Deutsche Akkreditierungsstelle GmbH

Annex to the Accreditation Certificate D-K-12107-01-00 according to DIN EN ISO/IEC 17025:2018

Valid from: **26.02.2021**

Date of issue: 26.02.2021

Holder of certificate:

IPH Institut "Prüffeld für elektrische Hochleistungstechnik" GmbH
Landsberger Allee 378A, 12681 Berlin

Calibration in the fields:

Electrical quantities

DC and low frequency quantities

- **DC voltage** *)
- **AC voltage** *)
- **DC current**
- **DC resistance** *)
- **High voltage impulse quantities** *)
- **AC current** *)

Thermodynamic quantities

Temperature quantities

- **Resistance thermometers**
- **Thermocouples**
- **Climatic chambers (temperature)** *)

*) **also on-site calibration**

Abbreviations used: see last page

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

The certificate together with its annex reflects the status at the time of the date of issue. The current status of the scope of accreditation can be found in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH. https://www.dakks.de/en/content/accredited-bodies-dakks

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Current ratio and phase displacement	1 A to 40 kA (primary) 1 A or 5 A (secondary)	Frequencies: 16.7 Hz; 50 Hz; 60 Hz	0.03 %; 1‘	Measurement uncertainty of ratio in %; Measurement uncertainty of phase displacement in ‘
Voltage ratio and phase displacement	0.1 kV to 72 kV (primary) 0.1 kV; 0.1 kV/√3; 0.11 kV; 0.11 kV/√3; 0.2 kV (secondary)	Frequencies: 16.7 Hz; 50 Hz; 60 Hz	0.03 %; 1‘	
DC voltage / Sensors, quadrupoles and measuring instruments	1 mV to 330 mV > 330 mV to 3.3 V > 3.3 V to 33 V > 33 V to 330 V > 330 V to 1020 V		0.005 % + 3 µV 0.003 % + 20 µV 0.003 % + 200 µV 0.003 % + 2 mV 0.003 % + 20 mV	
DC voltage */ Sensors and measuring systems	1 kV to 30 kV > 30 kV to 200 kV		0.3 % 0.7 %	Determination of scale factor and linearity according IEC 60060-2:2010
AC voltage / Sensors, quadrupoles and measuring instruments	1 mV to 10 mV	1 Hz to 40 Hz 41 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz	0.08 % + 2.5 µV 0.03 % + 1.5 µV 0.1 % + 2 µV 0.5 % + 10 µV 4 % + 30 µV	
	10.1 mV to 100 mV	1 Hz to 40 Hz 41 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 1 MHz 1 MHz to 25 MHz	0.02 % + 5 µV 0.02 % + 3 µV 0.04 % + 4 µV 0.1 % + 5 µV 1.5 % 4.5 % + 0.5 mV	
	> 100 mV to 1 V	1 Hz to 40 Hz 41 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 1 MHz 1 MHz to 25 MHz	0.02 % + 50 µV 0.02 % + 40 µV 0.04 % + 40 µV 0.1 % + 50 µV 1.5 % 4.5 % + 0.5 mV	
	> 1 V to 10 V	1 Hz to 40 Hz 41 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 1 MHz 1 MHz to 25 MHz	0.02 % + 0.5 mV 0.02 % + 0.4 mV 0.04 % + 0.4 mV 0.1 % + 0.5 mV 1.5 % 4.5 %	

[1)] The expanded uncertainties according to EA-4/02 M:2013 are part of CMC and are the best measurement uncertainties within accreditation. They have a coverage probability of approximately 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
AC voltage / Sensors, quadrupoles and measuring instruments	10 V to 100 V	1 Hz to 40 Hz 41 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 1 MHz	0.05 % + 5 mV 0.03 % + 5 mV 0.05 % + 5 mV 0.2 % + 5 mV 0.7 % +10 mV 2.5 %	
	> 100 V to 1000 V	1 Hz to 40 Hz 41 Hz to 10 kHz 10 kHz to 30 kHz	0.07 % + 50 mV 0.03 % + 5 mV 0.1 % + 50 mV	
	1 kV to 72 kV	16.7 Hz; 50 Hz; 60 Hz	0.3 %	Scale factor determination and linearity according to IEC 60060-2:2010
	1 kV to 200 kV	20 Hz to 200 Hz	0.7 %	Scale factor determination and linearity according to IEC 60060-2:2010; IEC 60060-3:2006
Lightning impulse voltage (*LI*)*/ measuring instruments, time parameters	9 V to 1600 V		0.6 %	Scale factor determination linearity and time parameter determination according to IEC 61083-1:2001
T_1	0.8 µs to 1.6 µs		2.2 %	
T_2	60 µs		2.2 %	
Lightning impulse voltage (*LI*)* Peak value / sensors and measuring systems	500 V to 150 kV 150 kV to 500 kV		0.8 % 1 %	Scale factor determination, linearity and time parameter determination according to IEC 60060-2:2010
time parameters				
T_1	0.8 µs to 1.6 µs		5 %	
T_2	40 µs to 60 µs		3 %	
Switching impulse voltage (*SI*)*/ measuring instruments	9 V to 1600 V		0.6 %	Scale factor determination, linearity and time parameter determination according to IEC 61083-1:2001
time parameters	20 µs 250 µs		2.2 % 2.2 %	
T_p	2500 µs		1.0 %	
T_2	4000 µs		1.0 %	

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Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Switching impulse voltage (*SI*)* Peak value / sensors and measuring system	80 kV to 500 kV		1 %	Scale factor determination, linearity and time parameter determination according to IEC 60060-2:2010
time parameter				
T_p	200 µs to 300 µs		3 %	
T_2	1000 µs to 4000 µs		3 %	
Impulse charge */ calibrators and partial discharge measuring devices	1 pC to 10 nC	IEC 60270:2000 AMD1:2015	0.02 q + 0.2 pC	q = Measured value
Rise time and Impulse width / Partial discharge calibrators, amplifier and sensors	1 ns to 1 ms	Measurement with oscilloscope	5 %	Rise time: the time required for a pulse to rise from 10 % to 90 % of its steady value
Puls duration / Partial discharge calibrators	10 ns to 1 s	Measurement with oscilloscope	2 %	Pulse duration: time between the 10% values of the amplitude of the rising edge and the falling edge of the charge pulse
DC current / sensors and measuring instruments	30 µA to 330 µA > 330 µA to 4 mA > 4 mA to 40 mA > 40 mA to 400 mA > 400 mA to 4 A > 4 A to 40 A > 40 A to 100 A		0.02 % + 0.02 µA 0.02 % + 0.8 µA 0.02 % + 10 µA 0.02 % + 80 µA 0.02 % + 0.8 mA 0.02 % + 8 mA 0.02 % + 60 mA	
Current clamps	> 100 A to 2000 A		1.0 %	
Scale factor DC / DC converter, shunt	1 µV/A to 100 mV/A	10 A < I < 1000 A; IEC 62475:2010	0.05 %	Determination of scale factor
	1 µV/A to 100 mV/A	1000 A < I < 5000 A; IEC 62475:2010	0.1 %	
Short time DC current DC converter. shunt	100 A to 1000 A	IEC 62475:2010	0.1 %	Determination of scale factor and linearity
	1 kA to 140 kA		1.0 %	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
DC resistance Measuring instruments	0 Ω to 11 Ω		0.005 % + 1.1 mΩ	Simulation with calibrator
	> 11 Ω to 33 Ω		0.003 % + 1.7 mΩ	
	> 33 Ω to 110 Ω		0.003 % + 2 mΩ	
	> 110 Ω to 330 Ω		0.003 % + 3 mΩ	
	> 330 Ω to 1100 Ω		0.003% + 4 mΩ	
	> 1100 Ω to 3300 Ω		0.003 % + 30 mΩ	
	> 3.3 kΩ to 11 kΩ		0.003 % + 40 mΩ	
	> 11 kΩ to 33 kΩ		0.003 % + 300 mΩ	
	> 33 kΩ to 110 kΩ		0.003 % + 400 mΩ	
	> 110 kΩ to 330 kΩ		0.0035 % + 2.5 Ω	
	> 330 kΩ to 1100 kΩ		0.0035 % + 4 Ω	
	> 1100 kΩ to 3300 kΩ		0.0065 % + 40 Ω	
	> 3.3 MΩ to 11 MΩ		0.015 % + 100 Ω	
	> 11 MΩ to 33 MΩ		0.03 % + 3 kΩ	
	> 33 MΩ to 110 MΩ		0.055 % + 6 kΩ	
	> 110 MΩ to 330 MΩ		0.35 % + 200 kΩ	
	> 330 MΩ to 1100 MΩ		1.5 % + 2000 kΩ	
DC resistance / Measuring instruments	5 µΩ	200 A to 1000 A	0.1 %	
	15 µΩ	200 A to 1000 A	0.1 %	
	100 µΩ	30 A	0.05 %	
	1 mΩ	200 A	0.05 %	
	10 mΩ	10 A	0.05 %	
	40 mΩ	3 A	0.05 %	
	100 mΩ	1A	0.05 %	
	600 mΩ	1 A	0.05 %	
	1 Ω	0.3 A	0.05 %	
	10 Ω	0.1 A	0.05 %	
	100 Ω	0.03 A	0.05 %	
	1 kΩ	0.01 A	0.05 %	
	10 kΩ	0.003 A	0.05 %	
	100 kΩ	0.001 A	0.05 %	
DC resistance	0.2 Ω to 2 Ω		0.0016 % + 0.01 mΩ	Determination of resistance with 8508A
	> 2 Ω to 20 Ω		0.001 % + 0.02 mΩ	
	> 20 Ω to 200 Ω		0.0008 % + 0.1 mΩ	
	> 200 Ω to 2 kΩ		0.0008 % + 1 mΩ	
	> 2 kΩ to 20 kΩ		0.0008 % + 0.06 Ω	
	> 20 kΩ to 200 kΩ		0.0008 % + 0.8 Ω	
	> 200 kΩ to 2 MΩ		0.0009 % + 0.02 kΩ	
	> 2 MΩ to 20 MΩ		0.0017 % + 0.1 kΩ	
	> 20 MΩ to 200 MΩ		0.007 % + 15 kΩ	
	200 MΩ to 2 GΩ		0.5 % + 1.5 MΩ	
DC resistance / shunt	10 µΩ to 200 µΩ	10 A	0.05 %	Determination of resistance
	> 200 µΩ to 2 mΩ	1 A, 10 A	0.05 %	
	> 2 mΩ to 20 mΩ	100 mA, 1 A, 10 A	0.05 %	
	> 20 mΩ to 2 Ω	1 A, 100 mA, 10 mA	0.05 %	
	> 2 Ω to 100 Ω	10 mA, 1 mA, 100 µA	0.05 %	
	1 µΩ to 10 µΩ	200 A < *I* < 1000 A	0.05 %	Voltage range for resistance: 1 mV to 9 V
	> 10 µΩ to 1 mΩ	50 A < *I* < 1000 A	0.05 %	
	> 1mΩ to 100 mΩ	10 A < *I* < 200 A	0.05 %	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
AC current / sensors and measuring instruments	0.2 mA to 100 A	10 Hz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	0.2 % 0.4 % 0.6 % 1.0 %	
	29 µA to 330 µA	10 Hz to 45 Hz 45 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz 10 kHz to 30 kHz	0.15 % + 0.15 µA 0.1 % + 0.15 µA 0.25% + 0.2 µA 0.6 % + 0.4 µA 1.5 % + 0.5 µA	
	> 330 µA to 4 mA	10 Hz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	0.05 % +2 µA 0.12 % + 2.5 µA 0.15 % + 5 µA 0.4 % + 7 µA	
	> 4 mA to 40 mA	10 Hz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	0.05 % +20 µA 0.12 % + 25 µA 0.15 % + 50 µA 0.4 % + 70 µA	
	> 40 mA to 400 mA	10 Hz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	0.05 % +200 µA 0.12% + 250 µA 0.15 % + 500 µA 0.4 % + 700 µA	
	> 400 mA to 4 A	10 Hz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	0.05 % +2 mA 0.12 % + 2.5 mA 0.15 % + 5 mA 0.4 % + 7 mA	
	> 4 A to 40 A	10 Hz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	0.05 % +20 mA 0.12% + 25 mA 0.15 % + 50 mA 0.4 % + 70 mA	
	> 40 A to 100 A	10 Hz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	0.05 % + 80 mA 0.12 % + 120 mA 0.15 % + 200 mA 0.4 % + 300 mA	
AC current/ Clamp meter	> 100 A to 2000 A	16.7 Hz; 50 Hz; 60 Hz	1.0 %	
Current AC / shunt. Rogowski-measuring systems; current transformer	5 A to 40 kA	IEC 62475:2010	0.3 %	Measurement RMS; 50 Hz; Continuous current
	100 A to 140 kA		1.0 %	Measurement RMS; 50 Hz; short time current
	250 A to 350 kA		1.0 %	Measurement peak; 50 Hz; short time current

[1)] The expanded uncertainties according to EA-4/02 M:2013 are part of CMC and are the best measurement uncertainties within accreditation. They have a coverage probability of approximately 95 % and have a coverage factor of k = 2 unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
impulse current / Shunt, Rogowski-measuring systems; current transformer	20 A to 8 kA	IEC 62475:2010	1.0 %	Measurement peak; 8/20 µs impulse current
Impulse current; time parameters	6 µs to 24 µs	IEC 62475:2010	3.0 %	Measurement front time and time to half value
Resistance thermometers direct reading thermometers and transducers with resistance thermometers	0 °C to 90 °C -20 °C to < 25 °C 25 °C to 140 °C	with liquid bath with dry-well-calibrator with dry-well-calibrator DKD-R 5-1:2018	0.3 K 0.7 K 0.5 K	Comparison with resistance thermometers
Thermocouples, direct reading thermometers and transducers with thermocouple sensors	-20 °C to 50 °C > 50 °C to 100 °C > 100 °C to 140 °C	with dry-well-calibrator with dry-well-calibrator with dry-well-calibrator DKD-R 5-1:2018	0.5 K 0.8 K 1.0 K	
Heating oven and climatic chambers	25 °C to 100 °C > 100 °C to 250 °C	DKD-R 5-7:2018 method A, B and C	1.0 K 2.0 K	

