

NO: SAMM 218

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LABORATORY LOCATION:  
(PERMANENT LABORATORY)

PROCAL SERVICES SDN. BHD.  
2, LORONG PERDA UTAMA 12  
BANDAR PERDA  
14000 BUKIT MERTAJAM, PENANG  
MALAYSIA



FIELDS OF CALIBRATION:

**DIMENSIONAL, MASS, FORCE AND TORQUE,  
PRESSURE, TEMPERATURE, ELECTRICAL**

This laboratory has demonstrated its technical competence to operate in accordance with MS ISO/IEC 17025:2017 (ISO/IEC 17025:2017).

This laboratory's fulfillment of the requirements of ISO/IEC 17025 means the laboratory meets both the technical competence requirements and management system requirements that are necessary for it to consistently deliver technically valid test results and calibrations. The management system requirements in ISO/IEC 17025 are written in language relevant to laboratory operations and operate generally in accordance with the principles of ISO 9001 (see Joint ISO-ILAC-IAF Communiqué dated April 2017).

\* The uncertainty covered by the CMC is expressed as the expanded uncertainty corresponding to a coverage probability of approximately 95 % and have a coverage factor of  $k=2$  unless stated otherwise.

**SCOPE OF CALIBRATION: DIMENSIONAL**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty ( $\pm$ )*	Remarks
Caliper External	0 mm to 600 mm	0.015 mm	Calibrated using gauge block as based on ISO 13385:2019
External Micrometer Up to 25mm 50mm frame 75mm frame 100mm frame 150mm frame 200mm frame 300mm frame	25mm tranverse 25mm tranverse 25mm tranverse 25mm tranverse 25mm tranverse 25mm tranverse	1.3 $\mu$ m 1.4 $\mu$ m 1.5 $\mu$ m 1.5 $\mu$ m 2.0 $\mu$ m 2.2 $\mu$ m 2.5 $\mu$ m	Calibrated using gauge block as based on ISO3611:2010
Height Gauge	0 mm to 300 mm 300 to 600 mm	4 $\mu$ m 6 $\mu$ m	Calibrated using gauge block as standards based on ISO 13225:2012
Dial Test Indicator	0 mm to 5 mm	2 $\mu$ m	Calibrated usingdial gauge calibrator as standards based on BS2795:1981

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**SCOPE OF CALIBRATION: DIMENSIONAL**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
Dial Gauge	0 mm to 25 mm	2 $\mu$ m	Calibrated using dial gauge calibrator as standards based on BS907:2008
Digital Indicator	0 mm to 50 mm	2 $\mu$ m	Calibrated using dial gauge Calibrator as standards according to BS907:2008
Feeler Gauge	0 mm to 3 mm	0.3 $\mu$ m	Contact method using SLYVAC digital linear gauge according to JIS B7524:2008
Coating Thickness Film	0 mm to 2 mm	0.3 $\mu$ m	SLYVAC digital linear gauge according to BS5411:1980
Diameter Pin Gauge (Diameter Only)	0 mm to 25 mm	0.7 $\mu$ m	Calibrated by using UMM
Plain Plug Gauge (Diameter Only)	25 mm to 100 mm	1.1 $\mu$ m	Calibrated by using ULM
Plain Ring Gauge (Diameter Only)	0 mm to 50 mm	3.1 $\mu$ m	Calibrated by using UMM
	50 mm to 100 mm	2.0 $\mu$ m	Calibrated using ULM
Gauge Block Set Grade '0' and lower	0 mm to 25 mm	0.08 $\mu$ m	Calibrated using gauge block comparison method according to ISO3650:1998
	Above 25 mm to 50 mm	0.09 $\mu$ m	
	Above 50 mm to 75 mm	0.10 $\mu$ m	
	Above 75 mm to 100 mm	0.12 $\mu$ m	
Thread Plug Gauge (Major diameter and simple pitch diameter)	0 mm to 70 mm	0.001 mm	Calibrated using ULM
Thread Ring Gauge (Minor diameter and simple pitch diameter)	3mm to 70mm	0.0025 mm	Calibrated using ULM
Radius Gauge	0.5 mm to 100 mm	0.008 mm	Calibrated using Profile Projector
Dial/Digital Thickness Gauge	0 mm to 25 mm	0.002 mm	Calibrated using Gauge Blocks
Setting Rod	0 to 25 mm	0.0005 mm	Calibrated using ULM
	25 mm to 100 mm	0.01 mm	
	100 mm to 200 mm	0.02 mm	
	200 mm to 300 mm	0.0028 mm	

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SCOPE OF CALIBRATION: DIMENSIONAL

SITE: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty ( $\pm$ )*	Remarks
Profile Projector	0mm to 300mm	3.9 $\mu$ m	Calibrated using standard glass scale according to JIS7184:2021

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**SCOPE OF CALIBRATION: MASS**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty ( $\pm$ )*	Remarks
Standard Weights	1mg	6 $\mu$ g	Calibrated using standard weights and balances as comparator using ABA Weighing Scheme
	2mg	10 $\mu$ g	
	5mg	10 $\mu$ g	
	10mg	10 $\mu$ g	
	20mg	10 $\mu$ g	
	50mg	10 $\mu$ g	
	100mg	10 $\mu$ g	
	200mg	10 $\mu$ g	
	500mg	20 $\mu$ g	
	1g	20 $\mu$ g	
	2g	20 $\mu$ g	
	5g	30 $\mu$ g	
	10g	30 $\mu$ g	
	20g	50 $\mu$ g	
	50g	0.2 mg	
	100g	0.2mg	
	200g	0.3mg	
	500g	2mg	
	1kg	5mg	
	2kg	10mg	
5kg	20mg		
10kg	0.5g		
20kg	0.20g		

