

Schedule

Techsystems Services & Integration Asia Pte Ltd
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Loyang Industrial Estate
Singapore 508913

Certificate No. : LA-2000-0175-C
Issue No. : 13
Date : 12 June 2009
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SCOPE OF ACCREDITATION

FIELD OF TESTING : Calibration and Measurement

MEASURED QUANTITIES/INSTRUMENTS/RANGE TO BE CALIBRATED	METHOD	BEST MEASUREMENT CAPABILITY EXPRESSED AS AN UNCERTAINTY (±) *
1. DC Voltage Measuring Instrument 1 V 10 V 100 V 1000 V 100 µV to 10 V 10 V to 100 V 100 V to 1000 V	TS-99-1 Comparison with a calibrated Standard zener diode, Potentiometric Measurement Potentiometric Measurement	2.8 ppm 4.2 ppm 4.2 ppm 4.2 ppm 4.1 ppm + 0.4 µV 4.1 ppm + 3.5 µV 4.1 ppm + 35 µV
2. AC Voltage 2.1 Source	TS-99-2 Comparison with DC voltage Source through calibrated AD/DC transfer unit	
10 mV	1 kHz 50 kHz 1 MHz	330 ppm + 0.11 mV 350 ppm + 0.11 mV 1800 ppm + 0.11 mV
100 mV	1 kHz 50 kHz 1 MHz	63 ppm + 0.11 mV 120 ppm + 0.11 mV 750 ppm + 0.11 mV
1 V	1 kHz 50 kHz 1 MHz	24 ppm + 1.3 µV 49 ppm + 1.3 µV 530 ppm + 1.3 µV

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MEASURED QUANTITIES/INSTRUMENTS / RANGE TO BE CALIBRATED	METHOD	BEST MEASUREMENT CAPABILITY EXPRESSED AS AN UNCERTAINTY (\pm) *
10 V	1 kHz 20 kHz 50 kHz 1 MHz	28 ppm + 3.6 μ V 28 ppm + 3.6 μ V 49 ppm + 3.6 μ V 560 ppm + 3.6 μ V
19 V	1 kHz	28 ppm + 6.4 μ V
100 V	1 kHz 20 kHz	39 ppm + 57 μ V 77 ppm + 57 μ V
700 V	50 kHz	87 ppm + 448 μ V
1000 V	1 kHz	34 ppm + 448 μ V
	Direct measurement with Precision multimeter	(% of reading + % of range)
10 mV	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	0.035 % + 0.035 % 0.23 % + 0.013 % 0.035 % + 0.013 % 0.12 % + 0.013 % 0.58 % + 0.013 % 4.6 % + 0.023 %
100 mV, 1 V, 10 V	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	0.0081 % + 0.0046 % 0.0081 % + 0.0023 % 0.016 % + 0.0023 % 0.035 % + 0.0023 % 0.092 % + 0.0023 % 0.35 % + 0.012 % 1.2 % + 0.012 % 1.7 % + 0.012 %
100 V	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	0.023 % + 0.0046 % 0.023 % + 0.0023 % 0.023 % + 0.0023 % 0.040 % + 0.0023 % 0.14 % + 0.0023 % 0.46 % + 0.012 % 1.7% % + 0.012 %

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1000 V	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	0.046 % + 0.0046 % 0.046 % + 0.0023 % 0.069 % + 0.0023 % 0.14 % + 0.0023 % 0.35 % + 0.0023 %
2.2 Measure	Direct measurement with an AC Voltage source	
2.2 mV	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	240 ppm + 4 μ V 90 ppm + 4 μ V 80 ppm + 4 μ V 200 ppm + 4 μ V 500 ppm + 5 μ V 1100 ppm + 10 μ V 1400 ppm + 20 μ V 2700 ppm + 20 μ V
22 mV	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	240 ppm + 4 μ V 90 ppm + 4 μ V 80 ppm + 4 μ V 200 ppm + 4 μ V 500 ppm + 5 μ V 1100 ppm + 10 μ V 1400 ppm + 20 μ V 2700 ppm + 20 μ V
220 mV	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	240 ppm + 12 μ V 90 ppm + 7 μ V 80 ppm + 7 μ V 200 ppm + 7 μ V 460 ppm + 17 μ V 900 ppm + 20 μ V 1400 ppm + 25 μ V 2700 ppm + 45 μ V

