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

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CALIBRATION

Valid To: June 30, 2024 Certificate Number: 2357.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations[1, 6]:

I. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 4, 5] (±)	Comments
DC Voltage – Generate	0.0 V (0 to 320) mV 320 mV to 3.2 V (3.2 to 32) V (32 to 320) V (320 to 1050) V	4.2 µV 0.19 % 0.052 % 0.043 % 0.077 % 0.034 %	Wavetek 9100
DC Voltage – Measure[3]	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V	53 µV/V + 0.23 µV 30 µV/V + 0.23 µV 28 µV/V + 0.39 µV 44 µV/V + 23 µV 47 µV/V + 78 µV	Keithley 2700
Fixed Points	0.001 V 0.0019 V 0.0023 V 0.005 V 0.006 V 0.019 V 0.023 V 0.05 V 0.06 V 0.19 V 0.23 V 0.5 V	9.4 µV 9.5 µV 9.7 µV 8.8 µV 7.3 µV 7.6 µV 7.7 µV 7.0 µV 6.8 µV 9.0 µV 10 µV 18 µV	Agilent / HP 3458A

Parameter/Equipment	Range	CMC[2, 4, 5] (±)	Comments
DC Voltage – Measure[3], Fixed Points (cont)	0.6 V 1.9 V 2.3 V 5 V 6 V 19 V 23 V 50 V 60 V 190 V	22 µV 74 µV 73 µV 170 µV 570 µV 720 µV 970 µV 1.9 mV 2.3 mV 6.5 mV	Agilent / HP 3458A
Oscilloscope Probe DC Gain – Measure	(0 to 100) mV 100 mV to 1 V (1 to 10) V	4.8 mV/V + 0.23 µV 0.6 mV/V + 0.23 µV 0.3 mV/V + 0.39 µV	Keithley 2700 and Keithley 2400
AC Voltage – Generate[3], Sinewave (Vrms)			
500 Hz	320 mV to 3.2 V (3.2 to 32) V (32 to 320) V (320 to 800) V	0.14 % 0.13 % 0.10 % 0.10 %	Wavetek 9100
AC Voltage – Generate[3], Squarewave (V_{p-p})			
1 kHz	1 mV to 5.0 V, 50 Ω 1 mV to 200 V, 1 MΩ	0.79 mV/V + 7.8 µV 0.79 mV/V + 7.8 µV	Wavetek 9500, Fluke 9500/B w/ 9530

Parameter/Range	Frequency	CMC[2, 5] (±)	Comments
AC Voltage – Measure[3]			
(0 to 10) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz 100 kHz to 1 MHz (1 to 4) MHz (4 to 8) MHz	0.27 µV/V + 2.3 µV 0.18 µV/V + 0.85 µV 0.25 µV/V + 0.85 µV 0.78 µV/V + 0.85 µV 3.9 µV/V + 0.85 µV 31 µV/V + 3.9 µV 54 µV/V + 5.4 µV 0.16 mV/V + 6.2 µV	Keysight 3458A

Parameter/Range	Frequency	CMC[2, 5] (±)	Comments
AC Voltage – Measure[3] (cont)			
(10 to 100) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 4) MHz (4 to 8) MHz (8 to 10) MHz	0.13 µV/V + 3.1 µV 71 nV/V + 1.6 µV 0.11 µV/V + 1.6 µV 0.23 µV/V + 1.6 µV 0.62 µV/V + 1.6 µV 2.3 µV/V + 7.8 µV 7.8 µV/V + 7.8 µV 31 µV/V + 54 µV 31 µV/V + 62 µV 0.12 V/V + 78 µV	Keysight 3458A
(0.1 to 1) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 4) MHz (4 to 8) MHz (8 to 10) MHz	0.28 mV/V + 31 µV 98 µV/V + 16 µV 0.14 mV/V + 16 µV 0.25 mV/V + 16 µV 0.63 mV/V + 16 µV 2.9 mV/V + 78 µV 7.9 mV/V + 78 µV 31 mV/V + 0.54 mV 31 mV/V + 0.62 mV 0.12 V/V + 0.78 mV	
(1 to 10) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 4) MHz (4 to 8) MHz (8 to 10) MHz	0.28 mV/V + 0.31 mV 97 µV/V + 0.16 mV 0.13 mV/V + 0.16 mV 0.25 mV/V + 0.16 mV 0.63 mV/V + 0.16 mV 2.9 mV/V + 0.78 mV 7.9 mV/V + 0.78 mV 31 mV/V + 5.4 mV 31 mV/V + 6.2 mV 0.12 V/V + 7.8 mV	
(10 to 100) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.31 mV/V + 3.1 mV 0.17 mV/V + 1.6 mV 0.17 mV/V + 1.6 mV 0.28 mV/V + 1.6 mV 0.93 mV/V + 1.6 mV 3.5 mV/V + 7.8 mV 12 mV/V + 7.8 mV	

