

Schedule

Techsystems Services & Integration Asia Pte Ltd
2 Loyang Lane #06-03
Loyang Industrial Estate
Singapore 508913

Certificate No. : LA-2000-0175-C

Issue No. : 29

Date : 17 July 2023

Expiry of Certificate : 30 June 2025

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FIELD OF TESTING : Calibration and Measurement

MEASURED QUANTITIES/INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD/FREQUENCY	CALIBRATION AND MEASUREMENT CAPABILITY (CMC*)
1 DC Voltage		
1.1 Source	TS-08J	
0 mV ~ 100 mV	Direct measurement with	0.0017 % + 0.40 μ V
0.1 V ~ 1 V	Precision Multimeter	0.0008 % + 0.40 μ V
1 V ~ 10 V		0.0008 % + 1.0 μ V
10 V ~ 100 V		0.0010 % + 37 μ V
100 V ~ 1000 V		0.0025 % + 0.30 mV
1.2 Measurement	TS-41A	
10 V	Comparison with a calibrated Standard Zener diode, Potentiometric Measurement	93 μ V
0 mV ~ 220 mV	TS-08J	0.00080 % + 0.5 μ V
0.22 V ~ 2.2 V	Direct measurement of DC	0.00050 % + 1.0 μ V
2.2 V ~ 11 V	Voltage sourced by Multifunction	0.00040 % + 3.0 μ V
11 V ~ 22 V	Calibrator	0.00040 % + 6.0 μ V
22 V ~ 220 V		0.00060 % + 50 μ V
220 V ~ 1100 V		0.00070 % + 500 μ V

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MEASURED QUANTITIES/INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD/FREQUENCY	CALIBRATION AND MEASUREMENT CAPABILITY (CMC*)
2 AC Voltage 2.1 Source	TS-42A Direct measurement with Precision Multimeter	
1 mV ~ 10 mV	10 Hz ~ 20 Hz 20 Hz ~ 40 Hz 40 Hz ~ 100 Hz 100 Hz ~ 20 kHz 20 kHz ~ 50 kHz 50 kHz ~ 100 kHz 100 kHz ~ 250 kHz	(% reading + floor) 0.47 % + 37 μ V 0.18 % + 29 μ V 0.070 % + 29 μ V 0.030 % + 29 μ V 0.18 % + 37 μ V 0.81 % + 41 μ V 4.7 % + 81 μ V
10 mV ~ 100 mV	10 Hz ~ 20 Hz 20 Hz ~ 40 Hz 40 Hz ~ 100 Hz 100 Hz ~ 20 kHz 20 kHz ~ 50 kHz 50 kHz ~ 100 kHz 100 kHz ~ 250 kHz 250 kHz ~ 500 kHz 500 kHz ~ 1 MHz 1 MHz ~ 2 MHz	0.47 % + 24 μ V 0.18 % + 24 μ V 0.070 % + 12 μ V 0.030 % + 12 μ V 0.18 % + 47 μ V 0.70 % + 93 μ V 2.4 % + 0.58 mV 3.5 % + 0.70 mV 6.0 % + 2.4 mV 12 % + 6.0 mV
0.1 V ~ 1 V	10 Hz ~ 20 Hz 20 Hz ~ 40 Hz 40 Hz ~ 100 Hz 100 Hz ~ 20 kHz 20 kHz ~ 50 kHz 50 kHz ~ 100 kHz 100 kHz ~ 250 kHz 250 kHz ~ 500 kHz 500 kHz ~ 1 MHz 1 MHz ~ 2 MHz	0.47 % + 0.24 mV 0.18 % + 0.24 mV 0.070 % + 0.12 mV 0.030 % + 0.12 mV 0.18 % + 0.47 mV 0.70 % + 0.93 mV 2.4 % + 5.8 mV 3.5 % + 7.0 mV 5.8 % + 24 mV 12 % + 58 mV

