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FCC UNII REPORT

Certification

Applicant Name:
SAMSUNG Electronics Co., Ltd.

Address:
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Suwon-si, Gyeonggi-do, 16677, Rep. of Korea

Date of Issue:
December 26, 2018
Location:
HCT CO., LTD.,
74, Seoicheon-ro 578beon-gil, Majang-myeon,
Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
Report No.: HCT-RF-1812-FC031

FCC ID:	**A3LSMG887N**
APPLICANT:	**SAMSUNG Electronics Co., Ltd.**

Model:	SM-G887N
EUT Type:	Mobile Phone
Modulation type	OFDM
FCC Classification:	Unlicensed National Information Infrastructure(UNII)
FCC Rule Part(s):	Part 15.407

Engineering Statement:

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

HCT CO., LTD. Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998,21 U.S. C.853(a)

Report prepared by : Jung Ki Lim
Engineer of Telecommunication testing center

Approved by : Jong Seok Lee
Manager of Telecommunication testing center

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-1812-FC031	December 26, 2018	- First Approval Report

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1. GENERAL INFORMATION

EUT DESCRIPTION

Model	SM-G887N	
EUT Type	Mobile Phone	
Power Supply	DC 3.85 V	
Battery Information	Model: EB-BA750ABU Type: Li-ion Battery	
Travel Adapter Information	Model: EP-TA20KWK Manufacture: DONGYANG E&P	
Modulation Type	OFDM : 802.11a, 802.11n, 802.11ac	
Frequency Range (MHz)	UNII 1	20MHz BW : 5180 - 5240 40MHz BW : 5190 - 5230 80MHz BW : 5210
	UNII 2A	20MHz BW : 5260 - 5320 40MHz BW : 5270 - 5310 80MHz BW : 5290
	UNII 2C	20MHz BW : 5500 - 5720 40MHz BW : 5510 - 5710 80MHz BW : 5530 – 5690
	UNII 3	20MHz BW : 5745 - 5825 40MHz BW : 5755 - 5795 80MHz BW : 5775
Antenna	Ant 1 : BT/WLAN antenna / Ant 2: WLAN 2nd antenna	
Antenna Specification	Type : [Ant 1] Metal Frame Antenna Peak Gain : -0.99 dBi Type : [Ant 2] FPCB Peak Gain : -0.42 dBi	
TDWR Band	Supported	
Dynamic Frequency Selection	Slave without radar detection	
Date(s) of Tests	November 28, 2018 ~ December 19, 2018	

ANTENNA CONFIGURATIONS

1. The device employs MIMO technology. Below are the possible configurations

Configurations	SISO		SDM	CDD
	Ant1	Ant2	Ant1 + Ant2	Ant1 + Ant2
802.11a	O	O	X	O
802.11n	O	O	O	O
802.11ac	O	O	O	O

Note:

1. O = Support, X = Not Support
2. SISO = Single Input Single Output
3. SDM = Spatial Diversity Multiplexing
4. CDD = Cyclic Delay Diversity

2. This device supports simultaneous transmission operation, which allows for two SISO channels to operate independent of one another in the 2.4GHz and 5GHz bands simultaneously on each antenna.

Frequency	Supported
2.4 GHz Ant 1 + 5 GHz Ant 2	O
2.4 GHz Ant 2 + 5 GHz Ant 1	X
2.4 GHz Ant 1 + 5 GHz Ant 1	X
2.4 GHz Ant 2 + 5 GHz Ant 2	X

2. MAXIMUM OUTPUT POWER

The transmitter has a maximum total conducted average output power as follows:

Band	Mode	Ant1 Power (dBm)	Ant2 Power (dBm)	Ant1+ Ant2 Power (dBm)	Ant1+ Ant2 Power (W)
UNII1	802.11a	12.680	12.410	15.419	0.035
	802.11n (HT20)	12.502	12.222	15.262	0.034
	802.11n (HT40)	11.573	11.023	14.313	0.027
	802.11ac (VHT20)	10.447	10.017	13.072	0.020
	802.11ac (VHT40)	11.443	11.203	14.334	0.027
	802.11ac (VHT80)	9.251	9.371	12.321	0.017
UNII2A	802.11a	13.480	11.930	15.750	0.038
	802.11n (HT20)	12.742	11.692	15.244	0.033
	802.11n (HT40)	11.993	10.633	14.350	0.027
	802.11ac (VHT20)	11.297	9.727	13.558	0.023
	802.11ac (VHT40)	11.793	10.923	14.379	0.027
	802.11ac (VHT80)	11.811	11.081	14.464	0.028
UNII2C	802.11a	13.200	12.830	15.543	0.036
	802.11n (HT20)	12.982	12.672	15.376	0.034
	802.11n (HT40)	10.643	11.413	13.752	0.024
	802.11ac (VHT20)	10.977	10.657	13.344	0.022
	802.11ac (VHT40)	10.383	11.373	13.711	0.024
	802.11ac (VHT80)	10.951	11.421	14.199	0.026
UNII3	802.11a	12.110	13.990	16.111	0.041
	802.11n (HT20)	11.042	12.982	15.077	0.032
	802.11n (HT40)	10.223	11.583	13.940	0.025
	802.11ac (VHT20)	9.997	11.987	14.060	0.025
	802.11ac (VHT40)	10.123	11.523	13.861	0.024
	802.11ac (VHT80)	9.571	10.821	13.229	0.021

3. TEST METHODOLOGY

The measurement procedure described in FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01 dated December 14, 2017 entitled “Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part15, Subpart E” and ANSI C63.10(Version : 2013) ‘the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices’ were used in the measurement.

EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.407 under the FCC Rules Part 15 Subpart E.

GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1GHz. Above 1GHz with 1.5m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3.75 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 8 of ANSI C63.10. (Version: 2013)

Conducted Antenna Terminal

See Section from 8.1 to 8.4.(KDB 789033 D02 v02r01)

DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment's, which is traceable to recognized national standards.

Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.

Detailed description of test facility was submitted to the Commission and accepted dated April 02, 2018 (Registration Number: KR0032).

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

6. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203, §15.407:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

* The antennas of this E.U.T are permanently attached.

* The E.U.T Complies with the requirement of §15.203, §15.407

7. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95 % level of confidence.

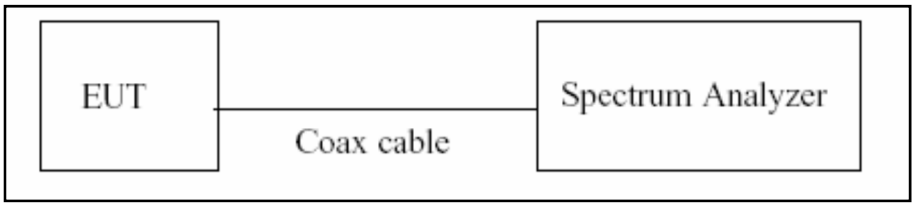
The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (±dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.82
Radiated Disturbance (9 kHz ~ 30 MHz)	3.40
Radiated Disturbance (30 MHz ~ 1 GHz)	4.80
Radiated Disturbance (1 GHz ~ 18 GHz)	5.70
Radiated Disturbance (18 GHz ~ 40 GHz)	5.71

8. DESCRIPTION OF TESTS

8.1. Duty Cycle

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

We tested according to Procedure B.2 in KDB 789033 D02 v02r01.

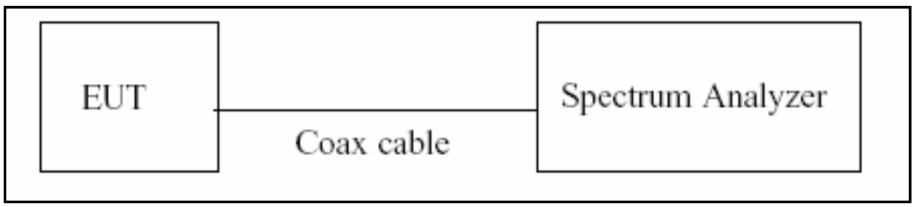
1. RBW = 8 MHz (the largest availble value)
2. VBW = 8 MHz (≥ RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure T_{total} and T_{on}
8. Calculate Duty Cycle = T_{on}/ T_{total} and Duty Cycle Factor = 10*log(1/Duty Cycle)

8.2. Bandwidth Measurement

Limit

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

Test Configuration



Test Procedure(26dB Bandwidth)

The transmitter output is connected to the Spectrum Analyzer.

We tested according to Procedure C.1 in KDB 789033 D02 v02r01.

1. RBW = approximately 1 % of the emission bandwidth
2. VBW > RBW
3. Detector = Peak
4. Trace mode = max hold
5. 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 %.

Test Procedure(6dB Bandwidth)

The transmitter output is connected to the Spectrum Analyzer.

We tested according to Procedure C.2 in KDB 789033 D02 v02r01.

1. RBW = 100 kHz
2. VBW ≥ 3*RBW
3. Detector = Peak
4. Trace mode = max hold
5. Allow the trace to stabilize
6. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points(upper and lower frequencies) that are attenuated by 6 dB relative to the maximum lever measured in the fundamental emission.

Note:

1. We tested X dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer.
2. DFS test channels should be defined. So, We performed the OBW test to prove that no part of the fundamental emissions of any channels belong to UNII1 and UNII3 band for DFS.
3. The 26 dB bandwidth is used to determine the conducted power limits.

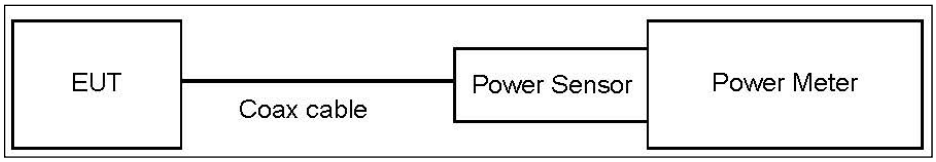
8.3. Output Power Measurement

Limit

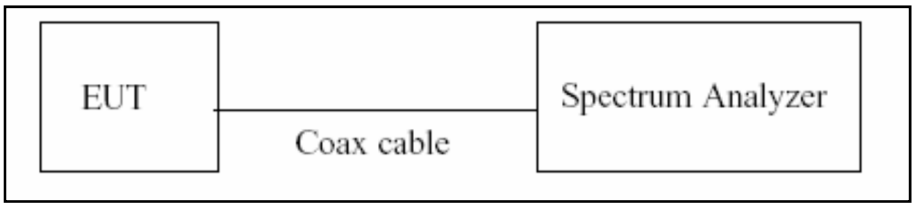
Band	Limit
UNII 1	- Master : Not exceed 1 W(=30dBm) - Slave : Not exceed 250 mW(=23.98 dBm)
UNII 2A, 2C	Not exceed the lesser of 250 mW or 11 dBm + 10 log B, (where B is the 26 dB emission bandwidth in megahertz.)
UNII 3	Not exceed 1 W(=30dBm)

Test Configuration

Power Meter(BW : 20MHz)



Spectrum Analyzer(BW : 40MHz, 80MHz)



Test Procedure(Power Meter)

We tested according to Procedure E.3.a in KDB 789033 D02 v02r01.

1. Measure the duty cycle.
2. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
3. Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

Test Procedure(Spectrum Analyzer)

The transmitter output is connected to the Spectrum Analyzer.

We use the spectrum analyzer's integrated band power measurement function.

We tested according to Procedure E.2.d) in KDB 789033 D02 v02r01.

1. Measure the duty cycle.
2. Set span to encompass the 26 dB EBW of the signal.
3. RBW = 1 MHz.
4. VBW ≥ 3 MHz.
5. Number of points in sweep ≥ 2*span/RBW.
6. Sweep time = auto.
7. Detector = RMS.
8. Do not use sweep triggering. Allow the sweep to "free run".
9. Trace average at least 100 traces in power averaging(RMS) mode
10. Integrated bandwidth = OBW
11. Add 10log(1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

Sample Calculation

Total Power(dBm) = Reading Value(dBm) + ATT loss(dB) + Cable loss(dB) + Duty Cycle Factor(dB)

Note

1. Spectrum reading values are not plot data.
   The power results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Spectrum offset = Attenuator loss + Cable loss
3. Actual value of loss for the attenuator and cable combination is below table.

