S/N: 2112

STANDARDS MALAYSIA

Certificate of Accreditation

No: SAMM 176

Accredited since: 17 September 1999

This is to certify that

SIRIM CALIBRATION SDN. BHD.
SENAI, JOHOR
MALAYSIA

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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 3, 3 January 2023 replacement of SAMM 176 dated 6 December 2017)

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

Issue date: 3 January 2023
Valid until: 17 September 2023

NO: SAMM 176
(Issue 3, 3 January 2023 replacement
of SAMM 176 dated 15 March 2022)

LABORATORY LOCATION:
(PERMANENT LABORATORY)

SIRIM CALIBRATION SDN. BHD.
BANGUNAN SIRIM BERHAD
NO. 3, JALAN TEKNOLOGI 5
TAMAN TEKNOLOGI JOHOR
81400 SENAI, JOHOR
MALAYSIA

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

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: 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	1.6 µV 3.2 µV 20 µV 180 µV 1.7 mV	Generation using calibrator model Fluke 5522 A
(b) Resistance	0 Ω to 11 Ω 11Ω to 33 Ω 33 Ω to 110 Ω 110 Ω to 330 Ω 330 Ω to 1.1kΩ 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 100 MΩ 100 MΩ to 330 MΩ 330 MΩ to 1100 MΩ	220 µΩ 200 µΩ 740 µΩ 1.3 mΩ 4.3 mΩ 12 mΩ 54 mΩ 160 mΩ 450 mΩ 1.7 Ω 9 Ω 34 Ω 140 Ω 1.1 kΩ 2.7 kΩ 79 kΩ 560 kΩ	Generation 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)			
(b) Resistance	0 Ω to 1 Ω 1 Ω to 100 Ω 100 Ω to 10 kΩ 10 kΩ to 100 kΩ 10 kΩ to 10 MΩ	6 μΩ 1 mΩ 1 mΩ 700 mΩ 22 Ω	Generation using Decade resistance box Yokogawa 2793 & Standard Resistor Yokogawa 2792
(c) DC Current	0 μA to 330 μA 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 10 A 10 A to 21 A	5.2 nA 34 nA 910 nA 8.7 μA 42 μA 100 μA 1.4 mA 9 mA	Generation using calibrator model Fluke 5522 A
(d) AC Voltage (See Matrix A)	See Matrix A	See Matrix A	Generation using calibrator model Fluke 5522 A

Matrix A
AC Voltage Measurement

Range	Frequency									
	10 Hz to 45 Hz	45 Hz to 1 kHz	1 kHz to 5 kHz	5kHz to 10 kHz	1 kHz to 10 kHz	45 Hz to 10 kHz	10 kHz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz	100 kHz to 500 kHz
0 to 33 mV	2 μV	-	-	-	-	2.4 μV	2 μV	3.0 μV	5.0 μV	26 μV
33 mV to 330 mV	13 μV	-	-	-	-	7.3 μV	8 μV	9.5 μV	12 μV	20 μV
330 mV to 3.3 V	73 μV	-	-	-	-	59 μV	71 μV	100 μV	140 μV	3 mV
3.3 V to 33 V	810 μV	-	-	-	-	710 μV	810 μV	1.8 mV	2.8 mV	-
33 V to 330 V	-	9.9 mV	-	-	8.2 mV	-	10 mV	22 mV	74 mV	-
330 V to 1020 V	-	33 mV	35 mV	37 mV	-	-	-	-	-	-

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
1. Measuring Instruments (continued) (e) AC Current (See Matrix B)	See Matrix B	See Matrix B	Generation using calibrator model Fluke 5522 A
(f) Frequency Measure (Measuring Instrument) (g) Level	DC 0 MHz to 60 MHz 60 MHz to 2 GHz + 7 dBm to -70 dBm	5 Hz 1 Hz 1.5 dBm	Generate using Function Generator HP 3325 B / Signal Generator Agilent E4433B
(h) Capacitance	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	9.3 nF 21 nF 85 nF 290 nF 920 nF 6.4 µF 19 µF 37 µF 130 µF 540 µF	Generate using Fluke 5522A

Matrix B
AC Current Measurement

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 30 kHz
0 to 330 µA	28 nA	-	26 nA	-	26 nA	-	33 nA	72 nA	340 nA
0.33 mA to 3.3 mA	630 nA	-	620 nA	-	620 nA	-	630 nA	650 nA	920 nA
3.3 mA to 33 mA	4.9 µA	-	3.4 µA	-	5.7 µA	-	9.9 µA	10 µA	13 µA
33 mA to 330 mA	46 µA	-	28 µA	-	27 µA	-	31 µA	36 µA	50 µA
330 mA to 1.1 A	-	590 µA	-	-	160 µA	-	200 µA	380 µA	-
1.1 A to 3 A	-	330 µA	-	-	440 µA	-	930 µA	2 mA	-
3 A to 10 A	-	-	-	1 mA	-	1 mA	4.5 mA	-	-
10 A to 21 A				6 mA		6 mA	11 mA		
20 A to 50 A				300 mA					

