

# Deutsche Akkreditierungsstelle GmbH

## Annex to the Accreditation Certificate D-K-15155-01-00 according to ISO/IEC 17025:2005

Period of validity: 2014-12-08 to 2019-12-07

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Holder of certificate:

**Laboratorio Custodio Patrón Nacional de Magnitudes Eléctricas – LCPN-ME  
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Accredited since: 2009-12-15

Calibrations in the fields:

### **Electrical Quantities**

#### **DC and low frequency quantities**

- DC voltage
- DC current
- DC resistance
- AC voltage
- AC current
- Electric energy

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Permanent Laboratory

Measured quantity / Calibration item	Range	Measurement conditions / Procedure	Best measurement capability <sup>1)</sup>	Remarks
DC voltage Calibrators	0.1 V		$2.3 \cdot 10^{-6} \cdot U$	U= measured value
	0.2 V		$4.0 \cdot 10^{-6} \cdot U$	
	0.6 V		$2.0 \cdot 10^{-6} \cdot U$	
	1 V		$1.2 \cdot 10^{-6} \cdot U$	
	2 V; 6 V		$2.0 \cdot 10^{-6} \cdot U$	
	10 V		$1.2 \cdot 10^{-6} \cdot U$	
	20 V; 60 V		$2.0 \cdot 10^{-6} \cdot U$	
	100 V		$1.2 \cdot 10^{-6} \cdot U$	
	200 V		$2.0 \cdot 10^{-6} \cdot U$	
	600 V		$3.0 \cdot 10^{-6} \cdot U$	
	1000 V		$1.4 \cdot 10^{-6} \cdot U$	
	> 0.01 V to 0.1 V		$3.3 \cdot 10^{-6} \cdot U + 0.7 \mu\text{V}$	
	> 0.1 V to 1 V		$3.3 \cdot 10^{-6} \cdot U + 0.6 \mu\text{V}$	
	> 1 V to 10 V		$3.5 \cdot 10^{-6} \cdot U + 0.7 \mu\text{V}$	
> 10 V to 100 V		$5.8 \cdot 10^{-6} \cdot U + 35 \mu\text{V}$		
> 100 V to 1000 V		$15 \cdot 10^{-6} \cdot U + 50 \mu\text{V}$		
DC voltage Meters	0.1 V; 0.2 V		$6.5 \cdot 10^{-6} \cdot U$	U= measured value
	0.6 V		$4.0 \cdot 10^{-6} \cdot U$	
	1 V		$2.1 \cdot 10^{-6} \cdot U$	
	2 V; 6 V		$3.5 \cdot 10^{-6} \cdot U$	
	10 V		$2.0 \cdot 10^{-6} \cdot U$	
	20 V; 60 V		$3.5 \cdot 10^{-6} \cdot U$	
	100 V		$2.0 \cdot 10^{-6} \cdot U$	
	200 V		$4.5 \cdot 10^{-6} \cdot U$	
	600 V		$6.5 \cdot 10^{-6} \cdot U$	
	1000 V		$3.0 \cdot 10^{-6} \cdot U$	
	22 mV to 220 mV		$7.0 \cdot 10^{-6} \cdot U + 0.7 \mu\text{V}$	
	> 0.22 V to 2.2 V		$5.0 \cdot 10^{-6} \cdot U + 0.9 \mu\text{V}$	
	> 2.2 V to 22 V		$3.5 \cdot 10^{-6} \cdot U + 5.0 \mu\text{V}$	
	> 22 V to 220 V		$5.0 \cdot 10^{-6} \cdot U + 45 \mu\text{V}$	
> 220 V to 1000 V		$8.0 \cdot 10^{-6} \cdot U + 0.4 \text{ mV}$		
DC current Calibrators	0.1 mA		$4.0 \cdot 10^{-6} \cdot I$	I= measured value
	0.2 mA		$7.0 \cdot 10^{-6} \cdot I$	
	1 mA		$4.0 \cdot 10^{-6} \cdot I$	
	2 mA		$6.0 \cdot 10^{-6} \cdot I$	
	10 mA		$4.0 \cdot 10^{-6} \cdot I$	
	20 mA; 30 mA		$8.0 \cdot 10^{-6} \cdot I$	
	50 mA; 100 mA		$8.0 \cdot 10^{-6} \cdot I$	
	200 mA		$10 \cdot 10^{-6} \cdot I$	
	300 mA; 500 mA		$22 \cdot 10^{-6} \cdot I$	
	1 A		$15 \cdot 10^{-6} \cdot I$	
	2 A		$30 \cdot 10^{-6} \cdot I$	
	3 A; 5 A		$25 \cdot 10^{-6} \cdot I$	
	10 A		$20 \cdot 10^{-6} \cdot I$	
	20 A		$30 \cdot 10^{-6} \cdot I$	
	> 0.1 mA to 1 mA		$9.0 \cdot 10^{-6} \cdot I$	
	> 1 mA to 10 mA		$7.0 \cdot 10^{-6} \cdot I$	
	> 10 mA to 100 mA		$8.0 \cdot 10^{-6} \cdot I$	
	> 100 mA to 1000 mA		$39 \cdot 10^{-6} \cdot I$	
	> 1 A to 3 A		$60 \cdot 10^{-6} \cdot I$	
	> 3 A to 20 A		$70 \cdot 10^{-6} \cdot I$	

