



MEASUREMENT REPORT

FCC PART 15.407/ WLAN 802.11a/n/ac/ax

FCC ID: 2AF5PMH7601
Application: MTRLC LLC

Application Type: Certification
Product: AX1800 Dual-band Mesh WiFi
Model No.: MH7601
Serial Model No.: MH760XY (Where X can be 0, 1, 2, 3, or 4, and Y can be A, B, C, D, or blank)
Brand Name: Motorola
FCC Classification: Unlicensed National Information Infrastructure (NII)
FCC Rule Part(s): Part15 Subpart E (Section 15.407)
Test Procedure(s): ANSI C63.10-2013
Test Date: May 10 ~ 22, 2021

Reviewed By:

Vincent Yu

Vincent Yu

Approved By:

Robin Wu

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 here in relate only to the item(s) tested.

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

Revision History

Report No.	Version	Description	Issue Date	Note
2105RSZ007-U2	Rev. 01	Initial Report	08-04-2021	Valid

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☐	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 FCC: CN1166 VCCI: R-20025, G-20034, C-20020, T-20020
	CNAS: L10551 ISED: CN0001
☒	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 FCC: CN1284
	CNAS: L10551 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	AX1800 Dual-band Mesh WiFi
Model No.	MH7601
Serial Model No.	MH760XY (Where X can be 0, 1, 2, 3, or 4, and Y can be A, B, C, D, or blank)
Brand Name	Motorola
Wi-Fi Specification	802.11a/b/g/n/ac/ax
Test Sample ID	2021050701#(Radiated) 2021050702#(Conducted)
Operating Temp.	0 ~ 40°C
Power Supply	AC/DC adapter
Accessories	
Adapter	Model No: S15B22-050A300-PK Input: 100 ~ 240V ~ 50/60Hz, max 0.7A Output: 5V=3A
Remark: The different models are only for marketing different clients, others are the same.	

1.5. Radio Specification under Test

Frequency Range	For 802.11a/n-HT20/ac-VHT20/ax-HE20: 5180 ~ 5240MHz, 5745 ~ 5825MHz For 802.11n-HT40/ac-VHT40/ax-HE40: 5190 ~ 5230MHz, 5755 ~ 5795MHz For 802.11ac-VHT80/ax-HE80: 5210MHz, 5775MHz
Modulation	802.11a/n/ac: OFDM; 802.11ax: OFDMA
Data Rate	802.11a: 6/9/12/18/24/36/48/54Mbps 802.11n: up to 300Mbps 802.11ac: up to 866.7Mbps 802.11ax: up to 1201.0Mbps
Maximum Average Output Power	802.11a: 29.19 dBm 802.11ac-VHT20: 29.30dBm 802.11ac-VHT40: 29.34dBm 802.11ac-VHT80: 23.51dBm 802.11ax-HE20: 29.38dBm 802.11ax-HE40: 29.71dBm 802.11ax-HE80: 23.35dBm

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

1.6. Description of Available Antennas

Antenna Type	Frequency Band (GHz)	Antenna Gain(dBi)		Directional Gain(dBi)	
		Ant 1	Ant 2	For Power	For PSD
PIFA Antenna	2.4~2.5	3.0	3.0	3.0	6.01
	5.15 ~ 5.25	3.0	3.0	3.0	6.01
	5.725 ~ 5.85				

Note 1: The EUT supports Cyclic Delay Diversity (CDD) technology for 802.11a/b/g/n/ac/ax mode.

Note 2: 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 $N_{ANT} \leq 4$;

If antenna gains are not equal, Directional gain may be calculated by using the formulas applicable to equal gain antennas with G_{ANT} set equal to the gain of the antenna having the highest gain.

Note 3: The antenna gain is declared by manufacture.

1.7. Working Frequencies for this Report

802.11a/n-HT20/ac-VHT20/ ax-HE20

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/ ax-HE40

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

802.11ac-VHT80/ ax-HE80

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

1.8. Test Mode

Test Mode	Mode 1: Transmit by 802.11a (6Mbps)
	Mode 2: Transmit by 802.11ac-VHT20 (MCS0)
	Mode 3: Transmit by 802.11ac-VHT40 (MCS0)
	Mode 4: Transmit by 802.11ac-VHT80 (MCS0)
	Mode 5: Transmit by 802.11ax-HE20 (MCS0)
	Mode 6: Transmit by 802.11ax-HE40 (MCS0)
	Mode 7: Transmit by 802.11ax-HE80 (MCS0)

Note 1: Due to the same modulation between 802.11n and 802.11ac, so 802.11n-HT20 and HT40 are covered by 802.11ac-VHT20 and VHT40 in this report, meanwhile, power setting for 802.11n-HT20 and HT40 will not be greater than 802.11ac-VHT20 and VHT40.

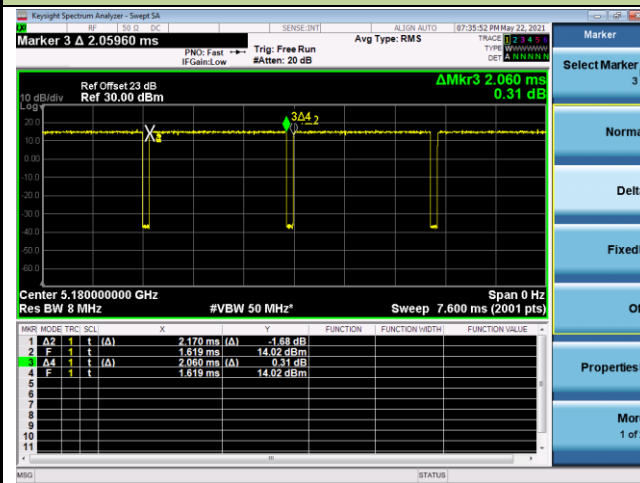
1.9. Duty Cycle

5GHz (NII) operation is possible in 20MHz, 40MHz and 80MHz channel bandwidths. 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:

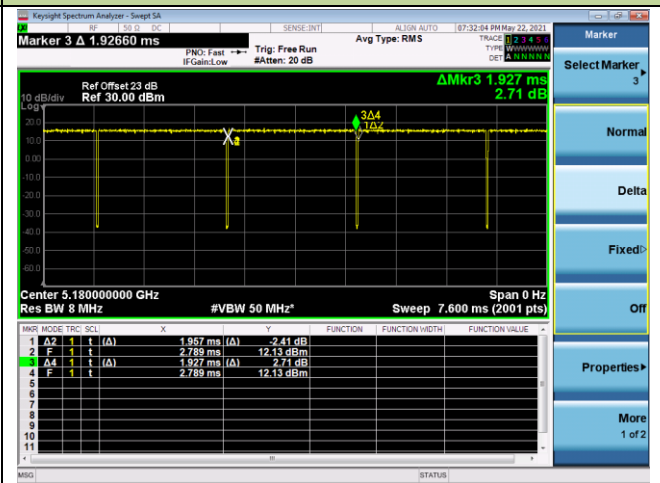
Test Mode	Duty Cycle
802.11a	94.93%
802.11ac-VHT20	98.47%
802.11ac-VHT40	96.90%
802.11ac-VHT80	93.78%
802.11ax-HE20	97.63%
802.11ax-HE40	96.03%
802.11ax-HE80	92.58%

Duty Cycle (T = Transmission Duration)

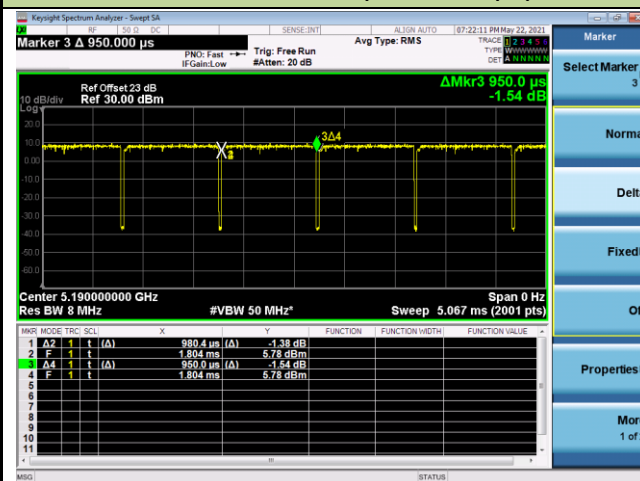
802.11a (T = 2.060ms)



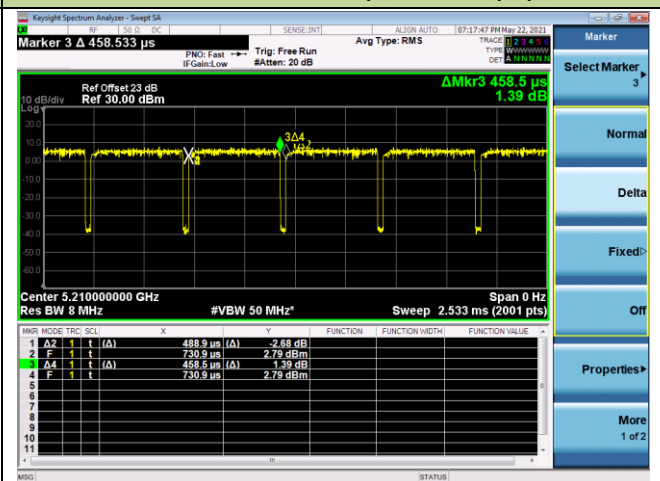
802.11ac-VHT20 (T = 1.927ms)



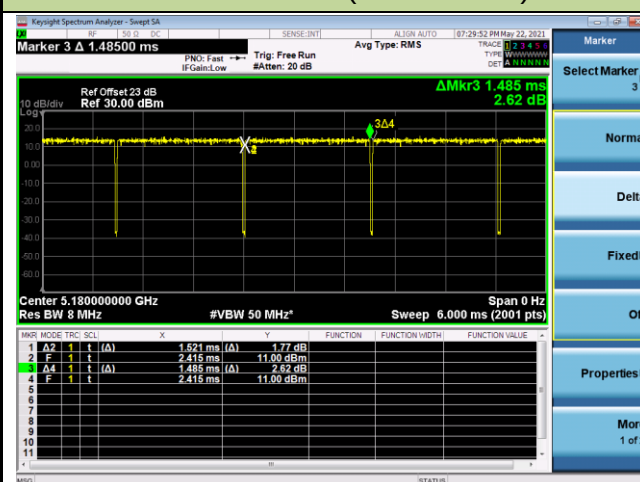
802.11ac-VHT40 (T = 950.0μs)



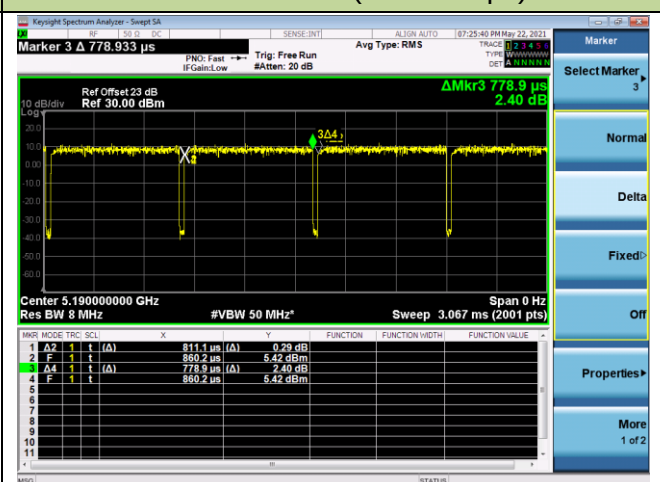
802.11ac-VHT80 (T = 458.5μs)

