SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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CALIBRATION

Valid To: April 30, 2024 Certificate Number: 2941.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations[1, 8]:

I. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 4, 5] (±)	Comments
DC Resistance – Generate[3]	10 Ω to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ	33 µΩ/Ω 46 µΩ/Ω 0.013 %	Fluke 5700A, 5720A
	(0 to 10) Ω (10 to 330) Ω 330 Ω to 3.3 kΩ (3.3 to 33) kΩ (33 to 330) kΩ 330 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ	0.024 % + 0.001 Ω 0.020 % + 0.015 Ω 0.013 % + 0.06 Ω 0.013 % + 0.6 Ω 0.020 % + 6 Ω 0.024 % + 55 Ω 0.080 % + 550 Ω 0.60 % + 5.5 kΩ	Fluke 5500A, 5522A
Fixed Points	1 Ω	6.0 µΩ/Ω	Fluke 742A-1
	10 kΩ	3.0 µΩ/Ω	ESI SR104

Parameter/Equipment	Range	CMC[2, 4, 5] (±)	Comments
DC Resistance – Measure[3]	10 Ω to 1 MΩ	33μΩ/Ω	Fluke 742A-1, ESI SR104, Guildline 6675A
	(0 to 1) Ω 1 Ω to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ	0.11 % 65 μΩ/Ω 65 μΩ/Ω 0.053 %	HP 3458A
Fixed Points	1 Ω 10 kΩ	6 μΩ/Ω 4 μΩ/Ω	Fluke 742A-1, ESI SR104, Guildline 6675A
DC Voltage – Generate[3]	(0 to 220) mV 220 mV to 2.2 V (2.2 to 22) V (22 to 220) V 220 V to 1 kV	9 μV/V + 1 μV 8 μV/V + 1.2 μV 8 μV/V + 8 μV 9 μV/V + 100 μV 11 μV/V + 600 μV	Fluke 5700A, 5720A
	(0 to 330) mV 330 mV to 3.3 V (3.3 to 33) V (33 to 330) V 330 V to 1 kV	90 μV/V + 3 μV 61 μV/V + 5 μV 61 μV/V + 50 μV 70 μV/V + 500 μV 70 μV/V + 1.5 mV	Fluke 5500A, 5522A
	1 kV to 10 kV	0.3 %	Kikusui 149-10A
Fixed Point	10 V	3 parts in 10^6 V	Fluke 732B

Parameter/Equipment	Range	CMC[2, 4, 5] (±)	Comments
DC Voltage – Measure[3]	(0 to 0.1) V (0.1 to 1) V (1 to 10) V (10 to 100) V 100 V to 1 kV (1 to 10) kV Fixed Point 10 V	9 µV/V + 10 µV 8 µV/V + 1 µV 8 µV/V + 0.2 µV 10 µV/V + 30 µV 10 µV/V + 100 µV 0.3 % 3 parts in 10^6 V	HP3458A Kikusui 149-10A HP 3458A, Fluke 732B
DC Current – Generate[3]	100 µA to 100 mA 100 mA to 1 A (1 to 2.2) A (0 to 3.3) mA (3.3 to 33) mA (33 to 330) mA 330 mA to 2.2 A (2.2 to 10) A	55 µA/A 55 µA/A 55 µA/A 0.020 % + 0.05 µA 0.014 % + 0.25 µA 0.014 % + 3.3 µA 0.040 % + 44 µA 0.074 % + 330 µA	Fluke 5700A, 5720A Fluke 5500A, 5522A
DC Current – Measure[3]	100 µA to 100 mA 100 mA to 1 A (1 to 10) A (10 to 100) µA 100 µA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1A	40 µA/A 35 µA/A 35 µA/A 55 µA/A 55 µA/A 55 µA/A 68 µA/A 0.020 %	Guildline 9211A, HP3458A HP3458A

