



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 Mexico, S. de R.L.
Av. Camino al ITESO #8900-1B Col Pinar de la Calma
Tlaquepaque, Jalisco 45080 Mexico

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-1498.13

Certificate Number


ANAB Approval

Certificate Valid: 11/01/2017-11/16/2018
Version No. 001 Issued: 11/01/2017



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 Mexico, S. de R.L.
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CALIBRATION

Valid to: **November 16, 2018**

Certificate Number: **AC-1498.13**

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 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
	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



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current - Source	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 0.3 mA/A + 0.4 mA	Fluke 5720A with Fluke 5725A
	100 μ A	1.6 nA	Fluke 5700A/5720A disciplined with HP 3458A
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 + 0.1 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 0.4 k Ω 1.5 k Ω 12 k Ω	Fluke 5720A



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance - Source Fixed Points	10 Ω	0.17 mΩ	Fluke 5700A/5720A disciplined with HP 3458A
	100 Ω	1.3 mΩ	
	1 kΩ	7 mΩ	
	10 kΩ	70 mΩ	
	100 kΩ	0.69 Ω	
	1 MΩ	10 Ω	
	10 MΩ	0.27 kΩ	
AC Voltage - Source	100 MΩ	7.3 kΩ	Fluke 5720A
	Up to 22 mV		
	(10 to 20) Hz	0.25 mV/V + 12 μV	
	(20 to 40) Hz	95 μV/V + 7.3 μV	
	40 Hz to 20 kHz	86 μV/V + 7.3 μV	
	(20 to 50) kHz	0.18 mV/V + 9.4 μV	
	(50 to 100) kHz	0.49 mV/V + 16 μV	
	(100 to 300) kHz	0.88 mV/V + 20 μV	
	(300 to 500) kHz	1.4 mV/V + 33 μV	
	500 kHz to 1 MHz	2.7 mV/V + 0.48 mV	
	(22 to 220) mV		
	(10 to 20) Hz	0.27 mV/V + 4.5 μV	
	(20 to 40) Hz	0.13 mV/V + 4.5 μV	
	40 Hz to 20 kHz	0.11 mV/V + 4.5 μV	
	(20 to 50) kHz	0.27 mV/V + 4.5 μV	
	(50 to 100) kHz	0.54 mV/V + 5.3 μV	
	(100 to 300) kHz	1.2 mV/V + 10 μV	
	(300 to 500) kHz	1.7 mV/V + 24 μV	
	500 kHz to 1 MHz	3 mV/V + 24 μV	
	220 mV to 2.2 V		
	(10 to 20) Hz	0.25 mV/V + 39 μV	
(20 to 40) Hz	99 μV/V + 15 μV		
40 Hz to 20 kHz	63 μV/V + 5.9 μV		
(20 to 50) kHz	86 μV/V + 8.3 μV		
(50 to 100) kHz	0.11 mV/V + 30 μV		
(100 to 300) kHz	0.41 mV/V + 78 μV		
(300 to 500) kHz	0.99 mV/V + 0.2 mV		
500 kHz to 1 MHz	1.6 mV/V + 0.32 mV		



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Source	(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	0.26 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	Fluke 5720A
	(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	0.24 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	
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
	(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



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Fixed Values, Fixed Frequencies	0.01 V		Fluke 5700A or Fluke 5720A disciplined with HP 3458A
	1 kHz	2.7 μ V	
	20 kHz	2.8 μ V	
	100 kHz	3.6 μ V	
	300 kHz	4.6 μ V	
	0.1 V		
	1 kHz	4.6 μ V	
	20 kHz	4.6 μ V	
	100 kHz	17 μ V	
	300 kHz	22 μ V	
	1 V		
	1 kHz	37 μ V	
	20 kHz	37 μ V	
	50 kHz	42 μ V	
	100 kHz	65 μ V	
	300 kHz	0.14 mV	
	500 kHz	0.24 mV	
	1 MHz	0.66 mV	
	10 V		
	10 Hz	0.67 mV	
	20 Hz	0.6 mV	
	40 Hz	0.42 mV	
	200 Hz	0.42 mV	
	500 Hz	0.42 mV	
	1 kHz	0.37 mV	
	10 kHz	0.37 mV	
	20 kHz	0.37 mV	
	50 kHz	0.41 mV	
	500 kHz	2.4 mV	
	1 MHz	6.6 mV	
100 V			
1 kHz	3.7 mV		
20 kHz	3.7 mV		
50 kHz	4.2 mV		
100 kHz	6.8 mV		
700 V			
1 kHz	46 mV		



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage Flatness - Source	300 μ V to 3.5 V (10 to 30) Hz	2.7 mV/V	Fluke 5720A, Fluke 5700A, or Fluke 5700A-03 (referenced to 1 kHz)
	30 Hz to 120 kHz	1.4 mV/V	
	300 μ V to 1.1 mV 120 kHz to 2 MHz	4.6 mV/V	
	(2 to 10) MHz	6.2 mV/V	
	(10 to 20) MHz	8 mV/V	
	(20 to 30) MHz	24 mV/V	
	1.1 μ V to 3 mV 120 kHz to 2 MHz	2.2 mV/V	
	(2 to 10) MHz	3.7 mV/V	
	(10 to 20) MHz	5.5 mV/V	
	(20 to 30) MHz	14 mV/V	
AC Voltage Flatness - Source Fixed Points	3 mV to 3.5 V 120 kHz to 2 MHz	1.2 mV/V	Fluke 5700A or Fluke 5720A disciplined with HP 3458A
	(2 to 10) MHz	2.1 mV/V	
	(10 to 20) MHz	3.8 mV/V	
	(20 to 30) MHz	8.6 mV/V	
AC Voltage Flatness - Measure	0.1 V at 1 MHz	94 μ V	Agilent 11049A, Agilent 11050A, Agilent 11051A Thermal Voltage Converters
	1 V at 1 MHz	0.73 mV	
	Up to 3 V		
	10 Hz	0.2 mV/V + 6.9 μ V	
	100 Hz	80 μ V/V + 5.5 μ V	
	(10, 30) kHz	80 μ V/V + 3.2 μ V	
	100 kHz	0.1 mV/V + 8 μ V	
	300 kHz	0.1 mV/V + 5.2 μ V	
	1 MHz	0.1 mV/V + 6.5 μ V	
	3 MHz	1.3 mV/V + 59 μ V	
	8 MHz	1.3 mV/V + 0.11 mV	
	10 MHz	1.3 mV/V + 91 μ V	
	20 MHz	2.5 mV/V + 0.21 mV	
	30 MHz	2.5 mV/V + 0.24 mV	
	50 MHz	6.1 mV/V + 0.34 mV	
70 MHz	9 mV/V + 0.24 mV		
80 MHz	11 mV/V + 0.79 mV		
100 MHz	13 mV/V + 0.94 mV		



