

Deutsche Akkreditierungsstelle

Annex to the Partial Accreditation Certificate D-K-15015-01-01 according to DIN EN ISO/IEC 17025:2018

Valid from: 10.01.2024

Date of issue: 10.01.2024

This annex is a part of the accreditation certificate D-K-15015-01-00.

Holder of partial accreditation certificate:

Trescal GmbH
Borsigstraße 11, 64291 Darmstadt

with the locations

Trescal GmbH
Borsigstraße 11, 64291 Darmstadt

Trescal GmbH
Branch Neustadt
Ernst-Abbe-Straße 18, 01844 Neustadt

Trescal GmbH
Branch Esslingen
Limburgstraße 6, 73734 Esslingen

Trescal GmbH
Branch Parchim
Ludwigsluster Chaussee 5, 19370 Parchim

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>.

**Trescal GmbH
Branch Mahlow
Ibsenstraße 71, 15831 Mahlow**

**Trescal GmbH
Branch Donauwörth
Dr.-Ludwig-Bölkow-Straße 1, 86609 Donauwörth**

**Trescal GmbH
Branch Halver
Oststraße 7, 58553 Halver**

**Trescal GmbH
Branch Braunschweig
Weinbergweg 36, 38106 Braunschweig**

**Trescal GmbH
Branch Leipzig
BMW-Werk Leipzig, BMW-Allee 1, 04349 Leipzig**

**Trescal GmbH
Branch Wetzlar
Friedenstraße 26, 35578 Wetzlar**

**Trescal GmbH
Branch Ruhla
Bahnhofstraße 25, 99842 Ruhla**

**Trescal GmbH
Branch Nürnberg
Poststraße 15a, 90471 Nürnberg**

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 general principles of DIN EN ISO 9001.

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Annex to the Partial Accreditation Certificate D-K-15015-01-01

Calibration in the fields:

Dimensional quantities

Length

- Length measuring devices ^{b)}
- Length measuring instruments ^{a) c)}
- Length gauges
- Diameter ^{c)}
- Thread
- Form error
- Straightness ^{b)}
- Flatness ^{b)}
- Roughness
- Stylus instruments ^{a)}

Coordinate measuring technology

- Coordinate measuring machines ^{b)}

Electrical quantities

DC and low frequency quantities

- DC voltage ^{a)}
- AC voltage ^{a)}
- DC current ^{a)}
- AC current ^{a)}
- DC resistance ^{a)}
- Capacitance ^{a)}
- Inductance
- Electric power ^{a)}
- Power factor ^{a)}
- Voltage ratio ^{a)}

Time and frequency

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

High frequency and radiation quantities

High frequency quantities

- HF voltage
- Oscilloscope quantities ^{a)}
- Rise time ^{a)}
- Band width ^{a)}

^{a)} also as On-site calibration

^{b)} only as On-site calibration

^{c)} also in mobile laboratory

Within the measurands/calibration items marked with *, the calibration laboratory is permitted, without being required to inform and obtain prior approval from DAkkS, to use calibration standards or equivalent calibration procedures listed here with different issue dates.

The calibration laboratory maintains a current list of all calibration standards / equivalent calibration procedures within the flexible scope of accreditation.

Valid from: 10.01.2024

Date of issue: 10.01.2024

Page 3 of 72

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

Darmstadt

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC and Low frequency				
DC voltage	0 V		0.5 μ V	Short circuit adaptor
Measurement instruments	0.1 V 1 V 10 V; 100 V; 1000 V		$13 \cdot 10^{-6} \cdot U$ $1.7 \cdot 10^{-6} \cdot U$ $2.5 \cdot 10^{-6} \cdot U$	U = measured value Calibration with Fluke 732A and 752A
	0 mV to 0.22 V > 0.22 V to 2.2 V > 2.2 V to 11 V > 11 V to 22 V > 22 V to 220 V > 220 V to 1100 V		$6 \cdot 10^{-6} \cdot U + 2 \mu$ V $7 \cdot 10^{-6} \cdot U + 3 \mu$ V $8 \cdot 10^{-6} \cdot U + 6 \mu$ V $6 \cdot 10^{-6} \cdot U + 20 \mu$ V $10 \cdot 10^{-6} \cdot U + 0.25$ mV $10 \cdot 10^{-6} \cdot U + 1.3$ mV	Calibration with Calibrator Fluke 5700A
	0 mV to 0.2 V > 0.2 V to 2 V > 2 V to 20 V > 20 V to 200 V > 200 V to 1000 V		$2 \cdot 10^{-6} \cdot U + 2 \mu$ V $2 \cdot 10^{-6} \cdot U + 3 \mu$ V $2 \cdot 10^{-6} \cdot U + 20 \mu$ V $4 \cdot 10^{-6} \cdot U + 0.24$ mV $5 \cdot 10^{-6} \cdot U + 1.2$ mV	Calibration via substitution method with DMM Fluke 8508A
DC voltage Sources	0.1 V 1 V 10 V; 100 V; 1000 V		$16 \cdot 10^{-6} \cdot U$ $1.9 \cdot 10^{-6} \cdot U$ $2.5 \cdot 10^{-6} \cdot U$	Calibration with Fluke 732A and 752A
	0 mV to 0.12 V > 0.12 V to 1.2 V > 1.2 V to 12 V > 12 V to 100 V > 100 V to 200 V > 200 V to 500 V > 500 V to 700 V > 700 V to 1000 V		$5 \cdot 10^{-6} \cdot U + 2 \mu$ V $4.5 \cdot 10^{-6} \cdot U + 2 \mu$ V $7 \cdot 10^{-6} \cdot U + 3 \mu$ V $15 \cdot 10^{-6} \cdot U + 40 \mu$ V $7 \cdot 10^{-6} \cdot U + 0.17$ mV $10 \cdot 10^{-6} \cdot U + 0.17$ mV $13 \cdot 10^{-6} \cdot U + 0.17$ mV $20 \cdot 10^{-6} \cdot U + 0.17$ mV	Calibration with DMM HP 3458A
DC voltage Sources	0 mV to 0.2 V > 0.2 V to 2 V > 2 V to 20 V > 20 V to 200 V > 200 V to 1000 V		$1 \cdot 10^{-6} \cdot U + 2 \mu$ V $2 \cdot 10^{-6} \cdot U + 3 \mu$ V $2 \cdot 10^{-6} \cdot U + 20 \mu$ V $3 \cdot 10^{-6} \cdot U + 0.23$ mV $4 \cdot 10^{-6} \cdot U + 1.2$ mV	Calibration with DMM Fluke 8508A
	1 kV to 6 kV		$1 \cdot 10^{-3} \cdot U$	Calibration with multimeter and high voltage divider

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC voltage Sources	0 V		1.5 μ V	Calibration with DMM Fluke 8508A
	50 mV		2 μ V	
	100 mV		2 μ V	
	500 mV		2.5 μ V	
	1 V		3 μ V	
	1.9 V		15 μ V	
	4 V		15 μ V	
	5 V		20 μ V	
	6 V		20 μ V	
	8 V		25 μ V	
	10 V		25 μ V	
	12 V		35 μ V	
	15 V		40 μ V	
	19 V		45 μ V	
	50 V		0.2 mV	
100 V		0.32 mV		
500 V		2.2 mV		
1000 V		3.3 mV		
DC current Measurement instruments	1 μ A to 0.12 mA		$20 \cdot 10^{-6} \cdot I + 2 \text{ nA}$	I = measured value Substitution method with DMM HP 3458A and Shunt Fluke Y5020
	> 0.12 mA to 1.2 mA		$20 \cdot 10^{-6} \cdot I + 15 \text{ nA}$	
	> 1.2 mA to 12 mA		$20 \cdot 10^{-6} \cdot I + 0.15 \mu\text{A}$	
	> 12 mA to 0.12 A		$40 \cdot 10^{-6} \cdot I + 1.5 \mu\text{A}$	
	> 0.12 A to 1.05 A		$0.12 \cdot 10^{-3} \cdot I + 15 \mu\text{A}$	
	> 1.05 A to 11 A		$30 \cdot 10^{-6} \cdot I + 0.4 \text{ mA}$	
	> 11 A to 20 A		$35 \cdot 10^{-6} \cdot I + 0.22 \text{ mA}$	
	100 nA to 200 μ A		$11 \cdot 10^{-6} \cdot I + 1 \text{ nA}$	Substitution method with DMM HP 8508A
	> 200 μ A to 2 mA		$11 \cdot 10^{-6} \cdot I + 10 \text{ nA}$	
> 2 mA to 20 mA		$12 \cdot 10^{-6} \cdot I + 0.1 \mu\text{A}$		
> 20 mA to 200 mA		$40 \cdot 10^{-6} \cdot I + 1 \mu\text{A}$		
> 0.2 A to 2 A		$0.15 \cdot 10^{-3} \cdot I + 20 \mu\text{A}$		
> 2 A to 20 A		$0.35 \cdot 10^{-3} \cdot I + 0.5 \text{ mA}$		
> 20 A to 50 A		$0.5 \cdot 10^{-3} \cdot I + 5 \text{ mA}$	Substitution method with DMM HP 3458A / H&B 0.01 Ω	
DC current Measurement instruments with converter method	> 10 A to 16.5 A		$6 \cdot 10^{-3} \cdot I + 0.1 \text{ A}$	Calibration with Fluke 5500A / Coil
	> 16.5 A to 150 A		$6 \cdot 10^{-3} \cdot I + 0.2 \text{ A}$	
	> 150 A to 1025 A		$6 \cdot 10^{-3} \cdot I + 0.5 \text{ A}$	
DC current Sources	1 μ A to 0.12 mA		$20 \cdot 10^{-6} \cdot I + 2 \text{ nA}$	Calibration with DMM HP 3458A
	> 0.12 mA to 1.2 mA		$20 \cdot 10^{-6} \cdot I + 8 \text{ nA}$	
	> 1.2 mA to 12 mA		$20 \cdot 10^{-6} \cdot I + 80 \text{ nA}$	
	> 12 mA to 0.12 A		$40 \cdot 10^{-6} \cdot I + 0.7 \mu\text{A}$	
	> 0.12 A to 1.05 A		$0.12 \cdot 10^{-3} \cdot I + 15 \mu\text{A}$	
	> 1.05 A to 11 A		$30 \cdot 10^{-6} \cdot I + 0.4 \text{ mA}$	
> 11 A to 20 A		$35 \cdot 10^{-6} \cdot I + 0.22 \text{ mA}$	Calibration with DMM HP 3458A and Shunt Fluke Y 5020	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Page 5 of 72

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Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC current Sources	> 20 A to 50 A		$0.5 \cdot 10^{-3} \cdot I + 5 \text{ mA}$	Calibration with DMM HP 3458A and H&B 0.01 Ω
	100 nA to 200 μ A > 200 μ A to 2 mA > 2 mA to 20 mA > 20 mA to 200 mA > 0.2 A to 2 A > 2 A to 20 A		$10 \cdot 10^{-6} \cdot I + 1 \text{ nA}$ $10 \cdot 10^{-6} \cdot I + 10 \text{ nA}$ $10 \cdot 10^{-6} \cdot I + 0.1 \mu\text{A}$ $38 \cdot 10^{-6} \cdot I + 1 \mu\text{A}$ $0.15 \cdot 10^{-3} \cdot I + 20 \mu\text{A}$ $0.34 \cdot 10^{-3} \cdot I + 0.5 \text{ mA}$	I = measured value Calibration with Fluke 8508A
DC power Measurement instruments	0.1 W to 336 W	0.33 mA to < 0.33 A	$0.7 \cdot 10^{-3} \cdot P$	P = measured value Calibration with Calibrator Fluke 5520 A
	1 W to 3059 W	0.33 A to < 3 A	$0.7 \cdot 10^{-3} \cdot P$	
	10 W to 20.9 kW	3 A to 20.5 A	$1 \cdot 10^{-3} \cdot P$	
DC resistance Resistors	10 m Ω 1 Ω ; 10 k Ω		$35 \cdot 10^{-6} \cdot R$ $5.2 \cdot 10^{-6} \cdot R$	R = measured value
	1 m Ω to 10 m Ω > 10 m Ω to 0.1 Ω > 0.1 Ω to 1 Ω		$40 \cdot 10^{-6} \cdot R + 1 \mu\Omega$ $20 \cdot 10^{-6} \cdot R + 10 \mu\Omega$ $10 \cdot 10^{-6} \cdot R + 25 \mu\Omega$	Comparison with Shunt Fluke Y 5020 and Standard resistor Tinsley 5685B-1 Ω
	> 1 Ω to 12 Ω > 12 Ω to 120 Ω > 120 Ω to 1.2 k Ω > 1.2 k Ω to 12 k Ω > 12 k Ω to 120 k Ω > 120 k Ω to 1.2 M Ω > 1.2 M Ω to 12 M Ω > 12 M Ω to 120 M Ω		$19 \cdot 10^{-6} \cdot R + 70 \mu\Omega$ $13 \cdot 10^{-6} \cdot R + 0.7 \text{ m}\Omega$ $11 \cdot 10^{-6} \cdot R + 1.5 \text{ m}\Omega$ $11 \cdot 10^{-6} \cdot R + 15 \text{ m}\Omega$ $11 \cdot 10^{-6} \cdot R + 0.15 \Omega$ $15 \cdot 10^{-6} \cdot R + 4 \Omega$ $60 \cdot 10^{-6} \cdot R + 0.2 \text{ k}\Omega$ $0.6 \cdot 10^{-3} \cdot R + 2 \text{ k}\Omega$	Calibration with DMM HP 3458A
	> 1 Ω to < 2 Ω 2 Ω to < 20 Ω 20 Ω to < 200 Ω 200 Ω to < 2 k Ω 2 k Ω to < 20 k Ω 20 k Ω to < 200 k Ω 200 k Ω to < 2 M Ω 2 M Ω to < 20 M Ω 20 M Ω to < 200 M Ω 200 M Ω to < 2 G Ω		$15 \cdot 10^{-6} \cdot R + 10 \mu\Omega$ $8 \cdot 10^{-6} \cdot R + 50 \mu\Omega$ $7 \cdot 10^{-6} \cdot R + 0.5 \text{ m}\Omega$ $6 \cdot 10^{-6} \cdot R + 5 \text{ m}\Omega$ $6 \cdot 10^{-6} \cdot R + 50 \text{ m}\Omega$ $6 \cdot 10^{-6} \cdot R + 0.5 \Omega$ $7 \cdot 10^{-6} \cdot R + 5 \Omega$ $10 \cdot 10^{-6} \cdot R + 50 \Omega$ $40 \cdot 10^{-6} \cdot R + 1.5 \text{ k}\Omega$ $0.4 \cdot 10^{-3} \cdot R + 0.1 \text{ M}\Omega$	Calibration with Fluke 8508A
DC resistance Resistances-measurement instruments	0 Ω		20 $\mu\Omega$	Short circuit adaptor on Fluke 8508A

Valid from: 10.01.2024

Date of issue: 10.01.2024

Page 6 of 72

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

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Darmstadt

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Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC resistance Resistance- measurement instruments	10 mΩ		$40 \cdot 10^{-6} \cdot R$	Calibration with Calibrator Fluke 5700A, Calibration at 0.01 Ω with Shunt Fluke Y5020, Calibration at 1 Ω & 10 kΩ with Standard resistors Tinsley 5685B-1 Ω & 10 kΩ
	0.1 Ω		$0.13 \cdot 10^{-3} \cdot R$	
	1 Ω		$5.2 \cdot 10^{-6} \cdot R$	
	1.9 Ω		$0.12 \cdot 10^{-3} \cdot R$	
	10 Ω		$35 \cdot 10^{-6} \cdot R$	
	19 Ω		$33 \cdot 10^{-6} \cdot R$	
	100 Ω		$23 \cdot 10^{-6} \cdot R$	
	190 Ω		$23 \cdot 10^{-6} \cdot R$	
	1 kΩ		$16 \cdot 10^{-6} \cdot R$	
	1.9 kΩ		$16 \cdot 10^{-6} \cdot R$	
	10 kΩ		$5 \cdot 10^{-6} \cdot R$	
	19 kΩ		$15 \cdot 10^{-6} \cdot R$	
	100 kΩ		$16 \cdot 10^{-6} \cdot R$	
	190 kΩ		$18 \cdot 10^{-6} \cdot R$	
	1 MΩ		$22 \cdot 10^{-6} \cdot R$	
1.9 MΩ	$25 \cdot 10^{-6} \cdot R$			
10 MΩ	$50 \cdot 10^{-6} \cdot R$			
19 MΩ	$60 \cdot 10^{-6} \cdot R$			
100 MΩ	$0.15 \cdot 10^{-3} \cdot R$			
	0.01 Ω to 0.1 Ω		$0.1 \cdot 10^{-3} \cdot R + 20 \mu\Omega$	Calibration with Shunt Fluke Y5020 and HP 3458 via current/voltage- method
	> 0.1 Ω to 1 Ω		$0.1 \cdot 10^{-3} \cdot R + 0.2 \text{ m}\Omega$	
	> 1 Ω to 10 Ω		$0.1 \cdot 10^{-3} \cdot R + 2 \text{ m}\Omega$	
	10 Ω to 100 Ω		$0.1 \cdot 10^{-3} \cdot R + 20 \text{ m}\Omega$	Calibration via substitution method with a resistor and a multimeter
	> 100 Ω to 1 kΩ		$0.1 \cdot 10^{-3} \cdot R + 0.2 \Omega$	
	> 1 kΩ to 10 kΩ		$0.1 \cdot 10^{-3} \cdot R + 2 \Omega$	
	> 10 kΩ to 100 kΩ		$0.1 \cdot 10^{-3} \cdot R + 20 \Omega$	
	> 100 kΩ to 1 MΩ		$0.1 \cdot 10^{-3} \cdot R + 0.2 \text{ k}\Omega$	
	> 1 MΩ to 10 MΩ		$0.1 \cdot 10^{-3} \cdot R + 2 \text{ k}\Omega$	
	> 10 MΩ to 100 MΩ		$0.6 \cdot 10^{-3} \cdot R + 20 \text{ k}\Omega$	
	> 100 MΩ to 10 GΩ		$7 \cdot 10^{-3} \cdot R + 0.2 \text{ M}\Omega$	
AC voltage Measurement instruments	0.1 V	20 Hz; 40 Hz; 1 kHz	25 μV	Calibration with calibrator Fluke 5700A / 5725A
		10 kHz; 20 kHz	25 μV	
		50 kHz	40 μV	
		100 kHz	50 μV	
	1 V	20 Hz	0.1 mV	
		40 Hz; 1 kHz; 10 kHz	70 μV	
		20 kHz	80 μV	
50 kHz; 70 kHz; 100 kHz		0.1 mV		
200 kHz		0.2 mV		
4 V	500 kHz	1 mV		
	1 MHz	2 mV		
	1 kHz; 10 kHz	0.25 mV		
6 V	1 kHz; 10 kHz	0.35 mV		
8 V	1 kHz; 10 kHz	0.4 mV		

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Measurement instruments	10 V	20 Hz 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 70 kHz; 100 kHz 200 kHz 500 kHz 1 MHz	0.7 mV 0.5 mV 0.6 mV 1 mV 1.2 mV 3 mV 10 mV 15 mV	Calibration with calibrator Fluke 5700A / 5725A
	13 V	1 kHz; 10 kHz	0.5 mV	
	15 V	1 kHz; 10 kHz	0.8 mV	
	18 V	1 kHz; 10 kHz	1 mV	
	20 V	1 kHz; 10 kHz	1.1 mV	
	100 V	20 Hz 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 70 kHz 100 kHz	10 mV 7 mV 7 mV 20 mV 30 mV 37 mV	
	700 V	50 Hz; 500 Hz; 1 kHz	80 mV	
	1000 V	50 Hz; 500 Hz; 1 kHz	0.1 V	
	AC voltage Measurement instruments	2 mV to 2.2 mV	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 > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	
> 2.2 mV to 22 mV		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 > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.59 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$ $0.22 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$ $0.11 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$ $0.39 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$ $1 \cdot 10^{-3} \cdot U + 12 \mu\text{V}$ $1.4 \cdot 10^{-3} \cdot U + 20 \mu\text{V}$ $2 \cdot 10^{-3} \cdot U + 40 \mu\text{V}$ $3.8 \cdot 10^{-3} \cdot U + 40 \mu\text{V}$	
> 22 mV to 0.22 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 > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.63 \cdot 10^{-3} \cdot U + 20 \mu\text{V}$ $0.25 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$ $0.12 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$ $0.37 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$ $0.9 \cdot 10^{-3} \cdot U + 35 \mu\text{V}$ $1.2 \cdot 10^{-3} \cdot U + 40 \mu\text{V}$ $2 \cdot 10^{-3} \cdot U + 50 \mu\text{V}$ $3.8 \cdot 10^{-3} \cdot U + 0.13 \text{ mV}$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Darmstadt

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Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Measurement instruments	> 0.22 V to 2.2 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 > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.64 \cdot 10^{-3} \cdot U + 0.13 \text{ mV}$ $0.2 \cdot 10^{-3} \cdot U + 40 \text{ } \mu\text{V}$ $85 \cdot 10^{-6} \cdot U + 18 \text{ } \mu\text{V}$ $0.15 \cdot 10^{-3} \cdot U + 30 \text{ } \mu\text{V}$ $0.3 \cdot 10^{-3} \cdot U + 90 \text{ } \mu\text{V}$ $0.5 \cdot 10^{-3} \cdot U + 0.17 \text{ mV}$ $1.3 \cdot 10^{-3} \cdot U + 0.45 \text{ mV}$ $2.5 \cdot 10^{-3} \cdot U + 1.2 \text{ mV}$	U = measured value Calibration with calibrator Fluke 5700A / 5725A
	> 2.2 V to 22 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 > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.64 \cdot 10^{-3} \cdot U + 1.3 \text{ mV}$ $0.2 \cdot 10^{-3} \cdot U + 0.35 \text{ mV}$ $90 \cdot 10^{-6} \cdot U + 0.13 \text{ mV}$ $0.15 \cdot 10^{-3} \cdot U + 0.25 \text{ mV}$ $0.3 \cdot 10^{-3} \cdot U + 0.45 \text{ mV}$ $0.6 \cdot 10^{-3} \cdot U + 2 \text{ mV}$ $1.6 \cdot 10^{-3} \cdot U + 5.5 \text{ mV}$ $3.2 \cdot 10^{-3} \cdot U + 10 \text{ mV}$	
	> 22 V 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	$0.65 \cdot 10^{-3} \cdot U + 12 \text{ mV}$ $0.2 \cdot 10^{-3} \cdot U + 3.5 \text{ mV}$ $0.1 \cdot 10^{-3} \cdot U + 1.7 \text{ mV}$ $0.25 \cdot 10^{-3} \cdot U + 4.8 \text{ mV}$ $0.7 \cdot 10^{-3} \cdot U + 10 \text{ mV}$	
	> 220 V to 1.1 kV	40 Hz to < 50 Hz 50 Hz to 1 kHz > 1 kHz to 20 kHz	$80 \cdot 10^{-6} \cdot U + 25 \text{ mV}$ $80 \cdot 10^{-6} \cdot U + 25 \text{ mV}$ $0.15 \cdot 10^{-3} \cdot U + 20 \text{ mV}$	
	0.1 V	20 Hz; 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 100 kHz	25 μV 25 μV 40 μV 50 μV	
AC voltage Sources	1 V	20 Hz 40 Hz; 1 kHz; 10 kHz 20 kHz 50 kHz; 70 kHz; 100 kHz 200 kHz 500 kHz 1 MHz	0.1 mV 70 μV 80 μV 0.1 mV 0.2 mV 1 mV 2 mV	
	4 V	1 kHz; 10 kHz	0.25 mV	
	6 V	1 kHz; 10 kHz	0.35 mV	
	8 V	1 kHz; 10 kHz	0.4 mV	
	10 V	20 Hz 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 70 kHz; 100 kHz 200 kHz 500 kHz 1 MHz	0.7 mV 0.5 mV 0.6 mV 1 mV 1.2 mV 3 mV 10 mV 15 mV	
	13 V	1 kHz; 10 kHz	0.5 mV	
	Substitution method with calibrator Fluke 5700A / 5725A			

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

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AC voltage Sources	15 V	1 kHz; 10 kHz	0.8 mV	Substitution method with calibrator Fluke 5700A / 5725A	
	18 V	1 kHz; 10 kHz	1 mV		
	20 V	1 kHz; 10 kHz	1.1 mV		
	100 V	20 Hz			10 mV
		40 Hz; 1 kHz			7 mV
		10 kHz; 20 kHz			7 mV
		50 kHz			20 mV
	70 kHz		30 mV		
	100 kHz		37 mV		
	700 V	50 Hz; 500 Hz; 1 kHz		80 mV	
1000 V	50 Hz; 500 Hz; 1 kHz		0.1 V		
0.1 V to 0.22 V	20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz		$0.25 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$ $0.12 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$ $0.37 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$ $0.9 \cdot 10^{-3} \cdot U + 35 \mu\text{V}$	$U =$ measured value	
> 0.22 V to 2.2 V	20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz		$0.2 \cdot 10^{-3} \cdot U + 40 \mu\text{V}$ $80 \cdot 10^{-6} \cdot U + 25 \mu\text{V}$ $0.15 \cdot 10^{-3} \cdot U + 30 \mu\text{V}$ $0.3 \cdot 10^{-3} \cdot U + 90 \mu\text{V}$ $0.5 \cdot 10^{-3} \cdot U + 0.17 \text{ mV}$ $1.3 \cdot 10^{-3} \cdot U + 0.45 \text{ mV}$ $2.5 \cdot 10^{-3} \cdot U + 1.2 \text{ mV}$		
> 2.2 V to 22 V	20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz		$0.2 \cdot 10^{-3} \cdot U + 0.35 \text{ mV}$ $0.1 \cdot 10^{-3} \cdot U + 0.15 \text{ mV}$ $0.15 \cdot 10^{-3} \cdot U + 0.28 \text{ mV}$ $0.3 \cdot 10^{-3} \cdot U + 0.45 \text{ mV}$ $0.6 \cdot 10^{-3} \cdot U + 2 \text{ mV}$ $1.6 \cdot 10^{-3} \cdot U + 5.5 \text{ mV}$ $3.2 \cdot 10^{-3} \cdot U + 10 \text{ mV}$		
> 22 V to 220 V	20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz		$0.22 \cdot 10^{-3} \cdot U + 3.5 \text{ mV}$ $0.12 \cdot 10^{-3} \cdot U + 1.7 \text{ mV}$ $0.25 \cdot 10^{-3} \cdot U + 4.8 \text{ mV}$ $0.7 \cdot 10^{-3} \cdot U + 10 \text{ mV}$		
> 220 V to 1.1 kV	40 Hz to < 50 Hz 50 Hz to 1 kHz > 1 kHz to 20 kHz		$90 \cdot 10^{-6} \cdot U + 25 \text{ mV}$ $90 \cdot 10^{-6} \cdot U + 25 \text{ mV}$ $0.15 \cdot 10^{-3} \cdot U + 20 \text{ mV}$		
1 mV to 2.2 mV	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 > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz		$1.6 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$ $0.6 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$ $0.3 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$ $0.75 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$ $1.1 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$ $2.3 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$ $2.6 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$ $3.7 \cdot 10^{-3} \cdot U + 11 \mu\text{V}$		

