

Deutsche Akkreditierungsstelle GmbH

Annex to the Accreditation Certificate D-K-15195-01-01 according to DIN EN ISO/IEC 17025:2018

Valid from: 29.07.2019

Date of issue: 29.07.2019

Holder of certificate:

Rohde & Schwarz Meßgerätebau GmbH

with its calibration laboratory

Rohde-und-Schwarz-Straße 1, 87700 Memmingen

Calibration in the fields:

Electrical quantities

DC and frequency quantities

- **DC voltage**
- **AC voltage**
- **DC current**
- **AC current**
- **DC resistance**

Time and frequency

- **Time interval**
- **Frequency**

High frequency quantities

- **HF voltage**
- **HF power**
- **HF impedance (reflectance factor)**
- **HF attenuation**
- **HF noise**
- **Waveform quantities**
- **Antenna quantities**
- **Rise time**
- **Modulation quantities**

Abbreviations used: see last page

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks	
HF power Sources, devices with mismatch correction	1 mW	> DC to 1 MHz	$3.7 \cdot 10^{-3}$	Connector ²⁾ : N50	
		> 1 MHz to 50 MHz	$3.9 \cdot 10^{-3}$		
		> 50 MHz to 100 MHz	$4.1 \cdot 10^{-3}$		
		> 100 MHz to 2 GHz	$6.6 \cdot 10^{-3}$		
		> 2 GHz to 8 GHz	$7.7 \cdot 10^{-3}$		
		> 8 GHz to 12.4 GHz	$8.8 \cdot 10^{-3}$		
		> 12.4 GHz to 18 GHz	$12 \cdot 10^{-3}$		
		18 GHz to 26.5 GHz	$8.3 \cdot 10^{-3}$		Connector ²⁾ : PC-2.92
		26.5 GHz to 40 GHz	$9.6 \cdot 10^{-3}$		
		40 GHz to 50 GHz	$19 \cdot 10^{-3}$		Connector ²⁾ : PC-2.4
	50 GHz to 67 GHz	$32 \cdot 10^{-3}$	Connector ²⁾ : PC-1.85		
	67 GHz to 75 GHz	$39 \cdot 10^{-3}$	Connector ²⁾ : PC-1.10		
	> 75 GHz to 95 GHz	$41 \cdot 10^{-3}$			
		> 95 GHz to 110 GHz	$43 \cdot 10^{-3}$		
		1 μ W to 80 μ W	> DC to 100 MHz	$6 \cdot 10^{-3}$	Connector ²⁾ : N50
	> 100 MHz to 2 GHz		$8 \cdot 10^{-3}$		
	> 2 GHz to 8 GHz		$12 \cdot 10^{-3}$		
	> 8 GHz to 12.4 GHz		$17 \cdot 10^{-3}$		
	> 12.4 GHz to 18 GHz		$20 \cdot 10^{-3}$		
	> 18 GHz to 26.5 GHz		$22 \cdot 10^{-3}$	Connector ²⁾ : PC-3.5	
	80 μ W to 10 mW	> DC to 100 MHz	$4 \cdot 10^{-3}$	Connector ²⁾ : N50	
		> 100 MHz to 2 GHz	$6.5 \cdot 10^{-3}$		
		> 2 GHz to 8 GHz	$9.2 \cdot 10^{-3}$		
		> 8 GHz to 12.4 GHz	$10 \cdot 10^{-3}$		
		> 12.4 GHz to 18 GHz	$13 \cdot 10^{-3}$		
		> 18 GHz to 26.5 GHz	$22 \cdot 10^{-3}$		Connector ²⁾ : PC-3.5
	> 10 mW to 100 mW	> DC to 70 MHz	$7.1 \cdot 10^{-3}$	Connector ²⁾ : N50	
		> 70 MHz to 2 GHz	$8.3 \cdot 10^{-3}$		
		> 2 GHz to 8 GHz	$9.2 \cdot 10^{-3}$		
		> 8 GHz to 12.4 GHz	$10 \cdot 10^{-3}$		
		> 12.4 GHz to 18 GHz	$13 \cdot 10^{-3}$		

¹⁾ The expanded uncertainties according to EA-4/02 M:2013 are part of CMC and are the best measurement uncertainties within accreditation. They have a coverage probability of approximately 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

