The American Association for Laboratory Accreditation

World Class Accreditation

Accredited Laboratory

A2LA has accredited

TESTEQUITY LLC

Moorpark, CA

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 any additional program requirements in the field of calibration. 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 23rd day of April 2012.

President & CEO
For the Accreditation Council
Certificate Number 2356.01
Valid to October 31, 2013

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

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: October 31, 2013 Certificate Number: 2356.01

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, 3, 4] (±)	Comments
DC Voltage – Generate	100 mV 1 V 10 V 100 V 1000 V	1.2 µV 5.4 µV 34 µV 530 µV 7 mV	Fluke 5700A/EP
DC Voltage – Measure	100 mV 1 V 10 V 100 V 1000 V	0.78 µV 4.0 µV 31 µV 570 mV 5.7 mV	HP 3458A with option 002
DC Current – Generate	100 µA 1 mA 10 mA 100 mA 1 A 10A	0.01 µA 0.07 µA 0.69 µA 7.6 µA 110 µA 3.2 mA	Fluke 5700A/EP with Fluke 5725A

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Parameter/Equipment	Range	CMC[2, 3, 4] (±)	Comments
DC Current – Measure	100 µA 1 mA 10 mA 100 mA 1 A	0.01 µA 0.062 µA 0.63 µA 7.1 µA 130 µA	HP 3458A with option 002
Resistance – Generate, Fixed Points	10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 mΩ 10 mΩ 100 mΩ 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ	110 µΩ 0.23 mΩ 1.7 mΩ 13 mΩ 12 Ω 19 Ω 320 Ω 4.8 kΩ 1.6 uΩ 17 uΩ 160 uΩ 1.6 mΩ 7.8 mΩ 78 mΩ 0.78 Ω 7.8 Ω 78 Ω	Fluke 5700A/EP Resistor Set HP 42030A four terminal pair standard
Resistance – Measure	10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ	190 µΩ 1.7 mΩ 11 mΩ 99 mΩ 5.9 Ω 18 Ω 740 Ω 60 kΩ	HP 3458A with option 002

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
Resistance – Generate, Fixed Points			
10 Ω	1 MHz 2 MHz	9.8 mΩ 13 mΩ	HP 42030A four terminal pair, standard resistor set
100 Ω	1 MHz 2 MHz	98 mΩ 130 mΩ	
1 kΩ	1 MHz 2 MHz	690 mΩ 980 mΩ	
10 kΩ	100 kHz 1 MHz	6.2 Ω 6.9 Ω	
100 kΩ	100 kHz 1 MHz	70 Ω 99 Ω	
AC Voltage – Generate			
100 mV	10 Hz 40 Hz 1 kHz 20 kHz 100 kHz 1 MHz	26 µV 15 µV 15 µV 26 µV 65 µV 340 µV	Fluke 5700/EP
1 V	10 Hz 40 Hz 1 kHz 20 kHz 100 kHz 1 MHz	330 µV 110 µV 640 µV 93 µV 170 µV 2.0 mV	
10 V	10 Hz 40 Hz 1 kHz 20 kHz 100 kHz 1 MHz	2.8 mV 1.1 mV 610 µV 890 µV 1.4 mV 20 mV	

Parameter/Range	Frequency	CMC[2, 3, 4] (±)	Comments
AC Voltage – Generate (cont)			
100 V	10 Hz 40 Hz 1 kHz 20 kHz 100 kHz	28 mV 11 mV 7.0 mV 8.8 mV 21 mV	Fluke 5700/EP
1000 V	40 Hz to 1 kHz	0.3 V	
AC Voltage – Measure			
10 mV	1 kHz 20 kHz 100 kHz 1 MHz	13 µV 26 µV 65 µV 860 µV	HP 3458A with option 002
100 mV	1 kHz 20 kHz 100 kHz 1 MHz	19 µV 38 µV 96 µV 1.3 mV	
1V	1 kHz 20 kHz 100 kHz 1 MHz	31 µV 380 µV 950 µV 12 mV	
10 V	10 Hz 40 Hz 1 kHz 20 kHz 100 kHz 1 MHz	1.4 mV 1.1 mV 1.9 mV 3.7 mV 9.5 mV 120 mV	
100 V	1 kHz 20 kHz 100 kHz	26 mV 43 mV 150 mV	
Fixed Point, 700 V	1 kHz 20 kHz	720 mV 950 mV	

