Issue date: 19 October 2020
Valid until: 17 October 2023

NO: SAMM 533

LABORATORY LOCATION:
(PERMANENT LABORATORY)

SIRIM STANDARDS TECHNOLOGY SDN BHD
BANGUNAN SIRIM BERHAD
LOT 802, JALAN DEMAK LAUT 2
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MALAYSIA

FIELDS OF CALIBRATION: **DIMENSIONAL, 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 expanded uncertainties are based on an estimated confidence 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(±)*	Remarks
Caliper	0.01 mm to 600 mm	10 µm	Caliper Checker
Micrometer	0.001 mm to 25 mm	1 µm	Gauge Block

Signatory:

1. **Mohd Najib Mohammad**

SCOPE OF CALIBRATION: PRESSURE

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Pressure Measuring Device (oil medium)	0 psi to 100 psi	0.3 psi	Reference Standard:
	101 psi to 500 psi	1.5 psi	BS EN 837-1
	501 psi to 1000 psi	3.3 psi	
	1001 psi to 5000 psi	14 psi	
	5001 psi to 10 000 psi	40 psi	
	10 001 psi to 16 000 psi	42 psi	

Signatory:

1. **Mohd Najib Mohammad**
2. **Abang Mohd Ibnur Aswandi**

SCOPE OF CALIBRATION: TEMPERATURE

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Liquid-in-glass Thermometer (Total Immersion)	-20 ºC to 250 ºC	0.05 ºC	Comparison method using Pt 100 Reference Standard in liquid bath
Temperature Sensor with Digital Indicator	-20 ºC to 250 ºC	0.04 ºC	Comparison method using Pt 100 Reference Standard in liquid bath
Mechanical Thermometer	-20 ºC to 250 ºC	0.3 °C	Comparison method using Pt 100 Reference Standard in liquid bath

Signatory:

1. **Mohd Najib Mohammad**

SCOPE OF CALIBRATION: TEMPERATURE

SITE CALIBRATION: CATEGORY 1

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Temperature Controlled Enclosure	0°C to 300°C	1.1°C	Temperature Recorder and TC Wire based on AS 2853:1986

Signatory:

1. **Mohd Najib Mohammad**

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
1.Measuring Instruments			
(a) DC Voltage(±)	0 mV to 330 mV 330 mV to 3.3 V 3.3V to 33 V 33 V to 330 V 330 V to 1020 V	23 µV/V + 1.7 µV 11 µV/V + 9.9 µV 13 µV/V + 96 µV 24 µV/V + 0.97 mV 24 µV/V + 5.5 mV	Generate using calibrator model Fluke 5522 A
(b) Resistance	0 Ω to 11Ω 11Ω to 33 Ω 33 Ω to 110 Ω 110 Ω to 330 Ω 330 Ω to 1.1 kΩ 1.1 kΩ to 3.3 kΩ 3.3 kΩ to 11 kΩ 11 kΩ to 33 kΩ 33 kΩ to 110 kΩ 110 kΩ to 330 kΩ 330 kΩ to 1.1 MΩ 1.1 MΩ to 3.3 MΩ 3.3 MΩ to 11 MΩ 11 MΩ to 33 MΩ 33 MΩ to 110 MΩ 110 MΩ to 330 MΩ 330 MΩ to 1100 MΩ	48 µΩ/Ω + 1.2 mΩ 35 µΩ/Ω + 1.8 mΩ 34 µΩ/Ω + 1.6 mΩ 33 µΩ/Ω + 2.4 mΩ 1.3 µΩ/Ω + 0.67 Ω 4.8 µΩ/Ω + 0.67 Ω 12 µΩ/Ω + 0.64 Ω 27 µΩ/Ω + 0.6 Ω 32 µΩ/Ω + 0.42 Ω 38 µΩ/Ω + 2.4 Ω 37 µΩ/Ω + 3.8 Ω 70 µΩ/Ω + 35 Ω 0.16 mΩ/Ω + 62 Ω 0.3 mΩ/Ω + 2.9 kΩ 0.6 mΩ/Ω + 4.7 kΩ 3.6 mΩ/Ω + 0.11 MΩ 18 mΩ/Ω + 5.8 MΩ	Generate using calibrator model Fluke 5522 A

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
1.Measuring Instruments(continued) (c) AC Voltage (See Matrix A)	0 mV to 1020V See Matrix A	See Matrix A	Generate using calibrator model Fluke 5522 A

Matrix A
AC Voltage Measurement. Generate using calibrator model Fluke 5522 A

Range	Frequency									
	10 Hz to 45Hz	45 Hz to 1 kHz	1 kHz to 5 kHz	5 kHz to 10 kHz	45 Hz to 10 kHz	1 kHz to 10 kHz	10kHz to 20kHz	20 kHz to 50 kHz	50 kHz to 100 kHz	100 kHz to 500 kHz
1 mV to 33 mV	1.9 + 0.11	-	-	-	0.42 + 0.11	-	0.72 + 0.11	2 + 0.11	4.5 + 0.11	9.4 + 0.12
33mV to 330 mV	1.8 + 0.11	-	-	-	0.43 + 0.11	-	0.72 + 0.11	1.8 + 0.11	2.5 + 0.12	3.3 + 0.15
330 mV to 3.3 V	1.8 + 0.24	-	-	-	0.45 + 0.24	-	0.74 + 0.24	1.8 + 0.24	2.5 + 0.12	3.3 + 0.15
3.3 V to 33 V	1.8 + 2.5	-	-	-	0.44 + 2.5	-	1.1 + 1	2.4 + 2.5	5.9 + 2.8	-
33 V to 330 V	-	1.8 + 12	-	-	-	0.63 + 14	7 + 12	9.3 + 13	12 + 27	-
330 V to 1020 V	-	1.8 + 37	0.86 + 39	0.88 + 38	-	-	-	-	-	-

The expanded uncertainties given in this table are expressed in mV/V + mV unless otherwise stated.

FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
1.Measuring Instruments(continued)			
(d) Frequency	0.01 Hz to 120 Hz 120 Hz to 1200 Hz 1.2 kHz to 12 kHz 12 kHz to 120 kHz 120 kHz to 1.2 MHz 1.2 MHz to 2 MHz	2.4 µHz/Hz + 79 µHz 2.5 µHz/Hz + 0.61 mHz 64 nHz/Hz + 0.89 Hz 0.53 µHz/Hz + 0.88 Hz 0.62 µHz/Hz + 8.7 Hz 1.4 µHz/Hz + 7.9 µHz	Generate using calibrator model Fluke 5522 A
(e)Capacitance	220 pF to 400 pF 0.4 nF to 1.1 nF 1.1 nF to 3.3 nF 3.3 nF to 11 nF 11nF to 33 nF 33 nF to 110 nF 110 nF to 320 nF 0.33 µF to 1.1 µF 1.1 µF to 3.3 µF 3.3 µF to 11 µF 11 µF to 33 µF 33 µF to 110 µF 110 µF to 330 µF 0.33 mF to 1.1 mF 1.1 mF to 3.3 mF 3.3 mF to 11 mF 11 mF to 33 mF 33 mF to 110 mF	5.8 µF/F + 12 pF 5.6 mF/F + 13 pF 5.9 mF/F + 12 pF 3 mF/F + 12 pF 3.4 mF/F + 7 pF 2.9 mF/F + 21 pF 2.9 mF/F + 59 pF 3 mF/F + 1.2 nF 3 mF/F + 3.6 nF 3 mF/F + 12 nF 4.6 mF/F + 38 nF 5.3 mF/F + 0.13 µF 5.2 mF/F + 0.36 µF 5.3 mF/F + 1.2 µF 5.3 mF/F + 3.5 µF 5.8 mF/F + 17 µF 8.7 mF/F + 35 µF 13 mF/F + 0.12 mF	Generate using calibrator model Fluke 5522 A
(f) DC Current (±)	0 µA to 330µA 330 mA to 3.3 mA 3.3 mA to 33 mA 33 mA to 330 mA 330 mA to 1.1 mA 1.1 A to 3 A 3 A to 11 A 11 A to 20.5 A	0.18 mA/A + 24 nA 0.12 mA/A + 59 nA 0.12 mA/A + 0.33 µA 0.12 mA/A + 3.3 µA 0.24 mA/A + 51 µA 0.44 mA/A + 59 µA 0.56 mA/A + 0.92 mA 1.3 mA/A + 1.1 mA	Generate using calibrator model Fluke 5522 A
(g) AC Current (See Matrix B)	See Matrix B	See Matrix B	Generate using calibrator model Fluke 5522 A

FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

Matrix B
AC Current Measurement. Generate using calibrator model Fluke 5522 A

Range	Frequency								
	10 Hz to 20 Hz	10 Hz to 45 Hz	20 Hz to 45 Hz	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 30kHz
29 µA to 330 µA	2.7 + 0.57	-	1.9 + 0.58	-	1.2 + 0.58	-	6.7 + 0.6	15 + 0.61	24 + 0.73
0.33mA to 3.3mA	2.8 + 1.6	-	1.5 + 1.6	-	0.96 + 1.5	-	6.3 + 1.8	13 + 1.8	19 + 0.89
3.3 mA to 33 mA	2.7 + 5.9	-	1.2 + 5.9	-	0.95 + 6.4	-	3.6 + 6.2	8.5 + 6.7	13 + 2.5
33 mA to 330 mA	2.8 + 58	-	1.2 + 57	-	0.5 + 60	-	1.2 + 79	2.6 mA/A + 0.13 mA	8.3 mA/A + 0.21 mA
330 mA to 1.1A	-	3.1 mA/A + 0.55 mA	-	-	0.98 mA/A + 0.58 mA	-	14 mA/A + 1.2 mA	37 mA/A + 5.3 mA	-
1.1 A to 3A	-	3.2 mA/A + 0.54 mA	-	-	1.1 mA/A + 0.59 mA	-	14 mA/A + 1.2 mA	37 mA/A + 5.1 mA	-
3A to 11A	-	-	-	2.5 mA/A + 4.2 mA	-	1.7 mA/A + 4.2 mA	36 mA/A + 3.9 mA	-	-
11A to 20.5A	-	-	-	2.7 mA/A + 6.2 mA	-	2.7 mA/A + 6.2 mA	2.7 mA/A + 7.6 mA	-	-

The expanded uncertainties given in this table are expressed in mA/A + µA unless otherwise stated.

