MEASUREMENT REPORT

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

FCC ID:	2AXJ4X50V2
Applicant:	TP-Link Corporation Limited
Application Type:	Certification
Product:	AX3000 Whole Home Mesh Wi-Fi 6 System
Model No.:	Deco X50
Brand Name:	tp-link
FCC Classification:	Unlicensed National Information Infrastructure (UNII)
FCC Rule Part(s):	Part15 Subpart E (Section 15.407)
Test Date:	November 30 ~ December 27, 2021

Reviewed By: Paddy Chen
(Paddy Chen)

Approved By: Chenz Ker
(Chenz Ker)

Testing Laboratory
3261

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 (Taiwan) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date	Note
2111TW0005-U2	V1.0	Original report	2021-12-27	Valid

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General Information

Applicant	TP-Link Corporation Limited
Applicant Address	Room 901, 9/F., New East Ocean Centre, 9 Science Museum Road, Tsim Sha Tsui, Kowloon, Hongkong
Manufacturer	TP-Link Corporation Limited
Manufacturer Address	Room 901, 9/F., New East Ocean Centre, 9 Science Museum Road, Tsim Sha Tsui, Kowloon, Hongkong
Test Site	MRT Technology (Taiwan) Co., Ltd
Test Site Address	No. 38, Fuxing Second Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C)
MRT FCC Registration No.	291082
FCC Rule Part(s)	Part 15.407

Test Facility / Accreditations

1. MRT facility is a FCC registered (Reg. No. 291082) test facility with the site description report on file and is designated by the FCC as an Accredited Test Firm.
2. MRT facility is an IC registered (MRT Reg. No. 21723) test laboratory with the site description on file at Industry Canada.
3. MRT Lab is accredited to ISO 17025 by the Taiwan Accreditation Foundation (TAF Cert. No. 3261) in EMC, Telecommunications and Radio testing for FCC (Designation Number: TW3261), Industry Taiwan, EU and TELEC Rules.

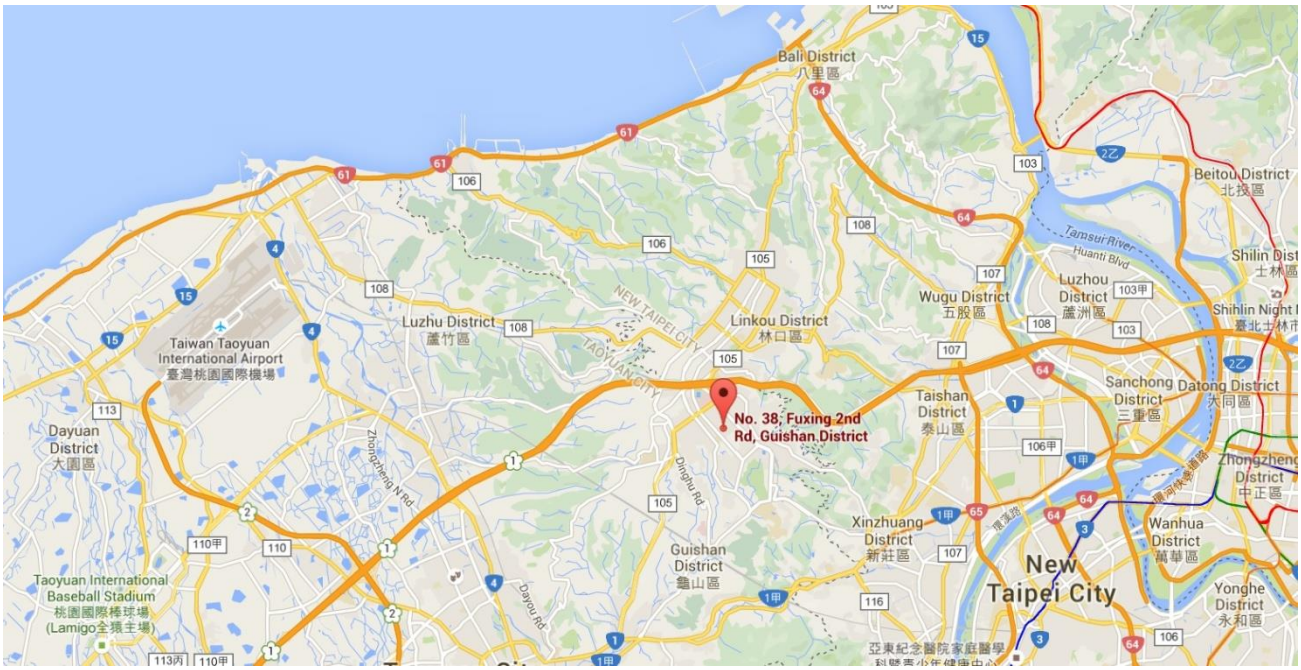
1. INTRODUCTION

1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taoyuan City. These measurement tests were conducted at the MRT Technology (Taiwan) Co., Ltd. Facility located at No.38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 33377, Taiwan (R.O.C).



2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name	AX3000 Whole Home Mesh Wi-Fi 6 System
Model No.	Deco X50
Wi-Fi Specification	802.11a/b/g/n/ac/ax
Power Type	AC Power Adapter
EUT Identification No.:	20211115Sample#12 (Conducted) 20211115Sample#13 (Radiated & AC conducted emission)
Operating Environment	Indoor Use
Antenna Information	Refer to Section 2.4
Accessories	
AC Power Adapter	Model: T120120-2B4 Input: 100-240V ~ 50/60Hz, 0.4A Output: 12V, 1.2A

Note: The information shown above was provided by manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.

2.2. Product Specification Subjective to this Report

Frequency Range	For 802.11a/n-HT20/ac-VHT20/ax-HE20: 5180~5250MHz, 5745~5825MHz For 802.11n-HT40/ac-VHT40/ax-HE40: 5190~5230MHz, 5755~5795MHz For 802.11ac-VHT80/ax-HE80: 5210MHz, 5775MHz For 802.11ac-VHT160/ax-HE160: 5250 MHz
Type of 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 1733.3Mbps 802.11ax: up to 2402Mbps

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

2.3. 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	--	--

802.11ac-VHT160/ax-HE160

Channel	Frequency	Channel	Frequency
50	5250 MHz	--	--

2.4. Description of Available Antennas

Antenna Type	Frequency Band (GHz)	Tx Path	Max Peak Gain (dBi)	CDD Directional Gain (dBi)	
				For Power	For PSD
Omni	2.4 ~ 2.5	2	1.94	1.94	4.95
	5.15 ~ 5.25	2	2.97	2.97	5.98
	5.25 ~ 5.35	2	2.87	2.87	5.88
	5.725 ~ 5.85	2	2.94	2.94	5.95

Note:

The EUT supports Cyclic Delay Diversity (CDD) mode, and CDD signals are correlated.

For CDD transmissions, directional gain is calculated as follows, N_{ANT} =2, N_{SS} = 1.

If all antennas have the same gain, G_{ANT}, Directional gain = G_{ANT} + 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 = 3.01;

- For power measurements on IEEE 802.11 devices,

  Array Gain = 0 dB for $N_{ANT} \leq 4$;

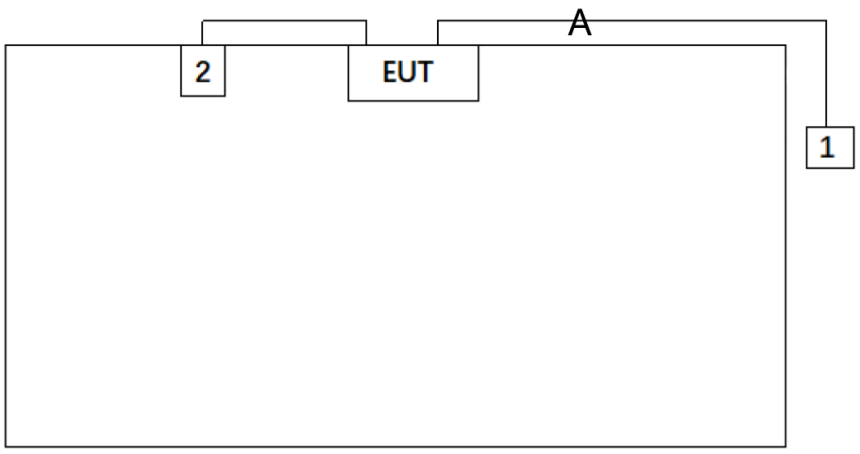
2.5. Test Mode

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 802.11ac-VHT160 (MCS0)
	Mode 6: Transmit by 802.11ax-HE20 (MCS0)
	Mode 7: Transmit by 802.11ax-HE40 (MCS0)
	Mode 8: Transmit by 802.11ax-HE80 (MCS0)
	Mode 9: Transmit by 802.11ax-HE160 (MCS0)

Note: Due to the same modulation between 802.11n and 802.11ac, so 802.11n is covered by 802.11ac in this report, meanwhile, power setting for 802.11n will be equal or less than 802.11ac.

2.6. Configuration of Test System

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.



Product		Manufacturer	Model No.
1	Notebook	ThinkPad	E495
2	AC Adapter	TP-Link Corporation Limited	T120120-2B4

Note 1: The test utility software used during testing was “accessMtool”, and the version was “3.2.1.2”.

Note 2: Detail power setting refer to operation description.

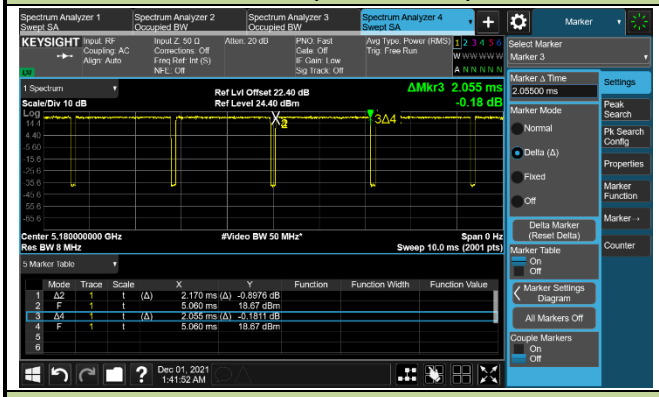
2.7. Duty Cycle

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:

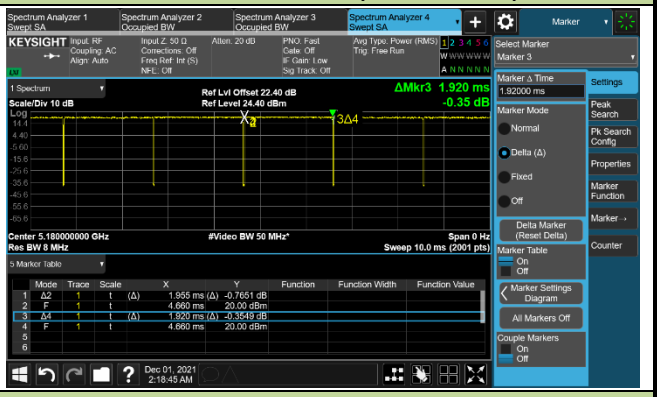
Test Mode	Duty Cycle	Test Mode	Duty Cycle
802.11a	94.70%	802.11ax-HE20	97.43%
802.11ac-VHT20	98.21%	802.11ax-HE40	95.81%
802.11ac-VHT40	96.64%	802.11ax-HE80	92.38%
802.11ac-VHT80	93.67%	802.11ax-HE160	89.43%
802.11ac-VHT160	89.24%	--	--

Duty Cycle (T = Transmission Duration)

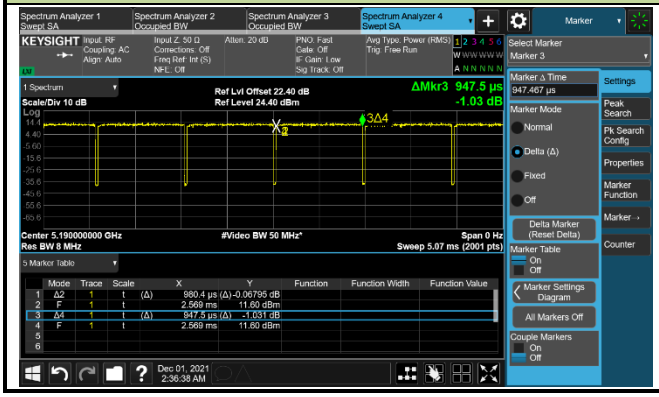
802.11a (T=2.055ms)



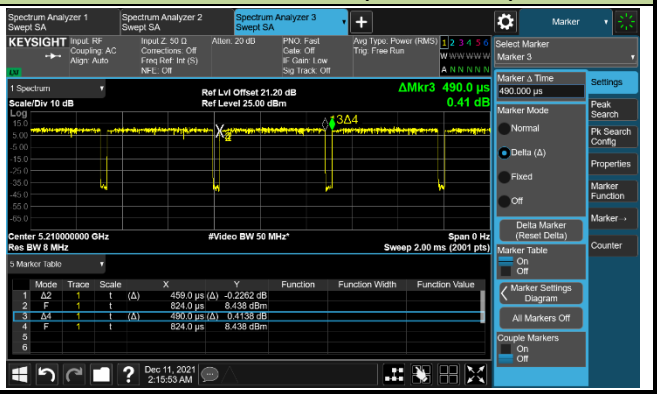
802.11ac-VHT20 (T=1.920ms)



