



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

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CALIBRATION

Valid To: August 31, 2019

Certificate Number: 0952.04

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1</sup>:

I. Electrical – RF/Microwave

Parameter/Equipment	Frequency	CMC <sup>2</sup> (±)	Comments
Antenna Factor – Biconical Antennas (3 and 10) Meters	(30 to 300) MHz (300 to 1000) MHz	1.2 dB 2.5 dB	ANSI C63.5: 1998 Using Standard Site method with HP 4396A and Agilent 87512A
10 Meters	(30 to 300) MHz (300 to 1000) MHz	1.2 dB 2.5 dB	ANSI C63.5:2006 Using Standard Site method and reference antenna methods with HP 4396A, Agilent 87512A and R&S SMY02

Parameter/Equipment	Frequency	CMC <sup>2</sup> (±)	Comments
Antenna Factor (cont) – Log Periodic Antennas (3 and 10) Meters	(200 to 1000) MHz	3.2 dB	ANSI C63.5: 1998 Using Standard Site method with HP 4396A and Agilent 87512A
10 Meters	(200 to 1000) MHz	3.2. dB	ANSI C63.5:2006 Using Standard Site method and Reference antenna method w/ HP 4396A & Agilent 87512A
10 Meters	(300 to 1000) MHz	1.0 dB	ANSI C63.5: 1998, 2006 Using reference antenna method with R&S SMY02
Dipole Antenna 10 Meters	(30 to 300) MHz (300 to 1000) MHz	1.3 dB 1.4 dB	ANSI C63.5: 1998, 2006 Using reference antenna method with R&S SMY02
Horn Antennas	(1 to 18) GHz	2.1 dB	ANSI C63.5: 1998, 2006 Using Standard Site method and Reference antenna method w/ Agilent E4446A Agilent E8257D
	(1 to 18) GHz	2.3 dB	AgilentN5230A
Monopole Antenna	100 kHz to 50 MHz	2.5 dB	CISPR 25:2008, CISPR 16-1-4:2010+A1:2012, CISPR 16-1-6:2014 ECSM w/ R&S, ESHS10 & ESVS10 & SMY02
Antenna Balance – Biconical Antennas	(30 to 300) MHz	0.50 dB	CISPR 16-1-4:2010 +A1:2012, CISPR 16-1-6:2014 ANSI C63.5:2006, IEEE291:1991 w/ Agilent 4396A, Agilent 87512A and Agilent 8753D

Parameter/Equipment	Frequency	CMC <sup>2,5</sup> (±)	Comments
Antenna Cross-Polarization –			
Log.Per. Antennas	(200 to 1000) MHz	0.60 dB	CISPR 16-1-4:2010+A1:2012, CISPR 16-1-6:2014 ANSI C63.5:2006, IEEE291:1991 w/ Agilent 4396A, Agilent 87512A and Agilent 8753D
Horn Antennas	(1 to 18) GHz	0.80 dB	CISPR 16-1-4 2007,A1 2007 CISPR 16-1-6:2014 ANSI C63.5:2006 IEEE291:1991 w/ Agilent E4446A, Agilent E8257D
	(1 to 18) GHz	2.1 dB	CISPR 16-1-4 2007,A1 2007 CISPR 16-1-6:2014 ANSI C63.5:2006 IEEE291:1991 w/ Agilent N5230A
LISN –			
Impedance	9 kHz to 30 MHz 30 kHz to 1 GHz	3.0 % 0.98 %	CISPR 16-1-2:2014, CISPR 16-4-1:2009, CISPR 16-4-2:2011+A1 :2014
Phase	9 kHz to 30 MHz	0.51 deg	CISPR 16-4-3:2004+A1:2006, CISPR 16-4-4:2007,
Decoupling Factor	9 kHz to 1 GHz	1.7 dB	ANSI C63.4:2014 Using Agilent 4395A, Agilent 87512A and Agilent 85032B
Voltage Division Factor	9 kHz to 30 MHz 30 kHz to 1 GHz	0.12 dB 0.34 dB	
VSWR	9 kHz to 30 MHz	2.1 %	

