

Accreditation



The Deutsche Akkreditierungsstelle attests with this **Accreditation Certificate** that the calibration laboratory

Rohde & Schwarz Meßgerätebau GmbH

with its calibration laboratories

Rohde-und-Schwarz-Straße 1, 87700 Memmingen

Graf Zeppelin-Straße 18, 51147 Köln

Spidrova 49, 38501 Vimperk, Tschechien

meets the requirements according to DIN EN ISO/IEC 17025:2018 for the conformity assessment activities listed in the annex to this certificate. This includes additional existing legal and normative requirements for the calibration laboratory, including those in relevant sectoral schemes, provided they are explicitly confirmed in the annex to this certificate.

The management system requirements of DIN EN ISO/IEC 17025 are written in the language relevant to the operations of calibration laboratories and confirm generally with the principles of DIN EN ISO 9001.

This accreditation was issued in accordance with Art. 5 Para. 1 Sentence 2 of Regulation (EC) 765/2008, after an accreditation procedure was carried out in compliance with the minimum requirements of DIN EN ISO/IEC 17011 and on the basis of a review and decision of the appointed accreditation committees.

This accreditation certificate only applies in connection with the notices of 01.03.2023 with accreditation number D-K-15195-01.

It consists of this cover sheet, the reverse side of the cover sheet and the following annex with a total of 30 pages.

Registration number of the accreditation certificate: **D-K-15195-01-00**

Berlin, 01.03.2023

Dr. Florian Witt
Head of Technical Unit

Translation issued:
01.03.2022



Dr. Florian Witt
Head of Technical Unit

The certificate together with the annex reflects the status as indicated by the date of issue. The current status of any given scope of accreditation can be found in the directory of accredited bodies maintained by Deutsche Akkreditierungsstelle GmbH (www.dakks.de).

This document is a translation. The definitive version is the original German accreditation certificate.

See notes overleaf

Deutsche Akkreditierungsstelle GmbH

Office Berlin
Spittelmarkt 10
10117 Berlin

Office Frankfurt am Main
Europa-Allee 52
60327 Frankfurt am Main

Office Braunschweig
Bundesallee 100
38116 Braunschweig

The Deutsche Akkreditierungsstelle GmbH (DAkKS) is the entrusted national accreditation body of the Federal Republic of Germany according to § 8 section 1 AkkStelleG in conjunction with § 1 section 1 AkkStelleGBV. DAkKS is designated as the national accreditation authority by Germany according to Art. 4 Para. 4 of Regulation (EC) 765/2008 and clause 4.7 of DIN EN ISO/IEC 17000.

Pursuant to Art. 11 section 2 of Regulation (EC) 765/2008, the accreditation certificate shall be recognised as equivalent by the national authorities within the scope of this Regulation as well as by the WTO member states that have committed themselves in bilateral or multilateral mutual agreements to recognise the certificates of accreditation bodies that are members of ILAC or IAF as equivalent.

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 Co-operation (ILAC).

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

Annex to the Accreditation Certificate D-K-15195-01-00 according to DIN EN ISO/IEC 17025:2018

Valid from: 01.03.2023

Date of issue: 01.03.2023

Holder of accreditation certificate:

Rohde & Schwarz Meßgerätebau GmbH
Rohde-und-Schwarz-Straße 1, 87700 Memmingen

The calibration laboratory meets the minimal requirements of DIN EN ISO/IEC 17025:2018 and, if applicable, additional legal and normative requirements, including those in relevant sectoral schemes, in order to carry out the conformity assessment activities listed below.

The management system requirements of DIN EN ISO/IEC 17025 are written in the language relevant to the operations of calibration laboratories and confirm generally with the principles of DIN EN ISO 9001.

with its calibration laboratories:

Rohde-und-Schwarz-Straße 1, 87700 Memmingen
Graf Zeppelin-Straße 18, 51147 Köln
Spidrova 49, 38501 Vimperk, Tschechien

This certificate annex is only valid together with the written accreditation certificate and reflects the status as indicated by the date of issue. The current status of any given scope of accreditation can be found in the directory of accredited bodies maintained by Deutsche Akkreditierungsstelle GmbH at <https://www.dakks.de>.

Annex to the Accreditation Certificate D-K-15195-01-00

Calibration in the fields:

Electrical quantities

DC and low frequency quantities

- DC voltage^{a)}
- AC voltage^{a)}
- DC current^{a)}
- AC current^{a)}
- DC resistance^{a)}
- AC/DC Transfer
- Capacitance^{a)}

Time and frequency

- Time interval^{a)}
- Frequency^{a)}

High frequency quantities

- HF voltage^{a)}
- HF power^{a)}
- HF attenuation^{a)}
- HF impedance^{a)}
- HF noise
- Waveform quantities^{a)}
- Modulation quantities^{a)}
- Antenna quantities^{a)}
- Rise Time^{a)}
- Modulation quantities^{a)}

a) also mobile facilities at location Köln

Annex to the Accreditation Certificate D-K-15195-01-00

Location Memmingen, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
DC voltage Sources, Measuring instruments	1.018 V		$2 \cdot 10^{-6} \cdot U$	U: Measured value
	10 V		$1 \cdot 10^{-6} \cdot U$	
DC current Measuring instruments	0 V to 500 V		$10 \cdot 10^{-6} \cdot U + 1 \mu V$	I: Measured value
	> 500 V to 1 kV		$10 \cdot 10^{-6} \cdot U$	
Sources	0 μA to 10 μA		1 nA	I: Measured value
	> 10 μA to 220 mA		$0.1 \cdot 10^{-3} \cdot I$	
Sources	> 220 mA to 2.2 A		$0.14 \cdot 10^{-3} \cdot I$	I: Measured value
	0 μA to 10 μA		1 nA	
Sources	> 10 μA to 100 mA		$0.1 \cdot 10^{-3} \cdot I$	I: Measured value
	> 100 mA to 60 A		$0.2 \cdot 10^{-3} \cdot I$	
DC resistance Resistance, measuring instruments	0 Ω to 100 k Ω		$15 \cdot 10^{-6} \cdot R + 60 \mu \Omega$	R: Measured value
	> 100 k Ω to 1 M Ω		$20 \cdot 10^{-6} \cdot R + 2 \Omega$	
	> 1 M Ω to 10 M Ω		$60 \cdot 10^{-6} \cdot R + 0.1 k\Omega$	
	> 10 M Ω to 100 M Ω		$0.6 \cdot 10^{-3} \cdot R$	
	> 100 M Ω to 1 G Ω		$5.1 \cdot 10^{-3} \cdot R$	
AC voltage Measuring instruments	1 mV to 220 V	10 Hz to < 20 Hz	$0.40 \cdot 10^{-3} \cdot U + 8 \mu V$	U: Measured value
		20 Hz to 20 kHz	$0.21 \cdot 10^{-3} \cdot U + 2 \mu V$	
		> 20 kHz to 50 kHz	$0.20 \cdot 10^{-3} \cdot U + 2 \mu V$	
		> 50 kHz to 100 kHz	$0.50 \cdot 10^{-3} \cdot U + 2 \mu V$	
	1 mV to 22 V	> 100 kHz to 300 kHz	$1.0 \cdot 10^{-3} \cdot U + 18 \mu V$	Umax = $22 \cdot 10^6 \cdot V$ Hz/ f[Hz]
		> 300 kHz to 500 kHz	$1.8 \cdot 10^{-3} \cdot U + 20 \mu V$	
		> 500 kHz to 1 MHz	$4.0 \cdot 10^{-3} \cdot U + 20 \mu V$	
	> 22 V to Umax	> 100 kHz to 300 kHz	$1.0 \cdot 10^{-3} \cdot U + 16 mV$	Umax = $22 \cdot 10^6 \cdot V$ Hz/ f[Hz]
		> 300 kHz to 500 kHz	$5.0 \cdot 10^{-3} \cdot U + 30 mV$	
	> 500 kHz to 1 MHz	> 300 kHz to 500 kHz	$5.0 \cdot 10^{-3} \cdot U + 30 mV$	Umax = $22 \cdot 10^6 \cdot V$ Hz/ f[Hz]
> 500 kHz to 1 MHz		$8.0 \cdot 10^{-3} \cdot U + 80 mV$		
> 220 V to 1 kV	15 Hz to 50 Hz	$0.40 \cdot 10^{-3} \cdot U + 2.5 mV$	Umax = $22 \cdot 10^6 \cdot V$ Hz/ f[Hz]	
	> 50 Hz to 1 kHz	$0.11 \cdot 10^{-3} \cdot U + 2.5 mV$		
Sources	1 mV to 3.5 V	10 Hz to 30 Hz	$3.3 \cdot 10^{-3} \cdot U + 3 \mu V$	Voltage at 50 Ω
		> 30 Hz to 120 Hz	$1.6 \cdot 10^{-3} \cdot U + 3 \mu V$	
		> 120 Hz to 120 kHz	$1.3 \cdot 10^{-3} \cdot U + 3 \mu V$	
		> 120 kHz to 2 MHz	$1.5 \cdot 10^{-3} \cdot U + 3 \mu V$	
		> 2 MHz to 10 MHz	$3.5 \cdot 10^{-3} \cdot U + 3 \mu V$	
		> 10 MHz to 20 MHz	$11.0 \cdot 10^{-3} \cdot U + 3 \mu V$	
		> 20 MHz to 30 MHz	$25.0 \cdot 10^{-3} \cdot U + 15 \mu V$	
		> 30 MHz to 50 MHz	$40.0 \cdot 10^{-3} \cdot U + 15 \mu V$	
		> 50 MHz to 100 MHz	$40.0 \cdot 10^{-3} \cdot U + 15 \mu V$	
Sources	1 mV to 10 mV	10 Hz to 20 kHz	$0.5 \cdot 10^{-3} \cdot U + 4 \mu V$	Voltage at 50 Ω
		> 20 kHz to 50 kHz	$0.8 \cdot 10^{-3} \cdot U + 4 \mu V$	
		> 50 kHz to 100 kHz	$5.0 \cdot 10^{-3} \cdot U + 4 \mu V$	
		> 100 kHz to 1 MHz	$12.0 \cdot 10^{-3} \cdot U + 10 \mu V$	

Annex to the Accreditation Certificate D-K-15195-01-00

Location Memmingen, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
AC voltage Sources	> 10 mV to 100 V	10 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 1 MHz	$0.5 \cdot 10^{-3} \cdot U + 2 \mu V$ $0.5 \cdot 10^{-3} \cdot U + 2 \mu V$ $1.4 \cdot 10^{-3} \cdot U + 2 \mu V$ $4.0 \cdot 10^{-3} \cdot U + 2 \mu V$ $11.0 \cdot 10^{-3} \cdot U + 10 \mu V$	U: Measured value
	> 100 V to 700 V	10 Hz to 20 Hz > 20 Hz to 50 kHz > 50 kHz to 100 kHz	$0.8 \cdot 10^{-3} \cdot U + 2 mV$ $1.4 \cdot 10^{-3} \cdot U + 2 mV$ $3.2 \cdot 10^{-3} \cdot U + 2 mV$	
AC current Measuring instruments	100 μA to 220 μA	10 Hz to 20 Hz > 20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3 \cdot 10^{-3} \cdot I + 16 nA$ $0.2 \cdot 10^{-3} \cdot I + 10 nA$ $0.3 \cdot 10^{-3} \cdot I + 12 nA$ $1.1 \cdot 10^{-3} \cdot I + 0.1 \mu A$	I: Measured value
	> 220 μA to 2.2 mA	10 Hz to 20 Hz > 20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3 \cdot 10^{-3} \cdot I + 40 nA$ $0.2 \cdot 10^{-3} \cdot I + 35 nA$ $0.22 \cdot 10^{-3} \cdot I + 110 nA$ $1.2 \cdot 10^{-3} \cdot I + 1 \mu A$	
	> 2.2 mA to 22 mA	10 Hz to 20 Hz > 20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3 \cdot 10^{-3} \cdot I + 400 nA$ $0.2 \cdot 10^{-3} \cdot I + 350 nA$ $0.22 \cdot 10^{-3} \cdot I + 550 nA$ $1.2 \cdot 10^{-3} \cdot I + 5 \mu A$	
	> 22 mA to 220 mA	10 Hz to 20 Hz > 20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3 \cdot 10^{-3} \cdot I + 4 \mu A$ $0.2 \cdot 10^{-3} \cdot I + 3.5 \mu A$ $0.22 \cdot 10^{-3} \cdot I + 3.5 \mu A$ $1.2 \cdot 10^{-3} \cdot I + 10 \mu A$	
	> 220 mA to 2.2 A	20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.2 \cdot 10^{-3} \cdot I + 35 \mu A$ $0.47 \cdot 10^{-3} \cdot I + 80 \mu A$ $7.1 \cdot 10^{-3} \cdot I + 160 \mu A$	
	> 2.2 A to < 3 A	10 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$2 \cdot 10^{-3} \cdot I + 100 \mu A$ $0.7 \cdot 10^{-3} \cdot I + 100 \mu A$ $6.6 \cdot 10^{-3} \cdot I + 1 mA$ $28 \cdot 10^{-3} \cdot I + 5 mA$	
	3 A to < 11 A	45 Hz to 100 Hz > 100 Hz to 1 kHz > 1 kHz to 5 kHz	$0.7 \cdot 10^{-3} \cdot I + 2 mA$ $1.1 \cdot 10^{-3} \cdot I + 2 mA$ $0.3 \cdot 10^{-3} \cdot I + 16 nA$	
	Sources	100 μA to 1.2 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 10 kHz	

