



# Test report

REP0019265-1R1TRFEMC

Date of issue: July 26, 2023

Applicant:

JTECH An HME Company

Product Description:

Radio Base Station / Hub

Model:

LWHUB (Ninja Base)

PMN(s):

LWTX00100, LWTX00200

FCC ID:

WDC-JLWHUB

ISED Certification Number:

7752A-JLWHUB

Specifications:

- ◆ FCC 47 CFR § 15.225 - Operation within the band 13.110-14.010 MHz
- ◆ RSS-210 — Licence-Exempt Radio Apparatus: Category I Equipment, Issue 10 (December 2019), Annex B.6

#### Lab and test locations

|                    |                                                                                   |
|--------------------|-----------------------------------------------------------------------------------|
| Company name       | Nemko USA Inc.                                                                    |
| Address            | 2210 Faraday Ave, Suite 150                                                       |
| City               | Carlsbad                                                                          |
| State              | California                                                                        |
| Postal code        | 92008                                                                             |
| Country            | USA                                                                               |
| Telephone          | +1 760 444 3500                                                                   |
| Website            | www.nemko.com                                                                     |
| FCC Site Number    | Test Firm Registration Number: 392943; Designation Number: US5058                 |
| ISED Test Site     | 2040B-3                                                                           |
| Tested by          | Martha Espinoza, Wireless Test Engineer                                           |
| Reviewed by        | James Cunningham, EMC/WL Manager                                                  |
| Review date        | July 26, 2023                                                                     |
| Reviewer signature |  |

#### Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko USA's ISO/IEC 17025 accreditation.

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## Section 1 Report summary

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### 1.1 Test specifications

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FCC 47 CFR § 15.225  
RSS-210 Issue 10 (December 2019)

Operation within the band 13.110-14.010 MHz  
Licence-Exempt Radio Apparatus: Category I Equipment, Annex B.6

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### 1.2 Test methods

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ANSI C63.10: 2013

American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

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### 1.3 Exclusions

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None.

### 1.4 Statement of compliance

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Testing was performed against all relevant requirements of the test standard(s).

Results obtained indicate that the product under test complies in full with the tested requirements.

The test results relate only to the item(s) tested.

See "Section 2 Summary of test results" for full details.

### 1.5 Test report revision history

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**Table 1.5-1:** Test report revision history

| Revision #           | Details of changes made to test report                                                         |
|----------------------|------------------------------------------------------------------------------------------------|
| REP0019265-1TRFEMC   | Original report issued                                                                         |
| REP0019265-1R1TRFEMC | Information from front page updated; page 6 was updated; Figure 8.4-5 and Table 8.4-8 updated. |

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## Section 2 Summary of test results

### 2.1 Sample information

|                        |            |
|------------------------|------------|
| Receipt date           | 28-Nov-22  |
| Nemko sample ID number | REP0019265 |

### 2.2 Testing period

|                 |           |
|-----------------|-----------|
| Test start date | 13-Jan-23 |
| Test end date   | 18-Jan-23 |

### 2.3 Test results

**Table 2.3-1: Summary of results**

| FCC Clause | IC Clause   | Test description                                                             | Verdict                     |
|------------|-------------|------------------------------------------------------------------------------|-----------------------------|
| §15.207(a) | RSS-Gen 8.8 | Conducted limits                                                             | Pass <sup>1</sup>           |
| §15.31(e)  |             | Variation of power source                                                    | Pass                        |
| §15.203    |             | Antenna requirement                                                          | Pass <sup>2</sup>           |
| §15.215(c) | RSS-Gen 6.6 | 20 dB bandwidth                                                              | Pass                        |
|            |             | Occupied bandwidth                                                           | Pass                        |
|            |             | RSS-Gen 7.3 Receiver radiated emission limits                                | Not applicable <sup>3</sup> |
|            | RSS-Gen 7.4 | Receiver conducted emission limits                                           | Not applicable <sup>3</sup> |
| §15.225(a) | B.6(a)(i)   | Field strength within 13.553–13.567 MHz band                                 | Pass                        |
| §15.225(b) | B.6(a)(ii)  | The field strength within the bands 13.410–13.553 MHz and 13.567–13.710 MHz  | Pass                        |
| §15.225(c) | B.6(a)(iii) | The field strength within the bands 13.110–13.410 MHz and 13.710–14.010 MHz. | Pass                        |
| §15.225(d) | B.6(a)(iv)  | The field strength outside the band 13.110–14.010 MHz.                       | Pass                        |
| §15.225(e) | B6(b)       | Frequency tolerance of carrier signals                                       | Pass                        |

Note 1: The EUT is AC powered

Note 2: The antenna is integral to the EUT and cannot be removed

Note 3: According to sections 5.2 and 5.3 of RSS-Gen, the EUT does not have a stand-alone receiver nor is it a scanning receiver and is therefore exempt from receiver requirements.

## Section 3 Equipment under test (EUT) details

### 3.1 Disclaimer

This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

### 3.2 Applicant

|                 |                                    |
|-----------------|------------------------------------|
| Company name    | JTECH An HME Company               |
| Address         | 1400 Northbrook Parkway, Suite 320 |
| City            | Suwanee                            |
| State           | Georgia                            |
| Postal/Zip code | 30024                              |
| Country         | USA                                |

### 3.3 Manufacturer

|                 |                                    |
|-----------------|------------------------------------|
| Company name    | JTECH An HME Company               |
| Address         | 1400 Northbrook Parkway, Suite 320 |
| City            | Suwanee                            |
| State           | Georgia                            |
| Postal/Zip code | 30024                              |
| Country         | USA                                |

### 3.4 EUT information

|                                 |                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product name                    | Radio Base Station / Hub                                                                                                                                                                                                            |
| Model                           | LWHUB (Ninja Base)                                                                                                                                                                                                                  |
| Serial number                   | N/A                                                                                                                                                                                                                                 |
| Part number                     | N/A                                                                                                                                                                                                                                 |
| Variants                        | LWTX0010, LWTX00200<br><br>LWTX00100 and LWTX00200 are electrically identical except the latter contains an approved POCSAG module. All testing was performed on an LWTX00200 variant and is representative of both model variants. |
| Frequency band(s)               | 13.110 – 14.010 MHz                                                                                                                                                                                                                 |
| Fundamental frequency           | 13.56                                                                                                                                                                                                                               |
| Power requirements              | 100-240 VAC, 50-60 Hz                                                                                                                                                                                                               |
| Description/theory of operation | NFC                                                                                                                                                                                                                                 |
| Antenna information             | Integrated antenna                                                                                                                                                                                                                  |
| Software details                | N/A                                                                                                                                                                                                                                 |

### 3.5 EUT exercise and monitoring details

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**EUT description of the methods used to exercise the EUT and all relevant ports:**

- The EUT was exercised with the 13.56 MHz transmitter operating at maximum power.

**EUT setup/configuration rationale:**

- The EUT setup in a configuration that was expected to produce the highest amplitude emissions relative to the limit and that satisfy normal operation/installation practice by the end user.
- The type and construction of cables used in the measurement set-up were consistent with normal or typical use. Cables with mitigation features (for example, screening, tighter/more twists per length, ferrite beads) have been noted below:
  - None
- The EUT was setup in a manner that was consistent with its typical arrangement and use. The measurement arrangement of the EUT, local ancillary equipment and associated cabling was representative of normal practice. Any deviations from typical arrangements have been noted below:
  - None

### 3.6 EUT setup details

**Table 3.6-1: EUT sub assemblies**

| Description | Brand name | Model/Part number | Serial number | Rev. |
|-------------|------------|-------------------|---------------|------|
| N/A         |            |                   |               |      |

