ASSOCIATION
FOR LABORATORY
ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

PRIMARY INSTRUMENTS INCORPORATED
Chatsworth, CA

for technical competence in the field of

Calibration

The accreditation covers the specific calibrations listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration Laboratories" Laboratories that comply with this International Standard also operate in accordance with ISO 9001 or ISO 9002 (1994). This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration.

Presented this 8th day of October 2003.

President
For the Accreditation Council
Certificate Number 2011.01
Valid to September 30, 2005

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

American Association for Laboratory Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025-1999
& ANSI/NCSL Z540-1-1994

PRIMARY INSTRUMENTS, INC.
9553 Vassar Avenue
Chatsworth, CA 91311
Cesar D. Bautista, Jr. Phone: 818 993 4971

CALIBRATION

Valid To: September 30, 2005 Certificate Number: 2011.01

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[3]

Parameter/Equipment	Range	Best Uncertainty[2,4,5] (±)	Comments
DC Voltage – Generate	(0 to 220) mV (0.22 to 2.2) V (0 to 11) V (11 to 22) V (22 to 275) V (275 to 1000) V	15 ppm + 0.5 µV 14 parts in 10^6 10 ppm + 5 µV 11 parts in 10^6 13 parts in 10^6 12 parts in 10^6	Fluke 5440B
Fixed Points	1.018 V 10.0 V	0.2 parts in 10^6 0.8 parts in 10^6	Wavetek 4910
	Ratio: 10:1 Ratio: 100:1	0.4 parts in 10^6 1.0 parts in 10^6	Fluke 752A
DC Voltage – Measure	100 mV 1 V 10 V 100 V 1000 V	14 ppm + 3 ppm (range) 10 parts in 10^6 8.2 parts in 10^6 12 parts in 10^6 12 parts in 10^6*	HP 3458A, Option 2 *add 12 ppm $(V_{in}/1000)^2$ for $V_{in} > 100$ V
Fixed Points	1.018 10 V	2.5 parts in 10^6 0.85 parts in 10^6	Fluke 732B

5301 Buckeystown Pike, Suite 350 • Frederick, MD 21704-8373 • Phone: 301-644 3248 • Fax: 301-662 2974

Parameter/Equipment	Range	Best Uncertainty[2] (±)	Comments
DC Current – Generate	(0 to 3.3) mA (3.3 to 33) mA (33 to 330) mA (0.33 to 1.0) A (1.0 to 11) A (11 to 100) A	0.016 % + 0.05 µA 0.015 % 0.016 % 0.04 % 0.074 % 0.07 %	Fluke 5500A Valhalla 2555
DC Current – Measure	100 µA 1 mA 10 mA 100 mA 1 A (1 to 15) A (1 to 100) A	86 parts in 10^6 46 parts in 10^6 46 parts in 10^6 59 parts in 10^6 160 parts in 10^6 0.083 % 0.084 %	HP 3458A w/ L&N 4360 w/ L&N 4363
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	3.5 parts in 10^6 3.4 parts in 10^6 3.4 parts in 10^6 0.22 parts in 10^6 0.38 parts in 10^6 0.75 parts in 10^6 0.3 parts in 10^6 0.36 parts in 10^6 0.38 parts in 10^6 0.9 parts in 10^6 2.4 parts in 10^6	L&N 4223-B L&N 4222 L&N 4221 Thomas 4210 L&N Rosa Type Guildline 9330-10
DC Resistance – Measure (Fixed Points)	0.01 Ω 0.1 Ω 1 Ω (10, 100) Ω (1, 10) kΩ 100 kΩ 1 MΩ 10 MΩ	6 parts in 10^6 3 parts in 10^6 2 parts in 10^6 3 parts in 10^6 3 parts in 10^6 6 parts in 10^6 20 parts in 10^6 150 parts in 10^6	Guildline 9975