Annex to the Accreditation Certificate D-K-15195-01-00

Location Memmingen, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
AC current Sources	> 1.2 mA to 120 mA	> 10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 10 kHz	$6.0 \cdot 10^{-3} \cdot I + 1 \mu\text{A}$ $3.2 \cdot 10^{-3} \cdot I + 1 \mu\text{A}$ $2.3 \cdot 10^{-3} \cdot I + 1 \mu\text{A}$	f: Measured value
	> 120 mA to 1 A	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 5 kHz > 5 kHz to 10 kHz	$6.0 \cdot 10^{-3} \cdot I + 1 \mu\text{A}$ $3.3 \cdot 10^{-3} \cdot I + 1 \mu\text{A}$ $2.7 \cdot 10^{-3} \cdot I + 1 \mu\text{A}$ $4.7 \cdot 10^{-3} \cdot I + 1 \mu\text{A}$	
Frequency Oscillators Measuring instruments	0.1 MHz		$5 \cdot 10^{-12} \cdot f$	f: Measured value U_{TRIG} : Trigger-uncertainty
	1 MHz			
	5 MHz			
	10 MHz			
	0.1 MHz to 110 GHz		$\sqrt{(1 \cdot 10^{-10} \cdot f)^2 + U_{\text{TRIG}}^2}$	
Time interval	1 ns to 100 s		$\sqrt{(1 \text{ ns})^2 + (1 \cdot 10^{-10} \cdot t)^2 + U_{\text{TRIG}}^2}$	t: Measured value
HF-Power Sources with mismatch correction	100 μW to 10 mW	> DC to 1 MHz	$1.8 \cdot 10^{-3} \cdot P$	P: Measured value PC Type-N ²⁾ to 18 GHz WG R220 ²⁾ WG R320 ²⁾ WG R400 ²⁾ WG R620 ²⁾ WG R620 ²⁾ WG: R900 ²⁾ WG: R900 ²⁾
		> 1 MHz to 50 MHz	$2.3 \cdot 10^{-3} \cdot P$	
		> 50 MHz to 100 MHz	$2.5 \cdot 10^{-3} \cdot P$	
		> 100 MHz to 2.5 GHz	$4.0 \cdot 10^{-3} \cdot P$	
		2.5 GHz to 8 GHz	$6.0 \cdot 10^{-3} \cdot P$	
		> 8 GHz to 12.4 GHz	$7.7 \cdot 10^{-3} \cdot P$	
		> 12.4 GHz to 18 GHz	$10 \cdot 10^{-3} \cdot P$	
		18 GHz to 26.5 GHz	$5.3 \cdot 10^{-3} \cdot P$	
		26.5 GHz to 40 GHz	$5.6 \cdot 10^{-3} \cdot P$	
		40 GHz to 50 GHz	$15 \cdot 10^{-3} \cdot P$	
		50 GHz to 67 GHz	$29 \cdot 10^{-3} \cdot P$	
		> 67 GHz to 75 GHz	$32 \cdot 10^{-3} \cdot P$	
		75 GHz to 95 GHz	$32 \cdot 10^{-3} \cdot P$	
> 95 GHz to 110 GHz	$33 \cdot 10^{-3} \cdot P$			
HF-Power Sensors with mismatch correction	100 nW to 10 μW	> DC to 100 MHz	$5.8 \cdot 10^{-3} \cdot P$	P: Measured value PC Type-N ²⁾ to 18 GHz PC-3.5 ²⁾ to 33 GHz PC-2.92 ²⁾ to 40 GHz PC-2.4 ²⁾ to 50 GHz PC-1.85 ²⁾ to 67 GHz PC-1.00 ²⁾ to 110 GHz
		> 100 MHz to 2.5 GHz	$7.0 \cdot 10^{-3} \cdot P$	
		> 2.5 GHz to 4 GHz	$8.0 \cdot 10^{-3} \cdot P$	
		> 4 GHz to 8 GHz	$10 \cdot 10^{-3} \cdot P$	
		> 8 GHz to 12.4 GHz	$13 \cdot 10^{-3} \cdot P$	
		> 12.4 GHz to 18 GHz	$15 \cdot 10^{-3} \cdot P$	
		> 18 GHz to 26.5 GHz	$15 \cdot 10^{-3} \cdot P$	
		> 26.5 GHz to 40 GHz	$19 \cdot 10^{-3} \cdot P$	

Valid from: 01.03.2023

Date of issue: 01.03.2023

Annex to the Accreditation Certificate D-K-15195-01-00

Location Memmingen, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
HF-Power Sensors with mismatch correction	10 μ W to 200 mW	> DC to 1 MHz > 1 MHz to 100 MHz > 100 MHz to 2.5 GHz 2.5 GHz to 8 GHz > 8 GHz to 12.4 GHz > 12.4 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	$3.0 \cdot 10^{-3} \cdot P$ $3.4 \cdot 10^{-3} \cdot P$ $5.1 \cdot 10^{-3} \cdot P$ $6.8 \cdot 10^{-3} \cdot P$ $8.4 \cdot 10^{-3} \cdot P$ $11 \cdot 10^{-3} \cdot P$ $14 \cdot 10^{-3} \cdot P$ $17 \cdot 10^{-3} \cdot P$ $21 \cdot 10^{-3} \cdot P$ $33 \cdot 10^{-3} \cdot P$	P: Measured value
	10 μ W to 125 mW	> 67 GHz to 75 GHz > 75 GHz to 95 GHz > 95 GHz to 110 GHz	$37 \cdot 10^{-3} \cdot P$ $41 \cdot 10^{-3} \cdot P$ $43 \cdot 10^{-3} \cdot P$	
HF-Power Sources. Measuring instruments with mismatch correction	0.2 fW to < 10 pW	> DC to 8 GHz > 8 GHz to 20 GHz	$21 \cdot 10^{-3} \cdot P$ $24 \cdot 10^{-3} \cdot P$	
	1 fW to < 10 pW	> 20 GHz to 40 GHz	$29 \cdot 10^{-3} \cdot P$	
	10 fW to < 10 pW	> 40 GHz to 50 GHz > 50 GHz to 67 GHz	$43 \cdot 10^{-3} \cdot P$ $49 \cdot 10^{-3} \cdot P$	
	10 pW to < 100 nW	> DC to 100 MHz > 100 MHz to 8 GHz > 8 GHz to 20 GHz > 20 GHz to 40 GHz > 40 GHz to 50 GHz > 50 GHz to 67 GHz	$15 \cdot 10^{-3} \cdot P$ $17 \cdot 10^{-3} \cdot P$ $20 \cdot 10^{-3} \cdot P$ $26 \cdot 10^{-3} \cdot P$ $34 \cdot 10^{-3} \cdot P$ $43 \cdot 10^{-3} \cdot P$	
	100 pW to < 100 uW	> 67 GHz to 75 GHz > 75 GHz to 95 GHz > 95 GHz to 110 GHz	$45 \cdot 10^{-3} \cdot P$ $47 \cdot 10^{-3} \cdot P$ $49 \cdot 10^{-3} \cdot P$	
	100 nW to 200 mW	> DC to 100 MHz > 100 MHz to 8 GHz > 8 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	$10 \cdot 10^{-3} \cdot P$ $13 \cdot 10^{-3} \cdot P$ $16 \cdot 10^{-3} \cdot P$ $23 \cdot 10^{-3} \cdot P$ $23 \cdot 10^{-3} \cdot P$ $30 \cdot 10^{-3} \cdot P$ $35 \cdot 10^{-3} \cdot P$	
	100 μ W to 125 mW	> 67 GHz to 75 GHz > 75 GHz to 95 GHz > 95 GHz to 110 GHz	$40 \cdot 10^{-3} \cdot P$ $42 \cdot 10^{-3} \cdot P$ $44 \cdot 10^{-3} \cdot P$	
without mismatch correction	> 200 mW to 20 W	> DC to 100 MHz > 100 MHz to 4 GHz	$11 \cdot 10^{-3} \cdot P$ $14 \cdot 10^{-3} \cdot P$	
	> 200 mW to 4 W	> 4 GHz to 8 GHz > 8 GHz to 12.5 GHz > 12.5 GHz to 18 GHz	$15 \cdot 10^{-3} \cdot P$ $19 \cdot 10^{-3} \cdot P$ $23 \cdot 10^{-3} \cdot P$	

Valid from: 01.03.2023

Date of issue: 01.03.2023

Annex to the Accreditation Certificate D-K-15195-01-00

Location Memmingen, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
HF-Power Sources, Measuring instruments	> 200 mW to 2 W	> 18 GHz to 26.5 GHz	$25 \cdot 10^{-3} \cdot P$	
	> 200 mW to 1 W	> 26.5 GHz to 40 GHz	$31 \cdot 10^{-3} \cdot P$	
	> 20 W to 2 kW	> DC to 1 GHz	$24 \cdot 10^{-3} \cdot P$	
Display Linearity, Tuned HF Power, Attenuation	0 dB to 21 dB	> DC to 40 GHz	0.003 dB	A: Measured value
	> 21 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 60 dB	> 67 GHz to 110 GHz	$0.03 \text{ dB} + 0.001 \cdot A$	
	> 60 dB to 80 dB	> 67 GHz to 110 GHz	0.6 dB	
	> 80 dB to 90 dB	> 67 GHz to 110 GHz	1.8 dB	
		0 dB to 10 dB	65 GHz to < 70 GHz	0.11 dB
	0 dB to 10 dB	70 GHz to 85 GHz	0.10 dB	
HF-Transmission Phase angle φ	- 180 ° to 180 °	> DC to 100 MHz	0.5 °	Depending on attenuation value
		> 100 MHz to 10 GHz	0.7 °	
		> 10 GHz to 20 GHz	1.0 °	
		> 20 GHz to 40 GHz	1.8 °	
		> 40 GHz to 67 GHz	2.0 °	
		> 67 GHz to 110 GHz	3.0 °	
HF-Impedance Reflection factor	0.0 to 0.4	> DC to 10 GHz	0.0034	PC Type-N ²⁾ Γ : Magnitude of complex reflection Factor
	> 0.4 to 1.0	> DC to 10 GHz	$0.0015 + 0.005 \cdot \Gamma $	
	0.0 to 0.4	> 10 GHz to 18 GHz	0.0034	PC-3.5 ²⁾
	> 0.4 to 1.0	> 10 GHz to 18 GHz	$0.01 \cdot \Gamma $	
	0.0 to 0.4	> 18 GHz to 33 GHz	0.0065	PC-2.9 ²⁾
	> 0.4 to 1.0	> 18 GHz to 33 GHz	$0.001 + 0.013 \cdot \Gamma $	
	0.0 to 0.4	> 33 GHz to 40 GHz	0.011	PC-2.4 ²⁾ . PC-1.85 ²⁾
	> 0.4 to 1.0	> 33 GHz to 40 GHz	$0.005 + 0.016 \cdot \Gamma $	
	0.0 to 1.0	> DC to 2 GHz	$0.0035 + 0.0042 \cdot \Gamma ^2$	
		> 2 GHz to 10 GHz	$0.0037 + 0.0050 \cdot \Gamma ^2$	
		> 10 GHz to 20 GHz	$0.0042 + 0.0069 \cdot \Gamma ^2$	
		> 20 GHz to 30 GHz	$0.0055 + 0.0101 \cdot \Gamma ^2$	
		> 30 GHz to 40 GHz	$0.0067 + 0.0120 \cdot \Gamma ^2$	
		> 40 GHz to 50 GHz	$0.0085 + 0.0151 \cdot \Gamma ^2$	
> 50 GHz to 67 GHz		$0.0113 + 0.0183 \cdot \Gamma ^2$		
> 67 GHz to 90 GHz		$0.0036 + 0.0049 \cdot \Gamma ^2$		
0.0 to 1.0	> DC to 2 GHz	$0.0036 + 0.0052 \cdot \Gamma ^2$	PC-1.00 ²⁾	
	> 2 GHz to 10 GHz	$0.0041 + 0.0068 \cdot \Gamma ^2$		
	> 10 GHz to 20 GHz	$0.0049 + 0.0095 \cdot \Gamma ^2$		
	> 20 GHz to 30 GHz	$0.0056 + 0.0117 \cdot \Gamma ^2$		
	> 30 GHz to 40 GHz	$0.0063 + 0.0131 \cdot \Gamma ^2$		
	> 40 GHz to 50 GHz	$0.0074 + 0.0173 \cdot \Gamma ^2$		
	> 50 GHz to 67 GHz	$0.0093 + 0.0213 \cdot \Gamma ^2$		
	> 67 GHz to 90 GHz	$0.0122 + 0.0280 \cdot \Gamma ^2$		
	> 90 GHz to 110 GHz	$0.0142 + 0.0331 \cdot \Gamma ^2$		
	> 110 GHz bis 114 GHz	$0.0142 + 0.0331 \cdot \Gamma ^2$		

