to 100 kHz	10 MHz to 50 GHz	1.0 %	
Phase Noise – Measure[3]			
Carrier Frequency:			
(1 to 10) MHz			
(-40 to -176) dBc	1 Hz Offset	2.7 dB	Rohde & Schwarz FSWP50
	10 Hz Offset	2.5 dB	
	100 Hz Offset	1.6 dB	
	1 kHz Offset	1.6 dB	
	10 kHz Offset	1.6 dB	
	100 kHz Offset	1.6 dB	
	1 MHz Offset	4.0 dB	
(10 to 100) MHz			
(-66 to -175) dBc	1 Hz Offset	3.7 dB	
	10 Hz Offset	2.8 dB	
	100 Hz Offset	1.6 dB	
	1 kHz Offset	1.6 dB	
	10 kHz Offset	1.6 dB	
	100 kHz Offset	1.6 dB	
	1 MHz Offset	2.7 dB	
	10 MHz Offset	3.3 dB	
	>30 MHz Offset	4.0 dB	
100 MHz to 1 GHz			
(-46 to -173) dBc	1 Hz Offset	3.2 dB	
	10 Hz Offset	2.4 dB	
	100 Hz Offset	1.7 dB	
	1 kHz Offset	1.6 dB	
	10 kHz Offset	1.6 dB	
	100 kHz Offset	1.6 dB	
	1 MHz Offset	3.9 dB	
	10 MHz Offset	4.0 dB	
	>30 MHz Offset	4.0 dB	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
Phase Noise – Measure[3] (cont)			
(1 to 3) GHz (+10 to -170) dBc	1 Hz Offset 10 Hz Offset 100 Hz Offset 1 kHz Offset 10 kHz Offset 100 kHz Offset 1 MHz Offset 10 MHz Offset >30 MHz Offset	4.2 dB 2.0 dB 1.6 dB 1.6 dB 1.6 dB 1.6 dB 3.8 dB 4.4 dB 4.1 dB	Rohde & Schwarz FSWP50
(3 to 7) GHz (+17 to -166) dBc	1 Hz Offset 10 Hz Offset 100 Hz Offset 1 kHz Offset 10 kHz Offset 100 kHz Offset 1 MHz Offset 10 MHz Offset >30 MHz Offset	4.4 dB 2.6 dB 1.7 dB 1.6 dB 1.6 dB 1.6 dB 3.3 dB 3.9 dB 4.6 dB	
(7 to 10) GHz (+20 to -175) dBc	1 Hz Offset 10 Hz Offset 100 Hz Offset 1 kHz Offset 10 kHz Offset 100 kHz Offset 1 MHz Offset 10 MHz Offset >30 MHz Offset	4.4 dB 2.7 dB 1.8 dB 1.6 dB 1.6 dB 1.6 dB 3.5 dB 3.3 dB 4.6 dB	
(10 to 16) GHz (+24 to -171) dBc	1 Hz Offset 10 Hz Offset 100 Hz Offset 1 kHz Offset 10 kHz Offset 100 kHz Offset 1 MHz Offset 10 MHz Offset >30 MHz Offset	3.2 dB 2.7 dB 1.7 dB 1.6 dB 1.6 dB 1.6 dB 3.3 dB 4.1 dB 4.0 dB	

Parameter/Range	Frequency	CMC[2, 4, 7] (±)	Comments
Phase Noise – Measure[3] (cont)			
(16 to 26.5) GHz (+28 to -167) dBc	1 Hz Offset 10 Hz Offset 100 Hz Offset 1 kHz Offset 10 kHz Offset 100 kHz Offset 1 MHz Offset 10 MHz Offset >30 MHz Offset	4.1 dB 2.7 dB 1.7 dB 1.6 dB 1.6 dB 1.6 dB 3.6 dB 4.2 dB 4.0 dB	Rohde & Schwarz FSWP50
(26.5 to 50) GHz (+34 to -161) dBc	1 Hz Offset 10 Hz Offset 100 Hz Offset 1 kHz Offset 10 kHz Offset 100 kHz Offset 1 MHz Offset 10 MHz Offset >30 MHz Offset	4.1 dB 2.0 dB 1.8 dB 1.6 dB 1.6 dB 1.6 dB 3.7 dB 3.6 dB 4.4 dB	
Digital Modulation – Measure[3]			Rohde & Schwarz FSMR50
Carrier: 2 MHz to 50 GHz			Types: 2FSK & 4FSK (include GFSK), BPSK, QPSK (3GPP WCDMA, CDMA2000®), OQPSK, DQPSK, π/4 DQPSK, 8PSK, D8PSK, 3 π/8 8PSK (EDGE), 16QAM, 32QAM, 64QAM, 128QAM, 256 QAM, D16QAM, D32QAM, D64QAM, D128QAM, D256QAM, 8VSB, GSM, NADC, PDC, PHS, Bluetooth®, DECT, TETRA
Error Vector Magnitude for Modulation	Symbol Rate ≤1 MHz ≤10 MHz ≤15 MHz	 0.53 % 1.1 % 2.1 %	
Phase Error for Modulation	Mod Freq Span ≤100 kHz ≤1 MHz ≤10 MHz >10 MHz	 0.32 ° 0.42 ° 0.64 ° 1.3 °	

