

NO: SAMP 192

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LABORATORY LOCATION:
(PERMANENT LABORATORY)
TEKMARK SDN. BHD.
NO. 7, LINTANG BATU MAUNG 1
DESA DYANAVIEW SHOPLLOT
11960 BAYAN LEPAS
PULAU PINANG
MALAYSIA

FIELD OF CALIBRATION: ELECTRICAL

This laboratory has demonstrated its technical competence to operate in accordance with MS ISO/IEC 17025:2005 (ISO/IEC 17025:2005).

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 expanded uncertainties are based on an estimated confidence probability of approximately 95% and have a coverage factor of $k=2$ unless stated otherwise.

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(\pm)*	Remarks
A. Indicating Meters/ Instruments DC/Low Freq 1. DC Voltage	0 mV to 329.9999 mV 0 V to 3.299999 V 0 V to 32.99999 V 0 V to 329.99999 V 0 V to 1000.000 V	(output + floor) 20 μ V/ V + 1 μ V 11 μ V/ V + 2 μ V 12 μ V/ V + 20 μ V 18 μ V/ V + 150 μ V 18 μ V/ V + 1500 μ V	Generation using calibrator model Fluke 5520A/5522A
2. AC Voltage	1.0 mV to 1020 V (See MatrixA)	(See Matrix A)	

Matrix A AC Voltage Source

Range		Frequency (kHz)								
		0.01 to 0.045	0.045 to 10	10 to 20	20 to 50	50 to 100	100 to 500	0.045 to 1	1 to 5	5 to 10
32.999 mV	1.0 mV to 32.999 mV	0.8 + 0.006	0.15 + 0.006	0.2 + 0.006	1.0 + 0.006	3.5 + 0.012	8.0 + 0.050	-	-	-
329.999 mV	33 mV to 329.999 mV	0.3 + 0.008	0.15 + 0.008	0.16 + 0.008	0.35 + 0.008	0.8 + 0.032	2.0 + 0.070	-	-	-
3.29999 V	330 mV to 3.29999 V	0.3 + 0.05	0.15 + 0.06	0.19 + 0.06	0.3 + 0.05	0.7 + 0.125	2.4 + 0.6	-	-	-
32.9999 V	3.3 V to 32.9999 V	0.3 + 0.65	0.15 + 0.6	0.24 + 0.6	0.35 + 0.6	0.9 + 1.6	-	-	-	-
329.999 V	33 V to 329.999 V	-	-	0.25 + 6	0.3 + 6	2.0 + 50	-	0.19 + 2	0.2 + 6	0.2 + 6
1020 V	330 V to 1020 V	-	-	-	-	-	-	0.3 + 10	0.25 + 10	0.3 + 10

The calibration uncertainties given in this table are expressed in mV/V + mV

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(\pm)*	Remarks
3. DC Current	0 μ A to 329.999 μ A 0 mA to 3.29999 mA 0 mA to 32.9999 mA 0 mA to 329.999 mA 0 A to 1.09999 A 1.1 A to 2.99999 A 0 A to 10.9999 A 11 A to 20.0 A	150 μ A/A + 0.02 μ A 100 μ A/A + 0.05 μ A 100 μ A/A + 0.25 μ A 100 μ A/A + 2.5 μ A 200 μ A/A + 40 μ A 380 μ A/A + 40 μ A 500 μ A/A + 500 μ A 1.0 mA/A + 750 μ A	Generation using calibrator model Fluke 5520A/5522A
4. AC Current	29 μA to 20.5 A (See Matrix B)	(See Matrix B)	

