Report No.: AAEMT/RF/230404-01-01

FCC RADIO TEST REPORT

Part 15 subpart E

FCC ID: 2AZOI4XL2D

Report Reference No. ..... :	AAEMT/RF/230404-01-01
Date of issue ..... :	16/08/2023
Testing Laboratory ..... :	AA Electro Magnetic Test Laboratory Private Limited
Address..... :	Plot No 174, Udyog Vihar - Phase 4, Sector 18, Gurgaon, Haryana, India
Applicant's name..... :	HFCL Limited
Address..... :	Plot no. 38, Institutional Area, Sector 32,Gurgaon -122001
Manufacturer ..... :	HFCL Limited Plot no. 38, Institutional Area, Sector 32,Gurgaon -122001
Test specification:	
Test item description ..... :	IO 5 GHz 1000 Mbps UBR with Integrated Antenna (23 dBi) with dying gasp
Trade Mark..... :	io by HFCL
Model/Type reference ..... :	ion4xl2_d
Ratings..... :	**Input of PoE: 100-240VAC, 50/60Hz** **Output of PoE/input of EUT: +48V (PoE), 0.315A**

Prepared By: (+ signature) Ankur Kumar

Reviewed & Approved by: (+ signature)

Dr. Lenin Raja (Authorized Representative) (/ lenin83/)

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Report No.: AAEMT/RF/230404-01-01

TEST REPORT DECLARE

Applicant	:	HFCL Limited
Address	:	Plot No. 38, Institutional Area, Sector 32, Gurgaon-122001
Equipment under Test	:	IO 5 GHz 1000 Mbps UBR with Integrated Antenna (23 dBi) with dying gasp
Model No	:	ion4xl2_d
Trade Mark	:	io by HFCL
Manufacturer	:	HFCL Limited
Address	:	Plot No. 38, Institutional Area, Sector 32, Gurgaon-122001

Test Standard Used: FCC Part 15E 15.407

Test procedure used: ANSI C63.10-2013 and KDB 789033 D02 General UNII Test Procedures New Rules v02r01 .

We Declare:

The equipment described above is tested by AA Electro Magnetic Test Laboratory Private Limited and in the configuration tested the equipment complied with the standards specified above. The test results are contained in this test report and AA Electro Magnetic Test Laboratory Private Limited is assumed of full responsibility for the accuracy and completeness of these tests.

After test and evaluation, our opinion is that the equipment provided for test compliance with the requirement of the above FCC standards.

Report No:	AAEMT/RF/230404-01-01		
Date of Test:	May 02, 2023~June 28, 2023	**Date of Report**:	Aug. 16, 2023

Note: This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of AA Electro Magnetic Test Laboratory Private Limited

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1. SUMMARY OF TEST RESULTS

The EUT have been tested according to the applicable standards as referenced below.		
FCC Part15 (15.407) , Subpart E		
Description of Test Item	**Standard**	**Results**
AC Power Line Conducted Emissions	FCC §15.207/ RSS-Gen	PASS
Spurious Radiated Emissions	FCC §15.209(a), 15.407(b)	PASS
26 dB and 99% Emission Bandwidth	FCC §15.407(a)	PASS
Maximum Conducted Output Power	FCC §407(a) (1)	PASS
Band Edges	FCC §2.1051, §15.407(b)	PASS
Power Spectral Density	FCC §15.407(a)(1)	PASS
Spurious Emissions at Antenna Terminals	FCC §2.1051, §15.407(b)	PASS
Antenna Requirement	FCC §15.203	PASS

2. GENERAL TEST INFORMATION

2.1. DESCRIPTION OF EUT

EUT Name	:	IO 5 GHz 1000 Mbps UBR with Integrated Antenna (23 dBi) with dying gasp
Model Number	:	ion4xl2_d
Power supply	:	**Input of PoE: 100-240VAC, 50/60Hz,** **Output of PoE/input of EUT: +48V (PoE),0.315A**
Operation frequency	:	WiFi: 802.11a/n(HT20)/ac(VHT20)/ax(HE20): 5180MHz~5240MHz; 5745MHz~5825MHz 802.11n(HT40)/ac(VHT40)/ax(HE40): 5190MHz~5230MHz; 5755MHz~5795MHz 802.11ac(VHT80)/ax(HE80):5210MHz; 5775MHz
Modulation	:	802.11a/n: BPSK/QPSK/16QAM/64QAM 802.11ac/ax: BPSK/QPSK/16QAM/64QAM/256QAM/1024QAM
Data Rate	:	802.11a:6,9,12,18,24,36,48,54Mbps; 802.11ac(VHT20):MCS0-MCS9 802.11ac(VHT40/80):MCS0-MCS9 802.11n(HT20): MCS0 to MCS9; 802.11n(HT40):MCS0-MCS9; 802.11ax(HE20):MCS0-MCS11; 802.11ax(HE40/80):MCS0-MCS11
Antenna Type	:	Dish Type Antenna
Antenna gain	:	23dBi
H/W No.	:	C1
S/W No.	:	1.7.0.0
Battery	:	N/A
Date of Receipt	:	April. 04, 2023
Condition of Sample on receipt		Good
Note:		1 .For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual. 2. Antenna gain and antenna type provided by manufacturer.
Note:	:	**For 5GHz (Port J1 – Chain 1) is the worst case.**

Channel List							
802.11a/n/ac/ax (20MHz)							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
36	5180	40	5200	44	5220	48	5240
149	5745	153	5765	157	5785	161	5805
165	5825	--	--	--	--	--	--
802.11n/ac/ax (40MHz)							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
38	5190	46	5230	151	5755	159	5795
802.11ac/ax (80MHz)							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
42	5210	-	-	-	-	155	5775

2.2. ACCESSORIES OF EUT

Description of Accessories	Shielded Type	Ferrite Core	Length
PoE Injector	-	-	-

2.3. ASSISTANT EQUIPMENT USED FOR TEST

Description of Assistant equipment	Manufacturer	Model number or Type	EMC Compliance	SN
Laptop	DELL	Latitude 3490	-	5M2Z1W2
DC Power Supply	JUNKE	JK1504K	-	20181126-43

3. EQUIPMENT'S LIST FOR ALL TEST ITEMS

S No	Test Equipment	Manufacturer	Model No	Serial No	Cal. Date	Cal.Due Date
1	Spectrum Analyzer	Rohde and Schwarz	FSP	101163	2023/02/13	2025/02/13
2	Loop antenna	DAZE Beijing	ZN30900C	18052	2021/09/15	2023/09/15
3	Hi power horn antenna	DAZE Beijing	ZN30700	18012	2023/07/27	2025/07/27
4	Horn antenna	DAZE Beijing	ZN30702	18006	2021/09/15	2023/09/15
5	Horn antenna	DAZE Beijing	ZN30703	18005	2021/09/15	2023/09/15
6	MXA Signal Analyzer	Keysight	N9020A	6272323218	2022/07/27	2023/07/26
7	Pre amplifier	KELIANDA	LNA-0009295	-	2023/01/13	2024/01/13
8	Pre amplifier	KELIANDA	CF-00218	-	2023/01/13	2024/01/13
9	Biconical Antenna	DAZE Beijing	ZN30505C	17038	2021/09/15	2023/09/15
10	EMI-RECEIVER	Schwarzbeck	FCKL	1528194	2023/01/13	2024/01/13
11	LISN	Kyoritsu	KNW-407	8-1789-5	2023/01/13	2024/01/13
12	Network-LISN	SCHWAR ZBECK	NNBM8125	81251314	2023/01/13	2024/01/13
13	Network-LISN	SCHWAR ZBECK	NNBM8125	81251315	2023/01/13	2024/01/13
14	PULSELIMITER	Rohde and Schwarz	ESH3-Z2	100681	2023/01/13	2024/01/13
15	50Ω Coaxial Switch	DAIWA	1565157	-	2023/01/13	2024/01/13
16	50Ω Coaxial Switch	-	-	-	2023/01/13	2024/01/13
17	Wireless signal power meter	DARE!!	RPR3006W	RFSW190220	2023/01/13	2024/01/13
18	Signal Generator	KEYSIGHT	N5181A	512071	2023/01/13	2024/01/13

19	RF Vector Signal Generator	Keysight	N5182B	512094	2023/01/13	2024/01/13
20	Spectrum analyzer	R&S	FSV-40N	101385	2023/01/13	2024/01/13
21	Radio Communication Tester	R&S	CMW 500	124589	2021/09/15	2023/09/15
22	Signal Generator	R&S	SMP02	837017/004 836593/005	2021/09/15	2023/09/15
23	DC Regulated Power Supply	Metravi	RPS-3005	669076	2022/12/13	2023/12/12
24	Climatic Chamber	Sunrise Scientific Instruments	-	-	2022/11/22	2023/11/21
25	Attenuators	AGILENT	8494B	-	-	-
26	Attenuators	AGILENT	8495B	-	-	-

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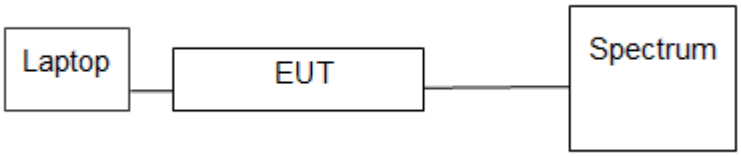
3.1. BLOCK DIAGRAM OF EUT CONFIGURATION FOR TEST



3.2. TEST ENVIRONMENT CONDITIONS

During the measurement the environmental conditions were within the listed ranges:

Temperature range:	21-25℃
Humidity range:	40-75%
Pressure range:	86-106kPa

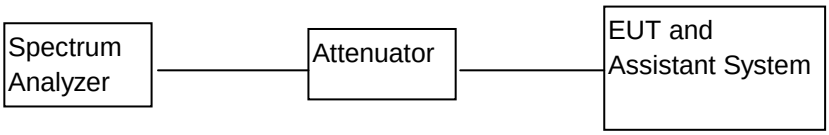
3.3. MEASUREMENT UNCERTAINTY

No.	Item	Uncertainty
1	Conducted Emission Test	2.70dB
2	Radiated Emission Test	3.09dB
3	RF power, conducted	2.46dB
4	RF power density, conducted	2.24dB
5	Spurious emissions, conducted	2.71dB
6	All emissions, radiated(<1G)	3.08dB
7	All emissions, radiated(>1G)	3.09dB

Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

4. POWER SPECTRAL DENSITY TEST

4.1. BLOCK DIAGRAM OF TEST SETUP



4.2. APPLIED PROCEDURES / LIMIT

According to FCC §15.407(a)(3)

For the band 5.15-5.25 GHz,

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omni directional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the band 5.725-5.85 GHz

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 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi..

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4.3. TEST PROCEDURE

(For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in § 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, "provided that the measured power is integrated over the full reference bandwidth" to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 KHz bandwidth, the following adjustments to the procedures apply:

a) Set RBW ≥ 1/T, where T is defined in section II.B.l.a).

b) Set VBW ≥ 3 RBW.

c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add 10log(500kHz/RBW) to the measured result, whereas RBW (< 500 KHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.

d) If measurement bandwidth of Maximum PSD is specified in 1 MHz, add 10log(1MHz/RBW) to the measured result, whereas RBW (< 1 MHz) is the reduced resolution bandwidth of spectrum analyzer set during measurement.

e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

Note: As a practical matter, it is recommended to use reduced RBW of 100 KHz for the sections 5.c) and 5.d) above, since RBW=100 KHZ is available on nearly all spectrum analyzers.

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4.4. TEST RESULT:

CH. No.	Frequency	power density (dBm/MHz)	Limit (dBm/MHz)	Result
TX 802.11a Mode				
CH36	5180	-0.58	17	Pass
CH40	5200	-0.97	17	Pass
CH48	5240	-0.21	17	Pass
TX 802.11n20 Mode				
CH36	5180	-0.95	17	Pass
CH40	5200	-0.59	17	Pass
CH48	5240	-0.07	17	Pass
TX 802.11n40 Mode				
CH38	5190	-4.44	17	Pass
CH46	5230	-5.42	17	Pass
TX 802.11ac20 Mode				
CH36	5180	-1.91	17	Pass
CH40	5200	-3.14	17	Pass
CH48	5240	-2.76	17	Pass
TX 802.11ac40 Mode				
CH38	5190	-5.39	17	Pass
CH46	5230	-6.38	17	Pass
TX 802.11ac80 Mode				
CH42	5210	-10.34	17	Pass
TX 802.11ax20 Mode				
CH36	5180	-1.65	17	Pass
CH40	5200	-3.13	17	Pass
CH48	5240	-2.75	17	Pass
TX 802.11ax40 Mode				
CH38	5190	-5.15	17	Pass
CH46	5230	-5.13	17	Pass
TX 802.11ax80 Mode				
CH42	5210	-10.08	17	Pass

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TEST RESULT

CH. No.	Frequency	Limit (dBm/500KHz)	Limit (dBm/500KHz)	Result
TX 802.11a Mode				
CH 149	5745	-5.24	30	Pass
CH 157	5785	-5.74	30	Pass
CH 165	5825	-6.53	30	Pass
TX 802.11n20 Mode				
CH 149	5745	-4.16	30	Pass
CH 157	5785	-4.82	30	Pass
CH 165	5825	-5.62	30	Pass
TX 802.11n40 Mode				
CH151	5755	-7.90	30	Pass
CH159	5795	-8.09	30	Pass
TX 802.11ac20 Mode				
CH 149	5745	-4.97	30	Pass
CH 157	5785	-6.20	30	Pass
CH 165	5825	-6.57	30	Pass
TX 802.11ac40 Mode				
CH151	5755	-8.42	30	Pass
CH159	5795	-8.53	30	Pass
TX 802.11ac80 Mode				
CH155	5775	-8.58	30	Pass
TX 802.11ax20 Mode				
CH 149	5745	-4.43	30	Pass
CH 157	5785	-5.80	30	Pass
CH 165	5825	-6.11	30	Pass
TX 802.11ax40 Mode				
CH151	5755	-7.69	30	Pass
CH159	5795	-8.09	30	Pass
TX 802.11ax80 Mode				
CH155	5775	-8.09	30	Pass

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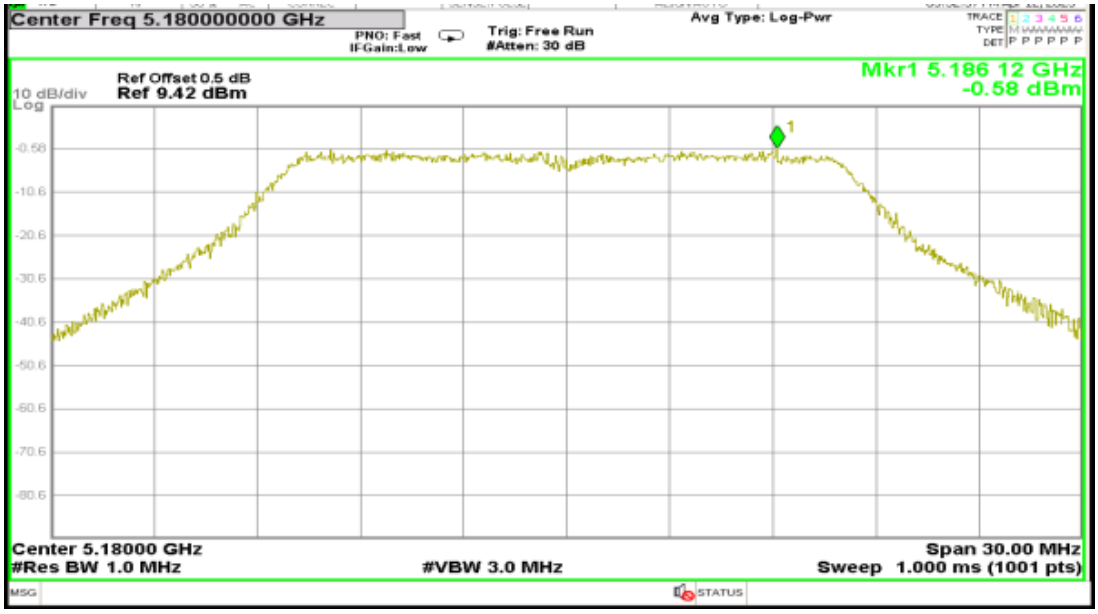
Test plots as followed

