FCC RF Test Report

For

Purism SPC

Test Standards:	Part 15 Subpart E §15. 407
Product Description:	Librem Mini
Tested Model:	LMv1-01
FCC ID:	2AT9R-LMV1-01
Classification	(NII)Unlicensed National Information Infrastructure
Report No.:	EC2005029RF04
Tested Date:	2020-05-29 to 2020-06-15
Issued Date:	2020-06-15
Prepared By:	Jerry Wang / Engineer
Approved By:	Bacon Wu / RF Manager

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Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	2020.06.15	Valid	Original Report

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Summary of Test Result

FCC Rule	Description	Limit	Result	Remark
2.1049 15.403(i)	26dB & 99% Bandwidth	>500kHz	Pass	U-NII-3
15.407(a)	Maximum Conducted Output Power	≤30dBm	Pass	U-NII-3
15.407(a)	Power Spectral Density	≤30dBm/500kHz	Pass	U-NII-3
15.407(b)	Unwanted Emissions	15.407(b) 15.209(a)	Pass	Under limit 6.05 dB at 593.57 MHz
15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 8.24 dB at 7.566 MHz
15.407(g)	Frequency Stability	Within Operation Band	Pass	
15.407(c)	Automatically Discontinue Transmission	Discontinue Transmission	Pass	
15.203 & 15.407(a)	Antenna Requirement	N/A	Pass	

1 Test Laboratory

1.1 Test facility

CNAS (accreditation number: L11138)

Hunan Ecloud Testing Technology Co., Ltd. has obtained the accreditation of China National Accreditation Service for Conformity Assessment (CNAS).

FCC (Designation number: CN1244 , Test Firm Registration Number: 793308)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

ISED(CAB identifier: CN0012, ISED# :24347)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the Wireless Device Testing Laboratories list of innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements.

A2LA (Certificate Code: 4895.01)

Hunan Ecloud Testing Technology Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

2 General Description

2.1 Applicant

Purism SPC
1 Market Street, 36th Floor, San Francisco, CA94105, United States

2.2 Manufacturer

Purism, SPC
One Market Street, 36th Floor, San Francisco, CA 94105, USA

2.3 General Description Of EUT

PRODUCT	Librem Mini
MODEL NO.	LMv1-01
Additional NO.	N/A
Difference Description	N/A
FCC ID	2AT9R-LMV1-01
POWER SUPPLY	120Vac for adapter
MODULATION TECHNOLOGY	256QAM,64QAM, 16QAM, QPSK, BPSK for OFDM
MODULATION TYPE	802.11ac : OFDM
OPERATING FREQUENCY	U-NII-3:5725~5850MHz
MAX. OUTPUT POWER	802.11ac VHT80 : 11.82 dBm (0.0152 W)
ANTENNA TYPE	FPC Antenna with 5dBi gain at U-NII-3
HW version	N/A
SW version	N/A
I/O PORTS	Refer to user's manual

NOTE:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.

2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.

3. The EUT was powered by the following adapters:

MODEL:	ADS-40SI-19-3 19040E
INPUT:	100-240V~50/60Hz 1.0A MAX
OUTPUT:	19V DC 2.1A
DC LINE:	2.5 m

2.4 Modification of EUT

No modifications are made to the EUT during all test items.

2.5 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart E §15.407
- ANSI C63.10-2013
- FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r04

Remark:

1. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

3 Test Configuration of Equipment Under Test

3.1 Carrier Frequency and Channel

U-NII-3

CHANNEL	FREQUENCY
155	5775 MHz

3.2 Test Mode

Based on the baseline scan, the worst - case data rates were:

MODULATION	DATA RATE
802.11ac VHT80	MCS0

3.2.1 Antenna Port Conducted Measurement

Summary table of Test Cases	
Test Item	Modulation
	802.11ac VHT80
U-NII-1	Mode 1: CH155

3.2.2 Radiated Emission Test (Below 1GHz)

Radiated Test Cases	802.11ac VHT80
	Mode 1: CH155

Note : 1. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type. It was determined that Y orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Y orientation.

2. Following channel(s) was (were) selected for the final test as listed above

3.2.3 Radiated Bandedge and Radiated Emission Test (Above 1GHz)

Summary table of Test Cases	
Test Item	Modulation
	802.11ac VHT80
U-NII-1	Mode 1: CH155

Note : 1. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna

diversity architecture) and packet type. It was determined that Y orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Y orientation.

2. Following channel(s) was (were) selected for the final test as listed above

3.2.4 Power Line Conducted Emission Test:

AC Conducted Emission	Mode 1 : 5G WLAN Link + HDMI + Earphone + Burnin test + ping

3.3 Support Equipment

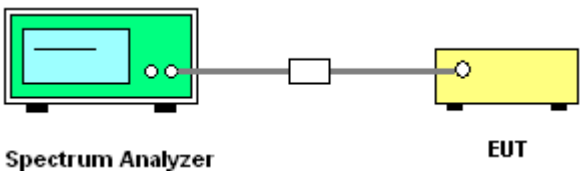
Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	NETGARE	R7800	PY315100319	N/A	unshielded AC I/P cable1.2 m
2.	Notebook	Lenovo	E470C	FCC DoC	N/A	shielded cable DC O/P 1.8 m unshielded AC I/P cable1.2 m
3.	Flat Panel Monitor	Dell	P2317H	FCC DoC	N/A	Unshielded, 1.5 m
4.	Bluetooth Keyboard	Sariana LLC	ST-ACBKM	ZE9-ST-ACBKM	N/A	N/A

3.4 Test Setup

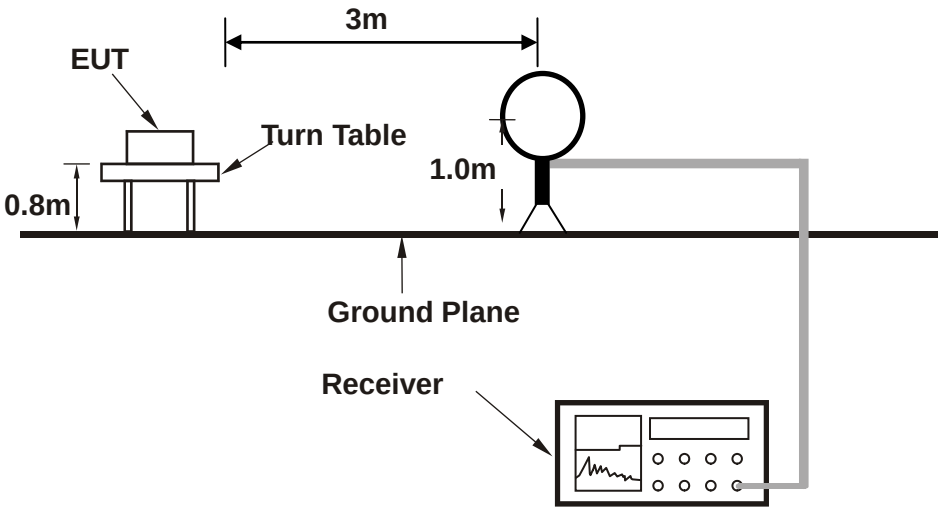
The EUT is continuously communicating to the WIFI tester during the tests.

EUT was set in the Hidden menu mode to enable WIFI communications.

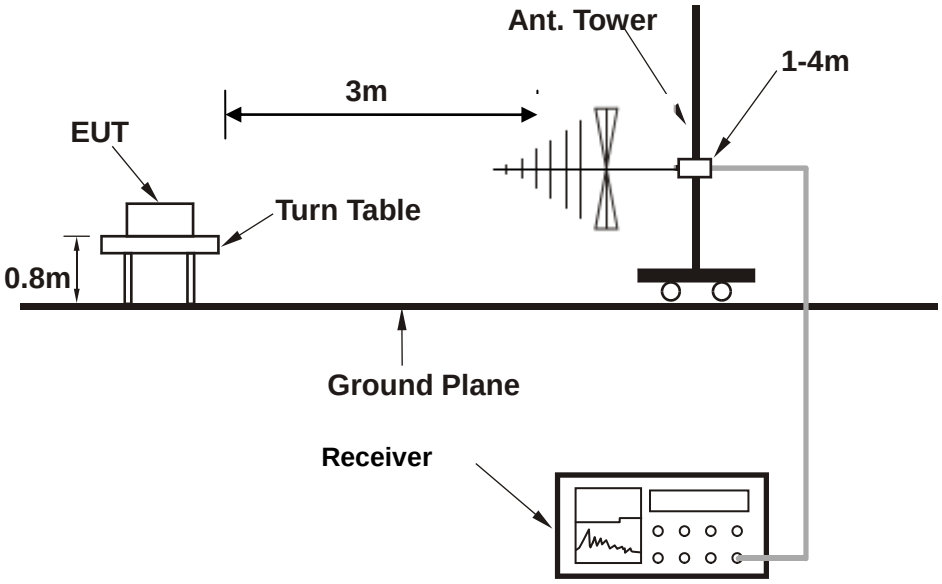
Setup diagram for Conducted Test



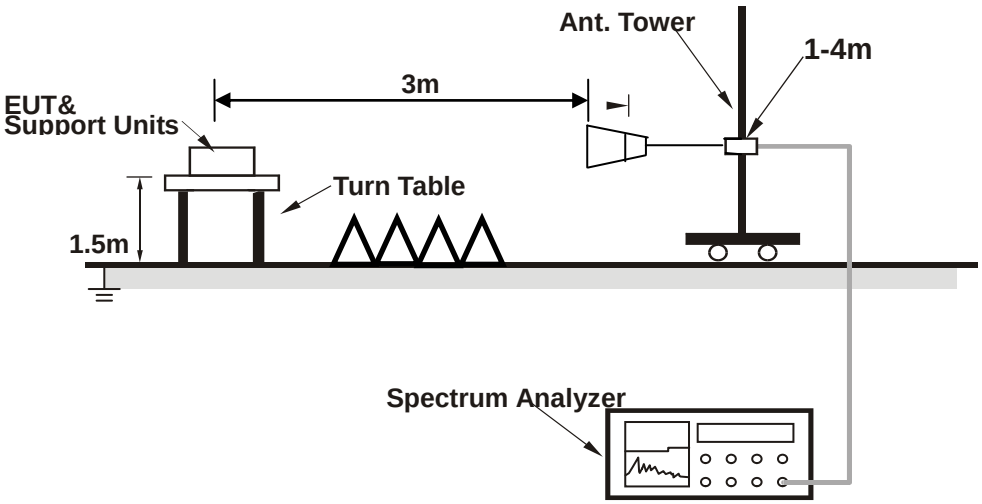
Setup diagram for Raidation(9KHz~30MHz) Test



