SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005.
&ANSI/NCSL Z540-1.1994 & ANSI/NCSL Z540.3.2006

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CALIBRATION

Valid To: December 31, 2018 Certificate Number: 2258.01

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

I. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Voltage – Generate, Fixed Values	100 mV 1 V 10 V 19 V 100 V 1 kV	2.8 µV/V 0.7 µV/V 0.6 µV/V 0.6 µV/V 0.6 µV/V 0.7 µV/V	Fluke 5720A characterized calibrator
DC Voltage – Generate and Measure, Fixed Value	10 V	0.34 µV/V	Fluke 732B
DC Voltage – Generate	(1 to 40) kV	0.12 %	Spellman power supply with HVD-100-1

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Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Voltage – Generate & Measure	1 mV to 1V (1 to 10) V	0.44 µV 0.62 µV/V	Fluke 732B w/720A
Fixed Values	0.1V 1 V 10 V 100 V 1000 V	2.5 µV/V 0.6 µV/V 0.4 µV/V 0.6 µV/V 0.9 µV/V	Fluke 732A w/752A
DC Voltage – Measure	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	5.3 µV/V + 0.1 µV 3.6 µV/V + 0.4 µV 3.5 µV/V + 4.0 µV 4.6 µV/V + 40 µV 4.6 µV/V + 0.5 mV	Fluke 8508A
	(1.0 to 100) kV	0.12 %	Spellman HVD-100-1 w/HP 3458A
DC Current – Generate	(1 to 10) µA (10 to 220) µA 220 µA to 2.2 mA (2.2 to 22) mA (22 to 220) mA	40 µA/A 11 µA/A 11 µA/A 10 µA/A 10 µA/A	Fluke 5720A w/8508A
	>200 mA to 2 A (2 to 20) A	17 µA/A 17 µA/A	Fluke 5720A w/8508A
	(>20 to 100) A	88 µA/A + 4 mA	Fluke 52120A w/5720A

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Current – Measure	(1 to 10) µA (10 to 100) µA 100 µA to 1 mA (1 to 10) mA (10 to 100) mA >200 mA to 2 A (2 to 20) A (>20 to 100) A	40 µA/A 11 µA/A 11 µA/A 11 µA/A 10 µA/A 17 µA/A 17 µA/A 91 µA/A	Fluke 8508A w/Fluke 742A std. resistors Leeds & Northrup 0.1 Ω Leeds & Northrup 0.01 Ω Fluke Y5020, Leeds & Northrup 0.01 Ω
DC Resistance – Generate, Fixed Points	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 100 MΩ 1 GΩ	15 µΩ/Ω 11 µΩ/Ω 13 µΩ/Ω 1.1 µΩ/Ω 1.1 µΩ/Ω 1.1 µΩ/Ω 1.1 µΩ/Ω 1.2 µΩ/Ω 1.2 µΩ/Ω 2.7 µΩ/Ω 4.2 µΩ/Ω 10 µΩ/Ω 32 µΩ/Ω	Leeds & Northrup resistors Fluke 742-1 Fluke 742-10 Fluke 742-100 Fluke 742-1k Fluke 742-10k Fluke 742-100k Fluke 742-1M Fluke 742-10M Guildline 9334
DC Resistance – Measure	(1 to 10) mΩ (10 to 100) mΩ 100 mΩ to 1 Ω (1 to 10) Ω (10 to100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1GΩ 1 GΩ	0.80 µΩ/Ω 0.79 µΩ/Ω 0.51 µΩ/Ω 0.36 µΩ/Ω 0.36 µΩ/Ω 0.37 µΩ/Ω 0.40 µΩ/Ω 0.20 µΩ/Ω 0.70 µΩ/Ω 0.86 µΩ/Ω 1.6 µΩ/Ω 3.5 µΩ/Ω 11 µΩ/Ω	MI 6010C/MI6011 resistors in oil MI 6000B resistors in air bath

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Resistance – Measure (cont)	20 MΩ to 200 MΩ 200 MΩ to 2 GΩ (2 to 20) GΩ (20 to 200) GΩ 200 GΩ to 2 TΩ (2 to 20) TΩ	0.015 % 0.022 % 0.063 % 0.17 % 0.21 % 0.43 %	Guildline 6530

Parameter/Range	Frequency	CMC[2] (±)	Comments
AC Voltage – Generate / Measure, Fixed Points			
2.2 mV	10 Hz 20 Hz 40 Hz 1 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz	320 µV/V 370 µV/V 370 µV/V 360 µV/V 370 µV/V 370 µV/V 440 µV/V 540 µV/V 640 µV/V 740 µV/V	Fluke 792A
22 mV	10 Hz 20 Hz 40 Hz 1 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz	82 µV/V 66 µV/V 62 µV/V 61 µV/V 61 µV/V 81 µV/V 150 µV/V 230 µV/V 310 µV/V 370 µV/V	

Parameter/Range	Frequency	CMC[2] (±)	Comments
AC Voltage – Generate / Measure, Fixed Points (cont)			
70 mV	10 Hz	67 µV/V	Fluke 792A
	20 Hz	44 µV/V	
	100 Hz	40 µV/V	
	1 kHz	39 µV/V	
	10 kHz	36 µV/V	
	20 kHz	35 µV/V	
	50 kHz	43 µV/V	
	100 kHz	79 µV/V	
	300 kHz	150 µV/V	
	500 kHz	220 µV/V	
	1 MHz	290 µV/V	
220 mV	10 Hz	28 µV/V	
	20 Hz	24 µV/V	
	100 Hz	14 µV/V	
	1 kHz	14 µV/V	
	10 kHz	14 µV/V	
	20 kHz	14 µV/V	
	50 kHz	22 µV/V	
	100 kHz	42 µV/V	
	300 kHz	76 µV/V	
	500 kHz	120 µV/V	
	1 MHz	190 µV/V	
700 mV	10 Hz	27 µV/V	
	20 Hz	21 µV/V	
	100 Hz	11 µV/V	
	1 kHz	9 µV/V	
	10 kHz	9 µV/V	
	20 kHz	9 µV/V	
	50 kHz	9 µV/V	
	100 kHz	14 µV/V	
	300 kHz	27 µV/V	
	500 kHz	33 µV/V	
	1 MHz	75 µV/V	

