SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017,
ANSI/NCSL Z540-1-1994, & ANSI/NCSL Z540.3-2006

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CALIBRATION

Valid To: March 31, 2028 Certificate Number: 2079.01

In recognition of the successful completion of the A2LA evaluation process (including an assessment of the organization's compliance with R205 – A2LA's Calibration Program Requirements), accreditation is granted to this laboratory to perform the following calibrations[1, 8]:

I. Dimensional

Parameter/Equipment	Range	CMC[2, 3, 7] (±)	Comments
One Dimensional Length – Measure	(0.01 to 500) mm (0.01 to 25.4) mm	(0.60 + 0.0033*L*) µm 0.30 µm	CMM or similar device Drop indicator
Flatness – Measure	(0.1 to 254) mm (0.1 to 25) mm	0.58 µm 0.30 µm	CMM or similar device 3D optical profiler
Pin Depth	(-50 to 50) µm (-50 to 50) µm	0.54 µm 0.28 µm	CMM or similar device White light interferometer microscope
Diameter – Measure	(1 to 16) mm	(0.59 + 0.0024*D*) µm	CMM or similar device
Diameter, Outer – Measure	(0.4 to 16) mm	0.48 µm	Z-Mike 1210 gold laser micrometer

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
Diameter, Inner – Measure	(1.845 to 1.855) mm (2.395 to 2.405) mm (2.912 to 2.928) mm (3.495 to 3.505) mm (6.492 to 6.508) mm (6.995 to 7.005) mm	0.49 µm 0.49 µm 0.49 µm 0.49 µm 0.49 µm 0.49 µm	Ring gages w/ 1.85 mm air probe 2.4 mm air probe 2.92 mm air probe 3.5 mm air probe 6.5 mm air probe 7 mm air probe

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
Resistance – Measure	(10 to 100) Ω	16 mΩ	34970A data acquisition system

III. Electrical – RF/Microwave

Parameter/Range	CMC[2, 7] (±)	Comments
Reflection S_{11}/S_{22} – Measure[4]		
10 MHz to 18 GHz		
(0.000 01 to 1.0) lin	(±0.000 50 to ±0.0032) lin	Network analyzer, ET33717 Type N characterized device cal kit
(0 to 0.01) lin	(±2.7 to ±180) deg	
(>0.01 to 0.1) lin	(±0.29 to ±1.3) deg	
(>0.1 to 0.5) lin	(±0.11 to ±0.29) deg	
(>0.5 to 1.0) lin	(±0.04 to ±0.19) deg	
10 MHz to 18 GHz		
(0.000 01 to 1.0) lin	(±0.000 40 to ±0.0032) lin	Network analyzer, ET33733 APC 7 mm, characterized device cal kit
(0 to 0.01) lin	(±1.7 to ±180) deg	
(>0.01 to 0.1) lin	(±0.20 to ±1.3) deg	
(>0.1 to 0.5) lin	(±0.10 to ±0.29) deg	
(>0.5 to 1.0) lin	(±0.02 to ±0.19) deg	

Parameter/Range	CMC[2, 7] (±)	Comments
Reflection S_{11}/S_{22} – Measure[4] (cont)		
10 MHz to 33.0 GHz		
(0.000 01 to 1.0) lin	(±0.000 50 to ±0.0032) lin	Network analyzer, ET33700 3.5 mm, characterized device cal kit
(0 to 0.01) lin	(±2.3 to ±180) deg	
(>0.01 to 0.1) lin	(±0.26 to ±1.3) deg	
(>0.1 to 0.5) lin	(±0.11 to ±0.36) deg	
(>0.5 to 1.0) lin	(±0.03 to ±0.35) deg	
10 MHz to 50 GHz		
(0.000 01 to 1.0) lin	(±0.000 50 to ±0.0032) lin	Network analyzer, ET33702 2.4 mm, characterized device cal kit
(0 to 0.01) lin	(±1.4 to ± 180) deg	
(>0.01 to 0.1) lin	(±0.25 to ±2.3) deg	
(>0.1 to 0.5) lin	(±0.11 to ±0.66) deg	
(>0.5 to 1.0) lin	(±0.02 to ±0.33) deg	
10 MHz to 70 GHz		
(0.000 01 to 1.0) lin	(±0.0011 to ±0.0096) lin	Network analyzer, ET36411 1.85 mm, multi-offset short mode, characterized device cal kit
(0 to 0.01) lin	(±6.8 to ±180) deg	
(>0.01 to 0.1) lin	(±0.62 to ± 6.6) deg	
(>0.1 to 0.5) lin	(±0.15 to ±0.72) deg	
(>0.5 to 1.0) lin	(±0.11 to ±0.71) deg	
10 MHz to 8.2 GHz		
(0.000 01 to 1.0) lin	(±0.000 50 to ±0.0032) lin	Network analyzer, ET51601 7-16 connector, characterized device cal kit
(0 to 0.01) lin	(±2.4 to ±180) deg	
(>0.01 to 0.1) lin	(±0.26 to ±1.3) deg	
(>0.1 to 0.5) lin	(±0.11 to ±0.29) deg	
(>0.5 to 1.0) lin	(±0.03 to ±0.19) deg	
10 MHz to 12 GHz		
(0.000 01 to 1.0) lin	(±0.000 40 to ±0.0043) lin	Network analyzer, ET36409 type N 75 ohm, characterized device cal kit
(0 to 0.01) lin	(±2.1 to ±180) deg	
(>0.01 to 0.1) lin	(±0.24 to ±2.2) deg	
(>0.1 to 0.5) lin	(±0.11 to ±0.44) deg	
(>0.5 to 1.0) lin	(±0.02 to ±0.36) deg	

Parameter/Range	CMC[2, 7] (±)	Comments
Reflection S_{11}/S_{22} – Measure[4] (cont)		
10 MHz to 6.2 GHz		
(0.000 01 to 1.0) lin	(±0.000 40 to ±0.0032) lin	Network analyzer, ET36442 type F 75 ohm, characterized device cal kit
(0 to 0.01) lin	(±2.2 to ±180) deg	
(>0.01 to 0.1) lin	(±0.25 to ±1.3) deg	
(>0.1 to 0.5) lin	(±0.11 to ±0.29) deg	
(>0.5 to 1.0) lin	(±0.03 to ±0.19) deg	
10 MHz to 45 GHz		
(0.000 01 to 1.0) lin	(±0.0016 to ±0.0075) lin	Network analyzer, 85056K option H01 2.92 mm multiple offset short, open, load calibration kit
(0 to 0.01) lin	(±8.6 to ±180) deg	
(>0.01 to 0.1) lin	(±0.87 to ±2.9) deg	
(>0.1 to 0.5) lin	(±0.22 to ±0.79) deg	
(>0.5 to 1.0) lin	(±0.14 to ±0.71) deg	
(8.2 to 12.4) GHz		
(0.000 01 to 1.0) lin	(±0.0012 to ±0.0075) lin	Network analyzer, ET36405 X band, TRL cal kit
(0 to 0.01) lin	(±8.9 to ±180) deg	
(>0.01 to 0.1) lin	(±2.5 to ±8.9) deg	
(>0.1 to 0.5) lin	(±1.9 to ±2.5) deg	
(>0.5 to 1.0) lin	(±1.9 to ±1.9) deg	
(12.4 to 18.0) GHz		
(0.000 01 to 1.0) lin	(±0.000 73 to ±0.0023) lin	Network analyzer, ET36406 P band, TRL cal kit
(0 to 0.01) lin	(±4.5 to ±180) deg	
(>0.01 to 0.1) lin	(±0.72 to ±4.5) deg	
(>0.1 to 0.5) lin	(±0.41 to ±0.72) deg	
(>0.5 to 1.0) lin	(±0.73 to ±0.41) deg	

