

RF MEASUREMENT REPORT

FCC ID: HDC17600031F1

Applicant: Adtran Inc.

Application Type: Certification

Product: WiFi 5 Mesh AP

Model No.: 831-t5

FCC Classification: Unlicensed National Information Infrastructure (NII)

FCC Rule Part(s): Part 15 Subpart E (Section 15.407)

Test Date: August 19 ~ November 04, 2021

Reviewed By:

Vincent Yu

Approved By:

Robin Wu



The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in KDB 789033 D02v02r01. Test results reported herein relate only to the item(s) tested.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Suzhou) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date	Note
2108RSU047-U2	Rev. 01	Initial Report	11-20-2021	Valid

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1. General Information

1.1. Applicant

Adtran Inc.

901 Explorer Blvd NW Huntsville, AL 35806, USA

1.2. Manufacturer

Adtran Inc.

901 Explorer Blvd NW Huntsville, AL 35806, USA

1.3. Testing Facility

☒	Test Site – MRT Suzhou Laboratory
	Laboratory Location (Suzhou - Wuzhong) D8 Building, No.2 Tian’edang Rd., Wuzhong Economic Development Zone, Suzhou, China
	Laboratory Location (Suzhou - SIP) 4b Building, Liando U Valley, No.200 Xingpu Rd., Shengpu Town, Suzhou Industrial Park, China
	Laboratory Accreditations
	A2LA: 3628.01 CNAS: L10551 FCC: CN1166 ISED: CN0001
	VCCI: ☐ R-20025 ☐ G-20034 ☐ C-20020 ☐ T-20020 ☐ R-20141 ☐ G-20134 ☐ C-20103 ☐ T-20104
☒	Test Site – MRT Shenzhen Laboratory
	Laboratory Location (Shenzhen) 1G, Building A, Junxiangda Building, Zhongshanyuan Road West, Nanshan District, Shenzhen, China
	Laboratory Accreditations
	A2LA: 3628.02 CNAS: L10551 FCC: CN1284 ISED: CN0105
☐	Test Site – MRT Taiwan Laboratory
	Laboratory Location (Taiwan) No. 38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)
	Laboratory Accreditations
	TAF: L3261-190725 FCC: 291082, TW3261 ISED: TW3261

1.4. Product Information

Product Name	WiFi 5 Mesh AP
Model No.	831-t5
Serial No.	831t5A0719000001
Wi-Fi Specification	802.11a/b/g/n/ac, VHT
Antenna Information	Refer to section 1.7
Power Supply	AC/DC Adapter
Accessories	
Adapter	MODEL: S36B52-120A300-C4-6 INPUT: 100-240V~50/60Hz 1.0A OUTPUT: 12.0V DC, 3A, 36.0W
Remark: The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.	

1.5. Radio Specification

Frequency Range	For 802.11a/n-HT20/ac-VHT20: 5180 ~ 5240MHz, 5745 ~ 5825MHz For 802.11n-HT40/ac-VHT40: 5190 ~ 5230MHz, 5755 ~ 5795MHz For 802.11ac-VHT80: 5210MH, 5775MHz
Modulation	802.11a/n/ac: OFDM
Data Rate	802.11a: 6/9/12/18/24/36/48/54Mbps 802.11n: up to 600Mbps 802.11ac: up to 1733.2Mbps

Note: For other features of this EUT, test report will be issued separately.

1.6. Working Frequencies

802.11a/n-HT20/ac-VHT20

Channel	Frequency	Channel	Frequency	Channel	Frequency
36	5180 MHz	40	5200 MHz	44	5220 MHz
48	5240 MHz	149	5745 MHz	153	5765 MHz
157	5785 MHz	161	5805 MHz	165	5825 MHz

802.11n-HT40/ac-VHT40

Channel	Frequency	Channel	Frequency	Channel	Frequency
38	5190 MHz	46	5230 MHz	151	5755 MHz
159	5795 MHz	--	--	--	--

802.11ac-VHT80

Channel	Frequency	Channel	Frequency	Channel	Frequency
42	5210 MHz	155	5775 MHz	--	--

1.7. Antenna Details

Antenna Type	Frequency Band	Tx Paths	Max. Antenna Gain (dBi)	Beamforming Directional Gain (dBi)	CDD Directional Gain (dBi)	
					For Power	For PSD
PCB Antenna	2.4GHz Band	2	3.5	6.51	3.5	6.51
	5GHz Low Band	2	4.9	7.91	4.9	7.91
	5GHz High Band	4	5.5	11.52	5.5	11.52

Remark:

- The EUT supports Cyclic Delay Diversity (CDD) mode, and CDD signals are correlated.
If all antennas have the same gain, G_{ANT} , Directional gain = $G_{ANT} + \text{Array Gain}$, where Array Gain is as follows.
 - For power spectral density (PSD) measurements on all devices,
Array Gain = $10 \log (N_{ANT} / N_{SS})$ dB;
 - For power measurements on IEEE 802.11 devices,
Array Gain = 0 dB for $N_{ANT} \leq 4$;
- The EUT also supports Beam Forming mode, and the Beam Forming support 802.11n/ac and VHT, not include 802.11a/b/g. The conducted output power in the beamforming mode will be reduced below the conducted output power in the CDD mode by the amount in dB that the beamforming gain exceeds the maximum antenna gain.

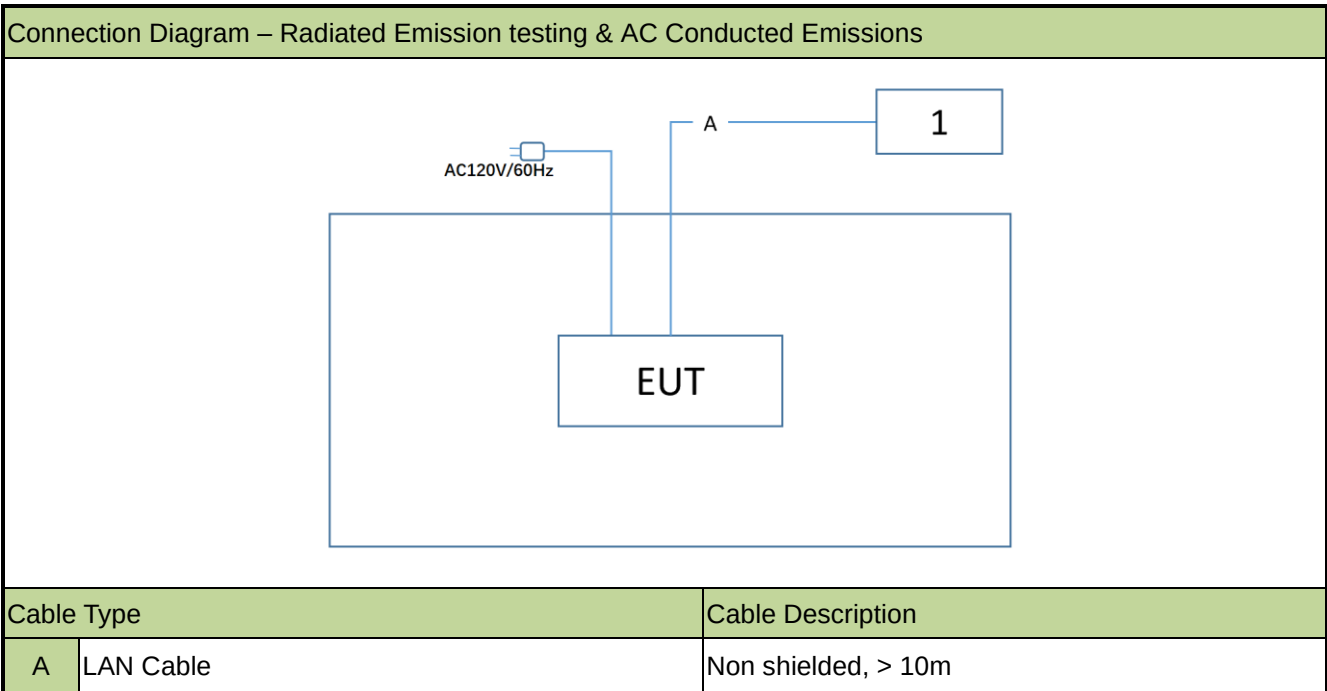
2. Test Configuration

2.1. Test Mode

Test Mode	Mode 1: Transmit by 802.11a (CDD Mode)
	Mode 2: Transmit by 802.11n-HT20 (CDD Mode)
	Mode 3: Transmit by 802.11n-HT40 (CDD Mode)
	Mode 4: Transmit by 802.11ac-VHT20 (CDD Mode)
	Mode 5: Transmit by 802.11ac-VHT40 (CDD Mode)
	Mode 6: Transmit by 802.11ac-VHT80 (CDD Mode)

2.2. Test System Connection Diagram

The device was tested per the guidance ANSI C63.10: 2013 was used to reference the appropriate EUT setup for radiated emissions testing and AC line conducted testing.



2.3. Test System Details

Product	Manufacturer	Model No.
1	Notebook	HP
		735G5

2.4. Test Software

The test utility software used during testing was “MT7615 QA”, and the version was v0.0.1.90.

Power parameter value refers to Operation Description.

2.5. Applied Standards

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

- FCC Part 15.407
- KDB 789033 D02v02r01
- KDB 662911 D01v02r01
- ANSI C63.10-2013

2.6. Duty Cycle

The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz. The RBW and VBW were both greater than $50/T$, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Test Mode	Duty Cycle
Low Band (5180MHz ~ 5240MHz)	
802.11a	95.45%
802.11n-HT20	92.22%
802.11n-HT40	85.86%
802.11ac-VHT20	91.13%
802.11ac-VHT40	85.63%
802.11ac-VHT80	76.59%
High Band (5745MHz ~ 5825MHz)	
802.11a	95.31%
802.11n-HT20	85.61%
802.11n-HT40	78.42%
802.11ac-VHT20	86.38%
802.11ac-VHT40	78.48%
802.11ac-VHT80	68.72%

2.7. Test Environment Condition

Ambient Temperature	15°C ~ 35°C
Relative Humidity	20%RH ~ 75%RH

3. Antenna Requirements

Excerpt from §15.203 of the FCC Rules/Regulations:

“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.”

- The antenna of the device is **permanently attached**.
- There are no provisions for connection to an external antenna.

Conclusion:

The unit complies with the requirement of §15.203.

4. Measuring Instrument

No.	Instrument	Manufacturer	Model No.	Asset No.	Cali. Interval	Cali. Due Date	Test Site
1	Horn Antenna	Schwarzbeck	BBHA 9170	MRTSUE06292	1 year	2021/10/24	NS-AC1
					1 year	2022/10/20	
2	Anechoic Chamber	BOOMWAVE	NS-AC1	MRTSUE06496	1 year	2022/7/24	NS-AC1
3	Horn Antenna	Schwarzbeck	BBHA 9120D	MRTSUE06572	1 year	2022/3/14	NS-AC1
4	TRILOG Antenna	Schwarzbeck	VULB 9162	MRTSUE06573	1 year	2022/6/29	NS-AC1
5	Preamplifier	Schwarzbeck	BBV 9718	MRTSUE06574	1 year	2022/7/12	NS-AC1
6	EMI Test Receiver	R&S	ESR3	MRTSUE06575	1 year	2022/6/27	NS-AC1
7	USB Power Sensor	Keysight	U2021XA	MRTSUE06581	1 year	2022/8/15	NS-TR2
8	Thermohygrometer	DELI	NO.8813	MRTSUE06588	1 year	2022/6/30	NS-AC1
9	Preamplifier	EMCI	EMC184045SE	MRTSUE06641	1 year	2022/1/14	NS-AC1
10	Thermohygrometer	DELI	NO.8813	MRTSUE06783	1 year	2022/5/9	NS-TR2
11	Temperature Chamber	OUKE	OK-TH-100C	MRTSUE06899	1 year	2021/11/27	NS-TR2
12	Signal Analyzer	Keysight	N9020A	MRTSUE10065	1 year	2022/6/17	NS-AC1/NS-TR2
13	Signal Analyzer	Agilent	N9010A	MRTSUE06195	1 year	2022/3/17	NS-AC1/NS-TR2
14	EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2022/1/4	WZ-AC1
15	Horn Antenna	Schwarzbeck	BBHA 9120D	MRTSUE06023	1 year	2021/09/27	WZ-AC1
					1 year	2022/9/16	
16	Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2021/11/8	WZ-AC1
17	Preamplifier	Agilent	83017A	MRTSUE06076	1 year	2021/11/14	WZ-AC1
18	TRILOG Antenna	Schwarzbeck	VULB 9168	MRTSUE06172	1 year	2022/8/5	WZ-AC1
19	Thermohygrometer	Yuhua	HTC-2	MRTSUE06184	1 year	2022/8/10	WZ-AC1
20	Anechoic Chamber	TDK	WZ-AC1	MRTSUE06212	1 year	2022/4/29	WZ-AC1
21	Horn Antenna	ETS	3117	MRTSUE06257	1 year	2021/9/27	WZ-AC1
					1 year	2022/9/25	
22	Thermohygrometer	testo	608-H1	MRTSUE06403	1 year	2022/6/28	WZ-AC1
23	Horn Antenna	Schwarzbeck	BBHA 9170	MRTSUE06597	1 year	2021/12/14	WZ-AC1
24	Signal Analyzer	Keysight	N9010B	MRTSUE06607	1 year	2022/1/6	WZ-AC1
25	Preamplifier	EMCI	EMC184045SE	MRTSUE06640	1 year	2022/1/14	WZ-AC1
26	Preamplifier	EMCI	EMC051845SE	MRTSUE06987	1 year	2021/9/10	WZ-AC1
					1 year	2022/9/9	
27	Attenuator	SHX	TS2-4dB-6G	MRTSUE06812	2022/6/30	2022/6/29	NS-TR2
28	Directional Coupler	narda	4226-10	MRTSUE06253	2021/3/16	2022/3/15	NS-TR2

Note: The test site with "WZ" code is in the MRT Suzhou laboratory, the test site with "NS" code is in the MRT Shenzhen Laboratory.

