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LABORATORY LOCATION/ CENTRAL OFFICE:	Caltech Laboratory Sdn Bhd 51, Lebuh Bukit Kecil 2 Taman Sri Nibong 11900 Bayan Lepas, Pulau Pinang , 11900, PULAU PINANG MALAYSIA
ACCREDITED SINCE :	18 MARCH 2025
FIELD(S) OF CALIBRATION:	ELECTRICAL 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	Caltech Laboratory Sdn Bhd 51, Lebuh Bukit Kecil 2 Taman Sri Nibong 11900 Bayan Lepas, Pulau Pinang , 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**
(a) (ii) Square Wave Signal (in 1, 2, 5 Sequence)	50 Q load at 10 Hz to 10 kHz 1 mV to 24.999 mV 25 mV to 109.99 mV 110 mV to 2.1999 V 2.2V to6.6V	2.0 mV/V + 0.031 mV 2.0 mV/V + 0.031 mV 2.0 mV/V + 0.034 mV 2.0 mV/V + 0.074 mV	

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
	50 Q load at 10 Hz to 10 kHz 1 mV to 24.999 mV 25 mV to 109.99 mV 110 mV to 2.1999 V 2.2Vto6.6V	2.0 mV/V + 0.031 mV 2.0 mV/V + 0.031 mV 2.0 mV/V + 0.034 mV 2.0 mV/V + 0.074 mV	
(a1) Dc Voltage (a2) Dc Voltage (hipot)	0 to 100 mV 100 mV to1V 1Vto10V 10 V to 100 V 100 V to 1000 V to2 kV 2 kV to 20 kV	5.7 uV/V + 0.34 4.6 + 0.34 UV 4.6 + 0.57 6.8 + 0.034 mV 6.8 + 0.12 mV 0.46 mV/V + 0.46 V 0.46 mV/V + 4.6 V	HP 3458A, Vitrek 4620B
(b) Ac Cutoff Current (hipot)	0 mA to 30 mA at Frequency (Hz): 20 to 50 50 to 10k 10 k to 20k	16 mA/A + 7.7 pA 3.9 + 7.7 HA 16 mA/A + 16 PA	Fluke 45
	0 mA to 30 mA at Frequency (Hz): 20 to 50 50 to 10k 10 k to 20k	16 mA/A + 7.7 pA 3.9 + 7.7 HA 16 mA/A + 16	
(b) Ac Voltage	0 to 1000 V	See Matrix F	Fluke 5790A
	See Matrix C See Matrix D	See Matrix C See Matrix D	Generation using calibrator model
	See Matrix C See Matrix D	None	Fluke 5522 A &
	See Matrix C See Matrix D	None	Wavetek 9100
	10 mV to 700V (See Matrix C)	(See Matrix C)	
	10 mV to 700V (See Matrix G)	(See Matrix G)	
(b) Bandwidth	Hz): 50 k to 1000 k 600M 600 M to 1050 M 1050 4Gto26G	0.31 + 5.7 Hz 0.20 + 5.7 kHz 0.77 pHz/Hz + 5.7 Hz 2.3 pHz/Hz + 5.7 Hz 51 fHz/Hz + 0.57 kHz	Fluke 5520A (SC600), Agilent 8648D, HP 8673D, Novatech 2960AR
	Hz): 50 k to 1000 k 600M 600 M to 1050 M 1050 Mto4G 4Gto26G	0.31 + 5.7 Hz 0.20 + 5.7 kHz 0.77 pHz/Hz + 5.7 Hz 2.3 pHz/Hz + 5.7 Hz 51 fHz/Hz + 0.57 kHz	Fluke 5520A (SC600), Agilent 8648D, HP 8673D, Novatech 2960AR
(b) Dc Current	Oto2pA 2 pA to 20 pA 20 pA to 200 pA 200 pA to 2 nA 2 nA to 20 nA 20 nA to 200 nA	4.9 mA/A + 0.012 pA 4.3 mA/A + 0.012 pA 2.9 mA/A + 0.034 pA 0.74 mA/A + 0.12 pA 0.74 + 1.2 pA 0.40 mA/A + 0.012 nA	Generation using calibrator model Fluke 5700A, 5725A, 5520A, Keithley 263

Instrument Calibrated/Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
	0 to 329.999 LA 330 YA to 3.29999 mA 3.3 mA to 32.9999 mA 33 mA to 329.999 mA 330 mA to 1.09999 A 1.1 A to 2.99999 A 3 A to 10.9999 A	0.12 + 16 nA 77 + 24 nA 77 + 0.16 PA 77 + 1.6 PA 0.16 + 31 PA 0.29 +31 0.39 mA/A + 0.26 mA	
	+ 100 nA Range, nA to 120 nA)	34 + 47 pA	Measure using 8 % Digit Multimeter Keysight 3458A Opt. 002
	+ 1 yA Range pA to 1.2 yA)	24 + 47 pA	Measure using 8 % Digit Multimeter Keysight 3458A Opt. 002
	+ 10 pA Range, pA to 12 yA)	25 + 0.12 nA	Measure using 8 % Digit Multimeter Keysight 3458A Opt. 002
	+ 100 yA Range, + (10 pA to 120 yA)	19 +	Measure using 8 % Digit Multimeter Keysight 3458A Opt. 002
	Range, + (0.1 mA to 1.2mA)	22	Measure using 8 % Digit Multimeter Keysight 3458A Opt. 002
	+ 10 mA Range +(1 mA to 12 mA)	22 + 0.11	Measure using 8 % Digit Multimeter Keysight 3458A Opt. 002
	+ 100 mA Range, + (10 mA to 120 mA)	41 pA/A + 1.2 pA	Measure using 8 % Digit Multimeter Keysight 3458A Opt. 002
	+ 1A Range, + (0.1 A to 1.05 A)	0.12 + 23 pA	Measure using 8 % Digit Multimeter Keysight 3458A Opt. 002
	Range, +(1Ato3A)	0.14 + 69 pA	Measure using 6 % Digit Multimeter HP 34401A
	0 mA to 10 mA 10 mA to 100 mA 100 mA to 1000 mA 1Ato3A 3Ato20A	9.1 pA 72 pA 1.6 mA 5.7mA 6.0 mA	Measured using Multimeter HP 3458A & Active Shunt Ballantine 1625A