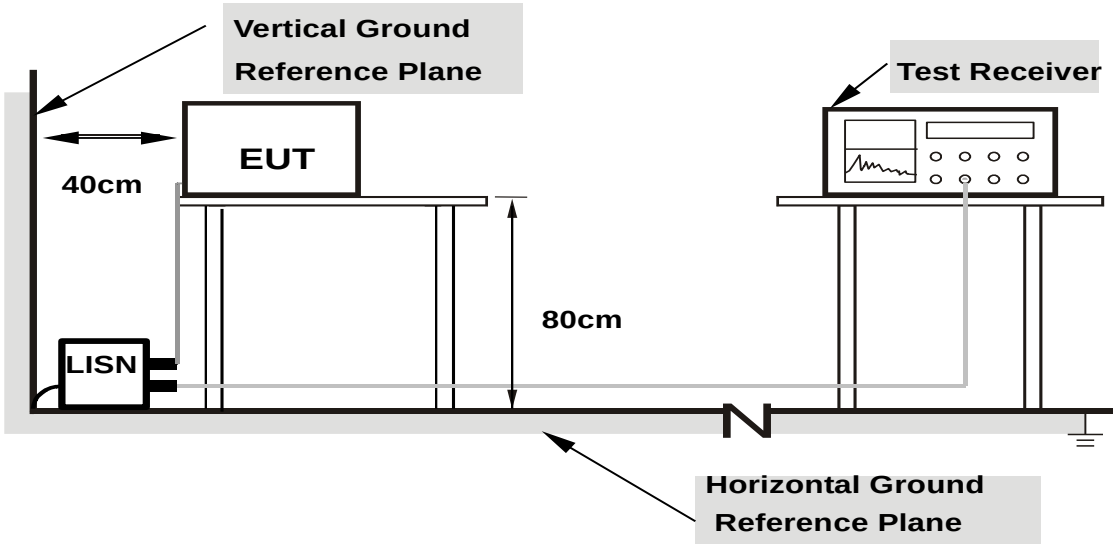
Setup diagram for Raidation(Below 1G) Test



Setup diagram for Raidation(Above1G) Test



Setup diagram for AC Conducted Emission Test



Note: 1.Support units were connected to second LISN.

2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

3.5 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 5 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

= 5 + 10 = 15 (dB)

For all radiated test items:

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

Over Limit (dB μ V/m) = Level(dB μ V/m) - Limit Level (dB μ V/m)

4 Test Result

4.1 6dB, 26dB and 99% Occupied Bandwidth Measurement

4.1.1 Limit of 6dB, 26dB and 99% Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz for U-NII-3.

4.1.2 Test Procedures

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules .
3. Remove the antenna from the EUT and then connect a low loss RF cable from the Antenna port to the spectrum analyzer.
4. 26dB Band width Measurement: Set the spectrum analyzer as 1% of emission BW Sweep=auto,Detector = Peak, Trace Mode = Max Hold, Manually readjust RBW until the RBW/EBW ratio is 1% based on EBW as observed on the result of pre-sequence measurement.
5. Mark the peak frequency and –26dB (upper and lower) frequency.
6. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement.
7. Repeat the procedures as list above until all test default channels (low, middle, and high) are completed.
8. Measure and record the results in the test report.

4.1.3 Test Result of 26dB Bandwidth

Refer to Appendix A1 of this test report.

4.1.4 Test Result of 99% Bandwidth

Refer to Appendix A2 of this test report.

4.1.5 Test Result of 6dB Bandwidth

Refer to Appendix A3 of this test report.

4.2 Maximum Conducted Output Power Measurement

4.2.1 Limit of Output Power

Operation Band	EUT Category		Limit
U-NII-1		Access Point(Mater Device)	1 Watt(30dBm)
		Fixed point-to-point Acess Ponit	1 Watt(30dBm)
		Mobile and portable clinet device	250mW(23.98dBm)
U-NII-2A			250mW(23.98dBm) or 11dBm+10 log B
U-NII-2C			250mW(23.98dBm) or 11dBm+10 log B
U-NII-3	√		1 W(30dBm)

4.2.2 Test Procedures

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules .
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Spectrum Analyzer.
4. Spectrum Analyzer is used as the auxiliary test equipment to conduct the output power measurement.
5. Set span to encompass the entire emission bandwidth (EBW) of the signal. Set sweep trigger to “free run.”, RBW = 1 MHz, Set VBW ≥ 1/T, where T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation, Sweep time = auto, Detector = peak..
6. Video filtering shall be applied to power signal (rms), it shall be set to operate on a linear voltage signal.
7. Trace mode = max hold. Allow max hold to run for at least 60 seconds
8. Repeat above procedures until all frequency (low, middle, and high channel) measured were complete.

4.2.3 Test Result of Output Power

Refer to Appendix B of this test report.

4.3 Power Spectral Density Measurement

4.3.1 Limits of Power Spectral Density

Operztion Band	EUT Category		Limit
U-NII-1		Access Point(Mater Device)	17dBm/MHz
		Fixed point-to-point Acess Ponit	
		Mobile and portable clinet device	11dBm/ MHz
U-NII-2A			11dBm/ MHz
U-NII-2C			11dBm/ MHz
U-NII-3	√		30 dBm/500kHz

4.3.2 Test Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules .
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to Spectrum.
4. Set RBW=1MHz, VBW=3MHz, where span is enough to capture the entire bandwidth, Sweep time = Auto (601 pts), detector = sample, traces 100 sweeps of video averaging(SA-2 with the omission of procedure x, the integration with 26dB EBW bandwidth)
5. User the cursor on spectrum to peak search the highest level of trace.
6. Record the max. reading and add 10 log(1/duty cycle).
7. Repeat above procedures until all default test channel (low, middle, and high) was complete.

4.3.3 Test Result of Power Spectral Density

Refer to Appendix C of this test report.

4.4 Unwanted Emissions Measurement

This section as specified in FCC Part 15.407(b) is to measure unwanted emissions through radiated measurement for band edge spurious emissions and out of band emissions measurement. The unwanted emissions shall comply with 15.407(b)(1) to (6), and restricted bands per FCC Part15.205.

4.4.1 Limit of Unwanted Emissions

(1) For transmitters operating in the 5150-5250 MHz band: all emissions outside of the 5150-5350 MHz band shall not exceed an EIRP of –27dBm/MHz.

For transmitters operating in the 5250-5350 MHz band: all emissions outside of the 5150-5350MHz band shall not exceed an EIRP of -27 dBm/MHz. Devices operating in the 5250-5350 MHz band that generate emissions in the 5150-5250 MHz band must meet all applicable technical requirements for operation in the 5150-5250 MHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5150-5250 MHz band.

For transmitters operating in the 5470-5600 MHz and 5650-5725MHz band: all emissions outside of the 5470-5600 MHz and 5650-5725MHz band shall not exceed an EIRP of -27 dBm/MHz.

(2) Unwanted spurious emissions fallen in restricted bands shall comply with the general field strength limits as below table

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

Note: The following formula is used to convert the EIRP to field strength.

$$E=\frac{1000000\sqrt{30P}}{3}$$ μV/m, where P is the eirp (Watts)

EIRP (dBm)	Field Strength at 3m (dBμV/m)
-17	78.2
-27	68.2

4.4.2 Test Procedures

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW=3*RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
   (3) For average measurement:
   VBW = 10 Hz, when duty cycle is no less than 98 percent.
   VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
5. Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP.
6. Convert the resultant EIRP to an equivalent electric field strength using the following relationship:

   $E = EIRP - 20 \log d + 104.8$

   Where:

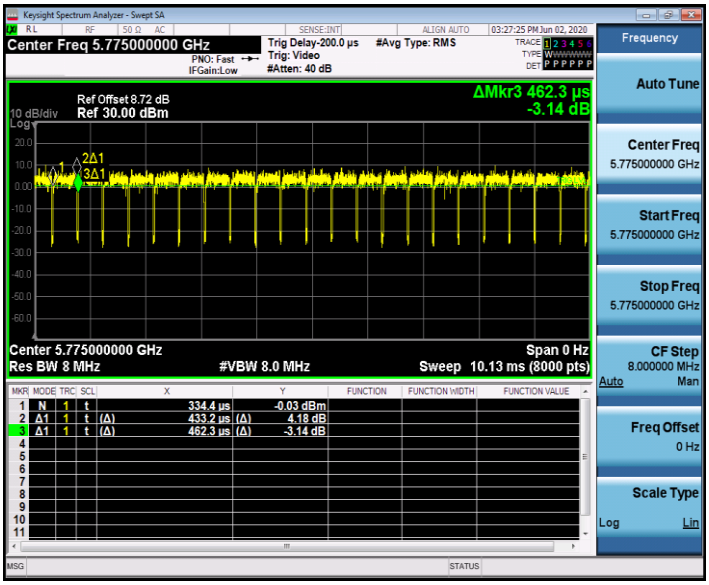
   E is the electric field strength in dBμV/m

   EIRP is the equivalent isotropically radiated power in dBm

   d is the specified measurement distance in m

   E[dBμV/m] = EIRP[dBm] + 95.2, for d = 3 m.
7. Compare the resultant electric field strength level with the applicable regulatory limit.

Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
802.11ac HT80	93.70	0.43	2.33	3kHz



