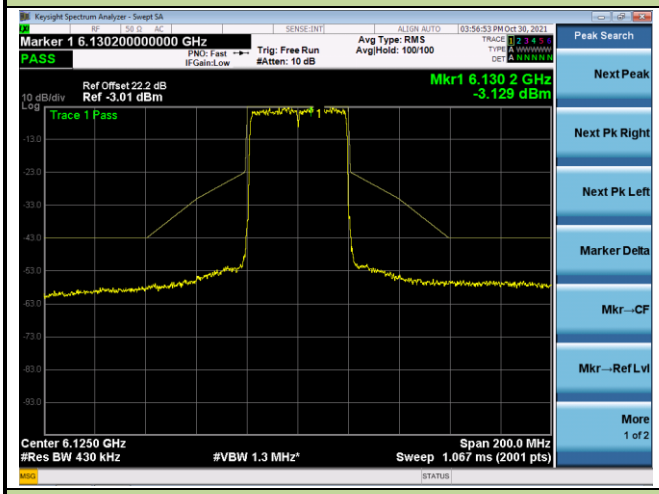
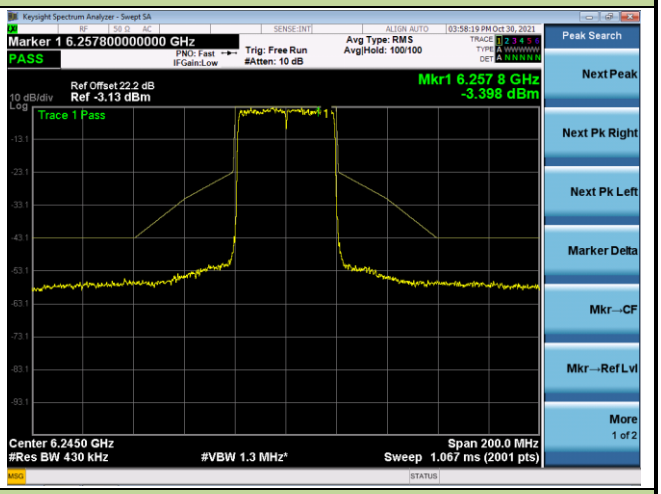
802.11ax-HE40 - Ant 1

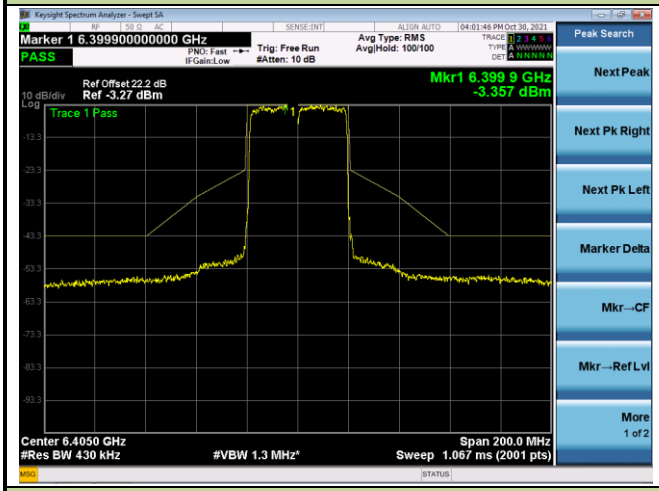
Channel 35 (6125MHz)



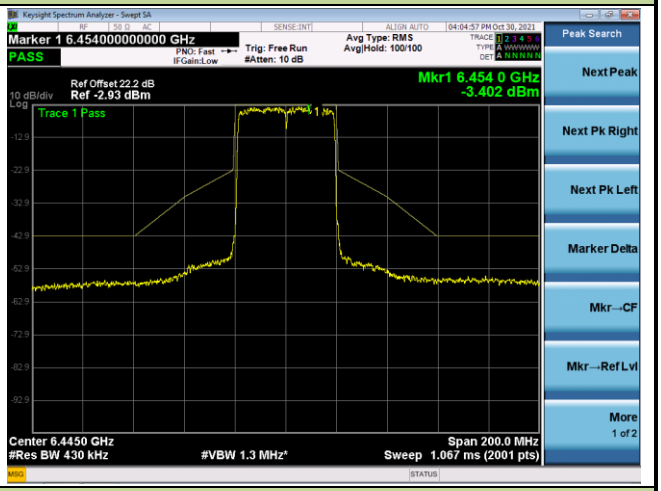
Channel 59 (6245MHz)



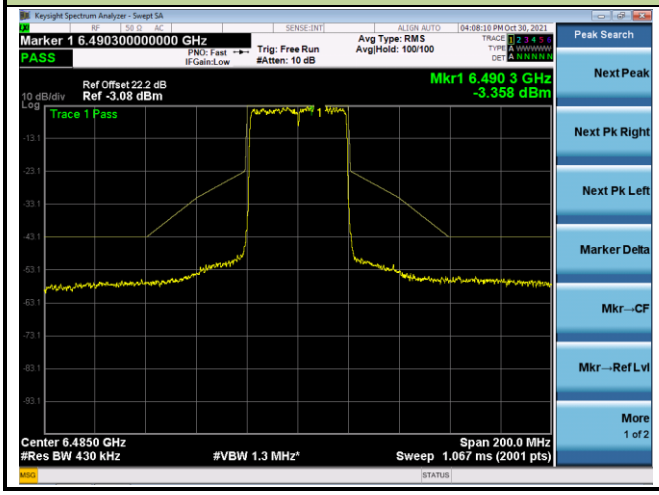
Channel 91 (6405MHz)



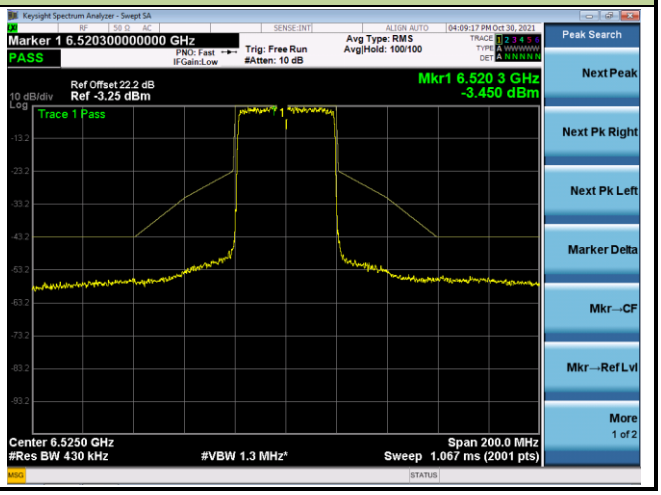
Channel 99 (6445MHz)



Channel 107 (6485MHz)

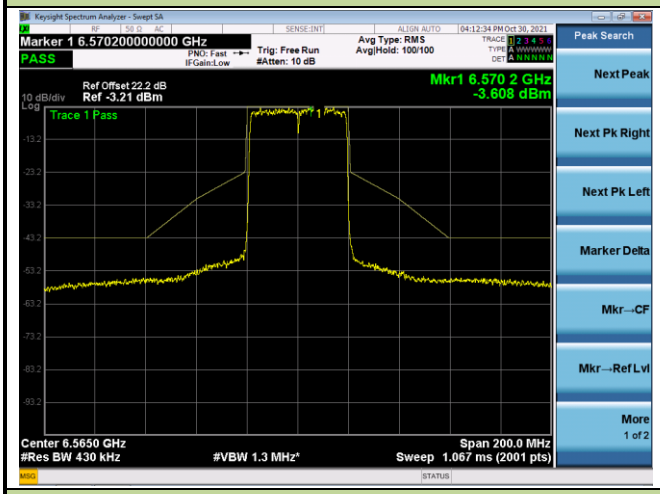


Channel 115 (6525MHz)

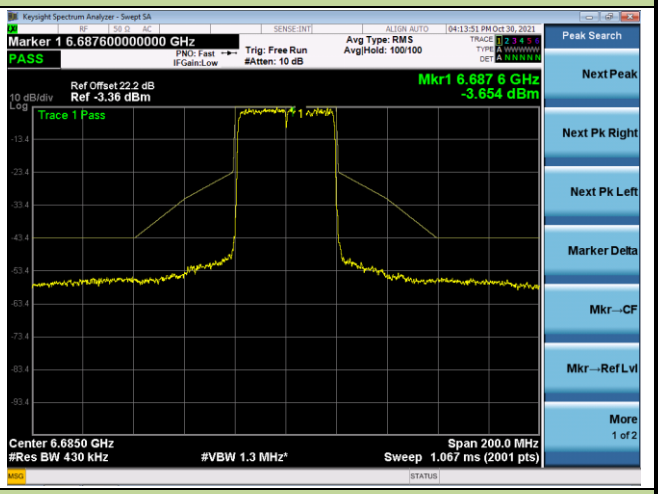


802.11ax-HE40 - Ant 1

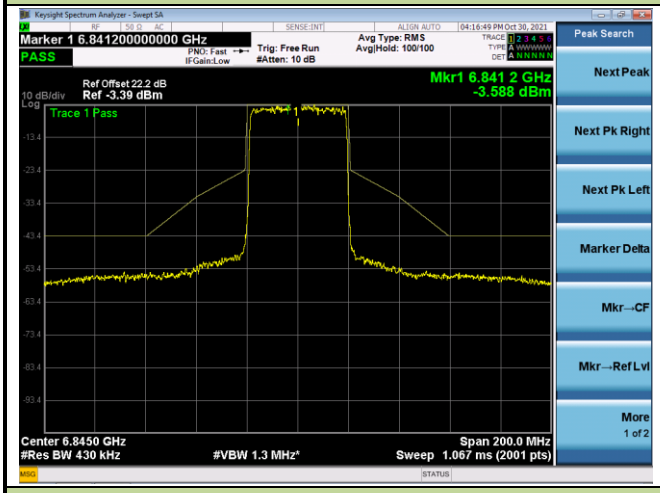
Channel 123 (6565MHz)



