

# **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**  
**RADIO FREQUENCY CALIBRATION LABORATORY**

Accreditation Number: **706**

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

## **RADIO 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

## RADIO FREQUENCY METROLOGY

Accreditation Number: 706

| <b>Permanent Address of Laboratory:</b><br>Concilium Technologies (Pty) Ltd<br>1 Standford Office Park<br>12 Bauhinia Street<br>Highveld Technopark<br>Centurion<br>0157                                |                                                                                                                                                                                                                                                                                                                                                        | <b>Technical Signatories:</b> Mr BJH Bremmer<br>Mr GD Schuster                                                                                          |                                                                                                                                                |                                                                                                                                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Postal Address:</b><br>P O Box 67611<br>Highveld<br>0169<br><br>Tel: (012) 678-9200<br>Fax: (012) 665-4160<br>E-mail: <a href="mailto:bart_bremmer@concilium.co.za">bart_bremmer@concilium.co.za</a> |                                                                                                                                                                                                                                                                                                                                                        | <b>Nominated Representative:</b> Mr BJH Bremmer<br><br>Issue No.: 21<br>Date of Issue: 31 January 2022<br>Expiry Date: 30 January 2027                  |                                                                                                                                                |                                                                                                                                                                   |
| 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                                                                                                                                                |
| 11                                                                                                                                                                                                      | RADIO FREQUENCY MEASUREMENTS                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                         |                                                                                                                                                |                                                                                                                                                                   |
| 11.1                                                                                                                                                                                                    | Radio Frequency Power                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                         |                                                                                                                                                |                                                                                                                                                                   |
| 11.1.1                                                                                                                                                                                                  | Absolute power in coaxial line: power meter, power source                                                                                                                                                                                                                                                                                              |                                                                                                                                                         |                                                                                                                                                |                                                                                                                                                                   |
| i)                                                                                                                                                                                                      | 0 dBm (1 mW)<br><br>-60 dBm to -20 dBm (1 nW to 10 $\mu$ W)<br>-30 dBm to +20 dBm (1 $\mu$ W to 100 mW)<br>-60 dBm to +20 dBm (1 nW to 100 mW)<br>-60 dBm to +20 dBm (1 nW to 100 mW)<br><br>-110 dBm to -30 dBm (10 fW to 1 $\mu$ W)<br>-110 dBm to -60 dBm (10 fW to 1 nW)<br>-110 dBm to -60 dBm (10 fW to 1 nW)<br>N-Type Connector (50 $\Omega$ ) | 50 MHz<br><br>10 MHz to 1 GHz<br>100 kHz to 1 GHz<br>1 GHz to 10 GHz<br>10 GHz to 18 GHz<br><br>100 kHz to 1 GHz<br>1 GHz to 10 GHz<br>10 GHz to 18 GHz | 0,08 dB<br><br>0,2 dB<br>0,2 dB<br>0,3 dB<br>0,4 dB<br><br>0,2 dB + 0,005 dB per dBm<br>0,3 dB + 0,010 dB per dBm<br>0,4 dB + 0,015 dB per dBm | Direct measurement method using a power source or comparative measurement using a reference standard or indirect method through a directional couple or splinter. |

Original Date of Accreditation: 1980

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\* Generation Limitation: 100 kHz to 26,5 GHz: + 13 dBm

\*\* Generation Limitation: 26,5 GHz to 50 GHz: +4 dBm

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.: 706  
Date of Issue: 31 January 2022  
Expiry Date: 30 January 2027