Parameter/Equipment	Range	Best Uncertainty[2] (±)	Comments
DC Resistance – Measure	10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ	33 ppm + 5 ppm (range) 26 parts in 10^6 18 parts in 10^6 18 parts in 10^6 20 parts in 10^6 36 parts in 10^6 90 parts in 10^6 630 parts in 10^6	HP 3458A, Option 2
Inductance – Generate Fixed Points (@ 1 kHz)	100 µH 1 mH 10 mH 100 mH 1 H 2 H	0.78 % 0.27 % 0.22 % 0.21 % 0.21 % 0.22 %	GenRad 1482B GenRad 1482E GenRad 1482H GenRad 1484L GenRad 1482P GenRad 1482Q
Inductance – Measure (@ 1 kHz)	10 mH to 10 H	0.058 %	GenRad 1689M
Capacitance – Generate (@ 1 kHz) Fixed Values (@ 1 kHz)	1 pF to 1µF 1 pF 10 pF 100 pF 1000 pF (10, 100) µF 1 mF 10 mF	0.1 % + 0.5 pF 5.6 parts in 10^6 5.1 parts in 10^6 5.1 parts in 10^6 5.1 parts in 10^6 0.3 % 0.3 % 0.37 %	GenRad 1413 GenRad 1403-K GenRad 1403-C GenRad 1403-B GenRad 1403-A GenRad 1417
Capacitance – Measure 1 kHz Input	10 pF to 100 µF	0.58 %	GenRad 1689M

Parameter/Range	Frequency	Best Uncertainty[2] (±)	Comments
AC Voltage[4] – Generate			Fluke 5500A w/ SC600
(1 to 33) mV	(10 to 45) Hz	0.55 %	
	45 Hz to 10 kHz	0.35 %	
	(10 to 20) kHz	0.4 %	
	(20 to 50) kHz	0.45 %	
	(50 to 100) kHz	0.68 %	
	(100 to 500) kHz	1.6 %	
(33 to 330) mV	(10 to 45) Hz	0.3 %	
	45 Hz to 10 kHz	0.07 %	
	(10 to 20) kHz	0.12 %	
	(20 to 50) kHz	0.2 %	
	(50 to 100) kHz	0.41 %	
	(100 to 500) kHz	1.3 %	
(0.33 to 3.3) V	(10 to 45) Hz	0.18 %	
	45 Hz to 10 kHz	0.036 %	
	(10 to 20) kHz	0.086 %	
	(20 to 50) kHz	0.17 %	
	(50 to 100) kHz	0.41 %	
	(100 to 500) kHz	0.83 %	
(3.3 to 33) V	(10 to 45) Hz	0.18 %	
	45 Hz to 10 kHz	0.046 %	
	(10 to 20) kHz	0.11 %	
	(20 to 50) kHz	0.24 %	
	(50 to 100) kHz	0.41 %	
(33 to 330) V	45 Hz to 1 kHz	0.057 %	
	(1 to 10) kHz	0.08 %	
	(10 to 20) kHz	0.098 %	
(330 to 1000) V	45 Hz to 1 kHz	0.058 %	
	(1 to 10) kHz	0.2 %	
	(10 to 20) kHz	0.2 %	
AC Voltage[4] – Measure			HP 3458A, Option 2
10 mV	(1 to 40) Hz	0.087 %	
	40 Hz to 1 kHz	0.064 %	
	(1 to 20) kHz	0.066 %	
	(20 to 50) kHz	0.14 %	
	(50 to 100) kHz	0.6 %	
	(100 to 300) kHz	4.7 %	

Parameter/Range	Frequency	Best Uncertainty[2] (±)	Comments
AC Voltage[4] – Measure (cont)			HP 3458A, Option 2
100 mV	(1 to 40) Hz	0.018 %	
	40 Hz to 1 kHz	0.017 %	
	(1 to 20) kHz	0.024 %	
	(20 to 50) kHz	0.04 %	
	(50 to 100) kHz	0.11 %	
	(100 to 300) kHz	0.38 %	
	(0.3 to 1) MHz	1.2 %	
	(1 to 2) MHz	1.8 %	
1 V	(1 to 40) Hz	0.014 %	
	40 Hz to 1 kHz	0.012 %	
	(1 to 20) kHz	0.019 %	
	(20 to 50) kHz	0.038 %	
	(50 to 100) kHz	0.095 %	
	(100 to 300) kHz	0.36 %	
	(0.3 to 1) MHz	1.2 %	
	(1 to 2) MHz	1.8 %	
10 V	(1 to 40) Hz	0.014 %	
	40 Hz to 1 kHz	0.013 %	
	(1 to 20) kHz	0.019 %	
	(20 to 50) kHz	0.038 %	
	(50 to 100) kHz	0.096 %	
	(100 to 300) kHz	0.36 %	
	(0.3 to 1) MHz	1.2 %	
	(1 to 2) MHz	1.8 %	
100 V	(1 to 40) Hz	0.029 %	
	40 Hz to 1 kHz	0.026 %	
	(1 to 20) kHz	0.026 %	
	(20 to 50) kHz	0.044 %	
	(50 to 100) kHz	0.14 %	
	(100 to 300) kHz	0.48 %	
	(0.3 to 1) MHz	1.8 %	
1000 V	(1 to 40) Hz	0.51 %	
	40 Hz to 1 kHz	0.049 %	
	(1 to 20) kHz	0.072 %	
	(20 to 50) kHz	0.14 %	
	(50 to 100) kHz	0.35 %	