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
2. Insulation Tester (Max. Voltage 1000 V)	10 kΩ to 100 kΩ 100 kΩ to 10 MΩ 10 MΩ to 100 MΩ 100 MΩ to 1000 MΩ 1000 MΩ to 10 GΩ	0.58 Ω 580 Ω 6 kΩ 69 kΩ 600 kΩ	Generate using high resistance decade box IET HRRS
3. Sourcing/Generating Instrument (a) DC Voltage	0 mV to 100 mV 100 mV to 1 V 1 V to 10 V 10 V to 100 V 100 V to 1000 V	0.9 µV 8.8 µV 58 µV 0.6 mV 6.1 mV	Measure using System Multimeter HP 3458A
(b) DC Current	0 µA to 10 mA 10 mA to 100 mA 100 mA to 1 A	580 nA 7.8 µA 590 µA	Measure using System Multimeter HP 3458A
(c) AC Voltage	100 mV to 10 V 40 Hz to 20 kHz 50 kHz to 1 MHz 10 V to 100 V 40 Hz to 1 kHz 100 V to 700 V 40 Hz to 1 kHz	 590 µV 604 µV 6 mV 59 mV	Measure using System Multimeter HP 3458A
(d) AC Current At 1 kHz	0 to 10 mA 10 mA to 100 mA 100 mA to 1 A	71 µA 23 µA 780 µA	Measure using System Multimeter HP 3458A
(e) Resistance	0 Ω to 10 Ω 10 Ω to 100 Ω 100 Ω to 1 kΩ 1 kΩ to 10 kΩ 10 kΩ to 100 kΩ 100 kΩ to 1 MΩ 1 MΩ to 10 MΩ	665 µΩ 6 mΩ 16 mΩ 150 mΩ 1.7 Ω 24 Ω 730 Ω	Measure using System Multimeter HP 3458A

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
(e) Resistance (continued)	0 Ω to 10 Ω 10 Ω to 100 Ω 100 Ω to 1 kΩ 1 kΩ to 10 kΩ 10 kΩ to 100 kΩ 100 kΩ to 1 MΩ 1 MΩ to 10 MΩ 10 MΩ to 100 MΩ	230 µΩ 1.9 mΩ 15 mΩ 125 mΩ 620 mΩ 19 Ω 230 Ω 13 kΩ	Measure using System Multimeter HP 3458A Measure (direct measurement for resistance boxes)
	0 Ω to 1 Ω 1 Ω to 10 Ω 10 Ω to 10 kΩ	79 µΩ 230 µΩ 120 mΩ	Measure using System Multimeter HP 3458A Measure (Standard Resistors)
i) DC Current:	1 A to 2 A 2 A to 10 A	210 µA 3 mA	Measure using System Multimeter HP 3458 A & AC / DC Current Shunt Ballantine 1625 A
ii) AC Current to 1 kHz:	0 A to 2 A 2 A to 10 A	1 mA 21 mA	
iii) AC Current 1 to 5 kHz:	0 A to 10 A	22 mA	
iv) AC Current 5 to 10 kHz:	0 A to 2 A	1 mA	
DC Current (Source)	10 A to 20 A 20 A to 100 A	3 mA 3 mA	
AC Current @ 50 Hz to 1 kHz (Source)	0 A to 20 A 0 A to 100 A	21 mA 40 mA	
(f) Frequency	3 GHz to 5 GHz 0 MHz to 3 GHz	210 nHz 175 nHz	Measuring using Universal Counter Agilent 53132A

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
4. High Voltage Meters/ Testers	DC V: 0 - 40 kV AC V: 0 - 28 kV (peak ac at 50 Hz)	31 V 120 V	Measure with probes using Digital Multimeter & High Voltage Probe Fluke 80K-40
	DC V: 0 - 2 kV DCV: 2 – 20 kV AC V: 0 - 2 kV at 50 Hz AC V: 2 - 20 kV at 50 Hz	600 mV 1.0 V 700 mV 17 V	Measure direct using Precision High Voltage Meter Vitrek 4700
	DC V: 0 - 10 kV AC V: 0 - 10 kV at 50 Hz	1.0 V 17 V	Generate using Withstanding Voltage Tester Kikusui TOS 5101 & Precision High Voltage Meter Vitrek 4700
5. Clamp Meters	**DC Current** 0 A to ± 10 A (up to 1000 A via multi-turn coil – 10 & 50 Turn Coil)	57 mA	Generate using Calibrator Wavetek 9100
	AC Current 0 A to ± 10 A 40 Hz to 440 Hz (up to 1000 A via multi-turn coil – 10 & 50 Turn Coil)	61 mA	
	AC Current 10 A to 20 A 40 Hz to 110 Hz	73 mA	

