Test report

REP026818-2R1TRFWL

Date of issue: April 25, 2024

Applicant:

Murphy's Bowl LLC

Product:

Murphy's Bowl Access Portal (MBAP)

Model:

IDAP v1.0, IDAP nUWB x1.0

Variant(s):

None

FCC ID:

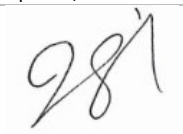
2BE69-MBPA01

Specifications:

- FCC 47 CFR § 15.225 - Operation within the band 13.110-14.010 MHz

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 25, 2024
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	Operation within the band 13.110-14.010 MHz

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
REP026818-2TRFWL	March 30, 2024	Original report issued
REP026818-2R1TRFWL	April 25, 2024	Updated following TCB feedback

Section 2 Summary of test results

2.1 Sample information

Receipt date	06-Feb-24
Nemko sample ID number	REP026818

2.2 Testing period

Test start date	06-Feb-24
Test end date	23-Feb-24

2.3 Test results

Table 2.3-1: *Summary of results*

FCC Clause	Test description	Verdict
§15.207(a)	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
§15.225(a)	Field strength within 13.553–13.567 MHz band	Pass
§15.225(b)	The field strength within the bands 13.410–13.553 MHz and 13.567–13.710 MHz	Not applicable
§15.225(c)	The field strength within the bands 13.110–13.410 MHz and 13.710–14.010 MHz	Not applicable
§15.225(d)	The field strength outside the band 13.110–14.010 MHz.	Pass
§15.225(e)	Frequency tolerance of carrier signals	Pass

Note 1: The EUT is powered via PoE (power over ethernet). While AC conducted emissions measurements are not mandatory, they are provided for informational purposes. Emissions were measured at the AC port of the supporting power supply which fed 48 V DC PoE to the EUT.

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

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	Murphy's Bowl LLC
Address	10400 NE 4th Street, Suite 3600,
City	Bellevue
State	WA
Postal/Zip code	98004
Country	Unites States

3.3 Manufacturer

Company name	Schippers and Crew, Inc.
Address	5309 Shilshole Ave NW, Suite 100
City	Seattle
State	WA
Postal/Zip code	98107
Country	United States

3.4 EUT information

Product name	Murphy's Bowl Access Portal (MBAP)
Model	IDAP v1.0, IDAP nUWB x1.0
Variant(s)	None
Serial number	None
Part number	None

Frequency band(s)	13.110-14.010MHz
Fundamental frequency	13.56MHz
Power requirements	48v DC or PoE
Description/theory of operation	Turn on the device, the NFC module will activate automatically
Antenna information	Integrated antenna
Software details	None

3.5 EUT exercise and monitoring details

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

- Turn on the devices, NFC module will activate automatically.

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	None	None	None	None

Table 3.6-2: *EUT interface ports*

Description	Qty.
USB	2
Ethernet	3
Power	1

Table 3.6-3: *Support equipment*

Description	Brand name	Model/Part number	Serial number	Rev.
Laptop	HP	Latitude 5420	None	None
Network switch	Netgear	MS108EUP	6R52285WA0057	None

