Test report

REP008103-1R1TRFWL

Date of issue: April 10, 2023

Applicant:

Nalu Medical, Inc.

Product:

Charging System for Wearable Medical Device

Model:	Variant(s):
43012	None
FCC ID:	IC ID:
2AMB3-BSC	Not provided

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	Chenhao Ma, Wireless Test Technician
Reviewed by	James Cunningham, EMC/WL Manager
Review date	April 10, 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.

Copyright notification

Table of Contents

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 #	Issue Date	Details of changes made to test report
REP008103-1TRFEMC	March 29, 2023	Original report issued
REP008103-1R1TRFWL	April 10, 2023	Updated following TCB review comments

Section 2 Summary of test results

2.1 Sample information

Receipt date	8-Mar-23
Nemko sample ID number	REP008103

2.2 Testing period

Test start date	9-Mar-23
Test end date	10-Mar-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)		20 dB bandwidth	Pass
	RSS-Gen 6.6	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)	RSS-210 B.6(a)(i)	Field strength within 13.553–13.567 MHz band	Pass
§15.225(b)	RSS-210 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)	RSS-210 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)	RSS-210 B.6(a) (iv)	The field strength outside the band 13.110–14.010 MHz.	Pass
§15.225(e)	RSS-210 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	Nalu Medical, Inc.
Address	2320 Faraday Ave, Suite 100
City	Carlsbad
State	CA
Postal/Zip code	92008
Country	USA

3.3 Manufacturer

Company name	Nalu Medical, Inc.
Address	2320 Faraday Ave, Suite 100
City	Carlsbad
State	CA
Postal/Zip code	92008
Country	USA

3.4 EUT information

Product name	Charging System for Wearable Medical Device
Model	43012
Variant(s)	None
Serial number	N/A
Part number	N/A

Frequency band(s)	13.56 MHz
Fundamental frequency	13.56 MHz
Power requirements	120 Vac
Description/theory of operation	Wireless charger
Antenna information	Antenna is integrated inside the device and not removeable
Software details	None

3.5 EUT exercise and monitoring details

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

- The NFC system was configured to continuously transmit at the maximum power level.

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.
None				

Table 3.6-2: *EUT interface ports*

Description	Qty.
USB-C	1

Table 3.6-3: *Support equipment*

Description	Brand name	Model/Part number	Serial number	Rev.
Therapy Disc Gen 2	Nalu Medical	34014-001	N/A	N/A

Table 3.6-4: *Inter-connection cables*

Cable description	From	To	Length (m)
USB/Power	Wall adapter	Charging system	1

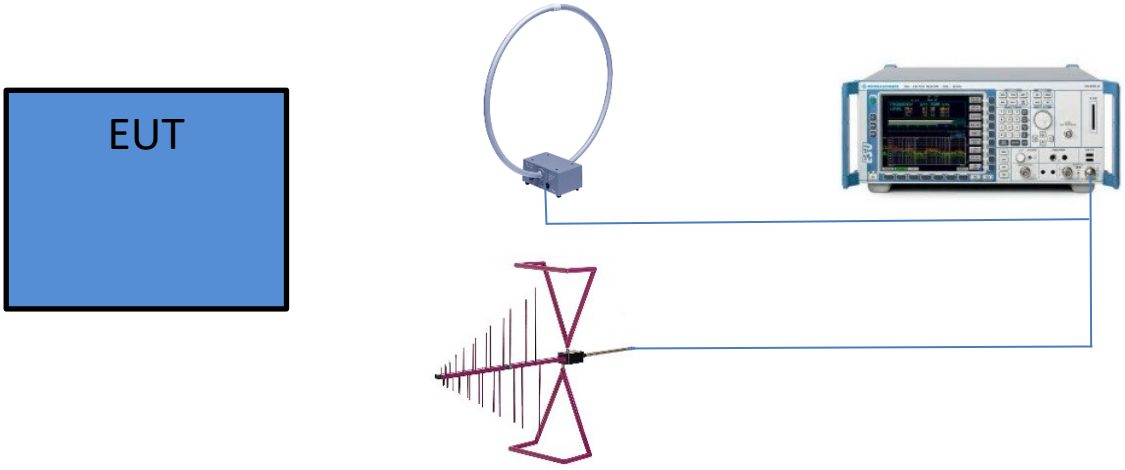

Figure 3.6-1: Test setup diagram

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 is 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 is no measured disturbance level, increased by (U_{lab} - U_{cispr}), exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance level, increased by (U_{lab} - U_{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		03-14-2022	03-14-2024
System controller	Sunol Sciences	SC104V	E1191	NCR	NCR
Active Loop Antenna (9kHz-30MHz)	EMCO	6507	1733	06-17-2022	06-17-2023
Bilog Antenna (30-1000MHz)	Schaffner-Chase	CBL 6111D	1763	04-01-2022	04-01-2024
Signal and Spectrum Analyzer	Rohde & Schwarz	FSV40	E1120	12-09-2021	12-09-2023
Variac	Shanghai China	TDGC	S1043	NCR	NCR
Temperature chamber	Test Equity	115A	E116	08-29-2022	08-29-2023