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SCOPE OF CALIBRATION: MASS

SITE: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty ( $\pm$ )*	Remarks
Weighing Instruments	Up to 200g	1mg	Calibrated using standard weight with reference to ASTM E898- 20
	Up to 500g	5mg	
	Up to 1kg	6mg	
	Up to 2kg	0.01g	
	Up to 5kg	0.05g	
	Up to 10kg	0.5g	
	Up to 20kg	0.7g	
	Up to 50kg	3g	
	Up to 100kg	7g	
	Up to 200kg	13g	
	Up to 300kg	22g	
	Up to 500kg	28g	
	Up to 1000kg	80g	

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**SCOPE OF CALIBRATION: FORCE**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b>Force</b>			
Tension Measuring Device	0kgf to 20kgf 20kgf to 50kgf 50kgf to 100kgf	0.002kgf 0.02kgf 0.2kgf	Calibrated using poise weights

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**SCOPE OF CALIBRATION: TORQUE**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b>Torque</b>			
Torque Measuring Device	0kgf.cm to 10kgf.cm 10kgf.cm to 100kgf.cm	0.016kgf.cm 0.13kgf.cm	Calibrated using poise weights as standards with reference to BS7882:2017
Torque Tools	0N.m to 1N.m 1N.m to 10N.m 10N.m to 50N.m 50N.m to 100N.m 100N.m to 300N.m	0.003N.m 0.03N.m 0.1N.m 0.2N.m 0.4N.m	Calibrated using Torque Tester with reference to ISO6789-1:2017

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**SCOPE OF CALIBRATION: PRESSURE****SITE: CATEGORY I**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b>PRESSURE</b>			
Pressure Measuring Device			Calibrated with reference to AS 1349:1986 (R2018) using Pressure Tester
Vacuum	-0.9bar to 0bar	0.03bar	
Pneumatic	0bar to 0.35bar 0.35bar to 6bar 6bar to 20bar	0.0012bar 0.004bar 0.03bar	
Hydraulic	0bar to 350bar	0.5 bar	

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**SCOPE OF CALIBRATION: PRESSURE**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
Liquid in Glass Thermometer Total Immersion Partial Immersion	-20°C to 200°C -10 to 110°C	0.5°C 0.5°C	Comparison with PT100 as reference
Temperature Sensor Thermocouple	-20°C to 200°C 200°C to 400°C 400°C to 600°C 600°C to 800°C 800°C to 1000°C 1000°C to 1200°C	0.5°C 1.9°C 1.9°C 2.9°C 3.3°C 4.2°C	Comparison with standard thermocouple/PT100 as reference
PRT	-20°C to 200°C	0.5°C	Comparison with SPRT as reference
Temperature Indicating Device K-Type J-Type T-Type E-Type R-Type Pt100	-100°C to 1300°C -100°C to 1200°C -100°C to 400°C -100°C to 950°C 0°C to 1700°C -100°C to 800°C	1.0°C 0.8°C 1.0°C 0.6°C 2.0°C 0.4°C	Calibration by electrical simulation
Temperature Measuring Devices	-20°C to 60°C	0.7°C	Calibrated by comparison with PT100 in Humidity Chamber
Thermohygro Measuring Device	15°C to 35°C  30% rh to 95%rh @ 23°C	0.7°C  5% rh	Calibrated by comparison with standard thermohygrometer in humidity chamber based on BS1339:2004

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1. **Chan Siew Ling**
2. **Mohd Yussairos bin Mohd Yusof**



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**SCOPE OF CALIBRATION: TEMPERATURE****SITE: CATEGORY I**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
Temperature Controlled Enclosure	-50°C to -20°C -20°C to 200°C 200°C to 500°C	1.0°C 1.1°C 1.6°C	With reference to TLAS G-20 by using temperature recorder with thermocouple sensors
	500°C to 600°C 600°C to 800°C 800°C to 1000°C	1.6°C 3.0°C 3.4°C	With reference to AS2853:1986 by using temperature recorder with thermocouple sensors
Temperature Indicating Device			
K-Type	-100°C to 1300°C	1.0°C	Calibration by electrical simulation by using temperature calibrator
J-Type	-100°C to 1200°C	0.8°C	
T-Type	-100°C to 400°C	1.0°C	
E-Type	-100°C to 950°C	0.6°C	
R-Type	0°C to 1700°C	2.0°C	
Pt100	-100°C to 800°C	0.4°C	
Temperature Sensor			
	-30 to 600°C 600°C to 1000°C 1000°C to 1200°C	0.5°C 2.0°C 3.0°C	Comparison with standard thermocouple/PT100 as reference

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**SCOPE OF CALIBRATION: ELECTRICAL**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks	
<b><u>Measuring Instrument ( DC &amp; Low Frequency )</u></b>				
1. DC Voltage	0 mV to 330 mV	23 µV/V + 1.3 µV	Comparison with multiproduct calibrator	
	330 mV to 3.3 V	13 µV/V + 2.4 µV		
	3.3 V to 33 V	14 µV/V + 22 µV		
	33 V to 330 V	21 µV/V + 0.13 mV		
	330 V to 1020 V	24 µV/V + 0.67 mV		
2. AC Voltage	0 to 1020 V	See Matrix A	Comparison with multiproduct calibrator	
3. DC Current	0 µA to 330 µA	0.17 mA/A + 24 nA	Comparison with multiproduct calibrator	
	330 µA to 3.3 mA	0.11 mA/A + 57 nA		
	3.3 mA to 33 mA	0.12 mA/A + 0.29 µA		
	33 mA to 330 mA	0.12 mA/A + 2.9 µA		
	330 mA to 1.1 A	0.23 mA/A + 45 µA		
	1.1 A to 3 A	0.43 mA/A + 46 µA		
	3 A to 11 A	0.58 mA/A + 0.57 mA		
4. DC Current Clamp a. Hall Effect Clamps	10 A to 40 A	5.6 mA/A + 78 mA	Comparison with multiproduct calibrator & Current Coil	
	40 A to 200 A	6.8 mA/A + 0.13 A		
	200 A to 1000 A	5.3 mA/A + 0.42 A		
5. AC Current	0 to 20.5 A	See Matrix B	Comparison with multiproduct calibrator	
6. AC Current Clamp a. Hall Effect Clamps	45 to 60 Hz	5.6 mA/A + 79 mA	Comparison with multiproduct calibrator & Current Coil	
	10 A to 40 A			
	40 A to 200 A			
	200 A to 1000 A	6.8 mA/A + 0.13 A		
	b. Wound Clamps	10 A to 40 A		5.4 mA/A + 0.46 A
		40 A to 200 A		4.2 mA/A + 11 mA
200 A to 1000 A		4.8 mA/A + 30 mA 2.8 mA/A + 0.43 A		

