THE AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

TECHMASTER ELECTRONICS INC.

Vista, 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/NCSL Z540-1-1994 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 18 June 2005*).

Presented this 16th day of September 2008.

President
For the Accreditation Council
Certificate Number 2729.01
Valid to October 31, 2010

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

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CALIBRATION

Valid To: October 31, 2010 Certificate Number: 2729.01

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/Range	Frequency	Best Uncertainty[2, 3] (±)	Comments
Capacitance – Generate			
(0.19 to 1.1) nF	10 Hz to 10 kHz	0.05 % of rdg + 0.01 nF	Fluke 5520A
(1.1 to 3.3) nF	10 Hz to 3 kHz	0.5 % of rdg + 0.1 nF	
(3.3 to 110) nF	10 Hz to 10 kHz	0.25 % of rdg + 0.1 nF	
(110 to 330) nF	10 Hz to 10 kHz	0.25 % of rdg + 0.3 nF	
(0.33 to 1.1) µF	10 Hz to 600 Hz	0.2 % of rdg + 0.1 nF	
(1.1 to 3.3) µF	10 Hz to 300 Hz	0.25 % of rdg + 3 nF	
(3.3 to 11) µF	10 Hz to 150 Hz	0.25 % of rdg + 10 nF	
(11 to 33) µF	10 Hz to 120 Hz	0.4 % of rdg + 30 nF	
(33 to 110) µF	10 Hz to 80 Hz	0.45 % of rdg + 100 nF	

Parameter/Equipment	Range	Best Uncertainty[2, 3] (±)	Comments
Electrical Calibration of Thermocouple Indicating Devices – Measure and Generate			
Type K	(-200 to -50) °C	0.56 °C (1.0 °F)	Fluke 5520A
	(-50 to 1372) °C	0.28 °C (0.5 °F)	
Type T	(-200 to -50) °C	0.56 °C (1.0 °F)	
	(-50 to 400) °C	0.28 °C (0.5 °F)	

Parameter/Equipment	Range	Best Uncertainty[2, 3] (±)	Comments
Electrical Calibration of Thermocouple Indicating Devices – Measure and Generate (cont)			Fluke 5520A
Type J	(-210 to -50) °C (-50 to 760) °C	0.56 °C (1.0 °F) 0.28 °C (0.5 °F)	
Type N	(-200 to -50) °C (-50 to 1300) °C	0.56 °C (1.0 °F) 0.28 °C (0.5 °F)	
Type E	(-230 to -50) °C (-50 to 1000) °C	0.56 °C (1.0 °F) 0.28 °C (0.5 °F)	
Type R	(0 to 1768) °C	0.95 °C (1.8 °F)	
Type S	(0 to 1768) °C	0.95 °C (1.8 °F)	
Type B	(500 to 1820) °C	0.95 °C (1.8 °F)	
Type C	(0 to 2316) °C	0.95 °C (1.8 °F)	
Oscilloscopes –			Fluke 5520A sc600
Square Wave Signal			
10 Hz to 10 kHz 50 Ω 1 MΩ	 1 mV to 6.6 V_{pk-pk} 1 mV to 130 V_{pk-pk}	 0.25 % of rdg + 40 µV 0.25 % of rdg + 40 µV	
Level Sine Wave	5 mV to 5.5 V	2 % of rdg + 300 µV	
Amplitude	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	3.5 % of rdg + 300 µV 4 % of rdg + 300 µV 6 % of rdg + 300 µV	
Flatness referenced to 50 kHz reference	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	1.5 % of rdg + 100 µV 2 % of rdg + 100 µV 4 % of rdg + 100 µV	
Time Markers (5-2-1 sequence) into a 50 Ω load	5 s to 50 ms 20 ms to 100 ns 50 ns to 20 ns 10 ns 5 ns to 2 ns	25 µHz/Hz + 15 mHz 2.5 µHz/Hz 2.5 µHz/Hz 2.5 µHz/Hz 2.5 µHz/Hz	
Rise Time	≤ 300 ps	+ 0 ps / - 100 ps	