802.11ac-VHT40 (T=947.5us)

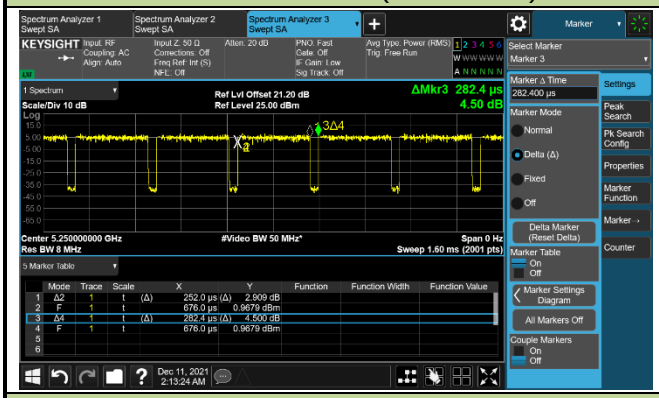


802.11ac-VHT80 (T=490.0us)

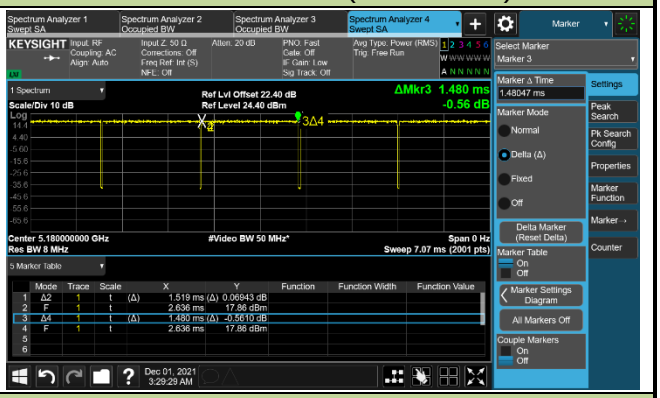


Duty Cycle (T = Transmission Duration)

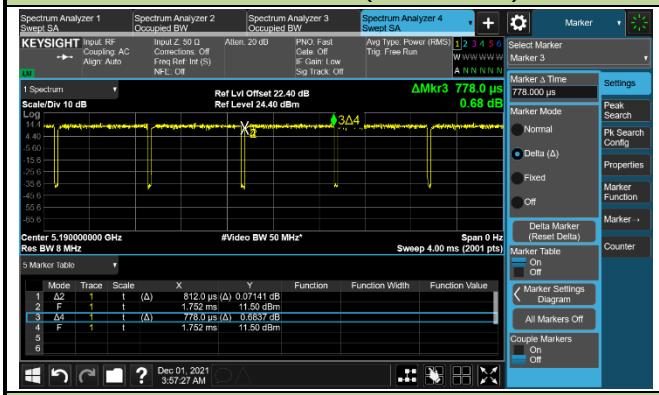
802.11ac-VHT160 (T=282.4us)



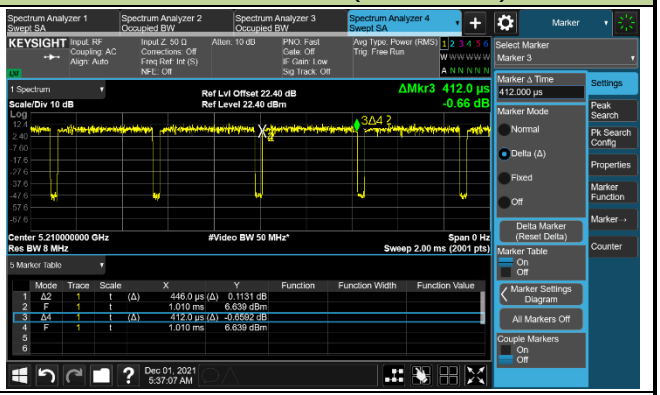
802.11ax-HE20 (T=1.480ms)



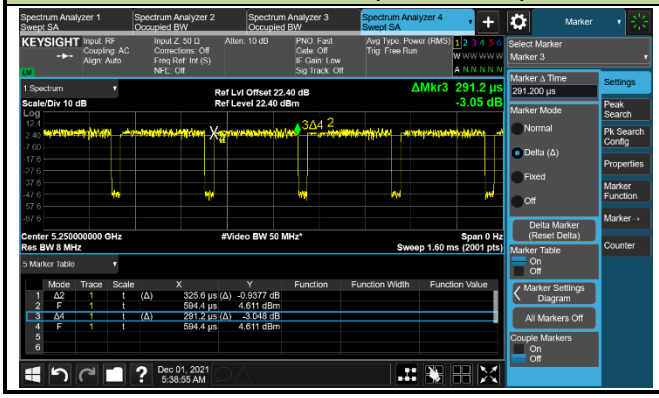
802.11ax-HE40 (T=778.0us)



802.11ax-HE80 (T=412.0us)



802.11ax-HE160 (T=291.2us)



2.8. Applicable Standards

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

- ANSI C63.10-2013
- FCC KDB 789033 D02v02r01
- FCC KDB 662911 D01v02r01
- FCC KDB 414788 D01v01r01

2.9. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

2.10. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase. However, when the device is so small wherein placement of the label with specified statement is not practical, only the FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

3. DESCRIPTION OF TEST

3.1. Evaluation Procedure

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013), and the guidance provided in KDB 789033 D02v02r01 were used in the measurement.

3.2. AC Line Conducted Emissions

The line-conducted facility is located inside an8'x4'x4' shielded enclosure. A 1m x 2m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50uH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.
The EUT is powered from one LISN and the support equipment is powered from the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference ground-plane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.
Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the receiver and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The receiver was scanned from 150kHz to 30MHz. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was also maximized by varying: power lines, the mode of operation or data exchange speed, or support equipment whichever determined the worst-case emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions are used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.
An extension cord was used to connect to a single LISN which powered by EUT. The extension cord was calibrated with LISN, the impedance and insertion loss are compliance with the requirements as stated in ANSI C63.10-2013.

3.3. Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. A MF Model 210SS turntable is used for radiated measurement. It is a continuously rotatable, remote controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An80cm high PVC support structure is placed on top of the turntable.
For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up for frequencies below 1GHz was placed on top of the 0.8 meter high, 1 x 1.5 meter table; and test set-up for frequencies 1-40GHz was placed on top of the 1.5 meter high, 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, if applicable, turntable azimuth, and receive antenna height was noted for each frequency found.
Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions. According to 3dB Beam-Width of horn antenna, the horn antenna should be always directed to the EUT when rising height.

4. 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.

5. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions -SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Two-Line V-Network	R&S	ENV 216	MRTTWA00019	1 year	2022/3/23
Two-Line V-Network	R&S	ENV 216	MRTTWA00020	1 year	2022/4/24
8-Wire ISN (T8)	R&S	ENY81	MRTTWA00018	1 year	2022/5/30
EMI Test Receiver	R&S	ESR3	MRTTWA00045	1 year	2022/5/25
Temperature/Humidity Meter	TFA	35.1083	MRTTWA00050	1 year	2022/6/3

Radiated Emissions – AC1/AC2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Active Loop Antenna	SCHWARZBECK	FMZB 1519B	MRTTWA00002	1 year	2022/4/27
Broadband TRILOG Antenna	SCHWARZBECK	VULB 9162	MRTTWA00001	1 year	2022/10/4
Broadband Horn Antenna	SCHWARZBECK	BBHA 9120D	MRTTWA00003	1 year	2022/4/24
Broadband Horn Antenna	RFSPIN	DRH18-E	MRTTWA00087	1 year	2022/6/28
Broadband Horn Antenna	SCHWARZBECK	BBHA 9170	MRTTWA00004	1 year	2022/4/24
Broadband Preamplifier	SCHWARZBECK	BBV 9718	MRTTWA00005	1 year	2022/4/24
Broadband Preamplifier	EMC Instruments corporation	EMC118A45SE	MRTTWA00088	1 year	2022/6/28
Broadband Amplifier	SCHWARZBECK	BBV 9721	MRTTWA00006	1 year	2022/4/24
Signal Analyzer	R&S	FSV40	MRTTWA00007	1 year	2022/3/23
EMI Test Receiver	R&S	ESR3	MRTTWA00009	1 year	2022/3/24
EXA Signal Analyzer	KEYSIGHT	N9010A	MRTTWA00012	1 year	2022/11/14
Antenna Cable	HUBERSUHNER	SF106	MRTTWE00010	1 year	2022/6/28
Cable	Rosnol	K1K50-UP0264-K1K50-4M	MRTTWE00012	1 year	2022/6/20
Antenna Cable	HUBERSUHNER	SF106	MRTTWE00034	1 year	2022/6/28
Cable	HUBERSUHNER	EMC105-NM-NM-3000	MRTTWE00035	1 year	2022/6/28
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00032	1 year	2022/6/6

Conducted Test Equipment – SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
X-Series USB Peak and Average Power Sensor	KEYSIGHT	U2021XA	MRTTWA00014	1 year	2022/4/21
EXA Signal Analyzer	KEYSIGHT	N9010A	MRTTWA00012	1 year	2022/11/14
EXA Signal Analyzer	KEYSIGHT	N9010B	MRTTWA00074	1 year	2022/7/19
Attenuator	WTI	218FS-20	MRTTWE00027	1 year	2022/6/16
Attenuator	WTI	218FS-10	MRTTWE00028	1 year	2022/6/16
Attenuator	WTI	218FS-06	MRTTWE00029	1 year	2022/6/16
Temperature/Humidity Meter	TFA	35.1083	MRTTWA00050	1 year	2022/6/3

Software	Version	Function
e3	9.160520a	EMI Test Software

6. 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
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 150kHz~30MHz: 2.53dB
Radiated Emission Measurement
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 9kHz ~ 1GHz: 4.25dB 1GHz ~ 40GHz: 4.45dB
Conducted Power (Carrier Power / Power Density)
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): ± 0.84dB
Conducted Spurious Emission
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): ± 2.65 dB
Occupied Bandwidth
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 3.3%
Temp. / Humidity
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): ±0.82°C/ ±3%
Frequency Error
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): ±78.4Hz

7. TEST RESULT

7.1. Summary

FCC Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.407(a)	26dB Bandwidth	N/A	Conducted	Pass	Section 7.2
15.407(e)	6dB Bandwidth	≥ 500kHz		Pass	Section 7.3
15.407(a)(1)(ii), (2), (3)(i)	Maximum Conducted Output Power	≤ 30dBm (NII-1 & NII-3) ≤ 250mW (NII-2)		Pass	Section 7.4
15.407(h)(1)	Transmit Power Control	≤ 24 dBm		Pass	Section 7.5
15.407(a)(1)(ii), (2), (3)(i), (12)	Peak Power Spectral Density	≤ 17dBm/MHz (NII-1) ≤ 11dBm/MHz (NII-2) ≤ 30dBm/500kHz (NII-3)		Pass	Section 7.6
15.407(g)	Frequency Stability	± 20 ppm		Pass	Section 7.7
15.407(b)(1), (2), (3), (4)(i)	Undesirable Emissions	Refer to Section 7.8	Radiated	Pass	Section 7.8 & 7.9
15.407(b)(8), (9), (10)	General Field Strength (Restricted Bands and Radiated Emission)	Emissions in restricted bands must meet the radiated limits detailed in15.209		Pass	
15.207	AC Conducted Emissions 150kHz - 30MHz	< FCC 15.207 limits	Line Conducted	Pass	Section 7.10

Notes:

1) 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.
2) Determining compliance is based on the test results met the regulation limits or requirements declared by clients, and the test results don't take into account the value of measurement uncertainty.
3) EUT supports one configuration only in 802.11ax full RU mode.