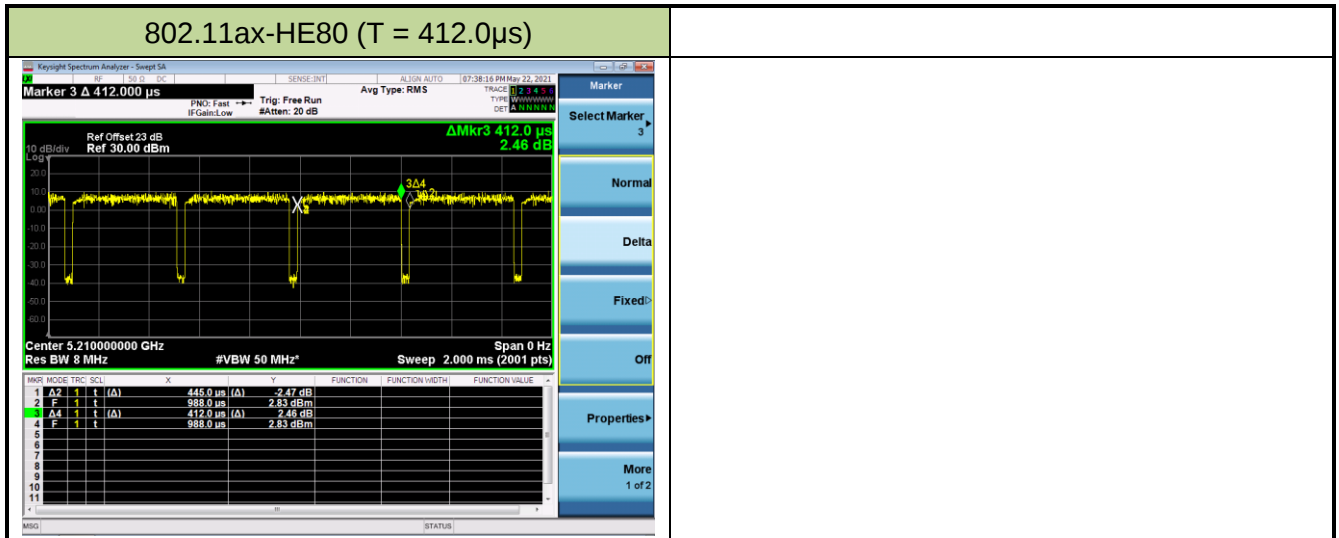


802.11ax-HE20 (T = 1.485ms)



802.11ax-HE40 (T = 778.9μs)





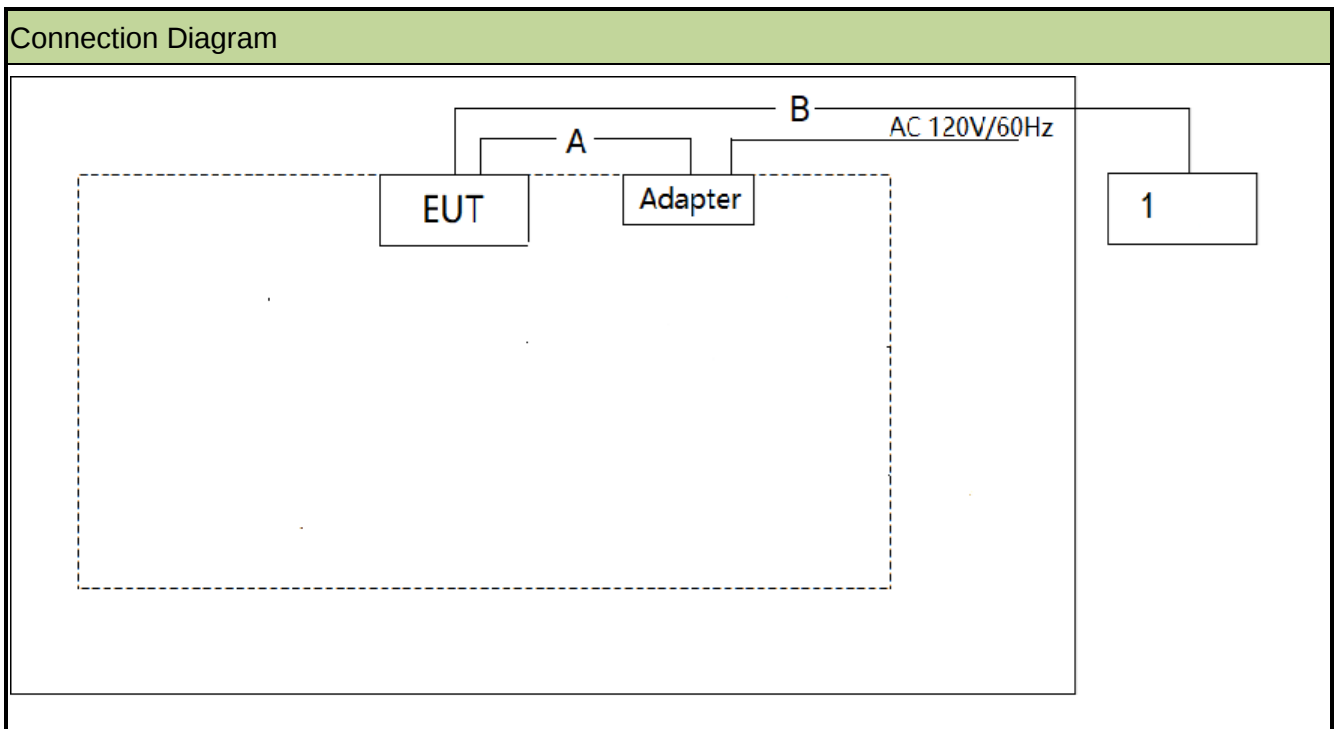
1.10. Description of Test Software

The test utility software used during testing was “accessMTool.exe”, and the version was v3.1.0.6. Power parameter value refers to operation description.

1.11. Test Environment Condition

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

1.12. Description of Test Configuration



Cable Type		Cable Description
A	Power Cable	Non-Shielded, 1.5m
B	LAN Cable	Non-Shielded, >10m

1.13. Test System Details

Product		Manufacturer	Model No.	Power Cord
1	Notebook	Lenovo	E495	Non-Shielded, 1.8m

2. 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.

3. TEST EQUIPMENT CALIBRATION DATE

Conducted Emission (NS-SR2)

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESL3	MRTSUE06576	1 year	2021/07/09
				1 year	2022/06/27
ENV216-LV-NETZNACHB	R&S	ENV216	MRTSUE06577	1 year	2021/07/09
				1 year	2022/07/04
ENV216-LV-NETZNACHB	R&S	ENV216	MRTSUE06578	1 year	2021/07/09
				1 year	2022/07/04
Temperature/Humidity Meter	deli	NO.8813	MRTSUE06587	1 year	2021/07/08
				1 year	2022/06/30
Shielding Anechoic Chamber	BOOMWAVE	SR2	MRTSUE06551	5 year	2024/06/04

Radiated Emission (NS-AC1)

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cal. Due Date
EMI Test Receiver	R&S	ESR3	MRTSUE06575	1 year	2021/07/09
				1 year	2022/06/27
EXA Signal Analyzer	Keysight	N9010A	MRTSUE06195	1 year	2022/03/17
Signal Analyzer	Keysight	N9020B	MRTSUE06604	1 year	2021/09/26
Horn Antenna	Schwarzbeck	BBHA 9170	MRTSUE06292	1 year	2021/10/24
Broad-Band Horn Antenna	Schwarzbeck	9120D	MRTSUE06572	1 year	2022/03/14
Bilog Period Antenna	Schwarzbeck	VULB 9162	MRTSUE06573	1 year	2021/07/03
				1 year	2022/06/30
Preamplifier	Schwarzbeck	BBV 9721	MRTSUE06121	1 year	2021/06/11
				1 year	2022/06/09
Broadband Coaxial Preamplifier	Schwarzbeck	BBV 9718	MRTSUE06574	1 year	2021/07/13
				1 year	2022/07/12
Anechoic Chamber	BOOMWAVE	AC1	MRTSUE06496	1 year	2021/07/25
				1 year	2022/07/24
Temperature/Humidity Meter	deli	NO.8813	MRTSUE06588	1 year	2021/07/08
				1 year	2022/06/30

Conducted Test Equipment (NS-TR2)

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Thermal Hygrometer	DELI	No.8813	MRTSUE06783	1 year	2021/05/13
				1 year	2022/05/09
USB wideband power sensor	Keysight	U2021XA	MRTSUE06581	1 year	2021/08/20
10dB Attenuator	MVE	10dB	N/A	1 year	2021/08/20
EXA Signal Analyzer	Keysight	N9020A	MRTSUE10065	1 year	2021/06/16
				1 year	2022/06/17
EXA Signal Analyzer	Keysight	N9010A	MRTSUE06195	1 year	2022/03/17

Software	Version	Function
EMI Software	V3	EMI Test Software

4. 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% ($U=2U_c(y)$): 9kHz~150kHz: 3.74dB 150kHz~30MHz: 3.44dB
Radiated Emission Measurement
Measurement Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 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% ($U=2U_c(y)$): 0.78dB
Output Power
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 1.13dB
Power Spectrum Density
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 1.15dB
Occupied Bandwidth
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 0.28%

5. TEST RESULT

5.1. Summary

FCC Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.407(a)	26dB Bandwidth	N/A	Conducted	Pass	Section 5.2
15.407(e)	6dB Bandwidth	$\geq 500\text{kHz}$		Pass	Section 5.3
15.407(a)(1)(ii), (3)	Maximum Conducted Output Power	U-NII-1: $\leq 1\text{W}$ U-NII-3: $\leq 1\text{W}$		Pass	Section 5.4
15.407(h)(1)	Transmit Power Control	$\leq 24\text{dBm}$		N/A	Section 5.5
15.407(a)(1)(ii), (3)	Power Spectral Density	Refer to Section 5.6		Pass	Section 5.6
15.407(g)	Frequency Stability	N/A		Pass	Section 5.7
15.407(b)(1) , (4)(i)	Undesirable Emissions	Refer to Section 5.9	Radiated	Pass	Section 5.8 Section 5.9
15.205, 15.209 15.407 (b)(1), (4)(i)	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209		Pass	
15.207	AC Conducted Emissions 150kHz-30MHz	< FCC 15.207 limits	Line Conducted	Pass	Section 5.10

Notes:

- 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.
- 802.11ax is the full RU mode, 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 details refer to relevant section.
- For the item of Occupied Bandwidth, we only evaluated the Ant 1 RF port due to the higher conducted average power than Ant 2 RF port.

5.2. Emission Bandwidth Measurement

5.2.1. Test Limit

N/A

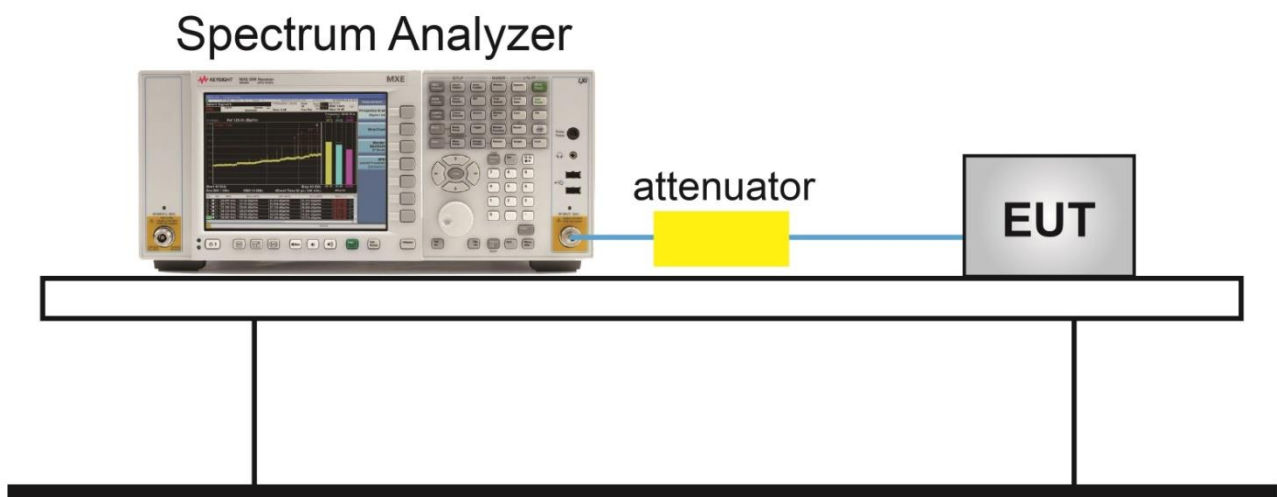
5.2.2. Test Procedure Used

KDB 789033 D02v02r01 -Section C.1

5.2.3. Test Setting

1. Set RBW = approximately 1% of the emission bandwidth.
2. Set the VBW > RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. 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.

