



RF MEASUREMENT REPORT

FCC ID: SFK-WF810

Applicant: CIG Shanghai Co., Ltd.

Product: Tri-band Wi-Fi 6 Extender

Model No.: WF-810

Brand Name: CIG

FCC Classification: Unlicensed National Information Infrastructure (NII)

FCC Rule Part(s): Part 15 Subpart E (Section 15.407)

Result: Complies

Test Date: 2022-05-09 ~ 2022-06-13

Reviewed By:

Kevin Guo

Approved By:

Robin Wu



The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in KDB 789033. 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
2204RSU031-U3	Rev. 01	Initial Report	2022-06-21	Valid

CONTENTS

Description	Page
1. General Information	6
1.1. Applicant	6
1.2. Manufacturer	6
1.3. Testing Facility	6
1.4. Product Information	7
1.5. Radio Specification	8
1.6. Working Frequencies	8
1.7. Antenna Details	9
2. Test Configuration	10
2.1. Test Mode	10
2.2. Test System Connection Diagram	10
2.3. Test Software	11
2.4. Applied Standards	11
2.5. Test Environment Condition	11
3. Antenna Requirements	12
4. Measuring Instrument	13
5. Decision Rules and Measurement Uncertainty	14
5.1. Decision Rules	14
5.2. Measurement Uncertainty	14
6. Test Result	15
6.1. Summary	15
6.2. 26dB & 99% Bandwidth Measurement	16
6.2.1. Test Limit	16
6.2.2. Test Procedure	16
6.2.3. Test Setting	16
6.2.4. Test Setup	17
6.2.5. Test Result	17
6.3. 6dB Bandwidth Measurement	18
6.3.1. Test Limit	18
6.3.2. Test Procedure	18
6.3.3. Test Setting	18
6.3.4. Test Setup	18
6.3.5. Test Result	18
6.4. Output Power Measurement	19
6.4.1. Test Limit	19

6.4.2.	Test Procedure	19
6.4.3.	Test Setting	19
6.4.4.	Test Setup.....	19
6.4.5.	Test Result	19
6.5.	Transmit Power Control Measurement.....	20
6.5.1.	Test Limit.....	20
6.5.2.	Test Procedure	20
6.5.3.	Test Setting	20
6.5.4.	Test Setup.....	20
6.5.5.	Test Result	20
6.6.	Power Spectral Density Measurement	21
6.6.1.	Test Limit.....	21
6.6.2.	Test Procedure	21
6.6.3.	Test Setting	21
6.6.4.	Test Setup.....	22
6.6.5.	Test Result	22
6.7.	Frequency Stability Measurement.....	23
6.7.1.	Test Limit.....	23
6.7.2.	Test Procedure	23
6.7.3.	Test Setup.....	23
6.7.4.	Test Result	24
6.8.	Radiated Spurious Emission Measurement	25
6.8.1.	Test Limit.....	25
6.8.2.	Test Procedure	25
6.8.3.	Test Setting	25
6.8.4.	Test Setup.....	27
6.8.5.	Test Result	27
6.9.	Radiated Restricted Band Edge Measurement	28
6.9.1.	Test Limit.....	28
6.9.2.	Test Procedure	30
6.9.3.	Test Setting	30
6.9.4.	Test Setup.....	31
6.9.5.	Test Result	31
6.10.	AC Conducted Emissions Measurement.....	32
6.10.1.	Test Limit.....	32
6.10.2.	Test Setup.....	32
6.10.3.	Test Result	32
Appendix A – Test Result.....		33
A.1	Duty Cycle Test Result.....	33

A.2	26dB Bandwidth Test Result	35
A.3	6dB Bandwidth Test Result	52
A.4	Output Power Test Result	57
A.5	Power Spectral Density Test Result.....	60
A.6	Frequency Stability Test Result.....	102
A.7	Radiated Spurious Emission Test Result.....	103
A.8	Radiated Restricted Band Edge Test Result.....	180
A.9	AC Conducted Emissions Test Result	318
Appendix B – Test Setup Photograph		320
Appendix C – EUT Photograph		321

1. General Information

1.1. Applicant

CIG Shanghai Co., Ltd.

5F, Building 8, NO.2388 CHENGHANG ROAD, MINHANG DISTRICT, SHANGHAI

1.2. Manufacturer

CIG Shanghai Co., Ltd.

5F, Building 8, NO.2388 CHENGHANG ROAD, MINHANG DISTRICT, SHANGHAI

1.3. Testing Facility

☒	Test Site – MRT Suzhou Laboratory Laboratory Location (Suzhou - Wuzhong) D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China Laboratory Location (Suzhou - SIP) 4b Building, Liando U Valley, No.200 Xingpu Rd., Shengpu Town, Suzhou Industrial Park, China Laboratory Accreditations A2LA: 3628.01 CNAS: L10551 FCC: CN1166 ISED: CN0001 VCCI: ☐ R-20025 ☐ G-20034 ☐ C-20020 ☐ T-20020 ☐ R-20141 ☐ G-20134 ☐ C-20103 ☐ T-20104
☐	Test Site – MRT Shenzhen Laboratory Laboratory Location (Shenzhen) 1G, Building A, Junxiangda Building, Zhongshanyuan Road West, Nanshan District, Shenzhen, China Laboratory Accreditations A2LA: 3628.02 CNAS: L10551 FCC: CN1284 ISED: CN0105
☐	Test Site – MRT Taiwan Laboratory Laboratory Location (Taiwan) No. 38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.) Laboratory Accreditations TAF: L3261-190725 FCC: 291082, TW3261 ISED: TW3261

1.4. Product Information

Product Name	Tri-band Wi-Fi 6 Extender
Model No.	WF-810
Serial No.	1HG221100023 (Radiated) 1HG221100030 (Conducted)
Wi-Fi Specification	802.11a/b/g/n/ac/ax
Bluetooth Specification	v5.0 single mode for BLE
Antenna Information	Refer to Section 1.7
Working Voltage	AC/DC Adapter
Accessories	
AC/DC Adapter 1#	Model No.: ADS036G-W 120300 Input: 100-240V~50-60Hz, 1.0A Output: 5.0V, 3.0A, 15.0W 9.0V, 3.0A, 27.0W 12.0V, 3.0A, 36.0W
AC/DC Adapter 2#	Model No.: ADT-38FKJ-PCU00F Input: 100-240V~50-60Hz, Max. 1.0A Output: 5.0V, 3.0A or 12.0V, 3.0A
Remark:	
- The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer. - AC-DC Adapter 1# was used for AC Conducted Emissions testing, and AC-DC Adapter 2# was used for other items testing.	

1.5. Radio Specification

Frequency Range	For 802.11a/n-HT20/ac-VHT20/ax-HE20: 5180~5240MHz, 5260~5320MHz, 5500~5720MHz, 5745~5825MHz For 802.11n-HT40/ac-VHT40/ax-HE40: 5190~5230MHz, 5270~5310MHz, 5510~5710MHz, 5755~5795MHz For 802.11ac-VHT80/ax-HE80: 5210MHz, 5290MHz, 5530MHz, 5610 MHz, 5690MHz, 5775MHz For 802.11ac-VHT160/ax-HE160: 5250MHz, 5570MHz
Type of Modulation	802.11a/n/ac: OFDM 802.11ax: OFDMA
Data Rate	802.11a: 6/9/12/18/24/36/48/54Mbps 802.11n: up to 600Mbps 802.11ac: up to 3466.8Mbps 802.11ax: up to 4804Mbps

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

1.6. Working Frequencies

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

Channel	Frequency	Channel	Frequency	Channel	Frequency
36	5180 MHz	40	5200 MHz	44	5220 MHz
48	5240 MHz	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/ax-HE40

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/ax-HE80

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-VHT160/ax-HE160

Channel	Frequency	Channel	Frequency	Channel	Frequency
50	5250 MHz	114	5570 MHz	--	--

1.7. Antenna Details

Radio Spec.	Frequency Band (MHz)	Antenna Type			
		Ant 0	Ant 1	Ant 2	Ant 3
Bluetooth	2400 ~ 2483.5	PCB Antenna	--	--	--
2.4G Wi-Fi	2400 ~ 2483.5	PCB Antenna	PIFA Antenna	--	--
5G Wi-Fi	5150 ~ 5350	PIFA Antenna	PCB Antenna	--	--
	5470 ~ 5850	PCB Antenna	PCB Antenna	PCB Antenna	PIFA Antenna

Radio Spec.	Frequency Band (MHz)	Tx Path	Antenna Gain (dBi)				CDD Mode Correlated Gain (dBi)		STBC Mode Uncorrelated Gain (dBi)
			Ant 0	Ant 1	Ant 2	Ant 3	For Power	For PSD	
Bluetooth	2400 ~ 2483.5	1	0.88	--	--	--	--	--	--
2.4G Wi-Fi	2400 ~ 2483.5	2	3.76	4.22	--	--	4.22	4.69	1.90
5G Wi-Fi	5150 ~ 5350	2	4.67	4.31	--	--	4.67	6.13	3.21
	5470 ~ 5850	4	3.96	5.48	5.16	6.61	6.61	8.49	2.73

Remark:

- The antenna gain and directional gain refer to manufacturer's antenna specification.
- The EUT supports CDD mode at 802.11a/b/g and CDD signals are correlated.
For power measurements: $\text{Array Gain} = 0 \text{ dB for } N_{\text{ANT}} \leq 4$, the directional gain = max antenna gain + array gain
For power spectral density (PSD) measurements: the max directional gain (each angle) = $10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2 / N_{\text{ANT}}]$
- The EUT also supports STBC mode at 802.11n/ac/ax and STBC signals are uncorrelated, the max directional gain (each angle) = $10 \log[(10^{G1/10} + 10^{G2/10} + \dots + 10^{GN/10}) / N_{\text{ANT}}]$

2. Test Configuration

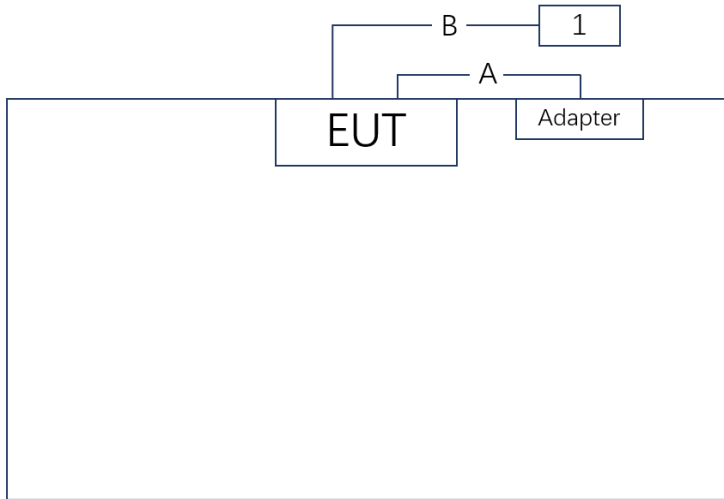
2.1. Test Mode

Mode 1: Transmit by 802.11a (24Mbps) (CDD Mode)
Mode 2: Transmit by 802.11ac-VHT20 (MCS5) (STBC Mode)
Mode 3: Transmit by 802.11ac-VHT40 (MCS0) (STBC Mode)
Mode 4: Transmit by 802.11ac-VHT80 (MCS5) (STBC Mode)
Mode 5: Transmit by 802.11ac-VHT160 (MCS0) (STBC Mode)
Mode 6: Transmit by 802.11ax-HE20 (MCS6) (STBC Mode)
Mode 7: Transmit by 802.11ax-HE40 (MCS6) (STBC Mode)
Mode 8: Transmit by 802.11ax-HE80 (MCS6) (STBC Mode)
Mode 9: Transmit by 802.11 ax-HE160 (MCS6) (STBC Mode)

Note: Due to the same modulation between 802.11n and 802.11ac, so 802.11n-HT20 and HT40 are covered by 802.11ac-VHT20 and VHT40 in this report, meanwhile, power setting for 802.11n-HT20 and HT40 will not be greater than 802.11ac-VHT20 and VHT40.

2.2. Test System Connection Diagram

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

Connection Diagram – Radiated Emission testing & AC Conducted Emissions			
			
No.	Cable Type	Cable Spec.	Length
A	Power Cable	Non-Shielding	1.2m
B	Ethernet Cable	Non-Shielding	>5m
No.	Product	Manufacturer	Model No.
1	Notebook	HP	2L4T5PA#AB2

2.3. Test Software

The test utility software used during testing was “QSPR”, and the version was v5.0-00196.

