Issue date: 11 November 2020
Valid until: 14 September 2023

NO: SAMM 088
(Issue 2, 11 November 2020 replacement of SAMM 088 dated 26 August 2020)

LABORATORY LOCATION:
(PERMANENT LABORATORY)

SIRIM STANDARDS TECHNOLOGY SDN. BHD.
(Company No.: 292201-P)
LOT 12, 18 & 20, JALAN BEREMBAN 15/12
SEKSYEN 15
40200 SHAH ALAM, SELANGOR
MALAYSIA

FIELDS OF CALIBRATION: **ELECTRICAL, ACOUSTIC & VIBRATION MEASUREMENT, PRESSURE, DIMENSIONAL, MASS AND MASS RELATED, TEMPERATURE**

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 Instrument DC VOLTAGE	± 220 mV Range ± (0 mV to 220 mV)	7.5 µV/V + 0.4 µV	
	± 2.2 V Range ± (0 V to 2.2 V)	5 µV/V + 0.7 µV	
	± 11 V Range ± (0 V to 11 V)	3.5 µV/V + 2.5 µV	Fluke 5730A
	± 22 V Range ± (0 V to 22 V)	3.5 µV/V + 4 µV	
	± 220 V Range ± (0 V to 220 V)	5 µV/V + 40 µV	

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
1. Measuring Instrument Continue DC VOLTAGE	± 1100 V Range ± (100 V to 1100 V)	6.5 µV/V + 0.4 mV	Fluke 5730A
AC VOLTAGE	2.2 mV to 220 V (See Matrix A)	(See Matrix A)	Fluke 5730A
	1100 V Range (110 V to 1100 V) 15 Hz to 50 Hz 50 Hz to 1 kHz	360 µV/V + 20 mV 85 µV/V + 4 mV	Fluke 5730A
	800 V to 1050 V 1 kHz to 3 kHz 3 kHz to 10 kHz 10 kHz to 20 kHz	0.8 mV/V + 0.13 V 0.8 mV/V + 0.21 V 1.2 mV/V + 0.32 V	Wavetek 9100
DC CURRENT	± 220 µA Range ± (0 µA to 220 µA) ± 2.2 mA Range ± (0 mA to 2.2 mA) ± 22 mA Range ± (0 mA to 22 mA) ± 220 mA Range ± (0 mA to 220 mA) ± 2.2 A Range ± (0 A to 2.2 A)	40 µA/A + 6 nA 35 µA/A + 7 nA 35 µA/A + 40 nA 45 µA/A + 0.7 µA 80 µA/A + 12 µA	Fluke 5730A
	± 3.2 A Range ± (0.32 A to 3.2 A) ± 10.5 A Range ± (3.2 A to 10.5 A) ± 20 A Range ± (10.5 A to 20 A)	0.6 mA/A + 0.12 mA 0.55 mA/A + 0.94 mA 0.55 mA/A + 4.5 mA	Wavetek 9100
	± 100 A Range ± (20 A to 100 A)	0.45 mA/A + 20 mA	California 3213K

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
1. Measuring Instrument Continue AC CURRENT	9 µA to 2.2 A (See Matrix B)	(See Matrix B)	Fluke 5730A
	0.32 A to 3.2 A 10 Hz to 3 kHz 3 kHz to 10 kHz 3.2 A to 10.5 A 10 Hz to 3 kHz 3 kHz to 10 kHz 10.5 A to 20 A 10 Hz to 3 kHz 3 kHz to 10 kHz	1 mA/A + 0.48 mA 2.5 mA/A + 2.6 mA 2 mA/A + 3 mA 5 mA/A + 10 mA 2 mA/A + 6.9 mA 5 mA/A + 23 mA	Wavetek 9100
	20 A to 100 A 10 Hz to 1 kHz 1 kHz to 10 kHz	2.5 mA/A + 0.03 A 5 mA/A + 0.05 A	California Instruments CA 3213K
Residual Current	3 mA to 3A At Time interval up to 5 s At Time interval <190 ms	0.14 mA/A 0.3 mA/A	For RCD Tester Calibrator (using Transmille 3200)
CAPACITANCE	(See Matrix C)	(See Matrix C)	Wavetek 9100
Fixed Value	**20 Hz to 1 MHz** 1 pF, 10 pF, 100 pF, 1000 pF, 0.01 µF, 0.1 µF and 1.0 µF	1 mF/F	HP 1600A series
INDUCTANCE Fixed Value	100 µH @ 1 kHz (1, 10, 100) mH @ 1 kHz 1H @ 1 kHz	2.5 mH/H 1 mH/H 1 mH/H	Ando RS-100 series

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
1. Measuring Instrument Continue RESISTANCE Fixed Value	1 mΩ 10 mΩ 100 mΩ 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ	0.2 mΩ/Ω 0.1 mΩ/Ω 0.02 mΩ/Ω 5 μΩ/Ω 95 μΩ/Ω 5 μΩ/Ω 23 μΩ/Ω 5 μΩ/Ω 10 μΩ/Ω 5 μΩ/Ω 6.5 μΩ/Ω 5 μΩ/Ω 6.5 μΩ/Ω 5 μΩ/Ω 8.5 μΩ/Ω 5 μΩ/Ω 18 μΩ/Ω 5 μΩ/Ω 47 μΩ/Ω	Fluke 5730A & Fluke 742A Series Resistance Standard
	100 MΩ 1 GΩ 10 GΩ 100 GΩ 1 TΩ	0.1 mΩ/Ω 5 μΩ/Ω 0.02 Ω/Ω 0.05 Ω/Ω 0.05 Ω/Ω	Fluke 5730A & Takeda Riken TR45 Series Standard Resistor
POWER/ ENERGY (DC)	1 kW to 20 kW 0.1 W to 1 kW	0.7 mW/W 0.22 mW/W	Fluke 5520A
POWER / ENERGY (AC), (45 Hz to 65 Hz at PF=1)	10 kW to 20 kW 1 W to 10 kW 0.1 W to 1 W	1 mW/W 0.9 mW/W 1 mW/W	

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
1. Measuring Instrument Continue TIME	1 s to 24 Hrs	0.06 μs/s + 0.021 s	Agilent 33250A & Universal Counter HP 53132A
	20 ms to 5 s	0.7 ms	For RCD Tester Calibrator (using Transmille 3200)
Residual Current Duration	10 ms to 5 s	0.4 ms	
RPM Measuring Instruments (Non Contact)	60 to 5999 rpm 6000 to 29999 rpm 30000 to 59999 rpm 60000 to 99999 rpm	0.07 rpm 7 rpm 36 rpm 70 rpm	In-House method, ESF/0303
HIGH VOLTAGE METER DC Voltage	0.5 kV to 10 kV	5 mV/V	TDV 20 ADS & TOS 5101
AC Voltage @ (50/60) Hz		8 mV/V	
CLAMP METER DC Current 10 – Turn Coil	± 3.2 A to 32 A ± 32 A to 105 A ± 105 A to 200 A	0.06 mA/A + 1.18 mA 0.55 mA/A + 9.4 mA 0.55 mA/A + 45 mA	Wavetek 9100 c/w Current Coil
50 – Turn Coil	± 16 A to 160 A ± 160 A to 525 A ± 525 A to 1000 A	0.6 mA/A + 5.9 mA 0.55 mA/A + 47 mA 0.55 mA/A + 0.23 A	
AC Current 10 – Turn Coil	<u>3.2 A to 32 A</u> 10 Hz to 100 Hz 100 Hz to 440 Hz <u>32 A to 200 A</u> 10 Hz to 100 Hz 100 Hz to 440 Hz	2 mA/A + 5.5 mA 7.8 mA/A + 27 mA 2.1 mA/A + 90 mA 6.7 mA/A + 0.25 A	

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
1. Measuring Instrument Continue CLAMP METER 50 – Turn Coil	16 A to 160 A 10 Hz to 100 Hz 160 A to 1000 A 10 Hz to 100 Hz	2 mA/A + 28 mA 2.1 mA/A + 0.45 A	Wavetek 9100 c/w Current Coil
INSULATION TESTER	(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 600 GΩ) @ 5000	0.5 mΩ/Ω 1 mΩ/Ω 10 mΩ/Ω 50 mΩ/Ω 0.1 Ω/Ω 50 mΩ/Ω	Tinsley 4720
OSCILLOSCOPE Vertical Deflection DC Signal	0 V to ± 6.6 V (50 Ω Load) 0 V to ± 130 V (1 MΩ Load)	2.5 mV/V+ 0.04 mV 0.5 mV/V + 0.04 mV	Fluke 5500A SC600
Vertical Deflection Square Wave Signal	± 1 mVp-p to ± 6.6 Vp-p (50 Ω Load) ± 1 mVp-p to ± 130 Vp-p (1 MΩ Load)	2.5 mVp-p/Vp-p + 0.04mVp-p 1 mVp-p/Vp-p + 0.04 mVp-p	
Horizontal Deflection Time Markers (50 Ω Load)	2 ns/div to 20 ms/div 50 ms/div to 5 s/div	2.5 μs/s (25+(Output x 1000)) μs/s	
Risetime	≤ 300 ps	+0 ns / -0.1 ns	
Bandwidth Frequency	50 kHz to 600 MHz	2.5 μHz/Hz	
	600 MHz to 40 GHz (+11 dBm to –135 dBm)	7 nHz/Hz	Agilent E8257D Reference to Pendulum GPS-12R Disciplined by GPS

Issue date: 11 November 2020
Valid until: 14 September 2023

NO: SAMM 088
(Issue 2, 11 November 2020 replacement
of SAMM 088 dated 26 August 2020)

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
1. Measuring Instrument Continue OSCILLOSCOPE Bandwidth Amplitude	50 kHz to 600 MHz	0.03 Vp-p	Fluke 5500A SC600
	600 MHz to 40 GHz (+11 dBm to –135 dBm)	0.92 dBm	Agilent E8257D
Frequency	1 μHz to 80 MHz (10 mVpp to 10 Vpp) 10 kHz to 40 GHz (+11 dBm to –135dBm)	36 nHz/Hz 7 nHz/Hz	(Agilent 33250A, ifR2042 or Agilent E8257D) Reference to Pendulum GPS-12R Disciplined by GPS
Amplitude	10 mVp-p to 10 Vp-p (1 μHz to 80 MHz, Into 50 Ω)	10 mVpp/Vpp + 1 mVpp	Agilent 33250A
	+13 dBm to –144dBm (10 kHz to 5.4 GHz)	0.58 dBm	ifR2042
	+11 dBm to –135dBm (250 kHz to 40 GHz)	0.92 dBm	Agilent E8257D
Flatness	Sine Wave Relative to 1 kHz (Auto range On)	0.4 dBm	Agilent 33250A

SCOPE OF CALIBRATION: ELECTRICAL

Matrix A
AC Voltage Measurement

Range		Frequency			
		Hz		kHz	
		10 to 20	20 to 40	0.04 to 20	20 to 50
2.2 mV	**0.22 mV to 2.2 mV**	0.24 + 0.004	0.09 + 0.004	0.08 + 0.004	0.2 + 0.004
22 mV	**2.2 mV to 22 mV**	0.24 + 0.004	0.09 + 0.004	0.08 + 0.004	0.2 + 0.004
220 mV	**22 mV to 220 mV**	0.24 + 0.012	0.09 + 0.007	0.057 + 0.007	0.12 + 0.007
2.2 V	**0.22 V to 2.2 V**	0.24 + 0.04	0.09 + 0.015	0.042 + 0.008	0.067 + 0.01
22 V	**2.2 V to 22 V**	0.24 + 0.4	0.09 + 0.15	0.042 + 0.05	0.067 + 0.1
220 V	**22 V to 220 V**	0.24 + 4	0.09 + 1.5	0.052 + 0.6	0.08 + 1

Range		Frequency			
		MHz			
		0.05 to 0.1	0.1 to 0.3	0.3 to 0.5	0.5 to 1
2.2 mV	**0.22 mV to 2.2 mV**	0.5 + 0.005	1.05 + 0.01	1.4 + 0.02	2.7 + 0.02
22 mV	**2.2 mV to 22 mV**	0.5 + 0.005	1.05 + 0.01	1.4 + 0.02	2.7 + 0.02
220 mV	**22 mV to 220 mV**	0.31 + 0.017	0.655 + 0.03	1.4 + 0.025	2.7+ 0.045
2.2 V	**0.22 V to 2.2 V**	0.085 + 0.03	0.336 + 0.08	1 + 0.2	1.7 + 0.3
22 V	**2.2 V to 22 V**	0.085 + 0.2	0.254 + 0.6	1 + 2	1.5 + 3.2
220 V	**22 V to 220 V**	0.15 + 2.5	0.9 + 16	4.4 + 40	8 + 80

