

# Deutsche Akkreditierungsstelle GmbH

## Annex to the Accreditation Certificate D-K-15115-01-01 according to DIN EN ISO/IEC 17025:2005

**Valid from: 25.03.2020**

Date of issue: 25.03.2020

Holder of certificate:

**1A CAL GmbH**  
**Falderbaumstraße 23, 34123 Kassel**

Head: Karl-Peter Lallmann  
Deputy: Klaus Reitze  
Marc-Gunnar Schröder  
Michael Becker

Accredited as calibration laboratory since: 10.12.2010

Calibration in the fields:

### Electrical quantities

#### DC and low frequency quantities

- DC voltage \*)
- DC current \*)
- DC resistance
- AC voltage \*)
- AC current \*)
- AC/DC transfer
- Capacitance

#### High frequency quantities

- HF voltage
- Oscilloscope quantities \*)
- Rise time \*)
- Band width \*)

### Time and frequency

- Frequency

\*) also on-site calibrations

Abbreviations used: see last page

*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>

**Annex to the accreditation certificate D-K-15115-01-01**

**Permanent Laboratory**

**Calibration and Measurement Capabilities (CMC)**

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
DC voltage Digital voltmeter	0.01 V to 10 V		13 nV	Comparison with Josephson voltage standard
Voltage standards	1 V; 1.018 V; 10 V		0.2 μV	
Linearity of digital voltmeters	0.01 V to 10 V		$\frac{23 \text{ nV}}{U_{\text{JPH}}}$	$U_{\text{JPH}}$ = Josephson standard potential
divider ratio	0.01 V to 10 V		$2 \cdot 10^{-9} \cdot \sqrt{23 + 67 \cdot \left(\frac{1}{k_{\text{UF}}}\right)^2}$	$k_{\text{UF}}$ = transmission factor of divider to be calibrated
measuring instruments	10 μV to 1 V		$0.2 \cdot 10^{-6} \cdot \sqrt{2.4 + \left(\frac{1.1\text{V}}{U}\right)^2}$	$U$ = voltage to be calibrated
	> 1 V to 10 V		$0.2 \cdot 10^{-6} \cdot \sqrt{0.3 + \left(\frac{1.1\text{V}}{U}\right)^2}$	
	> 10 V to 100 V		$0.34 \cdot 10^{-6}$	
	> 100 V to 1000 V		$0.63 \cdot 10^{-6}$	
measuring instruments and sources	10 μV to 10 V		$0.2 \cdot 10^{-6} \cdot \sqrt{0.7 + \left(\frac{1.1\text{V}}{U}\right)^2}$	$U$ = voltage to be calibrated
	> 10 V to 100 V		$0.3 \cdot 10^{-6}$	
	> 100 V to 1000 V		$0.6 \cdot 10^{-6}$	
High voltage sources and dividers	> 1000 V to 40 000 V		$0.15 \cdot 10^{-3}$	
DC current measuring instruments	0.1 μA		$35 \cdot 10^{-6}$	
	> 0.1 μA to < 1 μA		$15 \cdot 10^{-6}$	
	1 μA to < 10 μA		$8 \cdot 10^{-6}$	
	10 μA to 2 A		$7 \cdot 10^{-6}$	
	> 2 A to 10 A		$15 \cdot 10^{-6}$	
	> 10 A to 20 A		$20 \cdot 10^{-6}$	
Current clamps	0 A to 100 A		$0.5 \text{ mA} + 5 \cdot 10^{-3} \cdot I$	$I$ = measured value
	> 100 A to 1000 A		$5 \cdot 10^{-3}$	
Sources	0.1 μA		$35 \cdot 10^{-6}$	
	> 0.1 μA to < 1 μA		$7 \cdot 10^{-6}$	
	1 μA to 0.2 A		$6 \cdot 10^{-6}$	
	> 0.2 A to 2 A		$7 \cdot 10^{-6}$	
	> 2 A to 10 A		$12 \cdot 10^{-6}$	
	> 10 A to 20 A		$14 \cdot 10^{-6}$	

<sup>1)</sup> 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.

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
DC resistance resistors and measuring instruments	10 $\mu\Omega$ to < 100 $\mu\Omega$		$22 \cdot 10^{-6}$	
	100 $\mu\Omega$ to < 1 m $\Omega$		$4.6 \cdot 10^{-6}$	
	1 m $\Omega$ to < 10 m $\Omega$		$2.3 \cdot 10^{-6}$	
	10 m $\Omega$ to < 1 $\Omega$		$1.2 \cdot 10^{-6}$	
	1 $\Omega$ to < 10 k $\Omega$		$0.3 \cdot 10^{-6}$	
	10 k $\Omega$ to 1 M $\Omega$		$0.5 \cdot 10^{-6}$	
	> 1 M $\Omega$ to 100 M $\Omega$		$2 \cdot 10^{-6}$	
	> 100 M $\Omega$ to 1000 M $\Omega$		$8 \cdot 10^{-6}$	
	> 1 G $\Omega$ to 10 G $\Omega$		$1.1 \cdot 10^{-3}$	
DC power measuring instruments and calibrators	10 mW to 20 kW		$25 \cdot 10^{-6}$	
AC voltage measuring instruments	1 mV	10 Hz 20 Hz; 30 Hz 40 Hz; 55 Hz; 60 Hz 120 Hz; 300 Hz; 400 Hz 500 Hz; 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz; 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	$0.45 \cdot 10^{-3}$ $0.42 \cdot 10^{-3}$ $0.42 \cdot 10^{-3}$ $0.42 \cdot 10^{-3}$ $0.42 \cdot 10^{-3}$ $0.42 \cdot 10^{-3}$ $0.42 \cdot 10^{-3}$ $0.45 \cdot 10^{-3}$ $0.45 \cdot 10^{-3}$ $0.50 \cdot 10^{-3}$ $0.60 \cdot 10^{-3}$	Fluke 5790A measuring range: 2.2 mV
	2 mV	10 Hz 20 Hz; 30 Hz 40 Hz; 55 Hz; 60 Hz 120 Hz; 300 Hz; 400 Hz 500 Hz; 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz; 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	$0.22 \cdot 10^{-3}$ $0.20 \cdot 10^{-3}$ $0.20 \cdot 10^{-3}$ $0.20 \cdot 10^{-3}$ $0.20 \cdot 10^{-3}$ $0.20 \cdot 10^{-3}$ $0.20 \cdot 10^{-3}$ $0.22 \cdot 10^{-3}$ $0.22 \cdot 10^{-3}$ $0.25 \cdot 10^{-3}$ $0.30 \cdot 10^{-3}$	
	2 mV	10 Hz 20 Hz 30 Hz; 40 Hz; 55 Hz; 60 Hz 120 Hz; 300 Hz; 400 Hz 500 Hz; 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz 100 kHz 200 kHz; 300 kHz; 500 kHz 700 kHz; 800 kHz 1 MHz	$0.20 \cdot 10^{-3}$ $0.18 \cdot 10^{-3}$ $0.17 \cdot 10^{-3}$ $0.17 \cdot 10^{-3}$ $0.17 \cdot 10^{-3}$ $0.17 \cdot 10^{-3}$ $0.17 \cdot 10^{-3}$ $0.18 \cdot 10^{-3}$ $0.19 \cdot 10^{-3}$ $0.22 \cdot 10^{-3}$ $0.25 \cdot 10^{-3}$	Fluke 5790A measuring range: 7 mV

<sup>1)</sup> 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.

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**Calibration and Measurement Capabilities (CMC)**

