

Deutsche Akkreditierungsstelle

Annex to the Partial Accreditation Certificate D-K-19342-01-01 according to DIN EN ISO/IEC 17025:2018

Valid from: 14.05.2024

Date of issue: 14.05.2024

This annex is a part of the accreditation certificate D-K-19342-01-00.

Holder of partial accreditation certificate:

Ahlborn Mess- und Regelungstechnik GmbH
Eichenfeldstraße 1-3, 83607 Holzkirchen

with the location

Ahlborn Mess- und Regelungstechnik GmbH
Eichenfeldstraße 1-3, 83607 Holzkirchen

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

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

Calibration in the fields:

Electrical quantities

Time and frequency

- Frequency

DC and low frequency quantities

- DC voltage
- DC current
- DC resistance
- AC voltage
- AC current

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

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

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Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement	Remarks
DC voltage Sources	0 V to < 0.2 V		$0.2 \mu\text{V} + 5 \cdot 10^{-6} \cdot U$	U: measured value
	0.2 V to < 2 V		$0.5 \mu\text{V} + 5 \cdot 10^{-6} \cdot U$	
	2 V to < 20 V		$5 \mu\text{V} + 5 \cdot 10^{-6} \cdot U$	
	20 V to < 200 V		$50 \mu\text{V} + 5 \cdot 10^{-6} \cdot U$	
	200 V to 1000 V		$0.5 \text{ mV} + 5 \cdot 10^{-6} \cdot U$	
Measuring instruments	0 V to < 0.33 V		$0.8 \mu\text{V} + 22 \cdot 10^{-6} \cdot U$	U: measured value
	0.33 V to < 3.3 V		$1.4 \mu\text{V} + 10 \cdot 10^{-6} \cdot U$	
	3.3 V to < 33 V		$16 \cdot 10^{-6} \cdot U$	
	33 V to < 330 V		$0.1 \text{ mV} + 16 \cdot 10^{-6} \cdot U$	
	330 V to 1020 V		$1.0 \text{ mV} + 16 \cdot 10^{-6} \cdot U$	
DC current Sources	1 μA to < 200 μA		$0.4 \text{ nA} + 15 \cdot 10^{-6} \cdot I$	I: measured value
	200 μA to < 2 mA		$4.0 \text{ nA} + 15 \cdot 10^{-6} \cdot I$	
	2 mA to < 20 mA		$40 \text{ nA} + 15 \cdot 10^{-6} \cdot I$	
	20 mA to < 200 mA		$0.8 \mu\text{A} + 45 \cdot 10^{-6} \cdot I$	
	200 mA to < 2 A		$16 \mu\text{A} + 0.17 \cdot 10^{-3} \cdot I$	
	2 A to 20 A		$0.4 \text{ mA} + 0.37 \cdot 10^{-3} \cdot I$	
Measuring instruments	1 μA to < 330 μA		$20 \text{ nA} + 0.1 \cdot 10^{-3} \cdot I$	I: measured value
	330 μA to < 3.3 mA		$40 \text{ nA} + 77 \cdot 10^{-6} \cdot I$	
	3.3 mA to < 33 mA		$0.22 \mu\text{A} + 77 \cdot 10^{-6} \cdot I$	
	33 mA to < 330 mA		$2.2 \mu\text{A} + 77 \cdot 10^{-6} \cdot I$	
	330 mA to < 1.1 A		$30 \mu\text{A} + 0.16 \cdot 10^{-3} \cdot I$	
	1.1 A to < 3 A		$30 \mu\text{A} + 0.28 \cdot 10^{-3} \cdot I$	
	3 A to < 11 A		$0.3 \text{ mA} + 0.40 \cdot 10^{-3} \cdot I$	
	11 A to 20.5 A		$0.3 \text{ mA} + 0.78 \cdot 10^{-3} \cdot I$	
DC resistance Sources	0.1 Ω to < 2 Ω		$4 \mu\Omega + 15 \cdot 10^{-6} \cdot R$	R: measured value
	2 Ω to < 20 Ω		$20 \mu\Omega + 9 \cdot 10^{-6} \cdot R$	
	20 Ω to < 200 Ω		$40 \mu\Omega + 8 \cdot 10^{-6} \cdot R$	
	200 Ω to < 2 k Ω		$10 \cdot 10^{-6} \cdot R$	
	2 k Ω to < 20 k Ω		$10 \cdot 10^{-6} \cdot R$	
	20 k Ω to < 200 k Ω		$10 \cdot 10^{-6} \cdot R$	
	200 k Ω to < 2 M Ω		$14 \cdot 10^{-6} \cdot R$	
	2 M Ω to < 20 M Ω		$0.1 \text{ k}\Omega + 20 \cdot 10^{-6} \cdot R$	
	20 M Ω to < 200 M Ω		$10 \text{ k}\Omega + 0.11 \cdot 10^{-3} \cdot R$	
	200 M Ω to 2 G Ω		$1 \text{ M}\Omega + 0.55 \cdot 10^{-3} \cdot R$	