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
1.Measuring Instruments (continued)			
(h). Clamp Meters DC Current via Current Coil	10 A to 16.5 A 16.5 A to 150 A 150 A to 1025 A	2.8 mA/A + 5 mA 4.5 mA/A - 55 mA 3 mA/A + 27 mA	Generate using Calibrator Fluke 5522A with Fluke 5500 A/Coil (50-Turn Coil)
	0 A to 20.5 A	4.3 mA/A + 8.7 mA	Generate using Calibrator Fluke 5522A with Transmille 2901 AC/DC Clamp Coil Adaptor (1-Turn Coil)
	0 A to 102.5 A	4.9 mA/A + 9.9 mA	Generate using Calibrator Fluke 5522A with Transmille 2901 AC/DC Clamp Coil Adaptor (5-Turn Coil)
	0 A to 1025 A	2.9 mA/A + 18 mA	Generate using Calibrator Fluke 5522A with Transmille 2901 AC/DC Clamp Coil Adaptor (50-Turn Coil)
AC Current via Current Coil	**(45 Hz to 65 Hz)** 10 A to 16.5 A 16.5 A to 150 A 150 A to 1025 A **(65 Hz to 440 Hz)** 10 A to 16.5 A 16.5 A to 150 A 150 A to 1025 A	 2.8 mA/A + 19 mA 3.2 mA/A + 43 mA 2.8 mA/A + 0.22 A 8.9 mA/A + 10 mA 9.2 mA/A + 31 mA 9.1 mA/A + 0.17 A	Generate using Calibrator Fluke 5522A with Fluke 5500 A/Coil (50-Turn Coil)

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
1.Measuring Instruments (continued) (h). Clamp Meters AC Current via Current Coil(continued)	30 Hz to 60 Hz 0 A to 20.5 A	3.2 mA/A + 46 mA	Generate using Calibrator Fluke 5522A withTransmille 2901 AC/DC Clamp Coil Adaptor(1-Turn Coil)
	30 Hz to 60 Hz 0 A to 102.5 A	2.9 mA/A + 44 mA	Generate using Calibrator Fluke 5522A withTransmille 2901 AC/DC Clamp Coil Adaptor(5-Turn Coil)
	30 Hz to 60 Hz 0 A to 1025 A	2.9 mA/A + 18 mA	Generate using Calibrator Fluke 5522A withTransmille 2901 AC/DC Clamp Coil Adaptor(50-Turn Coil
(i) Timer/ Stopwatch	0 sec. to 10 sec. 0 sec. to 100 sec. 0 sec. to 1000 sec. 0 sec. to 10000 sec. 0 hr. to 24 hr.	33 µs/s + 40 ms 1.2 µs/s + 41 ms 0.95 µs/s + 40 ms. 67 ns/s + 41 ms 0.12 µs/s + 40 ms	Comparison using Time Calibrator SST-2
(j). Power Meters DC Power Energy	0.1 W to 1 kW 1 kW to 20 kW	0.26 mW/W + 0.28 mW 0.82 mW/W - 2.7 mW	Generate using Fluke 5522A
AC Power Energy 45 Hz to 65 Hz at PF = 1	0.1 W to 1 W 1 W to 10 kW 10 kW to 20 kW	0.2 mW/W + 23 mW 1.2 mW/W + 7.8 mW 1.2 mW/W + 50 mW	Generate using Fluke 5522A

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
2. Source/ Generating Instruments			
(a) DC Voltage	± 100 mV Range ±(100 µV to 120 mV) ±1 V Range ±(0.1 V to 1.2 V) ± 10 V Range ±(1 V to 12 V) ±100 V Range ±(10 V to 10 V) ±1000 V Range ±(100 V to 1050 V)	4.4 µV/V + 0.7 µV 3.6 µV/V + 2 µV 4.7 µV/V + 2.6 µV 6.1 µV/V + 0.16 mV 6.1 µV/V + 1.5 mV	Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002
(b) AC Voltage	10 mV to 700V (See Matrix C)	(See Matrix C)	

Matrix C
AC Voltage Generation. Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002

Range		AC Band ≤ 2 MHz							
		1 Hz to 40 Hz	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
10 mV	1mV to 12 mV	0.32 mV/V + 4.4 µV	0.18 mV/V + 3 µV	0.27 mV/V + 3 µV	1.1 mV/V + 2.6 µV	5.7 mV/V + 2.5 µV	47 mV/V + 2.7 µV	-	-
100 mV	12 mV to 120 mV	62 µV/V + 9.7 µV	53 µV/V + 8.7 µV	0.11 mV/V + 11 µV	0.29 mV/V + 9.5 µV	0.72 mV/V + 28 µV	3.3 mV/V + 37 µV	12 mV/V + 39 µV	18 mV/V + 31 µV
1 V	120 mV to 1.2 V	84 µV/V + 51 µV	83 µV/V + 31 µV	0.17 mV/V + 29 µV	0.35 mV/V + 30 µV	0.93 mV/V + 28 µV	3.5 mV/V + 0.13 mV	12 mV/V + 0.13 mV	18 mV/V + 0.18 mV
10 V	1.2 V to 12 V	85 µV/V + 0.51 mV	83 µV/V + 0.31 mV	0.17 mV/V + 0.29 mV	0.35 mV/V + 0.28 mV	0.93 mV/V + 0.26 mV	3.5 mV/V + 1.3 mV	12 mV/V + 1.3 mV	18 mV/V + 1.7 mV
100 V	12 V to 120 V	0.24 mV/V + 5.1 mV	0.23 mV/V + 2.9 mV	0.23 mV/V + 2.9 mV	0.4 mV/V + 3.1 mV	1.4 mV/V + 2.6 mV	4.7 mV/V + 12 mV	18 mV/V + 12 mV	-
1000 V	120 V to 700 V	0.45 mV/V + 67 mV	0.44 mV/V + 48 mV	0.68 mV/V + 43 mV	1.4 mV/V + 35 mV	3.5 mV/V + 28 mV	-	-	-