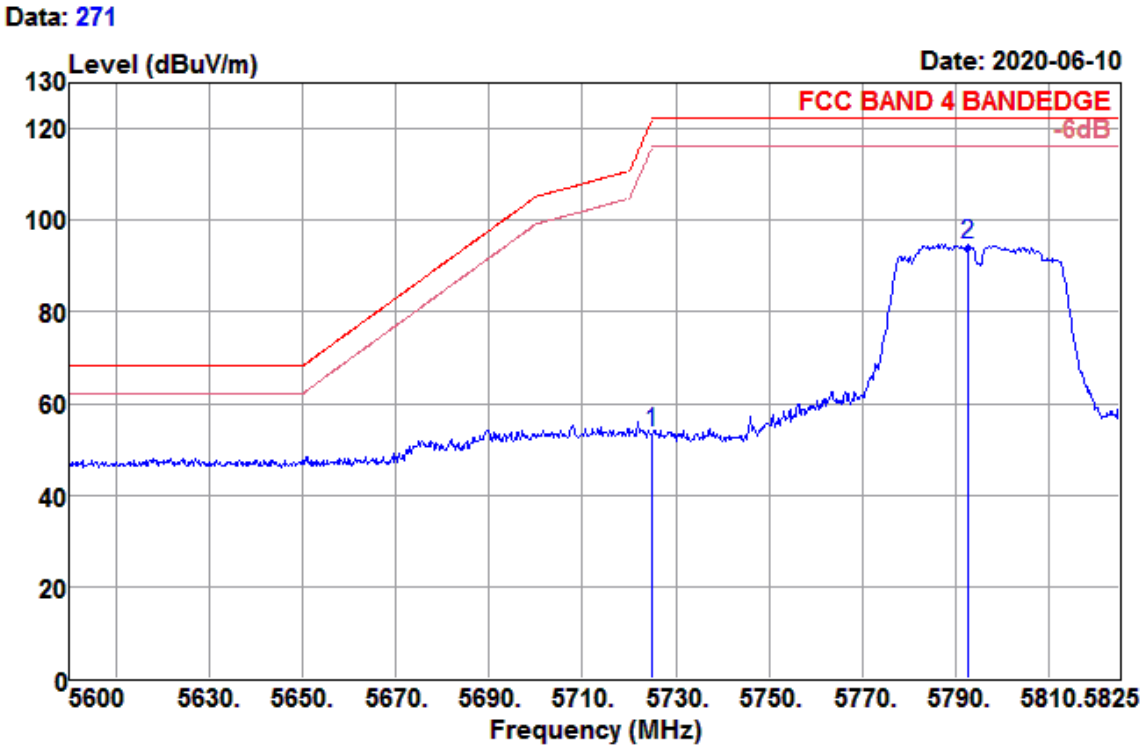
802.11ac HT80

4.4.3 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

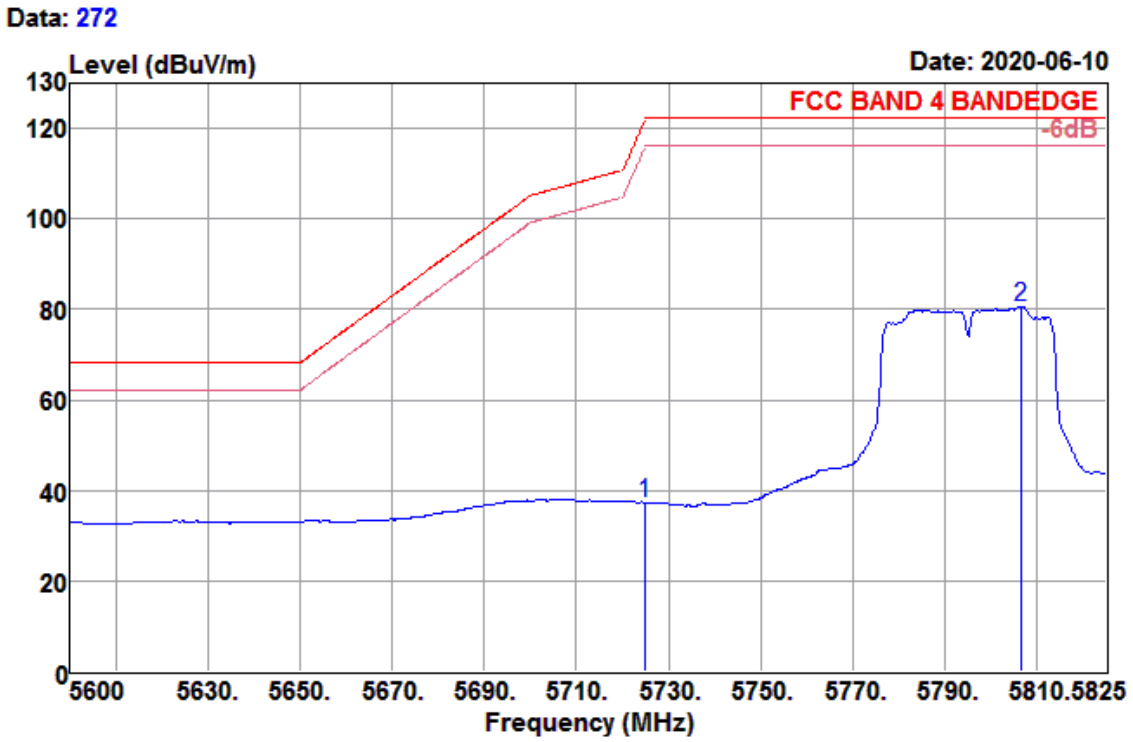
4.4.4 Test Result of Radiated Spurious at Band Edges

Test Mode :	802.11ac VHT80 CH155 5775MHz	**Temperature :**	21~23℃
Test Engineer :	Jack Liu	**Relative Humidity :**	63~65%
Frequencey Range	5.6GHz~5.825GHz	**Polarization :**	Horizontal



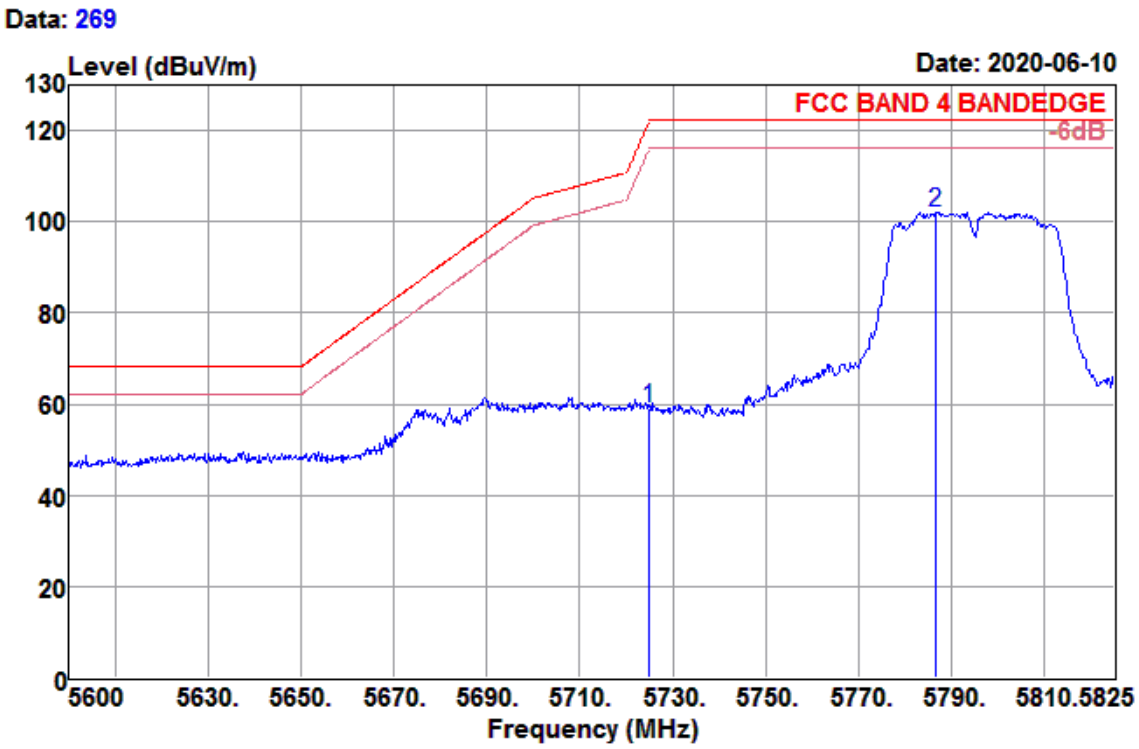
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
5725.000	50.40	31.96	6.31	34.91	53.76	122.20	-68.44	Peak
5792.600	91.33	32.07	6.30	34.82	94.88	122.20	-27.32	Peak

Test Mode :	802.11ac VHT80 CH155 5775MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	5.6GHz~5.825GHz	Polarization :	Horizontal



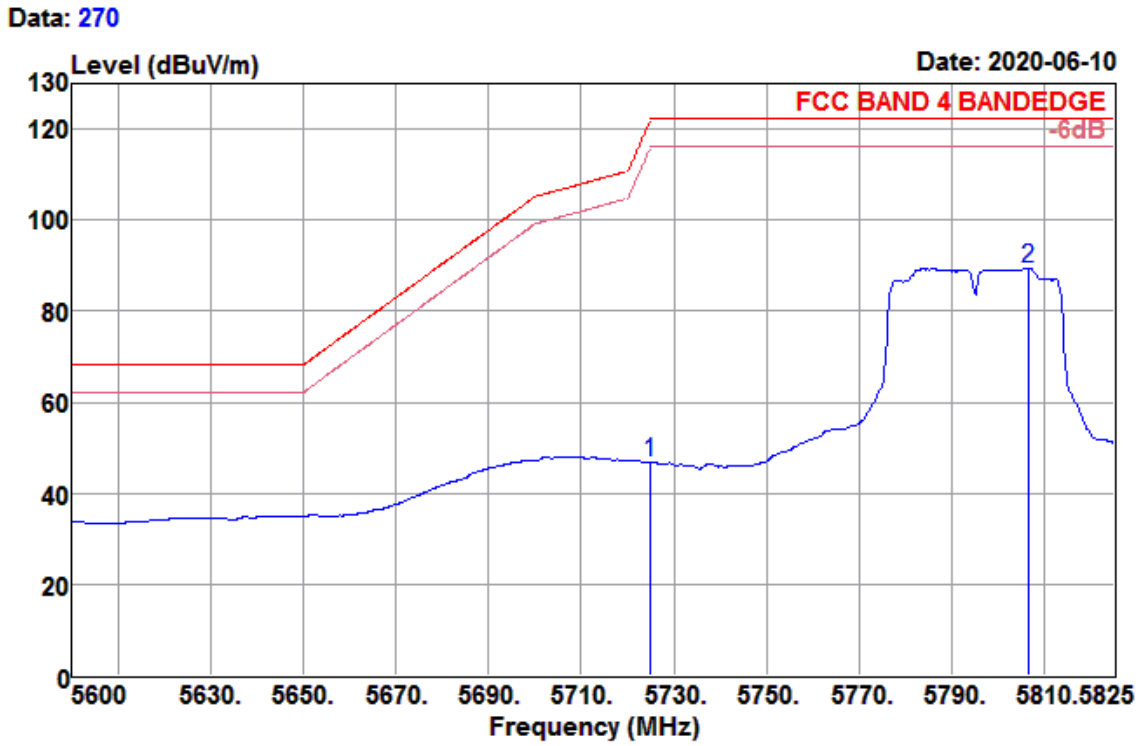
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
5725.000	33.93	31.96	6.31	34.91	37.29	122.20	-84.91	Average
5806.550	76.95	32.09	6.33	34.80	80.57	122.20	-41.63	Average

Test Mode :	802.11ac VHT80 CH155 5775MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	5.6GHz~5.825GHz	Polarization :	Vertical



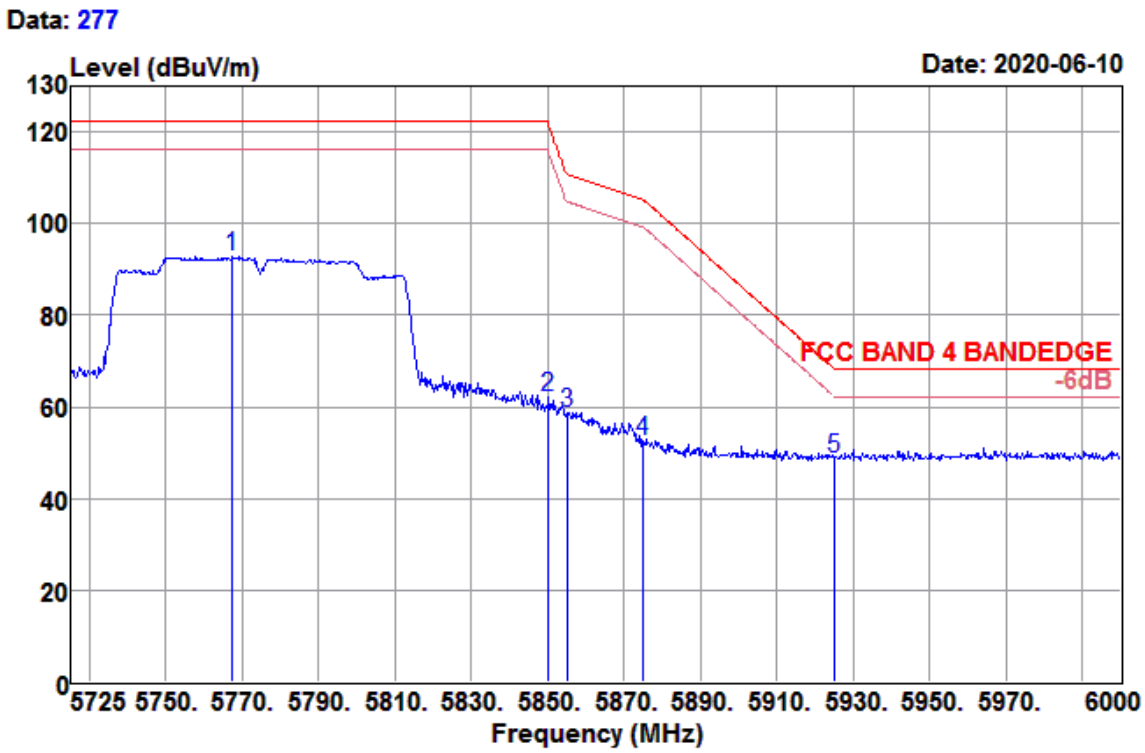
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
5725.000	55.54	31.96	6.31	34.91	58.90	122.20	-63.30	Peak
5786.750	98.66	32.06	6.30	34.82	102.20	122.20	-20.00	Peak