The expanded uncertainties given in this table are expressed in mV/V + mV

Matrix B
AC Current Measurement

Range	Frequency (kHz)				
	0.01 to 0.02	0.02 to 0.04	0.04 to 1	1 to 5	5 to 10
9 µA to 220 µA	0.25 + 0.016	0.16 + 0.01	0.103 + 0.008	0.28 + 0.012	1.1 + 0.065
0.22 mA to 2.2 mA	0.25 + 0.04	0.16 + 0.035	0.103 + 0.035	0.2 + 0.11	1.1 + 0.65
2.2 mA to 22 mA	0.25 + 0.4	0.16 + 0.35	0.103 + 0.35	0.2 + 0.55	1.1 + 5
22 mA to 220 mA	0.25 + 4	0.16 + 3.5	0.103 + 2.5	0.2 + 3.5	1.1 + 10
0.22 A to 2.2 A	Frequency (kHz)				
			0.02 to 1	**1 to 5**	**5 to 10**
			0.244 + 35	0.45 + 80	7 + 160

The expanded uncertainties given in this table are expressed in mA/A + µA

SCOPE OF CALIBRATION: ELECTRICAL

Matrix C
Capacitance Measurement

Range	Frequency	
	≤ 350 Hz	**350 Hz to 1.5 kHz**
0.5 nF to 4 nF	3 mF/F + 15 pF	6 mF/F + 0.03 nF
4 nF to 40 nF	3 mF/F + 30 pF	6 mF/F + 0.06 nF
40 nF to 400 nF	3 mF/F + 0.16 nF	6 mF/F + 0.32 nF
400 nF to 4 μF	4 mF/F + 1.6 nF	8 mF/F + 3.2 nF
	5 mF/F + 16 nF	10 mF/F + 32 nF
40 μF to 400 μF	5 mF/F + 0.16 μF	10 mF/F + 0.32 μF
400 μF to 4 mF	5 mF/F + 1.6 μF	10 mF/F + 3.2 μF
4 mF to 40 mF	10 mF/F + 0.06 mF	20 mF/F + 0.12 mF

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
2. Generating Instrument DC VOLTAGE	± 100 mV Range ± (100 μV to 120 mV)	5 μV/V + 0.3 μV	HP 3458A Opt. 002
	±1 V Range ± (100 mV to 1.2 V)	4 μV/V + 0.3 μV	
	± 10 V Range ± (1 V to 12 V)	4 μV/V + 0.5 μV	
	±100 V Range ± (10 V to 120 V)	6 μV/V + 0.03 mV	
	±1000 V Range ± (100 V to 1050 V)	6 μV/V + 0.1 mV	

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
2. Generating Instrument Continue DC VOLTAGE	100 mV @ ± 100 % Band Span ± (85 mV to 115 mV)	4 µV/V	Wavetek 4950
	1 V @ ± 100 % Band Span ± (0.9 V to 1.1 V)	2.2 µV/V	
	10 V @ ± 100 % Band Span ± (9 V to 11 V)	1.4 µV/V	
	10 V @ ± 190 % Band Span ± (18 V to 19.5 V)	1.8 µV/V	
	100 V @ ± 100 % Band Span ± (90 V to 110 V)	2 µV/V	
	1000 V @ ± 100 % Band Span ± (900 V to 1100 V)	2 µV/V	
AC VOLTAGE	1 mV to 1000V (See Matrix D)	(See Matrix D)	Wavetek 4950
	2.2 mV to 1000V (See Matrix E)	(See Matrix E)	Fluke 5790A
	10 mV to 700V (See Matrix F)	(See Matrix F)	HP 3458A Opt. 002
DC CURRENT	110 µA @ ± 100 % Band Span ± (90 µA to 110 µA)	21 µA/A	Wavetek 4950
	1 mA @ ± 100 % Band Span ± (0.9 mA to 1.1 mA)	11 µA/A	
	10 mA @ ± 100 % Band Span ± (9 mA to 11 mA)	11 µA/A	
	100 mA @ ± 100 % Band Span ± (90 mA to 110 mA)	15 µA/A	
	1 A @ ± 100 % Band Span ± (0.9 A to 1.1 A)	25 µA/A	

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
2. Generating Instrument Continue DC CURRENT	± (1 nA to 100 nA) ± (100 nA to 1 μA) ± (1 μA to 10 μA) ± (10 μA to 100 μA) ± (100 μA to 1 mA) ± (1 mA to 10 mA) ± (10 mA to 100 mA) ± (100 mA to 1 A)	30 μA/A + 0.04 nA 20 μA/A + 0.04 nA 20 μA/A + 0.1 nA 20 μA/A + 0.8 nA 20 μA/A + 5 nA 20 μA/A + 0.05 μA 35 μA/A + 0.5 μA 0.11 mA/A + 0.01 mA	HP 3458A Opt. 002
	± (1 pA to 20 pA) ± (20 pA to 200 pA) ± (200 pA to 2 nA)	0.01 A/A + 3 nA 0.01 A/A + 5 nA 2 mA/A + 0.3 μA	Keithley 6517/ Agilent 4339A
	10 A @ ± 100 % Band Span ± (9 A to 11 A)	55 μA/A	Wavetek 4950 & 4953
	± (1 A to 10 A) ± (10 A to 100 A)	5.1 mA 0.05 A	HP 3458A & Guildline 9211A
AC CURRENT	5 μA to 1 A (See Matrix G)	(See Matrix G)	HP 3458A
	90 μA to 1 A (See Matrix H)	(See Matrix H)	Wavetek 4950
	10 A @ 100 % Band Span (See Matrix I)	(See Matrix I)	Wavetek 4950 & 4953

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
2. Generating Instrument Continue AC CURRENT	1 A to 50 A 50 Hz/ 60 Hz	0.5 mA/A	HP 3458A & Zenith H007098
RESISTANCE	0 Ω to 10 Ω 10 Ω to 100 Ω 0.1 kΩ to 1 kΩ 1 kΩ to 10 kΩ 10 kΩ to 100 kΩ 0.1 MΩ to 1 MΩ 1 MΩ to 10 MΩ 10 MΩ to 100 MΩ 100 MΩ to 1 GΩ 1 GΩ to 2 GΩ 2 GΩ to 20 GΩ 20 GΩ to 200 GΩ 0.2 TΩ to 2 TΩ 2 TΩ to 20 TΩ 20 TΩ to 200 TΩ	15 μΩ/Ω + 0.05 mΩ 12 μΩ/Ω + 0.5 mΩ 10 μΩ/Ω + 0.5 mΩ 10 μΩ/Ω + 5 mΩ 10 μΩ/Ω + 0.05 Ω 15 μΩ/Ω + 2 Ω 50 μΩ/Ω + 0.1 kΩ 0.5 mΩ/Ω + 1 kΩ 5 mΩ/Ω + 0.01 MΩ 2.3 mΩ/Ω + 0.01 MΩ 2.3 mΩ/Ω + 0.1 MΩ 3.5 mΩ/Ω + 1 MΩ 3.5 mΩ/Ω + 0.01 GΩ 10 mΩ/Ω + 0.1 GΩ 12 mΩ/Ω + 1 GΩ	HP 3458A Opt 002 & Keithley 6517 / Agilent 4339A
	<u>10 Ω</u> 10 % Band Span (Zero to 2 Ω), 30 % Band Span (2 Ω to 4 Ω), 100 % Band Span (9 Ω to 11 Ω), 190 % Band Span (18 Ω to 19.5 Ω) <u>100 Ω</u> 30 % Band Span (20 Ω to 40 Ω), 100 % Band Span (90 Ω to 110 Ω), 190 % Band Span (180 Ω to 195 Ω)	8 μΩ/Ω 6 μΩ/Ω	Wavetek 4950

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
2. Generating Instrument Continue RESISTANCE	<u>1 kΩ</u> 30 % Band Span (0.2 kΩ to 0.4 kΩ), 100 % Band Span (0.9 kΩ to 1.1 kΩ), 190 % Band Span (1.8 kΩ to 1.95 kΩ)	3 μΩ/Ω	Wavetek 4950
	<u>10 kΩ</u> 30 % Band Span (2 kΩ to 4 kΩ), 100 % Band Span (9 kΩ to 11 kΩ), 190 % Band Span (18 kΩ to 19.5 kΩ)	3 μΩ/Ω	
	<u>100 kΩ</u> 30 % Band Span (20 kΩ to 40 kΩ), 100 % Band Span 90 kΩ to 110 kΩ) & 190 % Band Span (180 kΩ to 195 kΩ)	6 μΩ/Ω	
	<u>1 MΩ</u> 30 % Band Span (0.2 MΩ to 0.4 MΩ), 100 % Band Span (0.9 MΩ to 1.1 MΩ) & 190 % Band Span (1.8 MΩ to 1.95 MΩ)	11 μΩ/Ω	
	<u>10 MΩ</u> 30 % Band Span (2 MΩ to 4 MΩ), 100 % Band Span (9 MΩ to 11 MΩ) & 190 % Band Span (18 MΩ to 19.5 MΩ)	21 μΩ/Ω	

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
2. Generating Instrument Continue RESISTANCE	100 MΩ 30 % Band Span (20 MΩ to 40 MΩ), 100 % Band Span (90 MΩ to 110 MΩ)	83 μΩ/Ω	Wavetek 4950
CAPACITANCE	1 pF to 1 mF @ (10 Hz to 1 MHz)	0.5 mF/F	HP 4284A
INDUCTANCE	1 μH to 10 H @ (10 Hz to 1 MHz)	0.5 mH/H	
FREQUENCY	1 Hz to 5 GHz	0.89 pHz/Hz	HP53132A Reference to Pendulum GPS-12R Disciplined by GPS
AMPLITUDE/ LEVEL	-20 dBm to +30 dBm (100 kHz to 2.6 GHz)	0.04 dBm	HP 8902 with 11722A
RF FREQUENCY	5 GHz to 26.5 GHz	0.89 Hz/Hz	HP8563E Reference to Pendulum GPS-12R Disciplined by GPS
RF AMPLITUDE/ LEVEL	-30 dB to +30 dB (2.6 GHz to 18 GHz)	0.27 dBm	Agilent E4418B with HP 8481A
	-120 dB to +30 dB (30 Hz to 26.5 GHz)	1 dBm	HP8563E
TUNED RF LEVEL	-127 dB to 0 dB (2.5 MHz to 1.3 GHz)	0.07 dBm	HP 8902 with 11722A

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
2. Generating Instrument Continue MODULATION Related Signal: Amplitude Modulation (AM) AM Depth: 5% to 99%	Carrier Frequency 150 kHz to 10 MHz Modulation Frequency 50 Hz to 10 kHz	0.17 %	
	Carrier Frequency 150 kHz to 1300 MHz Modulation Frequency 20 Hz to 10 kHz	0.19 %	
	Carrier Frequency 10 MHz to 1300 MHz Modulation Frequency 50 Hz to 100 kHz	0.13 %	
Frequency Modulation (FM) FM Deviation: ≤ 40 kHz peak	Carrier Frequency 150 kHz to 10 MHz Modulation Frequency 20 Hz to 10 kHz	0.13 kHz	HP 8902 with 11722A
FM Deviation: ≤ 400 kHz peak	Carrier Frequency 10 MHz to 1300 MHz Modulation Frequency 50 Hz to 100 kHz	0.03 kHz	
	Carrier Frequency 10 MHz to 1300 MHz Modulation Frequency 100 kHz to 200 kHz	0.32 kHz	
Phase Modulation (ΦM) ΦM Deviation: ≤ 40 Radians peak	Carrier Frequency 150 kHz to 10 MHz Modulation Frequency 200 Hz to 10 kHz	0.15 Radians	
ΦM Deviation: ≤ 400 Radians peak	Carrier Frequency 10 MHz to 1.3 GHz Modulation Frequency 200 Hz to 20 kHz	0.14 Radians	

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
2. Generating Instrument Continue DISTORTION Related Signal: Audio Distortion (-99 to 0) dB	Fundamental Frequency 20 Hz to 20 kHz Fundamental Frequency 20 kHz to 100 kHz	1 dB 2 dB	HP 8903B
RPM Non Contact Measurement Contact Measurement	10 to 29 rpm 30 to 59 rpm 60 to 99 rpm 100 to 299 rpm 300 to 599 rpm 600 to 999 rpm 1000 to 2999 rpm 3000 to 5999 rpm 6000 to 9999 rpm 10000 to 29999 rpm 30000 to 59999 rpm 60000 to 99999 rpm 20 to 29 rpm 30 to 59 rpm 60 to 99 rpm 100 to 299 rpm 300 to 599 rpm 600 to 999 rpm 1000 to 2999 rpm 3000 to 5999 rpm 6000 to 9999 rpm 10000 to 12999 rpm 13000 to 25999 rpm 26000 to 29999 rpm	0.014 rpm 0.036 rpm 0.07 rpm 0.14 rpm 0.37 rpm 0.7 rpm 1.4 rpm 3.6 rpm 7 rpm 14 rpm 36 rpm 70 rpm 0.011 rpm 0.016 rpm 0.029 rpm 0.07 rpm 0.16 rpm 0.29 rpm 0.7 rpm 1.6 rpm 2.9 rpm 7 rpm 8 rpm 14 rpm	In-House method, ESF/0303
High Voltage Tester DC VOLTAGE	0 kV to 9.99 kV 10 kV to <20 kV 20 kV to 35 kV >35 kV to 40 kV	5 mV/V + 2 V 20 mV/V 10 mV/V 20 mV/V	TDV 20 ADS Fluke 80K-40

