SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017
&ANSI/NCSL Z540-1.1994 & ANSI/NCSL Z540.3.2006

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CALIBRATION

Valid To: December 31, 2020 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, 5]:

I. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 3] (±)	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	(0.1 to 220) mV (>0.22 to 2.2) V (>2.2 to 11) V (>11 to 22) V (>22 to 220) V (>220 to 1100) V	0.64 µV 3.4 µV 8.4 µV 11 µV 350 µV 1.9 mV	Fluke 5730A characterized calibrator
DC Voltage – Generate and Measure, Fixed Value	10 V	0.33 µV/V	Fluke 732B
DC Voltage – Generate	(1 to 40) kV	0.12 %	Spellman power supply with HVD-100-1

WITHDRAWN

Parameter/Equipment	Range	CMC[2, 3] (±)	Comments
DC Voltage – Generate & Measure, Fixed Values	0.1 V 1 V 10 V 100 V 1000 V	2.5 µV/V 0.60 µV/V 0.40 µV/V 0.60 µV/V 0.90 µV/V	Fluke 732B w/752A
DC Voltage – Measure	0 mV (> 0 to 199.990) mV >199.990 mV to 1.9999 V (>1.9999 to 19.999) V (>19.999 to 199.99) V (>199.99 to 1050) V (1.0 to 100) kV	0.2 µV 3.6 µV/V + 0.1 µV 3.6 µV/V + 0.4 µV 3.4 µV/V + 4.0 µV 4.2 µV/V + 40 µV 4.4 µV/V + 0.53 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 120) A	40 µA/A 11 µA/A 11 µA/A 10 µA/A 10 µA/A 17 µA/A 17 µA/A 100 µA/A + 5 mA	Fluke 5720A w/8508A & standard resistors Fluke 5720A w/8508A & standard resistors Fluke 52120A/5720A w/8508A & standard resistors

WITHDRAWN

Parameter/Equipment	Range	CMC[2, 3] (±)	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 >100 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 & standard resistors Shunts
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 10 GΩ 100 GΩ 1 TΩ 10 TΩ	1.8 µΩ/Ω 5.2 µΩ/Ω 3.2 µΩ/Ω 0.40 µΩ/Ω 0.40 µΩ/Ω 0.50 µΩ/Ω 0.70 µΩ/Ω 0.70 µΩ/Ω 0.69 µΩ/Ω 0.86 µΩ/Ω 1.6 µΩ/Ω 94 µΩ/Ω 180 µΩ/Ω 460 µΩ/Ω 700 µΩ/Ω 1200 µΩ/Ω 2900 µΩ/Ω	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 Ohms Lab
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 <1 MΩ (1 to <10) MΩ (10 to <100) MΩ 100 MΩ to <1 GΩ 1 GΩ	1.8 µΩ/Ω 1.2 µΩ/Ω 0.7 µΩ/Ω 0.3 µΩ/Ω 0.4 µΩ/Ω 0.5 µΩ/Ω 0.6 µΩ/Ω 0.17 µΩ/Ω 0.67 µΩ/Ω 0.83 µΩ/Ω 1.5 µΩ/Ω 3.4 µΩ/Ω 7 µΩ/Ω	MI 6010C/MI6011 resistors in oil MI 6000B resistors in air bath

WITHDRAWN

Parameter/Equipment	Range	CMC[2, 3] (±)	Comments
DC Resistance – Measure (cont)	(20 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	94 µΩ/Ω 0.017 % 0.046 % 0.069 % 0.13 % 0.29 %	Guildline 6530XP

Parameter/Range	Frequency	CMC[2] (±)	Comments
AC Voltage – Generate / Measure			
0.01 mV to 2.2 mV	10 Hz 20 Hz 40 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz	320 µV/V 380 µV/V 380 µV/V 370 µV/V 340 µV/V 390 µV/V 380 µV/V 450 µV/V 540 µV/V 640 µV/V 740 µV/V	Fluke 792A w/ 5720A & 8508A
>2.2 mV to 7 mV	10 Hz 20 Hz 40 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz	210 µV/V 210 µV/V 170 µV/V 170 µV/V 160 µV/V 170 µV/V 210 µV/V 280 µV/V 460 µV/V 460 µV/V 720 µV/V	Fluke 792A w/ 5720A & 8508A

