



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Keysight Technologies Japan K.K.
9-1, Takakura-cho, Hachioji-shi
Tokyo, 192-8550 Japan

Fulfills the requirements of

ISO/IEC 17025:2017

In the field of

CALIBRATION

This certificate is valid only when accompanied by a current scope of accreditation document.
The current scope of accreditation can be verified at www.anab.org.

Jason Stine, Vice President

Expiry Date: 15 March 2027

Certificate Number: AC-1930



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory
quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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CALIBRATION

Valid to: **March 15, 2027**

Certificate Number: **AC-1930**

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 + 0.41 μ V 4.7 μ V/V + 0.62 μ V 3.1 μ V/V + 2.3 μ V 3.1 μ V/V + 4.5 μ V 4.7 μ V/V + 39 μ V 6.2 μ V/V + 0.39 mV	Comparison to Fluke 57X0A Multi Product Calibrator
DC Voltage – Source Fixed Value	0 V 100 mV 1 V 10 V 100 V 1 kV	54 nV 91 nV 0.32 μ V 2.5 μ V 38 μ V 0.66 mV	Comparison to Fluke 57X0A Multi Product Calibrator, + Keysight 3458A ² Multimeter
DC Voltage – Source Fixed Value	10 V	0.7 μ V/V	Comparison to Fluke 732A Voltage Standard
DC Voltage – Measure ¹	Up to 100 mV 100 mV to 1 V (1 to 12) V (12 to 120) V 120 V to 1 050 kV	6.4 μ V/V + 0.41 μ V 5.9 μ V/V + 0.41 μ V 5.3 μ V/V + 0.91 μ V 7.5 μ V/V + 41 μ V 7.5 μ V/V + 0.14 mV	Comparison to Keysight 3458 Multimeter
DC Current - Source	Up to 220 μ A 220 μ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 10) A	39 μ A/A + 5 nA 31 μ A/A + 6 nA 31 μ A/A + 39 nA 39 μ A/A + 0.62 μ A 70 μ A/A + 12 μ A 0.28 mA/A + 0.38 mA	Comparison to Fluke 57X0A Multi Product Calibrator



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
DC Current - Source	(10 to 20.5) A	0.78 mA/A + 0.59 mA	Comparison to Fluke 5520A Multi Product Calibrator
DC Current – Source Fixed Value	0 A 100 μA 1 mA 10 mA 100 mA 1 A	42 pA 0.15 nA 1.5 nA 17 nA 0.47 μA 9.6 μA	Comparison to Fluke 57X0A Multi Product Calibrator + Keysight 3458A ² Multimeter
DC Current – Measure ¹	Up to 100 nA (0.1 to 1.2) μA (1.2 to 12) μA (12 to 120) μA 120 μA to 1.2 mA (1.2 to 12) mA (12 to 120) mA 120 mA to 1.05 A	41 μA/A + 63 pA 23 μA/A + 63 pA 23 μA/A + 0.13 nA 23 μA/A + 1.1 nA 23 μA/A + 7.4 nA 23 μA/A + 74 nA 40 μA/A + 0.74 μA 0.12 mA/A + 13 μA	Comparison to Keysight 3458A Multimeter
DC Current – Measure ¹	(1 to 15) A (15 to 50) A (50 to 100) A (100 to 500) A (500 to 1 000) A	74 μA/A + 0.056 μA 73 μA/A + 36 μA 72 μA/A + 1.5 mA 58 μA/A + 40 μA 140 μA/A + 0.42 mA	Comparison to Guildline 9230 Shunt + Keysight 3458A Multimeter
DC Current – Measure ¹	(5 to 10) A (10 to 30) A (30 to 36) A (36 to 45) A (45 to 60) A (60 to 90) A (90 to 180) A (180 to 340) A (340 to 510) A (510 to 1 000) A	93 μA/A + 0.39 mA 140 μA/A 94 μA/A + 1.5 mA 92 μA/A + 1.9 mA 93 μA/A + 2.6 mA 91 μA/A + 4 mA 87 μA/A + 8.5 mA 200 μA/A 180 μA/A + 8.8 mA 180 μA/A + 18 mA	Comparison to Keysight 3458A DMM + CT1000 Transducer



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Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
DC Current – Measure ¹	Shunt 100 kΩ (1 to 11.5) μA	13 μA/A + 28 pA	Comparison to Keysight 16353A Shunt + Keysight 3458A Multimeter
	Shunt 1 MΩ (0.1 to 1.15) μA	20 μA/A + 1.7 pA	
	Shunt 10 MΩ (10 to 115) nA (1 to 11.5) nA	51 μA/A + 0.54 pA 26 μA/A + 0.25 pA	
	Shunt 100 MΩ (1 to 11.5) nA	0.14 mA/A + 0.11 pA	
	Shunt 1 GΩ (0.1 to 1.15) nA (10 to 115) pA	0.24 mA/A + 21 fA 0.24 mA/A + 1.4 fA	
	Shunt 10 GΩ (10 to 115) pA	0.92 mA/A + 0.38 fA	
	Shunt 100 GΩ – (0.1 to 1.15) pA	0.83 mA/A + 0.59 fA	
	DC Current – Measure ¹	(1 to 3) A (3 to 20) A	
DC Voltage - with Divider	Up to 1 mV 1 mV	8.6 μV/V + 3 nV 10 nV	Comparison to Fluke 57X0A Multi Product Calibrator + Voltage divider
	(1 to 10) mV 10 mV	7.5 μV/V + 5 nV 76 nV	
DC Voltage - with Divider ¹	(1 to 3) kV	110 μV/V	Comparison to Keysight 16332A High Voltage Divider + Keysight 3458A Multimeter
DC Voltage - with Divider ¹	(1 to 5) kV	110 μV/V	Comparison to Ohm-Labs KVVB-5-5 Voltage Divider + Keysight 3458A Multimeter
Resistance - Source	1 Ω	6 μΩ/Ω	Comparison to Fluke 742A Resistance Standards
	10 Ω	1.7 μΩ/Ω	



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Resistance - Source	1 Ω	22 μΩ/Ω	Comparison to Fluke 57X0A Multi Product Calibrator
	10 Ω	7.1 μΩ/Ω	
	100 Ω	3.5 μΩ/Ω	
	1 kΩ	3 μΩ/Ω	
	10 kΩ	2.9 μΩ/Ω	
	100 kΩ	3.4 μΩ/Ω	
	1 MΩ	4.3 μΩ/Ω	
	10 MΩ	12 μΩ/Ω	
	100 MΩ	55 μΩ/Ω	
	1.9 Ω	14 μΩ/Ω	
	19 Ω	6.7 μΩ/Ω	
	190 Ω	3.4 μΩ/Ω	
	1.9 kΩ	3 μΩ/Ω	
	19 kΩ	3.4 μΩ/Ω	
	190 kΩ	4.2 μΩ/Ω	
1.9 MΩ	4.6 μΩ/Ω		
19 MΩ	17 μΩ/Ω		
Resistance - Source	(0 to 11) Ω	31 μΩ/Ω + 0.78 mΩ	Comparison to Fluke 5520A Multi Product Calibrator
	(11 to 33) Ω	23 μΩ/Ω + 1.2 mΩ	
	(33 to 110) Ω	22 μΩ/Ω + 1.1 mΩ	
	(110 to 330) Ω	22 μΩ/Ω + 1.6 mΩ	
	330 Ω to 1.1 kΩ	22 μΩ/Ω + 1.6 mΩ	
	(1.1 to 3.3) kΩ	22 μΩ/Ω + 16 mΩ	
	(3.3 to 11) kΩ	22 μΩ/Ω + 16 mΩ	
	(11 to 33) kΩ	22 μΩ/Ω + 0.16 Ω	
	(33 to 110) kΩ	22 μΩ/Ω + 0.16 Ω	
	(110 to 330) kΩ	25 μΩ/Ω + 1.6 Ω	
330 kΩ to 1.1 MΩ	25 μΩ/Ω + 1.6 Ω		
(1.1 to 3.3) MΩ	47 μΩ/Ω + 23 Ω		
Resistance - Source	(3.3 to 11) MΩ	0.1 mΩ/Ω + 39 Ω	Comparison to Fluke 5520A Multi Product Calibrator
	(11 to 33) MΩ	0.19 mΩ/Ω + 1.9 kΩ	
	(33 to 110) MΩ	0.39 mΩ/Ω + 2.3 kΩ	
	(110 to 330) MΩ	2.3 mΩ/Ω + 78 kΩ	
	330 MΩ to 1.1 GΩ	12 mΩ/Ω + 0.39 MΩ	



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Resistance – Source Fixed Values	0 Ω	7.6 μΩ	Comparison to Fluke 57X0A Multi Product Calibrator + Keysight 3458A ² Multimeter
	10 Ω	13 μΩ	
	100 Ω	76 μΩ	
	1 kΩ	0.4 mΩ	
	10 kΩ	4.5 mΩ	
	100 kΩ	42 mΩ	
	1 MΩ	0.88 Ω	
	10 MΩ	22 Ω	
Resistance – Measure ¹	(0 to 10) Ω	20 μΩ/Ω + 79 μΩ	Comparison to Keysight 3458A Multimeter
	(10 to 100) Ω	15 μΩ/Ω + 0.79 mΩ	
	100 Ω to 1 kΩ	13 μΩ/Ω + 0.79 mΩ	
	(1 to 10) kΩ	13 μΩ/Ω + 7.8 mΩ	
	(10 to 100) kΩ	13 μΩ/Ω + 78 mΩ	
	100 kΩ to 1 MΩ	17 μΩ/Ω + 2.6 Ω	
	(1 to 10) MΩ	61 μΩ/Ω + 0.12 kΩ	
	(10 to 100) MΩ	0.58 mΩ/Ω + 3.6 kΩ	
AC Current - Source	Up to 220 μA		Comparison to Fluke 57X0A Multi Product Calibrator
	(10 to 20) Hz	0.23 mA/A + 16 nA	
	(20 to 40) Hz	0.16 mA/A + 9.3 nA	
	40 Hz to 1 kHz	0.11 mA/A + 7.8 nA	
	(1 to 5) kHz	0.27 mA/A + 12 nA	
	(5 to 10) kHz	1 mA/A + 62 nA	
	220 μA to 2.2 mA		
	(10 to 20) Hz	0.23 mA/A + 40 nA	
	(20 to 40) Hz	0.16 mA/A + 32 nA	
	40 Hz to 1 kHz	0.11 mA/A + 31 nA	
	(1 to 5) kHz	0.19 mA/A + 0.10 μA	
	(5 to 10) kHz	1 mA/A + 0.62 μA	
	(2.2 to 22) mA		
	(10 to 20) Hz	0.23 mA/A + 0.39 μA	
	(20 to 40) Hz	0.16 mA/A + 0.31 μA	
	40 Hz to 1 kHz	0.11 mA/A + 0.31 μA	
(1 to 5) kHz	0.19 mA/A + 0.54 μA		
(5 to 10) kHz	1 mA/A + 4.7 μA		

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Current - Source	(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	0.23 mA/A + 4 μ A 0.16 mA/A + 3.1 μ A 0.11 mA/A + 2.3 μ A 0.19 mA/A + 3.1 μ A 1 mA/A + 9.3 μ A	Comparison to Fluke 57X0A Multi Product Calibrator
	220 mA to 2.2 A 20 Hz - 1 kHz (1 to 5) kHz (5 to 10) kHz (2.2 to 11) A 40 Hz - 1 kHz (1 to 5) kHz (5 to 10) kHz	0.25 mA/A + 32 μ A 0.39 mA/A + 78 μ A 6.2 mA/A + 0.16 mA 0.36 mA/A + 0.17 mA 0.74 mA/A + 0.37 mA 2.8 mA/A + 0.64 mA	
AC Current – Source Fixed Values	1 kHz 10 μ A 100 μ A 1 mA 10 mA 100 mA 1 A	3 nA 2.6 nA 33 nA 0.33 μ A 3.3 μ A 38 μ A	Comparison to Fluke 57X0A Multi Product Calibrator + Keysight 3458A ² Multimeter
AC Current – Measure ¹	Up to 120 μ A (10 to 20) Hz (20 to 45) Hz 45 Hz to 5 kHz	4.6 mA/A + 34 nA 1.7 mA/A + 34 nA 0.69 mA/A + 34 nA	Comparison to Keysight 3458A Multimeter
	120 μ A to 1.2 mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	4.6 mA/A + 0.23 μ A 1.7 mA/A + 0.23 μ A 0.69 mA/A + 0.23 μ A 0.35 mA/A + 0.23 μ A	
	(1.2 to 12) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	4.6 mA/A + 2.3 μ A 1.7 mA/A + 2.3 μ A 0.69 mA/A + 2.3 μ A 0.35 mA/A + 2.3 μ A	
	(12 to 120) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	4.6 mA/A + 23 μ A 1.7 mA/A + 23 μ A 0.69 mA/A + 23 μ A 0.35 mA/A + 23 μ A	



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Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Current - Measure	120 mA to 1.05 A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	4.6 mA/A + 0.23 mA 1.8 mA/A + 0.23 mA 0.93 mA/A + 0.23 m 1.1 mA/A + 0.23 mA	Comparison to Keysight 3458A Multimeter
AC Current – Measure ¹	(1 to 10) A (1 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz	2 mA/A 1 mA/A 8 mA/A	Comparison to Guildline 9230 Shunt + Keysight 3458A Multimeter
AC Current – Measure ¹	(45 Hz to 100 Hz) (5 to 10) A (10 to 60) A (60 to 90) A (90 to 180) A (180 to 240) A (240 to 360) A (360 to 700) A	0.82 mA/A + 1.5 mA 1 mA/A 0.78 mA/A + 18 mA 0.78 mA/A + 37 mA 1 mA/A + 0.12 A 1 mA/A + 0.18 A 1 mA/A + 0.36 A	Comparison to Keysight 3458A DMM + CT1000 Transducer
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	0.23 mV/V + 3.9 μV 90 μV/V + 3.9 μV 78 μV/V + 3.9 μV 0.19 mV/V + 3.9 μV 0.47 mV/V + 4.7 μV 1 mV/V + 9.3 μV 1.3 mV/V + 19 μV 2.6 mV/V + 19 μV 0.23 mV/V + 12 μV 89 μV/V + 6.2 μV 78 μV/V + 6.2 μV 0.19 mV/V + 6.3 μV 0.47 mV/V + 16 μV 0.9 mV/V + 19 μV 1.3 mV/V + 23 μV 2.6 mV/V + 47 μV	Comparison to Fluke 57X0A Multi Product Calibrator