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
2. Source/ Generating Instruments(continued) (b) AC Voltage(continued)	10 mV to 700V (See Matrix C)	(See Matrix C)	Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002

Matrix C (continued)
AC Voltage Generation. Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002

Range		AC Band> 2 MHz				
		45 Hz to 100 kHz	100 kHz to 1 MHz	1 MHz to 4 MHz	4 MHz to 8 MHz	8 MHz to 10 MHz
10 mV	1mV to 12 mV	1.1 mV/V + 7.5 µV	14 mV/V + 6.3 µV	81 mV/V + 8.3 µV	0.24 V/V + 9.4 µV	-
100 mV	12 mV to 120 mV	1.1 mV/V + 71 µV	24 mV/V + 63 µV	47 mV/V + 88 µV	47 mV/V + 0.1 mV	0.18 V/V + 0.12 mV
1 V	120 mV to 1.2 V	1.1 mV/V + 0.7 mV	24 mV/V + 0.58 mV	47 mV/V + 0.83 mV	47 mV/V + 0.95 mV	0.18 V/V + 1.2 mV
10 V	1.2 V to 12 V	1.1 mV/V + 7 mV	24 mV/V + 5.8 mV	47 mV/V + 8.7 mV	47 mV/V + 9.5 mV	0.18 V/V + 12 mV
100 V	12 V to 120 V	1.4 mV/V + 2.6 mV	-	-	-	-
1000 V	120 V to 700 V	3.5 mV/V + 0.12 V	-	-	-	-

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
2. Source/ Generating Instruments(continued)			
(c) Frequency or Period	Input Signal 1 mVrms to 700 Vrms 1 Hz to 40 Hz or 1 s to 25 ns 40 Hz to 10 MHz or 25 ns to 100 ns	0.58 mHz/Hz + 0.11 µHz 0.58 ms/s - 31 ps 0.12 mHz/Hz - 8.3 mHz 0.12 ms/s + 2 fs	Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002
(d) Resistance, (Four-wire Ohms and Two-wire Ohms)	0 Ω to 12Ω 10 Ω to 120 Ω 0.1 kΩ to 1.2 kΩ 1 kΩ to 12 kΩ 10 kΩto 120 kΩ 0.1 MΩ to 1.2 MΩ 1 MΩ to 12 MΩ 10 MΩ to 120 MΩ 0.1 GΩ to 1.2 GΩ	15 µΩ/Ω + 0.11 mΩ 13 µΩ/Ω + 0.79 mΩ 11 µΩ/Ω + 2.3 mΩ 11 µΩ/Ω + 22 mΩ 8.6 µΩ/Ω + 0.46 Ω 13 µΩ/Ω + 10 Ω 52 µΩ/Ω + 0.2 kΩ 0.55 mΩ/Ω + 5 kΩ 58 mΩ/Ω + 10 kΩ	Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002
(e) DC CURRENT	± 100 nA Range ± (1 nA to 120 nA) ± 1 µA Range ± (0.1 µA to 1.2 µA) ± 10 µA Range ± (1 µA to 12 µA) ± 100 µA Range ± (10 µA to 120 µA) ± 1 mA Range ± (0.1 mA to 1.2 mA) ± 10 mA Range ± (1 mA to 12 mA) ± 100 mA Range ± (10 mA to 120 mA) ± 1 A Range ± (0.1 A to 1.05 A)	30 mA/A + 48 pA 20 mA/A + 48 pA 26 µA/A + 0.12 nA 19 µA/A + 2.1 nA 22 µA/A + 12 nA 23 µA/A + 0.11 µA 42 µA/A + 1.4 µA 0.12 mA/A + 21 µA	Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
2. Source/ Generating Instruments(continued) (f) AC CURRENT	5 μA to 1 A (See Matrix D)	(See Matrix D)	Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002

Matrix D
AC Current Generation. Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002

Range		Frequency Band			
		10 Hz to 20 Hz	20 Hz to 45 Hz	45 Hz to 100 Hz	100 Hz to 1 kHz
100 □A	5□A to 120 □A	4.7 nA/A + 36 nA	1.8 nA/A + 36 nA	0.7 nA/A + 36 nA	0.7 nA/A + 36 nA
1 mA	0.05 mA to 1.2 mA	4.7 μA/A + 0.24 μA	1.8 μA/A + 0.24 μA	0.71 μA/A + 0.24 μA	0.36 μA/A + 0.23 μA
10 mA	0.5 mA to 12 mA	4.7 μA/A + 2.4 μA	1.8 μA/A + 2.4 μA	0.7 μA/A + 2.4 μA	0.36 μA/A + 2.5 μA
100 mA	5 mA to 120 mA	4.7 μA/A + 24 μA	1.8 μA/A + 24 μA	0.7 μA/A + 24 μA	0.36 μA/A + 25 μA
1 A	0.05 A to 1.05 A	4.7 mA/A + 0.25 mA	1.9 mA/A + .25 mA	0.92 mA/A + 0.25 mA	1.3 mA/A + 0.15 mA