Parameter/Range	Frequency	CMC[2, 4, 5] (±)	Comments
AC Voltage – Generate[3]			
100 mV to 1 kV	1 kHz	0.011 % + 10 µV	Fluke 5700A, 5720A
100 mV to 1 V	40 Hz to 1 kHz	0.022 % + 8 µV	
(1 to 10) V	40 Hz to 1 kHz (1 to 50) kHz (50 to 100) kHz (100 to 500) kHz 500 kHz to 1 MHz	0.012 % + 60 µV 0.018 % + 160 µV 0.033 % + 350 µV 0.19 % + 4.3 mV 0.38 % + 8.5 mV	
(10 to 100) V	40 Hz to 20 kHz	0.010 % + 0.8 mV	
(100 to 1000) V	40 Hz to 20 kHz	0.020 % + 6 mV	Fluke 5720A & 5725A
1 V	(10 to 40) Hz 40 Hz to 100 kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.060 % + 100 µV 0.030 % + 80 µV 0.050 % + 150 µV 0.12 % + 400 µV 0.23 % + 1 mV	Fluke 5700A, 5720A
(100 to 330) mV (0.33 to 3.3) V (3.3 to 33) V (33 to 330) V (330 to 1000) V	1 kHz 1 kHz 1 kHz 1 kHz 1 kHz	0.070 % + 20 µV 0.040 % + 60 µV 0.052 % + 600 µV 0.061 % + 6.6 mV 0.070 % + 80 mV	Fluke 5500A, 5522A
1 V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.21 % + 250 µV 0.043 % + 60 µV 0.10 % + 60 µV 0.20 % + 300 µV 0.50 % + 1.7 mV 1.0 % + 3.3 mV	
(1 to 2) kV (2 to 10) kV	(50, 60) Hz (50, 60) Hz	1.8 % 1.4 %	Kikusui 149-10A

Parameter/Range	Frequency	CMC[2, 4, 5] (±)	Comments
AC Voltage – Measure[3]			
100 mV to 1 kV	1 kHz	55 µV/V + 2 µV	Fluke 5790A
100 mV to 1 V	40 Hz to 1 kHz	43 µV/V + 1.5 µV	
(1 to 10) V	40 Hz to 1 kHz (1 to 50) kHz (50 to 100) kHz (100 to 500) kHz 500 kHz to 1 MHz	30 µV/V 50 µV/V 80 µV/V 0.041 % 0.13 %	
(10 to 100) V	40 Hz to 20 kHz	32 µV/V	
(100 to 1000) V	40 Hz to 20 kHz	39 µV/V	
1 V	40 Hz to 1 kHz (1 to 50) kHz (50 to 100) kHz (100 to 500) kHz 500 kHz to 1 MHz	43 µV/V 47 µV/V 72 µV/V 0.027 % 0.092 %	
(1 to 2) kV (2 to 10) kV	(50, 60) Hz (50, 60) Hz	0.50 % 0.30 %	Kikusui 149-10A
AC Current – Generate[3]			
60 mA to 2.2 A (2.2 to 10) A	50 Hz, 60 Hz 50 Hz, 60 Hz	0.090 % + 100 nA 0.10 % + 200 µA	Fluke 5700A, 5720A Fluke 5720A & 5725A
(60 to 330) mA (0.33 to 2.2) A (2.2 to 10) A	50 Hz, 60 Hz 50 Hz, 60 Hz 50 Hz, 60 Hz	0.12 % + 30 µA 0.14 % + 300 µA 0.10 % + 2000 µA	Fluke 5500A, 5522A
AC Current – Measure[3]			
60 mA to 10 A	50 Hz, 60 Hz	100 µA/A	Fluke 5790A, L&N 4385
(1 to 10) mA (10 to 100) mA 100 mA to 1 A	50 Hz, 60 Hz 50 Hz, 60 Hz 50 Hz, 60 Hz	0.050 % 0.047 % 0.081 %	HP3458A

Parameter/Range	Frequency	CMC[2, 4, 5] (±)	Comments
AC Resistance – Measure[3] Impedance			
1 Ω	50 Hz to 1 kHz (1 to 10) kHz	0.28 % 0.28 %	HP 4284A
10 Ω	50 Hz to 1 kHz (1 to 10) kHz	0.07 % 0.11 %	
100 Ω	50 Hz to 1 kHz (1 to 100) kHz 100 kHz to 1 MHz	0.06 % 0.09 % 0.19 %	
1 kΩ	50 Hz to 10 kHz (10 to 100) kHz 100 kHz to 1 MHz	0.06 % 0.09 % 0.19 %	
10 kΩ	50 Hz to 10 kHz (10 to 100) kHz 100 kHz to 1 MHz	0.06 % 0.09 % 0.21 %	
100 kΩ	50 Hz to 10 kHz (10 to 100) kHz 100 kHz to 1 MHz	0.08 % 0.08 % 0.36 %	
1 MΩ	50 Hz to 100 kHz	0.28 %	
10 MΩ	100 Hz to 10 kHz	1.8 %	