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DC resistance Measuring instruments	0 Ω to < 11 Ω		$0.75 \text{ m}\Omega + 36 \cdot 10^{-6} \cdot R$	R: measured value
	11 Ω to < 33 Ω		$1.1 \text{ m}\Omega + 24 \cdot 10^{-6} \cdot R$	
	33 Ω to < 110 Ω		$1.0 \text{ m}\Omega + 22 \cdot 10^{-6} \cdot R$	
	110 Ω to < 330 Ω		$1.4 \text{ m}\Omega + 22 \cdot 10^{-6} \cdot R$	
	330 Ω to < 1.1 kΩ		$30 \cdot 10^{-6} \cdot R$	
	1.1 kΩ to < 3.3 kΩ		$35 \cdot 10^{-6} \cdot R$	
	3.3 kΩ to < 11 kΩ		$30 \cdot 10^{-6} \cdot R$	
	11 kΩ to < 33 kΩ		$35 \cdot 10^{-6} \cdot R$	
	33 kΩ to < 110 kΩ		$30 \cdot 10^{-6} \cdot R$	
	110 kΩ to < 330 kΩ		$40 \cdot 10^{-6} \cdot R$	
	330 kΩ to < 1.1 MΩ		$30 \cdot 10^{-6} \cdot R$	
	1.1 MΩ to < 3.3 MΩ		$80 \cdot 10^{-6} \cdot R$	
	3.3 MΩ to < 11 MΩ		$0.16 \cdot 10^{-3} \cdot R$	
	11 MΩ to < 33 MΩ		$0.30 \cdot 10^{-3} \cdot R$	
	33 MΩ to < 110 MΩ		$0.60 \cdot 10^{-3} \cdot R$	
110 MΩ to < 330 MΩ	$3.5 \cdot 10^{-3} \cdot R$			
330 MΩ to 1.1 GΩ	$18 \cdot 10^{-3} \cdot R$			
AC voltage Sources	10 mV to < 200 mV	10 Hz to 40 Hz	$4 \mu\text{V} + 0.14 \cdot 10^{-3} \cdot U$	U: measured value
		> 40 Hz to 10 kHz	$4 \mu\text{V} + 0.14 \cdot 10^{-3} \cdot U$	
		> 10 kHz to 30 kHz	$25 \mu\text{V} + 0.25 \cdot 10^{-3} \cdot U$	
		> 30 kHz to 100 kHz	$0.1 \text{ mV} + 0.30 \cdot 10^{-3} \cdot U$	
	0.2 V to < 2 V	10 Hz to 40 Hz	$20 \mu\text{V} + 0.11 \cdot 10^{-3} \cdot U$	
		> 40 Hz to 10 kHz	$20 \mu\text{V} + 0.10 \cdot 10^{-3} \cdot U$	
		> 10 kHz to 30 kHz	$40 \mu\text{V} + 0.20 \cdot 10^{-3} \cdot U$	
		> 30 kHz to 100 kHz	$0.2 \text{ mV} + 0.5 \cdot 10^{-3} \cdot U$	
	2 V to < 20 V	10 Hz to 40 Hz	$0.2 \text{ mV} + 0.11 \cdot 10^{-3} \cdot U$	
		> 40 Hz to 10 kHz	$0.2 \text{ mV} + 0.10 \cdot 10^{-3} \cdot U$	
		> 10 kHz to 30 kHz	$0.4 \text{ mV} + 0.20 \cdot 10^{-3} \cdot U$	
		> 30 kHz to 100 kHz	$2 \text{ mV} + 0.50 \cdot 10^{-3} \cdot U$	
	20 V to < 200 V	10 Hz to 40 Hz	$2 \text{ mV} + 0.11 \cdot 10^{-3} \cdot U$	
		> 40 Hz to 10 kHz	$2 \text{ mV} + 90 \cdot 10^{-6} \cdot U$	
		> 10 kHz to 30 kHz	$4 \text{ mV} + 0.20 \cdot 10^{-3} \cdot U$	
		> 30 kHz to 100 kHz	$20 \text{ mV} + 0.50 \cdot 10^{-3} \cdot U$	
200 V to 1050 V	40 Hz to 10 kHz	$20 \text{ mV} + 0.12 \cdot 10^{-3} \cdot U$		