5.2.4. Test Setup



5.2.5.Test Result

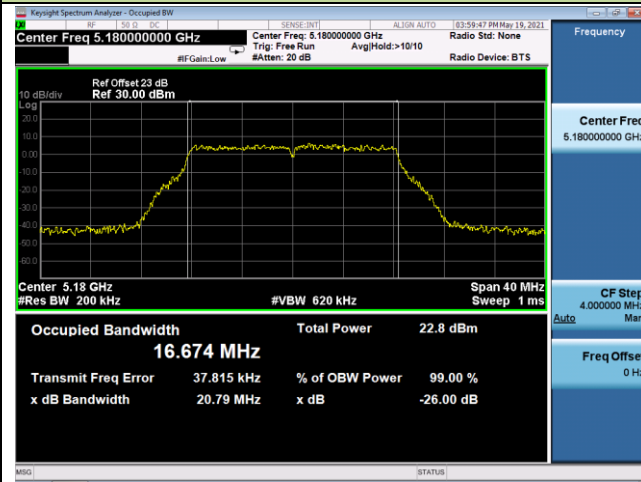
Test Site	NS-SR2	Test Engineer	Summer Tang
Test Date	2021/05/22		

Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	99% Bandwidth (MHz)	26dB Bandwidth (MHz)
Ant 1 / Ant 1 + 2					
802.11a	6Mbps	36	5180	16.67	20.79
802.11a	6Mbps	44	5220	19.47	39.55
802.11a	6Mbps	48	5240	18.92	39.41
802.11a	6Mbps	149	5745	17.56	35.12
802.11a	6Mbps	157	5785	18.94	39.81
802.11a	6Mbps	165	5825	19.01	38.63
802.11ac-VHT20	MCS0	36	5180	17.87	21.51
802.11ac-VHT20	MCS0	44	5220	18.81	35.29
802.11ac-VHT20	MCS0	48	5240	19.16	38.20
802.11ac-VHT20	MCS0	149	5745	19.55	37.63
802.11ac-VHT20	MCS0	157	5785	19.75	39.04
802.11ac-VHT20	MCS0	165	5825	19.66	38.87
802.11ac-VHT40	MCS0	38	5190	36.27	39.78
802.11ac-VHT40	MCS0	46	5230	37.22	74.51
802.11ac-VHT40	MCS0	151	5755	36.51	58.75
802.11ac-VHT40	MCS0	159	5795	37.04	74.86

Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	99% Bandwidth (MHz)	26dB Bandwidth (MHz)
Ant 1 / Ant 1 + 2					
802.11ac-VHT80	MCS0	42	5210	75.62	81.46
802.11ac-VHT80	MCS0	155	5775	75.80	81.87
802.11ax-HE20	MCS0	36	5180	19.06	21.10
802.11ax-HE20	MCS0	44	5220	19.76	38.59
802.11ax-HE20	MCS0	48	5240	19.76	37.92
802.11ax-HE20	MCS0	149	5745	19.61	38.76
802.11ax-HE20	MCS0	157	5785	19.58	39.67
802.11ax-HE20	MCS0	165	5825	19.80	38.74
802.11ax-HE40	MCS0	38	5190	37.55	39.90
802.11ax-HE40	MCS0	46	5230	38.66	73.19
802.11ax-HE40	MCS0	151	5755	37.57	41.82
802.11ax-HE40	MCS0	159	5795	37.99	71.48
802.11ax-HE80	MCS0	42	5210	76.95	80.38
802.11ax-HE80	MCS0	155	5775	77.03	80.71

802.11a 26dB Bandwidth

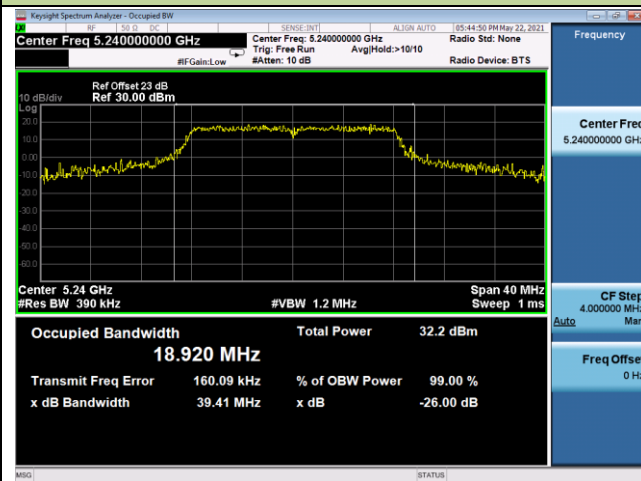
Channel 36 (5180MHz)



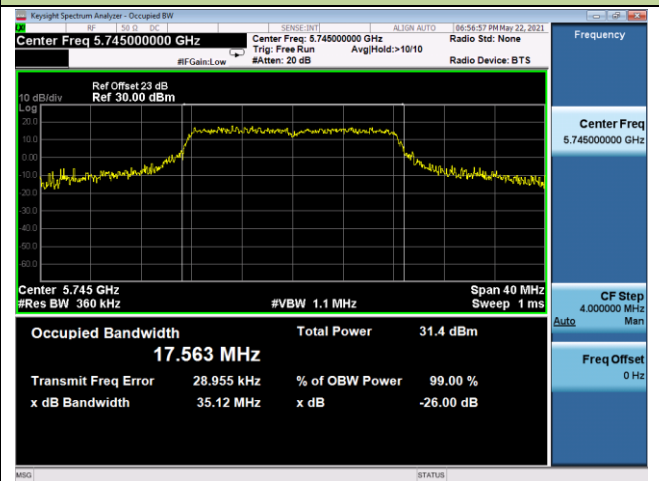
Channel 44 (5220MHz)



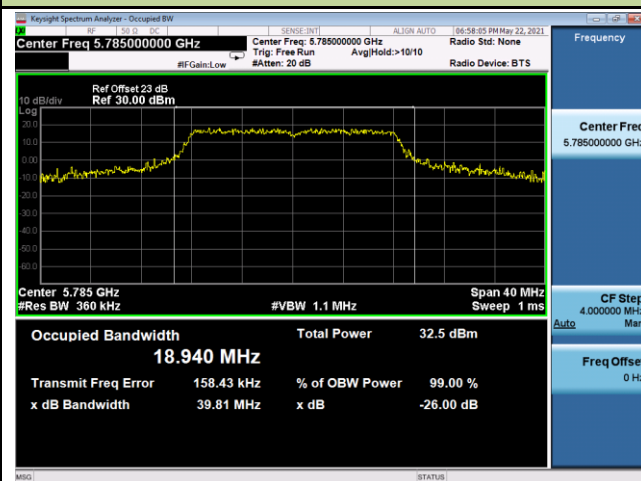
Channel 48 (5240MHz)



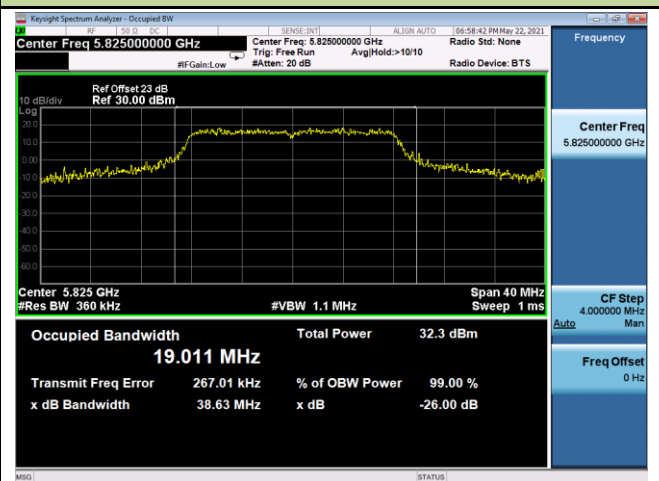
Channel 149 (5745MHz)



Channel 157 (5785MHz)



Channel 165 (5825MHz)



802.11ac-VHT20 26dB Bandwidth

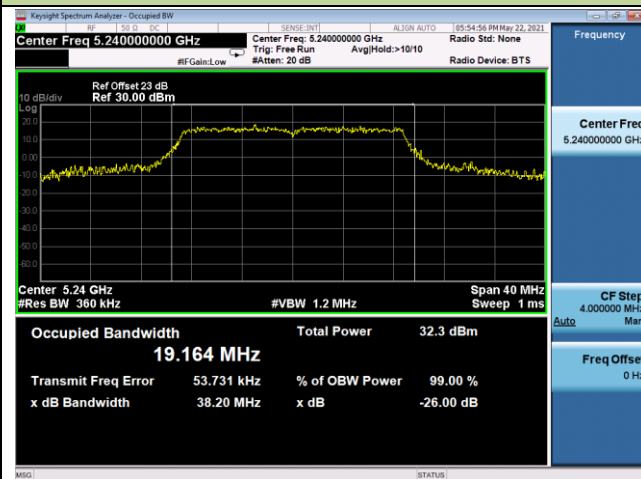
Channel 36 (5180MHz)



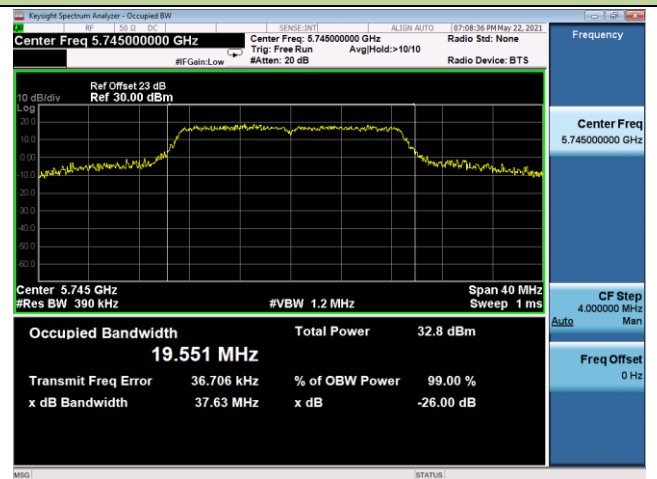
Channel 44 (5220MHz)



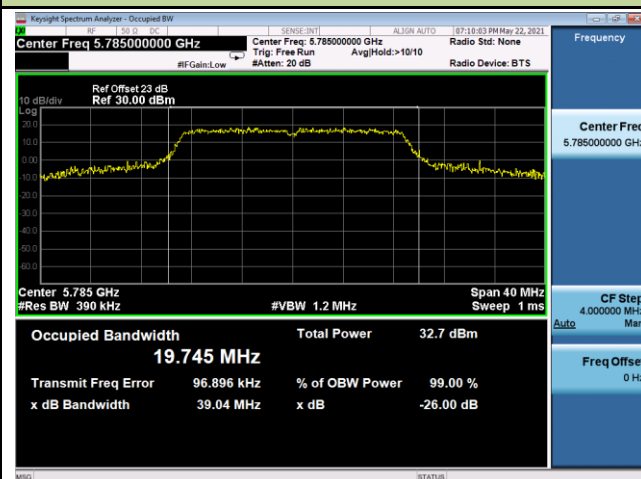
Channel 48 (5240MHz)



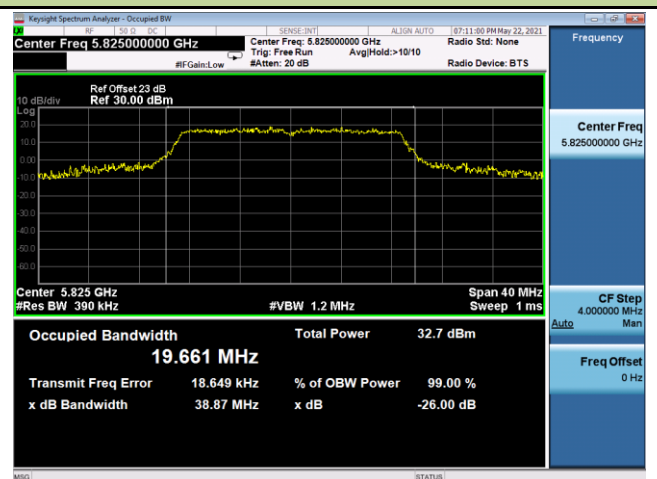
Channel 149 (5745MHz)



Channel 157 (5785MHz)

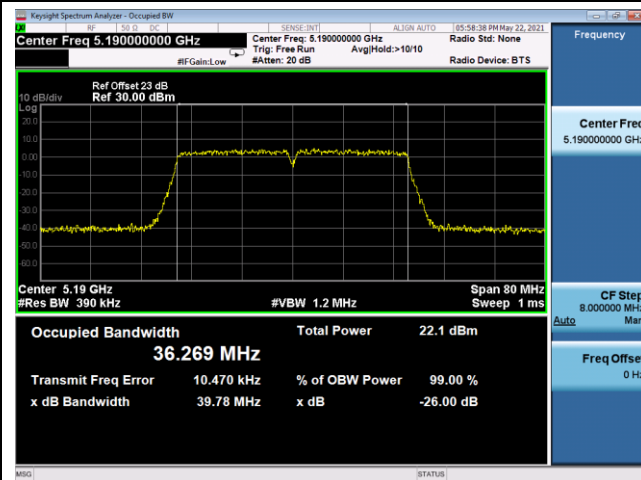


Channel 165 (5825MHz)

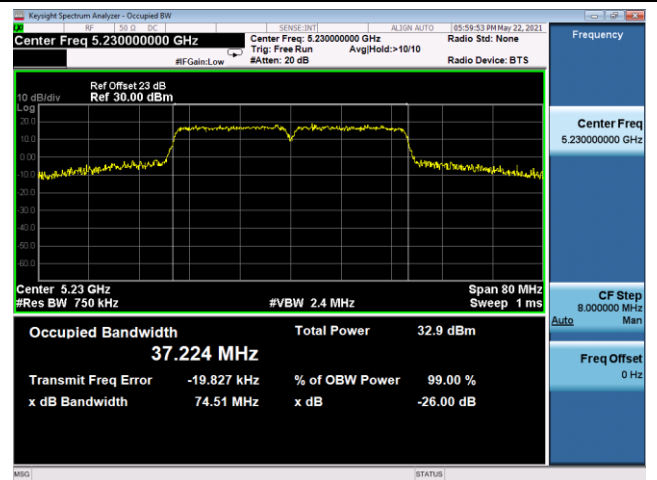


802.11ac-VHT40 26dB Bandwidth

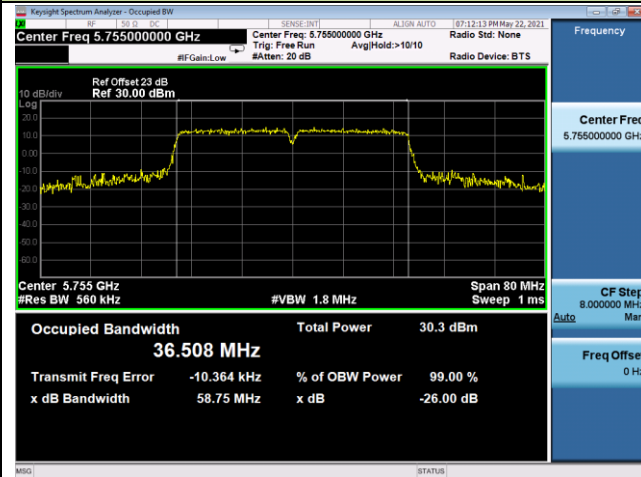
Channel 38 (5190MHz)



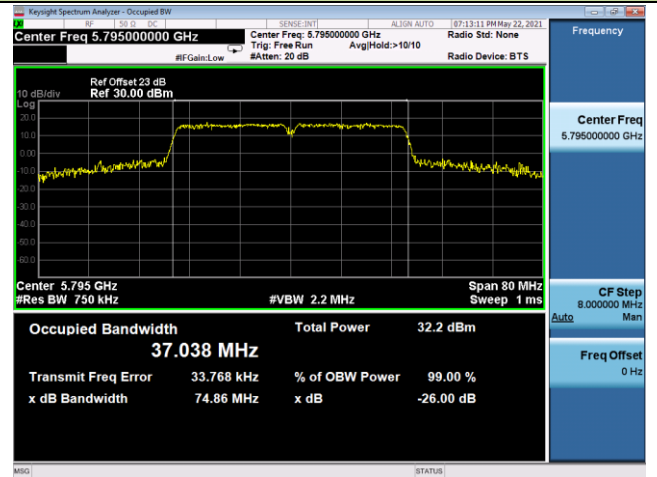
Channel 46 (5230MHz)



Channel 151 (5755MHz)

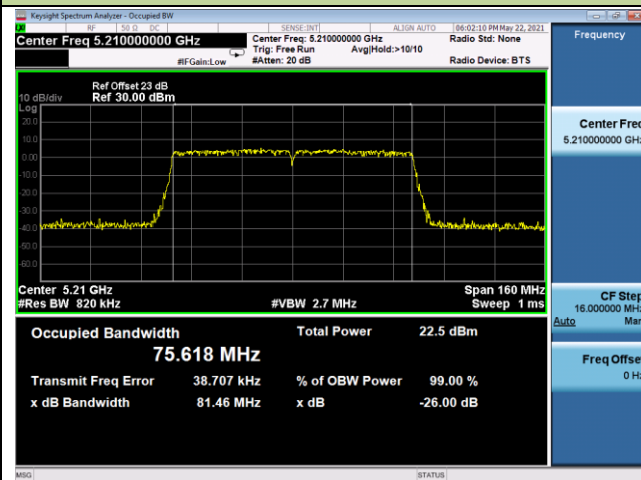


Channel 159 (5795MHz)

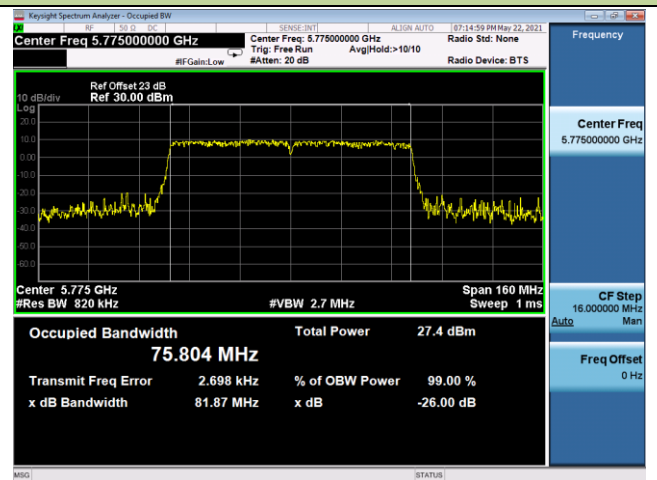


802.11ac-VHT80 26dB Bandwidth

Channel 42 (5210MHz)

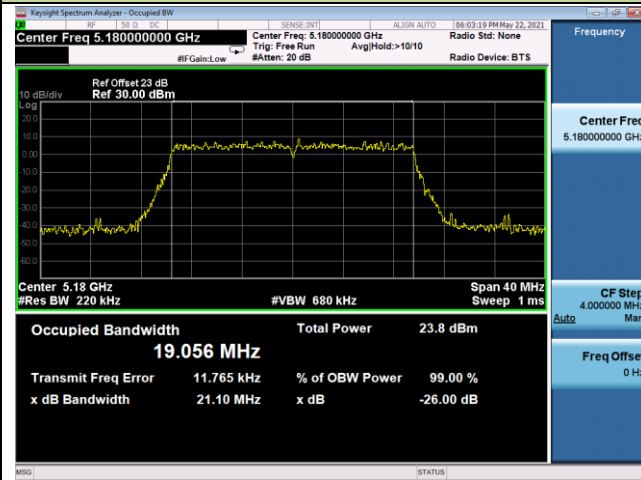


Channel 155 (5775MHz)



802.11ax-HE20 26dB Bandwidth

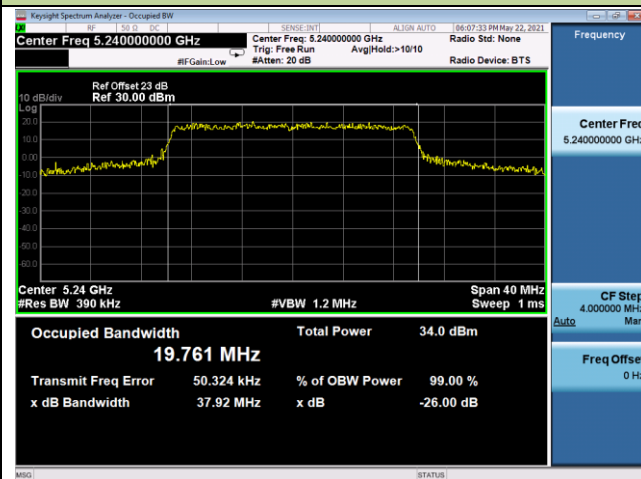
Channel 36 (5180MHz)



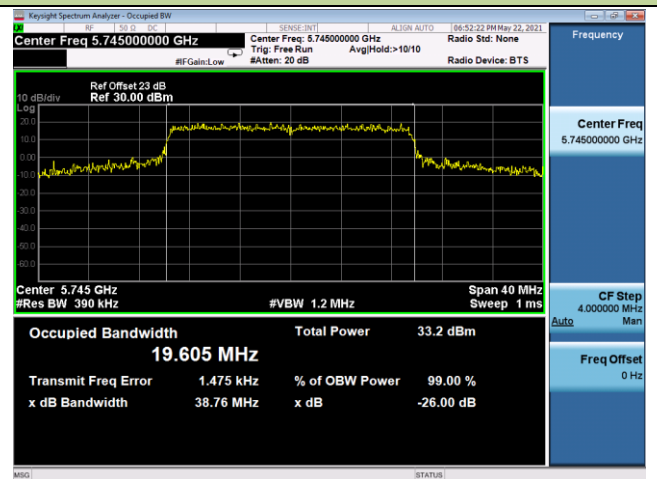
Channel 44 (5220MHz)



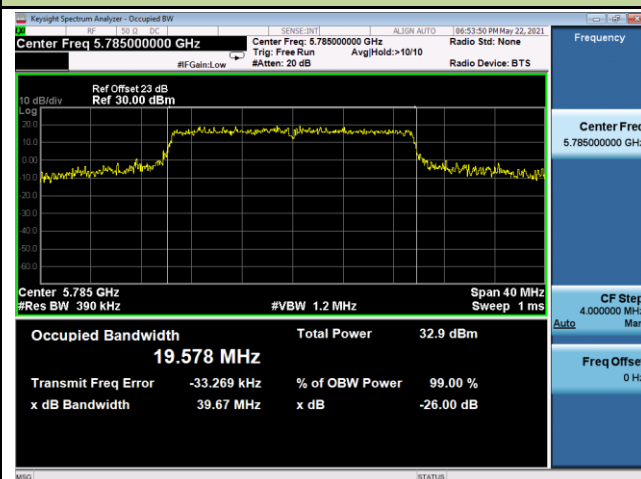
Channel 48 (5240MHz)



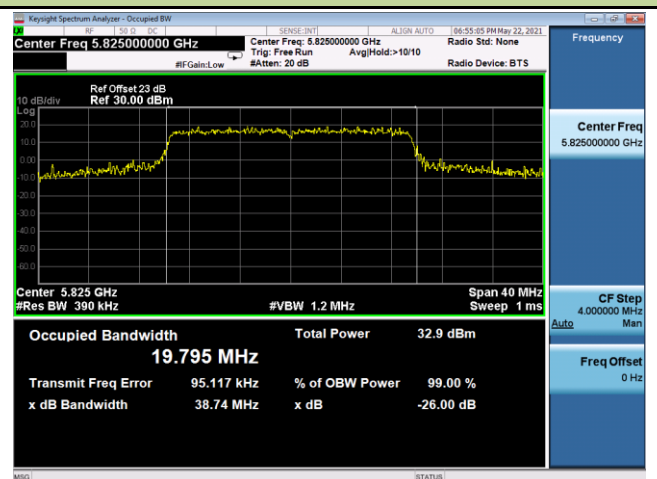
Channel 149 (5745MHz)



Channel 157 (5785MHz)

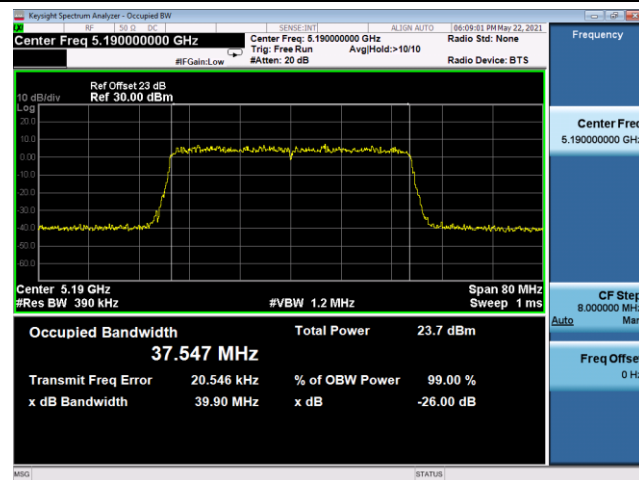


Channel 165 (5825MHz)

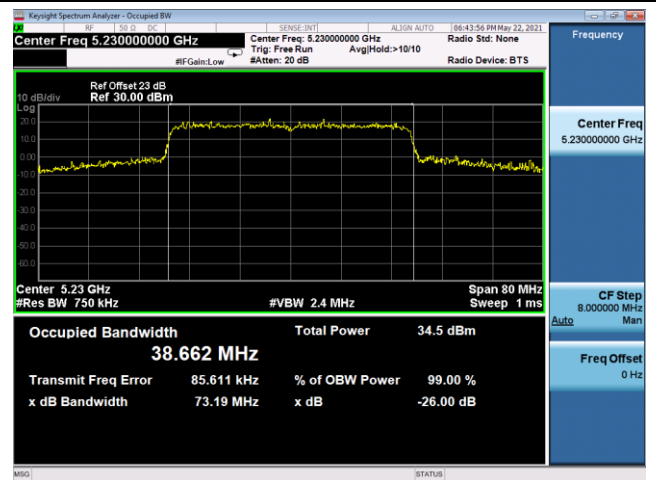


802.11ax-HE40 26dB Bandwidth

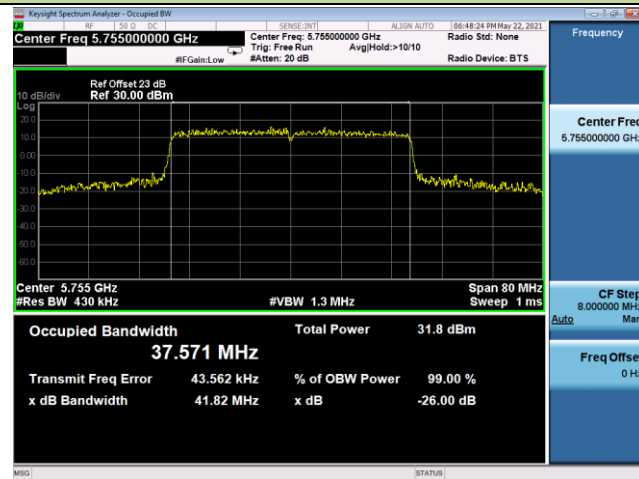
Channel 38 (5190MHz)



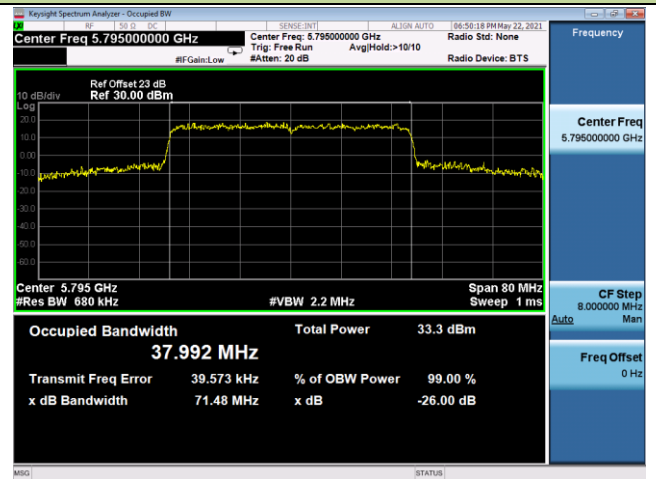
Channel 46 (5230MHz)



Channel 151 (5755MHz)

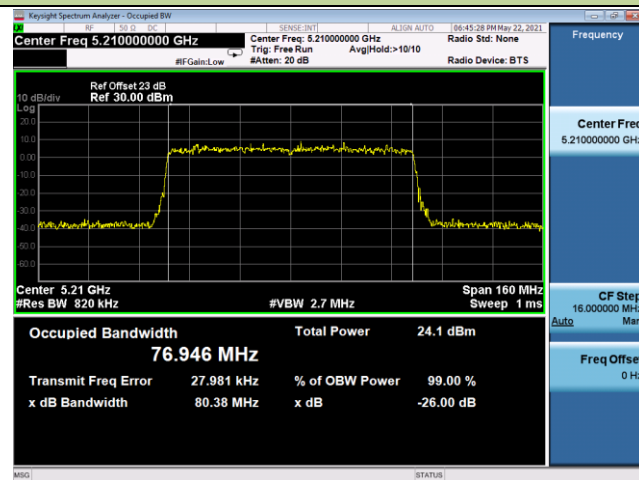


Channel 159 (5795MHz)

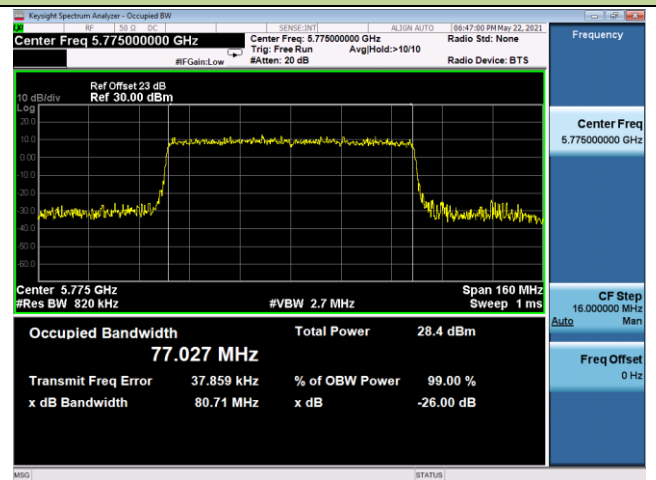


802.11ax-HE80 26dB Bandwidth

Channel 42 (5210MHz)



Channel 155 (5775MHz)



5.3. 6dB Bandwidth Measurement

5.3.1. Test Limit

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

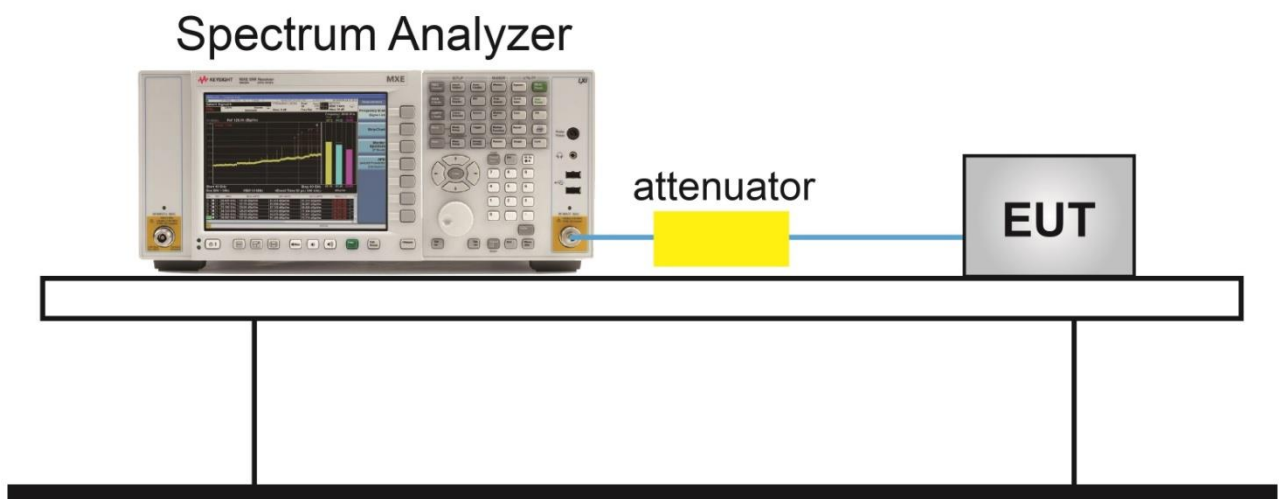
5.3.2. Test Procedure Used

KDB 789033 D02v02r01 - Section C.2

5.3.3. Test Setting

1. Set center frequency to the nominal EUT channel center frequency.
2. RBW = 100 kHz.
3. VBW $\geq 3 \times$ 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.