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## SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b><u>Measuring Instrument ( DC &amp; Low Frequency )</u></b>			
7. Resistance	0 $\Omega$ to 11 $\Omega$	46 $\mu\Omega/\Omega$ + 1.1 m $\Omega$	Comparison with multiproduct calibrator
	11 $\Omega$ to 33 $\Omega$	34 $\mu\Omega/\Omega$ + 1.7 m $\Omega$	
	33 $\Omega$ to 110 $\Omega$	33 $\mu\Omega/\Omega$ + 1.5 m $\Omega$	
	110 $\Omega$ to 330 $\Omega$	32 $\mu\Omega/\Omega$ + 2.3 m $\Omega$	
	330 $\Omega$ to 1.1 k $\Omega$	33 $\mu\Omega/\Omega$ + 2.0 m $\Omega$	
	1.1 k $\Omega$ to 3.3 k $\Omega$	32 $\mu\Omega/\Omega$ + 23 m $\Omega$	
	3.3 k $\Omega$ to 11 k $\Omega$	33 $\mu\Omega/\Omega$ + 21 m $\Omega$	
	11 k $\Omega$ to 33 k $\Omega$	32 $\mu\Omega/\Omega$ + 0.23 $\Omega$	
	33 k $\Omega$ to 110 k $\Omega$	33 $\mu\Omega/\Omega$ + 0.20 $\Omega$	
	110 k $\Omega$ to 330 k $\Omega$	37 $\mu\Omega/\Omega$ + 2.3 $\Omega$	
	330 k $\Omega$ to 1.1 M $\Omega$	38 $\mu\Omega/\Omega$ + 1.8 $\Omega$	
	1.1 M $\Omega$ to 3.3 M $\Omega$	69 $\mu\Omega/\Omega$ + 35 $\Omega$	
	3.3 M $\Omega$ to 11 M $\Omega$	0.15 m $\Omega/\Omega$ + 56 $\Omega$	
	11 M $\Omega$ to 33 M $\Omega$	0.29 m $\Omega/\Omega$ + 2.8 k $\Omega$	
33 M $\Omega$ to 110 M $\Omega$	0.58 m $\Omega/\Omega$ + 3.6 k $\Omega$		
110 M $\Omega$ to 330 M $\Omega$	3.4 m $\Omega/\Omega$ + 0.11 M $\Omega$		
330 M $\Omega$ to 1100 M $\Omega$	17 m $\Omega/\Omega$ + 0.54 M $\Omega$		

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**SCOPE OF CALIBRATION: ELECTRICAL**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b><u>Measuring Instrument ( DC &amp; Low Frequency )</u></b>			
8. Capacitance	220 pF to 400 pF	5.1 mF/F + 12 pF	Comparison with multiproduct calibrator
	400 pF to 1100 pF	5.5 mF/F + 12 pF	
	1.1 nF to 3.3 nF	6.1 mF/F + 11 pF	
	3.3 nF to 11 nF	2.9 mF/F + 11 pF	
	11 nF to 33 nF	2.9 mF/F + 11 pF	
	33 nF to 110 nF	2.9 mF/F + 11 pF	
	110 nF to 330 nF	2.9 mF/F + 41 pF	
	0.33 $\mu$ F to 1.1 $\mu$ F	2.9 mF/F + 1.1 nF	
	1.1 $\mu$ F to 3.3 $\mu$ F	2.9 mF/F + 3.4 nF	
	3.3 $\mu$ F to 11 $\mu$ F	2.9 mF/F + 11 nF	
	11 $\mu$ F to 33 $\mu$ F	4.6 mF/F + 34 nF	
	33 $\mu$ F to 110 $\mu$ F	5.3 mF/F + 0.11 $\mu$ F	
	110 $\mu$ F to 330 $\mu$ F	5.1 mF/F + 0.35 $\mu$ F	
330 $\mu$ F to 1.1 mF	5.1 mF/F + 1.1 $\mu$ F		
1.1 mF to 3.3 mF	4.4 mF/F + 6.9 $\mu$ F		
9. Frequency	10 Hz to 120 Hz	2.5 $\mu$ Hz/Hz + 51 $\mu$ Hz	Comparison with multiproduct calibrator
	120 Hz to 1200 Hz	2.5 $\mu$ Hz/Hz + 0.49 mHz	
	1.2 kHz to 12 kHz	2.4 $\mu$ Hz/Hz + 5.2 mHz	
	12 kHz to 120 kHz	2.4 $\mu$ Hz/Hz + 52 mHz	
	120 kHz to 1200 kHz	2.4 $\mu$ Hz/Hz + 0.47 Hz	

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**SCOPE OF CALIBRATION: ELECTRICAL**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b><u>Measuring Instrument ( DC &amp; Low Frequency )</u></b>			
10. DC Power	9 W to 20 kW	See Matrix C	Comparison with multiproduct calibrator
11. AC Power	9 W to 20 kW	See Matrix D	Comparison with multiproduct calibrator
<b><u>Generating Instrument ( DC &amp; Low Frequency )</u></b>			
1. DC Voltage	1 kV to 10 kV	5.7 mV/V + 3.4 V	Comparison with Precision High Voltage Meter
2. AC Voltage	1 kV to 10 kV (50Hz)	11 mV/V + 10 V	Comparison with Precision High Voltage Meter
3. DC Voltage	0 mV to 100 mV	6.6 $\mu$ V/V + 1.0 $\mu$ V	Direct measure with precision multimeter
	100 mV to 1 V	6.6 $\mu$ V/V + 3.5 $\mu$ V	
	1 V to 10 V	7.3 $\mu$ V/V + 21 $\mu$ V	
	10 V to 100 V	9.0 $\mu$ V/V + 0.31 mV	
	100 V to 1000 V	8.2 $\mu$ V/V + 4.0 mV	
4. DC Current	0 mA to 1 mA	20 $\mu$ A/A + 9.3 nA	Direct measure with precision multimeter
	1 mA to 10 mA	21 $\mu$ A/A + 75 nA	
	10 mA to 100 mA	38 $\mu$ A/A + 0.72 $\mu$ A	
	100 mA to 1 A	87 $\mu$ A/A + 64 $\mu$ A	