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AC voltage Measuring instruments	1 mV to < 33 mV	10 Hz to 45 Hz	$5 \mu\text{V} + 0.6 \cdot 10^{-3} \cdot U$	U: measured value
		> 45 Hz to 10 kHz	$5 \mu\text{V} + 0.12 \cdot 10^{-3} \cdot U$	
		> 10 kHz to 20 kHz	$5 \mu\text{V} + 0.15 \cdot 10^{-3} \cdot U$	
		> 20 kHz to 50 kHz	$5 \mu\text{V} + 0.75 \cdot 10^{-3} \cdot U$	
		> 50 kHz to 100 kHz	$10 \mu\text{V} + 3 \cdot 10^{-3} \cdot U$	
	33 mV to < 330 mV	10 Hz to 45 Hz	$5 \mu\text{V} + 0.40 \cdot 10^{-3} \cdot U$	
		> 45 Hz to 10 kHz	$5 \mu\text{V} + 0.18 \cdot 10^{-3} \cdot U$	
		> 10 kHz to 20 kHz	$5 \mu\text{V} + 0.25 \cdot 10^{-3} \cdot U$	
		> 20 kHz to 50 kHz	$5 \mu\text{V} + 0.50 \cdot 10^{-3} \cdot U$	
		> 50 kHz to 100 kHz	$20 \mu\text{V} + 0.80 \cdot 10^{-3} \cdot U$	
	330 mV to < 3.3 V	10 Hz to 45 Hz	$35 \mu\text{V} + 0.28 \cdot 10^{-3} \cdot U$	
		> 45 Hz to 10 kHz	$25 \mu\text{V} + 0.18 \cdot 10^{-3} \cdot U$	
		> 10 kHz to 20 kHz	$45 \mu\text{V} + 0.20 \cdot 10^{-3} \cdot U$	
		> 20 kHz to 50 kHz	$25 \mu\text{V} + 0.30 \cdot 10^{-3} \cdot U$	
		> 50 kHz to 100 kHz	$0.80 \cdot 10^{-3} \cdot U$	
	3.3 V to < 33 V	10 Hz to 45 Hz	$0.30 \text{ mV} + 0.30 \cdot 10^{-3} \cdot U$	
		> 45 Hz to 10 kHz	$0.30 \text{ mV} + 0.20 \cdot 10^{-3} \cdot U$	
		> 10 kHz to 20 kHz	$0.15 \text{ mV} + 0.28 \cdot 10^{-3} \cdot U$	
		> 20 kHz to 50 kHz	$0.15 \text{ mV} + 0.35 \cdot 10^{-3} \cdot U$	
		> 50 kHz to 100 kHz	$0.15 \text{ mV} + 1.0 \cdot 10^{-3} \cdot U$	
33 V to < 330 V	45 Hz to 1 kHz	$0.2 \text{ mV} + 0.20 \cdot 10^{-3} \cdot U$		
	> 1 kHz to 10 kHz	$0.2 \text{ mV} + 0.28 \cdot 10^{-3} \cdot U$		
	> 10 kHz to 20 kHz	$0.1 \text{ mV} + 0.35 \cdot 10^{-3} \cdot U$		
	> 20 kHz to 50 kHz	$4 \text{ mV} + 0.50 \cdot 10^{-3} \cdot U$		
	> 50 kHz to 100 kHz	$30 \text{ mV} + 2.0 \cdot 10^{-3} \cdot U$		
330 V to 1020 V	45 Hz to 10 kHz	$0.25 \cdot 10^{-3} \cdot U$		
AC current Sources	1 μA to < 200 μA	1 Hz to 10 kHz	$0.03 \mu\text{A} + 0.43 \cdot 10^{-3} \cdot I$	I: measured value
	200 μA to < 2 mA	10 Hz to 10 kHz	$0.30 \mu\text{A} + 0.28 \cdot 10^{-3} \cdot I$	
	2 mA to < 20 mA	10 Hz to 10 kHz	$2.2 \mu\text{A} + 0.32 \cdot 10^{-3} \cdot I$	
	20 mA to < 200 mA	10 Hz to 10 kHz	$22 \mu\text{A} + 0.3 \cdot 10^{-3} \cdot I$	
	200 mA to < 2 A	10 Hz to 2 kHz	$0.22 \text{ mA} + 0.65 \cdot 10^{-3} \cdot I$	
	2 A to 20 A	10 Hz to 2 kHz	$2 \text{ mA} + 0.85 \cdot 10^{-3} \cdot I$	

