

# **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:-*

**TECHNOLOGY RESEARCH AND CALIBRATION LABORATORIES CC**

**Co. Reg. No.: 2001/068368/23**

**TRADING AS  
TRAC LABORATORIES**

**Accreditation Number: 101**

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: 26 July 2021  
Certificate Expires: 30 May 2026**

## ANNEXURE A

# SCOPE OF ACCREDITATION

## DC LOW FREQUENCY METROLOGY

Accreditation Number: 101

|                                                                                                                                                                                                                                                                                                                                         |  |                                                                                                                                                                                         |  |  |
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| <b>Permanent Address of Laboratory:</b><br>TRAC Laboratories cc<br>65 2nd Avenue<br>Alberton<br>1453<br><br><b>Postal Address:</b><br>P O Box 145940<br>Bracken Gardens<br>1452<br><br>Tel: (011) 869-4831<br>Fax: (011) 869-4828<br>Mobile: 082 400 9659<br>E-mail: <a href="mailto:aubrey@tracclabs.co.za">aubrey@tracclabs.co.za</a> |  | <b>Technical Signatory:</b> Mr A E Loxton<br><br><br><b>Nominated Representative:</b> Mr A E Loxton<br><br><br>Issue No.: 13<br>Date of Issue: 26 July 2021<br>Expiry Date: 30 May 2026 |  |  |
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| ITEM  | MEASURED QUANTITY,<br>TYPE OF GAUGE OR<br>INSTRUMENT AND RANGE<br>OF MEASURED QUANTITY | NOMINAL FREQUENCY | CALIBRATION AND<br>MEASUREMENT<br>CAPABILITY EXPRESSED<br>AS AN UNCERTAINTY ( $\pm$ ) | METHOD /<br>PROCEDURE                                                                   |
|-------|----------------------------------------------------------------------------------------|-------------------|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| 1     | DC Voltage (up to 1 100 V)                                                             |                   |                                                                                       |                                                                                         |
| 1.1   | DC voltage sources                                                                     |                   |                                                                                       |                                                                                         |
| 1.1.1 | Single Values                                                                          |                   |                                                                                       | Direct measurement or comparison with a DC voltage reference standard.                  |
|       | 10 V                                                                                   | DC                | $2 \cdot 10^{-6} \cdot U$                                                             |                                                                                         |
| 1.1.2 | Low values ( $\leq 10$ V)                                                              |                   |                                                                                       |                                                                                         |
|       | 0 mV to 10 V                                                                           | DC                | $2 \cdot 10^{-6} \cdot U + 1 \mu V$                                                   |                                                                                         |
| 1.1.3 | Intermediate values ( $> 10$ V to 1 100 V)                                             |                   |                                                                                       |                                                                                         |
|       | 10 V to 100 V                                                                          | DC                | $2 \cdot 10^{-6} \cdot U$                                                             | Direct measurement or comparison with a DC voltage source or multi-function calibrator. |
|       | 100 V to 1 000 V                                                                       | DC                | $5 \cdot 10^{-6} \cdot U$                                                             |                                                                                         |
|       | 1 000 V to 1 100 V                                                                     | DC                | $1 \cdot 10^{-3} \cdot U$                                                             |                                                                                         |
| 1.2   | DC voltage meters                                                                      |                   |                                                                                       |                                                                                         |
| 1.2.1 | Very low values ( $\leq 1$ mV)                                                         |                   |                                                                                       | Direct measurement or comparison with a DC voltage source or multi-function calibrator  |
|       | 0,01 mV to 1 mV                                                                        | DC                | $2 \cdot 10^{-6} \cdot U + 1 \mu V$                                                   |                                                                                         |
| 1.2.2 | Intermediate values ( $> 1$ mV to 1 100 V)                                             |                   |                                                                                       |                                                                                         |
|       | 1 mV to 10 V                                                                           | DC                | $2 \cdot 10^{-6} \cdot U + 1 \mu V$                                                   |                                                                                         |
|       | 10 V to 100 V                                                                          | DC                | $3 \cdot 10^{-6} \cdot U$                                                             |                                                                                         |
|       | 100 V to 1 000 V                                                                       | DC                | $5 \cdot 10^{-6} \cdot U$                                                             |                                                                                         |
|       | 1 000 V to 1 100 V                                                                     | DC                | $1 \cdot 10^{-3} \cdot U$                                                             |                                                                                         |