Parameter/Equipment	Frequency	CMC <sup>2</sup> (±)	Comments	
ISN (Impedance Stabilization Network) –				
Termination Impedance	(0.1 to 80) MHz	0.35 Ω	CISPR 22:2008, EN 55022:2010, HP 4396A with Agilent 85046B, 4395A with 87512A, 85032B Type N calibration kit	
Phase of Basic Network for Asymmetric Disturbance	(0.1 to 80) MHz	0.74 deg		
Voltage Division Factor	(0.1 to 80) MHz	0.76 dB		
Insertion Loss	(0.1 to 80) MHz	0.76 dB		
Decoupling Attenuation	(0.1 to 80) MHz	0.70 dB		CISPR 22:2008, EN 55022:2010 with HP 8753D
Longitudinal Conversion Loss (LCL)	(0.1 to 80) MHz	0.73 dB		
Asymmetric Attenuation	(0.1 to 80) MHz	1.4 dB		
Amplifier –				
Gain	30 kHz to 3 GHz	0.60 dB	HP 8753D	
	(2 to 18) GHz	1.1 dB	Agilent E8257D & Agilent E4418A w/ Agilent E4412A	
Linearity	30 kHz to 3 GHz	2.0 dB	HP 8753D	
	(2 to 18) GHz	1.4 dB	Agilent E8257D & Agilent E4418A w/ Agilent E4412A	
Harmonic Distortion	100 kHz to 1.8 GHz	1.8 dB	Agilent E4446A	

Parameter/Equipment	Frequency	CMC <sup>2, 5</sup> (±)	Comments
Absorbing Clamp –			
Clamp Factor	(30 to 300) MHz (300 to 1000) MHz	2.9 dB 3.0 dB	Ordinal Method CISPR 16-1-3:2004, CISPR 16-1-3, Corrigendum 1:2006
Clamp Factor	(30 to 300) MHz (300 to 1000) MHz	1.8 dB 2.1 dB	Reference Device Method CISPR 16-1-3:2004, CISPR 16-1-3, Corrigendum 1:2006
Decoupling Factor DF	(30 to 300) MHz	0.57 dB	
Decoupling Factor DR	(30 to 300) MHz	0.58 dB	
Capacitive Voltage Probe –			
Pulse Response	100 kHz to 30 MHz	0.83 dB	CISPR 16-1-2:2014, ANSI C63.4:2014, CISPR 16-1-1:2015 w/ IGUU2916
Relative Pulse Response	100 kHz to 30 MHz	1.1 dB	
CW Response (Voltage Division Factor)	100 kHz to 30 MHz	1.3 dB	Network analyzer 4396A + 85046A
	100 kHz to 30 MHz	0.44 dB	Generator & receiver SMY02 + FCKL1528
Decoupling	100 kHz to 30 MHz	1.9 dB	Network analyzer 8753D
	100 kHz to 30 MHz	1.9 dB	Generator & receiver SMY02 + FCKL1528
CDN –			
Coupling Factor	100 kHz to 230 MHz	0.87 dB	IEC 61000-4-6: 2013, EN 61000-4-6:2014, HP 4396A & Agilent 85046A
Impedance	100 kHz to 230 MHz	1.1 %	& Agilent 85032B Type N calibration kit

