S/N: 2110

STANDARDS MALAYSIA

Certificate of Accreditation

No: SAMM 141

Accredited since: 2 July 1998

This is to certify that

SIRIM CALIBRATION SDN. BHD.
PERMATANG PAUH, PULAU PINANG
MALAYSIA

Scan this QR Code or visit
www.jsm.gov.my/cab-directories
for the current scope of accreditation

has been granted accreditation in respect of the scope of accreditation described in the schedule, subject to the terms and conditions governing the *Skim Akreditasi Makmal Malaysia* (SAMM), the Laboratory Accreditation Scheme of Malaysia.

Laboratories accredited under SAMM meet the requirements of MS ISO/IEC 17025. This Malaysian Standard is identical with ISO/IEC 17025 published by the International Organization for Standardization (ISO).

(SHAHARUL SADRI BIN ALWI)
Director General
Department of Standards Malaysia

Date of issue: 3 January 2023
(Issue 2, 3 January 2023 replacement of SAMM 141 dated 5 November 2018)

This certificate is made pursuant to subsections 16(2) and 16(3), [*Act 549*]

Issue date: 3 January 2023
Valid until: 2 July 2024

NO: SAMM 141
(Issue 2, 3 January 2023 replacement
of SAMM 141 dated 5 July 2021)

LABORATORY LOCATION:
(PERMANENT LABORATORY)

SIRIM CALIBRATION SDN. BHD.
BANGUNAN SIRIM, LOT PT 483
MUKIM 6 JALAN PERMATANG PAUH
13500 PERMATANG PAUH, PULAU PINANG
MALAYSIA

FIELDS OF CALIBRATION: **TEMPERATURE, DIMENSIONAL, MASS, PRESSURE, FORCE, TORQUE AND 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: TEMPERATURE

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Liquid-in-glass Thermometer (Total immersion)	-30 °C to 70 °C 70 °C to 300 °C	0.1 °C 0.3 °C	Comparison with PT100 in: temperature bath
Temperature Sensor 1)Thermocouple 2) Pt 100	-30 °C to 70 °C 70 °C to 400 °C	0.1 °C 0.3 °C	
Temperature Indicating Instruments Thermocouple: K Type J Type T Type E Type PT100	 -100 °C to 1300 °C -100 °C to 1100 °C -100 °C to 400 °C -100 °C to 800 °C -100 °C to 800 °C	 0.5 °C 0.4 °C 0.6 °C 0.5 °C 0.6 °C	By electrical simulation using calibrator
Dry Block Calibrator	0 °C to 400 °C	0.2 °C	Comparison with PT100
Temperature switch	0 °C to 400 °C	0.9 °C	Comparison with PT100 in Dry Block Calibrator or temperature bath

SCOPE OF CALIBRATION: TEMPERATURE

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Mechanical Thermometer	-30 °C to 300 °C	1.3 °C	Comparison with Dry Block Calibrator or temperature bath
Thermohygrograph / Thermohygrometer @ 23°C	25 %rh to 95 %rh 0 °C to 50 °C	3.5 % rh 0.8 °C	Comparison with thermohygrometer humidity chamber

Signatories:

1. **Norihan Zainal**
2. **Hasni Jamaluddin**

SCOPE OF CALIBRATION: TEMPERATURE

SITE CALIBRATION: CATEGORY 1

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Temperature Indicating Instruments (by electrical simulation) Thermocouple: (with cold junction compensation) Resistant Temperature Detector	K Type -100 °C to 1300 °C J Type -100 °C to 1100 °C T Type -100 °C to 400 °C E Type -100 °C to 800 °C R Type 0 °C to 1700 °C S Type 0°C to 1700 °C PT100 -100 °C to 800 °C	0.5 °C 0.4 °C 0.6 °C 0.5 °C 1.4 °C 1.4 °C 0.6 °C	By electrical simulation using calibrator & temperature reference to ITS-90
Temperature Controlled Heat Enclosures	-60 °C to 200 °C 200 °C to 400 °C	0.7 °C 1.3 °C	Using temperature recorder and Thermocouple Wires with reference to AS 2853-1986
Humidity Chamber @ 23°C	35 %rh to 95 %rh	3.5 %rh	Comparison with Humidity Temperature Recorder & wet and dry bulb thermocouple

Signatories:

1. **Norihan Zainal**
2. **Hasni Jamaluddin**

SCOPE OF CALIBRATION: DIMENSIONAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Digital Thickness Gauge	Up to 50 mm	1.5 µm	Calibrated using gauge block as standard
Depth-Micro-Checker	Up to 300 mm	3 µm	Calibrated using gauge block as standard
Height Gauge	Up to 300 mm 300 mm to 600 mm	3.5 µm 5.5 µm	Calibrated using gauge block as standard JIS B 7517: 1993
Standard Rod (Length Only)	Up to 300 mm 300 mm to 600 mm	3 µm 5 µm	Calibrated using gauge block as standard
Micrometer (External)	Up to 25 mm	1.3 µm	Calibrated using gauge block and related accessories as standard according ISO 3611: 2010
Caliper (Vernier, Dial, Digital)	Up to 300 mm 300 mm to 600 mm 600mm to 1000 mm	8 µm 12 µm 20 µm	Calibrated using caliper checker as standard according to JIS B 7507: 1993
Caliper Checker -External measurement only	Up to 300 mm 300 mm to 600 mm	3 µm 5 µm	Calibrated using steel gauge block as standard
Feeler Gauge (Thickness and Wrap)	Up to 1 mm	2.5 µm	Calibrated by Sylvac digital probe as reference standard
Dial Gauge	Up to 50 mm	3.0 µm	
Pin Gauge (External diameter only)	Up to 40 mm	2.5 µm	Calibrated using Master Pin Gauge as reference standard
Ruler	0.1 mm to 1000 mm	0.1 mm	Liner Scale
Tape	0 m to 10 m	(0.24 + 0.05L) mm L is length in unit meter	Linear Scale

Signatories:

1. **Norihan Zainal**
2. **Ibnu Sina Muhamad**

Issue date: 3 January 2023
Valid until: 2 July 2024

NO: SAMM 141
(Issue 2, 3 January 2023 replacement
of SAMM 141 dated 5 July 2021)

SCOPE OF CALIBRATION: DIMENSIONAL

SITE CALIBRATION: CATEGORY 1

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Surface Plate Overall Flatness	600 mm x 600 mm Up to 1500 mm x 2000 mm	3 µm 4 µm	Calibrated using Planekator as Standards according to ISO 8512-2:1990
Profile Projector –Linear Scale Only	Up to 80 mm 80 m to 200 mm	4 µm 7 µm	Calibrated using glass scale as reference standard

Signatories:

1. **Norihan Zainal**
2. **Ibnu Sina Muhamad**

SCOPE OF CALIBRATION: MASS

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Standard Weights and Weight Block	1 mg 2 mg 5 mg 10 mg 20 mg 50 mg 100 mg 200 mg 500 mg 1 g 2 g 5 g 10 g 20 g 50 g 100 g 200 g 500 g 1 kg 2 kg 5 kg 10 kg 20 kg 50 kg 60 kg	0.005 mg 0.005 mg 0.005 mg 0.005 mg 0.006 mg 0.006 mg 0.007 mg 0.010 mg 0.010 mg 0.012 mg 0.014 mg 0.016 mg 0.021 mg 0.025 mg 0.06 mg 0.06 mg 2 mg 3 mg 3 mg 14 mg 15 mg 50 mg 155 mg 157 mg 167 mg	Comparison against OIML class E2 weight

Signatories:

1. **Norihan Zainal**

SCOPE OF CALIBRATION: MASS

SITE CALIBRATION: CATEGORY 1

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Analytical Balance	Up to 200 g	0.2 mg	Using standard weight
Balance / Scale (Mechanical, Electronic)	Up to 30 kg 30 kg to 100 kg 100 kg to 500 kg 500 kg to 1000 kg	0.1 g 10 g 50 g 100 g	

Signatories:

1. **Norihan Zainal**

SCOPE OF CALIBRATION: FORCE

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Tension Gauge	10 gf to 100 gf 100 gf to 350 gf 35 gf to 1000 gf	0.2 gf 2.5 gf 7.0 gf	Standard weight & deadweight

Signatory:

1. **Norihan Zainal**

SCOPE OF CALIBRATION: FORCE

SITE CALIBRATION: CATEGORY 1

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Universal Testing Machine	0 kgf to 500 kgf 500 kgf to 1000 kgf 1000 kgf to 3000 kgf 3000 kgf to 5000 kgf 5000 kgf to 10000 kgf	0.24 kgf 2.5 kgf 14 kgf 15 kgf 16 kgf	BS EN ISO 7500-1: 2004 Load Cell 500 kgf, 1000 kgf, 3000 kgf, 5000 kgf, 10000 kgf operating in compression mode

Signatory:

1. **Norihan Zainal**

Issue date: 3 January 2023
Valid until: 2 July 2024

NO: SAMM 141
(Issue 2, 3 January 2023 replacement
of SAMM 141 dated 5 July 2021)

SCOPE OF CALIBRATION: TORQUE

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Torque Wrench	0 N.m to 2 N.m 2 N.m to 25 N.m 26 N.m to 400 N.m 401 N.m to 1500 N.m	0.02 N.m 0.10 N.m 0.52 N.m 3.3 N.m	Comparison with torque transducers with reference to BS EN ISO 6789: 2003. Transducers 2 N.m, 25 N.m, 400 N.m and 1500 N.m