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
AC Voltage – Generate / Measure (cont)			
>7 mV to 10 mV	10 Hz 20 Hz 40 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz	87 µV/V 78 µV/V 71 µV/V 71 µV/V 71 µV/V 71 µV/V 81 µV/V 140 µV/V 210 µV/V 280 µV/V 380 µV/V	Fluke 792A w/ 5720A & 8508A
>10 mV to 22 mV	10 Hz 20 Hz 40 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz	84 µV/V 67 µV/V 63 µV/V 61 µV/V 61 µV/V 61 µV/V 81 µV/V 140 µV/V 220 µV/V 300 µV/V 370 µV/V	Fluke 792A w/ 5720A & 8508A

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
AC Voltage – Generate / Measure (cont)			
>22 mV to 70 mV	10 Hz 20 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz	67 µV/V 44 µV/V 40 µV/V 39 µV/V 36 µV/V 35 µV/V 43 µV/V 79 µV/V 150 µV/V 220 µV/V 290 µV/V	Fluke 792A w/ 5720A & 8508A
>70 mV to 220 mV	10 Hz 20 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz	28 µV/V 24 µV/V 14 µV/V 14 µV/V 14 µV/V 14 µV/V 22 µV/V 42 µV/V 76 µV/V 120 µV/V 190 µV/V	
>220 mV to 700 mV	10 Hz 20 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz	27 µV/V 21 µV/V 11 µV/V 9 µV/V 9 µV/V 9 µV/V 9 µV/V 14 µV/V 27 µV/V 33 µV/V 75 µV/V	

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
AC Voltage – Generate / Measure (cont)			
>700 mV to 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	26 µV/V 16 µV/V 7 µV/V 7 µV/V 7 µV/V 7 µV/V 7 µV/V 11 µV/V 22 µV/V 30 µV/V 56 µV/V	Fluke 792A w/ 5720A & 8508A
>2.2 V to 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	

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
AC Voltage – Generate / Measure (cont)			
>7 V to 22 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 8 µV/V 7 µV/V 7 µV/V 7 µV/V 8 µV/V 11 µV/V 21 µV/V 26 µV/V 48 µV/V	Fluke 792A w/ 5720A & 8508A
>22 V to 70 V	10 Hz 20 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz	26 µV/V 16 µV/V 9 µV/V 8 µV/V 8 µV/V 8 µV/V 10 µV/V 12 µV/V 26 µV/V	
>70 V to 220 V	10 Hz 20 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz	37 µV/V 16 µV/V 9 µV/V 9 µV/V 9 µV/V 9 µV/V 11 µV/V 23 µV/V	
>220 V to 700 V	100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz	13 µV/V 13 µV/V 14 µV/V 13 µV/V 20 µV/V 55 µV/V	

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
AC Voltage – Generate / Measure (cont)			
>700 V to 1000 V	100 Hz 1 kHz 10 kHz 20 kHz	13 µV/V 12 µV/V 13 µV/V 13 µV/V	Fluke 792A w/ 5720A & 8508A
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	0.045 % + 1.3 µV 0.037 % + 1.3 µV 0.043 % + 1.3 µV 0.024 % + 4 µV 0.024 % + 2.5 µV 0.034 % + 4 µV 0.16 % + 8 µV 0.38 % + 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	0.020 % + 1.3 µV 0.014 % + 1.3 µV 0.015 % + 1.3 µV 0.012 % + 2 µV 0.01 % + 2.5 µV 0.11 % + 4 µV 0.12 % + 8 µV 0.22 % + 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	0.014 % + 1.3 µV 69 µV/V + 1.3 µV 0.011 % + 1.3 µV 56 µV/V + 2 µV 0.011 % + 2.5 µV 0.025 % + 4 µV 0.021 % + 8 µV 0.15 % + 8 µV	

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
AC Voltage – Generate / 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	0.011 % + 1.5 µV 43 µV/V + 1.5 µV 30 µV/V + 1.5 µV 43 µV/V + 2.0 µV 87 µV/V + 2.5 µV 0.023 % + 4.0 µV 0.026 % + 8.0 µV 0.10 % + 8.0 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	77 µV/V + 1.5 µV 43 µV/V + 1.5 µV 35 µV/V + 1.5 µV 43 µV/V + 2 µV 0.012 % + 2.5 µV 0.018 % + 4 µV 0.028 % + 8 µV 0.10 % + 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	72 µV/V + 1.5 µV 37 µV/V + 1.5 µV 27 µV/V + 1.5 µV 30 µV/V + 2 µV 77 µV/V + 2.5 µV 0.012 % + 4 µV 0.029 % + 8 µV 0.11 % + 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	79 µV/V 51 µV/V 33 µV/V 29 µV/V 63 µV/V 130 µV/V 0.028 % 0.12 %	

