RF MEASUREMENT REPORT

FCC ID:	2AXJ4X50POE
Applicant:	TP-Link Corporation Limited
Product:	AX3000 Whole Home Mesh Wi-Fi 6 AP with PoE
Model No.:	HX510-PoE
Brand Name:	tp-link
FCC Classification:	Unlicensed National Information Infrastructure (NII)
FCC Rule Part(s):	Part 15 Subpart E (Section 15.407)
Result:	Complies
Received Date:	2023-08-05
Test Date:	2023-08-21 ~ 2023-08-31

Reviewed By: Kevin Guo

Approved By: Robin Wu

ACCREDITED
TESTING LABORATORY
CERTIFICATE #3628.01

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.

Revision History

Report No.	Version	Description	Issue Date	Note
2308RSU061-U1	V01	Initial Report	2023-10-09	Valid

Note: This report is prepared for FCC Class II permissive change supplement based on the FCC ID: 2AXJ4X50POE, original grant date: 11/14/2022 to open the NII-2a/-2c bands and Beamforming function at Wi-Fi 5GHz Bands via the software.

CONTENTS

1. General Information

1.1. Applicant

TP-Link Corporation Limited

Room 901, 9/F., New East Ocean Centre, 9 Science Museum Road, Tsim Sha Tsui, Kowloon, Hongkong

1.2. Manufacturer

TP-Link Corporation Limited

Room 901, 9/F., New East Ocean Centre, 9 Science Museum Road, Tsim Sha Tsui, Kowloon, Hongkong

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: 3261				
	FCC: 291082, TW3261		ISED: TW3261		

1.4. Product Information

Product Name	AX3000 Whole Home Mesh Wi-Fi 6 AP with PoE
Model No.	HX510-PoE
EUT Serial No.	SN: EC2300ECA186 SN: EC2300ECC156 (For Conducted)
Wi-Fi Specification	802.11a/b/g/n/ac/ax
Antenna Information	Refer to section 1.7
Working Voltage	By Adapter
Accessory	
Adapter	Model: T120150-2B1 Input: 100-240V ~ 50/60Hz 0.6A Output: 12V 1.5A
Note: 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 under Test

Frequency Range	For 802.11a/n-HT20/ac-VHT20/ax-HE20: 5260~5320MHz, 5500~5700MHz For 802.11n-HT40/ac-VHT40/ax-HE40: 5270~5310MHz, 5510~5670MHz For 802.11ac-VHT80/ax-HE80: 5290MHz, 5530MHz, 5610 MHz For 802.11ac-VHT160/ax-HE160: 5570MHz	
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 1733.4Mbps 802.11ax: up to 2402Mbps	
Channel Puncturing Function	☐ Supported	☒ Unsupported
Support RU	☒ Full RU	☐ Partial RU

1.6. Working Frequencies

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

Channel	Frequency	Channel	Frequency	Channel	Frequency
52	5260 MHz	56	5280 MHz	60	5300 MHz
64	5320 MHz	100	5500 MHz	104	5520 MHz
108	5540 MHz	112	5560 MHz	116	5580 MHz
120	5600 MHz	124	5620 MHz	128	5640 MHz
132	5660 MHz	136	5680 MHz	140	5700 MHz

802.11n-HT40/ac-VHT40/ax-HE40

Channel	Frequency	Channel	Frequency	Channel	Frequency
54	5270 MHz	62	5310 MHz	102	5510 MHz
110	5550MHz	118	5590 MHz	126	5630 MHz
134	5670 MHz	--	--	--	--

802.11ac-VHT80/ax-HE80

Channel	Frequency	Channel	Frequency	Channel	Frequency
58	5290 MHz	106	5530 MHz	122	5610 MHz

802.11ac-VHT160/ax-HE160

Channel	Frequency	Channel	Frequency	Channel	Frequency
114	5570 MHz	--	--	--	--

1.7. Antenna Details

Antenna Type	Frequency Band (MHz)	T_X Paths	Antenna Gain (dBi)	Beamforming Directional Gain (dBi)	CDD Directional Gain (dBi)	
					For Power	For PSD
Dipole Antenna	5150 ~ 5850	2	0.97	3.98	0.97	3.98

Remark:

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

   If all antennas have the same gain, G_{ANT}, Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows.

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

   Array Gain = 10 log (N_{ANT}/ N_{SS}) dB;

   - For power measurements on IEEE 802.11 devices,

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

2. The EUT also supports Beam Forming mode, and the Beam Forming support 802.11ac/ax, not include 802.11a/b/g/n. BF Directional gain = G_{ANT} + 10 log (N_{ANT}).

3. The information as above is from the antenna specifications.

Test Mode	TX Paths	CDD Mode	Beamforming Mode
802.11a (NII)	2	√	X
802.11n/ac/ax (NII)	2	√	√

Note: "√" means "Support", "X" means "Not support".

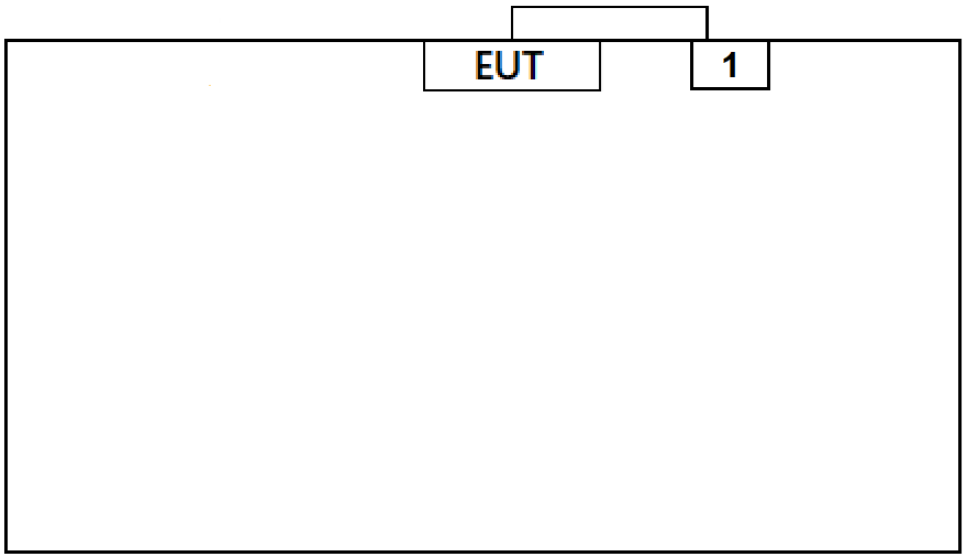
2. Test Configuration

2.1. Test Mode

CDD Mode
Mode 1: Transmit by 802.11a_Nss=1 (6Mbps)
Mode 2: Transmit by 802.11ac-VHT20_Nss=1 (MCS0)
Mode 3: Transmit by 802.11ac-VHT40_Nss=1 (MCS0)
Mode 4: Transmit by 802.11ac-VHT80_Nss=1 (MCS0)
Mode 5: Transmit by 802.11ac-VHT160_Nss=1 (MCS0)
Mode 6: Transmit by 802.11ax-HE20_Nss=1 (MCS0)
Mode 7: Transmit by 802.11ax-HE40_Nss=1 (MCS0)
Mode 8: Transmit by 802.11ax-HE80_Nss=1 (MCS0)
Mode 9: Transmit by 802.11ax-HE160_Nss=1 (MCS0)
Note: 1. For Radiated emission, the modulation and the data rate picked for testing are determined by the Max. RF conducted power. 2. For CDD mode, this device supports 2 N_{SS} and power level is the same of spatial multiplexing. The worst case is N_{SS}=1. 3. 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 level for 802.11n-HT20 and HT40 will not be greater than 802.11ac-VHT20 and VHT40. 4. All modes of operation and data rates were investigated, so all RF test requirements shall be executed at the worst data rat. 5. All test items were evaluated under CDD mode in this report. The RF output power setting under beamforming mode is same as CDD mode, so there is no additional test under beamforming mode. 6. EUT supports one configuration only in 802.11ax full RU mode.

2.2. Test System Connection Diagram

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

Connection Diagram


2.3. Test System Details

Product		Manufacturer	Model No.
1	Notebook (for RF Test)	Hp	ZHAN99 G1

2.4. Test Software

The test utility software used during testing was “QSPR”, and the version was 5.0-00202.

Note: Final power setting please refer to operational description.

2.5. Applied Standards

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

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

2.6. 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."

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

Conclusion:

The unit complies with the requirement of §15.203.

4. Measuring Instrument

Instrument	Manufacturer	Model No.	Asset No.	Cali. Interval	Cali. Due Date	Test Site
TRILOG Antenna	Sunol Sciences Corp.	JB1	MRTSUE06021	1 year	2024-04-09	NS-AC1
Horn Antenna	Schwarzbeck	BBHA 9170	MRTSUE06292	1 year	2023-10-18	NS-AC1
Anechoic Chamber	BOOMWAVE	NS-AC1	MRTSUE06496	1 year	2024-07-12	NS-AC1
Horn Antenna	Schwarzbeck	BBHA 9120D	MRTSUE06572	1 year	2024-03-31	NS-AC1
TRILOG Antenna	Schwarzbeck	VULB 9162	MRTSUE06573	1 year	2024-06-09	NS-AC1
Preamplifier	Schwarzbeck	BBV 9718	MRTSUE06574	1 year	2024-07-07	NS-AC1
EMI Test Receiver	R&S	ESR3	MRTSUE06575	1 year	2024-06-18	NS-AC1
Preamplifier	EMCI	EMC184045SE	MRTSUE06641	1 year	2024-01-12	NS-AC1
Thermohygrometer	testo	608-H1	MRTSUE11020	1 year	2024-05-03	NS-AC1
Thermohygrometer	testo	608-H1	MRTSUE11104	1 year	2024-05-03	NS-AC1
Signal Analyzer	Agilent	N9010A	MRTSUE06195	1 year	2023-12-20	NS-AC1/NS-TR2
Signal Analyzer	Keysight	N9020A	MRTSUE10065	1 year	2023-12-20	NS-AC1/NS-TR2
Shielding Room	BOOMWAVE	NS-SR2	MRTSUE06551	5 years	2024-06-03	NS-SR2
EMI Test Receiver	R&S	ESL3	MRTSUE06576	1 year	2024-06-18	NS-SR2
Two-Line V-Network	R&S	ENV216	MRTSUE06577	1 year	2024-04-25	NS-SR2
Two-Line V-Network	R&S	ENV216	MRTSUE06578	1 year	2024-04-25	NS-SR2
Thermohygrometer	testo	608-H1	MRTSUE11106	1 year	2024-05-03	NS-SR2
Attenuator	MVE	MVE2213	MRTSUE11062	1 year	2024-06-08	NS
Attenuator	MVE	MVE2213	MRTSUE11063	1 year	2024-06-08	NS
Attenuator	MVE	MVE2213	MRTSUE11064	1 year	2024-06-08	NS
Attenuator	MVE	MVE2213	MRTSUE11065	1 year	2024-06-08	NS
USB Power Sensor	Keysight	U2021XA	MRTSUE06581	1 year	2024-06-30	NS-SR2/NS-TR2
Thermohygrometer	DELI	NO.8813	MRTSUE06783	1 year	2023-12-28	NS-TR2
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2023-12-28	WZ-AC1
Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2023-09-29	WZ-AC1
Thermohygrometer	testo	608-H1	MRTSUE11039	1 year	2023-11-01	WZ-AC1

Software	Version	Function
EMI V3	V 3.0.0	EMI Test Software
Controller_T-E-TAC-2	1.02	RE Antenna & Turntable
Controller_MF 7802	2.03C	RE Antenna & Turntable
BenchVue Power Meter	2021	Power

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
The maximum measurement uncertainty is evaluated as: 9kHz~150kHz: 3.58dB 150kHz~30MHz: 3.20dB
Radiated Emission Measurement
The maximum measurement uncertainty is evaluated as: Coaxial: 9kHz~30MHz: 2.59dB Coplanar: 9kHz~30MHz: 2.60dB Horizontal: 30MHz~200MHz: 3.85dB 200MHz~1GHz: 4.36dB 1GHz~40GHz: 4.98dB Vertical: 30MHz~200MHz: 4.06dB 200MHz~1GHz: 5.28dB 1GHz~40GHz: 4.91dB
Spurious Emissions, Conducted
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 2.3dB
Output Power
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 1.5dB
Power Spectrum Density
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 2.3dB
Occupied Bandwidth
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 3.2%

6. Test Result

6.1. Summary

FCC Section(s)	Test Description	Test Condition	Verdict
15.407(a)	26dB Bandwidth	Conducted	Pass
15.407(a) (2)	Maximum Conducted Output Power		Pass
15.407(h)(1)	Transmit Power Control		Pass
15.407(a)(2), (12)	Peak Power Spectral Density		Pass
15.407(g)	Frequency Stability		Pass
15.407(b)(2), (3)	Undesirable Emissions	Radiated	Pass
15.205, 15.209 15.407(b)(8), (9), (10)	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)		Pass
15.207	AC Conducted Emissions 150kHz - 30MHz	Line Conducted	Pass

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. For radiated emission test, the test results shown in the following sections represent the worst-case emissions.