Parameter/Range	Frequency	CMC[2] (±)	Comments
AC Voltage – Generate / Measure, Fixed Points (cont)			
2.2 V	10 Hz	26 µV/V	Fluke 792A
	20 Hz	16 µV/V	
	100 Hz	7 µV/V	
	1 kHz	7 µV/V	
	10 kHz	7 µV/V	
	20 kHz	7 µV/V	
	50 kHz	7 µV/V	
	100 kHz	11 µV/V	
	300 kHz	22 µV/V	
	500 kHz	30 µV/V	
	1 MHz	56 µV/V	
7 V	10 Hz	26 µV/V	
	20 Hz	16 µV/V	
	100 Hz	7 µV/V	
	1 kHz	6 µV/V	
	10 kHz	6 µV/V	
	20 kHz	7 µV/V	
	50 kHz	7 µV/V	
	100 kHz	8 µV/V	
	300 kHz	21 µV/V	
	500 kHz	26 µV/V	
	1 MHz	67 µV/V	

Parameter/Range	Frequency	CMC[2] (±)	Comments
AC Voltage – Generate / Measure, Fixed Points (cont)			
22 V	10 Hz	26 µV/V	Fluke 792A
	20 Hz	16 µV/V	
	100 Hz	8 µV/V	
	1 kHz	7 µV/V	
	10 kHz	7 µV/V	
	20 kHz	7 µV/V	
	50 kHz	8 µV/V	
	100 kHz	11 µV/V	
	300 kHz	21 µV/V	
	500 kHz	26 µV/V	
	1 MHz	48 µV/V	
70 V	10 Hz	26 µV/V	
	20 Hz	16 µV/V	
	100 Hz	9 µV/V	
	1 kHz	8 µV/V	
	10 kHz	8 µV/V	
	20 kHz	8 µV/V	
	50 kHz	10 µV/V	
	100 kHz	12 µV/V	
	300 kHz	26 µV/V	
220 V	10 Hz	37 µV/V	
	20 Hz	16 µV/V	
	100 Hz	9 µV/V	
	1 kHz	9 µV/V	
	10 kHz	9 µV/V	
	20 kHz	9 µV/V	
	50 kHz	11 µV/V	
	100 kHz	23 µV/V	
700 V	100 Hz	13 µV/V	
	1 kHz	13 µV/V	
	10 kHz	14 µV/V	
	20 kHz	13 µV/V	
	50 kHz	20 µV/V	
	100 kHz	55 µV/V	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate / Measure, Fixed Points (cont)			
1000 V	100 Hz 1 kHz 10 kHz 20 kHz	13 µV/V 12 µV/V 13 µV/V 13 µV/V	Fluke 792A
AC Voltage – Generate / Measure			
10 µV to 2.2 mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.049 % + 1.3 µV 0.044 % + 1.3 µV 0.042 % + 1.3 µV 0.021 % + 4 µV 0.021 % + 2.5 µV 0.031 % + 4 µV 0.16 % + 8 µV 0.41 % + 8 µV	Fluke 5790A
(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 500 kHz to 1 MHz	0.015 % + 1.3 µV 68 µV/V + 1.3 µV 83 µV/V + 1.3 µV 62 µV/V + 2 µV 49 µV/V + 2.5 µV 0.11 % + 4 µV 0.12 % + 8 µV 0.23 % + 8 µV	
(7 to 22) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.017 % + 1.3 µV 48 µV/V + 1.3 µV 89 µV/V + 1.3 µV 24 µV/V + 2 µV 90 µV/V + 2.5 µV 0.027 % + 4 µV 0.021 % + 8 µV 0.15 % + 8 µV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate / Measure (cont)			
(22 to 70) mV	(10 to 20) Hz	0.015 % + 1.5 µV	Fluke 5790A
	(20 to 40) Hz	64 µV/V + 1.5 µV	
	40 Hz to 20 kHz	40 µV/V + 1.5 µV	
	(20 to 50) kHz	62 µV/V + 2.0 µV	
	(50 to 100) kHz	0.013 % + 2.5 µV	
	(100 to 300) kHz	0.031 % + 4.0 µV	
	(300 to 500) kHz	0.035 % + 8.0 µV	
	500 kHz to 1 MHz	0.11 % + 8.0 µV	
(70 to 220) mV	(10 to 20) Hz	84 µV/V + 1.5 µV	
	(20 to 40) Hz	47 µV/V + 1.5 µV	
	40 Hz to 20 kHz	38 µV/V + 1.5 µV	
	(20 to 50) kHz	54 µV/V + 2 µV	
	(50 to 100) kHz	0.014 % + 2.5 µV	
	(100 to 300) kHz	0.021 % + 4 µV	
	(300 to 500) kHz	0.03 % + 8 µV	
	500 kHz to 1 MHz	0.11 % + 8 µV	
(220 to 700) mV	(10 to 20) Hz	76 µV/V + 1.5 µV	
	(20 to 40) Hz	48 µV/V + 1.5 µV	
	40 Hz to 20 kHz	29 µV/V + 1.5 µV	
	(20 to 50) kHz	35 µV/V + 2 µV	
	(50 to 100) kHz	79 µV/V + 2.5 µV	
	(100 to 300) kHz	0.015 % + 4 µV	
	(300 to 500) kHz	0.031 % + 8 µV	
	500 kHz to 1 MHz	0.12 % + 8 µV	
700 mV to 2.2 V	(10 to 20) Hz	80 µV/V	
	(20 to 40) Hz	51 µV/V	
	40 Hz to 20 kHz	33 µV/V	
	(20 to 50) kHz	32 µV/V	
	(50 to 100) kHz	64 µV/V	
	(100 to 300) kHz	150 µV/V	
	(300 to 500) kHz	0.030 %	
	500 kHz to 1 MHz	0.13 %	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate / Measure (cont)			
(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 500 kHz to 1 MHz	80 µV/V 42 µV/V 29 µV/V 40 µV/V 86 µV/V 0.020 % 0.042 % 0.14 %	Fluke 5790A
(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 500 kHz to 1 MHz	80 µV/V 44 µV/V 28 µV/V 31 µV/V 73 µV/V 0.02 % 0.044 % 0.14 %	
(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 500 kHz to 1 MHz	82 µV/V 51 µV/V 37 µV/V 48 µV/V 93 µV/V 0.022 % 0.043 % 0.13 %	
(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	90 µV/V 50 µV/V 38 µV/V 43 µV/V 86 µV/V 0.018 % 0.050 %	
(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	200 µV/V 98 µV/V 39 µV/V 0.015 % 0.050 %	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate / Measure (cont)			
(700 to 1000) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.020 % 98 µV/V 40 µV/V 0.014 % 0.055%	Fluke 5790A
AC Current – Generate			
Up to 220) µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.038 % + 16 nA 0.019 % + 10 nA 0.013 % + 8 nA 0.029 % + 12 nA 0.11 % + 65 nA	Fluke 5720A w/5725A
220 µA to 2.2 mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.040 % + 40 nA 0.030 % + 35 nA 0.027 % + 35 nA 0.031 % + 110 nA 0.12 % + 650 nA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.074 % + 0.4 µA 0.043 % + 0.35 µA 0.015 % + 0.35 µA 0.061 % + 4.0 µA 0.16 % + 8.0 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	0.074 % + 4.0 µA 0.040 % + 3.5 µA 0.016 % + 3.5 µA 0.061 % + 40 µA 0.16 % + 80 µA	
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.069 % + 35 µA 0.076 % + 80 µA 0.85 % + 0.16 mA	
(2.2 to 10) A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.066 % + 0.17 mA 0.11 % + 0.38 mA 0.37 % + 0.75 mA	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Current – Generate (cont)			
(10 to 20) A	(10 to 65) Hz (65 to 300) Hz 300 Hz to 1 kHz (1 to 3) kHz (3 to 6) kHz (6 to 10) kHz	0.033 % + 9.4 mA 0.026 % + 9.4 mA 0.078 % + 9.4 mA 0.23 % + 31 mA 0.78 % + 62 mA 2.4 % + 94 mA	Fluke 52120A w/5720A
(20 to 120) A	(10 to 65) Hz (65 to 300) Hz 300 Hz to 1 kHz (1 to 3) kHz (3 to 6) kHz (6 to 10) kHz	0.032 % + 20 mA 0.025 % + 28 mA 0.079 % + 94 mA 0.23 % + 240 mA 0.78 % + 420 mA 3.1 % + 700 mA	
AC Current – Measure			
(100 to 300) µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz	0.023 % 0.011 % 68 µA/A 87 µA/A	AC resistor shunts w/ Fluke 792A
(1 to 2) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz	0.023 % 0.011 % 59 µA/A 86 µA/A	
(2 to 20) mA	(10 to 20) Hz (20 to 40) Hz (40 to 400) Hz 400 Hz to 10 kHz	0.023 % 93 µA/A 60 µA/A 55 µA/A	A40 current shunts w/ Fluke 5790A
(20 to 200) mA	(10 to 40) Hz (20 to 40) Hz 40 Hz to 10 kHz	0.023 % 95 µA/A 54 µA/A	
200 mA to 2 A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 5 kHz (5 to 10) kHz	0.024 % 0.012 % 92 µA/A 0.011 %	
(2 to 10) A	(10 to 40) Hz 40 Hz to 5 kHz (5 to 10) kHz	0.027 % 0.012 % 0.025 %	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Current – Measure (cont)			
(10 to 20) A	20 Hz to 10 kHz	0.085 %	A40 current shunts w/ Fluke 5790A
AC Voltage Flatness – Generate			
1.1 mV	10 Hz 20 Hz 50 Hz 100 Hz 200 Hz 2 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 700 kHz 1 MHz 1.2 MHz 2 MHz 3 MHz 4 MHz 6 MHz 8 MHz 9 MHz 10 MHz 12 MHz 15 MHz 17 MHz 20 MHz 23 MHz 26 MHz 28 MHz 30 MHz	0.05 % 0.05 % 0.04 % 0.03 % 0.03 % 0.02 % 0.04 % 0.02 % 0.04 % 0.02 % 0.04 % 0.03 % 0.08 % 0.08 % 0.05 % 0.05 % 0.04 % 0.08 % 0.10 % 0.07 % 0.08 % 0.10 % 0.12 % 0.11 % 0.10 % 0.14 % 0.15 % 0.16 % 0.17 % 0.19 %	Fluke 5720A w/option 03, referenced to 1 kHz, characterized output

