



CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board

500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

TECHMASTER ASIA (Thailand) Co., Ltd
5/41 Home In Town, Paholyothin 73, Sanambin Donmuang
Bangkok 10210, Thailand

has been assessed by ANAB
and meets the requirements of international standard

ISO/IEC 17025:2005

while demonstrating technical competence in the field of

CALIBRATION

Refer to the accompanying Scope of Accreditation for information regarding the types of calibrations to which this accreditation applies.

AC-1736.08
Certificate Number


ANAB Approval

Certificate Valid: 08/15/2017-10/29/2018
Version No. 003 Issued: 08/15/2017



This laboratory is accredited in accordance with the 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 to joint ISO-ILAC-IAF Communiqué dated April 2017).



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005 AND ANSI/NC SL Z540-1-1994 (R2002)

Techmaster Asia (Thailand) Co. Ltd.

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CALIBRATION

Valid to: October 29, 2018

Certificate Number: AC-1736.08

Acoustics and Vibration

Table with 4 columns: Parameter / Equipment, Range, Expanded Uncertainty of Measurement (+/-), Reference Standard, Method and/or Equipment. Row 1: Sound Level Meters, 94 dB to 114 dB, 0.48 dB, Center 326.

Chemical Quantities

Table with 4 columns: Parameter / Equipment, Range, Expanded Uncertainty of Measurement (+/-), Reference Standard, Method and/or Equipment. Rows include pH - Source and Conductivity - Source with various measurement ranges and uncertainties.



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
DC Voltage - Source ¹	Up to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V 220 V to 1.1 kV	7.7 $\mu\text{V/V} + 0.86 \mu\text{V}$ 5.9 $\mu\text{V/V} + 0.87 \mu\text{V}$ 4.2 $\mu\text{V/V} + 3.1 \mu\text{V}$ 3.9 $\mu\text{V/V} + 14 \mu\text{V}$ 5.9 $\mu\text{V/V} + 48 \mu\text{V}$ 7.5 $\mu\text{V/V} + 0.76 \text{mV}$	Fluke 5700A
DC Voltage - Measure ¹	Up to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100 V to 1 kV	7.2 $\mu\text{V/V} + 0.55 \mu\text{V}$ 7 $\mu\text{V/V} + 0.42 \mu\text{V}$ 6.9 $\mu\text{V/V} + 0.86 \mu\text{V}$ 9.2 $\mu\text{V/V} + 38 \mu\text{V}$ 9.3 $\mu\text{V/V} + 0.13 \mu\text{V}$	HP 3458A Opt 002
	(1 to 20) kV (20 to 35) kV (35 to 40) kV	20 mV/V 10 mV/V 20 mV/V	HP 3458A Opt 002 with Fluke 80K-40 High Voltage Probe
DC Current - Source ¹	Up to 220 μA 220 μA to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A	48 $\mu\text{A/A} + 7.1 \text{nA}$ 41 $\mu\text{A/A} + 9.6 \text{nA}$ 42 $\mu\text{A/A} + 49 \text{nA}$ 54 $\mu\text{A/A} + 0.84 \mu\text{A}$ 95 $\mu\text{A/A} + 15 \mu\text{A}$	Fluke 5700A
	(2.2 to 3) A (3 to 11) A (11 to 20.5) A	0.45 mA/A + 66 μA 0.59 mA/A + 0.60 mA 1.2 mA/A + 0.91 mA	Fluke 5520A
DC Current - Source ¹ Clamp-On Ammeters	(20 to 1 000) A	2.9 mA/A + 0.08 A	Fluke 5520A with Fluke Coil
DC Current - Measure ¹	Up to 100 nA 100 nA to 1 μA (1 to 10) μA (10 to 100) μA 100 μA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	22 $\mu\text{A/A} + 93 \text{pA}$ 18 $\mu\text{A/A} + 0.10 \text{nA}$ 28 $\mu\text{A/A} + 0.14 \text{nA}$ 30 $\mu\text{A/A} + 0.98 \text{nA}$ 30 $\mu\text{A/A} + 6.5 \text{nA}$ 30 $\mu\text{A/A} + 63 \text{nA}$ 44 $\mu\text{A/A} + 1 \mu\text{A}$ 0.14 mA/A + 12 μA	HP 3458A Opt 002
	Up to 300 A	2.5 mA/A + 1 mA	HP 3458A Opt 002 with Empro HA-300-100