Annex to the accreditation certificate D-K-15195-01-01

Permanent Laboratory

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks	
HF power Sources with mismatch correction	1 mW	> DC to 1 MHz	$2.3 \cdot 10^{-3}$	Connector ²⁾ : N50	
		> 1 MHz to 50 MHz	$2.7 \cdot 10^{-3}$		
		> 50 MHz to 100 MHz	$2.9 \cdot 10^{-3}$		
		> 100 MHz to 2 GHz	$5.1 \cdot 10^{-3}$		
		> 2 GHz to 8 GHz	$6.4 \cdot 10^{-3}$		
		> 8 GHz to 12.4 GHz	$7.7 \cdot 10^{-3}$		
		> 12.4 GHz to 18 GHz	$11 \cdot 10^{-3}$		
		18 GHz to 26.5 GHz	$5.3 \cdot 10^{-3}$	Connector ²⁾ : R220	
		26.5 GHz to 40 GHz	$5.6 \cdot 10^{-3}$	Connector ²⁾ : R320	
		33 GHz to 50 GHz	$15 \cdot 10^{-3}$	Connector ²⁾ : R400	
		50 GHz to 67 GHz	$29 \cdot 10^{-3}$	Connector ²⁾ : R620	
		> 67 GHz to 75 GHz	$32 \cdot 10^{-3}$	Connector ²⁾ : R620	
		75 GHz to 95 GHz	$32 \cdot 10^{-3}$	Connector ²⁾ : R900	
		95 GHz to 110 GHz	$33 \cdot 10^{-3}$	Connector ²⁾ : R900	
Sources with mismatch correction > 2 GHz	0.2 fW to 10 pW	> DC to 100 MHz	$24 \cdot 10^{-3}$	Connector ²⁾ : PC-2.92	
		> 100 MHz to 8 GHz	$29 \cdot 10^{-3}$		
	1 fW to 10 pW	> 8 GHz to 20 GHz	$24 \cdot 10^{-3}$		
		> 20 GHz to 40 GHz	$29 \cdot 10^{-3}$		
	10 pW to 0.1 μW	> DC to 100 MHz	$15 \cdot 10^{-3}$		
		> 100 MHz to 8 GHz	$17 \cdot 10^{-3}$		
		> 8 GHz to 20 GHz	$20 \cdot 10^{-3}$		
		> 20 GHz to 40 GHz	$26 \cdot 10^{-3}$		
	0.1 μW to 0.1 mW	> DC to 100 MHz	$10 \cdot 10^{-3}$		
		> 100 MHz to 8 GHz	$13 \cdot 10^{-3}$		
		> 8 GHz to 20 GHz	$16 \cdot 10^{-3}$		
		> 20 GHz to 40 GHz	$23 \cdot 10^{-3}$		
	10 fW to 10 pW	> 40 GHz to 50 GHz	$43 \cdot 10^{-3}$		Connector ²⁾ : PC-1.85
		> 40 GHz to 67 GHz	$49 \cdot 10^{-3}$		
	10 pW to 0.1 mW	> 40 GHz to 50 GHz	$34 \cdot 10^{-3}$		
		> 50 GHz to 67 GHz	$43 \cdot 10^{-3}$		
Sources with mismatch correction	0.1 mW to 100 mW	> DC to 1 MHz	$2.5 \cdot 10^{-3}$	Connector ²⁾ : N50	
		> 1 MHz to 100 MHz	$3 \cdot 10^{-3}$		
		> 100 MHz to 2 GHz	$5 \cdot 10^{-3}$		
		> 2 GHz to 8 GHz	$6.5 \cdot 10^{-3}$		
		> 8 GHz to 12.4 GHz	$8 \cdot 10^{-3}$		
		> 12.4 GHz to 18 GHz	$11 \cdot 10^{-3}$	Connector ²⁾ : PC-2.92	
		> 18 GHz to 26.5 GHz	$11 \cdot 10^{-3}$		
		> 26.5 GHz to 40 GHz	$13 \cdot 10^{-3}$		
		> 40 GHz to 50 GHz	$21 \cdot 10^{-3}$	Connector ²⁾ : PC-2.4	
		> 50 GHz to 67 GHz	$33 \cdot 10^{-3}$	Connector ²⁾ : PC-1.85	
		> 67 GHz to 75 GHz	$40 \cdot 10^{-3}$	Connector ²⁾ : PC-1.00	
		> 75 to 90 GHz	$43 \cdot 10^{-3}$	Connector ²⁾ : PC-1.00	
		> 90 GHz to 110 GHz	$45 \cdot 10^{-3}$	Connector ²⁾ : PC-1.00	