Band	Loss(dB)
UNII 1	11.66
UNII 2A	11.66
UNII 2C	11.66
UNII 3	11.66

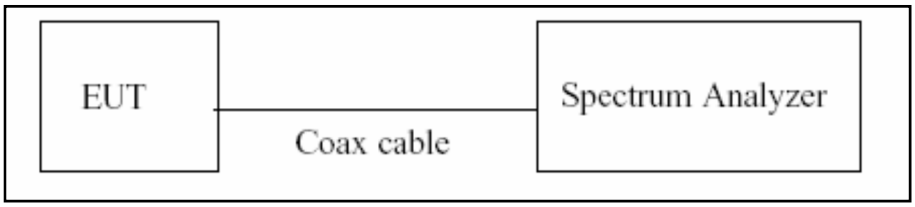
(Actual value of loss for the attenuator and cable combination)

8.4. Power Spectral Density

Limit

Band	Limit
UNII 1	11 dBm/MHz
UNII 2A, 2C	11 dBm/MHz
UNII 3	30 dBm/500 kHz

Test Configuration



Test Procedure

We tested according to Procedure F in KDB 789033 D02 v02r01.

1. Set span to encompass the entire emission bandwidth(EBW) of the signal.
2. RBW = 1 MHz(510 kHz for UNII 3)
3. VBW ≥ 3 MHz
4. Number of points in sweep ≥ 2*span/RBW.
5. Sweep time = auto.
6. Detector = RMS(i.e., power averaging), if available. Otherwise, use sample detector mode.
7. Do not use sweep triggering. Allow the sweep to “free run”.
8. Trace average at least 100 traces in power averaging(RMS) mode
9. Use the peak search function on the spectrum analyzer to find the peak of the spectrum.
10. If Method SA-2 was used, add 10 log(1/x), where x is the duty cycle, to the peak of the spectrum.

Sample Calculation

Total PSD(dBm) = Reading Value(dBm) + ATT loss(dB) + Cable loss(dB) + Duty Cycle Factor(dB)

Note

1. Spectrum reading values are not plot data.
   The PSD results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Spectrum offset = Attenuator loss + Cable loss
3. Actual value of loss for the attenuator and cable combination is below table.

Band	Loss(dB)
UNII 1	11.66
UNII 2A	11.66
UNII 2C	11.66
UNII 3	11.66

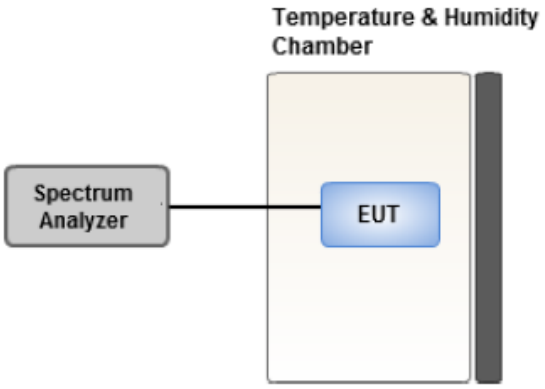
(Actual value of loss for the attenuator and cable combination)

8.5. Frequency Stability

Limit

Maintained within the band

Test Configuration



Test Procedure

1. The EUT was placed inside an environmental chamber as the temperature in the chamber was varied between -30 ℃ and 50 ℃.
2. The temperature was incremented by 10 ℃ intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded.
3. The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battety operating end point which shall be specified by the manufacturer.
4. While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.

8.6. AC Power line Conducted Emissions

Limit

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

*Decreases with the logarithm of the frequency.

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

Test Configuration

See test photographs attached in Annex A for the actual connections between EUT and support equipment.

Test Procedure

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors : Quasi Peak and Average Detector.

Sample Calculation

Quasi-peak(Final Result) = Reading Value + Correction Factor

8.7. Radiated Test

Limit

1. UNII 1: All emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of −27 dBm/MHz.

2. UNII 2A, 2C: All emissions outside of the 5.47-5.725 GHz band shall not exceed an EIRP of −27 dBm/MHz.

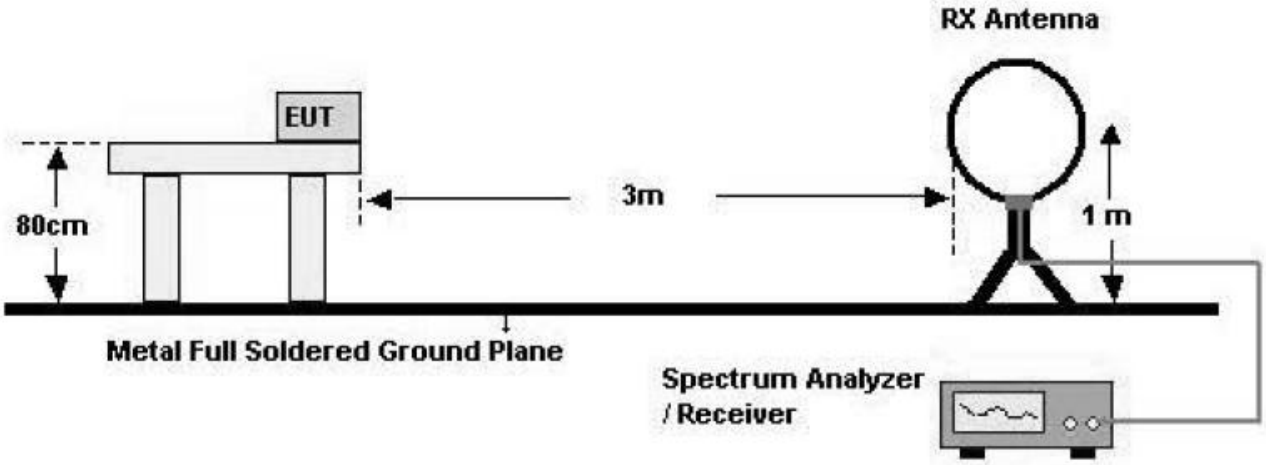
3. UNII 3: All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

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

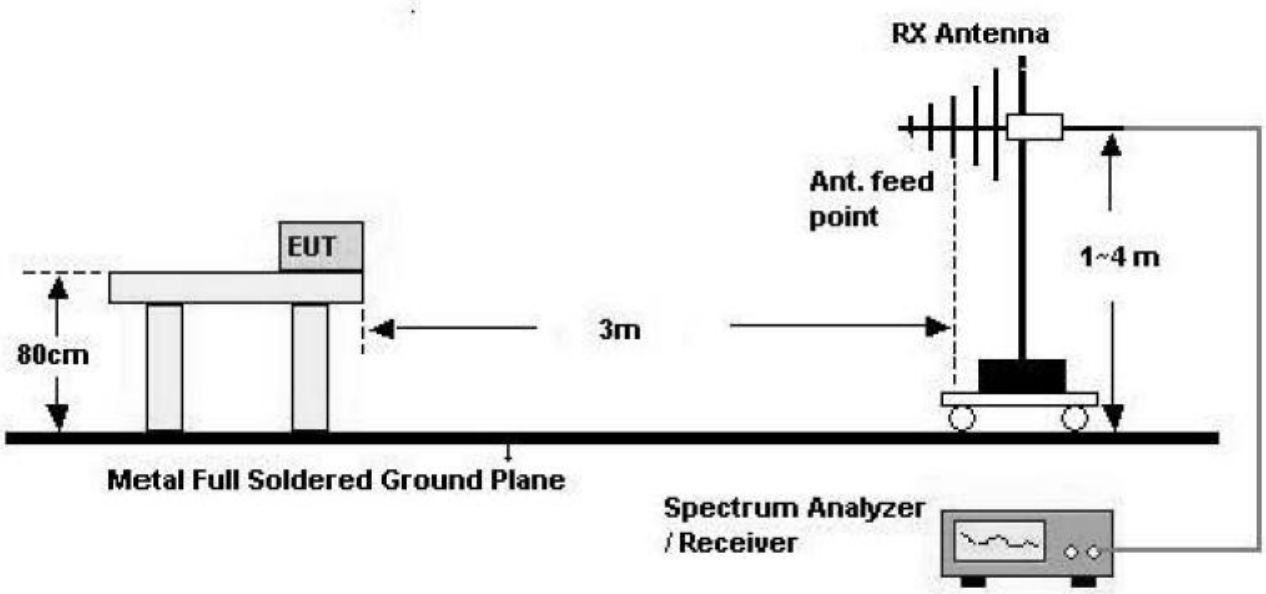
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

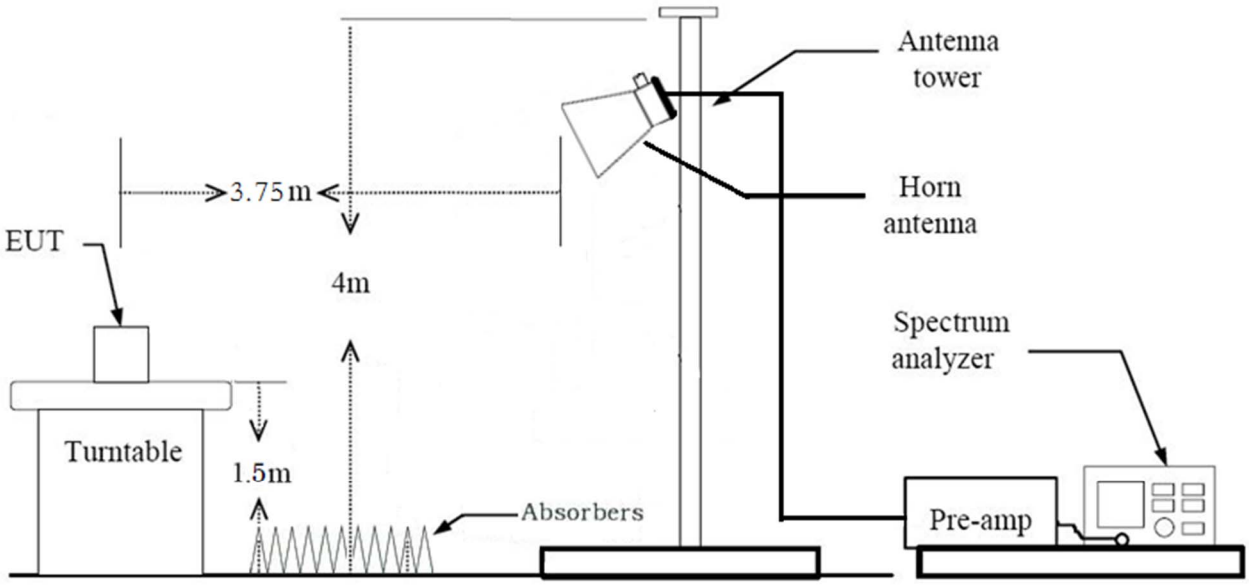
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz


Antenna tower
Horn antenna
3.75m
EUT
4m
Spectrum analyzer
Turntable
1.5m
Absorbers
Pre-amp

Test Procedure of Radiated spurious emissions (Above 1 GHz)

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3.75 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
5. According to SVSWR requirement in ANSI 63.4-2014, We performed the radiated test at 3.75 m distance from center of turn table. So, we applied the distance factor(reference distance : 3 m).
   *Distance extrapolation factor = 20*log (test distance / specific distance) (dB)
6. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
7. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
8. The unit was tested with its standard battery.
9. Spectrum Setting
   (1) Measurement Type(Peak, G.5 in KDB 789033 v02r01):
   - RBW = 1 MHz
   - VBW ≥ 3 MHz
   - Detector = Peak
   - Sweep Time = auto
   - Trace mode = max hold
   - Allow sweeps to continue until the trace stabilizes.
     Note that if the transmission is not continuous, the time required for the trace to stabilize will increase by a factor of approximately 1/x, where x is the duty cycle.