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

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AC voltage Sources	> 2.2 mV to 7 mV	10 Hz to 20 Hz	$0.8 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$	U = measured value Calibration with Fluke 5790A in direct measurement
		> 20 Hz to 40 Hz	$0.29 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$	
		> 40 Hz to 20 kHz	$0.14 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$	
		> 20 kHz to 50 kHz	$0.36 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$	
		> 50 kHz to 100 kHz	$0.58 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$	
		> 100 kHz to 300 kHz	$1.2 \cdot 10^{-3} \cdot U + 7 \mu\text{V}$	
		> 300 kHz to 500 kHz	$1.4 \cdot 10^{-3} \cdot U + 11 \mu\text{V}$	
> 500 kHz to 1 MHz	$2.4 \cdot 10^{-3} \cdot U + 12 \mu\text{V}$			
> 7 mV to 22 mV	10 Hz to 20 Hz	> 20 Hz to 40 Hz	$0.23 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$	
		> 40 Hz to 20 kHz	$0.13 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$	
		> 20 kHz to 50 kHz	$0.16 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$	
		> 50 kHz to 100 kHz	$0.16 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$	
		> 100 kHz to 300 kHz	$0.29 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$	
		> 300 kHz to 500 kHz	$0.8 \cdot 10^{-3} \cdot U + 9 \mu\text{V}$	
		> 500 kHz to 1 MHz	$0.95 \cdot 10^{-3} \cdot U + 12 \mu\text{V}$	
> 22 mV to 70 mV	10 Hz to 20 Hz	> 20 Hz to 40 Hz	$0.23 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$	
		> 40 Hz to 20 kHz	$0.11 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$	
		> 20 kHz to 50 kHz	$50 \cdot 10^{-6} \cdot U + 6 \mu\text{V}$	
		> 50 kHz to 100 kHz	$0.12 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$	
		> 100 kHz to 300 kHz	$0.27 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$	
		> 300 kHz to 500 kHz	$0.56 \cdot 10^{-3} \cdot U + 8 \mu\text{V}$	
		> 500 kHz to 1 MHz	$0.74 \cdot 10^{-3} \cdot U + 12 \mu\text{V}$	
> 70 mV to 220 mV	10 Hz to 20 Hz	> 20 Hz to 40 Hz	$0.23 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$	
		> 40 Hz to 20 kHz	$80 \cdot 10^{-6} \cdot U + 8 \mu\text{V}$	
		> 20 kHz to 50 kHz	$30 \cdot 10^{-6} \cdot U + 9 \mu\text{V}$	
		> 50 kHz to 100 kHz	$65 \cdot 10^{-6} \cdot U + 8 \mu\text{V}$	
		> 100 kHz to 300 kHz	$0.17 \cdot 10^{-3} \cdot U + 7 \mu\text{V}$	
		> 300 kHz to 500 kHz	$0.25 \cdot 10^{-3} \cdot U + 16 \mu\text{V}$	
		> 500 kHz to 1 MHz	$0.41 \cdot 10^{-3} \cdot U + 17 \mu\text{V}$	
> 220 mV to 700 mV	10 Hz to 20 Hz	> 20 Hz to 40 Hz	$0.23 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$	
		> 40 Hz to 20 kHz	$80 \cdot 10^{-6} \cdot U + 7 \mu\text{V}$	
		> 20 kHz to 50 kHz	$30 \cdot 10^{-6} \cdot U + 11 \mu\text{V}$	
		> 50 kHz to 100 kHz	$55 \cdot 10^{-6} \cdot U + 9 \mu\text{V}$	
		> 100 kHz to 300 kHz	$85 \cdot 10^{-6} \cdot U + 9 \mu\text{V}$	
		> 300 kHz to 500 kHz	$0.18 \cdot 10^{-3} \cdot U + 33 \mu\text{V}$	
		> 500 kHz to 1 MHz	$0.32 \cdot 10^{-3} \cdot U + 28 \mu\text{V}$	
> 700 mV to 2.2 V	10 Hz to 20 Hz	> 20 Hz to 40 Hz	$0.22 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$	
		> 40 Hz to 20 kHz	$75 \cdot 10^{-6} \cdot U + 8 \mu\text{V}$	
		> 20 kHz to 50 kHz	$25 \cdot 10^{-6} \cdot U + 17 \mu\text{V}$	
		> 50 kHz to 100 kHz	$50 \cdot 10^{-6} \cdot U + 11 \mu\text{V}$	
		> 100 kHz to 300 kHz	$75 \cdot 10^{-6} \cdot U + 12 \mu\text{V}$	
		> 300 kHz to 500 kHz	$0.16 \cdot 10^{-3} \cdot U + 80 \mu\text{V}$	
		> 500 kHz to 1 MHz	$0.28 \cdot 10^{-3} \cdot U + 56 \mu\text{V}$	
			$1 \cdot 10^{-3} \cdot U + 78 \mu\text{V}$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks	
AC voltage Sources	> 2.2 V to 7 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 > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.22 \cdot 10^{-3} \cdot U + 12 \mu\text{V}$ $75 \cdot 10^{-6} \cdot U + 17 \mu\text{V}$ $25 \cdot 10^{-6} \cdot U + 40 \mu\text{V}$ $55 \cdot 10^{-6} \cdot U + 23 \mu\text{V}$ $90 \cdot 10^{-6} \cdot U + 28 \mu\text{V}$ $0.19 \cdot 10^{-3} \cdot U + 0.2 \text{ mV}$ $0.45 \cdot 10^{-3} \cdot U + 0.11 \text{ mV}$ $1.4 \cdot 10^{-3} \cdot U + 0.17 \text{ mV}$	U = measured value Calibration with Fluke 5790A in direct measurement	
	> 7 V to 22 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 > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.22 \cdot 10^{-3} \cdot U + 40 \mu\text{V}$ $75 \cdot 10^{-6} \cdot U + 83 \mu\text{V}$ $25 \cdot 10^{-6} \cdot U + 0.16 \text{ mV}$ $55 \cdot 10^{-6} \cdot U + 0.11 \text{ mV}$ $90 \cdot 10^{-6} \cdot U + 95 \mu\text{V}$ $0.19 \cdot 10^{-3} \cdot U + 0.7 \text{ mV}$ $0.44 \cdot 10^{-3} \cdot U + 0.38 \text{ mV}$ $1.3 \cdot 10^{-3} \cdot U + 0.59 \text{ mV}$		
	> 22 V to 70 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 > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.22 \cdot 10^{-3} \cdot U + 0.18 \text{ mV}$ $75 \cdot 10^{-6} \cdot U + 0.36 \text{ mV}$ $30 \cdot 10^{-6} \cdot U + 0.62 \text{ mV}$ $65 \cdot 10^{-6} \cdot U + 0.42 \text{ mV}$ $0.1 \cdot 10^{-3} \cdot U + 0.38 \text{ mV}$ $0.21 \cdot 10^{-3} \cdot U + 1.1 \text{ mV}$ $0.46 \cdot 10^{-3} \cdot U + 0.55 \text{ mV}$ $1.4 \cdot 10^{-3} \cdot U + 0.77 \text{ mV}$		
	> 70 V 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	$0.22 \cdot 10^{-3} \cdot U + 1 \text{ mV}$ $75 \cdot 10^{-6} \cdot U + 1.7 \text{ mV}$ $30 \cdot 10^{-6} \cdot U + 2.8 \text{ mV}$ $65 \cdot 10^{-6} \cdot U + 1.7 \text{ mV}$ $0.1 \cdot 10^{-3} \cdot U + 2.6 \text{ mV}$		
	> 220 V to 700 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	$0.22 \cdot 10^{-3} \cdot U + 5.3 \text{ mV}$ $0.1 \cdot 10^{-3} \cdot U + 9.7 \text{ mV}$ $35 \cdot 10^{-6} \cdot U + 16 \text{ mV}$ $0.14 \cdot 10^{-3} \cdot U + 7.8 \text{ mV}$ $0.56 \cdot 10^{-3} \cdot U + 8.2 \text{ mV}$		
	> 700 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	$0.22 \cdot 10^{-3} \cdot U + 8.5 \text{ mV}$ $0.11 \cdot 10^{-3} \cdot U + 13 \text{ mV}$ $35 \cdot 10^{-6} \cdot U + 25 \text{ mV}$ $0.14 \cdot 10^{-3} \cdot U + 13 \text{ mV}$ $0.57 \cdot 10^{-3} \cdot U + 10 \text{ mV}$		
	1 kV to 6 kV	50 Hz	$2 \cdot 10^{-3} \cdot U$		Calibration with multimeter and high voltage divider

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

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AC voltage Sources	1 mV to 2.2 mV	> 1.2 kHz to 120 kHz > 120 kHz to 500 kHz > 500 kHz to 1.2 MHz > 1.2 MHz to 2 MHz > 2 MHz to 10 MHz > 10 MHz to 20 MHz > 20 MHz to 30 MHz	$0.4 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $0.7 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $0.5 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$ $0.5 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$ $1.3 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$ $2.8 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$ $7.6 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$	U = measured value Calibration with calibrator Fluke 5790A (Wide Band) in direct measurement
	> 2.2 mV to 7 mV	> 1.2 kHz to 120 kHz > 120 kHz to 500 kHz > 500 kHz to 1.2 MHz > 1.2 MHz to 2 MHz > 2 MHz to 10 MHz > 10 MHz to 20 MHz > 20 MHz to 30 MHz	$0.5 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$ $0.8 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$ $0.6 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$ $0.6 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$ $1 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$ $1.8 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$ $4.2 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$	
	> 7 mV to 22 mV	> 1.2 kHz to 120 kHz > 120 kHz to 500 kHz > 500 kHz to 1.2 MHz > 1.2 MHz to 2 MHz > 2 MHz to 10 MHz > 10 MHz to 20 MHz > 20 MHz to 30 MHz	$0.6 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$ $0.8 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$ $0.7 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$ $0.7 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$ $1.1 \cdot 10^{-3} \cdot U + 7 \mu\text{V}$ $2 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$ $4.3 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$	
	> 22 mV to 70 mV	> 1.2 kHz to 120 kHz > 120 kHz to 500 kHz > 500 kHz to 1.2 MHz > 1.2 MHz to 2 MHz > 2 MHz to 10 MHz > 10 MHz to 20 MHz > 20 MHz to 30 MHz	$0.6 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $0.6 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $0.6 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$ $0.6 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$ $1.2 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$ $1.8 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $4.1 \cdot 10^{-3} \cdot U + 1 \mu\text{V}$	
	> 70 mV to 220 mV	> 1.2 kHz to 120 kHz > 120 kHz to 500 kHz > 500 kHz to 1.2 MHz > 1.2 MHz to 2 MHz > 2 MHz to 10 MHz > 10 MHz to 20 MHz > 20 MHz to 30 MHz	$0.5 \cdot 10^{-3} \cdot U + 1 \mu\text{V}$ $0.5 \cdot 10^{-3} \cdot U + 1 \mu\text{V}$ $0.6 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $0.6 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $1.2 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $1.8 \cdot 10^{-3} \cdot U + 1 \mu\text{V}$ $4.1 \cdot 10^{-3} \cdot U + 1 \mu\text{V}$	
	> 220 mV to 700 mV	> 1.2 kHz to 120 kHz > 120 kHz to 500 kHz > 500 kHz to 1.2 MHz > 1.2 MHz to 2 MHz > 2 MHz to 10 MHz > 10 MHz to 20 MHz > 20 MHz to 30 MHz	$0.4 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $0.4 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $0.6 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $0.6 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $1.2 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $1.8 \cdot 10^{-3} \cdot U + 1 \mu\text{V}$ $4.1 \cdot 10^{-3} \cdot U + 1 \mu\text{V}$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks	
AC voltage Sources	> 700 mV to 2.2 V	> 1.2 kHz to 120 kHz > 120 kHz to 500 kHz > 500 kHz to 1.2 MHz > 1.2 MHz to 2 MHz > 2 MHz to 10 MHz > 10 MHz to 20 MHz > 20 MHz to 30 MHz	$0.4 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $0.4 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $0.61 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $0.61 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $1.2 \cdot 10^{-3} \cdot U + 2 \mu\text{V}$ $1.8 \cdot 10^{-3} \cdot U + 1 \mu\text{V}$ $4.1 \cdot 10^{-3} \cdot U + 1 \mu\text{V}$	U = measured value Calibration with calibrator Fluke 5790A (Wide Band) in direct measurement	
	> 2.2 V to 7 V	> 1.2 kHz to 120 kHz > 120 kHz to 500 kHz > 500 kHz to 1.2 MHz > 1.2 MHz to 2 MHz > 2 MHz to 10 MHz > 10 MHz to 20 MHz > 20 MHz to 30 MHz	$0.4 \cdot 10^{-3} \cdot U + 11 \mu\text{V}$ $0.4 \cdot 10^{-3} \cdot U + 11 \mu\text{V}$ $0.61 \cdot 10^{-3} \cdot U + 8 \mu\text{V}$ $0.61 \cdot 10^{-3} \cdot U + 8 \mu\text{V}$ $1.2 \cdot 10^{-3} \cdot U + 4 \mu\text{V}$ $1.8 \cdot 10^{-3} \cdot U + 3 \mu\text{V}$ $4.1 \cdot 10^{-3} \cdot U + 1 \mu\text{V}$		
AC current Measurement instruments	0.2 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	90 nA	Calibration with calibrator Fluke 5700A / 5725A	
	0.5 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.14 μA		
	1 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.24 μA		
	2 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.4 μA		
	5 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	1 μA		
	10 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	2 μA		
	20 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	3 μA		
	50 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	10 μA		
	0.1 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	20 μA		Calibration with calibrator Fluke 5700A / 5725A
	0.2 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	40 μA		
	0.5 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.12 mA		
	1 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.22 mA		
	2 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.4 mA 0.45 mA		
	3 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	1 mA		
	5 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	1.5 mA		

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

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AC current Measurement instruments	10 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	3 mA	Calibration with calibrator Fluke 5700A / 5725A
	50 µA to 220 µA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.81 \cdot 10^{-3} \cdot I + 50 \text{ nA}$ $0.44 \cdot 10^{-3} \cdot I + 50 \text{ nA}$ $0.16 \cdot 10^{-3} \cdot I + 50 \text{ nA}$ $0.7 \cdot 10^{-3} \cdot I + 0.1 \text{ µA}$ $2 \cdot 10^{-3} \cdot I + 0.2 \text{ µA}$	<i>I</i> = measured value
	> 220 µA to 2.2 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.81 \cdot 10^{-3} \cdot I + 0.1 \text{ µA}$ $0.44 \cdot 10^{-3} \cdot I + 0.1 \text{ µA}$ $0.16 \cdot 10^{-3} \cdot I + 0.1 \text{ µA}$ $0.7 \cdot 10^{-3} \cdot I + 0.8 \text{ µA}$ $2 \cdot 10^{-3} \cdot I + 1.5 \text{ µA}$	
	> 2.2 mA to 22 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.81 \cdot 10^{-3} \cdot I + 0.7 \text{ µA}$ $0.44 \cdot 10^{-3} \cdot I + 0.7 \text{ µA}$ $0.16 \cdot 10^{-3} \cdot I + 0.7 \text{ µA}$ $0.7 \cdot 10^{-3} \cdot I + 7 \text{ µA}$ $2 \cdot 10^{-3} \cdot I + 15 \text{ µA}$	
	> 22 mA to 220 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.81 \cdot 10^{-3} \cdot I + 6 \text{ µA}$ $0.44 \cdot 10^{-3} \cdot I + 6 \text{ µA}$ $0.16 \cdot 10^{-3} \cdot I + 7 \text{ µA}$ $0.7 \cdot 10^{-3} \cdot I + 60 \text{ µA}$ $2 \cdot 10^{-3} \cdot I + 0.15 \text{ mA}$	
	> 220 mA to 2.2 A	> 20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.75 \cdot 10^{-3} \cdot I + 60 \text{ µA}$ $0.87 \cdot 10^{-3} \cdot I + 0.14 \text{ mA}$ $11 \cdot 10^{-3} \cdot I + 0.24 \text{ mA}$	
	> 2.2 A to 11 A	> 40 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.45 \cdot 10^{-3} \cdot I + 0.38 \text{ mA}$ $0.98 \cdot 10^{-3} \cdot I + 0.53 \text{ mA}$ $4 \cdot 10^{-3} \cdot I + 0.9 \text{ mA}$	
	AC current Measurement instruments converter method, Toroid	10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A	45 Hz to 65 Hz	$5 \cdot 10^{-3} \cdot I + 0.1 \text{ A}$ $5 \cdot 10^{-3} \cdot I + 0.2 \text{ A}$ $5 \cdot 10^{-3} \cdot I + 0.2 \text{ A}$
10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A		> 65 Hz to 440 Hz	$11 \cdot 10^{-3} \cdot I + 0.1 \text{ A}$ $11 \cdot 10^{-3} \cdot I + 0.2 \text{ A}$ $11 \cdot 10^{-3} \cdot I + 0.2 \text{ A}$	
10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A		45 Hz to 65 Hz	$8 \cdot 10^{-3} \cdot I + 0.1 \text{ A}$ $8 \cdot 10^{-3} \cdot I + 0.3 \text{ A}$ $8 \cdot 10^{-3} \cdot I + 1 \text{ A}$	
AC current Measurement instruments converter method	10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A	45 Hz to 65 Hz	$8 \cdot 10^{-3} \cdot I + 0.1 \text{ A}$ $8 \cdot 10^{-3} \cdot I + 0.3 \text{ A}$ $8 \cdot 10^{-3} \cdot I + 1 \text{ A}$	
	10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A	> 65 Hz to 440 Hz	$14 \cdot 10^{-3} \cdot I + 0.1 \text{ A}$ $14 \cdot 10^{-3} \cdot I + 0.3 \text{ A}$ $14 \cdot 10^{-3} \cdot I + 1 \text{ A}$	
	10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A	45 Hz to 65 Hz	$8 \cdot 10^{-3} \cdot I + 0.1 \text{ A}$ $8 \cdot 10^{-3} \cdot I + 0.3 \text{ A}$ $8 \cdot 10^{-3} \cdot I + 1 \text{ A}$	
AC current Sources	1 mA to 10 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.23 \cdot 10^{-3} \cdot I + 0.3 \text{ µA}$ $82 \cdot 10^{-6} \cdot I + 0.4 \text{ µA}$ $50 \cdot 10^{-6} \cdot I + 0.4 \text{ µA}$	<i>I</i> = measured value Direct measurement with Shunt Fluke A40
	> 10 mA to 20 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.24 \cdot 10^{-3} \cdot I + 0.2 \text{ µA}$ $95 \cdot 10^{-6} \cdot I + 0.3 \text{ µA}$ $60 \cdot 10^{-6} \cdot I + 0.5 \text{ µA}$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Page 15 of 72

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

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks	
AC current Sources	> 20 mA to 50 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.26 \cdot 10^{-3} \cdot I + 0.8 \mu\text{A}$ $0.1 \cdot 10^{-3} \cdot I + 1.4 \mu\text{A}$ $70 \cdot 10^{-6} \cdot I + 1.6 \mu\text{A}$	I = measured value Direct measurement Shunt Fluke A40	
	> 50 mA to 100 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.24 \cdot 10^{-3} \cdot I + 0.9 \mu\text{A}$ $0.1 \cdot 10^{-3} \cdot I + 2 \mu\text{A}$ $70 \cdot 10^{-6} \cdot I + 2.5 \mu\text{A}$		
	> 100 mA to 200 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.24 \cdot 10^{-3} \cdot I + 1.5 \mu\text{A}$ $0.1 \cdot 10^{-3} \cdot I + 3 \mu\text{A}$ $70 \cdot 10^{-6} \cdot I + 4 \mu\text{A}$		
	> 200 mA to 500 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.24 \cdot 10^{-3} \cdot I + 30 \mu\text{A}$ $0.11 \cdot 10^{-3} \cdot I + 40 \mu\text{A}$ $95 \cdot 10^{-6} \cdot I + 40 \mu\text{A}$		
	> 500 mA to 1 A	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.25 \cdot 10^{-3} \cdot I + 25 \mu\text{A}$ $0.12 \cdot 10^{-3} \cdot I + 41 \mu\text{A}$ $0.95 \cdot 10^{-3} \cdot I + 50 \mu\text{A}$		
	> 1 A to 2 A	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.25 \cdot 10^{-3} \cdot I + 32 \mu\text{A}$ $0.12 \cdot 10^{-3} \cdot I + 60 \mu\text{A}$ $90 \cdot 10^{-6} \cdot I + 65 \mu\text{A}$		
	> 2 A to 3 A	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.23 \cdot 10^{-3} \cdot I + 0.1 \text{ mA}$ $75 \cdot 10^{-6} \cdot I + 0.18 \text{ mA}$ $40 \cdot 10^{-6} \cdot I + 0.24 \text{ mA}$		
	> 3 A to 5 A	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.23 \cdot 10^{-3} \cdot I + 0.13 \text{ mA}$ $75 \cdot 10^{-6} \cdot I + 0.13 \text{ mA}$ $40 \cdot 10^{-6} \cdot I + 0.13 \text{ mA}$		
	> 5 A to 10 A	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.24 \cdot 10^{-3} \cdot I + 53 \mu\text{A}$ $95 \cdot 10^{-6} \cdot I + 0.15 \text{ mA}$ $50 \cdot 10^{-6} \cdot I + 0.22 \text{ mA}$		
	> 10 A to 20 A	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.24 \cdot 10^{-3} \cdot I + 60 \mu\text{A}$ $95 \cdot 10^{-6} \cdot I + 0.15 \text{ mA}$ $50 \cdot 10^{-6} \cdot I + 0.22 \text{ mA}$		
	0.2 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	90 nA		Substitution method with calibrator Fluke 5700A / 5725A
	0.5 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.14 μA		
	1 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.24 μA		
2 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.4 μA			
5 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	1 μA			
10 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	2 μA			
20 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	3 μA			

Valid from: 10.01.2024

Date of issue: 10.01.2024

Page 16 of 72

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

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC current Sources	50 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	10 μ A	Substitution method with calibrator Fluke 5700A / 5725A
	0.1 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	20 μ A	
	0.2 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	40 μ A	
	0.5 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.12 mA	
	1 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.22 mA	
	2 A	40 Hz 100 Hz 500 Hz; 1 kHz	0.4 mA 0.45 mA 0.5 mA	
	3 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	1 mA	
	5 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	1.5 mA	
	10 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	3 mA	
		220 μ A to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 220 mA to 2.2 A > 2.2 A to 11 A > 11 A to 20 A	40 Hz to 1 kHz	
AC active power Measurement instruments	0.1 W to 9.15 W	3.3 mA to < 9 mA	$2 \cdot 10^{-3} \cdot P$	P = measured value Calibration with Fluke 5520A Frequencies from 45 Hz to 65 Hz $\cos \varphi = 1$
	0.1 W to 33.5 W	9 mA to < 33 mA	$1.7 \cdot 10^{-3} \cdot P$	
	0.1 W to 91.5 W	33 mA to < 90 mA	$2 \cdot 10^{-3} \cdot P$	
	0.1 W to 336.5 W	90 mA to < 0.33 A	$1.7 \cdot 10^{-3} \cdot P$	
	1 W to 917 W	0.33 A to < 0.9 A	$2 \cdot 10^{-3} \cdot P$	
	1 W to 2243 W	0.9 A to < 2.2 A	$1.8 \cdot 10^{-3} \cdot P$	
	10 W to 4589 W	2.2 A to < 4.5 A	$2 \cdot 10^{-3} \cdot P$	
	10 W to 20.9 kW	4.5 A to 20.5 A	$1.8 \cdot 10^{-3} \cdot P$	
Capacitance Measurement instruments	0.19 nF to 0.39 nF	10 Hz to 10 kHz	$40 \cdot 10^{-3} \cdot C$	C = measured value with calibrator Fluke 5520A
	0.4 nF to 1.09 nF	10 Hz to 10 kHz	$18 \cdot 10^{-3} \cdot C$	
	1.1 nF to 3.29 nF	10 Hz to 3 kHz	$12 \cdot 10^{-3} \cdot C$	
	3.3 nF to 10.9 nF	10 Hz to 1 kHz	$5 \cdot 10^{-3} \cdot C$	
	11 nF to 32.9 nF	10 Hz to 1 kHz	$5 \cdot 10^{-3} \cdot C$	
	33 nF to 109.9 nF	10 Hz to 1 kHz	$5 \cdot 10^{-3} \cdot C$	
	110 nF to 329 nF	10 Hz to 1 kHz	$5 \cdot 10^{-3} \cdot C$	
	0.33 μ F to 1.09 μ F	10 Hz to 600 Hz	$5 \cdot 10^{-3} \cdot C$	
	1.1 μ F to 3.29 μ F	10 Hz to 300 Hz	$5 \cdot 10^{-3} \cdot C$	
3.3 μ F to 10.99 μ F	10 Hz to 150 Hz	$5 \cdot 10^{-3} \cdot C$		