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Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
HF power Sources without mismatch correction	100 mW to 1 W	> DC to 100 MHz	$18 \cdot 10^{-3}$	Connector ²⁾ : N50
		> 100 MHz to 2 GHz	$19 \cdot 10^{-3}$	
		> 2 GHz to 8 GHz	$30 \cdot 10^{-3}$	
		> 8 GHz to 12.4 GHz	$40 \cdot 10^{-3}$	
		> 12.4 GHz to 18 GHz	$55 \cdot 10^{-3}$	
	1 W to 10 W	> DC to 100 MHz	$27 \cdot 10^{-3}$	Connector ²⁾ : N50
		> 100 MHz to 2 GHz	$28 \cdot 10^{-3}$	
		> 2 GHz to 8 GHz	$36 \cdot 10^{-3}$	
		> 8 GHz to 12.4 GHz	$45 \cdot 10^{-3}$	
		> 12.4 GHz to 18 GHz	$59 \cdot 10^{-3}$	
	10 W to 30 W	> DC to 100 MHz	$58 \cdot 10^{-3}$	Connector ²⁾ : N50
		> 100 MHz to 2 GHz	$58 \cdot 10^{-3}$	
		> 2 GHz to 8 GHz	$63 \cdot 10^{-3}$	
		> 8 GHz to 12.4 GHz	$68 \cdot 10^{-3}$	
		> 12.4 GHz to 18 GHz	$78 \cdot 10^{-3}$	
HF linearity HF power ratio	1 μ W to 100 μ W	100 kHz to 50 MHz	0.022 dB	Connector ²⁾ : N50
	100 μ W to 1 mW	DC to 50 GHz	0.006 dB	Connector ²⁾ : PC-2.4
		50 GHz to 67 GHz	0.008 dB	Connector ²⁾ : PC-1.85
	> 1 mW to 100 mW	DC to 50 GHz	0.006 dB	Connector ²⁾ : PC-2.4
		50 GHz to 67 GHz	0.007 dB	Connector ²⁾ : PC-1.85
	1 mW to 2 W	100 kHz to 50 MHz	0.016 dB	Connector ²⁾ : N50
	HF voltage ratio (effective voltage)	7 mV to 70 mV	100 kHz to 50 MHz	0.020 dB
> 70 mV to 220 mV		100 kHz to 50 MHz	0.016 dB	
> 220 mV to 11 V		100 kHz to 50 MHz	0.013 dB	

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
HF-Impedance (Reflection factor)	0.0 to 0.4	> DC to 10 GHz	0.0034	Connector ²⁾ : PC-7 $ I $: amplitude of reflection coefficient
	> 0.4 to 1.0		$0.0015 + 0.005 \cdot I $	
	0.0 to 0.4	> 10 GHz to 18 GHz	0.0034	Connector ²⁾ : PC-3.5
	> 0.4 to 1.0		$0.01 \cdot I $	
	0.0 to 0.4	> 18 GHz to 26.5 GHz	0.0065	Connector ²⁾ : PC-2.92
	> 0.4 to 1.0		$0.001 + 0.013 \cdot I $	
	0.0 to 0.4	> 26.5 GHz to 40 GHz	0.011	Connector ²⁾ : PC-2.4
	> 0.4 to 1.0		$0.005 + 0.016 \cdot I $	
	0.0 to 1.0	> DC to 2 GHz	$0.0035 + 0.0042 \cdot I $	Connector ²⁾ : PC-1.85
		> 2 GHz to 10 GHz	$0.0037 + 0.0065 \cdot I $	
		> 10 GHz to 20 GHz	$0.0049 + 0.0090 \cdot I $	
		> 20 GHz to 30 GHz	$0.0062 + 0.0114 \cdot I $	
		> 30 GHz to 40 GHz	$0.0075 + 0.0149 \cdot I $	
	0.0 to 1.0	> 40 GHz to 50 GHz	$0.0099 + 0.0162 \cdot I $	Connector ²⁾ : PC-1.00
		> DC to 2 GHz	$0.0035 + 0.0049 \cdot I $	
		> 2 GHz to 10 GHz	$0.0037 + 0.0050 \cdot I $	
		> 10 GHz to 20 GHz	$0.0042 + 0.0069 \cdot I $	
		> 20 GHz to 30 GHz	$0.0055 + 0.0101 \cdot I $	
	0.0 to 1.0	> 30 GHz to 40 GHz	$0.0067 + 0.0120 \cdot I $	Connector ²⁾ : R620
		> 40 GHz to 50 GHz	$0.0085 + 0.0151 \cdot I $	
> 50 GHz to 67 GHz		$0.0113 + 0.0183 \cdot I $		
> 67 GHz to 90 GHz		$0.0074 + 0.0173 \cdot I $		
> 90 GHz to 110 GHz		$0.0093 + 0.0213 \cdot I $		
0.0 to 0.2	50 GHz to 75 GHz	0.01	Connector ²⁾ : R740	
		$0.01 + 0.008 \cdot I $		
0.0 to 0.2	60 GHz to 90 GHz	0.01	Connector ²⁾ : R900	
> 0.2 to 1.0		$0.01 + 0.008 \cdot I $		
0.0 to 0.2	75 GHz to 110 GHz	0.01	Connector ²⁾ : R900	
> 0.2 to 1.0		$0.01 + 0.008 \cdot I $		
Phase angle φ	- 180° to +180°	> DC to 110 GHz	$U(\varphi) = \arcsin(U(I)/I) \cdot 180^\circ/\pi$	$U(I)$: Uncertainty of reflection coefficient

