RF MEASUREMENT REPORT

FCC ID:	2ALJ3AP43X
Applicant:	HAN Networks Co., Ltd.
Product:	HAN Access Point
Model No.:	AP431, AP411
Brand Name:	HANNETWORKS, HAN NETWORKS
FCC Classification:	Digital Transmission System (DTS)
FCC Rule Part(s):	Part 15 Subpart C (Section 15.247)
Result:	Complies
Received Date:	2023-03-14
Test Date:	2023-05-29 ~ 2023-06-20

Reviewed By: Jame Yuan

Approved By: Robin Wu

Revision History

Report No.	Version	Description	Issue Date	Note
2303RSU029-U2	V01	Initial Report	2023-09-01	Valid

Note: This report is a copy report based on MRT original report (Report No. 2303RSU028-U2). Only applicant information and product information (name, model and brand name) has changed in this report.

CONTENTS

1. General Information

1.1. Applicant

HAN Networks Co., Ltd.

101-A16, 1st Floor, Building 3, No.9 compound, Yongfeng Road, Haidian District, Beijing, P.R. China

1.2. Manufacturer

HAN Networks Co., Ltd.

101-A16, 1st Floor, Building 3, No.9 compound, Yongfeng Road, Haidian District, Beijing, P.R. China

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	HAN Access Point
Model No.	AP431, AP411
EUT Identification No.	20230313Sample#05 (AP431 Conducted) 20230525Sample#01 (AP431 Radiated) 20230614Sample#03 (AP411)
Wi-Fi Specification	802.11a/b/g/n/ac/ax
Bluetooth Specification	V5.1 Single Mode
Antenna Information	Refer to Section 1.7
Power Type	AC Adapter Input or PoE Input
Operating Environment	Indoor Use
Accessories	
AC Adapter (For both AP431 and AP411)	Model: ADP-50GR B Input: 100-240V ~ 50/60Hz, 1.3A Output: 48.0V, 1.042A, 50.1W MAX
PoE Injector (For AP431)	Model: POE60U-1BT-X Input: 100-240V ~ 1.5A, 50/60Hz Output: 56.0V, 0.535A, 30W PIN 3, 6+ PIN 1, 2 Return Output: 56.0V, 0.535A, 30W PIN 4, 5+ PIN 7, 8 Return
PoE Injector (For AP411)	Model: PD-9001GR/AT/AC Input: 100-240V ~ 0.67A, 50/60Hz Output: 55.0V, 0.6A

Remark:

1. The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.
2. AC Power Adapter and PoE Injector are not sold with Product.
   For this report, we select AC Adapter for testing.
3. Based on AP431, AP411 removed TPM (Trusted Platform Module), removed Eth1(LAN port) PoE function and modified the maximum data rate from 2.5Gbps to 1Gbps.
   USB 3.0 ports have different output current. For AP431, the max current is 1A. For AP411, the max current is 500mA.
   For the radio part, AP431 did all test items, and AP411 did the spot check.

1.5. Radio Specification under Test

Frequency Range	802.11b/g/n-HT20/ax-HE20: 2412 ~ 2462MHz 802.11n-HT40/ax-HE40: 2422 ~ 2452MHz	
Channel Number	802.11b/g/n-HT20/ax-HE20: 11 802.11n-HT40/ax-HE40: 7	
Type of Modulation	802.11b: DSSS 802.11g/n: OFDM 802.11ax: OFDMA	
Data Rate	802.11b: 1/2/5.5/11Mbps 802.11g: 6/9/12/18/24/36/48/54Mbps 802.11n: up to 300Mbps 802.11ax: up to 573.6Mbps	
Channel Puncturing Function	☐ Supported	☒ Unsupported
Support RU	☒ Full RU	☐ Partial RU

1.6. Working Frequencies

802.11b/g/n-HT20/ax-HE20

Channel	Frequency	Channel	Frequency	Channel	Frequency
01	2412 MHz	02	2417 MHz	03	2422 MHz
04	2427 MHz	05	2432 MHz	06	2437 MHz
07	2442 MHz	08	2447 MHz	09	2452 MHz
10	2457 MHz	11	2462 MHz	--	--

802.11n-HT40/ax-HE40

Channel	Frequency	Channel	Frequency	Channel	Frequency
03	2422 MHz	04	2427 MHz	05	2432 MHz
06	2437 MHz	07	2442 MHz	08	2447 MHz
09	2452 MHz	--	--	--	--

1.7. Description of Available Antennas

Antenna Type	Frequency Band (MHz)	T_X Paths	Max Antenna Gain (dBi)	Directional Gain (dBi)		Beamforming Directional Gain (dBi)
				For Power	For PSD	
Wi-Fi Antennas						
PIFA	2400 ~ 2483.5	2	4.15	4.15	7.16	7.16
PIFA	5150 ~ 5250	2	4.57	4.57	7.58	7.58
PIFA	5250 ~ 5350	2	4.55	4.55	7.56	7.56
PIFA	5470 ~ 5725	2	4.31	4.31	7.32	7.32
PIFA	5725 ~ 5850	2	4.30	4.30	7.31	7.31
PIFA	5925 ~ 6425	2	4.33	4.33	7.34	7.34
PIFA	6425 ~ 6525	2	4.77	4.77	7.78	7.78
PIFA	6525 ~ 6875	2	4.59	4.59	7.60	7.60
PIFA	6875 ~ 7125	2	4.01	4.01	7.02	7.02
Bluetooth Antenna						
PIFA	2400 ~ 2483.5	1	4.13	--	--	--

Remark:

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

For CDD transmissions, directional gain is calculated as follows.

Directional gain = $G_{ANT\ Max}$ + 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 supports 802.11n/ac/ax, not include 802.11a/b/g. Beamforming Directional gain = $G_{ANT\ Max}$ + 10 log (N_{ANT}/ N_{SS}).

2. Test Configuration

2.1. Test Mode

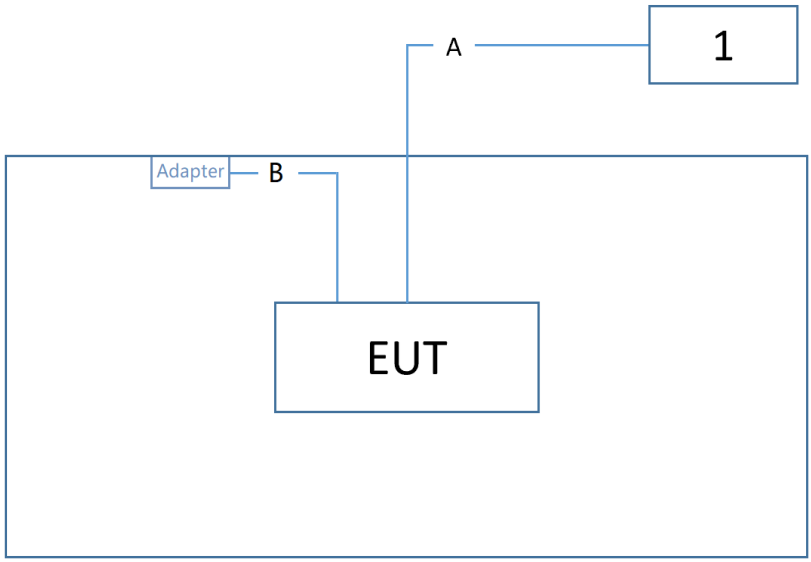
Mode 1: Transmit by 802.11b (1Mbps) (MIMO Mode)
Mode 2: Transmit by 802.11g (6Mbps) (MIMO Mode)
Mode 3: Transmit by 802.11n-HT20 (MCS0) _N_{SS}=1 (MIMO Mode)
Mode 4: Transmit by 802.11n-HT40 (MCS0) _N_{SS}=1 (MIMO Mode)
Mode 5: Transmit by 802.11ax-HE20 (MCS0) _N_{SS}=1 (MIMO Mode)
Mode 6: Transmit by 802.11ax-HE40 (MCS0) _N_{SS}=1 (MIMO Mode)
Remark: 1. For radiated spurious emission, the modulation and the date rate picked for testing are determined by the Max. RF conducted power. 2. This device supports 2 Nss and power level is the same of spatial multiplexing. The worst case is Nss=1. 3. After preliminary scan designated by the manufacturer, CDD mode is determined to be the worst case compared to Beamforming mode, hence, all the radiated test is performed in CDD mode. 4. For beamforming operation, manufacturer automatically backs power down based on CDD power. Therefore, only the CDD mode was evaluated in this report. 5. EUT supports one configuration only in 802.11ax full RU mode.

Spot check list of AP411:

Test Items	Test Mode	Test Channel	Test Frequency (MHz)
Output power	802.11n-HT20	1	2412
	802.11ax-HE20	1	2412
	802.11ax-HE40	9	2452
Radiated Spurious Emission	802.11ax-HE40	9	2452
Radiated Band Edge	802.11ax-HE20	1	2412

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 – Radiated Emission testing & AC Conducted Emissions			
			
Cable Type		Cable Description	
A	LAN Cable	Non shielded, > 10m	
B	Power Cable	Non shielded, 1.25m	
Product		Manufacturer	Model No.
1	Notebook	Dell	Latitude 5491

2.3. Test Software

The test utility software used during testing was “QSPR”, and the version was 5.0-00196.

2.4. Applied Standards

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

- FCC Part 15.247
- KDB 558074 D01v05r02
- ANSI C63.10-2013
- KDB 662911 D01v02r01

2.5. 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	2023-07-23	NS-AC1
Horn Antenna	Schwarzbeck	BBHA 9120D	MRTSUE06572	1 year	2024-03-31	NS-AC1
TRILOG Antenna	Schwarzbeck	VULB 9162	MRTSUE06573	1 year	2023-06-21	NS-AC1
Preamplifier	Schwarzbeck	BBV 9718	MRTSUE06574	1 year	2023-07-11	NS-AC1
EMI Test Receiver	R&S	ESR3	MRTSUE06575	1 year	2023-06-19	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	Keysight	N9020A	MRTSUE10065	1 year	2023-12-20	NS-AC1
Two-Line V-Network	R&S	ENV216	MRTSUE06002	1 year	2024-05-23	WZ-SR2
Shielding Room	MIX-BEP	WZ-SR2	MRTSUE06215	5 years	2026-12-20	WZ-SR2
Thermohygrometer	testo	608-H1	MRTSUE06404	1 year	2023-06-06	WZ-SR2
Thermohygrometer	testo	608-H1	MRTSUE06404	1 year	2024-05-31	WZ-SR2
Four-Line V-Network	R&S	ENV432	MRTSUE06615	1 year	2023-10-08	WZ-SR2
EMI Test Receiver	R&S	ESR3	MRTSUE06909	1 year	2023-10-27	WZ-SR2
USB Power Sensor	Keysight	U2021XA	MRTSUE06446	1 year	2024-05-23	WZ-SR5
Signal Analyzer	Keysight	N9010B	MRTSUE06457	1 year	2024-05-23	WZ-SR5
Attenuator	MVE	MVE2213	MRTSUE11082	1 year	2023-06-09	WZ-SR5
Attenuator	MVE	MVE2213	MRTSUE11082	1 year	2024-06-08	WZ-SR5
Thermohygrometer	testo	608-H1	MRTSUE06402	1 year	2023-06-06	WZ-SR5
Thermohygrometer	testo	608-H1	MRTSUE06402	1 year	2024-05-31	WZ-SR5
Shielding Room	HUAMING	WZ-SR5	MRTSUE06442	N/A	N/A	WZ-SR5
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2023-12-28	WZ-AC1
Horn Antenna	Schwarzbeck	BBHA 9120D	MRTSUE06023	1 year	2023-08-22	WZ-AC1
Preamplifier	Agilent	83017A	MRTSUE06076	1 year	2024-05-07	WZ-AC1
TRILOG Antenna	Schwarzbeck	VULB 9168	MRTSUE06172	1 year	2024-06-09	WZ-AC1
Anechoic Chamber	TDK	WZ-AC1	MRTSUE06212	1 year	2024-04-20	WZ-AC1
Thermohygrometer	testo	608-H1	MRTSUE06403	1 year	2024-05-31	WZ-AC1
Signal Analyzer	Keysight	N9010B	MRTSUE06607	1 year	2023-12-28	WZ-AC1
Thermohygrometer	testo	608-H1	MRTSUE11039	1 year	2023-11-01	WZ-AC1
Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2023-09-29	WZ-AC1

Software	Version	Function
EMI Software	V3.0.0	EMI Test Software
BenchVue Power Meter	2018.1	Power
Controller_T-E-TAC-2	1.02	RE Antenna & Turntable
Controller_MF 7802	2.03C	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: 3.58dB 150kHz~30MHz: 3.20dB
Radiated Disturbance
Measurement Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 9kHz~30MHz: 2.60dB 30MHz~200MHz: 4.06dB 200MHz~1GHz: 5.28dB 1GHz~40GHz: 4.98dB
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
15.247(a)(2)	6dB Bandwidth	Conducted	Pass
15.247(b)(3)	Output Power		Pass
15.247(e)	Power Spectral Density		Pass
15.247(d)	Band Edge / Out-of-Band Emissions		Pass
15.205 15.209	General Field Strength (Restricted Bands and Radiated Emission)	Radiated	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 tests, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst-case emissions.