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks	
Capacitance capacitors	1 pF; 10 pF	10 kHz	$0.63 \cdot 10^{-3}$	Direct measurement of capacitors	
	100 pF; 1000 pF	1 kHz and 10 kHz 100 kHz	$0.63 \cdot 10^{-3}$ $0.67 \cdot 10^{-3}$		
	10 nF; 100 nF 1 μ F	1 kHz 1 kHz	$0.63 \cdot 10^{-3}$ $0.61 \cdot 10^{-3}$		
	Capacitance bridges	1 pF; 10 pF	10 kHz	$0.26 \cdot 10^{-3}$	Calibration of capacitors via Substitution method
		100 pF; 1000 pF	1 kHz and 10 kHz 100 kHz	$0.26 \cdot 10^{-3}$ $0.36 \cdot 10^{-3}$	
		10 nF; 100 nF; 1 μ F	1 kHz	$0.26 \cdot 10^{-3}$	
Capacitance bridges	1 pF; 10 pF	10 kHz	$0.25 \cdot 10^{-3}$		
	100 pF; 1000 pF	1 kHz and 10 kHz 100 kHz	$0.25 \cdot 10^{-3}$ $0.30 \cdot 10^{-3}$		
	10 nF; 100 nF; 1 μ F	1 kHz	$0.25 \cdot 10^{-3}$		
Inductance Inductors	100 μ H 1 mH; 10 mH; 100 mH; 1 H	1 kHz and 10 kHz 100 Hz and 1 kHz	$1.5 \cdot 10^{-3}$ $1.5 \cdot 10^{-3}$	Direct measurement of inductances	
Inductors	100 μ H	1 kHz 10 kHz	$0.50 \cdot 10^{-3}$ $0.55 \cdot 10^{-3}$	Calibration of inductances via Substitution method	
	1 mH; 10 mH; 100 mH; 1 H	100 Hz 1 kHz	$0.50 \cdot 10^{-3}$ $0.50 \cdot 10^{-3}$		
Inductance bridges	100 μ H	1 kHz 10 kHz	$0.50 \cdot 10^{-3}$ $0.50 \cdot 10^{-3}$		
	1 mH; 10 mH; 100 mH; 1 H	100 Hz 1 kHz	$0.50 \cdot 10^{-3}$ $0.50 \cdot 10^{-3}$		
DC voltage Square wave generators	0 V to < 0.12 V 0.12 V to < 1.2 V 1.2 V to 12 V > 12 V to 120 V > 120 V to 1000 V	DC	$19 \cdot 10^{-6} \cdot U + 3 \mu$ V $10 \cdot 10^{-6} \cdot U + 3 \mu$ V $7 \cdot 10^{-6} \cdot U + 3 \mu$ V $10 \cdot 10^{-6} \cdot U + 30 \mu$ V $12 \cdot 10^{-6} \cdot U + 0.10$ mV	U = measured value Determination with DMM; HP 3458	
Square wave voltage Square wave generators	0 V to < 0.12 V 0.12 V to < 1.2 V 1.2 V to 12 V > 12 V to 120 V > 120 V to 1000 V	10 Hz, 100 Hz, 1 kHz	$0.3 \cdot 10^{-3} \cdot U + 6 \mu$ V $0.3 \cdot 10^{-3} \cdot U + 6 \mu$ V $0.3 \cdot 10^{-3} \cdot U + 6 \mu$ V $0.3 \cdot 10^{-3} \cdot U + 0.2$ mV $0.3 \cdot 10^{-3} \cdot U + 0.2$ mV	Determination with Sample-DMM; HP 3458	
	0.06 V to < 0.12 V 0.12 V to < 1.2 V 1.2 V to 12 V > 12 V to 120 V	10 kHz, 100 kHz	$0.7 \cdot 10^{-3} \cdot U + 0.1$ mV $0.7 \cdot 10^{-3} \cdot U + 0.9$ mV $0.7 \cdot 10^{-3} \cdot U + 9$ mV $0.7 \cdot 10^{-3} \cdot U + 90$ mV		

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Impulse amplitude Impulse generators	5 mV to 50 V	50 Ω	$85 \cdot 10^{-3} \cdot U$	Determination with oscilloscope $t_r, t_H > 10 \cdot t_{r, \text{System}}$ t_r : impuls rise time, t_H : puls half-power bandwidth $t_{r, \text{System}}$: rise time of measurement system
Rise time Impulse generators	825 ps to 100 ms		$60 \cdot 10^{-3} \cdot t_r + U_{\text{Tr}}$	The system rise time has to be considered when determining t_r by oscilloscope
Time of oscillation Impulse generators	1 ns to 1 s		$3.5 \cdot 10^{-3} \cdot t + 0.2 \text{ ns}$	Determination via oscilloscope
	0.33 ns to 1 s		$1 \cdot 10^{-10} \cdot t + U_{\text{Tr}}$	Determination via 1/frequency U_{Tr} : trigger uncertainty
Vertical deflection	6 mV to 200 V	1 MΩ (1 kHz)	$5 \cdot 10^{-3} \cdot U$	The uncertainty refers to generation of calibration signals incl. a reading error of 0.1 % for DSOs with self-recording raster.
	6 mV to 3 V	50 Ω (1 kHz)	$5 \cdot 10^{-3} \cdot U$	
	6 mV to 200 V	1 MΩ (1 kHz)	$6 \cdot 10^{-3} \cdot U$	The uncertainty refers to generation of calibration signals incl. a reading error of 0.3 % for picture tubes with fixed raster.
	6 mV to 3 V	50 Ω (1 kHz)	$6 \cdot 10^{-3} \cdot U$	
Horizontal deflection Time of oscillation	10 ns; 80 ns; 160 ns 400 ns to 5 s		$4 \cdot 10^{-3} \cdot t$	Reading error of 0.3 % for picture tubes with fixed raster
	10 ns; 80 ns; 160 ns 400 ns to 5 s		$2.5 \cdot 10^{-3} \cdot t$	Reading error of 0.1 % for DSOs with self-recording raster
Band width	100 kHz to 1 GHz	0.1 V to 1 V	$40 \cdot 10^{-3} \cdot b$	b = measured value Determination of 3-dB-point with power splitter and HF-voltage measurement
	> 1 GHz to 3 GHz	0.1 V to 1 V	$60 \cdot 10^{-3} \cdot b$	
Rise time	360 ps to 10 ns		15 ps	repetition rate 10 Hz to 1 MHz, with Tektronix-Puls head
HF-voltage HF generators	0.1 V to 2 V	100 kHz to 1 GHz > 1 GHz to 3 GHz > 3 GHz to 18 GHz	$15 \cdot 10^{-3} \cdot U$ $30 \cdot 10^{-3} \cdot U$ $40 \cdot 10^{-3} \cdot U$	Direct measurement of voltage with R&S Z-51

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
HF-voltage HF-Measurement instruments HF-Generators	0.5 V to 1 V	100 kHz to 10 MHz > 10 MHz to 30 MHz > 30 MHz to 50 MHz > 50 MHz to 500 MHz > 500 MHz to 1 GHz	$2 \cdot 10^{-3} \cdot U$ $3 \cdot 10^{-3} \cdot U$ $5 \cdot 10^{-3} \cdot U$ $10 \cdot 10^{-3} \cdot U$ $15 \cdot 10^{-3} \cdot U$	Voltage generation with T-Piece, N-Connector, the uncertainty rises with different connectors
HF-voltage HF-Measurement instruments	0.1 V to 1 V	100 kHz to 10 MHz > 1 GHz to 3 GHz	$15 \cdot 10^{-3} \cdot U$ $35 \cdot 10^{-3} \cdot U$	Direct measurement at Generator R&S SMT-03
	0.1 V to 1 V	100 kHz to 1 GHz > 1 GHz to 3 GHz > 3 GHz to 18 GHz	$15 \cdot 10^{-3} \cdot U$ $30 \cdot 10^{-3} \cdot U$ $45 \cdot 10^{-3} \cdot U$	Voltage generation with power splitter; voltage metering with R&S Z-51
Time and Frequency Frequency	100 kHz; 1 MHz 5 MHz; 10 MHz	Deviation measurement of phasing time with test time ≥ 2 h	$5 \cdot 10^{-11} \cdot f$	f = frequency
	1 Hz to 3 GHz	Digital frequency-measurement on count basis	$1 \cdot 10^{-10} \cdot f + U_{Tr}$	U_{Tr} = trigger uncertainty
	3 GHz to 26.5 GHz		$2 \cdot 10^{-10} \cdot f + 1$ Hz	
	1 Hz to 10 kHz		3.3 mHz	Optical procedure (tachometer)
Time interval	10 ms to 10 s		$6 \cdot 10^{-11} \cdot t + 2$ ns + U_{Tr}	U_{Tr} = trigger uncertainty t = time interval

On-site Calibration - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC and Low frequency DC voltage Measurement instruments	0 mV to 0.22 V		$8 \cdot 10^{-6} \cdot U + 3$ μ V	U = measured value Calibration with Calibrator Fluke 5700A
	> 0.22 V to 2.2 V		$9 \cdot 10^{-6} \cdot U + 3$ μ V	
	> 2.2 V to 11 V		$10 \cdot 10^{-6} \cdot U + 6$ μ V	
	> 11 V to 22 V		$8 \cdot 10^{-6} \cdot U + 20$ μ V	
	> 22 V to 220 V		$12 \cdot 10^{-6} \cdot U + 0.25$ mV	
	> 220 V to 1.1 kV		$12 \cdot 10^{-6} \cdot U + 1.3$ mV	
DC voltage Sources	0 mV to 0.12 V		$6 \cdot 10^{-6} \cdot U + 2.5$ μ V	Calibration with DMM HP 3458A
	> 0.12 V to 1.2 V		$5.5 \cdot 10^{-6} \cdot U + 2.5$ μ V	
	> 1.2 V to 12 V		$10 \cdot 10^{-6} \cdot U + 3$ μ V	
	> 12 V to 100 V		$15 \cdot 10^{-6} \cdot U + 80$ μ V	
	> 100 V to 200 V		$8 \cdot 10^{-6} \cdot U + 0.17$ mV	
	> 200 V to 500 V		$11 \cdot 10^{-6} \cdot U + 0.17$ mV	
	> 500 V to 700 V > 700 V to 1 kV		$14 \cdot 10^{-6} \cdot U + 0.17$ mV $21 \cdot 10^{-6} \cdot U + 0.17$ mV	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

On-site Calibration - Darmstadt

Calibration and Measurement Capabilities (CMC)				
Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC voltage Sources	1 kV to 6 kV		$1 \cdot 10^{-3} \cdot U$	Calibration with multimeter and high voltage divider
DC current Measurement instruments	1 μ A to 0.12 mA > 0.12 mA to 1.2 mA > 1.2 mA to 12 mA > 12 mA to 0.12 A > 0.12 A to 1.05 A > 1.05 A to 11 A > 11 A to 20 A		25 $\cdot 10^{-6} \cdot I + 3$ nA 25 $\cdot 10^{-6} \cdot I + 25$ nA 25 $\cdot 10^{-6} \cdot I + 0.25$ μ A 45 $\cdot 10^{-6} \cdot I + 2$ μ A 0.13 $\cdot 10^{-3} \cdot I + 21$ μ A 50 $\cdot 10^{-6} \cdot I + 0.4$ mA 60 $\cdot 10^{-6} \cdot I + 0.25$ mA	I = measured value Substitution method with DMM HP 3458A
	> 20 A to 50 A		$0.5 \cdot 10^{-3} \cdot I + 5$ mA	Substitution method with DMM HP 3458 / Shunt H&B 0.01 Ω
DC current Measurement instruments with converter method	> 10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A		$6 \cdot 10^{-3} \cdot I + 0.1$ A $6 \cdot 10^{-3} \cdot I + 0.2$ A $6 \cdot 10^{-3} \cdot I + 0.5$ A	Calibration with Fluke 5500A / Coil
DC current Sources	1 μ A to 0.12 mA > 0.12 mA to 1.2 mA > 1.2 mA to 12 mA > 12 mA to 0.12 A > 0.12 A to 1.05 A		25 $\cdot 10^{-6} \cdot I + 2$ nA 25 $\cdot 10^{-6} \cdot I + 15$ nA 25 $\cdot 10^{-6} \cdot I + 0.15$ μ A 45 $\cdot 10^{-6} \cdot I + 1.3$ μ A 0.13 $\cdot 10^{-3} \cdot I + 21$ μ A	Calibration with DMM HP 3458A
	> 1.05 A to 11 A > 11 A to 20 A		50 $\cdot 10^{-6} \cdot I + 0.4$ mA 55 $\cdot 10^{-6} \cdot I + 0.25$ mA	Calibration with DMM HP 3458A & Shunt Fluke Y5020
	> 20 A to 50 A		$0.5 \cdot 10^{-3} \cdot I + 5$ mA	Substitution method with HP 3458A and H&B 0.01 Ω
DC resistance Resistors	1 m Ω to 10 m Ω > 10 m Ω to 100 m Ω > 0.1 Ω to 1 Ω		45 $\cdot 10^{-6} \cdot R + 5$ $\mu\Omega$ 45 $\cdot 10^{-6} \cdot R + 50$ $\mu\Omega$ 40 $\cdot 10^{-6} \cdot R + 0.1$ m Ω	R = measured value Comparison with Shunt Fluke Y 5020 and standard resistor Tinsley 5685B-1 Ω
	> 1 Ω to 12 Ω > 12 Ω to 120 Ω > 120 Ω to 1.2 k Ω > 1.2 k Ω to 12 k Ω > 12 k Ω to 120 k Ω > 120 k Ω to 1.2 M Ω > 1.2 M Ω to 12 M Ω > 12 M Ω to 120 M Ω		26 $\cdot 10^{-6} \cdot R + 0.1$ m Ω 21 $\cdot 10^{-6} \cdot R + 1$ m Ω 17 $\cdot 10^{-6} \cdot R + 1$ m Ω 17 $\cdot 10^{-6} \cdot R + 10$ m Ω 17 $\cdot 10^{-6} \cdot R + 0.1$ Ω 20 $\cdot 10^{-6} \cdot R + 8$ Ω 80 $\cdot 10^{-6} \cdot R + 250$ Ω 0.7 $\cdot 10^{-3} \cdot R + 2.5$ k Ω	Calibration with DMM HP 3458A

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

On-site Calibration - Darmstadt

Calibration and Measurement Capabilities (CMC)				
Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC resistance Measurement instruments	0.01 Ω		$0.13 \cdot 10^{-3} \cdot R$	Calibration at 0.01 Ω with Shunt Fluke Y 5020, Calibration starting at 1 Ω with Calibrator Fluke 5700A
	1 Ω		$0.12 \cdot 10^{-3} \cdot R$	
	1.9 Ω		$0.12 \cdot 10^{-3} \cdot R$	
	10 Ω		$42 \cdot 10^{-6} \cdot R$	
	19 Ω		$49 \cdot 10^{-6} \cdot R$	
	100 Ω		$27 \cdot 10^{-6} \cdot R$	
	190 Ω		$24 \cdot 10^{-6} \cdot R$	
	1 kΩ		$19 \cdot 10^{-6} \cdot R$	
	1.9 kΩ		$19 \cdot 10^{-6} \cdot R$	
	10 kΩ		$18 \cdot 10^{-6} \cdot R$	
	19 kΩ		$18 \cdot 10^{-6} \cdot R$	
	100 kΩ		$21 \cdot 10^{-6} \cdot R$	
	190 kΩ		$29 \cdot 10^{-6} \cdot R$	
	1 MΩ		$28 \cdot 10^{-6} \cdot R$	
	1.9 MΩ		$0.12 \cdot 10^{-3} \cdot R$	
10 MΩ	$82 \cdot 10^{-6} \cdot R$			
19 MΩ	$0.64 \cdot 10^{-3} \cdot R$			
100 MΩ	$0.61 \cdot 10^{-3} \cdot R$			
	0.01 Ω to 0.1 Ω > 0.1 Ω to 1 Ω > 1 Ω to 10 Ω		$0.1 \cdot 10^{-3} \cdot R + 20 \mu\Omega$ $0.1 \cdot 10^{-3} \cdot R + 0.2 \text{ m}\Omega$ $0.1 \cdot 10^{-3} \cdot R + 2 \text{ m}\Omega$	Calibration with Shunt Fluke Y5020 and HP 3458 via current/voltage method
	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 10 GΩ		$0.1 \cdot 10^{-3} \cdot R + 20 \text{ m}\Omega$ $0.1 \cdot 10^{-3} \cdot R + 0.2 \Omega$ $0.1 \cdot 10^{-3} \cdot R + 2 \Omega$ $0.1 \cdot 10^{-3} \cdot R + 20 \Omega$ $0.1 \cdot 10^{-3} \cdot R + 0.2 \text{ k}\Omega$ $0.1 \cdot 10^{-3} \cdot R + 2 \text{ k}\Omega$ $0.6 \cdot 10^{-3} \cdot R + 20 \text{ k}\Omega$ $7 \cdot 10^{-3} \cdot R + 0.2 \text{ M}\Omega$	Calibration with a resistor and a multimeter via substitution method
DC power Measurement instruments	0.1 W to 336 W	3.3 mA to < 0.33 A	$0.7 \cdot 10^{-3} \cdot P$	P = measured value Calibration with Calibrator Fluke 5520A
	1 W to 3059 W	0.33 A to < 3 A	$0.7 \cdot 10^{-3} \cdot P$	
	10 W to 20.9 kW	3 A to 20.5 A	$1 \cdot 10^{-3} \cdot P$	
AC voltage Measurement instruments	0.1 V	20 Hz; 40 Hz; 1 kHz	25 μV	Calibration with Calibrator Fluke 5700A
		10 kHz; 20 kHz	25 μV	
		50 kHz	40 μV	
		100 kHz	50 μV	
	1 V	20 Hz	0.1 mV	
		40 Hz; 1 kHz; 10 kHz	70 μV	
		20 kHz	80 μV	
4 V	50 kHz; 70 kHz; 100 kHz	0.1 mV		
	200 kHz	0.2 mV		
	500 kHz	1 mV		
	1 MHz	2 mV		
6 V	1 kHz; 10 kHz	0.25 mV		
8 V	1 kHz; 10 kHz	0.35 mV		
			0.4 mV	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

On-site Calibration - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks	
AC voltage Measurement instruments	10 V	20 Hz 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 70 kHz; 100 kHz 200 kHz 500 kHz 1 MHz	0.7 mV 0.5 mV 0.6 mV 1 mV 1.2 mV 3 mV 10 mV 15 mV	Calibration with Calibrator Fluke 5700A	
	13 V	1 kHz; 10 kHz	0.5 mV		
	15 V	1 kHz; 10 kHz	0.8 mV		
	18 V	1 kHz; 10 kHz	1 mV		
	20 V	1 kHz; 10 kHz	1.1 mV		
	100 V	20 Hz 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 70 kHz 100 kHz	10 mV 7 mV 7 mV 20 mV 30 mV 37 mV		
	700 V	50 Hz; 500 Hz; 1 kHz	80 mV		
	1000 V	50 Hz; 500 Hz; 1 kHz	0.1 V		
	2 mV to 2.2 mV	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 > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.61 \cdot 10^{-3} \cdot U + 7 \mu\text{V}$ $0.24 \cdot 10^{-3} \cdot U + 7 \mu\text{V}$ $0.13 \cdot 10^{-3} \cdot U + 7 \mu\text{V}$ $0.41 \cdot 10^{-3} \cdot U + 7 \mu\text{V}$ $1.1 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$ $1.4 \cdot 10^{-3} \cdot U + 18 \mu\text{V}$ $2 \cdot 10^{-3} \cdot U + 35 \mu\text{V}$ $3 \cdot 10^{-3} \cdot U + 40 \mu\text{V}$		U = measured value Calibration with Calibrator Fluke 5700A/5725A
	> 2.2 mV to 22 mV	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 > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.59 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$ $0.22 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$ $0.11 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$ $0.39 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$ $1 \cdot 10^{-3} \cdot U + 12 \mu\text{V}$ $1.4 \cdot 10^{-3} \cdot U + 20 \mu\text{V}$ $2 \cdot 10^{-3} \cdot U + 40 \mu\text{V}$ $3.8 \cdot 10^{-3} \cdot U + 40 \mu\text{V}$		
> 22 mV to 220 mV	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 > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.63 \cdot 10^{-3} \cdot U + 20 \mu\text{V}$ $0.25 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$ $0.12 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$ $0.37 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$ $0.9 \cdot 10^{-3} \cdot U + 35 \mu\text{V}$ $1.2 \cdot 10^{-3} \cdot U + 40 \mu\text{V}$ $2 \cdot 10^{-3} \cdot U + 50 \mu\text{V}$ $3.8 \cdot 10^{-3} \cdot U + 0.13 \text{ mV}$			

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

On-site Calibration - Darmstadt

Calibration and Measurement Capabilities (CMC)				
Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
	> 0.22 V to 2.2 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 > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.64 \cdot 10^{-3} \cdot U + 0.13 \text{ mV}$ $0.2 \cdot 10^{-3} \cdot U + 40 \text{ }\mu\text{V}$ $85 \cdot 10^{-6} \cdot U + 18 \text{ }\mu\text{V}$ $0.15 \cdot 10^{-3} \cdot U + 30 \text{ }\mu\text{V}$ $0.3 \cdot 10^{-3} \cdot U + 90 \text{ }\mu\text{V}$ $0.5 \cdot 10^{-3} \cdot U + 0.17 \text{ mV}$ $1.3 \cdot 10^{-3} \cdot U + 0.45 \text{ mV}$ $2.5 \cdot 10^{-3} \cdot U + 1.2 \text{ mV}$	U = measured value Calibration with Calibrator Fluke 5700A/5725A
	> 2.2 V to 22 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 > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.64 \cdot 10^{-3} \cdot U + 1.3 \text{ mV}$ $0.2 \cdot 10^{-3} \cdot U + 0.35 \text{ mV}$ $90 \cdot 10^{-6} \cdot U + 0.13 \text{ mV}$ $0.15 \cdot 10^{-3} \cdot U + 0.25 \text{ mV}$ $0.3 \cdot 10^{-3} \cdot U + 0.45 \text{ mV}$ $0.6 \cdot 10^{-3} \cdot U + 2 \text{ mV}$ $1.6 \cdot 10^{-3} \cdot U + 5.5 \text{ mV}$ $3.2 \cdot 10^{-3} \cdot U + 10 \text{ mV}$	
	> 22 V 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	$0.65 \cdot 10^{-3} \cdot U + 12 \text{ mV}$ $0.2 \cdot 10^{-3} \cdot U + 3.5 \text{ mV}$ $0.1 \cdot 10^{-3} \cdot U + 1.7 \text{ mV}$ $0.25 \cdot 10^{-3} \cdot U + 4.8 \text{ mV}$ $0.7 \cdot 10^{-3} \cdot U + 10 \text{ mV}$	
	> 220 V to 1.1 kV	40 Hz to < 50 Hz 50 Hz to 1 kHz > 1 kHz to 20 kHz	$80 \cdot 10^{-6} \cdot U + 25 \text{ mV}$ $80 \cdot 10^{-6} \cdot U + 25 \text{ mV}$ $0.15 \cdot 10^{-3} \cdot U + 20 \text{ mV}$	
AC voltage Sources	0.1 V	20 Hz; 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 100 kHz	25 μV 25 μV 40 μV 50 μV	substitution method with Calibrator Fluke 5700A
	1 V	20 Hz	0.1 mV	
		40 Hz; 1 kHz; 10 kHz	70 μV	
		20 kHz	80 μV	
		50 kHz; 70 kHz; 100 kHz	0.1 mV	
		200 kHz	0.2 mV	
	4 V	500 kHz	1 mV	
		1 MHz	2 mV	
4 V	1 kHz; 10 kHz	0.25 mV		
6 V	1 kHz; 10 kHz	0.35 mV		
8 V	1 kHz; 10 kHz	0.4 mV		
10 V	20 Hz	0.7 mV		
	40 Hz; 1 kHz	0.5 mV		
	10 kHz; 20 kHz	0.6 mV		
	50 kHz	1 mV		
	70 kHz; 100 kHz	1.2 mV		
	200 kHz	3 mV		
13 V	500 kHz	10 mV		
	1 MHz	15 mV		
13 V	1 kHz; 10 kHz	0.5 mV		

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

On-site Calibration - Darmstadt

Calibration and Measurement Capabilities (CMC)				
Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage sources	15 V	1 kHz; 10 kHz	0.8 mV	
	18 V	1 kHz; 10 kHz	1 mV	
	20 V	1 kHz; 10 kHz	1.1 mV	
	100 V	20 Hz 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 70 kHz 100 kHz	10 mV 7 mV 7 mV 20 mV 30 mV 37 mV	
	700 V	50 Hz; 500 Hz; 1 kHz	80 mV	
	1000 V	50 Hz; 500 Hz; 1 kHz	0.1 V	
	1 kV to 6 kV	50 Hz	$2 \cdot 10^{-3} \cdot U$	$U =$ measured value Calibration with multimeter and high frequency divider
	0.1 V to 0.22 V	20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.25 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$ $0.12 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$ $0.37 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$ $0.9 \cdot 10^{-3} \cdot U + 35 \mu\text{V}$	$U =$ Measured value
	> 0.22 V to 2.2 V	20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.2 \cdot 10^{-3} \cdot U + 40 \mu\text{V}$ $80 \cdot 10^{-6} \cdot U + 25 \mu\text{V}$ $0.15 \cdot 10^{-3} \cdot U + 30 \mu\text{V}$ $0.3 \cdot 10^{-3} \cdot U + 90 \mu\text{V}$ $0.5 \cdot 10^{-3} \cdot U + 0.17 \text{ mV}$ $1.3 \cdot 10^{-3} \cdot U + 0.45 \text{ mV}$ $2.5 \cdot 10^{-3} \cdot U + 1.2 \text{ mV}$	
	> 2.2 V to 22 V	20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.2 \cdot 10^{-3} \cdot U + 0.35 \text{ mV}$ $0.1 \cdot 10^{-3} \cdot U + 0.15 \text{ mV}$ $0.15 \cdot 10^{-3} \cdot U + 0.28 \text{ mV}$ $0.3 \cdot 10^{-3} \cdot U + 0.45 \text{ mV}$ $0.6 \cdot 10^{-3} \cdot U + 2 \text{ mV}$ $1.6 \cdot 10^{-3} \cdot U + 5.5 \text{ mV}$ $3.2 \cdot 10^{-3} \cdot U + 10 \text{ mV}$	
> 22 V to 220 V	20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.22 \cdot 10^{-3} \cdot U + 3.5 \text{ mV}$ $0.12 \cdot 10^{-3} \cdot U + 1.7 \text{ mV}$ $0.25 \cdot 10^{-3} \cdot U + 4.8 \text{ mV}$ $0.7 \cdot 10^{-3} \cdot U + 10 \text{ mV}$		
> 220 V to 1.1 kV	40 Hz to < 50 Hz 50 Hz to 1 kHz > 1 kHz to 20 kHz	$90 \cdot 10^{-6} \cdot U + 25 \text{ mV}$ $90 \cdot 10^{-6} \cdot U + 25 \text{ mV}$ $0.15 \cdot 10^{-3} \cdot U + 20 \text{ mV}$		
AC current Measurement instruments	0.2 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	90 nA	Calibration with Calibrator Fluke 5700A / 5725A
	0.5 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.14 μA	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