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
	20 A to 100A	20 mA	
	100.1 uA to 1 mA 1.1 mA to 10 mA	500 500	
	10.1 mA to 100 mA	500 pA/A	
	100.1 mAto1A	810	
	1.1Ato10A	1.30 mA/A	
	100.1 uA to 1 mA 1.1 mA to 10 mA	500 500	
	10.1 mA to 100 mA	500	
	100.1 mAto1A	810	
	1.1Ato10A	1.30 mA/A	
(b) Dc Current (cont?)	16.5A 150A	1.9mA/A 1.9mA/A +0.011A	Fluke 5520A with 50 Turn Coil
(b1) Ac Voltage	0 to 1000 V	See Matrix M	Fluke 5790A
(b2) Ac Voltage (hipot)	to2 kV	None	
(c) Ac Voltage	1.0 mV to 1020 V	See Matrix K	
	0 mV to 10 mV (40 Hz to 1 kHz	5.4	Measured using Multimeter HP 3458A
	100 mV to 10 V	1.2mV	
	(40 Hz to 1 kHz	None	
	10 V to 100 V	29 mV	
	(40 Hz to 1 kHz	None	
	100 V to 1000 V	550 mV	
	(40 Hz to 1 kHz	None	
	40Hz to 50kHz	None	Measurement
	40Hz to 50kHz	None	Using Multimeter
	10.1 mV to 100 mV	760	Keysight 34470A
	100.1 mV	790	
	100.1 mV	810	
	10.1 V to 100 V	800	
	100.1 V to 750 V	950	
	40Hz to 50kHz	None	Measurement
	40Hz to 50kHz	None	Using Multimeter
	10.1 mV to 100 mV	760	Keysight 34470A
	100.1 mV to 1 V	790	
	1.1Vto10V	810	
	10.1 V to 100 V	800	
	100.1 V to 750 V	520	

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
(c) Dc Current	0 to 100 nA 100 nA to 1 1 yA to 10 pA 10 to 100 pA 100 pA to 10 mA 10 mA to 100 mA 100 mA to1A	(of reading) 0.034 mA/A + 0.046 nA 0.023 mA/A + 0.046 nA 0.023 mA/A + 0.12 nA 0.023 mA/A + 0.91 nA 0.023 mA/A + 5.7 nA 0.023 mA/A + 0.057 pA 0.040 mA/A + 0.57 HA 0.13 mA/A + 0.012 mA	HP 3458A, HP 34401A, Shunt
	0 to 100 nA 100 nA to 1 1 10 pA 10 to 100 pA 100 pA to 10 mA 10 mA to 100 mA 100 mA to1A	0.034 mA/A + 0.046 nA 0.023 mA/A + 0.046 nA 0.023 mA/A + 0.12 nA 0.023 mA/A + 0.91 nA 0.023 mA/A + 5.7 nA 0.023 mA/A + 0.057 pA 0.040 + 0.57 0.13 mA/A + 0.012 mA	HP 3458A, HP 34401A, Shunt
	0 UA to 330 pA 330 mA to 3.3 mA	5.2 nA	Generation using calibrator model
	3.3 mA to 33 mA	910 nA	Fluke 5522 A
	33 mA to 330 mA 330 mA to 1.1 mA 1.1Ato3A 3Ato10A	8.7 UA 42 pA 100 yA 1.4mA	
	10Ato21A	9mA	
	0 to 330 pA 330 to 3.3 mA 3.3 mA to 33 mA	25 nA 170 nA 670 nA	Generation using calibrator model Fluke 5522 A
	33 mA to 330 mA 330 mA to 1.1A 1.1Ato3A 3Ato11A	6.7 280 A 530 pA 2.4mA	
	11Ato21A	15 mA	
(c) Time Base	to 1000 ns 1 us to 1000 1 ms to 1000 ms isto5s	2.3 us/s + 0.31 ps 2.3 us/s + 0.31 ns 2.3 us/s + 0.31 us 0.032 + 0.57 ms	Fluke 5520A (SC600)
	to 1000 ns 1 us to 1000 us 1 ms to 1000 ms isto5s	2.3 us/s + 0.31 ps 2.3 us/s + 0.31 ns 2.3 us/s + 0.31 Us 0.032 + 0.57 ms	Fluke 5520A (SC600)
(continued)	DC to 1 kHz	(of reading) 0.0035 Q	Agilent 42030A
	at Frequency: 2.5 MHz to 1.3 GHz	(of reading)	HP 8902A and 11722A
	1 kHz	0.000048 nF	HP 16380A, HP 16380C