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
6. Withstanding / Insulation Voltage Testers			
(a) Generate: (direct)	DC V: 0 kV to 20 kV AC V: 0 kV to 20 kV at 50 Hz	1.2 V 17 V	Measure using Precision High Voltage Meter Vitrek 4700
(b) Resistance (Measure)	10 kΩ to 100 kΩ 100 kΩ to 10 MΩ 10 MΩ to 100 MΩ 100 MΩ to 1000 MΩ 1000 MΩ to 10 GΩ	0.58 Ω 577 Ω 6 kΩ 69 kΩ 600 kΩ	Generate using high resistance decade box IET HRRS
(c) Cut Off Current (AC Current)	0 mA to 1.0 mA 1.0 mA to 2.0 mA 2.0 mA to 5.0 mA 5.0 mA to 10.0 mA	12 µA 31 µA 60 µA 110 µA	Measure using Cut Off Current Kikusui TLC 501 B
(d) Timing	0 sec to 60 sec 1 min to 15 min 15 min to 25 min	62 msec 85 msec 800 msec	Measure using Time Calibrator SST-2

Note : dBm is measured relative to 1 mW

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
7. Oscilloscope			
(a) Amplitude	100 V	51 mV	Generate using Calibration Generator Tektronix PG 506A
	50 V	51 mV	
	20 V	170 µV	
	10 V	45 µV	
	5 V	23 µV	
	2 V	9.4 µV	
	1 V	4.8 µV	
	0.5 V	2.5 µV	
	0.2 V	1.2 µV	
	0.1 V	900 nV	
	10 mV	900 nV	
	1 mV	900 nV	
(b) Sweep	0.1 µs	570 ps	Generate using Time Mark Generator Tektronix TG 501A
	0.2 µs	1.2 ns	
	0.5 µs	2.8 ns	
	1 µs	4 ns	
	2 µs	9 ns	
	5 µs	22 ns	
	10 µs to 0.1 ms	460 ns	
	0.2 ms	820 ns	
	0.5 ms	2 µs	
	1 ms	4.5 µs	
	2 ms	8 µs	
	5 ms	20 µs	
	10 ms	45 µs	
	20 ms	80 µs	
	50 ms	200 µs	
	0.1 s	460 µs	
	0.2 s	930 µs	
	0.5 s	2 ms	
	1 s to 2 s	4.5 ms	
	5 s	23 ms	
(c) Bandwidth	0.25 MHz to 250 MHz	23 kHz	Generate using Levelled Sine Wave Generator Tegam SG 503 Generate using Signal Generator Agilent E4433B
	250 MHz to 1 GHz	230 kHz	

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
8. LCR Meters. Measuring Instruments.			
i) Inductance:	Frequency at 1 kHz		
	100 µH to 1000 µH	110 nH	Generate using Decade Inductor GR 1491G
	1 mH to 10 mH	800 nH	
	10 mH to 100 mH	12 µH	
	100 mH to 1000 mH	82 µH	
	1 H to 10 H	790 µH	
ii) Capacitance:	Frequency at 1 kHz		
	1 pF to 100 pF	0.084 pF	Generate using Decade Capacitor GR 1413
	100 pF to 10000 pF	0.57 pF	
	10 nF to 100 nF	12 pF	
	100 nF to 1000 nF	570 pF	
9. Time	0 sec to 10 sec	120 msec	Measure using Time Calibrator SST-2
	0 sec to 100 sec	120 msec	
	0 sec to 1000 sec	130 msec	
	0 sec to 10000 sec	590 msec	
	0 min to 100 min	590 msec	
	0 hr to 24 hr	590 msec	
10. RPM Related Measuring Instruments (Non Contact Type)	60 rpm to 5999 rpm	0.07 rpm	In-House Method ESF/0303
	6000 rpm to 29999 rpm	7 rpm	
	30000 rpm to 59999 rpm	36 rpm	
	60000 rpm to 99999 rpm	120 rpm	
11. Power Meters/ Indicating Instruments a) DC Power	0.1 W to 1 kW	$0.26\ \frac{\text{mW}}{\text{W}} + 0.46\ \text{mW}$	Generate using Fluke 5522A
	1 kW to 20 kW	$0.93\ \frac{\text{mW}}{\text{W}} - 120\ \text{mW}$	
b) AC Power 45 Hz to 65 Hz at PF = 1	0.1 W to 1 W	$0.59\ \frac{\text{mW}}{\text{W}} + 0.47\ \text{mW}$	Generate using Fluke 5522A
	1 W to 10 kW	$1.1\ \frac{\text{mW}}{\text{W}} + 430\ \text{mW}$	
	10 kW to 20 kW	$1.2\ \frac{\text{mW}}{\text{W}} + 580\ \text{mW}$	

