CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board

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

This is to certify that

Keysight Technologies, Inc. Service Centers
2840 Emerick Blvd., Suite A-4
Bethlehem, PA 18020

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

ISO/IEC 17025:2005

and national standards

ANSI/NCSL Z540-1-1994 AND
ANSI/NCSL Z540.3-2006

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-1498.09
Certificate Number

ANAB Approval

Certificate Valid: 04/07/2017-11/16/2018
Version No. 002 Issued: 04/07/2017

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 January 2009).

ANSI-ASQ National Accreditation Board

SCOPE OF ACCREDITATION TO
ISO/IEC 17025:2005, ANSI/NCSL Z540-1-1994, AND ANSI/NCSL Z540.3-2006

Keysight Technologies, Inc. Service Centers

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CALIBRATION

Valid to: November 16, 2018 Certificate Number: AC-1498.09

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
DC Voltage - Source	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 µV/V + 0.16 µV 5 µV/V + 0.15 µV 3 µV/V + 0.32 µV 4 µV/V + 5 µV 5 µV/V + 14 µV 7 µV/V + 41 µV	Fluke 5720A or 5730A with Fluke 5725A
DC Voltage – Source Fixed Values	100 mV 1 V 10 V 100 V 1000 V	0.72 µV 2.9 µV 2.6 µV 0.5 mV 7.3 mV	Fluke 57x0A disciplined with HP 3458A
	10 V	3 µV/V	Fluke 732A
DC Voltage - Measure	Up to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100 V to 1 kV	5.6 µV/V + 1.5 µV 5.2 µV/V + 1.2 µV 4.7 µV/V + 2.5 µV 6.6 µV/V + 45 µV 19 µV/V + 0.16 mV	Keysight 3458A/100 PLC Option 002
DC Voltage Transfer – Measure	0 to 0.1 V 0.1 to 1 V 1 to 10 V 10 to 100 V 100 to 1 000 V	0.62 µV/V + 62 nV 0.37 µV/V + 124 nV 62 nV/V + 0.62 µV 0.62 µV/V + 12 µV 1.9 µV/V + 63 µV	3458A
DC Current - Source	Up to 220 µA 220 µA to 2.2 mA (2.2 to 22) mA (22 to 100) mA (100 to 220) mA	36 µA/A + 0.12 nA 33 µA/A + 1.2 nA 34 µA/A + 12 nA 42 µA/A + 0.12 µA 51 µA/A	Fluke 5720A

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
DC Current – Source	220 mA to 1 A (1 to 2.2) A (2.2 to 11) A	76 µA/A + 1.5 µA 1.5 mA/A + 66 µA 0.30 mA/A + 0.4 mA	Fluke 5720A with Fluke 5725A
	100 µA 1 mA 10 mA 100 mA 1 A	1.9 nA 16 nA 0.16 µA 2.3 µA 49 µA	Fluke 57x0A disciplined with HP 3458A
	10 A to 20 A 20 A to 200 A 200 A to 1 000 A	0.53% + 22 mA 0.54% + 0.15 A 0.54% + 0.52 A	Fluke 5520A
DC Current - Measure	(10 to 100) µA 100 µA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1.1 A	20 µA/A 20 µA/A + 0.10 µA 20 µA/A + 60 nA 35 µA/A + 0.6 µA 0.11 mA/A + 11 µA	Keysight 3458A
DC Dissipated Power - 300 mA to Full Power	Shunt 15 A 100 mΩ, 25 W	0.14 mΩ/Ω	Guildline 9230-15
	Shunt 100A 10 mΩ, 100 W	0.14 mΩ/Ω	Guildline 9230-100
	Shunt 300A 10 mΩ, 90 W	0.12 mΩ/Ω	Guildline 9230-300
	Shunt 1 000A 100 µΩ, 100 W	0.36 mΩ/Ω	Guildline 9230-1000
Resistance - Source Fixed Points	0 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 k Ω 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	0.25 mΩ 0.27 mΩ 0.31 mΩ 0.34 mΩ 2.5 mΩ 2.7 mΩ 3.3 mΩ 9.3 mΩ 31 mΩ 93 mΩ 0.19 Ω 1.2 Ω 2.2 Ω 20 Ω 42 Ω 0.40 kΩ 1.5 kΩ 12 kΩ	Fluke 5720A

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
Resistance - Source Fixed Points	0 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ	21 µΩ 89 µΩ 0.86 mΩ 7.5 mΩ 75 mΩ 0.75 Ω 8 Ω 0.15 kΩ 24 kΩ	Fluke 57x0A disciplined with HP 3458A
Resistance – Source	0 to 11 Ω 11 to 110 Ω 110 Ω to 1.1 kΩ 1.1 to 3.3 kΩ 3.3 to 11 kΩ 11 to 110 kΩ 110 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 330 to 1100 MΩ	33 µΩ/Ω + 8.3 mΩ 25 µΩ/Ω + 12.5 mΩ 23 µΩ/Ω + 17 mΩ 23 µΩ/Ω + 170 mΩ 23 µΩ/Ω + 84 mΩ 23 µΩ/Ω + 0.84 Ω 27 µΩ/Ω + 8 Ω 50 µΩ/Ω + 125 Ω 0.11 mΩ/Ω + 0.2 kΩ 0.21 mΩ/Ω + 2 kΩ 0.41 mΩ/Ω + 2.8 kΩ 2.5 mΩ/Ω + 83 kΩ 13 mΩ/Ω + 0.4 MΩ	Fluke 5520A
Resistance – Measure	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	22 µΩ/Ω + 90 µΩ 19 µΩ/Ω + 0.88 mΩ 16 µΩ/Ω + 0.95 mΩ 16 µΩ/Ω + 9.5 mΩ 16 µΩ/Ω + 95 mΩ 22 µΩ/Ω + 3 Ω 65 µΩ/Ω + 132 Ω 0.62 mΩ/Ω + 4.5 kΩ 6.2 mΩ/Ω + 0.35 MΩ	3458A
AC Voltage - Source	**Up 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	 0.25 mV/V + 12 µV 95 µV/V + 7.3 µV 86 µV/V + 7.3 µV 0.18 mV/V + 9.4 µV 0.49 mV/V + 16 µV 0.88 mV/V + 20 µV 1.4 mV/V + 33 µV 2.7 mV/V + 0.48 mV 0.27 mV/V + 4.5 µV 0.13 mV/V + 4.5 µV 0.11 mV/V + 4.5 µV 0.27 mV/V + 4.5 µV 0.54 mV/V + 5.3 µV 1.2 mV/V + 10 µV 1.7 mV/V + 24 µV 3 mV/V + 24 µV	Fluke 5720A

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
AC Voltage - Source	**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 **(22 to 100) 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	 0.25 mV/V + 39 µV 99 µV/V + 15 µV 63 µV/V + 5.9 µV 86 µV/V + 8.3 µV 0.11 mV/V + 30 µV 0.41 mV/V + 78 µV 0.99 mV/V + 0.20 mV 1.6 mV/V + 0.32 mV 0.26 mV/V + 0.42 mV 0.11 mV/V + 0.15 mV 67 µV/V + 44 µV 91 µV/V + 90 µV 1.1 µV/V + 0.21 mV 2.9 µV/V + 0.65 mV 1.1 mV/V + 2 mV 1.6 mV/V + 3.3 mV 0.24 mV/V + 3.9 mV 0.1 mV/V + 1.5 mV 69 µV/V + 0.43 mV 98 µV/V + 0.91 mV 0.16 mV/V + 2.4 mV 0.87 mV/V + 16 mV 0.43 mV/V + 39 mV 7.9 mV/V + 79 mV	Fluke 5720A
AC Voltage - Source	**(100 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	 0.24 mV/V + 3.9 mV 0.10 mV/V + 1.5 mV 69 µV/V + 0.43 mV 0.17 mV/V + 0.56 mV 0.21 mV/V + 1.9 mV 0.87 mV/V + 16 mV 0.43 mV/V + 39 mV 7.9 mV/V + 79 mV	Fluke 5720A, Fluke 5720A with Fluke 5725A Amplifier
AC Voltage - Source	**(0 to 250) V** (15 to 50) Hz **250 V to 1.1 kV** 50 Hz to 1 kHz **220 V to 1.1 kV** 40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz **(220 to 750) V** (30 to 50) kHz (50 to 100) kHz	 0.31 mV/V + 17 mV 87 µV/V + 2.9 mV 0.91 mV/V + 2.9 mV 0.91 mV/V + 2.9 mV 5.1 mV/V + 9.6 mV 0.52 mV/V + 8.6 mV 1.9 mV/V + 37 mV	Fluke 5700A or Fluke 5720A disciplined with Keysight 3458A

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
AC Voltage - Source Fixed Values, Fixed Frequencies	**0.01 V**		Fluke 57x0A disciplined with Keysight 3458A
	1 kHz	2.8 µV	
	20 kHz	2.9 µV	
	100 kHz	9.0 µV	
	300 kHz	66 µV	
	0.1 V		
	1 kHz	5.7 µV	
	20 kHz	7.8 µV	
	100 kHz	37 µV	
	300 kHz	69 µV	
	1 V		
	1 kHz	55 µV	
	20 kHz	69 µV	
	50 kHz	0.13 mV	
	100 kHz	0.21 mV	
	300 kHz	0.6 mV	
	500 kHz	1.7 mV	
	3V		
	100 kHz	0.57 mV	
	10 V		
	10 Hz	0.78 mV	
	20 Hz	0.59 mV	
	40 Hz	0.52 mV	
	200 Hz	0.59 mV	
	500 Hz	0.59 mV	
	1 kHz	0.49 mV	
	10 kHz	0.68 mV	
	20 kHz	0.68 mV	
	50 kHz	1.3 mV	
	100 kHz	1.6 mV	
	300 kHz	5.1 mV	
	500 kHz	16 mV	
	1 MHz	19 mV	
	100 V		
	1 kHz	8.4 mV	
	20 kHz	12 mV	
	50 kHz	14 mV	
	100 kHz	34 mV	
	700 V		
	1 kHz	77 mV	

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
AC Voltage Flatness - Source	**300 µV to 3.5 V** (10 to 30) Hz 30 Hz to 120 kHz **300 µV to 1.1 mV** 120 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz **1.1 µV to 3 mV** 120 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	 2.7 mV/V 1.4 mV/V 4.6 mV/V 6.2 mV/V 8 mV/V 24 mV/V 2.2 mV/V 3.7 mV/V 5.5 mV/V 14 mV/V	Fluke 5720A, Fluke 5700A, or Fluke 5700A-03 (referenced to 1 kHz)
AC Voltage Flatness - Source	**3 mV to 3.5 V** 120 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	 1.2 mV/V 2.1 mV/V 3.8 mV/V 8.6 mV/V	Fluke 5720A, Fluke 5700A, or Fluke 5700A-03 (referenced to 1 kHz)
AC Voltage Flatness - Measure	**Up to 3 V** 10 Hz 100 Hz (10, 30) kHz 100 kHz 300 kHz 1 MHz 3 MHz 8 MHz 10 MHz 20 MHz 30 MHz 50 MHz 70 MHz 80 MHz 100 MHz	 0.2 mV/V + 6.9 µV 80 µV/V + 5.5 µV 80 µV/V + 3.2 µV 0.1 mV/V + 8 µV 0.1 mV/V + 5.2 µV 0.1 mV/V + 6.5 µV 1.3 mV/V + 59 µV 1.3 mV/V + 0.11 mV 1.3 mV/V + 91 µV 2.5 mV/V + 0.21 mV 2.5 mV/V + 0.24 mV 6.1 mV/V + 0.34 mV 9 mV/V + 0.24 mV 11 mV/V + 0.79 mV 13 mV/V + 0.94 mV	Agilent 11049A, Agilent 11050A, Agilent 11051A Thermal Voltage Converters

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
AC Voltage - Measure	**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 300 kHz to 1 MHz (1 to 4) MHz (4 to 8) MHz **(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 (2 to 4) MHz (4 to 8) MHz (8 to 10) MHz	 0.3 mV/V + 3.1 µV 0.2 mV/V + 1.2 µV 0.3 mV/V + 1.7 µV 1 mV/V + 1.6 µV 5 mV/V + 1.3 µV 40 mV/V + 2.1 µV 12 mV/V + 6.6 µV 70 mV/V + 7.5 µV 20 mV/V + 8.2 µV 70 µV/V + 4.1 µV 70 µV/V + 2.1 µV 0.14 mV/V + 2.3 µV 0.3 V/V + 2.6 µV 0.8 mV/V + 2.3 µV 3 mV/V + 15 µV 10 mV/V + 28 µV 15 mV/V + 20 µV 40 mV/V + 74 µV 40 mV/V + 83 µV 0.15 V/V + 0.11 mV	HP 3458A

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Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
AC Voltage - Measure	**100 mV to 1 V**		Keysight 3458A
	(1 to 40) Hz	70 µV/V + 41 µV	
	40 Hz to 1 kHz	70 µV/V + 21 µV	
	(1 to 20) kHz	0.14 mV/V + 22 µV	
	(20 to 50) kHz	0.30 mV/V + 22 µV	
	(50 to 100) kHz	0.80 mV/V + 22 µV	
	(100 to 300) kHz	3 mV/V + 0.12 mV	
	300 kHz to 1 MHz	10 mV/V + 0.30 mV	
	(1 to 2) MHz	15 mV/V + 0.21 mV	
	(2 to 4) MHz	40 mV/V + 0.73 mV	
	(4 to 8) MHz	40 mV/V + 0.83 mV	
	(8 to 10) MHz	0.15 V/V + 1 mV	
	(1 to 10) V		
	(1 to 40) Hz	70 µV/V + 0.42 mV	
	40 Hz to 1 kHz	70 µV/V + 0.22 mV	
	(1 to 20) kHz	0.14 mV/V + 0.24 mV	
	(20 to 50) kHz	0.3 mV/V + 0.25 mV	
	(50 to 100) kHz	0.8 mV/V + 0.22 mV	
	(100 to 300) kHz	3 mV/V + 1.1 mV	
	300 kHz to 1 MHz	10 mV/V + 1.1 mV	
	(1 to 2) MHz	15 mV/V + 1.1 mV	
	(2 to 4) MHz	40 mV/V + 7.1 mV	
	(4 to 8) MHz	40 mV/V + 8.1 mV	
	(8 to 10) MHz	0.15 mV/V + 11 mV	
	(10 to 100) V		
	(1 to 40) Hz	0.2 mV/V + 4.1 mV	
	40 Hz to 20 kHz	0.2 mV/V + 2.6 mV	
	(20 to 50) kHz	0.35 mV/V + 2.4 mV	
	(50 to 100) kHz	1.2 mV/V + 2.1 mV	
	(100 to 300) kHz	4 mV/V + 11 mV	
	300 kHz to 1 MHz	15 mV/V + 50 mV	
	(100 to 750) V		
	(1 to 40) Hz	0.4 mV/V + 31 mV	
	40 Hz to 1 kHz	0.4 mV/V + 16 mV	
	(1 to 20) kHz	0.6 mV/V + 16 mV	
	(20 to 50) kHz	1.2 mV/V + 16 mV	
	(50 to 100) kHz	3 mV/V + 15 mV	

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
AC Voltage - Measure	**Up to 1 mV** 0.02 Hz to 100 kHz 100 kHz to 1 MHz (1 to 3) MHz (3 to 10) MHz (10 to 20) MHz **(1 to 3) mV** 0.02 Hz to 100 kHz 100 kHz to 1 MHz (1 to 3) MHz (3 to 10) MHz (10 to 20) MHz **(3 to 10) mV** 0.02 Hz to 100 kHz 100 kHz to 1 MHz (1 to 3) MHz (3 to 10) MHz (10 to 20) MHz	6 mV/V + 90 nV 16 mV/V + 2 µV 30 mV/V + 9 µV 90 mV/V + 7 µV 0.22 V/V + 20 µV 6 mV/V + 30 nV 7 mV/V + 5 µV 33 mV/V + 10 µV 93 mV/V + 8 µV 0.24 V/V + 5 µV 6 mV/V + 10 nV 8 mV/V + 8 µV 16 mV/V + 20 µV 26 mV/V + 50 µV 65 mV/V + 90 µV	URE3
AC Current - Source	**Up to 220 µA** (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz **220 µA 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 **(2.2 to 22) mA** (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz **(22 to 220) mA** (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz **220 mA to 1 A** 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.16 mA/A + 63 nA 89 µA/A + 62 nA 60 µA/A + 62 nA 0.18 mA/A + 62 nA 0.1 mA/A + 90 nA 0.27 mA/A + 56 nA 0.2 mA/A + 51 nA 0.16 mA/A + 52 nA 0.23 mA/A + 0.12 µA 1.1 mA/A + 0.67 µA 0.27 mA/A + 0.56 µA 0.21 mA/A + 0.51 µA 0.16 mA/A + 0.52 µA 0.23 mA/A + 0.71 µA 1.1 mA + 5.1 µA 0.28 mA/A + 3.9 µA 0.21 mA/A + 3 µA 0.17 mA/A + 2.2 µA 0.24 A/A + 3.1 µA 1.1 mA/A + 10 µA 0.3 mA/A + 32 µA 0.44 mA/A + 83 µA 0.67 mA/A + 72 µA	Fluke 5720A

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
AC Current - Source	**(1 to 2.2) A** 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz **(2.2 to 11) A** 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz **10 A to 20 A** 45 Hz to 65 Hz 65 Hz to 440 Hz **20 A to 100 A** 45 Hz to 65 Hz 65 Hz to 440 Hz **200A to 1000A** 45 Hz to 65 Hz 65 Hz to 100 Hz 100 Hz to 440 Hz	 0.35 mA/A + 26 µA 0.55 mA/A + 72 µA 0.67 mA/A + 72 µA 0.4 mA/A + 0.13 mA 0.88 mA/A + 0.29 mA 3.1 mA/A + 0.64 mA 0.3% + 27 mA 0.88% - 1 mA 0.3% + 27 mA 0.85% + 28 mA 0.33% + 60 mA 0.86% + 90 mA 1% - 0.17 A	Fluke 5720A
AC Current - Source Fixed Values	**1 kHz** 10 uA 100 uA 1 mA 10 mA 100 mA 1 A	 5.1 pA 11 pA 110 pA 1 µA 11 µA 120 µA	Fluke 5700A or Fluke 5720A disciplined with Keysight 3458A
AC Current - Measure	**Up to 100 µA** (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz **100 µA to 1 mA** (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz **(1 to 10) mA** (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz **(10 to 100) mA** (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz **100 mA to 1.05 A** (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	 4 mA/A + 31 nA 1.5 mA/A + 31 nA 0.6 mA/A + 31 nA 4 mA/A + 0.31 µA 0.15 mA/A + 0.21 µA 0.6 mA/A + 0.21 µA 4 mA/A + 3.1 µA 1.5 mA/A + 2.1 µA 0.6 mA/A + 2.1 µA 4 mA/A + 31 µA 1.5 mA/A + 21 µA 0.6 mA/A + 21 µA 4 mA/A + 0.22 mA 1.6 mA/A + 0.22 mA 0.8 mA/A + 0.22 mA 1 mA/A + 0.22 mA	Keysight 3458A
Resistance - Source DC to 1 MHz, Direct Measurement	0.1 Ω (1, 10) Ω 100 Ω (1, 10, 100) kΩ	10 mΩ/Ω 1 mΩ/Ω 0.3 mΩ/Ω 0.3 mΩ/Ω	Agilent 16074A

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
Resistance Source, High Resistance	1 GΩ 10 GΩ 100 GΩ	0.23 MΩ 2.7 MΩ 24 MΩ	Agilent 16340A
Capacitance - Source **Direct Measure** 1 kHz	(1, 10, 100) pF (1, 10, 100) nF 1 µF	0.1 mF/F	Agilent 16380A, Agilent 16380C Standard Air Capacitor Set, BNC 4 Terminal Pair
Capacitance - Source **Algorithmic Derivation**	**1 pF** 1 MHz 2 MHz 3 MHz 4 MHz 5 MHz 10 MHz 13 MHz **(10, 100) pF** (1, 2) MHz 3 MHz 4 MHz 5 MHz 10 MHz 13 MHz **1 nF** 1 MHz 2 MHz 3 MHz 4 MHz 5 MHz 10 MHz 13 MHz	 50 µF/F 60 µF/F 1 mF/F 2 mF/F 3 mF/F 10 mF/F 15 mF/F 0.25 mF/F 3 mF/F 4 mF/F 6 mF/F 15 mF/F 20 mF/F 0.5 mF/F 0.6 mF/F 1 mF/F 1.5 mF/F 2 mF/F 5 mF/F 7 mF/F	
Capacitance - Source **Substitution Method** 120 Hz to 10 kHz 100 kHz	(0.01, 0.1, 1) µF (0.01, 0.1) µF 1 µF	0.25 mF/F 0.5 mF/F 1 mF/F	Agilent 16380A, Agilent 16380C Standard Air Capacitor Set, BNC 4 Terminal Pair
Capacitance - Source **Direct Measure** 10 Hz to 1 kHz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz	 (3.3 to 33) nF 330 nF to 110 µF (110 to 330) µF (3.3 to 11) µF	 4 mF/F 4 mF/F 4 mF/F 4 mF/F	

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
Electrical Simulation of Thermocouples	Type B 600 to 800) °C (800 to 1 000) °C (1 000 to 1 550) °C (1 550 to 1 820) °C Type C (0 to 150) °C (150 to 650) °C (650 to 1 000) °C (1 000 to 1800) °C (1 800 to 2316) °C Type E (-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 1000) °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 L (-200 to -100) °C (-100 to 800) °C (800 to 900) °C Type N (-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1 300) °C Type R (0 to 250) °C (250 to 400) °C (400 to 1 000) °C (1 000 to 1 767) °C Type S (0 to 250) °C (250 to 1 000) °C (1 000 to 1 400) °C (1 400 to 1 767) °C	0.47 °C 0.36 °C 0.32 °C 0.35 °C 0.32 °C 0.28 °C 0.33 °C 0.53°C 0.88 °C 0.53 °C 0.18 °C 0.16 °C 0.18 °C 0.23 °C 0.29 °C 0.18 °C 0.16 °C 0.19 °C 0.25 °C 0.35 °C 0.2 °C 0.18 °C 0.28 °C 0.42 °C 0.39 °C 0.28 °C 0.19 °C 0.42 °C 0.24 °C 0.21 °C 0.2 °C 0.29 °C 0.6 °C 0.37 °C 0.35 °C 0.42 °C 0.50 °C 0.38 °C 0.39 °C 0.49 °C	Fluke 5520A, Fluke 5522A

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
Electrical Simulation of Thermocouples	Type T (-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C Type U (-200 to 0) °C (0 to 600) °C	 0.66 °C 0.26 °C 0.18 °C 0.16 °C 0.59 °C 0.29 °C	Fluke 5520A, Fluke 5522A

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
Amplitude Modulation - Measure			HP 8902
rate: 50 Hz to 10 kHz, depth: 5 % to 99 %	**150 kHz to 10 MHz** (5 to 10) % (10 to 99) %	 0.025AM + 0.03 % 0.025AM + 0.14 %	
rate: 20 Hz to 10 kHz, depth: to 99 %	**150 kHz to 10 MHz** (5 to 10) % (10 to 99) %	 0.038AM + 0.03 % 0.038AM + 0.13 %	
rate: 50 Hz to 50 kHz, depth: 5 % to 99 %	**10 MHz to 1.3 GHz** (5 to 10) % (10 to 99) %	 0.012AM + 0.033 % 0.012AM + 0.17 %	
rate: 20 Hz to 100 kHz, depth: to 99 %	**10 MHz to 1.3 GHz** (5 to 10) % (10 to 99) %	 0.038AM + 0.03 % 0.037AM + 0.16 %	
rate: 50 Hz to 10 kHz, depth: 5 % to 99 %	**(1.3 to 26.5) GHz** (5 to 10) % (10 to 99) %	 0.019AM + 0.029 % 0.019AM + 0.14 %	with HP 11793A
rate: 20 Hz to 10 kHz, depth: to 99 %	**10 MHz to 26.5 GHz** (5 to 10) % (10 to 99) %	 0.038AM + 0.03 % 0.038AM + 0.11 %	
Frequency Modulation - Measure			HP 8902
rate: 20 Hz to 10 kHz, ≤40 kHz	**250 kHz to 10 MHz** (0 to 4) kHz $_{Peak}$ FM (4 to 40) kHz $_{Peak}$ FM	 0.024*FM* + 2.6 Hz $_{Peak}$ 0.024*FM* + 10 Hz $_{Peak}$	
rate: 50 Hz to 100 kHz, ≤400 kHz	**10 MHz to 1.3 GHz** (0 to 4) kHz $_{Peak}$ FM (4 to 40) kHz $_{Peak}$ FM (40 to 400) kHz $_{Peak}$ FM	 0.012*FM* + 2.6 Hz $_{Peak}$ 0.012*FM* + 12 Hz $_{Peak}$ 0.012*FM* + 110 Hz $_{Peak}$	
rate: 50 Hz to 100 kHz, ≤400 kHz	**(1.3 to 6.2) GHz** (0 to 4) kHz $_{Peak}$ FM (4 to 40) kHz $_{Peak}$ FM (40 to 400) kHz $_{Peak}$ FM	 0.0099*FM* + 10 Hz $_{Peak}$ 0.012*FM* + 12 Hz $_{Peak}$ 0.012*FM* + 100 Hz $_{Peak}$	
rate: 50 Hz to 100 kHz, ≤400 kHz	**(6.2 to 12.4) GHz** (0 to 4) kHz $_{Peak}$ FM (4 to 40) kHz $_{Peak}$ FM (40 to 400) kHz $_{Peak}$ FM	 0.0075*FM* + 24 Hz $_{Peak}$ 0.012*FM* + 12 Hz $_{Peak}$ 0.012*FM* + 85 Hz $_{Peak}$	

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
Frequency Modulation – Measure			HP 8902
rate: 50 Hz to 100 kHz, ≤400 kHz	**(12.4 to 18.6) GHz**		
	(0 to 4) kHz $_{Peak}$ FM	0.0049*FM* + 52 Hz $_{Peak}$	
	(4 to 40) kHz $_{Peak}$ FM	0.011*FM* + 36 Hz$_{Peak}$	
	(40 to 400) kHz $_{Peak}$ FM	0.012*FM* + 110 Hz$_{Peak}$	
rate: 50 Hz to 100 kHz, ≤400 kHz	**(18.6 to 26.5) GHz**		
	(0 to 4) kHz $_{Peak}$ FM	0.0035*FM* + 80 Hz$_{Peak}$	
	(4 to 40) kHz $_{Peak}$ FM	0.011*FM* + 46 Hz$_{Peak}$	
	(40 to 400) kHz $_{Peak}$ FM	0.012*FM* + 100 Hz$_{Peak}$	
rate: 20 Hz to 200 kHz, ≤400 kHz	**10 MHz to 1.3 GHz**		
	(0 to 4) kHz $_{Peak}$ FM	0.059FM + 2.8 Hz$_{Peak}$	
	(4 to 40) kHz $_{Peak}$ FM	0.059FM + 14 Hz$_{Peak}$	
	(40 to 400) kHz $_{Peak}$ FM	0.059FM + 120 Hz$_{Peak}$	
rate: 20 Hz to 200 kHz, ≤400 kHz	**(1.3 to 6.2) GHz**		
	(0 to 4) kHz $_{Peak}$ FM	0.058FM + 5.2 Hz $_{Peak}$	
	(4 to 40) kHz $_{Peak}$ FM	0.059FM + 14 Hz $_{Peak}$	
	(40 to 400) kHz $_{Peak}$ FM	0.059FM + 120 Hz $_{Peak}$	
rate: 20 Hz to 200 kHz, ≤400 kHz	**(6.2 to 12.4) GHz**		
	(0 to 4) kHz $_{Peak}$ FM	0.055FM + 15 Hz $_{Peak}$	
	(4 to 40) kHz $_{Peak}$ FM	0.059FM + 14 Hz $_{Peak}$	
	(40 to 400) kHz $_{Peak}$ FM	0.059FM + 120 Hz $_{Peak}$	
Frequency Modulation - Measure			HP 8902 with HP 11793A
rate: 20 Hz to 200 kHz, ≤400 kHz	**(12.4 to 18.6) GHz**		
	(0 to 4) kHz $_{Peak}$ FM	0.05FM + 37 Hz $_{Peak}$	
	(4 to 40) kHz $_{Peak}$ FM	0.059FM + 15 Hz $_{Peak}$	
	(40 to 400) kHz $_{Peak}$ FM	0.059FM + 120 Hz $_{Peak}$	
rate: 20 Hz to 200 kHz, ≤400 kHz	**(18.6 to 26.5) GHz**		
	(0 to 4) kHz $_{Peak}$ FM	0.045FM + 60 Hz $_{Peak}$	
	(4 to 40) kHz $_{Peak}$ FM	0.059FM + 16 Hz $_{Peak}$	
	(40 to 400) kHz $_{Peak}$ FM	0.059FM + 120 Hz $_{Peak}$	

DIGITAL MODULATION RF QUALITY		
PARAMETER/ EQUIPMENT	**MODULATION TYPES**	**FREQUENCY RANGE**
Digital Modulation RF Quality Measure – Carrier 2 MHz to 44 GHz	TETRA, PDC, NADC, PHS, EDGE, CDMA 200A/C, WCDMA, 3GPP, QPSK, BPSK, PI/4 DQPSK, 16QAM, 256QAM, DECT, PHP, GSM, 2FSK, 4FSK, GMSK, MSK, DQPSK, 8PSK, 32QAM FSK	2 MHz to 2.65 GHz using the VSA directly (2.65 to 44) GHz. The digitally modulated RF signal needs to be down-converted with an external Mixer and a Local Oscillator L.O. center frequency = (RF-150 MHz)

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
Error Vector Magnitude (EVM)	Mod Frequency Span: f ≤ 100kHz 100kHz ≤ f ≤ 1MHz f > 1MHz	 0.43 % 0.48 % 0.82 %	HP 89441A Vector Signal Analyzer
Phase Error	Mod Frequency Span: f ≤ 100kHz 100kHz ≤ f ≤ 1MHz f > 1MHz	 0.17 º rms 0.34 º rms 0.57 º rms	
Frequency Error	Mod Frequency 1 GHz 2 GHz 3 GHz 4 GHz 5 GHz 6 GHz	 0.063 % 0.068 % 0.079 % 0.099 % 0.33 % 0.39 %	
Modulation Accuracy (Rho)	Mod Frequency Span: f ≤ 100kHz 0.9999 ≤ ρ ≤ 1 0.9975 ≤ ρ< 0.9999 0.9936 ≤ ρ< 0.9975 0.99 ≤ ρ< 0.9936 0.978 ≤ ρ< 0.99 0.96 ≤ ρ< 0.978	 8.6 E-5 ρ 0.00043 ρ 0.00068 ρ 0.00084 ρ 0.0012 ρ 0.0016 ρ	
	Mod Frequency Span: 100 kHz ≤ f ≤ 1 MHz 0.9999 ≤ ρ≤ 1 0.9975 ≤ ρ< 0.9999 0.9936 ≤ ρ< 0.9975 0.99 ≤ ρ< 0.9936 0.978 ≤ ρ< 0.99 0.96 ≤ ρ< 0.978	 9.6 E-5 ρ 0.00048 ρ 0.00076 ρ 0.00094 ρ 0.0014 ρ 0.0018 ρ	
	Mod Frequency Span: f > 1MHz 0.9999 ≤ ρ ≤ 1 0.9975 ≤ ρ< 0.9999 0.9936 ≤ ρ< 0.9975 0.99 ≤ ρ< 0.9936 0.978 ≤ ρ< 0.99 0.96 ≤ ρ< 0.978	 1.6 E-4 ρ 0.00082 ρ 0.0013 ρ 0.0016 ρ 0.0024 ρ 0.0030 ρ	

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
Tuned RF Power - Absolute - Measure 2.5 MHz to 26.5 GHz	(-22 to +10) dBm (-42 to -22) dBm (-50 to -42) dBm (-60 to-50) dBm (-72 to -60) dBm (-80 to -72) dBm (-92 to -80) dBm (-102 to -92) dBm (-110 to -102) dBm (-120 to -110) dBm (-127 to -120) dBm	0.17 dB 0.18 dB 0.2 dB 0.21 dB 0.22 dB 0.23 dB 0.24 dB 0.27 dB 0.28 dB 0.31 dB 0.34 dB	HP 8902A with HP 11722A or with HP 11792A and HP 11793A
Tuned RF Power - Relative – Measure 2.5 MHz to 26.5 GHz	(+2 to +10) dBm (-12 to +2) dBm (-22 to -12) dBm (-31 to -22) dBm (-40 to -31) dBm (-50 to -40) dBm (-61 to -50) dBm (-71 to -61) dBm (-80 to -71) dBm (-90 to -80) dBm (-100 to -90) dBm (-110 to -100) dBm (-120 to -110) dBm (-127 to -120) dBm	0.08 dB 0.07 dB 0.08 dB 0.09 dB 0.1 dB 0.12 dB 0.15 dB 0.16 dB 0.17 dB 0.19 dB 0.22 dB 0.23 dB 0.27 dB 0.3 dB	HP 8902A with HP 11722A or with HP 11792A and HP 11793A
RF Power Sensors Cal Factors	10 MHz 30 MHz 50 MHz 100 MHz 300 MHz to 3 GHz 4 GHz 5 GHz (6 to 7) GHz 8 GHz 9 GHz 10 GHz 11 GHz 12 GHz 12.4 GHz (13 to 15) GHz 16 GHz 17 GHz 18 GHz (19 to 26) GHz 26.5 GHz 27 GHz (28 to 29) GHz 30 GHz (31 to 32) GHz 33 GHz	0.58 % 0.54% 0.41% 0.51% 0.6% 0.61% 0.67% 0.68% 0.7% 0.79% 0.82% 0.79% 0.76% 0.8% 0.79% 0.87% 0.91% 0.97% 1.5% 1.6% 1.7% 1.8% 1.7% 1.8% 1.7%	Keysight PNA-X 2.4, 3.5 mm Calibration Kits Reference Power Sensors

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
RF Power Sensors Cal Factors	(34 to 40) GHz 41 GHz (42 to 44) GHz (45 to 47) GHz (48 to 50) GHz	1.8% 2.4% 2.5% 2.6% 2.5%	Keysight PNA-X 2.4, 3.5 mm Calibration Kits Reference Power Sensors
RF Absolute Power - Source	0.02 V ≤ V < 7 V f < 10 MHz 10 MHz ≤ f ≤ 50 MHz 50 MHz ≤ f ≤ 80 MHz V ≤ 10mV 20 Hz ≤ f ≤ 20 kHz 20 kHz < f ≤ 50 kHz 50 kHz < f ≤ 100 kHz 100 kHz < f ≤ 300 kHz 10 mV < V ≤ 100 mV 20 Hz ≤ f ≤ 40 Hz 40 Hz ≤ f ≤ 1 kHz 1 kHz < f ≤ 20 kHz 20 kHz < f ≤ 50 kHz 50 kHz < f ≤ 100 kHz 100 kHz < f ≤ 300 kHz 100 mV < V ≤ 1 V 20 Hz ≤ f ≤ 1 kHz 1 kHz < f ≤ 20 kHz 20 kHz < f ≤ 50 kHz 50 kHz < f ≤ 100 kHz 100 kHz < f ≤ 300 kHz 1 V < V ≤ 3.5 V 20 Hz ≤ f ≤ 40 Hz 40 Hz ≤ f ≤ 1 kHz 1 kHz < f ≤ 20 kHz 20 kHz < f ≤ 50 kHz 50 kHz < f ≤ 100 kHz 100 kHz < f ≤ 300 kHz	 0.082 dB 0.16 dB 0.4 dB 0.017 mV 0.021 mV 0.050 mV 0.38 mV 0.029 mV 0.028 mV 0.032 mV 0.045 mV 0.08 mV 0.30 mV 0.7 mV 0.72 mV 0.79 mV 1.3 mV 3.7 mV 2.2 mV 2.1 mV 2.2 mV 2.5 mV 4.0 mV 13 mV	Function Generator and DVM Agilent 33250A, Agilent 33120A, Agilent 3458A
RF Absolute Power - Source	7dBm ≥ P ≥ 0 dBm 0.3 MHz ≤ f ≤ 1.1 GHz 1.1 GHz ≤ f ≤ 2.985 GHz 2.985 GHz < f ≤ 4 GHz 4 GHz < f ≤ 6 GHz 0 dBm > P ≥ -25 dBm 0.3 MHz ≤ f ≤ 1.1 GHz 1.1 GHz ≤ f ≤ 2.985 GHz 2.985 GHz < f ≤ 4 GHz 4 GHz < f ≤ 6 GHz -25 dBm > P ≥ -70 dBm 0.3 MHz ≤ f ≤ 1.1 GHz 1.1 GHz ≤ f ≤ 2.985 GHz 2.985 GHz < f ≤ 4 GHz 4 GHz < f ≤ 6 GHz	 0.49 dB 0.58 dB 0.69 dB 0.79 dB 0.49 dB 0.59 dB 0.69 dB 0.8 dB 0.50 dB 0.59 dB 0.69 dB 0.8 dB	Signal Source PSG, ESG

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
RF Absolute Power - Source	-70 dBm > P ≥ -95 dBm 0.3 MHz ≤ f ≤ 1.1 GHz 1.1 GHz ≤ f ≤ 2.985 GHz 2.985 GHz < f ≤ 4 GHz 4 GHz < f ≤ 6 GHz -95 dBm > P ≥ -125 dBm 0.3 MHz ≤ f ≤ 1.1 GHz 1.1 GHz ≤ f ≤ 2.985 GHz 2.985 GHz < f ≤ 4 GHz 4 GHz < f ≤ 6 GHz	 0.5 dB 0.6 dB 0.7 dB 0.8 dB 0.51 dB 0.6 dB 0.7 dB 1.5 dB	Signal Source PSG, ESG
Pulse - Measure RMS Jitter - Period, Delay and Width	33 MHz to 3 GHz	6.6 pS	HP 54124T or HP 86100 with 86107A
Attenuation - Source Coaxial, 1 dB Steps (0 to 11) dB	0 dB 50 MHz to 2 GHz (2 to 4) GHz 1 dB 50 MHz to 2 GHz (2 to 4) GHz 2 dB 50 MHz to 2 GHz (2 to 4) GHz 3 dB 50 MHz to 2 GHz (2 to 4) GHz 4 dB 50 MHz to 2 GHz (2 to 4) GHz 5 dB 50 MHz to 2 GHz (2 to 4) GHz 6 dB 50 MHz to 2 GHz (2 to 4) GHz 7 dB 50 MHz to 2 GHz (2 to 4) GHz 8 dB 50 MHz to 2 GHz (2 to 4) GHz 9 dB 50 MHz to 2 GHz (2 to 4) GHz 10 dB 50 MHz to 2 GHz (2 to 4) GHz 11 dB 50 MHz to 2 GHz (2 to 4) GHz	 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB	HP 8496G w/ Type-N(f)

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
Attenuation – Source Coaxial, 10 dB Steps	0 dB 50 MHz to 2 GHz (2 to 4) GHz 10 dB 50 MHz to 2 GHz (2 to 4) GHz 20 dB 50 MHz to 2 GHz (2 to 4) GHz 30 dB 50 MHz to 2 GHz (2 to 4) GHz 40 dB 50 MHz to 2 GHz (2 to 4) GHz 50 dB 50 MHz to 2 GHz (2 to 4) GHz 60 dB 50 MHz to 2 GHz (2 to 4) GHz 70 dB 50 MHz to 2 GHz (2 to 4) GHz 80 dB 50 MHz to 2 GHz (2 to 4) GHz 90 dB 50 MHz to 2 GHz (2 to 4) GHz 100 dB 50 MHz to 2 GHz (2 to 4) GHz 110 dB 50 MHz to 2 GHz (2 to 4) GHz	 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.03 dB 0.04 dB 0.04 dB 0.06 dB 0.05 dB 0.06 dB 0.06 dB 0.07 dB 0.06 dB 0.07 dB 0.06 dB 0.09 dB 0.07 dB 0.09 dB 0.08 dB 0.1 dB 0.08 dB 0.11 dB 0.08 dB	HP 8496G With Type-N(f)
Attenuation - Source Coaxial, Fixed	3 dB DC to 2 GHz, SWR < 1.25:1 (2 to 4) GHz, SWR < 1.2:1 (4 to 18) GHz, SWR < 1.2:1	 0.03 dB 0.03 dB 0.06 dB	HP 8491A/B With Type-N

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
Attenuation - Source Coaxial, Fixed	6 dB DC to 2 GHz, SWR < 1.25:1	0.03 dB	HP 8491A/B With Type-N
	(2 to 4) GHz, SWR < 1.2:1	0.03 dB	
	(4 to 18) GHz, SWR < 1.2:1	0.06 dB	
	10 dB DC to 2 GHz, SWR < 1.25:1	0.03 dB	
	(2 to 4) GHz, SWR < 1.2:1	0.03 dB	
	(4 to 18) GHz, SWR < 1.2:1	0.06 dB	
	20 dB DC to 2 GHz, SWR < 1.25:1	0.03 dB	
	(2 to 4) GHz, SWR < 1.2:1	0.03 dB	
	(4 to 18) GHz, SWR < 1.2:1	0.06 dB	

PARAMETER	(S11 - Reflection) Magnitude Uncertainty (lin)									
REFERENCE STANDARD OR EQUIPMENT	85054B, 85031B, ET33700, 85056A, 85058B									
Frequency Range	Measured Magnitude (+/- Linear)									
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
20 MHz to 2 GHz	0.00054	0.00062	0.0007	0.00081	0.00093	0.0011	0.0012	0.0014	0.0016	0.0017
(2 to 8) GHz	0.00078	0.00082	0.00089	0.00098	0.0011	0.0012	0.0014	0.0015	0.0017	0.0019
(8 to 20) GHz	0.0014	0.0014	0.0015	0.0015	0.0016	0.0017	0.0018	0.002	0.0023	0.0026
(20 to 26.5) GHz	0.0019	0.0019	0.0019	0.002	0.002	0.0021	0.0023	0.0025	0.0027	0.0031
(26.5 to 40) GHz	0.0039	0.0041	0.0044	0.0049	0.0056	0.0066	0.0077	0.0091	0.011	0.012
(40 to 50) GHz	0.0052	0.0054	0.0058	0.0063	0.007	0.0081	0.0095	0.011	0.013	0.015

PARAMETER	(S11 - Reflection) Phase Uncertainty (deg)									
REFERENCE STANDARD OR EQUIPMENT	85054B, 85031B, ET33700, 85056A, 85058B									
Frequency Range	Measured Magnitude (+/- Degrees)									
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
20 MHz to 2 GHz	0.31	0.17	0.13	0.11	0.1	0.1	0.098	0.098	0.1	0.1
(2 to 8) GHz	0.45	0.24	0.17	0.14	0.12	0.12	0.11	0.11	0.11	0.11
(8 to 20) GHz	0.81	0.42	0.29	0.23	0.19	0.16	0.15	0.14	0.13	0.13
(20 to 26.5) GHz	1.1	0.55	0.38	0.29	0.24	0.2	0.18	0.17	0.17	0.17
(26.5 to 40) GHz	2.3	1.3	1	0.93	0.9	0.91	0.93	0.94	0.96	0.99
(40 to 50) GHz	3.1	1.7	1.3	1.2	1.1	1.1	1.1	1.2	1.2	1.2

PARAMETER	(S21 - Transmission) Magnitude Uncertainty (dB)								
REFERENCE STANDARD OR EQUIPMENT	85054B, 85031B, ET33700, 85056A, 85058B								
Frequency Range	Measured Magnitude (+/- Linear)								
	0	3	6	10	20	30	40	50	60
20 MHz to 45 MHz	0.018	0.021	0.023	0.027	0.026	0.027	0.029	0.032	0.065
(45 to 130) MHz	0.016	0.015	0.015	0.017	0.02	0.03	0.052	0.074	0.13
130 MHz to 1.25 GHz	0.031	0.034	0.034	0.034	0.034	0.034	0.035	0.044	0.093
(1.25 to 4) GHZ	0.031	0.034	0.034	0.034	0.034	0.034	0.034	0.035	0.044
(4 to 5) GHz	0.032	0.035	0.035	0.035	0.035	0.035	0.035	0.036	0.045
(5 to 26.5) GHz	0.034	0.036	0.036	0.036	0.036	0.036	0.037	0.037	0.038
(26.5 to 40) GHz	0.037	0.039	0.039	0.039	0.039	0.039	0.04	0.04	0.048
(40 to 50) GHz	0.04	0.043	0.043	0.043	0.043	0.043	0.043	0.044	0.051

PARAMETER	(S21 - Transmission) Phase Uncertainty (deg)								
REFERENCE STANDARD OR EQUIPMENT	85054B, 85031B, ET33700, 85056A, 85058B								
Frequency Range	Measured Magnitude (+/- Degrees)								
	0	3	6	10	20	30	40	50	60
20 MHz to 45 MHz	0.62	0.62	0.62	0.62	0.23	0.23	0.23	0.23	0.58
(45 to 130) MHz	0.16	0.16	0.16	0.17	0.19	0.26	0.66	0.6	0.92
130 MHz to 1.25 GHz	0.37	0.37	0.37	0.37	0.38	0.38	0.38	0.41	0.68
(1.25 to 4) GHZ	0.42	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.46
(4.0 to 5) GHz	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.53
(5 to 26.5) GHz	0.89	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
(26.5 to 40) GHz	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
(40 to 50) GHz	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4

PARAMETER	RF Absolute Power Measure										
REFERENCE STANDARD OR EQUIPMENT	8482A, 8485A, 8487A, V8486A, N8481B, N8482B, N9030A, E444xA, E9300A, E9304A, N8485A										
	Frequency Ranges (uncertainties in dB)										
Frequency Range	9 KHz ≤ f < 100 KHz	100 KHz ≤ f < 10 MHz	10 MHz ≤ f < 30 MHz	30 MHz ≤ f < 500 MHz	500 MHz ≤ f < 1.2 GHz	1.2 GHz ≤ f < 2 GHz	2 GHz ≤ f < 6 GHz	6 GHz ≤ f < 8 GHz	8 GHz ≤ f < 12.4 GHz	12.4 GHz ≤ f < 14 GHz	14 GHz ≤ f < 18 GHz
-140 dBm ≤ P < -130 dBm	0.15	0.15	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
-130 dBm ≤ P < -110 dBm	0.13	0.13	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
-110 dBm ≤ P < -90 dBm	0.12	0.12	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07
-90 dBm ≤ P < -30 dBm	0.12	0.12	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06
-30 dBm ≤ P < -20 dBm	0.11	0.11	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05
-20 dBm ≤ P < -10 dBm	0.11	0.09	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05
-10 dBm ≤ P < 0 dBm	0.11	0.08	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
-1 dBm ≤ P < 2 dBm	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05
2 dBm ≤ P < 10 dBm	0.1	0.08	0.06	0.06	0.06	0.09	0.09	0.09	0.09	0.09	0.1
10 dBm ≤ P < 15 dBm	0.1	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
15 dBm ≤ P < 20 dBm	0.1	0.1	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
20 dBm ≤ P < 30 dBm	0.16	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.11	0.12	0.12
30 dBm ≤ P < 35 dBm		0.08	0.08	0.08	0.08	0.1	0.1	0.1	0.11	0.12	0.12
35 dBm ≤ P < 44 dBm		0.09	0.08	0.08	0.08	0.09	0.09	0.1	0.1	0.1	0.11

PARAMETER	RF Absolute Power Measure										
REFERENCE STANDARD OR EQUIPMENT	8482A, 8485A, 8487A, V8486A, N8481B, N8482B, N9030A, E444xA, E9300A, E9304A, N8485A										
	Frequencies / Frequency Ranges (uncertainties in dB)										
Frequency Range	18 GHz ≤ f ≤ 26.5 GHz	26.5 GHz ≤ f ≤ 33 GHz	33 GHz ≤ f < 40 GHz	40 GHz ≤ f < 45 GHz	45 GHz ≤ f ≤ 50 GHz	f = 51 GHz	52 GHz ≤ f ≤ 54 GHz	f = 55 GHz	56 GHz ≤ f ≤ 59 GHz	f = 60 GHz	f = 61 GHz
-140 dBm ≤ P < -130 dBm	0.1	0.1	0.1	0.12	0.12						
-130 dBm ≤ P < -110 dBm	0.1	0.09	0.09	0.09	0.09						
-110 dBm ≤ P < -90 dBm	0.08	0.08	0.08	0.08	0.08						
-90 dBm ≤ P < -30 dBm	0.07	0.06	0.06	0.06	0.06						
-30 dBm ≤ P < -20 dBm	0.07	0.05	0.05	0.06	0.06	0.34	0.33	0.29	0.34	0.3	0.34
-20 dBm ≤ P < -10 dBm	0.07	0.05	0.05	0.06	0.06	0.34	0.33	0.29	0.34	0.3	0.34
-10 dBm ≤ P < 0 dBm	0.07	0.06	0.06	0.06	0.06	0.34	0.33	0.29	0.34	0.3	0.34
-1 dBm ≤ P < 2 dBm	0.07	0.05	0.05	0.06	0.06	0.34	0.33	0.29	0.34	0.3	0.34
2 dBm ≤ P < 10 dBm	0.13	0.15	0.15	0.21	0.23	0.34	0.33	0.29	0.34	0.3	0.34
10 dBm ≤ P < 15 dBm	0.07	0.06	0.06	0.06	0.06	0.34	0.34	0.3	0.34	0.3	0.35
15 dBm ≤ P < 20 dBm	0.08	0.07	0.07	0.07	0.07	0.34	0.34	0.3	0.34	0.3	0.35
20 dBm ≤ P < 30 dBm	0.172										

PARAMETER	RF Absolute Power Measure				
REFERENCE STANDARD OR EQUIPMENT	8482A, 8485A, 8487A, V8486A, N8481B, N8482B, N9030A, E444xA, E9300A, E9304A, N8485A				
	Frequencies / Frequency Ranges (uncertainties in dB)				
Frequency Range	f = 62 GHz	63 GHz ≤ f ≤ 64 GHz	f = 65 GHz	f = 66 GHz	f = 67 GHz
-30 dBm ≤ P < -20 dBm	0.34	0.33	0.29	0.35	0.36
-20 dBm ≤ P < -10 dBm	0.34	0.33	0.29	0.35	0.36
-10 dBm ≤ P < 0 dBm	0.34	0.33	0.29	0.35	0.36
-1 dBm ≤ P < 2 dBm	0.34	0.33	0.29	0.35	0.36
2 dBm ≤ P < 10 dBm	0.34	0.33	0.29	0.35	0.36
10 dBm ≤ P < 15 dBm	0.34	0.34	0.2	0.36	0.36
15 dBm ≤ P < 20 dBm	0.34	0.34	0.2	0.36	0.36

Time & Frequency

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (±)]	Reference Standard or Equipment
Frequency - Source	5 MHz, 10 MHz	50 pHz/Hz	Datum 8040
Frequency - Measure	1 Hz to 40 GHz	50 pHz/Hz	HP 53132A, HP 5352B

Notes:

1. ***Calibration and Measurement Capabilities (CMC) (Expanded Uncertainties) are based on approximately a 95% confidence interval, using a coverage of k=2.***
2. ***This scope is formatted as part of a single document including the Certificate of Accreditation No. AC-1498.09.***

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