Table 3.6-4: *Inter-connection cables*

Cable description	From	To	Length (m)
Ethernet cable	Network switch	EUT	4m

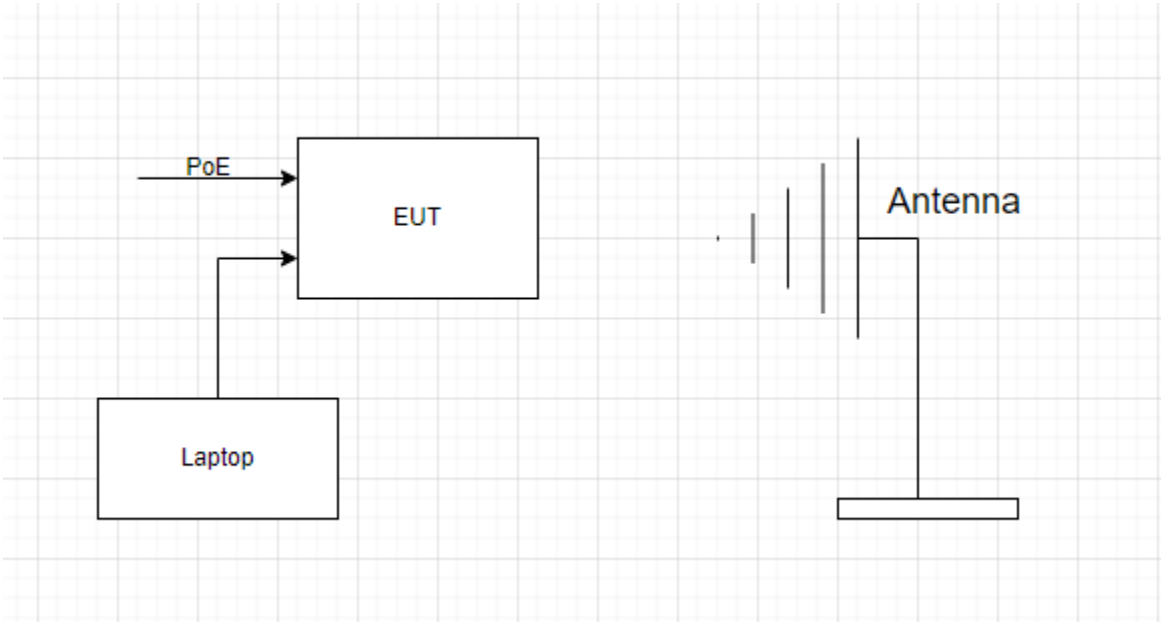


Figure 3.6-1: Test setup diagram

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	E1121	1 year	08-23-2024
System controller	Sunol Sciences	SC104V	E1191	NCR	NCR
Active Loop H Field Antenna	EMCO - HP	6502	E1267	2 years	08-02-2025
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	10-03-2024
Transient Limiter (10 dB pad)	Hewlett Packard	11947A	681	NCR	NCR
Temperature chamber	Test Equity	115A	E1162	1 year	08-23-2024

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
- 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	February 22, 2024	Temperature	21 °C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1003.4 mbar
Test location	☒ Ground plane ☐ Other:	Relative humidity	54 %

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. Measurements performed on the AC power input of 48 VDC power source.

8.1.4 Setup details

Port under test	AC power input
EUT power input during test	120 VAC to 48 VDC
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

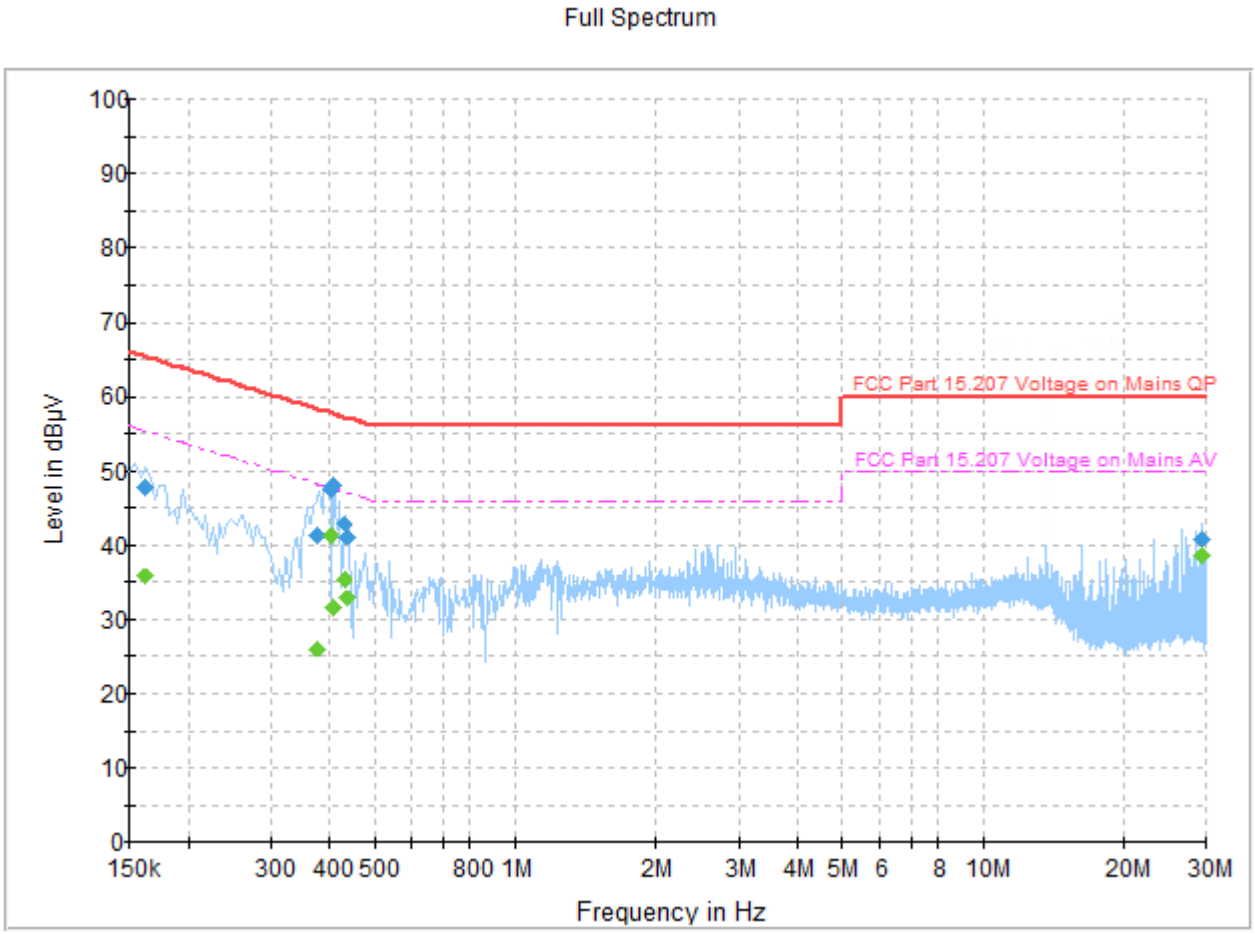


Figure 8.1-1: *Conducted emissions at mains port spectral plot (150 kHz - 30 MHz)*