Signatories:

1. **Gurdeep Singh a/l Gurdial Singh**

2. **Mohd Saharudin Bin Rahidi (DC and Low Frequency)**

SCOPE OF CALIBRATION: ELECTRICAL

SITE: 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 3.3 V to 33 V 33 V to 330 V 330 V to 1020 V	1.4 µV 15 µV 160 µV 880 µV 8.6 mV	Generation using calibrator model Fluke 5522 A
(b) AC Voltage	See Matrix C See Matrix D	See Matrix C See Matrix D	Generation using calibrator model Fluke 5522 A & Wavetek 9100

Matrix C
AC Voltage Measurement

Range	Frequency									
	10 Hz to 45 Hz	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	10 kHz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz	100 kHz to 500 kHz
0 mV to 33 mV	8 µV	-	-	-	7.1 µV	-	7.2 µV	8.1 µV	18 µV	67 µV
33 mV to 330 mV	9.6 µV	-	-	-	9.4 µV	-	9 µV	9.6 µV	38 µV	83 µV
330 mV to 3.3 V	400 µV	-	-	-	240 µV	-	290 µV	400 µV	950 µV	3.5 mV
3.3 V to 33 V	1.9 mV	-	-	-	1.3 mV	-	1.6 mV	2.0 mV	5.3 mV	-
33 V to 330 V	-	9.6 mV	-	-	-	15 mV	17 mV	18 mV	130 mV	-
330 V to 1020 V	-	130 mV	110 mV	130 mV	-	-	-	-	-	-

SCOPE OF CALIBRATION: ELECTRICAL

SITE: CATEGORY I

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (±) *	Remarks
(c) DC Current	0 to 330 µA 330 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 21 A	25 nA 170 nA 670 nA 6.7 µA 280 µA 530 µA 2.4 mA 15 mA	Generation using calibrator model Fluke 5522 A
(d) AC Current	See Matrix E See Matrix F	See Matrix E See Matrix F	Generation using calibrator model Fluke 5522 A & Wavetek 9100

Matrix D
AC Voltage Measurement

Range	Frequency									
	10 Hz to 45 Hz	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	10 kHz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz	100 kHz to 500 kHz
800 V to 1000 V	-	-	-	-	-	-	1.7 V	-	-	-

Matrix E
AC Current Measurement

Range	Frequency								
	10 Hz to 20 Hz	10 Hz to 45 Hz	20 Hz to 45 Hz	45 Hz to 100 Hz	100 Hz to 1 kHz	45 Hz to 1 kHz	1 kHz to 5 kHz	5 kHz to 10 kHz	10 kHz to 30 kHz
0 µA to 330 µA	120 nA	-	120 nA	-	-	120 nA	180 nA	240 nA	480 nA
0.33 mA to 3.3 mA	2.6 µA	-	1.7 µA	-	-	1.5 µA	2.6 µA	6.2 µA	12 µA
3.3 mA to 33 mA	4.4 µA	-	3.4 µA	-	-	7.0 µA	12 µA	27 µA	51 µA
33 mA to 330 mA	85 µA	-	54 µA	-	-	37 µA	92 µA	190 µA	370 µA
330 mA to 1.1 A	-	2.2 mA	-	-	-	0.3 mA	8.1 mA	350 mA	-
1.1 A to 3 A	-	2.2 mA	-	-	-	0.81 mA	8.1 mA	35 mA	-
3 A to 11 A	-	-	-	4.4 mA	5.8 mA	-	110 mA	-	-
11 A to 20.5 A	-	-	-	21 mA	24 mA	-	350 mA	-	-

SCOPE OF CALIBRATION: ELECTRICAL

SITE: CATEGORY I

Matrix F
AC Current Measurement

Range	Frequency								
	10 Hz to 20 Hz	10 Hz to 45 Hz	20 Hz to 45 Hz	45 Hz to 100 Hz	100 Hz to 1 kHz	45 Hz to 1 kHz	1 kHz to 5 kHz	5 kHz to 10 kHz	10 kHz to 30 kHz
11 A to 20 A	-	-	-	-	-	-	-	160 mA	-

