Deutsche Akkreditierungsstelle GmbH

Annex to the Accreditation Certificate D-K-17602-01-00 according to DIN EN ISO/IEC 17025:2005

Valid from: 20.01.2020

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Holder of certificate:

Tektronix GmbH
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Head:	Dipl.-Ing. Ralf Riedel
Deputy head:	Luca Johnen
Accredited as calibration laboratory since:	10.07.1995

Calibration in the fields:

Electrical quantities

DC and low frequency quantities

- **DC voltage**
- **DC current**
- **DC resistance**

High frequency quantities

- **Oscilloscope quantities** *)
- **Risetime** *)
- **Bandwidth** *)

Time and frequency quantities

- **Frequency** *)

*) Also on site calibration

Abbreviations used: see last page

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
DC voltage measurement instruments	10 mV to 220 mV		$4 \cdot 10^{-6} \cdot U + 2\ \mu V$	U = measured value
	> 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		$6 \cdot 10^{-6} \cdot U + 1\ mV$	
sources	10 mV to 100 mV		$5 \cdot 10^{-6} \cdot U + 3\ \mu V$	
	> 0.1 V 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		$7 \cdot 10^{-6} \cdot U + 1{,}5\ mV$	
DC current measurement instruments	1 µA to 220 µA		$45 \cdot 10^{-6} \cdot I + 7\ nA$	I = measured value
	> 0.22 mA to 2.2 mA		$43 \cdot 10^{-6} \cdot I + 70\ nA$	
	> 2.2 mA to 22 mA		$50 \cdot 10^{-6} \cdot I + 0.40\ \mu A$	
	> 22 mA to 220 mA		$65 \cdot 10^{-6} \cdot I + 0.50\ \mu A$	
	> 0.22 A to 2.2 A		$0.2 \cdot 10^{-3} \cdot I + 4\ \mu A$	
	> 2.2 A to 10 A		$0.21 \cdot 10^{-3} \cdot I + 0.14\ mA$	
current probes	5 mA to 30 A		$0.22 \cdot 10^{-3} \cdot I + 0.35\ \mu A$	coil with 5 turns
	> 50 mA to 50 A		$0.5 \cdot 10^{-3} \cdot I + 4\ \mu A$	coil with 10 turns
	> 50 mA to 250 A		$0.22 \cdot 10^{-3} \cdot I + 0.35\ \mu A$	coil with 50 turns
	> 5 A to 500 A		$13 \cdot 10^{-3} \cdot I + 0.1\ mA$	coil with 250 turns
sources	1 µA to 100 µA		$50 \cdot 10^{-6} \cdot I + 9\ nA$	I = measured value
	> 0.1 mA 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		$70 \cdot 10^{-6} \cdot I + 2\ \mu A$	
	> 0.1 A to 1 A		$0.24 \cdot 10^{-3} \cdot I + 10\ \mu A$	
	> 1 A to 10 A		$0.25 \cdot 10^{-3} \cdot I + 0.30\ mA$	
DC resistance measurement instruments	1 Ω		$90 \cdot 10^{-6} \cdot R$	R = measured value
	1.9 Ω		$90 \cdot 10^{-6} \cdot R$	
	10 Ω		$60 \cdot 10^{-6} \cdot R$	
	19 Ω		$75 \cdot 10^{-6} \cdot R$	
	100 Ω		$75 \cdot 10^{-6} \cdot R$	
	190 Ω		$75 \cdot 10^{-6} \cdot R$	
	1.9 kΩ		$75 \cdot 10^{-6} \cdot R$	
	10 kΩ		$75 \cdot 10^{-6} \cdot R$	
	19 kΩ		$75 \cdot 10^{-6} \cdot R$	
	100 kΩ		$75 \cdot 10^{-6} \cdot R$	
	190 kΩ		$75 \cdot 10^{-6} \cdot R$	
	1 MΩ		$75 \cdot 10^{-6} \cdot R$	
	1.9 MΩ		$0.1 \cdot 10^{-3} \cdot R$	
	10 MΩ		$0.1 \cdot 10^{-3} \cdot R$	
	19 MΩ		$20 \cdot 10^{-6} \cdot R$	
	100 MΩ		$15 \cdot 10^{-6} \cdot R$	
			$75 \cdot 10^{-6} \cdot R$	