Signatories:

1. **Norihan Zainal**
2. **Azizul Ehsan Alias**

SCOPE OF CALIBRATION: PRESSURE

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Pressure Measuring Device (Oil Medium)	10 psi to 100 psi 100 psi to 200 psi 200 psi to 400 psi 400 psi to 600 psi 600 psi to 800 psi 800 psi to 1000 psi 2000 psi to 4000 psi 4000 psi to 8000 psi 8000 psi to 12000 psi 12000 psi to 16000 psi	0.04 psi 0.06 psi 0.10 psi 0.14 psi 0.19 psi 0.60 psi 1.2 psi 3.2 psi 4.5 psi 5.3 psi	Hydraulic Dead Weight Tester
Pressure Measuring Device (Air Medium)	Up to 60 psi 60 psi to 320 psi 320 psi to 640 psi 640 psi to 960 psi 960 psi to 1280 psi 1280 psi to 1600 psi	0.03 psi 0.09 psi 0.18 psi 0.27 psi 0.36 psi 0.47 psi	Electronic Pressure Test Gauge and Air Dead Weight Tester
Vacuum	Up to 14 psi	0.02 psi	

Signatories:

1. **Norihan binti Zainal**
2. **Azizul Ehsan Alias**

SCOPE OF CALIBRATION: **PRESSURE**

SITE CALIBRATION: **CATEGORY 1**

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Vacuum	Up to 14 psi	0.018 psi	Pressure sensor
Pressure Measuring Device (Air Medium)	0 psi to 30 psi 30 psi to 600 psi	0.04 psi 0.8 psi	Pressure sensor
Pressure Measuring Device (Oil Medium)	0 to 30 psi 30 psi to 600 psi 600 psi to 6000 psi 6000 psi to 10000 psi	0.04 psi 0.8 psi 8 psi 12 psi	Pressure sensor

Signatory:

1. **Norihan binti Zainal**

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
A. Measuring Instrument 1. Multimeter/ Indicating Meter			
DC Voltage	0 to 330 mV 330 mV to 3.3 V 3.3 to 33 V 33 to 330 V 334 to 1000 V	12 µV 0.1 mV 1 mV 10 mV 80 mV	Multi Calibrator Fluke 5520A
Resistance	0 to 11 Ω 11 to 33 Ω 33 to 110 Ω 110 to 330 Ω 0.33 to 1.1 kΩ 1.1 to 3.3 kΩ 3.3 to 11 kΩ 11 to 33 kΩ 33 to 110 kΩ 110 to 330 kΩ 0.33 to 1.1 MΩ 1.1 to 3.3 MΩ 3.3 to 11 MΩ 11 to 33 MΩ 33 to 110 MΩ 110 to 330 MΩ	15 mΩ 19 mΩ 28 mΩ 28 mΩ 0.1 Ω 0.1 Ω 2.5 Ω 3.4 Ω 11 Ω 10 Ω 0.1 kΩ 0.4 kΩ 2 kΩ 17 kΩ 69 kΩ 1.2 MΩ	Multi Calibrator Fluke 5520A
DC Current	0 to 3.3 mA 3.3 to 33 mA 33 to 330 mA 330 mA to 1.1 A 1.1 to 3 A 3 to 11 A 11 to 20 A	0.4 µA 4 µA 95 µA 0.3 mA 2 mA 17 mA 0.08 A	Multi Calibrator Fluke 5520A

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
A. Measuring Instrument 1. Multimeter/ Indicating Meter (cont.)			
AC Voltage	0 to 33 mV		
	10 Hz to 45 Hz	0.03 mV	
	45 Hz to 10 kHz	0.01 mV	
	10 kHz to 20 kHz	0.01 mV	
	20 kHz to 50 kHz	0.04 mV	
	50 kHz to 100 kHz	0.12 mV	
	100 kHz to 500 kHz	0.27 mV	
	33 to 330 mV		
	10 Hz to 45 Hz	0.10 mV	
	45 Hz to 10 kHz	0.05 mV	
	10 kHz to 20 kHz	0.06 mV	
	20 kHz to 50 kHz	0.12 mV	
	50 kHz to 100 kHz	0.28 mV	
	100 kHz to 500 kHz	0.70 mV	
	0.33 to 3.3 V		Multi Calibrator Product Fluke 5520A
	10 Hz to 45 Hz	1.0 mV	
	45 Hz to 10 kHz	1.0 mV	
	10 kHz to 20 kHz	2.0 mV	
	20 kHz to 50 kHz	2.0 mV	
	50 kHz to 100 kHz	5.0 mV	
	100 kHz to 500 kHz	10 mV	
	3.3 to 33 V		
	10 Hz to 45 Hz	0.01 V	
	45 Hz to 10 kHz	0.01 V	
	10 kHz to 20 kHz	0.02 V	
	20 kHz to 50 kHz	0.02 V	
	50 kHz to 90 kHz	0.13 V	
	33 to 330 V		
	10 Hz to 45 Hz	0.13 V	
	45 Hz to 10 kHz	0.10 V	
	10 kHz to 18 kHz	0.10 V	
	330 to 1020 V		
	10 Hz to 45 Hz	0.36 V	
	45 Hz to 8 kHz	0.36 V	

