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ETC Report #: t29e24a309\_DSS Release 1

Report date: February 19, 2025

EMC testing of the Tektelic Communication Inc. CHICKADEE in accordance with FCC Part 15.247 and ANSI C63.10: 2013 as referenced by FCC OET KDB 558074 D01 15.247 Meas Guidance v05r02.

#### FCC ID: 2ALEPT0008814

Test Dates: 2024-12-04 to 2024-12-06

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## **REVISION RECORD**

| ISSUE     | DATE       | AUTHOR   | REVISIONS                           |
|-----------|------------|----------|-------------------------------------|
| DRAFT 1   | 2024-12-09 | I. Akram | Initial draft submitted for review. |
| DRAFT 2   | 2025-02-18 | I. Akram | Added EUT Serial# in Section 1.3    |
| Release 1 | 2025-02-19 | I. Akram | Sign Off                            |

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#### 1.0 INTRODUCTION

#### 1.1 Scope

The purpose of this report is to present the results of compliance testing performed in accordance with FCC Part 15.247 and ANSI C63.10-2013 to gain FCC Authorization for Low-Power License-Exempt transmitters. All test procedures, limits, criteria, and results described in this report apply only to the Tektelic Communication Inc. CHICKADEE test sample, referred to herein as the EUT (Equipment Under Test).

This report does not imply product endorsement by the Electronics Test Centre, A2LA, nor any Canadian Government agency.

#### 1.2 Applicant

This test report has been prepared for Tektelic Communication Inc., located in Calgary, Alberta, Canada.

#### 1.3 Test Sample Description

As provided to ETC (Airdrie) by Tektelic Communication Inc.:

| Product N                | lame:                             | CHICKADEE   |  |  |  |
|--------------------------|-----------------------------------|---|--|--|--|
|                          | Frequency Band                    | 902 – 928 MHz   |  |  |  |
| LoRa<br>Radio            | Frequency Range                   | 902.3 – 914.9 MHz   |  |  |  |
|                          | Mode of Operation                 | Hybrid 125KHz   |  |  |  |
|                          | Max Transmit<br>Power (Conducted) | 12.55 dBm (0.0180 W)  |  |  |  |
| Associated LoRa Antennas |                                   | RUN mXTENDTM (Model#NN02-224), Radiation Pattern:<br>Omnidirectional, Polarization: Linear, Max Gain: 2.2 dBi |  |  |  |
| Model# (T-Code)          |                                   | T0008534  |  |  |  |
| Serial#                  |                                   | 2432T0003   |  |  |  |
| Power su                 | oply:                             | Internal Battery  |  |  |  |

**Note:** All three channels (LOW, MID, High) on each axis (X, Y & Z) are analyzed to determine the worse channel. Full emission scan is performed on worse channel at worse axis for each radio. As per manufacture BLE and LoRa radios are not transmitting simultaneously, so colocation testing not required. Both variant T0008534 and T0009142 use same circuit board and enclosure except T0009142 has custom cradle external to enclosure to connect DC power supply for battery charging. Detail given in Family exhibit.

#### 1.4 General Test Conditions

The EUT was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. All inputs and outputs to and from other equipment associated with the EUT were adequately simulated. In order to meet the operational requirements during testing as per KDB 558074 D01 15.247 Meas Guidance v05r02 and ANSI C63.10-2013 clause 5.11 the device was programmed with a special firmware to transmit at a continuous transmit mode (100% duty cycle). Special firmware is strictly for testing purpose only and not available to end user. This special test case represents the worst-case duty cycle. For antenna port conducted emission SMA connector is soldered to the circuit board at the output of the radio to provide direct access to the radio output to connect the spectrum analyzer.

The environmental conditions are recorded during each test, and are reported in the relevant sections of this document.

### 1.5 Reference Standards

| Standards                                 | Description   |
|---|---|
| FCC, title 47 CFR § 15.247                | Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.   |
| FCC, title 47 CFR § 15.207                | Conducted limits for an intentional radiator that is designed to be connected to the public utility (AC) power line.  |
| FCC, title 47 CFR § 15.107                | Conducted limits for equipment that is designed to be connected to the public utility (AC) power line.  |
| FCC, title 47 CFR § 15.209                | Radiated emission limits; general requirements  |
| FCC, title 47 CFR § 15.109                | Radiated emission limits; from unintentional radiators digital devices.   |
| ANSI C63.10-2013                          | American National Standard of Procedures for Compliance Testing of<br>Unlicensed Wireless Devices   |
| ANSI C63.4-2014                           | American National Standard for Methods of Measurement of Radio –<br>Noise Emissions from Low-Voltage Electrical and Electronic<br>Equipment in the range of 9 KHz to 40 GHz                       |
| 558074 D01 15.247 Meas<br>Guidance v05r02 | Guidance For Compliance Measurements On<br>Digital Transmission System, Frequency Hopping Spread Spectrum<br>System, And Hybrid System Devices Operating Under Section 15.247<br>Of The FCC Rules |

#### 1.6 Test Methodology

Test methods are specified in the Basic Standard as referenced and/or modified by the Product Standard in the part of Section 2 of this report associated with each particular test case. EUT tested for RX mode to cover FCC Part 15 subpart B (digital Circuitry).

#### 1.6.1 Variations in Test Methodology

Any variance in methodology or deviation from the reference Standard is documented in the part of Section 2 of this report associated with each particular Test Case.

#### **1.6.2 Test Sample Verification, Configuration & Modifications**

EUT setup, configuration, protocols for operation and monitoring of EUT functions, and any modifications performed in order to meet the requirements, are detailed in each Test Case of Section 2 of this report.

#### **1.6.3 Uncertainty of Measurement:**

The factors contributing to measurement uncertainty are identified and calculated in accordance with CISPR 16-4-2: 2011.

This uncertainty estimate represents an expended uncertainty expressed at approximately 95% confidence using a coverage factor of k = 2.

| Test Method                                   | Uncertainty |
|---|-------------|
| Radiated Emissions Level (9 KHz – 1 GHz)      | ±5.8 dB     |
| Radiated Emissions Level (1 GHz – 18 GHz)     | ±4.9 dB     |
| Radiated Emissions Level (18 GHz – 26.5 GHz)  | ±5.0 dB     |
| Conducted Emissions Level (150 KHz – 30 MHz)  | ±3.0 dB     |
| Uncertainty Conducted Power level             | ±0.5 dB     |
| Uncertainty Conducted Spurious emission level | ±0.6 dB     |
| Uncertainty for Bandwidth test                | ±1.5 %      |

#### 2.0 TEST CONCLUSION

#### STATEMENT OF COMPLIANCE

The customer equipment referred to in this report was found to comply with the requirements, as summarized below.

The EUT was subjected to the following tests. Compliance status is reported as **Compliant** or **Non-compliant**. **N/A** indicates the test was Not Applicable to the EUT.

The measurement uncertainty is not accounted for determination of the statement of compliance. The statement of compliance is based only on the measurement value recorded.

**Note:** Maintenance of compliance is the responsibility of the Manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the EUT with respect to the standards detailed in this test report.

The following table summarizes the tests performed in terms of the specification, class or performance criterion applied, and the EUT modification state.

| Test<br>Case | Test Type   | Specification                  | Test Sample | Modifications | Config.    | Result    |
|--------------|---|--------------------------------|-------------|---------------|------------|-----------|
| 2.1          | AC Main Conducted<br>Emissions                                    | 15.207 /<br>15.109             | CHICKADEE   | none          | see § 2.1  | N/A       |
| 2.2          | Occupied Bandwidth  | 15.247(a)(1)<br>15.247(a)(2)   | CHICKADEE   | none          | see § 2.2  | Compliant |
| 2.3          | Max Output Average Power  | 15.247(b,2,3)                  | CHICKADEE   | none          | see § 2.3  | Compliant |
| 2.4          | Power Spectral Density  | 15.247(e)<br>15.247(f)         | CHICKADEE   | none          | see § 2.4  | Compliant |
| 2.5          | Band Edge   | 15.247(d)                      | CHICKADEE   | none          | see § 2.5  | Compliant |
| 2.6          | Conducted Spurious<br>Emission<br>(Non-Restricted Band Operation) | 15.247(d)                      | CHICKADEE   | none          | see § 2.6  | Compliant |
| 2.7          | Minimum channel separation  | 15.247(a)(1)                   | CHICKADEE   | none          | see § 2.7  | Compliant |
| 2.8          | Average time of Occupancy<br>for hybrid System                    | 15.247(f)                      | CHICKADEE   | none          | see § 2.8  | Compliant |
| 2.9          | EUT Position  | ANSI C63.4                     | CHICKADEE   | none          | see § 2.9  | X-Axis    |
| 2.10         | Radiated Spurious Emission<br>(Restricted Band)                   | 15.205,<br>15.209<br>15.247(d) | CHICKADEE   | none          | see § 2.10 | Compliant |
| 2.11         | Radiated Emission   | 15.109                         | CHICKADEE   | none          | see § 2.11 | Compliant |
| 2.12         | RF Exposure   | 15.247(i)                      | CHICKADEE   | none          | see § 2.12 | Exempt    |

Refer to the test data for applicable test conditions.

connection to AC main.

#### 2.1 AC Main Power Line Conducted Emissions: N/A

| Test Lab: Electronics Test Centre, Airdrie                                 | EUT: CHICKADEE  |  |  |  |  |
|--|---|--|--|--|--|
|  | Standard: FCC Part 15.207, FCC Part 15.107                            |  |  |  |  |
|  | Basic Standard: ANSI C63.10: 2013<br>Basic Standard: ANSI C63.4: 2014 |  |  |  |  |
| EUT sta  | tus: N/A  |  |  |  |  |
| Comments: EUT is internal rechargeable Battery powered. No Direct/indirect |   |  |  |  |  |

### 2.2 Occupied Bandwidth

Test Lab: Electronics Test Centre, Airdrie

Test Personnel: Imran Akram

EUT: CHICKADEE

Standard: FCC PART 15.247

Date: 2024-12-06 (20.0°C, 16.8% RH)

Basic Standard: ANSI C63.10-2013 FCC OET KDB 558074

## **EUT status: Compliant**

### Specification: FCC Part 15.247 (a, 1, i)

Criteria: The maximum allowed 20 dB bandwidth of the hopping channel is 250 kHz.

#### 2.2.1 Test Guidance: ANSI C63.10-2013, Clause 6.9.2 & 6.9.3/ FCC OET KDB 558074

This measurement is performed at low, mid and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

| Use the following spectrum analyzer setting: |   |  |  |  |  |  |  |
|--|---|--|--|--|--|--|--|
| Span   | Between two time and five times the channel center frequency OBW  |  |  |  |  |  |  |
| RBW  | RBW 1% to 5% of the OBW   |  |  |  |  |  |  |
| VBW Approximately three times of RBW         |   |  |  |  |  |  |  |
| Sweep Auto Couple                            |   |  |  |  |  |  |  |
| Detector Function Peak                       |   |  |  |  |  |  |  |
| Trace  | Trace Max Hold  |  |  |  |  |  |  |
|  | abilize. The automated 99% BW function of the spectrum analyzer is dwidth is measured with the X dB function. |  |  |  |  |  |  |

#### 2.2.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

#### 2.2.3 Test Equipment

Testing was performed with the following equipment:

| Equipment                      | Manufacturer  | Model #                | Asset # | Cal. Date  | Cal. Due   |
|--------------------------------|---------------|------------------------|---------|------------|------------|
| EMI receiver                   | Agilent       | N9038A<br>(FW A.25.05) | 6130    | 2023-08-11 | 2024-08-11 |
| Temp/Humidity                  | Extech        | 42270                  | 5871    | 2024-04-08 | 2025-04-08 |
| Attenuator<br>(DC to 26 GHz)   | Mini-Circuits | BW-S10-2W263+          | 6932    | 2022-12-10 | 2025-12-10 |
| Coaxial Cables (RF)            | W.L. GORE     | PGR01R01036            | 7024    | 2024-01-09 | 2025-01-09 |
| DC Blocker<br>(9 KHz - 27 GHz) | Centric RF    | C0927 SMA              | 6987    | 2024-01-19 | 2025-01-19 |

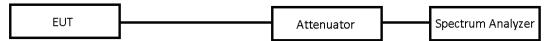
#### 2.2.4 Test Sample Verification, Configuration & Modifications

The EUT was set to transmit continuously on a selected channel with test-specific software. The output was modulated as in normal operation.

The EUT met the requirements without modification.

