



RF MEASUREMENT REPORT

FCC ID: TK4WPQ618HV
Applicant: Compex Systems Pte Ltd
Product: Wireless Access Point
Model No.: WPQ618HV, WPQ618LV
Brand Name: COMPEX
FCC Classification: Unlicensed National Information Infrastructure (NII)
FCC Rule Part(s): Part 15 Subpart E (Section 15.407)
Result: Complies
Test Date: 2022-04-19 ~ 2022-05-30

Reviewed By:

Jame Yuan

Jame Yuan

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 KDB789033. 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
2203RSU059-U4	Rev. 01	Initial Report	2022-08-08	Valid

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1. General Information

1.1. Applicant

Complex Systems Pte Ltd

No:9 Harrison Road, Harrison Industrial Building, #05-01, Singapore 369651

1.2. Manufacturer

Complex Systems Pte Ltd

No:9 Harrison Road, Harrison Industrial Building, #05-01, Singapore 369651

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	Wireless Access Point
Model No.	WPQ618HV, WPQ618LV
EUT Identification No.	20210407Sample#02
Wi-Fi Specification	802.11a/b/g/n/ac/ax
Bluetooth Specification	V4.2 dual mode
Antenna Information	Refer to section 1.6
Power Supply	AC/DC Adapter or PoE Adapter
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/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
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 866.6Mbps 802.11ax: up to 1201Mbps

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

1.6. Working Frequencies

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	--	--

1.7. Antenna Details

Antenna Type	Frequency Band (GHz)	Max Peak Gain (dBi)	CDD Directional Gain (dBi)	
			For Power	For PSD
Wi-Fi Antenna (2*2 MIMO)				
Omni Antenna 1#	2.4 ~ 2.5	8.00	8.00	11.01
	5.15 ~ 5.85	5.00	5.00	8.01
Omni Antenna 2# (P/NO: WD12020258G)	2.4 ~ 2.5	1.91	1.91	4.92
	5.15 ~ 5.85	3.39	3.39	6.40
Omni Antenna 3# (P/NO: 02S00029A)	2.4 ~ 2.5	3.41	3.41	6.42
	5.15 ~ 5.85	3.55	3.55	6.56
Bluetooth Antenna				
Omni-directional	2.4 ~ 2.5	2.00		

Note 1: 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 = $G_{ANT} + \text{Array Gain}$, where Array Gain is as follows.

- For power spectral density (PSD) measurements on all devices,

$$\text{Array Gain} = 10 \log (N_{ANT} / N_{SS}) \text{ dB} = 3.01;$$

- For power measurements on IEEE 802.11 devices,

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

Note 2: We selected the antenna 1# and antenna 3# to perform the test.

2. Test Configuration

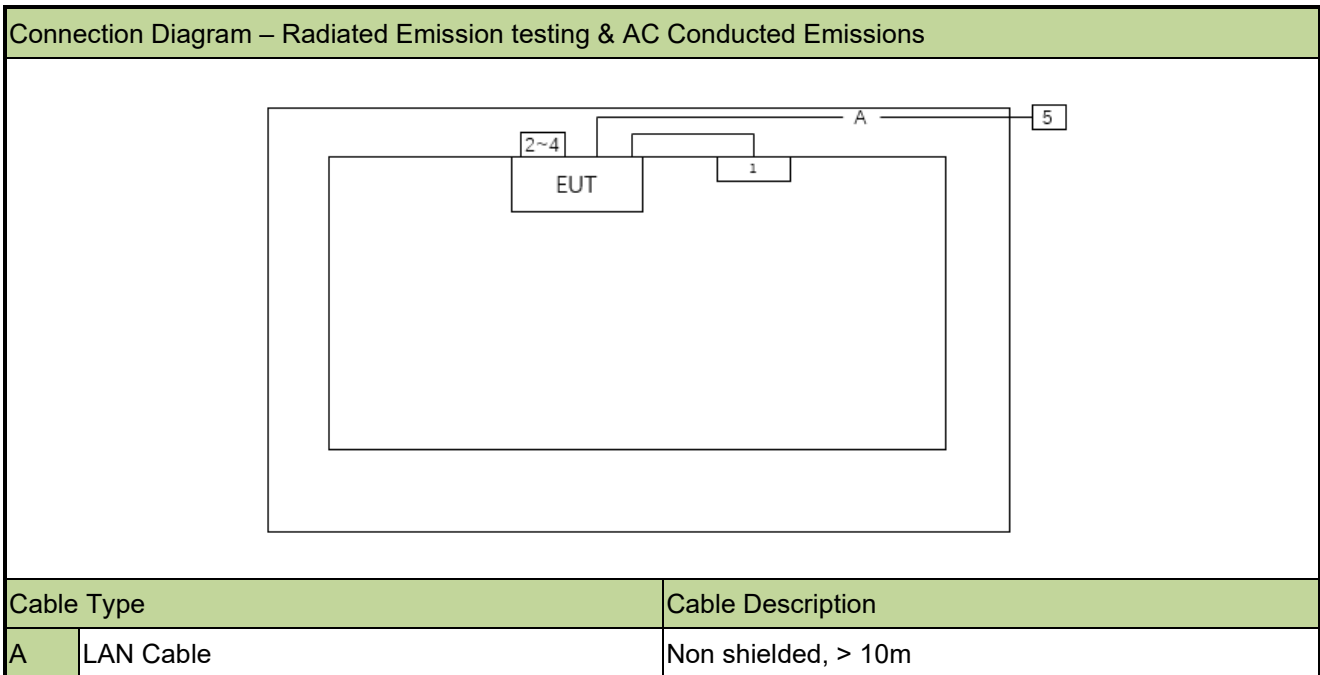
2.1. Test Mode

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 for 802.11n-HT20 and HT40 will not be greater than 802.11ac-VHT20 and VHT40.

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 Adapter	SWITCHING Power Supply	S050FU1200400
2~4 Simulated load	N/A	001
5 Notebook	Lenovo	E431

Note: This adapter is provided by the laboratory for testing only, not by the applicant.

2.4. Test Software

The test utility software used during testing was engineering order provided by manufacturer.

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. Test Environment Condition

Ambient Temperature	15 ~ 35°C
Relative Humidity	20 ~ 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.”

For Omni Antenna1# Configuration

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

For Omni Antenna 2# and Omni Antenna 3# Configuration

- The antenna of the device uses IPEX connector

Conclusion:

The unit complies with the requirement of §15.203.

4. Measuring Instrument

Instrument	Manufacturer	Model No.	Asset No.	Cali. Interval	Cali. Due Date	Test Site
Two-Line V-Network	R&S	ENV216	MRTSUE06002	1 year	2022-06-08	WZ-SR2
Shielding Room	MIX-BEP	WZ-SR2	MRTSUE06215	N/A	N/A	WZ-SR2
Thermohygrometer	testo	608-H1	MRTSUE06404	1 year	2022-06-28	WZ-SR2
EMI Test Receiver	R&S	ESR3	MRTSUE06909	1 year	2022-11-01	WZ-SR2
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2022-12-29	WZ-AC1
TRILOG Antenna	Schwarzbeck	VULB 9168	MRTSUE06172	1 year	2022-08-05	WZ-AC1
Anechoic Chamber	TDK	WZ-AC1	MRTSUE06212	1 year	2023-04-21	WZ-AC1
Thermohygrometer	testo	608-H1	MRTSUE06403	1 year	2022-06-28	WZ-AC1
Signal Analyzer	Keysight	N9010B	MRTSUE06607	1 year	2022-12-29	WZ-AC1
Thermohygrometer	testo	Testo 608-H1	MRTSUE11039	1 year	2022-11-11	WZ-AC1
Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2022-10-28	WZ-AC1
Horn Antenna	Schwarzbeck	BBHA 9170	MRTSUE06292	1 year	2022-10-20	NS-AC1
Anechoic Chamber	BOOMWAVE	NS-AC1	MRTSUE06496	1 year	2022-07-24	NS-AC1
Horn Antenna	Schwarzbeck	BBHA 9120D	MRTSUE06572	1 year	2023-04-01	NS-AC1
TRILOG Antenna	Schwarzbeck	VULB 9162	MRTSUE06573	1 year	2022-06-29	NS-AC1
Preamplifier	Schwarzbeck	BBV 9718	MRTSUE06574	1 year	2022-07-12	NS-AC1
EMI Test Receiver	R&S	ESR3	MRTSUE06575	1 year	2022-06-27	NS-AC1
Thermohygrometer	DELI	NO.8813	MRTSUE06588	1 year	2022-06-30	NS-AC1
Preamplifier	EMCI	EMC184045SE	MRTSUE06641	1 year	2023-01-13	NS-AC1
Signal Analyzer	Agilent	N9010A	MRTSUE06195	1 year	2023-04-13	NS-AC1
High Pass Filter	WI	WHKX10- 2501-3050-18000-80SS	MRTSUE06151	1 year	2023-03-09	NS-AC1
Signal Analyzer	Keysight	N9020A	MRTSUE10065	1 year	2022-06-17	NS-TR2
USB Power Sensor	Keysight	U2021XA	MRTSUE06581	1 year	2022-08-15	NS-TR2
Thermohygrometer	DELI	NO.8813	MRTSUE06783	1 year	2023-04-14	NS-TR2
Temperature Chamber	OUKE	OK-TH-100C	MRTSUE06899	1 year	2022-11-01	NS-TR2
Attenuator	MVE	MVE2213	MRTSUE11064	1 year	2023-06-09	NS-TR2
Attenuator	MVE	MVE2213	MRTSUE11065	1 year	2023-06-09	NS-TR2

Software	Version	Function
EMI V3	V3.0.0	EMI Test Software
Controller_MF 7802	2.03C	RE Antenna&turntable
BenchVue Power Meter	2021	Power
Controller_T-E-TAC-2	1.02	RE Antenna&turntable

5. Decision Rules and Measurement Uncertainty

5.1. Decision Rules

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4: 2012 Clause 8.2.

(Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

5.2. 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 Disturbance
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 & 99% Bandwidth	Conducted	Pass
15.407(e)	6dB Bandwidth		Pass
15.407(a)(1)(ii), (2), (3)(i)	Maximum Conducted Output Power		Pass
15.407(h)(1)	Transmit Power Control		Pass
15.407(a)(1)(ii), (2), (3)(i), (12)	Peak Power Spectral Density		Pass
15.407(b)(1), (2), (3), (4)(i)	Undesirable Emissions		Pass
15.205, 15.209 15.407(b)(8), (9), (10)	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.
- EUT supports one configuration only in 802.11ax full RU mode.

6.2. 26dB & 99% Bandwidth Measurement

6.2.1. Test Limit

N/A

6.2.2. Test Procedure

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

KDB 789033 D02v02r01- Section II)D) (99% Bandwidth)

6.2.3. Test Setting

26dB Bandwidth

1. The analyzers' automatic bandwidth measurement capability was used to perform the 26dB bandwidth
2. RBW = approximately 1% of the emission bandwidth.
3. VBW > RBW
4. Detector = Peak.
5. Trace mode = max hold.
6. Measure the maximum width of the emission that is 26 dB down from the maximum of the emission.

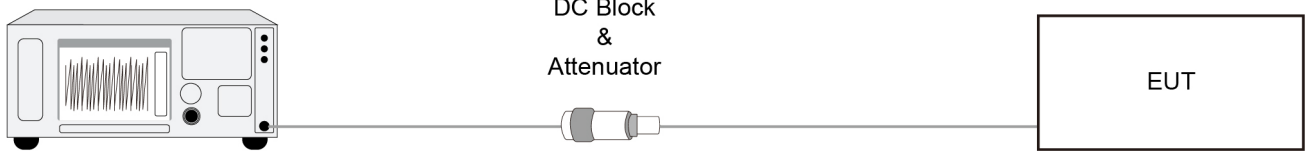
Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

99% Bandwidth

1. Set center frequency to the nominal EUT channel center frequency.
2. RBW = 1% to 5% of the OBW
3. $VBW \geq 3 \times RBW$
4. Span = 1.5 times to 5 times the OBW
5. Detector = peak
6. Trace mode = max hold
7. Allow the trace to stabilize
8. Use the 99% power bandwidth function of the instrument.

6.2.4. Test Setup

Spectrum Analyzer



6.2.5. Test Result

Refer to Appendix A.2.

