

RF TEST REPORT

FCC

APPLICANT

eero LLC

MODEL NAME

R010001

FCC ID

2AEM4-41123474

REPORT NUMBER

HA210810-AER-001-R07

TEST REPORT

Date of Issue
November 24, 2021

Test Site
Hyundai C-Tech, Inc. dba HCT America, Inc.
1726 Ringwood Ave, San Jose, CA 95131, USA

Applicant	eero LLC
Applicant Address	660 3 rd Street, 4 th Floor, San Francisco, CA 94107, USA
FCC ID	2AEM4-41123474
Model Name	R010001
EUT Type	Wireless Router / Access Point
Modulation Type	OFDM / OFDM-A
FCC Classification	Unlicensed National Information Infrastructure (NII)
FCC Rule Part(s)	Part 15.407
Test Procedure	ANSI C63.10-2013, KDB 789033 D02 v02r01, KDB 662911 D01

The device bearing the trade name and model specified above, has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures required. The results of testing in this report apply only to the product which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Hyundai C-Tech, Inc. dba HCT America, Inc. certifies that no party to application has been denied the FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C 862

Tested By



Yongsoo Park
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Reviewed By



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REVISION HISTORY

The revision history for this document is shown in table.

TEST REPORT NO.	DATE	DESCRIPTION
HA210810-AER-001-R07	November 24, 2021	Initial Issue

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1. GENERAL INFORMATION

EUT DESCRIPTION

Model	R010001
EUT Type	Wireless Router / Access Point
Serial Number	GGC1-UCD1-1416-0A1H : Radiated GGC1-UCD1-1432-0A5H : Conducted
Power Supply	5 V d.c. (USB type C - External adaptor)
RF Specification	WIFI 2.4 GHz : 802.11b/g/n(HT20/40)/ ax(HE20/40) WIFI 5 GHz : 802.11a/n(HT20/40)/ ac(VHT20/40/80/160)/ ax(HE20/40/80/160) Bluetooth 5.0 LE (1M) IEEE 802.15.4
Transmitter Chain	WIFI 2.4 GHz / 5 GHz : 2x2 MIMO Bluetooth LE / IEEE 802.15.4 : SISO
Operating Environment	Indoor
Operating Temperature	0 °C ~ +40 °C

RF SPECIFICATION SUBJECT TO THE REPORT

RF Specification	IEEE 802.11a/n(HT20/40)/ac(VHT20/40/80)/ ax(HE20/40/80)	
Transmitter Chain	2 x 2 MIMO	
Frequency Range	U-NII 1	20 MHz BW : 5180 MHz – 5240 MHz 40 MHz BW : 5190 MHz – 5230 MHz 80 MHz BW : 5210 MHz
Max. RF Output Power	27.33 dBm (540.14 mW)	
Modulation Type	OFDM / OFDM-A	
Antenna Specification ¹⁾	Antenna Type : Internal PCB Dipole Antenna Peak Gain : 4.36 dBi Uncorrelated / 7.37 dBi Correlated	
Firmware Version ²⁾	eero OS 6.8	
Hardware Version ²⁾	Rev. A	
Date(s) of Tests	October 11, 2021 ~ November 09, 2021	

Note(s) :

1. Antenna information is based on the document provided.
2. Firmware and Hardware Version are as received by the client.

ANTENNA CONFIGURATION

The device employs 2x2 MIMO technologies with possible configurations below.

Frequency	Configuration	SDM	CDD
		ANT1 + ANT2	ANT1 + ANT2
2.4 GHz	802.11b	X	O
	802.11g	X	O
	802.11n	O	O
	802.11ax	O	O
5 GHz	802.11a	X	O
	802.11n	O	O
	802.11ac	O	O
	802.11ax	O	O

The equipment under test supports Cyclic Diversity mode.

CDD mode was picked as worst case for testing even though the device support both CDD and SDM

ANTENNA DIRECTIONAL GAIN

Antenna Type	Type	RF Technology	Frequency	Gain (Ant 1)	Gain (Ant 2)
PCB	Dipole	802.11b/g/n/ax	2.4 GHz	3.69 dBi	3.06 dBi
PCB	Dipole	802.11a/n/ac/ax	5 GHz	4.50 dBi	4.22 dBi
Metal	Monopole	BLE / IEEE 802.15.4	2.4 GHz	2.90 dBi	

Ant 1 : 2.4 GHz (Chain 0) / 5 GHz (Chain 1)

Ant 2 : 2.4 GHz (Chain 1) / 5 GHz (Chain 0)

Directional Gain (2.4 GHz : Uncorrelated) = $10 \log[(10^{(3.69/10)} + 10^{(3.06/10)}) / 2] = 3.39 \text{ dBi}$

Directional Gain (5 GHz : Uncorrelated) = $10 \log[(10^{(4.50/10)} + 10^{(4.22/10)}) / 2] = 4.36 \text{ dBi}$

Directional Gain (2.4 GHz : Correlated) = $10 \log[(10^{(3.69/20)} + 10^{(3.06/20)})^2 / 2] = 6.39 \text{ dBi}$

Directional Gain (5 GHz : Correlated) = $10 \log[(10^{(4.50/20)} + 10^{(4.22/20)})^2 / 2] = 7.37 \text{ dBi}$

The device does not support beam foaming.

OPERATING FREQUENCY CHANNELS

Band	Frequency (MHz)	Channel	802.11a	802.11n HT20	802.11ac VHT20	802.11ax HE20
U-NII 1	5180	36	O	O	O	O
	5200	40	O	O	O	O
	5220	44	O	O	O	O
	5240	48	O	O	O	O

Band	Frequency (MHz)	Channel	802.11n HT40	802.11ac VHT40	802.11ax HE40
U-NII 1	5190	38	O	O	O
	5230	46	O	O	O

Band	Frequency (MHz)	Channel	802.11ac VHT80	802.11ax HE80
U-NII 1	5210	42	O	O

2. METHODOLOGY

The measurement procedure described in FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01 dated December 14, 2017 entitled "Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (UNII) Devices Part15, Subpart E" and ANSI C63.10 (Version : 2013) 'the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices' were used in the measurement.

EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.407 under the FCC Rules Part 15 Subpart E.

GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1GHz. Above 1GHz with 1.5m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. Also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emission, the relative positions of this hand-held transmitter (EUT) were rotated through three orthogonal axes according to the requirements in Section 8 of ANSI C63.10. (Version: 2013)

DESCRIPTION OF TEST MODES

The EUT has been tested at 5 GHz WLAN test mode. Qualcomm Radio Control Tool was used to control the channels, power level setting at continuous TX for each 802.11a/n(HT20/40) /ac(VHT20/40/80) /ax(HE20/40/80).

3. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment's, which is traceable to recognized national standards. Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

4. FACILITIES AND ACCREDITATIONS

FACILITIES

The SAC (Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at 1726 Ringwood Avenue, San Jose, California 95131, USA.

The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.



EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

5. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203:

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.”

- (1) The antenna of this E.U.T is permanently attached and there is no provision for connection to an external antenna.
- (2) The E.U.T Complies with the requirement of §15.203

6. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

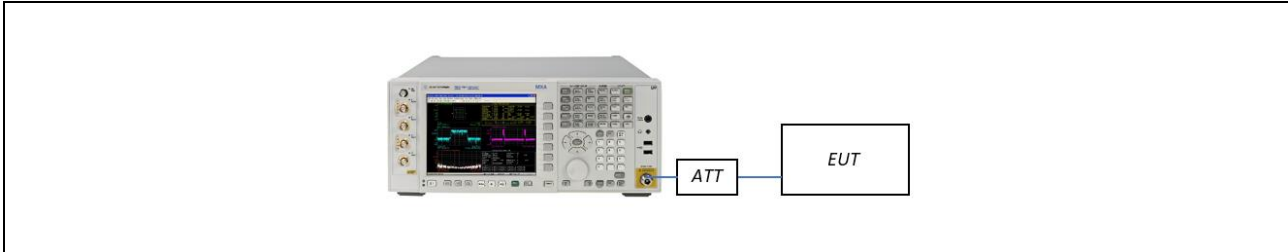
All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95 % level of confidence. The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty
Output Power, Conducted	± 0.35 dB
Occupied Bandwidth	± 12.4 kHz
Unwanted Emissions, Conducted	± 0.46 dB
Radiated Emissions (below 1 GHz)	± 6.09 dB
Radiated Emissions (Above 1 GHz)	± 5.23 dB

7. DESCRIPTION OF TESTS

7.1. DUTY CYCLE

TEST SETUP



TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer.

Measurement is performed in accordance with the section B.2 in KDB 789033 D02 v02r01.

The largest available value of RBW is 8 MHz and VBW is 50 MHz.

The zero-span method of measuring duty cycle shall not be used if $T \leq 6.25$ microseconds. ($50/6.25 = 8$)

The zero-span method was used because all measured T data are > 6.25 microseconds and both RBW and VBW are $> 50/T$.

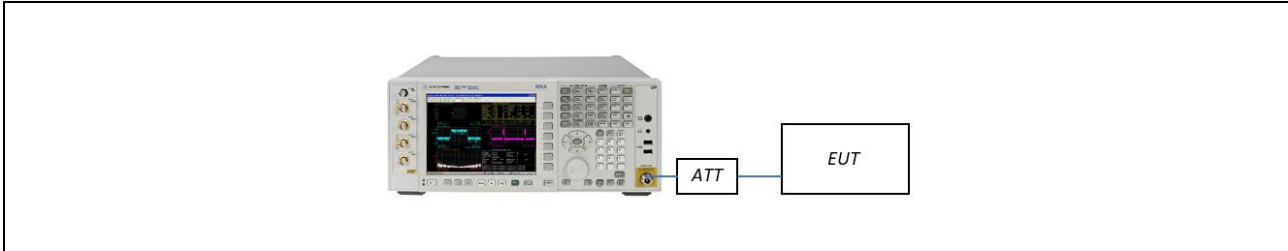
- RBW = 8 MHz (the largest available value)
- VBW = 8 MHz ($\geq$ RBW)
- SPAN = 0 Hz
- Detector = Peak
- Number of points in sweep > 100
- Trace mode = Clear write
- Measure T_{total} and T_{on}
- Calculate Duty Cycle = T_{on} / T_{total} and Duty Cycle Factor = $10 * \log(1/\text{Duty Cycle})$

7.2. 26 dB BANDWIDTH / 99 % OCCUPIED BANDWIDTH

LIMIT

Emission bandwidth was measured to define the minimum frequency range which the spectrum is integrated for maximum conducted output power measurement.

TEST SETUP



TEST PROCEDURE (26 dB Bandwidth)

Testing was performed according to the section C.1 in KDB 789033 D02 v02r01.

The transmitter output is connected to the spectrum analyzer.

The Spectrum Analyzer setting :

- RBW = Approximately 1 % of the emission bandwidth
- VBW > RBW
- Detector = Peak
- Trace mode = max hold
- Sweep = auto couple
- Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1 %.

TEST PROCEDURE (99% Bandwidth)

Testing was performed according to the section D in KDB 789033 D02 v02r01.

The transmitter output is connected to the spectrum analyzer.

- RBW = 1% ~ 5% of the occupied bandwidth
- VBW $\approx$ 3 x RBW
- Detector = Peak
- Trace mode = max hold
- Sweep = auto couple
- Allow the trace to stabilize

Note(s) :

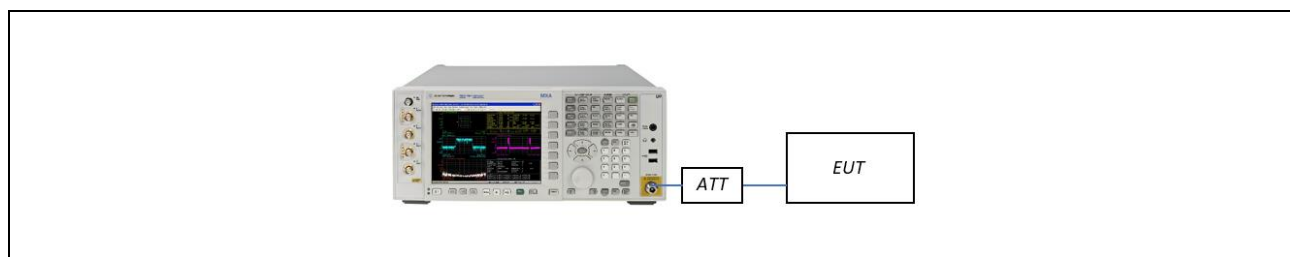
1. The bandwidth measurement function from the spectrum analyzer is used to measure X dB bandwidth.
2. 26 dB bandwidth is used to determine the conducted power limits.

7.3. OUTPUT POWER

LIMIT

Band	47 CFR §15.407(a)(1)	
U-NII 1	Master (Outdoor)	$\leq 1 \text{ W} (= 30\text{dBm})$ $\leq 125 \text{ mW} (= 21\text{dBm})$ EIRP at max elevation angle (30°) from horizon
	Master (Indoor)	$\leq 1 \text{ W} (= 30\text{dBm})$
	Client Device	$\leq 250 \text{ mW} (= 24 \text{ dBm})$

TEST SETUP



TEST PROCEDURE

Refer to the section E.2.d) in KDB 789033 D02 v02r01

The transmitter output is connected to the Spectrum Analyzer.

Spectrum analyzer's integrated band power measurement function was used.

- Measure the duty cycle.
- Set span to encompass the 26 dB EBW or 99 % OBW of the signal.
- RBW = 1 MHz
- VBW ≥ 3 MHz
- Number of points in sweep $\geq 2 \cdot \text{span} / \text{RBW}$.
- Sweep time = auto.
- Detector = RMS.
- Do not use sweep triggering. Allow the sweep to "free run".
- Trace average at least 100 traces in power averaging (RMS) mode
- Integrated bandwidth = EBW or 99 % OBW

Add $10\log(1/x)$, where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times

Sample Calculation

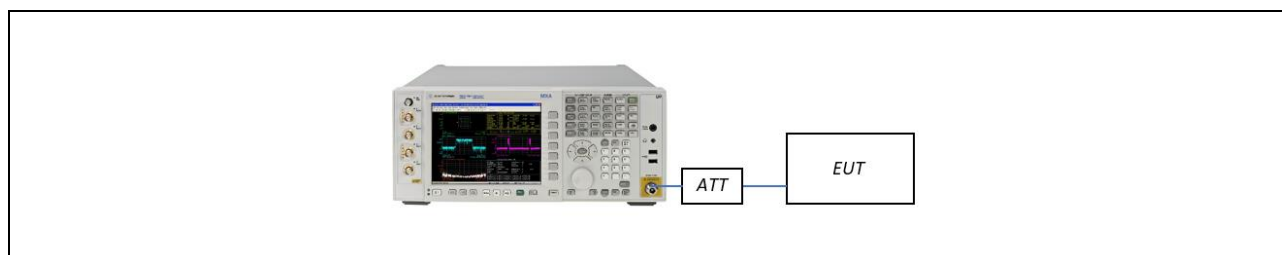
- Conducted Output Power (Average) = Reading Value + ATT loss + Cable loss + Duty Cycle Factor

7.4. POWER SPECTRAL DENSITY

LIMIT

Band	47 CFR §15.407(a)(1)	
U-NII 1	Master Device	≤ 17 dBm/MHz
	Client Device	≤ 11 dBm/MHz

TEST SETUP



TEST PROCEDURE

Refer to the section F in KDB 789033 D02 v02r01.

- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- RBW = 1 MHz (510 kHz for UNII 3)
- VBW ≥ 3 MHz
- Number of points in sweep $\geq 2 \times \text{span} / \text{RBW}$.
- Sweep time = auto.
- Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
- Do not use sweep triggering. Allow the sweep to “free run”.
- Trace average at least 100 traces in power averaging (RMS) mode
- Use the peak search function on the spectrum analyzer to find the peak of the spectrum.
- If Method SA-2 was used, add $10 \log(1/x)$, where x is the duty cycle, to the peak of the spectrum.

Sample Calculation

Total PSD (Average) = Reading Value + ATT loss + Cable loss + Duty Cycle Factor

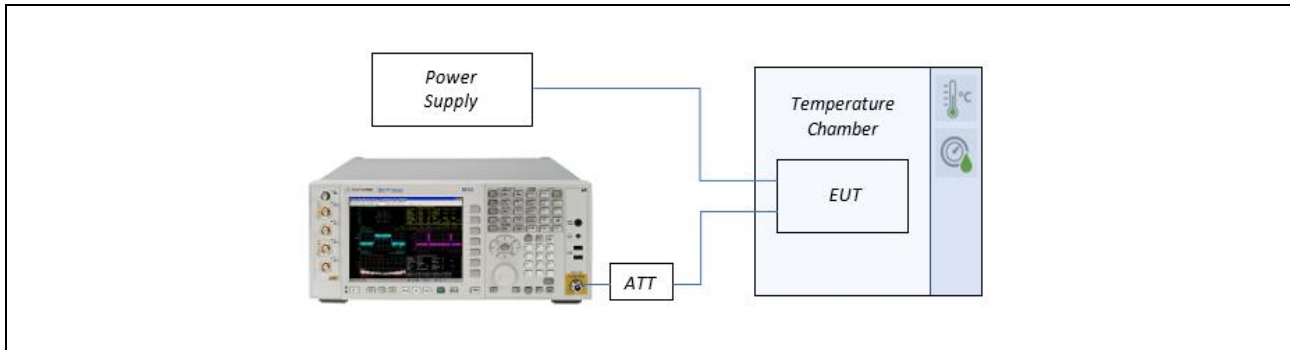
7.5. FREQUENCY STABILITY

LIMIT

§15.407(g)

Fundamental emissions of the radio devices should be kept within at least the central 80% of its permitted operating frequency band to minimize the possibility of out of band operation.

TEST SETUP



TEST PROCEDURE

- The EUT was placed inside an environmental chamber as the temperature in the chamber was varied between - 30 °C and 50 °C.
- The temperature was incremented by 10 °C intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded.
- The primary supply voltage is varied from 85% to 115% of the nominal value for non-hand carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.
- While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.

7.6. UNDESIRABLE EMISSION

LIMIT

Frequency Band	47 CFR §15.407(b)(1)
U-NII 1	In accordance with 47 CFR §15.407(b)(1) All emissions outside the 5.15-5.35 GHz band shall not exceed an -27 dBm/MHz e.i.r.p.

Note(s) :

For ISSED, The 26 dB bandwidth may fall into the 5250-5350 MHz band; however, if the occupied bandwidth also falls within the 5250-5350 MHz band, the transmission is considered as intentional and the devices shall comply with all requirements in the band 5250-5350 MHz including implementing dynamic frequency selection (DFS) and TPC, on the portion of the emission that resides in the 5250-5350 MHz band.

7.7. RADIATED EMISSIONS

RADIATION EMISSION LIMIT

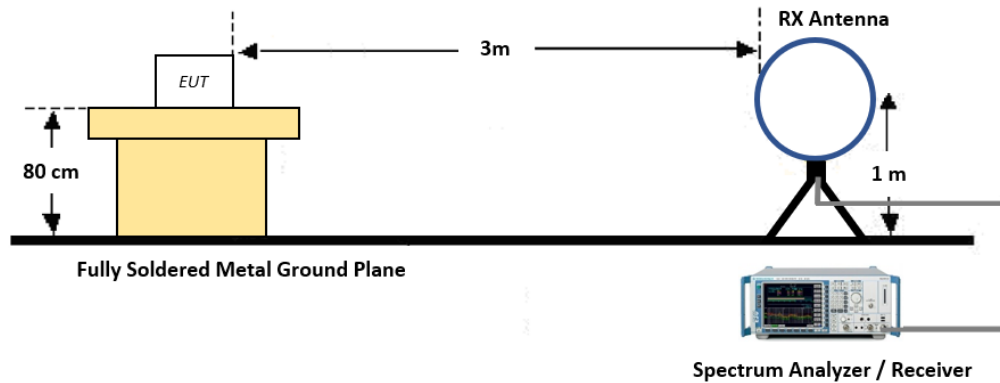
FCC : 47 CFR § 15.209		
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

RESTRICTED BANDS OF OPERATION

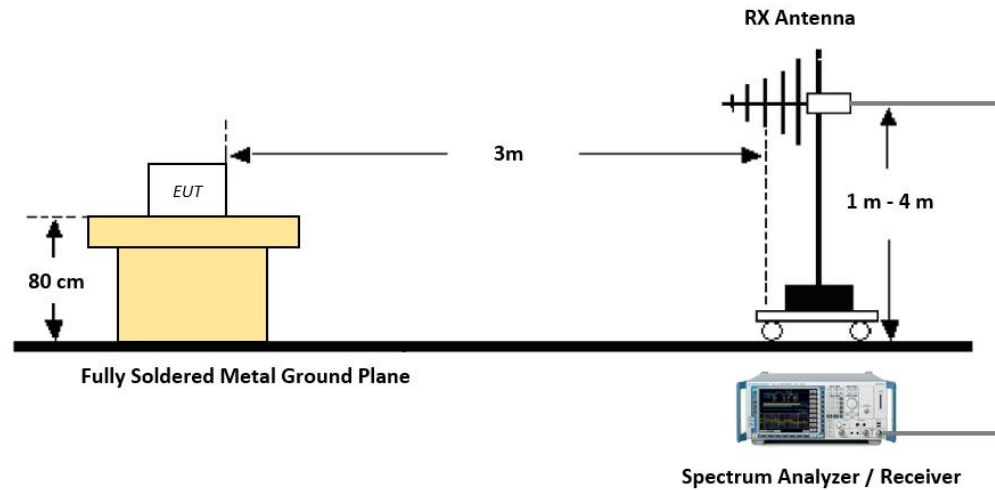
FCC : 47 CFR § 15.205(a)				
Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
0.090 - 0.110	12.29 - 12.293	149.9 - 150.05	1660.0 - 1710.0	8025 - 8500
0.495 - 0.505	12.51975 - 12.52025	156.52475 - 156.52525	1718.8 - 1722.2	9000 - 9200
2.1735 - 2.1905	12.57675 - 12.57725	156.7 - 156.9	2200.0 - 2300.0	9300 - 9500
4.125 - 4.128	13.36 - 13.41	162.0125 - 167.17	2310.0 - 2390.0	10600 - 12700
4.17725 - 4.17775	16.42 - 16.423	167.72 - 173.2	2483.5 - 2500.0	13250 - 13400
4.20725 - 4.20775	16.69475 - 16.69525	240.0 - 285.0	2690.0 - 2900.0	14470 - 14500
6.215 - 6.218	16.80425 - 16.80475	322.0 - 335.4	3260.0 - 3267.0	15350 - 16200
6.26775 - 6.26825	25.5 - 25.67	399.9 - 410.0	3332.0 - 3339.0	17700 - 21400
6.31175 - 6.31225	37.5 - 38.25	608.0 - 614.0	3345.8 - 3358.0	22010 - 23120
8.291 - 8.294	73 - 74.6	960.0 - 1240.0	3600.0 - 4400.0	23600 - 24000
8.362 - 8.366	74.8 - 75.2	1300.0 - 1427.0	4500.0 - 5150.0	31200 - 31800
8.37625 - 8.38675	108 - 121.94	1435.0 - 1626.5	5350.0 - 5460.0	36430 - 36500
8.41425 - 8.41475	123 - 138	1645.5 - 1646.5	7250.0 - 7750.0	Above 38600

TEST SETUP

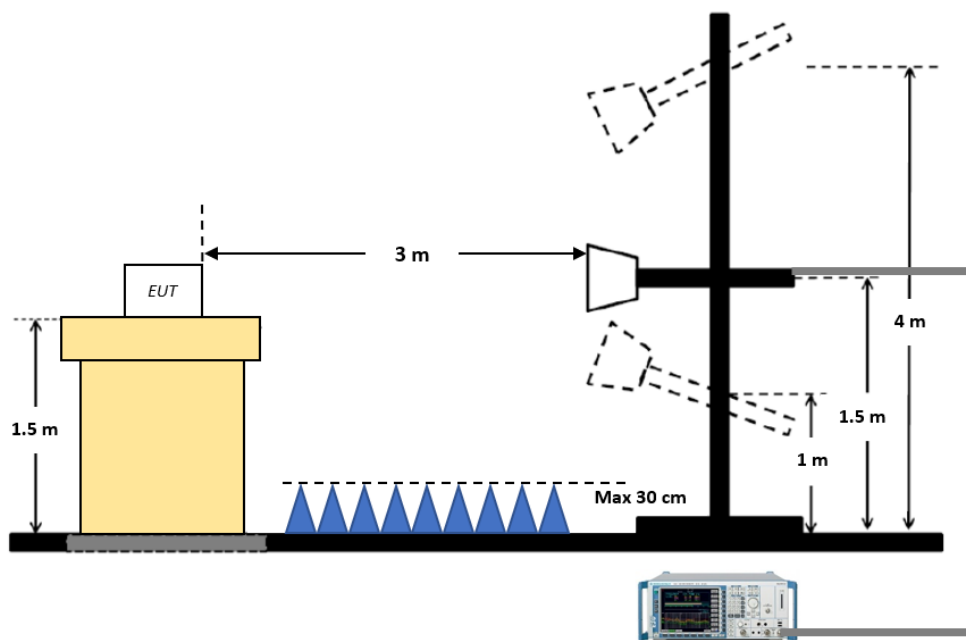
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



TEST PROCEDURE OF RADIATED SPURIOUS EMISSION (BELOW 30 MHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The loop antenna was placed at a location 3m from the EUT
3. The EUT is placed on a turntable, which is 0.8m above ground plane.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Distance Correction Factor (0.009 MHz – 0.490 MHz) = $40 \cdot \log(3 \text{ m}/300 \text{ m}) = -80 \text{ dB}$
Measurement Distance: 3 m
7. Distance Correction Factor (0.490 MHz – 30 MHz) = $40 \cdot \log(3 \text{ m}/30 \text{ m}) = -40 \text{ dB}$
Measurement Distance: 3 m
8. Spectrum Setting
 - Frequency Range = 9 kHz ~ 30 MHz
 - Detector = Peak
 - Trace = Max hold
 - RBW = 9 kHz
 - VBW $\geq 3 \cdot \text{RBW}$
9. Total = Reading Value + Antenna Factor (A.F) + Cable Loss (C.L)
10. There is a comparison data both open-field test site and alternative test site – semi-Anechoic chamber according to 414788 D01. And the results are properly calibrated.

TEST PROCEDURE OF RADIATED SPURIOUS EMISSION (30 MHz – 1 GHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The EUT is placed on a turntable, which is 0.8 m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. Spectrum Setting
 - (1) Measurement Type (Peak):
 - Measured Frequency Range: 30 MHz – 1 GHz
 - Detector = Peak
 - Trace = Max hold
 - RBW = 100 kHz
 - VBW $\geq 3 \cdot \text{RBW}$
 - (2) Measurement Type(Quasi-peak):
 - Measured Frequency Range: 30 MHz – 1 GHz
 - Detector = Quasi-Peak
 - RBW = 120 kHz
6. Total = Reading Value + Antenna Factor (A.F) + Cable Loss (C.L)

TEST PROCEDURE OF RADIATED SPURIOUS EMISSION (ABOVE 1 GHz)

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. The unit was tested with its standard battery.
8. Spectrum Setting

(1) Measurement Type(Peak, G.5 in KDB 789033 v02r01):

- RBW = 1 MHz
- VBW $\geq$ 3 MHz
- Detector = Peak
- Sweep Time = auto
- Trace mode = Max hold
- Allow sweeps to continue until the trace stabilizes.
- Note that if the transmission is not continuous, the time required for the trace to stabilize will increase by a factor of approximately $1/x$, where x is the duty cycle.

(2) Measurement Type(Average, G.6.d in KDB 789033 v02r01):

- RBW = 1 MHz
- VBW(Duty cycle $\geq$ 98 percent) = VBW $\leq$ RBW/100(i.e., 10 kHz) but not less than 10 Hz.
- VBW(Duty cycle is < 98 percent) = VBW $\geq$ $1/T$, where T is the minimum transmission duration.
- The analyzer is set to linear detector mode.
- Detector = Peak.
- Sweep time = auto.
- Trace mode = Max hold.
- Allow max hold to run for at least 50 traces if the transmitted signal is continuous or has at least 98 percent duty cycle. For lower duty cycles, increase the minimum number of traces by a factor of $1/x$, where x is the duty cycle.

9. Measurement value only up to 6 maximum emissions noted or would be lesser if no specific emissions from the EUT are recorded (i.e.: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor
10. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency (or 40 GHz whichever comes first)
11. Sample Calculation

(1) Total (Peak) = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G)

(2) Total (Average, Duty $\geq$ 98%) = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G)

(3) Total (Average, Duty < 98%) = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Duty Cycle Factor

TEST PROCEDURE OF RADIATED RESTRICTED BAND EDGE

1. Radiated test is performed with hopping off (if there is any)
2. The EUT is placed on a turntable, which is 1.5 m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. The unit was tested with its standard battery.
8. Spectrum Setting

(1) Measurement Type(Peak, G.5 in KDB 789033 v02r01):

- RBW = 1 MHz
- VBW $\geq$ 3 MHz
- Detector = Peak
- Sweep Time = auto
- Trace mode = Max hold
- Allow sweeps to continue until the trace stabilizes.
- Note that if the transmission is not continuous, the time required for the trace to stabilize will increase by a factor of approximately $1/x$, where x is the duty cycle.

(2) Measurement Type(Average, G.6.d in KDB 789033 v02r01):

- RBW = 1 MHz
- VBW(Duty cycle $\geq$ 98 percent) = VBW $\leq$ RBW/100(i.e., 10 kHz) but not less than 10 Hz.
- VBW(Duty cycle is < 98 percent) = VBW $\geq$ $1/T$, where T is the minimum transmission duration.
- The analyzer is set to linear detector mode.
- Detector = Peak.
- Sweep time = auto.
- Trace mode = Max hold.
- Allow max hold to run for at least 50 traces if the transmitted signal is continuous or has at least 98 percent duty cycle. For lower duty cycles, increase the minimum number of traces by a factor of $1/x$, where x is the duty cycle.

9. Sample Calculation

(1) Total (Peak) = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L)

(2) Total (Average, Duty $\geq$ 98%) = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G)

(3) Total (Average, Duty < 98%) = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Duty Cycle Factor

7.8. AC POWER LINE CONDUCTED EMISSIONS

LIMIT

47 CFR § 15.207

For an intentional radiator 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 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Limits (dB μ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

*Decreases with the logarithm of the frequency.

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

TEST SETUP

See test photographs attached in Annex A for the actual connections between EUT and support equipment.

