



MS ISO/IEC 17025

Certificate of Accreditation

No: SAMM 141

Valid until: 2 July 2012

This is to certify that

**SIME-SIRIM TECHNOLOGIES SDN BHD
PERMATANG PAUH, PULAU PINANG
MALAYSIA**

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

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.

Laboratories accredited under SAMM meet the requirements of MS ISO/IEC 17025 'General requirements for the competence of testing and calibration laboratories'. This Malaysian Standard is identical with ISO/IEC 17025 published by the International Organization for Standardization (ISO).

"This laboratory is accredited in accordance with recognized 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 18 June 2005)"



(FADILAH BAHARIN)

Director General
Department of Standards Malaysia
Date of issue: 24 June 2009

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LABORATORY LOCATION: SIME-SIRIM TECHNOLOGIES SDN BHD
(PERMANENT LABORATORY) BANGUNAN SIRIM, LOT PT 483, MUKIM 6
JALAN PERMATANG PAUH
13500 PERMATANG PAUH
PULAU PINANG, MALAYSIA

The standard used for assessment of this laboratory is MS ISO/IEC 17025:2005

FIELD OF CALIBRATION: TEMPERATURE

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
Liquid-in-glass Thermometer (Total immersion)	- 30 °C to 70°C 70 °C to 300°C	0.1 °C 0.3 °C
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 0.4 °C 0.5 °C
Resistance Temperature Detector	PT100 -100 °C to 900 °C	0.6 °C
Dry Block Calibrator	0 °C to 400 °C	0.2 °C
Temperature Switch	0 °C to 400 °C	2.0 °C
Mechanical Thermometer	30 °C to 300 °C	1.5 °C
Thermohygrograph / Thermohygrometer	25 % RH to 95 % RH 15 °C to 50 °C	5 % RH 0.8 °C

*** The uncertainties are based on an estimated confidence probability of not less than 95% unless otherwise stated.**

Signatories:

- Mohamad Zaini bin Ismail** I/C No. : 660102-07-5737
- Mahmuddin bin Daud** I/C No. : 580623-02-5735



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FIELD OF CALIBRATION: TEMPERATURE

SITE CALIBRATION - CATEGORY 1

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
Temperature Indicating Instruments (by Electrical Simulation)	K Type -100 °C to 1300 °C	0.5 °C
	J Type -100 °C to 1100 °C	0.4 °C
Thermocouple : (with cold junction compensation)	T Type -100 °C to 400 °C	0.4 °C
	E Type -100 °C to 800 °C	0.4 °C
	R Type 0 °C to 1700 °C	1.3 °C
	S Type 0 °C to 1700 °C	1.3 °C
Resistance Temperature Detector	PT100 -200 °C to 800 °C	0.6 °C
Temperature Controlled Enclosures	-30 °C to 200 °C	0.6 °C
	200 °C to 400 °C	1.2 °C

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FIELD OF CALIBRATION: DIMENSIONAL
SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
Digital Thickness Gauge	1 mm to 50 mm	1.4 μ m
Depth Micro-Checker	0 mm to 300 mm	5.8 μ m
Height Gauge	5 mm to 600 mm	11 μ m
Standard Rod	0 mm to 300 mm 301 mm to 600 mm	5.9 μ m 11 μ m
Micrometer (External)	0 mm to 25 mm	1.3 μ m
Caliper (Vernier, Dial, Digital)	1 mm to 600 mm	13 μ m
Caliper Checker	20 mm to 300 mm 300 mm to 600 mm	5.9 μ m 11 μ m

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FIELD OF CALIBRATION: DIMENSIONAL
SITE CALIBRATION - CATEGORY 1
SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
Profile Projector - Linear scale only	0 mm to 200 mm	4 μ m

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FIELDS OF CALIBRATION: MASS

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
Standard Weights And Weight Blocks	1 mg	0.003 mg
	2 mg	0.003 mg
	5 mg	0.004 mg
	10 mg	0.004 mg
	20 mg	0.004 mg
	50 mg	0.005 mg
	100 mg	0.006 mg
	200 mg	0.009 mg
	500 mg	0.009 mg
	1 g	0.01 mg
	2 g	0.015 mg
	5 g	0.015 mg
	10 g	0.04 mg
	20 g	0.04 mg
	50 g	0.05 mg
	100 g	0.06 mg
	200 g	1.0 mg
	500 g	1.0 mg
	1 kg	1.3 mg
	2 kg	11 mg
	5 kg	11 mg
	10 kg	36 mg
	20 kg	36 mg
	50 kg	120 mg
	60 kg	120 mg

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FIELD OF CALIBRATION: MASS

SITE CALIBRATION - CATEGORY 1

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
Analytical Balance	1 mg to 200 g	0.12 mg
Balance/Scale (Mechanical, Electronic)	1 mg to 30 kg	50 mg
	30 kg to 100 kg	9 g
	100 kg to 500 kg	40 g
	500 kg to 1000 kg	70 g

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FIELDS OF CALIBRATION: PRESSURE MEASUREMENT

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
Pressure Measuring Device (Oil Medium)	10 psi to 100 psi	0.04 psi
	100 psi to 200 psi	0.07 psi
	200 psi to 400 psi	0.15 psi
	400 psi to 1000 psi	0.40 psi
	1000 psi to 2000 psi	0.7 psi
	2000 psi to 5000 psi	2.0 psi
	5000 psi to 10000 psi	4.0 psi
	10000 psi to 16000 psi	7.0 psi
Pressure Measuring Device (Air Medium)	0 psi to 30 psi	0.03 psi
	30 psi to 60 psi	0.02 psi
	60 psi to 100 psi	0.03 psi
	100 psi to 800 psi	0.22 psi
	800 psi to 1600 psi	0.43 psi
Vacuum	0 psi to 13.5 psi	0.06 psi