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HF-Impedance (Reflection factor) Three-port device e.g. power splitter	0.0 to 0.3	> DC to 10 GHz	0.005	Connector ²⁾ : PC-7
		> 10 GHz to 18 GHz	0.009	
		> 18 GHz to 26.5 GHz	0.011	Connector ²⁾ : PC-3.5
		> 26.5 GHz to 40 GHz	0.015	Connector ²⁾ : PC-2.92
		> 40 GHz to 50 GHz	0.019	Connector ²⁾ : PC-2.4
	0.0 to 0.35	> 50 GHz to 67 GHz	0.022	Connector ²⁾ : PC-1.85
HF-Attenuation	0 dB to 3 dB	> DC to 2 GHz	0.017 dB	Connector ²⁾ : N50
		> 2 GHz to 10 GHz	0.020 dB	
		> 10 GHz to 18 GHz	0.025 dB	
		> 22 GHz to 26.5 GHz	0.03 dB	Connector ²⁾ : PC-3.5
		> 26.5 GHz to 40 GHz	0.04 dB	Connector ²⁾ : PC-2.92
		> 40 GHz to 50 GHz	0.05 dB	Connector ²⁾ : PC-2.4
		> 50 GHz to 67 GHz	0.06 dB	Connector ²⁾ : PC-1.85
		> 67 GHz to 75 GHz	0.08 dB	Connector ²⁾ : PC-1.00
	> 3 dB to 30 dB	> DC to 10 GHz	0.02 dB	Connector ²⁾ : PC-7
		> 10 GHz to 18 GHz	0.03 dB	
		> 18 GHz to 26.5 GHz	0.05 dB	Connector ²⁾ : PC-3.5
		> 26.5 GHz to 40 GHz	0.08 dB	Connector ²⁾ : PC-2.4
		> 40 GHz to 50 GHz	0.12 dB	
		> 50 GHz to 67 GHz	0.19 dB	Connector ²⁾ : PC-1.85
	> 30 dB to 60 dB	> DC to 10 GHz	0.04 dB	Connector ²⁾ : PC-7
		> 10 GHz to 18 GHz	0.05 dB	
		> 18 GHz to 26.5 GHz	0.07 dB	Connector ²⁾ : PC-3.5
		> 26.5 GHz to 40 GHz	0.11 dB	
		> 40 GHz to 50 GHz	0.19 dB	Connector ²⁾ : PC-2.4
		> 50 GHz to 67 GHz	0.32 dB	Connector ²⁾ : PC-1.85
HF-Transmission degree Phase angle φ	-180° to 180°	> DC to 10 GHz	$U_S \cdot 180^\circ / \pi + K \cdot f$	$U_S = \arcsin(10^{U/20} - 1)$ K: 0.01°/GHz U: uncertainty of attenuation A in dB
		> 10 GHz to 18 GHz		
		> 18 GHz to 26.5 GHz		
		> 26.5 GHz to 40 GHz		
		> 40 GHz to 50 GHz		
		> 50 GHz to 67 GHz		

