

Deutsche Akkreditierungsstelle

Annex to the Accreditation Certificate D-K-21039-01-00 according to DIN EN ISO/IEC 17025:2018

Valid from: 23.05.2023

Date of issue: 19.07.2024

Holder of accreditation certificate:

Framatome GmbH
Paul-Gossen-Straße 100, 91052 Erlangen

with the locations

Framatome GmbH
Kalibrierlaboratorium
Paul-Gossen-Straße 100, 91052 Erlangen

Framatome GmbH
Kalibrierlaboratorium
Seligenstädter Straße 100, 63791 Karlstein am Main

The calibration laboratory meets the requirements of DIN EN ISO/IEC 17025:2018 to carry out the conformity assessment activities listed in this annex. The calibration laboratory meets additional legal and normative requirements, if applicable, including those in relevant sectoral schemes, provided that these are explicitly confirmed below.

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

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>.

Abbreviations used: see last page

Page 1 of 13

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Annex to the Accreditation Certificate D-K-21039-01-00

Calibrations in the following areas:

Electrical quantities

DC and low frequency quantities

- DC voltage ^{a)}
- DC current ^{a)}
- DC resistance ^{a)}
- AC voltage ^{a)}
- AC current ^{a)}

Time and frequency

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

High frequency and radiation Measurements

High frequency quantities

- Oscilloscope quantities ^{a)}

^{a)} also on-site calibrations

Valid from: 23.05.2023

Date of issue: 19.07.2024

Page 2 of 13

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Annex to the Accreditation Certificate D-K-21039-01-00

Permanent Laboratory - Location Erlangen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Extended uncertainty of Measurement	Remarks
DC voltage Measurement instruments	0 V to < 0,33 V		$25 \cdot 10^{-6} \cdot U + 2,0 \mu\text{V}$	U: measured value
	0,33 V to < 3,3 V		$15 \cdot 10^{-6} \cdot U + 3,0 \mu\text{V}$	
	3,3 V to < 33 V		$15 \cdot 10^{-6} \cdot U + 30 \mu\text{V}$	
	33 V to < 330 V		$25 \cdot 10^{-6} \cdot U + 0,20 \text{ mV}$	
	330 V to 1000 V		$25 \cdot 10^{-6} \cdot U + 2,0 \text{ mV}$	
Sources	0 V to 0,1 V		$15 \cdot 10^{-6} \cdot U + 1,0 \mu\text{V}$	
	> 0,1 V to 1 V		$15 \cdot 10^{-6} \cdot U + 1,0 \mu\text{V}$	
	> 1 V to 10 V		$15 \cdot 10^{-6} \cdot U + 1,0 \mu\text{V}$	
	> 10 V to 100 V		$15 \cdot 10^{-6} \cdot U + 50 \mu\text{V}$	
	> 100 V to 1000 V		$15 \cdot 10^{-6} \cdot U + 0,15 \text{ mV}$	
DC current Measurement instruments	20 μA to < 330 μA		$0,20 \cdot 10^{-3} \cdot I + 0,10 \mu\text{A}$	I: measured value
	330 μA to < 3,3 mA		$0,15 \cdot 10^{-3} \cdot I + 0,10 \mu\text{A}$	
	3,3 mA to < 33 mA		$0,13 \cdot 10^{-3} \cdot I + 1,0 \mu\text{A}$	
	33 mA to < 330 mA		$0,13 \cdot 10^{-3} \cdot I + 5,0 \mu\text{A}$	
	330 mA to < 1,1 A		$0,25 \cdot 10^{-3} \cdot I + 60 \mu\text{A}$	
	1,1 A to < 3,0 A		$0,50 \cdot 10^{-3} \cdot I + 50 \mu\text{A}$	
	3,0 A to < 11 A		$0,60 \cdot 10^{-3} \cdot I + 0,70 \text{ mA}$	
Sources	> 0,1 μA to 1 μA		$30 \cdot 10^{-6} \cdot I + 0,00010 \mu\text{A}$	
	> 1 μA to 10 μA		$30 \cdot 10^{-6} \cdot I + 0,00015 \mu\text{A}$	
	> 10 μA to 100 μA		$30 \cdot 10^{-6} \cdot I + 0,0015 \mu\text{A}$	
	> 100 μA to 1 mA		$25 \cdot 10^{-6} \cdot I + 0,010 \mu\text{A}$	
	> 1 mA to 10 mA		$30 \cdot 10^{-6} \cdot I + 0,10 \mu\text{A}$	
	> 10 mA to 100 mA		$50 \cdot 10^{-6} \cdot I + 1,0 \mu\text{A}$	
	> 100 mA to 1 A		$150 \cdot 10^{-6} \cdot I + 10 \mu\text{A}$	