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	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	77 µV/V 39 µV/V 28 µV/V 36 µV/V 84 µV/V 0.015 % 0.041 % 0.13 %	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	81 µV/V 41 µV/V 26 µV/V 30 µV/V 72 µV/V 0.018 % 0.043 % 0.13 %	
(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 48 µV/V 35 µV/V 41 µV/V 90 µV/V 0.022 % 0.042 % 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	88 µV/V 46 µV/V 35 µV/V 42 µV/V 85 µV/V 0.017 % 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 0.014 % 0.050 %	

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	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 39 µV/V 0.014 % 0.054 %	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	0.032 % + 16 nA 0.018 % + 10 nA 0.016 % + 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	0.032 % + 40 nA 0.018 % + 35 nA 0.013 % + 35 nA 0.021 % + 0.11 µA 0.11 % + 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	0.027 % + 0.40 µA 0.018 % + 0.35 µA 0.013 % + 0.35 µA 0.021 % + 0.55 µA 0.11 % + 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	0.033 % + 4.0 µA 0.016 % + 3.5 µA 0.015 % + 2.5 µA 0.021 % + 3.5 µA 0.11 % + 10 µA	
220 mA to 2.2 A	20 Hz to 1 kHz (>1 to 5) kHz (>5 to 10) kHz	0.029 % + 35 µA 0.046 % + 80 µA 0.7 % + 0.16 mA	
(2.2 to 11) A	20 Hz to 1 kHz (>1 to 5) kHz (>5 to 10) kHz	0.049 % + 0.17 mA 0.098 % + 0.38 mA 0.36 % + 0.75 mA	

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	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	0.032 % + 9.4 mA 0.025 % + 9.4 mA 0.077 % + 9.4 mA 0.23 % + 31 mA 0.78 % + 62 mA 2.3 % + 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	0.031 % + 19 mA 0.025 % + 28 mA 0.079 % + 94 mA 0.23 % + 230 mA 0.78 % + 420 mA 3.1 % + 700 mA	
AC Current – Measure			
(10 to 300) µA	(10 to <20) Hz (20 to <40) Hz 40 Hz to 1 kHz (>1 to 10) kHz (>10 to 30) kHz	0.023 % 0.011 % 68 µA/A 87 µA/A 0.014 %	AC resistor shunts w/ Fluke 792A
(0.3 to 2) mA	(10 to <20) Hz (20 to <40) Hz 40 Hz to 1 kHz (>1 to 10) kHz (>10 to 30) kHz	0.023 % 93 µA/A 59 µA/A 59 µA/A 70 µA/A	
(2 to 20) mA	(10 to <20) Hz (20 to <40) Hz (40 to <400) Hz >400 Hz to 30 kHz	0.023 % 93 µA/A 60 µA/A 55 µA/A	A40 current shunts w/ Fluke 5790A
(20 to 200) mA	(10 to <20) Hz (20 to <40) Hz >40 Hz to 30 kHz	0.023 % 95 µA/A 55 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 % 0.016 % 0.025%	

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
AC Current – Measure (cont)			
(10 to 20) A	10 Hz to 10 kHz	0.088 %	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	0.048 % 0.043 % 0.033 % 0.029 % 0.024 % 0.018 % 0.032 % 0.019 % 0.036 % 0.02 % 0.039 % 0.022 % 0.071 % 0.071 % 0.041 % 0.049 % 0.04 % 0.075 % 0.10 % 0.062 % 0.078 % 0.10 % 0.12 % 0.11 % 0.10 % 0.14 % 0.15 % 0.16 % 0.24 % 0.20 %	Fluke 5720A w/option 03, referenced to 1 kHz, characterized output

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	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	0.036 % 0.034 % 0.016 % 0.015 % 0.016 % 0.016 % 0.016 % 0.018 % 0.02 % 0.018 % 0.021 % 0.019 % 0.036 % 0.042 % 0.023 % 0.022 % 0.029 % 0.035 % 0.048 % 0.047 % 0.051 % 0.049 % 0.07 % 0.073 % 0.072 % 0.10 % 0.12 % 0.14 % 0.17 % 0.17 %	Fluke 5720A w/option 03, referenced to 1 kHz, characterized output

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	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	0.036 % 0.031 % 0.012 % 0.014 % 0.014 % 0.012 % 0.012 % 0.015 % 0.013 % 0.016 % 0.013 % 0.014 % 0.026 % 0.023 % 0.02 % 0.022 % 0.029 % 0.032 % 0.042 % 0.046 % 0.051 % 0.052 % 0.065 % 0.077 % 0.082 % 0.11 % 0.12 % 0.14 % 0.17 % 0.18 %	Fluke 5720A w/option 03, referenced to 1 kHz, characterized output

