



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

LOCKHEED MARTIN RMS-ORLANDO
100 Global Innovation Cir.
Orlando, FL 32825
Jay Sellers Phone: 800 275 3488

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 calibrations¹:

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

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 (1.0 to 100) kV	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 0.12 %	Fluke 8508A 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 >200 mA to 2 A (2 to 20) A (>20 to 100) A	40 μA/A 11 μA/A 11 μA/A 10 μA/A 10 μA/A 17 μA/A 17 μA/A 88 μA/A + 4 mA	Fluke 5720A w/8508A Fluke 5720A w/8508A Fluke 52120A w/5720A

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
DC Current – Measure	(1 to 10) μ A (10 to 100) μ A 100 μ A 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 μ A/A 11 μ A/A 11 μ A/A 11 μ A/A 10 μ A/A 17 μ A/A 17 μ A/A 91 μ A/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 k Ω 10 k Ω 100 k Ω 1 M Ω 10 M Ω 100 M Ω 1 G Ω	15 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$ 13 $\mu\Omega/\Omega$ 1.1 $\mu\Omega/\Omega$ 1.1 $\mu\Omega/\Omega$ 1.1 $\mu\Omega/\Omega$ 1.1 $\mu\Omega/\Omega$ 1.2 $\mu\Omega/\Omega$ 1.2 $\mu\Omega/\Omega$ 2.7 $\mu\Omega/\Omega$ 4.2 $\mu\Omega/\Omega$ 10 $\mu\Omega/\Omega$ 32 $\mu\Omega/\Omega$	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) m Ω (10 to 100) m Ω 100 m Ω to 1 Ω (1 to 10) Ω (10 to 100) Ω 100 Ω to 1 k Ω (1 to 10) k Ω (10 to 100) k Ω 100 k Ω to 1M Ω (1 to 10) M Ω (10 to 100) M Ω 100 M Ω to 1G Ω 1 G Ω	0.80 $\mu\Omega/\Omega$ 0.79 $\mu\Omega/\Omega$ 0.51 $\mu\Omega/\Omega$ 0.36 $\mu\Omega/\Omega$ 0.36 $\mu\Omega/\Omega$ 0.37 $\mu\Omega/\Omega$ 0.40 $\mu\Omega/\Omega$ 0.20 $\mu\Omega/\Omega$ 0.70 $\mu\Omega/\Omega$ 0.86 $\mu\Omega/\Omega$ 1.6 $\mu\Omega/\Omega$ 3.5 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$	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	0.015 %	Guildline 6530
	200 MΩ to 2 GΩ	0.022 %	
	(2 to 20) GΩ	0.063 %	
	(20 to 200) GΩ	0.17 %	
	200 GΩ to 2 TΩ	0.21 %	
	(2 to 20) TΩ	0.43 %	

Parameter/Range	Frequency	CMC ² (±)	Comments	
AC Voltage – Generate / Measure, Fixed Points	2.2 mV	10 Hz	320 μV/V	Fluke 792A
		20 Hz	370 μV/V	
		40 Hz	370 μV/V	
		1 kHz	360 μV/V	
		20 kHz	370 μV/V	
		50 kHz	370 μV/V	
		100 kHz	440 μV/V	
		300 kHz	540 μV/V	
		500 kHz	640 μV/V	
	1 MHz	740 μV/V		
	22 mV	10 Hz	82 μV/V	
		20 Hz	66 μV/V	
		40 Hz	62 μV/V	
		1 kHz	61 μV/V	
		20 kHz	61 μV/V	
		50 kHz	81 μV/V	
		100 kHz	150 μV/V	
		300 kHz	230 μV/V	
		500 kHz	310 μV/V	
1 MHz		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)			Fluke 792A
	2.2 V	10 Hz 20 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz	
7 V	10 Hz 20 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz	26 μV/V 16 μV/V 7 μV/V 6 μV/V 6 μV/V 7 μV/V 7 μV/V 8 μV/V 21 μV/V 26 μV/V 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	
	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 – 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 – Measure (cont)			
(22 to 70) 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	0.031 % + 4 μV 0.035 % + 8 μV 0.11 % + 8 μV 0.015 % + 1.5 μV 64 μV/V + 1.5 μV 40 μV/V + 1.5 μV 62 μV/V + 2 μV 0.013 % + 2.5 μV	Fluke 5790A
(70 to 220) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	84 μV/V + 1.5 μV 47 μV/V + 1.5 μV 38 μV/V + 1.5 μV 54 μV/V + 2 μV 0.014 % + 2.5 μV 0.021 % + 4 μV 0.03 % + 8 μV 0.11 % + 8 μV	
(220 to 700) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	76 μV/V + 1.5 μV 48 μV/V + 1.5 μV 29 μV/V + 1.5 μV 35 μV/V + 2 μV 79 μV/V + 2.5 μV 0.015 % + 4 μV 0.031 % + 8 μV 0.12 % + 8 μV	
700 mV to 2.2 V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	80 μV/V 51 μV/V 33 μV/V 32 μV/V 64 μV/V 150 μV/V 0.030 % 0.13 %	

