

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:-

REPAIR AND METROLOGY SERVICES (PTY) LTD

Co. Reg. No.: 2004/021865/07

Accreditation Number: 129

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

Mr T Baleni
Acting Chief Executive Officer

Effective Date: 01 August 2021
Certificate Expires: 31 July 2026

ANNEXURE A

SCOPE OF ACCREDITATION
DC LOW FREQUENCY METROLOGY

Accreditation Number: 129

<p>Permanent Address of Laboratory: Repair and Metrology Services (Pty) Ltd No. 10 Enterprise Close Linbro Office Park Sandton 2065</p> <p>Postal Address: Private Bag 10917 Vorna Valley 1686</p> <p>Tel: (011) 608-8550 Fax: (011) 608-0406 E-mail: lesw@repmet.co.za</p>	<p>Technical Signatories: Mr LR Wesson Mr RJ van Pletzen Mr GJ van Staden</p> <p>Nominated Representative: Mr LR Wesson</p> <p>Issue No.: 16 Date of Issue: 01 August 2021 Expiry Date: 31 July 2026</p>
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ITEM	MEASURED QUANTITY OR TYPE OF GAUGE OR INSTRUMENT AND NOMINAL RANGE	NOMINAL FREQUENCY	CALIBRATION AND MEASUREMENT CAPABILITY EXPRESSED AS AN UNCERTAINTY (\pm)	METHOD / PROCEDURE
1	DC Voltage (up to 1100 V)			
1.1	DC voltage sources			
1.1.1	Single values			
	10 V	DC	$5 \cdot 10^{-7} \cdot U$	Direct comparison a with a DC voltage standard.
1.1.2	Low values (≤ 10 V)			
	0 V to 10 V	DC	$1 \cdot 10^{-6} \cdot U + 0.2 \mu\text{V}$	Direct measurement or comparison with a DC voltage reference standard.
1.1.3	Intermediate values (>10 V to 1 100 V)			
	10 V to 1 000 V	DC	$2 \cdot 10^{-6} \cdot U$	Direct measurement or comparison with a DC voltage source on a multi-function calibrator.

Original Date of Accreditation: 1988

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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%

Executive Accreditation

ANNEXURE A

Accreditation No: 129
Date of Issue: 01 August 2021
Expiry Date: 31 July 2026

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1.2	DC voltage meters			
1.2.1	Very low values (≤ 1 mV)			
	0 mV to 1 mV	DC	0.2 μ V	Direct measurement or comparison with a DC voltage source and short.
1.2.2	Intermediate values (> 1 mV to 1100 V)			
	1 mV to 10 V 10 V to 1 000 V	DC DC	$1 \cdot 10^{-6} \cdot U + 0.2 \mu$ V $2 \cdot 10^{-6} \cdot U$	Direct measurement or comparison with a DC voltage source or a multi-function calibrator.
2	DC resistance			
2.1	DC resistance standards and sources			
2.1.1	Low values ($\leq 1 \Omega$)			
	0,1 m Ω 1 m Ω 10 m Ω 0,1 Ω	DC DC DC DC	$6 \cdot 10^{-4} \cdot R$ $5 \cdot 10^{-4} \cdot R$ $5 \cdot 10^{-5} \cdot R$ $5 \cdot 10^{-5} \cdot R$	Direct, substitution or current volt drop method.
2.1.2	Intermediate values ($> 1 \Omega$ to 1 MΩ)			
	1 Ω 10 Ω 100 Ω 1 k Ω 10 k Ω 100 k Ω 1 M Ω	DC DC DC DC DC DC DC	$5 \cdot 10^{-6} \cdot R$ $5 \cdot 10^{-6} \cdot R$ $5 \cdot 10^{-6} \cdot R$ $5 \cdot 10^{-6} \cdot R$ $5 \cdot 10^{-6} \cdot R$ $7 \cdot 10^{-6} \cdot R$ $7 \cdot 10^{-6} \cdot R$	Direct, substitution or current volt drop method.
2.1.3	High values (> 1 MΩ)			
	10 M Ω 100 M Ω 200 M Ω 1 G Ω 10 G Ω	DC DC DC DC DC	$1 \cdot 10^{-5} \cdot R$ $1 \cdot 10^{-4} \cdot R$ $1 \cdot 10^{-3} \cdot R$ $1 \cdot 10^{-3} \cdot R$ $1 \cdot 10^{-3} \cdot R$	Direct or substitution method.
2.1.4	Standards for high current			
	0,002 m Ω 0,1 m Ω 1 m Ω	DC DC DC	$1 \cdot 10^{-3} \cdot R$ $5 \cdot 10^{-4} \cdot R$ $5 \cdot 10^{-4} \cdot R$	Direct or substitution method.
2.1.5	Multiple ranges			
	10 μ Ω to 1 m Ω 1 m Ω to 100 m Ω 0,1 Ω to 10 k Ω 10 k Ω to 1 M Ω 1 M Ω to 10 M Ω 10 M Ω to 100 M Ω 100 M Ω to 1 G Ω 1 G Ω to 10 G Ω	DC DC DC DC DC DC DC DC	$6 \cdot 10^{-4} \cdot R$ $5 \cdot 10^{-5} \cdot R$ $5 \cdot 10^{-6} \cdot R$ $7 \cdot 10^{-6} \cdot R$ $1 \cdot 10^{-5} \cdot R$ $1 \cdot 10^{-4} \cdot R$ $1 \cdot 10^{-3} \cdot R$ $1 \cdot 10^{-3} \cdot R$	Direct, substitution or current volt drop method.