Valid from: 23.05.2023

Date of issue: 19.07.2024

Page 3 of 13

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

Annex to the Accreditation Certificate D-K-21039-01-00

Permanent Laboratory - Location Erlangen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Extended uncertainty of Measurement	Remarks
DC resistance Measurement instruments	1 Ω to < 11 Ω		$25 \cdot 10^{-6} \cdot R + 0,70 \text{ m}\Omega$	R: measured value
	11 Ω to < 33 Ω		$30 \cdot 10^{-6} \cdot R + 0,50 \text{ m}\Omega$	
	33 Ω to < 330 Ω		$40 \cdot 10^{-6} \cdot R + 0,20 \text{ m}\Omega$	
	330 Ω to < 3,3 kΩ		$40 \cdot 10^{-6} \cdot R + 2,0 \text{ m}\Omega$	
	3,3 kΩ to < 33 kΩ		$40 \cdot 10^{-6} \cdot R + 20 \text{ m}\Omega$	
	33 kΩ to < 110 kΩ		$30 \cdot 10^{-6} \cdot R + 2,0 \Omega$	
	110 kΩ to < 330 kΩ		$40 \cdot 10^{-6} \cdot R + 10 \Omega$	
	330 kΩ to < 1,1 MΩ		$40 \cdot 10^{-6} \cdot R + 0,15 \text{ k}\Omega$	
	1,1 MΩ to < 3,3 MΩ		$40 \cdot 10^{-6} \cdot R + 1,5 \text{ k}\Omega$	
	3,3 MΩ to < 11 MΩ		$0,10 \cdot 10^{-3} \cdot R + 1,5 \text{ k}\Omega$	
	11 MΩ to < 33 MΩ		$0,30 \cdot 10^{-3} \cdot R + 1,5 \text{ k}\Omega$	
	33 MΩ to < 110 MΩ		$0,60 \cdot 10^{-3} \cdot R + 5,0 \text{ k}\Omega$	
	110 MΩ to < 330 MΩ		$3,5 \cdot 10^{-3} \cdot R + 5,0 \text{ k}\Omega$	
330 MΩ to < 1,1 GΩ	$18 \cdot 10^{-3} \cdot R + 5,0 \text{ k}\Omega$			
DC resistance Resistance	1 Ω to 10 Ω		$20 \cdot 10^{-6} \cdot R + 0,10 \text{ m}\Omega$	
	> 10 Ω to 100 Ω		$15 \cdot 10^{-6} \cdot R + 1,0 \text{ m}\Omega$	
	> 100 Ω to 1 kΩ		$15 \cdot 10^{-6} \cdot R + 1,0 \text{ m}\Omega$	
	> 1 kΩ to 10 kΩ		$15 \cdot 10^{-6} \cdot R + 10 \text{ m}\Omega$	
	> 10 kΩ to 100 kΩ		$15 \cdot 10^{-6} \cdot R + 0,10 \Omega$	
	> 100 kΩ to 1 MΩ		$20 \cdot 10^{-6} \cdot R + 4,0 \Omega$	
	> 1 MΩ to 10 MΩ		$60 \cdot 10^{-6} \cdot R + 0,20 \text{ k}\Omega$	
	> 10 MΩ to 100 MΩ		$0,60 \cdot 10^{-3} \cdot R + 1,5 \text{ k}\Omega$	
> 100 MΩ to 1 GΩ	$6,0 \cdot 10^{-3} \cdot R + 20 \text{ k}\Omega$			
AC voltage Measurement instruments	0,001 V to < 0,033 V	45 Hz to 10 kHz	$0,20 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$	U: measured value
	0,033 V to < 0,33 V		$0,20 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$	
	0,33 V to < 3,3 V		$0,20 \cdot 10^{-3} \cdot U + 0,10 \text{ mV}$	
	3,3 V to < 33 V		$0,20 \cdot 10^{-3} \cdot U + 1,0 \text{ mV}$	
	33 V to < 330 V		$0,25 \cdot 10^{-3} \cdot U + 10 \text{ mV}$	
	330 V to 1000 V		$0,35 \cdot 10^{-3} \cdot U + 15 \text{ mV}$	
Sources	0,001 V to 0,01 V	40 Hz to 20 kHz	$0,40 \cdot 10^{-3} \cdot U + 2,0 \mu\text{V}$	
	> 0,01 V to 0,1 V		$0,20 \cdot 10^{-3} \cdot U + 3,0 \mu\text{V}$	
	> 0,1 V to 1 V		$0,20 \cdot 10^{-3} \cdot U + 30 \mu\text{V}$	
	> 1 V to 10 V		$0,20 \cdot 10^{-3} \cdot U + 0,30 \text{ mV}$	
	> 10 V to 100 V		$0,30 \cdot 10^{-3} \cdot U + 3,0 \text{ mV}$	
	> 100 V to 700 V	40 Hz to 1 kHz	$0,60 \cdot 10^{-3} \cdot U + 30 \text{ mV}$	

Valid from: 23.05.2023

Date of issue: 19.07.2024

Page 4 of 13

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

Annex to the Accreditation Certificate D-K-21039-01-00

Permanent Laboratory - Location Erlangen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Extended uncertainty of Measurement	Remarks
AC current Measurement instruments	29 μ A to < 330 μ A	45 Hz to 1 kHz	$1,5 \cdot 10^{-3} \cdot I + 1,0 \mu\text{A}$	I: measured value
	330 μ A to < 3,3 mA		$1,2 \cdot 10^{-3} \cdot I + 1,0 \mu\text{A}$	
	3,3 mA to < 33 mA		$0,50 \cdot 10^{-3} \cdot I + 5,0 \mu\text{A}$	
	33 mA to < 330 mA		$0,50 \cdot 10^{-3} \cdot I + 50 \mu\text{A}$	
	330 mA to < 1,1 A		$0,60 \cdot 10^{-3} \cdot I + 0,20 \text{ mA}$	
	1,1 A to < 3 A		$0,70 \cdot 10^{-3} \cdot I + 0,20 \text{ mA}$	
	3 A to < 11 A		$1,2 \cdot 10^{-3} \cdot I + 3,0 \text{ mA}$	
Sources	11 A to 20 A		$1,8 \cdot 10^{-3} \cdot I + 12 \text{ mA}$	
	10 μ A to 100 μ A	45 Hz to 5 kHz	$0,70 \cdot 10^{-3} \cdot I + 0,10 \mu\text{A}$	
	> 100 μ A to 1 mA		$0,70 \cdot 10^{-3} \cdot I + 0,50 \mu\text{A}$	
	> 1 mA to 10 mA		$0,70 \cdot 10^{-3} \cdot I + 5,0 \mu\text{A}$	
	> 10 mA to 100 mA		$0,70 \cdot 10^{-3} \cdot I + 50 \mu\text{A}$	
> 100 mA to 1 A	45 Hz to 1 kHz	$1,5 \cdot 10^{-3} \cdot I + 0,30 \text{ mA}$		
Frequency Measurement instruments	0,1 Hz to 20 MHz		$25 \cdot 10^{-6} \cdot f$	f: measured value
	Sources	0,1 Hz to 20 MHz	$6,0 \cdot 10^{-6} \cdot f$	
Time interval Sources	50 ns to 10 s		$25 \cdot 10^{-6} \cdot t$	t: measured value