TEST PROCEDURE

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors : Quasi Peak and Average Detector.

According to FCC KDB 174176 D01 Line Conducted FAQ v01r01 :

Devices Operating Above 30 MHz

For a device with a permanent or detachable antenna operating above 30 MHz, measurements must be performed with the antenna connected as specified in clause 6.2 of ANSI C63.10-2013.

Devices Operating Below 30 MHz

For a device with a permanent or detachable antenna operating at or below 30 MHz, the FCC will accept measurements performed with a suitable dummy load in lieu of the antenna under the following conditions:

- (1) Perform the AC power-line conducted tests with the antenna connected to determine compliance with Section 15.207 limits outside the transmitter's fundamental emission band;
- (2) Retest with a dummy load in lieu of the antenna to determine compliance with Section 15.207 limits within the transmitter's fundamental emission band. For a detachable antenna, remove the antenna and connect a suitable dummy load to the antenna connector. For a permanent antenna, remove the antenna and terminate the RF output with a dummy load or network which simulates the antenna in the fundamental frequency band. All measurements must be performed as specified in clause 6.2 of ANSI C63.10-2013.

Sample Calculation

Quasi-peak(Final Result) = Reading Value + Correction Factor

8. SUMMARY OF TEST RESULTS

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
26dB Bandwidth	§15.407	N/A (For power measurement)	Conducted	-
Maximum Conducted Output Power	§15.407(a)(1)	$\leq 1 \text{ W}$		PASS
Power Spectral Density	§15.407(a)(1)	$\leq 17 \text{ dBm/MHz}$		PASS
Frequency Stability	§15.407(g) §2.1055	Maintained within the band		PASS
AC Power line Conducted Emissions	§15.207 §15.407(b)(9)	cf. Section 7.8		PASS
Undesirable Emissions	§15.407(b)(1)	cf. Section 7.6	Radiated	PASS
Radiated Spurious Emissions	§15.209 §15.407(b)(9)	cf. Section 7.7		PASS
Radiated Restricted Band Edge	§15.407(b)(7) §15.205(a)	cf. Section 7.7		PASS

WORST CASE CONFIGURATION

RADIATED TEST

1. EUT Axis

- All X, Y, and Z positions for horizontal / vertical antenna polarization were investigated to find the worst-case position.
- X position was selected for the final evaluation.

2. Operations with all the data rates available were investigated for each different channel BW mode. Lowest data rate was selected as the worst case.

3. Radiated test was performed at the worst case 2 x TX CDD mode

- Radiated band edge test was conducted for each different mode and bandwidth. 802.11a/n(HT20/40)/ac(VHT80)/ax(HE20/40/80) modes were reported as the worst case
- Radiated spurious emission test was performed for each different bandwidth. 802.11a, 802.11n HT40, 802.11ac VHT80 modes were reported as the worst-case spurious emission.

CONDUCTED TEST

1. AC line conducted emission test was performed at the worst case transmission mode.

WORST CASE DATA RATE

Mode	Worst Case Data Rate
802.11a	6 Mbps
802.11n	MCS0
802.11ac	MCS0
802.11ax	MCS0

CHANNEL UNDER TEST

Mode (U-NII 1)	Bandwidth (MHz)	Low Channel (MHz)	Mid Channel (MHz)	High Channel (MHz)
802.11a	20	5180	5220	5240
802.11n	20	5180	5220	5240
	40	5190	-	5230
802.11ac	80	5210		
802.11ax	20	5180	5220	5240
	40	5190	-	5230
	80	5210		

SUMMARY OF OUTPUT POWER

Bandwidth	Mode	Max Output Power (dBm)	Max Output Power (mW)	Channel Frequency (MHz)
20 MHz	802.11a	26.43	439.59	5220
	802.11n HT20	26.37	433.60	5240
	802.11ax HE20	26.89	488.59	5240
40 MHz	802.11n HT40	27.33	540.14	5230
	802.11ax HE40	26.19	415.92	5230
80 MHz	802.11ac VHT80	21.21	132.09	5210
	802.11ax HE80	20.22	105.20	5210

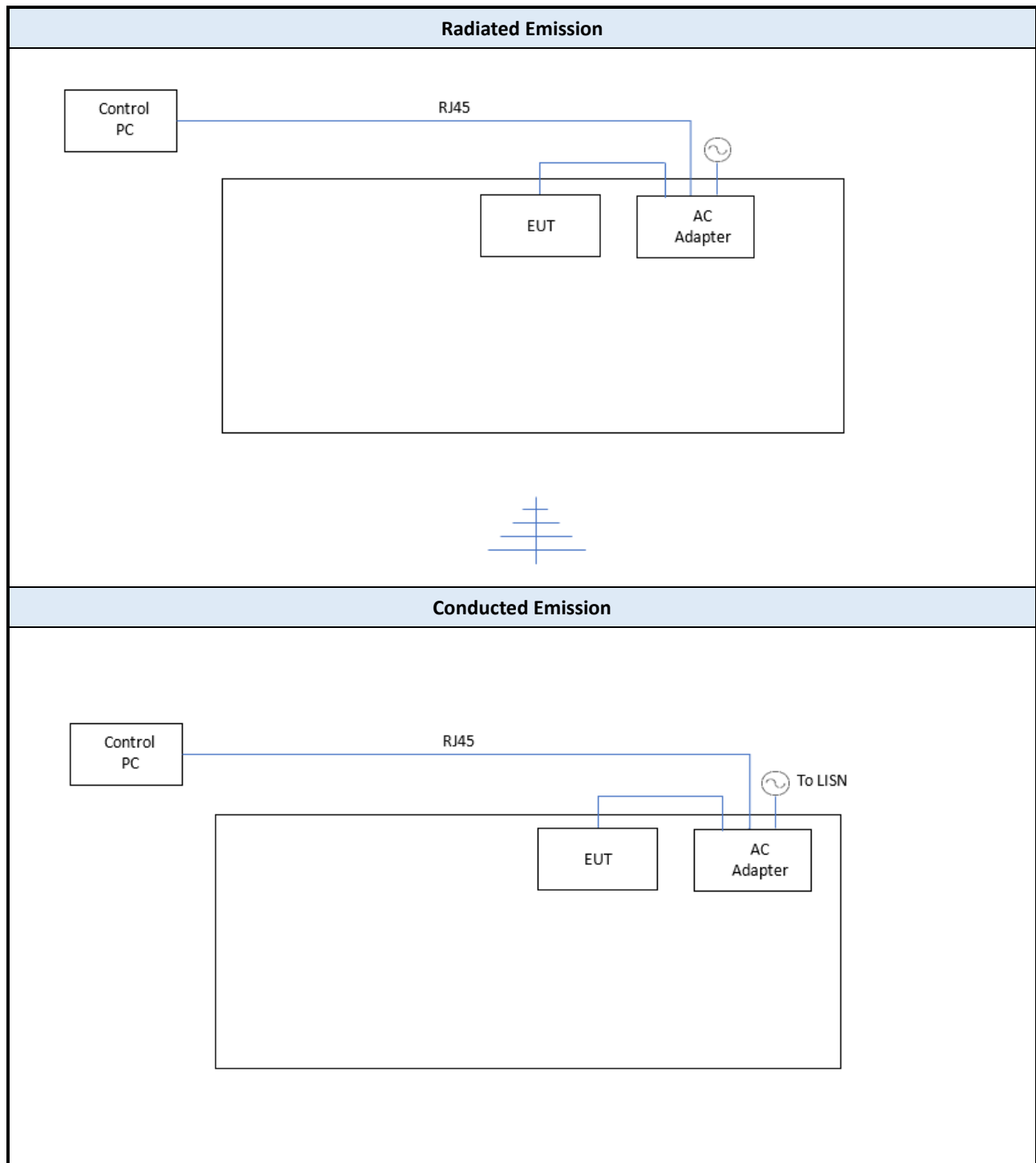
SUMMARY OF POWER LEVEL SETTING

U-NII 1 Band (20 MHz)		Power Level Setting / Chain			
Frequency (MHz)	Channel	802.11a	802.11n HT20	802.11ac VHT20	802.11ax HE20
5180	36	22	22	22	22.5
5200	40	22	22	22	22.5
5220	44	22	22	22	22.5
5240	48	22	22	22	23

U-NII 1 Band (40 MHz)		Power Level Setting / Chain		
Frequency (MHz)	Channel	802.11n HT40	802.11ac VHT40	802.11ax HE40
5190	38	18	18	18
5230	46	21.5	21.5	21.5

U-NII 1 Band (80 MHz)		Power Level Setting / Chain	
Frequency (MHz)	Channel	802.11ac VHT80	802.11ax HE80
5210	42	17	17

TEST CONFIGURATION



LIST OF SUPPORT EQUIPMENT

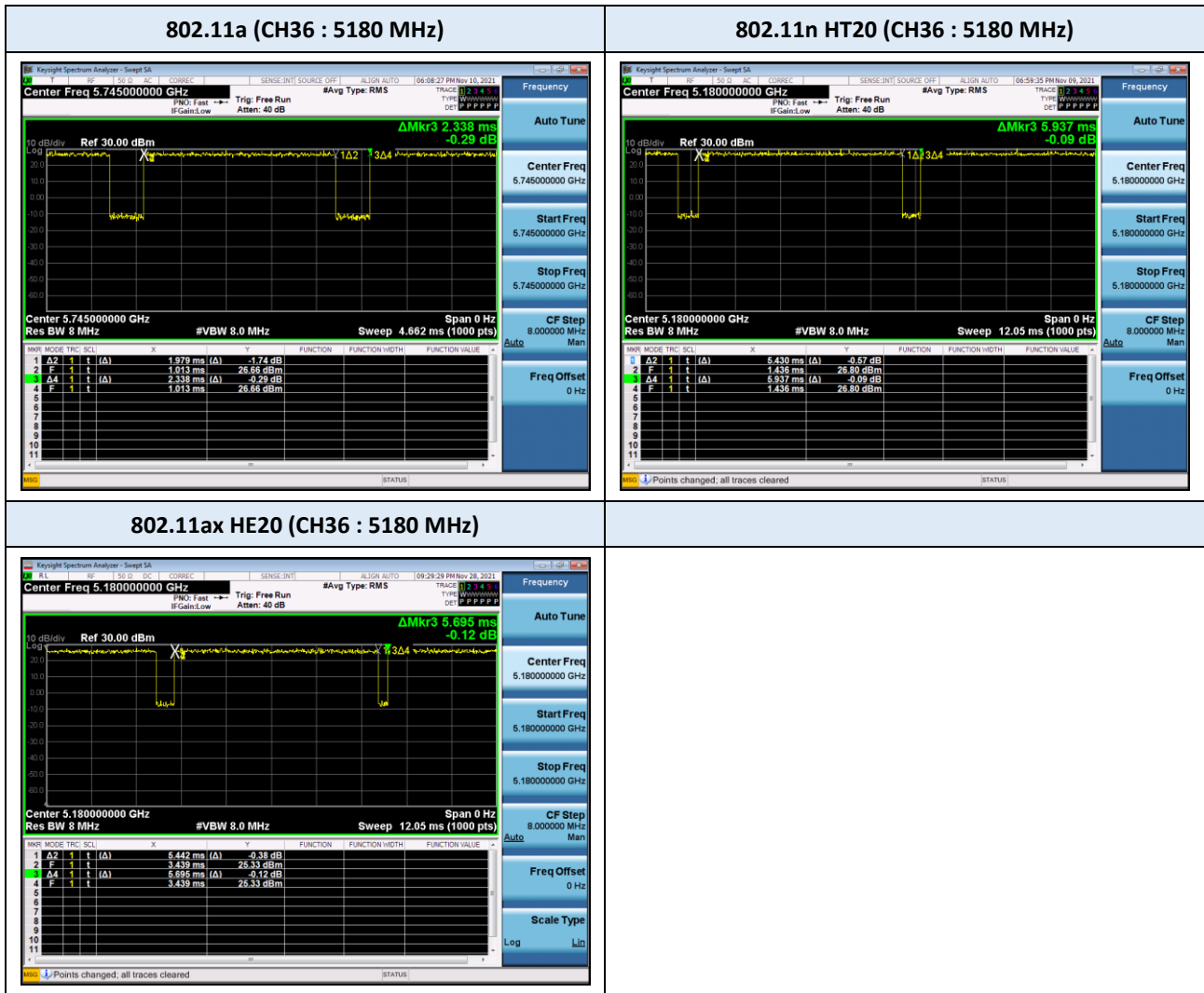
Equipment Type	Model No.	Serial Number	Manufacturer	Qty	Note
AC Adapter	C110011	1920L013622	eero	1	100-240 VAC, 0.45 A 50/60Hz (5 VDC)
Laptop	TP00076A	R9-0NUJ14 17/08	Lenovo	1	-

9. TEST RESULT

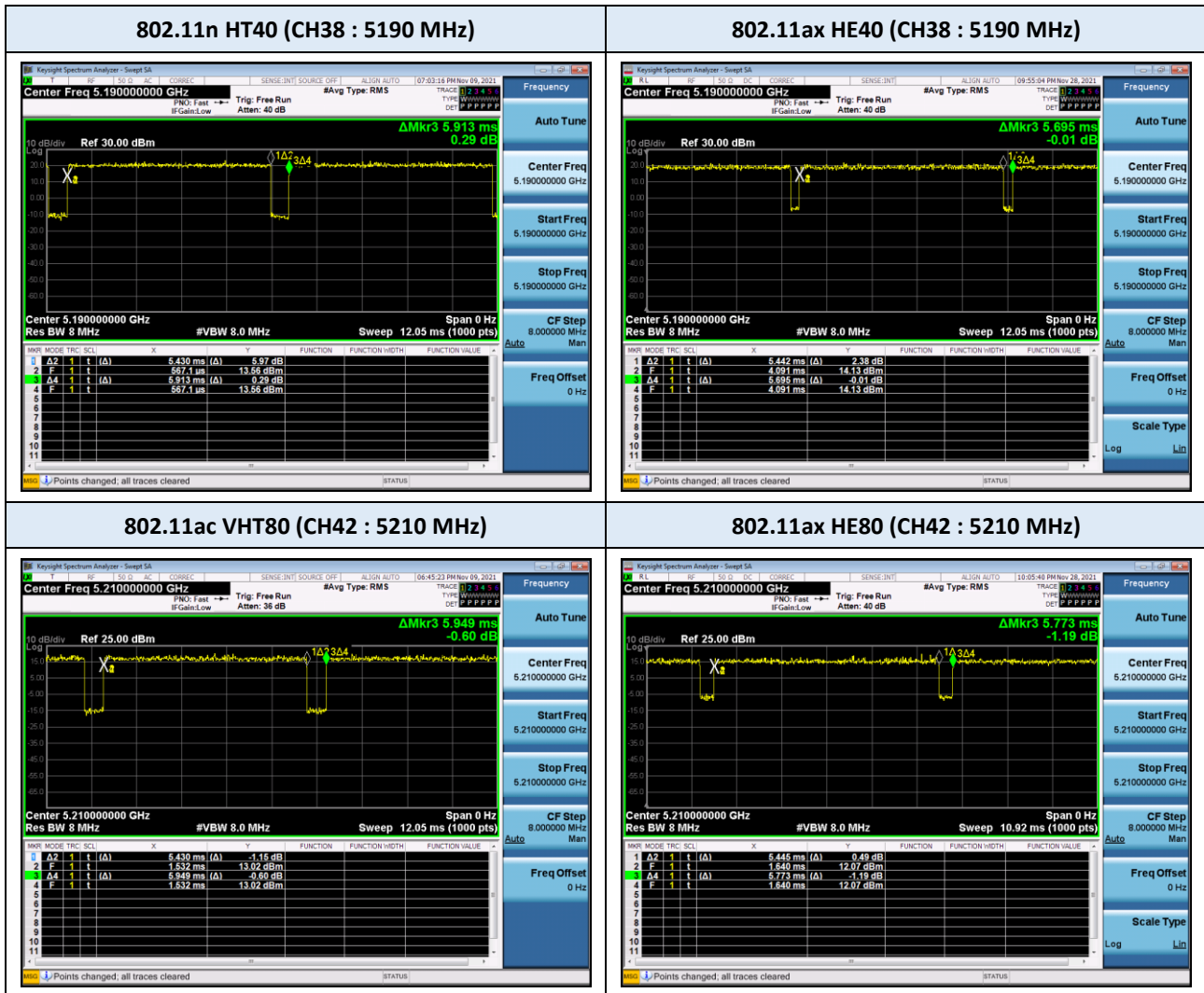
9.1 DUTY CYCLE

Mode	Data Rate	T _{on} (ms)	T _{total} (ms)	Duty Cycle	Duty Factor (dB)	VBW(1/T) (Hz)
802.11a	6 Mbps	1.98	2.34	0.85	0.72	505.31
802.11n HT20	MCS0	5.43	5.94	0.91	0.39	184.16
802.11ax HE20	MCS0	5.44	5.70	0.96	0.20	183.75
802.11n HT40	MCS0	5.43	5.91	0.92	0.37	184.16
802.11ax HE40	MCS0	5.44	5.70	0.96	0.20	183.75
802.11ac VHT80	MCS0	5.43	5.95	0.91	0.40	184.16
802.11ax HE80	MCS0	5.44	5.77	0.94	0.25	183.66