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2.2 V	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	240 ppm + 40 μV 90 ppm + 15 μV 45 ppm + 8 μV 75 ppm + 10 μV 110 ppm + 30 μV 420 ppm + 80 μV 1000 ppm + 200 μV 1700 ppm + 300 μV
22 V	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	240 ppm + 400 μV 99 ppm + 150 μV 45 ppm + 50 μV 75 ppm + 100 μV 100 ppm + 200 μV 280 ppm + 600 μV 1000 ppm + 200 μV 1500 ppm + 3200 μV
220 V	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	240 ppm + 4 mV 90 ppm + 1.5 mV 52 ppm + 0.6 mV 80 ppm + 1 mV 150 ppm + 2.5 mV 900 ppm + 16 mV 4400 ppm + 40 mV 8000 ppm + 80 mV
1100 V	15 Hz to 50 Hz 50 Hz to 1 kHz	300 ppm + 12 mV 70 ppm + 3.5 mV
Direct Measurement with an AC Voltage source and amplifier which output is reference to a precision multimeter		

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750 V	1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	700 ppm + 2.3 mV 1400 ppm + 2.3 mV 3500 ppm + 2.3 mV
3. Resistor	TS-99-3 Direct comparison with a fixed resistor	
0.1 Ω 1 Ω 10 Ω 100 Ω 1 k Ω 10 k Ω 100 k Ω		36 $\mu\Omega$ 42 ppm 12 ppm 7.5 ppm 4.5 ppm 4.5 ppm 5.6 ppm
Range 0 Ω to 10 Ω 10 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 M Ω to 1 G Ω	Direct measurement with a calibrated multi-meter in four-wire mode	18 ppm + 58 $\mu\Omega$ 14 ppm + 58 $\mu\Omega$ 12 ppm + 580 $\mu\Omega$ 12 ppm + 5.8 m Ω 12 ppm + 58 m Ω 18 ppm + 2.3 Ω 58 ppm + 120 Ω 580 ppm + 1.2 k Ω 0.58 % + 12 k Ω
4. DC Current		
4.1 Source		
Range 0 to 100 nA 100 nA to 1 μ A 1 μ A to 10 μ A 10 μ A to 100 μ A	TS-99-4 Direct measurement with a precision multimeter	35 ppm + 46 pA 23 ppm + 46 pA 23 ppm + 0.12 nA 23 ppm + 0.92 nA

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100 μ A to 1 mA 1 mA to 10 mA 10 mA to 100 mA 100 mA to 1 A 1 A to 5 A 5 A to 10 A 10 A to 25 A 25 A to 50 A	Voltage measurement through a calibrated shunt	23 ppm + 5.8 pA 23 ppm + 58 pA 40 ppm + 0.58 μ A 13 ppm + 12 μ A 0.6 mA 1.2 mA 3.0 mA 5.9 mA
4.2 Measure 0 to 220 μ A 220 μ A to 2.2 mA 2.2 mA to 22 mA 22 mA to 220 mA 220 μ A to 2.2 A 2.2 A to 11 A	Direct measurement with a calibrator	40 ppm + 6nA 35 ppm + 7 nA 35 ppm + 40 nA 45 ppm + 0.7 μ A 80 ppm + 12 μ A 0.07 % + 390 μ A
5. AC Current 5.1 Source Range 0 to 100 μ A 100 μ A to 1 mA	TS-99-5 Direct Measurement with precision multimeter 10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 1 kHz 10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 5 kHz 5 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	0.46 % + 23 nA 0.17 % + 23 nA 0.07 % + 23 nA 0.46 % + 0.23 μ A 0.17 % + 0.23 μ A 0.07 % + 0.23 μ A 0.035 % + 0.23 μ A 0.07 % + 0.23 μ A 0.46 % + 0.46 μ A 0.64 % + 1.8 μ A