Parameter/Range	CMC[2, 7] (±)	Comments
Reflection S_{11}/S_{22} – Measure[4] (cont)		
(18.0 to 26.5) GHz		
(0.000 01 to 1.0) lin	(±0.0013 to ± 0.0028) lin	Network analyzer, ET36407 K band, TRL cal kit
(0 to 0.01) lin	(±7.7 to ±180) deg	
(>0.01 to 0.1) lin	(±1.1 to ±7.8) deg	
(>0.1 to 0.5) lin	(±0.53 to ±1.2) deg	
(>0.5 to 1.0) lin	(±0.48 to ±0.65) deg	
(26.5 to 40) GHz		
(0.000 01 to 1.0) lin	(±0.0022 to ±0.0077) lin	Network analyzer, ET36320 R-band, TRL cal kit
(0 to 0.01) lin	(±13 to ±180) deg	
(>0.01 to 0.1) lin	(±1.7 to ±13) deg	
(>0.1 to 0.5) lin	(±0.67 to ±1.7) deg	
(>0.5 to 1.0) lin	(±0.64 to ±0.67) deg	
(33 to 50) GHz		
(0.000 01 to 1.0) lin	(±0.0022 to ±0.0077) lin	Network analyzer, ET36321 Q-band, TRL cal kit
(0 to 0.01) lin	(±13 to ±180) deg	
(>0.01 to 0.1) lin	(±1.7 to ±13) deg	
(>0.1 to 0.5) lin	(±0.74 to ±1.7) deg	
(>0.5 to 1.0) lin	(±0.70 to ±0.74) deg	
(40 to 60) GHz		
(0.000 01 to 1.0) lin	(±0.0012 to ±0.011) lin	Network analyzer HP8510C, multiplier test set HP U85104A, HP 85105A mm wave controller RF source HP83623B Lo source HP 83651A/B, ET36322 U-band, TRL cal kit
(0 to 0.01) lin	(±17 to ±180) deg	
(>0.01 to 0.1) lin	(±5.0 to ±17) deg	
(>0.1 to 0.5) lin	(±4.1 to ±5.0) deg	
(>0.5 to 1.0) lin	(±4.1 to ±4.2) deg	

Parameter/Range	CMC[2, 7] (±)	Comments
Reflection S_{11}/S_{22} – Measure[4] (cont)		
(50 to 75) GHz		
(0.000 01 to 1.0) lin	(±0.0022 to ±0.013) lin	Network analyzer HP8510C, multiplier test set HP V85104A, HP 85105A mm wave controller, source HP 83623B, source HP 83651A/B, ET36323 V-band, TRL cal kit
(0 to 0.01) lin	(±18 to ±180) deg	
(>0.01 to 0.1) lin	(±6.0 to ±18) deg	
(>0.1 to 0.5) lin	(±5.1 to +6.0) deg	
(>0.5 to 1.0) lin	(±5.1 to ±5.3) deg	
(75 to 110) GHz		
(0.000 01 to 1.0) lin	(±0.0022 to ±0.015) lin	Network analyzer HP8510C, multiplier test set HP W85104A, HP 85105A mm wave controller, source HP 83623B, source HP 83651 A/B, ET36324 W-band, TRL cal kit
(0 to 0.01) lin	(±30 to ±180) deg	
(>0.01 to 0.1) lin	(±9.1 to ±30) deg	
(>0.1 to 0.5) lin	(±7.5 to ±9.1) deg	
(>0.5 to 1.0) lin	(±7.5 to ±7.6) deg	
(110 to 170) GHz		
(0.000 01 to 1.0) lin	(±0.0011 to ±0.085) lin	Network analyzer N5247B VDI 6.5 VNAX frequency extender VDI WR6.5 calibration kit
(0 to 0.01) lin	(±4.9 to ±180) deg	
(>0.01 to 0.1) lin	(±1.6 to ±5.7) deg	
(>0.1 to 0.5) lin	(±1.5 to ±5.6) deg	
(>0.5 to 1.0) lin	(±1.2 to ±5.5) deg	
9 kHz to 8.5 GHz		
(0.000 01 to 1.0) lin	(±0.001 to ±0.0042) lin (±0.10 to ±180) deg	Network analyzer Type N cal kit ET33717
9 kHz to 8.5 GHz		
(0.000 01 to 1.0) lin	(±0.0003 to ±0.043) lin (±0.06 to ±180) deg	Network analyzer 3.5 mm cal kit ET33700

Parameter/Range	CMC[2, 7] (±)	Comments
Transmission S_{12}/S_{21} – Measure[5]		
9 kHz to 8.5 GHz		
(0 to 20) dB	(±0.0073 to ±0.057) dB (±0.09 to ±0.43) deg	Network analyzer Cal kit ET33717
(>20 to 40) dB	(±0.047 to ±0.10) dB (±0.33 to ±0.75) deg	
(>40 to 60) dB	(±0.072 to ±0.78) dB (±0.54 to ±5.13) deg	
9 kHz to 8.5 GHz		
(0 to 20) dB	(±0.0064 to ±0.055) dB (±0.09 to ±0.41) deg	Network analyzer Cal kit ET33700
(>20 to 40) dB	(±0.053 to ±0.10) dB (±0.39 to ±0.75) deg	
(>40 to 60) dB	(±0.072 to ±0.78) dB (±0.55 to ±5.1) deg	
10 MHz to 18 GHz		
(0 to 20) dB	(±0.012 to ±0.042) dB (±0.12 to ±0.34) deg	Network analyzer, ET33733 APC 7 mm, characterized device cal kit
(>20 to 40) dB	(±0.024 to ±0.025) dB (±0.22 to ±1.8) deg	
(>40 to 60) dB	(±0.036 to ±2.2) dB (±0.36 to ±17) deg	
10 MHz to 18 GHz		
(0 to 20) dB	(±0.012 to ±0.042) dB (±0.12 to ±0.34) deg	Network analyzer, ET33717 type N, characterized device cal kit
(>20 to 40) dB	(±0.024 to ±0.025) dB (±0.22 to ±1.8) deg	
(>40 to 60) dB	(±0.037 to ±2.2) dB (±0.36 to ±17) deg	

Parameter/Range	CMC[2, 7] (±)	Comments
Transmission S_{12}/S_{21} – Measure[5] (cont)		
10 MHz to 33.5 GHz		
(0 to 20) dB	(±0.012 to ±0.042) dB (±0.12 to ±0.34) deg	Network analyzer, ET33700 3.5 mm, characterized device cal kit
(>20 to 40) dB	(±0.024 to ± 0.025) dB (±0.22 to ±1.8) deg	
(>40 to 60) dB	(±0.036 to ± 2.2) dB (±0.36 to ±17) deg	
10 MHz to 45 GHz		
(0 to 20) dB	(±0.011 to ±0.14) dB (±0.10 to ±0.94) deg	Network analyzer, 85056K option H01 2.92 mm multiple offset short, open, load calibration kit
(>20 to 40) dB	(±0.016 to ±1.4) dB (±0.13 to ±9.1) deg	
(>40 to 60) dB	(±0.017 to ±14) dB (±0.29 to ±91.03) deg	
10 MHz to 50 GHz		
(0 to 20) dB	(±0.012 to ±0.051) dB (±0.12 to ±0.43) deg	Network analyzer, ET33702 2.4 mm, characterized device cal kit
(>20 to 40) dB	(±0.023 to ±0.027) dB (±0.23 to ±2.0) deg	
(>40 to 60) dB	(±0.034 to ±2.3) dB (±0.36 to ±18) deg	