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Phase noise Oscillators, measuring instruments	> -77 dBc/Hz ^{a)}	1 Hz ^{b)}	1.5 dB	Carrier frequency : 100 MHz to 500 MHz ^{a)} Phase noise related to carrier level in dBc/Hz
	-85 dBc/Hz to -77 dBc/Hz	1 Hz	2.5 dB	
	> -92 dBc/Hz	3 Hz to 10 Hz	1.5 dB	
	-100 dBc/Hz to -92 dBc/Hz	3 Hz to 10 Hz	2.5 dB	
	> -106 dBc/Hz	10 Hz to 100 Hz	1.5 dB	
	-114 dBc/Hz to -106 dBc/Hz	10 Hz to 100 Hz	2.5 dB	
	> -136 dBc/Hz	100 Hz to 1 kHz	1.5 dB	
	-146 dBc/Hz to -136 dBc/Hz	100 Hz to 1 kHz	2.5 dB	
	> -160 dBc/Hz	1 kHz to 10 kHz	1.5 dB	
	-168 dBc/Hz to -160 dBc/Hz	1 kHz to 10 kHz	2.5 dB	
	> -167 dBc/Hz	10 kHz to 100 kHz	1.5 dB	
	-175 dBc/Hz to -167 dBc/Hz	10 kHz to 100 kHz	2.5 dB	
	> -174 dBc/Hz	100 kHz to 1 MHz	1.5 dB	
	-182 dBc/Hz to -174 dBc/Hz	100 kHz to 1 MHz	2.5 dB	
	> -186 dBc/Hz	1 MHz to 10 MHz	1.5 dB	
	-192 dBc/Hz to -186 dBc/Hz	1 MHz to 10 MHz	2.5 dB	^{b)} Offset frequency related to carrier frequency
	-64 dBc/Hz	1 Hz	1.5 dB	
	-73 dBc/Hz to -64 dBc/Hz	1 Hz	2.5 dB	
	-82 dBc/Hz	3 Hz to 10 Hz	1.5 dB	
	-90 dBc/Hz to -82 dBc/Hz	3 Hz to 10 Hz	2.5 dB	
	-95 dBc/Hz	10 Hz to 100 Hz	1.5 dB	
	-103 dBc/Hz to -95 dBc/Hz	10 Hz to 100 Hz	2.5 dB	
	-123 dBc/Hz	100 Hz to 1 kHz	1.5 dB	
	-131 dBc/Hz to -123 dBc/Hz	100 Hz to 1 kHz	2.5 dB	
	-153 dBc/Hz	1 kHz to 10 kHz	1.5 dB	
	-161 dBc/Hz to -153 dBc/Hz	1 kHz to 10 kHz	2.5 dB	
	-170 dBc/Hz	10 kHz to 100 kHz	1.5 dB	
	-178 dBc/Hz to -170 dBc/Hz	10 kHz to 100 kHz	2.5 dB	
	-172 dBc/Hz	100 kHz to 1 MHz	1.5 dB	
	-180 dBc/Hz to -172 dBc/Hz	100 kHz to 1 MHz	2.5 dB	
	-172 dBc/Hz	1 MHz to 10 MHz	1.5 dB	
	-180 dBc/Hz to -172 dBc/Hz	1 MHz to 10 MHz	2.5 dB	
	-55 dBc/Hz	1 Hz	1.5 dB	
-67 dBc/Hz to -55 dBc/Hz	1 Hz	2.5 dB		
-67 dBc/Hz	3 Hz to 10 Hz	1.5 dB		
-79 dBc/Hz to -67 dBc/Hz	3 Hz to 10 Hz	2.5 dB		
-85 dBc/Hz	10 Hz to 100 Hz	1.5 dB		
-93 dBc/Hz to -85 dBc/Hz	10 Hz to 100 Hz	2.5 dB		
-114 dBc/Hz	100 Hz to 1 kHz	1.5 dB		
-122 dBc/Hz to -114 dBc/Hz	100 Hz to 1 kHz	2.5 dB		
-146 dBc/Hz	1 kHz to 10 kHz	1.5 dB		
-155 dBc/Hz to -146 dBc/Hz	1 kHz to 10 kHz	2.5 dB		
-166 dBc/Hz	10 kHz to 100 kHz	1.5 dB		
-174 dBc/Hz to -166 dBc/Hz	10 kHz to 100 kHz	2.5 dB		
-168 dBc/Hz	100 kHz to 1 MHz	1.5 dB		
			Carrier frequency : 1 GHz to 3 GHz	

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Phase noise Oscillators, measuring instruments	-176 dBc/Hz to -168 dBc/Hz	100 kHz to 1 MHz	2.5 dB	Carrier frequency: 1 GHz to 3 GHz
	-168 dBc/Hz	1 MHz to 10 MHz	1.5 dB	
	-76 dBc/Hz to -168 dBc/Hz	1 MHz to 10 MHz	2.5 dB	
	-49 dBc/Hz	1 Hz	1.5 dB	Carrier frequency : 3 GHz to 6 GHz
	-57 dBc/Hz to -49 dBc/Hz	1 Hz	2.5 dB	
	-62 dBc/Hz	3 Hz to 10 Hz	1.5 dB	
	-70 dBc/Hz to -62 dBc/Hz	3 Hz to 10 Hz	2.5 dB	
	-76 dBc/Hz	10 Hz to 100 Hz	1.5 dB	
	-84 dBc/Hz to -76 dBc/Hz	10 Hz to 100 Hz	2.5 dB	
	-105 dBc/Hz	100 Hz to 1 kHz	1.5 dB	
	-113 dBc/Hz to -105 dBc/Hz	100 Hz to 1 kHz	2.5 dB	
	-138 dBc/Hz	1 kHz to 10 kHz	1.5 dB	
	-146 dBc/Hz to -138 dBc/Hz	1 kHz to 10 kHz	2.5 dB	
	-156 dBc/Hz	10 kHz to 100 kHz	1.5 dB	
	-164 dBc/Hz to -156 dBc/Hz	10 kHz to 100 kHz	2.5 dB	
	-158 dBc/Hz	100 kHz to 1 MHz	1.5 dB	
	-166 dBc/Hz to -158 dBc/Hz	100 kHz to 1 MHz	2.5 dB	
	-158 dBc/Hz	1 MHz to 10 MHz	1.5 dB	
	-166 dBc/Hz to -158 dBc/Hz	1 MHz to 10 MHz	2.5 dB	
	-54 dBc/Hz	1 Hz	1.5 dB	
	-62 dBc/Hz to -54 dBc/Hz	1 Hz	2.5 dB	
	-68 dBc/Hz	3 Hz to 10 Hz	1.5 dB	
	-76 dBc/Hz to -68 dBc/Hz	3 Hz to 10 Hz	2.5 dB	
	-95 dBc/Hz	10 Hz to 100 Hz	1.5 dB	
	-103 dBc/Hz to -95 dBc/Hz	10 Hz to 100 Hz	2.5 dB	
	-122 dBc/Hz	100 Hz to 1 kHz	1.5 dB	
	-130 dBc/Hz to -122 dBc/Hz	100 Hz to 1 kHz	2.5 dB	
	-138 dBc/Hz	1 kHz to 10 kHz	1.5 dB	
	-146 dBc/Hz to -138 dBc/Hz	1 kHz to 10 kHz	2.5 dB	
	-142 dBc/Hz	10 kHz to 100 kHz	1.5 dB	
-146 dBc/Hz to -142 dBc/Hz	10 kHz to 100 kHz	2.5 dB		
-142 dBc/Hz	100 kHz to 1 MHz	1.5 dB		
-150 dBc/Hz to -142 dBc/Hz	100 kHz to 1 MHz	2.5 dB		
-142 dBc/Hz	1 MHz to 10 MHz	1.5 dB		
-150 dBc/Hz to -142 dBc/Hz	1 MHz to 10 MHz	2.5 dB		