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Matrix B AC Voltage Sources

Range		Frequency (kHz)								
		0.01 to 0.02	0.02 to 0.045	0.045 to 1	1 to 5	5 to 10	10 to 30	0.010 to 0.045	0.045 to 0.1	0.1 to 1
329.99 μ A	29 μ A to 329.99 μ A	2.0 + 0.0001	1.5 + 0.0001	1.3 + 0.0001	3.0 + 0.00015	8.0 + 0.0002	16 + 0.0004	-	-	-
3.2999 mA	0.33 mA to 3.2999 mA	2.0 + 0.00015	1.3 + 0.00015	1.0 + 0.00015	2.0 + 0.0002	5.0 + 0.0003	10 + 0.0006	-	-	-
32.999 mA	3.3 mA to 32.999 mA	1.8 + 0.002	0.9 + 0.002	0.4 + 0.002	0.8 + 0.002	2.0 + 0.003	4.0 + 0.004	-	-	-
329.99 mA	33 mA to 329.99 mA	1.8 + 0.02	0.9 + 0.02	0.4 + 0.02	1.0 + 0.05	2.0 + 0.1	4.0 + 0.2	-	-	-
1.09999 A	330 mA to 1.09999 A	-	-	0.5 + 0.1	6.0 + 1	25 + 5	-	1.8 + 0.1	-	-
2.99999 A	1.1 A to 2.99999 A	-	-	0.6 + 0.1	6 + 1	25 + 5	-	1.8 + 0.1	-	-
10.9999 A	3 A to 10.9999 A	-	-	-	30 + 2	-	-	-	0.6 + 2	1 + 2
20.5 A	11 A to 20.5A	-	-	-	30 + 5	-	-	-	1.2 + 5	1.5 + 5

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(\pm)*	Remarks
5. DC Resistance	0 Ω to 10.9999 Ω 11 Ω to 32.9999 Ω 33 Ω to 109.9999 Ω 110 Ω to 1.099999 k Ω 1.1 k Ω to 10.99999 k Ω 11 k Ω to 109.9999 k Ω 110 k Ω to 1.099999 M Ω 1.1 M Ω to 3.299999 M Ω 3.3 M Ω to 10.99999 M Ω 11 M Ω to 32.99999 M Ω 33 M Ω to 109.9999 M Ω 110 M Ω to 329.9999 M Ω 330 M Ω to 1100 M Ω	40 $\mu\Omega/\Omega$ + 1.0 m Ω 30 $\mu\Omega/\Omega$ + 1.5 m Ω 28 $\mu\Omega/\Omega$ + 1.4 m Ω 28 $\mu\Omega/\Omega$ + 2.0 m Ω 28 $\mu\Omega/\Omega$ + 20 m Ω 28 $\mu\Omega/\Omega$ + 0.20 Ω 32 $\mu\Omega/\Omega$ + 2.0 Ω 60 $\mu\Omega/\Omega$ + 30 Ω 130 $\mu\Omega/\Omega$ + 50 Ω 250 $\mu\Omega/\Omega$ + 2.5 k Ω 500 $\mu\Omega/\Omega$ + 3.0 k Ω 3.0 m Ω/Ω + 100 k Ω 15 m Ω/Ω + 500 k Ω	Generation using calibrator model Fluke 5520A/5522A
6. Capacitance	0.19 nF to 3.2999 nF 3.3 nF to 10.9999 nF 11 nF to 109.999 nF 110 nF to 329.999 nF 0.33 μ F to 1.09999 μ F 1.1 μ F to 3.29999 μ F 3.3 μ F to 10.9999 μ F 11 μ F to 32.9999 μ F 33 μ F to 109.999 μ F 110 μ F to 329.999 μ F 330 μ F to 1.09999 mF 1.1 mF to 3.2999 mF 3.3 mF to 10.9999 mF 11 mF to 32.9999 mF 33 mF to 110 mF	5.0 mF/F + 10 pF 2.5 mF/F + 10 pF 2.5 mF/F + 100 pF 2.5 mF/F + 300 pF 2.5 mF/F + 1.0 nF 2.5 mF/F + 3.0 nF 2.5 mF/F + 10 nF 4.0 mF/F + 30 nF 4.5 mF/F + 100 nF 4.5 mF/F + 300 nF 4.5 mF/F + 1.0 μ F 4.5 mF/F + 3.0 μ F 4.5 mF/F + 10 μ F 7.5 mF/F + 30 μ F 11 mF/F + 100 μ F	Generation using calibrator model Fluke 5520A/5522A
7. Frequency a. Measure	50 kHz to 1100 MHz	2.5 μ Hz/Hz	Generation using calibrator model Fluke 5520A/5522A