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

Table 7.1-2: T*est 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	March 9, 2023	Temperature	20 °C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1005 mbar
Test location	☒ Ground plane ☐ Other:	Relative humidity	50 %

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. Phase and neutral measurements are combined into a single worst-case plot.

8.1.4 Setup details

Port under test	AC power input
EUT power input during test	120 Vac
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ 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

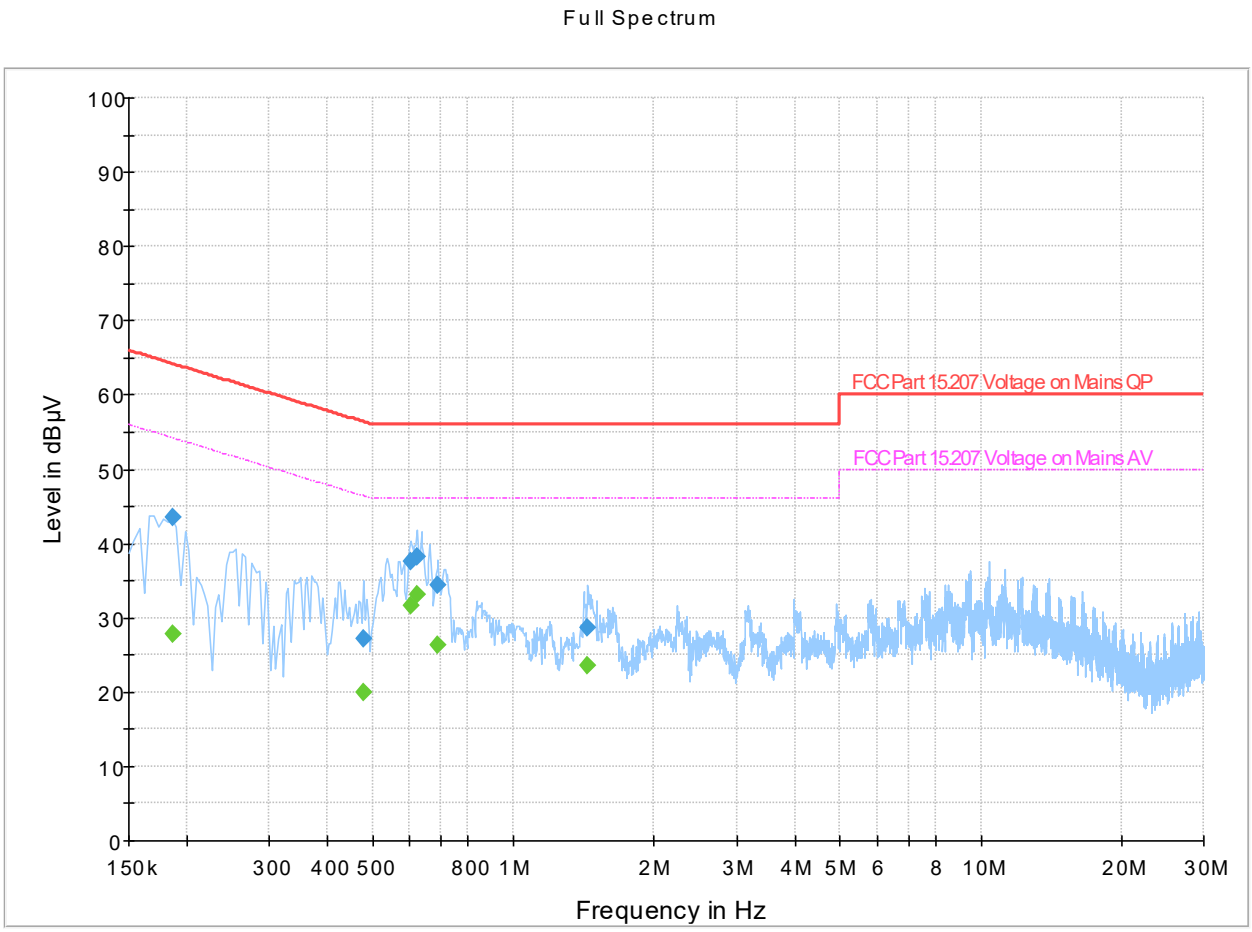

Figure 8.1-1: *Conducted emissions at mains port spectral plot (150 kHz - 30 MHz)*

