

Deutsche Akkreditierungsstelle

Annex to the Accreditation Certificate D-K-15103-01-00 according to DIN EN ISO/IEC 17025:2018

Valid from: 19.04.2022

Date of issue: 29.11.2022

Holder of accreditation certificate:

**ZERA GmbH
Kalibrierlabor
Humboldtstraße 2a, 53639 Königswinter**

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

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

Calibrations in the fields:

Electrical quantities

DC and low frequency quantities

- **DC voltage**
- **AC voltage**
- **AC current**
- **Electric power**
- **Electric energy**
- **Phase angle**
- **Voltage ratio**
- **Current ratio**

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

Abbreviations used: see last page

Page 1 of 11

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

Annex to the Accreditation Certificate D-K-15103-01-00

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Measurement range	Measurement conditions / procedures	Expanded measurement uncertainty	Remarks
DC voltage	1,018 V	Comparison with 1,018-V-standard	$3,2 \cdot 10^{-6}$	U: Measurement voltage
	10 V	Comparison with 10-V- standard	$3,3 \cdot 10^{-6}$	
	0,02 V to 0,1 V	with DMM HP 3458A	$17 \cdot 10^{-6} \cdot U + 13 \mu V$	
	> 0,1 V to < 1 V		$17 \cdot 10^{-6} \cdot U + 12 \mu V$	
	1 V to 10 V		$17 \cdot 10^{-6} \cdot U + 12 \mu V$	
	> 10 V to 100 V		$17 \cdot 10^{-6} \cdot U + 12 \mu V$	
	> 100 V to 1000 V		$18 \cdot 10^{-6} \cdot U + 11 \mu V$	
AC voltage three-phase	60 V; 120 V; 240 V	$40 \text{ Hz} \leq f \leq 60 \text{ Hz}$	$20 \cdot 10^{-6}$	with COM 303-3
	30 V to 240 V		$50 \cdot 10^{-6}$	
	> 240 V to 480 V		$57 \cdot 10^{-6}$	
single-phase	0,002 V to < 0,02 V	$40 \text{ Hz} \leq f \leq 60 \text{ Hz}$	$2,5 \cdot 10^{-3}$	with MT 3000
	0,02 V to < 0,2 V		$0,6 \cdot 10^{-3}$	
	0,2 V to < 2 V		$0,29 \cdot 10^{-3}$	
	2 V to < 30 V		$0,11 \cdot 10^{-3}$	
	0,005 V to < 0,05 V	$47,5 \text{ Hz} \leq f \leq 62,5 \text{ Hz}$	$50 \cdot 10^{-6}$	with PPCS system and RT-60
	0,05 V to < 0,5 V		$25 \cdot 10^{-6}$	
	0,5 V to 6 V		$13 \cdot 10^{-6}$	with PPCS system
	> 6 V to < 30 V		$20 \cdot 10^{-6}$	
	30 V to 240 V		$13 \cdot 10^{-6}$	
	> 240 V to 480 V		$32 \cdot 10^{-6}$	
AC current three-phase	5 mA to 20 mA	$40 \text{ Hz} \leq f \leq 60 \text{ Hz}$	$50 \cdot 10^{-6}$	with COM 303-3
	> 0,02 A to 0,1 A		$32 \cdot 10^{-6}$	
	> 0,1 A to 10 A		$22 \cdot 10^{-6}$	
	> 10 A to 160 A		$58 \cdot 10^{-6}$	
single-phase	0,05 A to 10 A	$47,5 \text{ Hz} \leq f \leq 62,5 \text{ Hz}$	$13 \cdot 10^{-6}$	with PPCS system
	> 10 A to 100 A		$28 \cdot 10^{-6}$	