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1 V ~ 10 V	10 Hz ~ 20 Hz	0.47 % + 2.4 mV
	20 Hz ~ 40 Hz	0.18 % + 2.4 mV
	40 Hz ~ 100 Hz	0.070 % + 1.2 mV
	100 Hz ~ 20 kHz	0.040 % + 1.2 mV
	20 kHz ~ 50 kHz	0.18 % + 4.7 mV
	50 kHz ~ 100 kHz	0.70 % + 9.3 mV
	100 kHz ~ 250 kHz	2.4 % + 58 mV
	250 kHz ~ 500 kHz	3.5 % + 70 mV
	500 kHz ~ 1 MHz	5.8 % + 240 mV
1 MHz ~ 2 MHz	12 % + 470 mV	
10 V ~ 100 V	10 Hz ~ 20 Hz	0.47 % + 24 mV
	20 Hz ~ 40 Hz	0.18 % + 24 mV
	40 Hz ~ 100 Hz	0.070 % + 12 mV
	100 Hz ~ 20 kHz	0.040 % + 12 mV
	20 kHz ~ 50 kHz	0.18 % + 47 mV
	50 kHz ~ 100 kHz	0.70 % + 93 mV
	100 kHz ~ 250 kHz	2.4 % + 0.58 V
	250 kHz ~ 500 kHz	3.5 % + 0.7 V
500 kHz ~ 1 MHz	5.8 % + 2.4 V	
100 V ~ 1000 V	10 Hz ~ 20 Hz	0.50 % + 0.35 V
	20 Hz ~ 40 Hz	0.20 % + 0.35 V
	40 Hz ~ 100 Hz	0.10 % + 0.24 V
	100 Hz ~ 20 kHz	0.070 % + 0.24 V
	20 kHz ~ 50 kHz	0.18 % + 0.47 V
	50 kHz ~ 100 kHz	0.70 % + 2.4 V

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2.2 Measurement	TS-08J-B Direct measurement of AC Voltage sourced by Multifunction Calibrator	
0.22 mV ~ 2.2 mV	10 Hz ~ 20 Hz 20 Hz ~ 40 Hz 40 Hz ~ 20 kHz 20 kHz ~ 50 kHz 50 kHz ~ 100 kHz 100 kHz ~ 300 kHz 300 kHz ~ 500 kHz 500 kHz ~ 1 MHz	0.024 % + 5.0 μ V 0.0090 % + 5.0 μ V 0.0080 % + 5.0 μ V 0.020 % + 5.0 μ V 0.050 % + 6.0 μ V 0.11 % + 20 μ V 0.14 % + 30 μ V 0.27 % + 50 μ V
2.2 mV ~ 22 mV	10 Hz ~ 20 Hz 20 Hz ~ 40 Hz 40 Hz ~ 20 kHz 20 kHz ~ 50 kHz 50 kHz ~ 100 kHz 100 kHz ~ 300 kHz 300 kHz ~ 500 kHz 500 kHz ~ 1 MHz	0.024 % + 5.0 μ V 0.0090 % + 5.0 μ V 0.0080 % + 5.0 μ V 0.020 % + 5.0 μ V 0.050 % + 6.0 μ V 0.11 % + 20 μ V 0.14 % + 30 μ V 0.27 % + 30 μ V
22 mV ~ 220 mV	10 Hz ~ 20 Hz 20 Hz ~ 40 Hz 40 Hz ~ 20 kHz 20 kHz ~ 50 kHz 50 kHz ~ 100 kHz 100 kHz ~ 300 kHz 300 kHz ~ 500 kHz 500 kHz ~ 1 MHz	0.024 % + 20 μ V 0.0090 % + 20 μ V 0.0080 % + 10 μ V 0.020 % + 10 μ V 0.046 % + 20 μ V 0.090 % + 30 μ V 0.14 % + 30 μ V 0.27 % + 50 μ V
0.22 V ~ 2.2 V	10 Hz ~ 20 Hz 20 Hz ~ 40 Hz 40 Hz ~ 20 kHz 20 kHz ~ 50 kHz 50 kHz ~ 100 kHz 100 kHz ~ 300 kHz 300 kHz ~ 500 kHz 500 kHz ~ 1 MHz	0.024 % + 50 μ V 0.0090 % + 20 μ V 0.0050 % + 10 μ V 0.0080 % + 20 μ V 0.011 % + 40 μ V 0.042 % + 90 μ V 0.10 % + 210 μ V 0.17 % + 310 μ V