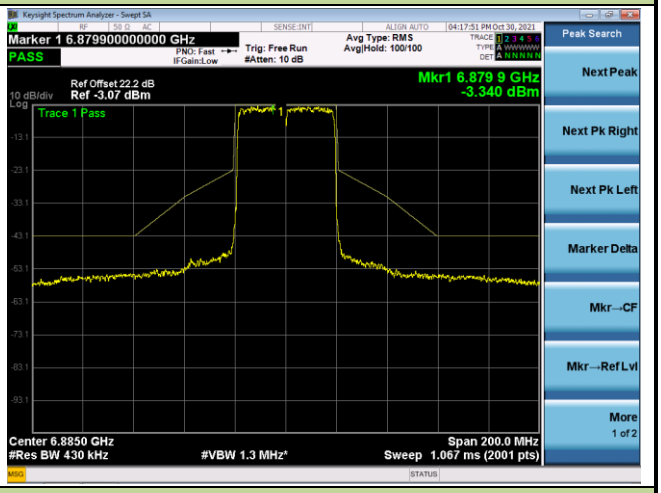
Channel 147 (6685MHz)



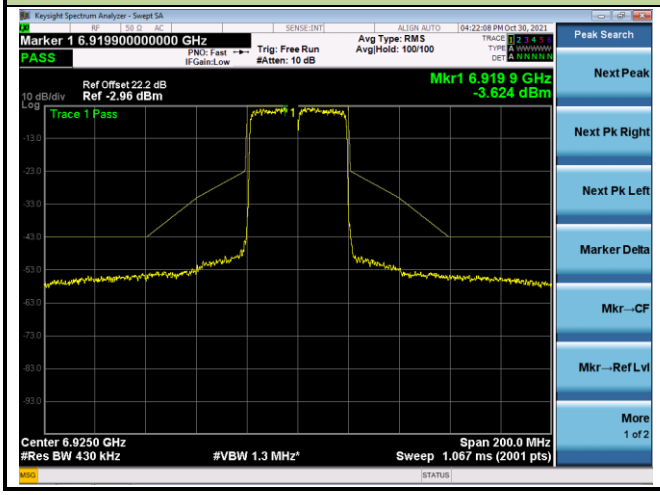
Channel 179 (6845MHz)



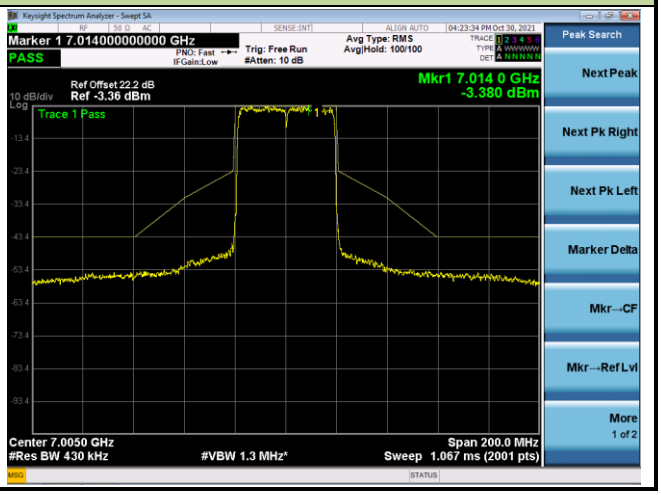
Channel 187 (6885MHz)

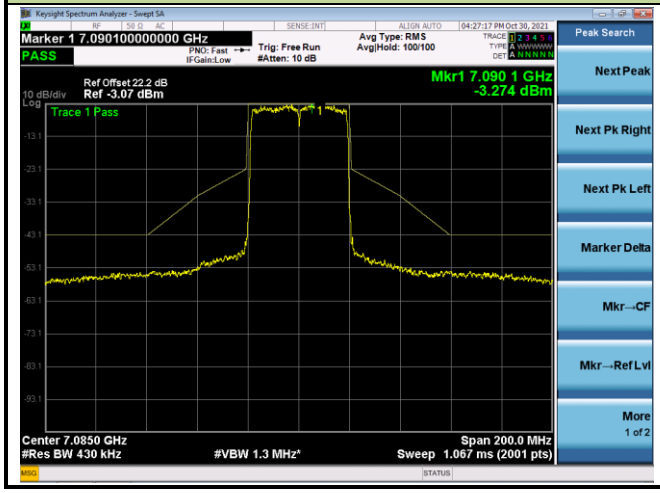


Channel 195 (6925MHz)



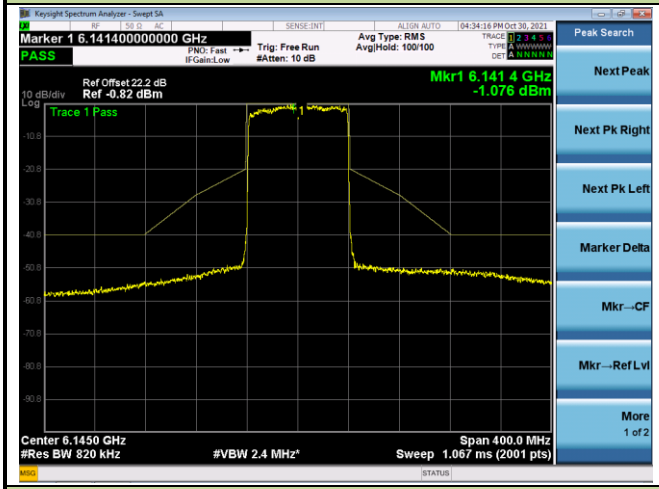
Channel 211 (7005MHz)



802.11ax-HE40 - Ant 1	
Channel 211 (7085MHz)	
	

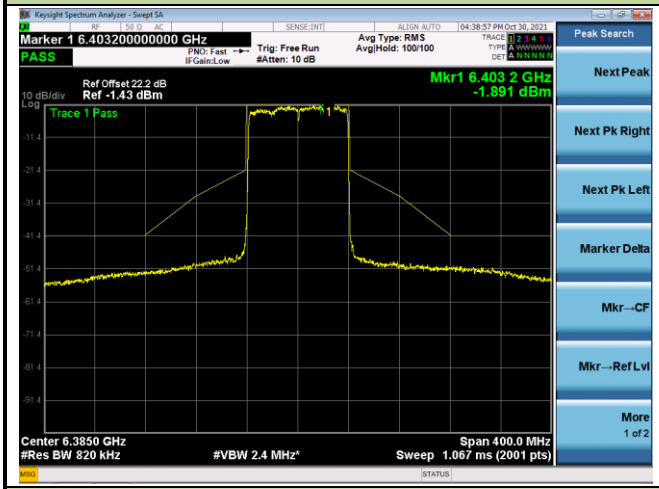
802.11ax-HE80 - Ant 1

Channel 39 (6145MHz)

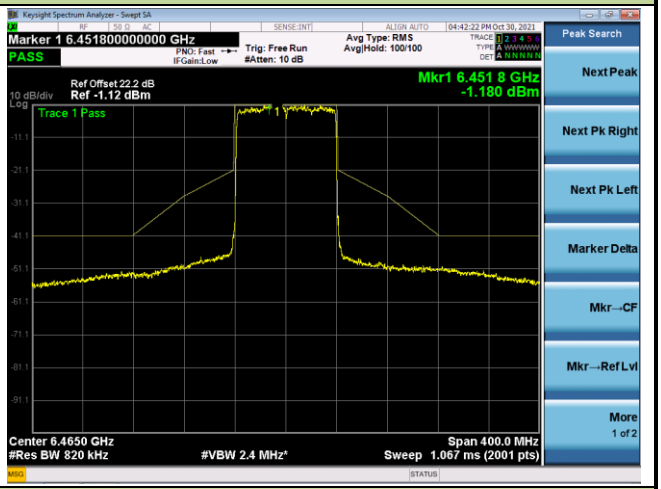


Channel 55 (6225MHz)

