



SCOPE OF ACCREDITATION TO ISO 17025:2005,
ANSI/NCSL Z540-1-1994, & ANSI/NCSL Z540.3-2006

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CALIBRATION

Valid To: March 31, 2012

Certificate Number: 2079.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations¹:

I. Dimensional

| Parameter/Equipment | Range | CMC ² (±) | Comments |
|------------------------|------------------|----------------------|--|
| Plain Ring Gages | (1 to 25) mm | 0.21 µm | OD/ID comparator |
| Plain Plug Gages | (0.5 to 75) mm | 0.8 µm | Supermicrometer w/ laser interferometer |
| Length – Coaxial Lines | (0.10 to 300) mm | $(0.9 + L/400)$ µm | Zeiss UPMC550 CMM (L is the numerical value of the nominal length in mm) |
| | (0.1 to 25.4) mm | 0.61 µm | HeidenHain Certo drop indicator |
| Pin Depth | (-50 to 50) µm | 0.95 µm | Zeiss UPMC550 CMM |
| | (-10 to 10) µm | 0.27 µm | Zygo white light interferometer microscope |

| Parameter/Equipment | Range | CMC ² (±) | Comments |
|---------------------|--|--|---|
| Diameter | (1 to 16) mm | $(0.9 + D/400) \mu\text{m}$ | Zeiss UPMC550 CMM D=Diameter (mm) |
| Diameter – Outer | (0.4 to 16) mm | 0.3 μm | Z-Mike 1210 gold laser micrometer |
| Diameter – Inner | (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 6.058) mm (6.995 to 7.005) mm | 0.6 μm 0.6 μm 0.6 μm 0.6 μm 0.6 μm 0.6 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 – RF/Microwave

| Parameter/Range | CMC ² (±) | Comments |
|--|---------------------------|---|
| Reflection S ₁₁ /S ₂₂ – Measure ³ | | |
| 45 MHz to 18 GHz | | |
| (0.0001 to 1.0) lin | (±0.00072 to ±0.0048) lin | Network analyzer HP8510C, S Parameter test set HP8515A, source HP 83651 A/B, cable HP 85133E APC 7mm, thru reflection line (TRL) cal kit |
| (0 to 0.01) lin | (±4.2 to ±180) deg | |
| (0.01 to 0.1) lin | (±0.54 to ±11) deg | |
| (0.1 to 0.5) lin | (±0.24 to ±1.4) deg | |
| (0.5 to 1.0) lin | (±0.18 to ±0.59) deg | |
| 45 MHz to 18 GHz | | |
| (0.0001 to 1.0) lin | (±0.0008 to ±0.0053) lin | Network analyzer HP8510C, S Parameter test set HP8515A, source HP 83651 A/B, cable HP 85133E Type N, TRL cal kit |
| (0 to 0.01) lin | (±4.7 to ±180) deg | |
| (0.01 to 0.1) lin | (±0.59 to ±12) deg | |
| (0.1 to 0.5) lin | (±0.27 to ±1.5) deg | |
| (0.5 to 1.0) lin | (±0.22 to ±0.63) deg | |

