



MS ISO/IEC 17025

# Certificate of Accreditation

No: SAMM 141

Valid until: 2 July 2018

This is to certify that

**SIRIM STANDARDS TECHNOLOGY SDN. BHD.  
PERMATANG PAUH, PULAU PINANG  
MALAYSIA**

(FIELDS OF CALIBRATION: TEMPERATURE, DIMENSIONAL,  
MASS, PRESSURE AND ELECTRICAL)

has been granted accreditation in respect of the scope of accreditation described in the SCHEDULE attached, subject to the terms and conditions governing the *Skim Akreditasi Makmal Malaysia (SAMM)*, the Laboratory Accreditation Scheme of Malaysia.

*"This laboratory is accredited in accordance with the recognised International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer joint ISO-ILAC-IAF Communiqué dated January 2009)".*

Issuance of this certificate is governed by Section 16 Subsection (2) and (3) of Standards of Malaysia Act 1996, (Act 549).



**(DATUK FADILAH BAHARIN)**

Director General  
Department of Standards Malaysia

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**LABORATORY LOCATION:** **SIRIM STANDARDS TECHNOLOGY SDN. BHD.**  
 (PERMANENT LABORATORY) **BANGUNAN SIRIM, LOT PT 483**  
**MUKIM 6 JALAN PERMATANG PAUH**  
**13500 PERMATANG PAUH**  
**PULAU PINANG**  
**MALAYSIA**

This laboratory accredited under *Skim Akreditasi Makmal Malaysia* (SAMM) meets the requirements of MS ISO/IEC 17025:2005 'General requirements for competence of testing and calibration laboratories'. This Malaysian Standards is identical with ISO/IEC 17025:2005 published by the International Organization for Standardization (ISO).

\* The expanded uncertainties are based on an estimated confidence probability of not less than 95% and have a coverage factor of  $k=2$  unless stated otherwise.

**FIELD OF CALIBRATION:** **TEMPERATURE**

**SCOPE OF ACCREDITATION:**

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
Liquid-in-glass Thermometer (Total immersion)	-30 °C to 70 °C 70 °C to 300 °C	0.1 °C 0.3 °C	Comparison with PT100 reference in: water/oil bath
Temperature Sensor 1) Thermocouple 2) Platinum Resistance Thermometer	-30 °C to 70 °C 70 °C to 400 °C	0.1 °C 0.3 °C	
Temperature Indicating Instruments (by electrical simulation) Thermocouple: (with cold junction compensation)	K Type -100 °C to 1300 °C J Type -100 °C to 1100 °C T Type -100 °C to 400 °C E Type -100 °C to 800 °C	0.5 °C 0.4 °C 0.6 °C 0.5 °C	By electrical simulation using calibrator reference to ITS-90
Resistance Temperature Detector	PT100 -100 °C to 900 °C	0.6 °C	



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FIELD OF CALIBRATION: TEMPERATURE

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
Dry Block Calibrator	0 °C to 400 °C	0.2 °C	Comparison with PT100 reference
Temperature switch	0 °C to 400 °C	1.6 °C	Dry Block Calibrator or oil/water bath
Mechanical Thermometer	30 °C to 300 °C	1.3 °C	Dry Block Calibrator or oil/water bath
Thermohygrograph / Thermohygrometer	25 %rh to 95 %rh 0 °C to 50 °C	5 %rh 0.8 °C	Comparison with wet/dry bulb in humidity chamber

## Signatories:

1. Mohamad Zaini Ismail
2. Norihan Zainal
3. Hasni Jamaluddin



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FIELD OF CALIBRATION: TEMPERATURE

SITE CALIBRATION: CATEGORY 1

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
Temperature Indicating Instruments (by electrical simulation)  Thermocouple: (with cold junction compensation) Resistance Temperature Detector	K Type -100 °C to 1300 °C J Type -100 °C to 1100 °C T Type -100 °C to 400 °C E Type -100 °C to 800 °C R Type 0 °C to 1700 °C S Type 0°C to 1700 °C  PT100 -200 °C to 850 °C	0.5 °C 0.4 °C 0.6 °C 0.5 °C 1.4 °C 1.4 °C  0.6 °C	By electrical simulation using calibrator reference to ITS-90
Temperature Controlled Enclosures	-30 °C to 200 °C 200 °C to 400 °C	0.6 °C 1.3 °C	Temperatures recorder and TC wires
Humidity Chamber	35 %rh to 95 %rh	3.5 %rh	Comparison with Humidity Temperature Recorder

## Signatories:

1. Norihan Zainal
2. Hasni Jamaluddin



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FIELD OF CALIBRATION: DIMENSIONAL

