



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 Center

3457 Apex Peakway

Apex NC 27502

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

ISO/IEC 17025:2005

and national standards

ANSI/NCSL Z540-1-1994 (R2002) and

ANSI/NCSL Z540.3-2006 (R2013)

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-1498.15

Certificate Number



ANAB Approval

Certificate Valid: 08/08/2017-11/16/2018
Version No. 001 Issued: 08/08/2017



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

Keysight Technologies, Inc. Service Center

3457 Apex Peakway
Apex, NC 27502
Scott Bray 954-723-8123

CALIBRATION

Valid to: November 16, 2018

Certificate Number: AC-1498.15

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/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 μ V/V + 0.5 μ V 5 μ V/V + 0.8 μ V 3 μ V/V + 4 μ V 4 μ V/V + 5 μ V 5 μ V/V + 20 μ V 7 μ V/V + 0.3 mV	Fluke 5720A or 5730A with Fluke 5725A
DC Voltage - Source Fixed Values	100 mV 1 V 10 V	0.75 μ V 4.1 μ V 37 μ V	Fluke 5700A or Fluke 5720A disciplined with HP 3458A
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 μ V/V + 1.5 μ V 5.2 μ V/V + 1.2 μ V 4.7 μ V/V + 2.5 μ V 6.6 μ V/V + 45 μ V 19 μ V/V + 0.16 mV	HP 3458A/100 PLC Option 002
DC Current - Source	Up to 220 μ A 220 μ A to 2.2 mA (2.2 to 22) mA (22 to 100) mA (100 to 220) mA	36 μ A/A + 9 nA 33 μ A/A + 8 nA 34 μ A/A + 40 nA 42 μ A/A + 0.68 μ A 51 μ A/A	Fluke 5720A
	220 mA to 1 A (1 to 2.2) A (2.2 to 11) A	76 μ A/A + 12 μ A 1.5 mA/A + 66 μ A 0.30 mA/A + 0.40 mA	Fluke 5720A with Fluke 5725A
	100 μ A	1.6 nA	Fluke 5700A/5720A disciplined with HP 3458A



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current - Measure	(10 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1.1 A	20 μ A/A 20 μ A/A + 0.10 μ A 20 μ A/A + 60 nA 35 μ A/A + 0.60 μ A 0.11 mA/A + 11 μ A	HP 3458A
DC Dissipated Power - 300 mA to Full Power	Shunt 15 A 100 m Ω , 25 W	0.14 m Ω / Ω	Guildline 9230-15
	Shunt 100A 10 m Ω , 100 W	0.14 m Ω / Ω	Guildline 9230-100
	Shunt 300A 10 m Ω , 90 W	0.12 m Ω / Ω	Guildline 9230-300
Resistance - Source Fixed Points	0 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 k Ω 1.9 k Ω 10 k Ω 19 k Ω 100 k Ω 190 k Ω 1 M Ω 1.9 M Ω 10 M Ω 19 M Ω 100 M Ω	0.25 m Ω 0.27 m Ω 0.31 m Ω 0.34 m Ω 2.5 m Ω 2.7 m Ω 3.3 m Ω 9.3 m Ω 31 m Ω 93 m Ω 0.19 Ω 1.2 Ω 2.2 Ω 20 Ω 42 Ω 0.40 k Ω 1.5 k Ω 12 k Ω	Fluke 5720A
	10 Ω 100 Ω 1 k Ω 10 k Ω 100 k Ω 1 M Ω 10 M Ω 100 M Ω	0.17 m Ω 1.3 m Ω 7 m Ω 70 m Ω 0.69 Ω 10 Ω 0.27 k Ω 7.3 k Ω	Fluke 5700A/5720A disciplined with HP 3458A



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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
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 0.10 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