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage Flatness – Generate (cont)			
3 mV	10 Hz 20 Hz 50 Hz 100 Hz 200 Hz 2 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 700 kHz 1 MHz 1.2 MHz 2 MHz 3 MHz 4 MHz 6 MHz 8 MHz 9 MHz 10 MHz 12 MHz 15 MHz 17 MHz 20 MHz 23 MHz 26 MHz 28 MHz 30 MHz	0.04 % 0.04 % 0.02 % 0.02 % 0.02 % 0.02 % 0.02 % 0.02 % 0.02 % 0.02 % 0.03 % 0.02 % 0.04 % 0.05 % 0.03 % 0.03 % 0.03 % 0.04 % 0.05 % 0.05 % 0.06 % 0.05 % 0.07 % 0.08 % 0.08 % 0.10 % 0.12 % 0.14 % 0.17 % 0.17 %	Fluke 5720A w/option 03, referenced to 1 kHz, characterized output

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage Flatness – Generate (cont)			
10 mV	10 Hz 20 Hz 50 Hz 100 Hz 200 Hz 2 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 700 kHz 1 MHz 1.2 MHz 2 MHz 3 MHz 4 MHz 6 MHz 8 MHz 9 MHz 10 MHz 12 MHz 15 MHz 17 MHz 20 MHz 23 MHz 26 MHz 28 MHz 30 MHz	0.04 % 0.04 % 0.02 % 0.02 % 0.02 % 0.02 % 0.02 % 0.02 % 0.02 % 0.02 % 0.02 % 0.02 % 0.03 % 0.03 % 0.02 % 0.03 % 0.03 % 0.04 % 0.05 % 0.05 % 0.06% 0.06 % 0.07 % 0.08 % 0.09 % 0.11 % 0.12 % 0.14 % 0.17 % 0.18 %	Fluke 5720A w/option 03, referenced to 1 kHz, characterized output

