Deutsche Akkreditierungsstelle

Annex to the Partial Accreditation Certificate D-K-15118-01-01 according to DIN EN ISO/IEC 17025:2018

Valid from: **10.07.2023**

Date of issue: 10.07.2023

This annex is a part of the accreditation certificate D-K-15118-01-00.

Holder of partial accreditation certificate:

Kessler QMP GmbH
Nisterberger Weg 16, 57520 Friedewald

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 confirm generally with the principles of DIN EN ISO 9001.

Calibrations in the fields:

Dimensional quantities

Length

- **Length gauges**
- **Diameter** [b)]
- **Form error**
- **Length measuring instruments** [b)]
- **Length measuring devices** [a)]
- **Flatness** [a)]
- **Straightness**
- **Line scales, distances**
- **Thread** [b)]

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.

- **Gear quantities**

Coordinate measuring technology

- **Application coordinate measuring machines**
- **Coordinate measuring machines** [c)]

Angle

- **Angle gauges**
- **Inclination measuring instruments**

Electrical quantities

DC and low frequency quantities

- **DC voltage** [b)]
- **AC voltage** [b)]
- **DC current** [b)]
- **AC current** [b)]
- **DC resistance** [b)]
- **Electric power** [b)]

Time and frequency

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

High frequency and radiation quantities

High frequency quantities

- **Oscilloscope quantities** [b)]
- **Rise time** [b)]
- **Band width** [b)]

[a)] also on-site-calibration
[b)] also calibration in the mobile laboratory
[c)] only on-site-calibration

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.

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Length				
Gauge blocks * made of steel according to DIN EN ISO 3650:1999	0.5 mm to 100 mm featuring the nominal values of the steel standards	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 smallest measurement uncertainties, the wringability and the wringing characteristics of both measuring surfaces must be checked using an appropriate optical flat	For the central length: 0.08 µm + 0.8 · 10^{-6} · l For the deviations f_o and f_u from the central length: 0.05 µm	l = gauge block length
Gauge blocks * made of ceramics according to DIN EN ISO 3650:1999			For the central length: 0.1 µm + 1.1 · 10^{-6} · l For the deviations f_o and f_u from the central length: 0.07 µm	
Gauge blocks * made of tungsten carbite according to DIN EN ISO 3650:1999			For the central length: 0.1 µm + 3.3 · 10^{-6} · l For the deviations f_o and f_u from the central length: 0.07 µm	
Setting plug gauges * Diameter	1 mm to 500 mm	VDI/VDE/DGQ 2618 part 4.1:2006, option 1, option 2	0.4 µm + 4 · 10^{-6} · d	d = measured diameter
		Option 3, option 4	0.8 µm + 3 · 10^{-6} · d	
Roundness deviation	to 40 µm	VDI/VDE/DGQ 2618 part 4.1:2006	0.3 µm + 2.5 10^{-2} · RONt	
Straigthness deviation	to 40 µm		0.4 µm + 2.5 10^{-2} · STRt	
Parallelism deviation	to 40 µm		0.7 µm + 2.5 10^{-2} · PARt	
Setting ring gauges * Diameter	2 mm to 200 mm	VDI/VDE/DGQ 2618 part 4.1:2006 option 1, option 2	0.6 µm + 3 · 10^{-6} · d	d = measured diameter
		Option 3, option 4	0.8 µm + 3 · 10^{-6} · d	
Roundness deviation	to 40 µm	VDI/VDE/DGQ 2618 part 4.1:2006	0.3 µm + 2.5 10^{-2} · RONt	
Straigthness deviation	to 40 µm		0.4 µm + 2.5 10^{-2} · STRt	
Parallelism deviation	to 40 µm		0.7 µm + 2.5 10^{-2} · PARt	
Roundness deviation	to 40 µm	TK 40:2020-01	0.3 µm + 2.5 10^{-2} · RONt	
Straigthness deviation	to 40 µm		0.4 µm + 2.5 10^{-2} · STRt	
Parallelism deviation	to 40 µm		0.7 µm + 2.5 10^{-2} · PARt	
Measuring pins / Pins for screw theads * Diameterr	1 mm to 50 mm	VDI/VDE/DGQ 2618 part 4.2:2007, option 1, option 2	0.6 µm	
	0.17 mm to 50 mm	Option 3	0.8 µm	
Roundness deviation	to 40 µm	VDI/VDE/DGQ 2618 part 4.1:2006	0.3 µm + 2.5 10^{-2} · RONt	
Straigthness deviation	to 40 µm		0.4 µm + 2.5 10^{-2} · STRt	

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Valid from: 10.07.2023

Date of issue: 10.07.2023

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Taper gauges * Taper plug gauges and Taper ring gauges Diameter	1 mm to 200 mm	VDI/VDE/DGQ 2618 part 4.12:2007, option 1 and 2	The uncertainty of measurement is determined with a uncertainty measurement balance sheet on the basic of the guideline VDI/VDE 2617 part 11:2011. The uncertainty of measurement is specified with a coverage probability of approximately 95 % (coverage factor k = 2) Exemplary of Uncertainty of measurement for a measuring problem: Taper plug gauge with a gap of 61 mm to the measuring high and a gap of 2 mm to the last measuring plane at the evaluation flat:	
Penetration radius			U = 0.42 µm	
Angular deviation	to 5‘		(90 mm/l)‘‘	Statement of l in mm
Roundness deviation	to 40 µm		0.5 µm	
Straigthness deviation	to 40 µm		0.5 µm	
Gap gauges *	5 mm to 200 mm	VDI/VDE/DGQ 2618 part 4.7:2005	3 µm + 10 · 10^{-6} · l	l = measured length
Straight edges * Flatness deviation	to 1000 mm	VDI/VDE/DGQ 2618 part 5.1:2013	1.1 µm + 1.6 · 10^{-6} · l	
Parallelism deviation			2.2 µm + 3.2 · 10^{-6} · l	
Knife straight edges *	to 1000 mm	VDI/VDE/DGQ 2618 part 5.2:2013	1.1 µm + 1.6 · 10^{-6} · l	
Surface plates * Flatness deviation	to 50 µm	VDI/VDE/DGQ 2618 part 6.2:2014 to 8 m edge length	1.1 µm + 2.7 · 10^{-6} · l	l = measured length with inclination measuring instruments
Steel squares * Flatness deviation	to 1000 mm	VDI/VDE/DGQ/DKD 2618 part 7.1:2019	1.1 µm + 1.6 · 10^{-6} · l	l = measured length
Angular deviation			3.1 µm + 5 · 10^{-6} · l	
Centring angles Flatness deviation	to 1000 mm	TK 90:2021-09	1.1 µm + 1.6 · 10^{-6} · l	
Angular deviation			3.1 µm + 5 · 10^{-6} · l	

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Protractors * Flatness deviation	0° to 360°	VDI/VDE/DGQ 2618 part 7.2:2008	5 µm	
Parallelism deviation			5 µm	
Angle * Scale interval 5‘	0° to 360°		4‘	
Scale interval 1°	0° to 180°		24‘	
Calipers for external, internal and depth dimensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 part 9.1:2006	30 µm + 30 · 10^{-6} · l	
	> 300 mm to 1500 mm		50 µm + 30 · 10^{-6} · l	
	> 1500 mm to 3000 mm		70 µm + 30 · 10^{-6} · l	
Depth calipers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 part 9.2:2006	30 µm + 30 · 10^{-6} · l	
	> 300 mm to 1500 mm		50 µm + 30 · 10^{-6} · l	
Height calipers * with analogue display	0 mm to 600 mm	VDI/VDE/DGQ 2618 part 9.3:2006	30 µm + 30 · 10^{-6} · l	
with digital display			20 µm + 30 · 10^{-6} · l	
Micrometers *	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.1:2001	3 µm + 10 · 10^{-6} · l	l = final value of the measuring range
	> 100 mm to 500 mm		4 µm + 10 · 10^{-6} · l	
Micrometers	> 500 mm to 1000 mm	TK 2:2020-02	5 µm + 10 · 10^{-6} · l	
	> 1000 mm to 1500 mm		6 µm + 10 · 10^{-6} · l	
Reference gauges for micrometers *	25 mm to 500 mm	VDI/VDE/DGQ 2618 part 4.4:2009	2 µm + 5 · 10^{-6} · l	
	> 500 mm to 1500 mm		3 µm + 5 · 10^{-6} · l	
Micrometers with interchangeable inserts *	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.2:2010	3 µm + 10 · 10^{-6} · l	
	> 100 mm to 300 mm		5 µm + 10 · 10^{-6} · l	
Micrometers with dial indicator *	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.3:2002	3 µm + 10 · 10^{-6} · l	
Micrometers heads *	0 mm to 50 mm	VDI/VDE/DGQ 2618 part 10.4:2008	3 µm + 10 · 10^{-6} · l	l = measured length
Depth micrometers *	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.5:2010	3 µm + 10 · 10^{-6} · l	
	> 100 mm to 500 mm		4 µm + 10 · 10^{-6} · l	
Internal micrometers with two-point contact *	25 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.7:2010	3 µm + 10 · 10^{-6} · l	
	> 100 mm to 500 mm		4 µm + 10 · 10^{-6} · l	
	> 500 mm to 1000 mm		5 µm + 10 · 10^{-6} · l	
	> 1000 mm to 1500 mm		6 µm + 10 · 10^{-6} · l	
Extensions for internal micrometers with two-point contact *	25 mm to 500 mm	VDI/VDE/DGQ 2618 part 10.7:2010	2 µm + 5 · 10^{-6} · l	
	> 500 mm to 1500 mm		3.5 µm + 5 · 10^{-6} · l	