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	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	0.024 % 0.023 % 0.011 % 0.012 % 0.012 % 0.01 % 0.01 % 0.013 % 0.011 % 0.014 % 0.011 % 0.014 % 0.02 % 0.017 % 0.016 % 0.016 % 0.022 % 0.026 % 0.036 % 0.048 % 0.051 % 0.05 % 0.064 % 0.074 % 0.08 % 0.10 % 0.11 % 0.14 % 0.15 % 0.15 %	Fluke 5720A w/option 03, referenced to 1 kHz, characterized output

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	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	0.028 % 0.02 % 0.009 % 0.011 % 0.01 % 0.009 % 0.009 % 0.013 % 0.011 % 0.015 % 0.011 % 0.013 % 0.019 % 0.016 % 0.016 % 0.015 % 0.021 % 0.025 % 0.031 % 0.034 % 0.038 % 0.038 % 0.046 % 0.055 % 0.056 % 0.081 % 0.089 % 0.11 % 0.12 % 0.13 %	Fluke 5720A w/option 03, referenced to 1 kHz, characterized output

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	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 % 0.012 % 0.007 % 0.009 % 0.009 % 0.007 % 0.007 % 0.011 % 0.01 % 0.012 % 0.01 % 0.01 % 0.016 % 0.013 % 0.012 % 0.013 % 0.014 % 0.021 % 0.028 % 0.037 % 0.043 % 0.044 % 0.051 % 0.062 % 0.065 % 0.09 % 0.097 % 0.11 % 0.12 % 0.13 %	Fluke 5720A w/option 03, referenced to 1 kHz, characterized output

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
AC Voltage Flatness – Generate (cont)			
1 V	10 Hz	0.016 %	

	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 % 0.006 % 0.008 % 0.008 % 0.007 % 0.006 % 0.012 % 0.01 % 0.011 % 0.011 % 0.009 % 0.015 % 0.012 % 0.011 % 0.011 % 0.013 % 0.02 % 0.027 % 0.035 % 0.043 % 0.045 % 0.05 % 0.064 % 0.067 % 0.091 % 0.099 % 0.11 % 0.11 % 0.12 %	Fluke 5720A w/option 03, referenced to 1 kHz, characterized output

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
AC Voltage Flatness – Generate (cont)			
3.2 V	10 Hz 20 Hz 50 Hz	0.012 % 0.008 % 0.005 %	Fluke 5720A w/option 03,

	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	0.007 % 0.009 % 0.006 % 0.006 % 0.011 % 0.009 % 0.013 % 0.01 % 0.011 % 0.015 % 0.01 % 0.011 % 0.011 % 0.011 % 0.018 % 0.022 % 0.029 % 0.035 % 0.035 % 0.038 % 0.049 % 0.053 % 0.076 % 0.082 % 0.096 % 0.097 % 0.11 %	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 120) kHz (120 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 % 0.063 % 0.055 % 0.061 % 0.077 % + 1 µV 0.076 % + 1 µV 0.087 % + 1 µV 0.20 % + 1 µV 0.33 % + 1 µV 0.73 % + 2 µV	Fluke 5790A w/option 030, relative to 1 kHz

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	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 120) kHz (120 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 % 0.061 % 0.051 % 0.053 % 0.073 % + 1 µV 0.073 % + 1 µV 0.074 % + 1 µV 0.11 % + 1 µV 0.20 % + 1 µV 0.41 % + 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 120) kHz (120 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 % 0.06 % 0.05 % 0.052 % 0.07 % 0.07 % 0.07 % 0.11 % 0.20 % 0.41 %	
70 mV	(10 to 30) Hz (30 to 120) Hz 120 Hz to 1.2 kHz (1.2 to 120) kHz (120 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 % 0.055 % 0.051 % 0.051% 0.052 % 0.053 % 0.053 % 0.11 % 0.18 % 0.38 %	
220 mV	(10 to 30) Hz (30 to 120) Hz 120 Hz to 1.2 kHz (1.2 to 120) kHz (120 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 % 0.045 % 0.041 % 0.041 % 0.042 % 0.053 % 0.043 % 0.11 % 0.17 % 0.37 %	

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Parameter/Range	Frequency	CMC[2, 3] (±)	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 120) kHz (120 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 % 0.031 % 0.032 % 0.052 % 0.052 % 0.11 % 0.17 % 0.37 %	Fluke 5790A w/option 030, relative to 1 kHz
Capacitance – Measure			
1 pF to 500 µF	100 Hz to 300 kHz	0.078 %	Keysight E4980AL
500 µF to 110 mF	DC	0.012 %	Fluke 5700A/Keysight 3458A