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)
0.186000	---	27.78	54.21	26.43	5000.0	9.000	N	ON	19.5
0.186000	43.63	---	64.21	20.58	5000.0	9.000	N	ON	19.5
0.478000	---	19.98	46.37	26.39	5000.0	9.000	L1	ON	19.4
0.478000	27.22	---	56.37	29.15	5000.0	9.000	L1	ON	19.4
0.602000	37.60	---	56.00	18.40	5000.0	9.000	N	ON	19.4
0.602000	---	31.57	46.00	14.43	5000.0	9.000	N	ON	19.4
0.622000	38.32	---	56.00	17.68	5000.0	9.000	N	ON	19.4
0.622000	---	33.18	46.00	12.82	5000.0	9.000	N	ON	19.4
0.690000	34.35	---	56.00	21.65	5000.0	9.000	N	ON	19.4
0.690000	---	26.25	46.00	19.75	5000.0	9.000	N	ON	19.4
1.442000	28.59	---	56.00	27.41	5000.0	9.000	N	ON	19.4
1.442000	---	23.48	46.00	22.52	5000.0	9.000	N	ON	19.4

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	March 9, 2023	Temperature	20 °C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1005 mbar
Test location	☐ Wireless bench ☒ Other: 3m chamber	Relative humidity	50 %

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 Vac
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:

Receiver settings:

Resolution bandwidth	20 kHz
Video bandwidth	50 kHz
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 (kHz)	Measured f_c (MHz)	Measured f_L (MHz)	Measured f_H (MHz)	Limit
13.56	461.53	13.56	13.330	13.791	f_H and f_L within 13.110 – 14.010MHz

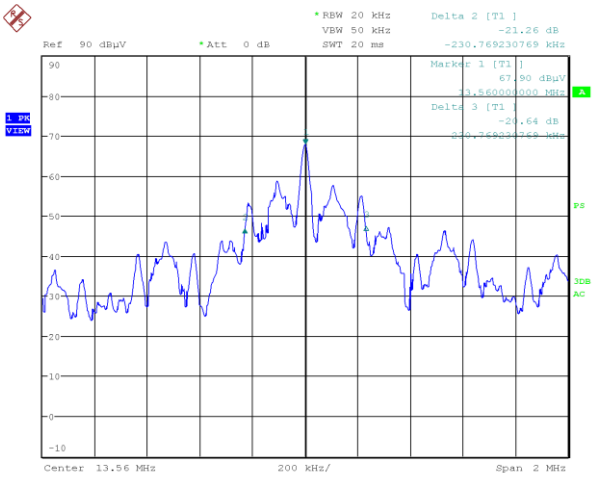

Figure 8.2-1: *20 dB occupied bandwidth, 13.56 MHz*

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	March 9, 2023	Temperature	20 °C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1005 mbar
Test location	☐ Wireless bench ☒ Other: 3m chamber	Relative humidity	50 %

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 theEUT.

8.3.4 Setup details

EUT power input during test	120 Vac
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:

Receiver settings:

Resolution bandwidth	20 kHz
Video bandwidth	50 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 (MHz)
13.56	1.17

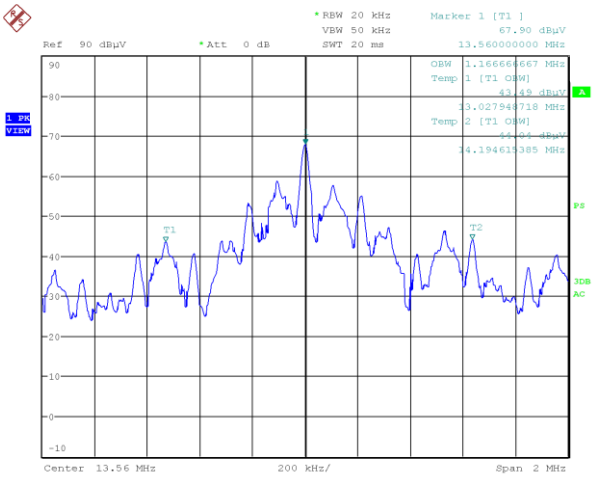

Figure 8.3-1: *99 % occupied bandwidth, 13.56 MHz*

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 µV/m	Field strength of emissions dBµV/m	Measurement distance, 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	March 9, 2023	Temperature	20 °C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1005 mbar
Test location	☐ 10m semi anechoic chamber ☒ 3m semi anechoic chamber ☐ Wireless bench ☐ Other:	Relative humidity	50 %