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

DAkkS Deutsche Akkreditierungsstelle

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Internal micrometers with three-point contact *	3 mm to 200 mm	VDI/VDE/DGQ 2618 part 10.8:2002	4 µm + 10 · 10^{-6} · d	d = measured diameter
Internal measuring instruments	3 mm to 200 mm	TK 57:2021-02	2 µm + 10 · 10^{-6} · d	d = measured diameter
Dial gauges * Scale interval > 1 µm	to 100 mm	VDI/VDE/DGQ/DKD 2618 part 11.1:2021	3 µm + 10 · 10^{-6} · l	l = measured length
Scale interval ≤ 1 µm			2 µm + 10 · 10^{-6} · l	
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 part 11.2:2002	1.1 µm	
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 part 11.3:2002	1.2 µm	
Dial gauges * with digital display	to 100 mm	VDI/VDE/DGQ/DKD 2618 part 11.4:2020	3 µm + 10 · 10^{-6} · l	
Lever gauges (quicktests) for external measurements *	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 12.1:2005	6 µm	
Thickness gauges * Scale interval 1 µm	0 mm to 30 mm	VDI/VDE/DGQ 2618 part 12.1:2005	1.3 µm + 10 · 10^{-6} · l	l = measured length
Scale interval 10 µm			6 µm + 10 · 10^{-6} · l	
Lever gauges (quicktests) for internal measurements *	2.5 mm to 500 mm	VDI/VDE/DGQ 2618 part 13.1:2005	6 µm	
Bore gauges with two-point contact * Form I – III	1 mm to 800 mm	VDI/VDE/DGQ 2618 part 13.2:2005	1.8 µm	Measuring length up to 3 mm
Electical probe and measuring device *	0 mm to 10 mm	VDI/VDE/DGQ 2618 part 14.1:2010	1.4 µm	
Feeler gauges	10 µm to 2 mm	TK 19:2021-02	1 µm	
Measuring tape, Circumference tape measure	0 m to 100 m	TK 85:2020-01	56 µm + 46 · 10^{-6} · l	l = measured length
Rules	0 m to 5 m	TK 85:2020-01	56 µm + 46 · 10^{-6} · l	Graduated metal rules, reference- and plotting scale, rules, folding rules
Diameter tape measure	0 m to 10 m	TK 85:2020-01	56 µm + 46 · 10^{-6} · l	
Setting dimension for height gauges	to 20 mm	TK 89:2020-01	0.5 µm	

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Valid from: 10.07.2023

Date of issue: 10.07.2023

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Height gauges *	0 mm to 1000 mm	VDI/VDE/DGQ 2618 part 16.1:2009	1.0 µm+ 1.4 · 10^{-6} · l	till 1000 mm lead length
Deviation from straightness and perpendicularity	to 40 µm		3 µm	l = measured length
Horizontal length measuring device *	0 mm to 5000 mm	VDI/VDE/DGQ 2618 part 17.1:2015	0.12 µm + 0.07 · 10^{-6} · l	with laser interferometer
	0 mm to 200 mm		0.12 µm + 0.6 · 10^{-6} · l	with gauge blocks
Thread gauges * single-start cylindrical external and internal threads with straight flanks, symmetrical profile and nominal thread angle 55° to 60°				
External thread with nominal lead 0.25 mm to 5.5 mm Simple pitch diameter	Nominal diameter: 2 mm to 200 mm	VDI/VDE/DGQ 2618 part 4.8:2006 (option 1) Three wire procedure (vertical to thread axis)	2.8 µm + 10 · 10^{-6} · d	d = pitch diameter
Internal thread with nominal lead 0.7 mm to 6.0 mm Simple pitch diameter	Nominal diameter: 4 mm to 200 mm	VDI/VDE/DGQ 2618 part 4.9:2006 (option 1) Two ball procedure (vertical to thread axis)	2.8 µm + 10 · 10^{-6} · d	d = Pitch diameter
Angle gauges 90 °	Leg length 40 mm to 1000 mm	TK 16:2021-05 pointwise measurement	2.4 µm	Angle auges of hard stone according to DIN 875-2:2008
Inclination measuring instruments elektronic and mechanical	± 20 mm/m	TK 56:2021-05	2.4 µm + 10 · 10^{-6} ·α	α = Nominal angle
	± 50 mm/m		21 µm/m	
	2.866° to 45°		0.01°	
	± 90°		2.3 µm/m	
	Zero point deviation		1.5 µm/m	
Caliper for trailer artifice	to 60 mm	TK 84:2021-08	2 µm	
Caliper for trailer artifice	to 120 mm	TK 83:2021-08	8 µm	
Layer thickness gauges	20 mm	TK 91:2021-07	0.7 µm + 180 · 10^{-6} · l	l = measured length
Calibration foil	20 mm	TK 70:2021-07	0.8 µm + 130 · 10^{-6} · l	
Micrometers according to DIN 863-3 form D10	0 mm to 100 mm	TK 2:2021-02	5 µm + 10 · 10^{-6} · d	d = measured diameter

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

DAkkS Deutsche Akkreditierungsstelle

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Gear quantities Profile deviation * F_α $f_{f\alpha}$ $f_{H\alpha}$	10 mm ≤ d_b ≤ 55 mm L_α ≤ 4 mm	VDI/VDE 2612-1:2018 Substitution measuring with 3D coordinate measuring machines Correction of F_α and $f_{H\alpha}$ by comparison against gear measurement standard with d_b = 29.88 mm L_α = 4 mm or rather with d_b = 122.192 mm L_α = 24 mm	1.6 µm 0.6 µm 1.4 µm	Internal and external gears Symbols according to: ISO 1328-1:2013
F_α $f_{f\alpha}$ $f_{H\alpha}$	100 mm ≤ d_b ≤ 150 mm L_α ≤ 24 mm		1.6 µm 0.6 µm 1.4 µm	
F_α $f_{f\alpha}$ $f_{H\alpha}$	10 mm ≤ d_b ≤ 150 mm L_α ≤ 24 mm	VDI/VDE 2612-1:2018 Measurement with 3D coordinate measuring machines without correction; traceability proved by involute measurement standard with d_b = 29.88 mm L_α = 4 mm or rather with d_b = 122.192 mm L_α = 24 mm	2.7 µm 1.0 µm 1.7 µm	
F_α $f_{f\alpha}$ $f_{H\alpha}$	10 mm ≤ d_b ≤ 500 mm L_α ≤ 50 mm	VDI/VDE 2612-1:2018 Measurement with 3D coordinate measuring machines without correction; traceability proved by involute measurement standard with d_b = 29.88 mm L_α = 4 mm or rather with d_b = 122.192 mm L_α = 24 mm	3.4 µm 1.0 µm 3.3 µm	

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Helix deviation *		VDI/VDE 2612-1:2018		Internal and external gears
F_{β} $f_{f\beta}$ $f_{H\beta}$	10 mm ≤ d ≤ 55 mm L_{β} ≤ 40 mm 0° < β ≤ 5°	Substitution measuring with 3D coordinate measuring machines Correction of F_{β} and $f_{H\beta}$ by comparison against gear measurement standard with d = 34.5 mm L_{β} = 30 mm β = 0° or rather with d = 104 mm L_{β} = 64 mm β = 0° β = 15° r+l β = 30° r+l	1.5 µm 0.7 µm 1.3 µm	Symbols according to: ISO 1328-1:2013
F_{β} $f_{f\beta}$ $f_{H\beta}$	100 mm ≤ d ≤ 150 mm L_{β} ≤ 64 mm 0° < β ≤ 5°		1.5 µm 0.7 µm 1.3 µm	
F_{β} $f_{f\beta}$ $f_{H\beta}$	100 mm ≤ d ≤ 150 mm L_{β} ≤ 64 mm 10° < β ≤ 20°		1.6 mm 0.7 mm 1.4 mm	
F_{β} $f_{f\beta}$ $f_{H\beta}$	100 mm ≤ d ≤ 150 mm L_{β} ≤ 40 mm 25° < β ≤ 35°		1.9 µm 0.7 µm 1.7 µm	
F_{β} $f_{f\beta}$ $f_{H\beta}$	10 mm ≤ d ≤ 150 mm L_{β} ≤ 40 mm 0° < β ≤ 10°	VDI/VDE 2612-1:2018 Measurement with 3D coordinate measuring machines without correction; traceability proved by helix measurement standard with d = 34.5 mm L_{β} = 30 mm β = 0° or rather with d = 104 mm L_{β} = 64 mm β = 0° β = 15° r+l β = 30° r+l	2.8 µm 1.0 µm 2.6 µm	
F_{β} $f_{f\beta}$ $f_{H\beta}$	100 mm ≤ d ≤ 150 mm L_{β} ≤ 64 mm 5° < β ≤ 10°		2.8 µm 1.0 µm 2.6 µm	
F_{β} $f_{f\beta}$ $f_{H\beta}$	100 mm ≤ d ≤ 150 mm L_{β} ≤ 64 mm 20° < β ≤ 25°		2.8 µm 1.0 µm 2.6 µm	
F_{β} $f_{f\beta}$ $f_{H\beta}$	100 mm ≤ d ≤ 150 mm L_{β} ≤ 64 mm 35° < β ≤ 45°		3.6 µm 1.0 µm 3.4 µm	
F_{β} $f_{f\beta}$ $f_{H\beta}$	10 mm ≤ d ≤ 500 mm L_{β} ≤ 200 mm β = 0°	VDI/VDE 2612-1:2018 Measurement with 3D coordinate measuring machines without correction; traceability proved by helix measurement standard with d = 34.5 mm L_{β} = 30 mm β = 0° or rather with d = 104 mm L_{β} = 64 mm β = 0° β = 15° r+l β = 30° r+l	3.4 µm 1.0 µm 3.2 µm	
F_{β} $f_{f\beta}$ $f_{H\beta}$	10 mm ≤ d ≤ 500 mm L_{β} ≤ 200 mm 0° < β ≤ 35°		3.9 µm 1.0 µm 3.7 µm	
F_{β} $f_{f\beta}$ $f_{H\beta}$	10 mm ≤ d ≤ 500 mm L_{β} ≤ 200 mm 35° < β ≤ 45°		4.3 µm 1.0 µm 4.2 µm	