Test Mode :	802.11ac VHT80 CH155 5775MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	5.6GHz~5.825GHz	Polarization :	Vertical



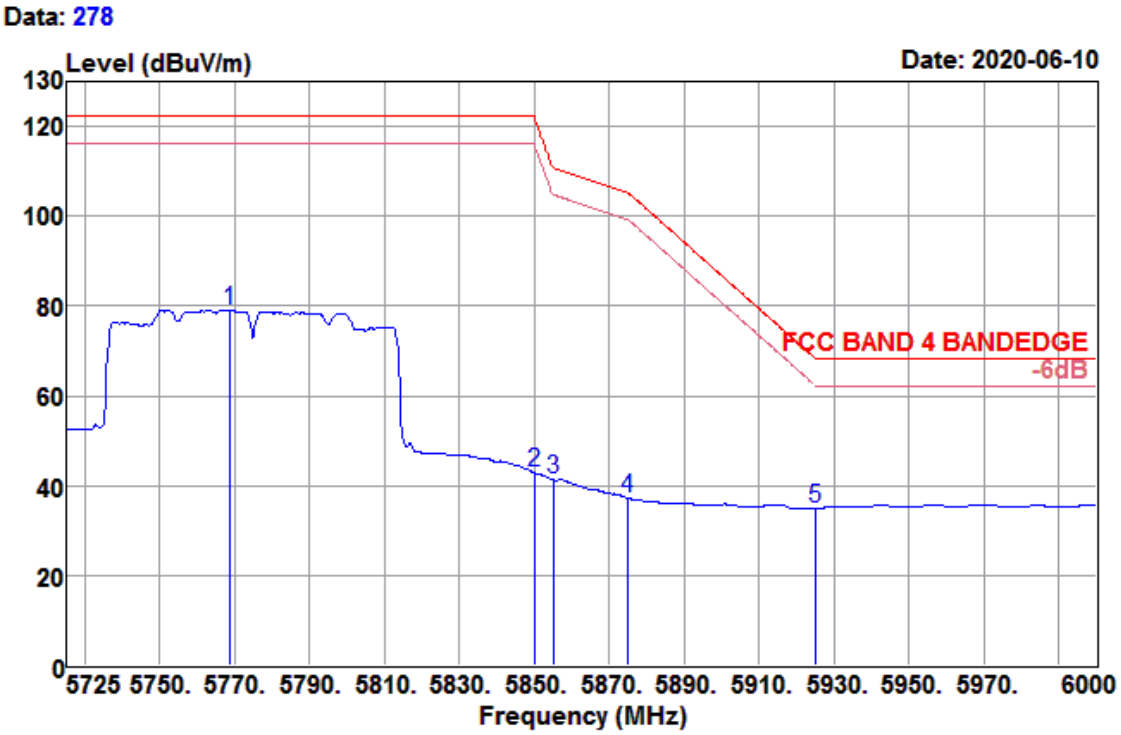
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
5725.000	43.45	31.96	6.31	34.91	46.81	122.20	-75.39	Average
5806.550	85.88	32.09	6.33	34.80	89.50	122.20	-32.70	Average

Test Mode :	802.11ac VHT80 CH155 5775MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	5.725GHz~6 GHz	Polarization :	Horizontal



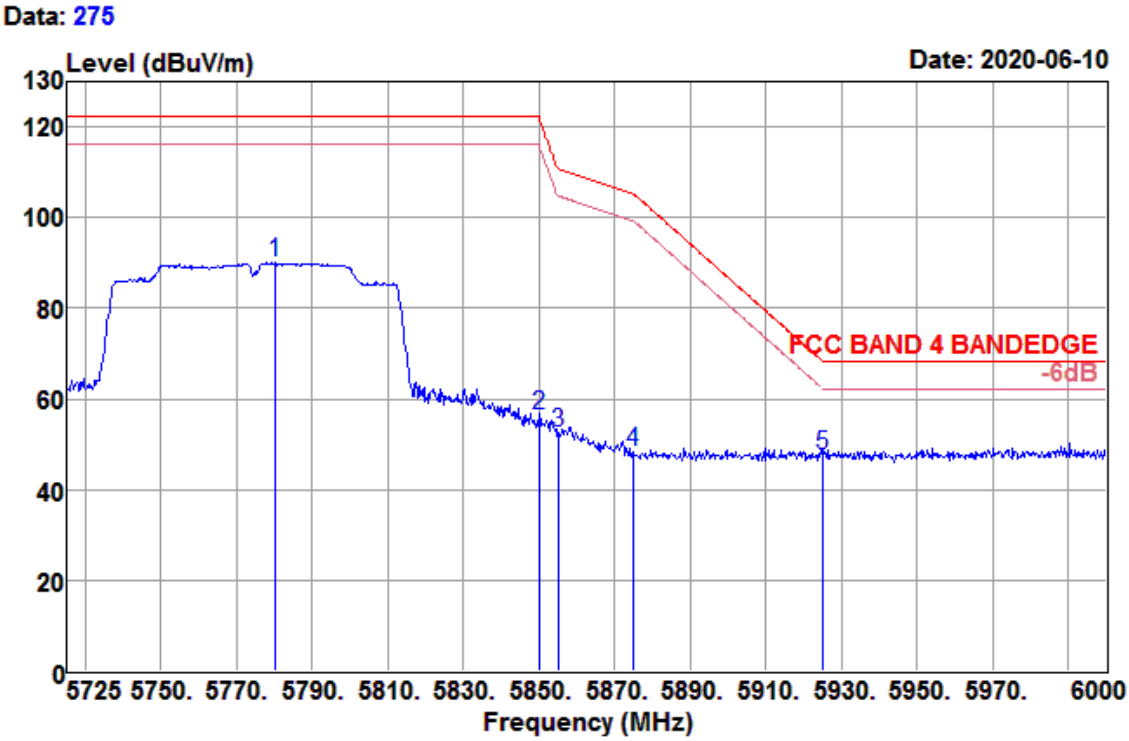
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
5767.350	89.22	32.03	6.30	34.85	92.70	122.20	-29.50	Peak
5850.000	58.17	32.16	6.53	34.74	62.12	122.20	-60.08	Peak
5855.000	54.58	32.17	6.56	34.73	58.58	110.80	-52.22	Peak
5875.000	48.54	32.20	6.65	34.70	52.69	105.20	-52.51	Peak
5925.000	44.12	32.28	6.88	34.63	48.65	68.20	-19.55	Peak

Test Mode :	802.11ac VHT80 CH155 5775MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	5.725GHz~6 GHz	Polarization :	Horizontal



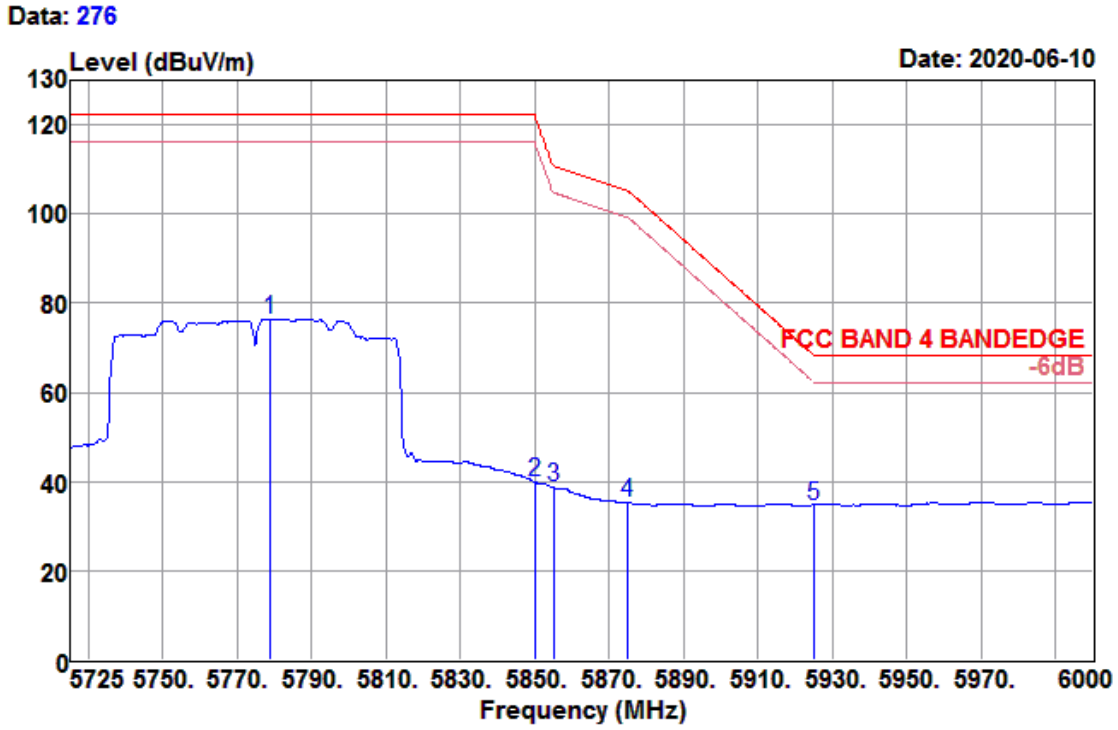
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
5768.450	75.53	32.03	6.30	34.85	79.01	122.20	-43.19	Average
5850.000	38.85	32.16	6.53	34.74	42.80	122.20	-79.40	Average
5855.000	37.24	32.17	6.56	34.73	41.24	110.80	-69.56	Average
5875.000	33.05	32.20	6.65	34.70	37.20	105.20	-68.00	Average
5925.000	30.50	32.28	6.88	34.63	35.03	68.20	-33.17	Average

Test Mode :	802.11ac VHT80 CH155 5775MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	5.725GHz~6 GHz	Polarization :	Vertical