Parameter/Range	Frequency	CMC[2, 4, 5] (±)	Comments
Capacitance – Measure[3]			
1 pF	1 kHz 10 kHz 100 kHz 1 MHz	28 % 3.0 % 0.65 % 0.67 %	HP 4284A
10 pF	1 kHz 10 kHz 100 kHz 1 MHz	3.0 % 0.50 % 0.41 % 0.42 %	
100 pF	1 kHz 10 kHz 100 kHz 1 MHz	0.49 % 0.18 % 0.16 % 0.19 %	
1000 pF	120 Hz 1 kHz 10 kHz 100 kHz 1 MHz	0.36 % 0.16 % 0.14 % 0.17 % 0.27 %	
0.01 µF	120 Hz 1 kHz 10 kHz	0.16 % 0.14 % 0.14 %	
0.1 µF	120 Hz 1 kHz 10 kHz	0.14 % 0.14 % 0.17 %	
1 µF	120 Hz 1 kHz 10 kHz	0.13 % 0.14 % 0.18 %	
10 µF	120Hz 1 kHz	0.14 % 0.15 %	

Parameter/Range	Frequency	CMC[2, 4, 5] (±)	Comments
Inductance – Measure[3]			
100 µH	1 kHz 10 kHz 100 kHz 1 MHz	0.53 % 0.34 % 0.20 % 0.19 %	HP 4284A
200 µH	10 kHz 100 kHz 1 MHz	0.31 % 0.19 % 0.19 %	
300 µH	10 kHz 100 kHz 1 MHz	0.29 % 0.19 % 0.19 %	
1 mH	1 kHz	0.25 %	
10 mH	1 kHz	0.14 %	
100 mH	1 kHz	0.14 %	
1000 mH	120 Hz 1 kHz	0.14 % 0.14 %	
Distortion[3]			
(0.1 to 30) %	20 Hz to 20 kHz	6.3 %	Shibasoku AC12B, Shibasoku H3012, Panasonic VP-7722A, Panasonic VP-7725A

II. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC[2] (±)	Comments
Biconical Antenna – Antenna Factor	(26 to 300) MHz	1.3 dB	SAE ARP958D, Agilent E5071C, Agilent E5061B
	(30 to 300) MHz	1.1 dB	ANSI C63.5-2006 (standard site method), Agilent E5071C, Agilent E5061B
Log-Periodic Antenna – Antenna Factor	(200 to 2400) MHz	1.2 dB	SAE ARP958D, Agilent E5071C, Agilent E5061B
	(240 to 1000) MHz	1.2 dB	ANSI C63.5-2006 (standard site method), Agilent E5071C, Agilent E5061B
Horn Antenna – Antenna Factor	(1 to 18) GHz	1.4 dB	SAE ARP958D, ANSI C63.5-2006 Agilent 8720D, Agilent E5071C

Parameter/Range	Frequency	CMC[2, 4, 6] (±)	Comments
EMI Receiver[3] –			CISPR 16-1-1 ANSI C63.2
Frequency	9 kHz to 10 MHz 10 MHz to 40 GHz	$(6.2 \times 10^{-6} \cdot F)$ Hz $(1.0 \times 10^{-7} \cdot F)$ Hz	Advantest R5373P R & S FSMR43
VSWR	9 kHz to 18 GHz	1.1 %	Agilent E5071C, Agilent E5061B, HP 8720D, HP 85054B, Anritsu 3653
Sine-Wave Accuracy	Band A [(9 to 150) kHz] Band B [(0.15 to 30) MHz] Band C [(30 to 300) MHz] Band D [(300 to 1000) MHz] Band E [(1 to 18) GHz]	0.27 dB 0.27 dB 0.27 dB 0.27 dB 0.27 dB	Agilent N1914A, E9304A, E9300A
	(18 to 40) GHz	1.6 dB	Agilent N1914A, E4413A,N8487A R & S FSMR43,NRP-Z55
Selectivity, 6 dB Bandwidth	Band A [(9 to 150) kHz] Band B [(0.15 to 30) MHz] Band C [(30 to 300) MHz] Band D [(300 to 1000) MHz] Band E [(1 to 18) GHz]	0.61 % 0.61 % 0.61 % 0.61 % 0.61 %	Advantest R5873P
Quasi-Peak Detector Verification	Band A [(9 to 150) kHz] Band B [(0.15 to 30) MHz] Band C [(30 to 300) MHz] Band D [(300 to 1000) MHz]	0.64 dB 0.64 dB 0.64 dB 0.64 dB	Schwarzbeck IGUU2916 Schwarzbeck IGUU2918