TEST PLOTS



TEST PLOTS (Continued)



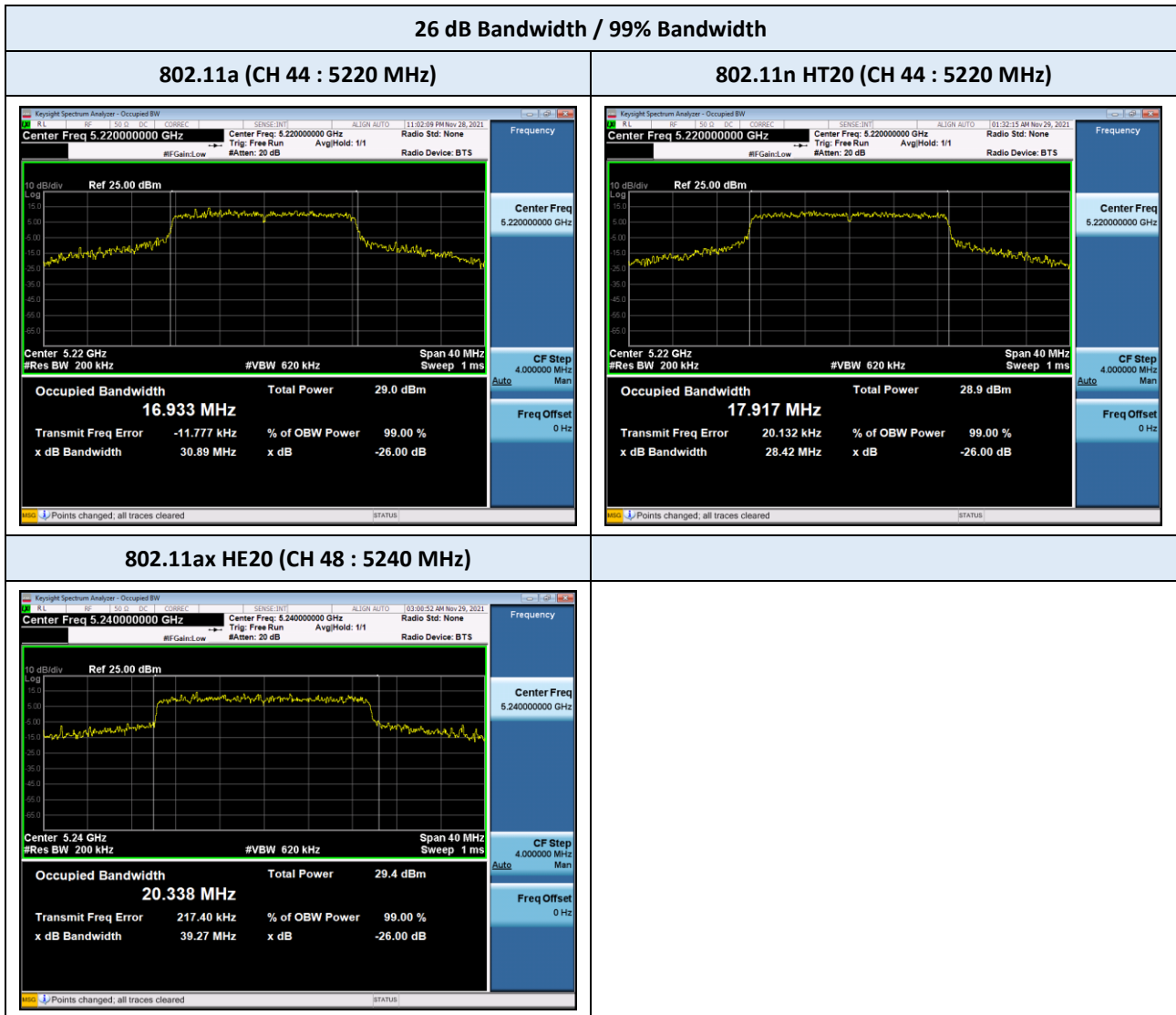
9.2 26 dB BANDWIDTH / 99% BANDWIDTH

U-NII 1 Band (20 MHz)			99% Bandwidth (MHz)		26 dB Bandwidth (MHz)	
Mode	Frequency (MHz)	Channel	Chain 0	Chain 1	Chain 0	Chain 1
802.11a	5180	36	16.471	16.782	20.461	26.938
	5220	44	16.557	16.933	21.499	30.886
	5240	48	16.570	16.744	23.695	26.878
802.11n HT20	5180	36	17.721	17.846	21.354	27.275
	5220	44	17.778	17.917	22.036	28.421
	5240	48	17.723	17.820	21.063	25.117
802.11ax HE20	5180	36	19.015	20.993	21.691	38.381
	5220	44	19.104	19.829	24.989	36.420
	5240	48	19.070	20.338	30.749	39.266

U-NII 1 Band (40 MHz)			99% Bandwidth (MHz)		26 dB Bandwidth (MHz)	
Mode	Frequency (MHz)	Channel	Chain 0	Chain 1	Chain 0	Chain 1
802.11n HT40	5190	38	36.133	36.177	39.304	38.871
	5230	46	36.214	36.439	42.682	52.900
802.11ax HE40	5190	38	37.824	37.751	39.444	40.289
	5230	46	37.860	38.143	39.996	59.202

U-NII 1 Band (80 MHz)			99% Bandwidth (MHz)		26 dB Bandwidth (MHz)	
Mode	Frequency (MHz)	Channel	Chain 0	Chain 1	Chain 0	Chain 1
802.11ac VHT80	5210	42	75.365	75.433	80.727	81.277
802.11ax HE80	5210	42	77.341	77.049	81.569	81.366

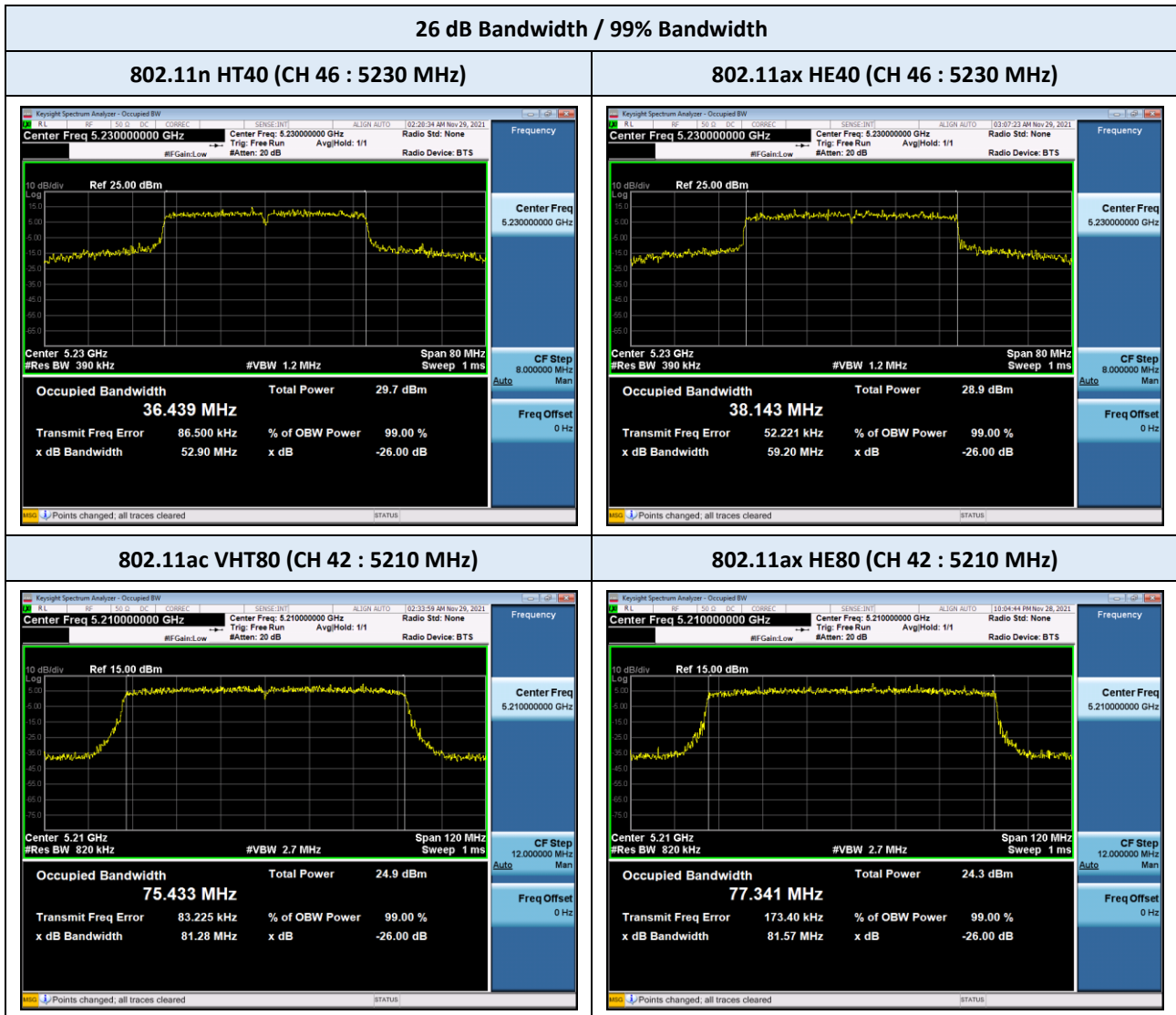
TEST PLOTS



Note(s) :

The worst plots are reported for each bandwidth mode.

TEST PLOTS (Continued)



Note(s) :

The worst plots are reported for each bandwidth mode.

9.3 OUTPUT POWER

U-NII 1 Band (20 MHz)				Test Result				Limit (dBm)
Mode	Frequency (MHz)	Channel	Data Rate	Measured Power (dBm)		Duty Factor (dB)	Measured Power (dBm)	
				Chain 0	Chain 1		Chain 0 + Chain 1	
802.11a	5180	36	6 Mbps	21.67	22.34	0.72	25.75	30
	5220	44	6 Mbps	22.39	22.98	0.72	26.43	30
	5240	48	6 Mbps	22.13	23.08	0.72	26.36	30
802.11n HT20	5180	36	MCS0	22.04	22.65	0.39	25.75	30
	5220	44	MCS0	22.58	23.31	0.39	26.36	30
	5240	48	MCS0	22.75	23.18	0.39	26.37	30
802.11ax HE20	5180	36	MCS0	22.25	21.80	0.20	25.24	30
	5220	44	MCS0	23.35	22.98	0.20	26.38	30
	5240	48	MCS0	23.65	23.71	0.20	26.89	30

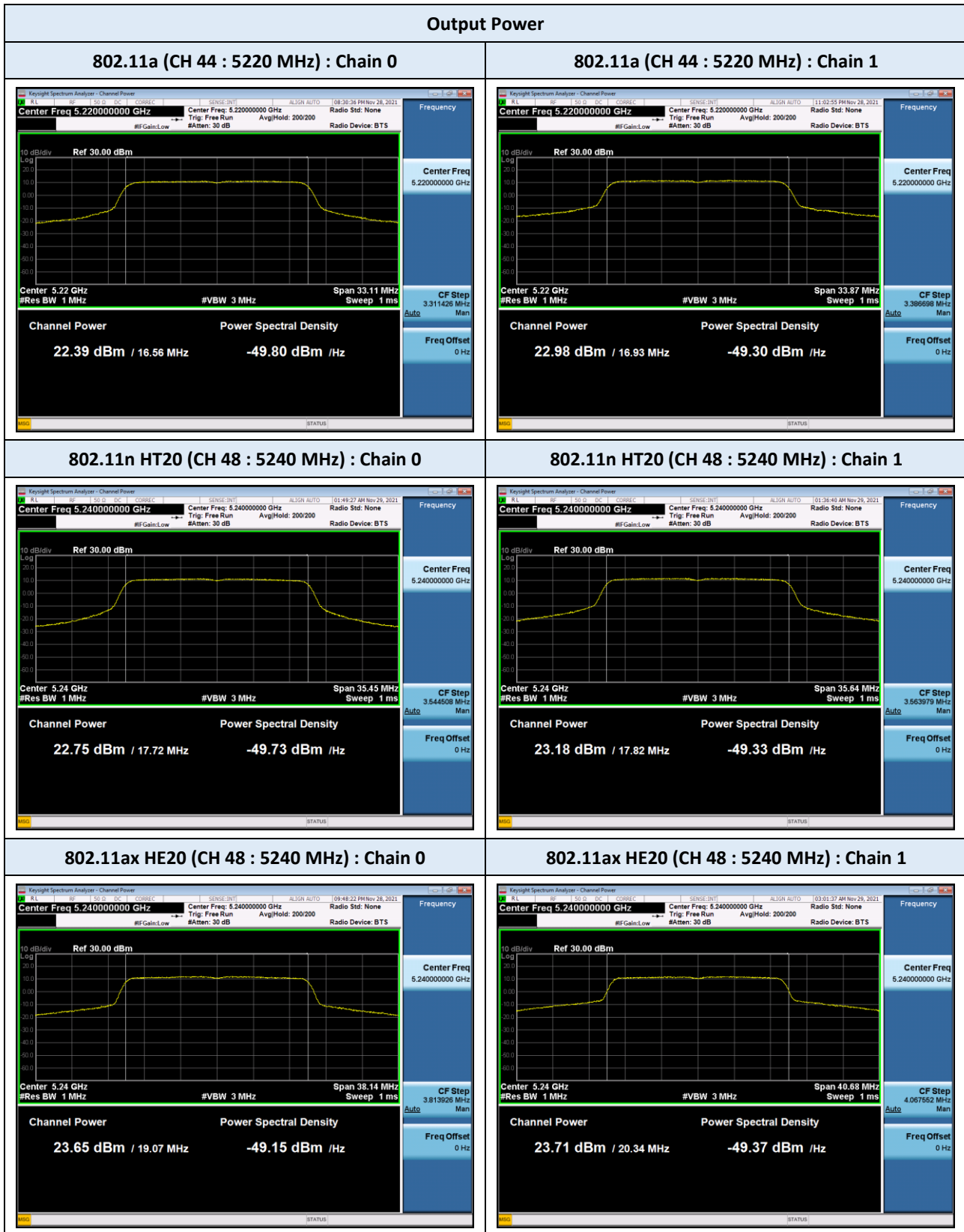
U-NII 1 Band (40 MHz)				Test Result				Limit (dBm)
Mode	Frequency (MHz)	Channel	Data Rate	Measured Power (dBm)		Duty Factor (dB)	Measured Power (dBm)	
				Chain 0	Chain 1		Chain 0 + Chain 1	
802.11n HT40	5190	38	MCS0	18.46	19.13	0.37	22.19	30
	5230	46	MCS0	23.59	24.27	0.37	27.33	30
802.11ax HE40	5190	38	MCS0	18.20	17.24	0.20	20.95	30
	5230	46	MCS0	23.24	22.71	0.20	26.19	30

U-NII 1 Band (80 MHz)				Test Result				Limit (dBm)
Mode	Frequency (MHz)	Channel	Data Rate	Measured Power (dBm)		Duty Factor (dB)	Measured Power (dBm)	
				Chain 0	Chain 1		Chain 0 + Chain 1	
802.11ac VHT80	5210	42	MCS0	17.24	18.30	0.40	21.21	30
802.11ax HE80	5210	42	MCS0	17.22	16.68	0.25	20.22	30

Note(s) :

1. The output power results in the table include the spectrum offset, which is a combination loss of the attenuator and the cable used for testing.