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
5780.275	86.68	32.05	6.30	34.83	90.20	122.20	-32.00	Peak
5850.000	52.56	32.16	6.53	34.74	56.51	122.20	-65.69	Peak
5855.000	48.60	32.17	6.56	34.73	52.60	110.80	-58.20	Peak
5875.000	44.17	32.20	6.65	34.70	48.32	105.20	-56.88	Peak
5925.000	43.11	32.28	6.88	34.63	47.64	68.20	-20.56	Peak

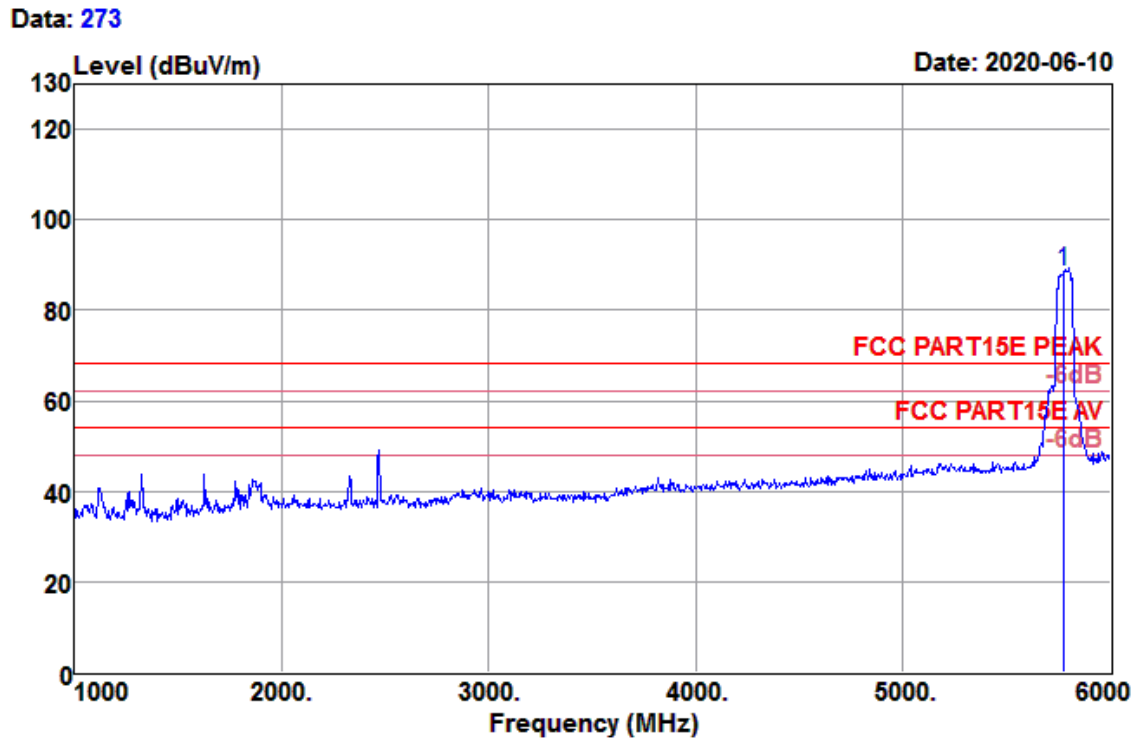
Test Mode :	802.11ac VHT80 CH155 5775MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	5.725GHz~6 GHz	Polarization :	Vertical



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
5778.625	72.95	32.05	6.30	34.84	76.46	122.20	-45.74	Average
5850.000	35.95	32.16	6.53	34.74	39.90	122.20	-82.30	Average
5855.000	34.63	32.17	6.56	34.73	38.63	110.80	-72.17	Average
5875.000	31.03	32.20	6.65	34.70	35.18	105.20	-70.02	Average
5925.000	30.19	32.28	6.88	34.63	34.72	68.20	-33.48	Average

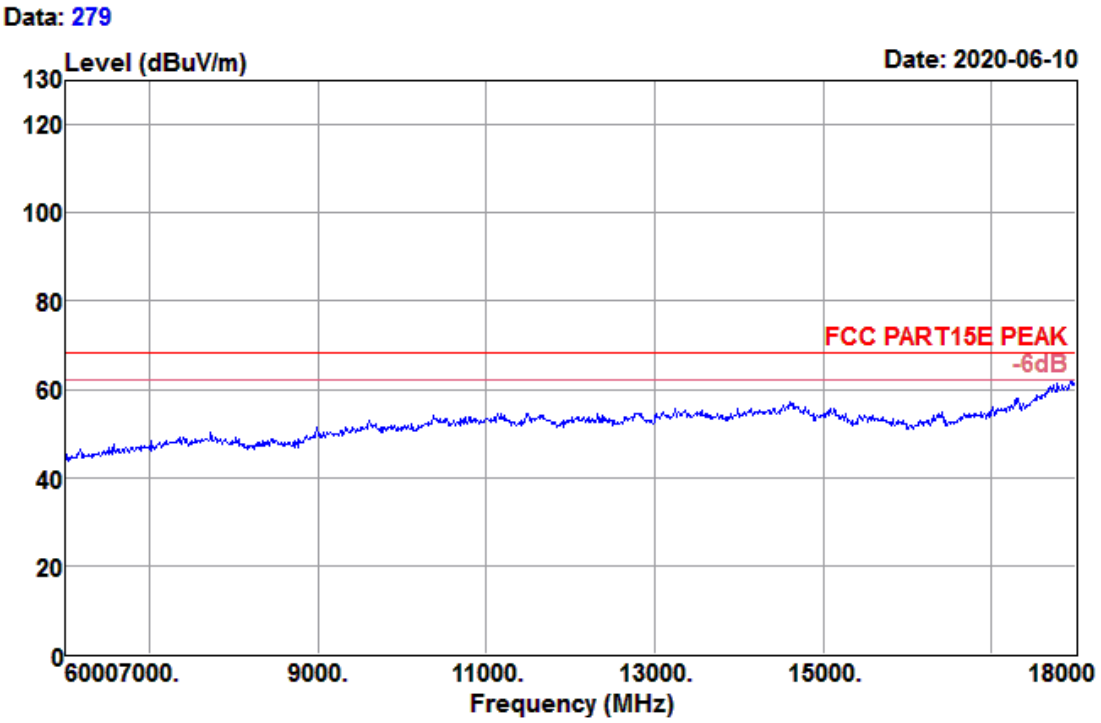
4.4.5 Test Result of Radiated Spurious Emission (1GHz ~ 10th Harmonic)

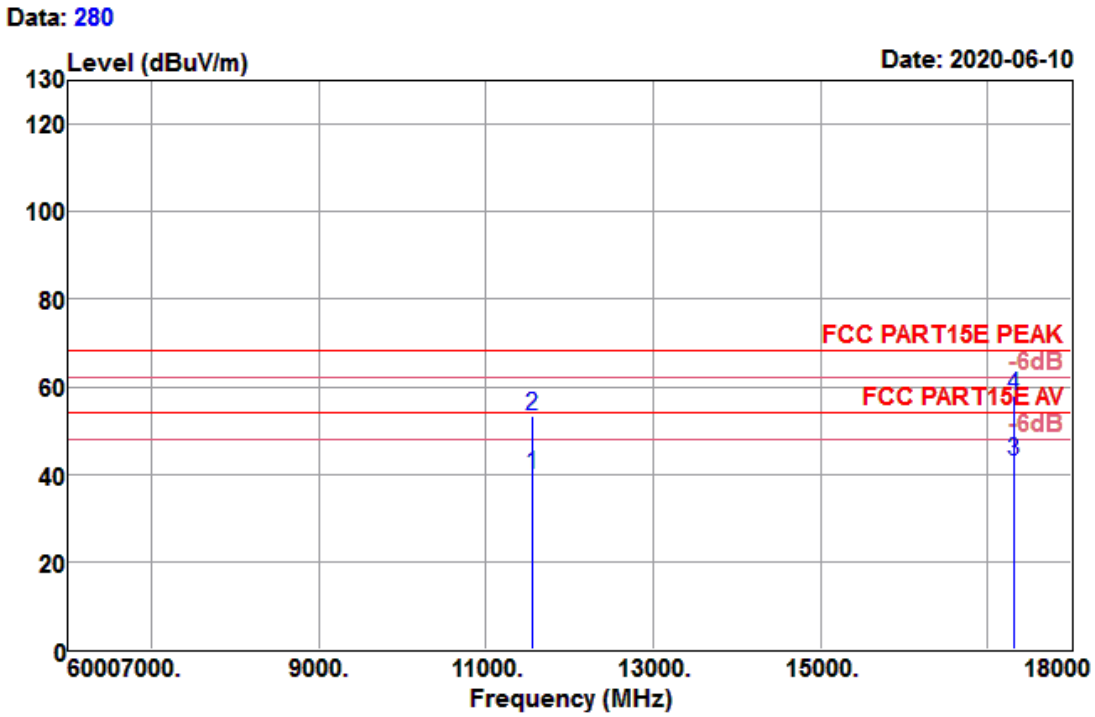
Test Mode :	802.11ac VHT80 CH155 5775MHz	**Temperature :**	21~23℃
Test Engineer :	Jack Liu	**Relative Humidity :**	63~65%
Frequencey Range	1GHz~6GHz	**Polarization :**	Horizontal



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
5775.000	84.96	32.04	6.30	34.84	88.46	68.20	20.26	Peak

Test Mode :	802.11ac VHT80 CH155 5775MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	6GHz~18GHz	Polarization :	Horizontal

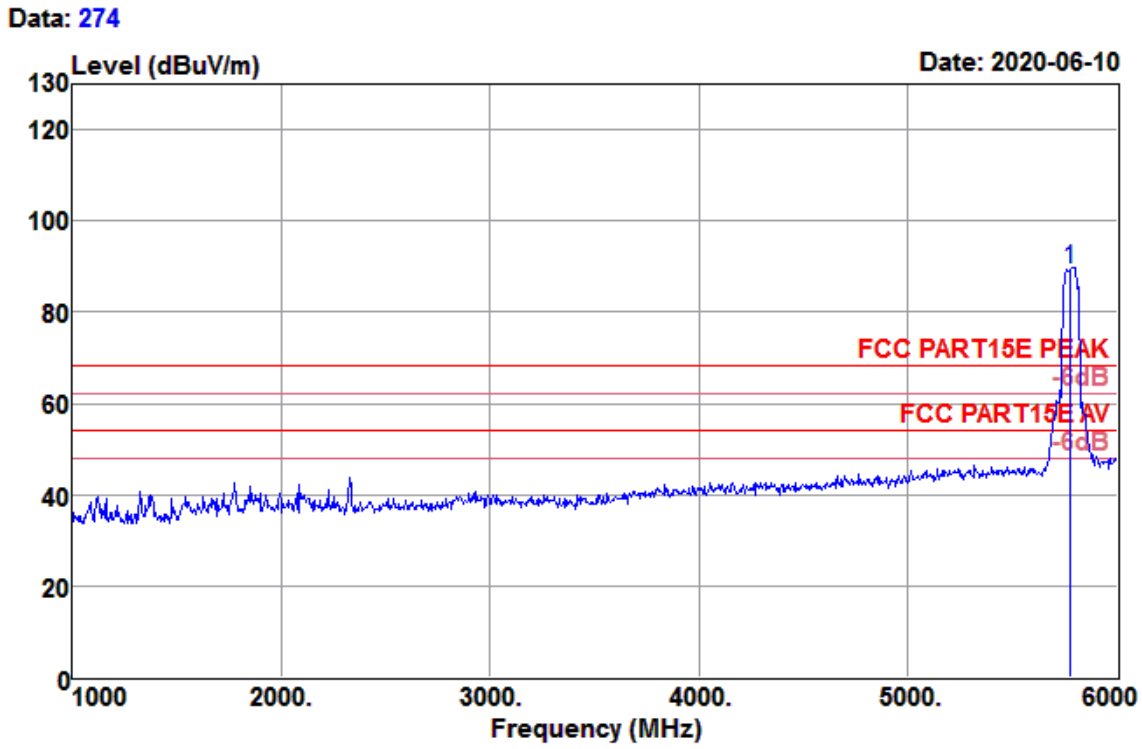




Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
11550.000	49.60	39.60	8.74	57.87	40.07	54.00	-13.93	Average
11550.000	62.88	39.60	8.74	57.87	53.35	68.20	-14.85	Peak
17325.000	49.52	41.20	9.51	57.34	42.89	54.00	-11.11	Average
17325.000	64.44	41.20	9.51	57.34	57.81	68.20	-10.39	Peak