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
	100 Q DC to 1 kHz	0.023 Q	Agilent 42030A
	None	0.5 bar	controller with
	None	None	
	Liquid Limit	None	
	None	None	
	None	None	
	None	None	
(continued) At Power Factor = 1	1.089 mW to 9.18 W	(of reading)	Fluke 5520A
(d) Ac Current	None	See Matrix G	
	29 WA to 20.5A	See Matrix	
	20 A to 100A	See Matrix N 0.16 + 1.6 mA	
	See Matrix E See Matrix F	See Matrix E See Matrix F	Generation using calibrator model
	See Matrix E See Matrix F	None	Fluke 5522 A &
	See Matrix E See Matrix F	None	Wavetek 9100
	OAto1A (10 Hz to 5 kHz	2.3mA	Measured using Multimeter HP 3458A & Active
	1Ato3A	8.1mA	Shunt Ballantine 1625A
	(10 Hz to 5 kHz	None	
	3Ato20A	26 mA	
	(10 Hz to 1 kHz	None	
	20 A to 100A	130 mA	
	(10 Hz to 1 kHz	None	
	20Hz to 5kHz	None	Measurement
	20Hz to 5kHz	None	Using Multimeter
	10.1 pA to 100 pA	0.95 mA/A	Keysight 34470A
	100.1 uA to 1 mA	1.10 mA/A	
	1.1 mA to 10 mA	1.10 mA/A	
	10.1 mA to 100 mA	1.10 mA/A	
	100.1 mAto1A	0.86 mA/A	
	1.1Ato10A	1.20 mA/A	
	20Hz to 5kHz	None	Measurement
	20Hz to 5kHz	None	Using Multimeter
	10.1 pA to 100 pA	0.95 mA/A	Keysight 34470A
	100.1 uA to 1 mA	1.10 mA/A	
	1.1 mA to 10 mA	1.10 mA/A	
	10.1 mA to 100 mA	1.10 mA/A	
	100.1 mAto1A	0.86 mA/A	
	1.1Ato10A	1.20 mA/A	

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
(e) (i) Dc Resistance	Fixed Value 02 10 1.90	51 96 pQ 0.19 mQ	Generation using calibrator model Fluke 5700A
	0 to 10.9999 Q 11 Q to 32.9999 Q 33 Q to 109.9999 Q 110 Q to 329.9999 2 330 Q to 1.099999 kQ 1.1 kQ to 3.299999 kQ 3.3 kQ to 10.99999 kQ 11 kQ to 32.99999 kQ 33 kQ to 109.9999 kQ 110 kQ to 329.9999 kQ 330 kQ to 1.099999 MQ 1.1 MQ to 3.299999 MQ 3.3 MQ to 10.99999 MQ	27 + 35 pQ 23 pO/O + 7.1 22 pO/Q + 2.5 22 + 0.76 22 + 28 pO 22 pO/Q + 7.6 22 + 0.28 ma 22 pO/Q + 76 pQ 22 + 2.5 ma 25 +0.67 ma 25 pAIQ + 22 ma 46 + 3.6 ma 0.10 + 53 mQ	
(e) (ii) Dc Resistance (insulation Tester)	100 Q to 100 kQ 100 kQ to 1 MQ 1 MQ to 10 MQ 10 MQ to 100 MQ	(of reading) 0.57 MQ/Q + 57 mA 0.57 MA/Q + 59 2.3 MA/Q + 5.0 MA 2.3 MA/Q + 0.50	Decade Resistor/Standard Resistor model Yokogawa 2793-03 ChenHwa 9001-200 MQ
	100 Q to 100 kQ 100 kQ to 1 MQ 1 MQ to 10 MQ 10 MQ to 100 MQ	(of reading) 0.57 MQ/Q + 57 mQ 0.57 MA/Q + 59 mQ 2.3 MA/Q + 5.0 MA 2.3 MA/Q + 0.50	Decade Resistor/Standard Resistor model Yokogawa 2793-03 ChenHwa 9001-200 MQ
(e) (iii) Dc Resistance (ground Bond / Continuity Tester)	100 mQ 500 mQ	0.57 mQ 0.57 mQ	Standard Resistor model CGS HSC200 Max. Current 40 A
	100 mQ 500 mQ	0.57 mQ 0.57 mQ	Standard Resistor model CGS HSC200 Max. Current 40 A

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
(e) (iv) Dc Resistance (multiple Ranges)	0 to 10.9999 Q 11 Q to 32.9999 Q 33 Q to 109.9999 2 110 Q to 329.9999 Q 330 Q to 1.099999 kQ 1.1 kQ to 3.299999 kQ 3.3 kQ to 10.99999 kQ 11 kQ to 32.99999 kQ 33 kQ to 109.9999 kQ 110 kQ to 329.9999 kQ 330 kQ to 1.099999 MQ 1.1 MQ to 3.299999 MQ 3.3 MQ to 10.99999 MQ	27 + 35 pQ 23 + 7.1 22 pO/Q + 2.5 22 + 0.76 ya 22 + 28 22 + 7.6 22 + 0.28 ma 22 + 76 pQ 22 + 2.5ma 25 +0.67 ma 25 + 22 ma 46 + 3.6 ma 0.10 MA/Q + 53	Fluke 5520A
(e) (v) Dc/ Ac Resistance	1mQ DC to 1 kHz	0.0012 mQ	Agilent 42030A
(e) Dc Resistance	0to10Q	0.017 MQ/Q + 0.057 mQ	HP 3458A
	10Q to 100 Q	0.017 MQ/Q + 0.057 ma 0.014 MQ/Q + 0.57	HP 3458A
(f) Dc / Ac Resistance	1mQ DC to 1 kHz	0.0012 mQ	Agilent 42030A
(f) Frequency	100 mHz to 1 Hz 1 Hz to 10 Hz 10 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 2.7 GHz to 26.5 GHz	37 pHz/Hz + 50 pHz 37 pHz/Hz + 0.50 nHz 37 pHz/Hz + 5.0 nHz 37 pHz/Hz + 50 nHz 37 pHz/Hz + 0.50 37 pHz/Hz + 5.0 37 pHz/Hz + 50 pHz 37 pHz/Hz + 0.50 mHz 37 pHz/Hz + 5.0 mHz 37 pHz/Hz + 50 mHz 22 pHz/Hz + 0.54 Hz 61 pHz/Hz + 0.33 Hz	Novatech 2960AR, Fluke PM6680B, EIP 548A