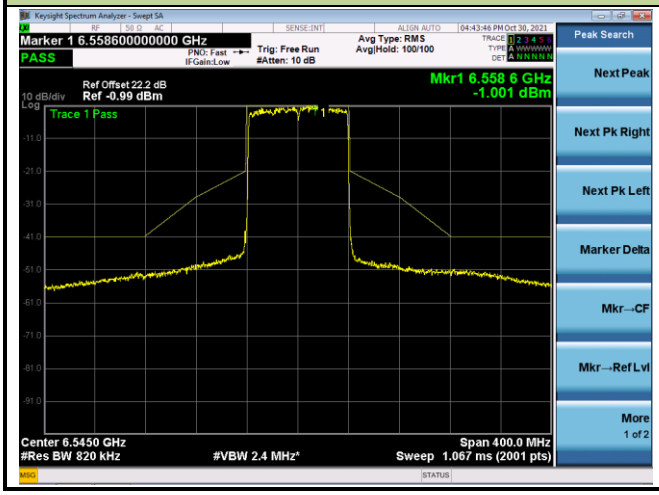
Channel 87 (6385MHz)



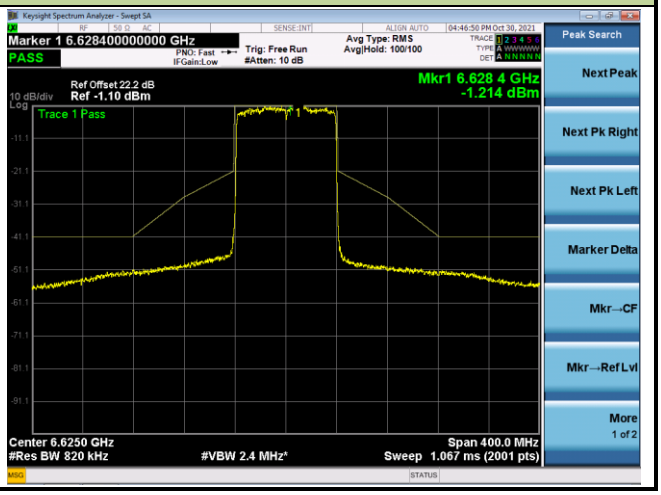
Channel 103 (6465MHz)

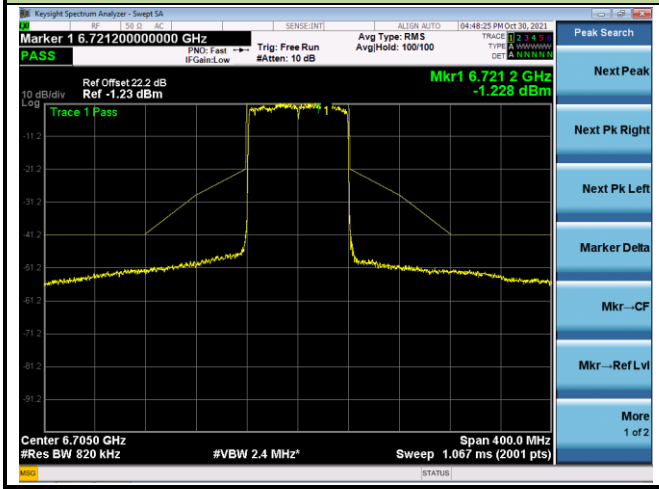
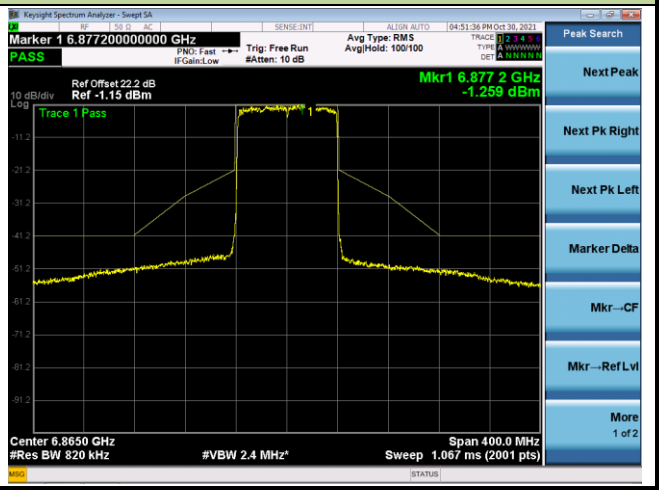
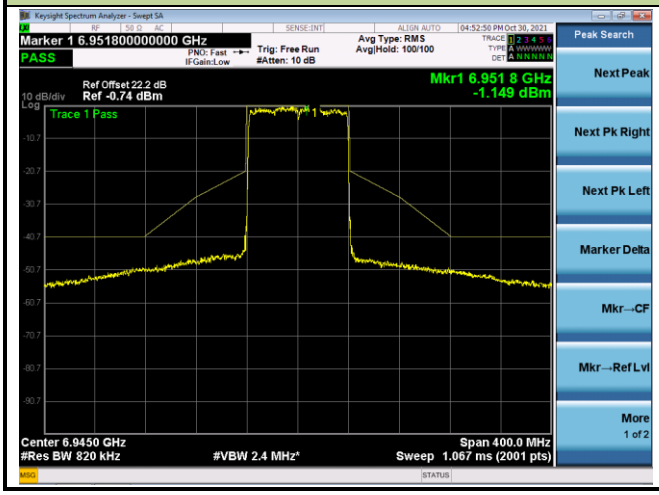
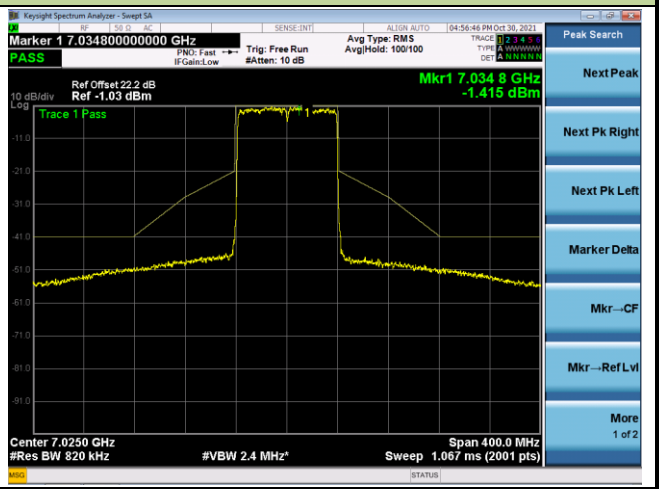


Channel 119 (6545MHz)



Channel 135 (6625MHz)

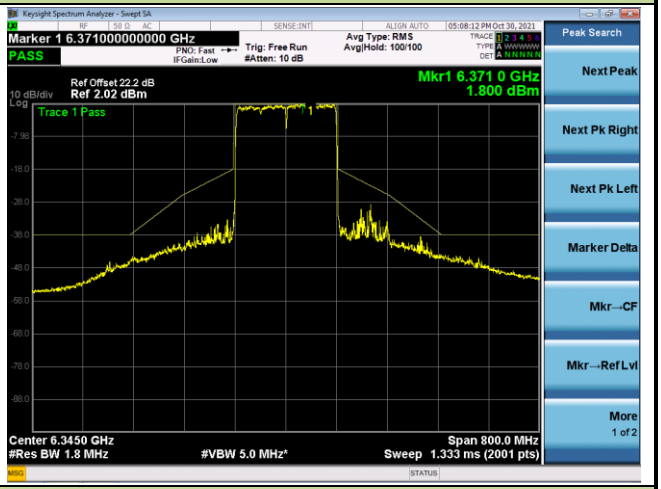


802.11ax-HE80 - Ant 1	
Channel 151 (6705MHz)	Channel 183 (6865MHz)
	
Channel 199 (6945MHz)	Channel 215 (7025MHz)
	

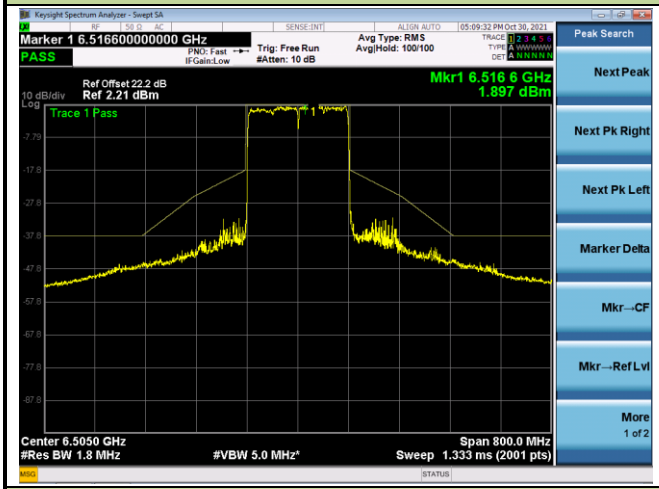
802.11ax-HE160 - Ant 1

Channel 47 (6185MHz)