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
Digital Thickness Gauge	Up to 50 mm	1.5 $\mu$ m	Calibrated using gauge block as standard
Depth-Micro-Checker	Up to 300 mm	3 $\mu$ m	Calibrated using gauge block as standard
Height Gauge	Up to 300 mm 300 mm to 600 mm	3.5 $\mu$ m 5.5 $\mu$ m	Calibrated using gauge block as standard JIS B 7517: 1993
Standard Rod (Length Only)	Up to 300 mm 300 mm to 600 mm	3 $\mu$ m 5 $\mu$ m	Calibrated using gauge block as standard
Micrometer (External)	Up to 25 mm	1.3 $\mu$ m	Calibrated using gauge block and related accessories as standard according BS 870: 2008
Caliper (Vernier, Dial, Digital)	Up to 300 mm 300 mm to 600 mm 600mm to 1000 mm	8 $\mu$ m 12 $\mu$ m 20 $\mu$ m	Calibrated using caliper checker as standard according to JIS B 7507: 1993
Caliper Checker	Up to 300 mm 300 mm to 600 mm	3 $\mu$ m 5 $\mu$ m	Calibrated using steel gauge block as standard

Signatories:

1. Mohamad Zaini Ismail
2. Mohamed Mokhtar Ishak





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FIELD OF CALIBRATION: DIMENSIONAL

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
Feeler Gauge (Thickness and Wrap)	Up to 1 mm	2.5 $\mu$ m	Calibrated by Sylvac digital probe as reference standard
Dial Gauge	Up to 50 mm	3.0 $\mu$ m	
Pin Gauge (External diameter only)	Up to 40 mm	2.5 $\mu$ m	Calibrated using Master Pin Gauge as reference standard

Signatory:

1. Mohamed Mokhtar Ishak

FIELD OF CALIBRATION: DIMENSIONAL

SITE CALIBRATION: CATEGORY 1

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
Surface Plate Overall Flatness	600 mm x 600 mm Up to 1500 mm x 2000 mm	3 $\mu$ m 4 $\mu$ m	Calibrated using planekator as Standards according to ISO 8512-2:1990
Profile Projector –Linear Scale Only	Up to 80 mm 80 mm to 200 mm	4 $\mu$ m 7 $\mu$ m	Calibrated using glass scale as reference standard

Signatory:

1. Mohamed Mokhtar Ishak



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FIELD OF CALIBRATION: MASS

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
Standard Weights and Weight Block	1 mg	0.005 mg	Comparison against OIML class E2 weight
	2 mg	0.005 mg	
	5 mg	0.005 mg	
	10 mg	0.005 mg	
	20 mg	0.006 mg	
	50 mg	0.006 mg	
	100 mg	0.007 mg	
	200 mg	0.010 mg	
	500 mg	0.010 mg	
	1 g	0.012 mg	
	2 g	0.014 mg	
	5 g	0.016 mg	
	10 g	0.021 mg	
	20 g	0.025 mg	
	50 g	0.06 mg	
	100 g	0.06 mg	
	200 g	2 mg	
	500 g	3 mg	
	1 kg	3 mg	
	2 kg	14 mg	
	5 kg	15 mg	
	10 kg	50 mg	
	20 kg	155 mg	
	50 kg	157 mg	
	60 kg	167 mg	

Signatory:

1. Mohamad Zaini Ismail
2. Mohamed Mokhtar Ishak



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FIELD OF CALIBRATION: MASS

SITE CALIBRATION: CATEGORY 1

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
Analytical Balance	Up to 200 g	1.2 mg	Using standard weight
Balance / Scale (Mechanical, Electronic)	Up to 30 kg 30 kg to 100 kg 100 kg to 500 kg 500 kg to 1000 kg	50 mg 10 g 40 g 70 g	

Signatory:

1. Mohamad Zaini Ismail
2. Mohamed Mokhtar Ishak



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FIELD OF CALIBRATION: PRESSURE

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
Pressure Measuring Device (Oil Medium)	10 psi to 100 psi 100 psi to 200 psi 200 psi to 400 psi 400 psi to 1000 psi 1000 psi to 2000 psi 2000 psi to 5000 psi 5000 psi to 10000 psi 10000 psi to 16000 psi	0.32 psi 0.36 psi 0.34 psi 0.38 psi 0.80 psi 2 psi 4 psi 7 psi	Dead Weight Tester
Pressure Measuring Device (Air Medium)	Up to 30 psi 30 psi to 60 psi 60 psi to 100 psi 100 psi to 800 psi 800 psi to 1600 psi	0.035 psi 0.02 psi 0.03 psi 0.22 psi 0.44 psi	Electronic Pressure Test Gauge and Air Dead Weight Tester
Vacuum	Up to 14 psi	0.018 psi	

Signatory:

1. Norihan Zainal



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FIELD OF CALIBRATION: PRESSURE

SITE CALIBRATION: CATEGORY 1

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
Vacuum	Up to 14 psi	0.018 psi	Pressure sensor
Pressure Measuring Device (Air Medium)	0 psi to 30 psi 30 psi to 600 psi	0.04 psi 0.8 psi	Pressure sensor
Pressure Measuring Device (Oil Medium)	0 to 30 psi 30 psi to 600 psi 600 psi to 6000 psi 6000 psi to 10000 psi	0.04 psi 0.8 psi 8 psi 12 psi	Pressure sensor

Signatory:

1. Norihan Zainal



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FIELD OF CALIBRATION: FORCE

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
Tension Gauge	10 gf to 100 gf 100 gf to 350 gf 35 gf to 1000 gf	0.2 gf 2.5 gf 7.0 gf	Standard weight & deadweight