Parameter/Range	Frequency	Best Uncertainty[2] (±)	Comments
AC Current[4] – Generate			Fluke 5500A w/ SC600
(0.03 to 0.33) mA	(10 to 20) Hz	0.4 %	
	(20 to 45) Hz	0.38 %	
	45 Hz to 1 kHz	0.38 %	
	(1 to 5) kHz	0.55 %	
	(5 to 10) kHz	1.4 %	
(0.33 to 3.3) mA	(10 to 20) Hz	0.23 %	
	(20 to 45) Hz	0.13 %	
	45 Hz to 1 kHz	0.13 %	
	(1 to 5) kHz	0.23 %	
	(5 to 10) kHz	0.63 %	
(3.3 to 33) mA	(10 to 20) Hz	0.23 %	
	(20 to 45) Hz	0.13 %	
	45 Hz to 1 kHz	0.12 %	
	(1 to 5) kHz	0.23 %	
	(5 to 10) kHz	0.63 %	
(33 to 330) mA	(10 to 20) Hz	0.23 %	
	(20 to 45) Hz	0.13 %	
	45 Hz to 1 kHz	0.12 %	
	(1 to 5) kHz	0.23 %	
	(5 to 10) kHz	0.63 %	
(0.33 to 2.2) A	(10 to 45) Hz	0.23 %	
	45 Hz to 1 kHz	0.13 %	
	(1 to 5) kHz	0.78 %	
(2.2 to 11) A	(45 to 65) Hz	0.08 %	
	(65 to 500) Hz	0.12 %	
	(0.5 to 1) kHz	0.35 %	Valhalla 2555
(11 to 100) A	(0.4 to 1) kHz	1.1 %	
AC Current – Measure			HP 3458A w/ Opt 002
100 µA	(10 to 20) Hz	0.43 %	
	(20 to 45) Hz	0.21 %	
	(45 to 100) Hz	0.11 %	
	(0.1 to 1) kHz	0.11 %	

Parameter/Range	Frequency	Best Uncertainty[2] (±)	Comments
AC Current – Measure			
1 mA	(10 to 20) Hz	0.49 %	HP 3458A w/ Opt 002
	(20 to 45) Hz	0.2 %	
	(45 to 100) Hz	0.094 %	
	(0.1 to 5) kHz	0.06 %	
	(5 to 20) kHz	0.94 %	
	(20 to 50) kHz	0.51 %	
	(50 to 100) kHz	0.81 %	
10 mA	(10 to 20) Hz	0.49 %	
	(20 to 45) Hz	0.2 %	
	(45 to 100) Hz	0.094 %	
	(0.1 to 5) kHz	0.064 %	
	(5 to 20) kHz	0.096 %	
	(20 to 50) kHz	0.51 %	
	(50 to 100) kHz	0.81 %	
100 mA	(10 to 20) Hz	0.49 %	
	(20 to 45) Hz	0.2 %	
	(45 to 100) Hz	0.12 %	
	(0.1 to 5) kHz	0.14 %	
	(5 to 20) kHz	0.094 %	
	(20 to 50) kHz	0.51 %	
1 A	(10 to 20) Hz	0.49 %	
	(20 to 45) Hz	0.2 %	
	(45 to 100) Hz	0.12 %	
	(0.1 to 5) kHz	0.14 %	
	(5 to 20) kHz	0.37 %	
	(20 to 50) kHz	1.3 %	
10 mA to 2 A	(0.1 to 20) kHz	0.024 %	Fluke A40 shunts

