



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

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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

1.1 Test specifications

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

1.2 Test methods

ANSI C63.10: 2013

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

1.3 Exclusions

None.

1.4 Statement of compliance

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

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.

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 ¹
§15.31(e)		Variation of power source	Pass
§15.203		Antenna requirement	Pass ²
§15.215(c)	RSS-Gen 6.6	20 dB bandwidth	Pass
		Occupied bandwidth	Pass
		RSS-Gen 7.3 Receiver radiated emission limits	Not applicable ³
	RSS-Gen 7.4	Receiver conducted emission limits	Not applicable ³
§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 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

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			

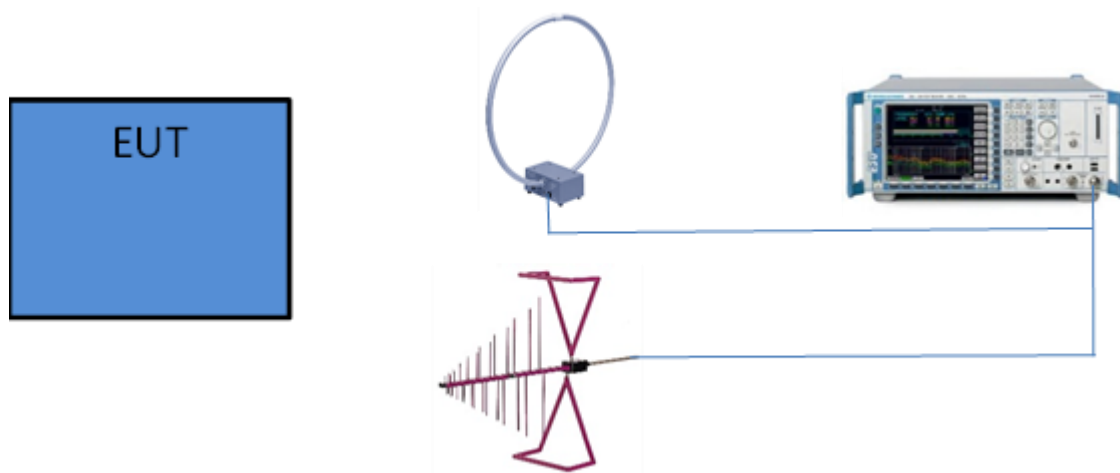


Figure 3.6-1: Test setup diagram

Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT

None.

4.2 Technical judgement

None.

4.3 Deviations from laboratory test procedures

None.

Section 5 Test conditions

5.1 Atmospheric conditions

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

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 ± 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_{cispr} dB	U_{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_{lab} is less than or equal to U_{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_{lab} is greater than U_{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, 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 <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 <input type="checkbox"/> Floor standing <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) – Quasi-peak and average (Final measurement)
Trace mode	Max Hold
Measurement time	– 100 ms (Peak preview measurement) – 5000 ms (Quasi-peak and average final measurement)