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

DAkkS Deutsche Akkreditierungsstelle

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Pitch deviation * F_p f_p F_x	10 mm ≤ d ≤ 500 mm β = 0° m_n > 0.5 mm	VDI/VDE 2613:2003 Measurement according to „Rosette method“ with 3D coordinate measuring machines	1.0 µm 0.9 µm 1.1 µm	Internal and external gears Symbols according to: ISO 1328-1:2013
F_p f_p F_x	10 mm ≤ d ≤ 500 mm β = 0° m_n > 0.5 mm	VDI/VDE 2613:2003 Measurement with 3D coordinate measuring machines without correction; traceability proved by pitch measurement standard with d = 67 mm m_n = 1 mm	5.1 µm 2.2 µm 5.2 µm	
Dimension over balls * M_{dK}	10 mm ≤ M_{dK} ≤ 150 mm β = 0° m_n > 0.5 mm	DIN 21773:2014 Measurement of M_{dK} on length comparator compared to traceable setting standard i	1.4 µm + 11 · 10^{-6} · l	Internal and external gears Symbols according to: ISO 1328-1:2013

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Coordinate measuring technology				
Prismatic, tapered and ball-shaped workpieces	Coordinate measuring machine with calibrated measuring volume of: X = 1200 mm Y = 1000 mm Z = 700 mm	TK 55:2020-02 Tactile measurements with single point probing with a coordinate measuring machine and determination of regular geometries through geometrical parameters (single-points, straight lines, planes, circles, balls, cylinders, tapers, toroid's) using the evaluation software of the coordinate measuring machine. Single-point measuring is carried out with fixed, predefined measuring force. Single point measurements in the form of „Self-centering measurements" are not used within the accreditation. For ensuring metrlogical traceability calibration of a simlar standard will be realized. Beyond that following limitations should be considered: - Measuring points have to be evenly distributed over the form element; - The calibration values can be determined in a multilayer method by averaging in order to reduce the measurement uncer-tainty.	The uncertainty of measurement is determined with a uncertainty measurement balance sheet on the basis of the guideline VDI/VDE 2617 part 11:2011. The uncertainty of measurement for specific feedings is specified with a coverage probability of approximately 95 % (coverage factor k = 2) Exemplary measurement uncertainty for a described measuring tasks: Gauge block with a nominal value of 1000 mm, determined is the expanded uncertainty of the inspection feature „Distance": U = 4.8 µm	For general measuring tasks the measuring uncertainty could be significant differently from the exemplary specified.

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Radius gauges	1 mm to 2500 mm	TK 86:2020-01	The uncertainty of measurement is determined with a uncertainty measurement balance sheet on the basic of the guideline VDI/VDE 2617 part 11:2011. The uncertainty of measurement is specified with a coverage probability of approximately 95 % (coverage factor k = 2) Uncertainty of measurement for a measuring problem: Radius with nominal value of 4 mm and an arc of 70°: U = 10 µm	
Calibration of control geometries of test and setting gauges with utilities		TK 88:2020-11		
	0 mm to 2000 mm		38 µm + 26 · 10^{-6} · l	Calipers, height gauges
	0 mm to 50 mm		4.9 µm + 2 · 10^{-6} · l	Micrometers
	0 mm to 1500 mm		0.2 µm + 4 · 10^{-6} · l	Horizontal and vertical length measuring device
	15 mm to 150 mm		2.5 µm + 2.7 · 10^{-6} · l	Bore gauges
	0° to 360°		0.08°	Universal angle meter, protractors
DC and low frequency quantities				
DC voltage Measuring instruments	1 mV to < 330 mV		2.0 µV + 35 · 10^{-6} · U	U = measured value
	0.33 V to < 3.3 V		3.0 µV + 16 · 10^{-6} · U	
	3.3 V to < 33 V		24 µV + 18 · 10^{-6} · U	
	33 V to < 330 V		0.2 mV + 24 · 10^{-6} · U	
	330 V to < 1000 V		1.7 mV + 24 · 10^{-6} · U	
DC voltage Sources	10 mV to 120 mV		2.0 µV + 12 · 10^{-6} · U	
	> 0.12 V to 1.2 V		2.0 µV + 10 · 10^{-6} · U	
	> 1.2 V to 12 V		2.5 µV + 10 · 10^{-6} · U	
	> 12 V to 120 V		35 µV + 14 · 10^{-6} · U	
	> 120 V to 1050 V		0.1 mV + 22 · 10^{-6} · U	

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
AC voltage Measuring instruments	1 mV to < 33 mV	10 Hz to 45 Hz	8 µV + 1.0 · 10^{-3} · U	U = measured value
		> 45 Hz to 10 kHz	8 µV + 0.2 · 10^{-3} · U	
		> 10 kHz to 20 kHz	8 µV + 0.25 · 10^{-3} · U	
		> 20 kHz to 50 kHz	8 µV + 1.3 · 10^{-3} · U	
		> 50 kHz to 100 kHz	15 µV + 4.2 · 10^{-3} · U	
		> 100 kHz to 500 kHz	60 µV + 10 · 10^{-3} · U	
	33 mV to < 330 mV	10 Hz to 45 Hz	10 µV + 0.4 · 10^{-3} · U	
		> 45 Hz to 10 kHz	10 µV + 0.2 · 10^{-3} · U	
		> 10 kHz to 20 kHz	10 µV + 0.2 · 10^{-3} · U	
		> 20 kHz to 50 kHz	10 µV + 0.43 · 10^{-3} · U	
		> 50 kHz to 100 kHz	40 µV + 0.95 · 10^{-3} · U	
		> 100 kHz to 500 kHz	85 µV + 2.5 · 10^{-3} · U	
	0.33 V to < 3,3 V	10 Hz to 45 Hz	60 µV + 0.4 · 10^{-3} · U	
		> 45 Hz to 10 kHz	75 µV + 0.2 · 10^{-3} · U	
		> 10 kHz to 20 kHz	75 µV + 0.24 · 10^{-3} · U	
		> 20 kHz to 50 kHz	60 µV + 0.35 · 10^{-3} · U	
		> 50 kHz to 100 kHz	0.15 mV + 0.85 · 10^{-3} · U	
		> 100 kHz to 500 kHz	0.7 mV + 3 · 10^{-3} · U	
	3.3 V to < 33 V	10 Hz to 45 Hz	0.75 mV + 0.38 · 10^{-3} · U	
		> 45 Hz to 10 kHz	0.7 mV + 0.2 · 10^{-3} · U	
		> 10 kHz to 20 kHz	0.7 mV + 0.29 · 10^{-3} · U	
		> 20 kHz to 50 kHz	0.7 mV + 0.42 · 10^{-3} · U	
		> 50 kHz to 100 kHz	1.9 mV + 1.1 · 10^{-3} · U	
	33 V to < 330 V	10 Hz to 45 Hz	2.4 mV + 0.24 · 10^{-3} · U	
		> 45 Hz to 10 kHz	7 mV + 0.25 · 10^{-3} · U	
		> 10 kHz to 20 kHz	7 mV + 0.31 · 10^{-3} · U	
		> 20 kHz to 50 kHz	7 mV + 0.37 · 10^{-3} · U	
		> 50 kHz to 100 kHz	58 mV + 2.4 · 10^{-3} · U	
	330 V to < 1000 V	45 Hz to 1 kHz	13 mV + 0.35 · 10^{-3} · U	
		> 1 kHz to 5 kHz	13 mV + 0.30 · 10^{-3} · U	
		> 5 kHz to 10 kHz	13 mV + 0.35 · 10^{-3} · U	
AC voltage Sources	10 mV to 120 mV	10 Hz to 40 Hz	25 µV + 0.11 · 10^{-3} · U	
		> 40 Hz to 1 kHz	20 µV + 0.11 · 10^{-3} · U	
		> 1 kHz to 20 kHz	20 µV + 0.19 · 10^{-3} · U	
		> 20 kHz to 50 kHz	20 µV + 0.38 · 10^{-3} · U	
		> 50 kHz to 100 kHz	20 µV + 1 · 10^{-3} · U	
		> 100 kHz to 300 kHz	20 µV + 4.2 · 10^{-3} · U	
	> 0.12 V to 1.2 V	10 Hz to 40 Hz	60 µV + 0.10 · 10^{-3} · U	
		> 40 Hz to 1 kHz	40 µV + 0.10 · 10^{-3} · U	
		> 1 kHz to 20 kHz	40 µV + 0.18 · 10^{-3} · U	
		> 20 kHz to 50 kHz	40 µV + 0.37 · 10^{-3} · U	
		> 50 kHz to 100 kHz	40 µV + 1.15 · 10^{-3} · U	
		> 100 kHz to 300 kHz	0.15 mV + 4 · 10^{-3} · U	
		> 300 kHz to 1 MHz	0.15 mV + 17 · 10^{-3} · U	

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
AC voltage Sources	> 1.2 V to 12 V	10 Hz to 40 Hz	0.6 mV + 90 · 10^{-6} · U	U = measured value
		> 40 Hz to 1 kHz	0.3 mV + 88 · 10^{-6} · U	
		> 1 kHz to 20 kHz	0.3 mV + 0.17 · 10^{-3} · U	
		> 20 kHz to 50 kHz	0.3 mV + 0.36 · 10^{-3} · U	
		> 50 kHz to 100 kHz	0.3 mV + 1.1 · 10^{-3} · U	
		> 100 kHz to 300 kHz	1.5 mV + 3.8 · 10^{-3} · U	
		> 300 kHz to 1 MHz	1.5 mV + 15 · 10^{-3} · U	
	> 12 V to 120 V	10 Hz to 40 Hz	6 mV + 0.25 · 10^{-3} · U	
		> 40 Hz to 1 kHz	3 mV + 0.25 · 10^{-3} · U	
		> 1 kHz to 20 kHz	3 mV + 0.25 · 10^{-3} · U	
		> 20 kHz to 50 kHz	3 mV + 0.45 · 10^{-3} · U	
		> 50 kHz to 100 kHz	3 mV + 1.6 · 10^{-3} · U	
	> 120 V to 700 V	10 Hz to 40 Hz	60 mV + 0.5 · 10^{-3} · U	
		> 40 Hz to 1 kHz	30 mV + 0.5 · 10^{-3} · U	
		> 1 kHz to 20 kHz	30 mV + 0.75 · 10^{-3} · U	
		> 20 kHz to 50 kHz	30 mV + 1.6 · 10^{-3} · U	
DC current Measuring instruments	10 µA to < 330 µA		0.1 µA + 0.22 · 10^{-3} · I	I = measured value
	0.33 mA to < 3.3 mA		0.1 µA + 0.15 · 10^{-3} · I	
	3.3 mA to < 33 mA		0.3 µA + 0.15 · 10^{-3} · I	
	33 mA to < 330 mA		3 µA + 0.15 · 10^{-3} · I	
	0.33 A to < 1.1 A		50 µA + 0.24 · 10^{-3} · I	
	1.1 A to < 3 A		50 µA + 0.45 · 10^{-3} · I	
	3 A to < 11 A		0.6 mA + 0.60 · 10^{-3} · I	
	11 A to < 20.5 A		1.8 mA + 1.3 · 10^{-3} · I	
DC current Sources	10 µA to 120 µA		1 nA + 24 · 10^{-6} · I	
	> 0.12 mA to 1.2 mA		6 nA + 24 · 10^{-6} · I	
	> 1.2 mA to 12 mA		60 nA + 24 · 10^{-6} · I	
	> 12 mA to 120 mA		0.6 µA + 42 · 10^{-6} · I	
	> 0.12 A to 1.05 A		60 µA + 0.12 · 10^{-3} · I	
	> 1.05 A to 20 A		0.3 mA + 18 · 10^{-6} · I	with 10 mΩ Shunt
DC current Current clamps	0.1 A to < 20 A		2 mA + 2 · 10^{-3} · I	
	20 A to < 150 A		0.2 A + 5 · 10^{-3} · I	with 50 turn coil
	150 A to 1000 A		0.5 A + 5 · 10^{-3} · I	
AC current Measuring instruments	30 µA to < 330 µA	10 Hz to 20 Hz	0.3 µA + 2.4 · 10^{-3} · I	
		> 20 Hz to 45 Hz	0.3 µA + 1.8 · 10^{-3} · I	
		> 45 Hz to 1 kHz	0.3 µA + 1.5 · 10^{-3} · I	
		> 1 kHz to 5 kHz	0.3 µA + 3.6 · 10^{-3} · I	
		> 5 kHz to 10 kHz	0.4 µA + 9.5 · 10^{-3} · I	
	0.33 mA to < 3.3 mA	10 Hz to 20 Hz	0.3 µA + 2.4 · 10^{-3} · I	
		> 20 Hz to 45 Hz	0.3 µA + 1.5 · 10^{-3} · I	
		> 45 Hz to 1 kHz	0.3 µA + 1.2 · 10^{-3} · I	
		> 1 kHz to 5 kHz	0.4 µA + 2.5 · 10^{-3} · I	
		> 5 kHz to 10 kHz	0.5 µA + 6.1 · 10^{-3} · I	

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
AC current Measuring instruments	3.3 mA to < 33 mA	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	2.5 µA + 2.1 · 10^{-3} · I 2.5 µA + 1.2 · 10^{-3} · I 2.5 µA + 0.5 · 10^{-3} · I 2.5 µA + 1.1 · 10^{-3} · I 3.8 µA + 2.6 · 10^{-3} · I	I = measured value
	33 mA to < 330 mA	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	25 µA + 2.1 · 10^{-3} · I 25 µA + 1.2 · 10^{-3} · I 25 µA + 0.5 · 10^{-3} · I 60 µA + 1.3 · 10^{-3} · I 0.13 mA + 2.8 · 10^{-3} · I	
	0.33 A to < 1.1 A	10 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	0.13 mA + 2.2 · 10^{-3} · I 0.13 mA + 0.6 · 10^{-3} · I 1.2 mA + 7 · 10^{-3} · I 5.9 mA + 30 · 10^{-3} · I	
	1.1 A to < 3 A	10 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	0.13 mA + 2.2 · 10^{-3} · I 0.13 mA + 0.7 · 10^{-3} · I 1.2 mA + 7 · 10^{-3} · I 5.9 mA + 30 · 10^{-3} · I	
	3 A to < 11 A	45 Hz to 100 Hz > 100 Hz to 1 kHz > 1 kHz to 5 kHz	2.4 mA + 0.73 · 10^{-3} · I 2.4 mA + 1.3 · 10^{-3} · I 2.4 mA + 35 · 10^{-3} · I	
	11 A to < 20.5 A	45 Hz to 100 Hz > 100 Hz to 1 kHz > 1 kHz to 5 kHz	6 mA + 1.6 · 10^{-3} · I 6 mA + 1.8 · 10^{-3} · I 6 mA + 35 · 10^{-3} · I	
AC current Sources	10 µA to 120 µA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 1 kHz	50 nA + 4.9 · 10^{-3} · I 50 nA + 4.9 · 10^{-3} · I 50 nA + 4.9 · 10^{-3} · I	
	> 0.12 mA to 1.2 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	0.3 µA + 4.8 · 10^{-3} · I 0.3 µA + 1.9 · 10^{-3} · I 0.3 µA + 0.72 · 10^{-3} · I 0.3 µA + 0.41 · 10^{-3} · I	
	> 1.2 mA to 12 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	2.6 µA + 4.7 · 10^{-3} · I 2.6 µA + 1.8 · 10^{-3} · I 2.6 µA + 0.71 · 10^{-3} · I 2.5 µA + 0.4 · 10^{-3} · I	
	> 12 mA to 120 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	25 µA + 4.7 · 10^{-3} · I 25 µA + 1.8 · 10^{-3} · I 25 µA + 0.71 · 10^{-3} · I 25 µA + 0.4 · 10^{-3} · I	
	> 0.12 A to 1.05 A	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	0.25 mA + 4.7 · 10^{-3} · I 0.25 mA + 1.9 · 10^{-3} · I 0.25 mA + 1.0 · 10^{-3} · I 0.25 mA + 1.3 · 10^{-3} · I	
	> 1.05 A to 20 A	10 Hz to 1 kHz	10 mA + 0.15 · 10^{-3} · I	with 10 mΩ Shunt

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
AC current Current clamps	0.1 A to < 20 A	45 Hz to 1 kHz	$8\ \text{mA} + 3 \cdot 10^{-3} \cdot I$	I = measured value
	20 A to < 150 A	45 Hz to 440 Hz	$50\ \text{mA} + 9 \cdot 10^{-3} \cdot I$	with 50 turn coil
	150 A to < 1000 A		$0.12\ \text{A} + 9 \cdot 10^{-3} \cdot I$	
DC resistance Measuring instruments	0.01 Ω to < 11 Ω		$2\ \text{m}\Omega + 50 \cdot 10^{-6} \cdot R$	R = measured value
	11 Ω to < 33 Ω		$2\ \text{m}\Omega + 45 \cdot 10^{-6} \cdot R$	
	33 Ω to < 1.1 kΩ		$2\ \text{m}\Omega + 40 \cdot 10^{-6} \cdot R$	
	1.1 kΩ to < 11 kΩ		$22\ \text{m}\Omega + 40 \cdot 10^{-6} \cdot R$	
	11 kΩ to < 110 kΩ		$0.22\ \Omega + 40 \cdot 10^{-6} \cdot R$	
	110 kΩ to < 1.1 MΩ		$2.2\ \Omega + 45 \cdot 10^{-6} \cdot R$	
	1.1 MΩ to < 3.3 MΩ		$32\ \Omega + 70 \cdot 10^{-6} \cdot R$	
	3.3 MΩ to < 11 MΩ		$60\ \Omega + 0.14 \cdot 10^{-3} \cdot R$	
	11 MΩ to < 33 MΩ		$2.5\ \text{k}\Omega + 0.27 \cdot 10^{-3} \cdot R$	
	33 MΩ to < 110 MΩ		$3.1\ \text{k}\Omega + 0.52 \cdot 10^{-3} \cdot R$	
	110 MΩ to < 330 MΩ		$0.12\ \text{M}\Omega + 5 \cdot 10^{-3} \cdot R$	
	330 MΩ to < 1.1 GΩ		$0.12\ \text{M}\Omega + 20 \cdot 10^{-3} \cdot R$	
DC resistance Sources	0.01 Ω to 12 Ω		$0.1\ \text{m}\Omega + 18 \cdot 10^{-6} \cdot R$	
	> 12 Ω to 120 Ω		$0.7\ \text{m}\Omega + 15 \cdot 10^{-6} \cdot R$	
	> 120 Ω to 1.2 kΩ		$0.7\ \text{m}\Omega + 13 \cdot 10^{-6} \cdot R$	
	> 1.2 kΩ to 12 kΩ		$7\ \text{m}\Omega + 13 \cdot 10^{-6} \cdot R$	
	> 12 kΩ to 120 kΩ		$70\ \text{m}\Omega + 13 \cdot 10^{-6} \cdot R$	
	> 120 kΩ to 1.2 MΩ		$2.2\ \Omega + 18 \cdot 10^{-6} \cdot R$	
	> 1.2 MΩ to 12 MΩ		$0.12\ \text{k}\Omega + 55 \cdot 10^{-6} \cdot R$	
	> 12 MΩ to 120 MΩ		$1.2\ \text{k}\Omega + 0.55 \cdot 10^{-3} \cdot R$	
	> 120 MΩ to 1.2 GΩ		$12\ \text{k}\Omega + 5.5 \cdot 10^{-3} \cdot R$	
DC power Measuring instruments	0,1 W to < 336 W	3,3 mA to < 0,33 A	$0{,}3 \cdot 10^{-3} \cdot P$	P = measured value
	1 W to < 3059 W	0,33 A to < 3 A	$0{,}4 \cdot 10^{-3} \cdot P$	
	10 W to 20,9 kW	3 A to 20,5 A	$0{,}9 \cdot 10^{-3} \cdot P$	
	0,1 W to < 20,9 kW	3,3 mA to < 20,5 A	$4 \cdot 10^{-3} \cdot P$	
	10 W to < 153 kW	20,5 A to < 150 A	$6 \cdot 10^{-3} \cdot P$	
	100 W to 1 MW	150 A to 1 kA	$8 \cdot 10^{-3} \cdot P$	
AC power Measuring instruments	1 W to 91,8 W	33 mA to < 90 mA	$1{,}5 \cdot 10^{-3} \cdot P$	Frequencies from 45 Hz to 65 Hz $\cos \varphi = 1$ single-phase
	1 W to 336 W	90 mA to < 0,33 A	$1{,}0 \cdot 10^{-3} \cdot P$	
	1 W to 917 W	0,33 A to < 0,9 A	$1{,}4 \cdot 10^{-3} \cdot P$	
	1 W to 2243 W	0,9 A to < 2,2 A	$1{,}2 \cdot 10^{-3} \cdot P$	
	10 W to 4590 W	2,2 A to < 4,5 A	$1{,}4 \cdot 10^{-3} \cdot P$	
	10 W to 20,9 kW	4,5 A to < 20,5 A	$1{,}3 \cdot 10^{-3} \cdot P$	
	1 W to < 20,9 kW	33 mA to < 20,5 A	$6 \cdot 10^{-3} \cdot P$	
	10 W to < 153 kW	20,5 A to < 150 A	$10 \cdot 10^{-3} \cdot P$	
	100 W to 1 MW	150 A to 1 kA	$12 \cdot 10^{-3} \cdot P$	