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

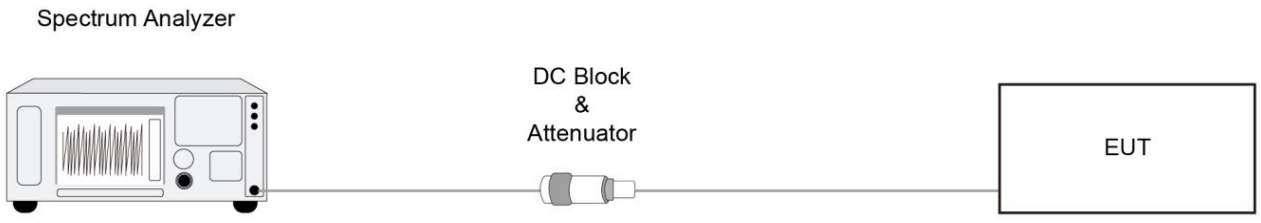
26dB Bandwidth

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 ≥ 3 × 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



6.2.5. Test Result

Refer to Appendix A.2.

6.3. Output Power Measurement

6.3.1. Test Limit

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 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.

6.3.2. Test Procedure

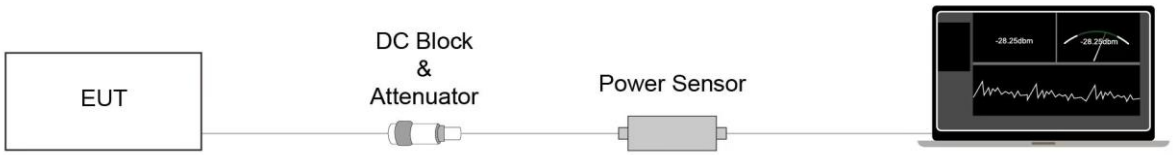
KDB 789033D02v02r01- Section II)E)3)b) Method PM-G

6.3.3. 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.

6.3.4. Test Setup



6.3.5. Test Result

Refer to Appendix A.3.

6.4. Transmit Power Control Measurement

6.4.1. 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.

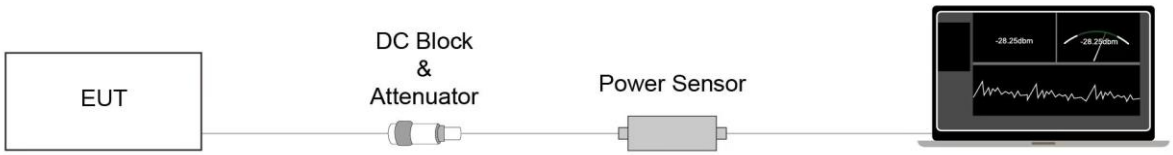
6.4.2. Test Procedure

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

6.4.3. 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. The trace was averaged over 100 traces to obtain the final measured average power.

6.4.4. Test Setup



6.4.5. Test Result

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

6.5. Power Spectral Density Measurement

6.5.1. Test Limit

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.

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.

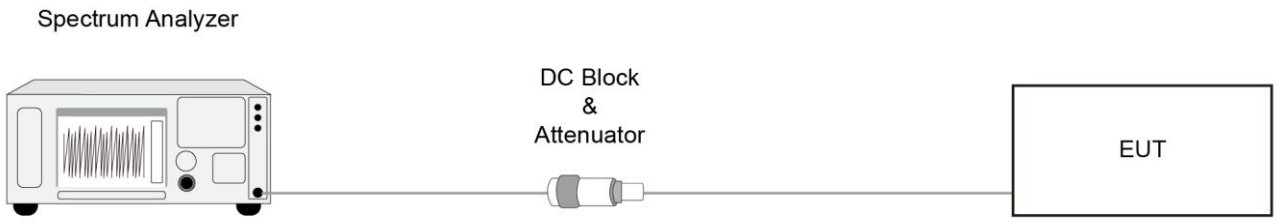
6.5.2. Test Procedure

KDB 789033 D02v02r01-Section II)F)

6.5.3. 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 × RBW
5. Number of sweep points ≥ 2 × (span / 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*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.

6.5.4. Test Setup



6.5.5. Test Result

Refer to Appendix A.4.

6.6. Frequency Stability Measurement

6.6.1. 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.

6.6.2. Test Procedure

Frequency Stability Under Temperature Variations:

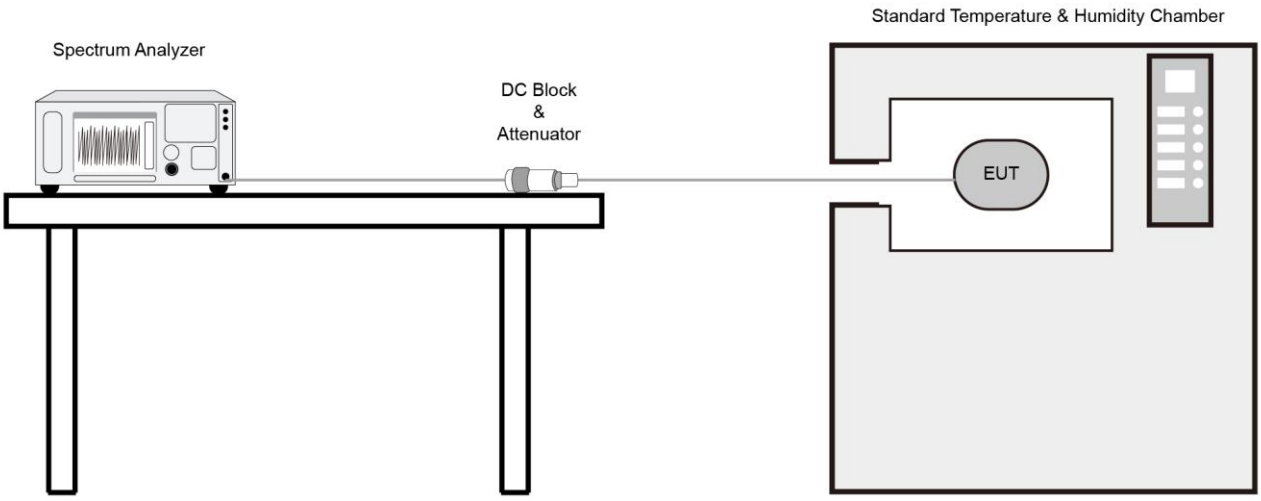
The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain 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 (±15%) and endpoint, record the maximum frequency change.

6.6.3. Test Setup



6.6.4. Test Result

Grantee ensure that the product meets e-CFR Title 47 section 15.407(g) and KDB 789033 D02v02r01 frequency stability such that the emissions are maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

6.7. Radiated Spurious Emission Measurement

6.7.1. Test Limit

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

FCC Part 15 Subpart C Paragraph 15.209		
Frequency [MHz]	Field Strength [uV/m]	Measured Distance [Meters]
0.009 - 0.490	2400/F (kHz)	300
0.490 - 1.705	24000/F (kHz)	30
1.705 - 30	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

6.7.2. Test Procedure

KDB 789033 D02v02r01- Section II)G)

6.7.3. Test Setting

Table 1 - RBW as a function of frequency

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

Quasi-Peak Measurements below 1GHz

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest

2. Span was set greater than 1MHz

3. RBW = as specified in Table 1

4. Detector = CISPR quasi-peak

5. Sweep time = auto couple

6. Trace was allowed to stabilize

Peak Measurements above 1GHz

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest

2. RBW = 1MHz

3. VBW = 3MHz

4. Detector = peak

5. Sweep time = auto couple

6. Trace mode = max hold

7. Trace was allowed to stabilize

Average Measurements above 1GHz (Method VB)

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest

2. RBW = 1MHz

3. VBW; If the EUT is configured to transmit with duty cycle ≥ 98%, set VBW = 10 Hz.

If the EUT duty cycle is < 98%, set VBW ≥ 1/T. T is the minimum transmission duration.