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage Flatness – Generate (cont)			
32 mV	10 Hz 20 Hz 50 Hz 100 Hz 200 Hz 2 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 700 kHz 1 MHz 1.2 MHz 2 MHz 3 MHz 4 MHz 6 MHz 8 MHz 9 MHz 10 MHz 12 MHz 15 MHz 17 MHz 20 MHz 23 MHz 26 MHz 28 MHz 30 MHz	0.03 % 0.03 % 0.02 % 0.02 % 0.02 % 0.10 % 0.10 % 0.02 % 0.02 % 0.02 % 0.02 % 0.02 % 0.02 % 0.02 % 0.02 % 0.02 % 0.03 % 0.03 % 0.04 % 0.05 % 0.06 % 0.05 % 0.07 % 0.08 % 0.08 % 0.10 % 0.11 % 0.14 % 0.15 % 0.15 %	Fluke 5720A w/option 03, referenced to 1 kHz, characterized output

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage Flatness – Generate (cont)			
100 mV	10 Hz 20 Hz 50 Hz 100 Hz 200 Hz 2 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 700 kHz 1 MHz 1.2 MHz 2 MHz 3 MHz 4 MHz 6 MHz 8 MHz 9 MHz 10 MHz 12 MHz 15 MHz 17 MHz 20 MHz 23 MHz 26 MHz 28 MHz 30 MHz	0.03 % 0.02 % 0.009 % 0.01 % 0.01 % 0.009 % 0.009 % 0.02 % 0.01 % 0.02 % 0.01 % 0.02 % 0.02 % 0.02 % 0.02 % 0.02 % 0.02 % 0.03 % 0.03 % 0.04 % 0.04 % 0.04 % 0.05 % 0.06 % 0.06 % 0.09 % 0.09 % 0.11 % 0.12 % 0.13 %	Fluke 5720A w/option 03, referenced to 1 kHz, characterized output

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage Flatness – Generate (cont)			
320 mV	10 Hz 20 Hz 50 Hz 100 Hz 200 Hz 2 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 700 kHz 1 MHz 1.2 MHz 2 MHz 3 MHz 4 MHz 6 MHz 8 MHz 9 MHz 10 MHz 12 MHz 15 MHz 17 MHz 20 MHz 23 MHz 26 MHz 28 MHz 30 MHz	0.02 % 0.01 % 0.008 % 0.009 % 0.009 % 0.008 % 0.007 % 0.01 % 0.01 % 0.01 % 0.01 % 0.01 % 0.02 % 0.02 % 0.01 % 0.02 % 0.02 % 0.02 % 0.03 % 0.04 % 0.05 % 0.05 % 0.05 % 0.06 % 0.07 % 0.09 % 0.10 % 0.11 % 0.12 % 0.13 %	Fluke 5720A w/option 03, referenced to 1 kHz, characterized output

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage Flatness – Generate (cont)			
1 V	10 Hz 20 Hz 50 Hz 100 Hz 200 Hz 2 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 700 kHz 1 MHz 1.2 MHz 2 MHz 3 MHz 4 MHz 6 MHz 8 MHz 9 MHz 10 MHz 12 MHz 15 MHz 17 MHz 20 MHz 23 MHz 26 MHz 28 MHz 30 MHz	0.02 % 0.01 % 0.006 % 0.008 % 0.008 % 0.008 % 0.006 % 0.01 % 0.01 % 0.01 % 0.01 % 0.01 % 0.02 % 0.01 % 0.01 % 0.01 % 0.01 % 0.02 % 0.03 % 0.03 % 0.05 % 0.05 % 0.05 % 0.06 % 0.07 % 0.09 % 0.10 % 0.11 % 0.11 % 0.12 %	Fluke 5720A w/ option 03, referenced to 1 kHz, characterized output

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage Flatness – Generate (cont)			
3.2 V	10 Hz 20 Hz 50 Hz 100 Hz 200 Hz 2 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 700 kHz 1 MHz 1.2 MHz 2 MHz 3 MHz 4 MHz 6 MHz 8 MHz 9 MHz 10 MHz 12 MHz 15 MHz 17 MHz 20 MHz 23 MHz 26 MHz 28 MHz 30 MHz	0.01 % 0.009 % 0.005 % 0.007 % 0.009 % 0.006 % 0.006 % 0.01 % 0.009 % 0.01 % 0.01 % 0.01 % 0.02 % 0.01 % 0.01 % 0.01 % 0.01 % 0.02 % 0.02 % 0.03 % 0.04 % 0.04 % 0.04 % 0.05 % 0.05 % 0.08 % 0.08 % 0.10 % 0.10 % 0.11 %	Fluke 5720A w/option 03, referenced to 1 kHz, characterized output
AC Voltage Flatness – Measure			
2.2 mV	(10 to 30) Hz (30 to 120) Hz 120 Hz to 1.2 kHz (1.2 to 500) kHz 500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.11 % 0.058 % 0.055 % 0.076 % + 1µV 0.076 % + 1µV 0.076 % + 1 µV 0.18 % + 1 µV 0.31 % + 1 µV 0.72 % + 2 µV	Fluke 5790A w/option 030, relative to 1 kHz

