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Appendix B: 802.11ax Test Plot

FCC ID
A3LSMF946B

REVISION HISTORY

The revision history for this document is shown in table.

Revision No.	Date of Issue	Description
0	May 19, 2023	Initial Release

Note:

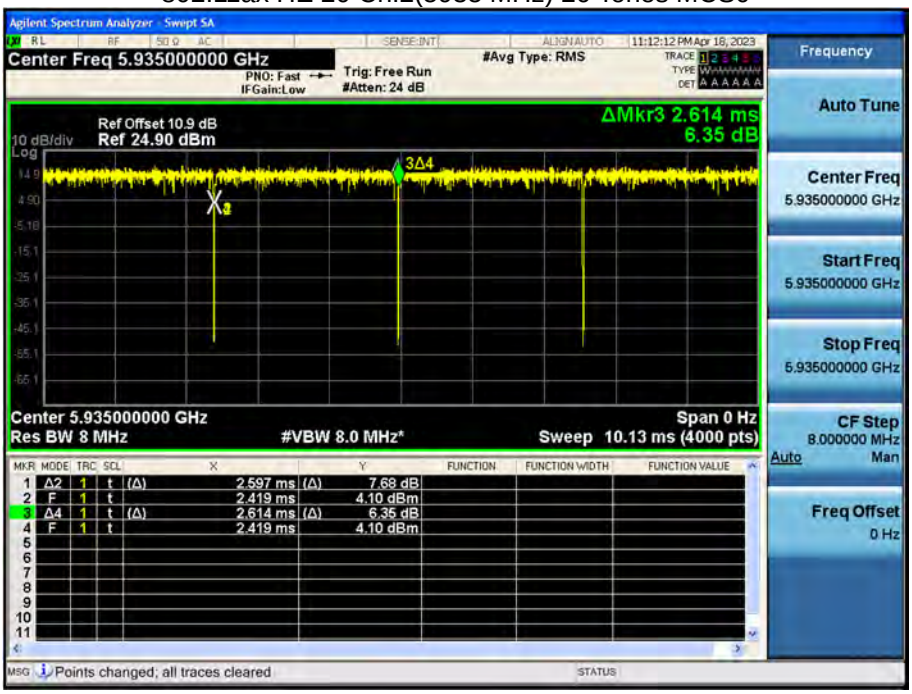
In order to simplify the report, attached plots were only the most lowest datarate.

1. Duty Cycle

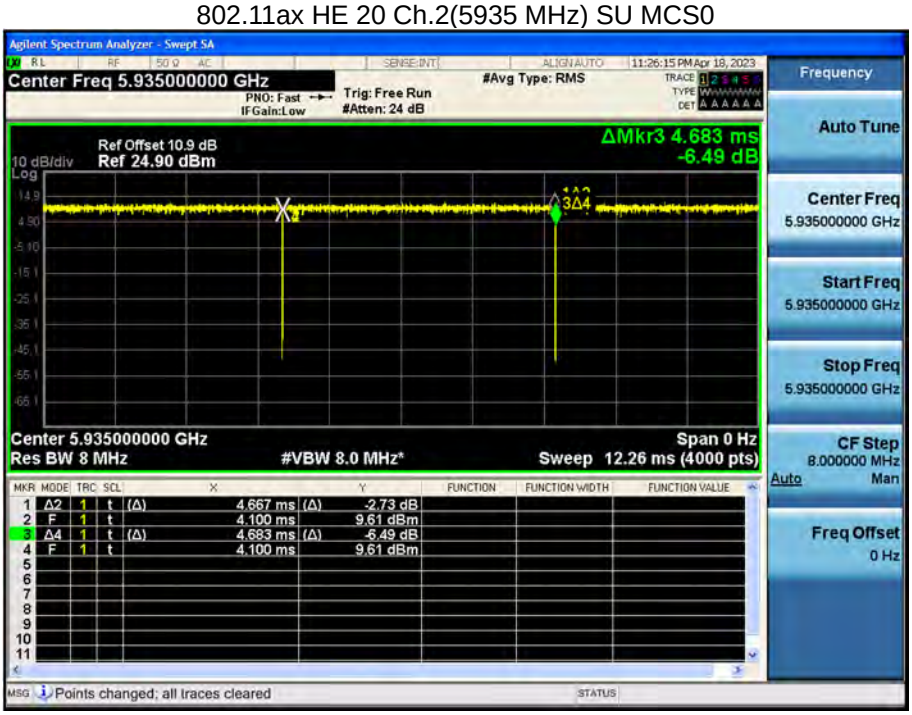
Note:

1.In order to simplify the report, attached plots were only the most lowest datarate .
2. Test was performed with continuous Tx.(Duty cycle ≥ 98% Continuous Signal)

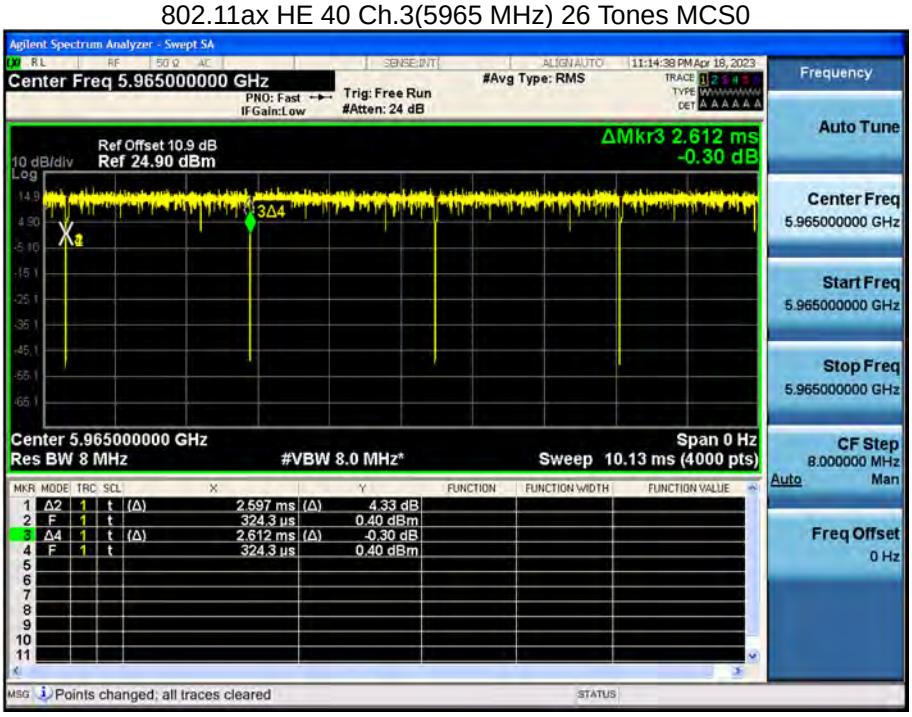
802.11ax HE 20 Ch.2(5935 MHz) 26 Tones MCS0



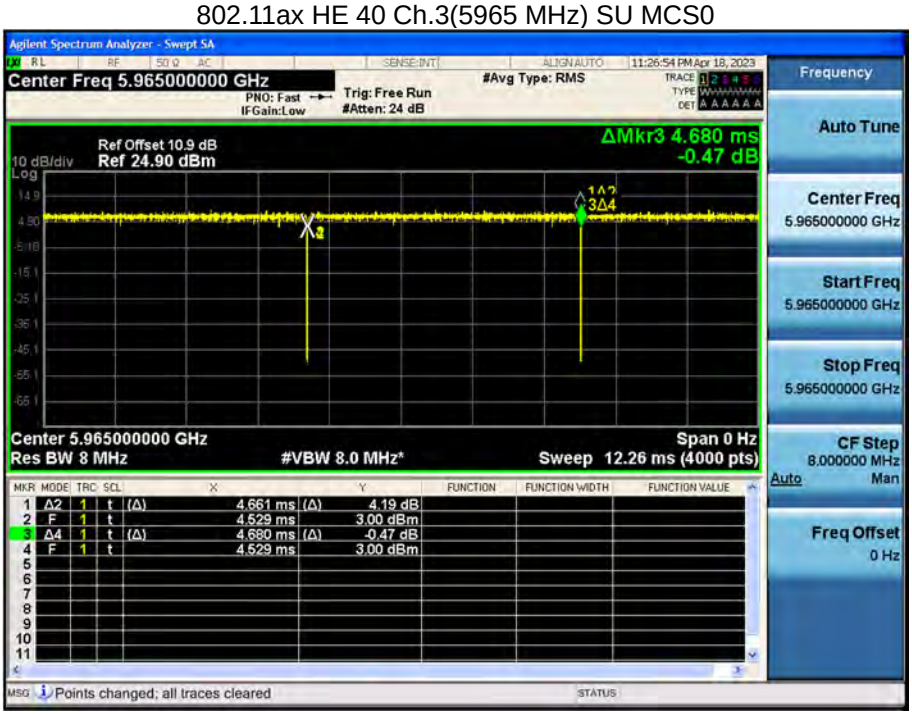
802.11ax HE 20 Ch.2(5935 MHz) SU MCS0



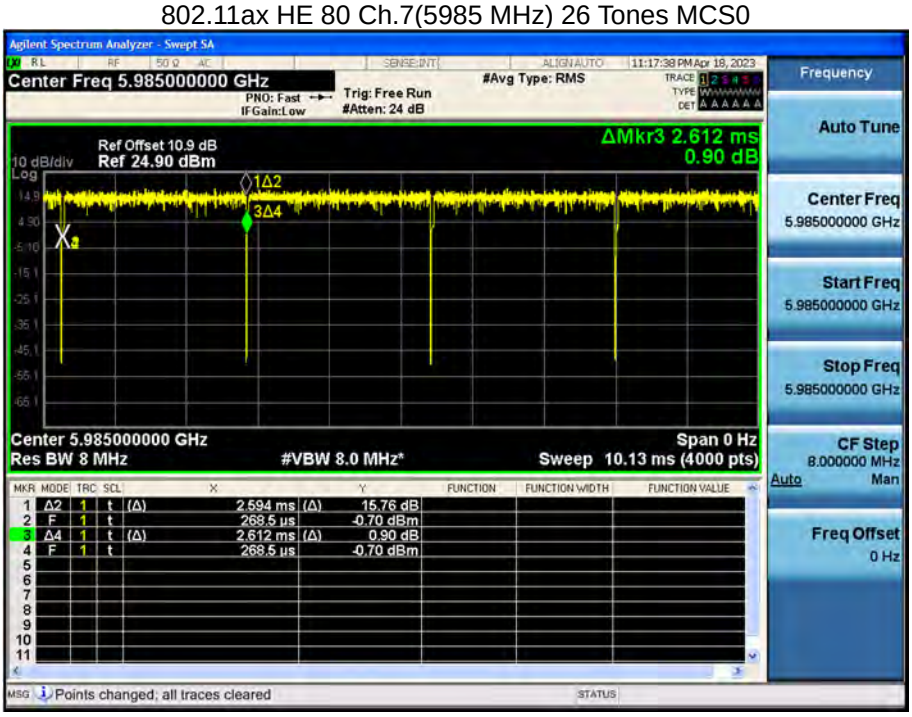
802.11ax HE 40 Ch.3(5965 MHz) 26 Tones MCS0



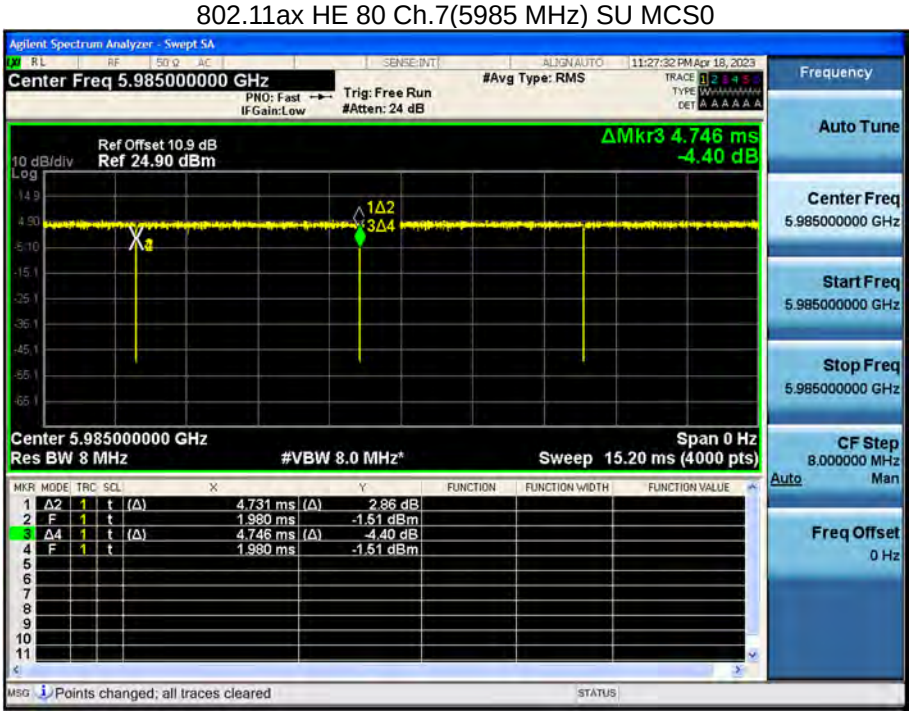
802.11ax HE 40 Ch.3(5965 MHz) SU MCS0



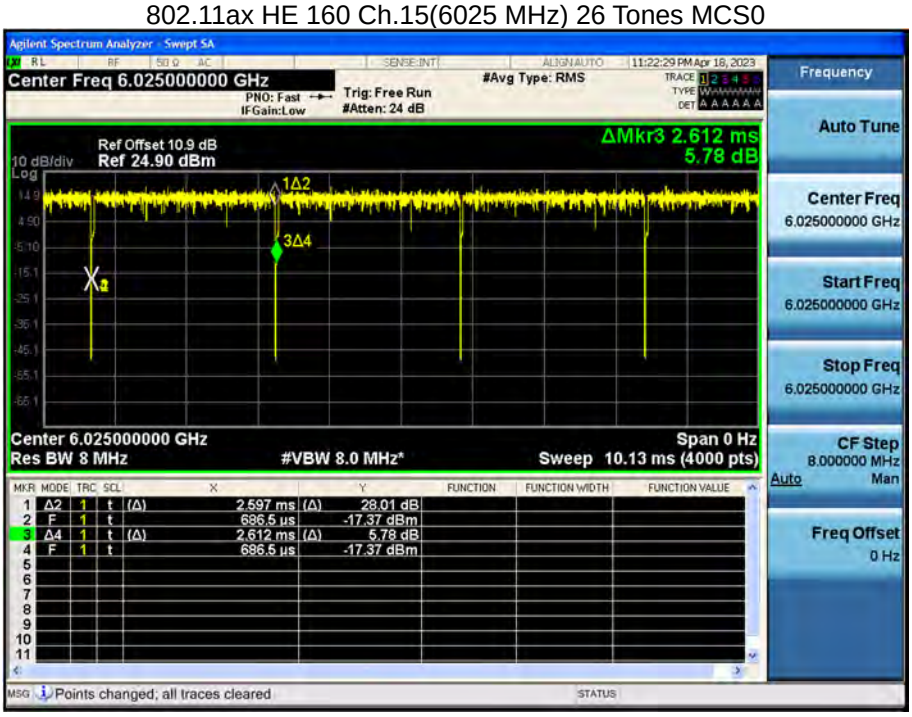
802.11ax HE 80 Ch.7(5985 MHz) 26 Tones MCS0



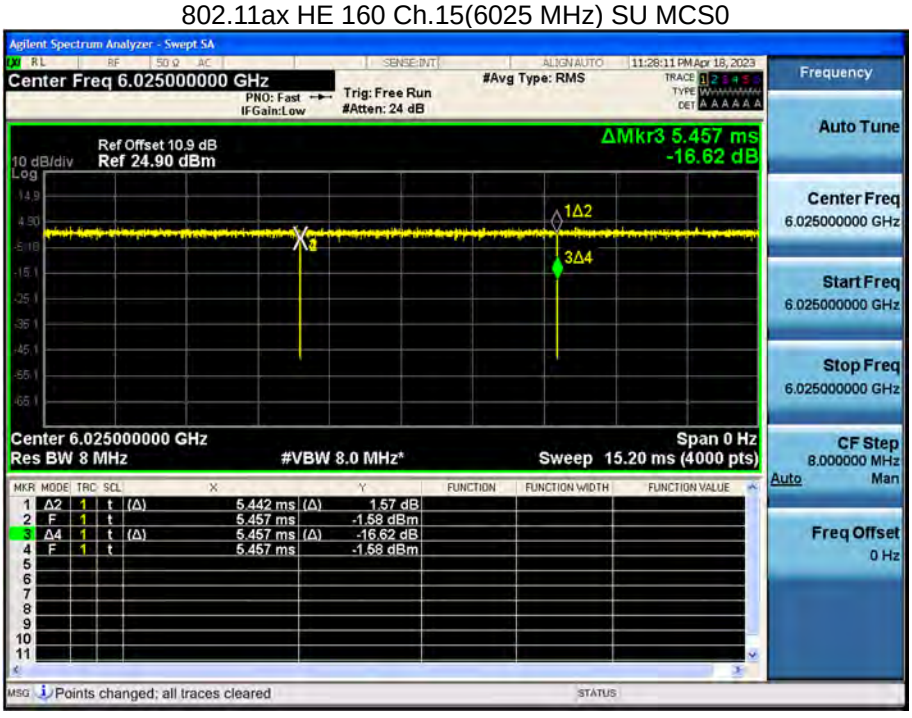
802.11ax HE 80 Ch.7(5985 MHz) SU MCS0



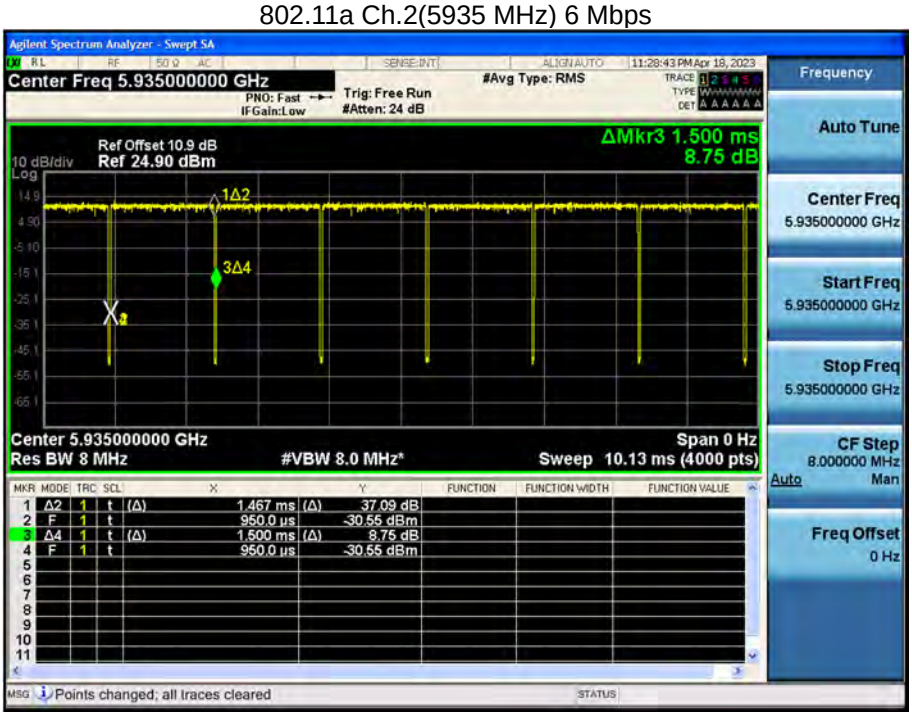
802.11ax HE 160 Ch.15(6025 MHz) 26 Tones MCS0



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



802.11a Ch.2(5935 MHz) 6 Mbps



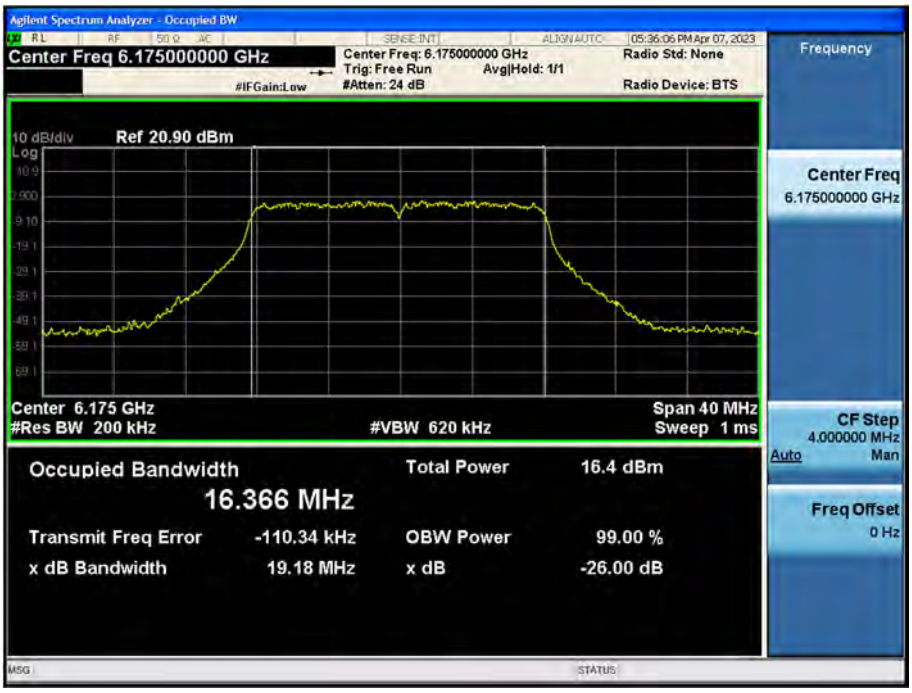
2. 26dB Bandwidth

2.1 Indoor client

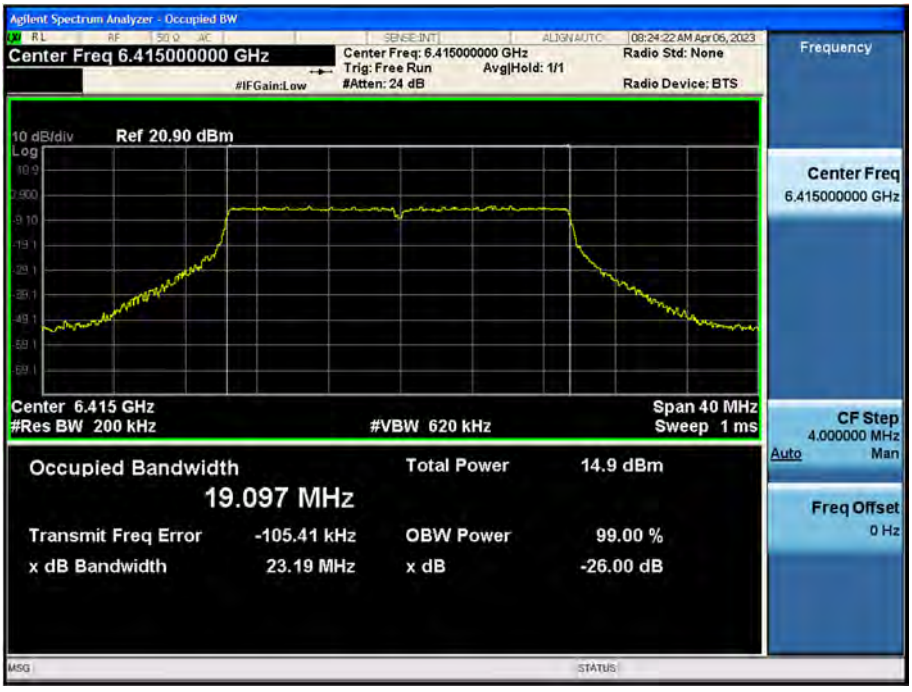
Note:
1. In order to simplify the report, attached plots were only the most wide channel.

Ant.1

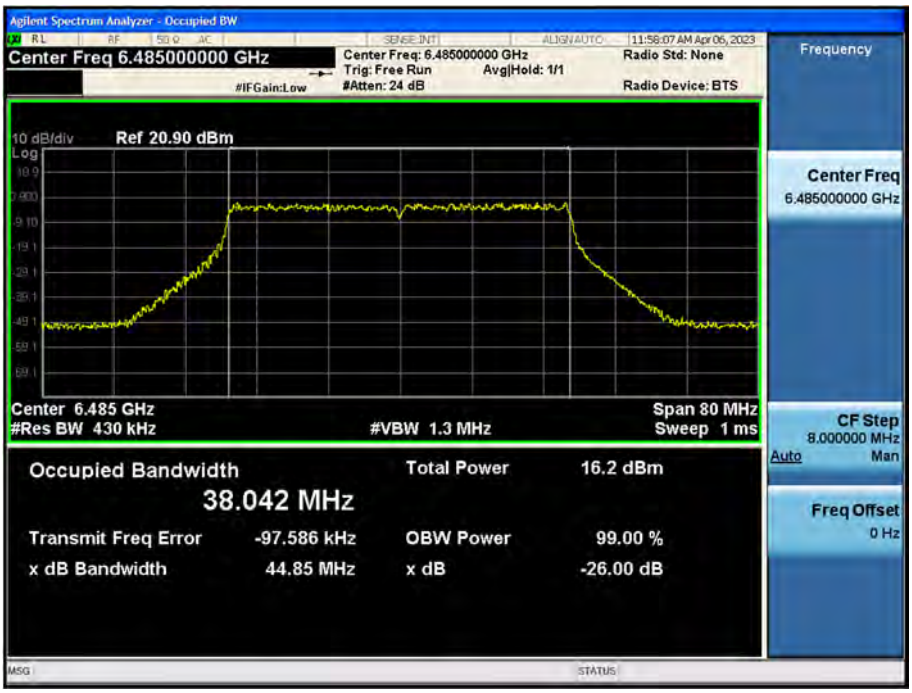
802.11a Ch.45(6175 MHz)



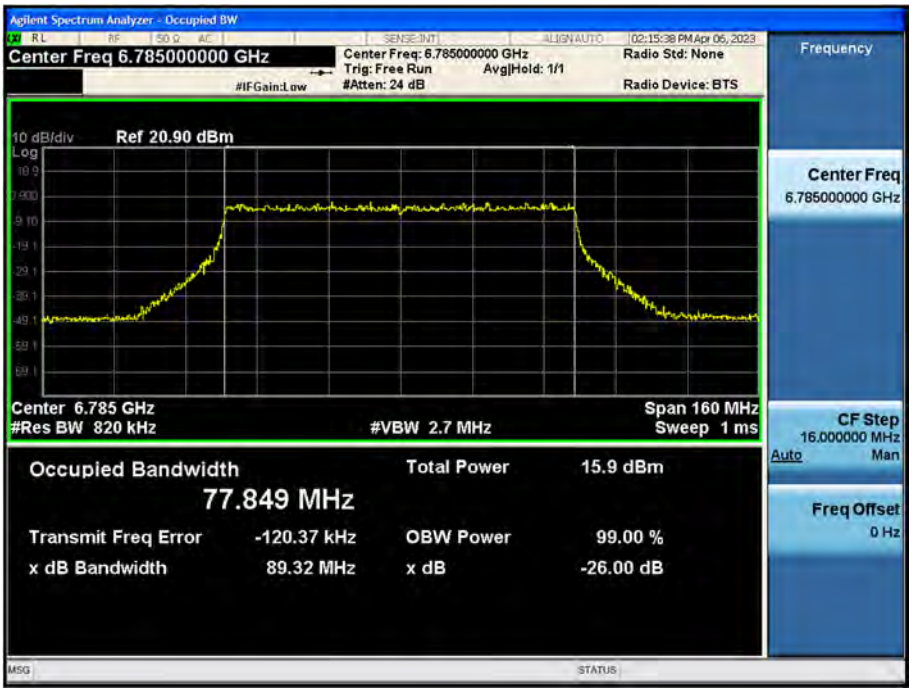
802.11ax HE20 Ch.93(6415 MHz) 242 Tones 61 RU



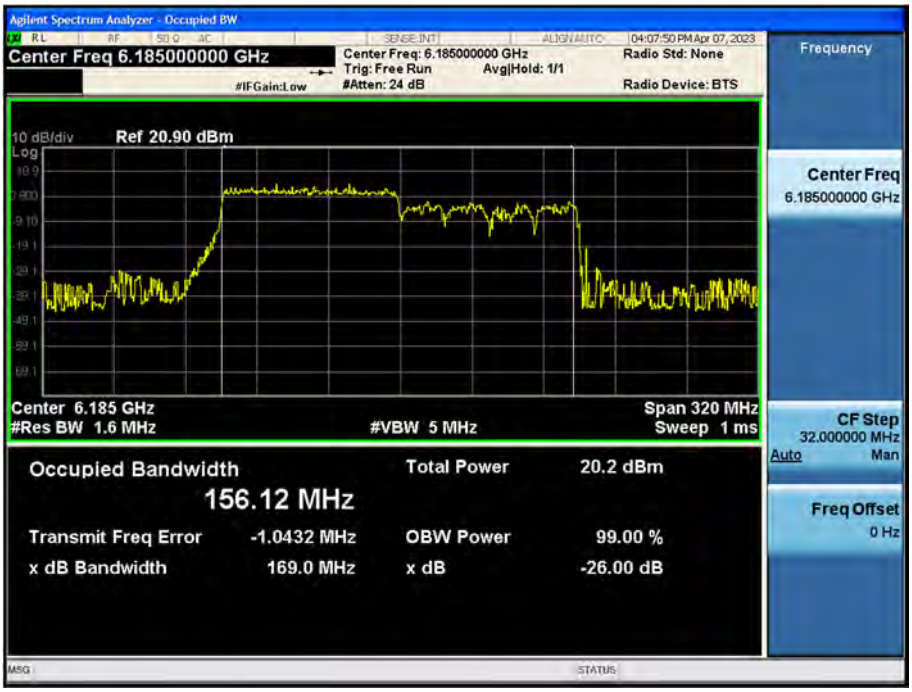
802.11ax HE40 Ch.107(6485 MHz) 484 Tones 65 RU



802.11ax HE80 Ch.167(6785 MHz) 996 Tones 67 RU

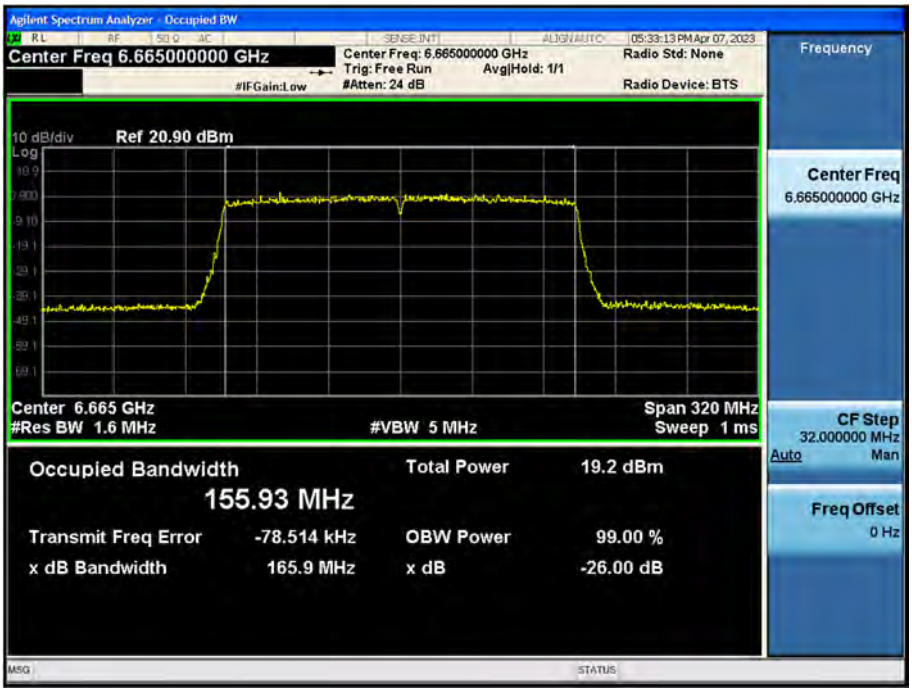


802.11ax HE160, 80_L Ch.47(6185 MHz) 996 Tones 67 RU

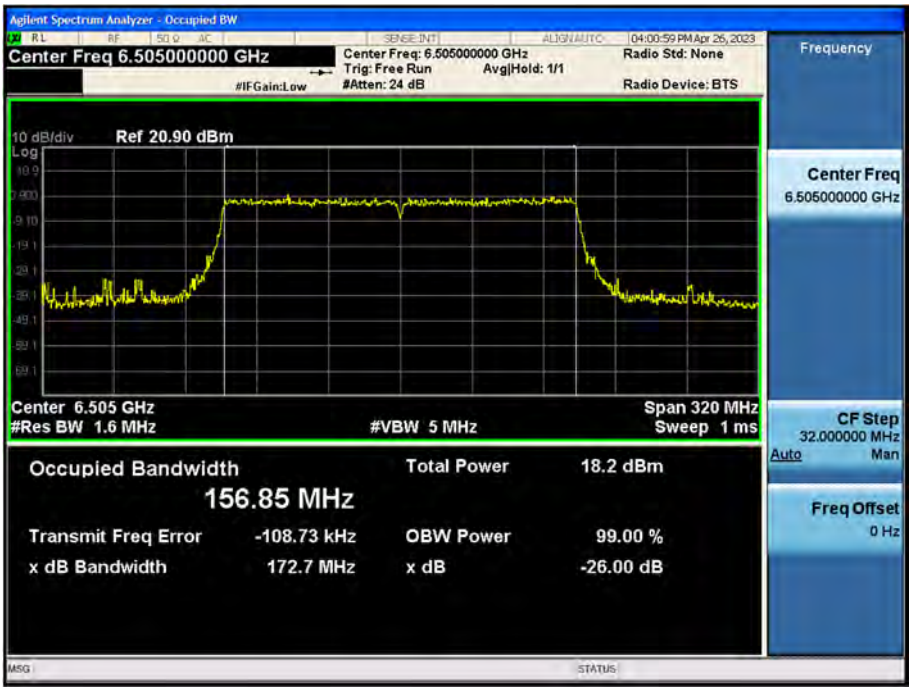


802.11ax HE160, 80_U Ch.111(6505 MHz) 484 Tones 66 RU

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

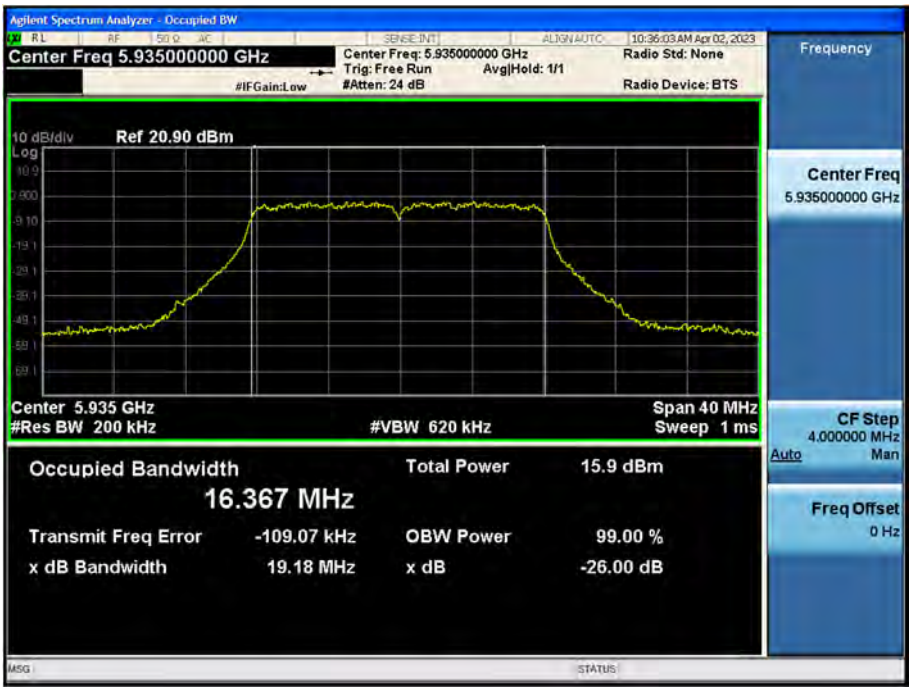


Bandwidth 160M, Ch. 111(6505 MHz) 996T x2 Tones 68 RU



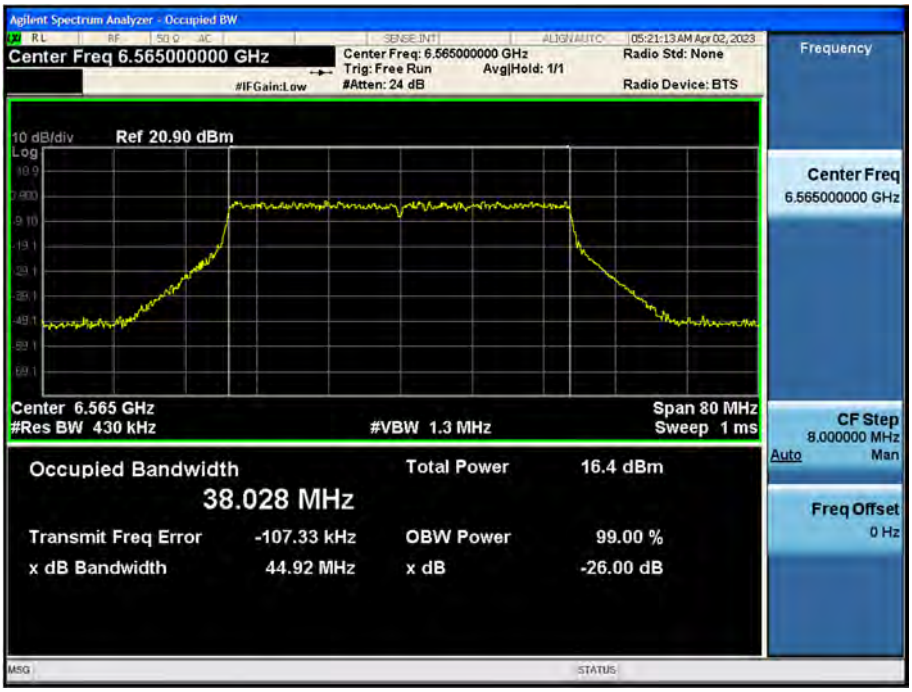
Ant.2

802.11a Ch.2(5935 MHz)