Signatory:

1. Norihan Zainal

FIELD OF CALIBRATION: FORCE

SITE CALIBRATION: CATEGORY 1

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
Tensile and Compression Testing Machine	Up to 20 kgf 20 kgf to 100 kgf	1 gf 80 gf	Comparison with deadweight
	100 kgf to 500 kgf 500 kgf to 1000 kgf	906 gf 1100 gf	Comparison with load column





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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<u>A. Measuring Instrument</u> 1. Multimeter/ Indicating Meter  DC Voltage	0 to 330 mV 0 to 3.3 V 0 to 33 V 33 to 330 V 334 to 1000 V	12 $\mu$ V 0.1 mV 1 mV 10 mV 80 mV	Generating using Multi Calibrator Fluke 5520A
Resistance	0 to 11 $\Omega$ 11 to 33 $\Omega$ 33 to 110 $\Omega$ 110 to 330 $\Omega$ 0.33 to 1.1 k $\Omega$ 1.1 to 3.3 k $\Omega$ 3.3 to 11 k $\Omega$ 11 to 33 k $\Omega$ 33 to 110 k $\Omega$ 110 to 330 k $\Omega$ 0.33 to 1.1 M $\Omega$ 1.1 to 3.3 M $\Omega$ 3.3 to 11 M $\Omega$ 11 to 33 M $\Omega$ 33 to 110 M $\Omega$ 110 to 330 M $\Omega$	15 m $\Omega$ 19 m $\Omega$ 28 m $\Omega$ 28 m $\Omega$ 0.1 $\Omega$ 0.1 $\Omega$ 2.5 $\Omega$ 3.4 $\Omega$ 11 $\Omega$ 10 $\Omega$ 0.1 k $\Omega$ 0.4 k $\Omega$ 2 k $\Omega$ 17 k $\Omega$ 69 k $\Omega$ 1.2 M $\Omega$	Generating using Multi Calibrator Fluke 5520A
DC Current	0 to 3.3 mA 0 to 33 mA 0 to 330 mA 0 to 1.1 A 0 to 3 A 0 to 11 A 11 to 20 A	0.4 $\mu$ A 4 $\mu$ A 95 $\mu$ A 0.3 mA 2 mA 17 mA 0.08 A	Generating using Multi Calibrator Fluke 5520A



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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b>A. Measuring Instrument</b> 1. Multimeter/ Indicating Meter (cont.)  AC Voltage	<b>1 to 30 mV</b>		
	10 Hz to 45 Hz	0.03 mV	
	45 Hz to 10 kHz	0.01 mV	
	10 kHz to 20 kHz	0.01 mV	
	20 kHz to 50 kHz	0.04 mV	
	50 kHz to 100 kHz	0.12 mV	
	100 kHz to 500 kHz	0.27 mV	
	<b>33 to 330 mV</b>		
	10 Hz to 45 Hz	0.10 mV	
	45 Hz to 10 kHz	0.05 mV	
	10 kHz to 20 kHz	0.06 mV	
	20 kHz to 50 kHz	0.12 mV	
	50 kHz to 100 kHz	0.28 mV	
	100 kHz to 500 kHz	0.70 mV	
	<b>0.33 to 3.3 V</b>		
	10 Hz to 45 Hz	1.0 mV	Generating using Multi Calibrator Fluke 5520A
	45 Hz to 10 kHz	1.0 mV	
	10 kHz to 20 kHz	2.0 mV	
	20 kHz to 50 kHz	2.0 mV	
	50 kHz to 100 kHz	5.0 mV	
	100 kHz to 500 kHz	10.0 mV	
	<b>3.3 to 33 V</b>		
	10 Hz to 45 Hz	0.01 V	
	45 Hz to 10 kHz	0.01 V	
	10 kHz to 20 kHz	0.02 V	
	20 kHz to 50 kHz	0.02 V	
	50 kHz to 90 kHz	0.13 V	
	<b>33 to 330 V</b>		
	10 Hz to 45 Hz	0.13 V	
	45 Hz to 10 kHz	0.10 V	
	10 kHz to 18 kHz	0.10 V	
	<b>330 to 1020 V</b>		
	10 Hz to 45 Hz	0.36 V	
	45 Hz to 8 kHz	0.36 V	