Original Date of Accreditation: 1980

Page 1 of 5

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**

# ANNEXURE A

Accreditation No.: 101  
Date of Issue: 26 July 2021  
Expiry Date: 30 May 2026

| ITEM  | MEASURED QUANTITY,<br>TYPE OF GAUGE OR<br>INSTRUMENT AND RANGE<br>OF MEASURED QUANTITY | NOMINAL FREQUENCY | CALIBRATION AND<br>MEASUREMENT<br>CAPABILITY EXPRESSED<br>AS AN UNCERTAINTY (±)<br>NOTES | METHOD /<br>PROCEDURE                                |
|-------|----------------------------------------------------------------------------------------|-------------------|------------------------------------------------------------------------------------------|------------------------------------------------------|
| 2     | DC resistance                                                                          |                   |                                                                                          |                                                      |
| 2.1   | DC resistance standards and source                                                     |                   |                                                                                          |                                                      |
| 2.1.1 | Low Values (<= 1 Ω)                                                                    |                   |                                                                                          |                                                      |
|       | 100 μΩ                                                                                 | DC                | 1•10 <sup>-4</sup> •R                                                                    | Direct, substitution or<br>current volt drop method. |
|       | 1 mΩ                                                                                   | DC                | 1•10 <sup>-4</sup> •R                                                                    |                                                      |
|       | 10 mΩ                                                                                  | DC                | 5•10 <sup>-5</sup> •R                                                                    |                                                      |
|       | 100 mΩ                                                                                 | DC                | 5•10 <sup>-5</sup> •R                                                                    |                                                      |
|       | 1 Ω                                                                                    | DC                | 1•10 <sup>-5</sup> •R                                                                    |                                                      |
| 2.1.2 | Intermediate Values (>1 Ω to 1 MΩ)                                                     |                   |                                                                                          |                                                      |
|       | 10 Ω                                                                                   | DC                | 1•10 <sup>-5</sup> •R                                                                    | Direct, substitution or<br>current volt drop method. |
|       | 100 Ω                                                                                  | DC                | 1•10 <sup>-5</sup> •R                                                                    |                                                      |
|       | 1 kΩ                                                                                   | DC                | 1•10 <sup>-5</sup> •R                                                                    |                                                      |
|       | 10 kΩ                                                                                  | DC                | 1•10 <sup>-5</sup> •R                                                                    |                                                      |
|       | 100 kΩ                                                                                 | DC                | 1•10 <sup>-5</sup> •R                                                                    |                                                      |
|       | 1 MΩ                                                                                   | DC                | 1•10 <sup>-4</sup> •R                                                                    |                                                      |
| 2.1.3 | High Values (> 1 MΩ)                                                                   |                   |                                                                                          |                                                      |
|       | 10 MΩ                                                                                  | DC                | 1•10 <sup>-4</sup> •R                                                                    | Direct or substitution<br>method.                    |
|       | 100 MΩ                                                                                 | DC                | 5•10 <sup>-4</sup> •R                                                                    |                                                      |
| 2.1.5 | Multiple ranges                                                                        |                   |                                                                                          |                                                      |
|       | 200 MΩ to 1 GΩ                                                                         | DC                | 5•10 <sup>-3</sup> •R                                                                    | Direct or substitution<br>method.                    |
| 2.2   | DC resistance meters                                                                   |                   |                                                                                          |                                                      |
| 2.2.1 | Low values (<= 1 Ω)                                                                    |                   |                                                                                          |                                                      |
|       | 100 μΩ to 1 mΩ                                                                         | DC                | 1•10 <sup>-4</sup> •R                                                                    | Direct or substitution<br>Method.                    |
|       | 1 mΩ to 1 Ω                                                                            | DC                | 5•10 <sup>-5</sup> •R                                                                    |                                                      |
| 2.2.2 | Intermediate values (> 1 Ω to 1 GΩ)                                                    |                   |                                                                                          |                                                      |
|       | 1 Ω to 100 kΩ                                                                          | DC                | 1•10 <sup>-5</sup> •R                                                                    | Direct or substitution<br>Method.                    |
|       | 100 kΩ to 10 MΩ                                                                        | DC                | 1•10 <sup>-4</sup> •R                                                                    |                                                      |
|       | 10 MΩ to 100 MΩ                                                                        | DC                | 5•10 <sup>-4</sup> •R                                                                    |                                                      |
|       | 100 MΩ to 1 GΩ                                                                         | DC                | 5•10 <sup>-3</sup> •R                                                                    |                                                      |

