Issue date: 28 July 2025
Valid Until: -

NO: SAMM 122

LABORATORY LOCATION/ CENTRAL OFFICE:	Trescal (Malaysia) Sdn. Bhd., Pulau Pinang 70-1-82 D'Plazza Mall Jalan Mahsuri, Bandar Bayan Baru, , 11900, PULAU PINANG MALAYSIA
ACCREDITED SINCE :	24 FEBRUARY 2025
FIELD(S) OF CALIBRATION:	ELECTRICAL HEAT & 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 uncertainty covered by the CMC is expressed as the expanded uncertainty corresponding to a coverage probability of approximately 95 % and have a coverage factor of k=2 unless stated otherwise.**

CENTRAL LOCATION	Trescal (Malaysia) Sdn. Bhd., Pulau Pinang 70-1-82 D'Plazza Mall Jalan Mahsuri, Bandar Bayan Baru, , 11900, Pulau Pinang
FIELD(S) OF CALIBRATION :	ELECTRICAL, HEAT & TEMPERATURE

SCOPE OF CALIBRATION : ELECTRICAL

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
Indicating Instrument 1 Dc Voltage	0 V to 200 mV 0.22 V to 2.2 V 2.2 V to 11 V 11 V to 22 V 22 V to 220 V 220 V to 1100 V	6.0 µV/V + 5.1 nV 1.8 µV/V + 0.052 nV 1.4 µV/V + 0.77 nV 1.2 µV/V + 42 nV 2.5 µV/V + 5.2 nV 2.0 µV/V + 64 nV	Generation using Fluke 5730A Calibrator

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
Indicating Instrument 2. Dc High Voltage	1000 V to 5000 V 5000 V to 10,000 V	8.6 mV/V + 0.33 mV 20.9 mV/V + 0.038 mV	10 kV DC High Voltage Source Compare with Vitrek 4700 Precision High Voltage Meter
Indicating Instrument 3. Dc Current	0 to 220 µA 0.22 mA to 2.2 mA 2.2 mA to 22 mA 22 mA to 220 mA 0.22 A to 2.2 A	11 µA/A + 4.8 pA 11 µA/A + 1.1 pA 11 µA/A + 11 pA 15 µA/A + 77 pA 28 µA/A + 0.41 nA	Generation using Fluke 5730A Calibrator
	0 µA to 330 µA 0.33 mA to 3.3 mA 3.3 mA to 33 mA 33 mA to 3.3 A 0 to 10 A 10 A to 20 A	14 µA/A + 6.0 nA 4.9 µA/A + 68 nA 4.9 µA/A + 0.76 µA 53 µA/A + 55 µA 41 µA/A + 0.61 mA 79 µA/A + 0.38 mA	Generation using Fluke 5522A Calibrator
	3.2 A to 32 A 32 A to 105 A 105 A to 200 A	1.3 mA/A + 50 mA 2.2 mA/A + 25 mA 2.3 mA/A + 29 mA	Generation using calibrator model Wavetek 9100 & 10 turn coil
	16 A to 160 A 160 A to 525 A 525 A to 1000 A	2.2 mA/A + 29 mA 2.3 mA/A + 23 mA 2.3 mA/A + 0.1 A	Generation using calibrator model Wavetek 9100 & 50 turn coil
Indicating Instrument 4. Ac Voltage	0.22 mV to 220 V 220 V to 1050 V	Refer Matrix A1 Refer Matrix A2 & A3	Generation using Fluke 5730A & Wavetek 9100
Indicating Instrument 5. Ac Current	0 µA to 10.5 A	(See Matrix B)	Generation using calibrator model Wavetek 9100
	2.2 µA to 2.2 A	(See Matrix C)	Generation using calibrator model Fluke 5700A
	3.2 A to 1000 A	(See Matrix D)	Generation using calibrator model Wavetek 9100 & 10/50 turn coil
Indicating Instrument 6. Dc Power	0.1024 mW to 10.5 kW	(See Matrix E)	Generation using calibrator model Wavetek 9100
Indicating Instrument 7. Ac Power	0.1024 mW to 7.7875 kW @ 10 Hz to 3 kHz	(See Matrix F) Power Factor = 1	Generation using calibrator model Wavetek 9100

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
Indicating Instrument 8. Dc Resistance (specific Value)	1 m? 10 m? 100 m? 1 ? 10 ? 100 ? 1 k? 10 k? 100 k?	0.87 µ? 11 µ? 0.11 m? 1.1 m? 3.9 m? 32 m? 0.32 ? 3.2 ? 32 ?	Generation using Standard Resistor model Agilent 42030A (4-Terminal Resistance)
	1 -„¦ 1.9 -„¦ 10 -„¦ 19 -„¦ 100 -„¦ 190 -„¦ 1 k-„¦ 1.9 k-„¦ 10 k-„¦ 19 k-„¦ 100 k-„¦ 190 k-„¦ 1 M-„¦ 1.9 M-„¦ 10 M-„¦ 19 M-„¦ 100 M-„¦	20 µ-„¦ 22 µ-„¦ 90 µ-„¦ 0.17 m-„¦ 0.25 m-„¦ 0.42 m-„¦ 3.2 m-„¦ 4.4 m-„¦ 20 m-„¦ 39 m-„¦ 0.24 -„¦ 0.78 -„¦ 5.0 -„¦ 7.9 -„¦ 0.13 k-„¦ 0.29 k-„¦ 7.4 k-„¦	Generation using Fluke 5730A Calibrator
Indicating Instrument 9. Resistance	1 ?	9 µ?	Generation using Fluke 742A-1 ohm
	10 k?	7 µ?	Generation using Fluke 742A-10 kohm
Indicating Instrument 10. Dc Resistance	0 ? to 40 ? 40 ? to 400 ? 400 ? to 4 k? 4 k? to 40 k? 40 k? to 400 k? 400 k? to 4 M? 4 M? to 40 M? 40 M? to 400 M?	0.57 m?/? + 23 m? 0.17 m?/? +25 m? 0.17 m?/? + 0.1 ? 0.17 m?/? + 1 ? 0.20 m?/? + 12 ? 0.22 m?/? + 0.14 k? 0.56 m?/? + 2.4 k? 0.64 m?/? + 64 k?	Generation using calibrator model Wavetek 9100
Indicating Instrument 11. Dc Resistance At High Voltage Range (25v To 5kv)	See Matrix G	(See Matrix G)	Generation using Decade Resistance model IET HRRS
Indicating Instrument 12. Ac Resistance (specific Value)	10 -„¦ 100 -„¦ 1 k-„¦ 10 k-„¦ 100 k-„¦	(See Matrix H)	Generation using Standard Resistor model Agilent 42030A (4-Terminal Resistance Set)