5.3.4. Test Setup



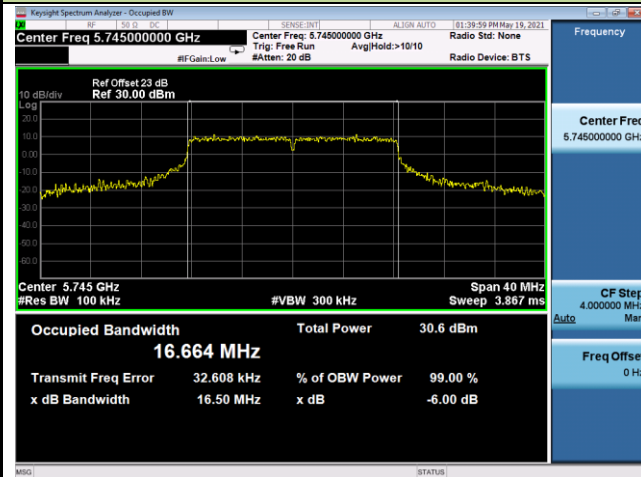
5.3.5. Test Result

Test Site	NS-SR2	Test Engineer	Summer Tang
Test Date	2021/05/19 ~ 2021/05/22		

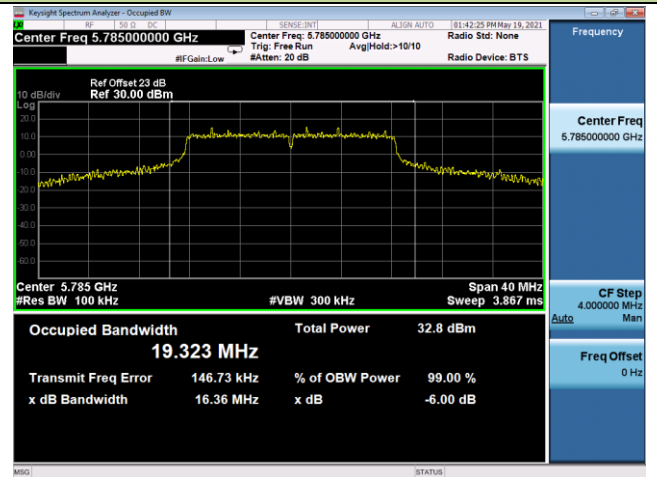
Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
Ant 1 / Ant 1 + 2						
802.11a	6Mbps	149	5745	16.50	≥0.5	Pass
802.11a	6Mbps	157	5785	16.36	≥0.5	Pass
802.11a	6Mbps	165	5825	16.33	≥0.5	Pass
802.11ac-VHT20	MCS0	149	5745	17.62	≥0.5	Pass
802.11ac-VHT20	MCS0	157	5785	17.77	≥0.5	Pass
802.11ac-VHT20	MCS0	165	5825	17.58	≥0.5	Pass
802.11ac-VHT40	MCS0	151	5755	36.38	≥0.5	Pass
802.11ac-VHT40	MCS0	159	5795	36.39	≥0.5	Pass
802.11ac-VHT80	MCS0	155	5775	76.05	≥0.5	Pass
802.11ax-HE20	MCS0	149	5745	19.08	≥0.5	Pass
802.11ax-HE20	MCS0	157	5785	18.78	≥0.5	Pass
802.11ax-HE20	MCS0	165	5825	18.76	≥0.5	Pass
802.11ax-HE40	MCS0	151	5755	37.44	≥0.5	Pass
802.11ax-HE40	MCS0	159	5795	37.74	≥0.5	Pass
802.11ax-HE80	MCS0	155	5775	77.28	≥0.5	Pass

802.11a 6dB Bandwidth

Channel 149 (5745MHz)



Channel 157 (5785MHz)

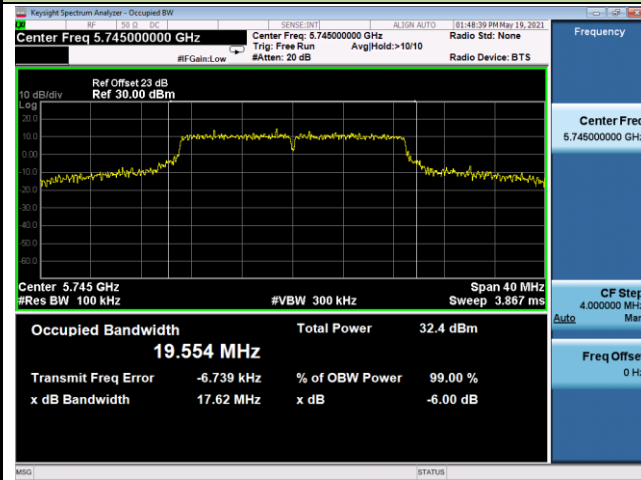


Channel 165 (5825MHz)

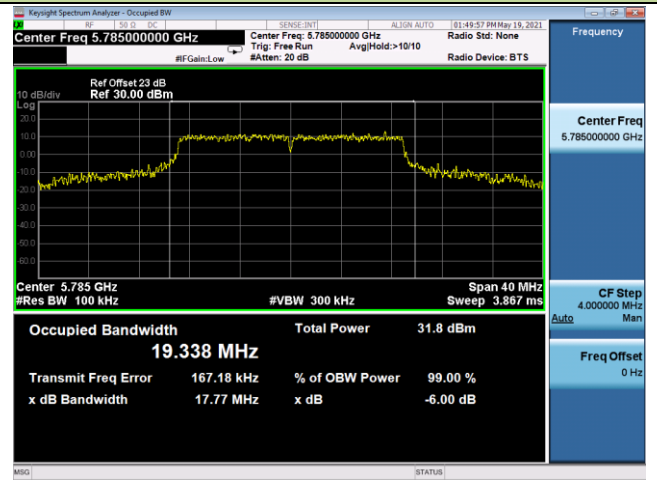


802.11ac-VHT20 6dB Bandwidth

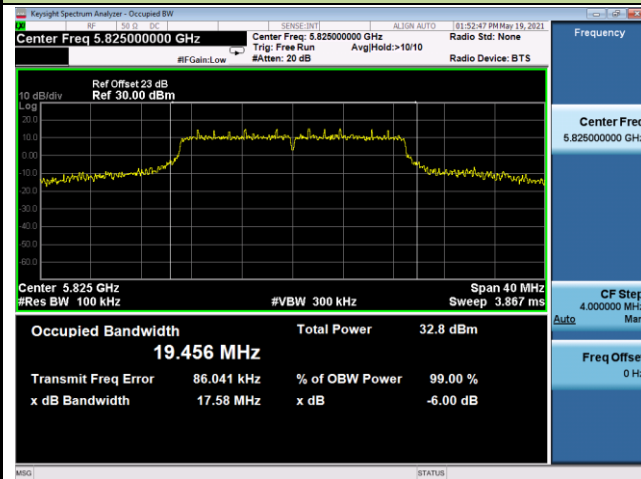
Channel 149 (5745MHz)



Channel 157 (5785MHz)

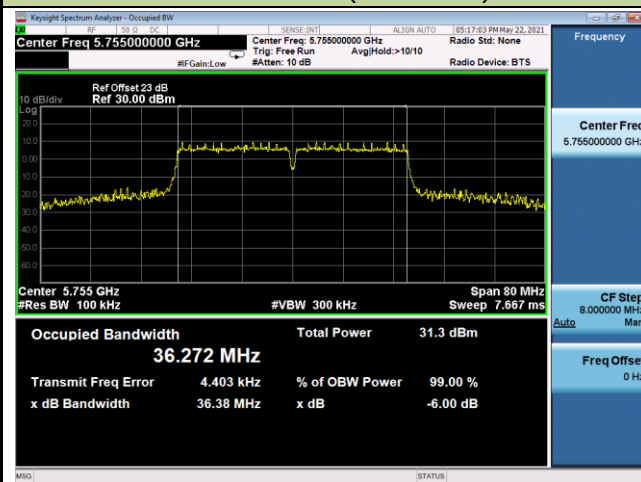


Channel 165 (5825MHz)

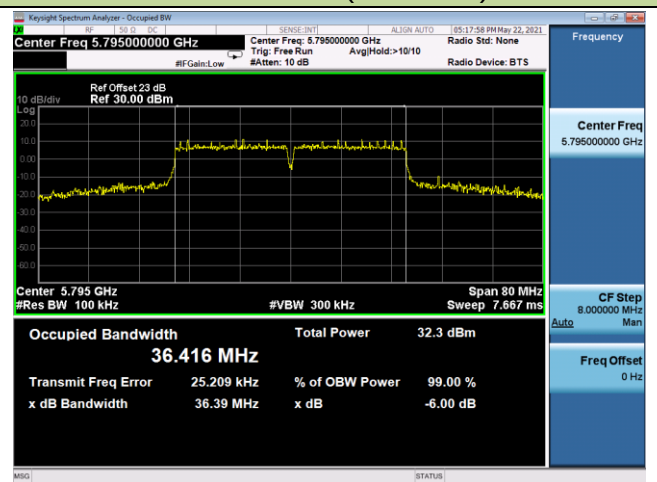


802.11ac-VHT40 6dB Bandwidth

Channel 151 (5755MHz)

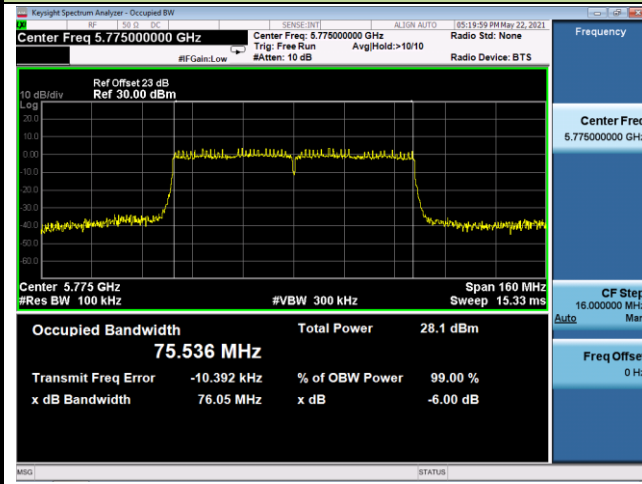


Channel 159 (5795MHz)



802.11ac-VHT80 6dB Bandwidth

Channel 155 (5775MHz)

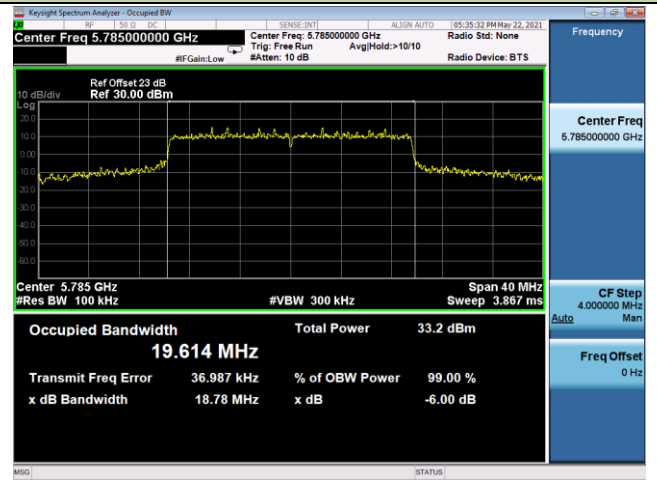


802.11ax-HE20 6dB Bandwidth

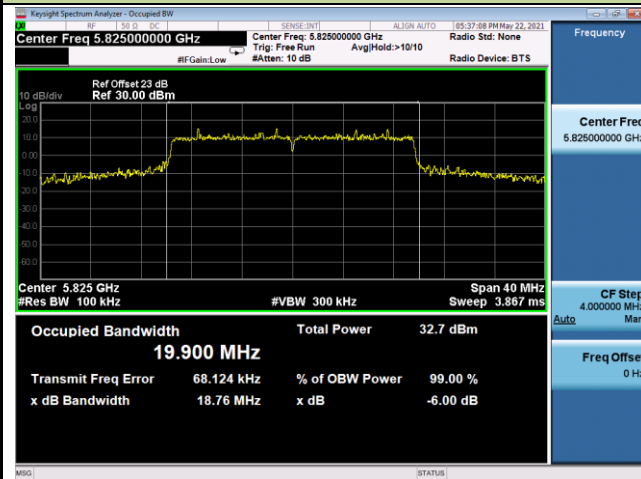
Channel 149 (5745MHz)



Channel 157 (5785MHz)

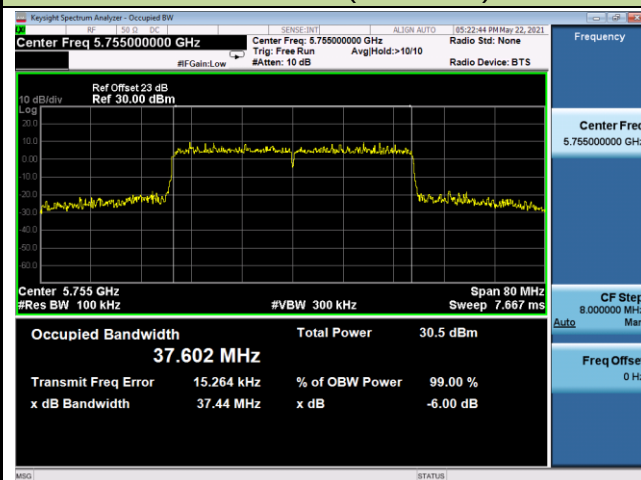


Channel 165 (5825MHz)

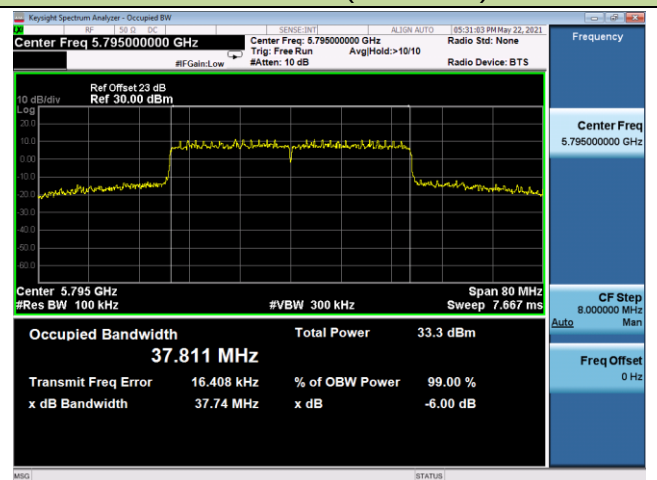


802.11ax-HE40 6dB Bandwidth

Channel 151 (5755MHz)



Channel 159 (5795MHz)



802.11ax-HE80 6dB Bandwidth

Channel 155 (5775MHz)



5.4. Output Power Measurement

5.4.1. Test Limit

For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 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.

