



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005
& ANSI/NCSL Z540-1-1994

MICRO PRECISION CALIBRATION MALAYSIA
No. 6 JLN, Kelisa Emas
Taman Kelisa, Seberang Jaya
13600, Penang, Malaysia
Kumaraguru Supramaniam Phone: 604 399 5100

CALIBRATION

Valid To: April 30, 2012

Certificate Number: 0935.14

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations¹:

I. Chemical Quantities

Parameter/Equipment	Range	CMC ² (±)	Comments
Conductivity ³ – Measure	111 mS 1015 µS 1408 µS	0.51 µS 0.51 µS 0.51 µS	Comparison to standard solutions
pH – Measure ³	(4, 7, 10) pH unit	0.02 pH unit	Comparison to standard solutions

II. Dimensional

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Calipers & Height Gages ³	(0.10 to 24) in (0 to 600) mm	(56 µin + 0.6L) µin (1.4 + 0.6L) µm	Mitutoyo gage blocks and length rods

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Micrometers ³ – Resolution: 1000 µin 100 µin	(0.10 to 12) in (0 to 300) mm (0.10 to 4) in (0 to 100) mm	(55 + 15L) µin (1.4 + 0.4L) µm (34 + 15L) µin (0.9 + 0.4L) µm	Master gage blocks
Surface Plates ³ Repeatability (Flatness only)	(12x12) in to (72x144) in (300x300) mm to (1800x3600) mm	40 µin 1.0 µm	Repeat-o-meter
Diameter, Pin Gages	(0.02 to 1.0) in (0.5 to 25) mm	75 µin 2 µm	Laser Mike 182
Rules & Tapes	(0 to 1000) mm (0 to 40) in	1 mm 0.04 in	Glass Scale Steel rule
Indicators ³ Up to 1 in (25 mm) 100 µin or 2 µm (1 to 4) in (25 to 100) mm 50 µin or 1 µm 100 µin or 2 µm	Resolution(R): 50 µin or 1 µm 100 µin or 2 µm 50 µin or 1 µm 100 µin or 2 µm	(20 + 0.6R) µin (0.5 + 0.6R) µm (20 + 0.3R) µin (0.5 + 0.3R) µm (4L + 0.5 R) µin (4L + 0.5 R) µm (4L + 0.5 R) µin (4L + 0.5 R) µm	Indicator Tester Gage blocks
Tachometer ³	(5 to 99.9) rpm (100 to 999) rpm (1 000 to 9 999) rpm (10 000 to 50 000) rpm (50 000 to 99 999) rpm	0.6 rpm 1.2 rpm 12 rpm 32 rpm 110 rpm	Tachometer Extech 461895

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,4,5} (±)	Comments
DC Voltage ³ – Generate	(0 to 220) mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100)V	11 μV/V + 0.6 μV 10 μV/V + 1.0 μV 11 μV/V + 3.5 μV 10 μV/V + 6.5 μV 11 μV/V + 80 μV 13 μV/V + 500 μV	Fluke 5700A
DC Voltage ³ – Measure	(0 to 100) mV 100 mV to 1V (1 to 10) V (10 to 100) V (100 to 1000) V	13 μV/V + 3.0 μV 17 μV/V + 0.3 μV 13 μV/V + 0.5 μV 15 μV/V + 30 μV 27 μV/V + 100 μV	HP 3458A
DC Current ³ – Generate	(0 to 220) μA 220 μA to 22 mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A (11 to 20.5) A	50 μA/A + 8 nA 50 μA/A + 8 nA 50 μA/A + 80 nA 60 μA/A + 0.8 μA 80 μA/A + 25 μA 0.12%	Fluke 5700A Fluke 5500A Wavetek 9100
DC Current ³ – Measure	Up to 100 nA 100 nA to 1 μA (1 to 10) μA (10 to 100) μA 100 μA to 10 mA (10 to 100) mA 100 mA to 1 A	35 μA/A + 400 μA 25 μA/A + 40 μA 25 μA/A + 10 μA 25 μA/A + 5 μA 25 μA/A + 5 μA 40 μA/A + 5 μA 0.012 % + 10 μA	HP 3458A
High DC Current ³	(1 to 200) A (100 to 1000)A	0.22 % of rdg 0.28 % of rdg	Shunt monitored with multimeter
DC Power ³ – @ 1000 V	Up to 11 A at 1000 V	0.14 % rdg + 0.45 μW	Fluke 5500A
Resistance ³ – Measure	(0 to 10) Ω (10 to 100) Ω 100 Ω to 100 kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	19 parts in 10 ⁶ + 0.06 mΩ 13 parts in 10 ⁶ + 0.6 mΩ 10 parts in 10 ⁶ + 0.6 mΩ 15 parts in 10 ⁶ + 2.4 Ω 59 parts in 10 ⁶ + 120 Ω 0.058 % + 1.2 kΩ 1.8 % + 10 kΩ	HP 3458A