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
A. Measuring Instrument			
1. Multimeter/ Indicating Meter (cont.)			
AC Current	0.03 mA to 0.33 mA		
	10 Hz to 20 Hz	1 µA	
	20 Hz to 45 Hz	1 µA	
	45 Hz to 1 kHz	1 µA	
	1 kHz to 5 kHz	1 µA	
	5 kHz to 10 kHz	3 µA	
	0.33 mA to 3.3 mA		
	10 Hz to 45 Hz	6.0 µA	
	45 Hz to 1 kHz	5.0 µA	
	1 kHz to 10 kHz	19 µA	
	3.3 mA to 33 mA		Multi Product Calibrator Fluke 5520A
	10 Hz to 45 Hz	43 µA	
	45 Hz to 1 kHz	31 µA	
	1 kHz to 10 kHz	80 µA	
	33 mA to 330 mA		
	10 Hz to 45 Hz	0.5 mA	
	45 Hz to 1 kHz	0.4 mA	
	1 kHz to 10 kHz	0.9 mA	
	0.33 A to 2.2 A		
	10 Hz to 45 Hz	3.0 mA	
	45 Hz to 1 kHz	2.0 mA	
	1 kHz to 10 kHz	5.0 mA	
	2.2 A to 11 A		
	45 Hz to 1 kHz	28 mA	
	11 A to 20 A		
	45 Hz to 1 kHz	0.04 A	

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
A. Measuring Instrument 1. Multimeter/ Indicating Meter (cont.)			
Frequency	0.01 Hz to 120 Hz 150 Hz to 1200 Hz 12 kHz to 120 kHz	12 mHz 95 mHz 9 Hz	Multi Product Calibrator Fluke 5520A
Capacitance (Test Frequency at 10 Hz to 10 kHz)	0.19 nF to 3.3 nF 3.3 nF to 33 nF 33 nF to 330 nF 0.33 µF to 3.3 µF 3.3 µF to 33 µF 33 µF to 110 µF 110 µF to 330 µF	2 pF 0.3 nF 1.2 nF 0.1 µF 0.2 µF 0.8 µF 1.8 µF	
Resistance	330 MΩ to 1100 MΩ	17 MΩ	
2. Impedance Meter Capacitance FIXED	Test Frequency 20 Hz to 1 MHz 1 pF to 10 nF 10 nF to 1 µF	 0.4 pF/F + 0.2 pF 1 pF/F + 5.2 pF	 Series HP/Keysight 16380 A/C Series
Inductance	Test Frequency 20 Hz to 1 MHz 100 µH to 1 mH 1 mH to 10 H	 0.8 nH/H + 0.02 mH 0.3 µH/H + 0.19 mH	 Standard Inductance/Decade Inductance General Radio 1491-G/1482 series & HP 4284A

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
A. Measuring Instrument Resistance	0 to 1 Ohm 1 Ohm to 100 Ohm 100 Ohm to 100 kOhm 100 kOhm to 1 MOhm	0.1 µΩ/Ω + 2.4 mΩ 8 µΩ/ Ω + 0.04 mΩ 8 mΩ/ Ω + 0.7 µΩ 8 Ω/ Ω + 0.02 mΩ	Standard Resistance / Decade Resistance Yew 2793 / IET HARS-X / 742A series
3. Low Current Meter DC Current	0 nA to 100 nA 100 nA to 10 µA 10 µA to 10 mA 10 mA to 100 mA	4.6 pA/A + 1.2 pA 0.6 nA/A + 1 nA 1.7nA/A + 0.03 µA 1.2 µA/A + 0.06 mA	Programmable Current Source / Keithley 220
4. High Voltage Type High Voltage Meter High Voltage Probe	DCV: 0 kV to 5 kV 5 kV to 10 kV ACV (50Hz): 0 kV to 5 kV 5 kV to 10 kV	53 V 93 V 39 V 41 V	Withstanding Voltage Tester / Standard High Voltage Meter (TOS 5101 & TDV 20ADS / Vitrex 4700)
5. Frequency Counter Frequency	0.1 Hz to 2 GHz	56 µHz	Function Generator- HP 3325B / Signal Generator- E4425B
6. Oscilloscope	Volt/Div (1 V to 20 V) Volt/Div (10 mV to 500 mV) Time/Div (5 ns to 500 ns) Time/Div (1 µs to 500 µs) Time/Div (1 ms to 500 ms) Time/Div (1 s to 5 s) Bandwith (3 MHz to 1 GHz) Risetime	90 mV 1.5 mV 0.46 ns 0.46 µs 0.058 m s/s 5 m s/s 24 kHz/MHz 1 ps/ns	Standard Multi Calibrator Fluke 5820A