802.11a

Channel: 36



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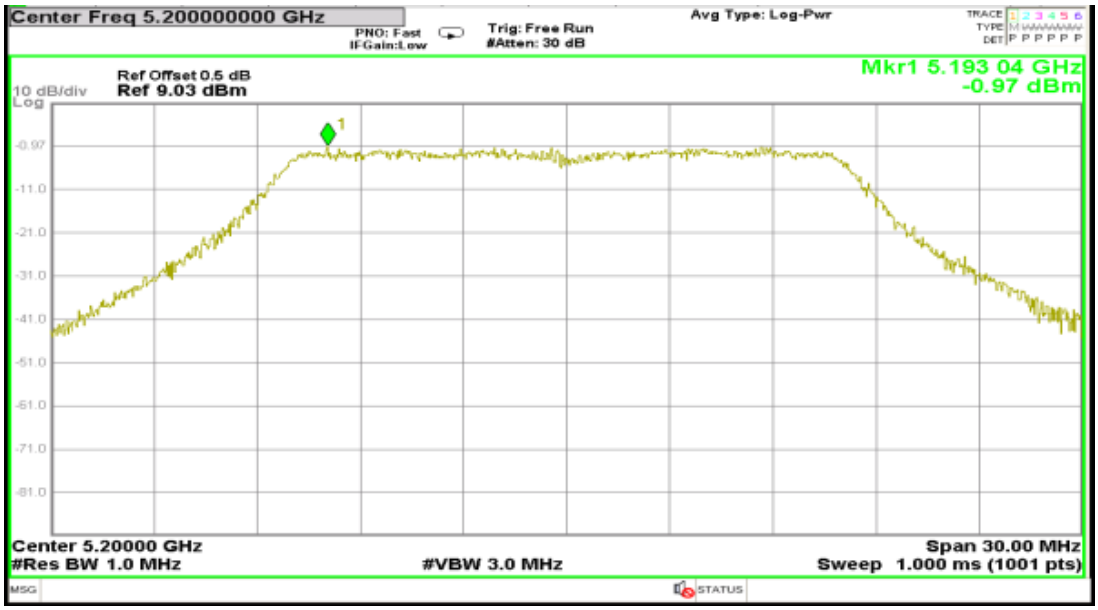

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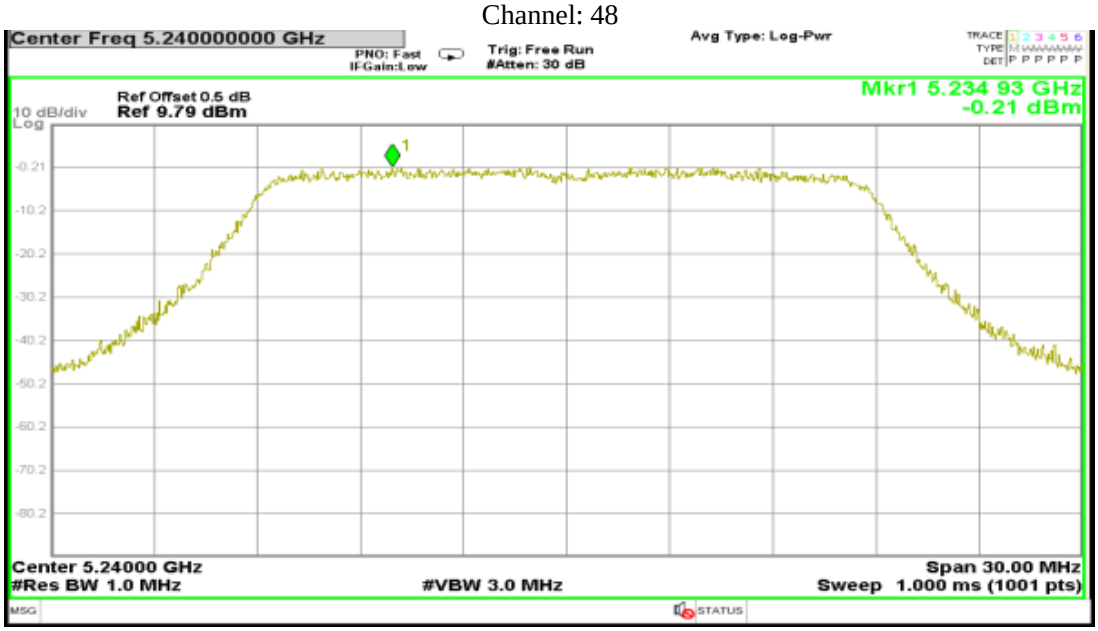

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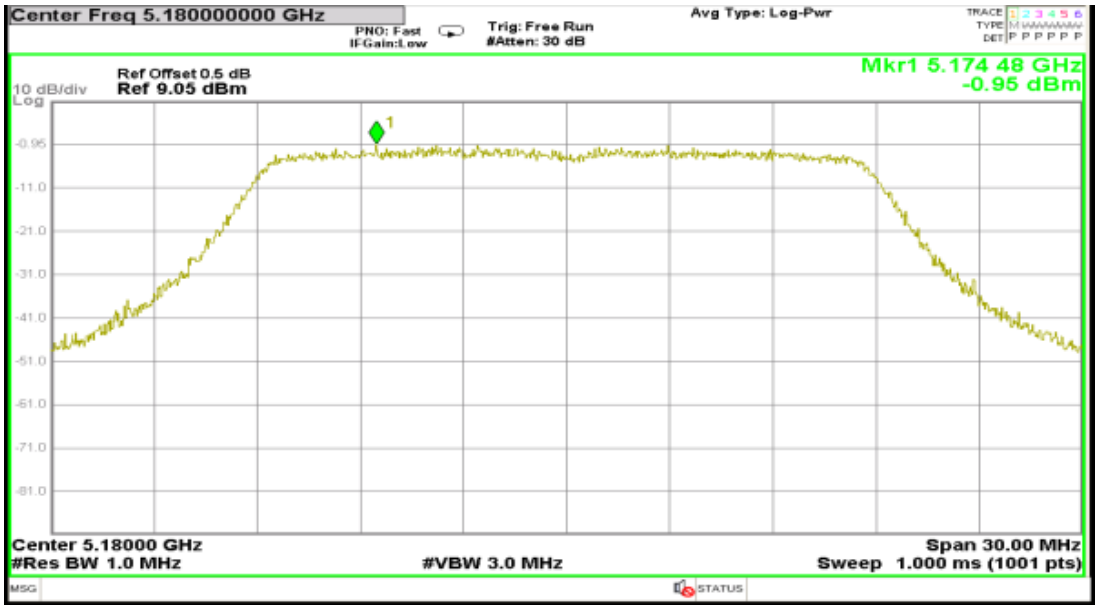
802.11n20

Channel: 36



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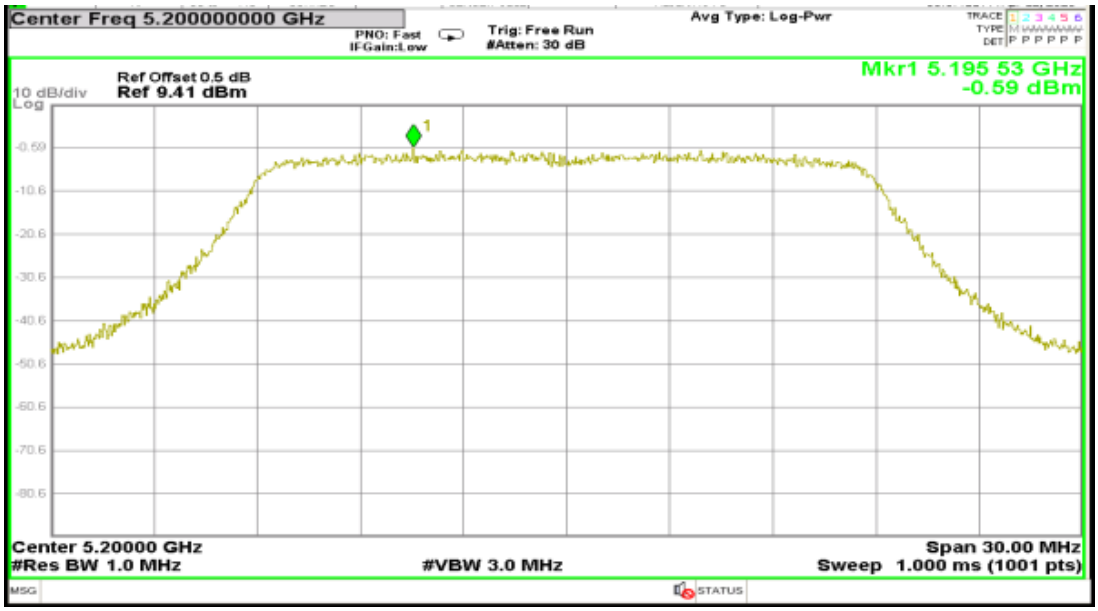

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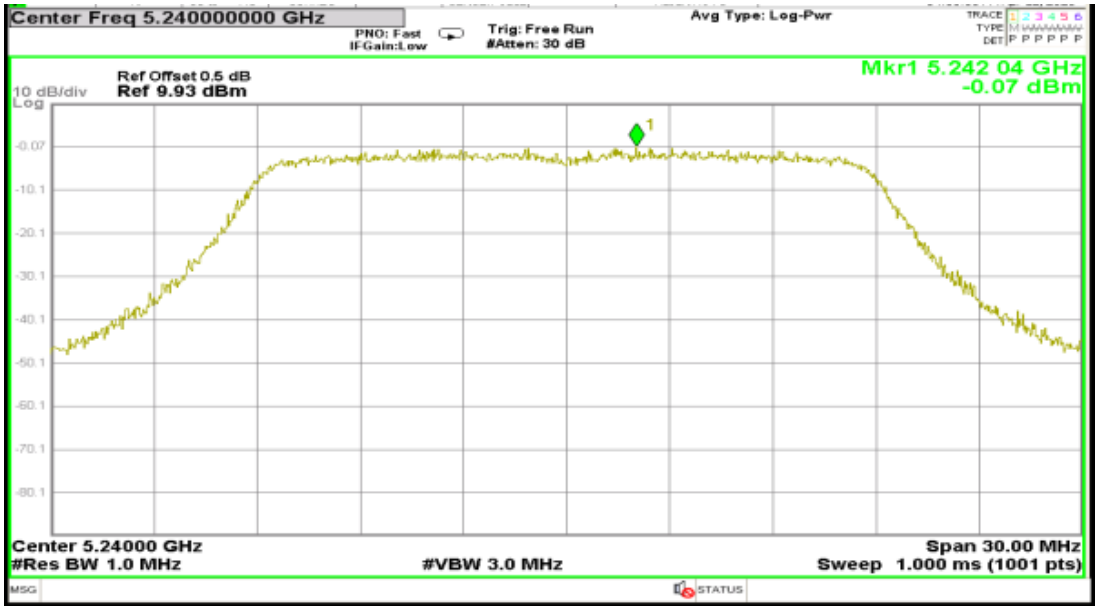

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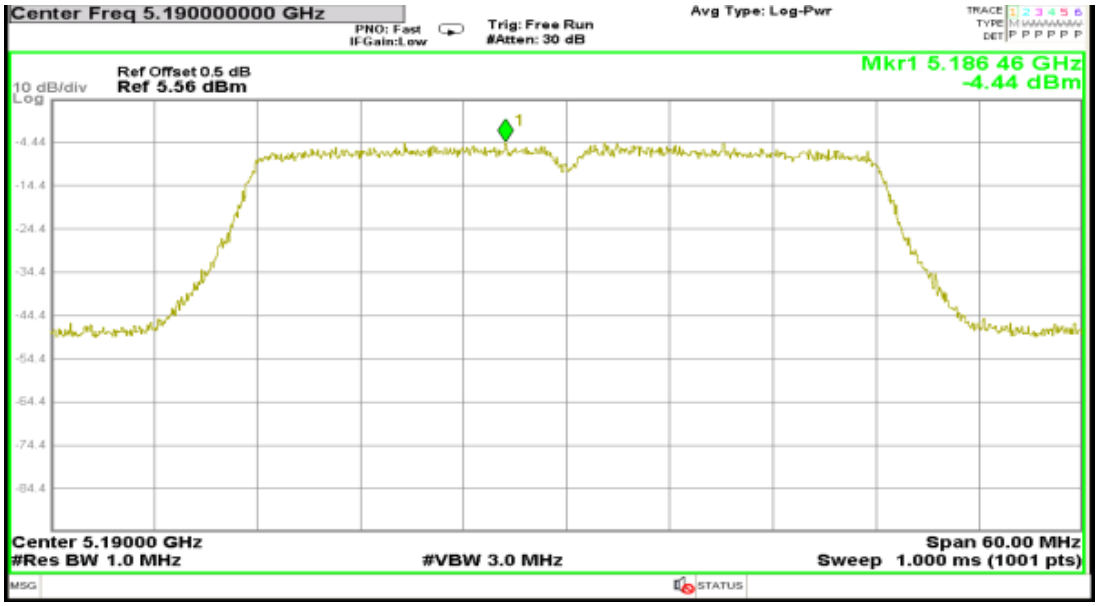
802.11n40

Channel: 38



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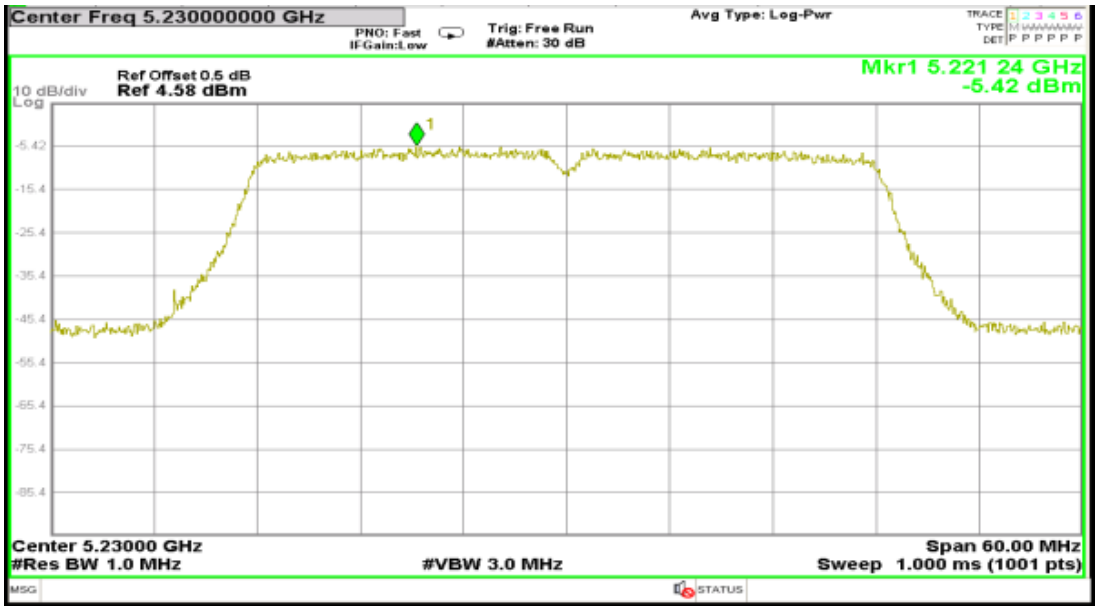

