

Test report

REP0019265-5R1TRFWL

Date of issue: July 31, 2023

Applicant:

JTECH An HME Company

Product Description:

LinkWear Hub

Model:

LWHUB

PMN(s):

LWTX00100, LWTX00200

FCC ID:

WDC-JLWHUB

ISED Certification Number:

7752A-JLWHUB

Specifications:

- ◆ **FCC 47 CFR Part 15, Subpart C – §15.407**
General technical requirements
- ◆ **Industry Canada RSS-247, Issue 2**
Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices

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/MIL/WL Supervisor
Review date	7/31/2023
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 Applicant

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

1.2 Manufacturer

Company name	JTECH An HME Company
Address	1400 Northbrook Parkway, Suite 320
Phoenix	Suwanee
State	GA
Postal/Zip code	30024
Country	USA

1.3 Test specifications

FCC 47 CFR Part 15, Subpart C – §15.407	General technical requirements
IC RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

1.4 Test methods

ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
558074 D01 DTS Measurement Guidance v05r02 (April, 2019)	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

1.5 Exclusions

None

1.6 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.7 Test report revision history

Table 1.7-1: Test report revision history

Revision #	Details of changes made to test report
REP0019265-5R1TRFWL	Original report issued
REP0019265-5R1TRFWL	Updated following TCB reviewer comments

Notes: None

Section 2 Summary of test results

2.1 FCC Part 15 Subpart C, general requirements

Part	Test description	Verdict
§15.207(a)	Conducted limits	Pass
§15.31(e)	Variation of power source	Pass
§15.203	Antenna requirement	Pass

Notes: EUT is AC powered
The antenna uses a unique coupling

2.2 FCC Part 15.407

Part	Test description	Verdict
§15.407(a)	Power limits	Pass
§15.407(b)	Undesirable emission limits	Pass
§15.407(c)	Automatic transmission termination	Not applicable
§15.407(d)	Operational restrictions for 6 GHz U-NII devices	Not applicable
§15.407(e)	Minimum 6 dB bandwidth	Pass
§15.407(f)	Radio frequency radiation exposure requirements	Not applicable
§15.407(g)	U-NII devices frequency stability	Pass
§15.407(h)	Transmit Power Control (TPC) and Dynamic Frequency Selection (DFS)	Not applicable
§15.407(i)	Operational Modes	Not applicable
§15.407(j)	Operator Filing Requirement	Not applicable
§15.407(k)	Automated frequency coordination (AFC) system	Not applicable
§15.407(l)	Incumbent Protection by AFC system: Fixed Microwave Services	Not applicable
§15.407(m)	Incumbent Protection by AFC system: Radio Astronomy Services	Not applicable
§15.407(n)	Incumbent Protection by AFC system: Fixed-Satellite Services	Not applicable

2.3 IC RSS-247, Issue 2

Part	Test description	Verdict
6.2	Power and unwanted emission limits	Pass
6.3	Dynamic frequency selection for devices operating in the bands 5250-5350 MHz, 5470-5600 MHz, and 5650-5725 MHz	Not applicable
6.4	Additional requirements	Not applicable

2.4 IC RSS-GEN, Issue 5

Part	Test description	Verdict
7.3	Receiver radiated emission limits	Not applicable
7.4	Receiver conducted emission limits	Not applicable
8.8	Power Line Conducted Emissions Limits for License-Exempt Radio Apparatus	Pass

Section 3 Equipment under test (EUT) details

3.1 Sample information

Receipt date	November 28, 2022
Nemko sample ID number	PRJ0019265

3.2 EUT information

Product name	LinkWear Hub
Model	LWHUB
Serial number	N/A
Part number	N/A

3.3 Technical information

Frequency bands	U-NII-1: 5150-5250 MHz U-NII-3: 5725-5850 MHz
Minimum frequency (MHz)	5180 MHz; 5745 MHz
Maximum frequency (MHz)	5240 MHz; 5825 MHz
Type of modulation	OFDM (IEEE 802.11n)
Power requirements	100-240V _{AC} , 50-60 Hz
Antenna information	Dipole Antenna detachable: 2.68 dBi Max Gain (U-NII-1); 1.55 dBi Max Gain (U-NII-3)
Bandwidth	20 MHz
# of transmit antenna	1 (MCS0 through MCS7 only)

3.4 EUT exercise and monitoring details

EUT was tested in IEEE 802.11n wireless network specifications, with 20 MHz channel bandwidth, on the low, mid, and high channels.

Table 3.4-1: EUT sub assemblies

Description	Brand name	Model/Part number	Serial number	Rev.
---	---	---	---	---

Table 3.4-2: EUT interface ports

Description	Qty.
Ethernet port	1

Table 3.4-3: Support equipment

Description	Brand name	Model/Part number	Serial number	Rev.
AC/DC Adapter	N/A	N/A	N/A	--
Laptop	Dell	N/A	N/A	--

Table 3.4-4: Inter-connection cables

Cable description	From	To	Length (m)
Ethernet	Support laptop	EUT	1

3.5 EUT setup diagram

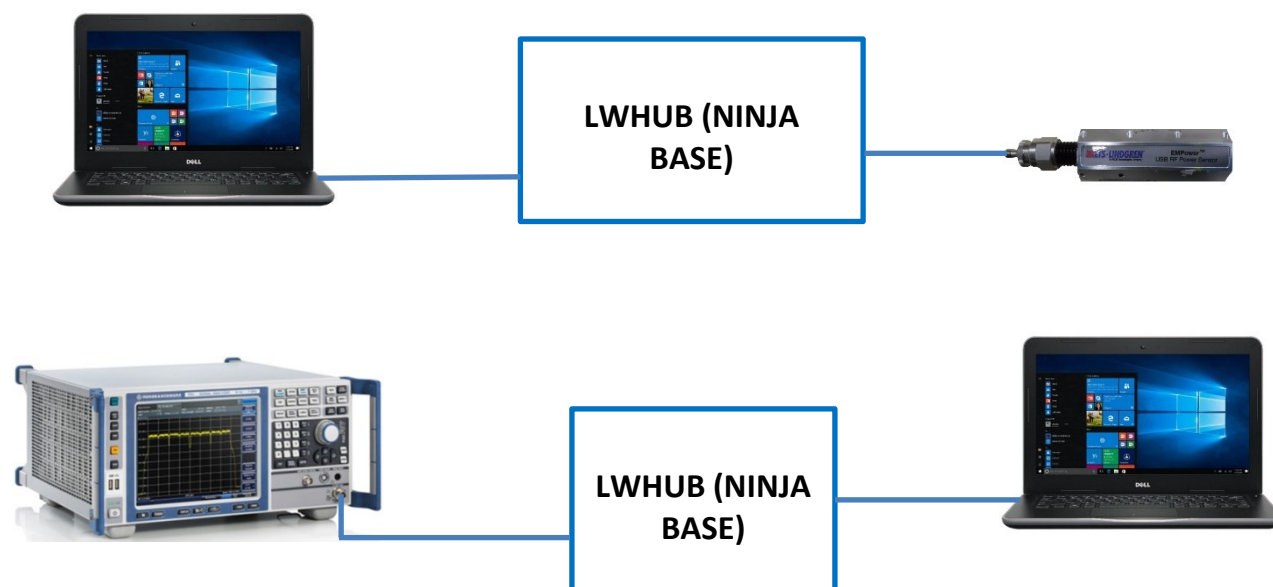


Figure 3.5-1: Conducted setup diagram.

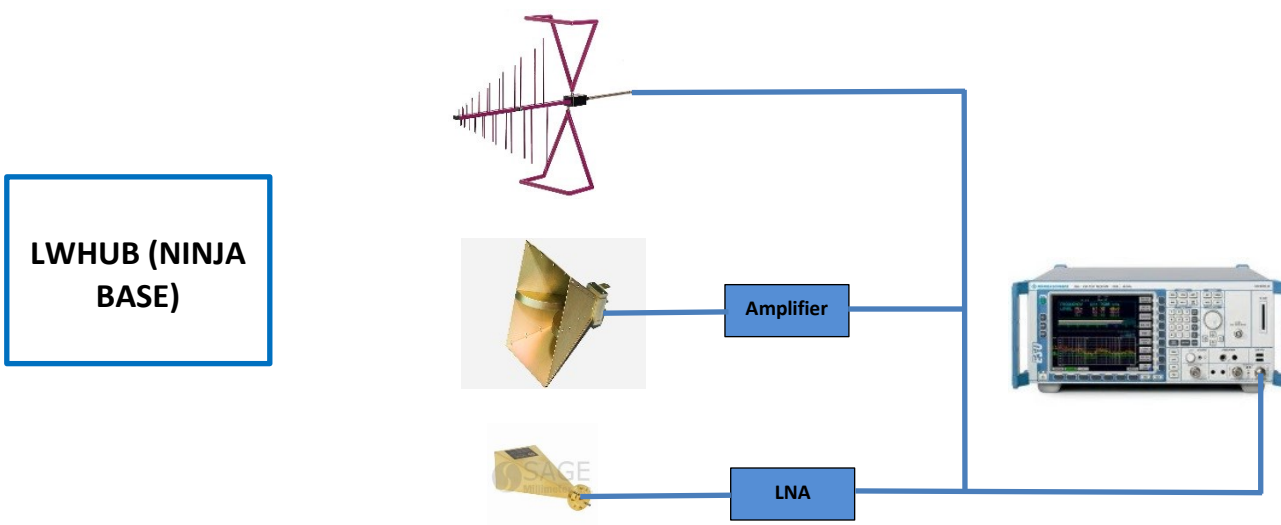


Figure 3.5-2: Radiated setup diagram.

Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

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 $\pm 5\%$, for which the equipment was designed.

Section 6 Measurement uncertainty

6.1 Uncertainty of measurement

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of $K = 2$ with 95% certainty.

Test name	Measurement uncertainty, dB
Radiated spurious emissions	3.78
Powerline conducted emissions	1.38
All antenna port measurements	0.55
Conducted spurious emissions	1.13

Section 7 Test Equipment

Table 6.1-1: Test Equipment List

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI Test Receiver	Rohde & Schwarz	ESCI 7	E1026	1 year	03-22-2023
Transient Limiter	Hewlett-Packard	11947A	681	VOU	VOU
Two Line V-Network	Rohde & Schwarz	ENV216	E1019	1 year	09-30-2023
Signal and spectrum analyzer	Rohde & Schwarz	FSV40	E1120	2 years	12-09-2023
Power sensor	ETS Lindgren	7002-006	E1061	1 year	06-21-2023
EMI Test Receiver	Rohde & Schwarz	ESU40	E1131	1 year	03-02-2023
System Controller	Sunol Sciences	SC104V	E1191	NCR	NCR
Bilog Antenna (30-1000 MHz)	Schaffner	CBL 6111D	1763	2 years	04-01-2024
DRG Horn (1-18 GHz)	ETS-Lindgren	3117-PA	E1139	2 years	04-19-2023
Horn antenna (18-26.5 GHz)	Eravant	SAZ-2410-42-S1	EW107	1 year	11-22-2023
Horn antenna (26.5-40 GHz)	Eravant	SAZ-2410-2-S1	EW108	1 year	11-22-2023
Low noise amplifier	Sage Millimeter, Inc.	SBL-1834034030-KFKF	E1228	VOU	VOU
2.4GHz notch filter	Micro-Tonics	HPM50110-01	E1142	NCR	NCR
Signal / Spectrum analyzer	Rohde & Schwarz	FSW43	E1302	1 year	10-20-2023

Notes: NCR - no calibration required

Table 6.1-2: Test Software

Manufacturer of Software	Details
Rohde & Schwarz	EMC 32 V10.60.15 (radiated emissions)

Notes: None

Section 8 Testing data

8.1 FCC 15.407(a) and RSS-247 Power Limits

8.1.1 Definition and limits

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart E → §15.407(a)

8.1.2 Test summary

Verdict	Pass		
Test date	December 12, 2022; December 14, 2022	Temperature	20 °C; 22 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1008 mbar; 1006 mbar
Test location	Wireless bench	Relative humidity	52 %; 53%

8.1.3 Notes

Testing was performed in Tx mode and the EUT transmitting on a fixed channel at power define in note 1 of section 8.1.5. Low, Middle, and High channel were tested using all the modulations declared by manufacturer used in IEEE 802.11n: MCS0 to MCS7. Based on the results, worst case modulation was selected and used for other testing of this document. Only one bandwidth was declared by the manufacturer.

The attenuation of the interconnecting cable was included in the power meter software as a correction factor.

The antenna gain is 2.68 dBi (U-NII-1) and 1.55 dBi (U-NII-3) per client declaration.

EIRP = Conducted Power + Declared Antenna Gain; Conducted limit: 23.98 dBm (250 mw); EIRP limit = 29.98 dBm (995.4054 mw).

8.1.4 Setup details

EUT setup configuration	Tabletop
Test facility	Nemko San Diego
Measurement method	ANSI C63.10 §11.9.1.3 PKPM1 (Peak Power Meter) method

8.1.5 Test data

Table 8.1-1: Output power U-NII-1 band: 5150-5250 MHz

Channel	Frequency	IEEE 802.11n: Power (dBm)							
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
36	5180 MHz	15.45	15.29	15.22	15.20	15.16	15.14	15.13	15.13
44	5220 MHz	16.47	16.38	16.36	16.35	16.29	16.27	16.23	16.20
48	5240 MHz	16.76	16.55	16.40	16.34	16.29	16.20	16.16	16.15

Table 8.1-2: Output power U-NII-3 band: 5725-5850 MHz

Channel	Frequency	IEEE 802.11n: Power (dBm)							
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
149	5745 MHz	14.61	14.00	13.90	13.77	13.65	13.61	13.57	13.54
157	5785 MHz	13.27	13.03	12.92	12.89	12.71	12.68	12.64	12.60
165	5825 MHz	11.73	11.43	11.34	11.31	11.20	11.10	11.08	11.05

Note 1: Based on the results above, the highest power in each band is considered as worst case.

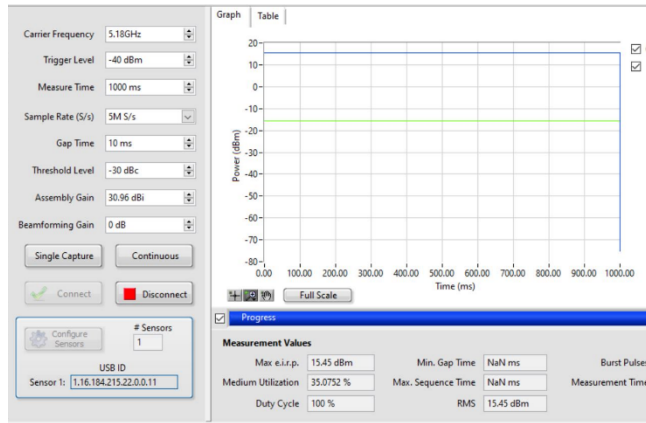
U-NII-1 band: 5150-5250 MHz → IEEE 802.11n MCS0 (worst case) → Power defined by software to get the power table 8.1.1: 15.5 dBm

U-NII-3 band: 5725-5850 MHz → IEEE 802.11n MCS0 (worst case). → Power defined by software to get the power table 8.1.2: 15.5 dBm

8.1.5 Test data, continued

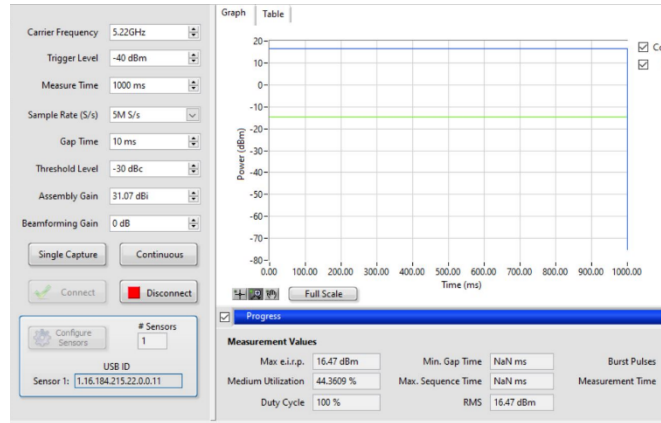
Operating Mode	Test Frequency (MHz)	Maximum Conducted Power (dBm)	Maximum Conducted Power (mW)	Declared Antenna Gain (dBi)	EIRP (dBm)	EIRP (mW)
MCS0; 20 MHz bandwidth; Channel 36	5180	15.45	35.076	2.68	18.13	65.013
MCS0; 20 MHz bandwidth; Channel 44	5220	16.47	44.361	2.68	19.15	82.225
MCS0; 20 MHz bandwidth; Channel 48	5240	16.76	47.425	2.68	19.44	87.903
MCS0; 20 MHz bandwidth; Channel 149	5745	14.61	28.907	1.55	16.16	41.305
MCS0; 20 MHz bandwidth; Channel 157	5785	13.27	21.233	1.55	14.82	30.339
MCS0; 20 MHz bandwidth; Channel 165	5825	11.73	14.894	1.55	13.28	21.282

Table 8.1-3: Output power and E.I.R.P.



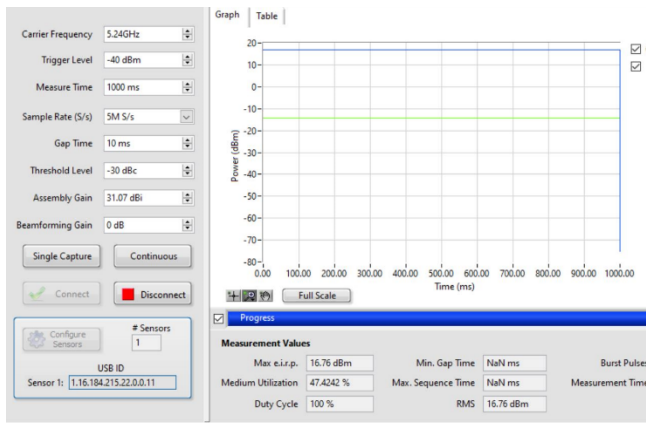
Acquisition Complete

Figure 8.1-1: IEEE 802.11n MCS0 20 MHz BW, Channel 36: 5180 MHz



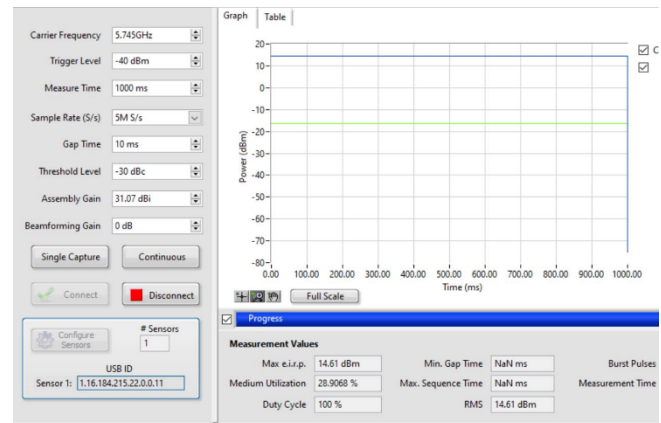
Acquisition Complete

Figure 8.1-2: IEEE 802.11n MCS0 20 MHz BW, Channel 44: 5220 MHz



Acquisition Complete

Figure 8.1-3: IEEE 802.11n MCS0 20 MHz BW, Channel 48: 5240 MHz



Acquisition Complete

Figure 8.1-4: IEEE 802.11n MCS0 20 MHz BW, Channel 149: 5745 MHz

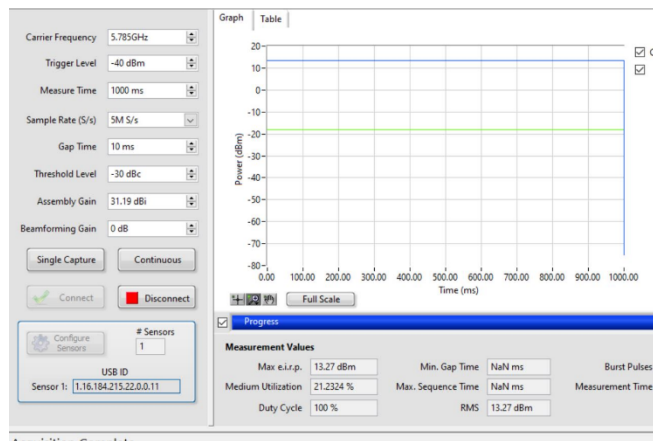


Figure 8.1-5: IEEE 802.11n MCS0 20 MHz BW, Channel 157: 5785 MHz

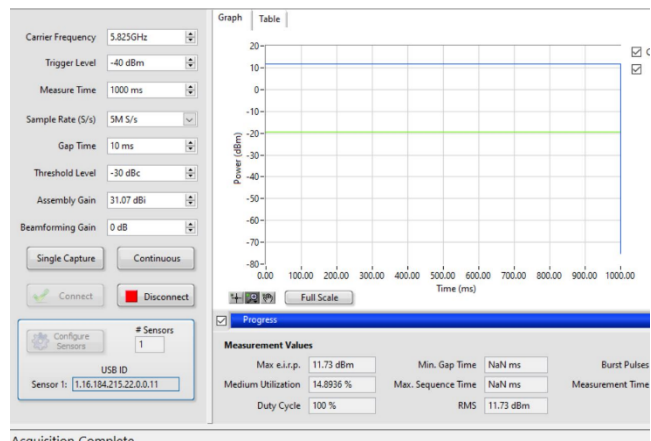


Figure 8.1-6: IEEE 802.11n MCS0 20 MHz BW, Channel 165: 5825 MHz

8.2 FCC 15.407(a) and RSS-247 99% Occupied Bandwidth

8.2.1 Definition and limits

KDB 789033 D02 (D)

The 99% occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. Measurement of the 99% occupied bandwidth is required only as a condition for using the optional band-edge measurement techniques described in II.G.3.d). Measurements of 99% occupied bandwidth may also optionally be used in lieu of the EBW to define the minimum frequency range over which the spectrum is integrated when measuring maximum conducted output power as described in II.E. However, the EBW must be measured to determine bandwidth dependent limits on maximum conducted output power in accordance with Section 15.407(a).