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
Phase – Generate[3]			
0° to 360°			
1:1	1 Hz to 1 kHz (>1 to 5) kHz (>5 to 50) kHz (>50 to 100) kHz	0.009 deg 0.015 deg 0.020 deg 0.048 deg	Clarke-Hess 5500-2
10:1	1 Hz to 1 kHz (>1 to 5) kHz (>5 to 50) kHz (>50 to 100) kHz	0.008 deg 0.014 deg 0.021 deg 0.057 deg	
100:1	1 Hz to 1 kHz (>1 to 5) kHz (>5 to 50) kHz (>50 to 100) kHz	0.008 deg 0.014 deg 0.022 deg 0.052 deg	

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Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
Phase – Measure			
0° to 360°	20 Hz to 2 kHz (>2 to 5) kHz (>5 to 10) kHz (>10 to 20) kHz (>20 to 50) kHz (>50 to 100) kHz	0.029 deg 0.055 deg 0.057 deg 0.084 deg 0.086 deg 0.22 deg	Clarke-Hess 2600A

II. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
RF Absolute Power – Measure			
(+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)

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Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
RF Absolute Power – Measure (cont)			
(+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	Agilent power meter E4418B w/Agilent power sensor /8487A 2.4 mm(m)
Attenuation Measure –			
(0.0 to -5.0) dB (-6 to -15) dB (-16 to -25) dB (-26 to -35) dB (-36 to -42) dB (-43 to -65) dB (-66 to -75) dB (-76 to -85) dB (-86 to -95) dB (-96 to -100) dB	100 kHz to 22 GHz	0.002 dB 0.006 dB 0.011 dB 0.016 dB 0.026 dB 0.036 dB 0.041 dB 0.051 dB 0.057 dB 0.067 dB	R&S FSMR

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Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
Attenuation – Measure (cont) (0.0 to -1.0) dB (-1 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB (-40 to -50) dB (-50 to -60) dB (-60 to -70) dB (-70 to -80) dB (-80 to -90) dB (-90 to -100) dB (-100 to -110) dB	(22 to 26.5) GHz	0.006 dB 0.007 dB 0.017 dB 0.020 dB 0.026 dB 0.045 dB 0.048 dB 0.053 dB 0.059 dB 0.080 dB 0.085 dB 0.13 dB	R&S FSMR
Attenuation – Generate (0 to -32) dB (-32 to -63) dB (-63 to -116) dB	100 kHz to 100 MHz	0.038 dB 0.054 dB 0.14 dB	Fluke 9640A
RF Absolute Power – Measure Power Reference 1 mW, Type-N(f), 50 Ω	50 MHz	0.31 % rdg	Agilent power meter 432A w/Agilent power sensor 478A-H76

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Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
Power Sensor Calibration Factor – Measure			
N Type			
1 µW to 100 mW	0.1 MHz	0.66 % Cal Factor	PSCAL/ Tegam 2505A calibration system
	0.2 MHz	0.59 % Cal Factor	
	0.5 MHz	0.60 % Cal Factor	
	1 MHz	0.57 % Cal Factor	
	3 MHz	0.57% Cal Factor	
	5 MHz	0.56 % Cal Factor	
	10 MHz	0.57 % Cal Factor	
	30 MHz to 2 GHz	0.56 % Cal Factor	
	(3 to 3.5) GHz	0.59 % Cal Factor	
	(4 to 4.2) GHz	0.60 % Cal Factor	
	(5 to 6) GHz	0.66 % Cal Factor	
	7 GHz	0.74 % Cal Factor	
	8 GHz	0.77 % Cal Factor	
	9 GHz	0.79 % Cal Factor	
	10 GHz	0.74 % Cal Factor	
	11 GHz	0.77 % Cal Factor	
	12 GHz	0.83 % Cal Factor	
	12.4 GHz	0.84 % Cal Factor	
	13 GHz	0.84 % Cal Factor	
	14 GHz	0.86 % Cal Factor	
	15 GHz	0.85 % Cal Factor	
	16 GHz	0.86 % Cal Factor	
	17 GHz	0.91 % Cal Factor	
	18 GHz	0.94 % Cal Factor	
N Type			
100 µW to 3 W	(10 to 500) MHz	0.63 % Cal Factor	
	800 MHz to 1 GHz	0.85 % Cal Factor	
	(1.2 to 3) GHz	1.1 % Cal Factor	
	(4 to 11) GHz	0.80% Cal Factor	
	(11 to 18) GHz	1.0 % Cal Factor	

