Annex to ISO/IEC 17025 declaration of accreditation
for registration number: **K 052**

of **Trescal B.V.**
Zoetermeer

This annex is valid from: **25-08-2010** to **01-03-2014** Replaces annex dated: **03-09-2007**

HCS code	Measured quantity, Range	Frequency	CMC*	Remarks
LF 0 0	DC/LF Quantities			
LF 1 0	DC Voltage			
	10 µV - 100 µV		$5 \cdot 10^{-3} \cdot U$	Measurement
	100 µV - 1 mV		$5 \cdot 10^{-4} \cdot U$	
	1 mV - 10 mV		$1 \cdot 10^{-4} \cdot U$	
	10 mV - 100 mV		$3 \cdot 10^{-5} \cdot U$	
	100 mV – 2 V		$7 \cdot 10^{-6} \cdot U$	
	2 V - 20 V		$3 \cdot 10^{-6} \cdot U$	
	20 V - 1 kV		$6 \cdot 10^{-6} \cdot U$	
	0,1 V		$1 \cdot 10^{-6} \cdot U$	Measurement and Generation
	1 V		$9 \cdot 10^{-7} \cdot U$	
	1,018 V		$0{,}9 \cdot 10^{-6} \cdot U$	
	10 V		$7 \cdot 10^{-7} \cdot U$	
	100 V		$7 \cdot 10^{-7} \cdot U$	
	1000 V		$1{,}2 \cdot 10^{-6} \cdot U$	
	10 mV - 100 mV		$6 \cdot 10^{-5} \cdot U$	Generation
	100 mV – 2,2 V		$1{,}5 \cdot 10^{-5} \cdot U$	
	2,2 V - 22 V		$7 \cdot 10^{-6} \cdot U$	
	22 V - 1 kV		$1 \cdot 10^{-5} \cdot U$	

This annex has been approved by:

Ir. J.C. van der Poel
Chief Executive

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HCS code	Measured quantity, Range	Frequency	CMC*	Remarks
LF 1 3	Direct high Voltage			
	1 kV – 30 kV		$8 \cdot 10^{-4} \cdot U$	Measurement
	1 kV – 30 kV		$1 \cdot 10^{-3} \cdot U$	Generation
LF 1 4	Pulse Amplitude			
	2mV	10 Hz	$1.10^{-3}.U$	Generation in 1MOhm
	2mV	100Hz/1kHz	$5.10^{-4}.U$	Generation in 1MOhm
	5mV - 100V	10Hz/100Hz/1kHz	$5.10^{-4}.U$	Generation in 1MOhm
	2mV - 100V	10 Hz - 1 kHz	$5.10^{-4}.U$	Measurement
LF 2 0	DC Current			Measurement and Generation
	10 µA - 1 mA		$1 \cdot 10^{-5} \cdot I$	
	1 mA – 150 mA		$2{,}5 \cdot 10^{-5} \cdot I$	
	0,15 A - 15 A		$2 \cdot 10^{-5} \cdot I$	
	15 A - 20 A		$5 \cdot 10^{-5} \cdot I$	
	20 A – 30 A		$2 \cdot 10^{-4} \cdot I$	
LF 3 0	AC Voltage			Measurement and Generation
	60 mV	10 Hz – 20 Hz	$3 \cdot 10^{-4} \cdot U$	Generation > 200V at 50 Hz – 1 kHz
		20 Hz – 40 Hz	$1{,}5 \cdot 10^{-4} \cdot U$	
		40 Hz – 20 kHz	$1 \cdot 10^{-4} \cdot U$	
		20 kHz – 50 kHz	$2 \cdot 10^{-4} \cdot U$	
		50 kHz – 100 kHz	$3{,}5 \cdot 10^{-4} \cdot U$	
		100 kHz – 300 kHz	$6 \cdot 10^{-4} \cdot U$	
		300 kHz – 500 kHz	$8{,}5 \cdot 10^{-4} \cdot U$	
		500 kHz – 1 MHz	$1{,}5 \cdot 10^{-3} \cdot U$	