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## SCOPE OF CALIBRATION: ELECTRICAL

## MATRIX A ( AC Voltage - Measuring Instruments )

Voltage Range	Frequency									
	10 Hz to 45 Hz	45 Hz to 1 kHz	45 Hz to 10 kHz	1 kHz to 5 kHz	1 kHz to 10 kHz	5 kHz to 10 kHz	10 kHz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz	100 kHz to 500 kHz
1 mV to 33 mV	0.90 mV/V + 7.2 $\mu$ V	-	0.17 mV/V + 6.9 $\mu$ V	-	-	-	0.23 mV/V + 6.9 $\mu$ V	1.1 mV/V + 7.0 $\mu$ V	4.0 mV/V + 14 $\mu$ V	9.1 mV/V + 57 $\mu$ V
33 mV to 330 mV	0.34 mV/V + 9.9 $\mu$ V	-	0.16 mV/V + 9.8 $\mu$ V	-	-	-	0.18 mV/V + 9.6 $\mu$ V	0.39 mV/V + 11 $\mu$ V	0.90 mV/V + 37 $\mu$ V	2.3 mV/V + 79 $\mu$ V
330 mV to 3.3 V	0.34 mV/V + 62 $\mu$ V	-	0.17 mV/V + 73 $\mu$ V	-	-	-	0.21 mV/V + 72 $\mu$ V	0.34 mV/V + 70 $\mu$ V	0.79 mV/V + 0.15 mV	2.7 mV/V + 0.68 mV
3.3 V to 33 V	0.34 mV/V + 0.80 mV	-	0.17 mV/V + 0.75 mV	-	-	-	0.27 mV/V + 0.83 mV	0.40 mV/V + 0.83 mV	1.0 mV/V + 2.1 mV	-
33 V to 330 V	-	0.21 mV/V + 3.0 mV	-	-	0.22 mV/V + 9.9 mV	-	0.28 mV/V + 9.6 mV	0.34 mV/V + 9.8 mV	2.3 mV/V + 60 mV	-
330 V to 1020 V	-	0.34 mV/V + 13 mV	-	0.28 mV/V + 19 mV	-	0.33 mV/V + 20 mV	-	-	-	-

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**SCOPE OF CALIBRATION: ELECTRICAL****MATRIX B ( AC Current - Measuring Instruments )**

Current Range	Frequency					
	45 Hz to 100 Hz	45 Hz to 1 kHz	100 Hz to 1 kHz	1 kHz to 5 kHz	5 kHz to 10 kHz	10 kHz to 30 kHz
30 $\mu$ A to 330 $\mu$ A	-	1.4 mA/A + 0.12 $\mu$ A	-	3.4 mA/A + 0.17 $\mu$ A	9.0 mA/A + 0.23 $\mu$ A	18 mA/A + 0.45 $\mu$ A
330 $\mu$ A to 3.3 mA	-	1.1 mA/A + 0.18 $\mu$ A	-	2.3 mA/A + 0.23 $\mu$ A	5.7 mA/A + 0.34 $\mu$ A	11 mA/A + 0.68 $\mu$ A
3.3 mA to 33 mA	-	0.48 mA/A + 2.3 $\mu$ A	-	0.95 mA/A + 2.2 $\mu$ A	2.3 mA/A + 3.4 $\mu$ A	4.5 mA/A + 4.5 $\mu$ A
33 mA to 330 mA	-	0.46 mA/A + 23 $\mu$ A	-	1.1 mA/A + 57 $\mu$ A	2.3 mA/A + 0.11 mA	4.5 mA/A + 0.23 $\mu$ A
330 mA to 1.1 A	-	0.58 mA/A + 0.11 mA	-	6.8 mA/A + 1.1 mA	28 mA/A + 5.7 mA	-
1.1 A to 3 A	-	0.69 mA/A + 0.11 mA	-	6.8 mA/A + 1.2 mA	28 mA/A + 5.7 mA	-
3 A to 11 A	0.68 mA/A + 2.4 mA	-	1.1 mA/A + 2.3 mA	34 mA/A + 4.3 mA	-	-
11 A to 20.5 A	1.4 mA/A + 5.5 mA	-	1.7 mA/A + 5.4 mA	34 mA/A + 6.5 mA	-	-

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**SCOPE OF CALIBRATION: ELECTRICAL****MATRIX C ( DC Power - Measuring Instruments )**

Voltage Range	Power & Current Range		
	9 W to 330 W ( 33 mA to 329.99 mA )	33 W to 3 kW ( 330 mA to 2.9999 A )	300 W to 20 kW ( 3 A to 20 A )
100 V to 1000 V	0.28 mW/W	0.26 mW/W	0.79 mW/W

**MATRIX D ( AC Power - Measuring Instruments )**

Voltage Range	Power & Current Range				
	9 W to 330 W ( 90 mA to 329.99 mA )	33 W to 900 W ( 330 mA to 0.8999 A )	90 W to 2,2 kW ( 0.9 A to 2.1999 A )	220 W to 4.5 kW ( 2.2 A to 4.4999 A )	450 W to 20 kW ( 4.5 A to 20 A )
100 V to 1000 V ( 45 Hz to 65 Hz ) ( at PF=1 )	0.92 mW/W	1.3 mW/W	1.0 mW/W	1.4 mW/W	1.2 mW/W



