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SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty ($\pm$)*	Remarks
Sourcing Instruments			
DC voltage	100 mV to 1 V 1 V to 10 V 10 V to 100 V 100 V to 1000 V	0.030 mV/V 0.025 mV/V 0.032 mV/V 0.035 mV/V	Direct measurement method
AC voltage	0 mV to 10 V (Refer The Matrix A)	(Refer The Matrix A)	
	10 V to 750 V (Refer The Matrix B)	(Refer The Matrix B)	
Resistance	100 Ω to 1 k Ω 1 k Ω to 10 k Ω 10 k Ω to 100 k Ω 100 k Ω to 1 M Ω 1 M Ω to 10 M Ω 10 M Ω to 100 M Ω	0.07 m Ω / Ω 0.07 m Ω / Ω 0.07 m Ω / Ω 0.08 m Ω / Ω 0.3 m Ω / Ω 5 m Ω / Ω	
DC current	10 mA to 100 mA 100 mA to 1 A 1 A to 3 A	0.33 μ A/A 0.66 mA/A 0.87 mA/A	
AC current	At 1 kHz 0 A to 1 A 1 A to 3 A	0.9 mA/A 1.4 mA/A	

Matrix A
AC voltage (Generator (Source))

Range		kHz			
		0.01 to 20	20 to 50	50 to 100	100 to 300
10 V	0 mV to 10 V	0.55 mV/V	0.99 mV/V	4.2 mV/V	30 mV/V

Matrix B
AC voltage (Generator (Source))

Range		kHz			
		0.04 to 1	-	-	-
750 V	10 V to 750 V	0.06 mV/V	-	-	-

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Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty ($\pm$)*	Remarks
Withstanding / Insulation Tester High voltage (measure) DC voltage AC voltage Cut-off current High voltage (source) DC voltage AC voltage	1 kV to 10 kV At 50 Hz 1 kV to 10 kV 0.5 mA to 10 mA 10 mA to 50 mA 1 kV to 10 kV At 50 Hz 1 kV to 10 kV	7 mV/V 13 mV/V 65 μ A/A 14 μ A/A 12 mV/V 16 mV/V	Direct measurement method
Measuring instruments LCR Indicating Meter Resistance Capacitance Inductance	0 Ω to 100 Ω 100 Ω to 1 k Ω 1 k Ω to 10 k Ω 10 k Ω to 100 k Ω 100 k Ω to 1 M Ω 1 M Ω to 10 M Ω 10 M Ω to 100 M Ω 100 pF to 900 pF 1 nF to 9 nF 10 nF to 90 nF 100 nF to 900 nF 1 μ F to 9 μ F 100 μ H to 1000 μ H 1 mH to 10 mH 10 mH to 100 mH 100 mH to 1000 mH	9.9 m Ω / Ω 0.9 m Ω / Ω 0.8 m Ω / Ω 0.9 m Ω / Ω 1.7 m Ω / Ω 1.5 m Ω / Ω 1.5 m Ω / Ω 8.3 mF/F 7.2 mF/F 6.1 mF/F 6.1 mF/F 8.9 mF/F 7 mH/H 7 mH/H 7 mH/H 0.6 mH/H	Using decade resistance, decade capacitance and decade inductance

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Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty ($\pm$)*	Remarks
Measuring / Indicating instruments a) DC voltage b) AC voltage	0 mV to 320 mV 320 mV to 3.2 V 3.2 V to 32 V 32 V to 320 V 320 V to 1050 V 0 mV to 105 V (Refer Matrix C) 105 V to 1050 V (Refer Matrix D)	0.063 μ V/V 0.063 mV/V 0.063 mV/V 0.063 mV/V 0.070 mV/V (Refer Matrix C) (Refer Matrix D)	Generation using calibrator model Wavetek 9100 / Fluke 5522 A

Matrix C
AC voltage (Indicating instruments)

Range		kHz				
		0.01 to 3	3 to 10	10 to 30	30 to 50	50 to 100
320 mV	0 mV to 320 mV	0.3 μ V/V	0.31 μ V/V	0.5 μ V/V	0.75 μ V/V	1.8 μ V/V
3.2 V	0.32 V to 3.2 V	0.3 mV/V	0.31 mV/V	0.5 mV/V	0.75 mV/V	1.8 mV/V
32 V	3.2 V to 32 V	0.3 mV/V	0.47 mV/V	0.59 mV/V	1.2 mV/V	2.7 mV/V
105 V	32 V to 105 V	0.3 mV/V	0.42 mV/V	0.57 mV/V	1.2 mV/V	2.9 mV/V

