



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: October 31, 2021

Certificate Number: 2354.01

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} (±)	Comments
DC Voltage – Measure ³	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 500) V (500 to 1000) V	9.6 μV 4.9 μV/V + 8.9 μV 6.7 μV/V + 28 μV 10 μV/V + 42 μV 6.8 mV 23 mV	HP 3458A
DC Voltage – Generate ³	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V	0.3 μV/V + 9.2 μV 4 μV/V + 10 μV 5.2 μV/V + 59 μV 7 μV/V + 460 μV 1.4 μV/V + 57 mV	Fluke 5700A (5-digit DUT)
DC Current – Measure ³	(0 to 100) μA 100 μA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	19 μA/A + 1.2 nA 19 μA/A + 6.8 nA 20 μA/A + 64 nA 36 μA/A + 590 nA 0.013 % + 9.7 μA	HP 3458A

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Resistance – Measure ³	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ	15 μΩ/Ω + 60 μΩ 15 μΩ/Ω + 600 μΩ 10 μΩ/Ω + 670 μΩ 10 μΩ/Ω + 6.7 mΩ 14 μΩ/Ω + 8.8 mΩ 16 μΩ/Ω + 2.4 Ω 52 μΩ/Ω + 110 Ω 0.047 % + 6.0 kΩ	HP 3458A

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage – Measure ³			
(1 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 to 300) kHz	0.058 % + 2.5 μV 0.02 % + 1.2 μV 0.055 % + 0.93 μV 0.11 % + 2.2 μV 0.46 % + 6.7 μV 3.9 % + 28 μV	HP 3458A
(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	52 μV/V + 7.3 μV 55 μV/V + 4.3 μV 97 μV/V + 7.6 μV 0.021 % + 17 μV 0.07 % + 15 μV 0.32 % + 7.2 μV 0.99 % + 27 μV	
100 mV 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	69 μV/V + 47 μV 65 μV/V + 31 μV 0.015 % + 34 μV 0.03 % + 31 μV 0.08 % + 30 μV 0.3 % + 120 μV 0.98 % + 530 μV	
(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	63 μV/V + 550 μV 64 μV/V + 310 μV 0.015 % + 260 μV 0.031 % + 270 μV 0.08 % + 280 μV 0.3 % + 1.2 mV 0.97 % + 5.7 mV	

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
AC Voltage – Measure ³ (cont)			
(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	0.019 % + 5.8 mV 0.02 % + 2.7 mV 0.021 % + 2.5 mV 0.036 % + 2.6 mV 0.12 % + 2.6 mV 0.4 % + 12 mV	HP 3458A
(100 to 700) V	40 Hz to 1 kHz	0.04 % + 25 mV	
AC Voltage – Generate ³			
(0 to 10) mV	40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.029 % + 5.2 μV 0.058 % + 5.4 μV 0.032 % + 17 μV	Fluke 5700A (4.5-digit DUT)
(10 to 100) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.062 % + 15 μV 0.024 % + 11 μV 0.012 % + 11 μV 0.031 % + 15 μV 0.087 % + 34 μV	
100 mV to 1 V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.063 % + 83 μV 0.017 % + 48 μV 0.009 % + 50 μV 0.01 % + 81 μV 0.019 % + 18 μV	
(1 to 10) V	40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.008 % + 450 μV 0.015 % + 380 μV 0.031 % + 320 μV	
(10 to 100) V	40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.009 % + 5 mV 0.026 % + 4.5 mV 0.059 % + 11 mV	
200 V	40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	61 mV 81 mV 140 mV	