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage - Source ¹	(1 to 2.2) mV		Fluke 5700A
	(10 to 20) Hz	0.34 mV/V + 5.8 μV	
	(20 to 40) Hz	0.12 mV/V + 5.1 μV	
	40 Hz to 20 kHz	98 μV/V + 4.9 μV	
	(20 to 50) kHz	0.25 mV/V + 4.9 μV	
	(50 to 100) kHz	0.67 mV/V + 6.7 μV	
	(100 to 300) kHz	1.5 mV/V + 13 μV	
	(2.2 to 22) mV		
	(10 to 20) Hz	0.3 mV/V + 4.9 μV	
	(20 to 40) Hz	0.11 mV/V + 4.9 μV	
	40 Hz to 20 kHz	96 μV/V + 4.8 μV	
	(20 to 50) kHz	24 μV/V + 4.8 μV	
	(50 to 100) kHz	0.6 mV/V + 6 μV	
	(100 to 300) kHz	1.3 mV/V + 12 μV	
	(300 to 500) kHz	1.7 mV/V + 24 μV	
	500 kHz to 1 MHz	3.2 mV/V + 24 μV	
	(22 to 220 mV		
	(10 to 20) Hz	0.29 mV/V + 14 μV	
	(20 to 40) Hz	0.1 mV/V + 9.4 μV	
	40 Hz to 20 kHz	92 μV/V + 9.2 μV	
	(20 to 50) kHz	0.24 mV/V + 88 μV	
	(50 to 100) kHz	0.55 mV/V + 20 μV	
	(100 to 300) kHz	1.1 mV/V + 24 μV	
	(300 to 500) kHz	1.7 mV/V + 30 μV	
500 kHz to 1 MHz	3.2 mV/V + 53 μV		
220 mV to 2.2 V			
(10 to 20) Hz	0.23 mV/V + 54 μV		
(20 to 40) Hz	0.11 mV/V + 19 μV		
40 Hz to 20 kHz	54 μV/V + 10 μV		
(20 to 50) kHz	88 μV/V + 14 μV		
(50 to 100) kHz	0.13 mV/V + 38 μV		
(100 to 300) kHz	0.5 mV/V + 96 μV		
(300 to 500) kHz	1.2 mV/V + 0.24 mV		
500 kHz to 1 MHz	2 mV/V + 0.35 mV		



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage - Source ¹	(2.2 to 22) V		Fluke 5700A
	(10 to 20) Hz	0.3 mV/V + 0.54 mV	
	(20 to 40) Hz	0.12 mV/V + 0.20 mV	
	40 Hz to 20 kHz	53 μV/V + 67 μV	
	(20 to 50) kHz	91 μV/V + 0.13 mV	
	(50 to 100) kHz	0.12 mV/V + 0.26 mV	
	(100 to 300) kHz	0.33 mV/V + 0.72 mV	
	(300 to 500) kHz	1.2 mV/V + 2.4 mV	
	500 kHz to 1 MHz	1.2 mV/V + 3.8 mV	
	(22 to 220) V		
	(10 to 20) Hz	0.3 mV/V + 5.4 mV	
	(20 to 40) Hz	0.12 mV/V + 1.8 mV	
	40 Hz to 20 kHz	59 μV/V + 0.85 mV	
	(20 to 50) kHz	99 μV/V + 1.4 mV	
(50 to 100) kHz	0.18 mV/V + 3.1 mV		
(100 to 300) kHz	1.2 mV/V + 19 mV		
220 V to 1.1 kV			
(15 to 50) Hz	0.36 mV/V + 20 mV		
50 Hz to 1 kHz	82 μV/V + 5.5 mV		
AC Voltage - Source ¹ Wide Band	300 μV to 3.5 V		Fluke 5700A/03 Wide Band Function
	(10 to 30) Hz	4.9 μV/V + 3.7 μV	
	30 Hz to 120 kHz	4.9 μV/V + 3.7 μV	
	300 μV to 1.1 mV		
	120 kHz to 2 MHz	2.4 μV/V + 3.5 μV	
	(2 to 10) MHz	4.7 μV/V + 3.5 μV	
	(10 to 20) MHz	7.1 μV/V + 3.5 μV	
	(20 to 30) MHz	18 μV/V + 18 μV	
	300 μV to 3 mV		
	120 kHz to 2 MHz	1.2 μV/V + 3.5 μV	
	(2 to 10) MHz	3.5 μV/V + 3.5 μV	
	(10 to 20) MHz	5.9 μV/V + 3.5 μV	
	(20 to 30) MHz	18 μV/V + 3.5 μV	
	3 mV to 3.5 V		
120 kHz to 2 MHz	1.2 μV/V + 3.5 μV		
(2 to 10) MHz	2.4 μV/V + 3.5 μV		
(10 to 20) MHz	4.7 μV/V + 3.5 μV		
(20 to 30) MHz	12 μV/V + 3.5 μV		



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage - Measure ¹	(1 to 10) 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	0.36 mV/V + 3.6 μV 0.23 mV/V + 1.4 μV 0.32 V/V + 1.7 μV 1.2 mV/V + 1.6 μV 5.7 mV/V + 2 μV 46 mV/V + 2.6 μV	HP 3458A Opt 002
AC Voltage - Measure ¹	100 mV to 10 V (1 Hz to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz (10 to 100) 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 300 kHz to 1 MHz 100 V to 1 kV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	72 μV/V + 0.85 mV 84 μV/V + 0.26 mV 0.17 mV/V + 0.26 mV 0.35 mV/V + 0.25 mV 0.93 mV/V + 0.27 mV 3.5 mV/V + 1.2 mV 12 mV/V + 1.2 mV 18 mV/V + 1.2 mV 0.24 mV + 4.7 mV 0.15 mV + 16 mV 0.15 mV + 17 mV 0.36 mV + 8.6 mV 1.4 mV/V + 3.9 mV 4.8 mV/V + 12 mV 18 mV/V + 12 mV 0.46 mV/V + 50 mV 0.46 mV/V + 28 mV 0.69 mV/V + 29 mV 1.5 mV/V + 24 mV 3.6 mV/V + 24 mV	HP 3458A Opt 002
	(1 to 40) kV 60 Hz	50 mV/V + 0.11 V	HP 3458A Opt 002 with Fluke 80K-40 High Voltage Probe

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Current - Source ¹	(9 to 220) μ A		Fluke 5700A
	(10 to 20) Hz	0.36 mA/A + 25 nA	
	(20 to 40) Hz	0.24 mA/A + 16 nA	
	40 Hz to 1 kHz	0.17 mA/A + 12 nA	
	(1 to 5) kHz	0.42 mA/A + 18 nA	
	(5 to 10) kHz	1.6 mA/A + 95 nA	
	220 μ A to 2.2 mA		
	(10 to 20) Hz	0.37 mA/A + 73 nA	
	(20 to 40) Hz	0.25 mA/A + 68 nA	
	40 Hz to 1 kHz	0.19 mA/A + 54 nA	
	(1 to 5) kHz	0.32 mA/A + 0.17 μ A	
	(5 to 10) kHz	1.6 mA/A + 0.95 μ A	
	(2.2 to 22) mA		
	(10 to 20) Hz	0.32 mA/A + 0.67 μ A	
	(20 to 40) Hz	0.2 mA/A + 0.57 μ A	
	40 Hz to 1 kHz	0.16 mA/A + 0.46 μ A	
(1 to 5) kHz	0.27 mA/A + 0.73 μ A		
(5 to 10) kHz	1.3 mA/A + 5.9 μ A		
(22 to 220) mA			
(10 to 20) Hz	0.32 mA/A + 6.1 μ A		
(20 to 40) Hz	0.2 mA/A + 5 μ A		
40 Hz to 1 kHz	0.16 mA/A + 3.4 μ A		
(1 to 5) kHz	1.4 μ A/A + 12 μ A		
220 mA to 2.2 A			
20 Hz to 1kHz	0.31 mA/A + 44 μ A		
(1 to 5) kHz	0.53 mA/A + 0.11 mV		
(5 to 10) kHz	8.3 mA/A + 0.29 mV		
AC Current - Source ¹ Clamp-On Ammeters	(20 to 1 000) A 45 Hz to 5 kHz	2.8 mA/A + 0.14 A	Fluke 5520A with Fluke Coil
AC Current - Measure ¹	Up to 100 μ A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 1 kHz	4.7 mA/A + 36 nA 1.8 mA/A + 35 nA 0.71 mA/A + 35 nA 0.7 mA/A + 35 nA	Agilent 3458A Opt 002



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Current - Measure ¹	100 μ A to 100 mA		Agilent 3458A Opt 002
	(10 to 20) Hz	4.7 mA/A + 24 μ A	
	(20 to 45) Hz	1.8 mA/A + 24 μ A	
	(45 to 100) Hz	0.71 mA/A + 24 μ A	
	100 Hz to 5 kHz	0.36 mA/A + 23 μ A	
	(5 to 20) kHz	0.71 mA/A + 24 μ A	
	(20 to 50) kHz	4.7 mA/A + 47 μ A	
	(50 to 100) kHz	6.5 mA/A + 0.18 mA	
	100 mA to 1 A		
	(10 to 20) Hz	4.7 mA/A + 0.24 mA	
	(20 to 45) Hz	1.9 mA/A + 0.24 mA	
	(45 to 100) Hz	0.95 mA/A + 0.24 mA	
	100 Hz to 5 kHz	1.1 mA/A + 0.26 mA	
	(5 to 20) kHz	3.5 mA/A + 0.24 mA	
(20 to 50) kHz	12 mA/A + 0.47 mA		
Resistance - Source ¹	Up to 11 Ω	5.7 $\mu\Omega/\Omega$ + 1.1 m Ω	Fluke 5520A
	(11 to 33) Ω	35 $\mu\Omega/\Omega$ + 1.8 m Ω	
	(33 to 110) Ω	29 $\mu\Omega/\Omega$ + 0.57 m Ω	
	(110 to 330) Ω	33 $\mu\Omega/\Omega$ + 2.4 m Ω	
	330 Ω to 1.1 k Ω	30 $\mu\Omega/\Omega$ + 4.3 m Ω	
	(1.1 to 3.3) k Ω	33 $\mu\Omega/\Omega$ + 27 m Ω	
	(3.3 to 11) k Ω	4.5 $\mu\Omega/\Omega$ + 1.7 Ω	
	(11 to 33) k Ω	34 $\mu\Omega/\Omega$ + 0.23 Ω	
	(33 to 110) k Ω	33 $\mu\Omega/\Omega$ + 0.33 Ω	
	(110 to 330) k Ω	35 $\mu\Omega/\Omega$ + 4 Ω	
	330 k Ω to 1.1 M Ω	37 $\mu\Omega/\Omega$ + 2.4 Ω	
	(1.1 to 3.3) M Ω	71 $\mu\Omega/\Omega$ + 36 Ω	
	(3.3 to 11) M Ω	0.15 m Ω/Ω + 67 Ω	
	(11 to 33) M Ω	0.39 m Ω/Ω + 3 k Ω	
(33 to 110) M Ω	0.58 m Ω/Ω + 4.8 k Ω		
(110 to 330) M Ω	3.5 m Ω/Ω + 0.12 M Ω		
330 M Ω to 1.1 G Ω	18 m Ω/Ω + 0.59 M Ω		
Resistance - Measure ¹ Fixed Points	10 Ω	22 $\mu\Omega/\Omega$ + 62 $\mu\Omega$	HP 3458A Opt 002
	100 Ω	18 $\mu\Omega/\Omega$ + 0.61 m Ω	
	1 k Ω	16 $\mu\Omega/\Omega$ + 0.73 m Ω	
	10 k Ω	15 $\mu\Omega/\Omega$ + 13 m Ω	
	100 k Ω	15 $\mu\Omega/\Omega$ + 67 m Ω	
	1 M Ω	21 $\mu\Omega/\Omega$ + 2.7 Ω	
	10 M Ω	46 $\mu\Omega/\Omega$ + 0.39 k Ω	
	100 M Ω	0.56 m Ω/Ω + 1.2 k Ω	
1 G Ω	6 m Ω/Ω + 12 k Ω		



