



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
4729 154th Place NE, Building 87, Room 1437
Redmond, WA 98052

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-1498.17
Certificate Number


ANAB Approval

Certificate Valid: 11/22/2017-11/16/2018
Version No. 001 Issued: 11/22/2017



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

4729 154th Place NE, Building 87, Room 1437

Redmond, WA 98052

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CALIBRATION

Valid to: **November 16, 2018**

Certificate Number: **AC-1498.17**

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 0.3 mA/A + 0.4 mA	Fluke 5720A with Fluke 5725A



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current - Source	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	
	100 MΩ	7.3 kΩ	
AC Voltage - Source	Up to 22 mV		Fluke 5720A
	(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 μ V	
	40 Hz to 1 kHz	0.2 mV/V + 1.2 μ V	
	(1 to 20) kHz	0.3 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	0.3 V/V + 2.6 μ V	
	(50 to 100) kHz	0.8 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	0.3 mV/V + 22 μ V	
	(50 to 100) kHz	0.8 mV/V + 22 μ V	
(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		

Electrical – RF/Microwave

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



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
Phase Modulation – Measure (0.15 to 10) MHz (0.01 to 26.5) GHz	Rate: (0.02 to 10) kHz Rate: (0.2 to 20) kHz	4.1 % Deviation 3.1 % Deviation	HP 8902A
Phase Modulation – Measure 100 kHz to 6.6 GHz (6.6 to 13.2) GHz (13.2 to 26.5) GHz (26.5 to 31.5) GHz (31.5 to 50) GHz	Deviations: (0.3 to 7) rad Deviations: > 7 rad Deviations: (0.6 to 2) rad Deviations: > 2 rad Deviations: (1.2 to 4) rad Deviations: > 4 rad Deviations: (1.3 to 4) rad Deviations: > 4 rad Deviations (2.4 to 8) rad Deviations: > 8 rad	3.1 % Deviation 1 % Deviation 3.1% Deviation 1 % Deviation 3.1 % Deviation 1 % Deviation 3.1% Deviation 1 % Deviation 3.1 % Deviation 1 % Deviation	Keysight E444xA with Opt. 233
Distortion Measure	20 Hz to 20 kHz (20 to 100) kHz	1.2 dB 2.4 dB	HP 8903A/B



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: $f \leq 100\text{kHz}$ $100\text{kHz} \leq f \leq 1\text{MHz}$ $f > 1\text{MHz}$	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 %	
Rho	Mod Frequency Span: $f \leq 100\text{kHz}$ $0.9999 \leq \text{Rho} \leq 1$ $0.9975 \leq \text{Rho} < 0.9999$ $0.9936 \leq \text{Rho} < 0.9975$ $0.99 \leq \text{Rho} < 0.9936$ $0.978 \leq \text{Rho} < 0.99$ $0.96 \leq \text{Rho} < 0.978$	8.6 E-5 0.000 43 0.000 68 0.00 084 0.001 2 0.001 6	



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rho	Mod Frequency Span: 100 kHz ≤ f ≤ 1 MHz		
	0.9999 ≤ Rho ≤ 1	9.6 E-5	
	0.9975 ≤ Rho < 0.9999	0.000 48	
	0.9936 ≤ Rho < 0.9975	0.000 76	
	0.99 ≤ Rho < 0.9936	0.000 94	
	0.978 ≤ Rho < 0.99	0.001 4	
Rho	0.96 ≤ Rho < 0.978	0.001 8	
	Mod Frequency Span: f > 1MHz		
	0.9999 ≤ Rho ≤ 1	1.6 E-4	
	0.9975 ≤ Rho < 0.9999	0.000 82	
	0.9936 ≤ Rho < 0.9975	0.001 3	
	0.99 ≤ Rho < 0.9936	0.001 6	
Tuned RF Power - Absolute - Measure 2.5 MHz to 26.5 GHz	0.978 ≤ Rho < 0.99	0.002 4	
	0.96 ≤ Rho < 0.978	0.003	
	(+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		



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 10 MHz ≤ f < 1.2 GHz	0.1 dB	Agilent 8481B
	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	Agilent 8482B
	6 GHz ≤ f ≤ 18 GHz	0.19 dB	
	0 dBm ≤ P < 30 dBm 100 kHz ≤ f < 500 MHz	0.1 dB	
	500 MHz ≤ f ≤ 4.2 GHz	0.11 dB	
	30 dBm ≤ P < 35 dBm 100 kHz ≤ f < 500 MHz	0.08 dB	Agilent 8481H
	500 MHz ≤ f ≤ 4.2 GHz	0.09 dB	
	35 dBm ≤ P ≤ 44 dBm 100 kHz ≤ f ≤ 4.2 GHz	0.18 dB	Agilent 8481H
	-10 dBm ≤ P < 25 dBm 10 MHz ≤ f < 6 GHz	0.1 dB	
	6 GHz ≤ f < 14 GHz	0.11 dB	
	14 GHz ≤ f ≤ 18 GHz	0.13 dB	Agilent 8481H
25 dBm ≤ P ≤ 35 dBm 10 MHz ≤ f < 6 GHz	0.19 dB		
6 GHz ≤ f ≤ 18 GHz	0.2 dB		