Parameter/Equipment	Frequency	CMC <sup>2,5</sup> (±)	Comments
EFT/Burst Generator – Peak Voltage Rise Time Pulse Duration Pulse Repetition Frequency Burst Period Burst Duration	250 V to 5 kV 5 ns 50 ns (5 to 100) kHz 300 ms 15 ms & 0.75 ms	2.8 % 5.8 % 1.2 % 0.50 % 0.20 % 0.80 %	IEC 61000-4-4:2012 with DSO80204B oscilloscope
Surge Generator – Open Circuit: Peak Voltage Front Time Duration Time to Half Value Short Circuit: Peak Current Front Time Duration Time to Half Value CDN Section Phase Shifting	(0.5, 1, 2, 4) kV (0.5, 1, 2, 4) kV (0.5, 1, 2, 4) kV (0.5, 1, 2, 4) kV 10 A to 2 kA 10 A to 2 kA 10 A to 2 kA 10 A to 2 kA 10 μs	2.4 % 2.3 % 2.3 % 2.3 % 2.5 % 2.3 % 2.3 % 2.3 % 10 μs	EN 61000-4-5:2014, IEC 61000-4-5:2014 with DSO6102A oscilloscope
EM Clamp or Current Injection Probe – Coupling Factor	100 kHz to 230 MHz	1.4 dB	IEC 61000-4-6:2013, EN 61000-4-6:2014 HP 4396A with 85046A, 4395A with 87512A
Impedance – 50 Ω Termination	9 kHz to 1.8 GHz	0.75 %	HP 4396A & HP 85046A HP 4395A & HP 87512A & HP 85032B Type N calibration kit

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Magnetic Field Strength Meter –	50 Hz, 60 Hz	0.28 %	IEC 61000-4-8:2009, EN 61000-4-8:2010, IEC 61786:1998 5.2.1.a (JIS C 1910:2004), Yokogawa 2558 and standard coil
Reflection Coefficient <sup>3</sup>	30 kHz to 3 GHz	1.6 %	HP 8753D & Agilent 85032B Type N calibration kit
	(3 to 18) GHz	1.3 %	Agilent 11692D & Agilent 773D
CISPR Pulse Generator <sup>6</sup> –			
Impulse Area	Band A Band B Band C and D	47 nVs 1.1 nVs 0.18 nVs	Agilent 86100C with Agilent 86112A (uncertainty based on Schwarzbeck IGUU 2916)
Impulse Bandwidth	Band A Band B Band C and D	3.7 ns 0.015 ns 0.020 ns	
Null Point Frequency	Band A Band B Band C and D	0.046 MHz 3.5 MHz 41 MHz	Agilent E4446A (uncertainty based on Schwarzbeck IGUU 2916)
Flatness of Spectrum Amplitude	Band A Band B Band C and D	0.45 dB 0.45 dB 0.57 dB	Agilent E4446A (uncertainty based on Schwarzbeck IGUU 2916)
Pulse Repetition Frequency	Band A Band B Band C and D	0.00050 Hz 0.00090 Hz 0.00075 Hz	Agilent 53132A + Symmetricom 8040C (uncertainty based on Schwarzbeck IGUU 2916)
Source Errors for Sinewave Output for CISPR Checks (@ 60 dB $\mu$ V)	(1, 10, and 100) MHz	0.11 dB	Agilent E4417A w/ Agilent E9304A (uncertainty based on Schwarzbeck IGUU 2916)

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
EMI Receiver <sup>4</sup> –			
Input Impedance	Band A Band B Band C Band D Band E	0.75 dB 0.75 dB 1.2 dB 1.2 dB 1.3 dB	CISPR16-1-1:2010+A1:2010, CISPR16-1-1:2015, CISPR16-4-2:2011+A1:2014 ANSI C63.2:1996, HP 4396A & HP 85032B HP 4395A & HP 87512A Type N calibration kit, Agilent 11692D & Agilent 773D
Pulse Response	Band A Band B Band C Band D	0.80 dB 0.80 dB 0.77 dB 0.77 dB	Schwarzbeck IGUU2916
Relative Pulse Response	Band A Band B Band C Band D	0.55 dB 0.35 dB 0.61 dB 0.61 dB	
Sine-wave Accuracy	Band A Band B Band C Band D Band E	0.67 dB 0.67 dB 0.67 dB 0.67 dB 0.72 dB	R&S SMY02 w/ HP 437B & HP 8482A  Agilent E8257D
Selectivity, 6 dB Bandwidth	Band A Band B Band C Band D Band E	2.0 Hz 0.11 kHz 0.22 kHz 0.22 kHz 2.9 kHz	R&S SMY02  Agilent E8257D
Intermediate Frequency Rejection Ratio	Band A Band B Band C Band D Band E	0.96 dB 0.96 dB 1.2 dB 1.2 dB 1.9 dB	R&S SMY02 & Agilent E8257D  Agilent E8257D
Image Frequency Rejection Ratio	Band A Band B Band C Band D Band E	0.87 dB 0.87 dB 0.87 dB 0.87 dB 1.9 dB	R&S SMY02  Agilent E8257D