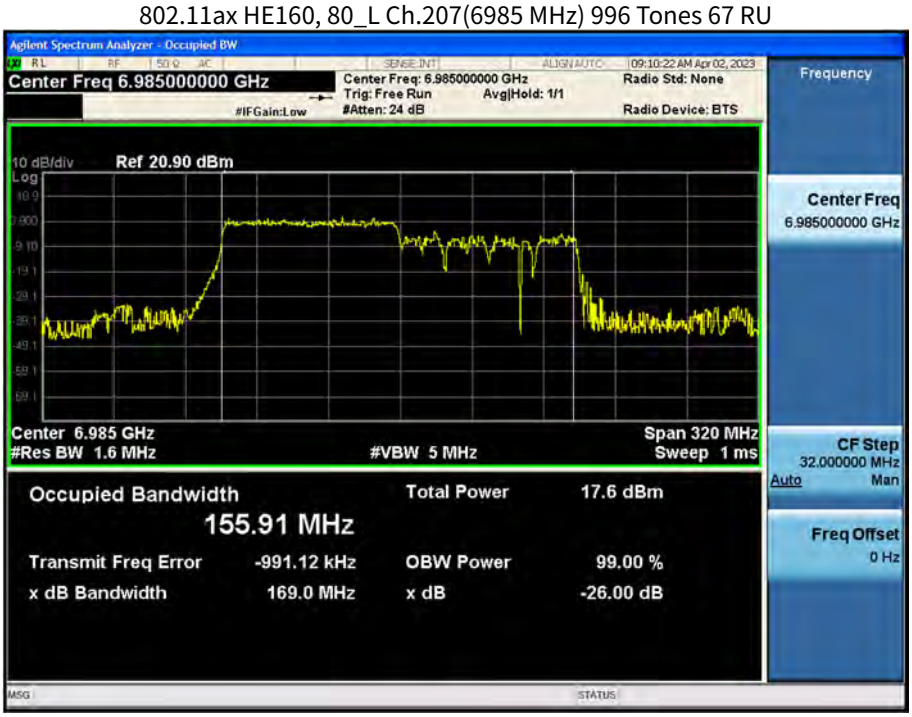
802.11ax HE20 Ch.45(6175 MHz) 242 Tones 61 RU

802.11ax HE40 Ch.123(6565 MHz) 484 Tones 65 RU

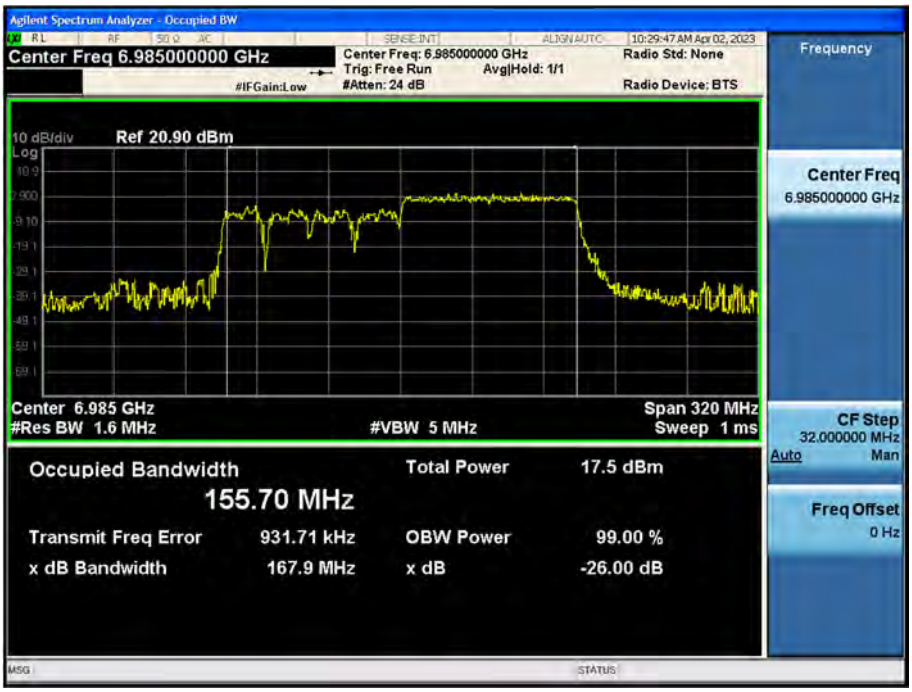


802.11ax HE80 Ch.7(5985 MHz) 996 Tones 67 RU

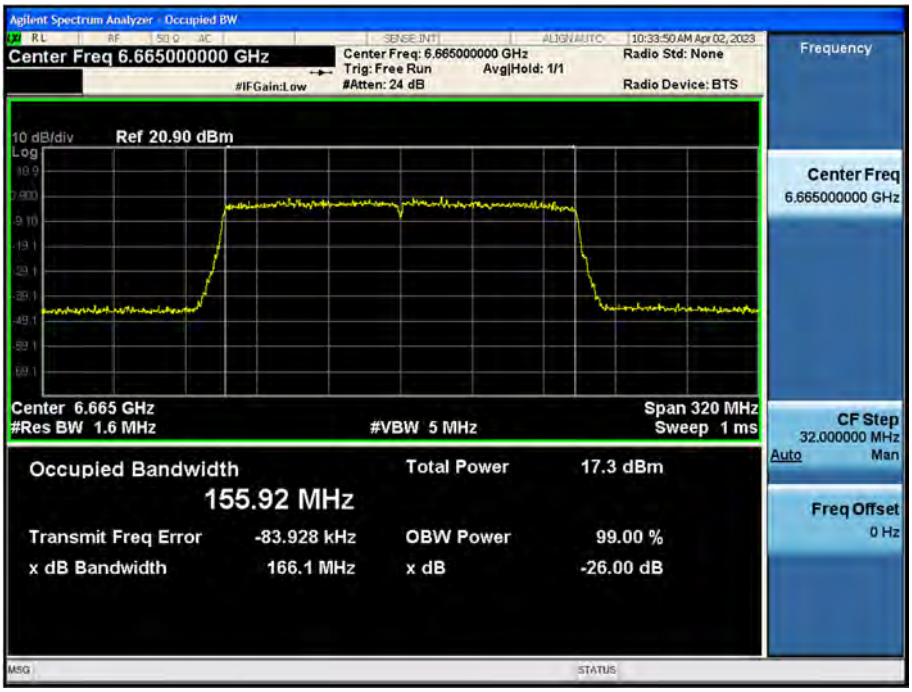
802.11ax HE160, 80_L Ch.207(6985 MHz) 996 Tones 67 RU



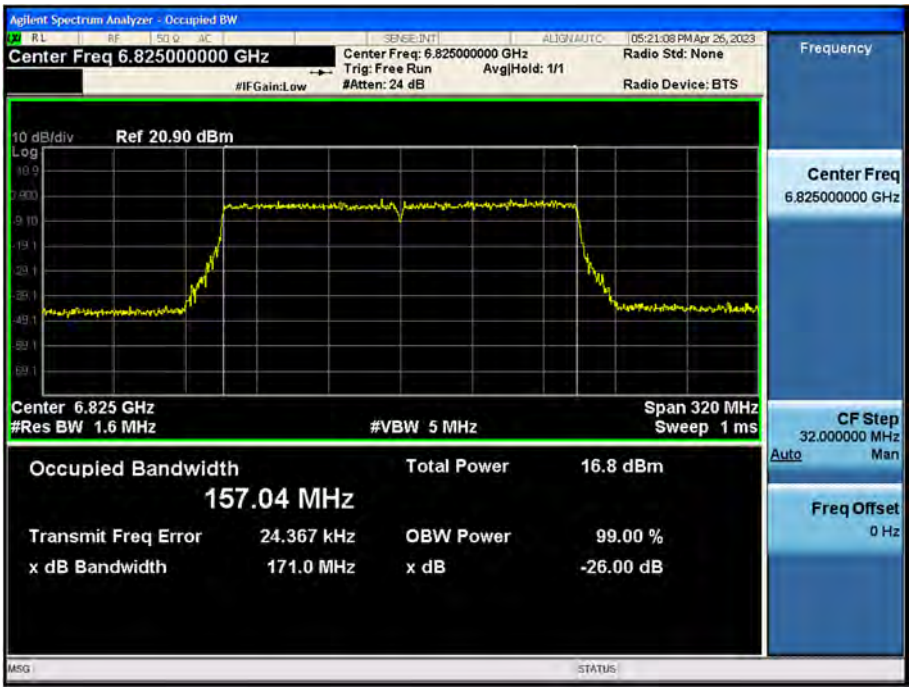
802.11ax HE160, 80_U Ch.207(6985 MHz) 996 Tones 67 RU



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



Bandwidth 160M, Ch. 175(6825 MHz) 996T x2 Tones 68 RU



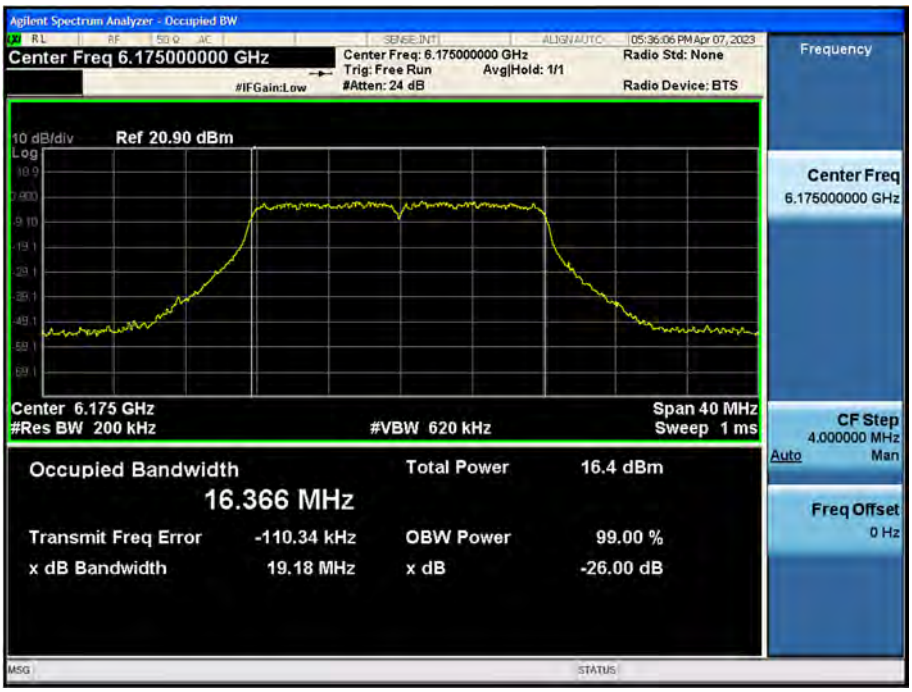
2.2 Standard client

Note:

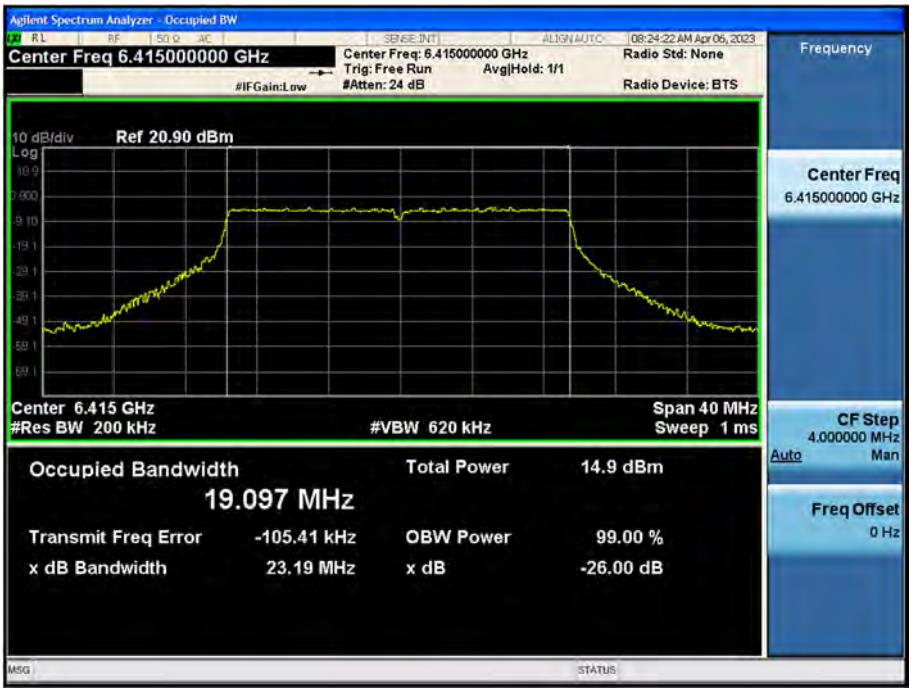
1. In order to simplify the report, attached plots were only the most wide channel.

Ant.1

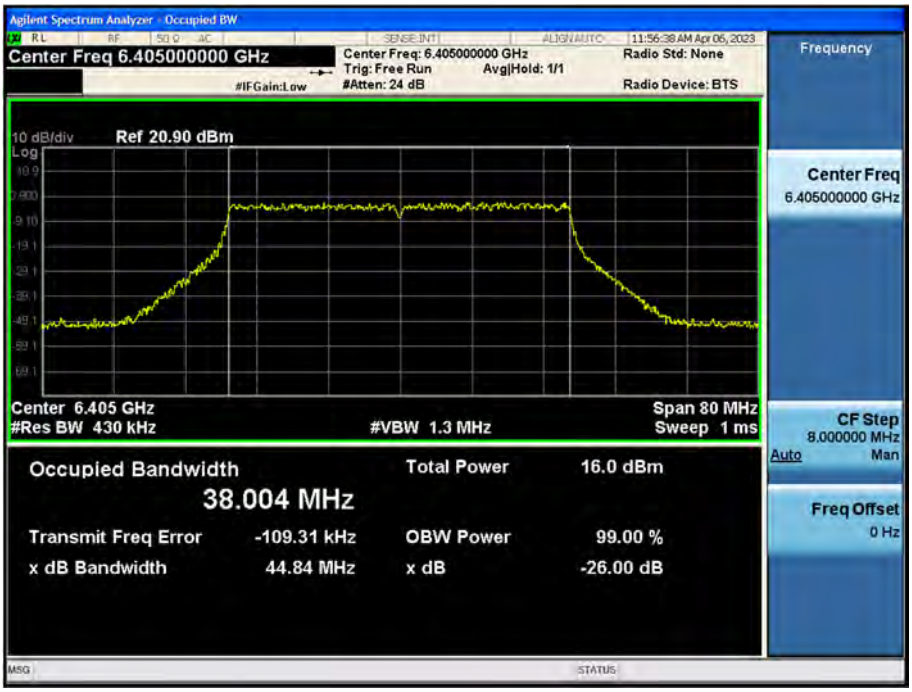
802.11a Ch.45(6175 MHz)