FIELDS OF CALIBRATION: PRESSURE MEASUREMENT

SITE CALIBRATION - CATEGORY 1

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
Vacuum	0 psi to 13.5 psi	0.06 psi
Pressure Measuring Device (Air Medium)	0 psi to 30 psi	0.03 psi
	30 psi to 600 psi	0.7 psi
Pressure Measuring Device (Oil Medium)	0 psi to 30 psi	0.03psi
	30 psi to 600 psi	0.7 psi
	600 psi to 6000 psi	7.0 psi
	6000 psi to 10000 psi	12 psi

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FIELDS OF CALIBRATION: FORCE MEASUREMENT

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
Tension Gauge	0 gf to 100 gf	0.2 gf
	100 gf to 350 gf	2.5 gf
	350 gf to 1000 gf	7.0 gf

FIELDS OF CALIBRATION: FORCE MEASUREMENT

SITE CALIBRATION - CATEGORY 1

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
Tensile and Compression Testing Machine	0 kgf to 20 kgf	1 gf
	20 kgf to 100 kgf	80 gf
	100 kgf to 500 kgf	250 gf
	500 kgf to 1000 kgf	800 gf

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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
A. Measuring Instruments		
1. Multimeter/ Indicating Meter DC Voltage	0 mV to 330 mV	72 $\mu\text{V/V}$
	0 V to 3.3 V	63 $\mu\text{V/V}$
	0 V to 33 V	63 $\mu\text{V/V}$
	33 V to 330 V	66 $\mu\text{V/V}$
	334 V to 1000 V	66 $\mu\text{V/V}$
Resistance	0 Ω to 11 Ω	0.2 m Ω/Ω
	11 Ω to 33 Ω	0.2 m Ω/Ω
	33 Ω to 110 Ω	0.2 m Ω/Ω
	110 Ω to 330 Ω	0.2 m Ω/Ω
	0.330 k Ω to 1.1 k Ω	0.2 $\mu\Omega/\Omega$
	1.1 k Ω to 3.3 k Ω	0.2 $\mu\Omega/\Omega$
	3.3 k Ω to 11 k Ω	0.2 $\mu\Omega/\Omega$
	11 k Ω to 33 k Ω	0.2 $\mu\Omega/\Omega$
	33 k Ω to 110 k Ω	0.3 $\mu\Omega/\Omega$
	110 k Ω to 330 k Ω	0.2 $\mu\Omega/\Omega$
	0.330 M Ω to 1.1 M Ω	0.3 m Ω/Ω
	1.1 M Ω to 3.3 M Ω	0.2 m Ω/Ω
	3.3 M Ω to 11 M Ω	0.7 m Ω/Ω
	11 M Ω to 33 M Ω	0.4 m Ω/Ω
	33 M Ω to 109.999 M Ω	1.4 m Ω/Ω
	110 M Ω to 330 M Ω	3.8 m Ω/Ω
DC Current	0 mA to 3.3 mA	0.2 mA/A
	0 mA to 33 mA	0.2 mA/A
	0 mA to 330 mA	0.3 mA/A
	0 A to 2.2 A	0.5 mA/A
	0 A to 11 A	0.4 mA/A



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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
A. Measuring Instruments		
1. Multimeter/Indicating Meter		
AC Voltage	<u>1 mV to 30.00 mV</u>	(of reading)
	10 Hz to 45 Hz	0.3 mV/V
	45 Hz to 10 kHz	0.2 mV/V
	10 kHz to 20 kHz	0.2 mV/V
	20 kHz to 50 kHz	0.2 mV/V
	50 kHz to 100 kHz	0.4 mV/V
	100 kHz to 500 kHz	1.0 mV/V
	<u>33 mV to 330 mV</u>	
	10 Hz to 45 Hz	0.3 mV/V
	45 Hz to 10 kHz	38 μ V/V
	10 kHz to 20 kHz	38 μ V/V
	20 kHz to 50 kHz	57 μ V/V
	50 kHz to 100 kHz	86 μ V/V
	100 kHz to 500 kHz	0.4 mV/V
	<u>0.33 V to 3.3 V</u>	
	10 Hz to 45 Hz	1.8 mV/V
	45 Hz to 10 kHz	0.4 mV/V
	10 kHz to 20 kHz	0.4 mV/V
	20 kHz to 50 kHz	1.6 mV/V
	50 kHz to 100 kHz	2.8 mV/V
	100 kHz to 500 kHz	8.0 mV/V
	<u>3.3 V to 33 V</u>	
	10 Hz to 45 Hz	1.8 mV/V
	45 Hz to 10 kHz	0.5 mV/V
	10 kHz to 20 kHz	0.5 mV/V
	20 kHz to 50 kHz	2.2 mV/V
	50 kHz to 500 kHz	2.2 mV/V
	<u>33 V to 330 V</u>	
	10 Hz to 45 Hz	1.7 mV/V
	45 Hz to 10 kHz	1.0 mV/V
	10 kHz to 20 kHz	1.1 mV/V
	<u>330 V to 1020 V</u>	
	10 Hz to 45 Hz	9.1 mV/V
	45 Hz to 10 kHz	9.1 mV/V