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
EMI Receiver <sup>4</sup> – (cont)			
Spurious Frequency Rejection Ratio	Band A	1.8 dB	R&S SMY02
	Band B	1.8 dB	
	Band C	1.3 dB	
	Band D	1.3 dB	
	Band E	1.9 dB	
Peak Detector Verification	Band A	0.74 dB	Schwarzbeck IGUU2916
	Band B	0.74 dB	
	Band C	0.74 dB	
	Band D	0.74 dB	
Average Detector Verification	Band A	0.74 dB	
	Band B	0.74 dB	
	Band C	0.74 dB	
	Band D	0.74 dB	
RMS Detector Verification	Band A	0.74 dB	
	Band B	0.74 dB	
	Band C	0.74 dB	
	Band D	0.74 dB	
Response to Intermittent, Unsteady & Drifting Narrowband Disturbances	Band A	0.64 dB	R&S SMY02
	Band B	0.64 dB	
	Band C	0.72 dB	
	Band D	0.72 dB	
Impulse Bandwidth Measurement (EMI Receiver & Spectrum Analyzer)	< 1 MHz 1 MHz resolution bandwidth	3.1 kHz	Agilent 81101A
Input Impedance on CISPR Band E	(1 to 18) GHz	2.1 dB	Network analyzer N5230A CISPR 16-1-1:2015

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
Signal Generator –			
Frequency Accuracy	9 kHz to 1 GHz	0.59 x10 <sup>-7</sup> %	Agilent 53132A + Symmetricom 8040C
	(1 to 18) GHz	1.0 x10 <sup>-8</sup> %	Agilent 53152A + Symmetricom 8040C
	(18 to 40) GHz	7.8 x10 <sup>-9</sup> %	Agilent 53152A + Symmetricom 8040C
Reference Frequency Accuracy	10 MHz	7.9 x10 <sup>-9</sup> %	Agilent 53132A + Symmetricom 8040C
Level Accuracy	9 kHz to 1 GHz	0.84 dB	Agilent E4417A w/ E9304A
	(1 to 18) GHz	0.50 dB	HP 437B w/ HP 8481A
(≥-30 dBm)	(18 to 40) GHz	1.1 dB	Agilent E4417A w/ 8487A
(<-30 dBm)	(18 to 40) GHz	1.4 dB	Agilent E4446A
AM Depth	(1 to 100) %	1.9 %	Agilent E4446A
Attenuator Setting Accuracy	9 kHz to 1 GHz (1 to 18) GHz (18 to 40) GHz	1.9 dB 1.6 dB 1.9 dB	Agilent E4446A
Harmonic Distortion	9 kHz to 1 GHz (1 to 18) GHz (18 to 40) GHz	1.7 dB 1.9 dB 3.0 dB	Agilent E4446A
AM Frequency	20 Hz to 100 kHz	0.059 %	Agilent E4446A
Insertion Loss –			
(0 to 80) dB	9 kHz to 500 MHz	0.48 dB	HP 4395A, HP 87512A
(0 to 130) dB	30 kHz to 3 GHz	0.67 dB	HP 8753D, HP 4396A 85032B (assuming no mismatch at input & output of EUT)
	(3 to 18) GHz	0.060 dB	Power sensor E4412A + power meter E4418A
	(18 to 40) GHz	2.3 dB	Power sensor 8487A + power meter E4417A