Parameter/Range	Frequency	CMC ^{2,4} (\pm)	Comments
AC Current – Measure ³			
(5 to 100) μ A	(45 to 100) Hz 100 Hz to 1 kHz	0.058 % + 0.035 μ A 0.058 % + 0.035 μ A	HP 3458A
100 μ A to 1 mA	(45 to 100) Hz 100 Hz to 5 kHz	0.056 % + 0.27 μ A 0.029 % + 0.23 μ A	
(1 to 10) mA	(45 to 100) Hz 100 Hz to 5 kHz	0.057 % + 2.7 μ A 0.03 % + 2.2 μ A	
(10 to 100) mA	(45 to 100) Hz 100 Hz to 5 kHz	0.06 % + 26 μ A 0.034 % + 22 μ A	
100 mA to 1 A	(45 to 100) Hz 100 Hz to 5 kHz	0.21 % + 250 μ A 0.12 % + 280 μ A	

II. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2,4} (\pm)	Comments
RF Power – Measure ³ (Absolute)			<i>M</i> is the mismatch uncertainty
(+23 to -19) dBm (<-19 to -40) dBm	9 kHz to 10 MHz 9 kHz to 10 MHz	0.048 dB + <i>M</i> 0.056 dB + <i>M</i>	R&S NRP-Z91
(+20 to -13) dBm	(10 to <100) MHz 100 MHz to 4 GHz (>4 to 8) GHz (>8 to 12.4) GHz (>12.4 to 18) GHz	0.052 dB + <i>M</i> 0.061 dB + <i>M</i> 0.074 dB + <i>M</i> 0.078 dB + <i>M</i> 0.1 dB + <i>M</i>	R&S NRP-Z51 (+20 to -20 dBm)
(<-13 to -20) dBm	(10 to < 100) MHz 100 MHz to 4 GHz (>4 to 8) GHz (>8 to 12.4) GHz (>12.4 to 18) GHz	(0.052 to 0.056 dB) + <i>M</i> (0.061 to 0.065 dB) + <i>M</i> (0.074 to 0.077 dB) + <i>M</i> (0.078 to 0.081 dB) + <i>M</i> 0.1 dB + <i>M</i>	
(<-20 to -40) dBm	(10 to <100) MHz 100 MHz to 4 GHz (>4 to 8) GHz (>8 to 12.4) GHz (>12.4 to 18) GHz	0.056 dB + <i>M</i> 0.066 dB + <i>M</i> 0.083 dB + <i>M</i> 0.094 dB + <i>M</i> 0.12 dB + <i>M</i>	

Parameter/Range	Frequency	CMC ^{2,4} (\pm)	Comments
RF Power – Measure ³ (Absolute) (cont)			<i>M</i> is the mismatch uncertainty
(-40 to -50) dBm	(10 to <100) MHz 100 MHz to 4 GHz (>4 to 8) GHz (>8 to 12.4) GHz (>12.4 to 18) GHz	(0.056 to 0.069 dB) + <i>M</i> (0.066 to 0.078 dB) + <i>M</i> (0.083 to 0.093 dB) + <i>M</i> (0.094 to 0.1 dB) + <i>M</i> (0.12 to 0.13 dB) + <i>M</i>	R&S NRP-Z21 (-20 to -50 dBm)
2.92 mm (50 Ω):			
(+13 to -13) dBm	(>18 to 40) GHz	0.18 dB + <i>M</i>	R&S NRP-Z85 (+13 to -50 dBm)
(<-13 to >-20) dBm	(>18 to 40) GHz	0.18 dB + <i>M</i>	
(<-20 to >-40) dBm	(>18 to 40) GHz	0.18 dB + <i>M</i>	
(<-40 to >-50) dBm -50 dBm	(>18 to 40) GHz	0.28 dB + <i>M</i> 0.69 dB + <i>M</i>	
2.4 mm (50 Ω):			
(+10 to -25) dBm	(>40 to 50) GHz	0.18 dB + <i>M</i>	R&S NRP-Z85 (+13 to -50) dBm
(<-25 to -30) dBm	(>40 to 50) GHz	0.24 dB + <i>M</i>	
(<-30 to -35) dBm	(>40 to 50) GHz	0.63 dB + <i>M</i>	
1.85 mm (50 Ω):			
(+15 to -20) dBm	(>50 to 67) GHz	0.29 dB + <i>M</i>	R&S NRP-Z57 (+15 to -20) dBm
RF Power – R&S Power Sensors ³ (Cal Factor)			<i>M</i> is the mismatch uncertainty
Type-N (50 Ω)	9 kHz to 0.1 GHz (>0.1 to 2.4) GHz (>2.4 to 8) GHz (>8 to 18) GHz	0.020 dB + <i>M</i> 0.024 dB + <i>M</i> 0.031 dB + <i>M</i> 0.048 dB + <i>M</i>	R&S NRPC18
3.5 mm (50 Ω)	(>18 to 26.5) GHz	0.046 dB + <i>M</i>	R&S NRPC33
2.92 mm (50 Ω)	(>26.5 to 40) GHz	0.057 dB + <i>M</i>	R&S NRPC40
2.4 mm (50 Ω)	(>40 to 41) GHz (>41 to 50) GHz	0.063 dB + <i>M</i> 0.094 dB + <i>M</i>	R&S NRPC50