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
	(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
	(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	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	Fluke 5700A or Fluke 5720A disciplined with HP 3458A
AC Voltage - Source	(220 to 750) V (30 to 50) kHz (50 to 100) kHz	0.52 mV/V + 8.6 mV 1.9 mV/V + 37 mV	Fluke 5700A or Fluke 5720A disciplined with HP 3458A
AC Voltage - Source Fixed Values, Fixed Frequencies	0.01 V 1 kHz 20 kHz 100 kHz 300 kHz 0.1 V 1 kHz 20 kHz 100 kHz 300 kHz 1 V 1 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz	2.7 μV 2.8 μV 3.6 μV 4.6 μV 4.6 μV 4.6 μV 17 μV 22 μV 37 μV 37 μV 42 μV 65 μV 0.14 mV 0.24 mV 0.66 mV	Fluke 5700A or Fluke 5720A disciplined with HP 3458A



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Source Fixed Values, Fixed Frequencies	10 V 10 Hz 20 Hz 40 Hz 200 Hz 500 Hz	0.67 mV 0.60 mV 0.42 mV 0.42 mV 0.42 mV	Fluke 5700A or Fluke 5720A disciplined with HP 3458A
AC Voltage Flatness - Source	300 μ V to 3.5 V (10 to 30) Hz 30 Hz to 120 kHz 300 μ V to 1.1 mV 120 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz 1.1 μ V to 3 mV 120 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz 3 mV to 3.5 V 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 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 - Source Fixed Points	0.1 V at 1 MHz 1 V at 1 MHz	94 μ V 0.73 mV	Fluke 5700A or Fluke 5720A disciplined with HP 3458A
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	0.20 mV/V + 6.9 μ V 80 μ V/V + 5.5 μ V 80 μ V/V + 3.2 μ V 0.10 mV/V + 8 μ V 0.10 mV/V + 5.2 μ V 0.10 mV/V + 6.5 μ V 1.3 mV/V + 59 μ V 1.3 mV/V + 0.11 mV 1.3 mV/V + 91 μ V 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



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Measure	Up to 10 mV		HP 3458A
	(1 to 40) Hz	0.30 mV/V + 3.1 μ V	
	40 Hz to 1 kHz	0.20 mV/V + 1.2 μ V	
	(1 to 20) kHz	0.30 mV/V + 1.7 μ V	
	(20 to 50) kHz	1 mV/V + 1.6 μ V	
	(50 to 100) kHz	5 mV/V + 1.3 μ V	
	(100 to 300) kHz	40 mV/V + 2.1 μ V	
	300 kHz to 1 MHz	12 mV/V + 6.6 μ V	
	(1 to 4) MHz	70 mV/V + 7.5 μ V	
	(4 to 8) MHz	20 mV/V + 8.2 μ V	
	(10 to 100) mV		
	(1 to 40) Hz	70 μ V/V + 4.1 μ V	
	40 Hz to 1 kHz	70 μ V/V + 2.1 μ V	
	(1 to 20) kHz	0.14 mV/V + 2.3 μ V	
	(20 to 50) kHz	0.30 V/V + 2.6 μ V	
	(50 to 100) kHz	0.80 mV/V + 2.3 μ V	
	(100 to 300) kHz	3 mV/V + 15 μ V	
	300 kHz to 1 MHz	10 mV/V + 28 μ V	
	(1 to 2) MHz	15 mV/V + 20 μ V	
	(2 to 4) MHz	40 mV/V + 74 μ V	
	(4 to 8) MHz	40 mV/V + 83 μ V	
	(8 to 10) MHz	0.15 V/V + 0.11 mV	
	100 mV to 1 V		
	(1 to 40) Hz	70 μ V/V + 41 μ V	
	40 Hz to 1 kHz	70 μ V/V + 21 μ V	
	(1 to 20) kHz	0.14 mV/V + 22 μ V	
	(20 to 50) kHz	0.30 mV/V + 22 μ V	
	(50 to 100) kHz	0.80 mV/V + 22 μ V	
	(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		