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
	1 to 10 10 to 100 100 to 1 mHz 1 mHz to 10 mHz 10 mHz to 100 mHz 100 mHz to 1 Hz 1 Hz to 10 Hz 10 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 4 GHz	(of reading) 8.5 nHz/Hz + 0.014 fHz 8.5 nHz/Hz + 0.14 fHz 8.5 nHz/Hz + 1.4 fHz 8.5 nHz/Hz + 14 fHz 8.5 nHz/Hz + 0.14 pHz 8.5 nHz/Hz + 1.4 pHz 8.5 nHz/Hz + 14 pHz 8.5 nHz/Hz + 0.14 nHz 8.5 nHz/Hz + 1.4 nHz 8.5 nHz/Hz + 14 nHz 8.5 nHz/Hz + 0.14 8.5 nHz/Hz + 1.4 8.5 nHz/Hz + 14 8.5 nHz/Hz + 0.14 mHz 8.5 nHz/Hz 1.4 mHz 5.8 nHz/Hz + 14 Hz	Agilent 33250A, Agilent 8648D, Philips PM9691
	3 GHz to 5 GHz	210 nHz	Measuring using Universal Counter
	0 MHz to 3 GHz	175 nHz	Agilent 53132A
	0.01 Hz to 120 Hz 120 Hz to 1200 Hz	9.0 9.0 mHz	Generation using calibrator model
	1.2 kHz to 12 kHz	29 mHz	Fluke 5522 A
	12 kHz to 120 kHz	290 mHz	
	120 kHz to 1200 kHz	820 mHz	
	1.2 MHz to 3.2 MHz	110 Hz	
	3.2 MHz to 10 MHz	350 kHz	
(f) Rf Power	0 dBm, 50 MHz (Ref.)	0.051 dB	HP 8902A and 11722A
	0 dBm, 50 MHz (Ref.)	0.051 dB	HP 8902A and 11722A
(g) Amplitude Modulation	Carrier Frequency: 150 kHz to 4000 MHz	See Matrix C	HP 8902A and 11722A Agilent 8648D
	Carrier Frequency:	None	HP 8902A and
(g) Capacitance	0.19 nF to 1.0999 nF at 10 Hz to 10 kHz 1.1 nF to 3.2999 nF at 10 Hz to 3 kHz	3.9 mE/F + 7.7 pF 3.9 mE/F + 7.7 pF	Generation using calibrator model Fluke 5520A

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
	220 pF to 400 pF 0.4 nF to 1.1 nF 1.1 nF to 3.3 nF 3.3 nF to 11 nF 11 nF to 33 nF 33 nF to 110 nF 110 nF to 330 nF 0.33 UF to 1.1 uF 1.1 uF to 3.3 UF 3.3 UF to 11 11 UF to 33 UF 33 UF to 110 110 UF to 330 UF 0.33 mF to 1.1 mF 1.1 mF to 3.3 mF 3.3 mF to 11 mF 11 mF to 33 mF 33 mF to 110 mF	13 pF 17 pF 23 pF 40 pF 98 pF 300 pF 900 pF 4.1 nF 9.3 nF 21 nF 85 nF 290 nF 920 nF 6.4 UF 19 38 UF 130 uF 540 UF	Generation using calibrator model Fluke 5522 A
(g) Rf Power	0 dBm, 50 MHz (Ref.)	0.051 dB	HP 8902A and
(h) Amplitude Modulation	Carrier Frequency: 150 kHz to 9000 MHz	See Matrix H	HP 8902A and 11722A
(h) Frequency Modulation	Carrier Frequency: 150 kHz to 4000 MHz	See Matrix D	HP 8902A and 11722A Agilent 8648D
	Carrier Frequency: 150 kHz to 1300 MHz	See Matrix P	
(i) Frequency Modulation	Carrier Frequency: 150 kHz to 9000 MHz	See Matrix	
(i) Phase Modulation	Carrier Frequency: 150 kHz to 4000 MHz	See Matrix E	HP 8902A and 11722A Agilent 8648D
	Carrier Frequency:	None	
(j) (i) Amplitude Modulation Distortion	fc: 150 kHz to 10 MHz fm: 20 Hz to 10 kHz	(of reading)	HP 8902A, Panasonic VP7722A
(j) (ii) Frequency Modulation Distortion	Depth: 5 % to 50 % Depth: 50 % to 99 % fc: 250 kHz to 10 MHz fm: 20 Hz to 10 kHz	0.028 %/% + 0.34 % 0.014 %/% + 0.69 %	HP 8902A, Panasonic VP7722A
(j) (iii) Phase Modulation Distortion	fc: 150 kHz to 10 MHz fm: 200 Hz to 10 kHz	(of reading)	HP 8902A, Panasonic
(j) (iv) Audio Distortion	10 Hz to 15.99 kHz 16 kHz to 110 kHz	0.14 %/% 0.48 %/%	Panasonic VP7722A
(j) Audio Distortion	10 Hz to 110 kHz -83.7 dBm to 16.2 dBm	0.17 dB	Agilent 33250A, SRS DS360
(j) Phase Modulation	Carrier Frequency: 150 kHz to 9000 MHz	See Matrix J	
(k) (i) Amplitude Modulation Distortion	fc: 150 kHz to 10 MHz fm: 20 Hz to 10 kHz	None	HP 8902A, Panasonic
(k) (ii) Frequency Modulation Distortion	fc: 250 kHz to 10 MHz fm: 20 Hz to 10 kHz	(of reading)	HP 8902A, Panasonic VP7722A