Parameter/Range	Frequency	CMC[2, 3, 4] (±)	Comments
AC Current – Measure			
100 µA	100 Hz to 5 kHz	0.11 µA	HP 3458A with option 002
1 mA	100 Hz to 5 KHz	0.59 µA	
10 mA	100 Hz to 5 kHz	6.0 µA	
100 mA	100 Hz to 5 kHz	60 µA	
1 A	100 Hz to 5 kHz	1.4 mA	
AC Current – Generate			
100 µA	10 Hz to 1 kHz (1 to 5) kHz	0.03 µA 0.14 µA	Fluke 5700A/EP
1 mA	10 Hz to 1 kHz (1 to 5) kHz	0.18 µA 0.32 µA	
10 mA	10 Hz to 1 kHz (1 to 5) kHz	2.0 µA 2.8 µA	
100 mA	10 Hz to 1 kHz (1 to 5) kHz	18 µA 26.0 µA	
1 A	10 Hz to 1 kHz (1 to 5) kHz	320 µA 570 µA	
10A	40 Hz to 1 kHz	3.7 mA	Fluke 5725A

II. Electrical – RF/Microwave

Parameter/Equipment	Range	CMC[2] (±)	Comments
Amplitude Modulation – Measure			
(0.15 to10) MHz (5 to 99) % Mod Depth	150 kHz to 10 MHz Carrier 50 Hz to 10 kHz Mod Rates 20 Hz to 10 kHz Mod Rates	 0.59 % 0.67 %	HP 8902 measuring receiver

Parameter/Equipment	Frequency	CMC[2] (±)	Comments
Amplitude Modulation – Measure (cont)			
(10 to 1300) MHz To 99 % Mod Depth	10 to 1300 MHz Carrier 50 Hz to 50 kHz Mod Rates 20 Hz to 100 kHz Mod Rates	 0.51 % 0.67 %	HP 8902 measuring receiver
Frequency Modulation – Measure			
(0.25 to10) MHz	20 Hz to 10 kHz Mod Rates 50 Hz to 10 kHz	0.1 kHz 0.59 kHz	HP 8902 measuring receiver
(10 to 1300) MHz	20 Hz to 100 kHz Mod Rates 50 Hz to 200 kHz Mod Rates	0.057 kHz 0.25 kHz	
Attenuation – Generate			
Coaxial, 1dB Step			
0 dB	50 kHz to 2 GHz (2 to 4) GHz	0.024 dB 0.027 dB	HP 8494G type N(f)
1 dB	50 kHz to 2 GHz (2 to 4) GHz	0.026 dB 0.027 dB	
2 dB	50 kHz to 2 GHz (2 to 4) GHz	0.028 dB 0.030 dB	
3 dB	50 kHz to 2 GHz (2 to 4) GHz	0.025 dB 0.025 dB	
4 dB	50 kHz to 2 GHz (2 to 4) GHz	0.027 dB 0.026 dB	
5 dB	50 kHz to 2 GHz (2 to 4) GHz	0.026 dB 0.028 dB	