Annex to the Accreditation Certificate D-K-15195-01-00

Location Memmingen, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
HF-Impedance Reflection factor	0.0 to 1.0	50 GHz to 75 GHz 60 GHz to 90 GHz 75 GHz to 110 GHz	$0.01 + 0.008 \cdot \Gamma $ $0.01 + 0.008 \cdot \Gamma $ $0.01 + 0.008 \cdot \Gamma $	Connector: R620 Connector: R740 Connector: R900
	0.0 to 0.6	65 GHz to < 70 GHz	0.027	Free space impedance
	> 0.6 to 1.0	65 GHz to < 70 GHz	0.032	
	0.0 to 0.6	70 GHz to 85 GHz	0.026	
	> 0.6 to 1.0	70 GHz to 85 GHz	0.029	
HF-Impedance Phase angle	- 180 ° to 180 °	> DC to 110 GHz	$U_s \cdot 180^\circ / \pi$	$U_s = \arcsin(U/ \Gamma)$ U: Uncertainty of reflection factor
Modulation quantities	0.0 to 1.0	> DC $f_m \leq 100$ kHz	$0.001 \cdot m + K$	m: Measurement value f_{HF} = Carrier frequency f_m = modulation freq. $f_{HF} > 5 \cdot f_m^{(3)}$
Amplitude modulation		100 kHz < $f_m \leq 1$ MHz	$0.002 \cdot m + K$	
Modulation degree m		1 MHz < $f_m \leq 10$ MHz	$0.007 \cdot m + K$	
Frequency modulation	10 Hz to 16 MHz	10 Hz < $f_m \leq 100$ kHz	$1 \cdot 10^{-3} \cdot \Delta f + K$	Δf : Measurement value $f_{HF} > 5 \cdot (f_m + \Delta f)^{(3)}$
Frequency deviation Δf		100 kHz < $f_m \leq 200$ kHz	$2 \cdot 10^{-3} \cdot \Delta f + K$	
		200 kHz < $f_m \leq 10$ MHz	$5 \cdot 10^{-3} \cdot \Delta f + K$	
Phase modulation	(10 Hz/ f_m) to (16 MHz/ f_m) rad	10 Hz < $f_m \leq 100$ kHz	$1 \cdot 10^{-3} \cdot \Delta \phi + K$	$\Delta \phi$: Measurement value $f_{HF} > 5 \cdot f_m^{(3)}$
Phase deviation $\Delta \phi$		100 kHz < $f_m \leq 200$ kHz	$2 \cdot 10^{-3} \cdot \Delta \phi + K$	
		200 kHz < $f_m \leq 10$ MHz	$5 \cdot 10^{-3} \cdot \Delta \phi + K$	
Waveform quantities	7 ps to 15 ps	Voltage range dependent on rise-time	4 ps	t: Measurement value
Rise time	> 15 ps to 25 ps		3 ps	
	> 25 ps to 100 ns		$40 \cdot 10^{-3} \cdot t + 2$ ps	
Pulse spectrum	0.1 μ Vs to 50 μ Vs	9 kHz to 150 kHz	$25 \cdot 10^{-3} \cdot IS$	IS: Measurement value
Cispr 16-1-1:2019	3 nVs to 1 μ Vs	150 kHz to 30 MHz	$25 \cdot 10^{-3} \cdot IS$	
	0.4 nVs to 200 nVs	30 MHz to 1 GHz	$27 \cdot 10^{-3} \cdot IS$	
Antenna factor	Depending on Antenna	20 MHz to 1 GHz	0.45 dB	with ground reflection
3-Antenna method Free-field		20 MHz to < 10 GHz	0.35 dB	without ground reflection
		10 GHz to 18 GHz	0.40 dB	SAE ARP958:1999
		20 MHz to < 2 GHz	0.40 dB	1 m distance
Full absorber facility		2 GHz to 18 GHz	0.55 dB	
		20 MHz to 18 GHz	0.60 dB	
Antenna factor (ECSM)	Preset by antennas	9 kHz to 30 MHz CISPR 16-1-6:2022	1.2 dB	monopole antennas ECSM procedure
Antenna factor				loop antennas standard field procedure

Valid from: 01.03.2023

Date of issue: 01.03.2023

Page 8 of 30

This document is a translation. The definitive version is the original German annex to the accreditation certificate.

Annex to the Accreditation Certificate D-K-15195-01-00

Location Memmingen, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
Phase noise	> -77 dBc/Hz ^{a)}	1 Hz ^{b)}	1.5 dB	Carrier frequency: 100 MHz to 500 MHz
Oscillators	-85 dBc/Hz to -77dBc/Hz	1 Hz	2.5 dB	
Measuring instruments	> -92 dBc/Hz	3 Hz to 10 Hz	1.5 dB	a) Phase noise to
	-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	Carrier level in dBc/Hz
	-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	b) Offset frequency to carrier frequency
	-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	
	> -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		
-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		

Valid from: 01.03.2023

Date of issue: 01.03.2023

Page 9 of 30

This document is a translation. The definitive version is the original German annex to the accreditation certificate.

Annex to the Accreditation Certificate D-K-15195-01-00

Location Memmingen, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
Phase noise Oscillators Measuring instruments	> -55 dBc/Hz	1 Hz	1.5 dB	Carrier frequency: 1 GHz to 3 GHz
	-67 dBc/Hz to -55 dBc/Hz	1 Hz	2.5 dB	
	> -67 dBc/Hz	3 Hz to 10 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	
	-176 dBc/Hz to -168 dBc/Hz	100 kHz to 1 MHz	2.5 dB	
	> -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	

Valid from: 01.03.2023

Date of issue: 01.03.2023

Annex to the Accreditation Certificate D-K-15195-01-00

Location Memmingen, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks	
Phase noise	> -49 dBc/Hz	1 Hz	1.5 dB	Carrier frequency: 3 GHz to 6 GHz	
Oscillators	-57 to -49 dBc/Hz	1 Hz	2.5 dB		
Measuring instruments	> -62 dBc/Hz	3 Hz to 10 Hz	1.5 dB		
	-70 to -62 dBc/Hz	3 Hz to 10 Hz	2.5 dB		
	> -76 dBc/Hz	10 Hz to 100 Hz	1.5 dB		
	-84 to -76 dBc/Hz	10 Hz to 100 Hz	2.5 dB		
	> -105 dBc/Hz	100 Hz to 1 kHz	1.5 dB		
	-113 to -105 dBc/Hz	100 Hz to 1 kHz	2.5 dB		
	> -138 dBc/Hz	1 kHz to 10 kHz	1.5 dB		
	-146 to -138 dBc/Hz	1 kHz to 10 kHz	2.5 dB		
	> -156 dBc/Hz	10 kHz to 100 kHz	1.5 dB		
	-164 to -156 dBc/Hz	10 kHz to 100 kHz	2.5 dB		
	> -158 dBc/Hz	100 kHz to 1 MHz	1.5 dB		
	-166 to -158 dBc/Hz	100 kHz to 1 MHz	2.5 dB		
	> -158 dBc/Hz	1 MHz to 10 MHz	1.5 dB		
	-166 to -158 dBc/Hz	1 MHz to 10 MHz	2.5 dB		
	> -54 dBc/Hz	1 Hz	1.5 dB		Carrier frequency: 6 GHz to 8 GHz
	-62 to -54 dBc/Hz	1 Hz	2.5 dB		
	> -68 dBc/Hz	3 Hz to 10 Hz	1.5 dB		
	-76 to -68 dBc/Hz	3 Hz to 10 Hz	2.5 dB		
> -95 dBc/Hz	10 Hz to 100 Hz	1.5 dB			
-103 to -95 dBc/Hz	10 Hz to 100 Hz	2.5 dB			
> -122 dBc/Hz	100 Hz to 1 kHz	1.5 dB			
-130 to -122 dBc/Hz	100 Hz to 1 kHz	2.5 dB			
> -138 dBc/Hz	1 kHz to 10 kHz	1.5 dB			
-146 to -138 dBc/Hz	1 kHz to 10 kHz	2.5 dB			
> -142 dBc/Hz	10 kHz to 100 kHz	1.5 dB			
-146 to -142 dBc/Hz	10 kHz to 100 kHz	2.5 dB			
> -142 dBc/Hz	100 kHz to 1 MHz	1.5 dB			
-150 to -142 dBc/Hz	100 kHz to 1 MHz	2.5 dB			
> -142 dBc/Hz	1 MHz to 10 MHz	1.5 dB			
-150 to -142 dBc/Hz	1 MHz to 10 MHz	2.5 dB			

Valid from: 01.03.2023

Date of issue: 01.03.2023

Annex to the Accreditation Certificate D-K-15195-01-00

Location Vimperk, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
DC voltage Sources. Measuring instruments	0 V to 220mV > 220mV to 1 kV		$10 \cdot 10^{-6} \cdot U + 1 \mu\text{V}$ $16 \cdot 10^{-6} \cdot U$	U: Measured value
DC current Measuring instruments	0 μA to 10 μA > 10 μA to 220 mA > 220 mA to 2.2 A 2.2 A to 3 A > 3 A to 11 A		1 nA $0.1 \cdot 10^{-3} \cdot I$ $0.14 \cdot 10^{-3} \cdot I$ $0.41 \cdot 10^{-3} \cdot I$ $0.55 \cdot 10^{-3} \cdot I + 500\mu\text{A}$	I: Measured value
Sources	0 μA to 10 μA > 10 μA to 100 mA > 100 mA to 60 A		1 nA $0.1 \cdot 10^{-3} \cdot I$ $0.2 \cdot 10^{-3} \cdot I$	
DC resistance Resistance, measuring instruments	0 Ω to 100 k Ω > 100 k Ω to 1 M Ω > 1 M Ω to 10 M Ω > 10 M Ω to 100 M Ω > 100 M Ω to 1 G Ω		$15 \cdot 10^{-6} \cdot R + 60 \mu\Omega$ $15 \cdot 10^{-6} \cdot R + 2 \Omega$ $50 \cdot 10^{-6} \cdot R + 100 \text{ k}\Omega$ $0.6 \cdot 10^{-3} \cdot R$ $5.1 \cdot 10^{-3} \cdot R$	R: Measured value
AC voltage Measuring instruments	1 mV to 220 V	10 Hz to < 20 Hz 20 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.40 \cdot 10^{-3} \cdot U + 8 \mu\text{V}$ $0.21 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $0.20 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $0.50 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$	U: Measured value
	1 mV to 22 V	> 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$1.0 \cdot 10^{-3} \cdot U + 18 \mu\text{V}$ $1.8 \cdot 10^{-3} \cdot U + 20 \mu\text{V}$ $4.0 \cdot 10^{-3} \cdot U + 20 \mu\text{V}$	
	> 22 V to U_{max}	> 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$1.0 \cdot 10^{-3} \cdot U + 16 \text{ mV}$ $5.0 \cdot 10^{-3} \cdot U + 30 \text{ mV}$ $8.0 \cdot 10^{-3} \cdot U + 80 \text{ mV}$	$U_{\text{max}} = 22 \cdot 10^6 \text{ V Hz/}$ f[Hz]
	> 220 V to 1 kV	15 Hz to 50 Hz > 50 Hz to 1 kHz	$0.40 \cdot 10^{-3} \cdot U + 2.5 \text{ mV}$ $0.11 \cdot 10^{-3} \cdot U + 2.5 \text{ mV}$	
	1 mV to 3.5 V	10 Hz to 30 Hz > 30 Hz to 120 Hz > 120 Hz to 120 kHz > 120 kHz to 2 MHz > 2 MHz to 10 MHz > 10 MHz to 20 MHz > 20 MHz to 30 MHz > 30 MHz to 50 MHz	$3.3 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$ $1.6 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$ $1.3 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$ $1.5 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$ $3.5 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$ $11.0 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$ $25.0 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$ $40.0 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$	Voltage at 50 Ω
Sources	1 mV to 10 mV	10 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 1 MHz	$0.5 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$ $0.8 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$ $5.0 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$ $12.0 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$	
	> 10 mV to 100 V	10 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz 100 kHz to 300 kHz > 300 kHz to 1 MHz	$0.5 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $0.5 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $1.4 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $0.4 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $11 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$	U: Measured value Voltage at 50 Ω

Valid from: 01.03.2023

Date of issue: 01.03.2023

Page 12 of 30

This document is a translation. The definitive version is the original German annex to the accreditation certificate.

