

Deutscher Kalibrierdienst (DKD)  
Akkreditierungsstelle

vertreten im

Deutschen AkkreditierungsRat



Akkreditierung

Die Akkreditierungsstelle des **Deutschen Kalibrierdienstes** akkreditiert hiermit

ROHDE & SCHWARZ GmbH & Co KG

Dienstleistungszentrum Köln

Graf Zeppelin-Straße 18

51147 Köln

nach DIN EN ISO/IEC 17025: 2005 für Kalibrierungen im Bereich / in den Bereichen:

elektrische Gleichstrom- und NF-Größen, elektrische HF-Größen, Zeit und  
Frequenz

Bestandteil der Urkunde ist: Anlage 22 (5 Seiten), 2007-05-25

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Dr.-Ing. Wolfgang Bosch  
Leiter der Akkreditierungsstelle



## Summary of our DKD Accredited Calibration Facilities

Parameter	Range	Conditions	Uncertainty	Remarks
DC voltage	1 V and 1,018 V 10 V 0 V to 1000 V > 1 kV to 10 kV		2·10 <sup>-6</sup> 1·10 <sup>-6</sup> 3·10 <sup>-6</sup> + 0,2 μV 1·10 <sup>-4</sup>	
DC current	1 μA to 10 A		1·10 <sup>-5</sup>	
DC resistance (resistors)	1,0 Ω 10 kΩ 1 mΩ to 1 Ω > 1 Ω to 100 kΩ > 100 kΩ to 1 MΩ > 1 MΩ to 10 MΩ > 10 MΩ to 100 MΩ >100 MΩ to 1 GΩ > 1 GΩ to 10 GΩ		2·10 <sup>-6</sup> 2·10 <sup>-6</sup> 1·10 <sup>-5</sup> 3·10 <sup>-6</sup> 5·10 <sup>-6</sup> 3·10 <sup>-5</sup> 1·10 <sup>-4</sup> 2·10 <sup>-4</sup> 2·10 <sup>-3</sup>	
DC resistance (ohmmeters)	1 mΩ to < 20 Ω 20 Ω to 100 kΩ > 100 kΩ to 1 MΩ > 1 MΩ to 10 MΩ > 10 MΩ to 100 MΩ >100 MΩ to 1 GΩ > 1 GΩ to 10 GΩ		3·10 <sup>-6</sup> + 20 μΩ 3·10 <sup>-6</sup> 5·10 <sup>-6</sup> 3·10 <sup>-5</sup> 1·10 <sup>-4</sup> 5·10 <sup>-4</sup> 5·10 <sup>-3</sup>	
AC voltage and AC/DC transfer	1 mV to < 10 mV 10 mV to < 0,2 V 0,2 V to 500 V	10 Hz to 100 kHz	1·10 <sup>-3</sup> 2·10 <sup>-4</sup> 1·10 <sup>-4</sup>	
	> 500 V to 1000 V	10 Hz to 50 kHz >50 kHz to 100 kHz	2·10 <sup>-4</sup> 3·10 <sup>-4</sup>	
	1 mV to < 0,2 V	100 kHz to 1 MHz >1 MHz to 10 MHz >10 MHz to 30 MHz >30 MHz to 50 MHz	1·10 <sup>-3</sup> 2·10 <sup>-3</sup> 3·10 <sup>-3</sup> 5·10 <sup>-3</sup>	uncertainty valid for type N - connector and 50 Ω load
	0,2 V to 10 V	100 kHz to 1 MHz >1 MHz to 10 MHz >10 MHz to 30 MHz >30 MHz to 50 MHz	1·10 <sup>-3</sup> 2·10 <sup>-3</sup> 3·10 <sup>-3</sup> 4·10 <sup>-3</sup>	uncertainty valid for GR 874 - connector
RF voltage	0,1 V to 2 V	>50 MHz to 100 MHz >100 MHz to 200 MHz >200 MHz to 300 MHz >300 MHz to 500 MHz >500 MHz to 1 GHz	4·10 <sup>-3</sup> 5·10 <sup>-3</sup> 7·10 <sup>-3</sup> 1·10 <sup>-2</sup> 1,5·10 <sup>-2</sup>	uncertainty valid for type N - connector
AC current and AC/DC transfer	2,5 mA to 10 mA > 10 mA to 3 A > 3 A to 10 A	20 Hz to 20 kHz	1·10 <sup>-4</sup> 2·10 <sup>-4</sup> 3·10 <sup>-4</sup>	