Parameter/Range	Frequency	CMC[2, 4, 7] (±)	Comments
Distortion – Measure[3]			
20 Hz to 20 kHz (20 to 50) kHz (50 to 300) kHz	(-80 to 0) dB (-70 to 0) dB (-65 to 0) dB	1.3 dB 2.3 dB 2.3 dB	HP 8903B
Amplitude Modulation Distortion – Measure			
Depth of Modulation: (5 to 99) %	Carrier Frequency: 100 kHz to 10 MHz ≥10 MHz	 0.36 % 0.44 %	R&S FSMR50
Frequency Modulation Distortion – Measure			
Deviation <10 kHz Deviation <50 kHz Deviation <100 kHz Deviation <500 kHz	200 kHz to 10 MHz ≥10 MHz	0.19 % 0.38 % 0.20 % 0.38 %	R&S FSMR50
Phase Modulation Distortion – Measure	200 kHz to 10 MHz ≥10 MHz	0.18 % 0.18 %	R&S FSMR50
Distortion – Audio Input – Measure			
(-100 to 0) dB	100 Hz to 100 kHz	0.60 dB	R&S FSMR50
Span Accuracy[3]	1 kHz to 2 MHz (2 to 500) MHz	0.15 % 0.25 %	Fluke 96270A
Residual FM[3] (@ 500 MHz)	5 kHz Span & 1 kHz RBW	0.11 mHz/Hz	Fluke 96270A, HP 83650B
Average Noise & Residuals (DANL)[3]	20 Hz to 50 GHz (-30 to -170) dBm	0.76 dB	50 Ω load

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
Average Noise & Residuals (DANL)[3]	20 Hz to 50 GHz (-30 to -170) dBm	0.76 dB	50 Ω load
Reference Level[3] –			
Log Scale	50 MHz (0 to -100) dB	0.13 dB	Fluke 96270A Agilent 83650B
Linear Scale	50 MHz (0 to -100) dB	0.15 dB	
BW Accuracy[3]	20 Hz to 50 MHz 50 MHz to 50 GHz	7.4 nHz/Hz 0.58 nHz/Hz	Agilent 83650B
BW Switching[3]	20 Hz to 50 MHz (-20 to 20) dB	0.17 dB	Fluke 96270A
	50 MHz to 50 GHz (-20 to 20) dB	2.0 dB	Agilent 83650B

Parameter/Equipment	Range	CMC[2] (±)	Comments
Attenuator Check[3]	(0 to 100) dB	0.11 dB	Agilent 8902A
Log Fidelity[3]	(20 to -100) dB	0.84 dB	Fluke 96270A
Linear Fidelity[3]	(20 to -100) dB	0.12 dB	Fluke 96270A

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
2nd Harmonic Distortion[3]	200 Hz to 50 MHz (0 to -120) dB	2.8 dB	Fluke 96270A
	50 MHz to 50 GHz (0 to -120) dB	3.7 dB	Agilent 83650B
3rd Order Intermodulation[3]	200 Hz to 50 MHz (0 to -120) dB	2.1 dB	Fluke 96270A
	50 MHz to 50 GHz (0 to -120) dB	3.0 dB	Agilent 83650B
Noise/System Sidebands[3]	200 Hz to 50 MHz (0 to -120) dB	0.54 dB	Fluke 96270A
	50 MHz to 50 GHz (0 to -120) dB	0.85 dB	Agilent 83650B
Frequency Response[3]	9 kHz to 18 GHz (20 to -30) dB	0.69 dB	Agilent E9304A-H19 Agilent 8487A
	50 MHz to 50 GHz (20 to -30) dB	0.37 dB	
Gain Compression[3]	200 Hz to 50 MHz (20 to -20) dB	0.23 dB	Fluke 96270A
	50 MHz to 50 GHz (20 to -20) dB	0.11 dB	Agilent 83650B