Range		Frequency Band		
		5 kHz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz
1 mA	0.05 mAto1.2 mA	0.71 μA/A + 0.24 μA	4.7 μA/A + 0.47 μA	6.4 μA/A + 1.8 μA
10 mA	0.5 mA to 12 mA	0.7 μA/A + 2.4 μA	4.7 μA/A + 4.7 μA	6.4 μA/A + 18 μA
100 mA	5 mA to 120 mA	0.7 μA/A + 24 μA	4.7 μA/A + 47 μA	6.4 μA/A + 0.18 mA
1 A	0.05 A to 1.05 A	3.5 mA/A + 0.25 mA	12 mA/A + 0.47 mA	-

Signatory:
1. **Mohd Najib Mohammad**
2. **Mohamed Fikri Mohd Nor**

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
1.Measuring Instruments			
(a) DC Voltage(±)	0 mV to 330 mV 330 mV to 3.3 V 3.3V to 33 V 33 V to 330 V 330 V to 1020 V	23 µV/V + 1.7 µV 11 µV/V + 9.9 µV 13 µV/V + 96 µV 24 µV/V + 0.97 mV 24 µV/V + 5.5 mV	Generate using calibrator model Fluke 5522 A
(b) Resistance	0 Ω to 11Ω 11Ω to 33 Ω 33 Ω to 110 Ω 110 Ω to 330 Ω 330 Ω to 1.1 kΩ 1.1 kΩ to 3.3 kΩ 3.3 kΩ to 11 kΩ 11 kΩ to 33 kΩ 33 kΩ to 110 kΩ 110 kΩ to 330 kΩ 330 kΩ to 1.1 MΩ 1.1 MΩ to 3.3 MΩ 3.3 MΩ to 11 MΩ 11 MΩ to 33 MΩ 33 MΩ to 110 MΩ 110 MΩ to 330 MΩ 330 MΩ to 1100 MΩ	48 µΩ/Ω + 1.2 mΩ 35 µΩ/Ω + 1.8 mΩ 34 µΩ/Ω + 1.6 mΩ 33 µΩ/Ω + 2.4 mΩ 1.3 µΩ/Ω + 0.67 Ω 4.8 µΩ/Ω + 0.67 Ω 12 µΩ/Ω + 0.64 Ω 27 µΩ/Ω + 0.6 Ω 32 µΩ/Ω + 0.42 Ω 38 µΩ/Ω + 2.4 Ω 37 µΩ/Ω + 3.8 Ω 70 µΩ/Ω + 35 Ω 0.16 mΩ/Ω + 62 Ω 0.3 mΩ/Ω + 2.9 kΩ 0.6 mΩ/Ω + 4.7 kΩ 3.6 mΩ/Ω + 0.11 MΩ 18 mΩ/Ω + 5.8 MΩ	Generate using calibrator model Fluke 5522 A

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
1.Measuring Instruments(continued)			
(c) AC Voltage (See Matrix E)	0 mV to 1020V See Matrix E	See Matrix E	Generate using calibrator model Fluke 5522 A

Matrix E
AC Voltage Measurement. Generate using calibrator model Fluke 5522 A

Range	Frequency									
	10 Hz to 45Hz	45 Hz to 1 kHz	1 kHz to 5 kHz	5 kHz to 10 kHz	45 Hz to 10 kHz	1 kHz to 10 kHz	10kHz to 20kHz	20 kHz to 50 kHz	50 kHz to 100 kHz	100 kHz to 500 kHz
1 mV to 33 mV	1.9 + 0.11	-	-	-	0.42 + 0.11	-	0.72 + 0.11	2 + 0.11	4.5 + 0.11	9.4 + 0.12
33mV to 330 mV	1.8 + 0.11	-	-	-	0.43 + 0.11	-	0.72 + 0.11	1.8 + 0.11	2.5 + 0.12	3.3 + 0.15
330 mV to 3.3 V	1.8 + 0.24	-	-	-	0.45 + 0.24	-	0.74 + 0.24	1.8 + 0.24	2.5 + 0.12	3.3 + 0.15
3.3 V to 33 V	1.8 + 2.5	-	-	-	0.44 + 2.5	-	1.1 + 1	2.4 + 2.5	5.9 + 2.8	-
33 V to 330 V	-	1.8 + 12	-	-	-	0.63 + 14	7 + 12	9.3 + 13	12 + 27	-
330 V to 1020 V	-	1.8 + 37	0.86 + 39	0.88 + 38	-	-	-	-	-	-

The expanded uncertainties given in this table are expressed in mV/V + mV unless otherwise stated.