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1 mA to 10 mA	10 Hz to 20 Hz	0.46 % + 2.3 μ A
	20 Hz to 45 Hz	0.17 % + 2.3 μ A
	45 Hz to 100 Hz	0.07 % + 2.3 μ A
	100 Hz to 5 kHz	0.035 % + 2.3 μ A
	5 kHz to 20 kHz	0.07 % + 2.3 μ A
	20 kHz to 50 kHz	0.46 % + 4.6 μ A
	50 kHz to 100 kHz	0.64 % + 18 μ A
10 mA to 100 mA	10 Hz to 20 Hz	0.46 % + 23 μ A
	20 Hz to 45 Hz	0.17 % + 23 μ A
	45 Hz to 100 Hz	0.07 % + 23 μ A
	100 Hz to 5 kHz	0.035 % + 23 μ A
	5 kHz to 20 kHz	0.07 % + 23 μ A
	20 kHz to 50 kHz	0.46 % + 46 μ A
	50 kHz to 100 kHz	0.64% + 0.18 mA
100 mA to 1 A	10 Hz to 20 Hz	0.46 % + 0.23 mA
	20 Hz to 45 Hz	0.17 % + 0.23 mA
	45 Hz to 100 Hz	0.07 % + 0.23 mA
	100 Hz to 5 kHz	0.035 % + 0.23 mA
	5 kHz to 20 kHz	0.07 % + 0.23 mA
	20 kHz to 50 kHz	0.46 % + 0.46 mA
	Voltage measurement through a calibrated AC shunt	
1 A to 4 A	45 Hz to 2 kHz	1.2 % + 0.002A
4 A to 10 A	45 Hz to 2 kHz	1.2 % + 0.02 A

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5.2 Measure	Direct measurement with a calibrator	
Range		
0 to 220 μ A	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	250 ppm + 16 nA 160 ppm + 10 nA 120 ppm + 8 nA 280 ppm + 12 nA 1100 ppm + 65 nA
220 μ A to 2.2 mA	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	250 ppm + 40 nA 160 ppm + 35 nA 120 ppm + 35 nA 200 ppm + 110 nA 1100 ppm + 650 nA
2.2 mA to 22 mA	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	250 ppm + 400 nA 160 ppm + 350 nA 120 ppm + 350 nA 200 ppm + 550 nA 1100 ppm + 5000 nA
22 mA to 220 mA	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	250 ppm + 4 μ A 160 ppm + 3.5 μ A 120 ppm + 2.5 μ A 200 ppm + 3.5 μ A 1100 ppm + 10 μ A
220 mA to 2.2 A	20 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	260 ppm + 35 μ A 450 ppm + 80 μ A 7000 ppm + 160 μ A
2.2 A to 11 A	45 Hz to 65 Hz 65 Hz to 500 Hz 500 Hz to 1 kHz	0.07 % + 2.3 mA 0.12 % + 2.3 mA 0.39 % + 2.3 mA

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6. Capacitor	TS-99-6 Comparison with Fixed Value Capacitors	
5 nF	1 kHz	0.016 % + 0.06 pF
10 nF		0.02 % + 0.06 pF
50 nF		0.02 % + 0.06 pF
100 nF	Direct Measurement with a calibrated LCR meter	0.02 % + 0.6 pF
500 nF		0.02 % + 6 pF
1 μ F		0.02 % + 60 pF
Range		
1 pF	40 kHz	0.46 %
	100 kHz	0.37 %
10 pF	4 kHz	0.39 %
	10 kHz	0.22 %
	20 kHz	0.23 %
100 pF	400 Hz	0.47 %
	1 kHz	0.20 %
	2 kHz	0.16 %
	4 kHz	0.13 %
	10 kHz	0.12 %
	20 kHz	0.12 %
	40 kHz	0.10 %
100 kHz	0.10 %	

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1 nF	100 Hz / 120 Hz	0.29 %
	200 Hz	0.18 %
	400 Hz	0.13 %
	1 kHz	0.11 %
	2 kHz	0.10 %
	4 kHz	0.10 %
	10 kHz	0.09 %
	20 kHz	0.10 %
	40 kHz	0.10 %
	100 kHz	0.10 %
10 nF	Direct measurement with a Calibrated LCR meter	
	100 Hz / 120 Hz	0.11 %
	200 Hz	0.10 %
	400 Hz	0.10 %
	1 kHz	0.09 %
	2 kHz	0.09 %
	4 kHz	0.09 %
	10 kHz	0.09 %
	20 kHz	0.12 %
	40 kHz	0.12 %
100 nF	100 Hz / 120 Hz	0.09 %
	200 Hz	0.09 %
	400 Hz	0.09 %
	1 kHz	0.09 %
	2 kHz	0.09 %
	4 kHz	0.09 %
	10 kHz	0.09 %
	20 kHz	0.12 %
	40 kHz	0.12 %
	100 kHz	0.18 %