

**Annex 01**

of 2009-12-15 to the accreditation certificate of the calibration laboratory **DKD-K-53101**

Registration number:

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at

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**Measured quantities:**

DC voltage  
DC current  
DC resistance  
AC voltage  
AC current

Head: Sr. Rodrigo Ramos Pradenas  
Deputy: Sr. Daniel Cárcamo Mayorga

Accredited since: 2009-12-15

**Permanent Laboratory**

Measured quantity / Calibration item	Range	Measurement conditions / procedure	Best measurement capability <sup>1)</sup>	Remarks
DC Voltage Calibrators Zener voltage standards	0.1 V 1 V; 10 V 100 V 1000 V 0.01 V to 0.1 V >0.1 V to 1 V >1 V to 10 V >10 V to 100 V >100 V to 1000 V		$2.3 \cdot 10^{-6} \cdot U$ $1.2 \cdot 10^{-6} \cdot U$ $1.2 \cdot 10^{-6} \cdot U$ $1.4 \cdot 10^{-6} \cdot U$ $3.3 \cdot 10^{-6} \cdot U + 0.7 \mu V$ $3.3 \cdot 10^{-6} \cdot U + 0.6 \mu V$ $3.5 \cdot 10^{-6} \cdot U + 0.7 \mu V$ $5.8 \cdot 10^{-6} \cdot U + 35 \mu V$ $15 \cdot 10^{-6} \cdot U + 50 \mu V$	$U =$ measured voltage
DC Voltage Meters	0.1 V 1 V 10 V 100 V 1000 V 22 mV to 220 mV >220 mV to 2.2 V >2.2 V to 22 V >22 V to 220 V >220 V to 1000 V		$8.5 \cdot 10^{-6} \cdot U$ $2.1 \cdot 10^{-6} \cdot U$ $2.0 \cdot 10^{-6} \cdot U$ $2.0 \cdot 10^{-6} \cdot U$ $3.0 \cdot 10^{-6} \cdot U$ $8.0 \cdot 10^{-6} \cdot U + 0.8 \mu V$ $7.0 \cdot 10^{-6} \cdot U + 1.2 \mu V$ $7.0 \cdot 10^{-6} \cdot U + 7.0 \mu V$ $8.0 \cdot 10^{-6} \cdot U + 80 \mu V$ $10 \cdot 10^{-6} \cdot U + 0.5 mV$	$U =$ measured voltage
DC Current Calibrators	0.1 mA 1.0 mA; 10 mA 100 mA 1.0 A 10 A 0.1 mA to 1 mA >1 mA to 10 mA >10 mA to 100 mA >100 mA to 1 A >1 A to 3 A > A to 20 A		$9.0 \cdot 10^{-6} \cdot I$ $5.0 \cdot 10^{-6} \cdot I$ $8.0 \cdot 10^{-6} \cdot I$ $22 \cdot 10^{-6} \cdot I$ $25 \cdot 10^{-6} \cdot I$ $15 \cdot 10^{-6} \cdot I$ $14 \cdot 10^{-6} \cdot I$ $15 \cdot 10^{-6} \cdot I$ $56 \cdot 10^{-6} \cdot I$ $60 \cdot 10^{-6} \cdot I$ $70 \cdot 10^{-6} \cdot I$	$I =$ measured current
DC Current Meters	0.1 mA 1.0 mA; 10 mA 100 mA 1.0 A 10 A 0.1 mA to 22 mA >0.22 mA to 2.2 mA >2.2 mA to 22 mA >22 mA to 220 mA >220 mA to 2.2 A > 4 A to 20 A		$10 \cdot 10^{-6} \cdot I$ $6.0 \cdot 10^{-6} \cdot I$ $9.0 \cdot 10^{-6} \cdot I$ $22 \cdot 10^{-6} \cdot I$ $26 \cdot 10^{-6} \cdot I$ $32 \cdot 10^{-6} \cdot I + 9.0 nA$ $25 \cdot 10^{-6} \cdot I + 7.0 nA$ $25 \cdot 10^{-6} \cdot I + 40 nA$ $35 \cdot 10^{-6} \cdot I + 0.7 \mu A$ $50 \cdot 10^{-6} \cdot I + 12 \mu A$ $0.25 \cdot 10^{-3} \cdot I + 0.5 mA$	$I =$ measured current

The best measurement capabilities are stated according to DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 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.