4. Detector = Peak

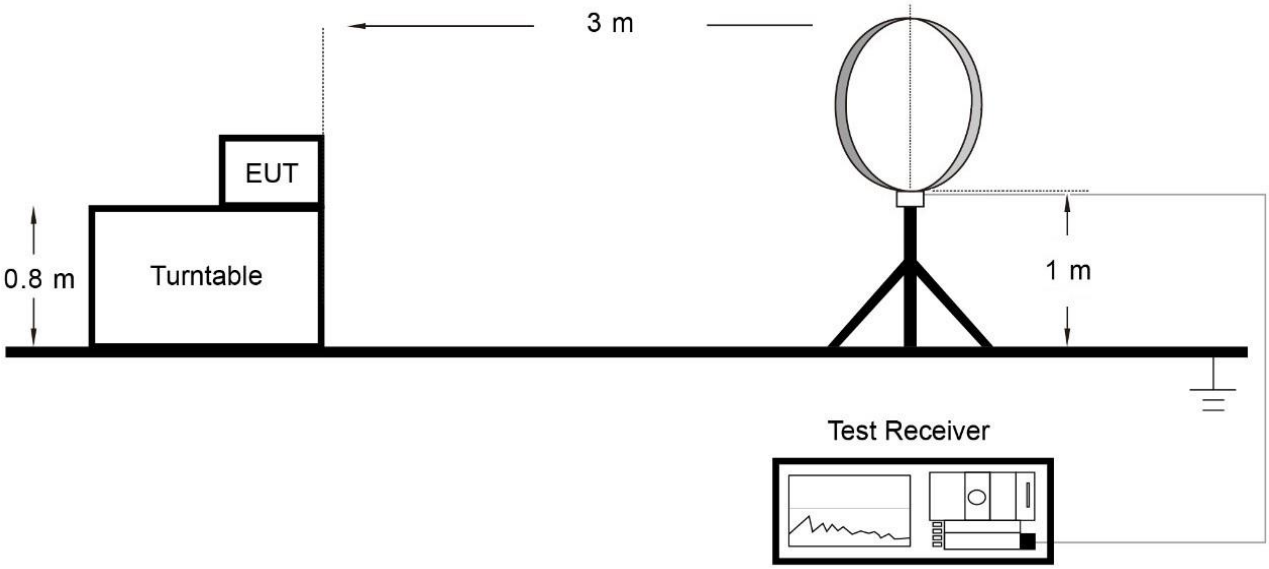
5. Sweep time = auto

6. Trace mode = max hold

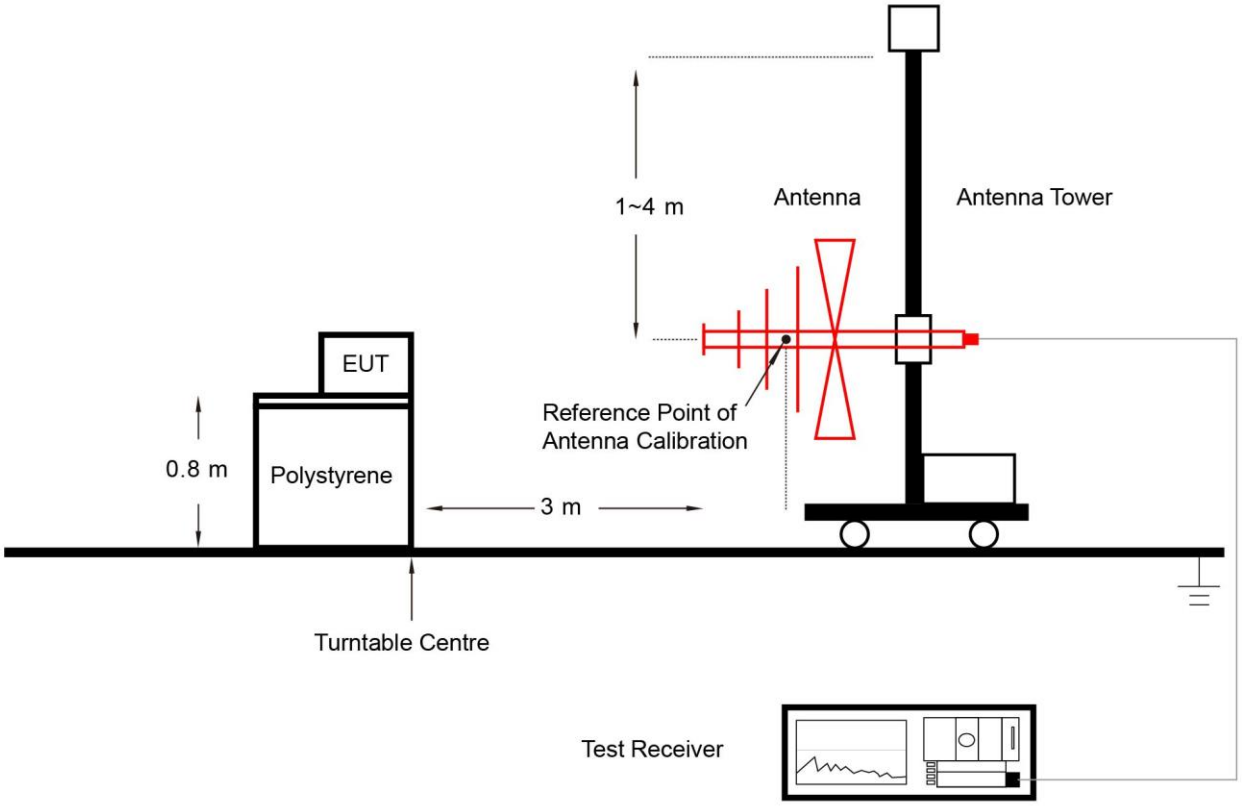
7. Trace was allowed to stabilize

6.7.4. Test Setup

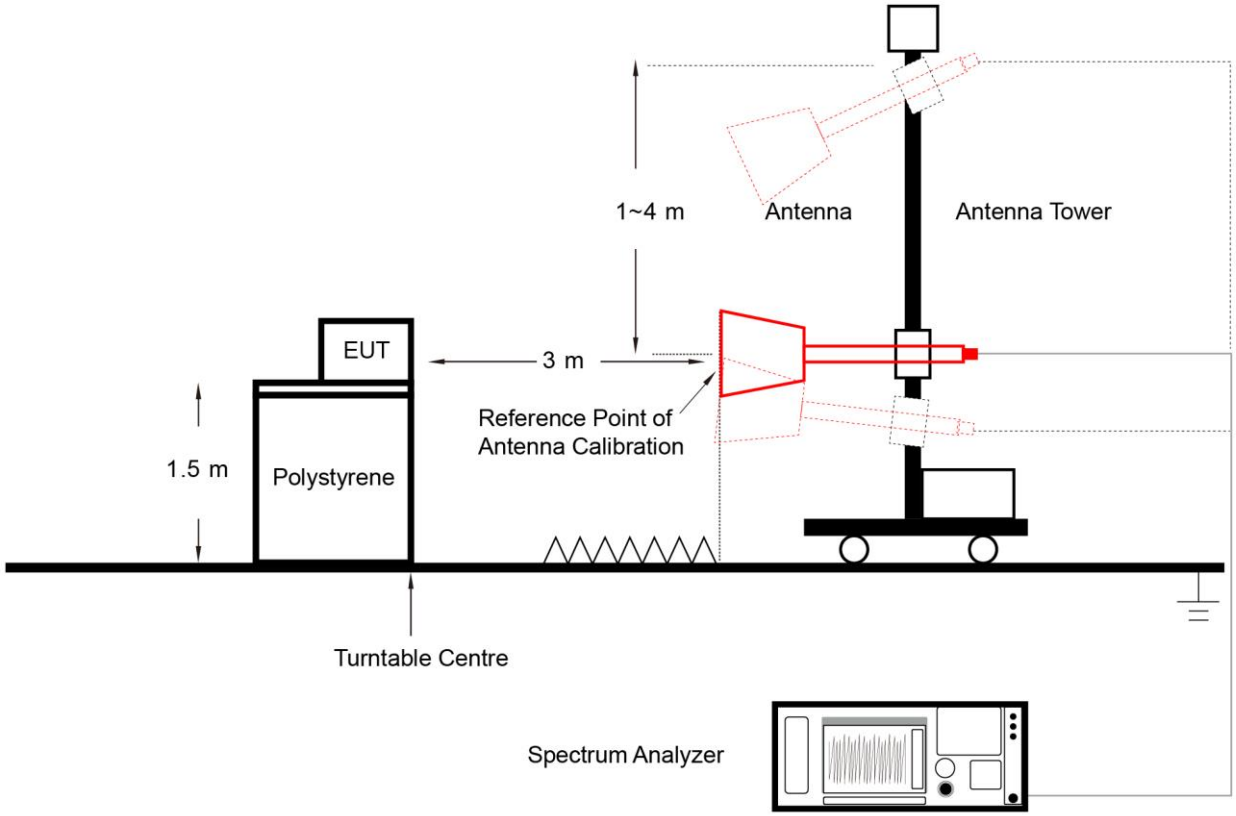
Below 30MHz Test Setup:



Below 1GHz Test Setup:



Above 1GHz Test Setup:



6.7.5. Test Result

Refer to Appendix A.5.

6.8. Radiated Restricted Band Edge Measurement

6.8.1. Test Limit

For 15.205 requirement:

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

Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (GHz)
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1] 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41	--	--	--

For 15.407(b) requirement:

For transmitters operating in the 5.25-5.35 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.

Refer to KDB 789033 D02v02r01 G)2)c), as specified in § 15.407(b), emissions above 1000 MHz that are outside of the restricted bands are subject to a maximum emission limit of -27 dBm/MHz (or -17 dBm/MHz as specified in § 15.407(b)(4)). However, an out-of-band emission that complies with both the peak and average limits of § 15.209 is not required to satisfy the -27 dBm/MHz or -17 dBm/MHz maximum emission limit.

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

FCC Part 15 Subpart C Paragraph 15.209		
Frequency [MHz]	Field Strength [uV/m]	Measured Distance [Meters]
0.009 - 0.490	2400/F (kHz)	300
0.490 - 1.705	24000/F (kHz)	30
1.705 - 30	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

6.8.2. Test Procedure

KDB 789033 D02v02r01- Section II)G)

6.8.3. Test Setting

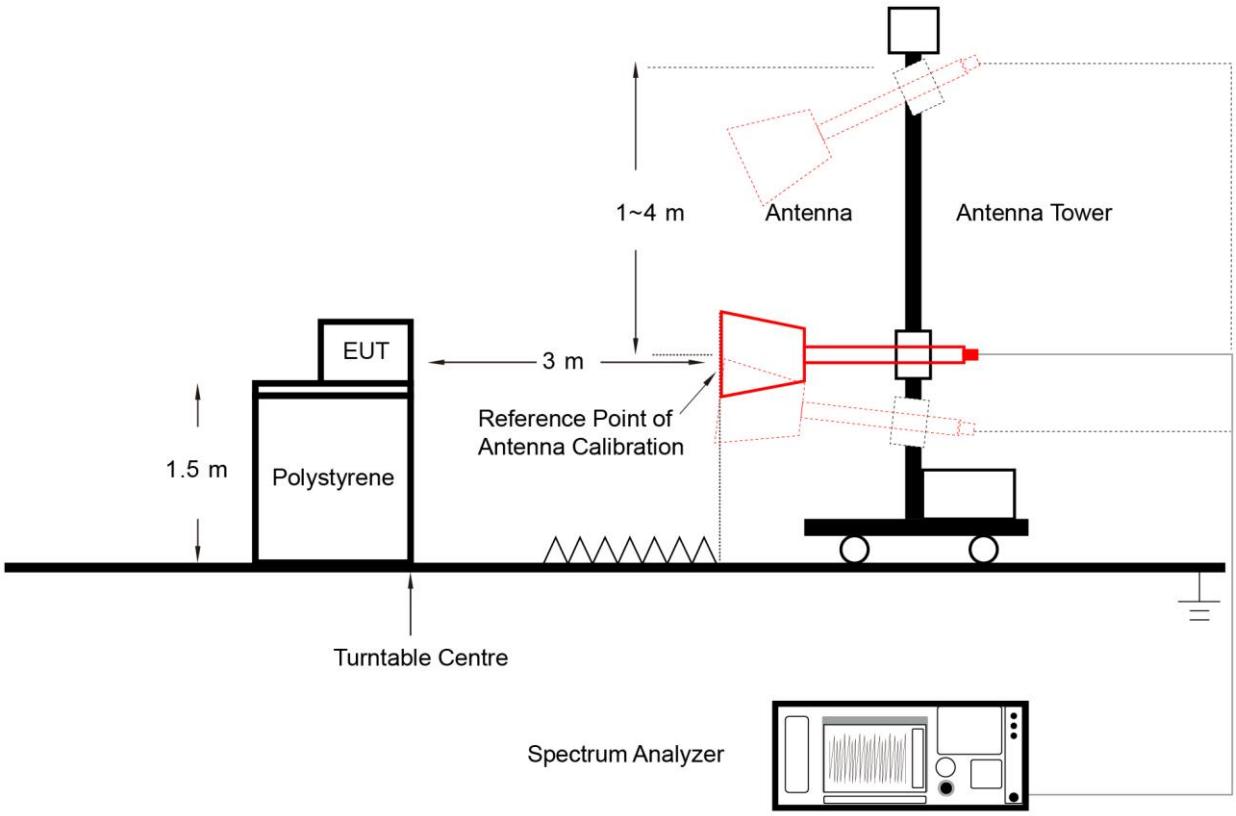
Peak Measurements above 1GHz

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

Average Measurements above 1GHz (Method VB)

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

6.8.4. Test Setup



6.8.5. Test Result

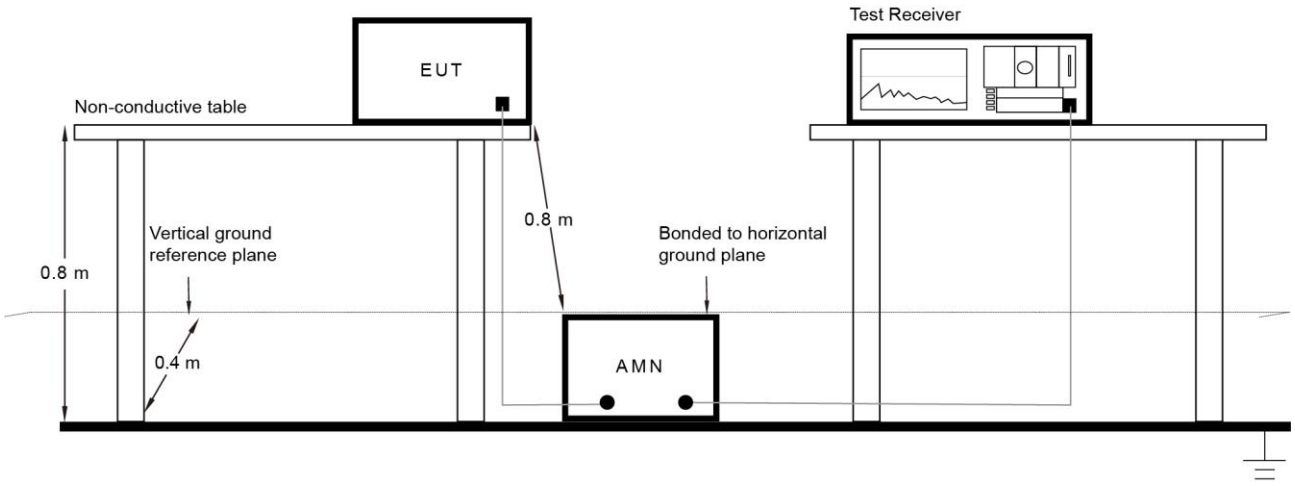
Refer to Appendix A.6.

6.9. AC Conducted Emissions Measurement

6.9.1. Test Limit

FCC Part 15.207 Limits		
Frequency (MHz)	QP (dBuV)	AV (dBuV)
0.15 - 0.50	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30	60	50
Note 1: The lower limit shall apply at the transition frequencies.		
Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.		