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
1.Measuring Instruments(continued)			
(d) Frequency	0.01 Hz to 120 Hz 120 Hz to 1200 Hz 1.2 kHz to 12 kHz 12 kHz to 120 kHz 120 kHz to 1.2 MHz 1.2 MHz to 2 MHz	2.4 µHz/Hz + 79 µHz 2.5 µHz/Hz + 0.61 mHz 64 nHz/Hz + 0.89 Hz 0.53 µHz/Hz + 0.88 Hz 0.62 µHz/Hz + 8.7 Hz 1.4 µHz/Hz + 7.9 µHz	Generate using calibrator model Fluke 5522 A
(e)Capacitance	220 pF to 400 pF 0.4 nF to 1.1 nF 1.1 nF to 3.3 nF 3.3 nF to 11 nF 11nF to 33 nF 33 nF to 110 nF 110 nF to 320 nF 0.33 µF to 1.1 µF 1.1 µF to 3.3 µF 3.3 µF to 11 µF 11 µF to 33 µF 33 µF to 110 µF 110 µF to 330 µF 0.33 mF to 1.1 mF 1.1 mF to 3.3 mF 3.3 mF to 11 mF 11 mF to 33 mF 33 mF to 110 mF	5.8 µF/F + 12 pF 5.6 mF/F + 13 pF 5.9 mF/F + 12 pF 3 mF/F + 12 pF 3.4 mF/F + 7 pF 2.9 mF/F + 21 pF 2.9 mF/F + 59 pF 3 mF/F + 1.2 nF 3 mF/F + 3.6 nF 3 mF/F + 12 nF 4.6 mF/F + 38 nF 5.3 mF/F + 0.13 µF 5.2 mF/F + 0.36 µF 5.3 mF/F + 1.2 µF 5.3 mF/F + 3.5 µF 5.8 mF/F + 17 µF 8.7 mF/F + 35 µF 13 mF/F + 0.12 mF	Generate using calibrator model Fluke 5522 A
(f) DC Current(±)	0 µA to 330µA 330 mA to 3.3 mA 3.3 mA to 33 mA 33 mA to 330 mA 330 mA to 1.1 mA 1.1 A to 3 A 3 A to 11 A 11 A to 20.5 A	0.18 mA/A + 24 nA 0.12 mA/A + 59 nA 0.12 mA/A + 0.33 µA 0.12 mA/A + 3.3 µA 0.24 mA/A + 51 µA 0.44 mA/A + 59 µA 0.56 mA/A + 0.92 mA 1.3 mA/A + 1.1 mA	Generate using calibrator model Fluke 5522 A
(g) AC Current (See Matrix F)	See Matrix F	See Matrix F	Generate using calibrator model Fluke 5522 A

SCOPE OF CALIBRATION: ELECTRICAL

Matrix F
AC Current Measurement. Generate using calibrator model Fluke 5522 A

Range	Frequency								
	10 Hz to 20 Hz	10 Hz to 45 Hz	20 Hz to 45 Hz	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 30kHz
29 µA to 330 µA	2.7 + 0.57	-	1.9 + 0.58	-	1.2 + 0.58	-	6.7 + 0.6	15 + 0.61	24 + 0.73
0.33mA to 3.3mA	2.8 + 1.6	-	1.5 + 1.6	-	0.96 + 1.5	-	6.3 + 1.8	13 + 1.8	19 + 0.89
3.3 mA to 33 mA	2.7 + 5.9	-	1.2 + 5.9	-	0.95 + 6.4	-	3.6 + 6.2	8.5 + 6.7	13 + 2.5
33 mA to 330 mA	2.8 + 58	-	1.2 + 57	-	0.5 + 60	-	1.2 + 79	2.6 mA/A + 0.13 mA	8.3 mA/A + 0.21 mA
330 mA to 1.1A	-	3.1 mA/A + 0.55 mA	-	-	0.98 mA/A + 0.58 mA	-	14 mA/A + 1.2 mA	37 mA/A + 5.3 mA	-
1.1 A to 3A	-	3.2 mA/A + 0.54 mA	-	-	1.1 mA/A + 0.59 mA	-	14 mA/A + 1.2 mA	37 mA/A + 5.1 mA	-
3A to 11A	-	-	-	2.5 mA/A + 4.2 mA	-	1.7 mA/A + 4.2 mA	36 mA/A + 3.9 mA	-	-
11A to 20.5A	-	-	-	2.7 mA/A + 6.2 mA	-	2.7 mA/A + 6.2 mA	2.7 mA/A + 7.6 mA	-	-

The expanded uncertainties given in this table are expressed in mA/A + µA unless otherwise stated.

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
1.Measuring Instruments (continued) (h). Clamp Meters DC Current via Current Coil	10 A to 16.5 A 16.5 A to 150 A 150 A to 1025 A	2.8 mA/A + 5 mA 4.5 mA/A - 55 mA 3 mA/A + 27 mA	Generate using Calibrator Fluke 5522A with Fluke 5500 A/Coil (50-Turn Coil)
	0 A to 20.5 A	4.3 mA/A + 8.7 mA	Generate using Calibrator Fluke 5522A with Transmille 2901 AC/DC Clamp Coil Adaptor (1-Turn Coil)
	0 A to 102.5 A	4.9 mA/A + 9.9 mA	Generate using Calibrator Fluke 5522A with Transmille 2901 AC/DC Clamp Coil Adaptor (5-Turn Coil)
	0 A to 1025 A	2.9 mA/A + 18 mA	Generate using Calibrator Fluke 5522A with Transmille 2901 AC/DC Clamp Coil Adaptor (50-Turn Coil)
AC Current via Current Coil	**(45 Hz to 65 Hz)** 10 A to 16.5 A 16.5 A to 150 A 150 A to 1025 A **(65 Hz to 440 Hz)** 10 A to 16.5 A 16.5 A to 150 A 150 A to 1025 A	 2.8 mA/A + 19 mA 3.2 mA/A + 43 mA 2.8 mA/A + 0.22 A 8.9 mA/A + 10 mA 9.2 mA/A + 31 mA 9.1 mA/A + 0.17 A	Generate using Calibrator Fluke 5522A with Fluke 5500 A/Coil (50-Turn Coil)