Parameter/Range	Frequency	CMC[2] (±)	Comments
Reflection Coefficient[3] (Into 50 Ω) –			
$0 < \rho \leq 0.2$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.0019 ρ 0.0028 ρ 0.0053 ρ	HP 8753D, HP 85056A
$0.2 < \rho \leq 0.4$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.0022 ρ 0.0031 ρ 0.0056 ρ	
$0.4 < \rho \leq 0.6$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.0027 ρ 0.0035 ρ 0.0062 ρ	
$0.6 < \rho \leq 0.8$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.0033 ρ 0.0042 ρ 0.0078 ρ	
$0.8 < \rho \leq 1$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.0040 ρ 0.0050 ρ 0.0091 ρ	
$0 < \rho \leq 0.2$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.0019 ρ 0.0028 ρ 0.0053 ρ	
$0.2 < \rho \leq 0.4$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.0022 ρ 0.0031 ρ 0.0056 ρ	
$0.4 < \rho \leq 0.6$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.0027 ρ 0.0035 ρ 0.0062 ρ	
$0.6 < \rho \leq 0.8$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.0033 ρ 0.0042 ρ 0.0078 ρ	
$0.8 < \rho \leq 1$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.0040 ρ 0.0050 ρ 0.0091 ρ	

Parameter/Range	Frequency	CMC[2] (±)	Comments
Reflection Coefficient[3] (Into 50 Ω) – (cont)			
0.000 < ρ ≤ 0.0476	45 MHz to 2 GHz (2 to 18) GHz	0.0042 ρ 0.0086 ρ	HP 8753D, HP 85056A
0.0476 < ρ ≤ 0.1111	45 MHz to 2 GHz (2 to 18) GHz	0.0051 ρ 0.0094 ρ	
0.1111 < ρ ≤ 0.200	45 MHz to 2 GHz (2 to 18) GHz	0.0052 ρ 0.0090 ρ	
0.200 < ρ ≤ 0.3333	45 MHz to 2 GHz (2 to 18) GHz	0.0091 ρ 0.012 ρ	
0.3333 < ρ ≤ 0.500	45 MHz to 2 GHz (2 to 18) GHz	0.012 ρ 0.017 ρ	
0.500 < ρ ≤ 1.000	45 MHz to 2 GHz (2 to 18) GHz	0.014 ρ 0.028 ρ	
0.000 < ρ ≤ 0.0476	45 MHz to 2 GHz (2 to 20) GHz (20 to 26.5) GHz	0.0043 ρ 0.0072 ρ 0.0076 ρ	
0.0476 < ρ ≤ 0.1111	45 MHz to 2 GHz (2 to 20) GHz (20 to 26.5) GHz	0.0052 ρ 0.0082 ρ 0.0095 ρ	
0.1111 < ρ ≤ 0.200	45 MHz to 2 GHz (2 to 20) GHz (20 to 26.5) GHz	0.0052 ρ 0.0077 ρ 0.0099 ρ	
0.200 < ρ ≤ 0.3333	45 MHz to 2 GHz (2 to 20) GHz (20 to 26.5) GHz	0.0092 ρ 0.012 ρ 0.015 ρ	
0.3333 < ρ ≤ 0.500	45 MHz to 2 GHz (2 to 20) GHz (20 to 26.5) GHz	0.013 ρ 0.016 ρ 0.019 ρ	