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	0.3 mV/V + 3.1 μV	
	40 Hz to 1 kHz	0.2 mV/V + 1.2 μV	
	(1 to 20) kHz	0.3 mV/V + 1.7 μV	
	(20 to 50) kHz	1 mV/V + 1.6 μV	
	(50 to 100) kHz	5 mV/V + 1.3 μV	
	(100 to 300) kHz	40 mV/V + 2.1 μV	
	300 kHz to 1 MHz	12 mV/V + 6.6 μV	
	(1 to 4) MHz	70 mV/V + 7.5 μV	
	(4 to 8) MHz	20 mV/V + 8.2 μV	
	(10 to 100) mV		
	(1 to 40) Hz	70 μV/V + 4.1 μV	
	40 Hz to 1 kHz	70 μV/V + 2.1 μV	
	(1 to 20) kHz	0.14 mV/V + 2.3 μV	
	(20 to 50) kHz	0.3 V/V + 2.6 μV	
	(50 to 100) kHz	0.80 mV/V + 2.3 μV	
	(100 to 300) kHz	3 mV/V + 15 μV	
	300 kHz to 1 MHz	10 mV/V + 28 μV	
	(1 to 2) MHz	15 mV/V + 20 μV	
	(2 to 4) MHz	40 mV/V + 74 μV	
	(4 to 8) MHz	40 mV/V + 83 μV	
	(8 to 10) MHz	0.15 V/V + 0.11 mV	
	100 mV to 1 V		
	(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	0.3 mV/V + 22 μV	
	(50 to 100) kHz	0.8 mV/V + 22 μV	
(100 to 300) kHz	3 mV/V + 0.12 mV		
300 kHz to 1 MHz	10 mV/V + 0.3 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	0.3 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		
AC Current - Source	Up to 220 μ A		Fluke 5720A
	(10 to 20) Hz	0.16 mA/A + 63 nA	
	(20 to 40) Hz	89 μ A/A + 62 nA	
	40 Hz to 1 kHz	60 μ A/A + 62 nA	
	(1 to 5) kHz	0.18 mA/A + 62 nA	
	(5 to 10) kHz	0.1 mA/A + 90 nA	
	220 μ A to 2.2 mA		
	(10 to 20) Hz	0.27 mA/A + 56 nA	
	(20 to 40) Hz	0.2 mA/A + 51 nA	
	40 Hz to 1 kHz	0.16 mA/A + 52 nA	
	(1 to 5) kHz	0.23 mA/A + 0.12 μ A	
	(5 to 10) kHz	1.1 mA/A + 0.67 μ A	



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current - Source	(2.2 to 22) mA		Fluke 5720A
	(10 to 20) Hz	0.27 mA/A + 0.56 μ A	
	(20 to 40) Hz	0.21 mA/A + 0.51 μ A	
	40 Hz to 1 kHz	0.16 mA/A + 0.52 μ A	
	(1 to 5) kHz	0.23 mA/A + 0.71 μ A	
	(5 to 10) kHz	1.1 mA + 5.1 μ A	
	(22 to 220) mA		
	(10 to 20) Hz	0.28 mA/A + 3.9 μ A	
	(20 to 40) Hz	0.21 mA/A + 3 μ A	
	40 Hz to 1 kHz	0.17 mA/A + 2.2 μ A	
	(1 to 5) kHz	0.24 mA/A + 3.1 μ A	
	(5 to 10) kHz	1.1 mA/A + 10 μ A	
	220 mA to 1 A		
	20 Hz to 1 kHz	0.3 mA/A + 32 μ A	
	(1 to 5) kHz	0.44 mA/A + 83 μ A	
(5 to 10) kHz	0.67 mA/A + 72 μ A		
AC Current - Source Fixed Values	1 kHz		Fluke 5700A or Fluke 5720A disciplined with HP 3458A
	10 μ A	5.1 pA	
	100 μ A	11 pA	
	1 mA	110 pA	
	10 mA	1 μ A	
	100 mA	11 μ A	
AC Current - Measure	1 A	120 μ A	HP 3458A
	Up to 100 μ A		
	(10 to 20) Hz	4 mA/A + 31 nA	
	(20 to 45) Hz	1.5 mA/A + 31 nA	
	45 Hz to 1 kHz	0.6 mA/A + 31 nA	



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current - Measure	100 μ A to 1 mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz	4 mA/A + 0.31 μ A 0.15 mA/A + 0.21 μ A 0.6 mA/A + 0.21 μ A	HP 3458A
	(1 to 10) mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz	4 mA/A + 3.1 μ A 1.5 mA/A + 2.1 μ A 0.6 mA/A + 2.1 μ A	
	(10 to 100) mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz	4 mA/A + 31 μ A 1.5 mA/A + 21 μ A 0.6 mA/A + 21 μ A	
	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 + 0.22 mA 1.6 mA/A + 0.22 mA 0.8 mA/A + 0.22 mA 1 mA/A + 0.22 mA	
Resistance - Source DC to 1 MHz, Direct Measurement	0.1 Ω	10 m Ω / Ω	Agilent 16074A
	(1, 10) Ω	1 m Ω / Ω	
	100 Ω	0.3 m Ω / Ω	
	(1, 10, 100) k Ω	0.3 m Ω / Ω	
Resistance Source, High Resistance	1 G Ω	0.23 M Ω	Agilent 16340A
	10 G Ω	2.7 M Ω	
	100 G Ω	24 M Ω	
Capacitance - Source Direct Measure 1 kHz	(1, 10, 100) pF (1, 10, 100) nF 1 μ F	0.1 mF/F	Agilent 16380A, Agilent 16380C Standard Air Capacitor Set, BNC 4 Terminal Pair
	1 pF 1 MHz 2 MHz 3 MHz 4 MHz 5 MHz 10 MHz 13 MHz	50 μ F/F 60 μ F/F 1 mF/F 2 mF/F 3 mF/F 10 mF/F 15 mF/F	



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance - Source Algorithmic Derivation	(10, 100) pF		Agilent 16380A, Agilent 16380C Standard Air Capacitor Set, BNC 4 Terminal Pair
	(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	0.5 mF/F	
	2 MHz	0.6 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 (0.01, 0.1) μ F 1 μ F	0.25 mF/F 0.5 mF/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 330 nF to 110 μ F (110 to 330) μ F (3.3 to 11) μ F	4 mF/F 4 mF/F 4 mF/F 4 mF/F	

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Amplitude Modulation – Measure (0.15 to 10) MHz (0.01 to 1.3) GHz (1.3 to 26.5) GHz	Rate: (0.05 to 10) kHz Rate: (0.05 to 50) kHz Rate: (0.05 to 10) kHz	2.1 % Depth 1.1 % Depth 1.6 % Depth	Agilent 8902A