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(\pm)*	Remarks
7. Frequency b. Amplitude	<u>0.01 Vpp to 5.00 Vpp</u> 1 μ Hz to 100 kHz 100 kHz to 20 MHz 20 MHz to 30.2 MHz <u>5 Vpp to 10 Vpp</u> 1 μ Hz to 100 kHz 100 kHz to 20 MHz 20 MHz to 30.2 MHz	47 mV/V 47 mV/V 59 mV/V 23 mV/V 23 mV/V 35 mV/V	Generated Using Calibrator Model DS345
Oscilloscope			
B. Sources 1. DC Voltage	0 mV to 210 mV 0.21 V to 2.1 V 2.1 V to 21 V 21 V to 210 V 210 V to 1100 V	23 μ V/V + 0.0018 mV 14 μ V/V + 0.0000018 V 13 μ V/V + 0.000003 V 25 μ V/V + 0.0004 V 26 μ V/V + 0.004 V	Measured Using Calibrator Model Keithley 2002
2. AC Voltage	200 mV to 750 V (See Matrix C)	(See Matrix C)	

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Matrix C
AC Voltage Measurements

Range	Frequency (kHz)									
	0.02 to 0.05	0.05 to 0.1	0.1 to 2	2 to 10	10 to 30	30 to 50	50 to 100	100 to 200	200 to 1000	1000 to 2000
200 mV	2.5 + 0.03	0.7 + 0.03	0.2 + 0.02	0.2 + 0.02	0.25 + 0.02	0.5 + 0.02	3.0 + 0.02	7.5 + 0.05	20 + 0.2	50 + 0.4
2 V	2.5 + 0.3	0.7 + 0.3	0.2 + 0.2	0.2 + 0.2	0.25 + 0.2	0.5 + 0.2	3.0 + 0.2	7.5 + 0.2	20 + 2	50 + 4
20 V	2.5 + 3	0.7 + 3	0.3 + 3	0.4 + 3	0.5 + 3	0.7 + 3	30 + 3	7.5 + 3	20 + 40	-
200 V ¹	2.5 + 30	0.7 + 30	0.3 + 30	0.4 + 30	0.5 + 30	0.7 + 30	30 + 30	-	-	-
750 V ¹	2.5 + 30	0.7 + 30	0.3 + 30	-	-	-	-	-	-	-

¹ Additional uncertainty 0.010 mV/V*(Vin/100V)² for input above 100V

The calibration uncertainties given in this table are expressed in mV/V + mV

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Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(\pm)*	Remarks
3. DC Current	0 μ A to 210 μ A 0 mA to 2.1 mA 0 mA to 21 mA 0 mA to 210 mA 0 A to 2 A	400 μ A/A + 0.005 μ A 309 μ A/A + 0.00004 mA 410 μ A/A + 0.0004 mA 540 μ A/A + 0.004 mA 880 μ A/A + 0.00004 A	Measured Using Calibrator Model Keithley 2002
	2 A to 10 A	2mA/A + 0.7 mA	Measured Using Calibrator Model Fluke 45
4. AC Current	200 μ A to 2 A (See Matrix D)	(See Matrix D)	Measured Using Calibrator Model Keithley 2002

Matrix D**AC Current Measurements**

Range	Frequency (kHz)			
	0.02 to 0.05	0.05 to 0.2	0.2 to 1	1 to 10
200 μ A	3.5 + 0.00003	20 + 0.00003	40 + 0.00003	50 + 0.00003
2 mA	3.0 + 0.0003	1.5 + 0.0003	1.2 + 0.0003	1.2 + 0.0003
20 mA	3.0 + 0.003	1.5 + 0.003	1.2 + 0.003	1.2 + 0.003
200 mA	3.0 + 0.03	1.5 + 0.03	1.2 + 0.03	1.2 + 0.03
2 A	3.5 + 0.3	20 + 0.3	30 + 0.3	4.5 + 0.3