Note: Final power setting please refer to operational description.

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
- KDB 662911 D01v02r01
- 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 **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
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2022-12-29	WZ-AC1
Horn Antenna	Schwarzbeck	BBHA 9120D	MRTSUE06023	1 year	2022-09-16	WZ-AC1
Preamplifier	Agilent	83017A	MRTSUE06076	1 year	2022-11-12	WZ-AC1
TRILOG Antenna	Schwarzbeck	VULB 9168	MRTSUE06172	1 year	2022-08-05	WZ-AC1
Anechoic Chamber	TDK	WZ-AC1	MRTSUE06212	1 year	2023-04-21	WZ-AC1
Thermohygrometer	testo	608-H1	MRTSUE06403	1 year	2022-06-28	WZ-AC1
Signal Analyzer	Keysight	N9010B	MRTSUE06607	1 year	2022-12-29	WZ-AC1
Thermohygrometer	testo	Testo 608-H1	MRTSUE11039	1 year	2022-11-11	WZ-AC1
Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2022-10-28	WZ-AC1
Two-Line V-Network	R&S	ENV216	MRTSUE06002	1 year	2023-06-04	WZ-SR2
Shielding Room	MIX-BEP	WZ-SR2	MRTSUE06215	5 years	2026-12-20	WZ-SR2
Thermohygrometer	testo	608-H1	MRTSUE06404	1 year	2022-06-28	WZ-SR2
Four-Line V-Network	R&S	ENV432	MRTSUE06615	1 year	2022-10-13	WZ-SR2
EMI Test Receiver	R&S	ESR3	MRTSUE06909	1 year	2022-11-01	WZ-SR2
USB Power Sensor	Agilent	U2021XA	MRTSUE06030	1 year	2022-10-10	SIP-TR1
Signal Analyzer	Agilent	N9020A	MRTSUE06106	1 year	2023-04-06	SIP-TR1
Thermohygrometer	testo	608-H1	MRTSUE06402	1 year	2022-06-28	SIP-TR1
Shielding Room	HUAMING	SIP-TR1	MRTSUE06442	N/A	N/A	SIP-TR1
Signal Analyzer	Keysight	N9010B	MRTSUE06457	1 year	2023-06-04	SIP-TR1
Attenuator	SHX	WDTS100-20dB-6G-B	MRTSUE06677	1 year	2023-03-02	WZ-SR5
Attenuator	SHX	WDTS100-20dB-6G-B	MRTSUE06678	1 year	2023-03-02	WZ-SR5
Attenuator	SHX	WDTS100-20dB-6G-B	MRTSUE06679	1 year	2023-03-02	WZ-SR5

Software	Version	Function
EMI V3	V 3.0.0	EMI Test Software
Agilent Power Panel	V 3.9	Power
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: 3.74dB 150kHz~30MHz: 3.44dB
Radiated Disturbance
Measurement Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): Horizontal: 30MHz~300MHz: 5.04dB 300MHz~1GHz: 4.95dB 1GHz~40GHz: 6.40dB Vertical: 30MHz~300MHz: 5.24dB 300MHz~1GHz: 6.03dB 1GHz~40GHz: 6.40dB
Spurious Emissions, Conducted
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 0.78dB
Output Power
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 1.13dB
Power Spectrum Density
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 1.15dB
Occupied Bandwidth
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 0.28%

6. Test Result

6.1. Summary

FCC Section(s)	Test Description	Test Condition	Verdict
15.407(a)	26dB Bandwidth	Conducted	Pass
15.407(e)	6dB Bandwidth		Pass
15.407(a)(1)(ii), (2), (3)(i)	Maximum Conducted Output Power		Pass
15.407(h)(1)	Transmit Power Control		Pass
15.407(a)(1)(ii), (2), (3)(i), (12)	Peak Power Spectral Density		Pass
15.407(g)	Frequency Stability		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
15.207	AC Conducted Emissions 150kHz - 30MHz	Line Conducted	Pass

Remark:

- Determining compliance is based on the test results met the regulation limits or requirements declared by clients, and the test results don't take into account the value of measurement uncertainty.
- 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.
- EUT supports one configuration only in 802.11ax full RU mode, i.e. 242 tone in 11ax-HE20, 484 tone in 11ax-HE40, 996 tone in 11ax-HE80 and 2x966 tone in 11ax-HE160.

6.2. 26dB & 99% Bandwidth Measurement

6.2.1. Test Limit

N/A

6.2.2. Test Procedure

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

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

6.2.3. Test Setting

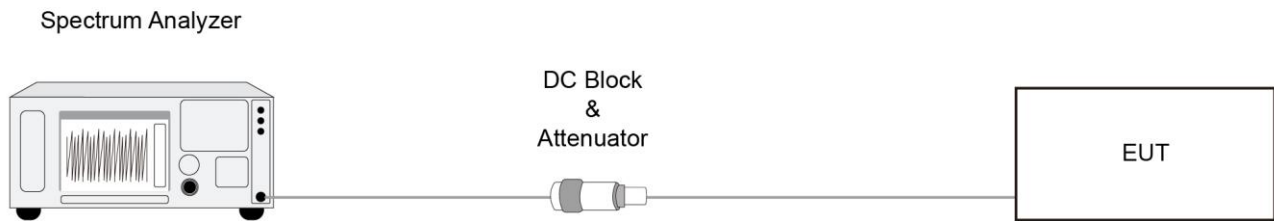
26dB Bandwidth

1. The analyzers' automatic bandwidth measurement capability was used to perform the 26dB bandwidth
2. RBW = approximately 1% of the emission bandwidth.
3. VBW > RBW
4. Detector = Peak.
5. Trace mode = max hold.
6. Measure the maximum width of the emission that is 26 dB down from the maximum of the emission.
Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

99% Bandwidth

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

6.2.4. Test Setup



6.2.5. Test Result

Refer to Appendix A.2.

6.3. 6dB Bandwidth Measurement

6.3.1. Test Limit

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

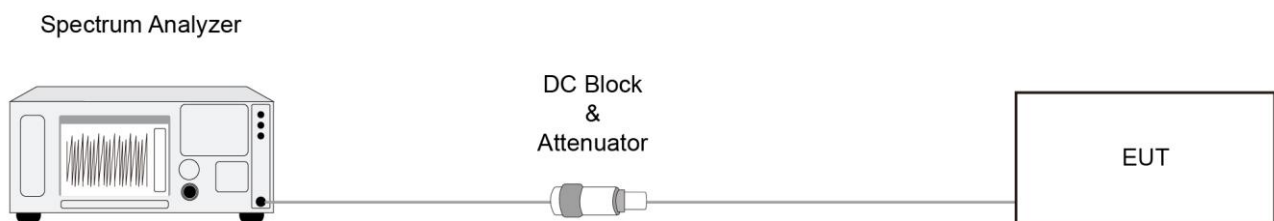
6.3.2. Test Procedure

KDB 789033 D02v02r01- Section II)C)2)

6.3.3. Test Setting

1. Set center frequency to the nominal EUT channel center frequency.
2. RBW = 100 kHz.
3. VBW $\geq 3 \times$ RBW.
4. Detector = Peak.
5. Trace mode = max hold.
6. Sweep = auto couple.
7. Allow the trace to stabilize.
8. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

6.3.4. Test Setup



6.3.5. Test Result

Refer to Appendix A.3.

6.4. Output Power Measurement

6.4.1. Test Limit

For the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi.

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz.

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W (30dBm).

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

6.4.2. Test Procedure

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

6.4.3. Test Setting

Average Power Measurement

Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter.

6.4.4. Test Setup



6.4.5. Test Result

Refer to Appendix A.4.

6.5. Transmit Power Control Measurement

6.5.1. Test Limit

The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30 dBm.

6.5.2. Test Procedure

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

6.5.3. Test Setting

Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter. The trace was averaged over 100 traces to obtain the final measured average power.

6.5.4. Test Setup



6.5.5. Test Result

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

6.6. Power Spectral Density Measurement

6.6.1. Test Limit

For the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band.

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

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

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

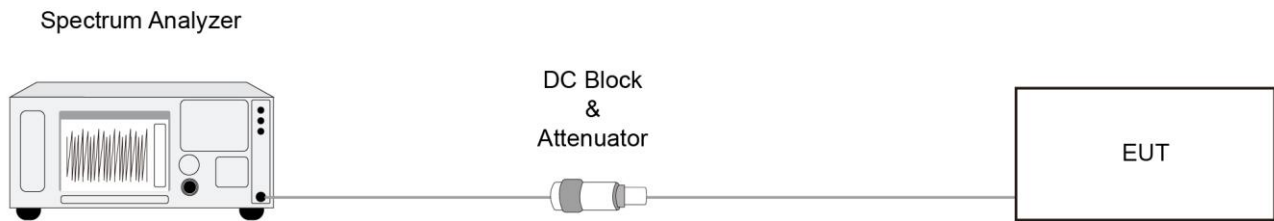
6.6.2. Test Procedure

KDB 789033 D02v02r01-Section II)F)

6.6.3. Test Setting

1. Analyzer was set to the center frequency of the UNII channel under investigation
2. Span was set to encompass the entire 26dB EBW of the signal.
3. RBW = 1MHz (510kHz, if measurement bandwidth of Maximum PSD is specified in 500 kHz)
4. VBW = $3 \times \text{RBW}$
5. Number of sweep points $\geq 2 \times (\text{span} / \text{RBW})$
6. Detector = power averaging (Average)
7. Sweep time = auto
8. Trigger = free run
9. Trace average at least 100 traces in power averaging (rms) mode; however, the number of traces to be averaged shall be increased above 100 as needed to ensure that the average accurately represents the true average over the on and off periods of the transmitter.
10. Use the peak search function on the instrument to find the peak of the spectrum and record its value.
11. Add $10 \cdot \log(1/x)$, where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission). For example, add $10 \cdot \log(1/0.25) = 6 \text{ dB}$ if the duty cycle is 25 percent.

6.6.4. Test Setup



6.6.5. Test Result

Refer to Appendix A.5.

6.7. Frequency Stability Measurement

6.7.1. Test Limit

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

6.7.2. Test Procedure

Frequency Stability Under Temperature Variations:

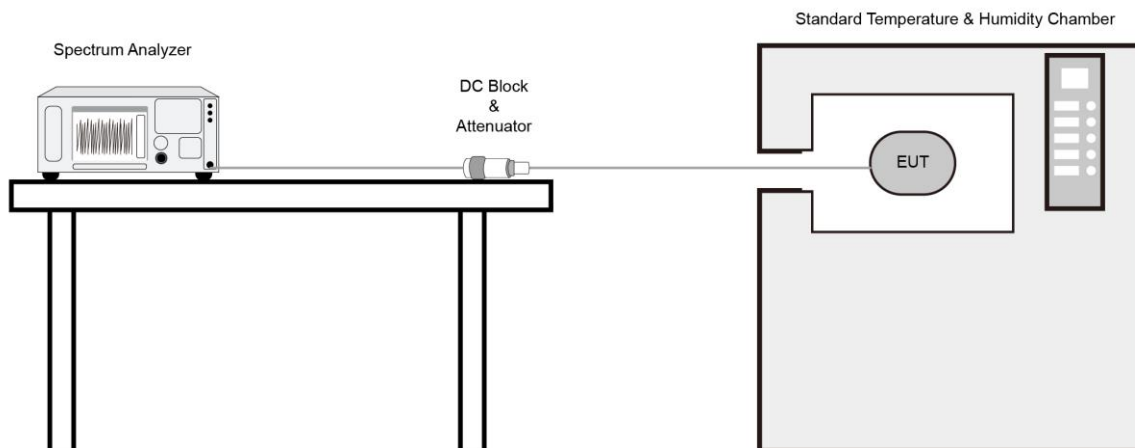
The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain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

Frequency Stability Under Voltage Variations:

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

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

6.7.3. Test Setup



6.7.4. Test Result

Refer to Appendix A.6.