#### Test setup diagrams for Occupied Bandwidth testing:

#### **Conducted:**



#### 2.2.5 Channel Occupied Bandwidth Data:

| Mode of operation | Channel | Freq.<br>[MHz] | Occupied BW<br>[kHz] | 20 dB BW<br>[kHz] | Limit<br>20dB BW<br>[KHz] |
|-------------------|---------|----------------|----------------------|-------------------|---------------------------|
|                   | Low     | 902.3          | 127.93               | 138.5             |                           |
| 125KHz Hybrid     | Mid     | 908.7          | 127.53               | 138.4             | ≤ 250                     |
|                   | High    | 914.9          | 127.90               | 138.4             |                           |

#### Hybrid (125 KHz) Mode

#### Screen Captures from the spectrum analyzer: Low Channel

| Agilent Spectrum Analyzer - Occupied BW<br>XI RF 50 Ω DC |           | SENSE:INT SOURCE                  | OFF ALIGN A               | UTO 12:16:19 PM | MDec 06, 2024        |              |                  |
|--|-----------|-----------------------------------|---------------------------|-----------------|----------------------|--------------|------------------|
| Center Freq 902.300000 M                                 |           | ter Freq: 902.30000<br>: Free Run | 00 MHz<br>Avg Hold:>10/10 | Radio Std:      | None                 | Trace/Detect | tor              |
|  |           | en: 30 dB                         |                           | Radio Dev       | ice: BTS             |              |                  |
| 10 dB/div Ref 33.80 dBm                                  |           |                                   |                           |                 |                      |              |                  |
| 23.8   |           |                                   |                           |                 |                      | ClearW       | Vrite            |
| 3.80   |           | · · · · ·                         |                           |                 |                      | Clearw       | WIILG            |
| 5.20   |           |                                   |                           |                 |                      |              |                  |
| 16.2   |           |                                   |                           |                 |                      | Aver         | rag              |
| 36.2   |           |                                   |                           |                 |                      |              |                  |
| 46.2   |           |                                   |                           |                 |                      | MaxH         | Hol              |
| 56.2   |           |                                   |                           |                 |                      | Muxi         |                  |
| enter 902.3 MHz<br>Res BW 3 kHz                          |           | #VBW 10 kHz                       | I                         | Spar<br>Sweep   | 1 250 kHz<br>26.4 ms | Min L        |                  |
| Occupied Bandwidth                                       |           | Total Power                       |                           | 28.9 dBm        |                      | Min Hol      |                  |
|  | 7.93 kHz  |                                   |                           |                 |                      | Dete         |                  |
| Transmit Freq Error                                      | 368 Hz    | OBW Po                            | wer                       | 99.00 %         |                      |              | eak<br><u>Ma</u> |
| x dB Bandwidth   | 138.5 kHz | x dB                              |                           | -20.00 dB       |                      |              |                  |
|  |           |                                   |                           |                 |                      |              |                  |
|  |           |                                   |                           |                 |                      |              |                  |
| SG   |           |                                   | 4                         | STATUS          |                      | I            |                  |

#### Screen Captures from the spectrum analyzer: MID Channel

| Agilent Spe   | ctrum Analyzer - Occ    |       |          |             |              |          |          |        |                         |                       |          |             |
|---------------|-------------------------|-------|----------|-------------|--------------|----------|----------|--------|-------------------------|-----------------------|----------|-------------|
| (X)<br>Contor | RF 50 Ω                 |       | -        |             | NSE:INT SOUR |          | ALIGN AU | ЛО     | 12:36:26 P<br>Radio Std | MDec 06, 2024         | Trac     | e/Detector  |
| Center        | Fieq 908.700            |       | <u> </u> | 📕 Trig: Fre | e Run        | Avg Hold | >10/10   |        |                         |                       |          |             |
|               |                         | #IF   | Gain:Low | #Atten: 3   | 0 dB         |          |          |        | Radio Dev               | rice: BTS             |          |             |
|               |                         |       |          |             |              |          |          |        |                         |                       |          |             |
| 10 dB/div     | Ref 33.80               | 0 dBm |          |             |              |          |          |        |                         |                       |          |             |
| 23.8          |                         |       |          |             |              |          |          |        |                         |                       |          |             |
| 13.8          |                         |       |          |             |              |          |          |        |                         |                       |          | Clear Write |
| 3.80          |                         |       |          |             |              |          |          |        |                         |                       |          |             |
| -6.20         |                         |       |          |             |              |          |          |        |                         |                       | <u> </u> |             |
|               |                         |       |          |             |              |          |          | $\sim$ | <u>_</u>                |                       |          | Average     |
| -16.2         |                         |       |          |             |              |          |          |        |                         |                       |          | Average     |
| -26.2         |                         |       |          |             |              |          |          |        |                         | and the second second | <u> </u> |             |
| -36.2         |                         |       |          |             |              |          |          |        |                         |                       |          |             |
| -46.2         |                         |       |          |             |              |          |          |        |                         |                       |          | Max Hold    |
| -56.2         |                         |       |          |             |              |          |          |        |                         |                       |          |             |
| Center        | 908.7 MHz               |       |          |             |              |          |          |        | Spar                    | ר 250 kHz             |          |             |
|               | N 3 kHz                 |       |          | #VE         | 3W 10 kH     | z        |          |        |                         | 26.4 ms               |          | Min Hold    |
|               |                         |       |          |             |              |          |          |        |                         |                       |          | WIIII HOIU  |
| Occ           | upied Band <sup>,</sup> | width |          |             | Total P      | ower     | 2        | 28.7   | dBm                     |                       |          |             |
|               |                         | 127   | ′.53 kł  | Ηz          |              |          |          |        |                         |                       |          | Detector    |
| L _           |                         |       |          |             |              |          |          | ~ ~    | ~~ ~                    |                       |          | Peak▶       |
| Tran          | smit Freq Err           | or    | 277      | Hz          | OBW P        | ower     |          | 99     | .00 %                   |                       | Auto     | <u>Man</u>  |
| x dB          | Bandwidth               |       | 138.4    | Hz          | x dB         |          | -        | 20.0   | 00 dB                   |                       |          |             |
|               |                         |       |          |             |              |          |          |        |                         |                       |          |             |
|               |                         |       |          |             |              |          |          |        |                         |                       |          |             |
|               |                         |       |          |             |              |          |          |        |                         |                       |          |             |
| MSG           |                         |       |          |             |              |          | S        | TATUS  |                         |                       | <u> </u> |             |

#### Screen Captures from the spectrum analyzer: High Channel

| Center Freq 914.900000 M  | Irig: I            | sense:INT source off<br>r Freq: 914.900000 MHz<br>Free Run Avg Ho<br>h: 30 dB | ALIGN AUTO<br>Id:>10/10 | 12:45:53 PM<br>Radio Std:<br>Radio Devi |         | Trace/Detector |                            |
|---------------------------|--------------------|---|-------------------------|---|---------|----------------|----------------------------|
| 10 dB/div Ref 33.80 dBm   |                    |   |                         |   |         |                |                            |
| 13.8                      |                    |   |                         |   |         |                | Clear Writ                 |
| 3.80                      |                    |   |                         |   |         |                | Avera                      |
| 26.2                      |                    |   |                         |   | hard    |                | Max Ho                     |
| 56.2                      |                    |   |                         | Span                                    | 250 kHz |                |                            |
| Res BW 3 kHz              | #                  | VBW 10 kHz  |                         |   | 26.4 ms |                | Min Ho                     |
| Occupied Bandwidth        |                    | Total Power   | 28.6                    | i dBm                                   |         |                |                            |
| ۲۲<br>Transmit Freq Error | 7.90 kHz<br>369 Hz | OBW Power   | 99                      | .00 %                                   |         | Auto           | Detect<br>Peal<br><u>M</u> |
| x dB Bandwidth            | 138.4 kHz          | x dB  | -20.                    | 00 dB                                   |         |                |                            |
|                           |                    |   |                         |   |         |                |                            |
| G                         |                    |   | STATUS                  | 5                                       |         |                |                            |

#### 2.3 Max Average Output Power

Test Lab: Electronics Test Centre, Airdrie

Test Personnel: Imran Akram

EUT: CHICKADEE

Standard: FCC PART 15.247

Date: 2024-12-06 (20.0°C, 16.8% RH)

Basic Standard: ANSI C63.10: 2013 FCC OET KDB 558074

## EUT status: Compliant

#### Specification: FCC Part 15.247(b, 2)

**Criteria** For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels

## 2.3.1 Test Guidance: ANSI C63.10-2013, Clause 11.9.2.2.2 Clause 7.8.5 / FCC OET KDB 558074

This measurement is performed at low, mid and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

| Output Po                 | ower Method AVGSA-1 For DTS   |
|---------------------------|---|
| Span                      | ≥ 1.5 times the OBW   |
| RBW                       | $1 - 5$ % of the OBW, $\leq 1$ MHz  |
| VBW                       | ≥ 3 x RBW   |
| Number of Points in sweep | ≥ 2 x Span / RBW  |
| Sweep time                | Auto Couple   |
| Detector                  | RMS (Power Averaging)   |
| Sweep trigger             | Free Run (Duty Cycle ≥98%)  |
| Trace Average             | Minimum 100 traces in power Averaging (RMS)   |
| Power measured            | Integrated the spectrum across the OBW of the signal using the S/A band power measurement function, with band limit set equal to the OBW band edge. |

### 2.3.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

### 2.3.3 Test Equipment

Testing was performed with the following equipment:

| Equipment                      | Manufacturer  | Model #                | Asset # | Cal. Date  | Cal. Due   |
|--------------------------------|---------------|------------------------|---------|------------|------------|
| EMI receiver                   | Agilent       | N9038A<br>(FW A.25.05) | 6130    | 2023-08-11 | 2024-08-11 |
| Temp/Humidity                  | Extech        | 42270                  | 5871    | 2024-04-08 | 2025-04-08 |
| Attenuator<br>(DC to 26 GHz)   | Mini-Circuits | BW-S10-2W263+          | 6932    | 2022-12-10 | 2025-12-10 |
| Coaxial Cables (RF)            | W.L. GORE     | PGR01R01036            | 7024    | 2024-01-09 | 2025-01-09 |
| DC Blocker<br>(9 KHz - 27 GHz) | Centric RF    | C0927 SMA              | 6987    | 2024-01-19 | 2025-01-19 |

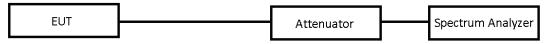
### 2.3.4 Test Sample Verification, Configuration & Modifications

The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation.

The EUT met the requirements without modification.

#### Test setup diagrams for Power testing:

#### Conducted:

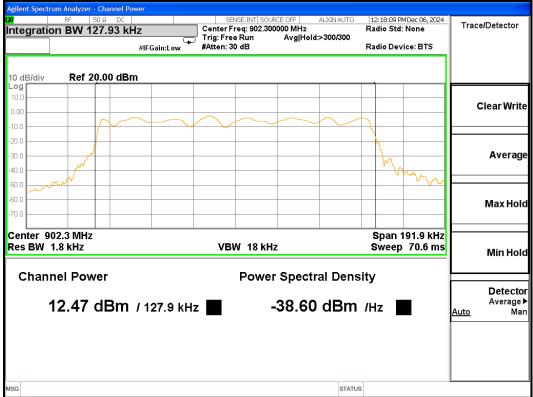


### 2.3.5 Max Output Power Data: DSS

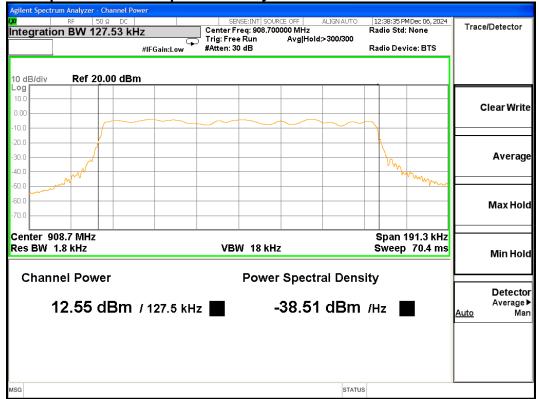
| Mode of operation | Channel | Freq.<br>[MHz] | Max Average<br>Power<br>[dBm] | Limit<br>Power<br>[dBm] |
|-------------------|---------|----------------|-------------------------------|-------------------------|
|                   | Low     | 902.3          | 12.47                         |                         |
| 125KHz Hybrid     | Mid     | 908.7          | 12.55                         | ≤ 30 (1Watt)            |
|                   | High    | 914.9          | 12.26                         |                         |

#### Hybrid (125 KHz) Mode

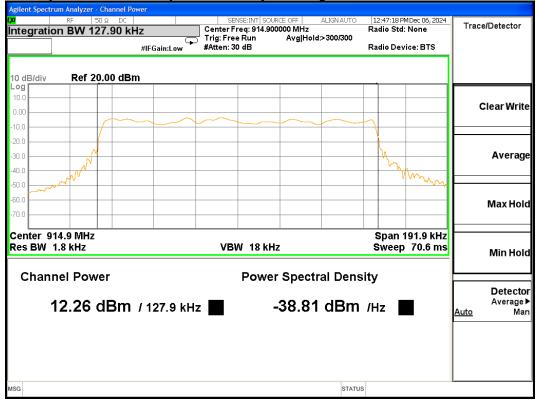
Screen Captures from the spectrum analyzer Low Channel



#### Screen Captures from the spectrum analyzer: MID Channel



#### Screen Captures from the spectrum analyzer: High Channel



#### 2.4 Power Spectral Density

Test Lab: Electronics Test Centre, Airdrie

Test Personnel: Imran Akram

EUT: CHICKADEE Standard: FCC PART 15.247

Date: 2024-12-06 (20.0°C, 16.8% RH)

Basic Standard: ANSI C63.10: 2013

## EUT status: Compliant

#### Specification: FCC Part 15.247(f)

**Criteria** The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3kHz band during any time interval of continuous transmission.