| Parameter/Range | CMC ² (±) | Comments |
|---|---------------------------|--|
| Reflection S ₁₁ /S ₂₂ – Measure ³ (cont.) | | |
| 45 MHz to 33.5 GHz | | |
| (0.0001 to 1.0) lin | (±0.00090 to ±0.0082) lin | Network analyzer HP8510C, S Parameter test set HP8515A, source HP 83651 A/B, cable HP 85133E 3.5 mm, TRL cal kit |
| (0 to 0.01) lin | (±5.3 to ±180) deg | |
| (0.01 to 0.1) lin | (±0.64 to ±15) deg | |
| (0.1 to 0.5) lin | (±0.26 to ±1.8) deg | |
| (0.5 to 1.0) lin | (±0.19 to ±0.88) deg | |
| 45 MHz to 50 GHz | | |
| (0.0001 to 1.0) lin | (0.0014 to ±0.012) lin | Network analyzer HP8510C, S Parameter test set HP8517A, source HP 83651 A/B, cable HP 85133E 2.4 mm, TRL cal kit |
| (0 to 0.01) lin | (±8.4 to ±180) deg | |
| (0.01 to 0.1) lin | (±0.96 to ±21) deg | |
| (0.1 to 0.5) lin | (±0.32 to ±2.9) deg | |
| (0.5 to 1.0) lin | (±0.27 to ±1.5) deg | |
| 45 MHz to 8.2 GHz | | |
| (0.0001 to 1.0) lin | (±0.00073 to ±0.0019) lin | Network analyzer HP8510C, S Parameter test set HP8515A, source HP 83631 A/B, cable HP 85133E 7-16 connector, TRL cal kit |
| (0 to 0.01) lin | (±4.3 to ±180) deg | |
| (0.01 to 0.1) lin | (±0.54 to ±4.4) deg | |
| (0.1 to 0.5) lin | (±0.24 to ±0.61) deg | |
| (0.5 to 1.0) lin | (±0.18 to ±0.30) deg | |
| 500 MHz to 12 GHz | | |
| (0.0001 to 1.0) lin | (±0.0010 to ±0.012) lin | Network analyzer HP8510C, S Parameter test set HP8515A, source HP 83651 A/B, cable HP 85133E Type N 75 ohm, TRL cal kit |
| (0 to 0.01) lin | (±5.7 to ±180) deg | |
| (0.01 to 0.1) lin | (±0.68 to ±35) deg | |
| (0.1 to 0.5) lin | (±0.28 to ±3.6) deg | |
| (0.5 to 1.0) lin | (±0.22 to ±1.0) deg | |
| 200 MHz to 6.2 GHz | | |
| (0.0001 to 1.0) lin | (±0.0011 to ±0.018) lin | Network analyzer HP8510C, S Parameter test set HP8515A, source HP 83651 A/B, cable HP 85133E Type F 75 ohm, TRL cal kit |
| (0 to 0.01) lin | (±6.2 to ±180) deg | |
| (0.01 to 0.1) lin | (±0.73 to ±19) deg | |
| (0.1 to 0.5) lin | (±0.28 to ±2.0) deg | |
| (0.5 to 1.0) lin | (±0.22 to ±1.2) deg | |

| Parameter/Range | CMC ² (±) | Comments |
|---|----------------------------|--|
| Reflection S ₁₁ /S ₂₂ – Measure ³ (cont.) | | |
| (8.2 to 12.4) GHz | | |
| (0.0001 to 1.0) lin | (±0.0012 to ±0.0075) lin | Network analyzer HP8510C, S Parameter test set HP8517A, source HP 83651 A/B, cable HP 85132E X-band waveguide HP X11644A, 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 | | |
| (0.0001 to 1.0) lin | (±0.00073 to ±0.00225) lin | Network analyzer HP8510C, S Parameter test set HP8517A, source HP 83651 A/B, cable HP 85132E P-band waveguide HP P11644A, 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 | (±0.37 to ±0.41) deg | |
| (18.0 to 26.5) GHz | | |
| (0.0001 to 1.0) lin | (±0.0013 to ±0.0028) lin | Network analyzer HP8510C, S Parameter test set HP8517A, source HP 83651 A/B, cable HP 85132E K-band waveguide HP K11644A, 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 | | |
| (0.0001 to 1.0) lin | (±0.0022 to ±0.0077) lin | Network analyzer HP8510C, source module HP 83554A, HP 85100A mm wave system RF source HP8340A, source HP 83651 A/B, R-band HP R11644A, 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 | | |
| (0.0001 to 1.0) lin | (±0.0022 to ±0.0077) lin | Network analyzer HP8510C, source module HP 83555A, HP 85100A mm wave system RF source HP8340A, source HP 83651 A/B, Q-band HP Q11644A, 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 | |