Parameter/Range	CMC[2, 7] (±)	Comments
Transmission S_{12}/S_{21} – Measure[5] (cont)		
10 MHz to 70 GHz		
(0 to 3) dB	(±0.0080 to ±0.29) dB (±0.094 to ±1.18) deg	Network analyzer, ET36411 1.85 mm, multi offset short mode characterized device cal kit
(>3 to 6) dB	(±0.016 to ±0.29) dB (±0.12 to ±1.18) deg	
(>6 to 10) dB	(±0.016 to ±0.29) dB (±0.13 to ±1.18) deg	
(>10 to 20) dB	(±0.016 to ±0.29) dB (±0.13 to ±1.18) deg	
(>20 to 40) dB	(±0.017 to ±0.1.38) dB (±0.13 to ±9.10) deg	
(>40 to 50) dB	(±0.022 to ±4.36) dB (±0.17 to ±28.78) deg	
(>50 to 60) dB	(±0.043 to ±13.80) dB (±0.29 to ±91.02) deg	
10 MHz to 8.2 GHz		
(0 to 20) dB	(±0.012 to ±0.042) dB (±0.12 to ±0.34) deg	Network analyzer, ET51601 7-16 connector, characterized device cal kit
(>20 to 40) dB	(±0.024 to ±0.25) dB (±0.22 to ±1.8) deg	
(>40 to 60) dB	(±0.038 to ±2.2) dB (±0.34 to ±17) deg	

Transmission S_{12}/S_{21} – Measure[5] (cont)		
10 MHz to 12 GHz		
(0 to 20) dB	(±0.012 to ±0.053) dB (±0.12 to ±0.39) deg	Network analyzer, ET36409 type N 75 ohm, characterized device cal kit
(>20 to 40) dB	(±0.024 to ±0.25) dB (±0.22 to ±1.8) deg	
(>40 to 60) dB	(±0.038 to ±2.2) dB (±0.37 to ±17) deg	
10 MHz to 6.2 GHz		
(0 to 20) dB	(±0.013 to ±0.048) dB (±0.12 to ±0.43) deg	Network analyzer, ET36442 type F 75 ohm, characterized device cal kit
(>20 to 40) dB	(±0.024 to ±0.27) dB (±0.22 to ±2.0) deg	
(>40 to 60) dB	(±0.039 to ±2.3) dB (±0.37 to ±18) deg	
(8.2 to 12.4) GHz		
(0 to 20) dB	(±0.0046 to ±0.0047) dB (±1.7 to ±1.8) deg	Network analyzer, ET36405 X-band, TRL cal kit
(>20 to 40) dB	(±0.047 to ± 0.051) dB (±1.8 to ±1.9) deg	
(>40 to 60) dB	(±0.051 to ±0.13) dB (±1.9 to ±2.5) deg	

Parameter/Range	CMC[2, 7] (±)	Comments
Transmission S_{12}/S_{21} – Measure[5] (cont)		
(12.4 to 18.0) GHz		
(0 to 20) dB	(±0.046 to ±0.046) dB (±2.6 to ±2.6) deg	Network analyzer, ET36406 P-band, TRL cal kit
(>20 to 40) dB	(±0.046 to ±0.051) dB (±2.6 to ±2.7) deg	
(>40 to 60) dB	(±0.051 to ±0.17) dB (±2.6 to ±3.7) deg	
(18.0 to 26.5) GHz		
(0 to 20) dB	(±0.046 to ±0.047) dB (±2.0 to ±5.9) deg	Network analyzer, ET36407 K-band, TRL cal kit
(>20 to 40) dB	(±0.047 to ±0.078) dB (±4.1 to ±6.2) deg	
(>40 to 60) dB	(±0.053 to ±0.57) dB (±4.2 to ±9.7) deg	
(26.5 to 40) GHz		
(0 to 20) dB	(±0.051 to ±0.052) dB (±2.5 to ±2.6) deg	Network analyzer, ET36320 R-band, TRL cal kit
(>20 to 40) dB	(±0.052 to ±0.073) dB (±2.6 to ±2.8) deg	
(>40 to 60) dB	(±0.073 to ±0.45) dB (±2.8 to ±5.5) deg	
(33 to 50) GHz		
(0 to 20) dB	(±0.051 to ±0.053) dB (±3.1 to ±3.2) deg	Network analyzer HP8510C, ET36321 Q-band, TRL cal kit
(>20 to 40) dB	(±0.052 to ±0.081) dB (±3.2 to ±3.5) deg	
(>40 to 60) dB	(±0.081 to ±0.56) dB (±3.5 to ±6.9) deg	

Parameter/Range	CMC[2, 7] (±)	Comments
Transmission S_{12}/S_{21} – Measure[5] (cont)		
(40 to 60) GHz		
(0 to 20) dB	(±0.051 to ±0.053) dB (±3.8 to ±3.8) deg	Network analyzer HP8510C, multiplier test set HP U85104A, HP 85105A mm wave controller RF source HP83623B, Lo source HP 83651A/B, ET36322 U-band, TRL cal kit
(>20 to 40) dB	(±0.053 to ±0.082) dB (±3.8 to ±4.1) deg	
(>40 to 60) dB	(±0.082 to ±0.60) dB (±4.1 to ±7.5) deg	
(50 to 75) GHz		
(0 to 20) dB	(±0.034 to ±0.040) dB (±4.7 to ±5.1) deg	Network analyzer HP8510C, multiplier test set HP V85104A, HP 85105A mm wave controller, source HP 83623B, source HP 83651 A/B ET36323 V-band, TRL cal kit
(>20 to 40) dB	(±0.040 to ±0.34) dB (±5.1 to ±9.4) deg	
(>40 to 60) dB	(±0.34 to ±16) dB (±9.4 to ±62) deg	
(75 to 110) GHz		
(0 to 20) dB	(±0.038 to ±0.065) dB (±6.9 to ±7.2) deg	Network analyzer HP8510C, multiplier test set HP W85104A, HP 85105A mm wave controller, source HP 83623B, source HP 83651 A/B, ET36324 W-band, TRL cal kit
(>20 to 40) dB	(±0.065 to ±0.33) dB (±7.1 to ±9.9) deg	
(>40 to 60) dB	(±0.33 to ±6.5) dB (±9.9 to ±39) deg	

Parameter/Range	CMC[2, 7] (±)	Comments
Transmission S_{12}/S_{21} – Measure[5] (cont) (110 to 170) GHz (0 to 20) dB (>20 to 40) dB (>40 to 60) dB	 (±0.23 to ±0.76) dB (±1.5 to ±5.6) deg (±0.23 to ±0.76) dB (±1.5 to ±5.6) deg (±0.23 to ±0.76) dB (±1.5 to ±5.6) deg	 Network analyzer N5247B VDI 6.5 VNAX frequency extender VDI WR6.5 calibration kit

Parameter/Range	CMC[2, 7] (±)	Comments
RF / μ-Wave Power, Power Sensor Calibration Factor – Measure 9 kHz to 18.0 GHz (0.009 to 10) MHz (0.01 to 0.03) GHz 0.050 GHz 0.10 GHz (0.20 to 2.6) GHz (>2.6 to 4.5) GHz (>4.5 to 5.7) GHz (>5.7 to 7.2 GHz (>7.2 to 7.9) GHz (>7.9 to 8.6) GHz (>8.6 to 10.1) GHz (>10.1 to 10.6) GHz (>10.6 to 11.2) GHz (>11.2 to 12.4) GHz (>12.4 to 12.8) GHz (>12.8 to 13.8) GHz (>13.8 to 14.2) GHz (>14.2 to 14.7) GHz (>14.7 to 15.6) GHz	 0.0040 CF 0.0050 CF 0.0033 CF 0.0031 CF 0.0032 CF 0.0033 CF 0.0034 CF 0.0035 CF 0.0036 CF 0.0037 CF 0.0038 CF 0.0039 CF 0.0040 CF 0.0041 CF 0.0042 CF 0.0043 CF 0.0044 CF 0.0045 CF 0.0046 CF	11051A thermal converter, 478A-H75 thermistor mount, 3458A DVM, E9304A power sensor N5183B signal generator 11667A power splitter, CN mount, Arbiter Type IV power meter N1914A power meter N432A power meter CF = calibration factor 8478B thermistor mount used as UUT