#### 2.4.1 Test Guidance: ANSI C63.10-2013, Clause 11.10.3 / FCC OET KDB 558074

This measurement is performed at low, mid and high frequencies, in continuous transmission, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

| Use the following Spe   | ectrum Analyzer settings   |
|-------------------------|--|
| Span                    | At least 1.5 times the OBW of channel center Frequency                     |
| RBW                     | 3 KHz  |
| VBW                     | ≥ 3 x VBW  |
| Sweep                   | Auto Couple  |
| Detector Function       | Power averaging (RMS) or Sample detector (when RMS not available.          |
| Trace                   | Employ trace average (rms) mode over a minimum of 100 traces.              |
| Ensure that the num     | ber of measurement points in the sweep $\geq$ [ 2 x span / RBW]. Allow the |
| trace to stabilize. Use | the peak marker function to determine the maximum amplitude level.         |

#### 2.4.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

#### 2.4.3 Test Equipment

Testing was performed with this equipment:

| Equipment                      | Manufacturer  | Model #                | Asset # | Cal. Date  | Cal. Due   |
|--------------------------------|---------------|------------------------|---------|------------|------------|
| EMI receiver                   | Agilent       | N9038A<br>(FW A.25.05) | 6130    | 2023-08-11 | 2024-08-11 |
| Temp/Humidity                  | Extech        | 42270                  | 5871    | 2024-04-08 | 2025-04-08 |
| Attenuator<br>(DC to 26 GHz)   | Mini-Circuits | BW-S10-2W263+          | 6932    | 2022-12-10 | 2025-12-10 |
| Coaxial Cables (RF)            | W.L. GORE     | PGR01R01036            | 7024    | 2024-01-09 | 2025-01-09 |
| DC Blocker<br>(9 KHz - 27 GHz) | Centric RF    | C0927 SMA              | 6987    | 2024-01-19 | 2025-01-19 |

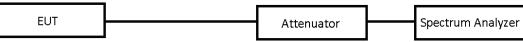
#### 2.4.4 Test Sample Verification, Configuration & Modifications

The EUT was set to transmit continuously on a selected channel with test-specific software. The output was modulated as in normal operation.

The EUT met the requirements without modification.

## Test setup diagrams for Power Spectral Density testing:

Conducted:



#### 2.4.5 Average PSD Data

| Mode of operation | Channel | Freq.<br>[MHz] | PSD<br>(dBm) | PSD Limit<br>(dBm |
|-------------------|---------|----------------|--------------|-------------------|
|                   | Low     | 902.3          | -1.692       |                   |
| LoRa 125 KHz      | Mid     | 908.7          | -2.258       | ≤ 8 3KHz          |
|                   | High    | 914.9          | -2.430       |                   |

#### Screen Capture from Spectrum Analyzer: Low Channel





#### Screen Capture from Spectrum Analyzer: MID Channel





#### 2.5 Band Edge Attenuation

Test Lab: Electronics Test Centre, Airdrie

Test Personnel: Imran Akram

Date: 2024-12-06 (20.0°C, 16.8% RH)

EUT: CHICKADEE Standard: FCC PART 15.247 Basic Standard: ANSI C63.10: 2013

## EUT status: Compliant

#### Specification: FCC Part 15.247(d)

**Criteria:** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.209(a) (see §15.205(c)).

# 2.5.1 Test Guidance: ANSI C63.10-2013 Clause 6.10.4 & 7.8.6, 6.10.6 / FCC OET KDB 558074

This measurement is performed at the low and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

| Use the following s | spectrum analyzer settings:  |
|---------------------|--|
| Span                | Wide enough to capture the peak level of the emission operating on       |
|                     | the channel closest to the band edge, as well as any modulation          |
|                     | products that fall outside of the authorized band of operation.          |
| Attenuation         | Auto (at least 10 dB preferred).   |
| RBW                 | 100 kHz  |
| VBW                 | 300 kHz  |
| Sweep               | Coupled  |
| Detector function   | peak   |
| Trace               | max hold   |
| Allow the trace to  | stabilize. Set the marker on the emission at the band edge, or on the    |
| highest modulation  | n product outside of the band, if this level is greater than that at the |
| band edge. Enable   | e the marker-delta function, and then use the marker-to-peak function    |
| to move the marke   | er to the peak of the in-band emission.                                  |

#### 2.5.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

#### 2.5.3 Test Equipment

Testing was performed with the following equipment:

| Equipment                      | Manufacturer  | Model #                | Asset # | Cal. Date  | Cal. Due   |
|--------------------------------|---------------|------------------------|---------|------------|------------|
| EMI receiver                   | Agilent       | N9038A<br>(FW A.25.05) | 6130    | 2023-08-11 | 2024-08-11 |
| Temp/Humidity                  | Extech        | 42270                  | 5871    | 2024-04-08 | 2025-04-08 |
| Attenuator<br>(DC to 26 GHz)   | Mini-Circuits | BW-S10-2W263+          | 6932    | 2022-12-10 | 2025-12-10 |
| Coaxial Cables (RF)            | W.L. GORE     | PGR01R01036            | 7024    | 2024-01-09 | 2025-01-09 |
| DC Blocker<br>(9 KHz - 27 GHz) | Centric RF    | C0927 SMA              | 6987    | 2024-01-19 | 2025-01-19 |

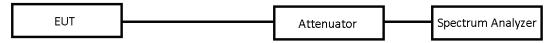
#### 2.5.4 Test Sample Verification, Configuration & Modifications

The EUT was set to transmit continuously on a selected channel with test-specific software. The output was modulated as in normal operation.

The EUT met the requirements without modification.

#### Test setup diagrams for Band Edge Attenuation testing:

#### Conducted:



#### 2.5.5 Band Edge Data

#### Worse Case Data

| Mode of operation | Channel  | Attenuation<br>at Band Edge | Attenuation Limit<br>at Band Edge |  |
|-------------------|--|-----------------------------|-----------------------------------|--|
| Lora 125KHz       | 902.3  | 49.519 dBc                  |                                   |  |
| (Non-Hopping)     | 914.9  | 65.716 dBc                  |                                   |  |
| Lora 125KHz       | KHz         902.3           oping)         914.9           KHz         902.3 | 56.135 dBc                  | ≥30 dBc                           |  |
| (Hopping)         | 914.9  | 65.716 dBc                  |                                   |  |

#### Screen Capture from the spectrum analyzer: Lower Band Edge (Non-Hopping)

|                               |                                |                         |                         |        |            |  |                                      | - Swept SA           |         |              | Spect         | gilent                  |
|-------------------------------|--------------------------------|-------------------------|-------------------------|--------|------------|--|--------------------------------------|----------------------|---------|--------------|---------------|-------------------------|
| Trace/Detector                | ADec 06, 2024<br>E 1 2 3 4 5 6 |                         | ALIGNAUTO<br>e: Log-Pwr |        | NSE:INT SO |  |                                      | 50 Ω DC  <br>898 kHz |         | RF           | (er 2         | l<br>arl                |
| Select Trace                  | 1.0 kHz<br>519 dB              | DE<br>Mkr2 29           | >300/300<br><u>\</u>    | AvgHo  |            | ┘ Trig: Fre<br>#Atten: 3               | PNO: Wide 🕞<br>IFGain:Low            | t 10.4 dB            | f Offse | Ref          |               | 0 dE                    |
| Clear Wri                     | <u>2∆3</u>                     |                         |                         |        |            |  |                                      |                      |         |              |               | .og<br>20.4<br>10.4     |
| Trace Averag                  | -17.53 dBm                     |                         |                         |        |            |  |                                      |                      |         |              |               | 9.60<br>19.6<br>29.6    |
| Max Ho                        |                                | × 3                     |                         | ~~~^^^ |            | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ |                                      | Annalisen            | - Ann   | <u>~~~</u> ~ | , a <u>^-</u> | 39.6<br>49.6<br>59.6    |
| Min Ho                        |                                | Stop 902.<br>.000 ms (: |                         |        |            | 300 kHz                                | #VBV                                 | X                    |         | .000<br>100  | s BW          | Res                     |
| <b>View Blank</b><br>Trace Or |                                |                         |                         |        | dB         | 12.628 d<br>49.519<br>-36.888 d        | 00 0 MHz<br>91.0 kHz (∆)<br>95 0 MHz | 2                    | (Δ)     | f<br>f       | N<br>∆3<br>F  | 2<br>3<br>4<br>5<br>6   |
| <b>Mo</b><br>1 of             |                                |                         |                         |        |            |  |                                      |                      |         |              |               | 7<br>8<br>9<br>10<br>11 |
|                               |                                |                         |                         |        |            |  |                                      |                      |         |              |               |                         |

#### Screen Capture from the spectrum analyzer: Upper Band Edge (Non-Hopping)

| lî.                    | MDec 06, 2024                                  | 10-54-41 0              | ALIGNAUTO  |                 |             |                      |                         | rept SA                       | nalyzer - Sw                   |                    | gilent !                        |
|------------------------|--|-------------------------|--|-----------------|-------------|----------------------|-------------------------|-------------------------------|--------------------------------|--------------------|---------------------------------|
| Trace/Detector         | TDEC 06, 2024<br>E 1 2 3 4 5 6<br>PE MW/////// | TRAC                    | : Log-Pwr  |                 | NSE:INT SOU |                      |                         | 0640 MH                       |                                |                    | /<br>lark                       |
| Select Trace           |  | ( <b>r2 -13.1</b>       |  | Avginoid        |             | #Atten: 3            | PNO: Fast C<br>Gain:Low |                               |                                |                    |                                 |
| 1                      | .716 dB  |                         |  |                 |             |                      |                         |                               | of Offset 1<br>of <b>30.40</b> |                    | 10 dB/                          |
| Clear Writ             |  |                         |  |                 |             |                      |                         |                               |                                | 2∆3                | 20.4 -                          |
|                        |  |                         |  |                 |             |                      |                         |                               |                                |                    | .400 -                          |
| Trace Averag           | -17.74 dBm                                     |                         |  |                 |             |                      |                         |                               |                                |                    | 9.60 -<br>19.6 -                |
|                        |  |                         |  |                 |             |                      |                         |                               |                                | +                  | 29.6                            |
| Max Hol                | goog and a little                              | monerally               | and the second of the second o | www.southyseles | manna       | -                    | nappenappenappena       | a a contraction of the second | mon                            | June               | -39.6 <mark>7</mark><br>-49.6 – |
|                        |  | //\\3                   |  |                 |             |                      |                         |                               |                                |                    | -59.6                           |
| Min Ho                 |  | Stop 930.<br>1.600 ms ( |  |                 |             | / 300 kHz            | #VB                     |                               |                                | 914.30:<br>BW 10   |                                 |
|                        | DN VALUE                                       | FUNCTIO                 | NCTION WIDTH   | TION FU         |             | Y<br>12.295 dl       | 00 MHz                  | ×<br>914.90                   |                                | ide tro s<br>N 1 1 | MKR MO                          |
| View Blank<br>Trace On |  |                         |  |                 |             | 65.716<br>-53.416 di | 59 MHz (Δ<br>05 MHz     |                               |                                |                    | 2 ∆<br>3 F<br>4                 |
| Trace On               |  |                         |  |                 |             |                      |                         |                               |                                |                    | 5<br>6<br>7                     |
| Mor                    |  |                         |  |                 |             |                      |                         |                               |                                |                    | 8<br>9                          |
| 1 of                   | ~  |                         |  |                 |             |                      |                         |                               |                                |                    | 10<br>11                        |
| <u></u>                |  | IS                      | STATUS   |                 |             |                      |                         |                               |                                |                    | SG                              |