8.2.2 Test summary

Verdict	Pass		
Test date	December 12, 2022	Temperature	20 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1008 mbar
Test location	Wireless bench	Relative humidity	52 %

8.2.3 Notes

Testing was performed in Tx mode and the EUT transmitting on a fixed channel. Low, Middle, and High channels were tested using worst case modulation for each band. Only one bandwidth was declared by the manufacturer.

U-NII-1 band: 5150-5250 MHz → IEEE 802.11n MCS0 (worst case)

U-NII-3 band: 5725-5850 MHz → IEEE 802.11n MCS0 (worst case)

8.2.4 Setup details

Receiver settings

Resolution bandwidth	1% to 5% of the OBW
Video bandwidth	≥ 3 x RBW
Span	1.5 time to 5.0 times the OBW
Detector mode	Peak
Trace mode	Max Hold

8.2.5 Test data

Channel	Frequency	99% OBW
CH 36 IEEE 802.11n MCS0	5180 MHz	18.281 MHz
CH 44 IEEE 802.11n MCS0	5220 MHz	18.341 MHz
CH 48 IEEE 802.11n MCS0	5240 MHz	18.341 MHz
CH 149 IEEE 802.11n MCS0	5745 MHz	18.281 MHz
CH 157 IEEE 802.11n MCS0	5785 MHz	18.281 MHz
CH 165 IEEE 802.11n MCS0	5825 MHz	18.221 MHz

Table 8.2-1: 99% Occupied bandwidth.

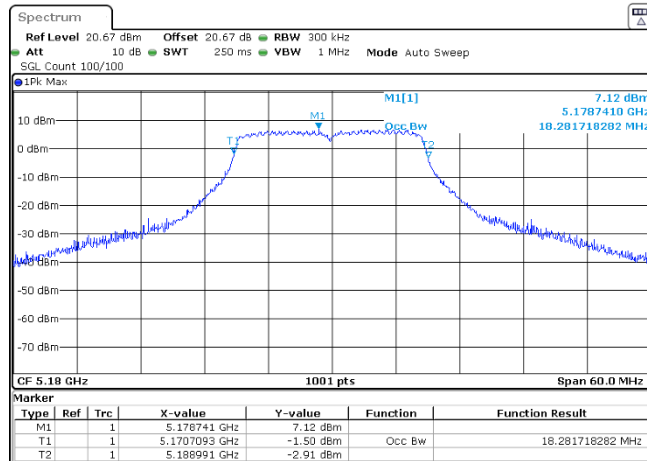


Figure 8.2-1: 99% OBW IEEE 802.11n MCS0, Channel 36: 5180 MHz

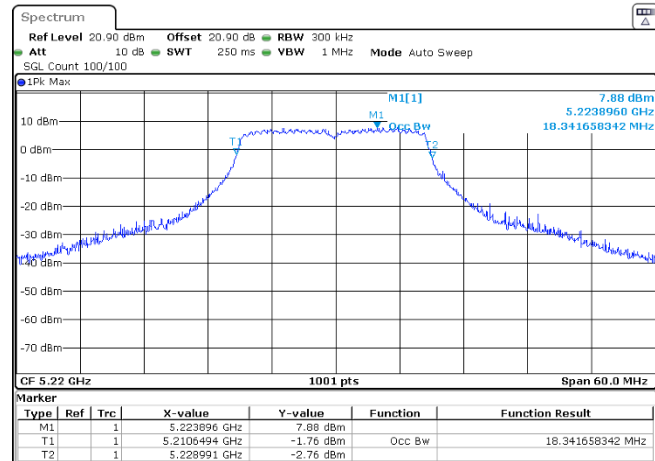


Figure 8.2-2: 99% OBW IEEE 802.11n MCS0, Channel 44: 5220 MHz

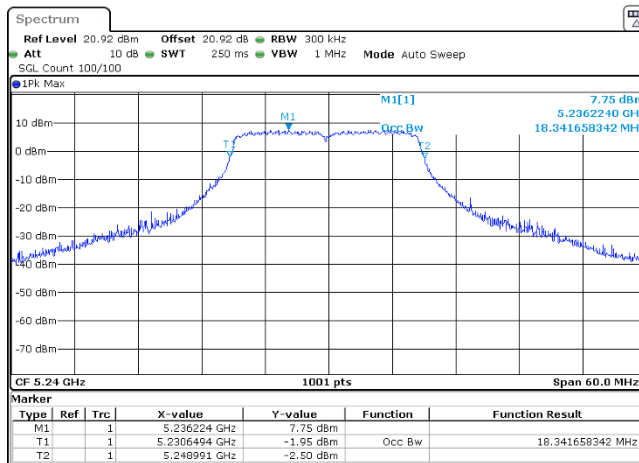


Figure 8.2-3: 99% OBW IEEE 802.11n MCS0, Channel 48: 5240 MHz

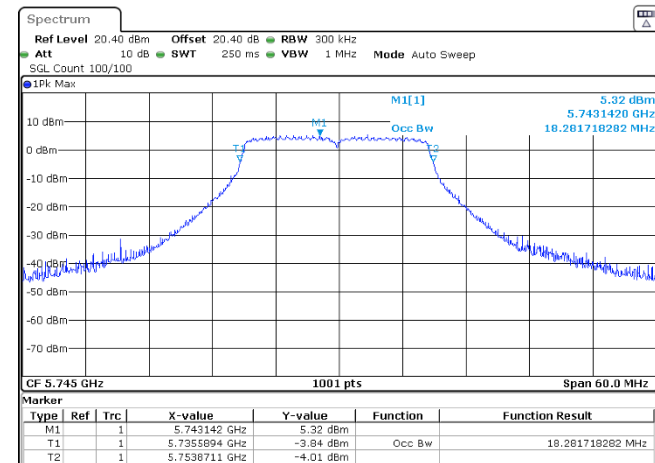


Figure 8.2-4: 99% OBW IEEE 802.11n MCS0, Channel 149: 5745 MHz

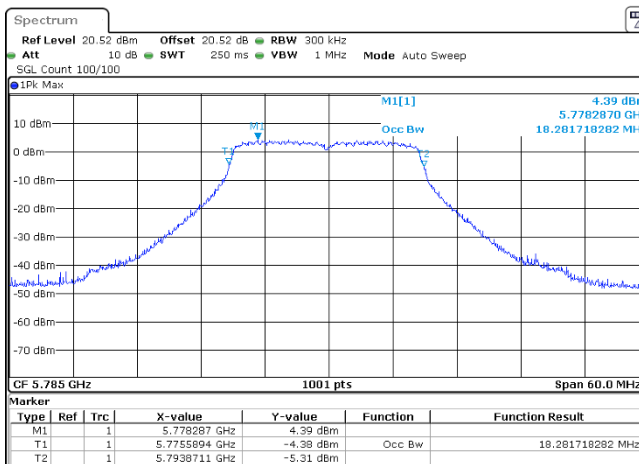


Figure 8.2-5: 99% OBW IEEE 802.11n MCS0, Channel 157: 5785 MHz

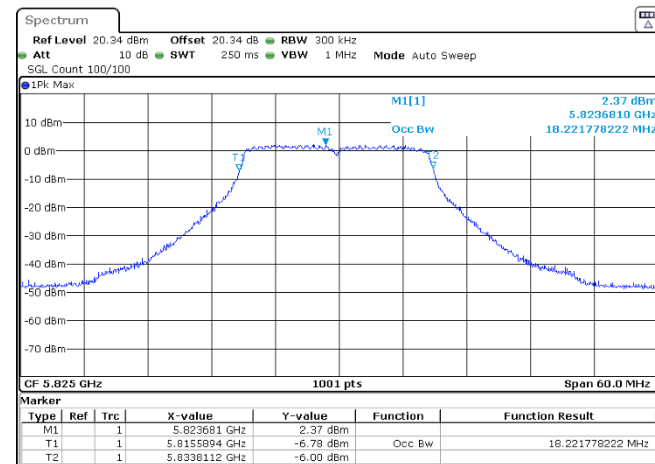


Figure 8.2-6: 99% OBW IEEE 802.11n MCS0, Channel 165: 5825 MHz

8.3 FCC 15.407(a) and RSS-247 Emission Bandwidth

8.3.1 Definition and limits

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart E → §15.407(e)

KDB 789033 D02

Within the 5.725-5.850 GHz and 5.850-5.895 GHz bands, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

8.3.2 Test summary

Verdict	Pass		
Test date	December 13, 2022	Temperature	21 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1007 mbar
Test location	Wireless bench	Relative humidity	54 %

8.3.3 Notes

Testing was performed in Tx mode and the EUT transmitting on a fixed channel. Low, Middle, and High channels were tested using worst case modulation for each band. Only one bandwidth was declared by the manufacturer.

U-NII-1 band: 5150-5250 MHz → IEEE 802.11n MCS0 (worst case) → 26 dB OBW

U-NII-3 band: 5725-5850 MHz → IEEE 802.11n MCS0 (worst case) → 6 dB OBW

8.3.4 Setup details

Receiver settings

Resolution bandwidth	1% of emission bandwidth (5150-5725 MHz band); 100 kHz (5725-5850 MHz band)
Video bandwidth	VBW > RBW (5150-5725 MHz band); ≥ 3 x RBW (5725-5850 MHz band)
Span	1.5 time to 5.0 times the OBW
Detector mode	Peak
Trace mode	Max Hold

8.3.5 Test data

Channel	Frequency	26 dB OBW	Limit
CH 36 IEEE 802.11n MCS0	5180 MHz	24.515 MHz	N/A
CH 44 IEEE 802.11n MCS0	5220 MHz	24.635 MHz	N/A
CH 48 IEEE 802.11n MCS0	5240 MHz	24.635 MHz	N/A
Channel	Frequency	6 dB OBW	Limit
CH 149 IEEE 802.11n MCS0	5745 MHz	17.7848 MHz	≥ 500 kHz
CH 157 IEEE 802.11n MCS0	5785 MHz	17.6995 MHz	≥ 500 kHz
CH 165 IEEE 802.11n MCS0	5825 MHz	17.6394 MHz	≥ 500 kHz

Table 8.3-1: Emission bandwidth.

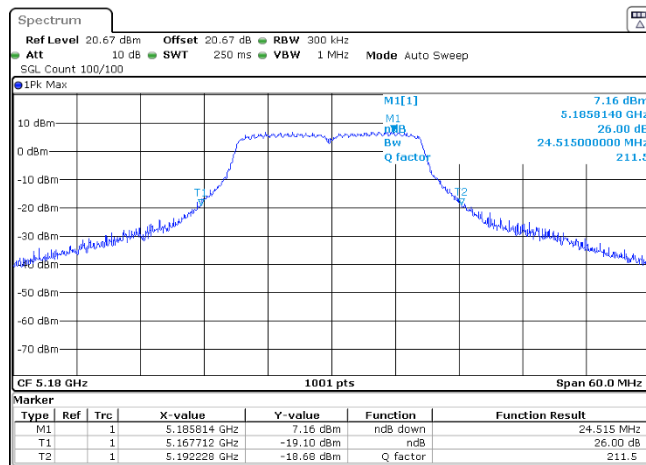


Figure 8.3-1: 26 dB Emission Bandwidth IEEE 802.11n MCS0, Channel 36: 5180 MHz

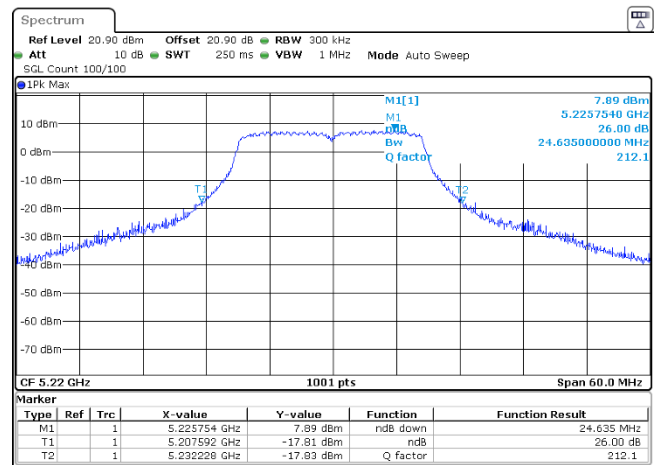


Figure 8.3-2: 26 dB Emission Bandwidth IEEE 802.11n MCS0, Channel 44: 5220 MHz

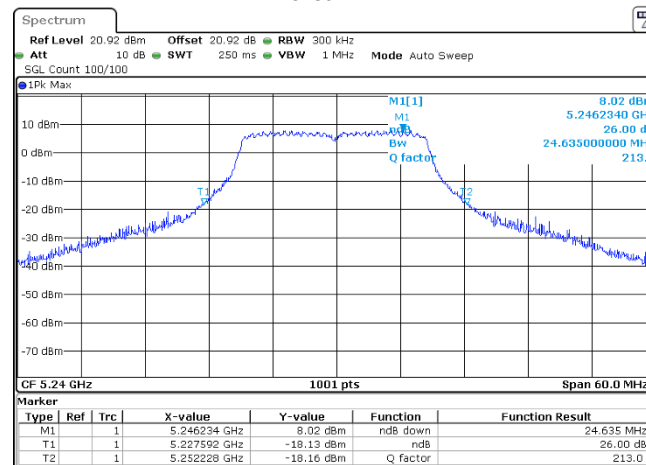


Figure 8.3-3: 26 dB Emission Bandwidth IEEE 802.11n MCS0, Channel 48: 5240 MHz

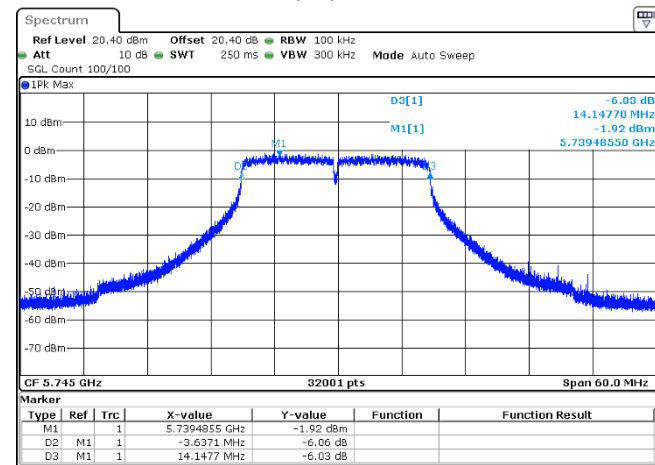


Figure 8.3-4: 6 dB Emission Bandwidth IEEE 802.11n MCS0, Channel 149: 5745 MHz

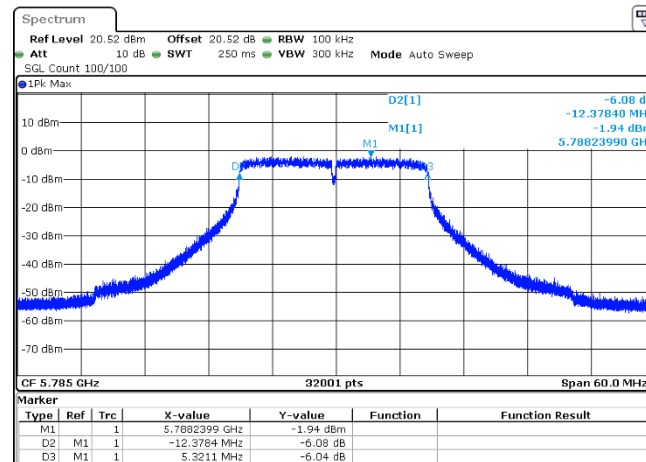


Figure 8.3-5: 6 dB Emission Bandwidth IEEE 802.11n MCS0, Channel 157: 5785 MHz

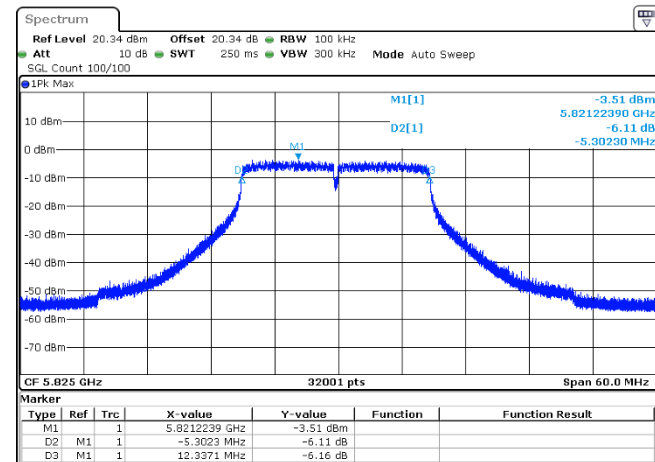


Figure 8.3-6: 6 dB Emission Bandwidth IEEE 802.11n MCS0, Channel 165: 5825 MHz

8.4 FCC 15.407(b) and RSS-247 5.5 Radiated restricted band-edges and spurious emission

8.4.1 Definition and limits

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart E → §15.407(b)

Table 8.4-1: FCC §15.209– Radiated emission limits

Frequency, MHz	Field strength of emissions		Measurement distance, m
	$\mu\text{V/m}$	$\text{dB}\mu\text{V/m}$	
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: 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	December 16, 2022; December 19, 2022; December 23, 2022;	Temperature	21 °C; 20 °C; 22 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure;	1001;1003;1005
Test location	3m semi-anechoic chamber (Radiated)	Relative humidity	53%;55%;52%

8.4.3 Notes

The EUT was configured to transmit continuously on the lowest and highest channels according to clause 15.407 (b)(11).