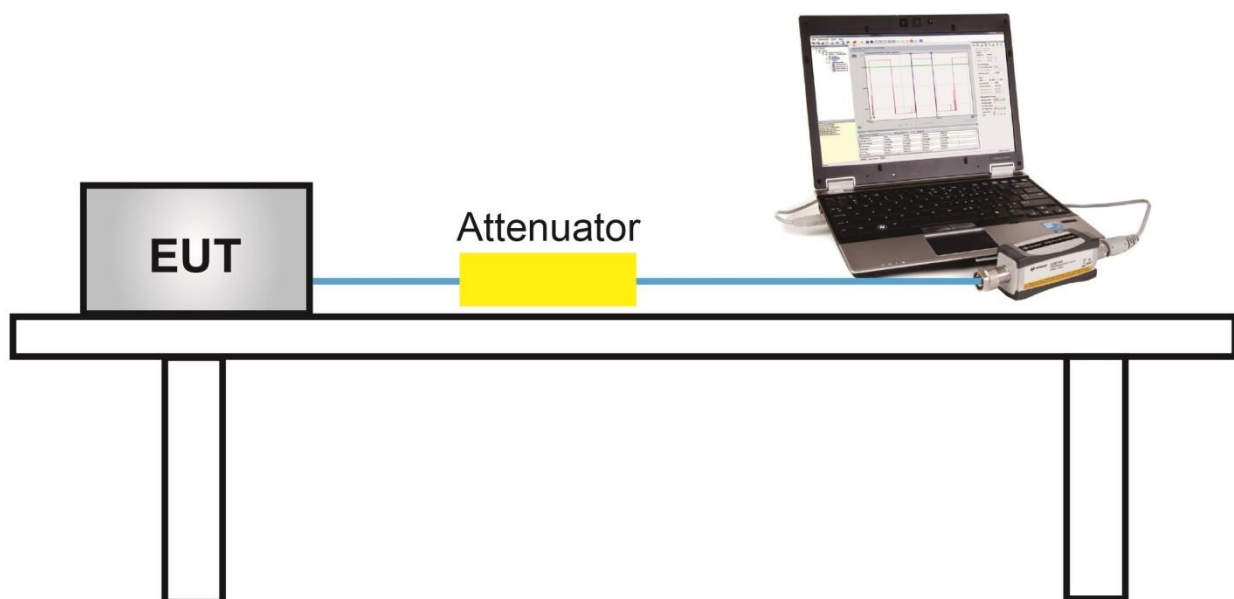
5.4.2. Test Procedure Used

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

5.4.3. Test Setting

Measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

5.4.4. Test Setup



5.4.5. 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.

Output power at various data rates for Ant 1 / Ant 1+1 port:

Test Mode	Bandwidth	Channel No.	Frequency (MHz)	Data Rate/ MCS	Average Power (dBm)
802.11a	20	36	5180	6Mbps	18.59
				24Mbps	18.44
				54Mbps	18.32
802.11n	20	36	5180	MCS0	18.80
				MCS4	18.68
				MCS7	18.51
802.11n	40	38	5190	MCS0	17.04
				MCS4	16.98
				MCS7	16.85
802.11ac	20	36	5180	MCS0	19.45
				MCS4	19.33
				MCS9	19.15
802.11ac	40	38	5190	MCS0	15.62
				MCS4	15.55
				MCS9	15.36
802.11ac	80	42	5210	MCS0	15.68
				MCS4	15.54
				MCS9	15.41
802.11ax	20	36	5180	MCS0	17.67
				MCS4	17.52
				MCS9	17.40
802.11ax	40	38	5190	MCS0	15.71
				MCS4	15.58
				MCS9	15.45
802.11ax	80	42	5210	MCS0	16.85
				MCS4	16.74
				MCS9	16.60

Test Site	NS-SR2	Test Engineer	Flag Yang
Test Date	2021/05/22		

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	Average Power (dBm)		Average Power (dBm)	Limit (dBm)	Result
				Ant 1	Ant 2			
802.11a	6Mbps	36	5180	18.59	18.31	28.50	≤ 30.00	Pass
802.11a	6Mbps	44	5220	24.38	24.52	27.46	≤ 30.00	Pass
802.11a	6Mbps	48	5240	24.59	24.44	27.53	≤ 30.00	Pass
802.11a	6Mbps	149	5745	25.83	25.13	28.50	≤ 30.00	Pass
802.11a	6Mbps	157	5785	26.58	25.73	29.19	≤ 30.00	Pass
802.11a	6Mbps	165	5825	26.39	25.78	29.11	≤ 30.00	Pass
802.11ac-VHT20	MCS0	36	5180	19.45	19.42	22.45	≤ 30.00	Pass
802.11ac-VHT20	MCS0	44	5220	24.83	24.89	27.87	≤ 30.00	Pass
802.11ac-VHT20	MCS0	48	5240	24.81	24.90	27.87	≤ 30.00	Pass
802.11ac-VHT20	MCS0	149	5745	26.71	25.83	29.30	≤ 30.00	Pass
802.11ac-VHT20	MCS0	157	5785	26.64	25.63	29.17	≤ 30.00	Pass
802.11ac-VHT20	MCS0	165	5825	26.35	25.54	28.97	≤ 30.00	Pass
802.11ac-VHT40	MCS0	38	5190	15.62	15.54	18.59	≤ 30.00	Pass
802.11ac-VHT40	MCS0	46	5230	26.31	26.34	29.34	≤ 30.00	Pass
802.11ac-VHT40	MCS0	151	5755	24.58	23.81	27.22	≤ 30.00	Pass
802.11ac-VHT40	MCS0	159	5795	25.87	25.31	28.61	≤ 30.00	Pass
802.11ac-VHT80	MCS0	42	5210	15.68	15.73	18.72	≤ 30.00	Pass
802.11ac-VHT80	MCS0	155	5775	20.92	20.04	23.51	≤ 30.00	Pass

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	Average Power (dBm)		Average Power (dBm)	Limit (dBm)	Result
				Ant 1	Ant 2			
802.11ax-HE20	MCS0	36	5180	17.67	17.41	20.55	≤ 30.00	Pass
802.11ax-HE20	MCS0	44	5220	24.99	25.01	28.01	≤ 30.00	Pass
802.11ax-HE20	MCS0	48	5240	25.02	24.91	27.98	≤ 30.00	Pass
802.11ax-HE20	MCS0	149	5745	26.68	26.03	29.38	≤ 30.00	Pass
802.11ax-HE20	MCS0	157	5785	26.71	25.67	29.23	≤ 30.00	Pass
802.11ax-HE20	MCS0	165	5825	26.43	25.68	29.08	≤ 30.00	Pass
802.11ax-HE40	MCS0	38	5190	15.71	15.81	18.77	≤ 30.00	Pass
802.11ax-HE40	MCS0	46	5230	26.88	26.51	29.71	≤ 30.00	Pass
802.11ax-HE40	MCS0	151	5755	24.61	23.86	27.26	≤ 30.00	Pass
802.11ax-HE40	MCS0	159	5795	25.75	25.11	28.45	≤ 30.00	Pass
802.11ax-HE80	MCS0	42	5210	16.85	16.73	19.80	≤ 30.00	Pass
802.11ax-HE80	MCS0	155	5775	20.63	20.02	23.35	≤ 30.00	Pass

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

5.5. Transmit Power Control

5.5.1. 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.

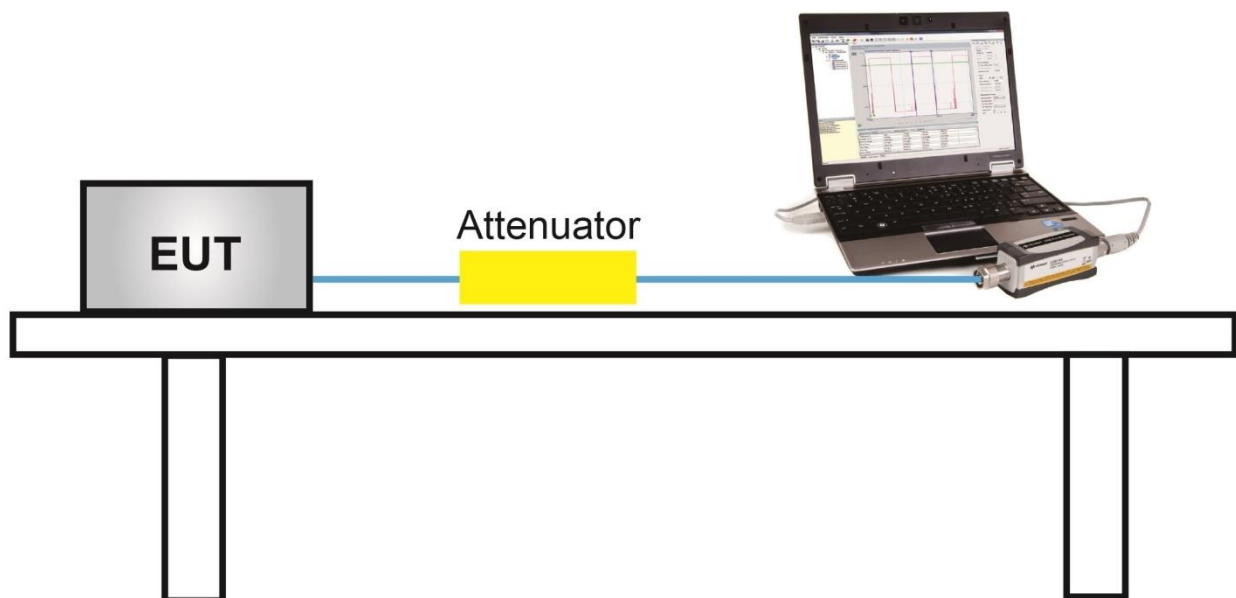
5.5.2. Test Procedure Used

KDB 789033D02v02r01- B 1 c)

5.5.3. 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.

5.5.4. Test Setup



5.5.5. Test Result

A TPC mechanism is not required for U-NII devices operating in the 5.15-5.25 GHz band and the 5.745-5.825 GHz band.

5.6. Power Spectral Density Measurement

5.6.1. Test Limit

For an indoor access point operating in 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.

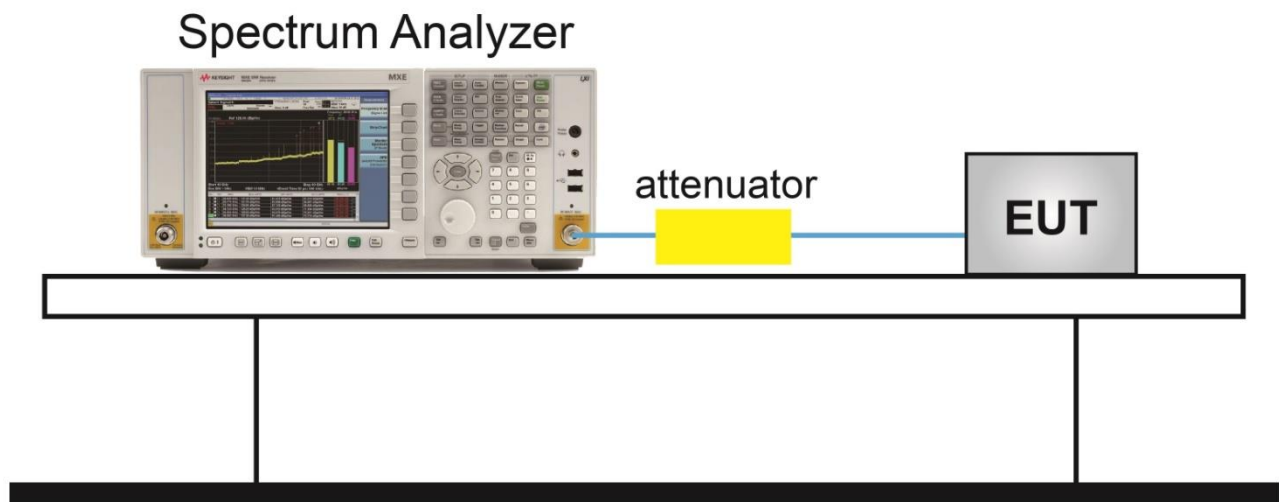
5.6.2. Test Procedure Used

KDB 789033 D02v02r01 - Section F

5.6.3. 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, RBW = 510kHz
4. VBW = 3MHz
5. Number of sweep points $\geq 2 \times (\text{span} / \text{RBW})$
6. Detector = Power averaging (RMS)
7. Trace average at least 100 traces in power averaging (rms) mode
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.

5.6.4. Test Setup



5.6.5. Test Result

Test Site	NS-SR2	Test Engineer	Flag Yang
Test Item	Power Spectral Density (UNII-Band 1)	Test Date	2021/05/22

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				
11a	6Mbps	36	5180	7.56	7.00	94.93	10.52	≤16.99	Pass
11a	6Mbps	44	5220	13.28	13.51	94.93	16.63	≤16.99	Pass
11a	6Mbps	48	5240	13.47	13.12	94.93	16.54	≤16.99	Pass
11ac-VHT20	MCS0	36	5180	8.15	8.16	98.47	11.16	≤16.99	Pass
11ac-VHT20	MCS0	44	5220	13.60	13.67	98.47	16.64	≤16.99	Pass
11ac-VHT20	MCS0	48	5240	13.60	13.70	98.47	16.66	≤16.99	Pass
11ac-VHT40	MCS0	38	5190	1.35	1.33	96.90	4.49	≤16.99	Pass
11ac-VHT40	MCS0	46	5230	11.93	12.02	96.90	15.12	≤16.99	Pass
11ac-VHT80	MCS0	42	5210	-1.53	-1.35	93.78	1.85	≤16.99	Pass
11ax-HE20	MCS0	36	5180	6.47	5.99	97.63	9.35	≤16.99	Pass
11ax-HE20	MCS0	44	5220	13.57	13.53	97.63	16.67	≤16.99	Pass
11ax-HE20	MCS0	48	5240	13.48	13.17	97.63	16.44	≤16.99	Pass
11ax-HE40	MCS0	38	5190	1.60	1.78	96.03	4.88	≤16.99	Pass
11ax-HE40	MCS0	46	5230	12.70	12.35	96.03	15.71	≤16.99	Pass
11ax-HE80	MCS0	42	5210	-0.27	-0.52	92.58	2.95	≤16.99	Pass

Note 1:

When EUT duty cycle < 98%, 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 - (6.01 - 6) = 16.99dBm/MHz;

Test Site	NS-SR2	Test Engineer	Flag Yang
Test Item	Power Spectral Density (UNII-Band 3)	Test Date	2021/05/22~2021/06/01

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	PSD (dBm/ 100kHz)		Duty Cycle (%)	Final PSD (dBm/ 500kHz)	Limit (dBm/ 500kHz)	Result
				Ant 1	Ant 2				
11a	6Mbps	149	5745	11.09	10.14	94.93	13.88	≤ 29.99	Pass
11a	6Mbps	157	5785	11.78	10.71	94.93	14.51	≤ 29.99	Pass
11a	6Mbps	165	5825	11.61	10.26	94.93	14.22	≤ 29.99	Pass
11ac-VHT20	MCS0	149	5745	12.05	10.36	98.47	14.30	≤ 29.99	Pass
11ac-VHT20	MCS0	157	5785	11.68	10.34	98.47	14.07	≤ 29.99	Pass
11ac-VHT20	MCS0	165	5825	11.88	10.22	98.47	14.14	≤ 29.99	Pass
11ac-VHT40	MCS0	151	5755	6.64	5.65	96.90	9.32	≤ 29.99	Pass
11ac-VHT40	MCS0	159	5795	8.03	7.07	96.90	10.73	≤ 29.99	Pass
11ac-VHT80	MCS0	155	5775	0.12	-0.97	93.78	2.90	≤ 29.99	Pass
11ax-HE20	MCS0	149	5745	11.55	10.13	97.63	14.01	≤ 29.99	Pass
11ax-HE20	MCS0	157	5785	11.37	10.12	97.63	13.90	≤ 29.99	Pass
11ax-HE20	MCS0	165	5825	11.42	10.12	97.63	13.94	≤ 29.99	Pass
11ax-HE40	MCS0	151	5755	6.76	5.75	96.03	9.47	≤ 29.99	Pass
11ax-HE40	MCS0	159	5795	7.64	6.87	96.03	10.46	≤ 29.99	Pass
11ax-HE80	MCS0	155	5775	-0.05	-0.94	92.58	2.87	≤ 29.99	Pass

Note 1:

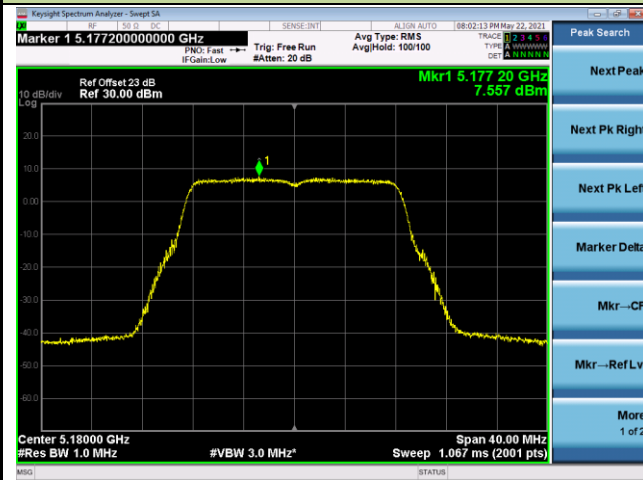
When EUT duty cycle < 98%, Final PSD (dBm / 510kHz) = $10 \cdot \log\{10^{(Ant\ 1\ AVG\ PSD/10)} + 10^{(Ant\ 2\ AVG\ PSD/10)}\} + 10 \cdot \log(1/Duty\ cycle)$.

Note 2: PSD Limit Calculation as below:

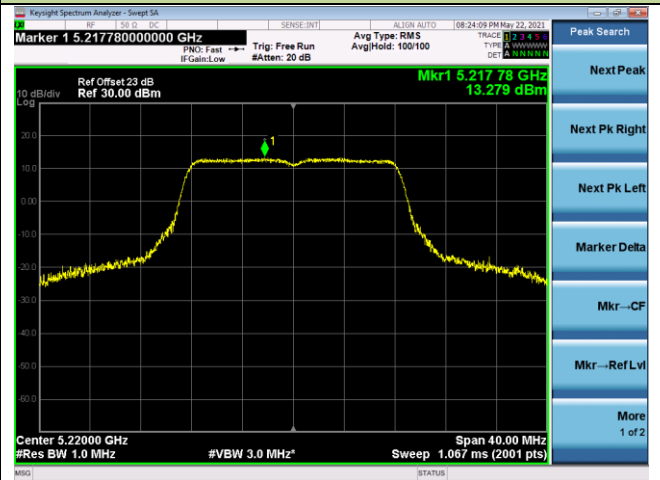
For 5725-5850MHz: PSD Limit = 30 - (6.01 - 6) = 29.99dBm/500KHz;

802.11a Power Spectral Density- Ant 1 / Ant 1 + 2

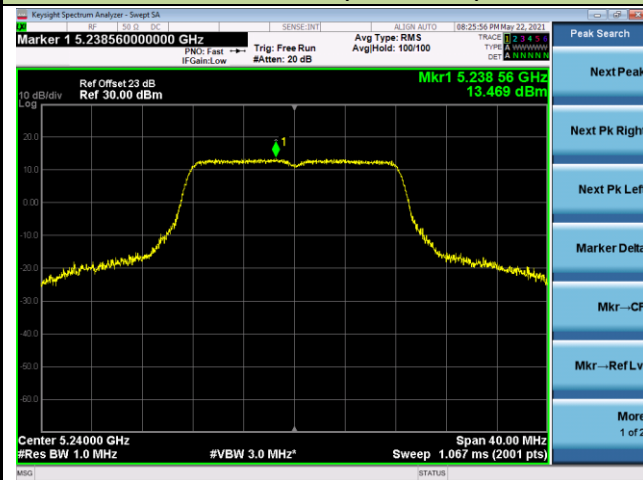
Channel 36 (5180MHz)



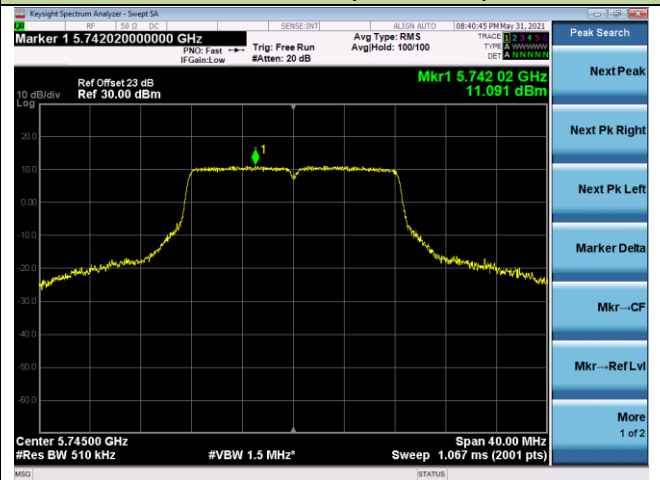
Channel 44 (5220MHz)



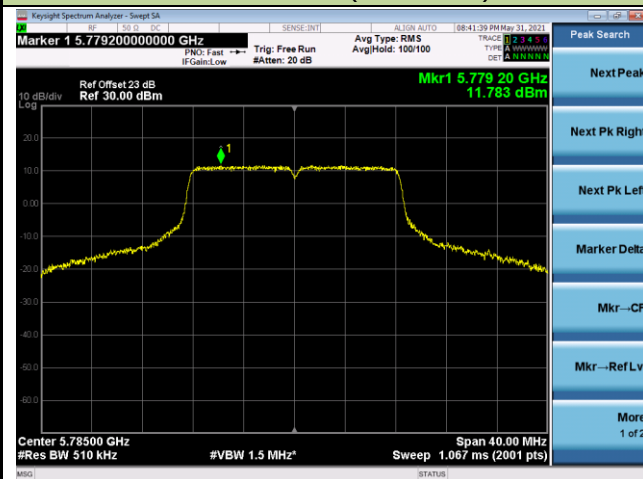
Channel 48 (5240MHz)



Channel 149 (5745MHz)



Channel 157 (5785MHz)



Channel 165 (5825MHz)