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Resistance Measuring instruments	10 kΩ to < 40 kΩ 40 kΩ to < 100 kΩ 100 kΩ to < 200 kΩ 200 kΩ to < 1 MΩ 1 MΩ to < 2 MΩ 2 MΩ to < 10 MΩ 10 MΩ to < 1 GΩ 10 MΩ to < 1 GΩ 1 GΩ to < 10 GΩ 1 GΩ to < 10 GΩ 10 GΩ to 100 GΩ	$\lvert U\rvert$ < 65 V $\lvert U\rvert$ < 400 V $\lvert U\rvert$ < 800 V $\lvert U\rvert$ < 1100 V $\lvert U\rvert$ < 1575 V $\lvert U\rvert$ < 2500 V $\lvert U\rvert$ < 3000 V $\lvert U\rvert$ < 5500 V $\lvert U\rvert$ < 3000 V $\lvert U\rvert$ < 5500 V $\lvert U\rvert$ < 5500 V	$2{,}5 \cdot 10^{-3} \cdot R$ $2{,}5 \cdot 10^{-3} \cdot R$ $2{,}5 \cdot 10^{-3} \cdot R$ $2{,}5 \cdot 10^{-3} \cdot R$ $3{,}6 \cdot 10^{-3} \cdot R$ $3{,}6 \cdot 10^{-3} \cdot R$ $6{,}0 \cdot 10^{-3} \cdot R$ $7{,}0 \cdot 10^{-3} \cdot R$ $13 \cdot 10^{-3} \cdot R$ $17 \cdot 10^{-3} \cdot R$ $40 \cdot 10^{-3} \cdot R$	R = measured value $\lvert U\rvert$ = test voltage High impedance resistance e.g. Insulation tester for electrical safety
Resistance Measuring instruments	100 mΩ to < 5 Ω 5 Ω to < 30 Ω 30 Ω to < 200 Ω 200 Ω to < 500 Ω 500 Ω to < 10 kΩ		10 mΩ + $2{,}3 \cdot 10^{-3} \cdot R$ 10 mΩ + $1{,}7 \cdot 10^{-3} \cdot R$ 10 mΩ + $1{,}7 \cdot 10^{-3} \cdot R$ $1{,}8 \cdot 10^{-3} \cdot R$ $1{,}7 \cdot 10^{-3} \cdot R$	Low impedance resistance e.g. PE resistance tester for electrical safety
Resistance Measuring instruments	14 mΩ 39 mΩ 94 mΩ 340 mΩ 490 mΩ 960 mΩ 1,7 Ω 4,7 Ω 9 Ω 17 Ω 47 Ω 90 Ω 170 Ω 470 Ω 900 Ω 1,7 kΩ		0,4 mΩ 0,6 mΩ 1 mΩ 1,6 mΩ 2,1 mΩ 3,8 mΩ 6,6 mΩ 20 mΩ 35 mΩ 35 mΩ 250 mΩ 400 mΩ 800 mΩ 2 Ω 4 Ω 8 Ω	Earth resistance Line impedance Loop impedance e.g. PE resistance tester or ground resistance tester for electrical safety
Leakage current Measuring instruments	0,1 mA to < 0,3 mA 0,3 mA to < 3 mA 3 mA to 30 mA		3 µA + $2 \cdot 10^{-3} \cdot I$ 4 µA + $3 \cdot 10^{-3} \cdot I$ 30 µA + $3 \cdot 10^{-3} \cdot I$	I = measured value e.g. leakage current tester for electrical safety
RCD initiation time Measuring instruments	10 mA to 3 A		$12 \cdot 10^{-3} \cdot I$	I = measured value
RCD initiation time Measuring instruments	10 ms to 5 s		0,25 ms + $0{,}2 \cdot 10^{-3} \cdot t$	t = measured value

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Oscilloscope quantities				
Vertical deflection	5 mV_{pp} to < 0,5 V_{pp} 0,5 V_{pp} to 6,6 V_{pp}	DC, 10 Hz to 1 kHz	40 µV + 2,2 · 10^{-3} · U 2,2 · 10^{-3} · U	R_i = 50 Ω
	5 mV_{pp} to < 0,5 V_{pp} 0,5 V_{pp} to 6,6 V_{pp}	> 1 kHz to 10 kHz	40 µV + 2,5 · 10^{-3} · U 2,5 · 10^{-3} · U	
	5 mV_{pp} to < 0,5 V_{pp} 0,5 V_{pp} to 130 V_{pp}	DC, 10 Hz to 1 kHz	40 µV + 1,5 · 10^{-3} · U 1,5 · 10^{-3} · U	R_i = 1 MΩ
	5 mV_{pp} to < 0,5 V_{pp} 0,5 V_{pp} to 130 V_{pp}	> 1 kHz to 10 kHz	40 µV + 2,5 · 10^{-3} · U 2,5 · 10^{-3} · U	
Horizontal deflection	1 ns to 20 ms > 50 ms to 5 s		2,5 · 10^{-6} · t (25 · 10^{-6} + 1 · 10^{-3} · $\frac{t_s}{s}$) · t	R_i = 50 Ω t = time in s t_s = triggered time in s
Bandwidth	5 mV to 5,5 V	50 kHz to 100 MHz > 100 MHz to 300 MHz > 300 MHz to 600 MHz	30 · 10^{-3} · f 35 · 10^{-3} · f 45 · 10^{-3} · f	R_i = 50 Ω
Rise time	0,5 ns to 10 ms	5 mV to 2,5 V at 1 kHz to 10 MHz	50 · 10^{-3} · t_r	t_r = Rise time
Input resistance	40 Ω to 60 Ω		2 · 10^{-3} · R	R = measured value 50 Ω nominal input resistance
	500 kΩ to 1,5 MΩ		2 · 10^{-3} · R	R = measured value 1 MΩ nominal input resistance
Time and frequency Frequency	1 Hz to 2,2 GHz		2 · 10^{-10} · f + U_{Tf}	f, t = measured value
Time interval	1 µs to 10 s		2 · 10^{-10} · t + U_{Tt} +1 ns	U_{Tf} , U_{Tt} = trigger uncertainty

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

On-site Calibration

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Length				
Surface plates * Flatness deviation	to 50 µm	VDI/VDE/DGQ 2618 part 6.2:2014 to 8 m edge length	1.1 µm + 2.7 · 10^{-6} · l	l = measured length with inclination measuring instruments
Height gauges *	0 mm to 1000 mm	VDI/VDE/DGQ 2618 part 16.1:2009	1.0 µm + 1.4 · 10^{-6} · l	till 1000 mm lead length
Deviation from straightness and perpendicularity	to 40 µm		3 µm	
Horizontal length measuring devices *	0 mm to 5000 mm	VDI/VDE/DGQ 2618 part 17.1:2015	0.12 µm + 0.07 · 10^{-6} · l	with laser interferometer
	0 mm to 200 mm		0.12 µm + 0,6 · 10^{-6} · l	with gauge blocks
Height calipers * with analogue display	0 mm to 600 mm	VDI/VDE/DGQ 2618 part 9.3:2006	30 µm + 30 · 10^{-6} · l	
with digital display			20 µm + 30 · 10^{-6} · l	
Coordinate measuring technology Measuring projectors Measuring microscopes *	Devices featuring a measuring plane with a face diagonal ≤ 900 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		
		Determination of probing error size P_{SX} and P_{SY} with a graduated scale made of glass according to VDI/VDE 2617 part 6.1:2019	0.8 µm	
		The error of indication for size measurement E_{UX}, E_{UY} uand E_{UXY} is determined with a graduated scale made of glass according to DIN EN ISO 10360-7:2011	1.6 µm + 1 · 10^{-6} · l	l = measured length