| Parameter/Range | CMC ² (\pm) | Comments |
|--|---|--|
| Reflection S_{11}/S_{22} – Measure ³ (cont.) | | |
| (40 to 60) GHz (0.0001 to 1.0) lin (0 to 0.01) lin (0.01 to 0.1) lin (0.1 to 0.5) lin (0.5 to 1.0) lin | (± 0.0012 to ± 0.011) lin (± 17 to ± 180) deg (± 5.0 to ± 17) deg (± 4.1 to ± 5.0) deg (± 4.1 to ± 4.2) deg | Network analyzer HP8510C, multiplier test set HP U85104A, HP 85105A mm wave controller RF source HP83623B Lo source HP 83651 A/B, U-band HP U11644A, TRL cal kit |
| (50 to 75) GHz (0.0001 to 1.0) lin (0 to 0.01) lin (0.01 to 0.1) lin (0.1 to 0.5) lin (0.5 to 1.0) lin | (± 0.0022 to ± 0.013) lin (± 18 to ± 180) deg (± 6.0 to ± 18) deg (± 5.1 to ± 6.0) deg (± 5.1 to ± 5.3) deg | Network analyzer HP8510C, multiplier test set HP V85104A, HP 85105A mm wave controller, source HP 83623B, source HP 83651 A/B, V-band HP V11644A, TRL cal kit |
| (75 to 110) GHz (0.0001 to 1.0) lin (0 to 0.01) lin (0.01 to 0.1) lin (0.1 to 0.5) lin (0.5 to 1.0) lin | (± 0.0022 to ± 0.015) lin (± 30 to ± 180) deg (± 9.1 to ± 30) deg (± 7.5 to ± 9.1) deg (± 7.5 to ± 7.6) deg | Network analyzer HP8510C, multiplier test set HP W85104A, HP 85105A mm wave controller, source HP 83623B, source HP 83651 A/B, W-band HP W11644A, TRL cal kit |
| Transmission S_{12}/S_{21} – Measure ⁴ | | |
| 45 MHz to 18 GHz (0 to 20) dB (20 to 40) dB (40 to 60) dB | (± 0.016 to ± 0.018) dB (± 0.15 to ± 2.0) deg (± 0.018 to ± 0.028) dB (± 0.23 to ± 2.2) deg (± 0.028 to ± 0.13) dB (± 0.32 to ± 4.5) deg | Network analyzer HP8510C, S Parameter test set HP8515A, source HP 83651 A/B, cable HP 85133E, APC 7mm, thru reflection line (TRL) cal kit |

| Parameter/Range | CMC ² (±) | Comments |
|---|--|---|
| Transmission S ₁₂ /S ₂₁ – Measure ⁴ (cont). | | |
| 45 MHz to 18 GHz | | |
| (0 to 20) dB | (±0.018 to ±0.019) dB (±0.17 to ±2.0) deg | Network analyzer HP8510C, S Parameter test set HP8515A, source HP 83651 A/B, cable HP 85133E Type N, TRL cal kit |
| (20 to 40) dB | (±0.019 to ±0.058) dB (±0.24 to ±2.2) deg | |
| (40 to 60) dB | (±0.045 to ±0.13) dB (±0.32 to ±4.5) deg | |
| 45 MHz to 33.5 GHz | | |
| (0 to 20) dB | (±0.017 to ±0.019) dB (±0.15 to ±2.9) deg | Network analyzer HP8510C, S Parameter test set HP8515A, source HP 83651 A/B, cable HP 85133E 3.5 mm, TRL cal kit |
| (20 to 40) dB | (±0.019 to ±0.028) dB (±0.24 to ±3.7) deg | |
| (40 to 60) dB | (±0.028 to ±0.13) dB (±0.32 to ±12) deg | |
| 45 MHz to 50 GHz | | |
| (0 to 20) dB | (±0.017 to ±0.023) dB (±0.15 to ±2.6) deg | Network analyzer HP8510C, S Parameter test set HP8517A, source HP 83651 A/B, cable HP 85133E, 2.4 mm, TRL cal kit |
| (20 to 40) dB | (±0.023 to ±0.037) dB (±0.34 to ±3.5) deg | |
| (40 to 60) dB | (±0.037 to ±0.26) dB (±0.32 to ±13) deg | |
| 45 MHz to 8.2 GHz | | |
| (0 to 20) dB | (±0.033 to ±0.038) dB (±0.15 to ±1.0) deg | Network analyzer HP8510C, S Parameter test set HP8515A, source HP 83631 A/B, cable HP 85133E, 7-16 connector, TRL cal kit |
| (20 to 40) dB | (±0.035 to ±0.046) dB (±0.24 to ±1.1) deg | |
| (40 to 60) dB | (±0.045 to ±0.29) dB (±0.32 to ±2.6) deg | |