On-Site Calibration - Location Erlangen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Extended uncertainty of Measurement	Remarks
DC voltage Measurement instruments	0 V to < 0,33 V		$25 \cdot 10^{-6} \cdot U + 2,0 \mu\text{V}$	U: measured value
	0,33 V to < 3,3 V		$15 \cdot 10^{-6} \cdot U + 3,0 \mu\text{V}$	
	3,3 V to < 33 V		$15 \cdot 10^{-6} \cdot U + 30 \mu\text{V}$	
	33 V to < 330 V		$25 \cdot 10^{-6} \cdot U + 0,20 \text{ mV}$	
	330 V to 1000 V		$25 \cdot 10^{-6} \cdot U + 2,0 \text{ mV}$	
Sources	0 V to 0,1 V		$15 \cdot 10^{-6} \cdot U + 1,0 \mu\text{V}$	
	> 0,1 V to 1 V		$15 \cdot 10^{-6} \cdot U + 1,0 \mu\text{V}$	
	> 1 V to 10 V		$15 \cdot 10^{-6} \cdot U + 1,0 \mu\text{V}$	
	> 10 V to 100 V		$15 \cdot 10^{-6} \cdot U + 50 \mu\text{V}$	
	> 100 V to 1000 V		$15 \cdot 10^{-6} \cdot U + 0,15 \text{ mV}$	

Valid from: 23.05.2023

Date of issue: 19.07.2024

Annex to the Accreditation Certificate D-K-21039-01-00

On-Site Calibration - Location Erlangen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Extended uncertainty of Measurement	Remarks
DC current Measurement instruments	20 μ A to < 330 μ A		$0,20 \cdot 10^{-3} \cdot I + 0,10 \mu$ A	I: measured value
	330 μ A to < 3,3 mA		$0,15 \cdot 10^{-3} \cdot I + 0,10 \mu$ A	
	3,3 mA to < 33 mA		$0,13 \cdot 10^{-3} \cdot I + 1,0 \mu$ A	
	33 mA to < 330 mA		$0,13 \cdot 10^{-3} \cdot I + 5,0 \mu$ A	
	330 mA to < 1,1 A		$0,25 \cdot 10^{-3} \cdot I + 60 \mu$ A	
	1,1 A to < 3,0 A		$0,50 \cdot 10^{-3} \cdot I + 50 \mu$ A	
	3,0 A to < 11 A		$0,60 \cdot 10^{-3} \cdot I + 0,70$ mA	
Sources	11 A to 20 A		$1,2 \cdot 10^{-3} \cdot I + 1,0$ mA	
	> 0,1 μ A to 1 μ A		$30 \cdot 10^{-6} \cdot I + 0,00010 \mu$ A	
	> 1 μ A to 10 μ A		$30 \cdot 10^{-6} \cdot I + 0,00015 \mu$ A	
	> 10 μ A to 100 μ A		$30 \cdot 10^{-6} \cdot I + 0,0015 \mu$ A	
	> 100 μ A to 1 mA		$25 \cdot 10^{-6} \cdot I + 0,010 \mu$ A	
	> 1 mA to 10 mA		$30 \cdot 10^{-6} \cdot I + 0,10 \mu$ A	
	> 10 mA to 100 mA		$50 \cdot 10^{-6} \cdot I + 1,0 \mu$ A	
DC resistance Measurement instruments	> 100 mA to 1 A		$150 \cdot 10^{-6} \cdot I + 10 \mu$ A	
	1 Ω to < 11 Ω		$25 \cdot 10^{-6} \cdot R + 0,70$ m Ω	R: measured value
	11 Ω to < 33 Ω		$30 \cdot 10^{-6} \cdot R + 0,50$ m Ω	
	33 Ω to < 330 Ω		$40 \cdot 10^{-6} \cdot R + 0,20$ m Ω	
	330 Ω to < 3,3 k Ω		$40 \cdot 10^{-6} \cdot R + 2,0$ m Ω	
	3,3 k Ω to < 33 k Ω		$40 \cdot 10^{-6} \cdot R + 20$ m Ω	
	33 k Ω to < 110 k Ω		$30 \cdot 10^{-6} \cdot R + 2,0 \Omega$	
	110 k Ω to < 330 k Ω		$40 \cdot 10^{-6} \cdot R + 10 \Omega$	
	330 k Ω to < 1,1 M Ω		$40 \cdot 10^{-6} \cdot R + 0,15$ k Ω	
	1,1 M Ω to < 3,3 M Ω		$40 \cdot 10^{-6} \cdot R + 1,5$ k Ω	
	3,3 M Ω to < 11 M Ω		$0,10 \cdot 10^{-3} \cdot R + 1,5$ k Ω	
	11 M Ω to < 33 M Ω		$0,30 \cdot 10^{-3} \cdot R + 1,5$ k Ω	
	33 M Ω to < 110 M Ω		$0,60 \cdot 10^{-3} \cdot R + 5,0$ k Ω	
110 M Ω to < 330 M Ω		$3,5 \cdot 10^{-3} \cdot R + 5,0$ k Ω		
330 M Ω to < 1,1 G Ω		$18 \cdot 10^{-3} \cdot R + 5,0$ k Ω		

Valid from: 23.05.2023

Date of issue: 19.07.2024

Page 6 of 13

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Annex to the Accreditation Certificate D-K-21039-01-00