802.11ac20

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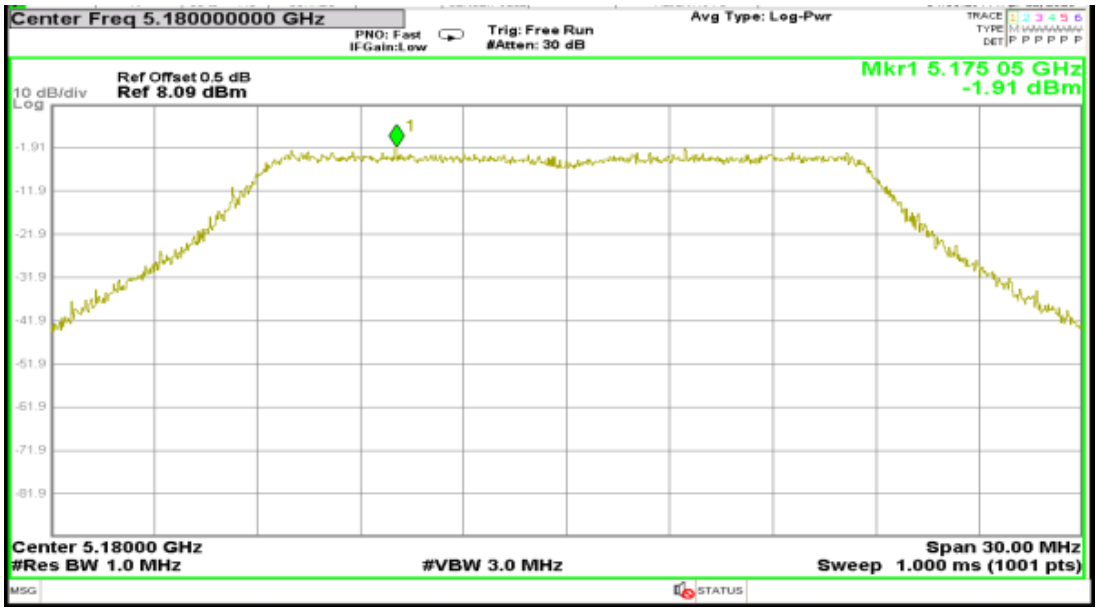

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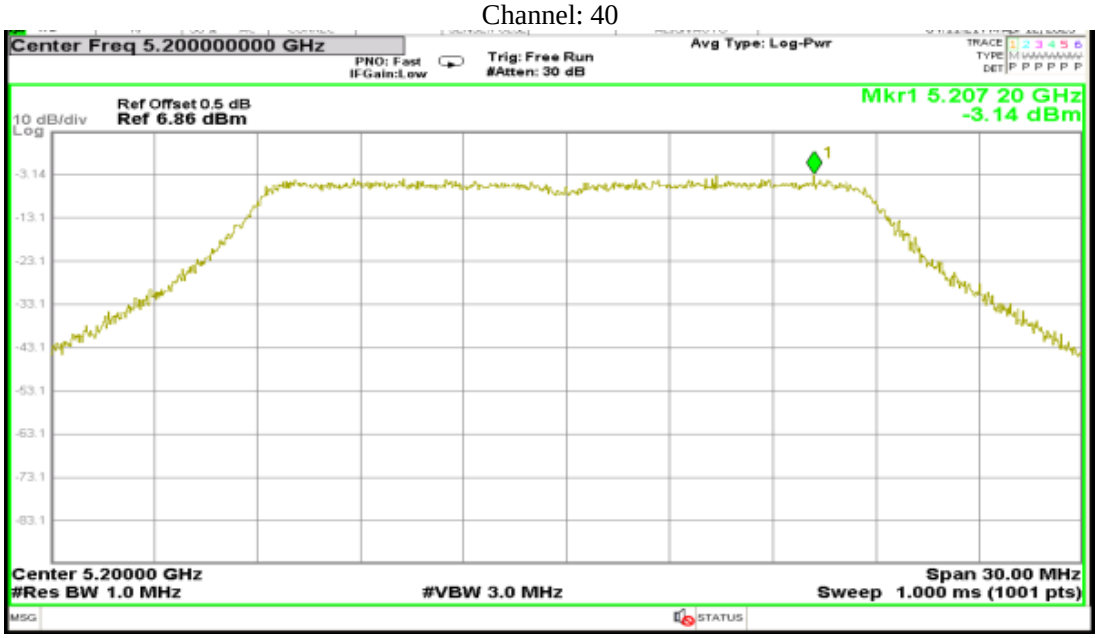

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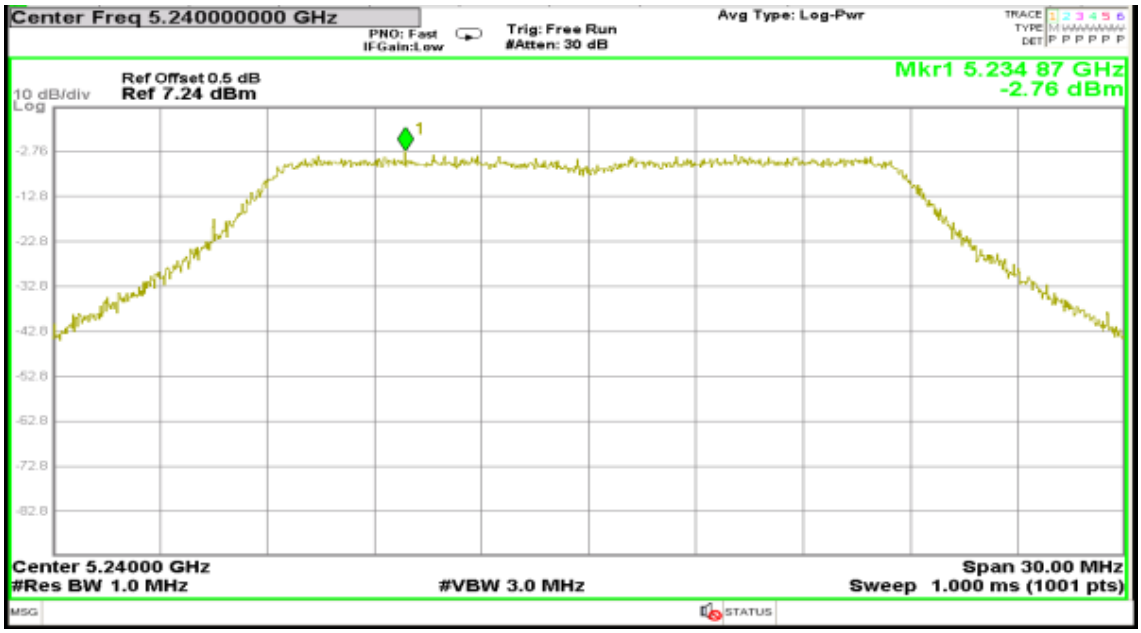
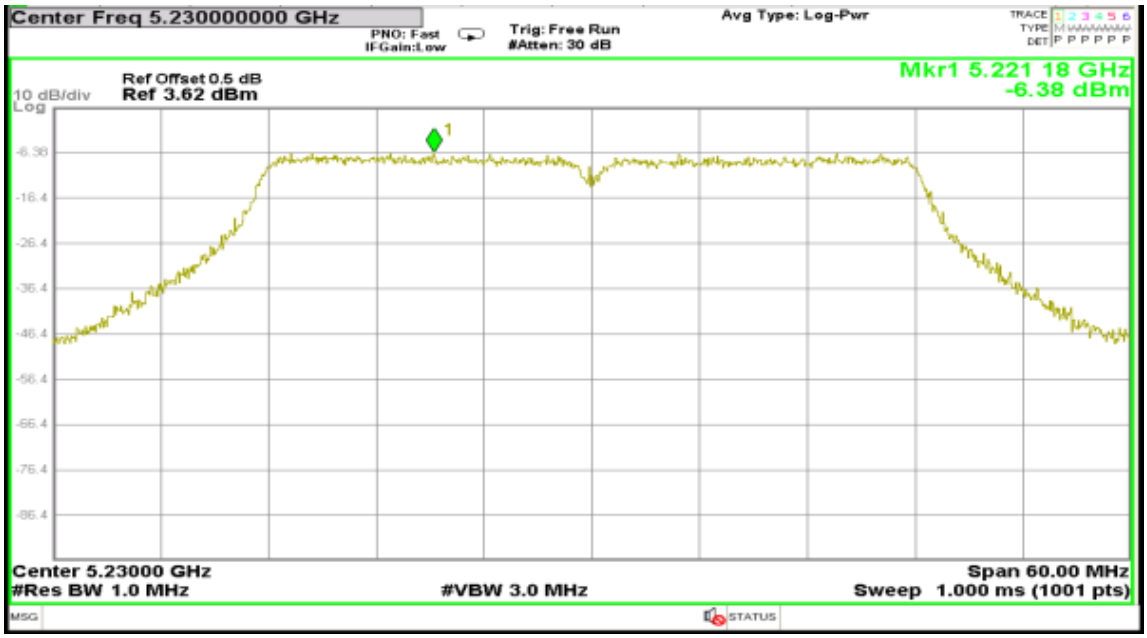