6.9.2. Test Setup



6.9.3. Test Result

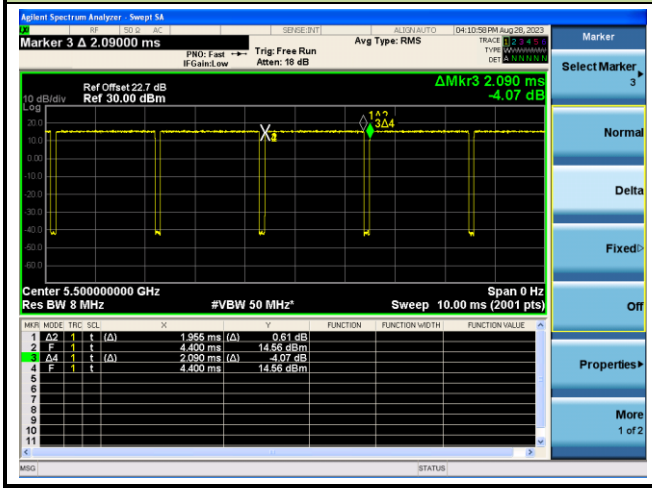
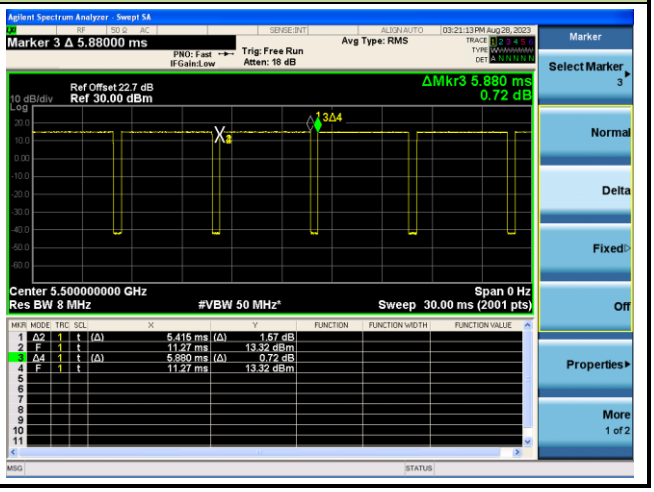
Refer to Appendix A.7.

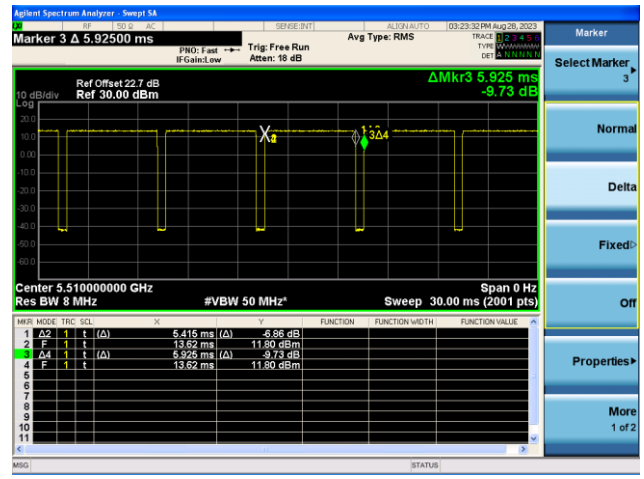
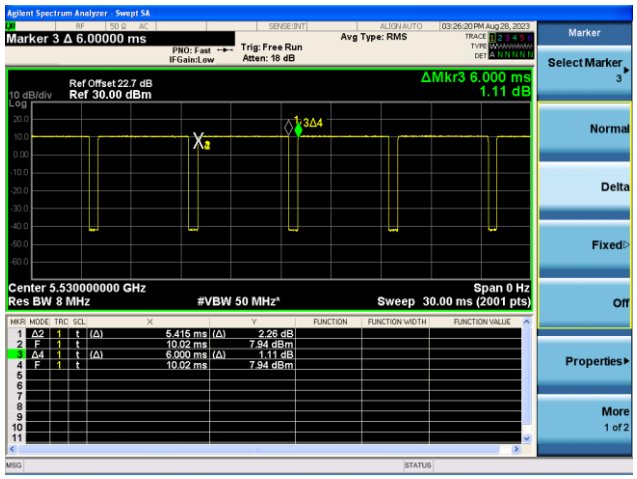
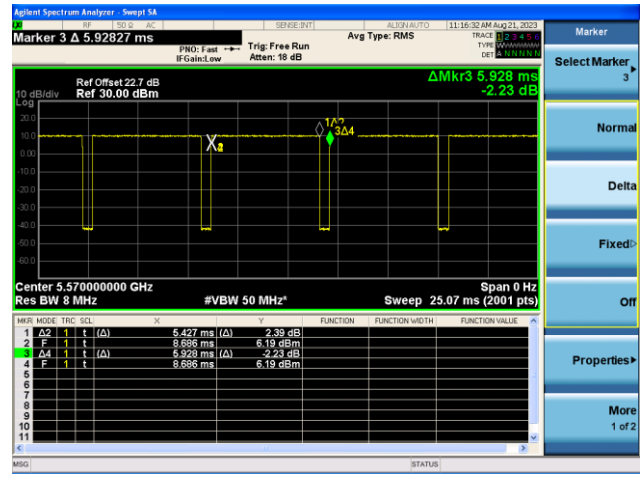
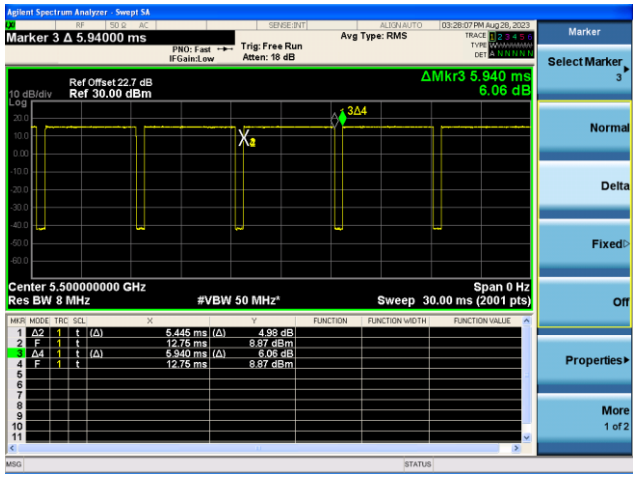
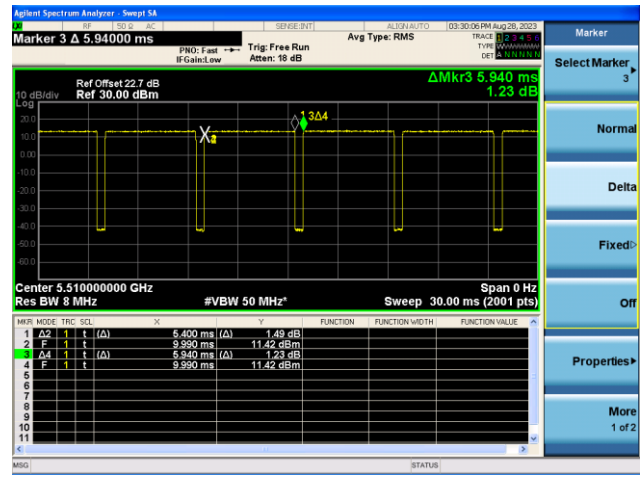
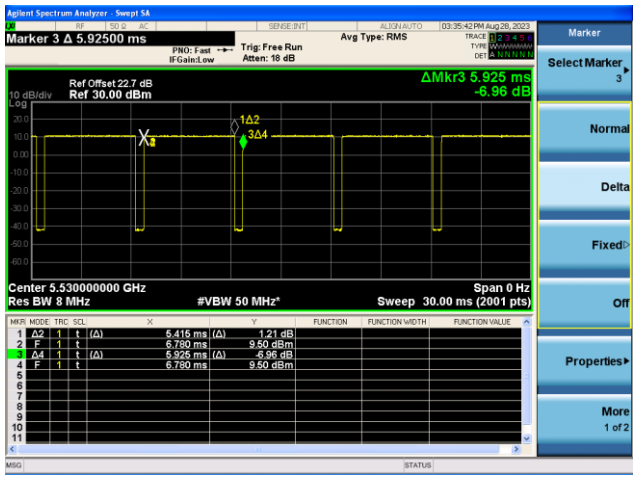
Appendix A – Test Result

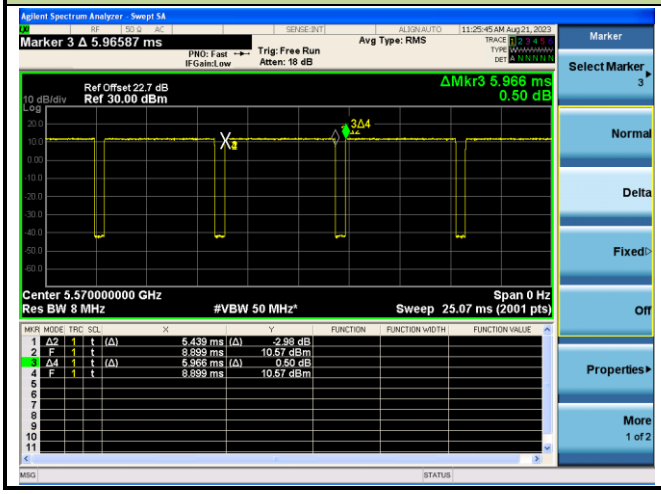
A.1 Duty Cycle Test Result

Test Site	NS-TR2	Test Engineer	Summer Tang
Test Date	2023-08-21~2023-08-28		

Test Mode	Duty Cycle
802.11a	93.54%
802.11ac-VHT20	92.09%
802.11ac-VHT40	91.39%
802.11ac-VHT80	90.25%
802.11ac-VHT160	91.55%
802.11ax-HE20	91.67%
802.11ax-HE40	90.91%
802.11ax-HE80	91.39%
802.11ax-HE160	91.17%

Duty Cycle (T = Transmission Duration)	
802.11a (T = 1.955ms)	802.11ac-VHT20 (T = 5.415ms)
	

Duty Cycle (T = Transmission Duration)	
802.11ac-VHT40 (T = 5.415ms)	802.11ac-VHT80 (T = 5.415ms)
	
802.11ac-VHT160 (T = 5.427ms)	802.11ax-HE20 (T = 5.445ms)
	
802.11ax-HE40 (T = 5.400ms)	802.11ax-HE80 (T = 5.415ms)
	

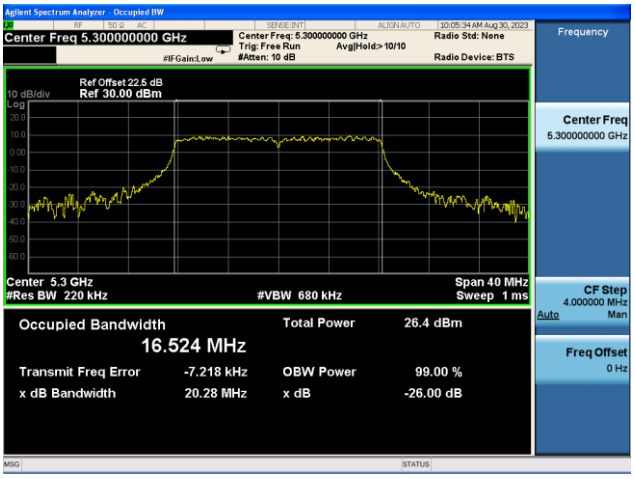
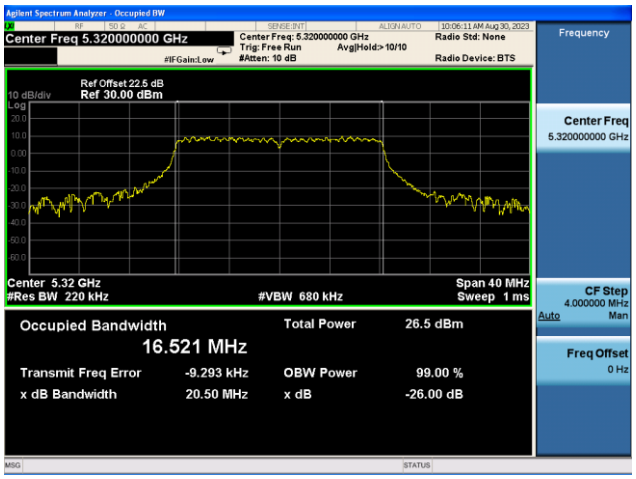
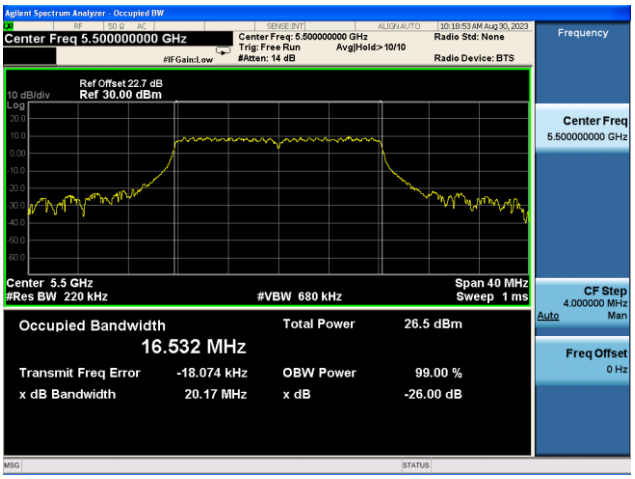
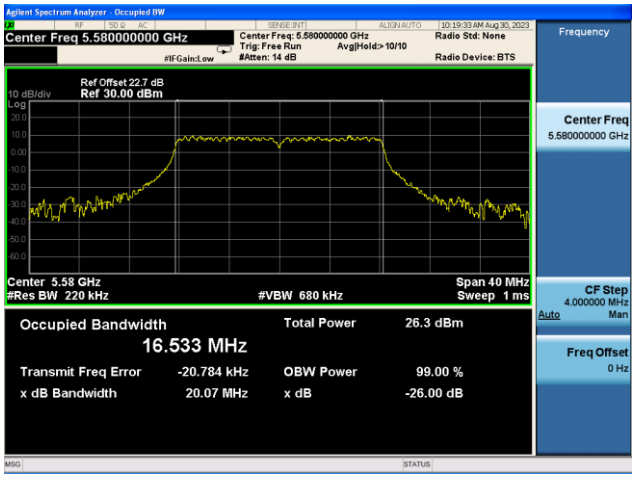
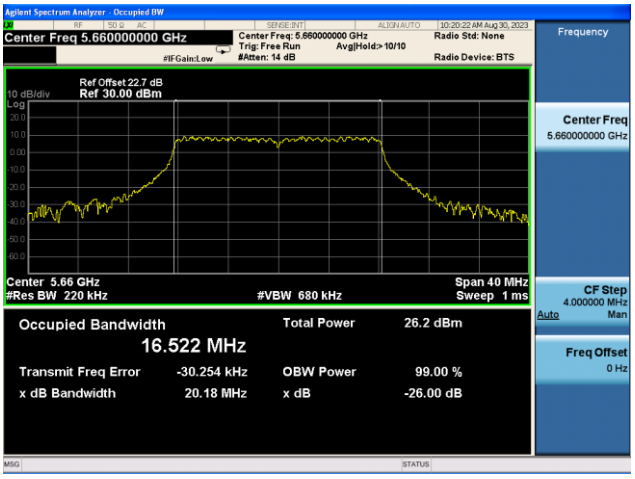
Duty Cycle (T = Transmission Duration)	
802.11ax-HE160 (T = 5.439ms)	
	