Annex to the Accreditation Certificate D-K-15103-01-00

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

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Power and energy AC current - active power single-phase	0 W to 2,4 kW	47,5 Hz ≤ f ≤ 62,5 Hz -90° ≤ φ _{U,I} ≤ 90° 30 V ≤ U ≤ 240 V 0,05 A ≤ I ≤ 10 A	18 · 10 ⁻⁶	with PPCS system relative measurement uncertainty related on the apparent power
	0 W to 24 kW	47,5 Hz ≤ f ≤ 62,5 Hz -90° ≤ φ _{U,I} ≤ 90° 30 V ≤ U ≤ 240 V 10 A ≤ I ≤ 100 A	45 · 10 ⁻⁶	
	0 W to 4,8 kW	47,5 Hz ≤ f ≤ 62,5 Hz -90° ≤ φ _{U,I} ≤ 90° 240 V < U ≤ 480 V 0,05 A ≤ I ≤ 10 A	47 · 10 ⁻⁶	
	0 W to 48 kW	47,5 Hz ≤ f ≤ 62,5 Hz -90° ≤ φ _{U,I} ≤ 90° 240 V < U ≤ 480 V 10 A ≤ I ≤ 100 A	50 · 10 ⁻⁶	
AC current - reactive power single-phase	0 var to 2,4 kvar	47,5 Hz ≤ f ≤ 62,5 Hz -90° ≤ φ _{U,I} ≤ 90° 30 V ≤ U ≤ 240 V 0,05 A ≤ I ≤ 10 A	18 · 10 ⁻⁶	with PPCS system relative measurement uncertainty related on the apparent power
	0 var to 24 kvar	47,5 Hz ≤ f ≤ 62,5 Hz -90° ≤ φ _{U,I} ≤ 90° 30 V ≤ U ≤ 240 V 10 A ≤ I ≤ 100 A	45 · 10 ⁻⁶	
	0 var to 4,8 kvar	47,5 Hz ≤ f ≤ 62,5 Hz -90° ≤ φ _{U,I} ≤ 90° 240 V < U ≤ 480 V 0,05 A ≤ I ≤ 10 A	47 · 10 ⁻⁶	
	0 var to 48 kvar	47,5 Hz ≤ f ≤ 62,5 Hz -90° ≤ φ _{U,I} ≤ 90° 240 V < U ≤ 480 V 10 A ≤ I ≤ 100 A	50 · 10 ⁻⁶	

Annex to the Accreditation Certificate D-K-15103-01-00

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)				
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AC current - apparent power single-phase	1,5 VA to 2,4 kVA	47,5 Hz ≤ f ≤ 62,5 Hz 30 V ≤ U ≤ 240 V 0,05 A ≤ I ≤ 10 A	18 · 10 ⁻⁶	with PPCS system
	300 VA to 24 kVA	47,5 Hz ≤ f ≤ 62,5 Hz 30 V ≤ U ≤ 240 V 10 A ≤ I ≤ 100 A	45 · 10 ⁻⁶	
	12 VA to 4,8 kVA	47,5 Hz ≤ f ≤ 62,5 Hz 240 V < U ≤ 480 V 0,05 A ≤ I ≤ 10 A	47 · 10 ⁻⁶	
	2,4 kVA to 48 kVA	47,5 Hz ≤ f ≤ 62,5 Hz 240 V < U ≤ 480 V 10 A ≤ I ≤ 100 A	50 · 10 ⁻⁶	
AC current- active power three-phase	0,1125 W to 115,2 kW	40 Hz ≤ f ≤ 60 Hz 0,25 ≤ cos φ ≤ 1 30 V ≤ U ≤ 240 V		relative measurement uncertainty related on the apparent power with COM 303-3
		5 mA ≤ I < 10 mA 0,01 A ≤ I < 0,02 A 0,02 A ≤ I < 0,05 A 0,05 A ≤ I < 0,1 A 0,1 A ≤ I < 20 A 20 A ≤ I ≤ 160 A	0,22 · 10 ⁻³ 0,17 · 10 ⁻³ 0,13 · 10 ⁻³ 0,10 · 10 ⁻³ 54 · 10 ⁻⁶ 72 · 10 ⁻⁶	
	0,9 W to 230,4 kW	40 Hz ≤ f ≤ 60 Hz 0,25 ≤ cos φ ≤ 1 240 V < U ≤ 480 V		
		5 mA ≤ I < 10 mA 0,01 A ≤ I < 0,02 A 0,02 A ≤ I < 0,05 A 0,05 A ≤ I < 0,1 A 0,1 A ≤ I < 20 A 20 A ≤ I ≤ 160 A	0,22 · 10 ⁻³ 0,17 · 10 ⁻³ 0,13 · 10 ⁻³ 0,16 · 10 ⁻³ 71 · 10 ⁻⁶ 86 · 10 ⁻⁶	