II. Electrical – RF & Microwave

Parameter/Range	Frequency	Best Uncertainty[2] (±)	Comments
RF Power Diode Sensors –			HP 436A with:
1 µW to 100 mW	(0.01 to 18) GHz 50 MHz to 26.5 GHz (33 to 50) GHz	4.7 % 5.3 % 5.3 %	HP 8481A HP 8485A HP Q8486A
0.3 µW to 100 mW	DC to 4.2 GHz	5.1 %	HP 8482A
100 pW to 100 µW	(0.05 to 16) GHz	5.8 %	HP 8485D
0.3 nW to 10 µW	(0.01 to 18) GHz	5.5 %	HP 8484A
RF Power Thermistor – Generate (@ 0 dBm)	10 MHz to 10 GHz	2.5 %	HP 432A w/ 478A
Tuned RF Power Level – Measure			HP 8902A w/ 11722A
Reference: 0 dB (0.0 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 (-110 to -127) dB	2.5 MHz to 1.3 GHz	0 dB 0.02 dB 0.04 dB 0.06 dB 0.08 dB 0.14 dB 0.16 dB 0.18 dB 0.2 dB 0.26 dB 0.28 dB 0.3 dB 0.4 dB	
RF Fixed Coaxial Attenuation – Measure			HP 8941B
3 dB	DC to 12.4 GHz (12.4 to 18) GHz	0.35 % 0.46 %	
6 dB	DC to 12.4 GHz (12.4 to 18) GHz	0.35 % 0.46 %	
20 dB	DC to 12.4 GHz (12.4 to 18) GHz	0.69 % 1.2 %	

Parameter/Range	Frequency	Best Uncertainty[2] (±)	Comments
Network Analysis – Measure		From Cal Kit Report	
Reflection S_{11}/S_{22} $\rho = 0.6$ lin	45 MHz to 26.5 GHz	(0.00136 to 0.00843) lin	HP 8510B, 8340B, 8515A
Transmission S_{12}/S_{21}			HP 85053A
20 dB Attenuator	45 MHz to 26.5 GHz	(0.038 to 0.054) dB	
40 dB Attenuator	45 MHz to 26.5 GHz	(0.053 to 0.331) dB	

III. Time & Frequency

Parameter/Range	Frequency	Best Uncertainty[2] (±)	Comments
Frequency – Generate	10 MHz	0.5 parts in 10^9 (24 hrs)	HP 8564E
	10 MHz to 26.5 GHz	1 part in 10^9 (24 hrs)	HP 8340B
	10 MHz to 20 GHz	10 MHz	Wiltron 6669M
	(20 to 40) GHz	20 MHz	
Fixed Points	1, 5, 10 MHz	1 part in 10^{11}	HP 5061A
Frequency – Measure	10 Hz to 26.5 GHz	1 part in 10^8	EIP 548A, Option 5 Best uncertainty is based upon 1-year manufacturer's specifications

IV. Thermodynamic

Parameter/Equipment	Range	Best Uncertainty[2, 6] (±)	Comments
Temperature[4] – Generate			
Dry Blocks	-30 °C to -93 °C	1 °C	Ametek DB 40L
	0 °C to 600 °C	1 °C	Jofra 601
Baths	-30 °C to 125 °C	0.8 °C	Hart 7103
	-10 °C to 110 °C	1 °C	Hart 5023
Temperature[4] – Measure			Hart 5901C, 1590 and Tinsley 268101 SPRT
Triple Point of Water	0.01 °C @ 25 °C	0.003 K	
Infrared Black Body – Generate	33 °C to 250 °C 250 °C to 400 °C	2 °C 2 °C	Hart 9131
	100 °C to 982 °C	25 % of reading	Vanzetti 1560
Dew Point – Measure	0 °C to 50 °C	0.1 %	M5.1MP psychrometer
Relative Humidity – Generate (Fixed Points) (@ 25 °C)			
Probe Kit	11.3 % 33.1 % 54.4 % 75.5 %	2 % 2 % 2 % 2 %	LiCl salt solution MgCl salt solution $MgNO_3$ salt solution NaCl salt solution
Salt Chamber	11.3 % 33.1 % 54.4 % 75.5 %	4 % 4 % 4 % 4 %	LiCl salt solution MgCl salt solution $MgNO_3$ salt solution NaCl salt solution
Relative Humidity – Measure	10 % to 90 %	0.5 %	M5.1MP psychrometer