Parameter/Range	Frequency	CMC[2] (±)	Comments
Reflection Coefficient[3] (Into 50 Ω) – (cont)			
0.500 < ρ ≤ 1.000	45 MHz to 2 GHz (2 to 20) GHz (20 to 26.5) GHz	0.016 ρ 0.032 ρ 0.033 ρ	Agilent N5230A w/: 85052B
0.000 < ρ ≤ 0.0476	45 MHz to 2 GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.0082 ρ 0.0083 ρ 0.013 ρ 0.017 ρ	
0.0476 < ρ ≤ 0.1111	45 MHz to 2 GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.0086 ρ 0.0092 ρ 0.014 ρ 0.018 ρ	
0.1111 < ρ ≤ 0.200	45 MHz to 2 GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.0086 ρ 0.0087 ρ 0.015 ρ 0.018 ρ	
0.200 < ρ ≤ 0.3333	45 MHz to 2 GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.011 ρ 0.012 ρ 0.019 ρ 0.021 ρ	
0.3333 < ρ ≤ 0.500	45 MHz to 2 GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.014 ρ 0.016 ρ 0.022 ρ 0.027 ρ	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
Reflection Coefficient[3] (cont)			
0.500 < ρ ≤ 1.000	45 MHz to 2 GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.016 ρ 0.020 ρ 0.030 ρ 0.038 ρ	Agilent N5230A w/ 85056A
Into 75 Ω, (0 to 360)° 0 < Γ ≤ 0.2 0.2 < Γ ≤ 0.4 0.4 < Γ ≤ 0.6 0.6 < Γ ≤ 0.8 0.8 < Γ ≤ 1.0	300 kHz to 2 GHz	0.0090 ρ 0.021 ρ 0.028 ρ 0.037 ρ 0.048 ρ	HP 8753D w/ 85046B and 85036B
Reflection Phase[3]			
0.0 < ρ < 1.0	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	1.2° 1.3° 1.5°	HP 8753D, HP 85056A
0 < Γ ≤ 0.4	45 MHz to 2 GHz (2 to 18) GHz	0.72° 1.2°	Agilent N5230A w/: 85054B
0.4 < Γ ≤ 1	45 MHz to 2 GHz (2 to 18) GHz	0.69° 1.7°	
0 < Γ ≤ 0.4	45 MHz to 2 GHz (2 to 20) GHz (20 to 26.5) GHz	0.72° 1.2° 1.2°	85052B
0.4 < Γ ≤ 1	45 MHz to 2 GHz (2 to 20) GHz (20 to 26.5) GHz	0.69° 1.7° 1.7°	
0 < Γ ≤ 0.4	45 MHz to 20 GHz (20 to 40) GHz (40 to 50) GHz	1.4° 2.4° 3.1°	85056A
0.4 < Γ ≤ 1	45 MHz to 20 GHz (20 to 40) GHz (40 to 50) GHz	1.0° 1.9° 2.5°	
Into 75 Ω, (0 to 360)° 0 < Γ ≤ 0.2 0.2 < Γ ≤ 0.4	300 kHz to 3 GHz	4.8° 3.4°	HP 8753D w/ 85036B

Parameter/Range	Frequency	CMC[2] (±)	Comments
Transmission Magnitude[3] –			
(-15 to 10) dBm	30 kHz to 3 GHz	0.091 dB	HP 8753D
(-25 to 0) dBm		0.026 dB	
(-35 to -10) dBm		0.04 dB	
(-45 to -20) dBm		0.063 dB	
(-55 to -30) dBm		0.13 dB	
(-65 to -40) dBm		0.36 dB	
(-75 to -50) dBm		0.72 dB	
(-85 to -60) dBm		0.77 dB	
(-15 to 10) dBm	(3 to 6) GHz	0.11 dB	
(-25 to 0) dBm		0.023 dB	
(-35 to -10) dBm		0.037 dB	
(-45 to -20) dBm		0.061 dB	
(-55 to -30) dBm		0.13 dB	
(-65 to -40) dBm		0.36 dB	
(-75 to -50) dBm		0.72 dB	
(-85 to -60) dBm		0.79 dB	
			Agilent N5230A w/:
(+10 to -90) dB	45 MHz to 2 GHz	(0.034 to 3.8) dB	85054B
	(2 to 18) GHz	(0.12 to 1.6) dB	
	45 MHz to 2 GHz	(0.039 to 22) dB	85052B
	(2 to 20) GHz	(0.13 to 13) dB	
	(20 to 26.5) GHz	(0.16 to 13) dB	
	45 MHz to 2 GHz	(0.041 to 22) dB	85056A
	(2 to 20) GHz	(0.080 to 13) dB	
	(20 to 40) GHz	(0.16 to 18) dB	
	(40 to 50) GHz	(0.27 to 23) dB	