#### Screen Capture from the spectrum analyzer: Lower Band Edge (Hopping)

|                  |   | 40.00.00.0              |              |                |           | 05                              |  | rept SA | alyzer - Sw            | um An<br>RF | Spectru       | tent :            |
|------------------|---|-------------------------|--------------|----------------|-----------|---------------------------------|--|---------|------------------------|-------------|---------------|-------------------|
| Peak Search      | MDec 06, 2024<br>CE 1 2 3 4 5 6<br>PE M M M M | TRAC                    | ALIGNAUTO    |                | NSE:INT S | <b>_</b>                        |  |         | .65216                 |             | er 2 2        | ark               |
| NextPe           |   | DE                      |              | Avginor        |           | #Atten: 3                       | PNO: Wide Ģ<br>IFGain:Low              |         |                        |             |               |                   |
|                  | 9.7 kHz<br>.135 dB                            | 0 Wkr2 28<br>56.        | Δι           |                |           |                                 |  |         | f Offset 10<br>f 30.40 |             | div           | dB/               |
|                  |   |                         | 2Δ3          |                |           |                                 |  |         |                        |             |               | 9<br>0.4          |
| Next Pk Rig      | <b>~~~~</b>                                   |                         |              | <mark>`</mark> |           |                                 |  |         |                        | _           |               | ).4 -             |
|                  |   |                         |              |                |           |                                 |  |         |                        |             |               | 00 -              |
| Next Pk Lo       | -17.53 dBm                                    |                         |              |                |           |                                 |  |         |                        |             |               | 60 -<br>3.6 -     |
|                  |   |                         |              |                |           |                                 |  |         |                        |             |               | 9.6 -             |
|                  | [   |                         |              |                |           | man                             |  |         |                        |             |               | 9.6 -             |
| Marker De        |   |                         |              | // \\3         | www.      |                                 | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ | warn-   | m. M. Mary             | Mr          | ~~~~~~~       | 9.6               |
|                  |   |                         |              |                |           |                                 |  |         |                        |             |               |                   |
| Mkr→0            |   | Stop 903.<br>.000 ms (: | Sweep 1      |                | z         | / 300 kHz                       | #VBW                                   |         |                        |             | 900.0<br>BW 1 |                   |
|                  | IN VALUE                                      | FUNCTIO                 | NCTION WIDTH | JNCTION FI     |           | Y                               |  | ×       | -                      |             | IDE TRO       |                   |
|                  |   |                         |              |                | dB        | 12.422 d<br>56.135<br>-43.713 d | 44 7 MHz<br>289.7 kHz (Δ)<br>55 0 MHz  |         | (Δ)                    | f<br>f      | 3 1           | 1 N<br>2 A<br>3 F |
| Mkr→RefL         |   |                         |              |                | Bm        | -43.713 0                       | 55 U WHZ                               | 901.9   |                        | Т           | -             | р г<br>4<br>5     |
|                  |   |                         |              |                |           |                                 |  |         |                        |             |               | 5                 |
|                  |   |                         |              |                |           |                                 |  |         |                        |             |               | 7                 |
|                  |   |                         |              |                |           |                                 |  |         |                        |             |               | 3                 |
| <b>Мо</b><br>1 о | ×   |                         |              |                |           |                                 |  |         |                        |             |               | 3                 |

#### Screen Capture from the spectrum analyzer: Upper Band Edge (Hopping)

|                |  |               |              |           |             |                        |                           | er - Swept SA           | um Analyzer<br>RE  | ent Spectr | Agiler         |
|----------------|--|---------------|--------------|-----------|-------------|------------------------|---------------------------|-------------------------|--------------------|------------|----------------|
| Trace/Detector | 4Dec 06, 2024<br>E 1 2 3 4 5 6<br>E M WARMAN | TRAC          | ALIGNAUTO    |           | NSE:INT SOU |                        |                           | 50 Ω DC<br>8964947 M    |                    | rker 2     | <b>M</b> ar    |
| Select Trace   |  | D             | >10/10       | Avginoid  |             | Atten: 3               | PNO: Fast (<br>IFGain:Low |                         |                    |            |                |
| 1              | 69 MHz<br>99 dBm                             |               | Mkr          |           |             |                        |                           | set 10.4 dB<br>).40 dBm |                    | dB/div     |                |
|                |  |               |              |           |             |                        |                           | 2                       |                    | ·          | 20.4           |
| Clear Writ     |  |               |              |           |             |                        |                           |                         | ******             | 4          | 10.4           |
|                |  |               |              |           |             |                        |                           |                         |                    |            | 0.400<br>-9.60 |
| Trace Averag   | -17.74 dBm                                   |               |              |           |             |                        |                           |                         |                    |            | -9.60          |
|                |  |               |              |           |             |                        |                           |                         |                    | 6          | -29.6          |
|                |  |               |              |           |             |                        |                           |                         |                    | 6          | -39.6          |
| Max Hol        | ennorm                                       | ant grand and | mandret      | ann ann   | manuel      | ula marine marine      | Monner                    | Marchage                |                    |            | -49.6          |
| L              |  |               |              |           |             |                        |                           |                         |                    |            | -59.6          |
| Min Hol        | .000 MHz<br>3001 pts)                        |               |              |           |             | W 300 kHz              | #VB                       |                         | 126 MH:<br>100 kHz |            |                |
|                | N VALUE                                      | FUNCTIO       | ICTION WIDTH | ICTION FU |             | Y<br>12.096 di         | 1.900 MHz                 | X                       | rc scl             | MODE TI    | MKE<br>1       |
| View Blank     |  |               |              |           |             | 12.096 di<br>12.099 di | 1.900 MHz<br>1.869 MHz    |                         | f                  |            | 23             |
| Trace On       |  |               |              |           |             |                        |                           |                         |                    |            | 4<br>5<br>6    |
| Mo             |  |               |              |           |             |                        |                           |                         |                    |            | 7<br>8         |
| 1 of           |  |               |              |           |             |                        |                           |                         |                    |            | 9<br>10        |
|                | >  |               |              |           |             |                        |                           |                         |                    |            | 11<br><        |
|                |  |               | STATUS       |           |             |                        |                           |                         |                    |            | ISG            |

#### 2.6 Conducted Spurious Emissions (Non- Restricted Band)

Test Lab: Electronics Test Centre, Airdrie

Test Personnel: Brendan Van Hee, Imran Akram EUT: CHICKADEE

Standard: FCC PART 15.247

Basic Standard: ANSI C63.4-2014 FCC OET KDB 558470 v04 DTS

Date: 2024-12-06 (20.0°C, 16.8% RH)

## **EUT status: Compliant**

#### Specification: FCC Part 15.247(d)

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

#### 2.6.1 Test Guidance: ANSI C63.10-2013, Clause 6.7, 7.8.8 / 558074 D01 15.247 Measurement Guidance v05r02

This measurement is performed at the low, mid and high frequencies, with modulation. The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

| Use the following s   | Use the following spectrum analyzer settings:                                  |  |  |  |  |  |  |  |  |  |
|---|--|--|--|--|--|--|--|--|--|--|
| Span  | Set the center frequency and span to encompass frequency range to be measured. |  |  |  |  |  |  |  |  |  |
| RBW   | 100 kHz  |  |  |  |  |  |  |  |  |  |
| VBW   | 300 kHz  |  |  |  |  |  |  |  |  |  |
| Sweep   | Auto Coupled   |  |  |  |  |  |  |  |  |  |
| Detector function   | peak   |  |  |  |  |  |  |  |  |  |
| Trace   | max hold   |  |  |  |  |  |  |  |  |  |
| Allow the trace to stabilize. Use the peak marker function to determine the maximum |  |  |  |  |  |  |  |  |  |  |

Allow the trace to stabilize. Use the peak marker function to determine the maximum amplitude level. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements specified in

#### 2.6.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

#### 2.6.3 Test Equipment

Testing was performed with the following equipment:

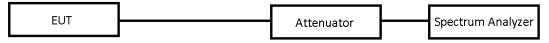
| Equipment                      | Manufacturer  | Model #                | Asset # | Cal. Date  | Cal. Due   |
|--------------------------------|---------------|------------------------|---------|------------|------------|
| EMI receiver                   | Agilent       | N9038A<br>(FW A.25.05) | 6130    | 2023-08-11 | 2024-08-11 |
| Temp/Humidity                  | Extech        | 42270                  | 5871    | 2024-04-08 | 2025-04-08 |
| Attenuator<br>(DC to 26 GHz)   | Mini-Circuits | BW-S10-2W263+          | 6932    | 2022-12-10 | 2025-12-10 |
| Coaxial Cables (RF)            | W.L. GORE     | PGR01R01036            | 7024    | 2024-01-09 | 2025-01-09 |
| DC Blocker<br>(9 KHz - 27 GHz) | Centric RF    | C0927 SMA              | 6987    | 2024-01-19 | 2025-01-19 |

#### 2.6.4 Test Sample Verification, Configuration & Modifications

The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation.

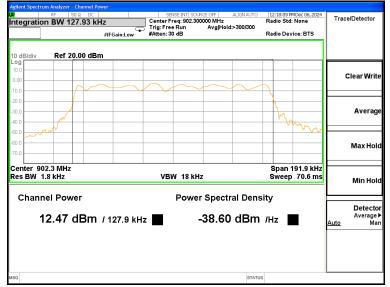
The EUT met the requirements without modification.

#### Test setup diagram for Conducted Spurious Emissions testing:



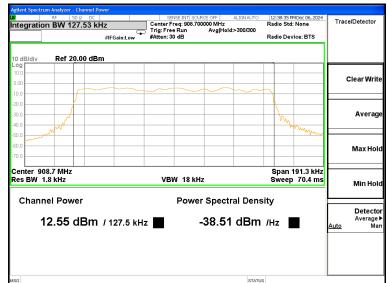
#### 2.6.5 Conducted Emissions Data:

#### Low Channel



| Agilent Spectru                | um Analyzer - Swept SA              |                           |                                 |   |   |                        | Agiler                     |                        | Analyzer - Sw                        |             |                     |                |              |                    |            |                |                                   |                        |
|--------------------------------|-------------------------------------|---------------------------|---------------------------------|---|---|------------------------|----------------------------|------------------------|--------------------------------------|-------------|---------------------|----------------|--------------|--------------------|------------|----------------|-----------------------------------|------------------------|
| <mark>⋈</mark><br>Average/     | RF 50 Ω DC<br>Hold Number 10        |                           |                                 | SOURCE OFF ALIGNAUTO<br>Avg Type: Log-Pwr<br>Avg Hold>10/10 | 12:26:01 PM Dec 06, 2024<br>TRACE 1 2 3 4 5 6           | Trace/Detector         | Mar                        |                        | r⊧ 50 Ω<br>5113500                   | 00000 GH    |                     |                | ISE:INT SOUP | Avg Typ<br>Avg Typ | e: Log-Pwr | TR/            | PMDec 06, 2024<br>ACE 1 2 3 4 5 6 | Trace/Detector         |
|                                |                                     | PNO: Fast 🗣<br>IFGain:Low | #Atten: 30 dB                   |   | DET P N N N N   | Select Trace           |                            |                        |                                      | PN0<br>IFGa | 0:Fast 🖵<br>ain:Low | #Atten: 30     |              | Avginoid           |            |                | YPE MUNUMUM<br>DET P N N N N N    | Select Trace           |
| 10 dB/div                      | Ref Offset 10.4 dB<br>Ref 30.40 dBm |                           |                                 | Mkr   | 1 902.303 MHz<br>12.618 dBm                             | 1                      |                            | R<br>B/div <b>R</b>    | ef Offset 1 <sup>°</sup><br>ef 31.00 | 1 dB<br>dBm |                     |                |              |                    | Mkr1       | 4.511<br>-39.7 | 350 GHz<br>′64 dBm                | 1                      |
| 20.4<br>10.4                   |                                     |                           |                                 |   | 1   | Clear Write            | Log<br>21.0<br>11.0        |                        |                                      |             |                     |                |              |                    |            |                |                                   | Clear Write            |
| -9.60<br>-19.6<br>-29.6        |                                     |                           |                                 |   | -17.53 dBm  | Trace Average          | -9.00<br>-19.0<br>-29.0    |                        |                                      |             |                     | 1              |              |                    |            |                | -17.53 dBm                        | Trace Average          |
| -39.6<br>-49.6<br>-59.6        |                                     | terre di la la antarativa | to have the track of the second |   |   | Max Hold               | -39.0<br>-49.0<br>-59.0    |                        |                                      |             |                     |                |              |                    |            |                |                                   | Max Hold               |
| Start 30 kl<br>#Res BW         | 100 kHz                             | #VBW                      | / 300 kHz                       | Sweep 96.   | Stop 1.0000 GHz<br>.00 ms (40001 pts)<br>FUNCTION VALUE | Min Hold               | #Re                        | rt 1.000 C<br>Is BW 10 | 0 kHz                                | ×           | #VBW                | / 300 kHz<br>Y |              |                    | weep 80    | 61.3 ms (      | 0.000 GHz<br>40001 pts)           | Min Hold               |
| 1 N 1<br>2<br>3<br>4<br>5<br>6 | f 902                               | 2.303 MHz                 | 12.618 dBm                      |   |   | View Blank<br>Trace On | 1<br>2<br>3<br>4<br>5<br>6 | N 1                    | ſ                                    | 4.511 350   | GHz                 | -39.764 dE     | 3m           |                    |            |                |                                   | View Blank<br>Trace On |
| 7<br>8<br>9<br>10<br>11        |                                     |                           |                                 |   |   | More<br>1 of 3         | 7<br>8<br>9<br>10<br>11    |                        |                                      |             |                     |                |              |                    |            |                | ×                                 | More<br>1 of 3         |
| MSG                            |                                     |                           |                                 | STATUS  |   |                        | MSG                        |                        |                                      |             |                     |                |              |                    | STATU      | s              |                                   | t                      |