802.11ac40

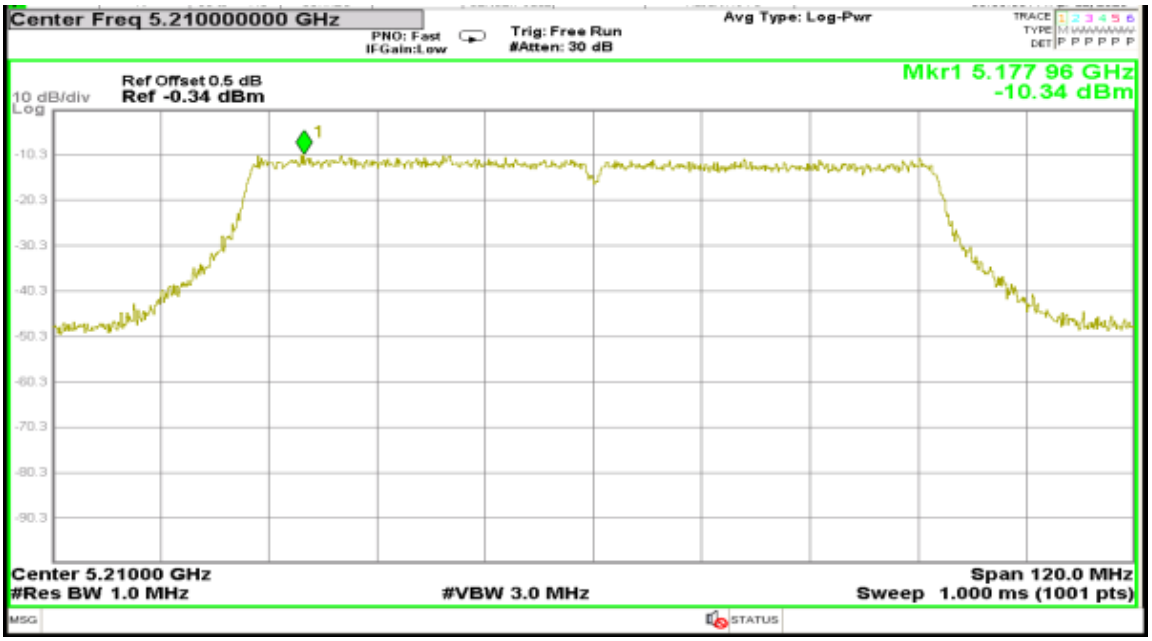
Channel: 38

Channel: 46



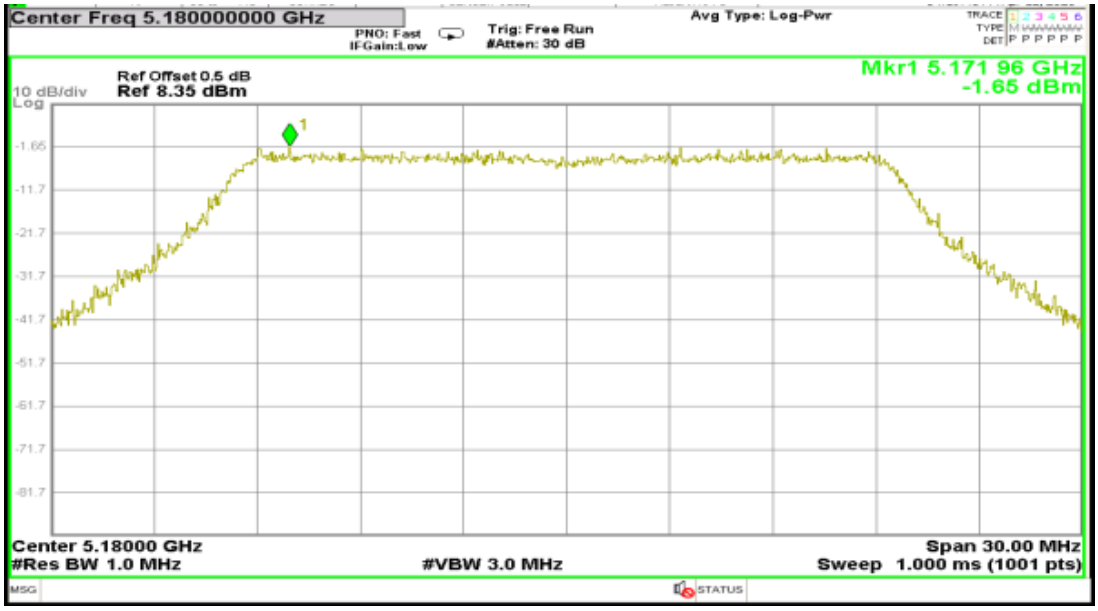
802.11ac80

Channel: 42

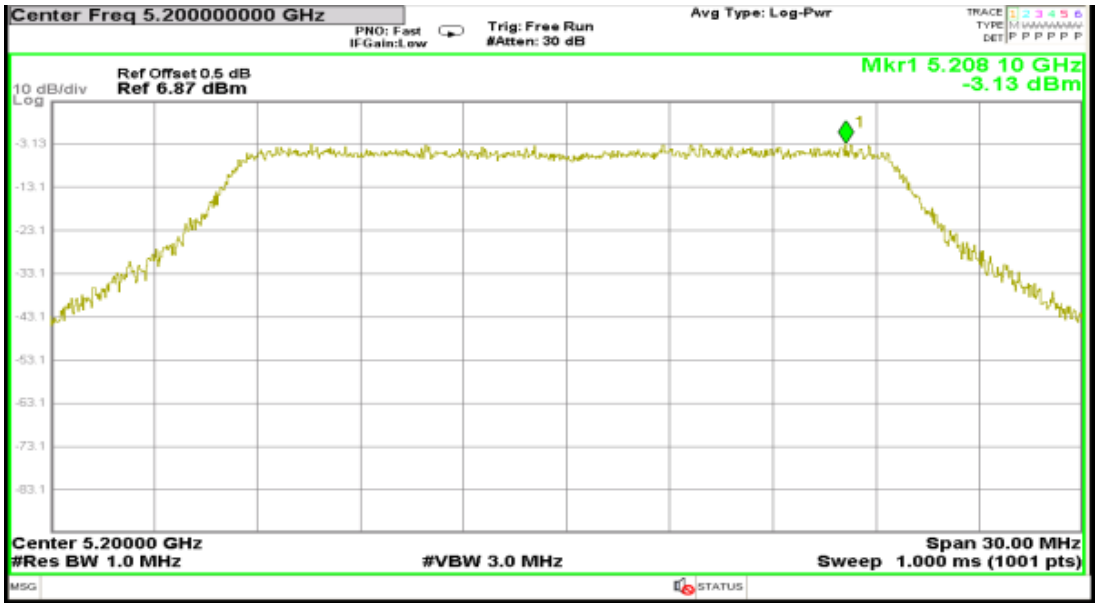


802.11ax20

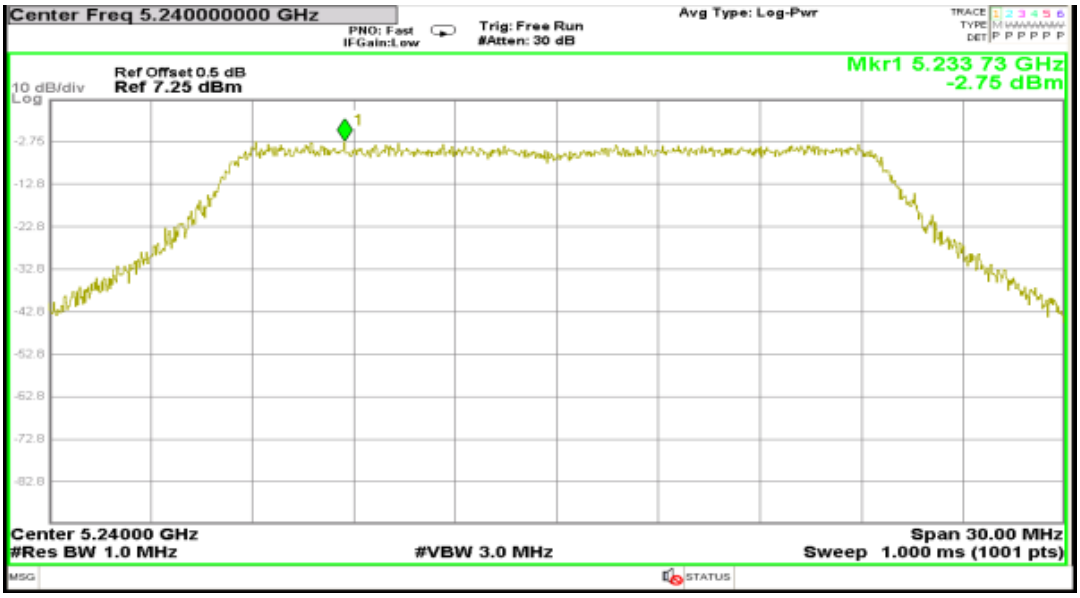
Channel: 36



Channel: 40

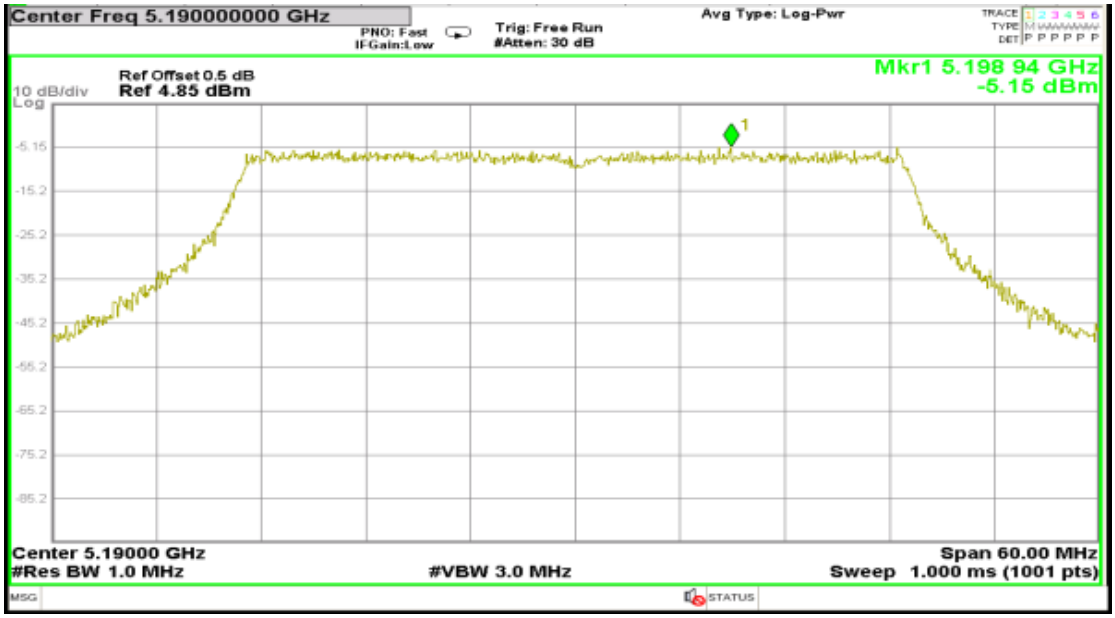


Channel: 48

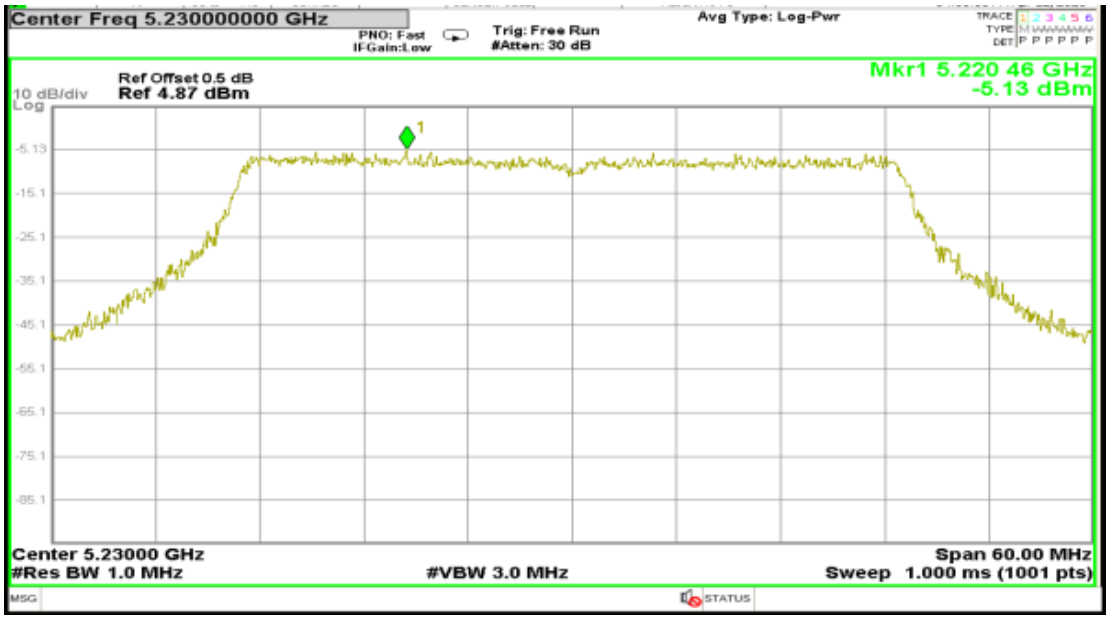

Center Freq 5.240000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Ref Offset 0.5 dB
10 dB/div
Ref 7.25 dBm
Log
Mkr1 5.233 73 GHz
-2.75 dBm
Center 5.24000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Span 30.00 MHz
Sweep 1.000 ms (1001 pts)

802.11ax40

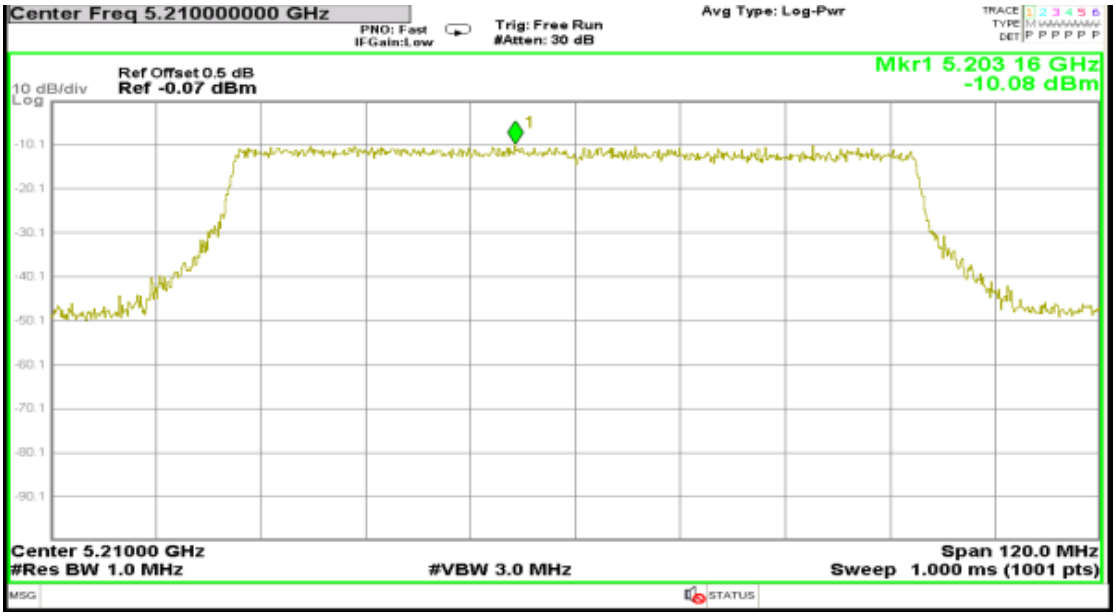
Channel: 38



Channel: 46



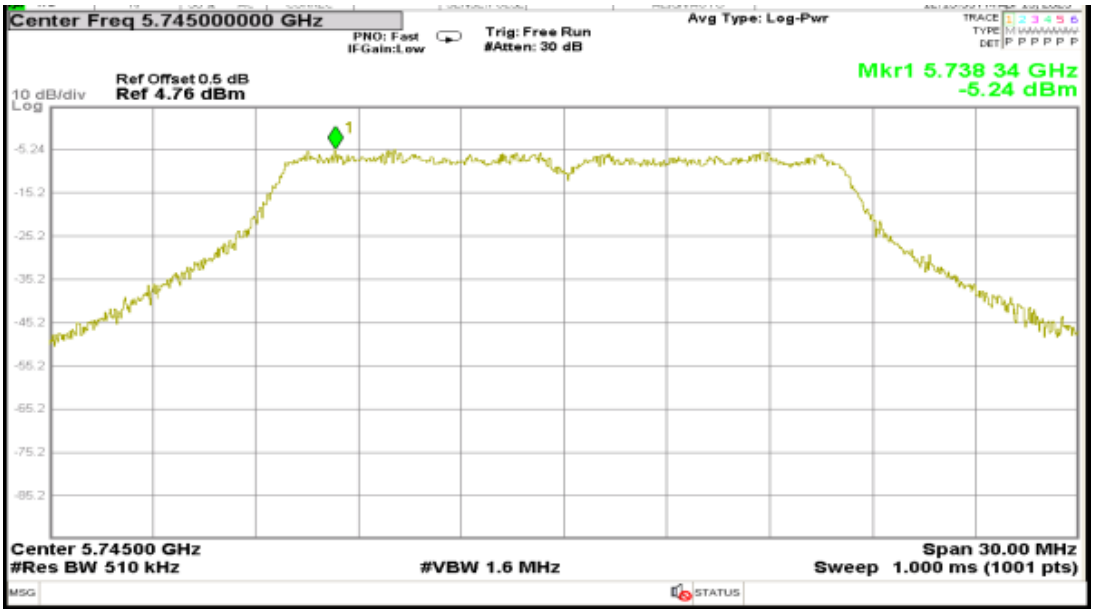
802.11ax80
Channel: 42



Test plots as followed:

802.11a

Channel: 149



Channel: 157

Channel: 165

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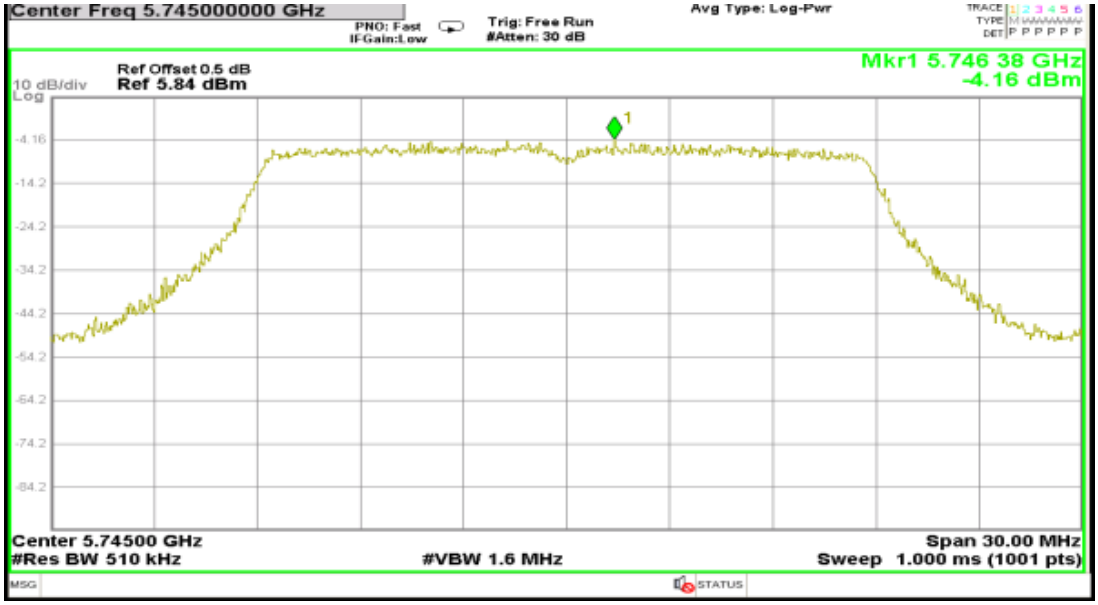
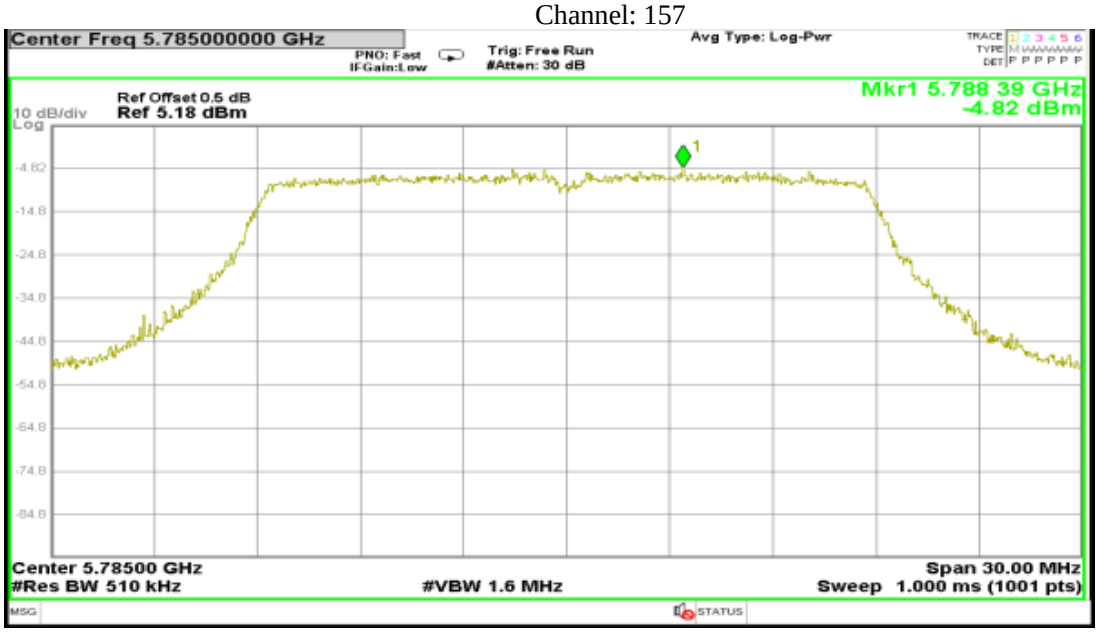
802.11n20