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
2. Generating Instrument Continue AC VOLTAGE	(0 kV to 9.99 kV) @ 50/60 Hz (10 kV to 20 kV) @ 50/60 Hz (20 kV to 28 kV) @ 50/60 Hz	7 mV/V + 3 V 7 mV/V + 30 V 50 mV/V	TDV 20 ADS Fluke 80K-40

Matrix D
AC Voltage Generation (Wavetek 4950)

Range		Frequency Band				
		9 to 11 Hz	18 to 22 Hz	27 to 33 Hz	36 to 44 Hz	46.3 to 63.7 Hz
1 mV	0.85 to 1.15 mV	0.28 mV/V				
10 mV	8.5 to 11.5 mV	0.16 mV/V				
100 mV	85 mV to 115 mV	0.12 mV/V				
1 V	0.9 to 1.1 V	36 μV/V			24 μV/V	
10 V	9 to 11 V					
100 V	90 to 110 V	41 μV/V			36 μV/V	
1000 V	900 to 1100 V	μ				37 μV/V

Range		Frequency Band				
		270 to 440 Hz	0.9 to 1.1 kHz	9 to 11 kHz	18 to 22 kHz	27 to 33 kHz
1 mV	0.85 to 1.15 mV	0.26 mV/V		0.28 mV/V	0.29 mV/V	0.39 mV/V
10 mV	8.5 to 11.5 mV	0.14 mV/V		0.16 mV/V	0.17 mV/V	0.24 mV/V
100 mV	85 mV to 115 mV	89 μV/V		0.12 mV/V	0.19 mV/V	
1 V	0.9 to 1.1 V	24 μV/V				
10 V	9 to 11 V					26 μV/V
	18 to 19.5 V	μ		μ	μ	μ
100 V	90 to 110 V	26 μV/V				29 μV/V
1000 V	900 to 1100 V	37 μV/V		42 μV/V	47 μV/V	74 μV/V

Range		Frequency Band (kHz)				
		45 to 55	90 to 110	180 to 220	270 to 330	450 to 550
1 mV	0.85 to 1.15 mV	0.39 mV/V	0.62 mV/V	μ	0.75 mV/V	0.77 mV/V
10 mV	8.5 to 11.5 mV	0.24 mV/V	0.4 mV/V		0.58 mV/V	0.61 mV/V
100 mV	85 mV to 115 mV	0.19 mV/V	0.36 mV/V			
1 V	0.9 to 1.1 V	31 μV/V	37 μV/V		96 μV/V	0.2 μV/V
10 V	9 to 11 V	26 μV/V			83 μV/V	0.18 mV/V
100 V	90 to 110 V	35 μV/V	64 μV/V	0.24 mV/V		
1000 V	600 to 800 V	0.11 mV/V	0.34 mV/V			

SCOPE OF CALIBRATION: ELECTRICAL

Matrix D
AC Voltage Generation Continue (Wavetek 4950)

Range		Frequency Band
		0.9 to 1.1 MHz
1 mV	0.85 to 1.15 mV	1.1 mV/V
10 mV	8.5 to 11.5 mV	0.95 mV/V
100 mV	85 mV to 115 mV	
1 V	0.9 to 1.1 V	0.56 mV/V
10 V	9 to 11 V	0.53 mV/V

Matrix E
AC Voltage Generation (Fluke 5790A)

Range		Frequency Band			
		10 to 20 Hz	20 to 40 Hz	40 Hz to 20 kHz	20 to 50 kHz
2.2 mV	0.6 to 2.2 mV	1.7 + 1.3	0.74 + 1.3	0.42 + 1.3	0.81 + 2
7 mV	1.9 to 7 mV	0.85 + 1.3	0.37 + 1.3	0.21 + 1.3	0.4 + 2
22 mV	8.5 to 11.5 mV	0.29 + 1.3	0.19 + 1.3	0.11 + 1.3	0.21 + 2
70 mV	19 to 70 mV	0.24 + 1.5	0.12 + 1.5	24 μV/V + 1.5	0.13 + 2
220 mV	60 to 220 mV	0.21 + 1.5	85 μV/V + 1.5	38 μV/V + 1.5	69 μV/V + 2
700 mV	190 to 700 mV		24 μV/V + 1.5	33 μV/V + 1.5	51 μV/V + 2
2.2 V	0.6 to 2.2 V	0.2	66 μV/V	24 μV/V	46 μV/V
7 V	1.9 to 7 V		67 μV/V		48 μV/V
22 V	6 to 22 V			27 μV/V	
70 V	19 to 70 V		68 μV/V	32 μV/V	57 μV/V
220 V	60 to 220 V			31 μV/V	69 μV/V
700 V	190 V to 700 V		99 μV/V	41 μV/V	0.13
1000 V	600 V to 1050 V			38 μV/V	

Range		Frequency Band			
		50 to 100 kHz	100 to 300 kHz	300 to 500 kHz	500 kHz to 1 MHz
2.2 mV	0.6 to 2.2 mV	1.2 + 2.5	2.3 + 4	2.4 + 8	3.5 + 8
7 mV	1.9 to 7 mV	0.6 + 2.5	1.2 + 4	1.3 + 8	2.3 + 8
22 mV	8.5 to 11.5 mV	0.31 + 2.5	0.81 + 4	0.89 + 8	1.7 + 8
70 mV	19 to 70 mV	0.26 + 2.5	0.51 + 4	0.67 + 8	1.1 + 8
220 mV	60 to 220 mV	0.16 + 2.5	0.25 + 4	0.38 + 8	1 + 8
700 mV	190 to 700 mV	79 μV/V + 2.5	0.18 + 4	0.3 + 8	0.96 + 8
2.2 V	0.6 to 2.2 V	71 μV/V	0.16	0.26	0.9
7 V	1.9 to 7 V	81 μV/V	0.19	0.4	1.2
22 V	6 to 22 V				
70 V	19 to 70 V	94 μV/V	0.2	0.41	
220 V	60 to 220 V	98 μV/V	0.21	0.5	
700 V	190 V to 700 V	0.5	μ		
1000 V	600 V to 1050 V				

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

SCOPE OF CALIBRATION: ELECTRICAL

Matrix F
AC Voltage Generation (HP 3458A)

Range		Frequency Band				
		1 to 40 Hz	0.1 to 1 MHz	1 to 4 MHz	4 to 8 MHz	8 to 10 MHz
10 mV	1 to 12 mV	0.3 + 3	12 + 5	70 + 7	0.2 V/V + 8	–

Range		Frequency Band				
		1 to 40 Hz	1 to 2 MHz	2 to 4 MHz	4 to 8 MHz	8 to 10 MHz
100 mV	10 to 120 mV	70 μV/V + 4	15 + 10	40 + 70	40 + 80	0.15 V/V + 0.1 mV
1 V	0.1 V 1.2 V	70 μV/V + 40	15 + 0.1 mV	40 + 0.7 mV	40 + 0.8 mV	0.15 V/V + 1 mV
10 V	1 to 12 V	70 μV/V + 0.4 mV	15 + 1 mV	40 + 7 mV	40 + 8 mV	0.15 V/V + 10 mV

Range		Frequency Band	
		1 to 40 Hz	0.3 to 1 MHz
100 V	10 to 120 V	0.2 + 4 mV	15 + 10 mV
1000 V	100 to 700 V	0.4 + 40 mV	

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

Matrix G
AC Current Generation (HP 3458A)

Range		Frequency Band			
		10 to 20 Hz	20 to 45 Hz	45 to 100 Hz	100 Hz to 5 kHz
100 μA	5 to 120 μA	4 + 30 nA	1.5 + 30 nA	0.6 + 3 nA	
1 mA	0.05 to 1.2 mA	4 + 0.2	1.5 + 0.2	0.6 + 0.2	0.3 + 0.2
10 mA	0.5 to 12 mA	4 + 2	1.5 + 2	0.6 + 2	0.3 + 2
100 mA	5 to 120 mA	4 + 20	1.5 + 20	0.6 + 20	0.3 + 20
1 A	0.05 to 1.05 A	4 + 0.2 mA	1.6 + 0.2 mA	0.8 + 0.2 mA	1 + 0.2 mA

Range		Frequency Band		
		5 to 20 kHz	20 to 50 kHz	50 to 100 kHz
1 mA	0.05 to 1.2 mA	0.6 + 0.2	4 + 0.4	5.5 + 1.5
10 mA	0.5 to 12 mA	0.6 + 2	4 + 4	5.5 + 15
100 mA	5 to 120 mA	0.6 + 20	4 + 40	5.5 + 0.15 mA
1 A	0.05 to 1.05 A	3 + 0.2 mA	10 + 0.4 mA	

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

SCOPE OF CALIBRATION: ELECTRICAL

Matrix H
AC Current Generation (Wavetek 4950)

Range		Frequency Band			
		9 to 11 Hz	18 to 22 Hz	27 to 33 Hz	36 to 44 Hz
100 μA	90 to 110 μA	0.12		0.11	85 μA/A
1 mA	0.9 to 1.1 mA			0.1	80 μA/A
10 mA	9 to 11 mA	0.13		96 μA/A	75 μA/A
100 mA	90 to 110 mA				
1 A	0.9 to 1.1 A	0.16			0.11

Range		Frequency Band			
		46.25 to 63.75 Hz	270 to 440 Hz	0.9 to 1.1 kHz	4.5 to 5.5 kHz
100 μA	90 to 110 μA	85 μA/A			0.13
1 mA	0.9 to 1.1 mA	80 μA/A			0.12
10 mA	9 to 11 mA	75 μA/A			
100 mA	90 to 110 mA				
1 A	0.9 to 1.1 A	0.11			0.21

Range		Frequency Band		
		9 to 11 kHz	18 to 22 kHz	27 to 33 kHz
100 μA	90 to 110 μA	0.3	0.33	0.4
1 mA	0.9 to 1.1 mA	0.26	0.28	0.35
10 mA	9 to 11 mA			
100 mA	90 to 110 mA			
1 A	0.9 to 1.1 A			

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

Matrix I
AC Current Generation (Wavetek 4950 & 4953)

Range		Frequency Band				
		9 to 11 Hz	18 to 22 Hz	27 to 33 Hz	36 to 44 Hz	46.25 to 63.75 Hz
10 A	9 to 11 A	0.24		0.23	0.21	0.2

Range		Frequency Band				
		270 to 440 Hz	0.9 to 1.1 kHz	4.5 to 5.5 kHz	9 to 11 kHz	18 to 22 kHz
10 A	9 to 11 A	0.2		0.26	0.34	1.2

The expanded uncertainties given in this table are expressed in mA/A.

Signatories:

1. **Muhammed Fahimy Bin Ahmad Ta'adin**
2. ****Mohamed Fikri Bin Mohd Nor**
3. **Syahrel Bin Shari**

** Non-resident signatory

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
1. Measuring Instrument DC VOLTAGE	± 220 mV Range ± (0 mV to 220 mV)	9 µV/V + 0.8 µV	Fluke 5700A
	± 2.2 V Range ±(0 V to 2.2 V)	8 µV/V + 1.2 µV	
	+11 V Range ± (0 V to 11 V)	8 µV/V + 4 µV	
	± 22 V Range ± (0 V to 22 V)	8 µV/V + 8 µV	
	±220 V Range ±(0 V to 220 V)	9 µV/V + 0.1 mV	
	± 1100 V Range ± (100 V to 1100 V)	11 µV/V + 0.6 mV	
AC VOLTAGE	2.2 mV to 220 V (See Matrix A)	(See Matrix A)	Fluke 5700A
	1100 V Range (110 V to 1100 V) 50 Hz to 1 kHz	90 µV/V + 4 mV	
	<u>800 V to 1050 V</u> 1 kHz to 3 kHz 3 kHz to 10 kHz 10 kHz to 20 kHz	0.8 mV/V + 0.13 V 0.8 mV/V + 0.21 V 1.2 mV/V + 0.32 V	Wavetek 9100
DC CURRENT	± 100 A Range ± (20 A to 100 A)	0.45 mA/A + 20 mA	California 3213K

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
1. Measuring Instrument Continue DC CURRENT	± 220 μA Range ± (0 mA to 220 μA)	60 μA/A + 10 nA	Fluke 5700A
	± 2.2 mA Range ± (0 mA to 2.2 mA)	60 μA/A + 10 nA	
	± 22 mA Range ± (0 mA to 22 mA)	60 μA/A + 0.1 μA	
	± 220 mA Range ± (0 mA to 220 mA)	70 μA/A + 1 μA	
	± 2.2 A Range ± (0 A to 2.2 A)	95 μA/A + 30 μA	
	± 3.2 A Range ± (0.32 A to 3.2 A)	0.6 mA/A + 0.12 mA	Wavetek 9100
	± 10.5 A Range ± (3.2 A to 10.5 A)	0.55 mA/A + 0.94 mA	
	± 20 A Range ± (10.5 A to 20 A)	0.55 mA/A + 4.5 mA	
AC CURRENT	9 μA to 2.2 A (See Matrix B)	(See Matrix B)	Fluke 5700A
	20 A to 100 A 10 Hz to 1 kHz 1 kHz to 10 kHz	2.5 mA/A + 0.03 A 5 mA/A + 0.05 A	California Instruments CA 3213K