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2.2 V ~ 22 V	10 Hz ~ 20 Hz	0.024 % + 410 μ V
	20 Hz ~ 40 Hz	0.0090 % + 160 μ V
	40 Hz ~ 20 kHz	0.0050 % + 60 μ V
	20 kHz ~ 50 kHz	0.0080 % + 110 μ V
	50 kHz ~ 100 kHz	0.010 % + 210 μ V
	100 kHz ~ 300 kHz	0.028 % + 610 μ V
	300 kHz ~ 500 kHz	0.10 % + 3.0 mV
22 V ~ 220 V	500 kHz ~ 1 MHz	0.15 % + 4 mV
	10 Hz ~ 20 Hz	0.024 % + 5.0 mV
	20 Hz ~ 40 Hz	0.0090 % + 2.0 mV
	40 Hz ~ 20 kHz	0.0060 % + 1.0 mV
	20 kHz ~ 50 kHz	0.0080 % + 2.0 mV
220 V ~ 1000 V	50 kHz ~ 100 kHz	0.015 % + 3.0 mV
	40 Hz ~ 1 kHz	0.011 % + 5.0 mV
	1 kHz ~ 20 kHz	0.020 % + 8.0 mV
220 V ~ 750 V	20 kHz ~ 30 kHz	0.072 % + 14 mV
	30 kHz ~ 50 kHz	0.070 % + 14 mV
220 V ~ 350 V	50 kHz ~ 100 kHz	0.30 % + 60 mV

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3. Resistance	TS-36F-C	
3.1 Measurement (specific value)	Measurement of calibrated resistance values from Standard Resistors	
1 mΩ		0.0010 mΩ
10 mΩ		0.0020 mΩ
100 mΩ		0.020 mΩ
0.1 Ω		3.0 μΩ
1 Ω		15 μΩ
10 Ω		80 μΩ
100 Ω		0.87 mΩ
1 kΩ		3.7 mΩ
10 kΩ		0.17 Ω
100 kΩ		0.56 Ω
1 MΩ		0.14 kΩ
10 MΩ		6.7 kΩ
100 MΩ		67 kΩ
1 GΩ		5.1 MΩ
10 GΩ		0.80 GΩ
100 GΩ		1.2 GΩ
1 TΩ		0.022 TΩ
1 Ω	TS-08J-D	0.10 mΩ
1.9 Ω	Measurement of calibrated resistance values from Multifunction Calibrator	0.19 mΩ
10 Ω		0.24 mΩ
19 Ω		0.45 mΩ
100 Ω		1.0 mΩ
190 Ω		1.9 mΩ
1 kΩ		8.6 mΩ
1.9 kΩ		17 mΩ
10 kΩ		86 mΩ
19 kΩ		0.17 Ω
100 kΩ		1.2 Ω
190 kΩ		2.1 Ω
1 MΩ		30 Ω
1.9 MΩ		80 Ω
10 MΩ		0.42 kΩ
19 MΩ		0.99 kΩ
100 MΩ		22 kΩ

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3.2 Measurement (variable value) 0 Ω ~ 11 Ω 11 Ω ~ 33 Ω 33 Ω ~ 110 Ω 110 Ω ~ 330 Ω 330 Ω ~ 1100 Ω 1.1 kΩ ~ 3.3 kΩ 3.3 kΩ ~ 11 kΩ 11 kΩ ~ 33 kΩ 33 kΩ ~ 110 kΩ 110 kΩ ~ 330 kΩ 330 kΩ ~ 1.1 MΩ 1.1 MΩ ~ 3.3 MΩ 3.3 MΩ ~ 11 MΩ 11 MΩ ~ 33 MΩ 33 MΩ ~ 110 MΩ 110 MΩ ~ 330 MΩ 330 MΩ ~1100 MΩ	TS-08J-D Measurement of resistance values generated by Multifunction Calibrator	13 mΩ 19 mΩ 21 mΩ 34 mΩ 83 mΩ 0.34 Ω 0.47 Ω 2.2 Ω 4.7 Ω 25 Ω 49 Ω 0.40 kΩ 2.0 kΩ 13 kΩ 68 kΩ 1.3 MΩ 17 MΩ
3.3 Source (variable value) 0 Ω ~ 10 Ω 10 Ω ~ 100 Ω 100 Ω ~ 1 kΩ 1 kΩ ~ 10 kΩ 10 kΩ ~ 100 kΩ 100 kΩ ~ 1 MΩ 1 MΩ ~ 10 MΩ 10 MΩ ~ 100 MΩ 100 MΩ ~ 1 GΩ 1 GΩ ~ 10 GΩ	TS-08J-D Resistance value measured by Precision DMM	240 μΩ 0.93 mΩ 17 mΩ 94 mΩ 0.93 Ω 20 Ω 0.33 kΩ 24 kΩ 0.64 MΩ 19 MΩ