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On-site Calibration

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Current ratio and phase displacement	1 A to 40 kA (primary) 1 A or 5 A (secondary)	Measuring frequencies: 16.7 Hz; 50 Hz; 60 Hz	(0.05 % ; 1.5‘)	Measurement uncertainty of ratio in %; Measurement uncertainty of phase displacement in ‘
Voltage ratio and phase displacement	0.1 kV to 72 kV (primary) 0.1 kV; 0.1 kV/√3; 0.11 kV; 0.11 kV/√3; 0.2 kV (secondary)	Measuring frequencies: 16.7 Hz; 50 Hz; 60 Hz	(0.05 % ; 1.5‘)	Measurement uncertainty of ratio in %; Measurement uncertainty of phase displacement in ‘
Heating oven and climatic chambers	25 °C to 100 °C > 100 °C to 250 °C	DKD-R 5-7:2018 mehod A, B and C	1.0 K 2.0 K	Comparison with resistance thermometers
DC voltage */ Sensors and measuring systems	1 kV to 30 kV > 30 kV to 200 kV		0.3 % 0.7 %	Determination of scale factor and linearity according IEC 60060-2:2010
AC voltage */ sensors and measuring systems	1 kV to 72 kV	16.7 Hz; 50 Hz; 60 Hz	0.3 %	Determination of scale factor and linearity according to IEC 60060-2:2010
	1 kV to 200 kV	20 Hz bis 200 Hz	0.7 %	
Lightning impulse voltage (*LI*)*/ measuring instruments, time parameters T_1 T_2	9 V to 1600 V 0.8 µs to 1.6 µs 60 µs		0.6 % 2.2 % 2.2 %	Determination of scale factor and linearity according to IEC 60060-2:2010, IEC 60060-3:2006
Lightning impulse voltage (*LI*)* Peak value / sensors and measuring systems time parameters T_1 T_2	500 V to 150 kV 150 kV to 500 kV 0.8 µs to 1.6 µs 40 µs to 60 µs		0.8 % 1 % 5 % 3 %	Determination of scale factor and linearity and determination of time parameters according to IEC 61083:2001

[1)] The expanded uncertainties according to EA-4/02 M:2013 are part of CMC and are the best measurement uncertainties within accreditation. They have a coverage probability of approximately 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

On-site Calibration

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Switching impulse voltage (*SI*)*/	9 V to 1600 V		0.6%	Determination of scale factor and linearity and determination of time parameters according to IEC 60060-2:2010
measuring instruments				
time parameters				
T_p	20 µs		2.2%	
T_2	250 µs		2.2%	
	2500 µs		1.0%	
	4000 µs		1.0%	
Switching impulse voltage (*SI*)*				Scale factor determination, linearity and time parameter determination according to IEC 60060-2:2010
Peak value / sensors and measuring system	500 V to 500 kV		1 %	
time parameter				
T_p	200 µs to 300 µs		3 %	
T_2	1000µs to 4000 µs		3 %	
Impulse charge */ calibrators and partial discharge measuring devices	1 pC to 10 nC	IEC 60270:2000 AMD1:2015	0.02 q + 0.2 pC	q = Measured value
Rise time and Impulse width / Partial discharge calibrators, amplifier and sensors	1 ns to 1 ms	Measurement with oscilloscope	5 %	Rise time: the time required for a pulse to rise from 10 % to 90 % of its steady value
Pulse duration / Partial discharge calibrators	10 ns to 1 s	Measurement with oscilloscope	2 %	Pulse duration: time between the 10% values of the amplitude of the rising edge and the falling edge of the charge pulse
Current AC / shunt. Rogowski-measuring systems; current transformer	5 A to 40 kA	IEC 62475:2010	0.3 %	Measurement RMS; 50 Hz; Continuous current
	100 A to 140 kA		1.0 %	Measurement RMS; 50 Hz; short time current
	250 A to 350 kA		1.0 %	Measurement peak; 50 Hz; short time current

[1)] The expanded uncertainties according to EA-4/02 M:2013 are part of CMC and are the best measurement uncertainties within accreditation. They have a coverage probability of approximately 95 % and have a coverage factor of k = 2 unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

On-site Calibration

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
impulse current / Shunt, Rogowski-measuring systems; current transformer	20 A to 8 kA	IEC 62475:2010	1.0 %	Measurement peak; 8/20 µs impulse current
Impulse current; time parameters	6 µs to 24 µs	IEC 62475:2010	3.0 %	Measurement front time and time to half value

Abbreviations used:

AMD1	Amendment 1 (Neufassung)
CMC	Calibration and measurement capabilities (Kalibrier- und Messmöglichkeiten)
IEC	International Electrotechnical Commission

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