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
1. Measuring Instrument Continue AC CURRENT	0.32 A to 3.2 A 10 Hz to 3 kHz 3 kHz to 10 kHz 3.2 A to 10.5 A 10 Hz to 3 kHz 3 kHz to 10 kHz 10.5 A to 20 A 10 Hz to 3 kHz 3 kHz to 10 kHz	1 mA/A + 0.48 mA 2.5 mA/A + 2.6 mA 2 mA/A + 3 mA 5 mA/A + 10 mA 2 mA/A + 6.9 mA 5 mA/A + 23 mA	Wavetek 9100
Residual Current	3 mA to 3A At Time interval up to 5 s At Time interval <190 ms	0.14 mA/A 0.3 mA/A	For RCD Tester Calibrator (using Transmille 3200)
CAPACITANCE	(See Matrix C)	(See Matrix C)	Wavetek 9100
Fixed Value	**20 z to 1 MHz** 1 pF, 10 pF, 100 pF, 1000 pF, 0.02 µF, 0.1 µF and 1.0 µF	1 mF/F	HP 1600A series
INDUCTANCE Fixed Value	100 µH @ 1 kHz (1, 10, 100) mH @ 1 kHz 1H @ 1 kHz	2.5 mH/H 1 mH/H 1 mH/H	Ando RS-100 series
POWER/ ENERGY (DC)	1 kW to 20 kW 0.1 W to 1 kW	0.7 mW/W 0.22 mW/W	Fluke 5520A
POWER/ ENERGY (AC), (45 Hz to 65 Hz at PF=1)	10 kW to 20 kW 1 W to 10 kW 0.1 W to 1 W	1 mW/W 0.9 mW/W 1 mW/W	

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
1. Measuring Instrument Continue RESISTANCE Fixed Value	1 mΩ 10 mΩ 100 mΩ 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ	0.2 mΩ/Ω 0.1 mΩ/Ω 0.02 mΩ/Ω 5 μΩ/Ω 0.11 mΩ/Ω 5 μΩ/Ω 31 μΩ/Ω 5 μΩ/Ω 0.02 mΩ/Ω 5 μΩ/Ω 15 μΩ/Ω 5 μΩ/Ω 14 μΩ/Ω 5 μΩ/Ω 15 μΩ/Ω 5 μΩ/Ω 24 μΩ/Ω 5 μΩ/Ω 0.05 mΩ/Ω	Fluke 5700A & Fluke 742A Series
	100 MΩ 1 GΩ 10 GΩ 100 GΩ 1 TΩ	0.13 mΩ/Ω 5 μΩ/Ω 0.02 Ω/Ω 0.05 Ω/Ω 0.05 Ω/Ω	Fluke 5700A & Takeda Riken TR45 Standard Resistor
TIME	1 s to 24 Hrs	0.06 μs/s + 0.021 s	Agilent 33250A & Universal Counter HP 53132A
	20 ms to 5 s	0.7 ms	For RCD Tester Calibrator (using Transmille 3200)
Residual Current Duration	10 ms to 5 s	0.4 ms	

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
1. Measuring Instrument Continue RPM Measuring Instruments (Non Contact)	60 to 5999 rpm 6000 to 29999 rpm 30000 to 59999 rpm 60000 to 99999 rpm	0.07 rpm 7 rpm 36 rpm 70 rpm	In-House method, ESF/0303
HIGH VOLTAGE METER DC Voltage	0.5 kV to 10 kV	5 mV/V	TDV 20 ADS & TOS 5101
AC Voltage @ (50/60) Hz		8 mV/V	
CLAMP METER DC Current 10 – Turn Coil	± 3.2 A to 32 A ± 32 A to 105 A ± 105 A to 200 A	0.06 mA/A + 1.18 mA 0.55 mA/A + 9.4 mA 0.55 mA/A + 45 mA	Wavetek 9100 c/w Current Coil
50 – Turn Coil	± 16 A to 160 A ± 160 A to 525 A ± 525 A to 1000 A	0.6 mA/A + 5.9 mA 0.55 mA/A + 47 mA 0.55 mA/A + 0.23 A	
AC Current 10 – Turn Coil	3.2 A to 32 A 10 Hz to 100 Hz 100 Hz to 440 Hz 32 A to 200 A 10 Hz to 100 Hz 100 Hz to 440 Hz	2 mA/A + 5.5 mA 7.8 mA/A + 27 mA 2.1 mA/A + 90 mA 6.7 mA/A + 0.25 A	
CLAMP METER 50 – Turn Coil	16 A to 160 A 10 Hz to 100 Hz 160 A to 1000 A 10 Hz to 100 Hz	2 mA/A + 28 mA 2.1 mA/A + 0.45 A	

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
1. Measuring Instrument Continue INSULATION TESTER	(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) @ 1 kV (1 GΩ to 10 GΩ) @ 5 kV (10 GΩ to 100 GΩ) @ 5 kV (100 GΩ to 600 GΩ) @ 5 kV	0.5 mΩ/Ω	Tinsley 4720
		1 mΩ/Ω	
		10 mΩ/Ω 50 mΩ/Ω 0.1 Ω/Ω 50 mΩ/Ω	
OSCILLOSCOPE Vertical Deflection DC Signal	0 V to ± 6.6 V (50 Ω Load) 0 V to ± 130 V (1 MΩ Load)	2.5 mV/V+ 0.04 mV 0.5 mV/V + 0.04 mV	Fluke 5500A SC600
Vertical Deflection Square Wave Signal	± 1 mVp-p to ± 6.6 Vp-p (50 Ω Load) ± 1 mVp-p to ± 130 Vp-p (1 MΩ Load)	2.5 mVp-p/Vp-p + 0.04mVp-p 1 mVp-p/Vp-p + 0.04 mVp-p	
Horizontal Deflection Time Markers (50 Ω Load)	2 ns/div to 20 ms/div 50 ms/div to 5 s/div	2.5 μs/s (25+(Output x 1000)) μs/s	
Risetime	≤ 300 ps	+0 ns / -0.1 ns	
Bandwidth Frequency	50 kHz to 600 MHz	2.5 μHz/Hz	
	600 MHz to 40 GHz (+11 dBm to –135 dBm)	7 nHz/Hz	Agilent E8257D Reference to Pendulum GPS-12R Disciplined by GPS
Bandwidth Amplitude	50 kHz to 600 MHz	0.03 Vp-p	Fluke 5500A SC600

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
1. Measuring Instrument Continue OSCILLOSCOPE Bandwidth Amplitude	600 MHz to 40 GHz (+11 dBm to –135 dBm)	0.92 dBm	Agilent E8257D
Frequency	1 μHz to 80 MHz (10 mVpp to 10 Vpp)	36 nHz/Hz	(Agilent 33250A, ifR2042 or Agilent E8257D) Reference to Pendulum GPS-12R Disciplined by GPS
	10 kHz to 40 GHz (+11 dBm to –135dBm)	7 nHz/Hz	
Amplitude	10 mVp-p to 10 Vp-p (1 μHz to 80 MHz, Into 50 Ω)	10 mVpp/Vpp + 1 mVpp	Agilent 33250A
	+13 dBm to –144dBm (10 kHz to 5.4 GHz)	0.58 dBm	ifR2042
	+11 dBm to –135dBm (250 kHz to 40 GHz)	0.92 dBm	Agilent E8257D
Flatness	Sine Wave Relative to 1 kHz (Auto range On)	0.4 dBm	Agilent 33250A

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

SCOPE OF ACCREDITATION:

Matrix A
AC Voltage Measurement

Range		Frequency			
		Hz		kHz	
		10 to 20	20 to 40	0.04 to 20	20 to 50
2.2 mV	**0.22 mV to 2.2 mV**	0.6 + 0.005	0.24 + 0.005	0.12 + 0.005	0.41 + 0.005
22 mV	**2.2 mV to 22 mV**	0.6 + 0.006	0.24 + 0.006	0.12 + 0.006	0.41 + 0.006
220 mV	**22 mV to 220 mV**	0.6 + 0.016	0.24 + 0.01	0.11 + 0.01	0.36 + 0.01
2.2 V	**0.22 V to 2.2 V**	0.6 + 0.1	0.18 + 0.03	0.085 + 0.007	0.14 + 0.02
22 V	**2.2 V to 22 V**	0.6 + 1	0.18 + 0.3	0.085 + 0.07	0.14 + 0.2
220 V	**22 V to 220 V**	0.6 + 10	0.18 + 3	0.09 + 1	0.25 + 4

Range		Frequency			
		MHz			
		0.05 to 0.1	0.1 to 0.3	0.3 to 0.5	0.5 to 1
2.2 mV	**0.22 mV to 2.2 mV**	0.95 + 0.008	1.3 + 0.015	1.8 + 0.03	3.6 + 0.03
22 mV	**2.2 mV to 22 mV**	0.95 + 0.008	1.3 + 0.015	1.8 + 0.03	3.6 + 0.03
220 mV	**22 mV to 220 mV**	0.9 + 0.03	1.1 + 0.03	1.8 + 0.04	3.6 + 0.1
2.2 V	**0.22 V to 2.2 V**	0.28 + 0.08	0.48 + 0.15	1.2 + 0.4	2.4 + 1
22 V	**2.2 V to 22 V**	0.28 + 0.4	0.6 + 1.7	1.4 + 5	3 + 9
220 V	**22 V to 220 V**	0.6 + 10	1.6 + 110	5.4 + 110	13 + 220

The expanded uncertainties given in this table are expressed in mV/V + mV

Matrix B
AC Current Measurement

Range	Frequency (kHz)				
	0.01 to 0.02	0.02 to 0.04	0.04 to 1	1 to 5	5 to 10
9 µA to 220 µA	0.8 + 0.03	0.42 + 0.025	0.16 + 0.02	0.7 + 0.05	1.8 + 0.1
0.22 mA to 2.2 mA	0.8 + 0.05	0.42 + 0.04	0.16 + 0.04	0.7 + 0.5	1.8 + 1
2.2 mA to 22 mA	0.8 + 0.5	0.42 + 0.4	0.16 + 0.4	0.7 + 10	1.8 + 0.01
22 mA to 220 mA	0.8 + 5	0.42 + 4	0.18 + 4	0.7 + 50	1.8 + 100
0.22 A to 2.2 A	-	-	0.75 + 40	0.85 + 100	10 + 200

The expanded uncertainties given in this table are expressed in mA/A + µA

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

Matrix C
Capacitance Measurement

Range	Frequency	
	≤ 350 Hz	**350 Hz to 1.5 kHz**
0.5 nF to 4 nF	3 mF/F + 15 pF	6 mF/F + 0.03 nF
4 nF to 40 nF	3 mF/F + 30 pF	6 mF/F + 0.06 nF
40 nF to 400 nF	3 mF/F + 0.16 nF	6 mF/F + 0.32 nF
400 nF to 4 μF	4 mF/F + 1.6 nF	8 mF/F + 3.2 nF
4 μF to 40 μF	5 mF/F + 16 nF	10 mF/F + 32 nF
40 μF to 400 μF	5 mF/F + 0.16 μF	10 mF/F + 0.32 μF
400 μF to 4 mF	5 mF/F + 1.6 μF	10 mF/F + 3.2 μF
4 mF to 40 mF	10 mF/F + 0.06 mF	20 mF/F + 0.12 mF

Instrument Calibrated/ Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±) ***	**Remarks**
2. Generating Instrument DC VOLTAGE	± 100 mV Range ± (100 μV to 120 mV)	5 μV/V + 0.3 μV	HP 3458A Opt. 002
	±1 V Range ± (100 mV to 1.2 V)	4 μV/V + 0.3 μV	
	± 10 V Range ± (1 V to 12 V)	4 μV/V + 0.5 μV	
	±100 V Range ± (10 V to 120 V)	6 μV/V + 0.03 mV	
	±1000 V Range ± (100 V to 1050 V)	6 μV/V + 0.1 mV	
AC VOLTAGE	10 mV to 700V (See Matrix D)	(See Matrix D)	HP 3458A
AC CURRENT	5 μA to 1 A (See Matrix E)	(See Matrix E)	

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
2. Generating Instrument Continue AC CURRENT	1 A to 50 A 50 Hz/ 60 Hz	0.5 mA/A	HP 3458A & Zenith H007098
	50 A to 1000 A 50 Hz/ 60 Hz 40 Hz to 1 kHz	15 mA/A + 2 A 0.03 A/A + 4 A	Kyoritsu 2003
DC CURRENT	± (1 nA to 100 nA) ± (100 nA to 1 μA) ± (1 μA to 10 μA) ± (10 μA to 100 μA) ± (100 μA to 1 mA) ± (1 mA to 10 mA) ± (10 mA to 100 mA) ± (100 mA to 1 A)	30 μA/A + 0.04 nA 20 μA/A + 0.04 nA 20 μA/A + 0.1 nA 20 μA/A + 0.8 nA 20 μA/A + 5 nA 20 μA/A + 0.05 μA 35 μA/A + 0.5 μA 0.11 mA/A + 0.01 mA	HP 3458A
	± (1 A to 10 A) ± (10 A to 100 A)	5.1 mA 0.05 A	HP 3458A & Guideline 9211A
	± (100 A to 1000 A)	15 mA/A + 2A	Kyoritsu 2003
CAPACITANCE	1 pF to 1 mF @ (10 Hz to 1 MHz)	0.5 mF/F	HP 4284A
INDUCTANCE	1 μH to 10 H @ (10 Hz to 1 MHz)	0.5 mH/H	