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AC current Measuring instruments	29 μ A to < 330 μ A	45 Hz to 1 kHz	$0.1 \mu\text{A} + 1 \cdot 10^{-3} \cdot I$	/: measured value
		> 1 kHz to 5 kHz	$0.2 \mu\text{A} + 3 \cdot 10^{-3} \cdot I$	
		> 5 kHz to 10 kHz	$0.2 \mu\text{A} + 6 \cdot 10^{-3} \cdot I$	
	330 μ A to < 3.3 mA	45 Hz to 1 kHz	$0.15 \mu\text{A} + 0.8 \cdot 10^{-3} \cdot I$	
		> 1 kHz to 5 kHz	$0.30 \mu\text{A} + 2 \cdot 10^{-3} \cdot I$	
		> 5 kHz to 10 kHz	$0.30 \mu\text{A} + 4 \cdot 10^{-3} \cdot I$	
	3.3 mA to < 33 mA	45 Hz to 1 kHz	$2 \mu\text{A} + 0.5 \cdot 10^{-3} \cdot I$	
		> 1 kHz to 5 kHz	$3 \mu\text{A} + 0.7 \cdot 10^{-3} \cdot I$	
		> 5 kHz to 10 kHz	$3 \mu\text{A} + 1.5 \cdot 10^{-3} \cdot I$	
	33 mA to < 330 mA	45 Hz to 1 kHz	$20 \mu\text{A} + 0.4 \cdot 10^{-3} \cdot I$	
		> 1 kHz to 5 kHz	$0.1 \text{ mA} + 0.8 \cdot 10^{-3} \cdot I$	
		> 5 kHz to 10 kHz	$0.1 \text{ mA} + 1.6 \cdot 10^{-3} \cdot I$	
	330 mA to < 1.1 A	45 Hz to 1 kHz	$50 \mu\text{A} + 0.45 \cdot 10^{-3} \cdot I$	
		> 1 kHz to 5 kHz	$0.7 \text{ mA} + 0.6 \cdot 10^{-3} \cdot I$	
	1.1 A to < 3 A	45 Hz to 1 kHz	$0.1 \text{ mA} + 0.6 \cdot 10^{-3} \cdot I$	
> 1 kHz to 5 kHz		$0.7 \text{ mA} + 5 \cdot 10^{-3} \cdot I$		
3 A to < 11 A	45 Hz to 100 Hz	$2 \text{ mA} + 0.6 \cdot 10^{-3} \cdot I$		
	> 100 Hz to 1 kHz	$2 \text{ mA} + 1 \cdot 10^{-3} \cdot I$		
11 A to 20.5 A	45 Hz to 100 Hz	$5 \text{ mA} + 1.2 \cdot 10^{-3} \cdot I$		
	> 100 Hz to 1 kHz	$5 \text{ mA} + 1.5 \cdot 10^{-3} \cdot I$		
Frequency Sources	10 Hz to 1.0 MHz		$20 \mu\text{Hz} + 13 \cdot 10^{-6} \cdot f$	f: measured value
Measuring instruments	0.01 Hz to < 120 Hz		$11 \text{ mHz} + 1 \cdot 10^{-6} \cdot f$	f: measured value
	120 Hz to < 1.2 kHz		$0.11 \text{ Hz} + 1 \cdot 10^{-6} \cdot f$	
	1.2 kHz to < 12 kHz		$1.1 \text{ Hz} + 1 \cdot 10^{-6} \cdot f$	
	12 kHz to < 0.12 MHz		$11 \text{ Hz} + 1 \cdot 10^{-6} \cdot f$	
	0.12 MHz to < 1.2 MHz		$0.11 \text{ kHz} + 1 \cdot 10^{-6} \cdot f$	
	1.2 MHz to 2.0 MHz		$1.1 \text{ kHz} + 1 \cdot 10^{-6} \cdot f$	

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