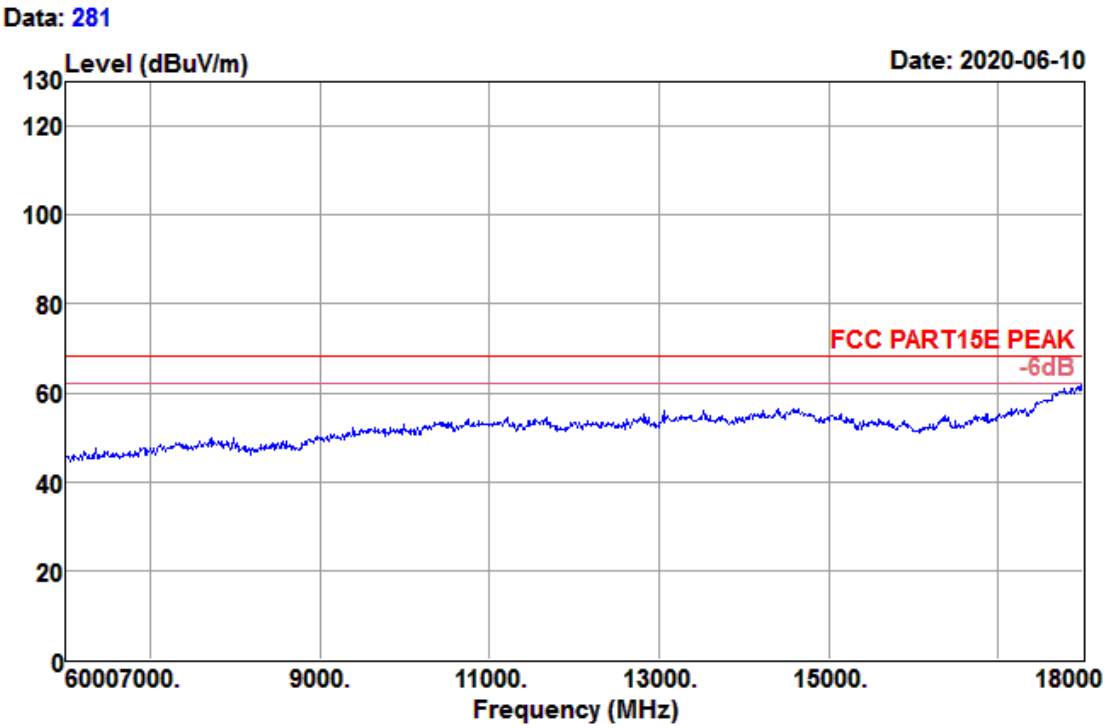
Note: Emission was scanned up to 40GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

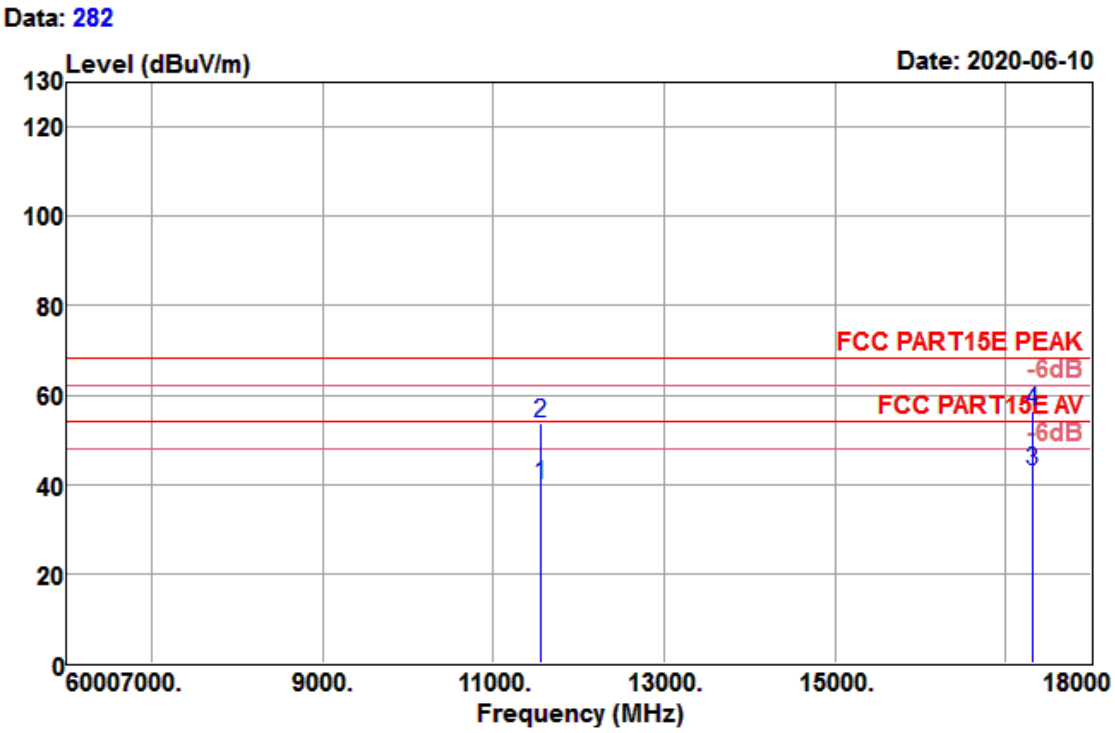
Test Mode :	802.11ac VHT80 CH155 5775MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	1GHz~6GHz	Polarization :	Vertical



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
5775.000	85.90	32.04	6.30	34.84	89.40	68.20	21.20	Peak

Test Mode :	802.11ac VHT80 CH155 5775MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	6GHz~18GHz	Polarization :	Vertical



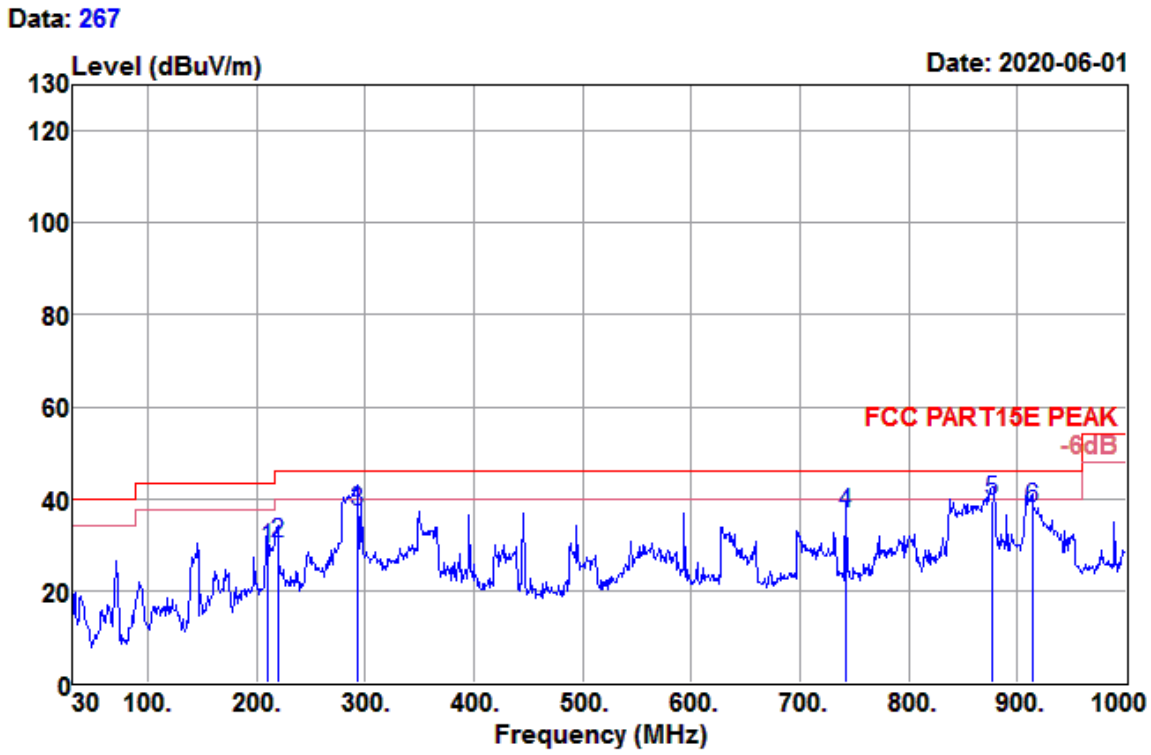


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
11550.000	49.53	39.60	8.74	57.87	40.00	54.00	-14.00	Average
11550.000	63.08	39.60	8.74	57.87	53.55	68.20	-14.65	Peak
17325.000	49.41	41.20	9.51	57.34	42.78	54.00	-11.22	Average
17325.000	63.15	41.20	9.51	57.34	56.52	68.20	-11.68	Peak

Note: Emission was scanned up to 40GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