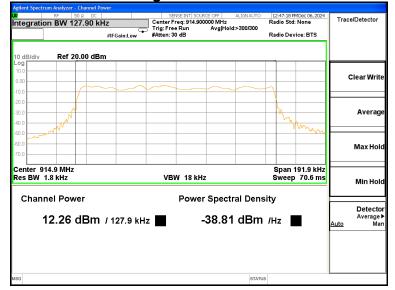
#### **MID Channel**



|                         | rum Analyzer - Swept SA             |                              |                 | ·                                       |            |  |                          | 1.11                    |                       | Analyzer - Sw            |                |                      |            |             |          |                        |          |   |                        |
|-------------------------|-------------------------------------|------------------------------|-----------------|---|------------|--|--------------------------|-------------------------|-----------------------|--------------------------|----------------|----------------------|------------|-------------|----------|------------------------|----------|---|------------------------|
| Agilent Spectr          | RF 50.0 DC                          |                              | CENCE IN C      |   |            | 10-40-14 PMD 05-0024   |                          | Agilen                  |                       |                          |                |                      | 073        |             |          |                        | 10:41:00 | DAID - OC DOD4                                      |                        |
| Display L               | Line -17.45 dBm                     |                              |                 | SOURCE OFF A<br>Avg Type:<br>Avg Hold:> | Log-Pwr    | 12:40:14 PMDec 06, 2024<br>TRACE 1 2 3 4 5 6<br>TYPE MUMUMUM | Trace/Detector           | Mar                     |                       |                          | 00000 GH       |                      |            | SE:INT SOUR |          | ALIGNAUTO<br>: Log-Pwr | TF       | PMDec 06, 2024<br>ACE 1 2 3 4 5 6<br>TYPE M 4444444 | Trace/Detector         |
|                         |                                     | PNO: Fast G                  | #Atten: 30 dB   | Arginolas                               |            | DET P N N N N N  | Select Trace             |                         |                       |                          | PN<br>IFG      | 0: Fast 🖵<br>ain:Low | #Atten: 30 | dB          | Avginoid |                        |          | DET P NNNNN   | Select Trace           |
| 10 dB/div               | Ref Offset 10.4 dB<br>Ref 30.40 dBm |                              |                 |   | Mkr        | 1 908.703 MHz<br>12.479 dBm                                  | 1                        |                         |                       | ef Offset 11<br>ef 31.00 |                |                      |            |             |          | Mkr1                   |          | 750 GHz<br>862 dBm                                  | 1                      |
| 20.4                    |                                     |                              |                 |   |            | 1  | Clear Write              | 21.0<br>21.0            |                       |                          |                |                      |            |             |          |                        |          |   | Clear Write            |
| 0.400                   |                                     |                              |                 |   |            |  |                          | 1.00                    |                       |                          |                |                      |            |             |          |                        |          |   |                        |
| -9.60                   |                                     |                              |                 |   |            | -17.45 dBm   |                          | -9.00                   |                       |                          |                |                      |            |             |          |                        |          | -17.45 dBm  |                        |
| -19.6                   |                                     |                              |                 |   |            |  | Trace Average            | -19.0                   |                       |                          |                |                      |            |             |          |                        |          |   | Trace Average          |
| -29.6                   |                                     |                              |                 |   |            |  |                          | -29.0<br>-39.0          |                       |                          |                | <b></b>              | 1          |             |          |                        |          |   |                        |
| -49.6                   |                                     | and the second second second |                 |   |            |  | Max Hold                 | -49.0                   | and the set of the    |                          |                |                      |            |             |          |                        |          |   | Max Hold               |
| -59.6                   |                                     |                              |                 |   |            |  |                          | -59.0                   |                       |                          |                |                      |            |             |          |                        |          |   |                        |
| Start 30 k<br>#Res BW   |                                     | #VBV                         | V 300 kHz       | Sw                                      |            | Stop 1.0000 GHz<br>00 ms (40001 pts)                         | Min Hold                 |                         | rt 1.000 (<br>s BW 10 |                          |                | #VBW                 | 300 kHz    |             | s        | weep 86                |          | 0.000 GHz<br>40001 pts)                             | Min Hold               |
| MKE MODE T              |                                     | 8.703 MHz                    | Y<br>12.479 dBm | FUNCTION FUNC                           | TION WIDTH | FUNCTION VALUE   |                          |                         | MODE TRC S            |                          | ×<br>4.543 750 | GHz                  | -39.862 dE |             | CTION FU | NCTION WIDTH           | FUNC     | TION VALUE  |                        |
| 2<br>3<br>4<br>5<br>6   |                                     |                              |                 |   |            |  | View Blank<br>Trace On ► | 2<br>3<br>4<br>5<br>6   |                       |                          |                |                      |            |             |          |                        |          |   | View Blank<br>Trace On |
| 7<br>8<br>9<br>10<br>11 |                                     |                              |                 |   |            | <u> </u>   | More<br>1 of 3           | 7<br>8<br>9<br>10<br>11 |                       |                          |                |                      |            |             |          |                        |          | ~   | More<br>1 of 3         |
| MSG                     |                                     |                              |                 |   | STATUS     | >  | []                       | MSG                     |                       |                          |                |                      |            |             |          | STATU                  | s        |   |                        |

#### FCC Part 15.247

#### High Channel



| Agilent Spec                 | trum Analyzer -                 |          |                        |                        |               |  |         |  |                        | Agiler                      | nt Spectru      | ım Analyzer - Sv          |             |                          |            |              |                                |                         |           |                                |                        |
|------------------------------|---------------------------------|----------|------------------------|------------------------|---------------|--|---------|--|------------------------|-----------------------------|-----------------|---------------------------|-------------|--------------------------|------------|--------------|--------------------------------|-------------------------|-----------|--------------------------------|------------------------|
| Marker '                     | RF 50                           | 54500 MH | z                      |                        | SE:INT SOURCE | E OFF ALIG<br>Avg Type: Lo<br>Avg Hold:>10 | a-Pwr   | 12:50:39 PM Dec 06, 2024<br>TRACE 1 2 3 4 5 6<br>TYPE M WWWWW<br>DET P N N N N N | Trace/Detector         | <mark>⊯</mark><br>Mar       | ker 1           | RF 50 S                   | 00000 (     | GHz                      |            | VSE:INT  SOU | Avg Typ<br>Avg Typ<br>AvalHold | ALIGNAUTO<br>e: Log-Pwr | TRA       | MDec 06, 2024                  | Trace/Detector         |
|                              |                                 | IF       | NO: Fast ⊂<br>Gain:Low | #Atten: 30             | dB            | Avginoid> io                               |         |  | Select Trace           |                             |                 |                           |             | PNO: Fast 🕞<br>FGain:Low | #Atten: 3  |              | Arghiona                       |                         |           | PE M WWWWWW<br>DET P N N N N N | Select Trace           |
| 10 dB/div                    | Ref Offset<br>Ref 30.4          |          |                        |                        |               |  | Mkr1    | 1 914.853 MHz<br>12.295 dBm  | 1 *                    |                             | IB/div          | Ref Offset 1<br>Ref 31.00 | 1 dB<br>dBm |                          |            |              |                                | Mkr1                    |           | 575 GHz<br>24 dBm              | 1*                     |
| 20.4<br>10.4<br>0.400        |                                 |          |                        |                        |               |  |         | <sup>1</sup>   | Clear Write            | Log<br>21.0<br>11.0<br>1.00 | )<br>)          |                           |             |                          |            |              |                                |                         |           |                                | Clear Write            |
| -9.60<br>-19.6               |                                 |          |                        |                        |               |  |         | -17.74 dBm   | Trace Average          | -9.00<br>-19.0<br>-29.0     |                 |                           |             |                          |            |              |                                |                         |           | -17.74 dBm                     | Trace Average          |
| -39.6<br>-49.6<br>-59.6      | elennistet en beskriftetet feis |          |                        | be so do distancione a |               |  |         |  | Max Hold               | -39.0<br>-49.0<br>-59.0     |                 |                           |             | <u>/~~~</u>              |            |              |                                |                         |           |                                | Max Hold               |
| Start 30<br>#Res BV          | V 100 kHz                       | ×        | #VBI                   | N 300 kHz              | EUNCT         |  | ep 96.0 | Stop 1.0000 GHz<br>00 ms (40001 pts)   | Min Hold               | #Re                         | rt 1.00<br>s BW | 100 kHz                   | ×           | #VBV                     | / 300 kHz  |              |                                | weep 86                 | 1.3 ms (4 | 0.000 GHz<br>10001 pts)        | Min Hold               |
|                              | 1 f                             | 914.85   | 3 MHz                  | 12.295 dB              | m             |  |         | F  | View Blank<br>Trace On |                             |                 | f                         | 4.574 5     | 75 GHz                   | -39.224 di | Зm           |                                |                         |           | =                              | View Blank<br>Trace On |
| 7<br>8<br>9<br>10<br>11<br>< |                                 |          |                        |                        |               |  |         | ~  | More<br>1 of 3         | 7<br>8<br>9<br>10<br>11     |                 |                           |             |                          |            |              |                                |                         |           | ¥                              | More<br>1 of 3         |
| MSG                          |                                 |          |                        |                        |               |  | STATUS  |  |                        | MSG                         |                 |                           |             |                          |            |              |                                | STATUS                  | 6         |                                |                        |

#### 2.7 Channel Separation (Hybrid Mode)

| Test Lab: Electronics Test Centre, Airdrie | EUT: CHICKADEE            |
|--|---------------------------|
| Test Personnel: Imran Akram                | Standard: FCC Part 15.247 |

## Basic Standard: ANSI C63.10: 2013

Date: 2024-12-06 (20.0°C, 16.8% RH)

## **EUT status: Compliant**

#### Specification: FCC Part 15.247(a, 1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

#### 2.7.1 Test Guidance: ANSI 63.10 Clause 7.8.2 / 558074 D01 15.247 Measurement Guidance v05r02

This measurement is performed with the EUT transmitter frequency hopping function active.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

The spectrum analyzer is set for a frequency span wide enough to capture at least two adjacent channels. The RBW is set to at least 1% of the span. The Peak detector is used, with the trace set to Max Hold. Channel Separation is displayed with the Marker Delta function.

#### 2.7.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

#### 2.7.3 Test Equipment

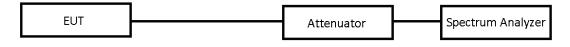
Testing was performed with the following equipment:

| Equipment                      | Manufacturer  | Model #                | Asset # | Cal. Date  | Cal. Due   |
|--------------------------------|---------------|------------------------|---------|------------|------------|
| EMI receiver                   | Agilent       | N9038A<br>(FW A.25.05) | 6130    | 2023-08-11 | 2024-08-11 |
| Temp/Humidity                  | Extech        | 42270                  | 5871    | 2024-04-08 | 2025-04-08 |
| Attenuator<br>(DC to 26 GHz)   | Mini-Circuits | BW-S10-2W263+          | 6932    | 2022-12-10 | 2025-12-10 |
| Coaxial Cables (RF)            | W.L. GORE     | PGR01R01036            | 7024    | 2024-01-09 | 2025-01-09 |
| DC Blocker<br>(9 KHz - 27 GHz) | Centric RF    | C0927 SMA              | 6987    | 2024-01-19 | 2025-01-19 |

#### 2.7.4 Test Sample Verification, Configuration & Modifications

SMA connector is soldered to the circuit board at the output of the radio to provide direct access to the radio output

#### EUT configuration for Channel Separation testing:



#### 2.7.5 Channel Separation Data:

The channel separation is **Compliant** for this device.

Channel separation measured = 200 KHz

#### Screen Captures from the spectrum analyzer:

|                        |   |                             |               |  |  |              | alyzer - Sv                |             | ectrui           | nt Spe            | Agile                      |
|------------------------|---|-----------------------------|---------------|--|--|--------------|----------------------------|-------------|------------------|-------------------|----------------------------|
| Trace/Detector         | 10:50:45 AM Dec 06, 2024<br>TRACE 1 2 3 4 5 6 | ALIGN AUTO<br>Type: Log-Pwr | IT SOURCE OFF | SENSE:   |  |              | 50 0<br>00000              | RF<br>200   | . 3 2            | kor               | <mark>X</mark><br>Mar      |
| Select Trace           | TYPE MWWWWW<br>DET P N N N N N                | lold:>100/100               |               | Trig: Free Ru<br>#Atten: 30 dE                     | NO: Wide 😱<br>Gain:Low                 |              | .00000                     | 200         | 52               | KCI               | Mai                        |
| 1                      | /lkr3 200.0 kHz<br>0.005 dB                   | ΔΝ                          |               |  |  |              | Offset 1<br>f <b>20.00</b> |             |                  | B/div             |                            |
| Clear Write            |   | 3∆4                         |               |  |  |              |                            |             |                  | r                 | Log<br>10.0                |
|                        |   |                             |               |  |  |              |                            |             |                  | I                 | -10.0                      |
| Trace Average          |   |                             |               |  |  |              |                            |             |                  | $\vdash$          | -20.0<br>-30.0<br>-40.0    |
| Max Hold               |   |                             |               |  |  |              |                            |             |                  | $\vdash$          | -40.0<br>-50.0<br>-60.0    |
|                        |   |                             |               |  |  |              |                            |             |                  |                   | -70.0                      |
| Min Hold               | Span 1.000 MHz<br>000 ms (3001 pts)           | •                           |               | 100 kHz  | #VBW                                   |              |                            | 51 k        | W 5              | s B               | #Re                        |
| View Blank<br>Trace On | FUNCTION VALUE 🛆                              | FUNCTION WIDTH              | FUNCTION      | 12.224 dBm<br>12.229 dBm<br>0.005 dB<br>12.224 dBm | 0 MHz<br>0 MHz<br>0.0 kHz (Δ)<br>0 MHz | 908.90<br>20 | (Δ)                        | f<br>f<br>f | 1<br>1<br>1<br>1 | N<br>N<br>A4<br>F | 1<br>2<br>3<br>4<br>5<br>6 |
| More<br>1 of 3         |   |                             |               |  |  |              |                            |             |                  |                   | 7<br>8<br>9<br>10<br>11    |
|                        |   | STATUS                      |               |  |  |              |                            |             |                  |                   | <<br>NSG                   |

#### 2.8 Time of Occupancy (Hybrid Mode)

Test Lab: Electronics Test Centre, Airdrie Test Personnel: Brendan Van Hee, Imran Akram EUT: CHICKADEE Standard: FCC PART 15.247 Basic Standard: ANSI C63.10: 20013

Date: 2024-12-06 (20.0°C, 16.8% RH)

## **EUT status: Compliant**

#### Specification: FCC Part 15.247 (f)

The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4

## 2.8.1 Test Guidance: ANSI 63.10 Clause 7.8.4 / 558074 D01 15.247 Measurement Guidance v05r02

This measurement is performed with the EUT frequency hopping function active.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

The spectrum analyzer is set for Peak detection over a 0 Hz frequency span (time domain) centered on a hopping channel. The RBW shall be  $\leq$  Channel spacing and where possible RBW should be set >> 1/T, where T is the expected dwell time per channel. VBW  $\geq$  RBW. The sweep time is adjusted to clearly capture one transmission. The Dwell time is measured with the Marker Delta function.