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
(k) (iii) Phase Modulation Distortion	fc: 150 kHz to 10 MHz fm: 200 Hz to 10 kHz Af:	0.069 %/% + 0.11 %	HP 8902A, Panasonic VP7722A
(k) (iv) Audio Distortion	10 Hz to 15.99 kHz 16 kHz to 110 kHz	0.14 %/% 0.48 %/%	Panasonic VP7722A
(k) Frequency	1 to 10 10 to 100 100 to 1 mHz 1 mHz to 10 mHz 10 mHz to 100 mHz 100 mHz to 1 Hz 1 Hz to 10 Hz 10 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 4 GHz 4 GHz to 10 GHz 10 GHz to 26 GHz	37 pHz/Hz + 0.50 fHz 37 pHz/Hz + 5.0 fHz 37 pHz/Hz + 50 fHz 37 pHz/Hz + 0.50 pHz 37 pHz/Hz + 5.0 pHz 37 pHz/Hz + 50 pHz 37 pHz/Hz + 0.50 nHz 37 pHz/Hz + 5.0 nHz 37 pHz/Hz + 50 nHz 37 pHz/Hz + 0.50 37 pHz/Hz + 5.0 37 pHz/Hz + 50 pHz 37 pHz/Hz + 0.50 mHz 37 pHz/Hz + 5.0 mHz 37 pHz/Hz + 50 mHz 22 pHz/Hz + 0.54 Hz 48 pHz/Hz + 0.43 Hz 16 pHz/Hz + 5.5 Hz	Novatech 2960AR, Agilent 8648D, Agilent 33250A, HP 8673D
	100 mHz to 1 Hz 1 Hz to 10 Hz 10 Hz to 100 Hz	8.5 nHz/Hz + 1.4 pHz 8.5 nHz/Hz + 14 pHz 8.5 nHz/Hz + 0.14 nHz	Philips PM9691, Fluke PM6680B
(m) Inductor / Decade Inductor	0 UH to 637 kH at 0 to 20 kHz	1.2 mH/H	
(m1) Ac Power At Power Factor = 1	0.1089 mW to 2.97 mW 33 mV to 330 mV /	(of reading) 0.76 + 5.3 nW	Fluke 5520A
(m2) Dc Power	0.01089 mW to 336.6 W 33 mV to 1020	(of reading) 0.12 mW/W + 0.57 nw	Fluke 5520A
1. Measuring Instruments (a) Dc Voltage	0 to 220 mV 220 mV to 2.2 V 2.2Vto11V 11Vto22V 22 V to 220 V 220 V to 1100 V 1 kV to 2 kV	8.1 + 0.61 LV 7.1 + 1.0 pV 7.1 + 3.6 7.1 + 6.6 pV 8.1 pV/V + 0.081 mV 9.1 + 0.51 mV 0.41 mV/V + 0.67 V	Generation using calibrator model Fluke 5700A, Vitrek 4620B,
	0 to 329.9999 mV 330 mV to 3.299999 V 3.3 V to 32.99999 V 33 V to 329.9999 V 330 V to 1020 V	(of reading) 16 uV/V + 0.77 8.4 uV/V + 1.6 9.2 uV/V + 12 14 mV 14. + 1.2 mV	Generation using calibrator model Fluke 5520A

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
	0 mV to 330 mV 330 mV to 3.3 V 3.3 V to 33 V 33 V to 330 V 330 V to 1020 V	15 160 880 LV 8.6 mV	Generation using calibrator model Fluke 5522 A
1. Temperature Recorder / Indicator	None	None	
	None	None	
2. Generating Instrument / Source	None	None	
2. Generating Instrument / Source (a) Dc Voltage	0 to 100 mV 100 mV to1V 1Vto10V 10 V to 100 V 100 V to 1000 V	5.7 + 0.34 4.6 + 0.34 UV 4.6 + 0.57 UV 6.8 V/V + 0.034 mV 6.8 + 0.12 mV 0.46 mV/V + 0.46 V	HP 3458A, Vitrek 4620B
2. Temperature Calibrator / Simulator	None	None	
	None	None	
3. Oscilloscope (a) (i) Dc Signal (in 1, 2, 5 Sequence)	50 Q load: 0 V to 2.1999 V 2.2V to6.6V	(of reading) 1.9 mV/V + 0.043 mV 1.9 mV/V + 0.074 mV	Fluke 5520A (SC600)
3. Temperature And Humidity Indicator Or Recorder	10 ?C to 80 ?C (At 50 %RH)	0.65 ?C	Comparison with dry bulb thermometer in humidity chamber.
3.(a) Dc Cutoff Current (hipot)	0 to 30 mA 30 mA to 100 mA 100 mA to 10A	0.38 mA/A + 2.4 0.38 + 17 1.6 mA/A + 3.9 mA	Fluke 45
4. (a) Dc Cutoff Current (hipot)	0 to 30 mA 30 mA to 100 mA 100 mA to 10A	0.38 mA/A + 2.4 pA 0.38 + 17 1.6 mA/A + 3.9 mA	Fluke 45
4. Oscilloscope (a) (i) Dc Signal (in 1, 2, 5 Sequence)	50 Q load: 0 V to 2.1999 V	(of reading) 1.9 mV/V + 0.043 mV 1.9 mV/V + 0.074 mV	Fluke 5520A (SC600)
4. Radiation Thermometer	35 ?C to 100 ?C 100 ?C to 200 ?C 200 ?C to 350 ?C 350 ?C to 500 ?C	0.46 ?C 0.67 ?C 1.1?C 1.5?C	Using IR Calibrator with reference to ASTM E 2847- 2014
5. Impedance Analyzer (a) Capacitance	1 pF 1 kHz 1 MHz 2 MHz 3 MHz 4 MHz 5 MHz 10 MHz 13 MHz 10 pF	0.000048 pF 0.000093 pF 0.00023 pF 0.00042 pF 0.00064 pF 0.00090 pF 0.0026 pF 0.0040 pF	HP 16380A, HP 16380C
6. Stop Watch	1500s 1500 s to 7200 s	0.12s	Totalizing Method with
	1 sec to 9 sec 10 sec to 90 sec 120 sec to 900 sec 1200 sec to 7200 sec	0.065 second 0.08 second 0.2 second 2 second	Comparison with timer (Omron H5CR).