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Electrical Calibration of Thermocouple Indicators ³ (cont) –			
Type S	0 °C to 250 °C 250 °C to 1400 °C 1400 °C to 1767 °C	0.48 °C 0.47 °C 0.54 °C	Fluke 5500A
Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 400 °C	0.56 °C 0.52 °C 0.58 °C	
Electrical Calibration of RTDs ³ –			
Pt 385, 1 kΩ	-200 °C to 100 °C 100 °C to 260 °C 260 °C to 600 °C 600 °C to 630 °C	0.03 °C 0.05 °C 0.07 °C 0.23 °C	Fluke 5500A
PtNi 385, 100 Ω	-80 °C to 100 °C 100 °C to 260 °C	0.08 °C 0.14 °C	
Cu 427, 10 Ω	-100 °C to 260 °C	0.3 °C	

Parameter/Range	Frequency	CMC ² (±)	Comments
Inductance ³ – Generate, Fixed Points, @ 1 kHz	20 mH 200 mH 1 H	0.054 % of rdg 0.059 % of rdg 0.075 % of rdg	Genrad 1482 series
AC Voltage ³ – Generate (0 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 kHz to 1 MHz	0.055 mV/V + 13 μV 0.021 mV/V + 8 μV 0.011 mV/V + 8 μV 0.037 mV/V + 8 μV 0.085 mV/V + 25 μV 0.34 mV/V + 80 μV	Fluke 5700A

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
AC Voltage ³ – Generate (cont) 220 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 kHz to 1 MHz	0.05 mV/V + 80 μV 0.016 mV/V + 25 μV 0.075 mV/V + 6 μV 0.012 mV/V + 16 μV 0.025 mV/V + 70 μV 0.22 mV/V + 850 μV	Fluke 5700A
(2.2 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 kHz to 1 MHz	0.05 mV/V + 0.8mV 0.016 mV/V + 0.25mV 0.075 mV/V + 0.06 mV 0.012 mV/V + 0.16 mV 0.025 mV/V + 25 μV 0.34 mV/V + 8.5 mV	
(22 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 kHz to 1 MHz	0.05 mV/V + 13 μV 0.021 mV/V + 8 μV 0.011 mV/V + 8 μV 0.037 mV/V + 8 μV 0.085 mV/V + 25 μV 0.34 mV/V + 80 μV	
(220 to 1100) V	15 Hz to 50 Hz 50 Hz to 1 kHz	0.19 mV/V + 2000 μV 0.30 mV/V + 10 000 μV	
AC Voltage ³ – Measure Up to 10 mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.03 % + 3 μV 0.02 % + 2 μV 0.03 % + 2 μV 0.12 % + 2 μV 0.58 % + 2 μV 4.6 % + 2 μV	HP 3458A
10 mV to 10 V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz	80 μV/V + 0.4 mV 80 μV/V + 0.2 mV 0.02 % + 0.2 mV 0.03 % + 0.2 mV 0.09 % + 0.2 mV 0.35 % + 2 mV 1.2 % + 1 mV 1.7 % + 2 mV	
(10 to 100) V	(1 to 40) Hz 40 Hz to 1 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.02 % + 4 mV 0.02 % + 2 mV 0.04 % + 2 mV 0.14 % + 2 mV 0.46 % + 10 mV 1.7 % + 10 mV	