8.1.5 Test data

Full Spectrum

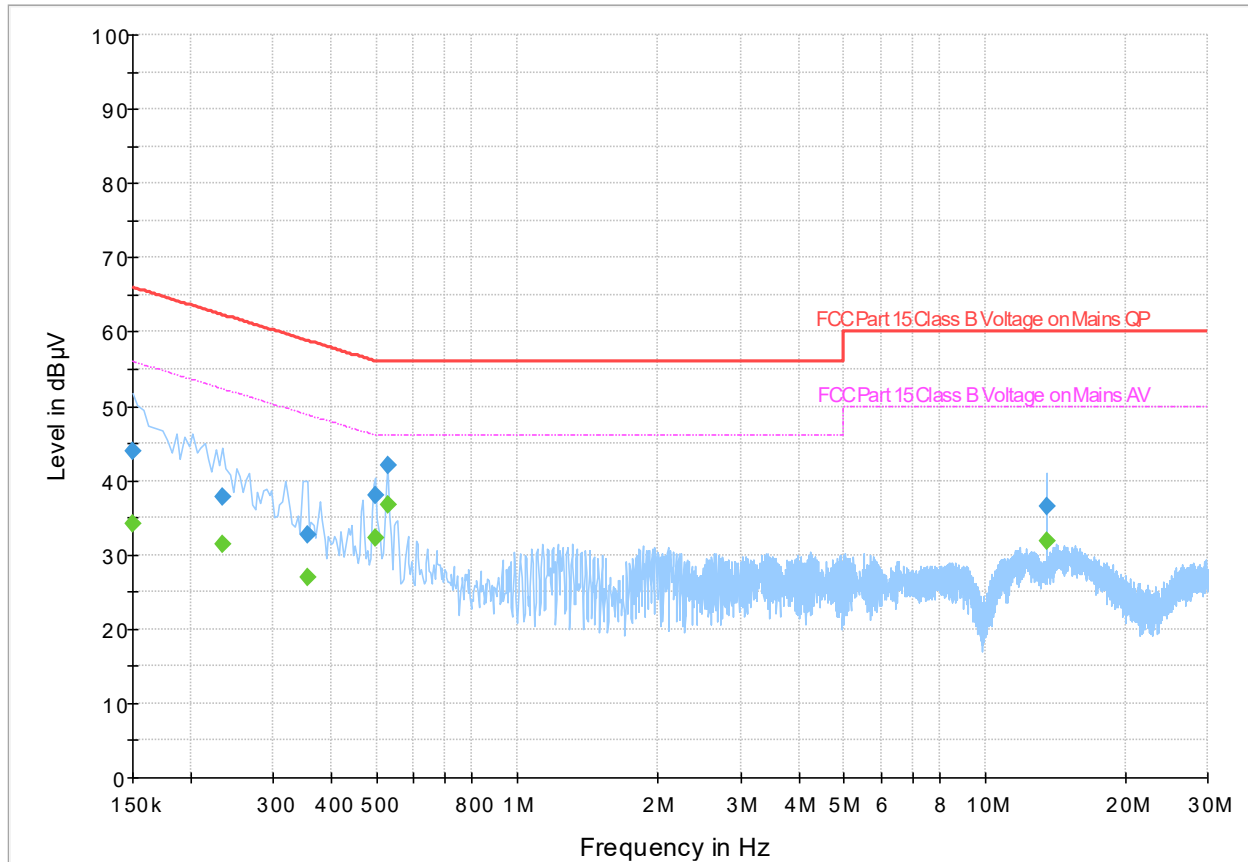


Figure 8.1-1: Conducted emissions at mains port spectral plot (150 kHz - 30 MHz)

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: ¹ Result (dBµV) = receiver analyzer value (dBµV) + correction factor (dB).
² Correction factors = LISN factor IL (dB) + cable loss (dB) + transient limiter (dB)
³ 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 <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 <input type="checkbox"/> Floor standing <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

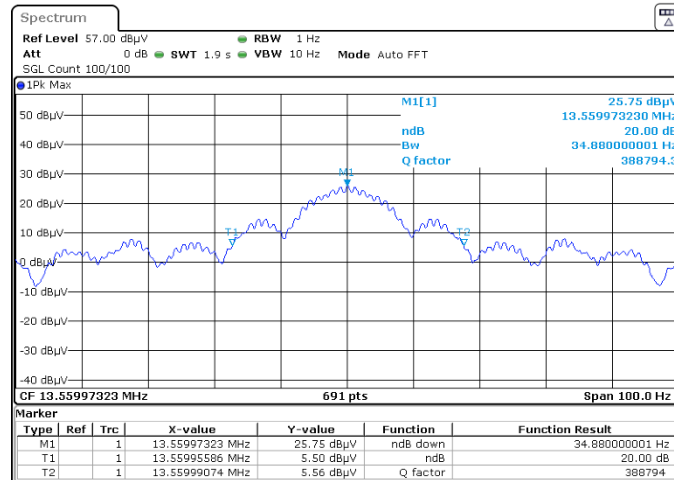


Figure 8.2-1: 20 dB occupied bandwidth, 13.56 MHz

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 <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 <input type="checkbox"/> Floor standing <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