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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b>A. Measuring Instrument</b> 1. Multimeter/ Indicating Meter (cont.)  AC Current	<u>0.03 mA to 0.33 mA</u>		
	10 Hz to 20 Hz	1 $\mu$ A	
	20 Hz to 45 Hz	1 $\mu$ A	
	45 Hz to 1 kHz	1 $\mu$ A	
	1 kHz to 5 kHz	1 $\mu$ A	
	5 kHz to 10 kHz	3 $\mu$ A	
	<u>0.33 mA to 3.3 mA</u>		
	10 Hz to 45 Hz	6.0 $\mu$ A	
	45 Hz to 1 kHz	5.0 $\mu$ A	
	1 kHz to 10 kHz	19 $\mu$ A	
	<u>3.3 mA to 33 mA</u>		
	10 Hz to 45 Hz	43 $\mu$ A	Generating using Multi Calibrator Fluke 5520A
	45 Hz to 1 kHz	31 $\mu$ A	
	1 kHz to 10 kHz	80 $\mu$ A	
	<u>33 mA to 330 mA</u>		
	10 Hz to 45 Hz	0.5 mA	
	45 Hz to 1 kHz	0.4 mA	
	1 kHz to 10 kHz	0.9 mA	
	<u>0.33 A to 2.2 A</u>		
	10 Hz to 45 Hz	3.0 mA	
	45 Hz to 1 kHz	2.0 mA	
	1 kHz to 10 kHz	5.0 mA	
	<u>2.2 A to 11 A</u>		
	45 Hz to 1 kHz	28 mA	
	<u>11 A to 20 A</u>		
	45 Hz to 1 kHz	0.04 A	





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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
<b>A. Measuring Instrument</b>			
1. Multimeter/ Indicating Meter (cont.)			
Frequency	0.01 Hz to 120 Hz 150 Hz to 1200 Hz 12 kHz to 120 kHz	12 mHz 95 mHz 9 Hz	Generating using Multi Product Calibrator Fluke 5520A
Capacitance (Test Frequency at 10 Hz to 10 kHz)	0.19 nF to 3.3 nF 3.3 nF to 33 nF 33 nF to 330 nF 0.33 µF to 3.3 µF 3.3 µF to 33 µF 33 µF to 110 µF 110 µF to 330 µF	2 pF 0.3 nF 1.2 nF 0.1 µF 0.2 µF 0.8 µF 1.8 µF	
Resistance	330 MΩ to 1100 MΩ	17 MΩ	
2. Impedance Meter			
Capacitance	20 Hz to 1 MHz 1 µF 10 nF 100 nF 1000 pF 100 pF 10 pF 1 pF	1 nF 0.01 nF 0.1 nF 1.4 pF 0.1 pF 14 fF 2 fF	Generating using Standard Capacitance/Decade Capacitance General Radio 1423A/1409 series HP 16380A series & HP 4284A
Inductance	20 Hz to 1 MHz 100 µH 1 mH 10 mH 100 mH 1 H 10 H	0.04 µH 1.0 µH 12 µH 0.1 mH 1.0 mH 39 mH	Generating using Standard Inductance/Decade Inductance General Radio 1491-G/1482 series & HP 4284A



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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b>A. Measuring Instrument</b> Resistance	10 $\Omega$ 100 $\Omega$ 1 k $\Omega$ 10 k $\Omega$ 100 k $\Omega$ 1 M $\Omega$	0.4 m $\Omega$ 0.1 m $\Omega$ 0.03 m $\Omega$ 0.2 $\Omega$ 7.2 $\Omega$ 0.3 k $\Omega$	Generating using Standard Resistance/Decade Resistance Yew 2793/742A series
3. Low Current Meter DC Current	1 nA 10 nA 100 nA 1 $\mu$ A 10 $\mu$ A 100 $\mu$ A 1 mA	8 pA 53 pA 0.5 nA 9 nA 19 nA 0.2 $\mu$ A 6 $\mu$ A	Generating using Multi Calibrator / Programmable Current Source
4. High Voltage Type High Voltage Meter  High Voltage Probe	DCV: 0 kV to 5 kV 5 kV to 10 kV  ACV (50Hz): 0 kV to 5 kV 5 kV to 10 kV	53 V 93 V  39 V 41 V	Generating using Withstanding Voltage Tester and Comparison with Standard High Voltage Meter TOS 5101/TDV 20ADS
5. Frequency Counter Frequency	0.1 Hz to 2 GHz	56 $\mu$ Hz	Generating using Standard Function Generator- HP 3325B / Signal Generator- E4425B
6. Oscilloscope	Volt/Div (1 V to 20 V) Volt/Div (10 mV to 500 mV) Time/Div (5 ns to 500 ns) Time/Div (1 $\mu$ s to 500 $\mu$ s) Time/Div (1 ms to 500 ms) Time/Div (1 s to 5 s) Bandwith (3 MHz to 1 GHz) Risetime	90 mV 1.5 mV 0.46 ns 0.46 $\mu$ s 0.058 m s/s 5 m s/s 24 kHz/MHz 1 ps/ns	Generating using Standard Multi Calibrator/ Calibration Generation/ Leveled Sine Wave Generator/Time Mark Generator

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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b><u>A. Measuring Instrument</u></b>			
7. Oscilloscope Vertical Deflection DC Signal	0 V to $\pm 6.6$ V (50 $\Omega$ Load) 0 V to $\pm 130$ V (1M $\Omega$ Load)	49 $\mu$ V 74 mV	Generating using Oscilloscope Calibrator Fluke 5820A & E4425B
Vertical Deflection	$\pm 1$ m Vpp to $\pm 6.6$ Vpp (50 $\Omega$ Load)	10 $\mu$ Vpp	
Square Wave Signal	$\pm 1$ m Vpp to $\pm 130$ Vpp (1M $\Omega$ Load)	99 mVpp	
Horizontal Deflection Time Markers (50 $\Omega$ Load)	2 ns/div to 20 ms/div 50 ms/div to 5 s/div	1 ps 1 ms	
Rise Time	$\leq 300$ ps	5 fs	
Bandwidth Frequency	50 kHz to 600 MHz 600 MHz to 2100 MHz	0.4 kHz 0.5 kHz	
Bandwidth Amplitude	50 kHz to 600 MHz 600 MHz to 2100 MHz	16 mVpp 14 mVpp	
8. Timer/Stop Watch Time	1 s to 50 s 50 s to 10 minutes 10 minutes to 1 hour 1 hour to 3 hours	0.13 s 0.51 s 0.73 s 0.98 s	Generating using Time Calibrator/Stop Watch