On-site Calibration - Darmstadt

Calibration and Measurement Capabilities (CMC)				
Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC current Measurement instruments	1 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.24 μ A	Calibration with Calibrator Fluke 5700A / 5725A
	2 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.4 μ A	
	5 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	1 μ A	
	10 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	2 μ A	
	20 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	3 μ A	
	50 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	10 μ A	
	0.1 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	20 μ A	
	0.2 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	40 μ A	
	0.5 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.12 mA	
	1 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.22 mA	
	2 A	40 Hz 100 Hz 500 Hz; 1 kHz	0.4 mA 0.45 mA 0.5 mA	
	3 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	1 mA	
	5 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	1.5 mA	
	10 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	3 mA	
	AC current Measurement instruments converter method, toroid	220 μ A to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 220 mA to 2.2 A > 2.2 A to 11 A	40 Hz to 1 kHz	
AC current Measurement instruments converter method, toroid	10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A	45 Hz to 65 Hz	5 · 10 ⁻³ · I + 0.1 A 5 · 10 ⁻³ · I + 0.2 A 5 · 10 ⁻³ · I + 0.2 A	Calibration with Calibrator Fluke 5500A / Coil
	10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A	> 65 Hz to 440 Hz	11 · 10 ⁻³ · I + 0.1 A 11 · 10 ⁻³ · I + 0.2 A 11 · 10 ⁻³ · I + 0.2 A	
	10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A	45 Hz to 65 Hz	8 · 10 ⁻³ · I + 0.1 A 8 · 10 ⁻³ · I + 0.3 A 8 · 10 ⁻³ · I + 1 A	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

On-site Calibration - Darmstadt

Calibration and Measurement Capabilities (CMC)				
Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC current Measurement instruments converter method	10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A	> 65 Hz to 440 Hz	$14 \cdot 10^{-3} \cdot I + 0.1 \text{ A}$ $14 \cdot 10^{-3} \cdot I + 0.3 \text{ A}$ $14 \cdot 10^{-3} \cdot I + 1 \text{ A}$	Calibration with Calibrator Fluke 5500A / Coil
AC current Sources	0.2 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	90 nA	substitution method with Calibrator Fluke 5700A / 5725A
	0.5 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.14 μA	
	1 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.24 μA	
	2 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.4 μA	
	5 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	1 μA	
	10 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	2 μA	
	20 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	3 μA	
	50 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	10 μA	
	0.1 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	20 μA	
	0.2 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	40 μA	
	0.5 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.12 mA	
	1 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.22 mA	
	2 A	40 Hz 100 Hz 500 Hz; 1 kHz	0.4 mA 0.45 mA 0.5 mA	
	3 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	1 mA	
	5 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	1.5 mA	
10 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	3 mA		
	220 μA to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 220 mA to 2.2 A > 2.2 A to 11 A > 11 A to 20 A	40 Hz to 1 kHz	$0.15 \cdot 10^{-3} \cdot I + 0.1 \mu\text{A}$ $0.15 \cdot 10^{-3} \cdot I + 0.8 \mu\text{A}$ $0.37 \cdot 10^{-3} \cdot I + 7 \mu\text{A}$ $0.75 \cdot 10^{-3} \cdot I + 60 \mu\text{A}$ $0.44 \cdot 10^{-3} \cdot I + 0.35 \text{ mA}$ $0.31 \cdot 10^{-3} \cdot I + 0.5 \text{ mA}$	I = measured value with Shunt Y 5020

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

On-site Calibration - Darmstadt

Calibration and Measurement Capabilities (CMC)				
Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC active power Measurement instruments	0.1 W to 9.15 W	3.3 mA to < 9 mA	$2 \cdot 10^{-3} \cdot P$	P = measured value Calibration with Fluke 5520A Frequency from 45 Hz to 65 Hz $\cos \varphi = 1$
	0.1 W to 33.5 W	9 mA to < 33 mA	$1.7 \cdot 10^{-3} \cdot P$	
	0.1 W to 91.5 W	33 mA to < 90 mA	$2 \cdot 10^{-3} \cdot P$	
	0.1 W to 336.5 W	90 mA to < 0.33 mA	$1.7 \cdot 10^{-3} \cdot P$	
	1 W to 917 W	0.33 A to < 0.9 A	$2 \cdot 10^{-3} \cdot P$	
	1 W to 2243 W	0.9 A to < 2.2 A	$1.8 \cdot 10^{-3} \cdot P$	
	10 W to 4589 W	2.2 A to < 4.5 A	$2 \cdot 10^{-3} \cdot P$	
	10 W to 20.9 kW	4.5 A to 20.5 A	$1.8 \cdot 10^{-3} \cdot P$	
Capacitance Measurement instruments	0.19 nF to 0.39 nF	10 Hz to 10 kHz	$40 \cdot 10^{-3} \cdot C$	C = measured value with Calibrator Fluke 5520A
	0.4 nF to 1.09 nF	10 Hz to 10 kHz	$18 \cdot 10^{-3} \cdot C$	
	1.1 nF to 3.29 nF	10 Hz to 3 kHz	$12 \cdot 10^{-3} \cdot C$	
	3.3 nF to 10.9 nF	10 Hz to 1 kHz	$5 \cdot 10^{-3} \cdot C$	
	11 nF to 32.9 nF	10 Hz to 1 kHz	$5 \cdot 10^{-3} \cdot C$	
	33 nF to 109.9 nF	10 Hz to 1 kHz	$5 \cdot 10^{-3} \cdot C$	
	110 nF to 329 nF	10 Hz to 1 kHz	$5 \cdot 10^{-3} \cdot C$	
	0.33 μF to 1.09 μF	10 Hz to 600 Hz	$5 \cdot 10^{-3} \cdot C$	
	1.1 μF to 3.29 μF	10 Hz to 300 Hz	$5 \cdot 10^{-3} \cdot C$	
3.3 μF to 10.99 μF	10 Hz to 150 Hz	$5 \cdot 10^{-3} \cdot C$		
DC voltage Square wave generators	0 V to < 0.12 V	DC	$25 \cdot 10^{-6} \cdot U + 5 \mu\text{V}$	U = measured value Determination with DMM HP 3458
	0.12 V to < 1.2 V		$15 \cdot 10^{-6} \cdot U + 5 \mu\text{V}$	
	1.2 V to 12 V		$10 \cdot 10^{-6} \cdot U + 5 \mu\text{V}$	
	> 12 V to 120 V		$15 \cdot 10^{-6} \cdot U + 70 \mu\text{V}$	
	> 120 V to 1000 V		$15 \cdot 10^{-6} \cdot U + 0.20 \text{ mV}$	
Square wave voltage Square wave generators	0 V to < 0.12 V	10 Hz, 100 Hz, 1 kHz	$0.3 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$	Determination with Sample-DMM; HP 3458
	0.12 V to < 1.2 V		$0.3 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$	
	1.2 V to 12 V		$0.3 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$	
	> 12 V to 120 V		$0.3 \cdot 10^{-3} \cdot U + 0.2 \text{ mV}$	
	> 120 V to 1000 V		$0.3 \cdot 10^{-3} \cdot U + 0.2 \text{ mV}$	
	0 V to < 0.12 V	10 kHz, 100 kHz	$0.7 \cdot 10^{-3} \cdot U + 0.1 \text{ mV}$	
	0.12 V to < 1.2 V		$0.7 \cdot 10^{-3} \cdot U + 0.9 \text{ mV}$	
	1.2 V to 12 V		$0.7 \cdot 10^{-3} \cdot U + 9 \text{ mV}$	
	> 12 V to 120 V		$0.7 \cdot 10^{-3} \cdot U + 90 \text{ mV}$	
Impulse amplitude Impulse generators	5 mV to 50 V	50 Ω	$85 \cdot 10^{-3} \cdot U$	Determination with oscilloscope $t_r, t_H > 10 \cdot t_{r, \text{System}}$ t_r = impulse rise time, t_H = pulse half-power bandwidth $t_{r, \text{System}}$ = rise time of measurement system
Rise time Impulse generators	825 ps to 100 ms		$60 \cdot 10^{-3} \cdot t_r + U_{Tf}$	The system rise time t_r has to be considered when determining t_r by oscilloscope

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

On-site Calibration - Darmstadt

Calibration and Measurement Capabilities (CMC)				
Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Time of oscillation Impulse generators	1 ns to 1 s		$3.5 \cdot 10^{-3} \cdot t + 0.2 \text{ ns}$	Determination with oscilloscope
	0.33 ns to 1 s		$1 \cdot 10^{-10} \cdot t + U_{Tr}$	Determination via 1/frequency U_{Tr} : trigger uncertainty
Vertical deflection	6 mV to 200 V	1 M Ω (1 kHz)	$5 \cdot 10^{-3} \cdot U$	The uncertainty refers to generation of calibration signals incl. a reading error of 0.1 % for DSOs with self-recording raster
	6 mV to 3 V	50 Ω (1 kHz)	$5 \cdot 10^{-3} \cdot U$	
	6 mV to 200 V	1 M Ω (1 kHz)	$6 \cdot 10^{-3} \cdot U$	The uncertainty refers to generation of calibration signals incl. a reading error of 0.3 % for picture tubes with fixed raster
	6 mV to 3 V	50 Ω (1 kHz)	$6 \cdot 10^{-3} \cdot U$	
Horizontal deflection	10 ns; 80 ns; 160 ns 400 ns to 5 s		$4 \cdot 10^{-3} \cdot t$	Reading error of 0.3 % for picture tubes with fixed raster
	10 ns; 80 ns; 160 ns 400 ns to 5 s		$2.5 \cdot 10^{-3} \cdot t$	Reading error of 0.1 % for DSOs with self-recording raster
Band width	100 kHz to 1 GHz	0.1 V to 1 V	$40 \cdot 10^{-3} \cdot b$	b = measured value
	> 1 GHz to 3 GHz	0.1 V to 1 V	$60 \cdot 10^{-3} \cdot b$	Determination of 3-dB-point with power splitter and HF-voltage measurement
Rise time	360 ps to 10 ns	Range of voltage 20 mV to 1 V $R_i = 50 \Omega$	15 ps	t_r = rise time repetition rate 10 Hz to 1 MHz with Tektronix-Pulse head
Time and Frequency Frequency	1 Hz to 3 GHz	Digital frequency-measurement on count basis	$2 \cdot \sqrt{(10^{-10} \cdot f)^2 + U_{Tr}^2}$	f = frequency U_{Tr} : trigger uncertainty
	3 GHz to 26.5 GHz		$2 \cdot \sqrt{(10^{-10} \cdot f)^2 + (1 \text{ Hz})^2/3}$	
Time interval	10 ms to 10 s		$2 \cdot \sqrt{(10^{-10} \cdot t)^2 + (1 \text{ ns})^2/3 + U_{Tr}^2}$	t = time interval U_{Tr} : trigger uncertainty

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Neustadt

Permanent Laboratory - Neustadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length Gauge blocks * made of steel according to DIN EN ISO 3650:1999	0.5 mm to 100 mm	VDI/VDE/DGQ 2618 Part 3.1:2004 Measurement of the deviation of the central length l_c from the nominal value l_n by comparison measurement Measurement of the deviations f_o and f_u from the central length by 5 points comparison measurement	For the central length: $0.08 \mu\text{m} + 0.8 \cdot 10^{-6} \cdot l$ For the deviations f_o and f_u from the central length: $0.07 \mu\text{m}$	in the nominal values of references $l =$ gauge block length Measuring surface quality as stated in QMH resp. in the test specifications For the smallest measurement uncertainties, the wringability and the wringing characteristics of both measuring surfaces must be checked using an appropriate optical flat
	0.5 mm to 100 mm		For the central length: $0.1 \mu\text{m} + 0.9 \cdot 10^{-6} \cdot l$ For the deviations f_o and f_u from the central length: $0.07 \mu\text{m}$	
Cylindrical setting gauges * Ring gauges Diameter	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 4.1:2006	$0.8 \mu\text{m} + 5 \cdot 10^{-6} \cdot d$	$d =$ measured diameter of the ring
Roundness deviation	3 mm to 200 mm		$0.1 \mu\text{m}$	
Straightness and parallelism deviation	5 mm to 300 mm		$1 \mu\text{m}$	Length of profile line
Setting plug gauges Diameter	1 mm to 200 mm		$0.8 \mu\text{m} + 5 \cdot 10^{-6} \cdot d$	$d =$ measured diameter of the plug
Roundness deviation	1 mm to 200 mm		$0.1 \mu\text{m}$	
Straightness and parallelism deviation	5 mm to 500 mm		$1 \mu\text{m}$	Length of profile line
Testing cylinder Roundness deviation	60 mm to 200 mm	Trescal KA27 01.1/2021	$0.1 \mu\text{m}$	Diameter
Straightness and parallelism deviation	5 mm to 300 mm		$1 \mu\text{m}$	Length of profile line
Angular deviation between front surface and surface line			$1 \mu\text{m}$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Page 30 of 72

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

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Neustadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Cylindrical plug gauge with taper	axial length to 400 mm	Trescal KA32 01.1/2021	0.6 μm	
Cylinder				
Diameter				
Form error				
Taper	Diameter to 50 mm		0.5 μm	
Form error				
Taper angle				
Coaxiality deviation				
Balls	5 mm to 50 mm	Trescal KA67 01.1/2021	$1 \mu\text{m} + 5 \cdot 10^{-6} \cdot d$	d = diameter of balls 2-point-diameter via mechanical probing
Diameter				
Roundness deviation			0.1 μm	
Gap gauges *	10 mm to 160 mm	VDI/VDE/DGQ 2618 Part 4.7:2005	$2 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	l = measured length
Feeler gauges	0.01 mm to 2 mm	Trescal KA29 01.1/2021	1 μm	
Limit gauges Distance at measuring points of plan-parallel areas	1 mm to 300 mm	Trescal KA66 01.1/2021	$1 \mu\text{m} + 5 \cdot 10^{-6} \cdot l$	l = distance between measuring surfaces distance by 2-Point-Measurement
Polygon plug gauges with plan-parallel measuring surfaces	1 mm to 100 mm	Trescal KA66 01.1/2021	$1 \mu\text{m} + 5 \cdot 10^{-6} \cdot l$	
Thread gauges * Pitch diameter on external thread	1 mm to 200 mm Lead ≥ 0.25 mm	VDI/VDE/DGQ 2618 Part 4.8:2006, Option 1	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	
Pitch diameter on internal thread	3 mm to 200 mm Lead ≥ 0.50 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.9:2006, Option 1	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	
Knife straight edges * Straightness deviation	to 1000 mm	VDI/VDE/DGQ 2618 Part 5.2:2013	$1 \mu\text{m} + 2.8 \cdot 10^{-6} \cdot l$	l = test edge length
Steal squares 90° (Flat and try square) * Squarness deviation	to 800 mm	VDI/VDE/DGQ/DKD 2618 Part 7.1:2019	$1 \mu\text{m} + 2.8 \cdot 10^{-6} \cdot l_z$	l_z = leg length
Protractors Angle deviation	0° to 360°	Trescal KA28 01.1/2021	30"	graduation of the scale = 1'
			2'	graduation of the scale = 5'
Straightness deviation	to 300 mm		1 μm	
Parallelism deviation			1.5 μm	

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Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Neustadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Calipers for external, internal and depth dimensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	l = measured length
	> 300 mm to 1000 mm		$50 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
Depth calipers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	l = measured length
	> 300 mm to 1000 mm		$50 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
Height calipers *	0 mm to 1000 mm	VDI/VDE/DGQ 2618 Part 9.3:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
Calipers with prismatic measuring surfaces	1 mm to 105 mm	Trescal KA16-3 01.1/2021	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot d$	d = measured diameter
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	l = measured length 300 mm = final value of the measuring range
	> 300 mm to 500 mm		$5 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	500 mm = final value of the measuring range
Reference gauges for micrometers *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 4.4:2009	$2 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	l = measured length
Micrometers with prismatic measuring surfaces form D10	1 mm to 105 mm	Trescal KA16-8 01.1/2021	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	d = measured diameter 105 mm = final value of the measuring range
Micrometers for screw thread measurement form D18 *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.2:2010	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	l = measured length
Micrometers with dial indicator form D13 *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.3:2002	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Micrometer heads *	0 mm to 50 mm	VDI/VDE/DGQ 2618 Part 10.4:2008	$3 \mu\text{m} + 5 \cdot 10^{-6} \cdot l$	final value of the measuring range
Depth micrometers with extensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.5:2010	$5 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	final value of the measuring range; Measuring element generally 25 mm range
Internal micrometers with jaws	5 mm to 200 mm	Trescal KA16-6 01.1/2021	$5 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	final value of the measuring range
Internal transverse groove micrometers	0 mm to 100 mm	Trescal KA16-7 01.1/2021	$5 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	final value of the measuring range
Internal micrometers with two-point contact *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.7:2010	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Internal micrometers with three-point contact *	3 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.8:2002	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	d = measured diameter
Dial gauges with analogue display *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	measured in vertical position
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.7 μm	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Page 32 of 72

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Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Neustadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	0.9 μm	
Dial gauges with digital display *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	measured in vertical position
Lever gauges (quicktests) for external measurements	0 mm to 200 mm	VDI/VDE/DGQ 2618 Part 12.1:2005	$7 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	l = measured length
Lever gauges (quicktests) for internal measurements	2.5 mm to 200 mm	VDI/VDE/DGQ 2618 Part 13.1:2005	$7 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Thickness gauges	0 mm to 200 mm	Trescal KA70 01.1/2021	$7 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
DC and Low frequency				
DC voltage Measurement instruments	0 mV to 220 mV > 0.22 V to 2.2 V > 2.2 V to 11 V > 11 V to 22 V > 22 V to 220 V > 220 V to 1000 V		$9 \cdot 10^{-6} \cdot U + 2 \mu\text{V}$ $6 \cdot 10^{-6} \cdot U + 1 \mu\text{V}$ $4 \cdot 10^{-6} \cdot U + 3 \mu\text{V}$ $4 \cdot 10^{-6} \cdot U + 5 \mu\text{V}$ $6 \cdot 10^{-6} \cdot U + 47 \mu\text{V}$ $8 \cdot 10^{-6} \cdot U + 0.5 \text{mV}$	U = measured value
DC voltage Calibrators	1 mV to 100 mV > 0.1 V to 1 V > 1 V to 10 V > 10 V to 100 V > 100 V to 1000 V		$12 \cdot 10^{-6} \cdot U + 2 \mu\text{V}$ $9 \cdot 10^{-6} \cdot U + 0.7 \mu\text{V}$ $9 \cdot 10^{-6} \cdot U + 0.8 \mu\text{V}$ $12 \cdot 10^{-6} \cdot U + 35 \mu\text{V}$ $11 \cdot 10^{-6} \cdot U + 0.6 \text{mV}$	
DC power Measurement instruments	20 μA to 220 μA > 0.22 mA to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 0.22 A to 2.1 A		$36 \cdot 10^{-6} \cdot I + 10 \text{nA}$ $39 \cdot 10^{-6} \cdot I + 10 \text{nA}$ $41 \cdot 10^{-6} \cdot I + 50 \text{nA}$ $52 \cdot 10^{-6} \cdot I + 0.8 \mu\text{A}$ $93 \cdot 10^{-6} \cdot I + 14 \mu\text{A}$	I = measured value
DC power Calibrators	1 μA to 10 μA > 10 μA to 100 μA > 0.1 mA to 1 mA > 1 mA to 10 mA > 10 mA to 100 mA > 0.1 A to 1 A		$1 \cdot 10^{-6} \cdot I + 10 \text{nA}$ $5 \cdot 10^{-6} \cdot I + 10 \text{nA}$ $19 \cdot 10^{-6} \cdot I + 10 \text{nA}$ $22 \cdot 10^{-6} \cdot I + 80 \text{nA}$ $39 \cdot 10^{-6} \cdot I + 0.8 \mu\text{A}$ $0.13 \cdot 10^{-3} \cdot I + 13 \mu\text{A}$	
AC voltage Measurement instruments	220 μV to 2.2 mV > 2.2 mV to 22 mV > 22 mV to 220 mV	10 Hz to 20 Hz > 20 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz 10 Hz to 20 Hz > 20 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz 10 Hz to 20 Hz > 20 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.3 \cdot 10^{-3} \cdot U + 7 \mu\text{V}$ $0.1 \cdot 10^{-3} \cdot U + 7 \mu\text{V}$ $0.2 \cdot 10^{-3} \cdot U + 7 \mu\text{V}$ $0.5 \cdot 10^{-3} \cdot U + 8 \mu\text{V}$ $0.3 \cdot 10^{-3} \cdot U + 7 \mu\text{V}$ $0.1 \cdot 10^{-3} \cdot U + 7 \mu\text{V}$ $0.2 \cdot 10^{-3} \cdot U + 7 \mu\text{V}$ $0.6 \cdot 10^{-3} \cdot U + 8 \mu\text{V}$ $0.3 \cdot 10^{-3} \cdot U + 14 \mu\text{V}$ $0.1 \cdot 10^{-3} \cdot U + 8 \mu\text{V}$ $0.2 \cdot 10^{-3} \cdot U + 8 \mu\text{V}$ $0.5 \cdot 10^{-3} \cdot U + 20 \mu\text{V}$	U = measured value

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Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Neustadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Measurement instruments	> 0.22 V to 2.2 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	$0.3 \cdot 10^{-3} \cdot U + 46 \mu\text{V}$ $0.1 \cdot 10^{-3} \cdot U + 17 \mu\text{V}$ $0.1 \cdot 10^{-3} \cdot U + 9 \mu\text{V}$ $0.1 \cdot 10^{-3} \cdot U + 12 \mu\text{V}$ $0.2 \cdot 10^{-3} \cdot U + 35 \mu\text{V}$	$U = \text{measured value}$
	> 2.2 V to 22 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	$0.3 \cdot 10^{-3} \cdot U + 0.5 \text{ mV}$ $0.1 \cdot 10^{-3} \cdot U + 0.2 \text{ mV}$ $0.1 \cdot 10^{-3} \cdot U + 58 \mu\text{V}$ $0.1 \cdot 10^{-3} \cdot U + 0.1 \text{ mV}$ $0.1 \cdot 10^{-3} \cdot U + 0.2 \text{ mV}$	
	> 22 V 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	$0.3 \cdot 10^{-3} \cdot U + 4.6 \text{ mV}$ $0.1 \cdot 10^{-3} \cdot U + 1.7 \text{ mV}$ $0.1 \cdot 10^{-3} \cdot U + 0.7 \text{ mV}$ $0.1 \cdot 10^{-3} \cdot U + 1.2 \text{ mV}$ $0.2 \cdot 10^{-3} \cdot U + 2.9 \text{ mV}$	
	> 220 V to 1100 V	50 Hz to 1 kHz	$0.1 \cdot 10^{-3} \cdot U + 4.1 \text{ mV}$	
AC voltage Calibrators	1 mV to 10 mV	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.3 \cdot 10^{-3} \cdot U + 7 \mu\text{V}$ $0.2 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$ $0.3 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$ $0.9 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$ $5.5 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$	
	> 10 mV to 100 mV	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.1 \cdot 10^{-3} \cdot U + 7 \mu\text{V}$ $0.1 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$ $0.7 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$ $0.7 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$ $1.1 \cdot 10^{-3} \cdot U + 5 \mu\text{V}$	
	> 0.1 V to 10 V	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.1 \cdot 10^{-3} \cdot U + 0.5 \text{ mV}$ $0.1 \cdot 10^{-3} \cdot U + 0.2 \text{ mV}$ $0.2 \cdot 10^{-3} \cdot U + 0.2 \text{ mV}$ $0.4 \cdot 10^{-3} \cdot U + 0.2 \text{ mV}$ $0.9 \cdot 10^{-3} \cdot U + 0.2 \text{ mV}$	
	> 10 V to 100 V	10 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.3 \cdot 10^{-3} \cdot U + 4.7 \text{ mV}$ $0.3 \cdot 10^{-3} \cdot U + 2.4 \text{ mV}$ $0.4 \cdot 10^{-3} \cdot U + 2.4 \text{ mV}$ $1.4 \cdot 10^{-3} \cdot U + 2.4 \text{ mV}$	
	> 100 V to 1000 V	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.5 \cdot 10^{-3} \cdot U + 47 \text{ mV}$ $0.5 \cdot 10^{-3} \cdot U + 24 \text{ mV}$ $0.7 \cdot 10^{-3} \cdot U + 24 \text{ mV}$ $1.4 \cdot 10^{-3} \cdot U + 24 \text{ mV}$ $3.5 \cdot 10^{-3} \cdot U + 24 \text{ mV}$	
AC current Measurement instruments	22 μA to 220 μA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3 \cdot 10^{-3} \cdot I + 30 \text{ nA}$ $0.2 \cdot 10^{-3} \cdot I + 20 \text{ nA}$ $0.2 \cdot 10^{-3} \cdot I + 20 \text{ nA}$ $0.4 \cdot 10^{-3} \cdot I + 20 \text{ nA}$ $1.3 \cdot 10^{-3} \cdot I + 80 \text{ nA}$	$I = \text{measured value}$