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



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



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



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



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



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



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



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 pF to 99 999 µF	1 kHz 1 kHz (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	2.4 µF/F 3.4 µF/F 0.49 % 0.12 % 0.04 % 0.031 % 0.021 % 0.031 % 0.031 % 0.05 % 0.07 % 0.10 % 0.20 %	Andeen Hagerling 2500A option - E 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 deg 0.08 deg 0.15 deg 0.46 deg	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	0.14 dBm	Agilent power meter E4418B w/Agilent power sensor /8485A 3.5 mm(m)
	(0.100 to 5) GHz	0.15 dBm	
	(5 to 15) GHz	0.15 dBm	
	(15 to 20) GHz	0.16 dBm	
	(20 to 26.5) GHz	0.16 dBm	
(-20 to -30) dBm, 50 Ω	(50 to 100) MHz	0.06 dBm	
	(0.100 to 8) GHz	0.06 dBm	
	(8 to 20) GHz	0.06 dBm	
	(20 to 26.5) GHz	0.07 dBm	
(-30 to -70) dBm, 50 Ω	(50 to 100) MHz	0.11 dBm	
	(0.100 to 8) GHz	0.11 dBm	
	(8 to 20) GHz	0.12 dBm	
	(20 to 26.5) GHz	0.13 dBm	
(+10 to -30) dBm, 50 Ω	(0.50 to 9) GHz	0.09 dBm	Agilent power meter E4418B w/Agilent power sensor /8487A 2.4 mm(m)
	(9 to 16) GHz	0.10 dBm	
	(16 to 20) GHz	0.10 dBm	
	(20 to 25) GHz	0.12 dBm	
	(25 to 28) GHz	0.13 dBm	
	(28 to 41) GHz	0.14 dBm	
	(41 to 42) GHz	0.14 dBm	
	(42 to 44) GHz	0.17 dBm	
	(44 to 48) GHz	0.18 dBm	
	(48 to 49) GHz	0.19 dBm	
(49 to 50) GHz	0.23 dBm		
(+20 to +10) dBm, 50 Ω	(0.50 to 5) GHz	0.15 dBm	
	(5 to 18) GHz	0.15 dBm	
	(18 to 21) GHz	0.16 dBm	
	(21 to 25) GHz	0.16 dBm	
	(25 to 28) GHz	0.17 dBm	
	(28 to 41) GHz	0.18 dBm	
	(41 to 42) GHz	0.19 dBm	
	(42 to 49) GHz	0.20 dBm	
	(44 to 48) GHz	0.21 dBm	
	(48 to 49) GHz	0.23 dBm	
(49 to 50) GHz	0.26 dBm		



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 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	PSCAL/ 11706S calibration system plus power sensors 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 800 MHz to 1.2 GHz (1.5 to 3) GHz 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	1.1 % Cal Factor 1.2 % Cal Factor 1.3 % Cal Factor 1.5 % Cal Factor 1.6 % Cal Factor 1.9 % Cal Factor 2.4 % Cal Factor 2.8 % Cal Factor 3.1 % Cal Factor 2.3 % Cal Factor 2.0 % Cal Factor 1.6 % Cal Factor 1.8 % Cal Factor 2.1 % Cal Factor 3.0 % Cal Factor 2.3 % Cal Factor 2.6 % Cal Factor 3.0 % Cal Factor 2.5 % Cal Factor	Agilent 8481A-H84
1 μW to 100 mW	0.1 MHz 0.3 to 1 MHz (3 to 100) MHz 300 MHz to 4.2GHz	1.4 % Cal Factor 1.3 % Cal Factor 1.2 % Cal Factor 1.3 % Cal Factor	Agilent 8482A-H84



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) 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	PSCAL/11706S calibration system plus power sensors 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 7 mm ³ 45 MHz to 18 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	
	(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 Agilent 85055A verification kit
	(0.6 to 0.8) lin	(0.006 to 0.018) lin	
	(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
Torque Wrenches	(10 to 320) in·ozf (20 to 240) in·lbf (24 to 500) ft·lbf (100 to 1000) ft·lbf	0.38 in·ozf 0.58 in·lbf 0.59 ft·lbf 1.4 ft·lbf	AKO torque system
Torque Calibrators and Transducers	(5 to 160) in·ozf (10 to 240) in·lbf (2 to 1000) ft·lbf	0.058 in·ozf 0.011 in·lbf 0.110 ft·lbf	Calibration arms and Class 1 and Class F weights
Pressure – Measuring Equipment	(14.6 to 150) psia	0.016 psia	Mensor 15000, transducer based comparison

Parameter/Equipment	Range	CMC ² (±)	Comments
Pressure Gauges and Transducers	(0.2 to 5.0) psia (5 to 25) psia (25 to 200) psia	2.7×10^{-4} psi/psi 4.3×10^{-5} psi/psi 2.7×10^{-5} psi/psi	Ruska 2465
	(0 to 3000) psig	1.4×10^{-4} psi/psi	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 °C 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	1.7×10^{-11} Hz/Hz	Agilent 5320A w/GPS
	0.1 Hz to 3 GHz	6.4×10^{-10} Hz/Hz + 4 μHz	HP 53132A w/GPS
	(3 to 40) GHz	4.4×10^{-10} Hz/Hz	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.



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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.

A handwritten signature in black ink, written over a horizontal line.

President and CEO
For the Accreditation Council
Certificate Number 2258.01
Valid to December 31, 2018

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