8.4.3 Notes

None

8.4.4 Setup details

EUT power input during test	120 Vac
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ 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

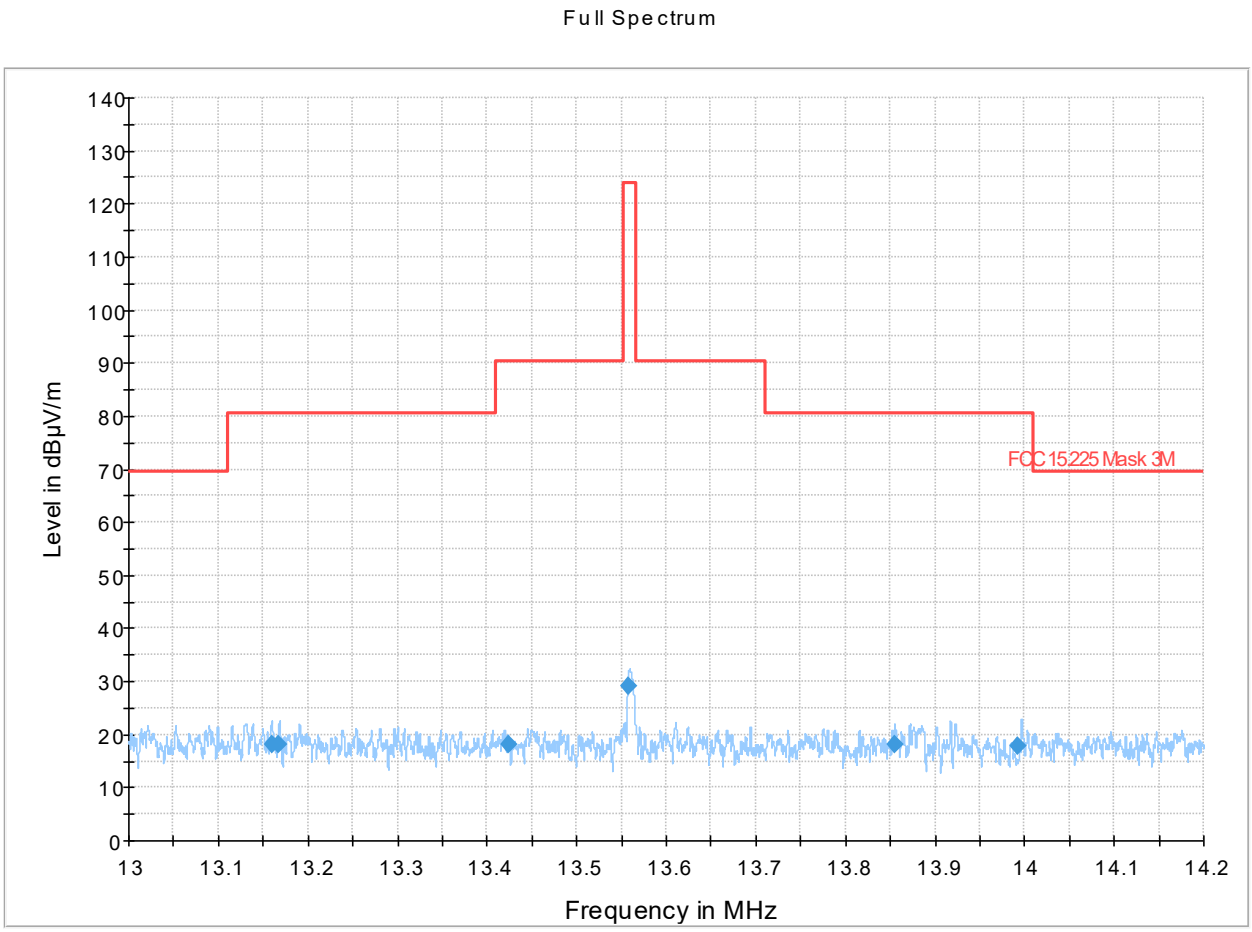

Figure 8.4-1: *Radiated emissions spectral plot (13 MHz - 14.2 MHz), 0 degrees*

Table 8.4-4*: Radiated emissions results, 0 degrees*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
13.159580	18.22	80.51	62.29	15000.0	9.000	H	48.0	11.0
13.166340	18.24	80.51	62.26	15000.0	9.000	H	115.0	11.0
13.424380	18.14	90.48	72.33	15000.0	9.000	H	317.0	11.0
13.557740	29.14	124.00	94.86	15000.0	9.000	H	343.0	11.0
13.855460	18.03	80.51	62.48	15000.0	9.000	H	301.0	11.0
13.991860	17.93	80.51	62.58	15000.0	9.000	H	332.0	11.0

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.