Valid from: 10.01.2024

Date of issue: 10.01.2024

Page 34 of 72

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

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Neustadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC current Measurement instruments	> 0.22 mA to 2.2 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3 \cdot 10^{-3} \cdot I + 0.1 \mu\text{A}$ $0.2 \cdot 10^{-3} \cdot I + 0.1 \mu\text{A}$ $0.2 \cdot 10^{-3} \cdot I + 0.1 \mu\text{A}$ $0.2 \cdot 10^{-3} \cdot I + 0.2 \mu\text{A}$ $1.3 \cdot 10^{-3} \cdot I + 0.8 \mu\text{A}$	$I =$ measured value
	> 2.2 mA to 22 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.4 \cdot 10^{-3} \cdot I + 0.1 \mu\text{A}$ $0.2 \cdot 10^{-3} \cdot I + 0.4 \mu\text{A}$ $0.2 \cdot 10^{-3} \cdot I + 0.4 \mu\text{A}$ $0.2 \cdot 10^{-3} \cdot I + 0.7 \mu\text{A}$ $1.3 \cdot 10^{-3} \cdot I + 5.8 \mu\text{A}$	
	> 22 mA to 220 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3 \cdot 10^{-3} \cdot I + 4.6 \mu\text{A}$ $0.3 \cdot 10^{-3} \cdot I + 4.1 \mu\text{A}$ $0.3 \cdot 10^{-3} \cdot I + 2.9 \mu\text{A}$ $0.3 \cdot 10^{-3} \cdot I + 4.1 \mu\text{A}$ $1.3 \cdot 10^{-3} \cdot I + 12 \mu\text{A}$	
	> 0.22 A to 2.2 A	20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3 \cdot 10^{-3} \cdot I + 41 \mu\text{A}$ $0.5 \cdot 10^{-3} \cdot I + 93 \mu\text{A}$ $8.1 \cdot 10^{-3} \cdot I + 19 \mu\text{A}$	
AC current Calibrators	10 μA to 100 μA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 1 kHz	$4.6 \cdot 10^{-3} \cdot I + 0.2 \mu\text{A}$ $1.7 \cdot 10^{-3} \cdot I + 0.2 \mu\text{A}$ $0.7 \cdot 10^{-3} \cdot I + 0.2 \mu\text{A}$	
	> 0.1 mA to 100 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	$4.6 \cdot 10^{-3} \cdot I + 23 \mu\text{A}$ $1.7 \cdot 10^{-3} \cdot I + 23 \mu\text{A}$ $0.7 \cdot 10^{-3} \cdot I + 23 \mu\text{A}$ $1.7 \cdot 10^{-3} \cdot I + 23 \mu\text{A}$	
	> 0.1 A to 1 A	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	$4.6 \cdot 10^{-3} \cdot I + 0.2 \text{ mA}$ $1.9 \cdot 10^{-3} \cdot I + 0.2 \text{ mA}$ $0.9 \cdot 10^{-3} \cdot I + 0.2 \text{ mA}$ $1.2 \cdot 10^{-3} \cdot I + 0.2 \text{ mA}$	
DC resistance Measurement instruments	1 Ω ; 1.9 Ω 10 Ω ; 19 Ω 100 Ω ; 190 Ω 1 k Ω ; 1.9 k Ω 10 k Ω ; 19 k Ω 100 k Ω ; 190 k Ω 1 M Ω 1.9 M Ω 10 M Ω 19 M Ω 100 M Ω		$0.1 \cdot 10^{-3} \cdot R$ $27 \cdot 10^{-6} \cdot R$ $12 \cdot 10^{-6} \cdot R$ $10 \cdot 10^{-6} \cdot R$ $10 \cdot 10^{-6} \cdot R$ $14 \cdot 10^{-6} \cdot R$ $24 \cdot 10^{-6} \cdot R$ $26 \cdot 10^{-6} \cdot R$ $47 \cdot 10^{-6} \cdot R$ $58 \cdot 10^{-6} \cdot R$ $0.1 \cdot 10^{-3} \cdot R$	$R =$ measured value
	DC resistance Resistors	> 0 Ω to 10 Ω > 10 Ω to 100 Ω > 0.1 k Ω to 1 k Ω > 1 k Ω to 10 k Ω > 10 k Ω to 100 k Ω > 0.1 M Ω to 1 M Ω > 1 M Ω to 10 M Ω > 10 M Ω to 100 M Ω	$17 \cdot 10^{-6} \cdot R + 60 \mu\Omega$ $14 \cdot 10^{-6} \cdot R + 0.6 \text{ m}\Omega$ $12 \cdot 10^{-6} \cdot R + 0.6 \text{ m}\Omega$ $12 \cdot 10^{-6} \cdot R + 6 \text{ m}\Omega$ $12 \cdot 10^{-6} \cdot R + 58 \text{ m}\Omega$ $17 \cdot 10^{-6} \cdot R + 2.3 \Omega$ $58 \cdot 10^{-6} \cdot R + 0.1 \text{ k}\Omega$ $0.6 \cdot 10^{-3} \cdot R + 1.1 \text{ k}\Omega$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

On-site Calibration - Neustadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length				
Calipers for external, internal and depth dimensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	300 mm = final value of the measuring range
Depth calipers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	l = measured length
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	measured in vertical position
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.7 μm	
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	0.9 μm	
Digital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	measured in vertical position
Horizontal length measuring devices	0 mm to 300 mm	Trescal KA06-1 01.1/2021	$0.2 \mu\text{m} + 2.5 \cdot 10^{-6} \cdot l$	l = measured length no calibration of additional axis (z-axis)
	Measuring element with max. 300 mm range, scope up to 1000 mm			
Vertical length measuring devices	0 mm to 1000 mm	Trescal KA06-2 01.1/2021	$1.7 \mu\text{m} + 1.6 \cdot 10^{-6} \cdot l$	l = measured length
Perpendicularity deviation	to 30 μm		$2.5 \mu\text{m} + 1.2 \cdot 10^{-6} \cdot l_z$	l_z = lead length up to 800 mm
Dial gauge testers	to 100 mm	Trescal KA02 01.1/2021	$0.4 \mu\text{m} + 2 \cdot 10^{-6} \cdot l$	l = measured length with incremental probe IKF 100
Plane areas for example hard stone straight edge Straightness deviation	to 50 μm	Trescal KA58 01.1/2021 to 10 m edge length	$1 \mu\text{m} + 0.5 \cdot 10^{-6} \cdot l$	l = edge length of the standard
Horizontal flatness embodiment, for example surface plates according to DIN 876:1984 Flatness deviation	to 50 μm	Trescal KA58 01.1/2021 to 10 m edge length	$1 \mu\text{m} + 0.5 \cdot 10^{-6} \cdot l$	

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Annex to the Partial Accreditation Certificate D-K-15015-01-01

Mobile Laboratory - Neustadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length Cylindrical setting gauges * Ring gauges Diameter	10 mm to 100 mm	VDI/VDE/DGQ 2618 part 4.1:2006 option 3 and 4	$1.0 \mu\text{m} + 14 \cdot 10^{-6} \cdot d$	d = measured diameter of ring
Setting plug gauges Diameter	3 mm to 100 mm		$1.0 \mu\text{m} + 14 \cdot 10^{-6} \cdot d$	d = measured diameter of plug
Calipers for external, internal and depth dimensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	300 mm = final value of the measuring range
Depth calipers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	l = measured length
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	measured in vertical position
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.7 μm	
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	0.9 μm	
Digital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	measured in vertical position

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Esslingen

Permanent Laboratory - Esslingen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length				
Cylindrical setting gauges *	1 mm to 200 mm	VDI/VDE/DGQ 2618 Part 4.1:2006, Option 3 and 4	$0.8 \mu\text{m} + 2 \cdot 10^{-6} \cdot d$	d = measured diameter
Plug gauges Diameter				
Ring gauges Diameter	10 mm to 200 mm	VDI/VDE/DGQ 2618 Part 4.1:2006, Option 3 and 4	$0.8 \mu\text{m} + 2 \cdot 10^{-6} \cdot d$	
Measuring pins, pins for screw threads *	1 mm to 20 mm	VDI/VDE/DGQ 2618 Part 4.2:2007, Option 3	$0.8 \mu\text{m} + 2 \cdot 10^{-6} \cdot d$	
Thread gauges * Pitch diameter on external thread	1 mm to 200 mm Lead 0.25 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.8:2006, Option 1	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	d = pitch diameter
Thread gauges * Pitch diameter on internal thread	3 mm to 200 mm Lead 0.5 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.9:2006, Option 1	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	Simple pitch diameter
Calipers for external, internal and depth dimensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	l = measured length
	> 300 mm to 1000 mm		$50 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
Depth calipers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
	> 300 mm to 1000 mm		$50 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
Height calipers *	0 mm to 1000 mm	VDI/VDE/DGQ 2618 Part 9.3:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	300 mm = final value of the measuring range
Internal micrometers with two-point contact *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.7:2010	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	l = measured length
Internal micrometers with three-point contact *	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 10.8:2002	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	d = measured diameter
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	l = measured length Vertically measured
Digital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.8 μm	
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	0.9 μm	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Esslingen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Lever gauges for external measurements (quick tests) *	0 mm to 200 mm	VDI/VDE/DGQ 2618 Part 12.1:2005	$7 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	l = measured length
Lever gauges for internal measurements (quick tests) *	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 13.1:2005	$7 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
DC and Low frequency Voltage ratio	0 mV/V to 2 mV/V	DC voltage, 225 Hz; 4800 Hz	$0.33 \cdot 10^{-3} \text{ mV/V}$	

On-site Calibration - Esslingen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC and Low frequency Voltage ratio	0 mV/V to 2 mV/V	DC voltage, 225 Hz; 4800 Hz	$0.33 \cdot 10^{-3} \text{ mV/V}$	

Valid from: 10.01.2024

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Annex to the Partial Accreditation Certificate D-K-15015-01-01

Parchim

Permanent Laboratory - Parchim

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length Gauge blocks * made of steel according to DIN EN ISO 3650:1999	0.5 mm to 100 mm	VDI/VDE/DGQ 2618 Part 3.1:2004 in the nominal values of the references Measurement of the deviation of the central length l_c from the nominal value l_n by comparison measurement Measurement of the deviations f_0 and f_u from the central length by 5 points comparison measurement	For the central length: $0.08 \mu\text{m} + 0.8 \cdot 10^{-6} \cdot l$ For the deviations f_0 and f_u from the central length: $0.08 \mu\text{m}$	l = gauge block length Measuring surface quality as stated in QMH rsp. in the test specifications For the smallest measurement uncertainties, the wringability and the wringing characteristics of both measuring surfaces must be checked using an appropriate optical flat.
Cylindrical setting gauges * Ring gauges Diameter	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 4.1:2006, Option 3 and 4	$0.8 \mu\text{m} + 5 \cdot 10^{-6} \cdot d$	d = measured diameter
Plug gauges Diameter	3 mm to 200 mm		$0.8 \mu\text{m} + 5 \cdot 10^{-6} \cdot d$	d = measured diameter
Thread gauges * Pitch diameter on external thread	1 mm to 200 mm Lead 0.25 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.8:2006, Option 1	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	d = pitch diameter Simple pitch diameter
Pitch diameter on internal thread	3 mm to 200 mm Lead 0.5 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.9:2006, Option 1	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	
Reference gauges for micrometers *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 4.4:2009	$2 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	l = measured length
Gap gauges *	10 mm to 160 mm	VDI/VDE/DGQ 2618 Part 4.7:2005	$2 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	Vertically measured l = measured length
Digital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	$0.7 \mu\text{m}$	
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	$0.9 \mu\text{m}$	
Calipers for external, internal and depth dimensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	l = measured length

Valid from: 10.01.2024

Date of issue: 10.01.2024

Page 40 of 72

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Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Parchim

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Depth calipers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	l = measured length
Lever gauges for external measurements (quick tests) *	0 mm to 200 mm	VDI/VDE/DGQ 2618 Part 12.1:2005	$7 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	l = Length of reference gauge
Lever gauges for internal measurements (quick tests) *	2.5 mm to 200 mm	VDI/VDE/DGQ 2618 Part 13.1:2005	$7 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	l = measured length 300 mm = final value of the measuring range
Internal micrometers with two-point contact *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.7:2010	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Internal micrometers with three-point contact *	3 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.8:2002	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	d = measured diameter 300 mm = final value of the measuring range

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Berlin / Mahlow

Permanent Laboratory – Berlin / Mahlow

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length Gauge blocks * made of steel according to DIN EN ISO 3650:1999	0.5 mm to 100 mm	VDI/VDE/DGQ 2618 Part 3.1:2004 in the nominal values of the references Measurement of the deviation of the central length l_c from the nominal value l_n by comparison measurement Measurement of the deviations f_0 and f_u from the central length by 5 points comparison measurement	For the central length: $0.08 \mu\text{m} + 0.8 \cdot 10^{-6} \cdot l$ For the deviations f_0 and f_u from the central length: $0.08 \mu\text{m}$	l = gauge block length Measuring surface quality as stated in QMH rsp. in the test specifications For the smallest measurement uncertainties, the wringability and the wringing characteristics of both measuring surfaces must be checked using an appropriate optical flat.
Cylindrical setting gauges * Ring gauges Diameter	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 4.1:2006 Option 3 and 4	$0.8 \mu\text{m} + 5 \cdot 10^{-6} \cdot d$	d = measured diameter
Plug gauges Diameter	3 mm to 200 mm		$0.8 \mu\text{m} + 5 \cdot 10^{-6} \cdot d$	d = measured diameter
Thread gauges * Pitch diameter on external thread	1 mm to 200 mm Lead 0.25 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.8:2006, Option 1	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	d = pitch diameter Simple pitch diameter
Pitch diameter on internal thread	3 mm to 200 mm Lead 0.5 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.9:2006, Option 1	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	
Reference gauges for micrometers *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 4.4:2009	$2 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	l = measured length
Gap gauges *	10 mm to 160 mm	VDI/VDE/DGQ 2618 Part 4.7:2005	$2 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	Vertically measured l = measured length
Digital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	$0.7 \mu\text{m}$	
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	$0.9 \mu\text{m}$	
Calipers for external, internal and depth dimensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	l = measured length
	> 300 mm to 1000 mm		$50 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Page 42 of 72

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

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory – Berlin / Mahlow

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Depth calipers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	l = measured length
Height calipers *	0 mm to 1000 mm	VDI/VDE/DGQ 2618 Part 9.3:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
Lever gauges for external measurements (quick tests) *	0 mm to 200 mm	VDI/VDE/DGQ 2618 Part 12.1:2005	$7 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Lever gauges for internal measurements (quick tests) *	2.5 mm to 200 mm	VDI/VDE/DGQ 2618 Part 13.1:2005	$7 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
	> 300 mm to 500 mm		$5 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	500 mm = final value of the measuring range
Internal micrometers with two-point contact *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.7:2010	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	300 mm = final value of the measuring range
Internal micrometers with three-point contact *	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 10.8:2002	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	d = measured diameter 200 mm = final value of the measuring range
Straight edges * Flatness and parallelism deviation	to 500 mm	VDI/VDE/DGQ 2618 Part 5.1:2013	$7 \mu\text{m} + 5 \cdot 10^{-6} \cdot l_z$	l_z = length of form embodiment
Steel squares * Squareness deviation	to 500 mm	VDI/VDE/DGQ/DKD 2618 Part 7.1:2019	$8 \mu\text{m} + 5 \cdot 10^{-6} \cdot l_z$	l_z = leg length
Flatness deviation			$7 \mu\text{m} + 5 \cdot 10^{-6} \cdot l_z$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Donauwörth

Permanent Laboratory - Donauwörth

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC and Low frequency				
DC voltage Measurement instruments	1 mV to 0.22 V > 0.22 V to 2.2 V > 2.2 V to 22 V > 22 V to 220 V > 220 V to 1000 V		$15 \cdot 10^{-6} \cdot U + 3 \mu\text{V}$ $15 \cdot 10^{-6} \cdot U + 3 \mu\text{V}$ $15 \cdot 10^{-6} \cdot U + 25 \mu\text{V}$ $15 \cdot 10^{-6} \cdot U + 0.25 \text{ mV}$ $15 \cdot 10^{-6} \cdot U + 2 \text{ mV}$	$U = \text{measured value}$
DC voltage Sources	1 mV to 1 V > 1 V to 10 V > 10 V to 100 V > 100 V to 1000 V		$30 \cdot 10^{-6} \cdot U + 3 \mu\text{V}$ $30 \cdot 10^{-6} \cdot U + 2 \mu\text{V}$ $30 \cdot 10^{-6} \cdot U + 50 \mu\text{V}$ $30 \cdot 10^{-6} \cdot U + 1 \text{ mV}$	
DC current Measurement instruments	1 μA to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 220 mA to 2.2 A		$80 \cdot 10^{-6} \cdot I + 0.1 \mu\text{A}$ $80 \cdot 10^{-6} \cdot I + 0.3 \mu\text{A}$ $90 \cdot 10^{-6} \cdot I + 5 \mu\text{A}$ $0.15 \cdot 10^{-3} \cdot I + 50 \mu\text{A}$	$I = \text{measured value}$
DC current Sources	1 μA to 1.2 mA > 1.2 mA to 12 mA > 12 mA to 120 mA > 120 mA to 1 A		$30 \cdot 10^{-6} \cdot I + 0.1 \mu\text{A}$ $30 \cdot 10^{-6} \cdot I + 0.3 \mu\text{A}$ $50 \cdot 10^{-6} \cdot I + 5 \mu\text{A}$ $50 \cdot 10^{-6} \cdot I + 0.15 \text{ mA}$	
DC resistance Measurement instruments	1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω ; 190 Ω ; 1 k Ω 1.9 k Ω ; 10 k Ω ; 19 k Ω 100 k Ω ; 190 k Ω ; 1 M Ω 1.9 M Ω 10 M Ω 19 M Ω ; 100 M Ω		$0.2 \cdot 10^{-3} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$ $50 \cdot 10^{-6} \cdot R$ $75 \cdot 10^{-6} \cdot R$ $50 \cdot 10^{-6} \cdot R$ $50 \cdot 10^{-6} \cdot R$ $50 \cdot 10^{-6} \cdot R$ $0.2 \cdot 10^{-3} \cdot R$ $0.1 \cdot 10^{-3} \cdot R$ $0.7 \cdot 10^{-3} \cdot R$	$R = \text{measured value}$
DC resistance Resistors	1 Ω to 12 Ω > 12 Ω to 120 Ω > 120 Ω to 1.2 k Ω > 1.2 k Ω to 12 k Ω > 12 k Ω to 120 k Ω > 120 k Ω to 1.2 M Ω > 1.2 M Ω to 12 M Ω > 12 M Ω to 120 M Ω		$15 \cdot 10^{-6} \cdot R + 0.3 \text{ m}\Omega$ $15 \cdot 10^{-6} \cdot R + 2.5 \text{ m}\Omega$ $15 \cdot 10^{-6} \cdot R + 15 \text{ m}\Omega$ $15 \cdot 10^{-6} \cdot R + 0.1 \Omega$ $15 \cdot 10^{-6} \cdot R + 1.5 \Omega$ $15 \cdot 10^{-6} \cdot R + 20 \Omega$ $30 \cdot 10^{-6} \cdot R + 1 \text{ k}\Omega$ $0.3 \cdot 10^{-3} \cdot R + 80 \text{ k}\Omega$	
AC current Measurement instruments	220 μA to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 220 mA to 2.2 A	40 Hz to 1 kHz	$0.2 \cdot 10^{-3} \cdot I + 0.5 \mu\text{A}$ $0.2 \cdot 10^{-3} \cdot I + 1.5 \mu\text{A}$ $0.5 \cdot 10^{-3} \cdot I + 50 \mu\text{A}$ $1.2 \cdot 10^{-3} \cdot I + 0.22 \text{ mA}$	$I = \text{measured value}$
AC current Sources	1 μA to 1.2 mA > 1.2 mA to 12 mA > 12 mA to 120 mA > 120 mA to 1 A	45 Hz to 1 kHz	$0.5 \cdot 10^{-3} \cdot I + 0.5 \mu\text{A}$ $0.5 \cdot 10^{-3} \cdot I + 5 \mu\text{A}$ $0.5 \cdot 10^{-3} \cdot I + 50 \mu\text{A}$ $1 \cdot 10^{-3} \cdot I + 0.5 \text{ mA}$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Donauwörth

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Measurement instruments	0.1 V to 0.22 V	20 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.3 \cdot 10^{-3} \cdot U + 30 \mu\text{V}$ $0.4 \cdot 10^{-3} \cdot U + 30 \mu\text{V}$ $1.2 \cdot 10^{-3} \cdot U + 30 \mu\text{V}$	$U =$ measured value
	> 0.22 V to 2.2 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.25 \cdot 10^{-3} \cdot U + 0.11 \text{ mV}$ $0.15 \cdot 10^{-3} \cdot U + 0.07 \text{ mV}$ $0.2 \cdot 10^{-3} \cdot U + 0.07 \text{ mV}$ $0.35 \cdot 10^{-3} \cdot U + 0.2 \text{ mV}$ $0.6 \cdot 10^{-3} \cdot U + 0.6 \text{ mV}$ $1.2 \cdot 10^{-3} \cdot U + 2 \text{ mV}$ $3 \cdot 10^{-3} \cdot U + 2.6 \text{ mV}$	
	> 2.2 V to 22 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.25 \cdot 10^{-3} \cdot U + 1.0 \text{ mV}$ $0.15 \cdot 10^{-3} \cdot U + 0.5 \text{ mV}$ $0.2 \cdot 10^{-3} \cdot U + 1 \text{ mV}$ $0.35 \cdot 10^{-3} \cdot U + 1.5 \text{ mV}$ $0.75 \cdot 10^{-3} \cdot U + 6 \text{ mV}$ $1.5 \cdot 10^{-3} \cdot U + 20 \text{ mV}$ $4 \cdot 10^{-3} \cdot U + 20 \text{ mV}$	
	> 22 V to 220 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.25 \cdot 10^{-3} \cdot U + 10 \text{ mV}$ $0.1 \cdot 10^{-3} \cdot U + 8 \text{ mV}$ $0.25 \cdot 10^{-3} \cdot U + 25 \text{ mV}$ $1 \cdot 10^{-3} \cdot U + 20 \text{ mV}$	
	> 220 V to 1100 V	50 Hz to 1 kHz	$0.1 \cdot 10^{-3} \cdot U + 0.25 \text{ V}$	
AC voltage Sources	0.1 V to 0.12 V	20 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.1 \cdot 10^{-3} \cdot U + 50 \mu\text{V}$ $0.2 \cdot 10^{-3} \cdot U + 50 \mu\text{V}$ $1 \cdot 10^{-3} \cdot U + 50 \mu\text{V}$	
	> 0.12 V to 1.2 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 1 MHz	$0.1 \cdot 10^{-3} \cdot U + 0.15 \text{ mV}$ $0.2 \cdot 10^{-3} \cdot U + 0.1 \text{ mV}$ $0.35 \cdot 10^{-3} \cdot U + 0.1 \text{ mV}$ $1 \cdot 10^{-3} \cdot U + 0.15 \text{ mV}$ $3.5 \cdot 10^{-3} \cdot U + 0.4 \text{ mV}$ $12 \cdot 10^{-3} \cdot U + 2 \text{ mV}$	
	> 1.2 V to 12 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 1 MHz	$0.1 \cdot 10^{-3} \cdot U + 1.5 \text{ mV}$ $0.15 \cdot 10^{-3} \cdot U + 1 \text{ mV}$ $0.35 \cdot 10^{-3} \cdot U + 1.5 \text{ mV}$ $1 \cdot 10^{-3} \cdot U + 1 \text{ mV}$ $3.5 \cdot 10^{-3} \cdot U + 4 \text{ mV}$ $12 \cdot 10^{-3} \cdot U + 15 \text{ mV}$	
	> 12 V to 120 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.25 \cdot 10^{-3} \cdot U + 15 \text{ mV}$ $0.25 \cdot 10^{-3} \cdot U + 10 \text{ mV}$ $0.4 \cdot 10^{-3} \cdot U + 10 \text{ mV}$ $1.5 \cdot 10^{-3} \cdot U + 20 \text{ mV}$	
	> 120 V to 700 V	40 Hz to 1 kHz	$0.5 \cdot 10^{-3} \cdot U + 0.2 \text{ V}$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Page 45 of 72

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

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Halver

Permanent Laboratory - Halver

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length Cylindrical setting gauges *	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 4.1:2006 Option 3 and 4	$0.8 \mu\text{m} + 5 \cdot 10^{-6} \cdot d$	$d = \text{measured diameter}$
Ring gauges Diameter				
Plug gauges Diameter	3 mm to 200 mm		$0.8 \mu\text{m} + 5 \cdot 10^{-6} \cdot d$	
Measuring pins, pins for screw threads Diameter	0.1 mm to 20 mm	VDI/VDE/DGQ 2618 Part 4.2:2007 Option 3	$1 \mu\text{m} + 2 \cdot 10^{-6} \cdot d$	
Thread gauges * Pitch diameter on external thread	1 mm to 200 mm Lead 0.25 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.8:2006 Option 1	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	$d = \text{pitch diameter}$ Simple pitch diameter
Pitch diameter on internal thread	3 mm to 200 mm Lead 0.5 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.9:2006 Option 1	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	
Reference gauges for micrometers *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 4.4:2009	$2 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	$l = \text{measured length}$
Gap gauges *	10 mm to 160 mm	VDI/VDE/DGQ 2618 Part 4.7:2005	$2 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	$l = \text{measured length}$
Calipers for external, internal and depth dimensions *	0 mm to 500 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
Depth calipers *	0 mm to 500 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
Height calipers *	0 mm to 500 mm	VDI/VDE/DGQ 2618 Part 9.3:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	300 mm = final value of measuring range
Micrometers with dial indicator form D 13 *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.3:2002	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Depth micrometers with extensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.5:2010	$5 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	final value of the measuring range; Measuring element generally 25 mm range
Internal micrometers with two-point contact *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.7:2010	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Internal micrometers with three-point contact *	3 mm to 150 mm	VDI/VDE/DGQ 2618 Part 10.8:2002	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	$d = \text{measured diameter}$

Valid from: 10.01.2024

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Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Halver

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	$l =$ measured length
Digital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.7 μm	
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	0.9 μm	
Lever gauges for external measurements (quick tests) *	0 mm to 200 mm	VDI/VDE/DGQ 2618 Part 12.1:2005	$7 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Lever gauges for internal measurements (quick tests) *	2.5 mm to 200 mm	VDI/VDE/DGQ 2618 Part 13.1:2005	$7 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
DC and Low frequency				
DC voltage Measurement instruments	100 mV 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		$24 \cdot 10^{-6} \cdot U + 1.1 \mu\text{V}$ $14 \cdot 10^{-6} \cdot U + 2.2 \mu\text{V}$ $16 \cdot 10^{-6} \cdot U + 21 \mu\text{V}$ $22 \cdot 10^{-6} \cdot U + 0.16 \text{ mV}$ $22 \cdot 10^{-6} \cdot U + 1.6 \text{ mV}$	$U =$ measured value
DC voltage Sources	0.1 V to < 1 V 1 V to < 10 V 10 V to < 100 V 100 V to 1000 V		$27 \cdot 10^{-6} \cdot U + 0.3 \mu\text{V}$ $13 \cdot 10^{-6} \cdot U + 0.2 \mu\text{V}$ $16 \cdot 10^{-6} \cdot U + 0.4 \mu\text{V}$ $17 \cdot 10^{-6} \cdot U + 0.8 \mu\text{V}$	
DC current Measurement instruments	100 μA to < 330 μA 330 μA to < 3.3 mA 3.3 mA to < 33 mA 33 mA to < 0.33 A 0.33 A to < 1.1 A 1.1 A to < 3 A 3 A to < 11 A 11 A to 20 A		$0.19 \cdot 10^{-3} \cdot I + 0.1 \mu\text{A}$ $0.12 \cdot 10^{-3} \cdot I + 0.1 \mu\text{A}$ $0.12 \cdot 10^{-3} \cdot I + 0.3 \mu\text{A}$ $0.12 \cdot 10^{-3} \cdot I + 2.8 \mu\text{A}$ $0.24 \cdot 10^{-3} \cdot I + 44 \mu\text{A}$ $0.44 \cdot 10^{-3} \cdot I + 45 \mu\text{A}$ $0.58 \cdot 10^{-3} \cdot I + 0.57 \text{ mA}$ $1.2 \cdot 10^{-3} \cdot I + 0.86 \text{ mA}$	$I =$ measured value
DC current Sources	0.1 mA to < 1 mA 1 mA to < 10 mA 10 mA to < 100 mA 100 mA to 1 A		$58 \cdot 10^{-6} \cdot I + 2.3 \mu\text{A}$ $60 \cdot 10^{-6} \cdot I + 2.3 \mu\text{A}$ $0.12 \cdot 10^{-3} \cdot I + 5.7 \mu\text{A}$ $0.22 \cdot 10^{-3} \cdot I + 9.9 \mu\text{A}$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Halver

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC resistance Measurement instruments	1 Ω to < 11 Ω		$50 \cdot 10^{-6} \cdot R + 2.7 \mu\Omega$	<i>R</i> = measured value
	11 Ω to < 33 Ω		$38 \cdot 10^{-6} \cdot R + 0.1 \mu\Omega$	
	33 Ω to < 110 Ω		$34 \cdot 10^{-6} \cdot R + 1.9 \mu\Omega$	
	110 Ω to < 330 Ω		$34 \cdot 10^{-6} \cdot R + 0.6 \mu\Omega$	
	330 Ω to < 1.1 kΩ		$34 \cdot 10^{-6} \cdot R + 19 \mu\Omega$	
	1.1 kΩ to < 3.3 kΩ		$34 \cdot 10^{-6} \cdot R + 5.9 \mu\Omega$	
	3.3 kΩ to < 11 kΩ		$34 \cdot 10^{-6} \cdot R + 0.19 \text{ m}\Omega$	
	11 kΩ to < 33 kΩ		$34 \cdot 10^{-6} \cdot R + 59 \mu\Omega$	
	33 kΩ to < 110 kΩ		$34 \cdot 10^{-6} \cdot R + 1.9 \text{ m}\Omega$	
	110 kΩ to < 330 kΩ		$38 \cdot 10^{-6} \cdot R + 0.51 \text{ m}\Omega$	
	330 kΩ to < 1.1 MΩ		$40 \cdot 10^{-6} \cdot R + 16 \text{ m}\Omega$	
	1.1 MΩ to < 3.3 MΩ		$75 \cdot 10^{-6} \cdot R + 0.11 \text{ m}\Omega$	
	3.3 MΩ to 10 MΩ		$0.16 \cdot 10^{-3} \cdot R + 42 \text{ m}\Omega$	
	1 Ω to < 10 Ω		$40 \cdot 10^{-6} \cdot R + 1.2 \mu\Omega$	
	10 Ω to < 100 Ω		$25 \cdot 10^{-6} \cdot R + 0.3 \mu\Omega$	
	100 Ω to < 1 kΩ		$19 \cdot 10^{-6} \cdot R + 0.4 \mu\Omega$	
	1 kΩ to < 10 kΩ		$16 \cdot 10^{-6} \cdot R + 0.9 \mu\Omega$	
	10 kΩ to < 100 kΩ		$18 \cdot 10^{-6} \cdot R + 4.2 \mu\Omega$	
	100 kΩ to < 1 MΩ		$28 \cdot 10^{-6} \cdot R + 26 \mu\Omega$	
	AC voltage Measurement instruments	33 mV to < 330 mV	10 Hz to < 45 Hz	
45 Hz to < 10 kHz			$0.17 \cdot 10^{-3} \cdot U + 9.0 \mu\text{V}$	
10 kHz to < 20 kHz			$0.19 \cdot 10^{-3} \cdot U + 9.1 \mu\text{V}$	
20 kHz to < 50 kHz			$0.41 \cdot 10^{-3} \cdot U + 9.1 \mu\text{V}$	
50 kHz to < 100 kHz			$0.69 \cdot 10^{-3} \cdot U + 36 \mu\text{V}$	
100 kHz to 500 kHz			$2.3 \cdot 10^{-3} \cdot U + 80 \mu\text{V}$	
0.33 V to < 3.3 V		10 Hz to < 45 Hz	$0.37 \cdot 10^{-3} \cdot U + 55 \mu\text{V}$	
		45 Hz to < 10 kHz	$0.17 \cdot 10^{-3} \cdot U + 69 \mu\text{V}$	
		10 kHz to < 20 kHz	$0.22 \cdot 10^{-3} \cdot U + 69 \mu\text{V}$	
		20 kHz to < 50 kHz	$0.35 \cdot 10^{-3} \cdot U + 57 \mu\text{V}$	
		50 kHz to < 100 kHz	$0.81 \cdot 10^{-3} \cdot U + 0.14 \text{ mV}$	
		100 kHz to 500 kHz	$2.5 \cdot 10^{-3} \cdot U + 0.60 \text{ mV}$	
3.3 V to < 33 V		10 Hz to < 45 Hz	$0.37 \cdot 10^{-3} \cdot U + 0.72 \text{ mV}$	
		45 Hz to < 10 kHz	$0.17 \cdot 10^{-3} \cdot U + 0.68 \text{ mV}$	
		10 kHz to < 20 kHz	$0.27 \cdot 10^{-3} \cdot U + 0.69 \text{ mV}$	
		20 kHz to < 50 kHz	$0.40 \cdot 10^{-3} \cdot U + 0.69 \text{ mV}$	
		50 kHz to 100 kHz	$1 \cdot 10^{-3} \cdot U + 1.8 \text{ mV}$	
33 V to < 330 V		45 Hz to < 1 kHz	$0.22 \cdot 10^{-3} \cdot U + 2.3 \text{ mV}$	
		1 kHz to < 10 kHz	$0.23 \cdot 10^{-3} \cdot U + 6.9 \text{ mV}$	
		10 kHz to < 20 kHz	$0.29 \cdot 10^{-3} \cdot U + 6.9 \text{ mV}$	
		20 kHz to < 50 kHz	$0.36 \cdot 10^{-3} \cdot U + 6.7 \text{ mV}$	
		50 kHz to 100 kHz	$2.3 \cdot 10^{-3} \cdot U + 57 \text{ mV}$	
330 V to < 1000 V	45 Hz to < 1 kHz	$0.35 \cdot 10^{-3} \cdot U + 12 \text{ mV}$		
	1 kHz to < 5 kHz	$0.29 \cdot 10^{-3} \cdot U + 12 \text{ mV}$		
	5 kHz to 10 kHz	$0.35 \cdot 10^{-3} \cdot U + 12 \text{ mV}$		

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Halver

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Sources	0.1 V to < 1 V 1 V to < 10 V 10 V to < 100 V 100 V to 1000 V	45 Hz to 1 kHz	$0.30 \cdot 10^{-3} \cdot U + 79 \text{ mV}$ $0.25 \cdot 10^{-3} \cdot U + 53 \text{ mV}$ $0.26 \cdot 10^{-3} \cdot U + 54 \text{ mV}$ $0.30 \cdot 10^{-3} \cdot U + 99 \text{ mV}$	$U =$ measured value
AC current Measurement instruments	100 μ A to < 330 μ A 0.33 mA to < 3.3 mA 3.3 mA to < 33 mA 33 mA to < 330 mA 0.33 A to < 1.1 A 1.1 A to < 11 A 11 A to 20 A	10 Hz to < 20 Hz 20 Hz to < 45 Hz 45 Hz to < 1 kHz 1 kHz to < 5 kHz 5 kHz to 10 kHz 10 Hz to < 20 Hz 20 Hz to < 45 Hz 45 Hz to < 1 kHz 1 kHz to < 5 kHz 5 kHz to 10 kHz 10 Hz to < 20 Hz 20 Hz to < 45 Hz 45 Hz to < 1 kHz 1 kHz to < 5 kHz 5 kHz to 10 kHz 10 Hz to < 45 Hz 45 Hz to < 1 kHz 1 kHz to < 5 kHz 5 kHz to 10 kHz 45 Hz to < 100 Hz 100 Hz to < 1 kHz 1 kHz to 5 kHz 45 Hz to < 100 Hz 100 Hz to < 1 kHz 1 kHz to 5 kHz	$0.23 \cdot 10^{-2} \cdot I + 0.2 \text{ } \mu\text{A}$ $0.17 \cdot 10^{-2} \cdot I + 0.2 \text{ } \mu\text{A}$ $0.14 \cdot 10^{-2} \cdot I + 0.2 \text{ } \mu\text{A}$ $0.34 \cdot 10^{-2} \cdot I + 0.2 \text{ } \mu\text{A}$ $0.92 \cdot 10^{-2} \cdot I + 0.3 \text{ } \mu\text{A}$ $0.23 \cdot 10^{-2} \cdot I + 0.2 \text{ } \mu\text{A}$ $0.14 \cdot 10^{-2} \cdot I + 0.2 \text{ } \mu\text{A}$ $0.11 \cdot 10^{-2} \cdot I + 0.2 \text{ } \mu\text{A}$ $0.23 \cdot 10^{-2} \cdot I + 0.3 \text{ } \mu\text{A}$ $0.57 \cdot 10^{-2} \cdot I + 0.4 \text{ } \mu\text{A}$ $0.20 \cdot 10^{-2} \cdot I + 2.3 \text{ } \mu\text{A}$ $0.10 \cdot 10^{-2} \cdot I + 2.3 \text{ } \mu\text{A}$ $0.46 \cdot 10^{-3} \cdot I + 2.3 \text{ } \mu\text{A}$ $0.92 \cdot 10^{-3} \cdot I + 2.3 \text{ } \mu\text{A}$ $0.23 \cdot 10^{-2} \cdot I + 3.4 \text{ } \mu\text{A}$ $0.20 \cdot 10^{-2} \cdot I + 23 \text{ } \mu\text{A}$ $0.10 \cdot 10^{-2} \cdot I + 23 \text{ } \mu\text{A}$ $0.46 \cdot 10^{-3} \cdot I + 23 \text{ } \mu\text{A}$ $0.11 \cdot 10^{-2} \cdot I + 57 \text{ } \mu\text{A}$ $0.23 \cdot 10^{-2} \cdot I + 0.11 \text{ mA}$ $0.20 \cdot 10^{-2} \cdot I + 0.11 \text{ mA}$ $0.58 \cdot 10^{-3} \cdot I + 0.11 \text{ mA}$ $0.69 \cdot 10^{-2} \cdot I + 1.1 \text{ mA}$ $2.8 \cdot 10^{-2} \cdot I + 5.7 \text{ mA}$ $0.69 \cdot 10^{-3} \cdot I + 2.3 \text{ mA}$ $0.12 \cdot 10^{-2} \cdot I + 2.3 \text{ mA}$ $0.34 \cdot 10^{-2} \cdot I + 2.3 \text{ mA}$ $0.14 \cdot 10^{-2} \cdot I + 5.7 \text{ mA}$ $0.17 \cdot 10^{-2} \cdot I + 5.7 \text{ mA}$ $3.4 \cdot 10^{-2} \cdot I + 5.7 \text{ mA}$	$I =$ measured value
AC current Sources	0.1 mA to < 1 mA 1 mA to < 10 mA 10 mA to < 100 mA 100 mA to 1 A	45 Hz to 1 kHz	$0.23 \cdot 10^{-3} \cdot I + 0.11 \text{ mA}$ $0.23 \cdot 10^{-3} \cdot I + 0.11 \text{ mA}$ $0.30 \cdot 10^{-3} \cdot I + 0.11 \text{ mA}$ $0.93 \cdot 10^{-3} \cdot I + 0.2 \text{ mA}$	
Time and Frequency Frequency Generators	1 Hz to 225 MHz		$0.2 \cdot 10^{-6} \cdot f$	$f =$ measured value

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Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Mobile Laboratory - Halver

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty ¹	Remarks
Length				
Cylindrical setting gauges *				<i>d</i> = measured diameter
Ring gauges Diameter	10 mm to 100 mm	VDI/VDE/DGQ 2618 Part 4.1:2006 Option 3 and 4	$0.8 \mu\text{m} + 14 \cdot 10^{-6} \cdot d$	
Plug gauges Diameter	3 mm to 100 mm		$0.8 \mu\text{m} + 14 \cdot 10^{-6} \cdot d$	
Calipers for external, internal and depth dimensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	<i>l</i> = measured length 300 mm = final value of the measuring range
Depth calipers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	300 mm = final value of the measuring range
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Digital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.7 μm	

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Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

On-site Calibration - Halver

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Coordinate measuring technology Measuring projectors Measuring microscopes *	0 mm to 200 mm	Calibration of metrological characteristics according to guideline DKD-R 4-3 part 18.1:2018, and the following standards and guidelines DIN EN ISO 10360 VDI/VDE 2617 JIS B 7184:1999		/ = measured length
		Determination of probing error <i>PS-ID(OT)</i> with a graduated scale made of glass according to VDI/VDE 2617 Part 6.1:2021	0.8 μm	
		Determination of length measurement error <i>E-ID(OT)</i> with a graduated scale made of glass according to VDI/VDE 2617 Part 6.1:2021	$1.6 \mu\text{m} + 1 \cdot 10^{-6} \cdot l$	

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Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Braunschweig

Permanent Laboratory - Braunschweig

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC and Low frequency				
DC voltage Measurement instruments	1 mV to 0.22 V > 0.22 V to 2.2 V > 2.2 V to 22 V > 22 V to 220 V > 220 V to 1000 V		$15 \cdot 10^{-6} \cdot U + 3 \mu\text{V}$ $15 \cdot 10^{-6} \cdot U + 3 \mu\text{V}$ $15 \cdot 10^{-6} \cdot U + 25 \mu\text{V}$ $15 \cdot 10^{-6} \cdot U + 0.25 \text{ mV}$ $15 \cdot 10^{-6} \cdot U + 2 \text{ mV}$	$U = \text{measured value}$
DC voltage Sources	1 mV to 1 V > 1 V to 10 V > 10 V to 100 V > 100 V to 1000 V		$30 \cdot 10^{-6} \cdot U + 3 \mu\text{V}$ $30 \cdot 10^{-6} \cdot U + 2 \mu\text{V}$ $30 \cdot 10^{-6} \cdot U + 50 \mu\text{V}$ $35 \cdot 10^{-6} \cdot U + 1 \text{ mV}$	
DC current Measurement instruments	1 μA to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 220 mA to 2.2 A > 2.2 A to 20 A		$80 \cdot 10^{-6} \cdot I + 0.1 \mu\text{A}$ $80 \cdot 10^{-6} \cdot I + 0.3 \mu\text{A}$ $90 \cdot 10^{-6} \cdot I + 5 \mu\text{A}$ $0.16 \cdot 10^{-3} \cdot I + 50 \mu\text{A}$ $0.6 \cdot 10^{-3} \cdot I + 2.5 \text{ mA}$	$I = \text{measured value}$
DC current Sources	1 μA to 1.2 mA > 1.2 mA to 12 mA > 12 mA to 120 mA > 120 mA to 1 A > 1 A to 10 A	with Shunt 0.01 Ω	$30 \cdot 10^{-6} \cdot I + 0.1 \mu\text{A}$ $35 \cdot 10^{-6} \cdot I + 0.1 \mu\text{A}$ $50 \cdot 10^{-6} \cdot I + 5 \mu\text{A}$ $0.15 \cdot 10^{-3} \cdot I + 50 \mu\text{A}$ $0.15 \cdot 10^{-3} \cdot I + 0.2 \text{ mA}$	
DC resistance Measurement instruments	1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω ; 190 Ω ; 1 k Ω 1.9 k Ω ; 10 k Ω ; 19 k Ω 100 k Ω ; 190 k Ω ; 1 M Ω 1.9 M Ω 10 M Ω 19 M Ω ; 100 M Ω		$0.2 \cdot 10^{-3} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$ $50 \cdot 10^{-6} \cdot R$ $75 \cdot 10^{-6} \cdot R$ $50 \cdot 10^{-6} \cdot R$ $50 \cdot 10^{-6} \cdot R$ $50 \cdot 10^{-6} \cdot R$ $0.2 \cdot 10^{-3} \cdot R$ $0.1 \cdot 10^{-3} \cdot R$ $0.7 \cdot 10^{-3} \cdot R$	$R = \text{measured value}$
DC resistance Resistors	1 Ω to 12 Ω > 12 Ω to 120 Ω > 120 Ω to 1.2 k Ω > 1.2 k Ω to 12 k Ω > 12 k Ω to 120 k Ω > 120 k Ω to 1.2 M Ω > 1.2 M Ω to 12 M Ω > 12 M Ω to 120 M Ω		$15 \cdot 10^{-6} \cdot R + 0.3 \text{ m}\Omega$ $15 \cdot 10^{-6} \cdot R + 2.5 \text{ m}\Omega$ $15 \cdot 10^{-6} \cdot R + 15 \text{ m}\Omega$ $15 \cdot 10^{-6} \cdot R + 0.1 \Omega$ $15 \cdot 10^{-6} \cdot R + 1.5 \Omega$ $15 \cdot 10^{-6} \cdot R + 20 \Omega$ $30 \cdot 10^{-6} \cdot R + 1 \text{ k}\Omega$ $0.3 \cdot 10^{-3} \cdot R + 80 \text{ k}\Omega$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Braunschweig

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Measurement instruments	0.1 V to 0.22 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.3 \cdot 10^{-3} \cdot U + 30 \mu\text{V}$ $0.3 \cdot 10^{-3} \cdot U + 30 \mu\text{V}$ $0.5 \cdot 10^{-3} \cdot U + 30 \mu\text{V}$ $1.2 \cdot 10^{-3} \cdot U + 30 \mu\text{V}$	$U = \text{measured value}$
	> 0.22 V to 2.2 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.25 \cdot 10^{-3} \cdot U + 0.11 \text{ mV}$ $0.15 \cdot 10^{-3} \cdot U + 0.07 \text{ mV}$ $0.2 \cdot 10^{-3} \cdot U + 0.07 \text{ mV}$ $0.35 \cdot 10^{-3} \cdot U + 0.2 \text{ mV}$ $0.6 \cdot 10^{-3} \cdot U + 0.6 \text{ mV}$ $2 \cdot 10^{-3} \cdot U + 1 \text{ mV}$ $3.5 \cdot 10^{-3} \cdot U + 1.2 \text{ mV}$	
	> 2.2 V to 22 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.25 \cdot 10^{-3} \cdot U + 1 \text{ mV}$ $0.15 \cdot 10^{-3} \cdot U + 0.5 \text{ mV}$ $0.2 \cdot 10^{-3} \cdot U + 1 \text{ mV}$ $0.35 \cdot 10^{-3} \cdot U + 1.5 \text{ mV}$ $0.75 \cdot 10^{-3} \cdot U + 6 \text{ mV}$ $2.5 \cdot 10^{-3} \cdot U + 10 \text{ mV}$ $4 \cdot 10^{-3} \cdot U + 20 \text{ mV}$	
	> 22 V to 220 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.25 \cdot 10^{-3} \cdot U + 10 \text{ mV}$ $0.1 \cdot 10^{-3} \cdot U + 8 \text{ mV}$ $0.3 \cdot 10^{-3} \cdot U + 20 \text{ mV}$ $1 \cdot 10^{-3} \cdot U + 20 \text{ mV}$	
	> 220 V to 1100 V	50 Hz to 1 kHz	$0.1 \cdot 10^{-3} \cdot U + 0.25 \text{ V}$	
AC voltage Sources	0.1 V to 0.12 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.1 \cdot 10^{-3} \cdot U + 50 \mu\text{V}$ $0.1 \cdot 10^{-3} \cdot U + 50 \mu\text{V}$ $0.2 \cdot 10^{-3} \cdot U + 50 \mu\text{V}$ $1 \cdot 10^{-3} \cdot U + 50 \mu\text{V}$	
	> 0.12 V to 1.2 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 1 MHz	$0.2 \cdot 10^{-3} \cdot U + 0.2 \text{ mV}$ $0.2 \cdot 10^{-3} \cdot U + 0.1 \text{ mV}$ $0.35 \cdot 10^{-3} \cdot U + 0.1 \text{ mV}$ $1 \cdot 10^{-3} \cdot U + 0.15 \text{ mV}$ $3.5 \cdot 10^{-3} \cdot U + 0.4 \text{ mV}$ $12 \cdot 10^{-3} \cdot U + 2 \text{ mV}$	
	> 1.2 V to 12 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 1 MHz	$0.1 \cdot 10^{-3} \cdot U + 1.5 \text{ mV}$ $0.15 \cdot 10^{-3} \cdot U + 1 \text{ mV}$ $0.35 \cdot 10^{-3} \cdot U + 1.5 \text{ mV}$ $1 \cdot 10^{-3} \cdot U + 1 \text{ mV}$ $3.5 \cdot 10^{-3} \cdot U + 4 \text{ mV}$ $12 \cdot 10^{-3} \cdot U + 15 \text{ mV}$	
	> 12 V to 120 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.25 \cdot 10^{-3} \cdot U + 15 \text{ mV}$ $0.25 \cdot 10^{-3} \cdot U + 10 \text{ mV}$ $0.4 \cdot 10^{-3} \cdot U + 10 \text{ mV}$ $1.5 \cdot 10^{-3} \cdot U + 20 \text{ mV}$	
	> 120 V to 700 V	40 Hz to 1 kHz	$0.55 \cdot 10^{-3} \cdot U + 20 \text{ mV}$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Braunschweig

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC current Measurement instruments	220 μA to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 220 mA to 2.2 A > 2.2 A to 10 A	40 Hz to 1 kHz	$0.2 \cdot 10^{-3} \cdot I + 0.5 \mu\text{A}$ $0.25 \cdot 10^{-3} \cdot I + 1.5 \mu\text{A}$ $0.5 \cdot 10^{-3} \cdot I + 50 \mu\text{A}$ $1.2 \cdot 10^{-3} \cdot I + 0.22 \text{ mA}$ $1.2 \cdot 10^{-3} \cdot I + 2.5 \text{ mA}$	$I =$ measured value
AC current Sources	200 μA to 1.2 mA > 1.2 mA to 12 mA > 12 mA to 120 mA > 120 mA to 1 A	45 Hz to 1 kHz	$0.5 \cdot 10^{-3} \cdot I + 0.5 \mu\text{A}$ $0.5 \cdot 10^{-3} \cdot I + 5 \mu\text{A}$ $0.5 \cdot 10^{-3} \cdot I + 50 \mu\text{A}$ $1 \cdot 10^{-3} \cdot I + 0.5 \text{ mA}$	
Time and frequency Frequency Measurement instruments	5 MHz; 10 MHz 1 Hz to 100 kHz > 100 kHz to 1 GHz		$7 \cdot 10^{-11} \cdot f + u_{\text{Tr}}$ $2 \cdot [(5 \cdot 10^{-11} \cdot f)^2 + (1 \mu\text{Hz})^2 + (u_{\text{Tr}})^2]^{1/2}$ $2 \cdot [(5 \cdot 10^{-11} \cdot f)^2 + (1 \text{ Hz})^2 + (u_{\text{Tr}})^2]^{1/2}$	$f =$ measured value $u_{\text{Tr}} =$ trigger uncertainty
Frequency Generators	10 Hz to 1 GHz		$2 \cdot [(1 \cdot 10^{-9} \cdot f)^2 + (u_{\text{Tr}})^2]^{1/2}$	$u_{\text{Tr}} =$ trigger uncertainty

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Leipzig

Permanent Laboratory - Leipzig

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length * Calipers for external, internal and depth dimensions	0 mm to 200 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	$l =$ measured length

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Annex to the Partial Accreditation Certificate D-K-15015-01-01

Wetzlar

Permanent Laboratory - Wetzlar

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC and Low frequency				
DC voltage Measurement instruments	100 µV to < 220 mV 220 mV to < 2.2 V 2.2 V to < 11 V 11 V to < 22 V 22 V to < 220 V 220 V to 1100 V		$12 \cdot 10^{-6} \cdot U + 2 \mu\text{V}$ $11 \cdot 10^{-6} \cdot U + 2 \mu\text{V}$ $11 \cdot 10^{-6} \cdot U + 7 \mu\text{V}$ $11 \cdot 10^{-6} \cdot U + 9 \mu\text{V}$ $12 \cdot 10^{-6} \cdot U + 0.16 \text{ mV}$ $14 \cdot 10^{-6} \cdot U + 1.2 \text{ mV}$	$U = \text{measured value}$
DC current Measurement instruments	50 µA to < 220 µA 0.22 mA to < 2.2 mA 2.2 mA to < 22 mA 22 mA to < 220 mA 0.22 A to 2.2 A > 2.2 A to 11 A		$69 \cdot 10^{-6} \cdot I + 12 \text{ nA}$ $68 \cdot 10^{-6} \cdot I + 16 \text{ nA}$ $68 \cdot 10^{-6} \cdot I + 0.16 \mu\text{A}$ $80 \cdot 10^{-6} \cdot I + 1.6 \mu\text{A}$ $0.11 \cdot 10^{-3} \cdot I + 43 \mu\text{A}$ $0.69 \cdot 10^{-3} \cdot I + 0.46 \text{ mA}$	$I = \text{measured value}$
Current clamps	1 mA to 20 A > 20 A to 900 A		$2.5 \cdot 10^{-3} \cdot I$ $4.0 \cdot 10^{-3} \cdot I$	
AC voltage Measurement instruments	2 mV to < 2.2 mV	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	$0.69 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$ $0.28 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$ $0.14 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$ $0.47 \cdot 10^{-3} \cdot U + 6 \mu\text{V}$ $1.1 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$	$U = \text{measured value}$
	2.2 mV to < 22 mV	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	$0.69 \cdot 10^{-3} \cdot U + 8 \mu\text{V}$ $0.28 \cdot 10^{-3} \cdot U + 8 \mu\text{V}$ $0.14 \cdot 10^{-3} \cdot U + 8 \mu\text{V}$ $0.47 \cdot 10^{-3} \cdot U + 8 \mu\text{V}$ $1.1 \cdot 10^{-3} \cdot U + 10 \mu\text{V}$	
	22 mV to < 220 mV	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	$0.76 \cdot 10^{-3} \cdot U + 20 \mu\text{V}$ $0.28 \cdot 10^{-3} \cdot U + 13 \mu\text{V}$ $0.13 \cdot 10^{-3} \cdot U + 13 \mu\text{V}$ $0.4 \cdot 10^{-3} \cdot U + 13 \mu\text{V}$ $0.42 \cdot 10^{-3} \cdot U + 13 \mu\text{V}$	
	0.22 V to < 2.2 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	$0.76 \cdot 10^{-3} \cdot U + 0.12 \text{ mV}$ $0.2 \cdot 10^{-3} \cdot U + 40 \mu\text{V}$ $0.1 \cdot 10^{-3} \cdot U + 15 \mu\text{V}$ $0.16 \cdot 10^{-3} \cdot U + 27 \mu\text{V}$ $0.32 \cdot 10^{-3} \cdot U + 96 \mu\text{V}$	
	2.2 V to < 22 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	$0.69 \cdot 10^{-3} \cdot U + 1.2 \text{ mV}$ $0.2 \cdot 10^{-3} \cdot U + 0.45 \text{ mV}$ $95 \cdot 10^{-6} \cdot U + 0.22 \text{ mV}$ $0.16 \cdot 10^{-3} \cdot U + 0.31 \text{ mV}$ $0.32 \cdot 10^{-3} \cdot U + 0.53 \text{ mV}$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Wetzlar

