RF MEASUREMENT REPORT

FCC ID:	TK4WLE1216V520
Applicant:	Compex Systems Pte Ltd
Product:	4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module
Model No.:	WLE1216V5-20, WLE1216V5-20-I
Brand Name:	COMPEX
FCC Classification:	Unlicensed National Information Infrastructure (NII)
FCC Rule Part(s):	Part 15 Subpart E (Section 15.407)
Result:	Complies
Received Date:	2024-02-27
Test Date:	2024-03-01 ~ 2024-03-13

Reviewed By: Jame Yuan

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.

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

Revision History

Report No.	Version	Description	Issue Date	Note
2402RSU020-U1	V01	Initial Report	2024-04-08	Valid

Note: This report is based on MRT original report (Report No.: 1710RSU02001) to add a new antenna 5#. The antenna gain of antenna 5# is higher than the maximum antenna gain of the original antennas, so we evaluate “Output Power”, “Power Spectral Density”, “Radiated Spurious Emission” & “Radiated Restricted Band Edge” to test.

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1. General Information

1.1. Applicant

Compex Systems Pte Ltd

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

1.2. Manufacturer

Compex Systems Pte Ltd

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

1.3. Testing Facility

☒	**Test Site – MRT Suzhou Laboratory**				
	Laboratory Location (Suzhou - Wuzhong) D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China **Laboratory Location (Suzhou - SIP)** 4b Building, Liando U Valley, No.200 Xingpu Rd., Shengpu Town, Suzhou Industrial Park, China				
	Laboratory Accreditations				
	A2LA: 3628.01		CNAS: L10551		
	FCC: CN1166		ISED: CN0001		
	VCCI:	☐R-20025	☐G-20034	☐C-20020	☐T-20020
		☐R-20141	☐G-20134	☐C-20103	☐T-20104
☐	**Test Site – MRT Shenzhen Laboratory**				
	Laboratory Location (Shenzhen) 1G, Building A, Junxiangda Building, Zhongshanyuan Road West, Nanshan District, Shenzhen, China				
	Laboratory Accreditations				
	A2LA: 3628.02		CNAS: L10551		
	FCC: CN1284		ISED: CN0105		
☐	**Test Site – MRT Taiwan Laboratory**				
	Laboratory Location (Taiwan) No. 38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)				
	Laboratory Accreditations				
	TAF: 3261				
	FCC: 291082, TW3261		ISED: TW3261		

1.4. Product Information

Product	4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module
Model No.	WLE1216V5-20, WLE1216V5-20-I
Brand Name	COMPEX
Serial No.	104833504
Wi-Fi Specification	802.11a/n/ac
Antenna Information	Refer to selection 1.7
Note 1: The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer. Note 2: The difference between models is for different market sale.	

1.5. Radio Specification under Test

Frequency Range	802.11a/n-HT20/ac-VHT20: 5180~5240MHz, 5260~5320MHz, 5500~5720MHz, 5745~5825MHz 802.11n-HT40/ac-VHT40: 5190~5230MHz, 5270~5310MHz, 5510~5710MHz, 5755~5795MHz 802.11ac-VHT80/ac-VHT80+80: 5210MHz, 5290MHz, 5530MHz, 5610 MHz, 5690MHz, 5775MHz
Type of Modulation	802.11a/n/ac: OFDM
Data Rate	802.11a: 6/9/12/18/24/36/48/54Mbps 802.11n: up to 600Mbps 802.11ac: up to 1733.2Mbps

1.6. Working Frequencies

802.11a/n-HT20/ac-VHT20

Channel	Frequency	Channel	Frequency	Channel	Frequency
36	5180 MHz	40	5200 MHz	44	5220 MHz
48	5240 MHz	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	144	5720 MHz	149	5745 MHz
153	5765 MHz	157	5785 MHz	161	5805 MHz
165	5825 MHz	--	--	--	--

802.11n-HT40/ac-VHT40

Channel	Frequency	Channel	Frequency	Channel	Frequency
38	5190 MHz	46	5230 MHz	54	5270 MHz
62	5310 MHz	102	5510 MHz	110	5550MHz
118	5590 MHz	126	5630 MHz	134	5670 MHz
142	5710 MHz	151	5755 MHz	159	5795 MHz

802.11ac-VHT80

Channel	Frequency	Channel	Frequency	Channel	Frequency
42	5210 MHz	58	5290 MHz	106	5530 MHz
122	5610 MHz	138	5690 MHz	155	5775 MHz

802.11ac-VHT80+80

Channel	Frequency	Channel	Frequency
42 + 106	5210 + 5530 MHz	42 + 122	5210 + 5610 MHz
42 + 138	5210 + 5690 MHz	42 + 155	5210 + 5775 MHz
58 + 106	5290 + 5530 MHz	58 + 122	5290 + 5610 MHz
58 + 138	5290 + 5690 MHz	58 + 155	5290 + 5775 MHz
106 + 155	5530 + 5775 MHz	122 + 155	5610 + 5775 MHz

1.7. Antenna Details

No.	Antenna	Manufacturer	Frequency Band (MHz)	Max. Peak Gain (dBi)
Wi-Fi External Antenna List (5GHz 4*4 MIMO)				
1#	Omni Directional	Exceltek Electronics Technology Co., Ltd.	2400 ~ 2500	3.0
			5150 ~ 5850	5.0
2#	Omni Directional	Laird Smart Technology Co., Ltd.	2400 ~ 2500	2.2
			5150 ~ 5850	3.5
3#	Omni Directional	Linx Technologies	2400 ~ 2500	2.5
			5150 ~ 5850	4.6
4#	Omni Directional	Kenbotong Technology Co., Ltd.	5150 ~ 5850	10.0
5#	Patch Array	Starry, Inc.	5150 ~ 5850	15.0

Note 1: The antenna gain is from antenna data sheet provided by the manufacturer.

Note 2: The device didn’t support beam-forming technology and Cyclic Delay Diversity (CDD) technology, and the transmit signals are uncorrected, so no add array gain to the band power and band PSD.

2. Test Configuration

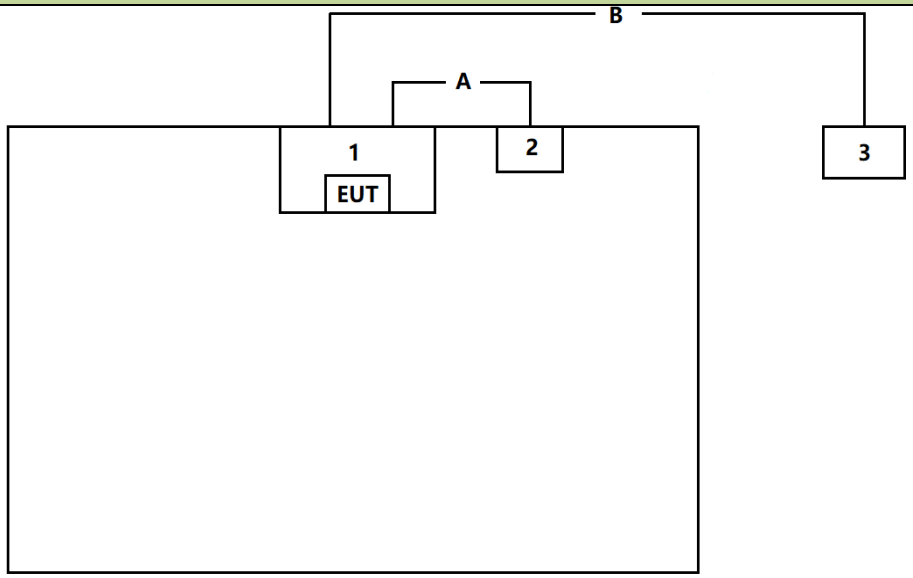
2.1. Test Mode

Mode 1: Transmit by 802.11a (6Mbps) – SISO Mode
Mode 2: Transmit by 802.11ac-VHT20 (MCS0) – MIMO Mode
Mode 3: Transmit by 802.11ac-VHT40 (MCS0) – MIMO Mode
Mode 4: Transmit by 802.11ac-VHT80 (MCS0) – MIMO Mode
Mode 5: Transmit by 802.11ac-VHT80+80 (MCS0) – MIMO Mode
Note 1: 802.11n and 802.11ac have same modulation type and same power parameter, so we only show 802.11ac test data in report. Note 2: All modes of operation and data rates were investigated, so all RF test requirements shall be executed at the worst data rate.

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.

Connection Diagram



Cable Type		Cable Description	Length
A	Power Cable	Non-Shielded	1.8m
B	LAN Cable	Non-Shielded, Cat 5e	>10m
Product		**Manufacturer**	**Model No.**
1	Mainboard	Compex	N/A
2	AC Adapter	AOEM	ADS024T-W 120200
3	Notebook	Lenovo	E430C

2.3. Test Software

The test utility software used during testing was “QRCT”, and the version was 4.0.00204.0.

2.4. Applied Standards

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

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

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 **unique coupling.**

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
EMI Test Receiver	Agilent	N9038A	MRTSUE06125	1 year	2024-05-23	WZ-AC2
Signal Analyzer	Keysight	N9010B	MRTSUE06607	1 year	2024-10-23	WZ-AC2
Active Loop Antenna	Schwarzbeck	FMZB 1519-60 D	MRTSUE07076	1 year	2024-12-04	WZ-AC2
TRILOG Antenna	Schwarzbeck	VULB 9162	MRTSUE06022	1 year	2024-05-15	WZ-AC2
Horn Antenna	Schwarzbeck	BBHA 9120D	MRTSUE06171	1 year	2024-10-11	WZ-AC2
Horn Antenna	Schwarzbeck	BBHA 9170	MRTSUE06597	1 year	2024-11-04	WZ-AC2
Preamplifier	Schwarzbeck	BBV 9718	MRTSUE06176	1 year	2024-05-07	WZ-AC2
Preamplifier	EMCI	EMC184045SE	MRTSUE06640	1 year	2025-01-11	WZ-AC2
Thermohygrometer	testo	608-H1	MRTSUE11263	1 year	2024-11-07	WZ-AC2
Anechoic Chamber	RIKEN	WZ-AC2	MRTSUE06213	1 year	2024-04-20	WZ-AC2
USB Power Sensor	Keysight	U2021XA	MRTSUE06446	1 year	2024-05-23	WZ-SR5
Signal Analyzer	Agilent	N9020A	MRTSUE06106	1 year	2025-02-03	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

Software	Version	Function
EMI V3	V3.0.0	EMI Test Software
Controller_MF 7802	1.02	RE Antenna & Turntable
BenchVue Power Meter	2018.1	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.

Radiated Emission Measurement
The maximum measurement uncertainty is evaluated as: Coaxial: 9kHz~30MHz: 2.61dB Coplanar: 9kHz~30MHz: 2.62dB Horizontal: 30MHz~200MHz: 3.79dB 200MHz~1GHz: 3.91dB 1GHz~40GHz: 4.99dB Vertical: 30MHz~200MHz: 4.06dB 200MHz~1GHz: 5.21dB 1GHz~40GHz: 4.90dB
Output Power
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 1.4dB
Power Spectrum Density
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 2.2dB

6. Test Result

6.1. Summary

FCC Section(s)	Test Description	Test Condition	Verdict
15.407(a)(1)(iv), (2), (3)(i)	Maximum Conducted Output Power	Conducted	Pass
15.407(a)(1)(iv), (2), (3)(i), (12)	Peak Power Spectral Density		Pass
15.407(b)(1), (2), (3), (4)(i)	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

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, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst-case emissions.