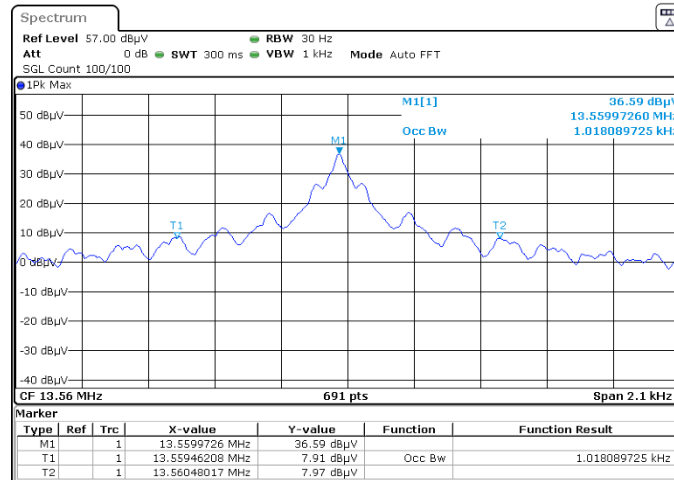


Figure 8.3-1: 99 % occupied bandwidth, 13.56 MHz

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, 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 <input type="checkbox"/> 3m semi anechoic chamber <input type="checkbox"/> Wireless bench <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 <input type="checkbox"/> Floor standing <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 9 kHz from 150 kHz – 30 MHz
Detector mode	– Peak (Preview measurement) – Quasi-peak (Final measurement)
Measurement time	– 100 ms (Peak preview measurement) – 15000 ms (Quasi-peak final measurement)

Receiver settings; 30 – 1000 MHz:

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

8.4.5 Test data

Full Spectrum

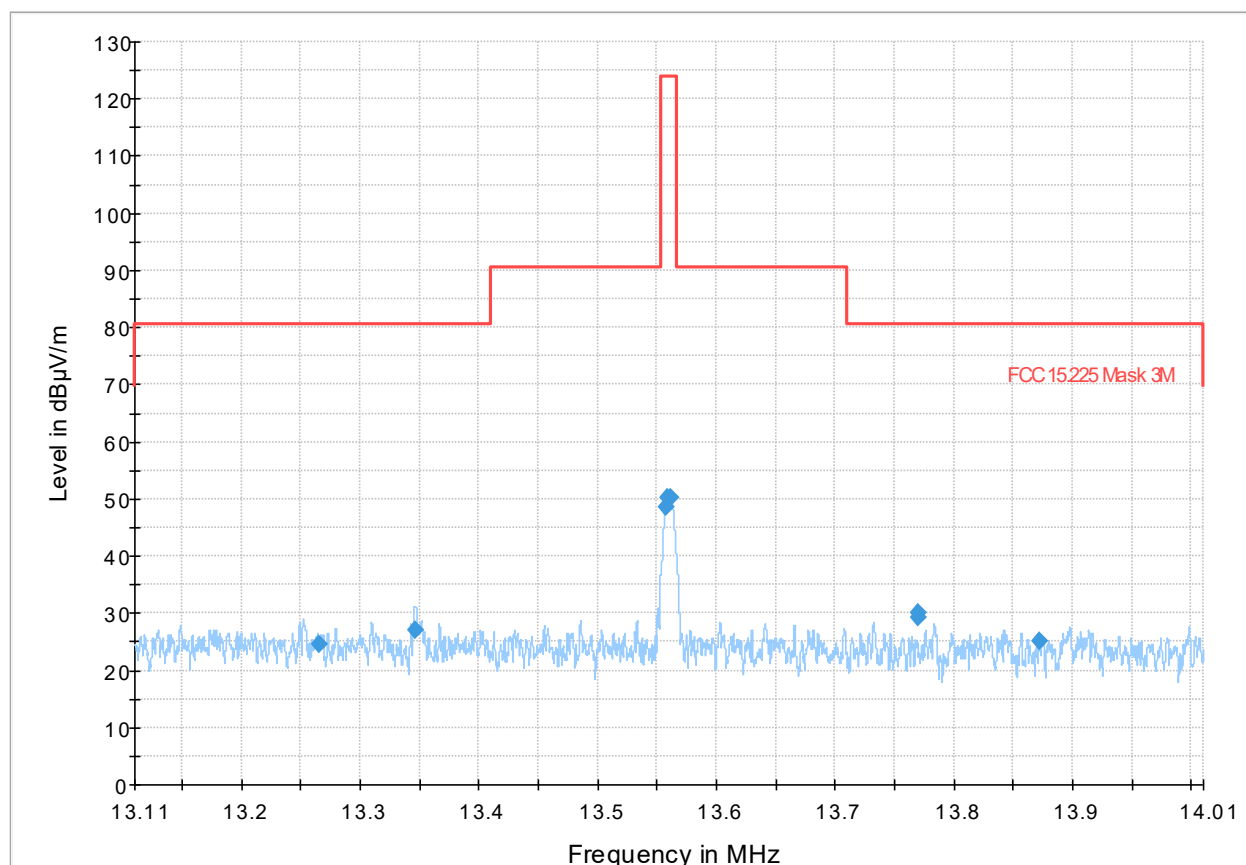


Figure 8.4-1: Radiated emissions spectral plot (13.11 MHz - 14.01 MHz), 0 degrees

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:

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

² Correction factors = antenna factor ACF (dB) + cable loss (dB)

³ 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

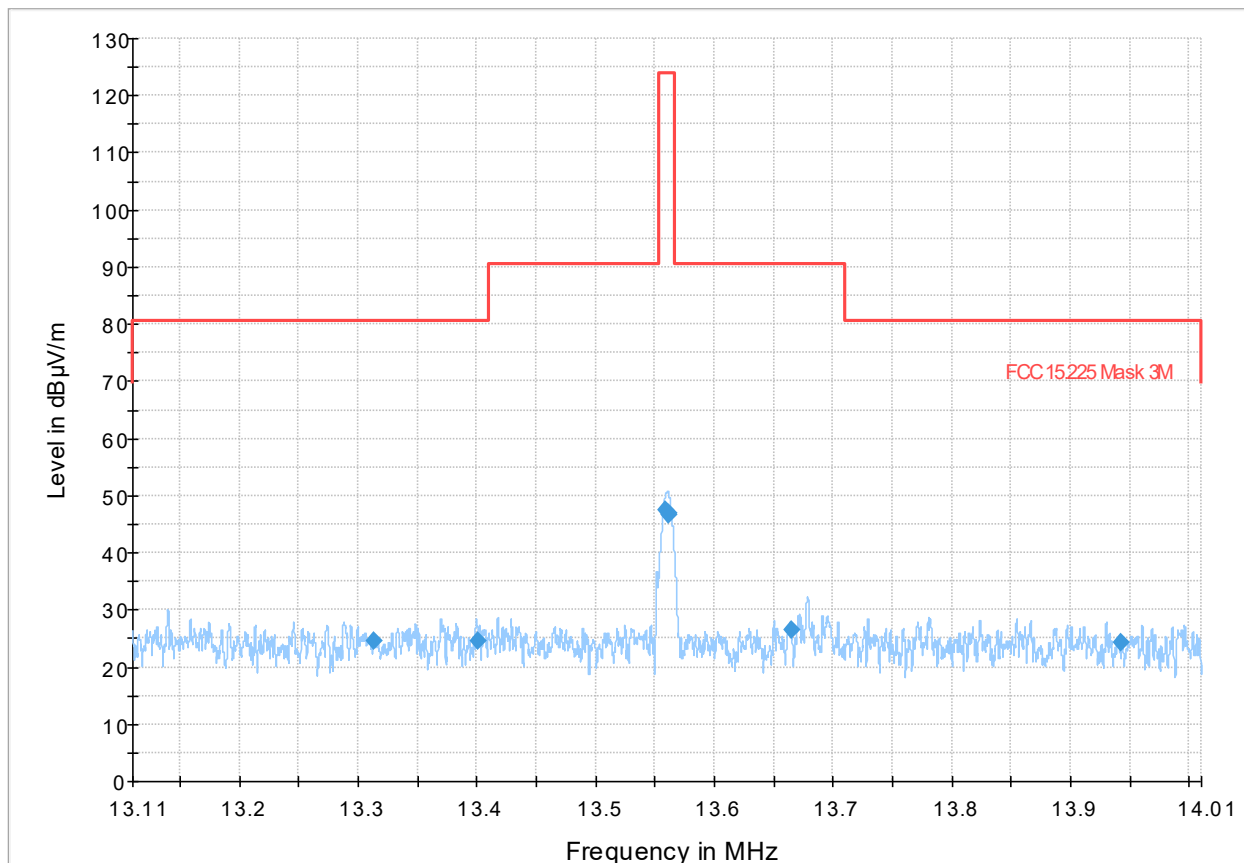


Figure 8.4-2: Radiated emissions spectral plot (13.11 MHz - 14.01 MHz)

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:

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

² Correction factors = antenna factor ACF (dB) + cable loss (dB)

³ 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

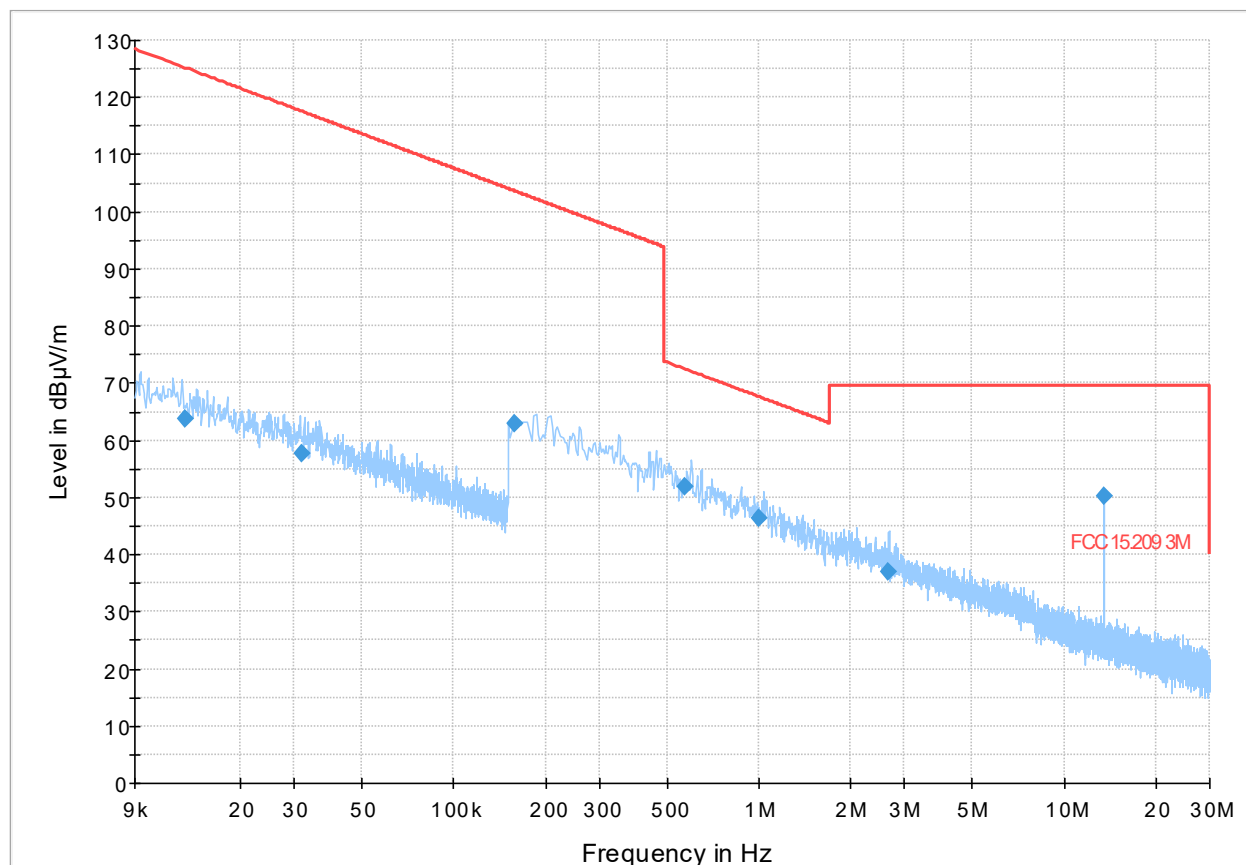


Figure 8.4-3: Radiated emissions spectral plot (9 kHz - 30 MHz), 0 degrees

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

² Correction factors = antenna factor ACF (dB) + cable loss (dB)

³ 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

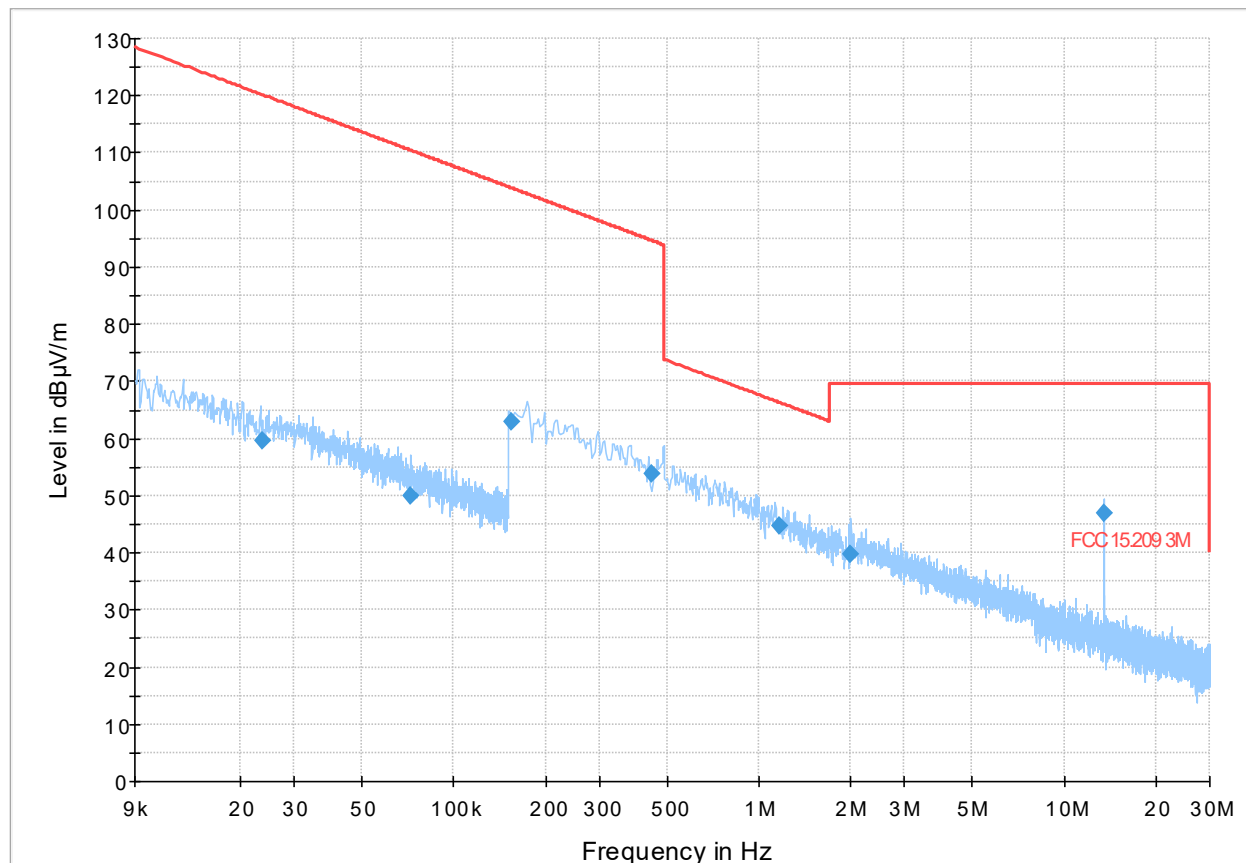


Figure 8.4-4: Radiated emissions spectral plot (9 kHz - 30 MHz)