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)
0.162000	---	35.79	55.36	19.57	5000.0	9.000	L1	ON	19.6
0.162000	47.76	---	65.36	17.60	5000.0	9.000	L1	ON	19.6
0.378000	41.36	---	58.32	16.96	5000.0	9.000	N	ON	19.5
0.378000	---	26.17	48.32	22.15	5000.0	9.000	N	ON	19.5
0.402000	47.53	---	57.81	10.28	5000.0	9.000	N	ON	19.5
0.402000	---	41.42	47.81	6.39	5000.0	9.000	N	ON	19.5
0.410000	48.20	---	57.65	9.45	5000.0	9.000	L1	ON	19.5
0.410000	---	31.60	47.65	16.05	5000.0	9.000	L1	ON	19.5
0.430000	42.90	---	57.25	14.36	5000.0	9.000	L1	ON	19.5
0.430000	---	35.51	47.25	11.74	5000.0	9.000	L1	ON	19.5
0.438000	---	32.89	47.10	14.21	5000.0	9.000	N	ON	19.5
0.438000	41.14	---	57.10	15.96	5000.0	9.000	N	ON	19.5
29.238000	---	38.54	50.00	11.46	5000.0	9.000	N	ON	20.6
29.238000	40.80	---	60.00	19.20	5000.0	9.000	N	ON	20.6

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	February 16, 2024	Temperature	22 °C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1002.1 mbar
Test location	☐ Wireless bench ☒ Other:3m Anechoic chamber	Relative humidity	54 %

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

Receiver settings:

Resolution bandwidth	10 Hz
Video bandwidth	30 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 (Hz)	Measured f_c (MHz)	Measured f_L (MHz)	Measured f_H (MHz)	Limit
13.56MHz	33.654	13.56054	13.56052	13.56055	f_H and f_L within 13.110 – 14.010MHz

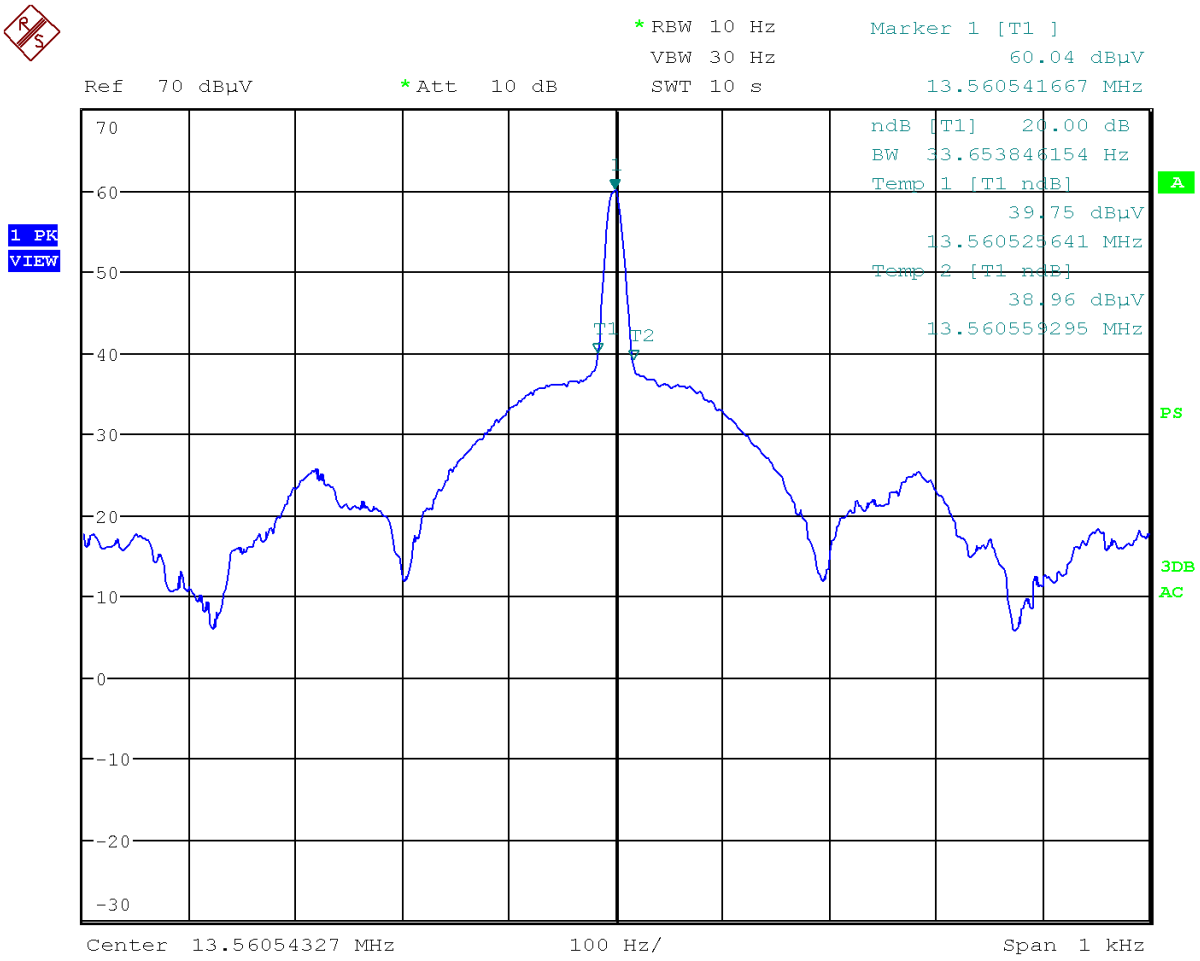


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Figure 8.2-1: *20 dB occupied bandwidth*

8.3 Radiated emissions

8.3.1 References and limits

- FCC §15.225(a)-(d)
- 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.