6.2. Output Power Measurement

6.2.1. Test Limit

For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi.

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 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.

6.2.2. Test Procedure

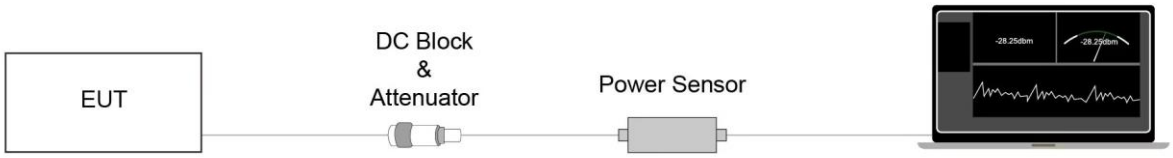
KDB 789033D02v02r01- Section II)E)3)b) Method PM-G

6.2.3. 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.

6.2.4. Test Setup



6.2.5. Test Result

Refer to Appendix A.2.

6.3. Power Spectral Density Measurement

6.3.1. Test Limit

For client devices in the 5.15-5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.

If transmitting antennas of directional gain greater than 6dBi are used, the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

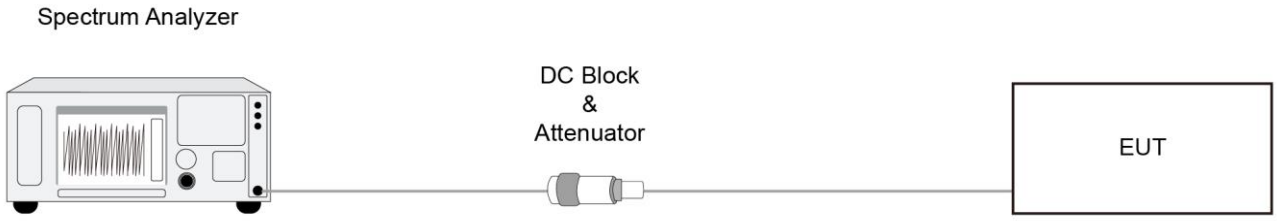
6.3.2. Test Procedure

KDB 789033 D02v02r01-Section II)F)

6.3.3. 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 = 3MHz
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.

6.3.4. Test Setup



6.3.5. Test Result

Refer to Appendix A.3.

6.4. Radiated Spurious Emission Measurement

6.4.1. 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

6.4.2. Test Procedure

KDB 789033 D02v02r01- Section II)G)

6.4.3. 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

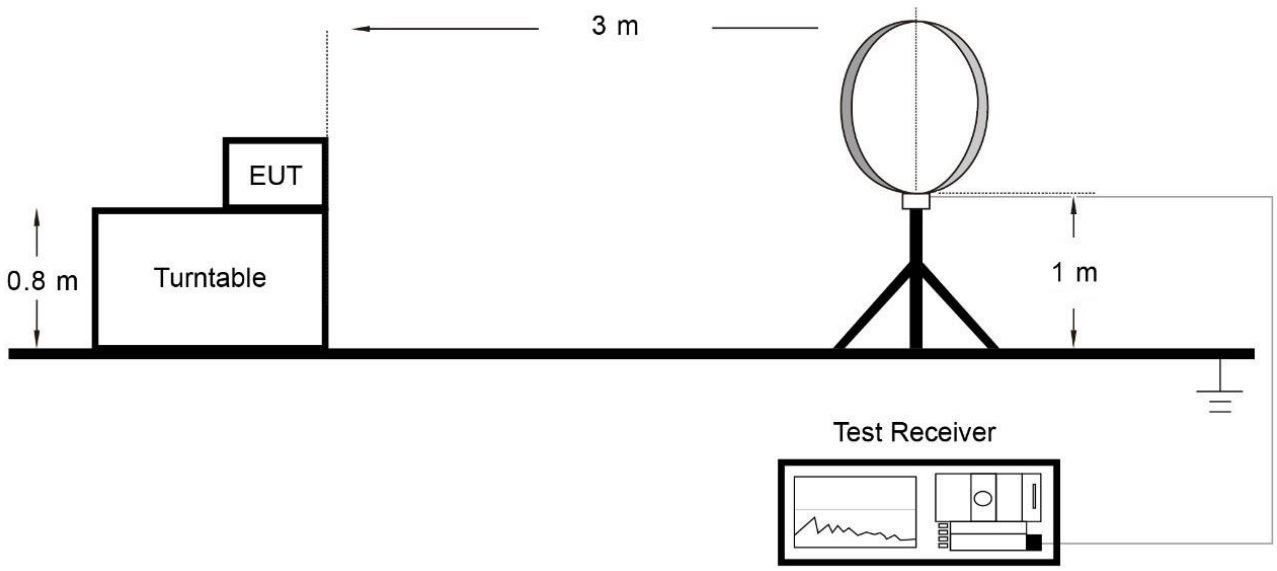
5. Sweep time = auto

6. Trace mode = max hold

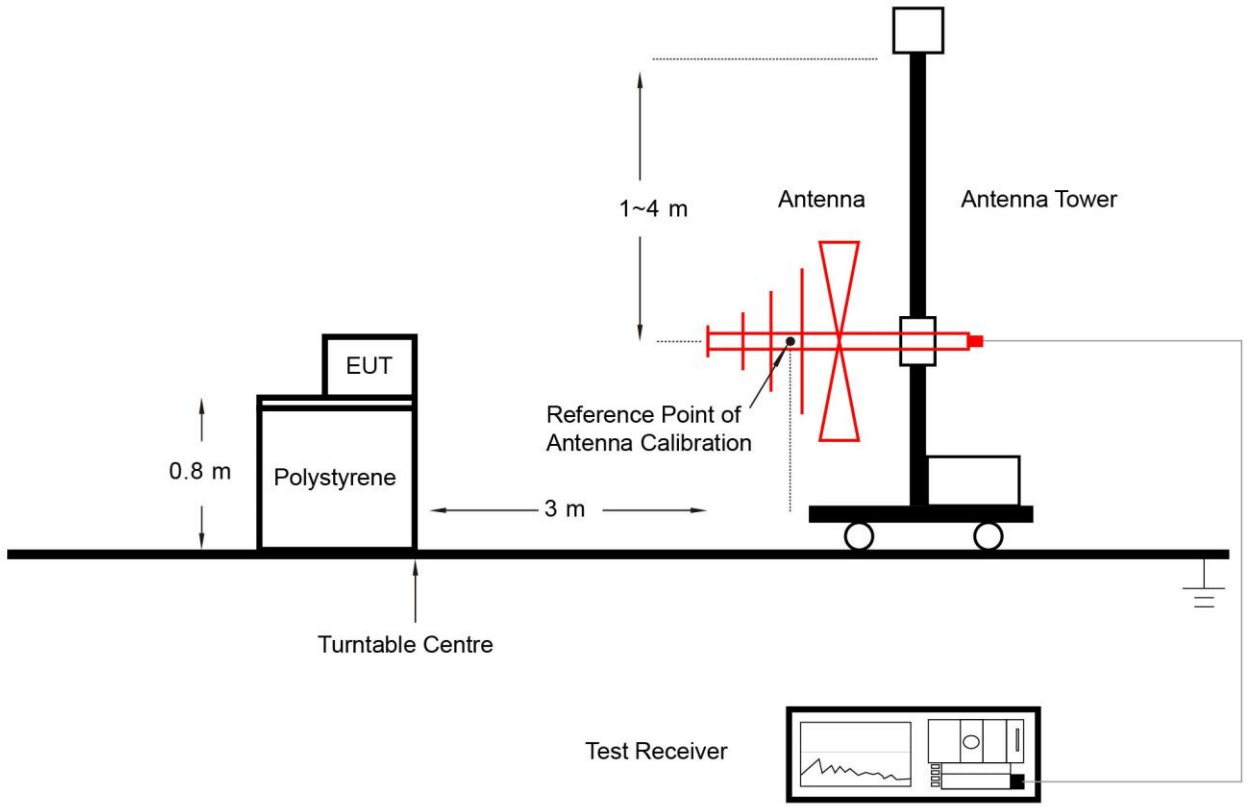
7. Trace was allowed to stabilize

6.4.4. Test Setup

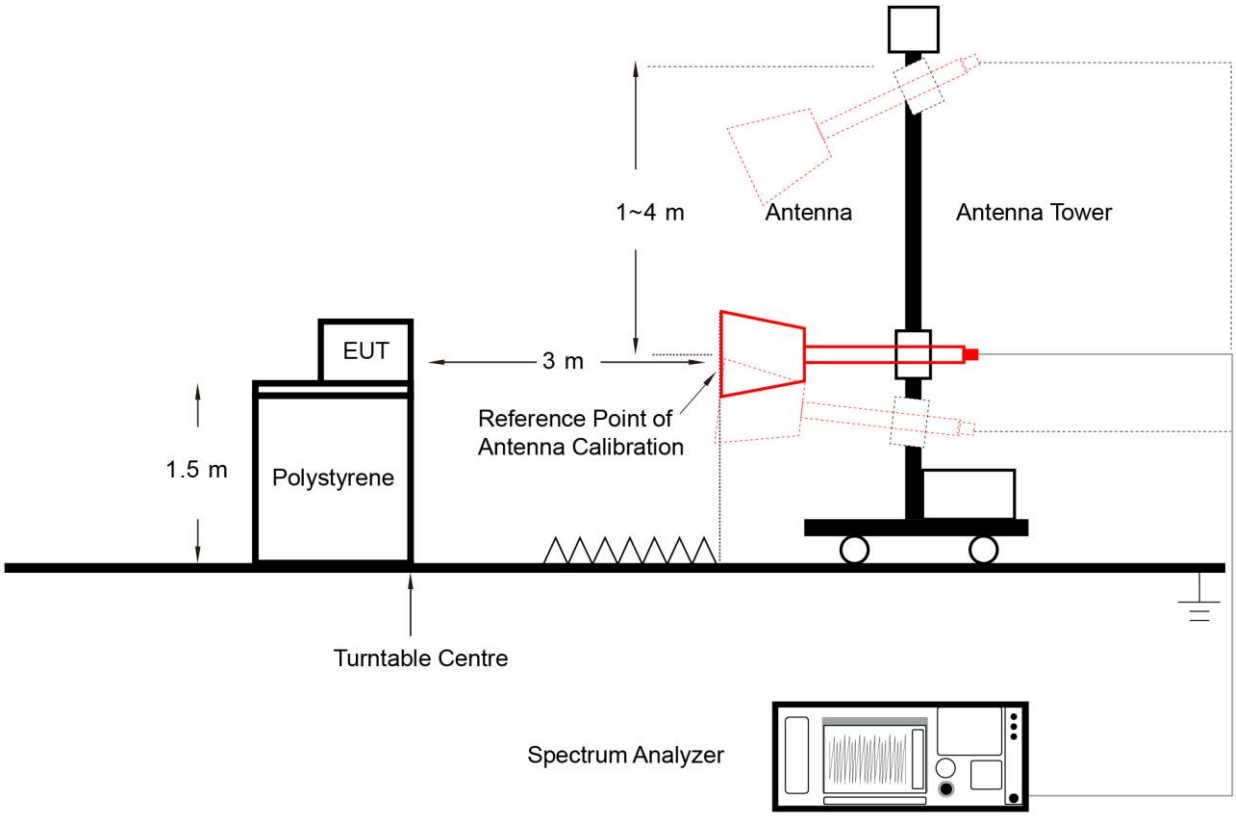
Below 30MHz Test Setup:



Below 1GHz Test Setup:



Above 1GHz Test Setup:



6.4.5. Test Result

Refer to Appendix A.4.