The calibration uncertainties given in this table are expressed in mA/A + mA

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(\pm)*	Remarks
5. DC Resistance	0 Ω to 20 Ω 0 Ω to 200 Ω 0 Ω to 2 k Ω 0 Ω to 20 k Ω 0 Ω to 200 k Ω 0 Ω to 2 M Ω 0 Ω to 20 M Ω 0 Ω to 200 M Ω	47 $\mu\Omega/\Omega$ + 0.00012 Ω 25 $\mu\Omega/\Omega$ + 0.0008 Ω 16 $\mu\Omega/\Omega$ + 0.0000008 k Ω 17 $\mu\Omega/\Omega$ + 0.000008 k Ω 43 $\mu\Omega/\Omega$ + 0.00018 Ω 80 $\mu\Omega/\Omega$ + 0.000001 M Ω 270 $\mu\Omega/\Omega$ + 0.000012 M Ω 570 $\mu\Omega/\Omega$ + 0.0006 M Ω	Measured Using Calibrator Model Keithley 2002
6. Frequency	1.0 Hz – 10 MHz 10 MHz – 100 MHz 100 MHz – 1.3 GHz	1 $\mu\text{Hz}/\text{Hz}$ + 0.1 Hz 1 $\mu\text{Hz}/\text{Hz}$ + 1 Hz 1 $\mu\text{Hz}/\text{Hz}$ + 10 Hz	Measured Using Calibrator Model CMC251
7. Vertical Amplitude Pk-Pk (1 M Ω Load)	200 μV to 1 mV	2.5 mV/V + 1 μV	Generation using calibrator model Tek PG506A
Pk-Pk (50 Ω Load)	1 mV to 130 V	1.0 mV/V + 40 μV	Generation using calibrator model Fluke 5520A/5522A
	100 μV to 5 V	2.5 mV/V + 1 μV	Generation using calibrator model Tek PG506A
	5 V to 6.6 V	2.5 mV/V + 40 μV	Generation using calibrator model Fluke 5520A/5522A
DC (1 M Ω Load)	0 V to 130 V	0.5 mV/V + 40 μV	
DC (50 Ω Load)	0 V to 6.6 V	2.5 mV/V + 40 μV	
8. Time Base	1 ns to 5 s	0.5 $\mu\text{s}/\text{s}$	Generation using calibrator model Fluke TG501A

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(\pm)*	Remarks
9. Bandwith Amplitude Flatness			
50 kHz to 100 MHz	5 mV to 5.5 Vp-p	(15 mV/V + 100 μ V) at ref.	Generated Using Calibrator Model Fluke 5520A/5522A
100 MHz to 300 MHz	5 mV to 5.5 V	(20 mV/V + 100 μ V) at ref.	
300 MHz to 1050 MHz	0.5 V to 4 Vp-p	40 mV/V at ref.	Generated Using Calibrator Model Tek SG504
1050 MHz to 1100 MHz	5 mV to 3.5 V	(50 mV/V + 100 μ V) at ref.	Generated Using Calibrator Model Fluke 5520A/5522A
1 GHz to 4 GHz	-60 dBm to 20 dBm	0.20 dB	Levelling Mehod (MG3694C, NRVS, NRV- Z15, Splitter)
4 GHz to 6 GHz		0.23 dB	
6 GHz to 12.4 GHz		0.24 dB	
12.4 GHz to 15 GHz		0.25 dB	
15 GHz to 16 GHz		0.26 dB	
16 GHz to 26.5 GHz		0.27 dB	
10. Bandwith Frequency		50 kHz to 26.5 GHz	

Schedule

Issue date: 17 August 2018
Valid until: 8 July 2021



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Signatories:

1. **Lim Aing Khoon**
2. *** Ramlah Mamat**
3. *** Rafizi Affandi**
4. *** Lalyn Soriano Duco**

* Non-resident

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Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(\pm)*	Remarks
Active And Differential Probe 11. Rise Time	≥ 17.5 ps	12 ps	Generated Using Puls Generator 80E04 and Measuring by DSA8200 and 80E03 Sampling Module