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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b><u>A. Measuring Instrument</u></b>			
9. Clamp Meter	3.2 to 32 A	0.04 A	Generating using Multi Calibrator Fluke 5520A & 50- Turn Coil Model Fluke 5500 A/Coil
DC Current	32 to 105 A	0.35 A	
50- Turn Coil	105 to 200 A	1.7 A	
	16 to 160 A	0.12 A	
	160 to 525 A	1.1 A	
	525 to 1000 A	3.7 A	
AC Current	<u>3.2 A to 32 A</u>	0.31 A	
50- Turn Coil	10 Hz to 100 Hz	0.33 A	
	100 Hz to 440 Hz	0.23 A	
	<u>32 A to 200 A</u>	0.25 A	
	10 Hz to 100 Hz	0.14 A	
	100 Hz to 440 Hz	0.47 A	
	<u>16 A to 160 A</u>	2.9 A	
	10 Hz to 100 Hz	13 A	
	100 Hz to 440 Hz		
	<u>160 A to 1000 A</u>		
	10 Hz to 100 Hz		
	100 Hz to 440 Hz		
10. Power/Energy			
DC Current	0.1 W to 1 kW	0.1 mW	
	1 kW to 20 kW	0.1 kW	
AC Current	0.1 W to 1 kW	0.1 mW	
(45 Hz to 65 Hz at PF=1)	1 kW to 10 kW	5.1 W	
	10 kW to 20 kW	0.1 kW	

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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b>A. Measuring Instrument</b> 11. Tachometer	60 rpm to 600 rpm 600 rpm to 6000 rpm 6000 rpm to 60000 rpm 60000 rpm to 99960 rpm	0.7 rpm 7.1 rpm 71 rpm 120 rpm	In-House Method ESF/0303 (Generating using Func. Generator HP 3325B)
12. Insulation Testers	(1 k $\Omega$ to 10 k $\Omega$ ) @10 V (10 k $\Omega$ to 100 k $\Omega$ ) @ 50 V (0.1 M $\Omega$ to 1 M $\Omega$ ) @150 V (1 M $\Omega$ to 10 M $\Omega$ ) @ 300 V (10 M $\Omega$ to 100 M $\Omega$ ) @ 500 V (0.1 G $\Omega$ to 1 G $\Omega$ ) @1000 V (1 G $\Omega$ to 10 G $\Omega$ ) @ 5000 V (10 G $\Omega$ to 100 G $\Omega$ ) @ 5000 V (100 G $\Omega$ to 500 G $\Omega$ ) @ 5000 V	8 $\Omega$ 19 $\Omega$ 0.2 k $\Omega$ 8 k $\Omega$ 71 k $\Omega$ 1.6 M $\Omega$ 12 M $\Omega$ 0.2 G $\Omega$ 2.8 G $\Omega$	Tinsley 4720
<b>B. Generating Instruments</b> 1. Calibrator DC Voltage	100 mV 1 V 10 V 100 V 1000 V	2 $\mu$ V 15 $\mu$ V 0.1 mV 2 mV 16 mV	Measurement using Digital Multimeter/ Direct Measurement Agilent 3458A
Resistance	10 $\Omega$ 100 $\Omega$ 1 k $\Omega$ 10 k $\Omega$ 100 k $\Omega$ 1 M $\Omega$ 10 M $\Omega$ 100 M $\Omega$	0.5 m $\Omega$ 2 m $\Omega$ 0.1 $\Omega$ 0.2 $\Omega$ 2.0 $\Omega$ 0.1 k $\Omega$ 0.8 k $\Omega$ 60 k $\Omega$	
DC Current	100 $\mu$ A 1 mA 10 mA 100 mA 1 A	0.02 $\mu$ A 0.1 $\mu$ A 0.8 $\mu$ A 9.2 $\mu$ A 0.2 mA	



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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b>B. Generating Instruments</b> 1. Calibrator (cont.) AC Voltage	<u>100 mV</u>		
	1 kHz to 20 kHz	0.03 mV	
	100 kHz	0.38 mV	
	300 kHz	1.2 mV	
	1 MHz	1.8 mV	
	<u>1V</u>		
	45 Hz to 20 kHz	0.4 mV	
	50 kHz	0.2 mV	
	100 kHz	3.6 mV	
	300 kHz	12 mV	
	500 kHz	12 mV	
	1 MHz	18 mV	
	<u>10 V</u>		
	45 Hz to 20 kHz	3.7 mV	
	50 kHz	2.4 mV	
	100 kHz	36 mV	
	300 kHz	0.1 V	
	500 kHz	0.1 V	
	1 MHz	0.2 V	
	<u>100 V</u>		
	45 Hz to 20 kHz	0.04 V	
	50 kHz	0.14 V	
	100 kHz	0.48 V	
	<u>1000 V</u>		
	10 Hz to 45 Hz	0.49 V	
Frequency	<u>Input Signal 1 mV to 700 V</u>		
	1 Hz	1 mHz	
	10 MHz	1 kHz	