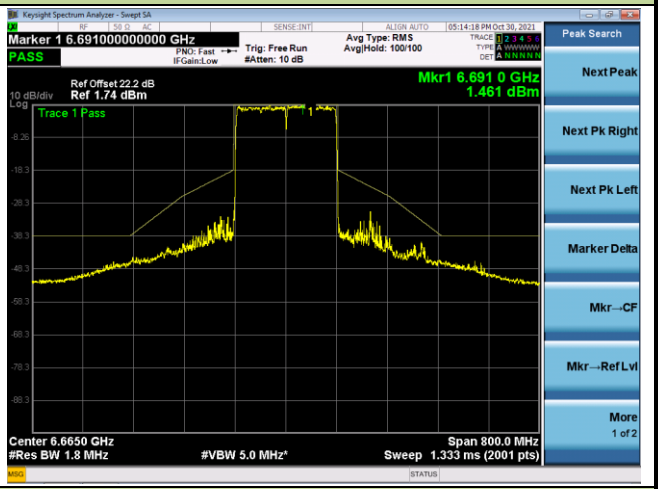
Channel 79 (6345MHz)



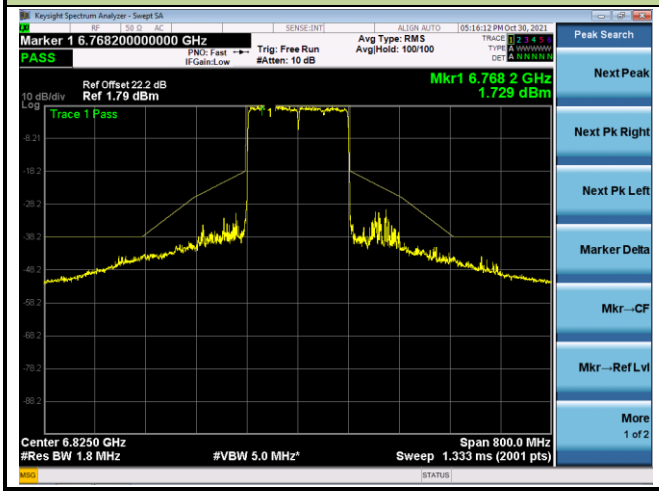
Channel 111 (6505MHz)



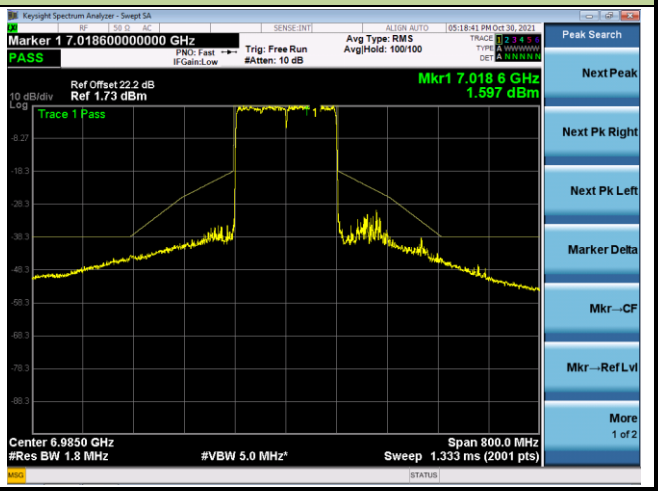
Channel 143 (6665MHz)



Channel 175 (6825MHz)



Channel 207 (6985MHz)



6.6. Frequency Stability Measurement

6.6.1.Test Limit

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

6.6.2.Test Procedure Used

Frequency Stability Under Temperature Variations:

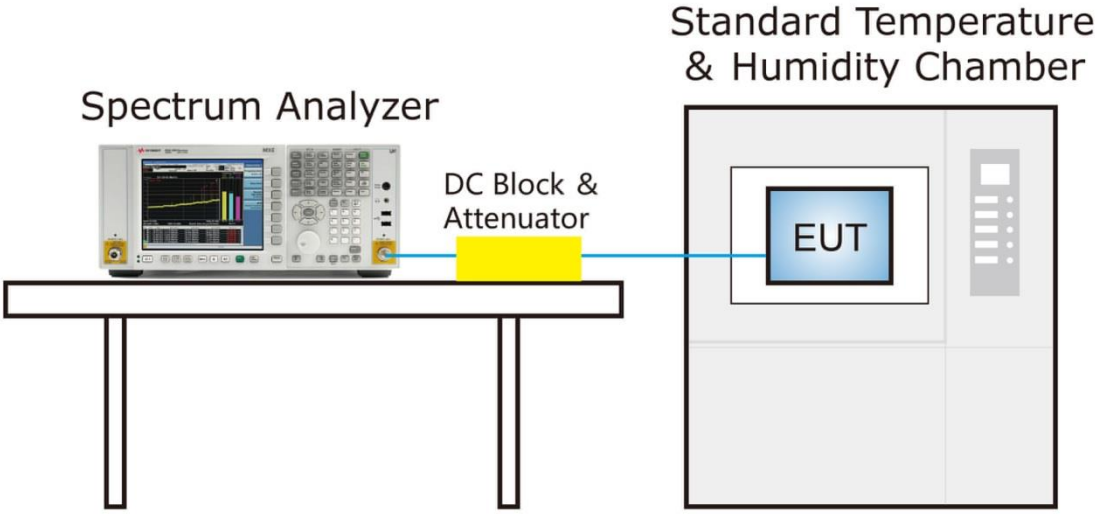
The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain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

Frequency Stability Under Voltage Variations:

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

Reduce the input voltage to specify extreme voltage variation (±15%) and endpoint, recordthe maximum frequency change.

6.6.3.Test Setup



6.6.4.Test Result

Test Site	WZ-TR3	Test Engineer	Dandy Li
Test Date	2021/10/20		
Test Mode	6115MHz (Carrier Mode)		

Voltage (%)	Power (VAC)	Temp (°C)	Frequency Tolerance (ppm)			
			0 minutes	2 minutes	5 minutes	10 minutes
100	120	- 30	2.75	2.74	2.72	2.70
		- 20	2.55	2.60	2.66	2.26
		- 10	2.58	2.45	2.58	2.53
		0	0.58	0.63	0.70	0.77
		+ 10	0.80	0.85	0.93	0.97
		+ 20	1.00	1.15	1.33	1.39
		+ 30	1.44	1.48	1.53	1.59
		+ 40	1.86	1.90	1.93	2.02
		+ 50	2.08	2.11	2.16	2.22
115	138	+ 20	2.25	2.31	2.33	2.35
85	102	+ 20	2.38	2.42	2.49	2.53

Note: Frequency Tolerance (ppm) = {[Measured Frequency (Hz) - Declared Frequency (Hz)] / Declared Frequency (Hz)} $*10^6$.

6.7. Contention Based Protocol

6.7.1.Test Limit

Unlicensed indoor low power device must detect co-channel radio frequency power that is at least -62dBm (The threshold is referenced to a 0dBi antenna gain.) or low.

Indoor low power device must detect an AWGN signal with 90% (or better) level of certainty.

6.7.2.Test Procedure Used

KDB 987594 D02v01- Section I

6.7.3.Test Setting

1. Configure the EUT to transmit with a constant duty cycle.

2. Set the operating parameters of the EUT including power level, operating frequency, modulation and bandwidth.

3. Set the signal analyzer center frequency to the nominal EUT channel center frequency. The span range of the signal analyzer shall be between two times and five times the OBW of the EUT. Connect the output port of the EUT to the signal analyzer 2. Ensure that the attenuator 2 provides enough attenuation to not overload the signal analyzer 2 receiver.

4. Monitoring the signal analyzer 2, verify the EUT is operating and transmitting with the parameters set at step two.

5. Using an AWGN signal source, generate a 10 MHz-wide AWGN signal. Use Table 1 of KDB 987594 to determine the center frequency of the 10 MHz AWGN signal relative to the EUT's channel bandwidth and center frequency.

6. Set the AWGN signal power to an extremely low level. Connect the AWGN signal source, via a 3-dB splitter, to the signal analyzer 1 and the EUT as shown in below figure.

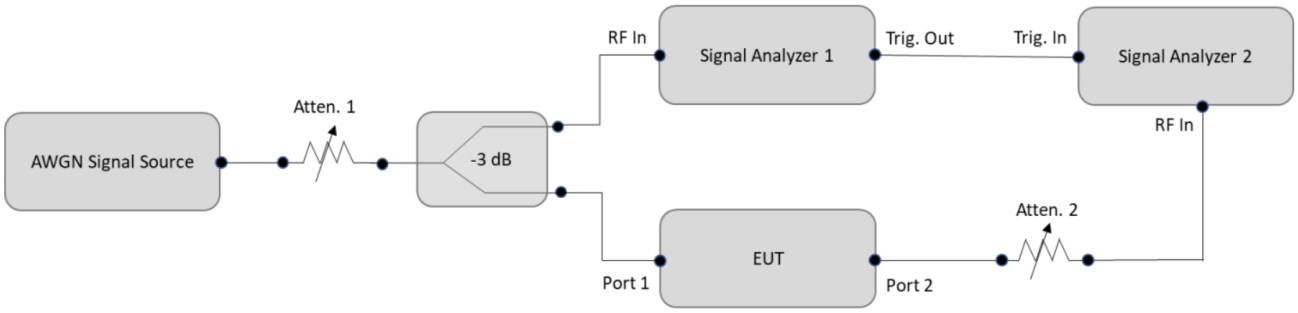
7. Transmit the AWGN signal (RF ON) and verify its characteristics on the signal analyzer 1.