Parameter/Range	CMC[2, 7] (±)	Comments
RF / μ-Wave Power, Power Sensor Calibration Factor – Measure (cont)		
9 kHz to 18.0 GHz		
(>15.6 to 16.0) GHz	0.0047 CF	11051A thermal converter,
(>16.0 to 16.7) GHz	0.0046 CF	478A-H75 thermistor mount,
(>16.7 to 16.9) GHz	0.0047 CF	3458A DVM,
(>16.9 to 17.1) GHz	0.0048 CF	E9304A power sensor
(>17.1 to 17.3) GHz	0.0049 CF	N5183B signal generator
(>17.3 to 18.0) GHz	0.0050 CF	11667A power splitter,
		CN mount,
9 kHz to 67 GHz		Arbiter Type IV power meter
		N1914A power meter
(9 to 30) kHz	0.0087 CF	N432A power meter
(>30 to 50) kHz	0.0083 CF	
(>50 to 100) kHz	0.0083 CF	CF = calibration factor
(>100 to 300) kHz	0.0086 CF	
(>300 to 500) kHz	0.0068 CF	8478B thermistor mount used as
(>0.50 to 1.00) MHz	0.0057 CF	UUT
(>1.00 to 3.00) MHz	0.0053 CF	
(>3.00 to 5.00) MHz	0.0078 CF	
(>0.005 to 0.01) GHz	0.0076 CF	
(>0.01 to 0.02) GHz	0.0066 CF	
(>0.02 to 0.03) GHz	0.0063 CF	
(>0.03 to 0.04) GHz	0.0062 CF	
(>0.04 to 0.05) GHz	0.0062 CF	U8488A-200 power sensor
(>0.10 to 0.20) GHz	0.0066 CF	N5247A/N5227A PNA-X
(>0.20 to 0.30) GHz	0.0073 CF	N1914B power meter (opt.)
(>0.3 to 0.5) GHz	0.0074 CF	
(>0.5 to 1.00) GHz	0.0073 CF	U8488A used as UUT
(>1.0 to 2.0) GHz	0.0072 CF	
(>2.0 to 3.0) GHz	0.0072 CF	
(>3.0 to 4.0) GHz	0.0091 CF	
(>4.0 to 5.0) GHz	0.0074 CF	
(>5.0 to 6.0) GHz	0.0078 CF	
(>6.0 to 7.0) GHz	0.0090 CF	
(>7.0 to 8.0) GHz	0.0090 CF	U8488A-200 power sensor
(>8.0 to 9.0) GHz	0.0084 CF	N5247A/N5227A PNA-X
(>9.0 to 10.0) GHz	0.0084 CF	N1914B power meter (opt.)
(>10.0 to 11.0) GHz	0.0083 CF	
(>11.0 to 12.0) GHz	0.0082 CF	
(>12.0 to 13.0) GHz	0.0087 CF	
(>13.0 to 14.0) GHz	0.0088 CF	
(>14.0 to 15.0) GHz	0.011 CF	
(>15.0 to 16.0) GHz	0.0094 CF	
(>16.0 to 17.0) GHz	0.011 CF	

Parameter/Range	CMC[2, 7] (±)	Comments
RF / μ-Wave Power, Power Sensor Calibration Factor – Measure (cont) 9 kHz to 67 GHz		
(>17.0 to 18.0) GHz	0.011 CF	U8488A-200 power sensor N5247A/N5227A PNA-X N1914B power meter (opt.) CF = calibration factor
(>18.0 to 19.0) GHz	0.015 CF	
(>19.0 to 20.0) GHz	0.013 CF	
(>20.0 to 21.0) GHz	0.017 CF	
(>21.0 to 22.0) GHz	0.013 CF	
(>22.0 to 23.0) GHz	0.015 CF	
(>23.0 to 24.0) GHz	0.014 CF	
(>24.0 to 25.0) GHz	0.014 CF	
(>25.0 to 26.0) GHz	0.021 CF	
(>26.0 to 27.0) GHz	0.025 CF	
(>27.0 to 28.0) GHz	0.021 CF	
(>28.0 to 29.0) GHz	0.017 CF	
(>29.0 to 30.0) GHz	0.021 CF	
(>30.0 to 31.0) GHz	0.017 CF	
(>31.0 to 32.0) GHz	0.024 CF	
(>32.0 to 33.0) GHz	0.020 CF	
(>33.0 to 34.0) GHz	0.020 CF	
(>34.0 to 35.0) GHz	0.018 CF	
(>35.0 to 36.0) GHz	0.018 CF	
(>36.0 to 37.0) GHz	0.019 CF	
(>37.0 to 38.0) GHz	0.018 CF	
(>38.0 to 39.0) GHz	0.021 CF	
(>39.0 to 40.0) GHz	0.020 CF	
(>40.0 to 41.0) GHz	0.021 CF	
(>41.0 to 42.0) GHz	0.021 CF	
(>42.0 to 43.0) GHz	0.022 CF	
(>43.0 to 44.0) GHz	0.022 CF	
(>44.0 to 45.0) GHz	0.025 CF	
(>45.0 to 46.0) GHz	0.023 CF	
(>46.0 to 47.0) GHz	0.022 CF	
(>47.0 to 48.0) GHz	0.022 CF	
(>48.0 to 49.0) GHz	0.037 CF	
(>49.0 to 50.0) GHz	0.029 CF	
(>50.0 to 51.0) GHz	0.025 CF	
(>51.0 to 52.0) GHz	0.027 CF	
(>52.0 to 53.0) GHz	0.024 CF	
(>53.0 to 54.0) GHz	0.023 CF	
(>54.0 to 55.0) GHz	0.022 CF	
(>55.0 to 56.0) GHz	0.021 CF	
(>56.0 to 57.0) GHz	0.022 CF	
(>57.0 to 58.0) GHz	0.032 CF	
(>58.0 to 59.0) GHz	0.025 CF	

Parameter/Range	CMC[2, 7] (±)	Comments
RF / μ-Wave Power, Power Sensor Calibration Factor – Measure (cont)		
9 kHz to 67 GHz		
(>59.0 to 60.0) GHz	0.021 CF	U8488A-200 power sensor
(>60.0 to 61.0) GHz	0.022 CF	N5247A/N5227A PNA-X
(>61.0 to 62.0) GHz	0.023 CF	N1914B power meter (opt.)
(>62.0 to 63.0) GHz	0.022 CF	
(>63.0 to 64.0) GHz	0.022 CF	CF = Cclibration factor
(>64.0 to 65.0) GHz	0.028 CF	
(>65.0 to 66.0) GHz	0.022 CF	
(>66.0 to 67.0) GHz	0.022 CF	
(50 to 75) GHz		
50.0 GHz	0.045 CF	45774H power sensor,
51.0 GHz	0.040 CF	E8257D signal generator as
52.0 GHZ	0.040 CF	source
53.0 GHz	0.040 CF	V8486A power sensor used as
54.0 GHz	0.038 CF	UUT
55.0 GHz	0.035 CF	
56.0 GHz	0.033 CF	CF = calibration factor
57.0 GHz	0.034 CF	
59.0 GHz	0.042 CF	
60.0 GHz	0.046 CF	
61.0 GHz	0.047 CF	
62.0 GHz	0.047 CF	
63.0 GHz	0.045 CF	
64.0 GHz	0.041 CF	
65.0 GHz	0.038 CF	
66.0 GHz	0.037 CF	
67.0 GHz	0.037 CF	
68.0 GHz	0.040 CF	
69.0 GHz	0.042 CF	
70.0 GHz	0.045 CF	
71.0 GHz	0.046 CF	
72.0 GHz	0.045 CF	
73.0 GHz	0.043 CF	
74.0 GHz	0.042 CF	
75.0 GHz	0.044 CF	