<sup>1)</sup> The best measurement capabilities are stated according to 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.

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Measured quantity / Calibration item	Range	Measurement conditions / Procedure	Best measurement capability <sup>1)</sup>	Remarks
DC current Meters	0.1 mA		$5.0 \cdot 10^{-6} \cdot I$	I= measured value
	0.2 mA		$8.0 \cdot 10^{-6} \cdot I$	
	1 mA		$5.0 \cdot 10^{-6} \cdot I$	
	2 mA		$7.0 \cdot 10^{-6} \cdot I$	
	10 mA		$5.0 \cdot 10^{-6} \cdot I$	
	20 mA		$9.0 \cdot 10^{-6} \cdot I$	
	30 mA; 50 mA		$10 \cdot 10^{-6} \cdot I$	
	100 mA		$9.0 \cdot 10^{-6} \cdot I$	
	200 mA		$11 \cdot 10^{-6} \cdot I$	
	300 mA; 500 mA		$24 \cdot 10^{-6} \cdot I$	
	1 A		$21 \cdot 10^{-6} \cdot I$	
	2 A; 3 A; 5 A		$32 \cdot 10^{-6} \cdot I$	
	10 A		$26 \cdot 10^{-6} \cdot I$	
	20 A		$40 \cdot 10^{-6} \cdot I$	
	> 0.1 mA to 0.22 mA		$32 \cdot 10^{-6} \cdot I + 9.0 \text{ nA}$	
	> 0.22 mA to 2.2 mA		$25 \cdot 10^{-6} \cdot I + 7.0 \text{ nA}$	
	> 2.2 mA to 22 mA		$25 \cdot 10^{-6} \cdot I + 40 \text{ nA}$	
	> 22 mA to 220 mA		$35 \cdot 10^{-6} \cdot I + 0.7 \mu\text{A}$	
> 0.22 A to 2.2 A		$50 \cdot 10^{-6} \cdot I + 12 \mu\text{A}$		
> 4 A to 20 A		$0.25 \cdot 10^{-3} \cdot I + 0.2 \text{ mA}$		
DC resistance Calibrators	1 Ω		$4.0 \cdot 10^{-6} \cdot R$	R= measured value
	10 Ω		$3.5 \cdot 10^{-6} \cdot R$	
	100 Ω		$3.5 \cdot 10^{-6} \cdot R$	
	1 kΩ		$3.5 \cdot 10^{-6} \cdot R$	
	10 kΩ		$3.5 \cdot 10^{-6} \cdot R$	
	100 kΩ		$5.0 \cdot 10^{-6} \cdot R$	
	1 MΩ		$10 \cdot 10^{-6} \cdot R$	
	10 MΩ		$12 \cdot 10^{-6} \cdot R$	
	100 MΩ		$25 \cdot 10^{-6} \cdot R$	
	1 Ω to 10 Ω		$6.5 \cdot 10^{-6} \cdot R + 12 \mu\Omega$	
	> 10 Ω to 100Ω		$4.0 \cdot 10^{-6} \cdot R + 72 \mu\Omega$	
	> 0.1 kΩ to 1 kΩ		$4.0 \cdot 10^{-6} \cdot R + 60 \mu\Omega$	
	> 1 kΩ to 10 kΩ		$4.0 \cdot 10^{-6} \cdot R + 0.5 \text{ m}\Omega$	
	> 10 kΩ to 100 kΩ		$6.0 \cdot 10^{-6} \cdot R + 2.7 \text{ m}\Omega$	
	> 0.1 MΩ to 1 MΩ		$12 \cdot 10^{-6} \cdot R + 0.1 \Omega$	
	> 1 MΩ to 10 MΩ		$18 \cdot 10^{-6} \cdot R + 6.7 \Omega$	
	> 10 MΩ to 100 MΩ		$67 \cdot 10^{-6} \cdot R + 0.55 \text{ k}\Omega$	
	> 0.1 GΩ to 1 GΩ		$0.59 \cdot 10^{-3} \cdot R + 6.0 \text{ k}\Omega$	
DC resistance Meters	1 Ω		$2.0 \cdot 10^{-6} \cdot R$	R= measured value
	10 Ω		$2.0 \cdot 10^{-6} \cdot R$	
	100 Ω		$2.0 \cdot 10^{-6} \cdot R$	
	1 kΩ		$2.0 \cdot 10^{-6} \cdot R$	
	10 kΩ		$2.0 \cdot 10^{-6} \cdot R$	
	100 kΩ		$3.0 \cdot 10^{-6} \cdot R$	
	1 MΩ		$6.0 \cdot 10^{-6} \cdot R$	
	10 MΩ		$8.0 \cdot 10^{-6} \cdot R$	
	100 MΩ		$23 \cdot 10^{-6} \cdot R$	
	1 GΩ		$50 \cdot 10^{-6} \cdot R$	