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Page 2 of 5

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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•10 <sup>-5</sup> •I                                                           | Direct or current volt<br>drop method.                    |
| 3.1.2 | Intermediate values (> 0,1 mA to 20 A)                                                 |                   |                                                                                 |                                                           |
|       | 0,1 mA to 20 A                                                                         | DC                | 1•10 <sup>-4</sup> •I                                                           |                                                           |
| 3.1.3 | High Values (> 20 A to 100 A)                                                          |                   |                                                                                 |                                                           |
|       | 20 A to 30 A                                                                           | DC                | 2•10 <sup>-4</sup> •I                                                           |                                                           |
|       | 30 A to 100 A                                                                          | DC                | 1•10 <sup>-3</sup> •I                                                           |                                                           |
| 3.2   | DC current meters                                                                      |                   |                                                                                 |                                                           |
| 3.2.1 | Low values (≤0,1 mA)                                                                   |                   |                                                                                 |                                                           |
|       | 1 µA to 100 µA                                                                         | DC                | 5•10 <sup>-5</sup> •I                                                           | Direct measurement.                                       |
| 3.2.2 | Intermediate values (>0,1 mA to 20 A)                                                  |                   |                                                                                 |                                                           |
|       | 0,1 mA to 1 A                                                                          | DC                | 5•10 <sup>-5</sup> •I                                                           |                                                           |
|       | 1 A to 20 A                                                                            | DC                | 1•10 <sup>-4</sup> •I                                                           |                                                           |
| 3.2.3 | High Values (> 20 A to 100 A)                                                          |                   |                                                                                 |                                                           |
|       | 20 A to 30 A                                                                           | DC                | 2•10 <sup>-4</sup> •I                                                           |                                                           |
|       | 30 A to 100 A                                                                          | DC                | 1•10 <sup>-3</sup> •I                                                           |                                                           |
| 4     | Impedance (up to the MHz range)                                                        |                   |                                                                                 |                                                           |
| 4.2   | Capacitance and dissipation factor (low loss capacitors) standard capacitor            |                   |                                                                                 |                                                           |
| 4.2.1 | Capacitance                                                                            |                   |                                                                                 |                                                           |
|       | 100 pF to 1 µF                                                                         | 100 Hz to 1 kHz   | 2•10 <sup>-4</sup> •C + 1 pF                                                    | Direct measurement or<br>substitution method              |
|       | 1 µF to 10 µF                                                                          | 100 Hz to 1 kHz   | 2•10 <sup>-4</sup> •C                                                           |                                                           |
| 4.2.4 | Meters                                                                                 |                   |                                                                                 |                                                           |
|       | 100 pF to 1 µF                                                                         | 100 Hz to 1 kHz   | 2•10 <sup>-4</sup> •C + 1 pF                                                    | Direct measurement of<br>reference standard<br>capacitor. |
|       | 1 µF to 10 µF                                                                          | 100 Hz to 1 kHz   | 2•10 <sup>-4</sup> •C                                                           |                                                           |
| 4.3   | Inductance                                                                             |                   |                                                                                 |                                                           |
| 4.3.2 | Self-inductance and equivalent series resistance, intermediate values (≥ 1 mH to 1 H)  |                   |                                                                                 |                                                           |
|       | 1 mH to 1 H                                                                            | 100 Hz to 1 kHz   | 2•10 <sup>-3</sup> •L                                                           | Direct or substitution<br>method.                         |
| 4.3.3 | Self-inductance and equivalent series resistance, high values (> 1 H)                  |                   |                                                                                 |                                                           |
|       | 1 H to 10 H                                                                            | 100 Hz to 1 kHz   | 2•10 <sup>-3</sup> •L                                                           |                                                           |
| 4.3.5 | Meters                                                                                 |                   |                                                                                 |                                                           |
|       | 1 mH to 10 H                                                                           | 100 Hz to 1 kHz   | 2•10 <sup>-3</sup> •L                                                           | Direct measurement.                                       |