6.8. Radiated Spurious Emission Measurement

6.8.1. Test Limit

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

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

6.8.2. Test Procedure

KDB 789033 D02v02r01- Section II)G)

6.8.3. Test Setting

Table 1 - RBW as a function of frequency

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

Quasi-Peak Measurements below 1GHz

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. Span was set greater than 1MHz
3. RBW = as specified in Table 1
4. Detector = CISPR quasi-peak
5. Sweep time = auto couple
6. Trace was allowed to stabilize

Peak Measurements above 1GHz

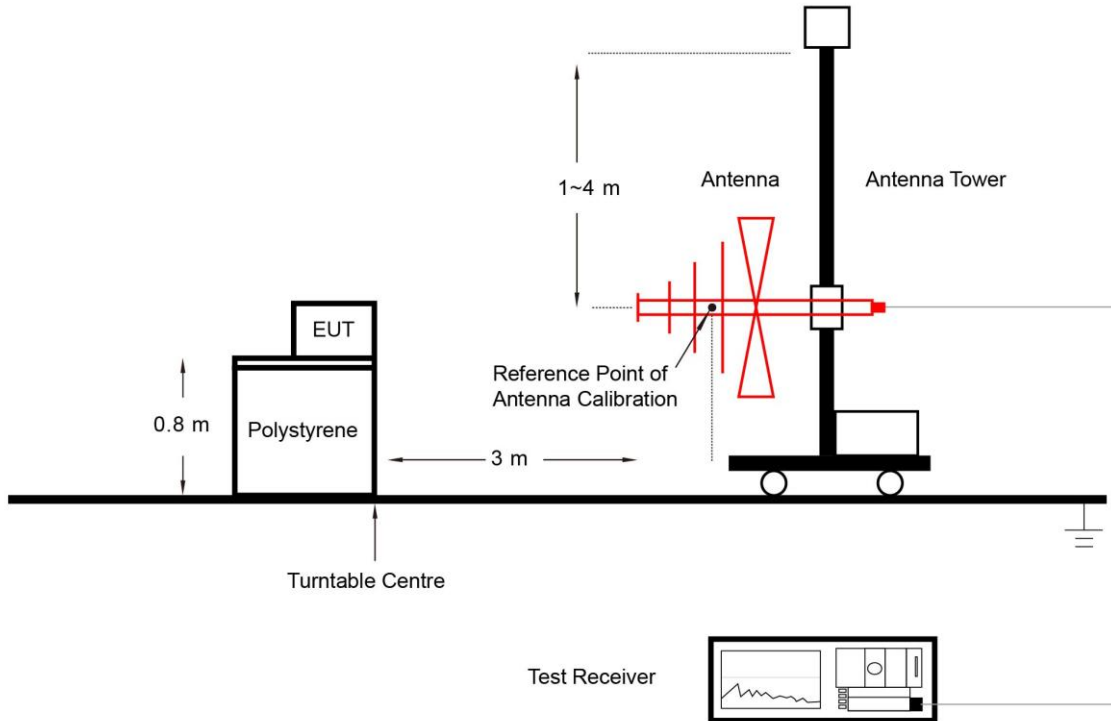
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Average Measurements above 1GHz (Method VB)

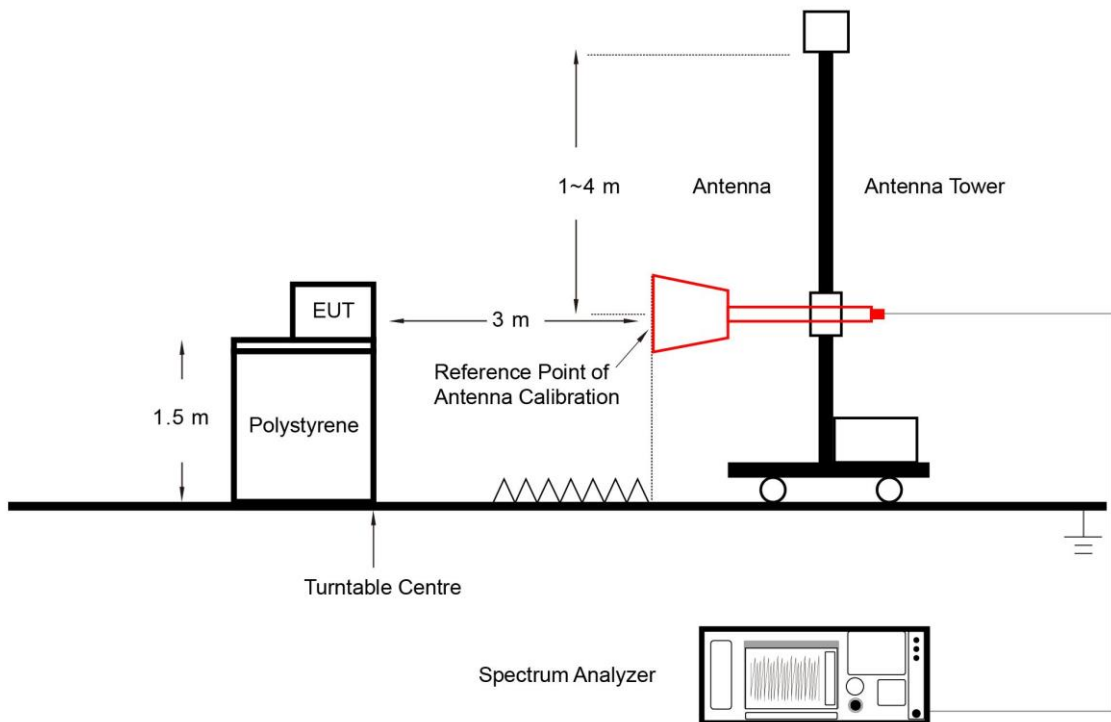
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW; If the EUT is configured to transmit with duty cycle $\geq 98\%$, set VBW = 10 Hz.
If the EUT duty cycle is $< 98\%$, set VBW $\geq 1/T$. T is the minimum transmission duration.
4.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

6.8.4. Test Setup

Below 1GHz Test Setup:



Above 1GHz Test Setup:



6.8.5. Test Result

Refer to Appendix A.7.

6.9. Radiated Restricted Band Edge Measurement

6.9.1. Test Limit

For 15.205 requirement:

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

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

For 15.407(b) requirement:

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

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

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

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

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

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

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

6.9.2. Test Procedure

KDB 789033 D02v02r01- Section II)G)

6.9.3. Test Setting

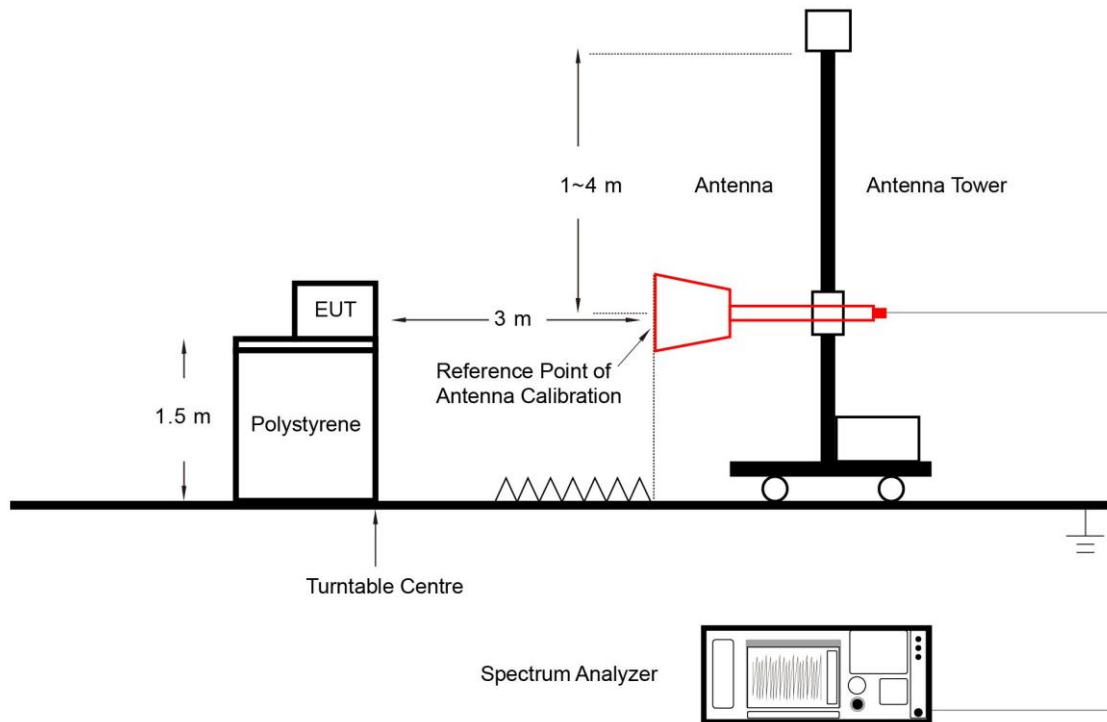
Peak Measurements above 1GHz

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

Average Measurements above 1GHz (Method VB)

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

6.9.4. Test Setup



6.9.5. Test Result

Refer to Appendix A.8.

6.10. AC Conducted Emissions Measurement

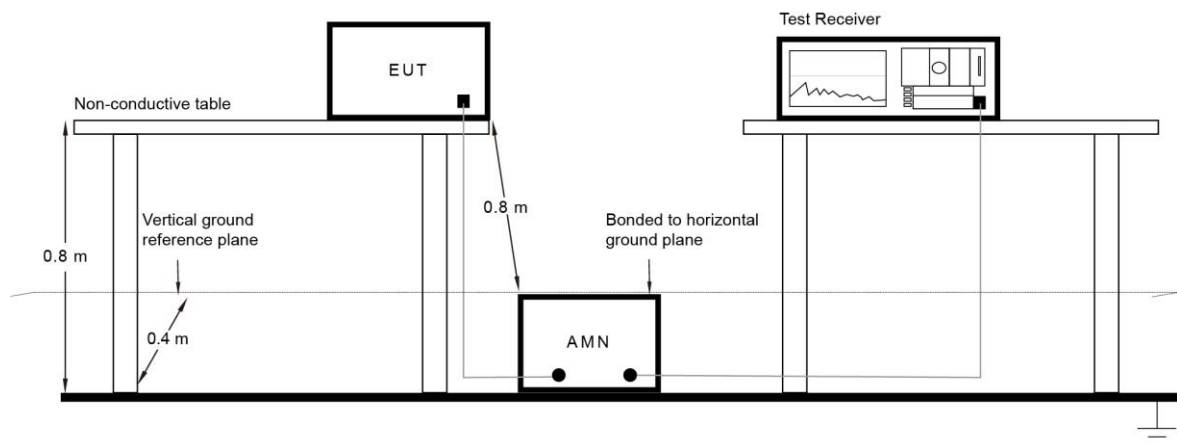
6.10.1. Test Limit

FCC Part 15.207 Limits		
Frequency (MHz)	QP (dBuV)	AV (dBuV)
0.15 - 0.50	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30	60	50

Note 1: The lower limit shall apply at the transition frequencies.

Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

6.10.2. Test Setup



6.10.3. Test Result

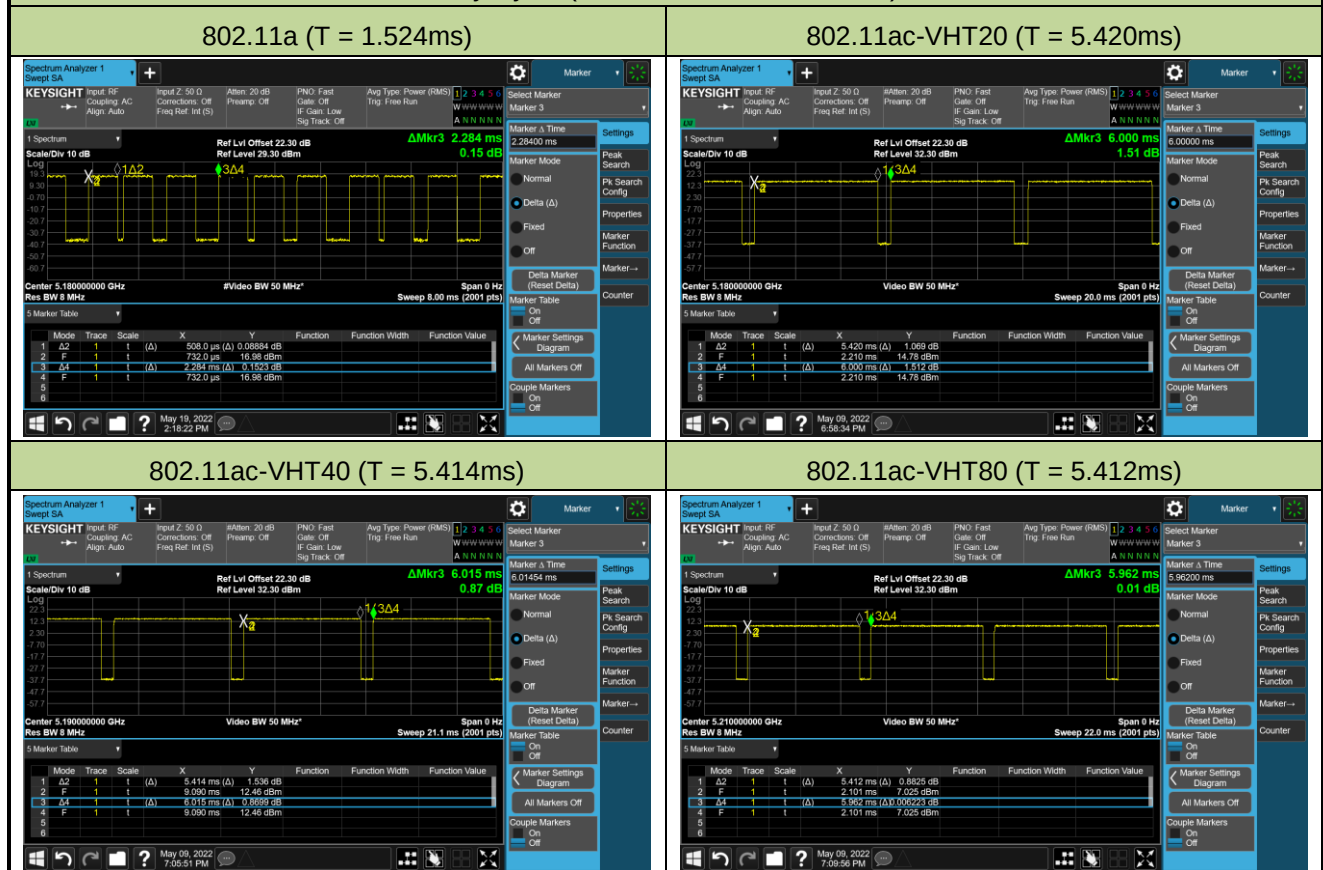
Refer to Appendix A.9.

Appendix A – Test Result

A.1 Duty Cycle Test Result

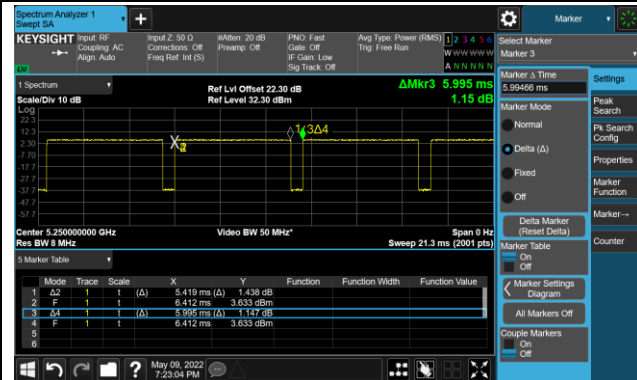
Test Mode	Duty Cycle
802.11a	66.73%
802.11ac-VHT20	90.33%
802.11ac-VHT40	90.01%
802.11ac-VHT80	90.77%
802.11ac-VHT160	90.39%
802.11ax-HE20	90.99%
802.11ax-HE40	90.36%
802.11ax-HE80	90.63%
802.11ax-HE160	90.65%

Duty Cycle (T = Transmission Duration)

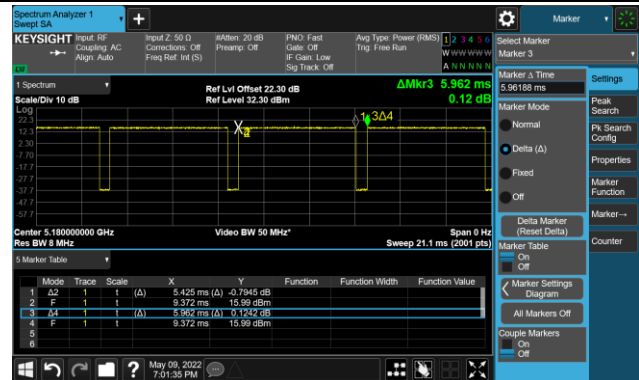


Duty Cycle (T = Transmission Duration)

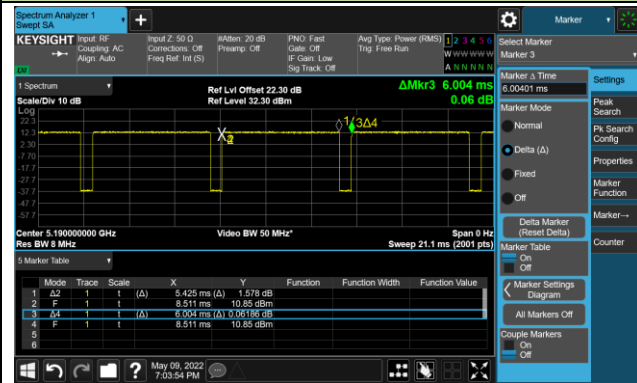
802.11ac-VHT160 (T = 5.419ms)



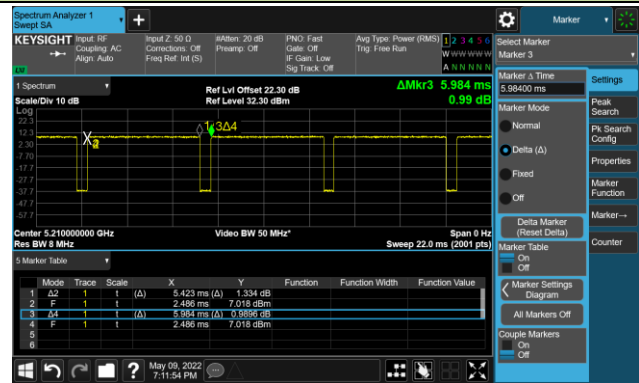
802.11ax-HE20 (T = 5.425ms)



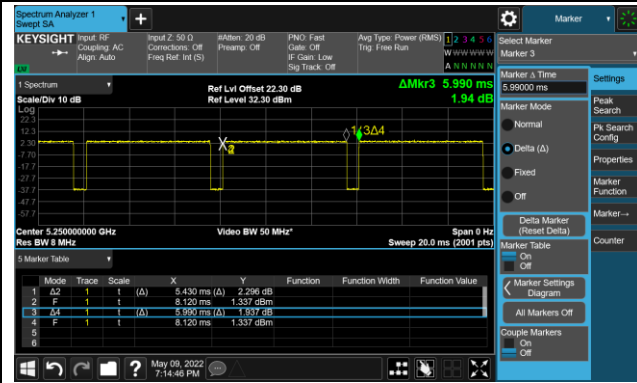
802.11ax-HE40 (T = 5.425ms)



802.11ax-HE80 (T = 5.423ms)



802.11ax-HE160 (T = 5.430ms)



A.2 26dB & 99% Bandwidth Test Result

Test Site	SIP-TR1	Test Engineer	Naddy Zhang
Test Date	2022/05/19 ~ 2022/05/30		

Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
11a	24Mbps	36	5180	18.76	16.331
11a	24Mbps	44	5220	20.65	16.330
11a	24Mbps	48	5240	20.61	16.390
11a	24Mbps	52	5260	18.29	16.297
11a	24Mbps	60	5300	18.16	16.300
11a	24Mbps	64	5320	18.10	16.295
11a	24Mbps	100	5500	19.88	16.476
11a	24Mbps	116	5580	20.57	16.511
11a	24Mbps	140	5700	20.41	16.508
11a	24Mbps	144	5720	20.67	16.509
11a	24Mbps	149	5745	34.62	17.435
11a	24Mbps	157	5785	34.83	17.423
11a	24Mbps	165	5825	36.82	18.298
11ac-VHT20	MCS5	36	5180	21.38	17.781
11ac-VHT20	MCS5	44	5220	31.20	18.141
11ac-VHT20	MCS5	48	5240	30.75	18.105
11ac-VHT20	MCS5	52	5260	21.41	17.780
11ac-VHT20	MCS5	60	5300	21.52	17.814
11ac-VHT20	MCS5	64	5320	21.51	17.808
11ac-VHT20	MCS5	100	5500	21.27	17.731
11ac-VHT20	MCS5	116	5580	21.73	17.728
11ac-VHT20	MCS5	140	5700	21.33	17.726
11ac-VHT20	MCS5	144	5720	21.34	17.747
11ac-VHT20	MCS5	149	5745	29.93	18.157
11ac-VHT20	MCS5	157	5785	35.65	18.293
11ac-VHT20	MCS5	165	5825	39.89	19.155

Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
11ac-VHT40	MCS0	38	5190	39.32	35.825
11ac-VHT40	MCS0	46	5230	39.65	35.911
11ac-VHT40	MCS0	54	5270	39.19	35.872
11ac-VHT40	MCS0	62	5310	39.38	35.843
11ac-VHT40	MCS0	102	5510	39.43	35.923
11ac-VHT40	MCS0	110	5550	39.51	35.928
11ac-VHT40	MCS0	134	5670	39.41	35.935
11ac-VHT40	MCS0	142	5710	39.73	35.946
11ac-VHT40	MCS0	151	5755	39.92	36.011
11ac-VHT40	MCS0	159	5795	40.02	35.999
11ac-VHT80	MCS5	42	5210	86.67	76.124
11ac-VHT80	MCS5	58	5290	87.72	76.114
11ac-VHT80	MCS5	106	5530	89.31	76.064
11ac-VHT80	MCS5	122	5610	88.63	76.107
11ac-VHT80	MCS5	138	5690	89.47	76.116
11ac-VHT80	MCS5	155	5775	88.55	75.967
11ac-VHT160	MCS0	50	5250	163.60	153.26
11ac-VHT160	MCS0	114	5570	165.10	153.88
11ax-HE20	MCS6	36	5180	22.03	19.104
11ax-HE20	MCS6	44	5220	34.03	19.336
11ax-HE20	MCS6	48	5240	34.45	19.282
11ax-HE20	MCS6	52	5260	21.91	19.074
11ax-HE20	MCS6	60	5300	21.94	19.085
11ax-HE20	MCS6	64	5320	21.60	19.056
11ax-HE20	MCS6	100	5500	21.92	19.017
11ax-HE20	MCS6	116	5580	21.48	19.028
11ax-HE20	MCS6	140	5700	21.38	19.032
11ax-HE20	MCS6	144	5720	21.47	19.013
11ax-HE20	MCS6	149	5745	39.64	19.413
11ax-HE20	MCS6	157	5785	37.05	19.301
11ax-HE20	MCS6	165	5825	39.49	19.562

Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
11ax-HE40	MCS6	38	5190	43.47	38.006
11ax-HE40	MCS6	46	5230	63.72	38.392
11ax-HE40	MCS6	54	5270	43.52	38.109
11ax-HE40	MCS6	62	5310	43.60	38.064
11ax-HE40	MCS6	102	5510	42.59	37.917
11ax-HE40	MCS6	110	5550	42.57	37.958
11ax-HE40	MCS6	134	5670	42.70	37.945
11ax-HE40	MCS6	142	5710	42.81	37.843
11ax-HE40	MCS6	151	5755	60.00	38.103
11ax-HE40	MCS6	159	5795	65.42	38.380
11ax-HE80	MCS6	42	5210	86.61	77.662
11ax-HE80	MCS6	58	5290	87.34	77.636
11ax-HE80	MCS6	106	5530	87.54	77.703
11ax-HE80	MCS6	122	5610	88.05	77.572
11ax-HE80	MCS6	138	5690	88.36	77.528
11ax-HE80	MCS6	155	5775	86.85	77.468
11ax-HE160	MCS6	50	5250	168.30	156.78
11ax-HE160	MCS6	114	5570	171.70	157.19

Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	F _H (MHz)	Limit (MHz)
802.11a	24Mbps	48	5240	5248.195	< 5250
802.11ac-VHT20	MCS5	48	5240	5249.053	< 5250
802.11ac-VHT40	MCS0	46	5230	5247.956	< 5250
802.11ac-VHT80	MCS5	42	5210	5248.062	< 5250
802.11ax-HE20	MCS6	48	5240	5249.641	< 5250
802.11ax-HE40	MCS6	46	5230	5249.196	< 5250
802.11ax-HE80	MCS6	42	5210	5248.831	< 5250

Note: F_H = Centre frequency + 99% OBW / 2.

For example, 802.11a 5240MHz, F_H = 5240 MHz + 16.390 MHz / 2 = 5248.195 MHz.