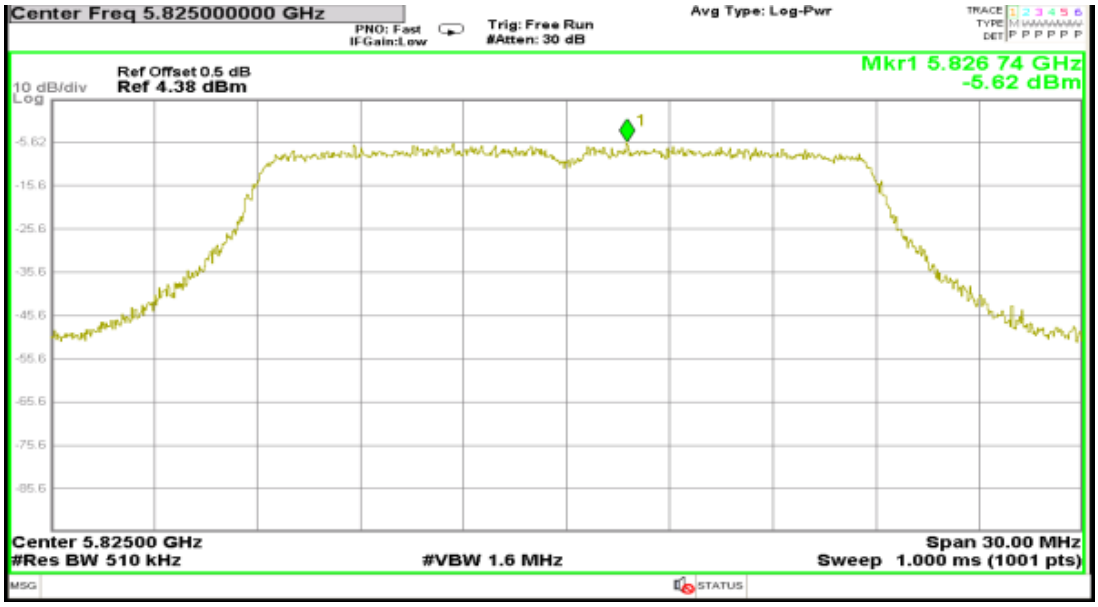
Channel: 149



Channel: 157

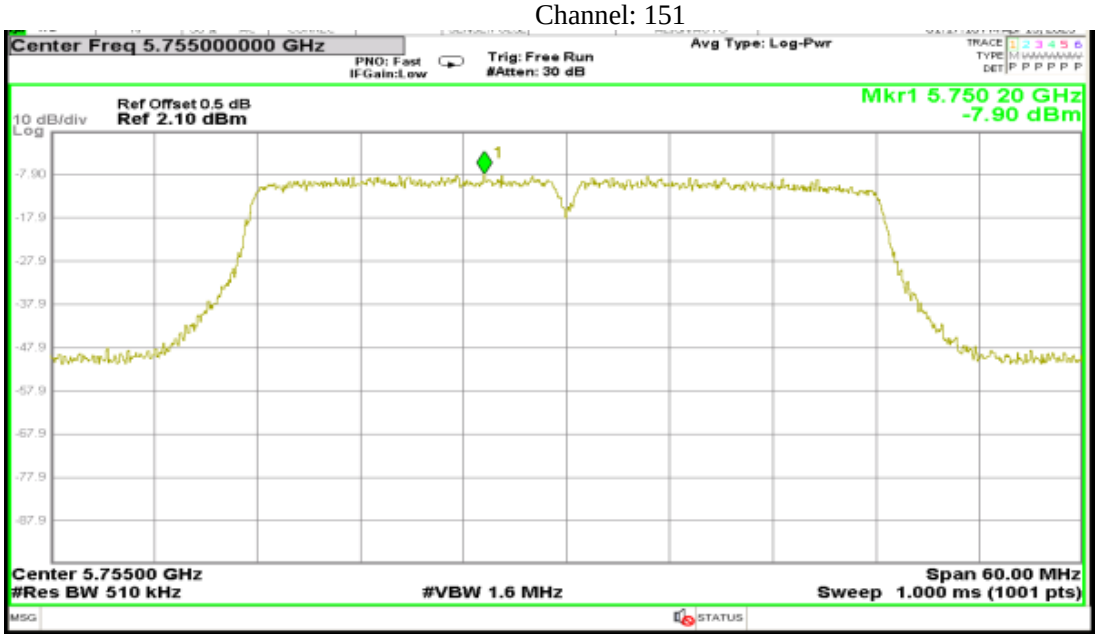


Channel: 165

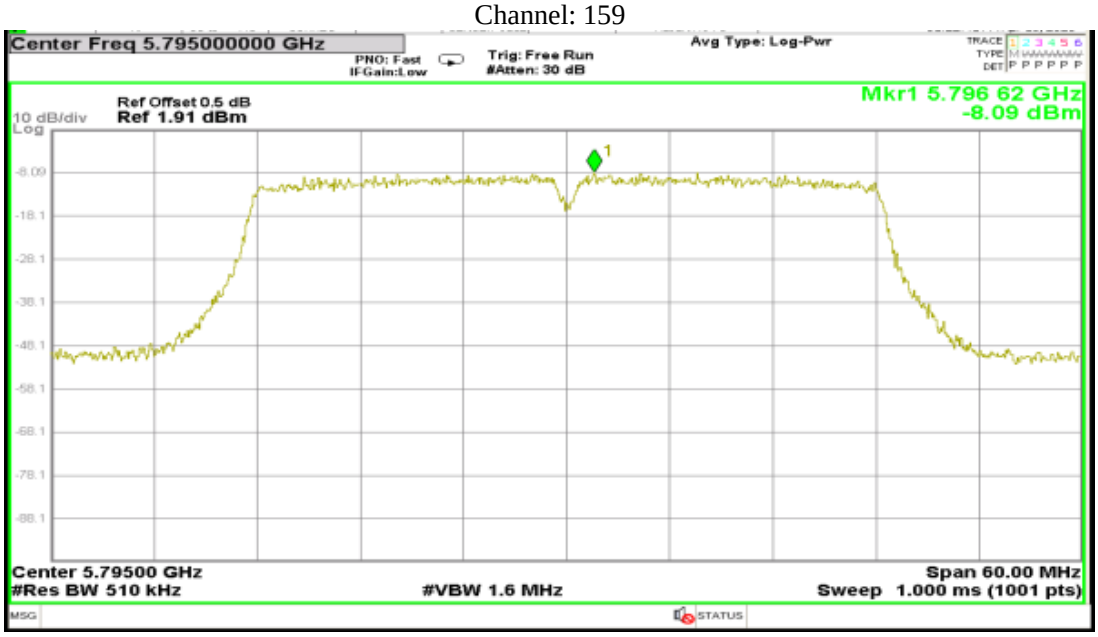

Center Freq 5.825000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Ref Offset 0.5 dB
10 dB/div
Ref 4.38 dBm
Mkr1 5.826 74 GHz
-5.62 dBm
Center 5.82500 GHz
#Res BW 510 kHz
#VBW 1.6 MHz
Span 30.00 MHz
Sweep 1.000 ms (1001 pts)