Masurement using  
Digital Multimeter  
Direct  
Measurement  
Agilent 3458A





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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b>B. Generating Instruments</b> 2. Standard Impedance Capacitance	10 Hz to 1 MHz 10 pF 100 pF 1000 pF 1 $\mu$ F 100 nF 10 nF	19 fF 0.2 pF 1.6 pF 2 nF 0.2 nF 0.01 nF	Measurement using Standard Capacitance/Decade Capacitance General Radio 1423A/1409 series HP 16380A series & HP 4284A
Inductance	10 Hz to 1 MHz 100 $\mu$ H 1 mH 10 mH 100 mH 1 H 10 H	0.1 $\mu$ H 1 $\mu$ H 0.01 mH 0.1 mH 1 mH 14 mH	Measurement using Standard Inductance/Decade Inductance General Radio 1491-G/1482 series & HP 4284A
Resistance	10 $\Omega$ 100 $\Omega$ 1 k $\Omega$ 10 k $\Omega$ 100 k $\Omega$ 1 M $\Omega$ 10 M $\Omega$ 100 M $\Omega$	0.34 m $\Omega$ 0.02 $\Omega$ 0.03 $\Omega$ 0.18 $\Omega$ 7.0 $\Omega$ 0.05 k $\Omega$ 2.2 k $\Omega$ 20 k $\Omega$	Measurement using Standard Resistance/Decade Resistance Yew 2793/742A series
3. High Voltage Type Generate	DCV: 0 kV to 20 kV ACV (50Hz): 0 kV to 20 kV	(of reading) 0.093 kV 0.041 kV	Measurement using Standard High Voltage Meter/H.V. Probe/ TDV 20 ADS/Fluke 80 kV-40 kV
4. Signal Generator Frequency	0.1 Hz to 5 GHz	(of reading) 19.2 $\mu$ Hz	Measurement using Standard Universal Counter /HP 53132A



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SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b>B. Generating Instruments</b> 5. AC Current			
	<u>29 <math>\mu</math>A to 0.33 mA</u>		
	10 Hz to 45 Hz	2.0 $\mu$ A	
	45 Hz to 100 Hz	0.3 $\mu$ A	
	100 Hz to 1 kHz	0.4 $\mu$ A	
	1 kHz to 5 kHz	0.3 $\mu$ A	
	<u>0.33 mA to 3.3 mA</u>		
	10 Hz to 45 Hz	6.0 $\mu$ A	
	45 Hz to 1 kHz	3.0 $\mu$ A	
	100 Hz to 1 kHz	2.0 $\mu$ A	
	1 kHz to 5 kHz	3.0 $\mu$ A	
	<u>3.3 mA to 33 mA</u>		
	10 Hz to 45 Hz	65 $\mu$ A	
	45 Hz to 100 Hz	65 $\mu$ A	
	100 Hz to 1 kHz	19 $\mu$ A	
	1 kHz to 5 kHz	31 $\mu$ A	
	5 kHz to 20 kHz	31 $\mu$ A	
	20 kHz to 50 kHz	17 $\mu$ A	
	50 kHz to 100 kHz	27 $\mu$ A	
	<u>33 mA to 330 mA</u>		
	10 Hz to 45 Hz	0.65 mA	
	45 Hz to 100 Hz	0.31 mA	
	100 Hz to 1 kHz	0.19 mA	
	1 kHz to 5 kHz	0.31 mA	
	5 kHz to 20 kHz	0.31 mA	
	20 kHz to 50 kHz	0.17 mA	
	<u>330 mA to 1A</u>		
	10 Hz to 45 Hz	1.6 mA	
	45 Hz to 100 Hz	0.6 mA	
	100 Hz to 1 kHz	2.0 mA	
	1 kHz to 5 kHz	4.0 mA	
	5 kHz to 20 kHz	4.0 mA	
	20 kHz to 50 kHz	2.7 mA	
			Measurement using Digital Multimeter Model 3458A

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SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b><u>B. Generating Instruments</u></b>			
6. Oscilloscope Calibrator (Calibration Generator, Time Mark Generator and Levelled Sine Wave Generator)	Frequency: 0.1 Hz to 5 GHz <u>Amplitude 100 mV to 10 V</u> 40 Hz to 1 kHz 1 kHz to 20 kHz 50 kHz to 100 kHz	(of reading) 19.2 $\mu$ Hz  1 mV 10 mV 36 mV	Measurement using Standard Universal Counter/Digital Multimeter Digitizing Oscilloscope HP53132/HP3458A/TDS680C
7. DC Current Source	1 A to 10 A	32 mA	Measurement using Standard Current Shunt/Digital Multimeter/ HP 3458A/VS 2575A
8. AC Current Source	1 A to 10 A (50 Hz to 10 kHz)	72 mA	