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Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
Power Sensor Calibration Factor – Measure (cont)			
N Type 100 pW to 10 µW	(10 to 30) MHz (50 to 500) MHz 800 MHz to 2 GHz (3 to 8) GHz (9 to 11) GHz (12 to 14) GHz 15 GHz (16 to 18) GHz	1.5 % Cal Factor 1.8 % Cal Factor 1.9 % Cal Factor 1.0 % Cal Factor 1.5 % Cal Factor 1.6 % Cal Factor 1.7 % Cal Factor 1.6 % Cal Factor	PSCAL/ Tegam 2505A w30dB reference attenuator calibration system
N Type 100 µW to 3 W	(0.1 to 4.2) GHz	0.65 % Cal Factor	PSCAL/ 11706S calibration system plus power sensors
3.5 mm 100 pW to 10 µW	50 MHz to 2GHz 3 GHz (4 to 5) GHz 6 GHz 7 GHz (8 to 9) GHz (10 to 11) GHz (12 to 12.4) GHz (13 to 17) GHz (18 to 20) GHz 21 GHz 22 GHz 23 GHz 24 GHz 25 GHz (26 to 26.5) GHz	1.3 % Cal Factor 1.4 % 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 2.1 % Cal Factor 3.0 % Cal Factor 3.2 % Cal Factor 3.1 % Cal Factor 3.3 % Cal Factor 3.2 % Cal Factor 3.1 % Cal Factor	PSCAL/ Tegam 2505A PSCAL/ Tegam 2505A w30dB reference attenuator calibration system

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
Power Sensor Calibration Factor – Measure (cont)			PSCAL/ Tegam 2510A calibration system
3.5 mm			
1 µW to 100 mW	(10 to 30) MHz	1.2 % Cal Factor	
	(50 to 500) MHz	0.90 % Cal Factor	
	(1 to 2) GHz	1.0 % Cal Factor	
	3 GHz	1.1 % Cal Factor	
	(4 to 5) GHz	1.2 % Cal Factor	
	(6 to 8) GHz	1.3 % Cal Factor	
	(9 to 10) GHz	1.4 % Cal Factor	
	11 GHz	1.5 % Cal Factor	
	(12 to 12.4) GHz	1.6 % Cal Factor	
	13 GHz	1.8 % Cal Factor	
	(14 to 15) GHz	1.7 % Cal Factor	
	(16 to 17) GHz	1.8 % Cal Factor	
	(18 to 18.5) GHz	1.9 % Cal Factor	
	(19 to 21) GHz	2.0 % Cal Factor	
	21.5 GHz	2.1 % Cal Factor	
	22 GHz	2.2 % Cal Factor	
	22.5 GHz	2.3 % Cal Factor	
	(23 to 23.5) GHz	2.4 % Cal Factor	
	(24 to 24.5) GHz	2.5 % Cal Factor	
	(25.5 to 26.5) GHz	2.4 % Cal Factor	

WITHDRAWN

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
Power Sensor Calibration Factor – Measure (cont)			
2.4 mm			
1 µW to 100 mW	50 MHz to 1 GHz	0.90 % Cal Factor	PSCAL/ Tegam 2505A calibration system
	2 GHz	0.95 % Cal Factor	
	3 GHz	1.0 % Cal Factor	
	4 GHz	1.1 % Cal Factor	
	5 GHz	1.2 % Cal Factor	
	(6 to 8) GHz	1.3 % Cal Factor	
	(9 to 10) GHz	1.4 % Cal Factor	
	(11 to 12) GHz	1.5 % Cal Factor	
	(13 to 15) GHz	1.7 % Cal Factor	
	(16 to 17) GHz	1.8 % Cal Factor	
	18 GHz	1.9 % Cal Factor	
	19 GHz	2.0 % Cal Factor	
	20 GHz	2.2 % Cal Factor	
	(21 to 23) GHz	2.1 % Cal Factor	
	24 GHz	2.4 % Cal Factor	
	(25 to 28) GHz	2.2 % Cal Factor	
	(29 to 30) GHz	2.6 % Cal Factor	
	(31to 33) GHz	2.5 % Cal Factor	
	(34 to 35) GHz	2.8 % Cal Factor	
	36 GHz	2.6 % Cal Factor	
	37 GHz	3.0 % Cal Factor	
	38 GHz	3.2 % Cal Factor	
	39 GHz	3.3 % Cal Factor	
	40 GHz	3.5 % Cal Factor	
	41 GHz	3.8 % Cal Factor	
	42 GHz	3.0 % Cal Factor	
	43 GHz	3.1 % Cal Factor	
	44 GHz	4.0 % Cal Factor	
	45 GHz	4.3 % Cal Factor	
	(46 to 47) GHz	3.7 % Cal Factor	
	48 GHz	4.9 % Cal Factor	
	49 GHz	4.6 % Cal Factor	
	50 GHz	4.9 % Cal Factor	

