CERTIFICATE OF ACCREDITATION

In terms of section 22(2) (b) of the Accreditation for Conformity Assessment, Calibration and Good Laboratory Practice Act, 2006 (Act 19 of 2006), read with sections 23(1), (2) and (3) of the said Act, I hereby certify that:-

CONCILIUM TECHNOLOGIES (PTY) LTD
Co. Reg. No.: 1999/013330/07
ELECTRICAL DC LOW FREQUENCY LABORATORY

Accreditation Number: **106**

is a South African National Accreditation System accredited Calibration Laboratory provided that all SANAS conditions and requirements are complied with

This certificate is valid as per the scope as stated in the accompanying scope of accreditation Annexure "A", bearing the above accreditation number for

DC LOW FREQUENCY METROLOGY

The facility is accredited in accordance with the recognised International Standard

ISO/IEC 17025:2017

The accreditation demonstrates technical competency for a defined scope and the operation of a laboratory quality management system

While this certificate remains valid, the Accredited Facility named above is authorised to use the relevant SANAS accreditation symbol to issue facility reports and/or certificates

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Mr T Baleni
Acting Chief Executive Officer

Effective Date: 31 January 2022
Certificate Expires: 30 January 2027

ANNEXURE A

SCOPE OF ACCREDITATION

DC LOW FREQUENCY METROLOGY

Accreditation Number: 106

Permanent Address of Laboratory:
Concilium Technologies (Pty) Ltd
Electrical DC Low Frequency Laboratory
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Technical Signatories: Mr BJH Bremmer, Mr GD Schuster

Nominated Representative: Mr BJH Bremmer

Issue No.: 15
Date of Issue: 31 January 2022
Expiry Date: 30 January 2027

ITEM	MEASURED QUANTITY OR TYPE OF GAUGE OR INSTRUMENT AND RANGE OF MEASURED QUANTITY	NOMINAL FREQUENCY	CALIBRATION AND MEASUREMENT CAPABILITY EXPRESSED AS AN UNCERTAINTY (±)	METHOD/ PROCEDURE
1	**DC Voltage (up to 1100 V)**			
1.1	**DC voltage sources**			
1.1.1	**Single values**			
	1,0 V 10 V	DC DC	$1 \cdot 10^{-6} \cdot U$ $1 \cdot 10^{-6} \cdot U$	Direct comparison with a DC voltage standard.
1.1.2	**Low values (<= 10 V)**			
	0 V to 10 V	DC	$1 \cdot 10^{-6} \cdot U$ + 0,3 µV	Direct measurement or comparison with a DC voltage standard.
1.1.3	**Intermediate values (>10 V to 1 100 V)**			
	10 V to 100 V 100 V to 1 000 V	DC DC	$3 \cdot 10^{-6} \cdot U$ $5 \cdot 10^{-6} \cdot U$	Direct measurement or comparison with a DC voltage Source or multifunction calibrator.
1.2	**DC voltage meters**			
1.2.1	**Very low values (<= 10 V)**			
	0 mV to 10 V	DC	$1 \cdot 10^{-6} \cdot U$ + 0,3 µV	Direct measurement or comparison with a DC Voltage source and short.
1.2.2	**Intermediate values (> 1 mV to 1 100 V)**			
	10 V to 100 V 100 V to 1 000 V	DC DC	$3 \cdot 10^{-6} \cdot U$ $5 \cdot 10^{-6} \cdot U$	Direct measurement or comparison with a DC voltage source or multifunction calibrator.

The CMC, expressed as an expanded uncertainty of measurement, is stated as the standard uncertainty of measurement multiplied by a coverage factor $k = 2$, corresponding to a confidence level of approximately 95%