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Page 3 of 5

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|------------------------------------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|------------------------------------|
| 5<br>5.2<br>5.2.1                              | AC voltage (up to the MHz range)                                                          |                                                                                               |                                                                                 |                                    |
|                                                | AC voltage up to 1 000 V                                                                  |                                                                                               |                                                                                 |                                    |
|                                                | Sources                                                                                   |                                                                                               |                                                                                 |                                    |
|                                                | 1 mV to 500 V<br>500 V to 1 kV                                                            | 40 Hz to 60 kHz<br>50 Hz                                                                      | $5 \cdot 10^{-5} \cdot U + 10 \mu V$<br>$3 \cdot 10^{-4} \cdot U$               | Calibration by direct measurement. |
|                                                | 200 mV to 100 V                                                                           | 30 Hz to 20 kHz<br>20 kHz to 100 kHz                                                          | $1 \cdot 10^{-4} \cdot U$<br>$2 \cdot 10^{-4} \cdot U$                          |                                    |
|                                                | 100 V to 500 V                                                                            | 30 Hz to 20 kHz<br>20 kHz to 100 kHz                                                          | $2 \cdot 10^{-4} \cdot U$<br>$3 \cdot 10^{-4} \cdot U$                          |                                    |
|                                                | 500 V to 1 000 V                                                                          | 30 Hz to 10 kHz<br>10 kHz to 50 kHz                                                           | $3 \cdot 10^{-4} \cdot U$<br>$4 \cdot 10^{-4} \cdot U$                          |                                    |
|                                                | 5.2.2 Meters                                                                              |                                                                                               |                                                                                 |                                    |
|                                                | 1 mV to 500 mV                                                                            | 40 Hz to 60 kHz                                                                               | $5 \cdot 10^{-5} \cdot U + 10 \mu V$                                            | Calibration by direct measurement. |
|                                                | 200 mV to 100 V                                                                           | 30 Hz to 20 kHz<br>20 kHz to 100 kHz                                                          | $1 \cdot 10^{-4} \cdot U$<br>$2 \cdot 10^{-4} \cdot U$                          |                                    |
|                                                | 100 V to 500 V                                                                            | 30 Hz to 20 kHz<br>20 kHz to 100 kHz                                                          | $2 \cdot 10^{-4} \cdot U$<br>$3 \cdot 10^{-4} \cdot U$                          |                                    |
|                                                | 500 V to 1 000 V                                                                          | 30 Hz to 10 kHz<br>10 kHz to 50 kHz                                                           | $3 \cdot 10^{-4} \cdot U$<br>$4 \cdot 10^{-4} \cdot U$                          |                                    |
| 6<br>6.2<br>6.2.1                              |                                                                                           |                                                                                               |                                                                                 |                                    |
| AC current                                     |                                                                                           |                                                                                               |                                                                                 |                                    |
| AC current up to 100 A                         |                                                                                           |                                                                                               |                                                                                 |                                    |
| Sources                                        |                                                                                           |                                                                                               |                                                                                 |                                    |
| 0,1 mA to 2 A<br>5 mA to 10 A<br>10 A to 100 A | 60 Hz to 500 Hz<br>40 Hz to 60 Hz<br>40 Hz to 60 Hz                                       | $5 \cdot 10^{-4} \cdot I + 1 \mu A$<br>$5 \cdot 10^{-5} \cdot I$<br>$1 \cdot 10^{-4} \cdot I$ | Direct measurement or<br>volt drop method.                                      |                                    |
| 6.2.2 Meter                                    |                                                                                           |                                                                                               |                                                                                 |                                    |
| 0,1 mA to 2 A<br>5 mA to 10 A<br>10 A to 100 A | 60 Hz to 500 Hz<br>40 Hz to 60 Hz<br>40 Hz to 60 Hz                                       | $5 \cdot 10^{-4} \cdot I + 1 \mu A$<br>$5 \cdot 10^{-5} \cdot I$<br>$1 \cdot 10^{-4} \cdot I$ | Direct measurement or<br>volt drop method.                                      |                                    |
| 7<br>7.1<br>7.1.1                              |                                                                                           |                                                                                               |                                                                                 |                                    |
| AC power                                       |                                                                                           |                                                                                               |                                                                                 |                                    |
| AC power and energy                            |                                                                                           |                                                                                               |                                                                                 |                                    |
| Single phase                                   |                                                                                           |                                                                                               |                                                                                 |                                    |
| 6 V to 500 V<br>50 mA to 100 A                 | 40 Hz to 60 Hz                                                                            | $1,2 \cdot 10^{-4} @ 1 PF$                                                                    | Direct comparison with a<br>reference standard.                                 |                                    |
| 7.1.3 Three phases                             |                                                                                           |                                                                                               |                                                                                 |                                    |
| 6 V to 500 V<br>50 mA to 100 A                 | 40 Hz to 60 Hz                                                                            | $1,2 \cdot 10^{-4} @ 1 PF$                                                                    | Direct comparison with a<br>reference standard                                  |                                    |