Another sweep is set to capture enough transmission events to calculate the number of events within the specified period of time. The Peak detector is used, with the trace set to Max Hold.

#### 2.8.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

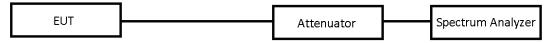
#### 2.8.3 Test Equipment

Equipment Manufacturer Model # Asset # Cal. Date Cal. Due N9038A EMI receiver Agilent 6130 2023-08-11 2024-08-11 (FW A.25.05) Temp/Humidity Extech 42270 5871 2024-04-08 2025-04-08 Attenuator Mini-Circuits BW-S10-2W263+ 6932 2022-12-10 2025-12-10 (DC to 26 GHz) Coaxial Cables (RF) W.L. GORE PGR01R01036 7024 2024-01-09 2025-01-09 DC Blocker Centric RF C0927 SMA 6987 2024-01-19 2025-01-19 (9 KHz - 27 GHz)

Testing was performed with the following equipment:

#### 2.8.4 Test Sample Verification, Configuration & Modifications

The EUT was operating in normal mode. The EUT met the requirements without modification. **EUT configuration for Dwell Time testing:** 



#### 2.8.5 Dwell Time Data:

| Measured Dwell time | Limit   |
|---------------------|---------|
| 375.5 ms            | ≤ 400ms |

Window of measurement is equal to number of hopping channels multiple by 400ms =

**0.4 x 64** = 25.6 Sec

Number of events in 25.6 Sec = 1 = 375.5ms

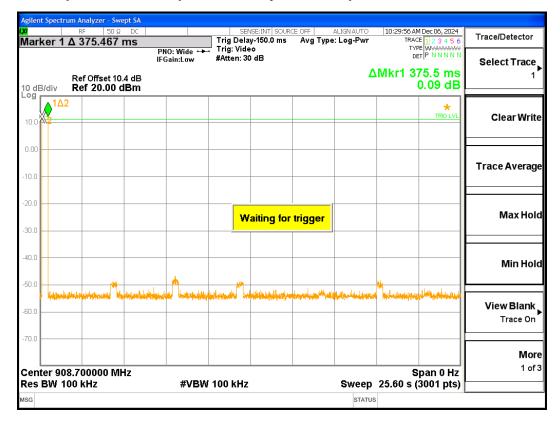
Measure numbers OF Channels= 64

|                               | :06,2024                    | :31 AM De    | 10:06        | AUTO                                   | AL IO  | E OFF   | NT SOUR        | ENSE:1 | SE                   |                  |                    |      |              | <mark>/zer - Swe</mark><br>50 Ω | RF                 |         | XI           |
|-------------------------------|-----------------------------|--------------|--------------|--|--------|---------|----------------|--------|----------------------|------------------|--------------------|------|--------------|---------------------------------|--------------------|---------|--------------|
| Trace/Detector                | TRACE 1 2 3 4 5 6<br>TYPE M |              | g-Pwr        | Avg Type: Log-Pwr<br>Avg Hold:>100/100 |        |         | Trig: Free Run |        |                      | 12.795000000 MHz |                    |      | ker 1        | Mar                             |                    |         |              |
| Select Trace                  | NNNNN                       | DET          |              |  | Id:>10 | AvgiHo  |                |        | rig: Fre<br>Atten: 3 |                  | 0: Fast<br>ain:Low |      |              |                                 |                    |         |              |
| 1                             | MHz<br>53 dB                |              | kr1 1        |  |        |         |                |        |                      |                  |                    |      |              | ffset 10.<br>2 <b>0.00</b> d    |                    | /div    | 10 dE        |
| Clear Wri                     | 1∆2 -                       | <u>trati</u> | <b>YTT</b> Y | ηm                                     | pqq    | ad that | <del>htu</del> | ryy    | <del>111</del>       | qq               | τr                 | nnpr | <u>a tta</u> | <u>ulti</u>                     | X <mark>e</mark> n |         | 10.0         |
| Trace Averag                  |                             |              |              |  |        |         |                |        |                      |                  |                    |      |              |                                 |                    |         | 0.00         |
| Max Ho                        |                             |              |              |  |        |         |                |        |                      |                  |                    |      |              |                                 |                    |         | 20.0<br>30.0 |
| Min Ho                        | 1                           |              |              |  |        |         |                |        |                      |                  |                    |      |              |                                 |                    |         | 40.0<br>50.0 |
| <b>View Blank</b><br>Trace Or | - ohulu                     |              |              |  |        |         |                |        |                      |                  |                    |      |              |                                 |                    | by when | 60.0         |
| <b>Mo</b><br>1 of             | 0 MHz                       | 916.00       | Stop         |  |        |         |                |        |                      | <u> </u>         |                    |      |              |                                 |                    | 901.    |              |
|                               | 01 pts)                     | ns (10       |              | status                                 | 5%     |         |                |        | ) kHz                | v 91             | VB                 |      |              | ۷                               |                    | BW      | Res          |

| RF 50 Ω DC RF   | · · · · · ·                  | FF ALIGNAUTO                                      | 10:20:51 AM Dec 06, 2024<br>TRACE 1 2 3 4 5 6<br>TYPE WWWWWWW | Trace/Detector                |
|---|------------------------------|---|---|-------------------------------|
| PNO: Fast ←<br>IFGain:Low<br>B/div Ref 20.00 dBm  | Trig: Video<br>#Atten: 30 dB | ΔN  | 1kr1 370.8 ms<br>0.13 dB                                      | Select Trace                  |
|   | -                            | والمعاصر المستعار والمساحر المراحد المعام والعرام | 1Δ2 *<br>TRIG LVL   | Clear Wri                     |
|   |                              |   |   | Trace Avera                   |
|   |                              |   |   | Max Ho                        |
| Lander wilfelden versteren er ander son er<br>Beste son er ander son er a |                              |   | ulajaka je stranovno stanjem                                  | Min Ho                        |
|   |                              |   |   | <b>View Blani</b><br>Trace Or |
| nter 908.700000 MHz<br>s BW 1.0 MHz #VB   | ₩ 4.0 MHz                    | Sweep 600   | Span 0 Hz<br>).0 ms (3001 pts)                                | <b>M</b> a<br>1 o             |

#### Screen Capture from the spectrum analyzer: sweep Time in 600 msec

#### Screen Capture from the spectrum analyzer: sweep Time in 25.6 Sec



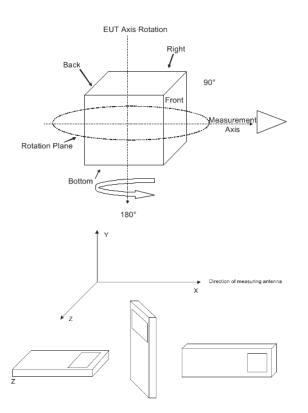
#### 2.9 EUT Positioning Assessment

| Test Lab: Electronics Test Centre, Airdrie | EUT: CHICKADEE                  |
|--|---------------------------------|
| Test Personnel: Brendan Van Hee, Imran     | Standard: FCC PART 15.247       |
|  | Basic Standard: ANSI C63.4-2014 |
| Date: 2024-12-04 (20.1°C, 15.7% RH)        |                                 |

**Comments**: LoRa (125 KHz Mode): Y-Axis is worse axis.

#### Specification: ANSI C63.4-2014, Clause 6.3.2.1

Portable, small, lightweight, or modular devices that may be handheld, worn on the body, or placed on a table during operation shall be positioned on a non-conducting platform, the top of which is 80 cm above the reference ground plane. The preferred area occupied by the EUT arrangement is 1 m by 1.5 m, but it may be larger or smaller to accommodate various sized EUTs (see Figure 6, Figure 7, and Figure 9). For testing purposes, ceiling- and wall-mounted devices also shall be positioned on a tabletop (see also 6.3.4 and 6.3.5). In making any tests involving handheld, body-worn, or ceiling-mounted equipment, it is essential to recognize that the measured levels may be dependent on the orientation (attitude) of the three orthogonal axes of the EUT. Thus, exploratory tests as specified in 8.3.1 shall be carried out for various axes orientations to determine the attitude having maximum or near-maximum emission level.



#### 2.10 Radiated Spurious Emissions within restricted band

Test Lab: Electronics Test Centre, Airdrie

Test Personnel: Brendan Van Hee

Date: 2024-12-(4-6) (20.0°C, 16.7% RH)

Standard: FCC PART 15.247/15.209

**EUT: CHICKADEE** 

Basic Standard: ANSI C63.10-2013

## EUT status: Compliant

#### Specification: FCC PART 15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

| MHz                      | MHz  | MHz  | MHz   | GHz  | GHz   |
|--------------------------|--|--|---|--|---|
| 8.2910000 -              | 16.804250 -  | 162.01250 -  | 1660.0000 -   | 3.6000000 -  | 14.470000 -   |
| 8.2940000                | 16.804750  | 167.17000  | 1710.0000   | 4.4000000  | 14.500000   |
| 8.3620000 -              | 25.500000 -  | 167.72000 -  | 1718.8000 –   | 4.5000000 –  | 15.350000 –   |
| 8.3660000                | 25.670000  | 173.20000  | 1722.2000   | 5.1500000  | 16.200000   |
| 8.3762500 -              | 37.500000 -  | 240.00000 –  | 2200.0000 -   | 5.3500000 –  | 17.700000 -   |
| 8.3867500                | 38.250000  | 285.00000  | 2300.0000   | 5.4600000  | 21.400000   |
| 8.4142500 -              | 73.000000 -  | 322.00000 -  | 2310.0000 –   | 7.2500000 –  | 22.010000 -   |
| 8.4147500                | 74.600000  | 335.40000  | 2390.0000   | 7.7500000  | 23.120000   |
| 12.290000 -              | 74.800000 -  | 399.90000 -  | 2483.5000 -   | 8.0250000 -  | 23.600000 -   |
| 12.293000                | 75.200000  | 410.00000  | 2500.0000   | 8.5000000  | 24.000000   |
| 12.519750 -              | 108.00000 -  | 608.00000 –  | 2655.0000 -   | 9.0000000 -  | 31.200000 -   |
| 12.520250                | 121.94000 **   | 614.00000  | 2900.0000   | 9.2000000  | 31.800000   |
| 12.576750 -              | 123.00000 -  | 960.00000 –  | 32600000 -  | 9.3000000 -  | 36.430000 -   |
| 12.577250                | 138.00000 <mark>**</mark>  | 1240.0000 ***  | 3267.0000   | 9.5000000  | 36.500000   |
| 13.360000 -              | 149.90000 -  | 1300.0000 –  | 3332.0000 –   | 10.600000 –  | Above   |
| 13.410000                | 150.05000  | 1427.0000 <mark>***</mark>   | 3339.0000   | 12.700000  | 38.600000   |
| 16.420000 -              | 156.52475-   | 1435.0000 –  | 3345.8000 –   | 13.250000 –  |   |
| 16.423000                | 156.52525  | 1626.5000  | 3358.0000   | 13.400000  |   |
| 16.694750 -<br>16.695250 | 156.70000 -<br>156.90000   | 1645.5000 –<br>1646.5000   | 3500.0000 –<br>3600.0000  |  |   |
|                          | 8.2910000 -<br>8.2940000<br>8.3660000<br>8.3660000<br>8.3762500 -<br>8.3867500<br>8.4142500 -<br>8.4147500<br>12.290000 -<br>12.293000<br>12.519750 -<br>12.520250<br>12.577250<br>13.360000 -<br>13.410000<br>16.420000 -<br>16.423000<br>16.694750 - | 8.2910000 -<br>8.2940000         16.804250 -<br>16.804750           8.3620000 -<br>8.3660000         25.500000 -<br>25.670000           8.3762500 -<br>8.3867500         37.500000 -<br>38.250000           8.4142500 -<br>8.4147500         73.000000 -<br>74.600000           12.290000 -<br>12.293000         74.800000 -<br>75.200000           12.519750 -<br>12.570750 -<br>12.577250         108.00000 -<br>123.00000 -<br>12.577250           13.360000 -<br>13.410000         149.90000 -<br>150.05000           16.420000 -<br>156.52475-<br>16.423000         156.52475-<br>156.52525           16.694750 -         156.70000 - | 8.2910000 -         16.804250 -         162.01250 -           8.2940000         16.804750         167.17000           8.3620000 -         25.500000 -         167.72000 -           8.3660000         25.670000         167.72000 -           8.3660000         25.670000 -         173.20000           8.3762500 -         37.500000 -         240.00000 -           8.3867500         38.250000         322.00000 -           8.4142500 -         73.000000 -         322.00000 -           8.4147500         74.600000 -         399.90000 -           12.290000 -         74.800000 -         399.90000 -           12.519750 -         108.00000 -         608.00000 -           12.570750 -         123.00000 -         1240.0000 ***           13.360000 -         149.90000 -         1300.0000 -           13.360000 -         149.90000 -         1427.0000 ***           16.420000 -         156.52475 -         1435.0000 -           16.423000         156.52475 -         1426.5000           16.694750 -         156.70000 -         1645.5000 - | 8.2910000         16.804250         162.01250         1660.0000           8.2940000         16.804750         167.17000         17110.0000           8.3620000         25.500000         167.72000         1718.8000           8.3660000         25.670000         167.72000         1722.2000           8.3762500         37.500000         240.00000         2200.0000           8.3762500         37.500000         22200.000         2300.0000           8.4142500         73.000000         322.00000         2310.0000           8.4147500         74.600000         399.90000         2483.5000           12.290000         74.800000         399.90000         2483.5000           12.519750         108.00000         608.00000         2900.0000           12.519750         123.00000         3260.0000         2900.0000           12.576750         123.00000         332.0000         33267.0000           13.360000         149.90000         1300.0000         3332.0000           13.360000         156.52475         1435.0000         3345.8000           16.422000         156.52475         1435.0000         3358.0000           16.694750         156.70000         1645.5000         3500.0000 | 8.291000 - $16.804250  162.01250  1660.0000  3.600000  8.3620000  25.500000  167.72000  1718.8000  4.4000000$ $8.3660000$ $25.670000  167.72000  1718.8000  4.5000000  8.3660000$ $25.670000  12722.2000  5.1500000  5.1500000  8.3762500  37.500000  240.00000  2200.0000  5.3500000  8.3867500$ $37.500000  240.0000  2200.0000  5.4600000  8.3867500$ $37.500000  240.0000  2200.0000  5.3500000  8.4142500  73.000000  322.00000  2310.0000  7.2500000  8.4147500$ $74.800000  399.9000  2483.5000  8.0250000  12.290000  74.800000  399.9000  2483.5000  8.0250000  12.59757  108.00000  608.00000  2655.0000  9.000000  12.576750  123.00000  1300.0000  33260.0000  3$ |