Valid from: 19.04.2022

Date of issue: 29.11.2022

Page 4 of 11

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

Annex to the Accreditation Certificate D-K-15103-01-00

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Measurement range	Measurement conditions / procedures	Expanded measurement uncertainty	Remarks
AC current-active power single-phase	7,5 mW to 10,8 kW	$40 \text{ Hz} \leq f \leq 60 \text{ Hz}$ $0,25 \leq \cos \varphi \leq 1$ $2 \text{ V} < U \leq 30 \text{ V}$ $5 \text{ mA} \leq I < 50 \text{ mA}$ $0,05 \text{ A} \leq I \leq 120 \text{ A}$	$0,42 \cdot 10^{-3}$ $0,30 \cdot 10^{-3}$	relative measurement uncertainty related on the apparent power with MT 3000
	0,75 mW to 720 W	$40 \text{ Hz} \leq f \leq 60 \text{ Hz}$ $0,25 \leq \cos \varphi \leq 1$ $0,2 \text{ V} < U \leq 2 \text{ V}$ $5 \text{ mA} \leq I < 50 \text{ mA}$ $0,05 \text{ A} \leq I \leq 120 \text{ A}$	$0,7 \cdot 10^{-3}$ $0,6 \cdot 10^{-3}$	
	75 μ W to 72 W	$40 \text{ Hz} \leq f \leq 60 \text{ Hz}$ $0,25 \leq \cos \varphi \leq 1$ $0,02 \text{ V} < U \leq 0,2 \text{ V}$ $5 \text{ mA} \leq I < 50 \text{ mA}$ $0,05 \text{ A} \leq I \leq 120 \text{ A}$	$1,2 \cdot 10^{-3}$ $1,1 \cdot 10^{-3}$	
	7,5 μ W to 7,2 W	$40 \text{ Hz} \leq f \leq 60 \text{ Hz}$ $0,25 \leq \cos \varphi \leq 1$ $0,002 \text{ V} \leq U \leq 0,02 \text{ V}$ $5 \text{ mA} \leq I < 120 \text{ A}$	$10 \cdot 10^{-3}$	
AC current-active energy three-phase	11,25 Ws to 3,2 kWh	$40 \text{ Hz} \leq f \leq 60 \text{ Hz}$ $0,25 \leq \cos \varphi \leq 1$ $30 \text{ V} < U \leq 240 \text{ V}$ $t = 100 \text{ s}$ $5 \text{ mA} \leq I < 10 \text{ mA}$ $0,01 \text{ A} \leq I < 0,02 \text{ A}$ $0,02 \text{ A} \leq I < 0,05 \text{ A}$ $0,05 \text{ A} \leq I < 0,1 \text{ A}$ $0,1 \text{ A} \leq I < 20 \text{ A}$ $20 \text{ A} \leq I \leq 160 \text{ A}$	$0,22 \cdot 10^{-3}$ $0,17 \cdot 10^{-3}$ $0,13 \cdot 10^{-3}$ $0,10 \cdot 10^{-3}$ $54 \cdot 10^{-6}$ $72 \cdot 10^{-6}$	relative measurement uncertainty related on the apparent energy with COM 303-3

Annex to the Accreditation Certificate D-K-15103-01-00

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

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AC current-active energy three-phase	90 Ws to 6,4 kWh	40 Hz ≤ f ≤ 60 Hz		relative measurement uncertainty related on the apparent energy with COM 303-3	
		0,25 ≤ cos φ ≤ 1			
		240 V < U ≤ 480 V			
		t = 100 s			
		5 mA ≤ I < 10 mA	0,22 · 10 ⁻³		
		0,01 A ≤ I < 0,02 A	0,17 · 10 ⁻³		
0,02 A ≤ I < 0,05 A	0,13 · 10 ⁻³				
0,05 A ≤ I < 0,1 A	0,16 · 10 ⁻³				
0,1 A ≤ I < 20 A	71 · 10 ⁻⁶				
20 A ≤ I ≤ 160 A	86 · 10 ⁻⁶				
AC current-reactive power three-phase	112,5 mvar to 115,2 kvar	40 Hz ≤ f ≤ 60 Hz		relative measurement uncertainty related on the apparent power with COM 303-3	
		0,25 ≤ sin φ ≤ 1			
		30 V < U ≤ 240 V			
		5 mA ≤ I < 10 mA	0,22 · 10 ⁻³		
		0,01 A ≤ I < 0,02 A	0,17 · 10 ⁻³		
		0,02 A ≤ I < 0,05 A	0,13 · 10 ⁻³		
	0,05 A ≤ I < 0,1 A	99 · 10 ⁻⁶			
	0,1 A ≤ I < 20 A	54 · 10 ⁻⁶			
	20 A ≤ I ≤ 160 A	76 · 10 ⁻⁶			
	0,9 var to 230,4 kvar	40 Hz ≤ f ≤ 60 Hz			
		0,25 ≤ sin φ ≤ 1			
		240 V < U ≤ 480 V			
5 mA ≤ I < 10 mA		0,22 · 10 ⁻³			
0,01 A ≤ I < 0,02 A		0,17 · 10 ⁻³			
0,02 A ≤ I < 0,05 A		0,13 · 10 ⁻³			
0,05 A ≤ I < 0,1 A	0,16 · 10 ⁻³				
0,1 A ≤ I < 20 A	71 · 10 ⁻⁶				
20 A ≤ I ≤ 160 A	91 · 10 ⁻⁶				