Table 8.3-1: *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 8.3-2: *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			

8.3.2 Test summary

Verdict	Pass		
Test date	February 15, 2024	Temperature	23 °C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1002.5mbar
Test location	☒ 10m semi anechoic chamber ☐ 3m semi anechoic chamber ☐ Wireless bench ☐ Other:	Relative humidity	58 %

8.3.3 Notes

The limits for radiated emissions in the range 9 kHz to 30 MHz were calculated from the 15.209 limits and extrapolated to a 3m measurement distance using equation [4] from ANSI C63.10 Section 6.4.4.2:

$$FS_{limit} = FS_{max} - 40\log\left(\frac{d_{limit}}{d_{measure}}\right)$$

Frequency (MHz)	Field strength (microvolts/meter)	Field strength (dBuV/m)	Limit Distance (m)	Mesurement Distance (m)	Adjusted Limit (dBuV/m)
0.009	266.67 (2400/f(kHz))	48.52	300	3	128.52
0.490	4.90 (2400/f(kHz))	13.80	300	3	93.80
0.490	48.90 (24000/f(kHz))	33.80	30	3	73.80
1.705	14.07 (24000/f(kHz))	22.97	30	3	62.97
1.705	30	29.54	30	3	69.54
30	30	29.54	30	3	69.54

Emissions mask measurment limits in the range 13.110 – 14.010 Mhz were calculated from the 15.225 limits and extrapolated to a 3m measurmeent distance using the same equation as above:

Frequency (MHz)	Field strength (microvolts/meter)	Field strength (dBuV/m)	Limit Distance (m)	Mesurement Distance (m)	Adjusted Limit (dBuV/m)
13.110	106	40.51	30	3	80.51
13.410	106	40.51	30	3	80.51
13.410	334	50.47	30	3	90.47
13.553	334	50.47	30	3	90.47
13.553	15848	84.00	30	3	124.00
13.567	15848	84.00	30	3	124.00
13.567	334	50.47	30	3	90.47
13.710	334	50.47	30	3	90.47
13.710	106	40.51	30	3	80.51
14.010	106	40.51	30	3	80.51

8.3.4 Setup details

EUT power input during test	PoE
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)