   (2) Measurement Type(Average, G.6.d in KDB 789033 v02r01):
   - RBW = 1 MHz
   - VBW(Duty cycle ≥ 98 percent) = VBW ≤ RBW/100(i.e., 10 kHz) but not less than 10 Hz.
   - VBW(Duty cycle is < 98 percent) = VBW ≥ 1/T, where T is the minimum transmission duration.
   - The analyzer is set to linear detector mode.
   - Detector = Peak.
   - Sweep time = auto.
   - Trace mode = max hold.
   - Allow max hold to run for at least 50 traces if the transmitted signal is continuous or has at least 98 percent duty cycle. For lower duty cycles, increase the minimym number of traces by a factor of 1/x, where x is the duty cycle.

10. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor

11. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency

12. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

Test Procedure of Radiated Restricted Band Edge

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3.75 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
5. According to SVSWR requirement in ANSI 63.4-2014, We performed the radiated test at 3.75 m distance from center of turn table. So, we applied the distance factor(reference distance : 3 m).
   *Distance extrapolation factor = 20*log (test distance / specific distance) (dB)
6. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
7. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
8. The unit was tested with its standard battery.
9. Spectrum Setting
   (1) Measurement Type(Peak, G.5 in KDB 789033 v02r01):
   - RBW = 1 MHz
   - VBW ≥ 3 MHz
   - Detector = Peak
   - Sweep Time = auto
   - Trace mode = max hold
   - Allow sweeps to continue until the trace stabilizes.
     Note that if the transmission is not continuous, the time required for the trace to stabilize will increase by a factor of approximately 1/x, where x is the duty cycle.

   (2) Measurement Type(Average, G.6.d in KDB 789033 v02r01):
   - RBW = 1 MHz
   - VBW(Duty cycle ≥ 98 percent) = VBW ≤ RBW/100(i.e., 10 kHz) but not less than 10 Hz.
   - VBW(Duty cycle is < 98 percent) = VBW ≥ 1/T, where T is the minimum transmission duration.
   - The analyzer is set to linear detector mode.
   - Detector = Peak.
   - Sweep time = auto.
   - Trace mode = max hold.
   - Allow max hold to run for at least 50 traces if the transmitted signal is continuous or has at least 98 percent duty cycle. For lower duty cycles, increase the minimym number of traces by a factor of 1/x, where x is the duty cycle.

10. Measured Frequency Range :

- 4500MHz ~ 5150MHz
- 5350MHz ~ 5460MHz
- 5460MHz ~ 5470MHz
- (75 MHz or more below the 5725MHz) ~ 5725MHz
- 5850MHz ~ (75 MHz or more above the 5850MHz)

11. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

The actual setting value of VBW

Mode	Worst Data rate (Mbps)	T_{on} (ms)	T_{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)	VBW(1/T) (Hz)	The actual setting value of VBW (Hz)
a	6	1.430	1.465	0.97643003	0.104	699	1000
802.11n(HT20)	MCS 0	1.340	1.380	0.97101449	0.128	746	1000
802.11ac(VHT20)	MCS 0	1.348	1.386	0.97257763	0.121	742	1000
802.11n(HT40)	MCS 0	0.664	0.700	0.94800000	0.232	1507	3000
802.11ac(VHT40)	MCS 0	0.672	0.708	0.94823970	0.231	1489	3000
802.11ac(VHT80)	MCS 0	0.333	0.368	0.90489130	0.434	3003	10000

8.8. Worst case configuration and mode

Radiated test

1. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone, Stand alone + external accessories(earphone, etc)
   - Worstcase : Stand alone

2. All configurations of antenna were investigated and the worst case configuration results are reported.
   - Mode : Ant1(SISO), Ant2(SISO), Ant1+Ant2(SDM), Ant1+Ant2(CDD)
   - Worstcase : Ant1+Ant2(CDD)

3. EUT Axis
   - Radiated Spurious Emissions : X
   - Radiated Restricted Band Edge : Y

4. All datarate of operation were investigated and the worst case datarate results are reported
   - 802.11a : 6Mbps
   - 802.11n : MCS0
   - 802.11ac : MCS0

Radiated test(RSDB)

1. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone, Stand alone + external accessories(earphone, etc)
   - Worstcase : Stand alone
2. EUT Axis
   - Radiated Spurious Emissions : X
3. The following tables show the worst case configurations determined during testing.

Description	2.4 GHz Emission	5 GHz Emission
Antenna	1	2
Channel	6	100
Data Rate	1Mbps	6Mbps
Mode	802.11b	802.11a

AC Power line Conducted Emissions

1. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone+Earphone+Travel Adapter, Stand alone+Travel Adapter
   - Worstcase : Stand alone+Travel Adapter

Conducted test

1. All datarate of operation were investigated and the worst case datarate results are reported
   - 802.11a : 18Mbps
   - 802.11n(HT20) : MCS2
   - 802.11ac(HT20) : MCS2
   - 802.11n(HT40) : MCS6
   - 802.11ac(HT40) : MCS1
   - 802.11ac(HT80) : MCS7

9. SUMMARY OF TEST RESULTS

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
26dB Bandwidth	§15.407 (for Power Measurement)	N/A	Conducted	PASS
6 dB Bandwidth	§15.407(e)	>500 kHz (5725-5850 MHz)		PASS
Maximum Conducted Output Power	§15.407(a)(1)	< 250 mW(5150-5250 MHz) < 250 mW or 11+10 log log $_{10}$ (BW) dBm (5250-5350 MHz) < 250 mW or 11+10 log log $_{10}$ (BW) dBm (5470-5725 MHz) <1 W(5725-5850 MHz)		PASS
Peak Power Spectral Density	§15.407(a)(1),(5)	<11 dBm/ MHz (5150-5250 MHz) <11 dBm/ MHz (5250-5350 MHz) <11 dBm/ MHz (5470-5725 MHz) <30 dBm/500 kHz(5725-5850 MHz)		PASS
Frequency Stability	§15.407(g) §2.1055	Maintained within the band		PASS
AC Conducted Emissions 150 kHz-30 MHz	15.207	<FCC 15.207 limits		PASS
Undesirable Emissions	§15.407(b)	<-27 dBm/MHz EIRP (UNII1, 2A, 2C) cf. Section 8.7 (UNII 3)	Radiated	PASS
General Field Strength Limits(Restricted Bands and Radiated Emission Limits)	15.205, 15.407(b)(5), (6)	Emissions in restricted bands must meet the radiated limits detailed in 15.209		PASS

10. TEST RESULT

10.1 DUTY CYCLE

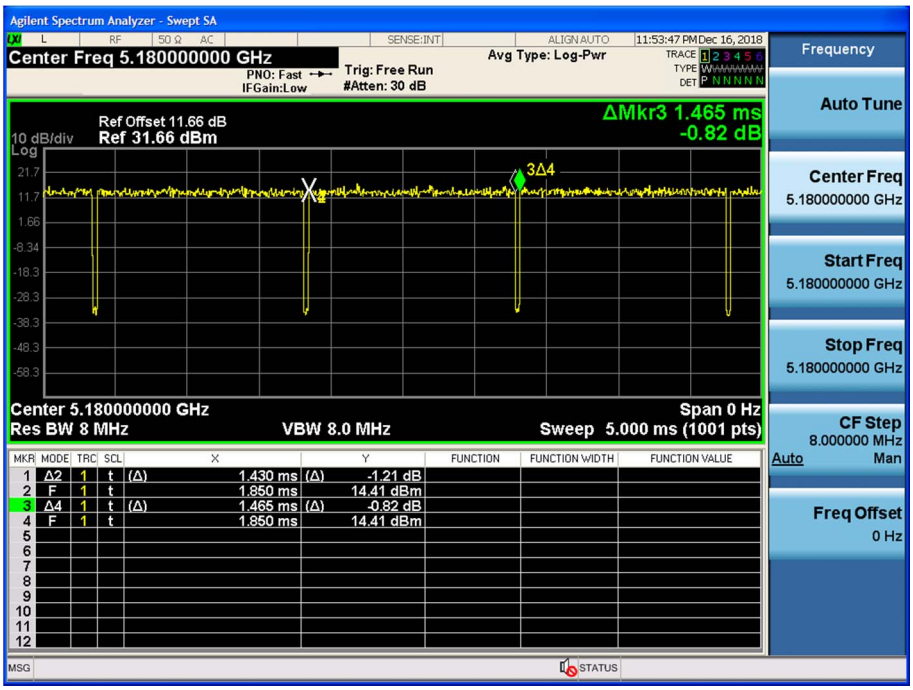
Mode	Data Rate (Mbps)	T_{on} (ms)	T_{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11a	6	1.430	1.468	0.97643003	0.104
	9	0.961	0.998	0.96317863	0.163
	12	0.728	0.765	0.95121993	0.217
	18	0.492	0.529	0.93114758	0.310
	24	0.376	0.413	0.90985244	0.410
	36	0.256	0.293	0.87644803	0.573
	48	0.200	0.236	0.84745763	0.719
	54	0.180	0.216	0.83275281	0.795

Mode	MCS Index	T_{on} (ms)	T_{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11n(HT20)	0	1.340	1.380	0.97101449	0.128
	1	0.689	0.725	0.94980695	0.224
	2	0.472	0.509	0.92844041	0.322
	3	0.364	0.400	0.90909091	0.414
	4	0.256	0.292	0.87626564	0.574
	5	0.200	0.236	0.84745763	0.719
	6	0.184	0.220	0.83636364	0.776
	7	0.168	0.204	0.82352941	0.843
802.11n(HT40)	0	0.664	0.700	0.94800000	0.232
	1	0.352	0.388	0.90737318	0.422
	2	0.249	0.284	0.87378613	0.586
	3	0.196	0.232	0.84523789	0.730
	4	0.144	0.180	0.79847015	0.977
	5	0.116	0.152	0.76209563	1.180
	6	0.108	0.144	0.75106445	1.243
	7	0.100	0.136	0.73423232	1.342

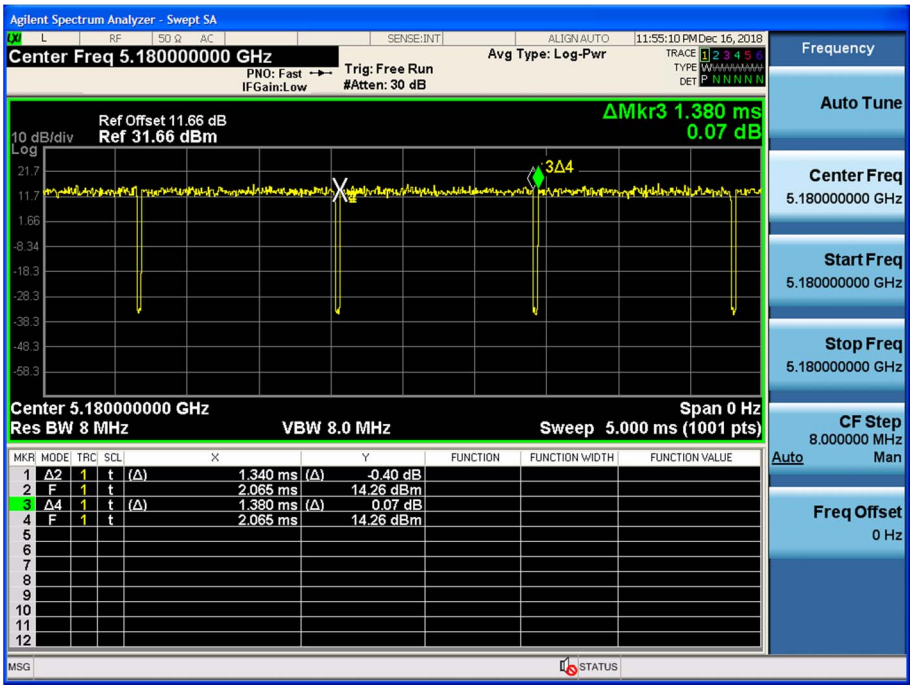
Mode	MCS Index	T_{on} (ms)	T_{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11ac(VHT20)	0	1.348	1.386	0.97257763	0.121
	1	0.695	0.733	0.94799100	0.232
	2	0.476	0.513	0.92736426	0.327
	3	0.368	0.405	0.91006417	0.409
	4	0.260	0.296	0.87782025	0.566
	5	0.204	0.240	0.84953796	0.708
	6	0.189	0.224	0.84375000	0.738
	7	0.172	0.208	0.82709413	0.824
	8	0.152	0.188	0.80867817	0.922
802.11ac(VHT40)	0	0.672	0.708	0.94823970	0.231
	1	0.356	0.392	0.90929281	0.413
	2	0.253	0.289	0.87547277	0.578
	3	0.200	0.236	0.84757633	0.718
	4	0.149	0.184	0.80670722	0.933
	5	0.120	0.156	0.76976915	1.136
	6	0.112	0.148	0.75735448	1.207
	7	0.104	0.140	0.74351932	1.287
	8	0.096	0.132	0.72727273	1.383
	9	0.088	0.124	0.70967742	1.489
802.11ac(VHT80)	0	0.333	0.368	0.90489130	0.434
	1	0.189	0.224	0.84132270	0.750
	2	0.141	0.176	0.79789554	0.981
	3	0.116	0.152	0.76585485	1.159
	4	0.092	0.128	0.72200908	1.415
	5	0.080	0.116	0.68965517	1.614
	6	0.076	0.112	0.67857143	1.684
	7	0.072	0.108	0.66666667	1.761
	8	0.068	0.104	0.65384615	1.845
	9	0.064	0.100	0.64000000	1.938