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FIELD OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b>A. Measuring Instrument</b>			
1. Multimeter/ Indicating Meter			
DC Voltage	0 to 330 mV 0 to 3.3 V 0 to 33 V 33 to 330 V 334 to 1000 V	15 $\mu$ V 0.1 mV 1 mV 11 mV 81 mV	Generating using Multi Calibrator Fluke 5520A
Resistance	0 to 11 $\Omega$ 11 to 33 $\Omega$ 33 to 110 $\Omega$ 110 to 330 $\Omega$ 0.33 to 1.1 k $\Omega$ 1.1 to 3.3 k $\Omega$ 3.3 to 11 k $\Omega$ 11 to 33 k $\Omega$ 33 to 110 k $\Omega$ 110 to 330 k $\Omega$ 0.33 to 1.1 M $\Omega$ 1.1 to 3.3 M $\Omega$ 3.3 to 11 M $\Omega$ 11 to 33 M $\Omega$ 33 to 110 M $\Omega$ 110 to 330 M $\Omega$ 330 to 1100 M $\Omega$	16 m $\Omega$ 19 m $\Omega$ 28 m $\Omega$ 0.2 $\Omega$ 3.0 $\Omega$ 2.8 $\Omega$ 2.7 $\Omega$ 4.0 $\Omega$ 24 $\Omega$ 30 $\Omega$ 0.1 k $\Omega$ 0.4 k $\Omega$ 2 k $\Omega$ 17 k $\Omega$ 180 k $\Omega$ 1.2 M $\Omega$ 2.1 M $\Omega$	Generating using Multi Calibrator Fluke 5520A
DC Current	0 mA to 300 $\mu$ A 0 mA to 3.3 mA 0 mA to 33 mA 0 mA to 330 mA 0 A to 1.1 A 0 A to 3 A 0 A to 11 A 11 A to 20.5 A	0.1 $\mu$ A 0.4 $\mu$ A 4.0 $\mu$ A 0.1 mA 0.3 mA 2.0 mA 17 mA 26 mA	Generating using Multi Calibrator Fluke 5520A



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SITE CALIBRATION: CATEGORY I

SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b>A. Measuring Instrument</b> 1. Multimeter/ Indicating Meter (cont.) AC Voltage	<u>1 to 30 mV</u>		Generating using Multi Calibrator Fluke 5520A
	10 Hz to 45 Hz	29 $\mu$ V	
	45 Hz to 10 kHz	6 $\mu$ V	
	10 kHz to 20 kHz	8 $\mu$ V	
	20 kHz to 50 kHz	35 $\mu$ V	
	50 kHz to 100 kHz	0.12 mV	
	100 kHz to 500 kHz	0.28 mV	
	<u>33 to 330 mV</u>		
	10 Hz to 45 Hz	0.11 mV	
	45 Hz to 10 kHz	0.06 mV	
	10 kHz to 20 kHz	0.06 mV	
	20 kHz to 50 kHz	0.12 mV	
	50 kHz to 100 kHz	0.28 mV	
	100 kHz to 500 kHz	0.70 mV	
	<u>0.33 to 3.3 V</u>		
	10 Hz to 45 Hz	1.0 mV	
	45 Hz to 10 kHz	1.0 mV	
	10 kHz to 20 kHz	2.0 mV	
	20 kHz to 50 kHz	2.0 mV	
	50 kHz to 100 kHz	5.0 mV	
	100 kHz to 500 kHz	10 mV	
	<u>3.3 to 33 V</u>		
	10 Hz to 45 Hz	10 mV	
	45 Hz to 10 kHz	15 mV	
	10 kHz to 20 kHz	17 mV	
	20 kHz to 50 kHz	19 mV	
	50 kHz to 90 kHz	0.13 V	
	<u>33 to 330 V</u>		
	10 Hz to 45 Hz	0.13 V	
	45 Hz to 10 kHz	0.10 V	
	10 kHz to 20 kHz	0.11 V	
	20 kHz to 50 kHz	0.11 V	
	50 kHz to 100 kHz	0.11 V	
	<u>330 to 1020 V</u>		
	45 Hz to 10 kHz	0.36 mV	