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Measurement instruments	22 V 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	$0.69 \cdot 10^{-3} \cdot U + 12 \text{ mV}$ $0.2 \cdot 10^{-3} \cdot U + 5 \text{ mV}$ $95 \cdot 10^{-6} \cdot U + 3.6 \text{ mV}$ $0.29 \cdot 10^{-3} \cdot U + 5.6 \text{ mV}$ $0.7 \cdot 10^{-3} \cdot U + 12 \text{ mV}$	$U = \text{measured value}$
	220 V to 1100 V	45 Hz to 330 Hz > 330 Hz to 10 kHz > 10 kHz to 33 kHz	$0.16 \cdot 10^{-3} \cdot U + 11 \text{ mV}$ $0.12 \cdot 10^{-3} \cdot U + 11 \text{ mV}$ $0.16 \cdot 10^{-3} \cdot U + 11 \text{ mV}$	
AC current Measurement instruments	50 μA to < 220 μA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 330 Hz > 330 Hz to 3.3 kHz > 3.3 kHz to 5 kHz	$0.92 \cdot 10^{-3} \cdot I + 0.04 \mu\text{A}$ $0.48 \cdot 10^{-3} \cdot I + 0.04 \mu\text{A}$ $0.18 \cdot 10^{-3} \cdot I + 0.03 \mu\text{A}$ $0.8 \cdot 10^{-3} \cdot I + 0.06 \mu\text{A}$ $0.8 \cdot 10^{-3} \cdot I + 0.06 \mu\text{A}$	$I = \text{measured value}$
		0.22 mA to < 2.2 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 330 Hz > 330 Hz to 3.3 kHz > 3.3 kHz to 5 kHz	
	2.2 mA to < 22 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 330 Hz > 330 Hz to 3.3 kHz > 3.3 kHz to 5 kHz	$0.92 \cdot 10^{-3} \cdot I + 0.7 \mu\text{A}$ $0.48 \cdot 10^{-3} \cdot I + 0.6 \mu\text{A}$ $0.18 \cdot 10^{-3} \cdot I + 0.7 \mu\text{A}$ $0.8 \cdot 10^{-3} \cdot I + 6 \mu\text{A}$ $0.8 \cdot 10^{-3} \cdot I + 6 \mu\text{A}$	
	22 mA to < 220 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 330 Hz > 330 Hz to 3.3 kHz > 3.3 kHz to 5 kHz	$0.92 \cdot 10^{-3} \cdot I + 7 \mu\text{A}$ $0.48 \cdot 10^{-3} \cdot I + 6 \mu\text{A}$ $0.2 \cdot 10^{-3} \cdot I + 7 \mu\text{A}$ $0.8 \cdot 10^{-3} \cdot I + 60 \mu\text{A}$ $0.8 \cdot 10^{-3} \cdot I + 60 \mu\text{A}$	
	0.22 A to 2.2 A	40 Hz to 330 Hz > 330 Hz to 3.3 kHz > 3.3 kHz to 5 kHz	$0.86 \cdot 10^{-3} \cdot I + 60 \mu\text{A}$ $0.98 \cdot 10^{-3} \cdot I + 0.13 \text{ mA}$ $0.98 \cdot 10^{-3} \cdot I + 0.13 \text{ mA}$	
	> 2.2 A to 11 A	50 Hz to 330 Hz > 330 Hz to 1 kHz	$1.2 \cdot 10^{-3} \cdot I + 2.4 \text{ mA}$ $3.9 \cdot 10^{-3} \cdot I + 2.4 \text{ mA}$	
Current clamps	1 mA to 20 A > 20 A to 900 A	45 Hz to 400 Hz	$2.5 \cdot 10^{-3} \cdot I$ $4.0 \cdot 10^{-3} \cdot I$	
DC power Measurement instruments	100 mW to 12 kW	Product of U and I ; $1 \text{ V} \leq U \leq 600 \text{ V}$ $0.1 \text{ A} \leq I \leq 20 \text{ A}$	$1.6 \cdot 10^{-3} \cdot P$	$P = \text{measured value}$
AC power Measurement instruments	100 mW to 12 kW	45 Hz to 65 Hz $0.5 \leq \cos \varphi \leq 1.0$ $1 \text{ V} \leq U \leq 600 \text{ V}$ $0.1 \text{ A} \leq I \leq 20 \text{ A}$	$0.44 \cdot 10^{-3} \cdot P$	
Power factor Measurement instruments	≥ 0.5 to ≤ 1.0	230 V; 2.5 A 45 Hz to 65 Hz	$1.0 \cdot 10^{-3} \cdot \cos \varphi$	$\cos \varphi = \text{measured value}$

Valid from: 10.01.2024

Date of issue: 10.01.2024

Page 57 of 72

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Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Wetzlar

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC resistance Measurement instruments	1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ		$20 \cdot 10^{-6} \cdot R$ $9 \cdot 10^{-6} \cdot R$ $7 \cdot 10^{-6} \cdot R$ $7 \cdot 10^{-6} \cdot R$ $30 \cdot 10^{-6} \cdot R$ $7 \cdot 10^{-6} \cdot R$ $9 \cdot 10^{-6} \cdot R$ $12 \cdot 10^{-6} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$	<i>R</i> = measured value with calibrator 5700A
	0.001 Ω 0.01 Ω 0.1 Ω 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 GΩ		$1.7 \cdot 10^{-3} \cdot R$ $0.12 \cdot 10^{-3} \cdot R$ $0.12 \cdot 10^{-3} \cdot R$ $17 \cdot 10^{-6} \cdot R$ $30 \cdot 10^{-6} \cdot R$ $26 \cdot 10^{-6} \cdot R$ $20 \cdot 10^{-6} \cdot R$ $20 \cdot 10^{-6} \cdot R$ $20 \cdot 10^{-6} \cdot R$ $30 \cdot 10^{-6} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$ $0.62 \cdot 10^{-3} \cdot R$ $1.8 \cdot 10^{-3} \cdot R$	<i>R</i> = measured value with fixed resistors
Frequency	10 Hz to 1 GHz		$1.0 \cdot 10^{-9} \cdot f$	<i>f</i> = measured value
DC voltage Sources	10 mV to 100 mV > 100 mV to 1 V > 1 V to 10 V > 10 V to 100 V > 100 V to 1000 V		$5 \cdot 10^{-6} \cdot U + 2.5 \mu\text{V}$ $10 \cdot 10^{-6} \cdot U + 2.0 \mu\text{V}$ $9 \cdot 10^{-6} \cdot U + 3.0 \mu\text{V}$ $15 \cdot 10^{-6} \cdot U$ $19 \cdot 10^{-6} \cdot U$	<i>U</i> = measured value
DC current Sources	100 μA to 1 mA > 1 mA to 10 mA > 10 mA to 100 mA > 100 mA to 1 A		$73 \cdot 10^{-6} \cdot I$ $73 \cdot 10^{-6} \cdot I$ $0.14 \cdot 10^{-3} \cdot I$ $0.21 \cdot 10^{-3} \cdot I$	<i>I</i> = measured value
AC voltage Sources	10 mV to 100 mV	40 Hz to 100 Hz > 100 Hz to 2 kHz > 2 kHz to 10 kHz	$0.62 \cdot 10^{-3} \cdot U + 4.5 \mu\text{V}$ $0.50 \cdot 10^{-3} \cdot U + 5.0 \mu\text{V}$ $0.62 \cdot 10^{-3} \cdot U + 4.5 \mu\text{V}$	<i>U</i> = measured value
	> 100 mV to 1 V	40 Hz to 100 Hz > 100 Hz to 2 kHz > 2 kHz to 10 kHz	$0.12 \cdot 10^{-3} \cdot U + 2.5 \mu\text{V}$ $0.10 \cdot 10^{-3} \cdot U + 5.0 \mu\text{V}$ $0.12 \cdot 10^{-3} \cdot U + 4.0 \mu\text{V}$	
	> 1 V to 10 V	40 Hz to 100 Hz > 100 Hz to 2 kHz > 2 kHz to 10 kHz	$0.13 \cdot 10^{-3} \cdot U$ $0.16 \cdot 10^{-3} \cdot U$ $0.23 \cdot 10^{-3} \cdot U$	
	> 10 V to 100 V	40 Hz to 100 Hz > 100 Hz to 2 kHz > 2 kHz to 10 kHz	$0.13 \cdot 10^{-3} \cdot U$ $0.11 \cdot 10^{-3} \cdot U$ $0.21 \cdot 10^{-3} \cdot U$	
	> 100 V to 1000 V	40 Hz to 100 Hz > 100 Hz to 2 kHz > 2 kHz to 10 kHz	$0.24 \cdot 10^{-3} \cdot U$ $0.16 \cdot 10^{-3} \cdot U$ $0.27 \cdot 10^{-3} \cdot U$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Wetzlar

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC current Sources	100 μ A to 1 mA	40 Hz to 100 Hz > 100 Hz to 1 kHz	$0.49 \cdot 10^{-3} \cdot I$ $0.48 \cdot 10^{-3} \cdot I$	I = measured value
	> 1 mA to 10 mA	40 Hz to 100 Hz > 100 Hz to 1 kHz	$0.48 \cdot 10^{-3} \cdot I$ $0.47 \cdot 10^{-3} \cdot I$	
	> 10 mA to 100 mA	40 Hz to 100 Hz > 100 Hz to 1 kHz	$0.49 \cdot 10^{-3} \cdot I$ $0.47 \cdot 10^{-3} \cdot I$	
	> 100 mA to 1 A	40 Hz to 100 Hz > 100 Hz to 1 kHz	$1.1 \cdot 10^{-3} \cdot I$ $1.1 \cdot 10^{-3} \cdot I$	
DC resistance Resistors	1 Ω to 10 Ω		$52 \cdot 10^{-6} \cdot R$	R = measured value 4-wire connection
	> 10 Ω to 100 Ω		$27 \cdot 10^{-6} \cdot R$	
	> 100 Ω to 1 k Ω		$18 \cdot 10^{-6} \cdot R$	
	> 1 k Ω to < 10 k Ω		$25 \cdot 10^{-6} \cdot R$	
	10 k Ω to 100 k Ω		$16 \cdot 10^{-6} \cdot R$	
	> 100 k Ω to 1 M Ω		$22 \cdot 10^{-6} \cdot R$	
	> 1 M Ω to 10 M Ω > 10 M Ω to 100 M Ω		$55 \cdot 10^{-6} \cdot R$ $0.59 \cdot 10^{-3} \cdot R$	
Oscilloscope quantities Vertical deflection	1 mV to 5 V	50 Ω	$2.0 \cdot 10^{-3} \cdot U + 0.15$ mV	U = measured value
	5 mV to 200 V	1 M Ω		
Horizontal deflection	2 ns to 10 ns		6 ps	t = measured value
	20 ns to 1 μ s		$50 \cdot 10^{-6} \cdot t + 0.6$ ns	
	2 μ s to 5 s		$4.0 \cdot 10^{-3} \cdot t$	
Rise time	≥ 1 ns	25 mV to 1 V	$50 \cdot 10^{-3} \cdot t + 3$ ps	t = measured value at 1 MHz

On-site Calibration - Wetzlar

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC and Low frequency DC voltage Measurement instruments	100 μ V to < 220 mV 220 mV to < 2.2 V 2.2 V to < 11 V 11 V to < 22 V 22 V to < 220 V 220 V to 1100 V		$12 \cdot 10^{-6} \cdot U + 2$ μ V $11 \cdot 10^{-6} \cdot U + 2$ μ V $11 \cdot 10^{-6} \cdot U + 7$ μ V $11 \cdot 10^{-6} \cdot U + 9$ μ V $12 \cdot 10^{-6} \cdot U + 0.16$ mV $14 \cdot 10^{-6} \cdot U + 1.2$ mV	U = measured value

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

On-site Calibration - Wetzlar

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC current Measurement instruments	50 μ A to < 220 μ A		$69 \cdot 10^{-6} \cdot I + 12 \text{ nA}$	$I =$ measured value
	0.22 mA to < 2.2 mA		$68 \cdot 10^{-6} \cdot I + 16 \text{ nA}$	
	2.2 mA to < 22 mA		$68 \cdot 10^{-6} \cdot I + 0.16 \text{ } \mu\text{A}$	
	22 mA to < 220 mA		$80 \cdot 10^{-6} \cdot I + 1.6 \text{ } \mu\text{A}$	
	0.22 A to 2.2 A		$0.11 \cdot 10^{-3} \cdot I + 43 \text{ } \mu\text{A}$	
Current clamps	> 2.2 A to 11 A		$0.69 \cdot 10^{-3} \cdot I + 0.46 \text{ mA}$	
	1 mA to 10 A		$3.0 \cdot 10^{-3} \cdot I$	$I =$ measured value with 1 to 50 turn coils
AC voltage Measurement instruments	> 10 A to 500 A		$5.0 \cdot 10^{-3} \cdot I$	
	2 mV to < 2.2 mV	10 Hz to 20 Hz	$0.69 \cdot 10^{-3} \cdot U + 6 \text{ } \mu\text{V}$	$U =$ measured value
		> 20 Hz to 40 Hz	$0.28 \cdot 10^{-3} \cdot U + 6 \text{ } \mu\text{V}$	
		> 40 Hz to 20 kHz	$0.14 \cdot 10^{-3} \cdot U + 6 \text{ } \mu\text{V}$	
		> 20 kHz to 50 kHz	$0.47 \cdot 10^{-3} \cdot U + 6 \text{ } \mu\text{V}$	
		> 50 kHz to 100 kHz	$1.1 \cdot 10^{-3} \cdot U + 10 \text{ } \mu\text{V}$	
	2.2 mV to < 22 mV	10 Hz to 20 Hz	$0.69 \cdot 10^{-3} \cdot U + 8 \text{ } \mu\text{V}$	
		> 20 Hz to 40 Hz	$0.28 \cdot 10^{-3} \cdot U + 8 \text{ } \mu\text{V}$	
		> 40 Hz to 20 kHz	$0.14 \cdot 10^{-3} \cdot U + 8 \text{ } \mu\text{V}$	
		> 20 kHz to 50 kHz	$0.47 \cdot 10^{-3} \cdot U + 8 \text{ } \mu\text{V}$	
		> 50 kHz to 100 kHz	$1.1 \cdot 10^{-3} \cdot U + 10 \text{ } \mu\text{V}$	
	22 mV to < 220 mV	10 Hz to 20 Hz	$0.76 \cdot 10^{-3} \cdot U + 20 \text{ } \mu\text{V}$	
		> 20 Hz to 40 Hz	$0.28 \cdot 10^{-3} \cdot U + 13 \text{ } \mu\text{V}$	
> 40 Hz to 20 kHz		$0.13 \cdot 10^{-3} \cdot U + 13 \text{ } \mu\text{V}$		
> 20 kHz to 50 kHz		$0.4 \cdot 10^{-3} \cdot U + 13 \text{ } \mu\text{V}$		
> 50 kHz to 100 kHz		$0.42 \cdot 10^{-3} \cdot U + 13 \text{ } \mu\text{V}$		
0.22 V to < 2.2 V	10 Hz to 20 Hz	$0.76 \cdot 10^{-3} \cdot U + 0.12 \text{ mV}$		
	> 20 Hz to 40 Hz	$0.2 \cdot 10^{-3} \cdot U + 40 \text{ } \mu\text{V}$		
	> 40 Hz to 20 kHz	$0.1 \cdot 10^{-3} \cdot U + 15 \text{ } \mu\text{V}$		
	> 20 kHz to 50 kHz	$0.16 \cdot 10^{-3} \cdot U + 27 \text{ } \mu\text{V}$		
	> 50 kHz to 100 kHz	$0.32 \cdot 10^{-3} \cdot U + 96 \text{ } \mu\text{V}$		
2.2 V to < 22 V	10 Hz to 20 Hz	$0.69 \cdot 10^{-3} \cdot U + 1.2 \text{ mV}$		
	> 20 Hz to 40 Hz	$0.2 \cdot 10^{-3} \cdot U + 0.45 \text{ mV}$		
	> 40 Hz to 20 kHz	$95 \cdot 10^{-6} \cdot U + 0.22 \text{ mV}$		
	> 20 kHz to 50 kHz	$0.16 \cdot 10^{-3} \cdot U + 0.31 \text{ mV}$		
	> 50 kHz to 100 kHz	$0.32 \cdot 10^{-3} \cdot U + 0.53 \text{ mV}$		
22 V to < 220 V	10 Hz to 20 Hz	$0.69 \cdot 10^{-3} \cdot U + 12 \text{ mV}$		
	> 20 Hz to 40 Hz	$0.2 \cdot 10^{-3} \cdot U + 5 \text{ mV}$		
	> 40 Hz to 20 kHz	$95 \cdot 10^{-6} \cdot U + 3.6 \text{ mV}$		
	> 20 kHz to 50 kHz	$0.29 \cdot 10^{-3} \cdot U + 5.6 \text{ mV}$		
	> 50 kHz to 100 kHz	$0.7 \cdot 10^{-3} \cdot U + 12 \text{ mV}$		
220 V 1100 V	45 Hz to 330 Hz	$0.16 \cdot 10^{-3} \cdot U + 11 \text{ mV}$		
	> 330 Hz to 10 kHz	$0.12 \cdot 10^{-3} \cdot U + 11 \text{ mV}$		
	> 10 kHz to 33 kHz	$0.16 \cdot 10^{-3} \cdot U + 11 \text{ mV}$		
AC current Measurement instruments	50 μ A to < 220 μ A	10 Hz to 20 Hz	$0.92 \cdot 10^{-3} \cdot I + 0.04 \text{ } \mu\text{A}$	$I =$ measured value
		> 20 Hz to 40 Hz	$0.48 \cdot 10^{-3} \cdot I + 0.04 \text{ } \mu\text{A}$	
		> 40 Hz to 330 Hz	$0.18 \cdot 10^{-3} \cdot I + 0.03 \text{ } \mu\text{A}$	
		> 330 Hz to 3.3 kHz	$0.8 \cdot 10^{-3} \cdot I + 0.06 \text{ } \mu\text{A}$	
		> 3.3 kHz to 5 kHz	$0.8 \cdot 10^{-3} \cdot I + 0.06 \text{ } \mu\text{A}$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Page 60 of 72

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

Annex to the Partial Accreditation Certificate D-K-15015-01-01

On-site Calibration - Wetzlar

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC current Measurement instruments	0.22 mA to < 2.2 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 330 Hz > 330 Hz to 3.3 kHz > 3.3 kHz to 5 kHz	$0.92 \cdot 10^{-3} \cdot I + 0.07 \mu\text{A}$ $0.48 \cdot 10^{-3} \cdot I + 0.06 \mu\text{A}$ $0.18 \cdot 10^{-3} \cdot I + 0.07 \mu\text{A}$ $0.8 \cdot 10^{-3} \cdot I + 0.6 \mu\text{A}$ $0.8 \cdot 10^{-3} \cdot I + 0.6 \mu\text{A}$	I = measured value
	2.2 mA to < 22 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 330 Hz > 330 Hz to 3.3 kHz > 3.3 kHz to 5 kHz	$0.92 \cdot 10^{-3} \cdot I + 0.7 \mu\text{A}$ $0.48 \cdot 10^{-3} \cdot I + 0.6 \mu\text{A}$ $0.18 \cdot 10^{-3} \cdot I + 0.7 \mu\text{A}$ $0.8 \cdot 10^{-3} \cdot I + 6 \mu\text{A}$ $0.8 \cdot 10^{-3} \cdot I + 6 \mu\text{A}$	
	22 mA to < 220 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 330 Hz > 330 Hz to 3.3 kHz > 3.3 kHz to 5 kHz	$0.92 \cdot 10^{-3} \cdot I + 7 \mu\text{A}$ $0.48 \cdot 10^{-3} \cdot I + 6 \mu\text{A}$ $0.2 \cdot 10^{-3} \cdot I + 7 \mu\text{A}$ $0.8 \cdot 10^{-3} \cdot I + 60 \mu\text{A}$ $0.8 \cdot 10^{-3} \cdot I + 60 \mu\text{A}$	
	0.22 A to 2.2 A	40 Hz to 330 Hz > 330 Hz to 3.3 kHz > 3.3 kHz to 5 kHz	$0.86 \cdot 10^{-3} \cdot I + 60 \mu\text{A}$ $0.98 \cdot 10^{-3} \cdot I + 0.13 \text{ mA}$ $0.98 \cdot 10^{-3} \cdot I + 0.13 \text{ mA}$	
	> 2.2 A to 11 A	50 Hz to 330 Hz > 330 Hz to 1 kHz	$1.2 \cdot 10^{-3} \cdot I + 2.4 \text{ mA}$ $3.9 \cdot 10^{-3} \cdot I + 2.4 \text{ mA}$	
	Current clamps	1 mA to 10 A > 10 A to 500 A	45 Hz to 400 Hz	
DC power Measurement instruments	100 mW to 10 kW	Product of U and I ; $100 \text{ mV} \leq U \leq 1000 \text{ V}$ $1 \text{ mA} \leq I \leq 10 \text{ A}$	$1.5 \cdot 10^{-3} \cdot P$	P = measured value
DC resistance Measurement instruments	1 Ω 10 Ω 100 Ω 1 k Ω 10 k Ω 100 k Ω 1 M Ω 10 M Ω 100 M Ω		$20 \cdot 10^{-6} \cdot R$ $9 \cdot 10^{-6} \cdot R$ $7 \cdot 10^{-6} \cdot R$ $7 \cdot 10^{-6} \cdot R$ $30 \cdot 10^{-6} \cdot R$ $7 \cdot 10^{-6} \cdot R$ $9 \cdot 10^{-6} \cdot R$ $12 \cdot 10^{-6} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$	R = measured value with calibrator 5700A
	0.001 Ω 0.01 Ω 0.1 Ω 1 Ω 10 Ω 100 Ω 1 k Ω 10 k Ω 100 k Ω 1 M Ω 10 M Ω 100 M Ω 1 G Ω		$1.7 \cdot 10^{-3} \cdot R$ $0.12 \cdot 10^{-3} \cdot R$ $0.12 \cdot 10^{-3} \cdot R$ $17 \cdot 10^{-6} \cdot R$ $30 \cdot 10^{-6} \cdot R$ $26 \cdot 10^{-6} \cdot R$ $20 \cdot 10^{-6} \cdot R$ $20 \cdot 10^{-6} \cdot R$ $20 \cdot 10^{-6} \cdot R$ $20 \cdot 10^{-6} \cdot R$ $30 \cdot 10^{-6} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$ $0.62 \cdot 10^{-3} \cdot R$ $1.8 \cdot 10^{-3} \cdot R$	with fixed resistors

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

On-site Calibration - Wetzlar

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC voltage Sources	10 mV to 100 mV > 100 mV to 1 V > 1 V to 10 V > 10 V to 100 V > 100 V to 1 kV		$0.25 \cdot 10^{-3} \cdot U + 2.0 \mu\text{V}$ $60 \cdot 10^{-6} \cdot U + 2.0 \mu\text{V}$ $75 \cdot 10^{-6} \cdot U + 2.0 \mu\text{V}$ $0.1 \cdot 10^{-3} \cdot U$ $0.13 \cdot 10^{-3} \cdot U$	U = measured value
DC current Sources	100 μA to 10 mA > 10 mA to 100 mA > 100 mA to 1 A		$1.5 \cdot 10^{-3} \cdot I$ $9.9 \cdot 10^{-3} \cdot I$ $1.9 \cdot 10^{-3} \cdot I$	I = measured value
AC voltage Sources	10 mV to 100 mV > 100 mV to 1 V > 1 V to 10 V > 10 V to 100 V > 100 V to 750 V	40 Hz to 10 kHz	$4.5 \cdot 10^{-3} \cdot U + 2.0 \mu\text{V}$ $4.5 \cdot 10^{-3} \cdot U + 2.0 \mu\text{V}$ $4.5 \cdot 10^{-3} \cdot U$ $4.5 \cdot 10^{-3} \cdot U$ $3.6 \cdot 10^{-3} \cdot U$	U = measured value
AC Current Sources	1 mA to 10 mA > 10 mA to 100 mA > 100 mA to 1 A	40 Hz to 1 kHz	$0.56 \cdot I$ $56 \cdot 10^{-3} \cdot I$ $7.0 \cdot 10^{-3} \cdot I$	I = measured value
DC resistance Resistors	1 Ω to 10 Ω > 10 Ω to 100 Ω > 100 Ω to 1 k Ω > 1 k Ω to 10 k Ω > 10 k Ω to 100 k Ω > 100 k Ω to 1 M Ω		$0.2 \cdot 10^{-3} \cdot R$ $0.18 \cdot 10^{-3} \cdot R$ $85 \cdot 10^{-6} \cdot R$ $85 \cdot 10^{-6} \cdot R$ $0.13 \cdot 10^{-3} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$	R = measured value with 4-wire-connection
DC resistance Resistors	> 1 M Ω to 10 M Ω > 10 M Ω to 100 M Ω		$0.52 \cdot 10^{-3} \cdot R$ $1.9 \cdot 10^{-3} \cdot R$	with 2-wire-connection
Oscilloscope quantities				
Vertical deflection	1 mV to 5 V	50 Ω	$2.0 \cdot 10^{-3} \cdot U + 0.15 \text{ mV}$	U = measured value
	5 mV to 200 V	1 M Ω		
Horizontal deflection	2 ns to 10 ns		6 ps	t = measured value
	20 ns to 1 μs		$50 \cdot 10^{-6} \cdot t + 0.6 \text{ ns}$	
	2 μs to 5 s		$4.0 \cdot 10^{-3} \cdot t$	
Rise time	$\geq 1 \text{ ns}$	25 mV to 1 V	$50 \cdot 10^{-3} \cdot t + 3 \text{ ps}$	t = measured value at 1 MHz