Signatories:

1. **Lim Aing Khoo**
2. *** Rafizi Affandi**
3. *** Lalyn Soriano Duco**

* Non Resident

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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
A. Indicating Meters/ Instruments DC/Low Freq 1. DC Voltage	0 mV to 329.9999 mV 0 V to 3.299999 V 0 V to 32.99999 V 0 V to 329.99999 V 0 V to 1000.000 V	(output + floor) 20 μ V/ V + 1 μ V 11 μ V/ V + 2 μ V 12 μ V/ V + 20 μ V 18 μ V/ V + 150 μ V 18 μ V/ V + 1500 μ V	Generation using calibrator model Fluke 5720A/5522A
2. AC Voltage	1.0 mV to 1020 V (See MatrixA)	(See Matrix A)	

Scan this QR Code or visit www.ism.gov.my/cab-directories for the current scope of accreditation**Matrix A**
AC Voltage Sources

Range		Frequency (kHz)								
		0.01 to 0.045	0.045 to 10	10 to 20	20 to 50	50 to 100	100 to 500	0.045 to 1	1 to 5	5 to 10
32.999 mV	1.0 mV to 32.999 mV	0.8 + 0.006	0.15 + 0.006	0.2 + 0.006	1.0 + 0.006	3.5 + 0.012	8.0 + 0.050	-	-	-
329.999 mV	33 mV to 329.999 mV	0.3 + 0.008	0.15 + 0.008	0.16 + 0.008	0.35 + 0.008	0.8 + 0.032	2.0 + 0.070	-	-	-
3.29999 V	330 mV to 3.29999 V	0.3 + 0.05	0.15 + 0.06	0.19 + 0.06	0.3 + 0.05	0.7 + 0.125	2.4 + 0.6	-	-	-
32.9999 V	3.3 V to 32.9999 V	0.3 + 0.65	0.15 + 0.6	0.24 + 0.6	0.35 + 0.6	0.9 + 1.6	-	-	-	-
329.999 V	33 V to 329.999 V	-	-	0.25 + 6	0.3 + 6	2.0 + 50	-	0.19 + 2	0.2 + 6	0.2 + 6
1020 V	330 V to 1020 V	-	-	-	-	-	-	0.3 + 10	0.25 + 10	0.3 + 10

The calibration uncertainties given in this table are expressed in mV/V + mV

SCOPE OF CALIBRATION: ELECTRICAL

SITE: CATEGORY I

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(\pm)*	Remarks
3. DC Current	0 μ A to 329.999 μ A 0 mA to 3.29999 mA 0 mA to 32.9999 mA 0 mA to 329.999 mA 0 A to 1.09999 A 1.1 A to 2.99999 A 0 A to 10.9999 A 11 A to 20.0 A	150 μ A/A + 0.02 μ A 100 μ A/A + 0.05 μ A 100 μ A/A + 0.25 μ A 100 μ A/A + 2.5 μ A 200 μ A/A + 40 μ A 380 μ A/A + 40 μ A 500 μ A/A + 500 μ A 1.0 mA/A + 750 μ A	Generation using calibrator model Fluke 5520A/5522A
4. AC Current	29 μA to 20.5 A (See Matrix B)	(See Matrix B)	

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**Matrix B
AC Current Sources**