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Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b>A. Measuring Instrument</b> 1. Multimeter/ Indicating Meter (cont.) AC Current	<u>29 <math>\mu</math>A to 330 <math>\mu</math>A</u>		
	45 Hz to 1 kHz	1 $\mu$ A	
	1 kHz to 5 kHz	1 $\mu$ A	
	5 kHz to 10 kHz	3 $\mu$ A	
	<u>0.33 mA to 3.3 mA</u>		
	45 Hz to 1 kHz	6 $\mu$ A	
	1 kHz to 5 kHz	5 $\mu$ A	
	5 kHz to 10 kHz	20 $\mu$ A	
	<u>3.3 mA to 33 mA</u>		
	45 Hz to 1 kHz	32 $\mu$ A	
	1 kHz to 5 kHz	41 $\mu$ A	
	5 kHz to 10 kHz	81 $\mu$ A	
	<u>33 mA to 330 mA</u>		
	45 Hz to 1 kHz	0.4 mA	Generating using Multi Calibrator Fluke 5520A
	1 kHz to 5 kHz	1 mA	
	5 kHz to 10 kHz	1 mA	
	<u>0.33 A to 1.1 A</u>		
	45 Hz to 1 kHz	3 mA	
	1 kHz to 5 kHz	2 mA	
	5 kHz to 10 kHz	35 mA	
	<u>1.1 A to 3 A</u>		
	45 Hz to 1 kHz	5 mA	
	1 kHz to 5 kHz	24 mA	
	5 kHz to 10 kHz	93 mA	
	<u>3 A to 11 A</u>		
	45 Hz to 1 kHz	28 mA	
	<u>11 A to 20 A</u>		
	45 Hz to 1 kHz	44 mA	



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SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<b>A. Measuring Instrument</b>			
1. Multimeter/ Indicating Meter (cont.)			
Frequency	0.01 Hz to 120 Hz 120 Hz to 1200 Hz 12 kHz to 120 kHz	9 mHz 76 mHz 9 Hz	Generating using Multi Calibrator Fluke 5520A
Capacitance (Test Frequency at 10 Hz to 10 kHz)	0.19 nF to 3.3 nF 3.3 nF to 33 nF 33 nF to 330 nF 0.33 $\mu$ F to 3.3 $\mu$ F 3.3 $\mu$ F to 33 $\mu$ F 33 $\mu$ F to 110 $\mu$ F	2 pF 0.2 nF 1.2 nF 59 nF 0.2 $\mu$ F 0.5 $\mu$ F	Generating using Multi Calibrator Fluke 5520A
2. Timer/Stop Watch Time	1 s to 50 s 50 s to 10 minutes 10 minutes to 1 hour 1 hour to 3 hours	0.13 s 0.74 s 0.81 s 1.0 s	Generating using Time Calibrator
3. Insulation Testers	(1 k $\Omega$ to 10 k $\Omega$ ) @10 V (10 k $\Omega$ to 100 k $\Omega$ ) @ 50 V (0.1 M $\Omega$ to 1 M $\Omega$ ) @150 V (1 M $\Omega$ to 10 M $\Omega$ ) @ 300 V (10 M $\Omega$ to 100 M $\Omega$ ) @ 500 V (0.1 G $\Omega$ to 1 G $\Omega$ ) @1000 V (1 G $\Omega$ to 10 G $\Omega$ ) @ 5000 V (10 G $\Omega$ to 100 G $\Omega$ ) @ 5000 V (100 G $\Omega$ to 500 G $\Omega$ ) @ 5000 V	8 $\Omega$ 19 $\Omega$ 0.2 k $\Omega$ 8 k $\Omega$ 71 k $\Omega$ 1.6 M $\Omega$ 12 M $\Omega$ 0.2 G $\Omega$ 2.8 G $\Omega$	Tinsley 4720



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Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty(±)*	Remarks
<b><u>A. Measuring Instrument</u></b>			
4. Oscilloscope Vertical Deflection DC Signal	0 V to ± 6.6 V (50 Ω Load) 0 V to ± 130 V (1MΩ Load)	49 μV 74 mV	Generating using Oscilloscope Calibrator Fluke 5820A & E4425B
Vertical Deflection	±1m Vpp to ± 6.6 Vpp (50 Ω Load)	10 μVpp	
Square Wave Signal	±1m Vpp to ± 130 Vpp (1MΩ Load)	99 mVpp	
Horizontal Deflection Time Markers (50 Ω Load)	2 ns/div to 20 ms/div 50 ms/div to 5 s/div	1 ps 1 ms	
Rise Time	≤ 300 ps	5 fs	
Bandwidth Frequency	50 kHz to 600 MHz 600 MHz to 2100 MHz	0.4 kHz 0.5 kHz	
Bandwidth Amplitude	50 kHz to 600 MHz 600 MHz to 2100 MHz	16 mVpp 14 mVpp	
<b><u>B. Generating Instruments</u></b>			
1. DC Power Supply DC Voltage	100 mV 1000 mV 10 V 100 V 1000 V	8 μV 0.6 mV 18 mV 150 mV 0.5 V	Measurement using Digital Multimeter & Current Shunt Fluke 45 & Vahalla 2575A
DC Current	100 mA 10 A 100 A	280 μA 110 mA 1.2 A	

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SCOPE OF ACCREDITATION:

Instrument Calibrated / Measurement Parameter	Range	Calibration and Measurement Capability Expressed as an Uncertainty( $\pm$ )*	Remarks
<u>B. Generating Instruments</u>  2. High Voltage Type	DCV: 0 kV to 20 kV ACV (50Hz): 0 kV to 20 kV	10 V/kV 17 V/kV	Measurement using Standard High Voltage Meter/High Voltage Probe/Digital Multimeter T.D.V. 20 ADS/Fluke 80 kV-40 & MX 56

## Signatories:

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