Instrument calibrated/ Measurement parameter	**Range**	**Calibration and Measurement Capability expressed as an uncertainty (±) ***	**Remarks**
(e) Resistance	0 to 11 Ω 11 Ω to 33 Ω 33 Ω to 110 Ω 110 Ω to 330 Ω 330 kΩ 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 1.1MΩ 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	1.2 mΩ 2.1 mΩ 2.7 mΩ 5.9 mΩ 35 mΩ 62 mΩ 130 mΩ 620 mΩ 1.3 Ω 6.4 Ω 39 Ω 120 Ω 570 Ω 6.4 kΩ 23 kΩ 500 kΩ 6.3 MΩ	Generation using calibrator model Fluke 5522 A
Resistance Up to 1000 Vmax	100 Ω to 1 kΩ 1 kΩ to 10 kΩ 10 kΩ to 100 kΩ 100 kΩ to 1000 kΩ 1000 kΩ to 10 MΩ 10 MΩ to 100 MΩ 100 MΩ to 1000 MΩ 1000 MΩ to 10 GΩ	140 mΩ 57 Ω 58 Ω 130 Ω 1.5 kΩ 24 kΩ 270 kΩ 130 MΩ	Generate using High Resistance Decade Substitute IET HRRS & Yokogawa 2793
	0 Ω to 1 Ω 1 Ω to 100 Ω	6 µΩ 1 mΩ	ESD/0360 Rev 5.0 Generating using Standard Resistor & Decade Resistance Box model Yokogawa 2792 & 2793 respectively

SCOPE OF CALIBRATION: ELECTRICAL

SITE: CATEGORY I

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (±) *	Remarks
(f) 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 1200 kHz 1.2 MHz to 3.2 MHz 3.2 MHz to 10 MHz	9.0 µHz 9.0 mHz 29 mHz 290 mHz 820 mHz 110 Hz 350 kHz	Generation using calibrator model Fluke 5522 A
(g) 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 11 nF to 33 nF 33 nF to 110 nF 110 nF to 330 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	13 pF 17 pF 23 pF 40 pF 98 pF 300 pF 900 pF 4.1 nF 9.3 nF 21 nF 85 nF 290 nF 920 nF 6.4 µF 19 µF 38 µF 130 µF 540 µF	Generation using calibrator model Fluke 5522 A
Frequency at 1 KHz (h) Inductance	1 pF to 100 pF 100 pF to 10000 pF 10 nF to 100 nF 100 nF to 1000 nF 100 µH to 1000 µH 1 mH to 10 mH 10 mH to 100 mH 100 mH to 1000 mH 1 H to 10 H	0.67 pF 1 pF 12 pF 570 pF 0.16 µH 0.28 mH 0.34 mH 0.95 mH 0.3 H	ESD/0360 Rev 5.0 Generation using Decade Capacitor model GR 1413 ESD/0360 Rev 5.0 Generating using Decade Inductor model GR 1491-G

SCOPE OF CALIBRATION: ELECTRICAL

SITE: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
2. Source / Generating Instruments			
(a) DC Voltage	0 mV to 100 mV	2.2 µV	Measured using Multimeter HP 3458A
	100 mV to 1 V	14 µV	
	1 V to 10 V	230 µV	
	10 V to 100 V	1.5 mV	
	100 V to 1000 V	15 mV	
(b) DC Current	0 mA to 10 mA	9.1 µA	Measured using Multimeter HP 3458A & Active Shunt Ballantine 1625A
	10 mA to 100 mA	72 µA	
	100 mA to 1000 mA	1.6 mA	
	1 A to 3 A	5.7 mA	
	3 A to 20 A	6.0 mA	
	20 A to 100 A	20 mA	
(c) AC Voltage	0 mV to 10 mV (40 Hz to 1 kHz)	5.4 µV	Measured using Multimeter HP 3458A
	100 mV to 10 V (40 Hz to 1 kHz)	1.2 mV	
	10 V to 100 V (40 Hz to 1 kHz)	29 mV	
	100 V to 1000 V (40 Hz to 1 kHz)	550 mV	
(d) AC Current	0 A to 1 A (10 Hz to 5 kHz)	2.3 mA	Measured using Multimeter HP 3458A & Active Shunt Ballantine 1625A
	1 A to 3 A (10 Hz to 5 kHz)	8.1 mA	
	3 A to 20 A (10 Hz to 1 kHz)	26 mA	
	20 A to 100 A (10 Hz to 1 kHz)	130 mA	

SCOPE OF CALIBRATION: ELECTRICAL

SITE: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
3. High Voltage Measurement - High Voltage Testers / Puncture Testers / Spark Testers			
DC Voltage	0 kV to 2 kV 2 kV to 5 kV 5 kV to 10 kV 10 kV to 15 kV 15 kV to 20 kV	1.3 V 7.9 V 11 V 13 V 16 V	Measured using High Voltage Meter Vitrek 4700A
AC Voltage 20 Hz to 100 Hz	0 kV to 2 kV 2 kV to 5 kV 5 kV to 10 kV 10 kV to 15 kV 15 kV to 20 kV	4 V 30 V 34 V 45 V 57 V	
Cut Off Current AC Current 40 Hz to 1 kHz	0 mA to 0.5 mA 0.5 mA to 1 mA 1 mA to 2 mA 2 mA to 5 mA 5 mA to 10 mA	0.03 mA 0.05 mA 0.06 mA 0.12 mA 0.20 mA	Measured using cut-o current meter TLC-50
4. Timer	0 sec to 10 sec 0 sec to 100 sec 0 sec to 1000 sec 0 sec to 10000 sec 0 min to 100 min 0 hr to 24 hr	120 msec 120 msec 130 msec 570 msec 570 msec 570 msec	Measure using Time Calibrator SST-2
5. Source Instruments Resistance	0 to 10 Ω 10 Ω to 100 Ω 100 Ω to 1 kΩ 1 kΩ to 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 1 G Ω	240 µΩ 2 mΩ 2.9 mΩ 130 mΩ 180 mΩ 20 Ω 690 Ω 59 kΩ 590 kΩ	Measure using Multimeter HP 3458 A