On-Site Calibration - Location Erlangen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Extended uncertainty of Measurement	Remarks
DC resistance Resistance	1 Ω to 10 Ω > 10 Ω to 100 Ω > 100 Ω to 1 kΩ > 1 kΩ to 10 kΩ > 10 kΩ to 100 kΩ > 100 kΩ to 1 MΩ > 1 MΩ to 10 MΩ > 10 MΩ to 100 MΩ > 100 MΩ to 1 GΩ		$20 \cdot 10^{-6} \cdot R + 0,10 \text{ m}\Omega$ $15 \cdot 10^{-6} \cdot R + 1,0 \text{ m}\Omega$ $15 \cdot 10^{-6} \cdot R + 1,0 \text{ m}\Omega$ $15 \cdot 10^{-6} \cdot R + 10 \text{ m}\Omega$ $15 \cdot 10^{-6} \cdot R + 0,10 \Omega$ $20 \cdot 10^{-6} \cdot R + 4,0 \Omega$ $60 \cdot 10^{-6} \cdot R + 0,20 \text{ k}\Omega$ $0,60 \cdot 10^{-3} \cdot R + 1,5 \text{ k}\Omega$ $6,0 \cdot 10^{-3} \cdot R + 20 \text{ k}\Omega$	R: measured value
AC voltage Measurement instruments	0,001 V to < 0,033 V 0,033 V to < 0,33 V 0,33 V to < 3,3 V 3,3 V to < 33 V 33 V to < 330 V 330 V to 1000 V	45 Hz to 10 kHz	$0,20 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$ $0,20 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$ $0,20 \cdot 10^{-3} \cdot U + 0,10 \text{ mV}$ $0,20 \cdot 10^{-3} \cdot U + 1,0 \text{ mV}$ $0,25 \cdot 10^{-3} \cdot U + 10 \text{ mV}$ $0,35 \cdot 10^{-3} \cdot U + 15 \text{ mV}$	U: measured value
Sources	0,001 V to 0,01 V > 0,01 V to 0,1 V > 0,1 V to 1 V > 1 V to 10 V > 10 V to 100 V ----- > 100 V to 700 V	40 Hz to 20 kHz ----- 40 Hz to 1 kHz	$0,40 \cdot 10^{-3} \cdot U + 2,0 \mu\text{V}$ $0,20 \cdot 10^{-3} \cdot U + 3,0 \mu\text{V}$ $0,20 \cdot 10^{-3} \cdot U + 30 \mu\text{V}$ $0,20 \cdot 10^{-3} \cdot U + 0,30 \text{ mV}$ $0,30 \cdot 10^{-3} \cdot U + 3,0 \text{ mV}$ ----- $0,60 \cdot 10^{-3} \cdot U + 30 \text{ mV}$	
AC current Measurement instruments	29 μA to < 330 μA 330 μA to < 3,3 mA 3,3 mA to < 33 mA 33 mA to < 330 mA 330 mA to < 1,1 A 1,1 A to < 3 A 3 A to < 11 A 11 A to 20 A	45 Hz to 1 kHz	$1,5 \cdot 10^{-3} \cdot I + 1,0 \mu\text{A}$ $1,2 \cdot 10^{-3} \cdot I + 1,0 \mu\text{A}$ $0,50 \cdot 10^{-3} \cdot I + 5,0 \mu\text{A}$ $0,50 \cdot 10^{-3} \cdot I + 50 \mu\text{A}$ $0,60 \cdot 10^{-3} \cdot I + 0,20 \text{ mA}$ $0,70 \cdot 10^{-3} \cdot I + 0,20 \text{ mA}$ $1,2 \cdot 10^{-3} \cdot I + 3,0 \text{ mA}$ $1,8 \cdot 10^{-3} \cdot I + 12 \text{ mA}$	I: measured value
Sources	10 μA to 100 μA > 100 μA to 1 mA > 1 mA to 10 mA > 10 mA to 100 mA ----- > 100 mA to 1 A	45 Hz to 5 kHz ----- 45 Hz to 1 kHz	$0,70 \cdot 10^{-3} \cdot I + 0,10 \mu\text{A}$ $0,70 \cdot 10^{-3} \cdot I + 0,50 \mu\text{A}$ $0,70 \cdot 10^{-3} \cdot I + 5,0 \mu\text{A}$ $0,70 \cdot 10^{-3} \cdot I + 50 \mu\text{A}$ ----- $1,5 \cdot 10^{-3} \cdot I + 0,30 \text{ mA}$	

Valid from: 23.05.2023

Date of issue: 19.07.2024

Page 7 of 13

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

Annex to the Accreditation Certificate D-K-21039-01-00

On-Site Calibration - Location Erlangen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Extended uncertainty of Measurement	Remarks
Frequency				
Measurement instruments	0,1 Hz to 20 MHz		$25 \cdot 10^{-6} \cdot f$	<i>f</i> : measured value
Sources	0,1 Hz to 20 MHz		$6,0 \cdot 10^{-6} \cdot f$	
Time interval				
Sources	50 ns to 10 s		$25 \cdot 10^{-6} \cdot t$	<i>t</i> : measured value