Annex to the Accreditation Certificate D-K-15103-01-00

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Measurement range	Measurement conditions / procedures	Expanded measurement uncertainty	Remarks
AC current-reactive power single-phase	7,5 mvar to 10,8 kvar	$40 \text{ Hz} \leq f \leq 60 \text{ Hz}$ $0,25 \leq \sin \varphi \leq 1$ $2 \text{ V} < U \leq 30 \text{ V}$ $5 \text{ mA} \leq I < 50 \text{ mA}$ $0,05 \text{ A} \leq I \leq 120 \text{ A}$	$0,42 \cdot 10^{-3}$ $0,30 \cdot 10^{-3}$	relative measurement uncertainty related on the apparent power with MT 3000
	0,75 mvar to 720 var	$40 \text{ Hz} \leq f \leq 60 \text{ Hz}$ $0,25 \leq \sin \varphi \leq 1$ $0,2 \text{ V} < U \leq 2 \text{ V}$ $5 \text{ mA} \leq I < 50 \text{ mA}$ $0,05 \text{ A} \leq I \leq 120 \text{ A}$	$0,7 \cdot 10^{-3}$ $0,6 \cdot 10^{-3}$	
	75 μ var to 72 var	$40 \text{ Hz} \leq f \leq 60 \text{ Hz}$ $0,25 \leq \sin \varphi \leq 1$ $0,02 \text{ V} < U \leq 0,2 \text{ V}$ $5 \text{ mA} \leq I < 50 \text{ mA}$ $0,05 \text{ A} \leq I \leq 120 \text{ A}$	$1,2 \cdot 10^{-3}$ $1,1 \cdot 10^{-3}$	
	7,5 μ var to 7,2 var	$40 \text{ Hz} \leq f \leq 60 \text{ Hz}$ $0,25 \leq \sin \varphi \leq 1$ $0,002 \text{ V} \leq U \leq 0,02 \text{ V}$ $5 \text{ mA} \leq I < 120 \text{ A}$	$10 \cdot 10^{-3}$	
AC current-reactive energy three-phase	11,25 vars to 3,2 kvarh	$40 \text{ Hz} \leq f \leq 60 \text{ Hz}$ $0,25 \leq \sin \varphi \leq 1$ $30 \text{ V} < U \leq 240 \text{ V}$ $t = 100 \text{ s}$ $5 \text{ mA} \leq I < 10 \text{ mA}$ $0,01 \text{ A} \leq I < 0,02 \text{ A}$ $0,02 \text{ A} \leq I < 0,05 \text{ A}$ $0,05 \text{ A} \leq I < 0,1 \text{ A}$ $0,1 \text{ A} \leq I < 20 \text{ A}$ $20 \text{ A} \leq I \leq 160 \text{ A}$	$0,22 \cdot 10^{-3}$ $0,17 \cdot 10^{-3}$ $0,13 \cdot 10^{-3}$ $99 \cdot 10^{-6}$ $54 \cdot 10^{-6}$ $76 \cdot 10^{-6}$	relative measurement uncertainty related on the apparent energy with COM 303-3

Annex to the Accreditation Certificate D-K-15103-01-00

Permanent Laboratory

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Measurement quantity / Calibration item	Measurement range	Measurement conditions / procedures	Expanded measurement uncertainty	Remarks	
AC current-reactive energy three-phase	90 vars to 6,4 kvarh	40 Hz ≤ f ≤ 60 Hz		relative measurement uncertainty related on the apparent energy with COM 303-3	
		0,25 ≤ sin φ ≤ 1			
		240 V < U ≤ 480 V			
		t = 100 s			
		5 mA ≤ I < 10 mA	0,22 · 10 ⁻³		
		0,01 A ≤ I < 0,02 A	0,17 · 10 ⁻³		
0,02 A ≤ I < 0,05 A	0,13 · 10 ⁻³				
0,05 A ≤ I < 0,1 A	0,16 · 10 ⁻³				
0,1 A ≤ I < 20 A	71 · 10 ⁻⁶				
20 A ≤ I ≤ 160 A	91 · 10 ⁻⁶				
AC current-apparent power three-phase	0,45 VA to 115,2 kVA	40 Hz ≤ f ≤ 60 Hz		with COM 303-3	
		30 V < U ≤ 240 V			
		5 mA ≤ I < 10 mA	0,22 · 10 ⁻³		
		0,01 A ≤ I < 0,02 A	0,17 · 10 ⁻³		
		0,02 A ≤ I < 0,05 A	0,13 · 10 ⁻³		
	0,05 A ≤ I < 0,1 A	99 · 10 ⁻⁶			
	0,1 A ≤ I < 20 A	54 · 10 ⁻⁶			
	20 A ≤ I < 160 A	68 · 10 ⁻⁶			
	3,6 VA to 230,4 kVA	40 Hz ≤ f ≤ 60 Hz			
		240 V < U ≤ 480 V			
5 mA ≤ I < 10 mA		0,22 · 10 ⁻³			
0,01 A ≤ I < 0,02 A		0,17 · 10 ⁻³			
0,02 A ≤ I < 0,05 A		0,13 · 10 ⁻³			
0,05 A ≤ I < 0,1 A	99 · 10 ⁻⁶				
0,1 A ≤ I < 20 A	69 · 10 ⁻⁶				
20 A ≤ I < 160 A	84 · 10 ⁻⁶				
AC current-apparent power single-phase	30 mVA to 10,8 kVA	40 Hz ≤ f ≤ 60 Hz		with MT 3000	
		2 V < U ≤ 30 V			
		5 mA ≤ I < 50 mA	0,42 · 10 ⁻³		
0,05 A ≤ I ≤ 120 A	0,30 · 10 ⁻³				

Valid from: 19.04.2022

Date of issue: 29.11.2022

Page 8 of 11

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

Annex to the Accreditation Certificate D-K-15103-01-00

Permanent Laboratory

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Measurement quantity / Calibration item	Measurement range	Measurement conditions / procedures	Expanded measurement uncertainty	Remarks
AC current- apparent power single-phase	3 mVA to 720 VA	40 Hz ≤ f ≤ 60 Hz 0,2 V < U ≤ 2 V	0,7 · 10 ⁻³ 0,6 · 10 ⁻³	with MT 3000
		5 mA ≤ I < 50 mA 0,05 A ≤ I ≤ 120 A		
	0,3 mVA to 72 VA	40 Hz ≤ f ≤ 60 Hz 0,02 V < U ≤ 0,2 V	1,2 · 10 ⁻³ 1,1 · 10 ⁻³	
	30 μVA to 7,2 VA	40 Hz ≤ f ≤ 60 Hz 0,002 V < U ≤ 0,02 V	10 · 10 ⁻³	
AC current- apparent energy three-phase	45 VAs to 3,2 kVAh	40 Hz ≤ f ≤ 60 Hz 30 V < U ≤ 240 V t = 100 s	0,22 · 10 ⁻³ 0,17 · 10 ⁻³ 0,13 · 10 ⁻³ 99 · 10 ⁻⁶ 54 · 10 ⁻⁶ 68 · 10 ⁻⁶	with COM 303-3
		5 mA ≤ I < 10 mA 0,01 A ≤ I < 0,02 A 0,02 A ≤ I < 0,05 A 0,05 A ≤ I < 0,1 A 0,1 A ≤ I < 20 A 20 A ≤ I < 160 A		
	360 VAs to 6,4 kVAh	40 Hz ≤ f ≤ 60 Hz 240 V < U ≤ 480 V t = 100 s	0,22 · 10 ⁻³ 0,17 · 10 ⁻³ 0,13 · 10 ⁻³ 99 · 10 ⁻⁶ 69 · 10 ⁻⁶ 84 · 10 ⁻⁶	