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4. DC Current		
4.1 Source	TS-44A-C DC Current Source Measurement	
0 A ~ 1 A		0.0010 A
1 A ~ 20 A		0.010 A
20 A ~ 50 A	TS-44-A DC Current Source Measurement	0.26 A
4.2 Measurement	TS-08J-N	
0 μ A ~ 220 μ A	Measurement of current sourced by multifunction calibrator	0.0041 % + 6.1 nA
0.22 mA ~ 2.2 mA		0.0036 % + 8.0 nA
2.2 mA ~ 22 mA		0.0036 % + 0.050 μ A
22 mA ~ 220 mA		0.0046 % + 1.0 μ A
0.22 A ~ 1 A		0.0081 % + 23 μ A
1 A ~ 2.2 A		0.0081 % + 120 μ A
2.2 A ~ 11 A		0.060 % + 1.0 mA
11 A ~ 20 A		0.12 % + 1.8 mA
5. AC Current	TS-44A	
5.1 Source	Calibration of AC current using precision Multimeter	
10 μ A ~ 100 μ A	10 Hz – 20 Hz 20 Hz – 45 Hz 45 Hz – 100 Hz 100 Hz – 5 kHz	0.47 % + 0.035 μ A 0.18 % + 0.035 μ A 0.070 % + 0.035 μ A 0.070 % + 0.035 μ A
0.1 mA ~ 1 mA	10 Hz ~ 20 Hz 20 Hz ~ 45 Hz 45 Hz ~ 100 Hz 100 Hz ~ 5 kHz 5 kHz ~ 20 kHz	0.47 % + 0.24 μ A 0.18 % + 0.24 μ A 0.070 % + 0.24 μ A 0.040 % + 0.24 μ A 0.070 % + 0.24 μ A
1 mA ~ 10 mA	10 Hz ~ 20 Hz 20 Hz ~ 45 Hz 45 Hz ~ 100 Hz 100 Hz ~ 5 kHz 5 kHz ~ 20 kHz	0.47 % + 2.4 μ A 0.18 % + 2.4 μ A 0.070 % + 2.4 μ A 0.040 % + 2.4 μ A 0.070 % + 2.4 μ A

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10 mA ~ 100 mA	10 Hz ~ 20 Hz 20 Hz ~ 45 Hz 45 Hz ~ 100 Hz 100 Hz ~ 5 kHz 5 kHz ~ 20 kHz	0.47 % + 24 μ A 0.18 % + 24 μ A 0.070 % + 24 μ A 0.040 % + 24 μ A 0.070 % + 24 μ A
0.1 A ~ 1 A	10 Hz ~ 20 Hz 20 Hz ~ 45 Hz 45 Hz ~ 100 Hz 100 Hz ~ 5 kHz 5 kHz ~ 20 kHz TS-44A Transfer of calibrated current value	0.47 % + 240 μ A 0.19 % + 240 μ A 0.10 % + 240 μ A 0.12 % + 240 μ A 0.35 % + 240 μ A
1 A ~ 11 A	10 Hz ~ 100 Hz 100 Hz ~ 1 kHz 1 kHz ~ 5 kHz	0.17 % + 6.9 mA 0.17 % + 6.9 mA 0.17 % + 6.9 mA
11 A ~ 20 A	10 Hz ~ 100 Hz 100 Hz ~ 1 kHz 1 kHz ~ 5 kHz	0.090 % + 2.4 mA 0.090 % + 2.4 mA 0.29 % + 2.5 mA
5.2 Measurement	TS-44A Measurement of AC current generated by Multifunction Calibrator	
10 μ A ~ 220 μ A	10 Hz - 20 Hz 20 Hz - 40 Hz 40 Hz - 1 kHz 1 kHz - 5 kHz 5 kHz - 10 kHz	0.25 % + 17 nA 0.016 % + 11 nA 0.012 % + 9.0 nA 0.028 % + 13 nA 0.11 % + 66 nA
0.22 mA ~ 2.2 mA	10 Hz - 20 Hz 20 Hz - 40 Hz 40 Hz - 1 kHz 1 kHz - 5 kHz 5 kHz - 10 kHz	0.025 % + 0.050 μ A 0.016 % + 0.040 μ A 0.012 % + 0.040 μ A 0.020 % + 0.12 μ A 0.11 % + 0.66 μ A