Parameter/Range	CMC[2, 7] (±)	Comments
RF / μ-Wave Power, Power Sensor Calibration Factor – Measure (cont)		
(75 to 110) GHz		
75 GHz	0.055 CF	45776H power sensor,
76 GHz	0.055 CF	E8357D source,
78 GHz	0.052 CF	OML E8257DS10 multiplier
80 GHz	0.052 CF	head
82 GHz	0.050 CF	PNA-X N5247B NA
84 GHz	0.050 CF	VDI E8257DVDI10 multiplier
86 GHz	0.048 CF	head
88 GHz	0.047 CF	
90 GHz	0.045 CF	CF = falibration factor
92 GHz	0.045 CF	
94 GHz	0.044 CF	
95 GHz	0.044 CF	
96 GHz	0.043 CF	
98 GHz	0.043 CF	
100 GHz	0.042 CF	
102 GHz	0.042 CF	
104 GHz	0.044 CF	
108 GHz	0.050 CF	
110 GHz	0.053 CF	
(110 to 170) GHz		
110 GHz	0.055 CF	VDI PM5B calorimeter
111 GHz	0.057 CF	E8257D signal source
112 GHz	0.051 CF	VDI 6.5 SGX multiplier
113 GHz	0.056 CF	
114 GHz	0.057 CF	U8486AD sensor used as UUT
115 GHz	0.059 CF	
116 GHz	0.060 CF	CF = falibration factor
117 GHz	0.058 CF	
118 GHz	0.058 CF	
119 GHz	0.052 CF	
120 GHz	0.056 CF	
121 GHz	0.054 CF	
122 GHz	0.057 CF	
123 GHz	0.057 CF	
124 GHz	0.059 CF	
125 GHz	0.057 CF	
126 GHz	0.056 CF	
127 GHz	0.057 CF	

Parameter/Range	CMC[2, 7] (±)	Comments
RF / μ-Wave Power, Power Sensor Calibration Factor – Measure (cont)		
(75 to 110) GHz		
128 GHz	0.059 CF	VDI PM5B calorimeter
129 GHz	0.058 CF	E8257D signal source
130 GHz	0.071 CF	VDI 6.5 SGX multiplier
131 GHz	0.059 CF	
132 GHz	0.053 CF	U8486AD sensor used as UUT
133 GHz	0.059 CF	
134 GHz	0.077 CF	CF = calibration factor
135 GHz	0.060 CF	
136 GHz	0.058 CF	
137 GHz	0.058 CF	
138 GHz	0.060 CF	
139 GHz	0.059 CF	
140 GHz	0.056 CF	
141 GHz	0.058 CF	
142 GHz	0.061 CF	
143 GHz	0.056 CF	
144 GHz	0.064 CF	
145 GHz	0.058 CF	
146 GHz	0.059 CF	
147 GHz	0.060 CF	
148 GHz	0.058 CF	
149 GHz	0.058 CF	
150 GHz	0.058 CF	
151 GHz	0.061 CF	
152 GHz	0.056 CF	
153 GHz	0.060 CF	
154 GHz	0.058 CF	
155 GHz	0.059 CF	
156 GHz	0.059 CF	
157 GHz	0.060 CF	
158 GHz	0.072 CF	
159 GHz	0.060 CF	
160 GHz	0.058 CF	
161 GHz	0.062 CF	
162 GHz	0.060 CF	
163 GHz	0.059 CF	
164 GHz	0.060 CF	
165 GHz	0.060 CF	
166 GHz	0.056 CF	
167 Ghz	0.063 CF	
168 GHz	0.057 CF	
169 GHz	0.060 CF	
170 GHz	0.062 CF	

Parameter/Range	CMC[2, 7] (±)	Comments
RF / µ-Wave Power Absolute Power – Measure 50 MHz 1000 µW (0 dBm) 3.2 µW (-25 dBm) 1.0 µW (-30 dBm)	 4.0 µW 15 nW 20 nW	 478A-H75 thermistor mount, 34970 + 34901A data acquisition switch w/DMM, E9304A power sensor, 50 MHz 1-mW ref oscillator, E4419B power meter

Parameter/Range	CMC[2, 7] (±)	Comments
Spectrum Analyzer – Absolute Amplitude @ 50 MHz (-81 to -11) dBm Frequency Response Relative to 50 MHz (100 to 300) kHz 300 kHz to 1.0 MHz 1 MHz to 2 GHz (2 to 3.6) GHz (>3.6 to 6) GHz (>6 to 12) GHz (>12 to 14) GHz (>14 to 18) GHz (>18 to 22) GHz (>22 to 26.5) GHz (>26.5 to 28) GHz (>28 to 35) GHz (>35 to 40) GHz (>40 to 42) GHz (>42 to 50) GHz Display Scale Fidelity @ 50 MHz (-85 to -16) dBm	 0.081 dB 0.043 dB 0.042 dB 0.038 dB 0.044 dB 0.14 dB 0.15 dB 0.15 dB 0.16 dB 0.17 dB 0.18 dB 0.22 dB 0.26 dB 0.27 dB 0.31 dB 0.36 dB 0.014 dB	N7800A test environment manager, N7814A X-series signal analyzer 8494G, 8496G step attenuator 8482A, 8485A, N8487A 8487D, U8489A, 8485D, E9304A, E9300A, N8488A, N8485A power sensors, E4419B power meter, E8257D signal generator, 11667B, 11667C power splitters, 3458A DVM, 33120A function generator

Parameter/Range[6]	CMC[2] (±)	Comments
Spectrum Analyzer – (cont)		
Third Order Intercept		
50.01 MHz	0.27 dB	Using RF power instrumentation
1700.21 MHz	0.27 dB	
2800.21 MHz	0.28 dB	
5000.21 MHZ	0.31 dB	
13000.21 MHz	0.34 dB	
19500.21 MHz	0.48 dB	
23500.21 MHz	0.49 dB	Using mmWave instrumentation
28000.21 MHz	0.60 dB	
37000.21 MHz	0.61 dB	
41500.21 MHz	0.70 dB	
46000.21 MHz	0.69 dB	
Second Harmonic Intercept Two Tone 1 MHz offset		N7800A test environment manager, N7814A X-series signal analyzer
50 MHz	0.86 dB	8494G, 8496G step attenuator
290.10 MHz	0.86 dB	8482A, 8485A, N8487A
1748.10 MHz	0.86 dB	8487D, U8589A, 8485D,
3900.10 MHz	0.87 dB	E9304A, E9300A, N8488A,
8200.10 MHz	0.89 dB	N8485A power sensors,
11750.10 MHz	0.90 dB	E4419B power meter,
DANL		E8257D signal generator, 11667B, 11667C power
50 kHz to 110 G Hz	0.28 dB	splitters, 3458A DVM, 33120A function generator
LO Phase Noise @ 1GHz		
Frequency Offset:	0.36 dB	Ultra-low phase noise source
(0.10, 0.99, 10) kHz	0.64 dB	
(100, 1000, 9900) kHz		
Total Amplitude *f*>50 GHz		
(50 to 67) GHz	0.63 dB	U8489A power sensor,
(>67 to 80) GHz	0.65 dB	millimeter wave multiplier
(>80 to 95) GHz	0.67 dB	module
(>95 to 110) GHz	0.66 dB	10 dB attenuator