Matrix D
AC voltage (Indicating instruments)

Range		kHz					
		0.04 to 0.1	0.1 to 1	1 to 3	3 to 10	10 to 20	20 to 30
320 V	105 V to 320 V	0.41 mV/V	0.41 mV/V	0.56 mV/V	0.59 mV/V	0.84 mV/V	1.1 mV/V
800 V	320 V to 800 V	0.38 mV/V	0.38 mV/V	0.54 mV/V	0.56 mV/V	-	-
1050 V	800 V to 1050 V	0.29 mV/V	0.29 mV/V	0.41 mV/V	0.43 mV/V	-	-

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Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty ($\pm$)*	Remarks
Measuring / Indicating instruments c) DC current d) AC current	0 A to 320 μ A 0.32 mA to 3.2 mA 3.2 mA to 32 mA 32 mA to 320 mA 0.32 A to 3.2 A 3.2 A to 10.5 A 3.2 μA to 10 A (Refer Matrix E)	0.013 μ A/A 0.13 μ A/A 0.13 μ A/A 0.14 μ A/A 0.41 mA/A 0.4 mA/A (Refer Matrix E)	Generation using calibrator model Wavetek 9100 / Fluke 5522A

Matrix E
AC current (Indicating instruments)

Range		kHz			
		0.01 to 3	3 to 10	10 to 20	20 to 30
320 μ A	32 μ A to 320 μ A	0.10 μ A/A	0.18 μ A/A	0.5 μ A/A	0.72 μ A/A
3.2 mA	0.32 mA to 3.2 mA	0.59 μ A/A	4.7 μ A/A	5 μ A/A	5.7 μ A/A
32 mA	3.2 mA to 32 mA	0.56 μ A/A	0.84 μ A/A	1.5 μ A/A	2 μ A/A
320 mA	32 mA to 320 mA	0.63 μ A/A	0.81 μ A/A	1.4 μ A/A	1.8 μ A/A
3.2 A	0.32 A to 3.2 A	0.75 mA/A	2 mA/A	-	-
10 A	3.2 A to 10 A	1.6 mA/A	3.8 mA/A	-	-

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Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty ($\pm$)*	Remarks
Measuring / Indicating instruments			
e) Resistance	0 Ω to 40 Ω 40 Ω to 400 Ω 0.4 k Ω to 4 k Ω 4 k Ω to 40 k Ω 40 k Ω to 400 k Ω 0.4 M Ω to 4 M Ω 4 M Ω to 40 M Ω 40 M Ω to 400 M Ω	0.63 m Ω/Ω 0.12 m Ω/Ω 0.11 m Ω/Ω 0.11 m Ω/Ω 0.12 m Ω/Ω 0.14 m Ω/Ω 0.38 m Ω/Ω 0.45 m Ω/Ω	Generation using calibrator model Wavetek 9100 / Fluke 5522A
f) Capacitance	0.5 nF to 4 nF 4 nF to 40 nF 40 nF to 400 nF 400 nF to 4 μ F 4 μ F to 40 μ F 40 μ F to 400 μ F 400 μ F to 4 mF 4 mF to 40 mF	4.5 mF/F 2.3 mF/F 2.4 mF/F 3 mF/F 3.5 mF/F 3.5 mF/F 3.5 mF/F 7.5 mF/F	

Signatory:**1. Manivannan A/L Subramaniam**

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SCOPE OF CALIBRATION: ELECTRICAL

SITE: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty ($\pm$)*	Remarks
Sourcing Instruments			Direct measurement methods
a) DC voltage	1 mV to 100 mV 100 mV to 1 V 1 V to 10 V 10 V to 100 V 100 V to 1000 V	0.059 μ V/V 0.034 mV/V 0.029 mV/V 0.037 mV/V 0.039 mV/V	Measurement been made by using Fluke 8845A Precision Multimeter
b) AC voltage	1 mV to 750 V (Refer Matrix F)	(Refer Matrix F)	

Matrix F
AC voltage (Generator (Source))

Range		kHz					
		0.003 to 0.005	0.005 to 0.01	0.01 to 20	20 to 50	50 to 100	100 to 300
100 mV	1 mV to 100 mV	0.51 μ V/V	6.2 μ V/V	6.2 μ V/V	6.2 μ V/V	6.2 μ V/V	9.2 μ V/V
1 V	100 mV to 1 V	0.37 mV/V	0.37 mV/V	0.26 mV/V	0.37 mV/V	0.84 mV/V	3.2 mV/V
10 V	1 V to 10 V	0.38 mV/V	0.38 mV/V	0.32 mV/V	0.42 mV/V	1.2 mV/V	1.2 mV/V
100 V	10 V to 100 V	0.23 mV/V	0.23 mV/V	0.33 mV/V	0.38 mV/V	2.7 mV/V	2.7 mV/V
750 V	100 V to 750 V	0.36 mV/V	0.36 mV/V	0.36 mV/V	0.36 mV/V	0.36 mV/V	0.36 mV/V