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2.2 mA ~ 22 mA	10 Hz - 20 Hz 20 Hz - 40 Hz 40 Hz - 1 kHz 1 kHz - 5 kHz 5 kHz - 10 kHz	0.025 % + 0.50 μ A 0.016 % + 0.40 μ A 0.012 % + 0.40 μ A 0.020 % + 0.60 μ A 0.11 % + 5.1 μ A
22 mA ~ 220 mA	10 Hz - 20 Hz 20 Hz - 40 Hz 40 Hz - 1 kHz 1 kHz - 5 kHz 5 kHz - 10 kHz	0.025 % + 5.0 μ A 0.016 % + 4.0 μ A 0.012 % + 3.0 μ A 0.020 % + 4.0 μ A 0.11 % + 11 μ A
0.22 A ~ 2.2 A	20 Hz - 1 kHz 1 kHz - 5 kHz 5 kHz - 10 kHz	0.026 % + 40 μ A 0.045 % + 90 μ A 0.70 % + 170 μ A
2.2 A ~ 11 A	45 Hz ~ 100 Hz 100 Hz ~ 1 kHz 1 kHz ~ 5 kHz	0.070 % + 10 mA 0.12 % + 10 mA 3.5 % + 10 mA
11 A ~ 20 A	45 Hz ~ 100 Hz 100 Hz ~ 1 kHz 1 kHz ~ 5 kHz	1.1 % + 20 mA 0.40 % + 20 mA 3.5 % + 20 mA

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6. Capacitance Measurement		
5 nF	TS-36F-B	0.80 pF
10 nF	Direct measurement at 1 kHz	2.0 pF
50 nF	using standard capacitors	8.0 pF
100 nF		0.014 nF
500 nF		0.060 nF
1 μ F		0.13 nF
0.19 nF ~ 3.3 nF	Direct measurement	0.020 nF
3.3 nF ~ 110 nF	using Reference Calibrator	0.21 nF
110 nF ~ 330 nF		0.68 nF
0.33 μ F ~ 1.1 μ F		0.0030 μ F
1.1 μ F ~ 11 μ F		0.021 μ F
11 μ F ~ 110 μ F		0.32 μ F
110 μ F ~ 1.1 mF		0.0040 mF
1.1 mF ~ 11 mF		0.032 mF
11 mF ~ 110 mF		0.76 mF
7. Inductance Measurement	TS-36F-A	
100 μ H	Direct measurement at 1 kHz	0.22 μ H
1 mH	using standard inductors	0.0012 mH
10 mH		0.012 mH
100 mH		0.12 mH
1 H		0.0012 H
5 H		0.0011 H

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8. Frequency 10 MHz Timebase Frequency Output 0.1 Hz 1 kHz 1 MHz 100 MHz 225 MHz 1000 MHz ~ 26.5 GHz	TS-01J Comparison with Frequency Standard	5.8 E-10 1.3 E-02 1.4 E-09 8.7 E-08 8.7 E-06 6.9 E-10 1.2 E-07
9. High Voltage 1 kV to 10 kV	TS-06F Direct Measurement with a calibrated HV meter DC AC (50 ~ 60 Hz)	0.0030 kV 0.0080 kV