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Resistance - Source ¹ Fixed Points	1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	0.12 mΩ 0.22 mΩ 0.28 mΩ 0.58 mΩ 1.3 mΩ 2.4 mΩ 10 mΩ 20 mΩ 90 mΩ 0.19 Ω 1.3 Ω 2.5 Ω 2.4 Ω 47 Ω 0.47 kΩ 1.3 kΩ 12 kΩ	Fluke 5700A
	10 mΩ to 1 kΩ (1 to 100) kΩ 100 kΩ to 1 GΩ (1 to 10) GΩ (10 to 100) GΩ	0.1 mΩ/Ω + 2 mΩ 0.1 mΩ/Ω + 0.18 Ω 1 mΩ/Ω + 11 kΩ 2 mΩ/Ω + 0.58 kΩ 5 mΩ/Ω + 23 Ω	ESI DB62-11K ESI DB62-111K IET HRRS-Q-3-100M-5KV
Capacitance - Source ¹ 190 pF to 1.1 nF (1.1 to 11) nF (11 to 110) nF (110 to 330) nF 330 nF to 1.1 μF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF (110 to 330) μF 330 μF to 1.1 mF	10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 10 kHz 10 Hz to 10 kHz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (10 to 80) Hz (10 to 80) Hz	5 mF/F + 12 pF 5.8 mF/F + 12 pF 2.9 mF/F + 0.12 nF 2.9 mF/F + 0.35 nF 3 mF/F + 1.2 nF 4.1 mF/F + 3.5 nF 4.1 mF/F + 11 nF 4.7 mF/F + 35 nF 5.9 mF/F + 0.11 μF 8.1 mF/F + 0.35 μF 12 mF/F + 0.27 μF	Fluke 5520A
Capacitance - Source ¹ @ 1 kHz	1 pF 10 pF 100 pF 1 nF	1.2 fF 12 fF 0.12 pF 1.2 pF	Hewlett Packard 16380A Set consisting of 16381A, 16382A, 16383A, and 16384A



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Capacitance - Source ¹ Algorithmic Deviation (1 to 3) MHz 4 MHz 5 MHz 10 MHz 13 MHz	1 pF	1.2 fF 1.3 fF 1.5 fF 2.8 fF 3.9 fF	Hewlett Packard 16380A Set consisting of 16381A, 16382A, 16383A, and 16384A
Capacitance - Source ¹ Algorithmic Deviation (1 to 13) MHz	10 pF	12 fF	
Capacitance - Source ¹ Algorithmic Deviation (1 to 10) MHz 13 MHz	100 pF	0.12 pF 0.13 pF	
Capacitance - Source ¹ Algorithmic Deviation (1 to 4) MHz 5 MHz 10 MHz 13 MHz	1 nF	1.2 pF 1.3 pF 2.2 pF 3 pF	
Inductance - Source	100 μH to 1 mH (1 to 10) mH (10 to 100) mH 100 mH to 1 H (1 to 10) H	24 mH/H + 5 μH 24 mH/H + 0.7 mH 19 mH/H + 8.2 μH 9.5 mH/H + 0.13 mH 9.5 mH/H + 1.5 mH	IET 1491-G
Electrical Simulation of Thermocouple Indicating Devices - Source and Measure ¹	Type K (-200 to -50) °C (-50 to 1 372) °C Type T (-200 to -50) °C (-50 to 400) °C Type J (-210 to -50) °C (-50 to 760) °C Type E (-230 to -50) °C (-50 to 1 000) °C Type R (0 to 1 768) °C	0.56 °C (1 °F) 0.28 °C (0.5 °F) 0.56 °C (1 °F) 0.28 °C (0.5 °F) 0.56 °C (1 °F) 0.28 °C (0.5 °F) 0.56 °C (1 °F) 0.28 °C (0.5 °F) 0.95 °C (1.8 °F)	Fluke 5520A