SCOPE OF CALIBRATION: **ELECTRICAL**

SITE CALIBRATION: **CATEGORY I**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
2. Generating Instrument Continue RESISTANCE	0 Ω to 10 Ω 10 Ω to 100 Ω 0.1 kΩ to 1 kΩ 1 kΩ to 10 kΩ 10 kΩ to 100 kΩ 0.1 MΩ to 1 MΩ 1 MΩ to 10 MΩ 10 MΩ to 100 MΩ 100 MΩ to 1 GΩ	15 μΩ/Ω + 0.05 mΩ 12 μΩ/Ω + 0.05 mΩ 10 μΩ/Ω + 0.05 mΩ 10 μΩ/Ω + 5 mΩ 10 μΩ/Ω + 0.05 Ω 15 μΩ/Ω + 2 Ω 50 μΩ/Ω + 0.1 kΩ 0.5 mΩ/Ω + 1 kΩ 5 mΩ/Ω + 0.01 MΩ	HP 3458A
Signal Genarator FREQUENCY	1 Hz to 5 GHz	0.91 pHz/Hz	HP53132A Reference to Pendulum GPS-12R Manual hold-over
	5 GHz to 27 GHz	0.89 Hz/Hz	HP8563E Reference to Pendulum GPS-12R Manual hold-over
AMPLITUDE/ LEVEL	-20 dBm to +30 dBm (100 kHz to 2.6 GHz)	0.04 dBm	HP 8902 with 11722A
	-30 dB to +30 dB (2.6 GHz to 18 GHz)	0.27 dBm	Agilent E4418B with HP 8481A
	-120 dB to +30 dB (30 Hz to 27 GHz)	1 dBm	HP8563E
TUNED RF LEVEL	-127 dB to 0 dB (2.5 MHz to 1.3 GHz)	0.07 dBm	HP 8902 with 11722A

SCOPE OF CALIBRATION: **ELECTRICAL**

SITE CALIBRATION: **CATEGORY I**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
2. Generating Instrument Continue RPM (Non-Contact Type)	10 to 29 rpm 30 to 59 rpm 60 to 99 rpm 100 to 299 rpm 300 to 599 rpm 600 to 999 rpm 1000 to 2999 rpm 3000 to 5999 rpm 6000 to 9999 rpm 10000 to 29999 rpm 30000 to 59999 rpm 60000 to 99999 rpm	0.014 rpm 0.036 rpm 0.07 rpm 0.14 rpm 0.37 rpm 0.7 rpm 1.4 rpm 3.6 rpm 7 rpm 14 rpm 36 rpm 70 rpm	In-House method, ESF/0303.
RPM (Contact Type)	20 to 29 rpm 30 to 59 rpm 60 to 99 rpm 100 to 299 rpm 300 to 599 rpm 600 to 999 rpm 1000 to 2999 rpm 3000 to 5999 rpm 6000 to 9999 rpm 10000 to 12999 rpm 13000 to 25999 rpm 26000 to 29999 rpm	0.011 rpm 0.016 rpm 0.029 rpm 0.07 rpm 0.16 rpm 0.29 rpm 0.7 rpm 1.6 rpm 2.9 rpm 7 rpm 8 rpm 14 rpm	
High Voltage Tester DC VOLTAGE	0 kV to 9.9 kV 10 kV to <20 kV 20 kV to 35 kV >35 kV to 40 kV	5 mV/V + 2 V 20 mV/V 10 mV/V 20 mV/V	TDV 20 ADS Fluke 80K-40
AC VOLTAGE	(0 kV to 9.99 kV) @ 50/60Hz (10 kV to 20 kV) @ 50/60 Hz (20 kV to 28 kV) @ 50/60 Hz	7 mV/V + 3 V 7 mV/V + 30 V 50 mV/V	

SCOPE OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

Matrix D
AC Voltage Generation (HP 3458A)

Range		Frequency Band				
		1 to 40 Hz	0.1 to 1 MHz	1 to 4 MHz	4 to 8 MHz	8 to 10 MHz
10 mV	1 to 12 mV	0.3 + 3	12 + 5	70 + 7	0.2 V/V + 8	–

Range		Frequency Band				
		1 to 40 Hz	1 to 2 MHz	2 to 4 MHz	4 to 8 MHz	8 to 10 MHz
100 mV	10 to 120 mV	70 μV/V + 4	15 + 10	40 + 70	40 + 80	0.15 V/V + 0.1 mV
1 V	0.1 V 1.2 V	70 μV/V + 40	15 + 0.1 mV	40 + 0.7 mV	40 + 0.8 mV	0.15 V/V + 1 mV
10 V	1 to 12 V	70 μV/V + 0.4 mV	15 + 1 mV	40 + 7 mV	40 + 8 mV	0.15 V/V + 10 mV

Range		Frequency Band	
		1 to 40 Hz	0.3 to 1 MHz
100 V	10 to 120 V	0.2 + 4 mV	15 + 10 mV
1000 V	100 to 700 V	0.4 + 40 mV	

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

Matrix E
AC Current Generation (HP 3458A)

Range		Frequency Band			
		10 to 20 Hz	20 to 45 Hz	45 to 100 Hz	100 Hz to 5 kHz
100 μA	5 to 120 μA	4 + 30 nA	1.5 + 30 nA	0.6 + 3 nA	
1 mA	0.05 to 1.2 mA	4 + 0.2	1.5 + 0.2	0.6 + 0.2	0.3 + 0.2
10 mA	0.5 to 12 mA	4 + 2	1.5 + 2	0.6 + 2	0.3 + 2
100 mA	5 to 120 mA	4 + 20	1.5 + 20	0.6 + 20	0.3 + 20
1 A	0.05 to 1.05 A	4 + 0.2 mA	1.6 + 0.2 mA	0.8 + 0.2 mA	1 + 0.2 mA

Range		Frequency Band		
		5 to 20 kHz	20 to 50 kHz	50 to 100 kHz
1 mA	0.05 to 1.2 mA	0.6 + 0.2	4 + 0.4	5.5 + 1.5
10 mA	0.5 to 12 mA	0.6 + 2	4 + 4	5.5 + 15
100 mA	5 to 120 mA	0.6 + 20	4 + 40	5.5 + 0.15 mA
1 A	0.05 to 1.05 A	3 + 0.2 mA	10 + 0.4 mA	

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

Signatories:

1. **Muhammed Fahimy Bin Ahmad Ta'adin**
2. ****Mohamed Fikri Bin Mohd Nor**
3. **Syahrel Bin Shari**

** Non-resident signatory

SCOPE OF CALIBRATION: TEMPERATURE

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
Liquid In-glass Thermometer (Partial Immersion)	0 ºC to 200 ºC	2 ºC	Comparison method using SPRT / PRT in liquid bath.
Liquid-in-glass thermometer (Total Immersion)	- 80 ºC to 0 ºC 0 ºC to 80 ºC 80 ºC to 250 ºC 250 ºC to 500 ºC	0.05 ºC 0.03 ºC 0.05 ºC 0.10 ºC	Comparison method using SPRT / PRT in liquid bath.
Platinum Resistance Thermometer	- 80 ºC to 600 ºC 600 ºC to 950 ºC	0.05 ºC 0.5 ºC	Comparison method using SPRT / PRT in liquid bath/dry block
Thermocouple	- 80 ºC to 600 ºC 600 ºC to 950 ºC	0.1 ºC 0.3 ºC	Comparison method using SPRT/ PRT/ Standard Thermocouple Type R liquid bath/dry block
Psychrometer Thermohygrograph Thermohygrometer @ 23 ºC	10 ºC to 50 ºC 35 % to 95 %RH	0.5 ºC 3.0 %RH	Comparison Method Using Wet and Dry bulb base on BS 1339-1 2002 in climatic chamber
Temperature switch	- 50 ºC to 10 ºC 10 ºC to 100 ºC 100 ºC to 600 ºC	1 º C 2 º C 3 º C	Comparison method using SPRT/ PRT/ Thermocouple Type R in liquid bath/dry block
Mechanical thermometer	- 80 ºC to 100 ºC 100 ºC to 200 ºC 200 ºC to 600 ºC	0.1 ºC 0.6 ºC 1.5 ºC	Comparison method using SPRT/ PRT/ Thermocouple Type R in liquid bath/dry block
Temperature Calibrator (Dry block)	- 30 ºC to 600 ºC 600 ºC to 950 ºC	0.11 ºC 0.63 ºC	EA-10 /13 (EAL Guideline for calibration of Dry block Calibrator)

SCOPE OF CALIBRATION: TEMPERATURE

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
Temperature Indicating Instruments			
K - type	- 200 ºC to 0 ºC 0 ºC to 1300 ºC	0.4 ºC 0.4 ºC	
J - type	- 200 ºC to 0 ºC 0 ºC to 1100 ºC	0.3 ºC 0.3 ºC	
T - type	- 200 ºC to 0 ºC 0 ºC to 400 ºC	0.5 ºC 0.4 ºC	
E - type	- 200 ºC to 0 ºC 0 ºC to 900 ºC	0.4 ºC 0.3 ºC	Calibration by Electrical simulation using Temperature Calibrator
R – type	0 ºC to 1000 ºC 1000 ºC to 1700 ºC	1.3 ºC 1.1 ºC	
S - type	0 ºC to 1000 ºC 1000 ºC to 1700 ºC	1.3 ºC 1.2 ºC	
Pt 100	- 200 ºC to 0 ºC 0 ºC to 800 ºC	0.2 ºC 0.5 ºC	

Signatory:

1. **Zulkifli Ahmad**

SCOPE OF CALIBRATION: TEMPERATURE

SITE CALIBRATION: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
Humidity Chamber	20 % to 95 %RH	2.0 % of RH	AS 2853-1986 BS 1339-1 :2002
Temperature Controlled Enclosure	- 60 ºC to 200 ºC 200 ºC to 400 ºC 400 ºC to 950 ºC	0.8 ºC 1.2 ºC 2 ºC	AS 2853 -1986
Temperature Indicating Instruments			
K - type	- 200 ºC to 0 ºC 0 ºC to 1300 ºC	0.4 ºC 0.4 ºC	
J - type	- 200 ºC to 0 ºC 0 ºC to 1100 ºC	0.3 ºC 0.3 ºC	
T - type	- 200 ºC to 0 ºC 0 ºC to 400 ºC	0.5 ºC 0.4 ºC	
E - type	- 200 ºC to 0 ºC 0 ºC to 900 ºC	0.4 ºC 0.3 ºC	Calibration by Electrical simulation using Temperature Calibrator
R – type	0 ºC to 1000 ºC 1000 ºC to 1700 ºC	1.3 ºC 1.1 ºC	
S - type	0 ºC to 1000 ºC 1000 ºC to 1700 ºC	1.3 ºC 1.2 ºC	
Pt 100	- 200 ºC to 0 ºC 0 ºC to 800 ºC	0.2 ºC 0.5 ºC	

Signatory:

1. **Zulkifli Ahmad**

Issue date: 11 November 2020
Valid until: 14 September 2023

NO: SAMM 088
(Issue 2, 11 November 2020 replacement
of SAMM 088 dated 26 August 2020)

SCOPE OF CALIBRATION: TEMPERATURE

SITE CALIBRATION: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
Temperature Sensor with Indicator			
-PT100	0 ºC to 300 ºC	0.15 ºC	Calibration by comparison method using:
	301 ºC to 600 ºC	0.26 ºC	
-Thermocouple	0 ºC to 300 ºC	0.15 ºC	1-Pt100 / Type R Thermocouple as reference standards
	301 ºC to 600 ºC	0.26 ºC	
	601 ºC to 950 ºC	1.1 ºC	2-Dry Block Calibrator

Signatory:

1. **Zulkifli Ahmad**

SCOPE OF CALIBRATION: DIMENSIONAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
Gauge Block	0.5 mm to 100 mm 100 mm to 250 mm	(0.1 + 1.0 L) µm L in m	Reference Equipment: Gauge block
Gauge Block (Imperial units)	0.05 inch to 4 inch	(0.004 + 1.0 L) µinch L in inch	Gauge block
Bevel Protractor	0 to 360 degrees: Graduation 5 min. Graduation 1 deg.	3 minute 0.5 degree	Angle block
Snap Gauge / Caliper Gauge	Up to 200 mm	5 µm	Uni. Measuring M/c
Micrometer 25 mm travels for frame Sizes 25 mm, 50 mm, 75 mm and 100mm	0.001 mm to 100 mm	2 µm	Gauge Block
Caliper	0.01 mm to 300 mm 300 mm to 600 mm 600 mm to 1000 mm	7 µm 9 µm 12 µm	Gauge Block Caliper Checker
Height Gauge	0.01 mm to 600 mm	10 µm	Caliper Checker
Caliper Checker	20 mm to 300 mm 301 mm to 600 mm	3 µm 6 µm	Long Gauge block
Calibration Tester	0 mm to 25 mm	2 µm	Dig.Length Indicator /Gauge Block
Dial / Digital Test Indicator	0.001 mm to 100 mm	2 µm	Dial gauge testing machine
Dial / Digital Gauge	0.001 mm to 100 mm	2 µm	Dial gauge testing machine
Dial / Digital Thickness Gauge	0.01 mm to 50 mm	5 µm	Gauge Block
Depth Micro-Checker	0 mm to 300 mm	6 µm	Gauge Block / Pre. Height Gauge