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Measure	(1 to 10) V		HP 3458A
	(1 to 40) Hz	70 μ V/V + 0.42 mV	
	40 Hz to 1 kHz	70 μ V/V + 0.22 mV	
	(1 to 20) kHz	0.14 mV/V + 0.24 mV	
	(20 to 50) kHz	0.30 mV/V + 0.25 mV	
	(50 to 100) kHz	0.80 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	0.20 mV/V + 4.1 mV	
	40 Hz to 20 kHz	0.20 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	0.40 mV/V + 31 mV		
40 Hz to 1 kHz	0.40 mV/V + 16 mV		
(1 to 20) kHz	0.60 mV/V + 16 mV		
(20 to 50) kHz	1.2 mV/V + 16 mV		
(50 to 100) kHz	3 mV/V + 15 mV		
AC Voltage - Measure	Up to 1 mV		URE3
	0.02 Hz to 100 kHz	6 mV/V + 90 nV	
	100 kHz to 1 MHz	16 mV/V + 2 μ V	
	(1 to 3) MHz	30 mV/V + 9 μ V	
	(3 to 10) MHz	90 mV/V + 7 μ V	
	(10 to 20) MHz	0.22 V/V + 20 μ V	
	(1 to 3) mV		
	0.02 Hz to 100 kHz	6 mV/V + 30 nV	
	100 kHz to 1 MHz	7 mV/V + 5 μ V	
	(1 to 3) MHz	33 mV/V + 10 μ V	
	(3 to 10) MHz	93 mV/V + 8 μ V	
	(10 to 20) MHz	0.24 V/V + 5 μ V	



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Measure	(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 + 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 (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	0.16 mA/A + 63 nA 89 μA/A + 62 nA 60 μA/A + 62 nA 0.18 mA/A + 62 nA 0.10 mA/A + 90 nA 0.27 mA/A + 56 nA 0.20 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 mA/A + 3.1 μA 1.1 mA/A + 10 μA 0.30 mA/A + 32 μA 0.44 mA/A + 83 μA 0.67 mA/A + 72 μA 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	Fluke 5720A



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 uA 11 uA 120 uA	Fluke 5700A or Fluke 5720A disciplined with HP 3458A
AC Current - Measure	Up to 100 uA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz 100 uA 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 0.60 mA/A + 31 nA 4 mA/A + 0.31 uA 0.15 mA/A + 0.21 uA 0.60 mA/A + 0.21 uA 4 mA/A + 3.1 uA 1.5 mA/A + 2.1 uA 0.60 mA/A + 2.1 uA 4 mA/A + 31 uA 1.5 mA/A + 21 uA 0.60 mA/A + 21 uA 4 mA/A + 0.22 mA 1.6 mA/A + 0.22 mA 0.80 mA/A + 0.22 mA 1 mA/A + 0.22 mA	HP 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 0.30 mΩ/Ω 0.30 mΩ/Ω	Agilent 16074A
Capacitance - Source Direct Measure 1 kHz	(1, 10, 100) pF (1, 10, 100) nF 1 uF	0.10 mF/F	Agilent 16380A, Agilent 16380C Standard Air Capacitor Set, BNC 4 Terminal Pair

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance - Source Algorithmic Derivation	1 pF		Agilent 16380A, Agilent 16380C Standard Air Capacitor Set, BNC 4 Terminal Pair
	1 MHz	50 μ F/F	
	2 MHz	60 μ F/F	
	3 MHz	1 mF/F	
	4 MHz	2 mF/F	
	5 MHz	3 mF/F	
	10 MHz	10 mF/F	
	13 MHz	15 mF/F	
	(10, 100) pF		
	(1, 2) MHz	0.25 mF/F	
	3 MHz	3 mF/F	
	4 MHz	4 mF/F	
	5 MHz	6 mF/F	
	10 MHz	15 mF/F	
	13 MHz	20 mF/F	
1 nF	1 MHz	0.50 mF/F	
	2 MHz	0.60 mF/F	
	3 MHz	1 mF/F	
	4 MHz	1.5 mF/F	
	5 MHz	2 mF/F	
	10 MHz	5 mF/F	
	13 MHz	7 mF/F	
	Capacitance - Source Substitution Method 120 Hz to 10 kHz 100 kHz	(0.01, 0.1, 1) μ F	0.25 mF/F
(0.01, 0.1) μ F		0.50 mF/F	
1 μ F		1 mF/F	
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	4 mF/F	
	330 nF to 110 μ F	4 mF/F	
	(110 to 330) μ F	4 mF/F	
	(3.3 to 11) μ F	4 mF/F	