8. Monitor the signal analyzer 2 to verify if the AWGN signal has been detected and the EUT has ceased transmission. If the EUT continues to transmit, then incrementally increase the AWGN signal power level until the EUT stops transmitting.

9. Determine and record the AWGN signal power level (at the EUT's antenna port) at which the EUT ceased transmission. Repeat the procedure at least 10 times to verify the EUT can detect an AWGN signal with 90% (or better) level of certainty.

10. Refer to Table 1 to determine number of times the detection threshold testing needs to be repeated. If testing is required more than once, then go back to step 5, choose a different center frequency for the AWGN signal and repeat the process.

6.7.4.Test Setup



6.7.5.Test Result

Test Site	WZ-SR5	Test Engineer	Liz Yuan
Test Date	2022/01/08		

Test Channel	Bandwidth (MHz)	Freq. (MHz)	Interference Freq. (MHz)	AWGN Level (dBm)	Detected Number	Detection Probability (%)	Limit (%)	Test Result
Operation Band: U-NII 5								
33	20	6115	6115	-84	10	100	90	Pass
47	160	6185	6110	-84	10	100	90	Pass
47	160	6185	6185	-85	10	100	90	Pass
47	160	6185	6260	-86	10	100	90	Pass
Operation Band: U-NII 6								
97	20	6435	6435	-89	10	100	90	Pass
103	80	6465	6430	-87	10	100	90	Pass
103	80	6465	6465	-88	10	100	90	Pass
103	80	6465	6500	-88	10	100	90	Pass
Operation Band: U-NII 7								
153	20	6715	6715	-87	10	100	90	Pass
143	160	6665	6590	-88	10	100	90	Pass
143	160	6665	6665	-86	10	100	90	Pass
143	160	6665	6740	-85	10	100	90	Pass
Operation Band: U-NII 8								
213	20	7015	7015	-82	10	100	90	Pass
207	160	6985	6910	-86	10	100	90	Pass
207	160	6985	6985	-87	10	100	90	Pass
207	160	6985	7060	-88	10	100	90	Pass

Note: Due to the Interference level is too low, so when we test, we use amplifier to calibration the signal.

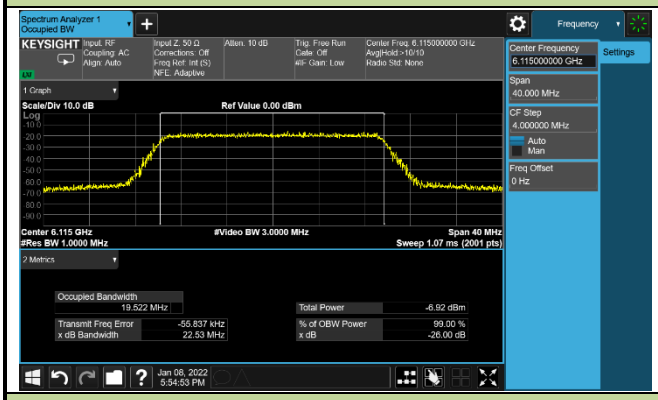
Test Site	WZ-SR5	Test Engineer	Liz Yuan
Test Date	2022/01/08		
Remark	Lowest Interference (AWGN) Level Check		

Test Channel	Bandwidth (MHz)	Freq. (MHz)	Interference Freq. (MHz)	AWGN Level (dBm)	EUT Status
Operation Band: U-NII 5					
33	20	6115	6115	-84	Ceased
				-85	Minimal
47	160	6185	6110	-84	Ceased
				-85	Minimal
47	160	6185	6185	-85	Ceased
				-86	Minimal
47	160	6185	6260	-86	Ceased
				-87	Minimal
Operation Band: U-NII 6					
97	20	6435	6435	-89	Ceased
				-90	Minimal
103	80	6465	6430	-87	Ceased
				-88	Minimal
103	80	6465	6465	-88	Ceased
				-89	Minimal
103	80	6465	6500	-88	Ceased
				-89	Minimal
Operation Band: U-NII 7					
153	20	6715	6715	-87	Ceased
				-88	Minimal
143	160	6665	6590	-88	Ceased
				-89	Minimal
143	160	6665	6665	-86	Ceased
				-87	Minimal
143	160	6665	6740	-85	Ceased
				-86	Minimal

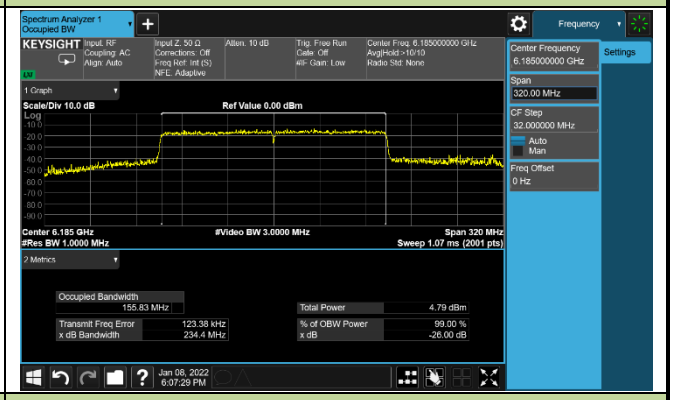
Test Channel	Bandwidth (MHz)	Freq. (MHz)	Interference Freq. (MHz)	AWGN Level (dBm)	EUT Status
Operation Band: U-NII 8					
213	20	7015	7015	-82	Ceased
				-83	Minimal
207	160	6985	6910	-86	Ceased
				-87	Minimal
207	160	6985	6985	-87	Ceased
				-88	Minimal
207	160	6985	7060	-88	Ceased
				-89	Minimal