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Oscilloscopes ¹			
Square Wave Signal			
10 Hz to 10 kHz 50 Ω 1 M Ω	1 mV to 6.6 V p-p 1 mV to 130 V p-p	0.25 mV/V p-p + 0.11 V 2.5 mV/V p-p + 58 mV	Fluke 5520A
Level Sine Wave	5 mV to 5.5 V	11 mV/V + 0.11 V	
Amplitude	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	25 mV/V + 0.11 V 30 mV/V + 0.11 V 52 mV/V + 0.11 V	
Flatness referenced to 50 kHz reference	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	6.3 mV/V + 0.11 V 5.9 mV/V + 0.17 V 23 mV/V + 0.17 V	
Time Markers (5-2-1 sequence) into a 50 Ω load	5 s to 50 ms 20 ms to 100 ns (50 to 20) ns 10 ns (5 to 2) ns	0.30 mHz/Hz + 0.12 Hz 2.5 x 10 ⁻⁶ Hz 2.5 x 10 ⁻⁶ Hz 2.5 x 10 ⁻⁶ Hz 2.5 x 10 ⁻⁶ Hz	
Rise Time	≤ 300 ps	0.06 ps/s + 0.03 ps	

Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Amplitude Modulation - Measure ¹			
Rate: 50 Hz to 10 kHz, 5 % to 99 %	150 kHz to 10 MHz	0.044 % + 2.332 %	HP 8902A
50 Hz to 100 kHz, 20 % to 99 %	10 MHz to 1.3 GHz	0.012 % + 1.181 %	



Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Frequency Modulation - Measure ¹ Rate: 20 Hz to 10 kHz Dev:20 Hz to 40 kHz peak	250 kHz to 10 MHz	0.022 kHz + 2.266 %	HP8902A
Rate: 50 Hz to 200 kHz Dev:250 Hz to 400 kHz peak	10 MHz to 1.3 GHz	0.16 kHz + 5.833 %	
Frequency Modulation - Source ¹ Rate: 1 kHz rate Max. Dev. 2 MHz Max. Dev. 4 MHz Max. Dev. 8 MHz Max. Dev. 16 MHz Max. Dev. 32 MHz	250 kHz to 1 GHz (1 to 2) GHz (2 to 3.2) GHz (3.2 to 10) GHz (10 to 20) GHz	4 % + 24 Hz	HP 83620B
Phase Modulation - Measure ¹ >0.7 rad Dev. >0.6 rad Dev.	150 kHz to 10.0 MHz 10 MHz to 1.3 GHz	0.003 rad + 4.932 % 0.067 rad + 3.378 %	HP 8902A
Phase Modulation - Measure ¹ Rate:200 Hz to 10 kHz Rate:200 Hz to 20 kHz	150 kHz to 10 MHz 10 MHz to 1.3 GHz	4.6 % + 1 digit 3.5 % + 1 digit	HP 8902A
Distortion - Measure ¹ Rate: 20 Hz to 250 kHz (0.01 to 100) %	20 Hz to 20 kHz (20 to 100) kHz	1.2 dB 2.3 dB	HP 8902B
Power - Measure ¹ 1 mW reference	50 MHz 100 kHz to 4.2 GHz 10 MHz to 18 GHz 50 MHz to 26.5 GHz	0.01 mW 3 % + 0.1 dBm 3.2 % + 0.1 dBm 3 % + 0.1 dBm	HP 478A with HP 432A HP 8482A, E4419B, HP 8481A, E4419B, HP 8485A, E4419B
Noise Figure - Source ¹ 15 dB ENR	10 MHz to 26.5 GHz	0.17 dB	HP 346C
Noise Figure - Measure ¹	100 kHz to 30 MHz 30 MHz to 3 GHz (3 to 26.5) GHz	0.43 dB 0.42 dB 0.47 dB	HP 346C, Agilent E4448A, HP 8449B



Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Ring Gages	Up to 6 in	$(3.6 + 10L) \mu\text{in}$	Mahr Federal UMM
Thread Measuring Wires	Up to 0.096 23 in	$(3.4 + 10L) \mu\text{in}$	
Thread Plug Gages - External Diameter	Up to 2 in (2 to 6) in	85 μin $(58 + 10L) \mu\text{in}$	
Thread Ring Gages - Internal Diameter	Up to 1.5 in (1 to 8) in	36 μin $(15 + 10L) \mu\text{in}$	
Gage Blocks	Up to 6 in (6 to 19) in	$(3.8 \text{ to } 10L) \mu\text{in}$ $(-24 + 8.8L) \mu\text{in}$	
Pin Gages	Up to 1 in (1 to 6) in	20 μin $(5.8 + 10L) \mu\text{in}$	
Bore Gages	Up to 1 in	110 μin	
Calipers External Diameter	Up to 40 inch (Up to 1 000 mm)	13 $\mu\text{in/in} + 590 \mu\text{in}$	Grade 2 Gage Blocks, End Rods
Inside Diameter (Fixed Points)	(1 and 2) in (25.4 and 50.8) mm	28 $\mu\text{in/in} + 660 \mu\text{in}$	Ring Gages
Micrometers and Thickness Gages	Up to 12 in (Up to 300 mm)	30 $\mu\text{in/in} + 19 \mu\text{in}$	Grade 2 Gage Blocks, End Rods
Height Gages	Up to 40 in (Up to 1 000 mm)	4.7 $\mu\text{in/in} + 750 \mu\text{in}$	
Depth Gages	Up to 40 in (Up to 1 000 mm)	21 $\mu\text{in/in} + 140 \mu\text{in}$	Grade 2 Gage Blocks, End Rods
Dial Indicators	Up to 4 in (Up to 100 mm)	21 $\mu\text{in/in} + 1\,800 \mu\text{in}$	Grade 2 Gage Blocks
Steel Rules	Up to 12 in (Up to 300 mm)	0.04 in	Grade 2 Gage Blocks
Tape Measure	Up to 12 in (Up to 300 mm)	0.04 in	
Feeler (Thickness) Gages	Up to 1 mm	0.000 14 mm	Mahr ULM 600
Holtest	Extension to 25 mm	0.000 12 % + 0.000 6 mm	
Optical Comparators and Visual System	Up to 300 mm	0.01 mm	Grade 2 Gage Blocks, Glass Scale



Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment	
Force Gages	Up to 20 kgf	23 gf	Class M1 Weights	
Pressure - Source	(-12 to 300) psi (300 to 10 000) psi	0.2 psi 0.000 1 % of Applied + 9.5 psi 0.21 psi	Fluke 718 300G (Air) Fluke 700P31 (Air) Fluke 700P-24 (Differential) Fluke P324 (Oil)	
	(0 to 15) psi (0 to 10 000) psi	0.02 % of Applied + 0.21 psi		
Torque Tools	(1 to 10) in lb	0.6 % of Applied + 0.008 in lb	Mountz LLT10i Mountz BMX100i Mountz BMX50F Mountz BMX250F	
	(10 to 100) in lb	0.6 % of Applied + 0.07 in lb		
	(5 to 50) ft lb	0.6 % of Applied + 0.04 ft lb		
	(25 to 250) ft lb	0.7 % of Applied + 0.15 ft lb		
Torque Transducers	Up to 22 cm kg	0.03 % of Applied + 0.000 3 cm kg	Mountz 4 in Torque Wheel and Weights	
Balances	1 g	0.15 mg	Class F Weights (Up to 18.11 kg)	
	2 g	0.15 mg		
	5 g	0.15 mg		
	10 g	0.23 mg		
	20 g	0.42 mg		
	50 g	1 mg		
	100 g	2 mg		
	200 g	4 mg		
	500 g	7 mg		
	1 kg	0.01 g		
	2 kg	0.02 g		
	5 kg	0.05 g		
	10 g	0.7 mg		Class M1 Weights (Up to 104 kg)
	20 g	0.9 mg		
	50 g	1 mg		
	100 g	1.7 mg		
200 g	3.3 mg			
500 g	8.3 mg			
1 kg	17 mg			
20 kg	0.3 g			
Mass	Up to 100 g	0.1 mg	Class F Weights, Balance	
	Up to 10 kg	0.01 g		
Air Velocity	Up to 7 040 fpm	1.2 % of Applied + 1.6 fpm	Interactive Instruments JS500, Omega HHF141A	