Software	Version	Function
EMI Software	V3	EMI Test Software

5. Measurement Uncertainty

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

AC Conducted Emission Measurement
Measurement Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 9kHz~150kHz: 3.74dB 150kHz~30MHz: 3.44dB
Radiated Emission Measurement
Measurement Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): Horizontal: 30MHz~300MHz: 5.04dB 300MHz~1GHz: 4.95dB 1GHz~40GHz: 6.40dB Vertical: 30MHz~300MHz: 5.24dB 300MHz~1GHz: 6.03dB 1GHz~40GHz: 6.40dB
Spurious Emissions, Conducted
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 0.78dB
Output Power
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 1.13dB
Power Spectrum Density
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 1.15dB
Occupied Bandwidth
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 0.28%

6. Test Result

6.1. Summary

FCC Section(s)	Test Description	Test Condition	Verdict
15.407(a)	26dB Bandwidth	Conducted	Pass
15.407(e)	6dB Bandwidth		Pass
15.407(a)(1)(ii), (3)	Maximum Conducted Output Power		Pass
15.407(h)(1)	Transmit Power Control		N/A
15.407(a)(1)(ii), (3), (12)	Power Spectral Density		Pass
15.407(b)(1), (4)(i)	Undesirable Emissions		Pass
15.205, 15.209 15.407(b)(7), (8), (9)	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Radiated	Pass
15.207	AC Conducted Emissions 150kHz - 30MHz	Line Conducted	Pass

Remark:

- The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
- Output power test was verified over all data rates of each mode (data refers to operational description), and then choose the maximum power output (low data rate) for final test of each channel.
- For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst-case emissions.
- "N/A" means that the test item is not applicable, and the detailed information refers to relevant section.

6.2. 26dB Bandwidth

6.2.1. Test Limit

N/A

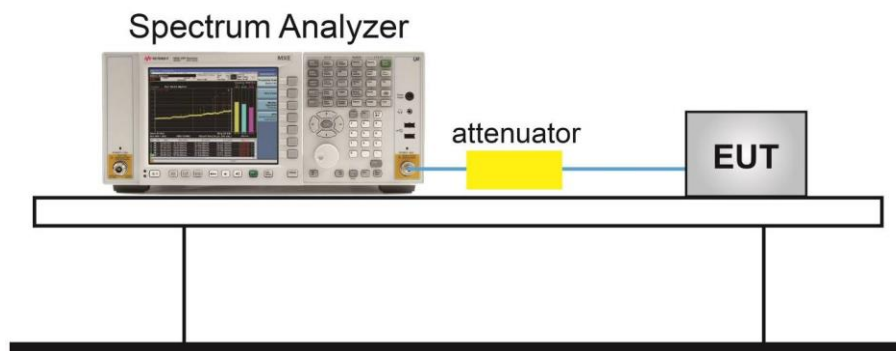
6.2.2. Test Procedure used

KDB 789033 D02v02r01- Section C.1

6.2.3. Test Setting

1. The analyzers' automatic bandwidth measurement capability was used to perform the 26dB bandwidth measurement. The "X" dB bandwidth parameter was set to $X = 26$. The automatic bandwidth measurement function also has the capability of simultaneously measuring the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediated power nulls in the fundamental emission.
2. RBW = approximately 1% of the emission bandwidth.
3. $VBW \geq 3 \times RBW$.
4. Detector = Peak.
5. Trace mode = max hold.

6.2.4. Test Setup



6.2.5. Test Result

Refer to Appendix A.1.

6.3. 6dB Bandwidth

6.3.1. Test Limit

The minimum 6dB bandwidth shall be at least 500 kHz.

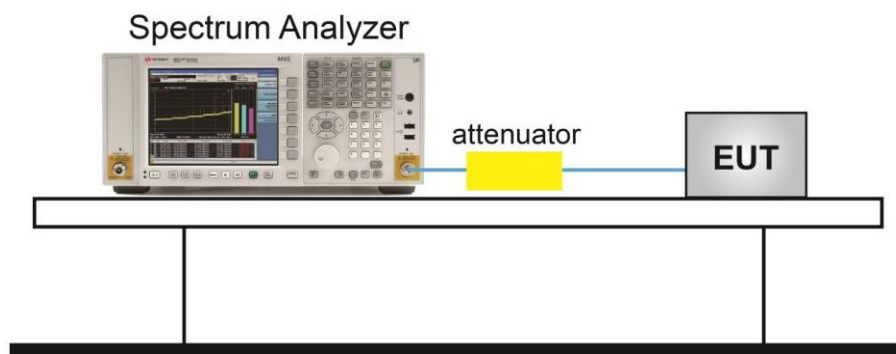
6.3.2. Test Procedure used

KDB 789033 D02v02r01- Section C.2

6.3.3. Test Setting

1. Set center frequency to the nominal EUT channel center frequency.
2. RBW = 100 kHz.
3. VBW $3 \times$ RBW.
4. Detector = Peak.
5. Trace mode = max hold.
6. Sweep = auto couple.
7. Allow the trace to stabilize.
8. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

6.3.4. Test Setup



6.3.5. Test Result

Refer to Appendix A.2.

6.4. Output Power

6.4.1. Test Limit

For the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi.

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W (30dBm).

If transmitting antennas of directional gain greater than 6dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

6.4.2. Test Procedure Used

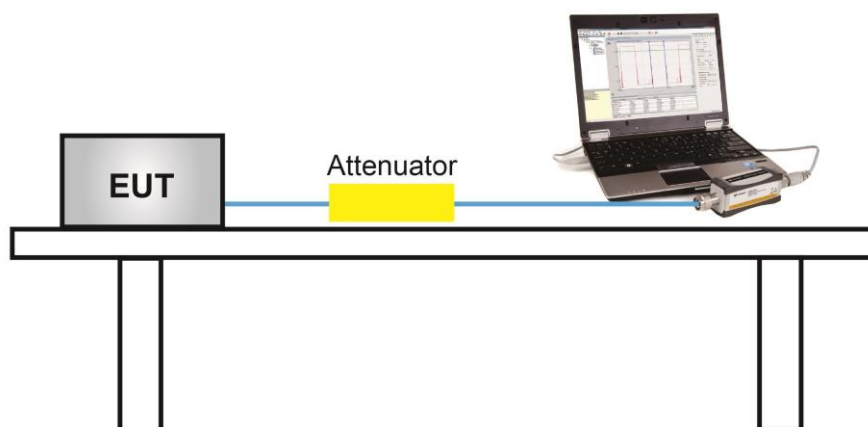
KDB 789033D02v02r01- Section E)3)b) Method PM-G

6.4.3. Test Setting

Average Power Measurement

Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter.

6.4.4. Test Setup



6.4.5. Test Result

Refer to Appendix A.3.

6.5. Transmit Power Control

6.5.1. Test Limit

The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30 dBm.

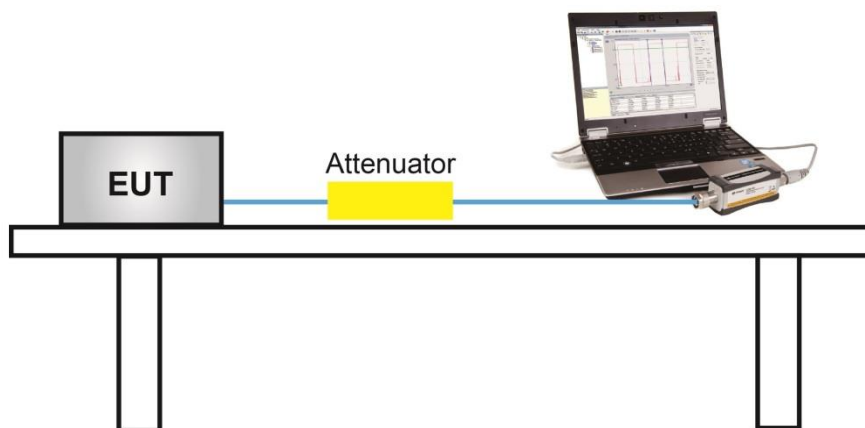
6.5.2. Test Procedure Used

KDB 789033 D02v01- Section E)3)b) Method PM-G

6.5.3. Test Setting

Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter. The trace was averaged over 100 traces to obtain the final measured average power.

6.5.4. Test Setup



6.5.5. Test Result

Refer to Appendix A.4.

6.6. Power Spectral Density

6.6.1. Test Limit

For the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band.

For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.

If transmitting antennas of directional gain greater than 6dBi are used, the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

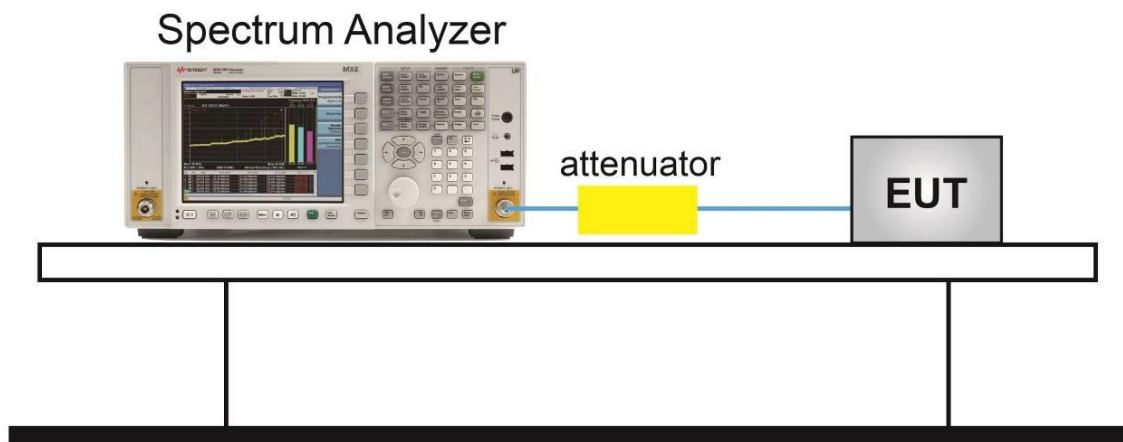
6.6.2. Test Procedure Used

KDB 789033 D02v02r01-SectionF

6.6.3. Test Setting

1. Analyzer was set to the center frequency of the UNII channel under investigation
2. Span was set to encompass the entire 26dB EBW of the signal.
3. RBW = 1MHz, if measurement bandwidth of Maximum PSD is specified in 500 kHz,
4. RBW = 510 kHz
5. VBW = 3MHz
6. Number of sweep points $\geq 2 \times (\text{span} / \text{RBW})$
7. Detector = power averaging (Average)
8. Sweep time = auto
9. Trigger = free run
10. Use the peak search function on the instrument to find the peak of the spectrum and record its value.
11. Add $10 \cdot \log(1/x)$, where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission). For example, add $10 \cdot \log(1/0.25) = 6$ dB if the duty cycle is 25 percent.

6.6.4. Test Setup



6.6.5. Test Result

Refer to Appendix A.5.

6.7. Radiated Spurious Emission

6.7.1. Test Limit

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table per Section 15.209.