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage Flatness – Measure (cont)			
7 mV	(10 to 30) Hz (30 to 120) Hz 120 Hz to 1.2 kHz (1.2 to 500) kHz 500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.11 % 0.051 % 0.051 % 0.072 % + 1 µV 0.073 % + 1 µV 0.073 % + 1 µV 0.11 % + 1 µV 0.19 % + 1 µV 0.39 % + 2 µV	Fluke 5790A w/option 030, relative to 1 kHz
22 mV	(10 to 30) Hz (30 to 120) Hz 120 Hz to 1.2 kHz (1.2 to 500) kHz 500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.10 % 0.05 % 0.05 % 0.07 % 0.07 % 0.07 % 0.10 % 0.17 % 0.39 %	
70 mV	(10 to 30) Hz (30 to 120) Hz 120 Hz to 1.2 kHz (1.2 to 500) kHz 500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.10 % 0.051 % 0.051 % 0.052 % 0.053 % 0.053 % 0.11 % 0.16 % 0.37 %	
220 mV	(10 to 30) Hz (30 to 120) Hz 120 Hz to 1.2 kHz (1.2 to 500) kHz 500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.10 % 0.041 % 0.041 % 0.042 % 0.053 % 0.053 % 0.11 % 0.16 % 0.37 %	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage Flatness – Measure (cont)			
700 mV to 7 V	(10 to 30) Hz (30 to 120) Hz 120 Hz to 1.2 kHz (1.2 to 500) kHz 500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.10 % 0.031 % 0.031 % 0.033 % 0.052 % 0.052 % 0.11 % 0.16 % 0.37 %	Fluke 5790A w/ option 030, relative to 1 kHz
Capacitance – Measure			
(1 to 100) pF (100 to 1 000 000) pF	1 kHz 1 kHz	2.4 µF/F 3.4 µF/F	Andeen Hagerling 2500A option - E
1 pF to 99 999 µF	(12 to 30) Hz (>30 to 100) Hz (>100 to 250) Hz >250 Hz to 1 kHz 1 kHz (>1 to 3) kHz (>3 to 6) kHz (>6 to 10) kHz (>10 to 20) kHz (>20 to 50) kHz (>50 to 100) kHz	0.49 % 0.12 % 0.04 % 0.031 % 0.021 % 0.031 % 0.031 % 0.05 % 0.07 % 0.10 % 0.20 %	Quad Tech 1693A
AC Resistance – Measure			
0.001 mΩ to 99 999 kΩ	(12 to 30) Hz (>30 to 100) Hz (>100 to 250) Hz >250 Hz to 1 kHz 1 kHz (>1 to 3) kHz (>3 to 6) kHz (>6 to 10) kHz (>10 to 20) kHz (>20 to 50) kHz (>50 to 100) kHz	0.07 % 0.05 % 0.04 % 0.031 % 0.021 % 0.031 % 0.031 % 0.05 % 0.07 % 0.10 % 0.20 %	Quad Tech 1693A

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
Inductance – Measure 0.001 µH to 99 999 H	(12 to 30) Hz (>30 to 100) Hz (>100 to 250) Hz >250 Hz to 1 kHz 1 kHz (>1 to 3) kHz (>3 to 6) kHz (>6 to 10) kHz (>10 to 20) kHz (>20 to 50) kHz	0.48 % 0.14 % 0.06 % 0.04 % 0.022 % 0.033 % 0.033 % 0.052 % 0.08 % 0.21 %	Quad Tech 1693A
Phase – Measure (0 to 360)°	20 Hz to 20 kHz (2 to 10) kHz (10 to 20) kHz (50 to 100) kHz	0.05° 0.08° 0.15° 0.46°	Clarke-Hess 2500A

II. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC[2] (±)	Comments
RF Absolute Power – Measure			
Coaxial Diode Power Sensors			
(+20 to +10) dBm, 50 Ω	(50 to 100) MHz (0.100 to 5) GHz (5 to 15) GHz (15 to 20) GHz (20 to 26.5) GHz	0.14 dBm 0.15 dBm 0.15 dBm 0.16 dBm 0.16 dBm	Agilent power meter E4418B w/Agilent power sensor /8485A 3.5 mm(m)
(-20 to -30) dBm, 50 Ω	(50 to 100) MHz (0.100 to 8) GHz (8 to 20) GHz (20 to 26.5) GHz	0.06 dBm 0.06 dBm 0.06 dBm 0.07 dBm	
(-30 to -70) dBm, 50 Ω	(50 to 100) MHz (0.100 to 8) GHz (8 to 20) GHz (20 to 26.5) GHz	0.11 dBm 0.11 dBm 0.12 dBm 0.13 dBm	
(+10 to -30) dBm, 50 Ω	(0.50 to 9) GHz (9 to 16) GHz (16 to 20) GHz (20 to 25) GHz (25 to 28) GHz (28 to 41) GHz (41 to 42) GHz (42 to 44) GHz (44 to 48) GHz (48 to 49) GHz (49 to 50) GHz	0.09 dBm 0.10 dBm 0.10 dBm 0.12 dBm 0.13 dBm 0.14 dBm 0.14 dBm 0.17 dBm 0.18 dBm 0.19 dBm 0.23 dBm	Agilent power meter E4418B w/Agilent power sensor /8487A 2.4 mm(m)
(+20 to +10) dBm, 50 Ω	(0.50 to 5) GHz (5 to 18) GHz (18 to 21) GHz (21 to 25) GHz (25 to 28) GHz (28 to 41) GHz (41 to 42) GHz (42 to 49) GHz (44 to 48) GHz (48 to 49) GHz (49 to 50) GHz	0.15 dBm 0.15 dBm 0.16 dBm 0.16 dBm 0.17 dBm 0.18 dBm 0.19 dBm 0.20 dBm 0.21 dBm 0.23 dBm 0.26 dBm	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Pulse – Measure Transition Time	>80 ps	20 ps	HP 54750A w/54752A

Parameter/Range	Frequency	CMC[2] (±)	Comments
Attenuation Measure –			
(0.0 to -5.0) dB	100 kHz to 22 GHz	0.002 dB	R&S FSMR
(-6 to -15) dB		0.006 dB	
(-16 to -25) dB		0.011 dB	
(-26 to -35) dB		0.016 dB	
(-36 to -42) dB		0.026 dB	
(-43 to -65) dB		0.036 dB	
(-66 to -75) dB		0.041 dB	
(-76 to -85) dB		0.051 dB	
(-86 to -95) dB		0.057 dB	
(-96 to -100) dB		0.067 dB	
(0.0 to -1.0) dB	(22 to 26.5) GHz	0.006 dB	
(-1 to -10) dB		0.007 dB	
(-10 to -20) dB		0.017 dB	
(-20 to -30) dB		0.020 dB	
(-30 to -40) dB		0.045 dB	
(-40 to -50) dB		0.048 dB	
(-50 to -60) dB		0.053 dB	
(-60 to -70) dB		0.059 dB	
(-70 to -80) dB		0.080 dB	
(-80 to -90) dB		0.085 dB	
(-90 to -100) dB		0.085 dB	
(-100 to -110) dB		0.13 dB	
Attenuation – Generate			
(0 to 33) dB	100 kHz to 100 MHz	0.043 dB	Fluke 9640A
(33 to 64) dB		0.054 dB	
(64 to 100) dB		0.14 dB	