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Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
Power Sensor Calibration Factor – Measure (cont) 2.4 mm 100 pW to 10 µW	(50 to 100) MHz 500 M to 3 GHz 4 GHz 5 GHz (6 to 8) GHz (9 to 11) GHz 12 GHz 13 GHz (14 to 16) GHz 17 GHz (18 to 19) GHz 20 GHz 21 GHz 22 GHz 23 GHz 24 GHz (25 to 26) GHz 27 GHz (28 to 29) GHz 30 GHz (31 to 32) GHz (33 to 34) GHz 35 GHz 36 GHz 37 GHz 38 GHz (39 to 41) GHz (42 to 43) GHz 44 GHz 45 GHz 46 GHz 47 GHz 48 GHz 49 GHz 50 GHz	1.1 % Cal Factor 1.2 % Cal Factor 1.3 % Cal Factor 1.4 % Cal Factor 1.5 % Cal Factor 1.6 % Cal Factor 1.7 % Cal Factor 1.9 % Cal Factor 1.8 % Cal Factor 1.9 % Cal Factor 2.0 % Cal Factor 2.1 % Cal Factor 3.1 % Cal Factor 3.2 % Cal Factor 3.3 % Cal Factor 3.4 % Cal Factor 3.3 % Cal Factor 3.4 % Cal Factor 3.7 % Cal Factor 3.5 % Cal Factor 3.6 % Cal Factor 3.9 % Cal Factor 3.8 % Cal Factor 3.6 % Cal Factor 3.7 % Cal Factor 4.0 % Cal Factor 4.2 % Cal Factor 3.9 % Cal Factor 4.6 % Cal Factor 5.1 % Cal Factor 4.9 % Cal Factor 5.0 % Cal Factor 5.5 % Cal Factor 5.7 % Cal Factor 6.0 % Cal Factor	PSCAL/ Tegam 2505A w30dB reference attenuator calibration system

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Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
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 11 GHz 12 GHZ 13 GHz 14 GHz 15 GHz 16 GHz 17 GHz 18 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 0.22 dB 0.24 dB 0.23 dB 0.26 dB 0.25 dB 0.26 dB 0.25 dB 0.27 dB	CalLab Solutions SAM, HP 346A H13

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Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
Thermal Noise Figure System – Measure (cont)			
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	0.16 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	0.20 dB	
	21 GHz	0.22 dB	
	22 GHz	0.24 dB	
	23 GHz	0.25 dB	
	24 GHz	0.24 dB	
	25 GHz	0.25 dB	
	26 GHz	0.24 dB	
	26.5 GHz	0.26 dB	

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Parameter/Equipment	Range	CMC[2, 3] (±)	Comments
Reflection – Measure S_{11}/S_{22}			
7 mm			
300 kHz to 6 GHz	(0.8 to 1) lin	(0.008 to 0.021) lin	Agilent 8753E network analyzer
	(0.6 to 0.8) lin	(0.006 to 0.012) lin	Agilent 85055A
	(0.4 to 0.6) lin (0.2 to 0.4) lin (0.0 to 0.2) lin	(0.005 to 0.012) lin (0.004 to 0.008) lin (0.004 to 0.005) lin	Agilent 85051A verification kit
7 mm			
45 MHz to 18 GHz	(0.8 to 1) lin	(0.008 to 0.021) lin	Agilent 8510C network analyzer
	(0.6 to 0.8) lin	(0.006 to 0.012) lin	Agilent 85051A verification kit
	(0.4 to 0.6) lin (0.2 to 0.4) lin (0.0 to 0.2) lin	(0.005 to 0.012) lin (0.004 to 0.008) lin (0.004 to 0.005) lin	Agilent 85051A verification kit
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 (0.4 to 0.6) lin (0.2 to 0.4) lin (0.0 to 0.2) lin	(0.006 to 0.018) lin (0.005 to 0.013) lin (0.004 to 0.0093) lin (0.004 to 0.0083) lin	Agilent 85055A verification kit
3.5 mm			
(2 to 26.5) GHz	(0.8 to 1) lin (0.6 to 0.8) lin (0.4 to 0.6) lin (0.2 to 0.4) lin (0.0 to 0.2) lin	(0.021 to 0.031) lin (0.015 to 0.021) lin (0.012 to 0.015) lin (0.011 to 0.012) lin (0.007 to 0.011) lin	Agilent 85053A verification kit
2.4 mm			
(26.5 to 50) GHz	(0.8 to 1) lin (0.6 to 0.8) lin (0.4 to 0.6) lin (0.2 to 0.4) lin (0.0 to 0.2) lin	(0.034 to 0.054) lin (0.026 to 0.042) lin (0.026 to 0.033) lin (0.017 to 0.025) lin (0.015 to 0.021) lin	Agilent 85057B verification kit