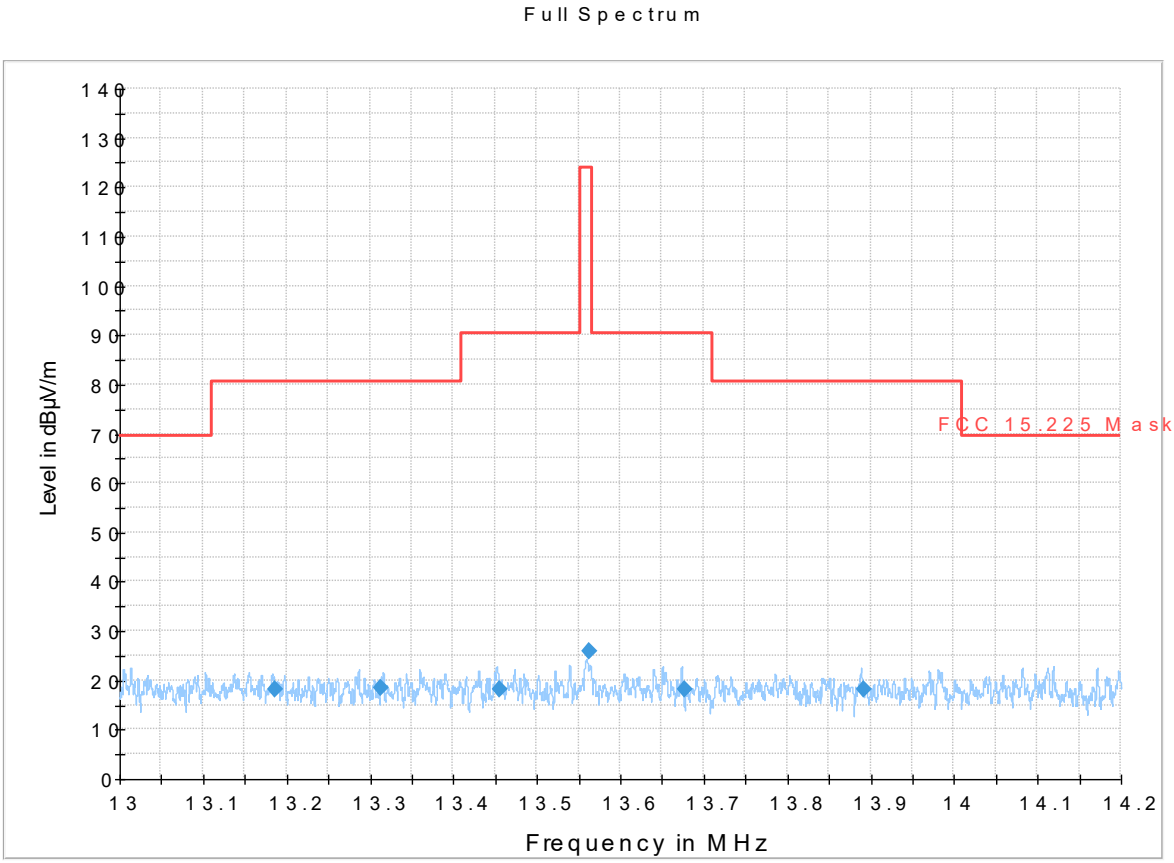

Figure 8.4-2: *Radiated emissions spectral plot (13 MHz - 14.2 MHz), 90 degrees*

Table 8.4-5*: Radiated emissions results, 90 degrees*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
13.186020	18.26	80.51	62.25	15000.0	9.000	H	52.0	11.0
13.312620	18.29	80.51	62.22	15000.0	9.000	H	250.0	11.0
13.454940	18.23	90.48	72.24	15000.0	9.000	H	288.0	11.0
13.563220	25.88	124.00	98.12	15000.0	9.000	H	255.0	11.0
13.676940	18.09	90.48	72.38	15000.0	9.000	H	194.0	11.0
13.891980	18.09	80.51	62.41	15000.0	9.000	H	230.0	11.0