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
RF Power – Measure (Absolute) (DUT: Generator) (<-20 to 20) dBm	>DC to 100 MHz >100 MHz to 4 GHz (>4 to 8) GHz (>8 to 12.5) GHz (>12.5 to 18 GHz) (>18 to 26.5) GHz (>26.5 to 40) GHz (>40 to 50) GHz (>50 to 67) GHz (>67 to 90) GHz	0.042 dB 0.052 dB 0.056 dB 0.065 dB 0.084 dB 0.09 dB 0.11 dB 0.14 dB 0.15 dB 0.47 dB	Indicating measuring instrument, direct RF power comparison (e.g. R&S NRP110T) UCS output power level – MS: power sensor – DUT: power standard (PS) UCS output power level – MS: power sensor – DUT: power standard (Gen)
RF Power – Generate (Absolute) (DUT: Power Meter) (<-40 to 23) dBm	>DC to 100 MHz >100 MHz to 4 GHz (>4 to 8) GHz (>8 to 12.5) GHz (>12.5 to 18 GHz) (>18 to 26.5) GHz (>26.5 to 40) GHz (>40 to 50) GHz (>50 to 67) GHz (>67 to 90) GHz	0.045 dB 0.072 dB 0.077 dB 0.079 dB 0.10 dB 0.15 dB 0.28 dB 0.38 dB 0.44 dB 0.58 dB	Material measure Direct RF power comparison (e.g.: R&S® NRP110T; R&S® RVZ67; R&S® SMZ90) Input power level - MS: power standard (PS) - DUT: spectrum analyzer Input power level - MS: power standard (Gen) - DUT: spectrum analyzer

Parameter/Range	Frequency	CMC ^{2,4} (\pm)	Comments
RF Power – Generate ³			<i>M</i> is the mismatch uncertainty
(+23 to -40) dBm	9 kHz to 10 MHz	0.075 dB + <i>M</i>	R&S NRP-Z91 with Weinschel 5628
(+20 to -13) dBm	(10 to 500) MHz >500 MHz to 1 GHz (>1 to 4) GHz (>4 to 8) GHz (>8 to 12.4) GHz (>12.4 to 18) GHz	0.075 dB + <i>M</i> 0.1 dB + <i>M</i> 0.13 dB + <i>M</i> 0.18 dB + <i>M</i> 0.2 dB + <i>M</i> 0.25 dB + <i>M</i>	R&S NRP-Z51 with Weinschel 5628
(<-13 to -20) dBm	(10 to 500) MHz >500 MHz to 1 GHz (>1 to 4) GHz (>4 to 8) GHz (>8 to 12.4) GHz (>12.4 to 18) GHz	0.075 dB + <i>M</i> 0.1 dB + <i>M</i> 0.13 dB + <i>M</i> 0.18 dB + <i>M</i> 0.2 dB + <i>M</i> 0.25 dB + <i>M</i>	
(<-20 to -40) dBm	(10 to 500) MHz >500 MHz to 1 GHz (>1 to 4) GHz (>4 to 8) GHz (>8 to 12.4) GHz (>12.4 to 18) GHz	0.075 dB + <i>M</i> 0.1 dB + <i>M</i> 0.13 dB + <i>M</i> 0.18 dB + <i>M</i> 0.2 dB + <i>M</i> 0.25 dB + <i>M</i>	R&S NRP-Z21 with Weinschel 5628
(<-40 to -50) dBm	(10 to 500) MHz >500 MHz to 1 GHz (>1 to 4) GHz (>4 to 8) GHz (>8 to 12.4) GHz (>12.4 to 18) GHz	0.09 dB + <i>M</i> 0.1 dB + <i>M</i> 0.13 dB + <i>M</i> 0.18 dB + <i>M</i> 0.2 dB + <i>M</i> 0.25 dB + <i>M</i>	
2.92 mm (50 Ω):			
(+13 to -13) dBm	(>18 to 40) GHz	0.22 dB + <i>M</i>	R&S NRP-Z85 with Weinschel 1534
(<-13 to -20) dBm	(>18 to 40) GHz	0.22 dB + <i>M</i>	
(>-20 to <-50) dBm	(>18 to 40) GHz	0.29 dB + <i>M</i>	
-50 dBm	(>18 to 40) GHz	0.68 dB + <i>M</i>	
2.4 mm (50 Ω):			
(+10 to -30) dBm	(<40 to 50) GHz	0.33 dB + <i>M</i>	R&S NRP-Z57 with Anritsu V241C
(<-30 to -35) dBm	(<40 to 50) GHz	0.81 dB + <i>M</i>	
1.85 mm (50 Ω):			
(+15 to -40) dBm	(>50 to 67) GHz	0.35 dB + <i>M</i>	

Parameter/Range	Frequency	CMC ^{2, 4, 5} (\pm)	Comments
Tuned RF Power – Measure (Relative) (DUT: Generator, Step Attenuator) (0 to -0.1) dB (-0.1 to -20) dB (-20 to -40) dB (-40 to -60) dB (-60 to -80) dB (-80 to -90) dB	(10 to 200) MHz	0.007 dB 0.010 dB 0.014 dB 0.016 dB 0.019 dB 0.023 dB	Indicating measuring instrument direct RF power comparison (e.g.: R&S® FSWP8) UCS display linearity - MS: spectrum analyzer - DUT: step attenuator
Tuned RF Power – Generate (Relative) (DUT: Power Meter) (0 to -0.1) dB (-0.1 to -20) dB (-20 to -40) dB (-40 to -60) dB (-60 to -80) dB (-80 to -90) dB	(10 to 200) MHz	0.010 dB 0.020 dB 0.023 dB 0.024 dB 0.027 dB 0.036 dB	Material measure direct RF power comparison (e.g.: R&S® RSC step attenuator; R&S® SMA100B) Display linearity - MS: step attenuator - DUT: spectrum analyzer
RF Power – Measure ³ 0 dBm	50 MHz Reference	0.025 dB (0.57 %)	R&S NRP-Z51 w/ R&S NRVC
RF Power – R&S Power Sensors ³ (-33 to <-30) dBm (-30 to <-10) dBm (-10 to <0) dBm (0 to 23) dBm (>23 to 26) dBm (>26 to 34) dBm	Linearity @ 50 MHz	0.022 dB 0.022 dB 0.019 dB 0.016 dB 0.016 dB 0.016 dB	R&S NRVC-B2