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	100 mV – 200 mV	10 Hz – 20 Hz	$2{,}5 \cdot 10^{-4} \cdot U$	
		20 Hz – 40 Hz	$1 \cdot 10^{-4} \cdot U$	
		40 Hz – 20 kHz	$1 \cdot 10^{-4} \cdot U$	
		20 kHz – 50 kHz	$1 \cdot 10^{-4} \cdot U$	
		50 kHz – 100 kHz	$2 \cdot 10^{-4} \cdot U$	
		100 kHz – 300 kHz	$3 \cdot 10^{-4} \cdot U$	
		300 kHz – 500 kHz	$5{,}5 \cdot 10^{-4} \cdot U$	
		500 kHz – 1 MHz	$1{,}4 \cdot 10^{-3} \cdot U$	
	200 mV – 600 mV	10 Hz – 20 Hz	$2{,}5 \cdot 10^{-4} \cdot U$	
		20 Hz – 40 Hz	$1 \cdot 10^{-4} \cdot U$	
		40 Hz – 20 kHz	$5 \cdot 10^{-5} \cdot U$	
		20 kHz – 50 kHz	$1 \cdot 10^{-4} \cdot U$	
		50 kHz – 100 kHz	$1 \cdot 10^{-4} \cdot U$	
		100 kHz – 300 kHz	$2{,}5 \cdot 10^{-4} \cdot U$	
		300 kHz – 500 kHz	$4 \cdot 10^{-4} \cdot U$	
		500 kHz – 1 MHz	$1{,}3 \cdot 10^{-3} \cdot U$	
	600 mV – 2 V	10 Hz – 20 Hz	$2 \cdot 10^{-4} \cdot U$	
		20 Hz – 40 Hz	$1 \cdot 10^{-4} \cdot U$	
		40 Hz – 20 kHz	$5 \cdot 10^{-5} \cdot U$	
		20 kHz – 50 kHz	$1 \cdot 10^{-4} \cdot U$	
		50 kHz – 100 kHz	$1 \cdot 10^{-4} \cdot U$	
		100 kHz – 300 kHz	$2 \cdot 10^{-4} \cdot U$	
		300 kHz – 500 kHz	$3{,}5 \cdot 10^{-4} \cdot U$	
		500 kHz – 1 MHz	$1{,}3 \cdot 10^{-3} \cdot U$	
	2 V – 20 V	10 Hz – 20 Hz	$2 \cdot 10^{-4} \cdot U$	
		20 Hz – 40 Hz	$1 \cdot 10^{-4} \cdot U$	
		40 Hz – 20 kHz	$5 \cdot 10^{-5} \cdot U$	

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HCS code	Measured quantity, Range	Frequency	CMC*	Remarks
		20 kHz – 50 kHz	$1 \cdot 10^{-4} \cdot U$	
		50 kHz – 100 kHz	$1 \cdot 10^{-4} \cdot U$	
		100 kHz – 200 kHz	$3 \cdot 10^{-4} \cdot U$	
		300 kHz – 500 kHz	$4{,}5 \cdot 10^{-4} \cdot U$	
		500 kHz – 1 MHz	$1{,}5 \cdot 10^{-3} \cdot U$	
	20 V – 200 V	10 Hz – 20 Hz	$2 \cdot 10^{-4} \cdot U$	
		20 Hz – 40 Hz	$1 \cdot 10^{-4} \cdot U$	
		40 Hz – 20 kHz	$5 \cdot 10^{-5} \cdot U$	
		20 kHz – 50 kHz	$1 \cdot 10^{-4} \cdot U$	
	200 V – 1000 V	10 Hz – 20 Hz	$2 \cdot 10^{-4} \cdot U$	
		20 Hz – 40 Hz	$1 \cdot 10^{-4} \cdot U$	
		40 Hz – 20 kHz	$5 \cdot 10^{-5} \cdot U$	
		20 kHz – 50 kHz	$1{,}5 \cdot 10^{-4} \cdot U$	
LF 3 3	Alternating high voltage			
	1 - 5 kV	50 Hz	$4 \cdot 10^{-3} \cdot U$	Measurement and Generation
LF 4 0	AC current			
	1 mA – 100 mA	20 Hz – 30 kHz	$3 \cdot 10^{-4} \cdot I$	
	100 mA – 1 A	20 Hz – 1 kHz	$3 \cdot 10^{-4} \cdot I$	
	100 mA – 1 A	1 kHz – 30 kHz	$4 \cdot 10^{-4} \cdot I$	
	1 A – 20 A	20 Hz – 5 kHz	$7 \cdot 10^{-4} \cdot I$	
	20 A – 30 A	50 Hz	$1 \cdot 10^{-3} \cdot I$	
	1 mA – 10 mA	20 Hz – 40 Hz	$5 \cdot 10^{-4} \cdot I$	Generation THD ≤ 1%
	1 mA – 10 mA	40 Hz – 1 kHz	$4 \cdot 10^{-4} \cdot I$	