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Mobile Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Length				
Gap gauges *	5 mm to 200 mm	VDI/VDE/DGQ 2618 part 4.7:2005	3 µm + 10 · 10^{-6} · l	l = measured length
Calipers for external, internal and depth dimensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 part 9.1:2006	30 µm + 30 · 10^{-6} · l	
	> 300 mm to 1500 mm		50 µm + 30 · 10^{-6} · l	
Depth calipers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 part 9.2:2006	30 µm + 30 · 10^{-6} · l	
	> 300 mm to 1000 mm		50 µm + 30 · 10^{-6} · l	
Height calipers * with analogue display	0 mm to 600 mm	VDI/VDE/DGQ 2618 part 9.3:2006	30 µm + 30 · 10^{-6} · l	l = measured length
with digital display			20 µm + 30 · 10^{-6} · l	
Micrometers *	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.1:2001	3 µm + 10 · 10^{-6} · l	l = final value of the measuring range
	> 100 mm to 500 mm		4 µm + 10 · 10^{-6} · l	
	> 500 mm to 1000 mm		5 µm + 10 · 10^{-6} · l	
Micrometers according to DIN 863-3 form D10	0 mm to 100 mm	TK 2:2021-02	5 µm + 10 · 10^{-6} · d	d = measured diameter
Reference gauges for micrometers *	25 mm to 1000 mm	VDI/VDE/DGQ 2618 part 4.4:2009	2 µm + 20 · 10^{-6} · l	l = measured length
Internal micrometers with three-point contact *	3 mm to 200 mm	VDI/VDE/DGQ 2618 part 10.8:2002	4 µm + 10 · 10^{-6} · d	d = measured diameter
Internal measuring instruments	3 mm to 200 mm	TK 57:2021-02	2 µm + 10 · 10^{-6} · d	
Dial gauges * Scale interval > 1 µm	to 100 mm	VDI/VDE/DGQ/DKD 2618 part 11.1:2021	3.2 µm + 10 · 10^{-6} · l	l = measured length
Scale interval ≤ 1 µm			2.8 µm + 11 · 10^{-6} · l	
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 part 11.2:2002	1.9 µm	
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 part 11.3:2002	2 µm	
Dial gauges * with digital display	to 100 mm	VDI/VDE/DGQ/DKD 2618 part 11.4:2020	3 µm + 10 · 10^{-6} · l	
Thickness gauges * Scale interval 1 µm	0 mm to 30 mm	VDI/VDE/DGQ 2618 part 12.1:2005	1.1 µm + 8 · 10^{-6} · l	
Scale interval 10 µm			6 µm	
Feeler gauges	10 µm to 2 mm	TK 19:2021-02	1.7 µm	

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Mobile Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Lever gauges (quicktests) for external measurements *	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 12.1:2005	6 µm	
Lever gauges (quicktests) for internal measurements *	2.5 mm to 500 mm	VDI/VDE/DGQ 2618 part 13.1:2005	6 µm	
Internal micrometers with two-point contact *	25 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.7:2010	3 µm + 10 · 10^{-6} · l	
	> 100 mm to 500 mm		4 µm + 10 · 10^{-6} · l	
	> 500 mm to 1000 mm		5 µm + 10 · 10^{-6} · l	
Extensions for internal micrometers with two-point contact *	25 mm to 1000 mm	VDI/VDE/DGQ 2618 part 10.7:2010	2 µm + 20 · 10^{-6} · l	
Micrometers with interchangeable inserts *	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.2:2010	3 µm + 10 · 10^{-6} · l	
	> 100 mm to 300 mm		5 µm + 10 · 10^{-6} · l	
Micrometers with dial indicators *	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.3:2002	3 µm + 10 · 10^{-6} · l	l = measured length
Micrometers heads *	0 mm to 50 mm	VDI/VDE/DGQ 2618 part 10.4:2008	3 µm + 10 · 10^{-6} · l	
Depth micrometers *	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.5:2010	3 µm + 10 · 10^{-6} · l	
	> 100 mm to 500 mm		4 µm + 10 · 10^{-6} · l	
Bore gauges with two-point contact * Form I – III	1 mm to 800 mm	VDI/VDE/DGQ 2618 part 13.2:2005	2.3 µm	Measuring length up to 3 mm
Protractors * Flatness deviation	0° to 360°	VDI/VDE/DGQ 2618 part 7.2:2008	5 µm	
Parallelism deviation			5 µm	
Angle * Scale interval 5‘	0° to 360°		4‘	
Scale interval 1°	0° to 180°		24‘	
Setting plug gauges * Diameter	1 mm to 500 mm	VDI/VDE/DGQ 2618 part 4.1:2006, option 3, option 4	0.8 µm + 3 · 10^{-6} · d	d = measured diameter
Setting ring gauges * Diameter	2 mm to 200 mm	VDI/VDE/DGQ 2618 part 4.1:2006 option 3, option 4	0.8 µm + 3 · 10^{-6} · d	
Measuring pins / Pins for screw theads * Diameterr	0.17 mm to 50 mm	VDI/VDE/DGQ 2618 part 4.2:2007, option 1	0.8 µm	
Electical probe and measuring device *	0 mm to 10 mm	VDI/VDE/DGQ 2618 part 14.1:2010	2 µm	
Layer thickness gauges	20 mm	TK 91:2021-02	0.7 µm + 180 · 10^{-6} · l	l = measured length

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Mobile Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Thread gauges * single-start cylindrical external and internal threads with straight flanks, symmetrical profile and nominal thread angle 55° to 60°				
External thread with nominal lead 0.25 mm to 5.5 mm Simple pitch diameter	Nominal diameter: 2 mm to 200 mm	VDI/VDE/DGQ 2618 part 4.8:2006 (option 1) Three wire procedure (vertical to thread axis)	2.8 µm + 10 · 10^{-6} · d	d = pitch diameter
Internal thread with nominal lead 0.7 mm to 6.0 mm Simple pitch diameter	Nominal diameter: 4 mm to 200 mm	VDI/VDE/DGQ 2618 part 4.9:2006 (option 1) Two ball procedure (vertical to thread axis)	2.8 µm + 10 · 10^{-6} · d	
DC and low frequency quantities				
DC voltage Measuring instruments	1 mV to < 330 mV		2.0 µV + 35 · 10^{-6} · U	U = measured value
	0.33 V to < 3.3 V		3.0 µV + 16 · 10^{-6} · U	
	3.3 V to < 33 V		24 µV + 18 · 10^{-6} · U	
	33 V to < 330 V		0.2 mV + 24 · 10^{-6} · U	
	330 V to < 1000 V		1.7 mV + 24 · 10^{-6} · U	
DC voltage Sources	10 mV to 120 mV		2.0 µV + 12 · 10^{-6} · U	
	> 0.12 V to 1.2 V		2.0 µV + 10 · 10^{-6} · U	
	> 1.2 V to 12 V		2.5 µV + 10 · 10^{-6} · U	
	> 12 V to 120 V		35 µV + 14 · 10^{-6} · U	
	> 120 V to 1050 V		0.1 mV + 22 · 10^{-6} · U	
AC voltage Measuring instruments	1 mV to < 33 mV	10 Hz to 45 Hz	8 µV + 1.0 · 10^{-3} · U	U = measured value
		> 45 Hz to 10 kHz	8 µV + 0.2 · 10^{-3} · U	
		> 10 kHz to 20 kHz	8 µV + 0.25 · 10^{-3} · U	
		> 20 kHz to 50 kHz	8 µV + 1.3 · 10^{-3} · U	
		> 50 kHz to 100 kHz	15 µV + 4.2 · 10^{-3} · U	
		> 100 kHz to 500 kHz	60 µV + 10 · 10^{-3} · U	
	33 mV to < 330 mV	10 Hz to 45 Hz	10 µV + 0.4 · 10^{-3} · U	
		> 45 Hz to 10 kHz	10 µV + 0.2 · 10^{-3} · U	
		> 10 kHz to 20 kHz	10 µV + 0.2 · 10^{-3} · U	
		> 20 kHz to 50 kHz	10 µV + 0.43 · 10^{-3} · U	
		> 50 kHz to 100 kHz	40 µV + 0.95 · 10^{-3} · U	
		> 100 kHz to 500 kHz	85 µV + 2.5 · 10^{-3} · U	
	0.33 V to < 3,3 V	10 Hz to 45 Hz	60 µV + 0.4 · 10^{-3} · U	
		> 45 Hz to 10 kHz	75 µV + 0.2 · 10^{-3} · U	
		> 10 kHz to 20 kHz	75 µV + 0.24 · 10^{-3} · U	
		> 20 kHz to 50 kHz	60 µV + 0.35 · 10^{-3} · U	
		> 50 kHz to 100 kHz	0.15 mV + 0.85 · 10^{-3} · U	
		> 100 kHz to 500 kHz	0.7 mV + 3 · 10^{-3} · U	