| Parameter/Range | CMC ² (±) | Comments |
|---|---|--|
| Transmission S ₁₂ /S ₂₁ – Measure ⁴ (cont.) | | |
| 500 MHz to 6.2 GHz | | |
| (0 to 20) dB | (±0.033 to ±0.042) dB (±0.17 to ±2.1) deg | Network analyzer HP8510C, S Parameter test set HP8515A, source HP 83651 A/B, cable HP 85133E, Type N 75 ohm, TRL cal kit |
| (20 to 40) dB | (±0.035 to ±0.062) dB (±0.24 to ±2.3) deg | |
| (40 to 60) dB | (±0.045 to ±0.39) dB (±0.32 to ±4.5) deg | |
| 200 MHz to 12 GHz | | |
| (0 to 20) dB | (±0.033 to ±0.042) dB (±0.17 to ±2.1) deg | Network analyzer HP8510C, S Parameter test set HP8515A, source HP 83651 A/B, cable HP 85133E, Type F 75 ohm, TRL cal kit |
| (20 to 40) dB | (±0.035 to ±0.062) dB ±0.24 to ±2.3) deg | |
| (40 to 60) dB | (±0.045 to ±0.39) dB (±0.32 to ±4.5) deg | |
| (8.2 to 12.4) GHz | | |
| (0 to 20) dB | (±0.046 to ±0.047) dB (±1.7 to ±1.8) deg | Network analyzer HP8510C, S Parameter test set HP8517A, source HP 83651 A/B, cable HP 85132E X-band waveguide HP X11644A, 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 | |
| (12.4 to 18.0) GHz | | |
| (0 to 20) dB | (±0.046 to ±0.046) dB (±2.57 to ±2.60) deg | Network analyzer HP8510C, S Parameter test set HP8517A, source HP 83651 A/B, cable HP 85132E P-band waveguide HP P11644A, 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 | |

| Parameter/Range | CMC ² (±) | Comments |
|---|---|--|
| Transmission S ₁₂ /S ₂₁ – Measure ⁴ (cont.) | | |
| (18.0 to 26.5) GHz | | |
| (0 to 20) dB | (±0.046 to ±0.047) dB (±4.0 to ±5.9) deg | Network analyzer HP8510C, S Parameter test set HP8517A, source HP 83651 A/B, cable HP 85132E K-band waveguide HP K11644A, 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 HP8510C, source module HP 83554A, HP 85100A mm wave system, RF source HP8340A, source HP 83651 A/B, R-band HP R11644A, 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 ±0.052) dB (±3.1 to ±3.2) deg | Network analyzer HP8510C, source module HP 83555A, HP 85100A mm wave system, RF source HP8340A, source HP 83651 A/B, Q-band HP Q11644A, 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 | |
| (40 to 60) GHz | | |
| (0 to 20) dB | (±0.051 to ±0.053) dB (±3.7 to ±3.8) deg | Network analyzer HP8510C, multiplier test set HP U85104A, HP 85105A mm wave controller RF source HP83623B, Lo source HP 83651 A/B, U-band HP U11644A, 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 | |