SCOPE OF CALIBRATION: ELECTRICAL

SITE: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
6. Oscilloscope (a) Vertical Deflection (Square Wave Signal)	100 V 50 V 20 V 10 V 5 V 2 V 1 V 0.5 V 0.2 V 0.1 V 10 mV 1 mV	51 mV 51 mV 170 µV 45 µV 23 µV 9.4 µV 4.8 µV 2.5 µV 1.2 µV 900 nV 900 nV 5.2 µV	Generate using Calibration Generator Tektronix PG 506A
(b) Vertical Deflection (DC Signal)	0mV to 330 mV 330 mV to 3.3 V 3.3 V to 33 V 33 V to 330 V 330 V to 1020 V	1.6 µV 23 µV 24 µV 290 µV 3.3 mV	Generation using Calibrator model Fluke 5522 A
(C) Sweep	0.1 µs 0.2 µs 0.5 µs 1 µs 2 µs 5 µs 10 µs to 0.1 ms 0.2 ms 0.5 ms 1 ms 2 ms 5 ms 10 ms 20 ms 50 ms 0.1 s 0.2 s 0.5 s 1 s to 2 s 5 s	570 ps 1.2 ns 2.8 ns 4 ns 9 ns 22 ns 460 ns 820 ns 2 µs 4.6 µs 8 µs 20 µs 45 µs 80 µs 200 µs 460 µs 930 µs 2 ms 4.6 ms 23 ms	Generate using Time Mark Generator Tektronix TG 501Ajim
(d) Bandwidth	0.25 MHz to 250 MHz 250 MHz to 4 GHz	23 kHz 230 kHz	Generate using Levelled Sine Wave Generator Tegam SG 503 & Signal Generator Agilent E4433B

SCOPE OF CALIBRATION: ELECTRICAL

SITE: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
7. Sourcing / Generating Instrument	0 Hz to 5 GHz	215 nHz	Measure using Universal Counter Agilent 53132A
(a) Frequency	5 GHz to 13 GHz	0.1 µHz	Measure using Spectrum Analyzer Agilent E4445A
(b) Amplitude / Level	-150 dB to +30 dB (3 Hz to 13 GHz)	1 dBm	Measure using Spectrum Analyzer Agilent E4445A
8. Measuring Instrument	0 MHz to 60 MHz	5 Hz	Generate using Synthesizer Function Generator HP 3325 B
(a) Frequency	60 MHz to 4 GHz	1 Hz	Generate using Signal Generator Agilent E4433B
(b) Amplitude / Level	+ 20 dBm to -136 dBm	0.9 dBm	Generate using Signal Generator Agilent E4433B
9. Power Meters/ Indicating Instruments			
a) DC Power	0.1 W to 1 kW	$0.26 \frac{\text{mW}}{\text{W}} + 0.46 \text{ mW}$	Generate using Fluke 5522A
	1 kW to 20 kW	$0.93 \frac{\text{mW}}{\text{W}} - 120 \text{ mW}$	
b) AC Power 45 Hz to 65 Hz at PF = 1	0.1 W to 1 W	$0.59 \frac{\text{mW}}{\text{W}} + 0.47 \text{ mW}$	Generate using Fluke 5522A
	1 W to 10 kW	$1.10 \frac{\text{mW}}{\text{W}} + 430 \text{ mW}$	
	10 kW to 20 kW	$1.20 \frac{\text{mW}}{\text{W}} + 580 \text{ mW}$	

Signatories:

1. Gurdeep Singh a/l Gurdial Singh

2. Mohd Saharudin Bin Rahidi (DC & Low Frequency)

SCOPE OF CALIBRATION: DIMENSIONAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
1. Micrometer	Up to 25 mm travers 25m to 50 mm 50 mm to 75 mm 75 mm to 100 mm	1 µm 1 µm 2 µm 2 µm	Calibrated using Steel Gauge Block as a Standard with reference to ISO 3611: 2010
2. Caliper	Up to 200 mm 200 mm to 600 mm	6 µm 11 µm	Calibrate using Caliper Checker as a Standard with reference to JIS B 7507:1993
3. Caliper Checker	20 mm to 350 mm 350 mm to 450 mm 450 mm to 600 mm	3 µm 5 µm 6 µm	Calibrate using Steel Gauge Block set as a Standard & Linear Height Gauge as a comparator
4. Standard Rod	20 mm to 100 mm 100 mm to 150 mm 150 mm to 300 mm 300 mm to 450 mm 450 mm to 800 mm	2 µm 3 µm 4 µm 5 µm 10 µm	Calibrate using Steel Gauge Block set as a Standard & Linear Height Gauge as a comparator
5. Calibration Tester	0.001 mm to 25 mm	1.3 µm	Calibrate using Steel Gauge Block set as a Standard & Sylvac as a Standard
6. Dial Thickness Gauge	0.001 mm to 50 mm 50 mm to 100 mm	1 µm 2 µm	Calibrate using Gauge Steel Block set as a Standard
7. Pin Gauge (Diameter Only)	0.2 mm to 40 mm	2.2 µm	Using Std. Pin Gauge set as a Standard & Laser Micrometer as a comparator
8. Feeler Gauge	0.005 mm to 2 mm	1.0 µm	Calibrate using Steel Gauge Block set as a Standard & Sylvac Probe as a comparator with reference to JIS-B-7524: 2008 (clause 5:1)

SCOPE OF CALIBRATION: DIMENSIONAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
9. Dial Test Indicator	0.01 mm to 1 mm	3 µm	Calibrate using Calibration Tester as a Standard with reference to JIS-B-7533:1990
10. Dial Gauge	0.01 mm to 100 mm	4 µm	Calibrate using Calibration Tester as a Standard with reference to JIS-B 7503:1997
11. Depth Gauges / Micrometer	0.001 to 300 mm	7 µm	Calibrate using Depth Microchecker as a Standard with reference to BS 6468:2008 or JIS-B 7518:1993
12. Digital Indicator (Linear Displacement)	0.001 to 50 mm 50 to 100 mm	1 µm 2 µm	Calibrate using steel gauge block as standard

Signatories:

1. **Murali a/l Subramaniam**
2. **Mokhtar Ali**

SCOPE OF CALIBRATION: DIMENSIONAL

SITE: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
Profile Projector / Tool Maker Microscope / Smart Scope (Measuring accuracies of respective X and Y Axis Only)	0.001 mm to 80 mm 80 mm to 300 mm	5 µm 7 µm	Calibrate using Glass Scale as a Standard according to JIS B 7153:1995, Performance No. 9

Signatories:

1. **Murali a/l Subramaniam**
2. **Mokhtar Ali**

SCOPE OF CALIBRATION: TEMPERATURE

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
1. Liquid In Glass Thermometer (Total Immersion)	-30 °C to 50 °C 50 °C to 150 °C 150 °C to 250 °C	0.09 °C 0.10 °C 0.15 °C	Comparison Method Using SPRT Module + PT100
2. Digital Thermometer with Probe	-40 °C to 250 °C 250 °C to 400 °C 400 °C to 600 °C	0.10 °C 0.15 °C 0.2 °C	Comparison Method Using SPRT Module + PT100
3. Mechanical Thermometer	-30 °C to 150 °C 150 °C to 250 °C	0.3 °C 0.6 °C	Comparison Method Using SPRT Module + PT100
4. Temperature Indicating Instruments	Type-K -100 °C to 1300 °C Type-J -100 °C to 1200 °C Type-T -100 °C to 400 °C Type-E -100 °C to 1000 °C Type-R 0 °C to 1700 °C Type-S 0 °C to 1700 °C PT100 -100 °C to 800 °C	0.3 °C 0.3 °C 0.3 °C 0.3 °C 0.4 °C 0.4 °C 0.2 °C	Electrical Simulation Using Documenting Process Calibrator based on EA-10/11 and ITS 90 Tables

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
5. Temperature Block Calibrator	-40 °C to 0 °C 0 °C to 600 °C	0.1 °C 0.2 °C	Using SPRT Module with PT 100 and PRT Based on EA-10/13
6. Thermo-Hygrometer / Thermo-Hygrograph	30 %rh to 90 %rh (@ 23 °C) 10 °C to 30 °C 30 °C to 50 °C	2.5 %rh 0.5 °C 0.6 °C	Comparison method using Std. Temperature and Humidity Meter based on BS 1339-3:2004
7. Infrared Thermometer	35 °C to 100 °C 100 °C to 200 °C 200 °C to 400 °C	0.7 °C 1.4 °C 1.7 °C	Calibration by Comparison Method using; 1. Infrared Thermometer 2. Blackbody calibrator

Signatory:

1. Zaidi Bin Borham

SITE CALIBRATION: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
1. Temperature Indicating Instruments	Type-K -100 °C to 1300 °C Type-J -100 °C to 1200 °C Type-T -100 °C to 400 °C Type-E -100 °C to 1000 °C Type-R 0 °C to 1700 °C Type-S 0 °C to 1700 °C PT100 -100 °C to 800 °C	0.4 °C 0.4 °C 0.4 °C 0.4 °C 0.5 °C 0.5 °C 0.3 °C	Electrical Simulation Using Documenting Process Calibrator based on EA-10/11 and ITS 90 Tables
2. Temperature Controlled Enclosure	-30 °C to 250 °C	0.7 °C	Using Temperature Recorder and Thermocouple Wires based on AS 2853
3. Temperature Sensor with Indicator	-40 °C to 250 °C 250 °C to 600 °C	0.3 °C 0.4 °C	Calibration by comparison method using: 1. PRT 2. Dry Block Calibrator

Signatory:

1. Zaidi Bin Borham

SCOPE OF CALIBRATION: MASS

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
Standard Weights	Up to 200 mg 500 mg 1 g 2 g 5 g 10 g 20 g 50 g 100 g 200 g 500 g 1000 g	0.018 mg 0.020 mg 0.023 mg 0.025 mg 0.031 mg 0.038 mg 0.046 mg 0.06 mg 0.10 mg 0.22 mg 2.1 mg 2.8 mg	Comparison Method using ABBA weighing scheme Using E2 Standard Weights by ABBA comparison weighing scheme
Standard Weights	2 kg 5 kg 10 kg 20 kg 25 kg	0.11 g 0.14 g 0.17 g 0.32 g 0.40 g	Using Standard Weights F1, F2 ABBA Method

Signatories:

1. Murali a/l Subramaniam

2. Zaidi Borham

SCOPE OF CALIBRATION: MASS

SITE CALIBRATION: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
1. Analytical Balance	Up to 200 g	0.2 mg	Using Std. Weight E2 as a Standard with reference to OIML R 76-I Edition 2006(E)
2. Electronic Balance	Up to 500 g Up to 1 kg Up to 10 kg Up to 20 kg Up to 100 kg Up to 200 kg Up to 500 kg Up to 1000 kg Up to 2000 kg	1.5 mg 6 mg 61 mg 100 mg 20 g 36 g 171 g 213 g 460 g	Using Standard Weight E2, F1, F2, M2 as a Standard with reference to OIML R 76-I Edition 2006(E)

Signatories:

1. **Murali a/l Subramaniam**
2. **Zaidi Borham**

SCOPE OF CALIBRATION: FORCE

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
Digital Force Gauges / Push Pull Gauges / Tension Gauges	1 mgf to 10 kgf 10 kgf to 50 kgf 50 kgf to 100 kgf	0.6 gf 10 gf 61 gf	Using Std. Weight as a Standard

Signatory:

1. Murali a/l Subramaniam

SCOPE OF CALIBRATION: FORCE

SITE CALIBRATION: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
Universal Testing Machine (Compression Mode)	150 kgf to 1000 kgf 1001 kgf to 5000 kgf 5001 kgf to 10000 kgf	0.2 kgf 3.2 kgf 2.6 kgf	Using Std. Load Cell * Calibration Loop as a Standard with reference to ISO 7500-1:2004

Signatory:

1. Murali a/l Subramaniam

Issue date: 3 January 2023
Valid until: 17 September 2023

NO: SAMM 176
(Issue 3, 3 January 2023 replacement
of SAMM 176 dated 15 March 2022)

SCOPE OF CALIBRATION: TORQUE

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
Torque Wrench	0 Nm to 100 Nm 0 Nm to 500 Nm 501 Nm to 800 Nm	0.12 Nm 0.58 Nm 1.5 Nm	Measuring using Torque Transducer

Signatories:

1. **Murali a/l Subramaniam**
2. **Mokhtar Ali**

SCOPE OF CALIBRATION: PRESSURE

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
Pressure Indicating Instruments (hydraulic medium)	0 psi to 800 psi 800 psi to 16000 psi	0.03 % of Reading 0.03 % of Reading	Using Dead Weight Tester / Pressure Comparator as a Standard
Pressure Indicating Instruments (Pneumatic)	-1 bar to 0 bar	0.002 bar	Generation Using Digital Pressure Calibrator
	0 bar to 120 bar	0.017 % of reading	Generating using Air Dead Weight Tester

Signatories:

1. **Murali a/l Subramaniam**
2. **Mokhtar Ali**

SCOPE OF CALIBRATION: PRESSURE

SITE CALIBRATION: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
Pressure Indicating Instruments (hydraulic medium)	0 psi to 800 psi 800 psi to 16000 psi	0.05 % of Reading + 0.06 psi 0.06 % of Reading + 0.03 psi	Using Pressure Comparator as a Standard
Pressure Indicating Instruments (Pneumatic)	-1 bar to 0 bar 0 bar to 20 bar	0.002 bar 0.017 bar	Generation Using Digital Pressure Calibrator

Signatories:

1. **Murali a/l Subramaniam**
2. **Mokhtar Ali**