FCC Part 15 Subpart C Paragraph 15.209		
Frequency [MHz]	Field Strength [uV/m]	Measured Distance [Meters]
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

6.7.2. Test Procedure Used

KDB 789033 D02v02r01- Section G

6.7.3. Test Setting

Table 1 - RBW as a function of frequency

Frequency	RBW
9 ~ 150 kHz	200 ~ 300 Hz
0.15 ~ 30 MHz	9 ~ 10 kHz
30 ~ 1000 MHz	100 ~ 120 kHz
> 1000MHz	1MHz

Quasi-Peak Measurements below 1GHz

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. Span was set greater than 1MHz
3. RBW = as specified in Table 1
4. Detector = CISPR quasi-peak
5. Sweep time = auto couple
6. Trace was allowed to stabilize

Peak Measurements above 1GHz

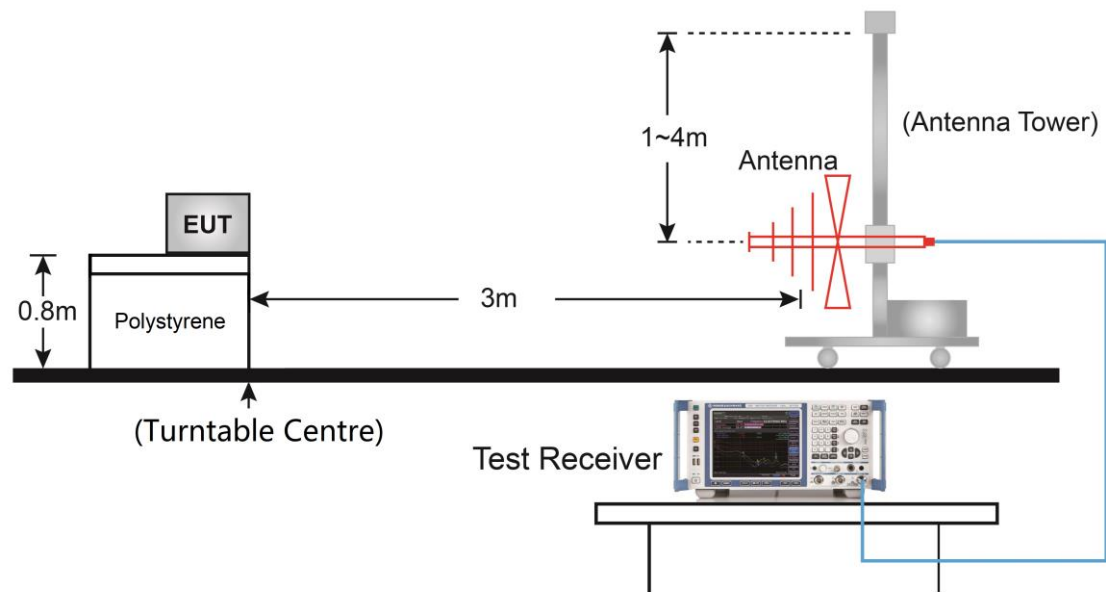
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Average Measurements above 1GHz (Method VB)

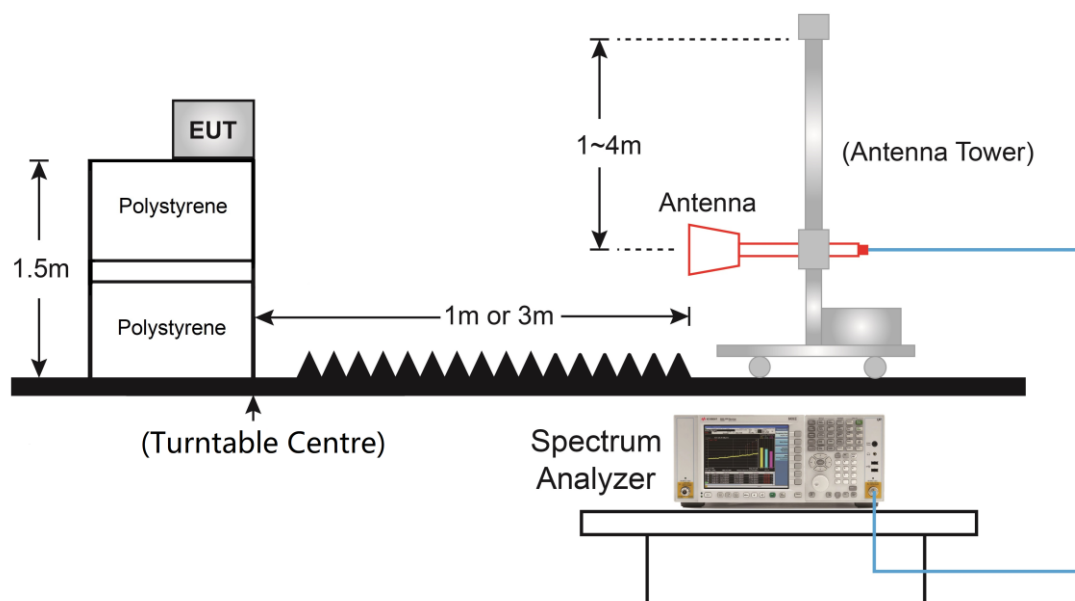
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW; If the EUT is configured to transmit with duty cycle $\geq 98\%$, set VBW = 10 Hz.
If the EUT duty cycle is $< 98\%$, set VBW $\geq 1/T$. T is the minimum transmission duration.
4. Detector = Peak
5. Sweep time = auto
6. Trace mode = max hold
7. Trace was allowed to stabilize

6.7.4. Test Setup

Below 1GHz Test Setup:



Above 1GHz Test Setup:



6.7.5. Test Result

Refer to Appendix A.6.

6.8. Radiated Restricted Band Edge

6.8.1. Test Limit

For 15.205 requirement:

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a) of FCC part 15, must also comply with the radiated emission limits specified in Section 15.209(a).

Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (GHz)
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 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	(²)
13.36 - 13.41	--	--	--

For 15.407(b) requirement:

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.

For transmitters operating in the 5.725-5.85 GHz band: 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.

Refer to KDB 789033 D02v02r01 G)2)c), as specified in § 15.407(b), emissions above 1000 MHz that are outside of the restricted bands are subject to a maximum emission limit of -27 dBm/MHz (or -17 dBm/MHz as

specified in § 15.407(b)(4)). However, an out-of-band emission that complies with both the peak and average limits of § 15.209 is not required to satisfy the -27 dBm/MHz or -17 dBm/MHz maximum emission limit.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47CFR must not exceed the limits shown in Table per Section 15.209.

FCC Part 15 Subpart C Paragraph 15.209		
Frequency [MHz]	Field Strength [uV/m]	Measured Distance [Meters]
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

6.8.2. Test Procedure Used

KDB 789033 D02v02r01- Section G

6.8.3. Test Setting

Peak Measurements above 1GHz

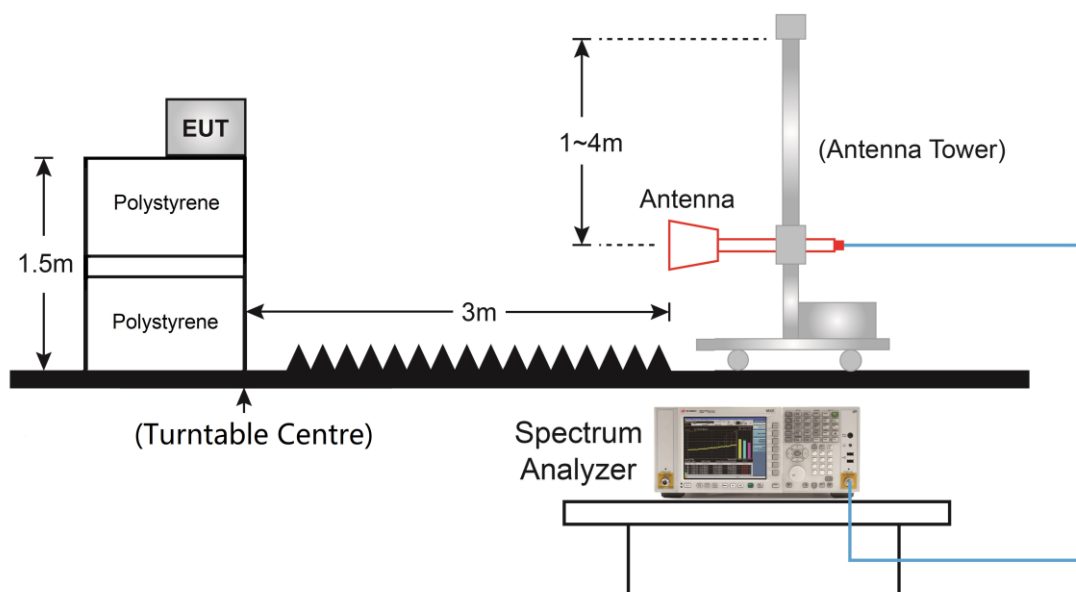
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = Peak
5. Sweep time = Auto couple
6. Trace mode = Max hold
7. Trace was allowed to stabilize

Average Measurements above 1GHz (Method VB)

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW; if the EUT is configured to transmit with duty cycle $\geq 98\%$, set VBW = 10Hz

4. If the EUT duty cycle is $< 98\%$, set $VBW \geq 1/T$. T is the minimum transmission duration
5. Detector = Peak
6. Sweep time = Auto
7. Trace mode = Max hold
8. Trace was allowed to stabilize

6.8.4. Test Setup



6.8.5. Test Result

Refer to Appendix A.7.

6.9. AC Conducted Emissions

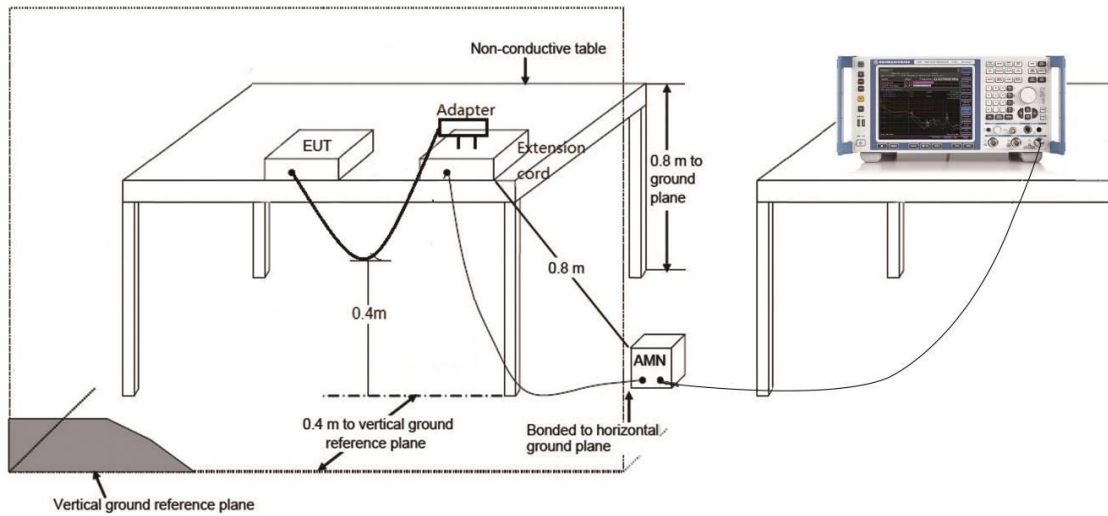
6.9.1. Test Limit

FCC Part 15.207 Limits		
Frequency (MHz)	QP (dBuV)	AV (dBuV)
0.15 - 0.50	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30	60	50

Note 1: The lower limit shall apply at the transition frequencies.

Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

6.9.2. Test Setup



6.9.3. Test Result

Refer to Appendix A.8.

7. Conclusion

The data collected relate only the item(s) tested and show that the device is in compliance with Part 15E of the FCC rules.