EUT Tx Waveform

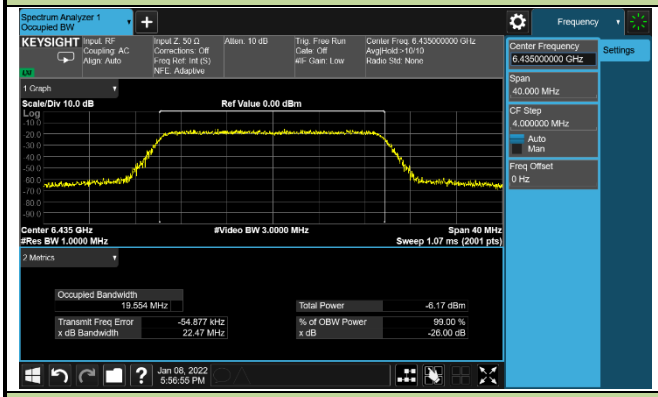
802.11ax-HE20 / CH33



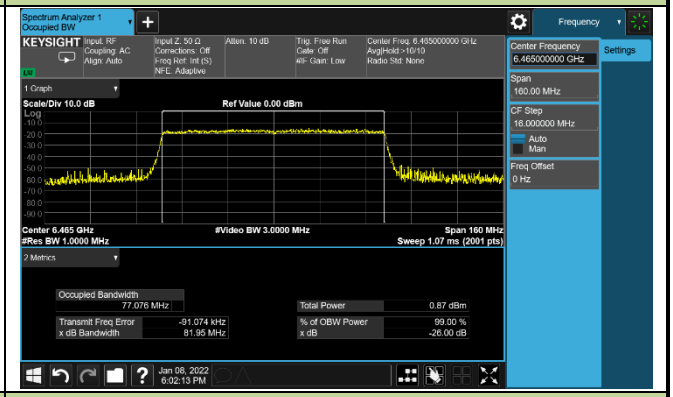
802.11ax-HE160 / CH47



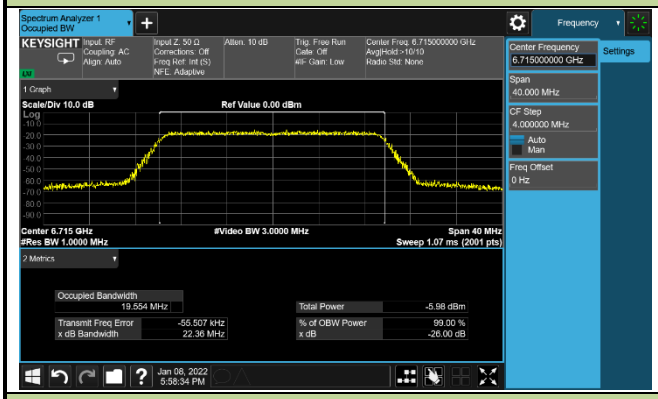
802.11ax-HE20 / CH97



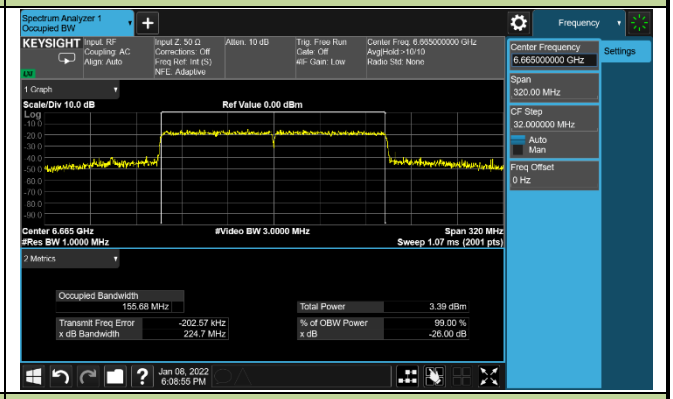
802.11ax-HE80 / CH103



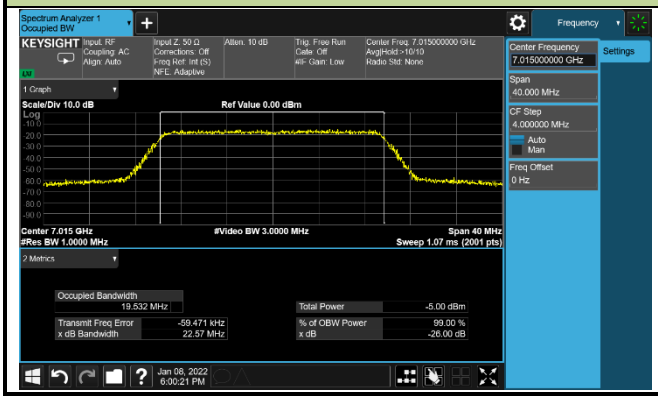
802.11ax-HE20 / CH153



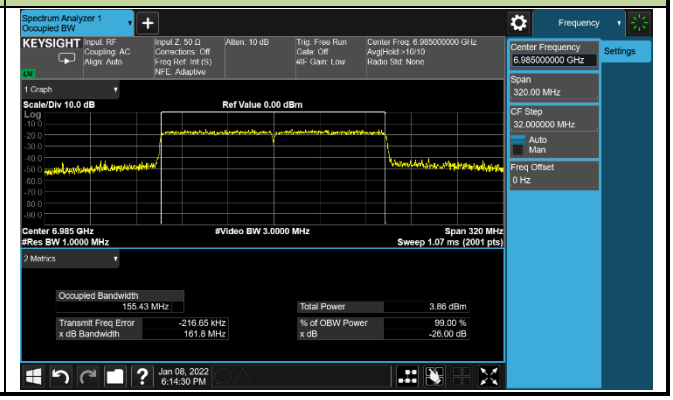
802.11ax-HE160 / CH143



802.11ax-HE20 / CH213

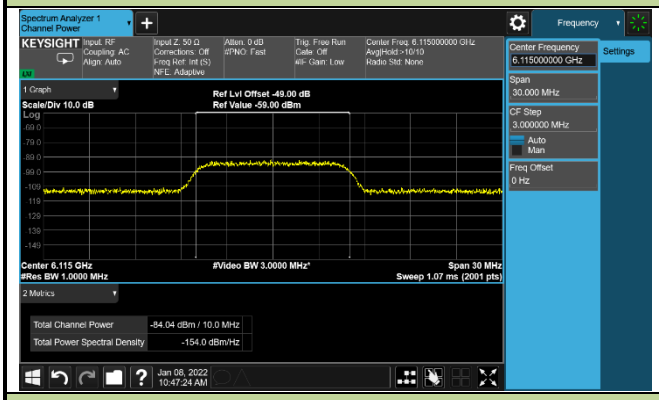


802.11ax-HE160 / CH207



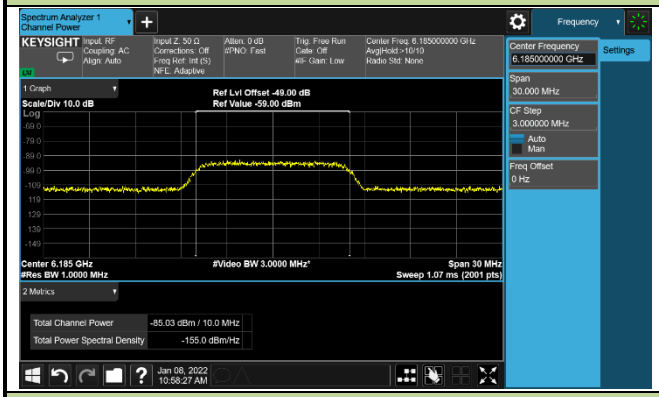
Incumbent Signal Calibration Plots (NII-5 Band)

802.11ax-HE20 / CH33



802.11ax-HE160 / CH47 (Low Edge)

802.11ax-HE160 / CH47 (Middle)



802.11ax-HE160 / CH47 (High Edge)

Incumbent Signal Calibration Plots (NII-6 Band)

802.11ax-HE20 / CH97

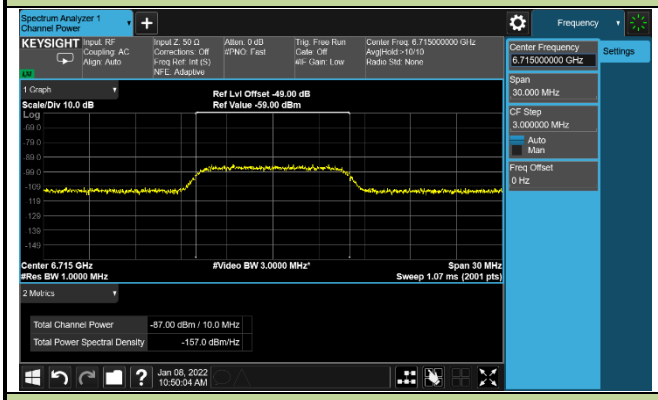
802.11ax-HE80 / CH103 (Low Edge)

802.11ax-HE80 / CH103 (Middle)

802.11ax-HE80 / CH103 (High Edge)

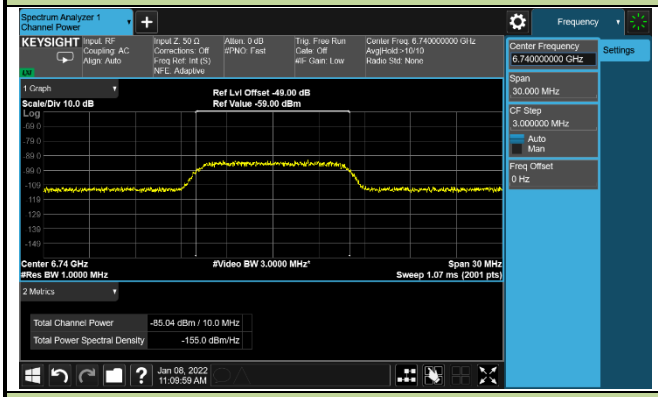
Incumbent Signal Calibration Plots (NII-7 Band)

802.11ax-HE20 / CH153



802.11ax-HE160 / CH143 (Low Edge)

802.11ax-HE160 / CH143 (Middle)

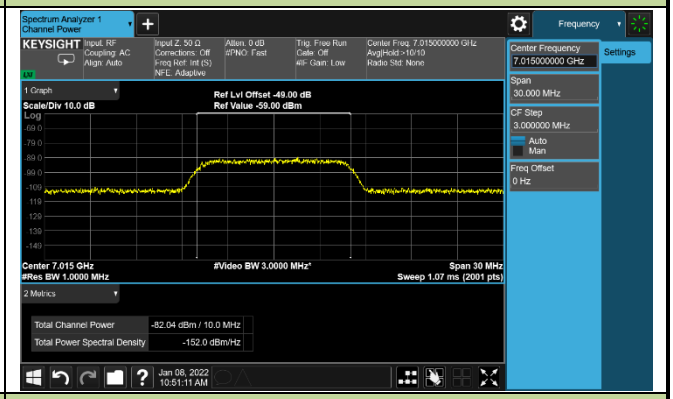


802.11ax-HE160 / CH143 (High Edge)

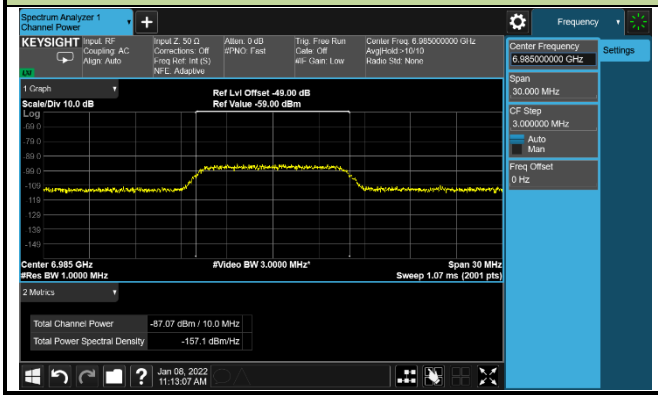
Incumbent Signal Calibration Plots (NII-8 Band)