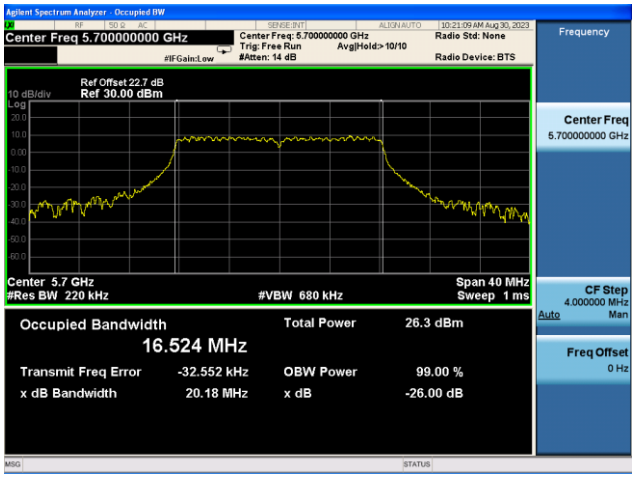
A.2 26dB Bandwidth Test Result

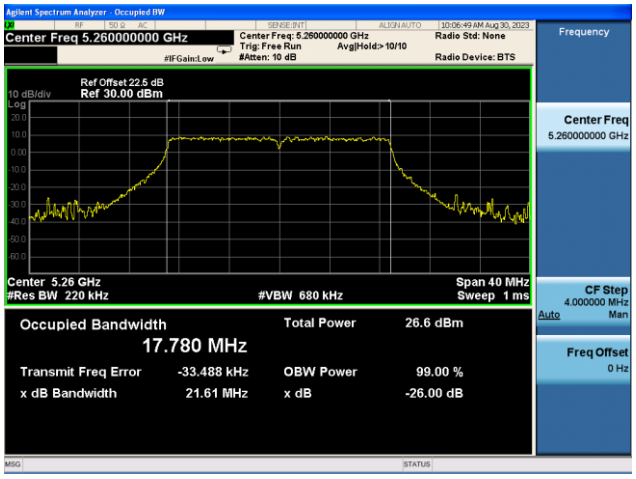
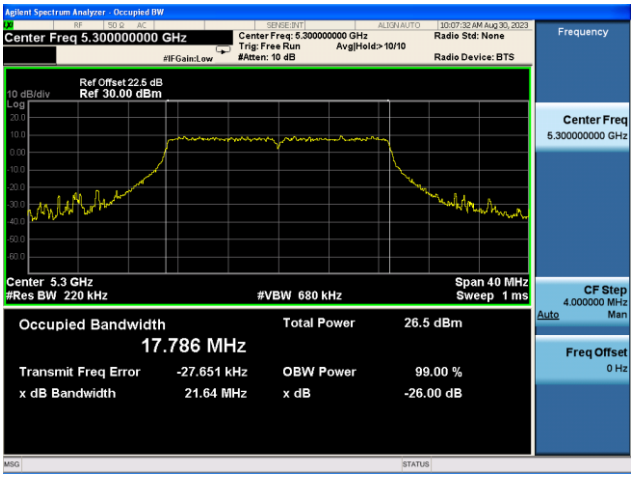
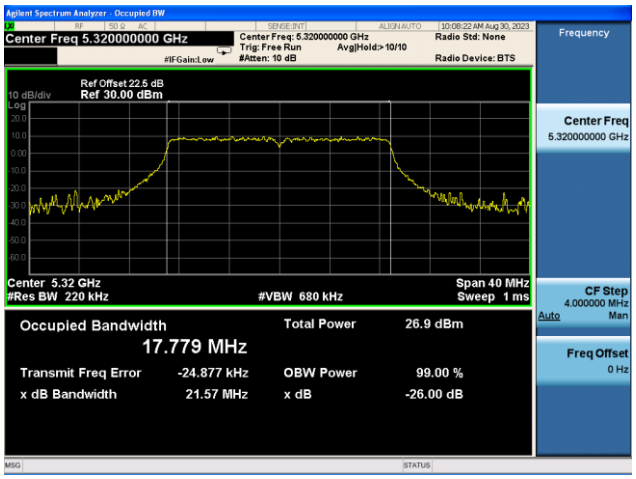
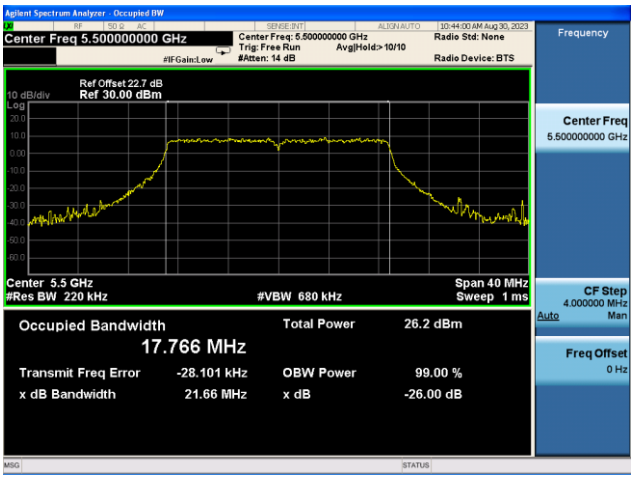
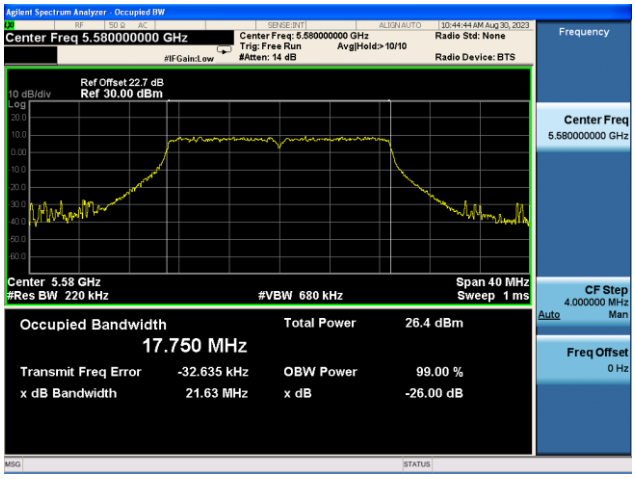
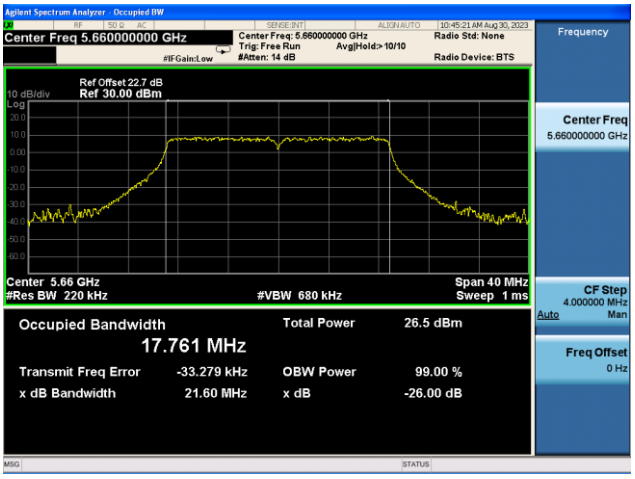
Test Site	NS-TR2	Test Engineer	Summer Tang
Test Date	2023-08-30		

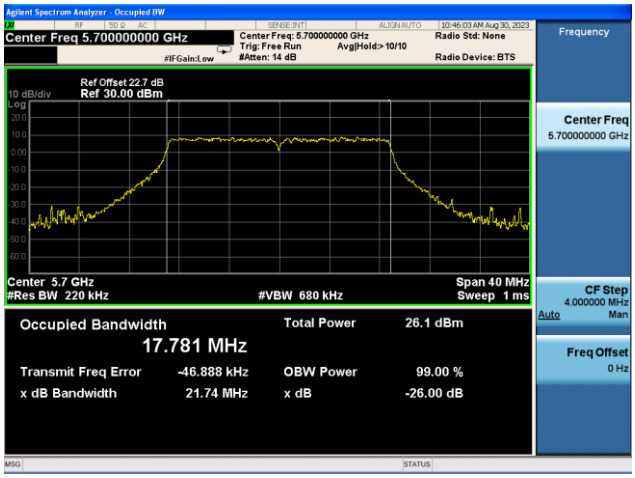
Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
11a	6Mbps	52	5260	20.19	16.506
11a	6Mbps	60	5300	20.28	16.524
11a	6Mbps	64	5320	20.50	16.521
11a	6Mbps	100	5500	20.17	16.532
11a	6Mbps	116	5580	20.07	16.533
11a	6Mbps	132	5660	20.18	16.522
11a	6Mbps	140	5700	20.18	16.524
11ac-VHT20	MCS0	52	5260	21.61	17.780
11ac-VHT20	MCS0	60	5300	21.64	17.786
11ac-VHT20	MCS0	64	5320	21.57	17.779
11ac-VHT20	MCS0	100	5500	21.66	17.766
11ac-VHT20	MCS0	116	5580	21.63	17.750
11ac-VHT20	MCS0	132	5660	21.60	17.761
11ac-VHT20	MCS0	140	5700	21.74	17.781
11ac-VHT40	MCS0	54	5270	44.47	36.659
11ac-VHT40	MCS0	62	5310	44.28	36.658
11ac-VHT40	MCS0	102	5510	43.59	36.582
11ac-VHT40	MCS0	110	5550	44.32	36.623
11ac-VHT40	MCS0	134	5670	44.35	36.635
11ac-VHT80	MCS0	58	5290	88.47	76.347
11ac-VHT80	MCS0	106	5530	88.52	76.413
11ac-VHT80	MCS0	122	5610	89.04	76.395
11ac-VHT160	MCS0	114	5570	232.10	155.90
11ax-HE20	MCS0	52	5260	22.46	19.130
11ax-HE20	MCS0	60	5300	21.62	19.111
11ax-HE20	MCS0	64	5320	22.11	19.103
11ax-HE20	MCS0	100	5500	21.90	19.103
11ax-HE20	MCS0	116	5580	22.28	19.084
11ax-HE20	MCS0	132	5660	21.90	19.073
11ax-HE20	MCS0	140	5700	22.10	19.106