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Amplitude Modulation – Measure (0.1 to 10) MHz (0.01 to 3) GHz (3 to 26.5) GHz (26.5 to 31.15) GHz (31.5 to 50) GHz	Rate: (0.05 to 10) kHz Rate: (0.05 to 100) kHz	0.8 % Depth 0.5 % Depth 1.5 % Depth 1.9 % Depth 6.1 % Depth	Agilent E444xA with Opt. 233
Frequency Modulation – Measure (0.25 to 10) MHz (0.01 to 26.5) GHz	Rate: (0.02 to 10) kHz Rate: (0.05 to 100) kHz	2.2 % Deviation 1.2 % Deviation	HP 8902A
Frequency Modulation – Measure (0.25 to 10) MHz (0.01 to 50) GHz	Rate: (0.02 to 10) kHz Rate: (0.05 to 200) kHz	1.1 % Deviation 1.1 % Deviation	E444xA with Opt. 233

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)

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
EVM	Mod Frequency Span: f ≤ 100kHz 100kHz ≤ f ≤ 1MHz f > 1MHz	0.43 % 0.48 % 0.82 %	HP 89441A Vector Signal Analyzer



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Phase Error	Mod Frequency Span: f ≤ 100kHz 100kHz ≤ f ≤ 1MHz f > 1MHz	0.17° rms 0.34° rms 0.57° rms	HP 89441A Vector Signal Analyzer
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 %	
Rho	Mod Frequency Span: f ≤ 100kHz 0.9999 ≤ Rho ≤ 1 0.9975 ≤ Rho < 0.9999 0.9936 ≤ Rho < 0.9975 0.99 ≤ Rho < 0.9936 0.978 ≤ Rho < 0.99 0.96 ≤ Rho < 0.978	8.6 E-5 0.00043 0.00068 0.00084 0.0012 0.0016	
Rho	Mod Frequency Span: 100 kHz ≤ f ≤ 1 MHz 0.9999 ≤ Rho ≤ 1 0.9975 ≤ Rho < 0.9999 0.9936 ≤ Rho < 0.9975 0.99 ≤ Rho < 0.9936 0.978 ≤ Rho < 0.99 0.96 ≤ Rho < 0.978	9.6 E-5 0.00048 0.00076 0.00094 0.0014 0.0018	
Rho	Mod Frequency Span: f > 1MHz 0.9999 ≤ Rho ≤ 1 0.9975 ≤ Rho < 0.9999 0.9936 ≤ Rho < 0.9975 0.99 ≤ Rho < 0.9936 0.978 ≤ Rho < 0.99 0.96 ≤ Rho < 0.978	1.6 E-4 0.00082 0.0013 0.0016 0.0024 0.0030	



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tuned RF Power - Absolute - Measure 2.5 MHz to 26.5 GHz	(+10 to -22) dBm	0.17 dB	HP 8902A with HP 11722A or with HP 11792A and HP 11793A
	(-22 to -42) dBm	0.18 dB	
	(-42 to -50) dBm	0.2 dB	
	(-50 to -60) dBm	0.21 dB	
	(-60 to -72) dBm	0.22 dB	
	(-72 to -80) dBm	0.23 dB	
	(-80 to -92) dBm	0.24 dB	
	(-92 to -102) dBm	0.27 dB	
	(-102 to -110) dBm	0.28 dB	
	(-110 to -120) dBm	0.31 dB	
(-120 to -127) dBm	0.34 dB		
Tuned RF Power - Relative – Measure 2.5 MHz to 26.5 GHz	(+10 to +2) dBm	0.08 dB	HP 8902A with HP 11722A or with HP 11792A and HP 11793A
	(+2 to -12) dBm	0.07 dB	
	(-12 to -22) dBm	0.08 dB	
	(-22 to -31) dBm	0.09 dB	
	(-31 to -40) dBm	0.1 dB	
	(-40 to -50) dBm	0.12 dB	
	(-50 to -61) dBm	0.15 dB	
	(-61 to -71) dBm	0.16 dB	
	(-71 to -80) dBm	0.17 dB	
	(-80 to -90) dBm	0.19 dB	
	(-90 to -100) dBm	0.22 dB	
	(-100 to -110) dBm	0.23 dB	
	(-110 to -120) dBm	0.27 dB	
(-120 to -127) dBm	0.3 dB		
RF Absolute Power - Measure	0 dBm ≤ P < 30 dBm		Agilent 8481B
	10 MHz ≤ f < 1.2 GHz	0.1 dB	
	1.2 GHz ≤ f < 6 GHz	0.11 dB	
	6 GHz ≤ f ≤ 18 GHz	0.13 dB	
	30 dBm ≤ P < 35 dBm		
	10 MHz ≤ f < 1.2 GHz	0.08 dB	
	1.2 GHz ≤ f < 6 GHz	0.1 dB	
	6 GHz ≤ f ≤ 18 GHz	0.12 dB	
35 dBm ≤ P ≤ 44 dBm			
10 MHz ≤ f < 6 GHz	0.18 dB		
6 GHz ≤ f ≤ 18 GHz	0.19 dB		



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power - Measure	0 dBm ≤ P < 30 dBm 100 kHz ≤ f < 500 MHz 500 MHz ≤ f ≤ 4.2 GHz	0.1 dB 0.11 dB	Agilent 8482B
	30 dBm ≤ P < 35 dBm 100 kHz ≤ f < 500 MHz 500 MHz ≤ f ≤ 4.2 GHz	0.08 dB 0.09 dB	
	35 dBm ≤ P ≤ 44 dBm 100 kHz ≤ f ≤ 4.2 GHz	0.18 dB	
	-10 dBm ≤ P < 25 dBm 10 MHz ≤ f < 6 GHz 6 GHz ≤ f < 14 GHz 14 GHz ≤ f ≤ 18 GHz	0.1 dB 0.11 dB 0.13 dB	Agilent 8481H
	25 dBm ≤ P ≤ 35 dBm 10 MHz ≤ f < 6 GHz 6 GHz ≤ f ≤ 18 GHz	0.19 dB 0.2 dB	Agilent 8481H
	-10 dBm ≤ P < 25 dBm 100 kHz ≤ f ≤ 4.2 GHz	0.1 dB	Agilent 8482H
	25 dBm ≤ P ≤ 35 dBm 100 kHz ≤ f ≤ 4.2 GHz	0.19 dB	
	-30 dBm ≤ P < -20 dBm 50 MHz ≤ f < 18 GHz 18 GHz ≤ f ≤ 26.5 GHz	0.28 dB 0.29 dB	Agilent 8485A
	-20 dBm ≤ P < -10 dBm 50 MHz ≤ f < 6 GHz 6 GHz ≤ f < 14 GHz 14 GHz ≤ f < 18 GHz 18 GHz ≤ f ≤ 26.5 GHz	0.09 dB 0.1 dB 0.11 dB 0.14 dB	
	-10 dBm ≤ P < 10 dBm 50 MHz ≤ f < 1.2 GHz 1.2 GHz ≤ f < 14 GHz 14 GHz ≤ f < 18 GHz 18 GHz ≤ f ≤ 26.5 GHz	0.08 dB 0.09 dB 0.11 dB 0.13 dB	
	10 dBm ≤ P ≤ 20 dBm 50 MHz ≤ f < 14 GHz 14 GHz ≤ f < 18 GHz 18 GHz ≤ f ≤ 26.5 GHz	0.14 dB 0.15 dB 0.16 dB	