802.11a 26dB & 99% Bandwidth

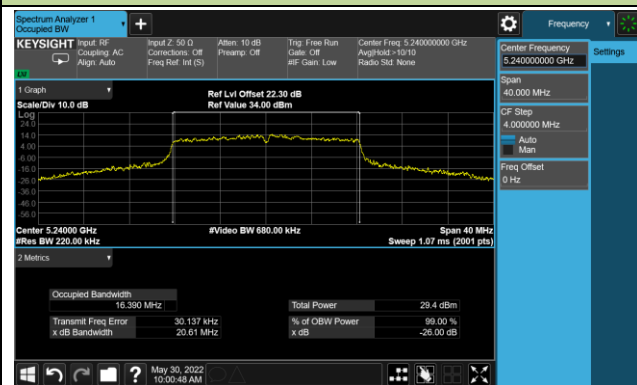
Channel 36 (5180MHz)



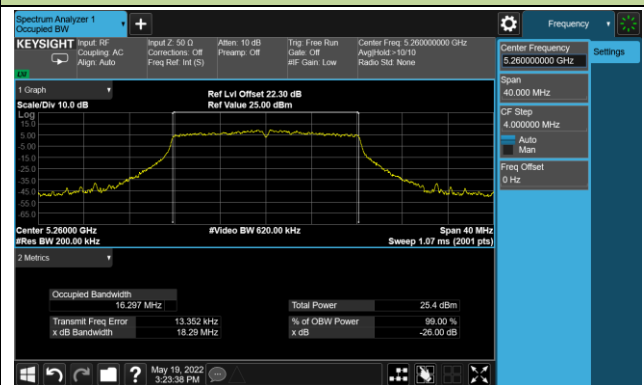
Channel 44 (5220MHz)



Channel 48 (5240MHz)



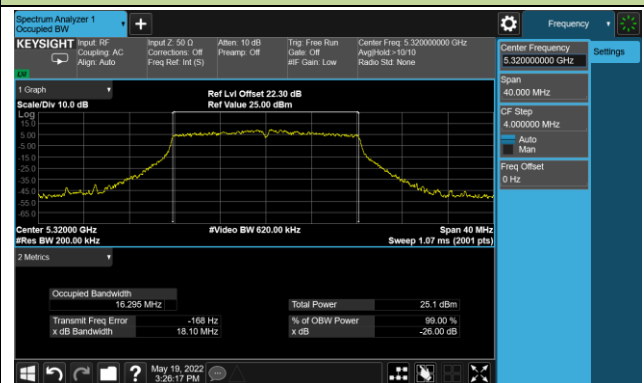
Channel 52 (5260MHz)



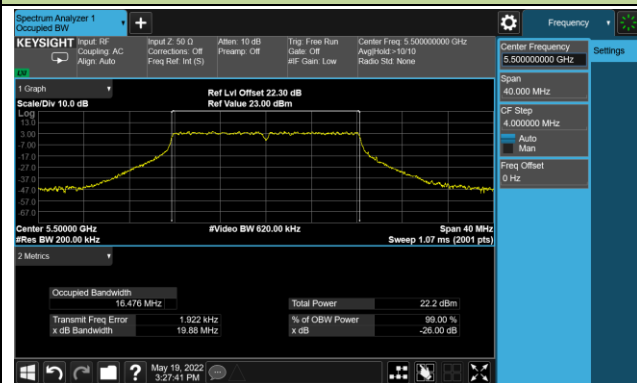
Channel 60 (5300MHz)



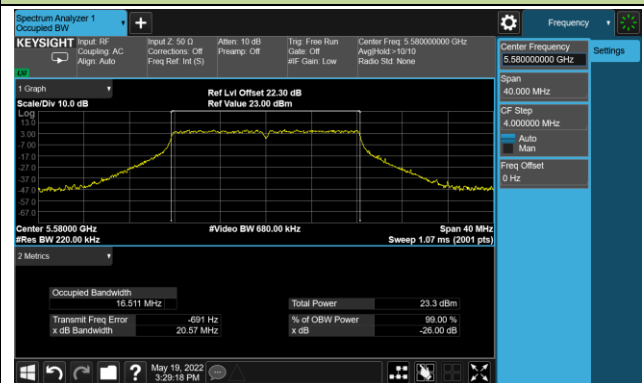
Channel 64 (5320MHz)



Channel 100 (5500MHz)

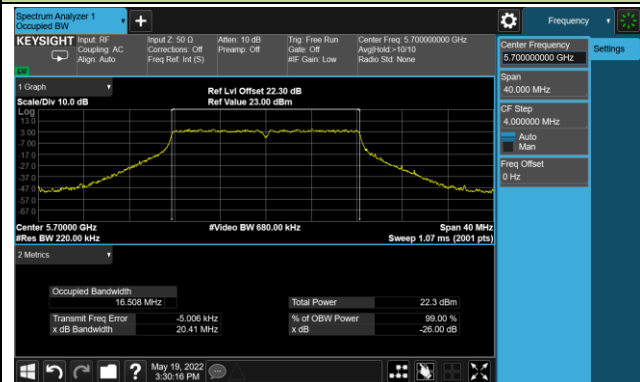


Channel 116 (5580MHz)

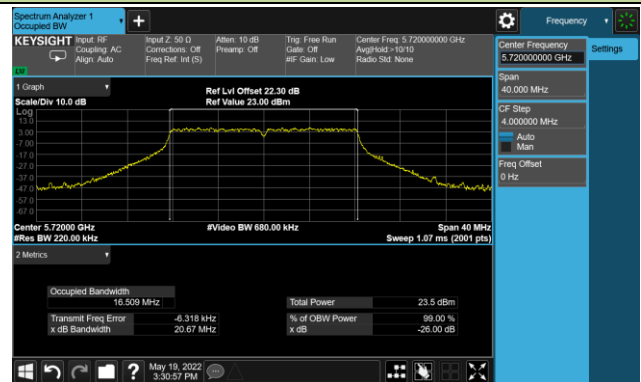


802.11a 26dB & 99% Bandwidth

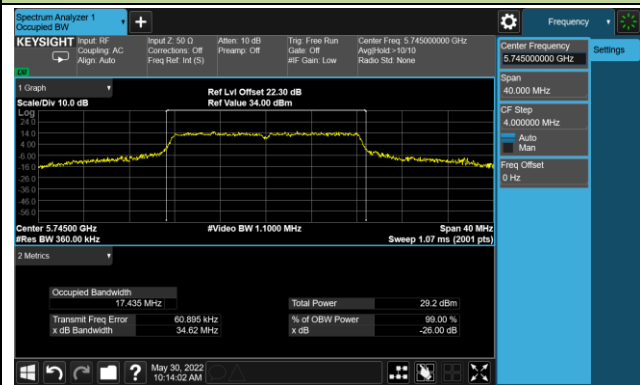
Channel 140 (5700MHz)



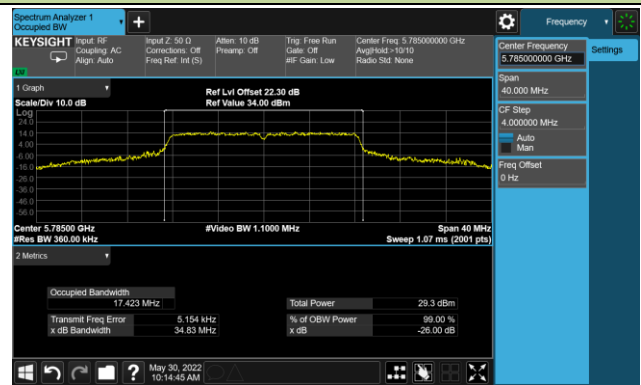
Channel 144(5720MHz)



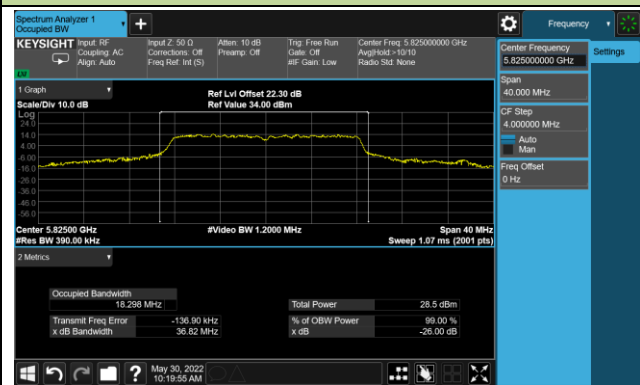
Channel 149 (5745MHz)



Channel 157 (5785MHz)

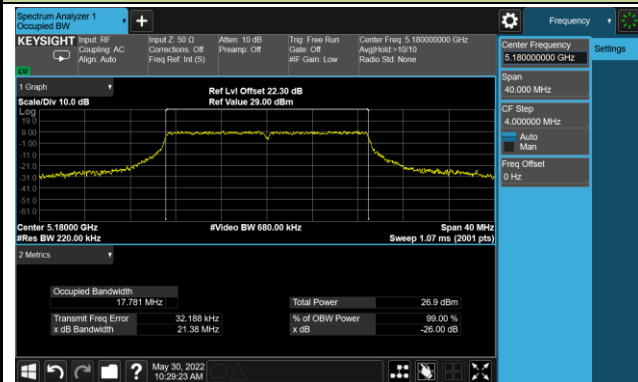


Channel 165 (5825MHz)

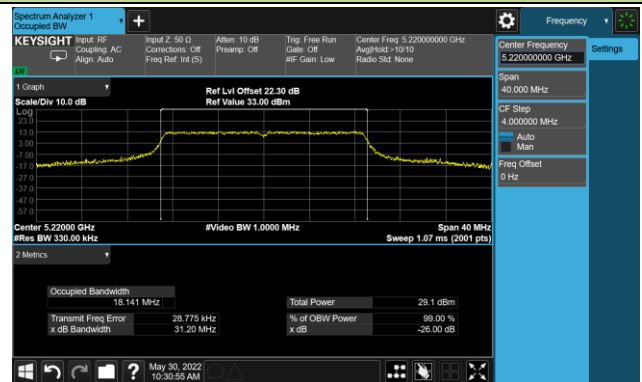


802.11ac-VHT20 26dB & 99% Bandwidth

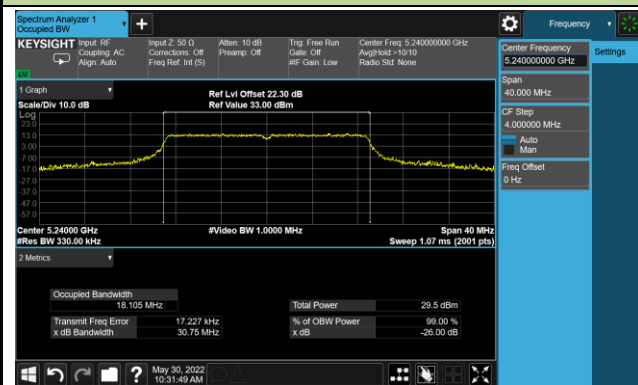
Channel 36 (5180MHz)



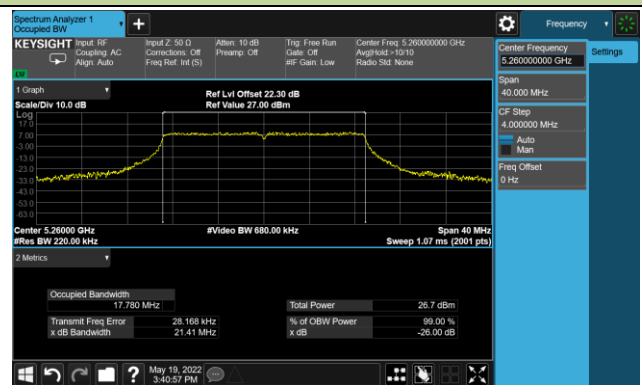
Channel 44 (5220MHz)



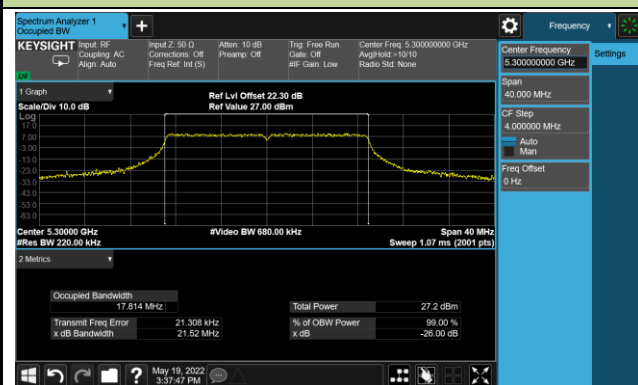
Channel 48 (5240MHz)