<sup>1)</sup> The best measurement capabilities are stated according to 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.

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Measured quantity / Calibration item	Range	Measurement conditions / Procedure	Best measurement capability <sup>1)</sup>	Remarks
AC voltage Meters / Calibrators	0.1 V	20 Hz	$35 \cdot 10^{-6} \cdot U$	U= measured value
		40 Hz	$28 \cdot 10^{-6} \cdot U$	
		1 kHz	$27 \cdot 10^{-6} \cdot U$	
		10 kHz	$27 \cdot 10^{-6} \cdot U$	
		100 kHz	$61 \cdot 10^{-6} \cdot U$	
		1 MHz	$56 \cdot 10^{-6} \cdot U$	
	0.2 V	20 Hz	$30 \cdot 10^{-6} \cdot U$	
		40 Hz	$30 \cdot 10^{-6} \cdot U$	
		1 kHz	$19 \cdot 10^{-6} \cdot U$	
		10 kHz	$19 \cdot 10^{-6} \cdot U$	
		100 kHz	$21 \cdot 10^{-6} \cdot U$	
		1 MHz	$54 \cdot 10^{-6} \cdot U$	
	0.6 V	40 Hz	$13 \cdot 10^{-6} \cdot U$	
		1 kHz	$12 \cdot 10^{-6} \cdot U$	
		10 kHz	$13 \cdot 10^{-6} \cdot U$	
		100 kHz	$17 \cdot 10^{-6} \cdot U$	
	1 V	40 Hz	$17 \cdot 10^{-6} \cdot U$	
		1 kHz	$12 \cdot 10^{-6} \cdot U$	
		10 kHz	$12 \cdot 10^{-6} \cdot U$	
		100 kHz	$17 \cdot 10^{-6} \cdot U$	
		1 MHz	$62 \cdot 10^{-6} \cdot U$	
		2 V	$20 \cdot 10^{-6} \cdot U$	
	2 V	20 Hz	$20 \cdot 10^{-6} \cdot U$	
		40 Hz	$18 \cdot 10^{-6} \cdot U$	
		1 kHz	$15 \cdot 10^{-6} \cdot U$	
		10 kHz	$17 \cdot 10^{-6} \cdot U$	
		100 kHz	$19 \cdot 10^{-6} \cdot U$	
		1 MHz	$59 \cdot 10^{-6} \cdot U$	
	6 V	20 Hz	$20 \cdot 10^{-6} \cdot U$	
		40 Hz	$13 \cdot 10^{-6} \cdot U$	
1 kHz		$12 \cdot 10^{-6} \cdot U$		
10 kHz		$12 \cdot 10^{-6} \cdot U$		
100 kHz		$15 \cdot 10^{-6} \cdot U$		
1 MHz		$41 \cdot 10^{-6} \cdot U$		
10 V	20 Hz	$16 \cdot 10^{-6} \cdot U$		
	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	$13 \cdot 10^{-6} \cdot U$		
	1 MHz	$61 \cdot 10^{-6} \cdot U$		
20 V	20 Hz	$18 \cdot 10^{-6} \cdot U$		
	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	$21 \cdot 10^{-6} \cdot U$		

<sup>1)</sup> The best measurement capabilities are stated according to 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.