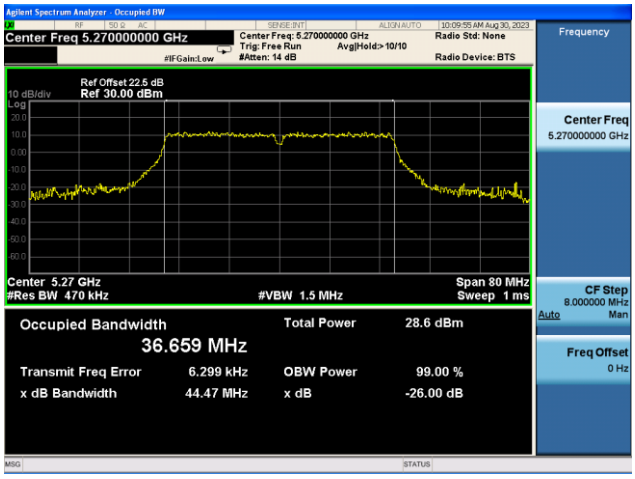
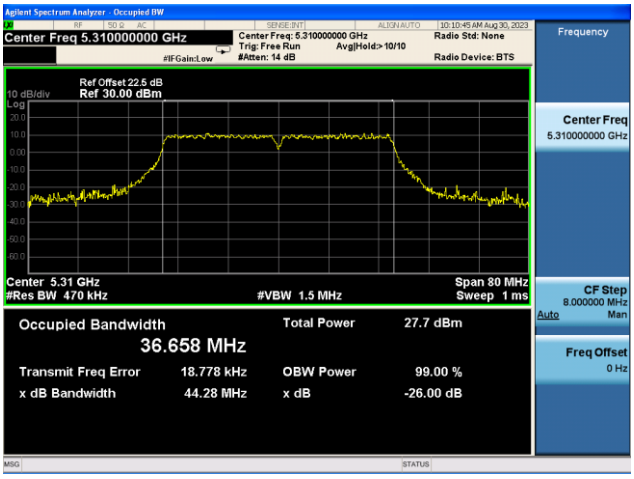
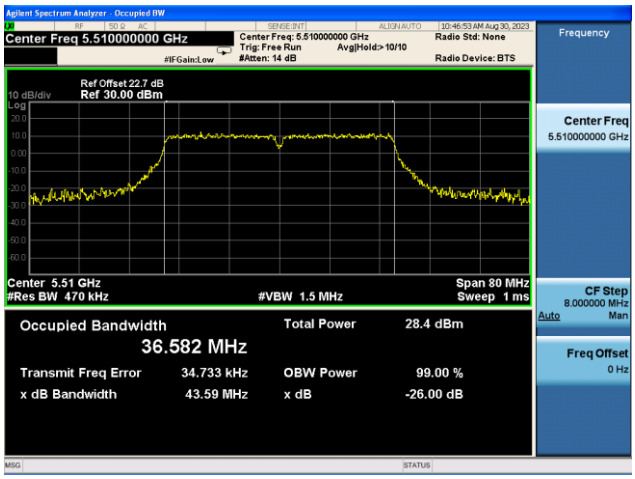
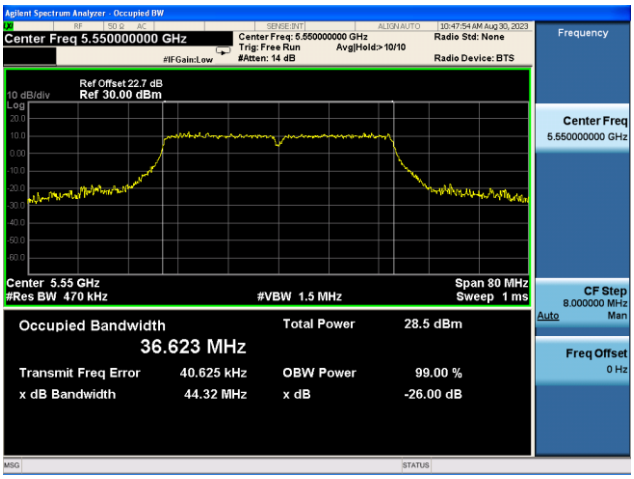
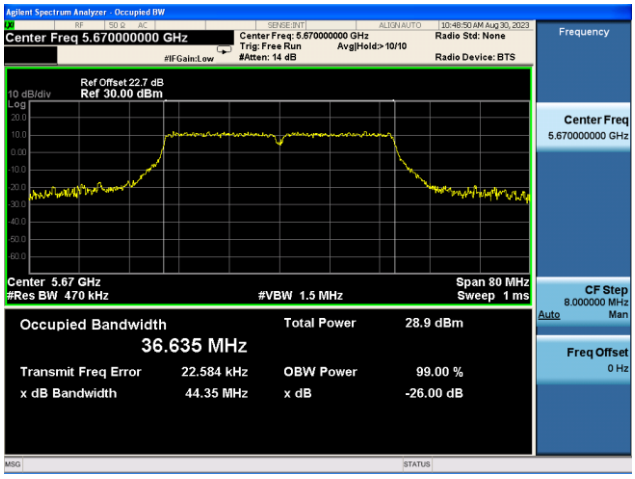
Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
11ax-HE40	MCS0	54	5270	44.05	38.220
11ax-HE40	MCS0	62	5310	43.20	38.077
11ax-HE40	MCS0	102	5510	44.52	38.161
11ax-HE40	MCS0	110	5550	44.08	38.061
11ax-HE40	MCS0	134	5670	44.73	38.107
11ax-HE80	MCS0	58	5290	88.48	77.902
11ax-HE80	MCS0	106	5530	86.37	77.829
11ax-HE80	MCS0	122	5610	87.95	77.825
11ax-HE160	MCS0	114	5570	223.90	157.45

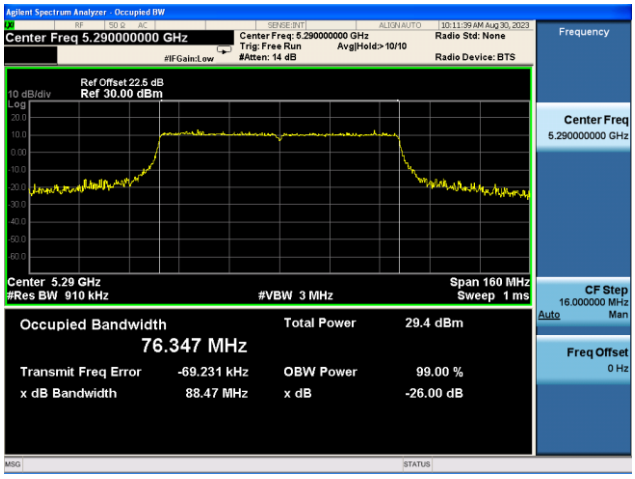
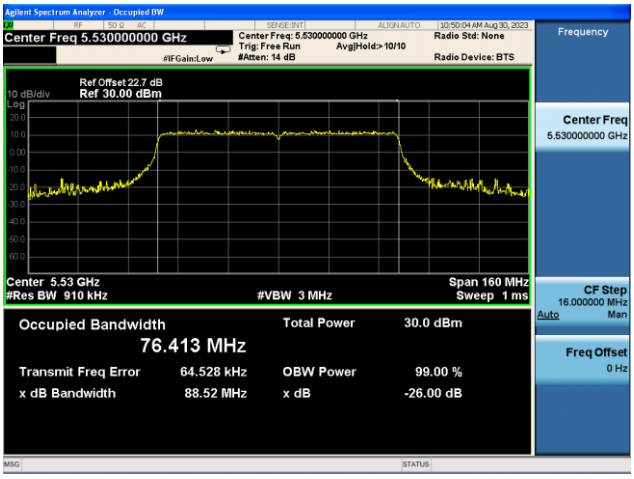
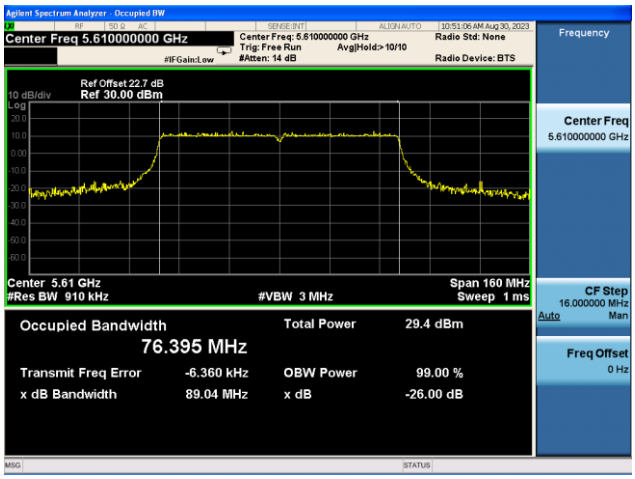
802.11a 26dB Bandwidth & 99% Bandwidth	
Channel 52 (5260MHz)	Channel 60 (5300MHz)
	
Channel 64 (5320MHz)	Channel 100 (5500MHz)
	
Channel 116 (5580MHz)	Channel 132 (5660MHz)
	

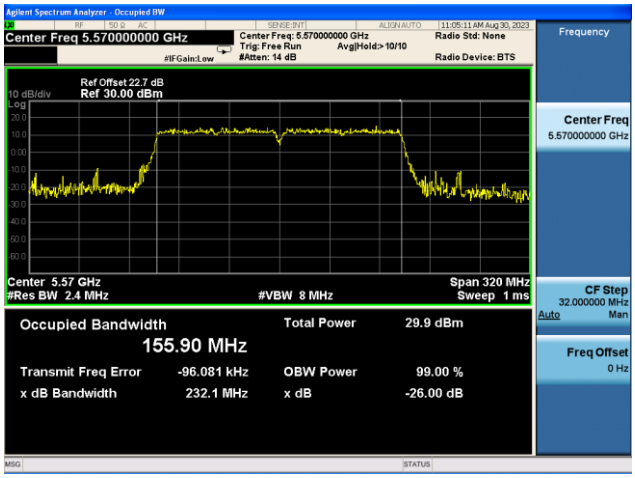
802.11a 26dB Bandwidth & 99% Bandwidth	
Channel 140 (5770MHz)	
	

802.11ac-VHT20 26dB Bandwidth	
Channel 52 (5260MHz)	Channel 60 (5300MHz)
	
Channel 64 (5320MHz)	Channel 100 (5500MHz)
	
Channel 116 (5580MHz)	Channel 132 (5660MHz)
	

802.11a 26dB Bandwidth & 99% Bandwidth	
Channel 140 (5700MHz)	
	

802.11ac-VHT40 26dB Bandwidth	
Channel 54 (5270MHz)	Channel 62 (5310MHz)
	
Channel 102 (5510MHz)	Channel 110 (5550MHz)
	
Channel 134 (5670MHz)	
	

802.11ac-VHT80 26dB Bandwidth & 99% Bandwidth	
Channel 58 (5290MHz)	Channel 106 (5530MHz)
	
Channel 122 (5610MHz)	
	

802.11ac-VHT160 26dB Bandwidth & 99% Bandwidth	
Channel 114 (5570MHz)	
	

802.11ax-HE20 26dB Bandwidth	
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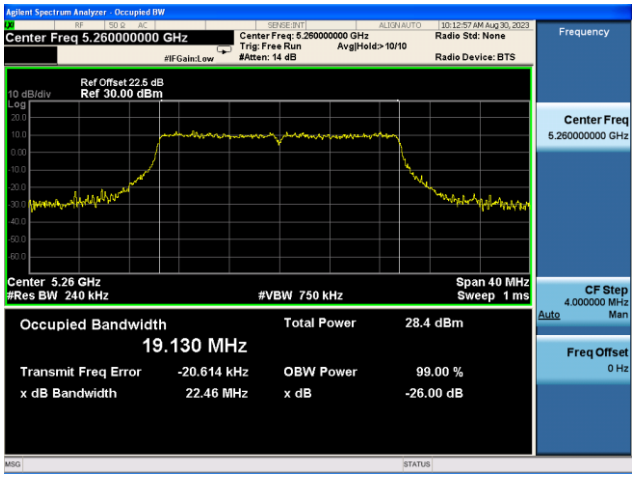
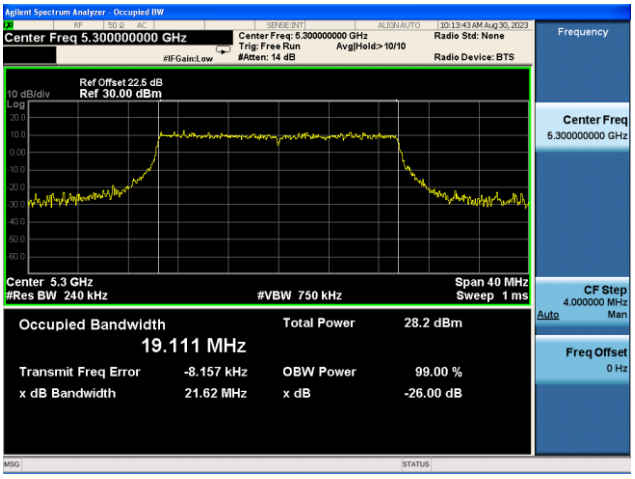
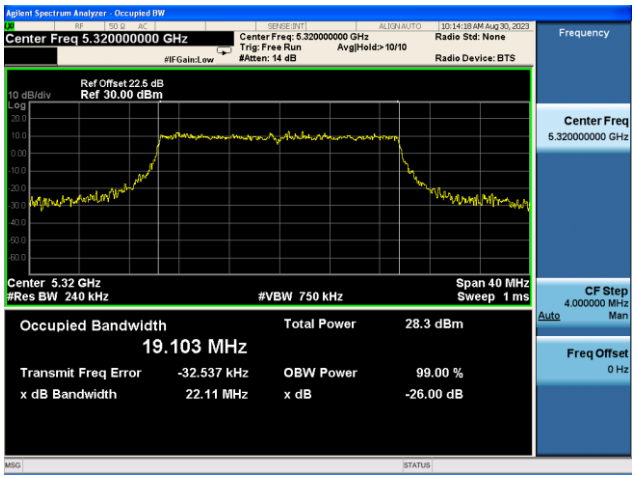
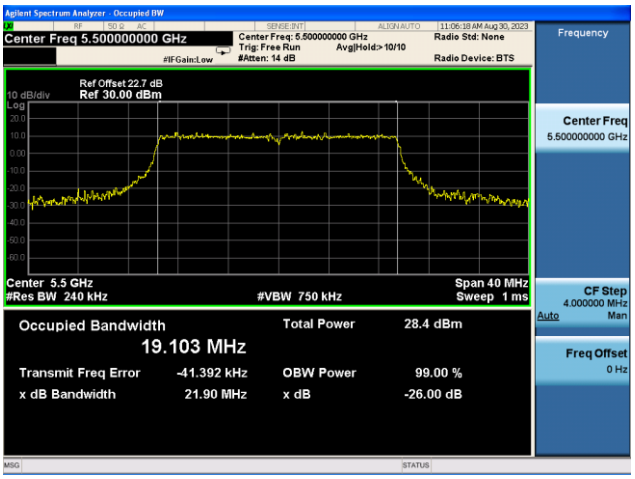
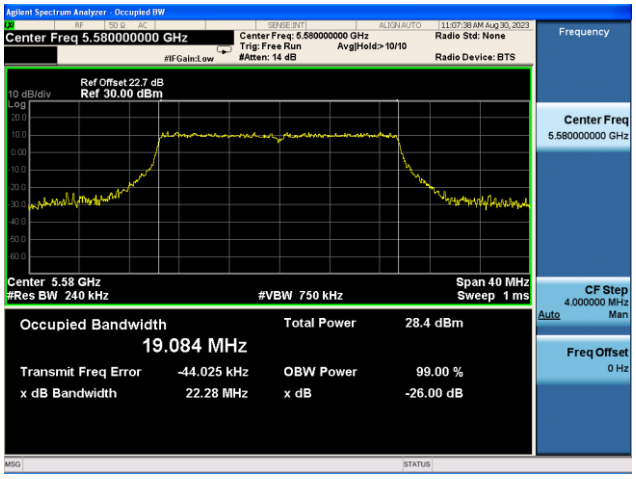
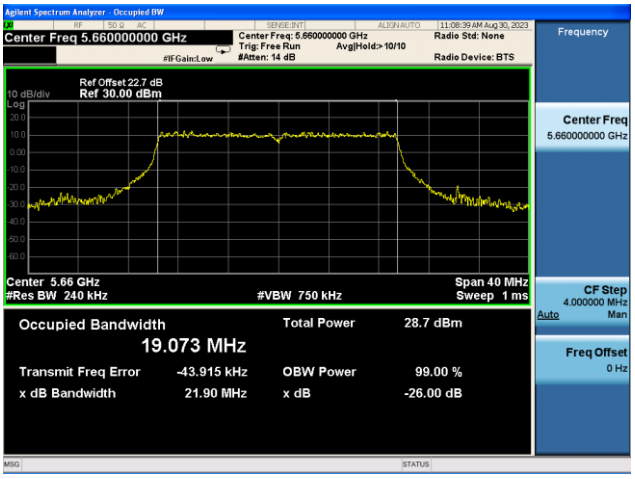
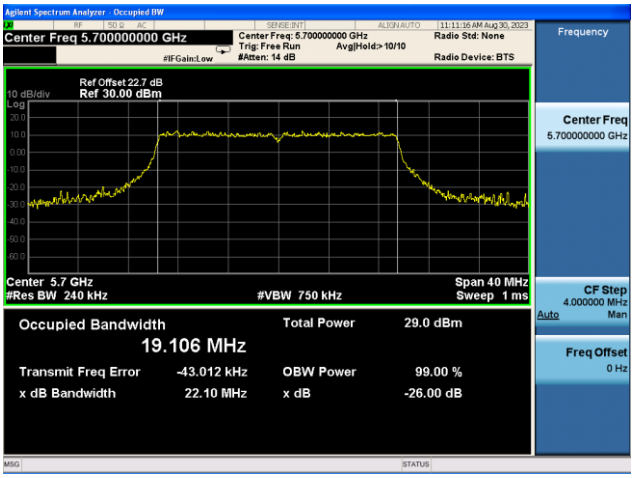
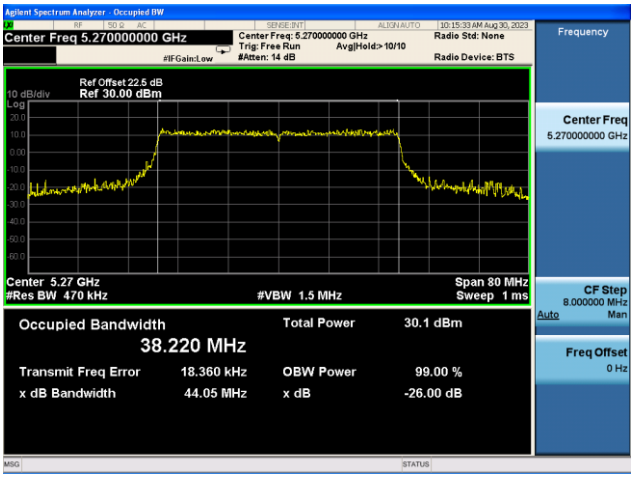
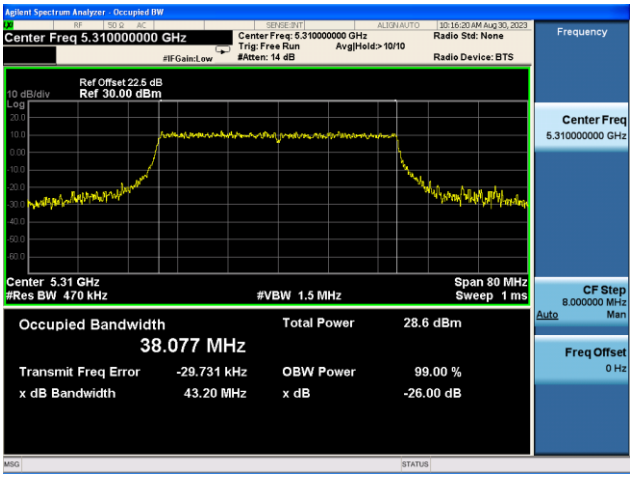
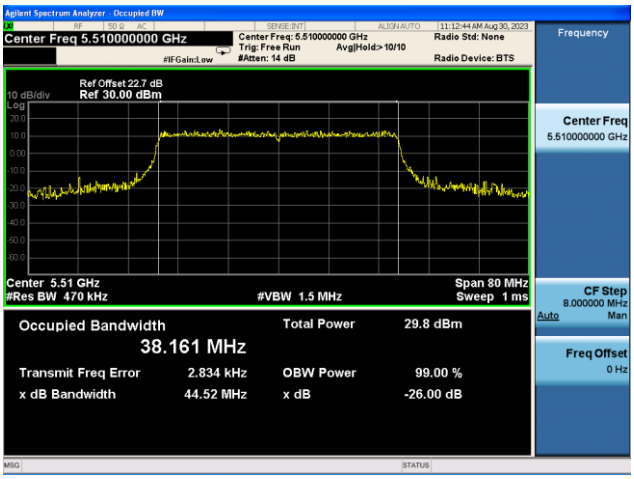
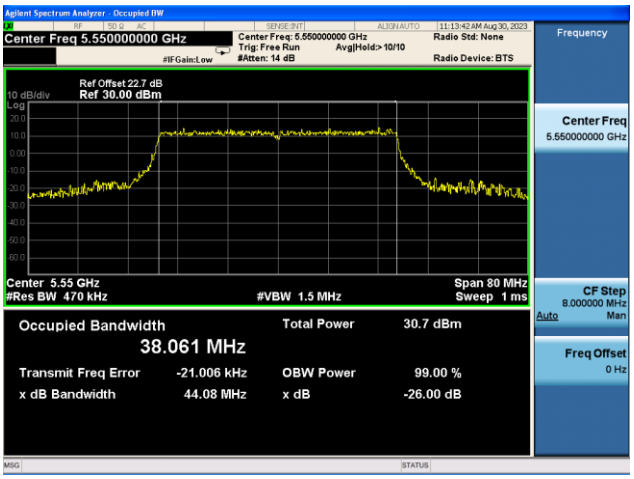
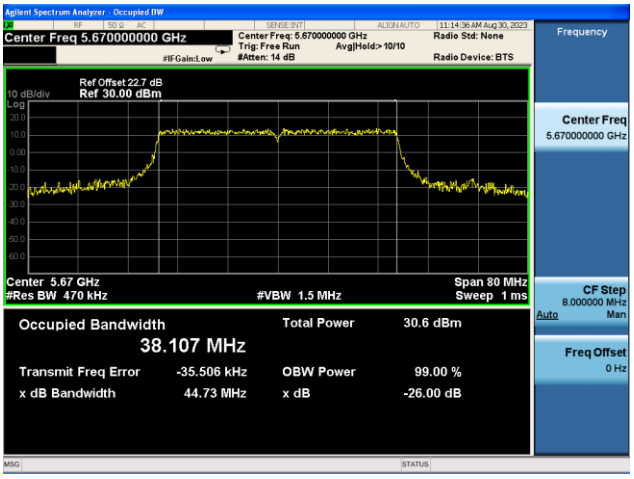
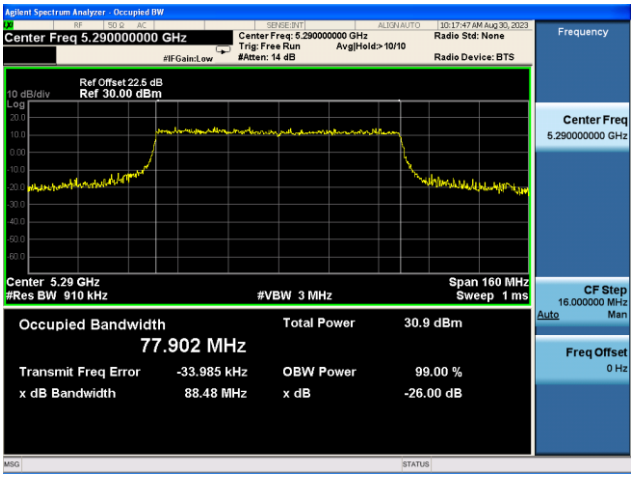
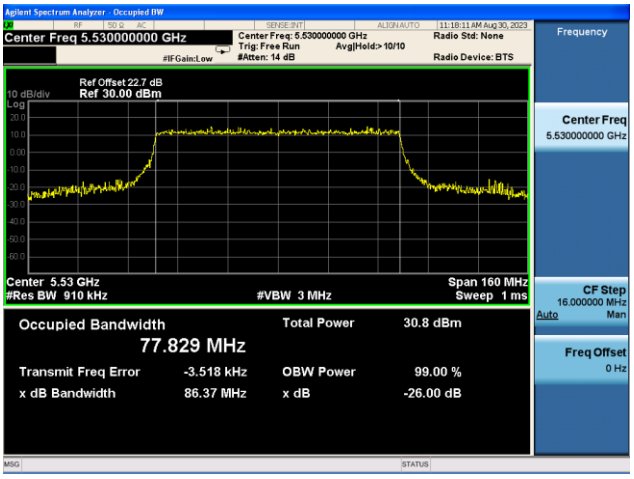
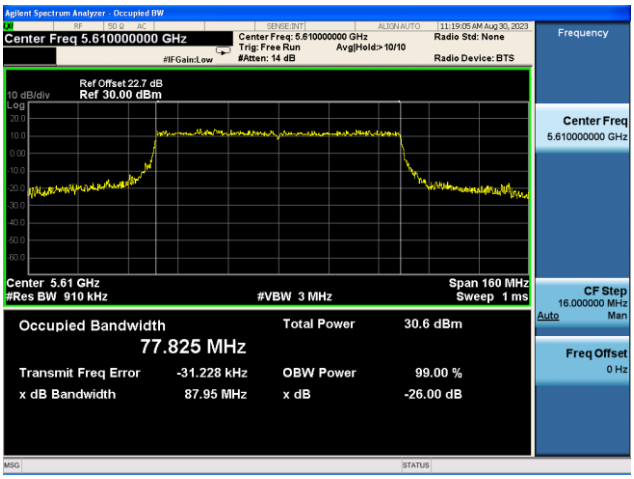
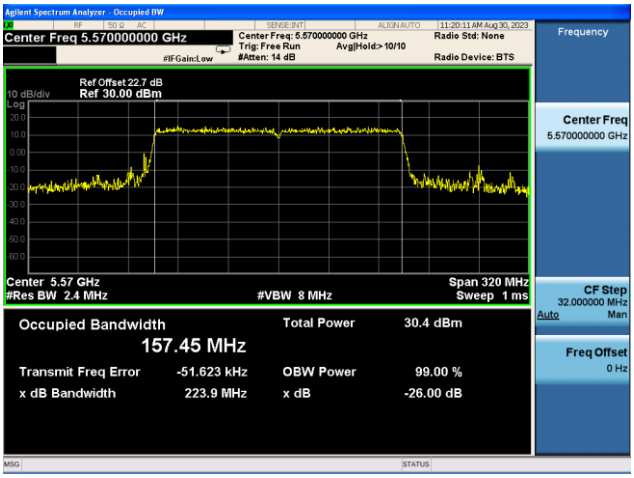
	
