



# CERTIFICATE OF ACCREDITATION

**The ANSI National Accreditation Board**

Hereby attests that

**Micro Precision Calibration Korea**  
**775 Gyeongin-ro Yeongdeungpo-gu**  
**Seoul, Korea 150-972**

Fulfils the requirements of

**ISO/IEC 17025:2017**

and national standards

**ANSI/NCSL Z540-1-1994 (R2002) and**  
**ANSI/NCSL Z540.3-2006 (R2013)**

In the field of

**CALIBRATION**

This certificate is valid only when accompanied by a current scope of accreditation document.  
The current scope of accreditation can be verified at [www.anab.org](http://www.anab.org).

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 31 October 2022

Certificate Number: AC-1969.13



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.  
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 17025:2017, ANSI/NCSL Z540-1-1994 (R2002) AND ANSI/NCSL Z540.3-2006 (R2013)

### Micro Precision Calibration Korea

775 Gyeongin-ro Yeongdeungpo-gu,  
Seoul, Korea 150-972  
Jeong-Hyun Park Phone: +82 70 7826 4450  
jh.park@microprecision.com www.microprecision.com

### CALIBRATION

Valid to: **October 31, 2022**

Certificate Number: **AC-1969.13**

#### Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage Source <sup>1</sup>	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	7.1 $\mu$ V/V + 0.4 $\mu$ V 4.1 $\mu$ V/V + 0.7 $\mu$ V 3 $\mu$ V/V + 2.5 $\mu$ V 3 $\mu$ V/V + 4 $\mu$ V 4.4 $\mu$ V/V + 40 $\mu$ V 5.5 $\mu$ V/V + 400 $\mu$ V	Multifunction Calibrator
DC Voltage Source <sup>1</sup> Fixed Values	1 V 1.018V 10 V	1.6 $\mu$ V/V 1.6 $\mu$ V/V 1.2 $\mu$ V/V	DC Voltage Standard
DC Voltage Measure <sup>1</sup>	(0.1 to 100) mV 100 mV to 1V (1 to 10) V (10 to 100) V 100 V to 1 kV	13 $\mu$ V/V + 0.3 $\mu$ V 11 $\mu$ V/V + 0.3 $\mu$ V 8 $\mu$ V/V + 0.5 $\mu$ V 12 $\mu$ V/V + 30 $\mu$ V 10 $\mu$ V/V + 0.1 mV	Multimeter
DC Voltage Measure <sup>1</sup>	(1 to 10) kV	7 V	High Voltage Meter with Probe
DC Current Source <sup>1</sup>	Up to 220 $\mu$ A 220 $\mu$ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A	40 $\mu$ A/A + 6 nA 35 $\mu$ A/A + 7 nA 35 $\mu$ A/A + 40 nA 46 $\mu$ A/A + 0.7 $\mu$ A 68 $\mu$ A/A + 12 $\mu$ A 437 $\mu$ A/A + 330 $\mu$ A	Multiproduct Calibrator
DC High Current - Source <sup>1</sup>	(11 to 20) A (20 to 100) A (100 to 1 000) A	0.3 % + 0.002 A 0.3 % + 0.015 A 0.4 % + 0.05 A	Multiproduct Calibrator with Current Coil

**Electrical – DC/Low Frequency**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
DC Current Measure <sup>1</sup>	(0.1 to 100) nA (0.1 to 1) µA (1 to 10) µA (10 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	84 µA/A + 40 pA 17 µA/A + 40 pA 17 µA/A + 70 pA 17 µA/A + 0.6 nA 17 µA/A + 4 nA 17 µA/A + 40 nA 34 µA/A + 0.4 µA 0.12 mA/A + 10 µA	Multimeter
DC High Current Measure <sup>1</sup>	(1 to 300) A	0.2 mA/A	Current Shunt monitored with Multimeter
Inductance Source <sup>1</sup> Fixed Points, @ 1 kHz	1 mH to 10 H	0.31 mH/H	Standard Inductors
Inductance Measure <sup>1</sup> 12 Hz to 10 kHz	100 mH to 10 H 12 Hz to 10 kHz	0.45 mH/H	RLC Digibridge
Resistance Source <sup>1</sup>	Up to 11 Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω 330 Ω to 1.1 kΩ (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ 330 kΩ to 1.1 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ	0.11 mΩ/Ω + 8 mΩ 0.11 mΩ/Ω + 15 mΩ 82 µΩ/Ω + 1.4 mΩ 80 µΩ/Ω + 15 mΩ 82 µΩ/Ω + 2 mΩ 82 µΩ/Ω + 60 mΩ 82 µΩ/Ω + 0.6 Ω 82 µΩ/Ω + 0.6 Ω 93 µΩ/Ω + 6 Ω 0.11 mΩ/Ω + 6 Ω 0.13 mΩ/Ω + 55 Ω 0.13 mΩ/Ω + 55 Ω 0.53 mΩ/Ω + 550 Ω 0.87 mΩ/Ω + 550 Ω 4.7 mΩ/Ω + 5.5 kΩ 4.7 mΩ/Ω + 16.5 kΩ	Multiproduct Calibrator
Resistance Source <sup>1</sup>	100 MΩ to 1 GΩ (1 to 10) GΩ (10 to 100) GΩ	1.2 mΩ/Ω 1.3 mΩ/Ω 1.5 mΩ/Ω	Decade Resistance Box
Resistance Source <sup>1</sup> Fixed Points	0 Ω 1.0 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω	50 µΩ/Ω 91 µΩ/Ω 91 µΩ/Ω 27 µΩ/Ω 27 µΩ/Ω 11 µΩ/Ω 11 µΩ/Ω	Multifunction Calibrator

## Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance Source <sup>1</sup> Fixed Points	1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	10 µΩ/Ω 10 µΩ/Ω 10 µΩ/Ω 10 µΩ/Ω 14 µΩ/Ω 14 µΩ/Ω 20 µΩ/Ω 21 µΩ/Ω 40 µΩ/Ω 49 µΩ/Ω 109 µΩ/Ω	Multifunction Calibrator
Resistance Measure <sup>1</sup>	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	7 µΩ/Ω + 30 µΩ 5 µΩ/Ω + 0.3 mΩ 3 µΩ/Ω + 0.2 mΩ 3 µΩ/Ω + 2 mΩ 4 µΩ/Ω + 20 mΩ 13 µΩ/Ω + 1 Ω 60 µΩ/Ω + 50 Ω 570 µΩ/Ω + 1 kΩ 7 mΩ/Ω + 10 kΩ	Multimeter
AC Resistance Source and Measure <sup>1</sup> 100 Hz to 10 kHz	(0.001 to 1) Ω (1 to 10) Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ	64 mΩ/Ω 64 mΩ/Ω 64 mΩ/Ω 0.64 µΩ/Ω 6.4 µΩ/Ω	RLC Digibridge
Capacitance Source <sup>1</sup> at 1 kHz	(330 to 490) pF 490 pF to 1.1 nF (1.1 to 3.3) nF (3.3 to 11) nF (11 to 33) nF (33 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	45 mF/F + 0.01 nF 15 mF/F + 0.01 nF 8 mF/F + 0.01 nF 6 mF/F + 0.01 nF 6 mF/F + 0.1 nF 6 mF/F + 0.1 nF 6 mF/F + 0.3 nF 6 mF/F + 1 nF 6 mF/F + 3 nF 6 mF/F + 10 nF 4 mF/F + 30 nF 4.5 mF/F + 100 nF 6 mF/F + 300 nF 11.3 mF/F + 300 nF	Multiproduct Calibrator

**Electrical – DC/Low Frequency**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
Capacitance Source <sup>1</sup> Fixed Points 1 kHz	(1, 10, 100, 1 000) pF (10, 100, 1 000) nF	1.3 mF/F 1.3 mF/F	Standard Capacitor Set
Electrical Stimulation of Thermocouple Indicators <sup>1</sup>	Type E (-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1 000) °C  Type J (-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1 200) °C  Type K (-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1 000) °C (1 000 to 1 372) °C  Type S (0 to 250) °C (250 to 1 000) °C (1 000 to 1 400) °C (1 400 to 1 767) °C  Type T (-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.70 °C 0.23 °C 0.2 °C 0.22 °C 0.3 °C  0.4 °C 0.22 °C 0.2 °C 0.25 °C 0.33 °C  0.46 °C 0.25 °C 0.22 °C 0.4 °C 0.56 °C  0.75 °C 0.53 °C 0.52 °C 0.64 °C  0.9 °C 0.33 °C 0.22 °C 0.2 °C	Multiproduct Calibrator
Electrical Calibration of RTD Indicators <sup>1</sup>	Pt 385, 100 Ω (-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.1 °C 0.1 °C 0.11 °C 0.16 °C 0.17 °C 0.21 °C 0.35 °C	Multiproduct Calibrator

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Calibration of RTD Indicators <sup>1</sup>	Pt 3926, 100 Ω (-200 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 630) °C  Pt 3916, 100 Ω (-200 to -190) °C (-190 to 0) °C (0 to 300) °C (300 to 600) °C (600 to 630) °C  Pt 385, 200 Ω (-200 to 100) °C (100 to 260) °C (260 to 600) °C (600 to 630) °C  Pt 385, 500 Ω (-200 to 100) °C (100 to 260) °C (260 to 600) °C (600 to 630) °C  Pt 385, 1 kΩ (-200 to 0) °C (0 to 260) °C (260 to 600) °C (600 to 630) °C  PtNi 385, 100 Ω (-80 to 100) °C (100 to 260) °C  Cu 427, 10 Ω (-100 to 260) °C	0.1 °C 0.1 °C 0.15 °C 0.16 °C  0.4 °C 0.1 °C 0.11 °C 0.13 °C 0.33 °C  0.1 °C 0.1 °C 0.2 °C 0.22 °C  0.1 °C 0.1 °C 0.15 °C 0.15 °C  0.04 °C 0.1 °C 0.1 °C 0.35 °C  0.11 °C 0.2 °C  0.45 °C	Multiproduct Calibrator
AC Voltage Source <sup>1</sup>	220 μV to 2.2 mV (10 to 20) Hz (20 to 40) Hz  40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.65 mV/V + 4 μV 0.25 mV/V + 4 μV 0.2 mV/V + 4 μV 0.45 mV/V + 4 μV 1 mV/V + 5 μV 1.5 mV/V + 10 μV 2.2 mV/V + 20 μV 4.5 mV/V + 20 μV	Multiproduct Calibrator

## Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage Source <sup>1</sup>	(2.2 to 22) mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz  (22 to 220) mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz  220 mV to 2.2 V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz  (2.2 to 22) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.6 mV/V + 4 µV 0.25 mV/V + 4 µV 0.15 mV/V + 4 µV 0.42 mV/V + 4 µV 1 mV/V + 5 µV 1.5 mV/V + 10 µV 2.1 mV/V + 20 µV 4.5 mV/V + 20 µV  0.6 mV/V + 12 µV 0.23 mV/V + 7 µV 0.15 mV/V + 7 µV 0.4 mV/V + 7 µV 1 mV/V + 17 µV 1.5 mV/V + 20 µV 2.1 mV/V + 25 µV 4.5 mV/V + 45 µV  0.55 mV/V + 40 µV 0.2 mV/V + 15 µV 0.16 mV/V + 8 µV 0.15 mV/V + 10 µV 0.3 mV/V + 30 µV 0.6 mV/V + 80 µV 1.5 mV/V + 0.2 mV 2.8 mV/V + 0.3 mV  0.55 mV/V + 400 µV 0.18 mV/V + 150 µV 0.16 mV/V + 50 µV 0.25 mV/V + 100 µV 0.50 mV/V + 200 µV 1.5 mV/V + 0.6 mV 4.8 mV/V + 2 mV 12 mV/V + 3.2 mV	Multiproduct Calibrator

**Electrical – DC/Low Frequency**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
AC Voltage Source <sup>1</sup>	(22 to 220) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz (220 to 1 100) V (15 to 50) Hz 50 Hz to 1 kHz	0.55 mV/V + 4 mV 0.2 mV/V + 1.5 mV 0.17 mV/V + 0.6 mV 0.25 mV/V + 1 mV 0.51 mV/V + 2.5 mV 1.7 mV/V + 16 mV 6.7 mV/V + 40 mV 15 mV/V + 80 mV  0.51 mV/V + 16 mV 0.51 mV/V + 3.5 mV	Multiproduct Calibrator
AC Voltage Measure <sup>1</sup>	Up 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 (10 to 100) 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 300 kHz to 1 MHz (1 to 2) MHz 100 mV to 1 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 (1 to 2) MHz	0.46 mV/V + 3 µV 0.35 mV/V + 1.1 µV 0.45 mV/V + 1.1 µV 1.2 mV/V + 1.1 µV 6 mV/V + 1.1 µV 45 mV/V + 1.1 µV  0.25 mV/V + 40 µV 0.15 mV/V + 20 µV 0.2 mV/V + 20 µV 0.5 mV/V + 20 µV 1.2 mV/V + 20 µV 3.6 mV/V + 100 µV 12 mV/V + 100 µV 17 mV/V + 100 µV  0.2 mV/V + 400 µV 0.2 mV/V + 200 µV 0.22 mV/V + 200 µV 0.36 mV/V + 200 µV 1 mV/V + 200 µV 3.5 mV/V + 1 mV 12 mV/V + 1 mV 17 mV/V + 1 mV	Multimeter

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage Measure <sup>1</sup>	(1 to 10) 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 (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 to 700) V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.2 mV/V + 4 mV 0.2 mV/V + 2 mV 0.22 mV/V + 2 mV 0.4 mV/V + 2 mV 1 mV/V + 2 mV 4 mV/V + 10 mV 16 mV/V + 10 mV 21 mV/V + 10 mV  0.3 mV/V + 4 mV 0.3 mV/V + 2 mV 0.3 mV/V + 2 mV 0.45 mV/V + 2 mV 1.5 mV/V + 2 mV 5 mV/V + 10 mV 21 mV/V + 10 mV  0.6 mV/V + 40 mV 0.7 mV/V + 20 mV 1 mV/V + 20 mV 1.6 mV/V + 20 mV 3.5 mV/V + 20 mV	Multimeter
AC High Voltage Measure <sup>1</sup> 60 Hz	(1 to 10) kV	13 mV/V	High Voltage Meter with Probe
AC Current Source <sup>1</sup>	Up to 220 $\mu$ A (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz  220 $\mu$ A to 2.2 mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.74 mA/A + 16 nA 0.39 mA/A + 10 nA 0.19 mA/A + 8 nA 0.70 mA/A + 12 nA 2.0 mA/A + 65 nA  0.74 mA/A + 40 nA 0.39 mA/A + 35 nA 0.19 mA/A + 35 nA 0.67 mA/A + 0.11 $\mu$ A 2 mA/A + 0.65 $\mu$ A	Multiproduct Calibrator



## **Electrical – DC/Low Frequency**

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current Measure <sup>1</sup>	(5 to 100) µA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 1 kHz 100 µA to 1 mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (1 to 10) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (10 to 100) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	6.5 mA/A + 0.03 µA 2.5 mA/A + 0.03 µA 1 mA/A + 0.03 µA 1 mA/A + 0.03 µA  6 mA/A + 0.2 µA 2 mA/A + 0.2 µA 1 mA/A + 0.2 µA 0.5 mA/A + 0.2 µA  6 mA/A + 2 µA 2 mA/A + 2 µA 1 mA/A + 2 µA 0.5 mA/A + 2 µA  6.7 mA/A + 20 µA 2.4 mA/A + 20 µA 1 mA/A + 20 µA 0.5 mA/A + 20 µA	Multimeter
AC Current Measure <sup>1</sup>	100 mA to 1 A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (100 Hz to 5) kHz (1 to 100) A 1 kHz	5 mA/A + 0.2 mA 2 mA/A + 0.2 mA 1 mA/A + 0.2 mA 1.4 mA/A + 0.2 mA  1.4 mA/A	Multimeter Current Shunt w/Multimeter
DC Power – Source <sup>1</sup>	0.1 W to 11 kW	3 mW/W	Multi-Function Calibrator
AC Power – Source <sup>1</sup> 60 Hz	0.1 W to 12 kW	2.2 mW/W	Power Energy Calibrator

### Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes <sup>1</sup> Square Wave Signal 50 Ω at 1 kHz 1 MΩ at 1 kHz	1 mV to 6.6 V 1 mV to 130 V	2.6 mV/V + 40 μV 8 mV/V to 40 μV	
Pulse & Rise Time 0.5, 1 V p-p 1 V p-p	10 MHz 1 MHz	0.4 ns 0.4 ns	Oscilloscope Calibrator, Active Head & RF Power Sensor
Time Mark Output <sup>4</sup> Into 50 ohms	2 ns to 20 ms 50 ms to 5 s	(25 + 1000t) parts in 10 <sup>6</sup> 25 parts in 10 <sup>6</sup>	
Leveled Sine Flatness	50 kHz reference 50 kHz to 100 MHz (100 to 600) MHz 600 MHz to 2.2 GHz (2.2 to 50) GHz	4 % of reading + 0.3 nV 4 % of reading + 0.3 nV 7 % of reading + 0.3 nV 9 % of reading + 0.3 nV 10 % of reading	

### Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tuned RF Power, Relative – Measure <sup>1</sup> 150 kHz to 26.5 GHz	(20.0 to -30) dB (-30 to -120) dB	0.25 dB 0.59 dB	Measuring Receiver
RF Power Absolute Measure <sup>1</sup> 100 kHz to 50 GHz	(-70 to -30) dBm (-30 to -20) dBm (-20 to 0) dBm (0.01 to 20) dBm	0.65 dB 0.1 dB 0.1 dB 1.2 % of reading	Measuring Receiver with Power Sensor
RF Power Source <sup>1</sup>	(-127 to 13) dBm 10 kHz to 1 GHz (-110 to 10) dBm 10 MHz to 2 GHz (2 to 50.0) GHz	1.2 dB 1.2 dB 1.3 dB	Signal Generator

**Electrical – RF/Microwave**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
Amplitude Modulation <sup>1</sup> – Depth Accuracy Measure	Rate: 50 Hz to 10 kHz Depth: (5 to 99) %	0.5 % Modulation	
150 kHz to 10 MHz	Rate: 50 Hz to 100 kHz Depth: (20 to 99) %	0.4 % Modulation	
10 MHz to 3 GHz	Rate: 50 Hz to 100 kHz Depth: (5 to 20) %	0.5 % Modulation	Measuring Receiver
10 MHz to 3 GHz	Rate: 50 Hz to 100 kHz Depth: (20 to 99) %	0.4 % Modulation	
(3 to 26.5) GHz	Rate: 50 Hz to 100 kHz Depth: (5 to 20) %	0.6 % Modulation	
(3 to 26.5) GHz	Rate: 50 Hz to 100 kHz Depth: (5 to 20) %		
Harmonic Measurements <sup>1</sup>	(≤ -80 to 0.1) dB 30 Hz to 50 GHz	1.5 dB	Spectrum Analyzer
Harmonic Distortion <sup>1</sup>	(0 to 100) dB 20 Hz to 20 kHz (20 to 100) kHz	1.6 dB 2.8 dB	Audio Analyzer
Frequency Modulation <sup>1</sup> – Deviation Accuracy Measure	Rate: 20 Hz to 10 kHz Dev: ≤ 40 kHz	0.4 % Modulation	
250 kHz to 10 MHz	Rate: 50 Hz to 200 kHz Dev: ≤ 400 kHz	0.5 % Modulation	
10 MHz to 6.6 GHz	Rate: 50 Hz to 200 kHz Dev: ≤ 400 kHz	0.5 % Modulation	Measuring Receiver
(6.6 to 13.2) GHz	Rate: 50 Hz to 200 kHz Dev: ≤ 400 kHz	0.5 % Modulation	
(13.2 to 26.5) GHz	Rate: 50 Hz to 200 kHz Dev: ≤ 400 kHz	0.5 % Modulation	
Amplitude Modulation Source1	Rate: 50 Hz to 100 kHz Depths: (5 to 95) %	0.2 % Depth	
10 kHz to 13.5 MHz	Rate: 50 Hz to 100 kHz Depths: (95 to 99) %	0.3 % Depth	AM/FM Test Source
10 kHz to 13.5 MHz			
Frequency Modulation Source1	Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	0.4 % Modulation	AM/FM Test Source
10 kHz to 432 MHz			

**Electrical – RF/Microwave**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
Digital Modulation Source and Measure <sup>1</sup>			
EVM, Power Ramp Relative Accuracy	$-0.11 \pm 0.60 \text{ dB}$	0.26 dB	
Phase and Frequency Error:			
Phase Error			
Peak Phase Error	$(0.01 \text{ to } 180)^\circ$	$0.5^\circ$	
Frequency Error	$-0.11 \pm 0.60 \text{ dB}$	$2^\circ$	
Output RF Spectrum Relative RF Power Uncertainty:	$(0.001 \text{ to } 10) \text{ Hz}$	$5 \text{ Hz} + \text{tfa}$	
Due to Modulation Offsets $\leq 1.2 \text{ MHz}$	$(-30 \text{ to } 10) \text{ dB}$	0.26 dB	
Offsets $\geq 1.8 \text{ MHz}$	$(1 \text{ to } 15)^\circ$	0.36 dB	
	$(3 \text{ to } 25)^\circ$		
Due to Switching	$(-30 \text{ to } 10) \text{ dB}$	0.27 dB	
	$(18 \text{ to } 30)^\circ$		
Absolute RF Power Accuracy	$(-30 \text{ to } 10) \text{ dB}$	0.4 dB	
	$(18 \text{ to } 30)^\circ$		
Excess Noise Ratio	$(4.5 \text{ to } 6.6) \text{ dB}$ 10 MHz to 7 GHz 7 GHz to 13 GHz 13 GHz to 18 GHz $(14 \text{ to } 16) \text{ dB}$ 10 MHz to 7 GHz 7 GHz to 13 GHz 13 GHz to 18 GHz $(12 \text{ to } 17) \text{ dB}$ (0.01 to 18) GHz (18 to 26.5) GHz	0.3 dB 0.32 dB 0.33 dB 0.30 dB 0.32 dB 0.33 dB 0.5 dB 0.7 dB	Noise Sources

<b>PARAMETER</b>		(S11 - Reflection) Magnitude Uncertainty (lin)									
<b>REFERENCE STANDARD OR EQUIPMENT</b>		Network Analyzer, Calibration Kit and Verification Kit									
Frequency Range	Measured Magnitude (+/- Linear)										
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	
30 kHz to 300 kHz	0.02	0.02	0.02	0.03	0.03	0.035	0.04	0.05	0.05	0.07	
300 kHz to 3 GHz	0.015	0.015	0.015	0.015	0.015	0.02	0.03	0.03	0.035	0.035	
(3 to 20) GHz	0.035	0.035	0.035	0.035	0.04	0.04	0.045	0.055	0.06	0.065	
(20 to 50) GHz	0.061	0.065	0.07	0.07	0.073	0.04	0.090	0.1	0.15	0.15	

<b>PARAMETER</b>		(S11 - Reflection) Phase Uncertainty (deg)									
<b>REFERENCE STANDARD OR EQUIPMENT</b>		Network Analyzer, Calibration Kit and Verification Kit									
Frequency Range	Measured Magnitude (+/- Degrees)										
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	
30 kHz to 300 kHz	8	5	3.5	3.5	4	3.5	3.5	3.5	3.5	3.5	
300 kHz to 3 GHz	7.5	4	3	2.5	2	2	2	2	2	3	
(3 to 20) GHz	20	10	7	5	5	4	4	4	4	4	
(20 to 50) GHz	32	20	13	11	10	7.5	7.5	7.5	7.5	7.5	

<b>PARAMETER</b>		(S21 - Transmission) Magnitude Uncertainty (lin)									
<b>REFERENCE STANDARD OR EQUIPMENT</b>		Network Analyzer, Calibration Kit and Verification Kit									
Frequency Range	Measured Magnitude (+/- Linear)										
	0	3	6	10	20	30	40	50	60		
30 kHz to 300 kHz	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	2		
300 kHz to 3 GHz	0.15	0.15	0.15	0.15	0.2	0.3	0.3	0.4	0.7		
(3 to 20) GHz	0.3	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.8		
(20 to 50) GHz	0.4	0.5	0.5	0.5	0.5	1	1	1.5	1.5		

<b>PARAMETER</b>		(S21 - Transmission) Magnitude Uncertainty (deg)								
<b>REFERENCE STANDARD OR EQUIPMENT</b>		Network Analyzer, Calibration Kit and Verification Kit								
Frequency Range		Measured Magnitude (+/- Linear)								
		0	3	6	10	20	30	40	50	
30 kHz to 300 kHz		3	3	3	3	3	3	3.5	5.5	7
300 kHz to 3 GHz		1	1	1	1.5	1.5	2	2	2.5	3.5
(3 to 20) GHz		1.5	2	2	2	2	2	3	3.5	4
(20 to 50) GHz		5	5	5.5	5.8	5.8	6	6.5	7	7.5

### Length – Dimensional Metrology

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
Calipers <sup>1,2</sup>	Up to 500 mm	$(0.24 + 0.002L) \mu\text{m}$	Gage Blocks
Height Gages <sup>1,2</sup>	Up to 500 mm	$(0.13 + 0.002L) \mu\text{m}$	Gage Blocks
Indicators <sup>2</sup>	Up to 100 mm	$(0.4 + 0.0002L) \mu\text{m}$	Gage Blocks
Micrometers <sup>1,2</sup>	Up to 500 mm	$(2.5 + 0.0003L) \mu\text{m}$	Gage Blocks

### Mass and Mass Related

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
Pressure <sup>1</sup>	(-15 to 200) psi (200 to 1 000) psi (1 000 to 10 000) psi	0.1 psi 0.06 psi 20 psi	Pressure Calibrator
Scales and Balances <sup>1</sup>	1 mg to 100 g (100 to 500) g 500 g to 10 kg (10 to 150) kg	0.29 mg 0.63 mg 3.6 g 12 g	Standard Weights
Torque Tools <sup>1</sup>	(0.01 to 10) N·m (60 to 600) lbf·ft	0.53 % of reading 0.5 % of reading	Torque Calibrator

### Photometry and Radiometry

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
Optical Wavelength Measure <sup>1</sup>	(700 to 1 650) nm	0.007 nm	Wavelength Meter

## Photometry and Radiometry

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Optical Power <sup>1</sup> Measure 850 nm 1 310 nm 1 550 nm	(-6 to -60) dB (-110 to 10) dB (-110 to 10) dB	3.5 % of reading + 0.01 dB 3.5 % of reading + 0.01 dB 3.8 % of reading + 0.01 dB	Optical Test System

## Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature <sup>1</sup>	(-195 to 0) °C (0 to 420) °C	0.043 °C 0.06 °C	Standard Thermometer
Relative Humidity <sup>1</sup>	(10 to 95) % RH	2.5 % RH	Hygrometer

## Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Source <sup>1</sup>	0.1 Hz to 50 GHz	$6 \times 10^{-11}$ Hz/Hz	GPS Receiver, Signal Generator
Frequency Measure <sup>1</sup> Fixed Point	10 MHz	$6 \times 10^{-11}$ Hz/Hz	GPS Receiver
Frequency Measure <sup>1</sup>	0.1 Hz to 3 GHz 10 Hz to 46 GHz	$7 \times 10^{-11}$ Hz/Hz $7 \times 10^{-10}$ Hz/Hz	GPS, Frequency Receiver and Counter
Photo Tachometer <sup>1</sup>	(0 to 100 000) rpm	0.8 rpm	Generator with LED

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. L = length in inches.
3. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1969.13.



R. Douglas Leonard Jr., VP, PILR SBU