SCOPE OF CALIBRATION: DIMENSIONAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
Feeler Gauge	0.005 mm to 2.0 mm	3 µm	Dig.Length Indicator
Glass Scale	up to 200 mm 200 mm to 300 mm	3.8 µm 5.6 µm	Uni. Measuring M/c
Grind Gauge/Fine Gauge	0.001 mm to 0.15 mm	2 µm	Dig.Length Indicator
Height master	0.001 mm to 600 mm	6 µm	Pre. Height Gauge / Gauge Block
Ruler	0.1 mm to 2000 mm	0.1 mm	Linear scale
Mu-checker	0.1 mm to 2000 µm	2 µm	Gauge Block
Precision Height Gauge	0.001 mm to 600 mm	4 µm	Gauge Block
Straight Edge	0 mm to 600 mm	1.5 µm	Dig.Length Indicator / Straight edge
Tape	0 m to 100 m	(0.33 + 0.019 L) mm *L is length in unit meter*	Linear scale
Thickness Foil	0.001 mm to 2.0 mm	3 µm	Dig.Length Indicator
Setting/Standard Rod	25 mm to 100 mm 100 mm to 600 mm	(0.15 + 0.0064 L) (0.11 + 0.008 L) *L is length in unit mm*	Universal Length Machine and Gauge Block
Plain Pin or Plug Gauge (Diameter Only)	0.2 mm to 50 mm	0.5 µm	Universal Length Machine
Plain Ring Gauge (Diameter Only)	1 mm to 100 mm 100 mm to 200 mm	(0.007 L+ 0.11) µm (0.0064 L+ 0.41) µm *L is diameter in unit mm*	Universal Length Machine and Gauge Block
Thread Plug Gauge (Simple Pitch Diameter)	2 mm to 50 mm	2 µm	Universal Length Machine (In-house Method)
Length Machine *(For in-house equipment only)*	0 mm to 1 m 0 mm to 10 m	0.1 mm 0.4 mm	Standard Scale

Issue date: 11 November 2020
Valid until: 14 September 2023

NO: SAMM 088
(Issue 2, 11 November 2020 replacement
of SAMM 088 dated 26 August 2020)

SCOPE OF CALIBRATION: DIMENSIONAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
Universal Measuring Microscope (Individual linear axis only- *For in-house equipment only*)	0 mm to 200 mm	2.5 µm	Standard Scale
Digital Length Indicator	0 to 25 mm	0.4 µm	Gauge Block

Signatories:

1. **Mohd Hashim Effandi**
2. **Mohd Amri Abd Aziz**

Issue date: 11 November 2020
Valid until: 14 September 2023

NO: SAMM 088
(Issue 2, 11 November 2020 replacement
of SAMM 088 dated 26 August 2020)

SCOPE OF CALIBRATION: DIMENSIONAL

SITE CALIBRATION: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
Profile Projector (Error of indication of linear scale X-Y)	1 mm to 200 mm 201 mm to 300 mm	5 µm 7 µm	Glass Scale
Surface Table/Plate	2500 mm x 1600 mm	4 µm	Levelnic / Plankator

Signatories:

1. **Mohd Hashim Effandi**
2. **Mohd Amri Abd Aziz**

SCOPE OF CALIBRATION: MASS

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
Standard Weights Class E2, F1, F2, M1, M2 & M3	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	0.002 mg 0.002 mg 0.002 mg 0.003 mg 0.003 mg 0.004 mg 0.005 mg 0.006 mg 0.008 mg 0.010 mg 0.012 mg 0.016 mg 0.020 mg 0.025 mg 0.03 mg 0.05 mg 0.10 mg 0.23 mg 0.5 mg 1.0 mg 3.0 mg 16 mg 100 mg	With general reference to OIML R111. Mass comparison using: ABBA weighing scheme for weights of OIML classes E2 and F1; and AB, AB weighing scheme for weights of OIML classes F2 and below
Weight Blocks	1 mg to 10 g Above 10 g to 50 g Above 50 g to 100 g Above 100 g to 200 g Above 200 g to 500 g Above 500 g to 1 kg Above 1 kg to 2 kg Above 2 kg to 5 kg Above 5 kg to 10 kg Above 10 kg to 20 kg Above 20 kg to 30 kg Above 30 kg to 60 kg Above 60 kg to 100 kg Above 100 kg to 200 kg Above 200 kg to 500 kg	2 mg 3 mg 5 mg 9 mg 0.02 g 0.05 g 0.09 g 0.2 g 0.5 g 0.9 g 1.3 g 2.6 g 0.02 kg 0.02 kg 0.04 kg	Mass comparison using AB, AB weighing scheme

Issue date: 11 November 2020
Valid until: 14 September 2023

NO: SAMM 088
(Issue 2, 11 November 2020 replacement
of SAMM 088 dated 26 August 2020)

SCOPE OF CALIBRATION: MASS

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
Spring /Hanging Scale	up to 5 kg up to 20 kg up to 50 kg up to 100 kg	16 g 31 g 62 g 0.13 kg	Using calibrated standard weights of OIML classes FI

Signatory:

1. **Mohammad Najib Kamaruddin**
2. **Mohd Suhaili Bahrom**

Issue date: 11 November 2020
Valid until: 14 September 2023

NO: SAMM 088
(Issue 2, 11 November 2020 replacement
of SAMM 088 dated 26 August 2020)

SCOPE OF CALIBRATION: **MASS**

SITE CALIBRATION: **CATEGORY I**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±) *	Remarks
Analytical Balance	up to 50 g up to 100 g up to 200 g	0.13 mg 0.15 mg 0.2 mg	OIML class E2 Reference Weights
Balance / Scale (Triple Beam, Single Beam Spring, Top Pan, Mechanical & Electronic)	up to 1000 g up to 2000 g up to 5000 g up to 10000 g up to 20 kg up to 50 kg up to 100 kg up to 200 kg up to 500 kg	2 mg 0.02 g 0.02 g 0.2 g 0.2 g 2 g 13 g 0.03 kg 0.1 kg	OIML classes F1/F2/M2 Reference Weights
Electrical and Mechanical Platform Balance	up to 1000 kg up to 2000 kg	0.27 kg 0.66 kg	OIML class M2 Reference Weights

Signatory:

1. **Mohammad Najib Kamaruddin**
2. **Mohd Suhaili Bahrom**

SCOPES OF CALIBRATION: FORCE & TORQUE

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
FORCE MEASUREMENT Proving Rings/Load Cells	 0 kgf to 100 kgf 101 kgf to 500 kgf 501 kgf to 1000 kgf 1001 kgf to 5000 kgf 5001 kgf to 10000 kgf 10001 kgf to 30000 kgf	 0.04 kgf 0.2 kgf 0.3 kgf 3 kgf 26 kgf 108 kgf	**ISO 376: 2004** LC 100 kgf LC 500 kgf LC 1000 kgf LC 5000 kgf LC 10000 kgf LC 45000 kgf
Push-pull/ Force Gauge	1 gf to 5 kgf 5 kgf to 20 kgf 20 kgf to 50 kgf 50 kgf to 100 kgf	16 gf 31 gf 62 gf 124 gf	ASTM E74-95 Reference F1 & F2
Gramme/ Dial Tension Gauge	1 gf to 50 gf 50 gf to 500 gf 500 gf to 2000 gf	1 gf 6 gf 30 gf	ASTM E74-95 Reference F1 & F2
TORQUE MEASUREMENT Torque wrench	 0 N.m to 2 N.m 2.1 N.m to 100 N.m 101 N.m to 500 N.m	 0.07 N.m 0.3 N.m 2 N.m	 Comparison with torque transducers with general reference to BS EN ISO 6789 : 2003 Transducer 2 N.m Transducer 100 N.m Transducer 1000 N.m
Torque meter and analyser	0 N.m to 2 N.m 3 N.m to 50 N.m 51 N.m to 100 N.m 101 N.m to 500 N.m	0.1% of reading 0.1% of reading 0.1% of reading 0.1% of reading	With general reference to BS 7882: 2008

Note: LC (Load Cell)

Signatory:

1. **Noor Azam Ismail**

Issue date: 11 November 2020
Valid until: 14 September 2023

NO: SAMM 088
(Issue 2, 11 November 2020 replacement
of SAMM 088 dated 26 August 2020)

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 (tension mode up to 5000 kgf)	0 kgf to 100 kgf 101 kgf to 500 kgf 501 kgf to 1000 kgf 1001 kgf to 5000 kgf 5001 kgf to 10000 kgf 10001 kgf to 60000 kgf 60001 kgf to 180000 kgf	0.04 kgf 0.2 kgf 0.3 kgf 3 kgf 26 kgf 378 kgf 460 kgf	**Comparison with load cell based on BS EN ISO 7500-1:2004** LC 100 kgf LC 500 kgf LC 1000 kgf LC 5000 kgf LC 10000 kgf LC 90000 kgf LC 200000 kg
Charpy / Izod Impact Tester	1 Joule to 300 Joules	1 % of reading	BS 131-7 : 1998

Note: LC (Load Cell)

Signatory:

1. **Noor Azam Ismail**

SCOPE OF CALIBRATION: PRESSURE

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
Pressure measuring device (Gas medium)	1 psi to 100 psi 101 psi to 1600 psi	0.02 % of pressure 0.02 % of pressure	Comparison with Dead Weight Tester based on BS EN 837-1: 1998 and 837-2, 837-3: 1998 ADWT ADWT
Pressure measuring device (Oil and water medium)	10 psi to 800 psi 801 psi to 16000 psi	0.02 % of pressure 0.02 % of pressure	DWT DWT
	16 0001 psi to 40000 psi	0.02 % of pressure	Based on BS EN 837-1: 1998 BS EN 837-3: 1998
Vacuum gauge	Ambient to -0.9 bar (Gauge mode) 0.1 bar (Absolute mode)	0.1 % of pressure	Mercury Manometer
Low Pressure Measuring Devices Mercury Manometer	0 to 1500 mm Hg	0.02 % of pressure	Digital Manometer Reference Pressure Balance
Deadweight Tester	10 psi to 40 000 psi	0.02 % of pressure	Cross float method OIML R110 1994(E) NCSL RISP-4 2000 EAL G26/EA-4/17 JULY 1997 Pressure Balance

Note: ADWT (Air Dead Weight Tester)
DWT (Dead Weight Tester)

Signatories:

1. **Noor Azam Ismail**

Issue date: 11 November 2020
Valid until: 14 September 2023

NO: SAMM 088
(Issue 2, 11 November 2020 replacement
of SAMM 088 dated 26 August 2020)

SCOPE OF CALIBRATION: PRESSURE

SITE CALIBRATION: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
Pressure measuring device (Oil medium)	0 psi to 500 psi 0 psi to 1000 psi 0 psi to 3000 psi 0 psi to 4500 psi 0 psi to 7500 psi 0 psi to 10 000 psi 0 psi to 12 000 psi 0 psi to 16 000 psi	0.7 % of pressure 0.7 % of pressure 0.6 % of pressure 0.4 % of pressure 0.4 % of pressure 0.7 % of pressure 0.6 % of pressure 0.6 % of pressure	BS EN 837-1: 1998 BS EN 837-3: 1998 Pressure Balance
Vacuum Measuring Devices	Ambient to -0.9 bar (Gauge mode) 0.1 bar (Absolute mode)	1.0 % of pressure	Pressure Calibrator BS EN 837-1: 1998 BS EN 837-3: 1998
Pressure Gauge	0 bar to 20 bar	0.5 % of pressure	Pressure Calibrator BS EN 837-1: 1998 BS EN 837-3: 1998

Signatory:

1. **Noor Azam Ismail**

SCOPE OF CALIBRATION: VOLUMETRIC

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
Bulb Pipette	1 ml to 5 ml 5 ml to 100 ml	0.008 ml 0.03 ml	Cal. Procedure No TCP 0002 REV2.0 Ref: ISO 4787
Graduated Pipette	1 ml to 5 ml 5 ml to 100 ml	0.008 ml 0.03 ml	Cal. Procedure No TCP 0002 REV2.0 Ref: ISO 4787
Measuring Cylinder	5 ml to 100 ml 100 ml to 500 ml 500 ml to 1000 ml 1000 ml to 2000 ml	0.05 ml 0.5 ml 2.0 ml 3.0 ml	Cal. Procedure No TCP 0001 REV2.0 Ref: ISO 4787
Burette	1 ml to 50 ml	0.05 ml	Cal. Procedure No TCP 0003 REV2.0 Ref: ISO 4787
Beaker & Flasks	5 ml to 100 ml 100 ml to 1000 ml 1000 ml to 2000 ml	1.0 ml 3.0 ml 5.0 ml	Cal. Procedure No TCP 0004 REV2.0 Ref: ISO 4787
Piston-operated Volumetric apparatus	10 µl to 20 µl 20 µl to 50 µl 50 µl to 100 µl 100 µl to 200 µl 200 µl to 500 µl 500 µl to 1000 µl 1000 µl to 5000 µl 5000 µl to 10000 µl 10000 µl	0.03 µl 0.09 µl 0.15 µl 0.4 µl 0.8 µl 1.8 µl 3.5 µl 20 µl 40 µl	No.TCP/0005 REV.0.0 Based on ISO 8655-6:2002