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
A. Measuring Instrument	0 V to ± 6.6 V (50 Ω Load)	49 µV	Generating using Oscilloscope Calibrator Fluke 5820A & E4425B
7. Oscilloscope Vertical Deflection DC Signal	0 V to ± 130 V (1MΩ Load)	74 mV	
Vertical Deflection	±1m Vpp to ± 6.6 Vpp (50 Ω Load)	10 µVpp	
Square Wave Signal	±1m Vpp to ± 130 Vpp (1MΩ Load)	99 mVpp	
Horizontal Deflection Time Markers (50 Ω Load)	2 ns/div to 20 ms/div 50 ms/div to 5 s/div	1 ps 1 ms	
Rise Time	≤ 300 ps	5 fs	
Bandwidth Frequency	50 kHz to 600 MHz 600 MHz to 2100 MHz	0.4 kHz 0.5 kHz	
Bandwidth Amplitude	50 kHz to 600 MHz 600 MHz to 2100 MHz	16 mVpp 14 mVpp	
8. Timer/Stop Watch Time	1 s to 50 s 50 s to 10 minutes 10 minutes to 1 hour 1 hour to 3 hours	0.13 s 0.51 s 0.73 s 0.98 s	Time Calibrator SST-2 / Stop Watch

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
A. Measuring Instrument			
9. Clamp Meter	3.2 to 32 A 32to 105 A 105to 200 A	0.04 A 0.35 A 1.7 A	
DC Current 50- Turn Coil	16 to 160 A 160 to 525 A 525 to 1000 A	0.12 A 1.1 A 3.7 A	
AC Current 50- Turn Coil	3.2 A to 32 A 10 Hz to 100 Hz 100 Hz to 440 Hz	0.31 A 0.33 A	Multi Calibrator Fluke 5520A & 50-Turn Coil Model Fluke 5500A/Coil
	32 A to 200 A 10 Hz to 100 Hz 100 Hz to 440 Hz	0.23 A 0.25 A	
	16 A to 160 A 10 Hz to 100 Hz 100 Hz to 440 Hz	0.14 A 0.47 A	
	160 A to 1000 A 10 Hz to 100 Hz 100 Hz to 440 Hz	2.9 A 13 A	
10. Power/Energy			
DC Current	0.1 W to 1 kW 1 kW to 20 kW	0.1 mW 0.1 kW	Multi Calibrator Fluke 5520A
AC Current (45 Hz to 65 Hz at PF=1)	0.1 W to 1 kW 1 kW to 10 kW 10 kW to 20 kW	0.1 mW 5.1 W 0.1 kW	

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
A. Measuring Instrument 11. Tachometer	60 rpm to 600 rpm 600 rpm to 6000 rpm 6000 rpm to 60000 rpm 60000 rpm to 99960 rpm	0.7 rpm 7.1 rpm 71 rpm 120 rpm	In-House Method ESF/0303 (Function Generator HP 3325B)
12. Insulation Testers	(1 kΩ to 10 kΩ) @10 V (10 kΩ to 100 kΩ) @ 50 V (0.1 MΩ to 1 MΩ) @150 V (1 MΩ to 10 MΩ) @ 300 V (10 MΩ to 100 MΩ) @ 500 V (0.1 GΩ to 1 GΩ) @1000 V (1 GΩ to 10 GΩ) @ 5000 V (10 GΩ to 100 GΩ) @ 5000 V (100 GΩ to 500 GΩ) @ 5000 V	8 Ω 19 Ω 0.2 kΩ 8 kΩ 71 kΩ 1.6 MΩ 12 MΩ 0.2 GΩ 2.8 GΩ	IET HRRS-Q-9-10k-10kV High Resistance Decade Substituter
B. Generating Instruments 1. Calibrator DC Voltage	(100µV to 100 mV) (100mV to 1V) (1V to 10V) (10V to 100 V) (100V to 1000 V)	9 µV/V + 0.6 µV 10 µV/V + 0.7 µV 6 µV/V + 0.6 mV 8 µV/V + 0.5 mV 9 µV/V + 5 mV	Multimeter/ Direct Measurement HP/Agilent 3458A/Keithley 486/Keithley 580
Resistance	0 Ω to 10 Ω 10 Ω to 100 Ω 100 Ω to 1 kΩ 1 kΩ 10 kΩ 10 kΩ to 100 kΩ 100 kΩ to 1 MΩ 1 MΩ to 10 MΩ 10 MΩ to 100 MΩ 100 MΩ to 1000 MΩ	0.02 mΩ/ Ω + 0.06 mΩ 0.02 mΩ/ Ω + 0.04 mΩ 9 µΩ/Ω + 1.1 mΩ 0.01 mΩ/Ω + 3.5 µΩ 0.01 mΩ/Ω + 3.2 µΩ 0.01 mΩ/Ω + 0.3 Ω 0.01 Ω/Ω + 3Ω 0.08 Ω/Ω + 0.4 mΩ 0.2 kΩ/Ω + 0.6Ω	
DC Current	0 to 100 nA 0.1 µA to 100 µA 100 µA to 10 mA 10 mA to 100 mA 100 mA to 1A	0.6 pA/A + 0.3 pA 30 pA/A + 0.07 nA 30 nA/A + 0.5 nA 30 nA/A + 0.1 µA 0.1 µA/A + 0.2 µA	