Parameter/Equipment	Frequency	CMC <sup>2,5</sup> (±)	Comments
Spectrum Analyzer –			
10 MHz Output Frequency Accuracy	10 MHz	0.10 Hz	Rubidium oscillator, counter
10 MHz Reference Frequency Accuracy	10 MHz	0.10 Hz	Rubidium oscillator, counter
Marker Readout Accuracy	DC to 26.5 GHz (>26.5 to 40) GHz	0.20 % 0.50 %	Synthesized generator
Frequency Span Accuracy	DC to 26.5 GHz (>26.5 to 40) GHz	0.47 % 0.70 %	Synthesized generator
Frequency Readout Accuracy	DC to 40 GHz	1.2 %	Synthesized generator
Noise Sidebands	DC to 26.5 GHz (>26.5 to 40) GHz	0.20 dB/Hz 1.0 dB/Hz	Synthesized generator
Spurious Responses	DC to 40 GHz	2.3 dB	Synthesized generator
Residual FM	DC to 26.5 GHz (>26.5 to 40) GHz	0.70 dB 0.80 dB	Synthesized generator
Display Scale Fidelity	DC to 26.5 GHz (>26.5 to 40) GHz	0.57 dB 0.12 dB	Synthesized generator, step attenuators
Input Attenuation Switching Uncertainty	DC to 26.5 GHz (>26.5 to 40) GHz	0.61 dB 0.41 dB	Synthesized generator, step attenuators
Reference Level Accuracy	DC to 26.5 GHz (>26.5 to 40) GHz	0.92 dB 0.10 dB	Synthesized generator, power meter with sensor, step attenuators
Resolution Bandwidth Switching Uncertainty	DC to 26.5 GHz	0.14 dB	Synthesized generator, attenuator
Absolute Amplitude Accuracy	DC to 26.5 GHz (>26.5 to 40) GHz	1.0 dB 0.31 dB	Power meter with sensor, splitter, attenuator
Resolution Bandwidth Accuracy	DC to 26.5 GHz (>26.5 to 40) GHz	0.40 dB 1.0 dB	Synthesized generator, power meter with sensor, splitter

Parameter/Equipment	Frequency	CMC <sup>2,5</sup> (±)	Comments
Spectrum Analyzer – (cont)			
Residual Response	DC to 26.5 GHz (>26.5 to 40) GHz	0.40 dB 0.26 dB	Termination
Displayed Average Noise Level	DC to 26.5 GHz (>26.5 to 40) GHz	0.26 dB 4.4 dB	Terminations
Frequency Response/Flatness	DC to 26.5 GHz (>26.5 to 40) GHz	0.52 dB 1.1 dB	Synthesized generator, power meter with sensor
Tracking Generator Level Flatness	DC to 26.5 GHz (>26.5 to 40) GHz	0.50 dB 0.10 dB	Synthesized generator, power meter with sensor
Overall Absolute Amplitude Accuracy	DC to 26.5 GHz (>26.5 to 40) GHz	1.1 dB 0.31 dB	Synthesized generator, power meter with sensor, step attenuators
Digital Multimeter –			
AC Voltage	(1.0 to 2.2) mV 50 Hz to 10 kHz	0.62 %	Fluke 5720A
	(2.2 to 22) mV 50 Hz to 10 kHz	0.21 %	Fluke 5720A
	(22 to 220) mV (50Hz to 10kHz)	0.084 %	Fluke 5720A
	(0.22 to 2.2) V 20 Hz to 100 kHz	0.054 %	Fluke 5720A
	(2.2 to 22) V 20 Hz to 100 kHz	0.064 %	Fluke 5720A
	(22 to 220) V 20 Hz to 100 kHz	0.26 %	Fluke 5720A
	(220 to 1000) V 50 Hz to 1 kHz	0.18 %	Fluke 5720A