Parameter/Range	Frequency	CMC ^{2,4,5} (\pm)	Comments
AC Voltage ³ – Measure (cont) (100 to 1000) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.05 % + 40 mV 0.05 % + 20 mV 0.07 % + 20 mV 0.14 % + 20 mV 0.35 % + 20 mV	HP 3458A
AC High Voltage ³ – Measure	(0 to 25) kV	2.0 % of rdg	TEK 6015A voltage probe
AC Power – Generate ³ Up to 1000 V, Up to 11 A	60 Hz	0.18 % rdg + 0.16 mW 0.45 % rdg + 0.16 mW	Fluke 5500a PF = 1 PF = 0.8
AC Current ³ – Generate (1 to 220) μ A 220 μ A to 22 mA (22 to 220) mA 220 mA to 2.2 A (3.2 to 32) A (32 to 200) A (16 to 160) A (160 to 1000) A	40 Hz to 1 kHz (60 to 100) Hz (100 to 440) Hz (60 to 100) Hz (100 to 440) Hz (60 to 100) Hz (60 to 100) Hz	0.09 % of rdg 0.024 % of rdg 0.026 % of rdg 0.093 % of rdg 0.4 % + 0.013 A 0.98 % + 0.054 A 0.41 % + 0.18 A 0.87 % + 0.5 A 0.4 % + 0.065 A 0.41 % + 0.91 A	Fluke 5500A 9100 Wavetek Using 10 coil turn Using 50 turn coil
AC Current ³ – Measure Up to 100 μ A	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz	0.46 % + 0.03 μ A 0.18 % + 0.03 μ A 0.078 % + 0.03 μ A	HP 3458A

Parameter/Range	Frequency	CMC ^{2,4,5} (\pm)	Comments
AC Current ³ – Measure (cont)			
100 μ A to 100 mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % + 20 μ A 0.17 % + 20 μ A 0.073 % + 20 μ A 0.042 % + 20 μ A	HP 3458A
100 mA to 1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % + 200 μ A 0.19 % + 200 μ A 0.10 % + 200 μ A 0.12 % + 200 μ A	
Capacitance ³ – Generate			
(0.19 to 3.3) nF (3.3 to 330) nF 330 nF to 3.3 μ F (3.3 to 33) μ F (33 to 330) μ F	50 Hz to 1 kHz	0.5 % + 0.01 nF 0.25 % + 0.3 nF 0.25 % + 3 nF 0.4 % + 30 nF 0.45 % + 0.3 μ F	Fluke 5500A
330 μ F to 3.3 mF (3.3 to 33) mF (33 to 110) mF	50 Hz to 300 Hz	0.45 % + 3 μ F 0.75 % + 30 μ F 1.1 % + 100 μ F	
Oscilloscopes ³ –			
Level Sine Amp 50 kHz ref.	5 mV to 5 V (V_{p-p})	2.0 % + 300 μ V	Fluke 5500A/SC600
Level Sine Flatness 5 mV to 5.5 V relative to 50 kHz reference	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	3.5 % + 300 μ V 4.0 % + 300 μ V 6.0 % + 300 μ V	
Square Wave 1 M Ω , 100 Hz 50 Ω , 1 kHz	1 mV to \pm 130 V \pm 1 mV to \pm 6.6 V	0.1 % + 40 μ V 0.25 % + 40 μ V	
Time Marker Output Into 50 Ω	2 ns to 20 ms 50 ms to 5 s	(25 + 1000 <i>t</i>) parts in 10 ⁶ 25 parts in 10 ⁶	<i>t</i> is the time in seconds
Pulse Rise Time 0.5 V, 1 V_{p-p} 1 V_{p-p}	10 MHz 1 MHz	100 ps 100 ps	