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2.2	DC resistance meters			
2.2.1	Low values ($\leq 1 \Omega$)			
	100 $\mu\Omega$ to 1 m Ω	DC	$5 \cdot 10^{-4} \cdot R$	Direct or substitution method.
	10 m Ω to 1 Ω	DC	$5 \cdot 10^{-5} \cdot R$	
2.2.2	Intermediate values ($> 1 \Omega$ to 1 GΩ)			
	1 Ω to 10 k Ω	DC	$5 \cdot 10^{-6} \cdot R$	Direct, substitution or current volt drop method.
	10 k Ω to 1 M Ω	DC	$7 \cdot 10^{-6} \cdot R$	
	1 M Ω to 10 M Ω	DC	$1 \cdot 10^{-5} \cdot R$	
	10 M Ω to 100 M Ω	DC	$1 \cdot 10^{-4} \cdot R$	
	100 M Ω to 1 G Ω	DC	$1 \cdot 10^{-4} \cdot R$	
2.2.3	High values ($> 1 \text{ G}\Omega$)			
	1 G Ω to 10 G Ω	DC	$1 \cdot 10^{-3} \cdot R$	Direct or substitution method
3	DC current (up to 100 A)			
3.1	DC current sources			
3.1.1	Low values ($\leq 0,1 \text{ mA}$)			
	0, 1 μA to 10 μA	DC	0,01 nA	Direct current or volt drop method.
	10 μA to 100 μA	DC	$5 \cdot 10^{-6} \cdot I + 0,01 \text{ nA}$	
3.1.2	Intermediate values ($> 0,1 \text{ mA}$ to 20 A)			
	0,1 mA to 100 mA	DC	$5 \cdot 10^{-6} \cdot I$	Direct current or volt drop method.
	0,1 A to 20 A	DC	$1 \cdot 10^{-5} \cdot I$	
3.2	DC current meters Low values ($\leq 0,1 \text{ mA}$)			
3.2.1				
	0,1 μA to 10 μA	DC	0,01 nA	Direct measurement.
	10 μA to 100 μA	DC	$5 \cdot 10^{-6} \cdot I + 0,01 \text{ nA}$	
3.2.2	Intermediate values ($> 0,1 \text{ mA}$ to 20 A)			
	0,1 mA to 100 mA	DC	$5 \cdot 10^{-6} \cdot I$	Direct measurement.
	100 mA to 20 A	DC	$1 \cdot 10^{-5} \cdot I$	
3.3	DC current Ratios (up to 1 000 A)			
3.3.1				
	20 A to 1 000 A	DC	$2 \cdot 10^{-3} \cdot I$	Comparison with a reference standard.
4	Impedance (up to 200 kHz range)			
4.2	Capacitance			
4.2.1	Capacitance and dissipation factor for low loss capacitors			
	0 μF to 10 μF	100 Hz to 1 kHz	$6 \cdot 10^{-4} \cdot C + 2 \text{ pF}$	Direct measurement or substitution method.
	10 μF to 11 mF	50 Hz	$6 \cdot 10^{-3} \cdot C$	
4.2.4	Meters			
	0 μF to 10 μF	100 Hz to 1 kHz	$6 \cdot 10^{-4} \cdot C + 2 \text{ pF}$	Direct measurement of reference standard capacitor.
	10 μF to 33 μF	50 Hz to 120 kHz	$5 \cdot 10^{-3} \cdot C$	
	33 μF to 110 μF	50 Hz to 80 Hz	$5 \cdot 10^{-3} \cdot C$	
	110 μF to 330 μF	50 Hz	$5 \cdot 10^{-3} \cdot C$	
	330 μF to 1 mF	50 Hz	$5 \cdot 10^{-3} \cdot C$	
	1 mF to 3.3 mF	50 Hz	$5 \cdot 10^{-3} \cdot C$	
	3.3 mF to 11 mF	10 Hz to 50 Hz	$5 \cdot 10^{-3} \cdot C$	