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Parameter/Equipment	Range	CMC[2, 3] (±)	Comments
Transmission – Measure S_{12}/S_{21}			
7 mm			
300 kHz to 6 GHz	(10 to 0) dB	(0.02 to 0.1) dB	Agilent 8753E network analyzer
	(0 to -10) dB	(0.02 to 0.06) dB	
	(-10 to -20) dB	(0.014 to 0.07) dB	Agilent 85051A verification kit
	(-20 to -30) dB	(0.05 to 0.08) dB	
	(-30 to -40) dB	(0.06 to 0.12) dB	
	(-40 to -50) dB	(0.12 to 0.2) dB	
7 mm			
300 kHz to 6 GHz	(-50 to -60) dB	(0.1 to 0.5) dB	Agilent 8753E network analyzer, Agilent 85051A verification kit
	(-60 to -70) dB	(0.25 to 1.5) dB	
	(-70 to -80) dB	0.65 to 3.5) dB	
7 mm			
45 MHz to 18 GHz	(10 to 0) dB	(0.032 to 0.14) dB	Agilent 8510C network analyzer, Agilent 85051A verification kit
	(0 to -10) dB	(0.026 to 0.054) dB	
	(-10 to -20) dB	(0.026 to 0.056) dB	
	(-20 to -30) dB	(0.037 to 0.056) dB	
	(-30 to -40) dB	(0.056 to 0.14) dB	
	(-40 to -50) dB	(0.061 to 0.41) dB	
	(-50 to -60) dB	(0.084 to 1.4) dB	
	(-60 to -70) dB	(0.16 to 5.2) dB	
Type N			
50 MHz to 18 GHz	(10 to 0) dB	(0.040 to 0.117) dB	Agilent PNAX network analyzer 85055A verification kit
	(0 to -10) dB	(0.040 to 0.12) dB	
	(-10 to -20) dB	(0.05 to 0.097) dB	
	(-20 to -30) dB	(0.065 to 0.11) dB	
	(-30 to -40) dB	(0.079 to 0.122) dB	
	(-40 to -50) dB	(0.10 to 0.32) dB	
	(-50 to -60) dB	(0.032 to 1.6) dB	
3.5 mm			
(2 to 26.5) GHz	(10 to 0) dB	(0.11 to 0.21) dB	Agilent PNAX network analyzer Agilent 85053A verification kit
	(0 to -10) dB	(0.11 to 0.12) dB	
	(-10 to -20) dB	(0.12 to 0.13) dB	
	(-20 to -30) dB	(0.12 to 0.14) dB	
	(-30 to -40) dB	(0.14 to 0.23) dB	
	(-40 to -50) dB	(0.23 to 0.50) dB	
	(-50 to -60) dB	(0.50 to 1.55) dB	

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Parameter/Equipment	Range	CMC[2, 3] (±)	Comments
Transmission – Measure S_{12}/S_{21} (cont)			
3.5 mm (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, 3] (±)	Comments
Pressure Gauges and Transducers	(0.3 to 5.0) psia (5 to 25) psia (25 to 200) psia	10×10^{-5} psi/psi 15×10^{-6} psi/psi 14×10^{-6} psi/psi	Ruska 2465

IV. Thermodynamics

Parameter/Equipment	Range	CMC[2, 3] (±)	Comments
Relative Humidity	(10 to 90) % RH	0.44 % RH	Thunder Scientific 2500
Temperature – Measuring Equipment	-30 °C to 150 °C	0.030 °C	Hart 9171, 2560, 5628

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V. Time & Frequency

Parameter/Equipment	Range	CMC[2, 3] (±)	Comments
Pulse – Measure Transition Time	>80 ps	20 ps	HP 54750A w/54752A
Time Interval	1 ms to 10 s 1 to 500 ns	2.5 ns 0.46 ns	HP 53132A Keysight 86100D w/ Keysight 86105D
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

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[1] This laboratory does not offer 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] 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.

[4] CMC is based on calibration performed within 24 hours of verification, based 50% of Clarke-Hess 5500-2 specification

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

Accredited Laboratory

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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/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 April 2017*).

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Presented this 31st day of January 2019.

Senior Director, Accreditation Services
For the Accreditation Council
Certificate Number 2258.01
Valid to December 31, 2020

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