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10. Oscilloscope	TS-11G	
a. Vertical Deflection	DC Voltage output from Scope Calibrator	
1 mV to 10 V	50 Ω Input	0.90 % + 0.050 mV
1 mV to 60 V	1 M Ω Input	1.2 % + 0.030 mV
b. Horizontal Deflection	TS-11G	
10 msec (2 ns to 20 ms)	Time Marker output from Scope Calibrator	0.00083 %
100 msec (50 ms to 5 s)		0.00034 %
c. Vertical Bandwidth (Cut-off Frequency at 3 dB Bandwidth)	TS-11G	
50 kHz to 100 MHz	Levelled Sine output from Scope Calibrator	4.0 %
100 MHz to 300 MHz		5.0 %
300 MHz to 500 MHz		8.0 %
500 MHz to 600 MHz		9.0 %

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11. Temperature		
11.1 Thermocouple Thermometer	TS-26M-E (i) Measurement of temperature by simulation via Reference Calibrator	
<u>Type K</u> -200 °C ~ -100 °C -100 °C ~ 120 °C 120 °C ~ 1000 °C 1000 °C ~ 1300 °C		0.45 °C 0.30 °C 0.40 °C 0.50 °C
<u>Type J</u> -210 °C ~ -100 °C -100 °C ~ 760 °C 760 °C ~ 1200 °C		0.45 °C 0.25 °C 0.30 °C
<u>Type E</u> -250 °C ~ -100 °C -100 °C ~ 650 °C 650 °C ~ 1000 °C		0.65 °C 0.25 °C 0.30 °C
<u>Type T</u> -250 °C ~ -150 °C -150 °C ~ 0 °C 0 °C ~ 400 °C		0.80 °C 0.35 °C 0.30 °C

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<p>11.2 Temperature Calibrator</p> <p><u>Type K</u> -200 °C ~ -100 °C -100 °C ~ 120 °C 120 °C ~ 1000 °C 1000 °C ~ 1300 °C</p> <p><u>Type J</u> -210 °C ~ -100 °C -100 °C ~ 760 °C 760 °C ~ 1200 °C</p> <p><u>Type E</u> -250 °C ~ -100 °C -100 °C ~ 650 °C 650 °C ~ 1000 °C</p> <p><u>Type T</u> -250 °C ~ -150 °C -150 °C ~ 0 °C 0 °C ~ 400 °C</p>	<p>TS-26M-E (ii) Measurement of simulated temperature sourced by UUT</p>	<p>0.40 °C 0.25 °C 0.35 °C 0.50 °C</p> <p>0.35 °C 0.25 °C 0.30 °C</p> <p>0.65 °C 0.25 °C 0.30 °C</p> <p>0.80 °C 0.35 °C 0.35 °C</p>
<p>11.3 <u>RTD Thermometer</u></p> <p>-190 °C ~ 500 °C</p>	<p>TS-26M-D</p> <p>Measurement of RTD resistance and convert to temperature based on ITS90</p>	<p>0.06 °C</p>
<p>11.4 <u>RTD Simulator / Calibrator</u></p> <p>-190 °C ~ -50 °C -50 °C ~ 50 °C 50 °C ~ 190 °C 190 °C ~ 500 °C</p>	<p>TS-26M-C</p> <p>Measurement of RTD simulated temperature based on ITS90 or simulator formula</p>	<p>0.004 °C 0.005 °C 0.007 °C 0.012 °C</p>

* CMC is expressed as an expanded uncertainty estimated at a level of confidence of approximately 95 %.

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Approved signatories:

Mr Lim Beng Soon

-Electrical: 1 to 9 items only.
-Temperature: all items under category 11

Mr Bernard Chew Lit Min

-Electrical: 8 to 10 items only

Mr Randy Gee Chen Loong

-Electrical: 1 to 7 items only
-Temperature: all items under category 11

Note

This laboratory is accredited in accordance with the recognised International Standard ISO/IEC 17025. A laboratory's fulfilment 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 calibration results. 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.