The spectrum was searched from 30 MHz to 40 GHz (10th harmonic of the highest transmit frequency but not more than 40 GHz).

Radiated measurements were performed at a 3 m measurement distance.

Only the worst cases were measured for this test (table 8.1.6 as reference).

U-NII-1 band: 5150-5250 MHz → IEEE 802.11n MCS0 (worst case)

U-NII-3 band: 5725-5850 MHz → IEEE 802.11n MCS0 (worst case)

8.4.4 Setup details

EUT setup configuration	Tabletop
Test facility	Nemko San Diego
Measurement details	Radiated spurious emissions measurement performed as per C63.10 §12.7

Receiver settings for radiated measurements within restricted bands below 1 GHz:

Resolution bandwidth	120 kHz
Video bandwidth	300 kHz
Detector mode	Peak (preview measurements) Quasi-Peak (final measurements)
Trace mode	Max Hold
Measurement time	5 s (final measurements)

Receiver settings for radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Average and peak (final measurements)
Trace mode	Max Hold
Measurement time	5 s (final measurements)

8.4.5 Test data: U-NII-1 band: 5150-5250 MHz

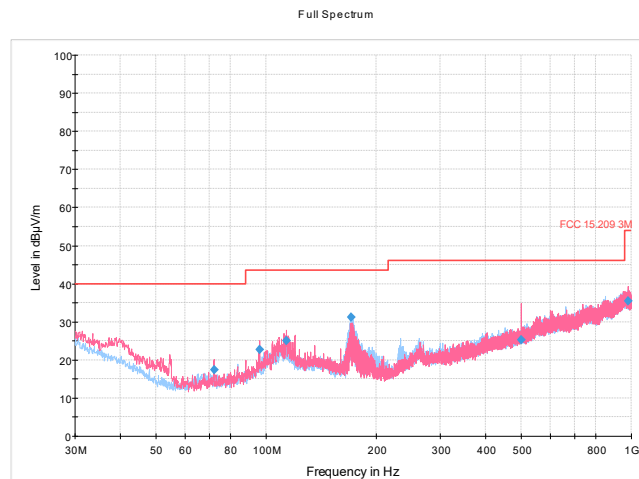


Figure 8.4-1: Radiated emissions, 0.030-1 GHz, 802.11n, MCS0, U-NII-1 band, low channel: 5180 MHz (CH36)

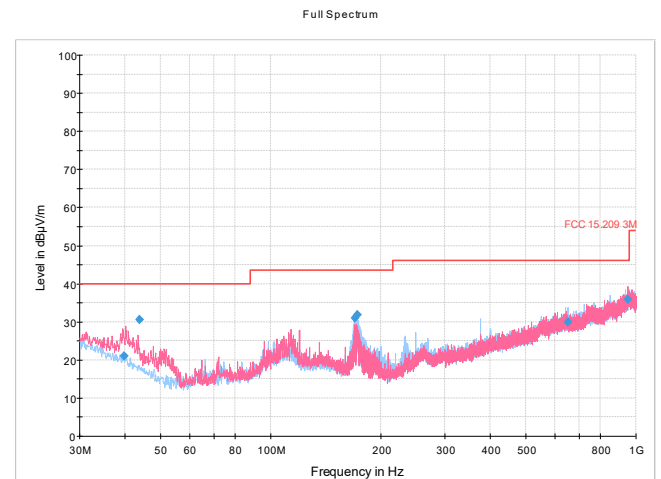


Figure 8.4-2: Radiated emissions, 0.030-1 GHz, 802.11n, MCS0, U-NII-1 band, high channel: 5240 MHz (CH48)

Two spectral plots in different color are showed in the above figure: red plot and blue plot, where the red one corresponds to vertical polarization scan and the blue one corresponds to horizontal polarization scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
72.041000	17.35	40.00	22.65	5000.0	120.000	381.0	V	0.0	13.5
96.000000	22.77	43.50	20.73	5000.0	120.000	400.0	V	206.0	16.5
113.654000	25.08	43.50	18.42	5000.0	120.000	384.0	V	238.0	18.5
170.827000	31.20	43.50	12.30	5000.0	120.000	177.0	H	269.0	17.3
499.205000	25.17	46.00	20.83	5000.0	120.000	295.0	V	188.0	26.8
978.888000	35.56	53.90	18.34	5000.0	120.000	212.0	V	200.0	35.8

Table 8.4-3: Radiated emissions results, 0.030-1 GHz, 802.11n, MCS0, U-NII-1 band, low channel: 5180 MHz (CH36)

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
39.648000	21.05	40.00	18.95	5000.0	120.000	201.0	V	22.0	20.4
43.826000	30.57	40.00	9.43	5000.0	120.000	358.0	V	47.0	18.0
170.357000	31.01	43.50	12.49	5000.0	120.000	110.0	H	268.0	17.3
172.474000	31.92	43.50	11.58	5000.0	120.000	150.0	H	279.0	17.2
652.969000	29.98	46.00	16.02	5000.0	120.000	366.0	H	188.0	30.4
950.885000	35.86	46.00	10.14	5000.0	120.000	169.0	V	238.0	36.1

Table 8.4-4: Radiated emissions results, 0.030-1 GHz, 802.11n, MCS0, U-NII-1 band, low channel: 5240 MHz (CH48)

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

² Correction factors = antenna factor ACF (dB) + cable loss (dB) – pre-amp (dB)

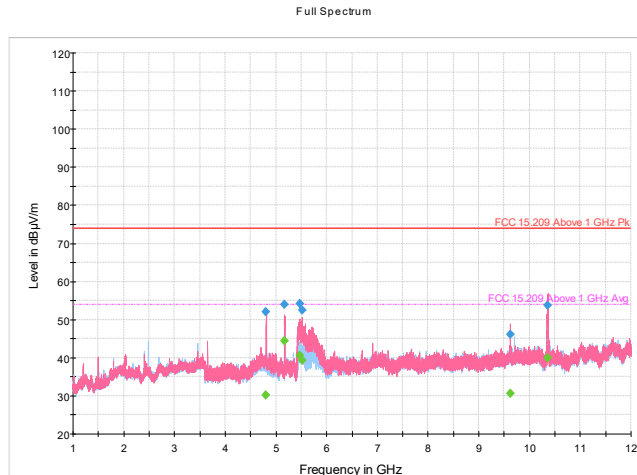


Figure 8.4-3: Radiated emissions, 1-12 GHz, 802.11n, MCS0, U-NII-1 band, low channel: 5180 MHz (CH36)

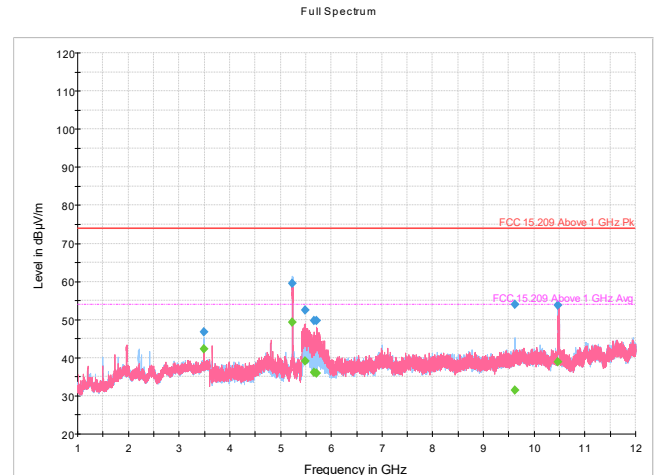


Figure 8.4-4: Radiated emissions, 1-12 GHz, 802.11n, MCS0, U-NII-1 band, high channel: 5240 MHz (CH48)

Two spectral plots in different color are showed in the above figure: red plot and blue plot, where the red one corresponds to vertical polarization scan and the blue one corresponds to horizontal polarization scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4804.444444	---	30.13	53.90	23.77	5000.0	1000.000	259.0	V	0.0	-2.3
4804.444444	52.15	---	73.90	21.75	5000.0	1000.000	259.0	V	0.0	-2.3
5171.677778	53.95	---	73.90	19.95	5000.0	1000.000	203.0	V	137.0	-2.4
5171.677778	---	44.35	53.90	9.55	5000.0	1000.000	203.0	V	137.0	-2.4
5476.555556	---	40.61	53.90	13.29	5000.0	1000.000	210.0	V	34.0	-2.4
5476.555556	54.22	---	73.90	19.68	5000.0	1000.000	210.0	V	34.0	-2.4
5513.222222	---	39.39	53.90	14.51	5000.0	1000.000	203.0	V	34.0	-2.6
5513.222222	52.48	---	73.90	21.42	5000.0	1000.000	203.0	V	34.0	-2.6
9617.277778	---	30.69	53.90	23.21	5000.0	1000.000	180.0	V	326.0	3.5
9617.277778	46.12	---	73.90	27.78	5000.0	1000.000	180.0	V	326.0	3.5
10356.455556	53.81	---	73.90	20.09	5000.0	1000.000	173.0	V	64.0	3.7
10356.455556	---	39.96	53.90	13.94	5000.0	1000.000	173.0	V	64.0	3.7

Table 8.4-5: Radiated emissions results, 1-12 GHz, 802.11n, MCS0, U-NII-1 band, low channel: 5180 MHz (CH36)

Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3493.122222	46.81	---	73.90	27.09	5000.0	1000.000	298.0	H	98.0	-6.4
3493.122222	---	42.27	53.90	11.63	5000.0	1000.000	298.0	H	98.0	-6.4
5232.555556	---	49.37	53.90	4.53	5000.0	1000.000	226.0	H	46.0	-2.2
5232.555556	59.41	---	73.90	14.49	5000.0	1000.000	226.0	H	46.0	-2.2
5478.544444	52.57	---	73.90	21.33	5000.0	1000.000	226.0	V	33.0	-2.4
5478.544444	---	39.16	53.90	14.74	5000.0	1000.000	226.0	V	33.0	-2.4
5662.255556	49.62	---	73.90	24.28	5000.0	1000.000	206.0	V	11.0	-2.0
5662.255556	---	36.19	53.90	17.71	5000.0	1000.000	206.0	V	11.0	-2.0
5711.311111	49.62	---	73.90	24.28	5000.0	1000.000	196.0	V	22.0	-1.5
5711.311111	---	35.93	53.90	17.97	5000.0	1000.000	196.0	V	22.0	-1.5
9615.277778	---	31.41	53.90	22.49	5000.0	1000.000	231.0	H	254.0	3.5
9615.277778	53.94	---	73.90	19.96	5000.0	1000.000	231.0	H	254.0	3.5
10471.933333	---	38.87	53.90	15.03	5000.0	1000.000	222.0	H	148.0	4.2
10471.933333	53.84	---	73.90	20.06	5000.0	1000.000	222.0	H	148.0	4.2

Table 8.4-6: Radiated emissions results, 1-12 GHz, 802.11n, MCS0, U-NII-1 band, low channel: 5240 MHz (CH48)

Notes:

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

² Correction factors = antenna factor ACF (dB) + cable loss (dB) – pre-amp (dB)

³ A notch filter was added for this range due the fundamental signal is not part of the scope of this test. Filter response stops at 12 GHz.

Full Spectrum

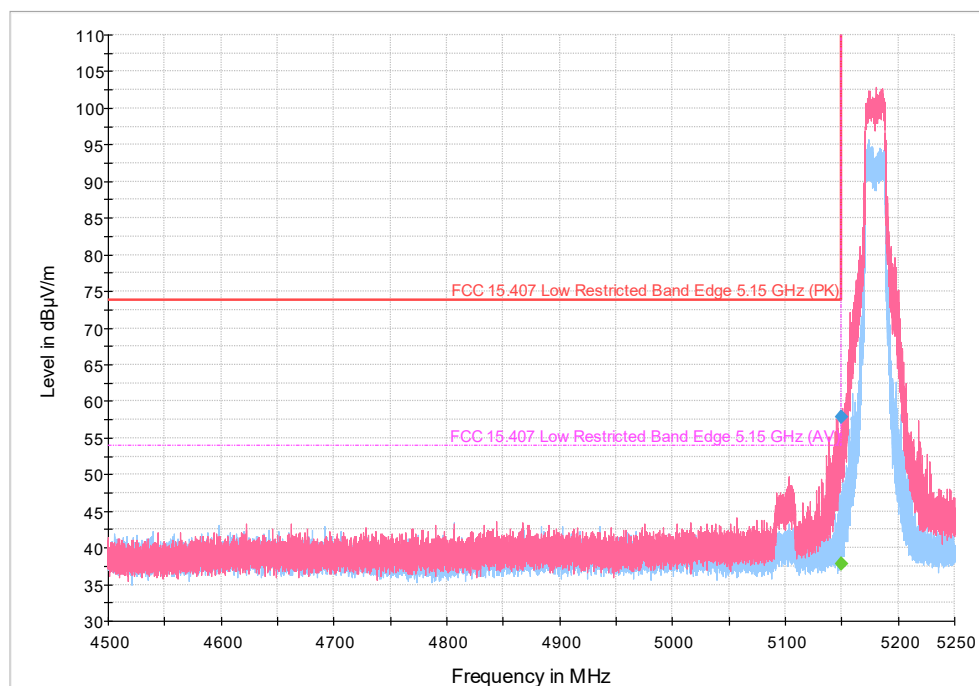


Figure 8.4-5: Radiated emissions, restricted band edge, 802.11n, MCS0, U-NII-1 band, low channel: 5180 MHz (CH36)

Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
5150.000000	57.94	---	73.90	15.96	5000.0	1000.000	171.0	V	0.0	-2.4
5150.000000	---	37.88	53.90	16.02	5000.0	1000.000	171.0	V	0.0	-2.4

Table 8.4-7: Radiated emissions, restricted band edge, 802.11n, MCS0, U-NII-1 band, low channel: 5180 MHz

Notes:

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

²Correction factors = antenna factor ACF (dB) + cable loss (dB) – pre-amp (dB)

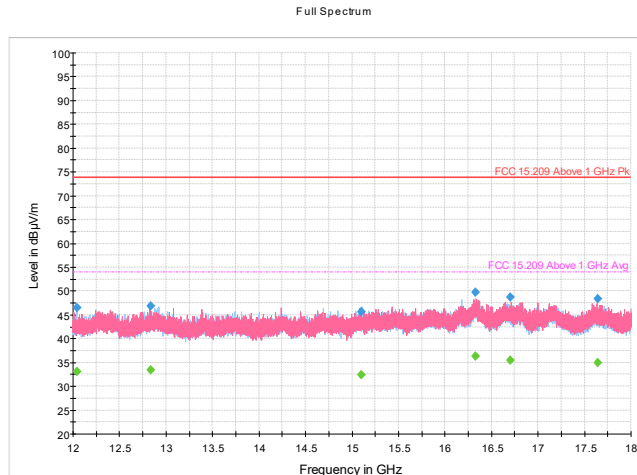


Figure 8.4-6: Radiated emissions, 12-18 GHz, 802.11n, MCS0, U-NII-1 band, low channel: 5180 MHz (CH36)

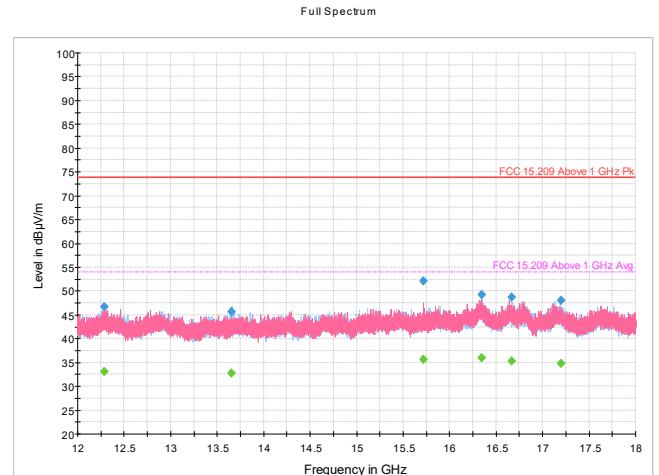


Figure 8.4-7: Radiated emissions, 12-18 GHz, 802.11n, MCS0, U-NII-1 band, high channel: 5240 MHz (CH48)

Two spectral plots in different color are showed in the above figure: red plot and blue plot, where the red one corresponds to vertical polarization scan and the blue one corresponds to horizontal polarization scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
12040.933333	46.52	---	73.90	27.38	5000.0	1000.000	268.0	H	0.0	6.4
12040.933333	---	33.15	53.90	20.75	5000.0	1000.000	268.0	H	0.0	6.4
12834.666667	---	33.50	53.90	20.40	5000.0	1000.000	140.0	V	352.0	8.7
12834.666667	46.77	---	73.90	27.13	5000.0	1000.000	140.0	V	352.0	8.7
15103.466667	---	32.46	53.90	21.44	5000.0	1000.000	137.0	H	275.0	10.4
15103.466667	45.71	---	73.90	28.19	5000.0	1000.000	137.0	H	275.0	10.4
16331.800000	49.69	---	73.90	24.21	5000.0	1000.000	259.0	H	10.0	13.2
16331.800000	---	36.27	53.90	17.63	5000.0	1000.000	259.0	H	10.0	13.2
16706.266667	48.68	---	73.90	25.22	5000.0	1000.000	290.0	V	34.0	14.7
16706.266667	---	35.37	53.90	18.53	5000.0	1000.000	290.0	V	34.0	14.7
17639.733333	48.44	---	73.90	25.46	5000.0	1000.000	164.0	V	47.0	13.7
17639.733333	---	35.00	53.90	18.90	5000.0	1000.000	164.0	V	47.0	13.7

Table 8.4-8: Radiated emissions results, 12-18 GHz, 802.11n, MCS0, U-NII-1 band, low channel: 5180 MHz (CH36)

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
12291.266667	46.73	---	73.90	27.17	5000.0	1000.000	340.0	V	260.0	7.1
12291.266667	---	33.00	53.90	20.90	5000.0	1000.000	340.0	V	260.0	7.1
13658.133333	---	32.77	53.90	21.13	5000.0	1000.000	400.0	H	0.0	8.9
13658.133333	45.65	---	73.90	28.25	5000.0	1000.000	400.0	H	0.0	8.9
15717.000000	---	35.65	53.90	18.25	5000.0	1000.000	204.0	V	71.0	10.6
15717.000000	52.08	---	73.90	21.82	5000.0	1000.000	204.0	V	71.0	10.6
16344.000000	49.24	---	73.90	24.66	5000.0	1000.000	349.0	H	0.0	13.2
16344.000000	---	35.99	53.90	17.91	5000.0	1000.000	349.0	H	0.0	13.2
16671.733333	48.66	---	73.90	25.24	5000.0	1000.000	116.0	H	177.0	14.3
16671.733333	---	35.37	53.90	18.53	5000.0	1000.000	116.0	H	177.0	14.3
17196.666667	48.01	---	73.90	25.89	5000.0	1000.000	266.0	H	33.0	14.9
17196.666667	---	34.86	53.90	19.04	5000.0	1000.000	266.0	H	33.0	14.9

Table 8.4-9: Radiated emissions results, 12-18 GHz, 802.11n, MCS0, U-NII-1 band, high channel: 5240 MHz (CH48)

Notes:

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

²Correction factors = antenna factor ACF (dB) + cable loss (dB) – pre-amp (dB)

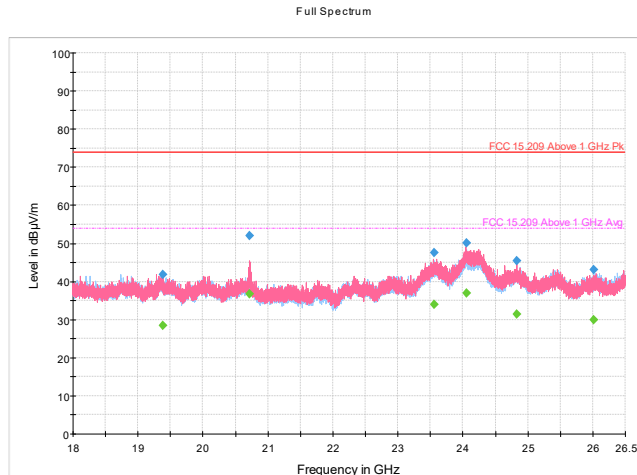


Figure 8.4-8: Radiated emissions, 18-26.5 GHz, 802.11n, MCS0, U-NII-1 band, low channel: 5180 MHz (CH36)

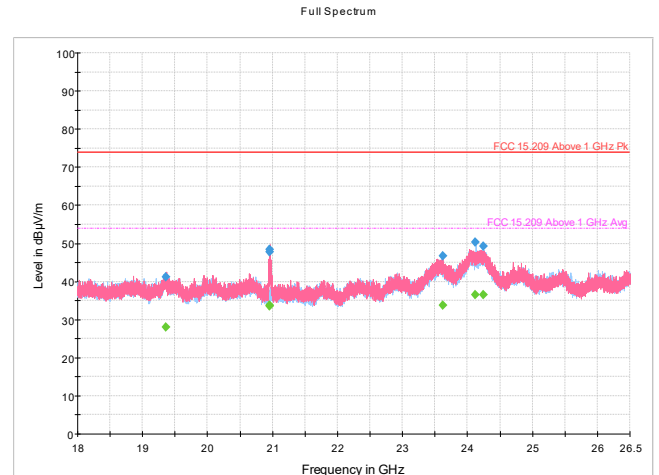


Figure 8.4-9: Radiated emissions, 18-26.5 GHz, 802.11n, MCS0, U-NII-1 band, high channel: 5240 MHz (CH48)

Two spectral plots in different color are showed in the above figure: red plot and blue plot, where the red one corresponds to vertical polarization scan and the blue one corresponds to horizontal polarization scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19379.750000	41.89	---	73.90	32.01	5000.0	1000.000	138.0	H	154.0	16.6
19379.750000	---	28.44	53.90	25.46	5000.0	1000.000	138.0	H	154.0	16.6
20719.137500	---	36.68	53.90	17.22	5000.0	1000.000	100.0	V	61.0	18.4
20719.137500	51.96	---	73.90	21.94	5000.0	1000.000	100.0	V	61.0	18.4
23557.125000	47.50	---	73.90	26.40	5000.0	1000.000	391.0	V	335.0	23.7
23557.125000	---	34.07	53.90	19.83	5000.0	1000.000	391.0	V	335.0	23.7
24051.025000	50.02	---	73.90	23.88	5000.0	1000.000	365.0	V	0.0	27.6
24051.025000	---	36.92	53.90	16.98	5000.0	1000.000	365.0	V	0.0	27.6
24830.212500	45.49	---	73.90	28.41	5000.0	1000.000	151.0	V	129.0	22.3
24830.212500	---	31.42	53.90	22.48	5000.0	1000.000	151.0	V	129.0	22.3
26017.175000	---	29.93	53.90	23.97	5000.0	1000.000	306.0	H	164.0	21.8
26017.175000	43.13	---	73.90	30.77	5000.0	1000.000	306.0	H	164.0	21.8

Table 8.4-10: Radiated emissions results, 18-26 GHz, 802.11n, MCS0, U-NII-1 band, low channel: 5180 MHz (CH36)

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19364.343750	---	27.95	53.90	25.95	5000.0	1000.000	399.0	H	266.0	16.7
19364.343750	41.10	---	73.90	32.80	5000.0	1000.000	399.0	H	266.0	16.7
20954.625000	48.41	---	73.90	25.49	5000.0	1000.000	100.0	V	61.0	16.2
20954.625000	---	33.63	53.90	20.27	5000.0	1000.000	100.0	V	61.0	16.2
20956.325000	47.86	---	73.90	26.04	5000.0	1000.000	100.0	V	61.0	16.2
20956.325000	---	33.70	53.90	20.20	5000.0	1000.000	100.0	V	61.0	16.2
23620.406250	---	33.67	53.90	20.23	5000.0	1000.000	383.0	V	288.0	23.7
23620.406250	46.76	---	73.90	27.14	5000.0	1000.000	383.0	V	288.0	23.7
24122.137500	50.27	---	73.90	23.63	5000.0	1000.000	209.0	H	22.0	27.3
24122.137500	---	36.50	53.90	17.40	5000.0	1000.000	209.0	H	22.0	27.3
24239.600000	49.33	---	73.90	24.57	5000.0	1000.000	327.0	H	0.0	27.0
24239.600000	---	36.42	53.90	17.48	5000.0	1000.000	327.0	H	0.0	27.0

Table 8.4-11: Radiated emissions results, 18- 26 GHz, 802.11n, MCS0, U-NII-1 band, high channel: 5240 MHz (CH48)

Notes:

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

²Correction factors = antenna factor ACF (dB) + cable loss (dB) – pre-amp (dB)

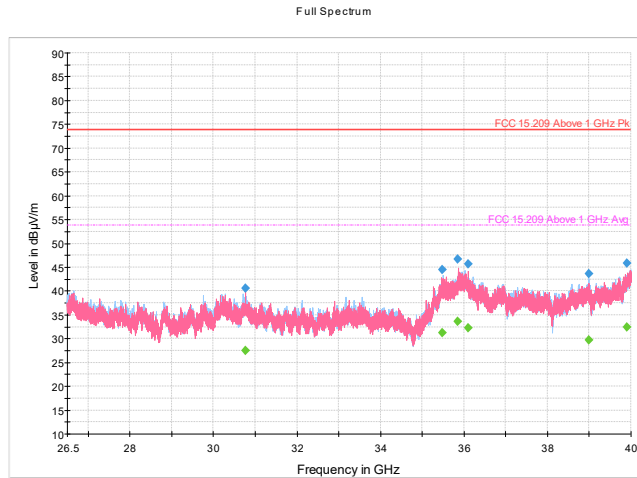


Figure 8.4-10: Radiated emissions, 26.5-40 GHz, 802.11n, MCS0, U-NII-1 band, low channel: 5180 MHz (CH36)

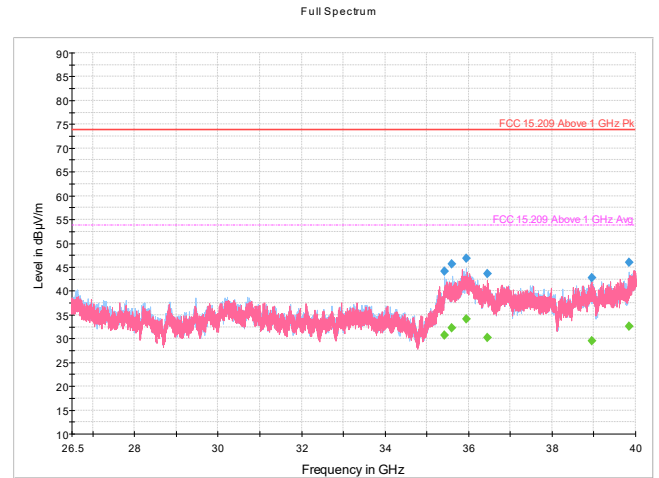


Figure 8.4-11: Radiated emissions, 26.5-40 GHz, 802.11n, MCS0, U-NII-1 band, high channel: 5240 MHz (CH48)

Two spectral plots in different color are showed in the above figure: red plot and blue plot, where the red one corresponds to vertical polarization scan and the blue one corresponds to horizontal polarization scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30771.218750	---	27.45	53.90	26.45	5000.0	1000.000	125.0	V	307.0	12.2
30771.218750	40.51	---	73.90	33.39	5000.0	1000.000	125.0	V	307.0	12.2
35486.218750	44.51	---	73.90	29.39	5000.0	1000.000	100.0	H	8.0	19.3
35486.218750	---	31.17	53.90	22.73	5000.0	1000.000	100.0	H	8.0	19.3
35858.675000	46.64	---	73.90	27.26	5000.0	1000.000	201.0	V	330.0	20.7
35858.675000	---	33.63	53.90	20.27	5000.0	1000.000	201.0	V	330.0	20.7
36105.318750	45.62	---	73.90	28.28	5000.0	1000.000	225.0	V	155.0	20.0
36105.318750	---	32.22	53.90	21.68	5000.0	1000.000	225.0	V	155.0	20.0
39000.625000	---	29.72	53.90	24.18	5000.0	1000.000	160.0	H	10.0	16.8
39000.625000	43.60	---	73.90	30.30	5000.0	1000.000	160.0	H	10.0	16.8
39906.887500	45.85	---	73.90	28.05	5000.0	1000.000	129.0	H	5.0	19.8
39906.887500	---	32.40	53.90	21.51	5000.0	1000.000	129.0	H	5.0	19.8

Table 8.4-12: Radiated emissions results, 26-40 GHz, 802.11n, MCS0, U-NII-1 band, low channel: 5180 MHz (CH36)

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
35416.850000	44.21	---	73.90	29.69	5000.0	1000.000	211.0	H	8.0	18.7
35416.850000	---	30.76	53.90	23.14	5000.0	1000.000	211.0	H	8.0	18.7
35602.962500	---	32.20	53.90	21.70	5000.0	1000.000	125.0	H	284.0	19.9
35602.962500	45.66	---	73.90	28.24	5000.0	1000.000	125.0	H	284.0	19.9
35944.162500	46.82	---	73.90	27.08	5000.0	1000.000	125.0	H	117.0	20.9
35944.162500	---	34.11	53.90	19.79	5000.0	1000.000	125.0	H	117.0	20.9
36448.225000	43.63	---	73.90	30.27	5000.0	1000.000	117.0	V	189.0	17.3
36448.225000	---	30.26	53.90	23.64	5000.0	1000.000	117.0	V	189.0	17.3
38955.856250	---	29.48	53.90	24.42	5000.0	1000.000	161.0	V	198.0	16.7
38955.856250	42.85	---	73.90	31.05	5000.0	1000.000	161.0	V	198.0	16.7
39850.512500	45.94	---	73.90	27.96	5000.0	1000.000	191.0	H	10.0	19.3
39850.512500	---	32.54	53.90	21.36	5000.0	1000.000	191.0	H	10.0	19.3

Table 8.4-13: Radiated emissions results, 26-40 GHz, 802.11n, MCS0, U-NII-1 band, high channel: 5240 MHz (CH48)

Notes:

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

²Correction factors = antenna factor ACF (dB) + cable loss (dB) – pre-amp (dB)

8.4.6 Test data: U-NII-3 band: 5725-5850 MHz

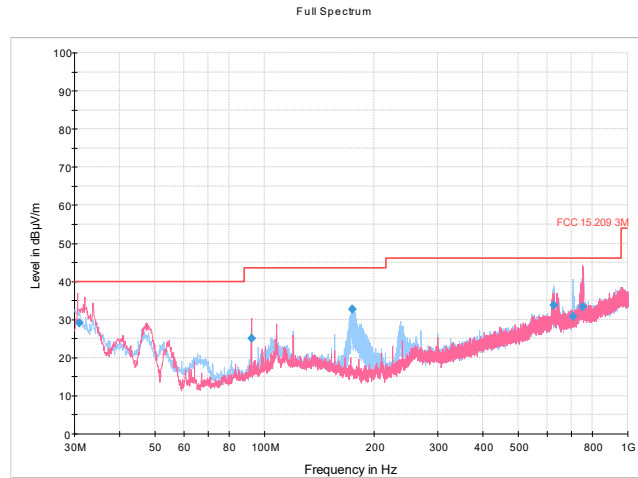


Figure 8.4-12: Radiated emissions, 0.030-1 GHz, 802.11n, MCS0, U-NII-3 band, low channel: 5745 MHz (CH149)

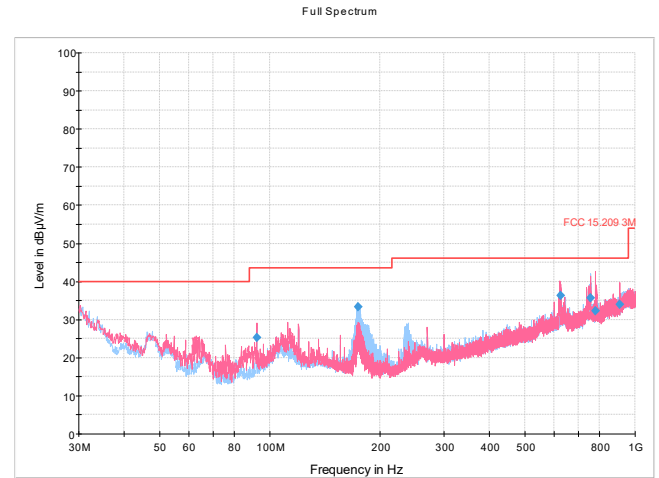


Figure 8.4-13: Radiated emissions, 0.030-1 GHz, 802.11n, MCS0, U-NII-3 band, high channel: 5825 MHz (CH165)

Two spectral plots in different color are showed in the above figure: red plot and blue plot, where the red one corresponds to vertical polarization scan and the blue one corresponds to horizontal polarization scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.880000	29.15	40.00	10.85	5000.0	120.000	204.0	V	133.0	24.9
92.160000	25.06	43.50	18.44	5000.0	120.000	116.0	V	358.0	15.9
174.347000	32.80	43.50	10.70	5000.0	120.000	181.0	H	281.0	17.1
623.736000	33.72	46.00	12.28	5000.0	120.000	281.0	H	0.0	30.3
706.887000	30.72	46.00	15.28	5000.0	120.000	266.0	H	0.0	30.7
749.756000	33.25	46.00	12.75	5000.0	120.000	400.0	V	147.0	32.4

Table 8.4-14: Radiated emissions results, 0.030-1 GHz, 802.11n, MCS0, U-NII-3 band, low channel: 5745 MHz (CH149)

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
92.160000	25.22	43.50	18.28	5000.0	120.000	271.0	H	135.0	15.9
174.513000	33.26	43.50	10.24	5000.0	120.000	193.0	H	285.0	17.0
623.767000	36.21	46.00	9.79	5000.0	120.000	260.0	V	350.0	30.3
754.053000	35.67	46.00	10.33	5000.0	120.000	367.0	H	112.0	32.4
779.061000	32.22	46.00	13.78	5000.0	120.000	238.0	V	98.0	32.3
906.804000	34.03	46.00	11.97	5000.0	120.000	249.0	V	204.0	34.2

Table 8.4-15: Radiated emissions results, 0.030-1 GHz, 802.11n, MCS0, U-NII-3 band, high channel: 5825 MHz (CH165)

Notes: ¹ Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
² Correction factors = antenna factor ACF (dB) + cable loss (dB) – pre-amp (dB)

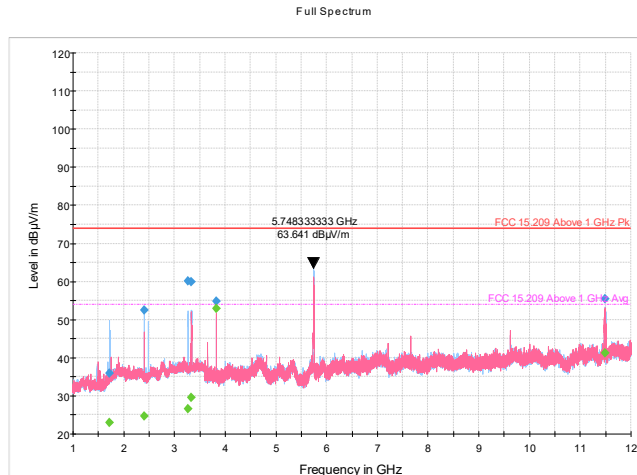


Figure 8.4-14: Radiated emissions, 1-12 GHz, 802.11n, MCS0, U-NII-3 band, low channel: 5745 MHz (CH149)

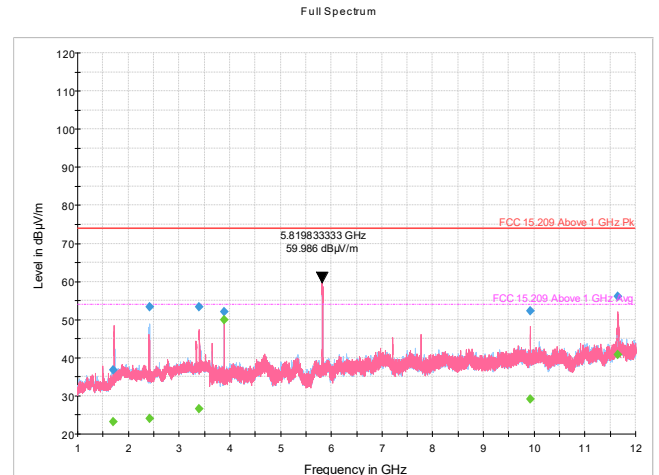


Figure 8.4-15: Radiated emissions, 1-12 GHz, 802.11n, MCS0, U-NII-3 band, high channel: 5825 MHz (CH165)

Two spectral plots in different color are showed in the above figure: red plot and blue plot, where the red one corresponds to vertical polarization scan and the blue one corresponds to horizontal polarization scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1712.577778	---	22.93	53.90	30.97	5000.0	1000.000	366.0	H	249.0	-13.1
1712.577778	35.84	---	73.90	38.06	5000.0	1000.000	366.0	H	249.0	-13.1
2402.122222	---	24.61	53.90	29.29	5000.0	1000.000	393.0	H	212.0	-10.0
2402.122222	52.48	---	73.90	21.42	5000.0	1000.000	393.0	H	212.0	-10.0
3269.322222	---	26.68	53.90	27.22	5000.0	1000.000	277.0	H	88.0	-7.0
3269.322222	60.18	---	73.90	13.72	5000.0	1000.000	277.0	H	88.0	-7.0
3334.466667	---	29.55	53.90	24.35	5000.0	1000.000	107.0	H	72.0	-6.8
3334.466667	59.93	---	73.90	13.97	5000.0	1000.000	107.0	H	72.0	-6.8
3829.844444	---	53.01	53.90	0.89	5000.0	1000.000	122.0	V	124.0	-4.5
3829.844444	54.73	---	73.90	19.17	5000.0	1000.000	122.0	V	124.0	-4.5
11492.511111	---	41.25	53.90	12.65	5000.0	1000.000	207.0	H	21.0	3.9
11492.511111	55.48	---	73.90	18.42	5000.0	1000.000	207.0	H	21.0	3.9

Table 8.4-16: Radiated emissions results, 1-12 GHz, 802.11n, MCS0, U-NII-3 band, low channel: 5745 MHz (CH149)

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1709.822222	---	23.08	53.90	30.82	5000.0	1000.000	276.0	V	0.0	-13.2
1709.822222	36.73	---	73.90	37.17	5000.0	1000.000	276.0	V	0.0	-13.2
2425.322222	---	24.05	53.90	29.85	5000.0	1000.000	115.0	H	60.0	-9.9
2425.322222	53.40	---	73.90	20.50	5000.0	1000.000	115.0	H	60.0	-9.9
3390.844444	---	26.64	53.90	27.26	5000.0	1000.000	170.0	V	160.0	-6.7
3390.844444	53.29	---	73.90	20.61	5000.0	1000.000	170.0	V	160.0	-6.7
3883.222222	---	49.92	53.90	3.98	5000.0	1000.000	288.0	H	0.0	-4.3
3883.222222	52.16	---	73.90	21.74	5000.0	1000.000	288.0	H	0.0	-4.3
9918.977778	---	29.20	53.90	24.70	5000.0	1000.000	207.0	V	10.0	3.3
9918.977778	52.18	---	73.90	21.72	5000.0	1000.000	207.0	V	10.0	3.3
11647.222222	---	40.89	53.90	13.01	5000.0	1000.000	208.0	V	22.0	5.0
11647.222222	56.13	---	73.90	17.77	5000.0	1000.000	208.0	V	22.0	5.0

Table 8.4-17: Radiated emissions results, 1-12 GHz, 802.11n, MCS0, U-NII-3 band, high channel: 5825 MHz (CH165)

Notes:

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

²Correction factors = antenna factor ACF (dB) + cable loss (dB) – pre-amp (dB)

³A notch filter was added for this range due the fundamental signal is not part of the scope of this test. Leakage signal was marked in the plot. Filter response stops at 12 GHz.