Parameter/Range	Frequency	CMC[2, 4, 6] (±)	Comments
EMI Receiver[3] – (cont)			
Peak Detector Verification	Band A [(9 to 150) kHz]	0.64 dB	Schwarzbeck IGUU2916, Schwarzbeck IGUU2918
	Band B [(0.15 to 30) MHz]	0.64 dB	
	Band C [(30 to 300) MHz]	0.64 dB	
	Band D [(300 to 1000) MHz]	0.64 dB	
Average Detector Verification	Band A [(9 to 150) kHz]	0.64 dB	Schwarzbeck IGUU2916, Schwarzbeck IGUU2918
	Band B [(0.15 to 30) MHz]	0.64 dB	
	Band C [(30 to 300) MHz]	0.64 dB	
	Band D [(300 to 1000) MHz]	0.64 dB	
RMS Detector Verification	Band A [(9 to 150) kHz]	0.64 dB	Schwarzbeck IGUU2916, Schwarzbeck IGUU2918
	Band B [(0.15 to 30) MHz]	0.64 dB	
	Band C [(30 to 300) MHz]	0.64 dB	
	Band D [(300 to 1000) MHz]	0.64 dB	
RMS-Average Detector	Band A [(9 to 150) kHz]	0.64 dB	Schwarzbeck IGUU2916, Schwarzbeck IGUU2918
	Band B [(0.15 to 30) MHz]	0.64 dB	
	Band C [(30 to 300) MHz]	0.64 dB	
	Band D [(300 to 1000) MHz]	0.64 dB	
Response to Intermittent, Unsteady & Drifting Narrowband Disturbances	Band A [(9 to 150) kHz]	0.62 dB	Agilent 33120A, Agilent E8265B
	Band B [(0.15 to 30) MHz]	0.62 dB	
	Band C [(30 to 300) MHz]	0.62 dB	
	Band D [(300 to 1000) MHz]	0.62 dB	

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Electrostatic Discharge Simulator[3] –			IEC 61000-4-2, ISO 10605
Output Voltage (+/-)	(2 to 30) kV	2.7 %	HV meter DHM-30/2
Discharge Current Waveform –			
Rise Time	(0.6 to 1) ns, Up to 15 kV (0.6 to 1) ns, Up to 30 kV	6.8 % 8.3 %	LeCroy WR204Xi-A, LeCroy WR6200A, Noiseken 06-00067A, TESEQ MD103
Peak Current (+/-)	Up to 56.25 A, Up to 15 kV Up to 112.5 A, Up to 30 kV	4.1 % 6.3 %	
Current, (30 to 800) ns	(0.3 to 30) A, Up to 15 kV (2.25 to 70) A, Up to 30 kV	4.4 % 6.3 %	
Lightning Surge Simulator[3] –			
Open Circuit Surge Voltage –			IEC 61000-4-5
Output Voltage (+/-)	250 V to 15 kV (peak)	3.6 %	LeCroy WR204Xi-A, LeCroy WR6200A Tektronix P6015A, Probe Master 4241A
Front Time/Time to Half Value	(0.8 to 900) µs	3.1 %	
Undershoot Residual Surge Voltage	Up to 3 kV	3.6 % 3.6 %	
Short Circuit Surge Current –			
Output Current (+/-)	10 A to 7.5 kA (peak)	5.8 %	LeCroy WR204Xi-A, LeCroy WR6200A, Pearson Electric A10, Pearson Electric 110, Pearson Electric 110A
Front Time/Time to Half Value	(0.9 to 400) µs	3.5 %	
Undershoot		3.6 %	
Phase Shifting	(0 to 360) °	2 %	LeCroy WR204Xi-A, LeCroy WR6200A, Probe Master 4241A

Parameter/Range	Frequency	CMC[2, 4, 5] (±)	Comments
RF Power Measure[3] –			
1 mW, Type-N, 50 Ω	50 MHz	0.08 dB	Agilent N1914A, E9304A, E9300A
(20 to -56) dBm (20 to -60) dBm (10 to -30) dBm	9 kHz to 10 MHz 10 kHz to 18 GHz 18 GHz to 40 GHz	0.15 dB + 0.08 dB 0.15 dB + 0.08 dB 0.64 dB + 0.08 dB	Agilent N1914A, E4413A, N8487A Rohde & Schwarz FSMR43, NRP-Z55
VSWR	9 kHz to 18 GHz	2.9 %	Agilent E5071C, Agilent E5061, HP 8720D, HP 85054B, Anritsu 3653
RF Voltage Meter[3] –			
0.5 V	(50 to 500) MHz	4 %	Boonton 9200B/952009
RF Attenuation[3] –			
(0 to 50) dB (50 to 90) dB	9 kHz to 1 GHz	0.40 dB 0.52 dB	Agilent E5071C, Agilent E5061B, HP 8720D
(0 to 50) dB (50 to 70) dB	(1 to 18) GHz	0.84 dB 1.0 dB	
Artificial Mains Network, Impedance Stabilization Network[3] –			CISPR 16-1-2, ANSI C63.4
Impedance (4 to 300) Ω	9 kHz to 400 MHz	2.9 %	Agilent E5071C, Agilent E5061B, HP 85054B, Anritsu 3653
Phase (0 to 360)°	9 kHz to 110 MHz	0.80°	
Insertion Loss (0 to -50) dB	9 kHz to 110 MHz	0.40 dB	
VSWR	9 kHz to 110 MHz	2.9 %	
Isolation	9 kHz to 110 MHz	1.0 dB	
LCL ≤ 65 dB LCL ≤ 75 dB	150 kHz to 30 MHz 150 kHz to 30 MHz	0.70 dB 2.1 dB	