Range		Frequency (kHz)								
		0.01 to 0.02	0.02 to 0.045	0.045 to 1	1 to 5	5 to 10	10 to 30	0.010 to 0.045	0.045 to 0.1	0.1 to 1
329.99 μ A	29 μ A to 329.99 μ A	2.0 + 0.0001	1.5 + 0.0001	1.3 + 0.0001	3.0 + 0.00015	8.0 + 0.0002	16 + 0.0004	-	-	-
3.2999 mA	0.33 mA to 3.2999 mA	2.0 + 0.00015	1.3 + 0.00015	1.0 + 0.00015	2.0 + 0.0002	5.0 + 0.0003	10 + 0.0006	-	-	-
32.999 mA	3.3 mA to 32.999 mA	1.8 + 0.002	0.9 + 0.002	0.4 + 0.002	0.8 + 0.002	2.0 + 0.003	4.0 + 0.004	-	-	-
329.99 mA	33 mA to 329.99 mA	1.8 + 0.02	0.9 + 0.02	0.4 + 0.02	1.0 + 0.05	2.0 + 0.1	4.0 + 0.2	-	-	-
1.09999 A	330 mA to 1.09999 A	-	-	0.5 + 0.1	6.0 + 1	25 + 5	-	1.8 + 0.1	-	-
2.99999 A	1.1 A to 2.99999 A	-	-	0.6 + 0.1	6 + 1	25 + 5	-	1.8 + 0.1	-	-
10.9999 A	3 A to 10.9999 A	-	-	-	30 + 2	-	-	-	0.6 + 2	1 + 2
20.5 A	11 A to 20.5A	-	-	-	30 + 5	-	-	-	1.2 + 5	1.5 + 5

The calibration uncertainties given in this table are expressed in mA/A + mA

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Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(\pm)*	Remarks
5. DC Resistance	0 Ω to 10.9999 Ω 11 Ω to 32.9999 Ω 33 Ω to 109.9999 Ω 110 Ω to 1.099999 k Ω 1.1 k Ω to 10.99999 k Ω 11 k Ω to 109.9999 k Ω 110 k Ω to 1.099999 M Ω 1.1 M Ω to 3.299999 M Ω 3.3 M Ω to 10.99999 M Ω 11 M Ω to 32.99999 M Ω 33 M Ω to 109.9999 M Ω 110 M Ω to 329.9999 M Ω 330 M Ω to 1100 M Ω	40 $\mu\Omega/\Omega$ + 1.0 m Ω 30 $\mu\Omega/\Omega$ + 1.5 m Ω 28 $\mu\Omega/\Omega$ + 1.4 m Ω 28 $\mu\Omega/\Omega$ + 2.0 m Ω 28 $\mu\Omega/\Omega$ + 20 m Ω 28 $\mu\Omega/\Omega$ + 0.20 Ω 32 $\mu\Omega/\Omega$ + 2.0 Ω 60 $\mu\Omega/\Omega$ + 30 Ω 130 $\mu\Omega/\Omega$ + 50 Ω 250 $\mu\Omega/\Omega$ + 2.5 k Ω 500 $\mu\Omega/\Omega$ + 3.0 k Ω 3.0 m Ω/Ω + 100 k Ω 15 m Ω/Ω + 500 k Ω	Generation using calibrator model Fluke 5520A/5522A
6. Capacitance	0.19 nF to 3.2999 nF 3.3 nF to 10.9999 nF 11 nF to 109.999 nF 110 nF to 329.999 nF 0.33 μ F to 1.09999 μ F 1.1 μ F to 3.29999 μ F 3.3 μ F to 10.9999 μ F 11 μ F to 32.9999 μ F 33 μ F to 109.999 μ F 110 μ F to 329.999 μ F 330 μ F to 1.09999 mF 1.1 mF to 3.2999 mF 3.3 mF to 10.9999 mF 11 mF to 32.9999 mF 33 mF to 110 mF	5.0 mF/F + 10 pF 2.5 mF/F + 10 pF 2.5 mF/F + 100 pF 2.5 mF/F + 300 pF 2.5 mF/F + 1.0 nF 2.5 mF/F + 3.0 nF 2.5 mF/F + 10 nF 4.0 mF/F + 30 nF 4.5 mF/F + 100 nF 4.5 mF/F + 300 nF 4.5 mF/F + 1.0 μ F 4.5 mF/F + 3.0 μ F 4.5 mF/F + 10 μ F 7.5 mF/F + 30 μ F 11 mF/F + 100 μ F	Generation using calibrator model Fluke 5520A/5522A
7. Frequency a. Source	50 kHz to 1100 MHz	2.5 μ Hz/Hz	Generation using calibrator model Fluke 5520A/5522A