6.5. Radiated Restricted Band Edge Measurement

6.5.1. Test Limit

For 15.205 requirement:

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

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

For 15.407(b) requirement:

For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

For transmitters operating in the 5.725-5.85 GHz band: All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

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

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

FCC Part 15 Subpart C Paragraph 15.209		
Frequency [MHz]	Field Strength [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

6.5.2. Test Procedure

KDB 789033 D02v02r01- Section II)G)

6.5.3. Test Setting

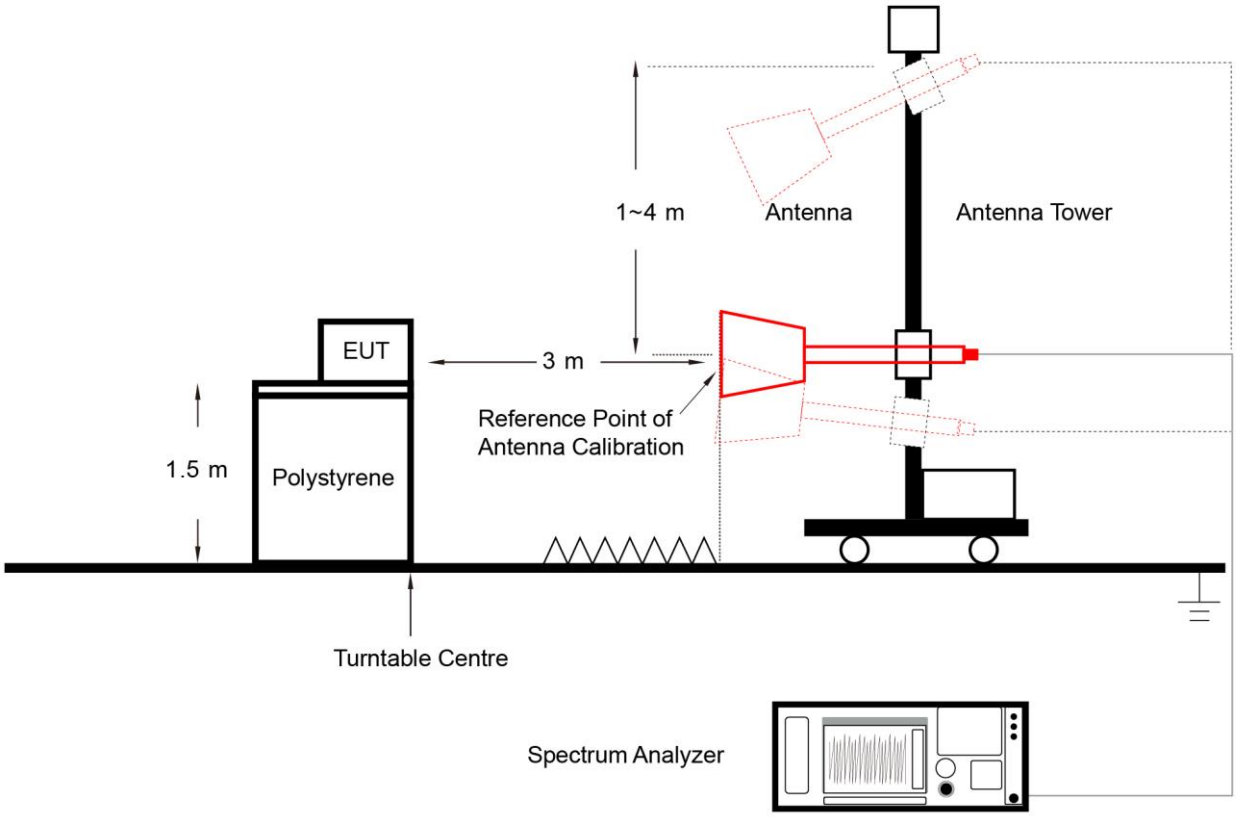
Peak Measurements above 1GHz

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

6.5.4. Test Setup



6.5.5. Test Result

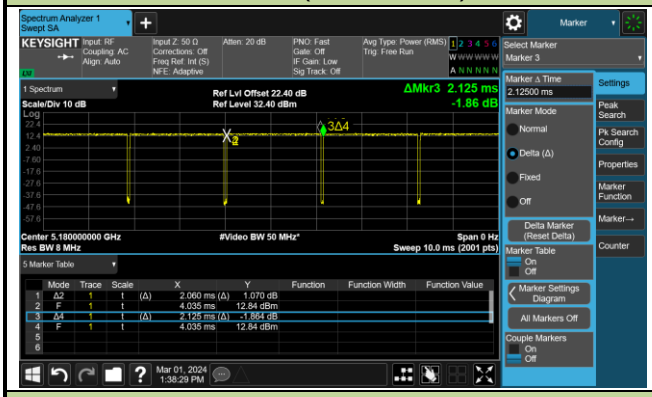
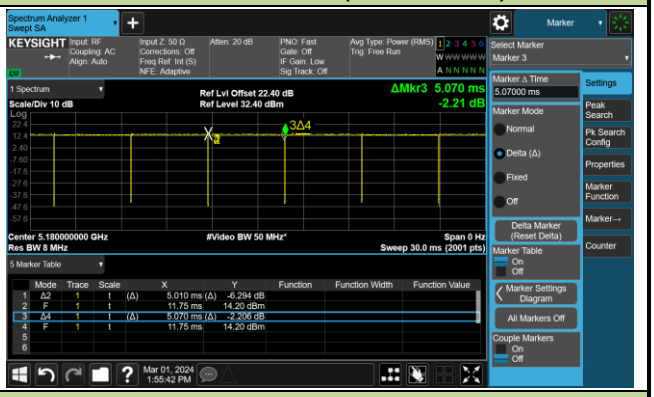
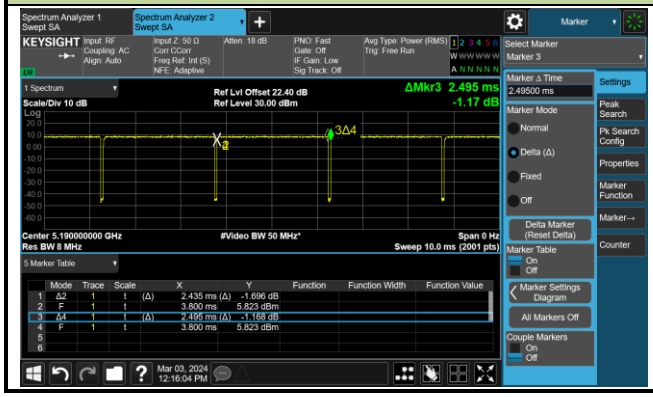
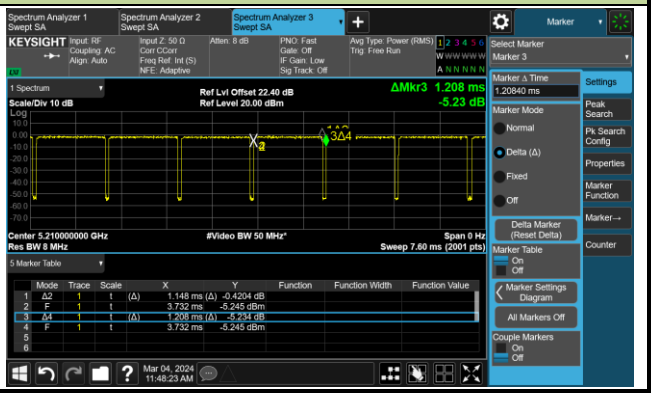
Refer to Appendix A.5.

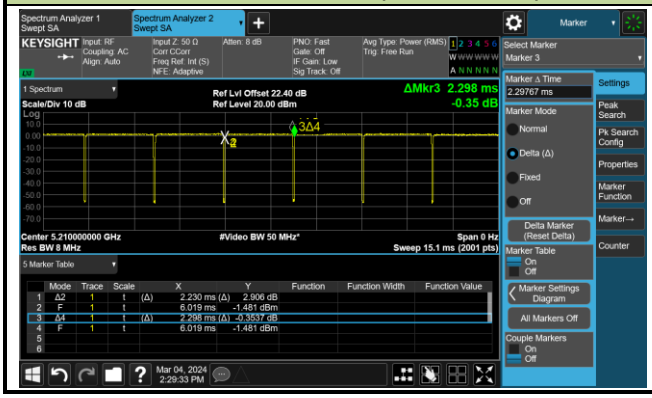
Appendix A – Test Result

A.1 Duty Cycle Test Result

Test Site	WZ-SR5	Test Engineer	Jeff Yang
Test Date	2024-03-01 ~ 2024-03-04		

Test Mode	Duty Cycle
802.11a	96.94%
802.11ac-VHT20	98.82%
802.11ac-VHT40	97.60%
802.11ac-VHT80	95.03%
802.11ac-VHT80+80	97.04%

Duty Cycle (T = Transmission Duration)	
802.11a (T = 2.060ms)	802.11ac-VHT20 (T = 5.010ms)
	
802.11ac-VHT40 (T = 2.435ms)	802.11ac-VHT80 (T = 1.148ms)
	

Duty Cycle (T = Transmission Duration)	
802.11ac-VHT80+80 (T = 2.230ms)	
	

A.2 Output Power Test Result

Test Site	WZ-SR5	Test Engineer	Jeff Yang
Test Date	2024-03-01 ~ 2024-03-13	Test Mode	SISO Mode

Test Mode	Data Rate / MCS	Channel No.	Freq. (MHz)	Average Power (dBm)				Power Limit (dBm)
				Ant 0	Ant 1	Ant 2	Ant 3	
11a	6Mbps	36	5180	12.44	12.63	12.43	13.25	≤ 14.98
11a	6Mbps	44	5220	13.24	13.14	13.05	13.29	≤ 14.98
11a	6Mbps	48	5240	13.10	13.02	13.08	13.06	≤ 14.98
11a	6Mbps	52	5260	12.97	13.12	13.08	13.17	≤ 14.92
11a	6Mbps	60	5300	12.38	12.88	12.73	12.74	≤ 14.88
11a	6Mbps	64	5320	12.25	12.69	12.69	12.82	≤ 14.91
11a	6Mbps	100	5500	12.89	13.00	12.87	12.68	≤ 14.82
11a	6Mbps	116	5580	12.77	12.57	12.74	12.71	≤ 14.96
11a	6Mbps	120	5600	12.84	12.45	12.84	12.67	≤ 14.84
11a	6Mbps	140	5700	13.07	13.12	12.66	12.72	≤ 14.87
11a	6Mbps	144	5720	12.67	12.33	12.45	12.68	≤ 13.69
11a	6Mbps	149	5745	20.61	20.66	20.67	20.70	≤ 21.00
11a	6Mbps	157	5785	20.45	20.63	20.53	20.73	≤ 21.00
11a	6Mbps	165	5825	20.84	20.77	20.86	20.85	≤ 21.00

Note:

For 5150 ~ 5250MHz Band: Power Limit (dBm) = 23.98 - (15 - 6) = 14.98dBm.