8.3.5 Test data

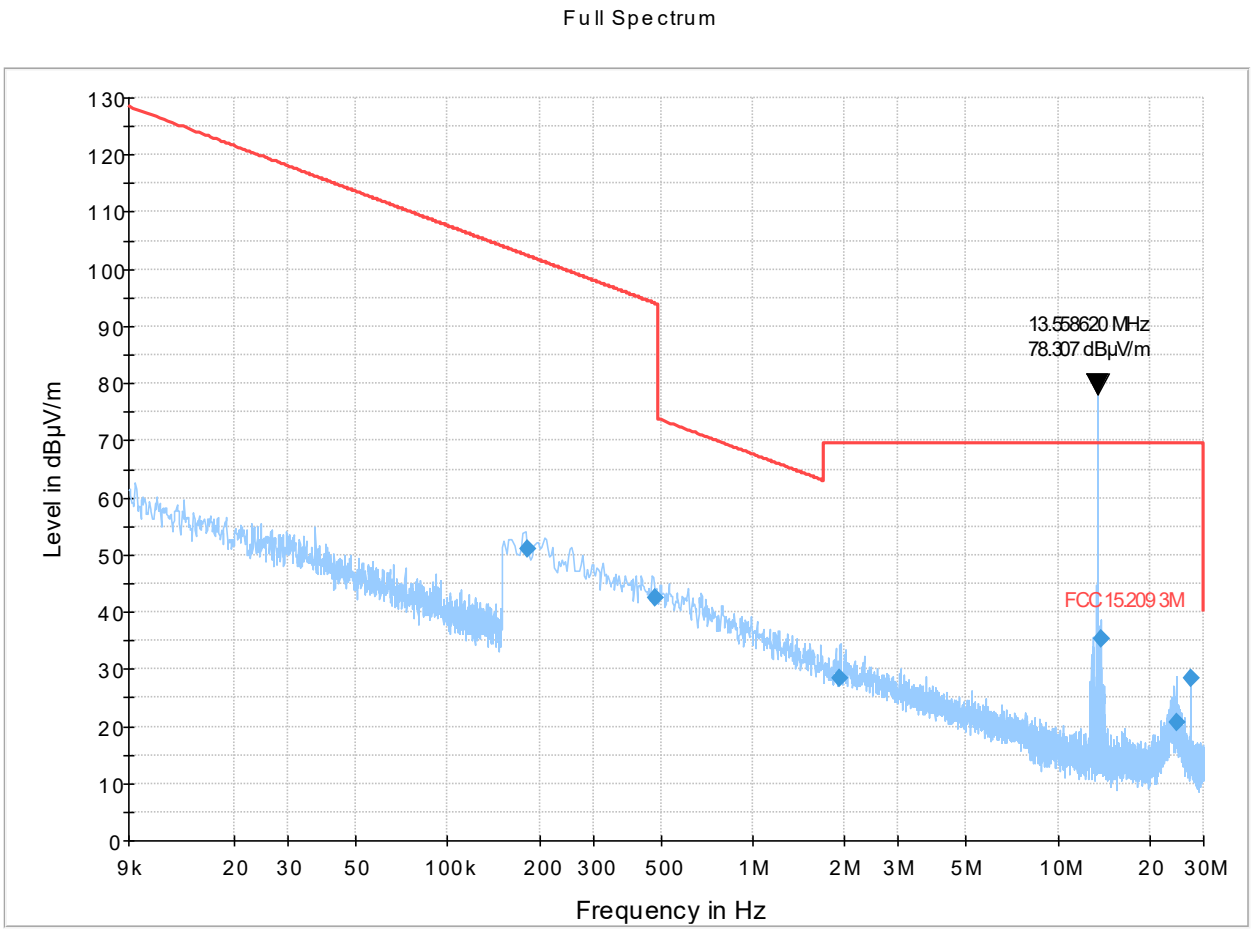

Figure 8.3-1: *Radiated emissions spectral plot (9 kHz - 30 MHz) 0degree*

Table 8.3-3*: Radiated emissions results*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
0.181365	50.99	102.43	51.44	15000.0	9.000	H	124.0	10.5
0.476880	42.39	94.04	51.65	15000.0	9.000	H	290.0	10.3
1.930530	28.54	69.50	40.96	15000.0	9.000	H	32.0	10.7
13.837695	35.43	69.50	34.07	15000.0	9.000	H	0.0	11.1
24.364805	20.61	69.50	48.89	15000.0	9.000	H	0.0	10.1
27.120945	28.40	69.50	41.10	15000.0	9.000	H	104.0	9.4

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

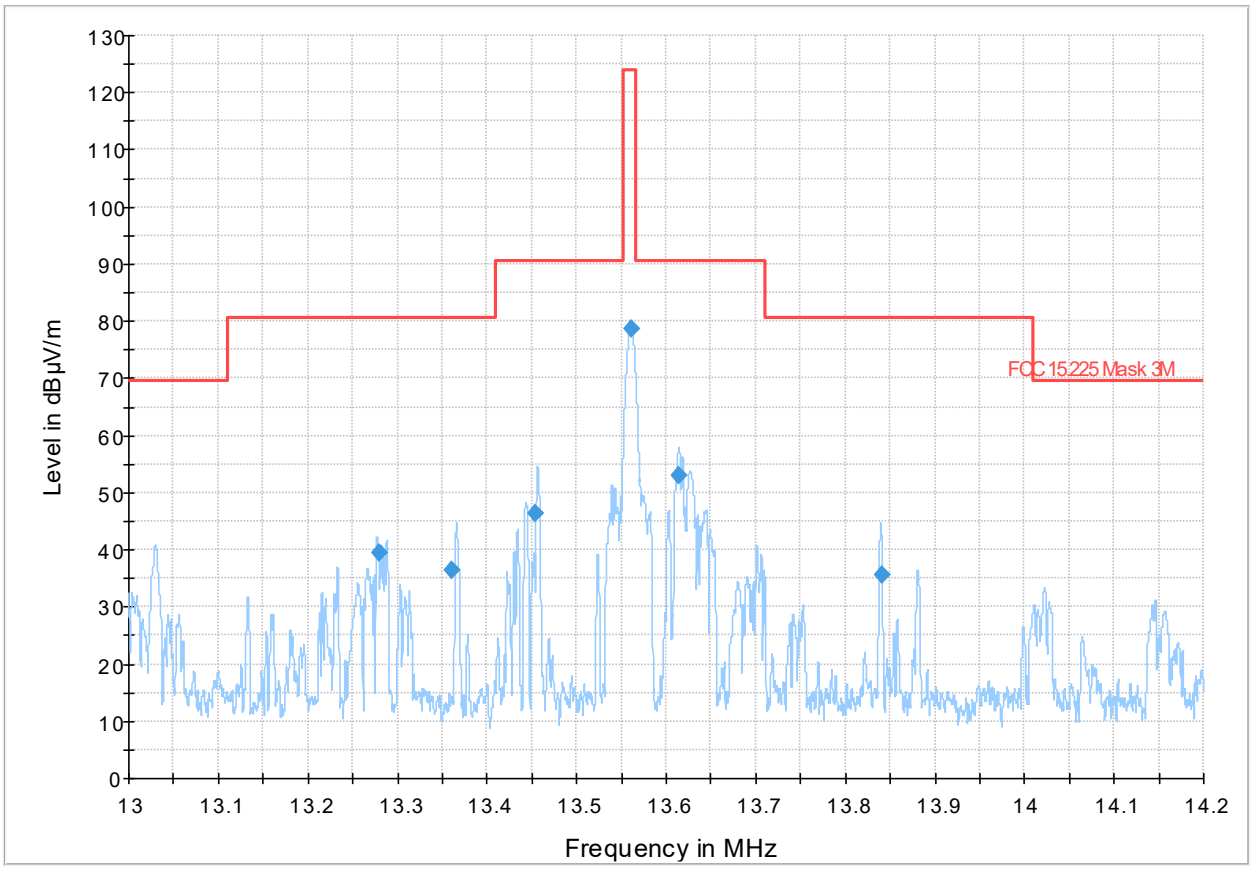

Figure 8.3-2: *Radiated emissions spectral plot (13 MHz - 14.2 MHz) 0 degree*

Table 8.3-4*: Radiated emissions results*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
13.279980	39.56	80.51	40.95	15000.0	9.000	H	0.0	11.0
13.361260	36.54	80.51	43.97	15000.0	9.000	H	0.0	11.0
13.453860	46.26	90.48	44.21	15000.0	9.000	H	8.0	11.0
13.561300	78.67	124.00	45.33	15000.0	9.000	H	8.0	11.1
13.613780	52.96	90.48	37.51	15000.0	9.000	H	7.0	11.1
13.840780	35.51	80.51	45.00	15000.0	9.000	H	0.0	11.1

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

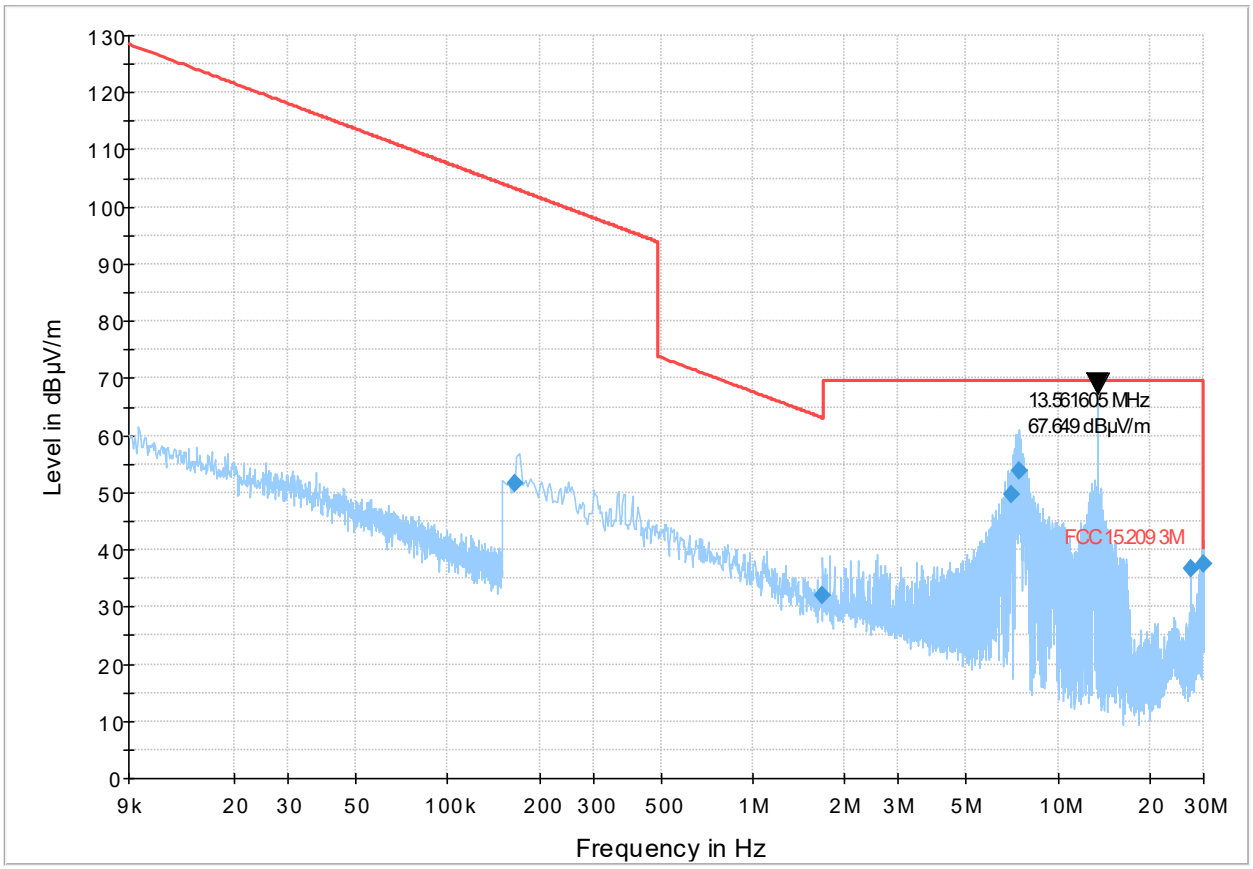

Figure 8.3-3: *Radiated emissions spectral plot (9 kHz - 30 MHz) 90degrees*

Table 8.3-5*: Radiated emissions results*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
0.166395	51.60	103.18	51.57	15000.0	9.000	H	111.0	10.6
1.694745	32.07	63.05	30.98	15000.0	9.000	H	325.0	10.7
7.030940	49.70	69.50	19.80	15000.0	9.000	H	144.0	10.8
7.497585	53.93	69.50	15.57	15000.0	9.000	H	238.0	10.8
27.119960	36.61	69.50	32.89	15000.0	9.000	H	31.0	9.4
29.982575	37.60	69.50	31.90	15000.0	9.000	H	162.0	8.6