Parameter/Range	Frequency	CMC[2] (±)	Comments
Transmission Phase[3] –			
(-15 to 10) dBm	30 kHz to 3 GHz	1.2°	8753D
(-25 to 0) dBm		0.77°	
(-35 to -10) dBm		3.5°	
(-45 to -20) dBm		2.4°	
(-55 to -30) dBm		2.9°	
(-65 to -40) dBm		1.8°	
(-75 to -50) dBm		2.7°	
(-85 to -60) dBm		2.5°	
(-15 to 10) dBm	(3 to 6) GHz	0.76°	
(-25 to 0) dBm		0.22°	
(-35 to -10) dBm		0.36°	
(-45 to -20) dBm		0.57°	
(-55 to -30) dBm		1.4°	
(-65 to -40) dBm		2.1°	
(-75 to -50) dBm		3.2°	
(-85 to -60) dBm		3.9°	
			Agilent N5230A w/:
(+10 to 0) dB	45 MHz to 18 GHz	(0.35 to 1.3)°	85054B
(0 to -10) dB		(0.37 to 1.1)°	
(-10 to -20) dB		(0.48 to 1.2)°	
(-20 to -30) dB		(0.88 to 1.2)°	
(-30 to -40) dB		(1.2 to 1.8)°	
(-40 to -50) dB		(1.4 to 3.9)°	
(-50 to -60) dB		(2.1 to 10)°	
(-60 to -70) dB		(4.2 to 31)°	
(+10 to 0) dB	45 MHz to 26.5 GHz	(0.36 to 2.3)°	85052B
(0 to -10) dB		(0.38 to 1.8)°	
(-10 to -20) dB		(0.48 to 1.8)°	
(-20 to -30) dB		(0.89 to 1.8)°	
(-30 to -40) dB		(1.3 to 1.9)°	
(-40 to -50) dB		(1.4 to 3.9)°	
(-50 to -60) dB		(2.1 to 10)°	
(-60 to -70) dB		(4.3 to 31)°	
(+10 to 0) dB	45 MHz to 20 GHz	0.37°	85056A

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
Transmission Phase[3] – (cont)			
(0 to -10) dB	45 MHz to 50 GHz	(0.37 to 8.3)°	Agilent N5230A w/: 85056A
(-10 to -20) dB		(0.43 to 9.0)°	
(-20 to -30) dB		(0.51 to 9.2)°	
(-30 to -40) dB		(0.74 to 9.3)°	
(-40 to -50) dB		(1.4 to 9.4)°	
(-50 to -60) dB		(2.7 to 9.8)°	
(-60 to -70) dB		(3.3 to 13)°	
Power Sensor[3] – Calibration Factor			
N Type	(9 to 50) kHz	0.95 %	Tegam M1111 or Weinschel M1110, dual type IV power meter, 8.5-digit reference multimeter, power meter, RF signal generator, function generator
	0.1 MHz	1.8 %	
	0.3 MHz	1.4 %	
	0.5 MHz	1.2 %	
	(1 to 10) MHz	1.1 %	
	(10 to 30) MHz	1.2 %	
	50 MHz	1.1 %	
	(0.1 to 1) GHz	1.0 %	
	1.2 GHz	1.1 %	
	1.5 GHz	1.0 %	
	(2 to 4.2) GHz	1.1 %	
	5 GHz	1.3 %	
	6 GHz	1.4 %	
	7 GHz	1.5 %	
	8 GHz	1.3 %	
	(9 to 10) GHz	1.4 %	
	11 GHz	1.3 %	
	(12 to 12.4) GHz	1.4 %	
	13 GHz	1.5 %	
	(14 to 15) GHz	1.4 %	
	16 GHz	1.5 %	
	17 GHz	1.6 %	
	18 GHz	1.4 %	
N Type – Low Power	(10 to 30) MHz	1.9 %	HP 8481D-H84, power meter, RF signal generator
	50 MHz	1.8 %	
	(0.1 to 5) GHz	1.9 %	
	(5 to 10) GHz	2.0 %	
	11 GHz	2.1 %	
	(12 to 15) GHz	2.0 %	
	16 GHz	2.2 %	
	(>16 to 18) GHz	2.3 %	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
Power Sensor[3] – Calibration Factor (cont)			
3.5 mm	10 MHz 30 MHz (0.05 to 1) GHz 1.2 GHz (1.5 to 2) GHz 2.5 GHz (2.6 to 3) GHz (3.5 to 4.2) GHz 5 GHz 6 GHz 7 GHz 8 GHz 9 GHz 10 GHz (11 to 12.4) GHz 13 GHz (14 to 17) GHz 18 GHz 19 GHz 20 GHz 21 GHz 22 GHz 23 GHz (>23 to 26.5) GHz	2.1 % 1.6 % 1.5 % 1.6 % 1.5 % 1.6 % 1.5 % 1.6 % 1.7 % 1.9 % 2.0 % 1.9 % 2.0 % 2.1 % 2.2 % 2.3 % 2.7 % 2.6 % 3.0 % 2.8 % 2.6 % 2.8 % 3.2 % 3.1 %	Tegam F1135B, dual type IV power meter, 8.5 digit reference multimeter, power meter, RF signal generator
3.5 mm – Low Power	50 MHz (0.1 to 4) GHz 4.2 GHz 5 GHz (6 to 8) GHz 9 GHz (10 to 12.4) GHz (>12.4 to 15) GHz 16 GHz 17 GHz 18 GHz (19 to 21) GHz (22 to 24) GHz (>24 to 26.5) GHz	1.5 % 1.7 % 1.8 % 1.9 % 2.0 % 2.1 % 2.0 % 2.1 % 2.2 % 2.3 % 2.1 % 2.3% 2.2 % 2.3 %	HP 8485D-H84, power meter, RF signal generator