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
1.Measuring Instruments (continued) (h). Clamp Meters AC Current via Current Coil(continued)	30 Hz to 60 Hz 0 A to 20.5 A	3.2 mA/A + 46 mA	Generate using Calibrator Fluke 5522A with Transmille 2901 AC/DC Clamp Coil Adaptor(1-Turn Coil)
	30 Hz to 60 Hz 0 A to 102.5 A	2.9 mA/A + 44 mA	Generate using Calibrator Fluke 5522A with Transmille 2901 AC/DC Clamp Coil Adaptor(5-Turn Coil)
	30 Hz to 60 Hz 0 A to 1025 A	2.9 mA/A + 18 mA	Generate using Calibrator Fluke 5522A with Transmille 2901 AC/DC Clamp Coil Adaptor(50-Turn Coil
(i) Timer/ Stopwatch	0 sec. to 10 sec. 0 sec. to 100 sec. 0 sec. to 1000 sec. 0 sec. to 10000 sec. 0 hr. to 24 hr.	33 µs/s + 40 ms 1.2 µs/s + 41 ms 0.95 µs/s + 40 ms 67 ns/s + 41 ms 0.12 µs/s + 40 ms	Comparison using Time Calibrator SST-2
(j). Power Meters DC Power Energy	0.1 W to 1 kW 1 kW to 20 kW	0.26 mW/W + 0.28 mW 0.82 mW/W - 2.7 mW	Generate using Fluke 5522A
AC Power Energy 45 Hz to 65 Hz at PF = 1	0.1 W to 1 W 1 W to 10 kW 10 kW to 20 kW	0.2 mW/W + 23 mW 1.2 mW/W + 7.8 mW 1.2 mW/W + 50 mW	Generate using Fluke 5522A

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
2. Source/ Generating Instruments			
(a) DC Voltage	± 100 mV Range ±(100 µV to 120 mV) ±1 V Range ±(0.1 V to 1.2 V) ± 10 V Range ±(1 V to 12 V) ±100 V Range ±(10 V to 10 V) ±1000 V Range ±(100 V to 1050 V)	4.4 µV/V + 0.7 µV 3.6 µV/V + 2 µV 4.7 µV/V + 2.6 µV 6.1 µV/V + 0.16 mV 6.1 µV/V + 1.5 mV	Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002
(b) AC Voltage	10 mV to 700V (See Matrix G)	(See Matrix G)	

Matrix G
AC Voltage Generation. Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002

Range		AC Band ≤ 2 MHz							
		1 Hz to 40 Hz	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
10 mV	1mV to 12 mV	0.32 mV/V + 4.4 µV	0.18 mV/V + 3 µV	0.27 mV/V + 3 µV	1.1 mV/V + 2.6 µV	5.7 mV/V + 2.5 µV	47 mV/V + 2.7 µV	-	-
100 mV	12 mV to 120 mV	62 µV/V + 9.7 µV	53 µV/V + 8.7 µV	0.11 mV/V + 11 µV	0.29 mV/V + 9.5 µV	0.72 mV/V + 28 µV	3.3 mV/V + 37 µV	12 mV/V + 39 µV	18 mV/V + 31 µV
1 V	120 mV to 1.2 V	84 µV/V + 51 µV	83 µV/V + 31 µV	0.17 mV/V + 29 µV	0.35 mV/V + 30 µV	0.93 mV/V + 28 µV	3.5 mV/V + 0.13 mV	12 mV/V + 0.13 mV	18 mV/V + 0.18 mV
10 V	1.2 V to 12 V	85 µV/V + 0.51 mV	83 µV/V + 0.31 mV	0.17 mV/V + 0.29 mV	0.35 mV/V + 0.28 mV	0.93 mV/V + 0.26 mV	3.5 mV/V + 1.3 mV	12 mV/V + 1.3 mV	18 mV/V + 1.7 mV
100 V	12 V to 120 V	0.24 mV/V + 5.1 mV	0.23 mV/V + 2.9 mV	0.23 mV/V + 2.9 mV	0.4 mV/V + 3.1 mV	1.4 mV/V + 2.6 mV	4.7 mV/V + 12 mV	18 mV/V + 12 mV	-
1000 V	120 V to 700 V	0.45 mV/V + 67 mV	0.44 mV/V + 48 mV	0.68 mV/V + 43 mV	1.4 mV/V + 35 mV	3.5 mV/V + 28 mV	-	-	-

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
2. Source/ Generating Instruments(continued) (b) AC Voltage(continued)	10 mV to 700V (See Matrix G)	(See Matrix G)	Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002

Matrix G (continued)
AC Voltage Generation. Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002