▣ Test Plots

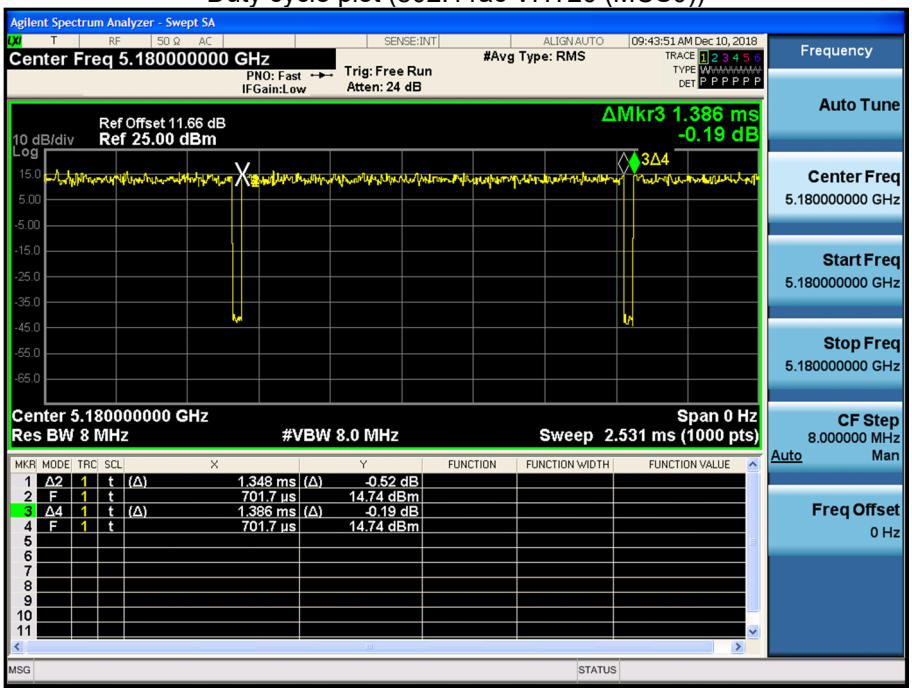
Duty cycle plot (802.11a(6Mbps))



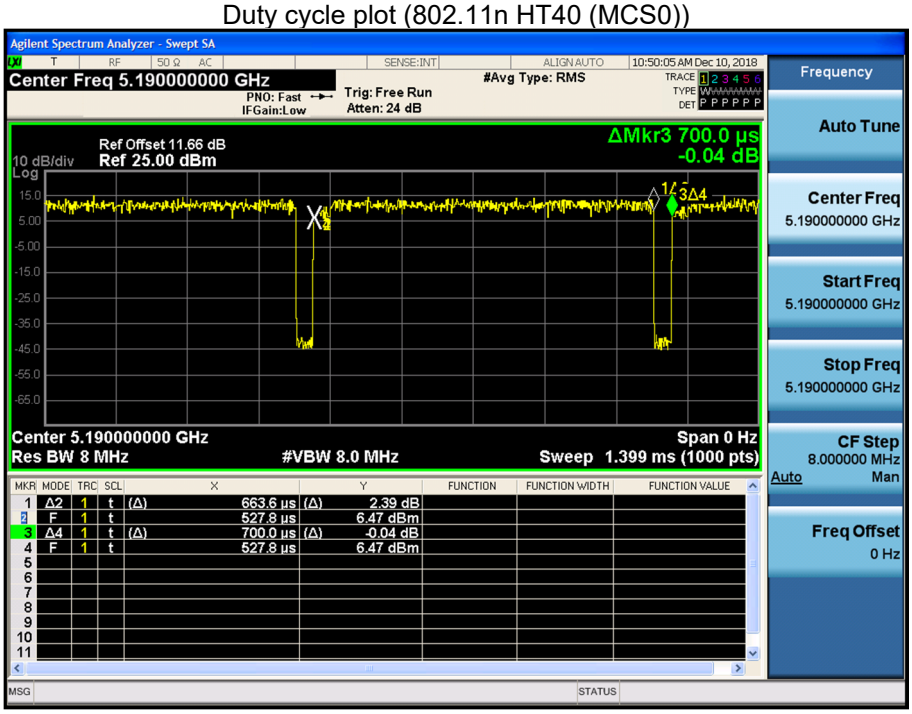
Duty cycle plot (802.11n HT20 (MCS0))



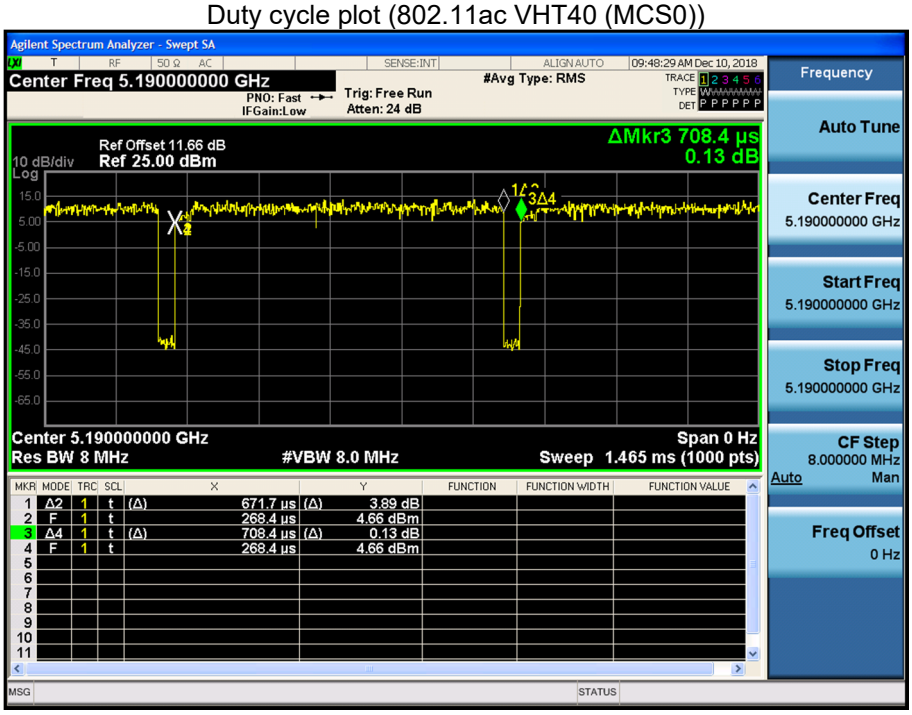
Duty cycle plot (802.11ac VHT20 (MCS0))



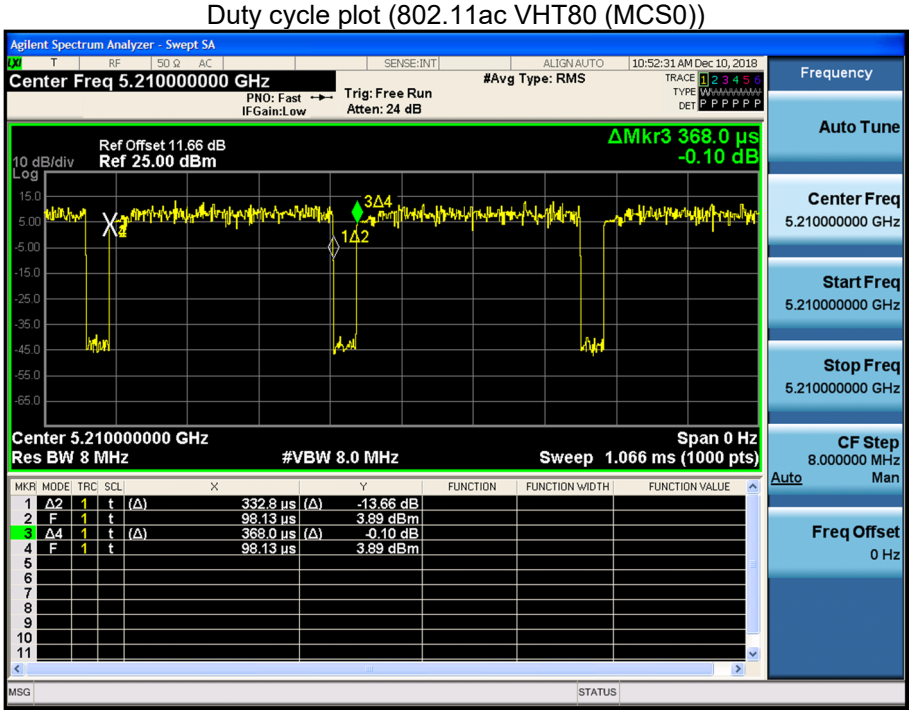
Duty cycle plot (802.11n HT40 (MCS0))



Duty cycle plot (802.11ac VHT40 (MCS0))



Duty cycle plot (802.11ac VHT80 (MCS0))



10.2 26DB BANDWIDTH

[Ant1]

802.11a Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5180	36	19.47	16.444
5200	40	19.94	16.439
5240	48	19.77	16.445
5260	52	20.56	16.458
5300	60	19.50	16.457
5320	64	20.08	16.452
5500	100	19.86	16.466
5600	120	20.27	16.417
5720	144	19.69	16.426
5745	149	20.05	16.441
5785	157	20.98	16.498
5825	165	20.60	16.487

802.11n(HT20) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5180	36	20.89	17.683
5200	40	20.58	17.662
5240	48	20.58	17.658
5260	52	20.63	17.685
5300	60	20.45	17.674
5320	64	20.69	17.656
5500	100	20.50	17.650
5600	120	20.37	17.662
5720	144	20.79	17.683
5745	149	20.96	17.655
5785	157	21.72	17.663
5825	165	20.63	17.671

802.11n(HT40) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5190	38	42.64	36.422
5230	46	42.76	36.416
5270	54	43.09	36.403
5310	62	43.30	36.485
5510	102	43.17	36.443
5590	118	42.58	36.492
5710	142	43.42	36.445
5755	151	42.60	36.460
5795	159	44.64	36.510

802.11ac(VHT20) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5180	36	20.59	17.643
5200	40	20.59	17.652
5240	48	20.77	17.665
5260	52	20.65	17.648
5300	60	20.75	17.662
5320	64	20.61	17.654
5500	100	20.96	17.663
5600	120	20.81	17.649
5720	144	21.17	17.655
5745	149	21.30	17.664
5785	157	20.84	17.671
5825	165	20.72	17.670