**Table 3.6-2: EUT interface ports**

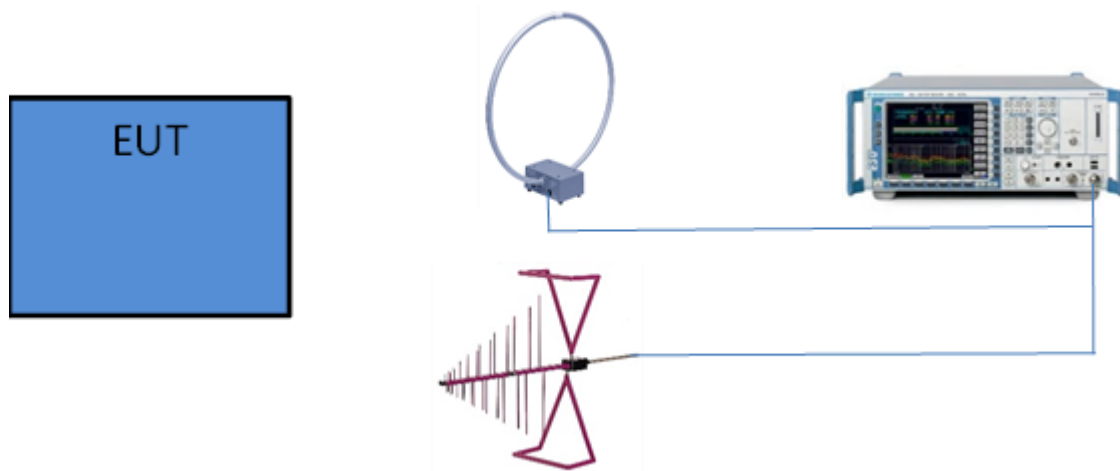
| Description | Qty. |
|-------------|------|
| None        |      |

**Table 3.6-3: Support equipment**

| Description   | Brand name | Model/Part number | Serial number | Rev. |
|---------------|------------|-------------------|---------------|------|
| AC/DC adapter |            |                   |               |      |

**Table 3.6-4: Inter-connection cables**

| Cable description | From | To | Length (m) |
|-------------------|------|----|------------|
| None              |      |    |            |



**Figure 3.6-1: Test setup diagram**

## Section 4 Engineering considerations

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### 4.1 Modifications incorporated in the EUT

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None.

### 4.2 Technical judgement

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None.

### 4.3 Deviations from laboratory test procedures

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None.

## Section 5 Test conditions

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### 5.1 Atmospheric conditions

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|                   |            |
|-------------------|------------|
| Temperature       | 15–30 °C   |
| Relative humidity | 20–75 %    |
| Air pressure      | 86–106 kPa |

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

### 5.2 Power supply range

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The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages  $\pm 5$  %, for which the equipment was designed.

## Section 6 Measurement uncertainty

### 6.1 Uncertainty of measurement

Nemko USA Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 "Uncertainty in EMC measurements." Measurement uncertainty was calculated using the methods described in CISPR 16-4-2 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics, and limit modelling – Measurement instrumentation uncertainty. The expression of Uncertainty in EMC testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

**Table 6.1-1: Measurement uncertainty calculations**

| Measurement                                                          |                   | $U_{\text{cispr}}$ dB | $U_{\text{lab}}$ dB |
|----------------------------------------------------------------------|-------------------|-----------------------|---------------------|
| Conducted disturbance at AC mains and other port power using a V-AMN | 9 kHz to 150 kHz  | 3.8                   | 2.9                 |
|                                                                      | 150 kHz to 30 MHz | 3.4                   | 2.3                 |
| Conducted disturbance at telecommunication port using AAN            | 150 kHz to 30 MHz | 5.0                   | 4.3                 |
| Conducted disturbance at telecommunication port using CVP            | 150 kHz to 30 MHz | 3.9                   | 2.9                 |
| Conducted disturbance at telecommunication port using CP             | 150 kHz to 30 MHz | 2.9                   | 1.4                 |
| Conducted disturbance at telecommunication port using CP and CVP     | 150 kHz to 30 MHz | 4.0                   | 3.1                 |
| Radiated disturbance (electric field strength in a SAC)              | 30 MHz to 1 GHz   | 6.3                   | 5.5                 |
| Radiated disturbance (electric field strength in a FAR)              | 1 GHz to 6 GHz    | 5.2                   | 4.7                 |
| Radiated disturbance (electric field strength in a FAR)              | 6 GHz to 18 GHz   | 5.5                   | 5.0                 |

- Notes:
- Compliance assessment:
    - If  $U_{\text{lab}}$  is less than or equal to  $U_{\text{cispr}}$  then:
      - compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
      - non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit
    - If  $U_{\text{lab}}$  is greater than  $U_{\text{cispr}}$  then:
      - compliance is deemed to occur if no measured disturbance level, increased by  $(U_{\text{lab}} - U_{\text{cispr}})$ , exceeds the disturbance limit;
      - non-compliance is deemed to occur if any measured disturbance level, increased by  $(U_{\text{lab}} - U_{\text{cispr}})$ , exceeds the disturbance limit

V-AMN: V type artificial mains network  
 AAN: Asymmetric artificial network  
 CP: Current probe  
 CVP: Capacitive voltage probe  
 SAC: Semi-anechoic chamber  
 FAR: Fully anechoic room

## Section 7 Test equipment

### 7.1 Test equipment list

**Table 7.1-1: Test equipment list**

| Equipment                        | Manufacturer    | Model no. | Asset no. | Cal cycle | Next cal.  |
|----------------------------------|-----------------|-----------|-----------|-----------|------------|
| EMI Test Receiver                | Rohde & Schwarz | ESU40     | E1131     | 1 year    | 03-02-2023 |
| System controller                | Sunol Sciences  | SC104V    | E1191     | NCR       | NCR        |
| Active Loop Antenna (9kHz-30MHz) | EMCO            | 6507      | 1733      | 1 year    | 06-17-2023 |
| Bilog Antenna (30-1000MHz)       | Schaffner-Chase | CBL 6111D | 1763      | 2 years   | 04-01-2024 |
| EMI Test Receiver                | Rohde & Schwarz | ESCI 7    | E1026     | 1 year    | 03-22-2024 |
| Two Line V-Network               | Rohde & Schwarz | ENV216    | E1019     | 1 year    | 09-30-2023 |
| Transient Limiter (10 dB pad)    | Hewlett Packard | 11947A    | 681       | NCR       | NCR        |
| Signal and Spectrum Analyzer     | Rohde & Schwarz | FSV40     | E1120     | 2 years   | 12-09-2023 |
| Variac                           | Shanghai China  | TDGC      | S1043     | NCR       | NCR        |
| Temperature chamber              | Test Equity     | 115A      | E116      | 1 year    | 08-29-2023 |

Notes: N/A – not applicable  
NCR – no calibration required  
VOU – verify on use

**Table 7.1-2: Test software details**

| Manufacturer of Software | Details          |
|--------------------------|------------------|
| Rohde & Schwarz          | EMC 32 V10.60.15 |

Notes: None

## Section 8 Testing data

### 8.1 AC power line conducted emissions

#### 8.1.1 References and limits

- FCC 47 CFR Part 15, Subpart C: §15.207
- RSS-Gen: 8.8
- Test method: ANSI C63.10-2014 §6.2

**Table 8.1-1: AC power line conducted emissions limit**

| Frequency of emission,<br>MHz | Conducted limit, dBμV |           |
|-------------------------------|-----------------------|-----------|
|                               | Quasi-peak            | Average   |
| 0.15 – 0.5                    | 66 to 56*             | 56 to 46* |
| 0.5 – 5                       | 56                    | 46        |
| 5 – 30                        | 60                    | 50        |

Note: \* - Decreases with the logarithm of the frequency.

#### 8.1.2 Test summary

|               |                                                                                     |                   |           |
|---------------|-------------------------------------------------------------------------------------|-------------------|-----------|
| Verdict       | Pass                                                                                |                   |           |
| Test date     | January 13, 2023                                                                    | Temperature       | 19 °C     |
| Test engineer | Martha Espinoza, Wireless Test Engineer                                             | Air pressure      | 1006 mbar |
| Test location | <input checked="" type="checkbox"/> Ground plane<br><input type="checkbox"/> Other: | Relative humidity | 56 %      |

#### 8.1.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power. Low, middle, and high channels were tested if supported by the EUT.