Parameter/Range	Frequency	CMC ^{2,4} (\pm)	Comments
Reflection S_{11}/S_{22} – Measure ³ Type-N (50 Ω)	(9 to 150) kHz: (0 to 1) lin	0.05 lin	R&S ZVR Agilent 85054B
	150 kHz to 10 MHz: (>0.5 to 1) lin	(0.0059 to 0.012) lin (0.68 to 0.07) $^\circ$	
	(>0.25 to 0.5) lin	(0.0041 to 0.0059) lin (0.94 to 0.68) $^\circ$	
	(>0.1 to 0.25) lin	(0.0036 to 0.0041) lin (2 to 0.94) $^\circ$	
	(>0.025 to 0.1) lin	(0.0035 to 0.0036) lin (8.0 to 2) $^\circ$	
	(0 to 0.025) lin	(0.0035) lin (180 to 8) $^\circ$	
	10 MHz to 8 GHz: (>0.5 to 1) lin	(0.01 to 0.02) lin (1.2 to 1.2) $^\circ$	R&S ZVK Agilent 85054B
	(>0.25 to 0.5) lin	(0.0058 to 0.01) lin (1.3 to 1.2) $^\circ$	
	(>0.1 to 0.25) lin	(0.0039 to 0.0058) lin (2.2 to 1.3) $^\circ$	
	(>0.025 to 0.1) lin	(0.0035 to 0.0039) lin (8 to 2.2) $^\circ$	
	(0 to 0.025) lin	(0.0035) lin (180 to 8) $^\circ$	

Parameter/Range	Frequency	CMC ^{2,4} (\pm)	Comments
Reflection S ₁₁ /S ₂₂ – Measure ³ (cont)	Type-N (50 Ω)	(8 to 18) GHz: (>0.5 to 1) lin	R&S ZVK Agilent 85054B
		(>0.25 to 0.5) lin	
		(>0.1 to 0.25) lin	
		(>0.025 to 0.1) lin	
		(0 to 0.025) lin	
	3.5 mm (50 Ω)	(18 to 26.5 GHz): (>0.5 to 1) lin	R&S ZVK Agilent 85052B
		(>0.25 to 0.5) lin	
		(>0.10 to 0.25) lin	
		(>0.025 to 0.1) lin	
		(0 to 0.025) lin	
	2.92 mm (50 Ω)	(26.5 to 40) GHz: (>0.5 to 1.0) lin	R&S ZVK Maury 8770C
		(>0.25 to 0.5) lin	
		(>0.1 to 0.25) lin	
		(>0.025 to 0.1) lin	
		(0 to 0.025) lin	

Parameter/Range	Frequency	CMC ^{2, 4} (\pm)	Comments
Reflection S_{11}/S_{22} – Measure ³ (cont)			
2.4 mm (50 Ω)	(> 40 to 50) GHz: $0.000\ 01 < \Gamma \leq 0.0008$	0.041 lin + 0.000 029 lin/lin (180 to 180) $^\circ$	R&S ZVA, R&S ZV-Z224
	$0.0008 < \Gamma \leq 0.0250$	0.041 lin + 0.000 93 lin/lin (180 to 180) $^\circ$	
	$0.0250 < \Gamma \leq 0.1000$	0.041 lin + 0.0045 lin/lin (180 to 25) $^\circ$	
	$0.1000 < \Gamma \leq 0.2500$	0.041 lin + 0.0098 lin/lin (10 to 25) $^\circ$	
	$0.2500 < \Gamma \leq 0.5000$	0.038 lin + 0.023 lin/lin (10 to 5.7) $^\circ$	
Transmission S_{21}/S_{12} – Measure ³			
Type-N (50 Ω)	(9 to 150) kHz (0 to 10) dB	0.15 dB	R&S ZVR Agilent 85054B
	(9 to 150) kHz (>10 to 41) dB	0.2 dB	
	150 kHz to 4 GHz (0 to 10) dB	0.05 dB 0.34 $^\circ$	R&S ZVK Agilent 85054B
	150 kHz to 4 GHz (>10 to 41) dB	0.06 dB 0.41 $^\circ$	
	(4 to 18) GHz (0 to 10) dB	0.065 dB 0.63 $^\circ$	
	(4 to 18) GHz (>10 to 41) dB	0.07 dB 0.66 $^\circ$	

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
Transmission S ₂₁ /S ₁₂ – Measure ³ (cont)			
3.5 mm (50 Ω)	(18 to 26.5) GHz (0 to 10) dB	0.29 dB 2.9°	R&S ZVK Agilent 85052B
	(10 to 41) dB	0.77 dB 5.6°	
2.92 mm (50 Ω)	(26.5 to 40) GHz (0 to 10) dB	0.36 dB 3.8°	R&S ZVK Maury 8770C
	(10 to 41) dB	1.6 dB 11°	
2.4 mm (50 Ω)	(>40 to 50) GHz (0 to -10) dB	0.013 linear + 0.12 linear/linear (7.7 to 9.0) deg	R&S ZVA, R&S ZV-Z224
	(-10 to -41) dB	0.028 linear + 0.03 linear/linear (18 to 180 deg)	

III. Electrical – RF/Microwave Device Specific Parameters

Parameter/Range	Frequency	CMC ^{2, 6} (±)	Comments
CISPR Pulse Characteristic – (Absolute) Measure (DUT: Pulse Generator)			Indicating measuring instrument direct pulse comparison (e.g.: receiver) CISPR 16-1-1
Band A 13.5 μVs; 25 Hz	(9 to 150) kHz	0.25 dB	
Band B 0.316 μVs; 100 Hz	150 kHz to 30 MHz	0.25 dB	UCS CISPR pulse level –
Band C/D 0.044 μVs; 100 Hz	(30 to 1000) MHz	0.26 dB	MS: spectrum analyzer – DUT: EMI pulse generator

Parameter/Range	Frequency	CMC ^{2, 5, 6} (±)	Comments
<p>CISPR Detector (Absolute) – Generate (DUT: Test Receiver)</p> <p>Band A Ref. BW 6 dB: 200 Hz</p> <p>Band B Ref. BW 6 dB: 9 kHz</p> <p>Band C/D Ref. BW 6 dB: 120 kHz</p>	<p>(9 to 150) kHz</p> <p>150 kHz to 30 MHz</p> <p>(30 to 1000) MHz</p>	<p>0.30 dB</p> <p>0.30 dB</p> <p>0.31 dB</p>	<p>Material measure direct pulse comparison (e.g.: Schwarzbeck® IGUU 2918) CISPR 16-1-1</p> <p>Absolute pulse response (Band E) - MS: pulsed RF generator - DUT: receiver</p>
<p>CISPR Pulse Repetition Rate – Measure (DUT: Pulse Generator)</p> <p>Band A</p> <p>Band B</p> <p>Band C/D</p>	<p>(9 to 150) kHz</p> <p>150 kHz to 30 MHz</p> <p>(30 to 1000) MHz</p>	<p>0.01 %</p> <p>0.01 %</p> <p>0.01 %</p>	<p>Indicating measuring instrument direct measurement (e.g.: R&S® HM8123) CISPR 16-1-1</p> <p>UCS pulse repetition rate - MS. frequency counter - DUT: EMI pulse generator</p>
<p>CISPR Detector – (Relative: Response Variation with Repetition Frequency) Generate (DUT: Test Receiver)</p> <p>Band A (0.1 to 100) Hz</p> <p>Band B 0.1 Hz to 4 kHz</p> <p>Band C/D 0.1 Hz to 50 kHz</p>	<p>(9 to 150) kHz</p> <p>150 kHz to 30 MHz</p> <p>(30 to 1000) MHz</p>	<p>0.05 dB</p> <p>0.05 dB</p> <p>0.05 dB</p>	<p>Material measure direct pulse comparison (e.g.: Schwarzbeck® IGUU 2918) CISPR 16-1-1</p> <p>Pulse repetition rate - MS. pulse generator - DUT: receiver</p>

