

Deutsche Akkreditierungsstelle GmbH

Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV

Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition

Accreditation



The Deutsche Akkreditierungsstelle GmbH attests that the

Rohde & Schwarz Meßgerätebau GmbH

with its calibration laboratory

Rohde-und-Schwarz-Straße 1, 87700 Memmingen

is competent under the terms of DIN EN ISO/IEC 17025:2018 to carry out calibrations in the following 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

The accreditation certificate shall only apply in connection with the notice of accreditation of 29.07.2019 with the accreditation number D-K-15195-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 12 pages.

Registration number of the certificate: **D-K-15195-01-01**

Braunschweig, 29.07.2019


Dr. Heike Manke
Head of Division

The certificate together with its annex reflects the status at the time of the date of issue. The current status of the scope of accreditation can be found in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH.

<https://www.dakks.de/en/content/accredited-bodies-dakks>

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The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkKS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.

No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkKS.

The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkKS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.

The up-to-date state of membership can be retrieved from the following websites:

EA: www.european-accreditation.org

ILAC: www.ilac.org

IAF: www.iaf.nu

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	$12 \cdot 10^{-3}$	Connector ²⁾ : PC-2.92
		18 GHz to 26.5 GHz	$8.3 \cdot 10^{-3}$	
		26.5 GHz to 40 GHz	$9.6 \cdot 10^{-3}$	Connector ²⁾ : PC-2.4
		40 GHz to 50 GHz	$19 \cdot 10^{-3}$	
		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	$17 \cdot 10^{-3}$	Connector ²⁾ : PC-3.5
		> 12.4 GHz to 18 GHz	$20 \cdot 10^{-3}$	
		> 18 GHz to 26.5 GHz	$22 \cdot 10^{-3}$	
	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	$10 \cdot 10^{-3}$	Connector ²⁾ : PC-3.5
		> 12.4 GHz to 18 GHz	$13 \cdot 10^{-3}$	
		> 18 GHz to 26.5 GHz	$22 \cdot 10^{-3}$	
	> 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

Calibration and Measurement Capabilities (CMC)

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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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
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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Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

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	> 110 GHz to 114 GHz	$0.0122 + 0.0280 \cdot I $	Connector ²⁾ : R740	
		0.01		
> 0.2 to 1.0	60 GHz to 90 GHz	$0.01 + 0.008 \cdot I $	Connector ²⁾ : R900	
0.0 to 0.2	75 GHz to 110 GHz	0.01		
> 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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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
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	
	> 30 dB to 60 dB	> 50 GHz to 67 GHz	0.19 dB	Connector ²⁾ : PC-1.85
		> 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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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	
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	^{b)} Offset frequency related to carrier frequency	
	-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		
	-64 dBc/Hz	1 Hz	1.5 dB		Carrier frequency : 500 MHz to 1 GHz
	-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	Carrier frequency : 1 GHz to 3 GHz	
	-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			

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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
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	Carrier frequency : 6 GHz to 8 GHz
	-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		

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.

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks	
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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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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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		$0.6 \cdot 10^{-3} \cdot R$	
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	
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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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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