Appendix A - Test Result

A.1 26dB & 99% Bandwidth Test Result

Test Site	NS-SR2	Test Engineer	Flay Yang
Test Date	2021/08/29 ~ 2021/11/04		

Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	99% Bandwidth (MHz)	26dB Bandwidth (MHz)
Low Band (5180MHz ~ 5240MHz), Ant 1					
11a	6Mbps	36	5180	16.49	19.55
11a	6Mbps	44	5220	16.51	20.36
11a	6Mbps	48	5240	16.55	21.35
11n-HT20	MCS0	36	5180	17.56	19.89
11n-HT20	MCS0	44	5220	17.55	19.94
11n-HT20	MCS0	48	5240	17.57	20.12
11n-HT40	MCS0	38	5190	36.07	40.58
11n-HT40	MCS0	46	5230	36.41	66.81
11ac-VHT20	MCS0	36	5180	17.56	19.92
11ac-VHT20	MCS0	44	5220	17.57	19.76
11ac-VHT20	MCS0	48	5240	17.56	19.94
11ac-VHT40	MCS0	38	5190	35.95	40.39
11ac-VHT40	MCS0	46	5230	36.66	68.98
11ac-VHT80	MCS0	42	5210	75.05	79.93

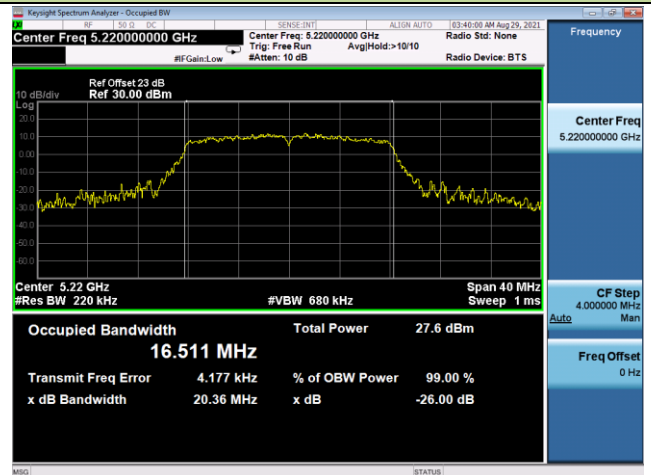
Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	99% Bandwidth (MHz)	26dB Bandwidth (MHz)
High Band (5745MHz ~ 5825MHz), Ant 2					
11a	6Mbps	149	5745	17.13	29.20
11a	6Mbps	157	5785	17.08	28.93
11a	6Mbps	165	5825	16.96	27.86
11n-HT20	MCS24	149	5745	17.82	22.97
11n-HT20	MCS24	157	5785	17.81	21.86
11n-HT20	MCS24	165	5825	17.73	20.33
11n-HT40	MCS24	151	5755	36.32	43.06
11n-HT40	MCS24	159	5795	36.27	41.00
11ac-VHT20	MCS0	149	5745	17.84	25.95
11ac-VHT20	MCS0	157	5785	17.83	26.62
11ac-VHT20	MCS0	165	5825	17.75	20.61
11ac-VHT40	MCS0	151	5755	36.17	40.06
11ac-VHT40	MCS0	159	5795	36.37	47.74
11ac-VHT80	MCS0	155	5775	75.58	80.37

11a 26dB & 99% Bandwidth

Channel 36 (5180MHz)



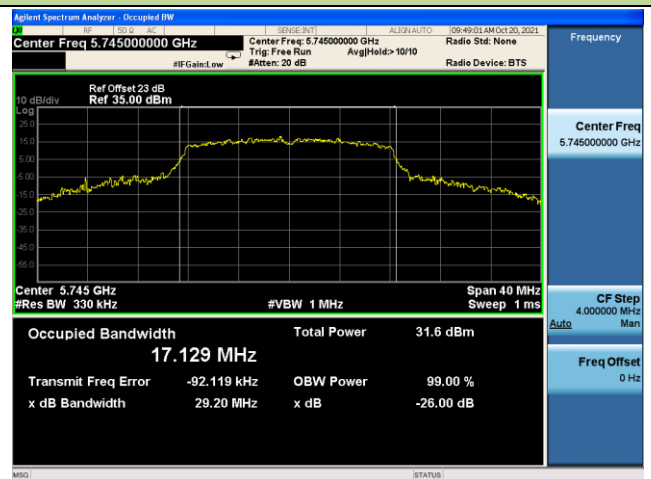
Channel 44 (5220MHz)



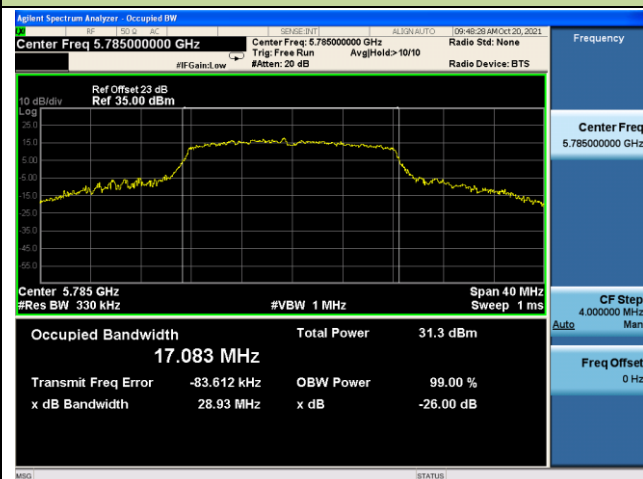
Channel 48 (5240MHz)



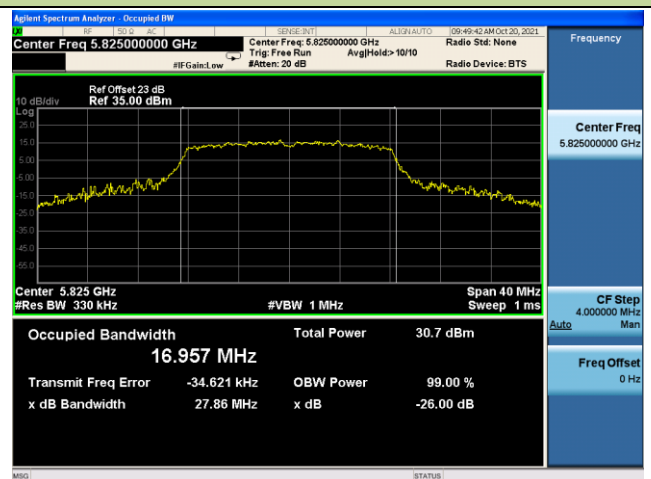
Channel 149 (5745MHz)



Channel 157 (5785MHz)



Channel 165 (5825MHz)

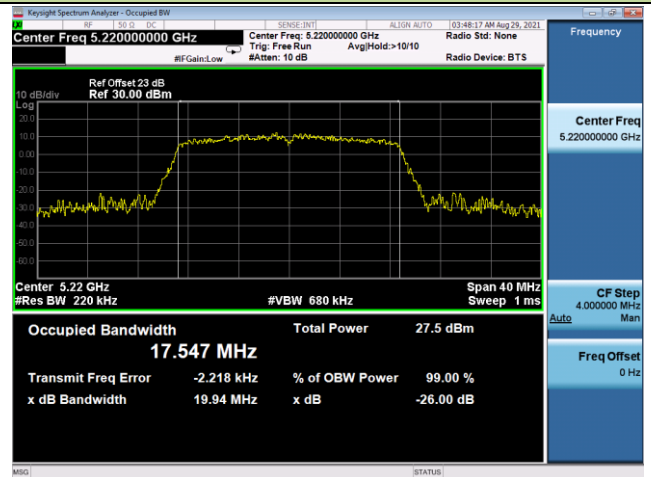


11n-HT20 26dB & 99% Bandwidth

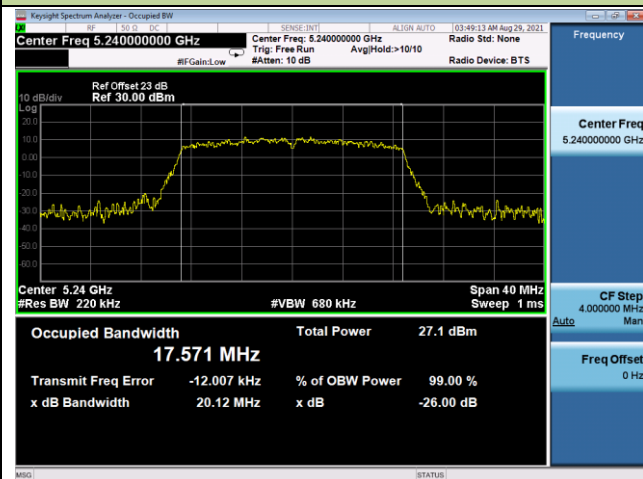
Channel 36 (5180MHz)



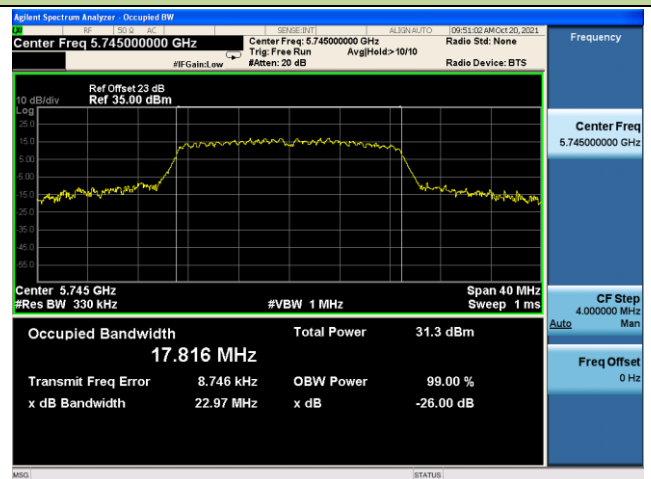
Channel 44 (5220MHz)



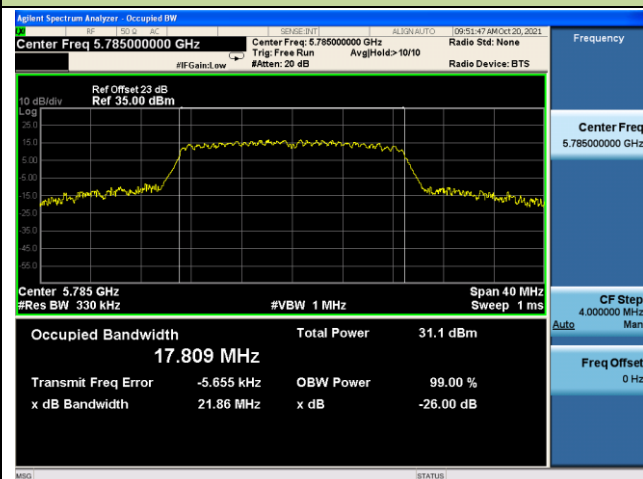
Channel 48 (5240MHz)



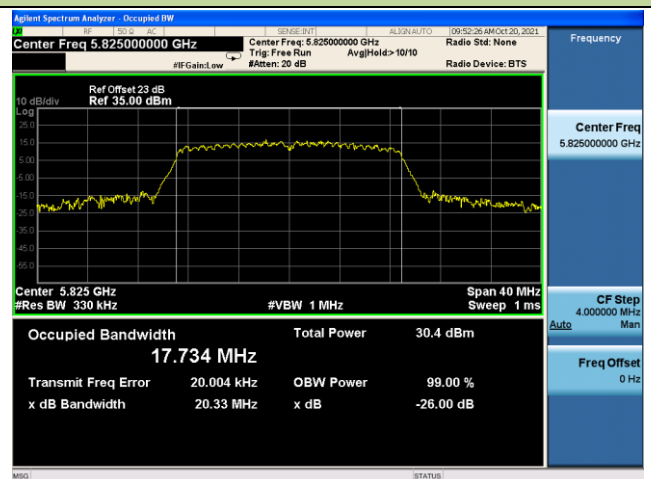
Channel 149 (5745MHz)



Channel 157 (5785MHz)

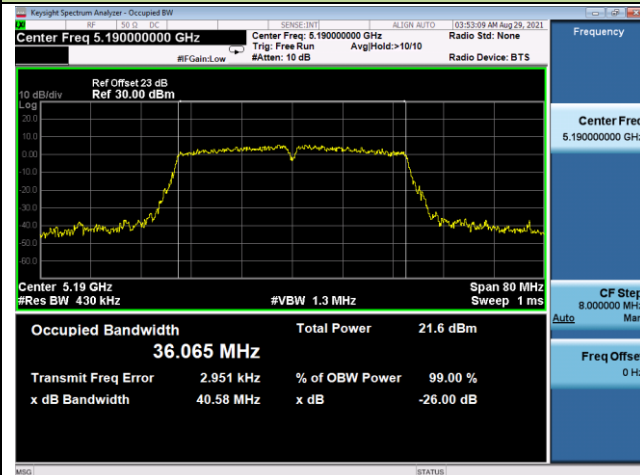


Channel 165 (5825MHz)

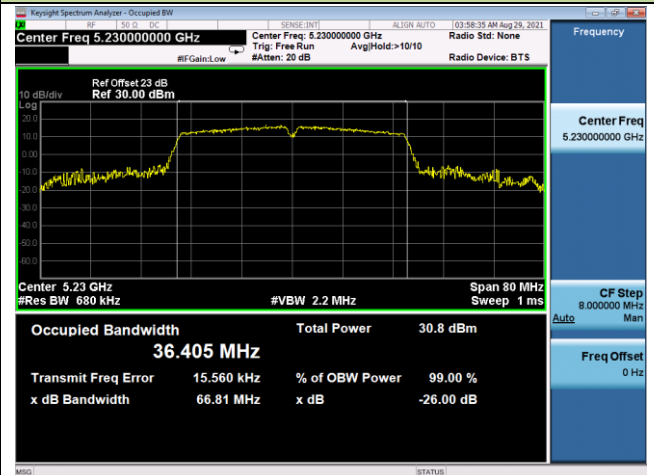


11n-HT40 26dB & 99% Bandwidth

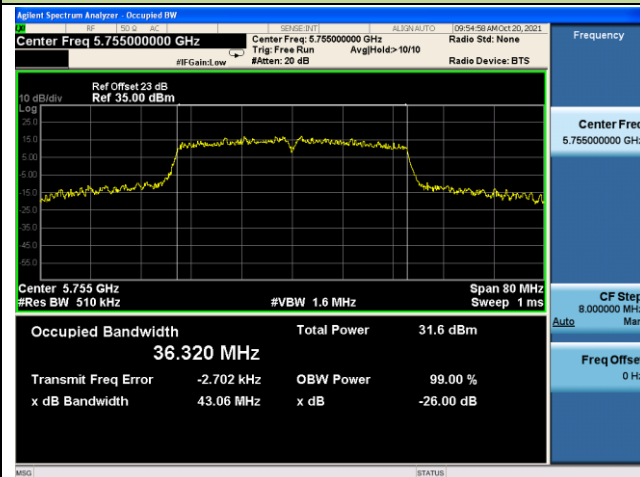
Channel 38 (5190MHz)