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Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(\pm)*	Remarks
7. Frequency b. Amplitude	<u>0.01 V_{pp} to 5.00 V_{pp}</u> 1 μ Hz to 100 kHz 100 kHz to 20 MHz 20 MHz to 30.2 MHz <u>5 V_{pp} to 10 V_{pp}</u> 1 μ Hz to 100 kHz 100 kHz to 20 MHz 20 MHz to 30.2 MHz	47 mV/V 47 mV/V 59 mV/V 23 mV/V 23 mV/V 35 mV/V	Generated Using Calibrator Model DS345
B. Sources 1. DC Voltage	0 mV to 210 mV 0.21 V to 2.1 V 2.1 V to 21 V 21 V to 210 V 210 V to 1100 V	23 μ V/V + 0.0018 mV 14 μ V/V + 0.0000018 V 13 μ V/V + 0.000003 V 25 μ V/V + 0.0004 V 26 μ V/V + 0.004 V	Measured Using Calibrator Model Keithley 2002
2. AC Voltage	200 mV to 750 V (See Matrix C)	(See Matrix C)	

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Matrix C
AC Voltage Measurements

Range	Frequency (kHz)									
	0.02 to 0.05	0.05 to 0.1	0.1 to 2	2 to 10	10 to 30	30 to 50	50 to 100	100 to 200	200 to 1000	1000 to 2000
200 mV	2.5 + 0.03	0.7 + 0.03	0.2 + 0.02	0.2 + 0.02	0.25 + 0.02	0.5 + 0.02	3.0 + 0.02	7.5 + 0.05	20 + 0.2	50 + 0.4
2 V	2.5 + 0.3	0.7 + 0.3	0.2 + 0.2	0.2 + 0.2	0.25 + 0.2	0.5 + 0.2	3.0 + 0.2	7.5 + 0.2	20 + 2	50 + 4
20 V	2.5 + 3	0.7 + 3	0.3 + 3	0.4 + 3	0.5 + 3	0.7 + 3	30 + 3	7.5 + 3	20 + 40	-
200 V ¹	2.5 + 30	0.7 + 30	0.3 + 30	0.4 + 30	0.5 + 30	0.7 + 30	30 + 30	-	-	-
750 V ¹	2.5 + 30	0.7 + 30	0.3 + 30	-	-	-	-	-	-	-

¹ Additional uncertainty 0.010 mV/V*(V_{in}/100V)² for input above 100V

The calibration uncertainties given in this table are expressed in mV/V + mV

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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
3. DC Current	0 μ A to 210 μ A 0 mA to 2.1 mA 0 mA to 21 mA 0 mA to 210 mA 0 A to 2 A	400 μ A/A + 0.005 μ A 309 μ A/A + 0.00004 mA 410 μ A/A + 0.0004 mA 540 μ A/A + 0.004 mA 880 μ A/A + 0.00004 A	Measured Using Calibrator Model Keithley 2002
	2 A to 10 A	2mA/A + 0.7 mA	Measured Using Calibrator Model Fluke 45
4. AC Current	200 μ A to 2 A (See Matrix D)	(See Matrix D)	Measured Using Calibrator Model Keithley 2002

Matrix D

AC Current Measurements

Range	Frequency (kHz)			
	0.02 to 0.05	0.05 to 0.2	0.2 to 1	1 to 10
200 μ A	3.5 + 0.00003	20 + 0.00003	40 + 0.00003	50 + 0.00003
2 mA	3.0 + 0.0003	1.5 + 0.0003	1.2 + 0.0003	1.2 + 0.0003
20 mA	3.0 + 0.003	1.5 + 0.003	1.2 + 0.003	1.2 + 0.003
200 mA	3.0 + 0.03	1.5 + 0.03	1.2 + 0.03	1.2 + 0.03
2 A	3.5 + 0.3	20 + 0.3	30 + 0.3	4.5 + 0.3