Parameter/Range	Frequency	CMC[2, 4, 6] (±)	Comments
Reference Impedance Network[3] –			IEC 61000-3-3 IEC 61000-3-11 JIS C 61000-3-2
Impedance (Reactance, Inductance) (0.01 to 1) Ω, (0.1 to 0.5) mH	(50, 60) Hz	1.0 %	HP 4284A
Resistance (0.3 to 3) Ω	DC	0.50 %	HP 3458A , Agilent 34410A, RM3548
RF Pre Amplifier[3] –			
Gain (0 to 60) dB	9 kHz to 10 MHz 10 MHz to 1 GHz (1 to 18) GHz	0.50 dB 0.40 dB 0.84 dB	Agilent E5071C, Agilent E5061C, HP 8720D
Linearity (Input Level)	(-60 to -30) dBm	0.84 dB	
Spectrum Analyzer[3] –			
Amplitude (+20 to -60) dBm	9 kHz to 18 GHz	0.27 dB	Agilent N1914A, E9304A, E9300A
(+10 to -30) dBm	18 GHz to 40 GHz	1.7 dB	Agilent N1914A, E4413A,N8487A R & S FSMR43,NRP-Z55
Frequency	9 kHz to 10 MHz 10 MHz to 40 GHz	$(6.2 \times 10^{-6} \cdot F)$ Hz $(1.0 \times 10^{-7} \cdot F)$ Hz	Advantest R5373P R & S FSMR43
Bandwidth	9 kHz to 18 GHz	0.61 %	Advantest R5373P
VSWR	9 kHz to 18 GHz	1.5 %	Agilent E5071C, Agilent E5061B, HP 8720D, HP 85054B, Anritsu 3653

Parameter/Range	Frequency	CMC[2, 4, 6] (±)	Comments
Coupling Decoupling Network[3] –			IEC61000-4-6
Impedance (4 to 300) Ω	150 kHz to 400 MHz	2.5 %	Agilent E5071C, Agilent E5061B, Agilent 85054B
Insertion Loss (0 to -50) dB	150 kHz to 1 GHz	0.50 dB	Anritsu 3653
Signal Generator[3] –			
Output Level (+20 to -60) dBm (-60 to -120) dBm	9 kHz to 26 GHz	 0.21 dB 0.30 dB	Agilent N1914A, E9304A, E9300A, FSMR,NRP-Z37
(+10 to -30) dBm	9 kHz to 40 GHz	0.73 dB	Agilent N1914A, E4413A,N8487A Rohde & Schwarz FSMR43,NRP-Z55
Frequency Accuracy	0.1 Hz to 40 GHz	$(3.9 \times 10^{-9} \cdot F + 0.05)$ Hz	Advantest R5373P, FSMR43
Reference Output Frequency	(1, 5, 10) MHz	$(3.9 \times 10^{-9} \cdot F)$ Hz	ptf4210A
Amplitude Modulation (5 to 99) %	150 kHz to 6 GHz	2.3 %	FSMR
Frequency Modulation Deviation 10 Hz to 200 kHz	150 kHz to 6 GHz	2.3 %	FSMR
Pulse Width – Width Cycle	 800 ns to 1 s (1 to 2) s	 0.3 % 0.3 %	 LeCroy WR204Xi-A LeCroy WR6200A
VSWR	9 kHz to 18 GHz	2.9 %	Agilent E5071C, Agilent E5061B, Agilent 8720D, Agilent 85054B Anritsu 3653