Parameter/Equipment	Frequency	CMC[2] (±)	Comments
Attenuation – Generate (cont)			
Coaxial, 1dB Step			
6 dB	50 kHz to 2 GHz (2 to 4) GHz	0.028 dB 0.034 dB	HP 8494G type N(f)
7 dB	50 kHz to 2 GHz (2 to 4) GHz	0.031 dB 0.034 dB	
8 dB	50 kHz to 2 GHz (2 to 4) GHz	0.034 dB 0.038 dB	
9 dB	50 kHz to 2 GHz (2 to 4) GHz	0.033 dB 0.035 dB	
10 dB	50 kHz to 2 GHz (2 to 4) GHz	0.036 dB 0.040 dB	
11 dB	50 MHz to 2 GHz (2 to 4) GHz	0.034 dB 0.036 dB	
Coaxial, 10 dB Step:			
0 dB	50 MHz to 2 GHz (2 to 4) GHz	0.032 dB 0.036 dB	HP 8496 G type N
10 dB	50 MHz to 2 GHz (2 to 4) GHz	0.032 dB 0.041 dB	
20 dB	50 MHz to 2 GHz (2 to 4) GHz	0.036 dB 0.041 dB	
30 dB	50 MHz to 2 GHz (2 to 4) GHz	0.035 dB 0.038 dB	
40 dB	50 MHz to 2 GHz (2 to 4) GHz	0.044 dB 0.050 dB	
50 dB	50 MHz to 2 GHz (2 to 4) GHz	0.056 dB 0.066 dB	
60 dB	50 MHz to 2 GHz (2 to 4) GHz	0.053 dB 0.056 dB	
70 dB	50 MHz to 2 GHz (2 to 4) GHz	0.058 dB 0.065 dB	
80 dB	50 MHz to 2 GHz (2 to 4) GHz	0.072 dB 0.075 dB	

Parameter	Frequency	CMC[2] (±)	Comments
Attenuation – Generate (cont.)			
Coaxial, 10 dB Step:			
90 dB	50 MHz to 2 GHz (2 to 4) GHz	0.066 dB 0.070 dB	HP 8496 G type N
100 dB	50 MHz to 2 GHz (2 to 4) GHz	0.075 dB 0.084 dB	
110 dB	50 MHz to 2 GHz (2 to 4) GHz	0.064 dB 0.072 dB	
Coaxial, Fixed			
3 dB	200 MHz to 12.4 GHz SWR< 1.25:1	0.025 dB	HP 8491A/B type N
	(12.4 to 18) GHz SWR< 1.2:1	0.028 dB	
6 dB	200 MHz to 12.4 GHz SWR< 1.25:1	0.029 dB	
	(12.4 to 18) GHz SWR< 1.2:1	0.028 dB	
10 dB	200 MHz to 12.4 GHz SWR< 1.25:1	0.024 dB	
	(12.4 to 18) GHz SWR< 1.2:1	0.034 dB	
20 dB	200 MHz to 12.4 GHz SWR< 1.25:1	0.026 dB	
	(12.4 to 18) GHz SWR< 1.2:1	0.041 dB	
30 dB	200 MHz to 12.4 GHz SWR< 1.25:1	0.024 dB	
	(12.4 to 18) GHz SWR< 1.2:1	0.028 dB	

Parameter/Range	Frequency	CMC[2] (±)	Comments
RF Absolute Power – Measure 1 mW, Type-N(f), 50 Ω	50 MHz	12 µW	HP 432A w/ HP478A-H76
RF Absolute Power – Measure (cont.) 100 mW to 1 µW, (+20 to -30) dBm, 50 Ω	100 kHz to 4.2 GHz	0.17dB	E4419B w/ HP 8482A, Type N(M)
100mW to 1 uW (+20 to -30) dBm, 50 Ω	50MHz to 18GHz	0.18 dB	E4419B w/ HP 8481A,Type N(M)
10 µW to 100 pW, (-20 to -70) dBm, 50 Ω	50 MHz to 18GHz	0.3 dB	E4419B w/ HP 8481D, Type N(M)
100mW to 1 uW (+20 to -30) dBm, 50 ohm	50 MHz to 50GHz	0.42 dB	E4419B w/ HP 8487A, Type 2.4 mm (M)
Tuned RF Power,Relative – Measure 0 dB Reference -10 dB -20 dB -30 dB -40 dB -50 dB -60 dB -70 dB -80 dB -90 dB -100 dB -110 dB	200 MHz	0.13 dB 0.14 dB 0.13 dB 0.18 dB 0.21 dB 0.21 dB 0.23 dB 0.31 dB 0.35 dB 0.40 dB 0.43 dB	HP 8902 with HP 8496H

Parameter/Range	Frequency	CMC[2] (±)	Comments
Tuned RF Power,Relative – Measure (cont)			
0 dB Reference			
-10 dB	1 GHz	0.13 dB	HP 8902 with HP 8496H
-20 dB		0.13 dB	
-30 dB		0.14 dB	
-40 dB		0.18 dB	
-50 dB		0.21 dB	
-60 dB		0.22 dB	
-70 dB		0.27 dB	
-80 dB		0.31 dB	
-90 dB		0.35 dB	
-100 dB		0.41 dB	
-110 dB		0.44 dB	
-10 dB	2 GHz	0.15 dB	
-20 dB		0.16 dB	
-30 dB		0.16 dB	
-40 dB		0.21 dB	
-50 dB		0.23 dB	
-60 dB		0.24 dB	
-70 dB		0.28 dB	
-80 dB		0.36 dB	
-90 dB		0.41 dB	
-100 dB		0.48 dB	
-110 dB		0.47 dB	
-10 dB	8 GHz	0.14 dB	HP 8902 with HP 11792A & HP 11793A
-20 dB		0.15 dB	
-30 dB		0.17 dB	
-40 dB		0.17 dB	
-50 dB		0.23 dB	
-60 dB		0.22 dB	
-70 dB		0.31 dB	
-80 dB		0.35 dB	
-90 dB		0.25 dB	
-100 dB		0.48 dB	

Parameter/Range	Frequency	CMC[2] (±)	Comments
Tuned RF Power, Relative – Measure (cont.)			
0 dB Reference	12 GHz	0.15 dB	HP 8902 with HP 11792A & HP 11793A
-10 dB		0.17 dB	
-20 dB		0.21 dB	
-30 dB		0.24 dB	
-40 dB		0.27 dB	
-50 dB		0.37 dB	
-60 dB		0.47 dB	
-70 dB		0.62 dB	
-80 dB		0.74 dB	
-90 dB		0.87 dB	
-100 dB			
-10 dB	18 GHz	0.19 dB	
-20 dB		0.16 dB	
-30 dB		0.17 dB	
-40 dB		0.22 dB	
-50 dB		0.28 dB	
-60 dB		0.34 dB	
-70 dB		0.43 dB	
-80 dB		0.60 dB	
-90 dB		0.74 dB	
-100 dB		0.89 dB	
RF Absolute Power – Generate			
(+23.98 to +13.52) dBm	0.001 Hz to 100 kHz SWR ≤ 1.2:1	0.1 dB of range 0.01 dB resolution	HP 3325A/B with BNC(f)
(+13.52 to -56.02) dBm	0.001 Hz to 100 kHz SWR ≤ 1.2:1	0.2 dB of range 0.01 dB resolution	
(+23.98 to +13.52) dBm	100 kHz to 20 MHz SWR ≤ 1.2:1	0.3 dB of range 0.01 dB resolution	
(+13.52 to -56.02) dBm	100 kHz to 10 MHz SWR ≤ 1.2:1	0.5 dB of range 0.01 dB resolution	
(+13.52 to -16.02) dBm	(10 to 20) MHz SWR ≤ 1.2:1	0.50 dB of range 0.01 dB resolution	
(-16.02 to -56.02) dBm	(10 to 20) MHz SWR ≤ 1.2:1	0.8 dB of range 0.01 dB resolution	