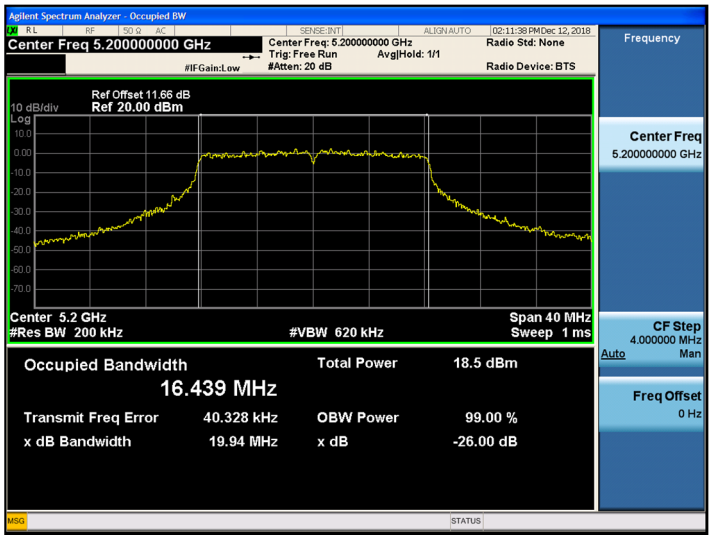
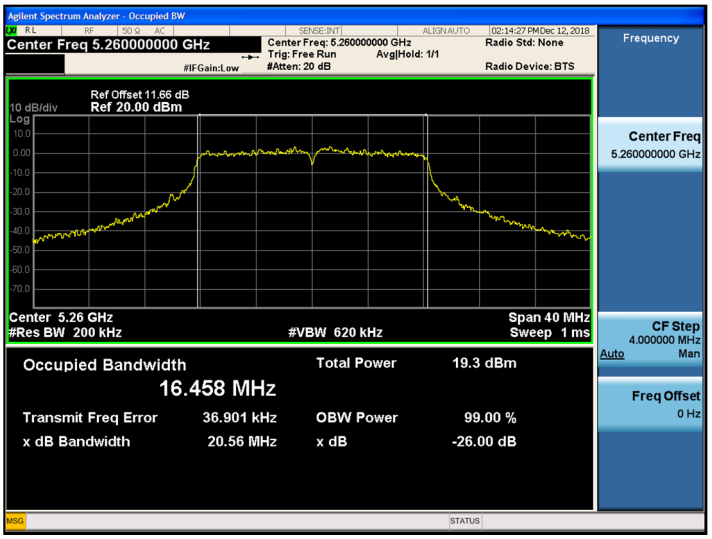
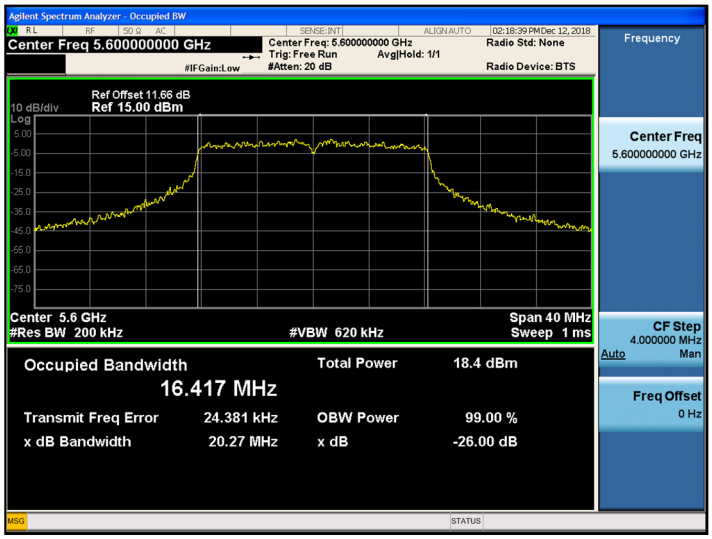
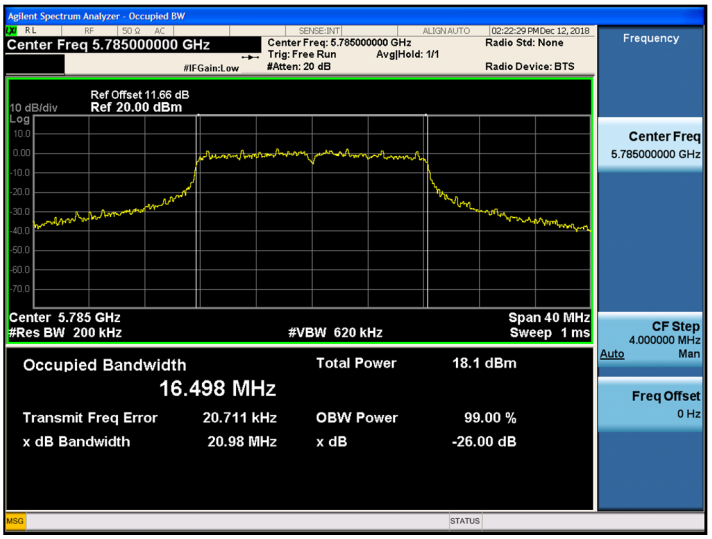
802.11ac(VHT40) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5190	38	40.65	36.237
5230	46	40.44	36.202
5270	54	40.47	36.204
5310	62	40.95	36.183
5510	102	40.50	36.192
5590	118	40.83	36.189
5710	142	40.72	36.193
5755	151	41.00	36.239
5795	159	41.16	36.194

802.11ac(VHT80) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5210	42	88.07	76.215
5290	58	89.02	76.256
5530	106	88.42	76.200
5610	122	89.42	76.267
5690	138	89.62	76.275
5775	155	88.38	76.291

▣ Test Plots(802.11a)

Note:

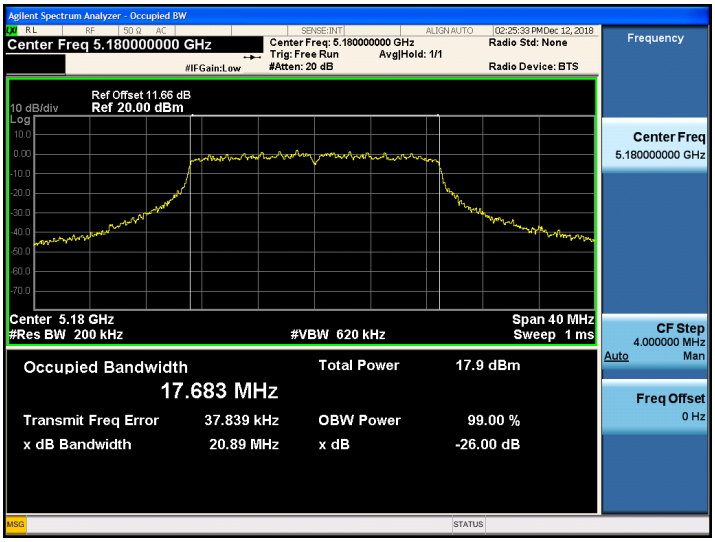
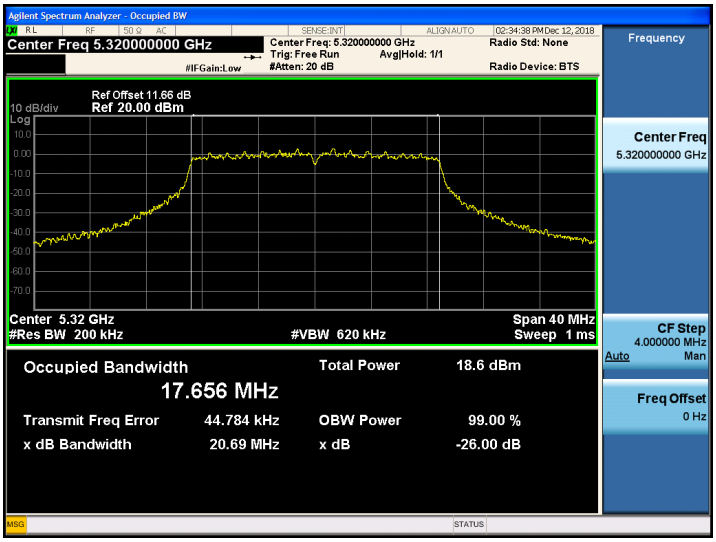
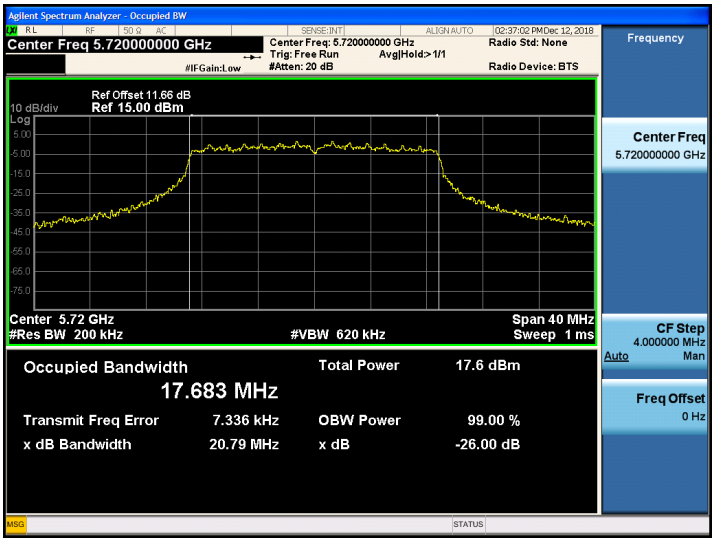
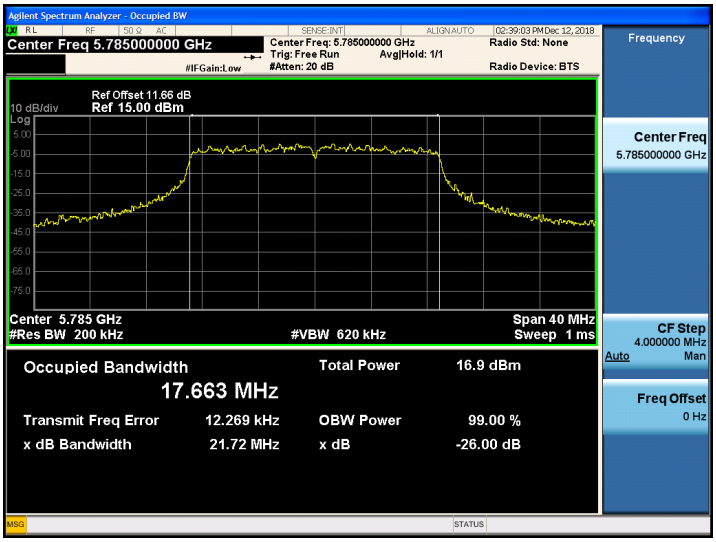
In order to simplify the report, attached plots were only the most wide channel.