802.11ax-HE20 / CH213

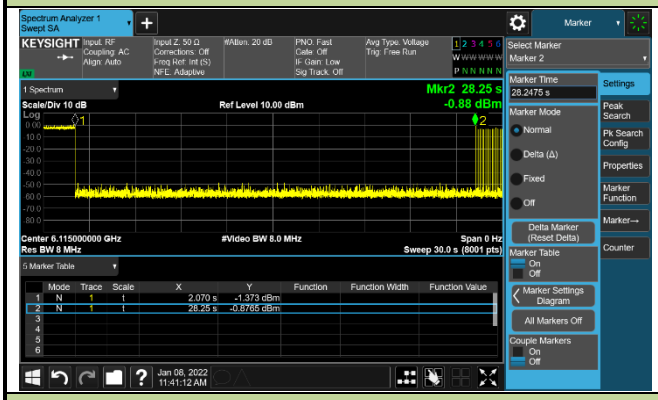
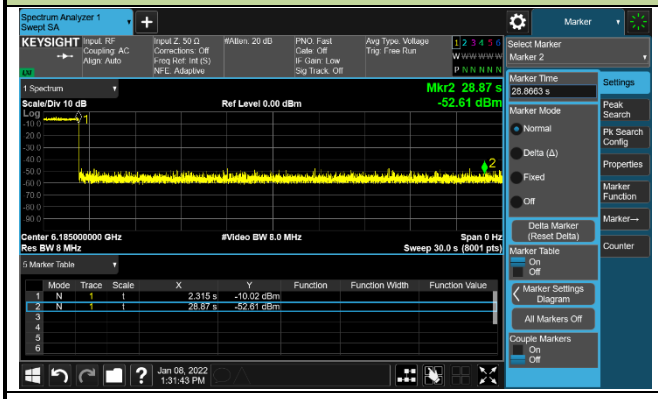
802.11ax-HE160 / CH207 (Low Edge)

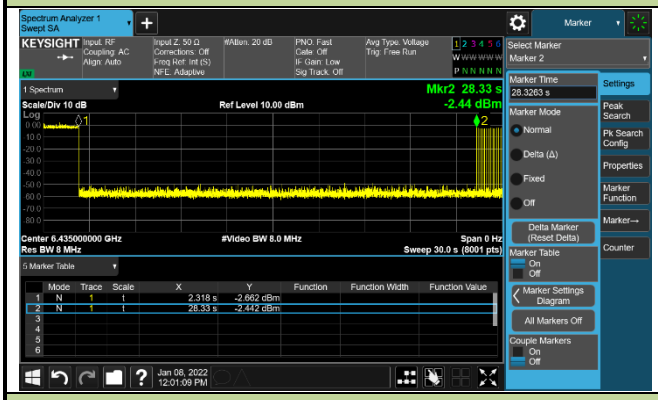
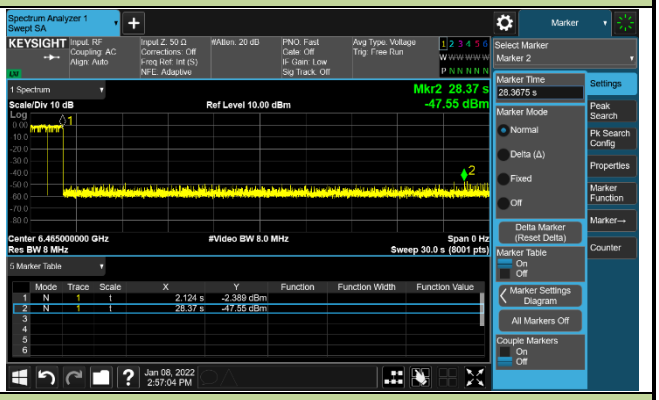
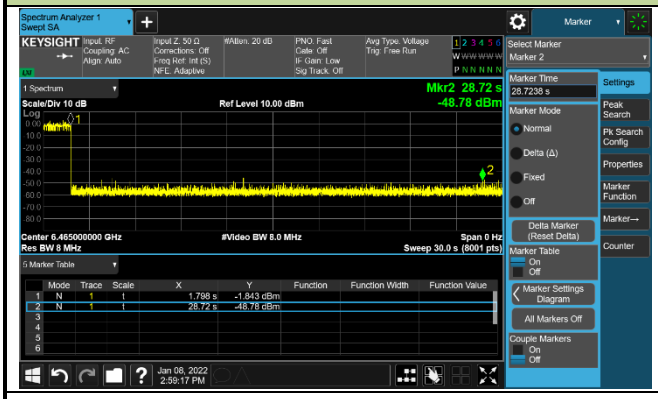
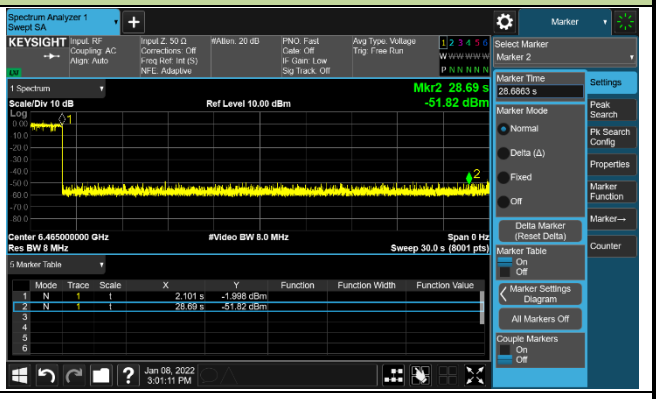


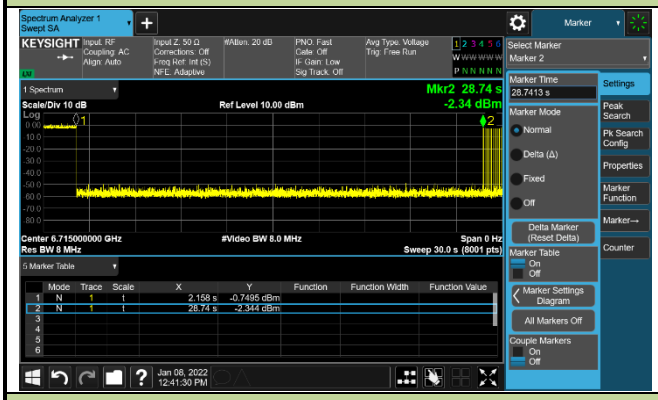
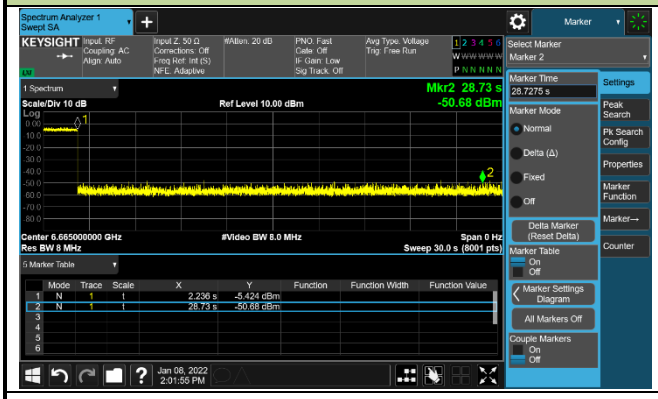
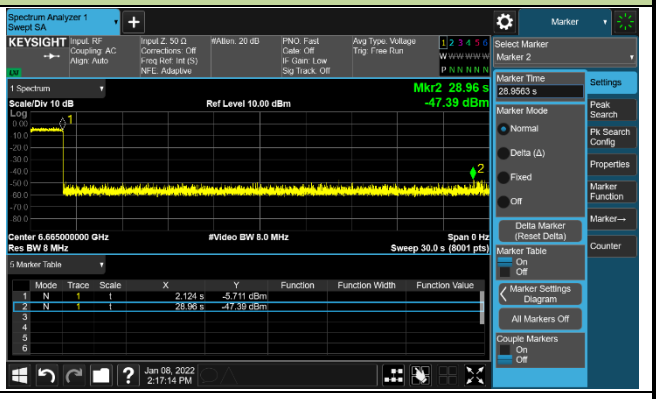
802.11ax-HE160 / CH207 (Middle)