The calibration uncertainties given in this table are expressed in mA/A + mA

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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
5. DC Resistance	0 Ω to 20 Ω 0 Ω to 200 Ω 0 Ω to 2 k Ω 0 Ω to 20 k Ω 0 Ω to 200 k Ω 0 Ω to 2 M Ω 0 Ω to 20 M Ω 0 Ω to 200 M Ω	47 $\mu\Omega/\Omega$ + 0.00012 Ω 25 $\mu\Omega/\Omega$ + 0.0008 Ω 16 $\mu\Omega/\Omega$ + 0.0000008 k Ω 17 $\mu\Omega/\Omega$ + 0.000008 k Ω 43 $\mu\Omega/\Omega$ + 0.00018 Ω 80 $\mu\Omega/\Omega$ + 0.000001 M Ω 270 $\mu\Omega/\Omega$ + 0.000012 M Ω 570 $\mu\Omega/\Omega$ + 0.0006 M Ω	Measured Using Calibrator Model Keithley 2002
6. Frequency	1.0 Hz – 10 MHz 10 MHz – 100 MHz 100 MHz – 1.3 GHz	1 $\mu\text{Hz}/\text{Hz}$ + 0.1 Hz 1 $\mu\text{Hz}/\text{Hz}$ + 1 Hz 1 $\mu\text{Hz}/\text{Hz}$ + 10 Hz	Measured Using Calibrator Model CMC251
Oscilloscope			
7. Vertical Amplitude Pk-Pk (1 M Ω Load)	200 μV to 1 mV	2.5 mV/V + 1 μV	Generation using calibrator model Tek PG506A
Pk-Pk (50 Ω Load)	1 mV to 130 V	1.0 mV/V + 40 μV	Generation using calibrator model Fluke 5520A/5522A
DC (1 M Ω Load)	100 μV to 5 V	2.5 mV/V + 1 μV	Generation using calibrator model Tek PG506A
	5 V to 6.6 V	2.5 mV/V + 40 μV	Generation using calibrator model Fluke 5520A/5522A
	0 V to 130 V	0.5 mV/V + 40 μV	
	DC (50 Ω Load)	0 V to 6.6 V	
8. Time Base	1 ns to 5 s	0.5 $\mu\text{s}/\text{s}$	Generation using calibrator model Fluke TG501A

SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(\pm)*	Remarks
9. Bandwith Amplitude Flatness			
50 kHz to 100 MHz	5 mV to 5.5 Vp-p	(15 mV/V + 100 μ V) at ref.	Generated Using Calibrator Model Fluke 5520A/5522A
100 MHz to 300 MHz	5 mV to 5.5 V	(20 mV/V + 100 μ V) at ref.	
300 MHz to 1050 MHz	0.5 V to 4 Vp-p	40 mV/V at ref.	Generated Using Calibrator Model Tek SG504
1050 MHz to 1100 MHz	5 mV to 3.5 V	(50 mV/V + 100 μ V) at ref.	Generated Using Calibrator Model Fluke 5520A/5522A
1 GHz to 4 GHz	-60 dBm to 20 dBm	0.20 dB	Levelling Mehod (MG3694C, NRVS, NRV- Z15, Splitter)
4 GHz to 6 GHz		0.23 dB	
6 GHz to 12.4 GHz		0.24 dB	
12.4 GHz to 15 GHz		0.25 dB	
15 GHz to 16 GHz		0.26 dB	
16 GHz to 26.5 GHz		0.27 dB	
10. Bandwith Frequency		50 kHz to 26.5 GHz	

Schedule

Issue date: 17 August 2018
Valid until: 8 July 2021



MS ISO/IEC 17025

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Signatories:

1. **Lim Aing Khoon**
2. *** Ramlah Mamat**
3. *** Rafizi Affandi**
4. *** Lalyn Soriano Duco**

* Non-resident

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SCOPE OF CALIBRATION: ELECTRICAL

Instrument Calibrated/ Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(\pm)*	Remarks
Active And Differential Probe 11. Rise Time	≥ 17.5 ps	12 ps	Generated Using Puls Generator 80E04 and Measuring by DSA8200 and 80E03 Sampling Module

Signatories:

1. **Lim Aing Khoon**
2. *** Rafizi Affandi**
3. *** Lalyn Soriano Duco**

* Non Resident