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
Indicating Instrument 13. Capacitance	0.5 nF – 40 mF	(See Matrix I)	Generation using calibrator model Wavetek 9100
Indicating Instrument 14. Capacitance (specific Value)	120 Hz 1 kHz 10 kHz 100 kHz 1 MHz 2 MHz 3 MHz 4 MHz 5 MHz 10 MHz 13 MHz	(See Matrix J)	Generation using Standard Capacitor model Agilent 16380A & 16380C (4-Terminal Capacitor Set)
Indicating Instrument 15. Inductance	1 kHz 1mH to 900 mH	23 mH/H + 0.57 µH	Generation using calibrator model IET LS-400A
Indicating Instrument 16. Inductance (specific Value)	100 Hz, 200 Hz, 1 kHz, 10 kHz 100 µH 1 mH 10 mH 100 mH 1 H	 0.57 µH 2.3 µH 23 µH 0.23 µH 2.3 mH	Generation using calibrator model General Radio 1482
Oscilloscope 16. Bandwidth	100 mHz to 100 MHz 100.01 MHz to 550 MHz 550.01 MHz to 1.1 GHz	22 mHz/Hz 34 mHz/Hz 43 mHz/Hz	Generation using calibrator model Fluke 9500/9510
	1 GHz to 3 GHz 3 GHz to 6 GHz	34 mHz/Hz + 1.2 MHz 48 mHz/Hz + 0.35 MHz	Generation using Calibrator model Fluke 9500B & 9560

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
Oscilloscope 17. Time Base	@100 mV to 500 mV 180.19 ps – 450 ps 450 ps – 900 ps 0.9 ns – 9 ns @100 mV to 1 V 9 ns - 100 ns 0.1 µs - 10 µs 10 µs - 100 µs 0.1 ms - 10 ms 10 ms - 100 ms 0.1 s - 10 s 10 s - 55 s	0.38 ns/s + 0.072 ps 0.77 ns/s + 0.079 ps 0.48 ns/s + 1.1 ps 0.063 ns/s + 79 ps 0.060 ns/s + 7.2 ns 0.063 ns/s + 79 ns 0.057 ns/s + 7.9 us 0.063 ns/s + 79 us 0.057 ns/s + 7.9 ms 0.046 ns/s + 57 ms	Generation using calibrator model Fluke 9500B & 9510/9560
Oscilloscope 18. Amplitude	35 µV to 222 V	(See Matrix K)	Generation using calibrator model Fluke 9500 & 9510/9560
Source 1. Dc Voltage	0 mV to 100 mV 0.1 V to 1 V 1 V to 10 V 10 V to 100 V 100 V to 1000 V	8.8 mV/V + 0.49 mV 8.2 mV / V + 0.44 mV 8.3 mV/V + 0.93 mV 11 mV/V + 77 mV 24 mV/V + 29 mV	Measurement using Multimeter model Agilent 3458A
Source 2. Dc High Voltage	0.1 kV to 1 kV 1 kV to 4 kV 4 kV to 10 kV	0.036 mV/V + 0.0043 V 0.10 mV/V + 0.026 V 0.11 mV/V + 0.0086 V	Direct Measurement Using Vitrek 4700 Precision High Voltage Meter
	1kV to 5 kV 5 kV to 10 kV	0.11 mV/V + 0.024 V 0.076 mV/V + 0.55 V	Direct Measurement Using Vitrek 4700 Precision High Voltage Meter + HVL-70 High Voltage Probe
Source 3. Ac Voltage	0 to 1000 V	(See Matrix L)	Measurement using Multimeter model Wavetek 1281
Source 4. Ac High Voltage	@50/60 Hz 0 to 1 kV 1 kV to 10 kV @400 Hz 0 to 1 kV	0.058 mV/V + 0.0057 V 0.42 mV/V + 0.0057 V 0.022 mV/V + 0.077 V	Direct measurement using Vitrek 4700 Precision High Voltage Meter

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
	@50/60 Hz 1 kV to 5 kV 5 kV to 15 kV	0.42 mV/V + 0.0047 V 0.28 mV/V + 0.18 V	Direct measurement using Vitrek 4700 Precision High Voltage Meter + HVL-70 High Voltage Probe
Source 5. Dc Current	0 to 100 nA 0.1 µA to 1.0 µA 1 µA to 10 µA 10 µA to 100 µA 0.1 mA to 1 mA 1 mA to 10 mA 10 mA to 100 mA 0.1 A to 1 A	97 µA/A + 0.61 pA 15 µA/A + 0.16 pA 7.2 µA/A + 0.033 pA 2.7 µA/A + 0.98 pA 1.9 µA/A + 12 pA 15 µA/A + 43 pA 3.1 µA/A + 2.3 µA 6.9 µA/A + 5.2 µA	Measurement using Agilent 3458A Digital Multimeter (Opt 002)
	1 A to 10 A 10 A to 20 A 20 A to 30 A	16 mA/A + 0.40 mA 48 mA/A + 0.25 mA 0.57 mA/A + 18 mA	Measurement using Multimeter & Current shunt model Agilent 3458A & 34330A
	30 A to 50 A 50 A to 100 A 100 A to 200 A 200 A to 300 A	46 mA/A + 0.72 mA 60 mA/A + 0.41 mA 71 mA/A + 0.21 mA 71 mA/A + 0.14 mA	Measurement using Multimeter & Current shunt model Agilent 3458A & Guildine 9230/1000
Source 6. Ac Current	0 to 2 A	(See Matrix M)	Measurement using Multimeter model Wavetek 1281
	2 A to 10 A	(See Matrix M)	Measurement using Multimeter & Current Shunt model Wavetek 1281 & Wavetek 4953
	@50/60 Hz 1 A to 10 A @50/60 Hz 10 A to 30 A	75 mA/A + 2.1 nA 0.12 mA/A + 0.30 nA	Direct measurement using Fluke 8588A reference Multimeter
Source 7. Dc Resistance	0 to 10 -„¦ 10 -„¦ to 100 -„¦ 0.1 k-„¦ to 1 k-„¦ 1 k-„¦ to 10 k-„¦ 10 k-„¦ to 100 k-„¦ 0.1 M-„¦ to 1 M-„¦ 1 M-„¦ to 10 M-„¦ 10 M-„¦ to 100 M-„¦ 0.1 G-„¦ to 1 G-„¦	0.17 µ-„¦/-„¦ + 6.1 µ-„¦ 1.2 µ-„¦/-„¦ + 0.88 µ-„¦ 0.66 µ-„¦/-„¦ + 16 µ-„¦ 0.43 µ-„¦/-„¦ + 0.24 m-„¦ 0.71 µ-„¦/-„¦ + 1.5 m-„¦ 3.0 µ-„¦/-„¦ + 2.7 m-„¦ 7.4 µ-„¦/-„¦ + 15 m-„¦ 38 µ-„¦/-„¦ + 0.16 -„¦ 0.14 m-„¦/-„¦ + 0.26 -„¦	Measurement using Agilent 3458A Digital Multimeter (Opt 002)