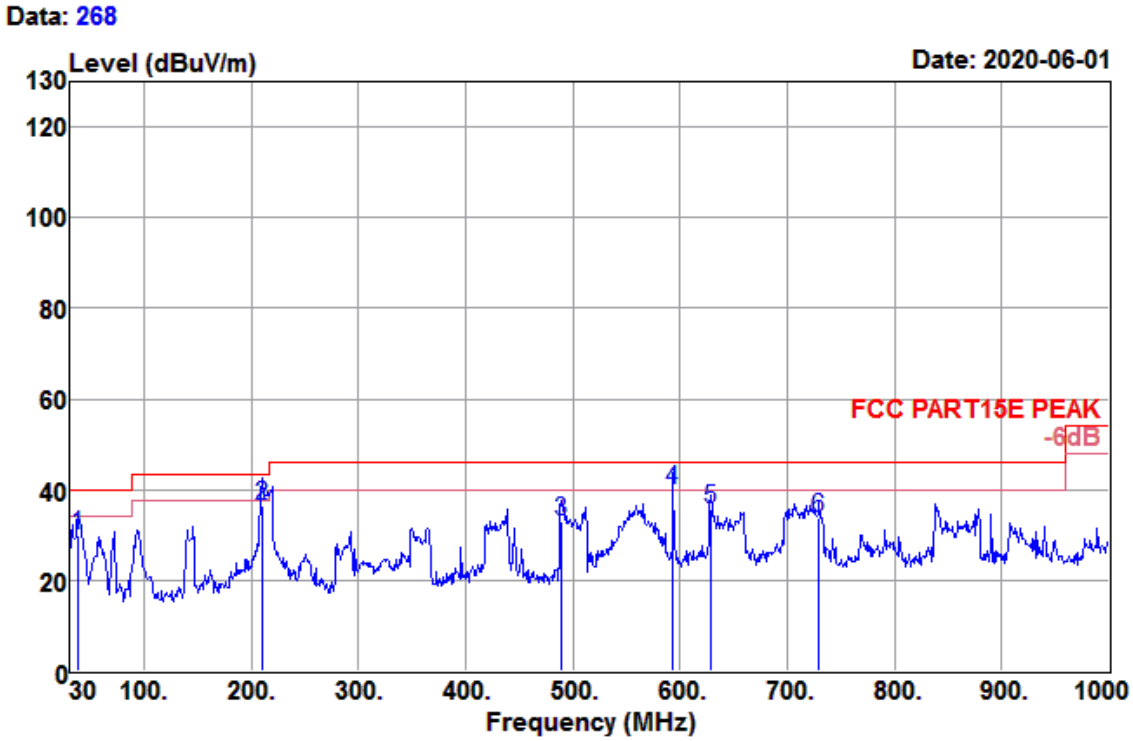
4.4.6 Test Result of Radiated Spurious Emission (30MHz ~ 1GHz)

Test Mode :	802.11 ac VHT80 CH42 5210MHz	**Temperature :**	21~23℃
Test Engineer :	Jack Liu	**Relative Humidity :**	63~65%
Frequencey Range	30MHz~1GHz	**Polarization :**	Horizontal



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
209.450	47.92	11.07	2.80	32.47	29.32	43.50	-14.18	QP
219.150	48.51	11.56	2.88	32.47	30.48	46.00	-15.52	QP
292.870	52.31	14.04	3.35	32.49	37.21	46.00	-8.79	QP
741.980	41.90	22.04	5.52	32.50	36.96	46.00	-9.04	QP
876.810	42.38	23.18	6.02	32.22	39.36	46.00	-6.64	QP
913.670	40.17	23.75	6.12	32.17	37.87	46.00	-8.13	QP

Test Mode :	802.11 ac VHT80 CH42 5210MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	30MHz~1GHz	Polarization :	Vertical



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
37.760	48.91	12.41	1.20	32.47	30.05	40.00	-9.95	QP
209.450	55.20	11.07	2.80	32.47	36.60	43.50	-6.90	QP
488.810	43.49	17.77	4.38	32.62	33.02	46.00	-12.98	QP
593.570	47.91	19.88	4.85	32.69	39.95	46.00	-6.05	QP
628.490	42.82	20.40	4.98	32.68	35.52	46.00	-10.48	QP
729.370	38.90	21.79	5.43	32.54	33.58	46.00	-12.42	QP

4.5 AC Conducted Emission Measurement

4.5.1 Limit of AC Conducted Emission

FCC §15.207

IC RSS-GEN 8.8

For equipment 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.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

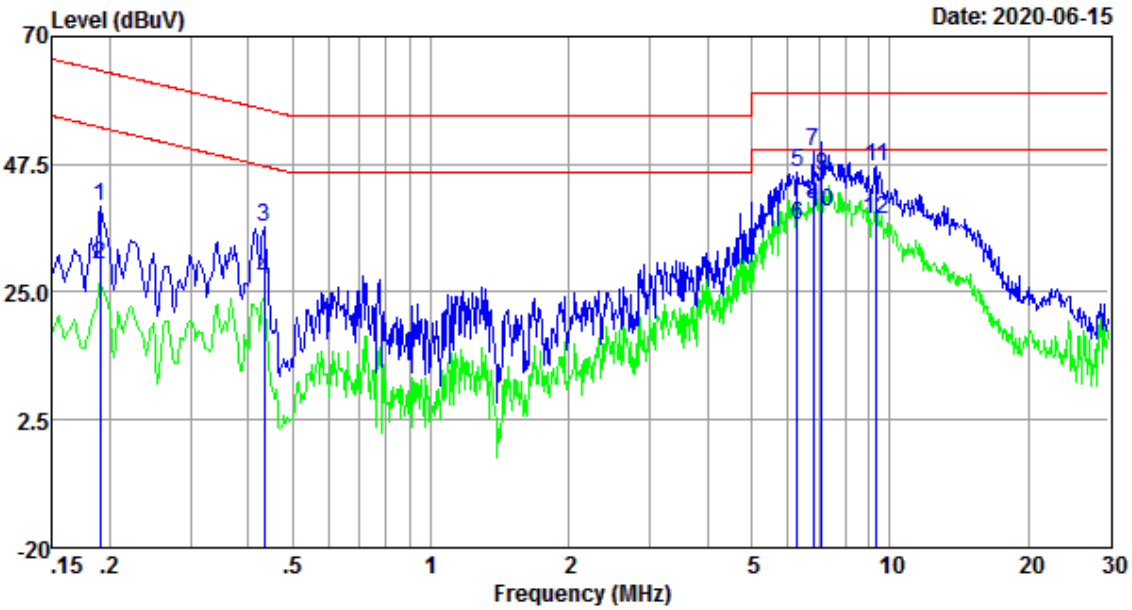
*Decreases with the logarithm of the frequency.

4.5.2 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

4.5.3 Test Result of AC Conducted Emission

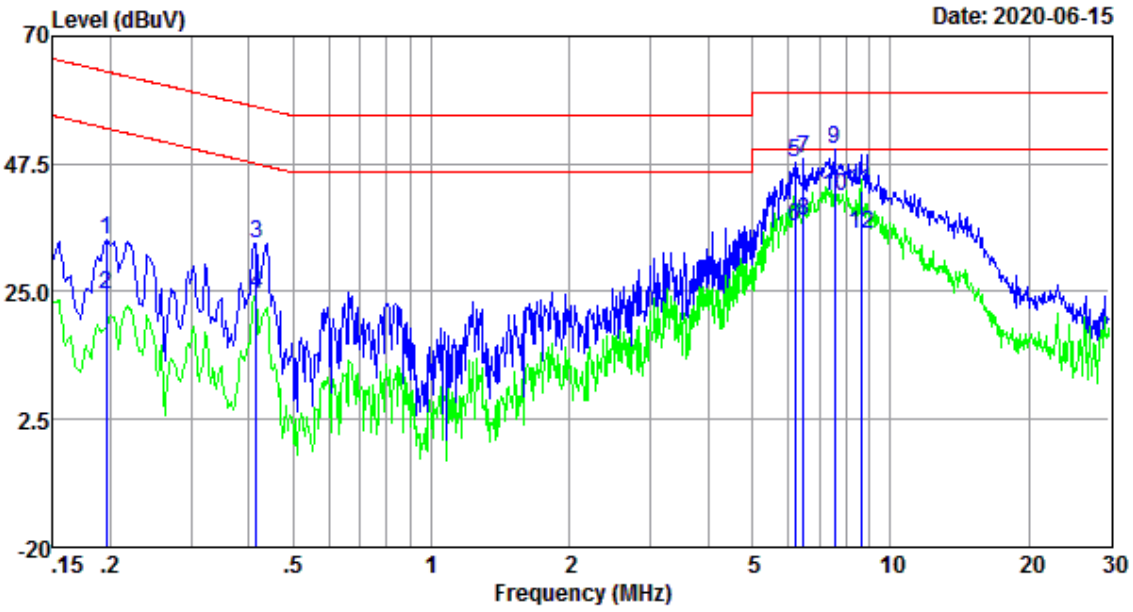
Test Mode :	Mode 1	**Temperature :**	21~23℃
Test Engineer :	Jerry Wang	**Relative Humidity :**	41~43%
Test Voltage :	120Vac / 60Hz	**Phase :**	Line
Function Type :	5G WLAN Link+ HDMI + Earphone + Burnin test + RJ45 ping		



Freq MHz	Reading level dBuV	LISN/ISN factor dB	Cable loss dB	Result level dBuV	Limit level dBuV	Over limit dB	Remark
0.190	30.62	9.55	0.03	40.20	64.02	-23.82	QP
0.190	20.13	9.55	0.03	29.71	54.02	-24.31	Average
0.433	26.99	9.56	0.02	36.57	57.20	-20.63	QP
0.433	17.53	9.56	0.02	27.11	47.20	-20.09	Average
6.285	36.31	9.71	0.05	46.07	60.00	-13.93	QP
6.285	27.02	9.71	0.05	36.78	50.00	-13.22	Average
6.805	39.91	9.73	0.06	49.70	60.00	-10.30	QP
6.805	30.72	9.73	0.06	40.51	50.00	-9.49	Average
7.100	35.51	9.74	0.06	45.31	60.00	-14.69	QP
7.100	29.31	9.74	0.06	39.11	50.00	-10.89	Average
9.352	37.15	9.83	0.08	47.06	60.00	-12.94	QP
9.352	27.86	9.83	0.08	37.77	50.00	-12.23	Average

Result Level= Reading Level + LISN Factor + Cable Loss

Test Mode :	Mode 1	Temperature :	21~23℃
Test Engineer :	Jerry Wang	Relative Humidity :	41~43%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	5G WLAN Link + HDMI + Earphone + Burnin test + RJ45 ping		



Freq MHz	Reading level dBuV	LISN/ISN factor dB	Cable loss dB	Result level dBuV	Limit level dBuV	Over limit dB	Remark
0.195	24.66	9.56	0.03	34.25	63.80	-29.55	QP
0.195	14.77	9.56	0.03	24.36	53.80	-29.44	Average
0.415	23.87	9.58	0.02	33.47	57.55	-24.08	QP
0.415	14.92	9.58	0.02	24.52	47.55	-23.03	Average
6.186	37.92	9.78	0.05	47.75	60.00	-12.25	QP
6.186	26.55	9.78	0.05	36.38	50.00	-13.62	Average
6.454	38.59	9.79	0.06	48.44	60.00	-11.56	QP
6.454	27.62	9.79	0.06	37.47	50.00	-12.53	Average
7.566	40.17	9.84	0.07	50.08	60.00	-9.92	QP
7.566	31.85	9.84	0.07	41.76	50.00	-8.24	Average
8.637	32.90	9.88	0.08	42.86	60.00	-17.14	QP
8.637	25.30	9.88	0.08	35.26	50.00	-14.74	Average

Result Level= Reading Level + LISN Factor + Cable Loss

4.6 Frequency Stability Measurement

4.6.1 Limit of Frequency Stability

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

4.6.2 Test Procedures

1. To ensure emission at the band edge is maintained within the authorized band, those values shall be measured by radiation emissions at upper and lower frequency points, and finally compensated by frequency deviation as procedures below.
2. The EUT was operated at the maximum output power, and connected to the spectrum analyzer, which is set to maximum hold function and peak detector. The peak value of the power envelope was measured and noted. The upper and lower frequency points were respectively measured relatively 10dB lower than the measured peak value.
3. The frequency deviation was calculated by adding the upper frequency point and the lower frequency point divided by two. Those detailed values of frequency deviation are provided in table below.