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power - Measure	-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	
	-30 dBm ≤ P < -20 dBm 10 MHz ≤ f < 6 GHz 6 GHz ≤ f ≤ 18 GHz	0.26 dB 0.27 dB	
	-20 dBm ≤ P < -10 dBm 10 MHz ≤ f < 30 MHz 30 MHz ≤ f < 500 MHz 500 MHz ≤ f < 1.2 GHz 1.2 GHz ≤ f < 6 GHz 6 GHz ≤ f < 14 GHz 14 GHz ≤ f ≤ 18 GHz	0.09 dB 0.08 dB 0.07 dB 0.08 dB 0.11 dB 0.12 dB	Agilent 8481A
	-10 dBm ≤ P < 10 dBm 10 MHz ≤ f < 30 MHz 30 MHz ≤ f < 500 MHz 500 MHz ≤ f < 1.2 GHz 1.2 GHz ≤ f < 6 GHz 6 GHz ≤ f < 14 GHz 14 GHz ≤ f ≤ 18 GHz	0.09 dB 0.08 dB 0.06 dB 0.08 dB 0.1 dB 0.11 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 10 MHz ≤ f < 500 MHz 500 MHz ≤ f < 1.2 GHz 1.2 GHz ≤ f < 6 GHz 6 GHz ≤ f ≤ 18 GHz	0.14 dB 0.13 dB 0.14 dB 0.15 dB	Agilent 8481A	
	-30 dBm ≤ P < -20 dBm 100 kHz ≤ f < 10 MHz 10 MHz ≤ f < 1.2 GHz 1.2 GHz ≤ f ≤ 4.2 GHz	0.23 dB 0.22 dB 0.23 dB	Agilent 8482A	
	-20 dBm ≤ P < -10 dBm 100 kHz ≤ f < 10 MHz 10 MHz ≤ f < 1.2 GHz 1.2 GHz ≤ f ≤ 4.2 GHz	0.09 dB 0.07 dB 0.11 dB		
	-10 dBm ≤ P < 10dBm 100 kHz ≤ f < 10 MHz 10 MHz ≤ f < 1.2 GHz 1.1 GHz ≤ f ≤ 4.2 GHz	0.08 dB 0.06 dB 0.1 dB		
	10 dBm ≤ P ≤ 20dBm 100 kHz ≤ f < 10 MHz 10 MHz ≤ f < 1.2 GHz 1.2 GHz ≤ f ≤ 4.2 GHz	0.14 dB 0.13 dB 0.15 dB		
	RF Absolute Power - Measure	-30 dBm ≤ P < -20dBm 50 MHz ≤ f < 18 GHz 18 GHz ≤ f < 26.5 GHz 26.5 GHz ≤ f < 40 GHz 40 GHz ≤ f < 45 GHz 45 GHz ≤ f ≤ 50 GHz	0.23 dB 0.24 dB 0.25 dB 0.27 dB 0.33 dB	Agilent 8487A
		-20 dBm ≤ P < -10dBm 50 MHz ≤ f < 500 MHz 500 MHz ≤ f < 1.2 GHz 1.2 GHz ≤ f < 14 GHz 14 GHz ≤ f < 18 GHz 18 GHz ≤ f < 26.5 GHz 26.5 GHz ≤ f < 40 GHz 40 GHz ≤ f < 45 GHz 45 GHz ≤ f ≤ 50 GHz	0.09 dB 0.08 dB 0.09 dB 0.1 dB 0.12 dB 0.14 dB 0.2 dB 0.22 dB	



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power - Measure	-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	
-30 dBm ≤ P < -20 dBm		Agilent 8483A	
100 kHz ≤ f ≤ 2 GHz	0.23 dB		
-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		
1.2 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		Agilent 8481D	
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		



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power - Measure	-50 dBm ≤ P < -30 dBm 10 MHz ≤ f < 30 MHz 30 MHz ≤ f < 1.2 GHz 1.2 GHz ≤ f < 6 GHz 6 GHz ≤ f < 14 GHz 14 GHz ≤ f ≤ 18 GHz	0.12 dB 0.07 dB 0.08 dB 0.11 dB 0.13 dB	Agilent 8481D
	-30 dBm ≤ P ≤ -20 dBm 10 MHz ≤ f < 30 MHz 30 MHz ≤ f < 1.2 GHz 1.2 GHz ≤ f < 6 GHz 6 GHz ≤ f < 14 GHz 14 GHz ≤ f ≤ 18 GHz	0.11 dB 0.07 dB 0.08 dB 0.1 dB 0.11 dB	
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 6 GHz ≤ f < 14 GHz 14 GHz ≤ f < 18 GHz 18 GHz ≤ f ≤ 26.5 GHz	0.14 dB 0.15 dB 0.16 dB 0.18 dB	
	-50 dBm ≤ P < -30 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 0.11 dB 0.12 dB 0.14 dB	
	-30 dBm ≤ P ≤ -20 dBm 50 MHz ≤ f < 6 GHz 6 GHz ≤ f < 14 GHz 14 GHz ≤ f < 18 GHz 18 GHz ≤ f ≤ 26.5 GHz	0.11 dB 0.12 dB 0.13 dB 0.14 dB	
	-70 dBm ≤ P < -60 dBm 30 MHz ≤ f < 33 GHz 33 GHz ≤ f < 40 GHz 40 GHz ≤ f ≤ 50 GHz	0.82 dB 0.83 dB 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	0.1 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		
		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	
		-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 10 MHz ≤ f < 30 MHz	0.37 dB	Agilent N8481A
	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 14 GHz ≤ f ≤ 18 GHz	0.09 dB 0.11 dB	
RF Absolute Power - Measure	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	
RF Absolute Power - Measure	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 0.30 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 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 $0.3 \text{ MHz} \leq f \leq 1.1 \text{ GHz}$ $1.1 \text{ GHz} \leq f \leq 2.985 \text{ GHz}$ $2.985 \text{ GHz} < f \leq 4 \text{ GHz}$ $4 \text{ GHz} < f \leq 6 \text{ GHz}$ $0.3 \text{ MHz} \leq f \leq 1.1 \text{ GHz}$ $1.1 \text{ GHz} \leq f \leq 2.985 \text{ GHz}$ $2.985 \text{ GHz} < f \leq 4 \text{ GHz}$ $4 \text{ GHz} < f \leq 6 \text{ GHz}$	$-70 \text{ dBm} > P \geq -95 \text{ dBm}$ $-95 \text{ dBm} > P \geq -125 \text{ dBm}$	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
Rise Time	2 kHz to 2 MHz (200 to 300) ps (2 to 10) MHz (200 to 350) ps	37 ps 37 ps	Fluke 55xxA + SC600/1100
Thermal Noise - Source ENR (14 to 16) dB	10 MHz to 18 GHz SWR 1.25:1 (18 to 26.5) GHz SWR 1.35:1	0.21 dB 0.22 dB	HP 346B w/ APC-3.5
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



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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Attenuation - Source Coaxial, 1 dB Step (0 to 11) dB	0 dB		HP 8494G with Type-N(f)
	50 MHz to 2 GHz	0.03 dB	
	(2 to 4) GHz	0.03 dB	
	1 dB		
	50 MHz to 2 GHz	0.03 dB	
	(2 to 4) GHz	0.03 dB	
	2 dB		
	50 MHz to 2 GHz	0.03 dB	
	(2 to 4) GHz	0.03 dB	
	3 dB		
	50 MHz to 2 GHz	0.03 dB	
	(2 to 4) GHz	0.03 dB	
	4 dB		
	50 MHz to 2 GHz	0.03 dB	
	(2 to 4) GHz	0.03 dB	
	5 dB		
	50 MHz to 2 GHz	0.03 dB	
	(2 to 4) GHz	0.03 dB	
6 dB			
50 MHz to 2 GHz	0.03 dB		
(2 to 4) GHz	0.03 dB		
7 dB			
50 MHz to 2 GHz	0.03 dB		
(2 to 4) GHz	0.03 dB		
8 dB			
50 MHz to 2 GHz	0.03 dB		
(2 to 4) GHz	0.03 dB		
9 dB			
50 MHz to 2 GHz	0.03 dB		
(2 to 4) GHz	0.03 dB		
10 dB			
50 MHz to 2 GHz	0.03 dB		
(2 to 4) GHz	0.03 dB		
11 dB			HP 8496G w/ Type-N(f)
50 MHz to 2 GHz	0.03 dB		
(2 to 4) GHz	0.03 dB		



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Attenuation – Source Coaxial, 10 dB Step	0 dB		HP 8496G With Type-N(f)
	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	
	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		



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment	
<p>Attenuation - Source Coaxial, Fixed</p>	3 dB		<p>HP 8491A/B With Type-N</p>	
	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		
	6 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		
	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 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-1498.17.



Vice President