[1] 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.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
DC resistance resistors	1 Ω to 10 Ω > 10 Ω to 100 Ω > 100 Ω to 1 MΩ > 1 MΩ to 10 MΩ > 10 MΩ to 100 MΩ		$20 \cdot 10^{-6} \cdot R$ $15 \cdot 10^{-6} \cdot R$ $25 \cdot 10^{-6} \cdot R$ $40 \cdot 10^{-6} \cdot R$ $0.1 \cdot 10^{-3} \cdot R$	R = measured value
Frequency sources and measurement instruments	1 MHz to 10 MHz 0.1 Hz to 20 GHz		$1 \cdot 10^{-11} \cdot f$ $1 \cdot 10^{-8} \cdot f + U_{Tf}$	1 MHz step width u_{Tf} = trigger uncertainty
Rise time sources	14 ps to 25 ns	50 mV to 50 V	$3 \cdot 10^{-2} \cdot t_R + 4$ ps	Periodic signals and impulse amplitudes t_R = rise time
measurement instruments	18 ps to 1 ns 500 ps to 3 ns 1.5 ns to 25 ns	10 mV to 250 mV 0.25 V to 3 V 25 V and 50 V	$3 \cdot 10^{-2} \cdot t_R + 8$ ps $2 \cdot 10^{-2} \cdot t_R + 65$ ps $2 \cdot 10^{-2} \cdot t_R + 120$ ps	
current probes	1.5 ns to 20 ns 100 ns to 300 ns	0.5 A and1A 5A	$3 \cdot 10^{-2} \cdot t_R + 200$ ps $3 \cdot 10^{-2} \cdot t_R$	
Oscilloscopes with oscilloscope calibrator DC voltage	0.0 V > 0.0 V to 0.1 V > 0.1 V to 1 V > 1 V to 5.6 V	1 MΩ or 50 Ω Input impedance	15 µV $0.50 \cdot 10^{-3} \cdot U + 26$ µV $0.22 \cdot 10^{-3} \cdot U + 65$ µV $0.26 \cdot 10^{-3} \cdot U + 50$ µV	with Fluke 9500 U = measured value
	> 5.6 V to 222.4 V	1 MΩ Input impedance	$0.30 \cdot 10^{-3} \cdot U$	U = measured value
Flatness	4.4 mV to 5.6 V 4.4 mV to 5.6 V 4.4 mV to 3.4 V 4.4 mV to 3.4 V 4.4 mV to 2.2 V	10 MHz to 100 MHz > 100 MHz to 550 MHz > 550 MHz to 1.1 GHz > 1.1 GHz to 2.5 GHz > 2.5 GHz to 3.2 GHz	0.22 dB 0.29 dB 0.37 dB 0.48 dB 0.48 dB	Measurement quantity: ratio of rms-value at frequency of interest- and reference frequency f_{ref}: 50 kHz to 10 MHz Measurement range: peak-to-peak value of incident wave $\lvert\Gamma_{DUT}\rvert \leq 0.23$ (50 Ω)
DC resistance	50 Ω 75 Ω 1 MΩ		$0.11 \cdot 10^{-2} \cdot R$ $0.13 \cdot 10^{-2} \cdot R$ $0.12 \cdot 10^{-2} \cdot R$	R = measured value
DC voltage scources	0 V to 5 V		$0.14 \cdot 10^{-3} \cdot U + 90$ µV	U = measured value
Frequency scources	12 kHz to 3.2 GHz		$0.27 \cdot 10^{-6}$	

[1] 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.

On-site Calibration

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Rise time sources	40 ps to 25 ns	50 mV to 50 V	$4 \cdot 10^{-2} \cdot t_R + 4$ ps	Periodic signals Impulse amplitudes
measurement instruments	40 ps to 1 ns 500 ps to 3 ns 1.5 ns to 25 ns	10 mV to 250 mV 0.25 V to 3 V 25 V and 50 V	$4 \cdot 10^{-2} \cdot t_R + 8$ ps $2 \cdot 10^{-2} \cdot t_R + 65$ ps $2 \cdot 10^{-2} \cdot t_R + 120$ ps	t_R = rise time
current probes	1.5 ns to 20 ns 100 ns to 300 ns	0.5 A and 1A 5A	$3 \cdot 10^{-2} \cdot t_R + 200$ ps $3 \cdot 10^{-2} \cdot t_R$	
Oscilloscopes with oscilloscope calibrator DC voltage	0.0 V > 0.0 V to 0.1 V > 0.1 V to 1 V > 1 V to 5.6 V	1 MΩ or 50 Ω Input impedance	15 µV $0.50 \cdot 10^{-3} \cdot U + 26$ µV $0.22 \cdot 10^{-3} \cdot U + 65$ µV $0.26 \cdot 10^{-3} \cdot U + 50$ µV	U= measured value
	> 5.6 V to 222.4 V	1 MΩ Input impedance	$0.30 \cdot 10^{-3} \cdot U$	
Flatness	4.4 mV 4 to 5.6 V 4.4 mV to 5.6 V 4.4 mV to 3.4 V 4.4 mV to 3.4 V 4.4 mV to 2.2 V	10 MHz to 100 MHz > 100 MHz to 550 MHz > 550 MHz to 1.1 GHz > 1.1 GHz to 2.5 GHz > 2.5 GHz to 3.2 GHz	0.22 dB 0.29 dB 0.37 dB 0.48 dB 0.48 dB	Measurement quantity: ratio of rms-value at frequency of interest- and reference frequency f_{ref}: 50 kHz to 10 MHz Measurement range: peak-to-peak value of incident wave $\lvert \Gamma_{\mathrm{DUT}} \rvert \leq 0.23$ (50 Ω)
Frequency scources	12 kHz to 3.2 GHz		$0.27 \cdot 10^{-6}$	

Abbreviations used:

EA-4/02 M: 2013 Evaluation of the Uncertainty of Measurement in Calibration, European co-operation for Accreditation

[1)] 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.