Parameter/Range	Frequency	CMC[2, 4, 5] (±)	Comments
AC Voltage – Measure[3] (cont)			
(100 to 700) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.42 mV/V + 31 mV 0.32 mV/V + 16 mV 0.47 mV/V + 16 mV 0.93 mV/V + 16 mV 2.3 mV/V + 16 mV	Keysight 3458A
RF Flatness – Measure[3]			
100 mV	(10 to 550) MHz	1.4 %	Rhode & Schwarz NRVS and NRV-Z5
100 mV	550 MHz to 1.5 GHz	2.1 %	
100 mV	(1.5 to 3) GHz	2.7 %	
300 mV	10 MHz to 1.5 GHz	1.4 %	
300 mV	(1.5 to 3) GHz	2.6 %	
1 V	(10 to 550) MHz	1.4 %	
1 V	550 MHz to 1.5 GHz	2.0 %	
1 V	(1.5 to 3 GHz)	2.6 %	
3 V	10 MHz to 2 GHz	1.7 %	
3 V	2.5 GHz	2.0 %	

Parameter/Equipment	Range	CMC[2, 4, 5] (±)	Comments
Resistance – Generate[3]	(40 to 400) Ω 400 Ω to 4 kΩ (4 to 40) kΩ (40 to 400) kΩ 400 kΩ to 4 MΩ (4 to 40) MΩ	0.076 % 0.055 % 0.056 % 0.11 % 0.15 % 0.32 %	Wavetek 9100
Fixed Points	50 Ω 1 MΩ	0.018 Ω 420 Ω	ESI DB877

Parameter/Equipment	Range	CMC[2, 5] (±)	Comments
Capacitance – Generate[3]	(20 to 25) pF (80 to 90) pF	0.28 pF 0.57 pF	Fixed capacitor
Oscilloscopes[3] –			
DC Voltage – Generate	(0 to ± 0.2) V	44 µV	50 Ohm termination
50 Ω Load	1 mV to ± 5.0 V	0.19 mV/V + 19 µV	Wavetek 9500, Fluke 9500/B w/ 9530
1 MΩ Load	1 mV to ± 200 V	0.2 mV/V + 19 µV	
Sinewave Flatness – Generate, 50 Ω Load, 50 kHz to 10 MHz Reference, $V_{(p-p)}$			
1 Hz to 100 MHz (100 to 550) MHz 550 MHz to 1.1 GHz (> 1.1 to 2.5) GHz (> 2.5 to 3.2) GHz	4.4 mV to 5.6 V 4.4 mV to 5.6 V 4.4 mV to 3.4 V 4.4 mV to 3.4 V 4.4 mV to 2.2 V	0.22 dB 0.27 dB 0.35 dB 0.39 dB 0.48 dB	Wavetek 9500, Fluke 9500/B w/ 9530
1.0 GHz 2.0 GHz 2.5 GHz	Up to 800 mV Up to 800 mV Up to 800 mV	0.22 dB 0.27 dB 0.34 dB	Synthesized signal generator w/ power meter and splitter
(> 3.2 to 8.0) GHz (> 3.2 to 8.0) GHz	Up to 300 mV > 300 mV	0.30 dB 0.31 dB	
(> 8 to 12.5) GHz (> 8 to 12.5) GHz	Up to 300 mV > 300 mV	0.37 dB 0.38 dB	
(> 12.5 to 16) GHz (> 12.5 to 16) GHz	Up to 300 mV > 300 mV	0.46 dB 0.42 dB	
(> 16 to 18) GHz (> 16 to 18) GHz	Up to 300 mV > 300 mV	0.52 dB 0.42 dB	
(> 18 to 20) GHz (> 18 to 20) GHz	Up to 300 mV > 300 mV	0.56 dB 0.40 dB	
(> 20 to 23) GHz (> 20 to 23) GHz	Up to 120 mV > 120 mV	0.54 dB 0.58 dB	
(> 23 to 25) GHz (> 23 to 25) GHz	Up to 120 mV > 120 mV	0.62 dB 0.65 dB	

Parameter/Equipment	Range	CMC[2, 4, 5] (±)	Comments
Oscilloscopes[3] – (cont)			
Sinewave Flatness – Generate, 50 Ω Load, 50 kHz to 10 MHz Reference, $V_{(p-p)}$			Synthesized signal generator w/ power meter and splitter
(> 25 to 33) GHz (> 25 to 33) GHz	Up to 120 mV > 120 mV	0.87 dB 0.84 dB	
(> 33 to 50) GHz	Up to 30 mV	0.36 dB	
(> 50 to 59) GHz	Up to 30 mV	0.37 dB	
(> 59 to 67) GHz	Up to 30 mV	0.41 dB	
AC Voltage – Generate, 50 Ω, Sinewave, $V_{(p-p)}$			
1 Hz to 550 MHz	4.4 mV to 5.6 V	3.3 %	Fluke 9500/B w/ 9530
550 MHz to 2.5 GHz (2.5 to 3.2) GHz (3.2 to 6.0) GHz	4.4 mV to 3.4 V 4.4 mV to 2.2 V 4.4 mV to 2.2 V	6.3 % 11 % 14 %	Synthesized signal Generat or
Time Mark – Generate	80 ms 400 ms	0.021 µs/s 3.4 ns/s	Wavetek 9500, Fluke 9500/B w/ 9530, w/ Fluke 910
Input Resistance – Measure	50 Ω 75 Ω 1 MΩ	0.044 Ω 0.12 Ω 0.27 Ω	Fluke 9500 w/ 9530 in DMM mode
DC Voltage – Measure	(0 to ± 5) V	0.014 % + 90 µV	Keithley 2000
	(0 to ± 0.2) V	33 µV	Tektronix MSO series