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
B. Generating Instruments 1. Calibrator (cont.) AC Voltage	<u>100 mV</u> 1 kHz to 20 kHz 100 kHz 300 kHz 1 MHz <u>1V</u> 45 Hz to 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz <u>10 V</u> 45 Hz to 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz <u>100 V</u> 45 Hz to 20 kHz 50 kHz 100 kHz <u>1000 V</u> 10 Hz to 45 Hz	 0.03 mV 0.38 mV 1.2 mV 1.8 mV 0.4 mV 0.2 mV 3.6 mV 12 mV 12 mV 18 mV 3.7 mV 2.4 mV 36 mV 0.1 V 0.1 V 0.2 V 0.04 V 0.14 V 0.48 V 0.49 V	Masurement using Digital Multimeter Direct Measurement HP/Agilent 3458A
Frequency	<u>Input Signal</u> <u>1 mV to 700 V</u> 1 Hz 10 MHz	 1 mHz 1 kHz	

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
B. Generating Instruments 2. Standard Impedance Capacitance	Test Frequency 10 Hz to 1 MHz 1 pF to 1000 pF 1 nF to 1 µF	 1.5 fF/F + 1 fF 1.1 nF/F + 0.1 pF	Measurement using Standard Capacitance/ Decade Capacitance General Radio 1423A/1409 series HP 16380A series & HP 4284A
Inductance	Test Frequency 10 Hz to 1 MHz 100 µH to 1 mH 1 mH to 10 H	 0.8 nH/H + 0.2 µH 1.6 µH/H + 0.08 mH	Measurement using Standard Inductance/Decade Inductance General Radio 1491-G/1482 series & HP 4284A
Resistance FIXED	1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ	0.07 µΩ 0.2 µΩ 2 µΩ 0.01 mΩ 0.1 Ω 1.5 Ω 23 Ω 1 kΩ 58 kΩ	Measurement using Standard Resistance/ Decade Resistance Yew 2793/742A series
3. High Voltage Type Generate	DCV: 0 kV to 20 kV ACV (50Hz): 0 kV to 20 kV	(of reading) 0.093 kV 0.041 kV	Measurement using Standard High Voltage Meter/High Voltage Probe/ Digital Multimeter (TDV 20 ADS/Fluke 80 kV-40 & Fluke 289)
4. Signal Generator Frequency	0.1 Hz to 5 GHz	(of reading) 20 µHz	Measurement using Standard Universal Counter /HP 53132A

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
B. Generating Instruments 5. AC Current	 29 µA to 0.33 mA 10 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 5 kHz 0.33 mA to 3.3 mA 10 Hz to 45 Hz 45 Hz to 1 kHz 100 Hz to 1 kHz 1 kHz to 5 kHz 3.3 mA to 33 mA 10 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 33 mA to 330 mA 10 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 20 kHz 20 kHz to 50 kHz 330 mA to 1A 10 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 20 kHz 20 kHz to 50 kHz	 2.0 µA 0.3 µA 0.4 µA 0.3 µA 6.0 µA 3.0 µA 2.0 µA 3.0 µA 65 µA 65 µA 19 µA 31 µA 31 µA 17 µA 27 µA 0.65 mA 0.31 mA 0.19 mA 0.31 mA 0.31 mA 0.17 mA 1.6 mA 0.6 mA 2.0 mA 4.0 mA 4.0 mA 2.7 mA	Measurement using Digital Multimeter Model 3458A