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SCOPE OF CALIBRATION: ELECTRICAL**SITE: CATEGORY I**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty ($\pm$)*	Remarks
Sourcing Instruments			Direct measurement methods
c) Resistance	10 $\mu\Omega$ to 100 Ω 100 Ω to 1 k Ω 1 k Ω to 10 k Ω 10 k Ω to 100 k Ω 100 k Ω to 1 M Ω 1 M Ω to 10 M Ω 10 M Ω to 100 M Ω	0.93 m Ω/Ω 0.07 m Ω/Ω 0.072 m Ω/Ω 0.072 m Ω/Ω 0.074 m Ω/Ω 0.029 m Ω/Ω 4.9 m Ω/Ω	Measurement been made by using Fluke 8845A Precision Multimeter
d) DC current	100 μ A to 1 mA 1 mA to 10 mA 10 mA to 100 mA 100 mA to 400 mA 400 mA to 1 A 1 A to 3 A 3 A to 10 A	0.36 μ A/A 0.44 μ A/A 0.35 μ A/A 0.35 μ A/A 0.49 mA/A 0.8 mA/A 1.2 mA/A	
e) AC current	100 μA to 10 A (Refer Matrix G)	(Refer Matrix G)	

Matrix G
AC current (Generator (Source))

Range		kHz			
		0.003 to 0.005	0.005 to 0.01	0.01 to 5	5 to 10
1 mA	100 μ A to 1 mA	22 μ A/A	22 μ A/A	22 μ A/A	22 μ A/A
10 mA	1 mA to 10 mA	7.1 μ A/A	2.6 μ A/A	1.7 μ A/A	6.6 μ A/A
100 mA	10 mA to 100 mA	6.5 μ A/A	2.2 μ A/A	1.9 μ A/A	4.1 μ A/A
400 mA	100 mA to 400 mA	6.5 μ A/A	2.4 μ A/A	1.3 μ A/A	5.5 μ A/A
1 A	400 mA to 1 A	6.2 mA/A	2.2 mA/A	7.2 mA/A	32 mA/A
3 A	1 A to 3 A	7.4 mA/A	2.3 mA/A	18 mA/A	19 mA/A
10 A	3 A to 10 A	6.9 mA/A	2.6 mA/A	1.9 mA/A	5.2 mA/A

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SCOPE OF CALIBRATION: ELECTRICAL**SITE: CATEGORY I**

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty ($\pm$)*	Remarks
Measuring / Indicating instruments (Measure) LCR indicating meter			Direct measurement methods
a) Resistance	0 Ω to 100 Ω 100 Ω to 1 k Ω 1 k Ω to 10 k Ω 10 k Ω to 100 k Ω 100 k Ω to 1 M Ω 1 M Ω to 10 M Ω 10 M Ω to 100 M Ω	9.9 m Ω/Ω 0.9 m Ω/Ω 0.8 m Ω/Ω 0.9 m Ω/Ω 1.7 m Ω/Ω 1.5 m Ω/Ω 1.5 m Ω/Ω	Generation using decade resistors box
b) Capacitance	100 pF to 900 pF 1 nF to 9 nF 10 nF to 90 nF 100 nF to 900 nF 1 μ F to 9 μ F	8.3 mF/F 7.2 mF/F 6.1 mF/F 6.1 mF/F 8.9 mF/F	Generation using decade capacitance box
c) Inductance	100 μ H to 1000 μ H 1 mH to 10 mH 10 mH to 100 mH 100 mH to 1000 mH	7 mH/H 7 mH/H 7 mH/H 0.6 mH/H	Generation using decade inductance box
Withstanding / Insulation Tester High voltage (Source)			
a) DC voltage	0 kV to 10 kV	7 mV/V	The measurement are measured using high voltage digital meter TOS-149-10A
b) AC voltage	0 kV to 10 kV (at 50 / 60 Hz)	13 mV/V	
c) Cut-off current	0.5 mA to 1 mA 1 mA to 2 mA 2 mA to 5 mA 5 mA to 10 mA 10 mA to 50 mA	65 μ A/A 65 μ A/A 65 μ A/A 65 μ A/A 14 μ A/A	The measurement are measured using current calibrator TOS-1200

Signatory:**1. Manivannan A/L Subramaniam**