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks	
AC voltage measuring instruments	6 mV	10 Hz	$0.12 \cdot 10^{-3}$	Fluke 5790A measuring range: 7 mV	
		20 Hz; 30 Hz	$0.10 \cdot 10^{-3}$		
		40 Hz; 55 Hz; 60 Hz	$0.10 \cdot 10^{-3}$		
		120 Hz; 300 Hz; 400 Hz	$0.10 \cdot 10^{-3}$		
		500 Hz; 1 kHz; 10 kHz	$0.10 \cdot 10^{-3}$		
		20 kHz; 30 kHz; 50 kHz	$0.10 \cdot 10^{-3}$		
		70 kHz; 100 kHz	$0.10 \cdot 10^{-3}$		
		200 kHz; 300 kHz; 500 kHz	$0.12 \cdot 10^{-3}$		
		700 kHz; 800 kHz	$0.14 \cdot 10^{-3}$		
		1 MHz	$0.17 \cdot 10^{-3}$		
AC voltage measuring instruments	2 mV	10 Hz	$0.19 \cdot 10^{-3}$	Fluke 5790A measuring range: 22 mV	
		20 Hz; 30 Hz	$0.16 \cdot 10^{-3}$		
		40 Hz; 55 Hz; 60 Hz	$0.16 \cdot 10^{-3}$		
		120 Hz; 300 Hz; 400 Hz	$0.16 \cdot 10^{-3}$		
		500 Hz; 1 kHz; 10 kHz	$0.16 \cdot 10^{-3}$		
		20 kHz; 30 kHz	$0.16 \cdot 10^{-3}$		
		50 kHz; 70 kHz; 100 kHz	$0.17 \cdot 10^{-3}$		
		200 kHz; 300 kHz; 500 kHz	$0.18 \cdot 10^{-3}$		
		700 kHz	$0.20 \cdot 10^{-3}$		
		800 kHz	$0.21 \cdot 10^{-3}$		
	1 MHz	$0.25 \cdot 10^{-3}$			
	6 mV	10 Hz	$0.10 \cdot 10^{-3}$		
		20 Hz; 30 Hz; 40 Hz	$80 \cdot 10^{-6}$		
		55 Hz; 60 Hz	$80 \cdot 10^{-6}$		
		120 Hz; 300 Hz	$80 \cdot 10^{-6}$		
		400 Hz; 500 Hz	$80 \cdot 10^{-6}$		
		1 kHz; 10 kHz	$80 \cdot 10^{-6}$		
		20 kHz; 30 kHz; 50 kHz	$75 \cdot 10^{-6}$		
		70 kHz	$75 \cdot 10^{-6}$		
		100 kHz	$80 \cdot 10^{-6}$		
		200 kHz; 300 kHz	$90 \cdot 10^{-6}$		
	500 kHz	$0.10 \cdot 10^{-3}$			
700 kHz; 800 kHz	$0.14 \cdot 10^{-3}$				
1 MHz	$0.16 \cdot 10^{-3}$				
10 mV	10 Hz	$80 \cdot 10^{-6}$			
	20 Hz; 30 Hz; 40 Hz	$60 \cdot 10^{-6}$			
	55 Hz; 60 Hz	$60 \cdot 10^{-6}$			
	120 Hz; 300 Hz	$60 \cdot 10^{-6}$			
	400 Hz; 500 Hz	$60 \cdot 10^{-6}$			
	1 kHz; 10 kHz	$60 \cdot 10^{-6}$			
	20 kHz; 30 kHz; 50 kHz	$55 \cdot 10^{-6}$			
	70 kHz	$55 \cdot 10^{-6}$			
	100 kHz	$60 \cdot 10^{-6}$			
	200 kHz; 300 kHz	$70 \cdot 10^{-6}$			
	500 kHz	$80 \cdot 10^{-6}$			
	700 kHz; 800 kHz	$0.10 \cdot 10^{-3}$			
1 MHz	$0.12 \cdot 10^{-3}$				

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks	
AC voltage measuring instruments	20 mV	10 Hz	$60 \cdot 10^{-6}$	Fluke 5790A measuring range: 22 mV	
		20 Hz; 30 Hz; 40 Hz	$40 \cdot 10^{-6}$		
		55 Hz; 60 Hz	$40 \cdot 10^{-6}$		
		120 Hz; 300 Hz	$40 \cdot 10^{-6}$		
		400 Hz; 500 Hz	$35 \cdot 10^{-6}$		
		1 kHz; 10 kHz	$35 \cdot 10^{-6}$		
		20 kHz; 30 kHz; 50 kHz	$35 \cdot 10^{-6}$		
		70 kHz	$35 \cdot 10^{-6}$		
		100 kHz	$35 \cdot 10^{-6}$		
		200 kHz; 300 kHz	$45 \cdot 10^{-6}$		
		500 kHz	$50 \cdot 10^{-6}$		
		700 kHz; 800 kHz	$70 \cdot 10^{-6}$		
		1 MHz	$80 \cdot 10^{-6}$		
AC voltage measuring instruments	20 mV	10 Hz	$90 \cdot 10^{-6}$	Fluke 5790A measuring range: 70 mV	
		20 Hz; 30 Hz; 40 Hz	$65 \cdot 10^{-6}$		
		55 Hz; 60 Hz	$65 \cdot 10^{-6}$		
		120 Hz; 300 Hz	$65 \cdot 10^{-6}$		
		400 Hz; 500 Hz	$60 \cdot 10^{-6}$		
		1 kHz; 10 kHz	$60 \cdot 10^{-6}$		
		20 kHz; 30 kHz; 50 kHz	$55 \cdot 10^{-6}$		
		70 kHz	$55 \cdot 10^{-6}$		
		100 kHz	$65 \cdot 10^{-6}$		
		200 kHz; 300 kHz	$80 \cdot 10^{-6}$		
		500 kHz	$90 \cdot 10^{-6}$		
		700 kHz; 800 kHz	$0.12 \cdot 10^{-3}$		
		1 MHz	$0.14 \cdot 10^{-3}$		
	40 mV	40 mV	10 Hz	$75 \cdot 10^{-6}$	
			20 Hz; 30 Hz; 40 Hz	$55 \cdot 10^{-6}$	
			55 Hz; 60 Hz	$55 \cdot 10^{-6}$	
			120 Hz; 300 Hz	$55 \cdot 10^{-6}$	
			400 Hz; 500 Hz	$50 \cdot 10^{-6}$	
			1 kHz; 10 kHz	$50 \cdot 10^{-6}$	
			20 kHz; 30 kHz; 50 kHz	$45 \cdot 10^{-6}$	
			70 kHz	$45 \cdot 10^{-6}$	
			100 kHz	$55 \cdot 10^{-6}$	
			200 kHz; 300 kHz	$65 \cdot 10^{-6}$	
			500 kHz	$75 \cdot 10^{-6}$	
			700 kHz; 800 kHz	$0.10 \cdot 10^{-3}$	
			1 MHz	$0.12 \cdot 10^{-3}$	
	60 mV	60 mV	10 Hz	$60 \cdot 10^{-6}$	
20 Hz; 30 Hz; 40 Hz			$40 \cdot 10^{-6}$		
55 Hz; 60 Hz			$40 \cdot 10^{-6}$		
120 Hz; 300 Hz			$40 \cdot 10^{-6}$		
400 Hz; 500 Hz			$35 \cdot 10^{-6}$		
1 kHz; 10 kHz			$35 \cdot 10^{-6}$		
20 kHz; 30 kHz			$35 \cdot 10^{-6}$		
50 kHz; 70 kHz; 100 kHz			$30 \cdot 10^{-6}$		
200 kHz; 300 kHz			$40 \cdot 10^{-6}$		
500 kHz			$50 \cdot 10^{-6}$		
700 kHz; 800 kHz			$70 \cdot 10^{-6}$		
1 MHz			$80 \cdot 10^{-6}$		

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
AC voltage measuring instruments	60 mV	10 Hz	$40 \cdot 10^{-6}$	Fluke 5790A measuring range: 220 mV
		20 Hz; 30 Hz	$30 \cdot 10^{-6}$	
		40 Hz; 55 Hz; 60 Hz	$30 \cdot 10^{-6}$	
		120 Hz; 300 Hz; 400 Hz	$30 \cdot 10^{-6}$	
		500 Hz; 1 kHz; 10 kHz	$30 \cdot 10^{-6}$	
		20 kHz; 30 kHz; 50 kHz	$30 \cdot 10^{-6}$	
		70 kHz; 100 kHz	$30 \cdot 10^{-6}$	
		200 kHz; 300 kHz	$40 \cdot 10^{-6}$	
		500 kHz	$75 \cdot 10^{-6}$	
		700 kHz; 800 kHz	$0.10 \cdot 10^{-3}$	
		1 MHz	$0.12 \cdot 10^{-3}$	
	100 mV; 200 mV	10 Hz	$15 \cdot 10^{-6}$	
		20 Hz	$12 \cdot 10^{-6}$	
		30 Hz; 40 Hz; 55 Hz	$12 \cdot 10^{-6}$	
		60 Hz; 120 Hz; 300 Hz	$12 \cdot 10^{-6}$	
		400 Hz; 500 Hz	$8 \cdot 10^{-6}$	
		1 kHz; 10 kHz; 20 kHz	$8 \cdot 10^{-6}$	
		30 kHz; 50 kHz; 70 kHz	$8 \cdot 10^{-6}$	
		100 kHz	$9 \cdot 10^{-6}$	
		200 kHz; 300 kHz	$20 \cdot 10^{-6}$	
	100 mV; 200 mV	500 kHz	$30 \cdot 10^{-6}$	
		700 kHz; 800 kHz	$40 \cdot 10^{-6}$	
		1 MHz	$45 \cdot 10^{-6}$	
	200 mV	10 Hz	$15 \cdot 10^{-6}$	Fluke 5790A measuring range: 700 mV
		20 Hz	$12 \cdot 10^{-6}$	
		30 Hz; 40 Hz; 55 Hz	$12 \cdot 10^{-6}$	
		60 Hz; 120 Hz; 300 Hz	$12 \cdot 10^{-6}$	
		400 Hz; 500 Hz	$8 \cdot 10^{-6}$	
		1 kHz; 10 kHz; 20 kHz	$8 \cdot 10^{-6}$	
		30 kHz; 50 kHz; 70 kHz	$8 \cdot 10^{-6}$	
		100 kHz	$9 \cdot 10^{-6}$	
		200 kHz; 300 kHz	$20 \cdot 10^{-6}$	
		500 kHz	$30 \cdot 10^{-6}$	
		700 kHz; 800 kHz	$40 \cdot 10^{-6}$	
		1 MHz	$45 \cdot 10^{-6}$	
	300 mV; 400 mV	10 Hz; 20 Hz	$12 \cdot 10^{-6}$	
		30 Hz; 40 Hz; 55 Hz	$12 \cdot 10^{-6}$	
		60 Hz; 120 Hz; 300 Hz	$12 \cdot 10^{-6}$	
		400 Hz; 500 Hz	$8 \cdot 10^{-6}$	
		1 kHz; 10 kHz	$8 \cdot 10^{-6}$	
		20 kHz; 30 kHz; 50 kHz	$6 \cdot 10^{-6}$	
		70 kHz	$7 \cdot 10^{-6}$	
		100 kHz	$9 \cdot 10^{-6}$	
		200 kHz; 300 kHz	$20 \cdot 10^{-6}$	
		500 kHz	$30 \cdot 10^{-6}$	
		700 kHz; 800 kHz	$40 \cdot 10^{-6}$	
		1 MHz	$45 \cdot 10^{-6}$	