Parameter/Range	Frequency	CMC[2] (±)	Comments
RF Absolute Power – Measure			
Power Reference 1 mW, Type-N(f), 50 Ω	50 MHz	0.47 % rdg	Agilent power meter 432A w/Agilent power sensor 478A-H76
Power Sensor Calibration Factor – Measure			PSCAL/ 11706S calibration system plus power sensors
N Type			
1 µW to 100 mW	10 MHz to 4 GHz 5 GHz 6 GHz 7 GHz 8 GHz 9 GHz 10 GHz 11 GHz 12 GHz 12.4 GHz 13 GHz 14 GHz 15 GHz 16 GHz 17 GHz 18 GHz	1.3 % Cal Factor 1.4 % Cal Factor 1.5 % Cal Factor 1.7 % Cal Factor 1.8 % Cal Factor 1.5 % Cal Factor 1.6 % Cal Factor 1.5 % Cal Factor 1.4 % Cal Factor 1.5 % Cal Factor 1.6 % Cal Factor 1.8 % Cal Factor 1.5 % Cal Factor 1.7 % Cal Factor 2.0 % Cal Factor 2.1 % Cal Factor	Agilent 8481A-H84
100 µW to 3 W	10 MHz to 7 GHz (8 to 9) GHz 10 GHz (11 to 14) GHz (15 to 18) GHz	2.0 % Cal Factor 3.0 % Cal Factor 2.2 % Cal Factor 2.0 % Cal Factor 3.0 % Cal Factor	Agilent 8481A-H84

Parameter/Range	Frequency	CMC[2] (±)	Comments
Power Sensor Calibration Factor – Measure (cont)			PSCAL/ 11706S calibration system plus power sensors
N Type			
100 pW to 10 μW	(10 to 500) MHz	1.1 % Cal Factor	Agilent 8481A-H84
	800 MHz to 1.2 GHz	1.2 % Cal Factor	
	(1.5 to 3) GHz	1.3 % Cal Factor	
	4 GHz	1.5 % Cal Factor	
	5 GHz	1.6 % Cal Factor	
	6 GHz	1.9 % Cal Factor	
	7 GHz	2.4 % Cal Factor	
	8 GHz	2.8 % Cal Factor	
	9 GHz	3.1 % Cal Factor	
	10 GHz	2.3 % Cal Factor	
	11 GHz	2.0 % Cal Factor	
	12 GHz	1.6 % Cal Factor	
	12.4 GHz	1.8 % Cal Factor	
	13 GHz	2.1 % Cal Factor	
	14 GHz	3.0 % Cal Factor	
	15 GHz	2.3 % Cal Factor	
	16 GHz	2.6 % Cal Factor	
	17 GHz	3.0 % Cal Factor	
	18 GHz	2.5 % Cal Factor	
1 μW to 100 mW	0.1 MHz	1.4 % Cal Factor	Agilent 8482A-H84
	0.3 to 1 MHz	1.3 % Cal Factor	
	(3 to 100) MHz	1.2 % Cal Factor	
	300 MHz to 4.2GHz	1.3 % Cal Factor	

Parameter/Range	Frequency	CMC[2] (±)	Comments
Power Sensor Calibration Factor – Measure (cont)			PSCAL/ 11706S calibration system plus power sensors
N Type			
100 µW to 3 W	(0.1 to 4.2) GHz	1.6 % Cal Factor	Agilent 8482A-H84
3.5 mm			
100 pW to 10 µW	(50 to 300) MHz 500 MHz (1 to 1.5) GHz 2 GHz 3 GHz (4 to 7) GHz (8 to 12) GHz (12.4 to 14) GHz 15 GHz (16 to 18) GHz (19 to 25) GHz 26 GHz 26.5 GHz	1.5 % Cal Factor 1.6 % Cal Factor 1.5 % Cal Factor 1.6 % Cal Factor 1.5 % Cal Factor 1.6 % Cal Factor 1.7 % Cal Factor 1.8 % Cal Factor 1.9 % Cal Factor 1.8 % Cal Factor 2.1 % Cal Factor 2.2 % Cal Factor 2.3 % Cal Factor	Agilent 8485D-H84
3.5 mm			
1 µW to 100 mW	(50 to 300) MHz 500 MHz (1 to 1.5) GHz 2 GHz 3 GHz (4 to 5) GHz 6 GHz 7 GHz 8 GHz	1.3 % Cal Factor 1.4 % Cal Factor 1.3 % Cal Factor 1.4 % Cal Factor 1.5 % Cal Factor 1.4 % Cal Factor 1.5 % Cal Factor 1.4 % Cal Factor 1.6 % Cal Factor	Agilent 8485A-H84

Parameter/Range	Frequency	CMC[2] (±)	Comments
Power Sensor Calibration Factor – Measure (cont)			PSCAL/11706S calibration system plus power sensors
3.5 mm 1 μW to 100 mW	(9 to 10) GHz 11 GHz 12 GHz 12.4 GHz (13 to 15) GHz (16 to 18) GHz 18.5 GHz 19 GHz 19.5 GHz 20 GHz 20.5 GHz 21 GHz 21.5 GHz 22 GHz 22.5 GHz 23 GHz 23.5 GHz 24.5 GHz 25 GHz 25.5 GHz 26 GHz 26.5 GHz	1.5 % Cal Factor 1.6 % Cal Factor 1.5 % Cal Factor 1.6 % Cal Factor 1.7 % Cal Factor 1.6 % Cal Factor 2.2 % Cal Factor 2.0 % Cal Factor 2.3 % Cal Factor 1.9 % Cal Factor 2.3 % Cal Factor 2.0 % Cal Factor 2.3 % Cal Factor 2.0 % Cal Factor 2.3 % Cal Factor 1.9 % Cal Factor 2.4 % Cal Factor 2.4 % Cal Factor 2.1 % Cal Factor 2.5 % Cal Factor 2.1 % Cal Factor 2.2 % Cal Factor	Agilent 8485A-H84