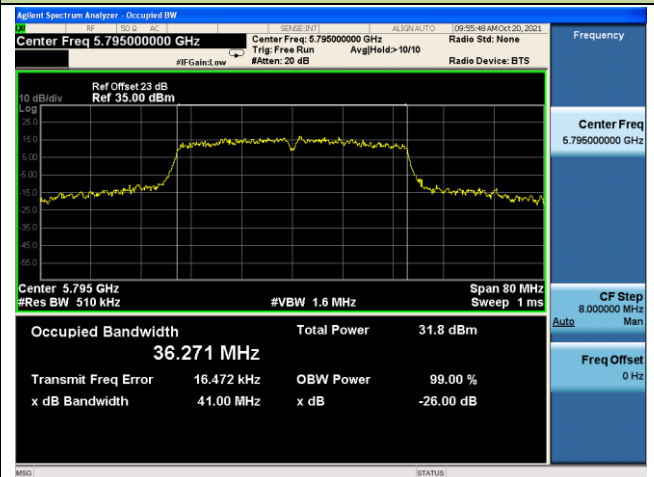
Channel 46 (5230MHz)



Channel 151 (5755MHz)



Channel 159 (5795MHz)

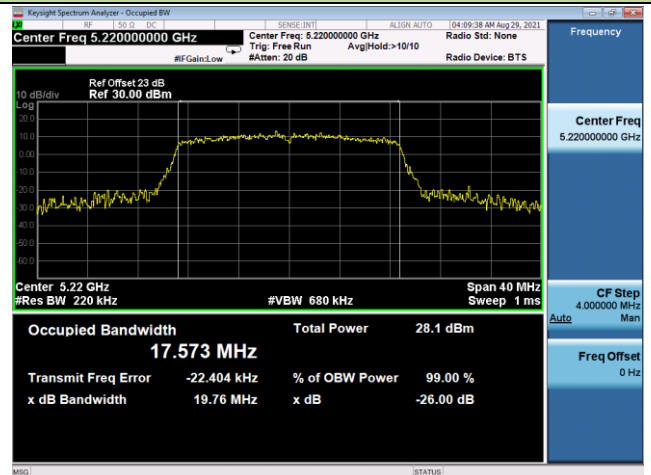


11ac-VHT20 26dB & 99% Bandwidth

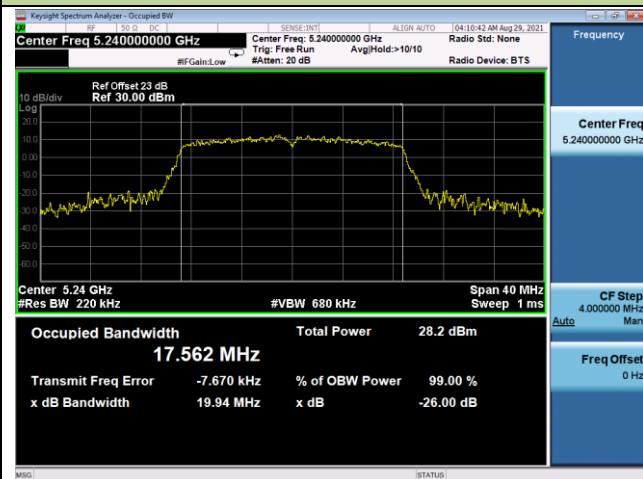
Channel 36 (5180MHz)



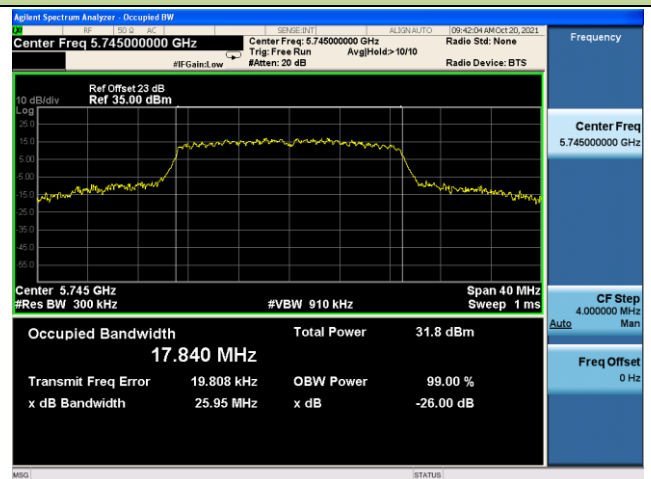
Channel 44 (5220MHz)



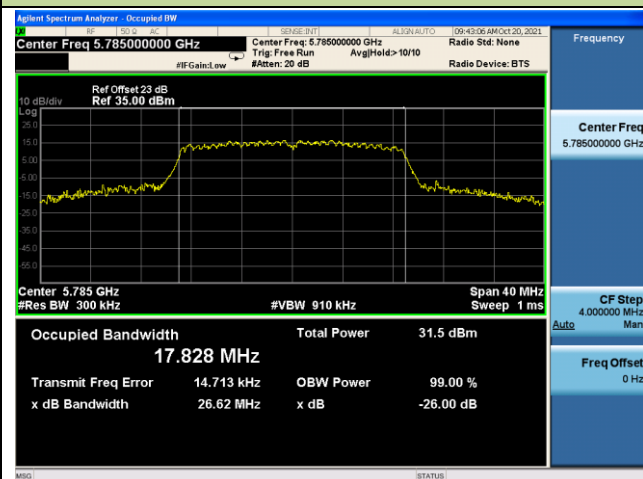
Channel 48 (5240MHz)



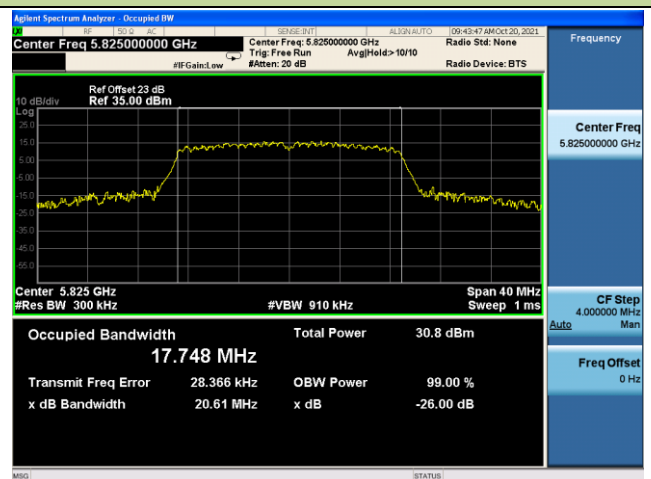
Channel 149 (5745MHz)



Channel 157 (5785MHz)

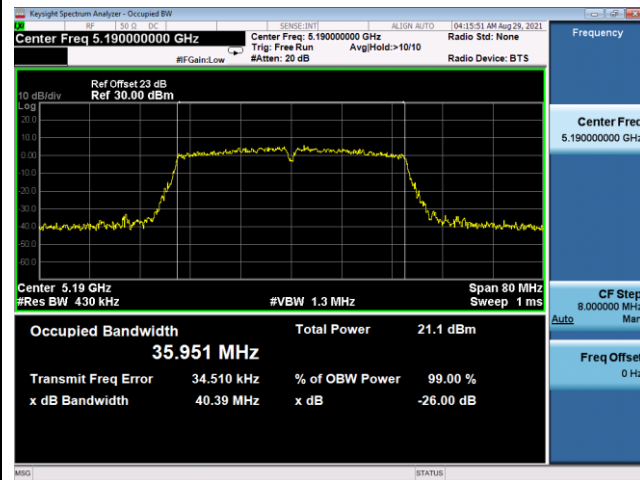


Channel 165 (5825MHz)

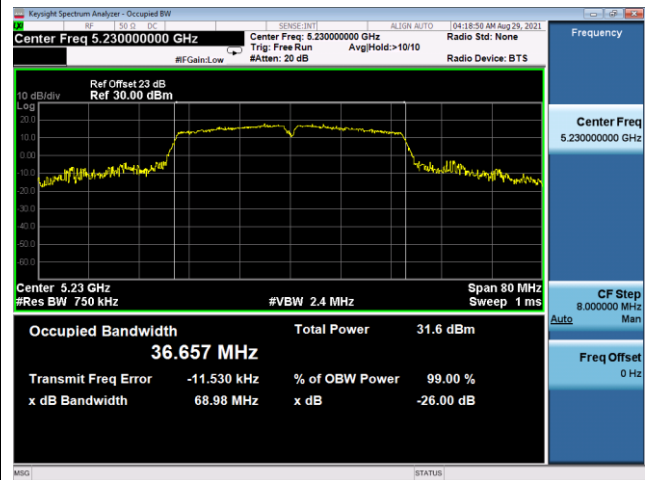


11ac-VHT40 26dB & 99% Bandwidth

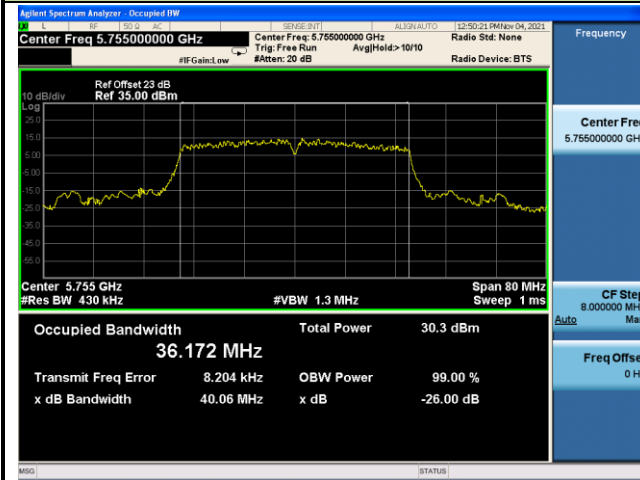
Channel 38 (5190MHz)



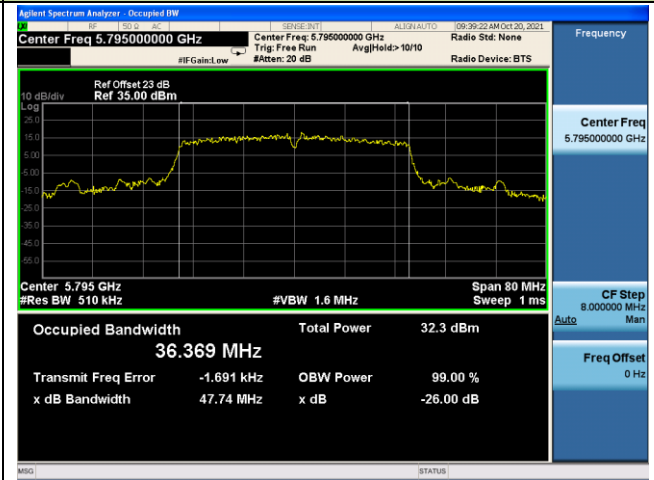
Channel 46 (5230MHz)



Channel 151 (5755MHz)

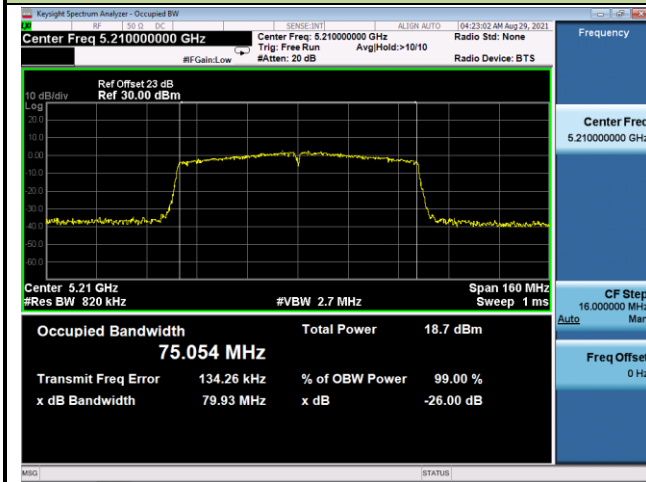


Channel 159 (5795MHz)



11ac-VHT80 26dB & 99% Bandwidth

Channel 42 (5210MHz)



Channel 155 (5775MHz)



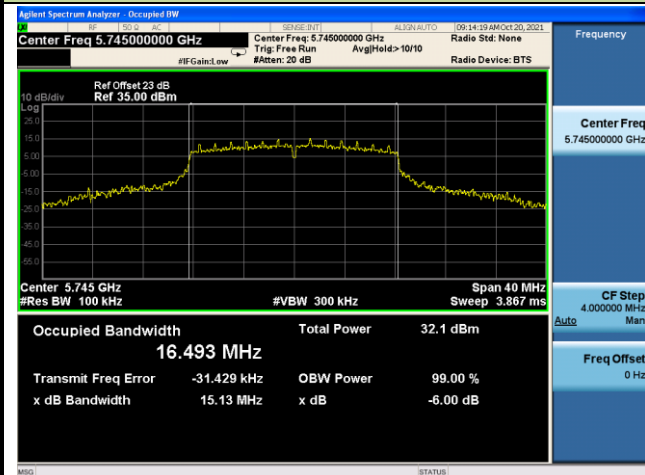
A.2 6dB Bandwidth Test Result

Test Site	NS-SR2	Test Engineer	Flay Yang
Test Date	2021/09/18 ~ 2021/11/04		

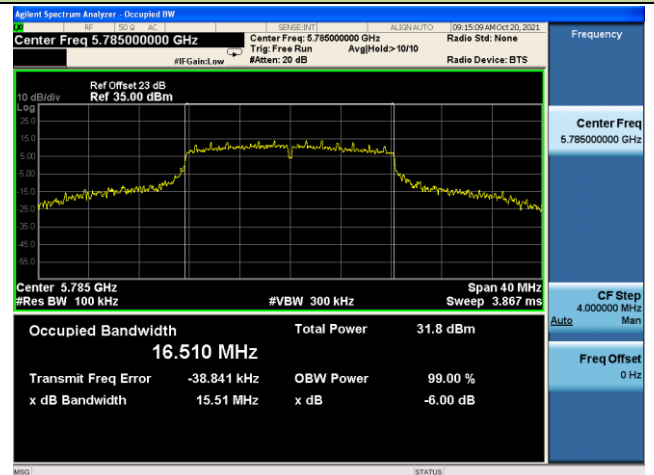
Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
Ant 2						
11a	6Mbps	149	5745	15.13	≥ 0.5	Pass
11a	6Mbps	157	5785	15.51	≥ 0.5	Pass
11a	6Mbps	165	5825	15.50	≥ 0.5	Pass
11n-HT20	MCS24	149	5745	15.72	≥ 0.5	Pass
11n-HT20	MCS24	157	5785	15.74	≥ 0.5	Pass
11n-HT20	MCS24	165	5825	16.32	≥ 0.5	Pass
11n-HT40	MCS24	151	5755	35.20	≥ 0.5	Pass
11n-HT40	MCS24	159	5795	35.18	≥ 0.5	Pass
11ac-VHT20	MCS0	149	5745	15.14	≥ 0.5	Pass
11ac-VHT20	MCS0	157	5785	15.73	≥ 0.5	Pass
11ac-VHT20	MCS0	165	5825	16.26	≥ 0.5	Pass
11ac-VHT40	MCS0	151	5755	35.20	≥ 0.5	Pass
11ac-VHT40	MCS0	159	5795	35.19	≥ 0.5	Pass
11ac-VHT80	MCS0	155	5775	75.69	≥ 0.5	Pass

11a 6dB Bandwidth

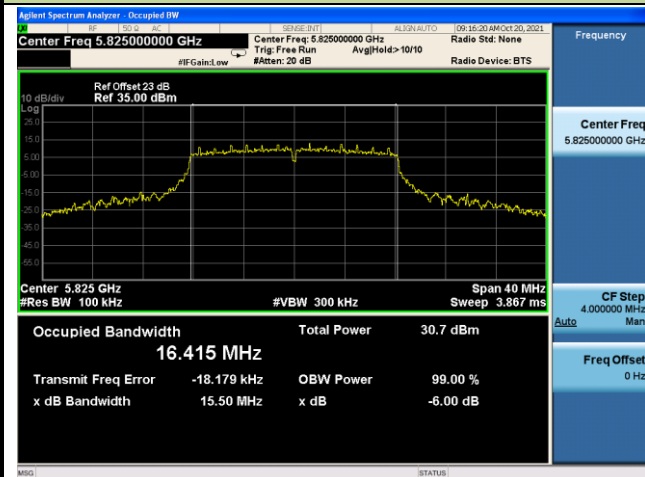
Channel 149 (5745MHz)



Channel 157 (5785MHz)

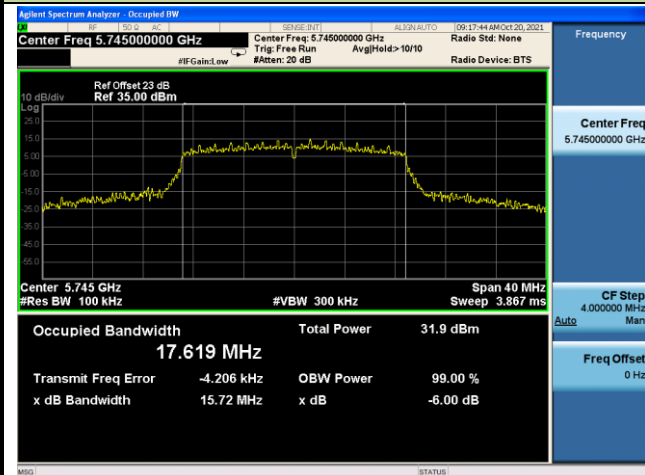


Channel 165 (5825MHz)

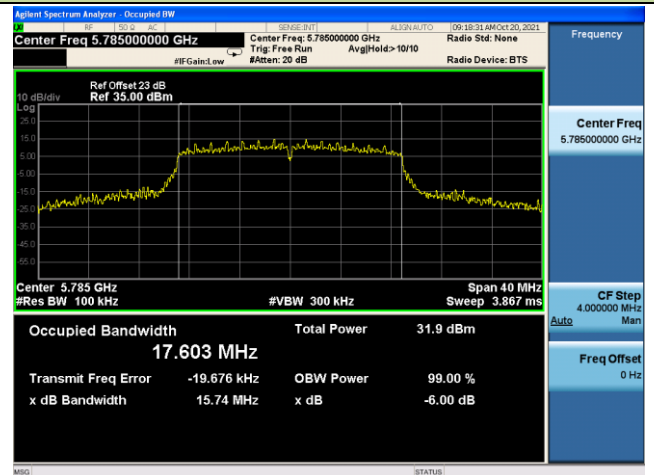


11n-HT20 6dB Bandwidth

Channel 149 (5745MHz)



Channel 157 (5785MHz)

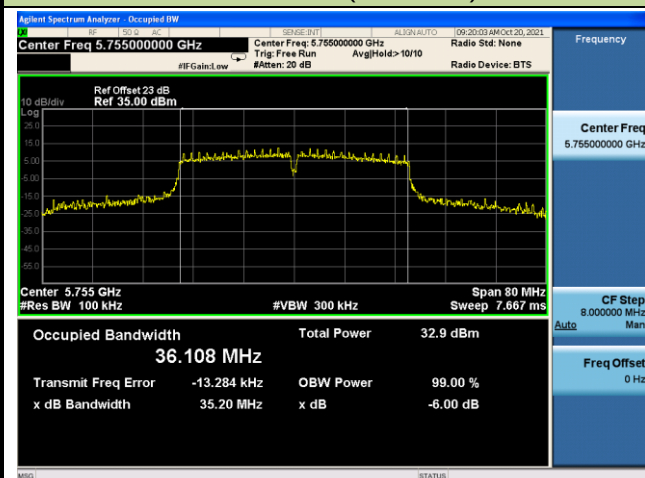


Channel 165 (5825MHz)

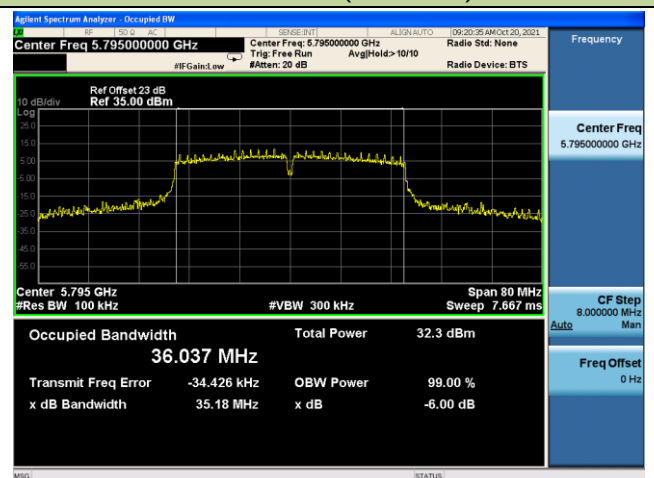


11n-HT40 6dB Bandwidth

Channel 151 (5755MHz)

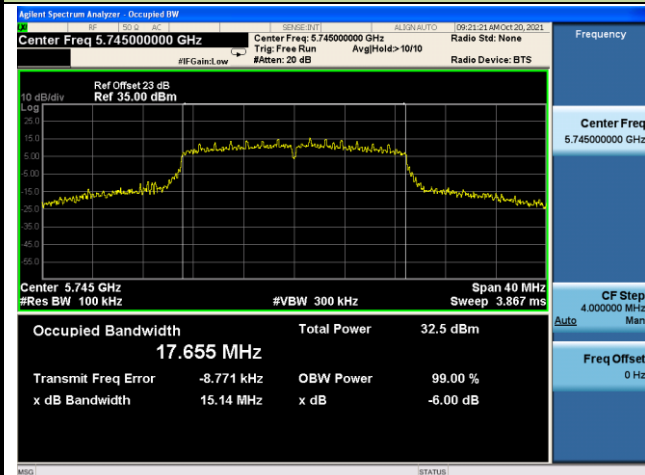


Channel 159 (5795MHz)

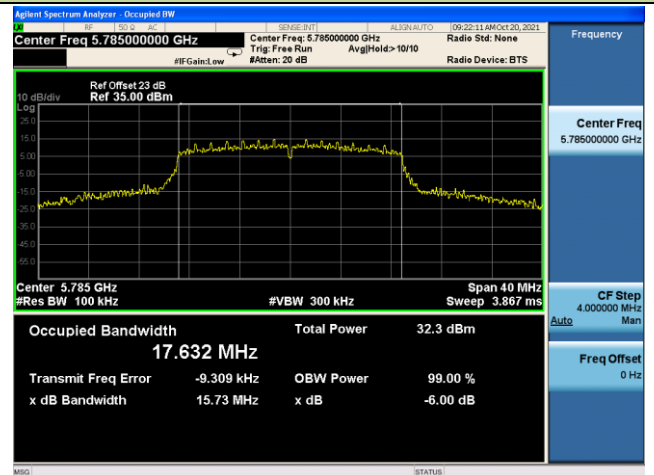


11ac-VHT20 6dB Bandwidth

Channel 149 (5745MHz)



Channel 157 (5785MHz)

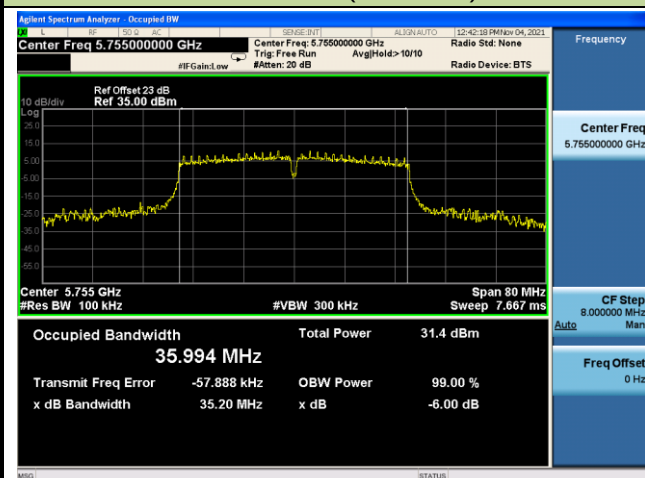


Channel 165 (5825MHz)

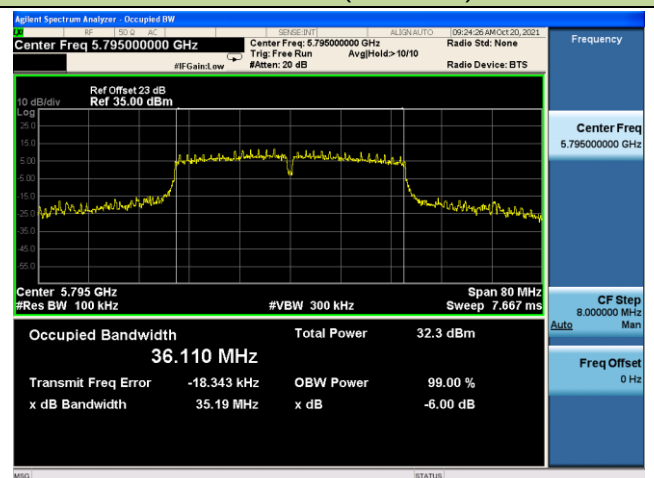


11ac-VHT40 6dB Bandwidth

Channel 151 (5755MHz)

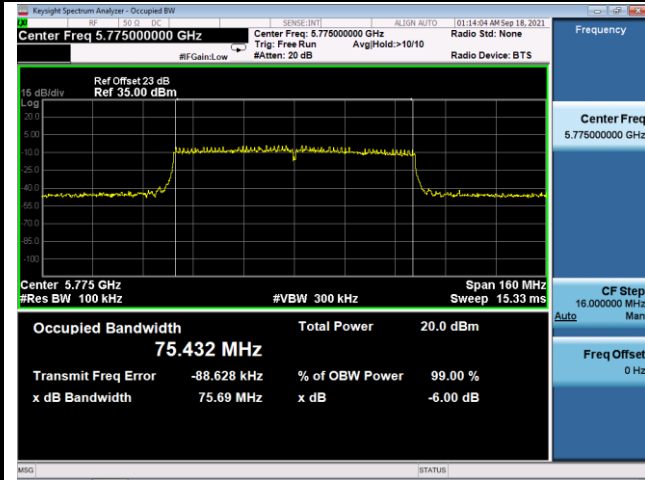


Channel 159 (5795MHz)



11ac-VHT80 6dB Bandwidth

Channel 155 (5775MHz)



A.3 Output Power Test Result

Output power test was verified over all data rates of each mode shown as below table, and then choose the maximum output power (gray marker) for final test of each channel.