Permanent Laboratory - Location Karlstein am Main

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Extended uncertainty of Measurement	Remarks
DC voltage				
Measurement instruments	0 V to < 0,33 V 0,33 V to < 3,3 V 3,3 V to < 33 V 33 V to < 330 V 330 V to 1000 V		$25 \cdot 10^{-6} \cdot U + 2,0 \mu\text{V}$ $15 \cdot 10^{-6} \cdot U + 3,0 \mu\text{V}$ $15 \cdot 10^{-6} \cdot U + 30 \mu\text{V}$ $25 \cdot 10^{-6} \cdot U + 0,20 \text{ mV}$ $25 \cdot 10^{-6} \cdot U + 2,0 \text{ mV}$	<i>U</i> : measured value
Sources	0 V to 0,1 V > 0,1 V to 1 V > 1 V to 10 V > 10 V to 100 V > 100 V to 1000 V		$15 \cdot 10^{-6} \cdot U + 1,0 \mu\text{V}$ $15 \cdot 10^{-6} \cdot U + 1,0 \mu\text{V}$ $15 \cdot 10^{-6} \cdot U + 1,0 \mu\text{V}$ $15 \cdot 10^{-6} \cdot U + 50 \mu\text{V}$ $15 \cdot 10^{-6} \cdot U + 0,15 \text{ mV}$	
DC current				
Measurement instruments	20 μA to < 330 μA 330 μA to < 3,3 mA 3,3 mA to < 33 mA 33 mA to < 330 mA 330 mA to < 1,1 A 1,1 A to < 3,0 A 3,0 A to < 11 A 11 A to 20 A		$0,20 \cdot 10^{-3} \cdot I + 0,10 \mu\text{A}$ $0,15 \cdot 10^{-3} \cdot I + 0,10 \mu\text{A}$ $0,13 \cdot 10^{-3} \cdot I + 1,0 \mu\text{A}$ $0,13 \cdot 10^{-3} \cdot I + 5,0 \mu\text{A}$ $0,25 \cdot 10^{-3} \cdot I + 60 \mu\text{A}$ $0,50 \cdot 10^{-3} \cdot I + 50 \mu\text{A}$ $0,60 \cdot 10^{-3} \cdot I + 0,70 \text{ mA}$ $1,2 \cdot 10^{-3} \cdot I + 1,0 \text{ mA}$	<i>I</i> : measured value
Sources	> 0,1 μA to 1 μA > 1 μA to 10 μA > 10 μA to 100 μA > 100 μA to 1 mA > 1 mA to 10 mA > 10 mA to 100 mA > 100 mA to 1 A		$30 \cdot 10^{-6} \cdot I + 0,00010 \mu\text{A}$ $30 \cdot 10^{-6} \cdot I + 0,00015 \mu\text{A}$ $30 \cdot 10^{-6} \cdot I + 0,0015 \mu\text{A}$ $25 \cdot 10^{-6} \cdot I + 0,010 \mu\text{A}$ $30 \cdot 10^{-6} \cdot I + 0,10 \mu\text{A}$ $50 \cdot 10^{-6} \cdot I + 1,0 \mu\text{A}$ $150 \cdot 10^{-6} \cdot I + 10 \mu\text{A}$	

Valid from: 23.05.2023

Date of issue: 19.07.2024

Annex to the Accreditation Certificate D-K-21039-01-00

Permanent Laboratory - Location Karlstein am Main

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Extended uncertainty of Measurement	Remarks
DC resistance Measurement instruments	1 Ω to < 11 Ω		$25 \cdot 10^{-6} \cdot R + 0,70 \text{ m}\Omega$	R: measured value
	11 Ω to < 33 Ω		$30 \cdot 10^{-6} \cdot R + 0,50 \text{ m}\Omega$	
	33 Ω to < 330 Ω		$40 \cdot 10^{-6} \cdot R + 0,20 \text{ m}\Omega$	
	330 Ω to < 3,3 kΩ		$40 \cdot 10^{-6} \cdot R + 2,0 \text{ m}\Omega$	
	3,3 kΩ to < 33 kΩ		$40 \cdot 10^{-6} \cdot R + 20 \text{ m}\Omega$	
	33 kΩ to < 110 kΩ		$30 \cdot 10^{-6} \cdot R + 2,0 \Omega$	
	110 kΩ to < 330 kΩ		$40 \cdot 10^{-6} \cdot R + 10 \Omega$	
	330 kΩ to < 1,1 MΩ		$40 \cdot 10^{-6} \cdot R + 0,15 \text{ k}\Omega$	
	1,1 MΩ to < 3,3 MΩ		$40 \cdot 10^{-6} \cdot R + 1,5 \text{ k}\Omega$	
	3,3 MΩ to < 11 MΩ		$0,10 \cdot 10^{-3} \cdot R + 1,5 \text{ k}\Omega$	
	11 MΩ to < 33 MΩ		$0,30 \cdot 10^{-3} \cdot R + 1,5 \text{ k}\Omega$	
	33 MΩ to < 110 MΩ		$0,60 \cdot 10^{-3} \cdot R + 5,0 \text{ k}\Omega$	
	110 MΩ to < 330 MΩ		$3,5 \cdot 10^{-3} \cdot R + 5,0 \text{ k}\Omega$	
330 MΩ to < 1,1 GΩ	$18 \cdot 10^{-3} \cdot R + 5,0 \text{ k}\Omega$			
DC resistance Resistance	1 Ω to 10 Ω		$20 \cdot 10^{-6} \cdot R + 0,10 \text{ m}\Omega$	
	> 10 Ω to 100 Ω		$15 \cdot 10^{-6} \cdot R + 1,0 \text{ m}\Omega$	
	> 100 Ω to 1 kΩ		$15 \cdot 10^{-6} \cdot R + 1,0 \text{ m}\Omega$	
	> 1 kΩ to 10 kΩ		$15 \cdot 10^{-6} \cdot R + 10 \text{ m}\Omega$	
	> 10 kΩ to 100 kΩ		$15 \cdot 10^{-6} \cdot R + 0,10 \Omega$	
	> 100 kΩ to 1 MΩ		$20 \cdot 10^{-6} \cdot R + 4,0 \Omega$	
	> 1 MΩ to 10 MΩ		$60 \cdot 10^{-6} \cdot R + 0,20 \text{ k}\Omega$	
	> 10 MΩ to 100 MΩ		$0,60 \cdot 10^{-3} \cdot R + 1,5 \text{ k}\Omega$	
> 100 MΩ to 1 GΩ	$6,0 \cdot 10^{-3} \cdot R + 20 \text{ k}\Omega$			
AC voltage Measurement instruments	0,001 V to < 0,033 V	45 Hz to 10 kHz	$0,20 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$	U: measured value
	0,033 V to < 0,33 V		$0,20 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$	
	0,33 V to < 3,3 V		$0,20 \cdot 10^{-3} \cdot U + 0,10 \text{ mV}$	
	3,3 V to < 33 V		$0,20 \cdot 10^{-3} \cdot U + 1,0 \text{ mV}$	
	33 V to < 330 V		$0,25 \cdot 10^{-3} \cdot U + 10 \text{ mV}$	
	330 V to 1000 V		$0,35 \cdot 10^{-3} \cdot U + 15 \text{ mV}$	
Sources	0,001 V to 0,01 V	40 Hz to 20 kHz	$0,40 \cdot 10^{-3} \cdot U + 2,0 \mu\text{V}$	
	> 0,01 V to 0,1 V		$0,20 \cdot 10^{-3} \cdot U + 3,0 \mu\text{V}$	
	> 0,1 V to 1 V		$0,20 \cdot 10^{-3} \cdot U + 30 \mu\text{V}$	
	> 1 V to 10 V		$0,20 \cdot 10^{-3} \cdot U + 0,30 \text{ mV}$	
	> 10 V to 100 V		$0,30 \cdot 10^{-3} \cdot U + 3,0 \text{ mV}$	
	> 100 V to 700 V	40 Hz to 1 kHz	$0,60 \cdot 10^{-3} \cdot U + 30 \text{ mV}$	