For 5250 ~ 5350MHz Band: Power Limit (dBm) = (23.98 or 11+10*$\log_{10}$EBW) - (15 - 6), which is less.

For 5470 ~ 5725MHz Band: Power Limit (dBm) = (23.98 or 11+10*$\log_{10}$EBW) - (15 - 6), which is less.

For 5725 ~ 5850MHz Band: Power Limit (dBm) = 30.00 - (15 - 6) = 21.00dBm.

For Band-Crossing channel: Power Limit (dBm) = (23.98 or 11+10*$\log_{10}$$EBW_{2C}$) - (15 - 6), which is less.

Test Site	WZ-SR5	Test Engineer	Jeff Yang
Test Date	2024-03-01~2024-03-12	Test Mode	MIMO Mode

Test Mode	Data Rate / MCS	Channel No.	Freq. (MHz)	Average Power (dBm)				Total Average Power (dBm)	Power Limit (dBm)
				Ant 0	Ant 1	Ant 2	Ant 3		
11ac-VHT20	MCS0	36	5180	8.03	7.30	7.15	7.17	13.45	≤ 14.98
11ac-VHT20	MCS0	44	5220	7.19	7.24	7.25	7.23	13.25	≤ 14.98
11ac-VHT20	MCS0	48	5240	7.22	7.60	7.31	7.26	13.37	≤ 14.98
11ac-VHT20	MCS0	52	5260	7.60	7.59	7.45	7.90	13.66	≤ 14.98
11ac-VHT20	MCS0	60	5300	7.63	7.54	7.38	7.84	13.62	≤ 14.98
11ac-VHT20	MCS0	64	5320	7.54	7.38	7.42	7.76	13.55	≤ 14.98
11ac-VHT20	MCS0	100	5500	7.50	7.77	7.54	8.04	13.74	≤ 14.98
11ac-VHT20	MCS0	116	5580	7.53	7.40	7.19	7.92	13.54	≤ 14.98
11ac-VHT20	MCS0	120	5600	7.72	7.67	7.91	8.18	13.90	≤ 14.98
11ac-VHT20	MCS0	140	5700	7.67	7.58	7.81	7.89	13.76	≤ 14.98
11ac-VHT20	MCS0	144	5720	7.32	7.38	7.62	7.68	13.52	≤ 13.76
11ac-VHT20	MCS0	149	5745	14.86	14.83	14.79	14.99	20.89	≤ 21.00
11ac-VHT20	MCS0	157	5785	15.06	14.64	14.33	14.43	20.64	≤ 21.00
11ac-VHT20	MCS0	165	5825	14.98	14.40	14.50	14.72	20.68	≤ 21.00
11ac-VHT40	MCS0	38	5190	8.81	8.56	8.48	8.73	14.67	≤ 14.98
11ac-VHT40	MCS0	46	5230	8.80	8.67	8.77	8.59	14.73	≤ 14.98
11ac-VHT40	MCS0	54	5270	8.49	8.82	8.73	8.74	14.72	≤ 14.98
11ac-VHT40	MCS0	62	5310	8.79	8.63	8.87	8.78	14.79	≤ 14.98
11ac-VHT40	MCS0	102	5510	8.44	8.55	8.31	8.95	14.59	≤ 14.98
11ac-VHT40	MCS0	110	5550	8.70	8.81	8.34	9.17	14.79	≤ 14.98
11ac-VHT40	MCS0	118	5590	8.78	8.63	8.26	8.50	14.57	≤ 14.98
11ac-VHT40	MCS0	134	5670	8.51	8.62	9.12	8.79	14.79	≤ 14.98
11ac-VHT40	MCS0	142	5710	9.06	8.23	8.67	8.22	14.58	≤ 14.98
11ac-VHT40	MCS0	151	5755	14.91	14.85	14.60	14.81	20.81	≤ 21.00
11ac-VHT40	MCS0	159	5795	15.36	14.75	14.26	14.56	20.77	≤ 21.00

Test Mode	Data Rate / MCS	Channel No.	Freq. (MHz)	Average Power (dBm)				Total Average Power (dBm)	Power Limit (dBm)
				Ant 0	Ant 1	Ant 2	Ant 3		
11ac-VHT80	MCS0	42	5210	9.22	8.71	8.45	8.48	14.75	≤ 14.98
11ac-VHT80	MCS0	58	5290	8.52	8.97	8.77	8.95	14.83	≤ 14.98
11ac-VHT80	MCS0	106	5530	8.57	8.65	8.20	8.78	14.58	≤ 14.98
11ac-VHT80	MCS0	122	5610	8.38	8.66	9.06	9.03	14.81	≤ 14.98
11ac-VHT80	MCS0	138	5690	8.12	8.43	8.63	8.69	14.49	≤ 14.98
11ac-VHT80	MCS0	155	5775	14.63	13.98	14.15	14.01	20.22	≤ 21.00
11ac-VHT80+80	MCS0	42	5210	11.67	11.48	--	--	14.59	≤ 14.98
11ac-VHT80+80	MCS0	42	5210	--	--	11.57	11.38	14.49	≤ 14.98
11ac-VHT80+80	MCS0	58	5290	11.64	11.75	--	--	14.71	≤ 14.98
11ac-VHT80+80	MCS0	58	5290	--	--	11.93	11.22	14.60	≤ 14.98
11ac-VHT80+80	MCS0	106	5530	11.45	11.69	--	--	14.58	≤ 14.98
11ac-VHT80+80	MCS0	106	5530	--	--	11.75	11.86	14.82	≤ 14.98
11ac-VHT80+80	MCS0	122	5610	11.62	11.94	--	--	14.79	≤ 14.98
11ac-VHT80+80	MCS0	122	5610	--	--	11.82	11.83	14.84	≤ 14.98
11ac-VHT80+80	MCS0	138	5690	11.34	11.67	--	--	14.52	≤ 14.98
11ac-VHT80+80	MCS0	138	5690	--	--	11.78	11.76	14.78	≤ 14.98
11ac-VHT80+80	MCS0	155	5775	14.85	14.17	--	--	17.53	≤ 21.00
11ac-VHT80+80	MCS0	155	5775	--	--	17.12	16.74	19.94	≤ 21.00

Note 1:

For 11ac-VHT80+80,

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

Ant 2+3 Average Power (dBm) = $10*\log \{10^{(\text{Ant 2 Average Power /10})} + 10^{(\text{Ant 3 Average Power /10})}\}$.

For other modes,

Total Average Power (dBm) = $10*\log \{10^{(\text{Ant 0 Average Power /10})} + 10^{(\text{Ant 1 Average Power /10})} + 10^{(\text{Ant 2 Average Power /10})} + 10^{(\text{Ant 3 Average Power /10})}\}$.

Note 2:

For 5150 ~ 5250MHz Band: Power Limit (dBm) = 23.98 - (15 - 6) = 14.98dBm.

For 5250 ~ 5350MHz Band: Power Limit (dBm) = (23.98 or $11+10*\log_{10}EBW$) - (15 - 6), which is less.

For 5470 ~ 5725MHz Band: Power Limit (dBm) = (23.98 or $11+10*\log_{10}EBW$) - (15 - 6), which is less.

For 5725 ~ 5850MHz Band: Power Limit (dBm) = 30.00 - (15 - 6) = 21.00dBm.

For Band-Crossing channel: Power Limit (dBm) = (23.98 or $11+10*\log_{10}EBW_{2C}$) - (15 - 6), which is less.

A.3 Power Spectral Density Test Result

Test Site	WZ-SR5	Test Engineer	Jeff Yang
Test Date	2024-03-01	Test Mode	SISO Mode
Test Item	Power Spectral Density (UNII-Band 1 & UNII-2a & UNII-2c)		

Test Mode	Data Rate / MCS	Channel No.	Freq. (MHz)	AVPSD (dBm/MHz)				PSD Limit (dBm/MHz)
				Ant 0	Ant 1	Ant 2	Ant 3	
11a	6Mbps	36	5180	1.405	1.320	1.468	1.773	≤ 2.00
11a	6Mbps	44	5220	1.811	1.742	1.488	1.576	≤ 2.00
11a	6Mbps	48	5240	1.649	1.767	1.527	1.606	≤ 2.00
11a	6Mbps	52	5260	1.742	1.809	1.754	1.736	≤ 2.00
11a	6Mbps	60	5300	1.555	1.490	1.479	1.410	≤ 2.00
11a	6Mbps	64	5320	1.578	1.566	1.449	1.504	≤ 2.00
11a	6Mbps	100	5500	1.474	1.758	1.677	1.517	≤ 2.00
11a	6Mbps	116	5580	1.541	1.608	1.497	1.394	≤ 2.00
11a	6Mbps	120	5600	1.446	1.522	1.808	1.556	≤ 2.00
11a	6Mbps	140	5700	1.795	1.726	1.461	1.419	≤ 2.00
11a	6Mbps	144	5720	1.568	1.793	1.644	1.677	≤ 2.00

Note:

For 5150 ~ 5250MHz Band: PSD Limit (dBm/MHz) = 11 - (15 - 6) = 2.00dBm/MHz.

For 5250 ~ 5350MHz Band: PSD Limit (dBm/MHz) = 11 - (15 - 6) = 2.00dBm/MHz.

For 5470 ~ 5725MHz Band: PSD Limit (dBm/MHz) = 11 - (15 - 6) = 2.00dBm/MHz.

Test Site	WZ-SR5	Test Engineer	Jeff Yang
Test Date	2024-03-04	Test Mode	SISO Mode
Test Item	Power Spectral Density (UNII-Band 3)		

Test Mode	Data Rate / MCS	Channel No.	Freq. (MHz)	AVPSD (dBm/510kHz)				PSD Limit (dBm/500kHz)
				Ant 0	Ant 1	Ant 2	Ant 3	
11a	6Mbps	149	5745	5.760	6.124	6.112	6.300	≤ 21.00
11a	6Mbps	157	5785	6.193	6.266	6.350	6.519	≤ 21.00
11a	6Mbps	165	5825	6.610	6.296	6.339	6.593	≤ 21.00

Note: PSD Limit (dBm/500kHz) = 30 - (15 - 6) = 21.00dBm/500kHz.