Signatories:

1. **Mohammad Najib Kamaruddin**
2. **Mohamad Yati A. Rahman**

Issue date: 11 November 2020
Valid until: 14 September 2023

NO: SAMM 088
(Issue 2, 11 November 2020 replacement
of SAMM 088 dated 26 August 2020)

SCOPE OF CALIBRATION: HYDROMETER

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
Density Hydrometer	0.600 g/ml to 0.650 g/ml 0.650 g/ml to 0.700 g/ml 0.700 g/ml to 0.750 g/ml 0.750 g/ml to 0.800 g/ml 0.800 g/ml to 0.850 g/ml 0.850 g/ml to 0.900 g/ml 0.900 g/ml to 0.950 g/ml 0.950 g/ml to 1.000 g/ml 1.000 g/ml to 1.050 g/ml 1.050 g/ml to 1.100 g/ml 1.100 g/ml to 1.150 g/ml 1.150 g/ml to 1.200 g/ml 1.200 g/ml to 1.250 g/ml 1.250 g/ml to 1.300 g/ml 1.300 g/ml to 1.350 g/ml 1.350 g/ml to 1.400 g/ml 1.400 g/ml to 1.450 g/ml 1.450 g/ml to 1.500 g/ml	0.001 g/ml (resolution 0.0005 g/ml)	Comparison Method BS 718:1991

Signatories:

1. Mohammad Najib Kamaruddin
2. Mohamad Yati A. Rahman

Issue date: 11 November 2020
Valid until: 14 September 2023

NO: SAMM 088
(Issue 2, 11 November 2020 replacement
of SAMM 088 dated 26 August 2020)

SCOPE OF CALIBRATION: **HYDROMETER**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
Temperature			
1. Specific Gravity Hydrometer	0.6 to 0.65 0.65 to 0.7 0.7 to 0.75 0.75 to 0.8 0.8 to 0.85 0.85 to 0.9 0.9 to 0.95 0.95 to 1 1 to 1.1 1.1 to 1.2 1.2 to 1.3 1.3 to 1.4 1.4 to 1.5	0.001 (resolution 0.0005)	Cal. Procedure No. MDL 0002 Rev.1.0 Reference: BS 718:1991

Signatories:

1. **Mohammad Najib Kamaruddin**
2. **Mohamad Yati A. Rahman**

SCOPE OF CALIBRATION: **ACOUSTIC & VIBRATION**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
Measuring Instrument Sound Level Meter	Nominal SPL 94 dB, 104 dB & 114 dB Reference 94 dB re 20 µPa at 1 kHz		Generating using Bruel & Kjaer 4226
	31.5 Hz to 1600 Hz	0.11 dB	
	124 dB (at 250Hz)	0.21 dB	Generating using Bruel & Kjaer 4228
	(54 to 134) dB (31.5 to 12500) Hz	0.13 dB	Electrical Signal Injection from signal operator Agilent 33220A
Sourcing/Generating Instrument Sound Calibrator	Nominal SPL 94dB, 104 dB & 114 dB Reference 94 dB re 20 µPa at 1 kHz		Comparison with reference Calibrator Bruel & Kjaer 4226 and Agilent 34401A
	31.5 Hz to 1600 Hz	0.11 dB	
	124 dB (at 250Hz)	0.21 dB	Comparison with reference Calibrator Bruel & Kjaer 4228 and Agilent 34401A

Signatories:

1. ****Mohamed Fikri Bin Mohd Nor**
2. **Syahrel Bin Shari**

** Non-resident signatory

SCOPE OF CALIBRATION: ACOUSTIC & VIBRATION

SCOPE OF ACCREDITATION: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
Measuring Instrument Sound Level Meter	Nominal SPL 94 dB, 104 dB & 114 dB Reference 94 dB re 20 µPa at 1 kHz		
	31.5 Hz to 1600 Hz	0.11 dB	Generating using Bruel & Kjaer 4226
	124 dB (at 250Hz)	0.21 dB	Generating using Bruel & Kjaer 4228
	(54 to 134) dB (31.5 to 12500) Hz	0.13 dB	Electrical Signal Injection from signal operator Agilent 33220A
Sourcing/Generating Instrument Sound Calibrator	Nominal SPL 94dB, 104 dB & 114 dB Reference 94 dB re 20 µPa at 1 kHz		
	31.5 Hz to 1600 Hz	0.11 dB	Comparison with reference Calibrator Bruel & Kjaer 4226 and Agilent 34401A
	124 dB (at 250Hz)	0.21 dB	Comparison with reference Calibrator Bruel & Kjaer 4228 and Agilent 34401A

Signatories:

1. ****Mohamed Fikri Bin Mohd Nor**
2. **Syahrel Bin Shari**

** Non-resident signatory

LABORATORY LOCATION: (BRANCH LABORATORY)

SIRIM STANDARDS TECHNOLOGY SDN. BHD.
(Company No.: 292201-P)
BANGUNAN SIRIM BERHAD,
JALAN PINTASAN KUANTAN– KUALA TERENGGANU,
KAWASAN PERINDUSTRIAN GEBENG
26100 KUANTAN.
PAHANG DARUL MAKMUR.
MALAYSIA

FEILDS OF CALIBRATION: **ELECTRICAL & PRESSURE**

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 0 V to 3.3 V 0 V to 33 V 30 V to 330 V 100 V to 1020 V	22 µV/V + 1.8 µV 11 µV/V + 9.9 µV 12 µV/V + 96 µV 23 µV/V + 0.98 mV 23 µV/V + 5.4 mV	
(b) Resistance	0 Ω to 11 Ω 11 Ω 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	47 µΩ/Ω + 1.2 mΩ 35 µΩ/Ω + 1.7 mΩ 33 µΩ/Ω + 1.6 mΩ 32 µΩ/Ω + 2.3 mΩ 13 µΩ/Ω + 54 mΩ 11 µΩ/Ω + 0.55 Ω 32 µΩ/Ω + 28 mΩ 29 µΩ/Ω + 0.41 Ω 32 µΩ/Ω + 0.3 Ω 37 µΩ/Ω + 2.4 Ω 36 µΩ/Ω + 3.7 Ω 69 µΩ/Ω + 35 Ω 0.15 mΩ/Ω + 61 Ω 0.29 mΩ/Ω + 2.8 kΩ 0.59 mΩ/Ω + 4.6 kΩ 3.5 mΩ/Ω + 0.11 MΩ 17 mΩ/Ω + 5.7 MΩ	Generate using calibrator model Fluke 5522 A
(b) Resistance	0.100 Ω to 0.110 Ω 0.110 Ω to 0.200 Ω 0.100 Ω to 1.100 Ω 1.100 Ω to 10.100 Ω 10.100 Ω to 100.100 Ω 100.100 Ω to 1000.100 Ω	0.12 mΩ/Ω + 2.3 mΩ 0.12 mΩ/Ω + 2.3 mΩ 0.12 mΩ/Ω + 2.3 mΩ 0.12 mΩ/Ω + 2.3 mΩ 0.12 mΩ/Ω + 2.3 mΩ 0.12 mΩ/Ω + 2.3 mΩ	Generate using Yokogawa 279301

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
1. Measuring Instruments (continued)			
(c) Capacitance	220 pF to 400 pF	5.7 μF/F + 12 pF	
	0.4 nF to 1.1 nF	5.5 mF/F + 13 pF	
	1.1 nF to 3.3 nF	5.8 mF/F + 12 pF	
	3.3 nF to 11 nF	2.9 mF/F + 12 pF	
	11 nF to 33 nF	3.4 mF/F + 6.8 pF	
	33 nF to 110 nF	2.9 mF/F + 20 pF	
	110 nF to 330 nF	2.9 mF/F + 58 pF	
	0.33 μF to 1.1 μF	2.9 mF/F + 1.2 nF	
	1.1 μF to 3.3 μF	2.9 mF/F + 3.5 nF	
	3.3 μF to 11 μF	2.9 mF/F + 12 nF	
	11 μF to 33 μF	4.5 mF/F + 38 nF	
	33 μF to 110 μF	5.2 mF/F + 0.13 μF	
	110 μF to 330 μF	5.1 mF/F + 0.35 μF	
	0.33 mF to 1.1 mF	5.2 mF/F + 1.2 μF	Generate using calibrator model Fluke 5522 A
	1.1 mF to 3.3 mF	5.2 mF/F + 3.4 μF	
	3.3 mF to 11 mF	5.7 mF/F + 17 μF	
	11 mF to 33 mF	8.5 mF/F + 35 μF	
	33 mF to 110 mF	13 mF/F + 0.12 mF	
(d) AC Voltage (See Matrix A)	0 mV to 1020 V See Matrix A	See Matrix A	
(e) DC Current (±)	0 μA to 330 μA	0.18 mA/A + 23 nA	
	0 mA to 3.3 mA	0.12 mA/A + 58 nA	
	0 mA to 33 mA	0.12 mA/A + 0.32 μA	
	0 mA to 330 mA	0.12 mA/A + 3.0 μA	
	0 A to 1.1 A	0.23 mA/A + 50 μA	
	1.1 A to 3 A	0.43 mA/A + 57 μA	
	0 A to 11 A	0.55 mA/A + 0.91 mA	
	11 A to 20.5 A	1.2 mA/A + 1.1 mA	
(f) AC Current (See Matrix B)	See Matrix B	See Matrix B	Generate using calibrator model Fluke 5522 A

FIELD OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
1. Measuring Instruments (continued) (g). 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 + 4.2 mA 4.3 mA/A - 54 mA 2.9 mA/A + 37 mA	Generate using Calibrator Fluke 5522A with Fluke 5500 A/Coil (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	2.7 mA/A + 19 mA 3.1 mA/A + 43 mA 3.1 mA/A + 0.23 A	
	(65 Hz to 440 Hz) 10 A to 16.5 A 16.5 A to 150 A 150 A to 1025 A	8.8 mA/A + 9.6 mA 9.0 mA/A + 31 mA 8.9 mA/A + 0.17 A	
(h). Power Meters DC Power Energy	0.1 W to 1 kW 1 kW to 20 kW	0.25 mW/W + 0.18 mW 0.80 mW/W - 1.7 mW	Generate using Fluke 5522A
AC Power Energy	(45 Hz to 65 Hz, 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 + 7.2 mW 1.2 mW/W + 31 mW	
(i) Time	1 s to 24 Hrs	0.83 ps/s + 29 ms	Agilent 33220A & Fluke PM 6680B Timer Counter Analyzer
(j). Frequency	1 µHz to 20 MHz	2.3 µHz/Hz + 2.1 µHz	Generate using Agilent 33220A Function / Arbitrary Waveform Generator
	250 kHz – 2 GHz	2 µHz/Hz + 2.9 mHz	Generate using Agilent E4420B ESG Series Signal Generator

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
1. Measuring Instruments (continued)			
(k). Time Base Input	10 MHz	1 µHz/Hz	Generate using Agilent E4420B ESG Series Signal Generator (Rear Time Base Output)
(l). Amplitude	10 mVpp to 10 Vpp (1 µHz to 20 MHz, Into 50 Ω)	12 mVpp/Vpp + 1.1 mVpp	Generate using Agilent 33220A Function/ Arbitrary Waveform Generator
	20 mVpp to 20 Vpp (1 µHz to 20 MHz, Into open circuit)	11 mVpp/Vpp + 9.5 mVpp	
	+7 to –120 dBm (250 kHz to 2 GHz)	-0.02 dBm/dBm + 0.06 dBm	Generate using Agilent E4420B ESG Series Signal Generator
(m) Modulation			
AM Depth Calibration factor	33.33 % nominal	0.06 %	Generate using HP 8901A (Calibration Output)
FM Deviation Calibration factor	340 kHz peak nominal	0.08 kHz	
(n) RPM Measuring Instruments (Non-Contact)	60 rpm to 999.99 rpm	17 µrpm/rpm + 8.4 mrpm	In-House method, ESF/0303
	1000.0 rpm to 9999.9 rpm	17 µrpm/rpm + 84 mrpm	
	10000 rpm to 99999 rpm	17 µrpm/rpm + 0.84 rpm	

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
1. Measuring Instruments (continued)			
(o). Oscilloscope Vertical Deflection DC Signal	0 V to ± 6.6 V (50 Ω Load)	2.8 mV/V + 0.48 mV	Generating using calibrator model Fluke 5500A SC600
	0 V to ± 130 V (1 MΩ Load)	0.56 mV/V + 0.48 mV	
Vertical Deflection Square Wave Signal	± 1 mVp-p to ± 6.6 Vp-p (50 Ω Load)	2.8 mVp-p/Vp-p + 0.48 mVp-p	
	± 1 mVp-p to ± 130 Vp-p (1 MΩ Load)	1.2 mVp-p/Vp-p + 0.47 mVp-p	
Horizontal Deflection Time Markers (50 Ω Load)	2 ns/div to 20 ms/div 50 ms/div to 5 s/div	73 ps/s + 12 ns 5.5 ms/s + 0.39 ms	
Risetime	1 kHz to 10 MHz 10 mV to 2.5 V	7.9 ns/s + 7.2 ps	
Bandwidth Frequency	50 kHz to 600 MHz (5 mV to 5.5 V)	2 mHz/Hz + 1.4 MHz	
	250 kHz – 2 GHz (+7 to –120 dBm)	2 nHz/Hz + 1.4 MHz	Generate using Agilent E4420B ESG Series Signal Generator
Bandwidth Amplitude	5 mV to 5.5 V (50 kHz to 600 MHz)	0.41 mVp-p/Vp-p + 0.34 Vp-p	Generating using calibrator model Fluke 5500A SC600
	+7 to –120 dBm (250 kHz – 2 GHz)	0.26 Vp-p	Generating using Agilent E4420B ESG Series Signal Generator

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
1. Measuring Instruments (continued)			
(p) Insulation Testers	(1.0 kΩ to 10.0 kΩ) @ 10.0 V	1.2 mΩ/Ω + 0.14 Ω	Tinsley 4720
	(10.0 kΩ to 100.0 kΩ) @ 50.0 V	1.2 mΩ/Ω + 1.4 Ω	
	(0.1 MΩ to 1.0 MΩ) @ 150.0 V	0.94 mΩ/Ω + 0.49 kΩ	
	(1.0 MΩ to 10.0 MΩ) @ 300.0 V	1.2 mΩ/Ω + 0.14 kΩ	
	(10.0 MΩ to 100.0 MΩ) @ 500.0 V	1.3 mΩ/Ω + 0.38 kΩ	
	(0.1 GΩ to 1.0 GΩ) @ 1000.0 V	13 mΩ/Ω - 0.20 MΩ	
	(1.0 GΩ to 10.0 GΩ) @ 5000.0 V	1.5 mΩ/Ω - 1.9 MΩ	
	(10.0 GΩ to 100.0 GΩ) @ 5000.0V	29 mΩ/Ω - 0.43 GΩ	
	(100.0 GΩ to 500.0 GΩ) @ 5000.0V	40 mΩ/Ω - 0.36 GΩ	

SCOPE OF CALIBRATION: **ELECTRICAL**

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	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	1.9 + 0.11	-	-	-	0.41 + 0.11	-	0.7 + 0.11	1.9 + 0.11	4.4 + 0.099	9.2 + 0.12
33 mV to 330 mV	1.8 + 0.11	-	-	-	0.43 + 0.11	-	0.71 + 0.11	1.8 + 0.11	2.5 + 0.11	3.2 + 0.13
0.33 V to 3.3 V	1.8 + 0.24	-	-	-	0.44 + 0.24	-	0.72 + 0.24	1.8 + 0.25	2.5 + 0.20	3.5 + 0.69
3.3 V to 33 V	1.8 + 3.2	-	-	-	0.43 + 2.5	-	1.1 + 0.98	2.3 + 2.5	5.8 + 2.7	-
33 V to 330 V	-	1.2 + 12	-	-	-	0.61 + 14	6.8 + 12	9.1 + 13	12 + 26	-
330 V to 1020 V	-	1.8 + 36	0.85 + 37	0.87 + 37	-	-	-	-	-	-

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

SCOPE OF CALIBRATION: ELECTRICAL

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	2.6 + 0.56	-	1.8 + 0.57	-	1.2 + 0.57	-	6.6 + 0.59	15 + 0.6	23 + 0.72
0.33 mA to 3.3 mA	2.8 + 1.5	-	1.5 + 1.5	-	0.94 + 1.5	-	6.1 + 1.7	13 + 1.7	19 + 0.89
3.3 mA to 33 mA	2.7 + 6.4	-	1.2 + 6.1	-	0.95 + 6.3	-	3.6 + 6.1	8.5 + 6.5	13 + 2.5
33 mA to 330 mA	2.7 + 63	-	1.2 + 59	-	0.49 + 59	-	1.2 + 78	2.6 mA/A + 0.13 mA	8.1 mA/A + 0.2 mA
0.33 A to 1.1A	-	3.0 mA/A + 0.59 mA	-	-	0.98 mA/A + 0.58 mA	-	14 mA/A + 1.2 mA	37 mA/A + 5.2 mA	-
1.1 A to 3 A	-	3.1 mA/A + 0.53 mA	-	-	1.1 mA/A + 0.57 mA	-	14 mA/A + 1.2 mA	37 mA/A + 5.0 mA	-
3 A to 11 A	-	-	-	2.4 mA/A + 4.4 mA	-	1.6 mA/A + 4.2 mA	36 mA/A + 3.3 mA	-	-
11 A to 20.5 A	-	-	-	-	-	2.7 mA/A + 6.1 mA	2.7 mA/A + 7.1 mA	-	-

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

NO: SAMM 088
(Issue 2, 11 November 2020 replacement
of SAMM 088 dated 26 August 2020)

SCOPE OF CALIBRATION: **ELECTRICAL**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
1. Generating Instruments			
(a) DC Voltage	± 100 mV Range ± (100 µV to 120 mV)	4.4 µV/V + 0.7 µV	
	± 1 V Range ± (0.1 V to 1.2 V)	3.6 µV/V + 1.9 µV	
	± 10 V Range ± (1 V to 12 V)	4.7 µV/V + 2.6 µV	
	± 100 V Range ± (10 V to 120 V)	6.1 µV/V + 0.16 mV	
	± 1000 V Range ± (100 V to 1050 V)	6.1 µV/V + 1.5 mV	
(b) DC Current	± 100 nA Range, ± (1 nA to 120 nA)	34 µA/A + 47 pA	Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002
	± 1 µA Range ± (0.1 µA to 1.2 µA)	24 µA/A + 47 pA	
	± 10 µA Range, ± (1 µA to 12 µA)	25 µA/A + 0.12 nA	
	± 100 µA Range, ± (10 µA to 120 µA)	19 µA/A + 2.1 nA	
	± 1 mA Range, ± (0.1 mA to 1.2mA)	22 µA/A + 11 nA	
	± 10 mA Range ± (1 mA to 12 mA)	22 µA/A + 0.11 µA	
	± 100 mA Range, ± (10 mA to 120 mA)	41 µA/A + 1.2 µA	
	± 1 A Range, ± (0.1 A to 1.05 A)	0.12 mA/A + 23 µA	
	± 3 A Range, ± (1 A to 3 A)	0.14 mA/A + 69 µA	Measure using 6 ½ Digit Multimeter HP 34401A

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
1. Generating Instruments (continued)			
(c) Resistance, (Four-wire Ohms and Two-wire Ohms.)	0 Ω to 12 Ω	3.3 μΩ/Ω + 76 mΩ	Measure using 8 ½ Digit Multimeter Keysight 3458A Opt. 002
	10 Ω to 120 Ω	0.32 μΩ/Ω + 0.56 mΩ	
	0.1 kΩ to 1.2 kΩ	0.78 μΩ/Ω + 0.55 mΩ	
	1 kΩ to 12 kΩ	0.79 μΩ/Ω + 5.5 mΩ	
	10 kΩ to 120 kΩ	8.4 μΩ/Ω + 0.45 Ω	
	0.1 MΩ to 1.2 MΩ	1.2 μΩ/Ω + 1.2 Ω	
	1 MΩ to 12 MΩ	5.1 μΩ/Ω + 21 Ω	
	10 MΩ to 120 MΩ	0.54 mΩ/Ω + 4.5 mΩ	
	0.1 GΩ to 1.2 GΩ	57 mΩ/Ω + 12 kΩ	
(d) AC Voltage	10 mV to 700V (See Matrix C)	(See Matrix C)	
(e) AC Current	5 μA to 1 A (See Matrix D)	(See Matrix D)	
(f) Frequency or Period	0.01 Hz to 225 MHz 6 ns to 100 s	5.8 μHz/Hz + 0.15 mHz 5.8 μs/s - 69 ps	Measure using Fluke PM 6680B Timer Counter Analyzer
	150 kHz to 650 MHz	14 μHz/Hz + 36 μHz	Measure using HP 8901A
	650 MHz to 1300 MHz	14 μHz/Hz + 35 μHz	
(g) Amplitude/ Level	0.1 W to 1 W (150 kHz to 60 MHz)	0.35 nW/W + 2.2 mW	
	0.01 W to 0.1 W (150 kHz to 60 MHz)	35 pW/W + 2.2 mW	
	1 mW to 10 mW (150 kHz to 60 MHz)	3.3 pW/W + 2.2 mW	
	0.1 W to 1 W (650 MHz to 1300 MHz)	0.30 nW/W + 2.6 mW	
	0.01 W to 0.1 W (650 MHz to 1300 MHz)	30 pW/W + 2.6 mW	
	1 mW to 10 mW (650 MHz to 1300 MHz)	2.2 pW/W + 2.6 mW	

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
1. Generating Instruments (continued)			Measure using HP 8901A
(h) MODULATION Related Signal: Amplitude Modulation (AM)			
AM Depth: 1 % to 99 %	Carrier Frequency 150 kHz to 10 MHz Modulation Frequency 50 Hz to 10 kHz	0.024 %/% + 0.011 %	
AM Depth: 1 % to 99 %	Carrier Frequency 150 kHz to 10 MHz Modulation Frequency 20 Hz to 10 kHz	0.036 %/% + 0.011 %	
AM Depth: 1 % to 99 %	Carrier Frequency 10 MHz to 1300 MHz Modulation Frequency 50 Hz to 50 kHz	0.024 %/% + 0.011 %	
AM Depth: 1 % to 99 %	Carrier Frequency 10 MHz to 1300 MHz Modulation Frequency 20 Hz to 100 kHz	0.036 %/% + 0.011 %	
Frequency Modulation (FM)			
FM Deviation: ≤ 40 kHz peak	Carrier Frequency 150 kHz to 10 MHz Modulation Frequency 20 Hz to 10 kHz	0.024 kHz/kHz + 0.0049 kHz	
FM Deviation: ≤ 400 kHz peak	Carrier Frequency 10 MHz to 1300 MHz Modulation Frequency 50 Hz to 100 kHz	0.012 kHz/kHz + 0.12 kHz	
FM Deviation: ≤ 40 kHz peak	Carrier Frequency 10 MHz to 1300 MHz Modulation Frequency 20 Hz to 200 kHz	0.057 kHz/kHz + 0.021 kHz	

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
1. Generating Instruments (continued) *Phase Modulation (ΦM)* *ΦM Deviation:* *≤ 400 Radians peak*	Carrier Frequency 10 kHz to 1300 MHz Modulation Frequency 200 Hz to 20 kHz	0.034 Radians/Radians + 0.12 Radians	Measure using HP 8901A
ΦM Deviation: *≤ 40 Radians peak*	Carrier Frequency 10 kHz to 1300 MHz Modulation Frequency 200 Hz to 20 kHz	0.034 Radians/Radians + 0.012 Radians	
ΦM Deviation: *≤ 4 Radians peak*	Carrier Frequency 10 kHz to 1300 MHz Modulation Frequency 200 Hz to 8 kHz	0.034 Radians/Radians + 0.0013 Radians	

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	1 mV 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	0.12 V 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

SCOPE OF CALIBRATION: **ELECTRICAL**

Matrix C (continued)

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
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	-	-	-

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

Range		AC Band > 2 MHz				
		45 Hz to100 kHz	100 kHz to 1 MHz	1 MHz to 4 MHz	4 MHz to 8 MHz	8 MHz to 10 MHz
10 mV	1 mV 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

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 5 kHz
100 µA	5 µA to 120 µA	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 + 2.4 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 + 0.25 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 mA to 1.2 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	-

Matrix E:
AC Current Generation. Measure using 6 ½ Digit Multimeter HP 34401A

Range		Frequency Band		
		3 Hz to 5 Hz	5 Hz to 10 Hz	10 Hz to 5 kHz
3 A	1 A to 3 A	13 mA/A + 2.1 mA	4.0 mA/A + 2.1 mA	1.8 mA/A + 2.1 mA

Signatories:

1. **Mohamed Fikri Bin Mohd Nor**
2. **Rushaida Abdul Aziz**

Issue date: 11 November 2020
Valid until: 14 September 2023

NO: SAMM 088
(Issue 2, 11 November 2020 replacement
of SAMM 088 dated 26 August 2020)

SCOPE OF CALIBRATION: PRESURRE

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
Pressure measuring device (Hydraulic of oil medium)	10 psi to 500 psi 500 psi to 10000 psi	0.021% of pressure 0.025% of pressure	Hydraulic Dead Weight Tester
Pressure Vacuum Gauge	-0.90 bar to 0 bar	3.4 mbar	Digital Pressure Indicator

Signatory:

1. Nor Azila Mat Jusoh