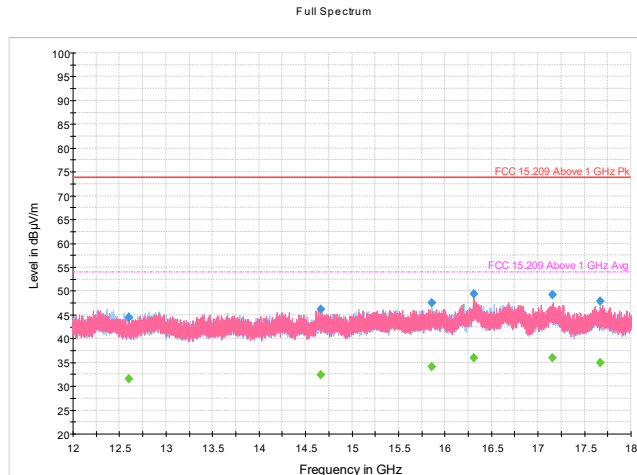


Figure 8.4-16: Radiated emissions, 12-18 GHz, 802.11n, MCS0, U-NII-3 band, low channel: 5745 MHz (CH149)

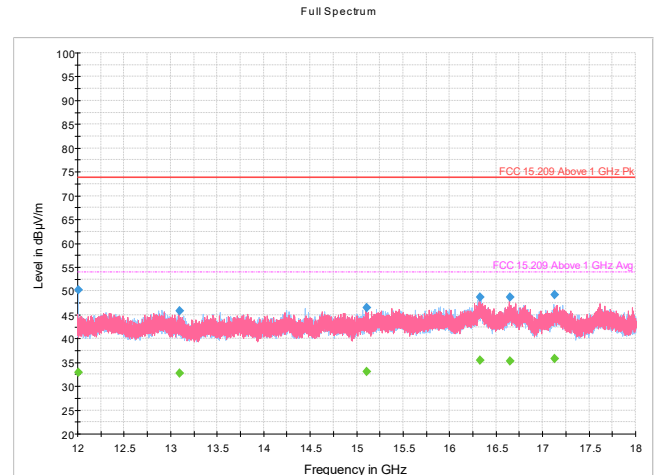


Figure 8.4-17: Radiated emissions, 12-18 GHz, 802.11n, MCS0, U-NII-3 band, high channel: 5825 MHz (CH165)

Two spectral plots in different color are showed in the above figure: red plot and blue plot, where the red one corresponds to vertical polarization scan and the blue one corresponds to horizontal polarization scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
12598.733333	---	31.50	53.90	22.40	5000.0	1000.000	271.0	H	96.0	7.7
12598.733333	44.44	---	73.90	29.46	5000.0	1000.000	271.0	H	96.0	7.7
14667.866667	---	32.40	53.90	21.50	5000.0	1000.000	191.0	H	227.0	9.3
14667.866667	46.21	---	73.90	27.69	5000.0	1000.000	191.0	H	227.0	9.3
15857.800000	---	34.15	53.90	19.75	5000.0	1000.000	130.0	H	0.0	11.3
15857.800000	47.58	---	73.90	26.32	5000.0	1000.000	130.0	H	0.0	11.3
16311.533333	49.46	---	73.90	24.44	5000.0	1000.000	247.0	V	172.0	13.4
16311.533333	---	35.92	53.90	17.98	5000.0	1000.000	247.0	V	172.0	13.4
17154.266667	---	35.98	53.90	17.92	5000.0	1000.000	376.0	V	303.0	14.4
17154.266667	49.15	---	73.90	24.75	5000.0	1000.000	376.0	V	303.0	14.4
17667.133333	47.83	---	73.90	26.07	5000.0	1000.000	324.0	H	242.0	13.9
17667.133333	---	35.00	53.90	18.90	5000.0	1000.000	324.0	H	242.0	13.9

Table 8.4-18: Radiated emissions results, 12-18 GHz, 802.11n, MCS0, U-NII-3 band, low channel: 5745 MHz (CH149)

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
12011.066667	50.25	---	73.90	23.65	5000.0	1000.000	207.0	H	244.0	6.2
12011.066667	---	32.90	53.90	21.00	5000.0	1000.000	207.0	H	244.0	6.2
13093.200000	45.85	---	73.90	28.05	5000.0	1000.000	235.0	V	173.0	8.5
13093.200000	---	32.81	53.90	21.09	5000.0	1000.000	235.0	V	173.0	8.5
15106.466667	46.47	---	73.90	27.43	5000.0	1000.000	207.0	H	70.0	10.4
15106.466667	---	33.07	53.90	20.83	5000.0	1000.000	207.0	H	70.0	10.4
16331.666667	---	35.51	53.90	18.39	5000.0	1000.000	231.0	H	180.0	13.2
16331.666667	48.78	---	73.90	25.12	5000.0	1000.000	231.0	H	180.0	13.2
16646.800000	---	35.36	53.90	18.54	5000.0	1000.000	144.0	V	151.0	14.0
16646.800000	48.65	---	73.90	25.25	5000.0	1000.000	144.0	V	151.0	14.0
17125.400000	49.19	---	73.90	24.71	5000.0	1000.000	380.0	H	156.0	13.9
17125.400000	---	35.83	53.90	18.07	5000.0	1000.000	380.0	H	156.0	13.9

Table 8.4-19: Radiated emissions results, 12-18 GHz, 802.11n, MCS0, U-NII-3 band, high channel: 5825 MHz (CH165)

Notes:

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

²Correction factors = antenna factor ACF (dB) + cable loss (dB) – pre-amp (dB)

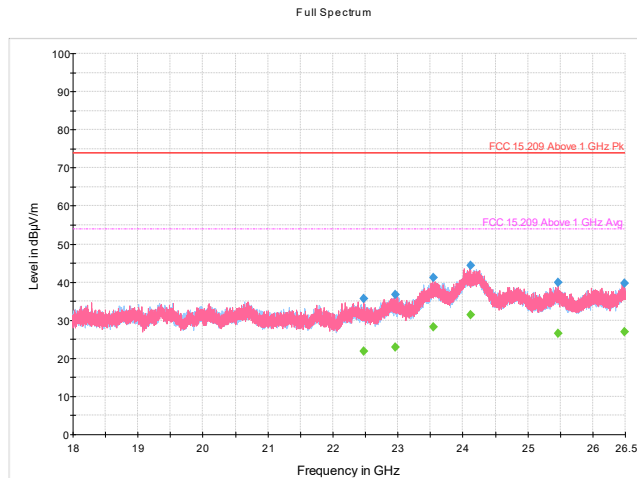


Figure 8.4-18: Radiated emissions, 18-26.5 GHz, 802.11n, MCS0, U-NII-3 band, low channel: 5745 MHz (CH149)

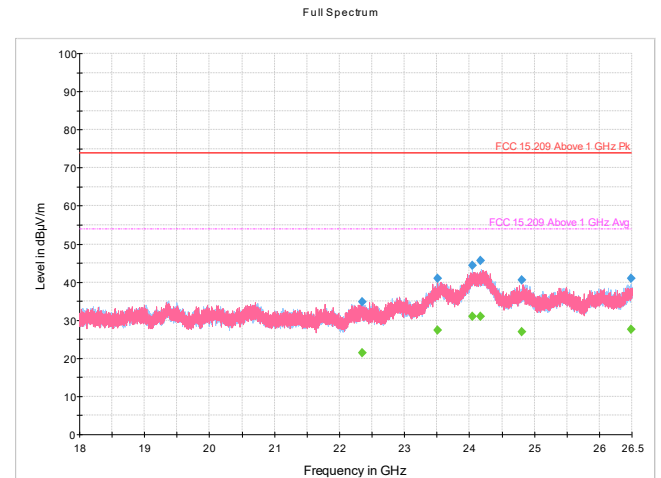


Figure 8.4-19: Radiated emissions, 18-26.5 GHz, 802.11n, MCS0, U-NII-3 band, high channel: 5825 MHz (CH165)

Two spectral plots in different color are showed in the above figure: red plot and blue plot, where the red one corresponds to vertical polarization scan and the blue one corresponds to horizontal polarization scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
22470.768750	35.63	---	73.90	38.27	5000.0	1000.000	376.0	V	126.0	17.5
22470.768750	---	21.96	53.90	31.94	5000.0	1000.000	376.0	V	126.0	17.5
22955.737500	---	22.91	53.90	30.99	5000.0	1000.000	281.0	H	230.0	18.9
22955.737500	36.75	---	73.90	37.15	5000.0	1000.000	281.0	H	230.0	18.9
23542.500000	---	28.14	53.90	25.76	5000.0	1000.000	208.0	V	336.0	23.5
23542.500000	41.15	---	73.90	32.75	5000.0	1000.000	208.0	V	336.0	23.5
24118.912500	---	31.42	53.90	22.48	5000.0	1000.000	212.0	V	113.0	27.4
24118.912500	44.38	---	73.90	29.52	5000.0	1000.000	212.0	V	113.0	27.4
25468.118750	40.01	---	73.90	33.89	5000.0	1000.000	282.0	V	148.0	21.8
25468.118750	---	26.62	53.90	27.28	5000.0	1000.000	282.0	V	148.0	21.8
26487.625000	---	26.94	53.90	26.96	5000.0	1000.000	201.0	H	118.0	23.4
26487.625000	39.76	---	73.90	34.14	5000.0	1000.000	201.0	H	118.0	23.4

Table 8.4-20: Radiated emissions results, 18-26 GHz, 802.11n, MCS0, U-NII-3 band, low channel: 5745 MHz (CH149)

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
22346.668750	34.77	---	73.90	39.13	5000.0	1000.000	221.0	V	35.0	17.5
22346.668750	---	21.52	53.90	32.38	5000.0	1000.000	221.0	V	35.0	17.5
23503.006250	40.90	---	73.90	33.00	5000.0	1000.000	141.0	V	61.0	23.1
23503.006250	---	27.42	53.90	26.48	5000.0	1000.000	141.0	V	61.0	23.1
24048.643750	---	30.96	53.90	22.94	5000.0	1000.000	328.0	H	222.0	27.6
24048.643750	44.45	---	73.90	29.45	5000.0	1000.000	328.0	H	222.0	27.6
24169.175000	---	31.07	53.90	22.83	5000.0	1000.000	276.0	H	59.0	27.2
24169.175000	45.64	---	73.90	28.26	5000.0	1000.000	276.0	H	59.0	27.2
24803.750000	---	26.99	53.90	26.91	5000.0	1000.000	263.0	V	140.0	22.3
24803.750000	40.62	---	73.90	33.28	5000.0	1000.000	263.0	V	140.0	22.3
26490.000000	---	27.61	53.90	26.29	5000.0	1000.000	336.0	H	0.0	23.4
26490.000000	41.05	---	73.90	32.85	5000.0	1000.000	336.0	H	0.0	23.4

Table 8.4-21: Radiated emissions results, 18-26 GHz, 802.11n, MCS0, U-NII-3 band, high channel: 5825 MHz (CH165)

Notes:

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

² Correction factors = antenna factor ACF (dB) + cable loss (dB) – pre-amp (dB)

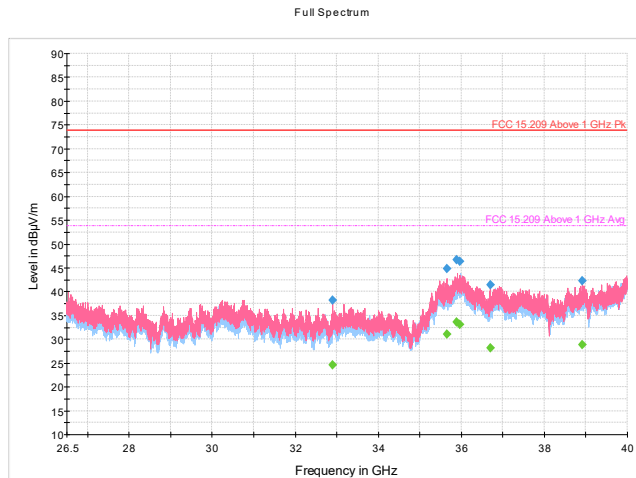


Figure 8.4-20: Radiated emissions, 26.5-40 GHz, 802.11n, MCS0, U-NII-3 band, low channel: 5745 MHz (CH149)

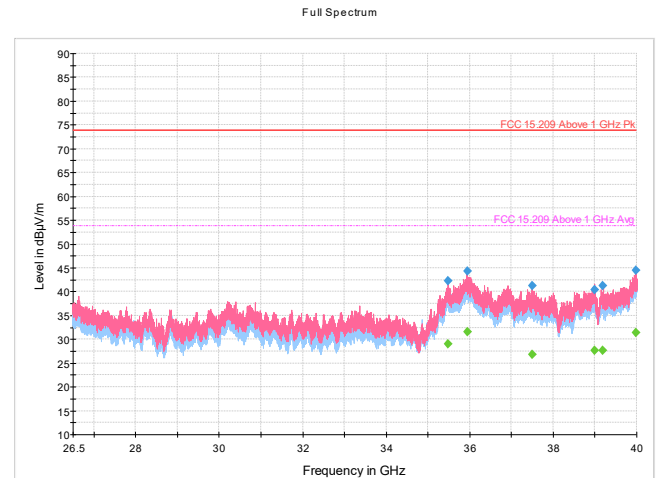


Figure 8.4-21: Radiated emissions, 26.5-40 GHz, 802.11n, MCS0, U-NII-3 band, high channel: 5825 MHz (CH165)

Two spectral plots in different color are showed in the above figure: red plot and blue plot, where the red one corresponds to vertical polarization scan and the blue one corresponds to horizontal polarization scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
32903.643750	38.15	---	73.90	35.75	5000.0	1000.000	157.0	V	77.0	11.6
32903.643750	---	24.54	53.90	29.37	5000.0	1000.000	157.0	V	77.0	11.6
35650.450000	---	31.03	53.90	22.87	5000.0	1000.000	207.0	V	8.0	20.1
35650.450000	44.81	---	73.90	29.09	5000.0	1000.000	207.0	V	8.0	20.1
35897.618750	46.62	---	73.90	27.28	5000.0	1000.000	201.0	V	38.0	20.8
35897.618750	---	33.60	53.90	20.30	5000.0	1000.000	201.0	V	38.0	20.8
35971.200000	---	33.08	53.90	20.82	5000.0	1000.000	151.0	H	94.0	20.9
35971.200000	46.33	---	73.90	27.57	5000.0	1000.000	151.0	H	94.0	20.9
36699.543750	---	28.16	53.90	25.74	5000.0	1000.000	167.0	V	168.0	16.8
36699.543750	41.35	---	73.90	32.55	5000.0	1000.000	167.0	V	168.0	16.8
38920.562500	---	28.91	53.90	24.99	5000.0	1000.000	143.0	V	353.0	16.7
38920.562500	42.21	---	73.90	31.69	5000.0	1000.000	143.0	V	353.0	16.7

Table 8.4-22: Radiated emissions results, 26-40 GHz, 802.11n, MCS0, U-NII-3 band, low channel: 5745 MHz (CH149)

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
35475.968750	---	28.95	53.90	24.95	5000.0	1000.000	104.0	V	47.0	19.2
35475.968750	42.21	---	73.90	31.69	5000.0	1000.000	104.0	V	47.0	19.2
35942.562500	---	31.50	53.90	22.40	5000.0	1000.000	107.0	V	51.0	20.9
35942.562500	44.36	---	73.90	29.54	5000.0	1000.000	107.0	V	51.0	20.9
37505.718750	---	26.85	53.90	27.05	5000.0	1000.000	113.0	V	47.0	15.9
37505.718750	41.19	---	73.90	32.71	5000.0	1000.000	113.0	V	47.0	15.9
38993.881250	40.34	---	73.90	33.56	5000.0	1000.000	225.0	V	3.0	16.8
38993.881250	---	27.61	53.90	26.29	5000.0	1000.000	225.0	V	3.0	16.8
39193.656250	41.31	---	73.90	32.59	5000.0	1000.000	104.0	V	82.0	16.8
39193.656250	---	27.59	53.90	26.31	5000.0	1000.000	104.0	V	82.0	16.8
39977.956250	---	31.44	53.90	22.46	5000.0	1000.000	175.0	V	10.0	20.8
39977.956250	44.53	---	73.90	29.37	5000.0	1000.000	175.0	V	10.0	20.8

Table 8.4-23: Radiated emissions results, 26-40 GHz, 802.11n, MCS0, U-NII-3 band, high channel: 5825 MHz (CH165)

Notes: ¹ Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
² Correction factors = antenna factor ACF (dB) + cable loss (dB) – pre-amp (dB)

8.5 FCC 15.407(b) Undesirable emission limits

8.5.1 Definition and limits

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart C → §15.407(b)

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- (d) Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:
- (1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
 - (2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
 - (3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
 - (4) For transmitters operating in the 5.725-5.85 GHz band:
 - (i) All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.
 - (ii) Devices certified before March 2, 2017 with antenna gain greater than 10 dBi may demonstrate compliance with the emission limits in § 15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease by March 2, 2018. Devices certified before March 2, 2018 with antenna gain of 10 dBi or less may demonstrate compliance with the emission limits in § 15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease before March 2, 2020.
 - (5) For transmitters operating within the 5.925-7.125 GHz band: Any emissions outside of the 5.925-7.125 GHz band must not exceed an e.i.r.p. of -27 dBm/MHz.
 - (6) For transmitters operating within the 5.925-7.125 GHz bands: Power spectral density must be suppressed by 20 dB at 1 MHz outside of channel edge, by 28 dB at one channel bandwidth from the channel center, and by 40 dB at one- and one-half times the channel bandwidth away from channel center. At frequencies between one megahertz outside an unlicensed device's channel edge and one channel bandwidth from the center of the channel, the limits must be linearly interpolated between 20 dB and 28 dB suppression, and at frequencies between one and one- and one-half times an unlicensed device's channel bandwidth, the limits must be linearly interpolated between 28 dB and 40 dB suppression. Emissions removed from the channel center by more than one- and one-half times the channel bandwidth must be suppressed by at least 40 dB.
 - (7) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.
 - (8) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in § 15.207.
 - (9) The provisions of § 15.205 apply to intentional radiators operating under this section.
 - (10) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

8.5.2 Test summary

Verdict	Pass		
Test date	December 14, 2022; December 15, 2022	Temperature	22 °C; 21 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1006 mbar; 1003 mbar
Test location	Wireless Bench	Relative humidity	53 %; 57%

8.5.3 Notes

Testing was performed in Tx mode and the EUT transmitting on a fixed channel. Low, Middle, and High channels were tested using worst case modulation for each band. Only one bandwidth was declared by the manufacturer.