Parameter/Range	Frequency	CMC[2] (±)	Comments
Power Sensor Calibration Factor – Measure (cont) 2.4 mm 1 µW to 100 mW	 50 MHz to 4 GHz (5 to 7) GHz (8 to 15) GHz (16 to 18) GHz (19 to 22) GHz (23 to 24) GHz (25 to 26) GHz (27 to 29) GHz (30 to 31) GHz 32 GHz 33 GHz (34 to 35) GHz 36 GHz (37 to 39) GHz 40 GHz (41 to 42) GHz 43 GHz 44 GHz 45 GHz 46 GHz 47 GHz 48 GHz 49 GHz 50 GHz	 1.3 % Cal Factor 1.4 % Cal Factor 1.5 % Cal Factor 1.6 % Cal Factor 1.9 % Cal Factor 2.0 % Cal Factor 2.1 % Cal Factor 2.3 % Cal Factor 2.5 % Cal Factor 2.4 % Cal Factor 2.3 % Cal Factor 2.2 % Cal Factor 2.1 % Cal Factor 2.2 % Cal Factor 2.1 % Cal Factor 2.7 % Cal Factor 3.0 % Cal Factor 2.9 % Cal Factor 3.6 % Cal Factor 3.7 % Cal Factor 3.4 % Cal Factor 3.2 % Cal Factor 3.5 % Cal Factor 4.0 % Cal Factor	PSCAL/11706S calibration system plus power sensors HP 8487A-H84
Thermal Noise Figure System – Measure 5 dB Excess Noise Ratio	 10 MHz 100 MHz 1 GHz 2 GHz 3 GHz 4 GHz 5 GHz 6 GHz 7 GHz 8 GHz 9 GHz 10 GHz	 0.15 dB 0.16 dB 0.15 dB 0.16 dB 0.16 dB 0.16 dB 0.17 dB 0.18 dB 0.18 dB 0.18 dB 0.21 dB 0.20 dB	 CalLab Solutions SAM HP 346A H13

Parameter/Range	Frequency	CMC[2] (±)	Comments
Thermal Noise Figure System – Measure (cont)			
5 dB Excess Noise Ratio	11 GHz	0.22 dB	CalLab Solutions SAM HP 346A H13
	12 GHZ	0.24 dB	
	13 GHz	0.23 dB	
	14 GHz	0.26 dB	
	15 GHz	0.25 dB	
	16 GHz	0.26 dB	
	17 GHz	0.25 dB	
	18 GHz	0.27 dB	
15 dB Excess Noise Ratio	10 MHz	0.15 dB	CalLab Solutions SAM HP 346C H13
	100 MHz	0.16 dB	
	1 GHz	0.15 dB	
	2 GHz	0.15 dB	
	3 GHz	0.16 dB	
	4 GHz	0.15 dB	
	5 GHz	0.17 dB	
	6 GHz	0.19 dB	
	7 GHz	0.21 dB	
	8 GHz	0.19 dB	
	9 GHz	0.22 dB	
	10 GHz	0.21 dB	
	11 GHz	0.22 dB	
	12 GHz	0.23 dB	
	13 GHz	0.22 dB	
	14 GHz	0.21 dB	
	15 GHz	0.22 dB	
	16 GHZ	0.20 dB	
	17 GHz	0.20 dB	
	18 GHz	0.20 dB	
	19 GHz	0.19 dB	
	20 GHz	0.22 dB	
	21 GHz	0.24 dB	
	22 GHz	0.25 dB	
	23 GHz	0.25 dB	
	24 GHz	0.24 dB	
	25 GHz	0.25 dB	
	26 GHz	0.26 dB	
	26.5 GHz	0.26 dB	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Reflection – Measure S_{11}/S_{22}			
7 mm[3]			
300 kHz to 6 GHz	(0.8 to 1) lin	(0.008 to 0.021) lin (1.1 to 5.2) deg	Agilent 8753E network analyzer
	(0.6 to 0.8) lin	(0.006 to 0.012) lin (1.1 to 5.1) deg	Agilent 85055A
	(0.4 to 0.6) lin	(0.005 to 0.012) lin (1.1 to 5.2) deg	Agilent 85051A verification kit
	(0.2 to 0.4) lin	(0.004 to 0.008) lin (1.2 to 5.5) deg	
	(0.0 to 0.2) lin	(0.004 to 0.005) lin (1.5 to 180) deg	
7 mm[3]			
45 MHz to 18 GHz	(0.8 to 1) lin	(0.008 to 0.021) lin (1.1 to 5.1) deg	Agilent 8510C network analyzer
	(0.6 to 0.8) lin	(0.006 to 0.012) lin (1.1 to 5.1) deg	Agilent 85051A verification kit
	(0.4 to 0.6) lin	(0.005 to 0.012) lin (1.1 to 5.1) deg	Agilent 85051A verification kit
	(0.2 to 0.4) lin	(0.004 to 0.008) lin (1.1 to 5.5) deg	
	(0.0 to 0.2) lin	(0.04 to 0.005) lin (1.5 to 180) deg	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Reflection – Measure S_{11}/S_{22} (cont)			
N-Type			
50 MHz to 18 GHz	(0.8 to 1) lin	(0.0073 to 0.026) lin	Agilent PNAX network analyzer
	(0.6 to 0.8) lin	(0.006 to 0.018) lin	Agilent 85055A verification kit
	(0.4 to 0.6) lin	(0.005 to 0.013) lin	
	(0.2 to 0.4) lin	(0.004 to 0.0093) lin	
	(0.0 to 0.2) lin	(0.004 to 0.0083) lin	
3.5 mm			
(2 to 26.5) GHz	(0.8 to 1) lin	(0.021 to 0.031) lin	Agilent 85053A verification kit
	(0.6 to 0.8) lin	(0.015 to 0.021) lin	
	(0.4 to 0.6) lin	(0.012 to 0.015) lin	
	(0.2 to 0.4) lin	(0.011 to 0.012) lin	
	(0.0 to 0.2) lin	(0.007 to 0.011) lin	
2.4 mm			
(26.5 to 50) GHz	(0.8 to 1) lin	(0.034 to 0.054) lin	Agilent 85057B verification kit
	(0.6 to 0.8) lin	(0.026 to 0.042) lin	
	(0.4 to 0.6) lin	(0.026 to 0.033) lin	
	(0.2 to 0.4) lin	(0.017 to 0.025) lin	
	(0.0 to 0.2) lin	(0.015 to 0.021) lin	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Transmission – Measure S_{12}/S_{21}			
7 mm[3]			
300 kHz to 6 GHz	(10 to 0) dB	(0.02 to 0.1) dB (0.2 to 0.9) deg	Agilent 8753E network analyzer
	(0 to -10) dB	(0.02 to 0.06) dB (0.2 to 0.4) deg	
	(-10 to -20) dB	(0.014 to 0.07) dB (0.3 to 0.5) deg	Agilent 85051A verification kit
	(-20 to -30) dB	(0.05 to 0.08) dB (0.38 to 0.58) deg	
	(-30 to -40) dB	(0.06 to 0.12) dB (0.4 to 0.7) deg	
	(-40 to -50) dB	(0.12 to 0.2) dB (0.7 to 1.5) deg	
7 mm[3]			
300 kHz to 6 GHz	(-50 to -60) dB	(0.1 to 0.5) dB (0.8 to 3.0) deg	Agilent 8753E network analyzer, Agilent 85051A verification kit
	(-60 to -70) dB	(0.25 to 1.5) dB (2.0 to 10) deg	
	(-70 to -80) dB	0.65 to 3.5) dB (5.0 to 12) deg	
7 mm[3]			
45 MHz to 18 GHz	(10 to 0) dB	(0.032 to 0.14) dB (0.9 to 4.2) deg	Agilent 8510C network analyzer, Agilent 85051A verification kit
	(0 to -10) dB	(0.026 to 0.054) dB (0.9 to 3.9) deg	
	(-10 to -20) dB	(0.026 to 0.056) dB (0.9 to 4.0) deg	
	(-20 to -30) dB	(0.037 to 0.056) dB (0.9 to 4.0) deg	
	(-30 to -40) dB	(0.056 to 0.14) dB (1.0 to 4.1) deg	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Transmission – Measure S_{12}/S_{21} (cont)			
7 mm[3]			
45 MHz to 18 GHz	(-40 to -50) dB	(0.061 to 0.41) dB (1.3 to 4.1) deg	Agilent PNAX network analyzer, Agilent 85051A verification kit
	(-50 to -60) dB	(0.084 to 1.4) dB (0.9 to 5.3) deg	
	(-60 to -70) dB	(0.16 to 5.2) dB (0.9 to 27) deg	
Type N			
50 MHz to 18 GHz	(10 to 0) dB (0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB (-40 to -50) dB (-50 to -60) dB	(0.040 to 0.117) dB (0.040 to 0.12) dB (0.05 to 0.097) dB (0.065 to 0.11) dB (0.079 to 0.122) dB (0.10 to 0.32) dB (0.032 to 1.6) dB	Agilent PNAX network analyzer 85055A verification kit
3.5 mm			
(2 to 26.5) GHz	(10 to 0) dB (0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB (-40 to -50) dB (-50 to -60) dB	(0.11 to 0.21) dB (0.11 to 0.12) dB (0.12 to 0.13) dB (0.12 to 0.14) dB (0.14 to 0.23) dB (0.23 to 0.50) dB (0.50 to 1.55) dB	Agilent PNAX network analyzer Agilent 85053A verification kit
(26.5 to 50) GHz	(10 to 0) dB (0 to -10) dB (-10 to -20) dB	(0.25 to 0.19) dB (0.19 to 0.23) dB (0.23 to 0.24) dB	Agilent 85057B verification kit
2.4 mm			
(26.5 to 50) GHz	(-20 to -30) dB (-30 to -40) dB (-40 to -50) dB	(0.24 to 0.26) dB (0.26 to 0.27) dB (0.27 to 0.28) dB	Agilent PNA network analyzer, Agilent 85057B verification kit