#### **Restricted Bands of Operation:**

#### 2.10.1 Test Guidance: ANSI C63.10-2013, Clause 13.4.2

From 9 kHz to 150 kHz (resolution bandwidth of 200 Hz) and from 150 kHz to 30 MHz (resolution bandwidth 9 kHz) measurements are performed with a loop antenna (as per KDB 460108).

From 30 MHz to 1000 MHz, measurements are performed with a broadband biconilog antenna and a resolution bandwidth of 120 kHz.

Above 1000 MHz, measurements are performed with a DRG Horn antenna or a Standard Gain horn, and a resolution bandwidth of 1 MHz The EUT is raised to 150 cm above the ground plane, and the area between the EUT and the antenna mast is covered with RF absorbent material.

The scan is performed at discreet increments of turntable azimuth and antenna height, which are selected in accordance with the applicable standard in order to assure capture of frequencies of interest. Optimization is performed based on the scan data.

Frequencies having peak emissions within 10dB of the limits are optimized. The EUT is rotated in azimuth over 360 degrees and the direction of maximum emission is noted.

Antenna height is varied from 1 - 4 meters at this azimuth to obtain the maximum emission. Then the maximum level is measured with the appropriate detector and recorded. Up to 1 GHz, measurements are performed with a Quasi-Peak detector. Above 1 GHz, measurements are recorded with Peak and/or Average detectors, as applicable.

#### 2.10.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

#### 2.10.3 Test Equipment

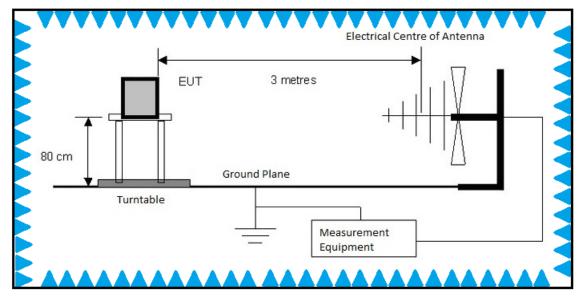
Testing was performed with the following equipment:

| Equipment                            | Manufacturer           | Model #                         | Asset #        | Cal. Date<br>(yyyy-mm-dd) | Cal. Due<br>(yyyy-mm-dd) |
|--------------------------------------|------------------------|---------------------------------|----------------|---------------------------|--------------------------|
| EMC Software                         | UL                     | Ver. 9.5                        | ETC-SW-EMC 2.1 | N                         | /A                       |
| EMI receiver                         | Agilent                | N9038A<br>(FW A.25.05)          | 6130           | 2023-08-11                | 2024-08-11               |
| Loop Antenna<br>(9KHz – 30MHz)       | EMCO                   | 6502                            | 10868          | 2023-06-21                | 2025-06-21               |
| Biconilog Antenna<br>(30 – 1000 MHz) | AR                     | JB1                             | 6905           | 2023-11-29                | 2025-11-29               |
| DRG Horn<br>(1000 – 18000 MHz)       | EMCO                   | 3115                            | 19357          | 2022-10-05                | 2024-10-05               |
| Humidity/Temp<br>Logger              | Extech Ins.<br>Corp.   | 42270                           | 5892           | 2023-04-14                | 2024-04-14               |
| Pre-Amplifier<br>(30 – 1400 MHz)     | HP                     | 8447D                           | 9291           | 2024-01-21                | 2025-01-23               |
| Low Noise Amplifier<br>(1 – 18 GHz)  | MITEQ                  | JS43-01001800-21-<br>5P         | 4354           | 2024-01-21                | 2025-01-23               |
| RE Cable below<br>1GHz               | Insulated Wire<br>Inc. | KPS-1501A-3600-<br>KPA-01102006 | 4419           | 2024-01-21                | 2025-01-23               |
| Re Cable Above 1<br>GHz              | A.H. System<br>Inc.    | SAC-26G-8.23                    | 6187           | 2024-01-21                | 2025-01-23               |
| 0.9GHz Notch Filter                  | Microtronics           | BRM20784                        | 6947           | 2024-01-21                | 2025-01-23               |

#### 2.10.4 Test Sample Verification, Configuration & Modifications

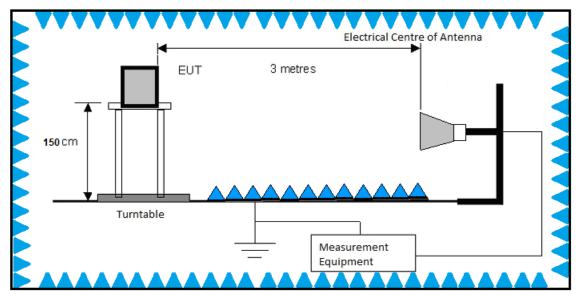
The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation. LoRa radio is transmitting at mid channel in ingle carrier configuration and high channel in dual carrier configurations.

The EUT met the requirements without modification. Power cable is soldered to the battery terminal to connect the DC power supply during radiated emission.



Test setup diagram for Radiated Spurious Emissions testing (below 1GHz):

Test setup diagram for Radiated Spurious Emissions testing (above 1GHz):



## 2.10.5 Radiated Emissions Data: Hybrid (125 KHz)

The emissions data are presented in tabular form, showing turntable azimuth, antenna height and polarization, the uncorrected spectrum analyzer reading, the correction factors applied, the net result, the value of the limit at the frequency investigated, and the Delta between the result and the limit.

#### Meter Reading in $dB_{\mu}V$ + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in $db_{\mu}V/m$ . Delta = Field Strength – Limit

Notes:

- When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss. Measurements reported are the result of adjusting the turntable azimuth and antenna height to obtain the maximum EUT emission. This may produce a different reading than the plot trace. The plot is a Peak Hold function obtained at discreet increments of height and azimuth, while the reported measurement is obtained with the appropriate Quasi Peak or Average detector after the height and azimuth have been adjusted for maximum emission. Preliminary scans were performed for all channels in Transmit modes. The Low band channel 902.3 MHz was selected as the worst-case condition for detailed examination. In Transmit mode, the EUT was assessed up to 10.0 GHz.

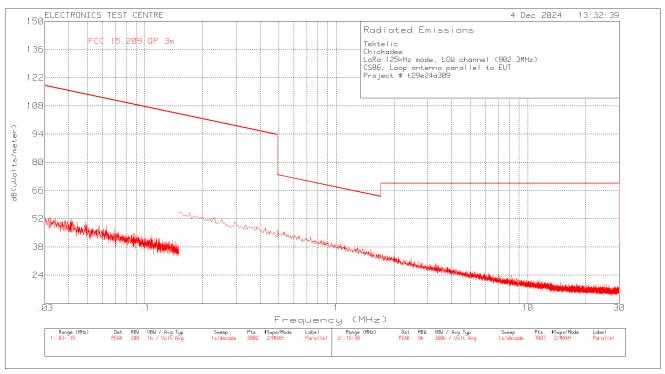
| Freq.<br>Marker | Freq.<br>[GHz] | Raw<br>reading<br>[dBµv] | Det | Antenna<br>Factor<br>[dB/m] | Pre amp<br>Gain [dB] | Corrected<br>Reading<br>[dBµv/m] | FCC 15.209<br>Limit<br>[dBµv/m] | Delta<br>[dB] | Azimuth<br>[Deg] | Height<br>[cm] | Polarization |
|-----------------|----------------|--------------------------|-----|-----------------------------|----------------------|----------------------------------|---------------------------------|---------------|------------------|----------------|--------------|
| 1               | 6.32           | 38.37                    | PK  | 34.4                        | -28.5                | 44.27                            | 74                              | -29.73        | 322              | 396            | Horizontal   |
|                 |                | 28.86                    | AV  |                             |                      | 34.76                            | 54                              | -19.24        |                  |                | Horizontal   |
| 2               | 6.32           | 42.19                    | PK  | 34.4                        | -28.5                | 48.09                            | 74                              | -25.91        | 104              | 395            | Vertical     |
| 2               |                | 34.42                    | AV  |                             |                      | 40.32                            | 54                              | -13.68        |                  |                | Vertical     |

### Negative values for Delta indicate compliance.

PK: Peak Detector

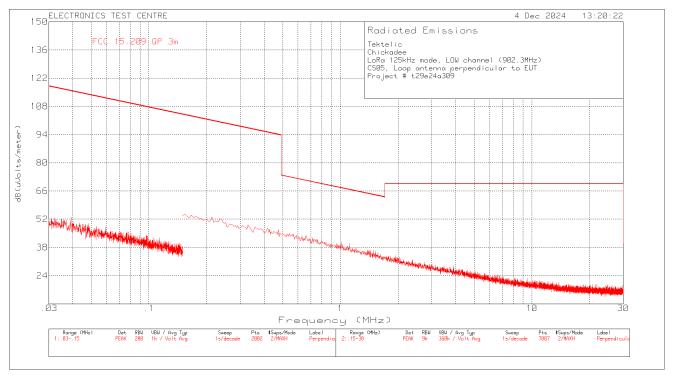
AV: Average Detector.