Test Site	WZ-SR5	Test Engineer	Jeff Yang
Test Date	2024-03-01 ~ 2024-03-04	Test Mode	MIMO Mode
Test Item	Power Spectral Density (UNII-Band 1 & 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	Ant 2	Ant 3			
11ac-VHT20	MCS0	36	5180	-4.685	-4.360	-4.370	-4.442	98.82	1.56	≤ 2.00
11ac-VHT20	MCS0	44	5220	-4.487	-4.627	-4.571	-4.727	98.82	1.42	≤ 2.00
11ac-VHT20	MCS0	48	5240	-4.164	-4.242	-4.518	-4.569	98.82	1.65	≤ 2.00
11ac-VHT20	MCS0	52	5260	-4.655	-4.330	-4.739	-4.513	98.82	1.46	≤ 2.00
11ac-VHT20	MCS0	60	5300	-4.844	-4.071	-4.057	-4.013	98.82	1.79	≤ 2.00
11ac-VHT20	MCS0	64	5320	-4.713	-4.063	-4.176	-4.141	98.82	1.75	≤ 2.00
11ac-VHT20	MCS0	100	5500	-4.612	-4.371	-4.351	-4.114	98.82	1.66	≤ 2.00
11ac-VHT20	MCS0	116	5580	-4.525	-4.651	-4.597	-4.293	98.82	1.51	≤ 2.00
11ac-VHT20	MCS0	120	5600	-4.715	-4.447	-4.068	-4.293	98.82	1.65	≤ 2.00
11ac-VHT20	MCS0	140	5700	-3.998	-4.280	-4.496	-4.288	98.82	1.76	≤ 2.00
11ac-VHT20	MCS0	144	5720	-4.178	-4.585	-4.628	-4.305	98.82	1.60	≤ 2.00
11ac-VHT40	MCS0	38	5190	-5.859	-5.821	-6.065	-6.251	97.60	0.13	≤ 2.00
11ac-VHT40	MCS0	46	5230	-5.816	-5.950	-6.120	-5.813	97.60	0.20	≤ 2.00
11ac-VHT40	MCS0	54	5270	-5.643	-5.305	-5.558	-5.571	97.60	0.61	≤ 2.00
11ac-VHT40	MCS0	62	5310	-5.493	-4.923	-4.907	-5.224	97.60	1.00	≤ 2.00
11ac-VHT40	MCS0	102	5510	-5.676	-5.812	-5.459	-5.543	97.60	0.51	≤ 2.00
11ac-VHT40	MCS0	110	5550	-5.862	-5.774	-5.689	-5.373	97.60	0.46	≤ 2.00
11ac-VHT40	MCS0	118	5590	-5.656	-5.939	-5.887	-5.710	97.60	0.33	≤ 2.00
11ac-VHT40	MCS0	134	5670	-6.142	-5.879	-5.730	-5.800	97.60	0.24	≤ 2.00
11ac-VHT40	MCS0	142	5710	-5.280	-5.569	-5.788	-5.411	97.60	0.62	≤ 2.00
11ac-VHT80	MCS0	42	5210	-9.724	-9.558	-9.794	-9.268	95.03	-3.34	≤ 2.00
11ac-VHT80	MCS0	58	5290	-9.192	-8.906	-8.701	-9.139	95.03	-2.74	≤ 2.00
11ac-VHT80	MCS0	106	5530	-9.380	-9.492	-9.402	-9.297	95.03	-3.15	≤ 2.00
11ac-VHT80	MCS0	122	5610	-9.358	-9.704	-9.054	-9.038	95.03	-3.04	≤ 2.00
11ac-VHT80	MCS0	138	5690	-10.046	-9.943	-9.996	-9.598	95.03	-3.65	≤ 2.00
11ac-VHT80+80	MCS0	42	5210	-6.772	-6.809	--	--	97.04	-3.65	≤ 2.00
11ac-VHT80+80	MCS0	42	5210	--	--	-6.243	-6.914	97.04	-3.42	≤ 2.00
11ac-VHT80+80	MCS0	58	5290	-6.639	-6.481	--	--	97.04	-3.42	≤ 2.00
11ac-VHT80+80	MCS0	58	5290	--	--	-5.837	-7.056	97.04	-3.26	≤ 2.00

11ac-VHT80+80	MCS0	106	5530	-6.931	-6.637	--	--	97.04	-3.64	≤ 2.00
11ac-VHT80+80	MCS0	106	5530	--	--	-6.485	-6.274	97.04	-3.24	≤ 2.00
11ac-VHT80+80	MCS0	122	5610	-6.320	-5.952	--	--	97.04	-2.99	≤ 2.00
11ac-VHT80+80	MCS0	122	5610	--	--	-5.637	-5.871	97.04	-2.61	≤ 2.00
11ac-VHT80+80	MCS0	138	5690	-6.700	-6.192	--	--	97.04	-3.30	≤ 2.00
11ac-VHT80+80	MCS0	138	5690	--	--	-6.042	-6.441	97.04	-3.10	≤ 2.00

Note 1:

For 11ac-VHT80+80,

When EUT duty cycle < 98%, Ant 0+1 PSD (dBm/MHz) = 10*log {$10^{(\text{Ant 0 PSD/10})}$ + $10^{(\text{Ant 1 PSD/10})}$} +10*log (1/Duty cycle), Ant 2+3 PSD (dBm/MHz) = 10*log {$10^{(\text{Ant 2 PSD/10})}$ + $10^{(\text{Ant 3 PSD/10})}$} +10*log (1/Duty cycle).

When EUT duty cycle ≥ 98%, Ant 0+1 PSD (dBm/MHz) = 10*log {$10^{(\text{Ant 0 PSD/10})}$ + $10^{(\text{Ant 1 PSD/10})}$}, Ant 2+3 PSD (dBm/MHz) = 10*log {$10^{(\text{Ant 2 PSD/10})}$ + $10^{(\text{Ant 3 PSD/10})}$}.

For other modes,

When EUT duty cycle < 98%, Total PSD (dBm/MHz) = 10*log {$10^{(\text{Ant 0 PSD/10})}$ + $10^{(\text{Ant 1 PSD/10})}$ +$10^{(\text{Ant 2 PSD/10})}$ + $10^{(\text{Ant 3 PSD/10})}$} +10*log (1/Duty cycle).

When EUT duty cycle ≥ 98%, Total PSD (dBm/MHz) = 10*log {$10^{(\text{Ant 0 PSD/10})}$ + $10^{(\text{Ant 1 PSD/10})}$ +$10^{(\text{Ant 2 PSD/10})}$ + $10^{(\text{Ant 3 PSD/10})}$}.

Note 2:

For 5150 - 5250MHz Band: PSD Limit (dBm/MHz) = 11 - (15 - 6) = 2.00dBm/MHz

For 5250 - 5350MHz Band: PSD Limit (dBm/MHz) = 11 - (15 - 6) = 2.00dBm/MHz.

For 5470 - 5725MHz Band: PSD Limit (dBm/MHz) = 11 - (15 - 6) = 2.00dBm/MHz.

Test Site	WZ-SR5	Test Engineer	Jeff Yang
Test Date	2024-03-01 ~ 2024-03-12	Test Mode	MIMO Mode
Test Item	Power Spectral Density (UNII-Band 3)		

Test Mode	Data Rate / MCS	Channel No.	Freq. (MHz)	AVPSD (dBm/510kHz)				Duty Cycle (%)	Total PSD (dBm/ 510kHz)	PSD Limit (dBm/ 500kHz)
				Ant 0	Ant 1	Ant 2	Ant 3			
11ac-VHT20	MCS0	149	5745	0.658	0.660	0.469	0.448	98.82	6.58	≤ 21.00
11ac-VHT20	MCS0	157	5785	1.673	0.612	0.450	0.483	98.82	6.86	≤ 21.00
11ac-VHT20	MCS0	165	5825	0.844	0.494	0.628	0.335	98.82	6.60	≤ 21.00
11ac-VHT40	MCS0	151	5755	-1.403	-1.931	-2.231	-2.225	97.60	4.19	≤ 21.00
11ac-VHT40	MCS0	159	5795	-1.393	-2.540	-2.326	-2.650	97.60	3.93	≤ 21.00
11ac-VHT80	MCS0	155	5775	-5.566	-6.341	-6.297	-6.260	95.03	0.14	≤ 21.00
11ac-VHT80+80	MCS0	155	5775	-5.677	-6.383	--	--	97.04	-2.87	≤ 21.00
11ac-VHT80+80	MCS0	155	5775	--	--	-3.057	-3.763	97.04	-0.25	≤ 21.00

Note 1:

For 11ac-VHT80+80,

When EUT duty cycle < 98%, Ant 0+1 PSD (dBm/510kHz) = 10*log {$10^{(\text{Ant 0 PSD/10})}$ + $10^{(\text{Ant 1 PSD/10})}$} + 10*log (1/Duty cycle), Ant 2+3 PSD (dBm/510kHz) = 10*log {$10^{(\text{Ant 2 PSD/10})}$ + $10^{(\text{Ant 3 PSD/10})}$} + 10*log (1/Duty cycle).

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

Ant 2+3 PSD (dBm/510kHz) = 10*log {$10^{(\text{Ant 2 PSD/10})}$ + $10^{(\text{Ant 3 PSD/10})}$}.

For other modes,

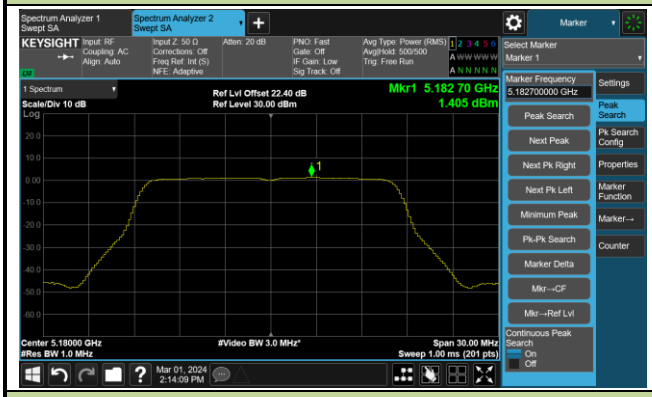
When EUT duty cycle < 98%, Total PSD (dBm/510kHz) = 10*log {$10^{(\text{Ant 0 PSD/10})}$ + $10^{(\text{Ant 1 PSD/10})}$ +$10^{(\text{Ant 2 PSD/10})}$ + $10^{(\text{Ant 3 PSD/10})}$} +10*log (1/Duty cycle).

When EUT duty cycle ≥ 98%, Total PSD (dBm/510kHz) = 10*log {$10^{(\text{Ant 0 PSD/10})}$ + $10^{(\text{Ant 1 PSD/10})}$ +$10^{(\text{Ant 2 PSD/10})}$ + $10^{(\text{Ant 3 PSD/10})}$}.

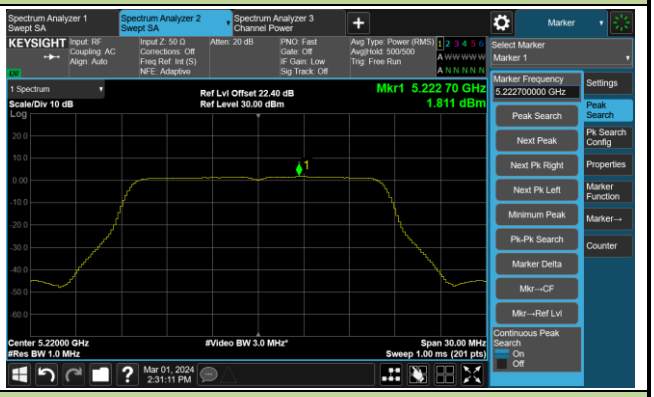
Note 2: PSD Limit (dBm/500kHz) = 30 - (15 - 6) = 21.00dBm/500kHz.