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Direct voltage	1.018 V		$2 \cdot 10^{-6} \cdot U$	U: Measured value	
	10 V		$2 \cdot 10^{-6} \cdot U$		
Measuring instruments	0 V to 220 mV		$10 \cdot 10^{-6} \cdot U + 1 \mu\text{V}$		
	> 220 mV to 1000 V		$10 \cdot 10^{-6} \cdot U$		
Sources	0 V to 100 mV		$10 \cdot 10^{-6} \cdot U + 2 \mu\text{V}$		
	> 100 mV to 100 V		$10 \cdot 10^{-6} \cdot U$		
	> 100 V to 1000 V		$20 \cdot 10^{-6} \cdot U$		
Alternating voltage Measuring instruments	1 mV to 220 V	10 Hz to < 20 Hz	$0.4 \cdot 10^{-3} \cdot U + 8 \mu\text{V}$		
		20 Hz to 20 kHz	$0.21 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$		
		> 20 kHz to 50 kHz	$0.2 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$		
		> 50 kHz to 100 kHz	$0.5 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$		
	1 mV to 22 V	> 100 kHz to 300 kHz	$1 \cdot 10^{-3} \cdot U + 18 \mu\text{V}$		
		> 300 kHz to 500 kHz	$1.8 \cdot 10^{-3} \cdot U + 20 \mu\text{V}$		
		> 500 kHz to 1 MHz	$4 \cdot 10^{-3} \cdot U + 20 \mu\text{V}$		
	> 22 V to U_{max}	> 100 kHz to 300 kHz	$1 \cdot 10^{-3} \cdot U + 16 \text{ mV}$		$U_{\text{max}} = \frac{22 \cdot 10^6 \text{ V} \cdot \text{Hz}}{f}$
		> 300 kHz to 500 kHz	$5 \cdot 10^{-3} \cdot U + 30 \text{ mV}$		
		> 500 kHz to 1 MHz	$8 \cdot 10^{-3} \cdot U + 80 \text{ mV}$		
> 220 V to 250 V	15 Hz to 50 Hz	$0.4 \cdot 10^{-3} \cdot U + 2.5 \text{ mV}$			
	> 220 V to 1000 V	50 Hz to 1 kHz	$0.11 \cdot 10^{-3} \cdot U + 2.5 \text{ mV}$		
1 mV to 3.5 V	10 Hz to 30 Hz	$3.3 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$	U at 50 Ω		
	> 30 Hz to 120 Hz	$1.6 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$			
	> 120 Hz to 120 kHz	$1.3 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$			
	> 120 kHz to 2 MHz	$1.5 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$			
	> 2 MHz to 10 MHz	$3.5 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$			
	> 10 MHz to 20 MHz	$11 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$			
	> 20 MHz to 30 MHz	$25 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$			
Sources	1 mV to 10 mV	10 Hz to 20 kHz	$0.5 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$		
		> 20 kHz to 50 kHz	$0.8 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$		
		> 50 kHz to 100 kHz	$5 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$		
		> 100 kHz to 1 MHz	$12 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$		
	> 10 mV to 100 V	10 Hz to 20 kHz	$0.5 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$		
		> 20 kHz to 50 kHz	$0.5 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$		
		> 50 kHz to 100 kHz	$1.4 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$		
	> 10 mV to 10 V	> 100 kHz to 300 kHz	$4 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$		
		> 300 kHz to 1 MHz	$11 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$		
	> 100 V to 700 V	10 Hz to 20 kHz	$0.8 \cdot 10^{-3} \cdot U + 2 \text{ mV}$		
		> 20 kHz to 50 kHz	$1.4 \cdot 10^{-3} \cdot U + 2 \text{ mV}$		
		> 50 kHz to 100 kHz	$3.2 \cdot 10^{-3} \cdot U + 2 \text{ mV}$		

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Annex to the accreditation certificate D-K-15195-01-01

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
Direct current Measuring instruments	0 µA to 10 µA		1 nA	/: Measured value
	> 10 µA to 0.22 A		$0.10 \cdot 10^{-3} \cdot I$	
	> 0.22 A to 2.2 A		$0.14 \cdot 10^{-3} \cdot I$	
Sources	0 A to 10 µA		1 nA	
	> 10 µA to 100 mA		$0.1 \cdot 10^{-3} \cdot I$	
	> 100 mA to 60 A		$0.2 \cdot 10^{-3} \cdot I$	
Alternating current Measuring instruments	100 µA to 220 µA	10 Hz to 20 Hz	$0.3 \cdot 10^{-3} \cdot I + 16 \text{ nA}$	
	> 220 µA to 2.2 mA		$0.3 \cdot 10^{-3} \cdot I + 40 \text{ nA}$	
	> 2.2 mA to 22 mA		$0.3 \cdot 10^{-3} \cdot I + 400 \text{ nA}$	
	> 22 mA to 220 mA		$0.3 \cdot 10^{-3} \cdot I + 4 \text{ µA}$	
	100 µA to 220 µA	> 20 Hz to 1 kHz	$0.2 \cdot 10^{-3} \cdot I + 10 \text{ nA}$	
	> 220 µA to 2.2 mA		$0.2 \cdot 10^{-3} \cdot I + 35 \text{ nA}$	
	> 2.2 mA to 22 mA		$0.2 \cdot 10^{-3} \cdot I + 350 \text{ nA}$	
	> 22 mA to 220 mA		$0.2 \cdot 10^{-3} \cdot I + 3.5 \text{ µA}$	
	> 220 mA to 2.2 A		$0.2 \cdot 10^{-3} \cdot I + 35 \text{ µA}$	
	100 µA to 220 µA	> 1 kHz to 5 kHz	$0.3 \cdot 10^{-3} \cdot I + 12 \text{ nA}$	
	> 220 µA to 2.2 mA		$0.22 \cdot 10^{-3} \cdot I + 110 \text{ nA}$	
	> 2.2 mA to 22 mA		$0.22 \cdot 10^{-3} \cdot I + 550 \text{ nA}$	
> 22 mA to 220 mA		$0.22 \cdot 10^{-3} \cdot I + 3.5 \text{ µA}$		
> 220 mA to 2.2 A		$0.47 \cdot 10^{-3} \cdot I + 80 \text{ µA}$		
Sources	100 µA to 1.2 mA	10 Hz to 20 Hz	$6 \cdot 10^{-3} \cdot I + 0.1 \text{ µA}$	
		> 20 Hz to 45 Hz	$3.5 \cdot 10^{-3} \cdot I + 0.1 \text{ µA}$	
		> 45 Hz to 10 kHz	$2.6 \cdot 10^{-3} \cdot I + 0.1 \text{ µA}$	
	> 1.2 mA to 120 mA	10 Hz to 20 Hz	$6 \cdot 10^{-3} \cdot I + 1 \text{ µA}$	
		> 20 Hz to 45 Hz	$3.2 \cdot 10^{-3} \cdot I + 1 \text{ µA}$	
		> 45 Hz to 10 kHz	$2.3 \cdot 10^{-3} \cdot I + 1 \text{ µA}$	
	> 120 mA to 1 A	10 Hz to 20 Hz	$6 \cdot 10^{-3} \cdot I + 1 \text{ µA}$	
		> 20 Hz to 45 Hz	$3.3 \cdot 10^{-3} \cdot I + 1 \text{ µA}$	
		> 45 Hz to 5 kHz	$2.7 \cdot 10^{-3} \cdot I + 1 \text{ µA}$	
		> 5 kHz to 10 kHz	$4.7 \cdot 10^{-3} \cdot I + 1 \text{ µA}$	

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Annex to the accreditation certificate D-K-15195-01-01