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

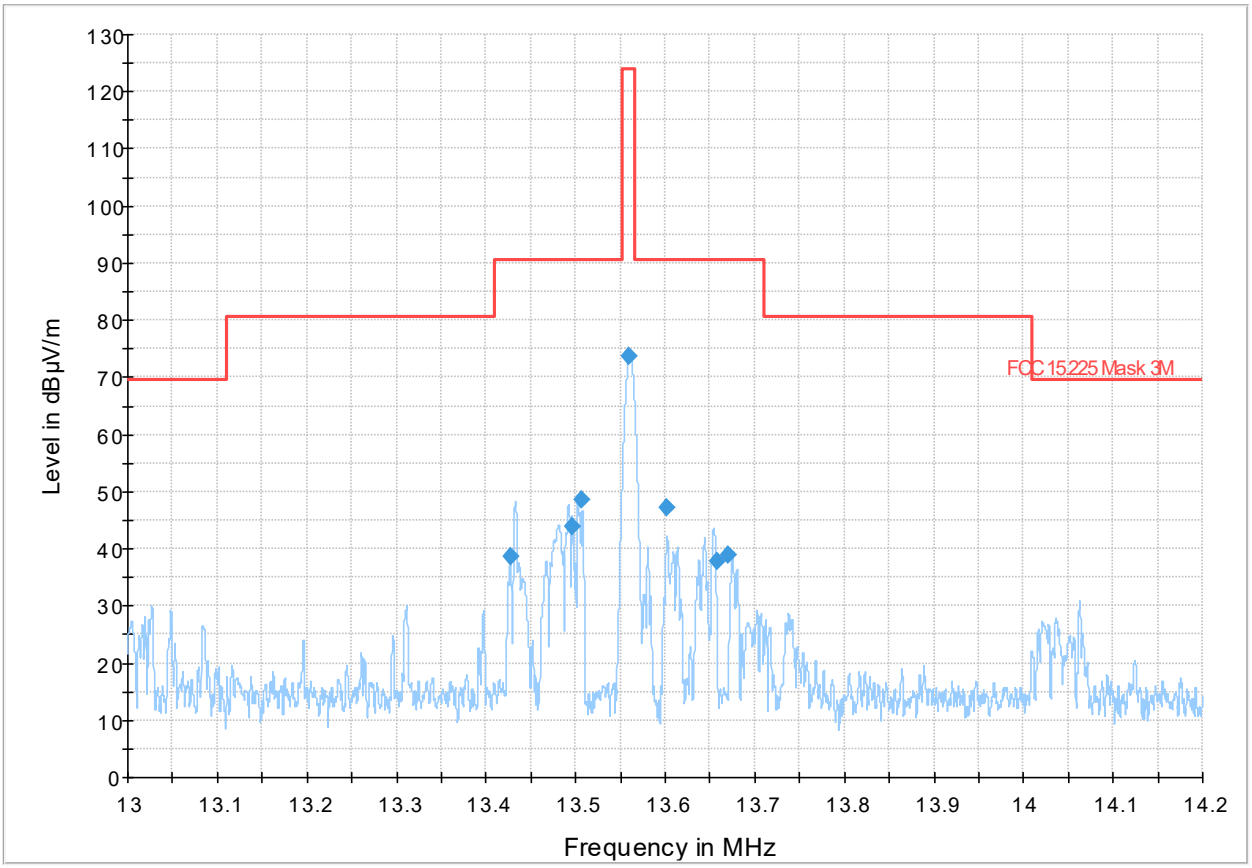

Figure 8.3-4: *Radiated emissions spectral plot (13 MHz - 14.2 MHz) 90 degrees*

Table 8.3-6*: Radiated emissions results*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
13.428220	38.62	90.48	51.85	15000.0	9.000	H	287.0	11.0
13.496020	43.79	90.48	46.68	15000.0	9.000	H	282.0	11.0
13.506940	48.62	90.48	41.86	15000.0	9.000	H	281.0	11.0
13.560140	73.77	124.00	50.23	15000.0	9.000	H	282.0	11.1
13.601540	47.19	90.48	43.29	15000.0	9.000	H	276.0	11.1
13.658740	37.73	90.48	52.74	15000.0	9.000	H	283.0	11.1
13.670620	38.90	90.48	51.58	15000.0	9.000	H	278.0	11.1