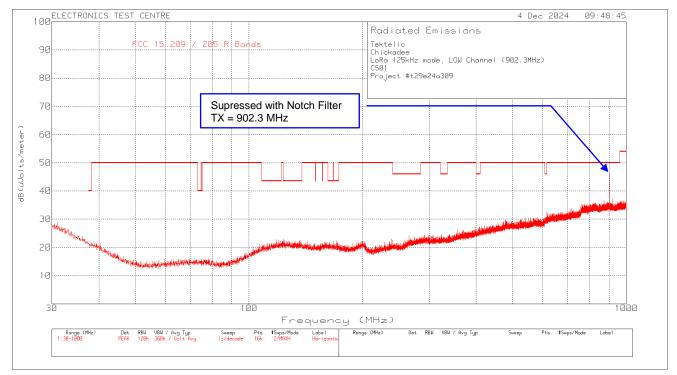
\* Spurious Emission in Restricted Band

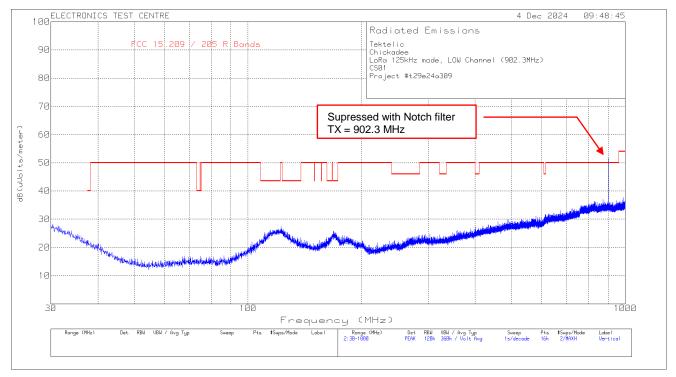


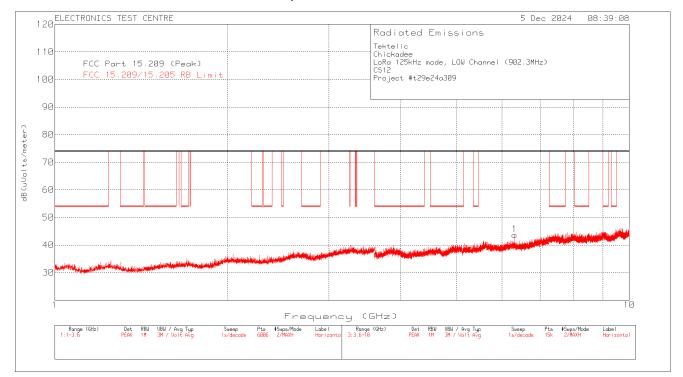
## Plot of Radiated Emissions: Parallel

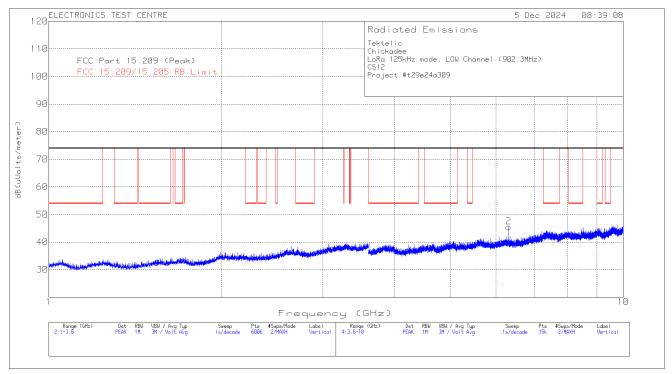
## Plot of Radiated Emissions: Perpendicular











## 2.11 Radiated Emissions (RX Mode)

Test Lab: Electronics Test Centre, Airdrie

Test Personnel: Brendan Van Hee

Date: 2024-12-04 (20.1°C, 15.7% RH)

EUT: CHICKADEE Standard: FCC Part 15.109 Basic Standard: ANSI C63.4: 2014 Class: B

## **EUT status: Compliant**

| Class B Limit (3m) |
|--------------------|
| 40 (dBµV/m)        |
| 43.52 (dBµV/m)     |
| 46.02 (dBµV/m)     |
| 53.98 (dBµV/m)     |
|                    |

**Criteria:** The radiated emissions produced by a device, measured at a distance of 3 meters, shall not exceed the limits as specified.

## 2.11.1 Test Guidance:

From 30 MHz to 1000 MHz, measurements are performed with a broadband biconilog antenna and a resolution bandwidth of 120 kHz.

Above 1000 MHz, measurements are performed with a DRG Horn antenna or a Standard Gain horn, and a resolution bandwidth of 1 MHz.

The scan is performed at discreet increments of turntable azimuth and stepped antenna height, with peak detector and Max Hold function which are selected in accordance with the applicable standard in order to assure capture of frequencies of interest. Optimization is performed based on the scan data.

After the pre-scan is completed, the frequencies of interest are optimized. The EUT is rotated in azimuth over 360 degrees and the direction of maximum emission is noted.

Antenna height is varied from 1 - 4 meters at this azimuth to obtain the maximum emission. Then the maximum level is measured with the appropriate detector and recorded. This may produce a different reading than the pre scan trace. Up to 1 GHz, measurements are performed with a Quasi-Peak detector. Above 1 GHz, measurements are recorded with Peak and/or Average detectors, as applicable.

## 2.11.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

## 2.11.3 Test Equipment

Testing was performed with the following equipment:

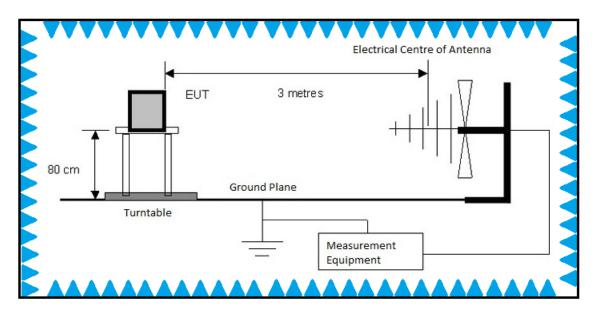
| Equipment                            | Manufacturer         | Model #                         | Asset #        | Cal. Date<br>(yyyy-mm-dd) | Cal. Due<br>(yyyy-mm-dd) |
|--------------------------------------|----------------------|---------------------------------|----------------|---------------------------|--------------------------|
| EMC Software                         | UL                   | Ver. 9.5                        | ETC-SW-EMC 2.1 | N                         | /A                       |
| EMI receiver                         | Agilent              | N9038A<br>(FW A.25.05)          | 6130           | 2023-08-11                | 2024-08-11               |
| Biconilog Antenna<br>(30 – 1000 MHz) | AR                   | JB1                             | 6905           | 2023-11-29                | 2025-11-29               |
| DRG Horn<br>(1000 – 18000 MHz)       | EMCO                 | 3115                            | 19357          | 2022-10-05                | 2024-10-05               |
| Humidity/Temp<br>Logger              | Extech Ins.<br>Corp. | 42270                           | 5892           | 2023-04-14                | 2024-04-14               |
| Pre-Amplifier<br>(30 – 1400 MHz)     | HP                   | 8447D                           | 9291           | 2024-01-23                | 2025-01-23               |
| Low Noise Amplifier<br>(1 – 18 GHz)  | MITEQ                | JS43-01001800-21-<br>5P         | 4354           | 2024-01-23                | 2025-01-23               |
| RE Cable below<br>1GHz               | Insulated Wire Inc.  | KPS-1501A-3600-<br>KPA-01102006 | 4419           | 2024-01-23                | 2025-01-23               |
| Re Cable Above 1<br>GHz              | A.H. System<br>Inc.  | SAC-26G-8.23                    | 6187           | 2024-01-23                | 2025-01-23               |

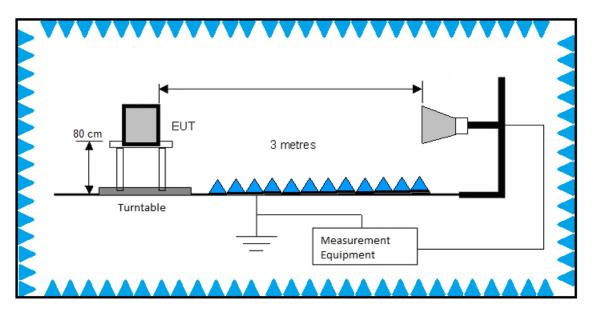
## 2.11.4 Test Sample Verification, Configuration & Modifications

To cover the unintentional radiated emission. The EUT was configured in receive mode. Unit was placed at the center of turntable in semi-anechoic chamber 80cm above the ground plane and at a distance of 3m from the test receive antenna.

The EUT met the requirements without modification.

### EUT RX configuration Block Diagram for Radiated Emissions testing:



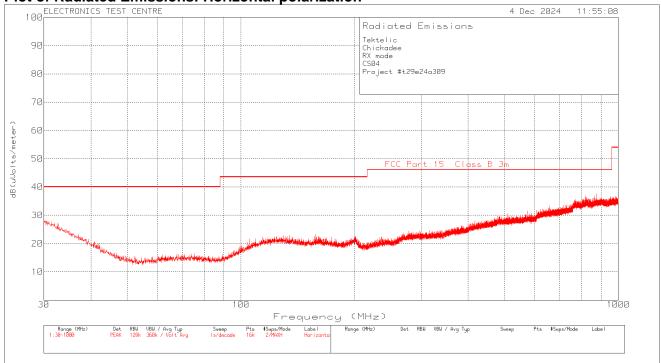


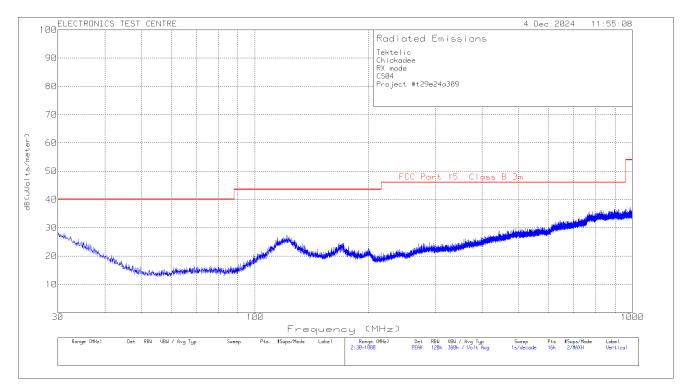
2.11.5 Radiated Emissions Data maximization:

No Emission observed within 10 dB from the specified limit

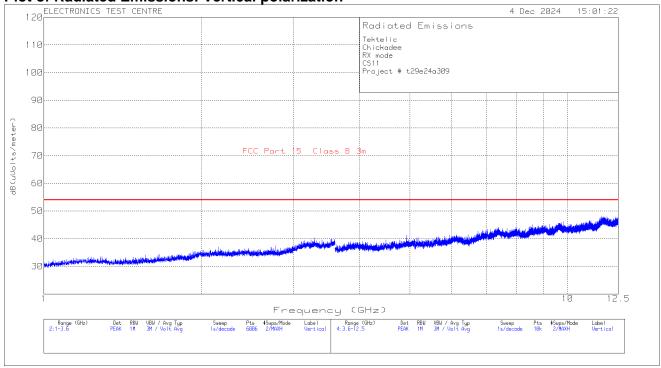
Meter Reading in dB<sub>µ</sub>V + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in db<sub>µ</sub>V/m.

- In receive mode, the EUT was assessed up to 12.5 GHz.









## 2.12 RF Exposure

Test Lab: Electronics Test Centre, Airdrie

Test Personnel:

EUT: CHICKADEE Standard: FCC PART 15.247

Date:

EUT status: Exempt from SAR evaluation

**Compliant:** RF exposure assessment to be provided in a separate Exhibit.

## 3.0 TEST FACILITY

### 3.1 Location

The CHICKADEE was tested at the Electronics Test Centre laboratory located in Airdrie, Alberta, Canada. The Radio Frequency Anechoic Chamber (RFAC), identified as Chamber 1, has a usable working space measuring 10.6 m long x 7.3 m wide x 6.5 m high.

Measurements taken at this site are accepted by Industry Canada as evidence of conformity per registration file # 2046A. This site is also listed with the FCC under Registration Number CA2046.

The floor, walls and ceiling consist of annealed steel panels. The walls and ceiling are covered with ferrite tile, augmented by RF absorbant foam material on the end wall nearest the turntable, and on the adjacent walls and the ceiling. The chamber floor supports a 15 cm high internal floor, constructed of annealed steel panels, that forms the ground plane, and is bonded to the chamber walls.

The 3-m diameter turntable is flush-mounted with the floor. A sub-floor cable-way is provided to route cables between the turntable pit and EUT support equipment located in the Control Room. Cables reach the EUT through an opening in the centre of the turntable.

Test instrumentation and EUT support equipment is located in the Control Room, consisting of two shielded vestibules joined together at the side of the main room. Cables are routed through bulkhead panels between the rooms and the test chamber as required. Power feeds are routed into the main room and vestibules through line filters providing at least 100 dB of attenuation between 10 kHz and 10 GHz.

Either floor mounted or table-top equipment can be tested at this facility.

### 3.2 Grounding Plan

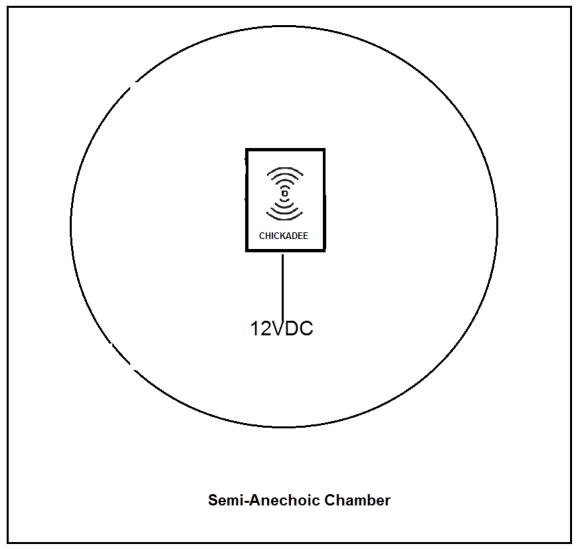
The CHICKADEE was placed at the center of the test chamber turntable on top of an 80-cm high polystyrene foam table below 1GHz and at 1.5m high polystyrene foam table above 1 GHz for transmits mode and 80cm high for RX mode. Ground connection is provided as per customer specification. There is no external grounding.

### 3.3 Power Supply

For radiated emission and antenna power was supplied via AC/DC adaptor.

## Appendix A – Test Setup Block Diagram





# **End of Document**