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
DC Resistance Resistances, measuring instruments	0 Ω to 10 Ω		$15 \cdot 10^{-6} \cdot R + 60 \mu\Omega$	R: Measured value in Ω
	> 10 Ω to 100 Ω		$12 \cdot 10^{-6} \cdot R + 0.5 \text{ m}\Omega$	
	> 100 Ω to 100 kΩ		$15 \cdot 10^{-6} \cdot R$	
	> 100 kΩ to 1 MΩ		$15 \cdot 10^{-6} \cdot R + 2 \Omega$	
	> 1 MΩ to 10 MΩ		$50 \cdot 10^{-6} \cdot R + 0.1 \text{ k}\Omega$	
	> 10 MΩ to 100 MΩ		$0.6 \cdot 10^{-3} \cdot R$	
	> 100 MΩ to 1 GΩ		$5.1 \cdot 10^{-3} \cdot R$	
Linearity of indication Level ratio, HF attenuation	0 dB to 21 dB	> DC to 40 GHz	0.003 dB	Attenuation A in dB
	11 dB to 111 dB	> DC to 40 GHz	$0.003 \text{ dB} + 0.0002 \cdot A$	
	111 dB to 121 dB	> DC to 40 GHz	0.03 dB	
	0 dB to 11 dB	40 GHz to 67 GHz	0.005 dB	
	11 dB to 111 dB	40 GHz to 67 GHz	$0.005 \text{ dB} + 0.0004 \cdot A$	
	0 dB to 21 dB	75 GHz	0.005 dB	
	0 dB to 21 dB	67 GHz to 110 GHz	0.007 dB	
Frequency	10 MHz to 100 MHz		$(2 \cdot 10^{-12} + U_{Tr}) \cdot f$	f: Measured value in Hz
	0.10 Hz to 67 GHz		$(0.1 \cdot 10^{-9} + U_{Tr}) \cdot f$	U _{Tr} : Trigger uncertainty
Time interval	10 ns to 100 s		$2 \text{ ns} + (1 \cdot 10^{-9} + U_{Tr}) \cdot t$	t: Measured value in s
Rise time	7 ps to 15 ps	Voltage range changes with rise time	4 ps	t: Measured value in s
	> 15 ps to 25 ps		3 ps	
	> 25 ps to 100 ns		$40 \cdot 10^{-3} \cdot t + 2 \text{ ps}$	
HF voltage	30 dB (μV) to 80 dB (μV)	9 kHz to 100 kHz	0.21 dB (Bandwidth: 200 Hz)	CISPR 16-1-1:2019 Voltage at 50 Ω
		> 100 kHz to 150 kHz	0.23 dB (Bandwidth: 200 Hz)	
		> 150 kHz to 30 MHz	0.23 dB (Bandwidth: 9 kHz)	
		> 30 MHz to 1 GHz	0.26 dB (Bandwidth: 1 MHz)	

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Annex to the accreditation certificate D-K-15195-01-01

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
Amplitude modulation Modulation degree	0.0 to 1.0	$f_{MOD} \leq 100$ kHz	$0.002 \cdot m$	$f_{HF} > 5 \cdot f_{MOD}$ m : Measured value f_{MOD} : Modulationfrequ.
		100 kHz $< f_{MOD} \leq 500$ kHz	$0.005 \cdot m$	
		500 kHz $< f_{MOD} \leq 3$ MHz	$0.02 \cdot m$	
		3 MHz $< f_{MOD} \leq 6$ MHz	$0.04 \cdot m$	
Frequency modulation Frequency depth	0 Hz to 16 MHz	0 Hz $< f_{MOD} \leq 100$ kHz	$1 \cdot 10^{-3}$	f_{MOD} : Modulationfrequ.
		100 kHz $< f_{MOD} \leq 200$ kHz	$2 \cdot 10^{-3}$	
		200 kHz $< f_{MOD} \leq 10$ MHz	$5 \cdot 10^{-3}$	
Phase modulation Phase depth	0 rad to $(16$ MHz/ $f_{MOD}) \cdot$ rad	10 Hz $< f_{MOD} \leq 100$ kHz	$1 \cdot 10^{-3}$	
		100 kHz $< f_{MOD} \leq 200$ kHz	$2 \cdot 10^{-3}$	
		200 kHz $< f_{MOD} \leq 10$ MHz	$5 \cdot 10^{-3}$	
Free space antenna factor	Predetermined by antenna	20 MHz to 1000 MHz including ground reflections 3-Antenna-Method	0.45 dB	Free field measuring site
		20 MHz to < 10 GHz not including ground reflections 3-Antenna-Method	0.35 dB	
		10 GHz to 18 GHz not including ground reflections 3-Antenna-Method	0.40 dB	
		20 MHz to < 2 GHz 1 m distance, according SAE ARP958	0.40 dB	Free field measuring site
		2 GHz to 18 GHz 1 m distance according SAE ARP958	0.55 dB	
		200 MHz to 18 GHz 3-Antenna-Method	0.60 dB	

Abbreviations used:

CISPR Comité international spécial des perturbations radioélectriques
 CMC Calibration and measurement capabilities

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