#### 8.1.4 Setup details

|                             |                                                                                                                                                                                                                                                  |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Port under test             | AC power input                                                                                                                                                                                                                                   |
| EUT power input during test | 120 VAC / 60 Hz                                                                                                                                                                                                                                  |
| EUT setup configuration     | <input checked="" type="checkbox"/> Table-top<br><input type="checkbox"/> Floor standing<br><input type="checkbox"/> Other:                                                                                                                      |
| Measurement details         | A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement. |

#### Receiver settings:

|                      |                                                                                             |
|----------------------|---------------------------------------------------------------------------------------------|
| Resolution bandwidth | 9 kHz                                                                                       |
| Detector mode        | – Peak (Preview measurement)<br>– Quasi-peak and average (Final measurement)                |
| Trace mode           | Max Hold                                                                                    |
| Measurement time     | – 100 ms (Peak preview measurement)<br>– 5000 ms (Quasi-peak and average final measurement) |

8.1.5 Test data

Full Spectrum

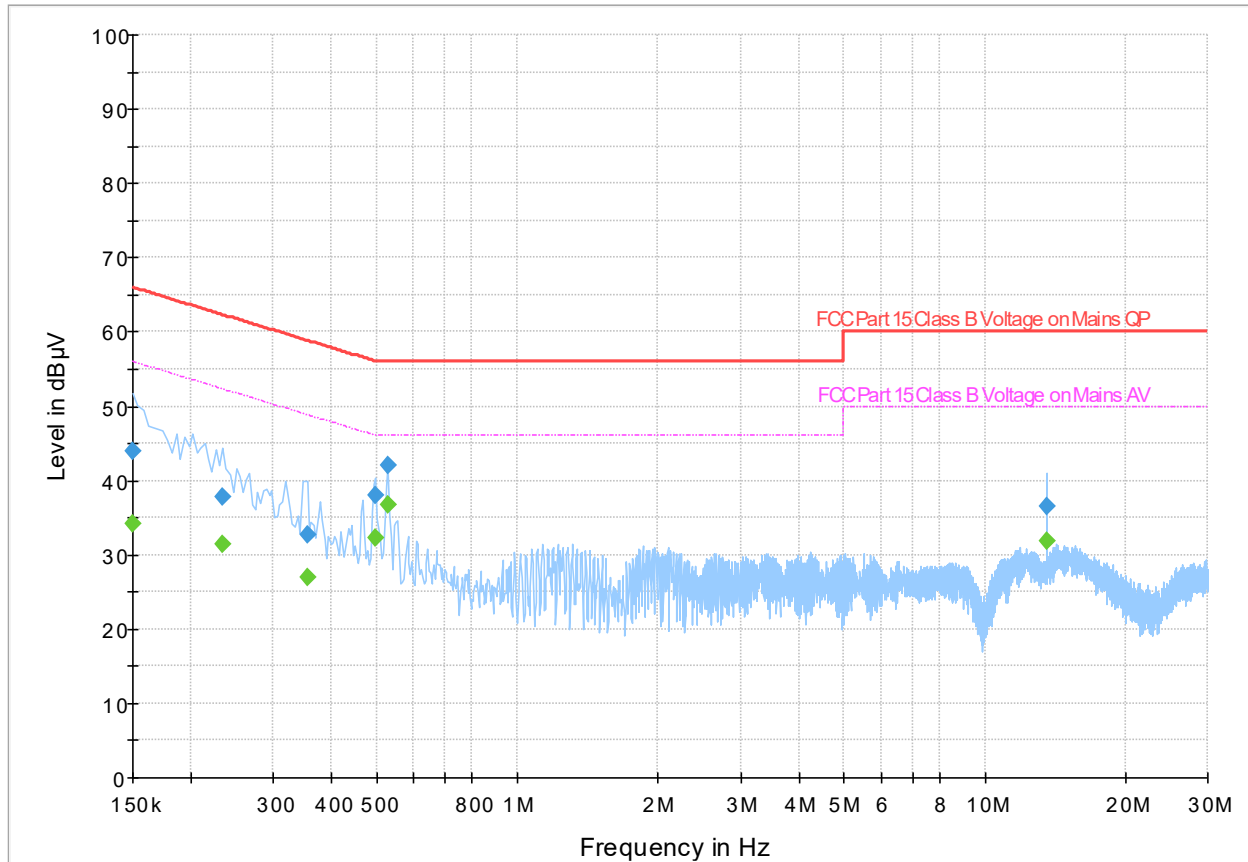


Figure 8.1-1: Conducted emissions at mains port spectral plot (150 kHz - 30 MHz)

Table 8.1-2: Conducted emissions at mains port results

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Filter | Corr. (dB) |
|-----------------|------------------|-----------------|--------------|-------------|-----------------|-----------------|------|--------|------------|
| 0.150000        | 44.03            | ---             | 66.00        | 21.97       | 5000.0          | 9.000           | N    | ON     | 19.7       |
| 0.150000        | ---              | 34.24           | 56.00        | 21.76       | 5000.0          | 9.000           | N    | ON     | 19.7       |
| 0.234000        | ---              | 31.45           | 52.31        | 20.86       | 5000.0          | 9.000           | N    | ON     | 19.6       |
| 0.234000        | 37.73            | ---             | 62.31        | 24.58       | 5000.0          | 9.000           | N    | ON     | 19.6       |
| 0.354000        | 32.64            | ---             | 58.87        | 26.23       | 5000.0          | 9.000           | N    | ON     | 19.5       |
| 0.354000        | ---              | 27.03           | 48.87        | 21.84       | 5000.0          | 9.000           | N    | ON     | 19.5       |
| 0.498000        | 37.90            | ---             | 56.03        | 18.13       | 5000.0          | 9.000           | N    | ON     | 19.5       |
| 0.498000        | ---              | 32.19           | 46.03        | 13.84       | 5000.0          | 9.000           | N    | ON     | 19.5       |
| 0.526000        | 42.01            | ---             | 56.00        | 13.99       | 5000.0          | 9.000           | N    | ON     | 19.5       |
| 0.526000        | ---              | 36.83           | 46.00        | 9.17        | 5000.0          | 9.000           | N    | ON     | 19.5       |
| 13.562000       | ---              | 31.86           | 50.00        | 18.14       | 5000.0          | 9.000           | L1   | ON     | 20.1       |
| 13.562000       | 36.42            | ---             | 60.00        | 23.58       | 5000.0          | 9.000           | L1   | ON     | 20.1       |

Notes: <sup>1</sup> Result (dBµV) = receiver analyzer value (dBµV) + correction factor (dB).  
<sup>2</sup> Correction factors = LISN factor IL (dB) + cable loss (dB) + transient limiter (dB)  
<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

## 8.2 20 dB bandwidth

### 8.2.1 References and limits

- FCC 47 CFR Part 15, Subpart B: §15.215(c)
- Test method: ANSI C63.4-2014: §6.9.2

§15.215:

- (c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

### 8.2.2 Test summary

|               |                                                                                       |                   |           |
|---------------|---------------------------------------------------------------------------------------|-------------------|-----------|
| Verdict       | Pass                                                                                  |                   |           |
| Test date     | January 18, 2023                                                                      | Temperature       | 19 °C     |
| Test engineer | Martha Espinoza, Wireless Test Engineer                                               | Air pressure      | 1001 mbar |
| Test location | <input checked="" type="checkbox"/> Wireless bench<br><input type="checkbox"/> Other: | Relative humidity | 55 %      |

### 8.2.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power. Low, middle, and high channels were tested if supported by the EUT.