Parameter/Range	Frequency	CMC[2] (±)	Comments
RF Absolute Power – Generate (cont.)			
(+13.01 to -86.98) dBm, 50 Ω, At Attenuator Settings:(In 2 dB steps)			
(0 to -18) dBm	200 Hz to 80 MHz	0.019 dB 0.01 dB resolution	HP 3335A w/ BNC(f)
(-20 to -58) dBm	200 Hz to 80 MHz	0.22 dB 0.01 dB resolution	
(-60 to -98) dBm	200 Hz to 80 MHz	0.33 dB 0.01 dB resolution	
+16 dBm -14 dBm -54 dBm -94 dBm -114 dBm -124 dBm	100 kHz to 2.56 GHz SWR ≤ 1.5:1	1.3 dBm 1.3 dBm 1.1 dBm 1.0 dBm 1.4 dBm 3.5 dBm	HP 8663A, type N(f)HP
>+10 dBm	10 MHz to 2 GHz SWR ≤ 1.6:1	2.1 dBm	
	(≥ 2 to ≤ 20) GHz SWR ≤ 1.6:1	2.3 dBm	83650B, 2.4mm(m)
>-10 dBm	10 MHz to 2 GHz SWR ≤ 1.6:1	1.6 dBm	
	(≥ 2 to ≤ 20) GHz SWR ≤ 1.6:1	1.9 dBm	
	(> 20 to ≤ 40) GHz SWR ≤ 1.8:1	2.5 dBm	

Parameter/Range	Frequency	CMC[2] (±)	Comments
RF Absolute Power – Generate (cont.)			
>-60 dBm	(>40 to ≤ 50) GHz SWR ≤ 2:1	4.7 dBm	83650B, 2.4mm(m)
	10 MHz to 2 GHz SWR ≤ 1.6:1	1.8 dBm	
	(≥ 2 to ≤ 20) GHz SWR ≤ 1.6:1	2.0 dBm	
(-70 to -110) dBm	(> 20 to ≤ 40) GHz SWR ≤ 1.8:1	2.8 dBm	HP 83650B, 2.4mm(m)
	(> 40 to ≤ 50) GHz SWR ≤ 2:1	5.0 dBm	
	10 MHz to 2 GHz SWR ≤ 1.6:1	2.6 dBm	
	(≥ 2 to ≤ 20) GHz SWR ≤ 1.6:1	2.9 dBm	
	(> 20 to ≤ 40) GHz SWR ≤ 1.8:1	2.8 dBm	
	(> 40 to ≤ 50) GHz SWR ≤ 2:1	5.6 dBm	

Parameter	Range	CMC[2] (±)	Comments
Reflection S_{11}/S_{22} – Measure	30 kHz to 1.3 GHz	0.070 lin 0.7 deg	HP 8753E , 50 Ω 7 mm with HP 85031B type 7 mm cal kit
	45 MHz to 50 GHz	0.024 lin 1.0 deg	HP8510C, HP8517A, HP 85032F, HP 85056A

Parameter	Range	CMC[2] (±)	Comments
Transmission S_{12}/S_{21} – Measure	30 kHz to 1.3 GHz	0.42 dB 0.7 deg	8753E, HP 85031B 7mm cal kit
	45 MHz to 50 GHz	0.06 dB 1.0 deg	HP 8510C, HP 8517A 2.4mm, HP 85056A cal kit

III. Time & Frequency

Parameter/Equipment	Range	CMC[2] (±)	Comments
Frequency – Measuring Equipment			
Time Base	10 MHz	1 part in 10^{11} + 1 digit	GPS receiver with 24 hours average
Frequency – Measure	0.01 kHz to 100 MHz	9.4 Hz 10^{-8} x Freq	Agilent 53132A
	100 MHz to 46 GHz	2.3 Hz 10^{-8} x Freq	Agilent 53152A electronic counters
Period – Measure	100 s to 1 ms	2 x10^{-9} Period	Agilent 53132A

[1] This laboratory does not offer commercial calibration service.

[2] Calibration and Measurement Capability (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. Calibration and Measurement Capabilities 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 measurands stated are generated with the Fluke 5700 series of instruments. This capability is suitable for the calibration of the devices intended to measure the stated measurand in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a fraction of the reading plus a fixed floor specification.

[4] HP 3458A CMC is read as either a specific value that covers the full range or as combination of the percent or portion of the reading plus a floor specification.