Parameter/Equipment	Frequency	CMC <sup>2.5</sup> (±)	Comments
Digital Multimeter –			
DC Voltage	(1 to 220) mV	0.0029 %	Fluke 5720A
	(0.22 to 2.2) V	0.0010 %	Fluke 5720A
	(2.2 to 1000) V	0.0053 %	Fluke 5720A
AC Current	(100 to 220) uA (50 Hz to 60Hz)	0.11 %	Fluke 5720A
	(0.22 to 220) mA (50 Hz to 60Hz)	0.065 %	Fluke 5720A
	(0.22 to 2.2) A (50 Hz to 60Hz)	0.58 %	Fluke 5720A
DC Current	1 mA to 60 A (50, 60, 400 800) Hz	0.22 %	Yokogawa 255800-1/B
	(10µA to 2.2) A	0.040 %	Fluke 5720A
Resistance	12 µA to 36 A	0.27 %	Yokogawa 256042-1/B
	(0.1 to 1111.21) Ω	0.52 %	Yokogawa 2793 01 Fluke 5720A
	0 Ω	100 µΩ	Yokogawa 2793 01 Fluke 5720A
Frequency	1 kΩ to 111.11 MΩ	0.23 %	Yokogawa 2793 03 Fluke 5720A
	0.1 Hz to 2 MHz	0.023 %	NF 1915

Parameter/Equipment	Frequency	CMC <sup>2,5</sup> (±)	Comments
Oscilloscope –			
DC Output	DC	0.020 %	Agilent 34401A
AC Output	DC to 2 GHz	0.028 %	Agilent 34401A
Time Interval Accuracy	DC to 2 GHz	0.23 %	Rohde & Schwarz SMY02
Input Impedance	DC to 2 GHz	0.45 %	Agilent 34401A
DC Voltage Measurement Accuracy	DC	1.3 %	Agilent 34401A
Bandwidth	DC to 2 GHz	0.31 dB	Rohde & Schwarz SMY02, Power sensor E9304A + Power meter E4417A
Trigger Sensitivity	DC to 2 GHz	1.6 %	Rohde & Schwarz SMY02
Zero Error	DC to 2 GHz	7.0 %	
Offset Gain	DC to 2 GHz	0.12 %	Agilent 34401A
DC Gain	DC	0.12 %	
Click Generator –			
QP Amplitude	150 kHz to 30 MHz	2.1 dB	Agilent DSO80204B
Click Duration	150 kHz to 30 MHz	1.1 %	
Click Analyzer –			
QP Amplitude	150 kHz to 30 MHz	4.5 dB	MEB TSG-1
Click Duration	150 kHz to 30 MHz	2.5 %	

Parameter/Equipment	Frequency	CMC <sup>2,5</sup> (±)	Comments
S-Parameter Test Set –			
Directivity	9 kHz to 6 GHz	0.58 dB	
Switch Repeatability	9 kHz to 6 GHz	1.2 dB	
Pre Amplifier –			
Gain	10 MHz to 18 GHz (18 to 40) GHz	1.7 dB 2.9 dB	Network analyzer N5230A
Linearity	10 MHz to 18 GHz (18 to 40) GHz	2.5 dB 2.9 dB	Network analyzer N5230A
Power Amplifier –			
Gain	10 MHz to 18 GHz	2.3 dB	With N5230A
Linearity	10 MHz to 18 GHz	2.3 dB	
Network Analyzer –			
Frequency Accuracy	9 kHz to 6 GHz (6 to 40) GHz	0.013 x 10 <sup>-6</sup> dB 1.7 x 10 <sup>-8</sup> dB	
Level Accuracy	9 kHz to 6 GHz	0.25 dB	
Level Flatness	9 kHz to 6 GHz	0.25 dB	
Level Accuracy / Level Flatness	(6 to 40) GHz	1.0 dB	
Power Linearity	9 kHz to 6 GHz (6 to 40) GHz	0.56 dB 1.1 dB	
Harmonics	9 kHz to 6 GHz	0.43 dB	
Noise Level / Input Cross Talk	9 kHz to 6 GHz	2.0 dB	
Noise Level	(6 to 40) GHz	3.7 dB	
Input Impedance	9 kHz to 6 GHz (6 to 40) GHz	1.2 dB 2.3 dB	
Absolute Amplitude Accuracy	9 kHz to 6 GHz	0.46 dB	