Low Band output power at various data rates for Ant 1

Test Mode	Bandwidth	Channel No.	Frequency (MHz)	Data Rate/ MCS	Average Power (dBm)
11a	20	36	5180	6Mbps	15.79
				24Mbps	15.56
				54Mbps	14.98
11n	20	36	5180	MCS0	14.01
				MCS4	12.22
				MCS7	8.63
11n	40	38	5190	MCS0	13.67
				MCS4	10.92
				MCS7	9.44
11ac	20	36	5180	MCS0	15.75
				MCS4	14.69
				MCS9	12.14
11ac	40	38	5190	MCS0	14.64
				MCS4	13.77
				MCS9	12.18
11ac	80	42	5210	MCS0	10.89
				MCS4	9.88
				MCS9	7.54

High Band output power at various data rates for Ant 1

Test Mode	Bandwidth	Channel No.	Frequency (MHz)	Data Rate/ MCS	Average Power (dBm)
11a	20	100	5745	6Mbps	21.97
				24Mbps	19.93
				54Mbps	18.61
11n	20	100	5745	MCS24	21.65
				MCS27	19.87
				MCS31	14.57
11n	40	102	5755	MCS24	22.18
				MCS27	21.15
				MCS31	16.25
11ac	20	100	5745	MCS0	21.67
				MCS4	19.65
				MCS9	13.82
11ac	40	102	5755	MCS0	21.39
				MCS4	19.79
				MCS9	12.41
11ac	80	106	5530	MCS0	12.06
				MCS4	9.62
				MCS9	4.49

Test Site	NS-SR2	Test Engineer	Flay Yang
Test Date	2021/08/22 ~ 2021/09/20		

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	Average Power (dBm)		Total Power (dBm)	Limit (dBm)	Result
				Ant 1	Ant 2			
Low Band (5180MHz ~ 5240MHz)								
11a	6Mbps	36	5180	15.79	15.75	18.78	≤ 30.00	Pass
11a	6Mbps	44	5220	21.51	21.61	24.57	≤ 30.00	Pass
11a	6Mbps	48	5240	22.21	21.95	25.09	≤ 30.00	Pass
11n-HT20	MCS0	36	5180	15.35	15.03	18.20	≤ 30.00	Pass
11n-HT20	MCS0	44	5220	21.81	21.36	24.60	≤ 30.00	Pass
11n-HT20	MCS0	48	5240	22.02	21.59	24.82	≤ 30.00	Pass
11n-HT40	MCS0	38	5190	14.84	14.91	17.89	≤ 30.00	Pass
11n-HT40	MCS0	46	5230	24.29	23.97	27.14	≤ 30.00	Pass
11ac-VHT20	MCS0	36	5180	15.75	15.42	18.60	≤ 30.00	Pass
11ac-VHT20	MCS0	44	5220	22.48	21.98	25.25	≤ 30.00	Pass
11ac-VHT20	MCS0	48	5240	22.64	22.38	25.52	≤ 30.00	Pass
11ac-VHT40	MCS0	38	5190	14.64	14.43	17.55	≤ 30.00	Pass
11ac-VHT40	MCS0	46	5230	25.38	25.07	28.24	≤ 30.00	Pass
11ac-VHT80	MCS0	42	5210	10.89	10.51	13.71	≤ 30.00	Pass

Note: Total Power (dBm) = $10 \cdot \log \{10^{(\text{Ant 1 Average Power} / 10)} + 10^{(\text{Ant 2 Average Power} / 10)}\}$ (dBm)

Test Mode	Data Rate/	Channe	Freq.	Average Power (dBm)				Total Power	Limit	Result
	MCS	I No.	(MHz)	Ant 1	Ant 2	Ant 3	Ant 4			
High Band (5745MHz ~ 5825MHz)										
11a	6Mbps	149	5745	21.95	24.33	23.91	24.33	29.75	≤ 30.00	Pass
11a	6Mbps	157	5785	23.38	23.69	23.56	23.57	29.57	≤ 30.00	Pass
11a	6Mbps	165	5825	24.59	23.58	23.29	23.63	29.82	≤ 30.00	Pass
11n-HT20	MCS24	149	5745	21.61	24.45	23.74	24.25	29.67	≤ 30.00	Pass
11n-HT20	MCS24	157	5785	23.33	24.03	23.67	23.98	29.78	≤ 30.00	Pass
11n-HT20	MCS24	165	5825	23.86	23.25	23.36	23.38	29.49	≤ 30.00	Pass
11n-HT40	MCS24	151	5755	22.11	24.18	24.01	24.33	29.76	≤ 30.00	Pass
11n-HT40	MCS24	159	5795	23.24	23.72	23.43	23.62	29.53	≤ 30.00	Pass
11ac-VHT20	MCS0	149	5745	21.78	24.03	24.12	24.26	29.68	≤ 30.00	Pass
11ac-VHT20	MCS0	157	5785	23.35	23.47	23.54	23.88	29.59	≤ 30.00	Pass
11ac-VHT20	MCS0	165	5825	24.48	23.95	23.06	23.25	29.74	≤ 30.00	Pass
11ac-VHT40	MCS0	151	5755	20.93	22.58	22.03	22.39	28.05	≤ 30.00	Pass
11ac-VHT40	MCS0	159	5795	23.75	24.03	23.69	23.64	29.80	≤ 30.00	Pass
11ac-VHT80	MCS0	155	5775	8.54	9.29	9.73	9.68	15.36	≤ 30.00	Pass

Note: Total Average Power (dBm) = $10 \cdot \log\{10^{(\text{Ant 1 Average Power}/10)} + 10^{(\text{Ant 2 Average Power}/10)} + 10^{(\text{Ant 3 Average Power}/10)} + 10^{(\text{Ant 4 Average Power}/10)}\}$ (dBm).

A.4 Transmit Power Control

U-NII devices operating only in the 5.25-5.35 GHz band and the 5.47-5.725 GHz band shall employ a TPC mechanism.”

A.5 Power Spectral Density Test Result

Test Site	NS-SR2	Test Engineer	Flay Yang
Test Date	2021/08/23 ~ 2021/08/29		

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	PSD (dBm/ MHz)		Duty Cycle (%)	Final PSD (dBm/MHz)	PSD Limit (dBm/MHz)	Result
	Ant 1			Ant 2					
Low Band (5180MHz ~ 5240MHz)									
11a	6Mbps	36	5180	6.24	6.08	95.45	9.37	≤ 15.09	Pass
11a	6Mbps	44	5220	11.45	11.52	95.45	14.70	≤ 15.09	Pass
11a	6Mbps	48	5240	11.47	11.37	95.45	14.63	≤ 15.09	Pass
11n-HT20	MCS0	36	5180	4.92	5.12	92.22	8.38	≤ 15.09	Pass
11n-HT20	MCS0	44	5220	11.51	11.25	92.22	14.74	≤ 15.09	Pass
11n-HT20	MCS0	48	5240	11.21	11.40	92.22	14.67	≤ 15.09	Pass
11n-HT40	MCS0	38	5190	2.34	1.96	85.86	5.83	≤ 15.09	Pass
11n-HT40	MCS0	46	5230	10.95	11.19	85.86	14.74	≤ 15.09	Pass
11ac-VHT20	MCS0	36	5180	4.68	4.87	91.13	8.19	≤ 15.09	Pass
11ac-VHT20	MCS0	44	5220	11.47	11.35	91.13	14.82	≤ 15.09	Pass
11ac-VHT20	MCS0	48	5240	11.49	11.44	91.13	14.88	≤ 15.09	Pass
11ac-VHT40	MCS0	38	5190	1.48	1.32	85.63	5.08	≤ 15.09	Pass
11ac-VHT40	MCS0	46	5230	11.14	11.09	85.63	14.80	≤ 15.09	Pass
11ac-VHT80	MCS0	42	5210	-5.04	-5.17	76.59	-0.94	≤ 15.09	Pass

Note 1: When EUT duty cycle < 98%,

For 5150 ~ 5250MHz: Final PSD (dBm/MHz) = $10 \cdot \log \{10^{(\text{Ant 1 AVGPSD}/10)} + 10^{(\text{Ant 2 AVGPSD}/10)}\} + 10 \cdot \log (1/\text{Duty cycle})$.

Note 2: PSD Limit Calculation as below:

For 5150 ~ 5250MHz: PSD Limit = 17 - (7.91 - 6) = 15.09 dBm/MHz

Test Site	NS-SR2	Test Engineer	Flay Yang
Test Date	2021/10/12 ~ 2021/11/04		

Test Mode	Data	Channel No.	Freq. (MHz)	PSD				Duty Cycle (%)	Final PSD (dBm/ 510kHz)	Limit (dBm/ 500kHz)	Result
	Rate/ MCS			(dBm/ 510kHz)							
				Ant 1	Ant 2	Ant 3	Ant 4				
High Band (5745MHz ~ 5825MHz)											
11a	6Mbps	149	5745	9.57	11.95	11.72	12.01	95.31	17.65	≤ 24.48	Pass
11a	6Mbps	157	5785	10.91	11.36	10.69	11.27	95.31	17.30	≤ 24.48	Pass
11a	6Mbps	165	5825	11.23	10.82	10.52	11.05	95.31	17.14	≤ 24.48	Pass
11n-HT20	MCS24	149	5745	9.33	11.56	10.86	11.40	85.61	17.57	≤ 24.48	Pass
11n-HT20	MCS24	157	5785	10.01	10.73	9.55	10.57	85.61	16.94	≤ 24.48	Pass
11n-HT20	MCS24	165	5825	10.10	10.77	10.18	10.40	85.61	17.07	≤ 24.48	Pass
11n-HT40	MCS24	151	5755	6.19	8.66	7.60	8.21	78.42	14.84	≤ 24.48	Pass
11n-HT40	MCS24	159	5795	6.70	6.92	7.00	7.13	78.42	14.02	≤ 24.48	Pass
11ac-VHT20	MCS0	149	5745	8.63	11.43	10.46	11.67	86.38	17.36	≤ 24.48	Pass
11ac-VHT20	MCS0	157	5785	9.74	10.75	10.99	11.31	86.38	17.39	≤ 24.48	Pass
11ac-VHT20	MCS0	165	5825	10.66	10.42	10.24	10.74	86.38	17.18	≤ 24.48	Pass
11ac-VHT40	MCS0	151	5755	4.38	5.99	5.79	6.04	78.48	12.67	≤ 24.48	Pass
11ac-VHT40	MCS0	159	5795	7.31	7.15	6.75	7.42	78.48	14.24	≤ 24.48	Pass
11ac-VHT80	MCS0	155	5775	-10.62	-9.13	-9.46	-9.81	68.72	-2.07	≤ 24.48	Pass

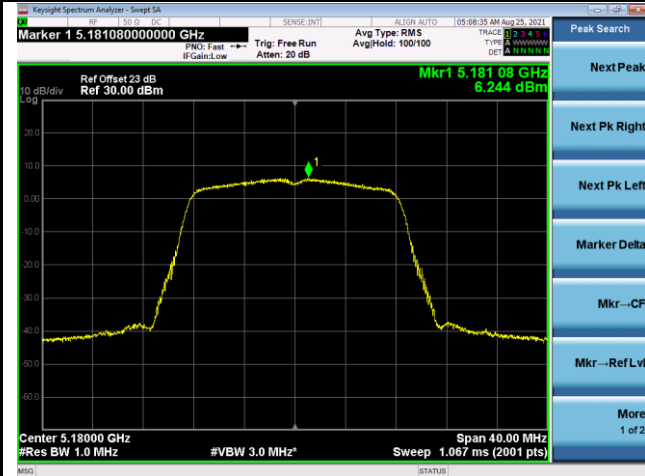
Note 1: When EUT duty cycle < 98%, Final PSD (dBm/510kHz) = $10 \cdot \log \{10^{(\text{Ant 1 AVGPSD}/10)} + 10^{(\text{Ant 2 AVGPSD}/10)} + 10^{(\text{Ant 3 AVGPSD}/10)} + 10^{(\text{Ant 4 AVGPSD}/10)}\} + 10 \cdot \log (1/\text{Duty cycle})$.