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Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
	1 sec to 9 sec 10 sec to 90 sec 120 sec to 900 sec 1200 sec to 7200 sec	0.065 second 0.08 second 0.2 second 2 second	Comparison with timer (Omron H5CR).
7. Timer	1s to 3600s	None	Stop Watch
8. Electrostatic	0 to +1000 V	(of reading) 5.1 mV/V + 0.80 V	BS 7506
B-type	600 ?C to 800 ?C 800 ?C to 1000 ?C 1000 ?C to 1550 ?C	0.34 ?C 0.26 ?C 0.23 ?C	By electrical simulation using Fluke calibrator
	600 ?C to 800 ?C	0.34 ?C	
C) Ac Voltage	0V to 1100 V	See Matrix A	Generating using calibrator model Fluke
	At 60 Hz 0Vto50V 50 V to 100 V 100 V to 200 V 200 V to 300 V	0.36 V 0.71V 1.39 V	Calibrate by electrical masurement using Multimeter. (Agilent:34401A)
Capacitance	100 pF to 190 pF at 10 Hz to 10 kHz	(of reading) 5.7 + 5.7 pF	Fluke 5520A, Genrad 1423A
	0.19 nF to 3.3 nF	2 pF	Calibrator Fluke
	1 pF to 1000 pF	1.5 fF/F + 1 fF	Capacitance General Radio
	0.19 nF to 3.3 nF	2 pF	Calibrator Fluke
	1 pF to 1000 pF	1.5 fF/F + 1 fF	Capacitance General Radio
	0.19 nF to 3.3 nF	2 pF	Calibrator Fluke
	1 pF to 1000 pF	1.5 fF/F + 1 fF	Capacitance General Radio
	0.19 nF to 3.3 nF	2 pF	Calibrator Fluke
	1 pF to 1000 pF	1.5 fF/F + 1 fF	Capacitance General Radio
	1 pF to 1000 pF	1.5 fF/F + 1 fF	Capacitance General Radio
	1 pF to 1000 pF	1.5 fF/F + 1 fF	Capacitance General Radio
	1 (10 Hz to 1 MHz)	0.5 mF/F	HP 4284A
	1 pF to1mF@ (10 Hz to 1 MHz)	0.5 mF/F	HP 4284A
	0.19 nF to 3.3 nF	2 pF	Calibrator Fluke
	1 pF to 1000 pF	1.5 fF/F + 1 fF	Capacitance General Radio
	0.19 nF to 3.3 nF	2 pF	Calibrator Fluke
	1 pF to 1000 pF	1.5 fF/F + 1 fF	Capacitance General Radio
	0.19 nF to 3.3 nF	2 pF	Calibrator Fluke

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
	1 pF to 1000 pF	1.5 fF/F + 1 fF	Capacitance General Radio
	0.19 nF to 3.3 nF	2 pF	Calibrator Fluke
	1 pF to 1000 pF	1.5 fF/F + 1 fF	Capacitance General Radio
	100 Hz	None	
	0 2 nF to 20 nF 20 nF to 200 nF 0.2 UF to 2 uF 2 UF to 20 UF 20 uF to 200 uF 200 UF to 1000 uF	5.9 pF/nF + 1.2 pF 2.6 pF/nF + 2.4 pF 2.6 + 0.024 nF 2.6 + 0.24 nF 2.6 + 2.4 nF 5.9 uF/mF + 0.024 uF 12 uF/mF + 0.25 pF	Measurement using LCR Meter
	120 Hz	None	
	0 to 2 nF 2 nF to 20 nF 20 nF to 200 nF 0.2 uF to 2 uF 2 UF to 20 uF 20 uF to 200 200 UF to 1000 uF	5.9 pF/nF + 0.90 pF 2.6 pF/nF + 2.4 pF 2.6 + 0.024 nF 2.6 + 0.24 nF 2.6 nF/UF + 2.4 nF 5.9 + 0.024 uF 12 uF/mF + 0.25 uF	
	1000 Hz	None	
	0 to 2 nF to 20 nF 20 nF to 200 nF 0.2 UF to 2 uF 2 to 20 uF	5.9 pF/nF + 0.59 pF 2.6 pF/nF + 2.4 pF 2.6 + 0.024 nF 2.6 + 0.24 nF 2.6 + 2.4 nF	
	0.5 nF to 4 nF 4 nF to 40 nF	3.6 mF/F + 0.019 nF 3.5 mF/F + 0.27 nF	
	40 nF to 400 nF 400 nF to 4 uF 4 uF to 40 uF 40 UF to 400 uF 400 UF to 4 mF 4 mF to 40 mF	3.6 mF/F + 0.39 nF 4.7 mF/F + 3.6 nF 5.9 mF/F + 34 nF 5.9 mF/F + 0.22 UF 5.9 mF/F + 0.0032 mF 12 mF/F + 0.071 mF	Generation using Calibrator model Wavetek 9100
	100 Hz 0 to 2 nF to 20 nF 20 nF to 200 nF 0.2 UF to 2uF 2 uF to 20 uF to 200 uF 200 UF to 1000 uF	5.9 pF/nF + 0.91 pF 2.5 pF/nF + 2.5 pF 2.5 + 0.024 nF 2.5 + 0.24 nF 2.5 +2.4 nF 5.9 + 0.025 uF 12 uF/mF + 0.25 uF	Measurement using GN Instek LCR Meter
	120 Hz	None	
	0 to 2 nF to 20 nF 20 nF to 200 nF 0.2 UF to 2 uF 2 UF to 20 uF 20 uF to 200 uF 200 UF to 1000 uF	5.9 pF/nF + 0.90 pF 2.5 pF/nF + 2.5 pF 2.5 + 0.025 nF 2.5 + 0.25 nF 2.5 + 2.5 nF 5.9 + 0.025 uF 12 + 0.25 pF	
	1000 Hz	None	