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
Network Analyzer – (cont)			
Dynamic Accuracy –			
Magnitude Ratio	9 kHz to 6 GHz	0.50 dB	
Phase	9 kHz to 6 GHz	3.9 deg	
Coaxial Cable –			
Cable Loss	9 kHz to 10 MHz	0.48 dB	4395A, 87512A
	10 MHz to 18 GHz	1.7 dB	Network analyzer N5230A
	(18 to 40) GHz	2.9 dB	
Attenuator –			
Attenuation	9 kHz to 10 MHz	0.48 dB	4395A, 87512A
	10 MHz to 18 GHz (18 to 40) GHz	1.7 dB 2.9 dB	Network analyzer N5230A
V.S.W.R	10 MHz to 18 GHz	1.8 dB	
ESD Simulator –			
Rise Time / Fall Time	(0.5 to 1.2) ns	0.031 ns	IEC 61000-4-2:2008 ISO 10605
Peak Current, Current at 30/60 ns	(1 to 15) kV	2.4 %	
DIP/Interruption Simulator –			
Output Voltage – (0 to 500) V <sub>(rms)</sub>	DC to 400 Hz	0.61 %	IEC 61000-4-11:2004
Repetition Time – 10 s	DC to 400 Hz	0.39 %	
Event Time – (0 to 500) ms	DC to 400 Hz	0.91 %	



Parameter/Equipment	Frequency	CMC <sup>2,5</sup> (±)	Comments
DIP/Interruption Simulator – (cont)			
Phase Shifting – (0 to 360)°	DC to 400 Hz	0.29 deg	
Rising Time/Falling Time – (1 to 5) µs	DC to 400 Hz	2.9 %	
Overshoot and Undershoot Voltage – Less than 5 % of Rated Voltage (Ut)	DC to 400 Hz	3.0 %	
Capacitive Clamp –			
Peak Voltage	2 kV (set voltage)	3.9 %	IEC 61000-4-4:2012
Rise time	5 ns	5.8 %	
Pulse Duration	50 ns	1.2 %	
AC Power Source –			
Frequency Accuracy	DC to 800 Hz	0.26 %	HP 34401A NF E-2001B Agilent DOS6102A
Voltage Accuracy	(1 to 700) V	0.47 %	
Distortion	20 Hz to 20 kHz	3.6 %	
In-Rush Current	10 kVA (par Phase)	0.83 %	
Supplying Capacity	10 kVA	2.1 %	
DC Power Source –			
Output Voltage Accuracy	1 mV to 1000 V	0.26 %	HP 34401A
Voltage Drop	DC	0.70 %	
Noise Level	DC	6.4 %	HP 3458A
Output Current Accuracy	100 µA to 3A	0.23 %	

Parameter/Equipment	Frequency	CMC <sup>2,5</sup> (±)	Comments
Audio Generator / Function Generator–			
Frequency Accuracy Sine Wave	1 Hz to 2 MHz	0.023 %	53152A, 53132A
Amplitude Accuracy Sine Wave	3 Hz to 300 kHz	0.50 %	HP 3458A, E9304A, +E4417A
Distortion Sine Wave	20 Hz to 20 kHz	3.5 %	Levear VP-7727D
Rise/Fall Time Square and Triangle Form Wave	DC to 2 MHz	0.91 ns	DSO6102A
Voltage Accuracy	DC to 2 MHz	3.0 %	HP 3458A
Duty Cycle	DC to 2 MHz	0.30 %	DSO6102A
Open Area Test Site –			
Site Attenuation	(30 to 300) MHz 300 MHz to 1 GHz	1.6 dB 1.5 dB	ANSI C63.5:2006
Site V.S.W.R.	(1 to 18) GHz	2.5 dB	CISPR 16-1-4
Current Probe –			
Transfer Impedance	100 kHz to 230 MHz 0.1 MHz to 1 GHz (1.0 to 2.1) GHz	0.40 dB 1.2 dB 1.9 dB	CISPR 16-1-2:2014 CISPR 16-1-2:2014 CISPR 16-1-2:2014
Television Analyzer –			
Field Strength	300 MHz to 1 GHz	1.4 dB	Antennae, Power meter w/sensor, Spectrum analyzer, Signal generator