802.11n40

Channel: 151

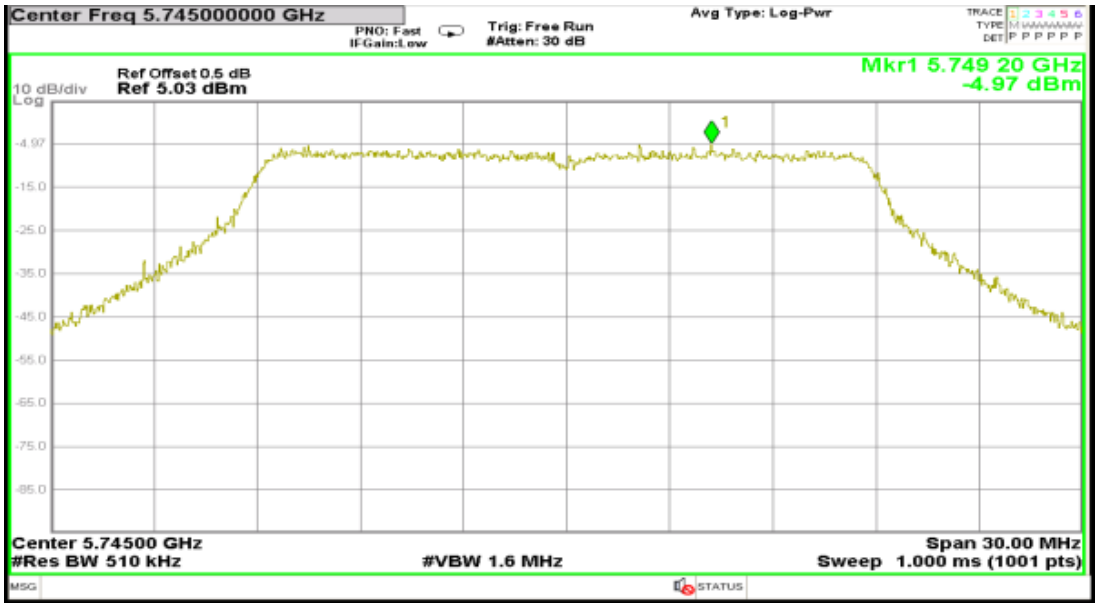


Channel: 159

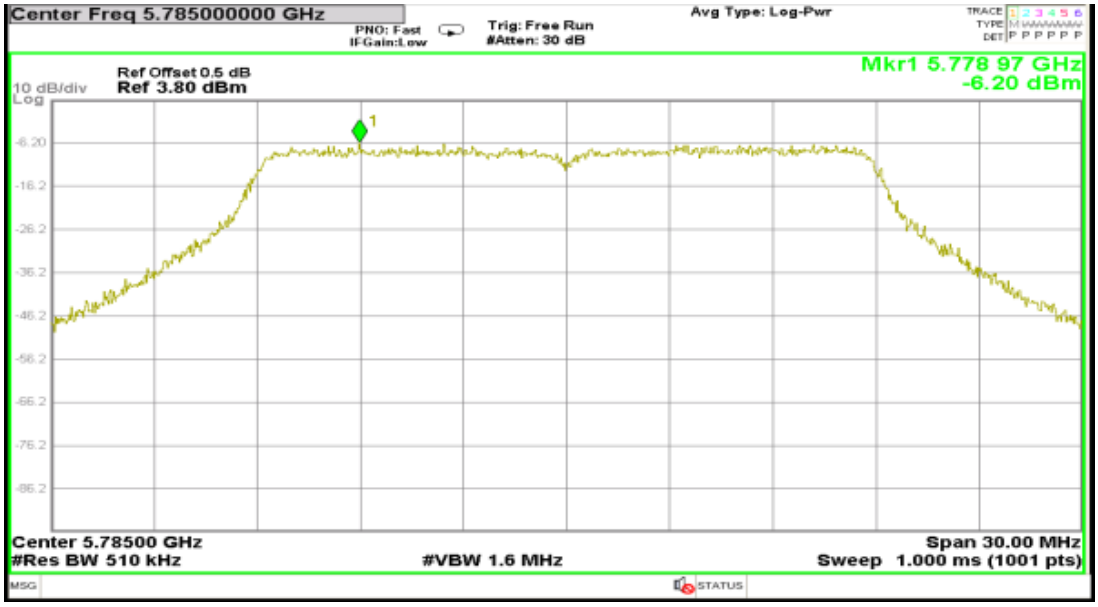


802.11ac20

Channel: 149



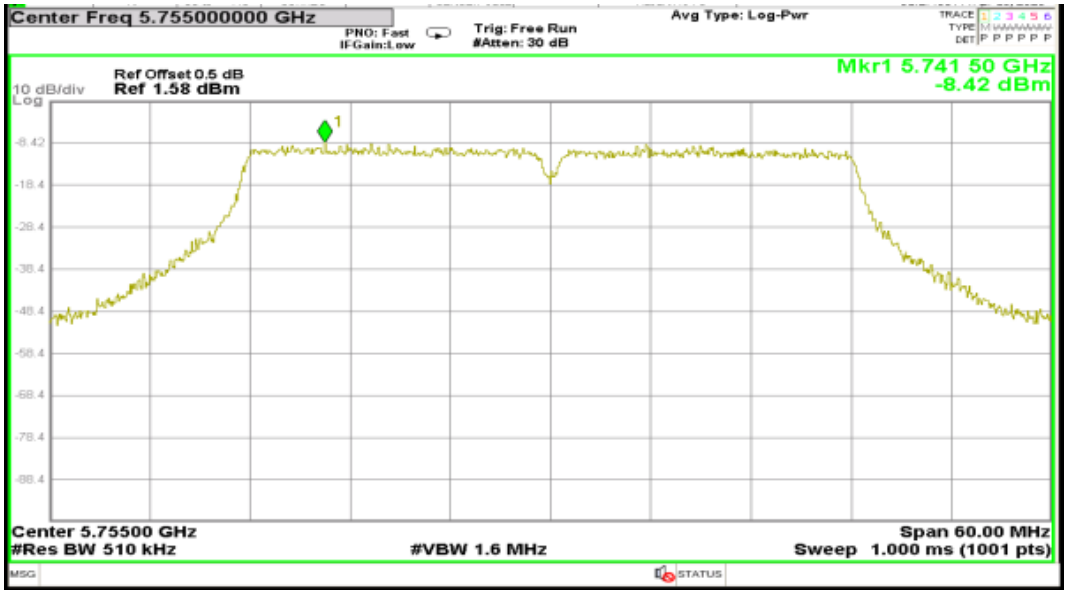
Channel: 157



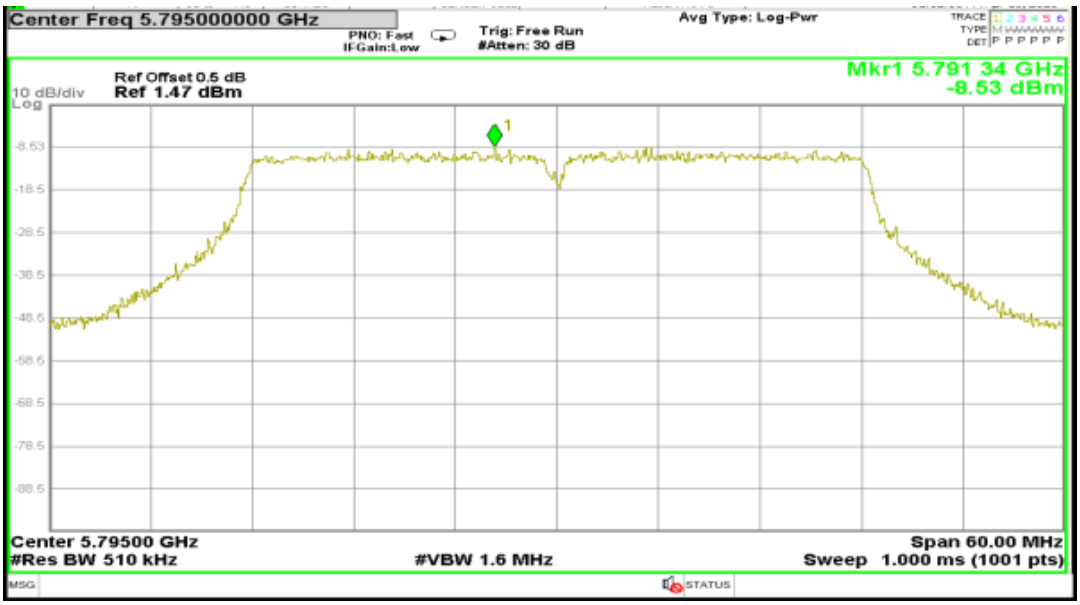
Channel: 165

802.11ac40

Channel: 151



Channel: 159

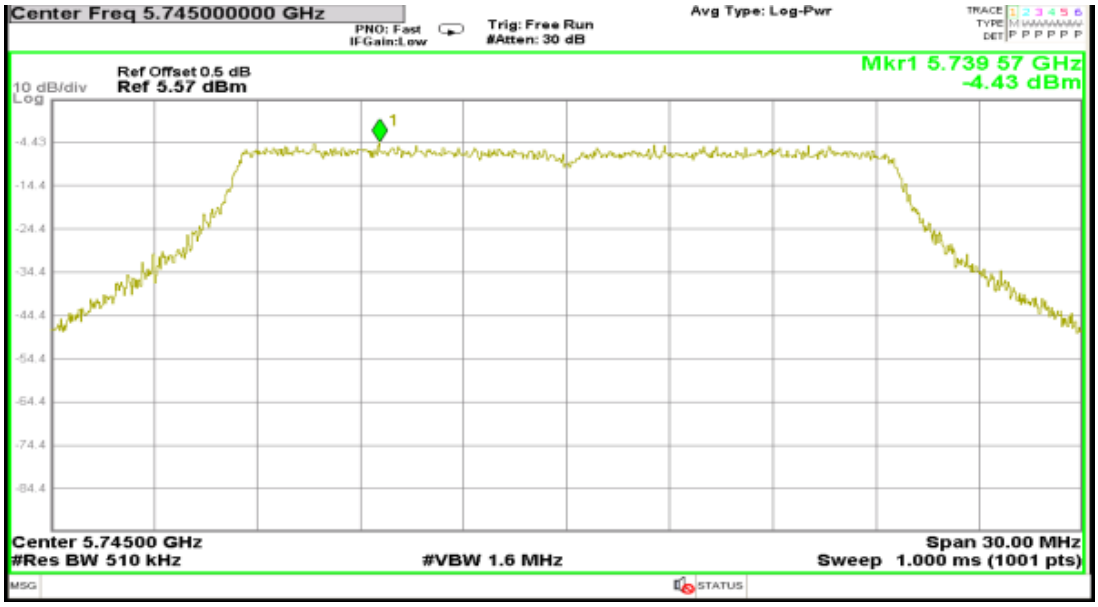


802.11ac80

Channel: 155

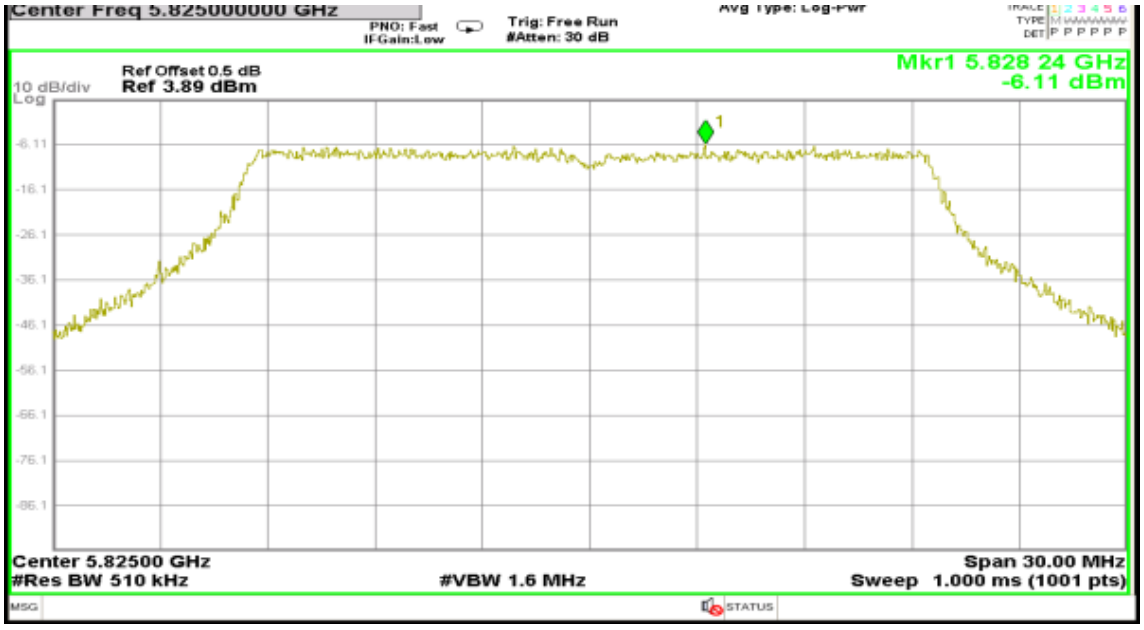
802.11ax20

Channel: 149



Channel: 157

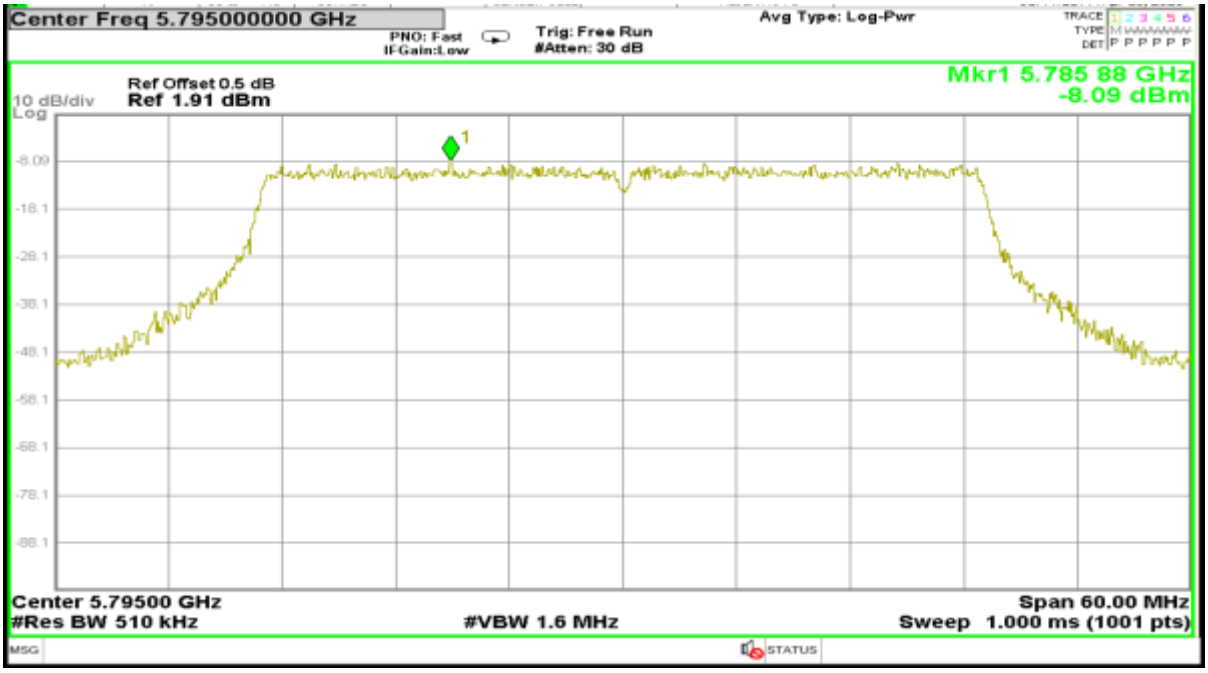
Channel: 165



802.11ax40

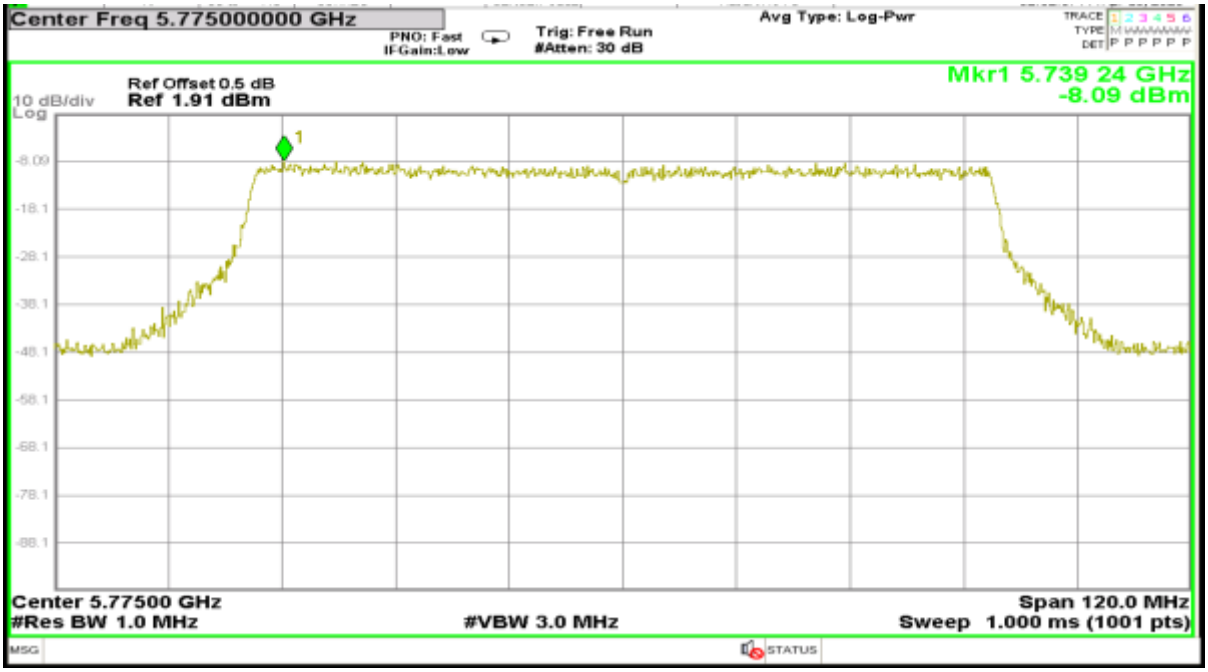
Channel: 151

Channel: 159



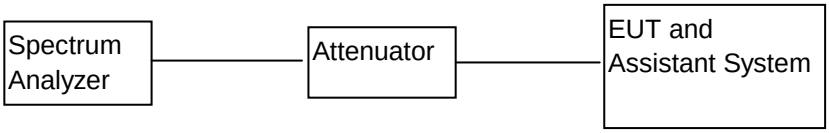
802.11ax80

Channel: 155



5. 26 dB & 99% Emission Bandwidth

5.1. BLOCK DIAGRAM OF TEST SETUP



5.2. APPLIED PROCEDURES / LIMIT

The maximum power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements in the 5.725-5.85 GHz band are made over a reference bandwidth of 500 kHz or the 26 dB emission bandwidth of the device, whichever is less. Measurements in the 5.15-5.25 GHz, 5.25-5.35 GHz, and the 5.47-5.725 GHz bands are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full reference bandwidth.

5.3. TEST PROCEDURE

a) Set RBW = approximately 1% of the emission bandwidth.

b) Set the VBW > RBW.

c) Detector = Peak.

d) Trace mode = max hold.

e) 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%.

The following procedure shall be used for measuring (99 %) power bandwidth:

1. Set center frequency to the nominal EUT channel center frequency.
2. Set span = 1.5 times to 5.0 times the OBW.
3. Set RBW = 1 % to 5 % of the OBW
4. Set VBW ≥ 3 · RBW
5. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
6. Use the 99 % power bandwidth function of the instrument (if available).
7. If the instrument does not have a 99 % power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5 % of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies.

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5.4. TEST RESULT

CH. No.	Frequency (MHz)	26dB Occupied Bandwidth (MHz)				99% Occupied Bandwidth (MHz)			
		802.11a	802.11n (HT20)	802.11ac (VHT20)	802.11ax (HE20)	802.11a	802.11n (HT20)	802.11ac (VHT20)	802.11ax (HE20)
36	5180.00	19.170	19.950	21.390	21.720	16.501	17.609	17.749	19.044
40	5200.00	20.010	20.100	21.270	22.050	16.518	17.620	17.746	19.039
48	5240.00	19.710	20.040	21.300	22.500	16.513	17.636	17.769	19.045
CH. No.	Frequency (MHz)	6dB Occupied Bandwidth (MHz)				99% Occupied Bandwidth (MHz)			
		802.11a	802.11n (HT20)	802.11ac (VHT20)	802.11ax (HE20)	802.11a	802.11n (HT20)	802.11ac (VHT20)	802.11ax (HE20)
149	5745.00	16.560	17.730	17.820	19.200	16.503	17.619	17.767	19.029
157	5785.00	16.530	17.700	17.880	19.200	16.503	17.628	17.765	19.070
165	5825.00	16.530	17.820	17.850	19.170	16.498	17.649	17.748	19.053

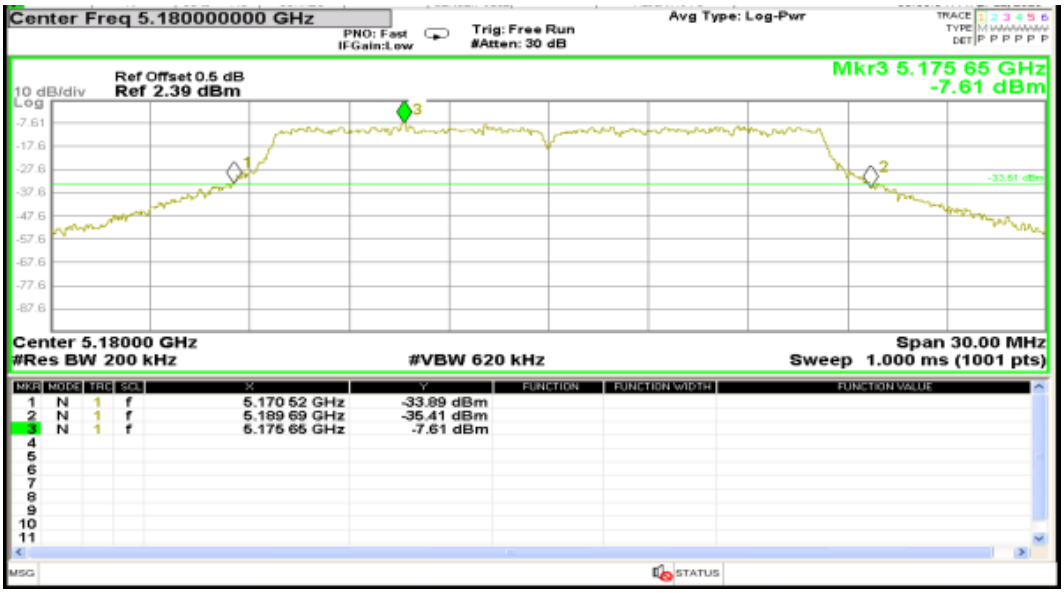
CH. No.	Frequency (MHz)	26dB Occupied Bandwidth (MHz)			99% Occupied Bandwidth (MHz)		
		802.11 n (HT40)	802.11ac (VHT40)	802.11ax (HE40)	802.11n (HT40)	802.11ac (VHT40)	802.11ax (HE40)
38	5190.00	39.660	42.420	42.900	36.166	36.441	37.952
46	5230.00	39.960	42.840	43.560	36.188	36.452	38.028
CH. No.	Frequency (MHz)	6dB Occupied Bandwidth (MHz)			99% Occupied Bandwidth (MHz)		
		802.11 n (HT40)	802.11ac (VHT40)	802.11ax (HE40)	802.11n (HT40)	802.11ac (VHT40)	802.11ax (HE40)
151	5755.00	36.540	36.600	38.400	36.140	36.429	37.983
159	5795.00	36.540	36.600	38.340	36.165	36.405	37.995