| ITEM                                                           | MEASURED QUANTITY OR TYPE OF GAUGE OR INSTRUMENT AND NOMINAL RANGE                              | NOMINAL FREQUENCY                                                         | CALIBRATION AND MEASUREMENT CAPABILITY EXPRESSED AS AN UNCERTAINTY (±) | METHOD / PROCEDURE                                                                                                                                                |
|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ii)                                                            | -30 dBm to +20 dBm (1 μW to 100 mW)                                                             | 50 MHz to 1 GHz                                                           | 0,2 dB                                                                 | Direct measurement method using a power sensor or comparative measurement using a reference standard or indirect method through a directional couple or splinter. |
|                                                                | -30 dBm to +20 dBm (1 μW to 100 mW)                                                             | 1 GHz to 10 GHz                                                           | 0,3 dB                                                                 |                                                                                                                                                                   |
|                                                                | -30 dBm to +20 dBm (1 μW to 100 mW)                                                             | 10 GHz to 26,5 GHz                                                        | 0,4 dB                                                                 |                                                                                                                                                                   |
|                                                                | -100 dBm to -30 dBm (10 fW to 1 μW)                                                             | 10 MHz to 1 GHz                                                           | 0,2 dB + 0,005 dB per dBm                                              |                                                                                                                                                                   |
|                                                                | -100 dBm to -60 dBm (10 fW to 1 nW)                                                             | 1 GHz to 10 GHz                                                           | 0,3 dB + 0,010 dB per dBm                                              |                                                                                                                                                                   |
|                                                                | -100 dBm to -60 dBm (10 fW to 1 nW)                                                             | 10 GHz to 26,5 GHz                                                        | 0,4 dB + 0,015 dB per dBm                                              |                                                                                                                                                                   |
|                                                                | PC – 3.5 Connector (50 Ω)                                                                       |                                                                           |                                                                        |                                                                                                                                                                   |
|                                                                | -60 dBm to - 20 dBm (1 nW to 10 μW)                                                             | 50 MHz to 1 GHz                                                           | 0,2 dB                                                                 |                                                                                                                                                                   |
|                                                                | -60 dBm to - 20 dBm (1 nW to 10 μW)                                                             | 1 GHz to 10 GHz                                                           | 0,3 dB                                                                 |                                                                                                                                                                   |
|                                                                | -60 dBm to - 20 dBm (1 nW to 10 μW)                                                             | 10 GHz to 40 GHz                                                          | 0,4 dB                                                                 |                                                                                                                                                                   |
| iii)                                                           | -60 dBm to - 20 dBm (1 nW to 10 μW)                                                             | 40 GHz to 50 GHz                                                          | 0,6 dB                                                                 |                                                                                                                                                                   |
|                                                                | -30 dBm to + 20 dBm (1 μW to 100 mW)                                                            | 50 MHz to 1 GHz                                                           | 0,2 dB                                                                 |                                                                                                                                                                   |
|                                                                | -30 dBm to + 20 dBm (1 μW to 100 mW)                                                            | 1 GHz to 10 GHz                                                           | 0,3 dB                                                                 |                                                                                                                                                                   |
|                                                                | -30 dBm to + 20 dBm (1 μW to 100 mW)                                                            | 10 GHz to 40 GHz                                                          | 0,4 dB                                                                 |                                                                                                                                                                   |
|                                                                | -30 dBm to + 20 dBm (1 μW to 100 mW)                                                            | 40 GHz to 50 GHz                                                          | 0,5 dB                                                                 |                                                                                                                                                                   |
|                                                                | -100 dBm to - 30 dBm (10 fW to 1 μW)                                                            | 10 MHz to 1 GHz                                                           | 0,2 dB + 0,005 dB per dBm                                              |                                                                                                                                                                   |
|                                                                | -100 dBm to - 30 dBm (10 fW to 1 μW)                                                            | 1 GHz to 10 GHz                                                           | 0,3 dB + 0,010 dB per dBm                                              |                                                                                                                                                                   |
|                                                                | -100 dBm to - 30 dBm (10 fW to 1 μW)                                                            | 10 GHz to 40 GHz                                                          | 0,4 dB + 0,015 dB per dBm                                              |                                                                                                                                                                   |
|                                                                | -100 dBm to - 30 dBm (10 fW to 1 μW) PC – 2.4 Connector (50 Ω)                                  | 40 GHz to 50 GHz                                                          | 0,5 dB + 0,020 dB per dBm                                              |                                                                                                                                                                   |
|                                                                | iv)                                                                                             | -30 dBm to +20 dBm (1 μW to 100 mW)<br>(Generation limitation : + 13 dBm) | 100 kHz to 2 GHz                                                       | 0,2 dB                                                                                                                                                            |
| -110 dBm to -30 dBm (10 fW to 1 μW)<br>N-Type Connector (75 Ω) |                                                                                                 | 100 kHz to 2 GHz                                                          | 0,2 dB + 0,005 dB per dBm                                              |                                                                                                                                                                   |
| 11.2                                                           | Scalar RF reflection coefficient and attenuation                                                |                                                                           |                                                                        |                                                                                                                                                                   |
| 11.2.3                                                         | Attenuation in coaxial line: Passive device                                                     |                                                                           |                                                                        |                                                                                                                                                                   |
| i)                                                             | 0 dB to 60 dB<br>60 dB to 80 dB<br>80 dB to 110 dB<br>DC Attenuation (50 Ω all connector types) | DC<br>DC<br>DC                                                            | 0,002 dB<br>0,01 dB<br>0,15 dB                                         | Voltage ratio method or<br>Substitution method or<br>Direct method.                                                                                               |