### 8.2.4 Setup details

|                             |                                                                                                                             |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| EUT power input during test | 120 V AC / 60 Hz                                                                                                            |
| EUT setup configuration     | <input checked="" type="checkbox"/> Table-top<br><input type="checkbox"/> Floor standing<br><input type="checkbox"/> Other: |

Receiver settings:

|                      |                                    |
|----------------------|------------------------------------|
| Resolution bandwidth | 1 Hz                               |
| Video bandwidth      | 10 Hz                              |
| Detector mode        | Peak                               |
| Trace mode           | Max Hold                           |
| Measurement time     | Long enough for trace to stabilize |

### 8.2.5 Test data

**Table 8.2-1: 20 dB occupied bandwidth test data**

| Test frequency (MHz) | Bandwidth | Measured $f_c$ (MHz) | Measured $f_L$ (MHz) | Measured $f_H$ (MHz) | Limit                                     |
|----------------------|-----------|----------------------|----------------------|----------------------|-------------------------------------------|
| 13.56                | 34.88 Hz  | 13.55997323          | 13.55995586          | 13.5599074           | $f_H$ and $f_L$ within 13.110 – 14.010MHz |

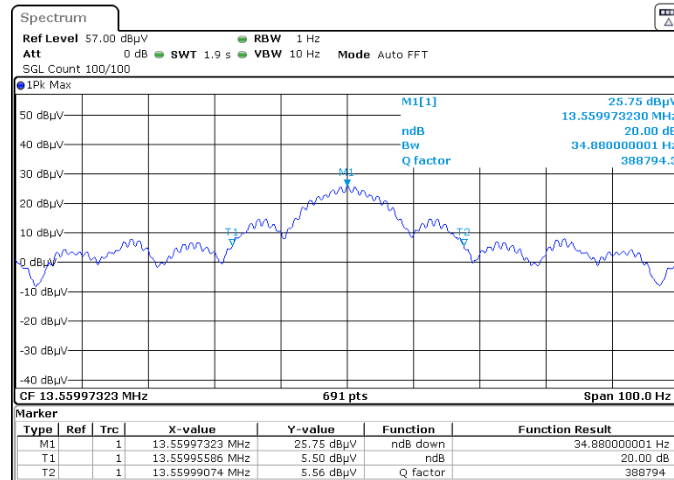


Figure 8.2-1: 20 dB occupied bandwidth, 13.56 MHz

## 8.3 99 % occupied bandwidth

### 8.3.1 References and limits

- RSS-Gen: §6.7
- Test method: ANSI C63.4-2014: §6.9.2

RSS-GEN:

- 6.7 The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

### 8.3.2 Test summary

|               |                                                                                       |                   |           |
|---------------|---------------------------------------------------------------------------------------|-------------------|-----------|
| Verdict       | Pass                                                                                  |                   |           |
| Test date     | January 18, 2023                                                                      | Temperature       | 19 °C     |
| Test engineer | Martha Espinoza, Wireless Test Engineer                                               | Air pressure      | 1001 mbar |
| Test location | <input checked="" type="checkbox"/> Wireless bench<br><input type="checkbox"/> Other: | Relative humidity | 55 %      |

### 8.3.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power. Low, middle, and high channels were tested if supported by the EUT.

### 8.3.4 Setup details

|                             |                                                                                                                             |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| EUT power input during test | 120 V AC / 60 Hz                                                                                                            |
| EUT setup configuration     | <input checked="" type="checkbox"/> Table-top<br><input type="checkbox"/> Floor standing<br><input type="checkbox"/> Other: |

Receiver settings:

|                      |                                    |
|----------------------|------------------------------------|
| Resolution bandwidth | 30 Hz                              |
| Video bandwidth      | 1 kHz                              |
| Detector mode        | Peak                               |
| Trace mode           | Max Hold                           |
| Measurement time     | Long enough for trace to stabilize |

### 8.3.5 Test data

**Table 8.3-1: 99 % occupied bandwidth test data**

| Test frequency (MHz) | Bandwidth | Measured $f_c$ (MHz) | Measured $f_l$ (MHz) | Measured $f_H$ (MHz) | Limit                                     |
|----------------------|-----------|----------------------|----------------------|----------------------|-------------------------------------------|
| 13.56                | 1.018 kHz | 13.5599726           | 13.55946208          | 13.56048017          | $f_H$ and $f_L$ within 13.110 – 14.010MHz |

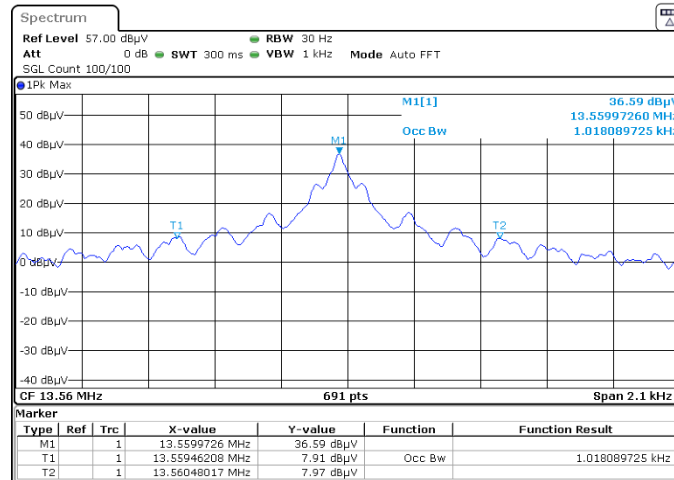


Figure 8.3-1: 99 % occupied bandwidth, 13.56 MHz

## 8.4 Radiated emissions

### 8.4.1 References and limits

- FCC §15.225(a)-(d)
- RSS-210 §B.6(a)
- Test method: ANSI C63.10 §6.4, 6.5

#### FCC §15.225(a)-(d):

- a. The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- b. Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- c. Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
- d. The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

#### RSS-210 §B.6(a):

The field strength of any emission shall not exceed the following limits:

- a. 15.848 mV/m (84 dBµV/m) at 30m, within the band 13.553-13.567 MHz;
- b. 334 µV/m (50.5 dBµV/m) at 30m, within the bands 13.410-13.553 MHz and 13.567-13.710 MHz;
- c. 106 µV/m (40.5 dBµV/m) at 30m, within the bands 13.110-13.410 MHz and 13.710-14.010 MHz; and
- d. RSS-Gen general field strength limits for frequencies outside the band 13.110-14.010 MHz.

**Table 8.4-1: FCC §15.209 and RSS-Gen – Radiated emission limits**

| Frequency,<br>MHz | Field strength of emissions |                                 | Measurement distance, m |
|-------------------|-----------------------------|---------------------------------|-------------------------|
|                   | µV/m                        | dBµV/m                          |                         |
| 0.009–0.490       | 2400/F                      | $67.6 - 20 \times \log_{10}(F)$ | 300                     |
| 0.490–1.705       | 24000/F                     | $87.6 - 20 \times \log_{10}(F)$ | 30                      |
| 1.705–30.0        | 30                          | 29.5                            | 30                      |
| 30–88             | 100                         | 40.0                            | 3                       |
| 88–216            | 150                         | 43.5                            | 3                       |
| 216–960           | 200                         | 46.0                            | 3                       |
| above 960         | 500                         | 54.0                            | 3                       |

Notes: In the emission table above, the tighter limit applies at the band edges.

For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

**Table 8.4-2: IC restricted frequency bands**

| MHz             | MHz                 | MHz           | GHz         |
|-----------------|---------------------|---------------|-------------|
| 0.090–0.110     | 12.51975–12.52025   | 399.9–410     | 5.35–5.46   |
| 2.1735–2.1905   | 12.57675–12.57725   | 608–614       | 7.25–7.75   |
| 3.020–3.026     | 13.36–13.41         | 960–1427      | 8.025–8.5   |
| 4.125–4.128     | 16.42–16.423        | 1435–1626.5   | 9.0–9.2     |
| 4.17725–4.17775 | 16.69475–16.69525   | 1645.5–1646.5 | 9.3–9.5     |
| 4.20725–4.20775 | 16.80425–16.80475   | 1660–1710     | 10.6–12.7   |
| 5.677–5.683     | 25.5–25.67          | 1718.8–1722.2 | 13.25–13.4  |
| 6.215–6.218     | 37.5–38.25          | 2200–2300     | 14.47–14.5  |
| 6.26775–6.26825 | 73–74.6             | 2310–2390     | 15.35–16.2  |
| 6.31175–6.31225 | 74.8–75.2           | 2655–2900     | 17.7–21.4   |
| 8.291–8.294     | 108–138             | 3260–3267     | 22.01–23.12 |
| 8.362–8.366     | 156.52475–156.52525 | 3332–3339     | 23.6–24.0   |
| 8.37625–8.38675 | 156.7–156.9         | 3345.8–3358   | 31.2–31.8   |
| 8.41425–8.41475 | 240–285             | 3500–4400     | 36.43–36.5  |
| 12.29–12.293    | 322–335.4           | 4500–5150     | Above 38.6  |