Parameter/Range	Frequency[6]	CMC[2] (±)	Comments
Signal Generator –			N7800A test environment manager
SSB Phase Noise			
At (1, 10, 100, 1 k, 10 k, 100 k, 1 M) Hz Offset	0.10 ≤ *f* ≤26.5 GHz	2.3 dB	E5505A phase noise system PNRS_E8257D reference source
At (10, 100) MHz Offset	0.10 ≤ *f* ≤26.5 GHz	4.6 dB	
Digital Modulation	0.50 ≤ *f* ≤44 GHz	0.015 %	Signal analyzer
EVM (16, 64, 256) QAM, BPSK, QPSK			
RF Absolute Power – Measure			
(>21 to 30) dBm	9 kHz to 10 MHz (10 to 100 MHz) 100 MHz to 8 GHz (8 to 18) GHz (18 to 26.5) GHz	0.16 dB 0.16 dB 0.16 dB 0.16 dB 0.16 dB	N7800A test environment manager signal analyzer
(>14 to 21) dBm	9 kHz to 10 MHz (10 to 100 MHz) 100 MHz to 8 GHz (8 to 18) GHz (18 to 26.5) GHz (>26.5 to 40) GHz (>40 to 50) GHz (50 to 60) GHz (60 to 67) GHz	0.043 dB 0.042 dB 0.042 dB 0.043 dB 0.055 dB 0.059 dB 0.074 dB 0.10 dB 0.15 dB	
(>-10 to +14) dBm	9 kHz to 10 MHz (10 to 100 MHz) 100 MHz to 8 GHz (8 to 18) GHz (18 to 26.5) GHz (>26.5 to 40) GHz (>40 to 50) GHz (50 to 60) GHz (60 to 67) GHz	0.032 dB 0.029 dB 0.030 dB 0.031 dB 0.046 dB 0.051 dB 0.068 dB 0.10 dB 0.14 dB	Power sensor V8486A, power meter E4419B

Parameter/Range	Frequency	CMC[2] (±)	Comments
Signal Generator – (cont)			
RF Absolute Power – Measure			
(1 to -1) dBm	9 kHz to 10 MHz (10 to 100 MHz) 100 MHz to 8 GHz (8 to 18) GHz (18 to 26.5) GHz (>26.5 to 40) GHz (>40 to 50) GHz (50 to 60) GHz (60 to 67) GHz	0.027 dB 0.023 dB 0.024 dB 0.026 dB 0.042 dB 0.048 dB 0.065 dB 0.098 dB 0.14 dB	N7800A test environment manager
(-10 to -30) dBm	9 kHz to 10 MHz (10 to 100 MHz) 100 MHz to 8 GHz (8 to 18) GHz (18 to 26.5) GHz (>26.5 to 40) GHz (>40 to 50) GHz	0.044 dB 0.034 dB 0.035 dB 0.036 dB 0.049 dB 0.054 dB 0.070 dB	
(>-30 to -90) dBm	9 kHz to 10 MHz (10 to 100 MHz) 100 MHz to 8 GHz (8 to 18) GHz (18 to 26.5) GHz (>26.5 to 40) GHz (>40 to 50) GHz	0.046 dB 0.036 dB 0.037 dB 0.038 dB 0.051 dB 0.055 dB 0.071 dB	
(<-90 to -110) dBm	9 kHz to 10 MHz (10 to 100 MHz) 100 MHz to 8 GHz (8 to 18) GHz (18 to 26.5) GHz (>26.5 to 40) GHz (>40 to 50) GHz	0.054 dB 0.046 dB 0.047 dB 0.049 dB 0.060 dB 0.064 dB 0.085 dB	
(<-110 to -130) dBm	9 kHz to 10 MHz (10 to 100 MHz) 100 MHz to 8 GHz (8 to 18) GHz (18 to 26.5) GHz (>26.5 to 40) GHz (>40 to 50) GHz	0.070 dB 0.061 dB 0.062 dB 0.066 dB 0.076 dB 0.079 dB 0.097 dB	

Table 1. Reflection S_{11}/S_{22} Magnitude 1.0 mm Connector CMCs

		Frequency					
		10 MHz to 100 MHz	>100 MHz to 1 GHz	>1 GHz to 10 GHz	>10 GHz to 20 GHz	>20 GHz to 40 GHz	>40 GHz to 60 GHz
abs(Sxx)	0	0.0004 to 0.0012	0.0005 to 0.0016	0.0015 to 0.0027	0.0014 to 0.0016	0.0015 to 0.0028	0.0020 to 0.0031
	0.1	0.0005 to 0.0013	0.0005 to 0.0016	0.0015 to 0.0026	0.0013 to 0.0016	0.0014 to 0.0019	0.0019 to 0.0030
	0.2	0.0006 to 0.0013	0.0006 to 0.0015	0.0015 to 0.0026	0.0014 to 0.0016	0.0014 to 0.0020	0.0020 to 0.0032
	0.3	0.0007 to 0.0015	0.0008 to 0.0015	0.0015 to 0.0025	0.0014 to 0.0016	0.0014 to 0.0022	0.0022 to 0.0037
	0.4	0.0009 to 0.0016	0.0009 to 0.0015	0.0015 to 0.0024	0.0014 to 0.0017	0.0014 to 0.0024	0.0024 to 0.0043
	0.5	0.0010 to 0.0018	0.0011 to 0.0015	0.0015 to 0.0022	0.0015 to 0.0018	0.0015 to 0.0027	0.0027 to 0.0049
	0.6	0.0012 to 0.0020	0.0012 to 0.0016	0.0016 to 0.0021	0.0016 to 0.0019	0.0016 to 0.0030	0.0030 to 0.0057
	0.7	0.0013 to 0.0022	0.0014 to 0.0016	0.0016 to 0.0020	0.0017 to 0.0020	0.0017 to 0.0033	0.0033 to 0.0064
	0.8	0.0015 to 0.0024	0.0015 to 0.0016	0.0016 to 0.0019	0.0019 to 0.0022	0.0019 to 0.0037	0.0037 to 0.0072
	0.9	0.0016 to 0.0027	0.0016 to 0.0017	0.0017 to 0.0021	0.0021 to 0.0023	0.0021 to 0.0040	0.0040 to 0.0080
	1	0.0006 to 0.0025	0.0006 to 0.0008	0.0006 to 0.0017	0.0017 to 0.0022	0.0019 to 0.0042	0.0042 to 0.0087

Table 2. Reflection S_{11}/S_{22} Magnitude 1.0 mm Connector CMCs (continued)

		Frequency				
		>60 GHz to 80 GHz	>80 GHz to 100 GHz	>100 GHz to 110 GHz	>110 GHz to 120 GHz	>120 GHz to 125 GHz
abs(Sxx)	0	0.0028 to 0.0053	0.0044 to 0.0053	0.0045 to 0.0053	0.0046 to 0.0077	0.0077 to 0.011
	0.1	0.0028 to 0.0051	0.0045 to 0.0051	0.0049 to 0.0052	0.0050 to 0.0074	0.0074 to 0.010
	0.2	0.0032 to 0.0056	0.0051 to 0.0058	0.0057 to 0.0060	0.0059 to 0.0081	0.0081 to 0.011
	0.3	0.0037 to 0.0063	0.0060 to 0.0068	0.0068 to 0.0072	0.0072 to 0.0092	0.0092 to 0.012
	0.4	0.0043 to 0.0071	0.0070 to 0.0081	0.0080 to 0.0087	0.0087 to 0.011	0.011 to 0.013
	0.5	0.0049 to 0.0081	0.0080 to 0.0094	0.0094 to 0.010	0.010 to 0.012	0.012 to 0.014
	0.6	0.0057 to 0.0089	0.0089 to 0.011	0.011 to 0.012	0.012 to 0.014	0.014 to 0.016
	0.7	0.0064 to 0.0099	0.0099 to 0.012	0.012 to 0.014	0.014 to 0.016	0.016 to 0.018
	0.8	0.0072 to 0.011	0.011 to 0.014	0.014 to 0.016	0.016 to 0.018	0.018 to 0.020
	0.9	0.0079 to 0.012	0.012 to 0.016	0.016 to 0.017	0.017 to 0.020	0.020 to 0.022
	1	0.0086 to 0.013	0.013 to 0.017	0.017 to 0.019	0.019 to 0.022	0.022 to 0.024

