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Appendix B: 802.11ax Test Plot

FCC ID
A3LSMX810

REVISION HISTORY

The revision history for this document is shown in table.

Revision No.	Date of Issue	Description
0	May 16, 2023	Initial Release

Note:

In order to simplify the report, attached plots were only the lowest datarate.

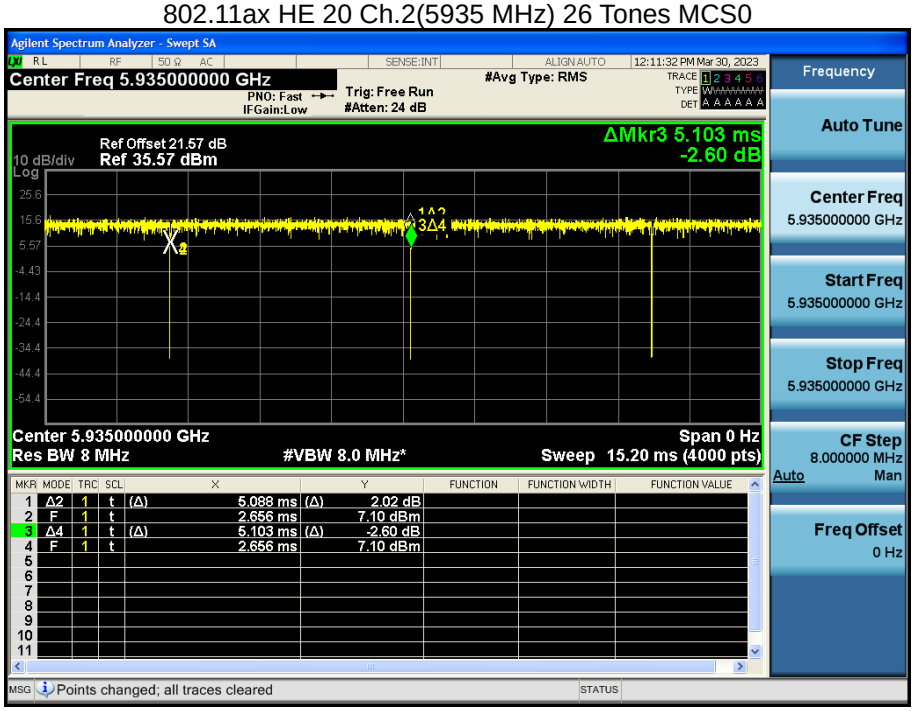
1. Duty Cycle

Note:

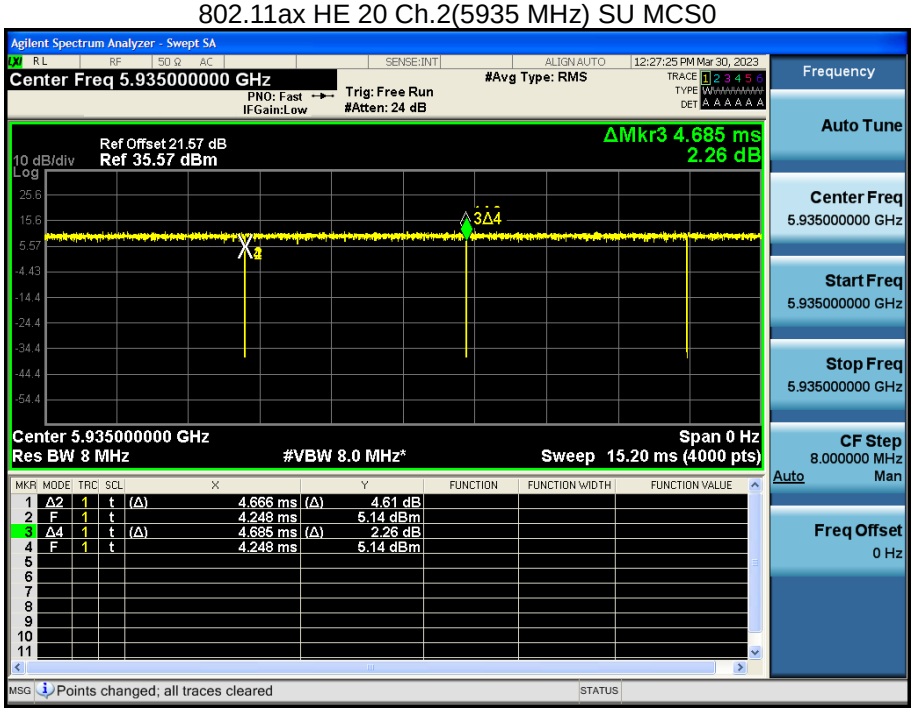
1.In order to simplify the report, attached plots were only the lowest datarate .

2. Test was performed with continuous Tx.(Duty cycle ≥ 98% Continuous Signal)

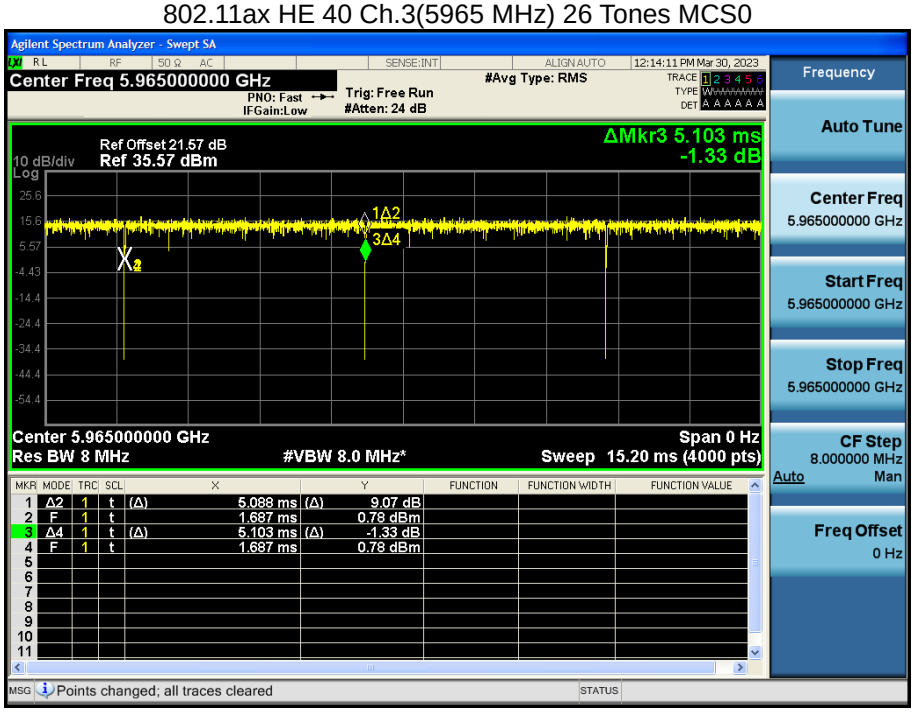
802.11ax HE 20 Ch.2(5935 MHz) 26 Tones MCS0



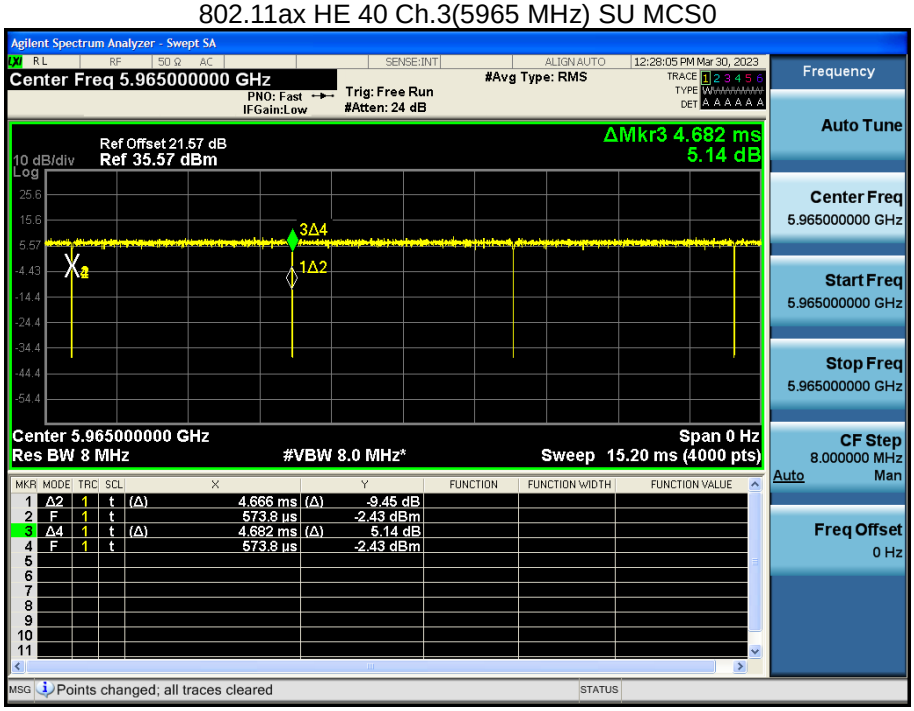
802.11ax HE 20 Ch.2(5935 MHz) SU MCS0



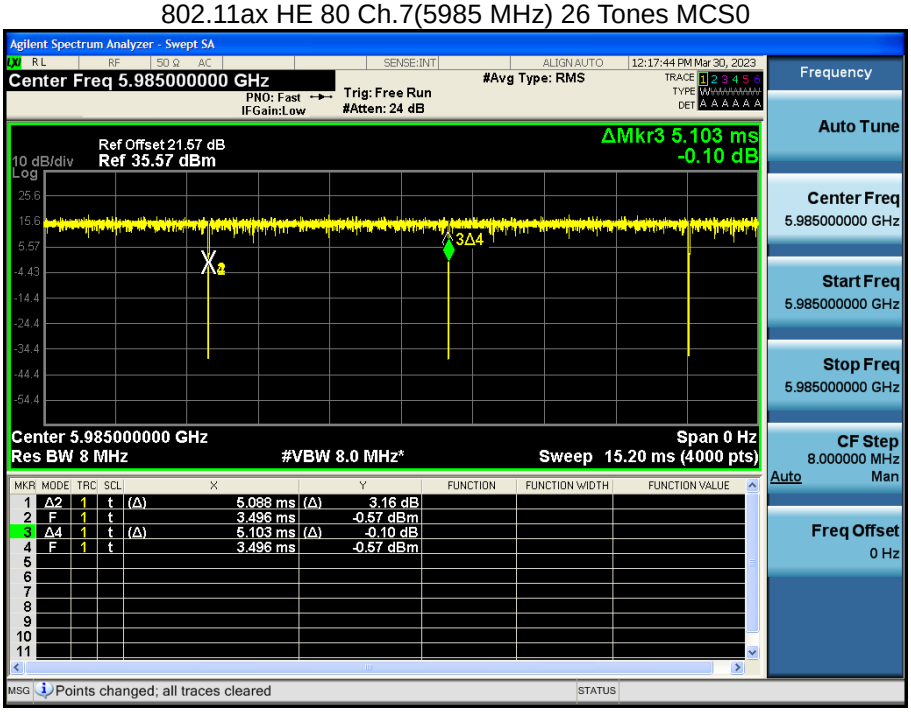
802.11ax HE 40 Ch.3(5965 MHz) 26 Tones MCS0



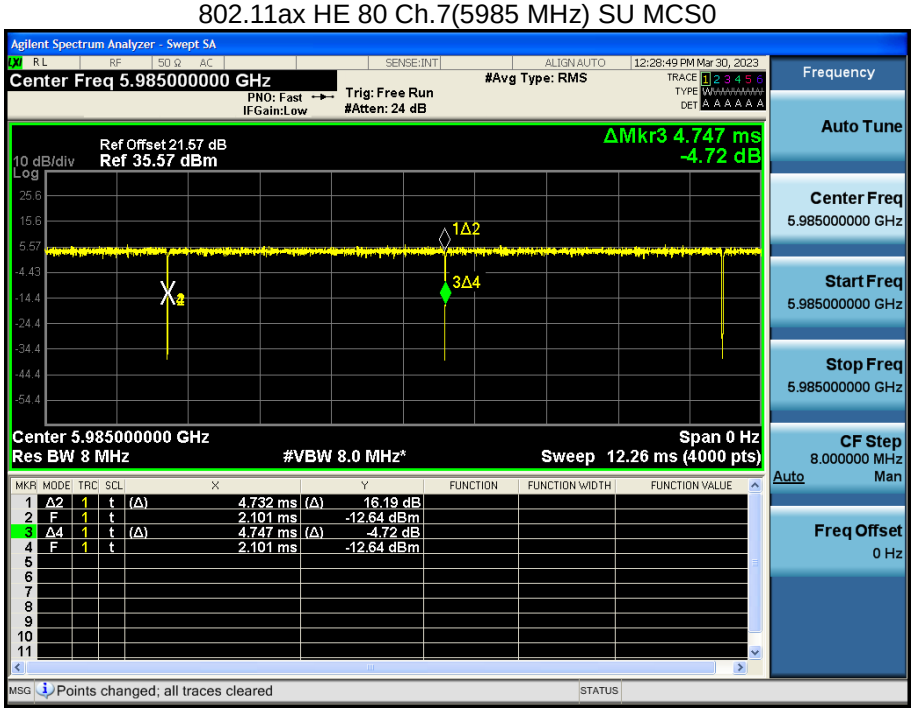
802.11ax HE 40 Ch.3(5965 MHz) SU MCS0



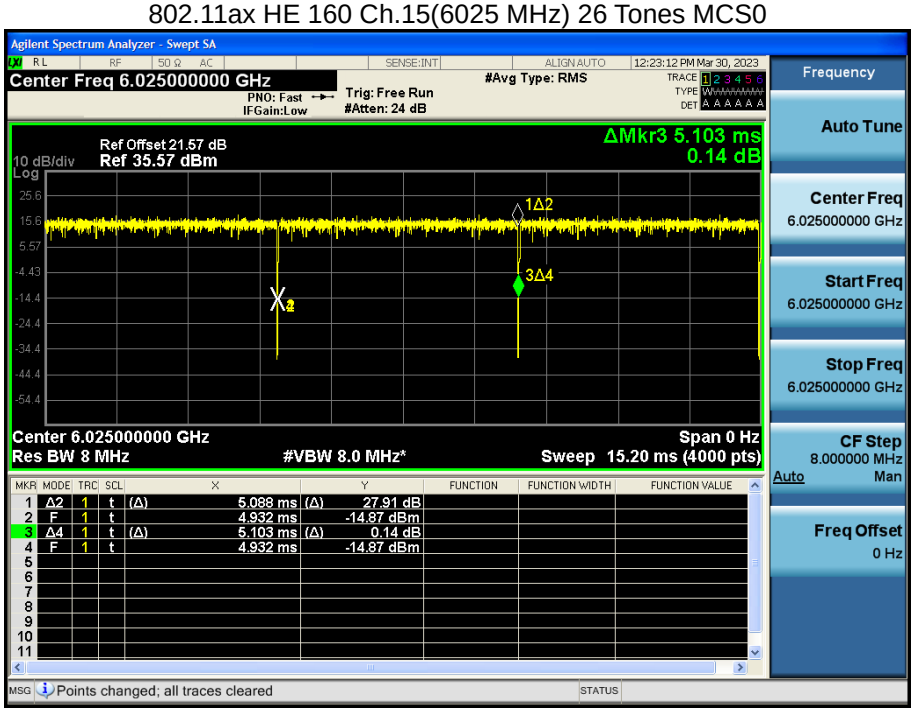
802.11ax HE 80 Ch.7(5985 MHz) 26 Tones MCS0



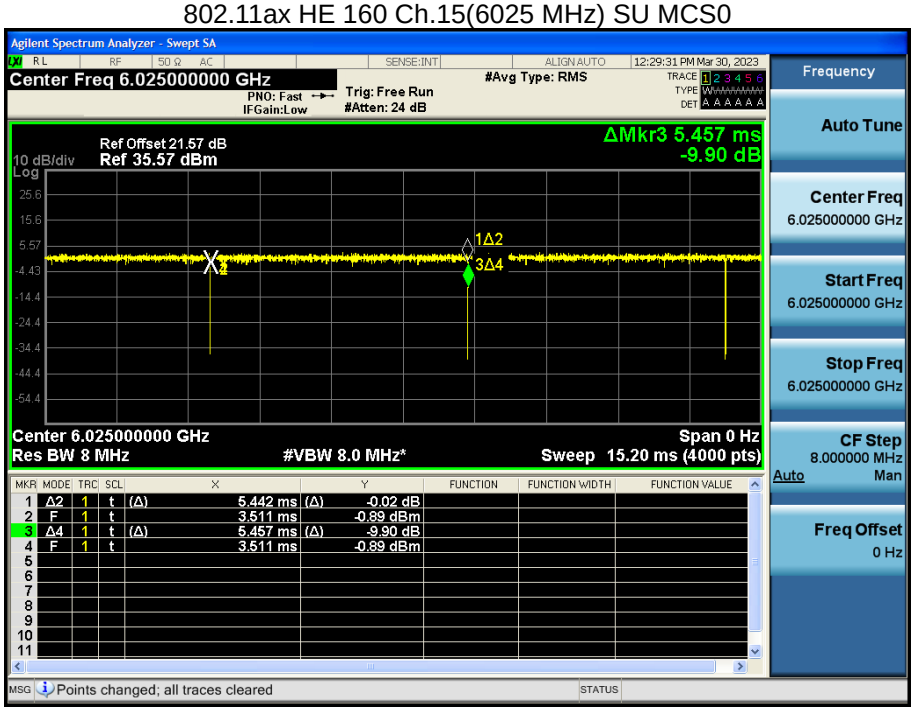
802.11ax HE 80 Ch.7(5985 MHz) SU MCS0



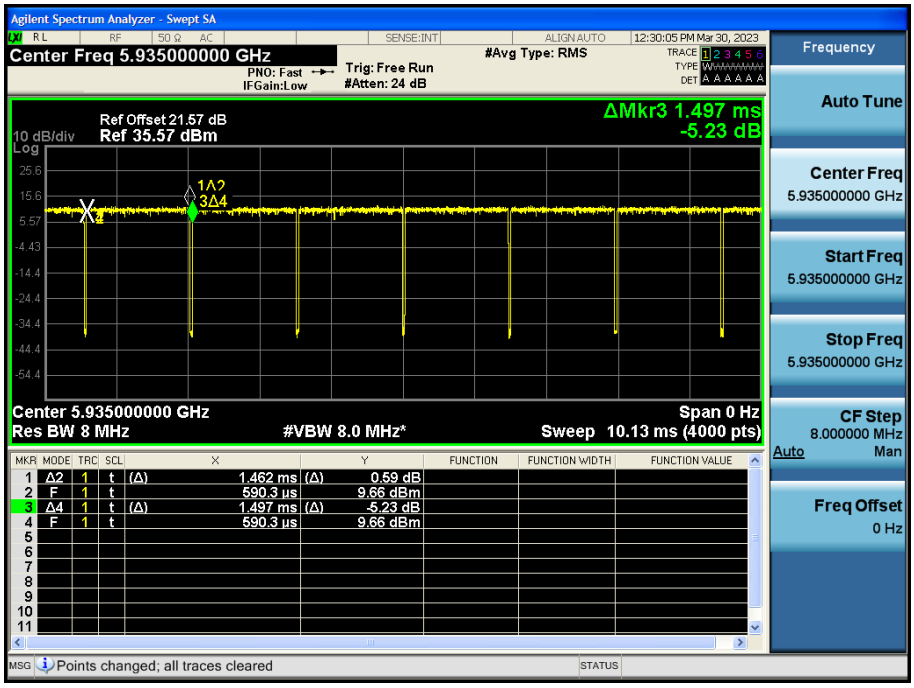
802.11ax HE 160 Ch.15(6025 MHz) 26 Tones MCS0



802.11ax HE 160 Ch.15(6025 MHz) SU MCS0



802.11a Ch.2(5935 MHz) 6 Mbps



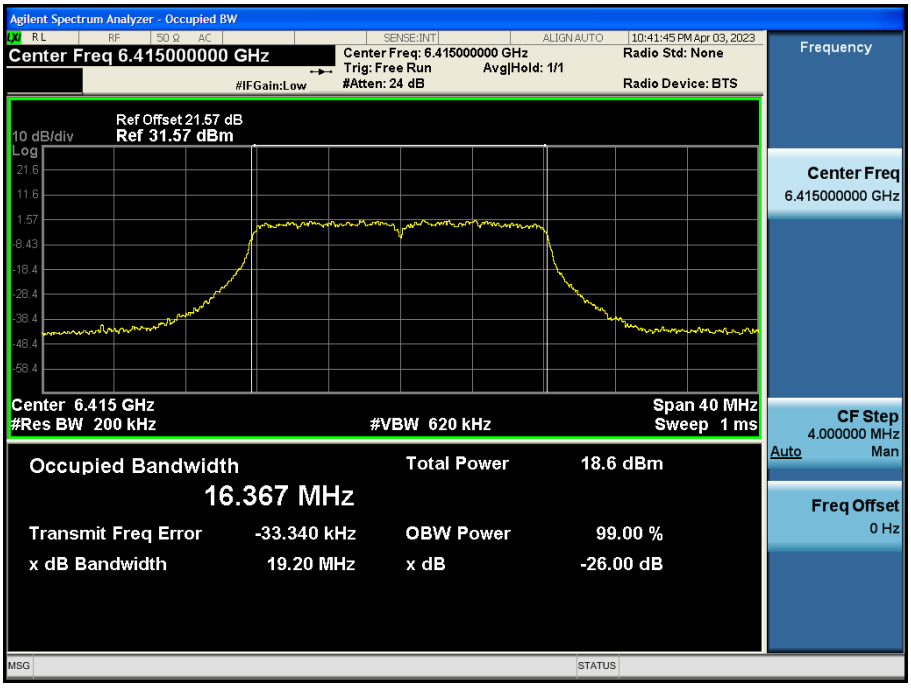
2. 26dB Bandwidth

2.1 Indoor client

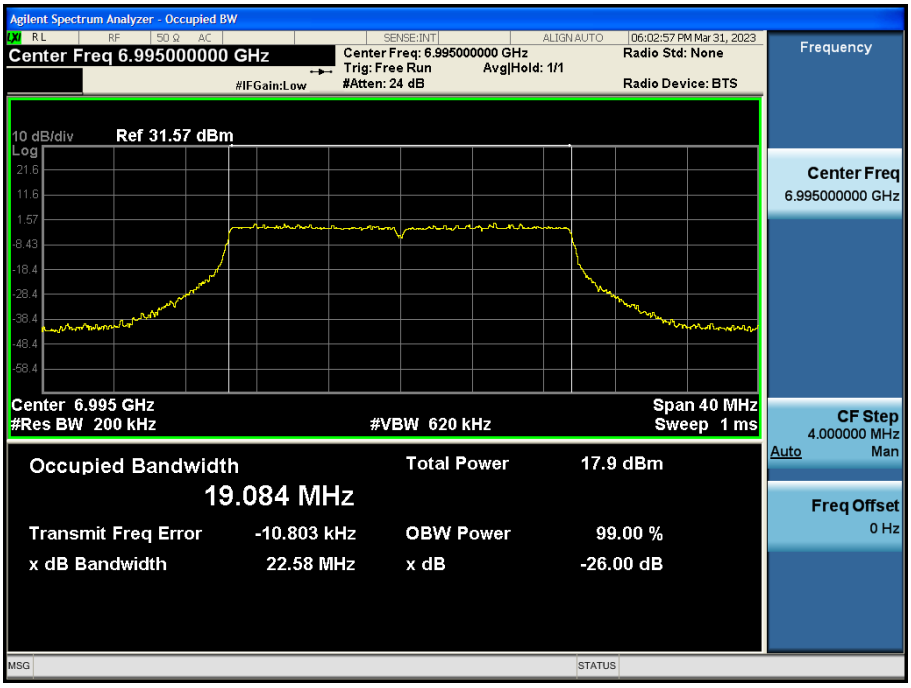
Note:
1. In order to simplify the report, attached plots were only the widest channel.

Ant.1

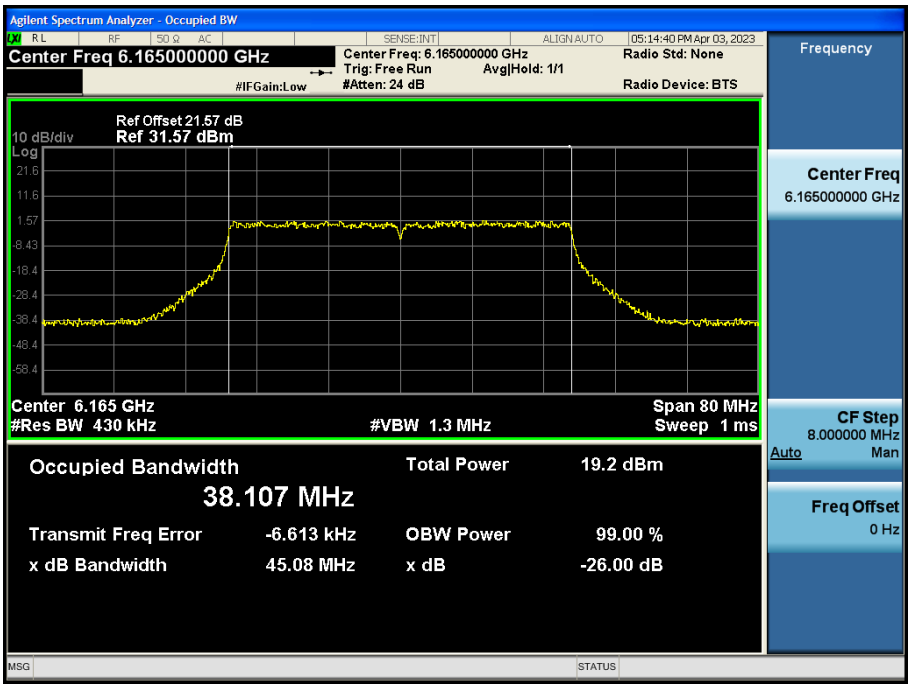
802.11a Ch.93(6415 MHz)



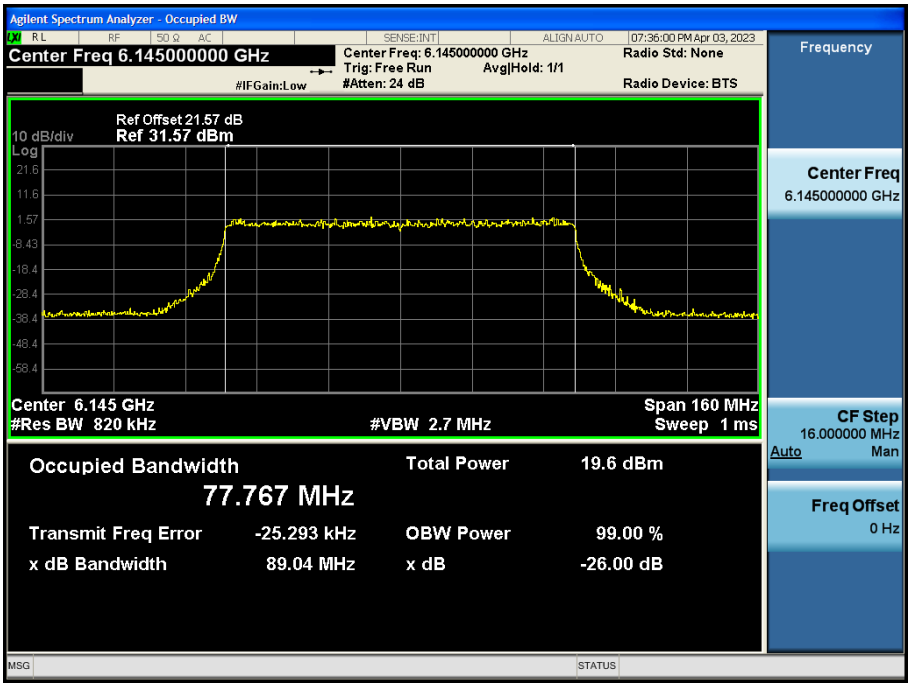
802.11ax HE20 Ch.209(6995 MHz) 242 Tones 61 RU



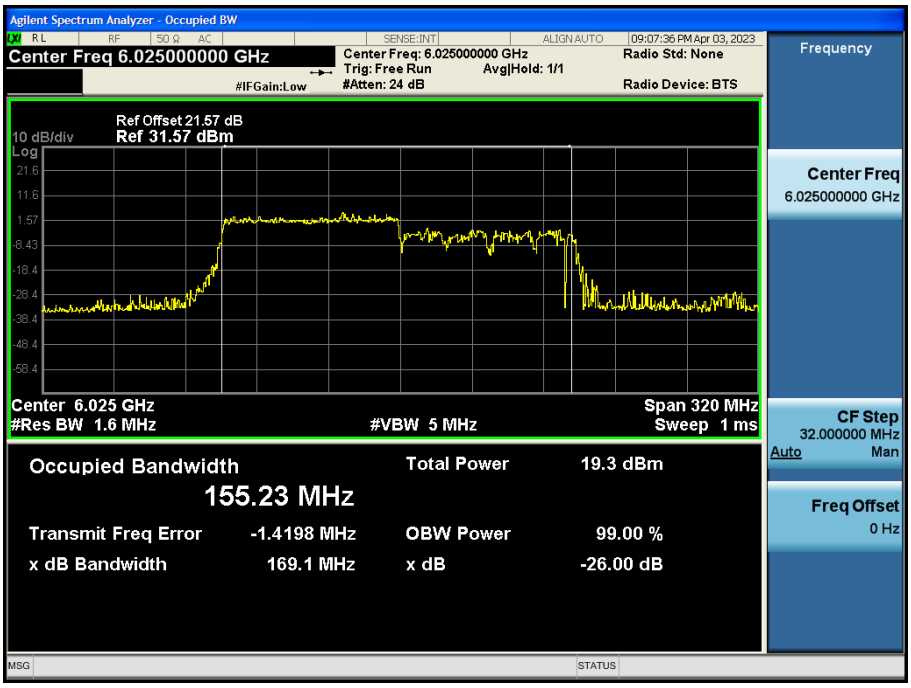
802.11ax HE40 Ch.43(6165 MHz) 484 Tones 65 RU



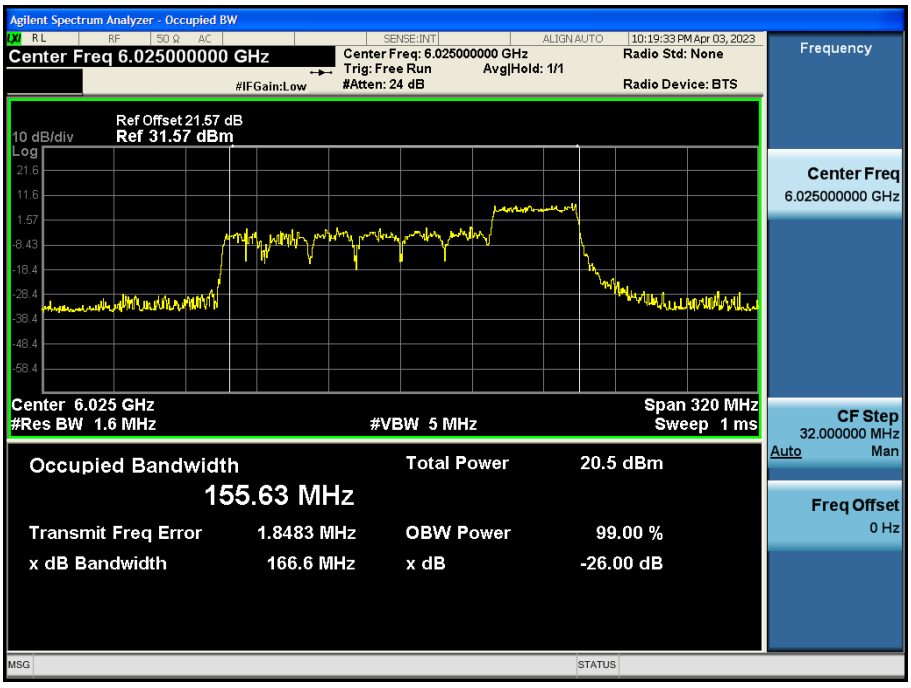
802.11ax HE80 Ch.39(6145 MHz) 996 Tones 67 RU



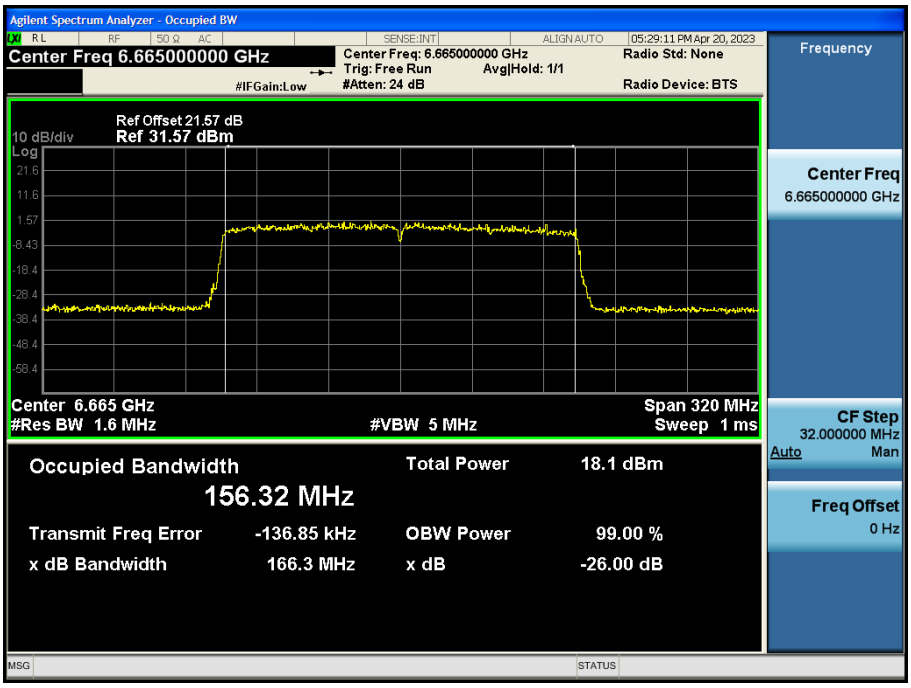
802.11ax HE160, 80_L Ch.15(6025 MHz) 996 Tones 67 RU



802.11ax HE160, 80_U Ch.15(6025 MHz) 484 Tones 66 RU

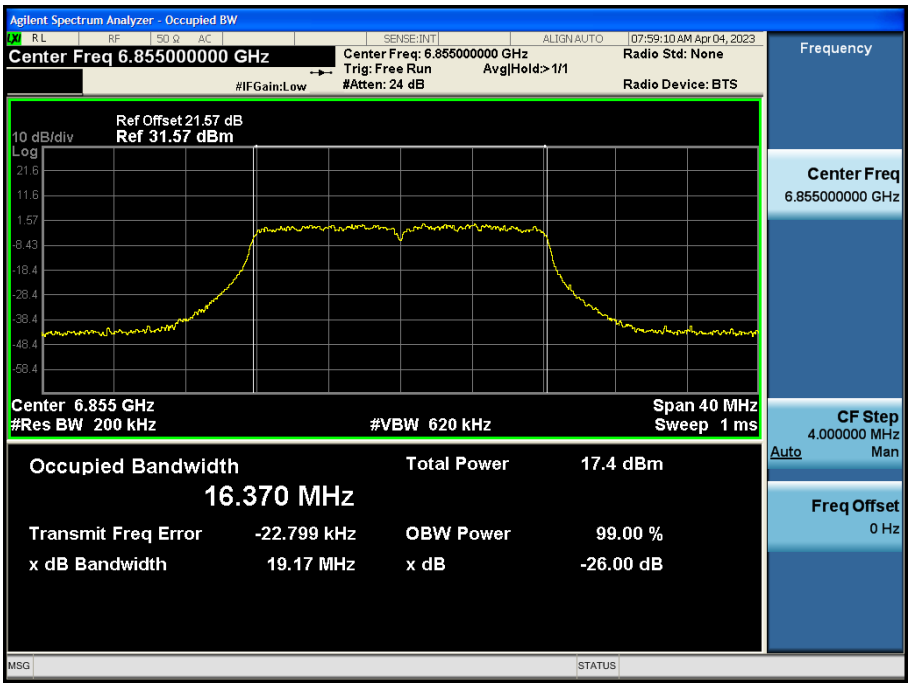


Bandwidth 160M, SU Ch. 143(6665 MHz) 996*2 Tones 68 RU

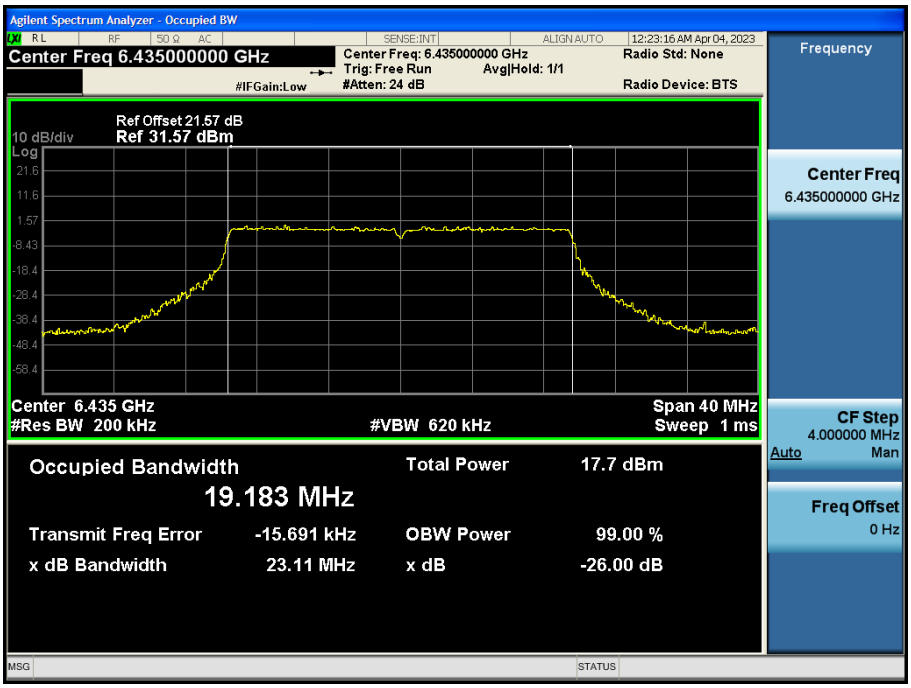


Ant.2

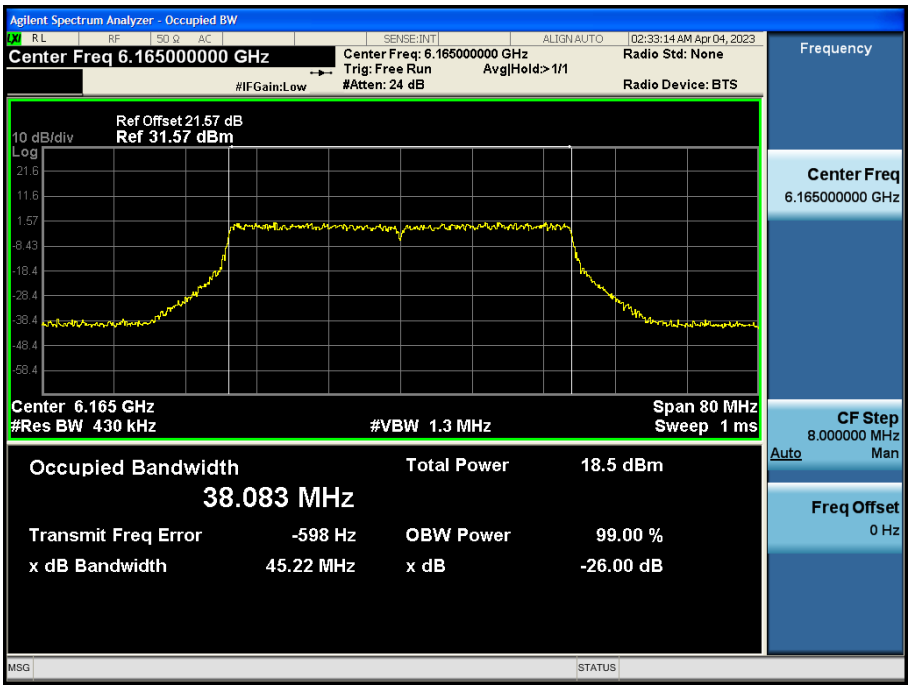
802.11a Ch.181(6855 MHz)



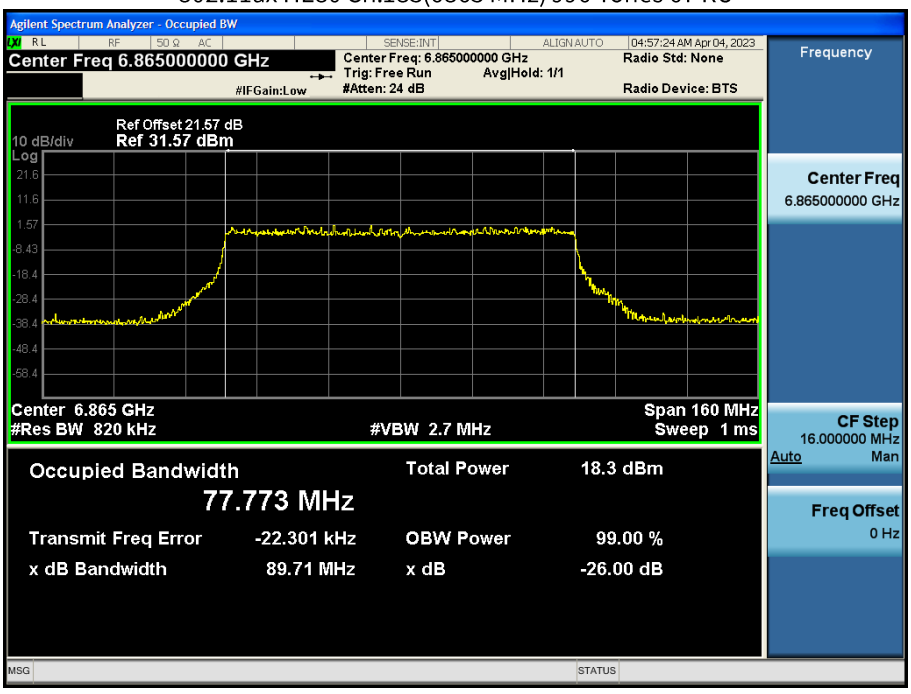
802.11ax HE20 Ch.97(6435 MHz) 242 Tones 61 RU



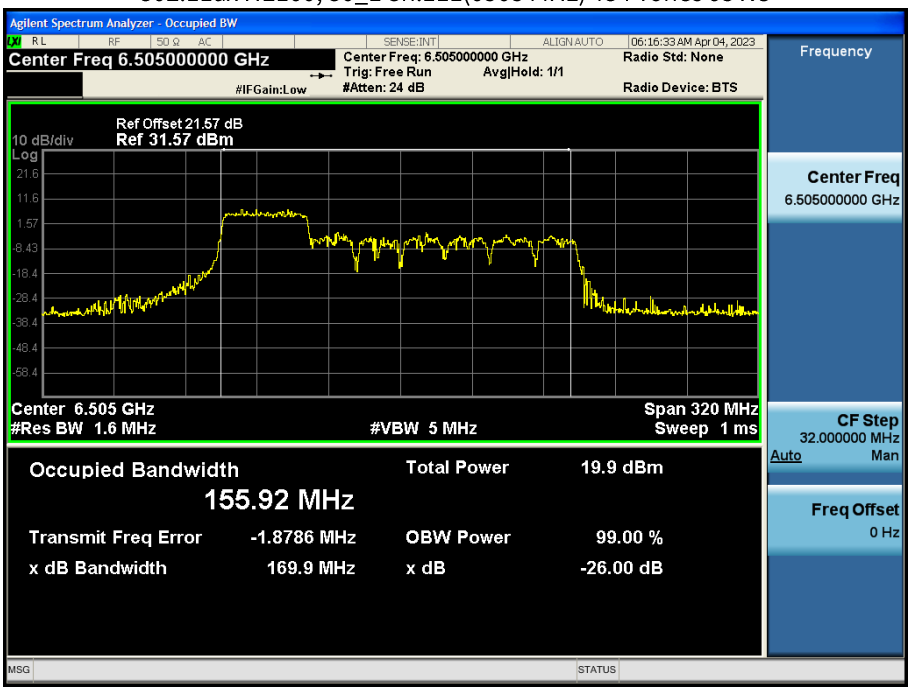
802.11ax HE40 Ch.43(6165 MHz) 484 Tones 65 RU



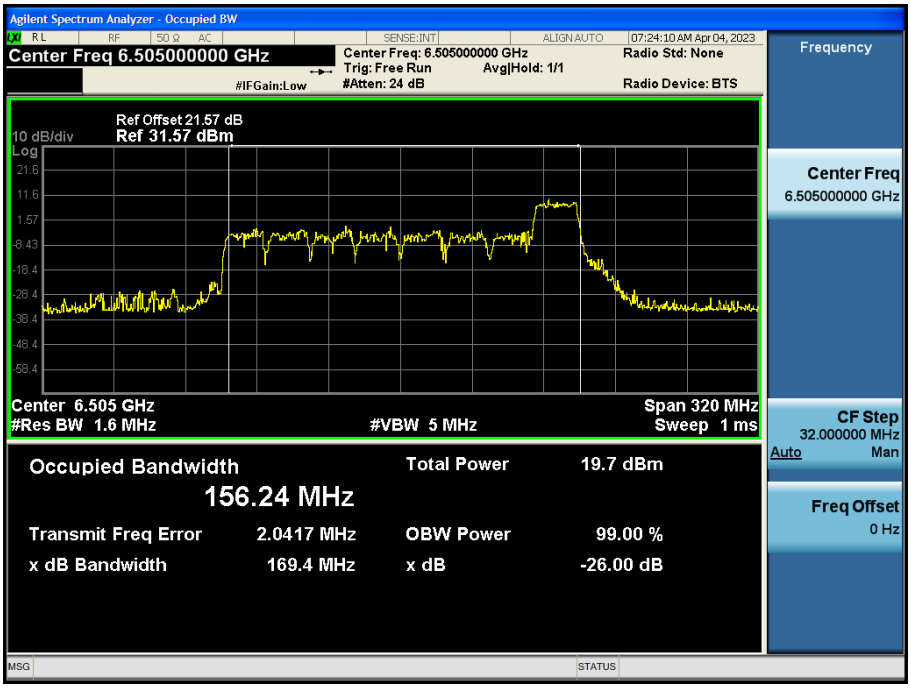
802.11ax HE80 Ch.183(6865 MHz) 996 Tones 67 RU



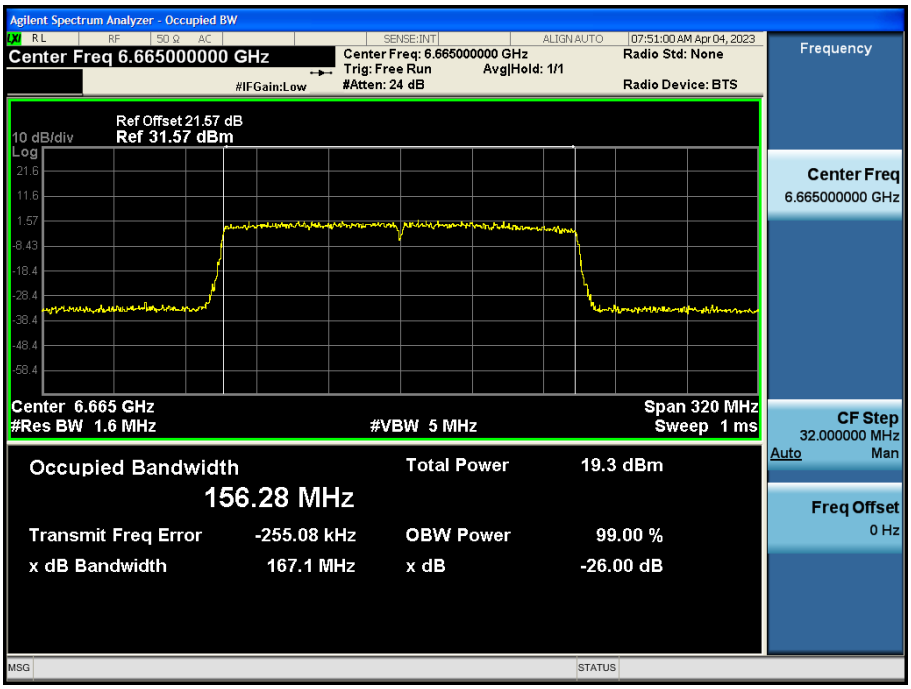
802.11ax HE160, 80_L Ch.111(6505 MHz) 484 Tones 65 RU



802.11ax HE160, 80_U Ch.111(6505 MHz) 242 Tones 64 RU



Bandwidth 160M, SU Ch. 143(6665 MHz) SU



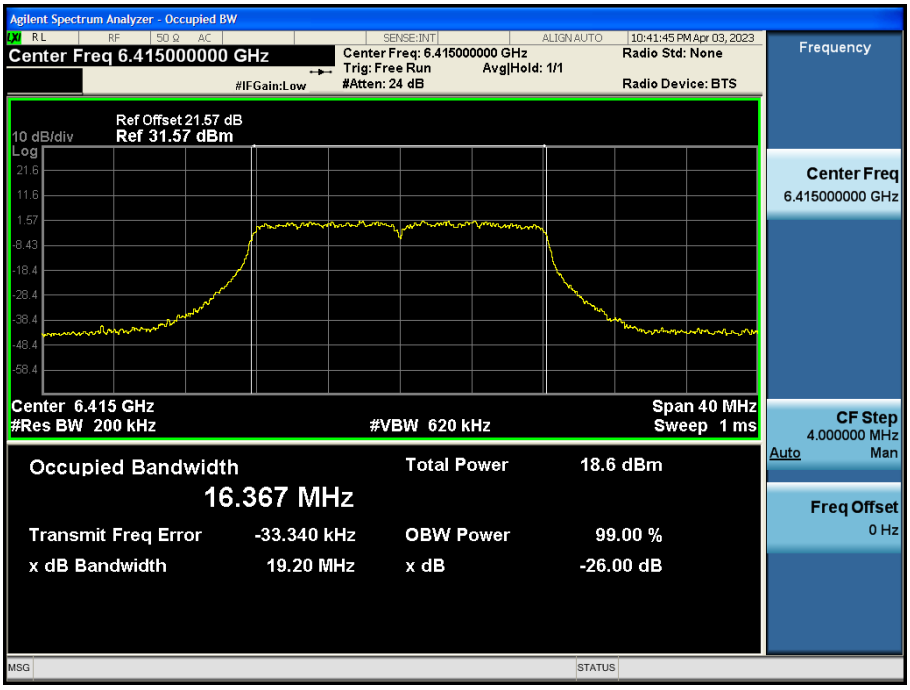
2.2 Standard client

Note:

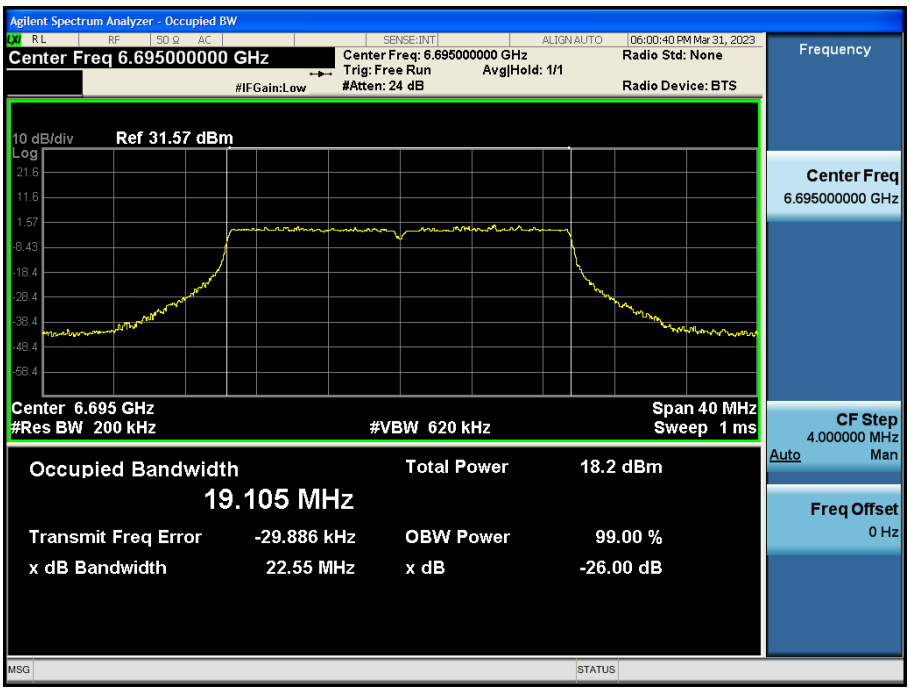
1. In order to simplify the report, attached plots were only the widest channel.

Ant.1

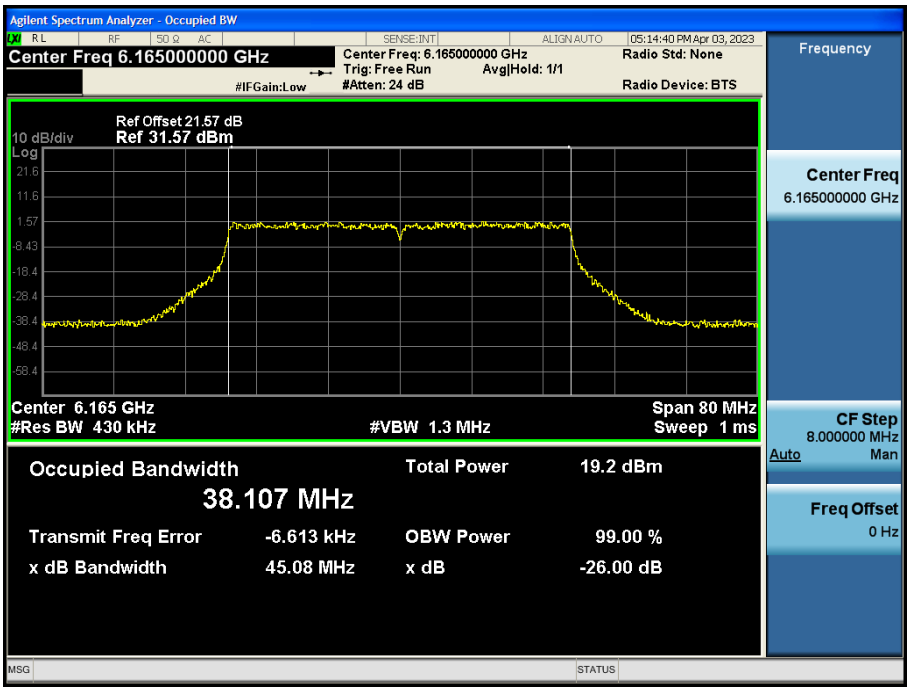
802.11a Ch.93(6415 MHz)



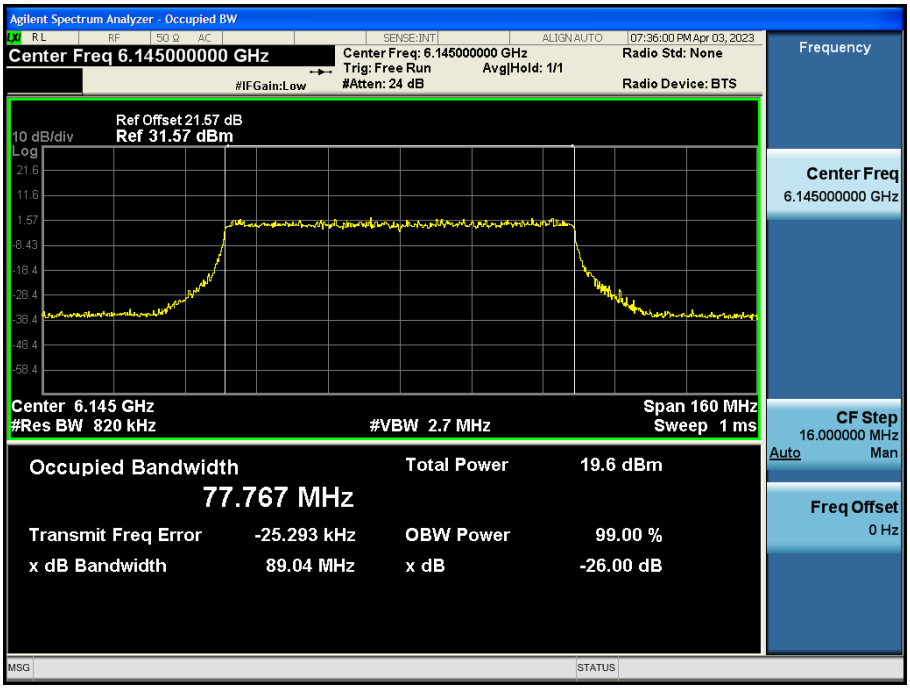
802.11ax HE20 Ch.149(6695 MHz) 242 Tones 61 RU



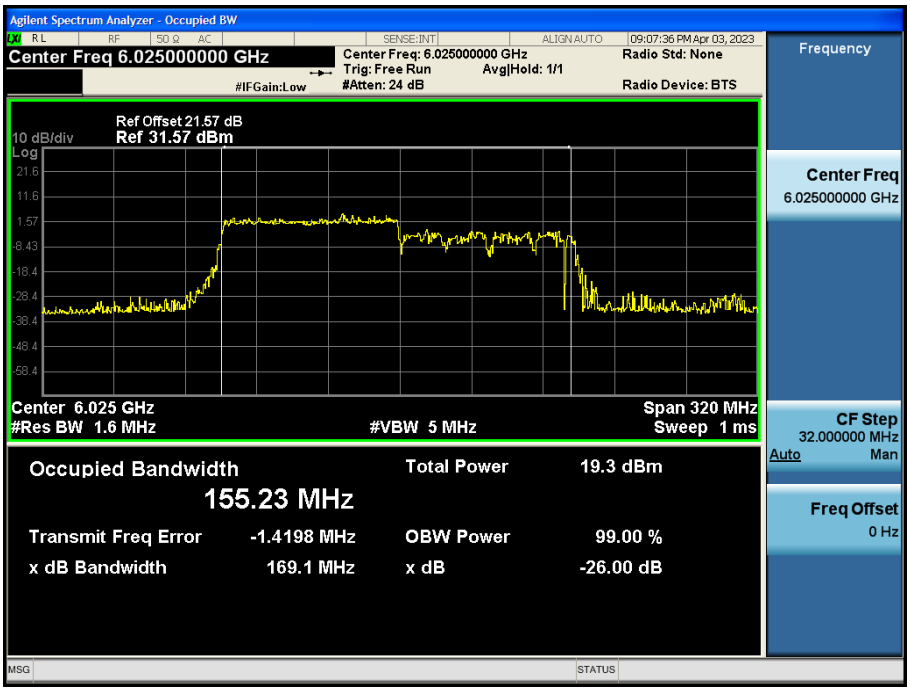
802.11ax HE40 Ch.43(6165 MHz) 484 Tones 65 RU



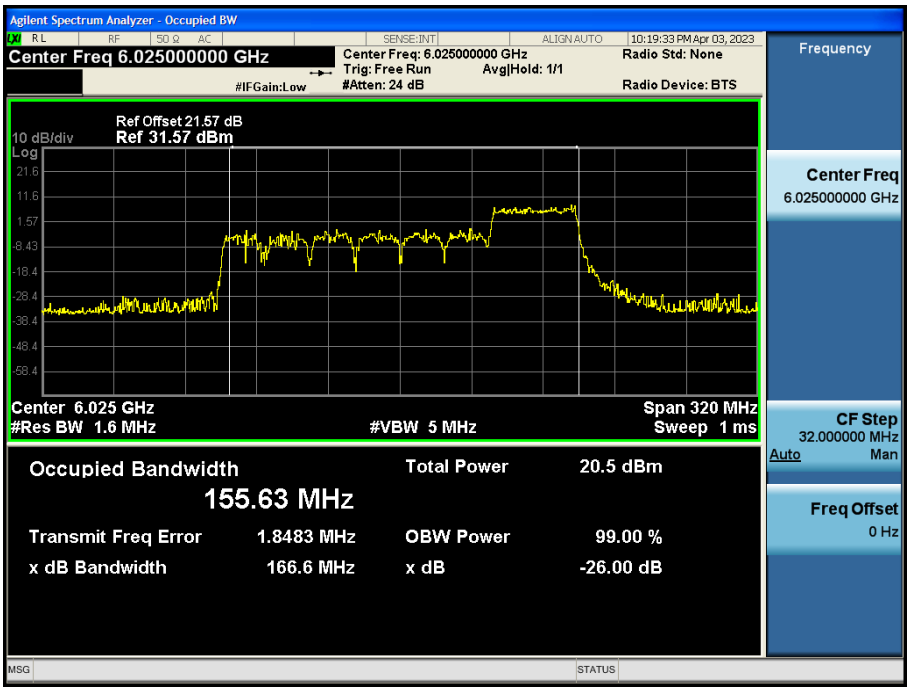
802.11ax HE80 Ch.39(6145 MHz) 996 Tones 67 RU



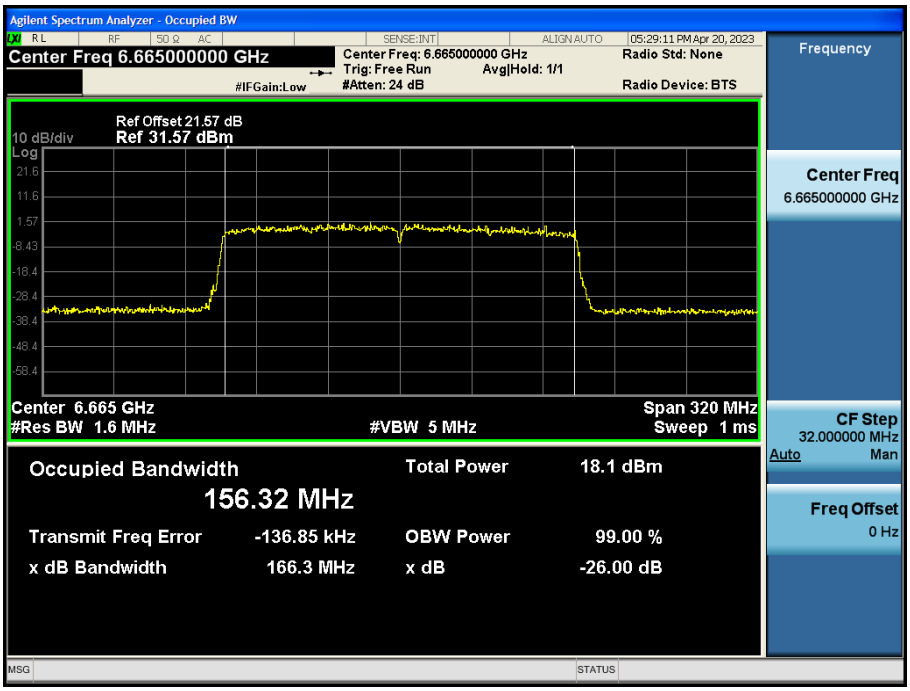
802.11ax HE160, 80_L Ch.15(6025 MHz) 996 Tones 67 RU



802.11ax HE160, 80_U Ch.15(6025 MHz) 484 Tones 66 RU

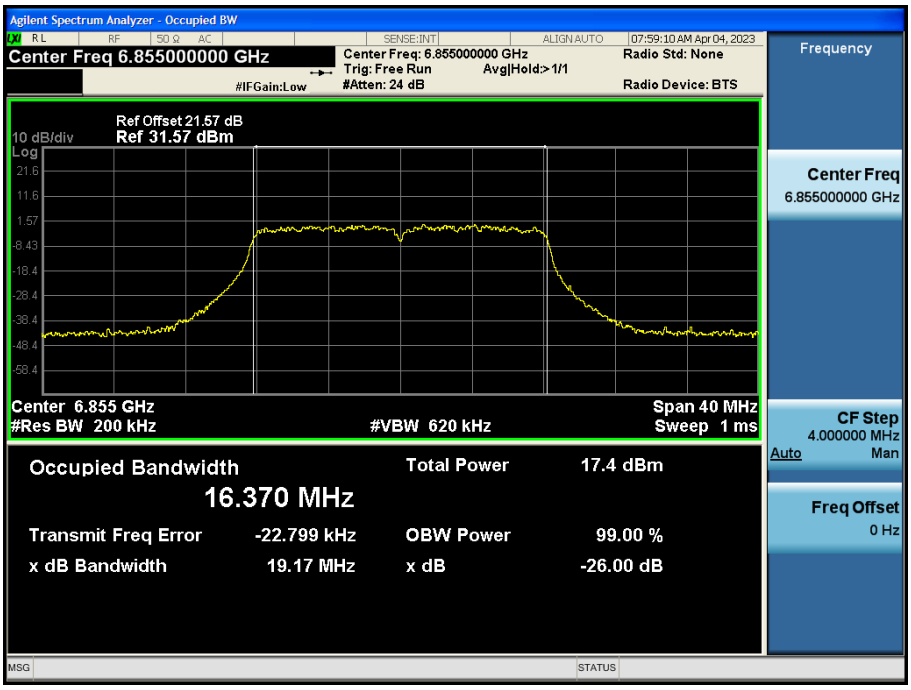


Bandwidth 160M, SU Ch. 143(6665 MHz) 996*2 Tones 68 RU

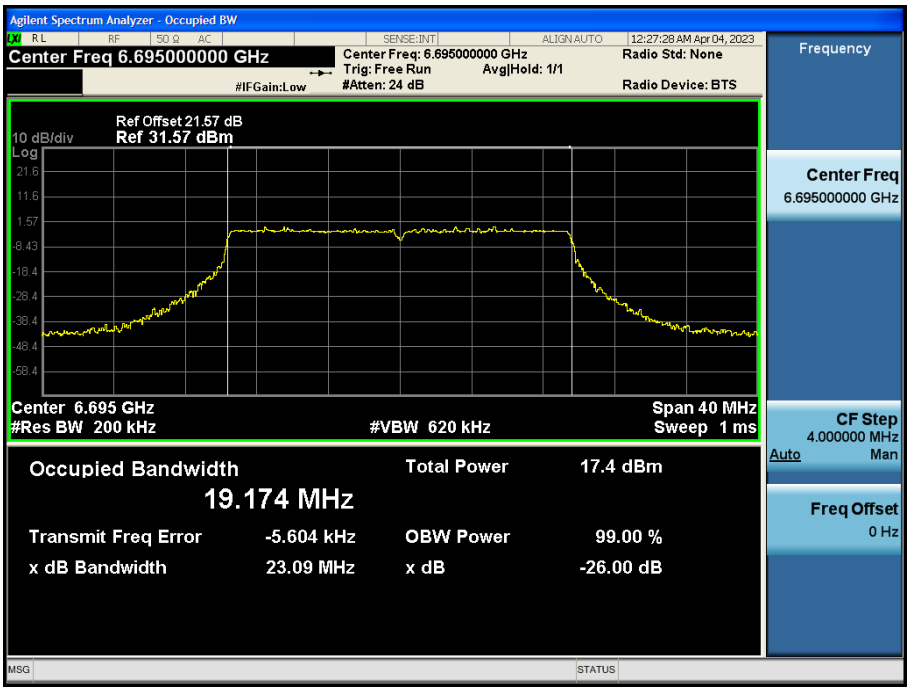


Ant.2

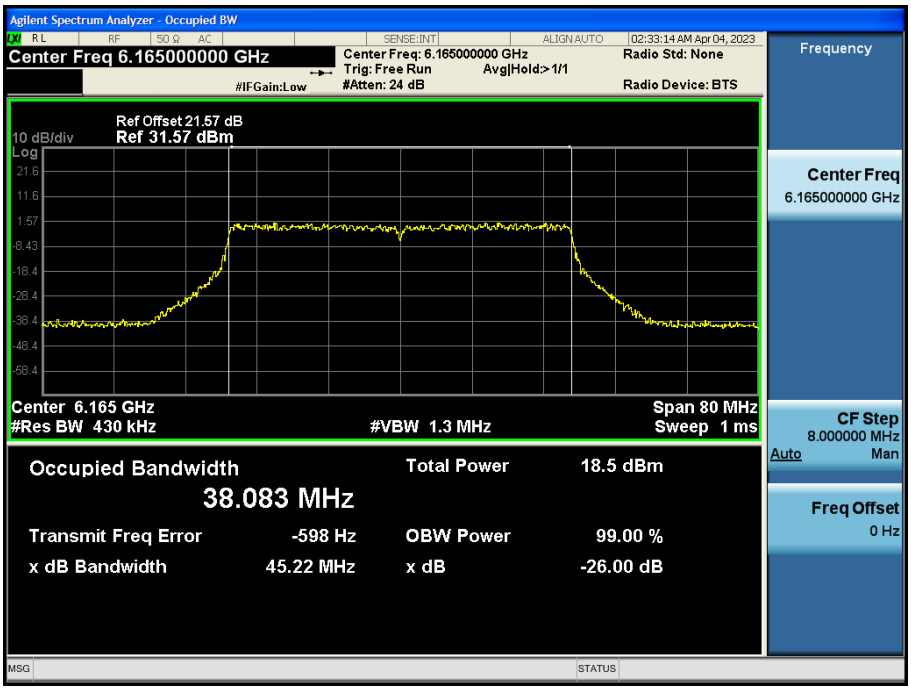
802.11a Ch.181(6855 MHz)



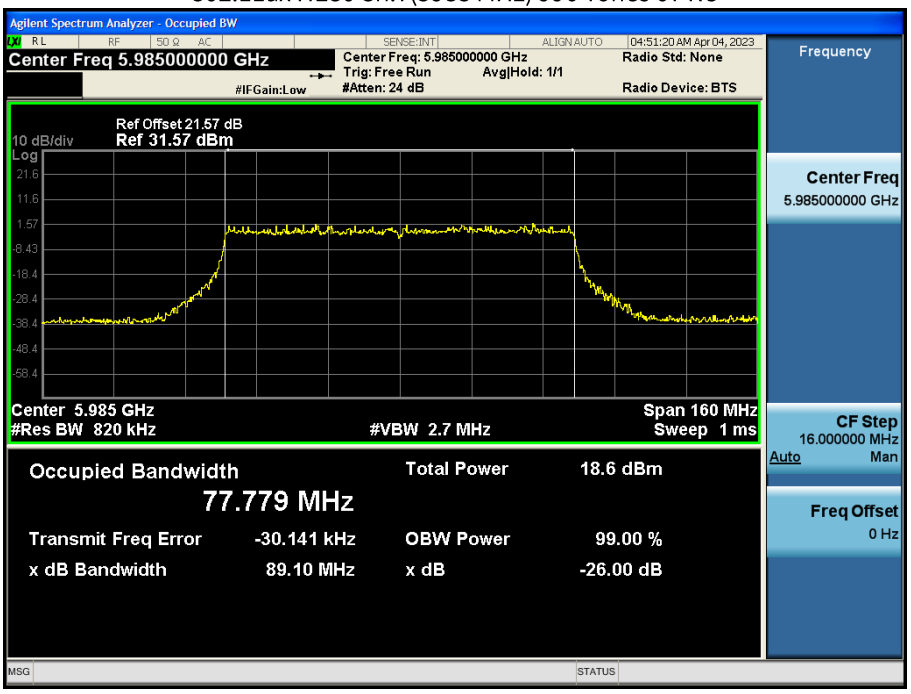
802.11ax HE20 Ch.149(6695 MHz) 242 Tones 61 RU



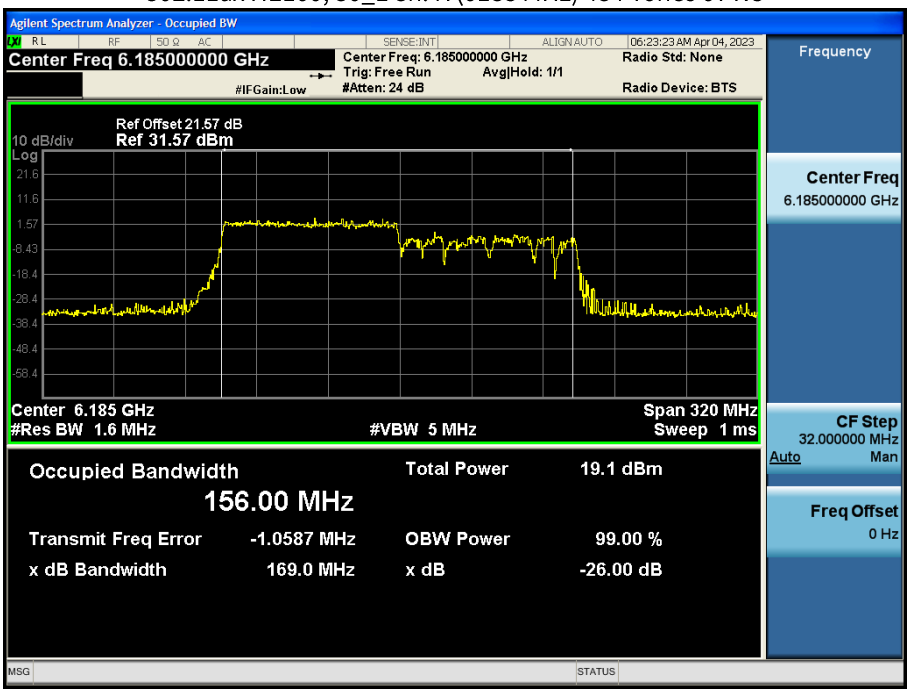
802.11ax HE40 Ch.43(6165 MHz) 484 Tones 65 RU



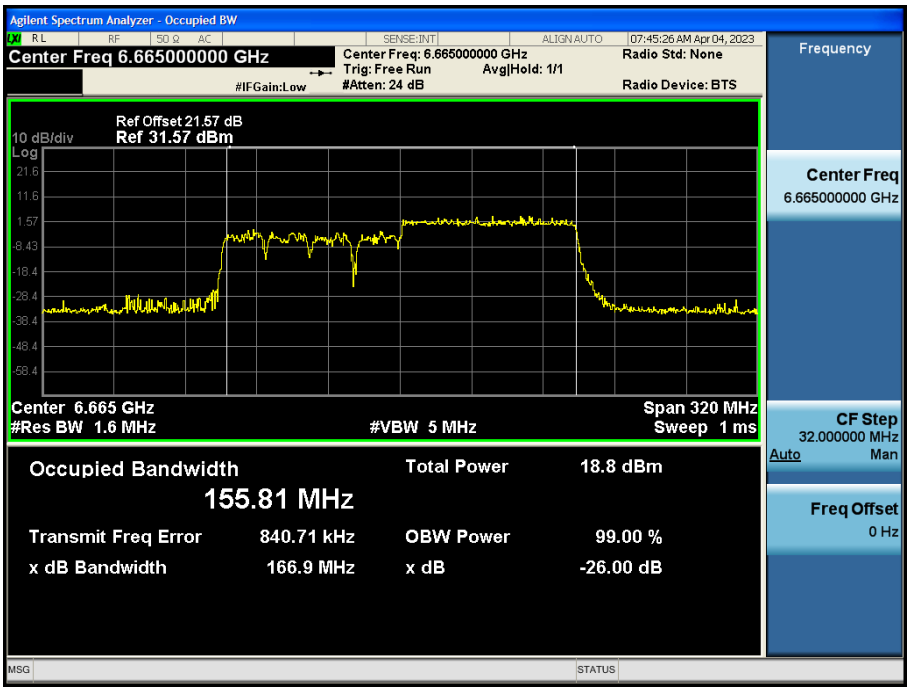
802.11ax HE80 Ch.7(5985 MHz) 996 Tones 67 RU



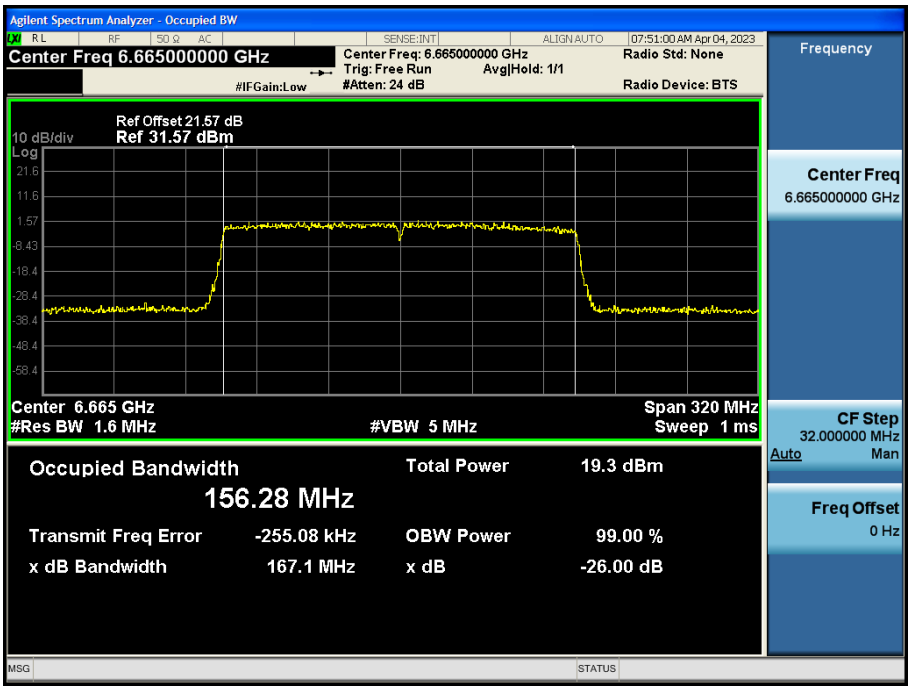
802.11ax HE160, 80_L Ch.47(6185 MHz) 484 Tones 67 RU



802.11ax HE160, 80_U Ch.143(6665 MHz) 996 Tones 67 RU



Bandwidth 160M, SU Ch. 143(6665 MHz) SU



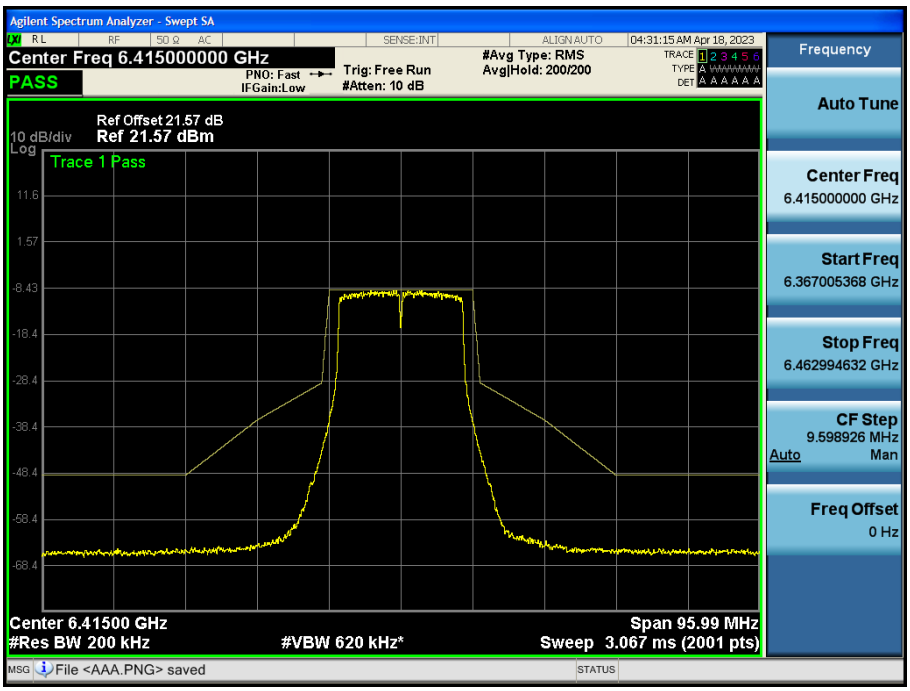
3. In-Band Emission (Emission Mask)

3.1 Indoor client

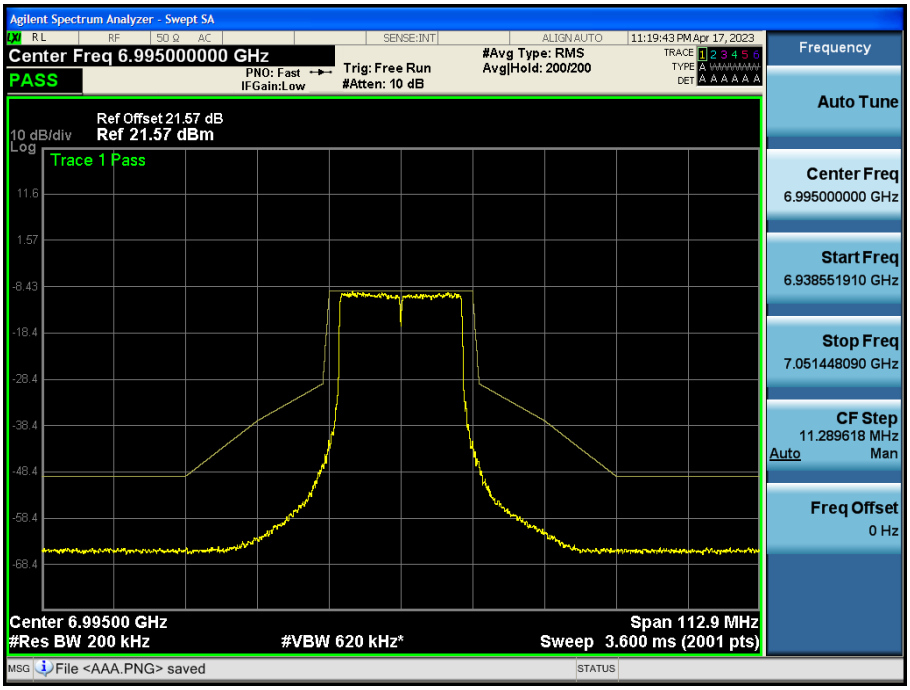
Note:
1. In order to simplify the report, attached plots were only the widest channel.

Ant.1

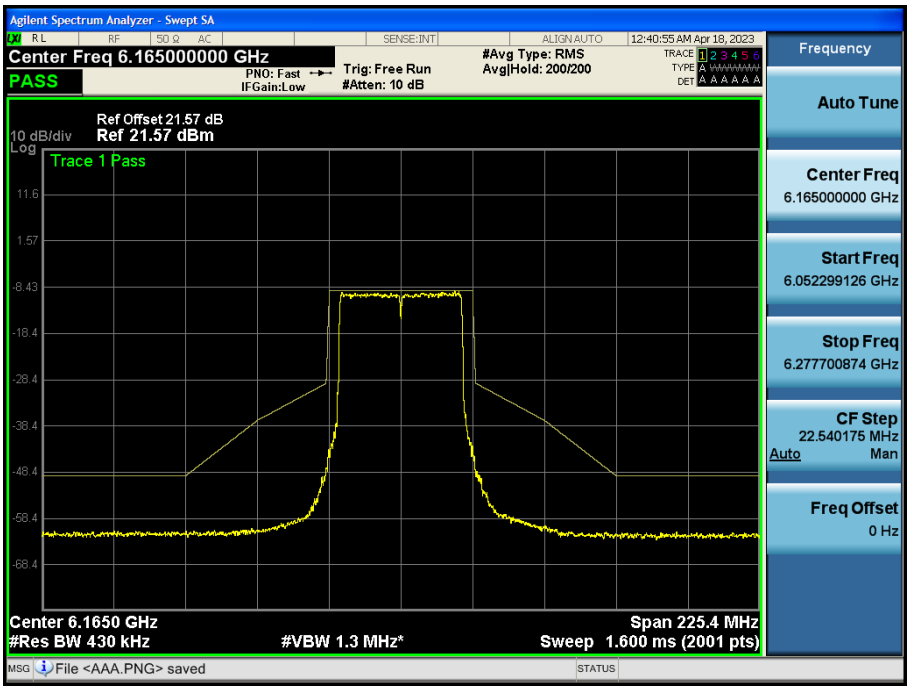
802.11a Ch.93(6415 MHz)



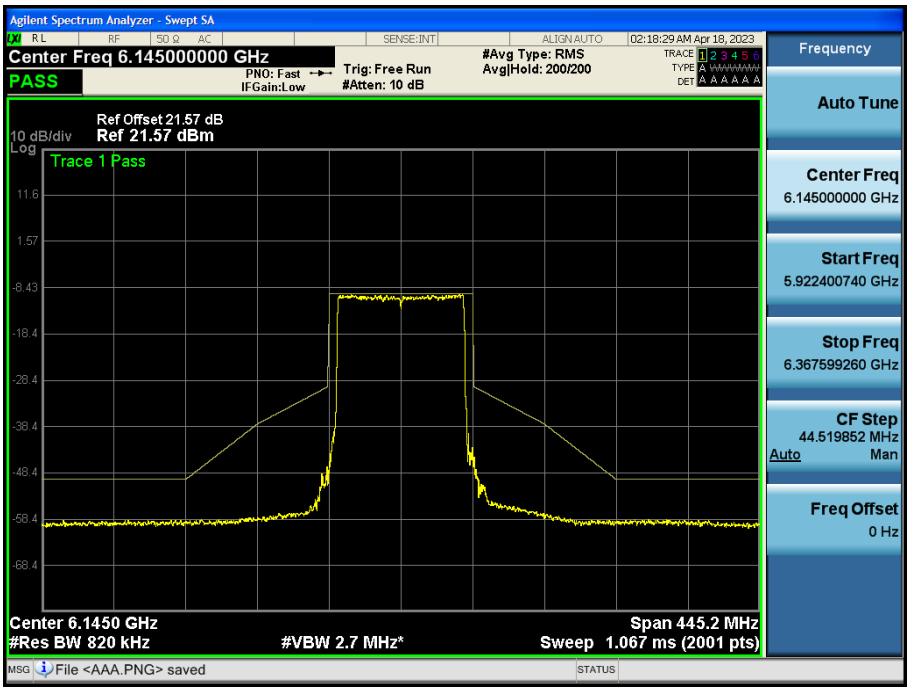
802.11ax HE20 Ch.209(6995 MHz) 242 Tones 61 RU



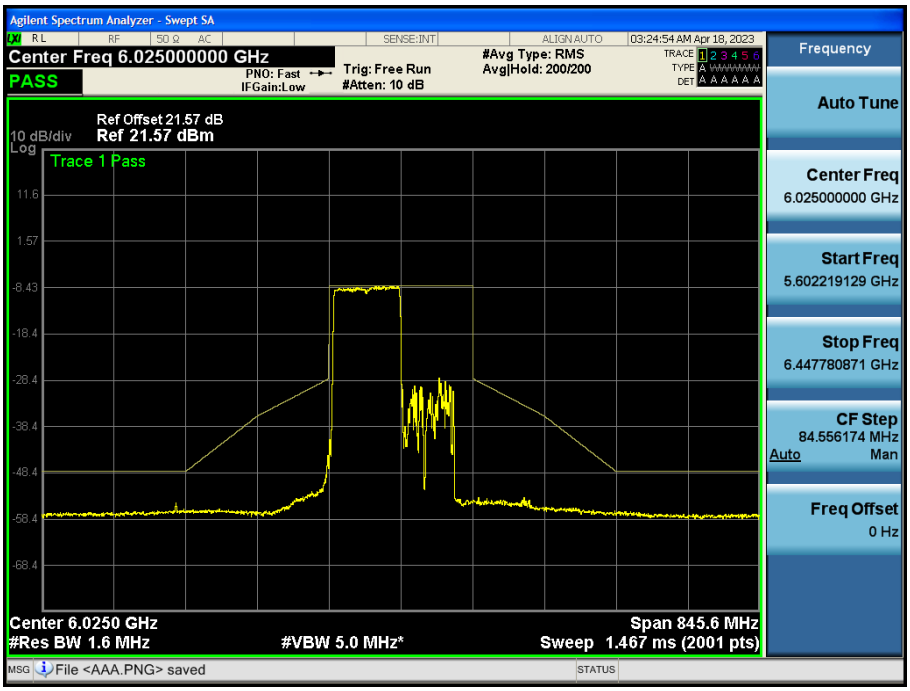
802.11ax HE40 Ch.43(6165 MHz) 484 Tones 65 RU



802.11ax HE80 Ch.39(6145 MHz) 996 Tones 67 RU

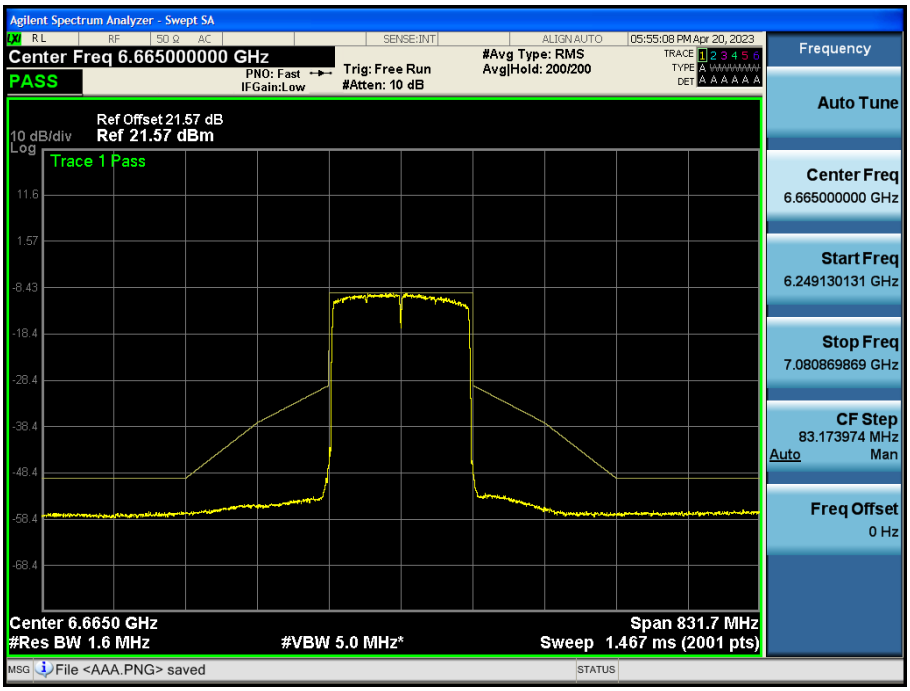


802.11ax HE160, 80_L Ch.15(6025 MHz) 996 Tones 67 RU



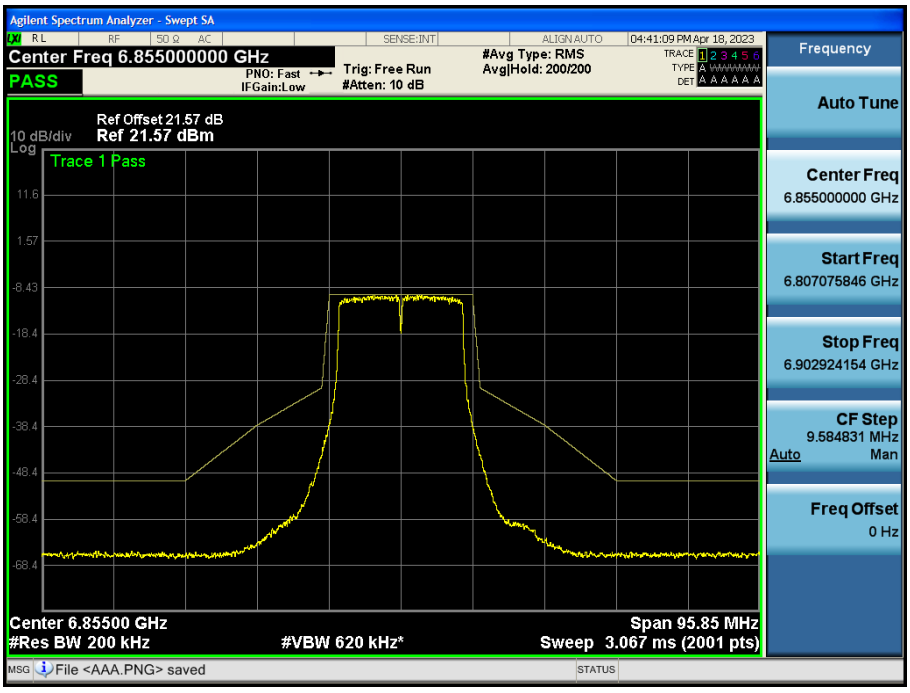
802.11ax HE160, 80_U Ch.15(6025 MHz) 484 Tones 66 RU

Bandwidth 160M, SU Ch. 143(6665 MHz) 996*2 Tones 68 RU

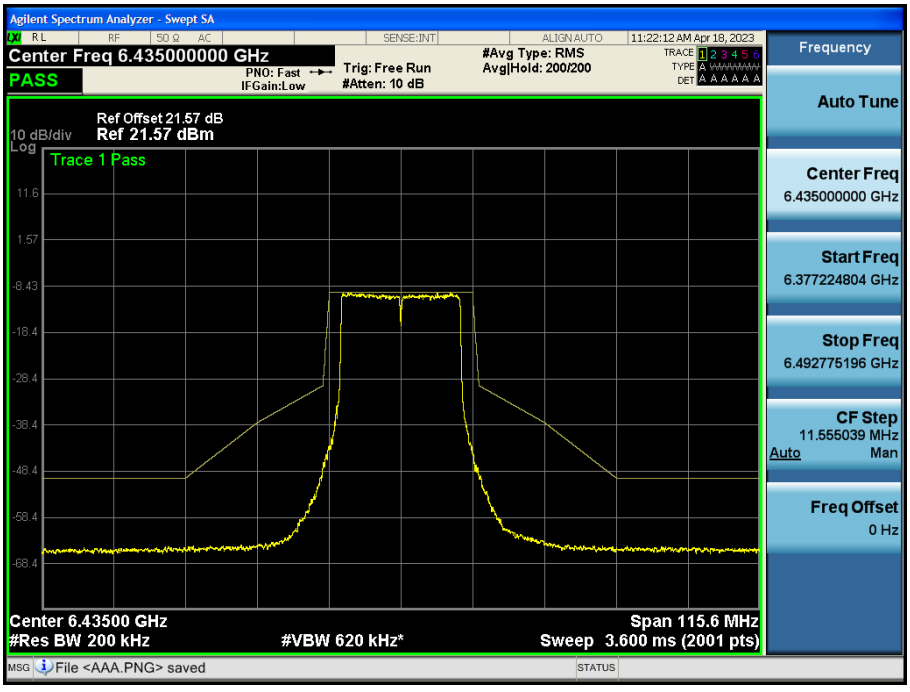


Ant.2

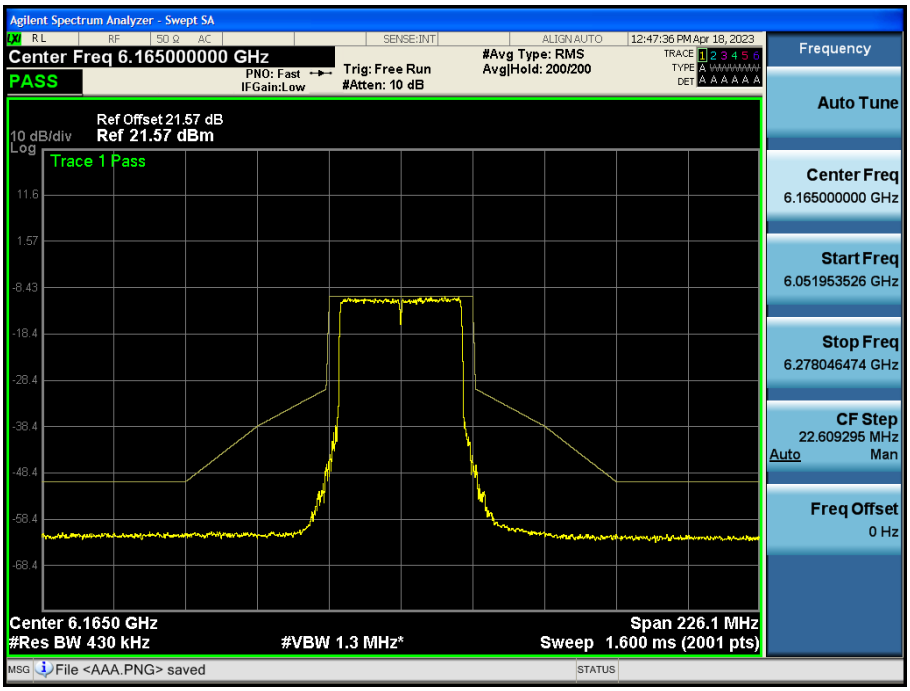
802.11a Ch.181(6855 MHz)



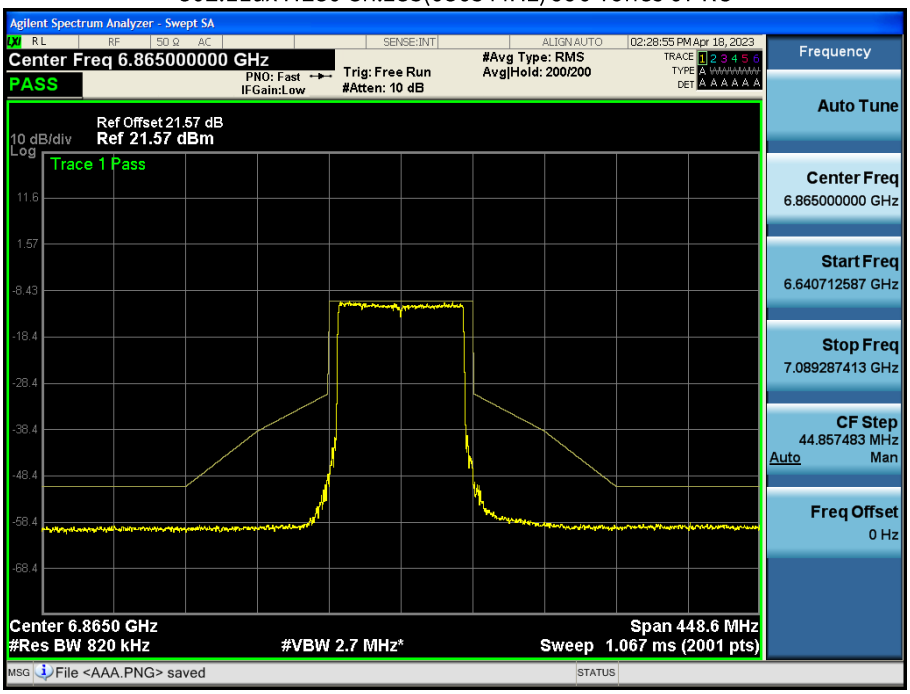
802.11ax HE20 Ch.97(6435 MHz) 242 Tones 61 RU



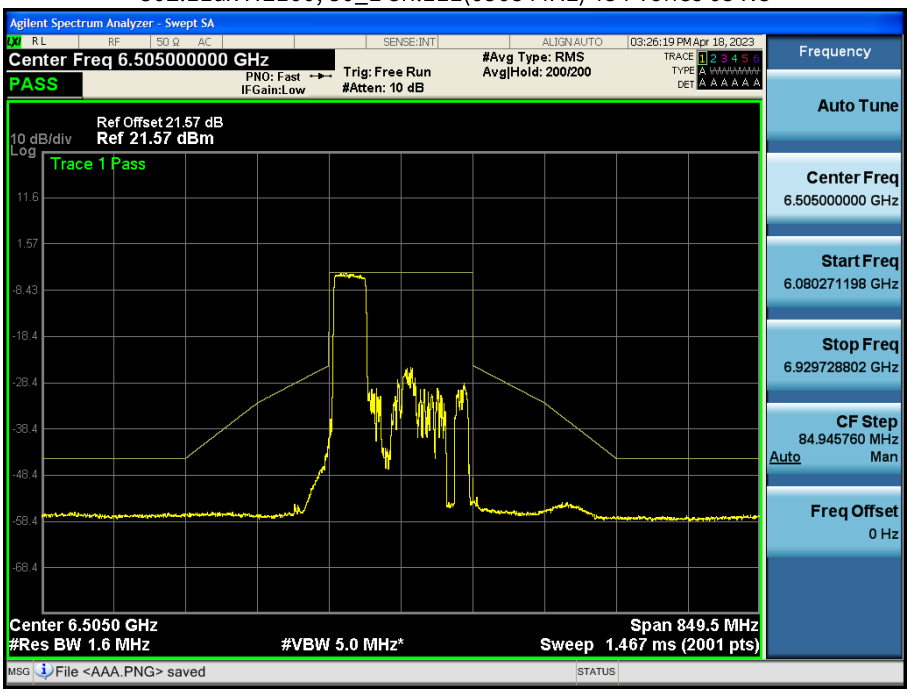
802.11ax HE40 Ch.43(6165 MHz) 484 Tones 65 RU



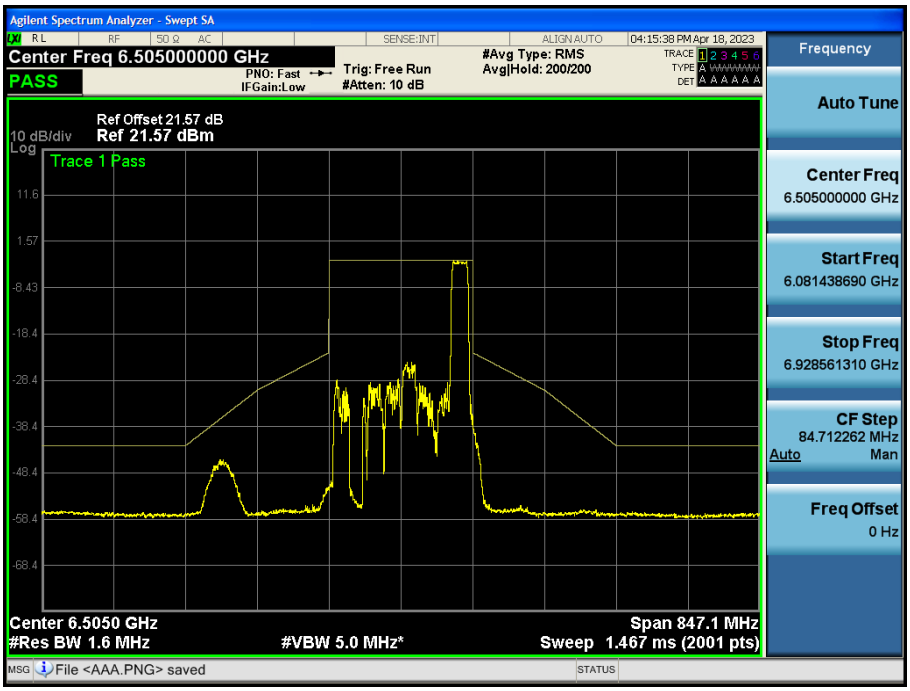
802.11ax HE80 Ch.183(6865 MHz) 996 Tones 67 RU



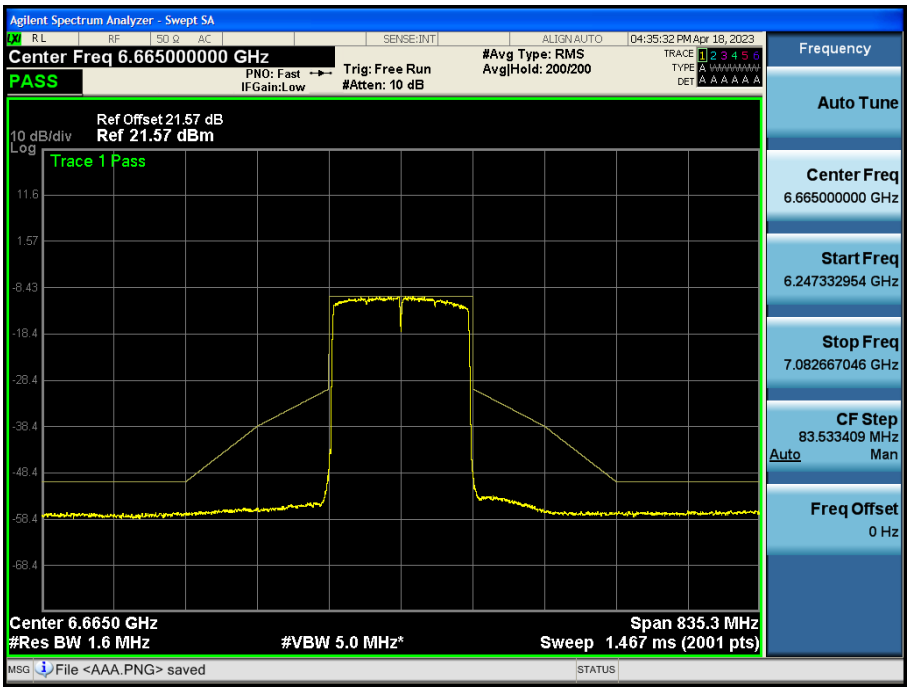
802.11ax HE160, 80_L Ch.111(6505 MHz) 484 Tones 65 RU



802.11ax HE160, 80_U Ch.111(6505 MHz) 242 Tones 64 RU



Bandwidth 160M, SU Ch. 143(6665 MHz) SU



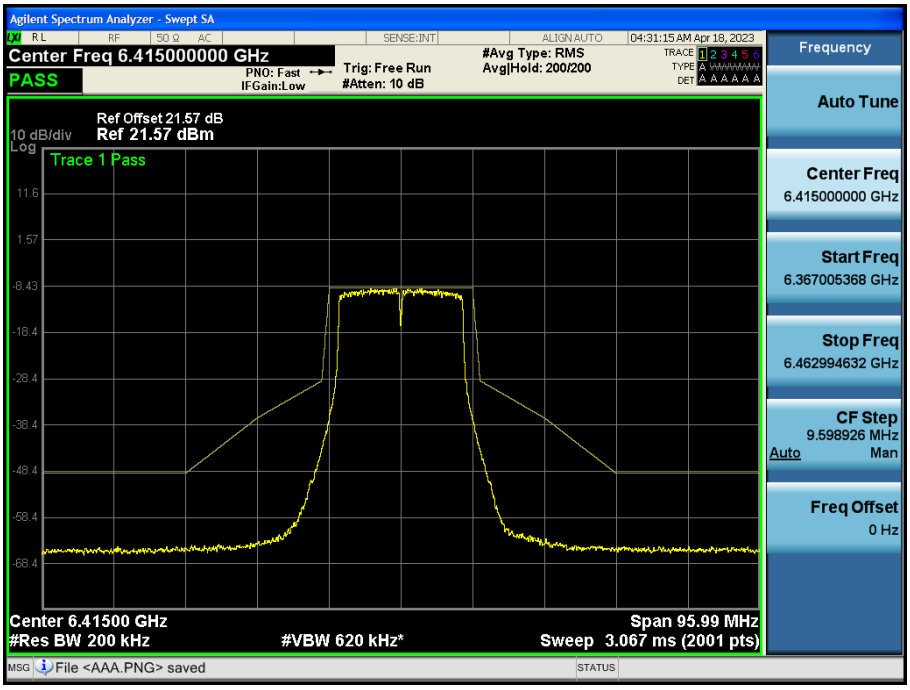
3.2 Standard client

Note:

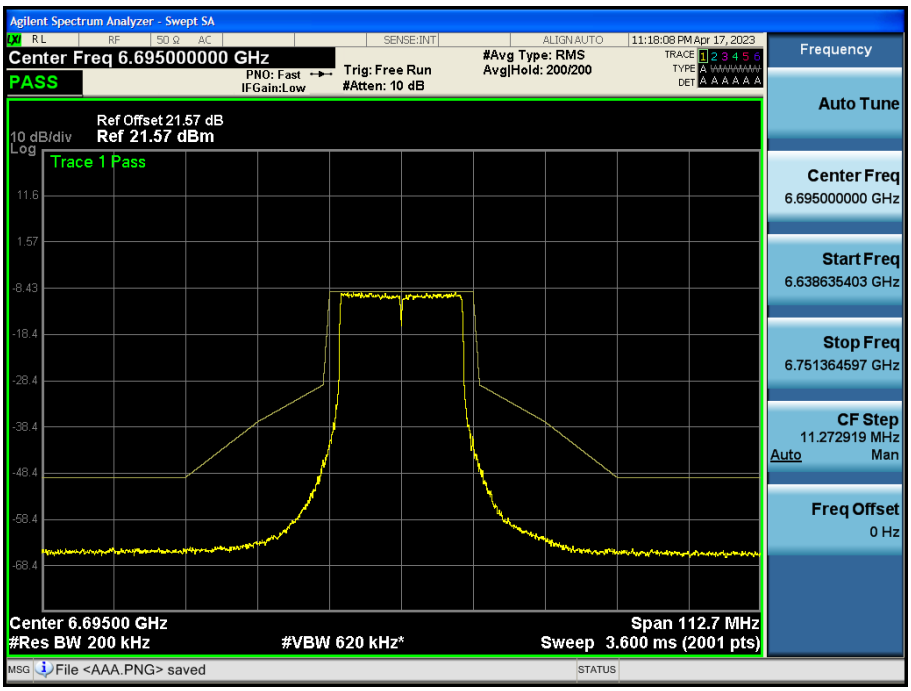
1. In order to simplify the report, attached plots were only the widest channel.

Ant.1

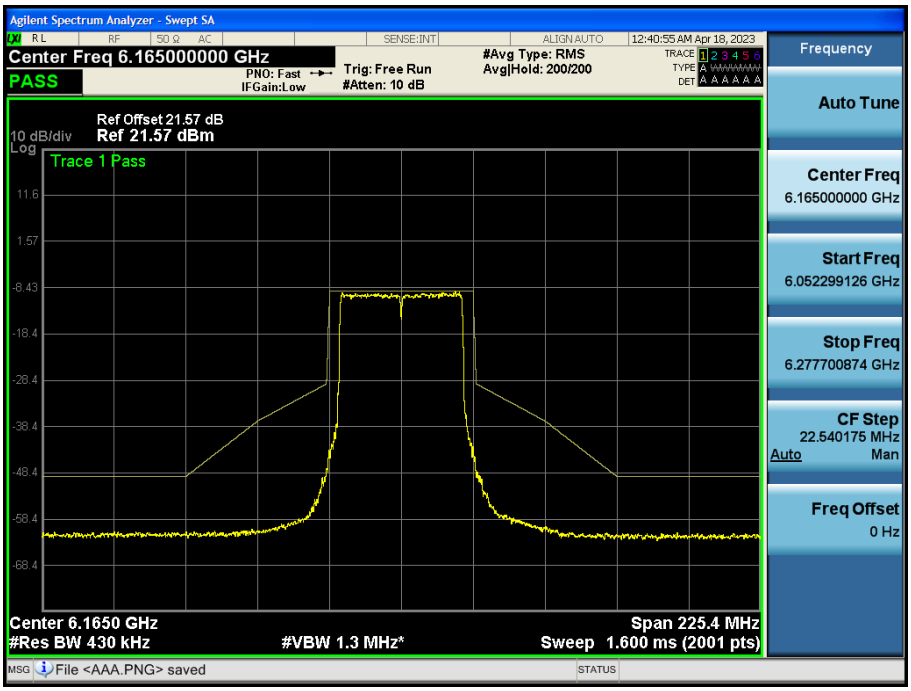
802.11a Ch.93(6415 MHz)



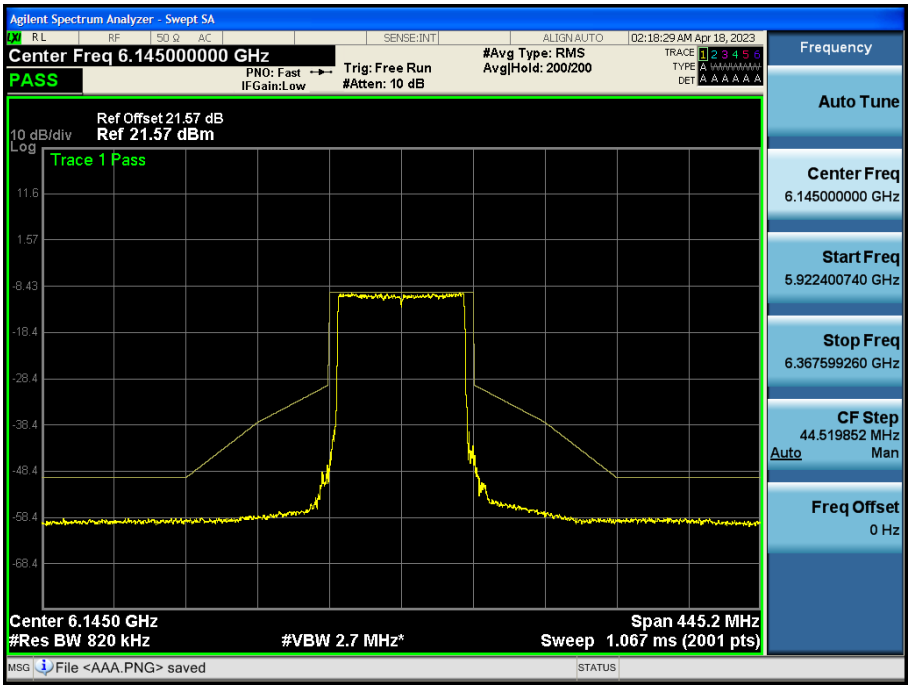
802.11ax HE20 Ch.149(6695 MHz) 242 Tones 61 RU



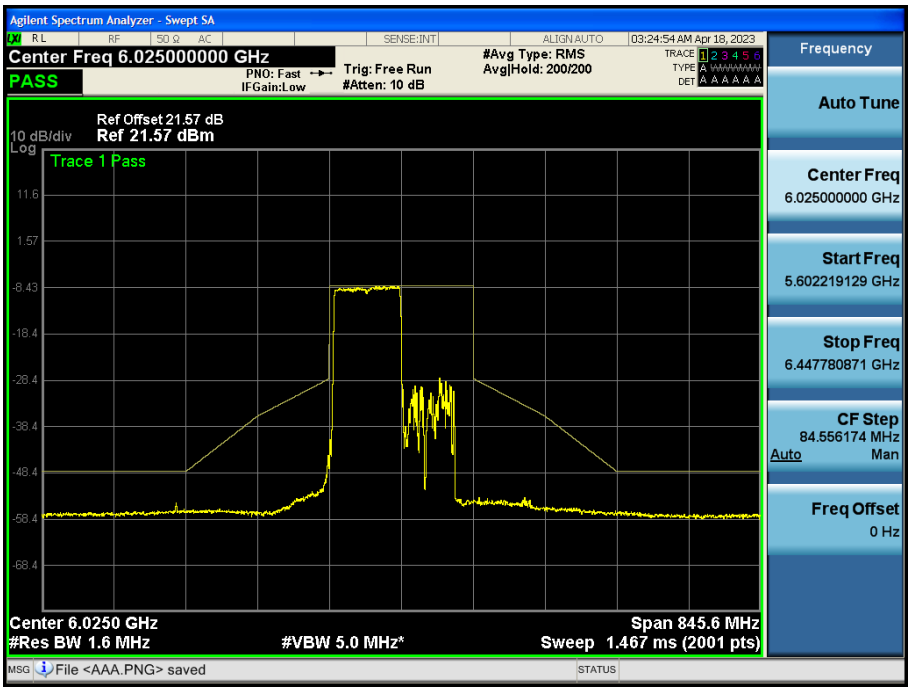
802.11ax HE40 Ch.43(6165 MHz) 484 Tones 65 RU



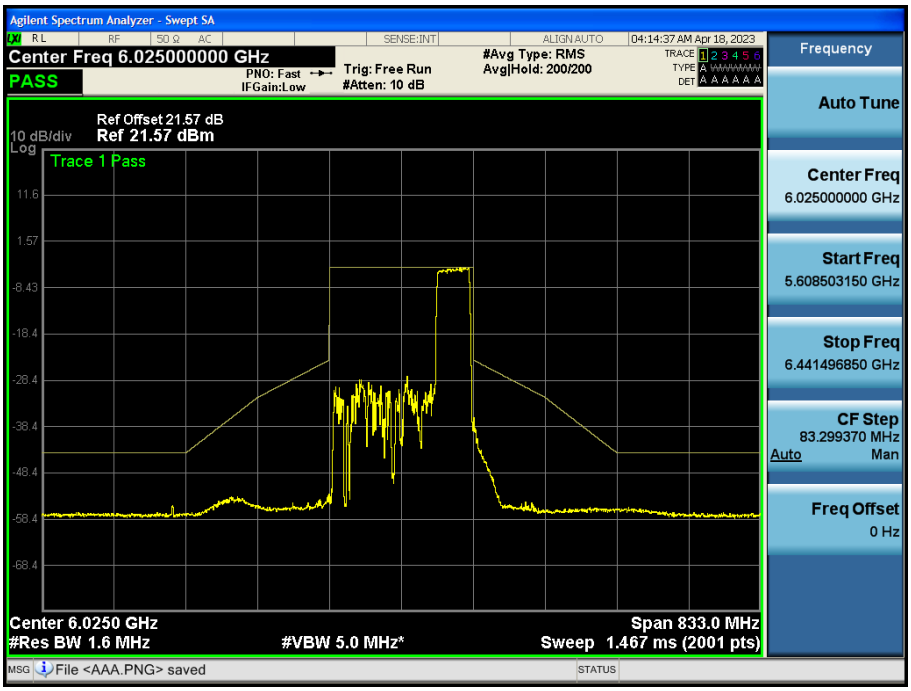
802.11ax HE80 Ch.39(6145 MHz) 996 Tones 67 RU



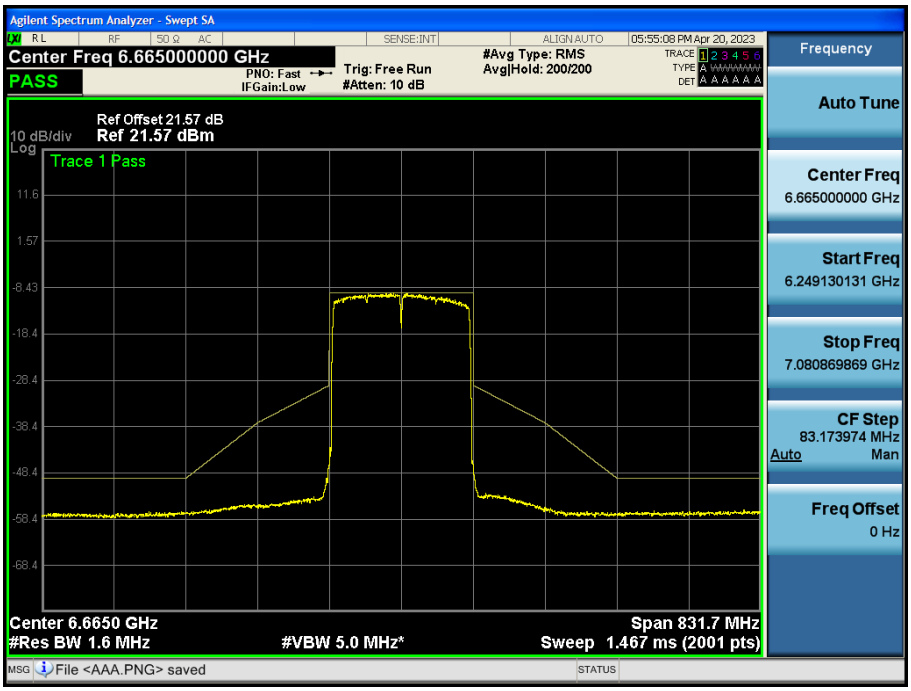
802.11ax HE160, 80_L Ch.15(6025 MHz) 996 Tones 67 RU



802.11ax HE160, 80_U Ch.15(6025 MHz) 484 Tones 66 RU

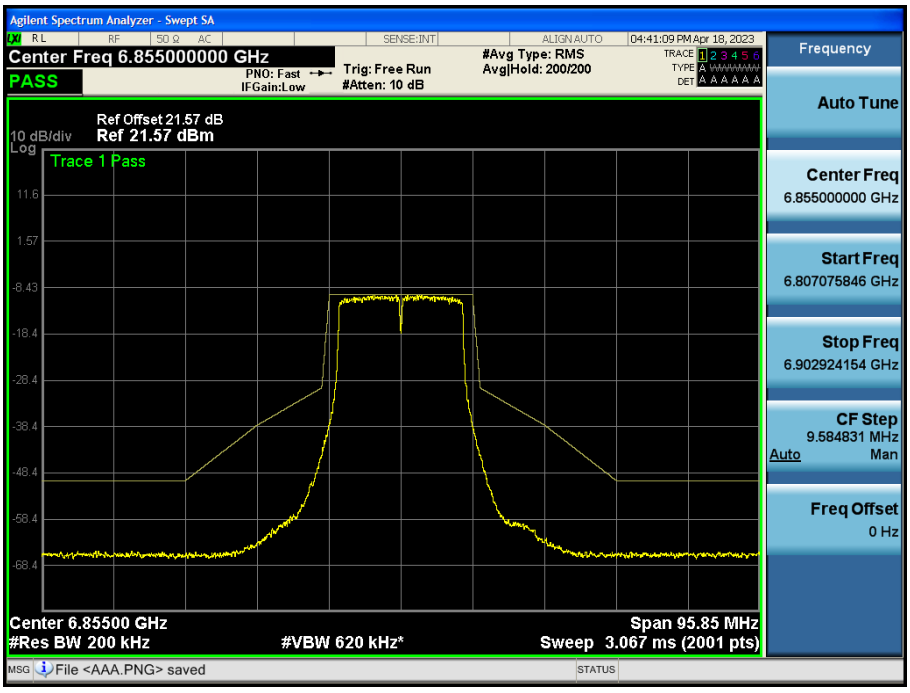


Bandwidth 160M, SU Ch. 143(6665 MHz) 996*2 Tones 68 RU

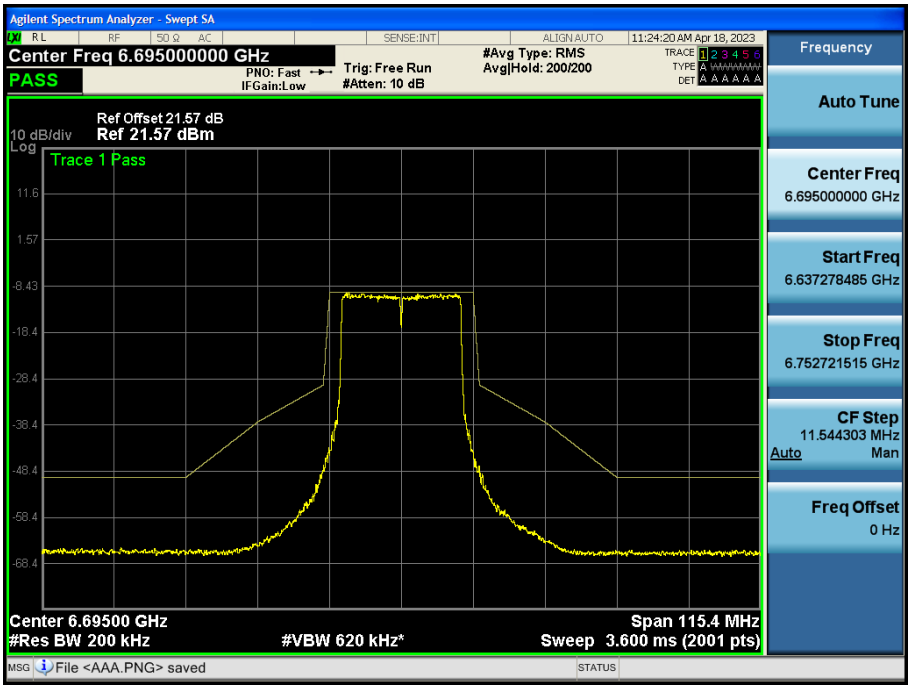


Ant.2

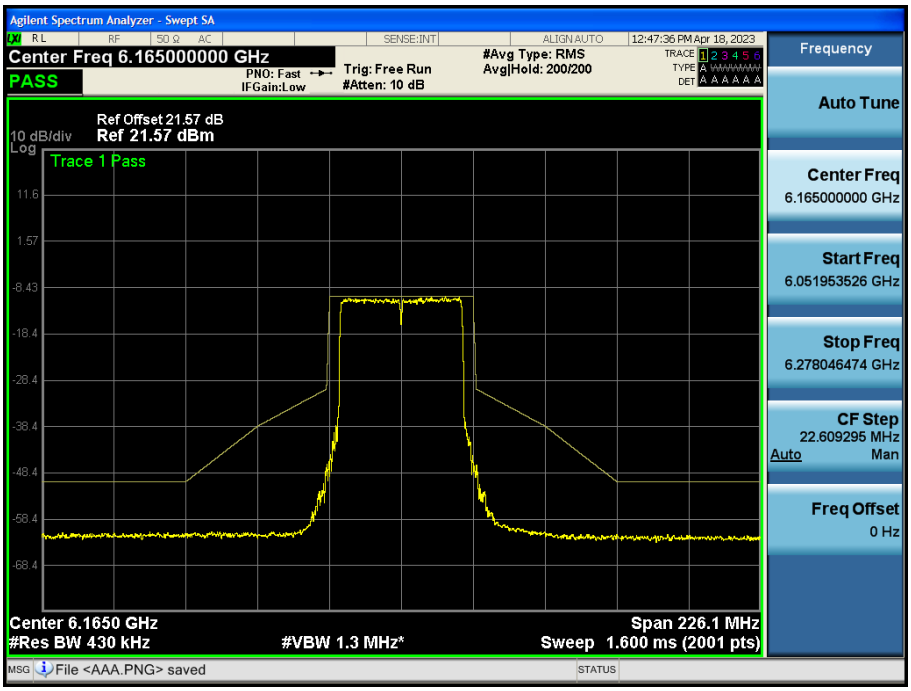
802.11a Ch.181(6855 MHz)



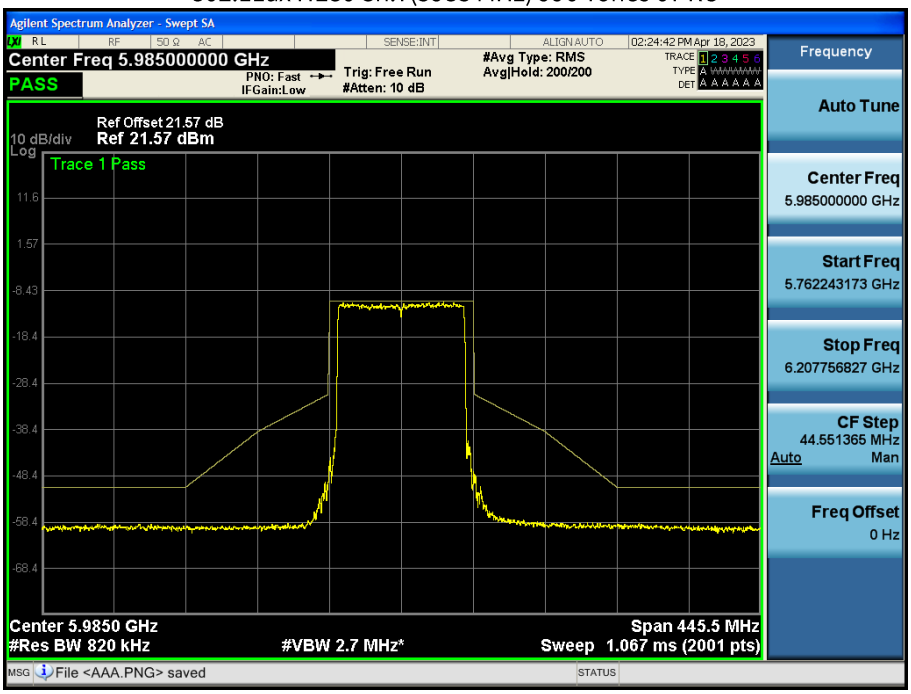
802.11ax HE20 Ch.149(6695 MHz) 242 Tones 61 RU



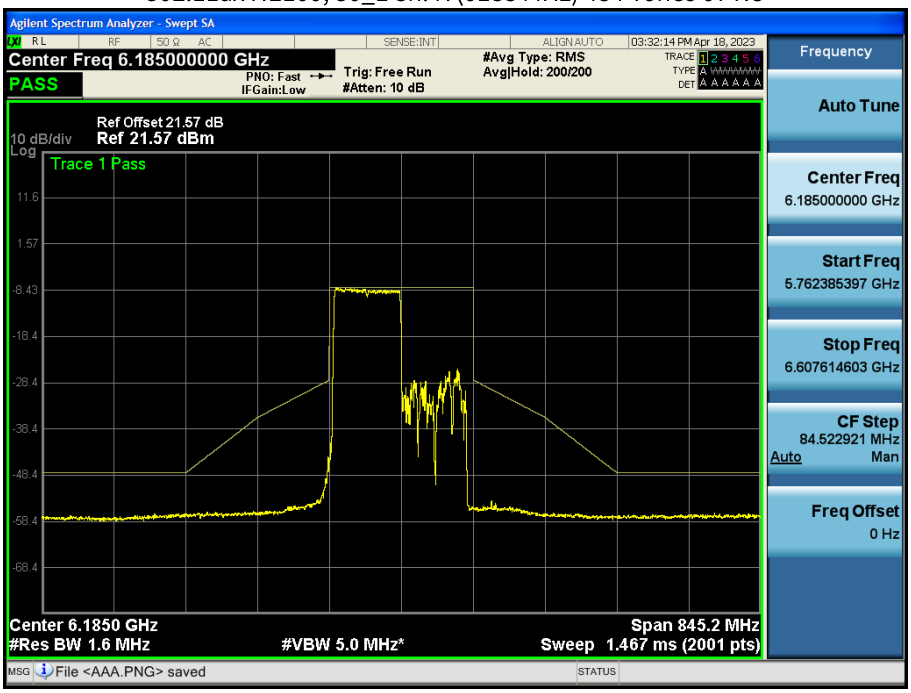
802.11ax HE40 Ch.43(6165 MHz) 484 Tones 65 RU



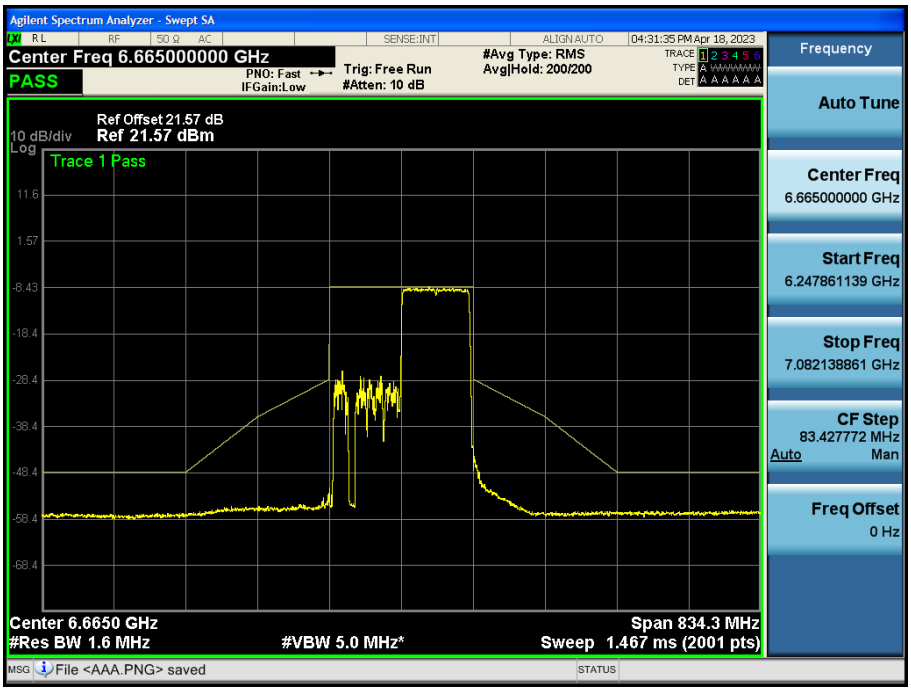
802.11ax HE80 Ch.7(5985 MHz) 996 Tones 67 RU



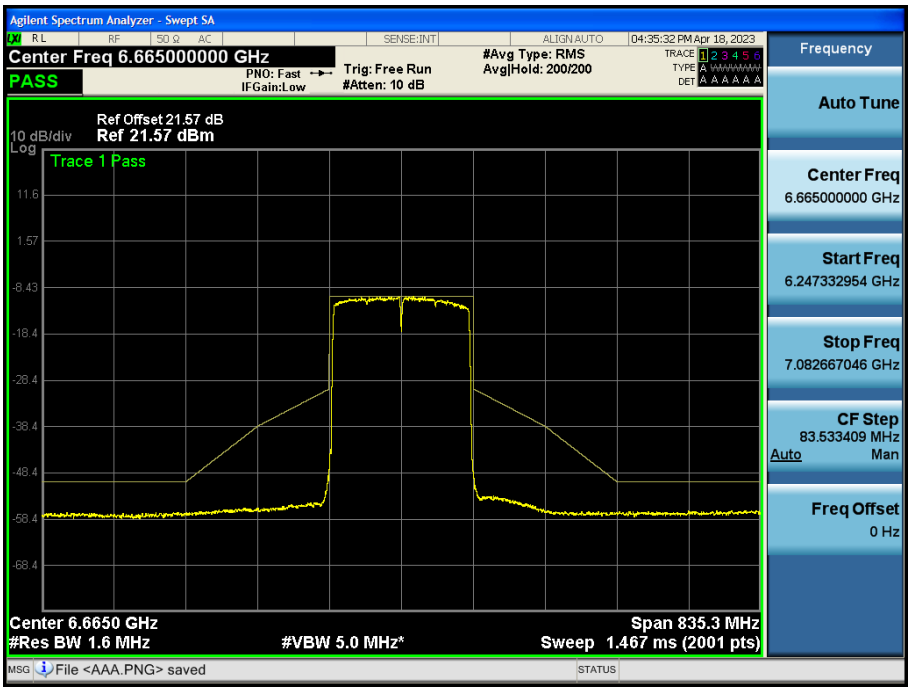
802.11ax HE160, 80_L Ch.47(6185 MHz) 484 Tones 67 RU



802.11ax HE160, 80_U Ch.143(6665 MHz) 996 Tones 67 RU



Bandwidth 160M, SU Ch. 143(6665 MHz) SU



4. Power Spectral Density

Note:

1. In order to simplify the report, attached plots were only channel of highest EIRP PSD.

2. According to KDB 662911 D01 Multiple Transmitter Output v02r01 F) 2) f) (ii)

Directional gain =

$$DirectionalGain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{SS}}\left\{\sum_{k=1}^{N_{ANT}} g_{j,k}\right\}^2}{N_{ANT}}\right]$$

Band	Ant Gain (dBi)		N_{ANT}/ N_{SS}	Directional Gain (dBi)
UNII 5	ANT1	-5.80	2 / 2	-3.46
	ANT2	-7.20		
UNII 6	ANT1	-6.80	2 / 2	-3.54
	ANT2	-6.30		
UNII 7	ANT1	-7.40	2 / 2	-4.39
	ANT2	-7.40		
UNII 8	ANT1	-8.50	2 / 2	-5.18
	ANT2	-7.90		

Note

According to Ansi C63.10-2013 section 14.4.3, the directional gain is calculated using the formula, where GN is the gain of the nth antenna and NANT is the total number of antennas used.

Directional Gain = $10 \cdot \log(((10^{(ANT1\ Gain/20)}+10^{(ANT2\ Gain/20)})^2)/2)$ dBi

Sample Calculation (Conducted Power, MIMO):

Ex) Ant 1 : 11.58 dBm Ant 2 : 12.08 dBm

Ant1 + Ant 2 = MIMO

(11.58 dBm + 12.08 dBm) = (14.387 mW + 16.143 mW) = 30.53 mW = 14.88 dBm

Sample Calculation (E.I.R.P & E.I.R.P Spectral Density, MIMO):

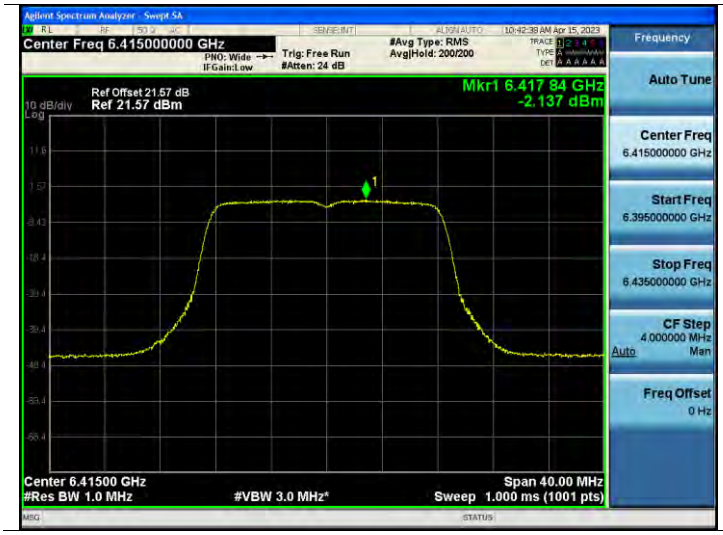
Ex) ANT1 : 15.35 dBm , ANT2 : 15.12 dBm, Directional Gain : 3 dBi

Conducted Power = (15.35 dBm + 15.12 dBm) = (34.276 mW + 32.508 mW) = 66.784 mW = 18.25 dBm

E.I.R.P = 18.25 dBm + 3 dBi = 21.25 dBm

4.1 Indoor client

[SUM (MIMO Ant 1 + MIMO Ant2)]

802.11a Ch.93(6415MHz)	
Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
0.914	0.104	1.018	-2.443

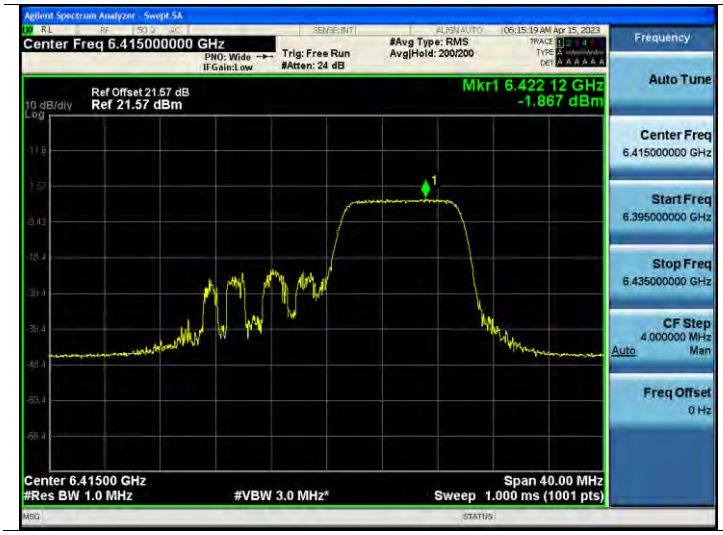
Note:

SUM PSD(dBm/MHz) = 10log(((10^(Ant 1 PSD /10)+10^(Ant 2 PSD/10))) (dBm)

Total PSD (dBm/MHz) = SUM PSD(dBm) + Duty Cycle Factor (dB)

EIRP PSD(dBm/MHz) = Total PSD (dBm/MHz) + Directional Gain(dBi)

802.11ax HE20 Ch.93(6415 MHz) 106 Tones RU 54

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
1.330	0.000	1.330	-2.132

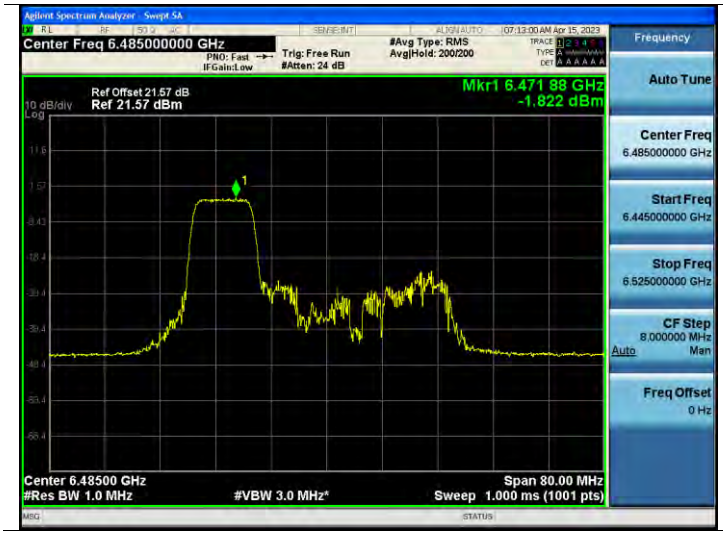
Note:

SUM PSD(dBm/MHz) = 10log(((10^(Ant 1 PSD /10)+10^(Ant 2 PSD/10))) (dBm)

Total PSD (dBm/MHz) = SUM PSD(dBm) + Duty Cycle Factor (dB)

EIRP PSD(dBm/MHz) = Total PSD (dBm/MHz) + Directional Gain(dBi)

802.11ax HE40 Ch.107(6485 MHz) 106 Tones RU 53

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
0.928	0.000	0.928	-2.608

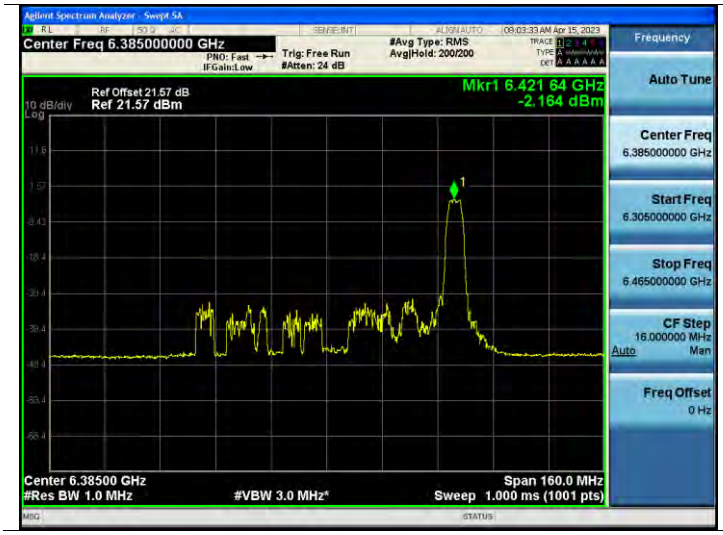
Note:

SUM PSD(dBm/MHz) = 10log(((10^(Ant 1 PSD /10)+10^(Ant 2 PSD/10))) (dBm)

Total PSD (dBm/MHz) = SUM PSD(dBm) + Duty Cycle Factor (dB)

EIRP PSD(dBm/MHz) = Total PSD (dBm/MHz) + Directional Gain(dBi)

802.11ax HE80 Ch.87(6385 MHz) 52 Tones RU 52

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
0.949	0.000	0.949	-2.512

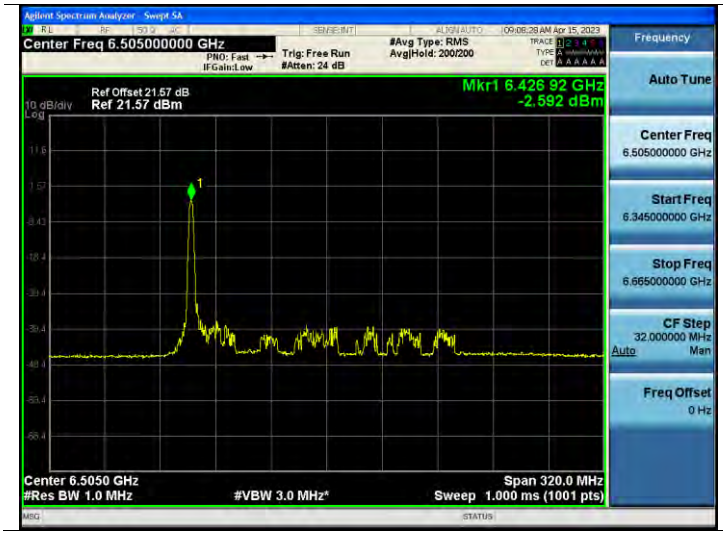
Note:

SUM PSD(dBm/MHz) = 10log(((10^(Ant 1 PSD /10)+10^(Ant 2 PSD/10))) (dBm)

Total PSD (dBm/MHz) = SUM PSD(dBm) + Duty Cycle Factor (dB)

EIRP PSD(dBm/MHz) = Total PSD (dBm/MHz) + Directional Gain(dBi)

802.11ax HE160 80_L Ch.111(6505 MHz) 26 Tones RU 0

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
0.804	0.000	0.804	-2.732

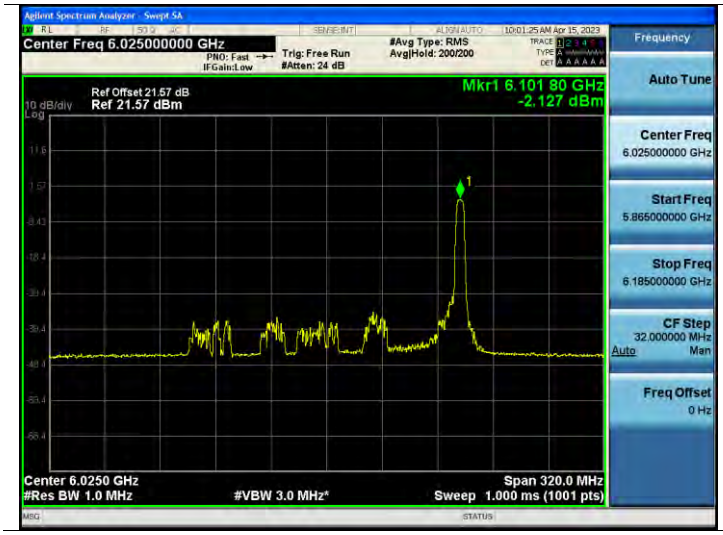
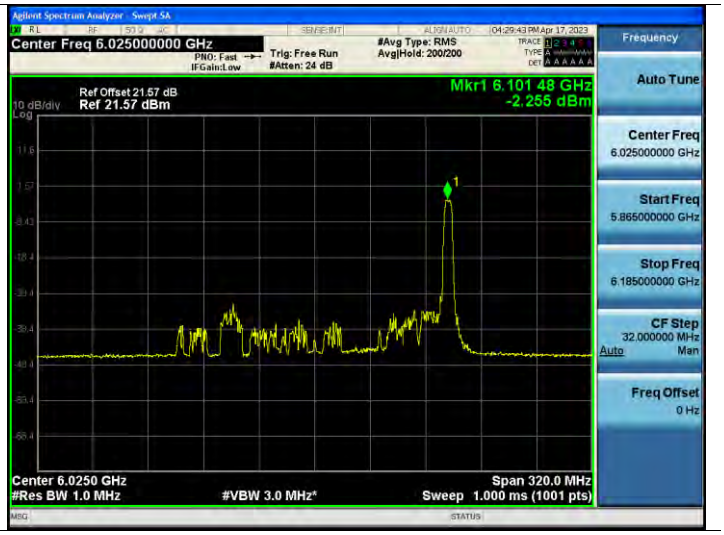
Note:

SUM PSD(dBm/MHz) = 10log(((10^(Ant 1 PSD /10)+10^(Ant 2 PSD/10))) (dBm)

Total PSD (dBm/MHz) = SUM PSD(dBm) + Duty Cycle Factor (dB)

EIRP PSD(dBm/MHz) = Total PSD (dBm/MHz) + Directional Gain(dBi)

802.11ax HE160 80_U Ch.15(6025 MHz) 52 Tones RU 52

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
0.820	0.000	0.820	-2.642

Note:

SUM PSD(dBm/MHz) = 10log(((10^(Ant 1 PSD /10)+10^(Ant 2 PSD/10))) (dBm)

Total PSD (dBm/MHz) = SUM PSD(dBm) + Duty Cycle Factor (dB)

EIRP PSD(dBm/MHz) = Total PSD (dBm/MHz) + Directional Gain(dBi)

802.11ax HE160 80_U Ch.79(6345 MHz) SU

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
-8.202	0.000	-8.202	-11.663

Note:

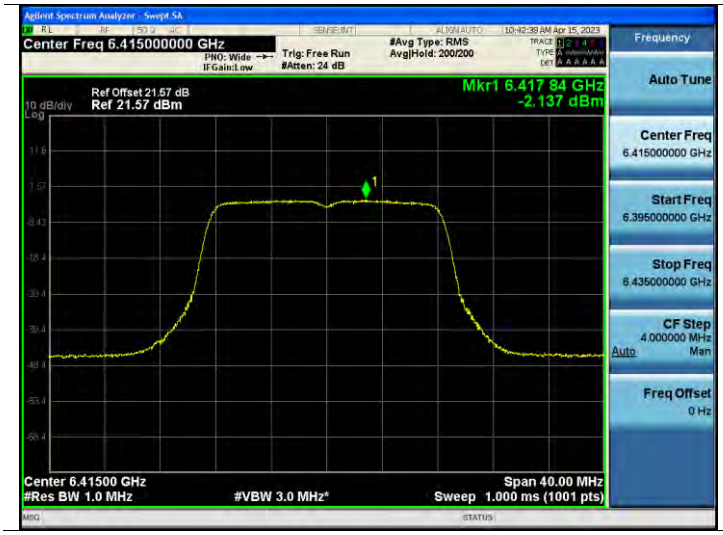
SUM PSD(dBm/MHz) = 10log(((10^(Ant 1 PSD /10)+10^(Ant 2 PSD/10))) (dBm)

Total PSD (dBm/MHz) = SUM PSD(dBm) + Duty Cycle Factor (dB)

EIRP PSD(dBm/MHz) = Total PSD (dBm/MHz) + Directional Gain(dBi)

4.2 Standard client

[SUM (MIMO Ant 1 + MIMO Ant2)]

802.11a Ch.93(6415MHz) SU	
Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
0.914	0.104	1.018	-2.443

Note:

SUM PSD(dBm/MHz) = 10log(((10^(Ant 1 PSD /10)+10^(Ant 2 PSD/10))) (dBm)

Total PSD (dBm/MHz) = SUM PSD(dBm) + Duty Cycle Factor (dB)

EIRP PSD(dBm/MHz) = Total PSD (dBm/MHz) + Directional Gain(dBi)

802.11ax HE20 Ch.93(6415MHz) 26 Tones RU 0

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
9.176	0.000	9.176	5.714

Note:

SUM PSD(dBm/MHz) = 10log(((10^(Ant 1 PSD /10)+10^(Ant 2 PSD/10))) (dBm)

Total PSD (dBm/MHz) = SUM PSD(dBm) + Duty Cycle Factor (dB)

EIRP PSD(dBm/MHz) = Total PSD (dBm/MHz) + Directional Gain(dBi)

802.11ax HE40 Ch.43 (6165 MHz) 26 Tones RU 17

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
9.049	0.000	9.049	5.587

Note:

SUM PSD(dBm/MHz) = 10log(((10^(Ant 1 PSD /10)+10^(Ant 2 PSD/10))) (dBm)

Total PSD (dBm/MHz) = SUM PSD(dBm) + Duty Cycle Factor (dB)

EIRP PSD(dBm/MHz) = Total PSD (dBm/MHz) + Directional Gain(dBi)

802.11ax HE80 Ch.39(6145 MHz) 26 Tones RU 36

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
9.069	0.000	9.069	5.608

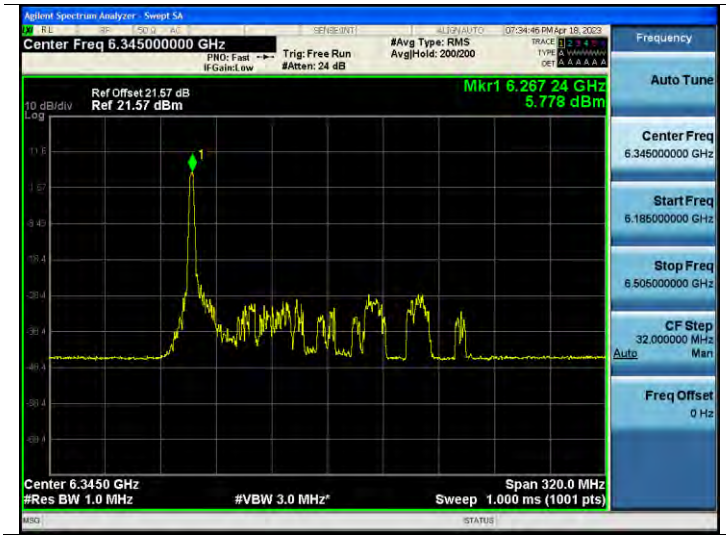
Note:

SUM PSD(dBm/MHz) = 10log(((10^(Ant 1 PSD /10)+10^(Ant 2 PSD/10))) (dBm)

Total PSD (dBm/MHz) = SUM PSD(dBm) + Duty Cycle Factor (dB)

EIRP PSD(dBm/MHz) = Total PSD (dBm/MHz) + Directional Gain(dBi)

802.11ax HE160 80_L Ch.79(6345MHz) 26 Tones RU 0

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
8.864	0.000	8.864	5.402

Note:

SUM PSD(dBm/MHz) = 10log(((10^(Ant 1 PSD /10)+10^(Ant 2 PSD/10))) (dBm)

Total PSD (dBm/MHz) = SUM PSD(dBm) + Duty Cycle Factor (dB)

EIRP PSD(dBm/MHz) = Total PSD (dBm/MHz) + Directional Gain(dBi)

802.11ax HE160 80_U Ch.15(6025 MHz) 26 Tones RU 36

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
8.769	0.000	8.769	5.307

Note:

SUM PSD(dBm/MHz) = 10log(((10^(Ant 1 PSD /10)+10^(Ant 2 PSD/10))) (dBm)

Total PSD (dBm/MHz) = SUM PSD(dBm) + Duty Cycle Factor (dB)

EIRP PSD(dBm/MHz) = Total PSD (dBm/MHz) + Directional Gain(dBi)

802.11ax HE160 80_U Ch.79(6345 MHz) SU	
Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
-8.202	0.000	-8.202	-11.663

Note:

SUM PSD(dBm/MHz) = 10log(((10^(Ant 1 PSD /10)+10^(Ant 2 PSD/10))) (dBm)

Total PSD (dBm/MHz) = SUM PSD(dBm) + Duty Cycle Factor (dB)

EIRP PSD(dBm/MHz) = Total PSD (dBm/MHz) + Directional Gain(dBi)

5. Contention Based Protocol

Note:

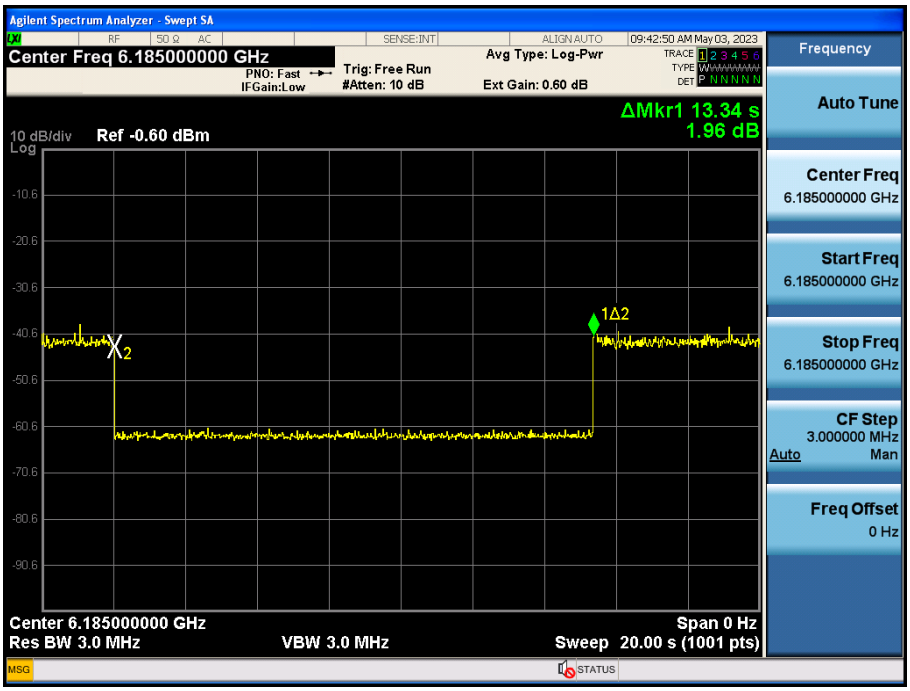
1. In order to simplify the report, Only worst case for each band have been inserted.
2. The worst case antenna gain(Minimum Gain) is selected from the table.
3. The lowest gain according to the incumbent frequency is applied.

Band	Ant 1 Gain (dBi)	Ant 2 Gain (dBi)
UNII-5	-	-7.20
UNII-6	-6.80	-
UNII-7	6 615 MHz, 6 590 MHz, 6 665 MHz: -6.80 6 740 MHz: -7.40	-
UNII-8	6 935 MHz, 6 910 MHz: -7.40 6 985 MHz, 7 050 MHz: -8.50	-

Incumbent Detection Result

UNII 5

802.11ax HE160 Ch.47(6185 MHz) Incumbent signal (Ceased)

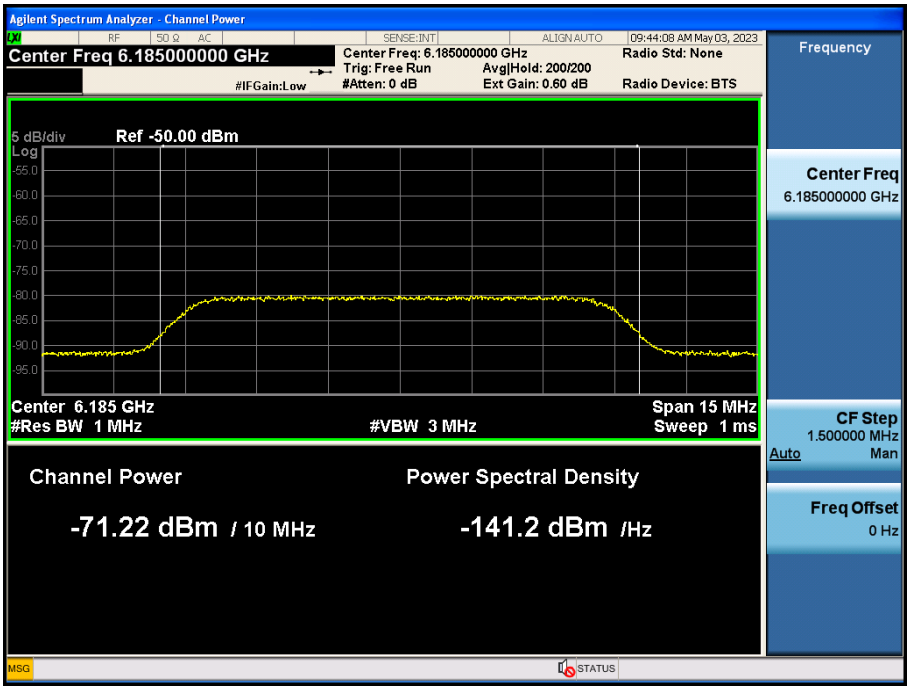


Note :

Marker 2 : AWGN Signal On

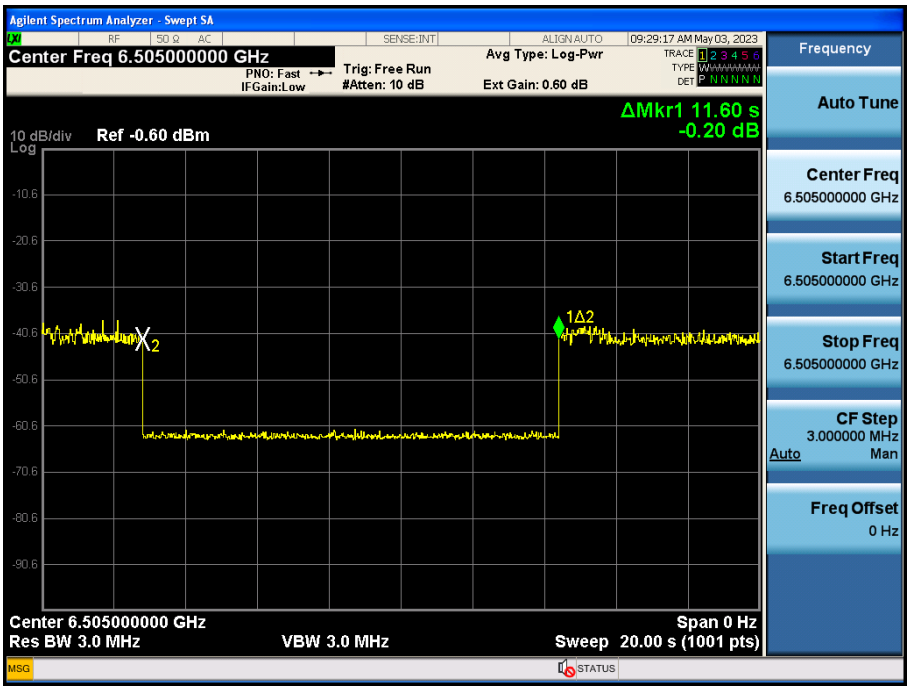
Marker 1△2 : AWGN signal Off (limit > 10s)

802.11ax HE160 Ch.47(6185 MHz) Detection Level



UNII 6

802.11ax HE160 Ch.111(6505 MHz) Incumbent signal (Ceased)

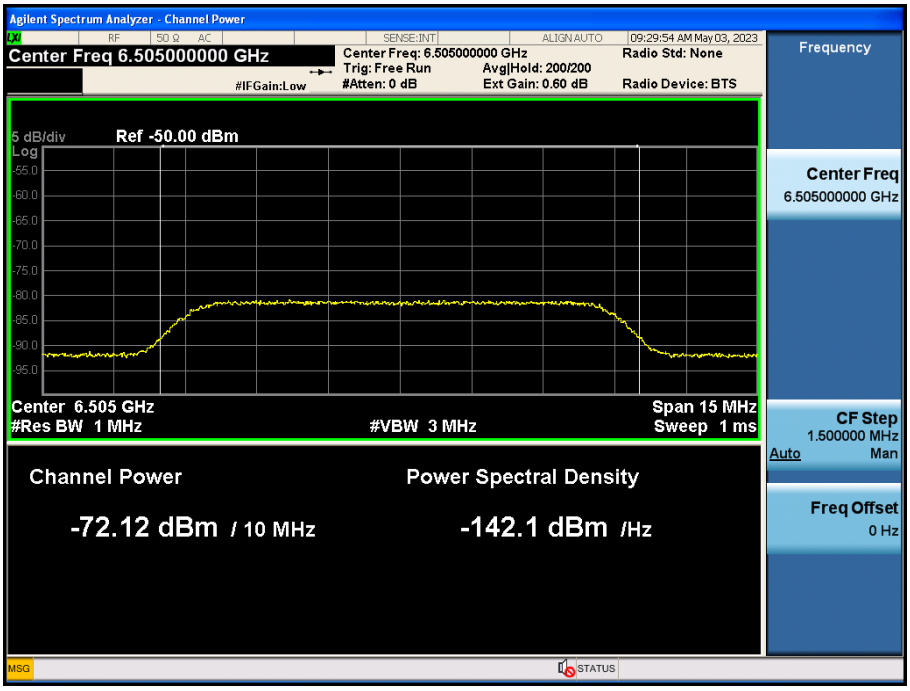


Note :

Marker 2 : AWGN Signal On

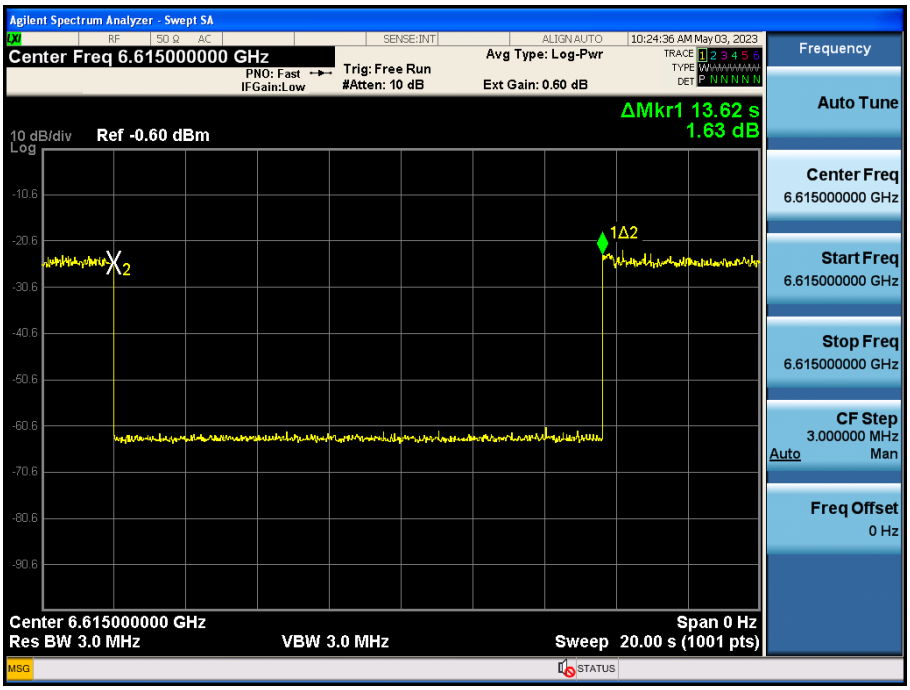
Marker 1△2 : AWGN signal Off (limit > 10s)

802.11ax HE160 Ch.111(6505 MHz) Detection Level



UNII 7

802.11ax HE160 Ch.133(6615 MHz) Incumbent signal (Ceased)

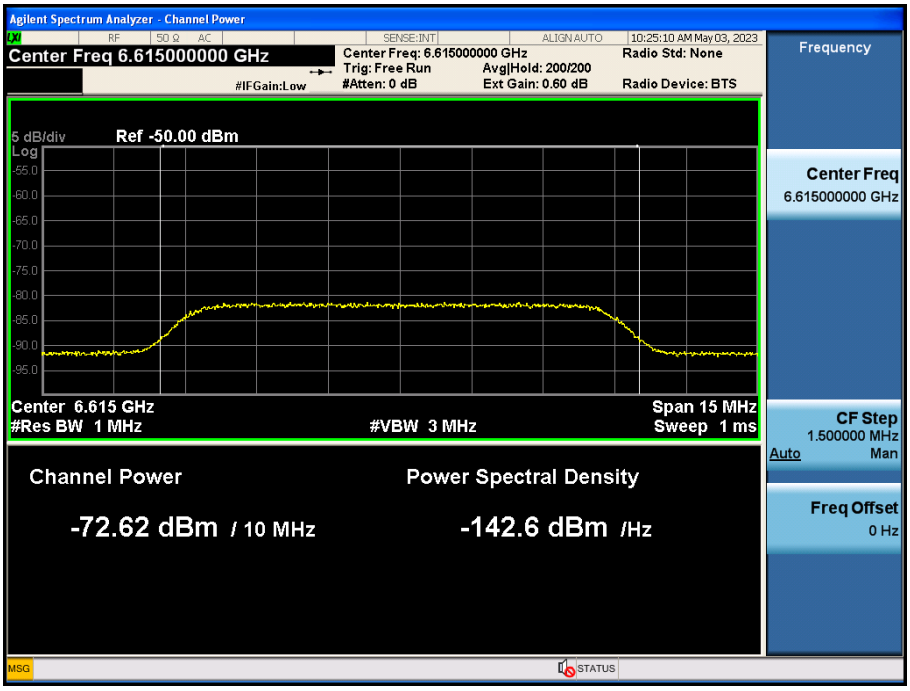


Note :

Marker 2 : AWGN Signal On

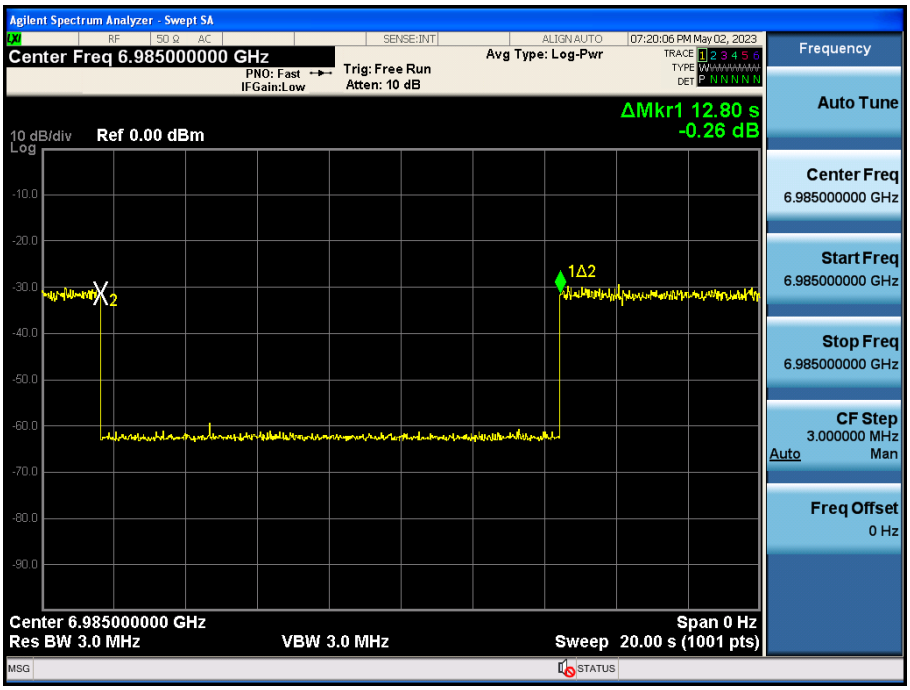
Marker 1△2 : AWGN signal Off (limit > 10s)

802.11ax HE160 Ch.133(6615 MHz) Detection Level



UNII 8

802.11ax HE160 Ch.207(6985 MHz) Incumbent signal (Ceased)



Note :

Marker 2 : AWGN Signal On

Marker 1△2 : AWGN signal Off (limit > 10s)

802.11ax HE160 Ch.207(6985 MHz) Detection Level