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment	
RF Absolute Power - Measure	-30 dBm ≤ P < -20 dBm 10 MHz ≤ f < 6 GHz	0.26 dB	Agilent 8481A	
	6 GHz ≤ f ≤ 18 GHz	0.27 dB		
	-20 dBm ≤ P < -10 dBm 10 MHz ≤ f < 30 MHz	0.09 dB		
	30 MHz ≤ f < 500 MHz	0.08 dB		
	500 MHz ≤ f < 1.2 GHz	0.07 dB		
	1.2 GHz ≤ f < 6 GHz	0.08 dB		
	6 GHz ≤ f < 14 GHz	0.11 dB		
	14 GHz ≤ f ≤ 18 GHz	0.12 dB		
	-10 dBm ≤ P < 10 dBm 10 MHz ≤ f < 30 MHz	0.09 dB		
	30 MHz ≤ f < 500 MHz	0.08 dB		
	500 MHz ≤ f < 1.2 GHz	0.06 dB		
	1.2 GHz ≤ f < 6 GHz	0.08 dB		
	6 GHz ≤ f < 14 GHz	0.1 dB		
	14 GHz ≤ f ≤ 18 GHz	0.11 dB		
	10 dBm ≤ P ≤ 20 dBm 10 MHz ≤ f < 500 MHz	0.14 dB		Agilent 8481A
	500 MHz ≤ f < 1.2 GHz	0.13 dB		
1.2 GHz ≤ f < 6 GHz	0.14 dB			
6 GHz ≤ f ≤ 18 GHz	0.15 dB			
RF Absolute Power - Measure	-30 dBm ≤ P < -20 dBm 100 kHz ≤ f < 10 MHz	0.23 dB	Agilent 8482A	
	10 MHz ≤ f < 1.2 GHz	0.22 dB		
	1.2 GHz ≤ f ≤ 4.2 GHz	0.23 dB		
	-20 dBm ≤ P < -10 dBm 100 kHz ≤ f < 10 MHz	0.09 dB		
	10 MHz ≤ f < 1.2 GHz	0.07 dB		
	1.2 GHz ≤ f ≤ 4.2 GHz	0.11 dB		
	-10 dBm ≤ P < 10dBm 100 kHz ≤ f < 10 MHz	0.08 dB		
	10 MHz ≤ f < 1.2 GHz	0.06 dB		
	1.2 GHz ≤ f ≤ 4.2 GHz	0.1 dB		
	10 dBm ≤ P ≤ 20dBm 100 kHz ≤ f < 10 MHz	0.14 dB		Agilent 8482A
	10 MHz ≤ f < 1.2 GHz	0.13 dB		
	1.2 GHz ≤ f ≤ 4.2 GHz	0.15 dB		



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment	
RF Absolute Power - Measure	-30 dBm ≤ P < -20dBm		Agilent 8487A	
	50 MHz ≤ f < 18 GHz	0.23 dB		
	18 GHz ≤ f < 26.5 GHz	0.24 dB		
	26.5 GHz ≤ f < 40 GHz	0.25 dB		
	40 GHz ≤ f < 45 GHz	0.27 dB		
	45 GHz ≤ f ≤ 50 GHz	0.33 dB		
	-20 dBm ≤ P < -10dBm			
	50 MHz ≤ f < 500 MHz	0.09 dB		
	500 MHz ≤ f < 1.2 GHz	0.08 dB		
	1.2 GHz ≤ f < 14 GHz	0.09 dB		
	14 GHz ≤ f < 18 GHz	0.1 dB		
	18 GHz ≤ f < 26.5 GHz	0.12 dB		
	26.5 GHz ≤ f < 40 GHz	0.14 dB		
	40 GHz ≤ f < 45 GHz	0.2 dB		
	45 GHz ≤ f ≤ 50 GHz	0.22 dB		
	-10 dBm ≤ P < 10 dBm			Agilent 8487A
	50 MHz ≤ f < 500 MHz	0.09 dB		
	500 MHz ≤ f < 1.2 GHz	0.08 dB		
1.2 GHz ≤ f < 14 GHz	0.09 dB			
14 GHz ≤ f < 18 GHz	0.1 dB			
18 GHz ≤ f < 26.5 GHz	0.13 dB			
26.5 GHz ≤ f < 40 GHz	0.15 dB			
40 GHz ≤ f < 45 GHz	0.21 dB			
45 GHz ≤ f ≤ 50 GHz	0.23 dB			
10 dBm ≤ P ≤ 20 dBm		Agilent 8487A		
50 MHz ≤ f < 14 GHz	0.14 dB			
14 GHz ≤ f < 18 GHz	0.15 dB			
18 GHz ≤ f < 26.5 GHz	0.16 dB			
26.5 GHz ≤ f < 40 GHz	0.17 dB			
40 GHz ≤ f < 45 GHz	0.25 dB			
45 GHz ≤ f ≤ 50 GHz	0.27 dB			