## Summary of our DKD Accredited Calibration Facilities

Parameter	Range	Conditions	Uncertainty	Remarks
RF power	5 nW to 0,5 $\mu$ W	0 MHz to 2 GHz > 2 GHz to 8 GHz > 8 GHz to 12,4 GHz >12,4 GHz to 18 GHz > 18 GHz to 26,5 GHz	$1,5 \cdot 10^{-2}$ $1,6 \cdot 10^{-2}$ $1,7 \cdot 10^{-2}$ $2,2 \cdot 10^{-2}$ $2,8 \cdot 10^{-2}$	generators and power meters with type N connector and $r < 0,1$ on other conditions increased uncertainty
	> 0,5 $\mu$ W to 50 $\mu$ W	0 MHz to 2 GHz > 2 GHz to 8 GHz > 8 GHz to 12,4 GHz >12,4 GHz to 18 GHz > 18 GHz to 26,5 GHz	$1,0 \cdot 10^{-2}$ $1,2 \cdot 10^{-2}$ $1,3 \cdot 10^{-2}$ $1,7 \cdot 10^{-2}$ $2,5 \cdot 10^{-2}$	
	> 50 $\mu$ W to 50 mW	0 MHz to 100 MHz 30 MHz / 50 MHz > 100 MHz to 2 GHz > 2 GHz to 8 GHz > 8 GHz to 12,4 GHz >12,4 GHz to 18 GHz > 18 GHz to 26,5 GHz	$0,6 \cdot 10^{-2}$ $0,4 \cdot 10^{-2}$ $0,8 \cdot 10^{-2}$ $1,0 \cdot 10^{-2}$ $1,2 \cdot 10^{-2}$ $1,5 \cdot 10^{-2}$ $2,3 \cdot 10^{-2}$	
	> 50 mW to 1 W	0 MHz to 2 GHz > 2 GHz to 8 GHz > 8 GHz to 12,4 GHz >12,4 GHz to 18 GHz > 18 GHz to 26,5 GHz	$1,0 \cdot 10^{-2}$ $1,2 \cdot 10^{-2}$ $1,3 \cdot 10^{-2}$ $1,7 \cdot 10^{-2}$ $2,3 \cdot 10^{-2}$	
	> 1 W to 2000 W	0 MHz to 1 GHz	$2,5 \cdot 10^{-2}$	
	> 1 W to 100 W	> 1 GHz to 8 GHz > 8 GHz to 12,4 GHz >12,4 GHz to 18 GHz	$3,5 \cdot 10^{-2}$ $4,0 \cdot 10^{-2}$ $5,0 \cdot 10^{-2}$	
	Attenuation	0 dB to 20 dB	0 MHz to 12 GHz > 12 GHz to 18 GHz > 18 GHz to 26,5 GHz	
> 20 dB to 50 dB		0 MHz to 12 GHz > 12 GHz to 18 GHz > 18 GHz to 26,5 GHz	0,01 dB / 10 dB 0,01 dB / 10 dB + 0,01dB 0,015 dB / 10 dB + 0,01dB	
> 50 dB to 60 dB		0 MHz to 12 GHz > 12 GHz to 18 GHz > 18 GHz to 26,5 GHz	0,01 dB / 10 dB 0,01 dB / 10 dB + 0,01dB 0,15 dB	
> 60 dB to 70 dB		0 MHz to 8 GHz > 8 GHz to 12 GHz > 12 GHz to 18 GHz > 18 GHz to 26,5 GHz	0,07 dB 0,08 dB 0,15 dB 0,40 dB	
> 70 dB to 80 dB		0 MHz to 4 GHz > 4 GHz to 8 GHz > 8 GHz to 12 GHz > 12 GHz to 18 GHz	0,10 dB 0,15 dB 0,30 dB 0,50 dB	