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
ESD Target –			
Flatness of Measurement Chain	30 kHz to 3 GHz	1.2 dB	IEC 61000-4-2:2008, ISO 10605:2008, 8753D
	10 MHz to 4 GHz	1.7 dB	N5230A
Input Resistance	DC	1.9 %	
Directional Couplers –			
Coupling Factor	9 kHz to 1 GHz (1 to 18) GHz (18 to 40) GHz	1.4 dB 1.8 dB 3.0 dB	4395A, 8753D, N5230A
Insertion loss	9 kHz to 1 GHz (1 to 18) GHz (18 to 40) GHz	1.3 dB 1.7 dB 2.9 dB	
V.S.W.R.	9 kHz to 1 GHz (1 to 18) GHz	0.55 dB 1.8 dB	
Directivity	9 kHz to 1 GHz (1 to 18) GHz (18 to 40) GHz	1.3 dB 1.9 dB 3.2 dB	
Coil –			
Magnetic Field Level	(40 to 800) Hz	0.41 %	Yokogawa 2558 EMCO HI-3624A
Power Sensor –			
V.S.W.R.	DC to 3 GHz (3 to 18) GHz	0.85 % 1.3 %	HP 8753D, Agilent E8257D, Agilent E4418A + Agilent E4412A, Agilent 11692D
Insertion Loss on Passage Typed Power Sensor	9 kHz to 1 GHz  (1 to 18) GHz	0.47 dB  1.7 dB	

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
Power Sensor – (cont)			
Level Accuracy			
-60 dBm to 0 dBm	9 kHz to 10 MHz	4.7 %	
-70 dBm to 0 dBm	10 MHz to 4 GHz	5.1 %	
	(4 to 6) GHz	5.7 %	
	(6 to 18) GHz	6.8 %	
-30 dBm to 0 dBm	(18 to 26.5) GHz	6.3 %	
	(26.5 to 40) GHz	12 %	
-70 dBm to -30 dBm	(18 to 26.5) GHz	6.6 %	
	(26.5 to 40) GHz	18 %	
Calibration Factor	9 kHz to 4 GHz	3.7 %	
	(4 to 6) GHz	5.0 %	
	(6 to 18) GHz	5.8 %	
	(18 to 26.5) GHz	8.9 %	
	(26.5 to 40) GHz	11 %	
Power Meter –			
Zero Carryover	50 MHz	0.34 %	Keysight 11683A
Instrument Accuracy	50 MHz	0.34 %	
Reference Power	50 MHz	0.59 %	Keysight 478A Option H76

<sup>1</sup> This laboratory offers commercial calibration service.

<sup>2</sup> 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.

<sup>3</sup> For Reflection Coefficient calibrations, CMCs are based on a 1 port device measurement.

<sup>4</sup> For the calibrations noted, CMCs are based on R&S ESHS10 and R&S ESVS10.

<sup>5</sup> In the statement of CMC, the value is defined as the percentage of reading unless otherwise noted.

<sup>6</sup> For CISPR Pulse Generator calibrations, CMCs are based on Schwarzbeck IGUU 2916.



## Accredited Laboratory

A2LA has accredited

**JEL LIMITED**

*Abiko-City, Chiba-Prefecture, Japan*

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 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 25<sup>th</sup> day of August 2017.

A handwritten signature in black ink, written over a horizontal line.

President and CEO  
For the Accreditation Council  
Certificate Number 0952.04  
Valid to August 31, 2019

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