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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
A.Measuring Instruments		(of reading)
1. Multimeter/Indicating Meter	<u>0.03 mA to 0.33 mA</u>	
	10 Hz to 20 Hz	1.7 mA/A
AC Current	20 Hz to 45 Hz	1.7mA/A
	45 Hz to 1 kHz	1.7 mA/A
	1 to 5 kHz	1.7 mA/A
	<u>0.33 mA to 3.3 mA</u>	
	10 Hz to 45 Hz	1.5 mA/A
	45 Hz to 1 kHz	1.5 mA/A
	1 to 5 kHz	1.5 mA/A
	<u>3.3 mA to 33 mA</u>	
	10 Hz to 45 Hz	1.5 mA/A
	45 Hz to 1 kHz	1.5 mA/A
	1 to 10 kHz	1.5 mA/A
	<u>33 mA to 330 mA</u>	
	10 Hz to 45 Hz	1.8 mA/A
	45 Hz to 1 kHz	1.8 mA/A
	1 kHz to 10 kHz	1.8 mA/A
	<u>0.33 A to 2.2 A</u>	
	10 to 45 Hz	2.1 mA/A
	45 Hz to 1 kHz	2.1 mA/A
	1 kHz to 5 kHz	3.6 mA/A
	<u>2.2 A to 11 A</u>	
	45 Hz to 1 kHz	1.5 mA/A



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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

Instrument Calibrated/ Measurement Parameter	Range	Best measurement capability expressed as an uncertainty (\pm) *
A. Measuring Instruments		
2. Impedance Meter Capacitance	Supply at 1 kHz	
	1 μ F	0.7 nF
	10 nF	6.4 pF
	100 nF	64 pF
	1000 pF	0.6 pF
	100 pF	69 fF
	10 pF	6.9 fF
	1 pF	1.3 fF
Inductance	Supply at 1 kHz	
	100 μ H	0.3 μ H
	1 mH	1.3 μ H
	10 mH	10 μ H
	100 mH	0.2 mH
	1 H	1.3 mH
	10 H	13 mH
Resistance	10 Ω	0.3 m Ω
	100 Ω	2.5 m Ω
	1 k Ω	20 m Ω
	10 k Ω	0.2 Ω
	100 k Ω	5.8 Ω
	1 M Ω	30 Ω
3. Low Current Meter DC Current	1 nA	7.5 pA
	10 nA	52 pA
	100 nA	0.5 pA
	1 μ A	6.4 nA
	10 μ A	22 nA
	100 μ A	0.2 μ A
	1 mA	1.8 μ A
		(of reading)
4. High Voltage Type High Voltage Meter	DCV : 0 kV to 10 kV	6.2 mV/V
	ACV (50 Hz) : 0 kV to 10 kV	15 mV/V
High Voltage Probe	DCV : 0 kV to 10 kV	6.2 mV/V
	ACV (50 Hz) : 0 kV to 10 kV	15 mV/V



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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
A. Measuring Instruments		
5. Frequency Counter		
Frequency	0.1 Hz to 2 GHz	61 nHz/Hz
6. Oscilloscope		
	Volt/Div (1 V to 20 V)	60 mV
	Volt/Div (10 mV to 500 mV)	600 μ V
	Time/Div (5 ns to 500 ns)	60 μ s
	Time/Div (1 μ s to 500 μ s)	600 ns
	Time/Div (1 ms to 500 ms)	0.6 μ s
	Time/Div (1 s to 5 s)	60 ms
	Bandwidth (3 MHz to 1 GHz)	0.62 MHz
	Risetime	0.012 ns
B. Generating Instruments		
1. Calibrator		
DC Voltage	100 mV	22 μ V/V
	1 V	14 μ V/V
	10 V	13 μ V/V
	100 V	16 μ V/V
	1000 V	17 μ V/V
Resistance	10 Ω	0.4 m Ω
	100 Ω	2.8 m Ω
	1 k Ω	19 m Ω
	10 k Ω	0.2 Ω
	100 k Ω	2.0 Ω
	1 M Ω	30 Ω
	10 M Ω	0.9 k Ω
	100 M Ω	60 k Ω
DC Current	100 μ A	0.2 mA/A
	1 mA	77 μ A/A
	10 mA	75 μ A/A
	100 mA	92 μ A/A
	1 A	0.3 mA/A



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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
B. Generating Instruments		
(of reading)		
1. Calibrator AC Voltage	<u>100 mV</u>	
	1 kHz to 20 kHz	0.3 mV/V
	100 kHz	1.5 mV/V
	300 kHz	3.8 mV/V
	1 MHz	4.6 mV/V
	<u>1 V</u>	
	45 Hz to 20 kHz	0.2 mV/V
	50 kHz	0.4 mV/V
	100 kHz	0.4 mV/V
	300 kHz	3.6 mV/V
	500 kHz	12 mV/V
	1 MHz	12 mV/V
	<u>10 V</u>	
	45 Hz to 20 kHz	0.2 mV/V
	50 kHz	0.2 mV/V
	100 kHz	1.0 mV/V
	300 kHz	3.6 mV/V
	500 kHz	12 mV/V
	1 MHz	14 mV/V
	<u>100 V</u>	
	45 Hz to 20 kHz	0.3 mV/V
	50 kHz	0.5 mV/V
	100 kHz	1.6 mV/V
	<u>1000 V</u>	
	45 Hz to 1 kHz	0.5 μ V/V
Frequency	<u>Input Signal 1 mV to 700 V</u>	
	1 Hz	0.6 mHz/Hz
	10 MHz	0.2 mHz/Hz