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power - Measure	-30 dBm ≤ P < -20 dBm 100 kHz ≤ f ≤ 2 GHz	0.23 dB	Agilent 8483A
	-20 dBm ≤ P < -10 dBm 100 kHz ≤ f < 50 MHz	0.1 dB	
	50 MHz ≤ f ≤ 2 GHz	0.09 dB	
	-10 dBm ≤ P < 10 dBm 100 kHz ≤ f < 10 MHz	0.09 dB	
	10 MHz ≤ f < 1.2 GHz	0.08 dB	
	1.3 GHz ≤ f ≤ 2 GHz	0.11 dB	
	10 dBm ≤ P ≤ 20 dBm 100 kHz ≤ f < 1.2 GHz	0.14 dB	
	1.2 GHz ≤ f ≤ 2 GHz	0.15 dB	
	-70 dBm ≤ P < -60 dBm 10 MHz ≤ f ≤ 18 GHz	0.82 dB	
	-60 dBm ≤ P < -50 dBm 10 MHz ≤ f < 30 MHz	0.16 dB	
	30 MHz ≤ f < 1.2 GHz	0.13 dB	
	1.2 GHz ≤ f < 6 GHz	0.14 dB	
	6 GHz ≤ f < 14 GHz	0.15 dB	
	14 GHz ≤ f ≤ 18 GHz	0.17 dB	
	RF Absolute Power - Measure	-50 dBm ≤ P < -30 dBm 10 MHz ≤ f < 30 MHz	0.12 dB
30 MHz ≤ f < 1.2 GHz		0.07 dB	
1.2 GHz ≤ f < 6 GHz		0.08 dB	
6 GHz ≤ f < 14 GHz		0.11 dB	
14 GHz ≤ f ≤ 18 GHz		0.13 dB	
-30 dBm ≤ P ≤ -20 dBm 10 MHz ≤ f < 30 MHz		0.11 dB	
30 MHz ≤ f < 1.2 GHz		0.07 dB	
1.2 GHz ≤ f < 6 GHz		0.08 dB	
6 GHz ≤ f < 14 GHz		0.1 dB	
14 GHz ≤ f ≤ 18 GHz		0.11 dB	



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power - Measure	-70 dBm ≤ P < -60 dBm 50 MHz ≤ f ≤ 26.5 GHz	0.82 dB	Agilent 8485D
	-60 dBm ≤ P < -50 dBm 50 MHz ≤ f < 6 GHz	0.14 dB	
	6 GHz ≤ f < 14 GHz	0.15 dB	
	14 GHz ≤ f < 18 GHz	0.16 dB	
	18 GHz ≤ f ≤ 26.5 GHz	0.18 dB	
	-50 dBm ≤ P < -30 dBm 50 MHz ≤ f < 6 GHz	0.09 dB	
	6 GHz ≤ f < 14 GHz	0.11 dB	
	14 GHz ≤ f < 18 GHz	0.12 dB	
	18 GHz ≤ f ≤ 26.5 GHz	0.14 dB	
	-30 dBm ≤ P ≤ -20 dBm 50 MHz ≤ f < 6 GHz	0.11 dB	
	6 GHz ≤ f < 14 GHz	0.12 dB	
	14 GHz ≤ f < 18 GHz	0.13 dB	
	18 GHz ≤ f ≤ 26.5 GHz	0.14 dB	
	-70 dBm ≤ P < -60 dBm 30 MHz ≤ f < 33 GHz	0.82 dB	
	33 GHz ≤ f < 40 GHz	0.83 dB	
40 GHz ≤ f ≤ 50 GHz	0.84 dB		



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power - Measure	-60 dBm ≤ P < -50 dBm		Agilent 8485D
	30 MHz ≤ f < 6 GHz	0.26 dB	
	6 GHz ≤ f < 18 GHz	0.27 dB	
	18 GHz ≤ f < 33 GHz	0.28 dB	
	33 GHz ≤ f < 40 GHz	0.31 dB	
	40 GHz ≤ f < 45 GHz	0.36 dB	
	45 GHz ≤ f ≤ 50 GHz	0.37 dB	
	-50 dBm ≤ P < -40 dBm		
	30 MHz ≤ f < 1.2 GHz	0.09 dB	
	1.2 GHz ≤ f < 6 GHz	0.1 dB	
	6 GHz ≤ f < 18 GHz	0.12 dB	
	18 GHz ≤ f < 33 GHz	0.15 dB	
	33 GHz ≤ f < 40 GHz	0.21 dB	
	40 GHz ≤ f < 45 GHz	0.27 dB	
	45 GHz ≤ f ≤ 50 GHz	0.29 dB	
	-40 dBm ≤ P < -30 dBm		
	30 MHz ≤ f < 1.2 GHz	0.09 dB	
	1.2 GHz ≤ f < 6 GHz	0.1 dB	
	6 GHz ≤ f < 14 GHz	0.12 dB	
	14 GHz ≤ f < 18 GHz	0.13 dB	
18 GHz ≤ f < 26.5 GHz	0.15 dB		
26.5 GHz ≤ f < 33 GHz	0.16 dB		
33 GHz ≤ f < 40 GHz	0.21 dB		
40 GHz ≤ f < 45 GHz	0.27 dB		
45 GHz ≤ f ≤ 50 GHz	0.29 dB		
	-30 dBm ≤ P ≤ -20 dBm		Agilent 8487D
	30 MHz ≤ f < 6 GHz	0.11 dB	
	6 GHz ≤ f < 18 GHz	0.13 dB	
	18 GHz ≤ f < 33 GHz	0.18 dB	
	33 GHz ≤ f < 40 GHz	0.23 dB	
	40 GHz ≤ f < 45 GHz	0.29 dB	
	45 GHz ≤ f ≤ 50 GHz	0.3 dB	
	-60 dBm ≤ P < -50 dBm		Agilent E9301A
	30 MHz ≤ f ≤ 18 GHz	1.8 dB	
	-50 dBm ≤ P < -40 dBm		
	30 MHz ≤ f ≤ 18 GHz	0.26 dB	



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power - Measure	-40 dBm ≤ P < -30 dBm 10 MHz ≤ f < 30 MHz	0.15 dB	Agilent E9300A
	30 MHz ≤ f < 500 MHz	0.14 dB	
	500 MHz ≤ f < 14 GHz	0.15 dB	
	14 GHz ≤ f < 18 GHz	0.16 dB	
	-30 dBm ≤ P < 0 dBm 10 MHz ≤ f < 1.2 GHz	0.11 dB	
	1.2 GHz ≤ f < 14 GHz	0.12 dB	
	14 GHz ≤ f < 18 GHz	0.13 dB	
	0 dBm ≤ P < 20 dBm 10 MHz ≤ f < 30 MHz	0.10 dB	
	30 MHz ≤ f < 500 MHz	0.09 dB	
	500 MHz ≤ f < 1.2 GHz	0.10 dB	
	1.2 GHz ≤ f < 14 GHz	0.11 dB	
	14 GHz ≤ f < 18 GHz	0.12 dB	
	-60 dBm ≤ P < -50 dBm 10 MHz ≤ f ≤ 6 GHz	1.8 dB	Agilent E9301A
	-50 dBm ≤ P < -40 dBm 10 MHz ≤ f ≤ 6 GHz	0.26 dB	
	-40 dBm ≤ P < -30 dBm 10 MHz ≤ f ≤ 6 GHz	0.15 dB	
	-30 dBm ≤ P < 0 dBm 10 MHz ≤ f ≤ 6 GHz	0.11 dB	
	0 dBm ≤ P < 10 dBm 10 Hz ≤ f ≤ 6 GHz	0.1 dB	
	10 dBm ≤ P < 20 dBm 10 Hz ≤ f < 30 MHz	0.1 dB	
30 Hz ≤ f < 2 GHz	0.09 dB		
2 GHz ≤ f ≤ 6 GHz	0.1 dB		
-60 dBm ≤ P < -50dBm 9 kHz ≤ f ≤ 6 GHz	1.8 dB	Agilent E9304A	
-50 dBm ≤ P < -40 dBm 9 kHz ≤ f ≤ 6 GHz	0.26 dB		
-40 dBm ≤ P < -30 dBm 9 kHz ≤ f ≤ 6 GHz	0.15 dB		
-30 dBm ≤ P < 0 dBm 9 kHz ≤ f ≤ 6 GHz	0.11 dB		
0 dBm ≤ P < 20 dBm 9 kHz ≤ f ≤ 6 GHz	0.1 dB		
9 kHz ≤ f ≤ 6 GHz	0.1 dB		