Instrument Calibrated/Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks
	0 to 2 nF 2 nF to 20 nF 20 nF to 200 nF 0.2 UF to 2 UF 2 UF to 20 UF	0.59 pF/nF + 0.59 pF 2.5 pF/nF + 2.4 pF 2.5 + 0.024 nF 2.5 + 0.24 nF 2.5 + 2.4 nF	
	0.5 to 4 nF 4 nF to 40 nF	3.6 mF/F + 0.018 nF 3.5 mF/F + 0.098 nF	Generation using Calibrator model
	40 nF to 400 nF	3.6 mF/F + 0.20 nF	Wavetek 9100
	400 nF to 4 uF 4 uF to 40 uF 40 to 400 pF 400 UF to 4 mF 4 mF to 40 mF	4.7 mF/F + 3.2 nF 5.9 mF/F + 29 nF 5.9 mF/F + 0.21 UF 5.9 mF/F + 0.0025 mF 12 mF/F + 0.070 mF	
	to 10 uF to 100 uF	0.0029 UF + 0.77 0.028 UF + 0.77	Measuring using Keysight U1282A
	1 nF to 5 nF	0.4 mF/F + 5 pF	Generation using
	None	None	
	10 MQ to 100 MQ 100 pF to 900 pF 1 nF to 9nF	1.5 8.3 mF/F 7.2 mF/F	Using decade resistance, decade capacitance and decade inductance
	10 nF to 90 nF	6.1 mF/F	
	100 nF to 900 nF	6.1 mF/F	
	1 UF to 9 UF	8.9 mF/F	
	to	+ 9.0nF	
	to	2.9MF/F + 53nF	
	to 109.999UF	3.5mF/F + 98nF	
	to	3.3mF/F +	
	0.33mF to 1.09999mF	3.5mF/F +	Measurement
	1.1mF to 3.29999mF	3.4mE/F +	using Fluke
	3.3mF to 10.9999mF	3.5mF/F +	5522A
	11mF to 32.9999mF	6.1mF/F +	
	33mF to 110mF	+	
	0Q to	+	
	110 to 32.99990,	+ 1.2mQ	
	33Q to	+	
	110Q to 329.99990	+ 1.7mQ	
	3300 to 1.09999kQ	+ 2.0mQ	
	1.1kQ to	+ 17mQ	
	3.3kQ to 10.99999kO	+ 12mQ	
	11kQ to	+ 0.170	
	100 Hz & 120 Hz	None	
	200 pF to 2000 pF	2.7 pF	
	2 nF to 20 nF	20 pF	
	20 nF to 200 nF	0.13 nF	
	200 nF to 2000 nF	1.3 nF	
	1 kHz	None	

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
	20 pF to 200 pF	0.25 pF	
	200 pF to 2000 pF	2.2 pF	
	2 nF to 20 nF	13 pF	
	20 nF to 200 nF	0.13 nF	
	200 nF to 2000 nF	1.3 nF	
	0.4 nF (0.19 nF to 0.4 nF) 10 Hz to 10 kHz	5.7 mF/F + 0.01 nF	Calibrator Fluke 5520A
	1.1 nF (0.4 nF to 1.1 nF) 10 Hz to 10 kHz	5.7 mF/F + 0.01 nF	Calibrator Fluke 5520A
	3.3 nF (1.1 nF to 3.3 nF) 10 Hz to 3 kHz	5.8 mF/F + 0.01 nF	Calibrator Fluke 5520A
	11 nF (3.3 nF to 11 nF) 10 Hz to 1 kHz	2.9 mF/F + 0.01 nF	Calibrator Fluke 5520A
	33 nF (11 nF to 33 nF) 10 Hz to 1 kHz	2.8 mF/F + 0.01 nF	Calibrator Fluke 5520A
	110 nF (33 nF to 110 nF) 10 Hz to 1 kHz	2.9 mF/F + 0.1 nF	Calibrator Fluke 5520A
	330 nF (110 nF to 330 nF) 10 Hz to 1 kHz	2.9 mF/F + 0.3 nF	Calibrator Fluke 5520A
	1.1 uF 0.4 to 1.1 uF 10 Hz to 600 Hz	2.9 MF/F + 1 nF	Calibrator Fluke 5520A
	3.3 UF (1.1 uF to 3.3 uF) 10 Hz to 300 Hz	2.9 MF/F + 3 nF	Calibrator Fluke 5520A
	11 F (3.3 UF to 11 uF) 10 Hz to 150 Hz	2.9 + 12nF	Calibrator Fluke 5520A
	OnF to 1 nF	2.3%of rdg+0.029nF	Direct measurement using
	0.1nF to 1 nF	rdg+0.014nF	Direct Measurement using Fluke
	110 nF to 0.330 uF 0.330 UF to 1.1 uF	4.0 4.0	
	1.1 uF to 3.3 UF	5.1	
	3.3 UF to 11	None	
	11 UF to 33 UF 33 UF to 110	5.7 mF /F 6.8 mF /F	
	110 UF to 330 UF	9.1	
	330 UF to 1.1 mF	12 mF/ F	
	0.01 Hz to 12 kHz	0.062 mHz / Hz	
Capacitor / Decade Capacitor	0 pF to at DC to 100 kHz	1.2	Fluke PM6304C
D) Ac Current	20.5A	See Matrix B	Generation using calibrator model Fluke 5700A, 5725A, 5520A
	10 Ato 1025A	See Matrix B	Fluke 5520A with 50 Turn Coil
	10A (Refer Matrix E)	(Refer Matrix E)	