CH. No.	Frequency (MHz)	26dB Occupied Bandwidth (MHz)		99% Occupied Bandwidth (MHz)	
		802.11ac (VHT80)	802.11ax (HE80)	802.11ac (VHT80)	802.11ax (HE80)
42	5210.00	86.640	87.120	76.153	77.709
CH. No.	Frequency (MHz)	6dB Occupied Bandwidth (MHz)		99% Occupied Bandwidth (MHz)	
		802.11ac (VHT80)	802.11ax (HE80)	802.11ac (VHT80)	802.11ax (HE80)
155	5775.00	76.800	78.360	76.173	77.755

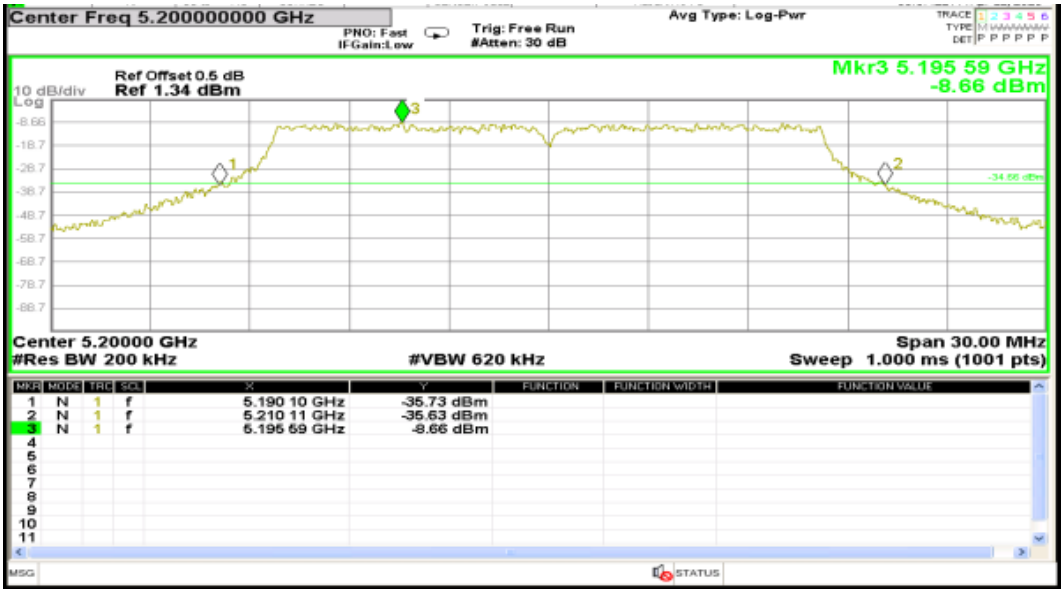
Test plots as followed:

26dB BW 802.11a

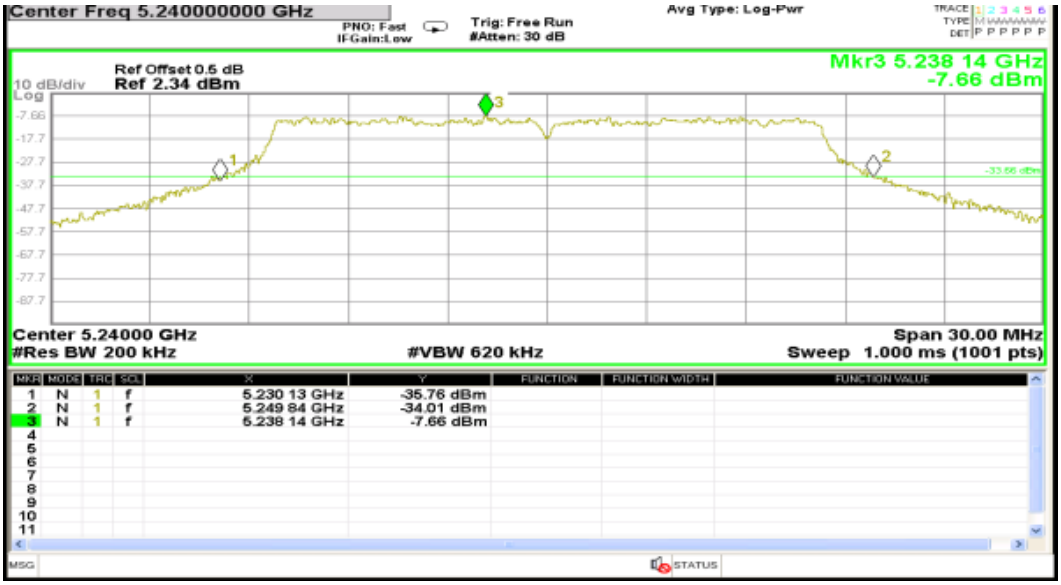
Channel: 36



Channel: 40



Channel: 48



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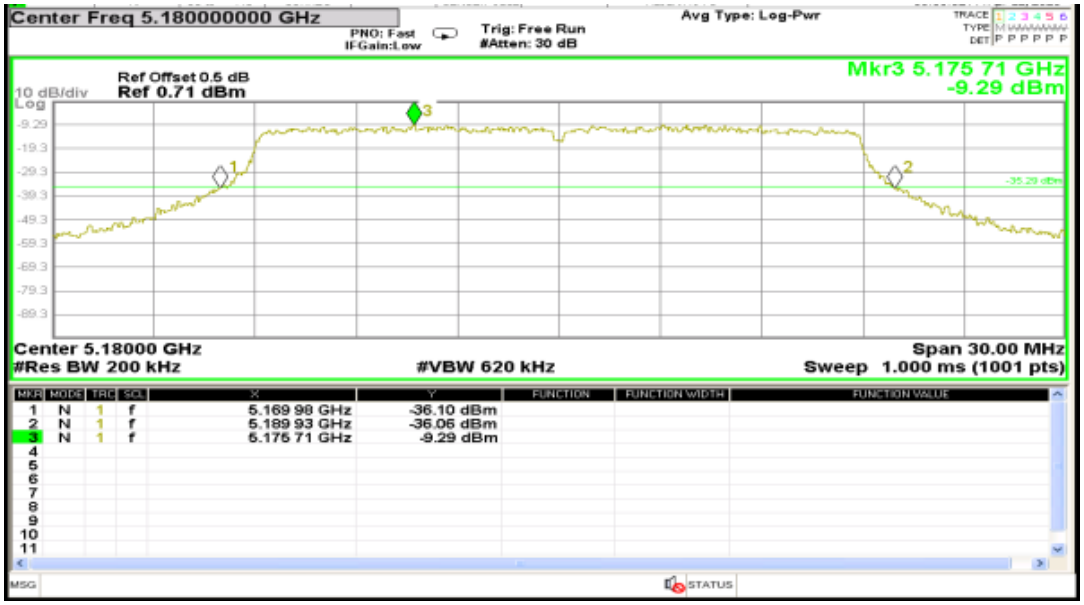
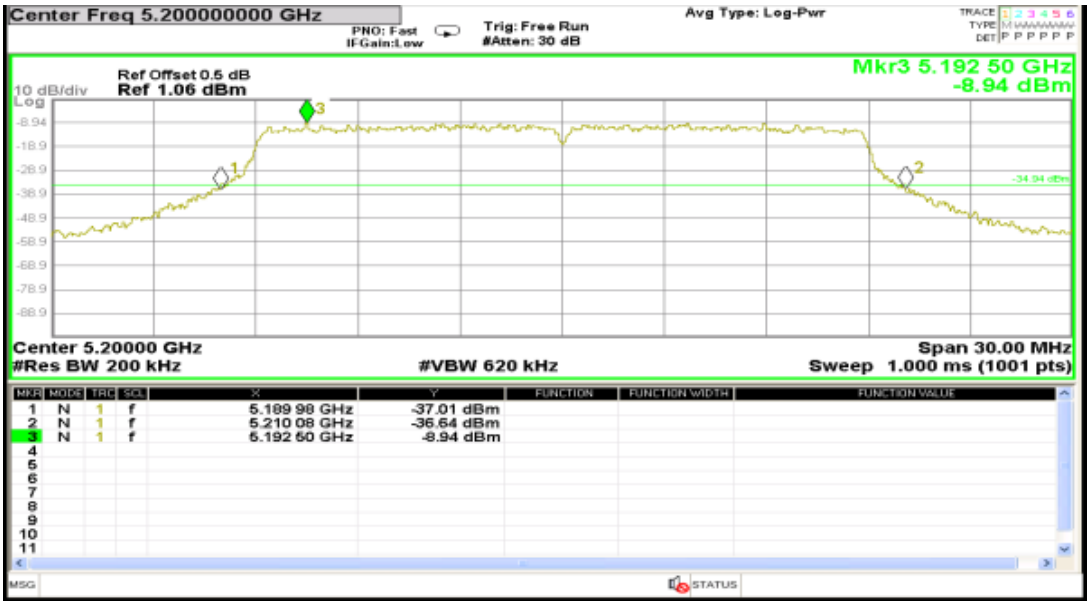
26dB BW 802.11n20

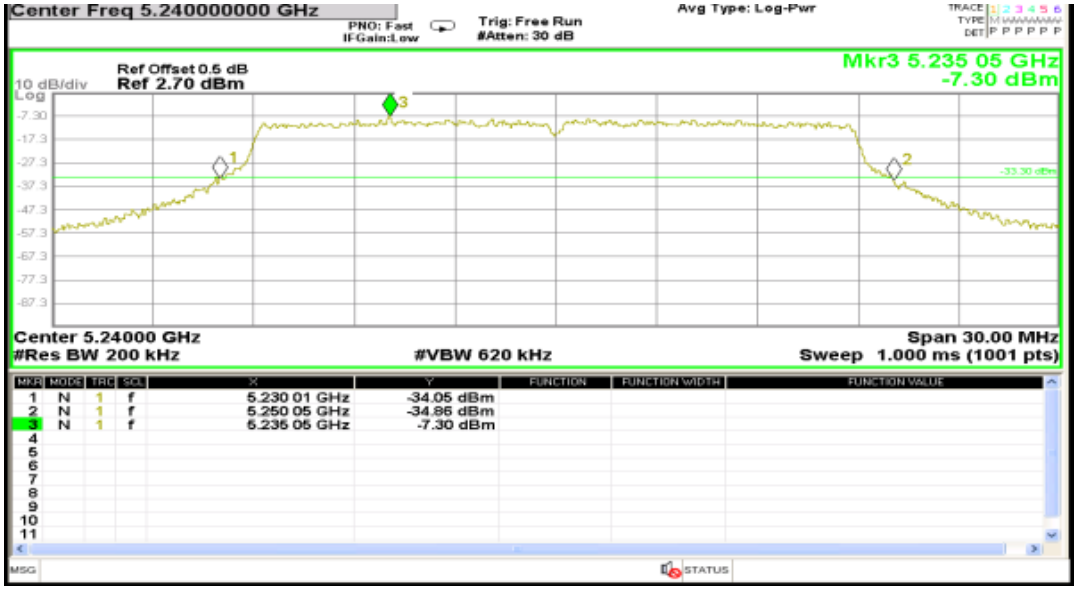
Channel: 36



Channel: 40



Channel: 48



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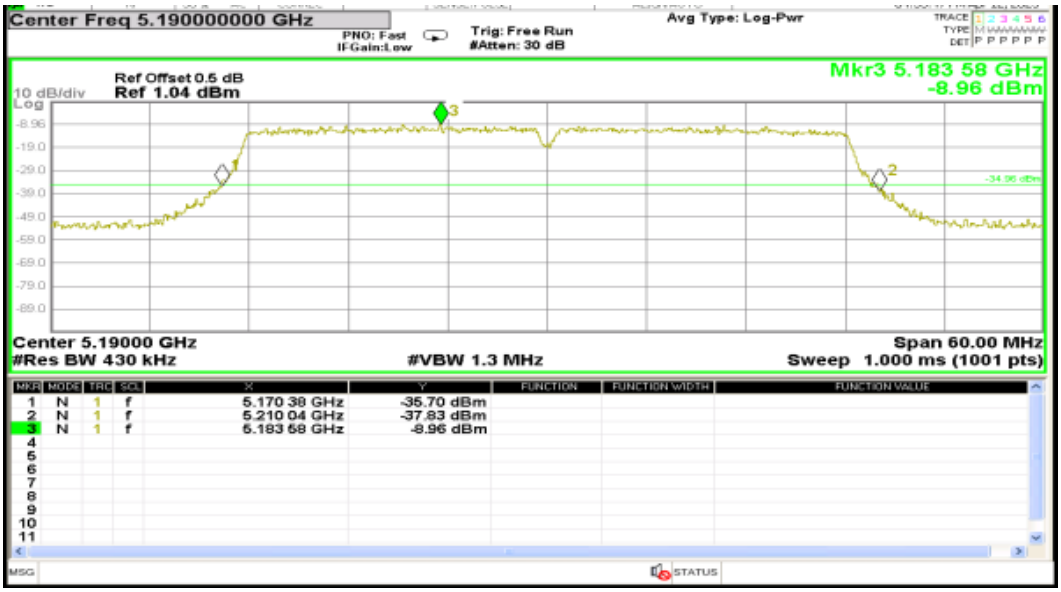
26dB BW 802.11n40