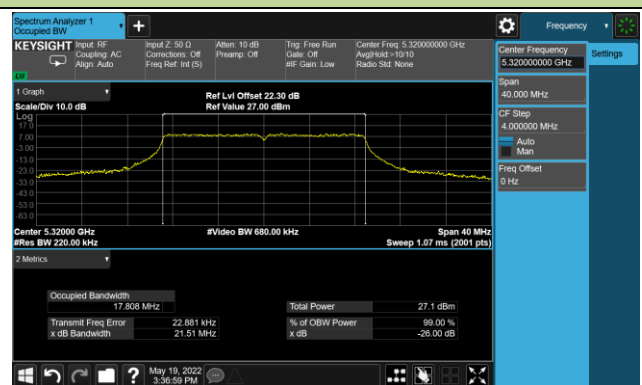
Channel 52 (5260MHz)



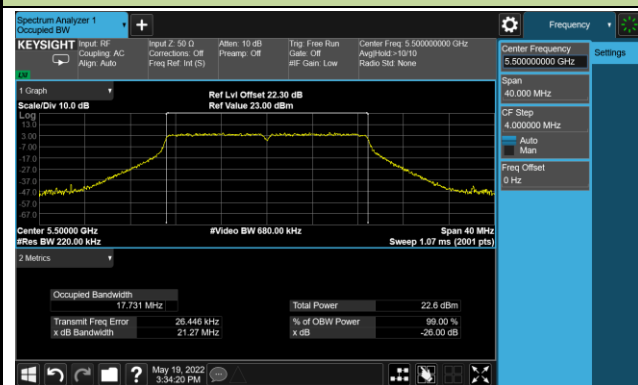
Channel 60 (5300MHz)



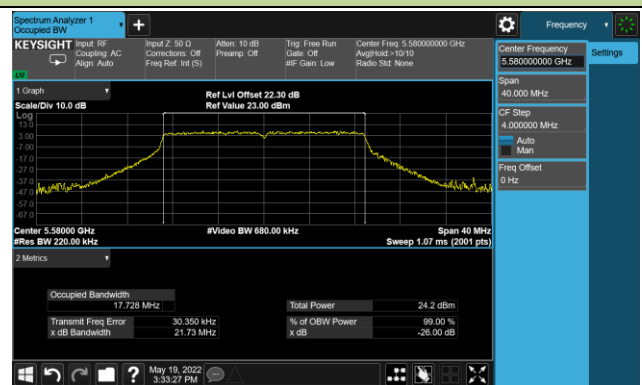
Channel 64 (5320MHz)



Channel 100 (5500MHz)

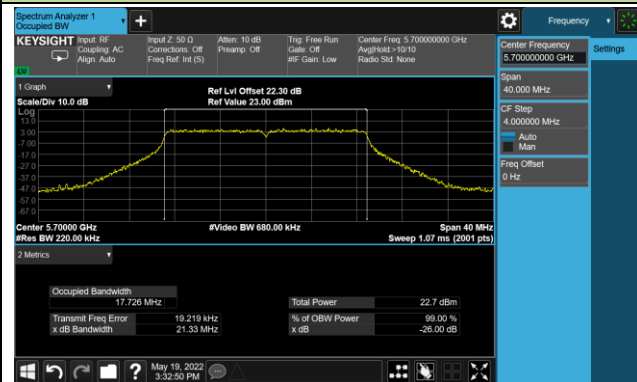


Channel 116 (5580MHz)

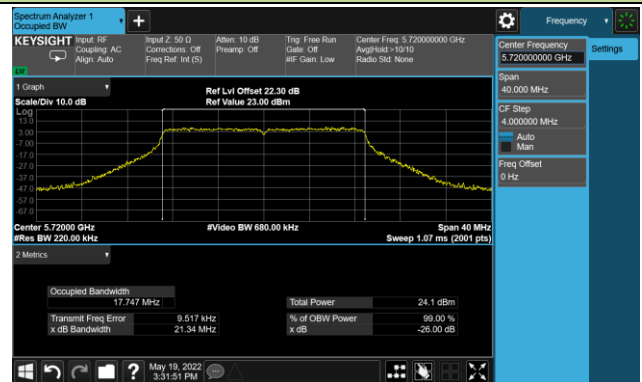


802.11ac-VHT20 26dB & 99% Bandwidth

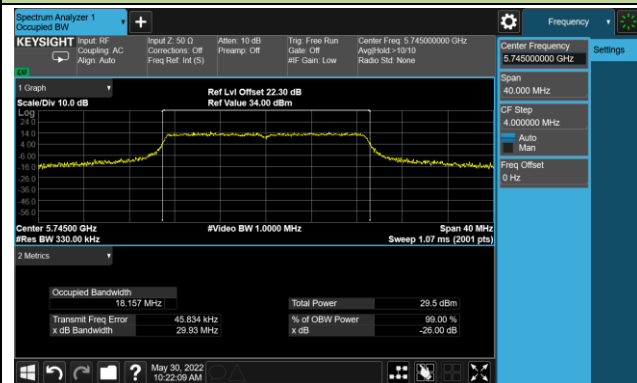
Channel 140 (5700MHz)



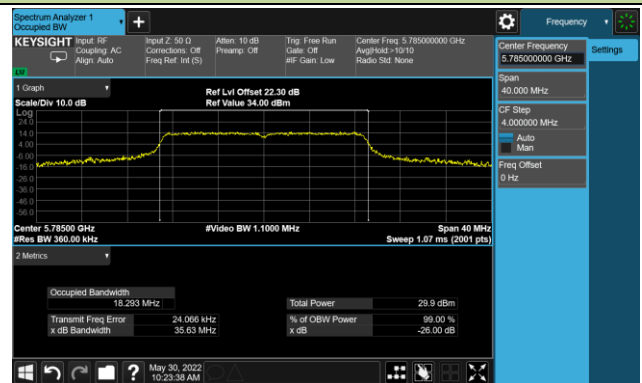
Channel 144(5720MHz)



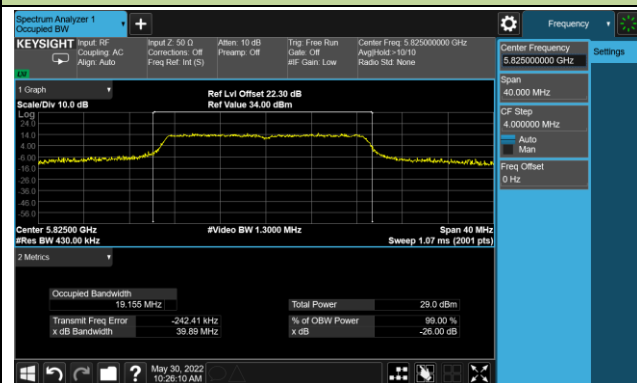
Channel 149 (5745MHz)



Channel 157 (5785MHz)

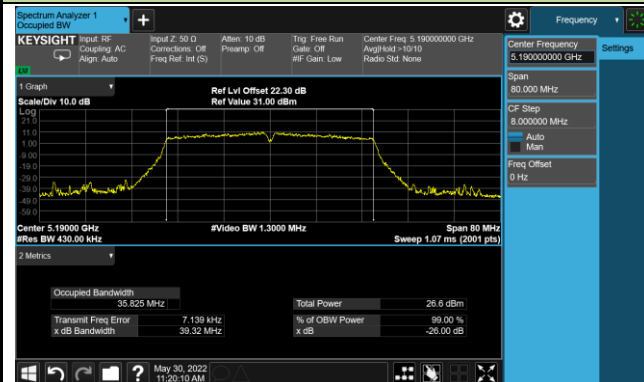


Channel 165 (5825MHz)



802.11ac-VHT40 26dB & 99% Bandwidth

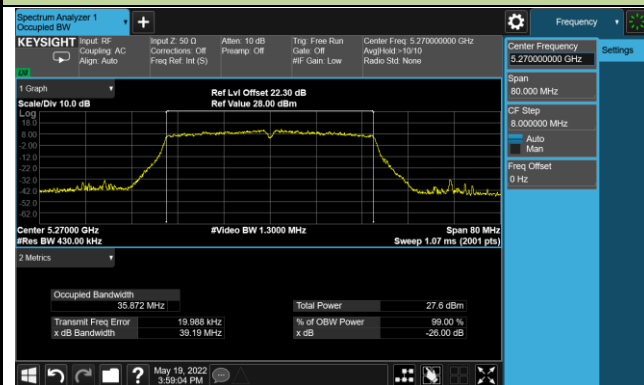
Channel 38 (5190MHz)



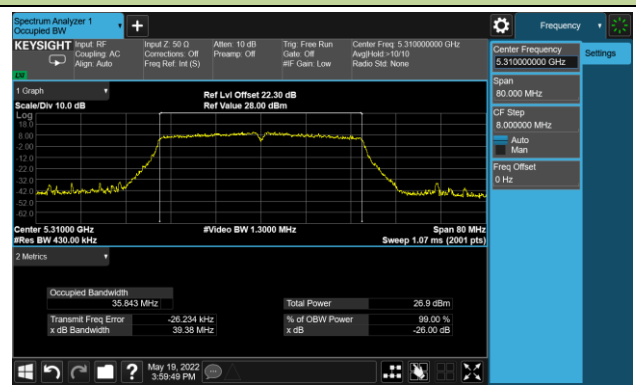
Channel 46 (5230MHz)



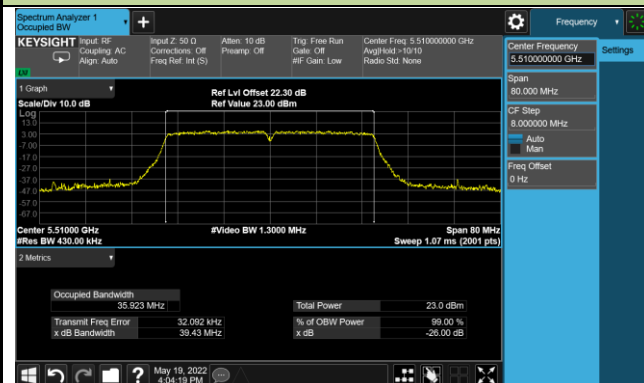
Channel 54 (5270MHz)



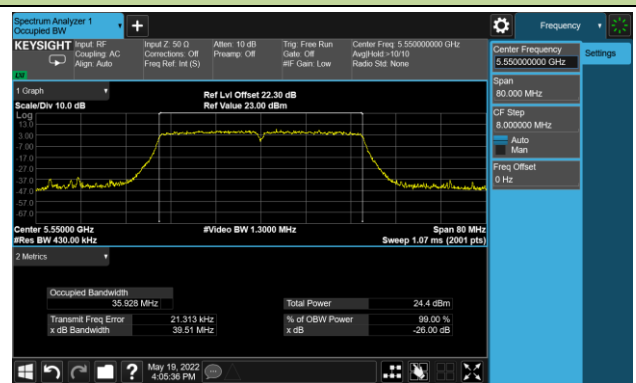
Channel 62 (5310MHz)



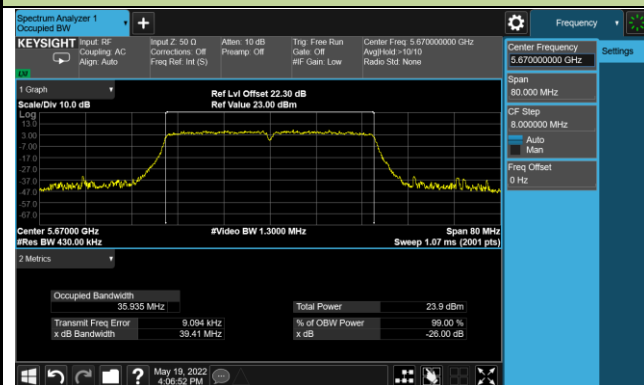
Channel 102 (5510MHz)



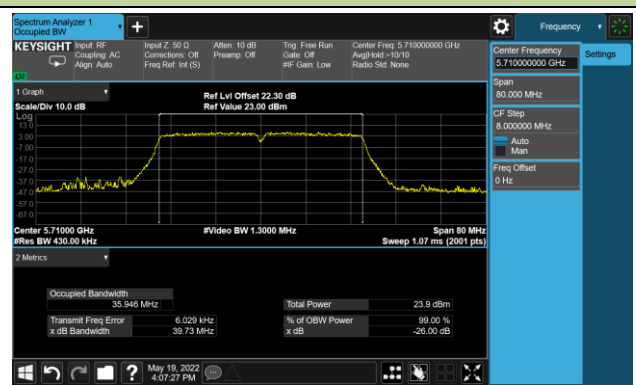
Channel 110 (5550MHz)