Note 2: PSD Limit (dBm/500kHz) = 30 - (11.52 - 6) = 24.48 (dBm/500KHz).

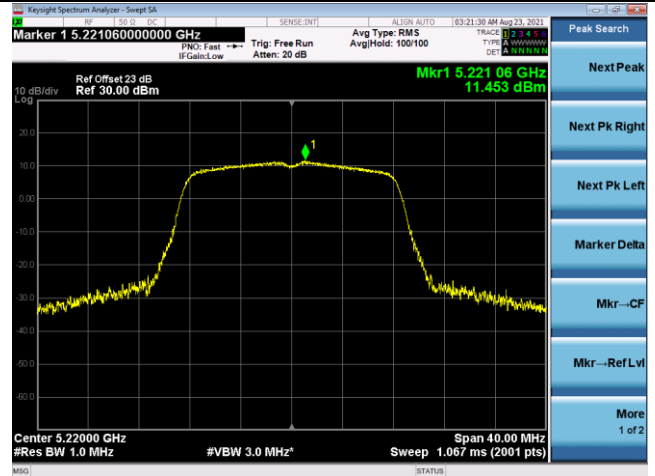
Low Band (5180MHz ~ 5240MHz)

11a Power Spectral Density - Ant 1

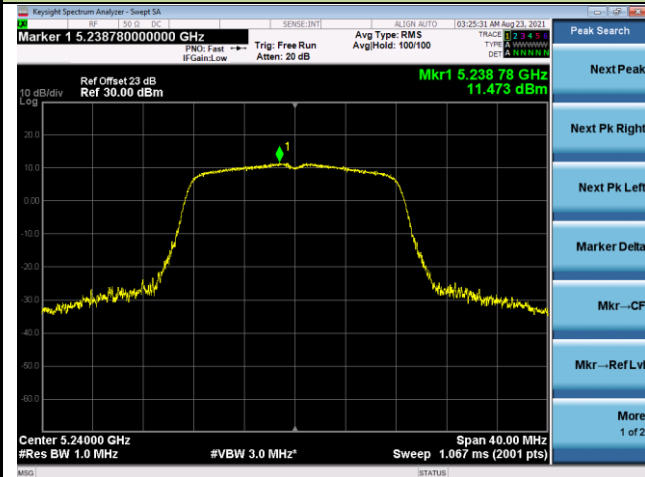
Channel 36 (5180MHz)



Channel 44 (5220MHz)

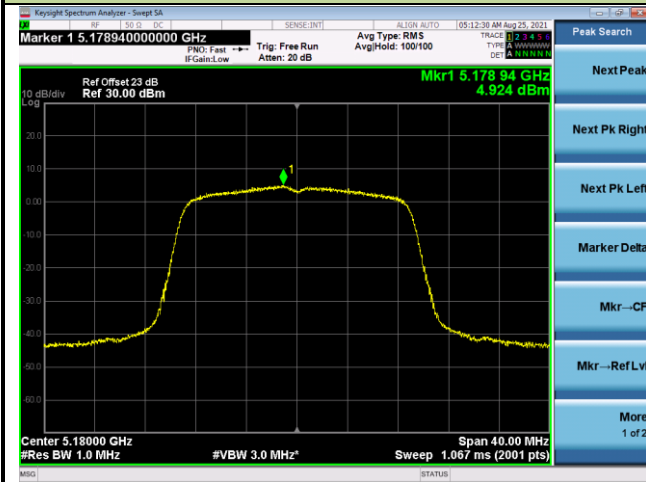


Channel 48 (5240MHz)

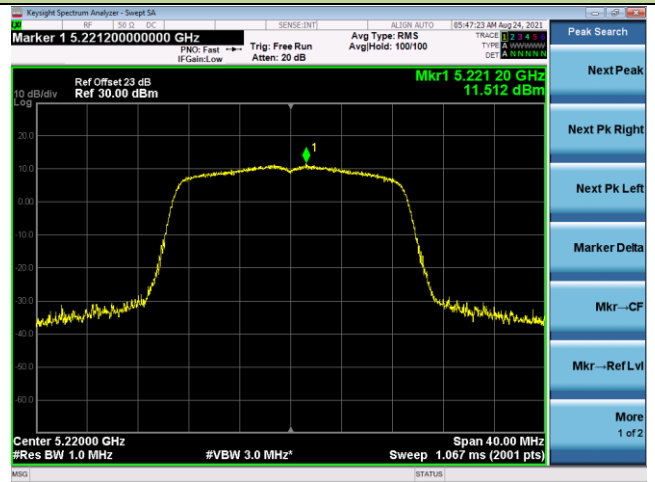


11n-HT20 Power Spectral Density - Ant 1

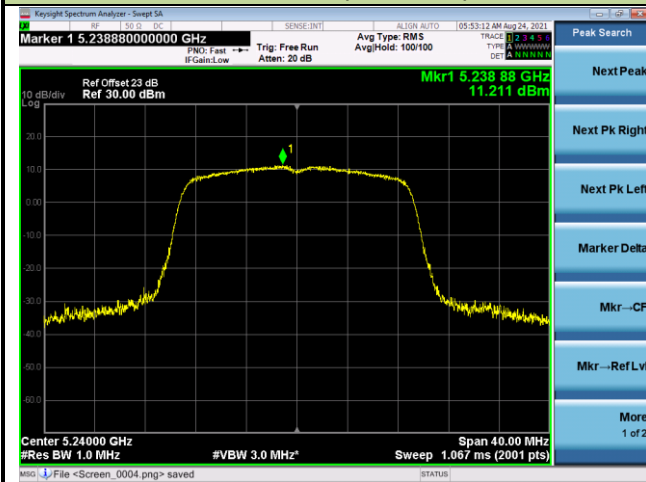
Channel 36 (5180MHz)



Channel 44 (5220MHz)

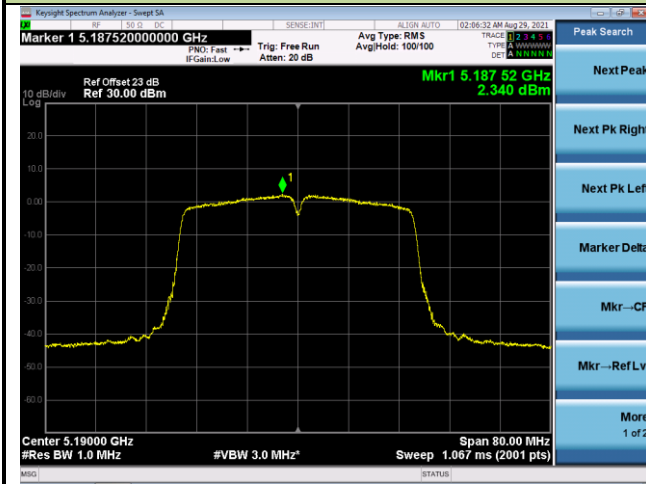


Channel 48 (5240MHz)

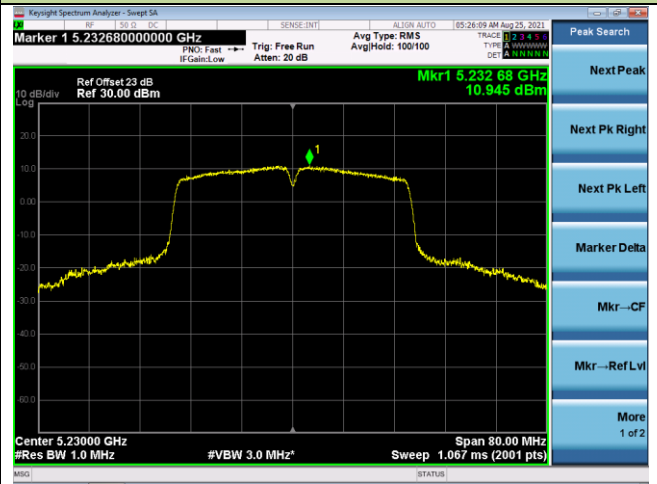


11n-HT40 Power Spectral Density - Ant 1

Channel 38 (5190MHz)

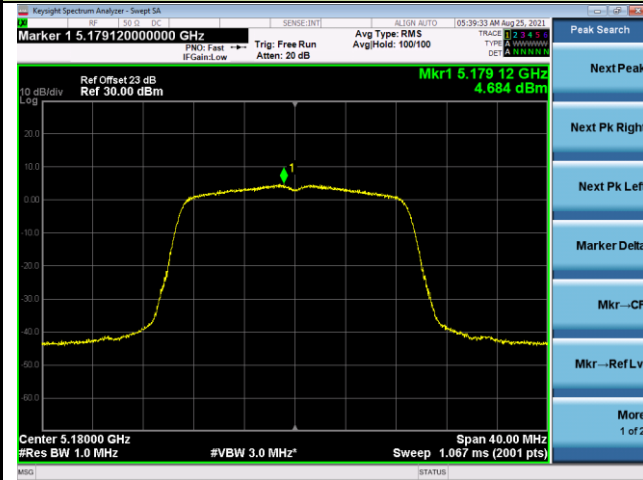


Channel 46 (5230MHz)

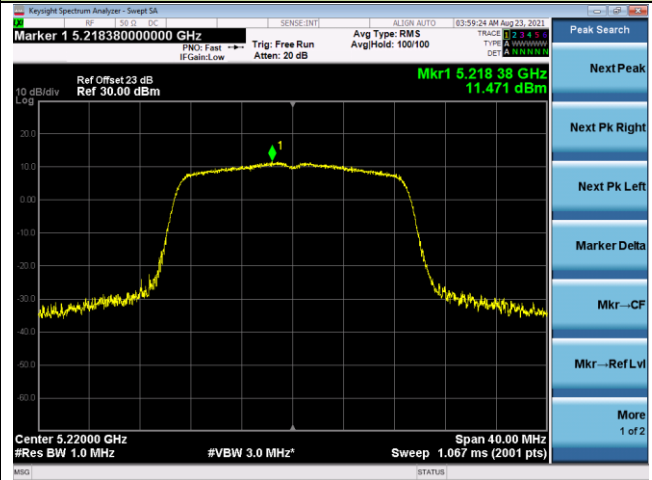


11ac-VHT20 Power Spectral Density - Ant 1

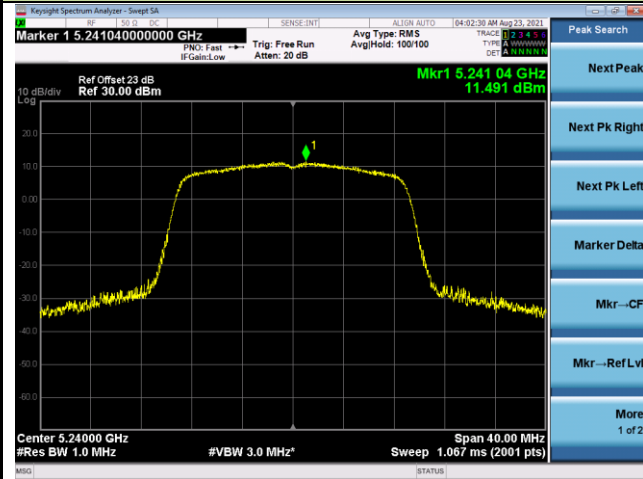
Channel 36 (5180MHz)



Channel 44 (5220MHz)

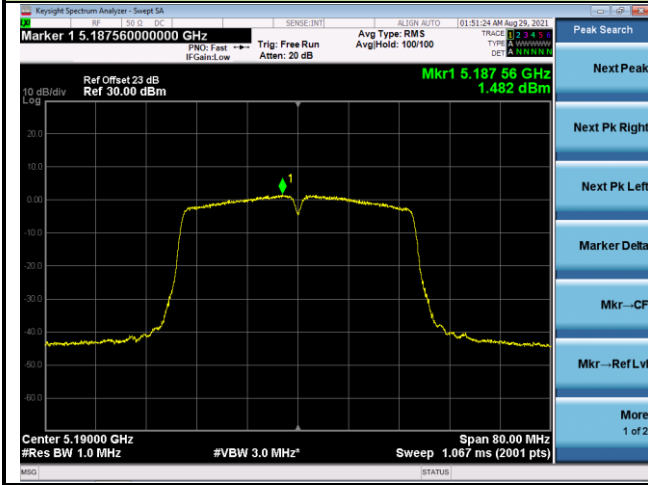


Channel 48 (5240MHz)



11ac-VHT40 Power Spectral Density - Ant 1

Channel 38 (5190MHz)



Channel 46 (5230MHz)