Measured quantity / Calibration item	Range	Measurement conditions / procedure	Best measurement capability <sup>1)</sup>	Remarks
DC Resistance Calibrators	1 Ω 10 Ω; 100 Ω; 1 kΩ; 10 kΩ; 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 Ω to 10 Ω >10 Ω to 100 Ω >0.1 kΩ to 1 kΩ >1 kΩ to 10 kΩ >10 kΩ to 100 kΩ >0.1 MΩ to 1 MΩ >1 MΩ to 10 MΩ >10 MΩ to 100 MΩ >100MΩ to 1 GΩ		$8.0 \cdot 10^{-6} \cdot R$ $5.0 \cdot 10^{-6} \cdot R$ $7.0 \cdot 10^{-6} \cdot R$ $13 \cdot 10^{-6} \cdot R$ $18 \cdot 10^{-6} \cdot R$ $32 \cdot 10^{-6} \cdot R$ $6.5 \cdot 10^{-6} \cdot R + 12 \mu\Omega$ $4.0 \cdot 10^{-6} \cdot R + 72 \mu\Omega$ $4.0 \cdot 10^{-6} \cdot R + 60 \mu\Omega$ $4.0 \cdot 10^{-6} \cdot R + 0.5 \text{ m}\Omega$ $6.0 \cdot 10^{-6} \cdot R + 2.7 \text{ m}\Omega$ $12 \cdot 10^{-6} \cdot R + 0.1 \Omega$ $18 \cdot 10^{-6} \cdot R + 6.7 \Omega$ $67 \cdot 10^{-6} \cdot R + 0.55 \text{ k}\Omega$ $0.59 \cdot 10^{-3} \cdot R + 6.0 \text{ k}\Omega$	$R =$ measured resistance
DC Resistance Resistance meters	1 Ω; 10 Ω; 100 Ω 1 kΩ; 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 GΩ		$4.0 \cdot 10^{-6} \cdot R$ $4.0 \cdot 10^{-6} \cdot R$ $6.0 \cdot 10^{-6} \cdot R$ $12 \cdot 10^{-6} \cdot R$ $17 \cdot 10^{-6} \cdot R$ $31 \cdot 10^{-6} \cdot R$ $86 \cdot 10^{-6} \cdot R$	$R =$ measured resistance
AC Voltage Calibrators Meters	0.1 V  0.2 V  0.6 V  1 V  2 V  6 V	10 Hz 40 Hz 1 kHz 10 kHz 100 kHz 1 MHz  10 Hz 40 Hz 1 kHz 10 kHz 100 kHz 1 MHz  40 Hz 1 kHz 10 kHz 100 kHz 1 MHz  10 Hz 40 Hz 1 kHz 10 kHz 100 kHz 1 MHz  10 Hz 40 Hz 1 kHz 10 kHz 100 kHz 1 MHz  10 Hz 40 Hz 1 kHz 10 kHz 100 kHz 1 MHz	$28 \cdot 10^{-6} \cdot U$ $28 \cdot 10^{-6} \cdot U$ $18 \cdot 10^{-6} \cdot U$ $17 \cdot 10^{-6} \cdot U$ $18 \cdot 10^{-6} \cdot U$ $56 \cdot 10^{-6} \cdot U$  $32 \cdot 10^{-6} \cdot U$ $30 \cdot 10^{-6} \cdot U$ $19 \cdot 10^{-6} \cdot U$ $19 \cdot 10^{-6} \cdot U$ $21 \cdot 10^{-6} \cdot U$ $54 \cdot 10^{-6} \cdot U$  $13 \cdot 10^{-6} \cdot U$ $12 \cdot 10^{-6} \cdot U$ $13 \cdot 10^{-6} \cdot U$ $17 \cdot 10^{-6} \cdot U$ $48 \cdot 10^{-6} \cdot U$  $24 \cdot 10^{-6} \cdot U$ $17 \cdot 10^{-6} \cdot U$ $20 \cdot 10^{-6} \cdot U$ $20 \cdot 10^{-6} \cdot U$ $29 \cdot 10^{-6} \cdot U$ $62 \cdot 10^{-6} \cdot U$  $83 \cdot 10^{-6} \cdot U$ $26 \cdot 10^{-6} \cdot U$ $25 \cdot 10^{-6} \cdot U$ $25 \cdot 10^{-6} \cdot U$ $27 \cdot 10^{-6} \cdot U$ $59 \cdot 10^{-6} \cdot U$  $15 \cdot 10^{-6} \cdot U$ $13 \cdot 10^{-6} \cdot U$ $11 \cdot 10^{-6} \cdot U$ $11 \cdot 10^{-6} \cdot U$ $13 \cdot 10^{-6} \cdot U$ $41 \cdot 10^{-6} \cdot U$	$U =$ measured voltage