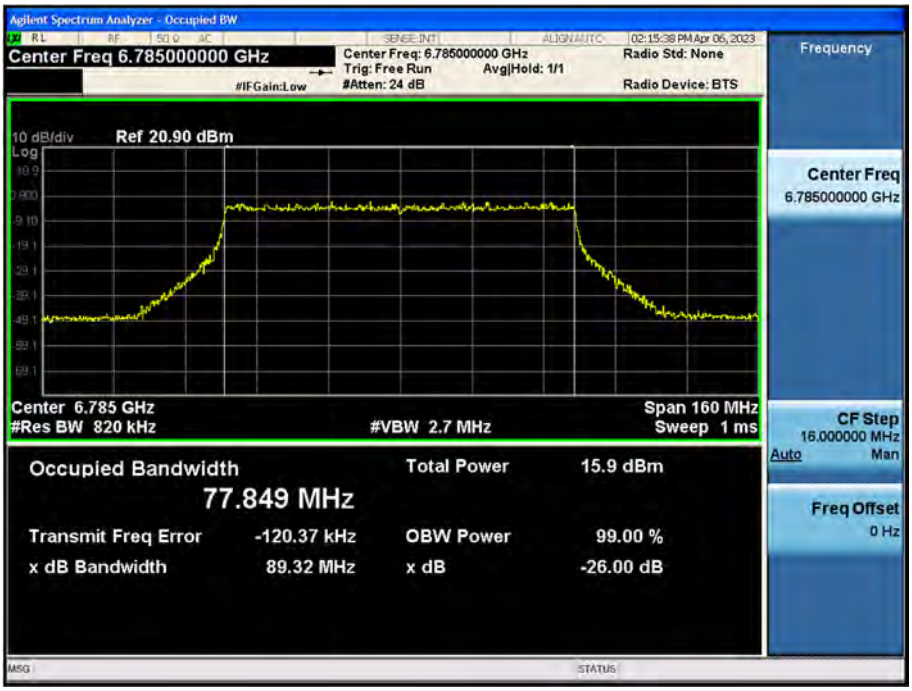
802.11ax HE20 Ch.93(6415 MHz) 242 Tones 61 RU



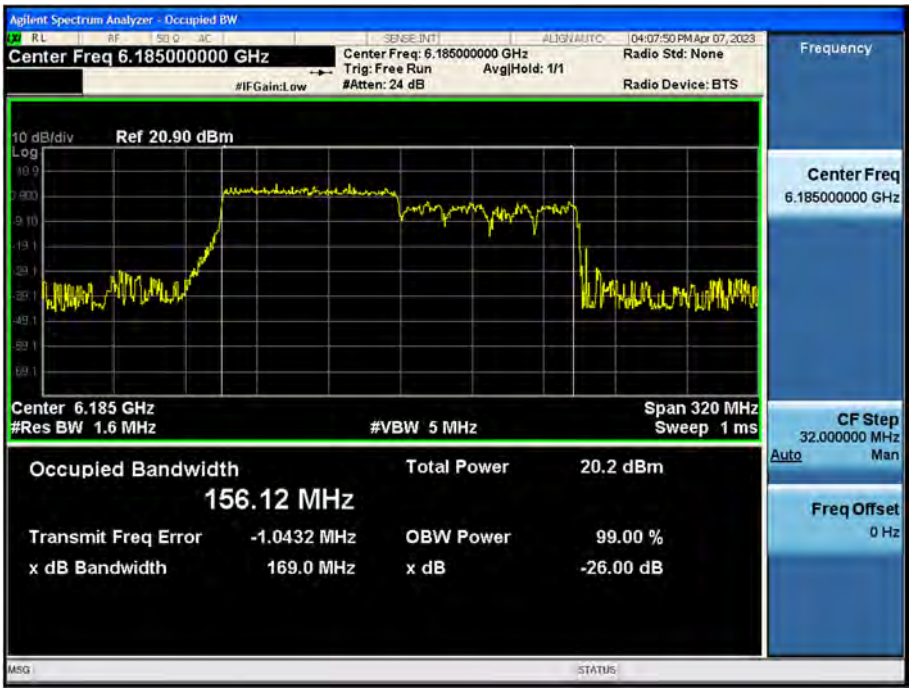
802.11ax HE40 Ch.91(6405 MHz) 484 Tones 65 RU



802.11ax HE80 Ch.167(6785 MHz) 996 Tones 67 RU

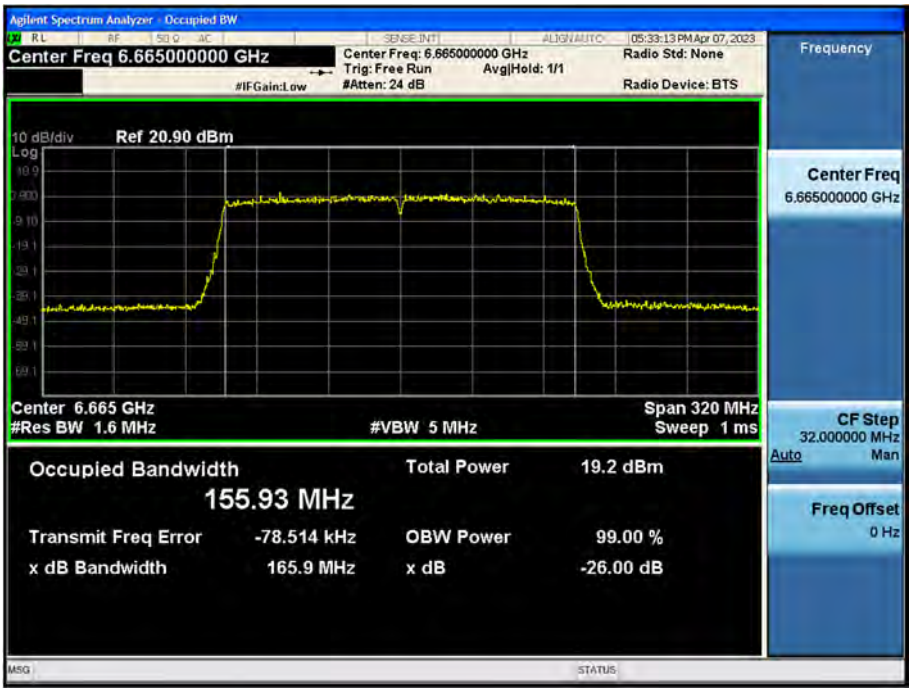


802.11ax HE160, 80_L Ch.47(6185 MHz) 996 Tones 67 RU

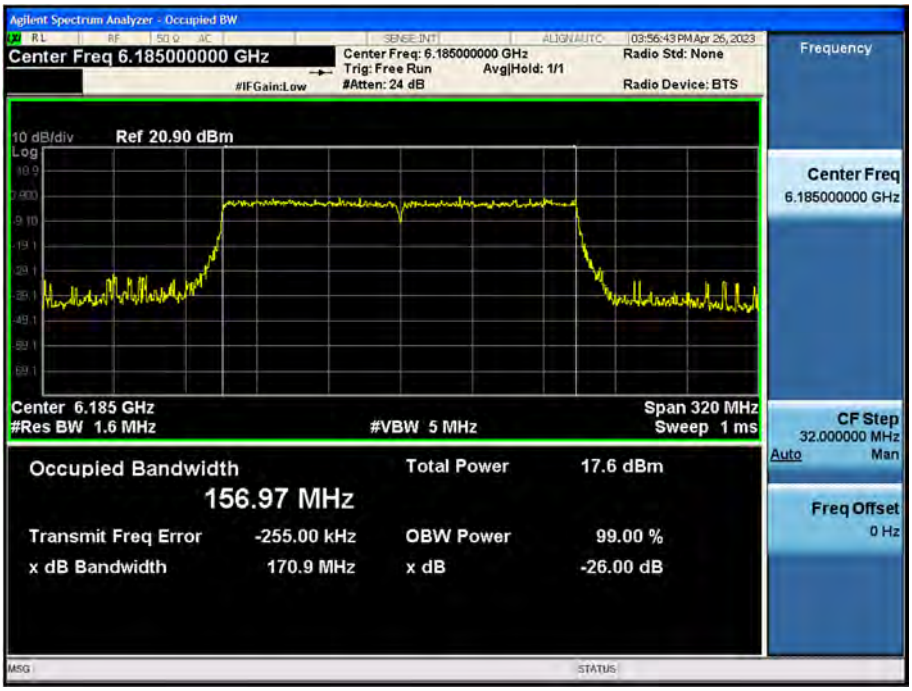


802.11ax HE160, 80_U Ch.79(6345 MHz) 996 Tones 67 RU

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

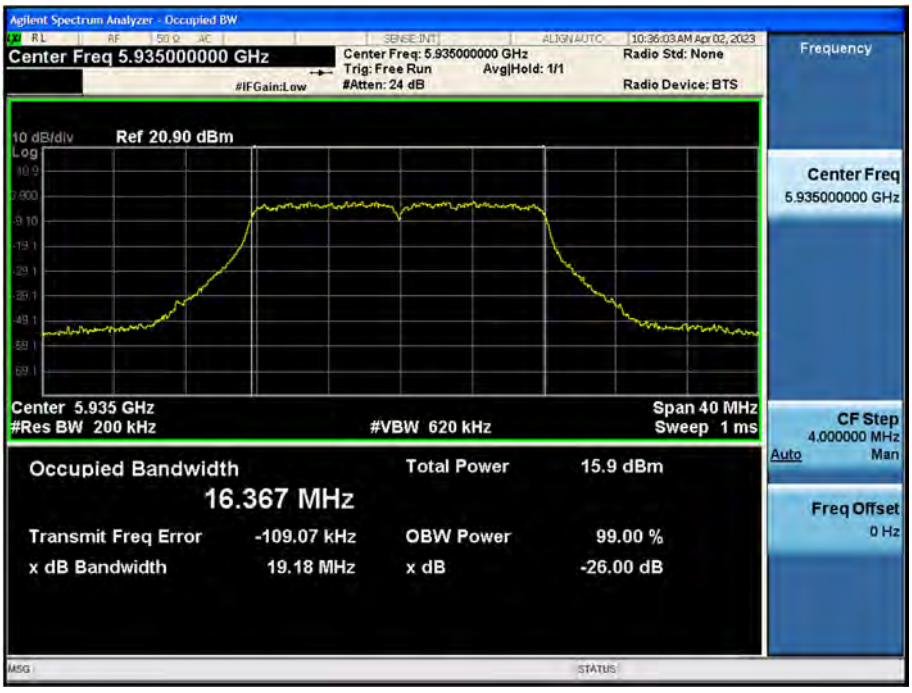


Bandwidth 160M, Ch. 47(6185 MHz) 996T x2 Tones 68 RU



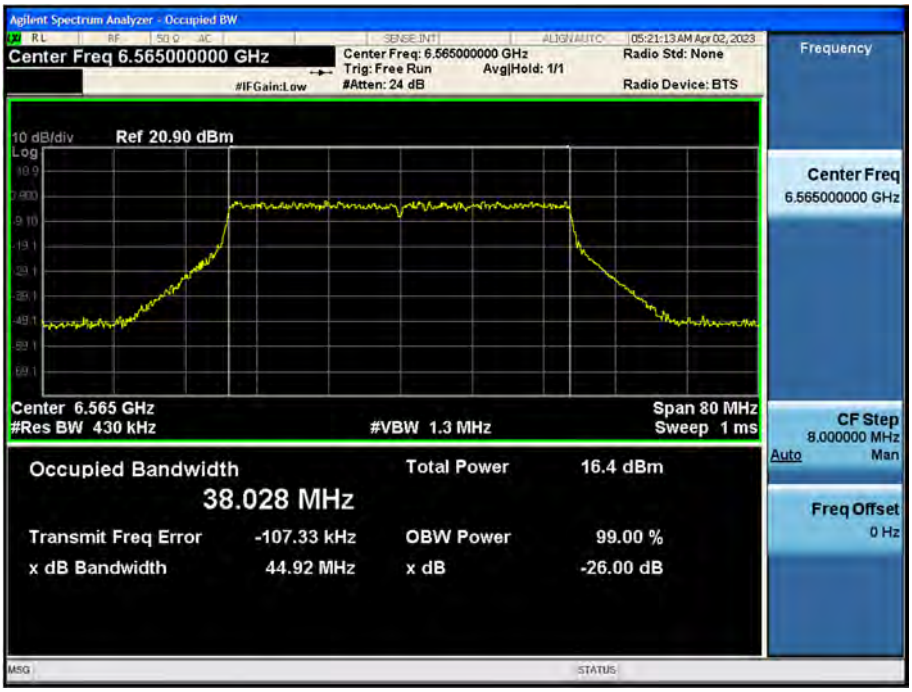
Ant.2

802.11a Ch.2(5935 MHz)



802.11ax HE20 Ch.45(6175 MHz) 242 Tones 61 RU

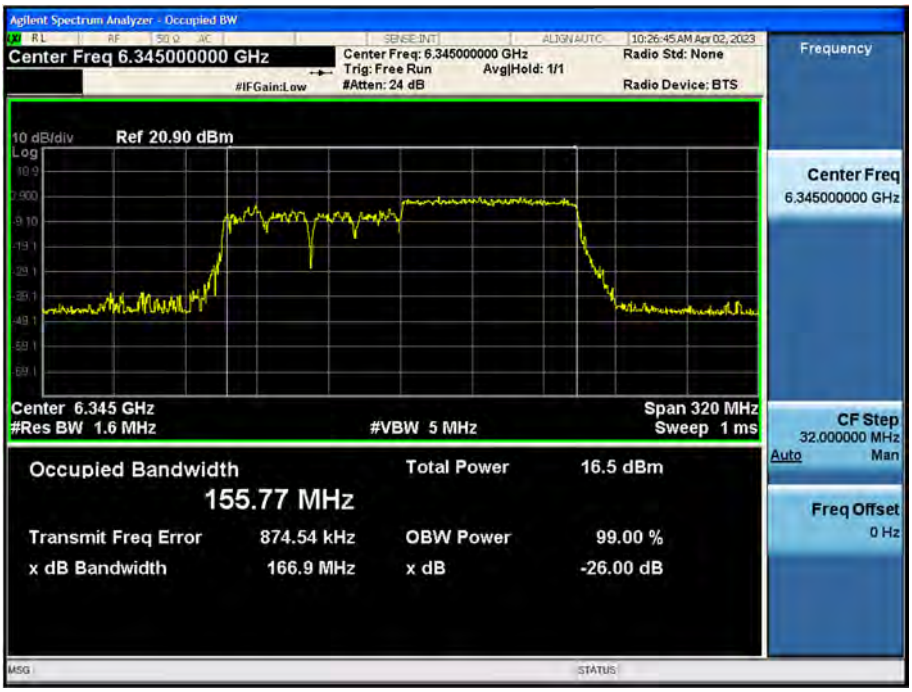
802.11ax HE40 Ch.123(6565 MHz) 484 Tones 65 RU



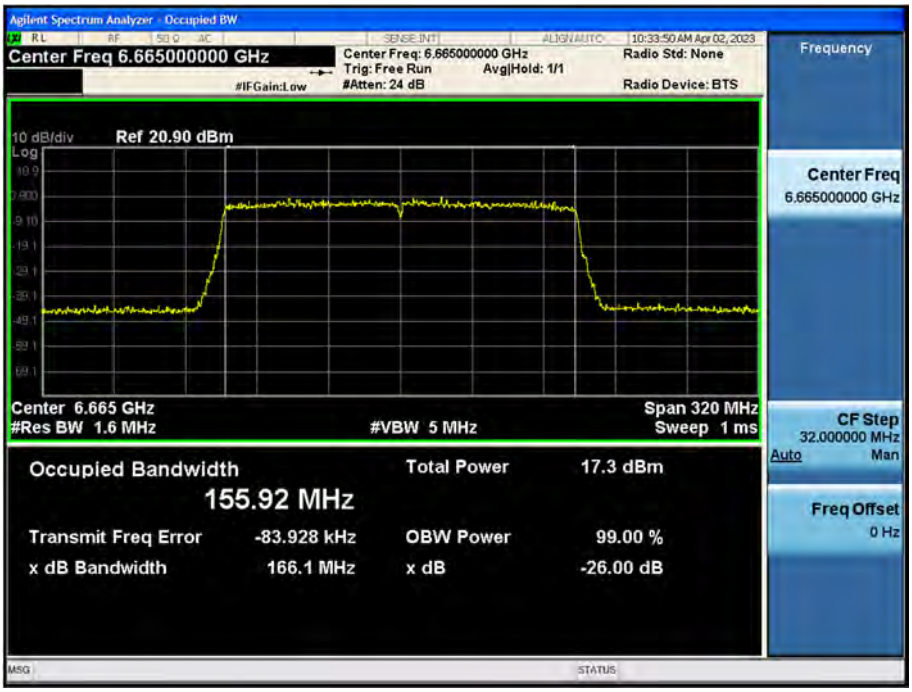
802.11ax HE80 Ch.7(5985 MHz) 996 Tones 67 RU

802.11ax HE160, 80_L Ch.15(6025 MHz) 484 Tones 65 RU

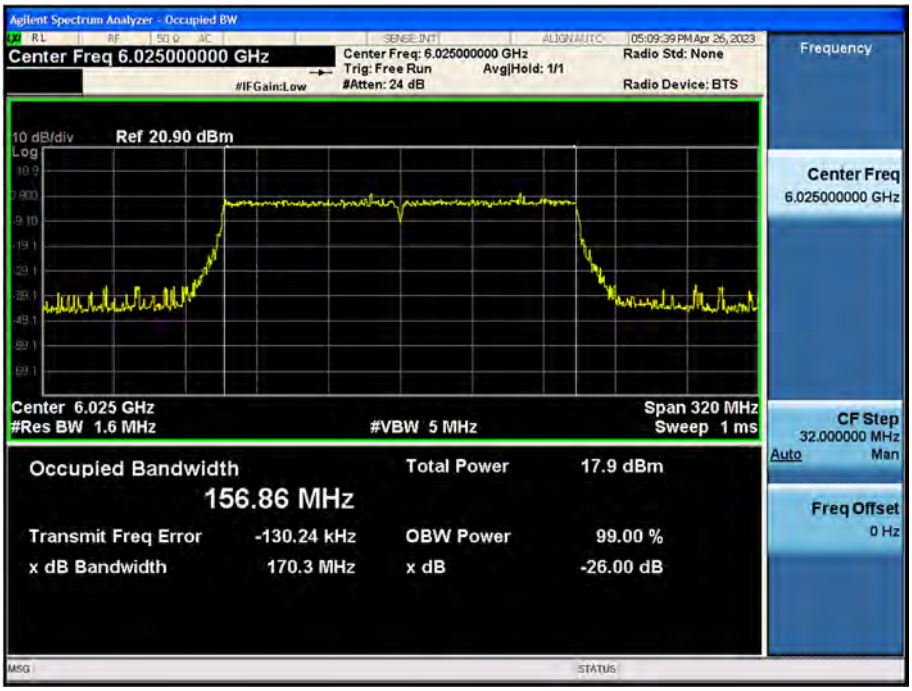
802.11ax HE160, 80_U Ch.79(6345 MHz) 996 Tones 67 RU



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



Bandwidth 160M, Ch. 15(6025 MHz) 996T x2 Tones 68 RU



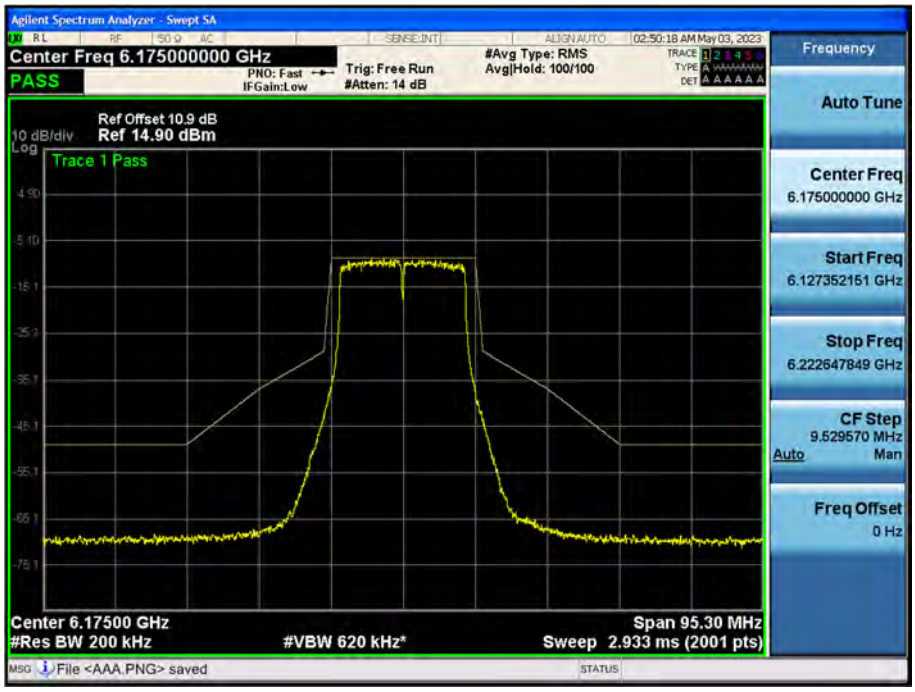
3. In-Band Emission (Emission Mask)

3.1 Indoor client

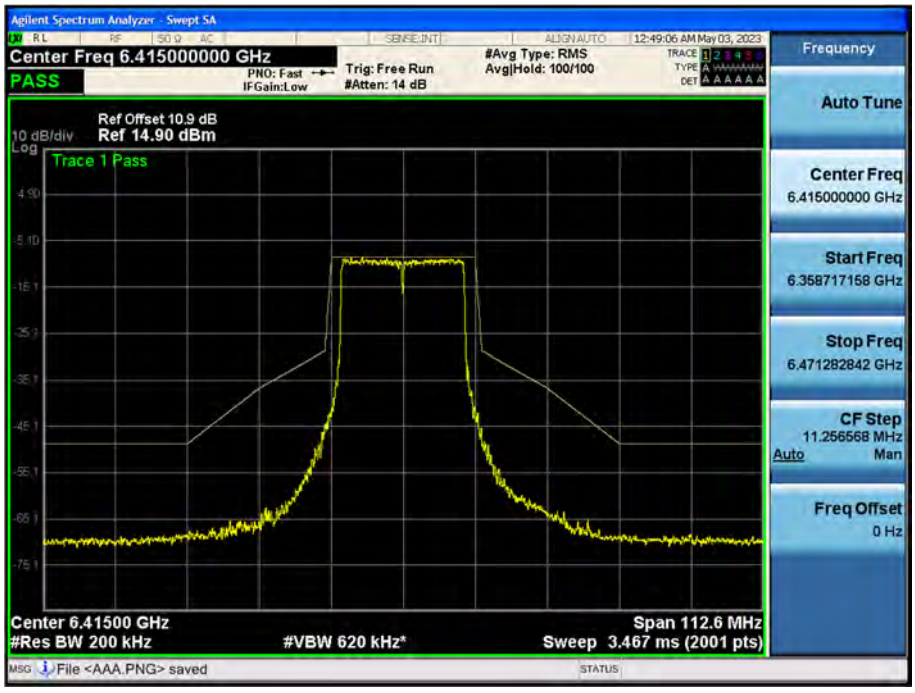
Note:
1. In order to simplify the report, attached plots were only the most wide channel.

Ant.1

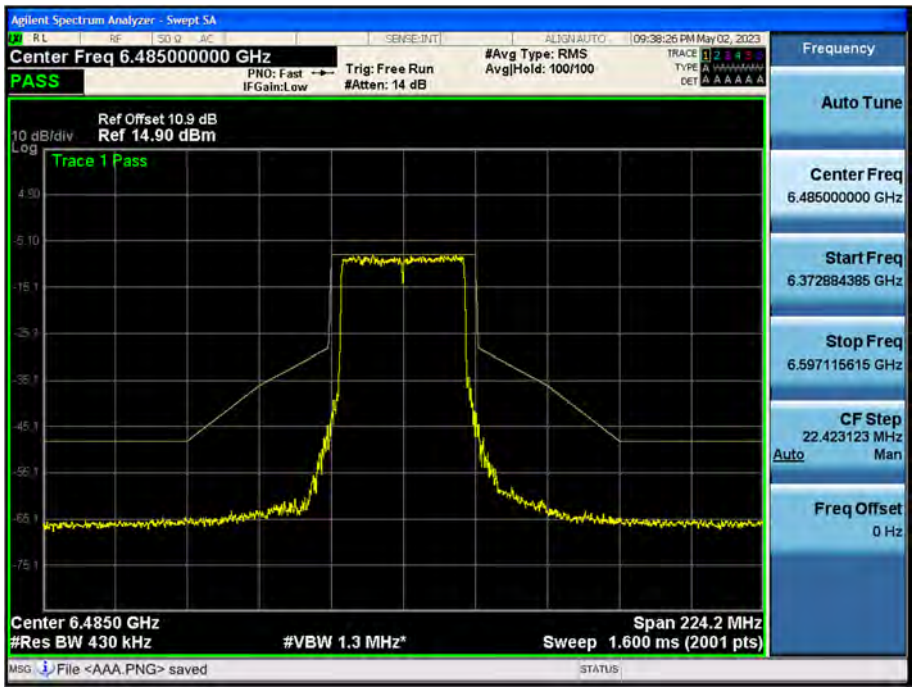
802.11a Ch.45(6175 MHz)



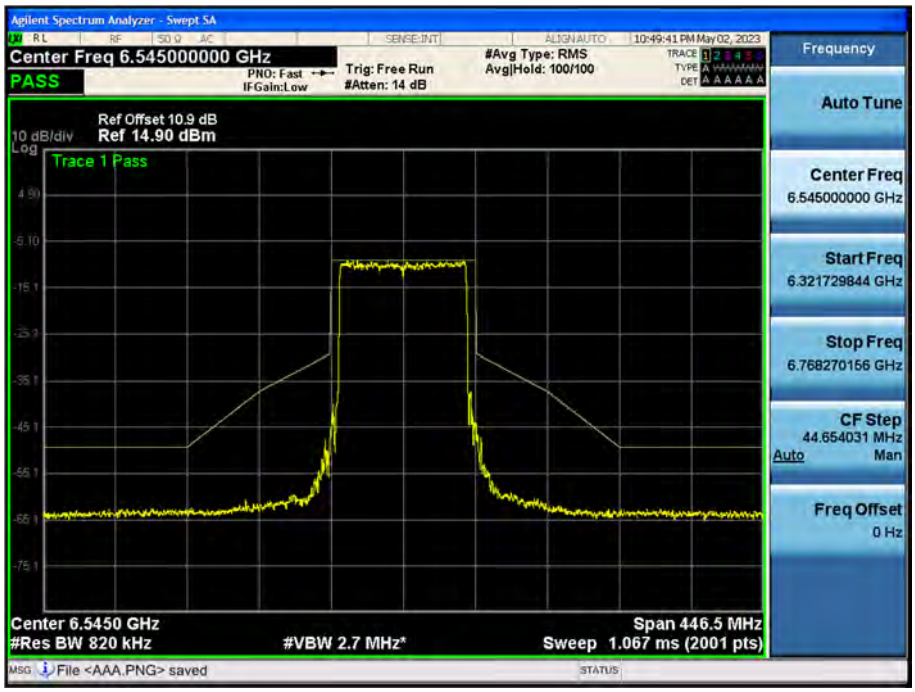
802.11ax HE20 Ch.93(6415 MHz) 242 Tones 61 RU



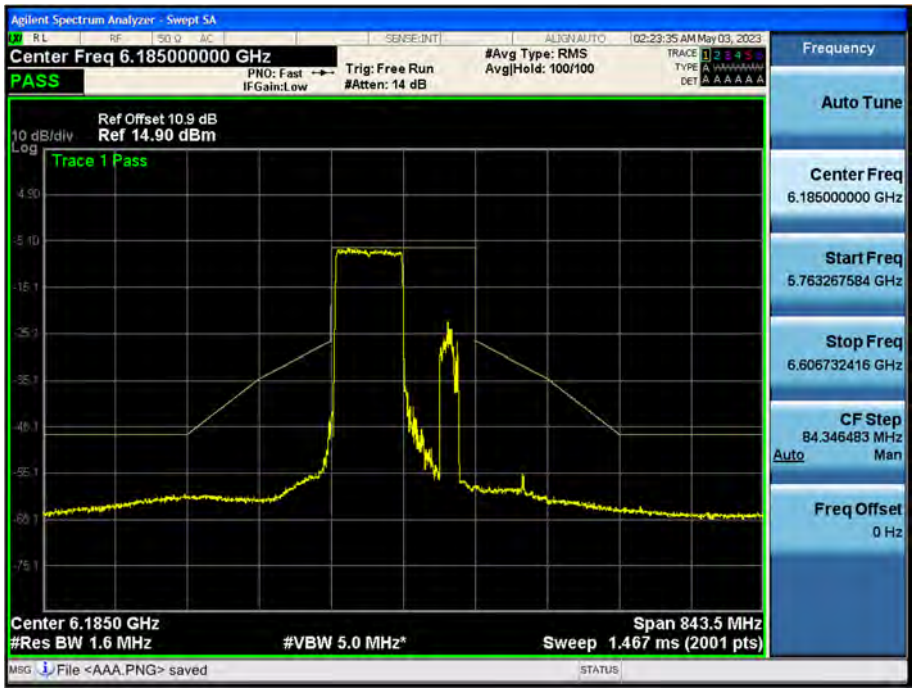
802.11ax HE40 Ch.107(6485 MHz) 484 Tones 65 RU



802.11ax HE80 Ch.119(6625 MHz) 996 Tones 67 RU

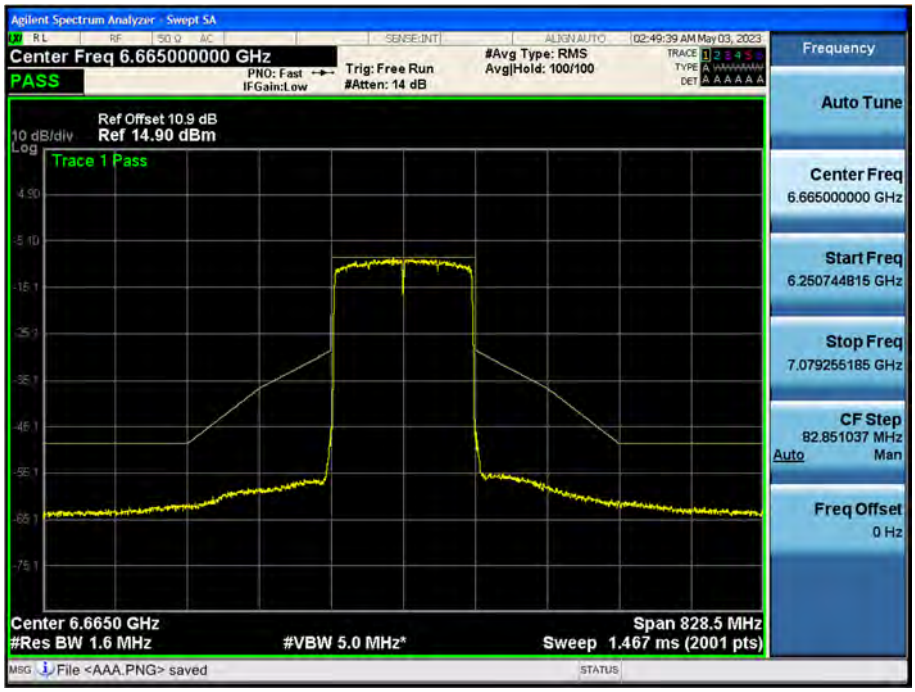


802.11ax HE160, 80_L Ch.47(6185 MHz) 996 Tones 67 RU

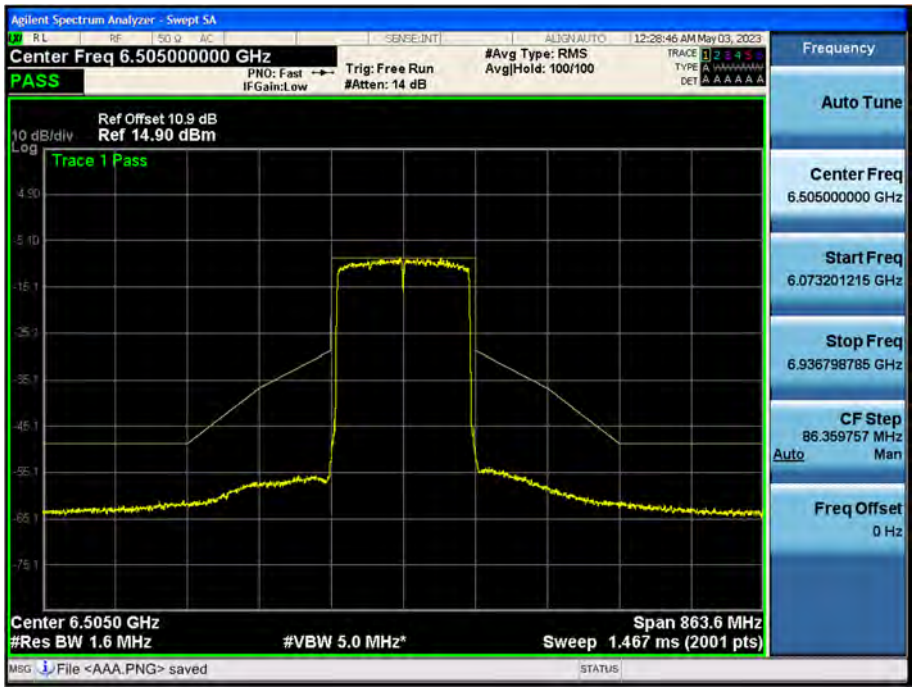


802.11ax HE160, 80_U Ch.111(6505 MHz) 484 Tones 66 RU

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

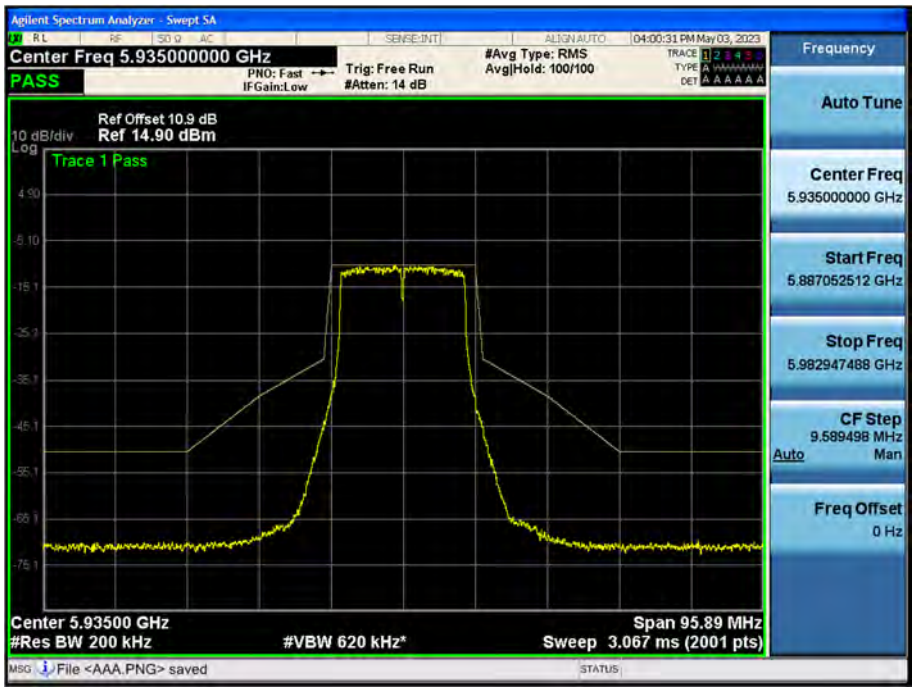


Bandwidth 160M, Ch. 111(6505 MHz) 996Tx2 Tones 68 RU

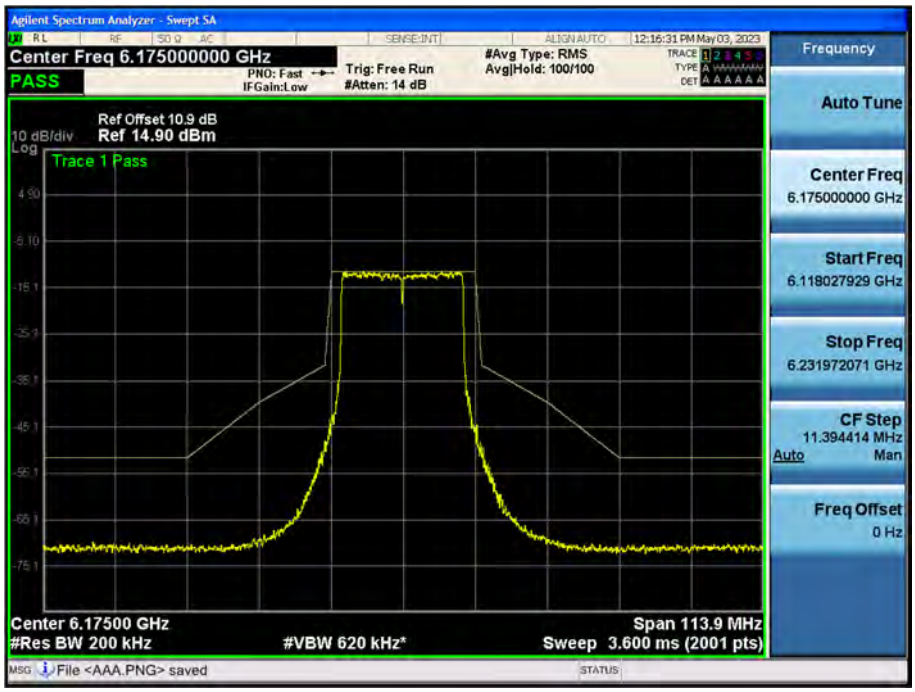


Ant.2

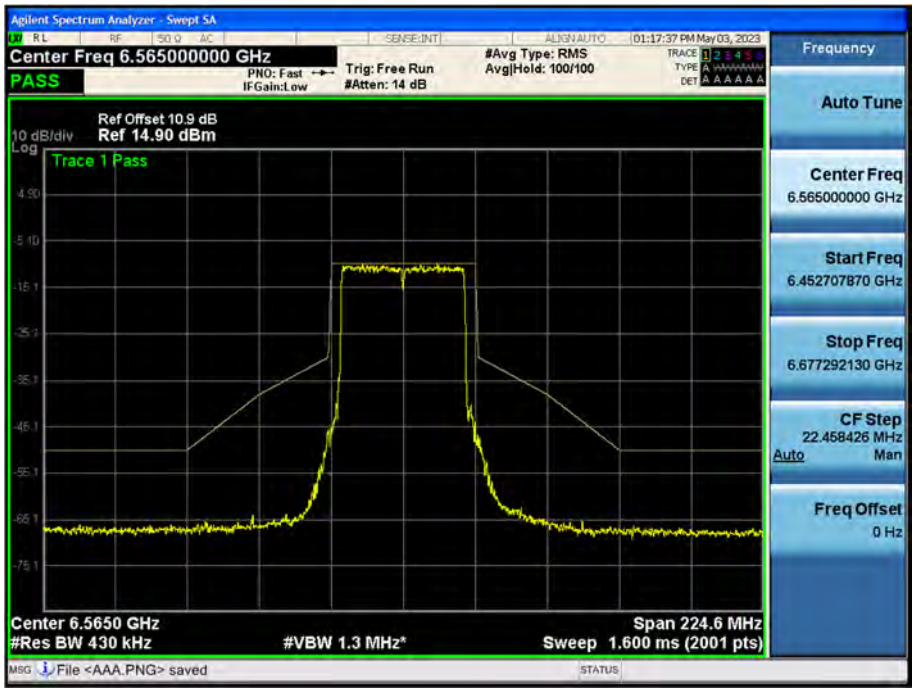
802.11a Ch.2(5935 MHz)



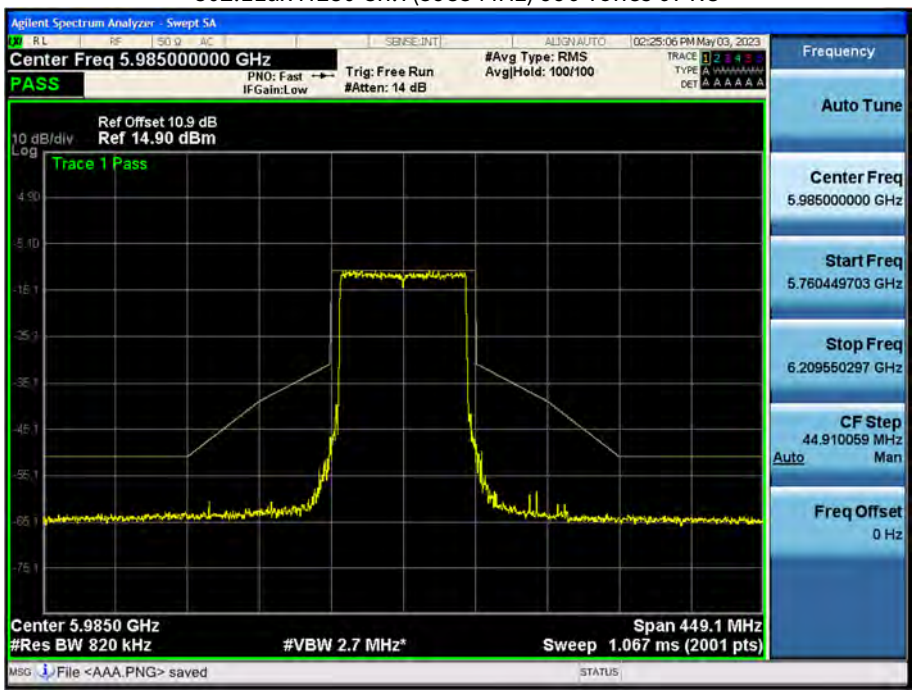
802.11ax HE20 Ch.45(6175 MHz) 242 Tones 61 RU



802.11ax HE40 Ch.123(6565 MHz) 484 Tones 65 RU

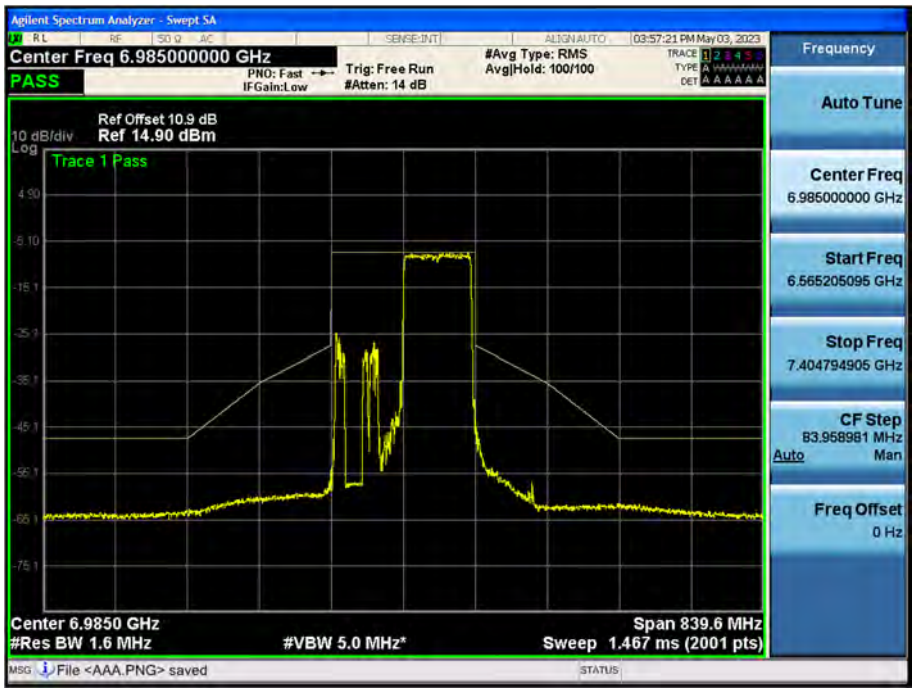


802.11ax HE80 Ch.7(5985 MHz) 996 Tones 67 RU

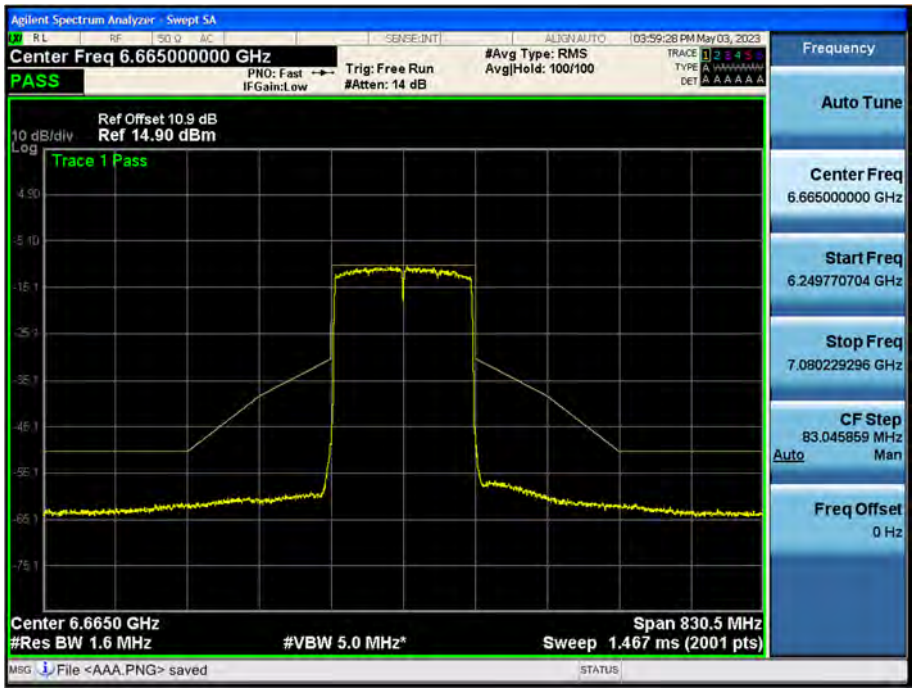


802.11ax HE160, 80_L Ch.207(6985 MHz) 996 Tones 67 RU

802.11ax HE160, 80_U Ch.207(6985 MHz) 996 Tones 67 RU



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



Bandwidth 160M, Ch. 175(6825 MHz) 996Tx2 Tones 68 RU

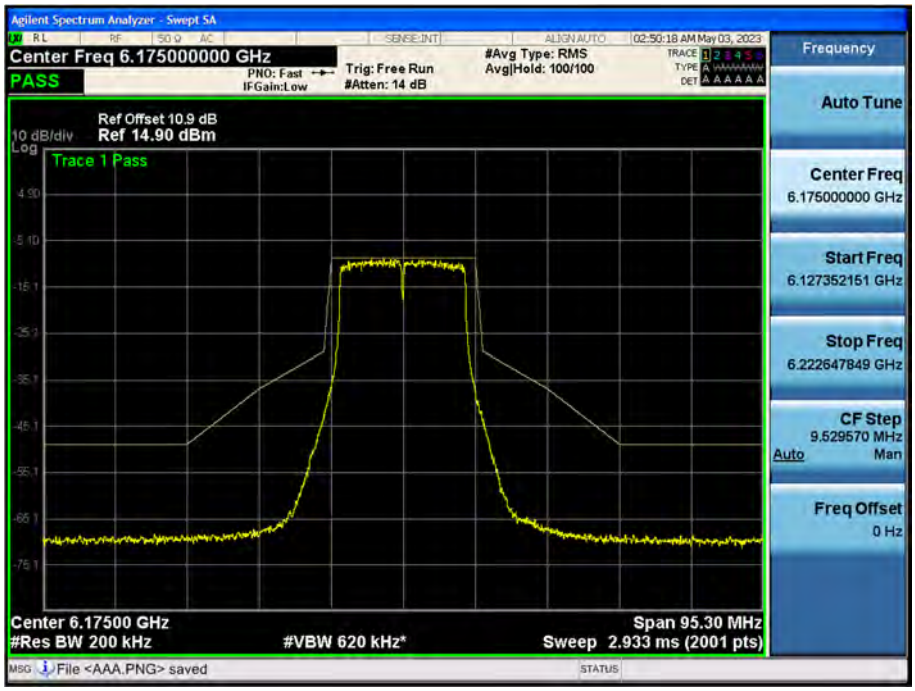
3.2 Standard client

Note:

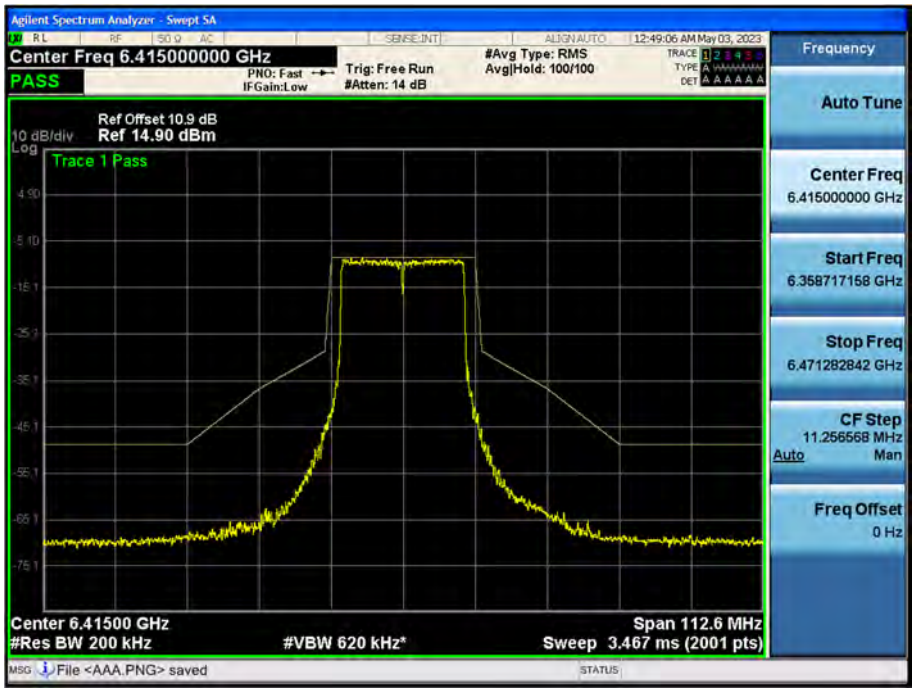
1. In order to simplify the report, attached plots were only the most wide channel.

Ant.1

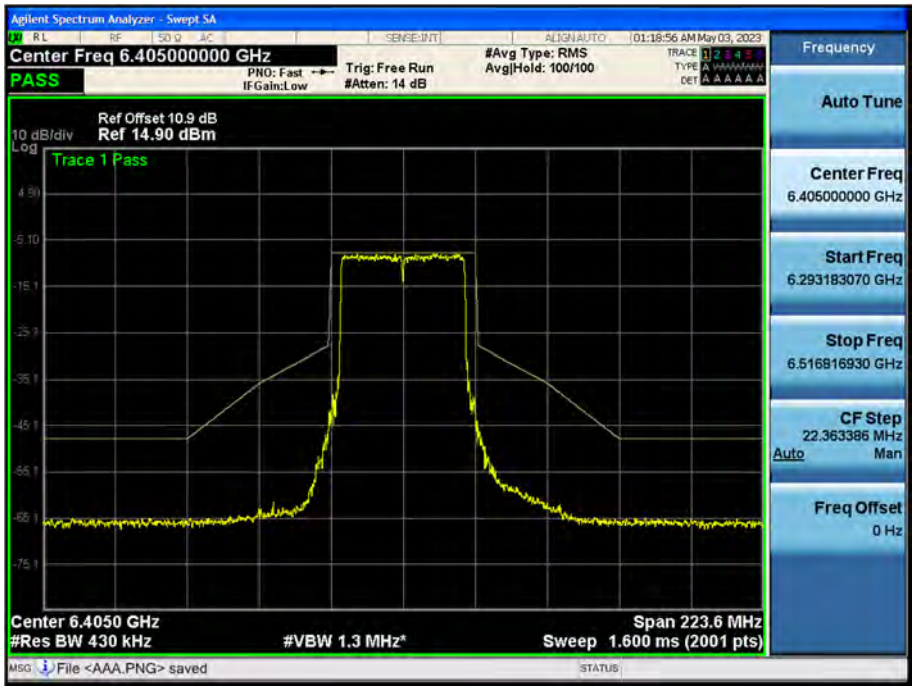
802.11a Ch.45(6175 MHz)



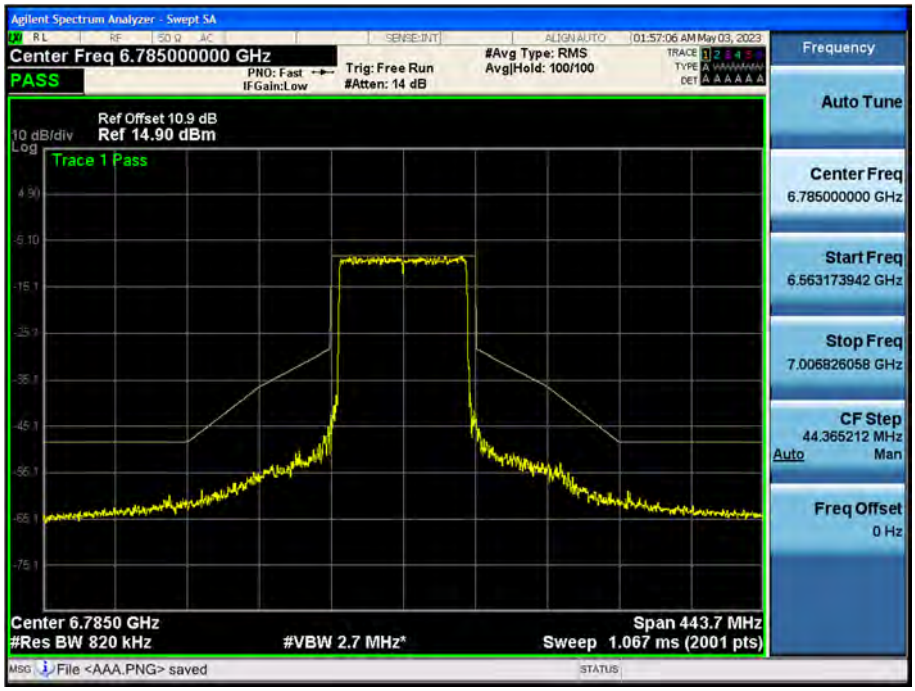
802.11ax HE20 Ch.93(6415 MHz) 242 Tones 61 RU



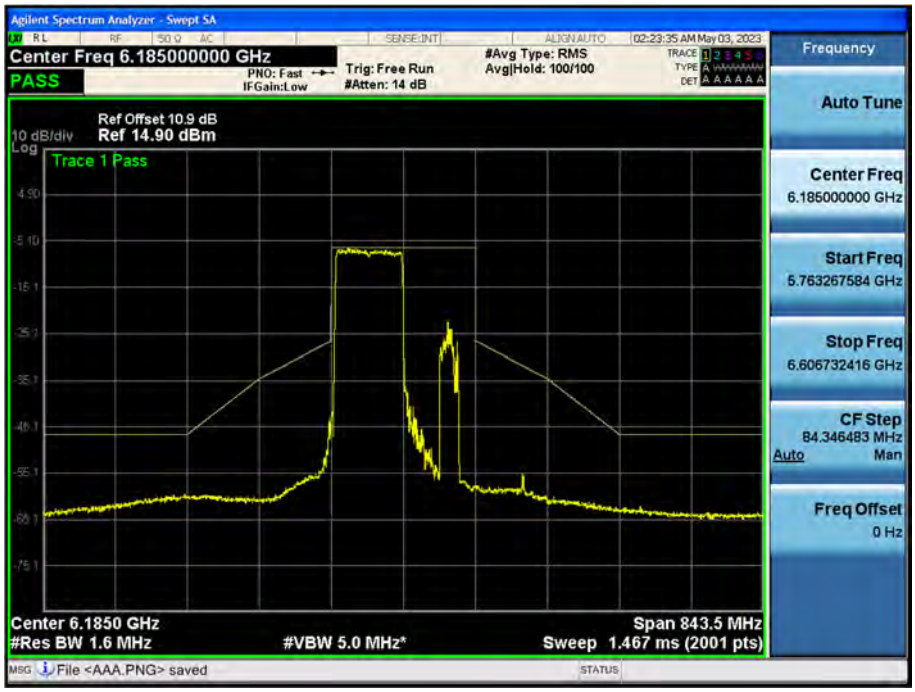
802.11ax HE40 Ch.91(6405 MHz) 484 Tones 65 RU



802.11ax HE80 Ch.167(6785 MHz) 996 Tones 67 RU

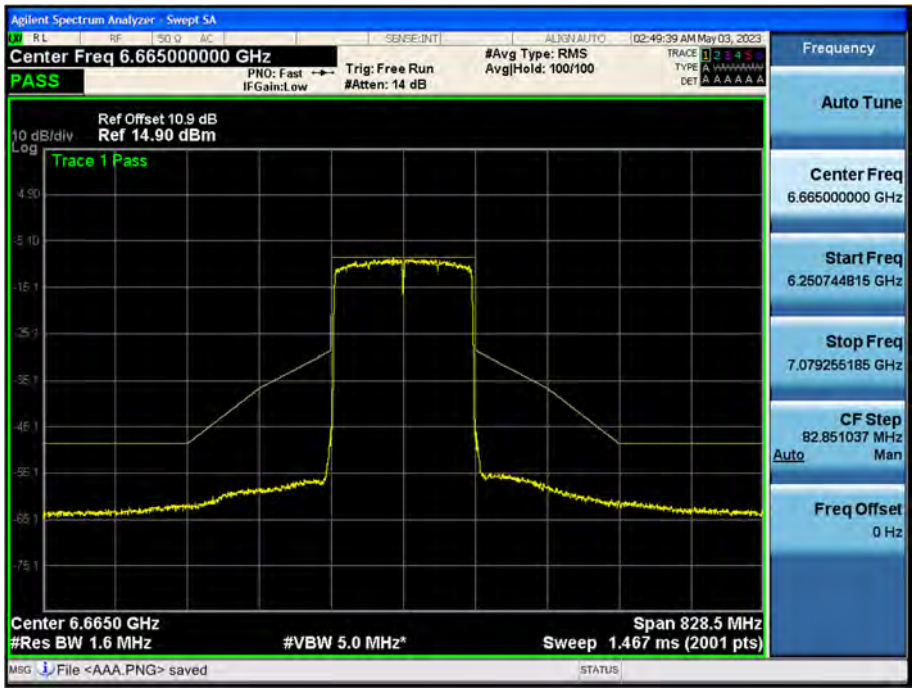


802.11ax HE160, 80_L Ch.47(6185 MHz) 996 Tones 67 RU



802.11ax HE160, 80_U Ch.79(6345 MHz) 996 Tones 67 RU

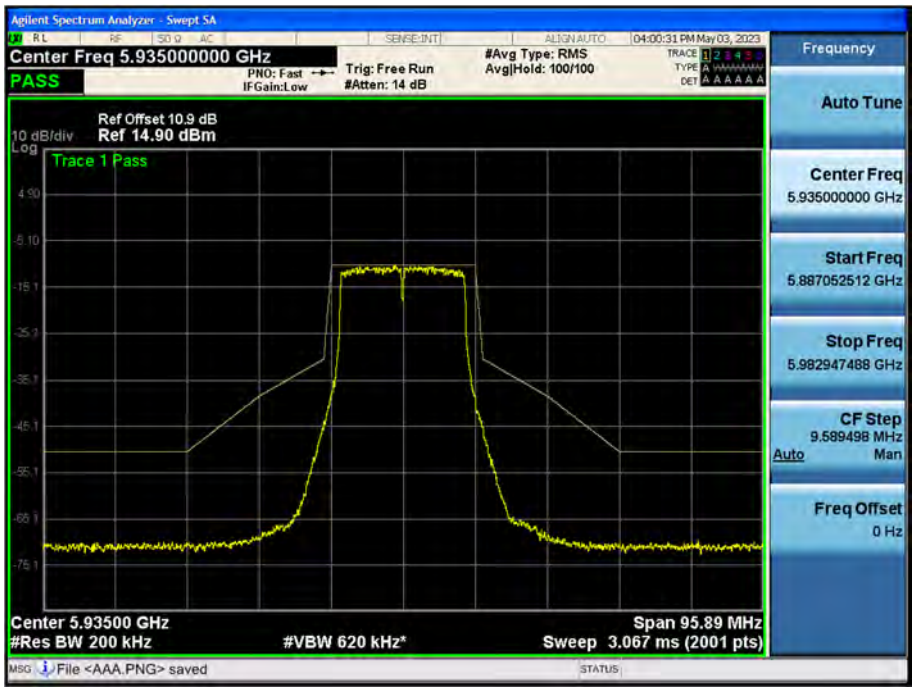
Bandwidth 160M, SU Ch. 143(6665 MHz)



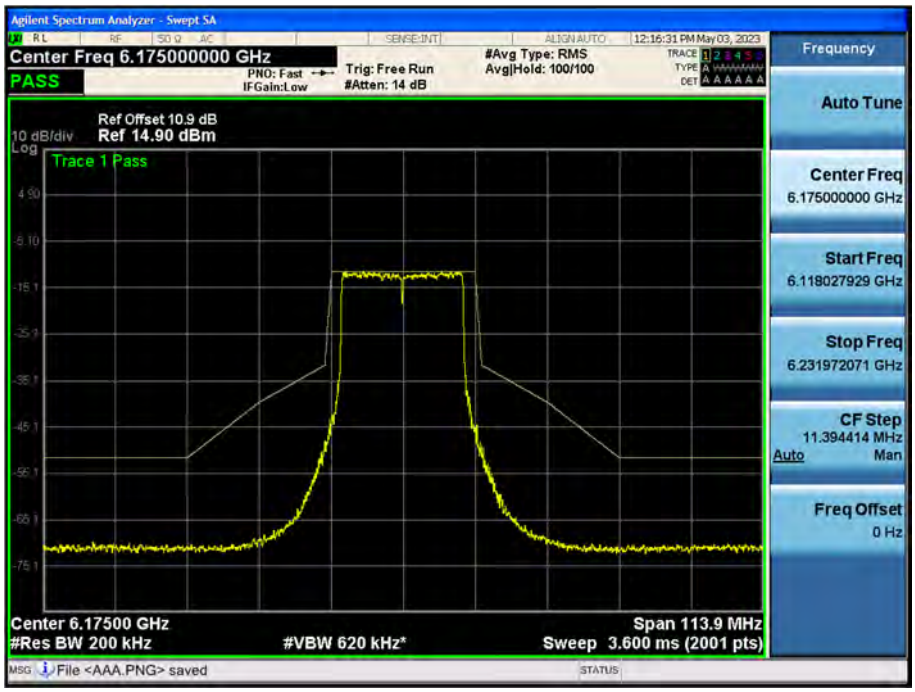
Bandwidth 160M, Ch. 47(6185 MHz) 996Tx2 Tones 68 RU

Ant.2

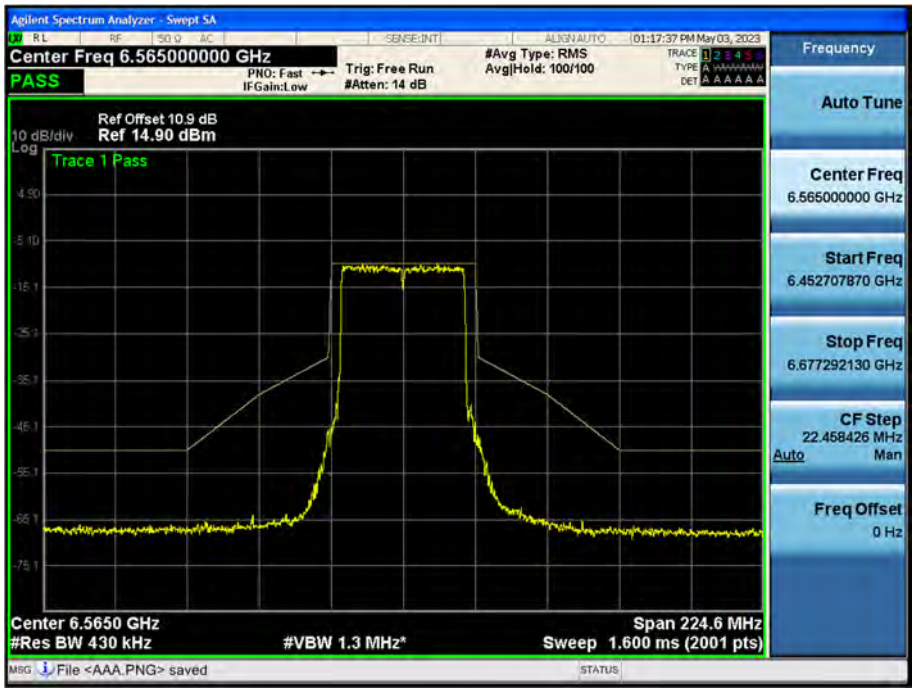
802.11a Ch.2(5935 MHz)



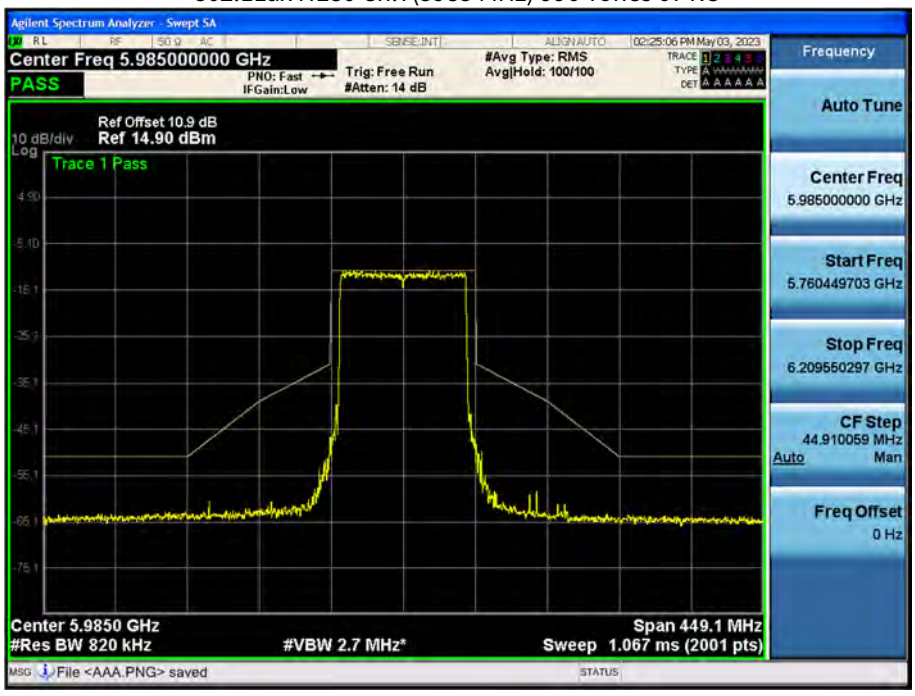
802.11ax HE20 Ch.45(6175 MHz) 242 Tones 61 RU



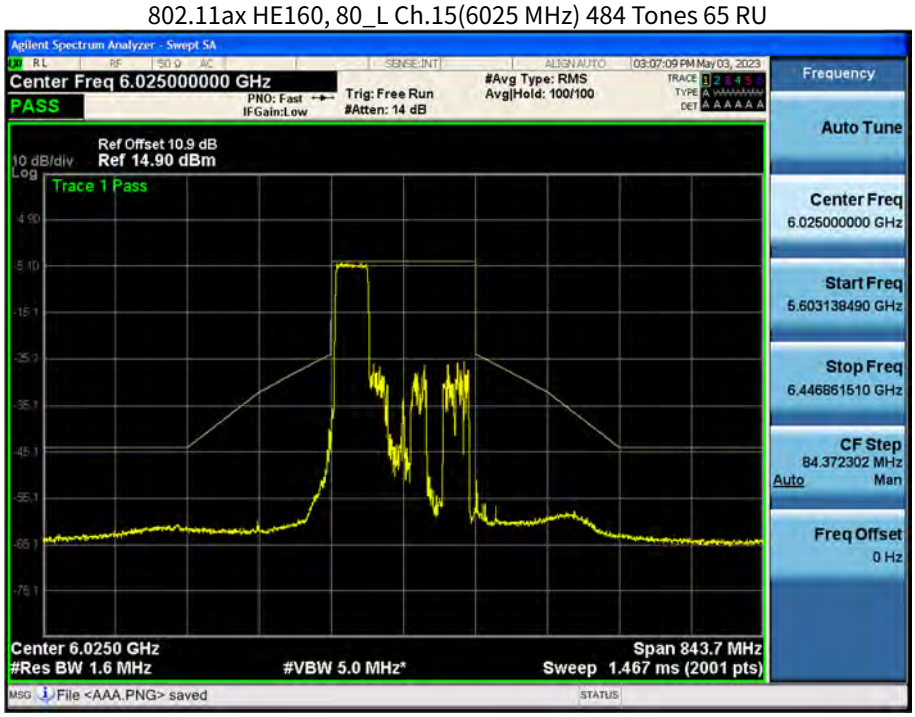
802.11ax HE40 Ch.123(6565 MHz) 484 Tones 65 RU



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

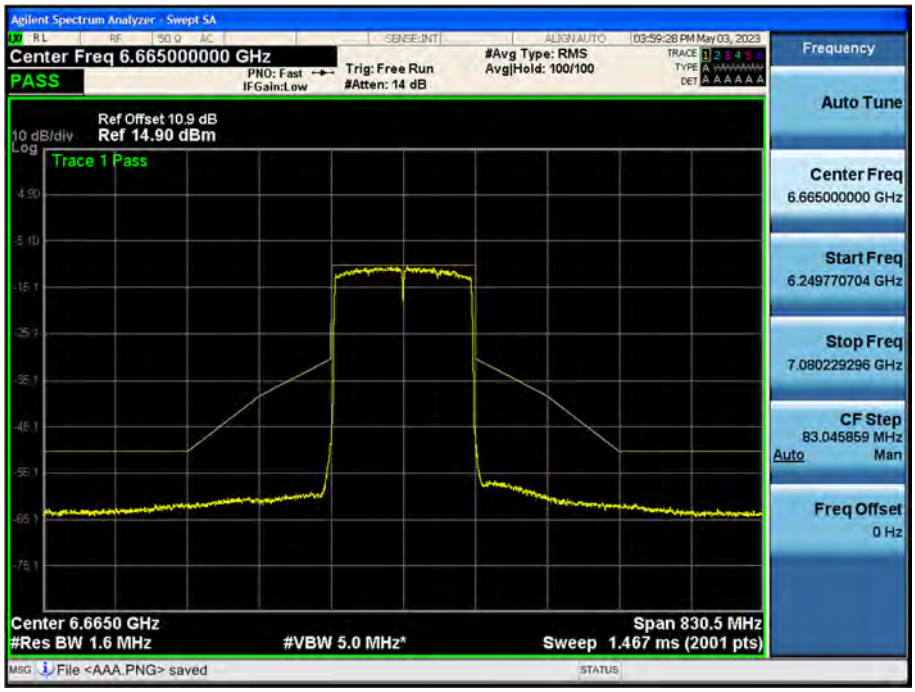


802.11ax HE160, 80_L Ch.15(6025 MHz) 484 Tones 65 RU



802.11ax HE160, 80_U Ch.79(6345 MHz) 996 Tones 67 RU

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



Bandwidth 160M, Ch. 15(6025 MHz) 996Tx2 Tones 68 RU

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)
	ANT1	ANT2		
UNII 5	-7.52	-5.51	2 / 2	-3.45
UNII 6	-7.52	-5.79	2 / 2	-3.60
UNII 7	-7.47	-5.60	2 / 2	-3.47
UNII 8	-8.33	-5.83	2 / 2	-3.98

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.181(6855MHz)	
Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
0.622	0.096	0.718	-2.756

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.2(5935MHz) 52 Tones RU 37

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
0.655	0.000	0.655	-2.792

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.123(6565MHz) 52 Tones RU 37

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
0.582	0.000	0.582	-2.892

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.167(6785MHz) 242 Tones RU 64

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
0.932	0.000	0.932	-2.542

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) 52 Tones RU 37

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
0.106	0.000	0.106	-3.496

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.143(6665MHz) 52 Tones RU 45

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
-0.102	0.000	-0.102	-3.576

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 Ch.15(6025MHz) SU

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
-8.261	0.000	-8.261	-11.707

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 Ch.15(6025MHz) 996T x2 Tones RU 68

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
-8.324	0.000	-8.324	-11.771

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.181(6855MHz)	
Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
0.622	0.096	0.718	-2.756

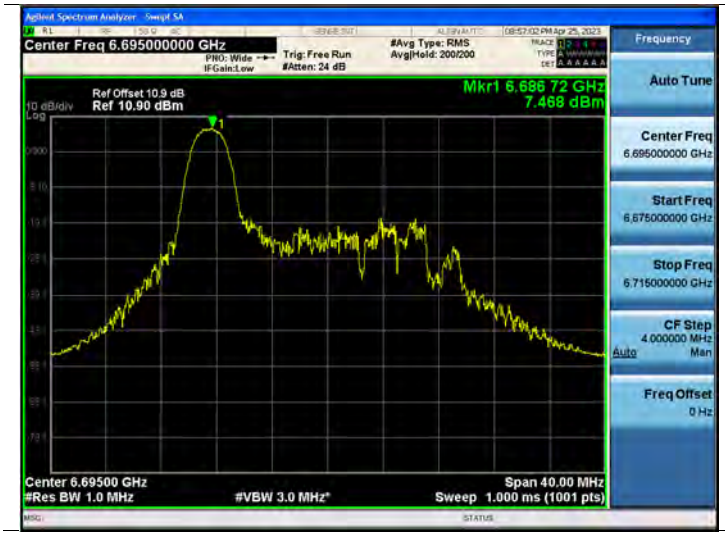
Note:

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.149(6695MHz) 26 Tones RU 0

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
9.494	0.000	9.494	6.020

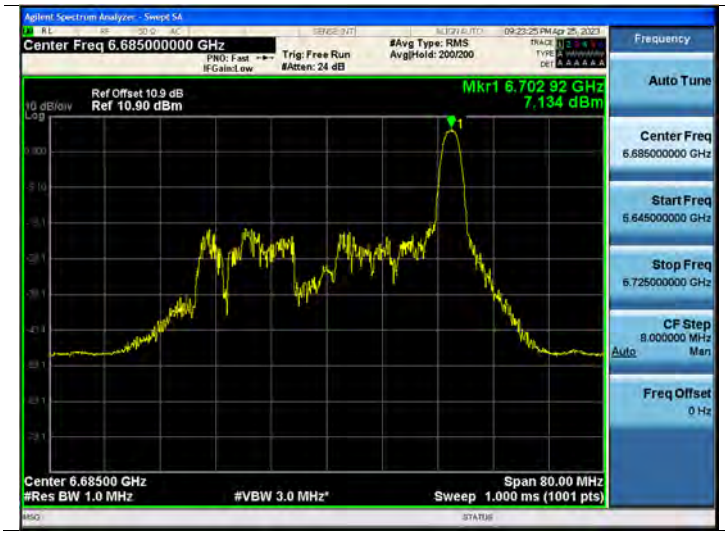
Note:

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.147(6685MHz) 26 Tones RU 17

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
9.012	0.000	9.012	5.538

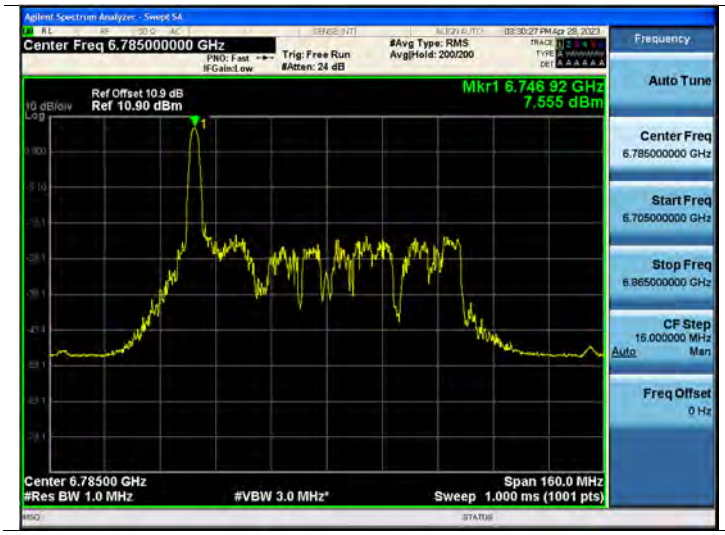
Note:

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.167(6785MHz) 26 Tones RU 0

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
10.093	0.000	10.093	6.619

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.143(6665MHz) 26 Tones RU 0

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
8.663	0.000	8.663	5.189

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.143(6665MHz) 26 Tones RU 36

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
9.102	0.000	9.102	5.627

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 Ch.15(6025MHz) SU

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
-8.261	0.000	-8.261	-11.707

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 Ch.15(6025MHz) 996T x2 Tones RU 68

Ant1	Ant2
	

SUM PSD (dBm/MHz)	Duty Cycle Factor (dB)	Total PSD (dBm/MHz)	EIRP PSD (dBm/MHz)
-8.324	0.000	-8.324	-11.771

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:

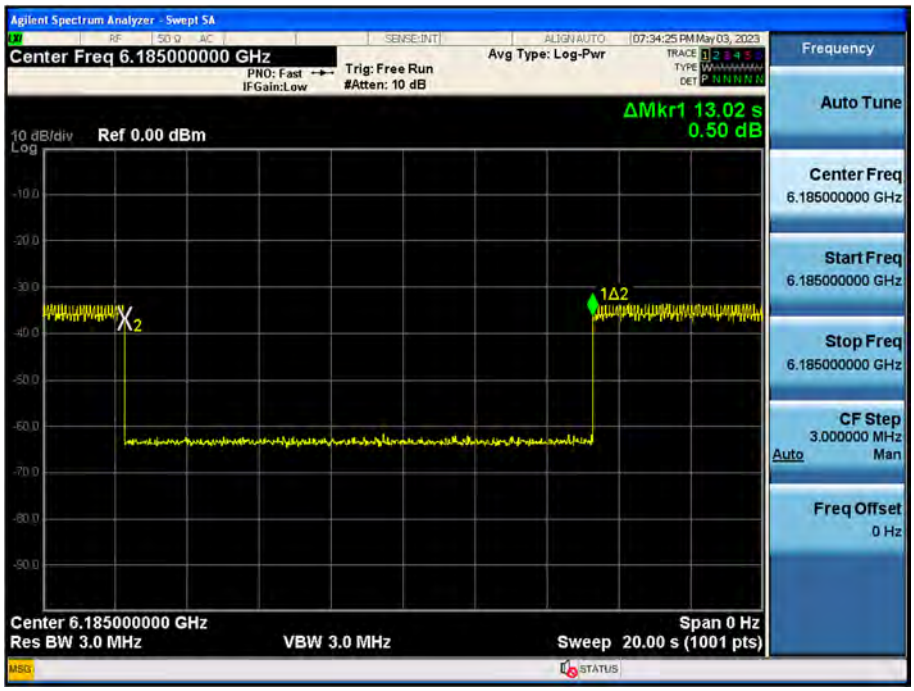
1. In order to simplify the report, Only worst case for each band have been inserted.
2. The worst case antenna gain(Minimum Gain) is selected from the table.
3. The lowest gain according to the incumbent frequency is applied.

Band	Ant 1 Gain (dBi)	Ant 2 Gain (dBi)
UNII-5	-7.91	-
UNII-6	-7.63	-
UNII-7	-7.80	-
UNII-8	6 935 MHz, 6 910 MHz: -8.33 6 985 MHz, 7 050 MHz: -9.71	-

Incumbent Detection Result

UNII 5

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

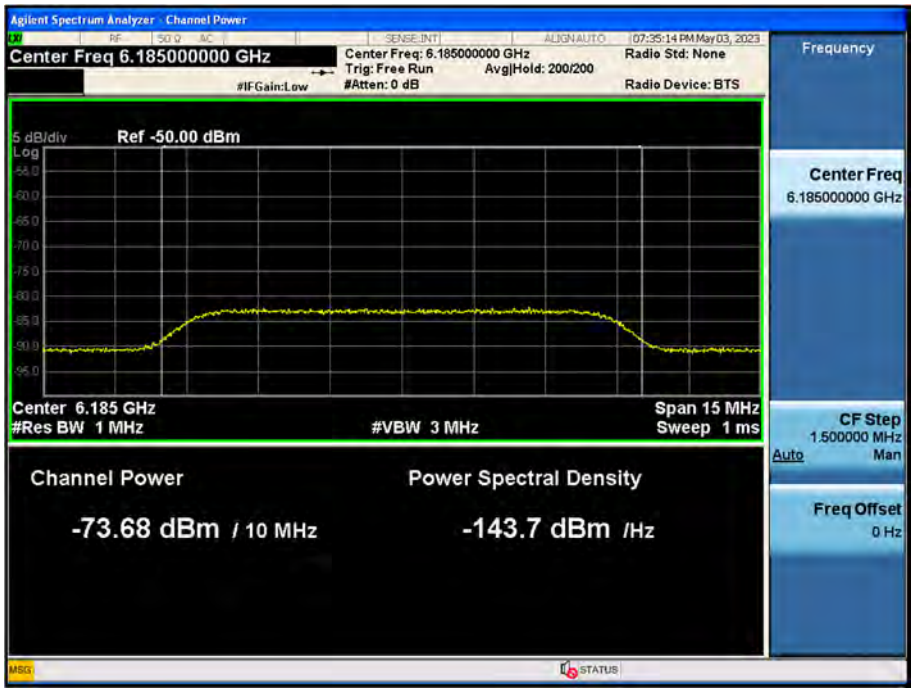


Note :

Marker 2 : AWGN Signal On

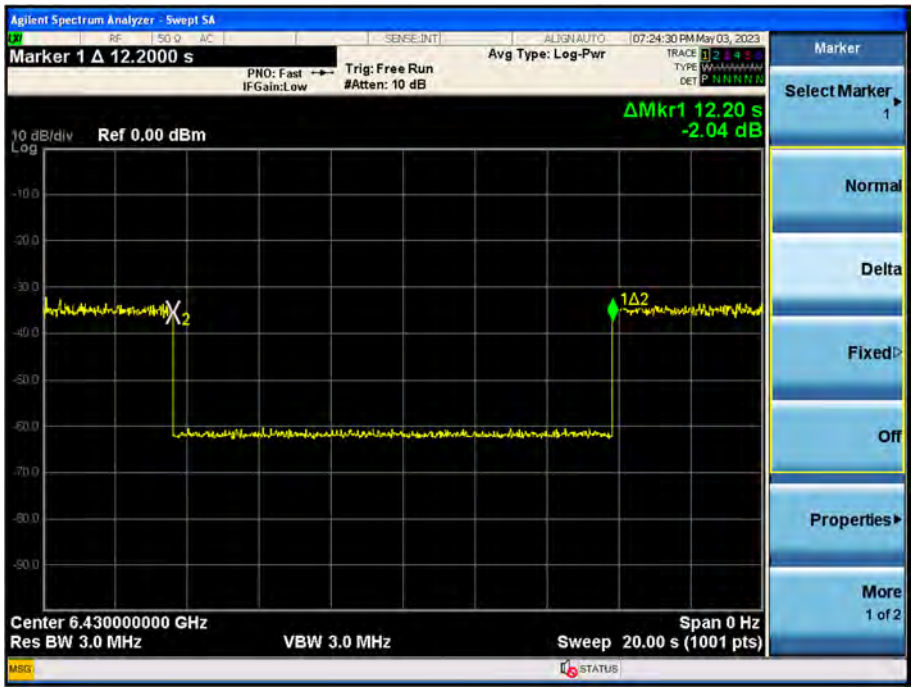
Marker 1△2 : AWGN signal Off (limit > 10s)

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



UNII 6

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

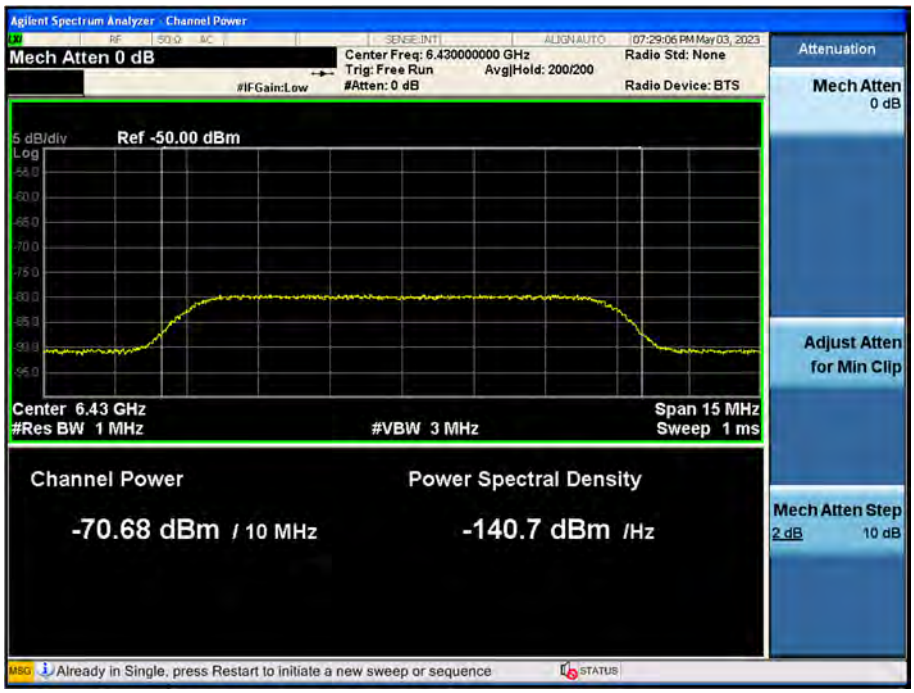


Note :

Marker 2 : AWGN Signal On

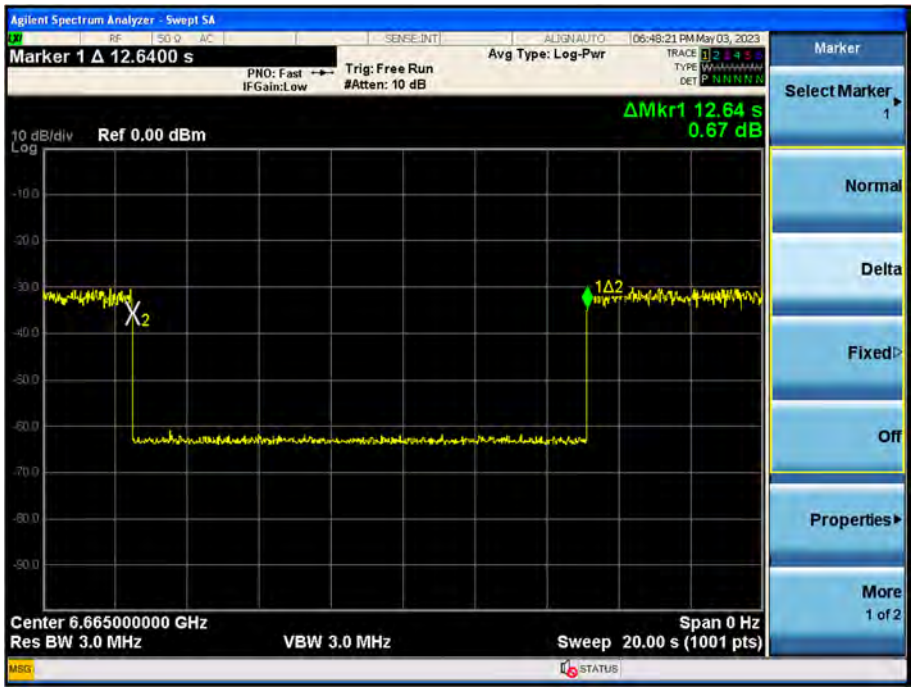
Marker 1△2 : AWGN signal Off (limit > 10s)

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



UNII 7

802.11ax HE160 Ch.143(6665 MHz) Incumbent signal (Ceased)



Note :

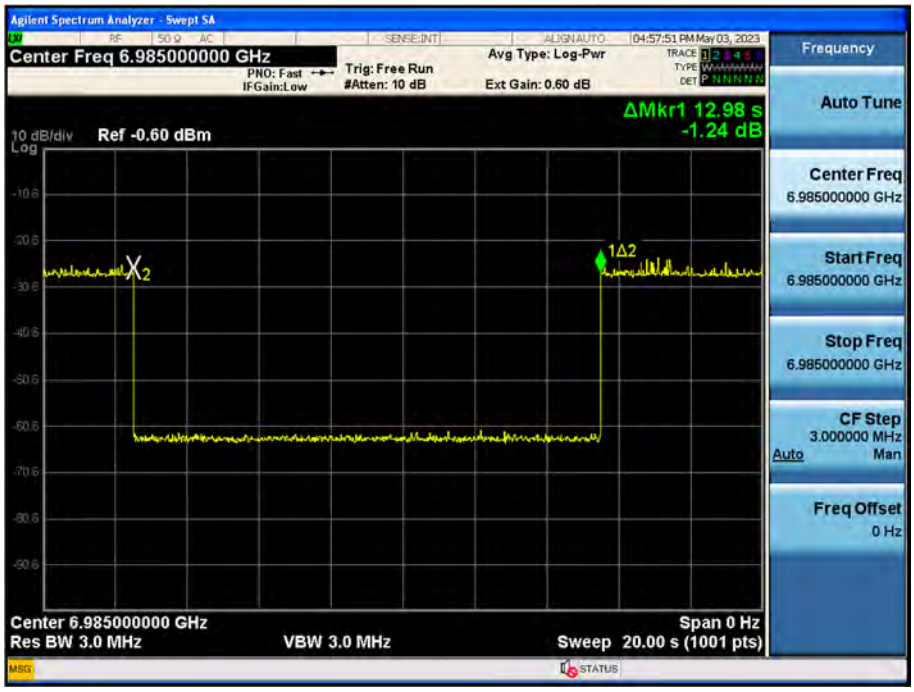
Marker 2 : AWGN Signal On

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

802.11ax HE160 Ch.143(6665 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