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
B. Generating Instruments 6. Oscilloscope Calibrator (Calibration Generator, Time Mark Generator and Levelled Sine Wave Generator)	Frequency: 0.1 Hz to 5 GHz Amplitude 100 mV to 10 V 40 Hz to 1 kHz 1 kHz to 20 kHz 50 kHz to 100 kHz	(of reading) 20 µHz 1 mV 10 mV 36 mV	Measurement using Standard Universal Counter/ Digital Multimeter Digitizing Oscilloscope HP53132/HP3458A/TDS680C
7. DC Current Source	1 A to 10 A 11 A TO 100 A	32 mA 0.05 A	Measurement using Standard Current Shunt VS2575A and Digital Multimeter HP 3458A
8. AC Current Source	1 A to 10 A (50 Hz to 10 kHz)	72 mA	

Signatories:

1. **Aminuddin Ahmad**
2. **Mohd Sahril Idrus**

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
A. Measuring Instrument 1. Multimeter/ Indicating Meter			
DC Voltage	0 to 330 mV 0 to 3.3 V 0 to 33 V 33 to 330 V 334 to 1000 V	15 µV 0.1 mV 1 mV 11 mV 81 mV	Generating using Multi Calibrator Fluke 5520A
Resistance	0 to 11 Ω 11 to 33 Ω 33 to 110 Ω 110 to 330 Ω 0.33 to 1.1 kΩ 1.1 to 3.3 kΩ 3.3 to 11 kΩ 11 to 33 kΩ 33 to 110 kΩ 110 to 330 kΩ 0.33 to 1.1 MΩ 1.1 to 3.3 MΩ 3.3 to 11 MΩ 11 to 33 MΩ 33 to 110 MΩ 110 to 330 MΩ 330 to 1100 MΩ	16 mΩ 19 mΩ 28 mΩ 0.2 Ω 3.0 Ω 2.8 Ω 2.7 Ω 4.0 Ω 24 Ω 30 Ω 0.1 kΩ 0.4 kΩ 2 kΩ 17 kΩ 0.18 MΩ 1.2 MΩ 2.1 MΩ	Generating using Multi Calibrator Fluke 5520A
DC Current	0 mA to 300 µA 300 µA to 3.3 mA 3.3 mA to 33 mA 33 mA to 330 mA 330 mA to 1.1 A 1.1 A to 3 A 3 A to 11 A 11 A to 20.5 A	0.1 µA 0.4 µA 4.0 µA 0.1 mA 0.3 mA 2.0 mA 17 mA 26 mA	Generating using Multi Calibrator Fluke 5520A

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
A. Measuring Instrument			
1. Multimeter/ Indicating Meter (cont.)			
AC Voltage	1 to 30 mV		
	10 Hz to 45 Hz	29 µV	
	45 Hz to 10 kHz	6 µV	
	10 kHz to 20 kHz	8 µV	
	20 kHz to 50 kHz	35 µV	
	50 kHz to 100 kHz	0.12 mV	
	100 kHz to 500 kHz	0.28 mV	
	33 to 330 mV		
	10 Hz to 45 Hz	0.11 mV	
	45 Hz to 10 kHz	0.06 mV	
	10 kHz to 20 kHz	0.06 mV	
	20 kHz to 50 kHz	0.12 mV	
	50 kHz to 100 kHz	0.28 mV	
	100 kHz to 500 kHz	0.70 mV	
	0.33 to 3.3 V		Generating using Multi Calibrator Fluke 5520A
	10 Hz to 45 Hz	1.0 mV	
	45 Hz to 10 kHz	1.0 mV	
	10 kHz to 20 kHz	2.0 mV	
	20 kHz to 50 kHz	2.0 mV	
	50 kHz to 100 kHz	5.0 mV	
	100 kHz to 500 kHz	10 mV	
	3.3 to 33 V		
	10 Hz to 45 Hz	10 mV	
	45 Hz to 10 kHz	15 mV	
	10 kHz to 20 kHz	17 mV	
	20 kHz to 50 kHz	19 mV	
	50 kHz to 90 kHz	0.13 V	
	33 to 330 V		
	10 Hz to 45 Hz	0.13 V	
	45 Hz to 10 kHz	0.10 V	
	10 kHz to 20 kHz	0.11 V	
	20 kHz to 50 kHz	0.11 V	
	50 kHz to 100 kHz	0.11 V	
	330 to 1020 V		
	45 Hz to 10 kHz	0.36 mV	