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Measured quantity / Calibration item	Range	Measurement conditions / procedure	Best measurement capability <sup>1)</sup>	Remarks	
AC Voltage Calibrators Meters	10 V	10 Hz	$14 \cdot 10^{-6} \cdot U$	$U =$ measured voltage	
		40 Hz	$12 \cdot 10^{-6} \cdot U$		
		1 kHz	$10 \cdot 10^{-6} \cdot U$		
		10 kHz	$10 \cdot 10^{-6} \cdot U$		
		100 kHz	$12 \cdot 10^{-6} \cdot U$		
		1 MHz	$61 \cdot 10^{-6} \cdot U$		
		20 V	10 Hz		$21 \cdot 10^{-6} \cdot U$
			40 Hz		$15 \cdot 10^{-6} \cdot U$
1 kHz	$12 \cdot 10^{-6} \cdot U$				
10 kHz	$12 \cdot 10^{-6} \cdot U$				
100 kHz	$21 \cdot 10^{-6} \cdot U$				
60 V	10 Hz	$28 \cdot 10^{-6} \cdot U$			
	40 Hz	$11 \cdot 10^{-6} \cdot U$			
	1 kHz	$11 \cdot 10^{-6} \cdot U$			
	100 kHz	$28 \cdot 10^{-6} \cdot U$			
100 V	10 Hz	$34 \cdot 10^{-6} \cdot U$			
	20 Hz	$28 \cdot 10^{-6} \cdot U$			
	40 Hz	$29 \cdot 10^{-6} \cdot U$			
	1 kHz	$19 \cdot 10^{-6} \cdot U$			
	10 kHz	$19 \cdot 10^{-6} \cdot U$			
200 V	10 Hz	$39 \cdot 10^{-6} \cdot U$			
	20 Hz	$28 \cdot 10^{-6} \cdot U$			
	40 Hz	$28 \cdot 10^{-6} \cdot U$			
	1 kHz	$18 \cdot 10^{-6} \cdot U$			
	10 kHz	$18 \cdot 10^{-6} \cdot U$			
600 V	55 Hz	$41 \cdot 10^{-6} \cdot U$			
	1 kHz	$29 \cdot 10^{-6} \cdot U$			
1000 V	55 Hz	$40 \cdot 10^{-6} \cdot U$			
	1 kHz	$29 \cdot 10^{-6} \cdot U$			
AC Voltage Calibrators	0.1 V to 0.22 V	40 Hz to 20 kHz	$37 \cdot 10^{-6} \cdot U + 1.5 \mu\text{V}$	$U =$ measured voltage	
		20 kHz to 50 kHz	$69 \cdot 10^{-6} \cdot U + 2.0 \mu\text{V}$		
		50 kHz to 100 kHz	$160 \cdot 10^{-6} \cdot U + 2.5 \mu\text{V}$		
	>0.22 V to 0.7 V	40 Hz to 20 kHz	$31 \cdot 10^{-6} \cdot U + 1.5 \mu\text{V}$		
		20 kHz to 50 kHz	$50 \cdot 10^{-6} \cdot U + 2.0 \mu\text{V}$		
		50 kHz to 100 kHz	$79 \cdot 10^{-6} \cdot U + 2.5 \mu\text{V}$		
	>0.7 V to 2.2 V	40 Hz to 20 kHz	$29 \cdot 10^{-6} \cdot U$		
		20 kHz to 50 kHz	$45 \cdot 10^{-6} \cdot U$		
		50 kHz to 100 kHz	$70 \cdot 10^{-6} \cdot U$		
	>2.2 V to 7 V	40 Hz to 20 kHz	$22 \cdot 10^{-6} \cdot U$		
20 kHz to 50 kHz		$46 \cdot 10^{-6} \cdot U$			
50 kHz to 100 kHz		$80 \cdot 10^{-6} \cdot U$			
>7 V to 22 V	40 Hz to 20 kHz	$25 \cdot 10^{-6} \cdot U$			
	20 kHz to 50 kHz	$46 \cdot 10^{-6} \cdot U$			
	50 kHz to 100 kHz	$80 \cdot 10^{-6} \cdot U$			
>22 V to 70 V	40 Hz to 20 kHz	$30 \cdot 10^{-6} \cdot U$			
	20 kHz to 50 kHz	$56 \cdot 10^{-6} \cdot U$			
	50 kHz to 100 kHz	$91 \cdot 10^{-6} \cdot U$			
>70 V to 220 V	40 Hz to 20 kHz	$38 \cdot 10^{-6} \cdot U$			
	20 kHz to 50 kHz	$67 \cdot 10^{-6} \cdot U$			
	50 kHz to 100 kHz	$96 \cdot 10^{-6} \cdot U$			
>220 V to 700 V	40 Hz to 20 kHz	$47 \cdot 10^{-6} \cdot U$			
>700 V to 1000 V	40 Hz to 20 kHz	$44 \cdot 10^{-6} \cdot U$			
AC Current Calibrators	10 mA	55 Hz	$39 \cdot 10^{-6} \cdot I$	$I =$ measured current	
		1 kHz	$48 \cdot 10^{-6} \cdot I$		
	100 mA	55 Hz; 1 kHz	$24 \cdot 10^{-6} \cdot I$		
	1 A	$30 \cdot 10^{-6} \cdot I$			
10 A; 20 A	$46 \cdot 10^{-6} \cdot I$				

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Measured quantity / Calibration item	Range	Measurement conditions / procedure	Best measurement capability <sup>1)</sup>	Remarks
AC Current Meters	10 mA	55 Hz 1 kHz	$40 \cdot 10^{-6} \cdot I$ $48 \cdot 10^{-6} \cdot I$	I = measured current
	100 mA	55 Hz 1 kHz	$26 \cdot 10^{-6} \cdot I$ $25 \cdot 10^{-6} \cdot I$	
	1 A	55 Hz 1 kHz	$33 \cdot 10^{-6} \cdot I$ $31 \cdot 10^{-6} \cdot I$	
	10 A; 20 A	55 Hz 1 kHz	$47 \cdot 10^{-6} \cdot I$ $47 \cdot 10^{-6} \cdot I$	

The best measurement capabilities are stated according to DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 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.