Table 3. Reflection S_{11}/S_{22} Phase 1.0 mm Connector CMCs

		Frequency					
		10 MHz to 100 MHz	>100 MHz to 1 GHz	>1 GHz to 10 GHz	>10 GHz to 20 GHz	>20 GHz to 40 GHz	>40 GHz to 60 GHz
abs(Sxx)	0	-	-	-	-	-	-
	0.1	0.23 deg to 0.69 deg	0.26 deg to 0.85 deg	0.85 deg to 1.45 deg	0.79 deg to 0.90 deg	0.84 deg to 1.13 deg	1.11 deg to 1.72 deg
	0.2	0.15 deg to 0.37 deg	0.17 deg to 0.41 deg	0.41 deg to 0.69 deg	0.44 deg to 0.50 deg	0.46 deg to 0.67 deg	0.67 deg to 1.11 deg
	0.3	0.12 deg to 0.26 deg	0.14 deg to 0.27 deg	0.27 deg to 0.45 deg	0.34 deg to 0.38 deg	0.34 deg to 0.56 deg	0.56 deg to 1.00 deg
	0.4	0.11 deg to 0.22 deg	0.13 deg to 0.21 deg	0.21 deg to 0.33 deg	0.29 deg to 0.32 deg	0.29 deg to 0.52 deg	0.52 deg to 0.97 deg
	0.5	0.11 deg to 0.19 deg	0.12 deg to 0.18 deg	0.18 deg to 0.29 deg	0.27 deg to 0.29 deg	0.27 deg to 0.52 deg	0.52 deg to 0.97 deg
	0.6	0.10 deg to 0.18 deg	0.12 deg to 0.17 deg	0.17 deg to 0.28 deg	0.27 deg to 0.28 deg	0.27 deg to 0.51 deg	0.51 deg to 0.97 deg
	0.7	0.10 deg to 0.17 deg	0.11 deg to 0.16 deg	0.16 deg to 0.27 deg	0.26 deg to 0.28 deg	0.26 deg to 0.51 deg	0.51 deg to 0.97 deg
	0.8	0.10 deg to 0.16 deg	0.11 deg to 0.15 deg	0.15 deg to 0.26 deg	0.26 deg to 0.27 deg	0.26 deg to 0.51 deg	0.51 deg to 0.97 deg
	0.9	0.10 deg to 0.16 deg	0.11 deg to 0.15 deg	0.15 deg to 0.26 deg	0.26 deg to 0.27 deg	0.26 deg to 0.51 deg	0.51 deg to 0.97 deg
	1	0.04 deg to 0.14 deg	0.06 deg to 0.13 deg	0.13 deg to 0.25 deg	0.25 deg to 0.26 deg	0.25 deg to 0.51 deg	0.51 deg to 0.97 deg

Table 4. Reflection S_{11}/S_{22} Phase 1.0 mm Connector CMCs (continued)

		Frequency				
		>60 GHz to 80 GHz	>80 GHz to 100 GHz	>100 GHz to 110 GHz	>110 GHz to 120 GHz	>120 GHz to 125 GHz
abs(Sxx)	0	-	-	-	-	-
	0.1	1.7 deg to 3.0 deg	2.8 deg to 3.0 deg	2.9 deg to 3.1 deg	3.1 deg to 4.4 deg	4.3 deg to 6.1 deg
	0.2	1.1 deg to 1.8 deg	1.8 deg to 2.0 deg	2.0 deg to 2.2 deg	2.2 deg to 2.8 deg	2.7 deg to 3.4 deg
	0.3	1.0 deg to 1.5 deg	1.5 deg to 1.8 deg	1.8 deg to 2.0 deg	2.0 deg to 2.4 deg	2.3 deg to 2.7 deg
	0.4	0.97 deg to 1.4 deg	1.4 deg to 1.7 deg	1.7 deg to 2.0 deg	2.0 deg to 2.2 deg	2.1 deg to 2.4 deg
	0.5	0.97 deg to 1.4 deg	1.4 deg to 1.7 deg	1.7 deg to 1.9 deg	1.9 deg to 2.2 deg	2.1 deg to 2.3 deg
	0.6	0.97 deg to 1.3 deg	1.3 deg to 1.7 deg	1.7 deg to 1.9 deg	1.9 deg to 2.1 deg	2.0 deg to 2.2 deg
	0.7	0.97 deg to 1.3 deg	1.3 deg to 1.7 deg	1.7 deg to 1.9 deg	1.9 deg to 2.1 deg	2.0 deg to 2.2 deg
	0.8	0.97 deg to 1.3 deg	1.3 deg to 1.7 deg	1.7 deg to 1.9 deg	1.9 deg to 2.1 deg	2.0 deg to 2.2 deg
	0.9	0.97 deg to 1.3 deg	1.3 deg to 1.7 deg	1.7 deg to 1.9 deg	1.9 deg to 2.1 deg	2.0 deg to 2.2 deg
	1	0.97 deg to 1.3 deg	1.3 deg to 1.7 deg	1.7 deg to 1.9 deg	1.9 deg to 2.1 deg	2.0 deg to 2.2 deg

Table 5. Transmission S_{21}/S_{12} Magnitude 1.0 mm Connector CMCs

		Frequency					
		10 MHz to 100 MHz	>100 MHz to 1 GHz	>1 GHz to 10 GHz	>10 GHz to 20 GHz	>20 GHz to 40 GHz	>40 GHz to 60 GHz
abs(Syx)	0 dB	0.007 dB to 0.021 dB	0.007 dB to 0.009 dB	0.008 dB to 0.013 dB	0.013 dB to 0.018 dB	0.018 dB to 0.038 dB	0.036 dB to 0.072 dB
	-3 dB	0.016 dB to 0.026 dB	0.016 dB to 0.017 dB	0.016 dB to 0.019 dB	0.019 dB to 0.022 dB	0.022 dB to 0.040 dB	0.039 dB to 0.073 dB
	-6 dB	0.016 dB to 0.028 dB	0.016 dB to 0.017 dB	0.017 dB to 0.019 dB	0.019 dB to 0.022 dB	0.022 dB to 0.040 dB	0.039 dB to 0.073 dB
	-10 dB	0.016 dB to 0.033 dB	0.016 dB to 0.017 dB	0.017 dB to 0.019 dB	0.019 dB to 0.023 dB	0.023 dB to 0.040 dB	0.039 dB to 0.073 dB
	-20 dB	0.017 dB to 0.074 dB	0.017 dB	0.017 dB to 0.020 dB	0.020 dB to 0.023 dB	0.023 dB to 0.040 dB	0.039 dB to 0.074 dB
	-30 dB	0.018 dB to 0.220 dB	0.017 dB to 0.018 dB	0.017 dB to 0.020 dB	0.020 dB to 0.023 dB	0.023 dB to 0.040 dB	0.039 dB to 0.074 dB
	-40 dB	0.021 dB to 0.691 dB	0.017 dB to 0.021 dB	0.018 dB to 0.020 dB	0.020 dB to 0.023 dB	0.023 dB to 0.041 dB	0.040 dB to 0.075 dB
	-60 dB	0.124 dB to 6.9 dB	0.033 dB to 0.12 dB	0.027 dB to 0.036 dB	0.029 dB to 0.032 dB	0.032 dB to 0.079 dB	0.073 dB to 0.10 dB
	-80 dB	1.2 dB to 69 dB	0.28 dB to 1.2 dB	0.20 dB to 0.31 dB	0.20 dB to 0.22 dB	0.20 dB to 0.69 dB	0.49 dB to 0.87 dB

Table 6. Transmission S_{21}/S_{12} Magnitude 1.0 mm Connector CMCs (continued)