Table 8.4-3: FCC restricted frequency bands

| MHz               | MHz                 | MHz           | GHz         |
|-------------------|---------------------|---------------|-------------|
| 0.090–0.110       | 16.42–16.423        | 399.9–410     | 4.5–5.15    |
| 0.495–0.505       | 16.69475–16.69525   | 608–614       | 5.35–5.46   |
| 2.1735–2.1905     | 16.80425–16.80475   | 960–1240      | 7.25–7.75   |
| 4.125–4.128       | 25.5–25.67          | 1300–1427     | 8.025–8.5   |
| 4.17725–4.17775   | 37.5–38.25          | 1435–1626.5   | 9.0–9.2     |
| 4.20725–4.20775   | 73–74.6             | 1645.5–1646.5 | 9.3–9.5     |
| 6.215–6.218       | 74.8–75.2           | 1660–1710     | 10.6–12.7   |
| 6.26775–6.26825   | 108–121.94          | 1718.8–1722.2 | 13.25–13.4  |
| 6.31175–6.31225   | 123–138             | 2200–2300     | 14.47–14.5  |
| 8.291–8.294       | 149.9–150.05        | 2310–2390     | 15.35–16.2  |
| 8.362–8.366       | 156.52475–156.52525 | 2483.5–2500   | 17.7–21.4   |
| 8.37625–8.38675   | 156.7–156.9         | 2690–2900     | 22.01–23.12 |
| 8.41425–8.41475   | 162.0125–167.17     | 3260–3267     | 23.6–24.0   |
| 12.29–12.293      | 167.72–173.2        | 3332–3339     | 31.2–31.8   |
| 12.51975–12.52025 | 240–285             | 3345.8–3358   | 36.43–36.5  |
| 12.57675–12.57725 | 322–335.4           | 3600–4400     | Above 38.6  |
| 13.36–13.41       |                     |               |             |

#### 8.4.2 Test summary

|               |                                                                                                                                                                                                  |                   |           |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------|
| Verdict       | Pass                                                                                                                                                                                             |                   |           |
| Test date     | January 16, 2023                                                                                                                                                                                 | Temperature       | 18 °C     |
| Test engineer | Martha Espinoza, Wireless Test Engineer                                                                                                                                                          | Air pressure      | 1005 mbar |
| Test location | <input checked="" type="checkbox"/> 10m semi anechoic chamber<br><input type="checkbox"/> 3m semi anechoic chamber<br><input type="checkbox"/> Wireless bench<br><input type="checkbox"/> Other: | Relative humidity | 58 %      |

#### 8.4.3 Notes

None

#### 8.4.4 Setup details

|                             |                                                                                                                                                                                                                             |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EUT power input during test | 120 V AC / 60 Hz                                                                                                                                                                                                            |
| EUT setup configuration     | <input checked="" type="checkbox"/> Table-top<br><input type="checkbox"/> Floor standing<br><input type="checkbox"/> Other:                                                                                                 |
| Measurement details         | A preview measurement was generated with the receiver in continuous scan mode. Selected emissions were re-measured with the appropriate detector(s) against the correlating limit(s) and recorded as the final measurement. |

##### Receiver settings; 9 kHz to 30 MHz:

|                      |                                                                                  |
|----------------------|----------------------------------------------------------------------------------|
| Resolution bandwidth | 200 Hz from 9 – 150 kHz<br>9 kHz from 150 kHz – 30 MHz                           |
| Detector mode        | – Peak (Preview measurement)<br>– Quasi-peak (Final measurement)                 |
| Measurement time     | – 100 ms (Peak preview measurement)<br>– 15000 ms (Quasi-peak final measurement) |

##### Receiver settings; 30 – 1000 MHz:

|                      |                                                                                 |
|----------------------|---------------------------------------------------------------------------------|
| Resolution bandwidth | 120 kHz                                                                         |
| Detector mode        | – Peak (Preview measurement)<br>– Quasi-peak (Final measurement)                |
| Measurement time     | – 100 ms (Peak preview measurement)<br>– 5000 ms (Quasi-peak final measurement) |

8.4.5 Test data

Full Spectrum

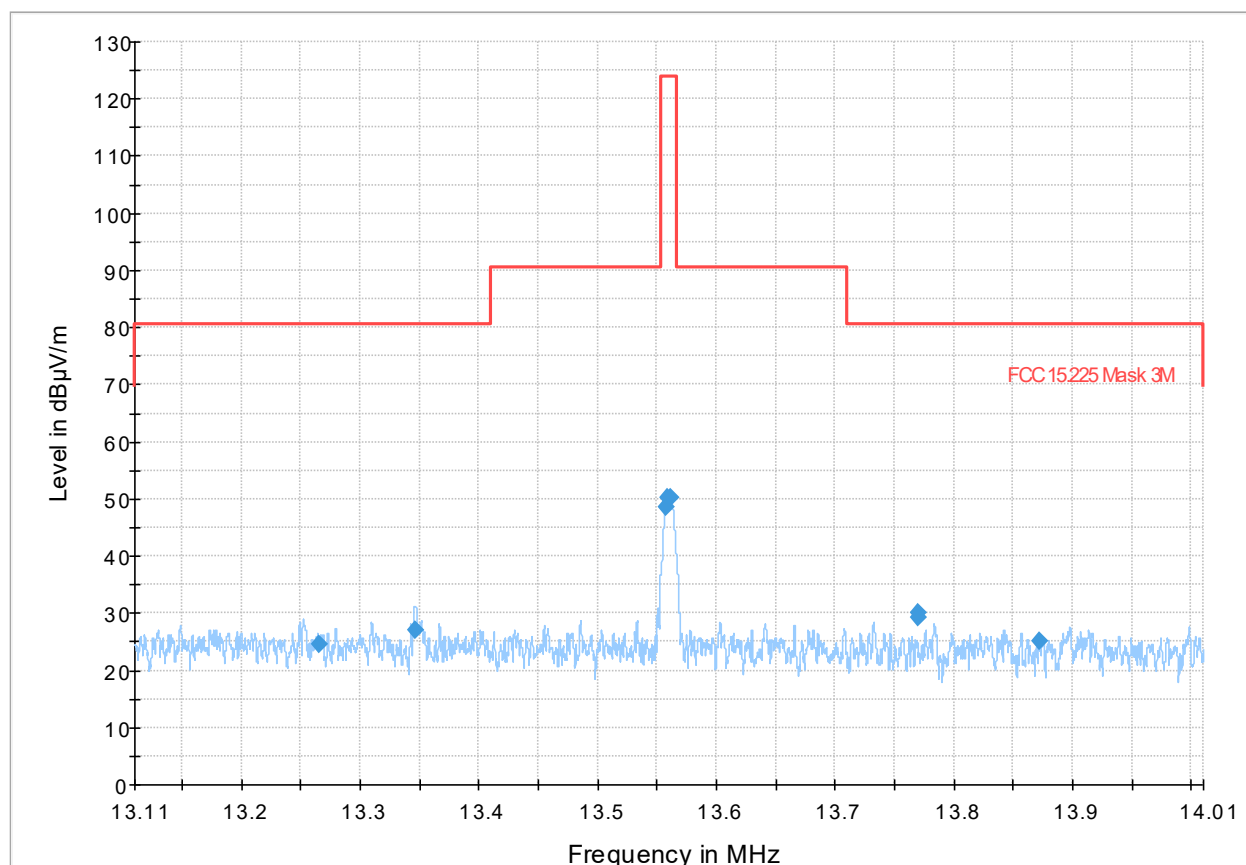


Figure 8.4-1: Radiated emissions spectral plot (13.11 MHz - 14.01 MHz), 0 degrees

Table 8.4-4: Radiated emissions results

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Pol | Azimuth (deg) | Corr. (dB/m) |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-----|---------------|--------------|
| 13.264840       | 24.50              | 80.51          | 56.00       | 15000.0         | 9.000           | H   | 130.0         | 17.4         |
| 13.346440       | 27.13              | 80.51          | 53.37       | 15000.0         | 9.000           | H   | 0.0           | 17.4         |
| 13.557270       | 48.45              | 124.00         | 75.55       | 15000.0         | 9.000           | H   | 348.0         | 17.4         |
| 13.558550       | 50.24              | 124.00         | 73.76       | 15000.0         | 9.000           | H   | 0.0           | 17.4         |
| 13.561090       | 50.31              | 124.00         | 73.69       | 15000.0         | 9.000           | H   | 354.0         | 17.4         |
| 13.769170       | 29.35              | 80.51          | 51.15       | 15000.0         | 9.000           | H   | 27.0          | 17.3         |
| 13.770200       | 30.12              | 80.51          | 50.38       | 15000.0         | 9.000           | H   | 335.0         | 17.3         |
| 13.872050       | 25.08              | 80.51          | 55.43       | 15000.0         | 9.000           | H   | 0.0           | 17.3         |

Notes:

<sup>1</sup> Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)

<sup>2</sup> Correction factors = antenna factor ACF (dB) + cable loss (dB)

<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Full Spectrum

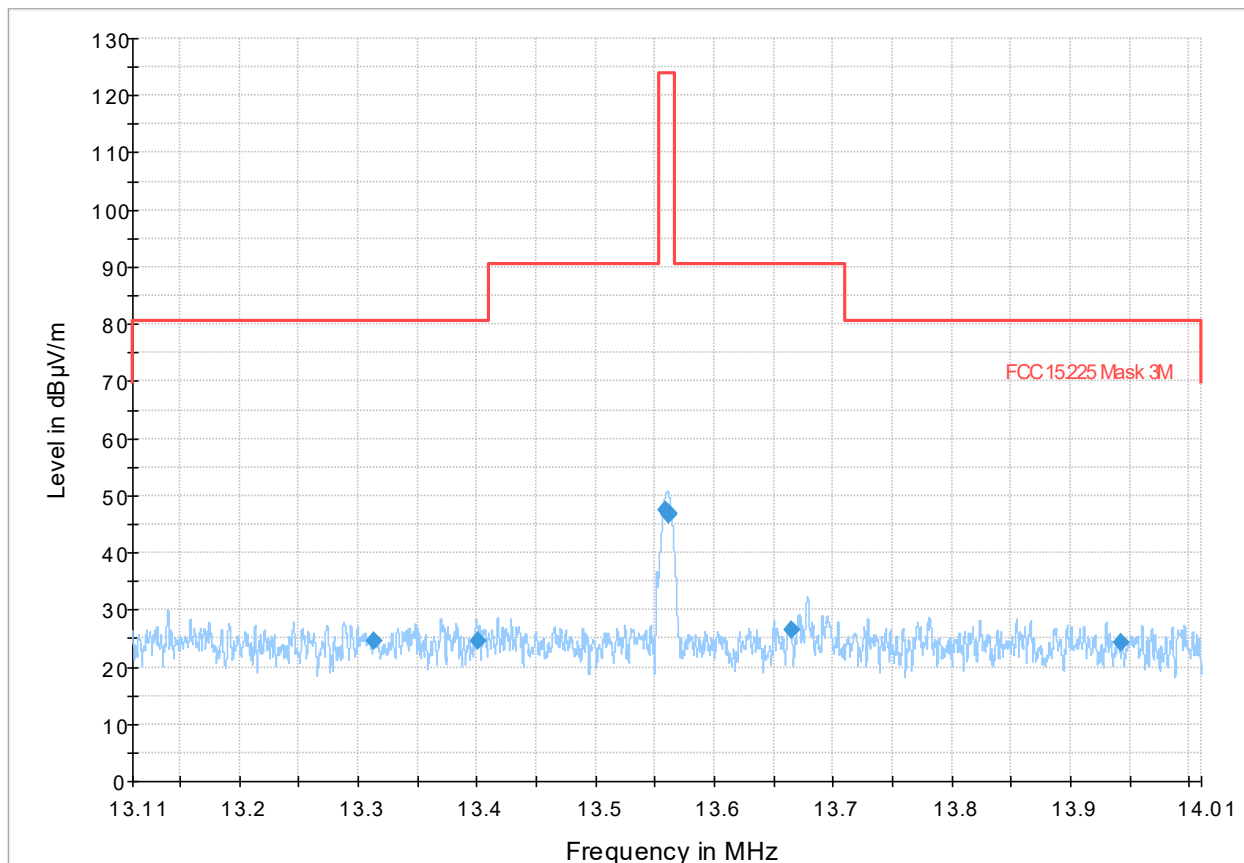


Figure 8.4-2: Radiated emissions spectral plot (13.11 MHz - 14.01 MHz)

Table 8.4-5: Radiated emissions results

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Pol | Azimuth (deg) | Corr. (dB/m) |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-----|---------------|--------------|
| 13.312570       | 24.60              | 80.51          | 55.91       | 15000.0         | 9.000           | H   | 265.0         | 17.4         |
| 13.400440       | 24.52              | 80.51          | 55.99       | 15000.0         | 9.000           | H   | 70.0          | 17.4         |
| 13.559000       | 47.41              | 124.00         | 76.59       | 15000.0         | 9.000           | H   | 104.0         | 17.4         |
| 13.561450       | 46.93              | 124.00         | 77.07       | 15000.0         | 9.000           | H   | 108.0         | 17.4         |
| 13.561720       | 46.72              | 124.00         | 77.28       | 15000.0         | 9.000           | H   | 99.0          | 17.4         |
| 13.665080       | 26.48              | 90.48          | 63.99       | 15000.0         | 9.000           | H   | 70.0          | 17.3         |
| 13.942540       | 24.18              | 80.51          | 56.33       | 15000.0         | 9.000           | H   | 176.0         | 17.3         |

Notes:

<sup>1</sup> Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)

<sup>2</sup> Correction factors = antenna factor ACF (dB) + cable loss (dB)

<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Full Spectrum

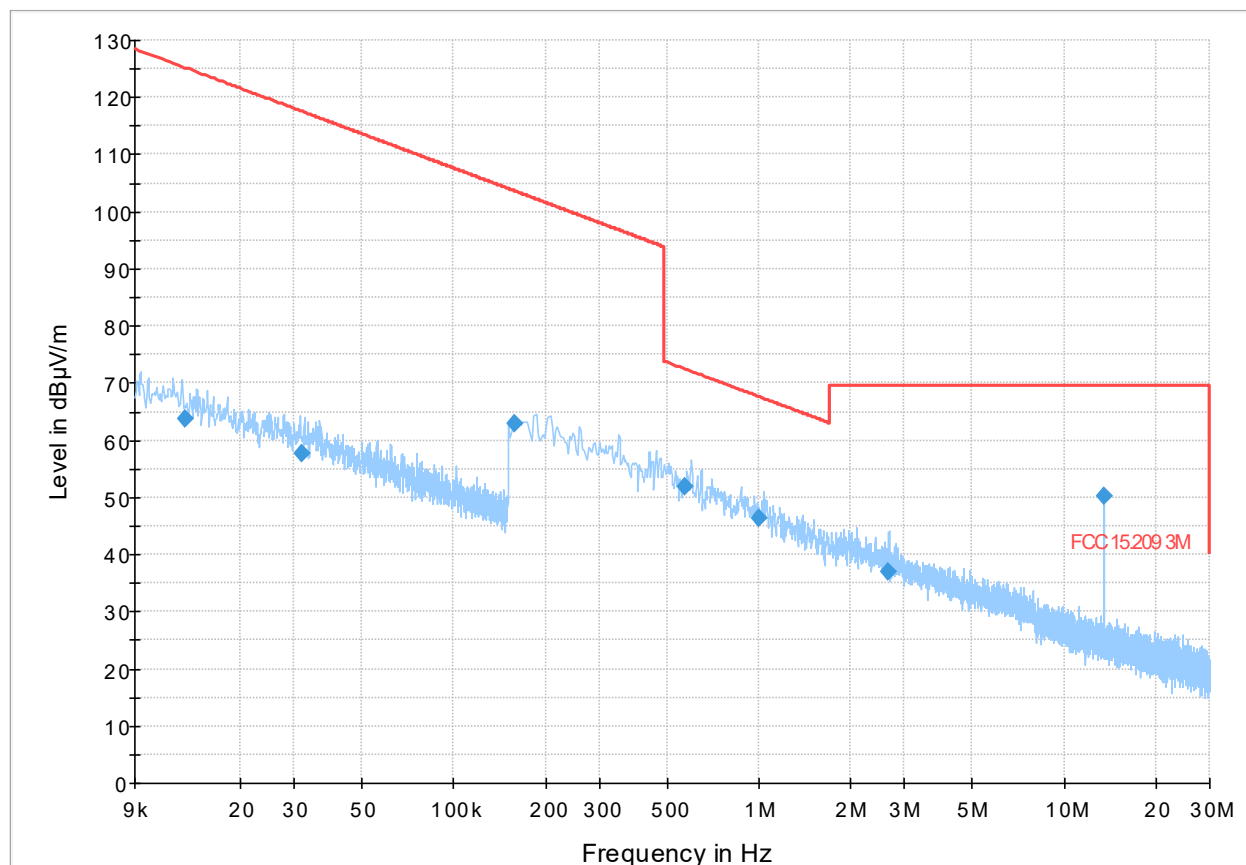


Figure 8.4-3: Radiated emissions spectral plot (9 kHz - 30 MHz), 0 degrees

Table 8.4-6: Radiated emissions results

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Pol | Azimuth (deg) | Corr. (dB/m) |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-----|---------------|--------------|
| 0.013167        | 63.84              | 125.20         | 61.35       | 15000.0         | 0.200           | H   | 183.0         | 26.9         |
| 0.031896        | 57.76              | 117.52         | 59.76       | 15000.0         | 0.200           | H   | 166.0         | 21.9         |
| 0.158730        | 62.81              | 103.59         | 40.78       | 15000.0         | 9.000           | H   | 65.0          | 18.2         |
| 0.571735        | 51.76              | 72.46          | 20.71       | 15000.0         | 9.000           | H   | 232.0         | 18.3         |
| 1.004530        | 46.34              | 67.58          | 21.25       | 15000.0         | 9.000           | H   | 64.0          | 18.6         |
| 2.649355        | 37.07              | 69.50          | 32.43       | 15000.0         | 9.000           | H   | 283.0         | 18.3         |
| 13.558605       | 50.35              | 69.50          | 19.15       | 15000.0         | 9.000           | H   | 7.0           | 17.4         |

Notes: <sup>1</sup> Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)

<sup>2</sup> Correction factors = antenna factor ACF (dB) + cable loss (dB)

<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Full Spectrum

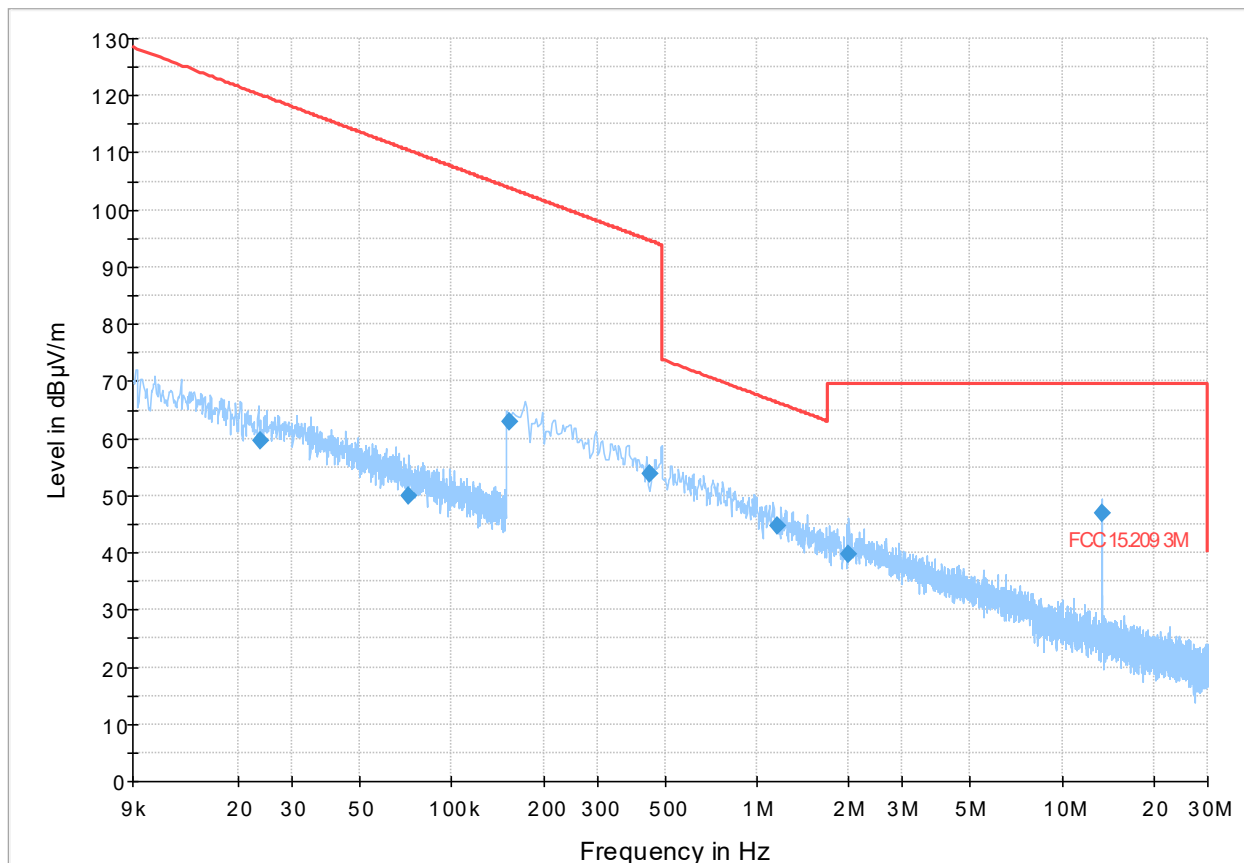


Figure 8.4-4: Radiated emissions spectral plot (9 kHz - 30 MHz)

Table 8.4-7: Radiated emissions results

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Pol | Azimuth (deg) | Corr. (dB/m) |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-----|---------------|--------------|
| 0.023722        | 59.58              | 120.09         | 60.50       | 15000.0         | 0.200           | H   | 149.0         | 23.0         |
| 0.072010        | 50.08              | 110.45         | 60.37       | 15000.0         | 0.200           | H   | 12.0          | 18.6         |
| 0.154000        | 63.05              | 103.85         | 40.80       | 15000.0         | 9.000           | H   | 169.0         | 18.2         |
| 0.443320        | 53.94              | 94.67          | 40.73       | 15000.0         | 9.000           | H   | 226.0         | 18.3         |
| 1.169065        | 44.82              | 66.27          | 21.45       | 15000.0         | 9.000           | H   | 249.0         | 18.6         |
| 2.000685        | 39.75              | 69.50          | 29.75       | 15000.0         | 9.000           | H   | 195.0         | 18.5         |
| 13.560605       | 47.01              | 69.50          | 22.49       | 15000.0         | 9.000           | H   | 78.0          | 17.4         |

Notes:

<sup>1</sup> Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)

<sup>2</sup> Correction factors = antenna factor ACF (dB) + cable loss (dB)