Channel 134 (5670MHz)

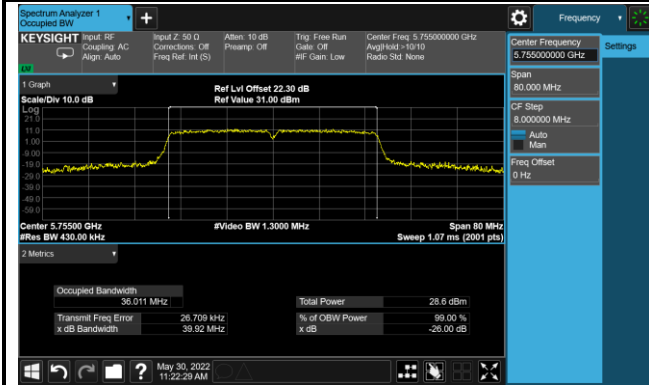


Channel 142(5710MHz)

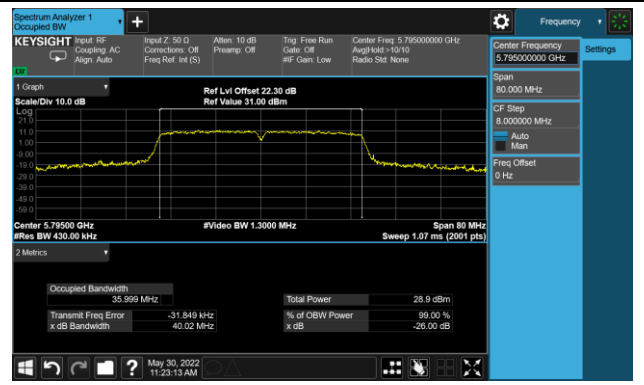


802.11ac-VHT40 26dB & 99% Bandwidth

Channel 151 (5755MHz)

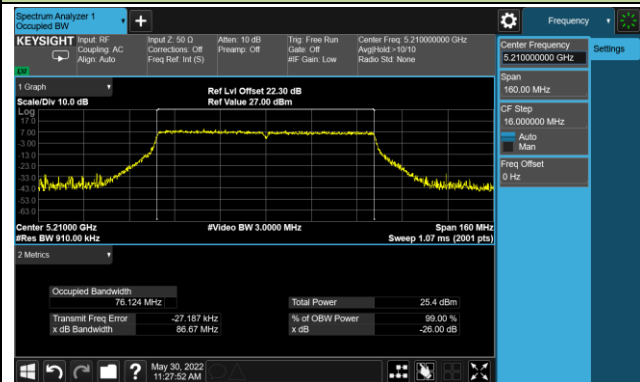


Channel 159 (5795MHz)

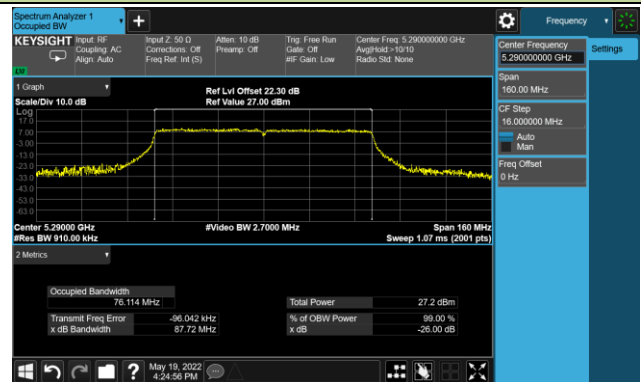


802.11ac-VHT80 26dB & 99% Bandwidth

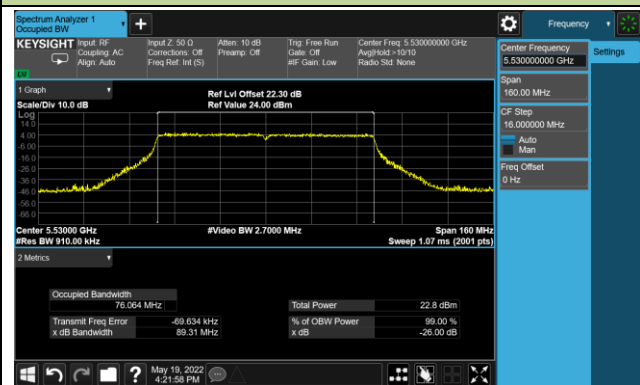
Channel 42 (5210MHz)



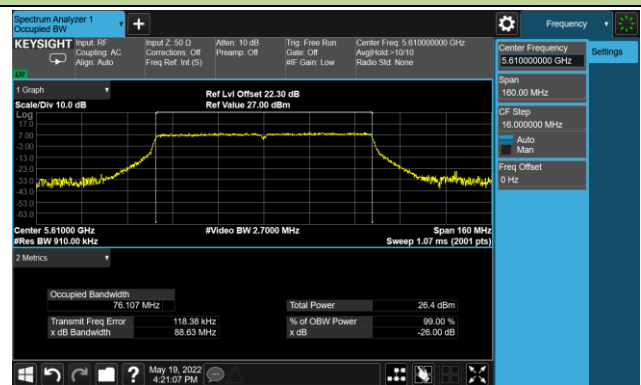
Channel 58 (5290MHz)



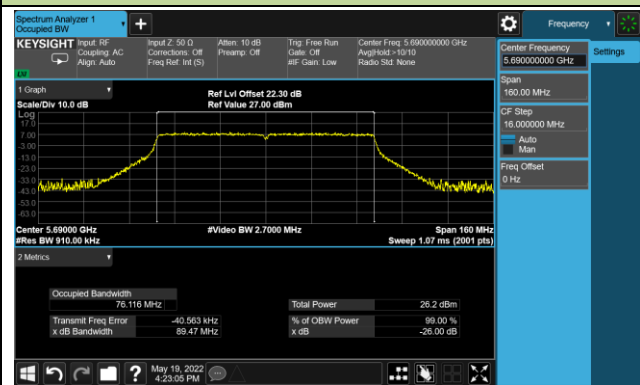
Channel 106 (5530MHz)



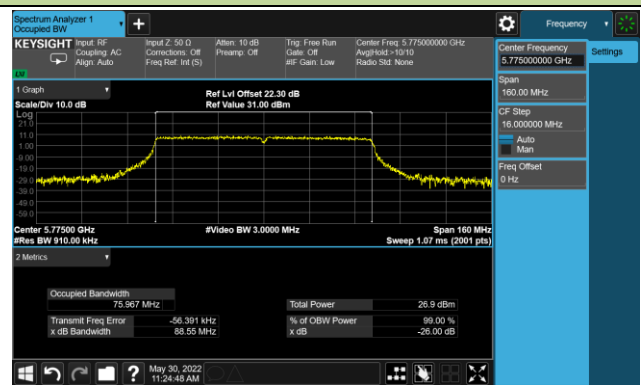
Channel 122 (5610MHz)

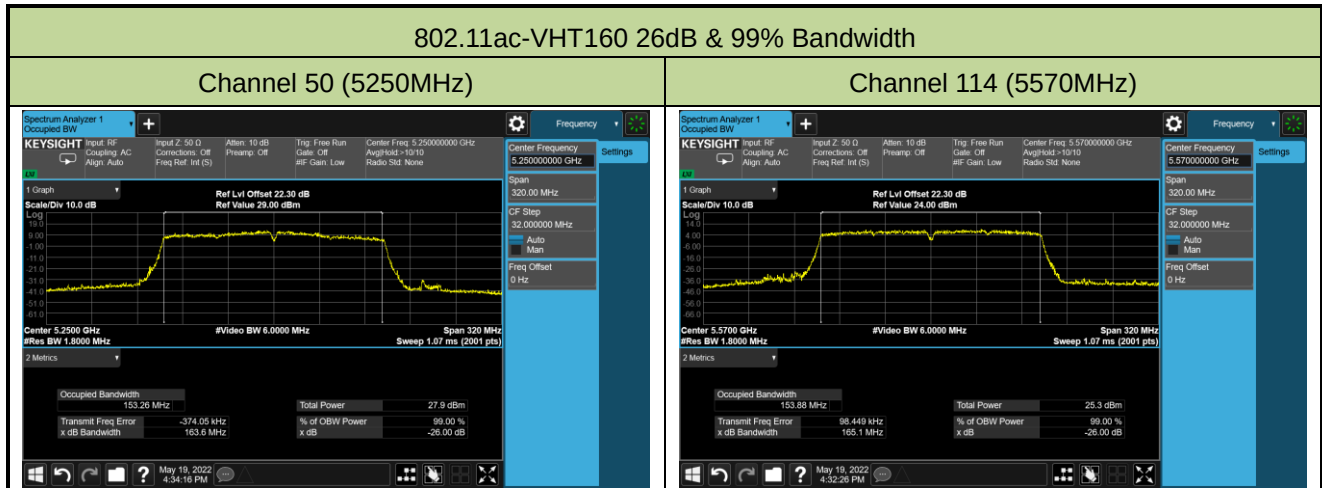


Channel 138 (5690MHz)



Channel 155 (5775MHz)



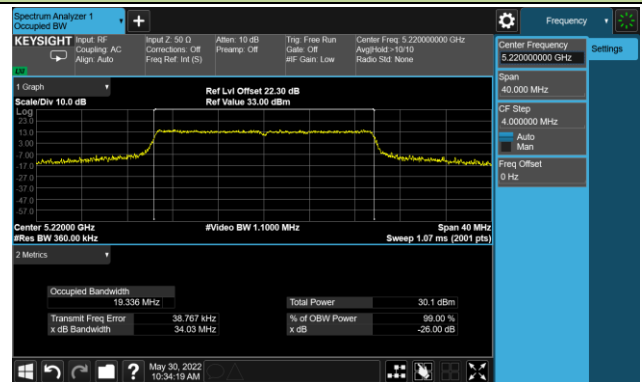


802.11ax-HE20 26dB & 99% Bandwidth

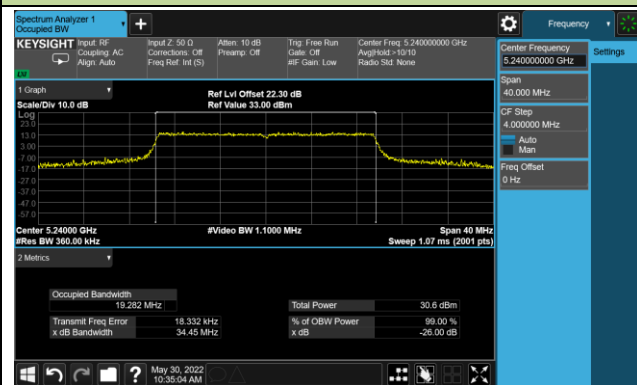
Channel 36 (5180MHz)



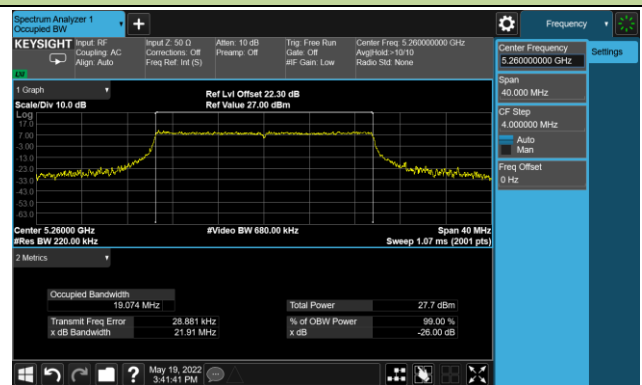
Channel 44 (5220MHz)



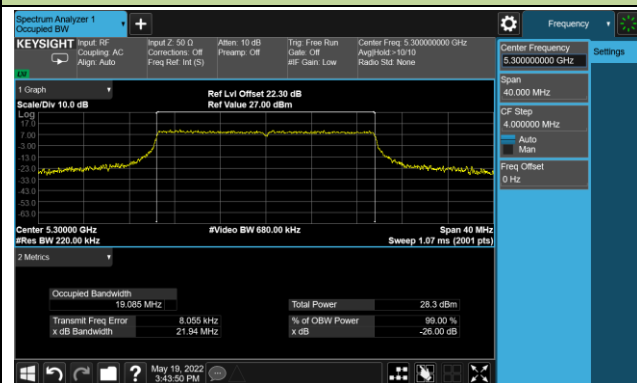
Channel 48 (5240MHz)