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HCS code	Measured quantity, Range	Frequency	CMC*	Remarks
	1 mA – 10 mA	1 kHz – 5 kHz	$2{,}5 \cdot 10^{-3} \cdot I$	
	1 mA – 10 mA	5 kHz – 10 kHz	$5 \cdot 10^{-3} \cdot I$	
	10 mA – 100 mA	20 Hz – 30 kHz	$3 \cdot 10^{-4} \cdot I$	
	100 mA – 1 A	20 Hz – 1 kHz	$3 \cdot 10^{-4} \cdot I$	
	100 mA – 1 A	1 kHz – 10 kHz	$4 \cdot 10^{-4} \cdot I$	
	1 A – 20 A	20 Hz – 5 kHz	$7 \cdot 10^{-4} \cdot I$	
	20 A – 50 A	50 Hz	$1 \cdot 10^{-3} \cdot I$	
LF 6 1	Resistance			
	0,08 mΩ		$1{,}5 \cdot 10^{-4} \cdot R$	Generation
	0,2 mΩ; 0,4 mΩ; 0,8 mΩ		$1 \cdot 10^{-4} \cdot R$	
	1 mΩ		$3{,}5 \cdot 10^{-5} \cdot R$	
	10 mΩ		$1{,}5 \cdot 10^{-5} \cdot R$	
	100 mΩ		$5 \cdot 10^{-6} \cdot R$	
	1; 10; 100; 1000 Ω		$3 \cdot 10^{-6} \cdot R$	
	10 kΩ		$1 \cdot 10^{-6} \cdot R$	
	100 kΩ		$4 \cdot 10^{-6} \cdot R$	
	1 MΩ		$6 \cdot 10^{-6} \cdot R$	
	10 MΩ		$8 \cdot 10^{-6} \cdot R$	
	100 MΩ		$5{,}5 \cdot 10^{-5} \cdot R$	
	0,08 mΩ		$1{,}5 \cdot 10^{-4} \cdot R$	Measurement
	1 mΩ		$6 \cdot 10^{-5} \cdot R$	
	10 mΩ		$5 \cdot 10^{-5} \cdot R$	
	100 mΩ		$3 \cdot 10^{-5} \cdot R$	
	1 Ω		$6 \cdot 10^{-6} \cdot R$	

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	10; 100; 1000 Ω		$3 \cdot 10^{-6} \cdot R$	
	10 kΩ		$1 \cdot 10^{-6} \cdot R$	
	100 kΩ		$4 \cdot 10^{-6} \cdot R$	
	1 MΩ		$6 \cdot 10^{-6} \cdot R$	
	10 MΩ		$1 \cdot 10^{-5} \cdot R$	
	100 MΩ		$6 \cdot 10^{-5} \cdot R$	
	0,08 mΩ – 1 mΩ		$1{,}5 \cdot 10^{-4} \cdot R$	Measurement
	1 mΩ – 1 Ω		$3{,}5 \cdot 10^{-5} \cdot R$	
	1 Ω - 2 Ω		$3 \cdot 10^{-5} \cdot R$	
	2 Ω - 20 Ω		$2 \cdot 10^{-5} \cdot R$	
	20 Ω - 200 kΩ		$5 \cdot 10^{-6} \cdot R$	
	200 kΩ - 2 MΩ		$1 \cdot 10^{-5} \, R$	
	2 MΩ - 20 MΩ		$5 \cdot 10^{-5} \cdot R$	
	20 MΩ - 200 MΩ		$5 \cdot 10^{-4} \cdot R$	
LF 6 4	Capacitance			
	1 pF	1 kHz	$1{,}5 \cdot 10^{-4} \cdot C$	Generation
	10 pF	1 kHz	$4.10^{-5} \cdot C$	
	100 pF; 1000 pF	1 kHz	$1{,}5 \cdot 10^{-5} \cdot C$	
	10 nF	1 kHz	$1 \cdot 10^{-4} \cdot C$	
	100 nF	1 kHz	$1 \cdot 10^{-4} \cdot C$	
	1 µF	1 kHz	$2{,}5 \cdot 10^{-4} \cdot C$	
	1 pF – 10 pF	1 kHz	$1{,}2 \cdot 10^{-5} \cdot C$	Measurement, D<0,01
	10 pF – 1 nF	1 kHz	$4 \cdot 10^{-5} \cdot C$	
	1 nF – 10 nF	1 kHz	$7 \cdot 10^{-5} \cdot C$	
	10 nF - 100 nF	1 kHz	$1{,}5 \cdot 10^{-4} \cdot C$	
	100 nF - 1 µF	1 kHz	$3{,}3 \cdot 10^{-4} \cdot C$	