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
AC voltage measuring instruments	500 mV; 600 mV; 700 mV	10 Hz; 20Hz 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz 1 kHz; 10 kHz; 20 kHz 30 kHz; 50 kHz 70 kHz 100 kHz 200 kHz; 300 kHz 500 kHz 700 Hz; 800 kHz 1 MHz	12 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup> 5 · 10 <sup>-6</sup> 5 · 10 <sup>-6</sup> 5 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 9 · 10 <sup>-6</sup> 20 · 10 <sup>-6</sup> 30 · 10 <sup>-6</sup> 40 · 10 <sup>-6</sup> 45 · 10 <sup>-6</sup>	Fluke 5790A measuring range:700 mV
	600 mV	10 Hz; 20 Hz 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz 1 kHz; 10 kHz; 20 kHz 30 kHz; 50 kHz 70 kHz 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	12 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup> 5 · 10 <sup>-6</sup> 5 · 10 <sup>-6</sup> 5 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 9 · 10 <sup>-6</sup> 20 · 10 <sup>-6</sup> 30 · 10 <sup>-6</sup> 40 · 10 <sup>-6</sup> 45 · 10 <sup>-6</sup>	Fluke 5790A measuring range: 2.2 V
AC voltage measuring instruments	1 V; 2 V	10 Hz 20 Hz; 30 Hz; 40 Hz 55 Hz; 60 Hz; 120 Hz 300 Hz; 400 Hz; 500 Hz 1 kHz; 10 kHz; 20 kHz 30 kHz; 50 kHz; 70 kHz 100 kHz; 200 kHz 300 kHz; 500 kHz 700 kHz; 800 kHz 1 MHz	5 · 10 <sup>-6</sup> 4 · 10 <sup>-6</sup> 4 · 10 <sup>-6</sup> 4 · 10 <sup>-6</sup> 4 · 10 <sup>-6</sup> 4 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 8 · 10 <sup>-6</sup> 10 · 10 <sup>-6</sup> 20 · 10 <sup>-6</sup>	Fluke 5790A measuring range: 2.2 V
	2 V; 3 V; 4 V; 5 V; 6 V; 7 V	10 Hz 20 Hz; 30 Hz; 40 Hz 55 Hz; 60 Hz; 120 Hz 300 Hz; 400 Hz; 500 Hz 1 kHz; 10 kHz; 20 kHz 30 kHz; 50 kHz; 70 kHz 100 kHz; 200 kHz 300 kHz; 500 kHz 700 kHz; 800 kHz 1 MHz	5 · 10 <sup>-6</sup> 4 · 10 <sup>-6</sup> 4 · 10 <sup>-6</sup> 4 · 10 <sup>-6</sup> 4 · 10 <sup>-6</sup> 4 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 8 · 10 <sup>-6</sup> 10 · 10 <sup>-6</sup> 20 · 10 <sup>-6</sup>	Fluke 5790A measuring range: 7 V

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
AC voltage measuring instruments	6 V; 8 V; 10 V	10 Hz 20 Hz; 30 Hz; 40 Hz 55 Hz; 60 Hz; 120 Hz 300 Hz; 400 Hz 500 Hz; 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz 100 kHz; 200 kHz 300 kHz; 500 kHz 700 kHz; 800 kHz 1 MHz	$5 \cdot 10^{-6}$ $4 \cdot 10^{-6}$ $4 \cdot 10^{-6}$ $4 \cdot 10^{-6}$ $4 \cdot 10^{-6}$ $4 \cdot 10^{-6}$ $4 \cdot 10^{-6}$ $6 \cdot 10^{-6}$ $8 \cdot 10^{-6}$ $10 \cdot 10^{-6}$ $20 \cdot 10^{-6}$	Fluke 5790A measuring range: 22 V
	20 V	10 Hz; 20 Hz 30 Hz; 40 Hz; 55 Hz; 60 Hz 120 Hz; 300 Hz; 400 Hz 500 Hz; 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz 100 kHz 200 kHz 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	$6 \cdot 10^{-6}$ $6 \cdot 10^{-6}$ $6 \cdot 10^{-6}$ $6 \cdot 10^{-6}$ $6 \cdot 10^{-6}$ $6 \cdot 10^{-6}$ $8 \cdot 10^{-6}$ $9 \cdot 10^{-6}$ $10 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $18 \cdot 10^{-6}$ $25 \cdot 10^{-6}$	Fluke 5790A measuring range: 22 V
	20 V	10 Hz; 20 Hz 30 Hz; 40 Hz; 55 Hz; 60 Hz 120 Hz; 300 Hz; 400 Hz 500 Hz; 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	$7 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $8 \cdot 10^{-6}$ $10 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $25 \cdot 10^{-6}$ $35 \cdot 10^{-6}$	Fluke 5790A measuring range: 70 V

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
AC voltage measuring instruments	30 V	10 Hz 20 Hz; 30 Hz 40 Hz; 55 Hz; 60 Hz 120 Hz; 300 Hz; 400 Hz 500 Hz; 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz	$8 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $9 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $15 \cdot 10^{-6}$ $25 \cdot 10^{-6}$	Fluke 5790A measuring range: 70 V
	40 V; 50 V; 60 V; 70 V	10 Hz 20 Hz; 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz 100 kHz	$9 \cdot 10^{-6}$ $8 \cdot 10^{-6}$ $8 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $9 \cdot 10^{-6}$ $12 \cdot 10^{-6}$	
	60 V	10 Hz 20 Hz; 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz 100 kHz	$9 \cdot 10^{-6}$ $8 \cdot 10^{-6}$ $8 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $9 \cdot 10^{-6}$ $12 \cdot 10^{-6}$	Fluke 5790A measuring range: 220 V
	100 V; 200 V	10 Hz 20 Hz; 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz 100 kHz	$14 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $18 \cdot 10^{-6}$ $30 \cdot 10^{-6}$	
	200 V	10 Hz 20 Hz; 30 Hz; 40 Hz 55 Hz; 60 Hz 120 Hz; 300 Hz; 400 Hz 500 Hz; 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz 100 kHz	$14 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $18 \cdot 10^{-6}$ $30 \cdot 10^{-6}$	
	300 V; 400 V	10 Hz 20 Hz; 30 Hz; 40 Hz 55 Hz; 60 Hz 120 Hz; 300 Hz; 400 Hz 500 Hz; 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz 100 kHz	$16 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $12 \cdot 10^{-6}$ $18 \cdot 10^{-6}$ $30 \cdot 10^{-6}$	Fluke 5790A measuring range: 700 V

<sup>1)</sup> 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.