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
Source 8. Capacitance	1 pF to 100 mF	(See Matrix N)	Measurement using HP 4263A LCR Meter
Rf 1. Frequency (indicating)	0.1 Hz to 100 Hz 0.1 kHz to 100 kHz 0.1 MHz to 100 MHz 0.1 GHz to 9 GHz	1.2 pHz/Hz + 0.79 mHz 0.12 nHz/Hz + 0.81 mHz 0.13 nHz/Hz + 0.12 mHz 0.13 nHz/Hz + 30 mHz	Generation using Signal Generator model Agilent 33250A, E8663B & SRS FS725 Rubidium Standard (Reference)
Rf 2. Rf Power (source)	30 dBm to 20 dBm (1 µW to 100 mW into 50 -„¦)	(See Matrix O)	Measurement using Power Meter & Power Sensor model Agilent EPM441A & 8482A
Rf 3. Frequency (source)	100 mHz to 1 Hz 1 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 10 kHz 10 kHz to 100 kHz 100 kHz to 1 MHz 1 MHz to 10 MHz 10 MHz to 100 MHz 100 MHz to 1 GHz 1 GHz to 2.7 GHz	83 nHz/Hz + 1.9 nHz 56 nHz/Hz + 2.9 mHz 85 nHz/Hz + 0.26 mHz 84 nHz/Hz + 11 mHz 83 nHz/Hz + 0.23 mHz 83 nHz/Hz + 1.9 mHz 84 nHz/Hz + 11 mHz 83 nHz/Hz + 0.23 Hz 83 nHz/Hz + 1.9 Hz 77 nHz/Hz + 31 Hz	Measurement using Frequency Counter model Fluke PM6680B
	300 MHz – 12.4 GHz	17 nHz/Hz	Measurement using Frequency Counter & model Agilent 53132A and SRS FS725 Rubidium Standard (Reference)
Time 1. Timer	1 s to 100 s 100 s to 400 s	38 µs/s + 30 µs 34 µs/s + 1.8 ms	Measurement using DSO7104A Oscilloscope

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NO: SAMM 122

SCOPE OF CALIBRATION : HEAT & TEMPERATURE

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
1. Temperature Indicator / Recorder / Controller Type K	-250 °C to -200 °C -200 °C to -100 °C -100 °C to +100 °C +100 °C to 600 °C +600 °C to +1372 °C	0.66 °C 0.32 °C 0.23 °C 0.28 °C 0.32 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
1. Temperature Indicator / Recorder / Controller Type J	-210 °C to -100 °C -100 °C to +800 °C +800 °C to +1000 °C +1000 °C to +1200 °C	0.30 °C 0.23 °C 0.26 °C 0.28 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
1. Temperature Indicator / Recorder / Controller Type T	-250 °C to -200 °C -200 °C to -100 °C -100 °C to 0 °C 0 °C to +400 °C	0.68 °C 0.32 °C 0.27 °C 0.21 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
1. Temperature Indicator / Recorder / Controller Type E	-250 °C to -200 °C -200 °C to -100 °C -100 °C to 100 °C 100 °C to 1000 °C	0.66 °C 0.26 °C 0.21 °C 0.25 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
1. Temperature Indicator / Recorder / Controller Type B	500 °C to 800 °C 800 °C to 1000 °C 1000 °C to 1400 °C 1400 °C to 1820 °C	0.63 °C 0.47 °C 0.39 °C 0.43 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
1. Temperature Indicator / Recorder / Controller Type N	-200 °C to -100 °C -100 °C to 900 °C 900 °C to 1100 °C 1100 °C to 1300 °C	0.67 °C 0.32 °C 0.26 °C 0.21 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
1. Temperature Indicator / Recorder / Controller Pt100 (pt385 & Pt392)	-200 °C to -100 °C -100 °C to 100 °C 100 °C to 630 °C 630 °C to 850 °C	0.18 °C 0.13 °C 0.23 °C 0.34 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90

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Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
2. Temperature Sensors Thermocouple / Temperature Probe	0.0 °C 20 °C 20 °C to 50 °C 50 °C to 200 °C 200 °C to 420 °C 420 °C to 550 °C 550 °C to 660 °C	0.074 °C 0.08 °C 0.085 °C 0.30 °C 0.31 °C 0.35 °C 0.37 °C	Comparison with Dry Block RTD Probe & ICE Point PRT Probe
2. Temperature Sensors Pt100	0.01 °C 20 °C to 50 °C 50 °C to 100 °C 100 °C to 200 °C 200 °C to 420 °C	0.0057 °C 0.035 °C 0.10 °C 0.11 °C 0.14 °C	Comparison with Standard PRT Probe in calibration Triple Point of Water Cell & Dry Block
3. Temperature & Humidity Indicator Thermohygrograph / Thermohygrometer	20 °C to 40 °C 41 °C to 60 °C	0.68 °C 1.7 °C	Comparison with Reference Temperature & Humidity Meter in Temperature Chamber
	30 %RH to 95 %RH	2.4 %RH	Comparison with Reference Temperature & Humidity Meter in Temperature Chamber
4. Temperature Calibrator / Simulator Type K	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 1000 °C 1000 °C to 1372 °C	0.33 °C 0.18 °C 0.16 °C 0.26 °C 0.40 °C	By electrical measurement using Temperature Calibrator
4. Temperature Calibrator / Simulator Type J	-210 °C to -100 °C -100 °C to -30 °C -30 °C to 150 °C 150 °C to 760 °C 760 °C to 1200 °C	0.27 °C 0.16 °C 0.14 °C 0.17 °C 0.23 °C	By electrical measurement using Temperature Calibrator
4. Temperature Calibrator / Simulator Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.63 °C 0.24 °C 0.16 °C 0.14 °C	By electrical measurement using Temperature Calibrator
4. Temperature Calibrator / Simulator Type E	-250 °C to -100 °C -100 °C to -25 °C -25 °C to 350 °C 350 °C to 650 °C 650 °C to 1000 °C	0.50 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °C	By electrical measurement using Temperature Calibrator

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Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
4. Temperature Calibrator / Simulator Type B	600 °C to 800 °C 800 °C to 1000 °C 1000 °C to 1550 °C 1550 °C to 1820 °C	0.44 °C 0.34 °C 0.30 °C 0.33 °C	By electrical measurement using Temperature Calibrator
4. Temperature Calibrator / Simulator Type N	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 410 °C 410 °C to 1300 °C	0.40 °C 0.22 °C 0.19 °C 0.18 °C 0.27 °C	By electrical measurement using Temperature Calibrator

SITE LOCATION (HQ)	1. CATEGORY I
FIELD(S) OF CALIBRATION :	ELECTRICAL,HEAT & TEMPERATURE

SCOPE OF CALIBRATION : ELECTRICAL

Material / Product Tested	**Type Of Test / Properties Measured / Range Of Measurement**	**Standard Test Methods / Equipment / Techniques**	**Remarks**
Indicating Instrument 1. Dc Voltage	0 V to 200 mV 0.22 V to 2.2 V 2.2 V to 11 V 11 V to 22 V 22 V to 220 V 220 V to 1100 V	6.0 µV/V + 5.1 nV 1.8 µV/V + 0.052 nV 1.4 µV/V + 0.77 nV 1.2 µV/V + 42 nV 2.5 µV/V + 5.2 nV 2.0 µV/V + 64 nV	Generation using Fluke 5730A Calibrator
Indicating Instrument 2. Dc High Voltage	1000 V to 5000 V 5000 V to 10,000 V	8.6 mV/V + 0.33 mV 20.9 mV/V + 0.038 mV	10 kV DC High Voltage Source Compare with Vitrek 4700 Precision High Voltage Meter
Indicating Instrument 3. Dc Current	0 to 220 mA 0.22 mA to 2.2 mA 2.2 mA to 22 mA 22 mA to 220 mA 0.22 A to 2.2 A	11 µA/A + 4.8 pA 11 µA/A + 1.1 pA 11 µA/A + 11 pA 15 µA/A + 77 pA 28 µA/A + 0.41 nA	Generation using Fluke 5730A Calibrator