6.3. 6dB Bandwidth Measurement

6.3.1. Test Limit

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

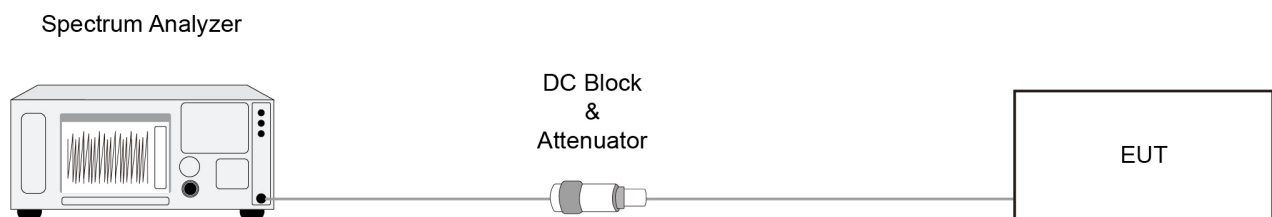
6.3.2. Test Procedure

KDB 789033 D02v02r01- Section II)C)2)

6.3.3. 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.

6.3.4. Test Setup



6.3.5. Test Result

Refer to Appendix A.3.

6.4. Output Power Measurement

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 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 or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz.

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

KDB 789033D02v02r01- Section II)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.4.

6.5. Transmit Power Control Measurement

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.

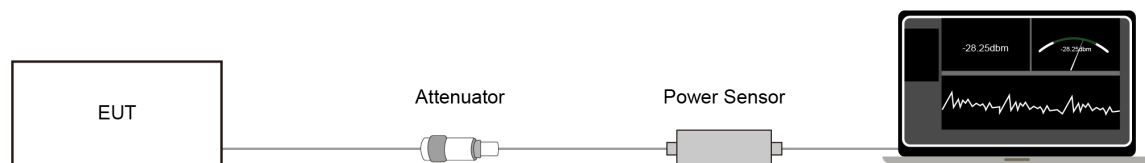
6.5.2. Test Procedure

KDB 789033 D02v01- Section II)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

Device supports TPC mechanism, details refer to the operational description.

6.6. Power Spectral Density Measurement

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 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.

6.6.2. Test Procedure

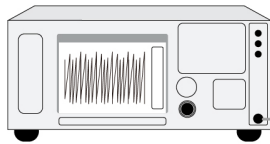
KDB 789033 D02v02r01-Section II)F)

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 (510kHz, if measurement bandwidth of Maximum PSD is specified in 500 kHz)
4. VBW = $3 \times \text{RBW}$
5. Number of sweep points $\geq 2 \times (\text{span} / \text{RBW})$
6. Detector = power averaging (Average)
7. Sweep time = auto
8. Trigger = free run
9. Trace average at least 100 traces in power averaging (rms) mode; however, the number of traces to be averaged shall be increased above 100 as needed to ensure that the average accurately represents the true average over the on and off periods of the transmitter.
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 $10 \cdot \log(1/0.25) = 6 \text{ dB}$ if the duty cycle is 25 percent.

6.6.4. Test Setup

Spectrum Analyzer



DC Block
&
Attenuator



EUT



6.6.5. Test Result

Refer to Appendix A.5.

6.7. Frequency Stability Measurement

6.7.1. Test Limit

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

6.7.2. Test Procedure

Frequency Stability Under Temperature Variations:

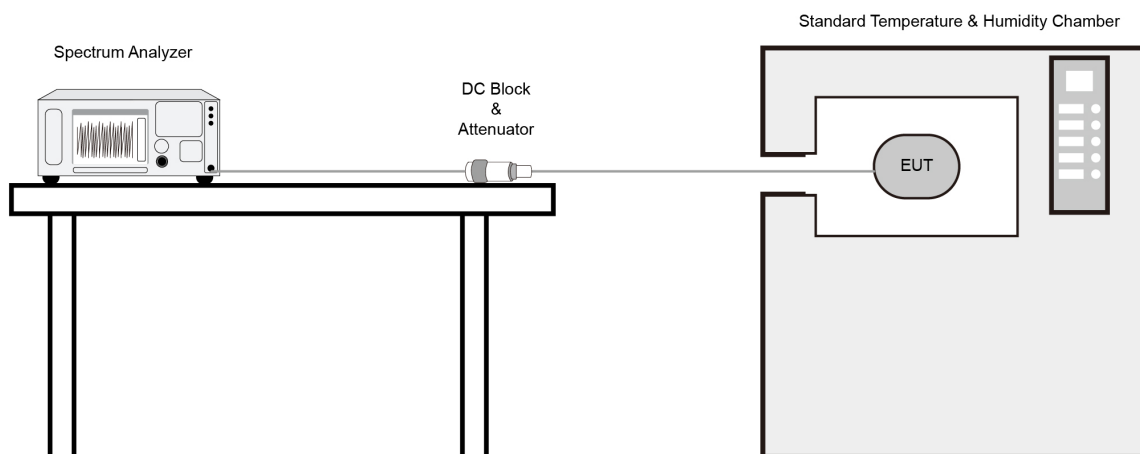
The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20°C operating frequency as reference frequency. Turn EUT off and set the chamber temperature to highest. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10°C decreased per stage until the lowest temperature reached.

Frequency Stability Under Voltage Variations:

Set chamber temperature to 20°C. Use a variable AC power supply / DC power source to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency.

Reduce the input voltage to specify extreme voltage variation ($\pm 15\%$) and endpoint, record the maximum frequency change.

6.7.3. Test Setup



6.7.4. Test Result

Refer to Appendix A.6.

6.8. Radiated Spurious Emission Measurement

6.8.1. 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

6.8.2. Test Procedure

KDB 789033 D02v02r01- Section II)G)

6.8.3. 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

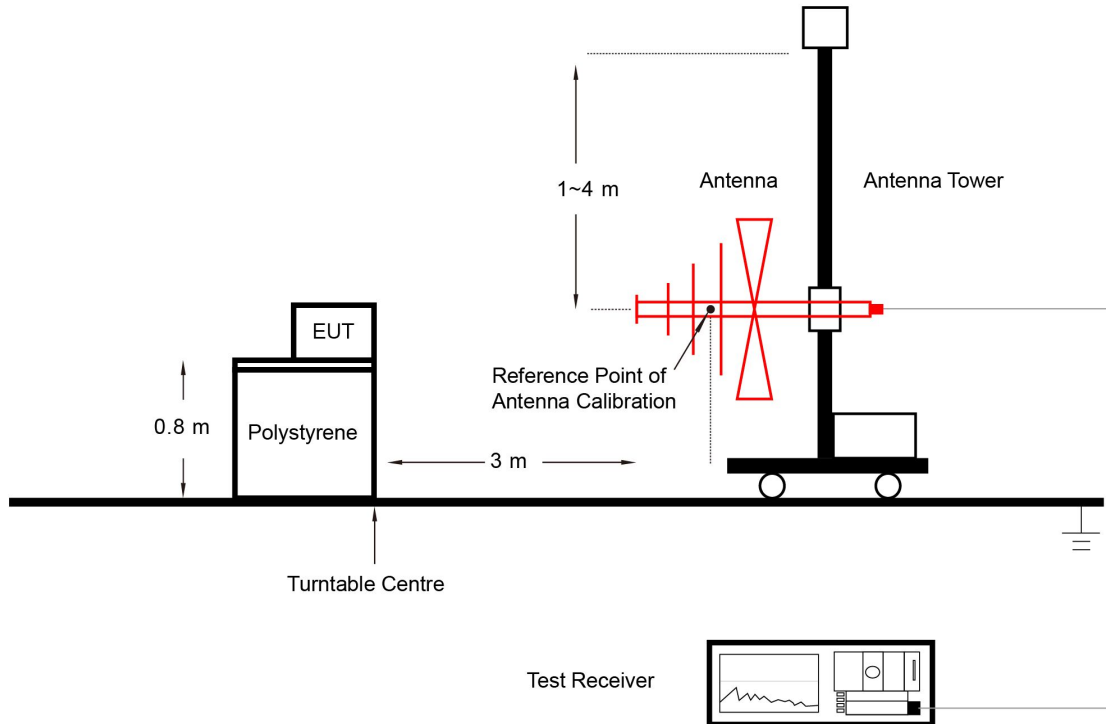
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Average Measurements above 1GHz (Method VB)

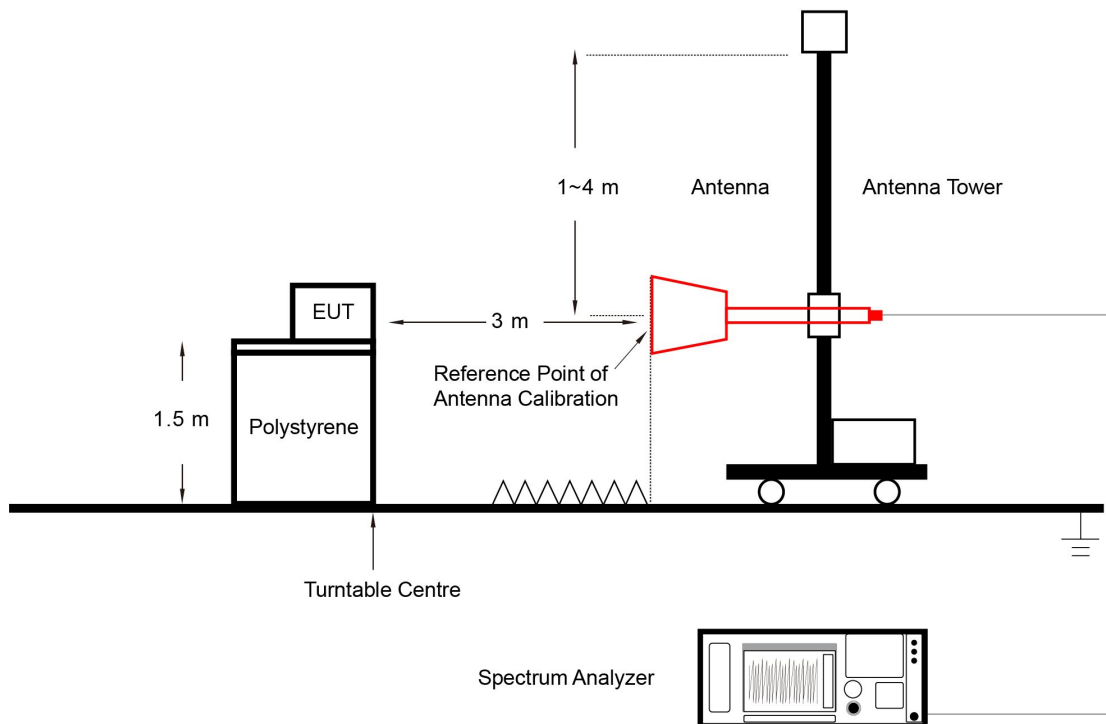
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW; If the EUT is configured to transmit with duty cycle $\geq 98\%$, set VBW = 10 Hz.
If the EUT duty cycle is $< 98\%$, set $\text{VBW} \geq 1/T$. T is the minimum transmission duration.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

6.8.4. Test Setup

Below 1GHz Test Setup:



Above 1GHz Test Setup:



6.8.5. Test Result

Refer to Appendix A.7.