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Annex to the Accreditation Certificate D-K-21039-01-00

Permanent Laboratory - Location Karlstein am Main

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Extended uncertainty of Measurement	Remarks
AC current Measurement instruments	29 μ A to < 330 μ A	45 Hz to 1 kHz	$1,5 \cdot 10^{-3} \cdot I + 1,0 \mu$ A	I: measured value
	330 μ A to < 3,3 mA		$1,2 \cdot 10^{-3} \cdot I + 1,0 \mu$ A	
	3,3 mA to < 33 mA		$0,50 \cdot 10^{-3} \cdot I + 5,0 \mu$ A	
	33 mA to < 330 mA		$0,50 \cdot 10^{-3} \cdot I + 50 \mu$ A	
	330 mA to < 1,1 A		$0,60 \cdot 10^{-3} \cdot I + 0,20$ mA	
	1,1 A to < 3 A		$0,70 \cdot 10^{-3} \cdot I + 0,20$ mA	
	3 A to < 11 A		$1,2 \cdot 10^{-3} \cdot I + 3,0$ mA	
	11 A to 20 A		$1,8 \cdot 10^{-3} \cdot I + 12$ mA	
Sources	10 μ A to 100 μ A	45 Hz to 5 kHz	$0,70 \cdot 10^{-3} \cdot I + 0,10 \mu$ A	
	> 100 μ A to 1 mA		$0,70 \cdot 10^{-3} \cdot I + 0,50 \mu$ A	
	> 1 mA to 10 mA		$0,70 \cdot 10^{-3} \cdot I + 5,0 \mu$ A	
	> 10 mA to 100 mA		$0,70 \cdot 10^{-3} \cdot I + 50 \mu$ A	
	> 100 mA to 1 A	45 Hz to 1 kHz	$1,5 \cdot 10^{-3} \cdot I + 0,30$ mA	
Frequency Measurement instruments	0,1 Hz to 20 MHz		$25 \cdot 10^{-6} \cdot f$	f: measured value
	Sources		$6,0 \cdot 10^{-6} \cdot f$	
Oscilloscope quantities Vertical deflection	5 mV to 10 mV	DC to 10 MHz	$40 \cdot 10^{-3} \cdot U$	Application: Voltage Measurement
	> 10 mV to 5 V		$35 \cdot 10^{-3} \cdot U$	
Horizontal deflection	0,5 MHz to 1 MHz		$2 \cdot 10^{-3} \cdot f$	Application: Frequency Measurement
	> 1 MHz to 2 MHz		$2 \cdot 10^{-3} \cdot f$	
	> 2 MHz to 5 MHz		$4 \cdot 10^{-3} \cdot f$	
	> 5 MHz to 10 MHz		$7 \cdot 10^{-3} \cdot f$	
	> 10 MHz to 20 MHz		$8 \cdot 10^{-3} \cdot f$	
	> 20 MHz to 25 MHz		$8 \cdot 10^{-3} \cdot f$	
	> 25 MHz to 30 MHz		$10 \cdot 10^{-3} \cdot f$	
> 30 MHz to 35 MHz	$12 \cdot 10^{-3} \cdot f$			
Horizontal deflection	2,0 ns to 10 ns		0,050 ns	Appliaction: Time-duration Measurement
	> 10 ns to 0,10 μ s		0,20 ns	
	> 0,1 μ s to 1,0 μ s		0,30 ns	
	> 1,0 μ s to 10 μ s		3,0 ns	
	> 10 μ s to 50 μ s		10 ns	
	> 50 μ s to 0,10 ms		30 ns	
	> 0,10 ms to 0,50 ms		100 ns	
	> 0,50 ms to 1,0 ms		300 ns	