6.2. 6dB Bandwidth Measurement

6.2.1. Test Limit

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

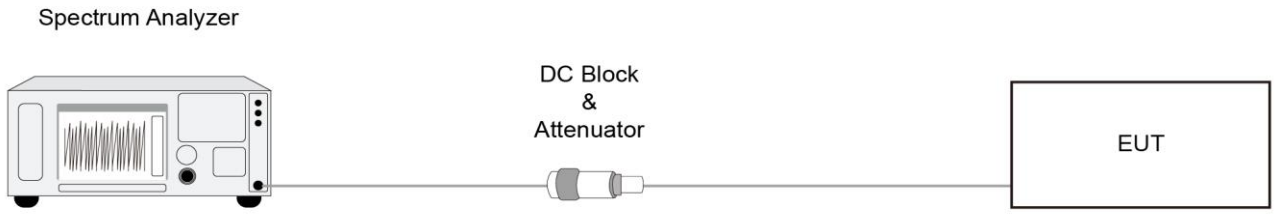
6.2.2. Test Procedure

ANSI C63.10 - 2013 - Section 11.8

6.2.3. Test Setting

1. The Spectrum's automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. Set RBW = 100 kHz
3. VBW ≥ 3 × RBW
4. Detector = Peak
5. Trace mode = Max hold
6. Sweep = Auto couple
7. Allow the trace to stabilize

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

The maximum output power shall be less 1 Watt (30dBm).

The conducted output power limit specified in paragraph FCC Part 15.247(b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs FCC Part 15.247(b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

6.3.2. Test Procedure

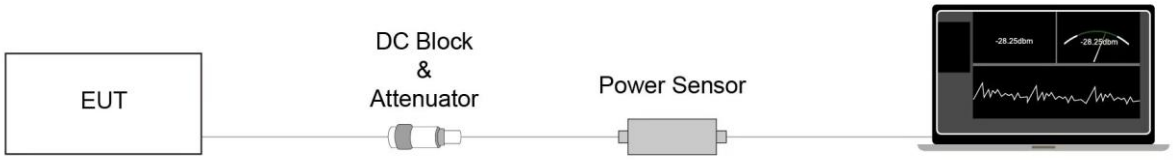
ANSI C63.10 - 2013 - Section 11.9.2.3.2

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. Power Spectral Density Measurement

6.4.1. Test Limit

The maximum permissible power spectral density is 8dBm in any 3 kHz band.

The same method of determining the conducted output power shall be used to determine the power spectral density.

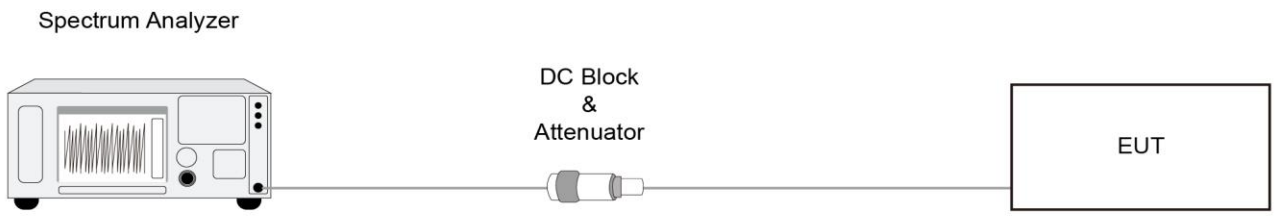
6.4.2. Test Procedure

ANSI C63.10 - 2013 - Section 11.10.5

6.4.3. Test Setting

1. Measure the duty cycle (x) of the transmitter output signal.
2. Set instrument center frequency to DTS channel center frequency.
3. Set span to at least 1.5 times the OBW.
4. RBW = 10 kHz.
5. VBW = 30 kHz.
6. Detector = RMS.
7. Ensure that the number of measurement points in the sweep ≥ 2 x span/RBW.
8. Sweep time = auto couple.
9. Don’t use sweep triggering. Allow sweep to “free run”.
10. Employ trace averaging (RMS) mode over a minimum of 100 traces.
11. Use the peak marker function to determine the maximum amplitude level.
12. Add 10 log (1/x), where x is the duty cycle measured in step (a, to the measured PSD to compute the average PSD during the actual transmission time. If measured value exceeds requirement specified by regulatory agency, then reduce RBW (but no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span to meet the minimum measurement point requirement as the RBW is reduced).

6.4.4. Test Setup



6.4.5. Test Result

Refer to Appendix A.4.

6.5. Conducted Band Edge and Out-of-Band Emissions Measurement

6.5.1. Test Limit

The limit for out-of-band spurious emissions at the band edge is 30dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100 kHz bandwidth per the PSD procedure.

6.5.2. Test Procedure

ANSI C63.10-2013 - Section 11.11

6.5.3. Test Settitng

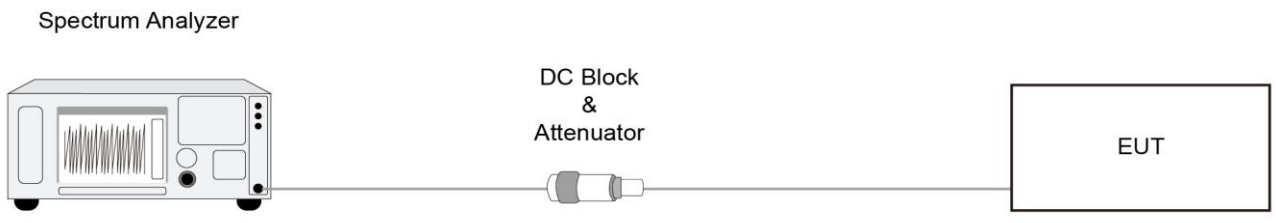
Reference level measurement

1. Set instrument center frequency to DTS channel center frequency
2. Set the span to ≥ 1.5 times the DTS bandwidth
3. Set the RBW = 100 kHz
4. Set the VBW ≥ 3 x RBW
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Allow trace to fully stabilize

Emission level measurement

1. Set the center frequency and span to encompass frequency range to be measured
2. RBW = 100kHz
3. VBW = 300kHz
4. Detector = Peak
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

6.5.4. Test Setup



6.5.5. Test Result

Refer to Appendix A.5.

6.6. Radiated Spurious Emission Measurement

6.6.1. 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 [μV/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

6.6.2. Test Procedure

ANSI C63.10 - 2013 - Section 11.11 & 11.12

ANSI C63.10 - 2013 - Section 6.3 (General Requirements)

ANSI C63.10 - 2013 - Section 6.4 (Standard test method below 30MHz)

ANSI C63.10 - 2013 - Section 6.5 (Standard test method above 30MHz to 1GHz)

ANSI C63.10 - 2013 - Section 6.6 (Standard test method above 1GHz)