Accreditation Manager

ITEM	MEASURED QUANTITY OR TYPE OF GAUGE OR INSTRUMENT AND RANGE OF MEASURED QUANTITY	NOMINAL FREQUENCY	CALIBRATION AND MEASUREMENT CAPABILITY EXPRESSED AS AN UNCERTAINTY (±)	METHOD / PROCEDURE
2	**DC Resistance**			
2.1	**DC Resistance Standards and Sources**			
2.1.1	**Low values (<= 1Ω)**			
	1 mΩ	DC	$2 \cdot 10^{-4} \cdot R$	Direct substitution or current volt drop method.
	10 mΩ	DC	$1 \cdot 10^{-4} \cdot R$	
	100 mΩ	DC	$1 \cdot 10^{-4} \cdot R$	
	1 Ω	DC	$5 \cdot 10^{-5} \cdot R$	
2.1.2	**Intermediate values (>1 Ω to 1 MΩ)**			
	10 Ω	DC	$5 \cdot 10^{-5} \cdot R$	Direct substitution or current volt drop method.
	100 Ω	DC	$5 \cdot 10^{-5} \cdot R$	
	1 kΩ	DC	$5 \cdot 10^{-5} \cdot R$	
	10 kΩ	DC	$5 \cdot 10^{-5} \cdot R$	
	100 kΩ	DC	$5 \cdot 10^{-5} \cdot R$	
	1 MΩ	DC	$1 \cdot 10^{-4} \cdot R$	
2.1.3	**High values (>1 MΩ)**			
	10 MΩ	DC	$2 \cdot 10^{-4} \cdot R$	Direct or substitution method.
	100 MΩ	DC	$5 \cdot 10^{-4} \cdot R$	
	1 GΩ	DC	$1 \cdot 10^{-3} \cdot R$	
2.2	**DC Resistance Meters**			
2.2.1	**Low values (≤ 1 Ω)**			
	1 mΩ	DC	$2 \cdot 10^{-4} \cdot R$	Direct or substitution method.
	10 mΩ	DC	$1 \cdot 10^{-4} \cdot R$	
	100 mΩ	DC	$1 \cdot 10^{-4} \cdot R$	
	1 Ω	DC	$5 \cdot 10^{-6} \cdot R$	
2.2.2	**Intermediate values (>1 Ω to 1 GΩ)**			
	10 Ω	DC	$5 \cdot 10^{-5} \cdot R$	Direct or substitution method.
	100 Ω	DC	$5 \cdot 10^{-5} \cdot R$	
	1 kΩ	DC	$5 \cdot 10^{-5} \cdot R$	
	10 kΩ	DC	$5 \cdot 10^{-6} \cdot R$	
	100 kΩ	DC	$5 \cdot 10^{-5} \cdot R$	
	1 MΩ	DC	$1 \cdot 10^{-4} \cdot R$	
	10 MΩ	DC	$2 \cdot 10^{-4} \cdot R$	
	100 MΩ	DC	$5 \cdot 10^{-5} \cdot R$	
2.2.3	**High values (>1 GΩ)**			
	1 GΩ	DC	$1 \cdot 10^{-3} \cdot R$	Direct or substitution method.
	10 GΩ	DC	$2 \cdot 10^{-3} \cdot R$	
	100 GΩ	DC	$5 \cdot 10^{-3} \cdot R$	

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Accreditation Manager

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3	**DC Current (up to 100 A)**			
3.1	**DC Current Sources**			
3.1.1	**Low values (≤ 0,1 mA)**			
	1 µA to 100 µA	DC	$5 \cdot 10^{-5} \cdot I$	Direct or current Volt drop method.
3.1.2	**Intermediate values (> 0,1 mA to 20 A)**			
	100 mA to 2 A 2 A to 10 A 10 A to 20 A	DC DC DC	$2 \cdot 10^{-4} \cdot I$ $2 \cdot 10^{-4} \cdot I$ $5 \cdot 10^{-4} \cdot I$	Direct or current Volt drop method.
3.1.3	**High values (> 20 A to 100 A)**			
	20 A to 50 A 50 A to 100 A	DC DC	$5 \cdot 10^{-4} \cdot I$ $2 \cdot 10^{-3} \cdot I$	Direct or current Volt drop method.
3.2	**Current Meters**			
3.2.1	**Low values (<0,1 mA)**			
	1 µA to 100 µA	DC	$5 \cdot 10^{-5} \cdot I$	Direct measurement.
3.2.2	**Intermediate values (0,1 mA to 20 A)**			
	0,1 mA to 100 mA 100 mA to 2 A 2 A to 10 A 10 A to 20 A	DC DC DC DC	$2 \cdot 10^{-4} \cdot I$ $2 \cdot 10^{-4} \cdot I$ $2 \cdot 10^{-4} \cdot I$ $2 \cdot 10^{-3} \cdot I$	Direct measurement.
3.2.3	**High values (>20 A to 100 A)**			
	20 A to 50 A	DC	$2 \cdot 10^{-3} \cdot I$	Direct measurement.
4	**Impendence (up to the MHz range**			
4.2	**Capacitance**			
4.2.1	**Standard Capacitors**			
	100 pF to 1 µF 1 µF to 10 µF 10 µF to 100 µF	120 Hz to 10 kHz 120 Hz to 10 kHz 120 Hz to 1 kHz	$1 \cdot 10^{-3} \cdot C$ $2 \cdot 10^{-3} \cdot C$ $2 \cdot 10^{-3} \cdot C$	Direct measurement or substitution method.
4.2.2	**Fixed Capacitor**			
	100 pF to 1 µF 1 µF to 10 µF 10 µF to 100 µF	120 Hz to 10 kHz 120 Hz to 10 kHz 120 Hz to 1 kHz	$1 \cdot 10^{-3} \cdot C$ $2 \cdot 10^{-3} \cdot C$ $2 \cdot 10^{-3} \cdot C$	Direct measurement or substitution method.
4.2.4	**Capacitance Meters and Bridges**			
	1 pF, 10 pF, 100 pF and 1 nF	50 Hz to 1 kHz 1 kHz to 1 MHz	$5 \cdot 10^{-5} \cdot C$ $5 \cdot 10^{-4} \cdot C$	Direct measurement of reference standard capacitor.
	10 nF	50 Hz to 1 kHz 1 kHz to 100 kHz 100 kHz to 500 kHz 500 kHz to 1 MHz	$5 \cdot 10^{-5} \cdot C$ $5 \cdot 10^{-4} \cdot C$ $1 \cdot 10^{-3} \cdot C$ $1 \cdot 10^{-2} \cdot C$	
	100 nF	50 Hz to 1 kHz 1 kHz to 10 kHz 10 kHz to 200 kHz	$5 \cdot 10^{-5} \cdot C$ $5 \cdot 10^{-4} \cdot C$ $3 \cdot 10^{-3} \cdot C$	
	1 µF	50 Hz to 1 kHz 1 kHz to 10 kHz 10 kHz to 50 kHz	$5 \cdot 10^{-5} \cdot C$ $1 \cdot 10^{-3} \cdot C$ $2 \cdot 10^{-3} \cdot C$	
	10 µF and 100 µF	120 Hz to 1 kHz	$2 \cdot 10^{-3} \cdot C$	