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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
B. Generating Instrument		
2. Standard Impedance Capacitance	Measured at 1 kHz	
	10 pF	6.9 fF
	100 pF	69 fF
	1000 pF	0.7 pF
	1 μ F	0.7 pF
	100 nF	65 pF
	10 nF	6.5 pF
Inductance	Measured at 1 kHz	
	100 μ H	0.3 μ H
	1 mH	1.3 μ H
	10 mH	13 μ H
	100 mH	0.2 mH
	1 H	1.3 mH
	10 H	13 mH
Resistance		
	10 Ω	0.3 m Ω
	100 Ω	2.4 m Ω
	1 k Ω	20 m Ω
	10 k Ω	0.2 Ω
	100 k Ω	5.8 Ω
	1 M Ω	30 Ω
	10 M Ω	0.9 k Ω
	100 M Ω	60 k Ω
		(of reading)
3. High Voltage Type Generate	DCV : 0 kV to 20 kV ACV (50Hz): 0 kV to 20 kV	6.2 mV/V 15 mV/V
		(of reading)
4. Signal Generator Frequency	0.1 Hz to 5 GHz	61 nHz/Hz
		(of reading)
5. 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	61 nHz/Hz 0.2 mV/V 0.2 mV/V 1 mV/V



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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
B. Generating Instrument		
6. DC Current Source		(of reading)
	1 A to 10 A	3.0 mA/A
7. AC Current Source		(of reading)
	1 A to 10 A (50 Hz to 10 kHz)	4.5 mA/A

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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
1. Noise Source		
Frequency	10 MHz to 26.5 GHz	
Noise Floor	-2 ENR to +20ENR(dB)	0.1 dB
2. Noise Figure Analyzer		
Frequency	10 MHz to 26.5 GHz	
Noise Floor	- 2 ENR to +20 ENR(dB)	0.4 dB
3. Noise Figure Meter		
Frequency	10 MHz to 26.5 GHz	
Noise Floor	- 2 ENR to +20 ENR(dB)	0.4 dB
4. Network Analyzer		
Frequency	9 kHz to 26.5 GHz	0.18 Hz
Power Level	- 5 dBm to +20 dBm	0.1 dB
5. Signal Generator		
RF Power : Measure	<u>Frequency</u>	
+30 dBm to -20 dBm	9 kHz to 50 GHz	0.3 dB
- 30 dBm to +20 dBm		
6. Spectrum Analyzer		
Power Level	<u>Frequency</u>	
	9 kHz to 40 GHz	1.2 dB

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FIELD OF CALIBRATION: ELECTRICAL

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
7. Timer	1 s to 50 s	0.11 s
	50s to 10 minutes	0.12 s
	10 minutes to 1 hour	0.57 s
	1 hour to 3 hours	0.57 s

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FIELD OF CALIBRATION: ELECTRICAL

SITE CALIBRATION - CATEGORY 1

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>		<u>Best measurement capability expressed as an uncertainty (±) *</u>	
A. Measuring Instruments				
1. DC Voltage	(0 to 330)	m V	13.4	μ V
	(0 to 3.3)	V	0.13	m V
	(0 to 33)	V	0.6	m V
	(30 to 330)	V	8.0	m V
	(100 to 1000)	V	30	m V
2. Resistance	(0 to 11)	Ω	12	m Ω
	(11 to 33)	Ω	18	m Ω
	(33 to 110)	Ω	20	m Ω
	(110 to 330)	Ω	32	m Ω
	(0.330 to 1.1)	k Ω	55	m Ω
	(1.1 to 3.3)	k Ω	0.3	Ω
	(3.3 to 11 0	k Ω	0.4	Ω
	(11 to 33)	k Ω	2.1	Ω
	(33 to 110)	k Ω	4.4	Ω
	(110 to 330)	k Ω	22	Ω
	(0.330 to 1.1)	M Ω	48	Ω
	(1.1 to 3.3)	M Ω	0.4	k Ω
	(3.3 to 11)	M Ω	1.8	k Ω
	(11 to 33)	M Ω	12	k Ω
	(33 to 110)	M Ω	61	k Ω
	(110 to 330)	M Ω	1.2	M Ω
	(330 to 1100)	M Ω	18	M Ω



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FIELD OF CALIBRATION: ELECTRICAL

SITE CALIBRATION - CATEGORY 1

SCOPE OF ACCREDITATION:

Instrument Calibrated/ Measurement Parameter	Range	Best measurement capability expressed as an uncertainty (±) *	
A. Measuring Instruments			
3. DC Current	(0 to 300) μ A	74	n A
	(0 to 3.3) m A	0.4	μ A
	(0 to 33) m A	3.8	μ A
	(0 to 330) m A	39	μ A
	(0 to 1.1) A	70	μ A
	(0 to 3) A	0.2	m A
	(0 to 11) A	1.0	m A
	(11 to 20.5) A	3.1	m A
4. AC Voltage	<u>1 to 30.00 mV</u>		
	10 to 45 Hz	8	μ V
	45 Hz to 10 kHz	6	μ V
	10 to 20 kHz	6	μ V
	20 kHz to 50 kHz	7	μ V
	50 kHz to 100 kHz	10	μ V
	100 kHz to 500 kHz	19	μ V
	<u>33 to 330 mV</u>		
	10 to 45 Hz	30	μ V
	45 Hz to 10 kHz	12	μ V
	10 to 20 kHz	12	μ V
	20 kHz to 50 kHz	16	μ V
	50 kHz to 100 kHz	27	μ V
	100 kHz to 500 kHz	74	μ V