6.6.3. 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

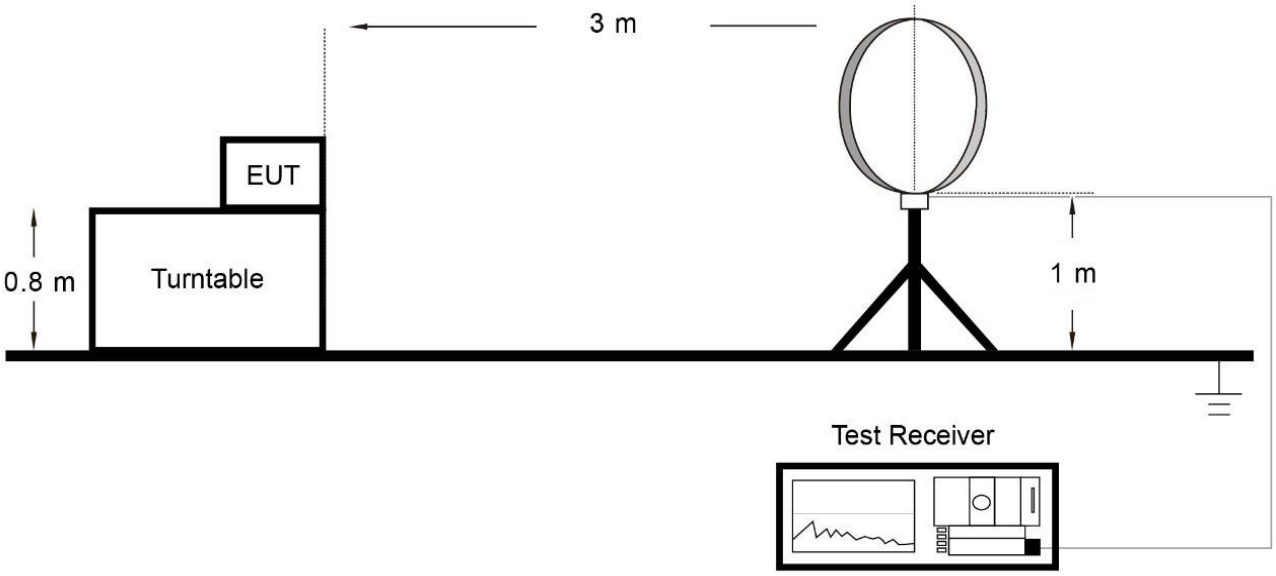
5. Sweep time = auto

6. Trace mode = max hold

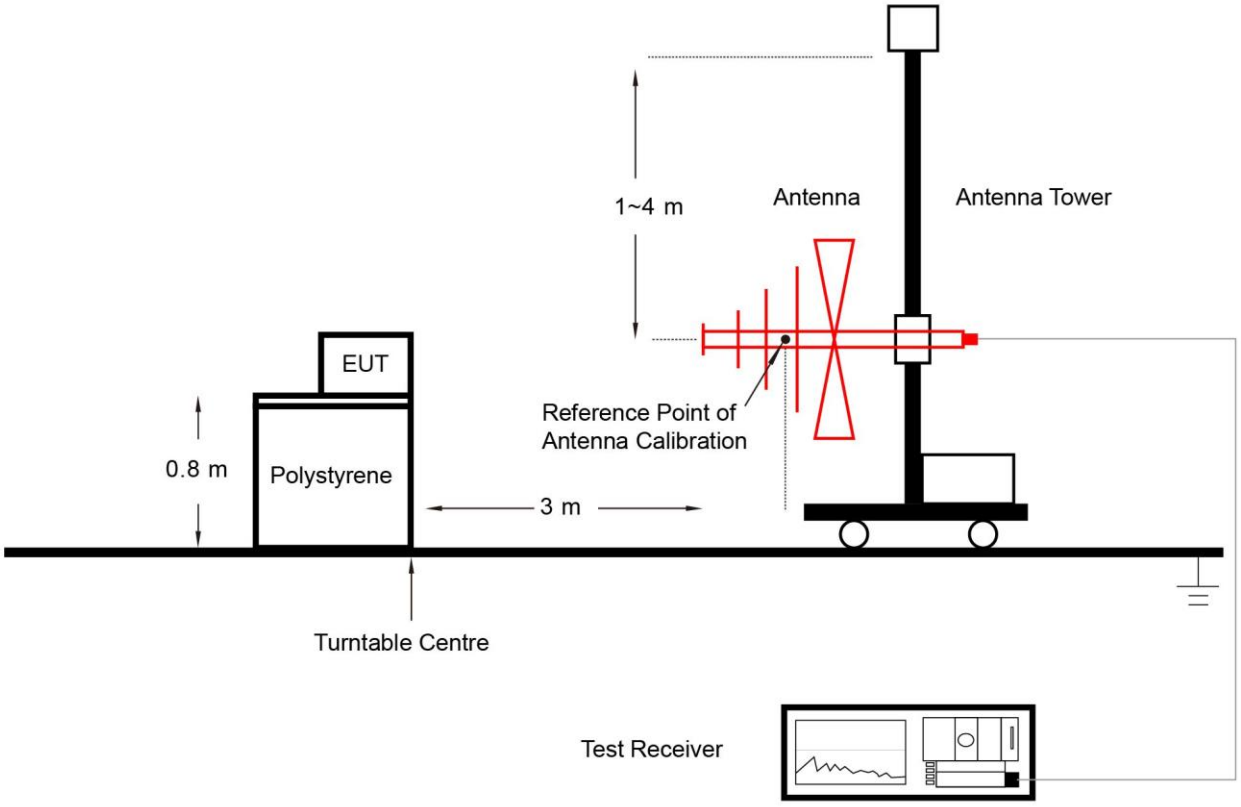
7. Trace was allowed to stabilize

6.6.4. Test Setup

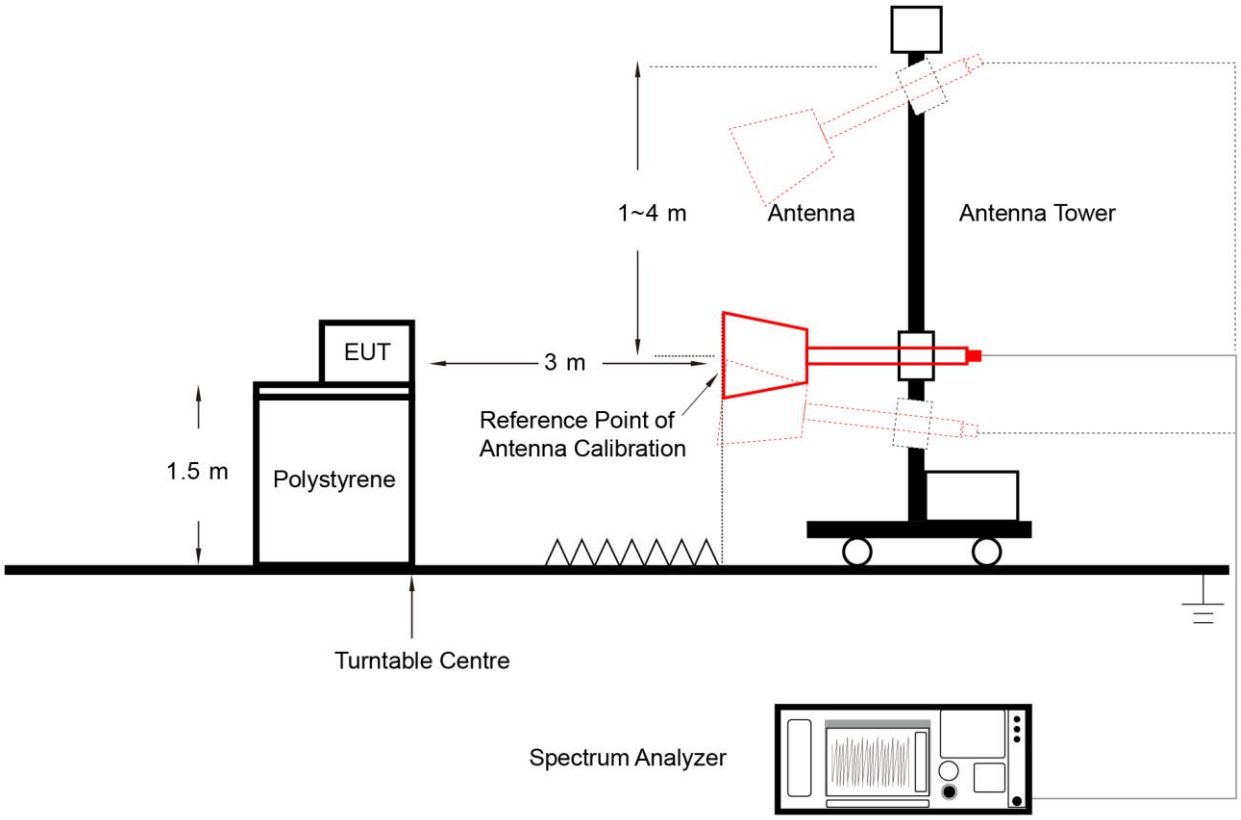
Below 30MHz Test Setup:



Below 1GHz Test Setup:



Above 1GHz Test Setup:



6.6.5. Test Result

Refer to Appendix A.6.

6.7. Radiated Restricted Band Edge Measurement

6.7.1. 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	--	--	--

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 [μV/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

ANSI C63.10-2013 Section 6.3 & 6.6 & 11.13

6.7.3. Test Setting

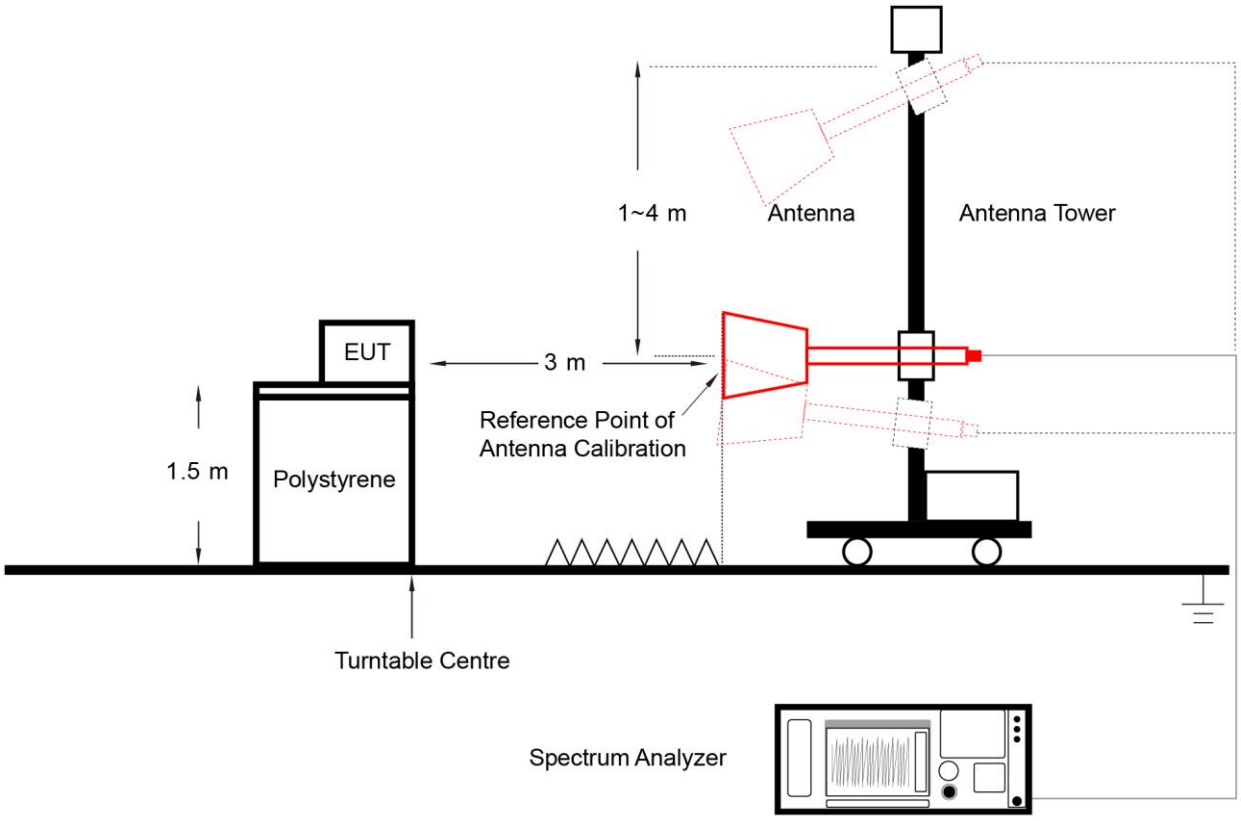
Peak Field Strength Measurements

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 Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW ≥ 1/T
4. Average Type = Voltage
5. Detector = Peak
6. Sweep time = auto
7. Trace mode = max hold
8. Allow max hold to run for at least 50 times (1/duty cycle) traces

6.7.4. Test Setup



6.7.5. Test Result

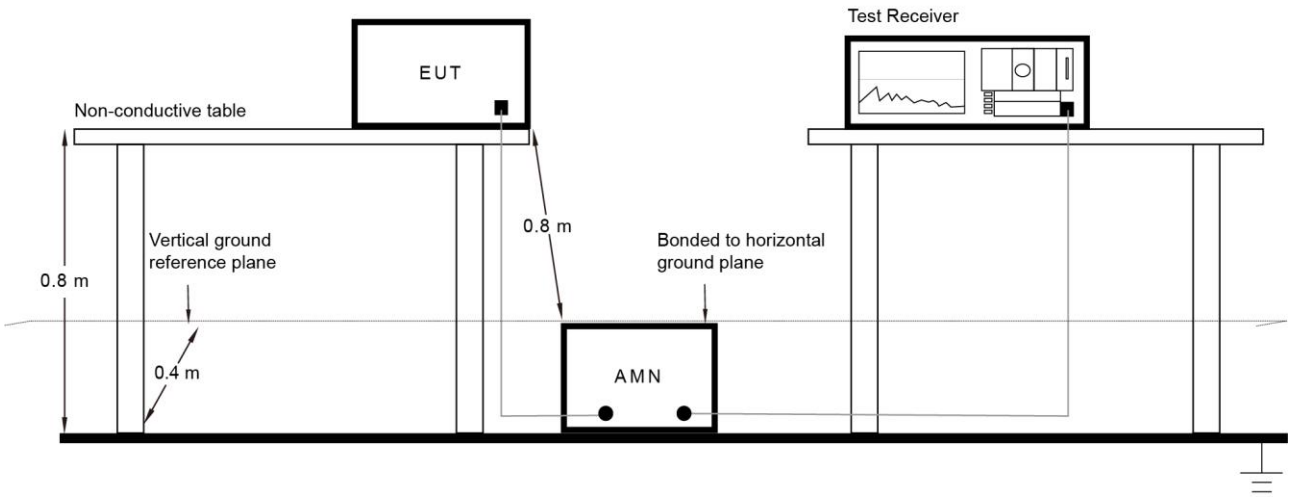
Refer to Appendix A.7.

6.8. AC Conducted Emissions Measurement

6.8.1. Test Limit

FCC Part 15 Subpart C Paragraph 15.207 Limits		
Frequency (MHz)	QP (dBμV)	AV (dBμV)
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.		

6.8.2. Test Setup



6.8.3. Test Result

Refer to Appendix A.8.