V. Dimensional[3]

Parameter/Equipment	Range	Best Uncertainty[2, 7] (±)	Comments
Gage Blocks	(0.05 to 0.9) in (1 to 4) in (0.5 to 5) mm (5 to 20) mm (20 to 25) mm (25 to 50) mm (50 to 75) mm (75 to 100) mm	$(2.0 + 4L)$ µin $(0.7 + 5L)$ µin 0.07 µm 0.12 µm 0.14 µm 0.26 µm 0.37 µm 0.48 µm	Mechanical comparison w/ Federal 130B-24
Calipers[4]	(0 to 40) in	$0.6R$	Comparison to reference gage blocks
Outside Micrometers[4]	(0 to 40) in	$0.6R$	Comparison to reference gage blocks
Height Gages[4]	(0.4 to 40) in	0.0013 µin	Comparison to reference gage blocks and Mitutoyo 516-402, 515-359
Height Masters	(1 to 12) in (12 to 24) in	60 µin 120 µin	Comparison to reference gage blocks and Mitutoyo 516-402, 515-359
Mu-Checker / Electronic Height Gage	± 0.00015 in ± 0.0005 in ± 0.0015 in ± 0.005 in ± 0.015 in ± 0.05 in	6.2 µin 12 µin 58 µin 120 µin 580 µin 1200 µin	Comparison to reference gage blocks
Plain Ring Gages – Up to Class X	(0.06 to 1) in (1 to 4) (4 to 7) (7 to 12)	10 µin $(10 + 4L)$ µin $(5 + 4L)$ µin $(10 + 4L)$ µin	Pratt & Whitney internal supermic model U36334

Parameter/Equipment	Range	Best Uncertainty[2, 7] (±)	Comments
Dial & Digimatic Indicators[4] – Resolution: 10 µin 50 µin 100 µin	(0 to 2) in	0.6*R* 0.6*R* 0.6*R*	Pratt & Whitney UMM model B
Indicator Calibrator – Resolution: 10 µin 50 µin 100 µin 1000 µin	(0 to 1) in	10 µin 30 µin 60 µin 0.6*R*	Mechanical comparison to master gage blocks

VI. Mechanical

Parameter/Equipment	Range	Best Uncertainty[2] (±)	Comments
Scales & Balances[3]	1 mg to 200 mg 2 oz to 200 lb	0.2 mg 0.26 lb	Class 1 weights Class F weights
Low Pressure	Up to 2 inH_2O	0.003 inH_2O	Dwyer Microtector 1430
Pressure – Measure Pneumatic Pistons Hydraulic Pistons	(0.5 to 5) psig (1.5 to 100) psig (15 to 1000) psig (6 to 15 140) psig	0.14 % 0.14 % 0.14 % 0.14 %	Volumetric 7-201 Ruska 2400HL
Torque Transducers	0.5 in·oz to 200 in·lb (37.5 to 2000) ft·lb	1 % 1 %	CDI 2000-400-0 CDI 2000-1-0

Parameter/Equipment	Range	Best Uncertainty[2] (±)	Comments
Torque Wrenches and Screwdrivers[3]	0.5 in·oz to 200 in·lb	2.4 %	CDI 2000-400-0
	(37.5 to 2000) ft·lb	2.4 %	CDI 2000-1-0
Pipettes –			
Spectrophotometric	(0.1 to 5000) µL	1 %	Artel PCS 3; best uncertainty is based upon manufacturer's specifications
Gravimetric	100 µL (500, 1000) µL (2000, 3000, 4000) µL 5000 µL	0.2 µL 1 µL 2 µL 3 µL	Mettler HK 60

[1] This laboratory offers commercial 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, to the environment (if the calibration is performed in the field) and to influences from the circumstances of the specific calibration.

[3] On-site calibration service is available for this calibration. 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."

[4] The measurands stated are generated with the Fluke 5000A series instruments. This capability is suitable for the calibration of the devices intended to measure the stated measurand in the ranges indicated. Best measurement uncertainties are expressed as either a specific value that covers the full range or as a combination of the percent or portion of the reading plus a fixed floor specification. Where "ppm" appears in the best measurement uncertainty, it is equivalent to that part in one million.

[5] The measurands stated are measured with the HP 3458A. This capability is suitable for the calibration of the devices intended to generate the measurand in the ranges indicated. Best measurement uncertainties are based upon a 90-day calibration cycle and expressed as either a specific value that covers the full range or as a combination of the percent or portion of the reading plus a fixed floor specification. Where "ppm" appears in the best measurement uncertainty, it is equivalent to that part in one million.

[6] Best uncertainty is based upon manufacturer's specifications

[7] In the statement of best uncertainty, L is the numerical value of the nominal length of the device measured in inches; R is the numerical value of the resolution of the device in micro inches.