II. Electrical – RF/Microwave

Parameter/Range	Frequency	Best Uncertainty[2] (±)	Comments
Attenuation – Generate			
Coaxial, 1 dB Step			
(0 to 11) dB	1 kHz (0 to 0.5) GHz (0.5 to 1.0) GHz	0.1 dB 0.25 dB 0.35 dB	HP 355C
Coaxial, 10 dB Step			
(0 to 90) dB	1 kHz 1 GHz	0.3 dB 1.5 dB	HP 355D
(90 to 120) dB	1 kHz 1 GHz	0.3 dB 3.0 dB	
Attenuation – Measure			
Coaxial, 10 dB Step			
(0 to 140) dB	100 kHz to 3.05 GHz (3.05 to 4.2) GHz	0.009 dB + 0.005 dB/10 dB Step 0.009 dB + 0.005 dB/10 dB Step	Agilent N5531S/OPT504
(0 to 136) dB (0 to 132) dB (0 to 119) dB (0 to 112) dB	(4.2 to 6.6) GHz (6.6 to 13.2) GHz (13.2 to 19.2) GHz (19.2 to 26.5) GHz	0.009 dB + 0.005 dB/10 dB Step 0.009 dB + 0.005 dB/10 dB Step 0.009 dB + 0.005 dB/10 dB Step 0.009 dB + 0.005 dB/10 dB Step	Agilent N5531S/OPT526
Attenuation – Measure[3]			
Coaxial, 10 dB Step			
(0 to 117) dB	2.5 MHz to 1.3 GHz	0.007 dB + 0.04 dB/10 dB Step	HP 8902B
(0 to 105) dB (0 to 75) dB (0 to 70) dB	(1.3 to 12.4) GHz (12.4 to 18) GHz (18 to 26.5) GHz	0.007 dB + 0.04 dB/10 dB Step 0.007 dB + 0.04 dB/10 dB Step 0.007 dB + 0.04 dB/10 dB Step	HP 8902B/11793A

Parameter/Range	Frequency	Best Uncertainty[2] (±)	Comments
Amplitude Modulation – Generate			
Rate:			
50 Hz to 50 kHz, 5 % to 99 %	(11 to 13.5) MHz	0.1 % of rdg	HP 11715A
(20 to 50) Hz 5 % to 99 %	20 Hz to 100 kHz	0.25 % of rdg	
9 kHz to 3.2 GHz 0 % to 100 %	DC to 15 kHz	5 % of rdg	HP 8648C
300 kHz to 6 GHz 0 % to 100 %	DC to 50 kHz	4 % of rdg	Rohde & Schwartz SMIQ06
10 MHz to 50 GHz 0 % to 30 %	DC to 100 kHz	5 % of rdg	Agilent 83650A
Amplitude Modulation – Measure			
Rate:			
50 Hz to 10 kHz, 5 % to 99 %	100 kHz to 10 MHz	0.75 % of rdg	Agilent N5531S
50 Hz to 100 kHz, 5 % to 20 %	10 MHz to 3 GHz	2.5 % of rdg	
50 Hz to 100 kHz, 20 % to 99 %	10 MHz to 3 GHz	0.5 % of rdg	
(3 to 26.5) GHz, 5 % to 20 %	(3 to 26.5) GHz	4.5 % of rdg	
(3 to 26.5) GHz, 20 % to 99 %	(3 to 26.5) GHz	1.5 % of rdg	