Valid from: 23.05.2023

Date of issue: 19.07.2024

Page 10 of 13

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

Annex to the Accreditation Certificate D-K-21039-01-00

On-Site Calibration - Location Karlstein am Main

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Extended uncertainty of Measurement	Remarks
DC voltage Measurement instruments	0 V to < 0,33 V		$25 \cdot 10^{-6} \cdot U + 2,0 \mu\text{V}$	U: measured value
	0,33 V to < 3,3 V		$15 \cdot 10^{-6} \cdot U + 3,0 \mu\text{V}$	
	3,3 V to < 33 V		$15 \cdot 10^{-6} \cdot U + 30 \mu\text{V}$	
	33 V to < 330 V		$25 \cdot 10^{-6} \cdot U + 0,20 \text{ mV}$	
	330 V to 1000 V		$25 \cdot 10^{-6} \cdot U + 2,0 \text{ mV}$	
Sources	0 V to 0,1 V		$15 \cdot 10^{-6} \cdot U + 1,0 \mu\text{V}$	
	> 0,1 V to 1 V		$15 \cdot 10^{-6} \cdot U + 1,0 \mu\text{V}$	
	> 1 V to 10 V		$15 \cdot 10^{-6} \cdot U + 1,0 \mu\text{V}$	
	> 10 V to 100 V		$15 \cdot 10^{-6} \cdot U + 50 \mu\text{V}$	
	> 100 V to 1000 V		$15 \cdot 10^{-6} \cdot U + 0,15 \text{ mV}$	
DC current Measurement instruments	20 μA to < 330 μA		$0,20 \cdot 10^{-3} \cdot I + 0,10 \mu\text{A}$	I: measured value
	330 μA to < 3,3 mA		$0,15 \cdot 10^{-3} \cdot I + 0,10 \mu\text{A}$	
	3,3 mA to < 33 mA		$0,13 \cdot 10^{-3} \cdot I + 1,0 \mu\text{A}$	
	33 mA to < 330 mA		$0,13 \cdot 10^{-3} \cdot I + 5,0 \mu\text{A}$	
	330 mA to < 1,1 A		$0,25 \cdot 10^{-3} \cdot I + 60 \mu\text{A}$	
	1,1 A to < 3,0 A		$0,50 \cdot 10^{-3} \cdot I + 50 \mu\text{A}$	
	3,0 A to < 11 A		$0,60 \cdot 10^{-3} \cdot I + 0,70 \text{ mA}$	
Sources	> 0,1 μA to 1 μA		$30 \cdot 10^{-6} \cdot I + 0,00010 \mu\text{A}$	
	> 1 μA to 10 μA		$30 \cdot 10^{-6} \cdot I + 0,00015 \mu\text{A}$	
	> 10 μA to 100 μA		$30 \cdot 10^{-6} \cdot I + 0,0015 \mu\text{A}$	
	> 100 μA to 1 mA		$25 \cdot 10^{-6} \cdot I + 0,010 \mu\text{A}$	
	> 1 mA to 10 mA		$30 \cdot 10^{-6} \cdot I + 0,10 \mu\text{A}$	
	> 10 mA to 100 mA		$50 \cdot 10^{-6} \cdot I + 1,0 \mu\text{A}$	
	> 100 mA to 1 A		$150 \cdot 10^{-6} \cdot I + 10 \mu\text{A}$	
DC resistance Measurement instruments	1 Ω to < 11 Ω		$25 \cdot 10^{-6} \cdot R + 0,70 \text{ m}\Omega$	R: measured value
	11 Ω to < 33 Ω		$30 \cdot 10^{-6} \cdot R + 0,50 \text{ m}\Omega$	
	33 Ω to < 330 Ω		$40 \cdot 10^{-6} \cdot R + 0,20 \text{ m}\Omega$	
	330 Ω to < 3,3 k Ω		$40 \cdot 10^{-6} \cdot R + 2,0 \text{ m}\Omega$	
	3,3 k Ω to < 33 k Ω		$40 \cdot 10^{-6} \cdot R + 20 \text{ m}\Omega$	
	33 k Ω to < 110 k Ω		$30 \cdot 10^{-6} \cdot R + 2,0 \Omega$	
	110 k Ω to < 330 k Ω		$40 \cdot 10^{-6} \cdot R + 10 \Omega$	
	330 k Ω to < 1,1 M Ω		$40 \cdot 10^{-6} \cdot R + 0,15 \text{ k}\Omega$	
	1,1 M Ω to < 3,3 M Ω		$40 \cdot 10^{-6} \cdot R + 1,5 \text{ k}\Omega$	
	3,3 M Ω to < 11 M Ω		$0,10 \cdot 10^{-3} \cdot R + 1,5 \text{ k}\Omega$	
	11 M Ω to < 33 M Ω		$0,30 \cdot 10^{-3} \cdot R + 1,5 \text{ k}\Omega$	
	33 M Ω to < 110 M Ω		$0,60 \cdot 10^{-3} \cdot R + 5,0 \text{ k}\Omega$	
	110 M Ω to < 330 M Ω		$3,5 \cdot 10^{-3} \cdot R + 5,0 \text{ k}\Omega$	
330 M Ω to < 1,1 G Ω		$18 \cdot 10^{-3} \cdot R + 5,0 \text{ k}\Omega$		