4.6.3 Test Result of Frequency Stability

Refer to Appendix D of this test report.

4.7 Automatically Discontinue Transmission

4.7.1 Limit of Automatically Discontinue Transmission

The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signaling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization to describe how this requirement is met.

4.7.2 Test Result of Automatically Discontinue Transmission

While the EUT is not transmitting any information, the EUT can automatically discontinue transmission and become standby mode for power saving. The EUT can detect the controlling signal of ACK message transmitting from remote device and verify whether it shall resend or discontinue transmission.

4.8 Antenna Requirements

4.8.1 Standard Applicable

If transmitting antenna directional gain is greater than 6 dBi, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

4.8.2 Antenna Connected Construction

An FPC antenna design is used.

4.8.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

5 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	Keysight	N9010A	MY56070788	2020-01-15	2021-01-14	Conducted
Power Sensor	Keysight	U2021XA	MY56510025	2020-01-16	2021-01-15	Conducted
Power Sensor	Keysight	U2021XA	MY57030005	2020-01-16	2021-01-15	Conducted
Power Sensor	Keysight	U2021XA	MY56510018	2020-01-16	2021-01-15	Conducted
Power Sensor	Keysight	U2021XA	MY56480002	2020-01-16	2021-01-15	Conducted
Thermal Chamber	Howkin	UHL-34	19111801	2020-05-09	2021-05-08	Conducted
Base Station	R&S	CMW 270	101231	2020-01-16	2021-01-15	Conducted
Signal Generator (Interferer)	Keysight	N5182B	MY56200384	2020-02-21	2021-02-20	Conducted
Signal Generator (Blocker)	Keysight	N5171B	MY56200661	2020-01-15	2021-01-14	Conducted

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV 40	101433	2020-01-16	2021-01-15	Radiation
Amplifier	Sonoma	310	363917	2020-01-15	2021-01-14	Radiation
Amplifier	Schwarzbeck	BBV 9718	327	2020-01-15	2021-01-14	Radiation
Amplifier	Narda	TTA1840-35-HG	2034380	2020-05-15	2021-05-14	Radiation
Loop Antenna	Schwarzbeck	FMZB 1519B	1519B-051	2020-02-14	2023-02-13	Radiation
Broadband Antenna	Schwarzbeck	VULB 9168	9168-757	2018-08-31	2021-08-30	Radiation
Horn Antenna	Schwarzbeck	BBHA 9120 D	1677	2020-02-14	2023-02-13	Radiation
Horn Antenna	COM-POWER	AH-1840	101117	2018-06-20	2021-06-19	Radiation
Test Software	Audix	E3	6.111221a	N/A	N/A	Radiation
Filter	Micro-Tronics	BRM 50702	G266	N/A	N/A	Radiation

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
LISN	R&S	ENV216	102125	2020-01-08	2021-01-07	Conducted
LISN	R&S	ENV432	101327	2020-01-08	2021-01-07	Conducted
EMI Test Receiver	R&S	ESR3	102143	2020-01-16	2021-01-15	Conducted
EMI Test Software	Audix	E3	N/A	N/A	N/A	Conducted

N/A: No Calibration Required

6 Uncertainty of Evaluation

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

MEASUREMENT	FREQUENCY	UNCERTAINTY
Conducted emissions	9kHz~30MHz	2.42dB
Radiated emissions	30MHz ~ 1GMHz	2.50dB
	1GHz ~ 18GHz	3.51dB
	18GHz ~ 40GHz	3.96dB

MEASUREMENT	UNCERTAINTY
Occupied Channel Bandwidth	±196.4Hz
RF output power, conducted	±2.31dB
Power density, conducted	±2.31dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

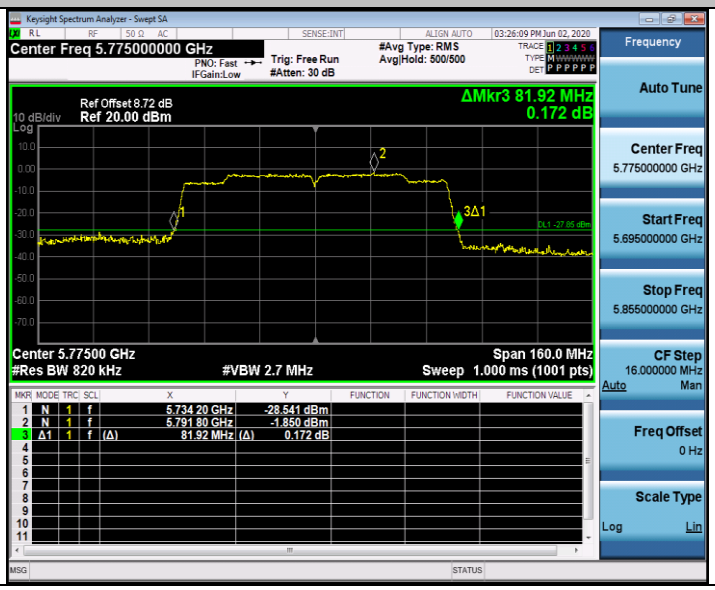
Appendix A1: Emission Bandwidth

Test Result

TestMode	Antenna	Channel	26db EBW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11AC80SISO	Ant1	5775	81.920	5734.200	5816.120	---	PASS

Test Graphs

11AC80SISO_Ant1_5775



Appendix A2: Occupied channel bandwidth

Test Result

TestMode	Antenna	Channel	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11AC80SISO	Ant1	5775	75.397	5737.361	5812.758	---	PASS

Test Graphs

11AC80SISO_Ant1_5775

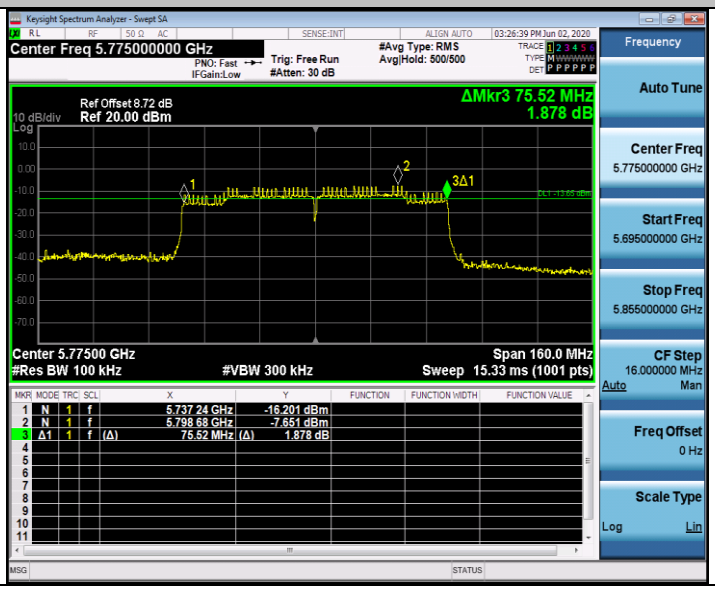
Appendix A3: Min emission bandwidth

Test Result

TestMode	Antenna	Channel	6db EBW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11AC80SISO	Ant1	5775	75.520	5737.240	5812.760	---	PASS

Test Graphs

11AC80SISO_Ant1_5775



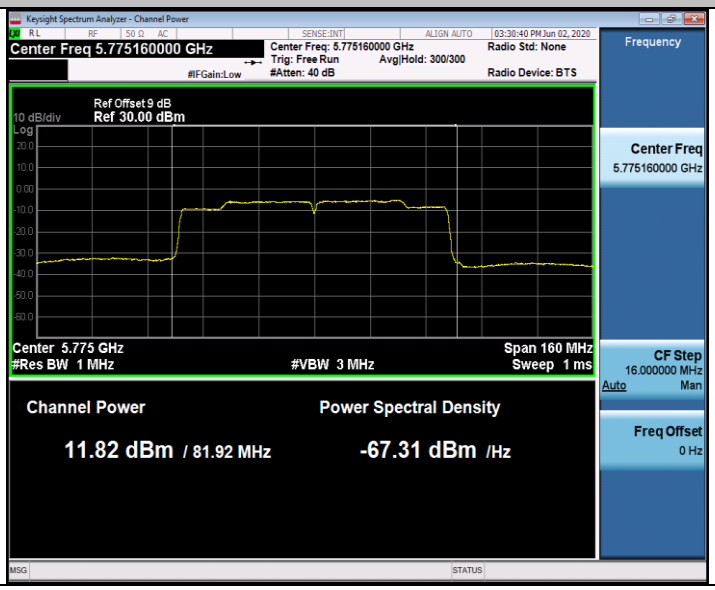
Appendix B: Maximum conducted output power

Test Result

TestMode	Antenna	Frequency	DT (%)	10 log (1/x)	Result[dBm]	Limit[dBm]	Verdict
11AC80SISO	Ant1	5775	93.7	0.28	11.82	<=30	PASS

Test Graphs

11AC80SISO_Ant1_5775



Note：The Duty Cycle Factor is compensated in the graph.

Appendix C: Maximum power spectral density

Test Result

TestMode	Antenna	Channel	DT (%)	10 log (1/x)	Result [dBm/MHz]	Limit[dBm/MHz]	Verdict
11AC80SISO	Ant1	5775	93.7	0.28	-1.92	<=30	PASS

Note：1.The Result and Limit Unit is dBm/500 kHz in the band 5.725–5.85 GHz.

2.The Duty Cycle Factor and RBW Factor is compensated in the graph.

Test Graphs

11AC80SISO_Ant1_5775

Appendix D: Frequency Stability

Test Result

Voltage								
TestMode	Antenna	Channel	Voltage [Vdc]	Temperature (℃)	Deviation (Hz)	Deviation (ppm)	Limit (ppm)	Verdict
11AC80 SISO	Ant1	5775	NV	NT	-50000	-8.658009	20	PASS
			LV	NT	-47000	-8.138528	20	PASS
			HV	NT	-47000	-8.138528	20	PASS

Temperature								
TestMode	Antenna	Channel	Voltage [Vdc]	Temperature (℃)	Deviation (Hz)	Deviation (ppm)	Limit (ppm)	Verdict
11AC80 SISO	Ant1	5775	NV	-30	-46000	-7.965368	20	PASS
			NV	-20	-46000	-7.965368	20	PASS
			NV	-10	-46000	-7.965368	20	PASS
			NV	0	-45000	-7.792208	20	PASS
			NV	10	-45000	-7.792208	20	PASS
			NV	20	-45000	-7.792208	20	PASS
			NV	30	-45000	-7.792208	20	PASS
			NV	40	-45000	-7.792208	20	PASS
			NV	50	-45000	-7.792208	20	PASS