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
AC voltage measuring instruments	500 V; 600 V; 700 V	10 Hz	$16 \cdot 10^{-6}$	Fluke 5790A measuring range: 700 V
		20 Hz; 30 Hz; 40 Hz	$12 \cdot 10^{-6}$	
		55 Hz; 60 Hz	$12 \cdot 10^{-6}$	
		120 Hz; 300 Hz; 400 Hz	$12 \cdot 10^{-6}$	
		500 Hz; 1 kHz; 10 kHz	$12 \cdot 10^{-6}$	
20 kHz; 30 kHz; 50 kHz	$12 \cdot 10^{-6}$			
70 kHz	$25 \cdot 10^{-6}$			
100 kHz	$35 \cdot 10^{-6}$			
200 V	200 V	10 Hz; 20 Hz; 30 Hz	$14 \cdot 10^{-6}$	Fluke 5790A measuring range: 1000 V
		40 Hz; 55 Hz; 60 Hz	$14 \cdot 10^{-6}$	
		120 Hz; 300 Hz	$14 \cdot 10^{-6}$	
		400 Hz; 500 Hz; 1 kHz	$12 \cdot 10^{-6}$	
		10 kHz; 20 kHz; 30 kHz	$12 \cdot 10^{-6}$	
		50 kHz	$12 \cdot 10^{-6}$	
		70 kHz	$18 \cdot 10^{-6}$	
		100 kHz	$30 \cdot 10^{-6}$	
300 V; 500 V	300 V; 500 V	10 Hz	$16 \cdot 10^{-6}$	
		20 Hz	$14 \cdot 10^{-6}$	
		30 Hz; 40 Hz; 55 Hz; 60 Hz	$12 \cdot 10^{-6}$	
		120 Hz; 300 Hz; 400 Hz	$12 \cdot 10^{-6}$	
		500 Hz; 1 kHz; 10 kHz	$12 \cdot 10^{-6}$	
		20 kHz; 30 kHz; 50 kHz	$12 \cdot 10^{-6}$	
		70 kHz	$18 \cdot 10^{-6}$	
		100 kHz	$30 \cdot 10^{-6}$	
600 V; 800 V; 1000 V	600 V; 800 V; 1000 V	10 Hz	$18 \cdot 10^{-6}$	
		20 Hz; 30 Hz; 40 Hz	$14 \cdot 10^{-6}$	
		55 Hz; 60 Hz; 120 Hz	$12 \cdot 10^{-6}$	
		300 Hz; 400 Hz; 500 Hz	$12 \cdot 10^{-6}$	
		1 kHz; 10 kHz; 20 kHz	$12 \cdot 10^{-6}$	
		30 kHz; 50 kHz	$12 \cdot 10^{-6}$	
		70 kHz	$25 \cdot 10^{-6}$	
		100 kHz	$35 \cdot 10^{-6}$	
measuring instruments and sources	0,01 V to 10 V	0,1 Hz to 10 Hz	$35 \cdot 10^{-6}$	

<sup>1)</sup> 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.

**Annex to the accreditation certificate D-K-15115-01-01**

**Permanent Laboratory**

**Calibration and Measurement Capabilities (CMC)**

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
AC/DC transfer	2 mV	10 Hz 20 Hz 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz; 1 kHz 10 kHz; 20 kHz 30 kHz; 50 kHz; 70 kHz 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	0.11 · 10 <sup>-3</sup> 90 · 10 <sup>-6</sup> 85 · 10 <sup>-6</sup> 85 · 10 <sup>-6</sup> 85 · 10 <sup>-6</sup> 85 · 10 <sup>-6</sup> 85 · 10 <sup>-6</sup> 90 · 10 <sup>-6</sup> 0.11 · 10 <sup>-3</sup> 0.12 · 10 <sup>-3</sup> 0.15 · 10 <sup>-3</sup> 0.19 · 10 <sup>-3</sup>	Fluke 792A measuring range: 22 mV
	6 mV	10 Hz 20 Hz; 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz 1 kHz; 10 kHz 20 kHz ; 30 kHz 50 kHz; 70 kHz 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	90 · 10 <sup>-6</sup> 65 · 10 <sup>-6</sup> 65 · 10 <sup>-6</sup> 60 · 10 <sup>-6</sup> 60 · 10 <sup>-6</sup> 55 · 10 <sup>-6</sup> 55 · 10 <sup>-6</sup> 60 · 10 <sup>-6</sup> 75 · 10 <sup>-6</sup> 90 · 10 <sup>-6</sup> 0.12 · 10 <sup>-3</sup> 0.14 · 10 <sup>-3</sup>	
	10 mV	10 Hz 20 Hz; 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz 1 kHz; 10 kHz 20 kHz ; 30 kHz 50 kHz; 70 kHz 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	75 · 10 <sup>-6</sup> 55 · 10 <sup>-6</sup> 55 · 10 <sup>-6</sup> 50 · 10 <sup>-6</sup> 50 · 10 <sup>-6</sup> 45 · 10 <sup>-6</sup> 45 · 10 <sup>-6</sup> 55 · 10 <sup>-6</sup> 65 · 10 <sup>-6</sup> 75 · 10 <sup>-6</sup> 95 · 10 <sup>-6</sup> 0.12 · 10 <sup>-3</sup>	
	20 mV	10 Hz 20 Hz; 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz 1 kHz; 10 kHz; 20 kHz 30 kHz; 50 kHz 70 kHz; 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	60 · 10 <sup>-6</sup> 40 · 10 <sup>-6</sup> 40 · 10 <sup>-6</sup> 35 · 10 <sup>-6</sup> 35 · 10 <sup>-6</sup> 30 · 10 <sup>-6</sup> 30 · 10 <sup>-6</sup> 40 · 10 <sup>-6</sup> 50 · 10 <sup>-6</sup> 70 · 10 <sup>-6</sup> 80 · 10 <sup>-6</sup>	

<sup>1)</sup> 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.

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**Calibration and Measurement Capabilities (CMC)**

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
AC/DC transfer	60 mV	10 Hz 20 Hz; 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz; 1 kHz 10 kHz; 20 kHz; 30 kHz 50 kHz; 70 kHz; 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	35 · 10 <sup>-6</sup> 25 · 10 <sup>-6</sup> 25 · 10 <sup>-6</sup> 25 · 10 <sup>-6</sup> 25 · 10 <sup>-6</sup> 25 · 10 <sup>-6</sup> 40 · 10 <sup>-6</sup> 50 · 10 <sup>-6</sup> 70 · 10 <sup>-6</sup> 80 · 10 <sup>-6</sup>	Fluke792A measuring range: 220 mV
	100 mV	10 Hz 20 Hz; 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz; 1 kHz 10 kHz; 20 kHz; 30 kHz 50 kHz; 70 kHz; 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	15 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup> 8 · 10 <sup>-6</sup> 8 · 10 <sup>-6</sup> 8 · 10 <sup>-6</sup> 20 · 10 <sup>-6</sup> 30 · 10 <sup>-6</sup> 40 · 10 <sup>-6</sup> 45 · 10 <sup>-6</sup>	
	200 mV	10 Hz 20 Hz 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz 1 kHz; 10 kHz; 20 kHz 30 kHz; 50 kHz; 70 kHz 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	15 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 7 · 10 <sup>-6</sup> 7 · 10 <sup>-6</sup> 7 · 10 <sup>-6</sup> 8 · 10 <sup>-6</sup> 20 · 10 <sup>-6</sup> 30 · 10 <sup>-6</sup> 40 · 10 <sup>-6</sup> 45 · 10 <sup>-6</sup>	
	200 mV	10 Hz 20 Hz; 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz; 1 kHz 10 kHz; 20 kHz; 30 kHz 50 kHz; 70 kHz 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	12 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 7 · 10 <sup>-6</sup> 7 · 10 <sup>-6</sup> 7 · 10 <sup>-6</sup> 8 · 10 <sup>-6</sup> 18 · 10 <sup>-6</sup> 30 · 10 <sup>-6</sup> 40 · 10 <sup>-6</sup> 45 · 10 <sup>-6</sup>	

<sup>1)</sup> 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.

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**Calibration and Measurement Capabilities (CMC)**

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
AC/DC transfer	300 mV; 400 mV; 500 mV; 600 mV; 700 mV	10 Hz; 20 Hz; 30 Hz 40 Hz; 55 Hz; 60 Hz 120 Hz; 300 Hz 400 Hz; 500 Hz; 1 kHz 10 kHz; 20 kHz; 30 kHz 50 kHz; 70 kHz 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	$11 \cdot 10^{-6}$ $11 \cdot 10^{-6}$ $11 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $8 \cdot 10^{-6}$ $18 \cdot 10^{-6}$ $30 \cdot 10^{-6}$ $40 \cdot 10^{-6}$ $45 \cdot 10^{-6}$	Fluke 792A measuring range: 700 mV
	600 mV	10 Hz; 20 Hz 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz; 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	$11 \cdot 10^{-6}$ $11 \cdot 10^{-6}$ $11 \cdot 10^{-6}$ $4 \cdot 10^{-6}$ $4 \cdot 10^{-6}$ $5 \cdot 10^{-6}$ $6 \cdot 10^{-6}$ $8 \cdot 10^{-6}$ $18 \cdot 10^{-6}$ $30 \cdot 10^{-6}$ $40 \cdot 10^{-6}$ $45 \cdot 10^{-6}$	Fluke 792A measuring range: 2.2 V
	1 V; 2 V	10 Hz 20 Hz 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz 300 Hz ; 400 Hz; 500 Hz 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	$4 \cdot 10^{-6}$ $3 \cdot 10^{-6}$ $2 \cdot 10^{-6}$ $2 \cdot 10^{-6}$ $2 \cdot 10^{-6}$ $2 \cdot 10^{-6}$ $2 \cdot 10^{-6}$ $3 \cdot 10^{-6}$ $4 \cdot 10^{-6}$ $5 \cdot 10^{-6}$ $7 \cdot 10^{-6}$ $9 \cdot 10^{-6}$ $15 \cdot 10^{-6}$	
	2 V; 3 V; 4 V 5 V; 6 V; 7 V	10 Hz 20 Hz 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz 300 Hz ; 400 Hz; 500 Hz 1 kHz; 10 kHz; 20 kHz 30 kHz; 50 kHz 70 kHz 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz 800 kHz 1 MHz	$4 \cdot 10^{-6}$ $3 \cdot 10^{-6}$ $2 \cdot 10^{-6}$ $2 \cdot 10^{-6}$ $2 \cdot 10^{-6}$ $2 \cdot 10^{-6}$ $2 \cdot 10^{-6}$ $4 \cdot 10^{-6}$ $5 \cdot 10^{-6}$ $6 \cdot 10^{-6}$ $8 \cdot 10^{-6}$ $9 \cdot 10^{-6}$ $15 \cdot 10^{-6}$	Fluke 792A measuring range: 7 V

<sup>1)</sup> 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.

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
AC/DC transfer	6 V; 8 V	10 Hz 20 Hz 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz 300 Hz ; 400 Hz; 500 Hz 1 kHz; 10 kHz; 20 kHz 30 kHz; 50 kHz; 70 kHz 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	4 · 10 <sup>-6</sup> 3 · 10 <sup>-6</sup> 2 · 10 <sup>-6</sup> 2 · 10 <sup>-6</sup> 2 · 10 <sup>-6</sup> 2 · 10 <sup>-6</sup> 2 · 10 <sup>-6</sup> 4 · 10 <sup>-6</sup> 5 · 10 <sup>-6</sup> 7 · 10 <sup>-6</sup> 9 · 10 <sup>-6</sup> 15 · 10 <sup>-6</sup>	Fluke 792A measuring range: 22 V
	10 V	10 Hz 20 Hz; 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz 300 Hz ; 400 Hz; 500 Hz 1 kHz; 10 kHz; 20 kHz 30 kHz; 50 kHz; 70 kHz 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	4 · 10 <sup>-6</sup> 3 · 10 <sup>-6</sup> 3 · 10 <sup>-6</sup> 3 · 10 <sup>-6</sup> 3 · 10 <sup>-6</sup> 3 · 10 <sup>-6</sup> 4 · 10 <sup>-6</sup> 5 · 10 <sup>-6</sup> 7 · 10 <sup>-6</sup> 9 · 10 <sup>-6</sup> 15 · 10 <sup>-6</sup>	Fluke 792A measuring range: 22 V
	20 V	10 Hz; 20 Hz; 30 Hz; 40 Hz 55 Hz; 60 Hz; 120 Hz 300 Hz ; 400 Hz; 500 Hz 1 kHz; 10 kHz; 20 kHz 30 kHz; 50 kHz; 70 kHz 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	6 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 3 · 10 <sup>-6</sup> 7 · 10 <sup>-6</sup> 9 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup> 18 · 10 <sup>-6</sup> 25 · 10 <sup>-6</sup>	
	20 V	10 Hz; 20 Hz; 30 Hz; 40 Hz 55 Hz; 60 Hz; 120 Hz 300 Hz ; 400 Hz; 500 Hz 1 kHz; 10 kHz; 20 kHz 30 kHz; 50 kHz; 70 kHz 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz; 800 kHz 1 MHz	6 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 3 · 10 <sup>-6</sup> 7 · 10 <sup>-6</sup> 9 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup> 18 · 10 <sup>-6</sup> 25 · 10 <sup>-6</sup>	Fluke 792A measuring range: 70 V
	30 V	10 Hz 20 Hz; 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz 500 Hz; 1 kHz 10 kHz; 20 kHz; 30 kHz 50 kHz; 70 kHz 100 kHz 200 kHz; 300 kHz 500 kHz 700 kHz	7 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 8 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup> 15 · 10 <sup>-6</sup> 25 · 10 <sup>-6</sup>	

<sup>1)</sup> 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.

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
AC/DC transfer	40 V; 50 V; 60 V; 70 V	10 Hz 20 Hz; 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz; 1 kHz 10 kHz; 20 kHz 30 kHz; 50 kHz 70 kHz 100 kHz	8 · 10 <sup>-6</sup> 7 · 10 <sup>-6</sup> 7 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 8 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup>	Fluke 792A measuring range: 70 V
	60 V	10 Hz 20 Hz; 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz; 1 kHz 10 kHz; 20 kHz 30 kHz; 50 kHz 70 kHz 100 kHz	8 · 10 <sup>-6</sup> 7 · 10 <sup>-6</sup> 7 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 6 · 10 <sup>-6</sup> 8 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup>	Fluke 792A measuring range: 220 V
	100 V	10 Hz 20 Hz; 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz; 1 kHz 10 kHz; 20 kHz 30 kHz; 50 kHz 70 kHz 100 kHz	12 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 18 · 10 <sup>-6</sup> 30 · 10 <sup>-6</sup>	
	200 V	10 Hz; 20 Hz 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz; 1 kHz 10 kHz; 20 kHz 30 kHz; 50 kHz 70 kHz 100 kHz	12 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 18 · 10 <sup>-6</sup> 30 · 10 <sup>-6</sup>	Fluke 792A measuring range: 220 V
	200 V	10 Hz 20 Hz 30 Hz; 40 Hz; 55 Hz 60 Hz; 120 Hz; 300 Hz 400 Hz; 500 Hz 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz 100 kHz	15 · 10 <sup>-6</sup> 13 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 18 · 10 <sup>-6</sup> 30 · 10 <sup>-6</sup>	Fluke 792A measuring range: 1000 V
	300 V	10 Hz 20 Hz; 30 Hz; 40 Hz; 55 Hz; 60 Hz 120 Hz; 300 Hz; 400 Hz 500 Hz; 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz 100 kHz	15 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 18 · 10 <sup>-6</sup> 30 · 10 <sup>-6</sup>	

<sup>1)</sup> 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.

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
AC/DC transfer	500 V	10 Hz 20 Hz; 30 Hz; 40 Hz; 55 Hz; 60 Hz 120 Hz; 300 Hz; 400 Hz 500 Hz; 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz 100 kHz	17 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 18 · 10 <sup>-6</sup> 35 · 10 <sup>-6</sup>	Fluke 792A measuring range: 1000 V
AC/DC transfer	600 V; 800 V; 1000 V	10 Hz 20 Hz; 30 Hz; 40 Hz 55 Hz; 60 Hz 120 Hz; 300 Hz; 400 Hz 500 Hz; 1 kHz; 10 kHz 20 kHz; 30 kHz; 50 kHz 70 kHz 100 kHz	17 · 10 <sup>-6</sup> 12 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 11 · 10 <sup>-6</sup> 18 · 10 <sup>-6</sup> 35 · 10 <sup>-6</sup>	Fluke 792A measuring range: 1000 V
AC voltage High voltage sources and dividers	1000 V to 20 000 V	50 Hz; 60 Hz	0.15 %	
AC voltage square wave and triangular voltage	1 mV	10 Hz to 40 Hz 55 Hz to 10 kHz 10 kHz to 100 kHz 200 kHz to 700 kHz 700 kHz to 1 MHz	0.50 · 10 <sup>-3</sup> 0.50 · 10 <sup>-3</sup> 0.50 · 10 <sup>-3</sup> 0.70 · 10 <sup>-3</sup> 0.90 · 10 <sup>-3</sup>	square wave and triangular voltage on 50 Ω and 1 MΩ input resistance
	2 mV	10 Hz to 40 Hz 55 Hz to 10 kHz 10 kHz to 100 kHz 200 kHz to 700 kHz 700 kHz to 1 MHz	0.30 · 10 <sup>-3</sup> 0.30 · 10 <sup>-3</sup> 0.30 · 10 <sup>-3</sup> 0.50 · 10 <sup>-3</sup> 0.80 · 10 <sup>-3</sup>	
	6 mV; 10 mV; 20 mV	10 Hz to 40 Hz 55 Hz to 10 kHz 10 kHz to 100 kHz 200 kHz to 700 kHz 700 kHz to 1 MHz	0.20 · 10 <sup>-3</sup> 0.20 · 10 <sup>-3</sup> 0.20 · 10 <sup>-3</sup> 0.50 · 10 <sup>-3</sup> 0.80 · 10 <sup>-3</sup>	
	40 mV	10 Hz to 40 Hz 55 Hz to 10 kHz 10 kHz to 100 kHz 200 kHz to 700 kHz 700 kHz to 1 MHz	0.20 · 10 <sup>-3</sup> 0.20 · 10 <sup>-3</sup> 0.20 · 10 <sup>-3</sup> 0.50 · 10 <sup>-3</sup> 0.80 · 10 <sup>-3</sup>	
	60 mV	10 Hz to 40 Hz 55 Hz to 10 kHz 10 kHz to 100 kHz 200 kHz to 700 kHz 700 kHz to 1 MHz	0.15 · 10 <sup>-3</sup> 0.15 · 10 <sup>-3</sup> 0.15 · 10 <sup>-3</sup> 0.50 · 10 <sup>-3</sup> 0.80 · 10 <sup>-3</sup>	
	100 mV to 20 V	10 Hz to 40 Hz 55 Hz to 10 kHz 10 kHz to 100 kHz 200 kHz to 700 kHz 700 kHz to 1 MHz	0.10 · 10 <sup>-3</sup> 0.10 · 10 <sup>-3</sup> 0.10 · 10 <sup>-3</sup> 0.45 · 10 <sup>-3</sup> 0.80 · 10 <sup>-3</sup>	

<sup>1)</sup> 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.