802.11a Power Spectral Density - SISO Mode Ant 0

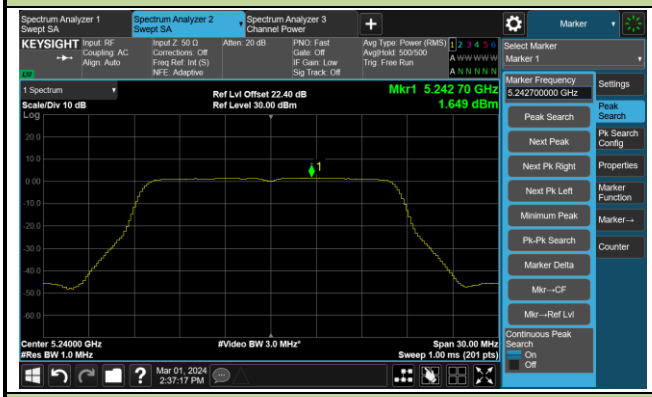
Channel 36 (5180MHz)



Channel 44 (5220MHz)

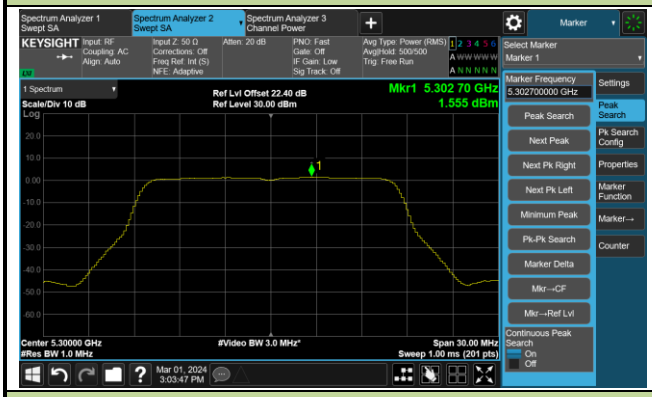


Channel 48 (5240MHz)

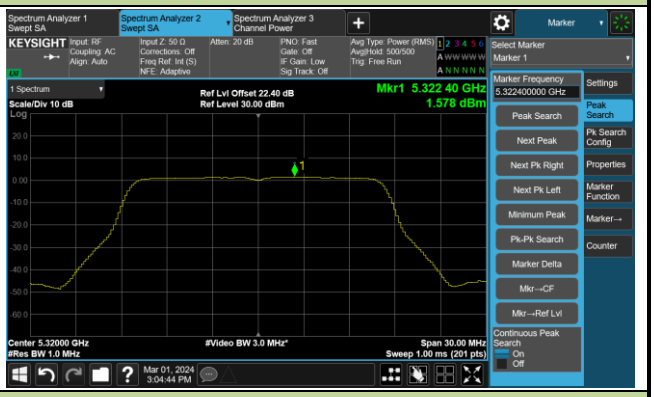


Channel 52 (5260MHz)

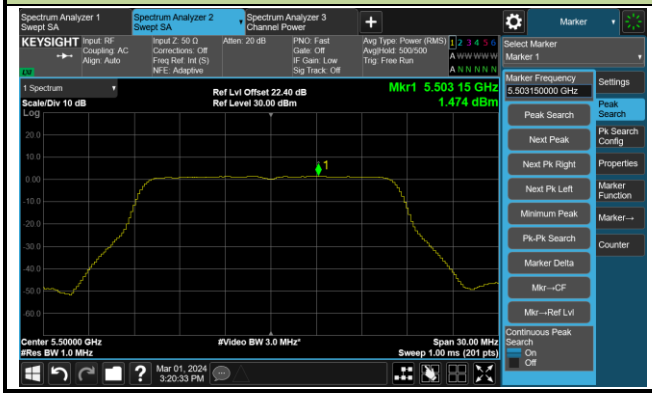
Channel 60 (5300MHz)



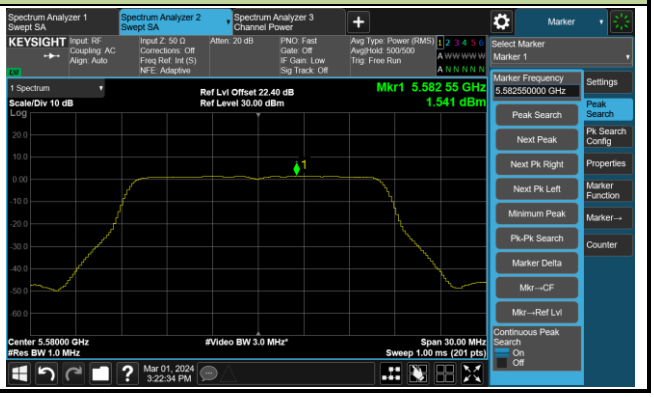
Channel 64 (5320MHz)

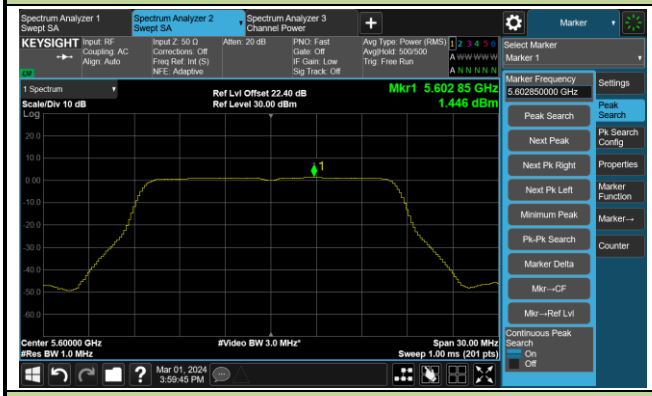
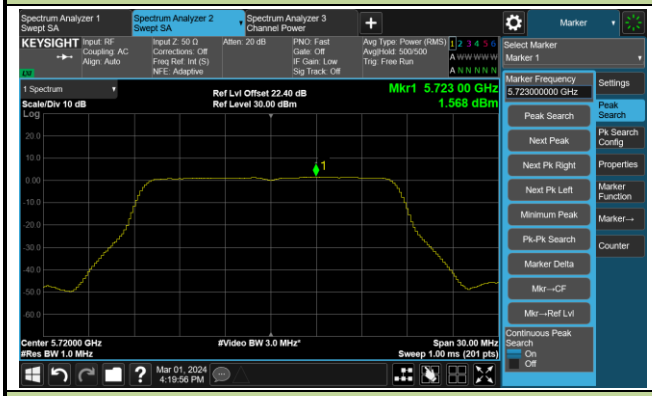
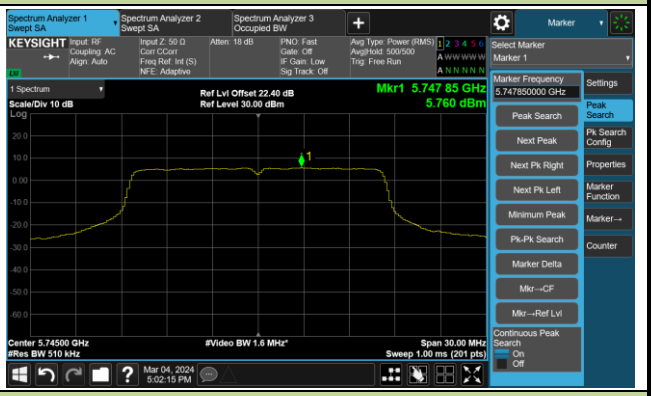
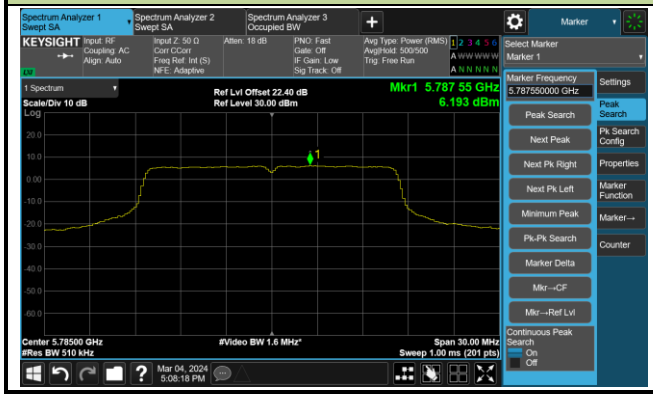
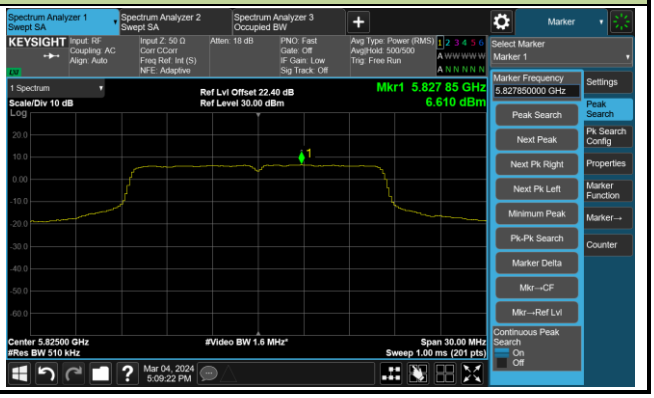


Channel 100 (5500MHz)



Channel 116 (5580MHz)



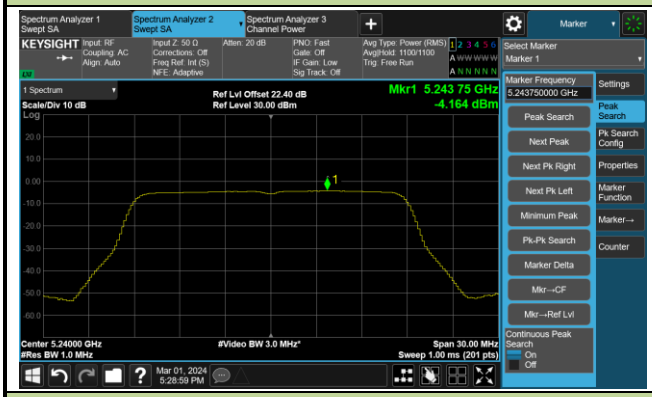
802.11a Power Spectral Density - SISO Mode Ant 0	
Channel 120 (5600MHz)	Channel 140 (5700MHz)
	
Channel 144 (5720MHz)	Channel 149 (5745MHz)
	
Channel 157 (5785MHz)	Channel 165 (5825MHz)
	

802.11ac-VHT20 Power Spectral Density - MIMO Mode Ant 0/Ant 0+1+2+3

Channel 36 (5180MHz)

Channel 44 (5220MHz)