6.9. Radiated Restricted Band Edge Measurement

6.9.1. 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 5.25-5.35 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 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 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

6.9.2. Test Procedure

KDB 789033 D02v02r01- Section II)G)

6.9.3. Test Setting

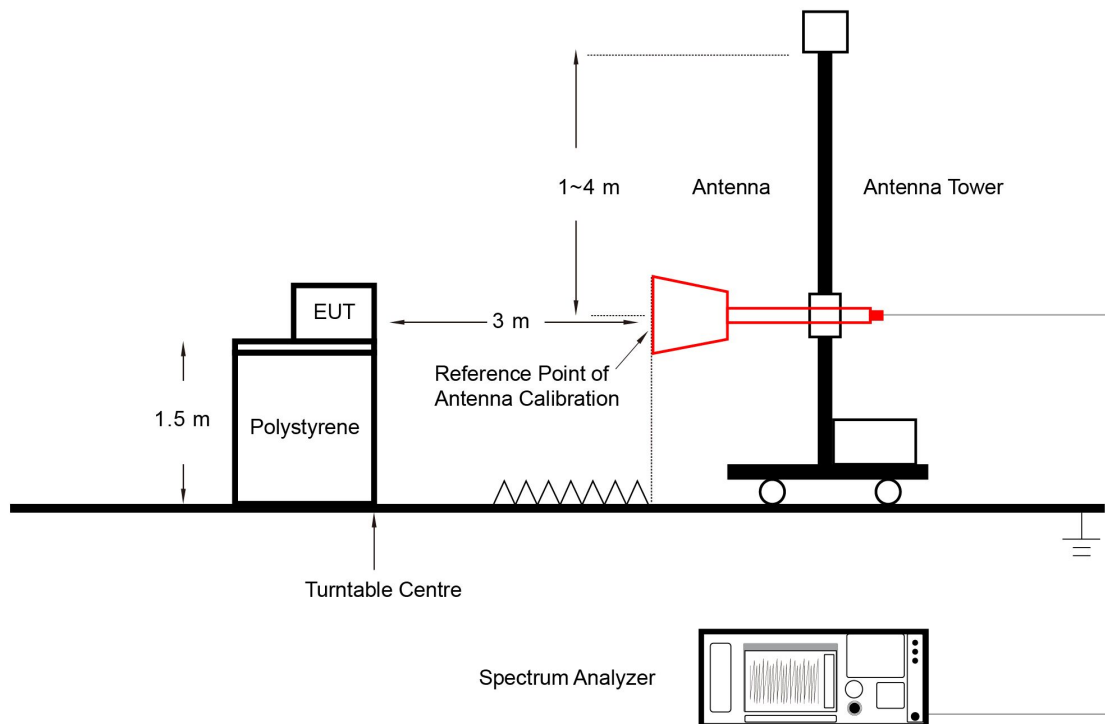
Peak Measurements above 1GHz

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

6.9.4. Test Setup



6.9.5. Test Result

Refer to Appendix A.8.

6.10. AC Conducted Emissions Measurement

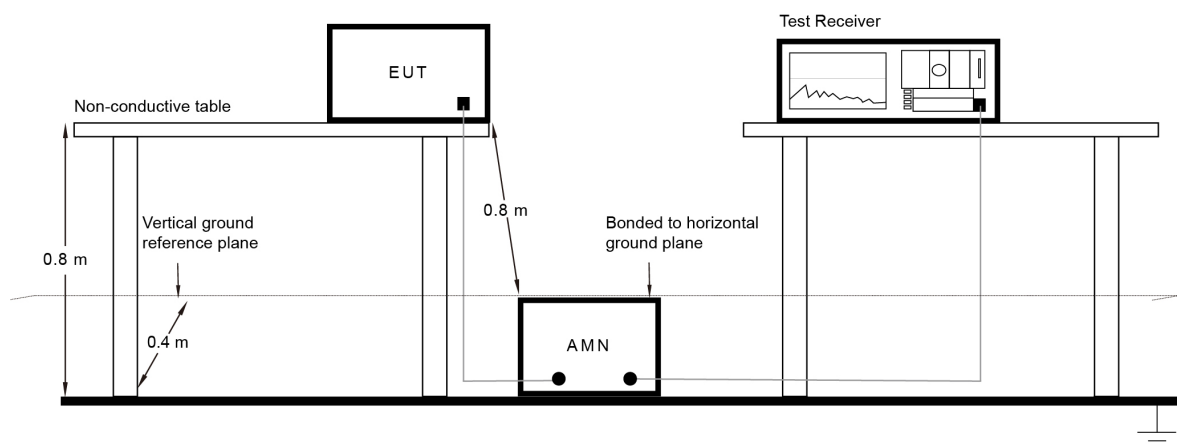
6.10.1. Test Limit

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.

6.10.2. Test Setup



6.10.3. Test Result

Refer to Appendix A.9.

Appendix A – Test Result

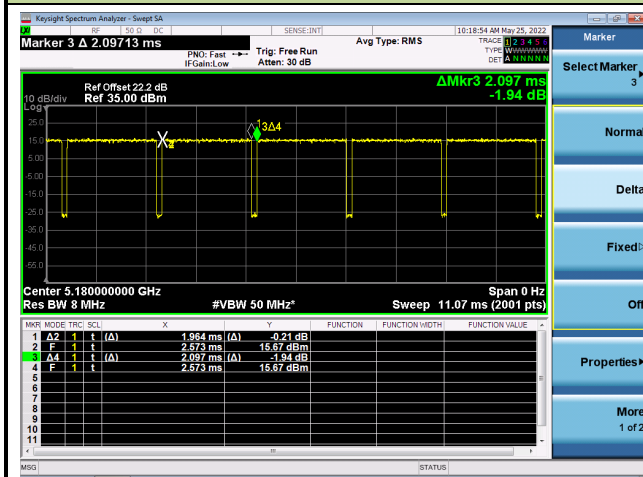
A.1 Duty Cycle Test Result

Test Site	NS-TR2	Test Engineer	Summer Tang
Test Date	2022/05/25		

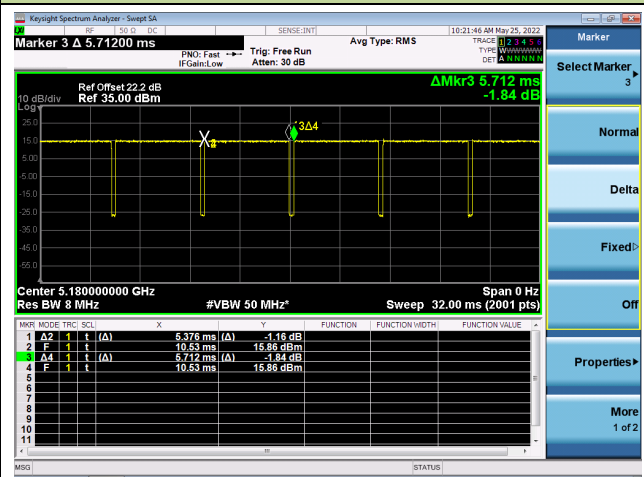
Test Mode	Duty Cycle	Test Mode	Duty Cycle
802.11a	93.66%	802.11ax-HE20	94.72%
802.11ac-VHT20	94.12%	802.11ax-HE40	96.02%
802.11ac-VHT40	89.40%	802.11ax-HE80	95.24%
802.1ac-VHT80	95.73%	--	--

Duty Cycle (T = Transmission Duration)

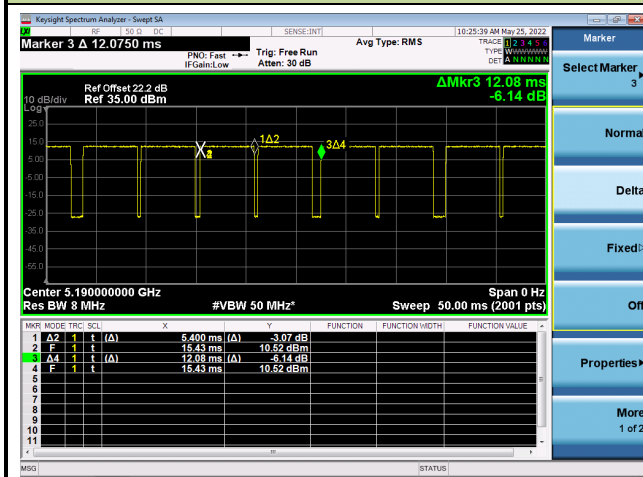
802.11a (T = 1.964ms)



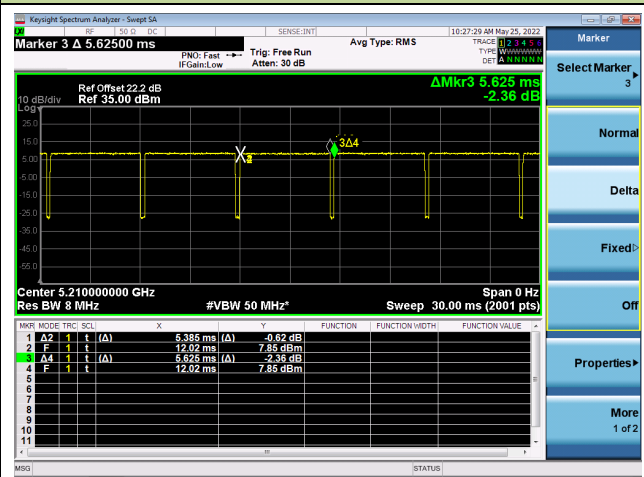
802.11ac-VHT20 (T = 5.376ms)



802.11ac-VHT40 (T = 5.400ms)

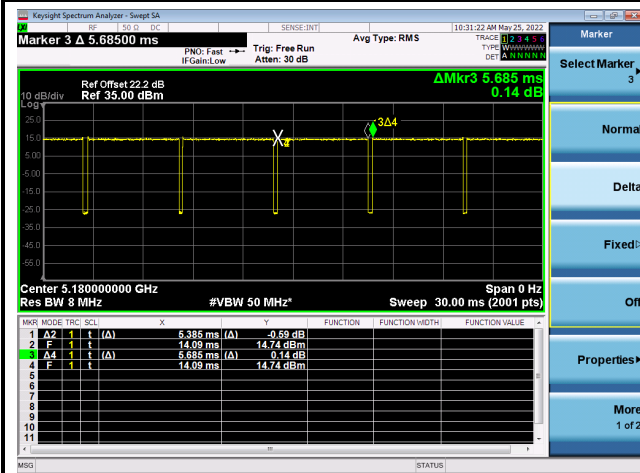


802.11ac-VHT80 (T = 5.385ms)

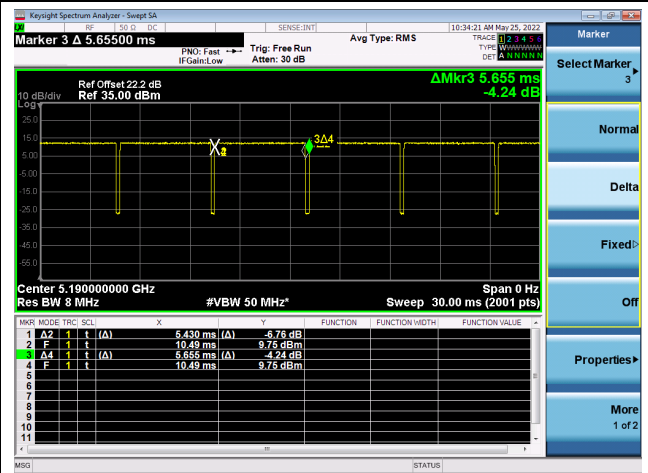


Duty Cycle (T = Transmission Duration)

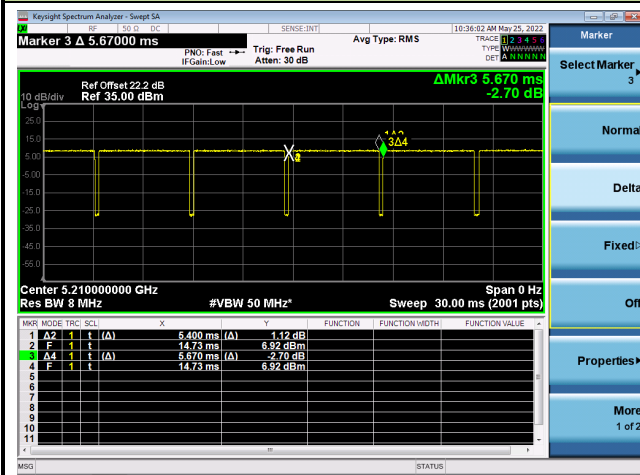
802.11ax-HE20 (T = 5.385ms)



802.11ax-HE40 (T = 5.430ms)



802.11ax-HE80 (T = 5.400ms)