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Measured quantity / Calibration item	Range	Measurement conditions / Procedure	Best measurement capability <sup>1)</sup>	Remarks
AC voltage Meters / Calibrators	60 V	20 Hz	$28 \cdot 10^{-6} \cdot U$	U= measured value
		40 Hz	$17 \cdot 10^{-6} \cdot U$	
		1 kHz	$15 \cdot 10^{-6} \cdot U$	
		10 kHz	$15 \cdot 10^{-6} \cdot U$	
		100 kHz	$30 \cdot 10^{-6} \cdot U$	
	100 V	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	$19 \cdot 10^{-6} \cdot U$	
		100 kHz	$34 \cdot 10^{-6} \cdot U$	
	200 V	20 Hz	$28 \cdot 10^{-6} \cdot U$	
		40 Hz	$28 \cdot 10^{-6} \cdot U$	
		1 kHz	$22 \cdot 10^{-6} \cdot U$	
		10 kHz	$21 \cdot 10^{-6} \cdot U$	
		100 kHz	$42 \cdot 10^{-6} \cdot U$	
	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	$38 \cdot 10^{-6} \cdot U + 1.5 \mu\text{V}$	U= measured value  Fluke 5790A
		50 kHz to 100 kHz	$0.16 \cdot 10^{-3} \cdot U + 2.5 \mu\text{V}$	
		500 kHz to 1 MHz	$1.0 \cdot 10^{-3} \cdot U + 8.0 \mu\text{V}$	
	> 0.22 V to 0.7 V	40 Hz to 20 kHz	$33 \cdot 10^{-6} \cdot U + 1.5 \mu\text{V}$	
		50 kHz to 100 kHz	$79 \cdot 10^{-6} \cdot U + 2.5 \mu\text{V}$	
		500 kHz to 1 MHz	$0.96 \cdot 10^{-3} \cdot U + 8.0 \mu\text{V}$	
	> 0.7 V to 2.2 V	40 Hz to 20 kHz	$24 \cdot 10^{-6} \cdot U$	
		50 kHz to 100 kHz	$71 \cdot 10^{-6} \cdot U$	
		500 kHz to 1 MHz	$0.9 \cdot 10^{-3} \cdot U$	
	> 2.2 V to 7 V	40 Hz to 20 kHz	$24 \cdot 10^{-6} \cdot U$	
		50 kHz to 100 kHz	$81 \cdot 10^{-6} \cdot U$	
		500 kHz to 1 MHz	$1.2 \cdot 10^{-3} \cdot U$	
	> 7 V to 22 V	40 Hz to 20 kHz	$27 \cdot 10^{-6} \cdot U$	
		50 kHz to 100 kHz	$81 \cdot 10^{-6} \cdot U$	
		500 kHz to 1 MHz	$1.2 \cdot 10^{-3} \cdot U$	
	> 22 V to 70 V	40 Hz to 20 kHz	$32 \cdot 10^{-6} \cdot U$	
		50 kHz to 100 kHz	$94 \cdot 10^{-6} \cdot U$	
		500 kHz to 1 MHz	$1.2 \cdot 10^{-3} \cdot U$	
	> 70 V to 220 V	40 Hz to 20 kHz	$38 \cdot 10^{-6} \cdot U$	
		50 kHz to 100 kHz	$98 \cdot 10^{-6} \cdot U$	
> 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	$44 \cdot 10^{-6} \cdot U$		

<sup>1)</sup> The best measurement capabilities are stated according to 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.