## Summary of our DKD Accredited Calibration Facilities

Parameter	Range	Conditions	Uncertainty	Remarks
Capacity	C=1 nF	f=1 kHz	$3 \cdot 10^{-5}$	substitution for GR 1404-standards and equivalent
	0,1 pF < C < 1 pF	50 Hz ≤ f < 100 Hz	$1 \cdot 10^{-1}$	direct capacity with bridge GR 1620
		100 Hz ≤ f < 200 Hz	$1 \cdot 10^{-2}$	
		200 Hz ≤ f < 1 kHz	$1 \cdot 10^{-3}$	
		1 kHz < f ≤ 10 kHz	$4 \cdot 10^{-4}$	
	1 pF ≤ C < 10 pF	50 Hz ≤ f < 100 Hz	$1 \cdot 10^{-2}$	$1 \cdot 10^{-3}$ $1,5 \cdot 10^{-4}$
		100 Hz ≤ f < 1 kHz	$1 \cdot 10^{-3}$	
		1 kHz ≤ f ≤ 10 kHz	$1,5 \cdot 10^{-4}$	
	10 pF ≤ C < 100 pF	50 Hz ≤ f < 1 kHz	$5 \cdot 10^{-4}$	$1 \cdot 10^{-4}$
	1 kHz ≤ f ≤ 10 kHz	$1 \cdot 10^{-4}$		
100 pF ≤ C < 50 nF	50 Hz ≤ f ≤ 10 kHz	$1 \cdot 10^{-4}$	$1 \cdot 10^{-4}$ $4 \cdot 10^{-4}$	
50 nF ≤ C < 200 nF	50 Hz ≤ f ≤ 1 kHz	$1 \cdot 10^{-4}$		
200 nF ≤ C < 1 μF	50 Hz ≤ f ≤ 1 kHz	$1 \cdot 10^{-4}$	$5 \cdot 10^{-4}$ $2 \cdot 10^{-3}$	
	1 kHz < f ≤ 5 kHz	$5 \cdot 10^{-4}$		
	5 kHz < f ≤ 10 kHz	$2 \cdot 10^{-3}$		
1 μF ≤ C < 5 μF	50 Hz ≤ f ≤ 1 kHz	$1 \cdot 10^{-4}$	$4 \cdot 10^{-4}$ $3 \cdot 10^{-3}$ $1 \cdot 10^{-2}$	
	1 kHz < f ≤ 2 kHz	$4 \cdot 10^{-4}$		
	2 kHz < f ≤ 5 kHz	$3 \cdot 10^{-3}$		
	5 kHz < f ≤ 10 kHz	$1 \cdot 10^{-2}$		
5 μF ≤ C ≤ 10 μF	50 Hz ≤ f ≤ 1 kHz	$2 \cdot 10^{-4}$	$8 \cdot 10^{-4}$ $5 \cdot 10^{-3}$ $2 \cdot 10^{-2}$	
	1 kHz < f ≤ 2 kHz	$8 \cdot 10^{-4}$		
	2 kHz < f ≤ 5 kHz	$5 \cdot 10^{-3}$		
	5 kHz < f ≤ 10 kHz	$2 \cdot 10^{-2}$		
Complex reflection coefficient (Impedance, VSWR)	$\Gamma = 0$ to 1 $\varphi = 0$ to 360°	9 kHz to 6 GHz > 6 GHz to 12 GHz > 12 GHz to 26,5 GHz	$0,005 + 0,005 \Gamma^{-2}$ $0,008 + 0,008 \Gamma^{-2}$ $0,01 + 0,01 \Gamma^{-2}$	coaxial with type N or 3.5 mm connector, on other conditions increased uncertainty
Frequency	100 kHz 1 MHz 5 MHz 10 MHz	phase comparison ( meas. time > 30 min )	$1 \cdot 10^{-11}$	
	0,1 mHz to 40 GHz	frequency counting ( meas. time > 5 min )	$\{(1 \cdot 10^{-10} \cdot f)^2 + (u_{Tf})^2\}^{1/2}$	
	1 Hz to 40 GHz	frequency synthesis ( meas. time > 5 min )	$1 \cdot 10^{-10}$	
Time interval	1 ns to 10000 s		$\{(1 \text{ ns})^2 + (10^{-10} \cdot t)^2 + (u_{Tt})^2\}^{1/2}$	** trigger uncertainty

### DKD calibrations onsite in your locations:

This overview shows the possibilities in the Cologne Service Center.

For all parameters (except capacity) we can also offer DKD accredited calibrations in our mobile laboratory – with slightly increased measurement uncertainties.