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## SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b><u>Measuring Instrument ( DC/AC &amp; Low Frequency )</u></b>			
Insulation Resistance	1 k $\Omega$ to 10 k $\Omega$	0.58 m $\Omega/\Omega$	Comparison with Decade Resistance Box
	10 $\Omega$ to 100 k $\Omega$	1.2 m $\Omega/\Omega$	
	100 k $\Omega$ to 1 M $\Omega$	2.5 m $\Omega/\Omega$	
	1 M $\Omega$ to 10 M $\Omega$	2.3 m $\Omega/\Omega$	
	10 M $\Omega$ to 100 M $\Omega$	2.3 m $\Omega/\Omega$	
	100 M $\Omega$ to 1 G $\Omega$	2.5 m $\Omega/\Omega$	
	1 G $\Omega$ to 10 G $\Omega$	5.7 m $\Omega/\Omega$	
	10 G $\Omega$ to 100 G $\Omega$	12 m $\Omega/\Omega$	
	100 G $\Omega$ to 1 T $\Omega$	12 m $\Omega/\Omega$	
Fixed Lo Resistance (DC)	1 m $\Omega$	0.28 $\mu\Omega$	Comparison with Precision Resistance Standard
	10 m $\Omega$	2.0 $\mu\Omega$	
	100 m $\Omega$	17 $\mu\Omega$	
	1 $\Omega$	0.15 m $\Omega/\Omega$	
	10 $\Omega$	1.5 m $\Omega/\Omega$	
Fixed Lo Resistance (AC) (50 to 60) Hz	1 m $\Omega$	1.2 $\mu\Omega$	Comparison with Precision Resistance Standard
	10 m $\Omega$	13 $\mu\Omega$	
	100 m $\Omega$	0.12 m $\Omega$	
	1 $\Omega$	1.2 m $\Omega/\Omega$	
	10 $\Omega$	12 m $\Omega/\Omega$	

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**SCOPE OF CALIBRATION: ELECTRICAL**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks	
<b><u>Generating Instruments ( DC/AC &amp; Low Frequency )</u></b>				
DC Voltage	0 mV to 100 mV	14 $\mu$ V/V + 0.34 $\mu$ V	Direct measure with precision multimeter	
	100 mV to 1 V	10 $\mu$ V/V + 0.34 $\mu$ V		
	1 V to 10 V	9.5 $\mu$ V/V + 0.57 $\mu$ V		
	10 V to 100 V	12 $\mu$ V/V + 34 $\mu$ V		
	100 V to 1000 V	12 $\mu$ V/V + 0.11 mV		
AC Voltage	1 mV to 1000 V	See Matrix E	Direct measure with precision multimeter	
DC Current	0 nA to 100 nA	35 $\mu$ A/A + 45 pA	Direct measure with precision multimeter	
	100 nA to 1 $\mu$ A	23 $\mu$ A/A + 45 pA		
	1 $\mu$ A to 10 $\mu$ A	23 $\mu$ A/A + 0.11 nA		
	10 $\mu$ A to 100 $\mu$ A	23 $\mu$ A/A + 0.91 nA		
	100 $\mu$ A to 1 mA	23 $\mu$ A/A + 5.7 nA		
	1 mA to 10 mA	23 $\mu$ A/A + 57 nA		
	10 mA to 100 mA	40 $\mu$ A/A + 0.57 $\mu$ A		
	100 mA to 1 A	0.14 mA/A + 11 $\mu$ A		
		1 A to 2 A	0.15 mA/A	Comparison with Precision Resistance Standard
		2 A to 20 A	0.19 mA/A	
	20 A to 100 A	0.28 mA/A		
AC Current	1 mA to 100 A	See Matrix F	Direct measure with precision multimeter	
Resistance	0 $\Omega$ to 10 $\Omega$	13 $\mu\Omega/\Omega$ + 0.12 $\mu\Omega$	Direct measure with precision multimeter	
	10 $\Omega$ to 100 $\Omega$	11 $\mu\Omega/\Omega$ + 1.0 m $\Omega$		
	100 $\Omega$ to 1 k $\Omega$	6.3 $\mu\Omega/\Omega$ + 8.6 m $\Omega$		
	1 k $\Omega$ to 10 k $\Omega$	6.3 $\mu\Omega/\Omega$ + 86 m $\Omega$		
	10 k $\Omega$ to 100 k $\Omega$	6.3 $\mu\Omega/\Omega$ + 0.86 $\Omega$		
	100 k $\Omega$ to 1 M $\Omega$	12 $\mu\Omega/\Omega$ + 9.8 $\Omega$		
	1 M $\Omega$ to 10 M $\Omega$	43 $\mu\Omega/\Omega$ + 0.32 k $\Omega$		
	10 M $\Omega$ to 100 M $\Omega$	0.56 m $\Omega/\Omega$ + 1.8 k $\Omega$		
	100 M $\Omega$ to 1 G $\Omega$	5.6 m $\Omega/\Omega$ + 23 k $\Omega$		

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## SCOPE OF CALIBRATION: ELECTRICAL