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
Power Sensor[3] – Calibration Factor (cont)			
2.4 mm	50 MHz (0.1 to 2) GHz (>2 to 6) GHz (7 to 8) GHz (9 to 13) GHz (>13 to 18) GHz (>18 to 23) GHz (>23 to 26) GHz 26.5 GHz 27 GHz (>27 to 33) GHz 34 GHz 35 GHz (>35 to 37) GHz 38 GHz 39 GHz (>39 to 41) GHz (>41 to 48) GHz (>48 to 50) GHz	1.4 % 1.5 % 1.6 % 1.7 % 1.8 % 1.9 % 2.1 % 2.2 % 2.1 % 2.4 % 2.3 % 2.4 % 2.5 % 2.6 % 2.5 % 2.8 % 2.9 % 3.0 % 3.1 %	HP 8487A-H84, power meter, RF signal generator
2.4 mm – Low Power	(50 to 500) MHz (> 0.5 to 7) GHz (> 7 to 15) GHz (>15 to 18) GHz (19 to 20) GHz (> 20 to 26) GHz (> 26 to 32) GHz 33 GHz 34 GHz 35 GHz (>35 to 37) GHz 38 GHz (>38 to 40) GHz 41 GHz (42to 43) GHz (>43 to 45) GHz 46 GHz 47 GHz 48 GHz 49 GHz 50 GHz	1.7 % 1.8 % 2.0 % 2.1 % 2.3 % 2.4 % 2.6 % 2.7 % 2.9 % 3.0 % 3.1 % 3.0 % 3.4 % 3.5 % 3.7 % 3.7 % 3.7 % 3.6 % 3.7 % 3.9 % 4.3 %	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
Noise Source – Generate & Measure[3]			
5 dB and 15 dB Excess Noise Ratio (ENR)	10 MHz 100 MHz 1 GHz 2 GHz 3 GHz 4 GHz 5 GHz 6 GHz 7 GHz 8 GHz 9 GHz 10 GHz 11 GHz 12 GHz 13 GHz 14 GHz 15 GHz 16 GHz 17 GHz 18 GHz 19 GHz 20 GHz 21 GHz 22 GHz 23 GHz 24 GHz 25 GHz 26 GHz 26.5 GHz	0.31 dB 0.31 dB 0.31 dB 0.35 dB 0.32 dB 0.31 dB 0.32 dB 0.31 dB 0.32 dB 0.31 dB 0.36 dB 0.33 dB 0.36 dB 0.35 dB 0.34 dB 0.35 dB 0.35 dB 0.33 dB 0.38 dB 0.35 dB 0.35 dB 0.33 dB 0.35 dB 0.40 dB 0.36 dB 0.31 dB 0.32 dB 0.32 dB 0.32 dB	HP 346C noise source w/ N8975A noise figure meter