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Page 4 of 5

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|-------|-------------------------------------------------------------------------------------------|-------------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| 8     | High Voltage and Current                                                                  |                   |                                                                                 |                                                                                                                                |
| 8.1   | High DC Voltage                                                                           |                   |                                                                                 |                                                                                                                                |
| 8.1.1 | High Voltage Sources                                                                      |                   |                                                                                 |                                                                                                                                |
| 8.1.2 | 1,1 kV to 100 kV                                                                          | DC                | 1•10 <sup>-3</sup> •U                                                           | Direct measurement or<br>comparison method.                                                                                    |
|       | High Voltage Meters                                                                       |                   |                                                                                 |                                                                                                                                |
|       | 1,1 kV to 100 kV                                                                          | DC                | 1•10 <sup>-3</sup> •U                                                           |                                                                                                                                |
| 8.3   | AC High Voltage and Voltage Transformers                                                  |                   |                                                                                 |                                                                                                                                |
| 8.3.1 | Sources, HV probe, Digital Multimeter                                                     |                   |                                                                                 |                                                                                                                                |
| 8.3.2 | 1 kV to 50 kV                                                                             | 50 Hz             | 1•10 <sup>-3</sup> •U                                                           | Direct measurement or<br>ratio<br>method.                                                                                      |
|       | 50 kV to 250 kV                                                                           | 50 Hz             | 1•10 <sup>-3</sup> •U                                                           |                                                                                                                                |
|       | Meters                                                                                    |                   |                                                                                 |                                                                                                                                |
| 8.3.3 | 1 kV to 50 kV                                                                             | 50 Hz             | 1•10 <sup>-3</sup> •U                                                           | Direct measurement or<br>comparison method.                                                                                    |
|       | Ratio error and Phase displacement                                                        |                   |                                                                                 |                                                                                                                                |
|       | 2,2 kV to 44 kV/<br>110 V                                                                 | 50 Hz             | Ratio: 3•10 <sup>-4</sup><br>Phase: 2 minutes                                   | Comparison to reference a<br>standard.                                                                                         |
|       | 44 kV to 400 kV/<br>√ 3      √ 3<br>110 V<br>√ 3                                          | 50 Hz             | Ratio: 5•10 <sup>-4</sup><br>Phase: 3 minutes                                   |                                                                                                                                |
| 8.6   | High AC current and Current transformers                                                  |                   |                                                                                 |                                                                                                                                |
| 8.6.3 | Ratio error and Phase displacements                                                       |                   |                                                                                 |                                                                                                                                |
|       | 1 A to 30 kA/<br>1 A and 5 A                                                              | 50 Hz             | Ratio: 2•10 <sup>-4</sup><br>Phase: 1 minute                                    | Comparison to reference a<br>standard                                                                                          |
| 8.7   | High DC Current (for currents ≤ 100 A see 3, for shunts see 2.1.4)                        |                   |                                                                                 |                                                                                                                                |
| 8.7.1 | Sources                                                                                   |                   |                                                                                 |                                                                                                                                |
| 8.7.2 | 100 A to 600 A                                                                            |                   | 2•10 <sup>-4</sup> •I                                                           | Direct measurement or ratio<br>method                                                                                          |
|       | 600 A to 1 000 A                                                                          |                   | 1•10 <sup>-3</sup> •I                                                           |                                                                                                                                |
|       | Meters                                                                                    |                   |                                                                                 |                                                                                                                                |
|       | 100 A to 600 A                                                                            |                   | 2•10 <sup>-4</sup> •I                                                           | Direct measurement or ratio<br>method                                                                                          |
| A     | Thermometry Equipment                                                                     |                   |                                                                                 |                                                                                                                                |
|       | - 270 °C to 1 768 °C                                                                      |                   | 1,0 K                                                                           | Calibration by the sourcing<br>or measurement of voltage<br>or resistance equivalent to<br>the relevant thermocouple or<br>RTD |
| 13    | On-site calibration for the above items                                                   |                   |                                                                                 |                                                                                                                                |

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Page 5 of 5

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