III. Mechanical

Parameter/Equipment	Range	CMC[2] (±)	Comments
Mass	1 mg 2 mg 5 mg 10 mg 20 mg 50 mg 100 mg 200 mg 500 mg 1 g 2 g 5 g 10 g 20 g 50 g 100 g 200 g 500 g 1000 g 2000 g	0.063 mg 0.078 mg 0.070 mg 0.073 mg 0.063 mg 0.087 mg 0.085 mg 0.106 mg 0.14 mg 0.00014 g 0.00014 g 0.00013 g 0.00015 g 0.00016 g 0.00014 g 0.00017 g 0.0031 g 0.0035 g 0.0035 g 0.0039 g	Comparison to Class 1 weights
Force – Tension and Compression	Up to 500 lbf	0.50 lbf	Class F weights
Pressure – Measuring Equipment	(14.6 to 150) psia	0.016 psia	Mensor 15000, transducer based comparison
Pressure Gauges and Transducers	(0.2 to 5.0) psia (5 to 25) psia (25 to 200) psia (0 to 3000) psig	2.7×10^{-4} psi/psi 4.3×10^{-5} psi/psi 2.7×10^{-5} psi/psi 1.4×10^{-4} psi/psi	Ruska 2465 Ruska 2470

IV. Thermodynamics

Parameter/Equipment	Range	CMC[2] (±)	Comments
Relative Humidity	(10 to 90) % RH	0.64 % RH	Thunder Scientific 2500
Temperature – Measuring Equipment	(-30 to 150) °C	0.03 °C	Hart 9171, 2560, 5628

V. Time & Frequency

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Time Interval	1 ms to 10 s	2.5 ns	HP 53132A
Stop Watch	1 s to 24 hrs	0.24 s	Datum GPS 1PPS out
Frequency – Measuring Equipment	10 MHz	5.0×10^{-12} Hz/Hz	Datum GPS rec. (Rubidium Osc.)
Frequency – Measure	10 MHz 0.1 Hz to 3 GHz (3 to 40) GHz	1.7×10^{-11} Hz/Hz 6.4×10^{-10} Hz/Hz + 4 µHz 4.4×10^{-10} Hz/Hz	Agilent 5320A w/GPS HP 53132A w/GPS HP 5352B w/GPS

[1] This laboratory offers commercial 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] Includes 7 mm and type N connectors with larger uncertainty for 7 mm coaxial.

[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 percent of or fraction of the reading plus a fixed floor specification.

Accredited Laboratory

A2LA has accredited

LOCKHEED MARTIN TRAINING LOGISTICS SOLUTIONS

Orlando, FL

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSLI Z540-1-1994 and the requirements of ANSI/NCSLI Z540.3-2006 and *R205 – Specific Requirements: Calibration Laboratory Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 22nd day of February 2017.

President and CEO
For the Accreditation Council
Certificate Number 2258.01
Valid to December 31, 2018
Revised on November 14, 2017

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