Annex to the Accreditation Certificate D-K-15195-01-00

Location Vimperk, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
AC voltage Sources	> 100 V to 700 V	10 Hz to 20 Hz > 20 Hz to 50 kHz > 50 kHz to 100 kHz	$0.8 \cdot 10^{-3} \cdot U + 2 \text{ mV}$ $1.4 \cdot 10^{-3} \cdot U + 2 \text{ mV}$ $3.2 \cdot 10^{-3} \cdot U + 2 \text{ mV}$	U: Measured value
AC current Measuring instruments	100 μA to 220 μA	10 Hz to 20 Hz > 20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3 \cdot 10^{-3} \cdot I + 16 \text{ nA}$ $0.2 \cdot 10^{-3} \cdot I + 10 \text{ nA}$ $0.3 \cdot 10^{-3} \cdot I + 12 \text{ nA}$ $1.1 \cdot 10^{-3} \cdot I + 0.1 \mu\text{A}$	I: Measured value
	> 220 μA to 2.2 mA	10 Hz to 20 Hz > 20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3 \cdot 10^{-3} \cdot I + 40 \text{ nA}$ $0.2 \cdot 10^{-3} \cdot I + 35 \text{ nA}$ $0.22 \cdot 10^{-3} \cdot I + 110 \text{ nA}$ $1.2 \cdot 10^{-3} \cdot I + 1 \mu\text{A}$	
	> 2.2 mA to 22 mA	10 Hz to 20 Hz > 20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3 \cdot 10^{-3} \cdot I + 400 \text{ nA}$ $0.2 \cdot 10^{-3} \cdot I + 350 \text{ nA}$ $0.22 \cdot 10^{-3} \cdot I + 550 \text{ nA}$ $1.2 \cdot 10^{-3} \cdot I + 5 \mu\text{A}$	
	> 22 mA to 220 mA	10 Hz to 20 Hz > 20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3 \cdot 10^{-3} \cdot I + 4 \mu\text{A}$ $0.2 \cdot 10^{-3} \cdot I + 3.5 \mu\text{A}$ $0.22 \cdot 10^{-3} \cdot I + 3.5 \mu\text{A}$ $0.47 \cdot 10^{-3} \cdot I + 10 \mu\text{A}$	
	> 220 mA to 2.2 A	20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.2 \cdot 10^{-3} \cdot I + 35 \mu\text{A}$ $0.47 \cdot 10^{-3} \cdot I + 80 \mu\text{A}$ $7.1 \cdot 10^{-3} \cdot I + 160 \mu\text{A}$	
	> 2.2 A to < 3 A	10 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$2 \cdot 10^{-3} \cdot I + 100 \mu\text{A}$ $0.7 \cdot 10^{-3} \cdot I + 100 \mu\text{A}$ $6.6 \cdot 10^{-3} \cdot I + 1 \text{ mA}$ $28 \cdot 10^{-3} \cdot I + 5 \text{ mA}$	
	3 A to < 11 A	45 Hz to 100 Hz > 100 Hz to 1 kHz > 1 kHz to 5 kHz	$0.7 \cdot 10^{-3} \cdot I + 2 \text{ mA}$ $1.1 \cdot 10^{-3} \cdot I + 2 \text{ mA}$ $33 \cdot 10^{-3} \cdot I + 2 \text{ mA}$	
Sources	100 μA to 1.2 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 10 kHz	$6.0 \cdot 10^{-3} \cdot I + 0.1 \mu\text{A}$ $3.5 \cdot 10^{-3} \cdot I + 0.1 \mu\text{A}$ $2.6 \cdot 10^{-3} \cdot I + 0.1 \mu\text{A}$	
	> 1.2 mA to 120 mA	> 10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 10 kHz	$6.0 \cdot 10^{-3} \cdot I + 1 \mu\text{A}$ $3.2 \cdot 10^{-3} \cdot I + 1 \mu\text{A}$ $2.3 \cdot 10^{-3} \cdot I + 1 \mu\text{A}$	
	> 120 mA to 1 A	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 5 kHz > 5 kHz to 10 kHz	$6.0 \cdot 10^{-3} \cdot I + 1 \mu\text{A}$ $3.3 \cdot 10^{-3} \cdot I + 1 \mu\text{A}$ $2.7 \cdot 10^{-3} \cdot I + 1 \mu\text{A}$ $4.7 \cdot 10^{-3} \cdot I + 1 \mu\text{A}$	

Valid from: 01.03.2023

Date of issue: 01.03.2023

Page 13 of 30

This document is a translation. The definitive version is the original German annex to the accreditation certificate.

Annex to the Accreditation Certificate D-K-15195-01-00

Location Vimperk, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
Capacitance	1.1 nF to < 3.3 nF	10 Hz to 3 kHz	$6 \cdot 10^{-3} \cdot C + 0.01 \text{ nF}$	C: Measured value
	3.3 nF to < 11 nF	10 Hz to 1 kHz	$2.8 \cdot 10^{-3} \cdot C + 0.01 \text{ nF}$	
	11 nF to < 33 nF	10 Hz to 1 kHz	$2.8 \cdot 10^{-3} \cdot C + 0.1 \text{ nF}$	
	33 nF to < 110 nF	10 Hz to 1 kHz	$2.8 \cdot 10^{-3} \cdot C + 0.1 \text{ nF}$	
	110 nF to < 330 nF	10 Hz to 1 kHz	$2.8 \cdot 10^{-3} \cdot C + 0.3 \text{ nF}$	
	0.33 μF to < 1.10 μF	10 Hz to 600 Hz	$2.8 \cdot 10^{-3} \cdot C + 1 \text{ nF}$	
	1.1 μF to < 11 μF	10 Hz to 300 Hz	$2.8 \cdot 10^{-3} \cdot C + 3 \text{ nF}$	
	11 μF to < 33 μF	10 Hz to 120 Hz	$4.5 \cdot 10^{-3} \cdot C + 30 \text{ nF}$	
	33 μF to < 110 μF	DC to 80 Hz	$5 \cdot 10^{-3} \cdot C + 100 \text{ nF}$	
	110 μF to < 330 μF	DC to 80 Hz	$5 \cdot 10^{-3} \cdot C + 300 \text{ nF}$	
0.33 mF to < 1.1 mF	DC to 50 Hz	$5 \cdot 10^{-3} \cdot C + 1 \text{ μF}$		
Frequency Oscillators Measuring instruments	0.1 MHz		$5 \cdot 10^{-12} \cdot f$	f: Measured value U_{TRIG} : Trigger-uncertainty
	1 MHz			
	5 MHz			
	10 MHz			
	0.1 mHz to 110 GHz		$\sqrt{(1 \cdot 10^{-10} \cdot f)^2 + U_{\text{TRIG}}^2}$	
Time period	1 ns to 100 s		$\sqrt{(1 \text{ ns})^2 + (1 \cdot 10^{-10} \cdot t)^2 + U_{\text{TRIG}}^2}$	t: Measured value
HF-Power HF-Power Sensors with mismatch correction	100 nW to 10 μW	> DC to 100 MHz	$5.8 \cdot 10^{-3} \cdot P$	P: Measured value PC Type-N ²⁾ to 18 GHz PC-3.5 ²⁾ to 33 GHz PC-2.92 ²⁾ to 40 GHz PC-2.4 ²⁾ to 50 GHz PC-1.85 ²⁾ to 67 GHz PC-1.00 ²⁾ to 110 GHz
		> 100 MHz to 2.4 GHz	$7.0 \cdot 10^{-3} \cdot P$	
		> 2.4 GHz to 4 GHz	$8.0 \cdot 10^{-3} \cdot P$	
		> 4 GHz to 8 GHz	$10 \cdot 10^{-3} \cdot P$	
		> 8 GHz to 12.4 GHz	$13 \cdot 10^{-3} \cdot P$	
	> 12.4 GHz to 18 GHz	$15 \cdot 10^{-3} \cdot P$		
	> 18 GHz to 26.5 GHz	$15 \cdot 10^{-3} \cdot P$		
	> 26.5 GHz to 40 GHz	$19 \cdot 10^{-3} \cdot P$		
	10 μW to 200 mW	> DC to 1 MHz	$3.0 \cdot 10^{-3} \cdot P$	
		> 1 MHz to 100 MHz	$3.4 \cdot 10^{-3} \cdot P$	
> 100 MHz to 2.4 GHz		$5.1 \cdot 10^{-3} \cdot P$		
2.4 GHz to 8 GHz		$6.8 \cdot 10^{-3} \cdot P$		
> 8 GHz to 12.4 GHz		$8.4 \cdot 10^{-3} \cdot P$		
> 12.4 GHz to 18 GHz	$11 \cdot 10^{-3} \cdot P$			
> 18 GHz to 26.5 GHz	$14 \cdot 10^{-3} \cdot P$			
> 26.5 GHz to 40 GHz	$17 \cdot 10^{-3} \cdot P$			
> 40 GHz to 50 GHz	$21 \cdot 10^{-3} \cdot P$			
> 50 GHz to 67 GHz	$33 \cdot 10^{-3} \cdot P$			
HF-Power Sources	1 mW	50 MHz	$4.0 \cdot 10^{-3} \cdot P$	
	10 μW to 200 mW	> DC to 100 MHz > 100 MHz to 1 GHz	$5.0 \cdot 10^{-3} \cdot P$ $6.0 \cdot 10^{-3} \cdot P$	

Valid from: 01.03.2023

Date of issue: 01.03.2023

Annex to the Accreditation Certificate D-K-15195-01-00

Location Vimperk, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
HF-Power Sources. Measuring instruments with mismatch correction	0.2 fW to < 10 pW	> DC to 8 GHz > 8 GHz to 20 GHz	$21 \cdot 10^{-3} \cdot P$ $24 \cdot 10^{-3} \cdot P$	P: Measured value
	1 fW to < 10 pW	> 20 GHz to 40 GHz	$29 \cdot 10^{-3} \cdot P$	
	10 fW to < 10 pW	> 40 GHz to 50 GHz > 50 GHz to 67 GHz	$43 \cdot 10^{-3} \cdot P$ $49 \cdot 10^{-3} \cdot P$	
	10 pW to < 100 nW	> DC to 100 MHz > 100 MHz to 8 GHz > 8 GHz to 20 GHz > 20 GHz to 40 GHz > 40 GHz to 50 GHz > 50 GHz to 67 GHz	$15 \cdot 10^{-3} \cdot P$ $17 \cdot 10^{-3} \cdot P$ $20 \cdot 10^{-3} \cdot P$ $26 \cdot 10^{-3} \cdot P$ $34 \cdot 10^{-3} \cdot P$ $43 \cdot 10^{-3} \cdot P$	
	100 pW to < 100 uW	> 67 GHz to 75 GHz > 75 GHz to 95 GHz > 95 GHz to 110 GHz	$45 \cdot 10^{-3} \cdot P$ $47 \cdot 10^{-3} \cdot P$ $49 \cdot 10^{-3} \cdot P$	
	100 nW to 200 mW	> DC to 100 MHz > 100 MHz to 8 GHz > 8 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	$10 \cdot 10^{-3} \cdot P$ $13 \cdot 10^{-3} \cdot P$ $16 \cdot 10^{-3} \cdot P$ $23 \cdot 10^{-3} \cdot P$ $23 \cdot 10^{-3} \cdot P$ $30 \cdot 10^{-3} \cdot P$ $35 \cdot 10^{-3} \cdot P$	
	10 µW to 125 mW	> 67 GHz to 75 GHz > 75 GHz to 95 GHz > 95 GHz to 110 GHz	$40 \cdot 10^{-3} \cdot P$ $42 \cdot 10^{-3} \cdot P$ $44 \cdot 10^{-3} \cdot P$	
without mismatch correction	> 200 mW to 20 W	> DC to 100 MHz > 100 MHz to 4 GHz	$11 \cdot 10^{-3} \cdot P$ $14 \cdot 10^{-3} \cdot P$	
	> 200 mW to 4 W	> 4 GHz to 8 GHz > 8 GHz to 12.5 GHz > 12.5 GHz to 18 GHz	$15 \cdot 10^{-3} \cdot P$ $19 \cdot 10^{-3} \cdot P$ $23 \cdot 10^{-3} \cdot P$	
	> 200 mW to 2 W	> 18 GHz to 26.5 GHz	$25 \cdot 10^{-3} \cdot P$	
	> 200 mW to 1 W	> 26.5 GHz to 40 GHz	$31 \cdot 10^{-3} \cdot P$	
Display Linearity. Level distance, Attenuation	0 dB to 21 dB	> DC to 40 GHz	0.003 dB	A: Measured value
	> 21 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 60 dB	> 67 GHz to 110 GHz	$0.03 \text{ dB} + 0.001 \cdot A$	
	> 60 dB to 80 dB > 80 dB to 90 dB	> 67 GHz to 110 GHz > 67 GHz to 110 GHz	0.6 dB 1.8 dB	