## MATRIX E ( AC Voltage - Generating Instruments )

Measuring by using HP 3458A							
Voltage Range	Frequency						
	40 Hz to 1 kHz	1 kHz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz	100 kHz to 300 kHz	300 kHz to 1 MHz	1 MHz to 2 MHz
1 mV to 10 mV	0.33 mV/V + 1.2 $\mu$ V	0.58 mV/V + 1.2 $\mu$ V	1.1 mV/V + 0.12 $\mu$ V	5.7 mV/V + 0.12 $\mu$ V	45 mV/V + 2.3 $\mu$ V	-	-
10 mV to 100 mV	0.17 mV/V + 2.3 $\mu$ V	0.22 mV/V + 2.3 $\mu$ V	0.34 mV/V + 2.3 $\mu$ V	1.1 mV/V + 2.3 $\mu$ V	3.5 mV/V + 11 $\mu$ V	311 mV/V + 11 $\mu$ V	17 mV/V + 11 $\mu$ V
100 mV to 1 V	0.11 mV/V + 23 $\mu$ V	0.17 mV/V + 23 $\mu$ V	0.35 mV/V + 23 $\mu$ V	0.92 mV/V + 23 $\mu$ V	3.4 mV/V + 0.11 mV	11 mV/V + 0.11 mV	17 mV/V + 0.11 mV
1 V to 10 V	91 $\mu$ V/V + 0.23 mV	0.16 mV/V + 0.23 mV	0.35 mV/V + 0.23 mV	0.91 mV/V + 0.23 mV	3.4 mV/V + 1.1 mV	11 mV/V + 1.1 mV	17 mV/V + 1.1 mV
10 V to 100 V	0.23 mV/V + 2.3 mV	0.23 mV/V + 2.3 mV	0.40 mV/V + 2.3 mV	1.4 mV/V + 2.3 mV	4.5 mV/V + 11 mV	17 mV/V + 11 mV	-
100 V to 1000 V	0.46 mV/V + 23 mV	0.68 mV/V + 23 mV	1.4 mV/V + 23 mV	3.4 mV/V + 23 mV	-	-	-

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**SCOPE OF CALIBRATION: ELECTRICAL****MATRIX F ( AC Current - Generating Instruments )**

Measuring by using HP 3458A							
Current Range	Frequency						
	10 Hz to 20 Hz	20 Hz to 45 Hz	45 Hz to 100 Hz	100 Hz to 5 kHz	5 kHz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz
1 $\mu$ A to 100 $\mu$ A	4.5mA/A + 34 nA	1.7mA/A + 34 nA	0.68mA/A + 34 nA	0.70mA/A + 34 nA	-	-	-
100 $\mu$ A to 1 mA	4.5 $\mu$ A/A + 0.23 $\mu$ A	1.7 $\mu$ A/A + 0.23 $\mu$ A	0.68 $\mu$ A/A + 0.23 $\mu$ A	0.37 $\mu$ A/A + 0.23 $\mu$ A	0.69 $\mu$ A/A + 0.23 $\mu$ A	4.5 $\mu$ A/A + 0.45 $\mu$ A	6.2 $\mu$ A/A + 1.7 $\mu$ A
1 mA to 10 mA	4.5 $\mu$ A/A + 2.3 $\mu$ A	1.7 $\mu$ A/A + 2.3 $\mu$ A	0.68 $\mu$ A/A + 2.3 $\mu$ A	0.37 $\mu$ A/A + 2.3 $\mu$ A	0.68 $\mu$ A/A + 2.3 $\mu$ A	4.5 $\mu$ A/A + 4.5 $\mu$ A	6.2 $\mu$ A/A + 17 $\mu$ A
10 mA to 100 mA	4.5 $\mu$ A/A + 23 $\mu$ A	1.7 $\mu$ A/A + 23 $\mu$ A	0.68 $\mu$ A/A + 23 $\mu$ A	0.37 $\mu$ A/A + 23 $\mu$ A	0.69 $\mu$ A/A + 23 $\mu$ A	4.5 $\mu$ A/A + 45 $\mu$ A	6.2 $\mu$ A/A + 0.17 $\mu$ A
100 mA to 1 A	4.5 mA/A + 0.23 mA	1.8mA/A + 0.23 mA	0.91mA/A + 0.23 mA	1.2mA/A + 0.23 mA	3.4mA/A + 0.23 mA	11mA/A + 0.45 mA	-
Measuring by using HP 3458A & Prodigit 7550A							
Current Range	Frequency						
	50 Hz to 400 Hz						
1 A to 2 A	1.2 mA/A						
2 A to 20 A	1.3 mA/A						
20 A to 100 A	1.3 mA/A						

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## SCOPE OF CALIBRATION: ELECTRICAL

## SITE: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b>Measuring Instrument ( DC &amp; Low Frequency )</b>			
1. DC Voltage	0 mV to 330 mV	23 $\mu$ V/V + 1.3 $\mu$ V	Comparison with multiproduct calibrator
	330 mV to 3.3 V	13 $\mu$ V/V + 2.4 $\mu$ V	
	3.3 V to 33 V	14 $\mu$ V/V + 22 $\mu$ V	
	33 V to 330 V	21 $\mu$ V/V + 0.13 mV	
	330 V to 1020 V	24 $\mu$ V/V + 0.67 mV	
2. AC Voltage	0 to 1020 V	See Matrix G	Comparison with multiproduct calibrator
3. DC Current	0 $\mu$ A to 330 $\mu$ A	0.17 mA/A + 24 nA	Comparison with multiproduct calibrator
	330 $\mu$ A to 3.3 mA	0.11 mA/A + 57 nA	
	3.3 mA to 33 mA	0.12 mA/A + 0.29 $\mu$ A	
	33 mA to 330 mA	0.12 mA/A + 2.9 $\mu$ A	
	330 mA to 1.1 A	0.23 mA/A + 45 $\mu$ A	
	1.1 A to 3 A	0.43 mA/A + 46 $\mu$ A	
	3 A to 11 A	0.58 mA/A + 0.57 mA	
4. DC Current Clamp a. Hall Effect Clamps	10 A to 40 A	5.6 mA/A + 78 mA	Comparison with multiproduct calibrator & Current Coil
	40 A to 200 A	6.8 mA/A + 0.13 A	
	200 A to 1000 A	5.3 mA/A + 0.42 A	
5. AC Current	0 to 20.5 A	See Matrix H	Comparison with multiproduct calibrator
6. AC Current Clamp a. Hall Effect Clamps	<u>45 to 60 Hz</u>	5.6 mA/A + 79 mA	Comparison with multiproduct calibrator & Current Coil
	10 A to 40 A		
b. Wound Clamps	40 A to 200 A	6.8 mA/A + 0.13 A	
	200 A to 1000 A	5.4 mA/A + 0.46 A	
	10 A to 40 A	4.2 mA/A + 11 mA	
	40 A to 200 A	4.8 mA/A + 30 mA	
	200 A to 1000 A	2.8 mA/A + 0.43 A	