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

DAkkS Deutsche Akkreditierungsstelle

Mobile Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
AC voltage Measuring instruments	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	$0.75\ mV + 0.38 \cdot 10^{-3} \cdot U$ $0.7\ mV + 0.2 \cdot 10^{-3} \cdot U$ $0.7\ mV + 0.29 \cdot 10^{-3} \cdot U$ $0.7\ mV + 0.42 \cdot 10^{-3} \cdot U$ $1.9\ mV + 1.1 \cdot 10^{-3} \cdot U$	U = measured value
	33 V to < 330 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	$2.4\ mV + 0.24 \cdot 10^{-3} \cdot U$ $7\ mV + 0.25 \cdot 10^{-3} \cdot U$ $7\ mV + 0.31 \cdot 10^{-3} \cdot U$ $7\ mV + 0.37 \cdot 10^{-3} \cdot U$ $58\ mV + 2.4 \cdot 10^{-3} \cdot U$	
	330 V to < 1000 V	45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$13\ mV + 0.35 \cdot 10^{-3} \cdot U$ $13\ mV + 0.30 \cdot 10^{-3} \cdot U$ $13\ mV + 0.35 \cdot 10^{-3} \cdot U$	
AC voltage Sources	10 mV to 120 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 > 100 kHz to 300 kHz	$25\ \mu V + 0.11 \cdot 10^{-3} \cdot U$ $20\ \mu V + 0.11 \cdot 10^{-3} \cdot U$ $20\ \mu V + 0.19 \cdot 10^{-3} \cdot U$ $20\ \mu V + 0.38 \cdot 10^{-3} \cdot U$ $20\ \mu V + 1 \cdot 10^{-3} \cdot U$ $20\ \mu V + 4.2 \cdot 10^{-3} \cdot U$	
	> 0.12 V to 1,2 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 > 100 kHz to 300 kHz > 300 kHz to 1 MHz	$60\ \mu V + 0.10 \cdot 10^{-3} \cdot U$ $40\ \mu V + 0.10 \cdot 10^{-3} \cdot U$ $40\ \mu V + 0.18 \cdot 10^{-3} \cdot U$ $40\ \mu V + 0.37 \cdot 10^{-3} \cdot U$ $40\ \mu V + 1.15 \cdot 10^{-3} \cdot U$ $0.15\ mV + 4 \cdot 10^{-3} \cdot U$ $0.15\ mV + 17 \cdot 10^{-3} \cdot U$	
	> 1.2 V to 12 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 > 100 kHz to 300 kHz > 300 kHz to 1 MHz	$0.6\ mV + 90 \cdot 10^{-6} \cdot U$ $0.3\ mV + 88 \cdot 10^{-6} \cdot U$ $0.3\ mV + 0.17 \cdot 10^{-3} \cdot U$ $0.3\ mV + 0.36 \cdot 10^{-3} \cdot U$ $0.3\ mV + 1.1 \cdot 10^{-3} \cdot U$ $1.5\ mV + 3.8 \cdot 10^{-3} \cdot U$ $1.5\ mV + 15 \cdot 10^{-3} \cdot U$	
	> 12 V to 120 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	$6\ mV + 0.25 \cdot 10^{-3} \cdot U$ $3\ mV + 0.25 \cdot 10^{-3} \cdot U$ $3\ mV + 0.25 \cdot 10^{-3} \cdot U$ $3\ mV + 0.45 \cdot 10^{-3} \cdot U$ $3\ mV + 1.6 \cdot 10^{-3} \cdot U$	
	> 120 V to 700 V	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 20 kHz > 20 kHz to 50 kHz	$60\ mV + 0.5 \cdot 10^{-3} \cdot U$ $30\ mV + 0.5 \cdot 10^{-3} \cdot U$ $30\ mV + 0.75 \cdot 10^{-3} \cdot U$ $30\ mV + 1.6 \cdot 10^{-3} \cdot U$	

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Mobile Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
DC current Measuring instruments	10 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		$0.1\ \mu A + 0.22 \cdot 10^{-3} \cdot I$ $0.1\ \mu A + 0.15 \cdot 10^{-3} \cdot I$ $0.3\ \mu A + 0.15 \cdot 10^{-3} \cdot I$ $3\ \mu A + 0.15 \cdot 10^{-3} \cdot I$ $50\ \mu A + 0.24 \cdot 10^{-3} \cdot I$ $50\ \mu A + 0.45 \cdot 10^{-3} \cdot I$ $0.6\ mA + 0.60 \cdot 10^{-3} \cdot I$ $1.8\ mA + 1.3 \cdot 10^{-3} \cdot I$	I = measured value
DC current Sources	10 µA to 120 µA > 0.12 mA to 1.2 mA > 1.2 mA to 12 mA > 12 mA to 120 mA > 0.12 A to 1.05 A		$1\ nA + 24 \cdot 10^{-6} \cdot I$ $6\ nA + 24 \cdot 10^{-6} \cdot I$ $60\ nA + 24 \cdot 10^{-6} \cdot I$ $0.6\ \mu A + 42 \cdot 10^{-6} \cdot I$ $60\ \mu A + 0.12 \cdot 10^{-3} \cdot I$	
	> 1.05 A to 20 A		$0.3\ mA + 18 \cdot 10^{-6} \cdot I$	with 10 mΩ Shunt
DC current Current clamps	0.1 A to < 20 A		$2\ mA + 2 \cdot 10^{-3} \cdot I$	
	20 A to < 150 A 150 A to 1000 A		$0.2\ A + 5 \cdot 10^{-3} \cdot I$ $0.5\ A + 5 \cdot 10^{-3} \cdot I$	with 50 turn coil
AC current Measuring instruments	30 µA to < 330 µA	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	$0.3\ \mu A + 2.4 \cdot 10^{-3} \cdot I$ $0.3\ \mu A + 1.8 \cdot 10^{-3} \cdot I$ $0.3\ \mu A + 1.5 \cdot 10^{-3} \cdot I$ $0.3\ \mu A + 3.6 \cdot 10^{-3} \cdot I$ $0.4\ \mu A + 9.5 \cdot 10^{-3} \cdot I$	
	0.33 mA to < 3.3 mA	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	$0.3\ \mu A + 2.4 \cdot 10^{-3} \cdot I$ $0.3\ \mu A + 1.5 \cdot 10^{-3} \cdot I$ $0.3\ \mu A + 1.2 \cdot 10^{-3} \cdot I$ $0.4\ \mu A + 2.5 \cdot 10^{-3} \cdot I$ $0.5\ \mu A + 6.1 \cdot 10^{-3} \cdot I$	
	3.3 mA to < 33 mA	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	$2.5\ \mu A + 2.1 \cdot 10^{-3} \cdot I$ $2.5\ \mu A + 1.2 \cdot 10^{-3} \cdot I$ $2.5\ \mu A + 0.5 \cdot 10^{-3} \cdot I$ $2.5\ \mu A + 1.1 \cdot 10^{-3} \cdot I$ $3.8\ \mu A + 2.6 \cdot 10^{-3} \cdot I$	
	33 mA to < 330 mA	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	$25\ \mu A + 2.1 \cdot 10^{-3} \cdot I$ $25\ \mu A + 1.2 \cdot 10^{-3} \cdot I$ $25\ \mu A + 0.5 \cdot 10^{-3} \cdot I$ $60\ \mu A + 1.3 \cdot 10^{-3} \cdot I$ $0.13\ mA + 2.8 \cdot 10^{-3} \cdot I$	
	0.33 A to < 1.1 A	10 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.13\ mA + 2.2 \cdot 10^{-3} \cdot I$ $0.13\ mA + 0.6 \cdot 10^{-3} \cdot I$ $1.2\ mA + 7 \cdot 10^{-3} \cdot I$ $5.9\ mA + 30 \cdot 10^{-3} \cdot I$	
	1.1 A to < 3 A	10 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.13\ mA + 2.2 \cdot 10^{-3} \cdot I$ $0.13\ mA + 0.7 \cdot 10^{-3} \cdot I$ $1.2\ mA + 7 \cdot 10^{-3} \cdot I$ $5.9\ mA + 30 \cdot 10^{-3} \cdot I$	

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Mobile Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
AC current Measuring instruments	3 A to < 11 A	45 Hz to 100 Hz > 100 Hz to 1 kHz > 1 kHz to 5 kHz	2.4 mA + 0.73 · 10^{-3} · I 2.4 mA + 1.3 · 10^{-3} · I 2.4 mA + 35 · 10^{-3} · I	I = measured value
	11 A to < 20.5 A	45 Hz to 100 Hz > 100 Hz to 1 kHz > 1 kHz to 5 kHz	6 mA + 1.6 · 10^{-3} · I 6 mA + 1.8 · 10^{-3} · I 6 mA + 35 · 10^{-3} · I	
AC current Sources	10 µA to 120 µA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 1 kHz	50 nA + 4.9 · 10^{-3} · I 50 nA + 4.9 · 10^{-3} · I 50 nA + 4.9 · 10^{-3} · I	
	> 0.12 mA to 1,2 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	0.3 µA + 4.8 · 10^{-3} · I 0.3 µA + 1.9 · 10^{-3} · I 0.3 µA + 0.72 · 10^{-3} · I 0.3 µA + 0.41 · 10^{-3} · I	
	> 1.2 mA to 12 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	2.6 µA + 4.7 · 10^{-3} · I 2.6 µA + 1.8 · 10^{-3} · I 2.6 µA + 0.71 · 10^{-3} · I 2.5 µA + 0.4 · 10^{-3} · I	
	> 12 mA to 120 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	25 µA + 4.7 · 10^{-3} · I 25 µA + 1.8 · 10^{-3} · I 25 µA + 0.71 · 10^{-3} · I 25 µA + 0.4 · 10^{-3} · I	
	> 0.12 A to 1.05 A	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	0.25 mA + 4.7 · 10^{-3} · I 0.25 mA + 1.9 · 10^{-3} · I 0.25 mA + 1.0 · 10^{-3} · I 0.25 mA + 1.3 · 10^{-3} · I	
	> 1.05 A to 20 A	10 Hz to 1 kHz	10 mA + 0.15 · 10^{-3} · I	with 10 mΩ Shunt
AC current Current clamps	0.1 A to < 20 A	45 Hz to 1 kHz	8 mA + 3 · 10^{-3} · I	
	20 A to < 150 A 150 A to < 1000 A	45 Hz to 440 Hz	50 mA + 9 · 10^{-3} · I 0.12 A + 9 · 10^{-3} · I	with 50 turn coil
DC resistance Measuring instruments	0.01 Ω to < 11 Ω 11 Ω to < 33 Ω 33 Ω to < 1.1 kΩ 1.1 kΩ to < 11 kΩ 11 kΩ to < 110 kΩ 110 kΩ to < 1.1 MΩ 1.1 MΩ to < 3.3 MΩ 3.3 MΩ to < 11 MΩ 11 MΩ to < 33 MΩ 33 MΩ to < 110 MΩ 110 MΩ to < 330 MΩ 330 MΩ to < 1.1 GΩ		2 mΩ + 50 · 10^{-6} · R 2 mΩ + 45 · 10^{-6} · R 2 mΩ + 40 · 10^{-6} · R 22 mΩ + 40 · 10^{-6} · R 0.22 Ω + 40 · 10^{-6} · R 2.2 Ω + 45 · 10^{-6} · R 32 Ω + 70 · 10^{-6} · R 60 Ω + 0,14 · 10^{-3} · R 2.5 kΩ + 0,27 · 10^{-3} · R 3.1 kΩ + 0,52 · 10^{-3} · R 0.12 MΩ + 5 · 10^{-3} · R 0.12 MΩ + 20 · 10^{-3} · R	R = measured value