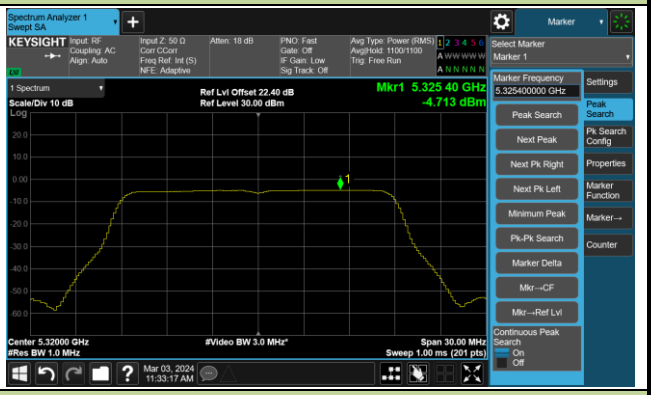
Channel 48 (5240MHz)



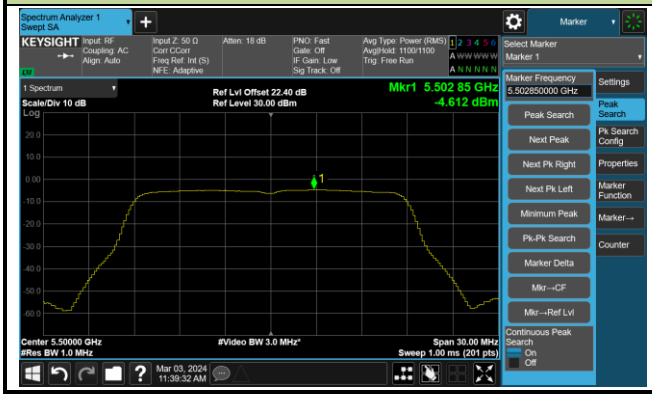
Channel 52 (5260MHz)

Channel 60 (5300MHz)

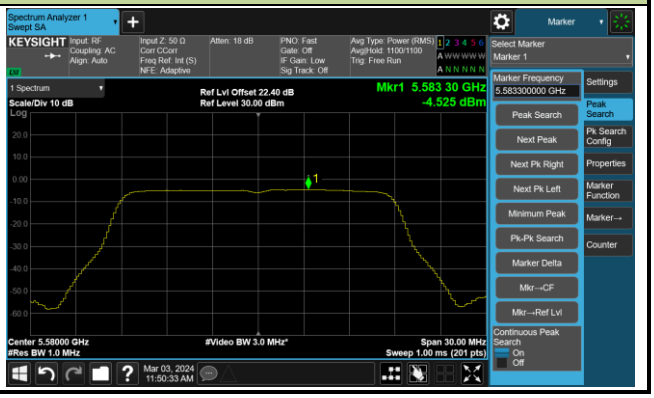
Channel 64 (5320MHz)



Channel 100 (5500MHz)



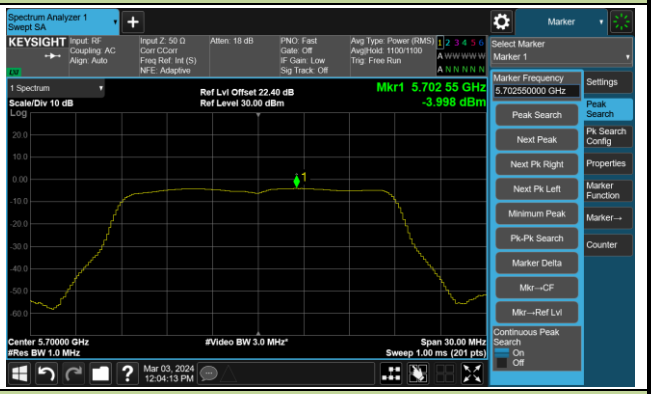
Channel 116 (5580MHz)



802.11ac-VHT20 Power Spectral Density - MIMO Mode Ant 0/Ant 0+1+2+3

Channel 120 (5600MHz)

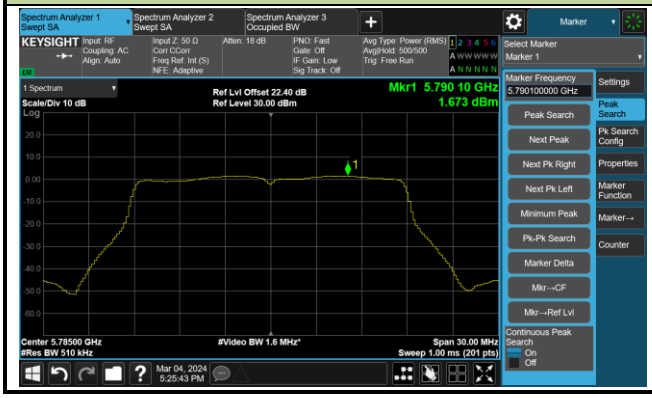
Channel 140 (5700MHz)



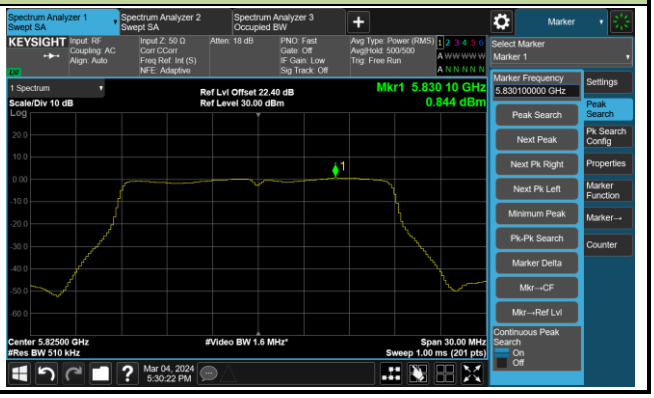
Channel 144 (5720MHz)

Channel 149 (5745MHz)

Channel 157 (5785MHz)



Channel 165 (5825MHz)

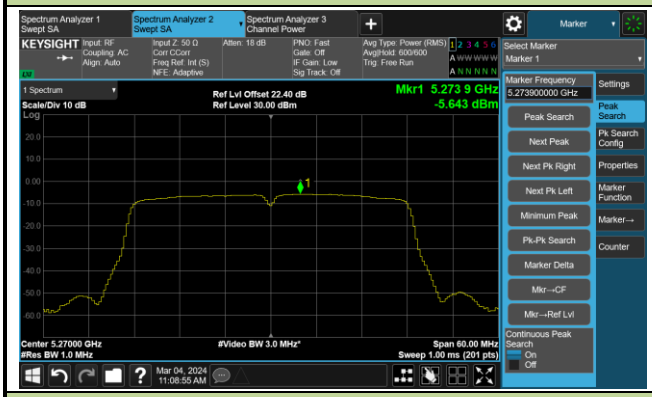


802.11ac-VHT40 Power Spectral Density - MIMO Mode Ant 0/Ant 0+1+2+3

Channel 38 (5190MHz)

Channel 46 (5230MHz)

Channel 54 (5270MHz)

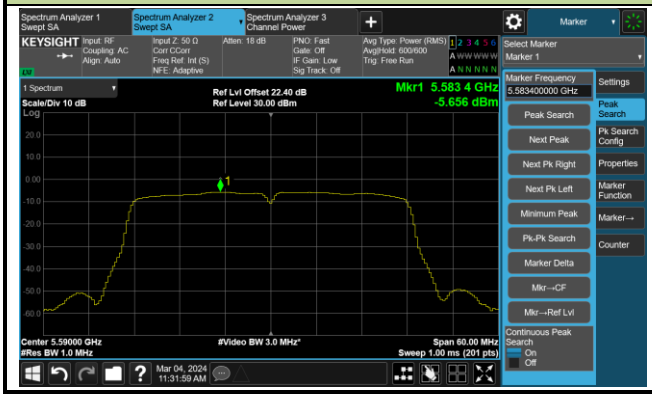


Channel 62 (5310MHz)

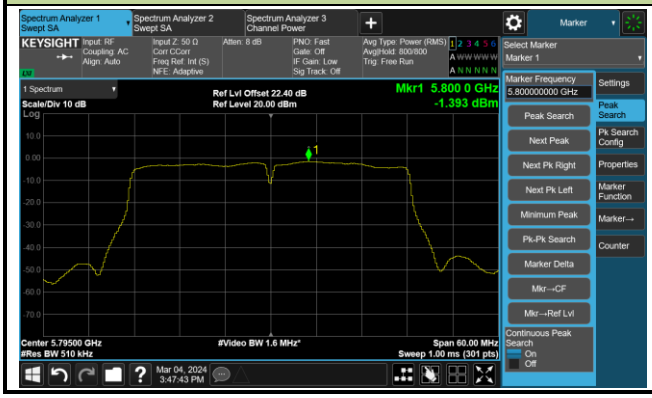
Channel 102 (5510MHz)

Channel 110 (5550MHz)

Channel 118 (5590MHz)

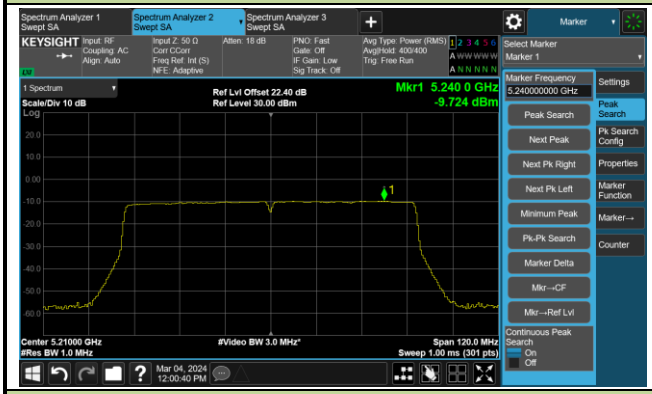


Channel 134 (5670MHz)

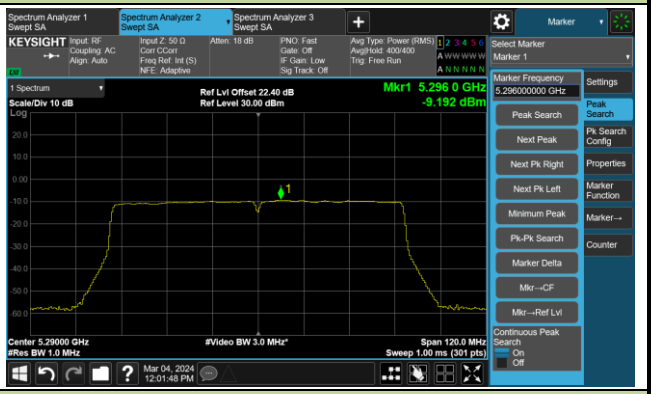
802.11ac-VHT40 Power Spectral Density - MIMO Mode Ant 0/Ant 0+1+2+3	
Channel 142 (5710MHz)	Channel 151 (5755MHz)
Channel 159 (5795MHz)	
	

802.11ac-VHT80 Power Spectral Density - MIMO Mode Ant 0/Ant 0+1+2+3

Channel 42 (5210MHz)