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Ruhla

Permanent Laboratory – Ruhla

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length				
Calipers for external, internal and depth dimensions *	0 mm to 500 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	$l =$ measured length
	> 500 mm to 1000 mm		$50 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
Depth calipers *	0 mm to 600 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
Height calipers *	0 mm to 600 mm	VDI/VDE/DGQ 2618 Part 9.3:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Internal micrometers with two-point contact *	25 mm to 100 mm	VDI/VDE/DGQ 2618 Part 10.7:2010	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
	> 100 mm to 500 mm		$4 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
	> 500 mm to 1000 mm		$5 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Extensions for Internal micrometers with two-point contact *	25 mm to 500 mm	VDI/VDE/DGQ 2618 Part 10.7:2010	$2 \mu\text{m} + 5 \cdot 10^{-6} \cdot l$	
	> 500 mm to 1000 mm		$3.5 \mu\text{m} + 5 \cdot 10^{-6} \cdot l$	
Internal micrometers with three-point contact *	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 10.8:2002	$4 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	$d =$ measured diameter
Micrometers with dial indicator *	0 mm to 100 mm	VDI/VDE/DGQ 2618 Part 10.3:2002	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	$l =$ measured length
Reference gauges for micrometers *	25 mm to 500 mm	VDI/VDE/DGQ 2618 Part 4.4:2009	$0.5 \mu\text{m} + 6 \cdot 10^{-6} \cdot l$	
Lever gauges (quicktests) for external measurements *	0 mm to 100 mm	VDI/VDE/DGQ 2618 Part 12.1:2005	$7 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Lever gauges (quicktests) for internal measurements *	2.5 mm to 500 mm	VDI/VDE/DGQ 2618 Part 13.1:2005	$7 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Square 90° *	40 mm to 500 mm	VDI/VDE/DGQ/DKD 2618 Part 7.1:2019	$4 \mu\text{m} + 6 \cdot 10^{-6} \cdot l_z$	$l_z =$ leg length
Protractors *	0° to 360°	VDI/VDE/DGQ 2618 Part 7.2:2008	1'	
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	$l =$ measured length
Digital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.6 μm	
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	0.8 μm	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory – Ruhla

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Plug gauges * Diameter	2 mm to 200 mm	VDI/VDE/DGQ 2618 Part 4.1:2006	$0.8 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	d = measured diameter
Roundness deviation	to 20 μm		0.4 μm	
Straightness deviation	to 20 μm		1.0 μm	
Parallelism deviation	to 20 μm		2.0 μm	
Ring gauges * Diameter	3 mm to 200 mm		$0.8 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	
Roundness deviation	to 20 μm		0.4 μm	
Straightness deviation	to 20 μm		1.0 μm	
Parallelism deviation	to 20 μm		2.0 μm	
Measuring pins, pins for screw threads * Diameter	0.1 mm to 20 mm	VDI/VDE/DGQ 2618 Part 4.2:2007	0.8 μm	
Roundness deviation	to 20 μm		0.4 μm	starting at 1 mm diameter
Straightness deviation	to 20 μm		1.0 μm	starting at 1.5 mm diameter
Parallelism deviation	to 20 μm		2.0 μm	starting at 1.5 mm diameter
Thread gauges * single-start cylindrical external and internal threads with straight flanks, symmetrical profile and nominal thread angle 60°				
External thread with nominal lead 0.25 mm to 5.5 mm Simple pitch diameter	2 mm to 100 mm	VDI/VDE/DGQ 2618 Part 4.8:2006 Option 1	$2.8 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	d = measured pitch diameter
Internal thread with nominal lead 0.5 mm to 6 mm Simple pitch diameter	4 mm to 100 mm	VDI/VDE/DGQ 2618 Part 4.9:2006 Option 1	$2.8 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

On-site Calibration - Ruhla

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Coordinate measuring technology Measuring projectors Measuring microscopes *	0 mm to 250 mm	DKD-R 4-3 Part 18.1:2018 Calibration of metrological characteristics of coordinate measuring machines (CMM) according to DIN EN ISO 10360 and VDI/VDE 2617		Visual probing with crosshair l = measured length
		Determination of probing error $PS-ID(OT)$ with a graduated scale made of glass according to VDI/VDE 2617 Part 6.1:2021	0.3 μ m	
		Determination of length measurement error $E-ID(OT)$ with a graduated scale made of glass according to VDI/VDE 2617 Part 6.1: 2021	$0.8 \mu\text{m} + 0.6 \cdot 10^{-6} \cdot l$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Nürnberg

Permanent Laboratory - Nürnberg

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length Gauge blocks * made of steel according to DIN EN ISO 3650:1999	0.5 mm to 100 mm	VDI/VDE/DGQ 2618 Part 3.1:2004 in the nominal values of the references Measurement of the deviation of the central length l_c from the nominal value l_n by comparison measurement	For the central length: $0.08 \mu\text{m} + 0.8 \cdot 10^{-6} \cdot l$ For the deviations f_0 and f_u from the central length: $0.08 \mu\text{m}$	l = gauge block length Measuring surface quality as stated in QMH resp. in the test specifications For the smallest measurement uncertainties, the wringability and the wringing characteristics of both measuring surfaces must be checked using an appropriate optical flat.
Gauge blocks * made of ceramics according to DIN EN ISO 3650:1999	0.5 mm to 100 mm	Measurement of the deviations f_0 and f_u from the central length by 5 points comparison measurement	For the central length: $0.1 \mu\text{m} + 0.9 \cdot 10^{-6} \cdot l$ For the deviations f_0 and f_u from the central length: $0.07 \mu\text{m}$	
Gauge blocks * made of tungsten carbide according to DIN EN ISO 3650:1999	0.5 mm to 100 mm		For the central length: $0.1 \mu\text{m} + 0.9 \cdot 10^{-6} \cdot l$ For the deviations f_0 and f_u from the central length: $0.07 \mu\text{m}$	
Gauge blocks * made of steel according to DIN EN ISO 3650:1999	> 100 mm to 1000 mm	VDI/VDE/DGQ 2618 Part 3.1:2004 in nominal lengths, that deviate up to 50 mm from the length of the standards Measurement of the deviation of the central length l_c from the nominal value l_n by comparison measurement	For the central length: $0.2 \mu\text{m} + 0.7 \cdot 10^{-6} \cdot l$	l = gauge block length

Valid from: 10.01.2024

Date of issue: 10.01.2024

Page 66 of 72

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

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Nürnberg

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Cylindrical setting gauges *	2 mm to 200 mm	VDI/VDE/DGQ 2618 Part 4.1:2006	$0.6 \mu\text{m} + 5 \cdot 10^{-6} \cdot d$	$d = \text{measured diameter}$
Ring gauges Diameter				starting at 2 mm diameter
Roundness deviation				starting at 3 mm diameter
Straightness and parallelism deviation	to 20 μm		1 μm	starting at 3 mm diameter
Plug gauges Diameter	1 mm to 200 mm		$0.6 \mu\text{m} + 5 \cdot 10^{-6} \cdot d$	$d = \text{measured diameter}$
Roundness deviation	to 20 μm		0.1 μm	starting at 1 mm diameter
Straightness and parallelism deviation	to 20 μm		1 μm	starting 1.5 mm diameter
Measuring pins, pins for screw threads Diameter	0.1 mm to 20 mm	VDI/VDE/DGQ 2618 Part 4.2:2007	0.6 μm	
Roundness deviation	to 20 μm		0.1 μm	starting at 1 mm diameter
Straightness and parallelism deviation	to 20 μm		1 μm	starting at 1.5 mm diameter
Reference gauges for micrometers *	25 mm to 1000 mm	VDI/VDE/DGQ 2618 Part 4.4:2009	$0.7 \mu\text{m} + 1.5 \cdot 10^{-6} \cdot l$	$l = \text{measured length}$
Gap gauges *	5 mm to 160 mm	VDI/VDE/DGQ 2618 Part 4.7:2005	$2 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	$l = \text{measured length}$
Feeler gauges	0.01 mm to 2 mm	Trescal KA29 08.1/2021	3 μm	
Calipers for external, internal and depth dimensions *	0 mm to 500 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	$l = \text{measured length}$
	> 500 mm to 1000 mm		$50 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
Depth calipers *	0 mm to 500 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
	> 500 mm to 1000 mm		$50 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
Height calipers *	0 mm to 1000 mm	VDI/VDE/DGQ 2618 Part 9.3:2006	$30 \mu\text{m} + 30 \cdot 10^{-6} \cdot l$	
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	$l = \text{measured length}$ 300 mm = final value of the measuring range
	> 300 mm to 600 mm		$5 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	600 mm = final value of the measuring range
Micrometers for screw thread measurements form D18 *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.2:2010	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	$l = \text{measured length}$ 300 mm = final value of the measuring range
Micrometers with dial indicator form D13 *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.3:2002	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Nürnberg

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Micrometer heads *	0 mm to 50 mm	VDI/VDE/DGQ 2618 Part 10.4:2008	$3 \mu\text{m} + 5 \cdot 10^{-6} \cdot l$	50 mm = final value of the measuring range
Depth micrometers with extensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.5:2010	$5 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	300 mm = final value of the measuring range; Measuring element generally 25 mm range
Internal micrometers with two-point contact *	25 mm to 1000 mm	VDI/VDE/DGQ 2618 Part 10.7:2010	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	
Internal micrometers with three-point contact *	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 10.8:2002	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	d = measured diameter
Internal micrometers with jaws	5 mm to 200 mm	Trescal KA16-6 01.1/2016	$5 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	200 mm = final value of the measuring range
Internal groove micrometers	0 mm to 100 mm	Trescal KA16-7 01.1/2016	$5 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	100 mm = final value of the measuring range
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	Vertically measured
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.7 μm	
Lever gauges *	to 3.2 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	0.9 μm	
Digital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	Vertically measured
Lever gauges for external measurements (quick tests) *	0 mm to 200 mm	VDI/VDE/DGQ 2618 Part 12.1:2005	$7 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	l = measured length
Lever gauges for internal measurements (quick tests) *	2.5 mm to 200 mm	VDI/VDE/DGQ 2618 Part 13.1:2005	$7 \mu\text{m} + 10 \cdot 10^{-6} \cdot l$	l = measured length
Thread gauges * (single- and multi-start cylindrical external and internal threads with straight flanks, symmetrical profile)				
Pitch diameter on external thread	1 mm to 200 mm	VDI/VDE/DGQ 2618 Part 4.8:2006 Option 1	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	d = pitch diameter simple pitch diameter
	Lead ≥ 0.25 mm			
Pitch diameter on internal thread	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 4.9:2006 Option 1	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	
	Lead ≥ 0.5 mm to 6 mm			

Valid from: 10.01.2024

Date of issue: 10.01.2024

Page 68 of 72

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

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Nürnberg

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Thread gauges * (single-and multi-start cylindrical external and internal threads with straight flanks, symmetrical and unsymmetrical profile)				
External thread Pitch diameter	1 mm to 150 mm Nominal diameter:	VDI/VDE/DGQ 2618 Part 4.8:2006 Option 1 to 4 Scanning method	$3 \mu\text{m} + 5 \cdot 10^{-6} \cdot d$	$d = \text{pitch diameter}$
Outside diameter, core diameter			$3 \mu\text{m} + 5 \cdot 10^{-6} \cdot d$	$d = \text{outside/core diameter}$
Lead or pitch			1 μm	
Thread angle α	$\geq 27^\circ$	(Specifying the thread angle α)	$(1.2 + 3 \text{ mm} / l_F)'$, but not lower than 6'	$l_F = \text{flank length}$
Internal thread Pitch diameter	2.5 mm to 160 mm Nominal diameter:	VDI/VDE/DGQ 2618 Part 4.9:2006 Option 1 to 4 Scanning method	$3 \mu\text{m} + 5 \cdot 10^{-6} \cdot d$	$d = \text{pitch diameter}$
Outside diameter, core diameter			$3 \mu\text{m} + 5 \cdot 10^{-6} \cdot d$	$d = \text{outside/ core diameter}$
Lead or pitch			1 μm	
Thread angle α	$\geq 27^\circ$	(Specifying the thread angle α)	$(1.2 + 3 \text{ mm} / l_F)'$, but not lower than 6'	$l_F = \text{flank length}$
DC and low frequency				
DC voltage Measurement instruments	0 mV to < 330 mV 0.33 V to < 3.3 V 3.3 V to < 33 V 33V to < 330 V 330 V to 1020 V		$30 \cdot 10^{-6} \cdot U + 5.0 \mu\text{V}$ $30 \cdot 10^{-6} \cdot U + 20 \mu\text{V}$ $30 \cdot 10^{-6} \cdot U + 0.20 \text{ mV}$ $30 \cdot 10^{-6} \cdot U + 2.0 \text{ mV}$ $30 \cdot 10^{-6} \cdot U + 5.0 \text{ mV}$	$U = \text{measured value}$
DC voltage Sources	1 mV to 200 mV > 0.2 V to 2 V > 2 V to 20 V > 20 V to 200 V > 200 V to 1000 V		$15 \cdot 10^{-6} \cdot U + 3.0 \mu\text{V}$ $15 \cdot 10^{-6} \cdot U + 4.0 \mu\text{V}$ $15 \cdot 10^{-6} \cdot U + 20 \mu\text{V}$ $15 \cdot 10^{-6} \cdot U + 0.23 \text{ mV}$ $15 \cdot 10^{-6} \cdot U + 1.2 \text{ mV}$	
DC current Measurement instruments	1 μA to < 330 μA 0.33 mA to < 3.3 mA 3.3 mA to < 33 mA 33 mA to < 330 mA 0.33 A to < 1.1 A 1.1 A to < 3 A 3 A to < 11 A 11 A to 20.5 A		$0.20 \cdot 10^{-3} \cdot I + 0.15 \mu\text{A}$ $0.15 \cdot 10^{-3} \cdot I + 0.20 \mu\text{A}$ $0.15 \cdot 10^{-3} \cdot I + 1.0 \mu\text{A}$ $0.15 \cdot 10^{-3} \cdot I + 20 \mu\text{A}$ $0.30 \cdot 10^{-3} \cdot I + 0.10 \text{ mA}$ $0.60 \cdot 10^{-3} \cdot I + 0.10 \text{ mA}$ $0.70 \cdot 10^{-3} \cdot I + 1.0 \text{ mA}$ $1.5 \cdot 10^{-3} \cdot I + 2.0 \text{ mA}$	$I = \text{measured value}$

Valid from: 10.01.2024

Date of issue: 10.01.2024

Page 69 of 72

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

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Nürnberg

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC current Sources	1 μ A to 200 μ A > 0.2 mA to 2 mA > 2 mA to 20 mA > 20 mA to 200 mA > 0.2 A to 2 A > 2 A to 20 A		$20 \cdot 10^{-6} \cdot I + 2.0$ nA $20 \cdot 10^{-6} \cdot I + 20$ nA $20 \cdot 10^{-6} \cdot I + 0.20$ μ A $70 \cdot 10^{-6} \cdot I + 2.0$ μ A $0.30 \cdot 10^{-3} \cdot I + 40$ μ A $0.70 \cdot 10^{-3} \cdot I + 1.0$ mA	$I =$ measured value
DC resistance Resistors	1 Ω to 2 Ω > 2 Ω to 20 Ω > 20 Ω to 200 Ω > 0.2 k Ω to 2 k Ω > 2 k Ω to 20 k Ω > 20 k Ω to 200 k Ω > 0.2 M Ω to 2 M Ω > 2 M Ω to 20 M Ω > 20 M Ω to 200 M Ω		$30 \cdot 10^{-6} \cdot R + 20$ $\mu\Omega$ $20 \cdot 10^{-6} \cdot R + 50$ $\mu\Omega$ $20 \cdot 10^{-6} \cdot R + 0.50$ m Ω $20 \cdot 10^{-6} \cdot R + 5.0$ m Ω $20 \cdot 10^{-6} \cdot R + 50$ m Ω $20 \cdot 10^{-6} \cdot R + 0.40$ Ω $20 \cdot 10^{-6} \cdot R + 5.0$ Ω $40 \cdot 10^{-6} \cdot R + 0.20$ k Ω $0.30 \cdot 10^{-3} \cdot R + 0.20$ M Ω	$R =$ measured value
DC resistance Measurement instruments	1 Ω to < 11 Ω 11 Ω to < 33 Ω 33 Ω to < 0.11 k Ω 0.11 k Ω to < 0.33 k Ω 0.33 k Ω to < 1.1 k Ω 1.1 k Ω to < 3.3 k Ω 3.3 k Ω to < 11 k Ω 11 k Ω to < 33 k Ω 33 k Ω to < 0.11 M Ω 0.11 M Ω to < 0.33 M Ω 0.33 M Ω to < 1.1 M Ω 1.1 M Ω to < 3.3 M Ω 3.3 M Ω to < 11 M Ω 11 M Ω to < 33 M Ω 33 M Ω to < 0.11 G Ω 0.11 G Ω to < 0.33 G Ω 0.33 G Ω to < 1.1 G Ω		$0.10 \cdot 10^{-3} \cdot R + 15$ m Ω $0.10 \cdot 10^{-3} \cdot R + 20$ m Ω $0.10 \cdot 10^{-3} \cdot R + 20$ m Ω $0.15 \cdot 10^{-3} \cdot R + 25$ m Ω $0.15 \cdot 10^{-3} \cdot R + 15$ m Ω $0.15 \cdot 10^{-3} \cdot R + 0.40$ Ω $0.15 \cdot 10^{-3} \cdot R + 0.10$ Ω $0.15 \cdot 10^{-3} \cdot R + 1.5$ Ω $0.15 \cdot 10^{-3} \cdot R + 1.0$ Ω $0.15 \cdot 10^{-3} \cdot R + 26$ Ω $0.15 \cdot 10^{-3} \cdot R + 20$ Ω $0.15 \cdot 10^{-3} \cdot R + 0.30$ k Ω $0.20 \cdot 10^{-3} \cdot R + 0.60$ k Ω $0.35 \cdot 10^{-3} \cdot R + 8.0$ k Ω $0.60 \cdot 10^{-3} \cdot R + 18$ k Ω $3.5 \cdot 10^{-3} \cdot R + 0.30$ M Ω $20 \cdot 10^{-3} \cdot R + 1.4$ M Ω	$R =$ measured value
AC voltage Measurement instruments	1 mV to < 33 mV 33 mV to < 330 mV	10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 500 kHz 10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 500 kHz	$0.90 \cdot 10^{-3} \cdot U + 20$ μ V $0.20 \cdot 10^{-3} \cdot U + 20$ μ V $0.25 \cdot 10^{-3} \cdot U + 20$ μ V $1.5 \cdot 10^{-3} \cdot U + 20$ μ V $4.5 \cdot 10^{-3} \cdot U + 30$ μ V $10 \cdot 10^{-3} \cdot U + 0.10$ mV $0.40 \cdot 10^{-3} \cdot U + 30$ μ V $0.20 \cdot 10^{-3} \cdot U + 30$ μ V $0.20 \cdot 10^{-3} \cdot U + 30$ μ V $0.50 \cdot 10^{-3} \cdot U + 30$ μ V $1.0 \cdot 10^{-3} \cdot U + 80$ μ V $2.5 \cdot 10^{-3} \cdot U + 0.20$ mV	$U =$ measured value

Valid from: 10.01.2024

Date of issue: 10.01.2024

Annex to the Partial Accreditation Certificate D-K-15015-01-01

Permanent Laboratory - Nürnberg

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Measurement instruments	0.33 V to < 3.3 V	10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 500 kHz	$0.40 \cdot 10^{-3} \cdot U + 0.10 \text{ mV}$ $0.20 \cdot 10^{-3} \cdot U + 0.10 \text{ mV}$ $0.25 \cdot 10^{-3} \cdot U + 0.10 \text{ mV}$ $0.40 \cdot 10^{-3} \cdot U + 0.10 \text{ mV}$ $1.0 \cdot 10^{-3} \cdot U + 0.20 \text{ mV}$ $3.0 \cdot 10^{-3} \cdot U + 2.0 \text{ mV}$	$U = \text{measured value}$
	3.3 V to < 33 V	10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.40 \cdot 10^{-3} \cdot U + 1.5 \text{ mV}$ $0.20 \cdot 10^{-3} \cdot U + 1.0 \text{ mV}$ $0.30 \cdot 10^{-3} \cdot U + 1.0 \text{ mV}$ $0.50 \cdot 10^{-3} \cdot U + 1.0 \text{ mV}$ $1.5 \cdot 10^{-3} \cdot U + 2.5 \text{ mV}$	
	33 V to < 330 V	45 Hz to 1 kHz > 1 kHz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.25 \cdot 10^{-3} \cdot U + 3.0 \text{ mV}$ $0.30 \cdot 10^{-3} \cdot U + 10 \text{ mV}$ $0.30 \cdot 10^{-3} \cdot U + 10 \text{ mV}$ $0.40 \cdot 10^{-3} \cdot U + 10 \text{ mV}$ $2.5 \cdot 10^{-3} \cdot U + 60 \text{ mV}$	
	330 V to 1020 V	45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.40 \cdot 10^{-3} \cdot U + 20 \text{ mV}$ $0.30 \cdot 10^{-3} \cdot U + 20 \text{ mV}$ $0.40 \cdot 10^{-3} \cdot U + 20 \text{ mV}$	
AC voltage Sources	0.1 V to 0.2 V	40 Hz to 100 Hz > 100 Hz to 2 kHz > 2 kHz to 10 kHz	$0.20 \cdot 10^{-3} \cdot U + 20 \text{ } \mu\text{V}$ $0.20 \cdot 10^{-3} \cdot U + 20 \text{ } \mu\text{V}$ $0.20 \cdot 10^{-3} \cdot U + 20 \text{ } \mu\text{V}$	
	> 0.2 V to 2 V	40 Hz to 100 Hz > 100 Hz to 2 kHz > 2 kHz to 10 kHz	$0.20 \cdot 10^{-3} \cdot U + 60 \text{ } \mu\text{V}$ $0.20 \cdot 10^{-3} \cdot U + 60 \text{ } \mu\text{V}$ $0.20 \cdot 10^{-3} \cdot U + 60 \text{ } \mu\text{V}$	
	> 2 V to 20 V	40 Hz to 100 Hz > 100 Hz to 2 kHz > 2 kHz to 10 kHz	$0.20 \cdot 10^{-3} \cdot U + 0.60 \text{ mV}$ $0.20 \cdot 10^{-3} \cdot U + 0.60 \text{ mV}$ $0.20 \cdot 10^{-3} \cdot U + 0.60 \text{ mV}$	
	> 20 V to 200 V	40 Hz to 100 Hz > 100 Hz to 2 kHz > 2 kHz to 10 kHz	$0.20 \cdot 10^{-3} \cdot U + 6.0 \text{ mV}$ $0.20 \cdot 10^{-3} \cdot U + 6.0 \text{ mV}$ $0.20 \cdot 10^{-3} \cdot U + 6.0 \text{ mV}$	
	> 200 V to 1050 V	40 Hz to 10 kHz	$0.40 \cdot 10^{-3} \cdot U + 80 \text{ mV}$	
AC current Measurement instruments	29 μA to < 330 μA	45 Hz to 1 kHz	$1.6 \cdot 10^{-3} \cdot I + 0.40 \text{ } \mu\text{A}$	$I = \text{measured value}$
	0.33 mA to < 3.3 mA		$1.5 \cdot 10^{-3} \cdot I + 0.60 \text{ } \mu\text{A}$	
	3.3 mA to < 33 mA		$0.50 \cdot 10^{-3} \cdot I + 6.0 \text{ } \mu\text{A}$	
	33 mA to < 330 mA		$0.50 \cdot 10^{-3} \cdot I + 60 \text{ } \mu\text{A}$	
	0.33 A to < 1.1 A		$0.60 \cdot 10^{-3} \cdot I + 0.30 \text{ mA}$	
	1.1 A to < 3 A		$0.70 \cdot 10^{-3} \cdot I + 0.40 \text{ mA}$	
	3 A to < 11 A		$1.5 \cdot 10^{-3} \cdot I + 5.0 \text{ mA}$	
11 A to 20.5 A		$2.0 \cdot 10^{-3} \cdot I + 10 \text{ mA}$		
AC current Sources	0.2 mA to 2 mA	45 Hz to 1 kHz	$0.50 \cdot 10^{-3} \cdot I + 0.60 \text{ } \mu\text{A}$	
	> 2 mA to 20 mA		$0.50 \cdot 10^{-3} \cdot I + 5.0 \text{ } \mu\text{A}$	
	> 20 mA to 200 mA		$0.50 \cdot 10^{-3} \cdot I + 50 \text{ } \mu\text{A}$	
	> 200 mA to 2 A > 2 A to 20 A		$0.80 \cdot 10^{-3} \cdot I + 0.50 \text{ mA}$ $1.1 \cdot 10^{-3} \cdot I + 5.0 \text{ mA}$	

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Abbreviations used:

CMC	Calibration and measurement capabilities
DGQ	Deutsche Gesellschaft für Qualität e.V.
DIN	Deutsches Institut für Normung e.V.
DKD	Deutscher Kalibrierdienst
DKD-R	Guideline of Deutscher Kalibrierdienst, published by Physikalisch-Technischen Bundesanstalt
Trescal KA	Calibration guide of Trescal GmbH
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik e.V.
VDI	Verein Deutscher Ingenieure e.V.