| Parameter/Range | CMC ² (±) | Comments |
|--|--|---|
| Transmission S ₁₂ /S ₂₁ – Measure ⁴ (cont.) | | |
| (50 to 75) GHz (0 to 20) dB (20 to 40) dB (40 to 60) dB | (±0.034 to ±0.040) dB (±4.7 to ±5.1) deg (±0.040 to ±0.34) dB (±5.1 to ±9.4) deg (±0.34 to ±16) dB (±9.4 to ±62) deg | Network analyzer HP8510C, multiplier test set HP V85104A, HP 85105A mm wave controller, source HP 83623B, source HP 83651 A/B V-band HP V11644A, TRL cal kit |
| (75 to 110) GHz (0 to 20) dB (20 to 40) dB (40 to 60) dB | (±0.038 to ±0.065) dB (±6.9 to ±7.2) deg (±0.065 to ±0.33) dB (±7.1 to ±9.9) deg (±0.33 to ±6.5) dB (±9.9 to ±39) deg | Network analyzer HP8510C, multiplier test set HP W85104A, HP 85105A mm wave controller, source HP 83623B, source HP 83651 A/B, W-band HP W11644A, TRL cal kit |
| 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 (0.050 to 1.0) GHz (1.0 to 1.6) GHz (1.8 to 2.0) GHz 2.2 GHz (2.4 to 3.6) GHz (3.8 to 4.6) GHz (4.8 to 5.2) GHz (5.4 to 5.6) GHz (5.8 to 6.4) GHz 6.6 GHz 7.6 GHz | 0.0040 0.0050 0.0035 0.0035 0.0035 0.0033 0.0033 0.0033 0.0033 0.0033 0.0036 0.0037 0.0039 0.0041 0.0043 | 83650A/B signal generator, 8648C/D signal generator, 11667A power splitter, 11051A thermal converter, 478A-H75 thermistor mount, 8478B thermistor mount, 3458A DVM, 34970 + 34901A data acquisition switch w/ DMM, 50 MHz 1 mW ref oscillator uncertainty based on 8481 or E9304A power sensor |

| Parameter/Range | CMC ² (±) | Comments |
|---|----------------------|---|
| RF / μ -Wave power Power Sensor Calibration Factor – Measure (cont.) | | |
| 9 kHz to 18.0 GHz | | |
| 7.8 GHz | 0.0043 | 83650A/B signal generator, 8648C/D signal generator, 11667A power splitter, 11051A thermal converter, 478A-H75 thermistor mount, 8478B thermistor mount, 3458A DVM, 34970 + 34901A data acquisition switch w/ DMM, 50 MHz 1 mW ref oscillator uncertainty based on 8481 or E9304A power sensor |
| 8.0 GHz | 0.0043 | |
| (8.2 to 9.6) GHz | 0.0048 | |
| (9.8 to 10.8) GHz | 0.0052 | |
| (11.0 to 11.4) GHz | 0.0053 | |
| (11.6 to 11.8) GHz | 0.0053 | |
| (12.00 to 12.5) GHz | 0.0059 | |
| (12.75 to 13.00) GHz | 0.0057 | |
| (13.25 to 13.75) GHz | 0.0059 | |
| (14.00 to 14.25) GHz | 0.0059 | |
| (14.50 to 14.75) GHz | 0.0057 | |
| (15.00 to 15.50) GHz | 0.0066 | |
| (15.75 to 16.00) GHz | 0.0066 | |
| 16.25 GHz | 0.0067 | |
| (16.50 to 17.00) GHz | 0.0077 | |
| 17.25 GHz | 0.0083 | |
| 17.50 GHz | 0.0081 | |
| 17.75 GHz | 0.0089 | |
| 18.00 GHz | 0.0094 | |
| 10 MHz to 50 GHz | | |
| (0.01 to 9.0) GHz | 0.015 | 83650A/B source, 11667C power splitter, 8487A power sensor uncertainty based on 8487A power sensor |
| (10.0 to 17.0) GHz | 0.016 | |
| (18.0 to 20.0) GHz | 0.017 | |
| (21.0 to 31.0) GHz | 0.017 | |
| (31.5 to 33.0) GHz | 0.020 | |
| (33.5 to 38.0) GHz | 0.019 | |
| (38.5 to 42.0) GHz | 0.022 | |
| 43.0 GHz | 0.023 | |
| 44.0 GHz | 0.026 | |
| (45.0, 49.0) GHz | 0.027 | |
| 50.0 GHz | 0.034 | |