V. Electrical – EMC

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
EFT Measure[3] –			IEC 61000-4-4 IEC 61000-4-12
Voltage (±)	10 V to 4.4 kV	2.9 %	KeyTek EFT-ATTN-1K LeCroy 204Xi
Rise Time	5 ns ± 20 %	48 ms/s	
Impulse Duration	(35 to 200) ns	44 ms/s	
Burst Duration	(0.5 to 20) ms	24 ms/s	
Burst Period	(100 to 500) ms	24 ms/s	
Repetition Frequency	1 kHz to 1 MHz	24 mHz/Hz	
ESD Measure[3] –			IEC 61000-4-2
Voltage	10 V to 30 kV	2.7 mV/V	LeCroy 204Xi Brandenburg HV meter Keytek ESD Target
Rise Time	(0.6 to 1) ns	18 ms/s	
Peak Current	(7.5 to 30) A	76 mA/A	
30 ns Current	(2 to 30) A	75 mA/A	
60 ns Current	(2 to 20) A	74 mA/A	
Surge Measure[3] –			IEC 61000-4-5
Front Time / Rise Time (±) Open / Short Circuit	(1.2 to 50) µs	55 ns	LeCroy 204Xi
Time to Half-Value / Duration (±)	(20 to 700) µs	0.22 µs	
Open Circuit Voltage (±)	10 V to 6 kV	35 mV/V	KeyTek PK1001D
Short Circuit Current (±)	(0.125 to 3) kA	1.1 mA/A	Pearson 110

Parameter/Range	Frequency	CMC[2] (±)	Comments
Current Probes and Bulk Injection Probes[3] –			
Insertion Loss	20 Hz to 10 kHz 10 kHz to 1 GHz Magnitude needed	0.17 dB 0.088 dB	E4418B, E9304A, 5700A (dB), 3561A
Transfer Impedance	20 Hz to 10 kHz 10 kHz to 1 GHz Magnitude needed	0.14 dB 0.15 dB	
LISN[3] –			
Insertion Loss	(9 to 150) kHz 150 kHz to 100 MHz (100 to 400) MHz Up to 60 dB	0.12 dB 0.12 dB 0.11 dB	ANSI C63.4, appendix B Agilent E441X w/ E9304A, HP 4195A
Impedance – Magnitude	(9 to 150) kHz 150 kHz to 100 MHz (100 to 400) MHz (0 to 150) Ω	0.51 Ω 1.0 Ω 1.7 Ω	
Impedance – Phase	150 kHz to 100 MHz (100 to 400) MHz (0 to 180)°	3.0° 2.5°	
Decoupling Isolation	150 kHz to 100 MHz (100 to 400) MHz Up to 60 dB	1.3 dB 0.99 dB	

Parameter/Range	Frequency	CMC[2] (±)	Comments
CDN[3] –			IEC 61000-4-6
Insertion Loss	150 kHz to 100 MHz (100 to 400) MHz Up to 60 dB	0.12 dB 0.12 dB	Agilent 4195A w/ 41952A
Impedance	150 kHz to 100 MHz (100 to 400) MHz (50 to 250) Ω	1.0 Ω 1.6 Ω	
Coupling Factor	150 kHz to 100 MHz (100 to 400) MHz Up to 60 dB	1.0 dB 0.84 dB	

VI. Mechanical

Parameter/Equipment	Range	CMC[2] (±)	Comments
Scales and Balances[3]	1 mg 2 mg (2 to 5) mg (5 to 10) mg (10 to 20) mg (20 to 50) mg (50 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	15 µg 15 µg 18 µg 15 µg 18 µg 16 µg 16 µg 17 µg 16 µg 41 µg 43 µg 51 µg 52 µg 60 µg 0.23 mg 0.31 mg 0.66 mg 1.1 mg 1.6 mg	Class 1 weights