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**Accreditation Manager**

## ANNEXURE A

Accreditation No.:706  
Date of Issue: 31 January 2022  
Expiry Date: 30 January 2027

| 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                                                                                                           |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| <b>11.2.3</b> | <b>Attenuation in coaxial line (values in db): Passive device</b>                                                                           |                                                                                                                        |                                                                                                                                                                        |                                                                                                                              |
| ii)           | 0 dB to 100 dB<br>0 dB to 100 dB<br>0 dB to 100 dB                                                                                          | 100 kHz to 1 GHz<br>1 GHz to 10 GHz<br>10 GHz to 18 GHz                                                                | 0,04 dB + 0,005 dB per dB<br>0,1 dB + 0,010 dB per dB<br>0,15 dB + 0,015 dB per dB                                                                                     | Power ratio method or Substitution method or Direct method using a RF detector.                                              |
|               | 100 dB to 120 dB<br>100 dB to 120 dB<br>100 dB to 120 dB<br>N-Type Connector (50 $\Omega$ )                                                 | 100 kHz to 1 GHz<br>1 GHz to 10 GHz<br>10 GHz to 18 GHz                                                                | 1 dB<br>2 dB<br>3 dB                                                                                                                                                   |                                                                                                                              |
| iii)          | 0 dB to 100 dB<br>0 dB to 100 dB<br>0 dB to 100 dB<br>0 dB to 100 dB<br>PC -3.5 Connector (50 $\Omega$ )                                    | 10 MHz to 1 GHz<br>1 GHz to 10 GHz<br>10 GHz to 18 GHz<br>18 GHz to 26,5 GHz                                           | 0,04 dB + 0,005 dB per dB<br>0,10 dB + 0,010 dB per dB<br>0,15 dB + 0,015 dB per dB<br>0,2 dB + 0,015 dB per dB                                                        |                                                                                                                              |
|               | 0 dB to 100 dB<br>0 dB to 100 dB<br>0 dB to 100 dB<br>0 dB to 100 dB<br>0 dB to 100 dB<br>0 dB to 100 dB<br>PC-2.4 Connector (50 $\Omega$ ) | 10 MHz to 1 GHz<br>1 GHz to 10 GHz<br>10 GHz to 18 GHz<br>18 GHz to 26,5 GHz<br>26,5 GHz to 40 GHz<br>40 GHz to 50 GHz | 0,04 dB + 0,015 dB per dB<br>0,1 dB + 0,020 dB per dB<br>0,15 dB + 0,020 dB per dB<br>0,2 dB + 0,020 dB per dB<br>0,4 dB + 0,015 dB per dB<br>0,5 dB + 0,025 dB per dB |                                                                                                                              |
| v)            | 0 dB to 100 dB<br>(75 $\Omega$ , N-Type connector)                                                                                          | 100 kHz to 2 GHz                                                                                                       | 0,04 dB + 0,005 dB per dB                                                                                                                                              |                                                                                                                              |
| vi)           | 0 dB to 60 dB<br>60 dB to 80 dB<br>80 dB to 110 dB<br>(75 $\Omega$ , N-Type connector)                                                      | DC<br>DC<br>DC                                                                                                         | 0,002 dB<br>0,01 dB<br>0,15 dB                                                                                                                                         | Voltage ratio method or substitution method or direct measurement method.                                                    |
| <b>11.2.1</b> | <b>Reflection coefficient in coaxial line: passive device</b>                                                                               |                                                                                                                        |                                                                                                                                                                        |                                                                                                                              |
| i)            | Ratio 0 to 1<br>Ratio 0 to 1<br>Ratio 0 to 1<br>N-Type Connector (50 $\Omega$ )                                                             | 5 Hz to 10 MHz<br>10 MHz to 15 GHz<br>15 GHz to 18 GHz                                                                 | 0,010 + 0,056 $\rho^2$<br>0,011 + 0,031 $\rho^2$<br>0,013 + 0,100 $\rho^2$                                                                                             | Calibration against a standard by using directional bridge and/or ripple extraction method and/or direct measurement method. |
| ii)           | Ratio 0 to 1<br>Ratio 0 to 1<br>Ratio 0 to 1<br>PC -3.5 Connector (50 $\Omega$ )                                                            | 10 MHz to 15 GHz<br>15 GHz to 18 GHz<br>18 GHz to 26,5 GHz                                                             | 0,017 + 0,037 $\rho^2$<br>0,013 + 0,100 $\rho^2$<br>0,018 + 0,172 $\rho^2$                                                                                             |                                                                                                                              |