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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
AC voltage square wave and triangular voltage	30 V to 100 V	10 Hz to 40 Hz	$0.10 \cdot 10^{-3}$	square wave and triangular voltage on 50 Ω and 1 MΩ input resistance
		55 Hz to 10 kHz	$0.10 \cdot 10^{-3}$	
		10 kHz to 100 kHz	$0.10 \cdot 10^{-3}$	
HF voltage frequency response of the output voltage of generators based on 1 kHz at the nominal impedance of 50 Ω	7 V	10 Hz to 30 Hz	$0.40 \cdot 10^{-3}$	$ I  \leq 0.01$
		> 30 Hz to 2 MHz	$0.32 \cdot 10^{-3}$	$ I  \leq 0.02$
		> 2 MHz to 10 MHz	$0.44 \cdot 10^{-3}$	
		>10 MHz to 20 MHz	$0.94 \cdot 10^{-3}$	
	2.2 V and 0.7 V	>20 MHz to 30 MHz	$1.1 \cdot 10^{-3}$	$ I  \leq 0.01$
		10 Hz to 30 Hz	$0.83 \cdot 10^{-3}$	
		> 30 Hz to 2 MHz	$0.44 \cdot 10^{-3}$	
		> 2 MHz to 10 MHz	$0.68 \cdot 10^{-3}$	
	70 mV and 220 mV	>10 MHz to 20 MHz	$1.2 \cdot 10^{-3}$	$ I  \leq 0.02$
		>20 MHz to 30 MHz	$1.4 \cdot 10^{-3}$	
		10 Hz to 30 Hz	$0.94 \cdot 10^{-3}$	
		> 30 Hz to 2 MHz	$0.49 \cdot 10^{-3}$	
	7 mV and 22 mV	>2 MHz to 10 MHz	$0.81 \cdot 10^{-3}$	$ I  \leq 0.02$
		>10 MHz to 20 MHz	$1.4 \cdot 10^{-3}$	
		>20 MHz to 30 MHz	$1.6 \cdot 10^{-3}$	
		10 Hz to 30 Hz	$1.1 \cdot 10^{-3}$	
	2.2 mV	> 30 Hz to 2 MHz	$0.58 \cdot 10^{-3}$	$ I  \leq 0.01$
		> 2 MHz to 10 MHz	$1.1 \cdot 10^{-3}$	
>10 MHz to 20 MHz		$2.1 \cdot 10^{-3}$		
>20 MHz to 30 MHz		$2.8 \cdot 10^{-3}$		
2.2 mV	10 Hz to 30 Hz	$1.2 \cdot 10^{-3}$	$ I  \leq 0.02$	
	> 30 Hz to 2 MHz	$0.62 \cdot 10^{-3}$		
	> 2 MHz to 10 MHz	$1.2 \cdot 10^{-3}$		
	>10 MHz to 20 MHz	$2.2 \cdot 10^{-3}$		
		>20 MHz to 30 MHz	$2.8 \cdot 10^{-3}$	

<sup>1)</sup> 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.

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**Calibration and Measurement Capabilities (CMC)**

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks	
HF voltage input voltage of HF mV meters with 50 Ω input impedance of the incident voltage based on 1 kHz	7 V	10 Hz to 30 Hz	$0.57 \cdot 10^{-3}$	$ Γ  \leq 0.005$	
		> 30 Hz to 2 MHz	$0.34 \cdot 10^{-3}$		
		> 2 MHz to 10 MHz	$0.60 \cdot 10^{-3}$		$ Γ  \leq 0.01$
		>10 MHz to 20 MHz	$1.0 \cdot 10^{-3}$		
		>20 MHz to 30 MHz	$1.2 \cdot 10^{-3}$		
	2.2 V and 0.7 V	10 Hz to 30 Hz	$0.75 \cdot 10^{-3}$	$ Γ  \leq 0.005$	
		> 30 Hz to 2 MHz	$0.42 \cdot 10^{-3}$		
		> 2 MHz to 10 MHz	$0.62 \cdot 10^{-3}$		$ Γ  \leq 0.01$
		>10 MHz to 20 MHz	$1.2 \cdot 10^{-3}$		
		>20 MHz to 30 MHz	$1.4 \cdot 10^{-3}$		
	70 mV and 220 mV	10 Hz to 30 Hz	$0.90 \cdot 10^{-3}$	$ Γ  \leq 0.005$	
		> 30 Hz to 2 MHz	$0.48 \cdot 10^{-3}$		
		> 2 MHz to 10 MHz	$0.78 \cdot 10^{-3}$		$ Γ  \leq 0.01$
		>10 MHz to 20 MHz	$1.3 \cdot 10^{-3}$		
		>20 MHz to 30 MHz	$1.6 \cdot 10^{-3}$		
	7 mV and 22 mV	10 Hz to 30 Hz	$1.0 \cdot 10^{-3}$	$ Γ  \leq 0.005$	
		> 30 Hz to 2 MHz	$0.56 \cdot 10^{-3}$		
		> 2 MHz to 10 MHz	$0.89 \cdot 10^{-3}$		$ Γ  \leq 0.02$
		>10 MHz to 20 MHz	$1.6 \cdot 10^{-3}$		
		>20 MHz to 30 MHz	$1.9 \cdot 10^{-3}$		
2 mV	10 Hz to 30 Hz	$1.1 \cdot 10^{-3}$	$ Γ  \leq 0.005$		
	> 30 Hz to 2 MHz	$0.60 \cdot 10^{-3}$			
	> 2 MHz to 10 MHz	$1.0 \cdot 10^{-3}$		$ Γ  \leq 0.02$	
	>10 MHz to 20 MHz	$1.7 \cdot 10^{-3}$			
	>20 MHz to 30 MHz	$2.1 \cdot 10^{-3}$			
				$ Γ $ : magnitude of complex reflection coefficient	
AC current transfer	300 μA; 1 mA; 3 mA; 5 mA	10 Hz to 40 Hz	$15 \cdot 10^{-6}$		
		> 40 Hz to 1 kHz	$11 \cdot 10^{-6}$		
		> 1 kHz to 10 kHz	$15 \cdot 10^{-6}$		
	10 mA; 20 mA; 30 mA; 50 mA; 100 mA; 200 mA	10 Hz to 40 Hz	$15 \cdot 10^{-6}$		
		> 40 Hz to 1 kHz	$11 \cdot 10^{-6}$		
		> 1 kHz to 10 kHz	$15 \cdot 10^{-6}$		
	300 mA; 500 mA	10 Hz to 40 Hz	$18 \cdot 10^{-6}$		
		> 40 Hz to 1 kHz	$14 \cdot 10^{-6}$		
		> 1 kHz to 10 kHz	$18 \cdot 10^{-6}$		
	1 A; 2 A	10 Hz to 40 Hz	$18 \cdot 10^{-6}$		
		> 40 Hz to 1 kHz	$14 \cdot 10^{-6}$		
		> 1 kHz to 10 kHz	$18 \cdot 10^{-6}$		
	3 A; 5 A	10 Hz to 40 Hz	$26 \cdot 10^{-6}$		
		> 40 Hz to 1 kHz	$24 \cdot 10^{-6}$		
> 1 kHz to 10 kHz		$26 \cdot 10^{-6}$			
10 A	10 Hz to 40 Hz	$30 \cdot 10^{-6}$			
	> 40 Hz to 1 kHz	$28 \cdot 10^{-6}$			
	> 1 kHz to 10 kHz	$30 \cdot 10^{-6}$			
20 A	10 Hz to 40 Hz	$35 \cdot 10^{-6}$			
	> 40 Hz to 1 kHz	$33 \cdot 10^{-6}$			
	> 1 kHz to 10 kHz	$35 \cdot 10^{-6}$			

<sup>1)</sup> 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.

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**Permanent Laboratory**

**Calibration and Measurement Capabilities (CMC)**

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
AC current calibrators	100 µA	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 10 kHz	65 · 10 <sup>-6</sup> 60 · 10 <sup>-6</sup> 65 · 10 <sup>-6</sup>	
	300 µA; 1 mA	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 10 kHz	25 · 10 <sup>-6</sup> 15 · 10 <sup>-6</sup> 25 · 10 <sup>-6</sup>	
	3 mA	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 10 kHz	20 · 10 <sup>-6</sup> 15 · 10 <sup>-6</sup> 25 · 10 <sup>-6</sup>	
	5 mA; 10 mA; 20 mA 30 mA; 50 mA; 100 mA; 200 mA	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 10 kHz	20 · 10 <sup>-6</sup> 15 · 10 <sup>-6</sup> 25 · 10 <sup>-6</sup>	
	300 mA; 500 mA; 1 A	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 10 kHz	25 · 10 <sup>-6</sup> 18 · 10 <sup>-6</sup> 30 · 10 <sup>-6</sup>	
	2 A	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 10 kHz	25 · 10 <sup>-6</sup> 18 · 10 <sup>-6</sup> 30 · 10 <sup>-6</sup>	
	3 A; 5 A	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 10 kHz	35 · 10 <sup>-6</sup> 30 · 10 <sup>-6</sup> 35 · 10 <sup>-6</sup>	
	10 A	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 10 kHz	40 · 10 <sup>-6</sup> 35 · 10 <sup>-6</sup> 40 · 10 <sup>-6</sup>	
	20 A	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 10 kHz	40 · 10 <sup>-6</sup> 40 · 10 <sup>-6</sup> 45 · 10 <sup>-6</sup>	

<sup>1)</sup> 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.