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
High Impedance Probe[3] –			CISPR 16-1-2
Insertion Loss (0 to -50) dB	9 kHz to 30 MHz	0.40 dB	Agilent E5071C, Agilent E5061B, Agilent 85054B
Current Probe, Injection Probe[3] –			CISPR 16-1-2
Transfer Impedance	(10 to 100) Hz 100 Hz to 1.0 GHz	1.8 dB 0.80 dB	Agilent E5071C, Agilent E5061B, Agilent 85054B
Electrical Fast Transient Burst Simulator[3] –			IEC61000-4-4
Peak Voltage (50 Ω)	125 V to 2 kV	4.3 %	LeCroy WR204Xi-A, LeCroy WR6200A, Haefely PAT50A
Peak Voltage (1 kΩ)	250 V to 4 kV	7.7 %	LeCroy WR204Xi-A, LeCroy WR6200A, Haefely PAT1000
Pulse Waveform –			
Pulse Rise Time (50 Ω / 1 kΩ)	5 ns	7.8 %	LeCroy WR204Xi-A, LeCroy WR6200A, Haefely PAT50A, Haefely PAT1000
Pulse Width (50 Ω / 1 kΩ)	50 ns	1.0 %	
Burst Duration	15 ms, 0.75 ms	0.6 %	
Burst Period	300 ms	0.6 %	
Repetition Frequency	(5, 100) kHz	1.9 %	
Residual Voltage	Up to 500 V	8.0 %	

Parameter/Range	Frequency	CMC[2, 4, 6] (±)	Comments
Electrical Fast Transient Burst Simulator[3] – (cont)			IEC61000-4-4
Capacitive Coupling Clamp			LeCroy WR204Xi-A, LeCroy WR6200A, Haefely PAT50A
Peak Voltage (50 Ω)	Up to 2 kV	4.2 %	
Pulse Waveform – Pulse Rise Time (50 Ω)	5 ns	8.0 %	
Pulse Width (50 Ω)	50 ns	0.73 %	
Voltage Dip Generator[3] –			IEC 61000-4-11, IEC 61000-4-34
Dip Voltage (50, 60 Hz)	Up to 250 V	0.50 %	HP 3458A, Agilent 34410A
Phase Angle	(0 to 360)°	2.2°	LeCroy WR204Xi-A, LeCroy WR6200A, Probe Master 4241A
Rise & Fall Time	(0.5 to 50) µs	1.5 %	
Overshoot & Undershoot	Up to 250 V	3.8 %	
Duration Voltage Dips	(5 to 1000) ms	1.5 %	
In-Rush Current	(1 to 1000) A (peak)	4.9 %	LeCroy WR204Xi-A, LeCroy WR6200A, Pearson Electric 110, Pearson Electric 110A

Parameter/Range	Frequency	CMC[2, 4, 6] (±)	Comments
CVCF Power Source[3] –			IEC 61000-3-2
AC Voltage (50, 60 Hz)	Up to 250 V	0.070 %	HP 3458 A, Agilent 34410A
AC Current (50, 60 Hz)	Up to 100 A	2.3 %	HP 3458 A, Agilent 34410A, Pearson Electric A10, Pearson Electric 110, Pearson Electric 110A
Frequency	(0.01 to 1) kHz	$(2.0 \times 10^{-6} \cdot F)$ Hz	Advantest R5373P
Distortion	(0.02 to 20) kHz	14 %	Panasonic VP-7722A

III. Time & Frequency

Parameter/Equipment	Range	CMC[2, 6, 7] (±)	Comments
Frequency – Measuring Equipment[3]	0.1 Hz to 40 GHz	$(3.9 \times 10^{-9} \cdot F + 0.05)$ Hz	Ptf 4210A, Agilent 33250A, Agilent 83620B, Agilent E8267C, Agilent N5183A
Fixed Point	10 MHz	$(3.9 \times 10^{-9} \cdot F)$ Hz	Ptf 4210A
Frequency – Measure[3]	0.1 Hz to 40 GHz	$(3.9 \times 10^{-9} \cdot F + 0.05)$ Hz	Ptf 4210A, Advantest R5373P, FSMR43

SATELLITE LABORATORY

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CALIBRATION

I. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 4, 5] (±)	Comments
DC Resistance – Generate[3]	10 Ω to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ	33 µΩ/Ω 46 µΩ/Ω 0.013 %	Fluke 5700A
	(0 to 10) Ω (10 to 330) Ω 330 Ω to 3.3 kΩ (3.3 to 33) kΩ (33 to 330) kΩ 330 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ	0.024 % + 0.001 Ω 0.020 % + 0.015 Ω 0.013 % + 0.06 Ω 0.013 % + 0.6 Ω 0.020 % + 6 Ω 0.024 % + 55 Ω 0.080 % + 550 Ω 0.60 % + 5.5 kΩ	Fluke 5522A
Fixed Points	1 Ω	6.0 µΩ/Ω	Alpha CSR-1R0
DC Resistance – Measure[3]	(0 to 1) Ω 1 Ω to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ	0.11 % 65 µΩ/Ω 65 µΩ/Ω 0.053 %	HP 3458A, Fluke 8508A