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4.3	Inductance			
4.3.1	Self-inductance and equivalent series resistance, low values (≥ 1 mH)			
	0 to 1 mH	100 Hz to 1 kHz	$5 \cdot 10^{-4} \cdot L + 0.1 \mu\text{H}$	Direct or substitution method.
4.3.2	Self-inductance and equivalent series resistance, intermediate values (≥ 1 mH to 1 H)			
	0,001 H to 1 H	100 Hz to 1 kHz	$5 \cdot 10^{-4} \cdot L + 0.1 \mu\text{H}$	Direct or substitution method.
4.3.3	Self-inductance and equivalent series resistance, high values (> 1 H)			
	1 H to 10 H	100 Hz to 120 Hz	$5 \cdot 10^{-4} \cdot L$	Direct or substitution method.
4.3.5	Meter			
	0,1 H to 10 H	100 Hz to 1 kHz	$5 \cdot 10^{-4} \cdot L$	Direct measurement.
5.2	AC voltage up to 1 000 V (for high voltage see 8.3)			
5.2.1	Sources			
	0 mV to 2 V	10 Hz to 20 kHz 20 kHz to 100 kHz 100 kHz to 500 kHz 500 kHz to 1 MHz	$4 \cdot 10^{-5} \cdot U + 5 \mu\text{V}$ $5 \cdot 10^{-5} \cdot U + 5 \mu\text{V}$ $1 \cdot 10^{-4} \cdot U + 5 \mu\text{V}$ $4 \cdot 10^{-4} \cdot U + 5 \mu\text{V}$	Direct comparison with a reference standard.
	2 V to 20 V	40 Hz to 20 kHz 20 kHz to 100 kHz 100 kHz to 500 kHz	$4 \cdot 10^{-5} \cdot U$ $5 \cdot 10^{-5} \cdot U$ $1 \cdot 10^{-4} \cdot U$	
	20 V to 200 V	500 kHz to 1 MHz 40 Hz to 20 kHz	$4 \cdot 10^{-4} \cdot U$ $4 \cdot 10^{-5} \cdot U$	
	200 V to 1 kV	20 kHz to 100 kHz 40 Hz to 1 kHz 1 kHz to 20 kHz	$5 \cdot 10^{-5} \cdot U$ $5 \cdot 10^{-5} \cdot U$ $6 \cdot 10^{-5} \cdot U$	
5.2.2	Meter			
	0 mV to 2 V	10 Hz to 20 kHz 20 kHz to 100 kHz 100 kHz to 500 kHz 500 kHz to 1 MHz	$4 \cdot 10^{-5} \cdot U + 5 \mu\text{V}$ $5 \cdot 10^{-5} \cdot U + 5 \mu\text{V}$ $1 \cdot 10^{-4} \cdot U + 5 \mu\text{V}$ $4 \cdot 10^{-4} \cdot U + 5 \mu\text{V}$	Direct measurement.
	2 V to 20 V	40 Hz to 20 kHz 20 kHz to 100 kHz 100 kHz to 500 kHz	$4 \cdot 10^{-5} \cdot U$ $5 \cdot 10^{-5} \cdot U$ $1 \cdot 10^{-4} \cdot U$	
	20 V to 200 V	500 kHz to 1 MHz 40 Hz to 20 kHz	$4 \cdot 10^{-4} \cdot U$ $4 \cdot 10^{-5} \cdot U$	
	200 V to 1 kV	20 kHz to 100 kHz 40 Hz to 1 kHz 1 kHz to 20 kHz	$5 \cdot 10^{-5} \cdot U$ $5 \cdot 10^{-5} \cdot U$ $6 \cdot 10^{-5} \cdot U$	