## Overview of Additional Calibration Facilities (traceable, but not accredited)

Parameter	Range	Conditions	Uncertainty	Remarks
RF power	5 nW to 1 W	> 26,5 GHz to 40 GHz	$2,5...5,0 \cdot 10^{-2}$	
Attenuation	0 dB to 20 dB	> 26,5 GHz to 40 GHz	0,05 dB	coaxial with connector 2.9 mm and $r < 0,1$ on other conditions increased uncertainty
	> 20 dB to 50 dB		0,015 dB / 10 dB + 0,01dB	
	> 50 dB to 60 dB		0,15 dB	
	> 60 dB to 70 dB		0,50 dB	
Display linearity	0 dB to 120 dB	30 MHz or 50 MHz	0,01 dB / 10 dB	on other frequencies increased uncertainty
Complex reflection coefficient	$\Gamma = 0$ to 1 $\varphi = 0$ to $360^\circ$	> 26,5 GHz to 40 GHz	$0,02 + 0,01 \Gamma^2$	coaxial with connector 2.9 mm
Analog modulation	AM, FM, $\varphi$ M	RF: 9 kHz to 40 GHz AF: DC to 50 MHz	$0,2...2,5 \cdot 10^{-2}$	
Digital modulation	FSK, GMSK, QAM	vector error phase error amplitude error	$1,0...3,0 \cdot 10^{-2}$ $0,5...3,0 \cdot 10^{-2}$ $0,5...3,0 \cdot 10^{-2}$	
Harmonics	0 dB to -80 dB	1 kHz to 40 GHz	0,5...1,5 dB	harmonic frequency
Non-harmonics	0 dB to -110 dB	1 kHz to 40 GHz	0,5...1,5 dB	
Intermodulation	0 dB to -100 dB	1 kHz to 40 GHz	0,5...1,5 dB	incl. intercept points
Distortion, SINAD	0 % to 30 %	1 Hz to 100 kHz	$2 \cdot 10^{-2}$ of rdg. + 0,001 %	
Noise figure	3 dB to 20 dB	10 MHz to 18 GHz	0,3 dB	
Noise (ENR)	3 dB to 20 dB	10 MHz to 18 GHz	0,3 dB	
Bandwidth	1 Hz to 1 GHz	3 dB, 6 dB, shape factor	$1,0 \cdot 10^{-2}$	receivers, analyzers, oscilloscopes...
Pulse response acc. CISPR 16	20 dB $\mu$ V to 60 dB $\mu$ V	9 kHz to 1 GHz	0,2 dB	
Rise time	min. 10 ps		$2 \cdot 10^{-2}$ of rdg. + 2 ps	
Pulse width	20 ps to 1 s		$2 \cdot 10^{-3}$ of rdg. + 2 ps	
Pulse amplitude	1 mV to 100 V		$0,1 ... 5,0 \cdot 10^{-2}$	depending on pulse form
Transfer impedance	-60 dB $\Omega$ to 34 dB $\Omega$	1 kHz to 500 MHz	0,1...2,0 dB	current probes, clamps
Capacity	1 pF to 1000 $\mu$ F	100 Hz to 100 MHz	$0,1 ... 10 \cdot 10^{-2}$	
Inductivity	1 nH to 1 H	100 Hz to 100 MHz	$0,1 ... 10 \cdot 10^{-2}$	

## Overview of Additional Calibration Facilities (traceable, but not accredited)

Parameter	Range	Conditions	Uncertainty	Remarks
Optical power	100 $\mu$ W to 5 mW	488 nm 633 nm	$2,0 \cdot 10^{-2}$ $3,0 \cdot 10^{-2}$	
	10 nW to 1 mW	850 nm 1300 nm 1530 nm 1550 nm 1570 nm 1610 nm	$2,0 \cdot 10^{-2} + 1$ nW	
Optical wave length	480 nm to 600 nm	32 $\mu$ W to 10 mW	$5,0 \cdot 10^{-6}$	single mode laser
	600 nm to 1650 nm	3,2 nW to 10 mW	$2,0 \cdot 10^{-6}$	
	1650 nm to 1700 nm	1 nW to 10 mW	$10 \cdot 10^{-6}$	
Optical attenuation	0 db to 80 dB	630 nm 850 nm 1310 nm 1525 nm 1630 nm	0,05 db to 0,1 dB	
Optical spectrum	600 nm to 1700 nm	0 dbc to -60 dBc	0,5 dB	
Optical fibre length	200 m 500 m 10 km	1300 nm 1550 nm	0,5 m	

For detailed information please do not hesitate to contact us:

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