TEST PLOTS



Note(s) :

The worst plots are reported for each bandwidth mode.

TEST PLOTS (Continued)



Note(s) :

The worst plots are reported for each bandwidth mode.

TEST PLOTS (Continued)



Note(s) :

The worst plots are reported for each bandwidth mode.

9.4 POWER SPECTRAL DENSITY

U-NII 1 Band (20 MHz)				Test Result				Limit (dBm/MHz)
Mode	Frequency (MHz)	Channel	Data Rate	Measured PSD (dBm/MHz)		Duty Factor (dB)	Total PSD (dBm/MHz)	
				Chain 0	Chain 1		Chain 0 + 1	
802.11a	5180	36	6 Mbps	10.15	11.46	0.72	14.59	15.63
	5220	44	6 Mbps	11.15	12.22	0.72	15.45	15.63
	5240	48	6 Mbps	10.77	11.97	0.72	15.15	15.63
802.11n HT20	5180	36	MCS0	10.75	11.63	0.39	14.61	15.63
	5220	44	MCS0	10.98	12.30	0.39	15.09	15.63
	5240	48	MCS0	11.10	11.99	0.39	14.97	15.63
802.11ax HE20	5180	36	MCS0	10.47	9.89	0.20	13.40	15.63
	5220	44	MCS0	11.60	11.47	0.20	14.74	15.63
	5240	48	MCS0	12.35	11.93	0.20	15.36	15.63

U-NII 1 Band (40 MHz)				Test Result				Limit (dBm/MHz)
Mode	Frequency (MHz)	Channel	Data Rate	Measured PSD (dBm/MHz)		Duty Factor (dB)	Total PSD (dBm/MHz)	
				Chain 0	Chain 1		Chain 0 + 1	
802.11n HT40	5190	38	MCS0	4.20	4.62	0.37	7.79	15.63
	5230	46	MCS0	9.16	9.73	0.37	12.83	15.63
802.11ax HE40	5190	38	MCS0	3.76	2.62	0.20	6.43	15.63
	5230	46	MCS0	8.75	7.99	0.20	11.60	15.63

U-NII 1 Band (80 MHz)				Test Result				Limit (dBm/MHz)
Mode	Frequency (MHz)	Channel	Data Rate	Measured PSD (dBm/MHz)		Duty Factor (dB)	Total PSD (dBm/MHz)	
				Chain 0	Chain 1		Chain 0 + 1	
802.11ac VHT80	5210	42	MCS0	-0.16	0.86	0.40	3.79	15.63
802.11ax HE80	5210	42	MCS0	-0.05	-0.67	0.25	2.91	15.63

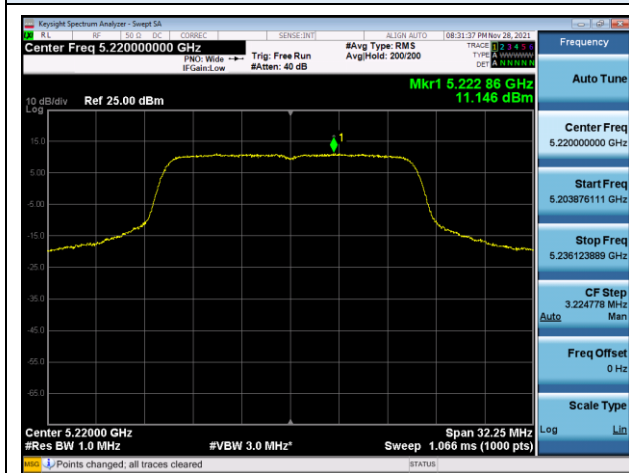
Note(s) :

1. The output power results in the table include the spectrum offset, which is a combination loss of the attenuator and the cable used for testing.
2. Conducted PSD limit = 17 dBm/MHz – (7.37 dBi – 6 dBi) = 15.63 dBm/MHz

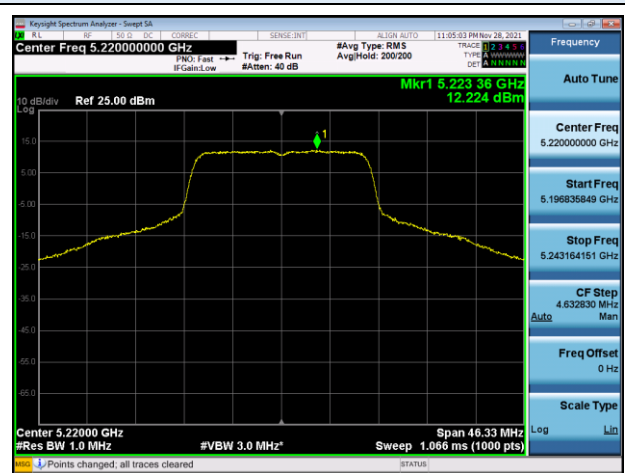
TEST PLOTS

Power Spectral Density

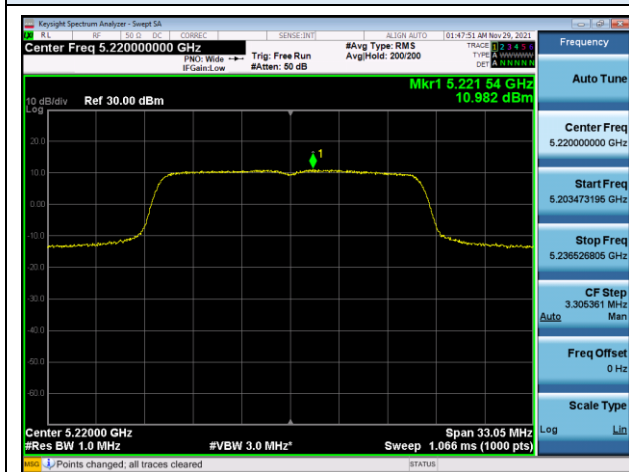
802.11a (CH 44 : 5220 MHz) : Chain 0



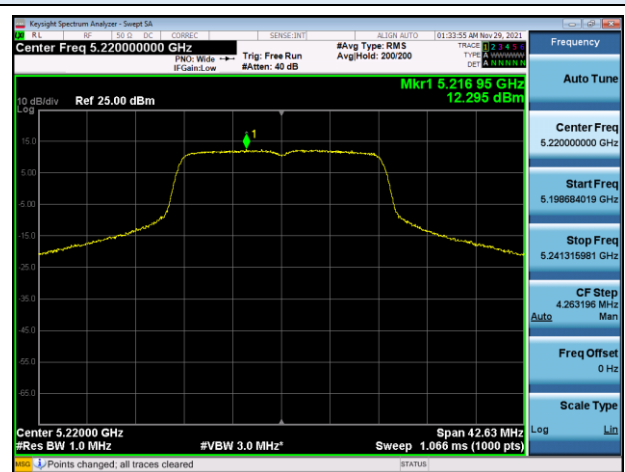
802.11a (CH 44 : 5220 MHz) : Chain 1



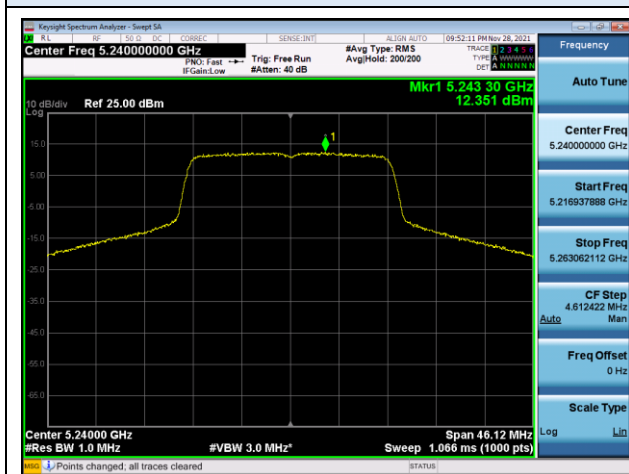
802.11n HT20 (CH 44 : 5220 MHz) : Chain 0



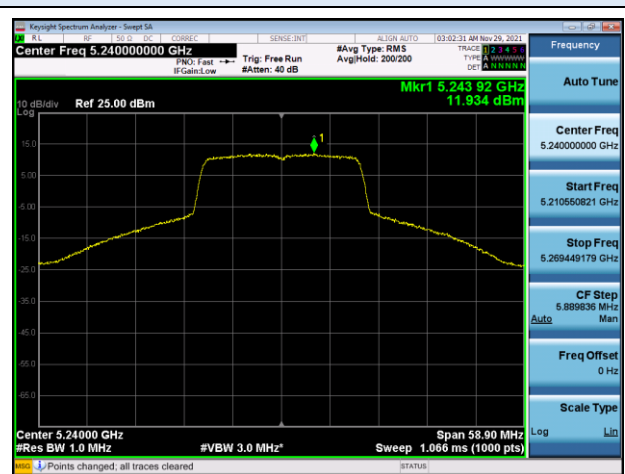
802.11n HT20 (CH 44 : 5220 MHz) : Chain 1



802.11ax HE20 (CH 48 : 5240 MHz) : Chain 0



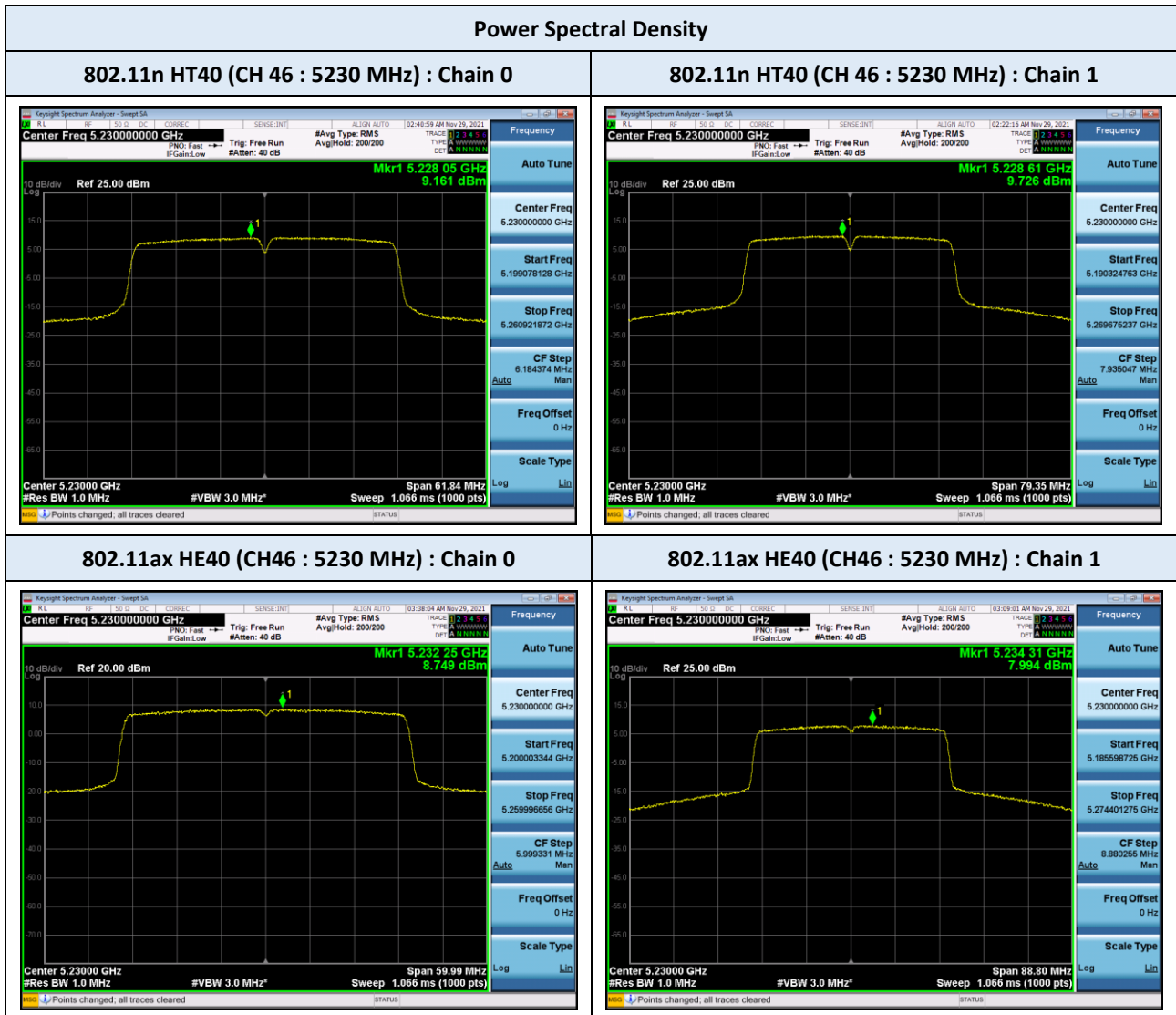
802.11ax HE20 (CH 48 : 5240 MHz) : Chain 1



Note(s) :

The worst plots are reported for each bandwidth mode.

TEST PLOTS (Continued)



Note(s) :

The worst plots are reported for each bandwidth mode.

TEST PLOTS (Continued)



Note(s) :

The worst plots are reported for each bandwidth mode.

9.5 FREQUENCY STABILITY

Operating Band :	U-NII Band 1
Operating Frequency :	5,180,000,000 Hz (CH 36)
Reference Voltage :	5 V d.c.