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

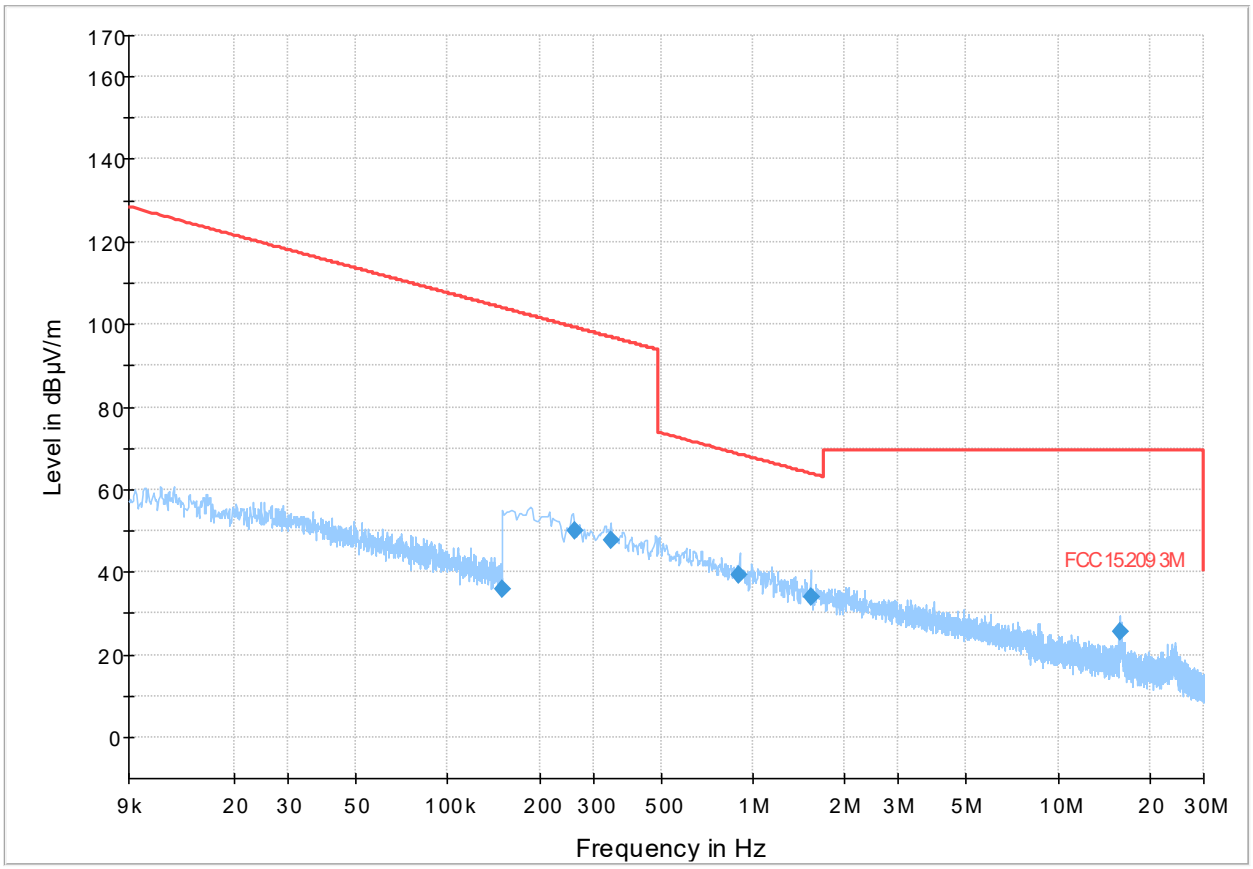

Figure 8.4-3: *Radiated emissions spectral plot (9 kHz - 30 MHz), 0 degrees*

Table 8.4-6*: Radiated emissions results, 0 degrees*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
0.150000	35.89	104.08	68.18	15000.0	0.200	H	267.0	10.4
0.261960	50.15	99.24	49.08	15000.0	9.000	H	347.0	10.2
0.344540	47.85	96.86	49.00	15000.0	9.000	H	87.0	10.2
0.900705	39.19	68.53	29.33	15000.0	9.000	H	26.0	10.4
1.550480	33.97	63.82	29.86	15000.0	9.000	H	54.0	10.7
16.046625	25.52	69.50	43.98	15000.0	9.000	H	114.0	11.0