Valid from: 01.03.2023

Date of issue: 01.03.2023

Annex to the Accreditation Certificate D-K-15195-01-00

Location Vimperk, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
HF-Transmission Phase angle φ	- 180 ° to 180 °	> DC to 100 MHz > 100 MHz to 10 GHz > 10 GHz to 20 GHz > 20 GHz to 40 GHz > 40 GHz to 67 GHz > 67 GHz to 110 GHz	0.5 ° 0.7 ° 1.0 ° 1.8 ° 2.0 ° 3.0 °	Dependent on Attenuation value
HF-Impedance Reflection factor	0.0 to 0.4	> DC to 10 GHz	0.0034	PC Type-N ²⁾ Γ : Magnitude of complex reflection factor
	> 0.4 to 1.0	> DC to 10 GHz	$0.0015 + 0.005 \cdot \Gamma $	
	0.0 to 0.4	> 10 GHz to 18 GHz	0.0034	PC-3.5 ²⁾
	> 0.4 to 1.0	> 10 GHz to 18 GHz	$0.01 \cdot \Gamma $	
	0.0 to 0.4	> 18 GHz to 33 GHz	0.0065	PC-2.92 ²⁾
	> 0.4 to 1.0	> 18 GHz to 33 GHz	$0.001 + 0.013 \cdot \Gamma $	
	0.0 to 0.4	> 33 GHz to 40 GHz	0.011	PC-2.4 ²⁾ . PC-1.85 ²⁾
> 0.4 to 1.0	> 33 GHz to 40 GHz	$0.005 + 0.016 \cdot \Gamma $		
	0.0 to 1.0	> DC to 2 GHz	$0.0035 + 0.0042 \cdot \Gamma ^2$	
		> 2 GHz to 10 GHz	$0.0037 + 0.0050 \cdot \Gamma ^2$	
		> 10 GHz to 20 GHz	$0.0042 + 0.0069 \cdot \Gamma ^2$	
		> 20 GHz to 30 GHz	$0.0055 + 0.0101 \cdot \Gamma ^2$	
		> 30 GHz to 40 GHz	$0.0067 + 0.0120 \cdot \Gamma ^2$	
		> 40 GHz to 50 GHz	$0.0085 + 0.0151 \cdot \Gamma ^2$	
		> 50 GHz to 67 GHz	$0.0113 + 0.0183 \cdot \Gamma ^2$	
	0.0 to 1.0	> DC to 2 GHz	$0.0036 + 0.0049 \cdot \Gamma ^2$	PC-1.00 ²⁾
		> 2 GHz to 10 GHz	$0.0036 + 0.0052 \cdot \Gamma ^2$	
		> 10 GHz to 20 GHz	$0.0041 + 0.0068 \cdot \Gamma ^2$	
		> 20 GHz to 40 GHz	$0.0049 + 0.0095 \cdot \Gamma ^2$	Connector: R620 Connector: R740 Connector: R900
		> 40 GHz to 50 GHz	$0.0056 + 0.0117 \cdot \Gamma ^2$	
		> 50 GHz to 67 GHz	$0.0063 + 0.0131 \cdot \Gamma ^2$	
		> 67 GHz to 90 GHz	$0.0074 + 0.0173 \cdot \Gamma ^2$	
		> 90 GHz to 110 GHz	$0.0093 + 0.0213 \cdot \Gamma ^2$	
0.0 to 1.0	> 110 GHz to 114 GHz	$0.0122 + 0.0280 \cdot \Gamma ^2$		
0.0 to 1.0	50 GHz to 75 GHz 60 GHz to 90 GHz 90 GHz to 110 GHz	$0.01 + 0.008 \cdot \Gamma $ $0.01 + 0.008 \cdot \Gamma $ $0.01 + 0.008 \cdot \Gamma $		
HF-Impedance Phase angle	- 180 ° to 180 °	> DC to 110 GHz	$U_s \cdot 180^\circ / \pi$	$U_s = \arcsin(U/ \Gamma)$ U: Uncertainty of reflection factor
Modulation quantities Amplitude modulation Modulation degree m	0.0 to 1.0	> DC $f_m \leq 100$ kHz	$0.001 \cdot m + K$	m : measured value f_{HF} = Carrier frequency f_m = Modulation freq. $f_{HF} > 5 \cdot f_m$ ³⁾
		100 kHz < $f_m \leq 1$ MHz	$0.002 \cdot m + K$	
		1 MHz < $f_m \leq 10$ MHz	$0.007 \cdot m + K$	
Frequency modulation Frequency deviation Δf	10 Hz to 16 MHz	10 Hz < $f_m \leq 100$ kHz	$1 \cdot 10^{-3} \cdot \Delta f$	Δf : measured value $f_{HF} > 5 \cdot f_m$ ³⁾
		100 kHz < $f_m \leq 200$ kHz	$2 \cdot 10^{-3} \cdot \Delta f$	
		200 kHz < $f_m \leq 10$ MHz	$5 \cdot 10^{-3} \cdot \Delta f$	

Valid from: 01.03.2023

Date of issue: 01.03.2023

Page 16 of 30

This document is a translation. The definitive version is the original German annex to the accreditation certificate.

Annex to the Accreditation Certificate D-K-15195-01-00

Location Vimperk, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
Phase modulation	(10 Hz/ to (16 MHz/	10 Hz < f_m ≤ 100 kHz	$1 \cdot 10^{-3} \cdot \Delta\phi$	$\Delta\phi$: measured value $f_{HF} > 5 \cdot f_m^{(3)}$
Phase deviation $\Delta\phi$	f_m) rad f_m) rad	100 kHz < f_m ≤ 200 kHz 200 kHz < f_m ≤ 10 MHz	$2 \cdot 10^{-3} \cdot \Delta\phi$ $5 \cdot 10^{-3} \cdot \Delta\phi$	
Waveform quantities	7 ps to 15 ps	Voltage range dependent on rise-time	4 ps	t: measured value
Rise time	>15 ps to 25 ps		3 ps	
	>25 ps to 100 ns		$40 \cdot 10^{-3} \cdot t + 2$ ps	
Pulse spectrum	0.1 μ Vs to 50 μ Vs	9 kHz to 150 kHz	$25 \cdot 10^{-3} \cdot /S$	/S: measured value
Cispr 16-1-1:2019	3 nVs to 1 μ Vs	150 kHz to 30 MHz	$25 \cdot 10^{-3} \cdot /S$	
	0.4 nVs to 200 nVs	30 MHz to 1 GHz	$27 \cdot 10^{-3} \cdot /S$	
Phase noise	> -77 dBc/Hz ^{a)}	1 Hz ^{b)}	1.5 dB	Carrier frequency: 100 MHz to 500 MHz
Oscillators,	-85 dBc/Hz to -77 dBc/Hz	1 Hz	2.5 dB	
Measuring instruments	> -92 dBc/Hz	3 Hz to 10 Hz	1.5 dB	a) Phase noise with regard to Carrier level in dBc/Hz
	-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 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 ^{b)}	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	Carrier frequency: 500 MHz to 1 GHz

Valid from: 01.03.2023

Date of issue: 01.03.2023

Annex to the Accreditation Certificate D-K-15195-01-00

Location Vimperk, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
Phase noise Oscillators, Measuring instruments	-180 dBc/Hz to -172 dBc/Hz	100 kHz to 1 MHz	2.5 dB	Carrier frequency: 500 MHz to 1 GHz
	> -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	Carrier frequency: 1 GHz to 3 GHz
	-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	
	-176 dBc/Hz to -168 dBc/Hz	100 kHz to 1 MHz	2.5 dB	
	> -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	
	-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		

Valid from: 01.03.2023

Date of issue: 01.03.2023

Page 18 of 30

This document is a translation. The definitive version is the original German annex to the accreditation certificate.

Annex to the Accreditation Certificate D-K-15195-01-00

Location Vimperk, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
	> -54 dBc/Hz	1 Hz	1.5 dB	Carrier frequency: 6 GHz to 8 GHz
	-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	

²⁾ By the use of different connection systems the measurement uncertainty increases.

³⁾ K: Uncertainty includes typical disturbances on carrier frequencies up to 3GHz. On carrier frequencies above 3GHz, disturbances, e.g. spurious deviation, has to be determined and considered in dependence of the measurement object.

Valid from: 01.03.2023

Date of issue: 01.03.2023

Page 19 of 30

This document is a translation. The definitive version is the original German annex to the accreditation certificate.

Annex to the Accreditation Certificate D-K-15195-01-00

Location Köln, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks	
DC voltage Sources, Measuring instruments	1 V; 1.018 V 10 V		$2 \cdot 10^{-6} \cdot U$ $1 \cdot 10^{-6} \cdot U$	U: Measured value	
	0 V to 1 kV > 1 kV to 10 kV > 10 kV to 20 kV > 20 kV to 30 kV		$3 \cdot 10^{-6} \cdot U + 0.2 \mu\text{V}$ $0.1 \cdot 10^{-3} \cdot U$ $6 \cdot 10^{-3} \cdot U$ $22 \cdot 10^{-3} \cdot U$		
	1 μA to 10 A > 10 A to 200 A		$10 \cdot 10^{-6} \cdot I$ $0.2 \cdot 10^{-3} \cdot I$		I: Measured value
	1 Ω 10 k Ω 0.1 m Ω to < 1 m Ω 1 m Ω to < 1 Ω 1 Ω to 100 k Ω > 100 k Ω to 1 M Ω > 1 M Ω to 10 M Ω > 10 M Ω to 100 M Ω > 100 M Ω to 1 G Ω > 1 G Ω to 10 G Ω		$2 \cdot 10^{-6} \cdot R$ $2 \cdot 10^{-6} \cdot R$ $50 \cdot 10^{-6} \cdot R$ $10 \cdot 10^{-6} \cdot R$ $3 \cdot 10^{-6} \cdot R$ $5 \cdot 10^{-6} \cdot R$ $30 \cdot 10^{-6} \cdot R$ $0.1 \cdot 10^{-3} \cdot R$ $0.2 \cdot 10^{-3} \cdot R$ $2 \cdot 10^{-3} \cdot R$		R: Measured value
Measuring instruments	0 Ω to 20 Ω > 20 Ω to 100 k Ω > 100 k Ω to 1 M Ω > 1 M Ω to 10 M Ω > 10 M Ω to 100 M Ω > 100 M Ω to 1 G Ω > 1 G Ω to 10 G Ω		$3 \cdot 10^{-6} \cdot R + 20 \mu\Omega$ $3 \cdot 10^{-6} \cdot R$ $5 \cdot 10^{-6} \cdot R$ $30 \cdot 10^{-6} \cdot R$ $0.1 \cdot 10^{-3} \cdot R$ $0.5 \cdot 10^{-3} \cdot R$ $5 \cdot 10^{-3} \cdot R$		
AC voltage and AC/DC Transfer Sources, Measuring instruments	1 mV to < 220 V	10 Hz to < 20 Hz 20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.2 \cdot 10^{-6} \cdot U + 0.5 \mu\text{V}$ $75 \cdot 10^{-6} \cdot U + 0.5 \mu\text{V}$ $35 \cdot 10^{-6} \cdot U + 0.5 \mu\text{V}$ $70 \cdot 10^{-6} \cdot U + 0.5 \mu\text{V}$ $0.1 \cdot 10^{-3} \cdot U + 1 \mu\text{V}$	U: Measured value	
	1 mV to 70 V	> 100 kHz to 300 kHz	$0.2 \cdot 10^{-3} \cdot U + 1.5 \mu\text{V}$		
	1 mV to 22 V	> 300 kHz to 1 MHz	$1.1 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$		
	220 V to 1000 V	10 Hz to < 20 Hz 20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.2 \cdot 10^{-3} \cdot U$ $0.1 \cdot 10^{-3} \cdot U$ $41 \cdot 10^{-6} \cdot U$ $0.14 \cdot 10^{-3} \cdot U$ $0.5 \cdot 10^{-3} \cdot U$		
	> 1 kV to 7 kV	45 Hz to 60 Hz	$2 \cdot 10^{-3} \cdot U$		
	1 mV to 7 V	1 MHz to 2 MHz > 2 MHz to 10 MHz > 10 MHz to 20 MHz > 20 MHz to 30 MHz	$0.6 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $1.0 \cdot 10^{-3} \cdot U + 2.5 \mu\text{V}$ $1.5 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$ $3.5 \cdot 10^{-3} \cdot U + 8 \mu\text{V}$		Voltage at 50 Ω
	0.1 V to 2 V	> 50 MHz to 100 MHz > 100 MHz to 200 MHz > 200 MHz to 300 MHz > 300 MHz to 500 MHz > 500 MHz to 1 GHz	$4 \cdot 10^{-3} \cdot U$ $5 \cdot 10^{-3} \cdot U$ $7 \cdot 10^{-3} \cdot U$ $10 \cdot 10^{-3} \cdot U$ $15 \cdot 10^{-3} \cdot U$		