7.2. 26dB Bandwidth Measurement

7.2.1.Test Limit

N/A

7.2.2.Test Procedure used

KDB 789033 D02v02r01- Section C.1 (26dB Bandwidth)

KDB 789033 D02v02r01- Section D (99% Bandwidth)

7.2.3.Test Setting

26dB Bandwidth

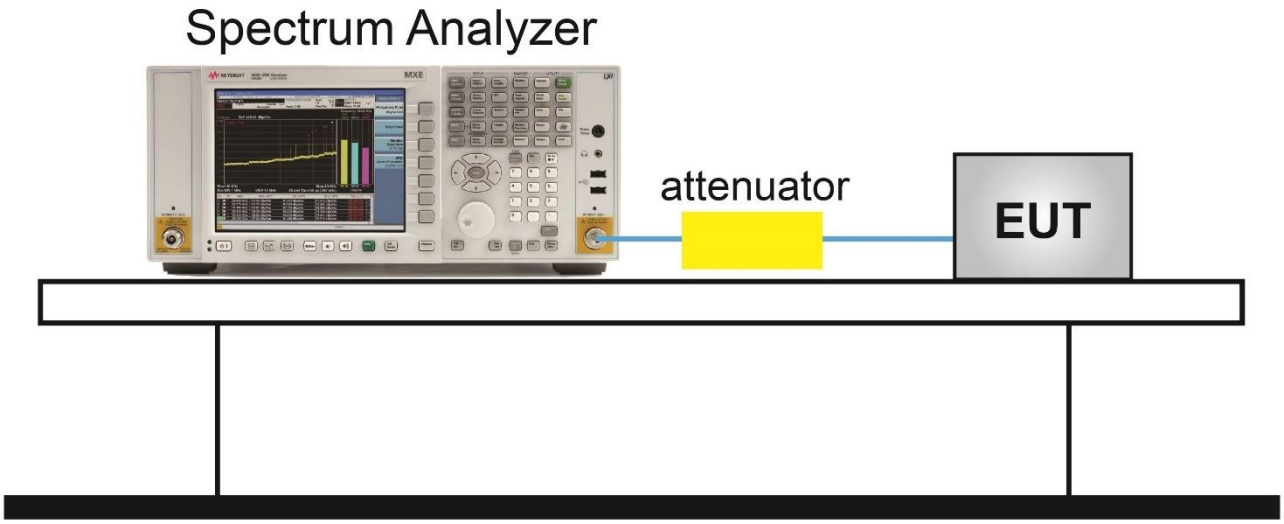
1. The analyzers' automatic bandwidth measurement capability was used to perform the 26dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 26. The automatic bandwidth measurement function also has the capability of simultaneously measuring the 99% occupied bandwidth. The bandwidth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

99% Bandwidth

1. Set center frequency to the nominal EUT channel center frequency.
2. Set span = 1.5 times to 5.0 times the OBW.
3. Set RBW = 1% to 5% of the OBW
4. Set VBW ≥ 3×RBW
5. Detector = Peak.

Use the 99% power bandwidth function of the instrument.

7.2.4.Test Setup



7.2.5.Test Result

Product	AX3000 Whole Home Mesh Wi-Fi 6 System	Temperature	19°C
Test Engineer	Eric Lin	Relative Humidity	61%
Test Site	SR2	Test Date	2021/12/01~2021/12/02

Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
802.11a	6Mbps	36	5180	21.44	16.81
802.11a	6Mbps	44	5220	38.04	17.94
802.11a	6Mbps	48	5240	38.42	18.66
802.11a	6Mbps	149	5745	38.95	19.78
802.11a	6Mbps	157	5785	39.07	19.82
802.11a	6Mbps	165	5825	39.15	19.79
802.11ac-VHT20	MCS0	36	5180	21.64	17.94
802.11ac-VHT20	MCS0	44	5220	39.01	19.58
802.11ac-VHT20	MCS0	48	5240	38.27	19.83
802.11ac-VHT20	MCS0	149	5745	39.58	19.55
802.11ac-VHT20	MCS0	157	5785	39.07	19.57
802.11ac-VHT20	MCS0	165	5825	39.77	19.97
802.11ac-VHT40	MCS0	38	5190	39.90	36.30
802.11ac-VHT40	MCS0	46	5230	77.68	38.15
802.11ac-VHT40	MCS0	151	5755	79.58	38.36
802.11ac-VHT40	MCS0	159	5795	79.81	38.15
802.11ac-VHT80	MCS0	42	5210	81.65	75.76
802.11ac-VHT80	MCS0	155	5775	150.4	77.29
802.11ac-VHT160	MCS0	50	5250	164.0	154.6
802.11ax-HE20	MCS0	36	5180	21.50	19.09
802.11ax-HE20	MCS0	44	5220	36.99	19.57
802.11ax-HE20	MCS0	48	5240	39.35	19.95
802.11ax-HE20	MCS0	149	5745	39.90	19.75
802.11ax-HE20	MCS0	157	5785	39.22	19.71
802.11ax-HE20	MCS0	165	5825	39.33	19.77

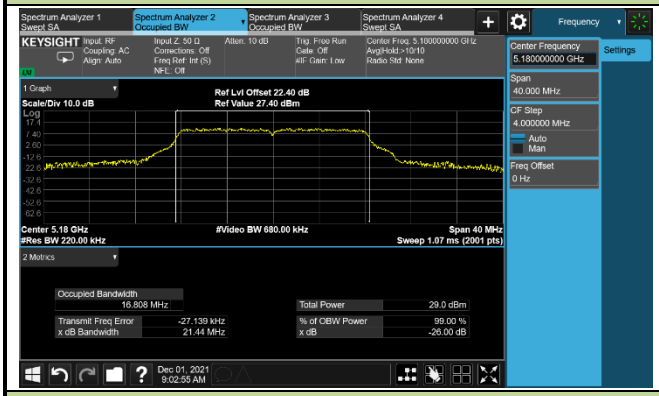
Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
802.11ax-HE40	MCS0	38	5190	39.86	37.52
802.11ax-HE40	MCS0	46	5230	74.74	38.47
802.11ax-HE40	MCS0	151	5755	76.04	39.08
802.11ax-HE40	MCS0	159	5795	77.94	39.25
802.11ax-HE80	MCS0	42	5210	81.01	76.94
802.11ax-HE80	MCS0	155	5775	144.1	79.69
802.11ax-HE160	MCS0	50	5250	164.5	156.0

Test Mode	Channel No.	Frequency (MHz)	99% Bandwidth (MHz)	F_H (MHz)	Result
802.11a	48	5240	18.66	5249.330	< 5250
802.11ac-VHT20	48	5240	19.83	5249.915	< 5250
802.11ac-VHT40	46	5230	38.15	5249.075	< 5250
802.11ac-VHT80	42	5210	75.76	5247.880	< 5250
802.11ax-HE20	48	5240	19.95	5249.975	< 5250
802.11ax-HE40	46	5230	38.47	5249.235	< 5250
802.11ax-HE80	42	5210	76.94	5248.470	< 5250

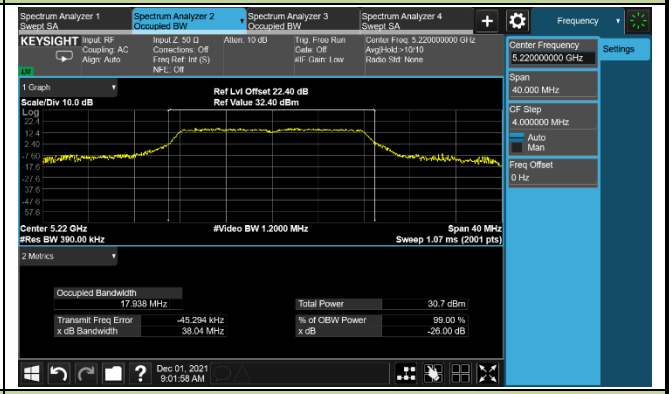
Note: F_H is the frequency of the upper resulting from the OBW.

802.11a 26dB Bandwidth & 99% Bandwidth

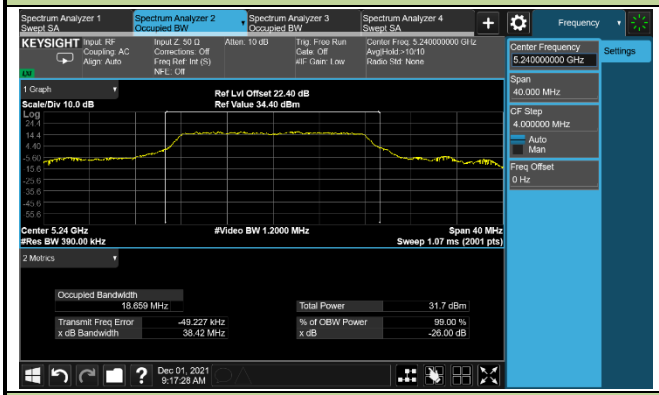
Channel 36 (5180MHz)



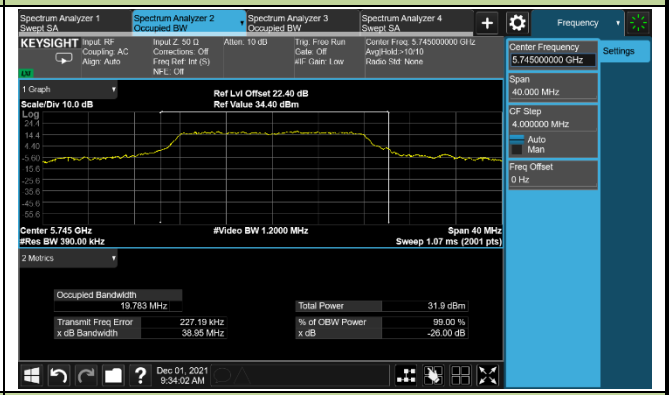
Channel 44 (5220MHz)



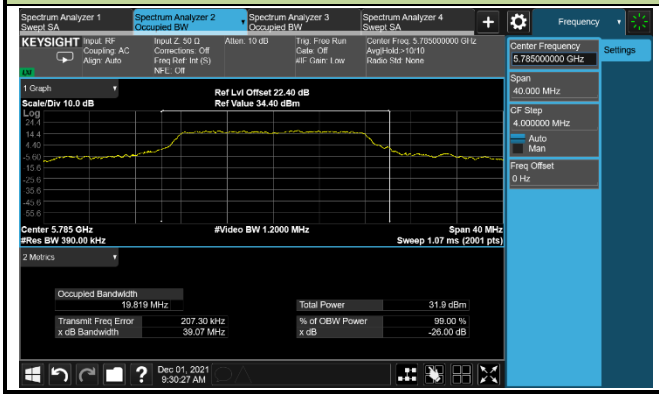
Channel 48 (5240MHz)



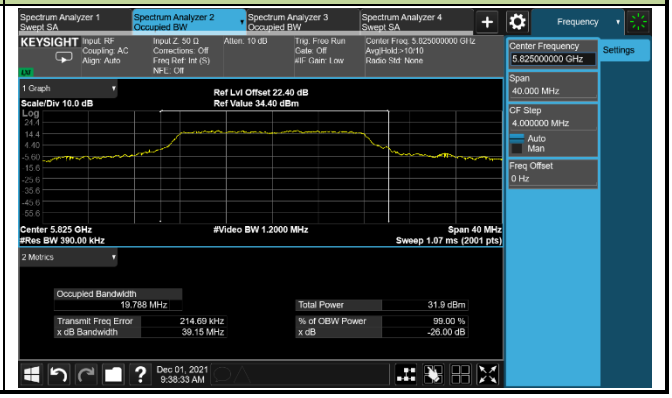
Channel 149 (5745MHz)



Channel 157 (5785MHz)

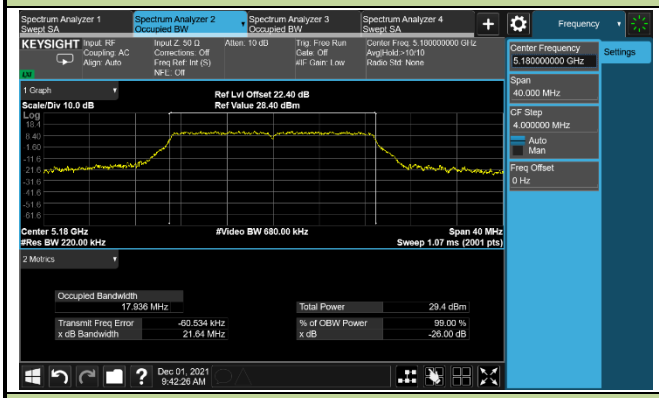


Channel 165 (5825MHz)



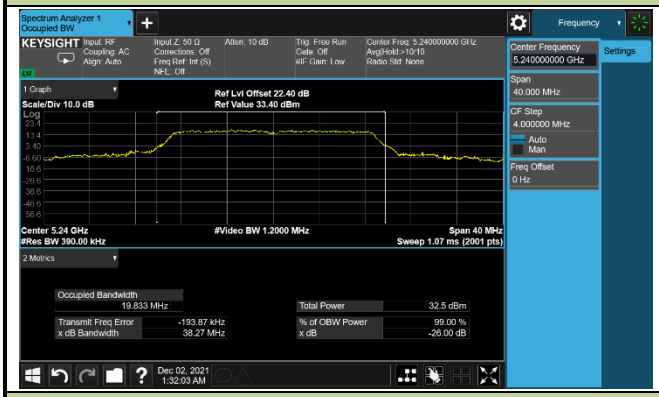
802.11ac-VHT20 26dB Bandwidth & 99% Bandwidth

Channel 36 (5180MHz)



Channel 44 (5220MHz)

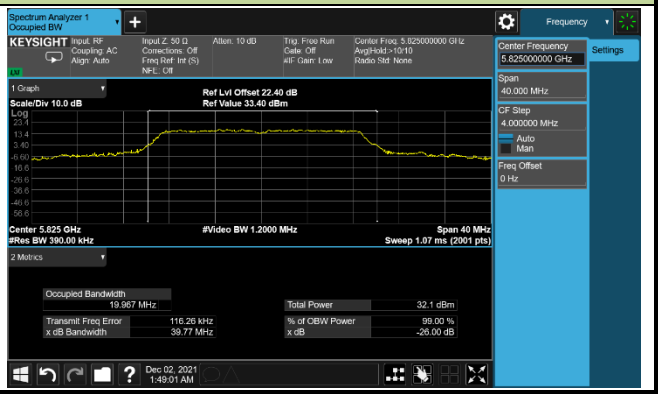
Channel 48 (5240MHz)

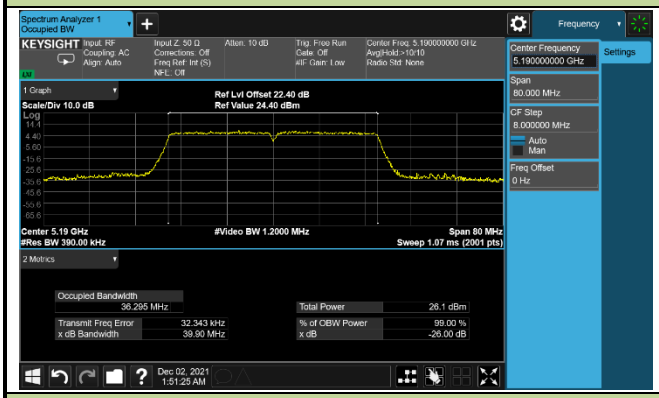
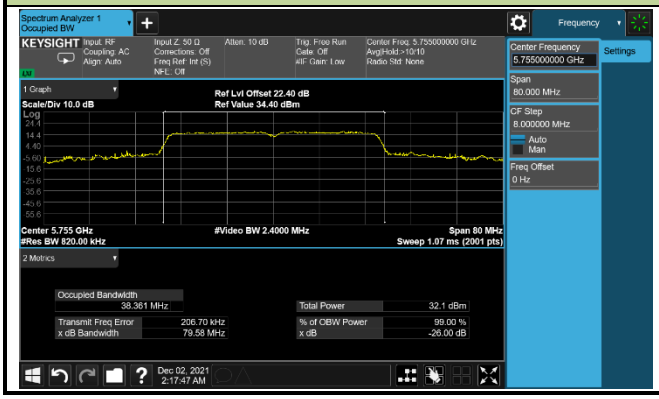
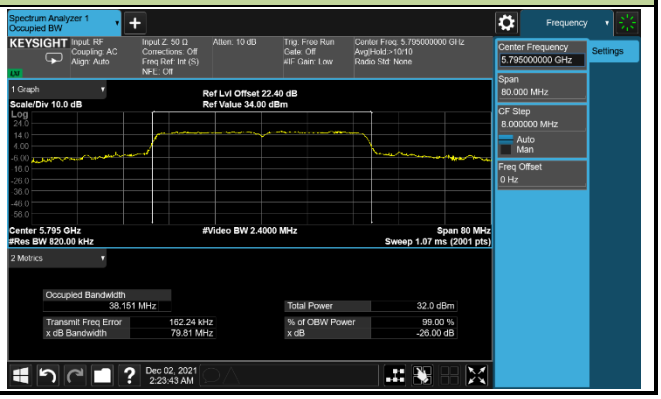


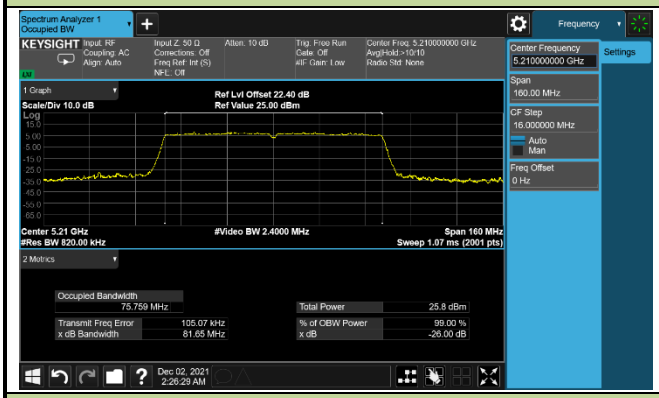
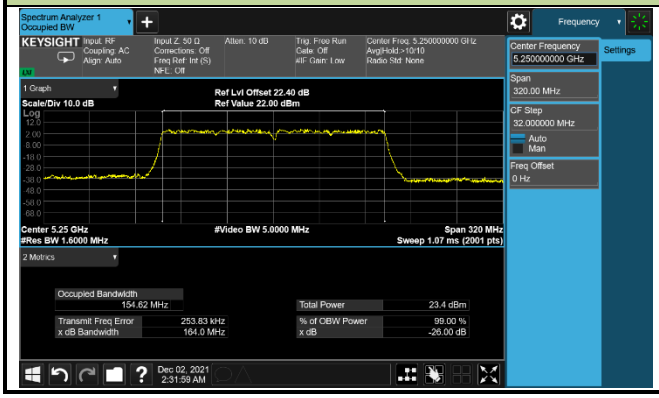
Channel 149 (5745MHz)

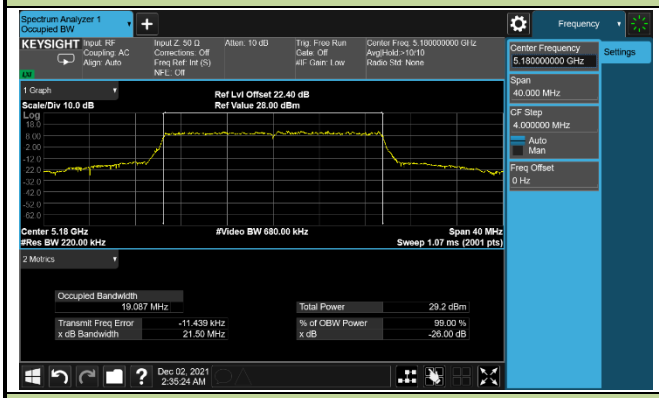
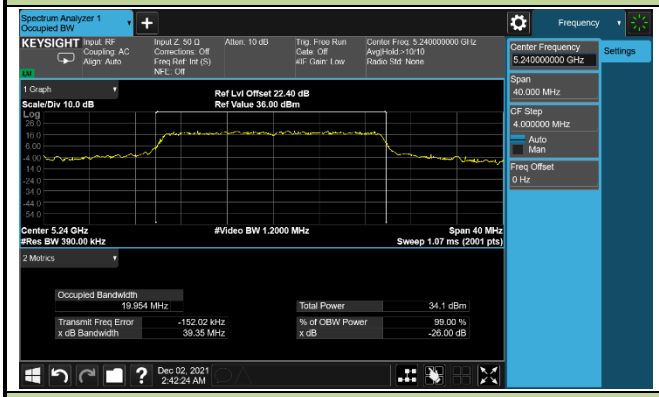
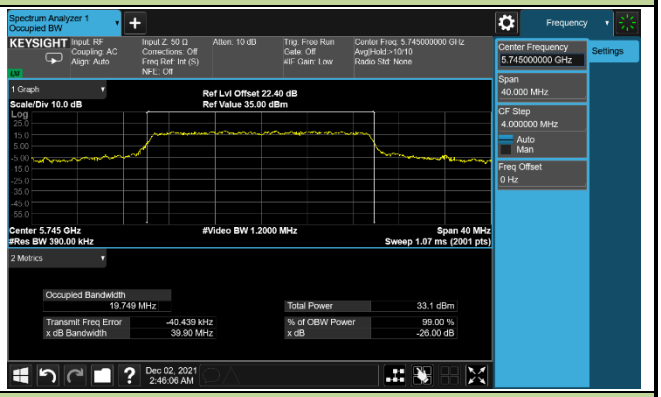
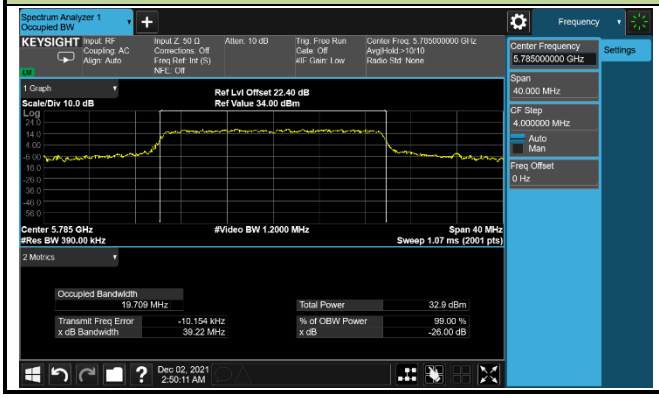
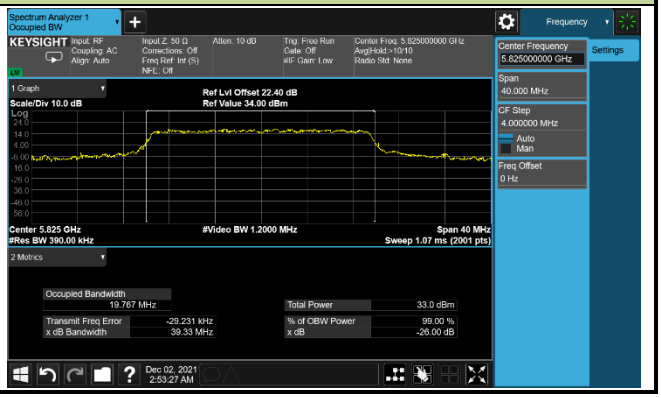
Channel 157 (5785MHz)

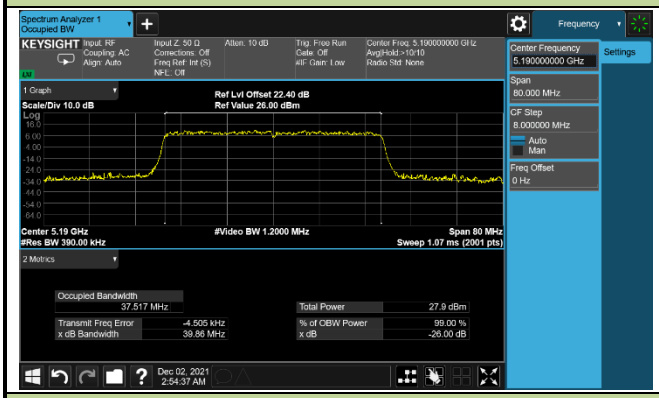
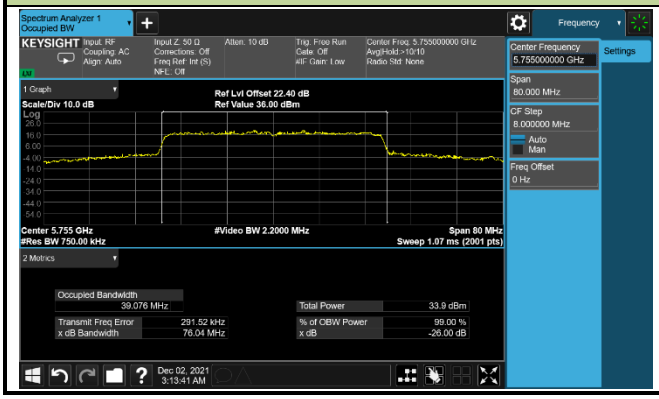
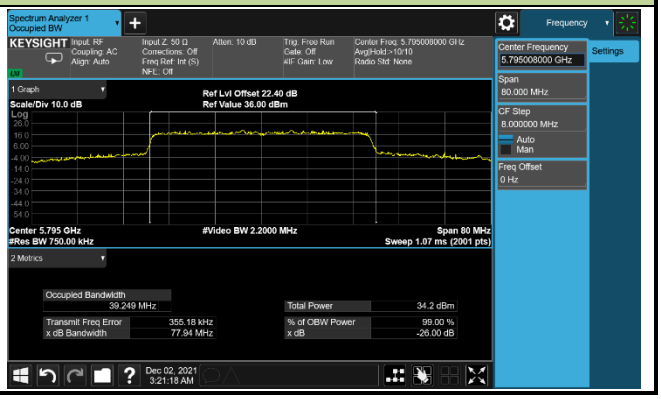
Channel 165 (5825MHz)

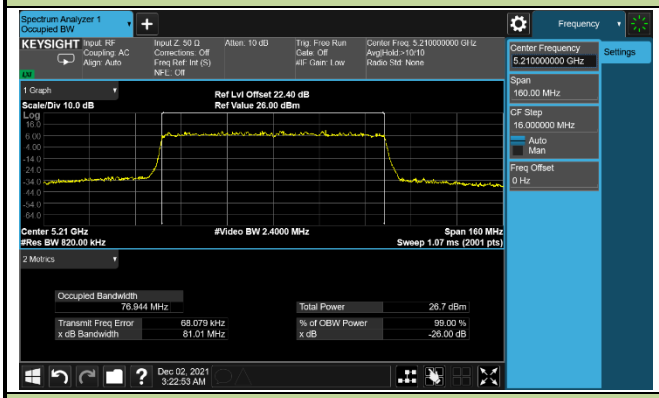
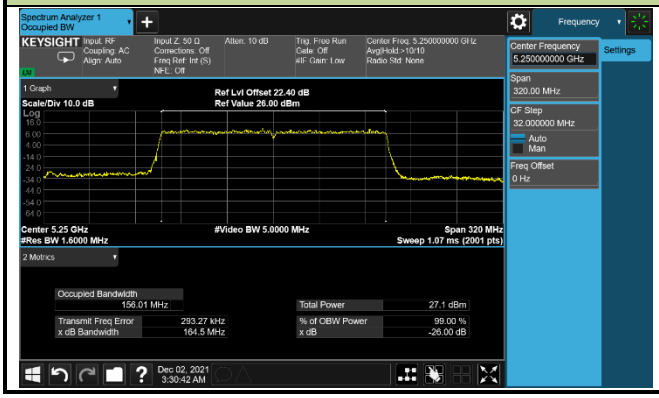


802.11ac-VHT40 26dB Bandwidth & 99% Bandwidth	
Channel 38 (5190MHz)	Channel 46 (5230MHz)
	
Channel 151 (5755MHz)	Channel 159 (5795MHz)
	

802.11ac-VHT80 26dB Bandwidth & 99% Bandwidth	
Channel 42 (5210MHz)	Channel 155 (5775MHz)
	
802.11ac-VHT160 26dB Bandwidth & 99% Bandwidth	
Channel 50 (5250MHz)	
	

802.11ax-HE20 26dB Bandwidth & 99% Bandwidth	
Channel 36 (5180MHz)	Channel 44 (5220MHz)
	
Channel 48 (5240MHz)	Channel 149 (5745MHz)
	
Channel 157 (5785MHz)	Channel 165 (5825MHz)
	

802.11ax-HE40 26dB Bandwidth & 99% Bandwidth	
Channel 38 (5190MHz)	Channel 46 (5230MHz)
	
Channel 151 (5755MHz)	Channel 159 (5795MHz)
	

802.11ax-HE80 26dB Bandwidth & 99% Bandwidth	
Channel 42 (5210MHz)	Channel 155 (5775MHz)
	
802.11ax-HE160 26dB Bandwidth & 99% Bandwidth	
Channel 50 (5250MHz)	
	

7.3. 6dB Bandwidth Measurement

7.3.1.Test Limit

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

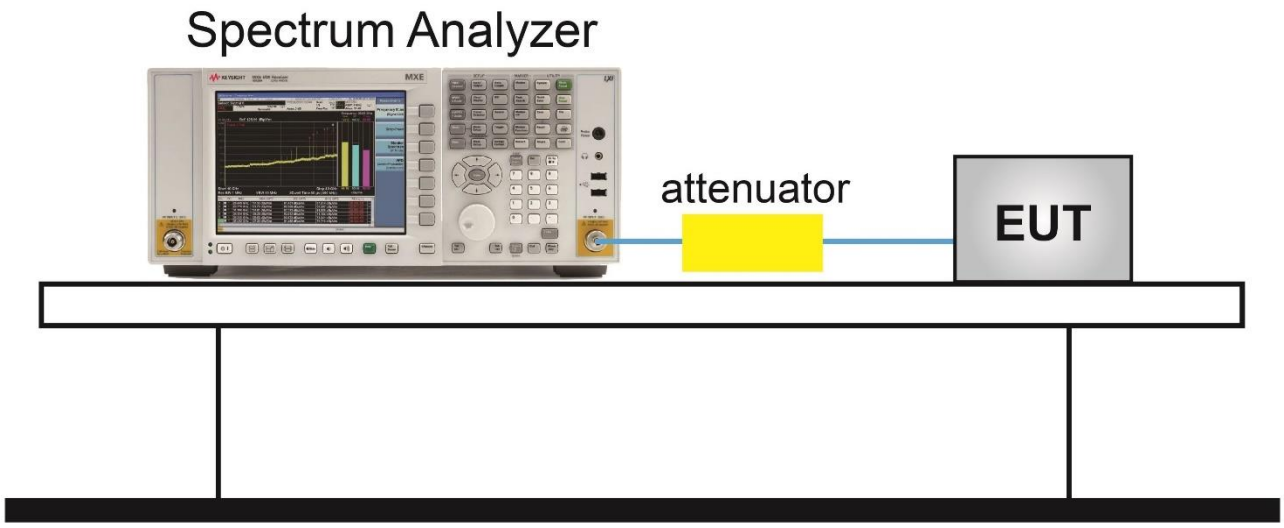
7.3.2.Test Procedure used

KDB 789033 D02v02r01- Section C.2

7.3.3.Test Setting

1. Set center frequency to the nominal EUT channel center frequency.
2. RBW = 100 kHz.
3. VBW ≥ 3 × 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.

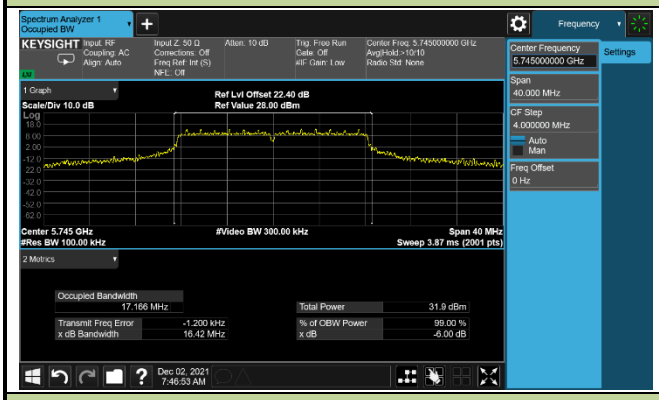
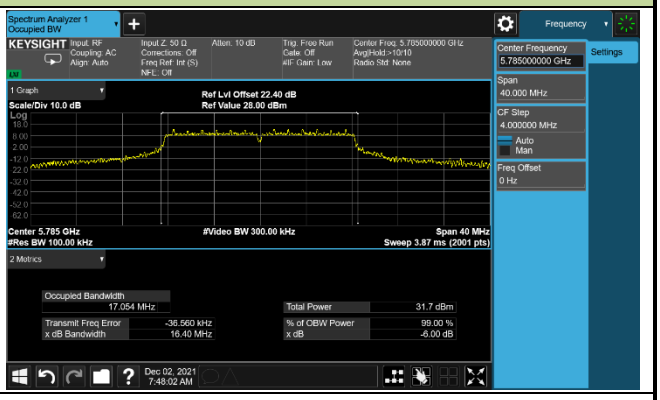
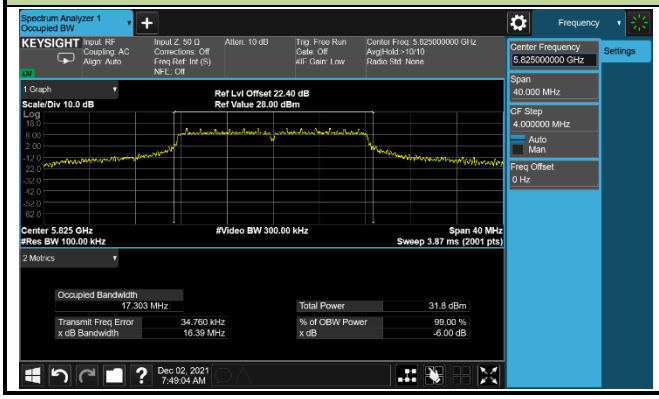
7.3.4.Test Setup

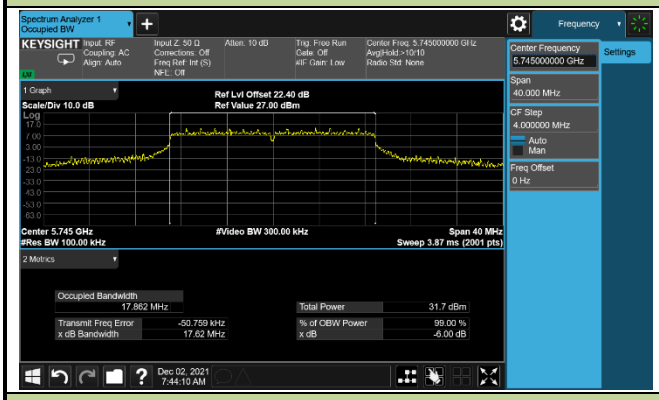
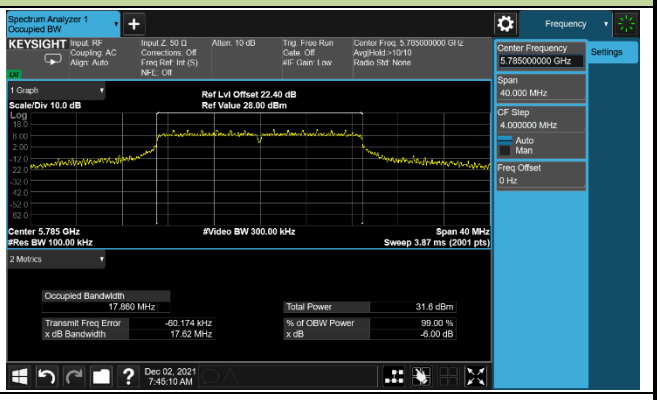
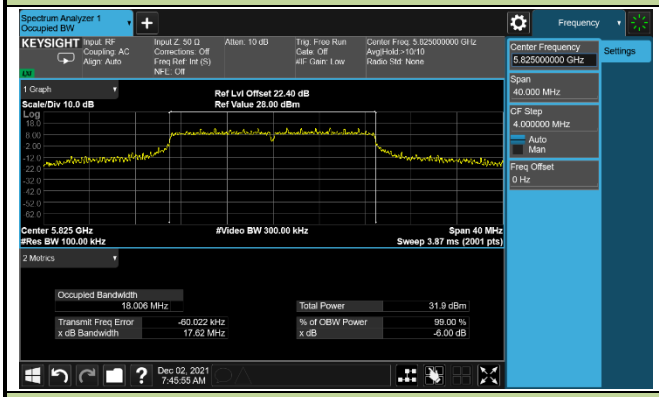


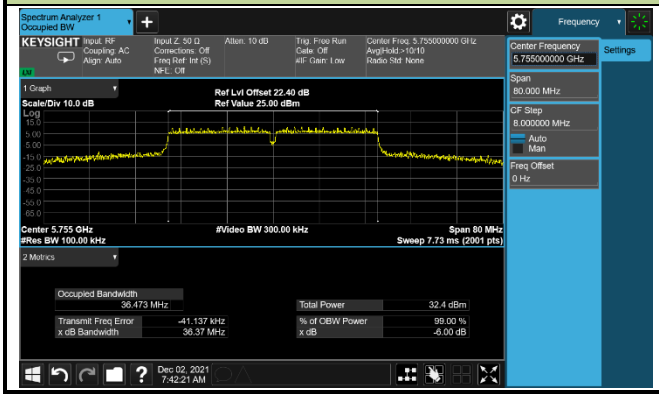
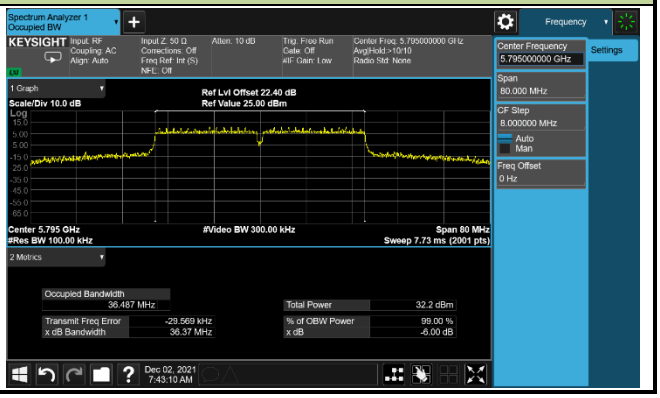
7.3.5.Test Result

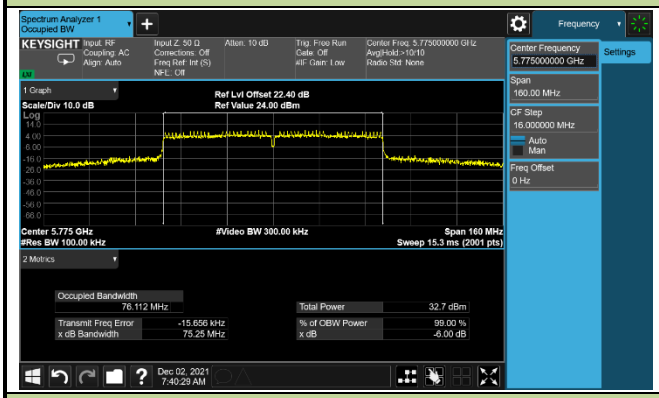
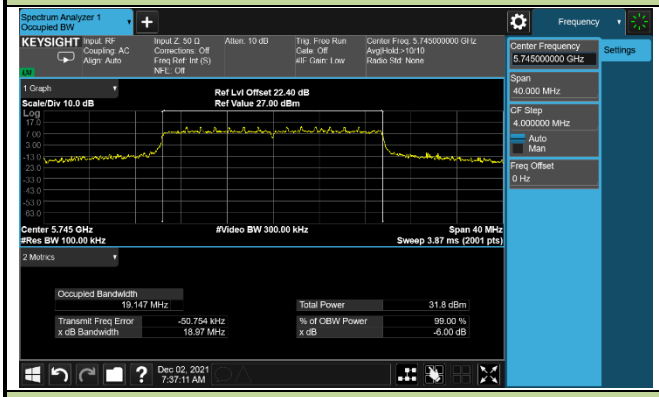
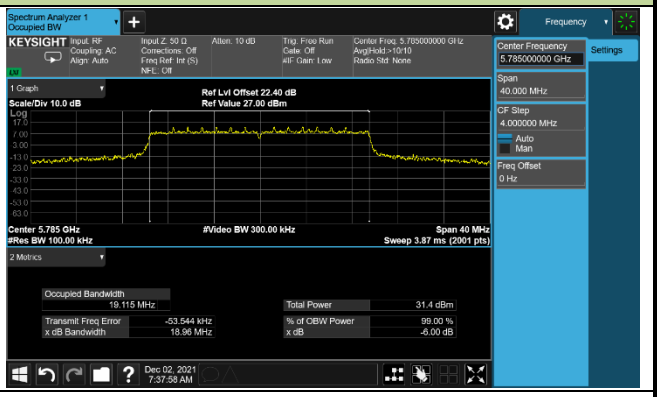
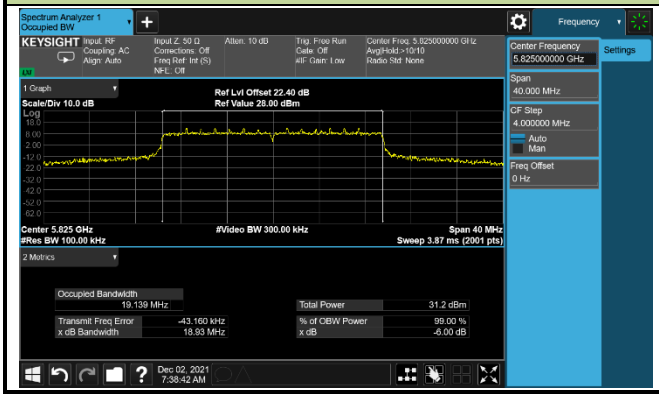
Product	AX3000 Whole Home Mesh Wi-Fi 6 System	Temperature	15~22°C
Test Engineer	Eric Lin	Relative Humidity	45~55%
Test Site	SR2	Test Date	2021/12/02
Frequency Band	U-NII-3		

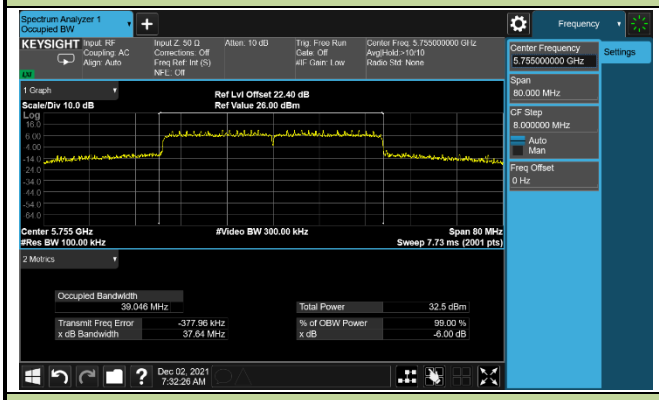
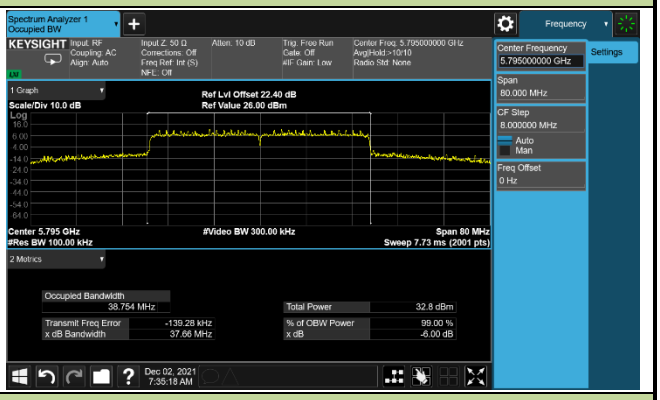
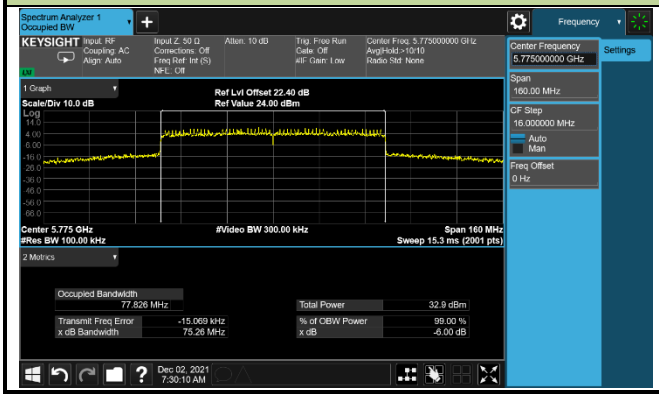
Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
802.11a	6Mbps	149	5745	16.42	≥ 0.5	Pass
802.11a	6Mbps	157	5785	16.40	≥ 0.5	Pass
802.11a	6Mbps	165	5825	16.39	≥ 0.5	Pass
802.11ac-VHT20	MCS0	149	5745	17.62	≥ 0.5	Pass
802.11ac-VHT20	MCS0	157	5785	17.62	≥ 0.5	Pass
802.11ac-VHT20	MCS0	165	5825	17.62	≥ 0.5	Pass
802.11ac-VHT40	MCS0	151	5755	36.37	≥ 0.5	Pass
802.11ac-VHT40	MCS0	159	5795	36.37	≥ 0.5	Pass
802.11ac-VHT80	MCS0	155	5775	75.25	≥ 0.5	Pass
802.11ax-HE20	MCS0	149	5745	18.97	≥ 0.5	Pass
802.11ax-HE20	MCS0	157	5785	18.96	≥ 0.5	Pass
802.11ax-HE20	MCS0	165	5825	18.93	≥ 0.5	Pass
802.11ax-HE40	MCS0	151	5755	37.64	≥ 0.5	Pass
802.11ax-HE40	MCS0	159	5795	37.66	≥ 0.5	Pass
802.11ax-HE80	MCS0	155	5775	75.26	≥ 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)	
	

7.4. Output Power Measurement

7.4.1.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 an indoor access point operating in the band 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW (23.98dBm) or 11dBm +10 log (26dB BW).
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.

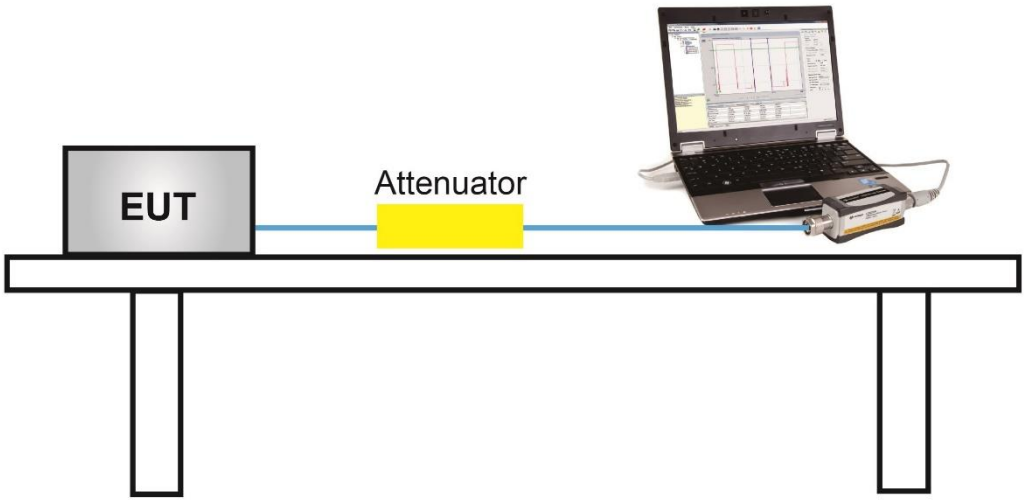
7.4.2.Test Procedure Used

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

7.4.3.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.

7.4.4.Test Setup



7.4.5.Test Result

Product	AX3000 Whole Home Mesh Wi-Fi 6 System	Temperature	15~22°C
Test Engineer	Eric Lin	Relative Humidity	45~55%
Test Site	SR2	Test Date	2021/11/30

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	Average Power (dBm)		Total Average Power (dBm)	Average Power Limit (dBm)	Result
				Ant 0	Ant 1			
CDD mode								
11a	6Mbps	36	5180	23.12	23.06	26.10	≤ 30.00	Pass
11a	6Mbps	44	5220	24.28	24.17	27.24	≤ 30.00	Pass
11a	6Mbps	48	5240	24.71	24.60	27.67	≤ 30.00	Pass
11a	6Mbps	149	5745	24.49	24.32	27.42	≤ 30.00	Pass
11a	6Mbps	157	5785	24.44	24.14	27.30	≤ 30.00	Pass
11a	6Mbps	165	5825	24.28	24.08	27.19	≤ 30.00	Pass
11ac-VHT20	MCS0	36	5180	22.91	22.84	25.89	≤ 30.00	Pass
11ac-VHT20	MCS0	40	5220	25.24	24.95	28.11	≤ 30.00	Pass
11ac-VHT20	MCS0	48	5240	25.26	25.06	28.17	≤ 30.00	Pass
11ac-VHT20	MCS0	149	5745	24.59	24.63	27.62	≤ 30.00	Pass
11ac-VHT20	MCS0	157	5785	24.02	23.98	27.01	≤ 30.00	Pass
11ac-VHT20	MCS0	165	5825	24.32	24.22	27.28	≤ 30.00	Pass
11ac-VHT40	MCS0	38	5190	20.35	20.42	23.40	≤ 30.00	Pass
11ac-VHT40	MCS0	46	5230	24.95	24.81	27.89	≤ 30.00	Pass
11ac-VHT40	MCS0	151	5755	24.51	24.62	27.58	≤ 30.00	Pass
11ac-VHT40	MCS0	159	5795	24.22	24.37	27.31	≤ 30.00	Pass
11ac-VHT80	MCS0	42	5210	19.31	19.18	22.26	≤ 30.00	Pass
11ac-VHT80	MCS0	155	5775	23.97	24.39	27.20	≤ 30.00	Pass
11ac-VHT160	MCS0	59	5250	19.21	19.36	22.30	≤ 23.98	Pass
11ax-HE20	MCS0	36	5180	22.62	22.39	25.52	≤ 30.00	Pass
11ax-HE20	MCS0	40	5220	25.14	24.66	27.92	≤ 30.00	Pass
11ax-HE20	MCS0	48	5240	25.64	25.34	28.50	≤ 30.00	Pass
11ax-HE20	MCS0	149	5745	24.45	24.49	27.48	≤ 30.00	Pass
11ax-HE20	MCS0	157	5785	24.19	23.91	27.06	≤ 30.00	Pass
11ax-HE20	MCS0	165	5825	24.26	24.24	27.26	≤ 30.00	Pass

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	Average Power (dBm)		Total Average Power (dBm)	Average Power Limit (dBm)	Result
				Ant 0	Ant 1			
CDD mode								
11ax-HE40	MCS0	38	5190	20.54	20.59	23.58	≤ 30.00	Pass
11ax-HE40	MCS0	46	5230	25.62	25.20	28.43	≤ 30.00	Pass
11ax-HE40	MCS0	151	5755	25.00	25.55	28.29	≤ 30.00	Pass
11ax-HE40	MCS0	159	5795	24.84	25.25	28.06	≤ 30.00	Pass
11ax-HE80	MCS0	42	5210	19.02	19.13	22.09	≤ 30.00	Pass
11ax-HE80	MCS0	155	5775	24.54	24.95	27.76	≤ 30.00	Pass
11ax-HE160	MCS0	50	5250	19.59	19.65	22.63	≤ 23.98	Pass

Note 1: The Total Average Power (dBm) = $10*\log\{10^{(\text{Ant 0 Average Power }/10)} + 10^{(\text{Ant 1 Average Power }/10)}\}$.

Note 2: For 802.11ac-VHT160/ax-HE160 Channel 50, the total average power within UNII-1 and UNII-2A bands comply with the UNII-2A average power limit.

7.5. Transmit Power Control

7.5.1.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.

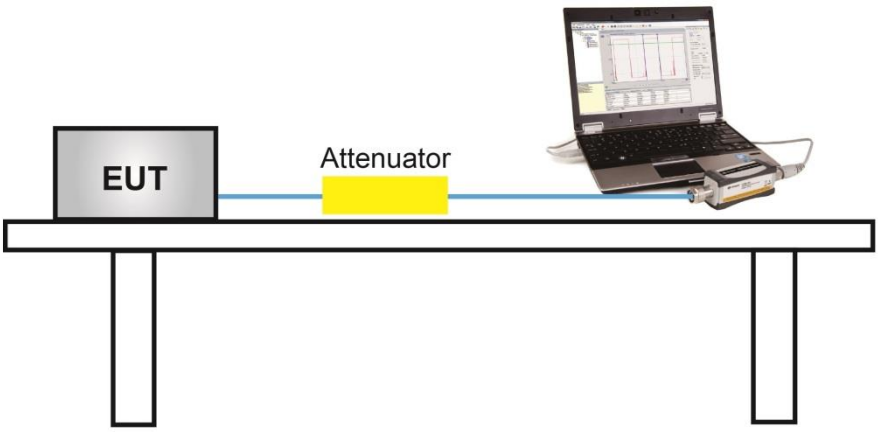
7.5.2.Test Procedure Used

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

7.5.3.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.

7.5.4.Test Setup



7.5.5.Test Result

A TPC mechanism is not required for systems with an e.i.r.p. of less than 500 mW.

7.6. Power Spectral Density Measurement

7.6.1.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 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum power spectral density shall not exceed 11 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.

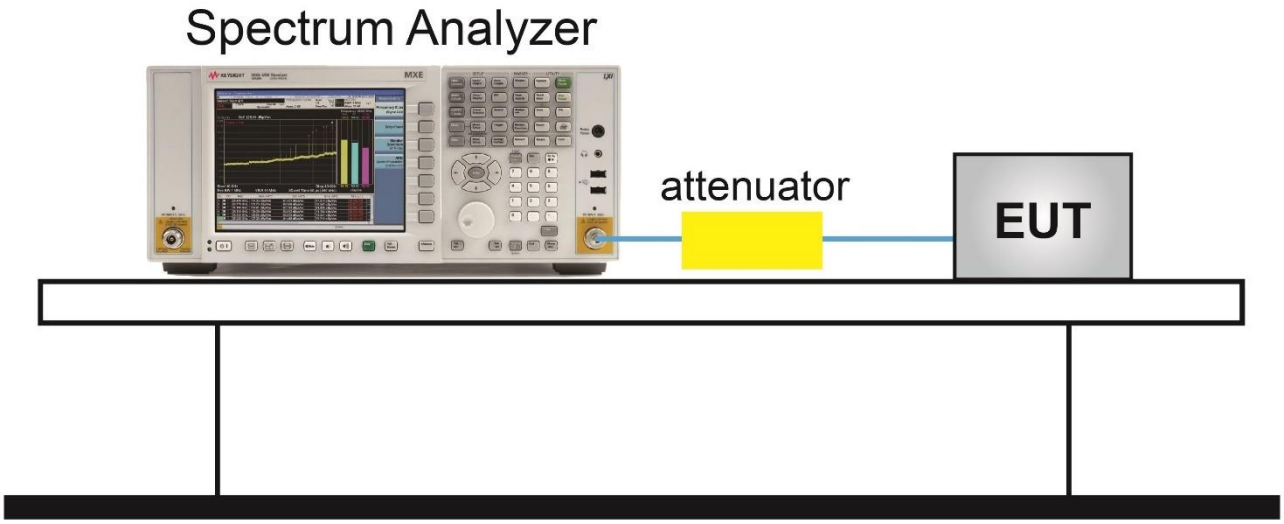
7.6.2.Test Procedure Used

KDB 789033 D02v02r01-Section F

7.6.3.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 ≥ 3RBW
5. Number of sweep points ≥ 2 × (span / RBW)
6. Detector = power averaging (Average)
7. Sweep time = auto
8. Trigger = free run
9. Use the peak search function on the instrument to find the peak of the spectrum and record its value.
10. Add 10*log(1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission). For example, add 10*log (1/0.25) = 6 dB if the duty cycle is 25 percent.

7.6.4.Test Setup



7.6.5.Test Result

Product	AX3000 Whole Home Mesh Wi-Fi 6 System	Temperature	15~22°C
Test Engineer	Eric Lin	Relative Humidity	45~55%
Test Site	SR2	Test Date	2021/12/01~2021/12/11
Test Item	Power Spectral Density (U-NII -1 & U-NII -2A)		

Test Mode	Data Rate /MCS	Ch. No.	Freq. (MHz)	PSD (dBm/MHz)		Duty Cycle (%)	Total PSD (dBm/ MHz)	PSD Limit (dBm/MHz)	Result
				Ant 0	Ant 1				
11a	6Mbps	36	5180	11.04	10.89	94.70	14.21	≤ 17.00	Pass
11a	6Mbps	44	5220	12.95	12.52	94.70	15.99	≤ 17.00	Pass
11a	6Mbps	48	5240	13.24	13.08	94.70	16.41	≤ 17.00	Pass
11ac-VHT20	MCS0	36	5180	11.38	11.26	98.21	14.33	≤ 17.00	Pass
11ac-VHT20	MCS0	44	5220	12.97	12.89	98.21	15.94	≤ 17.00	Pass
11ac-VHT20	MCS0	48	5240	13.79	13.36	98.21	16.59	≤ 17.00	Pass
11ac-VHT40	MCS0	38	5190	5.27	5.37	96.64	8.48	≤ 17.00	Pass
11ac-VHT40	MCS0	46	5230	10.36	10.06	96.64	13.37	≤ 17.00	Pass
11ac-VHT80	MCS0	42	5210	1.56	1.56	93.67	4.85	≤ 17.00	Pass
11ac-VHT160	MCS0	50	5250	-2.10	-1.58	89.24	1.67	≤ 11.00	Pass
11ax-HE20	MCS0	36	5180	9.95	9.29	97.43	12.76	≤ 17.00	Pass
11ax-HE20	MCS0	44	5220	13.24	12.92	97.43	16.20	≤ 17.00	Pass
11ax-HE20	MCS0	48	5240	13.75	13.38	97.43	16.70	≤ 17.00	Pass
11ax-HE40	MCS0	38	5190	5.39	4.48	95.81	8.15	≤ 17.00	Pass
11ax-HE40	MCS0	46	5230	10.75	10.64	95.81	13.89	≤ 17.00	Pass
11ax-HE80	MCS0	42	5210	1.26	0.92	92.38	4.45	≤ 17.00	Pass
11ax-HE160	MCS0	50	5250	-1.07	-1.28	89.43	2.32	≤ 11.00	Pass

Note 1: When EUT duty cycle ≥ 98%, the total PSD (dBm/MHz) = $10*\log\{10^{(\text{Ant 0 PSD}/10)} + 10^{(\text{Ant 1 PSD}/10)}\}$ (dBm/MHz).

When EUT duty cycle < 98%, the total PSD (dBm/MHz) = $10*\log\{10^{(\text{Ant 0 PSD}/10)} + 10^{(\text{Ant 1 PSD}/10)}\}$ (dBm/MHz) + 10*log (1/Duty Cycle).

Note 2: For 5150 - 5250MHz Band: PSD Limit (dBm/MHz) = 17dBm/MHz.

For ac-VHT160/ax-HE160, PSD Limit (dBm/MHz) = 11dBm/MHz.

Note 3: For 802.11ac-VHT160/ax-HE160 Channel 50, the Max PSD within UNII-1 and UNII-2A bands comply with the UNII-2A PSD limit.

Product	AX3000 Whole Home Mesh Wi-Fi 6 System	Temperature	15~22°C
Test Engineer	Eric Lin	Relative Humidity	45~55%
Test Site	SR2	Test Date	2021/12/02
Frequency Band	Power Spectral Density (U-NII-3)		

Test Mode	Data Rate/ MCS	Ch. No.	Freq. (MHz)	PSD (dBm/510kHz)		Duty Cycle (%)	Total PSD (dBm/ 510kHz)	Limit (dBm/ 500kHz)	Result
				Ant 0	Ant 1				
11a	6Mbps	149	5745	10.86	10.54	94.70	13.95	≤ 30.00	Pass
11a	6Mbps	157	5785	10.32	10.07	94.70	13.44	≤ 30.00	Pass
11a	6Mbps	165	5825	10.55	10.33	94.70	13.69	≤ 30.00	Pass
11ac-VHT20	MCS0	149	5745	10.04	10.11	98.21	13.09	≤ 30.00	Pass
11ac-VHT20	MCS0	157	5785	10.20	10.03	98.21	13.12	≤ 30.00	Pass
11ac-VHT20	MCS0	165	5825	10.52	10.35	98.21	13.45	≤ 30.00	Pass
11ac-VHT40	MCS0	151	5755	7.58	7.68	96.64	10.79	≤ 30.00	Pass
11ac-VHT40	MCS0	159	5795	7.18	7.39	96.64	10.45	≤ 30.00	Pass
11ac-VHT80	MCS0	155	5775	4.25	4.76	93.67	7.80	≤ 30.00	Pass
11ax-HE20	MCS0	149	5745	10.13	10.14	97.43	13.26	≤ 30.00	Pass
11ax-HE20	MCS0	157	5785	9.96	9.39	97.43	12.81	≤ 30.00	Pass
11ax-HE20	MCS0	165	5825	9.95	9.80	97.43	13.00	≤ 30.00	Pass
11ax-HE40	MCS0	151	5755	7.96	8.35	95.81	11.36	≤ 30.00	Pass
11ax-HE40	MCS0	159	5795	7.79	8.17	95.81	11.18	≤ 30.00	Pass
11ax-HE80	MCS0	155	5775	4.74	5.07	92.38	8.26	≤ 30.00	Pass

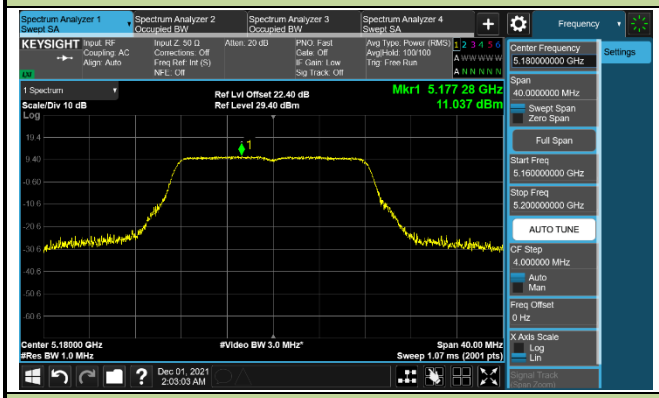
Note 1: When EUT duty cycle ≥ 98%, the total PSD (dBm/510kHz) = 10*log {$10^{(\text{Ant 0 PSD}/10)}$ + $10^{(\text{Ant 1 PSD}/10)}$} (dBm/510kHz)

When EUT duty cycle < 98%, the total PSD (dBm/510kHz) = 10*log {$10^{(\text{Ant 0 PSD}/10)}$ + $10^{(\text{Ant 1 PSD}/10)}$} (dBm/510kHz) + 10*log (1/Duty Cycle).

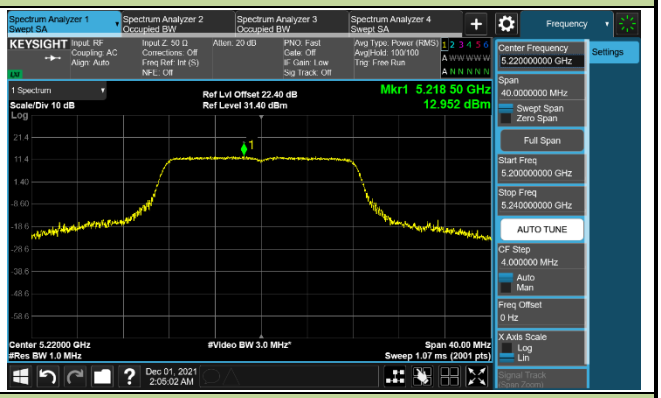
Note 2: PSD Limit (dBm/500kHz) = 30 dBm/500kHz.

802.11a Power Spectral Density – Ant 0

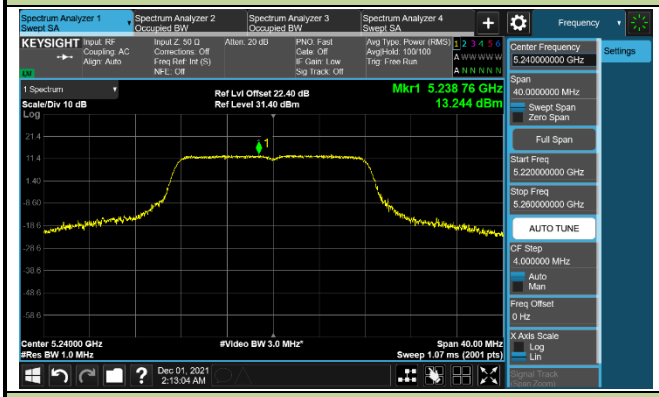
Channel 36 (5180MHz)



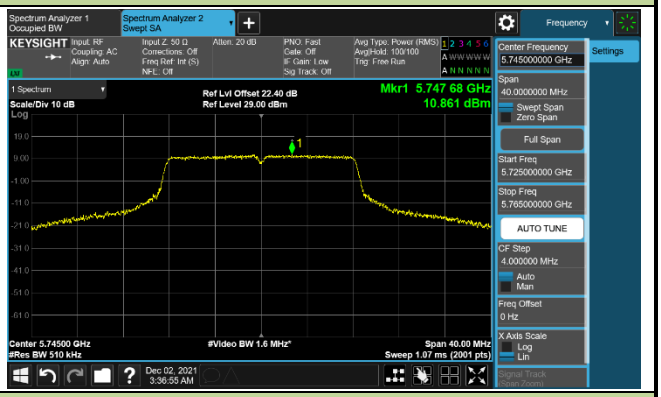
Channel 44 (5220MHz)



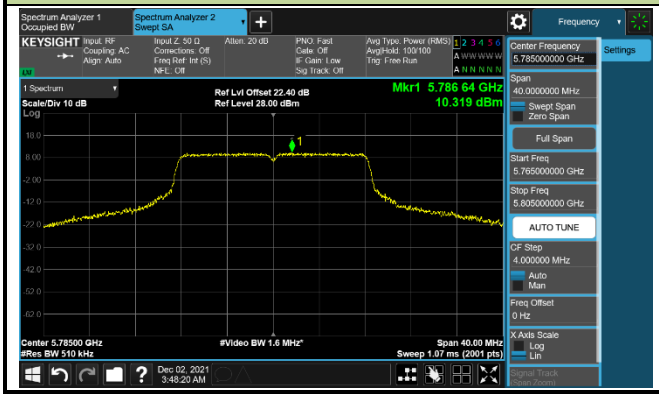
Channel 48 (5240MHz)



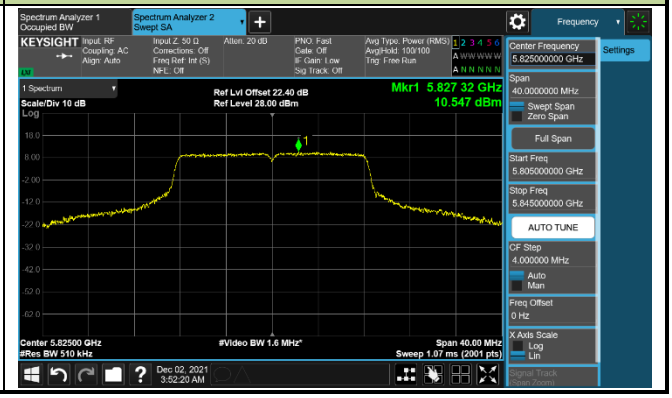
Channel 149 (5745MHz)

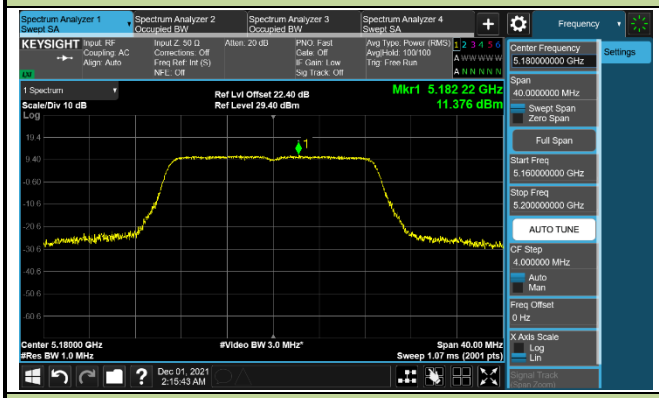
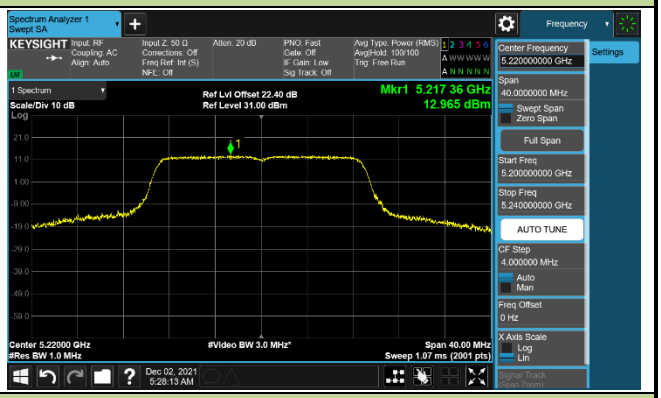
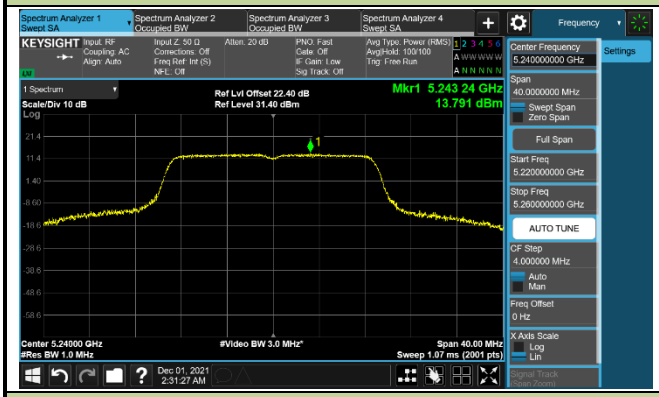
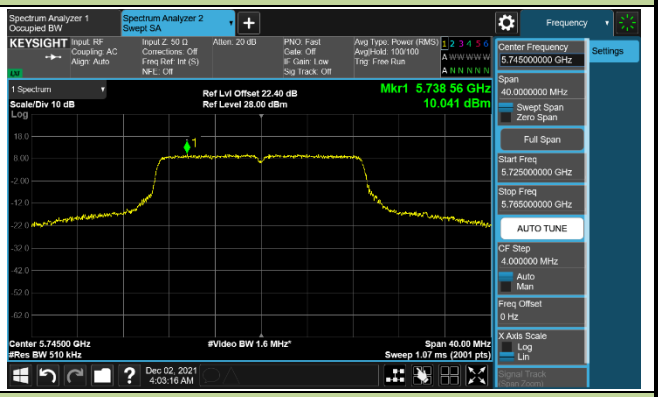
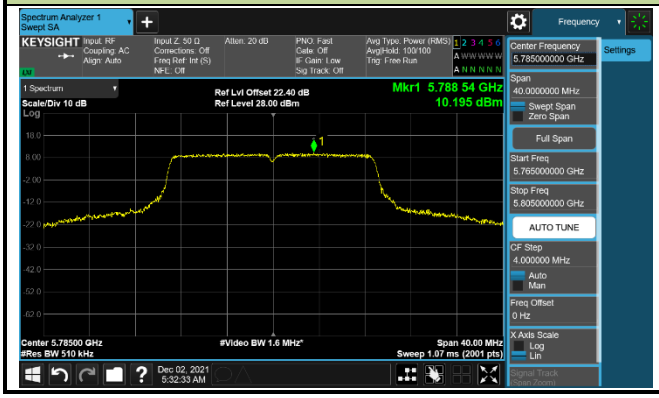
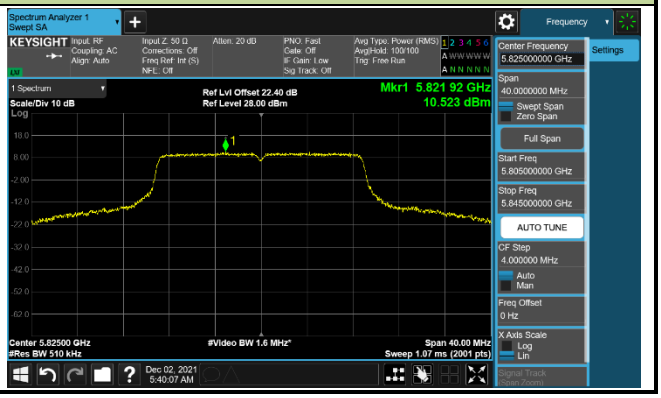


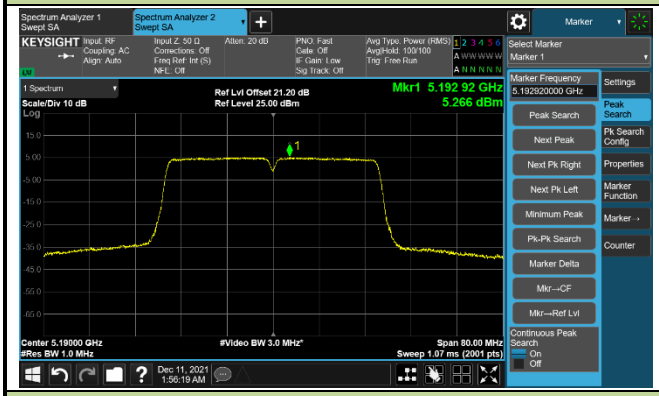
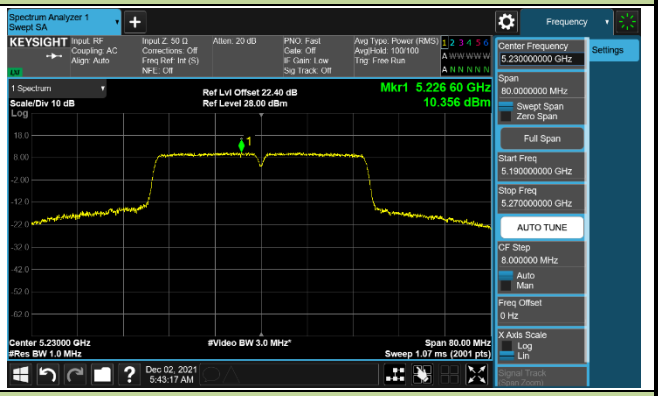
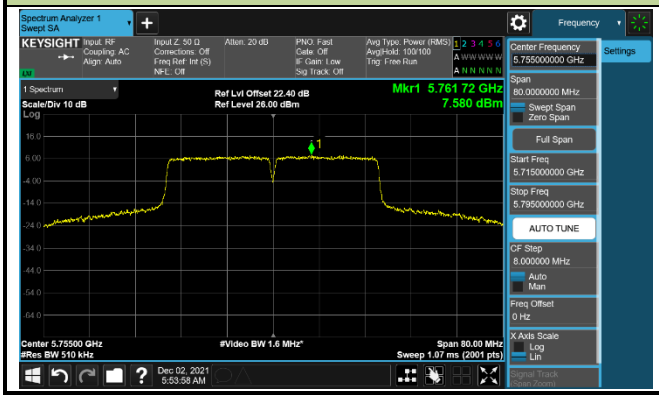
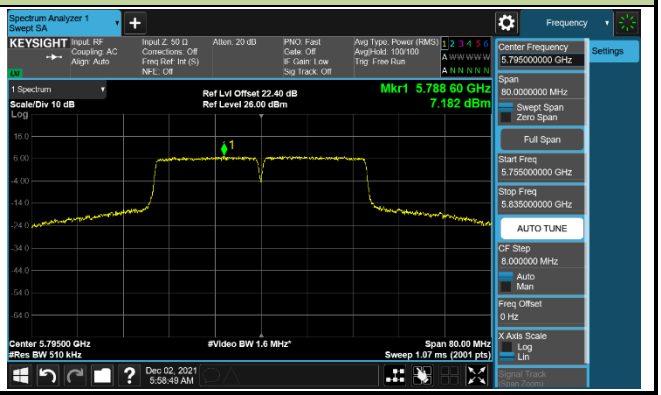
Channel 157 (5785MHz)

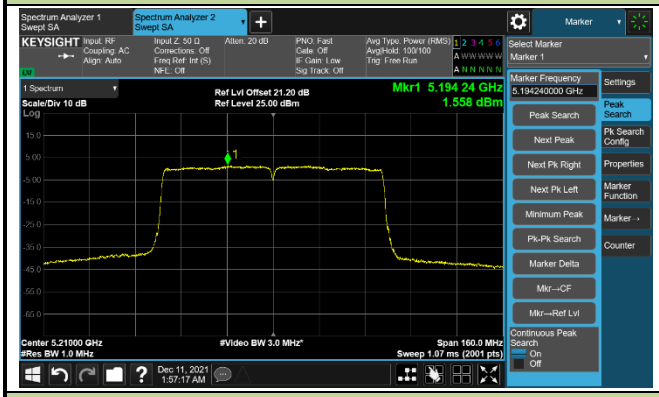
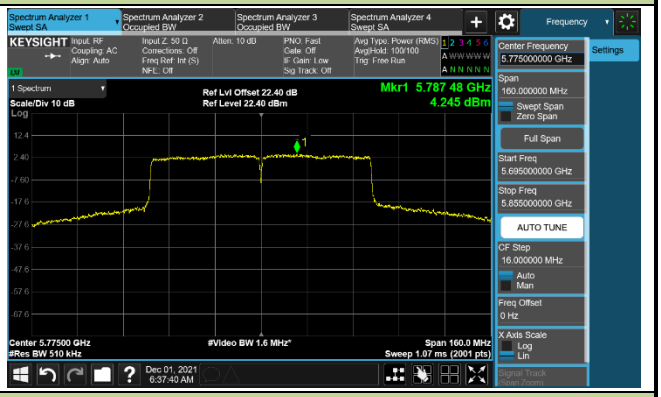


Channel 165 (5825MHz)



802.11ac-VHT20 Power Spectral Density – Ant 0	
Channel 36 (5180MHz)	Channel 44 (5220MHz)
	
Channel 48 (5240MHz)	Channel 149 (5745MHz)
	
Channel 157 (5785MHz)	Channel 165 (5825MHz)
	

802.11ac-VHT40 Power Spectral Density – Ant 0	
Channel 38 (5190MHz)	Channel 46 (5230MHz)
	
Channel 151 (5755MHz)	Channel 159 (5795MHz)
	

802.11ac-VHT80 Power Spectral Density – Ant 0	
Channel 42 (5210MHz)	Channel 155 (5775MHz)
	
802.11ac-VHT160 Power Spectral Density – Ant 0	
Channel 50 (5250MHz)