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment	
RF Absolute Power - Measure	-30 dBm ≤ P < -20 dBm 10 MHz ≤ f ≤ 18 GHz	1.8 dB	Agilent E9300B	
	-20 dBm ≤ P < -10 dBm 10 MHz ≤ f ≤ 18 GHz	0.26 dB		
	-10 dBm ≤ P < 0 dBm 10 MHz ≤ f ≤ 18 GHz	0.15 dB		
	0 dBm ≤ P < 44 dBm 10 MHz ≤ f < 8 GHz	0.1 dB		
	8 GHz ≤ f < 12.4 GHz	0.11 dB	Agilent E9301B	
	12.4 GHz ≤ f ≤ 18 GHz	0.12 dB		
	-30 dBm ≤ P < -20 dBm 10 MHz ≤ f ≤ 6 GHz	1.8 dB	Agilent E9301B	
	-20 dBm ≤ P < -10 dBm 10 MHz ≤ f ≤ 6 GHz	0.26 dB		
	-10 dBm ≤ P < 0 dBm 10 MHz ≤ f ≤ 6 GHz	0.15 dB		
	0 dBm ≤ P ≤ 44 dBm 10 MHz ≤ f ≤ 6 GHz	0.1 dB	Agilent E9301H	
	RF Absolute Power - Measure	-50 dBm ≤ P < -40 dBm 10 MHz ≤ f ≤ 18 GHz	1.8 dB	Agilent E9300H
		-40 dBm ≤ P < -30 dBm 10 MHz ≤ f ≤ 18 GHz	0.26 dB	
		-30 dBm ≤ P < -20 dBm 10 MHz ≤ f < 12.4 GHz	0.15 dB	
		12.4 GHz ≤ f ≤ 18 GHz	0.16 dB	
		-20 dBm ≤ P < 30 dBm 10 MHz ≤ f < 8 GHz	0.11 dB	
		8 GHz ≤ f < 12.4 GHz	0.12 dB	
12.4 GHz ≤ f ≤ 18 GHz		0.13 dB		
30 dBm = P 10 MHz ≤ f < 8 GHz		0.11 dB		
8 GHz ≤ f < 12.4 GHz		0.12 dB		
12.4 GHz ≤ f ≤ 18 GHz		0.13 dB		

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment	
RF Absolute Power - Measure	-50 dBm ≤ P < -40 dBm 10 MHz ≤ f ≤ 6 GHz	1.8 dB	Agilent E9301H	
	-40 dBm ≤ P < -30 dBm 10 MHz ≤ f ≤ 6 GHz	0.26 dB		
	-30 dBm ≤ P < -20 dBm 10 MHz ≤ f ≤ 6 GHz	0.15 dB		
	-20 dBm ≤ P ≤ 30 dBm 10 MHz ≤ f ≤ 6 GHz	0.11 dB		
	-70 dBm ≤ P < -60 dBm 10 MHz ≤ f ≤ 18 GHz	1.8 dB		Agilent E4412A
	-60 dBm ≤ P < -50 dBm 10 MHz ≤ f ≤ 18 GHz	0.27 dB		
	-50 dBm ≤ P < 10 dBm 10 MHz ≤ f < 2 GHz	0.15 dB		
	2 GHz ≤ f < 11 GHz	0.16 dB		
	11 GHz ≤ f ≤ 18 GHz	0.17 dB		
	10 dBm ≤ P ≤ 20 dBm 10 MHz ≤ f < 2 GHz	0.2 dB		
	2 GHz ≤ f ≤ 18 GHz	0.21 dB		
	-70 dBm ≤ P < -60 dBm 50 MHz ≤ f ≤ 26.5 GHz	1.8 dB	Agilent E4413A	
	-60 dBm ≤ P < -50 dBm 50 MHz ≤ f < 8 GHz	0.26 dB		
	8 GHz ≤ f ≤ 26.5 GHz	0.27 dB		
	-50 dBm ≤ P < 10 dBm 50 MHz ≤ f < 8 GHz	0.15 dB		
8 GHz ≤ f ≤ 26.5 GHz	0.17 dB			
10 dBm ≤ P ≤ 20 dBm 50 MHz ≤ f < 8 GHz	0.2 dB			
8 GHz ≤ f < 18 GHz	0.21 dB			
18 GHz ≤ f ≤ 26.5 GHz	0.22 dB			



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power - Measure	-35 dBm ≤ P < -20 dBm		Agilent N8481A
	10 MHz ≤ f < 30 MHz	0.37 dB	
	30 MHz ≤ f < 14 GHz	0.36 dB	
	14 GHz ≤ f ≤ 18 GHz	0.37 dB	
	-20 dBm ≤ P < 0 dBm		
	10 MHz ≤ f < 30 MHz	0.11 dB	
	30 MHz ≤ f < 1.2 GHz	0.06 dB	
	1.2 GHz ≤ f < 6 GHz	0.08 dB	
	6 GHz ≤ f < 14 GHz	0.09 dB	
	14 GHz ≤ f ≤ 18 GHz	0.11 dB	
	0 dBm ≤ P ≤ 20 dBm		
	10 MHz ≤ f < 30 MHz	0.12 dB	
	30 MHz ≤ f < 1.2 GHz	0.07 dB	
	1.2 GHz ≤ f < 6 GHz	0.08 dB	
	6 GHz ≤ f < 14 GHz	0.09 dB	
14 GHz ≤ f ≤ 18 GHz	0.11 dB		
35 dBm ≤ P < -20 dBm	100 kHz ≤ f < 1 MHz	0.37 dB	Agilent N8482A
	1 MHz ≤ f < 6 GHz	0.36 dB	
	-20 dBm ≤ P < 0 dBm		
	100 kHz ≤ f < 1 MHz	0.09 dB	
	1 MHz ≤ f ≤ 6 GHz	0.06 dB	
	0 dBm ≤ P ≤ 20 dBm		
100 kHz ≤ f < 1 MHz	0.1 dB	Agilent N8485A	
1 MHz ≤ f < 1.2 GHz	0.06 dB		
1.2 GHz ≤ f ≤ 6 GHz	0.07 dB		
-35 dBm ≤ P < -20 dBm			
10 MHz ≤ f < 30 MHz	0.34 dB		
30 MHz ≤ f < 12.4 GHz	0.33 dB		
12.4 GHz ≤ f ≤ 26.5 GHz	0.34 dB		