Range		AC Band> 2 MHz				
		45 Hz to 100 kHz	100 kHz to 1 MHz	1 MHz to 4 MHz	4 MHz to 8 MHz	8 MHz to 10 MHz
10 mV	1mV to 12 mV	1.1 mV/V + 7.5 µV	14 mV/V + 6.3 µV	81 mV/V + 8.3 µV	0.24 V/V + 9.4 µV	-
100 mV	12 mV to 120 mV	1.1 mV/V + 71 µV	24 mV/V + 63 µV	47 mV/V + 88 µV	47 mV/V + 0.1 mV	0.18 V/V + 0.12 mV
1 V	120 mV to 1.2 V	1.1 mV/V + 0.7 mV	24 mV/V + 0.58 mV	47 mV/V + 0.83 mV	47 mV/V + 0.95 mV	0.18 V/V + 1.2 mV
10 V	1.2 V to 12 V	1.1 mV/V + 7 mV	24 mV/V + 5.8 mV	47 mV/V + 8.7 mV	47 mV/V + 9.5 mV	0.18 V/V + 12 mV
100 V	12 V to 120 V	1.4 mV/V + 2.6 mV	-	-	-	-
1000 V	120 V to 700 V	3.5 mV/V + 0.12 V	-	-	-	-

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
2. Source/ Generating Instruments(continued)			
(c) Frequency or Period	Input Signal 1 mVrms to 700 Vrms 1 Hz to 40 Hz or 1 s to 25 ns 40 Hz to 10 MHz or 25 ms to 100 ns	0.58 mHz/Hz + 0.11 µHz 0.58 ms/s - 31 ps 0.12 mHz/Hz - 8.3 mHz 0.12 ms/s + 2 fs	Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002
(d) Resistance, (Four-wire Ohms and Two-wire Ohms.)	0 Ω to 12Ω 10 Ω to 120 Ω 100 Ω to 1.2 kΩ 1 kΩ to 12 kΩ 10 kΩto 120 kΩ 100 kΩ to 1.2 MΩ 1 MΩto 12 MΩ 10 MΩ to 120 MΩ 120 MΩ to 1.2 GΩ	15 µΩ/Ω + 0.11 mΩ 13 µΩ/Ω + 0.79 mΩ 11 µΩ/Ω + 2.3 mΩ 11 µΩ/Ω + 22 mΩ 8.6 µΩ/Ω + 0.46 Ω 13 µΩ/Ω + 10 Ω 52 µΩ/Ω + 0.2 kΩ 0.55 mΩ/Ω + 5 kΩ 58 mΩ/Ω + 10 kΩ	Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002
(e) DC CURRENT	± 100 nA Range ± (1 nA to 120 nA) ± 1 µA Range ± (0.1 µA to 1.2 µA) ± 10 µA Range ± (1 µA to 12 µA) ± 100 µA Range ± (10 µA to 120 µA) ± 1 mA Range ± (0.1 mA to 1.2 mA) ± 10 mA Range ± (1 mA to 12 mA) ± 100 mA Range ± (10 mA to 120 mA) ± 1 A Range ± (0.1 A to 1.05 A)	30 mA/A + 48 pA 20 mA/A + 48 pA 26 µA/A + 0.12 nA 19 µA/A + 2.1 nA 22 µA/A + 12 nA 23 µA/A + 0.11 µA 42 µA/A + 1.4 µA 0.12 mA/A + 21 µA	Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
2. Source/ Generating Instruments(continued) (f) AC CURRENT	5 μA to 1 A (See Matrix H)	(See Matrix H)	Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002

Matrix H
AC Current Generation. Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002

Range		Frequency Band			
		10 Hz to 20 Hz	20 Hz to 45 Hz	45 Hz to 100 Hz	100 Hz to 1 kHz
100 □A	5□A to 120 □A	4.7 nA/A + 36 nA	1.8 nA/A + 36 nA	0.7 nA/A + 36 nA	0.7 nA/A + 36 nA
1 mA	0.05 mA to 1.2 mA	4.7 μA/A + 0.24 μA	1.8 μA/A + 0.24 μA	0.71 μA/A + 0.24 μA	0.36 μA/A + 0.23 μA
10 mA	0.5 mA to 12 mA	4.7 μA/A + 2.4 μA	1.8 μA/A + 2.4 μA	0.7 μA/A + 2.4 μA	0.36 μA/A + 2.5 μA
100 mA	5 mA to 120 mA	4.7 μA/A + 24 μA	1.8 μA/A + 24 μA	0.7 μA/A + 24 μA	0.36 μA/A + 25 μA
1 A	0.05 A to 1.05 A	4.7 mA/A + 0.25 mA	1.9 mA/A + .25 mA	0.92 mA/A + 0.25 mA	1.3 mA/A + 0.15 mA

Range		Frequency Band		
		5 kHz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz
1 mA	0.05 mAto1.2 mA	0.71 μA/A + 0.24 μA	4.7 μA/A + 0.47 μA	6.4 μA/A + 1.8 μA
10 mA	0.5 mA to 12 mA	0.7 μA/A + 2.4 μA	4.7 μA/A + 4.7 μA	6.4 μA/A + 18 μA
100 mA	5 mA to 120 mA	0.7 μA/A + 24 μA	4.7 μA/A + 47 μA	6.4 μA/A + 0.18 mA
1 A	0.05 A to 1.05 A	3.5 mA/A + 0.25 mA	12 mA/A + 0.47 mA	-

Signatories:

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