U-NII-1 band: 5150-5250 MHz → IEEE 802.11n MCS0 (worst case)

U-NII-3 band: 5725-5850 MHz → IEEE 802.11n MCS0 (worst case)

The spectrum was searched from 100 kHz to 40 GHz (10th harmonic of the highest transmit frequency but not more than 40 GHz).

For conducted measurements, the loss of the connected cable was input into the spectrum analyzer as an offset.

8.5.4 Setup details

Receiver settings for radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Peak (final measurements)
Trace mode	Max Hold

8.5.5 Test data: U-NII-1 band: 5150-5250 MHz

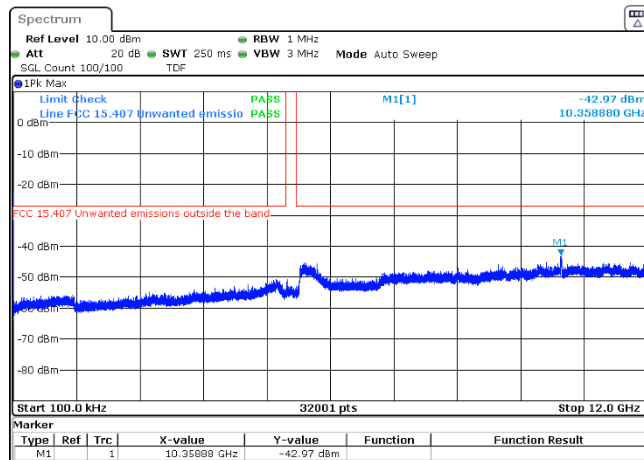


Figure 8.5-1: Radiated emissions, 0.0001 -12 GHz, 802.11n, MCS0, U-NII-1 band, low channel: 5180 MHz (CH36). Notch filter was used.

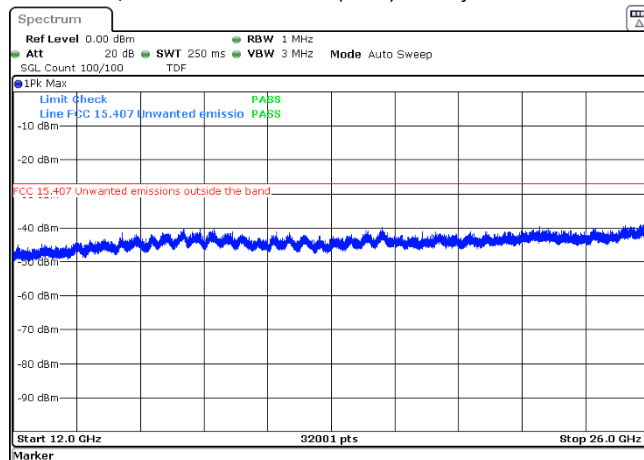


Figure 8.5-3: Radiated emissions, 12 -26 GHz, 802.11n, MCS0, U-NII-1 band, low channel: 5180 MHz (CH36). 20 dB attenuator was used.

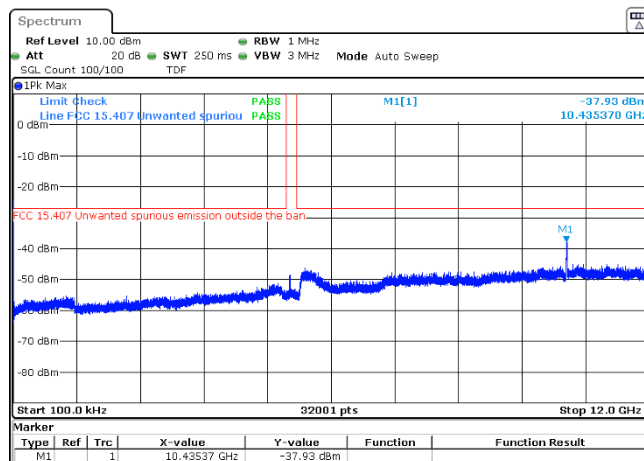


Figure 8.5-5: Radiated emissions, 0.0001 -12 GHz, 802.11n, MCS0, U-NII-1 band, middle channel: 5220 MHz (CH44). Notch filter was used.

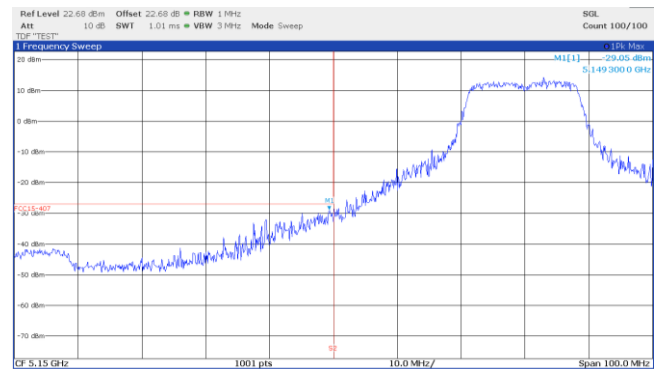


Figure 8.5-2: Low band edge, 802.11n, MCS0, U-NII-1 band, low channel: 5180 MHz (CH36). 20 dB attenuator was used.

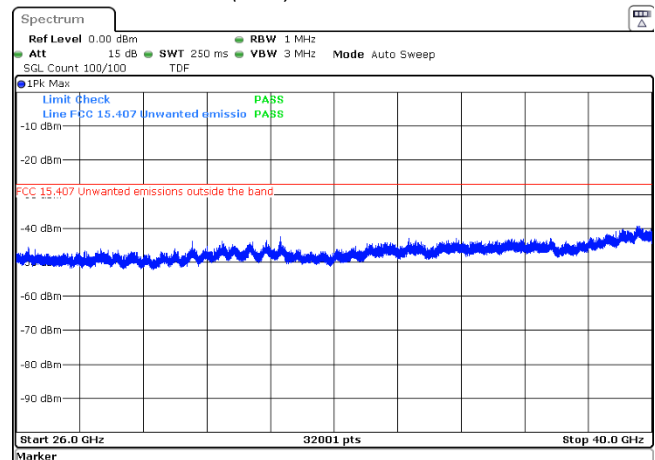


Figure 8.5-4: Radiated emissions, 26 -40 GHz, 802.11n, MCS0, U-NII-1 band, low channel: 5180 MHz (CH36).

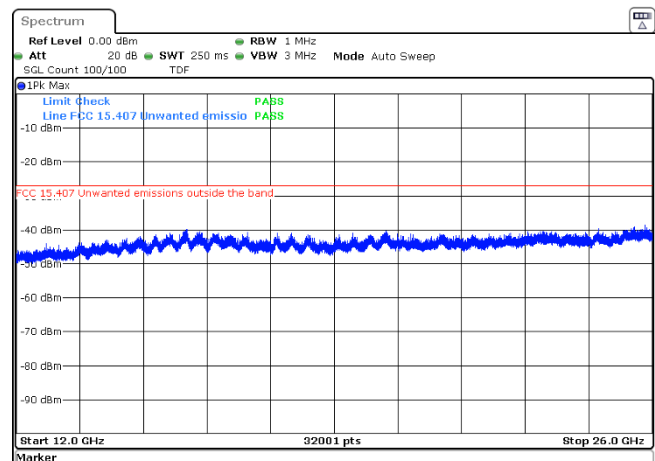
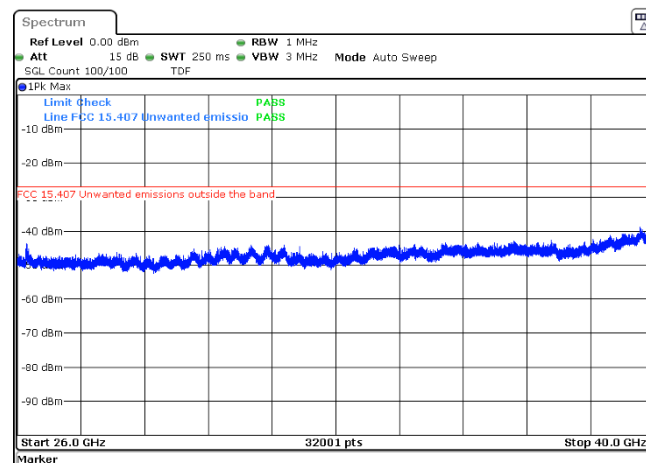
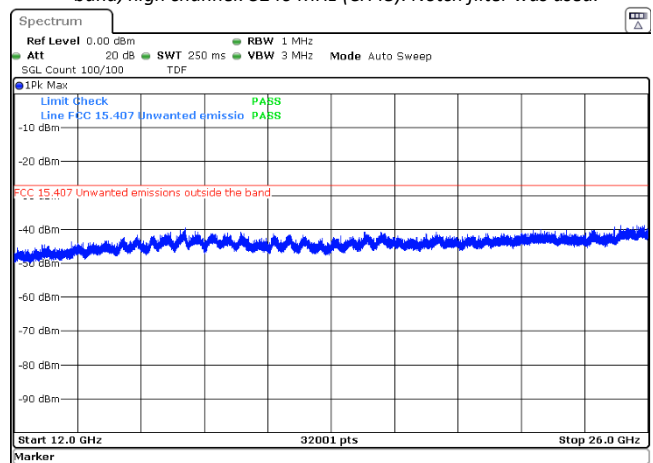
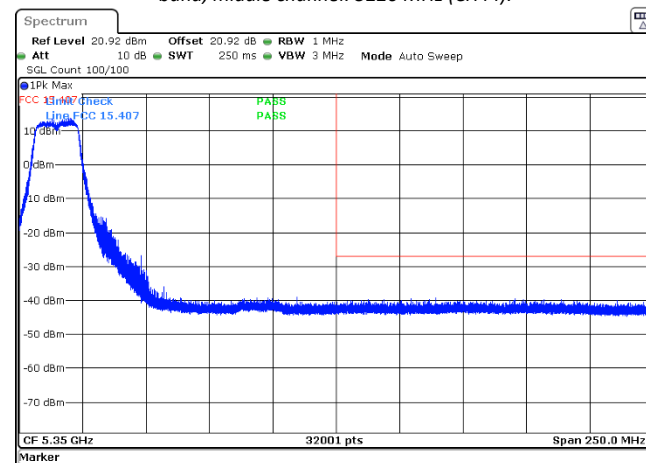
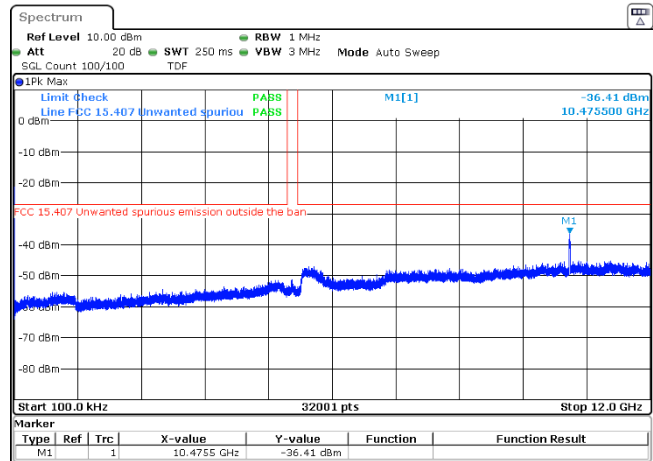
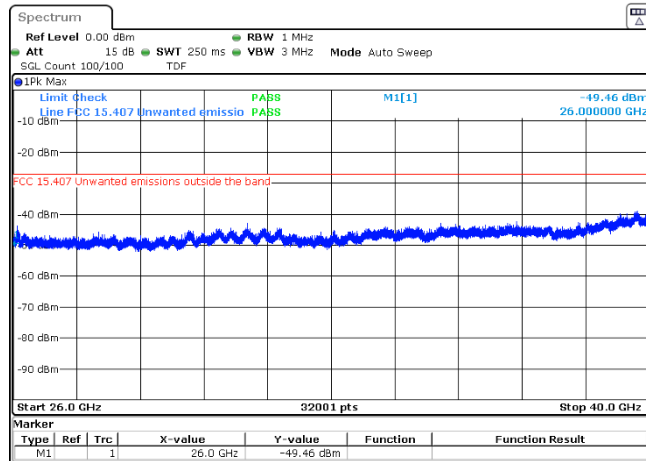


Figure 8.5-6: Radiated emissions, 12 -26 GHz, 802.11n, MCS0, U-NII-1 band, middle channel: 5220 MHz (CH44). 20 dB attenuator was used.



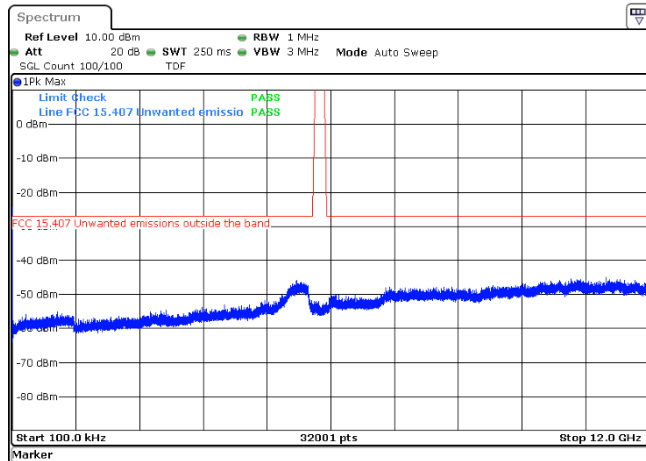


Figure 8.5-12: Radiated emissions, 0.0001 -12 GHz, 802.11n, MCS0, U-NII-3 band, low channel: 5745 MHz (CH149). Notch filter was used.

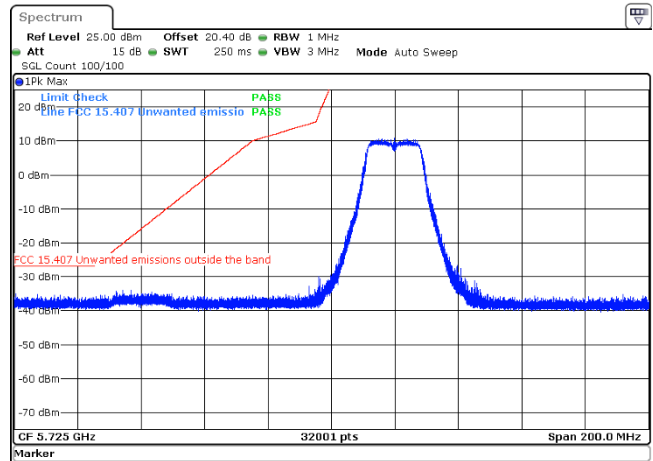


Figure 8.5-13: Low band edge, 802.11n, MCS0, U-NII-3 band, low channel: 5745 MHz (CH149). 20 dB attenuator was used.

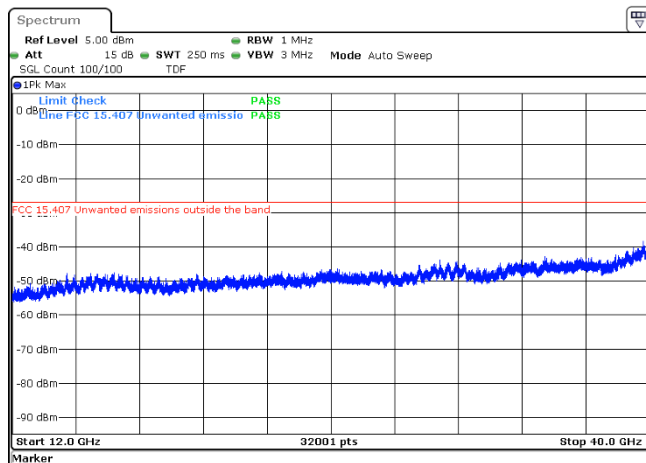


Figure 8.5-14: Radiated emissions, 12 -40 GHz, 802.11n, MCS0, U-NII-3 band, low channel: 5745 MHz (CH149).

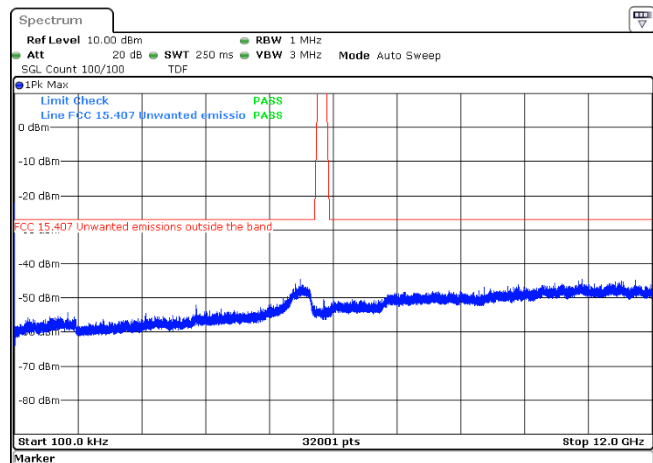


Figure 8.5-15: Radiated emissions, 0.0001 -12 GHz, 802.11n, MCS0, U-NII-3 band, high channel: 5825 MHz (CH165). Notch filter was used.

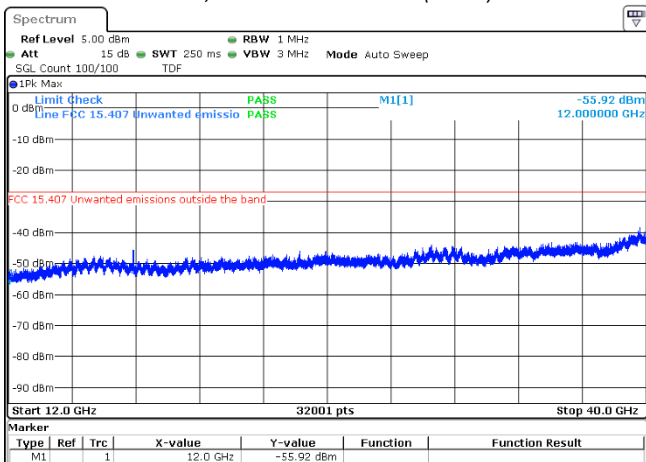


Figure 8.5-16: Radiated emissions, 12 -40 GHz, 802.11n, MCS0, U-NII-3 band, high channel: 5825 MHz (CH165).

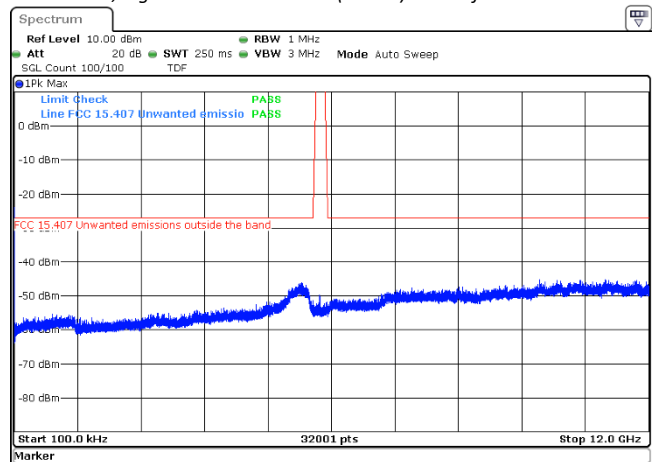
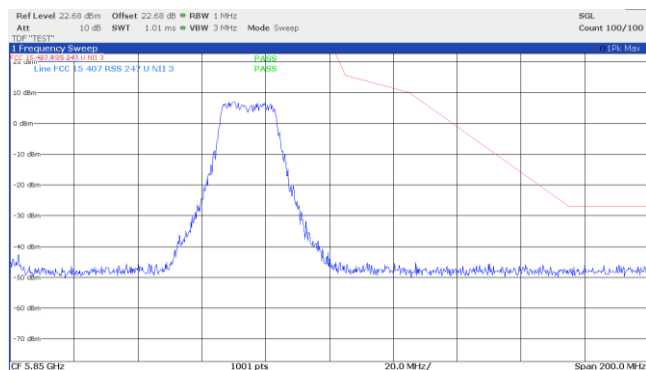


Figure 8.5-17: Radiated emissions, 0.0001 -12 GHz, 802.11n, MCS0, U-NII-3 band, middle channel: 5785 MHz (CH157). Notch filter was used.



Note: Offset includes 20 dB external attenuator plus declared antenna gain (2.68 dBi).
Connecting cable compensated with transducer factor.

Figure 8.5-18: High band edge, 802.11n, MCS0, U-NII-3 band, low channel: 5875 MHz (CH157). 20 dB attenuator was used.

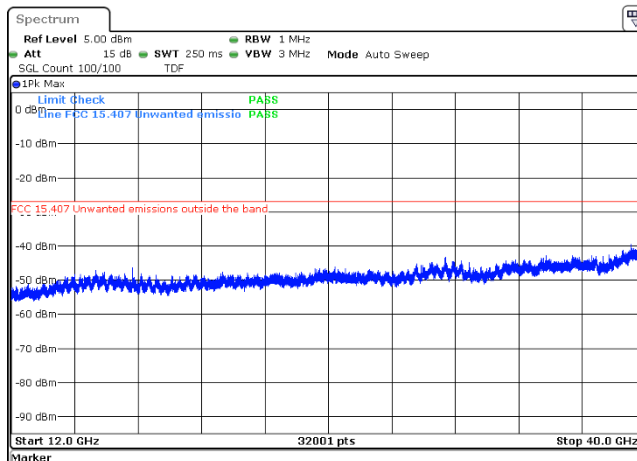


Figure 8.5-19: Radiated emissions, 12 -40 GHz, 802.11n, MCS0, U-NII-3 band, middle channel: 5785 MHz (CH157).

8.6 FCC 15.407(a) and RSS-247 Power Spectral Density

8.6.1 Definition and limits

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart C → §15.407(a)

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For the band 5.15-5.25 GHz.

For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the band 5.725-5.895 GHz:

For the band 5.725-5.850 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

8.6.2 Test summary

Verdict	Pass		
Test date	December 12, 2022; December 13, 2022	Temperature	20 °C; 21 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1008 mbar; 1007 mbar
Test location	Wireless bench	Relative humidity	52 %; 54 %

8.6.3 Notes

Testing was performed in Tx mode and the EUT transmitting on a fixed channel. Low, Middle, and High channels were tested using worst case modulation for each band. Only one bandwidth was declared by the manufacturer.

U-NII-1 band: 5150-5250 MHz → IEEE 802.11n MCS0 (worst case)

U-NII-3 band: 5725-5850 MHz → IEEE 802.11n MCS0 (worst case)

For conducted measurements, the loss of the connected cable was input into the spectrum analyzer as an offset.

8.6.4 Setup details

Receiver settings

Resolution bandwidth	1 MHz (5150-5250 MHz band); 500 kHz (5725 MHz-5850 MHz band)
Video bandwidth	≥ 3 x RBW
Span	Emission Bandwidth
Detector mode	RMS
Trace mode	Average

8.6.5 Test data

Channel	Frequency	PSD	Limit	Margin
CH 36 IEEE 802.11n MCS0	5180 MHz	3.64 dBm/1 MHz	11 dBm/1 MHz	7.36 dB
CH 44 IEEE 802.11n MCS0	5220 MHz	4.30 dBm/1 MHz	11 dBm/1 MHz	6.70 dB
CH 48 IEEE 802.11n MCS0	5240 MHz	4.42 dBm/1 MHz	11 dBm/1 MHz	6.58 dB
CH 149 IEEE 802.11n MCS0	5745 MHz	-1.41 dBm/500 kHz	30 dBm/500 kHz	31.41 dB
CH 157 IEEE 802.11n MCS0	5785 MHz	-2.40 dBm/500 kHz	30 dBm/500 kHz	32.40 dB
CH 165 IEEE 802.11n MCS0	5825 MHz	-4.32 dBm/500 kHz	30 dBm/500 kHz	34.32 dB

Table 8.6-1: Power Spectral Density.

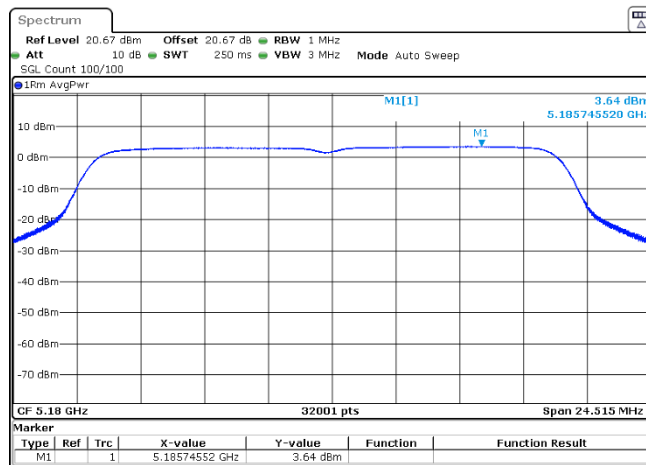


Figure 8.6-1: PSD, IEEE 802.11n MCS0, Channel 36: 5180 MHz

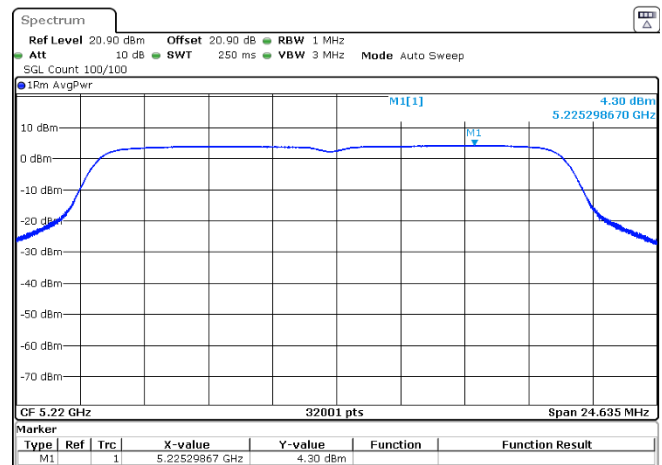


Figure 8.6-2: PSD, IEEE 802.11n MCS0, Channel 44: 5220 MHz

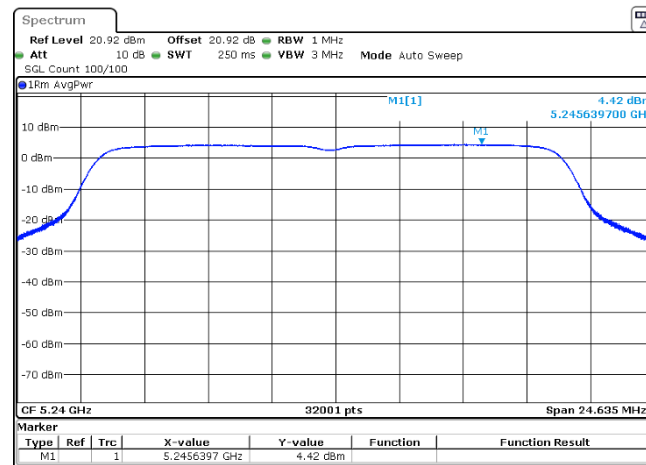


Figure 8.6-3: PSD, IEEE 802.11n MCS0, Channel 48: 5240 MHz

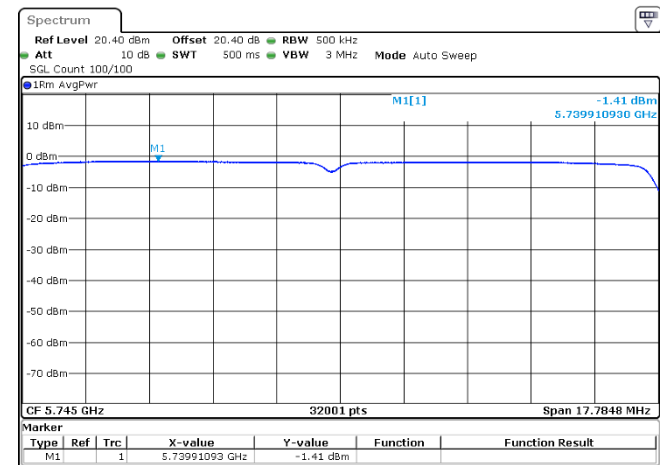


Figure 8.6-4: PSD, IEEE 802.11n MCS0, Channel 149: 5745 MHz

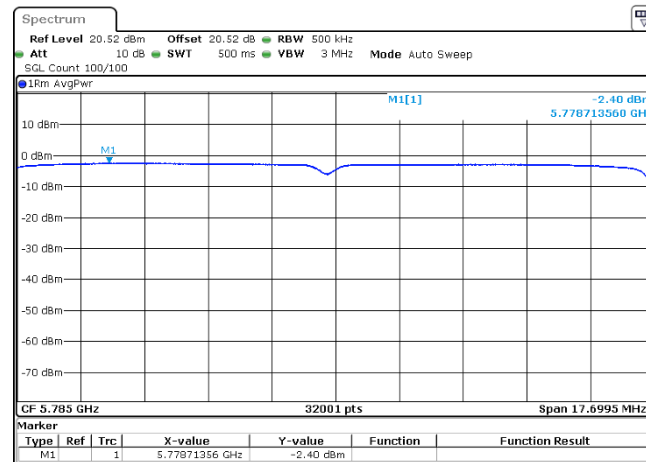


Figure 8.6-5: PSD, IEEE 802.11n MCS0, Channel 157: 5785 MHz

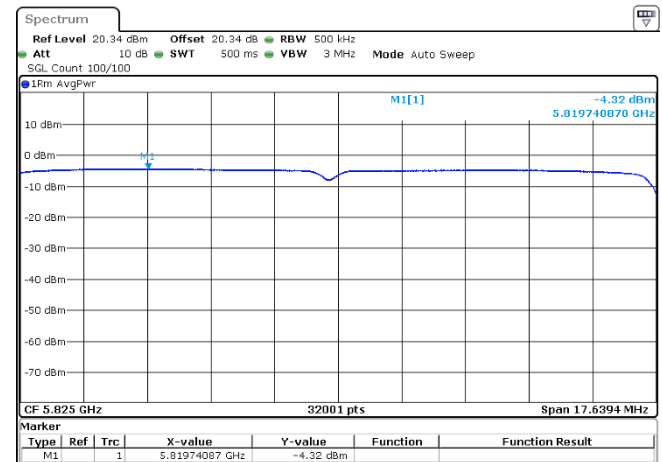


Figure 8.6-6: PSD, IEEE 802.11n MCS0, Channel 165: 5825 MHz

8.7 FCC 15.407(g) and RSS-247 Frequency Stability

8.7.1 Definition and limits

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart C → §15.407(g)

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Section 15.407(g) specifies that U-NII devices are required to ensure frequency stability. It is required that the emissions are maintained within the band of operation under all conditions of normal operation as specified in the user's manual. The grantee is responsible for ensuring that the EUT meets Section 15.407(g) requirements; however, the applications for equipment certification are not required to include test reports with explicit demonstration of compliance.

8.7.2 Test summary

Verdict	Pass		
Test date	December 14, 2022	Temperature	22 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1006 mbar
Test location	Wireless bench	Relative humidity	53 %

8.7.3 Notes

Testing was performed in Tx mode and the EUT transmitting on a fixed channel. Low, Middle, and High channels were tested using worst case modulation for each band. Only one bandwidth was declared by the manufacturer.

U-NII-1 band: 5150-5250 MHz → IEEE 802.11n MCS0 (worst case)

U-NII-3 band: 5725-5850 MHz → IEEE 802.11n MCS0 (worst case)

Extreme temperature declared by manufacturer: 0C to +50C. Standard voltage variation (±15% from nominal value, 120V 60 Hz): 102V-138V 60 Hz.

8.7.4 Setup details

Receiver settings

Resolution bandwidth	1% to 5% of the OBW
Video bandwidth	≥ 3 x RBW
Span	1.5 time to 5.0 times the OBW
Detector mode	Peak
Trace mode	Max Hold

8.7.5 Test data

5180 MHz (Low CH)				
Temperature	Low Frequency	High Frequency	Center Frequency	ppm
0 C	5170.5894	5189.2308	5179.9101	17.3552
+10 C	5170.6494	5189.1109	5179.8802	23.1371
+20 C (102V)	5170.7093	5188.9910	5179.8502	28.9286
+20 C	5170.7093	5189.0509	5179.8801	23.1467
+20 C (138V)	5170.7093	5188.9910	5179.8502	28.9286
+30 C	5170.6494	5188.9910	5179.8202	34.7104
+40 C	5170.6494	5188.9311	5179.7903	40.4923
+50 C	5170.6494	5188.9311	5179.7903	40.4923

Table 8.7-1: Frequency stability.

8.7.5 Test data, continued

5220 MHz (Middle CH)				
Temperature	Low Frequency	High Frequency	Center Frequency	ppm
0 C	5210.5295	5229.3506	5219.9401	11.4847
+10 C	5210.5894	5229.1109	5219.8502	28.7069
+20 C (102V)	5210.6494	5228.9910	5219.8202	34.4444
+20 C	5210.6494	5228.9910	5219.8202	34.4444
+20 C (138V)	5210.6494	5228.9910	5219.8202	34.4444
+30 C	5210.6494	5228.9311	5219.7903	40.1820
+40 C	5210.6494	5228.9311	5219.7903	40.1820
+50 C	5210.6494	5228.9311	5219.7903	40.1820
5240 MHz (High CH)				
Temperature	Low Frequency	High Frequency	Center Frequency	ppm
0 C	5230.4695	5249.3506	5239.9101	17.1660
+10 C	5230.5894	5249.1109	5239.8502	28.5973
+20 C (102V)	5230.6494	5248.9910	5239.8202	34.3130
+20 C	5230.6494	5248.9910	5239.8202	34.3130
+20 C (138V)	5230.6494	5248.9910	5239.8202	34.3130
+30 C	5230.6494	5248.9311	5239.7903	40.0286
+40 C	5230.6494	5248.9311	5239.7903	40.0286
+50 C	5230.6494	5248.9311	5239.7903	40.0286
5745 MHz (Low CH)				
Temperature	Low Frequency	High Frequency	Center Frequency	ppm
0 C	5735.5295	5754.0509	5744.7902	36.5187
+10 C	5735.5894	5753.8711	5744.7303	46.9539
+20 C (102V)	5735.5894	5753.8711	5744.7303	46.9539
+20 C	5735.5894	5753.8711	5744.7303	46.9539
+20 C (138V)	5735.5894	5753.8711	5744.7303	46.9539
+30 C	5735.5894	5753.8711	5744.7303	46.9539
+40 C	5735.5894	5753.8711	5744.7303	46.9539
+50 C	5735.5984	5753.8711	5744.7348	46.1706
5785 MHz (Middle CH)				
Temperature	Low Frequency	High Frequency	Center Frequency	ppm
0 C	5775.5894	5793.9311	5784.7603	41.4434
+10 C	5775.5894	5793.8711	5784.7303	46.6292
+20 C (102V)	5775.5894	5793.8112	5784.7003	51.8064
+20 C	5775.5894	5793.8112	5784.7003	51.8064
+20 C (138V)	5775.5894	5793.8711	5784.7303	46.6292
+30 C	5775.5295	5793.8711	5784.7003	51.8064
+40 C	5775.5292	5793.8112	5784.6702	57.0095
+50 C	5775.5295	5793.8112	5784.6704	56.9836
5825 MHz (High CH)				
Temperature	Low Frequency	High Frequency	Center Frequency	ppm
0 C	5815.5894	5833.8711	5824.7303	46.3090
+10 C	5815.5894	5833.8711	5824.7303	46.3090
+20 C (102V)	5815.5894	5833.8112	5824.7003	51.4506
+20 C	5815.5894	5833.8112	5824.7003	51.4506
+20 C (138V)	5815.5295	5833.8711	5824.7003	51.4506
+30 C	5815.5295	5833.8112	5824.6704	56.5923
+40 C	5815.5295	5833.8112	5824.6704	56.5923
+50 C	5815.5295	5833.8112	5824.6704	56.5923

Table 8.7-1: Frequency stability, continued.

8.8 AC Power Line Conducted Emissions

8.8.1 Definitions and limits

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart C → §15.207(a)

For Low-power radio-frequency devices that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN). The lower limit applies at the boundary between the frequency ranges.

Table 8-8-1: Conducted emissions limit

Frequency of emission, MHz	Conducted limit, dB μ V	
	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.

8.8.2 Test Summary

Verdict	Pass		
Test date	January 17, 2023	Temperature	18 °C
Test engineer	Martha Espinoza	Air pressure	1005 mbar
Test location	Ground plane	Relative humidity	50 %

8.8.3 Notes

Testing was performed with the EUT transmitting on a fixed channel at full power. The transmission was transmitting continuously: low, and high channel were evaluated for each sub-band:

U-NII-1 band: 5150-5250 MHz → IEEE 802.11n MCS0 (worst case)

U-NII-3 band: 5725-5850 MHz → IEEE 802.11n MCS0 (worst case)

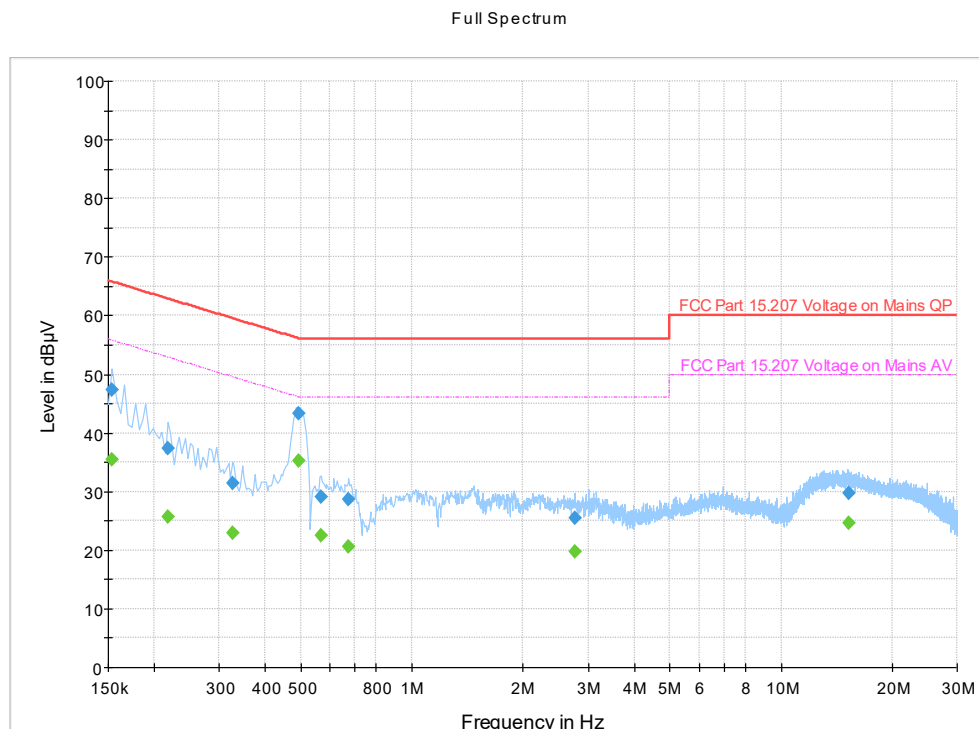
8.8.4 Setup Details

Port under test	AC mains
EUT setup configuration	Tabletop
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
Video bandwidth	30 kHz
Detector mode	– Peak and Average (Preview measurement) – Quasi-peak and CAverage (Final measurement)
Trace mode	Max Hold
Measurement time	– 100 ms (Peak and Average preview measurement) – 5000 ms (Quasi-peak final measurement) – 5000 ms (CAverage final measurement)

8.8.5 Test Data



The spectral plot has been corrected with transducer factors. (i.e. cable loss, LISN factors, and attenuators)

Figure 8.8-1: AC conducted emissions, 150 kHz – 30 MHz plot (TX Mode, low channel, U-NII-1: 5180 MHz).