Parameter/Range	Frequency	Best Uncertainty[2] (±)	Comments
Amplitude Modulation – Measure[3]			
Rate: 50 Hz to 10 kHz, 5 % to 99 %	150 kHz to 10 MHz	2 % of rdg	HP 8902A
20 Hz to 50 Hz, 5 % to 99 %	150 kHz to 10 MHz	3 % of rdg	
50 Hz to 50 kHz, 5 % to 99 %	10 MHz to 1.3 GHz	1 % of rdg	
20 Hz to 100 kHz, 5 % to 99 %	10 MHz to 1.3 GHz	3 % of rdg	
50 Hz to 50 kHz, 5 % to 99 %	(1.3 to 26.5) GHz	1.5 % of rdg	
20 Hz to 100 kHz, 5 % to 99 %	(1.3 to 26.5) GHz	3 % of rdg	HP 8902A w/11793A
Frequency Modulation – Measure			
Rate: 20 Hz to 10 kHz Dev.: ≤ 400 kHz peak	250 kHz to 10 MHz	1 % of rdg + 1 digit	Agilent N5531S
Rate: 50 Hz to 200 kHz Dev.: ≤ 400 kHz peak	10 MHz to 26.5 GHz	1 % of rdg + 1 digit	
Frequency Modulation[3] – Measure			
Rate: 20 Hz to 10 kHz Dev.: ≤ 40 kHz peak	250 kHz to 10 MHz	2 % of rdg + 1 digit	HP 8902A
Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak	10 MHz to 1.3 GHz	1 % of rdg + 1 digit	
Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	10 MHz to 1.3 GHz	5 % of rdg + 1 digit	
Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak	10 MHz to 26.5 GHz	1 % of rdg + 1 digit	
Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	10 MHz to 26.5 GHz	5 % of rdg + 1 digit	HP 8902A w/ 11793A

Parameter/Range	Frequency	Best Uncertainty[2] (±)	Comments
Frequency Modulation – Generate			
Rate: DC to 10 kHz Dev.: ≤ 100 kHz peak	(11 to 13.5) MHz	0.1 % of rdg	HP 11715A
Rate: DC to 10 kHz Dev.: ≤ 200 kHz peak	(11 to 13.5) MHz	0.25 % of rdg	
Rate: DC to 100 kHz Dev.: ≤ 100 kHz peak	(88 to 108) MHz	0.1 % of rdg	
Rate: DC to 100 kHz Dev.: ≤ 200 kHz peak	(88 to 108) MHz	0.25 % of rdg	
Rate: DC to 100 kHz Dev.: ≤ 100 kHz peak	(352 to 432) MHz	0.1 % of rdg	
Rate: DC to 100 kHz Dev.: ≤ 200 kHz peak	(352 to 432) MHz	0.25 % of rdg	
Rate: DC to 150 kHz Dev.: ≤ 200 kHz peak	9 kHz to 1 GHz	3 % of rdg + 30 Hz	HP 8648C
Rate: DC to 150 kHz Dev.: ≤ 400 kHz peak	(1 to 2) GHz	3 % of rdg + 60 Hz	
Rate: DC to 150 kHz Dev.: ≤ 400 kHz peak	(2 to 3) GHZ	3 % of rdg + 120 Hz	
Rate: DC to 800 kHz Dev.: ≤ 20 MHz peak	(3 to 6) GHz	11 % of rdg	HP 8665B
Rate: DC to 8 MHz Dev.: ≤ 8 MHz peak	10 MHz to 50 GHz	10 % of rdg	Agilent 83560B
Phase Modulation – Generate			
Rate: 20 Hz to 10 kHz	Carrier:		
(0 to 10) rad (0 to 20) rad (0 to 40) rad	9 kHz to 1 GHz (1 to 2) GHz (2 to 3.2) GHz	3 % of deviation + 0.05 rad 3 % of deviation + 0.1 rad 3 % of deviation + 0.2 rad	HP 8648C
Phase Modulation – Measure			
Rate: 200 Hz to 20 kHz	100 kHz to 26.5 GHz	1 % of rdg	Agilent N5531S