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| ITEM           | MEASURED QUANTITY OR<br>TYPE OF GAUGE OR<br>INSTRUMENT AND<br>NOMINAL RANGE                                                         | NOMINAL FREQUENCY                                                                                                                      |                                                                                                                                                      | CALIBRATION AND<br>MEASUREMENT<br>CAPABILITY<br>EXPRESSED AS AN<br>UNCERTAINTY ( $\pm$ )                                                                                                                                                                 | METHOD /<br>PROCEDURE                                                                                                                                                         |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11.2.1<br>iii) | Ratio 0 to 1<br>Ratio 0 to 1<br>Ratio 0 to 1<br>Ratio 0 to 1<br>Ratio 0 to 1<br>PC -2.4 Connector (50 $\Omega$ )                    | 10 MHz to 15 GHz<br>15 GHz to 18 GHz<br>18 GHz to 26,5 GHz<br>26,5 GHz to 40 GHz<br>40 GHz to 50 GHz                                   |                                                                                                                                                      | 0,011 + 0,057 $\rho^2$<br>0,013 + 0,100 $\rho^2$<br>0,018 + 0,172 $\rho^2$<br>0,050 + 0,167 $\rho^2$<br>0,059 + 0,290 $\rho^2$                                                                                                                           | Calibration against a<br>standard by using<br>directional bridge<br>and/or ripple<br>extraction method<br>and/or direct<br>measurement<br>method.                             |
|                | iv)<br><br>Ratio 0 to 1<br>N-Type Connector (75 $\Omega$ )                                                                          | 5 Hz to 10 MHz<br><br>10 MHz to 2 GHz                                                                                                  |                                                                                                                                                      | 0,010 + 0,056 $\rho^2$<br><br>0,014 + 0,081 $\rho^2$                                                                                                                                                                                                     |                                                                                                                                                                               |
| 11.6           | Signal and pulse characteristics                                                                                                    |                                                                                                                                        |                                                                                                                                                      |                                                                                                                                                                                                                                                          |                                                                                                                                                                               |
| 11.6.3         | Modulation, AM and FM: Signal generator, spectrum analyser, modulation meter, jitter meter                                          |                                                                                                                                        |                                                                                                                                                      |                                                                                                                                                                                                                                                          |                                                                                                                                                                               |
| i)             | Amplitude Modulation (50 $\Omega$ )                                                                                                 |                                                                                                                                        |                                                                                                                                                      |                                                                                                                                                                                                                                                          |                                                                                                                                                                               |
|                | Modulation Depth<br><br>0 % to 99 %<br>0 % to 99 %<br>1 % to 95 %<br>5 % to 90 %                                                    | Carrier<br><br>100 kHz to 1 MHz<br>1 MHz to 1,3 GHz<br>1,3 GHz to 18 GHz<br>18 GHz to 50 GHz                                           | Modulation<br><br>20 Hz to 50 kHz<br>20 Hz to 100 kHz<br>60 Hz to 100 kHz<br>60 Hz to 100 kHz                                                        | $2 \cdot 10^{-2} \cdot M + 0,01 \%$<br>$1 \cdot 10^{-2} \cdot M + 0,01 \%$<br>$3 \cdot 10^{-2} \cdot M$<br>$3 \cdot 10^{-2} \cdot M$                                                                                                                     | Calibration using<br>direct measurement<br>method with selective<br>detectors (e.g.<br>spectrum analysers) /<br>Modulation meter or<br>calibration using<br>bessel functions. |
| ii)            | Frequency Modulation (50 $\Omega$ )                                                                                                 |                                                                                                                                        |                                                                                                                                                      |                                                                                                                                                                                                                                                          |                                                                                                                                                                               |
|                | Peak Deviation<br><br>0 Hz to 75 kHz<br>0 Hz to 75 kHz<br>480 Hz to 3 MHz<br>480 Hz to 10 MHz<br>480 Hz to 8 MHz<br>75 kHz to 8 MHz | Carrier<br><br>100 kHz to 1 MHz<br>1 MHz to 1,3 GHz<br>1,3 GHz to 7 GHz<br>7 GHz to 18 GHz<br>18 GHz to 26,5 GHz<br>26,5 GHz to 50 GHz | Modulation<br><br>20 Hz to 35 kHz<br>20 Hz to 416 kHz<br>200 Hz to 1,25 MHz<br>200 Hz to 4,16 MHz<br>200 Hz to 3,33 MHz<br>31,185 kHz to 3,33<br>MHz | $5 \cdot 10^{-3} \cdot f + 1 \text{ Hz}$<br>$5 \cdot 10^{-3} \cdot f + 1 \text{ Hz}$<br>$5 \cdot 10^{-3} \cdot f + 10 \text{ Hz}$<br>$5 \cdot 10^{-3} \cdot f + 10 \text{ Hz}$<br>$5 \cdot 10^{-3} \cdot f + 10 \text{ Hz}$<br>$5 \cdot 10^{-3} \cdot f$ |                                                                                                                                                                               |

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ISSUED BY THE SOUTH AFRICAN NATIONAL ACCREDITATION SYSTEM

**Accreditation Manager**