Photometry and Radiometry

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Optical Wavelength – Measure ¹	(700 to 1 650) nm	3 parts in 10 ⁶	Agilent 86120A
Laser Power - Measure	Up to 50 W	9.9 mW/W + 18 mW	Gentect Maestro, UP50N-50H-W9-D0

Thermodynamic

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Temperature - Measure Ovens and Chambers	(-100 to 1 300) °C	1.2 °C	Agilent 34970A
Temperature - Measure Dry Well and Liquid Bath	(-40 to 180) °C	0.24 °C	Vaisala HM141/HMP46 Fluke 5626, Agilent 3458A
	(-200 to 0) °C (0 to 660) °C	0.01 °C 0.02 °C	
IR Temperature	(-18 to 149) °C	1 °C	Omega BB701 Omega BB-4A
	(100 to 932) °C	1.2 °C	
Relative Humidity - Measure Ovens and Chambers	Up to 90 %RH	0.2 % of Applied + 1.3 %RH	Vaisala HM141/HMP46
	(90 to 100) %RH	2.5 %RH	
Platinum Resistance Thermometers	(-8 to 100) °C	0.001 8 % + 0.006 °C	Fluke 9009, HP 3458A, Fluke 5626
	(100 to 350) °C	0.002 2 % + 0.006 °C	
Thermocouple Sensors	(-8 to 100) °C	0.26 °C	Fluke 9009, HP 3458A, Fluke 5626
	(100 to 350) °C	0.66 °C	

Time and Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Frequency – Source ¹	1 µHz to 80 MHz	5 x 10 ⁻¹² Hz	HP 33250A Agilent 8340B
	10 MHz to 26.5 GHz	5 x 10 ⁻¹² Hz	
Frequency – Measure ¹	1 µHz to 12.4 GHz	5 x 10 ⁻¹² Hz	HP 53132A Opt 124 Agilent E4440A
	1 Hz to 26.5 GHz	5 x 10 ⁻¹² Hz	
Stopwatches/Timers	Up to 3 600 S	0.25 S	HP 53132A



Time and Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
RPM – Measure Non-Contact	(60 to 3 000) rpm (3 000 to 6 000) rpm (6 000 to 12 000) rpm (12 000 to 60 000) rpm (60 000 to 100 000) rpm (100 000 to 120 000) rpm	0.13 rpm + 0.000 2 rpm 0.13 rpm + 0.000 2 rpm 0.16 rpm + 0.000 2 rpm 1.3 rpm + 0.000 2 rpm 1.6 rpm + 0.000 2 rpm 2.4 rpm + 0.000 2 rpm	Agilent 33250A
Stroboscopes	(0 to 100 000) rpm	0.000 07 % of Applied + 0.58 rpm	Fluke 5520A

Calibration and Measurement Capability (CMC) is expressed in terms of the measurement parameter, measurement range, expanded uncertainty of measurement and reference standard, method, and/or equipment. The expanded uncertainty of measurement is expressed as the standard uncertainty of the measurement multiplied by a coverage factor of 2 ($k=2$), corresponding to a confidence level of approximately 95%.

Notes:

1. On-site calibration service is available for this parameter, since on-site conditions are typically more variable than those in the laboratory, larger measurement uncertainties are expected on-site than what is reported on the accredited scope
2. The use of (L) signifies Length in inches.
3. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1736.08.



Vice President