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Mobile Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
DC resistance Sources	0.01 Ω to 12 Ω > 12 Ω to 120 Ω > 120 Ω to 1.2 kΩ > 1.2 kΩ to 12 kΩ > 12 kΩ to 120 kΩ > 120 kΩ to 1.2 MΩ > 1.2 MΩ to 12 MΩ > 12 MΩ to 120 MΩ > 120 MΩ to 1.2 GΩ		$0.1\ m\Omega + 18 \cdot 10^{-6} \cdot R$ $0.7\ m\Omega + 15 \cdot 10^{-6} \cdot R$ $0.7\ m\Omega + 13 \cdot 10^{-6} \cdot R$ $7\ m\Omega + 13 \cdot 10^{-6} \cdot R$ $70\ m\Omega + 13 \cdot 10^{-6} \cdot R$ $2.2\ \Omega + 18 \cdot 10^{-6} \cdot R$ $0.12\ k\Omega + 55 \cdot 10^{-6} \cdot R$ $1.2\ k\Omega + 0{,}55 \cdot 10^{-3} \cdot R$ $12\ k\Omega + 5.5 \cdot 10^{-3} \cdot R$	R = measured value
DC power Measuring instruments	0,1 W to < 336 W 1 W to < 3059 W 10 W to 20,9 kW	3,3 mA to < 0,33 A 0,33 A to < 3 A 3 A to 20,5 A	$0{,}3 \cdot 10^{-3} \cdot P$ $0{,}4 \cdot 10^{-3} \cdot P$ $0{,}9 \cdot 10^{-3} \cdot P$	P = measured value
	0,1 W to < 20,9 kW 10 W to < 153 kW 100 W to 1 MW	3,3 mA to < 20,5 A 20,5 A to < 150 A 150 A to 1 kA	$4 \cdot 10^{-3} \cdot P$ $6 \cdot 10^{-3} \cdot P$ $8 \cdot 10^{-3} \cdot P$	
AC power Measuring instruments	1 W to 91,8 W 1 W to 336 W 1 W to 917 W 1 W to 2243 W 10 W to 4590 W 10 W to 20,9 kW	33 mA to < 90 mA 90 mA to < 0,33 A 0,33 A to < 0,9 A 0,9 A to < 2,2 A 2,2 A to < 4,5 A 4,5 A to < 20,5 A	$1{,}5 \cdot 10^{-3} \cdot P$ $1{,}0 \cdot 10^{-3} \cdot P$ $1{,}4 \cdot 10^{-3} \cdot P$ $1{,}2 \cdot 10^{-3} \cdot P$ $1{,}4 \cdot 10^{-3} \cdot P$ $1{,}3 \cdot 10^{-3} \cdot P$	Frequencies form 45 Hz to 65 Hz $\cos \varphi = 1$ single-phase
	1 W to < 20,9 kW 10 W to < 153 kW 100 W to 1 MW	33 mA to < 20,5 A 20,5 A to < 150 A 150 A to 1 kA	$6 \cdot 10^{-3} \cdot P$ $10 \cdot 10^{-3} \cdot P$ $12 \cdot 10^{-3} \cdot P$	
Resistance Measuring instruments	10 kΩ to < 40 kΩ 40 kΩ to < 100 kΩ 100 kΩ to < 200 kΩ 200 kΩ to < 1 MΩ 1 MΩ to < 2 MΩ 2 MΩ to < 10 MΩ 10 MΩ to < 1 GΩ 10 MΩ to < 1 GΩ 1 GΩ to < 10 GΩ 1 GΩ to < 10 GΩ 10 GΩ to 100 GΩ	$\lvert U\rvert$ < 65 V $\lvert U\rvert$ < 400 V $\lvert U\rvert$ < 800 V $\lvert U\rvert$ < 1100 V $\lvert U\rvert$ < 1575 V $\lvert U\rvert$ < 2500 V $\lvert U\rvert$ < 3000 V $\lvert U\rvert$ < 5500 V $\lvert U\rvert$ < 3000 V $\lvert U\rvert$ < 5500 V $\lvert U\rvert$ < 5500 V	$2{,}5 \cdot 10^{-3} \cdot R$ $2{,}5 \cdot 10^{-3} \cdot R$ $2{,}5 \cdot 10^{-3} \cdot R$ $2{,}5 \cdot 10^{-3} \cdot R$ $3{,}6 \cdot 10^{-3} \cdot R$ $3{,}6 \cdot 10^{-3} \cdot R$ $6{,}0 \cdot 10^{-3} \cdot R$ $7{,}0 \cdot 10^{-3} \cdot R$ $13 \cdot 10^{-3} \cdot R$ $17 \cdot 10^{-3} \cdot R$ $40 \cdot 10^{-3} \cdot R$	R = measured value $\lvert U\rvert$ = test voltage High impedance resistance e.g. Insulation tester for electrical safety
Resistance Measuring instruments	100 mΩ to < 5 Ω 5 Ω to < 30 Ω 30 Ω to < 200 Ω 200 Ω to < 500 Ω 500 Ω to < 10 kΩ		$10\ m\Omega + 2{,}3 \cdot 10^{-3} \cdot R$ $10\ m\Omega + 1{,}7 \cdot 10^{-3} \cdot R$ $10\ m\Omega + 1{,}7 \cdot 10^{-3} \cdot R$ $1{,}8 \cdot 10^{-3} \cdot R$ $1{,}7 \cdot 10^{-3} \cdot R$	R = measured value Low impedance resistance e.g. PE resistance tester for electrical safety

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Mobile Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Resistance Measuring instruments	14 mΩ 39 mΩ 94 mΩ 340 mΩ 490 mΩ 960 mΩ 1,7 Ω 4,7 Ω 9 Ω 17 Ω 47 Ω 90 Ω 170 Ω 470 Ω 900 Ω 1,7 kΩ		0,4 mΩ 0,6 mΩ 1 mΩ 1,6 mΩ 2,1 mΩ 3,8 mΩ 6,6 mΩ 20 mΩ 35 mΩ 35 mΩ 250 mΩ 400 mΩ 800 mΩ 2 Ω 4 Ω 8 Ω	Earth resistance Line impedance Loop impedance e.g. PE resistance tester or ground resistance for electrical safety
Leakage current Measuring instruments	0,1 mA to < 0,3 mA 0,3 mA to < 3 mA 3 mA to 30 mA		$3\ \mu A + 2 \cdot 10^{-3} \cdot I$ $4\ \mu A + 3 \cdot 10^{-3} \cdot I$ $30\ \mu A + 3 \cdot 10^{-3} \cdot I$	I = measured value e.g. leakage current tester for electrical safety
RCD initiation current Measuring instruments	10 mA to 3 A		$12 \cdot 10^{-3} \cdot I$	I = measured value
RCD initiation timet Measuring instruments	10 ms to 5 s		$0{,}25\ ms + 0{,}2 \cdot 10^{-3} \cdot t$	t = measured value
Oscilloscope quantities				
Vertical deflection	5 mV_{pp} to < 0,5 V_{pp} 0,5 V_{pp} to 6,6 V_{pp}	DC, 10 Hz to 1 kHz	$40\ \mu V + 2{,}2 \cdot 10^{-3} \cdot U$ $2{,}2 \cdot 10^{-3} \cdot U$	R_i = 50 Ω
	5 mV_{pp} to < 0,5 V_{pp} 0,5 V_{pp} to 6,6 V_{pp}	> 1 kHz to 10 kHz	$40\ \mu V + 2{,}5 \cdot 10^{-3} \cdot U$ $2{,}5 \cdot 10^{-3} \cdot U$	
	5 mV_{pp} to < 0,5 V_{pp} 0,5 V_{pp} to 130 V_{pp}	DC, 10 Hz to 1 kHz	$40\ \mu V + 1{,}5 \cdot 10^{-3} \cdot U$ $1{,}5 \cdot 10^{-3} \cdot U$	R_i = 1 MΩ
	5 mV_{pp} to < 0,5 V_{pp} 0,5 V_{pp} to 130 V_{pp}	> 1 kHz to 10 kHz	$40\ \mu V + 2{,}5 \cdot 10^{-3} \cdot U$ $2{,}5 \cdot 10^{-3} \cdot U$	
Horizontal deflection	1 ns to 20 ms > 50 ms to 5 s		$2{,}5 \cdot 10^{-6} \cdot t$ $(25 \cdot 10^{-6} + 1 \cdot 10^{-3} \cdot \frac{t_s}{s}) \cdot t$	R_i = 50 Ω t = time in s t_s = triggered time in s
Bandwidth	5 mV to 5,5 V	50 kHz to 100 MHz > 100 MHz to 300 MHz > 300 MHz to 600 MHz	$30 \cdot 10^{-3} \cdot f$ $35 \cdot 10^{-3} \cdot f$ $45 \cdot 10^{-3} \cdot f$	R_i = 50 Ω
Rise time	0,5 ns to 10 ms	5 mV to 2,5 V at 1 kHz to 10 MHz	$50 \cdot 10^{-3} \cdot t_r$	t_r = Rise time

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

Mobile Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Input resistance	40 Ω to 60 Ω		$2 \cdot 10^{-3} \cdot R$	R = measured value 50 Ω nominal input resistance
	500 kΩ to 1,5 MΩ		$2 \cdot 10^{-3} \cdot R$	R = measured value 1 MΩ nominal input resistance

Abbreviations used:

CMC	Calibration and measurement capabilities (Kalibrier- und Messmöglichkeiten)
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-Technische Bundesanstalt
EURAMET	European Association of National Metrology Institutes
TK	Calibration guide of Kessler-QMP GmbH
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik e.V.
VDI	Verein Deutscher Ingenieure e.V.

β	Helix angle	$f_{f\beta}$	Helix form deviation
d	Reference diameter	$f_{H\beta}$	Helix slope deviation
d_b	Base diameter	F_p	Cumulative pitch deviation
F_α	Total profile deviation	f_p	Single pitch deviation
$f_{H\alpha}$	Profile slope deviation	L_α	Profile evaluation range
$f_{f\alpha}$	Profile form deviation	L_β	Helix evaluation range
F_β	Total helix deviation	m_n	Normal module

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.