802.11a UNII 1 BAND 26dB Bandwidth (CH 40)	802.11a UNII 2A BAND 26dB Bandwidth (CH 52)
	
802.11a UNII 2C BAND 26dB Bandwidth (CH120)	**802.11a UNII 3 BAND 26dB Bandwidth (CH 157)**
	

▣ Test Plots(802.11n(HT20))

Note:

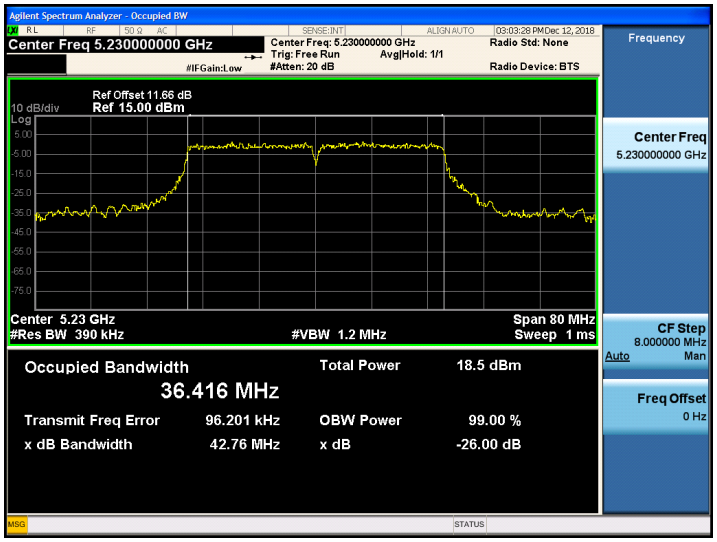
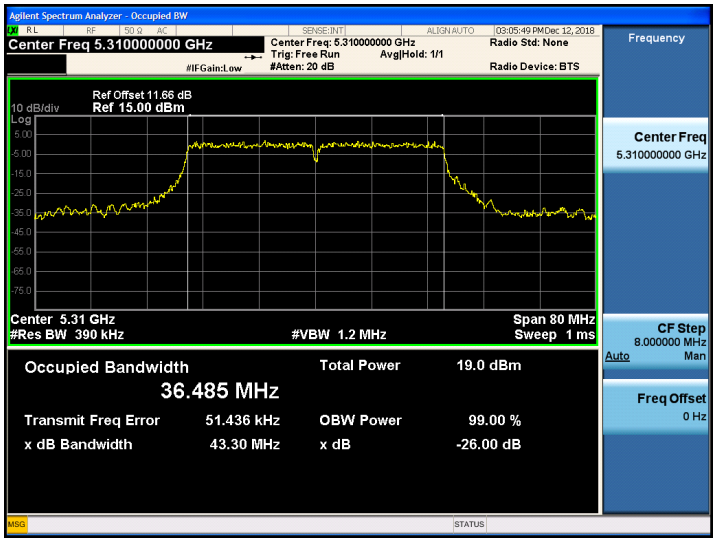
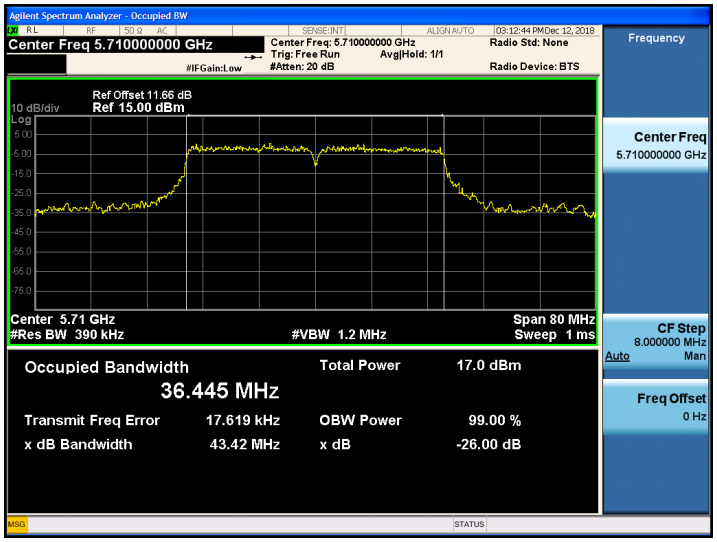
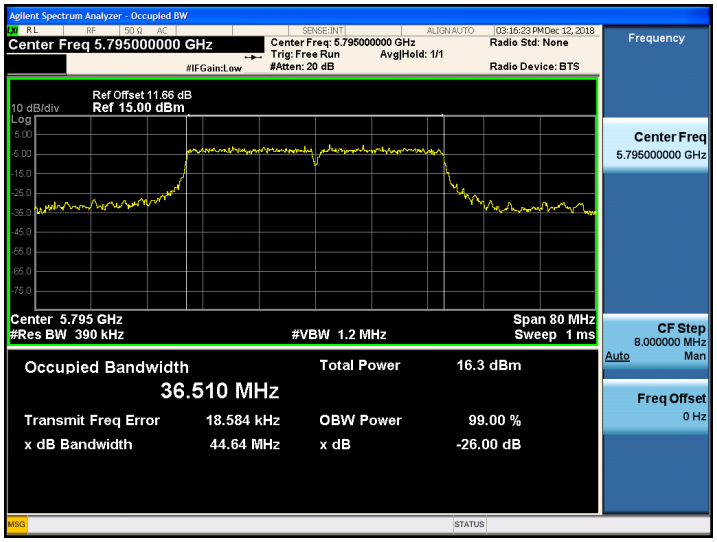
In order to simplify the report, attached plots were only the most wide channel.

802.11n_HT20 UNII 1 BAND 26dB Bandwidth(CH 36)	802.11n_HT20 UNII 2A BAND 26dB Bandwidth(CH 64)
	
802.11n_HT20 UNII 2C BAND 26dB Bandwidth(CH 144)	**802.11n_HT20 UNII 3 BAND 26dB Bandwidth(CH 157)**
	

▣ Test Plots(802.11n(HT40))

Note:

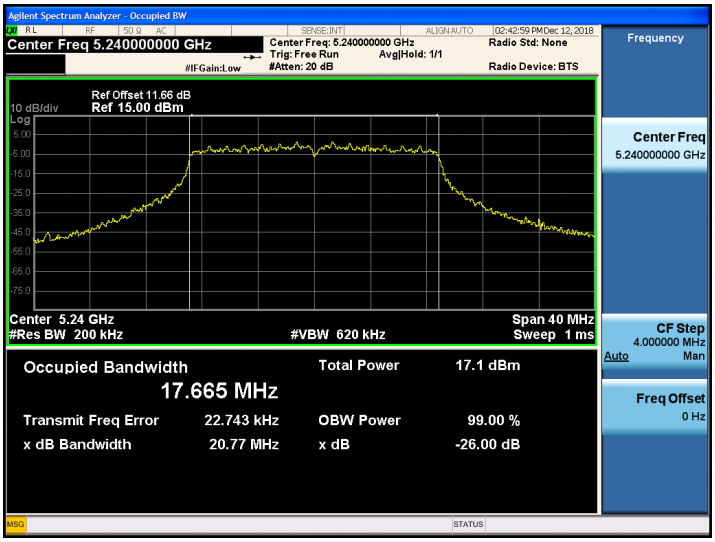
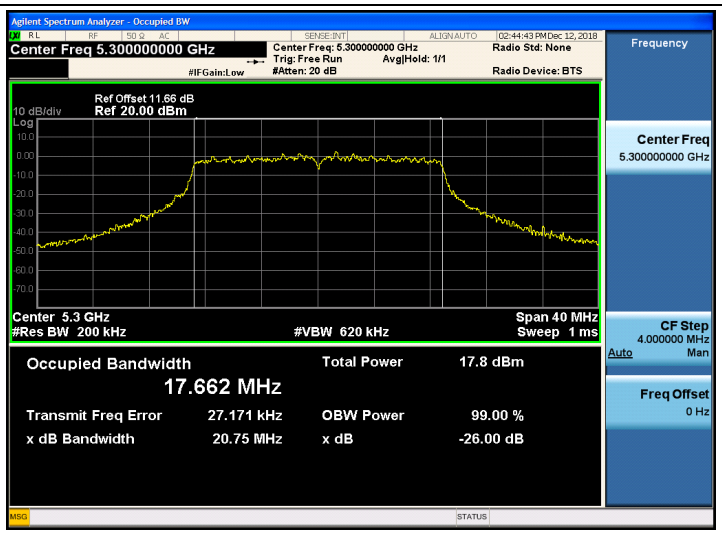
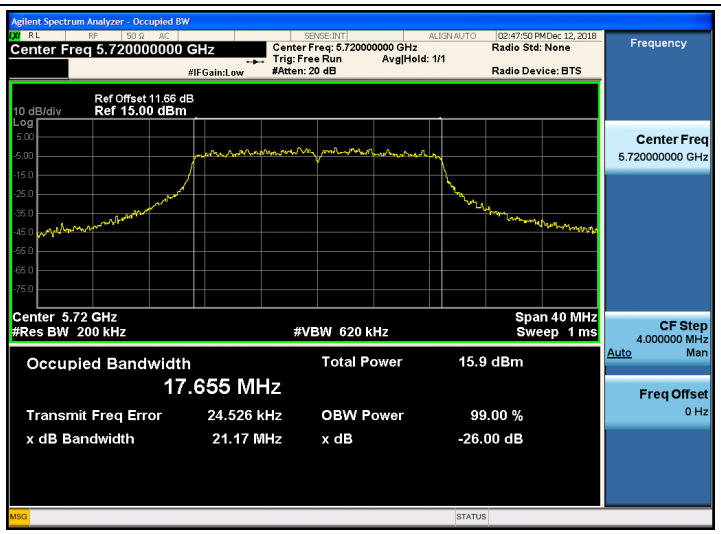
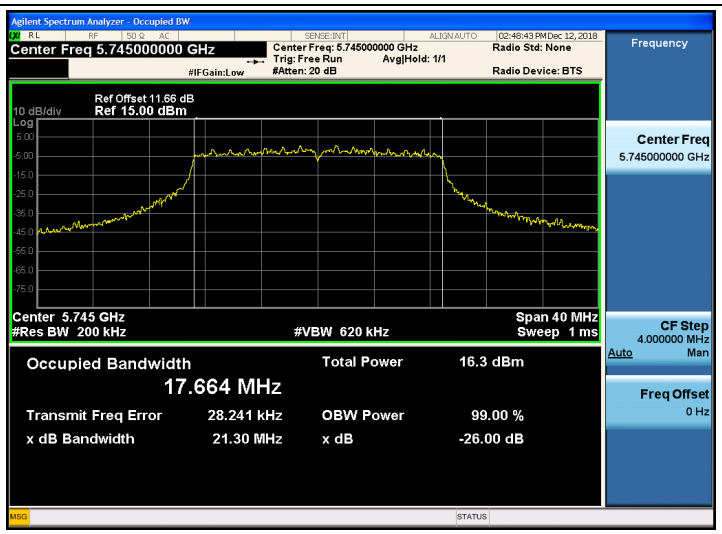
In order to simplify the report, attached plots were only the most wide channel.

802.11n_HT40 UNII 1 BAND 26dB Bandwidth(CH 46)	802.11n_HT40 UNII 2A BAND 26dB Bandwidth (CH 62)
	
802.11n_HT40 UNII 2C BAND 26dB Bandwidth(CH 142)	**802.11n_HT40 UNII 3 BAND 26dB Bandwidth (CH 159)**
	

▣ Test Plots(802.11ac(VHT20))

Note:

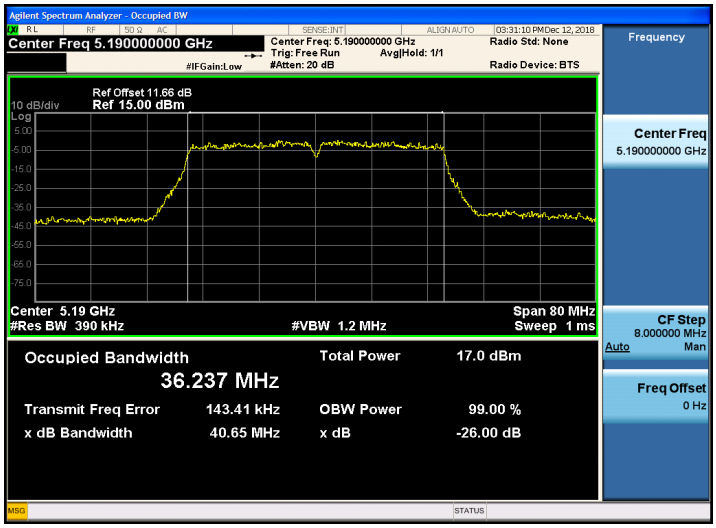
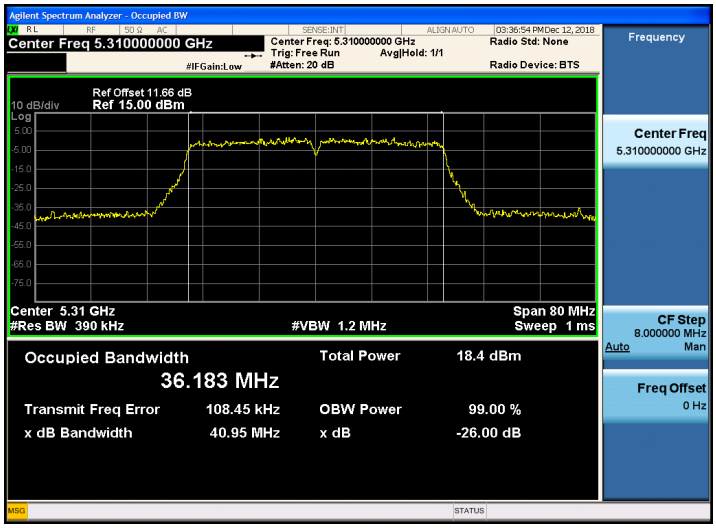
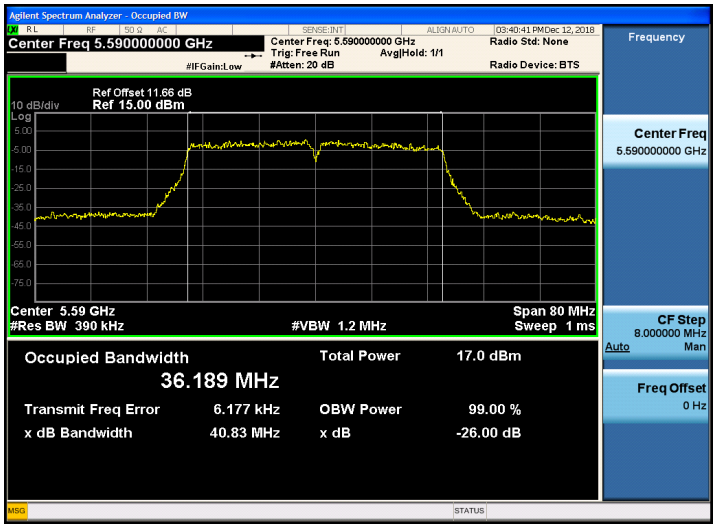
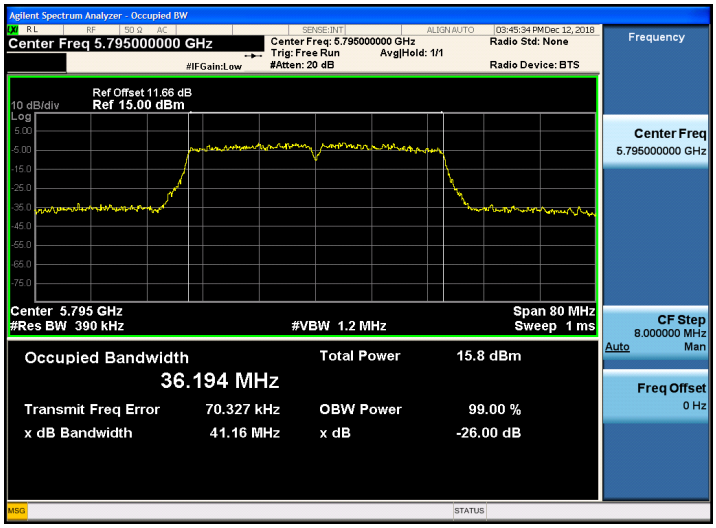
In order to simplify the report, attached plots were only the most wide channel.

802.11ac_VHT20 UNII 1 BAND 26dB Bandwidth(CH 48)	802.11ac_VHT20 UNII 2A BAND 26dB Bandwidth(CH 60)
	
802.11ac_VHT20 UNII 2C BAND 26dB Bandwidth(CH 144)	**802.11ac_VHT20 UNII 3 BAND 26dB Bandwidth(CH 149)**
	

▣ Test Plots(802.11ac(VHT40))

Note:

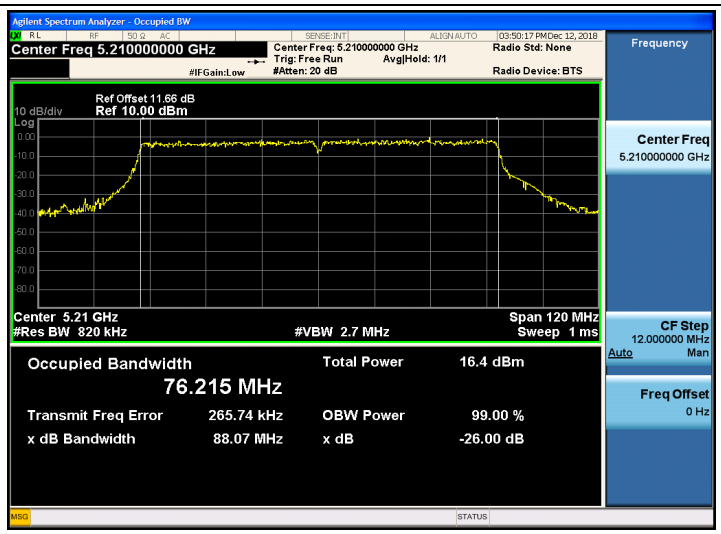
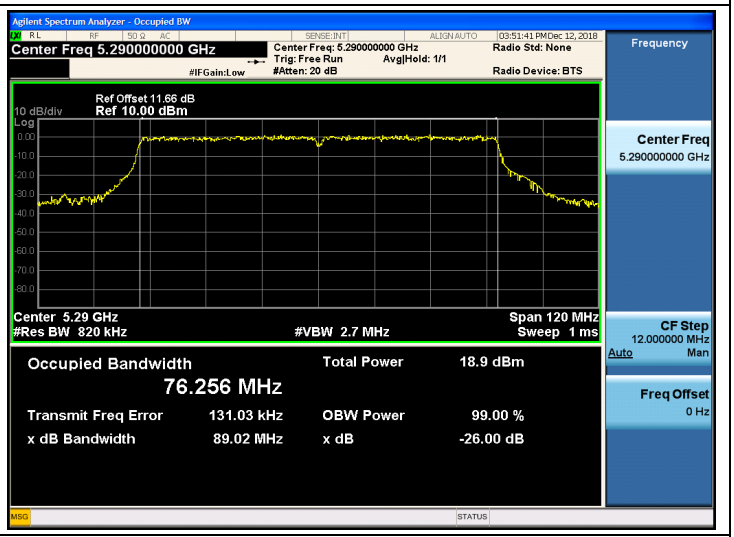
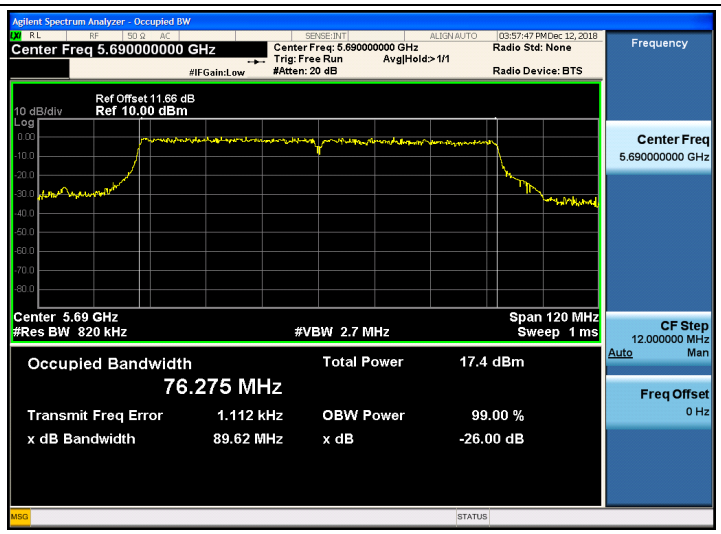
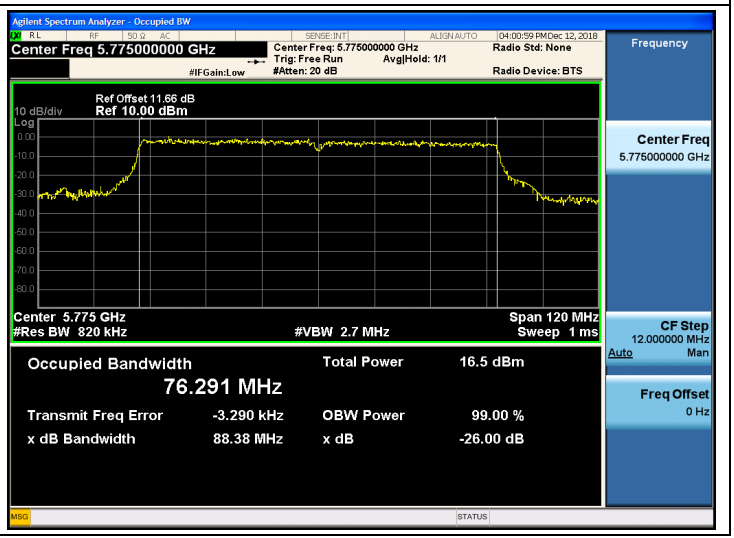
In order to simplify the report, attached plots were only the most wide channel.

802.11ac_VHT40 UNII 1 BAND 26dB Bandwidth(CH 38)	802.11ac_VHT40 UNII 2A BAND 26dB Bandwidth (CH 62)
	
802.11ac_VHT40 UNII 2C BAND 26dB Bandwidth(CH 118)	**802.11ac_VHT40 UNII 3 BAND 26dB Bandwidth (CH 159)**
	

▣ Test Plots(802.11ac(VHT80))

Note:

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

802.11ac_VHT80 UNII 1 BAND 26dB Bandwidth(CH 42)	802.11ac_VHT80 UNII 2A BAND 26dB Bandwidth (CH 58)
	
802.11ac_VHT80 UNII 2C BAND 26dB Bandwidth(CH 138)	**802.11ac_VHT80 UNII 3 BAND 26dB Bandwidth (CH 155)**
	

[Ant2]

802.11a Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5180	36	20.31	16.443
5200	40	19.99	16.432
5240	48	20.08	16.441
5260	52	20.37	16.428
5300	60	19.75	16.459
5320	64	20.06	16.433
5500	100	20.18	16.467
5600	120	20.01	16.423
5720	144	19.56	16.427
5745	149	19.88	16.459
5785	157	19.67	16.448
5825	165	19.72	16.437

802.11n(HT20) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5180	36	20.92	17.656
5200	40	20.46	17.662
5240	48	20.37	17.666
5260	52	20.57	17.667
5300	60	20.66	17.628
5320	64	20.89	17.649
5500	100	20.88	17.650
5600	120	20.66	17.664
5720	144	20.68	17.641
5745	149	20.56	17.654
5785	157	20.46	17.663
5825	165	21.00	17.657

802.11n(HT40) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5190	38	42.42	36.374
5230	46	43.97	36.366
5270	54	42.29	36.391
5310	62	42.74	36.377
5510	102	42.71	36.450
5590	118	42.61	36.431
5710	142	43.17	36.456
5755	151	42.58	36.406
5795	159	42.92	36.441

802.11ac(VHT20) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5180	36	20.54	17.645
5200	40	20.65	17.642
5240	48	20.47	17.650
5260	52	20.57	17.654
5300	60	20.96	17.647
5320	64	20.62	17.647
5500	100	20.96	17.663
5600	120	21.03	17.643
5720	144	20.67	17.647
5745	149	20.65	17.661
5785	157	20.74	17.655
5825	165	20.78	17.654