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage - Source	220 mV to 2.2 V		Comparison to Fluke 57X0A Multi Product Calibrator
	(10 to 20) Hz	0.23 mV/V + 39 μ V	
	(20 to 40) Hz	85 μ V/V + 16 μ V	
	40 Hz to 20 kHz	40 μ V/V + 8.5 μ V	
	(20 to 50) kHz	70 μ V/V + 10 μ V	
	(50 to 100) kHz	0.1 mV/V + 32 μ V	
	(100 to 300) kHz	0.39 mV/V + 78 μ V	
	(300 to 500) kHz	0.93 mV/V + 0.19 mV	
	500 kHz to 1 MHz	1.6 mV/V + 0.31 mV	
	(2.2 to 22) V		
	(10 to 20) Hz	0.23 mV/V + 0.39 mV	
	(20 to 40) Hz	85 μ V/V + 0.16 mV	
	40 Hz to 20 kHz	40 μ V/V + 59 μ V	
	(20 to 50) kHz	70 μ V/V + 98 μ V	
	(50 to 100) kHz	93 μ V/V + 0.2 mV	
	(100 to 300) kHz	0.25 mV/V + 0.62 mV	
	(300 to 500) kHz	0.93 mV/V + 1.9 mV	
	500 kHz to 1 MHz	1.4 mV/V + 3.1 mV	
	(22 to 220) V		
	(10 to 20) Hz	0.23 mV/V + 3.9 mV	
	(20 to 40) Hz	85 μ V/V + 1.6 mV	
	40 Hz to 20 kHz	50 μ V/V + 0.59 mV	
	(20 to 50) kHz	78 μ V/V + 1 mV	
	(50 to 100) kHz	0.14 mV/V + 2.4 mV	
(100 to 300) kHz	0.85 mV/V + 16 mV		
(300 to 500) kHz	4.2 mV/V + 39 mV		
500 kHz to 1 MHz	7.8 mV/V + 78 mV		
(220 to 750) V			
(30 to 50) kHz	0.47 mV/V + 9 mV		
(50 to 100) kHz	1.8 mV/V + 35 mV		
220 V to 1.1 kV			
(15 to 50) Hz	0.28 mV/V + 16 mV		
50 Hz to 1 kHz	66 μ V/V + 3.8 mV		
(1 to 20) kHz	0.13 mV/V + 5.2 mV		
(20 to 30) kHz	0.47 mV/V + 9 mV		



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage - Source Fixed Values	10 mV		Comparison to Fluke 57X0A Multi Product Calibrator + Keysight 3458A ² Multimeter
	1 kHz	0.64 μ V	
	20 kHz	0.31 μ V	
	100 kHz	4.2 μ V	
	300 kHz	33 μ V	
	1 MHz	5.1 μ V	
	4 MHz	28 μ V	
	100 mV		
	1 kHz	1.2 μ V	
	20 kHz	1.3 μ V	
	100 kHz	9 μ V	
	300 kHz	51 μ V	
	1 MHz	13 μ V	
	4 MHz	0.11 mV	
	8 MHz	0.18 mV	
	10 MHz	0.27 mV	
	1 V		
	1 kHz	6.1 μ V	
	20 kHz	12 μ V	
	50 kHz	24 μ V	
	100 kHz	55 μ V	
	300 kHz	0.2 mV	
	500 kHz	0.66 mV	
	1 MHz	0.28 mV	
4 MHz	1 mV		
8 MHz	1.7 mV		
10 MHz	2.3 mV		
3 V			
100 kHz	0.17 mV		
2 MHz	2.4 mV		
4 MHz	3.4 mV		
8 MHz	5.2 mV		
10 MHz	6.8 mV		



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AC Voltage - Source Fixed Values	10 V		Comparison to Fluke 57X0A Multi Product Calibrator + Keysight 3458A ² Multimeter
	10 Hz	0.13 mV	
	20 Hz	0.15 mV	
	40 Hz	0.16 mV	
	200 Hz	65 μV	
	500 Hz	63 μV	
	1 kHz	56 μV	
	10 kHz	0.12 mV	
	20 kHz	0.12 mV	
	50 kHz	0.19 mV	
	100 kHz	0.42 mV	
	300 kHz	1.5 mV	
	500 kHz	5 mV	
	1 MHz	5.1 mV	
	100 V	0.99 mV	
1 kHz	1.4 mV		
20 kHz	2.6 mV		
50 kHz	6.5 mV		
100 kHz			
700 V	14 mV		
1 kHz			
AC Voltage – Measure ¹	Up to 10 mV		Comparison to Keysight 3458A Multimeter
	(1 to 40) Hz	0.35 mV/V + 3.4 μV	
	40 Hz to 1 kHz	0.23 mV/V + 1.3 μV	
	(1 to 20) kHz	0.34 mV/V + 1.3 μV	
	(20 to 50) kHz	1.1 mV/V + 1.3 μV	
	(50 to 100) kHz	5.7 mV/V + 1.2 μV	
	(100 to 300) kHz	46 mV/V + 2.3 μV	
	300 kHz to 1 MHz	14 mV/V + 5.8 μV	
(1 to 4) MHz	81 mV/V + 8.1 μV		
(4 to 8) MHz	230 mV/V + 9.2 μV		



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Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage – Measure ¹	(10 to 100) mV		Comparison to Keysight 3458A Multimeter
	(1 to 40) Hz	83 μ V/V + 4.6 μ V	
	40 Hz to 1 kHz	83 μ V/V + 2.3 μ V	
	(1 to 20) kHz	0.16 mV/V + 2.3 μ V	
	(20 to 50) kHz	0.34 mV/V + 2.3 μ V	
	(50 to 100) kHz	0.92 mV/V + 2.3 μ V	
	(100 to 300) kHz	3.4 mV/V + 12 μ V	
	300 kHz to 1 MHz	11 mV/V + 12 μ V	
	(1 to 2) MHz	17 mV/V + 12 μ V	
	(2 to 4) MHz	46 mV/V + 81 μ V	
	(4 to 8) MHz	46 mV/V + 92 μ V	
	(8 to 10) MHz	170 mV/V + 120 μ V	
	120 mV to 1.2 V		
	(1 to 40) Hz	83 μ V/V + 46 μ V	
	40 Hz to 1 kHz	83 μ V/V + 23 μ V	
	(1 to 20) kHz	0.16 mV/V + 23 μ V	
	(20 to 50) kHz	0.34 mV/V + 23 μ V	
	(50 to 100) kHz	0.92 mV/V + 23 μ V	
	(100 to 300) kHz	3.4 mV/V + 0.11 mV	
	300 kHz to 1 MHz	11 mV/V + 0.12 mV	
	(1 to 2) MHz	17 mV/V + 0.12 mV	
	(2 to 4) MHz	46 mV/V + 0.81 mV	
	(4 to 8) MHz	46 mV/V + 0.92 mV	
	(8 to 10) MHz	170 mV/V + 1.2 mV	
	(1.2 to 12) V		
	(1 to 40) Hz	83 μ V/V + 0.46 mV	
	40 Hz to 1 kHz	83 μ V/V + 0.23 mV	
(1 to 20) kHz	0.16 mV/V + 0.23 mV		
(20 to 50) kHz	0.34 mV/V + 0.23 mV		
(50 to 100) kHz	0.92 mV/V + 0.23 mV		
(100 to 300) kHz	3.4 mV/V + 1.2 mV		
300 kHz to 1 MHz	11 mV/V + 1.2 mV		
(1 to 2) MHz	17 mV/V + 0.12 mV		
(2 to 4) MHz	46 mV/V + 0.81 mV		
(4 to 8) MHz	46 mV/V + 0.92 mV		
(8 to 10) MHz	170 mV/V + 1.2 mV		



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AC Voltage – Measure ¹	(12 to 120) V		Comparison to Keysight 3458A Multimeter
	(1 to 40) Hz	0.23 mV/V + 4.6 mV	
	40 Hz to 1 kHz	0.23 mV/V + 2.3 mV	
	(1 to 20) kHz	0.23 mV/V + 2.3 mV	
	(20 to 50) kHz	0.4 mV/V + 2.3 mV	
	(50 to 100) kHz	1.4 mV/V + 2.3 mV	
	(100 to 300) kHz	4.6 mV/V + 11 mV	
	300 kHz to 1 MHz	17 mV/V + 11 mV	
	(120 to 750) V		
	(1 to 40) Hz	0.46 mV/V + 46 mV	
	40 Hz to 1 kHz	0.46 mV/V + 23 mV	
	(1 to 20) kHz	0.7 mV/V + 23 mV	
	(20 to 50) kHz	1.4 mV/V + 23 mV	
	(50 to 100) kHz	3.5 mV/V + 23 mV	
4 Terminal Pair Resistance – Source ¹	1 mΩ		Comparison to Keysight 42030A, 42040A Standard Resistor
	1 kHz	0.085 % of reading	
	10 mΩ		
	1 kHz	0.028 % of reading	
	100 mΩ		
	100 Hz	0.03 % of reading	
	1 kHz	0.029 % of reading	
	1 Ω		
	120 Hz	0.014 % of reading	
	1 kHz	0.006 1 % of reading	
	10 Ω		
	(20 to 100) Hz	0.036 % of reading	
	120 Hz	0.003 1 % of reading	
	1 kHz	0.003 1 % of reading	
	100 Hz to 1 MHz	0.094 % of reading	
	2 MHz	0.094 % of reading	
	3 MHz	0.1 % of reading	
	4 MHz	0.1 % of reading	
5 MHz	0.12 % of reading		
10 MHz	0.4 % of reading		
13 MHz	0.6 % of reading		



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4 Terminal Pair Resistance – Source ¹	100 Ω		Comparison to Keysight 42030A, 42040A Standard Resistor	
	20 Hz	0.003 2 % of reading		
	(20 to 100) Hz	0.044 % of reading		
	125 Hz	0.002 7 % of reading		
	1 kHz	0.003 % of reading		
	12.5 kHz	0.002 9 % of reading		
	48 kHz	0.003 3 % of reading		
	96 kHz	0.004 5 % of reading		
	100 Hz to 1 MHz	0.043 % of reading		
	1 MHz	0.003 9 % of reading		
	2 MHz	0.04 % of reading		
	3 MHz	0.05 % of reading		
	4 MHz	0.05 % of reading		
	5 MHz	0.05 % of reading		
	10 MHz	0.2 % of reading		
	13 MHz	0.3 % of reading		
	1 kΩ			
	20 Hz	0.003 8 % of reading		
	(20 to 100) Hz	0.049 % of reading		
	125 Hz	0.003 7 % of reading		
	1 kHz	0.002 9 % of reading		
	12.5 kHz	0.003 % of reading		
	48 kHz	0.003 4 % of reading		
	96 kHz	0.004 2 % of reading		
	100 kHz	0.03 % of reading		
	100 Hz to 100 kHz	0.033 % of reading		
	100 kHz to 1 MHz	0.033 % of reading		
	1 MHz	0.004 2 % of reading		
	2 MHz	0.03 % of reading		
	3 MHz	0.03 % of reading		
	4 MHz	0.04 % of reading		
	5 MHz	0.05 % of reading		
	10 MHz	0.2 % of reading		
13 MHz	0.3 % of reading			



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
4 Terminal Pair Resistance – Source ¹	10 kΩ		Comparison to Keysight 42030A, 42040A Standard Resistor
	1 kHz	0.006 4 % of reading	
	20 Hz to 100 kHz	0.023 % of reading	
	100 kHz	0.02 % of reading	
	100 kHz to 1 MHz	0.032 % of reading	
	1 MHz	0.03 % of reading	
	100 kΩ		
	20 Hz to 100 kHz	0.088 % of reading	
	100 kHz	0.004 1 % of reading	
	100 kHz to 1 MHz	0.089 % of reading	
1 MHz	0.004 3 % of reading		
4 Terminal Pair Capacitance – Source ¹	1 pF		Comparison to Keysight 16380A/C Standard Capacitor
	(20 to 100) Hz	7.7 % of reading	
	100 Hz to 1 kHz	5.2 % of reading	
	1 kHz	0.26 % of reading	
	1 kHz to 1 MHz	0.26 % of reading	
	1 MHz	0.031 % of reading	
	2 MHz	0.037 % of reading	
	3 MHz	0.052 % of reading	
	4 MHz	0.07 % of reading	
	5 MHz	0.091 % of reading	
	10 MHz	0.25 % of reading	
	13 MHz	0.37 % of reading	
	10 pF		
	(20 to 100) Hz	5.8 % of reading	
	100 Hz to 1 kHz	0.53 % of reading	
	1 kHz	0.018 % of reading	
	12.5 kHz	0.017 % of reading	
	48 kHz	0.016 % of reading	
	96 kHz	0.016 % of reading	
	100 kHz	0.016 % of reading	
	300 kHz	0.016 % of reading	
	500 kHz	0.016 % of reading	
	1 kHz to 1 MHz	0.023 % of reading	
	1 MHz	0.016 % of reading	
	2 MHz	0.016 % of reading	
	3 MHz	0.018 % of reading	
	4 MHz	0.018 % of reading	
	5 MHz	0.018 % of reading	
10 MHz	0.022 % of reading		
13 MHz	0.024 % of reading		