Parameter/Equipment	Range	CMC[2, 5] (±)	Comments
Oscilloscopes[3] – (cont)			
RMS Noise – Measure	20 MHz BW 175 MHz BW (0.2 to 10) GHz BW	0.18 µV 2.2 µV 1.1 µV	Tektronix MSO series
Risetime –			
Generate	≥ 7 ps	2.3 ps	Tektronix sampling head cal unit
Jitter	0.03 ns 0.05 ns 62.5 ps 0.08 ns 83.3 ps 0.1 ns 166.7 ps 200 ps (0.3 to 2) ns 400 ps 500 ps 1000 ps 2 ns 5 ns 10 ns (2 to 14) ns 18 ns to 100 µs	0.021 ps 0.016 ps 0.0041 ps 0.025 ns 0.0015 ps 0.033 ns 0.0015 ps 0.0016 ps 0.03 ps 0.0017 ps 0.0018 ps 0.0065 ps 0.000 019 ns 0.000 026 ns 0.031 ps 0.14 ps 0.014 ps	Anritsu MG3694C

II. Electrical – RF/Microwave

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
Spectrum Analyzer-			
Third Order Intermodulation			
2.745 GHz	0 dBm	1.6 dBc	Anritsu MG3692C
4.2025 GHz	0 dBm	1.6 dBc	
Phase Noise @ 1 GHz			
Frequency Offset:			
10 kHz	0 dB	1.1 dBc/Hz	Anritsu MG3692C
100 kHz	0 dB	1.0 dBc/Hz	
1 MHz	0 dB	1.0 dBc/Hz	
RF Power – Generate			
(9 to 50) kHz	10 dBm	0.40 dB	Anritsu MG3692C
50 kHz to 1 MHz	10 dBm	0.43 dB	
1 MHz to 2 GHz	10 dBm	0.39 dB	
(2 to 6) GHz	10 dBm	0.51 dB	
(9 to 50) kHz	0 dBm	0.37 dB	
50 kHz to 1 MHz	0 dBm	0.37 dB	
1 MHz to 2 GHz	0 dBm	0.35 dB	
(2 to 6) GHz	0 dBm	0.37 dB	
(9 to 50) kHz	-15 dBm	0.39 dB	
50 kHz to 1 MHz	-15 dBm	0.44 dB	
1 MHz to 2 GHz	-15 dBm	0.37 dB	
(2 to 6) GHz	-15 dBm	0.39 dB	
RF Display Average Noise (DANL)			
(-15 to -25) dBm	(9 to 50) kHz	1.4 dBm/Hz	50 Ω load
	50 kHz to 5 MHz	2.2 dBm/Hz	
	(5 to 400) MHz	0.33 dBm/Hz	
	(0.4 to 3) GHz	0.48 dBm/Hz	
	(3 to 4) GHz	0.54 dBm/Hz	
	(4 to 6) GHz	0.46 dBm/Hz	

III. Time & Frequency

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
Frequency and Period – Generate	12 kHz to 3.2 GHz (3.2 to 40) GHz	1.3 parts in 10^9 1.4 parts in 10^6	Fluke 9500/B w/ 9530, Fluke 910 Anritsu MG3694C, Fluke 910
Frequency – Measure	0.001 Hz to 1 kHz (1 to 1000) kHz (1 to 225) MHz	0.12 mHz/Hz 0.3 nHz/Hz 0.12 nHz/Hz	Keysight 53131A, Fluke 910
(Delta Time Accuracy) Time Measurement	Up to 1 GHz (1 to 2) GHz (2 to 16) GHz (14.28 to 43.47) GHz	2.8 ps 0.14 ps 0.0015 ps 0.12 ps	Anritsu MG3694C Agilent E8257D

[1] This laboratory offers commercial calibration service and field 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 Uncertainty due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

[3] Field calibration service is available for this calibration. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.

[4] In the statement of the CMC, the given percentages are percent of reading.

[5] The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMC's are expressed as either a specific value that covers the full range or as a percent or fraction of the reading plus a fixed floor specification.

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

[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.

Accredited Laboratory

A2LA has accredited

TEKTRONIX, INC.

Beaverton, OR

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 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 23rd day of June 2022.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2357.01
Valid to June 30, 2024

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