Electromagnetic - RF/Microwave

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (\pm)]	Reference Standard or Equipment
Amplitude Modulation - Measure 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 %	HP 8902
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 rate: 20 Hz to 10 kHz, \leq 40 kHz	250 kHz to 10 MHz (0 to 4) kHz _{Peak} FM (4 to 40) kHz _{Peak} FM	0.024FM + 2.6 Hz _{Peak} 0.024FM + 10 Hz _{Peak}	
rate: 50 Hz to 100 kHz, \leq 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	0.012FM + 2.6 Hz _{Peak} 0.012FM + 12 Hz _{Peak} 0.012FM + 110 Hz _{Peak}	
rate: 50 Hz to 100 kHz, \leq 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	0.009 9FM + 10 Hz _{Peak} 0.012FM + 12 Hz _{Peak} 0.012FM + 100 Hz _{Peak}	HP 8902
rate: 50 Hz to 100 kHz, \leq 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	0.007 5FM + 24 Hz _{Peak} 0.012FM + 12 Hz _{Peak} 0.012FM + 85 Hz _{Peak}	
rate: 50 Hz to 100 kHz, \leq 400 kHz	(12.4 to 18.6) GHz (0 to 4) kHz _{Peak} FM (4 to 40) kHz _{Peak} FM (40 to 400) kHz _{Peak} FM	0.004 9FM + 52 Hz _{Peak} 0.011FM + 36 Hz _{Peak} 0.012FM + 110 Hz _{Peak}	



Electromagnetic - RF/Microwave

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (\pm)]	Reference Standard or Equipment
Frequency Modulation - Measure rate: 50 Hz to 100 kHz, ≤ 400 kHz rate: 20 Hz to 200 kHz, ≤ 400 kHz rate: 20 Hz to 200 kHz, ≤ 400 kHz rate: 20 Hz to 200 kHz, ≤ 400 kHz	(18.6 to 26.5) GHz (0 to 4) kHz _{Peak} FM (4 to 40) kHz _{Peak} FM (40 to 400) kHz _{Peak} FM 10 MHz to 1.3 GHz (0 to 4) kHz _{Peak} FM (4 to 40) kHz _{Peak} FM (40 to 400) kHz _{Peak} FM (1.3 to 6.2) GHz (0 to 4) kHz _{Peak} FM (4 to 40) kHz _{Peak} FM (40 to 400) kHz _{Peak} FM (6.2 to 12.4) GHz (0 to 4) kHz _{Peak} FM (4 to 40) kHz _{Peak} FM (40 to 400) kHz _{Peak} FM	0.003 5FM + 80 Hz _{Peak} 0.011FM + 46 Hz _{Peak} 0.012FM + 100 Hz _{Peak} 0.059FM + 2.8 Hz _{Peak} 0.059FM + 14 Hz _{Peak} 0.059FM + 120 Hz _{Peak} 0.058FM + 5.2 Hz _{Peak} 0.059FM + 14 Hz _{Peak} 0.059FM + 120 Hz _{Peak} 0.055FM + 15 Hz _{Peak} 0.059FM + 14 Hz _{Peak} 0.059FM + 120 Hz _{Peak}	HP 8902
Frequency Modulation - Measure rate: 20 Hz to 200 kHz, ≤ 400 kHz rate: 20 Hz to 200 kHz, ≤ 400 kHz	(12.4 to 18.6) GHz (0 to 4) kHz _{Peak} FM (4 to 40) kHz _{Peak} FM (40 to 400) kHz _{Peak} FM (18.6 to 26.5) GHz (0 to 4) kHz _{Peak} FM (4 to 40) kHz _{Peak} FM (40 to 400) kHz _{Peak} FM	0.05FM + 37 Hz _{Peak} 0.059FM + 15 Hz _{Peak} 0.059FM + 120 Hz _{Peak} 0.045FM + 60 Hz _{Peak} 0.059FM + 16 Hz _{Peak} 0.059FM + 120 Hz _{Peak}	HP 8902 with HP 11793A

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)