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FIELD OF CALIBRATION: ELECTRICAL

SITE CALIBRATION - CATEGORY 1

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
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A. Measuring Instruments

4. AC Voltage (continue)

<u>0.33 to 3.3 V</u>	
10 to 45 Hz	1.1 mV
45 Hz to 10 kHz	0.6 mV
10 to 20 kHz	0.6 mV
20 kHz to 50 kHz	1.1 mV
50 kHz to 100 kHz	2.5 mV
100 kHz to 500 kHz	8.8 mV
<u>3.3 to 33 V</u>	
10 to 45 Hz	11 mV
45 Hz to 10 kHz	6 mV
10 to 20 kHz	13 mV
20 kHz to 50 kHz	13 mV
50 kHz to 90 kHz	33 mV
<u>33 to 330 V</u>	
10 to 45 Hz	68 mV
45 Hz to 10 kHz	76 mV
10 kHz to 20 kHz	93 mV
20 kHz to 50 kHz	111 mV
50 kHz to 100 kHz	741 mV
<u>330 to 1020 V</u>	
45 Hz to 10 kHz	347 mV



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FIELD OF CALIBRATION: ELECTRICAL

SITE CALIBRATION - CATEGORY 1

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (±) *</u>	
A. Measuring Instruments			
5. AC Current	<u>29 μA to 330 μA</u>		
	45 Hz to 1 kHz	0.5	μ A
	(1 to 5) kHz	1.2	μ A
	(5 to 10) kHz	2.9	μ A
	<u>0.33 mA to 3.33 mA</u>		
	45 Hz to 1 kHz	3.6	μ A
	(1 to 5) kHz	7.1	μ A
	(5 to 10) kHz	17	μ A
	<u>3.3 mA to 33 mA</u>		
	45 Hz to 1 kHz	17	μ A
	(1 to 5) kHz	30	μ A
	(5 to 10) kHz	72	μ A
<u>33 to 330 mA</u>			
45 Hz to 1 kHz	0.2	m A	
(1 to 5) kHz	0.4	m A	
(5 to 10) kHz	0.8	m A	
<u>0.33 A to 1.1 A</u>			
45 Hz to 1 kHz	0.7	m A	
(1 to 5) kHz	7.9	m A	
(5 to 10) kHz	34	m A	



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FIELD OF CALIBRATION: ELECTRICAL
SITE CALIBRATION - CATEGORY 1
SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (±) *</u>		
A. Measuring Instruments				
5. AC Current (cont)	<u>1.1 A to 3 A</u>			
	45 Hz to 1 kHz	2.2	m A	
	(1 to 5) kHz	22	m A	
	(5 to 10) kHz	91	m A	
	<u>3 A to 11 A</u>			
	45 Hz to 1 kHz	14	m A	
	<u>11 A to 20 A</u>			
	45 Hz to 1 kHz	40	m A	
	6. Frequency	0.01 Hz to 120 Hz	0.01	Hz
		120 Hz to 1200 Hz	1	Hz
12 kHz to 120 kHz		0.1	k Hz	
7. Capacitance		0.19 nF to 3.3 nF	14	p F
	3.3 nF to 33 nF	0.2	n F	
	33 nF to 330 nF	1.2	n F	
	0.33 μF to 3.3 μF	12	n F	
	3.3 μF to 33 μF	0.2	μ F	
	33 μF to 110 μF	0.6	μ F	

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FIELD OF CALIBRATION: ELECTRICAL

SITE CALIBRATION - CATEGORY 1

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>		<u>Best measurement capability expressed as an uncertainty (±) *</u>	
B. Generating Instrument				
1.DC Voltage	100	m V	36	μ V
	1000	m V	0.4	m V
	10	V	3.6	m V
	100	V	36	m V
	1000	V	0.4	m V
2. DC Current	100	m A	63	μ A
	10	A	23	m A
	100	A	1.2	A

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FIELD OF CALIBRATION: ELECTRICAL

SITE CALIBRATION - CATEGORY 1

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
1. Noise Source		
Frequency	10 MHz to 26.5 GHz	
Noise Floor	-2 ENR to +20ENR(dB)	0.1 dB
2. Noise Figure Analyzer		
Frequency	10 MHz to 26.5 GHz	
Noise Floor	- 2 ENR to +20 ENR(dB)	0.4 dB
3. Noise Figure Meter		
Frequency	10 MHz to 26.5 GHz	
Noise Floor	- 2 ENR to +20 ENR(dB)	0.4 dB
4. Network Analyzer		
Frequency	9 kHz to 26.5 GHz	0.18 Hz
Power Level	- 5 dBm to +20 dBm	0.1 dB
5. Signal Generator		
RF Power : Measure	<u>Frequency</u>	
+30 dBm to -20 dBm	9 kHz to 50 GHz	0.3 dB
- 30 dBm to +20 dBm		
6. Spectrum Analyzer		
Power Level	<u>Frequency</u>	
	9 kHz to 40 GHz	1.2 dB

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FIELD OF CALIBRATION: ELECTRICAL

SITE CALIBRATION - CATEGORY 2

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
1. Measuring Instruments		
DC Voltage	<u>100 mV</u> 0 mV to 100 mV -100 mV to 0 mV	(of reading) 0.1 μ V/V 0.1 μ V/V
	<u>1 V</u> 0.0 V to +1.0 V -1.0 V to 0.0 V	7.3 μ V/V 7.3 μ V/V
	<u>10 V</u> 1.0 V to +10.0 V -10 V to -1.0 V	9.2 μ V/V 9.2 μ V/V
	<u>100 V</u> 10.0 V to +100.0 V -100.0 V to -10.0 V	0.1 mV/V 0.1 mV/V
	<u>1000 V</u> 100.0 V to +1000.0 V -1000.0 V to -100.0 V	0.6 mV/V 0.6 mV/V
Resistance (4 Wire)	10 Ω 100 Ω 1 k Ω 10 k Ω 100 k Ω 1 M Ω 10 M Ω 100 M Ω	30 $\mu\Omega$ 58 $\mu\Omega$ 11 $\mu\Omega$ 12 $\mu\Omega$ 58 $\mu\Omega$ 31 $\mu\Omega$ 61 $\mu\Omega$ 0.2 m Ω
Resistance (2 Wire)	10 Ω 100 Ω 1 k Ω 10 k Ω 100 k Ω 1 M Ω 10 M Ω 100 M Ω	2.6 m Ω 0.3 m Ω 0.3 m Ω 0.3 m Ω 0.3 m Ω 0.3 m Ω 0.3 m Ω 0.4 m Ω
DC Current	0 μ A to 100 μ A 100 μ A to 1 mA 1 mA to 10 mA 10 mA to 100 mA 100 mA to 1 A	130 μ A/A 48 μ A/A 48 μ A/A 75 μ A/A 119 μ A/A



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FIELD OF CALIBRATION: ELECTRICAL

SITE CALIBRATION - CATEGORY 2

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
1. Measuring Instruments		(of reading)
AC Voltage	<u>0.1 mV to 1 mV</u>	
	10 Hz to 30 Hz	2.2 mV/V
	30 Hz to 300 Hz	2.2 mV/V
	300 Hz to 1 kHz	2.2 mV/V
	1 kHz to 10 kHz	2.2 mV/V
	10 kHz to 30 kHz	2.6 mV/V
	30 kHz to 100 kHz	2.8 mV/V
	100 kHz to 300 kHz	3.8 mV/V
	300 kHz to 1 MHz	3.8 mV/V
	<u>1 mV to 10 mV</u>	
	10 Hz to 30 Hz	0.4 mV/V
	30 Hz to 300 Hz	0.4 mV/V
	300 Hz to 1 kHz	0.3 mV/V
	1 kHz to 10 kHz	0.4 mV/V
	10 kHz to 30 kHz	0.6 mV/V
	30 kHz to 100 kHz	0.7 mV/V
	100 kHz to 300 kHz	1.6 mV/V
	100 kHz to 1 MHz	2.6 mV/V
	<u>10 mV to 100 mV</u>	
	10 Hz to 30 Hz	0.3 mV/V
	30 Hz to 300 Hz	0.2 mV/V
	300 Hz to 1 kHz	0.2 mV/V
	1 kHz to 10 kHz	0.2 mV/V
	10 kHz to 30 kHz	0.4 mV/V
	30 kHz to 100 kHz	0.5 mV/V
	100 kHz to 300 kHz	1.3 mV/V
	100 kHz to 1 MHz	2.5 mV/V
	<u>100 mV to 1 V</u>	
	10 Hz to 30 Hz	0.1 mV/V
	30 Hz to 300 Hz	70.7 μ V/V
	300 Hz to 1 kHz	57.1 μ V/V
	1 kHz to 10 kHz	57.1 μ V/V
	10 kHz to 30 kHz	57.1 μ V/V
	30 kHz to 100 kHz	113.6 μ V/V
	100 kHz to 300 kHz	0.5 mV/V
	100 kHz to 1 MHz	2.8 mV/V



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SITE CALIBRATION - CATEGORY 2

SCOPE OF ACCREDITATION:

Instrument Calibrated/ Measurement Parameter	Range	Best measurement capability expressed as an uncertainty (\pm) *
1. Measuring Instruments	1 V to 10 V	
AC Voltage	10 Hz to 30 Hz	0.2 mV/V
(Continue)	30 Hz to 300 Hz	0.1 mV/V
	300 Hz to 1 kHz	0.1 mV/V
	1 kHz to 10 kHz	0.1 mV/V
	10 kHz to 30 kHz	0.1 mV/V
	30 kHz to 100 kHz	0.1 mV/V
	100 kHz to 300 kHz	0.3 mV/V
	100 kHz to 1 MHz	1.8 mV/V
	10 V to 100 V	
	10 Hz to 30 Hz	0.2 mV/V
	30 Hz to 300 Hz	0.1 mV/V
	300 Hz to 1 kHz	0.1 mV/V
	1 kHz to 10 kHz	0.1 mV/V
	10 kHz to 30 kHz	0.1 mV/V
	30 kHz to 100 kHz	0.3 mV/V
	100 V to 1000 V	
	55 Hz to 1 kHz	0.1 mV/V
	1 kHz to 10 kHz	0.2 mV/V
	10 kHz to 30 kHz	0.2 mV/V
	30 kHz to 100 kHz	1.4 mV/V
AC Current	100 μA to 1 mA	
	10 Hz to 300 Hz	0.2 mA/A
	300 Hz to 1 kHz	0.3 mA/A
	1 kHz to 5 kHz	0.3 mA/A
	1 mA to 10 mA	
	10 Hz to 300 Hz	0.2 mA/A
	300 Hz to 1 kHz	0.2 mA/A
	1 kHz to 5 kHz	0.3 mA/A
	10 mA to 100 mA	
	10 Hz to 300 Hz	0.6 mA/A
	300 Hz to 1 kHz	0.6 mA/A
	1 kHz to 5 kHz	0.6 mA/A
	100 mA to 1 A	
	10 Hz to 300 Hz	0.4 mA/A
	300 Hz to 1 kHz	0.4 mA/A
	1 kHz to 5 kHz	0.6 mA/A



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FIELD OF CALIBRATION: ELECTRICAL

SITE CALIBRATION - CATEGORY 2

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
(of reading)		
2. Source/Generating Instrument DC Voltage	<u>100 mV</u> + 100 μ V to + 100 mV - 100 mV to -100 μ V	22 μ V/V 22 μ V/V
	<u>1 V</u> +100 mV to 1V -1 V to -100 mV	13 μ V/V 13 μ V/V
	<u>10 V</u> +1 V to +10 V -10 V to -1 V	12 μ V/V 12 μ V/V
	<u>100 V</u> +10 V to +100 V -100 V to -10 V	15 μ V/V 15 μ V/V
	<u>1000 V</u> + 100 V to + 1000 V -1000 V to -100 V	16 μ V/V 16 μ V/V
	Resistance	
	10 Ω	0.4 m Ω
	100 Ω	2.8 m Ω
	1 k Ω	19 m Ω
	10 k Ω	0.2 Ω
	100 k Ω	2.0 Ω
	1 M Ω	25 Ω
	10 M Ω	0.8 k Ω
	100 M Ω	59 k Ω



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FIELD OF CALIBRATION: ELECTRICAL

SITE CALIBRATION - CATEGORY 2

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
DC Current		(of reading)
	<u>100μA</u>	
	+10 μ A to +100 μ A	0.2 mA/A
	-100 μ A to - 10 μ A	0.2 mA/A
	<u>1mA</u>	
	+100 μ A to +1 mA	74 μ A/A
	-1 mA to -100 μ A	74 μ A/A
	<u>10mA</u>	
	+1 mA to +10 mA	74 μ A/A
	-10 mA to -1 mA	74 μ A/A
	<u>100 mA</u>	
	+10 mA to +100 mA	91 μ A/A
	-100 mA to -10 mA	91 μ A/A
	<u>1 A</u>	
	+100 mA to + 1A	0.2 mA/A
	-1A to -100 mA	0.2 mA/A
AC Voltage	<u>0 mV to 10 mV</u>	
	40 Hz to 1 kHz	0.8 mV/V
	1 kHz to 20 kHz	0.8 mV/V
	20 kHz to 100 kHz	46 mV/V
	100 kHz to 300 kHz	46 mV/V
	<u>10 mV to 100 mV</u>	
	40 Hz to 1 kHz	0.3 mV/V
	1 kHz to 20 kHz	0.4 mV/V
	20 kHz to 100 kHz	3.7 mV/V
	100 kHz to 300 kHz	12 mV/V
	300 kHz to 1 MHz	18 mV/V
	<u>100 mV to 1 V</u>	
	40 Hz to 1 kHz	0.2 mV/V
	1 kHz to 20 kHz	0.4 mV/V
	20 kHz to 50 kHz	0.4 mV/V
	50 kHz to 100 kHz	3.5 mV/V
	100 kHz to 300 kHz	11 mV/V
	300 kHz to 500 kHz	12 mV/V
	500 kHz to 1 MHz	17 mV/V



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FIELD OF CALIBRATION: ELECTRICAL

SITE CALIBRATION - CATEGORY 2

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
2. Sourcing/Generating Instrument		(of reading)
AC Voltage (Continued)	<u>1 V to 10 V</u>	
	10 Hz to 20 Hz	0.2 mV/V
	20 Hz to 40 Hz	0.2 mV/V
	40 Hz to 1 kHz	0.2 mV/V
	1 kHz to 10 kHz	0.2 mV/V
	10 kHz to 20 kHz	0.2 mV/V
	20 kHz to 50 kHz	0.4 mV/V
	50 kHz to 100 kHz	1.0 mV/V
	100 kHz to 300 kHz	3.6 mV/V
	300 kHz to 500 kHz	12 mV/V
	500 kHz to 1 MHz	18 mV/V
	<u>10V to 100 V</u>	
	40 Hz to 1 kHz	0.3 mV/V
	1 kHz to 20 kHz	0.3 mV/V
	20 kHz to 50 kHz	0.5 mV/V
	50 kHz to 100 kHz	1.5 mV/V
	<u>100 V to 700 V</u>	
	40 Hz to 1 kHz	0.5 mV/V
3. High Current Generating DC Current	1 A to 10 A	9.7 mA/A

Signatories:

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FIELD OF CALIBRATION: ELECTRICAL

SITE CALIBRATION - CATEGORY 2

SCOPE OF ACCREDITATION:

<u>Instrument calibrated/ Measurement parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm)*</u>
1. Signal Generator		
Amplitude Modulation Depth : 10% to 90%	<u>Frequency Range</u>	
Rate : 20Hz to 10kHz	150 kHz to 10 MHz	4 % of reading
Rate : 20Hz to 100kHz	10 MHz to 1300 MHz	4 % of reading
Frequency Modulation – Rate : 20Hz to 10kHz (Dev. : \leq 40 kHz peak)	<u>Frequency Range</u> 150 kHz to 10 MHz	1.2 kHz
Rate : 50Hz to 200kHz (Dev. : \leq 400 kHz peak)	10 MHz to 1300 MHz	8 kHz
RF Power : Measure +30dBm to -20dBm - 30dBm to +20dBm	<u>Frequency</u> 100 kHz to 2.6 GHz 2.6 GHz to 4 GHz	1 dB 1 dB
	Tune Freq : 2.5 MHz to 1300 MHz [+ 20dBm to -127 dBm]	2 dB
Audio Distortion: (-80 dB to 0 dB)	Frequency 400 Hz 1 kHz	1 dB 1 dB
2. Function Generator	Frequency: 0.01 Hz to 60 MHz	2.5×10^{-11} MHz
	Amplitude : 1 mV to 10 Vp-p (+23.98 dBm to -56.02 dBm)	0.1 Vp-p 1 dB



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SITE CALIBRATION - CATEGORY 2

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (±) *</u>
Measuring Equipment :		
1. Frequency Counter		
Time Base	5 MHz	2.5×10^{-11} MHz
Frequency Range	100 Hz to 60 MHz	2.5×10^{-11} MHz
	0.1 MHz to 2.1 GHz	2.5×10^{-11} MHz
	10 MHz to 20 GHz	2.5×10^{-11} MHz
2. Modulation Analyzer		
Power Level:		
-25 dBm to 20 dBm (3μW to 100mW)		0.06 dBm
FM , Flatness:		
20 Hz to 100 kHz rates		0.1 kHz
100 kHz to 200 kHz rates		0.5 kHz
AM , Flatness		
50 Hz to 50 kHz		0.05 kHz
20 Hz to 100 kHz		0.25 kHz
Distortion		
Audio Distortion		
-70 dB minimum		1 dB
3. RF Power Meter		
Power Level	-25dBm to 20dBm (3μW to 100mW)	0.06 dBm



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SITE CALIBRATION - CATEGORY 2

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
Measuring Equipment:		
4. RF Power Sensor		(of reading)
Calibration Factor in a 50ohm system at	<u>Power Level</u> -30 dBm to +20 dBm	
Freq : 100 kHz to 4.2 GHz	100 kHz to 300kHz	1
	300 kHz to 1 MHz	1
	3 MHz to 30 MHz	1
	100 MHz to 3.5 GHz	1
	3.7 GHz to 4.2 GHz	1
Freq : 10 MHz to 18 GHz	<u>Power Level</u> -30 dBm to +20 dBm	
	10 MHz to 300 MHz	1
	300 MHz to 1.5 GHz	1
	1.5 GHz to 8.0 GHz	2
	8.0 GHz to 13.0 GHz	2
	13.0 GHz to 18.0 GHz	4
Freq : 100 kHz to 4.0 GHz	<u>Power Level</u> -10 dBm to +35 dBm	
	100 kHz to 500 kHz	1
	500 kHz to 10 MHz	1
	10 MHz to 50 MHz	1
	50 MHz to 2 GHz	1
	2 GHz to 4 GHz	1
5. Spectrum Analyzer		
Frequency Range	9 kHz to 20 GHz	1.0×10^{-4} Hz
Resolution Bandwidth	1 kHz to 3 MHz	1 MHz
Reference Level	-90 dBm to 0 dBm	1 dB



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SITE CALIBRATION - CATEGORY 2

SCOPE OF ACCREDITATION:

<u>Instrument Calibrated/ Measurement Parameter</u>	<u>Range</u>	<u>Best measurement capability expressed as an uncertainty (\pm) *</u>
Measuring Equipment :		
6. Network Analyzer		
Frequency	300 kHz to 3 GHz	0.06 MHz
Power Level	- 5 dBm to +20 dBm	1 dB
7. Audio Analyzer	Frequency :	
	20 Hz to 150 kHz	0.006 kHz
	Amplitude : 1 mV to 300 V	0.11 V
	Residual Distortion :	
	(-99.00 to 0 dB)	
	20 Hz to 20 kHz	1 dB
	20 kHz to 100 kHz	1 dB
8. Oscilloscope		
Period	5 ns/div. to 5 s/div.	0.0065 s
Squarewave :		
Amplitude – 1 M Ω @ 1kHz	1 mV/div to 20 V/div	0.052 V
Amplitude – 50 Ω @ 1kHz	1 mV/div to 2 V/div Risettime / Falltime	0.02 V 0.032 ns
Sinewave		
Amplitude –	10Hz to 50kHz :	
1 M Ω @ 50 kHz Ref.	1mV/div to 20V/div	0.2 V
Amplitude –	50kHz to 250MHz :	
50 Ω @ 50 kHz Ref	1mV/div to 2V/div	0.04 V
Bandwidth:	Freq : 10Hz to 250 MHz	0.12 MHz

Signatories:

- | | |
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