Material / Product Tested	**Type Of Test / Properties Measured / Range Of Measurement**	**Standard Test Methods / Equipment / Techniques**	**Remarks**
	0 µA to 330 µA 0.33 mA to 3.3 mA 3.3 mA to 33 mA 33 mA to 3.3 A 0 to 10 A 10 A to 20 A	14 µA/A + 6.0 nA 4.9 µA/A + 68 nA 4.9 µA/A + 0.76 µA 53 µA/A + 55 µA 41 µA/A + 0.61 mA 79 µA/A + 0.38 mA	Generation using Fluke 5522A Calibrator
	0 A to 500 A	5 mA/A + 0.51 A	Generation using calibrator model Fluke 5500A & 50 turn coil
Indicating Instrument 4. Ac Voltage	0.22 mV to 220 V 220 V to 1050 V	Refer Matrix P1 Refer Matrix P2 & P3	Generation using Fluke 5730A & Wavetek 9100
Indicating Instrument 5.ac Current	0 µA to 10.5 A	(See Matrix Q)	Generation using calibrator model Wavetek 9100
	2.2 µA to 2.2 A	(See Matrix R)	Generation using calibrator model Fluke 5700A
	110 A to 200 A @ 65 Hz to 440 Hz 110 A to 500 A @ 45 Hz to 65 Hz	5.1 mA/A + 0.51 A 5 mA/A + 0.5 A	Generation using calibrator model Fluke 5500A & 50 turn coil.
Indicating Instrument 6. Dc Power	0.0109 mW to 11 kW	(See Matrix S)	Generation using Calibrator model Fluke 5500A
Indicating Instrument 7. Ac Power	0.0109 mW to 11 kW @ 10 Hz to 10 kHz	(See Matrix T) Power Factor = 1	Generation using Calibrator model Fluke 5500A
Indicating Instrument 8. Dc Resistance (specific Value)	1 m? 10 m? 100 m? 1 ? 10 ? 100 ? 1 k? 10 k? 100 k?	0.87 u? 11 u? 0.11 m? 1.1 m? 3.9 m? 32 m? 0.32 ? 3.2 ? 32 ?	Generation using Standard Resistor model Agilent 42030A (4-Terminal Resistance set)

Material / Product Tested	Type Of Test / Properties Measured / Range Of Measurement	Standard Test Methods / Equipment / Techniques	Remarks
	1 -„¦ 1.9 -„¦ 10 -„¦ 19 -„¦ 100 -„¦ 190 -„¦ 1 k-„¦ 1.9 k-„¦ 10 k-„¦ 19 k-„¦ 100 k-„¦ 190 k-„¦ 1 M-„¦ 1.9 M-„¦ 10 M-„¦ 19 M-„¦ 100 M-„¦	20 µ-„¦ 22 µ-„¦ 90 µ-„¦ 0.17 m-„¦ 0.25 m-„¦ 0.42 m-„¦ 3.2 m-„¦ 4.4 m-„¦ 20 m-„¦ 39 m-„¦ 0.24 -„¦ 0.78 -„¦ 5.0 -„¦ 7.9 -„¦ 0.13 k-„¦ 0.29 k-„¦ 7.4 k-„¦	Generation using Fluke 5730A Calibrator
Indicating Instrument 9. Dc Resistance	0 ? to 40 ? 40 ? to 400 ? 400 ? to 4 k? 4 k? to 40 k? 40 k? to 400 k? 400 k? to 4 M? 4 M? to 40 M? 40 M? to 400 M?	0.57 m?/? + 23 m? 0.17 m?/? + 25 m? 0.17 m?/? + 0.1 ? 0.17 m?/? + 1 ? 0.20 m?/? + 12 ? 0.22 m?/? + 0.14 k? 0.56 m?/? + 2.4 k? 0.64 m?/? + 64 k?	Generation using calibrator model Wavetek 9100
Indicating Instrument 10. Dc Resistance At High Voltage (25 V To 5 Kv)	See Matrix U	(See Matrix U)	Generation using Decade Resistance model IET HRRS
Indicating Instrument 11. Ac Resistance (specific Value)	10 -„¦ 100 -„¦ 1 k-„¦ 10 k-„¦ 100 k-„¦	(See Matrix V)	Generation using Standard Resistor model Agilent 42030A (4-Terminal Resistance set)
Indicating Instrument 12. Capacitance	0.5 nF to 40 mF	(See Matrix W)	Generation using calibrator model Wavetek 9100
Indicating Instrument 13. Capacities (specific Value)	1 pF 10 pF 100 pF 1000 pF 10 nF 100 nF 1 µF	(See Matrix X)	Generation using Standard Capacitor model Agilent 16380A & 16380C (4-Terminal Capacitor Set)
Indicating Instrument 14. Resistance	1 ?	9 µ?	Generation using Fluke 742A-1 ohm
	10 k?	7 µ?	Generation using Fluke 742A-10 kohm

Material / Product Tested	Type Of Test / Properties Measured / Range Of Measurement	Standard Test Methods / Equipment / Techniques	Remarks
Oscilloscope 15. Bandwidth	100 mHz to 100 MHz 100.01 MHz to 550 MHz 550.01 MHz to 1.1 GHz	22 mHz/Hz 34 mHz/Hz 43 mHz/Hz	Generation using calibrator model Fluke 9500/9510
	1 GHz to 3 GHz 3 GHz to 6 GHz	34 mHz/Hz + 1.2 MHz 48 mHz/Hz + 0.35 MHz	Generation using Oscilloscope Calibrator model Fluke 9500B & 9560
Oscilloscope 16. Time Base	@100 mV to 500 mV 180.19 ps – 450 ps 450 ps – 900 ps 0.9 ns – 9 ns @100 mV to 1 V 9 ns - 100 ns 0.1 µs - 10 µs 10 µs - 100 µs 0.1 ms - 10 ms 10 ms - 100 ms 0.1 s - 10 s 10 s - 55 s	0.38 ns/s + 0.072 ps 0.77 ns/s + 0.079 ps 0.48 ns/s + 1.1 ps 0.063 ns/s + 79 ps 0.060 ns/s + 7.2 ns 0.063 ns/s + 79 ns 0.057 ns/s + 7.9 us 0.063 ns/s + 79 us 0.057 ns/s + 7.9 ms 0.046 ns/s + 57 ms	Generation using calibrator model Fluke 9500/9560
Oscilloscope 17. Amplitude	35 µV to 222 V	(See Matrix Y)	Generation using calibrator model Fluke 9500 & 9510/9560
	35 µV to 222 V	(See Matrix Z)	Generation using calibrator model Fluke 9500 & 9510/9560
Source 1.dc Voltage	0 mV to 100 mV 0.1 V to 1 V 1 V to 10 V 10 V to 100 V 100 V to 1000 V	8.8 µV/V + 0.49 µV 8.2 µV/V + 0.44 µV 8.3 µV/V + 0.93 µV 11 µV/V + 77 µV 24 µV/V + 29 µV	Measurement using Multimeter model Agilent 3458A
Source 2. Dc High Voltage	0.1 kV to 1 kV 1 kV to 4 kV 4 kV to 10 kV	0.036 mV/V + 0.0043 V 0.10 mV/V + 0.026 V 0.11 mV/V + 0.0086 V	Direct Measurement Using Vitrek 4700 Precision High Voltage Meter
	1kV to 5 kV 5 kV to 10 kV	0.11 mV/V + 0.024 V 0.076 mV/V + 0.55 V	Direct Measurement Using Vitrek 4700 Precision High Voltage Meter + HVL-70 High Voltage Probe
Source 3. Ac Voltage	0 to 1000 V	(See Matrix AA)	Measurement using Multimeter model Wavetek 1281