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
A. Measuring Instrument			
1. Multimeter/ Indicating Meter (cont.)			
AC Current	29 µA to 330 µA		
	45 Hz to 1 kHz	1 µA	
	1 kHz to 5 kHz	1 µA	
	5 kHz to 10 kHz	3 µA	
	0.33 mA to 3.3 mA		
	45 Hz to 1 kHz	6 µA	
	1 kHz to 5 kHz	5 µA	
	5 kHz to 10 kHz	20 µA	
	3.3 mA to 33 mA		
	45 Hz to 1 kHz	32 µA	
	1 kHz to 5 kHz	41 µA	
	5 kHz to 10 kHz	81 µA	
	33 mA to 330 mA		Generating using Multi Calibrator Fluke 5520A
	45 Hz to 1 kHz	0.4 mA	
	1 kHz to 5 kHz	1 mA	
	5 kHz to 10 kHz	1 mA	
	0.33 A to 1.1 A		
	45 Hz to 1 kHz	3 mA	
	1 kHz to 5 kHz	2 mA	
	5 kHz to 10 kHz	35 mA	
	1.1 A to 3 A		
	45 Hz to 1 kHz	5 mA	
	1 kHz to 5 kHz	24 mA	
	5 kHz to 10 kHz	93 mA	
	3 A to 11 A		
	45 Hz to 1 kHz	28 mA	
	11 A to 20 A		
	45 Hz to 1 kHz	44 mA	

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
A. Measuring Instrument 1. Multimeter/ Indicating Meter (cont.) Frequency	0.01 Hz to 120 Hz 120 Hz to 1200 Hz 12 kHz to 120 kHz	9 mHz 76 mHz 9 Hz	Generating using Multi Calibrator Fluke 5520A
Capacitance (Test Frequency at 10 Hz to 10 kHz)	0.19 nF to 3.3 nF 3.3 nF to 33 nF 33 nF to 330 nF 0.33 µF to 3.3 µF 3.3 µF to 33 µF 33 µF to 110 µF	2 pF 0.2 nF 1.2 nF 59 nF 0.2 µF 0.5 µF	Generating using Multi Calibrator Fluke 5520A
2. Timer/Stop Watch Time	1 s to 50 s 50 s to 10 minutes 10 minutes to 1 hour 1 hour to 3 hours	0.12 s 0.51 s 0.74 s 1.0 s	Generating using Time Calibrator
3. Insulation Testers	(1 kΩ to 10 kΩ) @10 V (10 kΩ to 100 kΩ) @ 50 V (0.1 MΩ to 1 MΩ) @150 V (1 MΩ to 10 MΩ) @ 300 V (10 MΩ to 100 MΩ) @ 500 V (0.1 GΩ to 1 GΩ) @1000 V (1 GΩ to 10 GΩ) @ 5000 V (10 GΩ to 100 GΩ) @ 5000 V (100 GΩ to 500 GΩ) @ 5000 V	8 Ω 19 Ω 0.2 kΩ 8 kΩ 71 kΩ 1.6 MΩ 12 MΩ 0.2 GΩ 2.8 GΩ	Generating Using IET HRRS-Q-9-10k-10kV High Resistance Decade Substituter

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
A. Measuring Instrument			
4. Oscilloscope Vertical Deflection DC Signal	0 V to ± 6.6 V (50 Ω Load) 0 V to ± 130 V (1MΩ Load)	49 µV 74 mV	Generating using Oscilloscope Calibrator Fluke 5820A & E4425B
Vertical Deflection	±1m Vpp to ± 6.6 Vpp (50 Ω Load)	10 µVpp	
Square Wave Signal	±1m Vpp to ± 130 Vpp (1MΩ Load)	99 µVpp	
Horizontal Deflection Time Markers (50 Ω Load)	2 ns/div to 20 ms/div 50 ms/div to 5 s/div	1 ps 1 ms	
Rise Time	≤ 300 ps	5 fs	
Bandwidth Frequency	50 kHz to 600 MHz 600 MHz to 2100 MHz	0.4 kHz 0.5 kHz	
Bandwidth Amplitude	50 kHz to 600 MHz 600 MHz to 2100 MHz	16 mVpp 14 mVpp	
B. Generating Instruments 1. DC Power Supply DC Voltage	(100µV to 100 mV) (100mV to 1V) (1V to 10V) (10V to 100 V) (100V to 1000 V)	9 µV/V + 0.6 µV 10 µV/V + 0.7 µV 6 µV/V + 0.6 mV 8 µV/V + 0.5 mV 9 µV/V + 5 mV	Measurement using Digital Multimeter HP3458A & Current Shunt VS 2575A
DC Current	100 mA to 1 A 10 A to 100 A	0.01 µA 0.05 A	

Issue date: 3 January 2023
Valid until: 2 July 2024

NO: SAMM 141
(Issue 2, 3 January 2023 replacement
of SAMM 141 dated 5 July 2021)

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
B. Generating Instruments 2. High Voltage Type	DCV: 0 kV to 20 kV ACV (50Hz): 0 kV to 20 kV	10 V/kV 17 V/kV	Measurement using Standard High Voltage Meter/High Voltage Probe/Digital Multimeter (TDV 20 ADS/Fluke 80 kV-40 & Fluke 289)

Signatories:

1. **Aminuddin Ahmad**
2. **Mohd Sahril Idrus**