Annex to the Accreditation Certificate D-K-15195-01-00

Location Köln, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
AC current and AC/DC-Transfer	1 mA to 10 A	10 Hz to < 10 kHz	$0.1 \cdot 10^{-3} \cdot I$	<i>I</i> : Measured value
AC current Sources Measuring instruments	> 10 A to 200 A	20 Hz to 45 Hz > 45 Hz to 5 kHz > 5 kHz to 20 kHz	$3 \cdot 10^{-3} \cdot I$ $2 \cdot 10^{-3} \cdot I$ $5 \cdot 10^{-3} \cdot I$	
Capacitance	1 nF	1 kHz	$30 \cdot 10^{-6} \cdot C$	C: Measured value substitution method direct measurement with brige
	0.1 pF to < 1 pF	50 Hz to < 100 Hz 100 Hz to < 200 Hz 200 Hz to < 1 kHz 1 kHz to 10 kHz	$0.1 \cdot C$ $10 \cdot 10^{-3} \cdot C$ $1 \cdot 10^{-3} \cdot C$ $0.4 \cdot 10^{-3} \cdot C$	
	1 pF to < 10 pF	50 Hz to < 100 Hz 100 Hz to < 1 kHz 1 kHz to 10 kHz	$10 \cdot 10^{-3} \cdot C$ $1 \cdot 10^{-3} \cdot C$ $0.15 \cdot 10^{-3} \cdot C$	
	10 pF to 100 pF	50 Hz to < 1 kHz 1 kHz to 10 kHz	$0.5 \cdot 10^{-3} \cdot C$ $0.1 \cdot 10^{-3} \cdot C$	
	100 pF to < 50 nF	50 Hz to 10 kHz	$0.1 \cdot 10^{-3} \cdot C$	
	50 nF to 200 nF	50 Hz to < 1 kHz 1 kHz to 10 kHz	$0.1 \cdot 10^{-3} \cdot C$ $0.4 \cdot 10^{-3} \cdot C$	
	200 nF to < 1 µF	50 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.1 \cdot 10^{-3} \cdot C$ $0.5 \cdot 10^{-3} \cdot C$ $2 \cdot 10^{-3} \cdot C$	
	1 µF to 5 µF	50 Hz to 1 kHz > 1 kHz to 2 kHz > 2 kHz to 5 kHz > 5 kHz to 10 kHz	$0.1 \cdot 10^{-3} \cdot C$ $0.4 \cdot 10^{-3} \cdot C$ $3 \cdot 10^{-3} \cdot C$ $10 \cdot 10^{-3} \cdot C$	
	5 µF to 10 µF	50 Hz to 1 kHz > 1 kHz to 2 kHz > 2 kHz to 5 kHz > 5 kHz to 10 kHz	$0.2 \cdot 10^{-3} \cdot C$ $0.8 \cdot 10^{-3} \cdot C$ $5 \cdot 10^{-3} \cdot C$ $20 \cdot 10^{-3} \cdot C$	
	10 µF to 100 µF	50 Hz to 1 kHz	$3 \cdot 10^{-3} \cdot C$	
Frequency Oscillators Measuring instruments	0.1 MHz 1 MHz 5 MHz 10 MHz		$5 \cdot 10^{-12} \cdot f$	<i>f</i> : Measured value U_{TRIG} : Trigger- uncertainty
	0.1 mHz to 110 GHz		$\sqrt{(1 \cdot 10^{-10} \cdot f)^2 + U_{\text{TRIG}}^2}$	
Time interval	1 ns to 10 000 s		$\sqrt{(1 \text{ ns})^2 + (1 \cdot 10^{-10} \cdot t)^2 + U_{\text{TRIG}}^2}$	<i>t</i> : Measured value

Valid from: 01.03.2023

Date of issue: 01.03.2023

Annex to the Accreditation Certificate D-K-15195-01-00

Location Köln, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
HF-Power HF-Power Sensors with mismatch correction	100 nW to 10 µW	> DC to 100 MHz > 100 MHz to 2.4 GHz > 2.4 GHz to 4 GHz > 4 GHz to 8 GHz > 8 GHz to 12.4 GHz > 12.4 GHz to 18 GHz > 18 GHz to 26.5 GHz > 26.5 GHz to 40 GHz	$5.8 \cdot 10^{-3} \cdot P$ $7.0 \cdot 10^{-3} \cdot P$ $8.0 \cdot 10^{-3} \cdot P$ $10 \cdot 10^{-3} \cdot P$ $13 \cdot 10^{-3} \cdot P$ $15 \cdot 10^{-3} \cdot P$ $15 \cdot 10^{-3} \cdot P$ $19 \cdot 10^{-3} \cdot P$	P: Measured value PC Type-N ²⁾ to 18 GHz PC-3.5 ²⁾ to 33 GHz PC-2.92 ²⁾ to 40 GHz PC-2.4 ²⁾ to 50 GHz PC-1.85 ²⁾ to 67 GHz PC-1.00 ²⁾ to 110 GHz
	10 µW to 200 mW	> DC to 1 MHz > 1 MHz to 100 MHz > 100 MHz to 2.4 GHz > 2.4 GHz to 8 GHz > 8 GHz to 12.4 GHz > 12.4 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	$3.0 \cdot 10^{-3} \cdot P$ $3.4 \cdot 10^{-3} \cdot P$ $5.1 \cdot 10^{-3} \cdot P$ $6.8 \cdot 10^{-3} \cdot P$ $8.4 \cdot 10^{-3} \cdot P$ $11 \cdot 10^{-3} \cdot P$ $14 \cdot 10^{-3} \cdot P$ $17 \cdot 10^{-3} \cdot P$ $21 \cdot 10^{-3} \cdot P$ $33 \cdot 10^{-3} \cdot P$	
Sources	1 mW	50 MHz	$4.0 \cdot 10^{-3} \cdot P$	
	10 µW to 200 mW	> DC to 100 MHz > 100 MHz to 1 GHz	$5.0 \cdot 10^{-3} \cdot P$ $6.0 \cdot 10^{-3} \cdot P$	
Sources. Measuring instruments with mismatch correction	0.2 fW to < 10 pW	> DC to 8 GHz > 8 GHz to 20 GHz	$21 \cdot 10^{-3} \cdot P$ $24 \cdot 10^{-3} \cdot P$	
	1 fW to < 10 pW	> 20 GHz to 40 GHz	$29 \cdot 10^{-3} \cdot P$	
	10 fW to < 10 pW	> 40 GHz to 50 GHz > 50 GHz to 67 GHz	$43 \cdot 10^{-3} \cdot P$ $49 \cdot 10^{-3} \cdot P$	
	10 pW to < 100 nW	> DC to 100 MHz > 100 MHz to 8 GHz > 8 GHz to 20 GHz > 20 GHz to 40 GHz > 40 GHz to 50 GHz > 50 GHz to 67 GHz	$15 \cdot 10^{-3} \cdot P$ $17 \cdot 10^{-3} \cdot P$ $20 \cdot 10^{-3} \cdot P$ $26 \cdot 10^{-3} \cdot P$ $34 \cdot 10^{-3} \cdot P$ $43 \cdot 10^{-3} \cdot P$	
	100 pW to < 100 uW	> 67 GHz to 75 GHz > 75 GHz to 95 GHz > 95 GHz to 110 GHz	$45 \cdot 10^{-3} \cdot P$ $47 \cdot 10^{-3} \cdot P$ $49 \cdot 10^{-3} \cdot P$	

Valid from: 01.03.2023

Date of issue: 01.03.2023

Page 22 of 30

This document is a translation. The definitive version is the original German annex to the accreditation certificate.

Annex to the Accreditation Certificate D-K-15195-01-00

Location Köln, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
HF-Power Sources. Measuring instruments with mismatch correction	100 nW to 200 mW	> DC to 100 MHz > 100 MHz to 8 GHz > 8 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	$10 \cdot 10^{-3} \cdot P$ $13 \cdot 10^{-3} \cdot P$ $16 \cdot 10^{-3} \cdot P$ $23 \cdot 10^{-3} \cdot P$ $23 \cdot 10^{-3} \cdot P$ $30 \cdot 10^{-3} \cdot P$ $35 \cdot 10^{-3} \cdot P$	P: Measured value
	10 µW to 125 mW	> 67 GHz to 75 GHz > 75 GHz to 95 GHz > 95 GHz to 110 GHz	$40 \cdot 10^{-3} \cdot P$ $42 \cdot 10^{-3} \cdot P$ $44 \cdot 10^{-3} \cdot P$	
	> 200 mW to 20 W	> DC to 100 MHz > 100 MHz to 4 GHz	$11 \cdot 10^{-3} \cdot P$ $14 \cdot 10^{-3} \cdot P$	
	> 200 mW to 4 W	> 4 GHz to 8 GHz > 8 GHz to 12.5 GHz > 12.5 GHz to 18 GHz	$15 \cdot 10^{-3} \cdot P$ $19 \cdot 10^{-3} \cdot P$ $23 \cdot 10^{-3} \cdot P$	
	> 200 mW to 2 W	> 20 GHz to 26.5 GHz	$25 \cdot 10^{-3} \cdot P$	
	> 200 mW to 1 W	> 26.5 GHz to 40 GHz	$31 \cdot 10^{-3} \cdot P$	
	without mismatch correction	> 20 W to 2 kW	> DC to 1 GHz	
> 20 W to 500 W		> 1 GHz to 4 GHz	$30 \cdot 10^{-3} \cdot P$	
> 4 W to 500 W		> 4 GHz to 10 GHz	$30 \cdot 10^{-3} \cdot P$	
> 4 W to 100 W		> 10 GHz to 18 GHz	$40 \cdot 10^{-3} \cdot P$	
> 2 kW to 10 kW		> DC to 1 GHz	$41 \cdot 10^{-3} \cdot P$	
Display Linearity Level distance, Attenuation	0 dB to 21 dB	> DC to 40 GHz	0.003 dB	A: Measured value
	> 21 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 60 dB	> 67 GHz to 110 GHz	$0.03 \text{ dB} + 0.001 \cdot A$	
	> 60 dB to 80 dB	> 67 GHz to 110 GHz	0.6 dB	
HF-Transmission Phase angle φ	- 180° to 180°	> DC to 100 MHz	0.5°	Dependent on Attenuation value
		> 100 MHz to 10 GHz	0.7°	
		> 10 GHz to 20 GHz	1.0°	
		> 20 GHz to 40 GHz	1.8°	
		> 40 GHz to 67 GHz	2.0°	
		> 67 GHz to 110 GHz	3.0°	

Annex to the Accreditation Certificate D-K-15195-01-00

Location Köln, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
HF-Impedance Reflection factor	0.0 to 0.4	> DC to 10 GHz	0.0034	PC Type-N ²⁾ Γ : Magnitude of complex reflection factor
	> 0.4 to 1.0	> DC to 10 GHz	0.0015 + 0.005 · Γ	
	0.0 to 0.4	> 10 GHz to 18 GHz	0.0034	PC-3.5 ²⁾
	> 0.4 to 1.0	> 10 GHz to 18 GHz	0.01 · Γ	
	0.0 to 0.4	> 18 GHz to 33 GHz	0.0065	PC-2.92 ³⁾
	> 0.4 to 1.0	> 18 GHz to 33 GHz	0.001 + 0.013 · Γ	
	0.0 to 0.4	> 33 GHz to 40 GHz	0.011	PC-2.4 ²⁾ , PC-1.85 ²⁾
> 0.4 to 1.0	> 33 GHz to 40 GHz	0.005 + 0.016 · Γ ²		
0.0 to 1.0	> DC to 2 GHz	0.0035 + 0.0042 · Γ ²	PC-1.00 ²⁾	
	> 2 GHz to 10 GHz	0.0037 + 0.0050 · Γ ²		
	> 10 GHz to 20 GHz	0.0042 + 0.0069 · Γ ²		
	> 20 GHz to 30 GHz	0.0055 + 0.0101 · Γ ²		
	> 30 GHz to 40 GHz	0.0067 + 0.0120 · Γ ²		
	> 40 GHz to 50 GHz	0.0085 + 0.0151 · Γ ²		
	> 50 GHz to 67 GHz	0.0113 + 0.0183 · Γ ²		
	> DC to 2 GHz	0.0036 + 0.0049 · Γ ²		
	> 2 GHz to 10 GHz	0.0036 + 0.0052 · Γ ²		
	> 10 GHz to 20 GHz	0.0041 + 0.0068 · Γ ²		
> 20 GHz to 30 GHz	0.0049 + 0.0095 · Γ ²			
> 30 GHz to 40 GHz	0.0056 + 0.0117 · Γ ²			
> 40 GHz to 50 GHz	0.0063 + 0.0131 · Γ ²			
> 50 GHz to 67 GHz	0.0074 + 0.0173 · Γ ²			
> 67 GHz to 90 GHz	0.0093 + 0.0213 · Γ ²			
> 90 GHz to 110 GHz	0.0122 + 0.0280 · Γ ²			
> 110 GHz to 114 GHz	0.0142 + 0.0331 · Γ ²			
0.0 to 1.0	50 GHz to 75 GHz	0.01 + 0.008 · Γ	Connector: R620 Connector: R740 Connector: R900	
	60 GHz to 90 GHz	0.01 + 0.008 · Γ		
	75 GHz to 110 GHz	0.01 + 0.008 · Γ		
HF-Impedance Phase angle φ	- 180 ° to 180 °	> DC to 110 GHz	$U_s \cdot 180^\circ / \pi$	$U_s = \arcsin(U/ \Gamma)$ U: Uncertainty of reflection factor
Modulation quantities Amplitude modulation Modulation degree m	0.01 to 1.0	> DC $f_m \leq 100$ kHz 100 kHz < $f_m \leq 1$ MHz 1 MHz < $f_m \leq 10$ MHz	0.001 · m + K 0.002 · m + K 0.007 · m + K	m: Measured value f_{HF} = Carrier frequency f_m = Modulation freq. $f_{HF} > 5 \cdot f_m^{(3)}$
Frequency modulation Frequency deviation Δf	10 Hz to 16 MHz	10 Hz < $f_m \leq 100$ kHz 100 kHz < $f_m \leq 200$ kHz 200 kHz < $f_m \leq 10$ MHz	$1 \cdot 10^{-3} \cdot \Delta f + K$ $2 \cdot 10^{-3} \cdot \Delta f + K$ $5 \cdot 10^{-3} \cdot \Delta f + K$	Δf: Measured value $f_{HF} > 5 \cdot (f_m + \Delta f)^{(3)}$
Phase modulation Phase deviation Δφ	(10 Hz/ f_m) rad to (16 MHz/ f_m) rad	10 Hz < $f_m \leq 100$ kHz 100 kHz < $f_m \leq 200$ kHz 200 kHz < $f_m \leq 10$ MHz	$1 \cdot 10^{-3} \cdot \Delta \phi + K$ $2 \cdot 10^{-3} \cdot \Delta \phi + K$ $5 \cdot 10^{-3} \cdot \Delta \phi + K$	Δφ: Measured value $f_{HF} > 5 \cdot (f_m + \Delta \phi)^{(3)}$

Valid from: 01.03.2023

Date of issue: 01.03.2023

Page 24 of 30

This document is a translation. The definitive version is the original German annex to the accreditation certificate.

Annex to the Accreditation Certificate D-K-15195-01-00

Location Köln, Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
Rise time	200 ps to 1 s	1 mV to 100 V in 50 Ω	$20 \cdot 10^{-3} \cdot t + (50 \text{ ps})^2/t$	t: Measured value
	2 ns to 1 s	100 V to 5 kV in 50 Ω	$20 \cdot 10^{-3} \cdot t + (0.3 \text{ ns})^2/t$	e.g. Burst according to EN 61000-4-4 :2013
	3 ns to 1 s	100 V to 8 kV in 1 kΩ	$20 \cdot 10^{-3} \cdot t + (0.5 \text{ ns})^2/t$	e.g. Surge according to EN 61000-4-5:2019
	10 ns to 1 s	100 V to 15 kV with HV-Probe	$20 \cdot 10^{-3} \cdot t + (2.2 \text{ ns})^2/t$	
	20 ns to 10 μs	1 mA to 5 kA with current transformer	$20 \cdot 10^{-3} \cdot t + (5 \text{ ns})^2/t$	
	0.7 ns to 500 ns	1 A to 150 A with ESD-Target	$30 \cdot 10^{-3} \cdot t$	ESD according to EN 61000-4-2:2009
Pulse duration	0.5 ns to 10 s		$2 \cdot 10^{-3} \cdot t + 10 \text{ ps} + \delta t_{\text{TRIG}}$	δt_{TRIG} : Triggeruncertainty
Repetition time	1 ns to 10 s			
Burst duration	5 ns to 10 s			
Burst period	5 ns to 10 s			
Pulse voltage	10 mV to 500 V	200 ps ≤ Δt ≤ 1 s at 50 Ω	$20 \cdot 10^{-3} \cdot U, \Delta t \geq 20 \text{ ns}$	U: Measured value Δt: Pulse duration
	10 V to 5 kV	2,5 ns ≤ Δt ≤ 1 s at 50 Ω	$30 \cdot 10^{-3} \cdot U, \Delta t < 20 \text{ ns}$	e.g. Burst according to EN 61000-4-4:2013
	10 V to 8 kV	2,5 ns ≤ Δt ≤ 1 s at 1 kΩ		e.g. Surge according to EN 61000-4-5:2019
	10 V to 15 kV	10 ns ≤ Δt ≤ 1 s, high resistance		
Pulse current	1 A to 5 kA	20 ns ≤ Δt ≤ 10 ms	$20 \cdot 10^{-3} \cdot I$	I: Measured value
ESD-current pulse	1 A to 150 A	Current peak	$40 \cdot 10^{-3} \cdot I$	I: Measured value
	0.2 A to 150 A	Current grid values after 30 ns and 60 ns	$25 \cdot 10^{-3} \cdot I$	Calibration with Target according to EN 61000-4-2:2009
Pulse spectrum	0.1 μVs to 50 μVs	9 kHz to 150 kHz	$25 \cdot 10^{-3} \cdot I_S$	I _S : Measured value CISPR 16-1-1:2019
	3 nVs to 1 μVs	150 kHz to 30 MHz	$25 \cdot 10^{-3} \cdot I_S$	
	0.4 nVs to 200 nVs	30 MHz to 1 GHz	$27 \cdot 10^{-3} \cdot I_S$	
Antenna factor (ECSM)	Preset by antennas	9 kHz to 30 MHz CISPR 16-1-6:2022	1.2 dB	monopole antennas ECSM procedure
Antenna factor				loop antennas standard field procedure

Valid from: 01.03.2023

Date of issue: 01.03.2023

Page 25 of 30

This document is a translation. The definitive version is the original German annex to the accreditation certificate.

Annex to the Accreditation Certificate D-K-15195-01-00

Location Köln, Mobile Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
Direct voltage Sources, Measuring instruments	0 V to 500 V		$10 \cdot 10^{-6} \cdot U + 1 \mu\text{V}$	U: Measured value
	500 V to 1000 V		$16 \cdot 10^{-6} \cdot U$	
	> 1 kV to 10 kV		$2 \cdot 10^{-3} \cdot U$	
	> 10 kV to 20 kV		$6 \cdot 10^{-3} \cdot U$	
	> 20 kV to 30 kV		$22 \cdot 10^{-3} \cdot U$	
Direct current, sources Measuring instruments	1 μA to 1 A		$0.1 \cdot 10^{-3} \cdot I + 1 \text{nA}$	I: Measured value
	> 1 A to 200 A		$0.2 \cdot 10^{-3} \cdot I$	
Direct resistance Resistance, measuring instruments	0 Ω to 100 k Ω		$15 \cdot 10^{-6} \cdot R + 60 \mu\Omega$	R: Measured value
	> 100 k Ω to 1 M Ω		$20 \cdot 10^{-6} \cdot R + 2 \Omega$	
	> 1 M Ω to 10 M Ω		$60 \cdot 10^{-6} \cdot R + 0.1 \text{k}\Omega$	
	> 10 M Ω to 100 M Ω		$0.6 \cdot 10^{-3} \cdot R$	
	> 100 M Ω to 1 G Ω		$5.1 \cdot 10^{-3} \cdot R$	
AC voltage Measuring instruments	1 mV to 220 V	10 Hz to < 20 Hz	$0.4 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$	U: Measured value
		20 Hz to 20 kHz	$0.2 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$	
		> 20 kHz to 100 kHz	$0.5 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$	
	> 200 to 1000 V	50 Hz to 1 kHz	$0.2 \cdot 10^{-3} \cdot U$	Voltage at 50 Ω
	1 mV to 10 V	100 kHz to 1 MHz	$2 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$	
		> 1 MHz to 10 MHz	$2.5 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$	
Voltage sources	1 mV to 100 V	10 Hz to 20 kHz	$0.5 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$	U: Measured value
		> 20 kHz to 50 kHz	$0.7 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$	
		> 50 kHz to 100 kHz	$1.5 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$	
	> 100 V to 1000 V	100 kHz to 1 MHz	$11 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$	
		10 Hz to 20 kHz	$0.8 \cdot 10^{-3} \cdot U$	
		> 20 kHz to 50 kHz	$1.5 \cdot 10^{-3} \cdot U$	
HF-Voltage	0.5 V to 3 V	> 50 kHz to 100 kHz	$3.2 \cdot 10^{-3} \cdot U$	U: Measured value
		45 Hz to 60 Hz	$2 \cdot 10^{-3} \cdot U$	
	0.5 V to 2 V	100 kHz to 30 MHz	$10 \cdot 10^{-3} \cdot U$	
		30 MHz to 100 MHz	$10 \cdot 10^{-3} \cdot U$	
AC current Measuring instruments	1 mA to 1 A	> 100 MHz to 500 MHz	$20 \cdot 10^{-3} \cdot U$	I: Measured value
		> 500 MHz to 1 GHz	$30 \cdot 10^{-3} \cdot U$	
		10 Hz to 20 Hz	$2 \cdot 10^{-3} \cdot I$	
		20 Hz to 1 kHz	$0.5 \cdot 10^{-3} \cdot I$	
	> 1 kHz to 5 kHz	$1 \cdot 10^{-3} \cdot I$		
	> 5 kHz to 10 kHz	$2 \cdot 10^{-3} \cdot I$		
Current sources	1 mA to 120 mA	> 1 A to 200 A	$3 \cdot 10^{-3} \cdot I$	
		> 20 Hz to 5 kHz	$2 \cdot 10^{-3} \cdot I$	
	> 5 kHz to 10 kHz	$5 \cdot 10^{-3} \cdot I$		
	> 120 mA to 200 A	20 Hz to 45 Hz	$3.0 \cdot 10^{-3} \cdot I$	
Capacitance	100 pF to <1 nF	20 Hz to 45 Hz	$2.0 \cdot 10^{-3} \cdot I$	C: Measured value
		45 Hz to 20 kHz	$2.0 \cdot 10^{-3} \cdot I$	
	1 nF to 1 μF	20 Hz to 45 Hz	$3.0 \cdot 10^{-3} \cdot I$	
	> 1 μF to 10 μF	> 45 Hz to 5 kHz	$2 \cdot 10^{-3} \cdot I$	
	> 10 μF to 100 μF	1 kHz to 10 kHz	$1.5 \cdot 10^{-3} \cdot C$	
HF-Power	100 pF to <1 nF	50 Hz to 10 kHz	$1.0 \cdot 10^{-3} \cdot C$	
		50 Hz to 1 kHz	$1.0 \cdot 10^{-3} \cdot C$	
	1 nF to 1 μF	> 1 kHz to 10 kHz	$3 \cdot 10^{-3} \cdot C$	
	> 1 μF to 10 μF	50 Hz to 1 kHz	$3 \cdot 10^{-3} \cdot C$	
	> 10 μF to 100 μF	> DC to 100 MHz	$5.8 \cdot 10^{-3} \cdot P$	

Valid from: 01.03.2023

Date of issue: 01.03.2023

Annex to the Accreditation Certificate D-K-15195-01-00

Location Köln, Mobile Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
HF-Power Sensors with mismatch correction		> 100 MHz to 2.4 GHz > 2.4 GHz to 4 GHz > 4 GHz to 8 GHz > 8 GHz to 12.4 GHz > 12.4 GHz to 18 GHz > 18 GHz to 26.5 GHz > 26.5 GHz to 40 GHz	$7.0 \cdot 10^{-3} \cdot P$ $8.0 \cdot 10^{-3} \cdot P$ $10 \cdot 10^{-3} \cdot P$ $13 \cdot 10^{-3} \cdot P$ $15 \cdot 10^{-3} \cdot P$ $15 \cdot 10^{-3} \cdot P$ $19 \cdot 10^{-3} \cdot P$	PC Type-N ²⁾ to 18 GHz PC-3.5 ²⁾ to 33 GHz PC-2.92 ²⁾ to 40 GHz PC-2.4 ²⁾ to 50 GHz PC-1.85 ²⁾ to 67 GHz PC-1.00 ²⁾ to 110 GHz
	10 µW to 200 mW	> DC to 1 MHz > 1 MHz to 100 MHz > 100 MHz to 2.4 GHz 2.4 GHz to 8 GHz > 8 GHz to 12.4 GHz > 12.4 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	$3.0 \cdot 10^{-3} \cdot P$ $3.4 \cdot 10^{-3} \cdot P$ $5.1 \cdot 10^{-3} \cdot P$ $6.8 \cdot 10^{-3} \cdot P$ $8.4 \cdot 10^{-3} \cdot P$ $11 \cdot 10^{-3} \cdot P$ $14 \cdot 10^{-3} \cdot P$ $17 \cdot 10^{-3} \cdot P$ $21 \cdot 10^{-3} \cdot P$ $33 \cdot 10^{-3} \cdot P$	
HF-Power Sources. Measuring instruments with mismatch correction	10 µW to 200 mW	> DC to 100 MHz > 100 MHz to 1 GHz	$5.0 \cdot 10^{-3} \cdot P$ $6.0 \cdot 10^{-3} \cdot P$	
	0.2 fW to < 10 pW	> DC to 8 GHz > 8 GHz to 20 GHz	$21 \cdot 10^{-3} \cdot P$ $24 \cdot 10^{-3} \cdot P$	
	1 fW to < 10 pW	> 20 GHz to 40 GHz	$29 \cdot 10^{-3} \cdot P$	
	10 fW to < 10 pW	> 40 GHz to 50 GHz > 50 GHz to 67 GHz	$43 \cdot 10^{-3} \cdot P$ $49 \cdot 10^{-3} \cdot P$	
	10 pW to < 100 nW	> DC to 100 MHz > 100 MHz to 8 GHz > 8 GHz to 20 GHz > 20 GHz to 40 GHz > 40 GHz to 50 GHz > 50 GHz to 67 GHz	$15 \cdot 10^{-3} \cdot P$ $17 \cdot 10^{-3} \cdot P$ $20 \cdot 10^{-3} \cdot P$ $26 \cdot 10^{-3} \cdot P$ $34 \cdot 10^{-3} \cdot P$ $43 \cdot 10^{-3} \cdot P$	
	100 pW to < 100 µW	> 67 GHz to 75 GHz > 75 GHz to 90 GHz > 90 GHz to 110 GHz	$45 \cdot 10^{-3} \cdot P$ $47 \cdot 10^{-3} \cdot P$ $49 \cdot 10^{-3} \cdot P$	
	100 pW to 200 mW	> DC to 100 MHz > 100 MHz to 8 GHz > 8 GHz to 18 GHz > 18 GHz to 40 GHz > 40 GHz to 50 GHz > 50 GHz to 67 GHz	$10 \cdot 10^{-3} \cdot P$ $13 \cdot 10^{-3} \cdot P$ $16 \cdot 10^{-3} \cdot P$ $23 \cdot 10^{-3} \cdot P$ $21 \cdot 10^{-3} \cdot P$ $33 \cdot 10^{-3} \cdot P$	
	100 µW to 125 mW	> 67 GHz to 75 GHz > 75 GHz to 90 GHz > 90 GHz to 110 GHz	$40 \cdot 10^{-3} \cdot P$ $42 \cdot 10^{-3} \cdot P$ $44 \cdot 10^{-3} \cdot P$	
	> 200 mW to 20 W	> DC to 100 MHz > 100 MHz to 4 GHz	$11 \cdot 10^{-3} \cdot P$ $14 \cdot 10^{-3} \cdot P$	