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
E-type	-250 ?C to -100 ?C	0.39 ?C	
	-250 ?C to -100 ?C	0.39 ?C	
Instrument ? Electrostatic Voltage	1000 V to 19000 V	0.018 VV +7.0V	Fluke 5520A, Vitrek 4620B,
J-type	-210 ?C to -100 ?C	0.21 ?C	
	-210 ?C to -100 ?C	0.21 ?C	
	-210 ?C to -100 ?C	0.31 ?C	744
K-type	-200 ?C to -100 ?C	0.26 ?C	
	-200 ?C to -100 ?C	0.26 ?C	
	-200 ?C to -100 ?C	0.37 ?C	
Lcr Meter (i1) Inductance	100 WH 100 Hz 120 Hz 1 kHz 10 kHz	0.13 0.13 pH 0.061 0.13 pH	Genrad 1482-B Genrad 1482-T Genrad 1482-L Genrad 1482-E Genrad 1482-H Genrad 1482-P
N) Phase	Q? to +180 ? 10 Hz to 65 Hz	0.076 ?	Fluke 5520A
N-type	-200 ?C to -100 ?C	0.31 ?C	
	-200 ?C to -100 ?C -100 ?C to -25 ?C	0.31 ?C 0.17 ?C	By electrical measurement
Pt 100	-200 ?C to 800 ?C	0.042 ?C	By electrical measurement
	- 200 °C to	0.2 °C	
	- 200 °C to 0 °C 0 °C to 800 °C	0.2 °C 0.5 °C	
	-100 to 800 °C	0.059 °C	
	-100 to 800 °C	0.065 °C	
	-200 to 850 °C	0.065 °C	
	-200 to 850 °C	0.059 °C	
Pt 100 (385)	-200 ?C to -80 ?C -80 ?C to0 ?C	0.039 ?C 0.039 ?C	By electrical measurement
	-200 ?C to 0 ?C 0 ?C to 400 ?C	0.15 ?C 0.20 ?C	
	-200 °C to 100 °C 100 °C to 790 °C	0.27 °C 0.35 °C	
	-200 °C to 100 °C 100 °C to 790 °C	0.27 °C 0.37 °C	By Electrical Measurement Using Temperature Calibrator and ITS 90 Tables
	-200 °C to 100 °C 100 °C to 790 °C	0.74 °C 0.79 °C	
Pt 100 (3916)	-200 ?C to -190 ?C -190 ?C to -80 ?C	0.20 ?C 0.031 ?C	

Instrument Calibrated/Measurement Parameter	**Range**	**Calibration and Measurement Capability Expressed as an Uncertainty (±)***	**Remarks**
	-200 ?C to -190 ?C -190 ?C to0 ?C	0.27 ?C 0.15 ?C	
Pt 100 (3926)	-200 ?C to -80 ?C -80 ?C to0 ?C	0.039 ?C 0.039 ?C	By electrical measurement
	-200 ?C to 0 ?C 0 ?C to 630 ?C	0.15 ?C 0.20 ?C	
	-200 °C to 100 °C 100 °C to 600 °C	0.27 °C 0.35 °C	
	-200 °C to 100 °C 100 °C to 600 °C	0.27 °C 0.35 °C	By Electrical Measurement Using Temperature Calibrator and ITS 90 Tables
	-200 °C to 100 °C 100 °C to 600 °C	0.74 °C 0.77 °C	
R-type	0 ?C to 250 ?C	0.44 ?C	
	0 ?C to 250 ?C	0.44 ?C	
S-type	0 ?C to 250 ?C	0.36 ?C	
	0 ?C to 250 ?C	0.36 ?C	
T-type	-250 ?C to -150 ?C	0.48 ?C	
	-250 ?C to -150 ?C	0.48 ?C	
	-250 ?C to -200 ?C	0.72 ?C	
Timer	1s to 3600s	0.16 s	Stopwatch
	Up to 10800 s	0.24s	Base on NIST Publication 960- 12
	5s to 3600s	None	Comparison method using Precision Timer
	5s to 3600s	None	Comparison method using Precision Timer
	Up to 10800 s	0.7s	Direct comparison (with reference to NIST SP
	Up to 10800 s	None	960-12: 2009)
	Up to 10800 s	0.7s	Direct comparison (with reference to NIST SP
	Up to 10800 s	None	960-12: 2009)
	0 sec to 60 sec 1 min to 5 min 5 min to 1 hour 1 hour to 3 hour	0.2 sec 0.2 sec 0.2 sec 0.2 sec	Calibrated by using comparison method according to NIST stop watch and timer calibration

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	0 sec to 60 sec 1 min to 5 min 5 min to 1 hour 1 hour to 3 hour	0.2 sec 0.2 sec 0.2 sec 0.2 sec	Calibrated by using comparison method according to NIST stop watch and timer calibration

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SCOPE OF CALIBRATION : TEMPERATURE

Instrument Calibrated/Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty (±)*	Remarks