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**Permanent Laboratory**

**Calibration and Measurement Capabilities (CMC)**

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
AC current measuring instruments	100 µA	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 10 kHz	0.10 · 10 <sup>-3</sup> 95 · 10 <sup>-6</sup> 0.15 · 10 <sup>-3</sup>	
	300 µA; 1 mA; 3 mA; 5 mA; 10 mA; 20 mA; 30 mA; 50 mA; 100 mA	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 10 kHz	75 · 10 <sup>-6</sup> 65 · 10 <sup>-6</sup> 0.14 · 10 <sup>-3</sup>	
	200 mA; 300 mA; 500 mA	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 10 kHz	75 · 10 <sup>-6</sup> 65 · 10 <sup>-6</sup> 0.14 · 10 <sup>-3</sup>	
	1 A; 2 A	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 10 kHz	75 · 10 <sup>-6</sup> 70 · 10 <sup>-6</sup> 0.14 · 10 <sup>-3</sup>	
	3 A; 5 A	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 10 kHz	80 · 10 <sup>-6</sup> 75 · 10 <sup>-6</sup> 0.14 · 10 <sup>-3</sup>	
	10 A	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 10 kHz	80 · 10 <sup>-6</sup> 75 · 10 <sup>-6</sup> 0.14 · 10 <sup>-3</sup>	
	20 A	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 10 kHz	90 · 10 <sup>-6</sup> 80 · 10 <sup>-6</sup> 0.14 · 10 <sup>-3</sup>	
AC current current clamps	0 A to 100 A	10 Hz to 100 Hz > 100 Hz to 1 kHz	7 · 10 <sup>-3</sup> · I + 0.5 mA 18 · 10 <sup>-3</sup> · I + 0.5 mA	I = measuring value
	> 100 A to 1000 A	10 Hz to 100 Hz > 100 Hz to 1 kHz	7 · 10 <sup>-3</sup> 18 · 10 <sup>-3</sup>	
Capacitance measuring instruments	1 pF	100 Hz; 120 Hz 1 kHz 10 kHz	1.6 · 10 <sup>-3</sup> 0.41 · 10 <sup>-3</sup> 0.47 · 10 <sup>-3</sup>	
	10 pF	100 Hz; 120 Hz 1 kHz; 10 kHz	0.47 · 10 <sup>-3</sup> 0.37 · 10 <sup>-3</sup>	
	100 pF	100 Hz; 120 Hz; 1 kHz; 10 kHz	0.37 · 10 <sup>-3</sup>	
	1 nF; 10 nF	100 Hz; 120 Hz 1 kHz 10 kHz	0.16 · 10 <sup>-3</sup> 0.13 · 10 <sup>-3</sup> 0.16 · 10 <sup>-3</sup>	
	100 nF	100 Hz; 120 Hz 1 kHz 10 kHz	0.20 · 10 <sup>-3</sup> 0.13 · 10 <sup>-3</sup> 0.42 · 10 <sup>-3</sup>	
	1 µF	100 Hz; 120 Hz; 1 kHz 10 kHz	0.20 · 10 <sup>-3</sup> 2.0 · 10 <sup>-3</sup>	

<sup>1)</sup> 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.

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
Capacitance standards	100 pF	1 kHz; 10 kHz	$0.38 \cdot 10^{-3}$	
	1 nF	100 Hz; 120 Hz 1 kHz 10 kHz	$0.20 \cdot 10^{-3}$ $0.15 \cdot 10^{-3}$ $0.18 \cdot 10^{-3}$	
	10 nF	100 Hz; 120 Hz 1 kHz 10 kHz	$0.20 \cdot 10^{-3}$ $0.14 \cdot 10^{-3}$ $0.20 \cdot 10^{-3}$	
	100 nF	100 Hz; 120 Hz 1 kHz 10 kHz	$0.20 \cdot 10^{-3}$ $0.15 \cdot 10^{-3}$ $0.43 \cdot 10^{-3}$	
	1 μF	100 Hz; 120 Hz; 1 kHz 10 kHz	$0.21 \cdot 10^{-3}$ $2.0 \cdot 10^{-3}$	
	10 μF	100 Hz; 120 Hz; 1 kHz; 10 kHz	$0.39 \cdot 10^{-3}$	
	100 μF	100 Hz; 120 Hz; 1 kHz	$0.25 \cdot 10^{-3}$	
calibrators	500 pF to < 30 nF	DC method	$0.70 \cdot 10^{-3}$	
	30 nF to < 600 nF		$0.40 \cdot 10^{-3}$	
	600 nF to 110 mF		$0.31 \cdot 10^{-3}$	
Frequency	1 MHz, 5 MHz, 10 MHz	Sine wave, $U_{\text{eff}} > 0.5 \text{ V}$ measuring time > 24 h	$9 \cdot 10^{-12}$	Analogue measurement of phase time difference
	0.01 Hz to 300 MHz	Sine wave, $U_{\text{eff}} > 0.5 \text{ V}$ measuring time > 1000 s	$1 \cdot 10^{-11} + U_{\text{tr}}$	$U_{\text{tr}}$ = trigger uncertainty, digital frequency measurement based on counting
	300 MHz to 20 GHz		$1 \cdot 10^{-11}$	
Revolution	0.016 s <sup>-1</sup> to 1700 s <sup>-1</sup>		$1 \cdot 10^{-6}$	
Oscilloscopes vertical deflection	5 mV to 30 mV	Square wave 10 kHz to 10 kHz	0.03 %	
	> 30 mV to 200 V		0.02 %	
horizontal deflection	> 500 ps to 5 s	Amplitude time mark < 1 V	$2 \text{ ps} + 1,5 \cdot 10^{-4} \cdot t$	$t$ = measured value
rise time	> 50 ps to 100 ps	Amplitude < 1 V	5 ps	
	> 100 ps to 10 ms		$5 \text{ ps} + 2 \cdot 10^{-2} \cdot t$	$t$ = actual rise time
frequency response	10 Hz to 6 GHz	5 mV to 3 V	3.5 % (0.3 dB)	For $  \Gamma   > 0.02$ the uncertainty increases. $  \Gamma  $ : magnitude of complex reflection coefficient
Oscilloscope calibrators vertical deflection	5 mV to 30 mV	Square wave 10 Hz to 10 kHz	$0.23 \cdot 10^{-3}$	
	> 30 mV to 300 mV		$0.12 \cdot 10^{-3}$	
	> 300 mV to 200 V		$40 \cdot 10^{-6}$	
horizontal deflection	> 500 ps to 10 ns	Amplitude time mark > 0.5 V	$2 \cdot 10^{-11} + W_{\text{tr}}$	$W_{\text{tr}}$ = relative trigger uncertainty; measuring time > 1000 s
	> 10 ns to 1 s		$2 \cdot 10^{-11} + W_{\text{tr}}$	
	> 1 s to 5 s		$3 \cdot 10^{-11} + W_{\text{tr}}$	

<sup>1)</sup> 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.

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**Permanent Laboratory**

**Calibration and Measurement Capabilities (CMC)**

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
rise time	> 15 ps to 100 ps	Amplitude < 1V	3 ps	t = actual rise time
	> 100 ps to 10 ms		$3 \text{ ps} + 2 \cdot 10^{-2} \cdot t$	
frequency response	10 Hz to 6 GHz	5 mV to 3 V	2.3 % (0.2 dB)	output voltage at 50 Ω