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment	
4 Terminal Pair Capacitance – Source ¹	100 pF		Comparison to Keysight 16380A/C Standard Capacitor	
	(20 to 100) Hz	0.85 % of reading		
	125 Hz	0.11 % of reading		
	100 Hz to 1 kHz	0.046 % of reading		
	1 kHz	0.012 % of reading		
	12.5 kHz	0.01 % of reading		
	48 kHz	0.01 % of reading		
	96 kHz	0.01 % of reading		
	100 kHz	0.013 % of reading		
	300 kHz	0.01 % of reading		
	500 kHz	0.01 % of reading		
	1 kHz to 1 MHz	0.014 % of reading		
	1 MHz	0.01 % of reading		
	2 MHz	0.01 % of reading		
	3 MHz	0.015 % of reading		
	4 MHz	0.016 % of reading		
	5 MHz	0.019 % of reading		
	10 MHz	0.036 % of reading		
	13 MHz	0.051 % of reading		
	1 000 pF			
	20 Hz	0.083 % of reading		
	(20 to 125) Hz	0.084 % of reading		
	100 Hz	0.015 % of reading		
	125 Hz	0.015 % of reading		
	100 Hz to 1 kHz	0.075 % of reading		
	1 kHz	0.01 % of reading		
	10 kHz	0.018 % of reading		
	12.5 kHz	0.011 % of reading		
	48 kHz	0.011 % of reading		
	96 kHz	0.011 % of reading		
	100 kHz	0.018 % of reading		
	300 kHz	0.013 % of reading		
	500 kHz	0.016 % of reading		
	1 kHz to 1 MHz	0.076 % of reading		
	1 MHz	0.012 % of reading		
	2 MHz	0.018 % of reading		
3 MHz	0.031 % of reading			
4 MHz	0.046 % of reading			
5 MHz	0.064 % of reading			
10 MHz	0.19 % of reading			
13 MHz	0.28 % of reading			



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
4 Terminal Pair Capacitance – Source ¹	10 nF	0.013 % of reading	Comparison to Keysight 16380A/C Standard Capacitor
	100 Hz	0.013 % of reading	
	120 Hz	0.01 % of reading	
	1 kHz	0.013 % of reading	
	10 kHz	0.013 % of reading	
	100 kHz	0.013 % of reading	
	100 nF	0.0097 % of reading	
	100 Hz	0.0097 % of reading	
	120 Hz	0.0097 % of reading	
	1 kHz	0.011 % of reading	
	10 kHz	0.0097 % of reading	
	100 kHz	0.013 % of reading	
	1 μF	0.013 % of reading	
	100 Hz	0.013 % of reading	
	120 Hz	0.01 % of reading	
	1 kHz	0.013 % of reading	
	10 kHz	0.015 % of reading	
	100 kHz	0.015 % of reading	
Dissipation Factor - Source ^{1,4}	DF = 0 to 0.01	0.012 % of reading	Comparison to Keysight 16380A/C Standard Capacitor
	1 pF	0.011 % of reading	
	100 Hz to 1 kHz	0.011 % of reading	
	1 kHz	0.011 % of reading	
	1 kHz to 1 MHz	0.011 % of reading	
	1 MHz	0.019 % of reading	
	2 MHz	0.025	
	3 MHz	0.0024	
	4 MHz	0.0024	
	5 MHz	0.00069	
	10 MHz	0.00095	
	13 MHz	0.00041	
		0.00042	



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Dissipation Factor - Source ^{1,4}	DF = 0 to 0.01		Comparison to Keysight 16380A/C Standard Capacitor
	10 pF	0.003 9	
	100 Hz to 1 kHz	0.000 071	
	1 kHz	0.000 061	
	12.5 kHz	0.000 061	
	48 kHz	0.000 061	
	96 kHz	0.000 061	
	100 kHz	0.000 061	
	300 kHz	0.000 061	
	500 kHz	0.000 061	
	1 kHz to 1 MHz	0.000 24	
	1 MHz	0.000 061	
	2 MHz	0.000 061	
	3 MHz	0.000 11	
	4 MHz	0.000 11	
	5 MHz	0.000 067	
	10 MHz	0.000 12	
	13 MHz	0.000 13	
	100 pF	0.003	
	(20 to 125) Hz	0.000 72	
	125 Hz	0.000 43	
	100 Hz to 1 kHz	0.000 061	
	1 kHz	0.000 061	
	12.5 kHz	0.000 061	
	48 kHz	0.000 061	
	96 kHz	0.000 061	
	100 kHz	0.000 061	
	300 kHz	0.000 061	
	500 kHz	0.000 061	
	1 kHz to 1 MHz	0.000 086	
	1 MHz	0.000 061	
	2 MHz	0.000 061	
	3 MHz	0.000 089	
4 MHz	0.000 097		
5 MHz	0.000 087		
10 MHz	0.000 018		
13 MHz	0.000 25		



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment	
Dissipation Factor - Source ^{1,4}	DF = 0 to 0.01		Comparison to Keysight 16380A/C Standard Capacitor	
	1 000 pF			
	20 Hz	0.000 31		
	(20 to 125) Hz	0.000 54		
	125 Hz	0.000 077		
	100 Hz to 1 kHz	0.000 46		
	1 kHz	0.000 061		
	10 kHz	0.000 065		
	12.5 kHz	0.000 065		
	48 kHz	0.000 065		
	96 kHz	0.000 065		
	100 kHz	0.000 065		
	300 kHz	0.000 065		
	500 kHz	0.000 065		
	1 kHz to 1 MHz	0.000 085		
	1 MHz	0.000 065		
	2 MHz	0.000 083		
	3 MHz	0.000 13		
	4 MHz	0.000 17		
	5 MHz	0.000 22		
	10 MHz	0.000 59		
	13 MHz	0.000 85		
	10 nF			
	100 Hz	0.000 062		
	120 Hz	0.000 062		
	1 kHz	0.000 061		
	10 kHz	0.000 061		
	100 kHz	0.000 061		
	100 nF			
	100 Hz	0.000 065		
	120 Hz	0.000 065		
	1 kHz	0.000 061		
10 kHz	0.000 061			
100 kHz	0.000 065			
1 μF				
100 Hz	0.000 071			
120 Hz	0.000 071			
1 kHz	0.000 061			
10 kHz	0.000 065			
100 kHz	0.000 08			



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Dissipation Factor - Source ^{1,4}	DF = 0 to 0.01 10 μ F		Comparison to Keysight 16380A/C Standard Capacitor
	20 Hz	0.000 073	
	(20 to 100) Hz	0.000 078	
	100 Hz	0.000 07	
	120 Hz	0.000 07	
	1 kHz	0.000 065	
10 kHz	0.000 29		
100 kHz	0.000 7		
Capacitance - Source	(190 to 400) pF	3.9 mF/F + 8 pF	Comparison to Fluke 5520A Multi Product Calibrator
	400 pF to 1.1 nF	3.9 mF/F + 8 pF	
	(1.1 to 3.3) nF	3.9 mF/F + 8 pF	
	(3.3 to 11) nF	1.9 mF/F + 8 pF	
	(11 to 33) nF	1.9 mF/F + 80 pF	
	(33 to 110) nF	1.9 mF/F + 80 pF	
	(110 to 330) nF	1.9 mF/F + 0.25 nF	
	330 nF to 1.1 μ F	1.9 mF/F + 0.8 nF	
	(1.1 to 3.3) μ F	1.9 mF/F + 2.5 nF	
	(3.3 to 11) μ F	1.9 mF/F + 8 nF	
	(11 to 33) μ F	3.1 mF/F + 25 nF	
	(33 to 110) μ F	3.5 mF/F + 80 nF	
	(110 to 330) μ F	3.5 mF/F + 0.25 μ F	
	330 μ F to 1.1 mF	3.5 mF/F + 0.8 μ F	
(1.1 to 3.3) mF	3.5 mF/F + 2.5 μ F		
(3.3 to 11) mF	3.5 mF/F + 8 μ F		
(11 to 33) mF	5.8 mF/F + 25 μ F		
33 mF to 110 mF	8.5 mF/F + 80 μ F		
Capacitance – Measure ¹	20 Hz		Comparison to Keysight E4980A LCR Meter, Agilent 4284A LCR Meter
	(1 to 10) nF	16 mF/F	
	10 nF to 100 μ F	1.2 mF/F	
	100 μ F to 1 mF	2 mF/F	
	(1 to 10) mF	5.2 mF/F	
	50 Hz		
	(1 to 10) nF	4.8 mF/F	
	10 nF to 100 μ F	1.2 mF/F	
100 μ F to 1 mF	2.4 mF/F		
(1 to 10) mF	8.1 mF/F		



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Capacitance – Measure ¹	100 Hz		Comparison to Keysight E4980A LCR Meter, Agilent 4284A LCR Meter
	100 pF to 1 nF (1 to 10) nF	20 mF/F 2.1 mF/F	
	10 nF to 10 μF (10 to 100) μF	0.63 mF/F 1.8 mF/F	
	100 μF to 1 mF (1 to 10) mF	2.8 mF/F 12 mF/F	
	120 Hz		
	100 pF to 1 nF (1 to 10) nF	15 mF/F 1.6 mF/F	
	10 nF to 10 μF (10 to 100) μF	0.62 mF/F 1.8 mF/F	
	100 μF to 1 mF (1 to 10) mF	3.1 mF/F 14 mF/F	
	1 kHz		
	(10 to 100) pF (1 to 10) nF	12 mF/F 1.4 mF/F	
	10 nF to 1 μF (1 to 10) μF	0.61 mF/F 1.2 mF/F	
	(10 to 100) μF 100 μF to 1 mF	1.7 mF/F 6.1 mF/F	
	10 kHz		
	(1 to 10) pF (10 to 100) pF	10 mF/F 1.2 mF/F	
	100 pF to 100 nF 100 nF to 10 μF (10 to 100) μF	0.61 mF/F 1.4 mF/F 5.2 mF/F	
	100 kHz		
	(1 to 100) pF 100 pF to 10 nF 10 nF to 1 μF (1 to 10) μF	1.5 mF/F 0.6 mF/F 1.3 mF/F 4.2 mF/F	
	1 MHz		
	(1 to 10) pF (10 to 100) pF 100 pF to 1 nF (1 to 100) nF	3 mF/F 1.2 mF/F 0.6 mF/F 1.3 mF/F	



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Capacitance - Measure ¹	2 MHz (1 to 10) pF (10 to 100) pF (1 to 10) nF (10 to 100) nF	3.6 mF/F 1.2 mF/F 2.3 mF/F 4.7 mF/F	Comparison to Keysight E4980A LCR Meter, Agilent 4284A LCR Meter
Capacitance – Measure	DC 200 µF to 110 mF	0.2 mF/F	Comparison to Keysight 3458A Multimeter + Fluke 5720A Multi Product Calibrator
Electrical Simulation of Thermocouple Indicators	Type J (-210 to -100) °C (-100 to 760) °C (760 to 1 200) °C Type K (-200 to -100) °C (-100 to 120) °C (120 to 1 000) °C (1 000 to 1 372) °C	0.25 °C 0.15 °C 0.2 °C 0.3 °C 0.15 °C 0.25 °C 0.35 °C	Comparison to Fluke 5520A Multi Product Calibrator
DC Voltage – Measure	0 V 100 mV 1 V 10 V 100 V 1 kV	0.12 µV 1.9 µV/V 0.85 µV/V 1.4 µV/V 1.3 µV/V 1.2 µV/V	Comparison to Fluke 732A DC Reference Standard, Fluke 752A Divider, Keysight 34420A Multimeter
DC Current – Measure	0 µA 10 µA 200 µA 2 mA 20 mA 100 mA 200 mA	78 pA 0.14 nA 1.6 nA 16 nA 0.19 µA 1.3 µA 1.9 µA	Comparison to Keysight 3458A Multimeter, Reference Resistors
DC Current – Measure	1 A 2 A 3 A 5 A 10 A	18 µA 37 µA 89 µA 0.35 mA 0.75 mA	Comparison to Keysight 3458A Multimeter, Reference Resistors



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Resistance - Measure Fixed Points	0 Ω	5.9 μΩ	Comparison to Keysight 3458A, Keysight 34420A Digital Multimeter
	1 Ω	12 μΩ	
	1.9 Ω	13 μΩ	
	10 Ω	47 μΩ	
	19 Ω	100 μΩ	
	100 Ω	0.33 mΩ	
	190 Ω	0.58 mΩ	
	1 kΩ	2.9 mΩ	
	1.9 kΩ	4 mΩ	
	10 kΩ	19 mΩ	
	19 kΩ	62 mΩ	
	100 kΩ	0.31 Ω	
	190 kΩ	0.71 Ω	
	1 MΩ	4.7 Ω	
	1.9 MΩ	10 Ω	
10 MΩ	91 Ω		
19 MΩ	0.27 kΩ		
100 MΩ	3 kΩ		
AC Voltage – Measure	0.6 mV		Comparison to Fluke 5790B Multiproduct Calibrator
	1 kHz	1.1 μV	
	2 mV		
	10 Hz	1.3 μV	
	20 Hz to 20 kHz	1.2 μV	
	50 kHz	1.7 μV	
	100 kHz	2.1 μV	
	300 kHz	3.5 μV	
	500 kHz	7.4 μV	
	1 MHz	11 μV	
	20 mV		
	10 Hz	2.5 μV	
	20 Hz	2.1 μV	
	40 Hz	1.9 μV	
	(1 to 20) kHz	1.8 μV	
50 kHz	2.5 μV		
100 kHz	3.3 μV		
300 kHz	6.3 μV		
500 kHz	13 μV		
1 MHz	31 μV		



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment	
AC Voltage – Measure	200 mV		Comparison to Fluke 5790B Multiproduct Calibrator	
	10 Hz	13 μ V		
	20 Hz	7.5 μ V		
	40 Hz	5.7 μ V		
	1 kHz	5.6 μ V		
	20 kHz	5.8 μ V		
	50 kHz	7.1 μ V		
	100 kHz	14 μ V		
	300 kHz	28 μ V		
	500 kHz	59 μ V		
	1 MHz	0.16 mV		
	0.5 V			
	40 Hz	11 μ V		
	1 kHz	12 μ V		
	20 kHz	12 μ V		
	100 kHz	26 μ V		
	300 kHz	56 μ V		
	1 MHz	0.38 mV		
	1 V			
	40 Hz	19 μ V		
	1 kHz	19 μ V		
	20 kHz	18 μ V		
	100 kHz	41 μ V		
	300 kHz	91 μ V		
	1 MHz	0.73 mV		
	2 V			
	10 Hz	0.12 mV		
	20 Hz	57 μ V		
40 Hz	37 μ V			
1 kHz	36 μ V			
20 kHz	36 μ V			
50 kHz	38 μ V			
100 kHz	84 μ V			
300 kHz	0.18 mV			
500 kHz	0.38 mV			
1 MHz	1.5 mV			



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage – Measure	2.3 V		
	1 kHz	42 μ V	Comparison to Fluke 5790B Multiproduct Calibrator
	20 V		
	10 Hz	1.1 mV	
	20 Hz	0.6 mV	
	40 Hz	0.37 mV	
	10 kHz	0.37 mV	
	20 kHz	0.38 mV	
	50 kHz	0.44 mV	
	100 kHz	1 mV	
	300 kHz	2.4 mV	
	500 kHz	6 mV	
	1 MHz	19 mV	
	200 V		
	10 Hz	13 mV	
	20 Hz	6.2 mV	
	40 Hz	4.4 mV	
	1 kHz	4.3 mV	
	20 kHz	4.4 mV	
	50 kHz	5.8 mV	
	100 kHz	11 mV	
	300 kHz	6.1 mV	
	500 kHz	12 mV	
1 MHz	27 mV		
250 V			
15 Hz	16 mV		
300 V			
40 Hz	7.2 mV		
1 kHz	7.4 mV		
20 kHz	7.6 mV		
50 kHz	26 mV		
100 kHz	0.12 V		
500 V			
50 Hz	12 mV		
1 kHz	13 mV		



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage – Measure	600 V 40 Hz 1 kHz 20 kHz 50 kHz 100 kHz	14 mV 15 mV 15 mV 53 mV 0.24 V	Comparison to Fluke 5790B Multiproduct Calibrator
	1 kV 40 Hz to 20 kHz 30 kHz	25 mV 91 mV	
AC Current – Measure	20 μ A 1 kHz, 10 kHz	2.7 nA	Comparison to Fluke 5790B Multiproduct Calibrator, Fluke 40B series Current Shunt
	200 μ A 10 Hz 20 Hz 40 Hz 1 kHz 5 kHz 10 kHz	34 nA 15 nA 7.8 nA 7.7 nA 7.6 nA 7.6 nA	
	2 mA 10 Hz 20 Hz 40 Hz 1 kHz 5 kHz 10 kHz	0.35 μ A 0.15 μ A 88 nA 88 nA 89 nA 88 nA	
	20 mA 10 Hz 20 Hz 40 Hz 1 kHz 5 kHz 10 kHz	3.2 μ A 1.1 μ A 0.61 μ A 0.61 μ A 0.62 μ A 0.63 μ A	
	200 mA 10 Hz 20 Hz 40 Hz to 10 kHz	32 μ A 11 μ A 6.3 μ A	



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment	
AC Current – Measure	2 A		Comparison to Fluke 5790B Multiproduct Calibrator, Fluke 40B series Current Shunt	
	20 Hz	0.15 mA		
	1 kHz	0.1 mA		
	5 kHz	0.1 mA		
	10 kHz	0.13 mA		
	3 A	40 Hz to 10 kHz		0.15 mA
	10 A	40 Hz		0.25 mA
	1 kHz	0.86 mA		
	5 kHz	0.88 mA		
	10 kHz	0.89 mA		

Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Amplitude Modulation – Measure ¹	fc: 2 Hz to 50 GHz fm: 10 Hz to 100 kHz	Refer to Matrix	Comparison to Keysight N9030B PXA Signal Analyzer fc = Carrier Frequency fm = Modulation Rate
AM Distortion – Measure ³ Freq: 500 kHz to 50 GHz	fc: 500 kHz to 50 GHz Distortion (0.01 to 0.1) % (> 0.1 to < 0.3) % (0.3 to 15) %	0.52 % of reading + 0.001 1 % 1.0 % of reading + 0.0006 3 % 1.2 % of reading	Comparison to Keysight N9030A/B PXA Signal Analyzer
Phase Modulation - Measure ¹ Freq: 2 MHz to 3.5 GHz Rate: 50 Hz to 50 kHz	(0.2 to 1) rad fm: 50 Hz to 50 kHz fc: 100 kHz to 3.6 GHz fc: 3.6 GHz to 17.1 GHz fc: 17.1 GHz to 34.5 GHz fc: 34.5 GHz to 50 GHz (1 to 10) rad fm: 50 Hz to 50 kHz fc: 100 kHz to 3.6 GHz fc: 3.6 GHz to 17.1 GHz fc: 17.1 GHz to 34.5 GHz fc: 34.5 GHz to 50 GHz	0.001 rad/rad + 0.001 rad 0.001 rad/rad + 0.002 rad 0.001 rad/rad + 0.002 5 rad 0.001 rad/rad + 0.004 9 rad 81 μrad/rad + 0.002 rad 150 μrad/rad + 0.003 rad 200 μrad/rad + 0.003 5 rad 580 μrad/rad + 0.005 8 rad	Comparison to Keysight N9030A/B PXA Signal Analyzer fc = Carrier Frequency fm = Modulation Rate

Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Phase Modulation Distortion - Measure Freq: 1 MHz to 50 GHz	(0.01 to 15) % Distortion	2.3 % Distortion	Comparison to Keysight N9030A/B PXA Signal Analyzer
Frequency Modulation – Measure ^{1,3}	fc: 2 MHz to 3.6 GHz fm: 20 Hz to 50 kHz FM Deviation: 200 Hz to 100 kHz Modulation Index: (0.2 to 100) Modulation Index: (100 to 2000)	0.35 % of reading + 0.2 % of modulation rate 0.8 % of reading	Comparison to Keysight N9030A PXA Signal Analyzer fc = Carrier Frequency fm = Modulation Rate
Frequency Modulation – Measure ^{1,3}	fc: 100 kHz to 50 GHz fm: 10 Hz to 1 MHz	Refer to Matrix	Comparison to Keysight N9030B PXA Signal Analyzer fc = Carrier Frequency fm = Modulation Rate
Frequency Modulation Distortion - Measure ^{1,3}	fc: 500 kHz to 50 GHz Distortion: (0.01 to 15) %	2.3 % of measured distortion	Comparison to Keysight N9030A/B PXA Signal Analyzer
Digital Modulation – Measure - Carrier: 2 MHz to 50 GHz Frequency Error for Modulation Types: DECT and FSK	Symbol Rate: 3.2 kHz 1.152 MHz	0.5 % RMS 1.5 % RMS	Comparison to Agilent 89441A Vector Signal Analyzer + Converter
Digital Modulation – Measure - Carrier: 2 MHz to 50 GHz Error Vector Magnitude for Modulation Types: TETRA, PDC, NADC, PHS, EDGE, CDMA2000A/C, WCDMA 3GPP, BPSK, QPSK, $\pi/4$ DQPSK, 16QAM, 32QAM, 64QAM and 256QAM	Mod Frequency Span: (1 to 100) kHz 100 kHz to 1 MHz (1 to 10) MHz	0.33 % RMS 0.52 % RMS 1 % RMS	Comparison to Agilent 89441A Vector Signal Analyzer + Converter



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Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Digital Modulation – Measure - Carrier: 2 MHz to 50 GHz Phase Error for Modulation Types: GMS, MSK, GMSK, BPSK, DQPSK, 8PSK, QPSK, $\pi/4$ DQPSK, 16QAM, 32QAM, 64QAM and 256QAM	Mod Frequency Span: (1 to 100) kHz 100 kHz to 1 MHz 1 MHz to 10 MHz	0.2° RMS 0.35° RMS 0.58° RMS	Comparison to Agilent 89441A Vector Signal Analyzer + Converter
Digital Modulation – Measure ^{1,4}	GSM EDGE 800 MHz to 1900 MHz EDGE residual EVM (rms) ⁴ GSM: rms residual phase error peak residual phase error ⁴	0.015 % 0.01° 0.12 %	Comparison to Keysight N9030A/B PXA Signal Analyzer
Digital Modulation – Measure ^{1,4}	CDMA2000, IS95, 1xEV-DO 800 MHz to 2100 MHz Residual EVM	0.023 %	Comparison to Keysight N9030A/B PXA Signal Analyzer
	W-CDMA 1800 MHz to 2200 MHz Residual EVM	0.025 %	
Digital Modulation – Measure ^{1,4}	BPSK: Residual EVM (0 to 2.5) % ≤ 3 GHz > 3 to 32 GHz > 32 to 44 GHz	0.02 % 0.055 % 0.07 %	Comparison to Keysight N9030A/B PXA Signal Analyzer
Digital Modulation – Measure ^{1,4}	QPSK - Residual EVM Up to 1 GHz (1 to 2) GHz (2 to 3) GHz (3 to 4) GHz (4 to 5) GHz (5 to 6) GHz (6 to 32) GHz (32 to 44) GHz	0.01 % 0.015 % 0.025 % 0.03 % 0.035 % 0.045 % 0.055 % 0.065 %	Comparison to Keysight N9030A/B PXA Signal Analyzer

Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Digital Modulation – Measure ^{1,4}	$\pi/4$ DQPSK - Residual EVM Up to 1 GHz (1 to 2) GHz (2 to 3) GHz (3 to 4) GHz (4 to 5) GHz (5 to 6) GHz	0.025 % 0.046 % 0.059 % 0.11 % 0.059 % 0.059 %	Comparison to Keysight N9030A/B PXA Signal Analyzer
Digital Modulation – Measure ^{1,4}	16, 64 and 256 QAM Residual EVM Up to 3 GHz (3 to 20) GHz (20 to 32) GHz (32 to 44) GHz	0.015 % 0.017 % 0.03 % 0.045 %	Comparison to Keysight N9030A/B PXA Signal Analyzer
Digital Modulation – Measure ¹	2FSK (including DECT) Shift error or Frequency Deviation Up to 3 GHz (3 to 6) GHz DECT - kHz	0.049 % Deviation 0.048 % Deviation 0.12 % Deviation	Comparison to Keysight N9030A/B PXA Signal Analyzer
Digital Modulation – Measure ^{1,4}	NADC: Residual EVM (350 to 950) MHz (0 to 2) %	0.042 %	Comparison to Keysight N9030A/B PXA Signal Analyzer
Digital Modulation – Measure ^{1,4}	PDC: Residual EVM (350 to 1501) MHz (0 to 2) %	0.055 %	Comparison to Keysight N9030A/B PXA Signal Analyzer
Digital Modulation – Measure ^{1,4}	PHS: Residual EVM (350 to 2000) MHz (0 to 2) %	0.035 %	Comparison to Keysight N9030A/B PXA Signal Analyzer
Digital Modulation – Measure ^{1,4}	TETRA: Residual EVM (350 to 1000) MHz (0 to 2) %	0.044 %	Comparison to Keysight N9030A/B PXA Signal Analyzer
RF Power - Measure	(-30 to 10) dBm (100 to 300) kHz (300 to 500) kHz 500 kHz to 3 GHz (10 to 20) dBm (100 to 300) kHz (300 to 500) kHz 500 kHz to 3 GHz	0.1 dB 0.09 dB 0.05 dB 0.18 dB 0.17 dB 0.16 dB	Comparison to Keysight 8483A 75 Ω Power Sensor

Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
RF Power – Measure - Linearity	(- 10 to 0) dBm 100 kHz to 13.2 GHz (13.2 to 26.5) GHz	0.12 % of reading 0.15 % of reading	Comparison to Keysight E4448A Spectrum Analyzer
RF Power – Source	50 MHz, 1 mW	3 μ W	Comparison to Agilent E4419B Power Meter, Thermistor Mount HP 478A-H76
	50 MHz, 1 mW	2.3 μ W	Comparison to Agilent E4419B Power Meter with UKAS calibration
Tuned RF Power Absolute – Measure	2.5 MHz to 26.5 GHz (10 to -30) dBm (-30 to -60) dBm (-60 to -100) dBm	0.15 dB 0.17 dB 0.19 dB	Comparison to Agilent 8902A Measuring Receiver + 11722A /+ 11792A + 11793A Sensors
	2.5 MHz to 2.6 GHz (-100 to -120) dBm	0.2 dB	
Tuned RF Power Absolute – Measure	2.5 MHz to 1.3 GHz (-110 to -120 dBm)	0.21 dB	Comparison to Agilent 8902A Measuring Receiver + 11722A /+ 11792A + 11793A Sensors



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Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment	
Tuned RF Power Relative – Measure	100 kHz to 31.15 GHz		Comparison to Keysight E4448A Spectrum Analyzer	
	(10 to -10) dBm	0.023 dB		
	(-10 to -30) dBm	0.029 dB		
	(-30 to -60) dBm	0.046 dB		
	(-60 to -75) dBm	0.068 dB		
	100 kHz to 19.2 GHz			
	(-75 to -90) dBm	0.096 dB		
	100 kHz to 3.05 GHz			
	(-90 to -110) dBm	0.1 dB		
	(-110 to -120) dBm	0.11 dB		
	(-120 to -130) dBm	0.12 dB		
	(-130 to -140) dBm	0.15 dB		
	(3.05 to 6.6) GHz			
	(-90 to -103) dBm	0.1 dB		
	(-103 to -113) dBm	0.11 dB		
	(-113 to -123) dBm	0.12 dB		
	(-123 to -133) dBm	0.15 dB		
	(6.6 to 13.2) GHz			
	(-90 to -100) dBm	0.1 dB		
	(-100 to -110) dBm	0.11 dB		
(-110 to -120) dBm	0.11 dB			
(-120 to -130) dBm	0.12 dB			
(13.2 to 19.2) GHz				
(-90 to -98) dBm	0.1 dB			
(-98 to -108) dBm	0.11 dB			
(-108 to -118) dBm	0.11 dB			
(-118 to -128) dBm	0.12 dB			



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Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Tuned RF Power Relative – Measure	(19.2 to 31.15) GHz		Comparison to Keysight E4448A Spectrum Analyzer
	(-75 to -86) dBm	0.096 dB	
	(-86 to -96) dBm	0.1 dB	
	(-96 to -106) dBm	0.11 dB	
	(-106 to -116) dBm	0.12 dB	
	(-116 to -126) dBm	0.12 dB	
	(31.15 to 41) GHz		
	(10 to -10) dBm	0.026 dB	
	(-10 to -30) dBm	0.031 dB	
	(-30 to -60) dBm	0.048 dB	
	(-60 to -76) dBm	0.07 dB	
	(-76 to -86) dBm	0.1 dB	
	(-86 to -96) dBm	0.11 dB	
	(-96 to -106) dBm	0.12 dB	
	(41 to 45) GHz		
	(10 to -10) dBm	0.16 dB	
	(-10 to -30) dBm	0.16 dB	
	(-30 to -60) dBm	0.17 dB	
	(-60 to -70) dBm	0.17 dB	
	(-70 to -80) dBm	0.17 dB	
(-80 to -90) dBm	0.19 dB		
(-90 to -100) dBm	0.19 dB		
(45 to 50) GHz			
(10 to -10) dBm	0.28 dB		
(-10 to -30) dBm	0.28 dB		
(-30 to -58) dBm	0.28 dB		
(-58 to -68) dBm	0.29 dB		
(-68 to -78) dBm	0.29 dB		
(-78 to -88) dBm	0.3 dB		
RF Power – Measure – Flatness ¹ (Function Generator Amplitude Flatness)	(0.1 to 8) V		Comparison to Keysight 3458A Digital Multimeter, Fluke 5790B Multiproduct Calibrator, Keysight E441x/N991x Power Meter, Keysight E9304A H84 Power Sensor, Keysight 8491A/B Attenuator
	100 kHz to 10 MHz	0.025 dB	
	(10 to <50) MHz	0.028 dB	
	50 MHz	0.018 dB	
	(>50 to 80) MHz	0.023 dB	
	(0.1 to 5.5) V		
	(80 to 300) MHz	0.023 dB	
	300 MHz to 1.1 GHz	0.033 dB	
	(0.01 to 0.1) V		
	(50 to 80) MHz	0.027 dB	
(80 to 300) MHz	0.032 dB		
300 MHz to 1.1 GHz	0.034 dB		

Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
RF Power – Relative (reference power levels between -20 dBm and +10 dBm)	9 kHz to 50 GHz (-130 to < -110) dB (-110 to -100) dB (> -100 to -90) dB (> -90 to -70) dB (> -70 to -50) dB (> -50 to -30) dB (> -30 to -10) dB (> -10 to +10) dB (> +10 to +20) dB (> +20 to +30) dB (50 to 67) GHz (-40 to < -35) dB (-35 to < -30) dB (-30 to -3) dB (> -3 to < +3) dB (+3 to < +10) dB (+10 to + 30) dB (-110 to -100 dB (9 to 100) kHz 100 kHz to 3.6 GHz (3.6 to 30) GHz (30 to 50) GHz	0.17 dB see below 0.045 dB 0.035 dB 0.029 dB 0.019 dB 0.01 dB 0.006 1 dB 0.01 dB 0.026 dB 0.14 dB 0.051 dB 0.026 dB 0.006 1 dB 0.014 dB 0.023 dB 0.064 dB 0.05 dB 0.07 dB 0.074 dB	Comparison to Keysight Technologies N191X Power Meter with 8481A, E9304A, N8481A, U8481A, or U8485A Sensor, PXA N9030A/B Signal Analyzer
RF Power Sensor - Calibration Factors ⁴	DC to 9 kHz	0.42 %	Comparison to 3458A Digital Multimeter
RF Power Sensor - Calibration Factors ⁴	9 kHz to 5 MHz 5 MHz to 50 MHz 50 MHz to 3 GHz (3 to 11) GHz (11 to 14) GHz (14 to 16) GHz (16 to 17) GHz (17 to 18) GHz (18 to 26) GHz (26 to 26.5) GHz (26.5 to 33) GHz (33 to 35) GHz (35 to 38) GHz (38 to 44) GHz (44 to 50) GHz	0.47 % 0.53 % 0.36 % 0.46 % 0.56 % 0.66 % 0.72 % 0.74 % 1.5 % 1.6 % 1.9 % 2 % 2.1 % 2.5 % 2.6 %	Comparison to Agilent 848x series, Keysight N848x series, E9304A Keysight 8478B Power Sensor



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Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
RF Power Sensor - Calibration Factors ⁴	50 GHz	4.7 %	Comparison to Keysight V8486A, E8486A, W8486A Waveguide Power Sensors
	(51 to 52) GHz	4.1 %	
	53 GHz	4 %	
	54 GHz	3.9 %	
	55 GHz	3.7 %	
	(56 to 57) GHz	3.5 %	
	58 GHz	4.1 %	
	59 GHz	4.5 %	
	60 GHz	4.8 %	
	61 GHz	5 %	
	62 GHz	4.8 %	
	63 GHz	4.7 %	
	64 GHz	4.4 %	
	65 GHz	4 %	
	(66 to 67) GHz	3.8 %	
	68 GHz	4.1 %	
	69 GHz	4.5 %	
	70 GHz	4.6 %	
	71 GHz	4.7 %	
	(72 to 75) GHz	4.5 %	
	76 GHz	5.6 %	
	77 GHz	5.4 %	
	78 GHz	5.3 %	
	79 GHz	5.2 %	
	80 GHz	5.3 %	
	(81 to 85) GHz	5.1 %	
	(86 to 89) GHz	5 %	
	90 GHz	4.9 %	
	(91 to 92) GHz	4.8 %	
	(93 to 94) GHz	4.7 %	
95 GHz	4.5 %		
96 GHz	4.6 %		
97 GHz	4.5 %		
98 GHz	4.4 %		
(99 to 103) GHz	4.3 %		
104 GHz	4.5 %		
105 GHz	4.7 %		
106 GHz	4.8 %		
107 GHz	4.9 %		
108 GHz	5.1 %		
109 GHz	5.6 %		
110 GHz	5.8 %		



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Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
RF Power – Relative For Dynamic accuracy of VNA ¹	1 MHz & 99.6 MHz (REF -10 dBm)		Comparison to Keysight Function Generator (33622A/33250A)
	(-60.0 to < -59.0) dBm	0.005 1 dB	
	(-59.0 >= to < -58.0) dBm	0.004 0 dB	
	(-58.0 >= to < -57.0) dBm	0.003 7 dB	
	(-57.0 >= to < -56.0) dBm	0.002 9 dB	
	(-56.0 >= to < -55.0) dBm	0.002 6 dB	
	(-55.0 >= to < -54.0) dBm	0.001 9 dB	
	(-54.0 >= to < -49.0) dBm	0.001 5 dB	
	(-49.0 >= to < -42.0) dBm	0.000 96 dB	
	(-42.0 >= to < -28.0) dBm	0.000 76 dB	
	(-28.0 >= to < -17.0) dBm	0.000 55 dB	
	(-17.0 >= to < -13.0) dBm	0.000 28 dB	
	(-13.0 >= to < -7.0) dBm	0.000 10 dB	
(-7.0 >= to < -2.0) dBm	0.000 32 dB		
1 MHz			
(-2.0 >= to 0.0) dBm	0.000 98 dB		
99.6 MHz			
(-2.0 >= to 0.0) dBm	0.000 74 dB		
RF Power – Relative For Dynamic accuracy of VNA ¹	30.6 MHz & 49.6 MHz		Comparison to Keysight PNA N5247B Network Analyzer, Ecal N469x Calibration Module, Sensor U8485A
	-60 dBm	0.004 9 dB	
	-50 dBm	0.002 6 dB	
	-40 dBm	0.001 6 dB	
	-35 dBm	0.001 7 dB	
	-30 dBm	0.001 dB	
	-25 dBm	0.001 3 dB	
	-15 dBm	0.001 3 dB	
	-10 dBm	0.001 4 dB	
	-5 dBm	0.001 6 dB	
-0 dBm	0.001 6 dB		

Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
RF Power – Relative For Dynamic accuracy of VNA ¹	Ref -20 dBm 99.6 MHz		Comparison to Keysight Function Generator (33250A), PNA N5247B Network Analyzer, Ecal N469x Calibration Module, Sensor U8485A
	-60 dBm	0.004 9 dB	
	(-60.0 > to < -59.0) dBm	0.009 5 dB	
	(-59.0 >= to < -58.0) dBm	0.008 6 dB	
	(-58.0 >= to < -57.0) dBm	0.007 9 dB	
	(-57.0 >= to < -56.0) dBm	0.006 9 dB	
	(-56.0 >= to < -52.0) dBm	0.006 3 dB	
	(-52.0 >= to < -50.0) dBm	0.005 9 dB	
	-50 dBm	0.002 6 dB	
	(-50.0 > to < -47.0) dBm	0.005 9 dB	
	(-47.0 >= to < -46.0) dBm	0.005 7 dB	
	(-46.0 >= to < -41.0) dBm	0.005 3 dB	
	(-41.0 >= to < -40.0) dBm	0.004 8 dB	
	-40 dBm	0.001 6 dB	
	(-40.0 > to < -37.0) dBm	0.004 8 dB	
	(-37.0 >= to < -35.0) dBm	0.004 dB	
	-35 dBm	0.001 7 dB	
	(-35.0 > to < -32.0) dBm	0.004 dB	
	(-32.0 >= to < -31.0) dBm	0.003 6 dB	
	(-31.0 >= to < -30.0) dBm	0.003 4 dB	
	-30 dBm	0.001 dB	
	(-30.0 > to < -27.0) dBm	0.003 4 dB	
	(-27.0 >= to < -26.0) dBm	0.003 1 dB	
(-26.0 >= to < -25.0) dBm	0.002 3 dB		
-25 dBm	0.001 3 dB		
(-25.0 > to < -21.0) dBm	0.002 3 dB		
(-21.0 >= to < -18.5) dBm	0.001 2 dB		
(-18.5 >= to < -15.0) dBm	0.002 3 dB		



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Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
RF Power – Relative For Dynamic accuracy of VNA ¹	-15 dBm	0.001 3 dB	Comparison to Keysight Function Generator (33250A), PNA N5247B, Network Analyzer, Ecal N469x Calibration Module, Sensor U8485A
	(-15.0 > to < -13.5) dBm	0.002 3 dB	
	(-13.5 >= to < -12.5) dBm	0.003 1 dB	
	(-12.5 >= to < -10.0) dBm	0.003 4 dB	
	-10 dBm	0.001 4 dB	
	(-10.0 > to < -8.5) dBm	0.003 4 dB	
	(-8.5 >= to < -7.5) dBm	0.003 6 dB	
	(-7.5 >= to < -5.0) dBm	0.004 dB	
	-5 dBm	0.001 6 dB	
	(-5.0 > to < -2.5) dBm	0.004 dB	
	(-2.5 >= to < 0.0) dBm	0.004 8 dB	
	-0 dBm	0.001 6 dB	
	(0.0 > to < 0.5) dBm	0.004 8 dB	
(0.5 >= to < 1.5) dBm	0.005 1 dB		
(1.5 >= to < 2.5) dBm	0.005 4 dB		
(2.5 >= to 5.0) dBm	0.005 5 dB		
RF Power – Relative For Dynamic accuracy of VNA ¹	Ref (-10 to -22) dBm		Comparison to Keysight Power Meter(E4419B), Keysight Power Sensor (N8482A, 8482A), Keysight Dynamic Accuracy Test Set (Z5623A)
	1.195 GHz	0.041 dB	
	(-80 to < -79) dBm	0.037 dB	
	(-79 >= to < -78) dBm	0.035 dB	
	(-78 >= to < -77) dBm	0.032 dB	
	(-77 >= to < -76) dBm	0.03 dB	
	(-76 >= to < -75) dBm	0.029 dB	
	(-75 >= to < -74) dBm	0.028 dB	
	(-74 >= to < -73) dBm	0.027 dB	
	(-73 >= to < -72) dBm	0.026 dB	
	(-72 >= to < -70) dBm	0.022 dB	
	(-70 >= to < -69) dBm	0.021 dB	
	(-69 >= to < -67) dBm	0.02 dB	
	(-67 >= to < -65) dBm	0.019 dB	
	(-65 >= to < -60) dBm	0.016 dB	
	(-60 >= to < -58) dBm	0.015 dB	
	(-58 >= to < -54) dBm	0.014 dB	
	(-54 >= to < -50) dBm	0.013 dB	
	(-50 >= to < -49) dBm	0.012 dB	
(-49 >= to < -45) dBm	0.011 dB		
(-45 >= to < -40) dBm	0.009 7 dB		
(-40 >= to < -39) dBm	0.009 1 dB		
(-39 >= to < -38) dBm	0.008 7 dB		
(-38 >= to < -37) dBm			



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Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
RF Power – Relative For Dynamic accuracy of VNA ¹	1.195 GHz		Comparison to Keysight Power Meter(E4419B), Keysight Power Sensor (N8482A, 8482A), Keysight Dynamic Accuracy Test Set (Z5623A)
	(-37 ≥ to < -35) dBm	0.008 2 dB	
	(-35 ≥ to < -31) dBm	0.007 9 dB	
	(-31 ≥ to < -30) dBm	0.007 8 dB	
	(-30 ≥ to < -29) dBm	0.006 6 dB	
	(-29 ≥ to < -28) dBm	0.005 7 dB	
	(-28 ≥ to < -27) dBm	0.005 1 dB	
	(-27 ≥ to < -26) dBm	0.004 6 dB	
	(-26 ≥ to < -24) dBm	0.004 1 dB	
	(-24 ≥ to < -21) dBm	0.003 8 dB	
(-21 ≥ to < 1) dBm	0.003 7 dB		
(1 ≥ to 10) dBm	0.005 3 dB		
RF Power – Relative For Dynamic accuracy of VNA ¹	Ref -20 dBm		Comparison to Keysight Power Meter(E4419B), Keysight Power Sensor (N8482A, 8482A), Keysight Dynamic Accuracy Test Set (U3020AD01)
	1.998 77 GHz	0.005 7 dB	
	(5 to < 1) dBm	0.004 7 dB	
	(1 ≥ to < -4) dBm	0.003 9 dB	
	(-4 ≥ to < -9) dBm	0.003 3 dB	
	(-9 ≥ to < -14) dBm	0.002 3 dB	
	(-14 ≥ to < -19) dBm	0.001 dB	
	(-19 ≥ to < -22) dBm	0.001 6 dB	
	(-22 ≥ to < -23) dBm	0.001 9 dB	
	(-23 ≥ to < -25) dBm	0.002 3 dB	
	(-25 ≥ to < -26) dBm	0.002 5 dB	
	(-26 ≥ to < -27) dBm	0.002 7 dB	
	(-27 ≥ to < -29) dBm	0.003 dB	
	(-29 ≥ to < -31) dBm	0.003 2 dB	
	(-31 ≥ to < -33) dBm	0.003 5 dB	
	(-33 ≥ to < -35) dBm	0.003 8 dB	
	(-35 ≥ to < -37) dBm	0.004 1 dB	
	(-37 ≥ to < -39) dBm	0.004 5 dB	
	(-39 ≥ to < -41) dBm	0.004 8 dB	
	(-41 ≥ to < -42) dBm	0.005 dB	
	(-42 ≥ to < -44) dBm	0.005 4 dB	
	(-44 ≥ to < -46) dBm	0.005 8 dB	
	(-46 ≥ to < -47) dBm	0.006 dB	
(-47 ≥ to < -49) dBm	0.006 3 dB		
(-49 ≥ to < -52) dBm	0.006 7 dB		
(-52 ≥ to < -57) dBm	0.007 1 dB		
(-57 ≥ to -60) dBm			



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Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Phase Noise for Signal Analyzers ¹ Carrier 1 GHz	Phase Noise Measurement dBc/Hz		Comparison to Wenzel 500-13438D Phase Noise Source
	Offset: 100 Hz		
	-96 ≤ PN	0.5 dB	
	-100 ≤ PN ≤ -96	0.52 dB	
	-102 ≤ PN ≤ -100	0.55 dB	
	-104 ≤ PN ≤ -102	0.6 dB	
	-106 ≤ PN ≤ -104	0.8 dB	
	-108 ≤ PN ≤ -106	1 dB	
	-110 ≤ PN ≤ -108	1.5 dB	
	-113 ≤ PN ≤ -110	2.5 dB	
	Offset: 1 kHz		
	-115 ≤ PN	0.36 dB	
	-121 ≤ PN < -115	0.41 dB	
	-123 ≤ PN < -121	0.47 dB	
	-125 ≤ PN < -123	0.59 dB	
	-129 ≤ PN < -125	1.2 dB	
	-130 ≤ PN < -129	1.4 dB	
	-133 ≤ PN < -130	2.5 dB	
	Offset: 10 kHz		
	-126 ≤ PN	0.36 dB	
	-129 ≤ PN < -126	0.37 dB	
	-132 ≤ PN < -129	0.39 dB	
	-135 ≤ PN < -132	0.47 dB	
	-138 ≤ PN < -135	0.69 dB	
-142 ≤ PN < -138	1.4 dB		
-145 ≤ PN < -142	2.5 dB		
Offset: 30 kHz			
-112 ≤ PN	0.36 dB		
-132 ≤ PN < -112	0.37 dB		
-134 ≤ PN < -132	0.39 dB		
-137 ≤ PN < -134	0.47 dB		
-140 ≤ PN < -137	0.69 dB		
-143 ≤ PN < -140	1.2 dB		
-144 ≤ PN < -143	1.4 dB		
-147 ≤ PN < -144	2.5 dB		



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Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Phase Noise for Signal Analyzers ¹ Carrier 1 GHz Phase Noise Measurement dBc/Hz	Offset: 100 kHz		Comparison to Wenzel 500-13438D Phase Noise Source
	-131 ≤ PN	0.39 dB	
	-132 ≤ PN < -131	0.39 dB	
	-136 ≤ PN < -132	0.42 dB	
	-139 ≤ PN < -136	0.49 dB	
	-142 ≤ PN < -139	0.71 dB	
	-145 ≤ PN < -142	1.2 dB	
	-146 ≤ PN < -145	1.4 dB	
	-149 ≤ PN < -146	2.5 dB	
	Offset: 1 MHz		
	-139 ≤ PN	0.39 dB	
	-142 ≤ PN < -139	0.4 dB	
	-145 ≤ PN < -142	0.42 dB	
	-148 ≤ PN < -143	0.49 dB	
	-150 ≤ PN < -148	0.61 dB	
	-152 ≤ PN < -150	0.83 dB	
	-155 ≤ PN < -152	1.4 dB	
	-158 ≤ PN < -155	2.5 dB	
Offsets: 9.9 and 10 MHz			
-136 ≤ PN	0.39 dB		
-156 ≤ PN < -136	0.54 dB		
-158 ≤ PN < -156	0.71 dB		
-159 ≤ PN < -158	0.8 dB		
-162 ≤ PN < -159	1.4 dB		
-165 ≤ PN < -162	2.5 dB		
Phase Noise for Signal Sources Offset Frequency: f_{offset} $(L_{\text{REF}} - L_{\text{DUT}}) \geq 15 \text{ dB}$	Carrier Frequency: f		Comparison to Keysight E5500 Phase Noise Measurement System
$f_{\text{offset}} \leq 100 \text{ kHz}$	$f \leq 100 \text{ MHz}$	2.2 dB	
$f_{\text{offset}} \leq 100 \text{ kHz}$	$100 \text{ MHz} < f \leq 26.5 \text{ MHz}$	2.1 dB	
$f_{\text{offset}} \leq 1 \text{ MHz}$	$50 \text{ kHz} < f \leq 26.5 \text{ GHz}$	2.2 dB	
$f_{\text{offset}} \leq 10 \text{ MHz}$	$50 \text{ kHz} < f \leq 26.5 \text{ GHz}$	4.0 dB	
$f_{\text{offset}} < 100 \text{ MHz}$	$50 \text{ kHz} < f \leq 26.5 \text{ GHz}$	4.1 dB	



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Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
$15 \text{ dB} > (L_{REF} - L_{DUT}) \geq 10 \text{ dB}$ $f_{offset} \leq 100 \text{ kHz}$ $f_{offset} \leq 100 \text{ kHz}$ $f_{offset} \leq 1 \text{ MHz}$ $f_{offset} \leq 10 \text{ MHz}$ $f_{offset} < 100 \text{ MHz}$	$f \leq 100 \text{ MHz}$ $100 \text{ MHz} < f \leq 26.5 \text{ MHz}$ $50 \text{ kHz} < f \leq 26.5 \text{ GHz}$ $50 \text{ kHz} < f \leq 26.5 \text{ GHz}$ $50 \text{ kHz} < f \leq 26.5 \text{ GHz}$	2.2 dB 2.2 dB 2.2 dB 4.0 dB 4.1 dB	Comparison to Keysight E5500 Phase Noise Measurement System
$10 \text{ dB} > (L_{REF} - L_{DUT}) \geq 5 \text{ dB}$ $f_{offset} \leq 100 \text{ kHz}$ $f_{offset} \leq 100 \text{ kHz}$ $f_{offset} \leq 1 \text{ MHz}$ $f_{offset} \leq 10 \text{ MHz}$ $f_{offset} < 100 \text{ MHz}$	$f \leq 100 \text{ MHz}$ $100 \text{ MHz} < f \leq 26.5 \text{ MHz}$ $50 \text{ kHz} < f \leq 26.5 \text{ GHz}$ $50 \text{ kHz} < f \leq 26.5 \text{ GHz}$ $50 \text{ kHz} < f \leq 26.5 \text{ GHz}$	2.7 dB 2.6 dB 2.7 dB 4.3 dB 4.4 dB	
$5 \text{ dB} > (L_{REF} - L_{DUT}) \geq 3 \text{ dB}$ $f_{offset} \leq 100 \text{ kHz}$ $f_{offset} \leq 100 \text{ kHz}$ $f_{offset} \leq 1 \text{ MHz}$ $f_{offset} \leq 10 \text{ MHz}$ $f_{offset} < 100 \text{ MHz}$	$f \leq 100 \text{ MHz}$ $100 \text{ MHz} < f \leq 26.5 \text{ GHz}$ $50 \text{ kHz} < f \leq 26.5 \text{ GHz}$ $50 \text{ kHz} < f \leq 26.5 \text{ GHz}$ $50 \text{ kHz} < f \leq 26.5 \text{ GHz}$	3.1 dB 3.1 dB 3.1 dB 4.7 dB 4.8 dB	
$3 \text{ dB} > (L_{REF} - L_{DUT}) \geq 0 \text{ dB}$ $f_{offset} \leq 100 \text{ kHz}$ $f_{offset} \leq 100 \text{ kHz}$ $f_{offset} \leq 1 \text{ MHz}$ $f_{offset} \leq 10 \text{ MHz}$ $f_{offset} < 100 \text{ MHz}$	$f \leq 100 \text{ MHz}$ $100 \text{ MHz} < f \leq 26.5 \text{ GHz}$ $50 \text{ kHz} < f \leq 26.5 \text{ GHz}$ $50 \text{ kHz} < f \leq 26.5 \text{ GHz}$ $50 \text{ kHz} < f \leq 26.5 \text{ GHz}$	4.2 dB 4.2 dB 4.2 dB 5.6 dB 5.6 dB	
Attenuation – Source ¹	(1 to 7) dB 1 MHz to 100 MHz 100 MHz to 1.5 GHz (1.5 to 8) GHz (8 to 14) GHz (14 to 18) GHz (8 to 11) dB 1 MHz to 100 MHz 100 MHz to 1.5 GHz (1.5 to 8) GHz (8 to 12) GHz (12 to 18) GHz	0.007 dB 0.008 dB 0.03 dB 0.06 dB 0.09 dB 0.009 dB 0.01 dB 0.03 dB 0.05 dB 0.08 dB	



ANSI National Accreditation Board

Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Attenuation – Source ¹	(10 to 20) dB		Comparison to Keysight 8494H, 8496H Step Attenuator
	(1 to 100) MHz	0.007 dB	
	100 MHz to 1.5 GHz	0.01 dB	
	(1.5 to 3) GHz	0.02 dB	
	(3 to 8) GHz	0.04 dB	
	(8 to 12) GHz	0.05 dB	
	(12 to 18) GHz	0.08 dB	
	(30 to 40) dB		
	(1 to 500) MHz	0.01 dB	
	500 MHz to 4 GHz	0.02 dB	
	(4 to 8) GHz	0.04 dB	
	(8 to 12) GHz	0.05 dB	
	(12 to 18) GHz	0.08 dB	
	50 dB		
	1 MHz to 1.5 GHz	0.013 dB	
	(1.5 to 8) GHz	0.03 dB	
	(8 to 18) GHz	0.08 dB	
	60 dB		
	1 MHz to 1.5 GHz	0.017 dB	
	(1.5 to 8) GHz	0.04 dB	
	(8 to 14) GHz	0.06 dB	
	(14 to 18) GHz	0.08 dB	
	70 dB		
	1 MHz to 1.5 GHz	0.04 dB	
(1.5 to 8) GHz	0.06 dB		
(8 to 10) GHz	0.07 dB		
(10 to 18) GHz	0.12 dB		
80 dB			
1 MHz to 1.5 GHz	0.05 dB		
(1.5 to 10) GHz	0.09 dB		
(10 to 18) GHz	0.2 dB		
90 dB			
(1 to 10) MHz	0.3 dB		
10 MHz to 6 GHz	0.3 dB		
(6 to 8) GHz	0.3 dB		
(8 to 18) GHz	0.8 dB		



ANSI National Accreditation Board

Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Attenuation – Source ¹	100 dB (1 to 10) MHz 10 MHz to 8 GHz (8 to 10) GHz (10 to 12) GHz (12 to 18) GHz 110 dB (1 to 10) MHz 10 MHz to 4 GHz (4 to 8) GHz (8 to 10) GHz (10 to 18) GHz	0.6 dB 0.5 dB 0.6 dB 1.0 dB 1.6 dB 1.6 dB 1.0 dB 1.5 dB 2.5 dB 3.5 dB	Comparison to Keysight 8494H, 8496H Step Attenuator
Attenuation – Measure ¹ Number of attenuation segments 1 or any configuration of multiple segments with attenuation totalling from 1 dB up to and including 40 dB	Type-N, 3.5 mm and 2.4 mm 1 dB to 40 dB 300 kHz to 500 MHz 500 MHz to 2 GHz (2 to 18) GHz (18 to 40) GHz (40 to 50) GHz	0.003 4 dB 0.004 7 dB ((0.011 % * <i>f</i>) + 0.004 9) dB, where <i>f</i> is the frequency in GHz 0.008 9 dB 0.012 dB	Comparison to Keysight Network Analyzers N5247B + Keysight Calibration Kits
Attenuation – Measure ¹ Number of attenuation segments 2	Type-N: 50 dB to 80 dB 3.5 mm: 50 dB and 60 dB 2.4 mm: 50 dB 300 kHz to 8 GHz (8 to 18) GHz (8 to 40) GHz (40 to 50) GHz	0.025 dB 0.029 dB 0.034 dB 0.037 dB	Comparison to Keysight Network Analyzers N5247B + Keysight Calibration Kits
Attenuation – Measure ¹ Number of attenuation segments 3	Type-N: 70 dB to 100 dB 3.5 mm: 70 dB or 80 dB 300 kHz to 18 GHz (18 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.048 dB 0.056 dB 0.059 dB 0.065 dB	Comparison to Keysight Network Analyzers N5247B + Keysight Calibration Kits

Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Thermal Noise – Source ENR Cold Source Method	(5 to 21) dB (0.5 to 6) GHz (6 to 18) GHz (18 to 26.5) GHz (26.5 to 33) GHz (33 to 36) GHz (36 to 39) GHz (39 to 40) GHz (40 to 48) GHz (48 to 50) GHz	0.1 dB 0.11 dB 0.13 dB 0.14 dB 0.15 dB 0.16 dB 0.17 dB 0.2 dB 0.21 dB	Comparison to Keysight PNA-X Network Analyzer opt.029
EMI Receiver [CISPR 16-1-1:2019] Quasi-Peak Detector Absolute Amplitude Band A (25 Hz) Band B/C (100 Hz)	(-1.5 to 1.5) dB (-1.5 to 1.5) dB	0.29 dB 0.29 dB	Comparison to Schwarzbeck IGUU2916 Pulse Generator, Agilent E4419B Power Meter + Keysight E9304A Power Sensor
EMI Receiver [CISPR 16-1-1:2019] Quasi-Peak Detector Variation with Pulse Repetition Frequency Band A (1, 2, 5, 10, 60, 100 Hz) Band B/C/D (1, 2, 10, 20 Hz)	(-21 to 5) dB (-33.5 to -5.5) dB	0.12 dB 0.12 dB	Comparison to Schwarzbeck IGUU2916 Pulse Generator, Agilent E4419B Power Meter + Keysight E9304A Power Sensor
EMI Receiver [CISPR 16-1-1:2019] Response to Pulses (Peak Detector) Band A (25 Hz) Band B (100 Hz) Band C/D (100 Hz)	(-1.5 to 1.5) dB (-1.5 to 1.5) dB (-1.5 to 1.5) dB	0.39 dB 0.34 dB 0.33 dB	Comparison to Schwarzbeck IGUU2916 Pulse Generator, Agilent E4419B Power Meter + Keysight E9304A Power Sensor
EMI Receiver [CISPR 16-1-1:2019] Response to Pulses (Average Detector) Band A (25 Hz) Band B (500 Hz) Band C/D (5 kHz)	(-1.5 to 1.5) dB (-1.5 to 1.5) dB (-1.5 to 1.5) dB	0.39 dB 0.34 dB 0.34 dB	Comparison to Schwarzbeck IGUU2916 Pulse Generator, Agilent E4419B Power Meter + Keysight E9304A Power Sensor

Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
EMI Receiver [CISPR 16-1-1:2019] Response to Pulses (RMS Detector) Band A (25 Hz) Band B (1000 Hz) Band C/D (1000 Hz)	(-1.5 to 1.5) dB (-1.5 to 1.5) dB (-1.5 to 1.5) dB	0.39 dB 0.35 dB 0.34 dB	Comparison to Schwarzbeck IGUU2916 Pulse Generator, Agilent E4419B Power Meter + Keysight E9304A Power Sensor
DC VSWR for Power Sensor ⁴	DC	0.000 32	Comparison to Keysight 3458A Digital Multi Meter

Electrical – RF/Microwave

Parameter/ Equipment	Amplitude Modulation Depth		
Reference Standard, Method, and/or Equipment	Comparison to N9030B PXA Signal Analyzer		
Range	AM Depth	Modulation Rate	Expanded Uncertainty of Measurement (+/-)
fc: 2 Hz to 50 GHz	(5 to 20) % Depth	fm: 10 Hz to 100 kHz	0.11 % of reading + 0.0083 %
	(>20 to 40) % Depth		0.022 % of reading + 0.026 %
	(>40 to 50) % Depth		0.0027 % of reading + 0.034 %
	(>50 to 60) % Depth		-0.013 % of reading + 0.043 %
	(>60 to 75) % Depth		-0.041 % of reading + 0.06 %
	(>75 to 90) % Depth		-0.091 % of reading + 0.099 %
	(>90 to 95) % Depth		0.01 %
	(>95 to 98) % Depth		0.0051 %
fc: 100 kHz to 13.6 GHz	(5 to 50)% Depth	fm: 10 Hz to 25 kHz	0.1 % of reading
	(5 to 30)% Depth	fm: 25 kHz to 50 kHz	0.16 % of reading
	(5 to 20)% Depth	fm: 50 kHz to 100 kHz	0.22 % of reading
	(5 to 95)% Depth	fm: 100 kHz to 250 kHz	0.32 % of reading
		fm: 250 kHz to 500 kHz	0.5 % of reading
		fm: 500 kHz to 1 MHz	0.71 % of reading
		fm: 1 MHz	1 % of reading

Electrical – RF/Microwave

Parameter/ Equipment		Amplitude Modulation Depth	
Reference Standard, Method, and/or Equipment		Comparison to N9030B PXA Signal Analyzer	
Range	AM Depth	Modulation Rate	Expanded Uncertainty of Measurement (+/-)
fc: 13.5 to 17.1 GHz	(5 to 50)% Depth	fm: 10 Hz to 10 kHz	0.1 % of reading
	(5 to 35)% Depth	fm: 10 kHz to 25 kHz	0.14 % of reading
	(5 to 20)% Depth	fm: 25 kHz to 50 kHz	0.22 % of reading
	(5 to 15)% Depth	fm: 50 kHz to 100 kHz	0.32 % of reading
	(5 to 95)% Depth	fm: 100 kHz to 250 kHz	0.45 % of reading
		fm: 250 kHz to 500 kHz	0.71 % of reading
		fm: 500 kHz to 1 MHz	1 % of reading
	fm: 1 MHz	1.4 % of reading	
fc: 17 to 34.5 GHz	(5 to 50)% Depth	fm: 10 Hz to 5 kHz	0.1 % of reading
	(5 to 55)% Depth	fm: 5 kHz to 10 kHz	0.095 % of reading
	(5 to 30)% Depth	fm: 10 kHz to 25 kHz	0.15 % of reading
	(5 to 20)% Depth	fm: 25 kHz to 50 kHz	0.25 % of reading
	(5 to 10)% Depth	fm: 50 kHz to 100 kHz	0.36 % of reading
	(5 to 95)% Depth	fm: 100 kHz to 250 kHz	0.52 % of reading
		fm: 250 kHz to 500 kHz	0.84 % of reading
		fm: 500 kHz to 1 MHz	1.2 % of reading
		fm: 1 MHz	1.7 % of reading
fc: 34.4 to 50 GHz	(5 to 15)% Depth	fm: 10 Hz to 5 kHz	0.25 % of reading
	(5 to 15)% Depth	fm: 5 kHz to 10 kHz	0.31 % of reading
	(5 to 10)% Depth	fm: 10 kHz to 25 kHz	0.37 % of reading
	(5 to 95)% Depth	fm: 100 kHz to 250 kHz	1.5 % of reading
		fm: 250 kHz to 500 kHz	3.3 % of reading
		fm: 500 kHz to 1 MHz	6.3 % of reading
		fm: 1 MHz	12 % of reading

Electrical – RF/Microwave

Parameter/ Equipment		Frequency Modulation Deviation		
Reference Standard, Method, and/or Equipment		Comparison to N9030B PXA Signal Analyzer		
Range	Deviation	Mod Rate	Mod Index	Expanded Uncertainty of Measurement (+/-)
100 kHz ≤ fc ≤ 3.6 GHz	20 Hz < FM Dev < 2 MHz	10 Hz ≤ fm < 500 kHz	β ≥ 0.5	0.20 % of reading
	10 Hz ≤ FM Dev < 10 MHz	20 Hz < fm ≤ 1 MHz	β ≥ 0.2	0.70 % of reading
	10 Hz ≤ FM Dev ≤ 16 MHz	50 Hz < fm ≤ 1 MHz	β ≥ 0.05	2.0 % of reading
	10 Hz < FM Dev < 50 kHz	100 Hz < fm ≤ 1 MHz	β ≥ 0.025	5.2 % of reading
	10 Hz ≤ FM Dev < 40 kHz	100 Hz < fm ≤ 1 MHz	β ≥ 0.020	10 % of reading
	10 Hz ≤ FM Dev < 20 kHz	500 Hz < fm ≤ 1 MHz	β ≥ 0.010	20 % of reading
3.5 GHz ≤ fc ≤ 8.4 GHz	20 Hz < FM Dev < 1 MHz	10 Hz ≤ fm < 500 kHz	β ≥ 0.5	0.21 % of reading
	10 Hz ≤ FM Dev < 5 MHz	20 Hz < fm ≤ 1 MHz	β ≥ 0.2	0.70 % of reading
	10 Hz ≤ FM Dev < 16 MHz	50 Hz < fm ≤ 1 MHz	β ≥ 0.05	2.2 % of reading
	10 Hz < FM Dev ≤ 16 MHz	100 Hz < fm ≤ 1 MHz	β ≥ 0.025	5.2 % of reading
	10 Hz ≤ FM Dev < 40 kHz	100 Hz < fm ≤ 1 MHz	β ≥ 0.020	10 % of reading
	10 Hz ≤ FM Dev < 20 kHz	500 Hz < fm ≤ 1 MHz	β ≥ 0.010	20 % of reading
8.3 GHz ≤ fc ≤ 13.6 GHz	20 Hz < FM Dev < 2 MHz	10 Hz ≤ fm < 500 kHz	β ≥ 0.5	0.21 % of reading
	10 Hz < FM Dev < 10 MHz	50 Hz < fm ≤ 1 MHz	β ≥ 0.2	0.70 % of reading
	10 Hz ≤ FM Dev ≤ 16 MHz	50 Hz < fm ≤ 1 MHz	β ≥ 0.05	2.2 % of reading
	10 Hz < FM Dev < 500 kHz	100 Hz < fm ≤ 1 MHz	β ≥ 0.025	5.2 % of reading
	10 Hz ≤ FM Dev < 40 kHz	100 Hz < fm ≤ 1 MHz	β ≥ 0.020	10 % of reading
	10 Hz ≤ FM Dev < 20 kHz	500 Hz < fm ≤ 1 MHz	β ≥ 0.010	20 % of reading
13.5 GHz ≤ fc ≤ 17.1 GHz	20 Hz < FM Dev < 1 MHz	10 Hz ≤ fm < 200 kHz	β ≥ 0.5	0.21 % of reading
	10 Hz ≤ FM Dev < 5 MHz	20 Hz < fm ≤ 1 MHz	β ≥ 0.2	0.70 % of reading
	10 Hz ≤ FM Dev < 16 MHz	50 Hz < fm ≤ 1 MHz	β ≥ 0.05	2.2 % of reading
	10 Hz < FM Dev ≤ 16 MHz	100 Hz < fm ≤ 1 MHz	β ≥ 0.025	5.2 % of reading
	10 Hz ≤ FM Dev ≤ 40 kHz	100 Hz < fm ≤ 1 MHz	β ≥ 0.020	10 % of reading
	10 Hz ≤ FM Dev ≤ 20 kHz	500 Hz < fm ≤ 1 MHz	β ≥ 0.010	20 % of reading
17.0 GHz ≤ fc ≤ 26.5 GHz	50 Hz < FM Dev < 400 kHz	10 Hz ≤ fm < 50 kHz	β ≥ 0.8	0.31 % of reading
	20 Hz < FM Dev < 5 MHz	10 Hz < fm ≤ 1 MHz	β ≥ 0.2	0.90 % of reading
	20 Hz < FM Dev < 10 MHz	100 Hz < fm ≤ 1 MHz	β ≥ 0.08	3.3 % of reading
	10 Hz < FM Dev ≤ 16 MHz	100 Hz < fm ≤ 1 MHz	β ≥ 0.04	6.3 % of reading
	10 Hz ≤ FM Dev ≤ 40 kHz	100 Hz < fm ≤ 1 MHz	β ≥ 0.020	12 % of reading
	10 Hz ≤ FM Dev ≤ 1 kHz	500 Hz < fm ≤ 100 kHz	β ≥ 0.010	30 % of reading



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26.4 GHz ≤ f _c ≤ 34.5 GHz	50 Hz < FM Dev < 400 kHz	10 Hz ≤ f _m < 50 kHz	β ≥ 0.8	0.31 % of reading
	20 Hz < FM Dev < 5 MHz	10 Hz < f _m < 1 MHz	β ≥ 0.2	0.90 % of reading
	20 Hz < FM Dev < 10 MHz	100 Hz < f _m ≤ 1 MHz	β ≥ 0.08	3.3 % of reading
	10 Hz < FM Dev < 16 MHz	100 Hz < f _m ≤ 1 MHz	β ≥ 0.04	6.3 % of reading
	10 Hz ≤ FM Dev ≤ 16 MHz	100 Hz < f _m ≤ 1 MHz	β ≥ 0.020	12 % of reading
	10 Hz ≤ FM Dev ≤ 1 kHz	500 Hz < f _m ≤ 100 kHz	β ≥ 0.010	30 % of reading
34.4 GHz ≤ f _c ≤ 50 GHz	50 Hz < FM Dev < 100 kHz	10 Hz ≤ f _m < 20 kHz	β ≥ 0.8	0.32 % of reading
	20 Hz < FM Dev < 500 kHz	10 Hz ≤ f _m < 200 kHz	β ≥ 0.2	0.90 % of reading
	20 Hz < FM Dev < 2 MHz	20 Hz < f _m ≤ 1 MHz	β ≥ 0.08	3.3 % of reading
	10 Hz < FM Dev < 5 MHz	50 Hz < f _m ≤ 1 MHz	β ≥ 0.04	6.4 % of reading
	10 Hz ≤ FM Dev < 16 MHz	100 Hz < f _m ≤ 1 MHz	β ≥ 0.020	12 % of reading
	10 Hz ≤ FM Dev ≤ 1.6 MHz	500 Hz < f _m ≤ 200 kHz	β ≥ 0.010	30 % of reading

Electrical – RF/Microwave

Parameter/ Equipment	Absolute RF Power Measure ¹											
Reference Standard, Method, and/or Equipment	Comparison to Keysight Power Sensors, Keysight N191xA/E441x Series Power Meter and Keysight PSA/PXA Series Signal Analyzer											
Range	Expanded Uncertainty of Measurement (+/-)											
Frequency Ranges	Amplitude in dB											
	(-140 to -130) dBm	(-130 to -110) dBm	(-110 to -90) dBm	(-90 to -30) dBm	(-30 to -20) dBm	(-20 to -10) dBm	(-10 to -3) dBm	(-3 to 3) dBm	(3 to 10) dBm	(10 to 15) dBm	(15 to 20) dBm	(20 to 30) dBm
(9 to < 100) kHz	0.17	0.16	0.16	0.16	0.16	0.13	0.13	0.027	0.058	0.097	0.1	0.16
100 kHz to < 10 MHz	0.15	0.15	0.14	0.14	0.13	0.13	0.13	0.027	0.058	0.097	0.1	0.16
(10 to < 30) MHz	0.074	0.066	0.052	0.043	0.042	0.042	0.042	0.030	0.038	0.047	0.048	0.16
(30 to < 500) MHz	0.073	0.065	0.051	0.042	0.041	0.04	0.04	0.024	0.036	0.045	0.047	0.16
500 MHz to < 1.2 GHz	0.073	0.065	0.051	0.042	0.041	0.04	0.04	0.025	0.036	0.045	0.047	0.16
(1.2 to < 6) GHz	0.078	0.071	0.055	0.045	0.044	0.044	0.044	0.03	0.04	0.048	0.050	0.16
(6 to < 8) GHz	0.079	0.072	0.056	0.047	0.046	0.045	0.045	0.029	0.042	0.050	0.052	0.16
(8 to < 12.4) GHz	0.083	0.078	0.064	0.057	0.056	0.055	0.055	0.031	0.052	0.059	0.060	0.17
(12.4 to < 14) GHz	0.089	0.084	0.071	0.064	0.064	0.063	0.063	0.031	0.06	0.066	0.068	0.17
(14 to 18) GHz	0.094	0.089	0.077	0.071	0.07	0.07	0.07	0.05	0.068	0.073	0.074	0.18
(18 to 24.0) GHz	0.10	0.097	0.085	0.078	0.078	0.077	0.077	0.073	0.075	0.08	0.081	0.19
(24 to 26.5) GHz	0.11	0.099	0.088	0.082	0.081	0.081	0.081	0.077	0.079	0.083	0.084	-
(26.5 to 33) GHz	0.12	0.11	0.1	0.097	0.097	0.096	0.096	0.093	0.095	0.099	0.099	-
(33 to 40) GHz	0.15	0.14	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	-
(40 to 50) GHz	0.16	0.15	0.15	0.14	0.14	0.13	0.13	0.13	0.13	0.14	0.14	-

Electrical – RF/Microwave

Parameter/ Equipment	Absolute RF Power Measure ¹											
Reference Standard, Method, and/or Equipment	Comparison to Keysight Power Sensors, Keysight N191xA/E441x Series Power Meter and Keysight PSA/PXA Series Signal Analyzer											
Range	Expanded Uncertainty of Measurement (+/-)											
Frequency Ranges	Amplitude in dB											
	(-140 to -130) dBm	(-130 to -110) dBm	(-110 to -90) dBm	(-90 to -30) dBm	(-30 to -20) dBm	(-20 to -10) dBm	(-10 to -3) dBm	(-3 to 3) dBm	(3 to 10) dBm	(10 to 15) dBm	(15 to 20) dBm	(20 to 30) dBm
(50 to 60) GHz	-	-	-	0.25	0.19	0.19	0.19	0.19	0.19	0.19	0.19	-
(60 to 67) GHz	-	-	-	0.23	0.17	0.17	0.17	0.17	0.17	0.17	0.18	0.18

Electrical – RF/Microwave

Parameter/ Equipment	S11/S22 - Reflection Magnitude ^{1,2}									
Reference Standard, Method, and/or Equipment	Comparison to Keysight Network Analyzers + Keysight Calibration Kits									
Range	Expanded Uncertainty of Measurement (+/-)									
Frequency	Measured VRC 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
900 Hz to 30 kHz	0.000 3	0.000 37	0.0004 2	0.000 47	0.000 5	0.000 54	0.000 57	0.000 6	0.000 63	0.000 63
30 kHz to 10 MHz	0.000 25	0.000 33	0.000 4	0.000 45	0.000 49	0.000 51	0.000 53	0.000 54	0.000 55	0.000 55
10 MHz to 2.0 GHz	0.000 51	0.000 54	0.000 56	0.000 58	0.000 58	0.000 58	0.000 58	0.000 57	0.000 57	0.000 57
(2.0 to 8.0) GHz	0.000 76	0.000 68	0.000 78	0.000 78	0.000 77	0.000 76	0.000 75	0.000 76	0.000 8	0.000 8
(8.0 to 20.0) GHz	0.001 4	0.000 74	0.000 92	0.001 1	0.001 3	0.001 3	0.001 2	0.001 3	0.001 1	0.001 5
(20.0 to 26.5) GHz	0.001 8	0.001 1	0.001 2	0.001 4	0.001 4	0.001 5	0.001 5	0.001 5	0.001 5	0.002 2
(26.5 to 33.0) GHz	0.002 1	0.001 1	0.001 3	0.001 6	0.002 1	0.002 3	0.002 3	0.002	0.001 8	0.004 1
(33.0 to 40.0) GHz	0.002 6	0.001 3	0.001 6	0.001 9	0.002 3	0.002 6	0.002 4	0.002 2	0.001 9	0.004 1
(40.0 to 45.0) GHz	0.002 6	0.001 6	0.001 8	0.002	0.002 3	0.002 6	0.002 9	0.002 6	0.002 4	0.004 5
(45.0 to 50.0) GHz	0.002 8	0.001 6	0.001 8	0.002 1	0.002 5	0.002 8	0.003	0.002 7	0.002 4	0.005
(50.0 to 67.0) GHz	0.003 9	0.002 7	0.003	0.003 4	0.003 8	0.004 4	0.005 1	0.005 9	0.006 8	0.007 8

Electrical – RF/Microwave

Parameter/ Equipment	S11/S22 - Reflection Phase CMC ^{1,4}									
Reference Standard, Method, and/or Equipment	Comparison to Keysight Network Analyzers + Keysight Calibration Kits									
Range	Expanded Uncertainty of Measurement (+/-)									
Frequency	Measured VRC Phase in degree									
	0 to 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	0.8 to 0.9
900 Hz to 30 kHz	0.17	0.1	0.079	0.065	0.056	0.05	0.045	0.041	0.038	0.021
30 kHz to 10 MHz	0.17	0.1	0.079	0.065	0.056	0.05	0.045	0.04	0.035	0.012
10 MHz to 2.0 GHz	0.24	0.16	0.11	0.09	0.076	0.064	0.055	0.046	0.04	0.021
(2.0 to 8.0) GHz	0.4	0.23	0.16	0.13	0.11	0.1	0.08	0.066	0.058	0.046
(8.0 to 20.0) GHz	0.38	0.22	0.17	0.15	0.12	0.11	0.087	0.069	0.059	0.047
(20.0 to 26.5) GHz	0.6	0.41	0.33	0.26	0.19	0.15	0.12	0.095	0.082	0.076
(26.5 to 33.0) GHz	0.58	0.37	0.32	0.28	0.21	0.16	0.12	0.097	0.082	0.077
(33.0 to 40.0) GHz	0.58	0.39	0.35	0.3	0.22	0.16	0.12	0.098	0.083	0.077
(40.0 to 45.0) GHz	0.86	0.5	0.4	0.34	0.25	0.2	0.16	0.13	0.12	0.12
(45.0 to 50.0) GHz	0.89	0.55	0.46	0.38	0.28	0.21	0.17	0.14	0.12	0.12
(50.0 to 67.0) GHz	1.5	0.82	0.63	0.5	0.38	0.3	0.25	0.22	0.21	0.21

Electrical – RF/Microwave

Parameter/ Equipment	S21/S12 - Transmission Magnitude CMC ^{1,2}									
Reference Standard, Method, and/or Equipment	Comparison to Keysight Network Analyzers + Keysight Calibration Kits									
Range	Expanded Uncertainty of Measurement (+/-)									
Frequency	Measured Magnitude in dB									
	(0 to ≤ 2) dB	(2 < to ≤ 4) dB	(4 < to ≤ 6) dB	(6 < to ≤ 8) dB	(8 < to ≤ 10) dB	(10 < to ≤ 12) dB	(12 < to 16) dB	(16 < to 20) dB	(20 < to 30) dB	
900 Hz to 30 kHz	0.005 9 dB	0.006 8 dB	0.007 7 dB	0.008 6 dB	0.009 6 dB	0.01 dB	0.012 dB	0.014 dB	0.019 dB	
30 kHz to 10 MHz	0.006 4 dB	0.007 2 dB	0.008 1 dB	0.009 dB	0.009 9 dB	0.011 dB	0.012 dB	0.014 dB	0.017 dB	
10 MHz to 2.0 GHz	0.007 dB	0.007 7 dB	0.008 5 dB	0.009 4 dB	0.01 dB	0.011 dB	0.012 dB	0.013 dB	0.017 dB	
(2.0 to 8.0) GHz	0.007 1 dB	0.007 5 dB	0.007 9 dB	0.008 4 dB	0.008 8 dB	0.009 3 dB	0.01 dB	0.011 dB	0.014 dB	
(8.0 to 20.0) GHz	0.008 9 dB	0.009 2 dB	0.009 6 dB	0.009 9 dB	0.01 dB	0.011 dB	0.012 dB	0.013 dB	0.015 dB	
(20.0 to 26.5) GHz	0.01 dB	0.011 dB	0.011 dB	0.011 dB	0.012 dB	0.012 dB	0.013 dB	0.014 dB	0.016 dB	
(26.5 to 33.0) GHz	0.015 dB	0.015 dB	0.015 dB	0.016 dB	0.016 dB	0.016 dB	0.017 dB	0.017 dB	0.019 dB	
(33.0 to 40.0) GHz	0.024 dB	0.024 dB	0.024 dB	0.024 dB	0.024 dB	0.025 dB	0.025 dB	0.026 dB	0.027 dB	
(40.0 to 45.0) GHz	0.025 dB	0.025 dB	0.026 dB	0.026 dB	0.026 dB	0.026 dB	0.026 dB	0.027 dB	0.028 dB	

Electrical – RF/Microwave

Parameter/ Equipment	S21/S12 - Transmission Magnitude CMC ^{1,2}									
Reference Standard, Method, and/or Equipment	Comparison to Keysight Network Analyzers + Keysight Calibration Kits									
Range	Expanded Uncertainty of Measurement (+/-)									
Frequency	Measured Magnitude in dB									
	(0 to ≤ 2) dB	(2 < to ≤ 4) dB	(4 < to ≤ 6) dB	(6 < to ≤ 8) dB	(8 < to ≤ 10) dB	(10 < to ≤ 12) dB	(12 < to 16) dB	(16 < to 20) dB	(20 < to 30) dB	
(45.0 to 50.0) GHz	0.029 dB	0.029 dB	0.029 dB	0.029 dB	0.029 dB	0.029 dB	0.03 dB	0.03 dB	0.031 dB	
(50.0 to 67.0) GHz	0.049 dB	0.049 dB	0.049 dB	0.049 dB	0.049 dB	0.049 dB	0.049 dB	0.049 dB	0.05 dB	

Electrical – RF/Microwave

Parameter/ Equipment	S21/S12 - Transmission Phase CMC ^{1,4}										
Reference Standard, Method, and/or Equipment	Comparison to Keysight Network Analyzers + Keysight Calibration Kits										
Range	Expanded Uncertainty of Measurement (+/-)										
Frequency	Measured Transmission Phase in degree										
	0 dB	0 dB to - 2 dB	-2 dB to -4 dB	-4 dB to -6 dB	-6 dB to -8 dB	-8 dB to -10 dB	-10 dB to -12 dB	-12 dB to -16 dB	-16 dB to -20 dB	-20 dB to - 30 dB	
900 Hz to 30 kHz	0.0083	0.0083	0.036	0.042	0.049	0.055	0.062	0.067	0.078	0.088	
30 kHz to 10 MHz	0.0058	0.0083	0.036	0.042	0.049	0.055	0.062	0.066	0.075	0.084	
10 MHz to 2.0 GHz	0.006	0.0083	0.034	0.037	0.041	0.044	0.048	0.052	0.06	0.068	
(2.0 to 8.0) GHz	0.018	0.018	0.036	0.04	0.043	0.046	0.05	0.054	0.061	0.069	
(8.0 to 20.0) GHz	0.02	0.02	0.037	0.04	0.043	0.047	0.05	0.054	0.061	0.069	
(20.0 to 26.5) GHz	0.031	0.031	0.042	0.045	0.048	0.051	0.054	0.058	0.065	0.072	
(26.5 to 33.0) GHz	0.032	0.032	0.042	0.045	0.048	0.051	0.054	0.057	0.064	0.072	
(33.0 to 40.0) GHz	0.033	0.033	0.042	0.045	0.048	0.051	0.054	0.058	0.065	0.072	
(40.0 to 45.0) GHz	0.048	0.048	0.054	0.057	0.059	0.062	0.064	0.067	0.073	0.08	
(45.0 to 50.0) GHz	0.047	0.047	0.054	0.056	0.058	0.061	0.064	0.067	0.073	0.08	
(50.0 to 67.0) GHz	0.075	0.075	0.08	0.081	0.083	0.085	0.087	0.089	0.094	0.099	

Electrical – RF/Microwave

Parameter/ Equipment	S11/S22 - Reflection Magnitude ^{1,2}
Reference Standard, Method, and/or Equipment	Keysight N5290x Network Analyzers + Keysight Waveguide Calibration Kits V11644A/W11644A
Range	Expanded Uncertainty of Measurement (+/-)



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Electrical – RF/Microwave

Parameter/ Equipment	S21/S12 - Transmission Phase CMC ^{1,4}										
Reference Standard, Method, and/or Equipment	Comparison to Keysight Network Analyzers + Keysight Calibration Kits										
Range	Expanded Uncertainty of Measurement (+/-)										
Frequency	Measured Transmission Phase in degree										
	0 dB	0 dB to -2 dB	-2 dB to -4 dB	-4 dB to -6 dB	-6 dB to -8 dB	-8 dB to -10 dB	-10 dB to -12 dB	-12 dB to -16 dB	-16 dB to -20 dB	-20 dB to -30 dB	
Frequency	Measured VRC Magnitude (Linear)										
	≤ 0.01	> 0.01 to ≤ 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
(50.0 to 110.0) GHz	0.005 5	0.006 2	0.007 1	0.008 1	0.009 3	0.011	0.012	0.014	0.016	0.018	0.02

Time and Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Frequency – Source	(1, 5, 10) MHz (0.01 to 10) Hz 10 Hz to 12.4 GHz	1.5×10^{-12} Hz/Hz 2×10^{-11} Hz/Hz 1.5×10^{-11} Hz/Hz	Comparison to Keysight 53132A Counter
Frequency – Source	(12.4 to 46) GHz	1.9 Hz	Comparison to Keysight 53152A Counter + Agilent 5071A Cesium Frequency Standard
Time Interval – Measure	10 ps to 1 ns 1 ns to 100 ns 100 ns to 1 us	11 ms/s + 1.3 ps 12 ps 1.5 ms/s + 1.1 ps	Comparison to Agilent 86100C Oscilloscope
Time Interval – Measure	100 ns to 1 s (1 to 10) s (10 to 100) s	650 ps 65 ps/s + 700 ps 80 ps/s + 700 ps	Comparison to Agilent 5071A Frequency Standard, Keysight 53132A Counter

Time and Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Jitter - Source	(0.01 to 25) ps		Comparison to Keysight E82x7D Signal Generator
	2.0 GHz	0.12 ps	
	2.5 GHz	44 fs	
	2.75 GHz	65 fs	
	3.0 GHz	0.13 ps	
	3.2 GHz	0.13 ps	
	5.0 GHz	0.1 ps	
	8.0 GHz	52 fs	
	10 GHz	31 fs	
	12 GHz	50 fs	
	13 GHz	50 fs	
	14 GHz	0.1 ps	
	15 GHz	50 fs	
	28 GHz	42 fs	
32 GHz	37 fs		
Jitter Measure	200 kHz to 15 GHz (0.1 to 130) ps	1.9 ps	Comparison to Keysight 86100x Oscilloscope with 86112/7A 20 GHz Module

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. Enhanced process by including the 3458A measurement system (Gold Standard) to accomplish reduced measurement uncertainty
3. Unless otherwise indicated, % = % modulation.
4. Unitless linear measure.
5. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1930.



Jason Stine, Vice President