Parameter/Range	Frequency	Best Uncertainty[2] (±)	Comments
Phase Modulation[3] – Measure			
Rate: 200 Hz to 10 kHz	150 kHz to 10 MHz	4 % of rdg + 1 digit	HP 8902A
Rate: 200 Hz to 20 kHz	10 MHz to 1.3 GHz	3 % of rdg + 1 digit	
Rate: 200 Hz to 20 kHz	(1.3 to 26.5) GHz	3 % of rdg + 1 digit	HP 8902A w/11793A
Noise Figure – Generate			
15 dB ENR	10 MHz to 26.5 GHz	0.20 dB	HP 346C
Power – Generate			
500 µW to 25 mW	100 kHz to 10 MHz 10 MHz to 4.2 GHz	1.4 % of rdg 1.5 % of rdg	Tegam F1119
	(0.05 to 10) GHz (10 to 18.0) GHz (18 to 26.5) GHz	1.6 % of rdg 1.7 % of rdg 2.8 % of rdg	Tegam F1117A
Power – Measure			
1 mW Reference	50 MHz	0.7 % of 1mW	HP 8478A
Magnitude – Measure	(0.05 to 2.0) GHz (2.0 to 8.0) GHz (8.0 to 20.0) GHz (20.0 to 40.0) GHz	0.05 dB 0.08 dB 0.1 dB 0.15 dB	HP 8751A/8722C
VSWR – Measure	(0 to 40) GHz	>36 dB	HP 8751A/8722C

III. Chemical

Parameter/Equipment	Range	Best Uncertainty[2, 3] (±)	Comments
pH – Generate	4.01 pH 7.00 pH 10.00 pH	0.01 pH 0.01 pH 0.01 pH	Cole-Parmer

Parameter/Equipment	Range	Best Uncertainty[2, 3] (±)	Comments
Conductivity – Generate	(445 to 3900) µS	1 % calibrated value on certificate	Myron L Company

IV. Dimensional

Parameter/Equipment	Range	Best Uncertainty[2, 3] (±)	Comments
Calipers			
Inside Diameter (Fixed Points)	1.0000 in	0.001 in	Ringmaster 1 inch ring gage
	1.5000 in	0.001 in	Ringmaster 1.5 inch ring gage

V. Mechanical

Parameter/Equipment	Range	Best Uncertainty[2, 3] (±)	Comments
Thickness – Measure	(0.3 to 30) mm	0.079 µm	Mitutoyo laser scan micrometer

VI. Optical Quantities

Parameter/Range	Frequency	Best Uncertainty[2, 3] (±)	Comments
Fiber Optics – Generate			
(-70 to 13) dBm	(1310 to 1550) nm	0.005 dB + 15 nm	HP 81657A/8158B
(-70 to -20) dBm	(850 to 1300) nm	0.005 dB + 15 nm	HP FOS850/1300
Fiber Optics – Measure			
(-110 to 27) dBm	(1310 to 1550) nm	0.04 dB	HP 81634B/81525A/E5574A
(-110 to 23) dBm	(850 to 1300) nm	0.04 dB	HP 81634B/81525A/E5574A

VII. Thermodynamics

Parameter/Equipment	Range	Best Uncertainty[2, 3] (±)	Comments
Relative Humidity – Measure	(0 to 90) % RH (90 to 100) % RH	2 % RH 4 % RH	Viasala HMI41 / HMP46

VIII. Time & Frequency

Parameter/Equipment	Range	Best Uncertainty[2, 3] (±)	Comments
Frequency – Generate	1 μHz to 20.999 MHz 10 MHz to 50 GHz	1 part in 10^{10} 1 part in 10^{10}	HP 3325A with 58503B Agilent 83650A with 58503B
Frequency – Measure	1 μHz to 225 MHz 0.1 Hz to 46 GHz	1 part in 10^{10} 1 part in 10^{10}	HP 53132A with FS700 Agilent 53152A with 58503B
Risetime – Generate	(0 to 90) %	<25 ps	Tektronix S-52

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

[2] "Best Uncertainty" 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 of nearly ideal measuring equipment. Best uncertainties represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The best uncertainty of a specific calibration performed by the laboratory may be greater than the best uncertainty due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

[3] Field calibration service is available for this calibration and this laboratory meets A2LA *R104 – General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. Please note the uncertainties achievable on a customer's site can normally be expected to be larger than the Best Measurement Capabilities (BMC) that the accredited laboratory has been assigned as Best Uncertainty on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the calibration uncertainty being larger than the BMC.