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

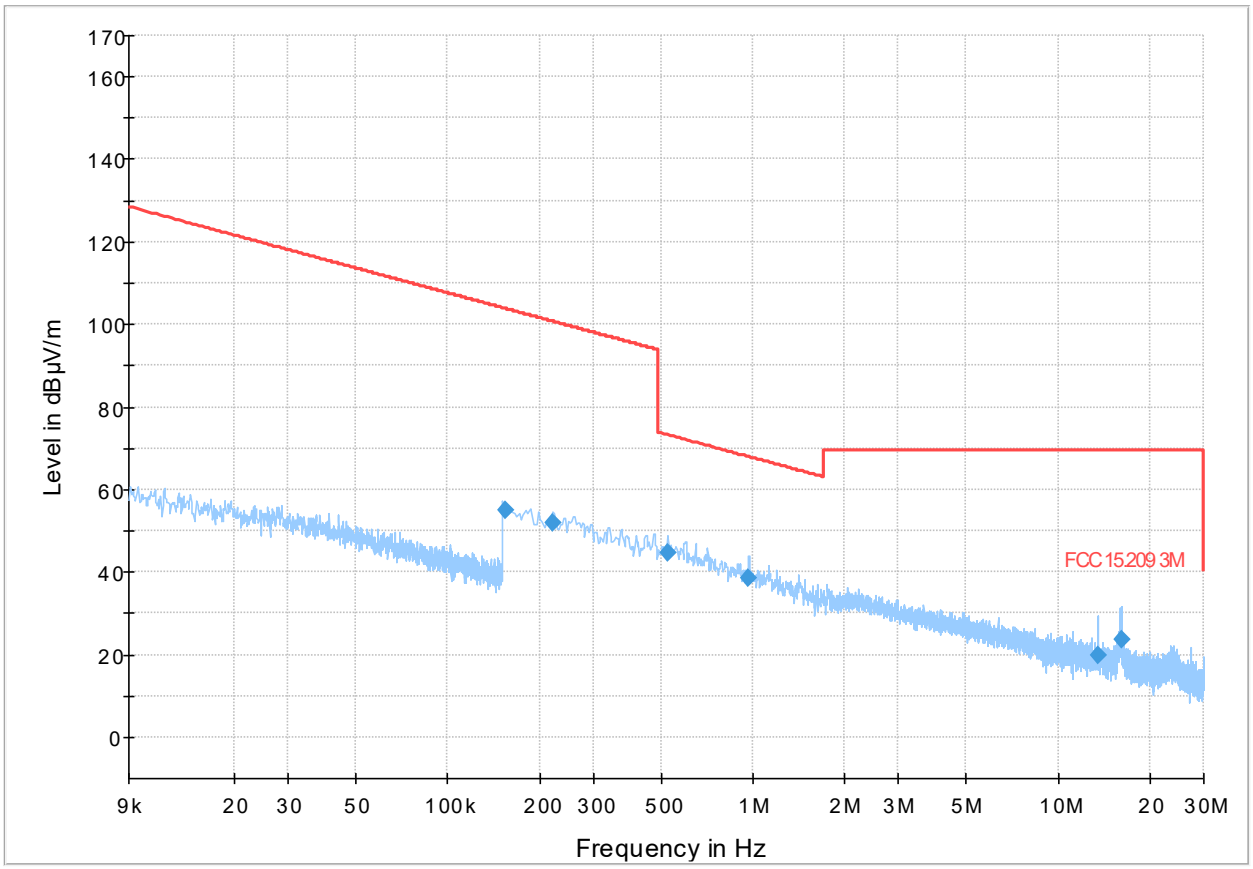

Figure 8.4-4: *Radiated emissions spectral plot (9 kHz - 30 MHz), 90 degrees*

Table 8.4-7*: Radiated emissions results, 90 degrees*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
0.154500	54.96	103.82	48.86	15000.0	9.000	H	329.0	10.3
0.221140	51.80	100.71	48.91	15000.0	9.000	H	20.0	10.2
0.527625	44.50	73.16	28.66	15000.0	9.000	H	279.0	10.4
0.966405	38.66	67.92	29.26	15000.0	9.000	H	13.0	10.6
13.554120	19.70	69.50	49.80	15000.0	9.000	H	200.0	11.0
16.128205	23.79	69.50	45.71	15000.0	9.000	H	119.0	11.0