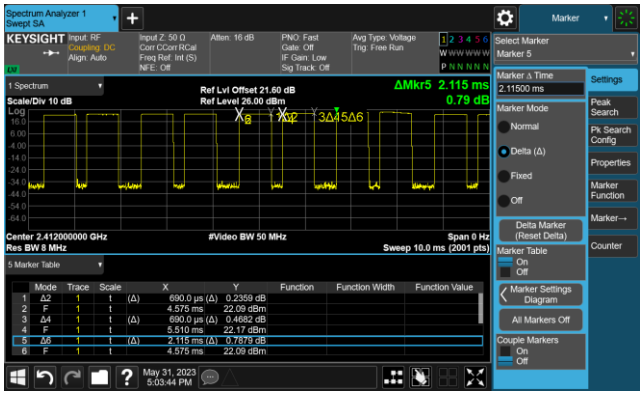
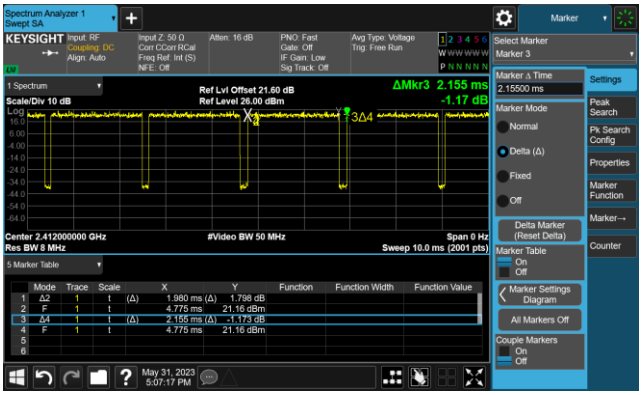
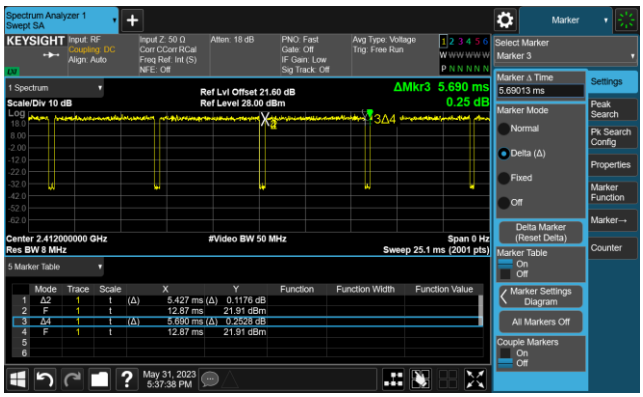
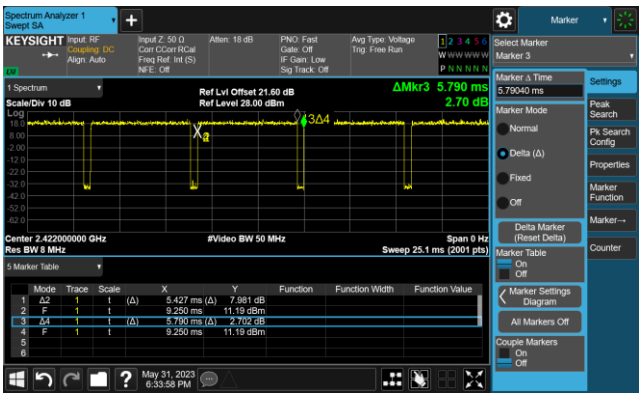
Appendix A - Test Result

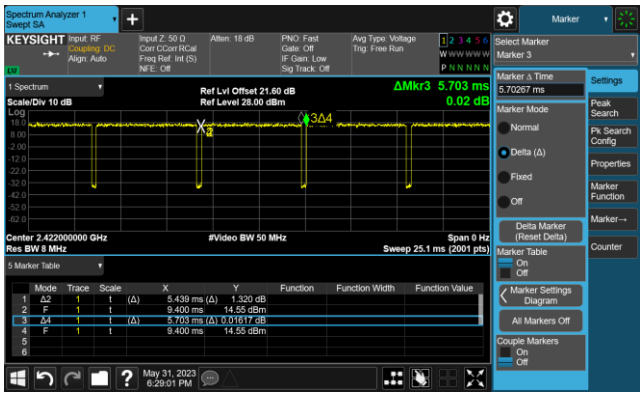
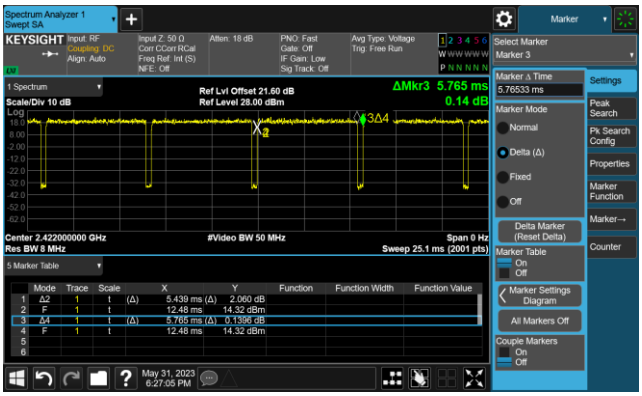
A.1 Duty Cycle Test Result

Test data of AP431:

Test Site	WZ-SR5	Test Engineer	Lynn Yang
Test Date	2023-05-31		

Test Mode	Duty Cycle
802.11b	65.25%
802.11g	91.88%
802.11n-HT20	95.38%
802.11n-HT40	93.73%
802.11ax-HE20	95.37%
802.11ax-HE40	94.35%

Duty Cycle (T = Transmission Duration)	
802.11b (T = 1.38ms)	802.11g (T = 1.980ms)
	
802.11n-HT20 (T = 5.427ms)	802.11n-HT40 (T = 5.427ms)
	

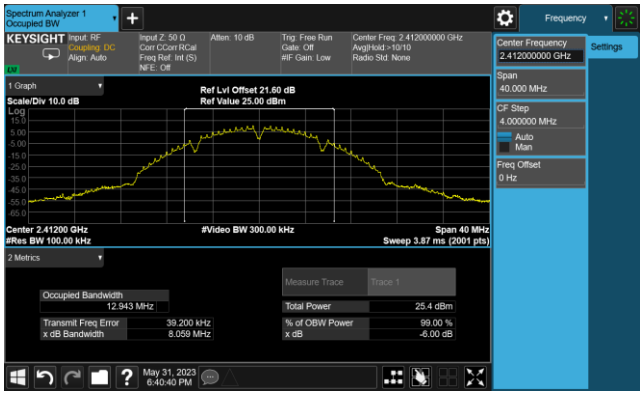
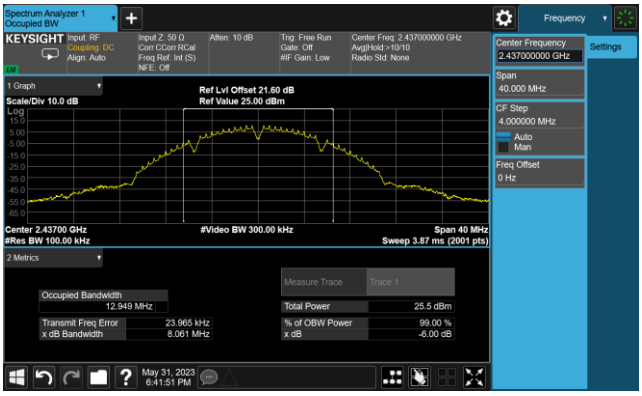
Duty Cycle (T = Transmission Duration)	
802.11ax-HE20 (T = 5.439ms)	802.11ax-HE40 (T = 5.439ms)
	

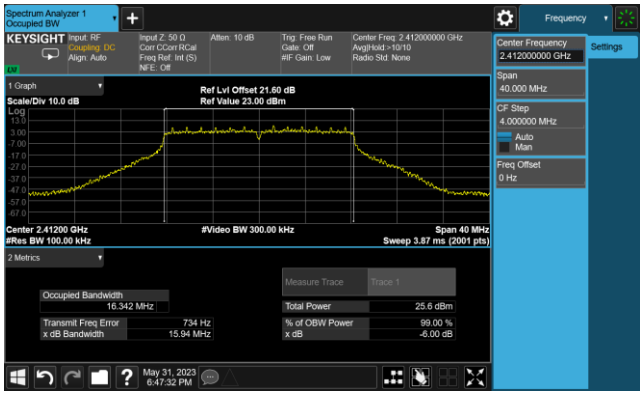
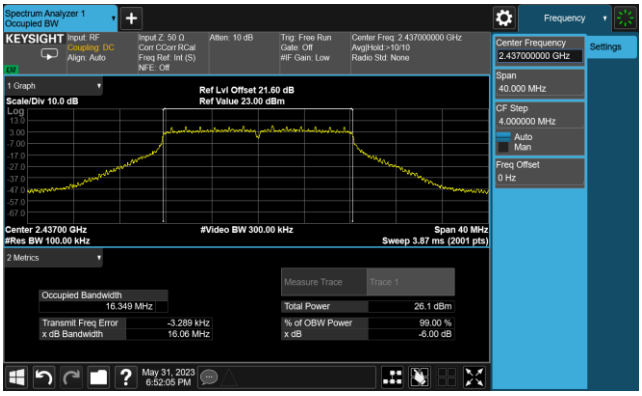
A.2 6dB Bandwidth Test Result

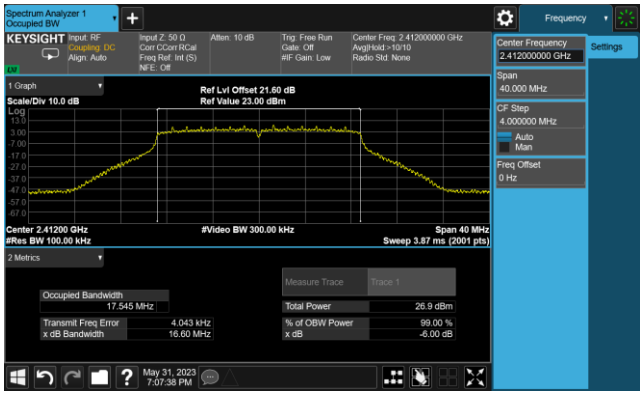
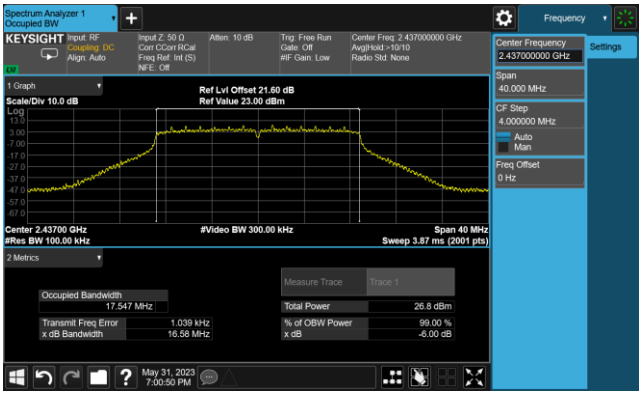
Test data of AP431:

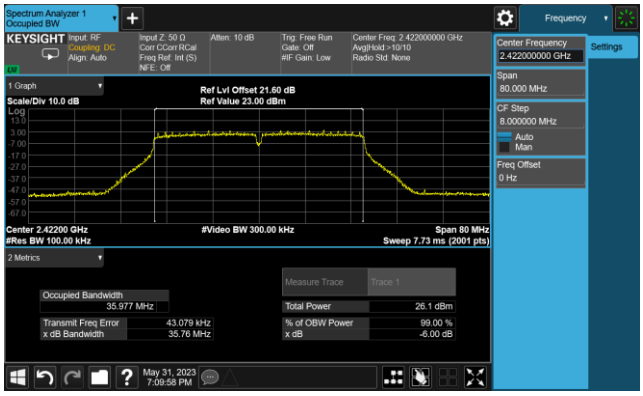
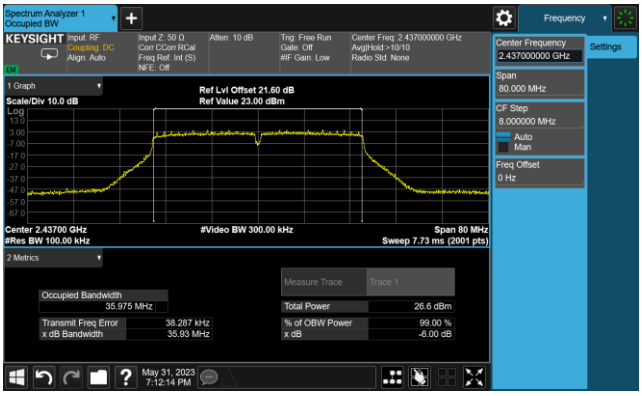
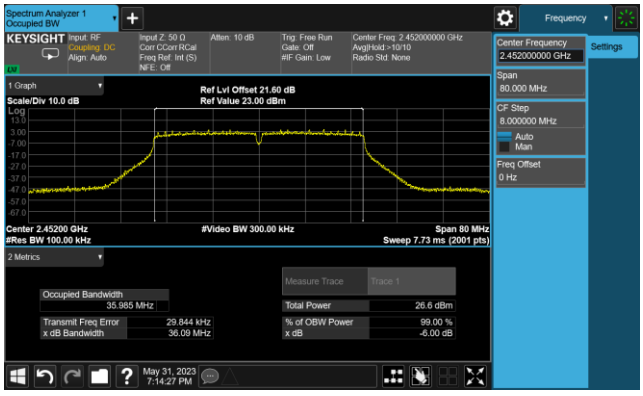
Test Site	WZ-SR5	Test Engineer	Lynn Yang
Test Date	2023-05-31		

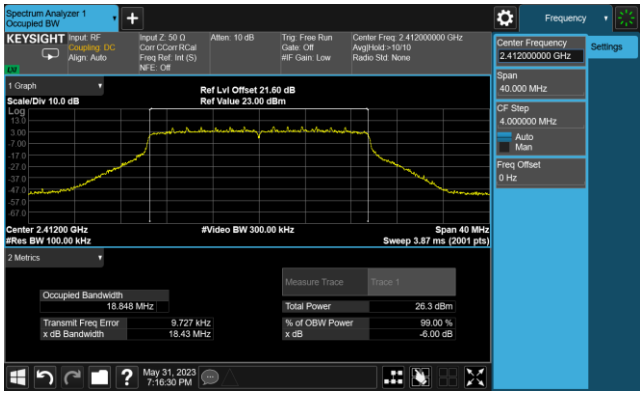
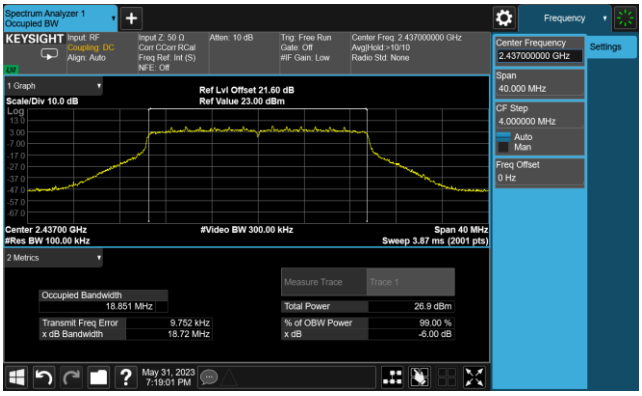
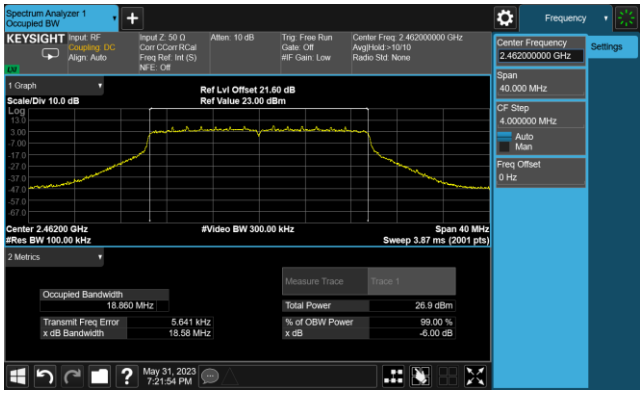
Test Mode	Data Rate / MCS	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)
11b	1Mbps	01	2412	8.059	≥ 0.5
11b	1Mbps	06	2437	8.061	≥ 0.5
11b	1Mbps	11	2462	8.071	≥ 0.5
11g	6Mbps	01	2412	15.94	≥ 0.5
11g	6Mbps	06	2437	16.06	≥ 0.5
11g	6Mbps	11	2462	15.80	≥ 0.5
11n-HT20	MCS0	01	2412	16.60	≥ 0.5
11n-HT20	MCS0	06	2437	16.58	≥ 0.5
11n-HT20	MCS0	11	2462	16.66	≥ 0.5
11n-HT40	MCS0	03	2422	35.76	≥ 0.5
11n-HT40	MCS0	06	2437	35.93	≥ 0.5
11n-HT40	MCS0	09	2452	36.09	≥ 0.5
11ax-HE20	MCS0	01	2412	18.43	≥ 0.5
11ax-HE20	MCS0	06	2437	18.72	≥ 0.5
11ax-HE20	MCS0	11	2462	18.58	≥ 0.5
11ax-HE40	MCS0	03	2422	37.84	≥ 0.5
11ax-HE40	MCS0	06	2437	37.85	≥ 0.5
11ax-HE40	MCS0	09	2452	38.01	≥ 0.5

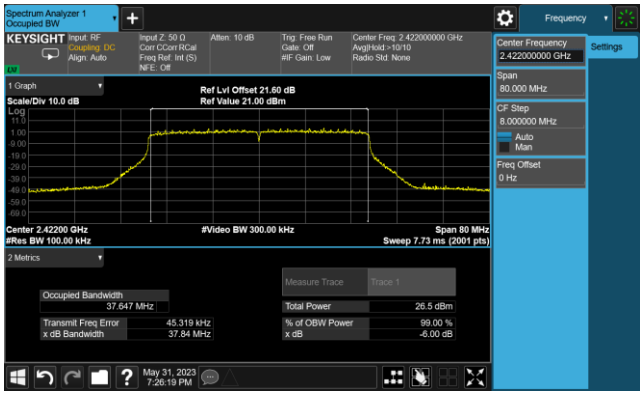
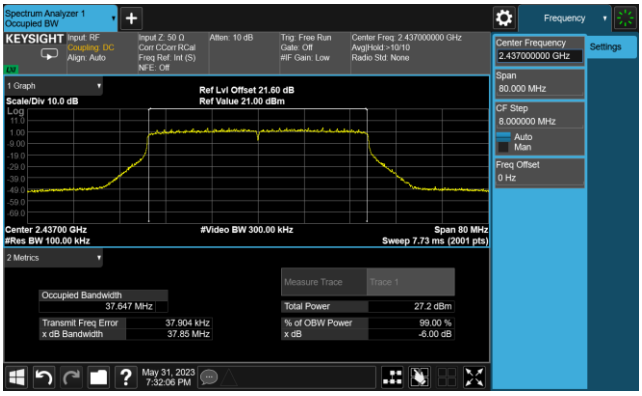
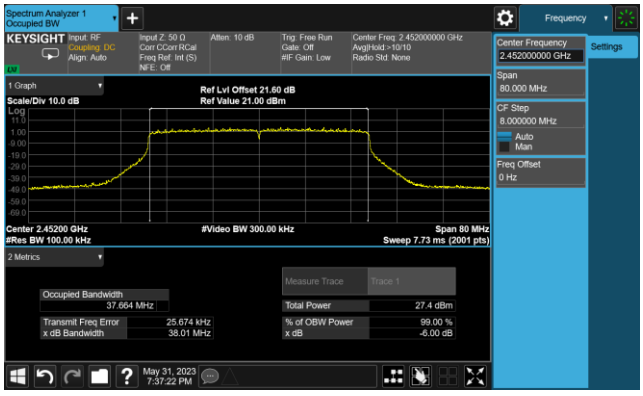
802.11b 6dB Bandwidth	
Channel 01 (2412MHz)	Channel 06 (2437MHz)
	
Channel 11 (2462MHz)	
	

802.11g 6dB Bandwidth	
Channel 01 (2412MHz)	Channel 06 (2437MHz)
	
Channel 11 (2462MHz)	
	

802.11n-HT20 6dB Bandwidth	
Channel 01 (2412MHz)	Channel 06 (2437MHz)
	
Channel 11 (2462MHz)	
	

802.11n-HT40 6dB Bandwidth	
Channel 03 (2422MHz)	Channel 06 (2437MHz)
	
Channel 09 (2452MHz)	
	

802.11ax-HE20 6dB Bandwidth	
Channel 01 (2412MHz)	Channel 06 (2437MHz)
	
Channel 11 (2462MHz)	
	

802.11ax-HE40 6dB Bandwidth	
Channel 03 (2422MHz)	Channel 06 (2437MHz)
	
Channel 09 (2452MHz)	
	

A.3 Output Power Test Result

Test data of AP431:

Test Site	WZ-SR5	Test Engineer	Lynn Yang
Test Date	2023-05-31		

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	Average Power(dBm)		Total AV Power(dBm)	Limit (dBm)
				Ant 0	Ant 1		
11b	1Mbps	01	2412	18.14	18.06	21.11	≤ 30.00
11b	1Mbps	06	2437	18.41	18.04	21.24	≤ 30.00
11b	1Mbps	11	2462	18.31	17.97	21.15	≤ 30.00
11g	6Mbps	01	2412	18.17	17.99	21.09	≤ 30.00
11g	6Mbps	06	2437	18.33	17.92	21.14	≤ 30.00
11g	6Mbps	11	2462	18.25	17.93	21.10	≤ 30.00
11n-HT20	MCS0	01	2412	18.43	18.15	21.30	≤ 30.00
11n-HT20	MCS0	06	2437	18.36	17.95	21.17	≤ 30.00
11n-HT20	MCS0	11	2462	18.11	17.78	20.96	≤ 30.00
11n-HT40	MCS0	03	2422	17.92	17.48	20.72	≤ 30.00
11n-HT40	MCS0	06	2437	18.39	18.08	21.25	≤ 30.00
11n-HT40	MCS0	09	2452	18.48	17.99	21.25	≤ 30.00
11ax-HE20	MCS0	01	2412	18.23	17.87	21.06	≤ 30.00
11ax-HE20	MCS0	06	2437	18.40	17.94	21.19	≤ 30.00
11ax-HE20	MCS0	11	2462	18.31	17.71	21.03	≤ 30.00
11ax-HE40	MCS0	03	2422	17.74	17.17	20.47	≤ 30.00
11ax-HE40	MCS0	06	2437	18.11	17.81	20.97	≤ 30.00
11ax-HE40	MCS0	09	2452	18.04	17.68	20.87	≤ 30.00

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

Spot Check Test Data of AP411:

Test Site	WZ-SR5	Test Engineer	Lynn Yang
Test Date	2023-06-20		

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	Average Power(dBm)		Total AV Power(dBm)	Limit (dBm)
				Ant 0	Ant 1		
11n-HT20	MCS0	01	2412	18.08	18.31	21.21	≤ 30.00
11ax-HE20	MCS0	01	2437	17.14	17.19	20.18	≤ 30.00
11ax-HE40	MCS0	09	2462	17.38	17.33	20.37	≤ 30.00

Note: Total AV 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 data of AP431:

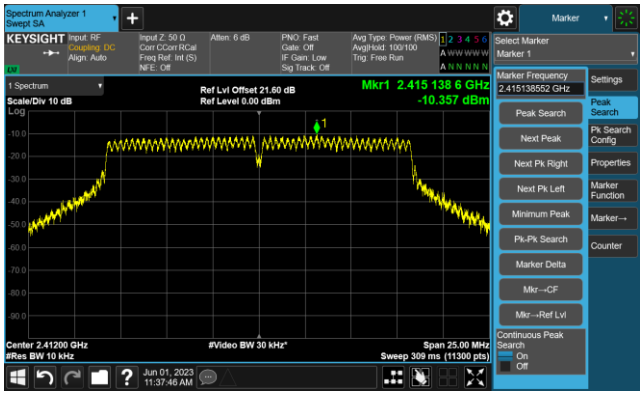
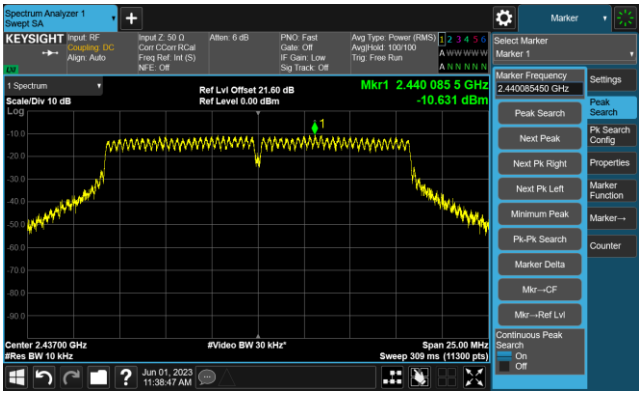
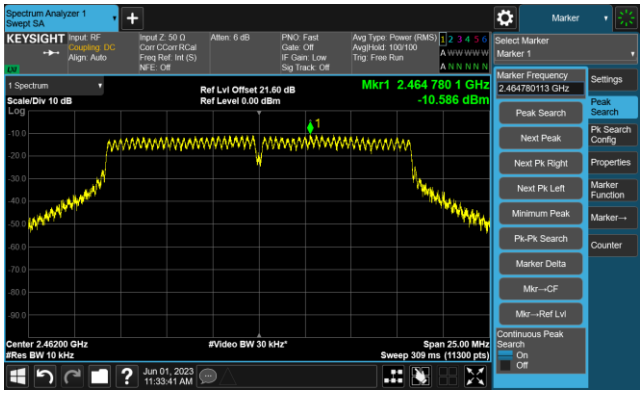
Test Site	WZ-SR5	Test Engineer	Lynn Yang
Test Date	2023-05-31~2023-06-01		

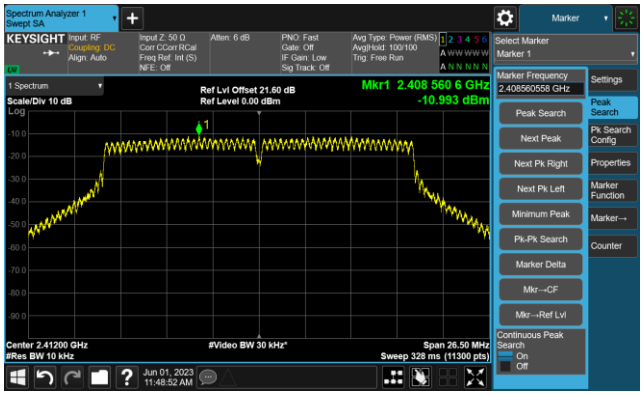
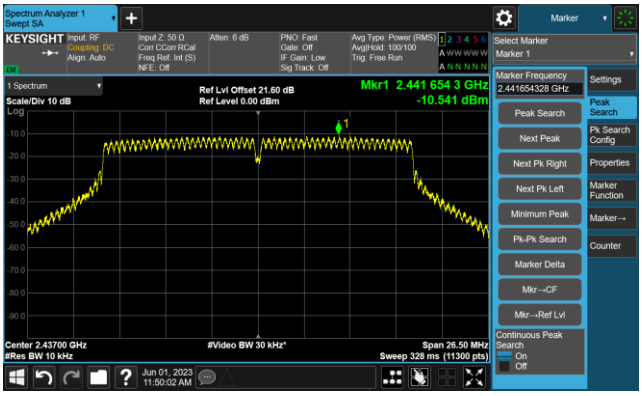
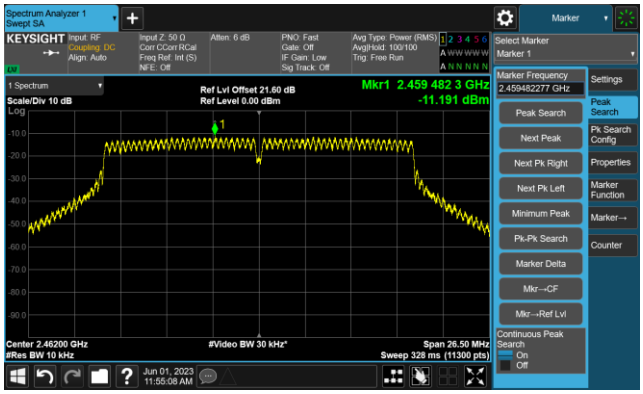
Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	PSD (dBm / 10kHz)		Total PSD (dBm/10kHz)	Limit (dBm / 3kHz)	Result
				Ant 0	Ant 1			
11b	1Mbps	01	2412	-6.695	-7.605	-2.26	≤ 6.84	Pass
11b	1Mbps	06	2437	-7.858	-8.414	-3.26	≤ 6.84	Pass
11b	1Mbps	11	2462	-8.085	-8.473	-3.41	≤ 6.84	Pass
11g	6Mbps	01	2412	-10.357	-11.280	-7.42	≤ 6.84	Pass
11g	6Mbps	06	2437	-10.631	-10.753	-7.31	≤ 6.84	Pass
11g	6Mbps	11	2462	-10.586	-11.258	-7.53	≤ 6.84	Pass
11n-HT20	MCS0	01	2412	-10.993	-11.640	-8.09	≤ 6.84	Pass
11n-HT20	MCS0	06	2437	-10.541	-11.127	-7.61	≤ 6.84	Pass
11n-HT20	MCS0	11	2462	-11.191	-11.486	-8.12	≤ 6.84	Pass
11n-HT40	MCS0	03	2422	-14.046	-14.276	-10.87	≤ 6.84	Pass
11n-HT40	MCS0	06	2437	-13.287	-14.589	-10.60	≤ 6.84	Pass
11n-HT40	MCS0	09	2452	-14.065	-14.320	-10.90	≤ 6.84	Pass
11ax-HE20	MCS0	01	2412	-12.422	-13.428	-9.68	≤ 6.84	Pass
11ax-HE20	MCS0	06	2437	-12.632	-13.204	-9.69	≤ 6.84	Pass
11ax-HE20	MCS0	11	2462	-12.646	-13.291	-9.74	≤ 6.84	Pass
11ax-HE40	MCS0	03	2422	-15.735	-16.188	-12.69	≤ 6.84	Pass
11ax-HE40	MCS0	06	2437	-15.165	-15.151	-11.90	≤ 6.84	Pass
11ax-HE40	MCS0	09	2452	-15.196	-15.587	-12.12	≤ 6.84	Pass

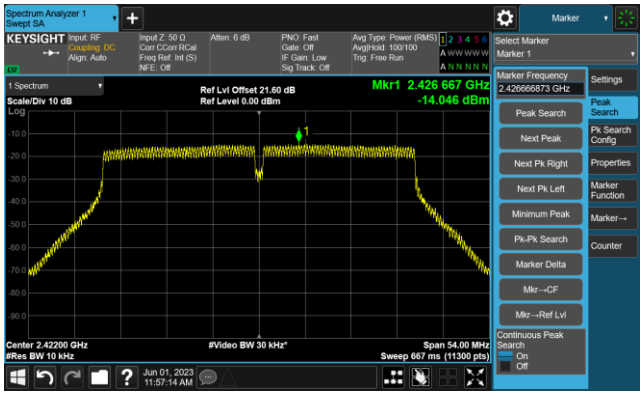
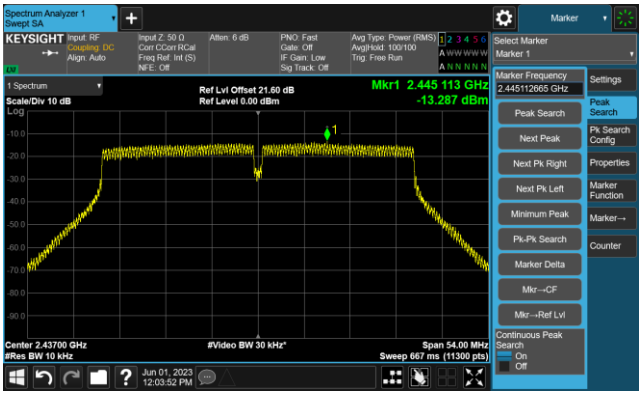
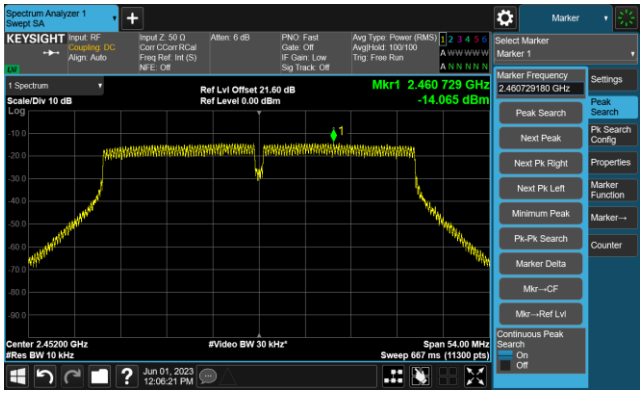
Note: When EUT duty cycle < 98%, the total PSD (dBm/10kHz) =10*log $\{10^{(\text{Ant 0 PSD/10})} + 10^{(\text{Ant 1 PSD/10})}\}$ +10*log (1/Duty cycle).

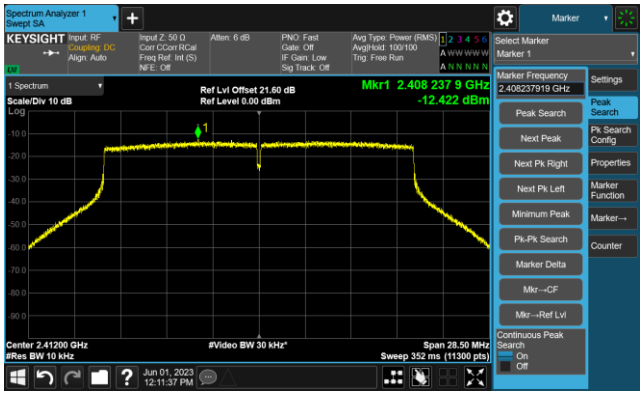
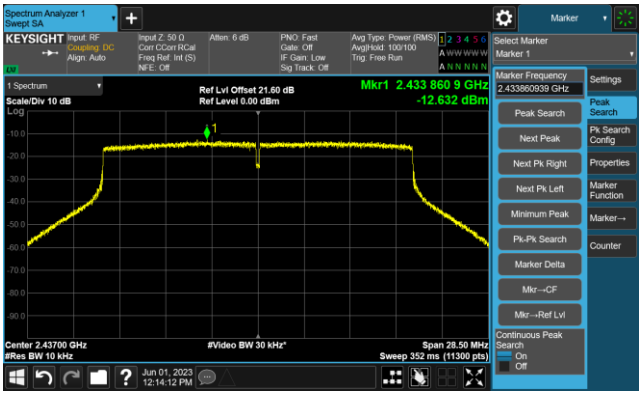
When EUT duty cycle ≥ 98%, the total PSD (dBm/10kHz) =10*log $\{10^{(\text{Ant 0 PSD/10})} + 10^{(\text{Ant 1 PSD/10})}\}$.