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

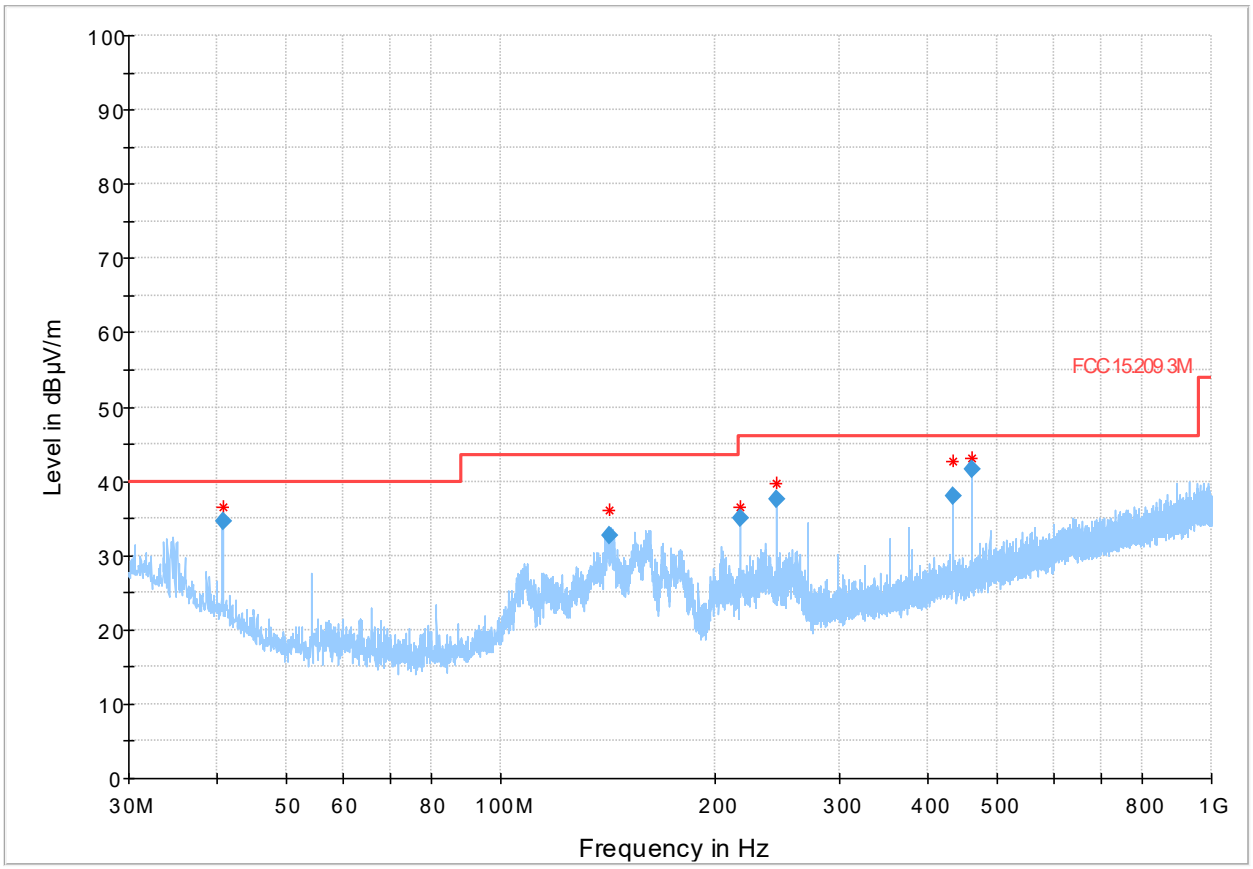

Figure 8.3-5: *Radiated emissions spectral plot (30 MHz - 1 GHz)*

Table 8.3-7*: 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)
40.690000	34.61	40.00	5.39	5000.0	120.000	98.0	V	298.0	20.7
142.130000	32.70	43.50	10.80	5000.0	120.000	196.0	H	154.0	19.3
216.979000	34.99	46.00	11.01	5000.0	120.000	121.0	H	0.0	17.6
244.099000	37.67	46.00	8.33	5000.0	120.000	98.0	H	345.0	20.1
433.936500	37.97	46.00	8.03	5000.0	120.000	117.0	V	155.0	25.4
461.048000	41.54	46.00	4.46	5000.0	120.000	174.0	H	298.0	26.0

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.

8.4 Frequency stability

8.4.1 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.

8.4.2 Test summary

Verdict	Pass		
Test date	February 15, 2024	Temperature	23 °C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1002.5mbar
Test location	☒ Wireless bench ☐ Other:	Relative humidity	58 %

8.4.3 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:

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

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

8.4.4 Setup details

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

8.4.5 Test data

Table 8.4-1: *Frequency stability with respect to ambient temperature results*

Temp (C°)	Voltage	Low Frequency (MHz)	High Frequency (MHz)	F_c (MHz)	Variation (ppm)	Variation (%)
-20	PoE	13.558553	13.562894	13.5607235	53.35545723	0.00320059
-10	PoE	13.558553	13.562894	13.5607235	53.35545723	0.005335546
0	PoE	13.558553	13.562894	13.5607235	53.35545723	0.005335546
10	PoE	13.558263	13.562605	13.560434	32.00589971	0.005335546
20	PoE	13.558263	13.562605	13.560434	32.00589971	0.00320059
30	PoE	13.558263	13.562605	13.560434	32.00589971	0.00320059
40	PoE	13.558263	13.562605	13.560434	32.00589971	0.00320059
50	PoE	13.558263	13.562605	13.560434	32.00589971	0.00320059

End of test report