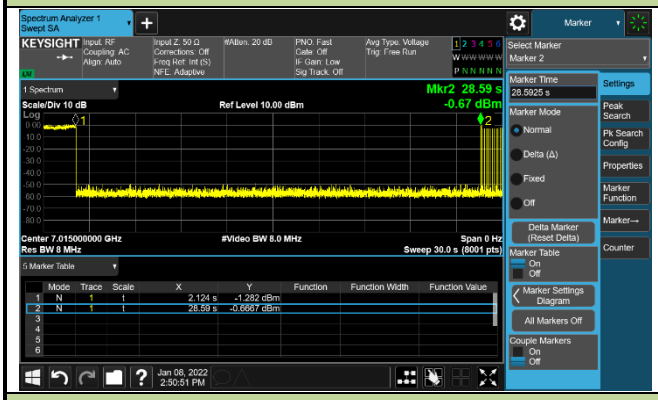
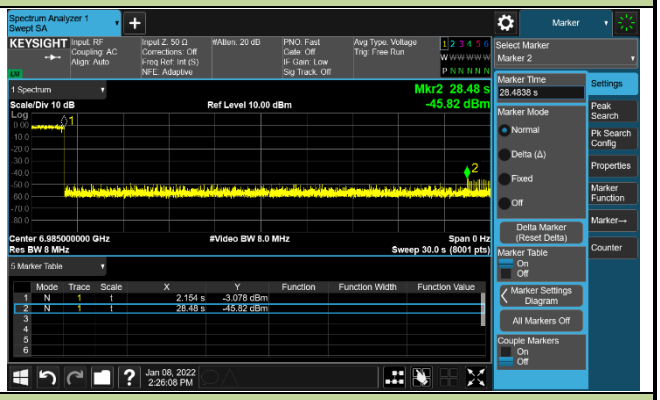
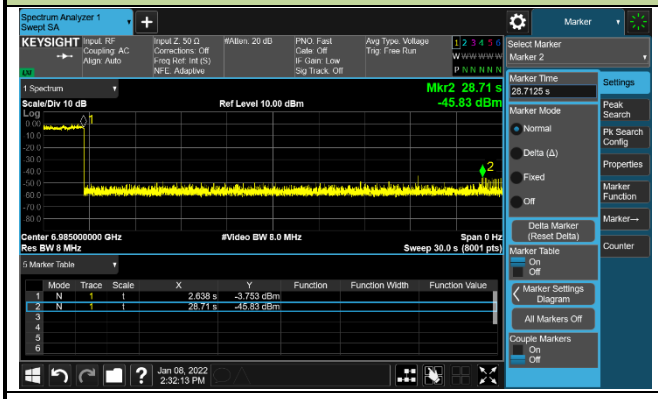
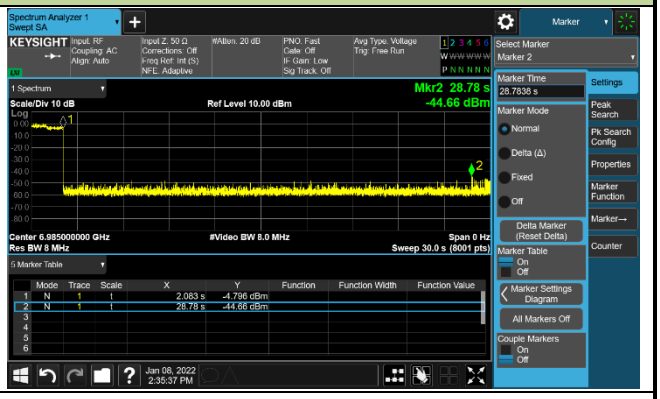


802.11ax-HE160 / CH207 (High Edge)

Test Result of EUT ceased transmission (NII-5 Band)	
802.11ax-HE20 / CH33	802.11ax-HE160 / CH47 (Low Edge)
	
802.11ax-HE160 / CH47 (Middle)	802.11ax-HE160 / CH47 (High Edge)
	
Note – M1: Injection of AWGN Signal, M2: Removal of AWGN Signal	

Test Result of EUT ceased transmission (NII-6 Band)	
802.11ax-HE20 / CH97	802.11ax-HE80 / CH103 (Low Edge)
	
802.11ax-HE80 / CH103 (Middle)	802.11ax-HE80 / CH103 (High Edge)
	
Note – M1: Injection of AWGN Signal, M2: Removal of AWGN Signal	

Test Result of EUT ceased transmission (NII-7 Band)	
802.11ax-HE20 / CH153	802.11ax-HE160 / CH143 (Low Edge)
	
802.11ax-HE160 / CH143 (Middle)	802.11ax-HE160 / CH143 (High Edge)
	
Note – M1: Injection of AWGN Signal, M2: Removal of AWGN Signal	

Test Result of EUT ceased transmission (NII-8 Band)	
802.11ax-HE20 / CH213	802.11ax-HE160 / CH207 (Low Edge)
	
802.11ax-HE160 / CH207 (Middle)	802.11ax-HE160 / CH207 (High Edge)
	
Note – M1: Injection of AWGN Signal, M2: Removal of AWGN Signal	

6.8. Radiated Spurious Emission Measurement

6.8.1.Test Limit

For 15.407(b)(5) requirement

For transmitters operating within the 5.925-7.125 GHz band: Any emissions outside of the 5.925-7.125 GHz band must not exceed an e.i.r.p. of −27 dBm/MHz.

Refer to 987594 D02 U-NII 6GHz EMC Measurement v01 clause G

Use guidance in KDB 789033 for measurements below 1000 MHz and above 1000 MHz. Unwanted emissions outside of restricted bands are measured with a RMS detector. In addition, 15.35(b) applies where the peak emissions must be limited to no more than 20 dB above the average limit. All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47CFR must not exceed the limits shown in Table per Section 15.209.

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

6.8.2.Test Procedure Used

KDB 789033 D02v02r01 – Section 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
>1000 MHz	1 MHz

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

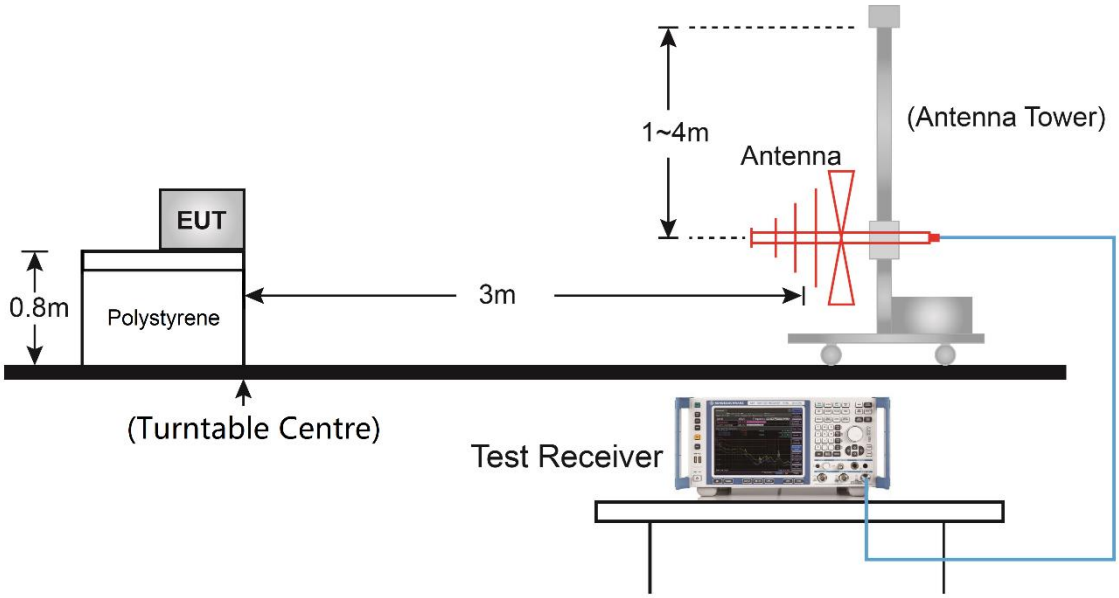
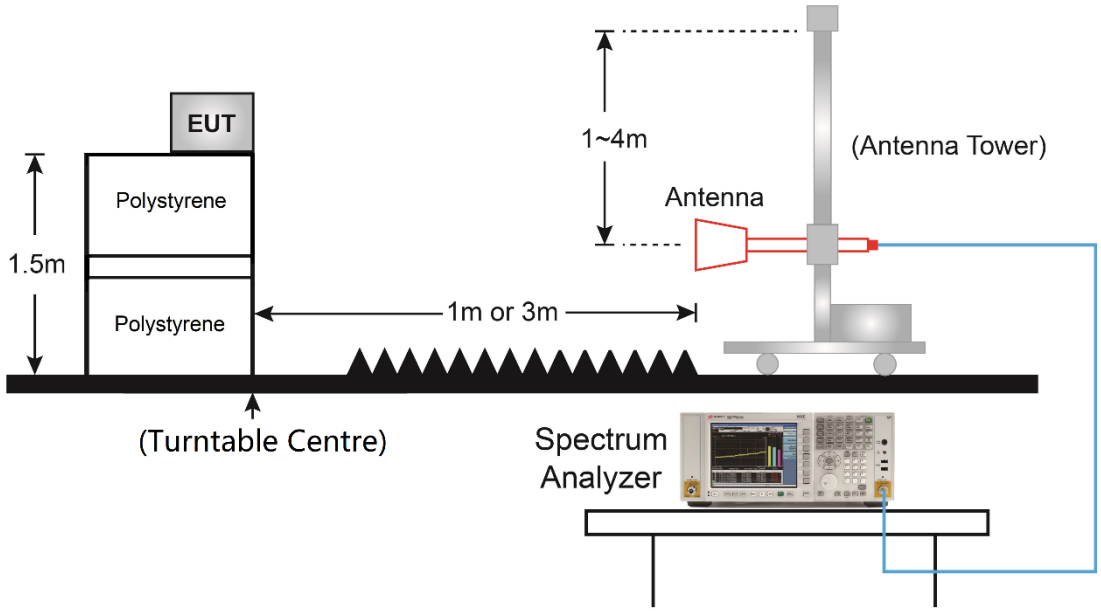
5. Sweep time = auto

6. Trace mode = max hold

7. Trace was allowed to stabilize

6.8.4.Test Setup

Below 1GHz Test Setup:



Above 1GHz Test Setup: