THE AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

TOYO CORPORATION CALIBRATION LABORATORY

Tokyo, Japan

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 8th day of July 2009.

President
For the Accreditation Council
Certificate Number 2296.01
Valid to June 30, 2011

For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005
& ANSI/NCSL Z540-1-1994

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CALIBRATION

Valid To: June 30, 2011 Certificate Number: 2296.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations[1, 6]:

I. Electrical DC & Low Frequency

Parameter/Equipment	Range	Best Uncertainty[2] (±)	Comments
DC Voltage[3] – Measure	(0 to 120) mV (0.12 to 1.20) V (1.2 to 12) V (12 to 120) V (120 to 300) V	11 µV/V + 0.3 µV 10 µV/V + 0.3 µV 10 µV/V + 0.5 µV 12 µV/V + 30 µV 14 µV/V + 100 µV	HP 3458A
DC Voltage[4] – Generate	(0 to 329.999) mV (0.330000 to 3.29999) V (3.30000 to 32.9999) V (33000 to 329.999) V	20 µV/V + 1 µV 11 µV/V + 2 µV 12 µV/V + 20 µV 18 µV/V + 150 µV	Fluke 5520A
Resistance[3] – Measure	(0 to 12) Ω (12 to 120) Ω 120 Ω to 1.2 kΩ (1.2 to 12) kΩ (12 to 120) kΩ 120 kΩ to 1.2 MΩ (1.2 to 12) MΩ (12 to 120) MΩ	18 µΩ/Ω + 50 µΩ 15 µΩ/Ω + 500 µΩ 13 µΩ/Ω + 500 µΩ 13 µΩ/Ω + 5 mΩ 13 µΩ/Ω + 50 mΩ 18 µΩ/Ω + 2 Ω 53 µΩ/Ω + 100 Ω 0.05 % + 1 kΩ	HP 3458A

Parameter/ Equipment	Range	Best Uncertainty[2] (±)	Comments
AC Flatness[3] – Measure			
@ 1 kHz reference	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.0017 dB 0.0014 dB 0.0019 dB 0.0031 dB 0.0074 dB 0.028 dB	HP 3458A
AC Voltage[3] – Measure			
(1.2 to 12) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.036 % + 3 μV 0.026 % + 1.1 μV 0.036 % + 1.1 μV 0.11 % + 1.1 μV 0.51 % + 1.1 μV 4 % + 2 μV	HP 3458A
(12 to 120) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.013 % + 4 μV 0.013 % + 2 μV 0.02 % + 2 μV 0.036 % + 2 μV 0.086 % + 2 μV 0.31 % + 10 μV	
120 mV to 1.2 V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.013 % + 40 μV 0.013 % + 20 μV 0.02 % + 20 μV 0.036 % + 20 μV 0.086 % + 20 μV 0.31 % + 100 μV	
(1.2 to 12) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.013 % + 400 μV 0.013 % + 200 μV 0.02 % + 200 μV 0.036 % + 200 μV 0.086 % + 200 μV 0.31 % + 1 mV	
(12 to 120) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.026 % + 4 mV 0.026 % + 2 mV 0.026 % + 2 mV 0.04 % + 2 mV 0.13 % + 2 mV 0.41 % + 10 mV	
(120 to 700) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.046 % + 40 mV 0.046 % + 20 mV 0.066 % + 20 mV 0.13 % + 20 mV 0.31 % + 20 mV	

Parameter/ Equipment	Range	Best Uncertainty[2] (±)	Comments
AC Voltage[4] – Generate			
(1.6500 to 16.4999) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.028 % + 0.2 µV 0.019 % + 0.24 µV 0.021 % + 0.24 µV 0.028 % + 0.2 µV 0.058 % + 0.5 µV 0.19 % + 2.4 µV	Fluke 5520A
(100 to 32.999) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.064 % + 4.8 µV 0.012 % + 4.8 µV 0.016 % + 4.8 µV 0.08 % + 4.8 µV 0. 28 % + 9.6 µV 0.64 % + 40 µV	
(3300 to 329.999) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.04 % + 6.4 µV 0.012 % + 6.4 µV 0.013 % + 6.4 µV 0.028 % + 6.4 µV 0.064 % + 26 µV 0.16 % + 56 µV	
(0.33000 to 3.29999) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.024 % + 40 µV 0.012 % + 48 µV 0.016 % + 48 µV 0.024 % + 40 µV 0.056 % + 100 µV 0.2 % + 480 µV	
(3.3 to 32.9999) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.024 % + 520 µV 0.012 % + 480 µV 0.02 % + 480 µV 0.028 % + 480 µV 0.072 % + 1.3 mV	
(3300 to 329.999) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.016 % + 1.6 mV 0.016 % + 4.8 mV 0.02 % + 4.8 mV 0.024 % + 4.8 mV 0.16 % + 40 mV	

II. Electrical - Microwave/RF

Parameter/Equipment	Range	Best Uncertainty[2] (±)	Comments[5]
Frequency Accuracy – Measure	9 kHz to 10 MHz 10 MHz to 18 GHz 50 MHz to 1 GHz (1 to 40) GHz	3×10^{-10} Hz + 10 mHz 2×10^{-9} Hz + 100 mHz 2×10^{-9} Hz + 1 Hz 1×10^{-9} Hz + 1 Hz	Frequency counter, frequency standard after 72 hr warm-up period for Frequency standard
Displayed Frequency Accuracy	9 kHz to 30 MHz 30 MHz to 1 GHz (1 to 10) GHz (10 to 40) GHz	10 Hz 60 Hz 700 Hz 1000 Hz	Signal generator, frequency standard
Span Readout Accuracy	9 kHz to 40 GHz	0.7 % of reading	Signal generator, frequency standard
Intercept Point Accuracy 3rd order (IP3) 2nd order (IP2)	 9 kHz to 3 GHz 9 kHz to 1 GHz	 1.8 dB 1.9 dB	 Signal generator, frequency standard

Parameter/Equipment	Range	Best Uncertainty[2] (±)	Comments[5]
Absolute Amplitude Accuracy –			Signal generator, frequency standard, power meter, power sensor, attenuator
Measure	9 kHz to 1 GHz (1 to 18) GHz (18 to 40) GHz	0.23 dB 0.40 dB 0.5 dB	
Measuring Equipment	9 kHz to 6 GHz 10 MHz to 18 GHz (18 to 40) GHz	0.17 dB 0.24 dB 0.21 dB	assuming "0" reflection coefficient at input of device under test.
Power Meter Ref. Out	50MHz,0 dBm	0.04 dB	
Amplitude Modulation –			Modulation analyzer
Carrier Frequency	(0.15 to 10) MHz (10 to 1300) MHz	2 % of reading 1.1 % of reading	
Modulation Frequency 400 Hz to 3 kHz			
Modulation Index 30 % to 95 %			
Frequency Modulation –			Modulation analyzer
Carrier Frequency	(0.25 to 10) MHz (10 to 1300) MHz	2.5 % of reading 1.3 % of reading	
Modulation Frequency (0.3 to 10) kHz			
FM Deviation (1 to 200) kHz			

Parameter/Equipment	Range	Best Uncertainty2 (±)	Comments[5]
Reference Level	9 kHz to 1 GHz (1 to 18) GHz	0.18 dB 0.31 dB	Signal generator, frequency standard, attenuator
Attenuator Check Measure Measuring Equipment	 9 kHz to 1 GHz (1 to 18) GHz 9 kHz to 1 MHz 1 MHz to 12 GHz (12 to 30) GHz (30 to 40) GHz	 0.18 dB 0.28 dB 0.36 dB 0.25 dB 0.32 dB 0.52 dB	Signal generator, frequency standard, attenuator Spectrum analyzer
Marker Amplitude Readout Accuracy	9 kHz to 1 GHz (1 to 18) GHz (18 to 40) GHz	0.23 dB 0.4 dB 0.5 dB	Signal generator, frequency standard, power meter, power sensor, attenuator assuming "0" reflection coefficient at input of device under test.
Log Fidelity – 9 kHz to 1 GHz 1 MHz to 1 GHz 5 MHz to 1 GHz (1 to 18) GHz	 (1 to 70) dB (71 to 80) dB (81 to 90) dB (91 to 100) dB (101 to 110) dB (111 to 120) dB (1 to 70) dB (71 to 80) dB (81 to 90) dB (91 to 100) dB (101 to 110) dB (111 to 120) dB	 0.11 dB 0.14 dB 0.19 dB 0.2 dB 0.24 dB 0.28 dB 0.28 dB 0.36 dB 0.39 dB 0.45 dB 0.57 dB 0.82 dB	Signal generator, frequency standard, attenuator

Parameter/Equipment	Range	Best Uncertainty[2] (±)	Comments[5]
Bandwidth Accuracy	9 kHz to 1 GHz (1 to 18) GHz	2 % 3.5 %	Signal generator, frequency standard, attenuator See Footnote 6
Bandwidth Switching Accuracy	9 kHz to 1 GHz (1 to 18) GHz	0.1 dB 0.1 dB	Signal generator, frequency standard, power meter, power sensor, attenuator
Harmonic Measurements	9 kHz to 18 GHz	1.8 dB	Signal generator, frequency standard, power meter, power sensor, spectrum analyzer
Displayed Average Noise Level	9 kHz to 3.6 GHz (3.6 to 8) GHz (8 to 40) GHz	1.2 dB 2 dB 2.7 dB	Termination
Frequency Response – Measure Measuring Equipment	 9 kHz to 1 GHz (1 to 18) GHz (18 to 40) GHz 9 kHz to 6 GHz 10 MHz to 18 GHz (18 to 40) GHz	 0.23 dB 0.4 dB 0.5 dB 0.17 dB 0.24 dB 0.21 dB	Signal generator, frequency standard, power meter, power sensor, attenuator assuming “0” reflection coefficient at input of device under test.

Parameter/Equipment	Range	Best Uncertainty[2] (±)	Comments[5]
Reflection S11/S22	9 kHz to 45 MHz 45 MHz to 2 GHz (2 to 18) GHz (18 to 26.5) GHz (26.5 to 40) GHz	0.006 (lin) 0.007 (lin) 0.012 (lin) 0.013 (lin) 0.02 (lin)	VNA with calibration kit
Transmission S21/S12	9 kHz to 0.1 MHz (0.1 to 45) MHz 45 MHz to 2 GHz (2 to 8) GHz (8 to 18) GHz (18 to 26.5) GHz (26.5 to 40) GHz	0.18 dB 0.09 dB 0.05 dB 0.08 dB 0.14 dB 0.17 dB 0.21 dB	VNA with calibration kit
CISPR Amplitude Calibration (Bands A/B/C/D)	Pulse Repetitions Flatness Amplitude Relationship Response to intermittent, unsteady and drifting narrowband disturbances	0.65 dB 0.9 dB 0.83 dB 0.65 dB	CISPR pulse generator, signal generator, power meter, power sensor, function generator See Footnote 6

Parameter/Equipment	Range	Best Uncertainty[2] (±)	Comments[5]
Impedance – Measure LISN, AN, AMN CDNs Terminator	 9 kHz to 110 MHz (0.1 to 230) MHz 9 kHz to 500 MHz 45 MHz to 18GHz	 0.7 Ω 4.7 Ω 0.7 Ω 1.3 Ω	VNA with calibration kit See Footnote 6
Impedance Phase Angle LISN, AN, AMN	9 kHz to 110 MHz	3 degree (Reflection Coefficient > 0.01)	VNA with calibration kit See Footnote 6
Insertion Loss LISN, AN, AMN (Voltage Division Factor, Isolation) CDNs ,(50 to 150) Ω Adapters , Amplifiers (Gain), Attenuators, Directional Couplers (Coupling Factor, Isolation), RF Cables and Filters	 9 kHz to 110 MHz 9 kHz to 230 MHz 9 kHz to 0.1 MHz (0.1 to 45) MHz 45 MHz to 2 GHz (2 to 8) GHz (8 to 18) GHz (18 to 26.5) GHz (26.5 to 40) GHz	 0.44 dB 0.18 dB 0.18 dB 0.09 dB 0.05 dB 0.08 dB 0.14 dB 0.17 dB 0.21 dB	VNA with calibration kit See Footnotes 6 & 7
Series Voltage Drop – Measure LISN, AN, AMN	(100, 200, 230) VAC 50/60 Hz	0.2 %	Power analyzer See Footnote 6
VSWR LISN, AN, AMN Terminator and Attenuator	 9 kHz to 45 MHz 45 MHz to 2 GHz (2 to 18) GHz (18 to 26.5) GHz (26.5 to 40) GHz	 0.006 (lin) 0.007 (lin) 0.012 (lin) 0.013 (lin) 0.02 (lin)	Network analyzer with calibration kit See Footnote 5

Parameter/Equipment	Range	Best Uncertainty[2] (±)	Comments[5]
Calibration Factor – Power Sensor	9 kHz to 6 GHz 10 MHz to 18 GHz 10 MHz to 26.5 GHz 10 MHz to 40 GHz	2 % 3 % 3.9 % 4.6 %	Signal generator, power meter, power sensor, power splitter
Pulse area – CISPR Pulse Generator	9 kHz to 1GHz	5.2 %	Oscilloscope See Footnote 6
Spectrum Flatness – CISPR Pulse Generator	9 kHz to 1GHz	0.34 dB	Power meter, power sensor, signal generator, EMI test receiver See Footnote 6

III. Time and Frequency

Parameter/Equipment	Range	Best Uncertainty[2] (±)	Comments
Frequency – Measure	0.1 Hz to 225 MHz	0.2 μHz/Hz	Frequency counter

[1] This laboratory offers commercial calibration service.

[2] "Best Uncertainty" is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards of nearly ideal measuring equipment. Best uncertainties represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The best uncertainty of a specific calibration performed by the laboratory may be greater than the best uncertainty due to the behavior of the customer's device, to the environment and to influences from the circumstances of the specific calibration.

[3] The measurands stated are measured with the HP 3458A. This capability is suitable for the calibration of the devices intended to generate the measurand in the ranges indicated. Best measurement uncertainties are expressed as either a specific value that covers the full range or as a combination of the fraction of the reading/output plus a range specification.

[4] The measurands stated are generated with the Fluke 5520A series of instruments. This capability is suitable for the calibration of the devices intended to measure the stated measurand in the ranges indicated. Best measurement uncertainties are expressed as either a specific value that covers the full range or as a fraction of the reading plus a fixed floor specification.

[5] For standards or methods listed below without a revision date, laboratories are expected to be competent in the use of the current version within one year of the date of publication of the standard test method or upon the date specified by the standard test method originator when the originator has implementation authority. When a superseded standard or method is required for an accredited test, the scope will include the superseded date/version

[6] Instruments are calibrated against standard's specifications. These calibrations may also, at customer request, be based on conformance to the calibration requirements of various standards such as ANSI C63.2, CISPR 16-1-1, CISPR 16-1-2, CISPR 25, Other standards may apply and the customer should contact the lab for further information.

[7] Uncertainty does not include mismatch error due to connections of the device to other devices in actual use. Mismatch uncertainties, due to the reflection coefficient of the device to be calibrated, are to be included in the overall measurement uncertainty, The approach of determining expanded uncertainties at approximately the 95% level of confidence, (using a coverage factor of k=2) is to be applied for this calculation as well.