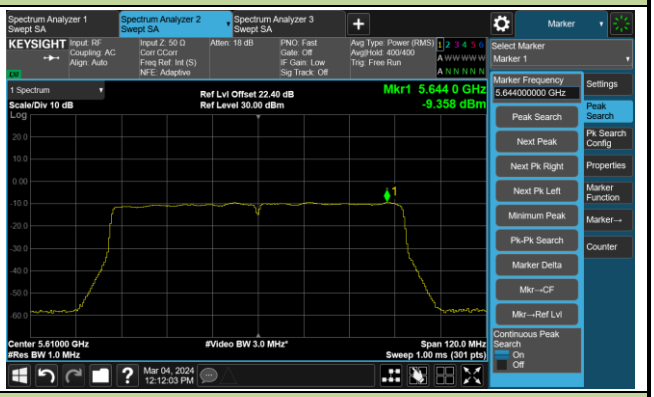


Channel 58 (5290MHz)

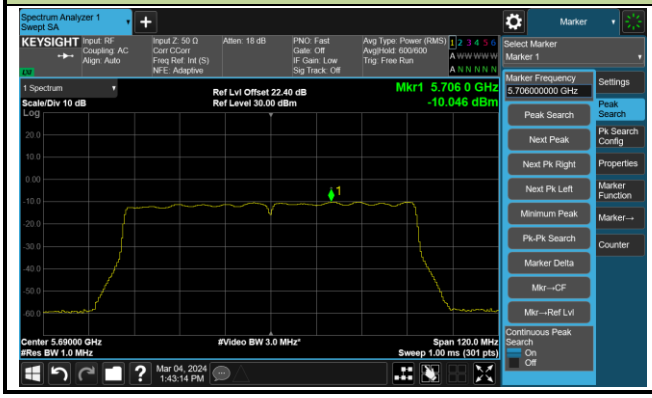


Channel 106 (5530MHz)

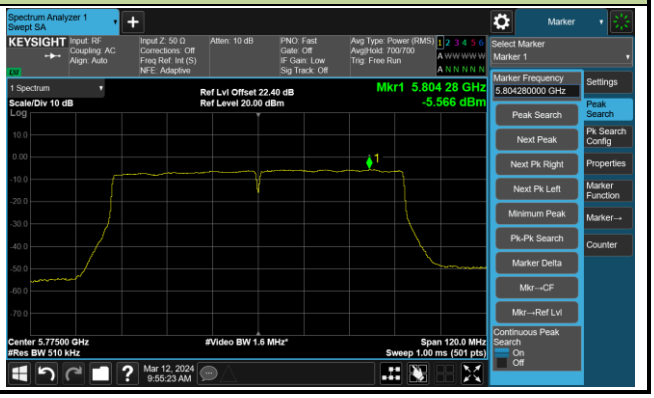
Channel 122 (5610MHz)

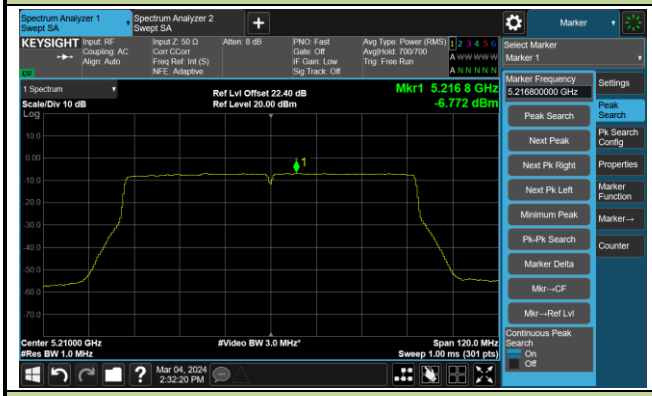
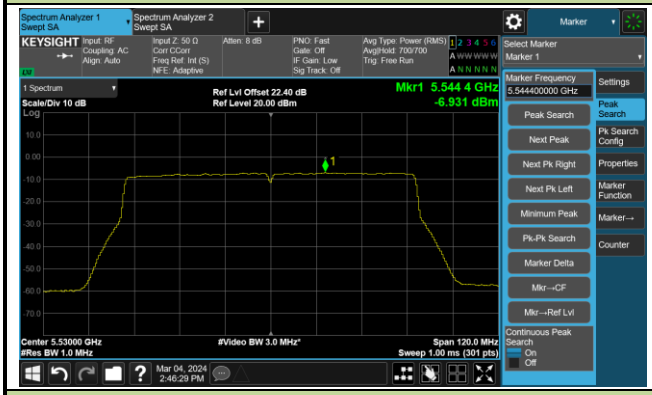
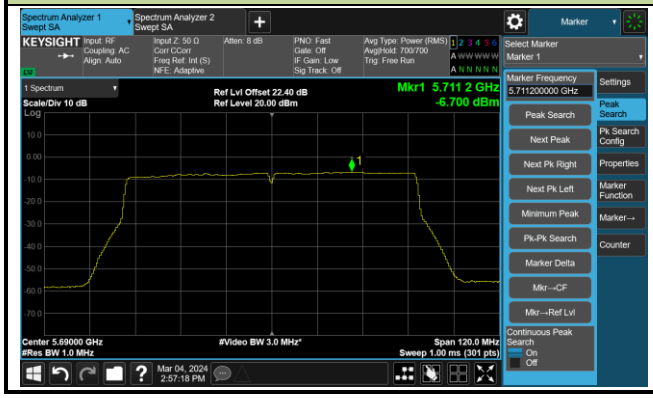


Channel 138 (5690MHz)



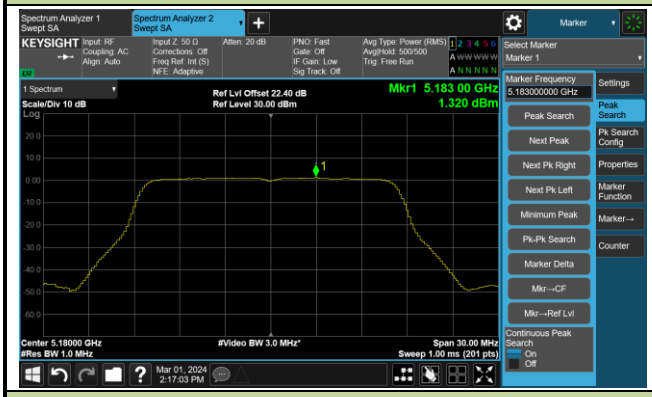
Channel 155 (5775MHz)



802.11ac-VHT80+80 Power Spectral Density - MIMO Mode Ant 0/Ant 0+1	
Channel 42 (5210MHz)	Channel 58 (5290MHz)
	
Channel 106 (5530MHz)	Channel 122 (5610MHz)
	
Channel 138 (5690MHz)	Channel 155 (5775MHz)
	

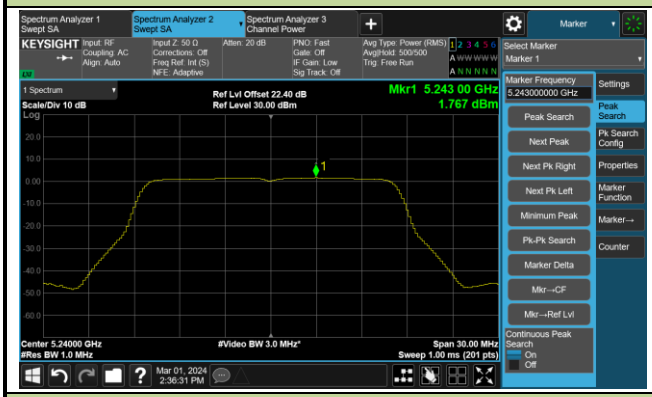
802.11a Power Spectral Density - SISO Mode Ant 1

Channel 36 (5180MHz)

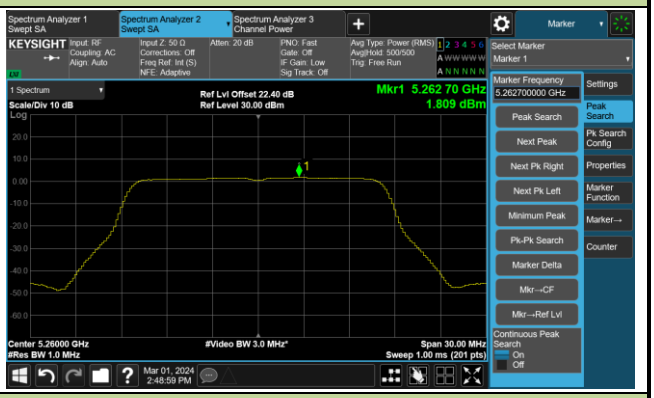


Channel 44 (5220MHz)

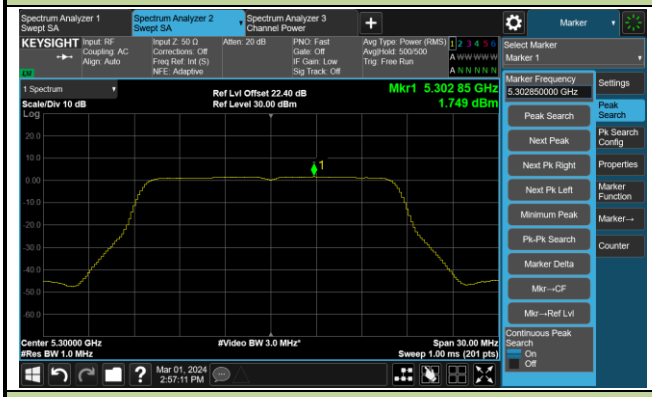
Channel 48 (5240MHz)



Channel 52 (5260MHz)

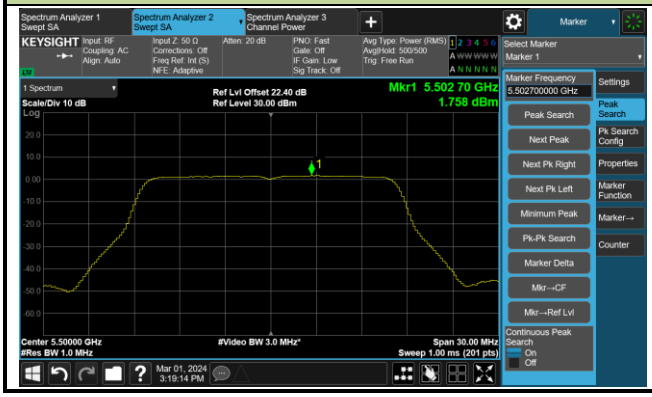
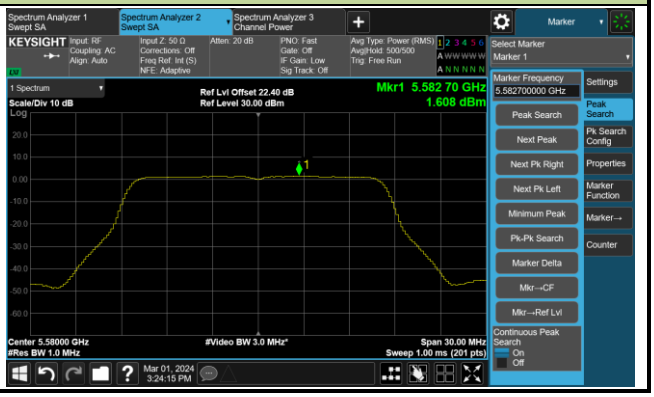


Channel 60 (5300MHz)



Channel 64 (5320MHz)

Channel 100 (5500MHz)



Channel 116 (5580MHz)