Deutscher Kalibrierdienst (DKD)
Accreditation Body

represented in

Deutscher AkkreditierungsRat

Accreditation

The Accreditation Body of **Deutscher Kalibrierdienst** hereby accredits

TEKTRONIX GmbH

Heinrich-Pesch-Straße 9-11

50739 Köln

according to DIN EN ISO/IEC 17025:2005 for calibrations in the field / fields:

electrical DC and LF quantities, time and frequency

Part of the certificate is: Annex 05 (2 pages), 2009-12-15

DAR registration number: DKD-K-14401
DKD accredited since: 1995-07-10

Braunschweig, 2009-12-15

Head of Accreditation Body
by proxy

Dr. Martin Czaske

See overleaf

Deutscher Kalibrierdienst

DKD

Accreditation Body

Annex 05

of 2009-12-15 to the accreditation certificate of the calibration laboratory

Registration number:

DKD-K-14401

at
TEKTRONIX GmbH
Heinrich-Pesch-Straße 9-11
50739 Köln
Germany

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Head: Dipl.-Ing. Ralf Riedel
Deputy: Dipl.-Ing. Wolfgang Werner

Accredited since: 1995-07-10

measured quantities:
DC voltage,
DC current,
DC resistance,
frequency,
rise time
oscilloscope

Permanent Laboratory

measured quantity / calibration item	range	measurement conditions / procedure	best measurement capability 1)	remarks
DC voltage				U = measured value
voltage sources	10 mV to 100 mV		$5 \cdot 10^{-6} \cdot U + 3\ \mu V$	
	>100 mV to 1 V		$4 \cdot 10^{-6} \cdot U + 9\ \mu V$	
	>1 V to 10 V		$5 \cdot 10^{-6} \cdot U + 15\ \mu V$	
	>10 V to 100 V		$5 \cdot 10^{-6} \cdot U + 0{,}15\ mV$	
	>100 V to 1100 V		$7 \cdot 10^{-6} \cdot U + 1{,}5\ mV$	
measuring instruments	10 mV to 220 mV		$4 \cdot 10^{-6} \cdot U + 2\ \mu V$	
	>220 mV to 2,2 V		$5 \cdot 10^{-6} \cdot U + 3\ \mu V$	
	>2,2 V to 22 V		$5 \cdot 10^{-6} \cdot U + 10\ \mu V$	
	>22 V to 220 V		$5 \cdot 10^{-6} \cdot U + 0{,}15\ mV$	
	>220 V to 1100 V		$6 \cdot 10^{-6} \cdot U + 1\ mV$	
DC current				I = measured value
current sources	1 µA to 100 µA		$50 \cdot 10^{-6} \cdot I + 9\ nA$	
	>100 µA to 1 mA		$50 \cdot 10^{-6} \cdot I + 80\ nA$	
	>1 mA to 10 mA		$60 \cdot 10^{-6} \cdot I + 0{,}5\ \mu A$	
	>10 mA to 100 mA		$70 \cdot 10^{-6} \cdot I + 2\ \mu A$	
	>100 mA to 1 A		$0{,}24 \cdot 10^{-3} \cdot I + 10\ \mu A$	
	>1 A to 10 A		$0{,}25 \cdot 10^{-3} \cdot I + 0{,}3\ mA$	
measuring instruments	1 µA to 220 µA		$45 \cdot 10^{-6} \cdot I + 7\ nA$	
	>220 µA to 2,2 mA		$43 \cdot 10^{-6} \cdot I + 70\ nA$	
	>2,2 mA to 22 mA		$50 \cdot 10^{-6} \cdot I + 0{,}4\ \mu A$	
	>22 mA to 220 mA		$65 \cdot 10^{-6} \cdot I + 0{,}5\ \mu A$	
	>220 mA to 2,2 A		$0{,}2 \cdot 10^{-3} \cdot I + 4\ \mu A$	
	>2,2 A to 11 A		$0{,}21 \cdot 10^{-3} \cdot I + 0{,}14\ mA$	
DC resistance				R = measured value
resistance	1 Ω to <10 Ω		$20 \cdot 10^{-6} \cdot R$	
	10 Ω to <100 Ω		$15 \cdot 10^{-6} \cdot R$	
	100 Ω to <1 MΩ		$25 \cdot 10^{-6} \cdot R$	
	1 MΩ to <10 MΩ		$40 \cdot 10^{-6} \cdot R$	
	10 MΩ to 100 MΩ		$0{,}1 \cdot 10^{-3} \cdot R$	
measuring instruments	1 Ω		$90 \cdot 10^{-6} \cdot R$	decade values and factor 1,9
	1,9 Ω		$60 \cdot 10^{-6} \cdot R$	
	10 Ω; 19 Ω		$20 \cdot 10^{-6} \cdot R$	
	100 Ω to 190 kΩ		$15 \cdot 10^{-6} \cdot R$	
	1 MΩ; 1,9 MΩ		$75 \cdot 10^{-6} \cdot R$	
	10 MΩ; 19 MΩ		$75 \cdot 10^{-6} \cdot R$	
	100 MΩ		$0{,}10 \cdot 10^{-3} \cdot R$	