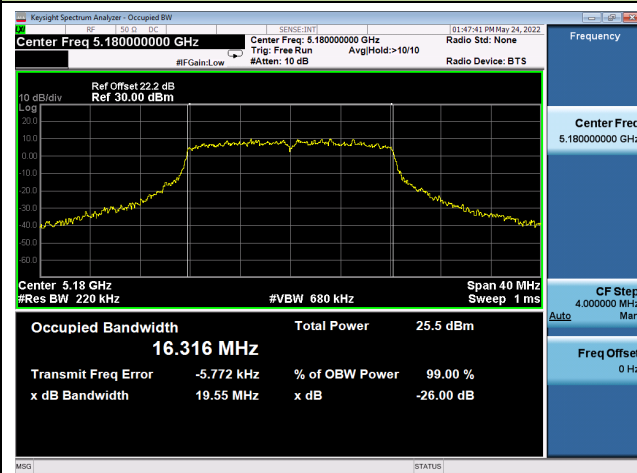
A.2 26dB Bandwidth Test Result

Test Site	NS-TR2	Test Engineer	Summer Tang
Test Date	2022/05/24		

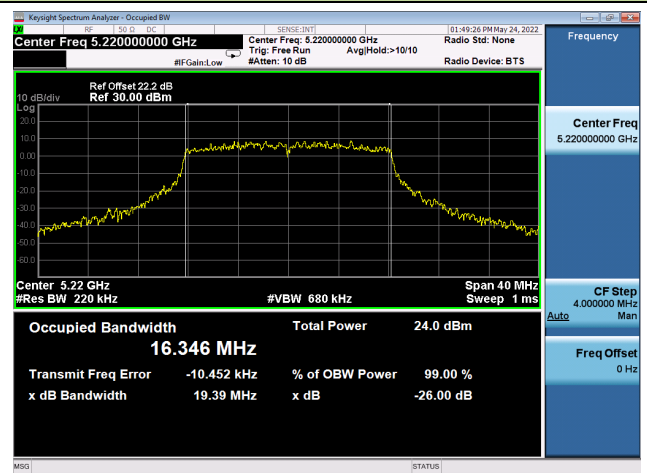
Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
802.11a	6Mbps	36	5180	19.55	16.316
802.11a	6Mbps	44	5220	19.39	16.346
802.11a	6Mbps	48	5240	18.63	16.296
802.11a	6Mbps	149	5745	20.03	16.394
802.11a	6Mbps	157	5785	19.52	16.384
802.11a	6Mbps	165	5825	19.61	16.388
802.11ac-VHT20	MCS0	36	5180	21.38	17.645
802.11ac-VHT20	MCS0	44	5220	21.08	17.652
802.11ac-VHT20	MCS0	48	5240	20.80	17.638
802.11ac-VHT20	MCS0	149	5745	21.02	17.643
802.11ac-VHT20	MCS0	157	5785	20.57	17.653
802.11ac-VHT20	MCS0	165	5825	20.85	17.639
802.11ac-VHT40	MCS0	38	5190	40.19	36.128
802.11ac-VHT40	MCS0	46	5230	39.78	36.101
802.11ac-VHT40	MCS0	151	5755	40.00	36.215
802.11ac-VHT40	MCS0	159	5795	39.33	36.090
802.11ac-VHT80	MCS0	42	5210	80.96	75.493
802.11ac-VHT80	MCS0	155	5775	81.39	75.432
802.11ax-HE20	MCS0	36	5180	21.28	18.935
802.11ax-HE20	MCS0	44	5220	20.69	18.956
802.11ax-HE20	MCS0	48	5240	20.91	18.951
802.11ax-HE20	MCS0	149	5745	21.26	18.979
802.11ax-HE20	MCS0	157	5785	21.50	18.999
802.11ax-HE20	MCS0	165	5825	20.49	18.902
802.11ax-HE40	MCS0	38	5190	40.34	37.634
802.11ax-HE40	MCS0	46	5230	40.58	37.685
802.11ax-HE40	MCS0	151	5755	40.36	37.624
802.11ax-HE40	MCS0	159	5795	40.62	37.795
802.11ax-HE80	MCS0	42	5210	81.83	76.946
802.11ax-HE80	MCS0	155	5775	81.23	77.182

802.11a 26dB & 99% Bandwidth

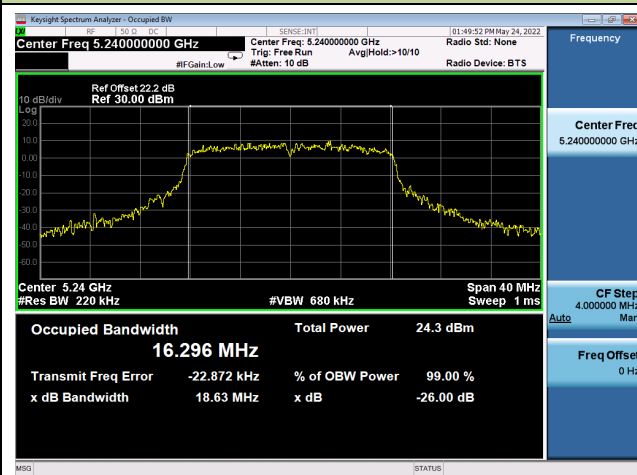
Channel 36 (5180MHz)



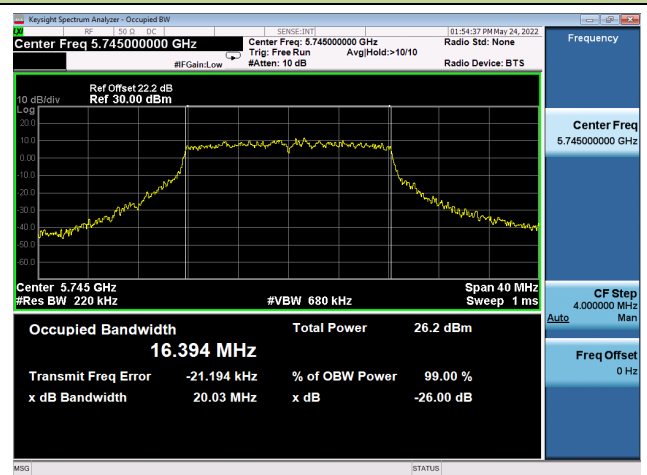
Channel 44 (5220MHz)



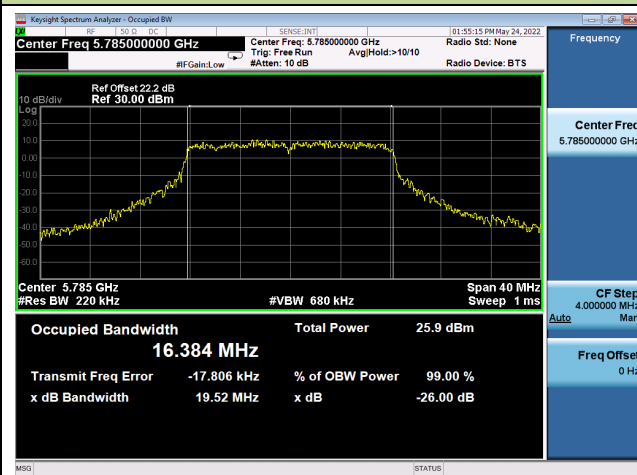
Channel 48 (5240MHz)



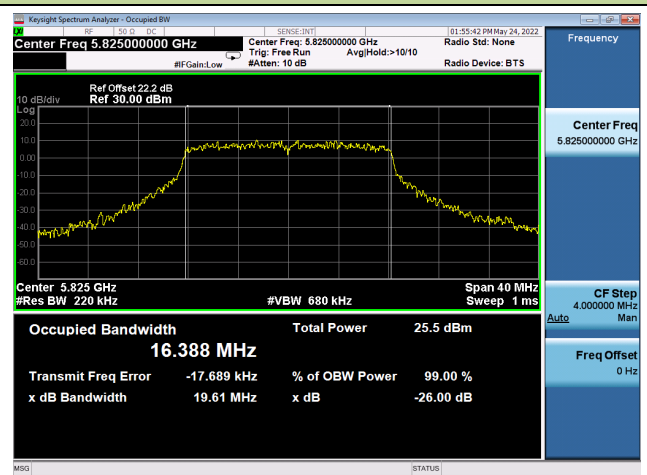
Channel 149 (5745MHz)



Channel 157 (5785MHz)



Channel 165 (5825MHz)

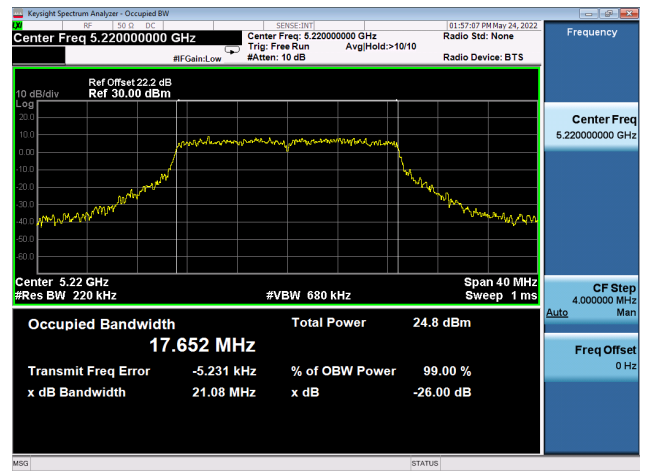


802.11ac-VHT20 26dB & 99% Bandwidth

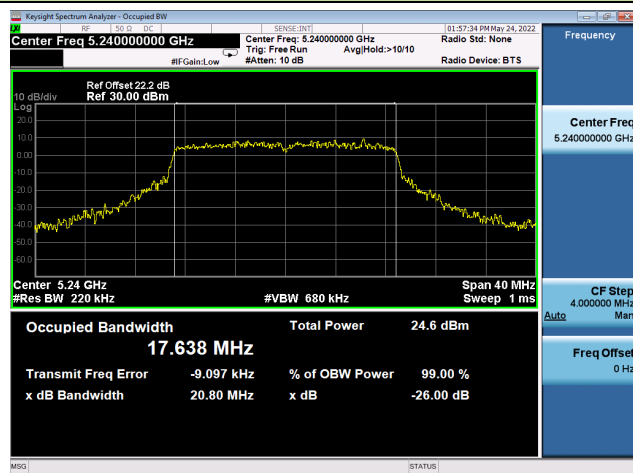
Channel 36 (5180MHz)



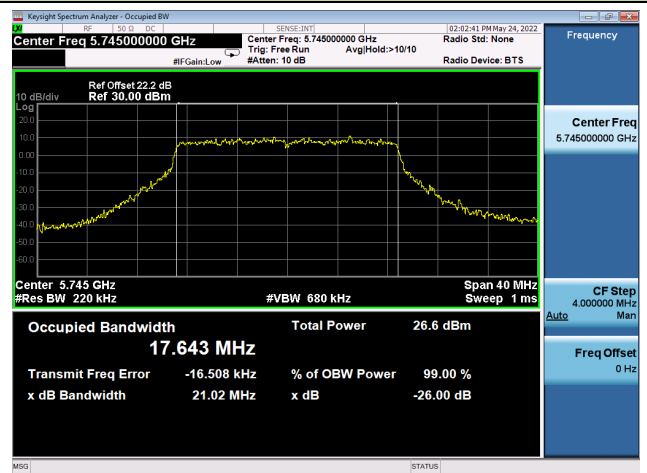
Channel 44 (5220MHz)



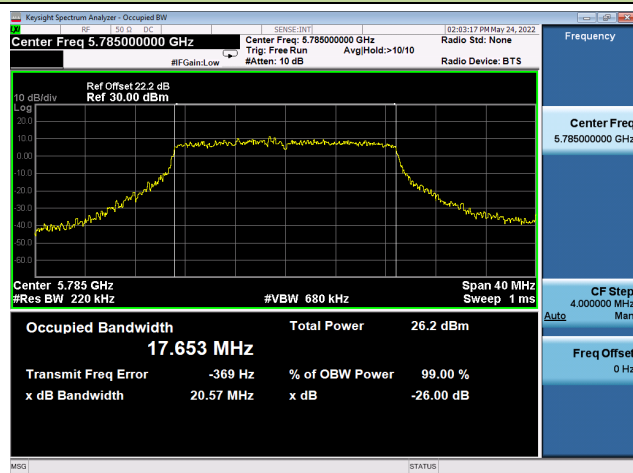
Channel 48 (5240MHz)



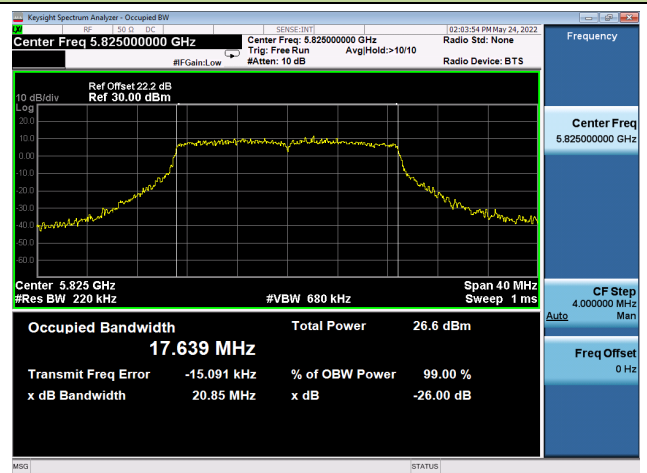
Channel 149 (5745MHz)



Channel 157 (5785MHz)

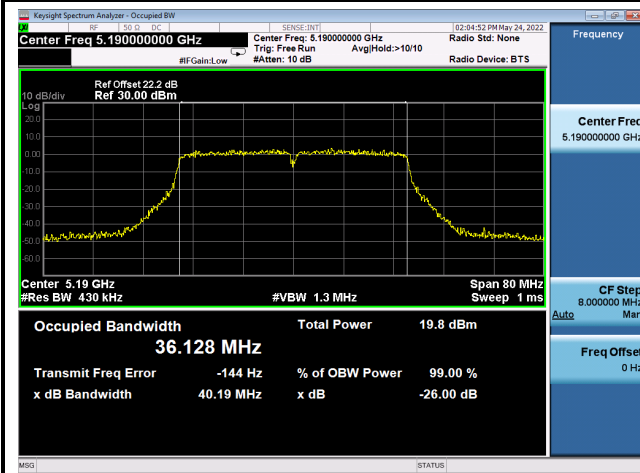


Channel 165 (5825MHz)

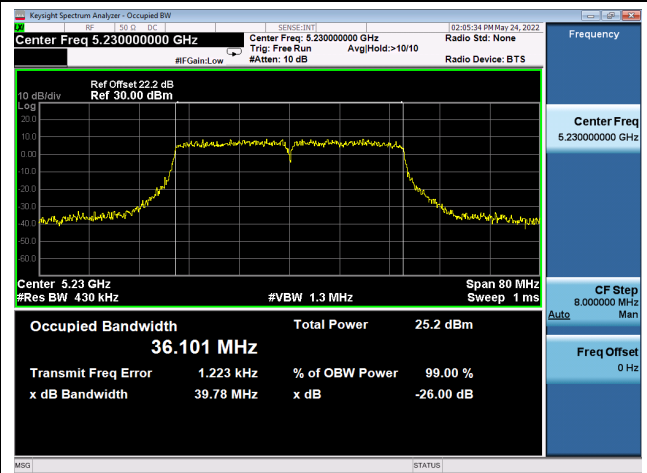


802.11ac-VHT40 26dB & 99% Bandwidth

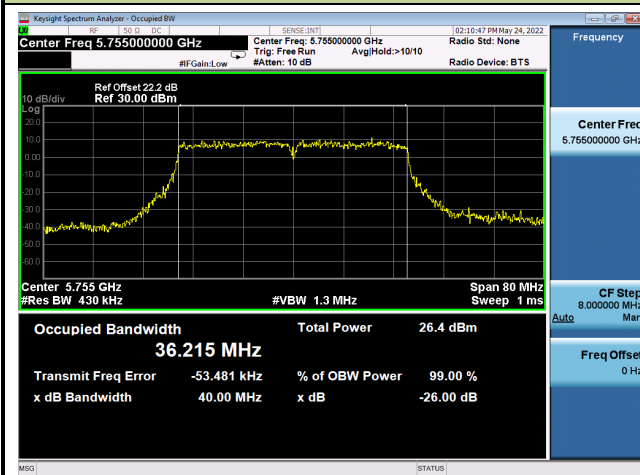
Channel 38 (5190MHz)



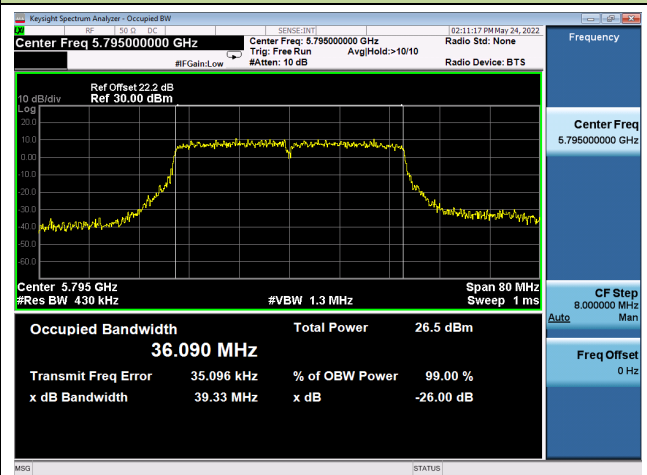
Channel 46 (5230MHz)



Channel 151 (5755MHz)

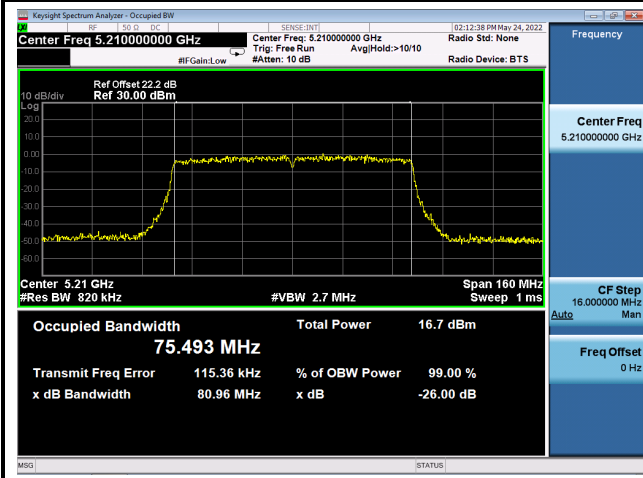


Channel 159 (5795MHz)

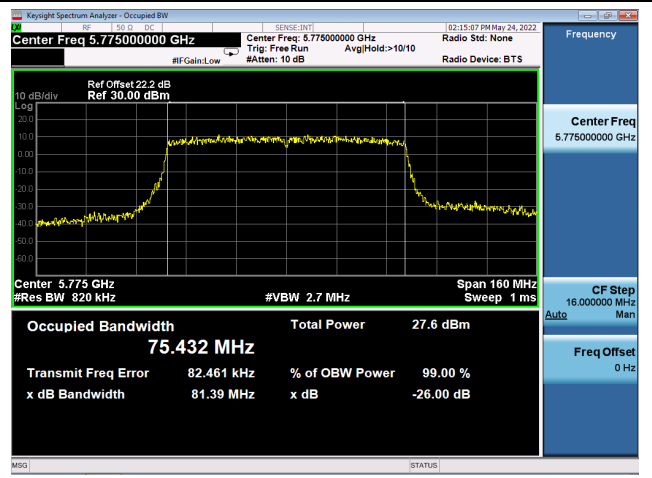


802.11ac-VHT80 26dB & 99% Bandwidth

Channel 42 (5210MHz)

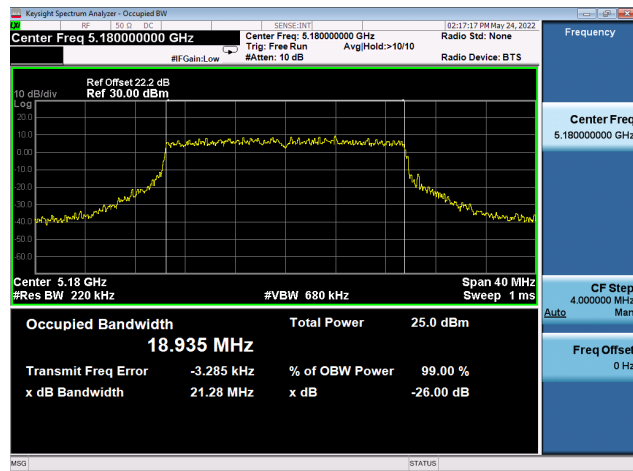


Channel 155 (5775MHz)

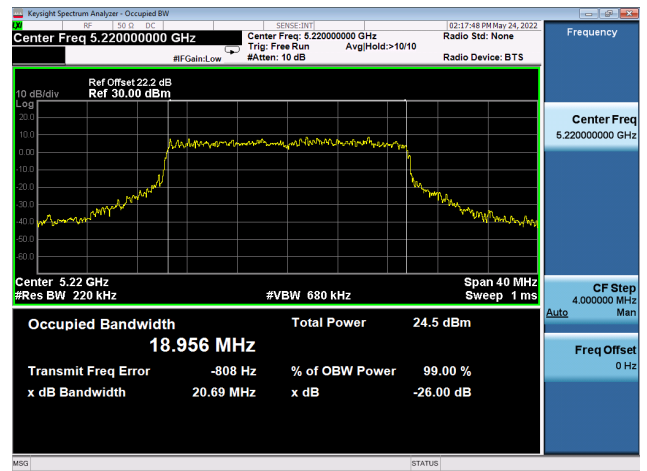


802.11ax-HE20 26dB & 99% Bandwidth

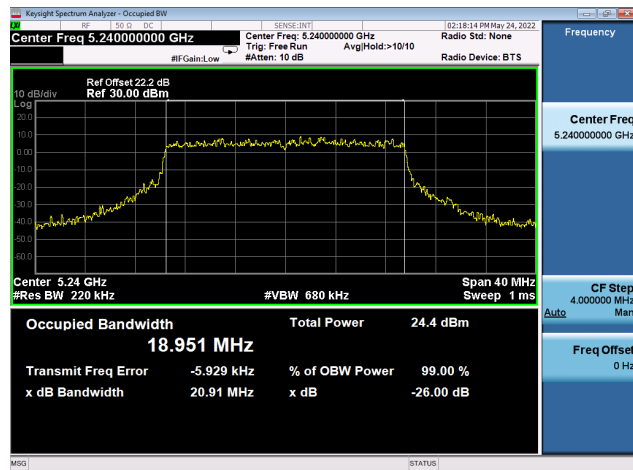
Channel 36 (5180MHz)



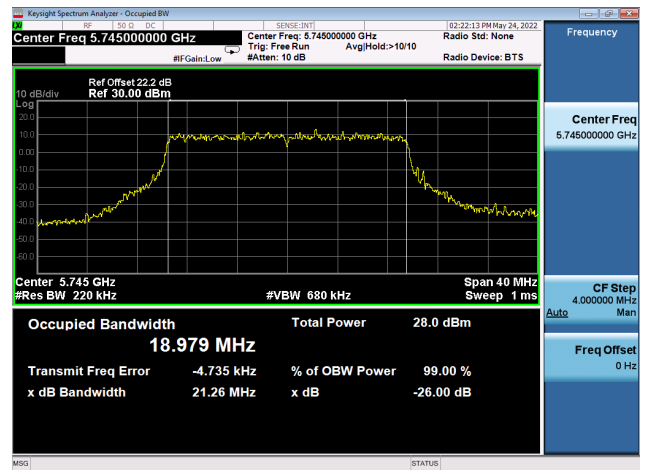
Channel 44 (5220MHz)



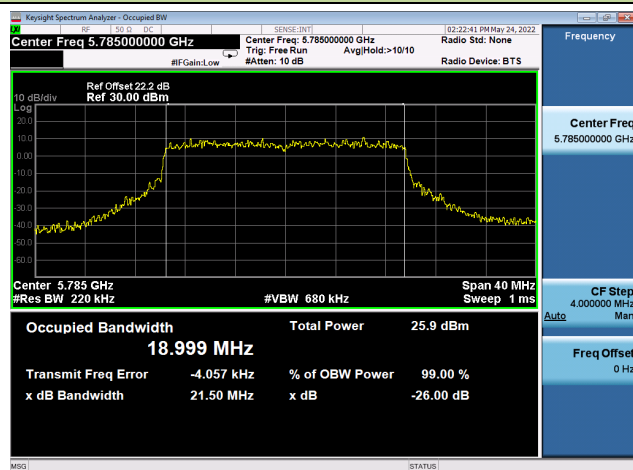
Channel 48 (5240MHz)



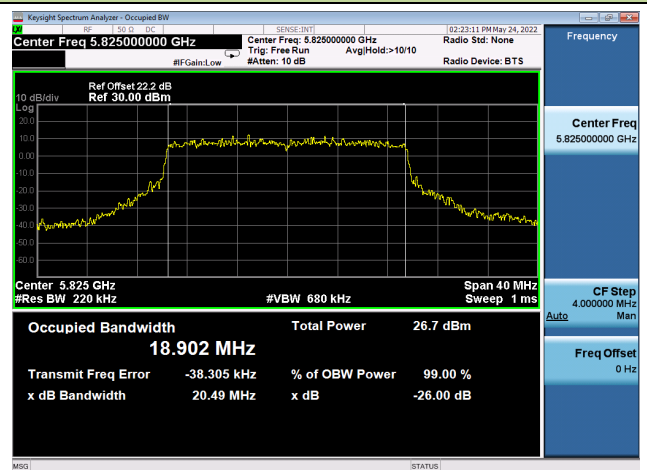
Channel 149 (5745MHz)



Channel 157 (5785MHz)

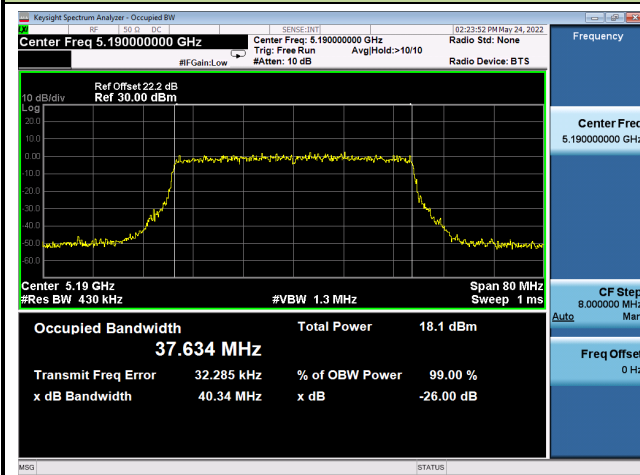


Channel 165 (5825MHz)

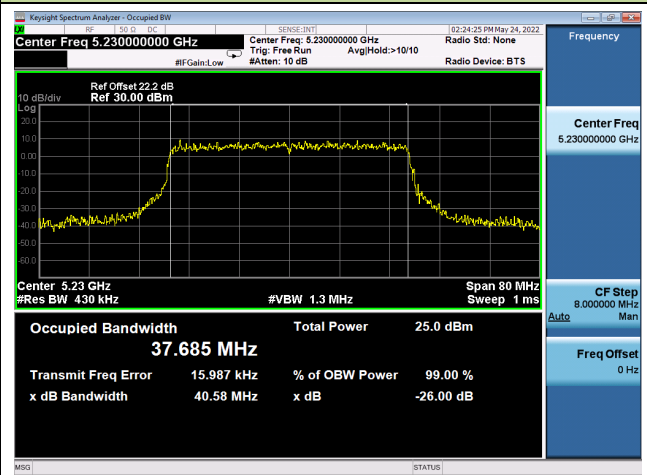


802.11ax-HE40 26dB & 99% Bandwidth

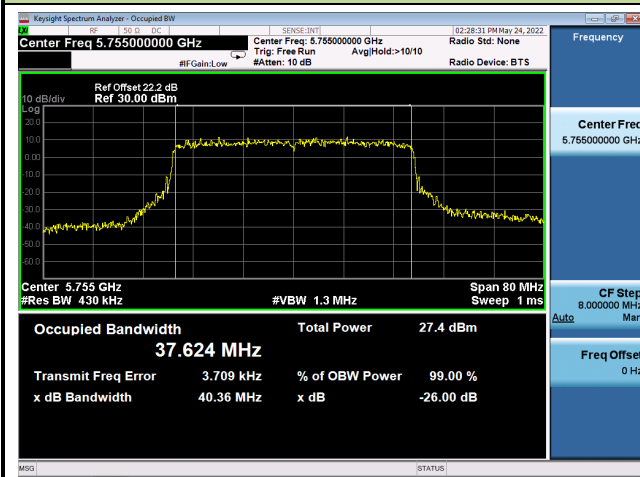
Channel 38 (5190MHz)



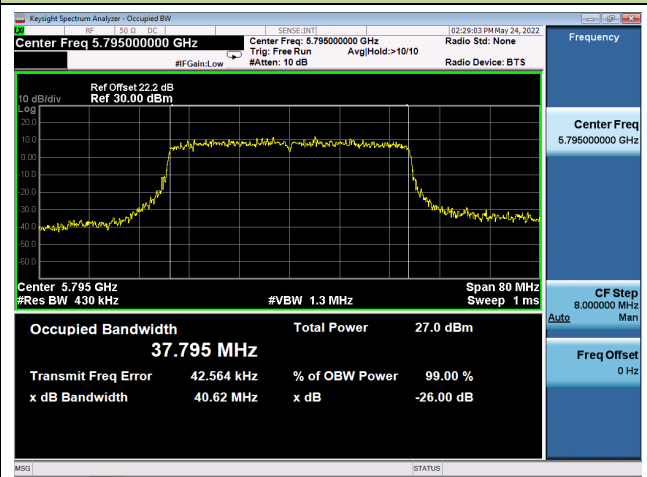
Channel 46 (5230MHz)



Channel 151 (5755MHz)

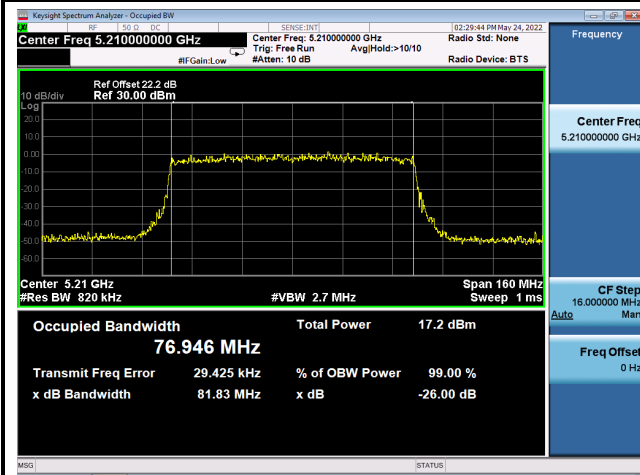


Channel 159 (5795MHz)

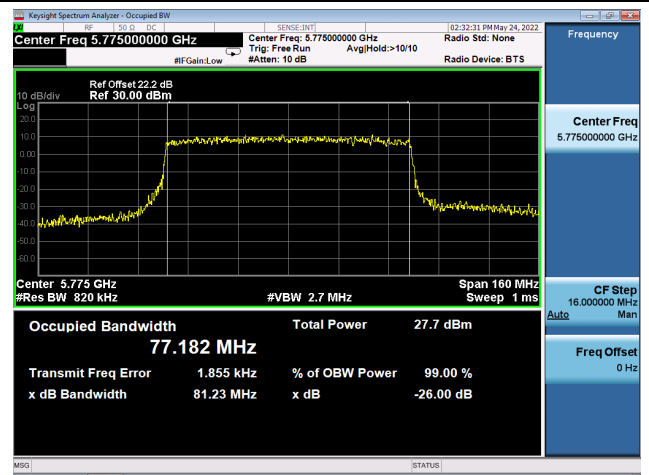


802.11ax-HE80 26dB & 99% Bandwidth

Channel 42 (5210MHz)



Channel 155 (5775MHz)



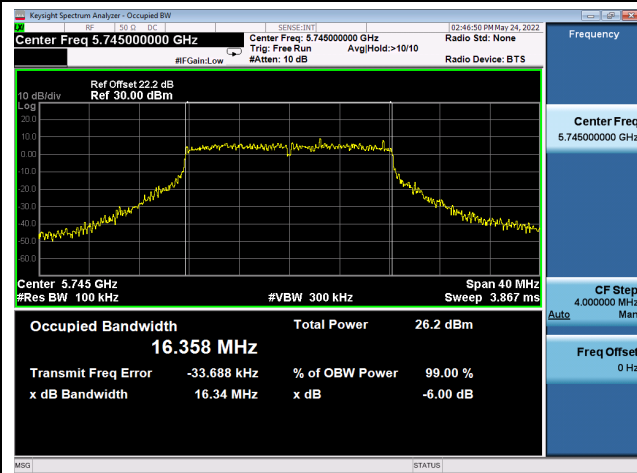
A.3 6dB Bandwidth Test Result

Test Site	NS-TR2	Test Engineer	Summer Tang
Test Date	2022/05/24		

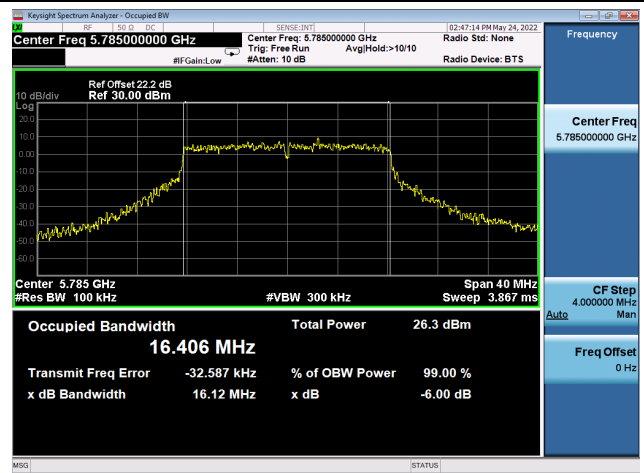
Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
802.11a	6Mbps	149	5745	16.34	≥ 0.5	Pass
802.11a	6Mbps	157	5785	16.12	≥ 0.5	Pass
802.11a	6Mbps	165	5825	16.33	≥ 0.5	Pass
802.11ac-VHT20	MCS0	149	5745	17.22	≥ 0.5	Pass
802.11ac-VHT20	MCS0	157	5785	17.64	≥ 0.5	Pass
802.11ac-VHT20	MCS0	165	5825	17.48	≥ 0.5	Pass
802.11ac-VHT40	MCS0	151	5755	36.43	≥ 0.5	Pass
802.11ac-VHT40	MCS0	159	5795	36.48	≥ 0.5	Pass
802.11ac-VHT80	MCS0	155	5775	74.69	≥ 0.5	Pass
802.11ax-HE20	MCS0	149	5745	19.07	≥ 0.5	Pass
802.11ax-HE20	MCS0	157	5785	18.87	≥ 0.5	Pass
802.11ax-HE20	MCS0	165	5825	19.05	≥ 0.5	Pass
802.11ax-HE40	MCS0	151	5755	37.84	≥ 0.5	Pass
802.11ax-HE40	MCS0	159	5795	37.86	≥ 0.5	Pass
802.11ax-HE80	MCS0	155	5775	76.26	≥ 0.5	Pass

802.11a 6dB Bandwidth

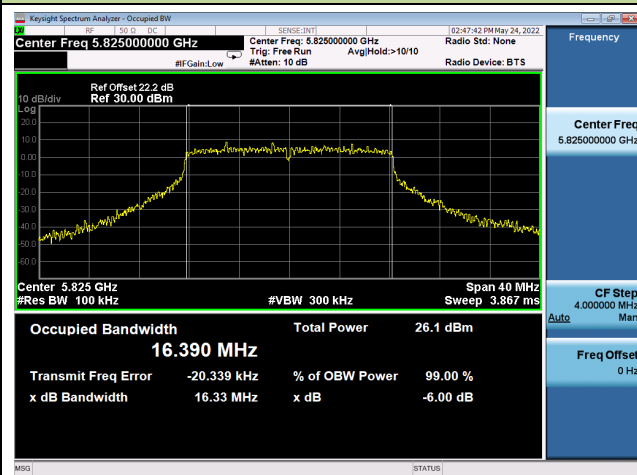
Channel 149 (5745MHz)



Channel 157 (5785MHz)

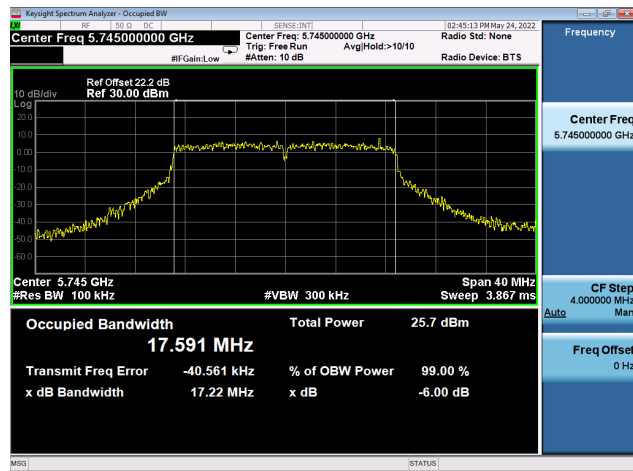


Channel 165 (5825MHz)

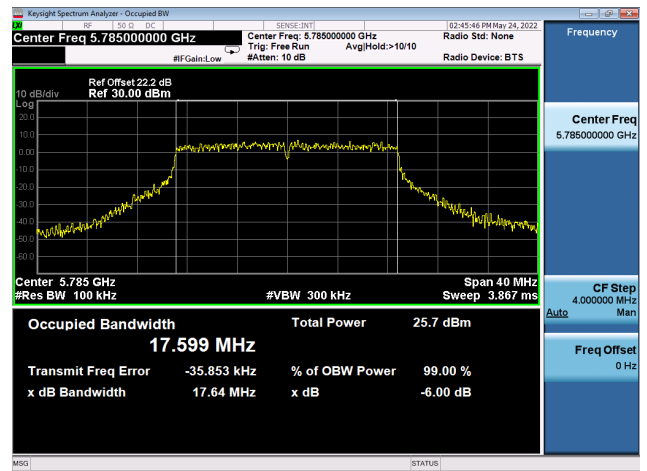


802.11ac-VHT20 6dB Bandwidth

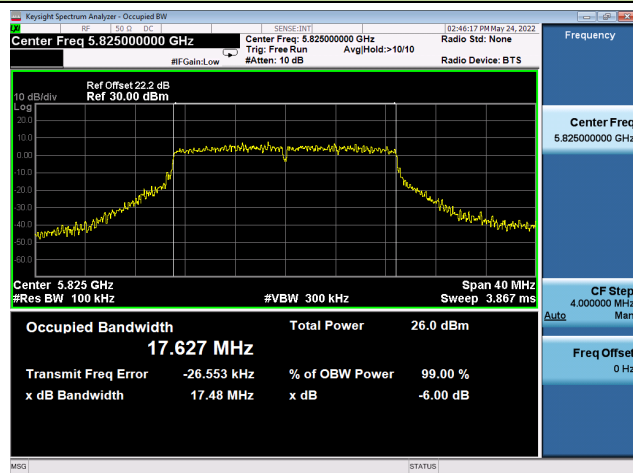
Channel 149 (5745MHz)



Channel 157 (5785MHz)

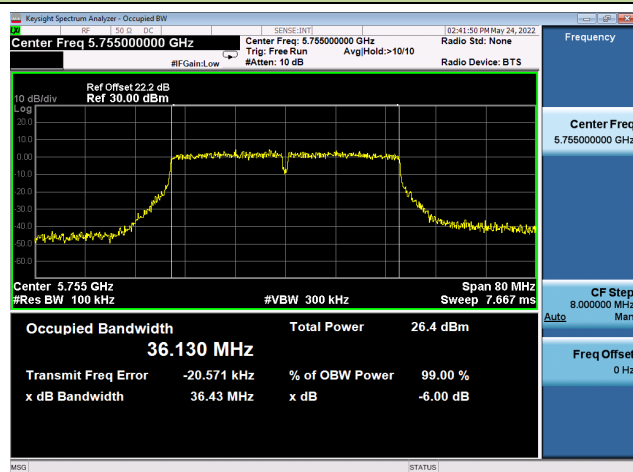


Channel 165 (5825MHz)

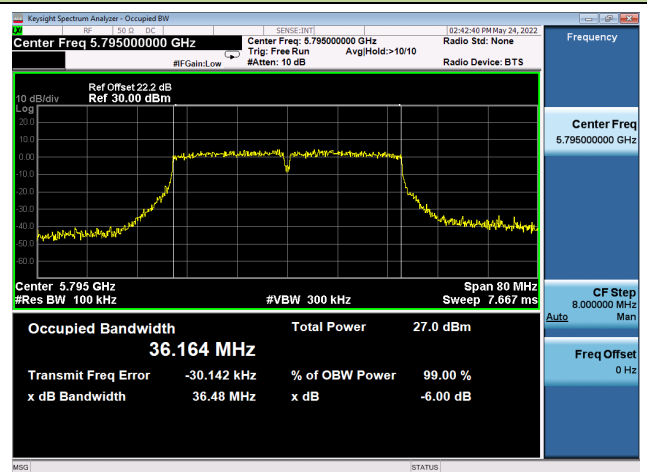


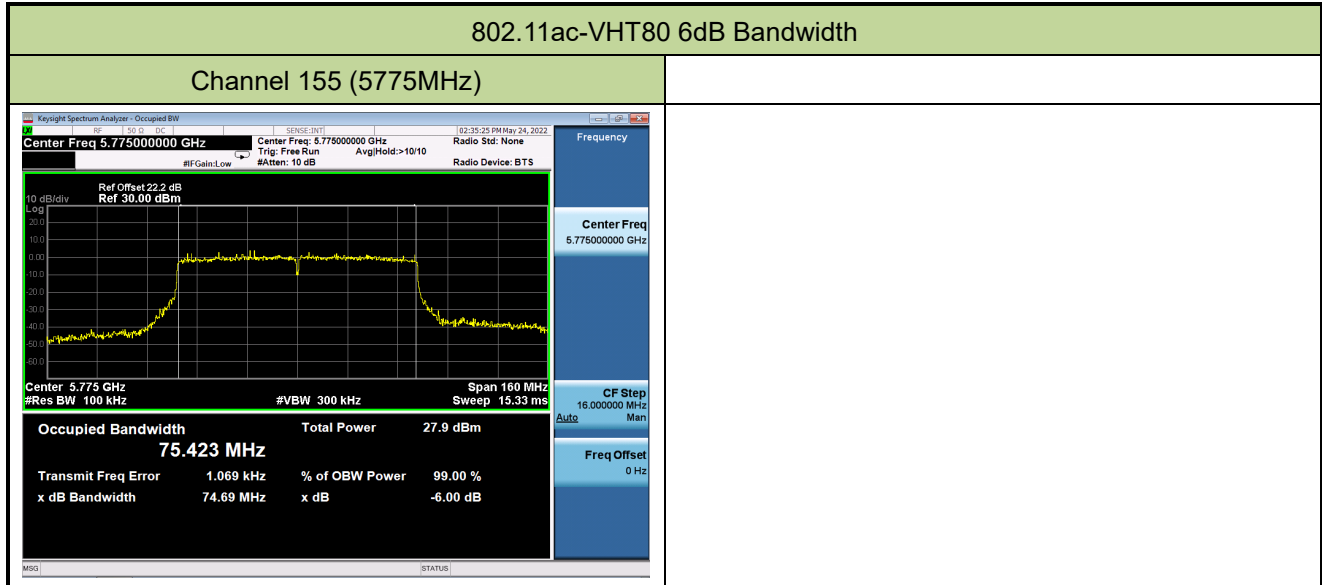
802.11ac-VHT40 6dB Bandwidth

Channel 151 (5755MHz)



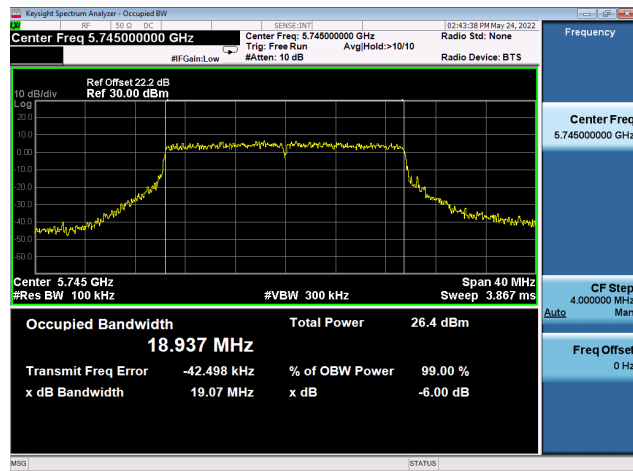
Channel 159 (5795MHz)



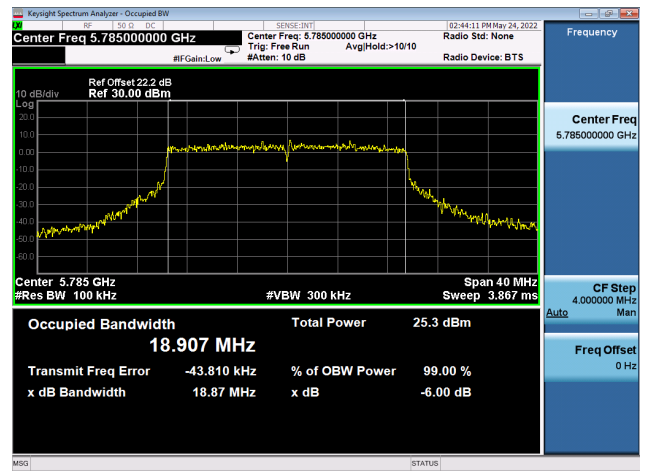


802.11ax-HE20 6dB Bandwidth

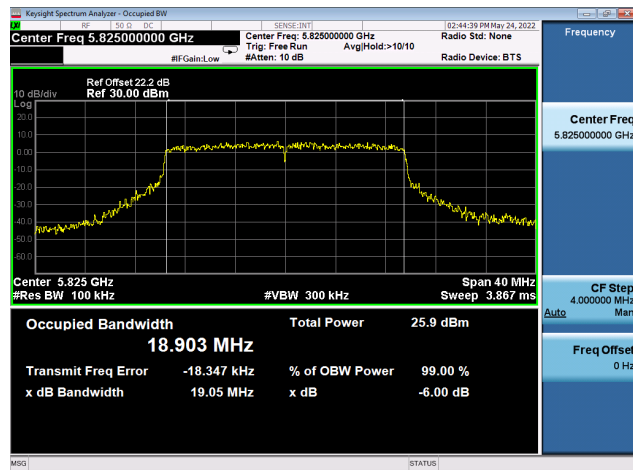
Channel 149 (5745MHz)



Channel 157 (5785MHz)

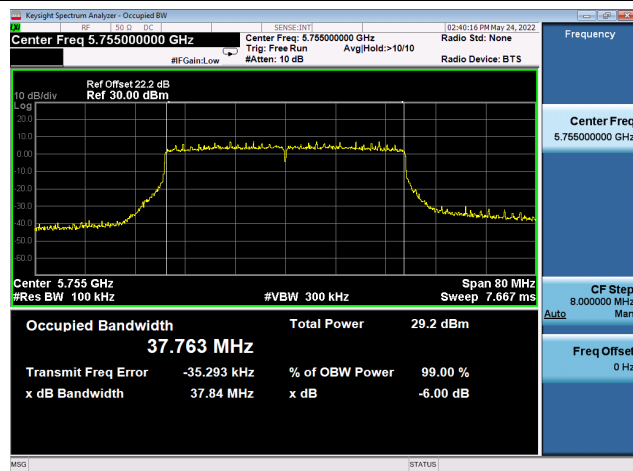


Channel 165 (5825MHz)

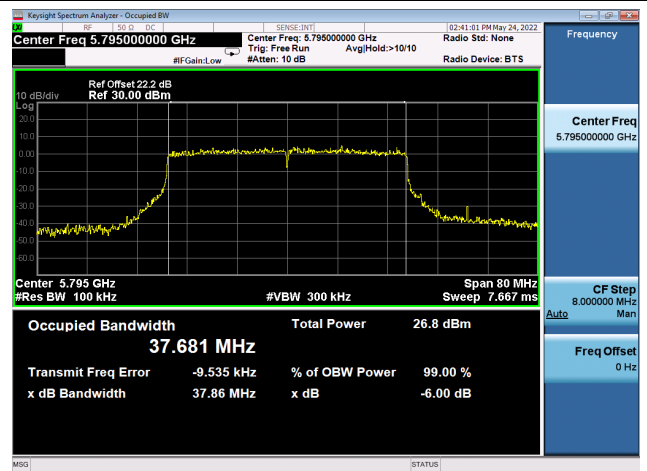


802.11ac-VHT40 6dB Bandwidth

Channel 151 (5755MHz)

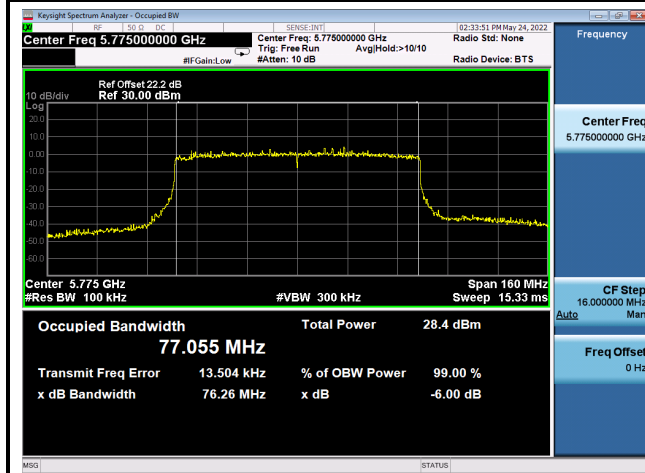


Channel 159 (5795MHz)



802.11ax-HE80 6dB Bandwidth

Channel 155 (5775MHz)



A.4 Output Power Test Result

Test Site	NS-TR2	Test Engineer	Summer Tang
Test Date	2022/05/23		

Test Mode	Data Rate MCS	Channel No.	Freq. (MHz)	Average Power (dBm)		Total Average Power (dBm)	Average Power Limit (dBm)
				Ant 0	Ant 1		
11a	6Mbps	36	5180	18.73	18.95	21.85	30.00
11a	6Mbps	44	5220	18.34	18.62	21.49	30.00
11a	6Mbps	48	5240	18.85	19.11	21.99	30.00
11a	6Mbps	149	5745	20.89	20.55	23.73	30.00
11a	6Mbps	157	5785	21.12	20.59	23.87	30.00
11a	6Mbps	165	5825	20.78	20.02	23.43	30.00
11ac-VHT20	MCS0	36	5180	18.56	18.80	21.69	30.00
11ac-VHT20	MCS0	44	5220	19.62	19.80	22.72	30.00
11ac-VHT20	MCS0	48	5240	19.18	19.52	22.36	30.00
11ac-VHT20	MCS0	149	5745	20.83	20.38	23.62	30.00
11ac-VHT20	MCS0	157	5785	21.03	20.45	23.76	30.00
11ac-VHT20	MCS0	165	5825	21.03	20.41	23.74	30.00
11ac-VHT40	MCS0	38	5190	12.86	12.98	15.93	30.00
11ac-VHT40	MCS0	46	5230	18.98	19.29	22.15	30.00
11ac-VHT40	MCS0	151	5755	21.21	20.63	23.94	30.00
11ac-VHT40	MCS0	159	5795	21.41	20.73	24.09	30.00
11ac-VHT80	MCS0	42	5210	9.54	9.90	12.73	30.00
11ac-VHT80	MCS0	155	5775	21.52	20.86	24.21	30.00
11ax-HE20	MCS0	36	5180	18.47	18.58	21.54	30.00
11ax-HE20	MCS0	44	5220	18.36	18.73	21.56	30.00
11ax-HE20	MCS0	48	5240	18.54	18.75	21.66	30.00
11ax-HE20	MCS0	149	5745	21.68	21.15	24.43	30.00
11ax-HE20	MCS0	157	5785	20.78	20.28	23.55	30.00
11ax-HE20	MCS0	165	5825	21.27	20.70	24.00	30.00
11ax-HE40	MCS0	38	5190	10.99	11.22	14.12	30.00
11ax-HE40	MCS0	46	5230	18.66	18.92	21.80	30.00
11ax-HE40	MCS0	151	5755	21.22	20.72	23.99	30.00
11ax-HE40	MCS0	159	5795	21.04	20.35	23.72	30.00
11ax-HE80	MCS0	42	5210	10.01	10.10	13.07	30.00
11ax-HE80	MCS0	155	5775	21.22	20.62	23.94	30.00

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

A.5 Power Spectral Density Test Result

Test Site	NS-TR2	Test Engineer	Summer Tang
Test Date	2022/05/24		
Test Item	Power Spectral Density (UNII-1)		

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	AVPSD (dBm/ MHz)		Duty Cycle (%)	Total PSD (dBm/ MHz)	PSD Limit (dBm/MHz)
				Ant 0	Ant 1			
11a	6Mbps	36	5180	7.934	7.925	93.66	11.22	14.99
11a	6Mbps	44	5220	7.382	7.953	93.66	10.97	14.99
11a	6Mbps	48	5240	8.153	8.305	93.66	11.52	14.99
11ac-VHT20	MCS0	36	5180	7.540	7.731	94.12	10.91	14.99
11ac-VHT20	MCS0	44	5220	8.172	8.466	94.12	11.59	14.99
11ac-VHT20	MCS0	48	5240	7.736	8.122	94.12	11.21	14.99
11ac-VHT40	MCS0	38	5190	-1.473	-0.941	89.40	2.30	14.99
11ac-VHT40	MCS0	46	5230	4.660	4.881	89.40	8.27	14.99
11ac-VHT80	MCS0	42	5210	-7.854	-7.226	95.73	-4.33	14.99
11ax-HE20	MCS0	36	5180	6.718	6.966	94.72	10.09	14.99
11ax-HE20	MCS0	44	5220	6.676	6.902	94.72	10.04	14.99
11ax-HE20	MCS0	48	5240	6.507	7.047	94.72	10.03	14.99
11ax-HE40	MCS0	38	5190	-3.328	-2.975	96.02	0.04	14.99
11ax-HE40	MCS0	46	5230	4.376	4.830	96.02	7.80	14.99
11ax-HE80	MCS0	42	5210	-7.196	-6.758	95.24	-3.75	14.99

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

Test Site	WZ-SR5	Test Engineer	Luis Yang
Test Date	2022/05/24		
Test Item	Power Spectral Density (UNII-3)		

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	AVPSD (dBm/ 510KHz)		Duty Cycle (%)	Total PSD (dBm/ 510KHz)	PSD Limit (dBm/ 500KHz)
				Ant 0	Ant 1			
11a	6Mbps	149	5745	7.983	7.406	93.66	11.00	27.99
11a	6Mbps	157	5785	8.128	7.155	93.66	10.96	27.99
11a	6Mbps	165	5825	7.269	6.521	93.66	10.21	27.99
11ac-VHT20	MCS0	149	5745	7.279	6.334	94.12	10.11	27.99
11ac-VHT20	MCS0	157	5785	7.568	6.890	94.12	10.52	27.99
11ac-VHT20	MCS0	165	5825	7.202	6.643	94.12	10.20	27.99
11ac-VHT40	MCS0	151	5755	4.867	3.483	89.40	7.73	27.99
11ac-VHT40	MCS0	159	5795	4.837	3.423	89.40	7.68	27.99
11ac-VHT80	MCS0	155	5775	1.954	0.799	95.73	4.61	27.99
11ax-HE20	MCS0	149	5745	8.320	7.029	94.72	10.97	27.99
11ax-HE20	MCS0	157	5785	6.809	5.760	94.72	9.56	27.99
11ax-HE20	MCS0	165	5825	7.610	6.122	94.72	10.18	27.99
11ax-HE40	MCS0	151	5755	5.081	3.995	96.02	7.76	27.99
11ax-HE40	MCS0	159	5795	4.567	3.686	96.02	7.34	27.99
11ax-HE80	MCS0	155	5775	1.784	0.804	95.24	4.54	27.99

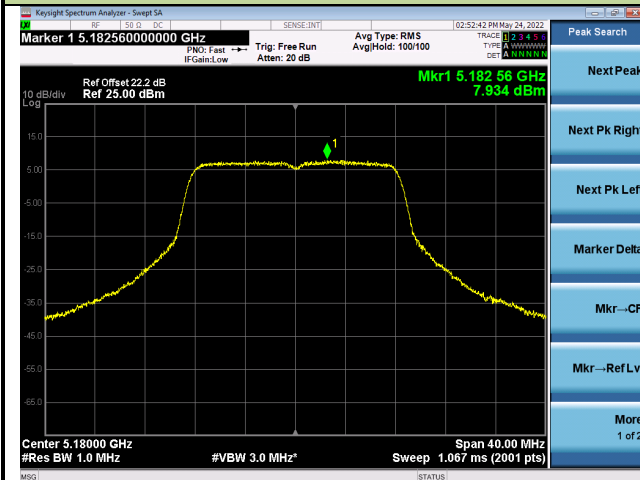
Note 1:

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

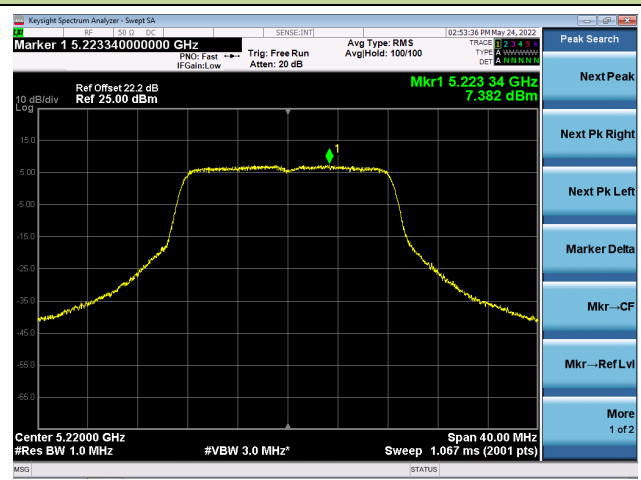
Note 2: PSD Limit (dBm/500KHz) = 30 - (8.01 - 6) = 27.99dBm/500kHz

802.11a Power Spectral Density – Ant 0

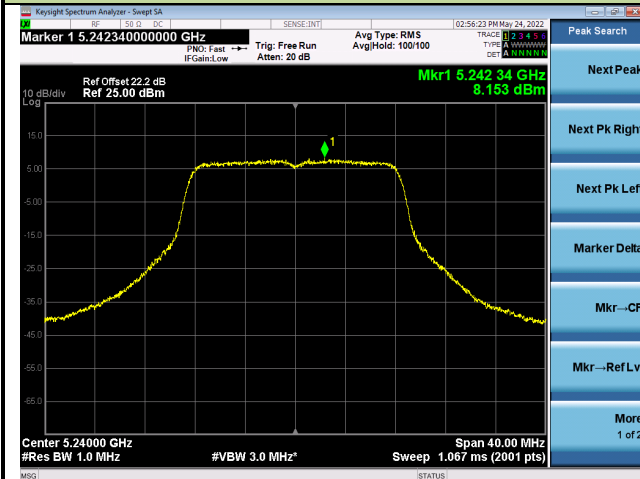
Channel 36 (5180MHz)



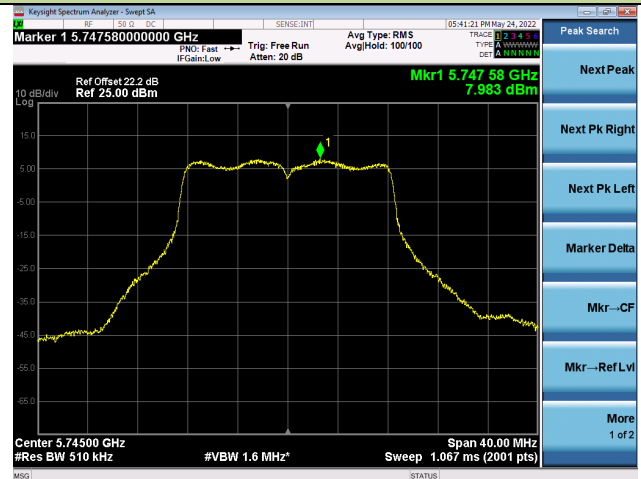
Channel 44 (5220MHz)



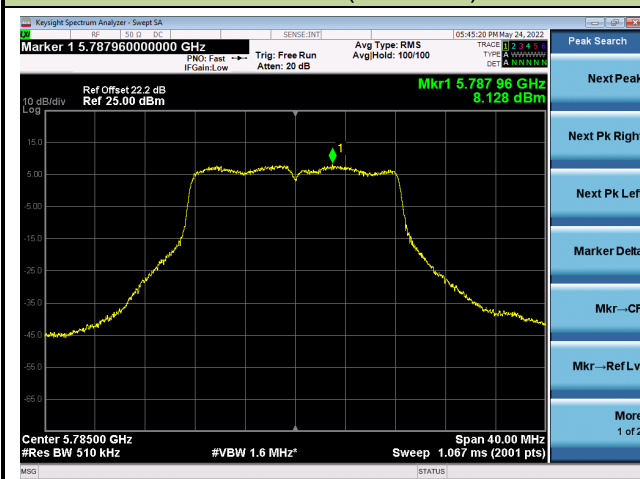
Channel 48 (5240MHz)



Channel 149 (5745MHz)



Channel 157 (5785MHz)



Channel 165 (5825MHz)