		Frequency				
		>60 GHz to 80 GHz	>80 GHz to 100 GHz	>100 GHz to 110 GHz	>110 GHz to 120 GHz	>120 GHz to 125 GHz
abs(Syx)	0 dB	0.071 dB to 0.11 dB	0.11 dB to 0.14 dB	0.14 dB to 0.16 dB	0.16 dB to 0.18 dB	0.18 dB to 0.20 dB
	-3 dB	0.072 dB to 0.11 dB	0.11 dB to 0.14 dB	0.14 dB to 0.16 dB	0.16 dB to 0.18 dB	0.18 dB to 0.20 dB
	-6 dB	0.072 dB to 0.11 dB	0.11 dB to 0.15 dB	0.14 dB to 0.16 dB	0.16 dB to 0.18 dB	0.18 dB to 0.20 dB
	-10 dB	0.072 dB to 0.11 dB	0.11 dB to 0.15 dB	0.14 dB to 0.16 dB	0.16 dB to 0.18 dB	0.18 dB to 0.20 dB
	-20 dB	0.073 dB to 0.11 dB	0.11 dB to 0.15 dB	0.14 dB to 0.16 dB	0.16 dB to 0.18 dB	0.18 dB to 0.20 dB
	-30 dB	0.073 dB to 0.11 dB	0.11 dB to 0.15 dB	0.14 dB to 0.16 dB	0.16 dB to 0.18 dB	0.18 dB to 0.20 dB
	-40 dB	0.074 dB to 0.11 dB	0.11 dB to 0.15 dB	0.14 dB to 0.16 dB	0.16 dB to 0.18 dB	0.18 dB to 0.20 dB
	-60 dB	0.093 dB to 0.14 dB	0.14 dB to 0.18 dB	0.18 dB to 0.20 dB	0.20 dB to 0.23 dB	0.23 dB to 0.25 dB
	-80 dB	0.50 dB to 0.81 dB	0.81 dB to 1.1 dB	1.1 dB to 1.3 dB	1.3 dB to 1.4 dB	1.4 dB to 1.6 dB

Table 7. Transmission S_{21}/S_{12} Phase 1.0 mm Connector CMCs

		Frequency					
		10 MHz to 100 MHz	>100 MHz to 1 GHz	>1 GHz to 10 GHz	>10 GHz to 20 GHz	>20 GHz to 40 GHz	>40 GHz to 60 GHz
abs(Syx)	0 dB	0.04 deg to 0.14 deg	0.06 deg to 0.17 deg	0.17 deg to 0.24 deg	0.21 deg to 0.38 deg	0.38 deg to 0.66 deg	0.66 deg to 1.1 deg
	-3 dB	0.10 deg to 0.17 deg	0.11 deg to 0.19 deg	0.19 deg to 0.25 deg	0.23 deg to 0.39 deg	0.39 deg to 0.66 deg	0.66 deg to 1.1 deg
	-6 dB	0.10 deg to 0.18 deg	0.11 deg to 0.19 deg	0.19 deg to 0.25 deg	0.23 deg to 0.39 deg	0.39 deg to 0.66 deg	0.66 deg to 1.1 deg
	-10 dB	0.10 deg to 0.22 deg	0.11 deg to 0.19 deg	0.19 deg to 0.25 deg	0.23 deg to 0.39 deg	0.39 deg to 0.66 deg	0.66 deg to 1.1 deg
	-20 dB	0.10 deg to 0.49 deg	0.11 deg to 0.19 deg	0.19 deg to 0.25 deg	0.23 deg to 0.39 deg	0.39 deg to 0.66 deg	0.66 deg to 1.1 deg
	-30 dB	0.11 deg to 1.5 deg	0.12 deg to 0.19 deg	0.19 deg to 0.25 deg	0.23 deg to 0.39 deg	0.39 deg to 0.66 deg	0.66 deg to 1.1 deg
	-40 dB	0.14 deg to 4.6 deg	0.13 deg to 0.19 deg	0.19 deg to 0.25 deg	0.23 deg to 0.39 deg	0.39 deg to 0.66 deg	0.66 deg to 1.1 deg
	-60 dB	0.82 deg to 46 deg	0.25 deg to 0.82 deg	0.26 deg to 0.33 deg	0.27 deg to 0.42 deg	0.42 deg to 0.79 deg	0.78 deg to 1.2 deg
	-80 dB	8.1 deg to 460 deg	1.8 deg to 8.1 deg	1.3 deg to 2.1 deg	1.3 deg to 1.5 deg	1.4 deg to 4.6 deg	3.4 deg to 5.8 deg

Table 8. Transmission S_{21}/S_{12} Phase 1.0 mm Connector CMCs (continued)

		Frequency				
		>60 GHz to 80 GHz	>80 GHz to 100 GHz	>100 GHz to 110 GHz	>110 GHz to 120 GHz	>120 GHz to 125 GHz
abs(Syx)	0 dB	1.1 deg to 1.3 deg	1.3 deg to 1.8 deg	1.8 deg to 1.9 deg	1.9 deg to 2.1 deg	2.1 deg to 2.4 deg
	-3 dB	1.1 deg to 1.3 deg	1.3 deg to 1.8 deg	1.8 deg to 2.0 deg	2.0 deg to 2.1 deg	2.1 deg to 2.4 deg
	-6 dB	1.1 deg to 1.3 deg	1.3 deg to 1.8 deg	1.8 deg to 2.0 deg	2.0 deg to 2.1 deg	2.1 deg to 2.4 deg
	-10 dB	1.1 deg to 1.3 deg	1.3 deg to 1.8 deg	1.8 deg to 2.0 deg	2.0 deg to 2.1 deg	2.1 deg to 2.4 deg
	-20 dB	1.1 deg to 1.3 deg	1.3 deg to 1.8 deg	1.8 deg to 2.0 deg	2.0 deg to 2.1 deg	2.1 deg to 2.4 deg
	-30 dB	1.1 deg to 1.4 deg	1.3 deg to 1.8 deg	1.8 deg to 2.0 deg	2.0 deg to 2.1 deg	2.1 deg to 2.4 deg
	-40 dB	1.1 deg to 1.4 deg	1.4 deg to 1.8 deg	1.8 deg to 2.0 deg	2.0 deg to 2.1 deg	2.1 deg to 2.4 deg
	-60 dB	1.2 deg to 1.5 deg	1.4 deg to 1.9 deg	1.9 deg to 2.1 deg	2.1 deg to 2.3 deg	2.3 deg to 2.6 deg
	-80 dB	3.4 deg to 5.4 deg	5.4 deg to 7.3 deg	7.3 deg to 8.4 deg	8.4 deg to 9.7 deg	9.7 deg to 10 deg

IV. Mechanical

Parameter/Equipment	Range	CMC[2] (±)	Comments
Torque Drivers & Wrenches	(1 to 50) ozf·in (2.5 to 250) lbf·in	1.8 % of reading 2.1 % of reading	Torque transducers

V. Time & Frequency

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
Frequency – Measuring Equipment	10 MHz	1 part in10^{12}	HP 5071A cesium beam; HP 58503B GPS-disciplined oscillator

[1] This laboratory offers commercial calibration service.

[2] Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

[3] In the statement of CMC, L is the numerical value of the nominal length in mm and D is the numerical value of the nominal diameter in mm.

[4] S_{11}/S_{22} reflection CMCs are a function of actual measured reflection and transmission magnitude. The CMC statements assume $S_{21}=S_{12}=0$.

[5] S_{21}/S_{12} transmission CMCs are a function of actual measured transmission and reflection magnitudes. These CMC statements assume $S_{11}=S_{22}=0$.

[6] In the frequency or parameter column, f is the frequency.

[7] The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.

[8] This scope meets A2LA's *P112 Flexible Scope Policy*.

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for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and the requirements of ANSI/NCSL Z540.3-2006 and R205 – Specific Requirements: Calibration Laboratory Accreditation Program. 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*).

Presented this 1st day of April 2026.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2079.01
Valid to March 31, 2028

For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.