Parameter/Equipment	Range	CMC[2, 4, 5] (±)	Comments
DC Voltage – Generate[3]	(0 to 220) mV 220 mV to 2.2 V (2.2 to 22) V (22 to 220) V 220 V to 1 kV (0 to 330) mV 330 mV to 3.3 V (3.3 to 33) V (33 to 330) V 330 V to 1 kV	9 µV/V + 1 µV 8 µV/V + 1.2 µV 8 µV/V + 8 µV 9 µV/V + 100 µV 11 µV/V + 600 µV 90 µV/V + 3 µV 61 µV/V + 5 µV 61 µV/V + 50 µV 70 µV/V + 500 µV 70 µV/V + 1.5 mV	Fluke 5700A Fluke 5522A
DC Voltage – Measure[3]	(0 to 0.1) V (0.1 to 1) V (1 to 10) V (10 to 100) V 100 V to 1 kV	9 µV/V + 10 µV 8 µV/V + 1 µV 8 µV/V + 0.2 µV 10 µV/V + 30 µV 10 µV/V + 100 µV	HP3458A
DC Current – Generate[3]	100 µA to 100 mA 100 mA to 1 A (1 to 2.2) A (0 to 3.3) mA (3.3 to 33) mA (33 to 330) mA 330 mA to 2.2 A (2.2 to 10) A	55 µA/A 55 µA/A 55 µA/A 0.020 % + 0.05 µA 0.014 % + 0.25 µA 0.014 % + 3.3 µA 0.040 % + 44 µA 0.074 % + 330 µA	Fluke 5700A Fluke 5522A
DC Current – Measure[3]	(10 to 20) µA (20 to 100) µA 100 µA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A (1 to 2) A (2 to 10) A	55 µA/A 55 µA/A 55 µA/A 55 µA/A 68 µA/A 0.020 % 0.020 % 0.043 %	HP3458A HP3458A, Fluke 8508A Fluke 8508A

Parameter/Range	Frequency	CMC[2, 4, 5] (±)	Comments
AC Voltage – Generate[3]			
100 mV to 1 kV	1 kHz	0.011 % + 10 µV	Fluke 5700A
100 mV to 1 V	40 Hz to 1 kHz	0.022 % + 8 µV	
(1 to 10) V	40 Hz to 1 kHz (1 to 50) kHz (50 to 100) kHz (100 to 500) kHz 500 kHz to 1 MHz	0.012 % + 60 µV 0.018 % + 160 µV 0.033 % + 350 µV 0.19 % + 4.3 mV 0.38 % + 8.5 mV	
(10 to 100) V	40 Hz to 20 kHz	0.010 % + 0.8 mV	
(100 to 1000) V	40 Hz to 20 kHz	0.020 % + 6 mV	Fluke 5700A & 5725A
1 V	(10 to 40) Hz 40 Hz to 100 kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.060 % + 100 µV 0.030 % + 80 µV 0.050 % + 150 µV 0.12 % + 400 µV 0.23 % + 1 mV	Fluke 5700A
(100 to 330) mV (0.33 to 3.3) V (3.3 to 33) V (33 to 330) V (330 to 1000) V	1 kHz 1 kHz 1 kHz 1 kHz 1 kHz	0.070 % + 20 µV 0.040 % + 60 µV 0.052 % + 600 µV 0.061 % + 6.6 mV 0.070 % + 80 mV	Fluke 5522A
1 V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.21 % + 250 µV 0.043 % + 60 µV 0.10 % + 60 µV 0.20 % + 300 µV 0.50 % + 1.7 mV 1.0 % + 3.3 mV	Fluke 5522A
AC Voltage – Measure[3]			
(100 to 600) mV	40 Hz to 20 kHz	0.018 % + 1.5 µV	Fluke 5790A
600 mV to 1 kV	40 Hz to 20 kHz	0.012 % + 1.5 µV	
(1 to 10) V	(10 to 40) Hz (20 to 100) kHz 100 kHz to 1 MHz	0.031 % 0.019 % 0.18 %	

Parameter/Range	Frequency	CMC[2, 4, 5] (±)	Comments
AC Current – Generate[3]			
60 mA to 2.2 A	50 Hz, 60 Hz	0.090 % + 100 nA	Fluke 5700A & 5725A
(2.2 to 10) A	50 Hz, 60 Hz	0.10 % + 200 µA	
(60 to 330) mA	50 Hz, 60 Hz	0.12 % + 30 µA	Fluke 5522A
(0.33 to 2.2) A	50 Hz, 60 Hz	0.14 % + 300 µA	
(2.2 to 10) A	50 Hz, 60 Hz	0.10 % + 2000 µA	
AC Current – Measure [3]			
(1 to 2) mA	50 Hz, 60 Hz	0.050 %	HP3458A
(2 to 10) mA	50 Hz, 60 Hz	0.050 %	HP3458A,
(10 to 100) mA	50 Hz, 60 Hz	0.047 %	Fluke 8508A
100 mA to 1 A	50 Hz, 60 Hz	0.081 %	
(1 to 2) A	50 Hz, 60 Hz	0.081 %	Fluke 8508A
(2 to 10) A	50 Hz, 60 Hz	0.11 %	