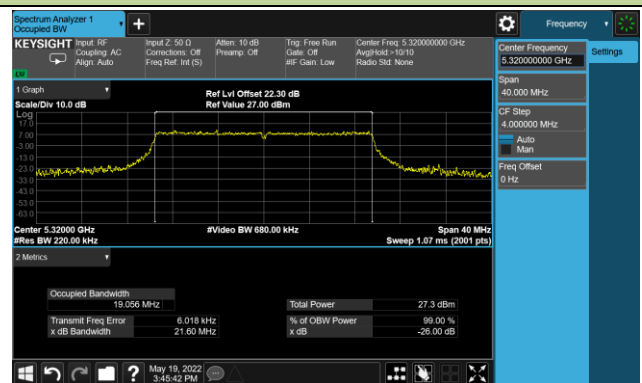
Channel 52 (5260MHz)



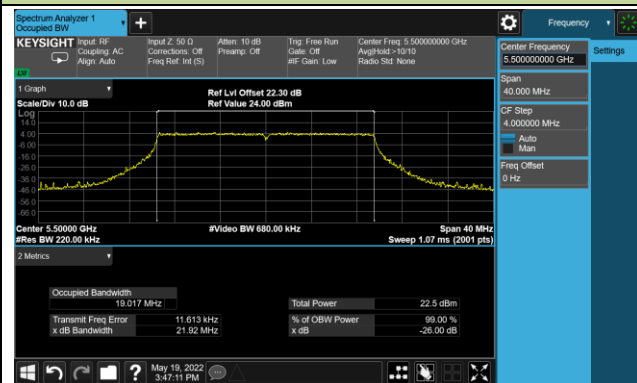
Channel 60 (5300MHz)



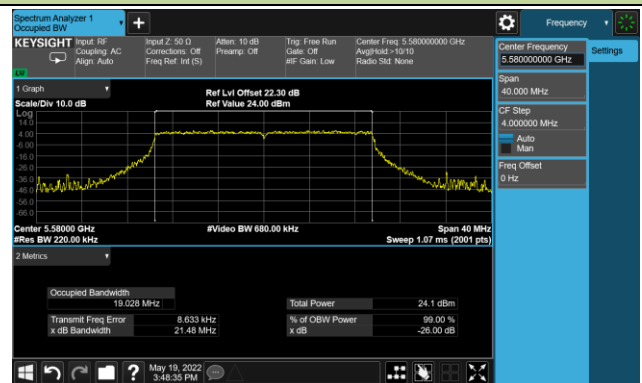
Channel 64 (5320MHz)



Channel 100 (5500MHz)

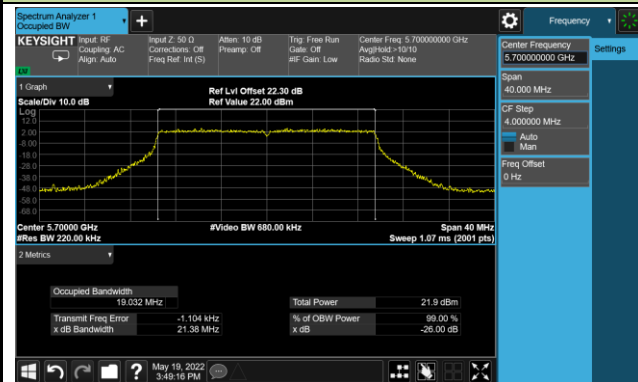


Channel 116 (5580MHz)

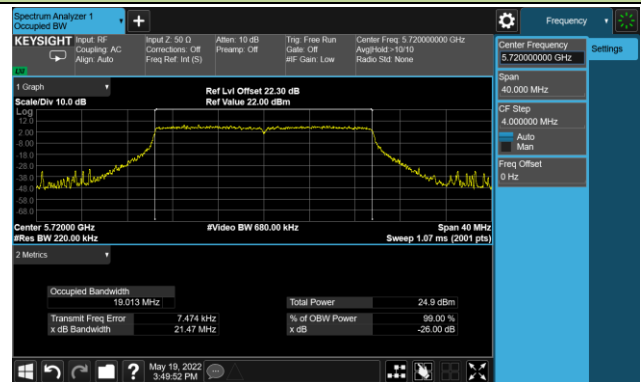


802.11ax-HE20 26dB & 99% Bandwidth

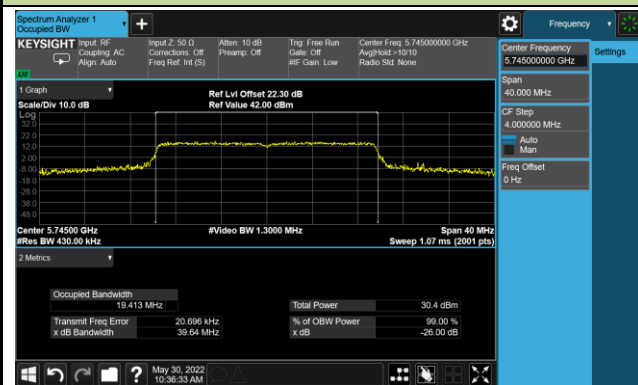
Channel 140 (5700MHz)



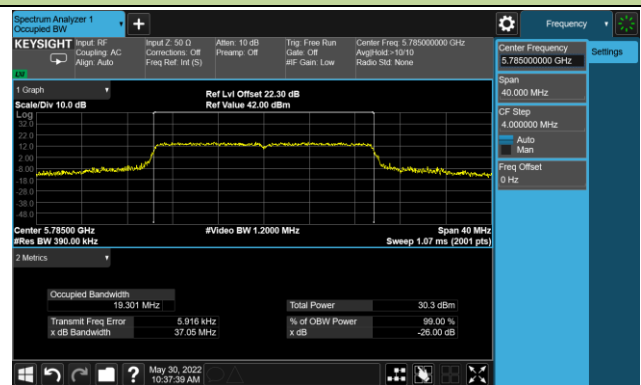
Channel 144(5720MHz)



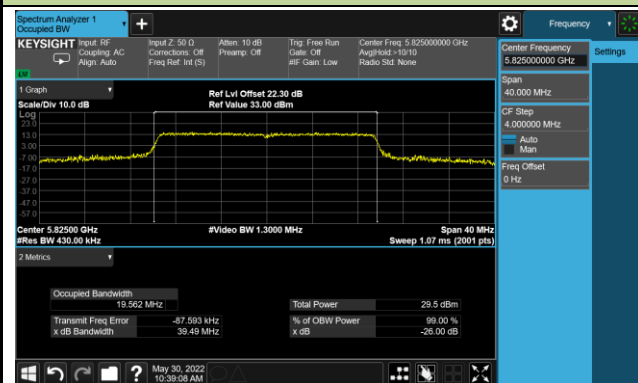
Channel 149 (5745MHz)



Channel 157 (5785MHz)

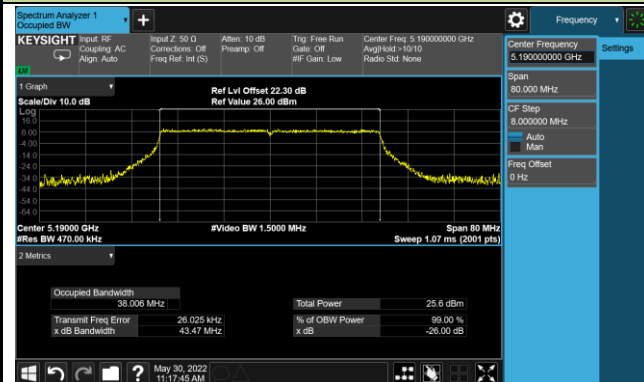


Channel 165 (5825MHz)

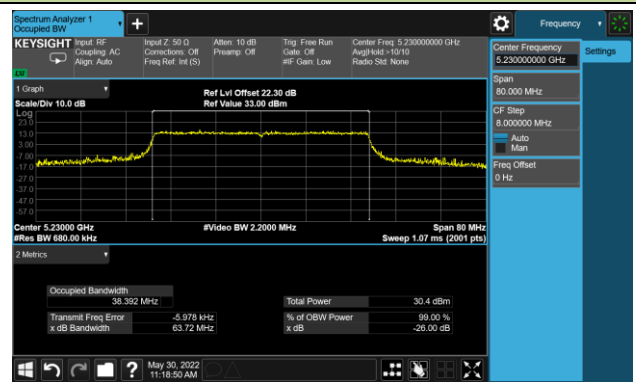


802.11ax-HE40 26dB & 99% Bandwidth

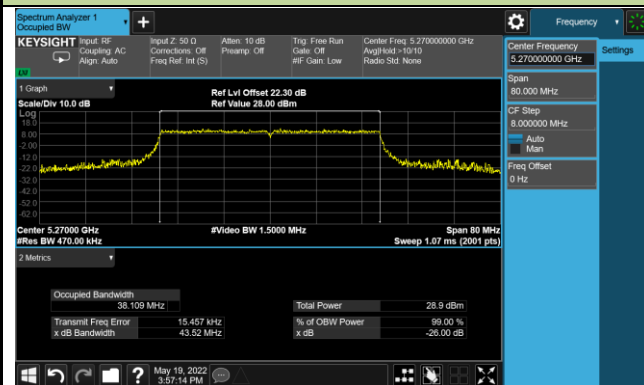
Channel 38 (5190MHz)



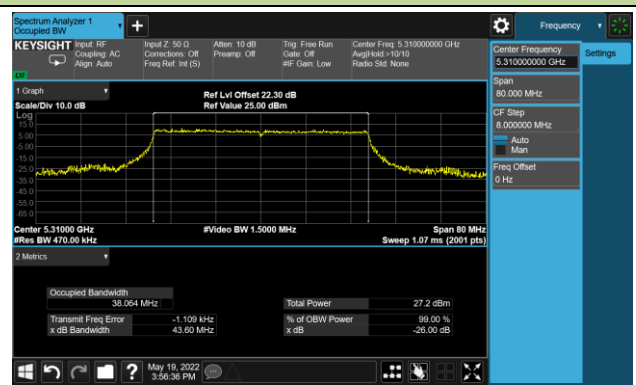
Channel 46 (5230MHz)



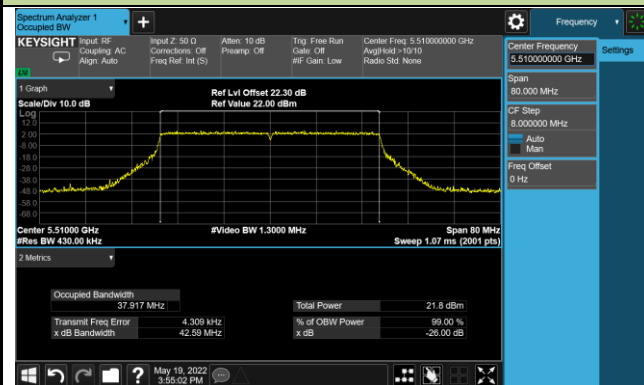
Channel 54 (5270MHz)



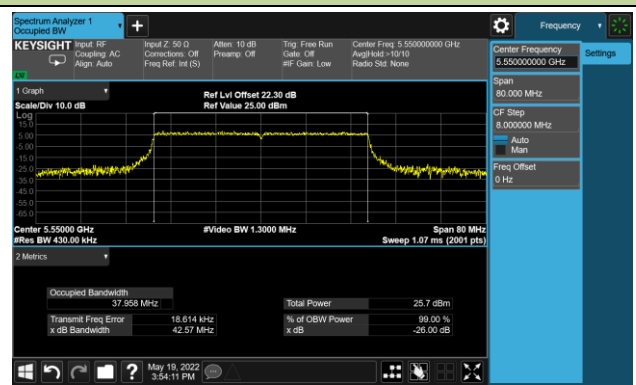
Channel 62 (5310MHz)



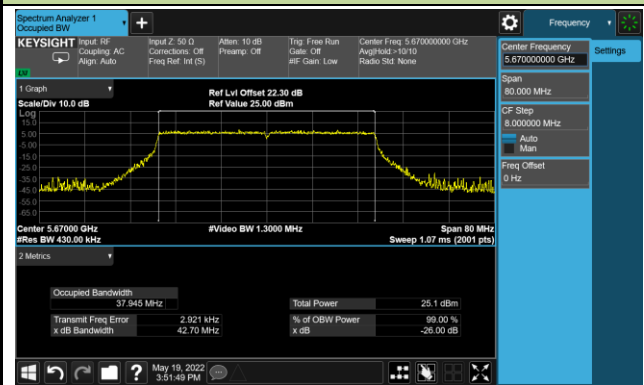
Channel 102 (5510MHz)



Channel 110 (5550MHz)



Channel 134 (5670MHz)



Channel 142(5710MHz)