1) 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 [1)]	remarks
frequency				f = measured value in steps of 1 MHz
	1 MHz to 10 MHz		$1 \cdot 10^{-11} \cdot f$	
	0,1 Hz to 2 GHz		$1 \cdot 10^{-8} \cdot f + u_{Tf}$	
rise time		periodical signal pulse amplitudes:		t_r = measured value
generation	14 ps to 10 ms	250 mV to 1 V	$3 \cdot 10^{-2} \cdot t_r + 4$ ps	
measurement	18 ps to 10 ms	10 mV to 1 V	$3 \cdot 10^{-2} \cdot t_r + 6$ ps	
oscilloscope deflection				
vertical	50 mV to 50 V	square wave voltage at 1 kHz	$3 \cdot 10^{-3} \cdot U$	
horizontal	0,5 ns to 5 s		$4 \cdot 10^{-6} \cdot t$	
rise time	18 ps to 10 ms		$3 \cdot 10^{-2} \cdot t_r + 6$ ps	
bandwidth				calculated: $0{,}34 = t_r \cdot b$ b=bandwidth t_r=rise time
	≤ 1 GHz		$5 \cdot 10^{-2} \cdot b$	
	> 1 GHz to 2 GHz		$6 \cdot 10^{-2} \cdot b$	
oscilloscope with oscilloscope -calibrator				Fluke 9500
DC voltage	0,0 V	into 50 Ω, 1 MΩ	15 µV	
	>0 mV to <0.1 V		$0.05 \cdot 10^{-2} \cdot U$ + 26 µV	
	0.1 V to 1 V		$0.022 \cdot 10^{-2} \cdot U$ + 65 µV	
	>1 V to 5.56 V		$0.026 \cdot 10^{-2} \cdot U$ + 50 µV	
	5.6 V to 222.4 V	into 1 MΩ	$0.03 \cdot 10^{-2} \cdot U$	
sine- Frequency response		into 50 Ω		
reference: 50 kHz to 10 MHz				Fluke 9500/9530 (1 Hz to 3.2 GHz)
1 Hz to 100 MHz	4.4 mV to 5.6 V		0.22 dB	
100 MHz to 550 MHz	4.4 mV to 3.4 V		0.29 dB	
550 MHz to 1.1 GHz	4.4 mV to 3.4 V		0.37 dB	
1.1 GHz to 2.5 GHz	4.4 mV to 2.2 V		0.48 dB	
2.5 GHz to 3.2 GHz	4.4 mV to 2.2 V		0.48 dB	
AC voltage (sine)		into 50 Ω		Fluke 9500/9530 (1 Hz to 3.2 GHz)
1 Hz to 550 MHz	4.4 mV to 5.6 V		$3.3 \cdot 10^{-2} \cdot U$	
550 MHz to 2.5 GHz	4.4 mV to 3.4 V		$6.3 \cdot 10^{-2} \cdot U$	
2.5 GHz to 3.2 GHz	4.4 mV to 2.2 V		$1{,}1 \cdot 10^{-1} \cdot U$	
resistance measurements	50 Ω		$0.13 \cdot 10^{-2} \cdot R$	Fluke 9500/9530
	1 MΩ		$0.12 \cdot 10^{-2} \cdot R$	
DC voltage measurements	0 V to 5 V		$1.1 \cdot 10^{-3} \cdot U$ + 3 mV	Keithley 2000
frequency / period measurements	12 kHz to 3.2 GHz		$0.27 \cdot 10^{-6}$	Fluke 9500 opt. 100

[1)] 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.