Voltage (%)	Power (V d.c.)	Temp (°C)	Frequency error (ppm)			
			0 minutes	2 minutes	5 minutes	10 minutes
100%	5.0	+20 (Ref)	6.28	6.85	7.23	7.44
100%		-30	13.10	13.47	13.63	13.70
100%		-20	16.33	16.44	16.51	16.51
100%		-10	16.83	16.97	16.77	16.76
100%		0	15.27	15.08	14.94	14.90
100%		+10	13.16	12.52	12.03	11.77
100%		+30	6.21	5.25	4.43	4.00
100%		+40	2.05	1.37	0.90	0.64
100%		+50	-1.45	-1.62	-1.66	-1.83
115%	5.8	+20	7.44	7.52	7.52	7.53
85%	4.3	+20	7.55	7.54	7.54	7.63

Note(s) :

According to the results of the frequency stability test above, the frequency deviation measured are very small. The channels at the band edge should remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore, the Radio frequency should remain in-band during operation over the temperature and voltage range as tested.

9.6 RADIATED SPURIOUS EMISSIONS

Frequency Range : Below 1 GHz

Test Mode 802.11a : TX mode
Operating Frequency 5180 MHz (CH 36)

Frequency (MHz)	Polarization	Reading (dBuV)	Corr. ¹⁾ (dB)	Total (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Measurement Type
38.918	V	41.1	-6.1	35.0	40	5.0	QP
40.949	V	38.8	-7.7	31.1	40	8.9	QP
55.221	V	48.7	-13.5	35.2	40	4.8	QP
108.226	V	42.9	-7.5	35.4	43.5	8.1	QP
250.001	H	37.4	-7.9	29.5	46	16.5	QP
250.001	V	36.8	-7.9	28.9	46	17.1	QP
500.006	H	33.4	-2.2	31.2	46	14.8	QP

Test Mode 802.11a : TX mode
Operating Frequency 5220 MHz (CH 44)

Frequency (MHz)	Polarization	Reading (dBuV)	Corr. ¹⁾ (dB)	Total (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Measurement Type
39.036	V	38.6	-6.2	32.4	40	7.6	QP
55.687	V	49.0	-13.4	35.6	40	4.4	QP
107.551	V	42.8	-7.6	35.2	43.5	8.3	QP
249.993	H	35.8	-7.9	27.9	46	18.1	QP
250.011	V	36.7	-7.9	28.8	46	17.2	QP
500.010	H	32.0	-2.2	29.8	46	16.2	QP

Test Mode 802.11a : TX mode
Operating Frequency 5240 MHz (CH 48)

Frequency (MHz)	Polarization	Reading (dBuV)	Corr. ¹⁾ (dB)	Total (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Measurement Type
42.340	V	40.1	-8.8	31.3	40	8.7	QP
55.316	V	49.1	-13.5	35.6	40	4.4	QP
85.753	V	43.1	-13.0	30.1	40	9.9	QP
107.867	V	42.5	-7.6	34.9	43.5	8.6	QP
250.000	V	37.1	-7.9	29.2	46	16.8	QP
250.016	H	36.8	-7.9	28.9	46	17.1	QP
499.999	H	31.8	-2.2	29.6	46	16.4	QP

Note(s) :

1. Correction Factor: Antenna Factor + Cable loss + Preamplifier Gain

Frequency Range : Above 1 GHz

Test Mode 802.11a : TX mode
Operating Frequency 5180 MHz (CH 36)

Frequency (MHz)	Polarization	Reading (dBuV)		Factor (dB)		Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
		AV	PK	Corr. ¹⁾	Duty	AV	PK	AV	PK	AV	PK
4799.827	V	38.8	45.6	7.6	-	46.4	53.2	54	74	7.6	20.8
4799.905	H	40.2	45.9	7.6	-	47.8	53.5	54	74	6.2	20.5

Test Mode 802.11a : TX mode
Operating Frequency 5220 MHz (CH 44)

Frequency (MHz)	Polarization	Reading (dBuV)		Factor (dB)		Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
		AV	PK	Corr. ¹⁾	Duty	AV	PK	AV	PK	AV	PK
4799.854	H	40.4	46.5	7.6	-	48.0	54.1	54	74	6.0	19.9
4799.957	V	39.7	45.3	7.6	-	47.3	52.9	54	74	6.7	21.1

Test Mode 802.11a : TX mode
Operating Frequency 5240 MHz (CH 48)

Frequency (MHz)	Polarization	Reading (dBuV)		Factor (dB)		Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
		AV	PK	Corr. ¹⁾	Duty	AV	PK	AV	PK	AV	PK
4799.919	H	40.1	46.3	7.6	-	47.7	53.9	54	74	6.3	20.1
4799.947	V	38.9	45.0	7.6	-	46.5	52.6	54	74	7.5	21.4

Note(s) :

1. Correction Factor: Antenna Factor + Cable loss + Preamplifier Gain
2. AV Level = Measured Power(dBm) + Correction Factor(dB) + Duty Cycle Factor(dB).
3. No duty cycle factor was applied since the spurious emissions around above are not harmonics of the fundamental frequency.

Frequency Range : Above 1 GHz

Test Mode 802.11n HT40 : TX mode

Operating Frequency 5190 MHz (CH 38)

Frequency (MHz)	Polarization	Reading (dBuV)		Factor (dB)		Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
		AV	PK	Corr. ¹⁾	Duty	AV	PK	AV	PK	AV	PK
4799.898	V	40.6	46.3	7.6	-	48.2	53.9	54	74	5.8	20.1
4799.926	H	41.8	46.9	7.6	-	49.4	54.5	54	74	4.6	19.5

Test Mode 802.11n HT40 : TX mode

Operating Frequency 5230 MHz (CH 46)

Frequency (MHz)	Polarization	Reading (dBuV)		Factor (dB)		Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
		AV	PK	Corr. ¹⁾	Duty	AV	PK	AV	PK	AV	PK
4799.891	V	39.4	44.8	7.6	-	47.0	52.4	54	74	7.0	21.6
4799.947	H	40.2	45.6	7.6	-	47.8	53.2	54	74	6.2	20.8

Frequency Range : Above 1 GHz

Test Mode 802.11ac VHT80 : TX mode

Operating Frequency 5210 MHz (CH 42)

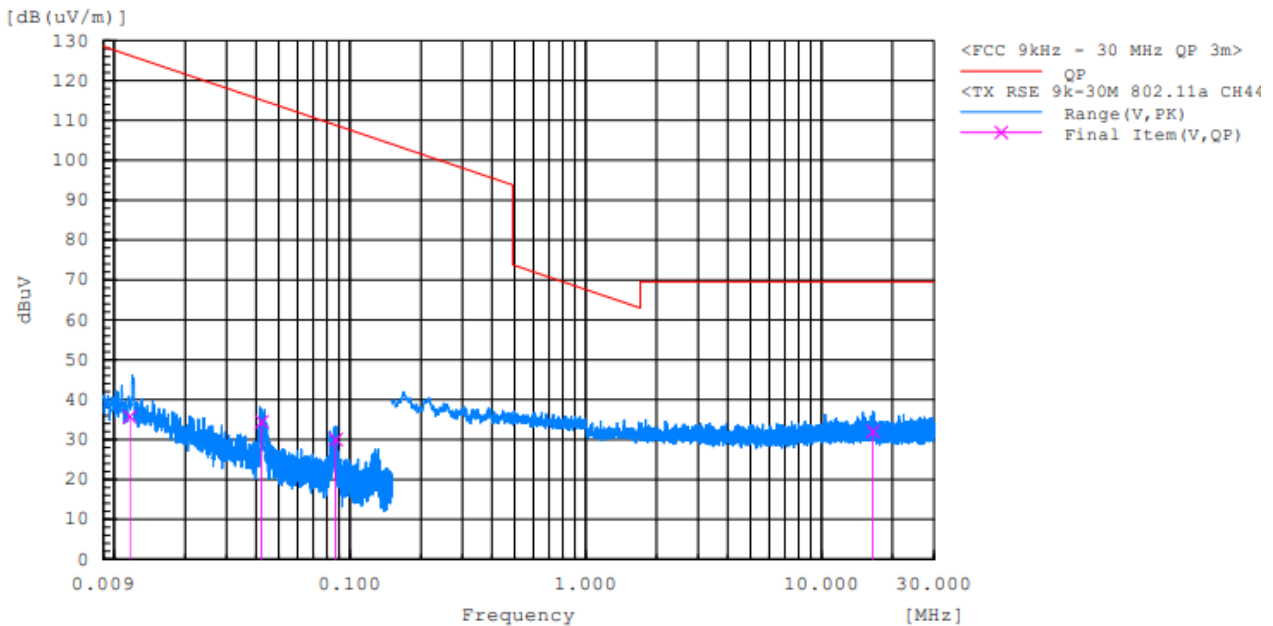
Frequency (MHz)	Polarization	Reading (dBuV)		Factor (dB)		Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
		AV	PK	Corr. ¹⁾	Duty	AV	PK	AV	PK	AV	PK
4799.898	H	35.4	43.0	7.6	-	43.0	50.6	54	74	11.0	23.4
4799.954	V	35.9	43.2	7.6	-	43.5	50.8	54	74	10.5	23.2
5759.836	H	-	47.3	9.7	-	-	57.0	-	68.2	-	11.2
5759.881	V	-	46.7	9.7	-	-	56.4	-	68.2	-	11.8

Note(s) :

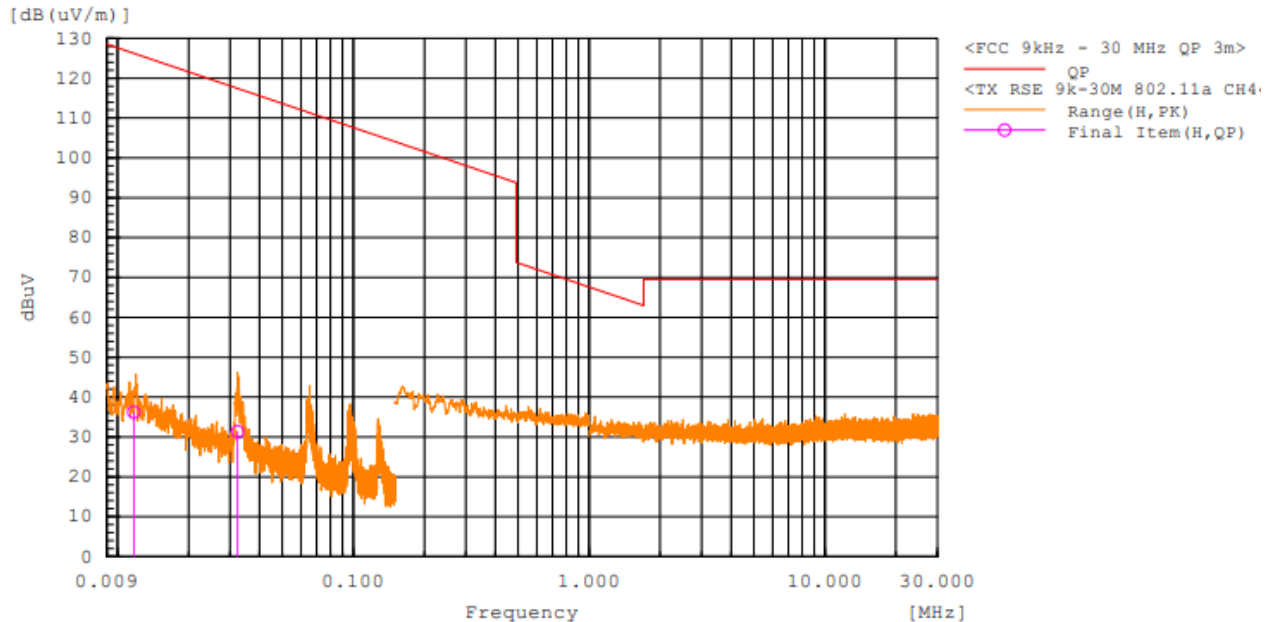
1. Correction Factor: Antenna Factor + Cable loss + Preamplifier Gain
2. AV Level = Measured Power(dBm) + Correction Factor(dB) + Duty Cycle Factor(dB).
3. No duty cycle factor was applied since the spurious emissions around above are not harmonics of the fundamental frequency.

■ TEST PLOTS

Radiated Spurious Emission 9 kHz – 30 MHz (Antenna Position 90°) : 802.11a (CH 44)



Radiated Spurious Emission 9 kHz – 30 MHz (Antenna Position 180°) : 802.11a (CH 44)

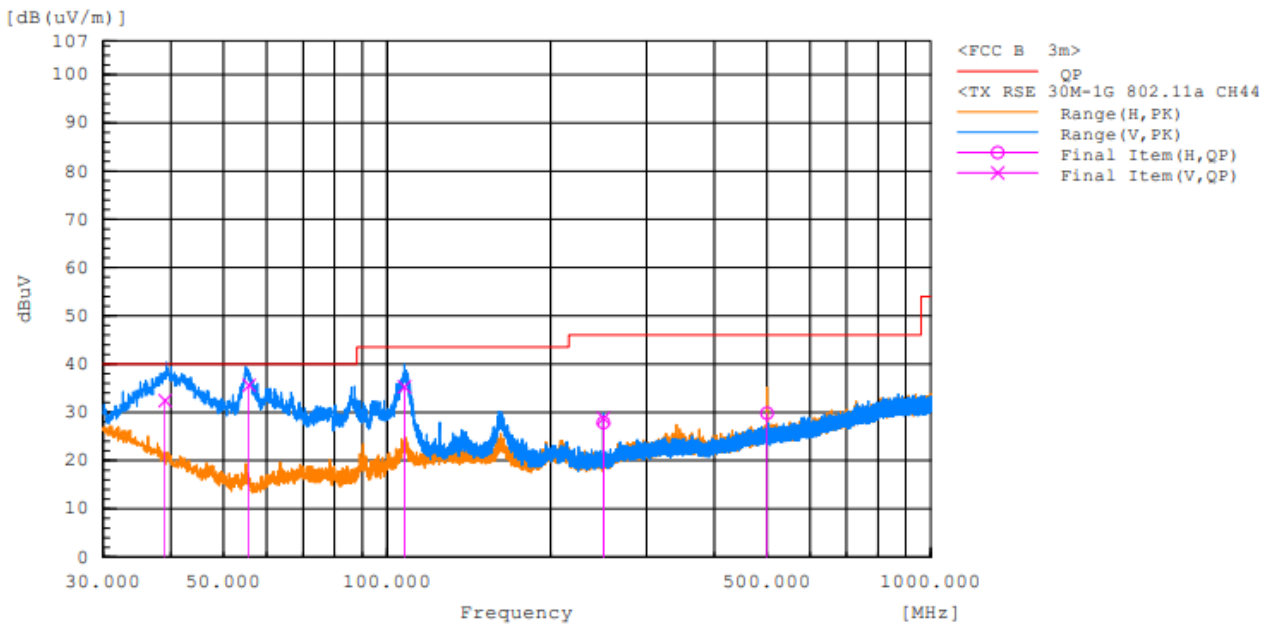


Note(s) :

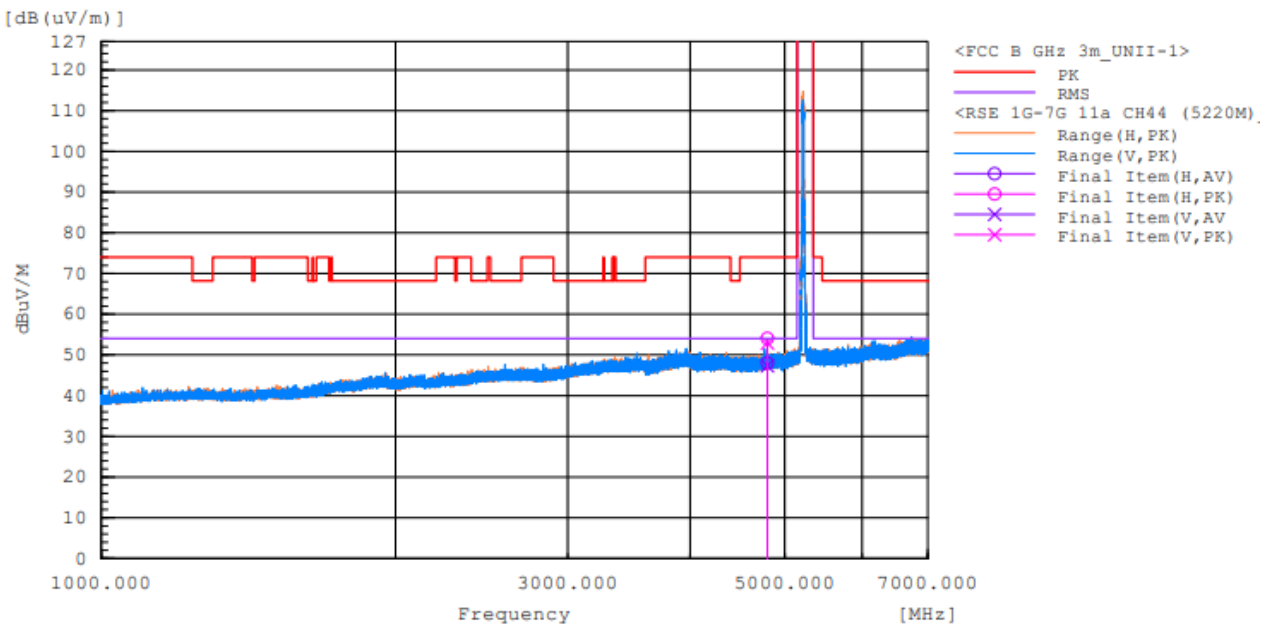
The worst-case plots are included in this report.

■ TEST PLOTS

Radiated Spurious Emission 30 MHz – 1 GHz : 802.11a (CH 44)



Radiated Spurious Emission 1 GHz - 7 GHz : 802.11a (CH 44)

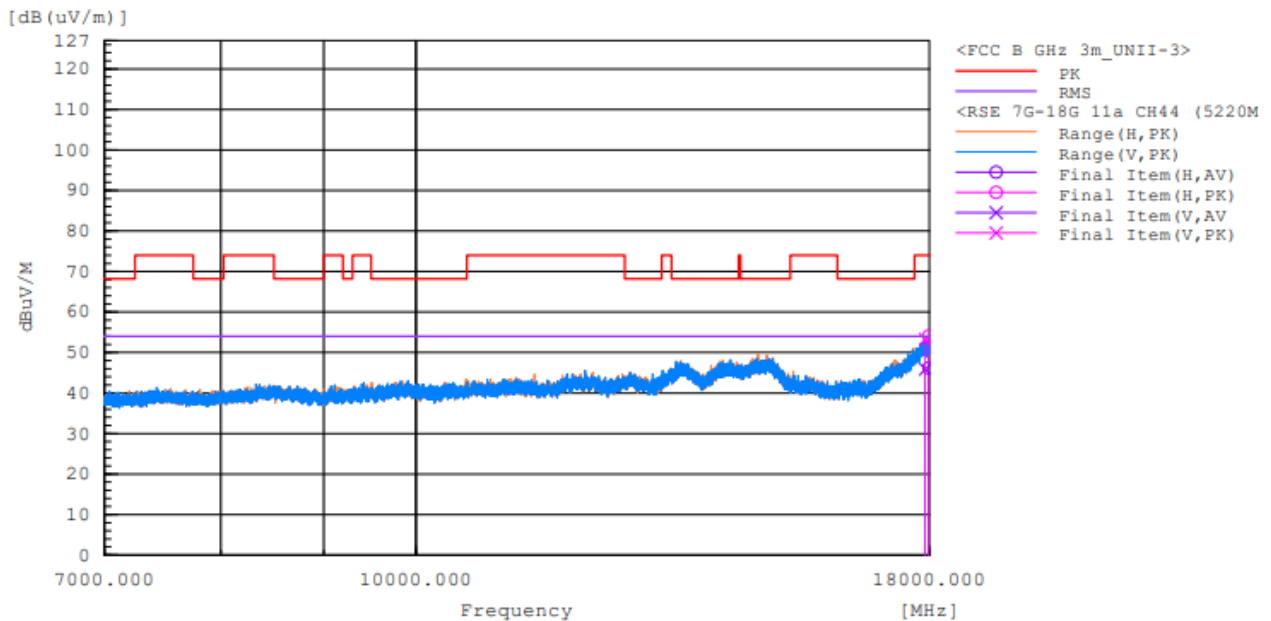


Note(s) :

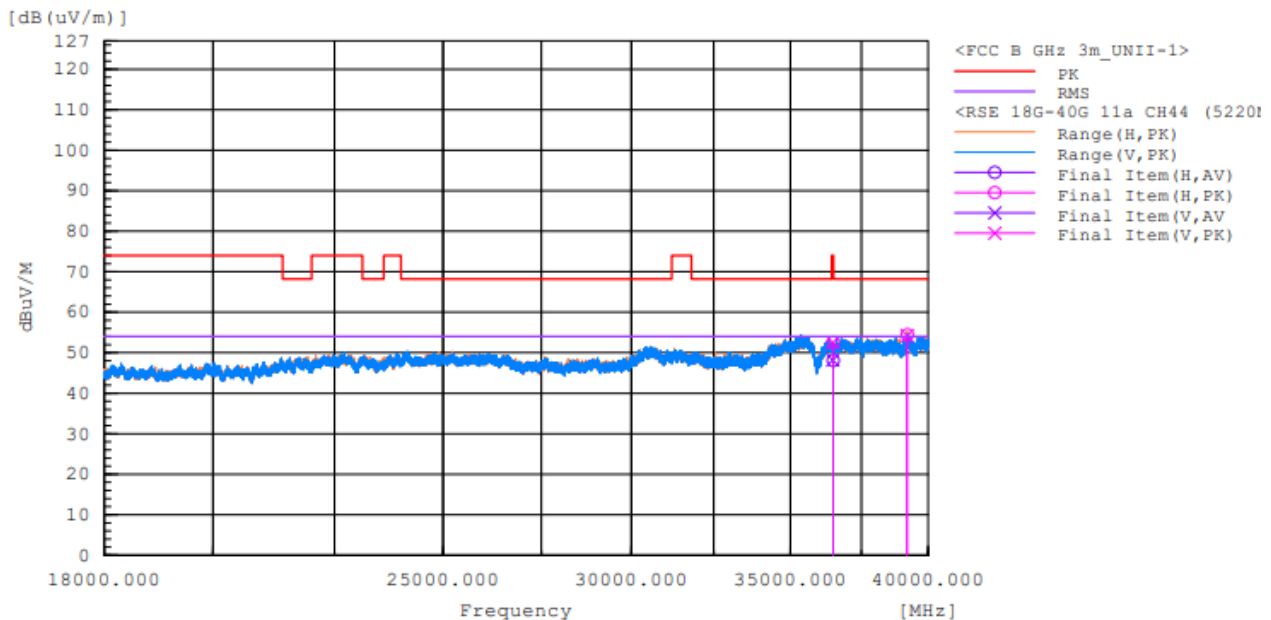
The worst-case plots are included in this report.

■ TEST PLOTS

Radiated Spurious Emission 7 GHz - 18 GHz : 802.11a (CH 44)



Radiated Spurious Emission 18 GHz - 40 GHz : 802.11a (CH 44)



Note(s) :

The worst-case plots are included in this report.

9.7 RADIATED RESTRICTED BAND EDGES

Test Mode 802.11a : TX mode
Operating Frequency 5180 MHz (CH 36)

Frequency (MHz)	Polarization	Reading (dBuV)		Factor (dB)		Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
		AV	PK	Corr. ¹⁾	Duty	AV	PK	AV	PK	AV	PK
5149.722	V	42.7	53.0	8.8	0.3	51.8	61.8	54	74	2.2	12.2
5150.000	H	43.9	54.7	8.8	0.3	53.0	63.5	54	74	1.0	10.5

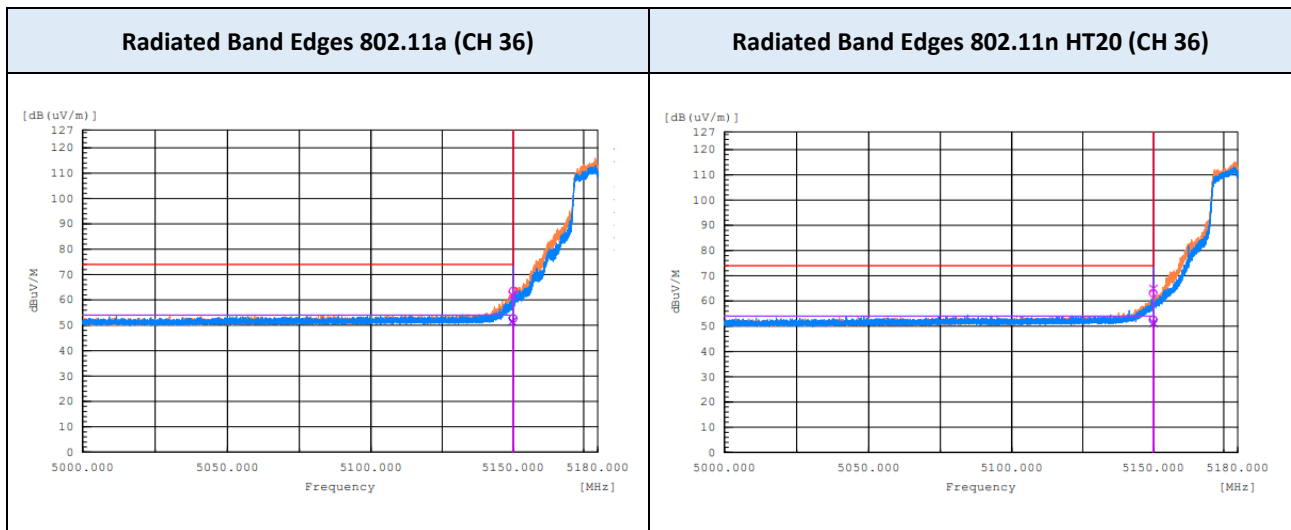
Test Mode 802.11n HT20 : TX mode
Operating Frequency 5180 MHz (CH 36)

Frequency (MHz)	Polarization	Reading (dBuV)		Factor (dB)		Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
		AV	PK	Corr. ¹⁾	Duty	AV	PK	AV	PK	AV	PK
5149.917	H	43.8	54.3	8.8	0.4	53.0	63.1	54	74	1.0	10.9
5149.986	V	42.6	56.1	8.8	0.4	51.8	64.9	54	74	2.2	9.1

Note(s) :

1. Correction Factor: Antenna Factor + Cable loss + Preamplifier Gain
2. AV Level = Measured Power(dBm) + Correction Factor(dB) + Duty Cycle Factor(dB).

TEST PLOTS



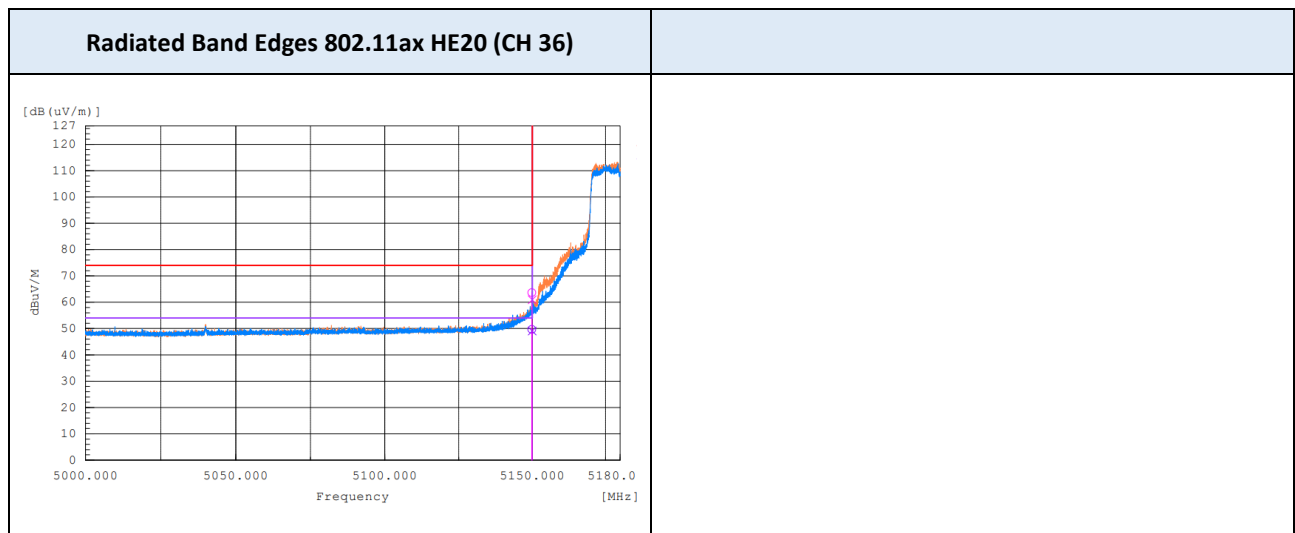
Test Mode 802.11ax HE20 : TX mode
Operating Frequency 5180 MHz (CH 36)

Frequency (MHz)	Polarization	Reading (dBuV)		Factor (dB)		Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
		AV	PK	Corr. ¹⁾	Duty	AV	PK	AV	PK	AV	PK
5149.843	H	40.9	54.9	8.8	0.2	49.9	63.7	54	74	4.1	10.3
5149.940	V	40.3	52.2	8.8	0.2	49.3	61.0	54	74	4.7	13.0

Note(s) :

1. Correction Factor: Antenna Factor + Cable loss + Preamplifier Gain
2. AV Level = Measured Power(dBm) + Correction Factor(dB) + Duty Cycle Factor(dB).