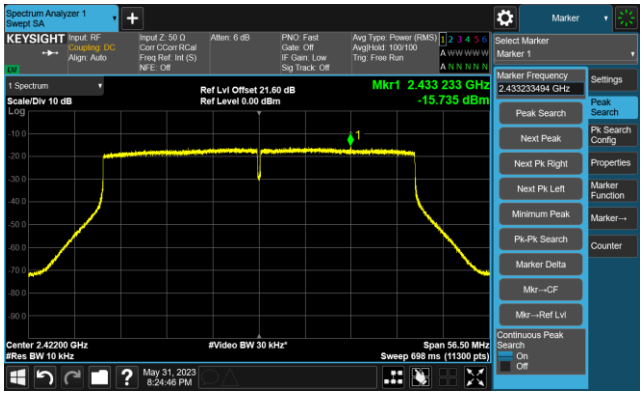
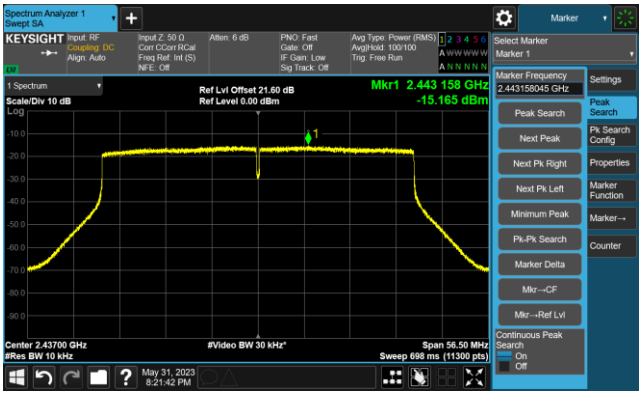
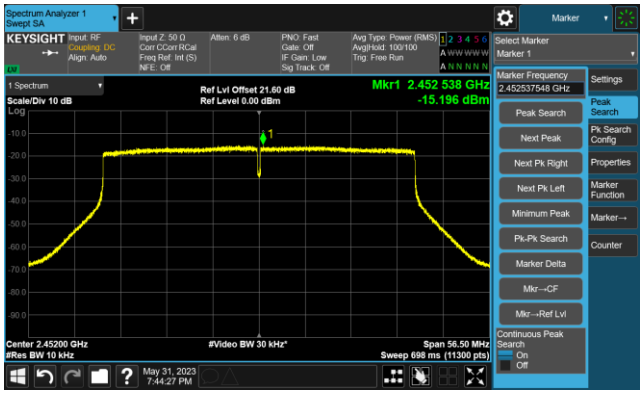
802.11b - PSD – Ant 0	
Channel 01 (2412MHz)	Channel 06 (2437MHz)
	
Channel 11 (2462MHz)	
	

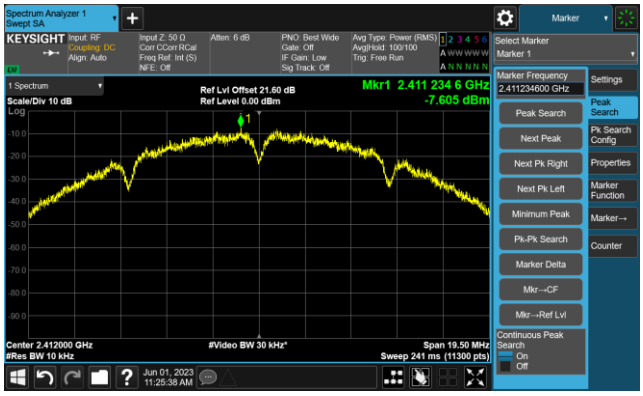
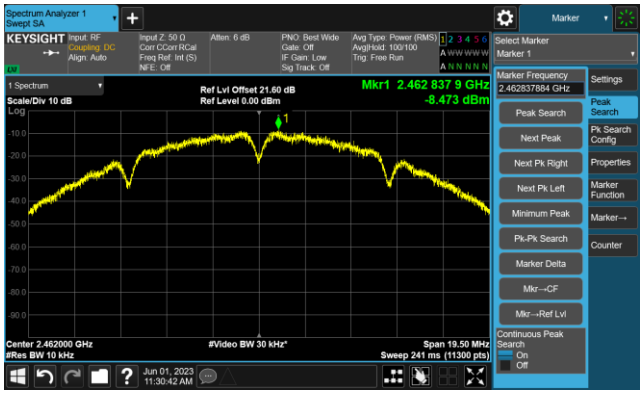
802.11g - PSD – Ant 0	
Channel 01 (2412MHz)	Channel 06 (2437MHz)
	
Channel 11 (2462MHz)	
	

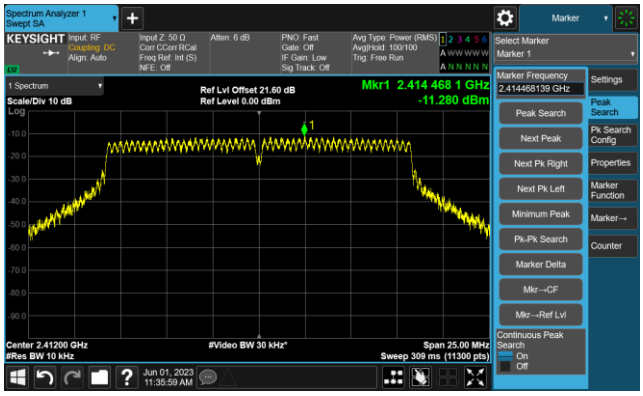
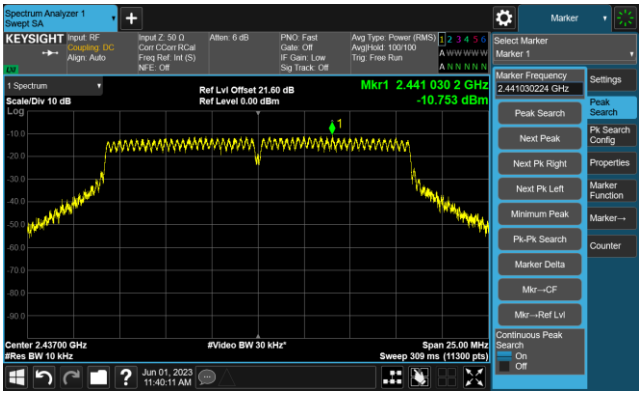
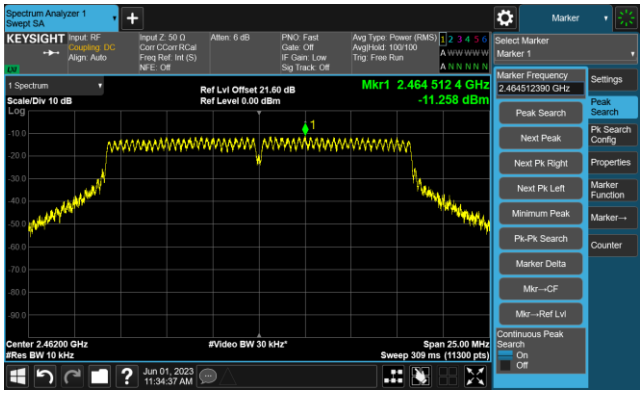
802.11n-HT20 - PSD – Ant 0	
Channel 01 (2412MHz)	Channel 06 (2437MHz)
	
Channel 11 (2462MHz)	
	

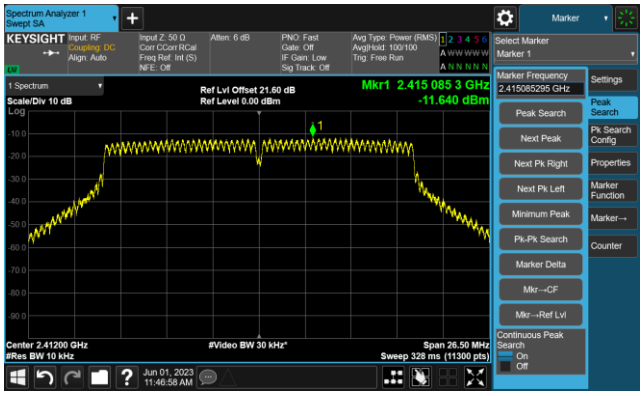
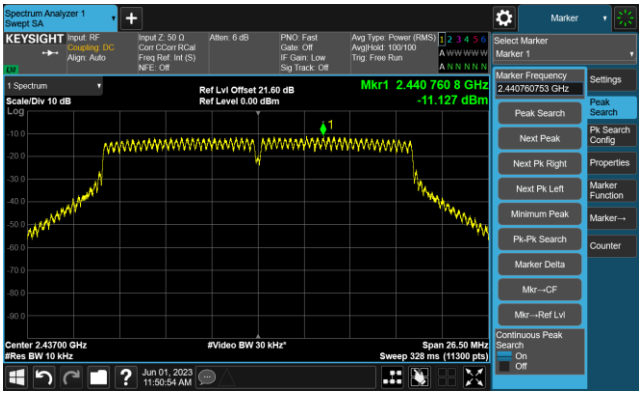
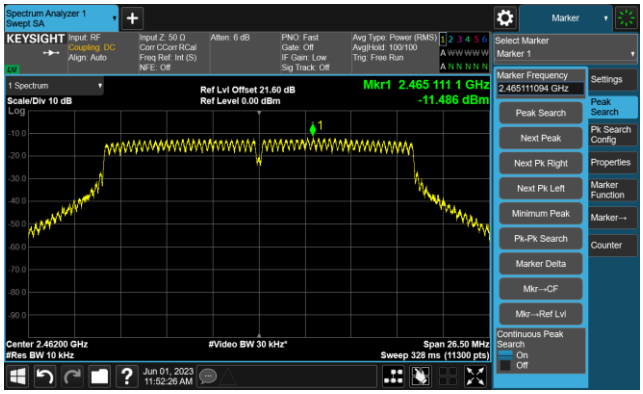
802.11n-HT40 - PSD – Ant 0	
Channel 03 (2422MHz)	Channel 06 (2437MHz)
	
Channel 09 (2452MHz)	
	

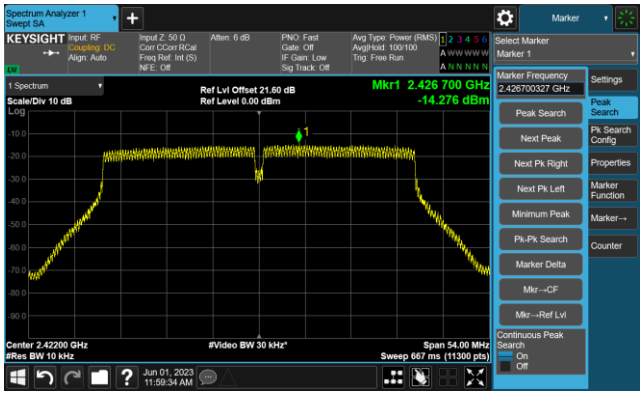
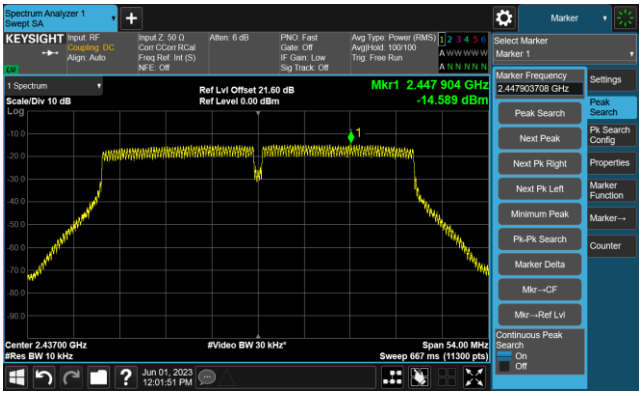
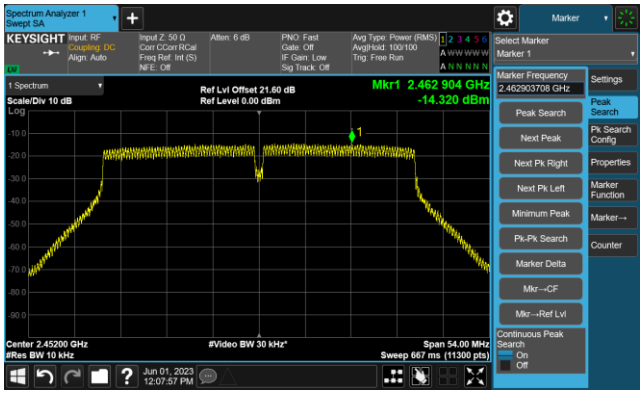
802.11ax-HE20 - PSD – Ant 0	
Channel 01 (2412MHz)	Channel 06 (2437MHz)
	