IV. Electrical – RF/Microwave

Parameter/Equipment	Range	CMC ² (±)	Comments
RF Tuned Power ³ – (0 to -127) dB	Up to 1.3 GHz 2.5 MHz to 26.5 GHz	0.04 dB 0.72 dB	HP 8902A, HP 11793A
RF Absolute Power ³ – Generate, (Connector Type N) 10 MHz to 50 GHz	(-70 to -30) dB (-30 to -20) dB (-20 to -10) dB (10 to 20) dB	0.64 dB 0.06 dB 0.068 dB 1.2 % of rdg	HP 8902A, 8481A, 8482A, 8485A 8487A
Amplitude Modulation ³ – Measure			
Rate: 150 kHz to 10 MHz Depth: (5 to 99)%	50 Hz to 10 kHz 20 Hz to 10 kHz	4 % IV 4.6 % IV	HP 8902A
Rate: 10 MHz to 1.3 GHz Depth: (5 to 99)%	50 Hz to 10 kHz 20 Hz to 10 kHz	3.6 % IV 4.6 % IV	
Frequency Modulation ³ – Measure			
Rate: 250 kHz to 10 MHz Dev: < 40 kHz	50 Hz to 10 kHz	3.1% IV	HP 8902A
Rate: 10 MHz to 1.3 GHz Dev: < 400 kHz	50 Hz to 100 kHz 20 Hz to 200 kHz	7.7 % IV 1.6 % IV	
Phase Modulation ³ –			
Rate: 10 MHz to 1.3 GHz	200 Hz to 20 kHz	7 % IV	HP 8902A

V. Mechanical

Parameter/Equipment	Range	CMC ² (±)	Comments
Pressure ³	(-15 to 400) “H ₂ O Up to 2000 psi Up to 10000 psi	0.10 % of rdg 0.09 % of rdg 0.10 % of rdg	Heise PTE Heise PTE Fluke 700P31
Torque ³	(0.1 to 10.0) Nm (10.0 to 40.0) Nm (40.0 to 1500) Nm	0.5 % of rdg 0.7 % of rdg 0.7 % of rdg	HP 100 Norbar
Scales (Platform & Spring) & Balances ³	Up to 100 kg	1.0 LSVD	Class 1 & F weights LSVD = least significant value digit

VI. Optical Quantities

Parameter/Equipment	Range	CMC ² (±)	Comments
Optical Wavelength Measure ³	(700 to 1650) nm	3.9 % of rdg	Burleigh WA-1000
Optical Power – Measure ³			
850 nm	(6 to -60) dB	4.9 % of rdg	Agilent 81554, 81533B, 8157A, 81532A, 81551MM
1310 nm	(10 to -110) dB	4.9 % of rdg	
1550 nm	(10 to -110) dB	4.7 % of rdg	
Fiber Optics Wavelength – Measuring Equipment ³	(1510 to 1540) nm	1.5 parts in 10 ⁶	NIST SRM 2517A

VII. Thermodynamics

Parameter/Equipment	Range	CMC ² (±)	Comments
Humidity Measuring Equipment ³ – Fixed Points	11 % RH 33 % RH 75.4 % RH 97 % RH	1.6 % RH 1.7 % RH 1.5 % RH 2 % RH	Standard salt solutions
Temperature ³ – Measure	-200 °C to 550 °C 550 °C to 850 °C	0.2 °C 0.35 °C	Heise PTE HQS-RTD1

VIII. Time & Frequency

Parameter/Range	Frequency	CMC ² (±)	Comments
Frequency – Measuring Equipment	1 MHz 10 MHz	5×10^{-12} 5×10^{-12}	HP 58503A, GPS

¹ This laboratory offers commercial calibration service and field 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 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 actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found 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 actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.

⁴ The measurands stated are generated with the Fluke 5500 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.

⁵ The measurands stated are measured with the HP 3458A series of instruments. This capability is suitable for the calibration of the devices intended to generate the measurand in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a combination of the fraction of the reading/output plus a range specification.

⁶ In the statement of CMC, L is the numerical value of the nominal length of the device measured in inches.



World Class Accreditation

The American Association for Laboratory Accreditation

Accredited Laboratory

A2LA has accredited

MICRO PRECISION CALIBRATION MALAYSIA

Penang, Malaysia

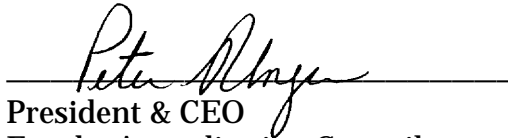
for technical competence in the field of

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 8 January 2009).

Presented this 20th day of October 2009.



A handwritten signature in black ink, appearing to read "Peter Abney", written over a horizontal line.

President & CEO
For the Accreditation Council
Certificate Number 935.14
Valid to April 30, 2012
Revised on January 26, 2012

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