Parameter/Equipment	Range	CMC[2, 7, 10] (±)	Comments
Scales and Balances[3] (cont)	(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 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 (500 to 1000) lb	3.2 mg 6.8 mg 9.2 mg 18 mg 33 mg 89 mg 0.10 g 0.0021 oz (0.14 g) 0.019 oz (0.54 g) 0.037 oz (1.1 g) 0.090 oz (2.7 g) 0.14 oz (4.0 g) 0.23 oz (6.4 g) 0.32 oz (9.1 g) 0.45 oz (13 g)	Class 1 weights Class S1 weights Class F weights
Pressure – Measure (Pneumatic)[3, 5]	(-15 to 15) psi (0 to 2400) psia (4 to 2030) psia (0 to 200) psig (0 to 2030) psig	0.0035 psi 0.020 %* + 0.0020 psi 0.020 %* + 0.0020 psi 0.020 %* 0.020 %*	Mensor CPC6050 Fluke PPC4EX 1.4M Fluke PPC4EX 14M Fluke PPC4EX 1.4M Fluke PPC4EX 14M *Note: for autoRange span
Torque Wrenches[3]	(1 to 10) lbf·in (5 to 50) ozf·in (15 to 200) ozf·in (5 to 50) lbf·in (25 to 250) lbf·in (100 to 1000) lbf·in (20 to 250) lbf·ft (200 to 2000) lbf·ft	0.60 % 0.60 % 0.32 % 0.30 % 0.31 % 0.47 % 0.43 % 0.45 %	Mountz LTT-10I torque CDI 2000-04-02 CDI 2000-05-02 CDI 2000-400-02 4 in 1 transducer CDI 2000-14-02

Parameter/Equipment	Range	CMC[2, 7, 10] (±)	Comments
Force – Tension[3] & Compression	(0 to 1) lbf (1 to 10) lbf (10 to 50) lbf (50 to 100) lbf (100 to 500) lbf Up to 200 lbf Up to 500 lbf	0.060 % 0.031 % 0.038 % 0.055 % 0.022 % (0.0083 + 0.0012 *f*) lbf (0.11 + 0.000045*f*) lbf	Class F weights w/ hanger Morehouse Precision Load Cell: 200 lbf load cell 500 lbf load cell *f* = force

VII. Thermodynamics

Parameter/Equipment	Range	CMC[2, 7, 10] (±)	Comments
Temperature[3] – Measuring Equipment	(-30 to 0.0) °C (0.0 to 100) °C (100 to 420) °C (420 to 650) °C	0.042 °C 0.064 °C 0.12 °C 1.0 °C	Hart 5615 w/Fluke 1594A and: Fluke 7103 Hart 9141 Hart 9141
Temperature[3] – Measure	(-196 to -38) °C (-38 to 0) °C (0 to 100) °C (100 to 420) °C	0.011 °C 0.012 °C 0.018 °C 0.026 °C	Hart 5615 w/ Fluke 1594A
Relative Humidity[3] – Measure	(5 to 90) % (90 to 100) %	1.3 % 2.4 %	Vaisala HMI41/HMP46

VIII. Time & Frequency

Parameter/Equipment	Range	CMC[2, 10] (±)	Comments
Timers and Stopwatches[3]	1 s to 24 h	40 ms/day	Timometer TM4500

Parameter/Equipment	Range	CMC[2, 6, 10] (±)	Comments
Frequency – Measuring Equipment[3]	10 MHz (0.001 to 1000) Hz 1000 Hz to 50 MHz 20 MHz to 50 GHz (10 to 100 000) RPM	5.8 mHz + 0.6*R* 1.1 µHz/Hz 0.59 nHz/Hz 0.58 nHz/Hz 0.0023 RPM	GPS HP 33250A w/ GPS HP 83650A/B w/ GPS HP 33250A w/ GPS
Frequency – Measure[3]	0.001 Hz to 1 kHz (1 to 1000) kHz (1 to 225) MHz 225 MHz to 12.4 GHz (12.4 to 46) GHz (10 to 100 000) RPM	0.66 µHz/Hz 0.64 nHz/Hz 0.59 nHz/Hz 0.59 nHz/Hz 0.58 nHz/Hz 0.0023 RPM	HP 53132A opt 12 w/ GPS HP 5352B w/ GPS HP 53132A opt 12 w/ GPS

[1] This laboratory offers commercial calibration service and field calibration service.

[2] 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.

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

[4] 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. 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.

[5] Negative gauges are limited by local barometric pressure.

[6] In the statement of CMC, *L* is the numerical value of the nominal length of the device measured in inches. In the statement of CMC, *R* is the numerical value of the resolution of the unit under test.

[7] In the statement of CMC, percentage refers to percent of reading.

[8] This laboratory meets *R205 – Specific Requirements: Calibration Laboratory Accreditation Program* for the types of dimensional tests listed above and is considered equivalent to that of a calibration.

[9] This scope meets A2LA's *P112 Flexible Scope Policy*.

[10] 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.

Duluth, GA

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 4th day of February 2022.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2357.19
Valid to March 31, 2024

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