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power - Measure	-20 dBm ≤ P < 0 dBm 10 MHz ≤ f < 30 MHz 30 MHz ≤ f < 100 MHz 30 MHz ≤ f < 2 GHz 2 GHz ≤ f < 12.4 GHz 12.4 GHz ≤ f < 18 GHz 18 GHz ≤ f ≤ 26.5 GHz	0.11 dB 0.06 dB 0.07 dB 0.09 dB 0.11 dB 0.12 dB	Agilent N8485A
	0 dBm ≤ P ≤ 20 dBm 10 MHz ≤ f < 30 MHz 30 MHz ≤ f < 2 GHz 2 GHz ≤ f < 12.4 GHz 12.4 GHz ≤ f < 18 GHz 18 GHz ≤ f ≤ 26.5 GHz	0.12 dB 0.08 dB 0.09 dB 0.11 dB 0.12 dB	
RF Absolute Power - Measure	-35 dBm ≤ P < -20 dBm 50 MHz ≤ f < 14 GHz 14 GHz ≤ f < 33 GHz 33 GHz ≤ f < 40 GHz 40 GHz ≤ f ≤ 50 GHz	0.36 dB 0.37 dB 0.38 dB 0.39 dB	Agilent N8487A
	-20 dBm ≤ P < -10 dBm 50 MHz ≤ f < 6 GHz 6 GHz ≤ f < 14 GHz 14 GHz ≤ f < 18 GHz 18 GHz ≤ f < 26.5 GHz 26.5 GHz ≤ f < 33 GHz 33 GHz ≤ f ≤ 50 GHz	0.08 dB 0.09 dB 0.1 dB 0.12 dB 0.14 dB 0.15 dB	
RF Absolute Power - Measure	-10 dBm ≤ P < 10 dBm 50 MHz ≤ f < 500 MHz 500 MHz ≤ f < 1.2 GHz 1.24 GHz ≤ f < 14 GHz 14 GHz ≤ f < 18 GHz 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	0.06 dB 0.08 dB 0.09 dB 0.1 dB 0.13 dB 0.14 dB 0.15 dB 0.19 dB 0.17 dB	



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power - Measure	10 dBm ≤ P ≤ 20 dBm 500 MHz ≤ f < 6 GHz 6 GHz ≤ f < 18 GHz 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	0.07 dB 0.08 dB 0.1 dB 0.12 dB 0.13 dB 0.16 dB 0.17 dB	Agilent N8487A
	-5 dBm ≤ P < 30 dBm 10 MHz ≤ f ≤ 18 GHz 30 dBm ≤ P ≤ 44 dBm 10 MHz ≤ f < 1.2 GHz 1.2 GHz ≤ f < 6 GHz 6 GHz ≤ f < 14 GHz 14 GHz ≤ f ≤ 18 GHz	0.15 dB 0.08 dB 0.09 dB 0.1 dB 0.11 dB	Agilent N8481B
	-5 dBm ≤ P < 30 dBm 100 kHz ≤ f < 500 MHz 500 MHz ≤ f ≤ 6 GHz 30 dBm ≤ P < 35 dBm 100 kHz ≤ f < 500 MHz 500 MHz ≤ f ≤ 6 GHz 35 dBm ≤ P ≤ 44 dBm 100 kHz ≤ f < 500 MHz 500 MHz ≤ f ≤ 6 GHz	0.14 dB 0.15 dB 0.08 dB 0.09 dB 0.09 dB 0.1 dB	Agilent N8482B
	-15 dBm ≤ P < 25 dBm 10 MHz ≤ f < 30 MHz 30 MHz ≤ f < 14 GHz 14 GHz ≤ f ≤ 18 GHz	0.14 dB 0.15 dB 0.16 dB	Agilent N8481H
	25 dBm ≤ P ≤ 35 dBm 30 MHz ≤ f < 1.2 GHz 1.2 GHz ≤ f < 6 GHz 6 GHz ≤ f < 14 GHz 14 GHz ≤ f ≤ 18 GHz	0.1 dB 0.11 dB 0.12 dB 0.13 dB	Agilent N8481H
	-15 dBm ≤ P < 25 dBm 100 kHz ≤ f ≤ 6 GHz 25 dBm ≤ P < 35 dBm 100 kHz ≤ f ≤ 6 GHz 35 dBm = P 100 kHz ≤ f ≤ 6 GHz	0.14 dB 0.09 dB 0.1 dB	Agilent N8482H



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power - Measure	-30 dBm ≤ P < 10 dBm		Agilent V8486A
	f =50 GHz	0.3 dB	
	f =51 GHz	0.34 dB	
	52 GHz ≤ f ≤ 54 GHz	0.33 dB	
	f =55 GHz	0.29 dB	
	56 GHz ≤ f ≤ 59 GHz	0.34 dB	
	f =60 GHz	0.3 dB	
	61 GHz ≤ f ≤ 62 GHz	0.34 dB	
	63 GHz ≤ f ≤ 64 GHz	0.33 dB	
	f =65 GHz	0.29 dB	
	f =66 GHz	0.35 dB	
	f =67 GHz	0.36 dB	
	10 dBm ≤ P ≤ 20 dBm		
	f =50 GHz	0.31 dB	
	51 GHz ≤ f ≤ 54 GHz	0.34 dB	
	f =55 GHz	0.3 dB	
	56 GHz ≤ f ≤ 57 GHz	0.34 dB	
	58 GHz ≤ f ≤ 59 GHz	0.34 dB	
	f =60 GHz	0.3 dB	
	f =61 GHz	0.35 dB	
62 GHz ≤ f ≤ 64 GHz	0.34 dB		
f =65GHz	0.1 dB		
66 GHz ≤ f ≤ 67 GHz	0.36 dB		
RF Absolute Power - Source			Function Generator and DVM Agilent 33250A, Agilent 33120A, Agilent 3458A
f < 10 MHz	0.02 V ≤ V < 7 V	0.082 dB	
10 MHz ≤ f ≤ 50 MHz	0.02 V ≤ V < 7 V	0.16 dB	
50 MHz ≤ f ≤ 80 MHz	0.02 V ≤ V < 7 V	0.4 dB	
20 Hz ≤ f ≤ 20 kHz	V ≤ 10mV	0.017 mV	
20 kHz < f ≤ 50 kHz		0.021 mV	
50 kHz < f ≤ 100 kHz		0.05 mV	
100 kHz < f ≤ 300 kHz		0.38 mV	





Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power - Source $20 \text{ Hz} \leq f \leq 40 \text{ Hz}$ $40 \text{ Hz} \leq f \leq 1 \text{ kHz}$ $1 \text{ kHz} < f \leq 20 \text{ kHz}$ $20 \text{ kHz} < f \leq 50 \text{ kHz}$ $50 \text{ kHz} < f \leq 100 \text{ kHz}$ $100 \text{ kHz} < f \leq 300 \text{ kHz}$ $20 \text{ Hz} \leq f \leq 1 \text{ kHz}$ $1 \text{ kHz} < f \leq 20 \text{ kHz}$ $20 \text{ kHz} < f \leq 50 \text{ kHz}$ $50 \text{ kHz} < f \leq 100 \text{ kHz}$ $100 \text{ kHz} < f \leq 300 \text{ kHz}$ $20 \text{ Hz} \leq f \leq 40 \text{ Hz}$ $40 \text{ Hz} \leq f \leq 1 \text{ kHz}$ $1 \text{ kHz} < f \leq 20 \text{ kHz}$ $20 \text{ kHz} < f \leq 50 \text{ kHz}$ $50 \text{ kHz} < f \leq 100 \text{ kHz}$ $100 \text{ kHz} < f \leq 300 \text{ kHz}$	$10 \text{ mV} < V \leq 100 \text{ mV}$ $100 \text{ mV} < V \leq 1 \text{ V}$ $1 \text{ V} < V \leq 3.5 \text{ V}$	0.029 mV 0.028 mV 0.032 mV 0.045 mV 0.08 mV 0.3 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 mV 13 mV	Function Generator and DVM Agilent 33250A, Agilent 33120A, Agilent 3458A
RF Absolute Power - Source $0.3 \text{ MHz} \leq f \leq 1.1 \text{ GHz}$ $1.1 \text{ GHz} \leq f \leq 2.985 \text{ GHz}$ $2.985 \text{ GHz} < f \leq 4 \text{ GHz}$ $4 \text{ GHz} < f \leq 6 \text{ GHz}$ $0.3 \text{ MHz} \leq f \leq 1.1 \text{ GHz}$ $1.1 \text{ GHz} \leq f \leq 2.985 \text{ GHz}$ $2.985 \text{ GHz} < f \leq 4 \text{ GHz}$ $4 \text{ GHz} < f \leq 6 \text{ GHz}$ $0.3 \text{ MHz} \leq f \leq 1.1 \text{ GHz}$ $1.1 \text{ GHz} \leq f \leq 2.985 \text{ GHz}$ $2.985 \text{ GHz} < f \leq 4 \text{ GHz}$ $4 \text{ GHz} < f \leq 6 \text{ GHz}$	$-7 \text{ dBm} \geq P \geq 0 \text{ dBm}$ $0 \text{ dBm} > P \geq -25 \text{ dBm}$ $-25 \text{ dBm} > P \geq -70 \text{ dBm}$	0.49 dB 0.58 dB 0.69 dB 0.79 dB 0.49 dB 0.59 dB 0.69 dB 0.8 dB 0.5 dB 0.59 dB 0.69 dB 0.8 dB	Signal Source PSG, ESG, E4438C, E4428C



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power - Source 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 0.3 MHz ≤ f ≤ 1.1 GHz 1.1 GHz ≤ f ≤ 2.985 GHz 2.985 GHz < f ≤ 4 GHz 4 GHz < f ≤ 6 GHz	-70 dBm > P ≥ -95 dBm -95 dBm > P ≥ -125 dBm	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, E4438C, E4428C
Pulse - Measure RMS Jitter - Period, Delay and Width	33 MHz to 3 GHz	6.6 ps	HP 54124T or HP 86100
Attenuation - Source Coaxial, 1 dB Step (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	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 8494G with Type-N(f)



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Attenuation - Source Coaxial, 1 dB Step (0 to 11) dB	8 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	HP 8494G with Type-N(f)
	9 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	
	10 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	
	11 dB 50 MHz to 2 GHz (2 to 4) GHz	0.03 dB 0.03 dB	
Attenuation – Source Coaxial, 10 dB Step	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	



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Attenuation – Source Coaxial, 10 dB Step	90 dB 50 MHz to 2 GHz (2 to 4) GHz	0.09 dB 0.08 dB	HP 8496G With Type-N(f)
	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	
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
	6 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	
	10 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	
	20 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	



PARAMETER REFERENCE STANDARD OR EQUIPMENT	RF Absolute Power Measure										
	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



PARAMETER	(S11 - Reflection) Magnitude Uncertainty (lin)									
REFERENCE STANDARD OR EQUIPMENT	85054B, 85031B, ET33700, 85056A, 85058B									
Freq	Measured Magnitude (+/- Linear)									
	≤ 0.1	> 0.1 to ≤ 0.2	> 0.2 to ≤ 0.3	> 0.3 to ≤ 0.4	> 0.4 to ≤ 0.5	> 0.5 to ≤ 0.6	> 0.6 to ≤ 0.7	> 0.7 to ≤ 0.8	> 0.8 to ≤ 0.9	> 0.9 to ≤ 1
(0.02 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	> 0.1 to ≤ 0.2	> 0.2 to ≤ 0.3	> 0.3 to ≤ 0.4	> 0.4 to ≤ 0.5	> 0.5 to ≤ 0.6	> 0.6 to ≤ 0.7	> 0.7 to ≤ 0.8	> 0.8 to ≤ 0.9	> 0.9 to ≤ 1
(0.02 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)								
	10 to ≤ 0	> 0 to ≤ 3	> 3 to ≤ 6	> 6 to ≤ 10	> 10 to ≤ 20	> 20 to ≤ 30	> 30 to ≤ 40	> 40 to ≤ 50	> 50 to ≤ 60
(20 to 130) MHz	0.016	0.015	0.015	0.017	0.02	0.03	0.052	0.074	0.13
(0.13 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)								
	10 to ≤ 0	> 0 to ≤ 3	> 3 to ≤ 6	> 6 to ≤ 10	> 10 to ≤ 20	> 20 to ≤ 30	> 30 to ≤ 40	> 40 to ≤ 50	> 50 to ≤ 60
(20 to 130) MHz	0.16	0.16	0.16	0.17	0.19	0.26	0.66	0.6	0.92
(0.13 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	Symmetricom 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-1498.13.



Vice President