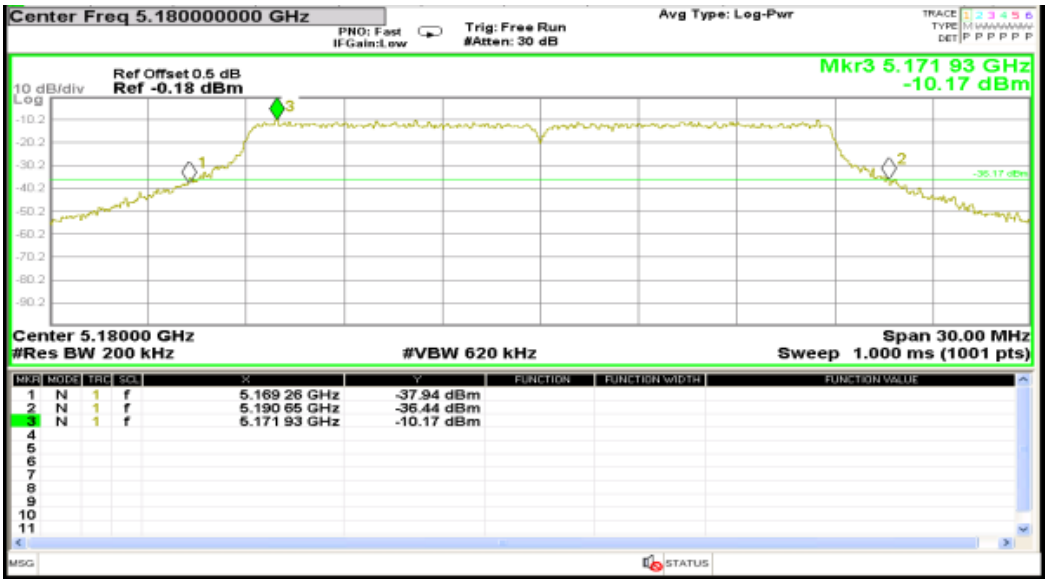
Channel: 38



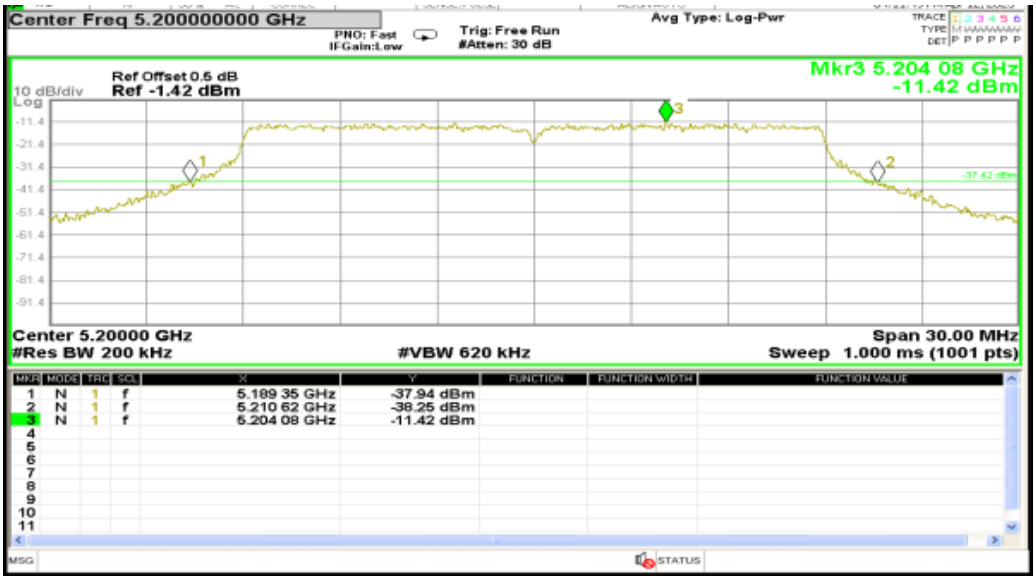
Channel: 46

26dB BW 802.11ac20

Channel: 36



Channel: 40



Channel: 48

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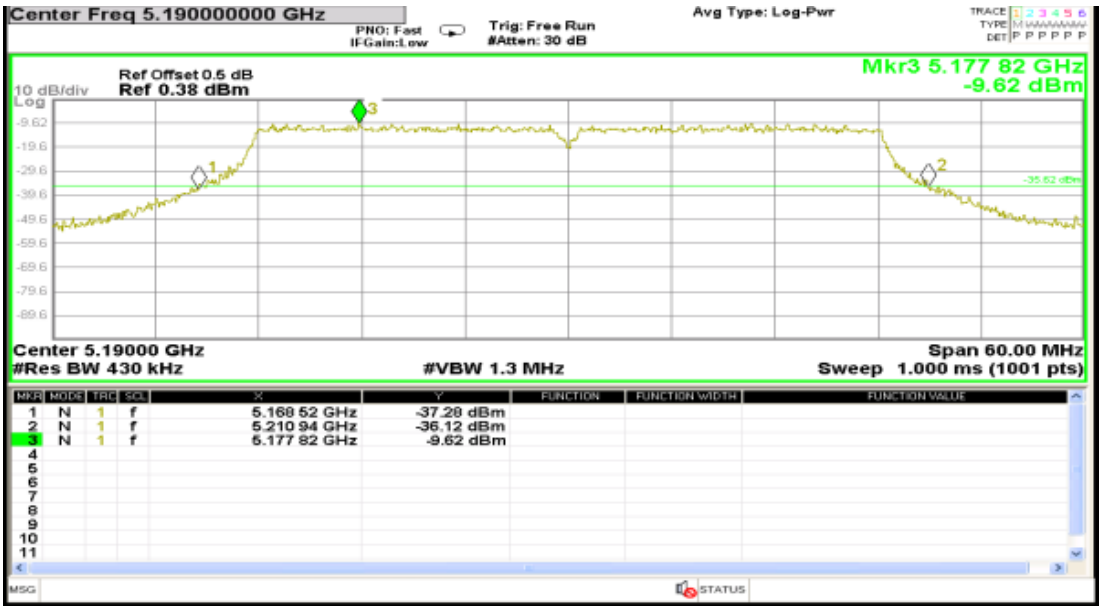
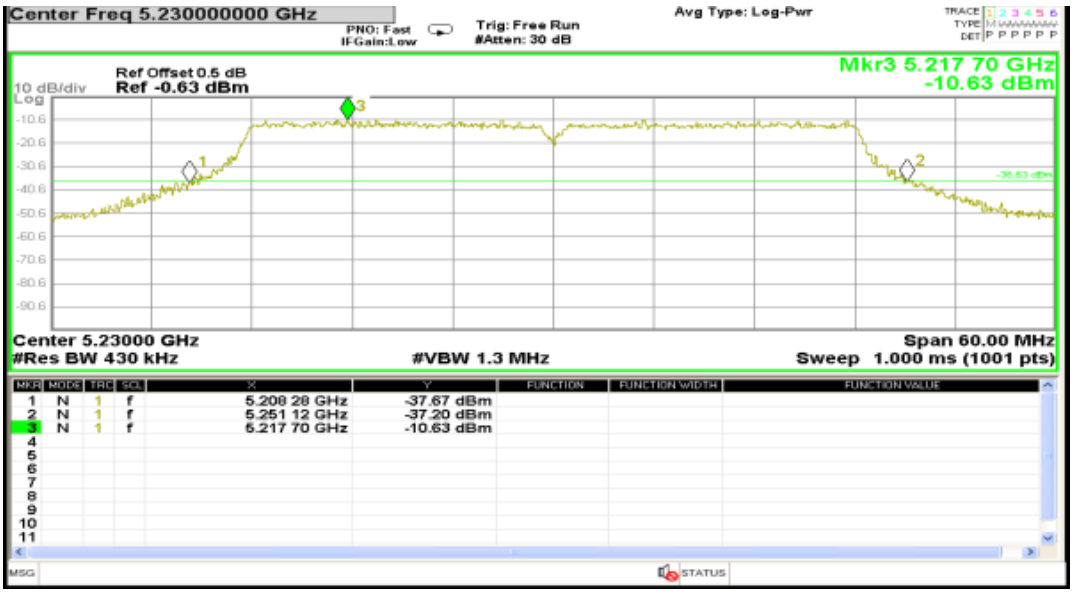
26dB BW 802.11ac40

Channel: 38



Channel: 46



26dB BW 802.11ac80
Channel: 42

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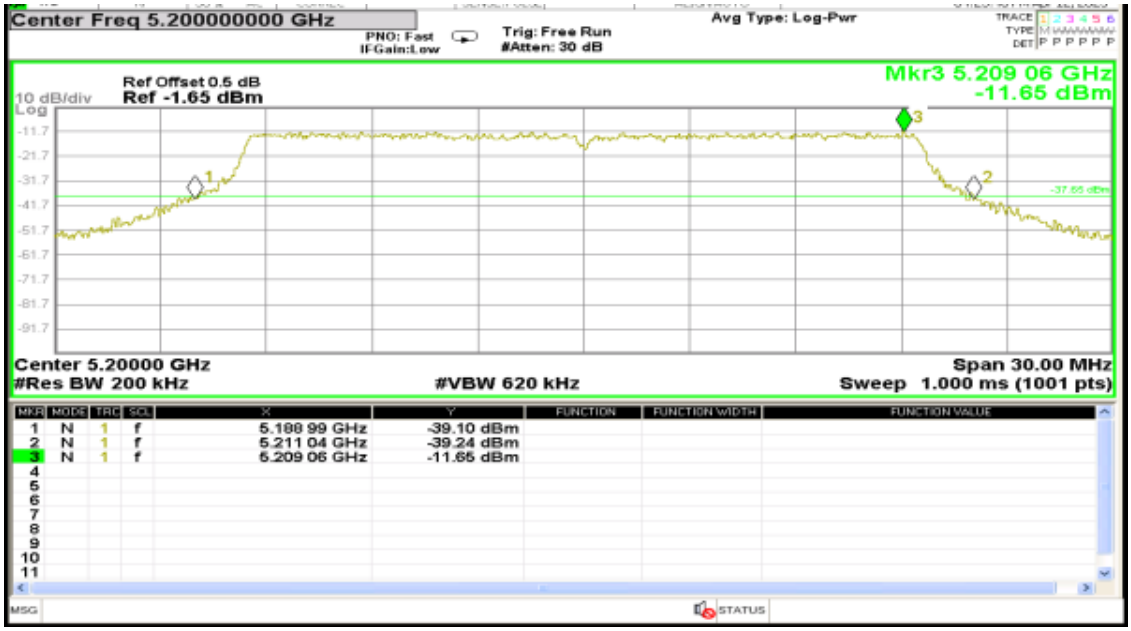
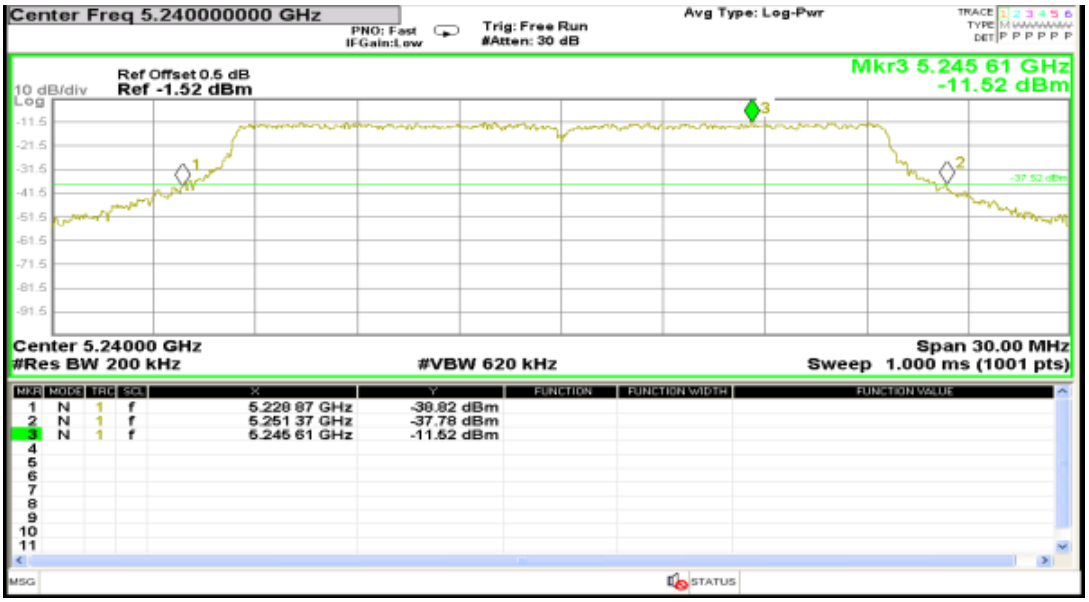
26dB BW 802.11ax20

Channel: 36

Channel: 40



Channel: 48



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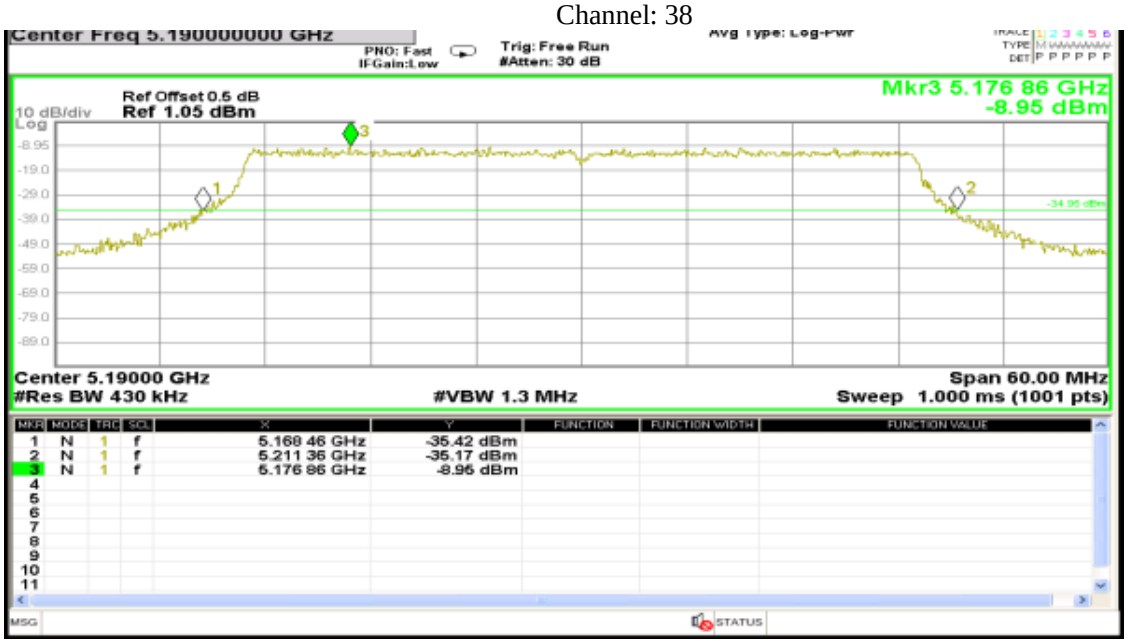
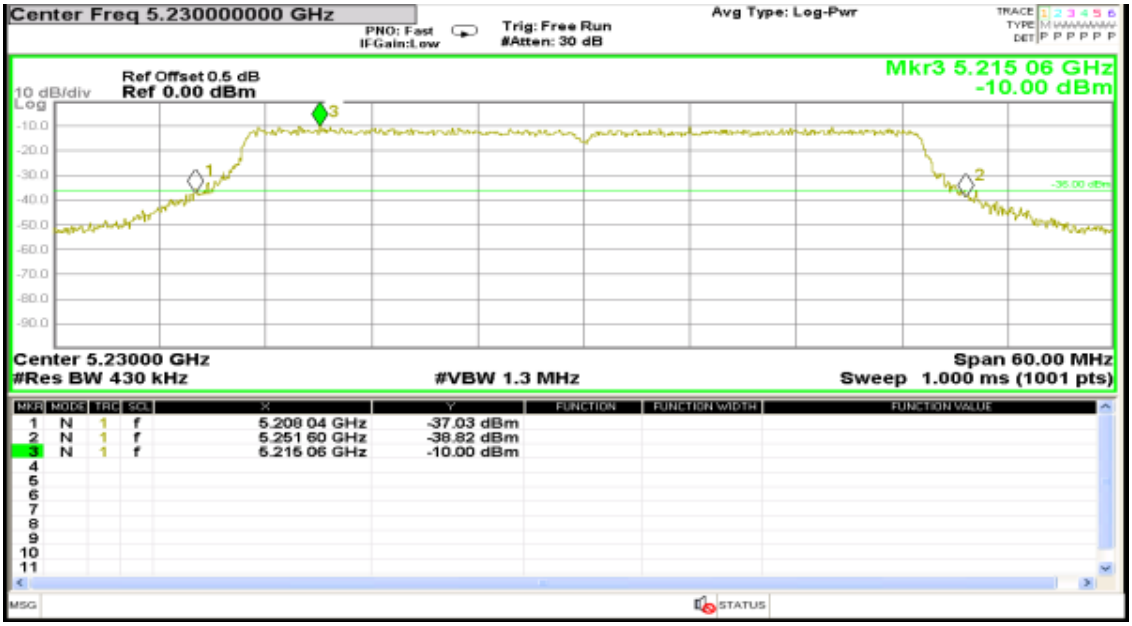
26dB BW 802.11ax40

Channel: 38



Channel: 46