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.154000	---	35.56	55.78	20.22	5000.0	9.000	N	ON	19.7
0.154000	47.27	---	65.78	18.52	5000.0	9.000	N	ON	19.7
0.218000	37.32	---	62.90	25.58	5000.0	9.000	N	ON	19.6
0.218000	---	25.68	52.90	27.21	5000.0	9.000	N	ON	19.6
0.326000	---	22.95	49.55	26.61	5000.0	9.000	N	ON	19.5
0.326000	31.35	---	59.55	28.20	5000.0	9.000	N	ON	19.5
0.494000	43.39	---	56.10	12.71	5000.0	9.000	N	ON	19.5
0.494000	---	35.25	46.10	10.85	5000.0	9.000	N	ON	19.5
0.566000	---	22.44	46.00	23.56	5000.0	9.000	L1	ON	19.5
0.566000	29.03	---	56.00	26.97	5000.0	9.000	L1	ON	19.5
0.674000	28.57	---	56.00	27.43	5000.0	9.000	L1	ON	19.5
0.674000	---	20.55	46.00	25.45	5000.0	9.000	L1	ON	19.5
2.762000	---	19.81	46.00	26.19	5000.0	9.000	L1	ON	19.5
2.762000	25.55	---	56.00	30.45	5000.0	9.000	L1	ON	19.5
15.238000	29.68	---	60.00	30.32	5000.0	9.000	L1	ON	20.3
15.238000	---	24.71	50.00	25.29	5000.0	9.000	L1	ON	20.3

Notes:

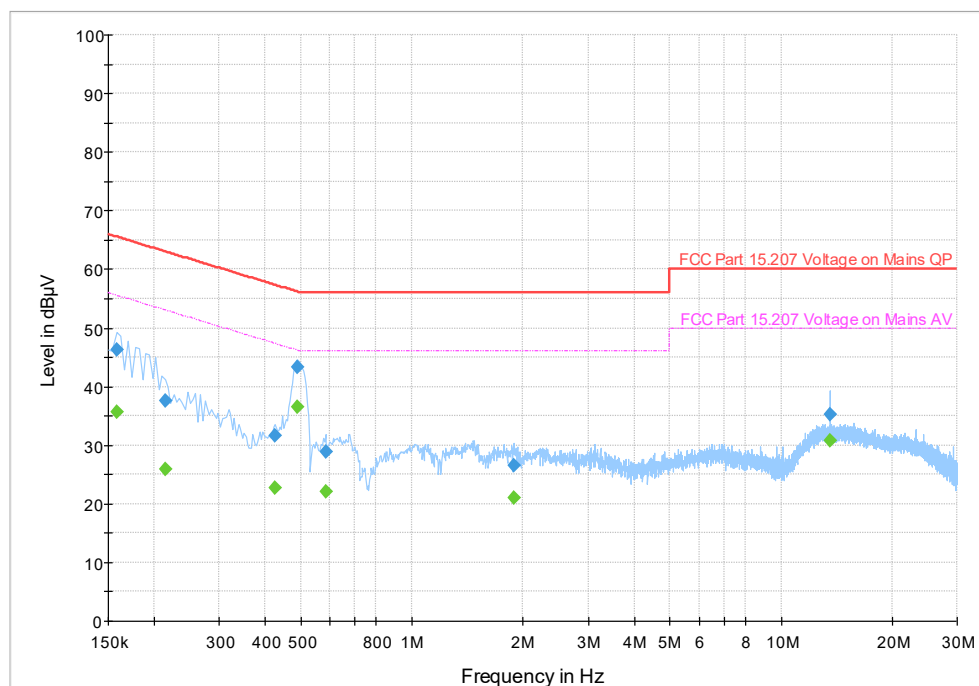
¹ Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)

² Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)

³ The maximum measured value observed over a period of 5 seconds was recorded.

Table 8.8-2: AC conducted emissions, 150 kHz – 30 MHz results (TX Mode, low channel, U-NII-1: 5180 MHz).

Full Spectrum



The spectral plot has been corrected with transducer factors. (i.e. cable loss, LISN factors, and attenuators)

Figure 8.8-2: AC conducted emissions, 150 kHz – 30 MHz plot (TX Mode, high channel, U-NII-1: 5240 MHz).

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.158000	46.35	---	65.57	19.22	5000.0	9.000	N	ON	19.7
0.158000	---	35.74	55.57	19.83	5000.0	9.000	N	ON	19.7
0.214000	---	25.90	53.05	27.15	5000.0	9.000	N	ON	19.6
0.214000	37.64	---	63.05	25.41	5000.0	9.000	N	ON	19.6
0.426000	31.55	---	57.33	25.78	5000.0	9.000	N	ON	19.5
0.426000	---	22.75	47.33	24.58	5000.0	9.000	N	ON	19.5
0.490000	---	36.55	46.17	9.62	5000.0	9.000	N	ON	19.5
0.490000	43.35	---	56.17	12.82	5000.0	9.000	N	ON	19.5
0.582000	---	22.04	46.00	23.96	5000.0	9.000	L1	ON	19.5
0.582000	28.98	---	56.00	27.02	5000.0	9.000	L1	ON	19.5
1.882000	---	21.07	46.00	24.93	5000.0	9.000	L1	ON	19.5
1.882000	26.54	---	56.00	29.46	5000.0	9.000	L1	ON	19.5
13.558000	---	30.82	50.00	19.18	5000.0	9.000	L1	ON	20.1
13.558000	35.24	---	60.00	24.76	5000.0	9.000	L1	ON	20.1

Notes:

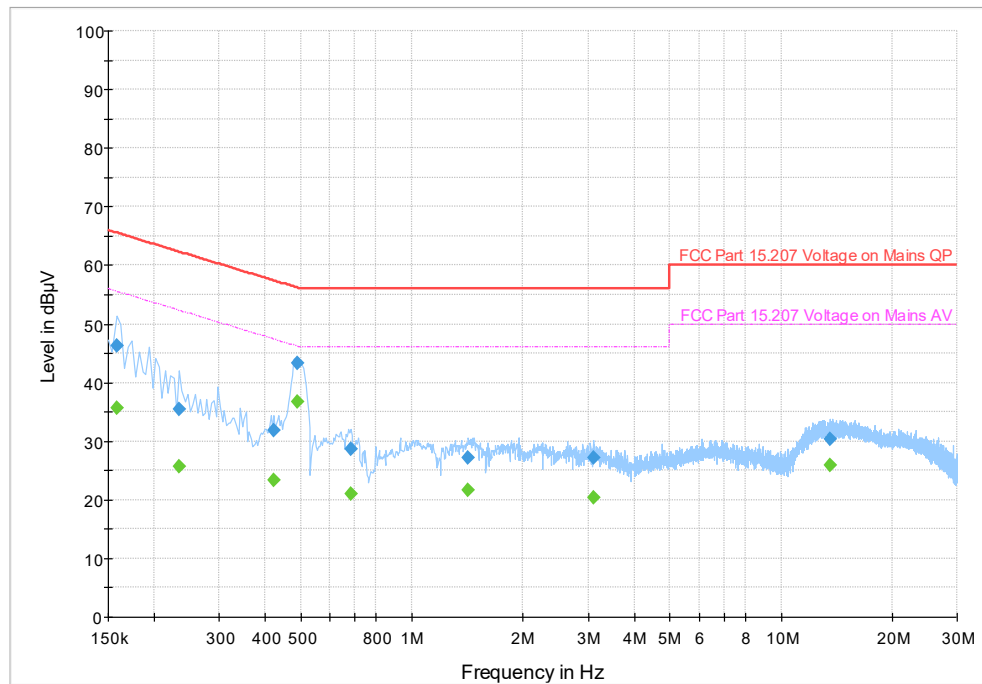
¹ Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)

² Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)

³ The maximum measured value observed over a period of 5 seconds was recorded.

Table 8.8-3: AC conducted emissions, 150 kHz – 30 MHz results (TX Mode, high channel, U-NII-1: 5240 MHz).

Full Spectrum



The spectral plot has been corrected with transducer factors. (i.e. cable loss, LISN factors, and attenuators)

Figure 8.8-3: AC conducted emissions, 150 kHz – 30 MHz plot (TX Mode, low channel, U-NII-3: 5745 MHz).

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.158000	---	35.74	55.57	19.83	5000.0	9.000	N	ON	19.7
0.158000	46.20	---	65.57	19.36	5000.0	9.000	N	ON	19.7
0.234000	35.44	---	62.31	26.86	5000.0	9.000	N	ON	19.6
0.234000	---	25.66	52.31	26.64	5000.0	9.000	N	ON	19.6
0.422000	---	23.38	47.41	24.02	5000.0	9.000	N	ON	19.5
0.422000	31.79	---	57.41	25.62	5000.0	9.000	N	ON	19.5
0.490000	43.39	---	56.17	12.77	5000.0	9.000	N	ON	19.5
0.490000	---	36.64	46.17	9.53	5000.0	9.000	N	ON	19.5
0.682000	---	20.95	46.00	25.05	5000.0	9.000	L1	ON	19.5
0.682000	28.70	---	56.00	27.30	5000.0	9.000	L1	ON	19.5
1.418000	27.09	---	56.00	28.91	5000.0	9.000	L1	ON	19.5
1.418000	---	21.68	46.00	24.32	5000.0	9.000	L1	ON	19.5
3.094000	---	20.46	46.00	25.54	5000.0	9.000	L1	ON	19.4
3.094000	27.13	---	56.00	28.87	5000.0	9.000	L1	ON	19.4
13.566000	30.39	---	60.00	29.61	5000.0	9.000	L1	ON	20.1
13.566000	---	25.95	50.00	24.05	5000.0	9.000	L1	ON	20.1

Notes:

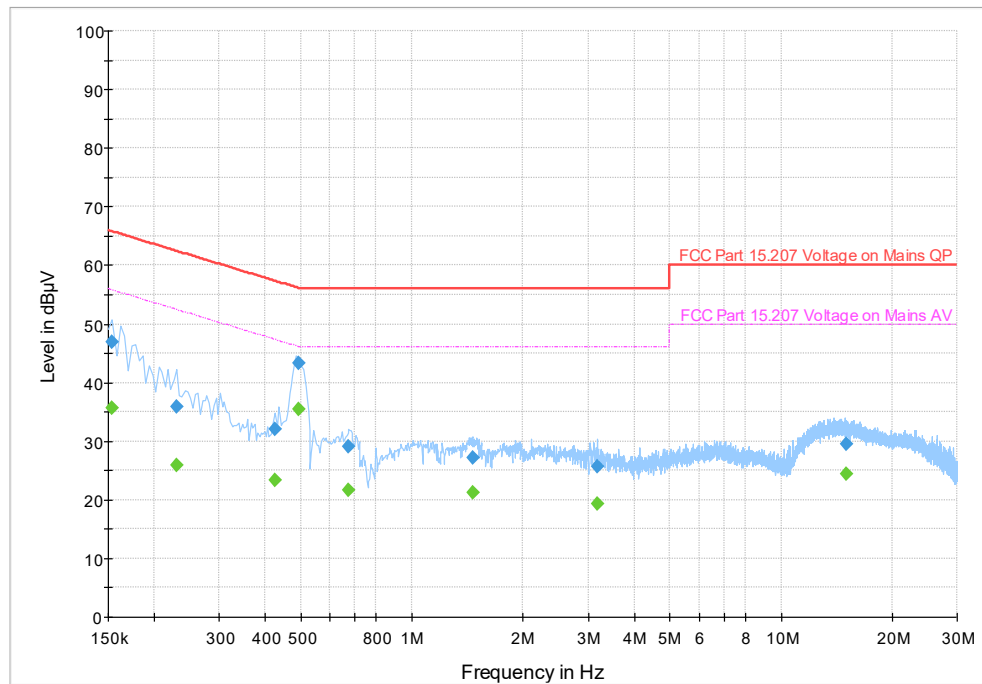
¹ Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)

² Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)

³ The maximum measured value observed over a period of 5 seconds was recorded.

Table 8.8-4: AC conducted emissions, 150 kHz – 30 MHz results (TX Mode, low channel, U-NII-3: 5745 MHz).

Full Spectrum



The spectral plot has been corrected with transducer factors. (i.e. cable loss, LISN factors, and attenuators)

Figure 8.8-4: AC conducted emissions, 150 kHz – 30 MHz plot (TX Mode, high channel, U-NII-3: 5825 MHz)

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.154000	---	35.57	55.78	20.21	5000.0	9.000	N	ON	19.7
0.154000	46.87	---	65.78	18.91	5000.0	9.000	N	ON	19.7
0.230000	35.98	---	62.45	26.47	5000.0	9.000	N	ON	19.6
0.230000	---	25.84	52.45	26.61	5000.0	9.000	N	ON	19.6
0.426000	---	23.37	47.33	23.96	5000.0	9.000	N	ON	19.5
0.426000	32.11	---	57.33	25.22	5000.0	9.000	N	ON	19.5
0.494000	43.41	---	56.10	12.69	5000.0	9.000	N	ON	19.5
0.494000	---	35.41	46.10	10.69	5000.0	9.000	N	ON	19.5
0.674000	---	21.58	46.00	24.42	5000.0	9.000	L1	ON	19.5
0.674000	29.05	---	56.00	26.95	5000.0	9.000	L1	ON	19.5
1.458000	27.12	---	56.00	28.88	5000.0	9.000	L1	ON	19.5
1.458000	---	21.14	46.00	24.86	5000.0	9.000	L1	ON	19.5
3.174000	---	19.37	46.00	26.63	5000.0	9.000	L1	ON	19.4
3.174000	25.63	---	56.00	30.37	5000.0	9.000	L1	ON	19.4
15.018000	29.48	---	60.00	30.52	5000.0	9.000	L1	ON	20.3
15.018000	---	24.38	50.00	25.62	5000.0	9.000	L1	ON	20.3

Notes:

¹ Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)

² Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)

³ The maximum measured value observed over a period of 5 seconds was recorded.

Table 8.8-5: AC conducted emissions, 150 kHz – 30 MHz results (TX Mode, high channel, U-NII-3: 5825 MHz).

Section 9 Block diagrams of test set-ups

9.1 Radiated emissions set-up

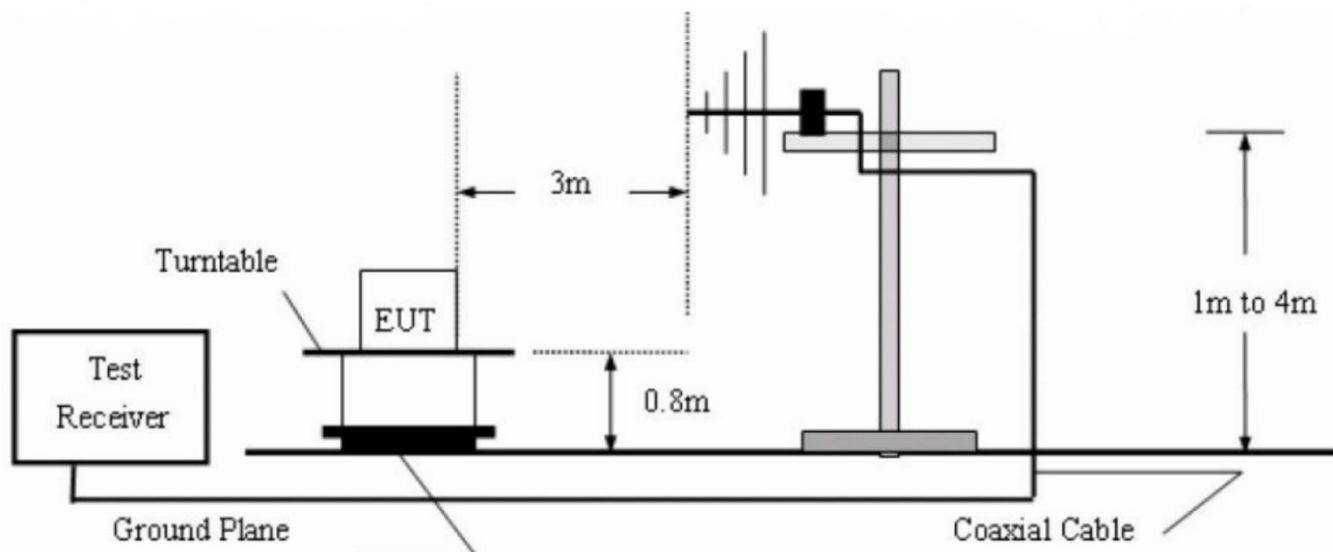


Figure 9.1-1: 30 MHz - 1000 MHz Setup

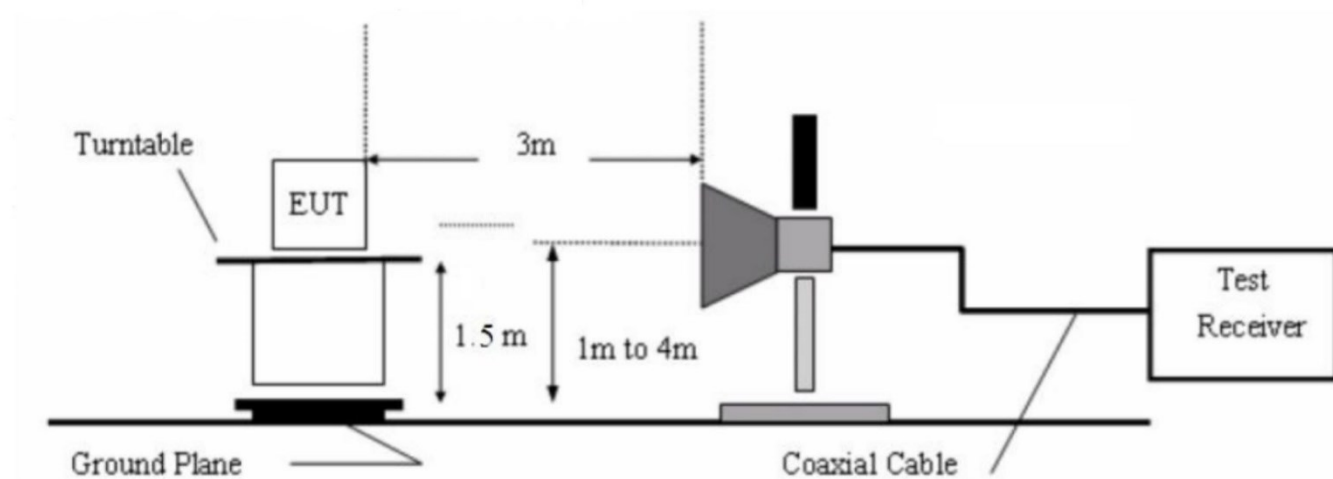


Figure 9.1-2: 1 GHz - 40 GHz Setup