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:

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

² Correction factors = antenna factor ACF (dB) + cable loss (dB)

³ 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

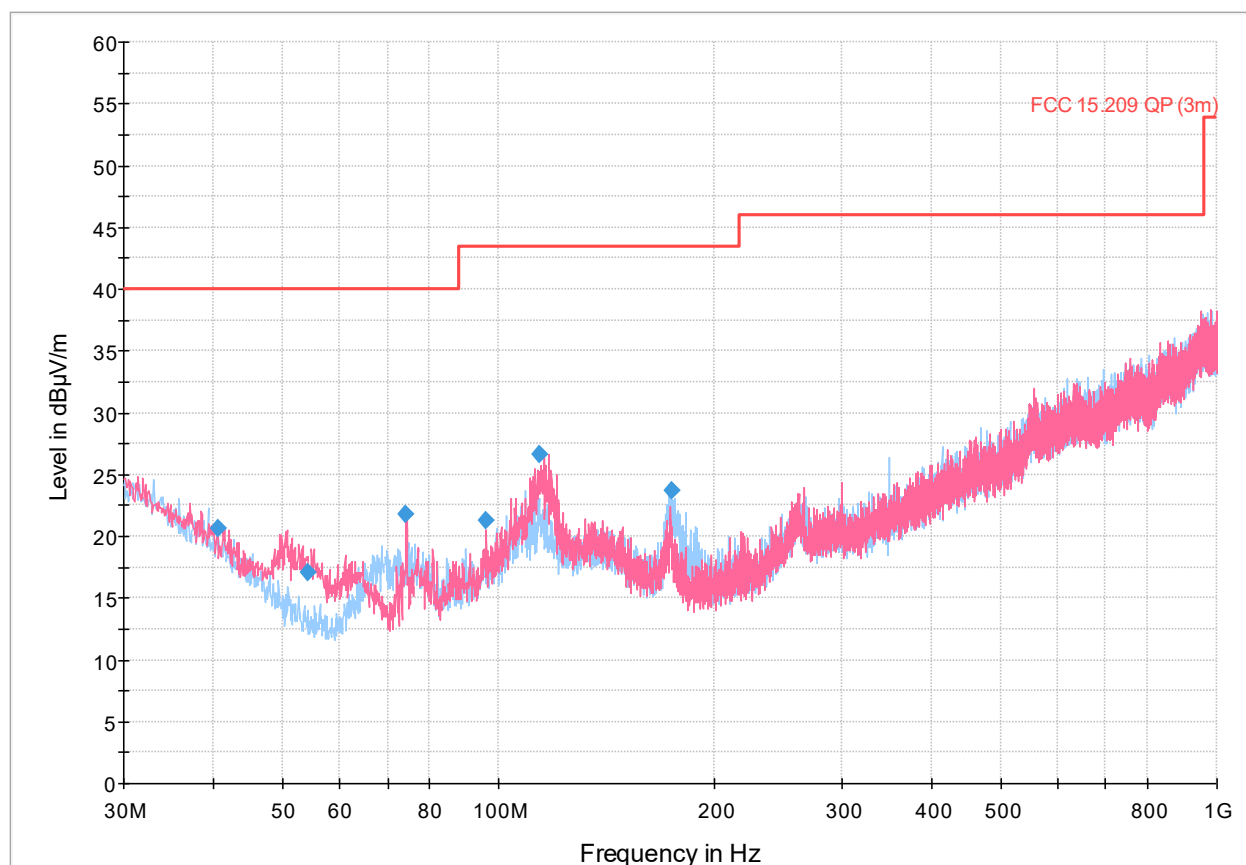


Figure 8.4-5: Radiated emissions spectral plot (30 MHz - 150 MHz)

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:

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

² Correction factors = antenna factor ACF (dB) + cable loss (dB)

³ 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 ± 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 <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 <input type="checkbox"/> Floor standing <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 _c (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