<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Full Spectrum

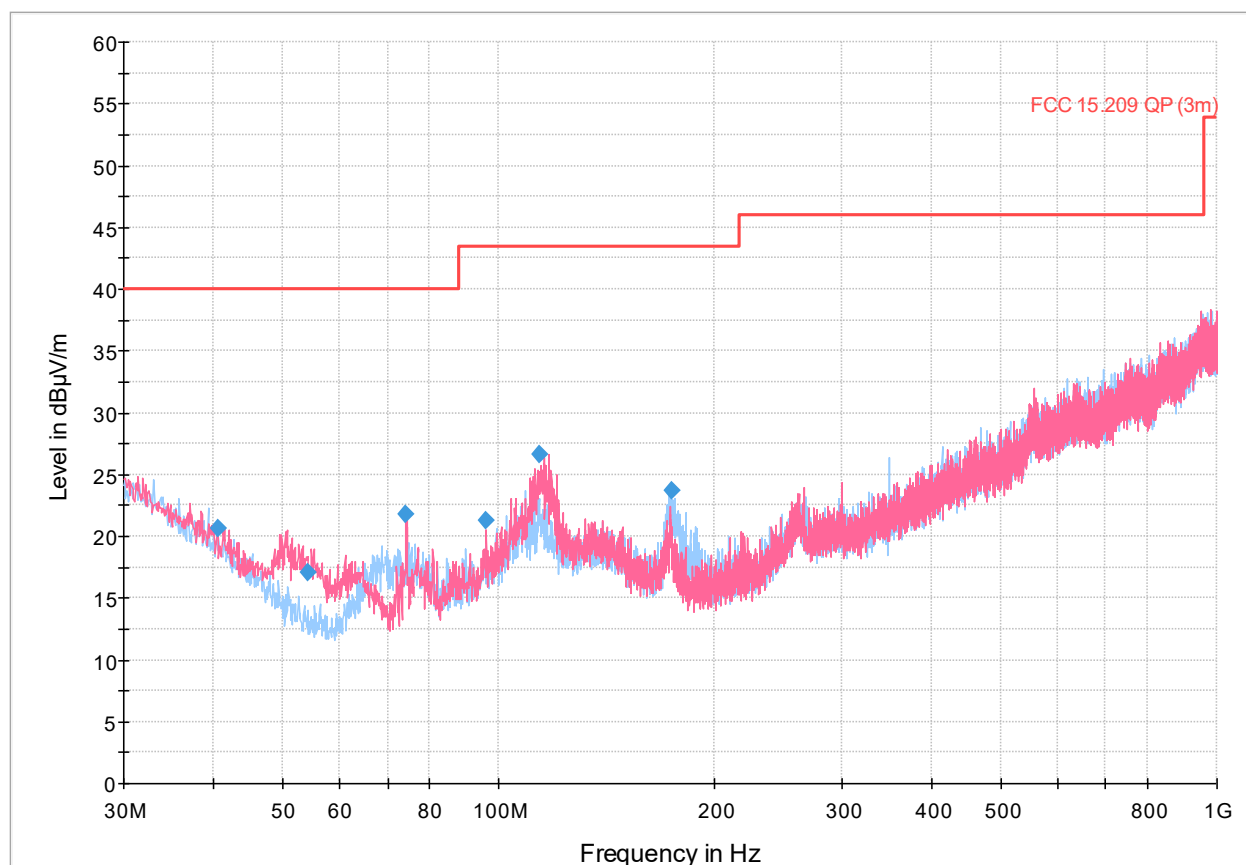


Figure 8.4-5: Radiated emissions spectral plot (30 MHz - 150 MHz)

Table 8.4-8: Radiated emissions results

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|--------------|
| 40.550000       | 20.65              | 40.00          | 19.35       | 5000.0          | 120.000         | 116.0       | V   | 270.0         | 22.0         |
| 54.120000       | 17.13              | 40.00          | 22.87       | 5000.0          | 120.000         | 135.0       | V   | 121.0         | 14.5         |
| 74.232000       | 21.74              | 40.00          | 18.27       | 5000.0          | 120.000         | 210.0       | V   | 201.0         | 14.6         |
| 96.001000       | 21.30              | 43.50          | 22.20       | 5000.0          | 120.000         | 337.0       | V   | 14.0          | 16.9         |
| 113.850000      | 26.60              | 43.50          | 16.90       | 5000.0          | 120.000         | 381.0       | V   | 22.0          | 19.2         |
| 173.687000      | 23.75              | 43.50          | 19.75       | 5000.0          | 120.000         | 279.0       | H   | 236.0         | 20.2         |

Notes:

<sup>1</sup> Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)

<sup>2</sup> Correction factors = antenna factor ACF (dB) + cable loss (dB)

<sup>3</sup> Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

## 8.5 Frequency stability

### 8.5.1 References and limits

- FCC §15.225(e)
- RSS-210 §B.6(b)
- Test method: ANSI C63.26, §6.8

#### FCC §15.225(e)

- e) The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency over a temperature variation of  $-20$  degrees to  $+50$  degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

#### RSS-210 §B.6(b):

- b) The carrier frequency stability shall not exceed  $\pm 100$  ppm.

### 8.5.2 Test summary

|               |                                                                                       |                   |           |
|---------------|---------------------------------------------------------------------------------------|-------------------|-----------|
| Verdict       | Pass                                                                                  |                   |           |
| Test date     | January 18, 2023                                                                      | Temperature       | 19 °C     |
| Test engineer | Martha Espinoza, Wireless Test Engineer                                               | Air pressure      | 1001 mbar |
| Test location | <input checked="" type="checkbox"/> Wireless bench<br><input type="checkbox"/> Other: | Relative humidity | 59 %      |

### 8.5.3 Notes

The carrier frequency  $f_c$  (MHz) was measured at each temperature and supply voltage using the spectrum analyzer Signal Count marker function. The variation in ppm and % were calculated as follows:

$$\text{Variation (ppm)} = \left( \left( \frac{f_{\text{expected}} - f_{\text{measured}}}{f_{\text{expected}}} \right) \times 1000000 \right)$$

$$\text{Variation (\%)} = \left( \left( \frac{f_{\text{expected}} - f_{\text{measured}}}{f_{\text{expected}}} \right) \times 100 \right)$$

### 8.5.4 Setup details

|                             |                                                                                                                             |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| EUT power input during test | 120 V AC / 60 Hz                                                                                                            |
| EUT setup configuration     | <input checked="" type="checkbox"/> Table-top<br><input type="checkbox"/> Floor standing<br><input type="checkbox"/> Other: |

### 8.5.5 Test data

**Table 8.5-1: Frequency stability results**

| Temp (C°) | Voltage                | Low Frequency (MHz) | High Frequency (MHz) | F <sub>c</sub> (MHz) | Variation (ppm) | Variation (%) |
|-----------|------------------------|---------------------|----------------------|----------------------|-----------------|---------------|
| +50       | Nominal (120 Vac)      | 13.55910999         | 13.56082489          | 13.55997             | 2.40118         | 0.00024       |
| +40       | Nominal (120 Vac)      | 13.55912446         | 13.56083213          | 13.55998             | 1.60066         | 0.00016       |
| +30       | Nominal (120 Vac)      | 13.55906657         | 13.56090449          | 13.55999             | 1.06711         | 0.00011       |
| +20       | Nominal (120 Vac)      | 13.55887844         | 13.56099855          | 13.55994             | 4.53577         | 0.00045       |
| +20       | 85% Nominal (102 Vac)  | 13.55888567         | 13.56100579          | 13.55995             | 4.00221         | 0.00040       |
| +20       | 115% Nominal (138 Vac) | 13.55874096         | 13.56111433          | 13.55993             | 5.33591         | 0.00053       |
| +10       | Nominal (120 Vac)      | 13.55885673         | 13.56109262          | 13.55997             | 1.86763         | 0.00019       |
| 0         | Nominal (120 Vac)      | 13.55885673         | 13.56110709          | 13.55998             | 1.33407         | 0.00013       |
| -10       | Nominal (120 Vac)      | 13.55871201         | 13.56125904          | 13.55999             | 1.06748         | 0.00011       |
| -20       | Nominal (120 Vac)      | 13.55844428         | 13.5612301           | 13.55984             | 12.00664        | 0.00120       |

End of test report