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6	AC current			
6.2	AC current up to 100 A			
6.2.1	Sources			
	0 A to 2 A	10 Hz to 5 kHz	$3 \cdot 10^{-4} \cdot I + 0,05 \mu A$	Direct measurement or volt drop method.
	2 A to 20 A	40 Hz to 5 kHz	$5 \cdot 10^{-4} \cdot I$	
6.2.2	Meter			
	0 A to 2 A	10 Hz to 5 kHz	$3 \cdot 10^{-4} \cdot I + 0,05 \mu A$	Direct measurement or volt drop method.
	2 A to 20 A	40 Hz to 5 kHz	$5 \cdot 10^{-4} \cdot I$	
6.3	AC Current ratio			
6.3.1	Real component (or modules) and imaginary component (or argument)			
	20 A to 1 000 A	40 Hz to 60 Hz	$5 \cdot 10^{-3} \cdot I$	Comparison with a reference standard.
7	AC Power			
7.1	AC Power and Energy			
7.1.1	Single Phase – Energy Meter			
	3.3 mA to 20 A 330 mV to 1000 V 0 to 1 pf	50 Hz to 60 Hz	$2 \cdot 10^{-3} \cdot W + 0,1 \text{ mW}$	Direct comparison with a reference standard.
8	High voltage and current			
8.1	High DC voltage (for voltages < 1 100 V see 1)			
8.1.1	High voltage sources			
	1 kV to 100 kV	DC	$1 \cdot 10^{-2} \cdot U$	Direct measurement or ratio method.
8.3	AC high voltage and voltage transformers (for voltages <1 100 V see 5.2)			
8.3.2	Sources			
	1 kV to 100 kV	50 Hz to 60 Hz	$1 \cdot 10^{-2} \cdot U$	Direct measurement or comparison method.
9.2	Phase angle			
9.2.1	Sources			
	0° to 360°	10 Hz to 100 kHz	0,05°	Direct measurement.
9.2.2	Meters			
	0° to 360°	10 Hz to 10 kHz	0,05°	Direct comparison with a reference standard.
	0° to 360°	10 kHz to 100 kHz	1,0°	
A	Thermometry equipment (Electrical equivalent)			
	Indicators	-273 °C to 2 000 °C	0,1 K	Calibration by the sourcing or measurement of voltages or resistance equivalent to the thermometer type.
	Transmitters	-273 °C to 2 000 °C	0,1 K	
	Calibrators	-273 °C to 2 000 °C	0,1 K	
	Cold junction compensation	0 °C to 30 °C	0,1 K	
B	Oscilloscopes up to 1 GHz			
	DC Voltage	1 mV/div to 50 V/div	0,5 %	Euramet cg-7 or direct comparison with a reference standard or calibrator.
	AC Voltage	1 mV/div to 50 V/div	0,5 %	
	Horizontal time-base	2 ns/div to 5 sec/div	0,5 %	
	Bandwidth	50 kHz to 250 MHz	5 %	
		1 GHz	5 %	
	Risetime	70 ps	10 ps	
Z	On-site calibrations for all above-mentioned items			

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ISSUED BY THE SOUTH AFRICAN NATIONAL ACCREDITATION SYSTEM

Executive Accreditation