Channel 11 (2462MHz)	
	

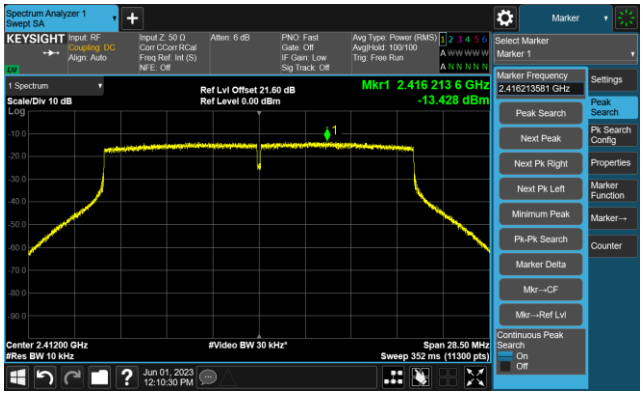
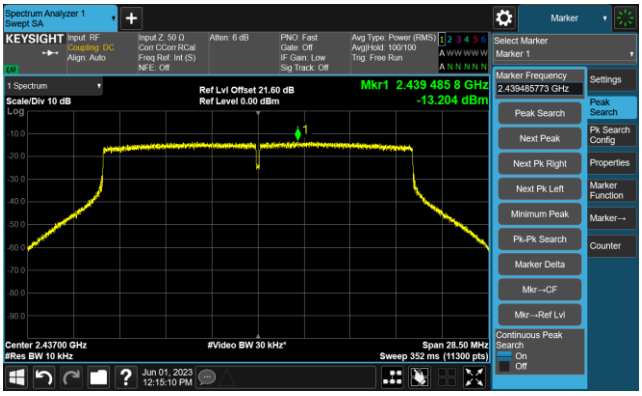
802.11ax-HE40 - PSD – Ant 0	
Channel 03 (2422MHz)	Channel 06 (2437MHz)
	
Channel 09 (2452MHz)	
	

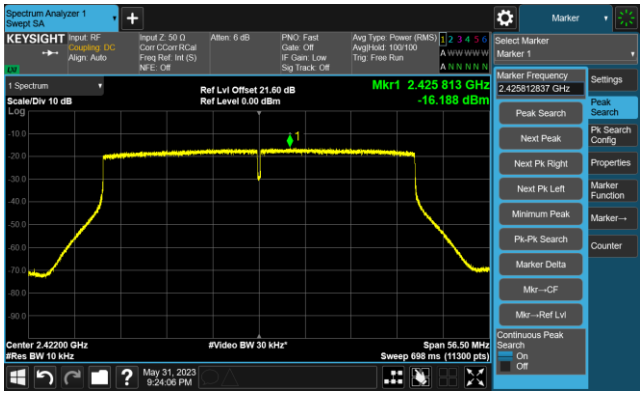
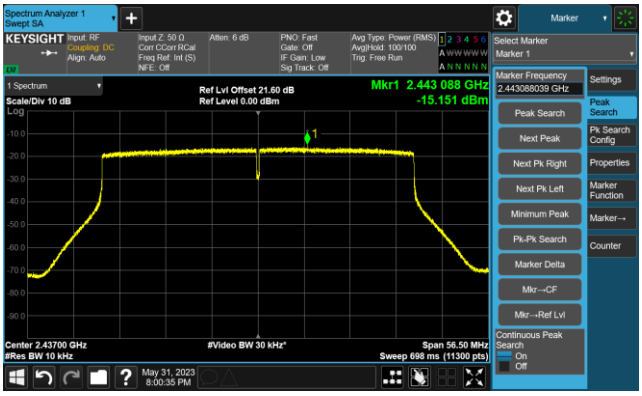
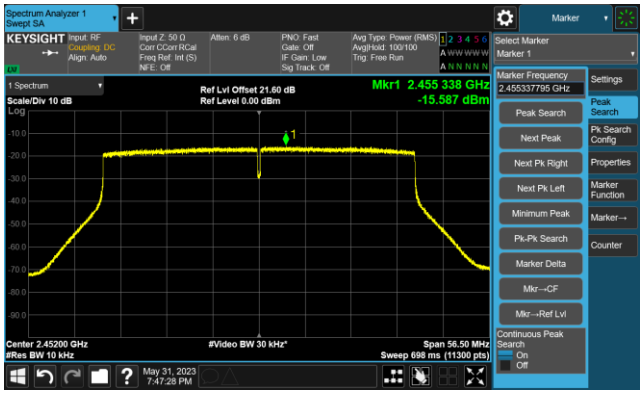
802.11b - PSD – Ant 1	
Channel 01 (2412MHz)	Channel 06 (2437MHz)
	
Channel 11 (2462MHz)	
	

802.11g - PSD – Ant 1	
Channel 01 (2412MHz)	Channel 06 (2437MHz)
	
Channel 11 (2462MHz)	
	

802.11n-HT20 - PSD – Ant 1	
Channel 01 (2412MHz)	Channel 06 (2437MHz)
	
Channel 11 (2462MHz)	
	

802.11n-HT40 - PSD – Ant 1	
Channel 03 (2422MHz)	Channel 06 (2437MHz)
	
Channel 09 (2452MHz)	
	

802.11ax-HE20 - PSD – Ant 1	
Channel 01 (2412MHz)	Channel 06 (2437MHz)
	
Channel 11 (2462MHz)	
	

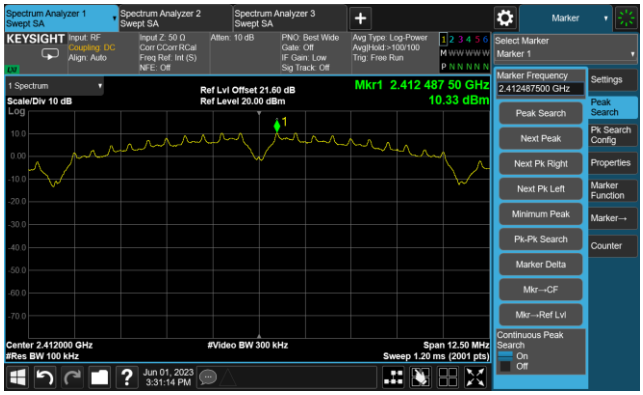
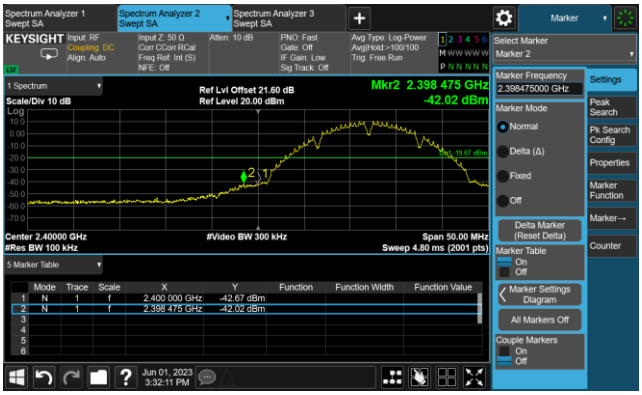
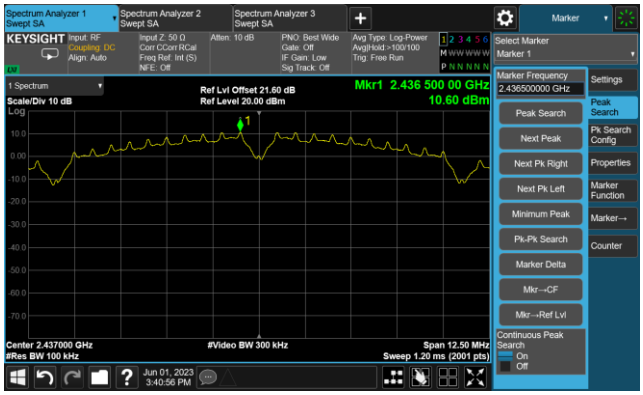
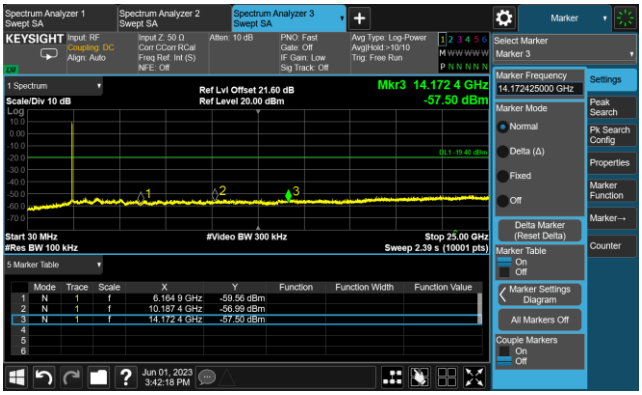
802.11ax-HE40 - PSD – Ant 1	
Channel 03 (2422MHz)	Channel 06 (2437MHz)
	
Channel 09 (2452MHz)	
	

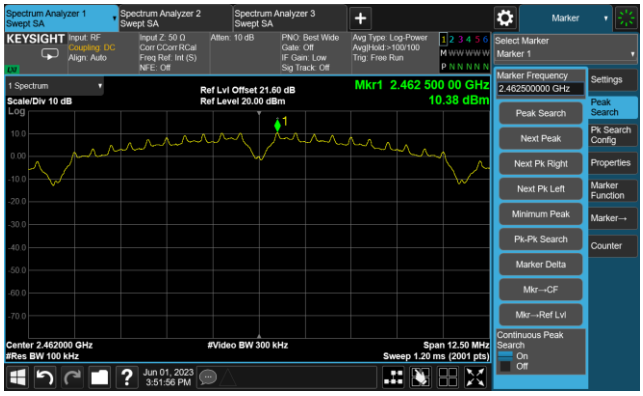
A.5 Conducted Band Edge and Out-of-Band Emissions Test Result

Test data of AP431:

Test Site	WZ-SR5	Test Engineer	Lynn Yang
Test Date	2023-06-01		

Test Mode	Data Rate / MCS	Channel No.	Frequency (MHz)	Limit
11b	1Mbps	01	2412	30dBc
11b	1Mbps	06	2437	30dBc
11b	1Mbps	11	2462	30dBc
11g	6Mbps	01	2412	30dBc
11g	6Mbps	06	2437	30dBc
11g	6Mbps	11	2462	30dBc
11n-HT20	MCS0	01	2412	30dBc
11n-HT20	MCS0	06	2437	30dBc
11n-HT20	MCS0	11	2462	30dBc
11n-HT40	MCS0	03	2422	30dBc
11n-HT40	MCS0	06	2437	30dBc
11n-HT40	MCS0	09	2452	30dBc
11ax-HE20	MCS0	01	2412	30dBc
11ax-HE20	MCS0	06	2437	30dBc
11ax-HE20	MCS0	11	2462	30dBc
11ax-HE40	MCS0	03	2422	30dBc
11ax-HE40	MCS0	06	2437	30dBc
11ax-HE40	MCS0	09	2452	30dBc

802.11b Out-of-Band Emissions – Ant 0	
Channel 01 (2412MHz)	
100kHz PSD Reference Level	Low Band Edge
	
Spurious Emission	
	
Channel 06 (2437MHz)	
100kHz PSD Reference Level	Spurious Emission
	

802.11b Out-of-Band Emissions – Ant 0	
Channel 11 (2462MHz)	
100kHz PSD Reference Level	High Band Edge
	
Spurious Emission