Electromagnetic - RF/Microwave

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (\pm)]	Reference Standard or Equipment
Error Vector Magnitude (EVM)	Mod Frequency Span: $f \leq 100\text{kHz}$ $100\text{kHz} \leq f \leq 1\text{MHz}$ $f > 1\text{MHz}$	0.43 % 0.48 % 0.82 %	HP 89441A Vector Signal Analyzer
Phase Error	Mod Frequency Span: $f \leq 100\text{kHz}$ $100\text{kHz} \leq f \leq 1\text{MHz}$ $f > 1\text{MHz}$	0.17 ° rms 0.34 ° rms 0.57 ° 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: $f \leq 100\text{kHz}$ $0.9999 \leq \rho \leq 1$ $0.9975 \leq \rho < 0.9999$ $0.9936 \leq \rho < 0.9975$ $0.99 \leq \rho < 0.9936$ $0.978 \leq \rho < 0.99$ $0.96 \leq \rho < 0.978$	$8.6 \text{E-5 } \rho$ 0.00043 ρ 0.00068 ρ 0.00084 ρ 0.0012 ρ 0.0016 ρ	HP 89441A Vector Signal Analyzer
	Mod Frequency Span: $100 \text{kHz} \leq f \leq 1 \text{MHz}$ $0.9999 \leq \rho \leq 1$ $0.9975 \leq \rho < 0.9999$ $0.9936 \leq \rho < 0.9975$ $0.99 \leq \rho < 0.9936$ $0.978 \leq \rho < 0.99$ $0.96 \leq \rho < 0.978$	$9.6 \text{E-5 } \rho$ 0.00048 ρ 0.00076 ρ 0.00094 ρ 0.0014 ρ 0.0018 ρ	
Modulation Accuracy (Rho)	Mod Frequency Span: $f > 1\text{MHz}$ $0.9999 \leq \rho \leq 1$ $0.9975 \leq \rho < 0.9999$ $0.9936 \leq \rho < 0.9975$ $0.99 \leq \rho < 0.9936$ $0.978 \leq \rho < 0.99$ $0.96 \leq \rho < 0.978$	$1.6 \text{E-4 } \rho$ 0.00082 ρ 0.0013 ρ 0.0016 ρ 0.0024 ρ 0.0030 ρ	HP 89441A Vector Signal Analyzer



Electromagnetic - RF/Microwave

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (\pm)]	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 Absolute Power - Source	0.02 V \leq V < 7 V f < 10 MHz 10 MHz \leq f \leq 50 MHz 50 MHz \leq f \leq 80 MHz V \leq 10mV 20 Hz \leq f \leq 20 kHz 20 kHz < f \leq 50 kHz 50 kHz < f \leq 100 kHz 100 kHz < f \leq 300 kHz 10 mV < V \leq 100 mV 20 Hz \leq f \leq 40 Hz 40 Hz \leq f \leq 1 kHz 1 kHz < f \leq 20 kHz 20 kHz < f \leq 50 kHz 50 kHz < f \leq 100 kHz 100 kHz < f \leq 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	Function Generator and DVM Agilent 33250A, Agilent 33120A, Agilent 3458A



Electromagnetic - RF/Microwave

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (\pm)]	Reference Standard or Equipment
RF Absolute Power - Source	$100 \text{ mV} < V \leq 1 \text{ V}$ $20 \text{ Hz} \leq f \leq 1 \text{ kHz}$ $1 \text{ kHz} < f \leq 20 \text{ kHz}$ $20 \text{ kHz} < f \leq 50 \text{ kHz}$ $50 \text{ kHz} < f \leq 100 \text{ kHz}$ $100 \text{ kHz} < f \leq 300 \text{ kHz}$ $1 \text{ V} < V \leq 3.5 \text{ V}$ $20 \text{ Hz} \leq f \leq 40 \text{ Hz}$ $40 \text{ Hz} \leq f \leq 1 \text{ kHz}$ $1 \text{ kHz} < f \leq 20 \text{ kHz}$ $20 \text{ kHz} < f \leq 50 \text{ kHz}$ $50 \text{ kHz} < f \leq 100 \text{ kHz}$ $100 \text{ kHz} < f \leq 300 \text{ kHz}$	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	$7 \text{ dBm} \geq P \geq 0 \text{ dBm}$ $0.3 \text{ MHz} \leq f \leq 1.1 \text{ GHz}$ $1.1 \text{ GHz} \leq f \leq 2.985 \text{ GHz}$ $2.985 \text{ GHz} < f \leq 4 \text{ GHz}$ $4 \text{ GHz} < f \leq 6 \text{ GHz}$ $0 \text{ dBm} > P \geq -25 \text{ dBm}$ $0.3 \text{ MHz} \leq f \leq 1.1 \text{ GHz}$ $1.1 \text{ GHz} \leq f \leq 2.985 \text{ GHz}$ $2.985 \text{ GHz} < f \leq 4 \text{ GHz}$ $4 \text{ GHz} < f \leq 6 \text{ GHz}$ $-25 \text{ dBm} > P \geq -70 \text{ dBm}$ $0.3 \text{ MHz} \leq f \leq 1.1 \text{ GHz}$ $1.1 \text{ GHz} \leq f \leq 2.985 \text{ GHz}$ $2.985 \text{ GHz} < f \leq 4 \text{ GHz}$ $4 \text{ GHz} < f \leq 6 \text{ GHz}$ $-70 \text{ dBm} > P \geq -95 \text{ dBm}$ $0.3 \text{ MHz} \leq f \leq 1.1 \text{ GHz}$ $1.1 \text{ GHz} \leq f \leq 2.985 \text{ GHz}$ $2.985 \text{ GHz} < f \leq 4 \text{ GHz}$ $4 \text{ GHz} < f \leq 6 \text{ GHz}$ $-95 \text{ dBm} > P \geq -125 \text{ dBm}$ $0.3 \text{ MHz} \leq f \leq 1.1 \text{ GHz}$ $1.1 \text{ GHz} \leq f \leq 2.985 \text{ GHz}$ $2.985 \text{ GHz} < f \leq 4 \text{ GHz}$ $4 \text{ GHz} < f \leq 6 \text{ GHz}$	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 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



Electromagnetic - RF/Microwave

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (\pm)]	Reference Standard or Equipment
Pulse - Measure RMS Jitter - Period, Delay and Width	33 MHz to 3 GHz	6.6 pS	HP 54124T or HP 86100 with 86107A
Pulse - Source Transition Time	<100 ps	0.13 ns	HP 8133A
Width	150 ps to 10 ns (10 to 100) ns 100 μ s to 10 ms (10 to 100) ms (100 to 0.99) ms	0.13 ns (0.013 * Width) + 1.2 ns (0.013 * Width) + 0.14 μ s (0.012 * Width) + 2 ns (0.012 * Width) + 0.19 μ s	HP 8161A
RMS Jitter - Period, Delay and Width	33 MHz to 3 GHz	10 pS	HP 8133A
Attenuation - Source Coaxial, 1 dB Steps (0 to 11) dB	0 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	HP 8496G w/ Type-N(f)
	1 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	
	2 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	
	3 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	
	4 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	
	5 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	
	6 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	
	7 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	
	8 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	
	9 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	



Electromagnetic - RF/Microwave

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (\pm)]	Reference Standard or Equipment
Attenuation - Source Coaxial, 1 dB Steps (0 to 11) dB	10 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	HP 8496G With Type-N(f)
	11 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	
Attenuation – Source Coaxial, 10 dB Steps	0 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	HP 8496G With Type-N(f)
	10 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	
	20 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	
	30 dB 50 MHz to 2 GHz (2 to 4) GHz	0.04 dB 0.04 dB	
	40 dB 50 MHz to 2 GHz (2 to 4) GHz	0.06 dB 0.05 dB	
	50 dB 50 MHz to 2 GHz (2 to 4) GHz	0.06 dB 0.06 dB	
	60 dB 50 MHz to 2 GHz (2 to 4) GHz	0.07 dB 0.06 dB	
	70 dB 50 MHz to 2 GHz (2 to 4) GHz	0.07 dB 0.06 dB	
	80 dB 50 MHz to 2 GHz (2 to 4) GHz	0.09 dB 0.07 dB	
	90 dB 50 MHz to 2 GHz (2 to 4) GHz	0.09 dB 0.08 dB	
	100 dB 50 MHz to 2 GHz (2 to 4) GHz	0.1 dB 0.08 dB	
	110 dB 50 MHz to 2 GHz (2 to 4) GHz	0.11 dB 0.08 dB	



Electromagnetic - RF/Microwave

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty (\pm)]	Reference Standard or Equipment
Attenuation - Source Coaxial, Fixed	3 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	
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	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 $\leq f \leq$ 26.5 GHz	26.5 GHz $\leq f \leq$ 33 GHz	33 GHz $\leq f <$ 40 GHz	40 GHz $\leq f <$ 45 GHz	45 GHz $\leq f \leq$ 50 GHz	f = 51 GHz	52 GHz $\leq f \leq$ 54 GHz	f = 55 GHz	56 GHz $\leq f \leq$ 59 GHz	f = 60 GHz	f = 61 GHz
-140 dBm $\leq P <$ -130 dBm	0.1	0.1	0.1	0.12	0.12						
-130 dBm $\leq P <$ -110 dBm	0.1	0.09	0.09	0.09	0.09						
-110 dBm $\leq P <$ -90 dBm	0.08	0.08	0.08	0.08	0.08						
-90 dBm $\leq P <$ -30 dBm	0.07	0.06	0.06	0.06	0.06						
-30 dBm $\leq P <$ -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 $\leq P <$ -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 $\leq P <$ 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 $\leq P <$ 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 $\leq P <$ 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 $\leq P <$ 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 $\leq P <$ 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 $\leq P <$ 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 $\leq f \leq$ 64 GHz	f = 65 GHz	f = 66 GHz	f = 67 GHz	
-30 dBm $\leq P <$ -20 dBm	0.34	0.33	0.29	0.35	0.36	
-20 dBm $\leq P <$ -10 dBm	0.34	0.33	0.29	0.35	0.36	
-10 dBm $\leq P <$ 0 dBm	0.34	0.33	0.29	0.35	0.36	
-1 dBm $\leq P <$ 2 dBm	0.34	0.33	0.29	0.35	0.36	
2 dBm $\leq P <$ 10 dBm	0.34	0.33	0.29	0.35	0.36	
10 dBm $\leq P <$ 15 dBm	0.34	0.34	0.2	0.36	0.36	
15 dBm $\leq P <$ 20 dBm	0.34	0.34	0.2	0.36	0.36	



PARAMETER	(S11 - Reflection) Magnitude Uncertainty (lin)									
REFERENCE STANDARD OR EQUIPMENT	85054B, 85031B, ET33700, 85056A, 85058B									
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
(50 to 67) GHz	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.018	0.018	0.019

PARAMETER	(S11 - Reflection) Phase Uncertainty (deg)									
REFERENCE STANDARD OR EQUIPMENT	85054B, 85031B, ET33700, 85056A, 85058B									
Freq:	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
(50 to 67) GHz	7.7	3.8	2.6	1.9	1.6	1.3	1.2	1	0.95	0.88



PARAMETER	(S21 - Transmission) Magnitude Uncertainty (dB)								
REFERENCE STANDARD OR EQUIPMENT	85054B, 85031B, ET33700, 85056A, 85058B								
Freq:	Measured Magnitude (+/- Linear)								
	0	3	6	10	20	30	40	50	60
(20 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
(50 to 67) GHz	0.094	0.094	0.095	0.096	0.099	0.11	0.14	0.28	0.78

PARAMETER	(S21 - Transmission) Phase Uncertainty (deg)								
REFERENCE STANDARD OR EQUIPMENT	85054B, 85031B, ET33700, 85056A, 85058B								
Freq:	Measured Magnitude (+/- Degrees)								
	0	3	6	10	20	30	40	50	60
(20 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
(50 to 67) GHz	0.63	0.63	0.64	0.66	0.67	0.76	0.97	1.9	5.5

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/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

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. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1498.15.



Vice President