Material / Product Tested	**Type Of Test / Properties Measured / Range Of Measurement**	**Standard Test Methods / Equipment / Techniques**	**Remarks**
Source 4. Ac High Voltage	@50/60 Hz 0 to 1 kV 1 kV to 10 kV @400 Hz 0 to 1 kV	0.058 mV/V + 0.0057 V 0.42 mV/V + 0.0057 V 0.022 mV/V + 0.077 V	Direct measurement using Vitrek 4700 Precision High Voltage Meter
	@50/60 Hz 1 kV to 5 kV 5 kV to 15 kV	0.42 mV/V + 0.0047 V 0.28 mV/V + 0.18 V	Direct measurement using Vitrek 4700 Precision High Voltage Meter + HVL-70 High Voltage Probe
Source 5. Dc Current	0 to 100 nA 0.1 µA to 1.0 µA 1 µA to 10 µA 10 µA to 100 µA 0.1 mA to 1 mA 1 mA to 10 mA 10 mA to 100 mA 0.1 A to 1 A	97 µA/A + 0.61 pA 15 µA/A + 0.16 pA 7.2 µA/A + 0.033 pA 2.7 µA/A + 0.98 pA 1.9 µA/A + 12 pA 15 µA/A + 43 pA 3.1 µA/A + 2.3 µA 6.9 µA/A + 5.2 µA	Measurement using Agilent 3458A Digital Multimeter (Opt 002)
	1 A to 10 A 10 A to 20 A 20 A to 30 A	16 µA/A + 0.40 mA 48 µA/A + 0.25 mA 0.57 mA/A + 18 µA	Measurement using Multimeter & Current shunt model Agilent 3458A & 34330A
	30 A to 50 A 50 A to 100 A 100 A to 200 A 200 A to 300 A	46 µA/A + 0.72 mA 60 µA/A + 0.41 mA 71 µA/A + 0.21 mA 71 µA/A + 0.14 mA	Measurement using Multimeter & Current shunt model Agilent 3458A & Guideline 9230/1000
Source 6. Ac Current	0 A to 2 A	(See Matrix AB)	Measurement using Multimeter model Wavetek 1281
	2 A to 10 A	(See Matrix AB)	Measurement using Multimeter & Current Shunt model Wavetek 1281 & 4953
	@50/60 Hz 1 A to 10 A @50/60 Hz 10 A to 30 A	75 mA/A + 2.1 nA 0.12 mA/A + 0.30 nA	Direct measurement using Fluke 8588A reference Multimeter

Material / Product Tested	Type Of Test / Properties Measured / Range Of Measurement	Standard Test Methods / Equipment / Techniques	Remarks
Source 7. Dc Resistance	0 to 10 ? 10 ? to 100 ? 0.1 k? to 1 k? 1 k? to 10 k? 10 k? to 100 k? 0.1 M? to 1 M? 1 M? to 10 M? 10 M? to 100 M? 0.1 G? to 1 G?	0.17 m?/? + 6.1 m? 1.2 m?/? + 0.88 m? 0.66 m?/? + 16 m? 0.43 m?/? + 0.24 m? 0.71 m?/? + 1.5 m? 3.0 m?/? + 2.7 m? 7.4 m?/? + 15 m? 38 m?/? + 0.16 ? 0.14 m?/? + 0.26 ?	Measurement using Agilent 3458A Digital Multimeter (Opt 002)
Source 8. Capacitance	1 pF to 100 mF	(See Matrix AC)	Measurement using HP 4263A LCR Meter
Radio Frequency (rf) 1. Frequency (indicating)	0.1 Hz to 100 Hz 0.1 kHz to 100 kHz 0.1 MHz to 100 MHz 0.1 GHz to 9 GHz	1.2 pHz/Hz + 0.79 µHz 0.12 nHz/Hz + 0.81 µHz 0.13 nHz/Hz + 0.12 µHz 0.13 nHz/Hz + 30 µHz	Generation using Signal Generator model Agilent 33250A, E8663B & SRS FS725 Rubidium Standard (Reference)
Radio Frequency (rf) 2. Rf Power (source)	-30 dBm to 20 dBm (1 µW to 100 mW into 50 -„¦)	(See Matrix AD)	Measurement using Power Meter & Power Sensor model Agilent EPM441A & 8482A
Radio Frequency (rf) 3. Frequency (source)	100 mHz to 1 Hz 1 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 10 kHz 10 kHz to 100 kHz 100 kHz to 1 MHz 1 MHz to 10 MHz 10 MHz to 100 MHz 100 MHz to 1 GHz 1 GHz to 2.7 GHz	83 nHz/Hz + 1.9 nHz 56 nHz/Hz + 2.9 µHz 85 nHz/Hz + 0.26 µHz 84 nHz/Hz + 11 µHz 83 nHz/Hz + 0.23 mHz 83 nHz/Hz + 1.9 mHz 84 nHz/Hz + 11 mHz 83 nHz/Hz + 0.23 Hz 83 nHz/Hz + 1.9 Hz 77 nHz/Hz + 31 Hz	Measurement using Frequency Counter model Fluke PM6680B
	300 MHz – 12.4 GHz	17 nHz/Hz	Measurement using Frequency Counter & model Agilent 53132A and SRS FS725 Rubidium Standard (Reference)
Time 1. Timer	1 s to 100 s 100 s to 400 s	38 µs/s + 30 µs 34 µs/s + 1.8 ms	Measurement using DSO7104A Oscilloscope

SCOPE OF CALIBRATION : HEAT & TEMPERATURE

Material / Product Tested	Type Of Test / Properties Measured / Range Of Measurement	Standard Test Methods / Equipment / Techniques	Remarks
1. Temperature Indicator / Recorder / Controller Type K	-200 °C to -100 °C -100 °C to -25 °C -25 °C to +120 °C +120 °C to +1000 °C +1000 °C to +1372 °C	0.38 °C 0.22 °C 0.19 °C 0.30 °C 0.46 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
1. Temperature Indicator / Recorder / Controller Type J	-210 °C to -100 °C -100 °C to –30 °C -30 °C to +150 °C +150 °C to +760 °C +760 °C to +1200 °C	0.32 °C 0.19 °C 0.17 °C 0.21 °C 0.27 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
1. Temperature Indicator / Recorder / Controller Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to +120 °C +120 °C to +400 °C	0.72 °C 0.28 °C 0.19 °C 0.17 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
1. Temperature Indicator / Recorder / Controller Type E	-250 °C to -100 °C -100 °C to -25 °C -25 °C to 350 °C 350 °C to 650 °C 650 °C to 1000 °C	0.50 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
1. Temperature Indicator / Recorder / Controller Type B	600 °C to 800 °C 800 °C to 1000 °C 1000 °C to 1550 °C 1550 °C to 1820 °C	0.44 °C 0.34 °C 0.30 °C 0.33 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
1. Temperature Indicator / Recorder / Controller Type N	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 410 °C 410 °C to 1300 °C	0.40 °C 0.22 °C 0.19 °C 0.18 °C 0.27 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
1. Temperature Indicator / Recorder / Controller Pt100 (pt385 & Pt392)	-200 °C to -100 °C -100 °C to 100 °C 100 °C to 630 °C 630 °C to 850 °C	0.18 °C 0.13 °C 0.23 °C 0.34 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
2. Temperature Sensor Thermocouple / Temperature Probe	0.0 °C 50 °C to 200 °C 200 °c to 420 °C 420 °C to 550 °C 550 °C to 660 °C	0.074 °C 0.30 °C 0.31 °C 0.35 °C 0.37 °C	Comparison with Dry Block RTD Probe & ICE Point PRT Probe

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Material / Product Tested	Type Of Test / Properties Measured / Range Of Measurement	Standard Test Methods / Equipment / Techniques	Remarks
3. Temperature Calibrator / Simulator Type K	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 1000 °C 1000 °C to 1372 °C	0.33 °C 0.18 °C 0.16 °C 0.26 °C 0.40 °C	By Electrical measurement using Temperature Calibrator
3. Temperature Calibrator / Simulator Type J	-210 °C to -100 °C -100 °C to -30 °C -30 °C to 150 °C 150 °C to 760 °C 760 °C to 1200 °C	0.27 °C 0.16 °C 0.14 °C 0.17 °C 0.23 °C	By Electrical measurement using Temperature Calibrator
3. Temperature Calibrator / Simulator Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.63 °C 0.24 °C 0.16 °C 0.14 °C	By Electrical measurement using Temperature Calibrator
3. Temperature Calibrator / Simulator Type E	-250 °C to -100 °C -100 °C to -25 °C -25 °C to 350 °C 350 °C to 650 °C 650 °C to 1000 °C	0.50 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °C	By Electrical measurement using Temperature Calibrator
3. Temperature Calibrator / Simulator Type B	600 °C to 800 °C 800 °C to 1000 °C 1000 °C to 1550 °C 1550 °C to 1820 °C	0.44 °C 0.34 °C 0.30 °C 0.33 °C	By Electrical measurement using Temperature Calibrator
3. Temperature Calibrator / Simulator Type N	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 410 °C 410 °C to 1300 °C	0.40 °C 0.22 °C 0.19 °C 0.18 °C 0.27 °C	By Electrical measurement using Temperature Calibrator
4. Temperature Controlled Enclosure Temperature Controlled Enclosure	-20 °C to 100 °C 100 °C to 400 °C	1.9 °C 2.0 °C	Calibration using Thermocouple Sensor & meter (Based on G-20 Document Thailand)

SITE LOCATION (HQ)	2. CATEGORY II
FIELD(S) OF CALIBRATION :	ELECTRICAL,HEAT & TEMPERATURE

SCOPE OF CALIBRATION : ELECTRICAL

Material / Product Tested	**Type Of Test / Properties Measured / Range Of Measurement**	**Standard Test Methods / Equipment / Techniques**	**Remarks**
Indicating Instrument 1. Dc Voltage	0 V to 200 mV 0.22 V to 2.2 V 2.2 V to 11 V 11 V to 22 V 22 V to 220 V 220 V to 1100 V	6.0 µV/V + 5.1 nV 1.8 µV/V + 0.052 nV 1.4 µV/V + 0.77 nV 1.2 µV/V + 42 nV 2.5 µV/V + 5.2 nV 2.0 µV/V + 64 nV	Generation using Fluke 5730A Calibrator
Indicating Instrument 2. Dc High Voltage	1000 V to 5000 V 5000 V to 10,000 V	8.6 mV/V + 0.33 mV 20.9 mV/V + 0.038 mV	10 kV DC High Voltage Source Compare with Vitrek 4700 Precision High Voltage Meter
Indicating Instrument 3. Dc Current	0 to 220 mA 0.22 mA to 2.2 mA 2.2 mA to 22 mA 22 mA to 220 mA 0.22 A to 2.2 A	11 µA/A + 4.8 pA 11 µA/A + 1.1 pA 11 µA/A + 11 pA 15 µA/A + 77 pA 28 µA/A + 0.41 nA	Generation using Fluke 5730A Calibrator
	0 µA to 330 µA 0.33 mA to 3.3 mA 3.3 mA to 33 mA 33 mA to 3.3 A 0 to 10 A 10 A to 20 A	14 µA/A + 6.0 nA 4.9 µA/A + 68 nA 4.9 µA/A + 0.76 µA 53 µA/A + 55 µA 41 µA/A + 0.61 mA 79 µA/A + 0.38 mA	Generation using Fluke 5522A Calibrator
	0 A to 500 A	5 mA/A + 0.51 A	Generation using calibrator model Fluke 5500A & 50 turn coil
Indicating Instrument 4. Ac Voltage	0.22 mV to 220 V 220 V to 1050 V	Refer Matrix AE1 Refer Matrix AE2 & AE3	Generation using Fluke 5730A & Wavetek 9100
Indicating Instrument 5.ac Current	0 µA to 10.5 A	(See Matrix AF)	Generation using calibrator model Wavetek 9100
	2.2 µA to 2.2 A	(See Matrix AG)	Generation using calibrator model Fluke 5700A
	110 A to 200 A @ 65 Hz to 440 Hz 110 A to 500 A @ 45 Hz to 65 Hz	5.1 mA/A + 0.51 A 5 mA/A + 0.5 A	Generation using calibrator model Fluke 5500A & 50 turn coil.
Indicating Instrument 6. Dc Power	0.0109 mW to 11 kW	(See Matrix AH)	Generation using Calibrator model Fluke 5500A
Indicating Instrument 7. Ac Power	0.0109 mW to 11 kW @ 10 Hz to 10 kHz	(See Matrix AI) Power Factor = 1	Generation using Calibrator model Fluke 5500A

Material / Product Tested	Type Of Test / Properties Measured / Range Of Measurement	Standard Test Methods / Equipment / Techniques	Remarks
Indicating Instrument 8. Dc Resistance (specific Value)	1 m? 10 m? 100 m? 1 ? 10 ? 100 ? 1 k? 10 k? 100 k?	0.87 u? 11 u? 0.11 m? 1.1 m? 3.9 m? 32 m? 0.32 ? 3.2 ? 32 ?	Generation using Standard Resistor model Agilent 42030A (4-Terminal Resistance set)
	1 -„¦ 1.9 -„¦ 10 -„¦ 19 -„¦ 100 -„¦ 190 -„¦ 1 k-„¦ 1.9 k-„¦ 10 k-„¦ 19 k-„¦ 100 k-„¦ 190 k-„¦ 1 M-„¦ 1.9 M-„¦ 10 M-„¦ 19 M-„¦ 100 M-„¦	20 µ-„¦ 22 µ-„¦ 90 µ-„¦ 0.17 m-„¦ 0.25 m-„¦ 0.42 m-„¦ 3.2 m-„¦ 4.4 m-„¦ 20 m-„¦ 39 m-„¦ 0.24 -„¦ 0.78 -„¦ 5.0 -„¦ 7.9 -„¦ 0.13 k-„¦ 0.29 k-„¦ 7.4 k-„¦	Generation using Fluke 5730A Calibrator
Indicating Instrument 9. Resistance	1 ?	9 m?	Generation using Fluke 742A-1 ohm
	10 k?	7 m?	Generation using Fluke 742A-10 kohm
Indicating Instrument 10. Dc Resistance	0 ? to 40 ? 40 ? to 400 ? 400 ? to 4 k? 4 k? to 40 k? 40 k? to 400 k? 400 k? to 4 M? 4 M? to 40 M? 40 M? to 400 M?	0.57 m?/? + 23 m? 0.17 m?/? + 25 m? 0.17 m?/? + 0.1 ? 0.17 m?/? + 1 ? 0.20 m?/? + 12 ? 0.22 m?/? + 0.14 k? 0.56 m?/? + 2.4 k? 0.64 m?/? + 64 k?	Generation using calibrator model Wavetek 9100
Indicating Instrument 11. Dc Resistance At High Voltage (25 V To 5 Kv)	See Matrix AJ	(See Matrix AJ)	Generation using Decade Resistance model IET HRRS
Indicating Instrument 12. Ac Resistance (specific Value)	10 -„¦ 100 -„¦ 1 k-„¦ 10 k-„¦ 100 k-„¦	(See Matrix AK)	Generation using Standard Resistor model Agilent 42030A (4-Terminal Resistance set)

Material / Product Tested	**Type Of Test / Properties Measured / Range Of Measurement**	**Standard Test Methods / Equipment / Techniques**	**Remarks**
Indicating Instrument 13. Capacitance	0.5 nF to 40 mF	(See Matrix AL)	Generation using calibrator model Wavetek 9100
Indicating Instrument 14. Capacitance (specific Value)	1 pF 10 pF 100 pF 1000 pF 10 nF 100 nF 1 µF	(See Matrix AM)	Generation using Standard Capacitor model Agilent 16380A & 16380C (4-Terminal Capacitor Set)
Oscilloscope 15. Bandwidth	100 mHz to 100 MHz 100.01 MHz to 550 MHz 550.01 MHz to 1.1 GHz	22 mHz/Hz 34 mHz/Hz 43 mHz/Hz	Generation using calibrator model Fluke 9500/9510
	1 GHz to 3 GHz 3 GHz to 6 GHz	34 mHz/Hz + 1.2 MHz 48 mHz/Hz + 0.35 MHz	Generation using Oscilloscope Calibrator model Fluke 9500B & 9560
Oscilloscope 16. Time Base	@100 mV to 500 mV 180.19 ps – 450 ps 450 ps – 900 ps 0.9 ns – 9 ns @100 mV to 1 V 9 ns - 100 ns 0.1 µs - 10 µs 10 µs - 100 µs 0.1 ms - 10 ms 10 ms - 100 ms 0.1 s - 10 s 10 s - 55 s	0.38 ns/s + 0.072 ps 0.77 ns/s + 0.079 ps 0.48 ns/s + 1.1 ps 0.063 ns/s + 79 ps 0.060 ns/s + 7.2 ns 0.063 ns/s + 79 ns 0.057 ns/s + 7.9 us 0.063 ns/s + 79 us 0.057 ns/s + 7.9 ms 0.046 ns/s + 57 ms	Generation using calibrator model Fluke 9500/9560
Oscilloscope 17. Amplitude	35 µV to 222 V	(See Matrix AN)	Generation using calibrator model Fluke 9500 & 9510/9560
	35 µV to 222 V	(See Matrix AO)	Generation using calibrator model Fluke 9500 & 9510/9560
Source 1.dc Voltage	0 mV to 100 mV 0.1 V to 1 V 1 V to 10 V 10 V to 100 V 100 V to 1000 V	8.8 µV/V + 0.49 µV 8.2 µV/V + 0.44 µV 8.3 µV/V + 0.93 µV 11 µV/V + 77 µV 24 µV/V + 29 µV	Measurement using Multimeter model Agilent 3458A

Material / Product Tested	Type Of Test / Properties Measured / Range Of Measurement	Standard Test Methods / Equipment / Techniques	Remarks
Source 2. Dc High Voltage	0.1 kV to 1 kV 1 kV to 4 kV 4 kV to 10 kV	0.036 mV/V + 0.0043 V 0.10 mV/V + 0.026 V 0.11 mV/V + 0.0086 V	Direct Measurement Using Vitrek 4700 Precision High Voltage Meter
	1 kV to 5 kV 5 kV to 10 kV	0.11 mV/V + 0.024 V 0.076 mV/V + 0.55 V	Direct Measurement Using Vitrek 4700 Precision High Voltage Meter + HVL-70 High Voltage Probe
Source 3. Ac Voltage	0 to 1000 V	(See Matrix AP)	Measurement using Multimeter model Wavetek 1281
Source 4. Ac High Voltage	@ 50/60 Hz 0 to 1 kV 1 kV to 10 kV	 0.058 mV/V + 0.0057 V 0.42 mV/V + 0.0057 V	Direct Measurement Using Vitrek 4700 Precision High Voltage Meter
	@ 400 Hz 0 to 1 kV @ 50/60 Hz 1 kV to 5 kV 5 kV to 15 kV	0.022 mV/V + 0.077 V 0.42 mV/V + 0.0047 V 0.28 mV/V + 0.18 V	Direct Measurement Using Vitrek 4700 Precision High Voltage Meter + HVL-70 High Voltage Probe
Source 5. Dc Current	0 to 100 nA 0.1 µA to 1.0 µA 1 µA to 10 µA 10 µA to 100 µA 0.1 mA to 1 mA 1 mA to 10 mA 10 mA to 100 mA 0.1 A to 1 A	97 µA/A + 0.61 pA 15 µA/A + 0.16 pA 7.2 µA/A + 0.033 pA 2.7 µA/A + 0.98 pA 1.9 µA/A + 12 pA 15 µA/A + 43 pA 3.1 µA/A + 2.3 µA 6.9 µA/A + 5.2 µA	Measurement using Agilent 3458A Digital Multimeter (Opt 002)
	1 A to 10 A 10 A to 20 A 20 A to 30 A	16 µA/A + 0.40 mA 48 µA/A + 0.25 mA 0.57 mA/A + 18 uA	Measurement using Multimeter & Current shunt model Agilent 3458A & 34330A
	30 A to 50 A 50 A to 100 A 100 A to 200 A 200 A to 300 A	46 µA/A + 0.72 mA 60 µA/A + 0.41 mA 71 µA/A + 0.21 mA 71 µA/A + 0.14 mA	Measurement using Multimeter & Current shunt model Agilent 3458A & Guildine 9230/1000
Source 6. Ac Current	0 to 2 A	(See Matrix AQ)	Measurement using Multimeter model Wavetek 1281

Material / Product Tested	Type Of Test / Properties Measured / Range Of Measurement	Standard Test Methods / Equipment / Techniques	Remarks
	2 A to 10 A	(See Matrix AQ)	Measurement using Multimeter & Current Shunt model Wavetek 1281 & 4953
	@50/60 Hz 1 A to 10 A @50/60 Hz 10 A to 30 A	75 mA/A + 2.1 nA 0.12 mA/A + 0.30 nA	Direct measurement using Fluke 8588A reference Multimeter
Source 7. Dc Resistance	0 to 10 -„¦ 10 -„¦ to 100 -„¦ 0.1 k-„¦ to 1 k-„¦ 1 k-„¦ to 10 k-„¦ 10 k-„¦ to 100 k-„¦ 0.1 M-„¦ to 1 M-„¦ 1 M-„¦ to 10 M-„¦ 10 M-„¦ to 100 M-„¦ 0.1 G-„¦ to 1 G-„¦	0.17 µ-„¦/-„¦ + 6.1 µ-„¦ 1.2 µ-„¦/-„¦ + 0.88 µ-„¦ 0.66 µ-„¦/-„¦ + 16 µ-„¦ 0.43 µ-„¦/-„¦ + 0.24 m-„¦ 0.71 µ-„¦/-„¦ + 1.5 m-„¦ 3.0 µ-„¦/-„¦ + 2.7 m-„¦ 7.4 µ-„¦/-„¦ + 15 m-„¦ 38 µ-„¦/-„¦ + 0.16 -„¦ 0.14 m-„¦/-„¦ + 0.26 -„¦	Measurement using Agilent 3458A Digital Multimeter (Opt 002)
Source 8. Capacitance	1 pF to 100 mF	(See Matrix AR)	Measurement using HP 4263A LCR Meter
Radio Frequency (rf) 1. Frequency (indicating)	0.1 Hz to 100 Hz 0.1 kHz to 100 kHz 0.1 MHz to 100 MHz 0.1 GHz to 9 GHz	1.2 pHz/Hz + 0.79 µHz 0.12 nHz/Hz + 0.81 µHz 0.13 nHz/Hz + 0.12 µHz 0.13 nHz/Hz + 30 µHz	Generation using Signal Generator model Agilent 33250A, E8663B & SRS FS725 Rubidium Standard (Reference)
Radio Frequency (rf) 2. Rf Power (source)	-30 dBm to 20 dBm (1 mW to 100 mW into 50 ?)	(See Matrix AS)	Measurement using Power Meter & Power Sensor model Agilent EPM441A & 8482A
Radio Frequency (rf) 3. Frequency (source)	100 mHz to 1 Hz 1 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 10 kHz 10 kHz to 100 kHz 100 kHz to 1 MHz 1 MHz to 10 MHz 10 MHz to 100 MHz 100 MHz to 1 GHz 1 GHz to 2.7 GHz	83 nHz/Hz + 1.9 nHz 56 nHz/Hz + 2.9 mHz 85 nHz/Hz + 0.26 mHz 84 nHz/Hz + 11 mHz 83 nHz/Hz + 0.23 mHz 83 nHz/Hz + 1.9 mHz 84 nHz/Hz + 11 mHz 83 nHz/Hz + 0.23 Hz 83 nHz/Hz + 1.9 Hz 77 nHz/Hz + 31 Hz	Measurement using Frequency Counter model Fluke PM6680B

Material / Product Tested	Type Of Test / Properties Measured / Range Of Measurement	Standard Test Methods / Equipment / Techniques	Remarks
	300 MHz – 12.4 GHz	17 nHz/Hz	Measurement using Frequency Counter & model Agilent 53132A and SRS FS725 Rubidium Standard (Reference)
Time 1. Timer	1 s to 100 s 100 s to 400 s	38 µs/s + 30 µs 34 µs/s + 1.8 ms	Measurement using DSO7104A Oscilloscope

SCOPE OF CALIBRATION : HEAT & TEMPERATURE

Material / Product Tested	Type Of Test / Properties Measured / Range Of Measurement	Standard Test Methods / Equipment / Techniques	Remarks
1. Temperature Indicator / Recorder / Controller Type K	-200 °C to -100 °C -100 °C to -25 °C . -25 °C to +120 °C +120 °C to +1000 °C +1000 °C to +1372 °C	0.38 °C 0.22 °C 0.19 °C 0.30 °C 0.46 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
1. Temperature Indicator / Recorder / Controller Type J	-210 °C to -100 °C -100 °C to -30 °C -30 °C to +150 °C +150 °C to +760 °C +760 °C to +1200 °C	0.32 °C 0.19 °C 0.17 °C 0.21 °C 0.27 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
1. Temperature Indicator / Recorder / Controller Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to +120 °C +120 °C to +400 °C	0.72 °C 0.28 °C 0.19 °C 0.17 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
1. Temperature Indicator / Recorder / Controller Type E	-250 °C to -100 °C -100 °C to -25 °C -25 °C to 350 °C 350 °C to 650 °C 650 °C to 1000 °C	0.50 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90

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Material / Product Tested	Type Of Test / Properties Measured / Range Of Measurement	Standard Test Methods / Equipment / Techniques	Remarks
1. Temperature Indicator / Recorder / Controller Type B	600 °C to 800 °C 800 °C to 1000 °C 1000 °C to 1550 °C 1550 °C to 1820 °C	0.44 °C 0.34 °C 0.30 °C 0.33 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
1. Temperature Indicator / Recorder / Controller Type N	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 410 °C 410 °C to 1300 °C	0.40 °C 0.22 °C 0.19 °C 0.18 °C 0.27 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
1. Temperature Indicator / Recorder / Controller Pt100 (pt385 & Pt392)	-200 °C to -100 °C -100 °C to 100 °C 100 °C to 630 °C 630 °C to 850 °C	0.18 °C 0.13 °C 0.23 °C 0.34 °C	By electrical simulation using Temperature Calibrator and reference table to ITS-90
2. Temperature Sensor Thermocouple / Temperature Probe	0.0 °C 50 °C to 200 °C 200 °c to 420 °C 420 °C to 550 °C 550 °C to 660 °C	0.074 °C 0.30 °C 0.31 °C 0.35 °C 0.37 °C	Comparison with Dry Block RTD Probe & ICE Point PRT Probe
3. Temperature Calibrator / Simulator Type K	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 1000 °C 1000 °C to 1372 °C	0.33 °C 0.18 °C 0.16 °C 0.26 °C 0.40 °C	By Electrical measurement using Temperature Calibrator
3. Temperature Calibrator / Simulator Type J	-210 °C to -100 °C -100 °C to -30 °C -30 °C to 150 °C 150 °C to 760 °C 760 °C to 1200 °C	0.27 °C 0.16 °C 0.14 °C 0.17 °C 0.23 °C	By Electrical measurement using Temperature Calibrator
3. Temperature Calibrator / Simulator Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.63 °C 0.24 °C 0.16 °C 0.14 °C	By Electrical measurement using Temperature Calibrator
3. Temperature Calibrator / Simulator Type E	-250 °C to -100 °C -100 °C to -25 °C -25 °C to 350 °C 350 °C to 650 °C 650 °C to 1000 °C	0.50 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °C	By Electrical measurement using Temperature Calibrator
3. Temperature Calibrator / Simulator Type B	600 °C to 800 °C 800 °C to 1000 °C 1000 °C to 1550 °C 1550 °C to 1820 °C	0.44 °C 0.34 °C 0.30 °C 0.33 °C	By Electrical measurement using Temperature Calibrator

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Valid Until: -

NO: SAMM 122

Material / Product Tested	Type Of Test / Properties Measured / Range Of Measurement	Standard Test Methods / Equipment / Techniques	Remarks
3. Temperature Calibrator / Simulator Type N	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 410 °C 410 °C to 1300 °C	0.40 °C 0.22 °C 0.19 °C 0.18 °C 0.27 °C	By Electrical measurement using Temperature Calibrator