**On-site Calibration**

**Calibration and Measurement Capabilities (CMC)**

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks	
DC voltage	0.01 V to 0.22 V		$2 \mu\text{V} + 8 \cdot 10^{-6} \cdot U$	U = measured value	
	> 0.22 V to 2.2 V		$2 \mu\text{V} + 5 \cdot 10^{-6} \cdot U$		
	> 2.2 V to 11 V		$8 \mu\text{V} + 4 \cdot 10^{-6} \cdot U$		
	> 11 V to 22 V		$5 \mu\text{V} + 4 \cdot 10^{-6} \cdot U$		
	> 22 V to 220 V		$60 \mu\text{V} + 7 \cdot 10^{-6} \cdot U$		
	> 220 V to 1000 V		$0.7 \text{ mV} + 8 \cdot 10^{-6} \cdot U$		
DC current	10 μA to 220 μA		$60 \cdot 10^{-6}$	I = measured value	
	> 220 μA to 2.2 mA		$60 \cdot 10^{-6}$		
	> 2.2 mA to 22 mA		$60 \cdot 10^{-6}$		
	> 22 mA to 220 mA		$1 \mu\text{A} + 70 \cdot 10^{-6} \cdot I$		
	> 0.22 A to 2.2 A		$25 \mu\text{A} + 70 \cdot 10^{-6} \cdot I$		
	> 2.2 A to 10 A		$0.48 \text{ mA} + 0.4 \cdot 10^{-3} \cdot I$		
DC current current clamps	0 A to 100 A		$0.5 \text{ mA} + 5 \cdot 10^{-3} \cdot I$		
	>100 A to 1000 A		$5 \cdot 10^{-3}$		
DC resistance	0.1 Ω to 1.9 Ω		$85 \cdot 10^{-6}$		
	> 1.9 Ω to 10 Ω		$30 \cdot 10^{-6}$		
	> 10 Ω to 19 Ω		$25 \cdot 10^{-6}$		
	> 19 Ω to 190 Ω		$20 \cdot 10^{-6}$		
	> 190 Ω to 1.9 kΩ		$15 \cdot 10^{-6}$		
	> 1.9 kΩ to 19 kΩ		$12 \cdot 10^{-6}$		
	> 19 kΩ to 190 kΩ		$15 \cdot 10^{-6}$		
	> 190 kΩ to 1.9 MΩ		$20 \cdot 10^{-6}$		
	> 1.9 MΩ to 10 MΩ		$35 \cdot 10^{-6}$		
	> 10 MΩ to 19 MΩ		$70 \cdot 10^{-6}$		
AC voltage	60 mV to 220 mV	10 Hz to 20 Hz	$0.84 \cdot 10^{-3}$		
		20 Hz to 40 Hz	$0.38 \cdot 10^{-3}$		
		40 Hz to 20 kHz	$0.27 \cdot 10^{-3}$		
		20 kHz to 50 kHz	$0.48 \cdot 10^{-3}$		
		50 kHz to 100 kHz	$1.3 \cdot 10^{-3}$		
		100 kHz to 300 kHz	$1.7 \cdot 10^{-3}$		
		300 kHz to 500 kHz	$2.5 \cdot 10^{-3}$		
		500 kHz to 1 MHz	$5.2 \cdot 10^{-3}$		

<sup>1)</sup> 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.

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**On-site Calibration**

Calibration and Measurement Capabilities (CMC)				
Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
AC voltage	> 220 mV to 2.2 V	10 Hz to 20 Hz	$0.95 \cdot 10^{-3}$	
		20 Hz to 40 Hz	$0.3 \cdot 10^{-3}$	
		40 Hz to 20 kHz	$0.11 \cdot 10^{-3}$	
		20 kHz to 50 kHz	$0.22 \cdot 10^{-3}$	
		50 kHz to 100 kHz	$0.62 \cdot 10^{-3}$	
		100 kHz to 300 kHz	$1.2 \cdot 10^{-3}$	
		300 kHz to 500 kHz	$3.0 \cdot 10^{-3}$	
AC voltage	> 2.2 V to 22 V	10 Hz to 20 Hz	$0.95 \cdot 10^{-3}$	
		20 Hz to 40 Hz	$0.30 \cdot 10^{-3}$	
		40 Hz to 20 kHz	$0.11 \cdot 10^{-3}$	
		20 kHz to 50 kHz	$0.22 \cdot 10^{-3}$	
		50 kHz to 100 kHz	$0.43 \cdot 10^{-3}$	
		100 kHz to 300 kHz	$1.4 \cdot 10^{-3}$	
		300 kHz to 500 kHz	$3.6 \cdot 10^{-3}$	
	500 kHz to 1 MHz	$7.4 \cdot 10^{-3}$		
	> 22 V to 220 V	10 Hz to 20 Hz	$0.95 \cdot 10^{-3}$	
		20 Hz to 40 Hz	$0.30 \cdot 10^{-3}$	
		40 Hz to 20 kHz	$0.13 \cdot 10^{-3}$	
		20 kHz to 50 kHz	$0.41 \cdot 10^{-3}$	
	> 220 V to 1100 V	50 kHz to 100 kHz	$0.95 \cdot 10^{-3}$	
		15 Hz to 50 Hz	$0.50 \cdot 10^{-3}$	
		50 Hz to 1 kHz	$0.15 \cdot 10^{-3}$	
		1 kHz to 20 kHz	$0.20 \cdot 10^{-3}$	
> 220 V to 750 V	20 kHz to 30 kHz	$0.50 \cdot 10^{-3}$		
	30 kHz to 50 kHz	$1.80 \cdot 10^{-3}$		
AC current	10 $\mu$ A to 220 $\mu$ A	50 kHz to 100 kHz	$0.70 \cdot 10^{-3}$	
		10 Hz to 20 Hz	$0.36 \cdot 10^{-3}$	
		20 Hz to 40 Hz	$0.14 \cdot 10^{-3}$	
		40 Hz to 1 kHz	$0.59 \cdot 10^{-3}$	
		1 kHz to 5 kHz	$1.70 \cdot 10^{-3}$	
	> 220 $\mu$ A to 2.2 mA	5 kHz to 10 kHz	$0.70 \cdot 10^{-3}$	
		10 Hz to 20 Hz	$0.36 \cdot 10^{-3}$	
		20 Hz to 40 Hz	$0.14 \cdot 10^{-3}$	
		40 Hz to 1 kHz	$1 \mu\text{A} + 0.59 \cdot 10^{-3} \cdot I$	
		1 kHz to 5 kHz	$10 \mu\text{A} + 1.70 \cdot 10^{-3} \cdot I$	
	> 2.2 mA to 22 mA	5 kHz to 10 kHz	$1 \mu\text{A} + 0.70 \cdot 10^{-3} \cdot I$	
		10 Hz to 20 Hz	$1 \mu\text{A} + 0.36 \cdot 10^{-3} \cdot I$	
		20 Hz to 40 Hz	$1 \mu\text{A} + 0.14 \cdot 10^{-3} \cdot I$	
		40 Hz to 1 kHz	$5 \mu\text{A} + 0.59 \cdot 10^{-3} \cdot I$	
		1 kHz to 5 kHz	$10 \mu\text{A} + 1.70 \cdot 10^{-3} \cdot I$	
	> 22 mA to 220 mA	5 kHz to 10 kHz	$5 \mu\text{A} + 0.70 \cdot 10^{-3} \cdot I$	
10 Hz to 20 Hz		$5 \mu\text{A} + 0.36 \cdot 10^{-3} \cdot I$		
20 Hz to 40 Hz		$5 \mu\text{A} + 0.14 \cdot 10^{-3} \cdot I$		
40 Hz to 1 kHz		$50 \mu\text{A} + 0.59 \cdot 10^{-3} \cdot I$		
1 kHz to 5 kHz		$0.1 \text{ mA} + 1.7 \cdot 10^{-3} \cdot I$		

<sup>1)</sup> 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.

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**On-site Calibration**

**Calibration and Measurement Capabilities (CMC)**

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement <sup>1)</sup>	Remarks
AC current	> 220 mA to 2.2 A	20 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	50 $\mu$ A + 0.64 $\cdot$ 10 <sup>-3</sup> $\cdot$ / 0.1 mA + 0.76 $\cdot$ 10 <sup>-3</sup> $\cdot$ / 0.2 mA + 8.7 $\cdot$ 10 <sup>-3</sup> $\cdot$ /	
	> 2.2 A to 11 A	40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	0.2 mA + 0.47 $\cdot$ 10 <sup>-3</sup> $\cdot$ / 0.5 mA + 1 $\cdot$ 10 <sup>-3</sup> $\cdot$ / 0.9 mA + 3.8 $\cdot$ 10 <sup>-3</sup> $\cdot$ /	
AC current current clamps	0 A to 100 A	10 Hz to 100 Hz >100 Hz to 1 kHz	0.5 mA + 7 $\cdot$ 10 <sup>-3</sup> $\cdot$ / 0.5 mA + 18 $\cdot$ 10 <sup>-3</sup> $\cdot$ /	
	> 100 A to 1000 A	10 Hz to 100 Hz >100 Hz to 1 kHz	7 $\cdot$ 10 <sup>-3</sup> 18 $\cdot$ 10 <sup>-3</sup>	
Oscilloscope quantities vertical deflection	5 mV to 30 mV	Square wave 10 kHz to 10 kHz	0.03 %	
	> 30 mV to 200 V		0.02 %	
horizontal deflection	> 500 ps to 5 s	Amplitude time mark < 1 V	2 ps + 1.5 $\cdot$ 10 <sup>-4</sup> $\cdot$ t	t = measured value
rise time	> 50 ps to 100 ps	Amplitude < 1 V	5 ps	
	> 100 ps to 10 ms		5 ps + 2 $\cdot$ 10 <sup>-2</sup> $\cdot$ t	t = actual rise time
frequency response	10 Hz to 6 GHz	5 mV to 3 V	3.5 % (0.3 dB)	For   $\Gamma$   > 0.02 the uncertainty increases.   $\Gamma$  : magnitude of complex reflection coefficient
measuring instruments and sources	0,01 V to 10 V	0,1 Hz to 10 Hz	35 $\cdot$ 10 <sup>-6</sup>	

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