Channel 64 (5320MHz)	Channel 100 (5500MHz)
	
Channel 116 (5580MHz)	Channel 132 (5660MHz)
	

802.11a 26dB Bandwidth & 99% Bandwidth	
Channel 140 (5700MHz)	
	

802.11ax-HE40 26dB Bandwidth	
Channel 54 (5270MHz)	Channel 62 (5310MHz)
	
Channel 102 (5510MHz)	Channel 110 (5550MHz)
	
Channel 134 (5670MHz)	
	

802.11ax-HE80 26dB Bandwidth & 99% Bandwidth	
Channel 58 (5290MHz)	Channel 106 (5530MHz)
	
Channel 122 (5610MHz)	
	

802.11ax-HE160 26dB Bandwidth & 99% Bandwidth	
Channel 114 (5570MHz)	
	

A.3 Output Power Test Result

Test Site	NS-TR2	Test Engineer	Summer Tang
Test Date	2023-08-21~2023-08-29		

Test Mode	Data Rate MCS	Channel No.	Freq. (MHz)	Average Power (dBm)		Total Average Power (dBm)	Power Limit (dBm)
				Ant 0	Ant 1		
11a	6Mbps	52	5260	17.84	19.16	21.56	≤ 23.98
11a	6Mbps	60	5300	18.35	19.58	22.02	≤ 23.98
11a	6Mbps	64	5320	18.08	19.55	21.89	≤ 23.98
11a	6Mbps	100	5500	18.14	19.22	21.72	≤ 23.98
11a	6Mbps	116	5580	18.23	19.30	21.81	≤ 23.98
11a	6Mbps	132	5660	18.05	19.04	21.58	≤ 23.98
11a	6Mbps	140	5700	18.52	19.41	22.00	≤ 23.98
11ac-VHT20	MCS0	52	5260	18.34	19.74	22.11	≤ 23.98
11ac-VHT20	MCS0	60	5300	18.35	19.68	22.08	≤ 23.98
11ac-VHT20	MCS0	64	5320	18.71	19.97	22.40	≤ 23.98
11ac-VHT20	MCS0	100	5500	18.11	19.28	21.74	≤ 23.98
11ac-VHT20	MCS0	116	5580	18.25	19.27	21.80	≤ 23.98
11ac-VHT20	MCS0	132	5660	18.51	19.65	22.13	≤ 23.98
11ac-VHT20	MCS0	140	5700	18.42	19.42	21.96	≤ 23.98
11ac-VHT40	MCS0	54	5270	19.98	21.16	23.62	≤ 23.98
11ac-VHT40	MCS0	62	5310	19.41	20.48	22.99	≤ 23.98
11ac-VHT40	MCS0	102	5510	20.09	20.75	23.44	≤ 23.98
11ac-VHT40	MCS0	110	5550	20.21	20.62	23.43	≤ 23.98
11ac-VHT40	MCS0	134	5670	20.46	21.06	23.78	≤ 23.98
11ac-VHT80	MCS0	58	5290	19.82	21.04	23.48	≤ 23.98
11ac-VHT80	MCS0	106	5530	20.52	21.16	23.86	≤ 23.98
11ac-VHT80	MCS0	122	5610	20.16	20.80	23.50	≤ 23.98
11ac-VHT160	MCS0	114	5570	20.32	20.82	23.59	≤ 23.98
11ax-HE20	MCS0	52	5260	18.51	19.85	22.24	≤ 23.98
11ax-HE20	MCS0	60	5300	18.95	20.11	22.58	≤ 23.98
11ax-HE20	MCS0	64	5320	18.78	20.08	22.49	≤ 23.98
11ax-HE20	MCS0	100	5500	18.70	19.76	22.27	≤ 23.98
11ax-HE20	MCS0	116	5580	19.37	19.38	22.39	≤ 23.98
11ax-HE20	MCS0	132	5660	18.62	19.67	22.19	≤ 23.98
11ax-HE20	MCS0	140	5700	19.05	19.95	22.53	≤ 23.98

Test Mode	Data Rate MCS	Channel No.	Freq. (MHz)	Average Power (dBm)		Total Average Power (dBm)	Power Limit (dBm)
				Ant 0	Ant 1		
11ax-HE40	MCS0	54	5270	20.09	21.14	23.66	≤ 23.98
11ax-HE40	MCS0	62	5310	18.82	19.98	22.45	≤ 23.98
11ax-HE40	MCS0	102	5510	20.11	20.71	23.43	≤ 23.98
11ax-HE40	MCS0	110	5550	20.71	21.10	23.92	≤ 23.98
11ax-HE40	MCS0	134	5670	20.52	21.12	23.84	≤ 23.98
11ax-HE80	MCS0	58	5290	19.86	21.12	23.55	≤ 23.98
11ax-HE80	MCS0	106	5530	20.51	21.13	23.84	≤ 23.98
11ax-HE80	MCS0	122	5610	20.17	20.78	23.50	≤ 23.98
11ax-HE160	MCS0	114	5570	20.54	20.91	23.74	≤ 23.98

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

A.4 Power Spectral Density Test Result

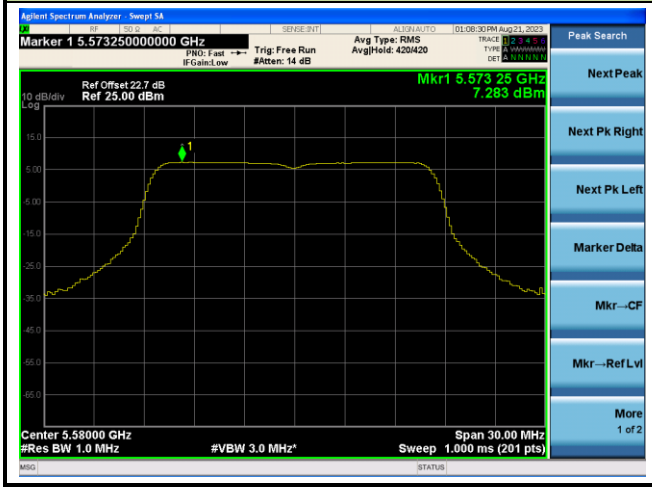
Test Site	NS-TR2	Test Engineer	Summer Tang
Test Date	2023-08-21~2023-08-29		
Test Item	Power Spectral Density (UNII-2a & UNII-2c)		

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	52	5260	6.594	8.085	93.54	10.70	11.00
11a	6Mbps	60	5300	6.907	8.249	93.54	10.93	11.00
11a	6Mbps	64	5320	6.678	8.003	93.54	10.69	11.00
11a	6Mbps	100	5500	7.277	7.759	93.54	10.83	11.00
11a	6Mbps	116	5580	7.283	7.883	93.54	10.89	11.00
11a	6Mbps	132	5660	7.140	7.441	93.54	10.59	11.00
11a	6Mbps	140	5700	7.429	7.740	93.54	10.89	11.00
11ac-VHT20	MCS0	52	5260	6.643	8.193	92.09	10.85	11.00
11ac-VHT20	MCS0	60	5300	6.479	7.778	92.09	10.55	11.00
11ac-VHT20	MCS0	64	5320	6.812	8.145	92.09	10.90	11.00
11ac-VHT20	MCS0	100	5500	6.951	7.540	92.09	10.62	11.00
11ac-VHT20	MCS0	116	5580	7.025	7.585	92.09	10.68	11.00
11ac-VHT20	MCS0	132	5660	7.195	7.779	92.09	10.86	11.00
11ac-VHT20	MCS0	140	5700	6.977	7.553	92.09	10.64	11.00
11ac-VHT40	MCS0	54	5270	5.047	6.427	91.39	9.19	11.00
11ac-VHT40	MCS0	62	5310	4.349	5.664	91.39	8.46	11.00
11ac-VHT40	MCS0	102	5510	5.005	5.895	91.39	8.87	11.00
11ac-VHT40	MCS0	110	5550	5.058	5.903	91.39	8.90	11.00
11ac-VHT40	MCS0	134	5670	5.559	6.283	91.39	9.34	11.00
11ac-VHT80	MCS0	58	5290	1.826	3.419	90.25	6.15	11.00
11ac-VHT80	MCS0	106	5530	2.219	3.258	90.25	6.23	11.00
11ac-VHT80	MCS0	122	5610	2.367	2.809	90.25	6.05	11.00
11ac-VHT160	MCS0	114	5570	-0.764	-0.144	91.55	2.95	11.00

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			
11ax-HE20	MCS0	52	5260	6.453	8.066	91.67	10.72	11.00
11ax-HE20	MCS0	60	5300	6.730	8.164	91.67	10.89	11.00
11ax-HE20	MCS0	64	5320	6.597	7.835	91.67	10.65	11.00
11ax-HE20	MCS0	100	5500	7.182	7.936	91.67	10.96	11.00
11ax-HE20	MCS0	116	5580	6.883	7.401	91.67	10.54	11.00
11ax-HE20	MCS0	132	5660	7.013	7.537	91.67	10.67	11.00
11ax-HE20	MCS0	140	5700	7.358	7.779	91.67	10.96	11.00
11ax-HE40	MCS0	54	5270	4.953	6.332	90.91	9.12	11.00
11ax-HE40	MCS0	62	5310	3.632	4.938	90.91	7.76	11.00
11ax-HE40	MCS0	102	5510	4.831	5.849	90.91	8.79	11.00
11ax-HE40	MCS0	110	5550	5.471	6.357	90.91	9.36	11.00
11ax-HE40	MCS0	134	5670	5.486	6.148	90.91	9.25	11.00
11ax-HE80	MCS0	58	5290	1.765	3.245	91.39	5.97	11.00
11ax-HE80	MCS0	106	5530	2.228	3.266	91.39	6.18	11.00
11ax-HE80	MCS0	122	5610	2.344	2.871	91.39	6.02	11.00
11ax-HE160	MCS0	114	5570	-0.516	0.136	91.17	3.23	11.00

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

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

802.11a Power Spectral Density- Ant 0	
Channel 52 (5260MHz)	Channel 60 (5300MHz)
	
Channel 64 (5320MHz)	Channel 100 (5500MHz)
	
Channel 116 (5580MHz)	Channel 132 (5660MHz)
	

802.11a Power Spectral Density- Ant 0	
Channel 140 (5700MHz)