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Accreditation Manager

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4	**Impedance (up to the MHz range)**			
4.3	**Inductance**			
4.3.2	**Fixed Indicator, Variable, Indicator box (1 mH to 1 H)**			
	1 mH to 1 H	120 Hz to 1 kHz	$2 \cdot 10^{-3} \cdot L$	Direct measurement or substitution method.
4.3.3	**Fixed Indicator, Variable, Indicator box (> 1 H)**			
	1 H to 10 H	120 Hz	$5 \cdot 10^{-3} \cdot L$	Direct measurement or substitution method.
4.3.5	**Inductance Meters and Bridges**			
	1 mH to 1 H 1 H to 10 H	120 Hz to 1 kHz 120 Hz	$2 \cdot 10^{-3} \cdot L$ $5 \cdot 10^{-3} \cdot L$	Direct measurement.
5	**AC Voltage**			
5.2.1	**AC Voltage Sources (up to 1 000 V)**			
	0 V to 10 V	30 Hz to 20 kHz 20 kHz to 100 kHz 100 kHz to 1 MHz	$1 \cdot 10^{-4} \cdot U + 10\ \mu V$ $2 \cdot 10^{-4} \cdot U + 10\ \mu V$ $3 \cdot 10^{-4} \cdot U + 10\ \mu V$	Direct measurement.
	10 V to 20 V	30 Hz to 20 kHz 20 kHz to 100 kHz	$1 \cdot 10^{-4} \cdot U$ $2 \cdot 10^{-4} \cdot U$	
	20 V to 200 V	30 Hz to 20 kHz 20 kHz to 100 kHz	$1 \cdot 10^{-4} \cdot U$ $2 \cdot 10^{-4} \cdot U$	
	200 V to 1 000 V	30 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 100 kHz	$3 \cdot 10^{-4} \cdot U$ $4 \cdot 10^{-4} \cdot U$ $6 \cdot 10^{-4} \cdot U$	
5.2	**AC Voltage (up to 1 000 V)**			
5.2.2	**Meters**			
	0 V to 10 V	30 Hz to 20 kHz 20 kHz to 100 kHz 100 kHz to 1 MHz	$1 \cdot 10^{-4} \cdot U + 10\ \mu V$ $2 \cdot 10^{-4} \cdot U + 10\ \mu V$ $3 \cdot 10^{-4} \cdot U + 10\ \mu V$	Direct measurement.
	10 V to 20 V	30 Hz to 20 kHz 20 kHz to 100 kHz 100 kHz to 500 kHz 500 kHz to 1 MHz	$1 \cdot 10^{-4} \cdot U$ $2 \cdot 10^{-4} \cdot U$ $3 \cdot 10^{-4} \cdot U$ $4 \cdot 10^{-4} \cdot U$	
	20 V to 200 V	30 Hz to 20 kHz 20 kHz to 100 kHz	$1 \cdot 10^{-4} \cdot U$ $2 \cdot 10^{-4} \cdot U$	
	200 V to 1 000 V	50 Hz to 1 kHz	$3 \cdot 10^{-4} \cdot U$	
6	**AC current**			
6.2	**AC current (up to 100 A)**			
6.2.1	**Sources**			
	0 A to 2 A	30 Hz to 5 kHz	$3 \cdot 10^{-4} \cdot I + 2\ \mu A$	Direct measurement or volt drop method.
6.2.2	**Meter**			
	0 A to 2 A	30 Hz to 5 kHz	$3 \cdot 10^{-4} \cdot I + 2\ \mu A$	Direct measurement or volt drop method.

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Accreditation Manager