| Parameter/Range | CMC ² (±) | Comments |
|---|----------------------|--|
| RF / μ -Wave power Power Sensor Calibration Factor – Measure (cont.) | | |
| (33 to 50) GHz | | |
| (33.0 to 34.1) GHz | 0.024 | Q8486A power sensor, 83650A/B signal generator, 83555A multiplier head, uncertainty based on Q8486A power sensor |
| (34.2 to 36.2) GHz | 0.026 | |
| (36.3 to 37.8) GHz | 0.024 | |
| (37.9 to 48.0) GHz | 0.023 | |
| (48.1 to 48,8) GHz | 0.024 | |
| (48.9 to 50.0) GHz | 0.027 | |
| (50 to 75) GHz | | |
| (50.0 to 54.0) GHz | 0.050 | 45774H power sensor, 83650A/B source, 83557A multiplier head, uncertainty based on V8486A power sensor |
| (55.0) GHz | 0.041 | |
| (56.00 to 67.0) GHz | 0.055 | |
| (67.5 to 75.0) GHz | 0.054 | |
| (75 to 110) GHz | | |
| 75 GHz | 0.055 | Hughes 45786H -1000 Calorimeter 45776H power sensor, 83650A/B source, 83558A multiplier head |
| 76 GHz | 0.055 | |
| 78 GHz | 0.053 | |
| 80 GHz | 0.054 | |
| 82 GHz | 0.050 | |
| 84 GHz | 0.052 | |
| 86 GHz | 0.048 | |
| 88 GHz | 0.047 | |
| 90 GHz | 0.045 | |
| 92 GHz | 0.045 | |
| 94 GHz | 0.044 | |
| 95 GHz | 0.044 | |
| 96 GHz | 0.043 | |
| 98 GHz | 0.044 | |
| 100 GHz | 0.046 | |
| 102 GHz | 0.047 | |
| 104 GHz | 0.048 | |
| 108 GHz | 0.050 | |
| 110 GHz | 0.053 | |

| Parameter/Range | CMC ² (±) | Comments |
|--|---|--|
| RF / μ -Wave Power Absolute Power – Measure 50 MHz 1000 μ W (0 dBm) 3.2 μ W (-25 dBm) 1.0 μ W (-30 dBm) | 4.0 μ W 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 |
| RF / μ -Wave Thermal Noise ENR – Measure 10 MHz to 18.0 GHz (4.5 to 6.5) dB 10 MHz to 1 GHz (2 to 17) GHz 18 GHz (14 to 16) dB 10 MHz to 11 GHz (12 to 17) GHz 18 GHz 10 MHz to 26.5 GHz (12 to 17) dB 10 MHz to 13 GHz (14 to 17) GHz (18 to 23) GHz (24 to 26) GHz 26.5 GHz | 0.10 dB 0.12 dB 0.16 dB 0.10 dB 0.12 dB 0.15 dB 0.10 dB 0.12 dB 0.15 dB 0.23 dB 0.27 dB | 83631 A/B source, N4000A noise source standard, N8973A noise figure analyzer (NFA) 83631 A/B source, N4001A noise source standard, N8973A noise figure analyzer (NFA) 83631 A/B source, N4002A noise source standard, N8973A noise figure analyzer (NFA) |

III. Mechanical

| Parameter/Equipment | Range | CMC ² (\pm) | Comments |
|---------------------|---|--------------------------------------|--------------------|
| Torque | (1 to 50) ozf·in (2.5 to 250) lbf·in | 0.6 % of reading 0.3 % of reading | Torque transducers |

¹ These laboratories offer commercial calibration service.

² Calibration and Measurement Capability (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. Calibration and Measurement Capabilities 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 S_{11}/S_{22} reflection CMCs are a function of actual measured reflection and transmission magnitude. The CMC statements assume $S_{21}=S_{12}=0$.

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



The American Association for Laboratory Accreditation

World Class Accreditation

Accredited Laboratory

A2LA has accredited

AGILENT TECHNOLOGIES SANTA ROSA METROLOGY SERVICES

Santa Rosa, CA

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This laboratory also meets the requirements of ANSI/NCSLI Z540-1-1994 and the requirements of ANSI/NCSLI Z540.3-2006 and any additional program requirements in the field of calibration. 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 8 January 2009).



Presented this 6th day of April 2010.

A handwritten signature in black ink, appearing to read "Peter M. Meyer", written over a horizontal line.

President & CEO
For the Accreditation Council
Certificate Number 2079.01
Valid to March 31, 2012

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