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HCS code	Measured quantity, Range	Frequency	CMC*	Remarks
LF 6 7	Inductance			Measurement and Generation
	100 µH	1 kHz	$1{,}5 \cdot 10^{-3} \cdot L$	
	1 mH	1 kHz	$5 \cdot 10^{-4} \cdot L$	
	10 mH	1 kHz	$5 \cdot 10^{-4} \cdot L$	
	100 mH	1 kHz	$5 \cdot 10^{-4} \cdot L$	
	1 H	1 kHz	$5 \cdot 10^{-4} \cdot L$	
	1 H	400 Hz	$5 \cdot 10^{-4} \cdot L$	
RF 0 0	High Frequency quantities			
RF 2 2	Attenuation			
	(10 – 30) dB	0,05 - < 1 GHz	0,05 dB	Measurement 2), 3), 5), 6)
		(1 - 14) GHz	0,10 dB	
		(> 14 - 18) GHz	0,15 dB	
	(> 30 – 60) dB	0,05 - < 1 GHz	0,07 dB	Measurement 2), 3), 5), 6)
		(1 - 16) GHz	0,10 dB	
		(> 16 - 18) GHz	0,15 dB	
RF 3 0	High frequency Power	(0,1 - 18) GHz	(1,3 – 2,8) %	Measurement
	Calibration factor			nom. 1 mW HP8481 A 1), 2), 4), 5)

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HCS code	Measured quantity, Range	Frequency	CMC*	Remarks
TF 0 0	Time and Frequency			
TF 2 1	Frequency			Measurement measuring time $\tau \geq 1000$ s
	100 kHz		$1 \cdot 10^{-11} \cdot f$	
	1 MHz		$1 \cdot 10^{-11} \cdot f$	
	5 MHz		$1 \cdot 10^{-11} \cdot f$	
	10 MHz		$1 \cdot 10^{-11} \cdot f$	
	0,1 Hz – 1 Hz		12 µHz	measuring, generating measuring time $\tau \geq 20$ s
	1 Hz – 10 Hz		12 µHz	
	10 Hz – 100 Hz		12 µHz – 1,2 µH	
	100 Hz – 1 kHz		1,2 µHz	
	1 kHz – 10 kHz		1,2 µHz	
	10 kHz – 100 kHz		1,2 µHz	
	100 kHz – 1 MHz		1,2 µHz – 12 µHz	
	1 MHz – 10 MHz		12 µHz – 0,12 mHz	
	10 MHz – 100 MHz		0,12 mHz – 1,2 mHz	
	100 MHz – 1 GHz		1,2 mHz – 12 mHz	
	1 GHz – 3 GHz		12 mHz – 14 mHz	
	3 GHz – 27,5 GHz		1,2 Hz	
TF 2 2	Time interval			Measurement
	0,1 µs - 1 s		$2 \cdot 10^{-6} \cdot t$ + 0,1 µs	

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HCS code	Measured quantity, Range	Frequency	CMC*	Remarks
OQ 1 0	Optical quantities			
OQ 1 5	Optical Power			
	(Calibrationfactor)			
	-23 dBm to -55 dBm (5µW to 3,16nW)	850 nm	0,09 dB (≈2,0%)	FC/PC multi mode
	-5 dBm to -55 dBm (316µW to 3,16nW)	1300 nm	0,13 dB (≈3,0%)	FC/PC multi mode
	+3 dBm to -55 dBm (2mW - 3,16nW)	1310 nm	0,09 dB (≈2,0%)	FC/PC single mode
	+3 dBm to -55 dBm (2mW - 3,16nW)	1550 nm	0,09 dB (≈2,0%)	FC/PC single mode
	-5 dBm to -55 dBm (316uW - 3,16nW)	1625 nm	0,10 dB (≈2,3%)	FC/PC single mode
	Incremental loss			
	0 dB to 30 dB	850 nm	0,060 dB	FC/PC multi mode
	0 dB to 45 dB	1300 nm	0,060 dB	FC/PC multi mode
	0 dB to 55 dB	1310 nm	0,050 dB	FC/PC single mode
	0 dB to 55 dB	1550 nm	0,050 dB	FC/PC single mode
	0 dB to 50 dB	1625 nm	0,050 dB	FC/PC single mode

Remarks:

Temperature conditions for calibrations performed in the basement (DC/LF calibrations) (23±1) ^{o}C; temperature conditions for calibrations performed on the 1st floor (RF/uW and Optical calibrations) (23±3) ^{o}C.

* Calibration and Measurement Capability (CMC): Demonstrated measurement uncertainty, with coverage probability of 95%, in a given measurement point or measurement range.
Measurement uncertainty, *U*, is calculated according to EA-4/02 "Expression of the Uncertainty of Measurement in Calibration".

The CMC in RF and Microwave measurements are applicable to transmission lines with a characteristic impedance of nominal 50 Ohm
1) Measurements are performed at a fixed set of measurement frequencies;
2) Measurements using N-type connectors;
3) Measurements using type APC-7 connectors;
4) Calibration factor is applicable to measurements relative to 50 MHz;
5) Best accuracy is calculated for a test object VSWR of 1.01;
6) The maximal VSWR for the uncertainty calculation is 1.35

The measurements are carried out inside Trescal BV 's laboratory.