Valid from: 23.05.2023

Date of issue: 19.07.2024

Page 11 of 13

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

Annex to the Accreditation Certificate D-K-21039-01-00

On-Site Calibration - Location Karlstein am Main

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Extended uncertainty of Measurement	Remarks
DC resistance Resistance	1 Ω to 10 Ω		$20 \cdot 10^{-6} \cdot R + 0,10 \text{ m}\Omega$	R: measured value
	> 10 Ω to 100 Ω		$15 \cdot 10^{-6} \cdot R + 1,0 \text{ m}\Omega$	
	> 100 Ω to 1 kΩ		$15 \cdot 10^{-6} \cdot R + 1,0 \text{ m}\Omega$	
	> 1 kΩ to 10 kΩ		$15 \cdot 10^{-6} \cdot R + 10 \text{ m}\Omega$	
	> 10 kΩ to 100 kΩ		$15 \cdot 10^{-6} \cdot R + 0,10 \Omega$	
	> 100 kΩ to 1 MΩ		$20 \cdot 10^{-6} \cdot R + 4,0 \Omega$	
	> 1 MΩ to 10 MΩ		$60 \cdot 10^{-6} \cdot R + 0,20 \text{ k}\Omega$	
	> 10 MΩ to 100 MΩ		$0,60 \cdot 10^{-3} \cdot R + 1,5 \text{ k}\Omega$	
	> 100 MΩ to 1 GΩ		$6,0 \cdot 10^{-3} \cdot R + 20 \text{ k}\Omega$	
AC voltage Measurement instruments	0,001 V to < 0,033 V	45 Hz to 10 kHz	$0,20 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$	U: measured value
	0,033 V to < 0,33 V		$0,20 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$	
	0,33 V to < 3,3 V		$0,20 \cdot 10^{-3} \cdot U + 0,10 \text{ mV}$	
	3,3 V to < 33 V		$0,20 \cdot 10^{-3} \cdot U + 1,0 \text{ mV}$	
	33 V to < 330 V		$0,25 \cdot 10^{-3} \cdot U + 10 \text{ mV}$	
	330 V to 1000 V		$0,35 \cdot 10^{-3} \cdot U + 15 \text{ mV}$	
Sources	0,001 V to 0,01 V	40 Hz to 20 kHz	$0,40 \cdot 10^{-3} \cdot U + 2,0 \mu\text{V}$	
	> 0,01 V to 0,1 V		$0,20 \cdot 10^{-3} \cdot U + 3,0 \mu\text{V}$	
	> 0,1 V to 1 V		$0,20 \cdot 10^{-3} \cdot U + 30 \mu\text{V}$	
	> 1 V to 10 V	$0,20 \cdot 10^{-3} \cdot U + 0,30 \text{ mV}$		
	> 10 V to 100 V	$0,30 \cdot 10^{-3} \cdot U + 3,0 \text{ mV}$		
	> 100 V to 700 V	40 Hz to 1 kHz	$0,60 \cdot 10^{-3} \cdot U + 30 \text{ mV}$	
AC current Measurement instruments	29 μA to < 330 μA	45 Hz to 1 kHz	$1,5 \cdot 10^{-3} \cdot I + 1,0 \mu\text{A}$	I: measured value
	330 μA to < 3,3 mA		$1,2 \cdot 10^{-3} \cdot I + 1,0 \mu\text{A}$	
	3,3 mA to < 33 mA		$0,50 \cdot 10^{-3} \cdot I + 5,0 \mu\text{A}$	
	33 mA to < 330 mA		$0,50 \cdot 10^{-3} \cdot I + 50 \mu\text{A}$	
	330 mA to < 1,1 A		$0,60 \cdot 10^{-3} \cdot I + 0,20 \text{ mA}$	
	1,1 A to < 3 A		$0,70 \cdot 10^{-3} \cdot I + 0,20 \text{ mA}$	
	3 A to < 11 A		$1,2 \cdot 10^{-3} \cdot I + 3,0 \text{ mA}$	
	11 A to 20 A		$1,8 \cdot 10^{-3} \cdot I + 12 \text{ mA}$	
Sources	10 μA to 100 μA	45 Hz to 5 kHz	$0,70 \cdot 10^{-3} \cdot I + 0,10 \mu\text{A}$	
	> 100 μA to 1 mA		$0,70 \cdot 10^{-3} \cdot I + 0,50 \mu\text{A}$	
	> 1 mA to 10 mA		$0,70 \cdot 10^{-3} \cdot I + 5,0 \mu\text{A}$	
	> 10 mA to 100 mA		$0,70 \cdot 10^{-3} \cdot I + 50 \mu\text{A}$	
	> 100 mA to 1 A	45 Hz to 1 kHz	$1,5 \cdot 10^{-3} \cdot I + 0,30 \text{ mA}$	

Valid from: 23.05.2023

Date of issue: 19.07.2024

Page 12 of 13

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

Annex to the Accreditation Certificate D-K-21039-01-00

On-Site Calibration - Location Karlstein am Main

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Extended uncertainty of Measurement	Remarks
Frequency				
Measurement instruments	0,1 Hz to 20 MHz		$25 \cdot 10^{-6} \cdot f$	<i>f</i> : measured value
Sources	0,1 Hz to 35 MHz		$6,0 \cdot 10^{-6} \cdot f$	
Oscilloscope quantities		DC to 10 MHz		Application: Voltage Measurement
Vertical deflection	5 mV to 10 mV > 10 mV to 5 V		$40 \cdot 10^{-3} \cdot U$ $35 \cdot 10^{-3} \cdot U$	
Horizontal deflection	0,5 MHz to 1 MHz > 1 MHz to 2 MHz > 2 MHz to 5 MHz > 5 MHz to 10 MHz > 10 MHz to 20 MHz > 20 MHz to 25 MHz > 25 MHz to 30 MHz > 30 MHz to 35 MHz		$2 \cdot 10^{-3} \cdot f$ $2 \cdot 10^{-3} \cdot f$ $4 \cdot 10^{-3} \cdot f$ $7 \cdot 10^{-3} \cdot f$ $8 \cdot 10^{-3} \cdot f$ $8 \cdot 10^{-3} \cdot f$ $10 \cdot 10^{-3} \cdot f$ $12 \cdot 10^{-3} \cdot f$	Application: Frequency Measurement
Horizontal deflection	2,0 ns to 10 ns > 10 ns to 0,10 µs > 0,1 µs to 1,0 µs > 1,0 µs to 10 µs > 10 µs to 50 µs > 50 µs to 0,10 ms > 0,10 ms to 0,50 ms > 0,50 ms to 1,0 ms		0,050 ns 0,20 ns 0,30 ns 3,0 ns 10 ns 30 ns 100 ns 300 ns	Application: Time-duration Measurement

Abbreviations used:

- DIN Deutsches Institut für Normung e.V.
 EN Europäische Norm
 IEC International Electrotechnical Commission – Internationale Elektrotechnische Kommission
 ISO International Organization for Standardization – Internationale Organisation für Normung