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Measured quantity / Calibration item	Range	Measurement conditions / Procedure	Best measurement capability <sup>1)</sup>	Remarks
AC voltage Meters	0.1 V to 0.22 V	40 Hz to 20 kHz	$80 \cdot 10^{-6} \cdot U + 7.0 \mu\text{V}$	U= measured value Fluke 5720A
		50 kHz to 100 kHz	$0.46 \cdot 10^{-3} \cdot U + 17 \mu\text{V}$	
		500 kHz to 1 MHz	$2.7 \cdot 10^{-3} \cdot U + 45 \mu\text{V}$	
	> 0.22 V to 2.2 V	40 Hz to 20 kHz	$45 \cdot 10^{-6} \cdot U + 8.0 \mu\text{V}$	
		50 kHz to 100 kHz	$0.11 \cdot 10^{-3} \cdot U + 30 \mu\text{V}$	
		500 kHz to 1 MHz	$1.7 \cdot 10^{-3} \cdot U + 0.3 \text{ mV}$	
	> 2.2 V to 22 V	40 Hz to 20 kHz	$45 \cdot 10^{-6} \cdot U + 50 \mu\text{V}$	
		50 kHz to 100 kHz	$0.1 \cdot 10^{-3} \cdot U + 0.2 \text{ mV}$	
	> 2.2 V to 10 V	500 kHz to 1 MHz	$1.5 \cdot 10^{-3} \cdot U + 3.2 \text{ mV}$	
	> 22 V to 220 V	20 Hz to 40 Hz	$90 \cdot 10^{-6} \cdot U + 1.5 \text{ mV}$	
40 Hz to 20 kHz		$52 \cdot 10^{-6} \cdot U + 0.6 \text{ mV}$		
50 kHz to 100 kHz		$0.15 \cdot 10^{-3} \cdot U + 2.5 \text{ mV}$		
> 220 V to 1100 V	50 Hz to 1 kHz	$70 \cdot 10^{-6} \cdot U + 3.5 \text{ mV}$		
AC current Calibrators	10 mA	55 Hz; 1 kHz	$34 \cdot 10^{-6} \cdot I$	I= measured value
	20 mA		$57 \cdot 10^{-6} \cdot I$	
	30 mA		$62 \cdot 10^{-6} \cdot I$	
	50 mA		$57 \cdot 10^{-6} \cdot I$	
	100 mA		$57 \cdot 10^{-6} \cdot I$	
	200 mA		$62 \cdot 10^{-6} \cdot I$	
	300 mA		$64 \cdot 10^{-6} \cdot I$	
	500 mA		$68 \cdot 10^{-6} \cdot I$	
	1 A		$60 \cdot 10^{-6} \cdot I$	
	2 A		$72 \cdot 10^{-6} \cdot I$	
	3 A; 5 A		$71 \cdot 10^{-6} \cdot I$	
	10 A; 20 A		$0.12 \cdot 10^{-3} \cdot I$	
AC current Meters	10 mA	55 Hz; 1 kHz	$37 \cdot 10^{-6} \cdot I$	I= measured value
	20 mA		$60 \cdot 10^{-6} \cdot I$	
	30 mA		$65 \cdot 10^{-6} \cdot I$	
	50 mA		$65 \cdot 10^{-6} \cdot I$	
	100 mA		$60 \cdot 10^{-6} \cdot I$	
	200 mA		$67 \cdot 10^{-6} \cdot I$	
	300 mA		$67 \cdot 10^{-6} \cdot I$	
	500 mA		$67 \cdot 10^{-6} \cdot I$	
	1 A		$65 \cdot 10^{-6} \cdot I$	
	2 A		$73 \cdot 10^{-6} \cdot I$	
	3 A; 5 A		$75 \cdot 10^{-6} \cdot I$	
	10 A; 20 A		$0.13 \cdot 10^{-3} \cdot I$	
AC energy three phase, active energy	3.6 Wh to 86.4 kWh	Voltage: 60V / 120 V / 240 V Current: 0.01 A to 0.05 A Frequency: 50 Hz to 60 Hz Phase angle: -60°, 0°, 60°	$0.18 \cdot 10^{-3} \cdot E$	E = measured value ZERA COM 3003
		Voltage: 60V / 120 V / 240 V Current: 0.05 A to 120 A Frequency: 50 Hz to 60 Hz Phase angle: -60°, 0°, 60°	$0.12 \cdot 10^{-3} \cdot E$	

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