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## SCOPE OF CALIBRATION: ELECTRICAL

## SITE: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b><u>Measuring Instrument ( DC &amp; Low Frequency )</u></b>			
7. Resistance	0 $\Omega$ to 11 $\Omega$	46 $\mu\Omega/\Omega$ + 1.1 m $\Omega$	Comparison with multiproduct calibrator
	11 $\Omega$ to 33 $\Omega$	34 $\mu\Omega/\Omega$ + 1.7 m $\Omega$	
	33 $\Omega$ to 110 $\Omega$	33 $\mu\Omega/\Omega$ + 1.5 m $\Omega$	
	110 $\Omega$ to 330 $\Omega$	32 $\mu\Omega/\Omega$ + 2.3 m $\Omega$	
	330 $\Omega$ to 1.1 k $\Omega$	33 $\mu\Omega/\Omega$ + 2.0 m $\Omega$	
	1.1 k $\Omega$ to 3.3 k $\Omega$	32 $\mu\Omega/\Omega$ + 23 m $\Omega$	
	3.3 k $\Omega$ to 11 k $\Omega$	33 $\mu\Omega/\Omega$ + 21 m $\Omega$	
	11 k $\Omega$ to 33 k $\Omega$	32 $\mu\Omega/\Omega$ + 0.23 $\Omega$	
	33 k $\Omega$ to 110 k $\Omega$	33 $\mu\Omega/\Omega$ + 0.20 $\Omega$	
	110 k $\Omega$ to 330 k $\Omega$	37 $\mu\Omega/\Omega$ + 2.3 $\Omega$	
	330 k $\Omega$ to 1.1 M $\Omega$	38 $\mu\Omega/\Omega$ + 1.8 $\Omega$	
	1.1 M $\Omega$ to 3.3 M $\Omega$	69 $\mu\Omega/\Omega$ + 35 $\Omega$	
	3.3 M $\Omega$ to 11 M $\Omega$	0.15 m $\Omega/\Omega$ + 56 $\Omega$	
	11 M $\Omega$ to 33 M $\Omega$	0.29 m $\Omega/\Omega$ + 2.8 k $\Omega$	
	33 M $\Omega$ to 110 M $\Omega$	0.58 m $\Omega/\Omega$ + 3.6 k $\Omega$	
110 M $\Omega$ to 330 M $\Omega$	3.4 m $\Omega/\Omega$ + 0.11 M $\Omega$		
330 M $\Omega$ to 1100 M $\Omega$	17 m $\Omega/\Omega$ + 0.54 M $\Omega$		

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## SCOPE OF CALIBRATION: ELECTRICAL

## SITE: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b><u>Measuring Instrument ( DC &amp; Low Frequency )</u></b>			
8. Capacitance	220 pF to 400 pF	5.1 mF/F + 12 pF	Comparison with multiproduct calibrator
	400 pF to 1100 pF	5.5 mF/F + 12 pF	
	1.1 nF to 3.3 nF	6.1 mF/F + 11 pF	
	3.3 nF to 11 nF	2.9 mF/F + 11 pF	
	11 nF to 33 nF	2.9 mF/F + 11 pF	
	33 nF to 110 nF	2.9 mF/F + 11 pF	
	110 nF to 330 nF	2.9 mF/F + 41 pF	
	0.33 $\mu$ F to 1.1 $\mu$ F	2.9 mF/F + 1.1 nF	
	1.1 $\mu$ F to 3.3 $\mu$ F	2.9 mF/F + 3.4 nF	
	3.3 $\mu$ F to 11 $\mu$ F	2.9 mF/F + 11 nF	
	11 $\mu$ F to 33 $\mu$ F	4.6 mF/F + 34 nF	
	33 $\mu$ F to 110 $\mu$ F	5.3 mF/F + 0.11 $\mu$ F	
	110 $\mu$ F to 330 $\mu$ F	5.1 mF/F + 0.35 $\mu$ F	
330 $\mu$ F to 1.1 mF	5.1 mF/F + 1.1 $\mu$ F		
1.1 mF to 3.3 mF	4.4 mF/F + 6.9 $\mu$ F		
9. Frequency	10 Hz to 120 Hz	2.5 $\mu$ Hz/Hz + 51 $\mu$ Hz	Comparison with multiproduct calibrator
	120 Hz to 1200 Hz	2.5 $\mu$ Hz/Hz + 0.49 mHz	
	1.2 kHz to 12 kHz	2.4 $\mu$ Hz/Hz + 5.2 mHz	
	12 kHz to 120 kHz	2.4 $\mu$ Hz/Hz + 52 mHz	
	120 kHz to 1200 kHz	2.4 $\mu$ Hz/Hz + 0.47 Hz	

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**SCOPE OF CALIBRATION: ELECTRICAL****SITE: CATEGORY I**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b><u>Measuring Instrument ( DC &amp; Low Frequency )</u></b>			
10. DC Power	9 W to 20 kW	See Matrix I	Comparison with multiproduct calibrator
11. AC Power	9 W to 20 kW	See Matrix J	Comparison with multiproduct calibrator
<b><u>Generating Instrument ( DC &amp; Low Frequency )</u></b>			
1. DC Voltage	1 kV to 10 kV	5.7 mV/V + 3.4 V	Comparison with Precision High Voltage Meter
2. AC Voltage	1 kV to 10 kV (50Hz)	11 mV/V + 10 V	Comparison with Precision High Voltage Meter
3. DC Voltage	0 mV to 100 mV	55 $\mu$ V/V + 4.2 $\mu$ V	Direct measure with precision multimeter
	100 mV to 1 V	44 $\mu$ V/V + 10 $\mu$ V	
	1 V to 10 V	39 $\mu$ V/V + 65 $\mu$ V	
	10 V to 100 V	49 $\mu$ V/V + 0.87 mV	
4. DC Current	100 V to 1000 V	49 $\mu$ V/V + 14 mV	Direct measure with precision multimeter
	0 mA to 10 mA	0.56 $\mu$ A/A + 2.3 $\mu$ A	
	10 mA to 100 mA	0.55 $\mu$ A/A + 7.0 $\mu$ A	
	100 mA to 1 A	1.1 mA/A + 0.72 $\mu$ A	
	1 A to 3 A	1.4 mA/A + 0.69 mA	