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

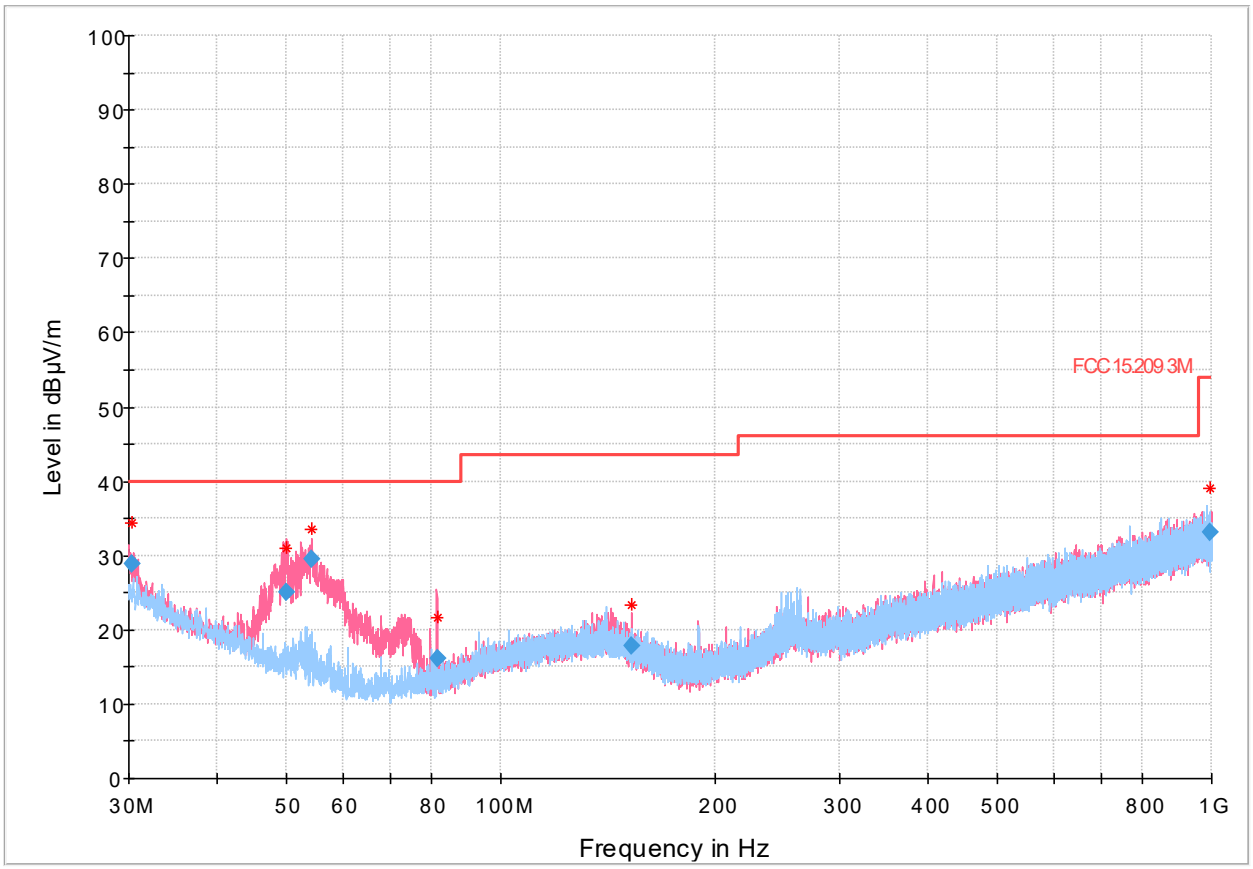

Figure 8.4-5: *Radiated emissions spectral plot (30 MHz - 1 GHz)*

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)
30.369667	28.96	40.00	11.04	5000.0	120.000	106.0	V	278.0	26.4
49.872667	25.09	40.00	14.91	5000.0	120.000	122.0	V	320.0	15.9
54.237667	29.52	40.00	10.48	5000.0	120.000	159.0	V	28.0	14.0
81.445333	16.15	40.00	23.85	5000.0	120.000	141.0	V	74.0	15.0
153.143667	17.93	43.50	25.57	5000.0	120.000	106.0	V	11.0	19.1
994.951333	33.06	53.90	20.84	5000.0	120.000	331.0	H	317.0	33.9

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 ±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	March 10, 2023	Temperature	20 °C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1007 mbar
Test location	☒ Wireless bench ☐ Other:	Relative humidity	51 %

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:

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

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

8.5.4 Setup details

EUT power input during test	120 Vac
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:

8.5.5 Test data

Table 8.5-1: *Frequency stability with respect to ambient temperature results*

Temp. (°C)	f_c (MHz)	Drift (%) (FCC)	Drift (ppm) (RSS)
50	13.560028	0.000206	2.06
40	13.560032	0.000236	2.36
30	13.560022	0.000162	1.62
20	13.560028	0.000206	*2.06*
10	13.560029	0.000133	2.06
0	13.560034	0.000177	2.36
-10	13.560083	0.000214	1.62
-20	13.560531	0.000251	*2.06*

Table 8.5-2: *Frequency stability with respect to supply voltage results*

Voltage (V)	f_c (MHz)	Drift (%) (FCC)	Drift (ppm) (RSS)
85%	13.560018	0.000133	1.33
Nominal	*13.560024*	0.000177	*1.77*
115%	13.560029	0.000214	2.14

End of test report