Parameter/Range	Frequency	CMC[2, 4, 5] (±)	Comments
AC Resistance – Measure[3] Impedance			
1 Ω	50 Hz to 1 kHz (1 to 10) kHz	0.28 % 0.28 %	HP 4284A
10 Ω	50 Hz to 1 kHz (1 to 10) kHz	0.07 % 0.11 %	
100 Ω	50 Hz to 1 kHz (1 to 100) kHz 100 kHz to 1 MHz	0.06 % 0.09 % 0.19 %	
1 kΩ	50 Hz to 10 kHz (10 to 100) kHz 100 kHz to 1 MHz	0.06 % 0.09 % 0.19 %	
10 kΩ	50 Hz to 10 kHz (10 to 100) kHz 100 kHz to 1 MHz	0.06 % 0.09 % 0.21 %	
100 kΩ	50 Hz to 10 kHz (10 to 100) kHz 100 kHz to 1 MHz	0.08 % 0.08 % 0.36 %	
1 MΩ	50 Hz to 100 kHz	0.28 %	
10 MΩ	100 Hz to 10 kHz	1.8 %	

Parameter/Range	Frequency	CMC[2, 4, 5] (±)	Comments
Capacitance – Measure[3]			
1 pF	1 kHz 10 kHz 100 kHz 1 MHz	28 % 3.0 % 0.65 % 0.67 %	HP 4284A
10 pF	1 kHz 10 kHz 100 kHz 1 MHz	3.0 % 0.50 % 0.41 % 0.42 %	
100 pF	1 kHz 10 kHz 100 kHz 1 MHz	0.49 % 0.18 % 0.16 % 0.19 %	
1000 pF	120 Hz 1 kHz 10 kHz 100 kHz 1 MHz	0.36 % 0.16 % 0.14 % 0.17 % 0.27 %	
0.01 µF	120 Hz 1 kHz 10 kHz	0.16 % 0.14 % 0.14 %	
0.1 µF	120 Hz 1 kHz 10 kHz	0.14 % 0.14 % 0.17 %	
1 µF	120 Hz 1 kHz 10 kHz	0.13 % 0.14 % 0.18 %	
10 µF	120 Hz 1 kHz	0.14 % 0.15 %	

Parameter/Range	Frequency	CMC[2, 4, 5] (±)	Comments
Inductance – Measure[3]			
100 µH	1 kHz 10 kHz 100 kHz 1 MHz	0.53 % 0.34 % 0.20 % 0.19 %	HP 4284A
200 µH	10 kHz 100 kHz 1 MHz	0.31 % 0.19 % 0.19 %	
300 µH	10 kHz 100 kHz 1 MHz	0.29 % 0.19 % 0.19 %	
1 mH	1 kHz	0.25 %	
10 mH	1 kHz	0.14 %	
100 mH	1 kHz	0.14 %	
1000 mH	120 Hz 1 kHz	0.14 % 0.14 %	

II. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC[2, 4, 5] (±)	Comments
RF Power Measure[3] – (20 to -30) dBm	9 kHz to 18 GHz	0.20 dB + 0.08 dB	R&S URV55/NRV-Z51

III. Time & Frequency

Parameter/Equipment	Range	CMC[2, 6, 7] (±)	**Comments**
Frequency – Measuring Equipment[3]	0.1 Hz to 3 GHz	$(3.9 \times 10^{-9} \cdot F + 0.05)$ Hz	Rb: A10-B, Agilent 53131A
Fixed Point	10 MHz	$(3.9 \times 10^{-9} \cdot F)$ Hz	Rb: A10-B
Frequency – Measure[3]	0.1 Hz to 3 GHz	$(3.9 \times 10^{-9} \cdot F + 0.05)$ Hz	Rb: A10-B, Agilent 53131A

[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 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 CMC, percentage represents a percent of reading unless otherwise noted.

[5] The measurands stated are generated using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure the measurand in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a fraction of the reading plus a fixed floor specification.

[6] In the statement of CMC, F represents the frequency in Hz.

[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.*

Accredited Laboratory

A2LA has accredited

PANASONIC SNET CALIBRATION LABORATORY

Yokohama, JAPAN

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 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 28th day of June 2022.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2941.01
Valid to April 30, 2024
Revised March 21, 2024

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