Valid from: 01.03.2023

Date of issue: 01.03.2023

Annex to the Accreditation Certificate D-K-15195-01-00

Location Köln, Mobile Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
HF-Power Sources. Measuring instruments with mismatch correction	> 200 mW to 4 W	> 4 GHz to 8 GHz > 8 GHz to 12.5 GHz > 12.5 GHz to 18 GHz	$15 \cdot 10^{-3} \cdot P$ $19 \cdot 10^{-3} \cdot P$ $23 \cdot 10^{-3} \cdot P$	P: Measured value
	> 200 mW to 2 W	> 18 GHz to 26.5 GHz	$25 \cdot 10^{-3} \cdot P$	
	> 200 mW to 1 W	> 26.5 GHz to 40 GHz	$31 \cdot 10^{-3} \cdot P$	
without mismatch correction	> 20 W to 2 kW	> DC to 1 GHz	$24 \cdot 10^{-3} \cdot P$	
	> 20 W to 500 W	> 1 GHz to 4 GHz	$30 \cdot 10^{-3} \cdot P$	
	> 4 W to 500 W	> 4 GHz to 10 GHz	$30 \cdot 10^{-3} \cdot P$	
	> 4 W to 100 W	> 10 GHz to 18 GHz	$40 \cdot 10^{-3} \cdot P$	
	> 2 kW to 10 kW	> DC to 250 MHz	$41 \cdot 10^{-3} \cdot P$	
Display Linearity Level distance, Attenuation	0 dB to 21 dB	> DC to 40 GHz	0.003 dB	A: Measured value
	> 21 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 60 dB	> 67 GHz to 110 GHz	$0.03 \text{ dB} + 0.001 \cdot A$	
	> 60 dB to 80 dB	> 67 GHz to 110 GHz	0.6 dB	
	> 80 dB to 90 dB	> 67 GHz to 110 GHz	1.8 dB	
HF-Transmission Phase angle φ	- 180 ° to 180 °	> DC to 100 MHz	0.5 °	Dependent on Attenuation value
		> 100 MHz to 10 GHz	0.7 °	
		> 10 GHz to 20 GHz	1.0 °	
		> 20 GHz to 40 GHz	1.8 °	
		> 40 GHz to 67 GHz	2.0 °	
		> 67 GHz to 110 GHz	3.0 °	
HF-Impedance Reflection factor	0.0 to 0.4	> DC to 10 GHz	0.0034	PC Type-N ²⁾ Γ : Magnitude of complex reflection factor
	> 0.4 to 1.0	> DC to 10 GHz	$0.0015 + 0.005 \cdot \Gamma $	
	0.0 to 0.4	> 10 GHz to 18 GHz	0.0034	PC-3.5 ²⁾
	> 0.4 to 1.0	> 10 GHz to 18 GHz	$0.01 \cdot \Gamma $	
	0.0 to 0.4	> 18 GHz to 26.5 GHz	0.0065	PC-2.92 ²⁾
	> 0.4 to 1.0	> 18 GHz to 26.5 GHz	$0.001 + 0.013 \cdot \Gamma $	
	0.0 to 0.4	> 26.5 GHz to 40 GHz	0.011	PC-2.4 ²⁾ , PC-1.85 ²⁾
	> 0.4 to 1.0	> 26.5 GHz to 40 GHz	$0.005 + 0.016 \cdot \Gamma $	
	0.0 to 1.0	> DC to 2 GHz	$0.0035 + 0.0042 \cdot \Gamma ^2$	
		> 2 GHz to 10 GHz	$0.0037 + 0.0050 \cdot \Gamma ^2$	
	> 10 GHz to 20 GHz	$0.0042 + 0.0069 \cdot \Gamma ^2$		
	> 20 GHz to 30 GHz	$0.0055 + 0.0101 \cdot \Gamma ^2$		
	> 30 GHz to 40 GHz	$0.0067 + 0.0120 \cdot \Gamma ^2$		
	> 40 GHz to 50 GHz	$0.0085 + 0.0151 \cdot \Gamma ^2$		
	> 50 GHz to 67 GHz	$0.0113 + 0.0183 \cdot \Gamma ^2$		

Valid from: 01.03.2023

Date of issue: 01.03.2023

Annex to the Accreditation Certificate D-K-15195-01-00

Location Köln, Mobile Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
HF-Impedance Reflection factor	0.0 to 1.0	> DC to 2 GHz > 2 GHz to 10 GHz > 10 GHz to 20 GHz > 20 GHz to 30 GHz > 30 GHz to 40 GHz > 40 GHz to 50 GHz > 50 GHz to 67 GHz > 67 GHz to 90 GHz > 90 GHz to 110 GHz > 110 GHz to 114 GHz	$0.0036 + 0.0049 \cdot \Gamma ^2$ $0.0036 + 0.0052 \cdot \Gamma ^2$ $0.0041 + 0.0068 \cdot \Gamma ^2$ $0.0049 + 0.0095 \cdot \Gamma ^2$ $0.0056 + 0.0117 \cdot \Gamma ^2$ $0.0063 + 0.0131 \cdot \Gamma ^2$ $0.0074 + 0.0173 \cdot \Gamma ^2$ $0.0093 + 0.0213 \cdot \Gamma ^2$ $0.0122 + 0.0280 \cdot \Gamma ^2$ $0.0142 + 0.0331 \cdot \Gamma ^2$	Connector ²⁾ : PC-1.00
	0.0 to 1.0	50 GHz to 75 GHz 60 GHz to 90 GHz 90 GHz to 110 GHz	$0.01 + 0.008 \cdot \Gamma $ $0.01 + 0.008 \cdot \Gamma $ $0.01 + 0.008 \cdot \Gamma $	Connector: R620 Connector: R740 Connector: R900
HF-Impedance Phase angle φ	- 180° to 180°	> DC to 110 GHz	$U_s \cdot 180^\circ / \pi$	$U_s = \arcsin(U/ \Gamma)$ U: Uncertainty of reflection factor
Frequency	0.1 MHz 1 MHz 5 MHz 10 MHz	Messzeit > 120 min	$1 \cdot 10^{-11} \cdot f$	f: Measured value U_{TRIG} : Trigger-uncertainty
	0.1 mHz to 110 GHz	Messzeit > 5 min	$\sqrt{(1 \cdot 10^{-10} \cdot f)^2 + U_{TRIG}^2}$	
Time interval	1 ns to 10 000 s		$\sqrt{(1 \text{ ns})^2 + (1 \cdot 10^{-10} \cdot t)^2 + U_{TRIG}^2}$	
Modulation quantities Amplitude modulation Modulation degree m	0.01 to 1.0	> DC $f_m \leq 100 \text{ kHz}$ $100 \text{ kHz} < f_m \leq 1 \text{ MHz}$ $1 \text{ MHz} < f_m \leq 10 \text{ MHz}$	$0.002 \cdot m + K$ $0.005 \cdot m + K$ $0.02 \cdot m + K$	m: Measured value f_{HF} = Carrier frequency f_m = Modulation freq. $f_{HF} > 5 \cdot f_m^{(3)}$
Frequency modulation Frequency deviation Δf	10 Hz to 16 MHz	$10 \text{ Hz} < f_m \leq 100 \text{ kHz}$ $100 \text{ kHz} < f_m \leq 200 \text{ kHz}$ $200 \text{ kHz} < f_m \leq 10 \text{ MHz}$	$1 \cdot 10^{-3} \cdot \Delta f + K$ $2 \cdot 10^{-3} \cdot \Delta f + K$ $5 \cdot 10^{-3} \cdot \Delta f + K$	Δf : Measured value $f_{HF} > 5 \cdot (f_m + \Delta f)^{(3)}$
Phase modulation Phase deviation $\Delta \phi$	(10 Hz/ f_m) rad to (16 MHz/ f_m) rad	$10 \text{ Hz} < f_m \leq 100 \text{ kHz}$ $100 \text{ kHz} < f_m \leq 200 \text{ kHz}$ $200 \text{ kHz} < f_m \leq 10 \text{ MHz}$	$1 \cdot 10^{-3} \cdot \Delta \phi + K$ $2 \cdot 10^{-3} \cdot \Delta \phi + K$ $5 \cdot 10^{-3} \cdot \Delta \phi + K$	$\Delta \phi$: Measured value $f_{HF} > 5 \cdot (f_m + \Delta \phi)^{(3)}$

Valid from: 01.03.2023

Date of issue: 01.03.2023

Page 29 of 30

This document is a translation. The definitive version is the original German annex to the accreditation certificate.

Annex to the Accreditation Certificate D-K-15195-01-00

Location Köln, Mobile Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
Waveform quantities	200 ps to 1 s	1 mV to 100 V in 50 Ω	$20 \cdot 10^{-3} \cdot t + (50 \text{ ps})^2/t$	t: Measured value
Rise time	2 ns to 1 s	100 V to 5 kV in 50 Ω	$20 \cdot 10^{-3} \cdot t + (0.3 \text{ ns})^2/t$	e.g. Burst according to EN 61000-4-4:2013
	3 ns to 1 s	100 V to 8 kV in 1 kΩ	$20 \cdot 10^{-3} \cdot t + (0.5 \text{ ns})^2/t$	e.g. Surge according to EN 61000-4-5:2019
	10 ns to 1 s	100 V to 15 kV. with HV-Probe	$20 \cdot 10^{-3} \cdot t + (2.2 \text{ ns})^2/t$	
	20 ns to 10 μs	1 mA to 5 kA with current transformer	$20 \cdot 10^{-3} \cdot t + (5 \text{ ns})^2/t$	
	0.7 ns to 500 ns	1 A to 150 A with ESD-Target	$30 \cdot 10^{-3} \cdot t$	ESD according to EN 61000-4-2:2009
Pulse duration	0.5 ns to 10 s		$2 \cdot 10^{-3} \cdot t + 10 \text{ ps} + \delta t_{\text{TRIG}}$	δt_{TRIG} : Trigger uncertainty
Repetition time	1 ns to 10 s			
Burst duration	5 ns to 10 s			
Burst period	5 ns to 10 s			
Pulse voltage	10 mV to 500 V	200 ps ≤ Δt ≤ 1 s at 50 Ω	$20 \cdot 10^{-3} \cdot U \cdot \Delta t \geq 20 \text{ ns}$	U: Measured value Δt: Pulse duration
	10 V to 5 kV	2.5 ns ≤ Δt ≤ 1 s at 50 Ω	$30 \cdot 10^{-3} \cdot U \cdot \Delta t < 20 \text{ ns}$	e.g. Burst according to EN 61000-4-4:2013
	10 V to 8 kV	2.5 ns ≤ Δt ≤ 1 s at 1 kΩ		e.g. Surge according to EN 61000-4-5:2019
	10 V to 15 kV	10 ns ≤ Δt ≤ 1 s, high resistance		
Pulse current	1 A to 5 kA	20 ns ≤ Δt ≤ 10 ms	$20 \cdot 10^{-3} \cdot I$	I: Measured value
ESD-current pulse	1 A to 150 A	Current peak	$40 \cdot 10^{-3} \cdot I$	I: Measured value
	1 A to 150 A	Current grid values after 30 ns und 60 ns	$25 \cdot 10^{-3} \cdot I$	Calibration with Target according to EN 61000-4-2:2009
Pulse spectrum	0.1 μVs to 50 μVs	9 kHz to 150 kHz	$25 \cdot 10^{-3} \cdot I/S$	I/S: Measured value
	3 nVs to 1 μVs	150 kHz to 30 MHz	$25 \cdot 10^{-3} \cdot I/S$	CISPR 16-1-1:2019
	0.4 nVs to 200 nVs	30 MHz to 1 GHz	$27 \cdot 10^{-3} \cdot I/S$	
Antenna factor (ECSM)	Preset by antennas	9 kHz to 30 MHz CISPR 16-1-6:2022	1.2 dB	monopole antennas ECSM procedure
Antenna factor				loop antennas standard field procedure

Abbreviations used:

CISPR	Comité international spécial des perturbations radioélectriques
CMC	Calibration and measurement capabilities
DIN	German institute for standardization

Valid from: 01.03.2023

Date of issue: 01.03.2023

Page 30 of 30

This document is a translation. The definitive version is the original German annex to the accreditation certificate.