TEST PLOTS



Test Mode 802.11n HT40 : TX mode
Operating Frequency 5190 MHz (CH 38)

Frequency (MHz)	Polarization	Reading (dBuV)		Factor (dB)		Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
		AV	PK	Corr. ¹⁾	Duty	AV	PK	AV	PK	AV	PK
5149.986	V	39	49.2	8.8	0.4	48.2	58.0	54	74	5.8	16.0
5149.987	H	42.6	52.7	8.8	0.4	51.8	61.5	54	74	2.2	12.5

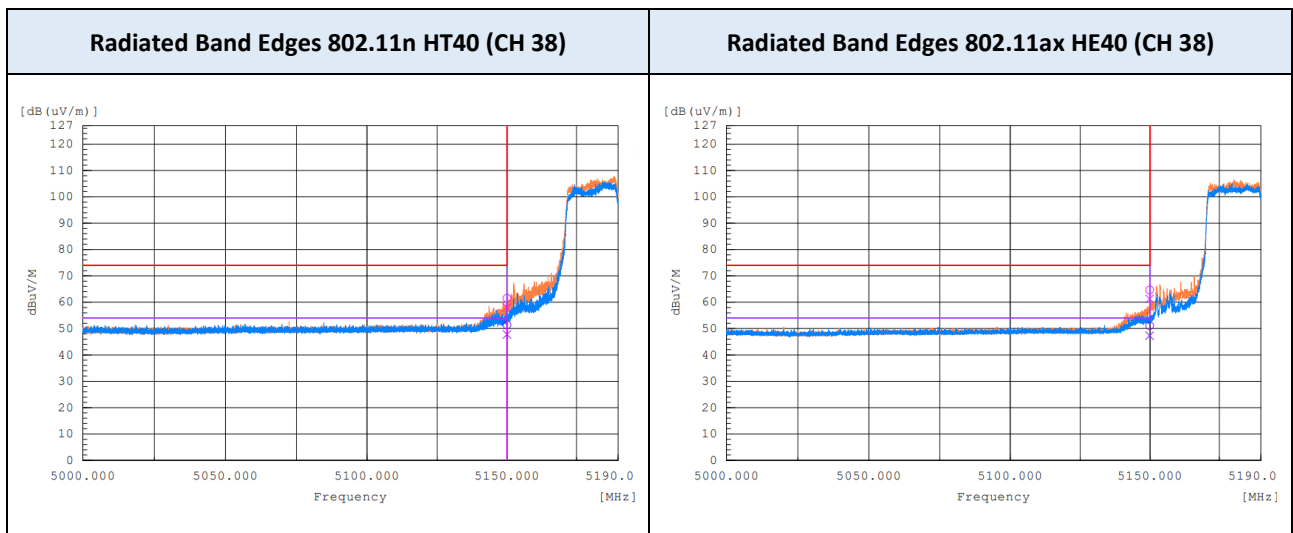
Test Mode 802.11ax HE40 : TX mode
Operating Frequency 5190 MHz (CH 38)

Frequency (MHz)	Polarization	Reading (dBuV)		Factor (dB)		Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
		AV	PK	Corr. ¹⁾	Duty	AV	PK	AV	PK	AV	PK
5149.830	V	38.5	52.5	8.8	0.2	47.5	61.3	54	74	6.5	12.7
5149.924	H	42.3	55.9	8.8	0.2	51.3	64.7	54	74	2.7	9.3

Note(s) :

1. Correction Factor: Antenna Factor + Cable loss + Preamplifier Gain
2. AV Level = Measured Power(dBm) + Correction Factor(dB) + Duty Cycle Factor(dB).

TEST PLOTS



Test Mode 802.11ac VHT80 : TX mode
Operating Frequency 5210 MHz (CH 42)

Frequency (MHz)	Polarization	Reading (dBuV)		Factor (dB)		Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
		AV	PK	Corr. ¹⁾	Duty	AV	PK	AV	PK	AV	PK
5145.522	V	38.8	48.9	8.8	0.4	48.0	57.7	54	74	6.0	16.3
5149.902	H	42.8	53.7	8.8	0.4	52.0	62.5	54	74	2.0	11.5
5125.010	H	36.3	50.1	8.7	0.4	45.4	58.8	54	74	8.6	15.2

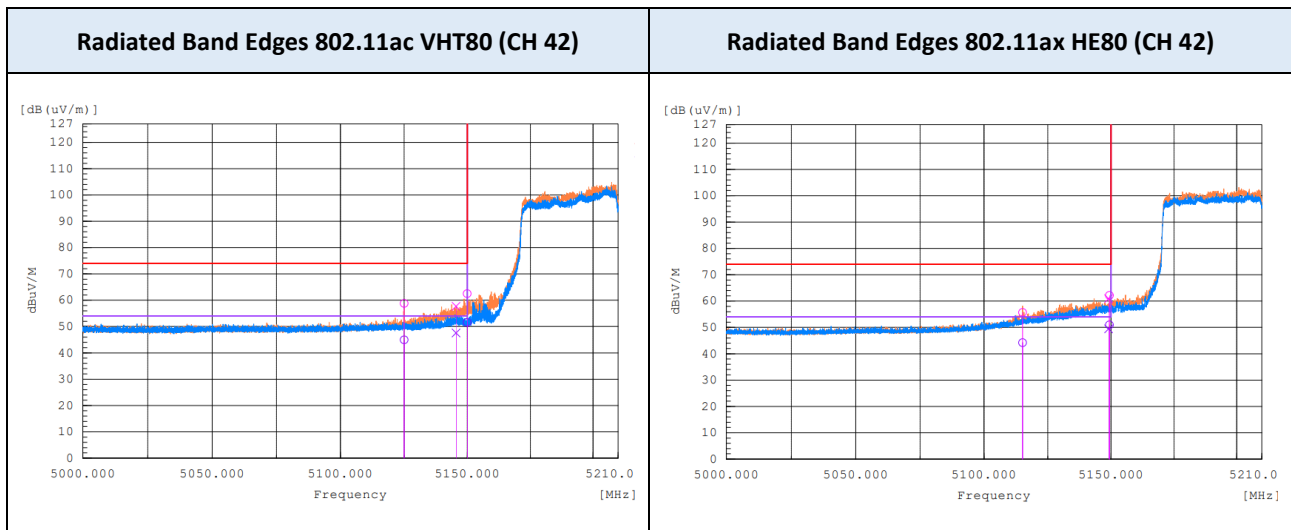
Test Mode 802.11ax HE80 : TX mode
Operating Frequency 5210 MHz (CH 42)

Frequency (MHz)	Polarization	Reading (dBuV)		Factor (dB)		Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
		AV	PK	Corr. ¹⁾	Duty	AV	PK	AV	PK	AV	PK
5115.128	H	35.5	47.0	8.7	0.2	44.4	55.7	54	74	9.6	18.3
5149.000	V	40.7	52.2	8.8	0.2	49.7	61.0	54	74	4.3	13.0
5149.335	H	42.2	53.4	8.8	0.2	51.2	62.2	54	74	2.8	11.8

Note(s) :

1. Correction Factor: Antenna Factor + Cable loss + Preamplifier Gain
2. AV Level = Measured Power(dBm) + Correction Factor(dB) + Duty Cycle Factor(dB).

TEST PLOTS



9.8 POWERLINE CONDUCTED EMISSIONS

Frequency (MHz)	Line	Reading (dBμV)		Corr. ¹⁾ (dB)	Level (dBμV)		Limit (dBμV)		Margin (dB)	
		QP	CAV		QP	CAV	QP	CAV	QP	CAV
0.165	L1	41.5	24.1	9.7	51.2	33.8	65.2	55.2	14.0	21.4
0.200	L1	35.5	17.0	9.7	45.2	26.7	63.6	53.6	18.4	26.9
0.563	L1	28.9	17.5	9.6	38.5	27.1	56	46	17.5	18.9
0.667	L1	21.6	10.1	9.6	31.2	19.7	56	46	24.8	26.3
10.706	L1	20.8	14.2	10.1	30.9	24.3	60	50	29.1	25.7
20.193	L1	21.0	13.9	10.4	31.4	24.3	60	50	28.6	25.7

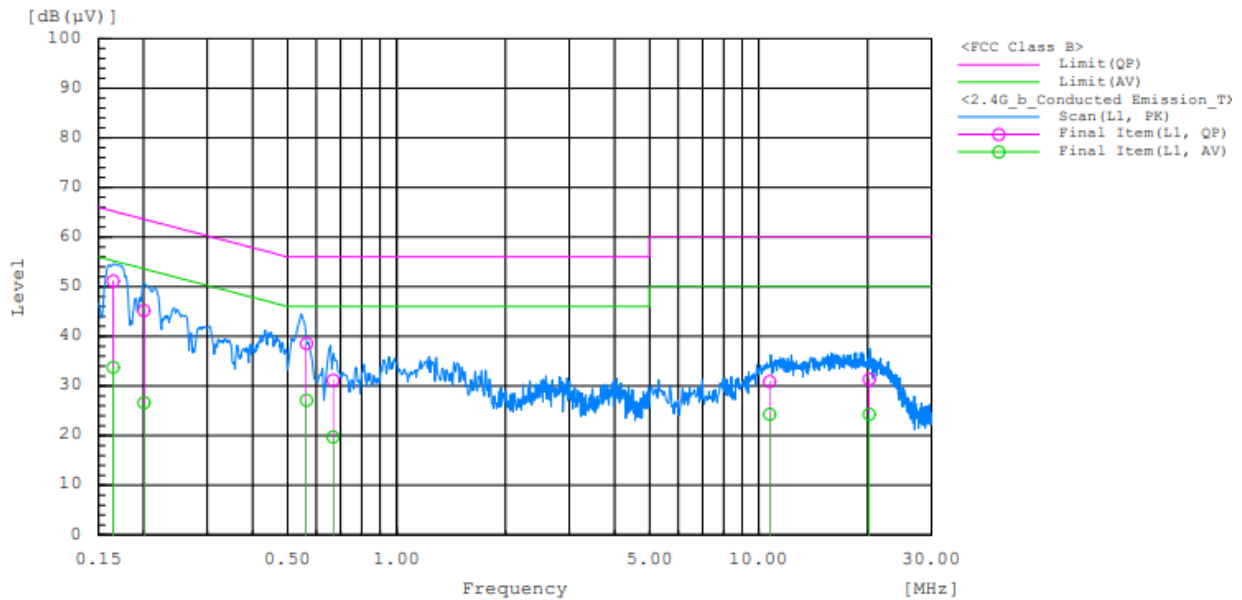
Frequency (MHz)	Line	Reading (dBμV)		Corr. ¹⁾ (dB)	Level (dBμV)		Limit (dBμV)		Margin (dB)	
		QP	CAV		QP	CAV	QP	CAV	QP	CAV
0.162	N	40.3	22.6	9.7	50.0	32.3	65.4	55.4	15.4	23.1
0.206	N	36.4	20.5	9.7	46.1	30.2	63.4	53.4	17.3	23.2
0.566	N	31.1	24.4	9.6	40.7	34.0	56	46	15.3	12.0
0.677	N	24.4	16.4	9.6	34.0	26.0	56	46	22.0	20.0
10.730	N	22.7	17.5	10.0	32.7	27.5	60	50	27.3	22.5
13.590	N	22.0	17.1	10.1	32.1	27.2	60	50	27.9	22.8

Note(s) :

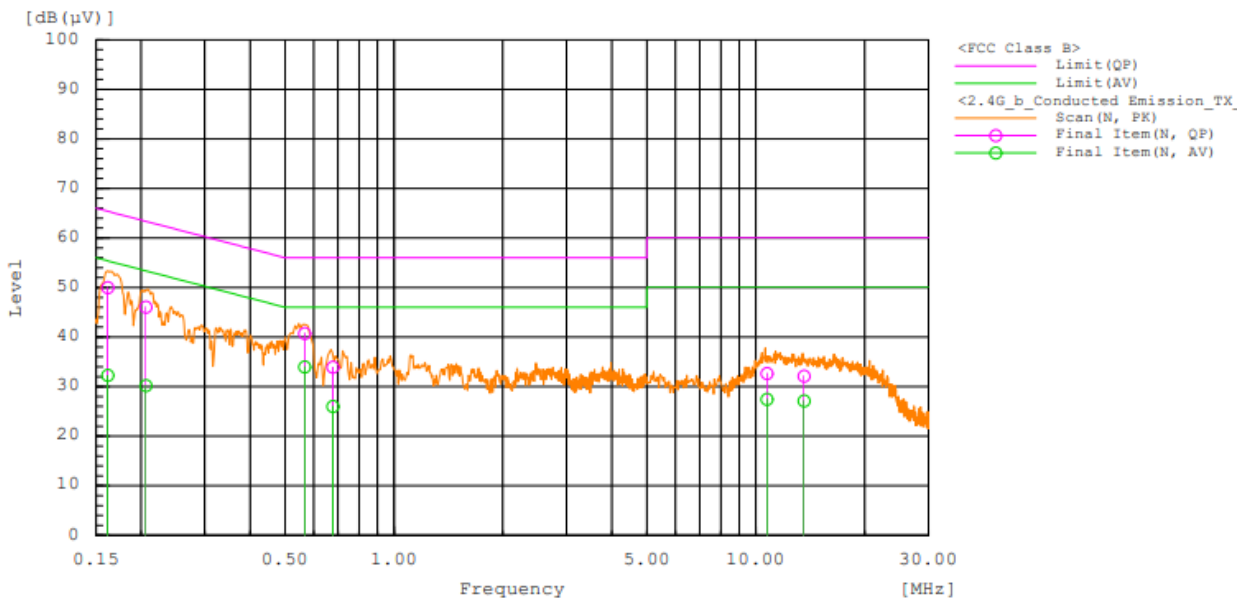
1. Quasi-peak(Final Result) = Reading Value + Correction Factor

■ TEST PLOTS

AC Line Conducted Emission (L1)



AC Line Conducted Emission (N)



10. LIST OF TEST EQUIPMENT

No.	Instrument	Model No.	Calibration Due (mm/dd/yy)	Manufacture	Serial No.
☒	Signal Analyzer (20 Hz ~ 40.0 GHz)	ESU40	12/09/2021	Rohde & Schwarz	100529
☒	Signal Analyzer (10 Hz ~ 40.0 GHz)	FSV40	02/03/2022	Rohde & Schwarz	101424
☒	Signal Analyzer (10 Hz ~ 26.5 GHz)	N9020A	11/04/2022	Keysight	MY52091291
☒	Attenuator (20 dB, DC ~ 26.5 GHz)	8493C	12/07/2021	HP	09072
☐	Attenuator (10 dB, DC ~ 26.5 GHz)	CFAD261002	01/07/2022	CERNEX	H0044
☒	Loop Antenna (0.009 ~ 30 MHz)	AL-130R	04/16/2023	Com-Power	121082
☒	BI-LOG Antenna (30 MHz ~ 6 GHz)	JB6	10/26/2022	Sunol	A071116
☒	LNA (30 MHz ~ 1GHz)	8447D	07/26/2022	HP	2443A03587
☒	Horn Antenna (1 GHz ~ 18 GHz)	DRH-118	10/21/2022	Sunol	A070516
☒	LNA (1 GHz ~ 18 GHz)	PAM-118A	07/06/2022	Com-Power	18040074
☒	Horn Antenna (18 GHz ~ 40 GHz)	DRH-1840	02/16/2022	Sunol	17121
☒	LNA (18 GHz ~ 40 GHz)	CBL184050-45-01	02/04/2022	CERNEX, Inc.	27973
☐	Power Divider-2way (DC ~ 26.5 GHz)	11636B	12/11/2021	HP	50820
☐	Directional Coupler (1-4GHz)	3022	12/15/2021	Narda	72118
☐	High Pass Filter	WHK10-2520-3000-18000-40EF	01/06/2022	Wainwright	9
☒	High Pass Filter	WHKX8-6090-7000-18000-40SS	01/06/2022	Wainwright	23
☒	EMI Test Receiver	ESR3	12/17/2021	Rohde & Schwarz	102363
☒	LISN	ENV216	01/16/2022	Rohde & Schwarz	101349

Note(s) :

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

APPENDIX A. TEST SETUP PHOTOS

The setup photos are provided as a separate document.

APPENDIX B. PHOTOGRAPHS OF EUT

B.1. EXTERNAL PHOTOS

The external photos are provided as a separate document.

B.2. INTERNAL PHOTOS

The internal photos are provided as a separate document.

END OF TEST REPORT