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SCOPE OF CALIBRATION: ELECTRICAL

SITE: CATEGORY I

MATRIX G ( AC Voltage - Measuring Instruments )

Voltage Range	Frequency									
	10 Hz to 45 Hz	45 Hz to 1 kHz	45 Hz to 10 kHz	1 kHz to 5 kHz	1 kHz to 10 kHz	5 kHz to 10 kHz	10 kHz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz	100 kHz to 500 kHz
1 mV to 33 mV	0.90 mV/V + 7.2 $\mu$ V	-	0.17 mV/V + 6.9 $\mu$ V	-	-	-	0.23 mV/V + 6.9 $\mu$ V	1.1 mV/V + 7.0 $\mu$ V	4.0 mV/V + 14 $\mu$ V	9.1 mV/V + 57 $\mu$ V
33 mV to 330 mV	0.34 mV/V + 9.9 $\mu$ V	-	0.16 mV/V + 9.8 $\mu$ V	-	-	-	0.18 mV/V + 9.6 $\mu$ V	0.39 mV/V + 11 $\mu$ V	0.90 mV/V + 37 $\mu$ V	2.3 mV/V + 79 $\mu$ V
330 mV to 3.3 V	0.34 mV/V + 62 $\mu$ V	-	0.17 mV/V + 73 $\mu$ V	-	-	-	0.21 mV/V + 72 $\mu$ V	0.34 mV/V + 70 $\mu$ V	0.79 mV/V + 0.15 mV	2.7 mV/V + 0.68 mV
3.3 V to 33 V	0.34 mV/V + 0.80 mV	-	0.17 mV/V + 0.75 mV	-	-	-	0.27 mV/V + 0.83 mV	0.40 mV/V + 0.83 mV	1.0 mV/V + 2.1 mV	-
33 V to 330 V	-	0.21 mV/V + 3.0 mV	-	-	0.22 mV/V + 9.9 mV	-	0.28 mV/V + 9.6 mV	0.34 mV/V + 9.8 mV	2.3 mV/V + 60 mV	-
330 V to 1020 V	-	0.34 mV/V + 13 mV	-	0.28 mV/V + 19 mV	-	0.33 mV/V + 20 mV	-	-	-	-

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## SCOPE OF CALIBRATION: ELECTRICAL

SITE: CATEGORY I

## MATRIX H (AC Current Measuring Instruments)

Current Range	Frequency					
	45 Hz to 100 Hz	45 Hz to 1 kHz	100 Hz to 1 kHz	1 kHz to 5 kHz	5 kHz to 10 kHz	10 kHz to 30 kHz
30 $\mu$ A to 330 $\mu$ A	-	1.4 mA/A + 0.12 $\mu$ A	-	3.4 mA/A + 0.17 $\mu$ A	9.0 mA/A + 0.23 $\mu$ A	18 mA/A + 0.45 $\mu$ A
330 $\mu$ A to 3.3 mA	-	1.1 mA/A + 0.18 $\mu$ A	-	2.3 mA/A + 0.23 $\mu$ A	5.7 mA/A + 0.34 $\mu$ A	11 mA/A + 0.68 $\mu$ A
3.3 mA to 33 mA	-	0.48 mA/A + 2.3 $\mu$ A	-	0.95 mA/A + 2.2 $\mu$ A	2.3 mA/A + 3.4 $\mu$ A	4.5 mA/A + 4.5 $\mu$ A
33 mA to 330 mA	-	0.46 mA/A + 23 $\mu$ A	-	1.1 mA/A + 57 $\mu$ A	2.3 mA/A + 0.11 mA	4.5 mA/A + 0.23 $\mu$ A
330 mA to 1.1 A	-	0.58 mA/A + 0.11 mA	-	6.8 mA/A + 1.1 mA	28 mA/A + 5.7 mA	-
1.1 A to 3 A	-	0.69 mA/A + 0.11 mA	-	6.8 mA/A + 1.2 mA	28 mA/A + 5.7 mA	-
3 A to 11 A	0.68 mA/A + 2.4 mA	-	1.1 mA/A + 2.3 mA	34 mA/A + 4.3 mA	-	-
11 A to 20.5 A	1.4 mA/A + 5.5 mA	-	1.7 mA/A + 5.4 mA	34 mA/A + 6.5 mA	-	-

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SCOPE OF CALIBRATION: ELECTRICAL

SITE: CATEGORY I

MATRIX I ( DC Power - Measuring Instruments )

Voltage Range	Power & Current Range		
	9 W to 330 W ( 33 mA to 329.99 mA )	33 W to 3 kW ( 330 mA to 2.9999 A )	300 W to 20 kW ( 3 A to 20 A )
100 V to 1000 V	0.28 mW/W	0.26 mW/W	0.79 mW/W

MATRIX J ( AC Power - Measuring Instruments )

Voltage Range	Power & Current Range				
	9 W to 330 W ( 90 mA to 329.99 mA )	33 W to 900 W ( 330 mA to 0.8999 A )	90 W to 2,2 kW ( 0.9 A to 2.1999 A )	220 W to 4.5 kW ( 2.2 A to 4.4999 A )	450 W to 20 kW ( 4.5 A to 20 A )
100 V to 1000 V ( 45 Hz to 65 Hz ) ( at PF=1 )	0.92 mW/W	1.3 mW/W	1.0 mW/W	1.4 mW/W	1.2 mW/W

Signatories:

1. Khairizal bin Muzamil
2. Shah Zulkifli Nor bin Arshad (Non-resident)
3. Muhammad Taufiq bin Abdul Rashid