Annex to the Accreditation Certificate D-K-15103-01-00

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Measurement range	Measurement conditions / procedures	Expanded measurement uncertainty	Remarks
AC voltage-phase angle	$-180^\circ \leq \delta_{U,U} \leq 180^\circ$	$40 \text{ Hz} \leq f \leq 60 \text{ Hz}$ $10 \text{ V} \leq U \leq 480 \text{ V}$	0,4'	with COM 303-3
		$47,5 \text{ Hz} \leq f \leq 62,5 \text{ Hz}$ $6 \text{ V} \leq U < 10 \text{ V}$ $0,5 \text{ V} \leq U < 6 \text{ V}$	0,1' 0,1'	with PPCS
		$47,5 \text{ Hz} \leq f \leq 62,5 \text{ Hz}$ $0,05 \text{ V} \leq U < 0,5 \text{ V}$ $0,005 \text{ V} \leq U < 0,05 \text{ V}$	0,2' 0,3'	with PPCS and RT-60
AC current-phase angle	$-180^\circ \leq \delta_{I,I} \leq 180^\circ$	$40 \text{ Hz} \leq f \leq 60 \text{ Hz}$ $5 \text{ mA} \leq I < 50 \text{ mA}$ $0,05 \text{ A} \leq I \leq 120 \text{ A}$	0,2' 0,1'	with COM 303-3
Isolating current transformer with ratio 1:1; 1:2; 10:1	Primary currents	PTB-PR issue 12 (1979)		Comparison with two standards in substitution methods
	5 mA to < 50 mA 50 mA to 120 A	$45 \text{ Hz} \leq f \leq 65 \text{ Hz}$	0,016 %; 0,02 crad 0,011 %; 0,014 crad	MU value; phase MU value; phase
AC voltage measuring bridge	3,75 V to < 15 V	PTB-PR issue 12 (1979) $50 \text{ Hz} \leq f \leq 60 \text{ Hz}$ TV 0,5 bis 1	0,019 %; 0,025 crad	with WM3000 U MU value; phase
	15 V to 480 V		0,014 %; 0,016 crad	MU value; phase
AC voltage measuring bridge with EVT	25 mV to < 200 mV	PTB-PR issue 12 (1979) $50 \text{ Hz} \leq f \leq 60 \text{ Hz}$	0,04 %; 0,044 crad	with WM3000 U only for EVT MU value; phase
	200 mV to 15 V		0,031 %; 0,032 crad	MU value; phase
AC current measuring bridge	5 mA to < 50 mA	PTB-PR issue 12 (1979) $50 \text{ Hz} \leq f \leq 60 \text{ Hz}$ TV 0,5 bis 1	0,024 %; 0,025 crad	with WM3000 I MU value; phase
	50 mA to 15 A		0,014 %; 0,016 crad	MU value; phase

Valid from: 19.04.2022

Date of issue: 29.11.2022

Page 10 of 11

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

Annex to the Accreditation Certificate D-K-15103-01-00

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)				
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AC current measuring bridge with ECT	25 mV to < 200 mV	PTB-PR issue 12 (1979) 50 Hz ≤ f ≤ 60 Hz	0,04 %; 0,042 crad	with WM3000 I only for ECT MU value; phase
	200 mV to 15 V		0,031 %; 0,037 crad	MU value; phase

Abbreviations used:

CMC	Calibration and Measurement Capabilities
COM 303-3	Standard measuring device (Comparator)
MT3000	Measuring standard for small voltage ranges
PPCS	Precision Power Calibration System
RT-60	Inductive voltage divider
$\delta_{U,U}$	AC voltage phase angle between voltages
$\delta_{I,I}$	AC current phase angle between currents
TV	Divider ratio
MU	Measurement uncertainty
WM3000 U	Voltage Transformer Measuring Bridge
WM3000 I	Current Transformer Measuring Bridge
EVT	Electronic Voltage Transformer
ECT	Electronic Current Transformer
PTB	Physikalisch Technische Bundesanstalt (National Metrology Institute)
PTB-PR	PTB testing rules

Valid from: 19.04.2022

Date of issue: 29.11.2022

Page 11 of 11

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