Parameter/Range	Frequency	CMC ^{2, 4, 6, 7} (±)	Comments
CISPR Detector – (Absolute) Generate (DUT: Test Receiver) Band E (Pulse Modulated Carrier) Ref. BW 6 dB: 1 MHz	(1 to 4) GHz (4 to 8) GHz (8 to 18) GHz	0.10 dB 0.11 dB 0.13 dB	Material measure direct comparison pulse to modulated carrier (e.g.: R&S® SMA100B) CISPR 16-1-1 Absolute pulse response (Band E) - MS: pulsed RF generator - DUT: receiver
CISPR Detector – (Relative) Generate (DUT: Test Receiver) Band E (Pulse Modulated Carrier) 100 Hz to 400 kHz	(1 to 18) GHz	0.05 dB	Pulse repetition rate - MS. pulse generator - DUT: receiver
Phase Noise – Measure	100 MHz to 16 GHz Carrier	0.67 dB	R&S LPN
Resolution Bandwidth – Bandwidth Switching ³	100 Hz to 80 MHz (RBW)	0.011 dB	R&S NRP-Z91 power sensor
Amplitude Modulation – Generate & Measure ³	(5 to 6000) MHz (AM = 5 % to 99 %)	(0.0005 <i>m</i> + 0.0042) % AM	R&S FSMR <i>m</i> is the AM from (5 to 99) %

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
Frequency Modulation – Generate & Measure ³	(46.8 to 6000) MHz (FM _{Dev} 1 kHz to 300 kHz)	0.001 x FM _{Dev} + 2 Hz	R&S FSQ
Digital Modulation – Generate & Measure ³ Carrier: 2 MHz to 6 GHz Error Vector Magnitude (RMS) for Modulation Types: MSK, GMSK, BPSK, DQPSK, $\pi/4$ DQPSK, 8 PSK, 16 QAM & 32QAM, QPSK Phase Error (RMS) for Modulation Types: MSK, GMSK, BPSK, DQPSK, $\pi/4$ DQPSK, 8 PSK, 16 QAM & 32 QAM, QPSK	(20 to 1500) MHz (>1500 to 2600) MHz (>2600 to 6000) MHz (20 to 1500) MHz (>1500 to 2600) MHz (>2600 to 6000) MHz	0.018 % RMS 0.019 % RMS 0.046 % RMS 0.0099° RMS 0.011° RMS 0.026° RMS	R&S FSQ

IV. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 7} (±)	Comments
Frequency – Measure ³	20 Hz to 2.5 GHz (2.5 to 40) GHz (>40 to 50) GHz (>50 to 67) GHz	0.12 Hz 5.7 mHz/GHz + 0.018 Hz 2.5 Hz – 0.045 Hz/GHz 1.9 Hz – 0.022 Hz/GHz	Fluke 910R GPS-controlled Rubidium frequency standard w/ FSQ spectrum analyzer
Frequency – Measuring Equipment, Oscillator Offset ³	10 MHz	3.9 pHz/Hz (3.9 parts in 10 ¹²)	Fluke 910R w/ Fluke 6690 counter

Parameter/Equipment	Range	CMC ^{2,7} (\pm)	Comments
Time – Measure	100 ns	3.9 ps/s (3.9 parts in 10 ¹²)	Fluke 910R w/ Fluke 6690 counter

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 and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. 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 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. CMCs 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.

⁵ In the statement of CMC, % refers to a percent of reading unless otherwise noted.

⁶ Calibration of EMI Test Receivers according to CISPR 16-1-1.

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

ROHDE & SCHWARZ USA, INC.

Columbia, MD

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/NC SL Z540-1-1994 and the requirements of ANSI/NC SL 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 22nd day of October 2019.

A blue ink signature of the Vice President of Accreditation Services.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2354.01
Valid to October 31, 2021

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