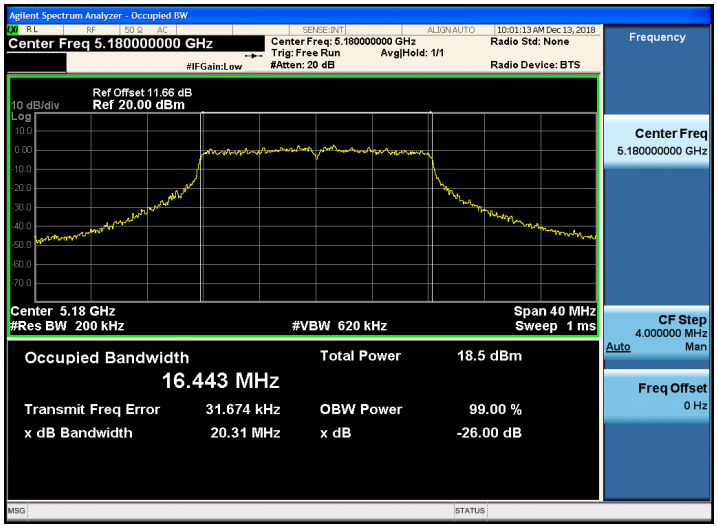
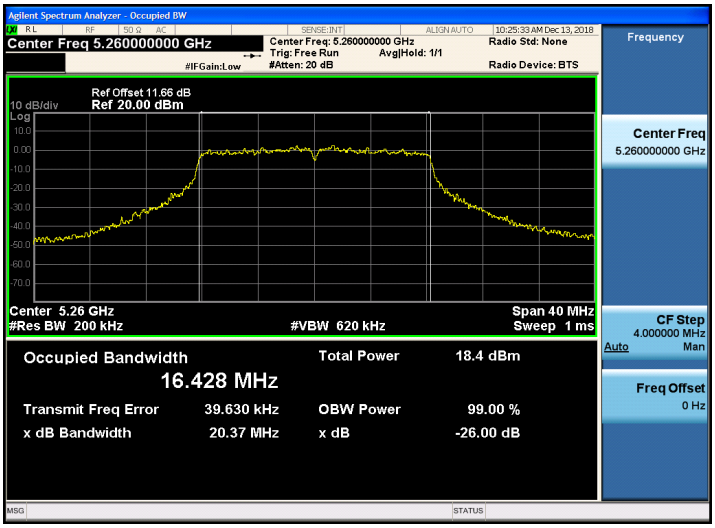
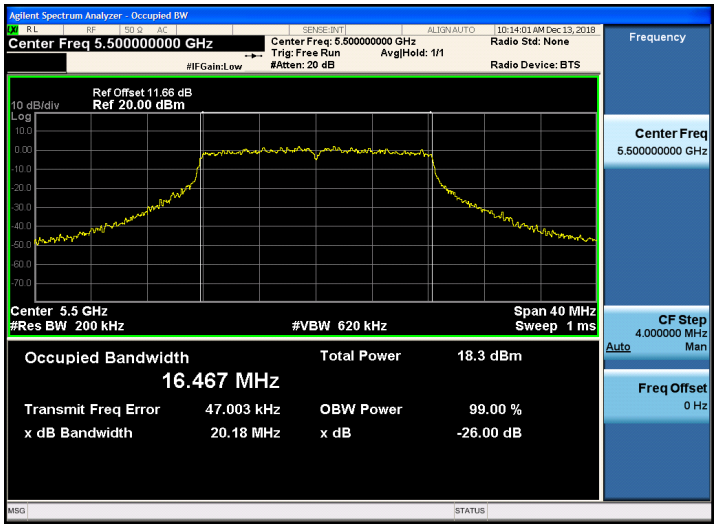
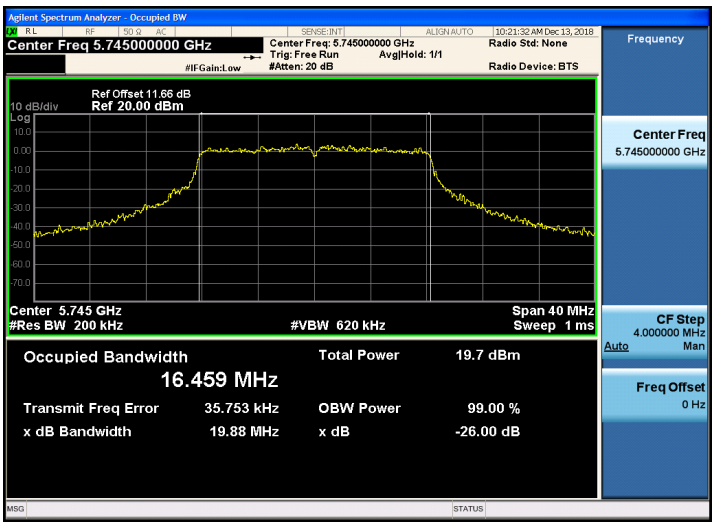
802.11ac(VHT40) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5190	38	40.39	36.213
5230	46	41.06	36.196
5270	54	40.91	36.205
5310	62	40.70	36.193
5510	102	41.22	36.230
5590	118	40.44	36.209
5710	142	40.65	36.186
5755	151	40.49	36.189
5795	159	40.63	36.192

802.11ac(VHT80) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5210	42	88.19	76.276
5290	58	89.14	76.233
5530	106	87.60	76.166
5610	122	87.97	76.237
5690	138	89.30	76.200
5775	155	87.96	76.356

▣ Test Plots(802.11a)

Note:

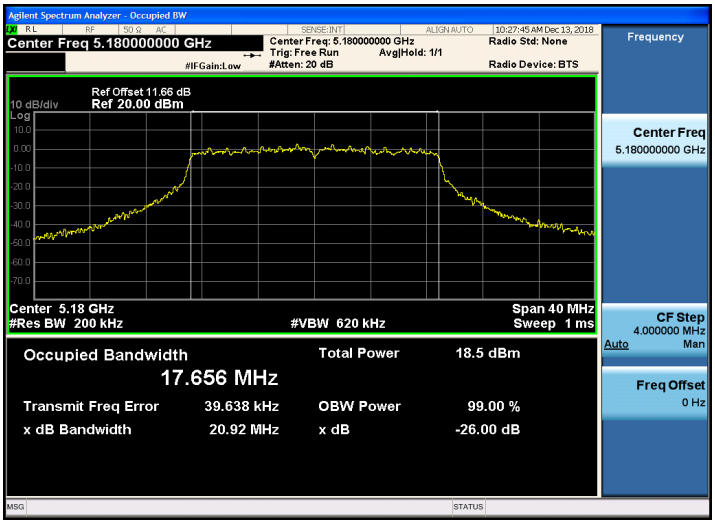
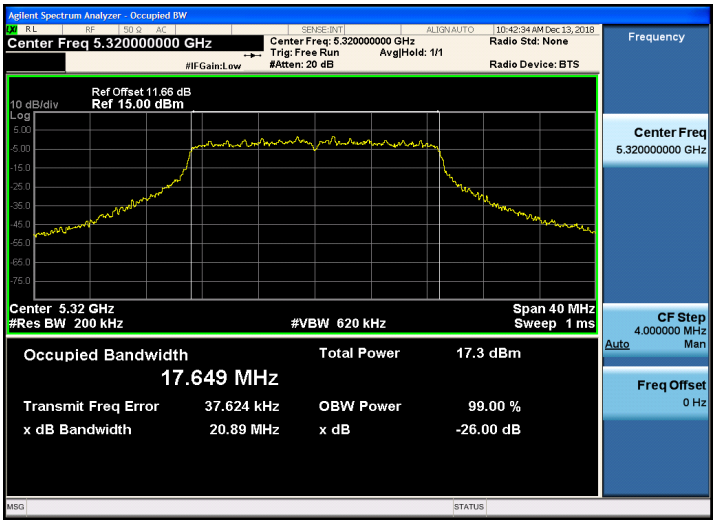
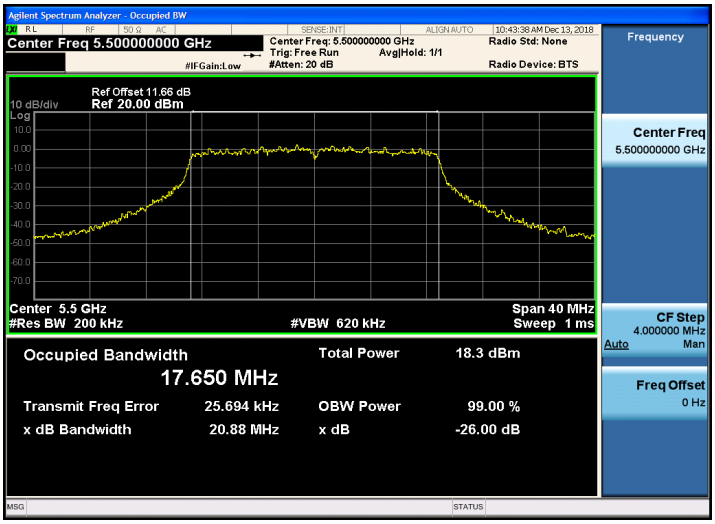
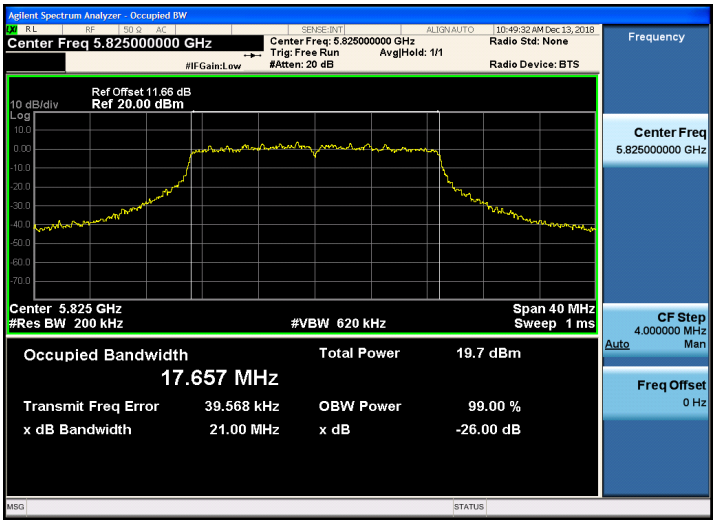
In order to simplify the report, attached plots were only the most wide channel.

802.11a UNII 1 BAND 26dB Bandwidth (CH 36)	802.11a UNII 2A BAND 26dB Bandwidth (CH 52)
	
802.11a UNII 2C BAND 26dB Bandwidth (CH100)	**802.11a UNII 3 BAND 26dB Bandwidth (CH 149)**
	

▣ Test Plots(802.11n(HT20))

Note:

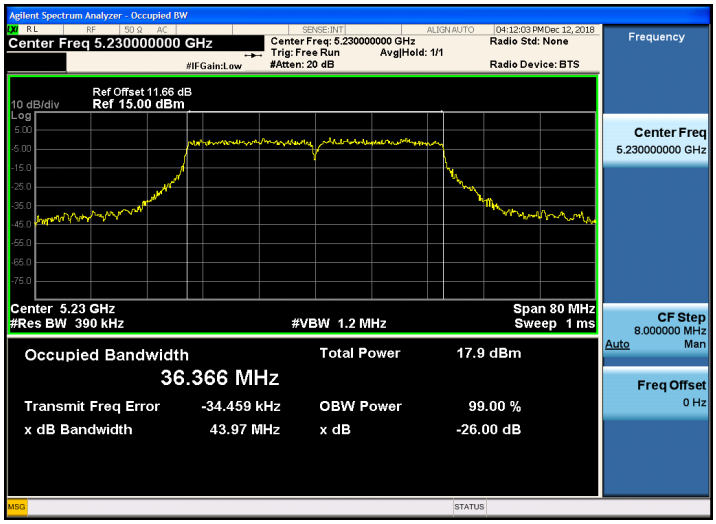
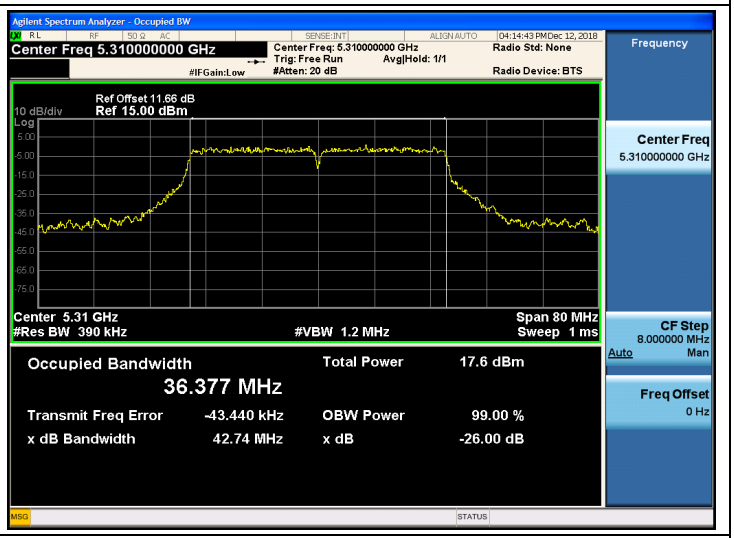
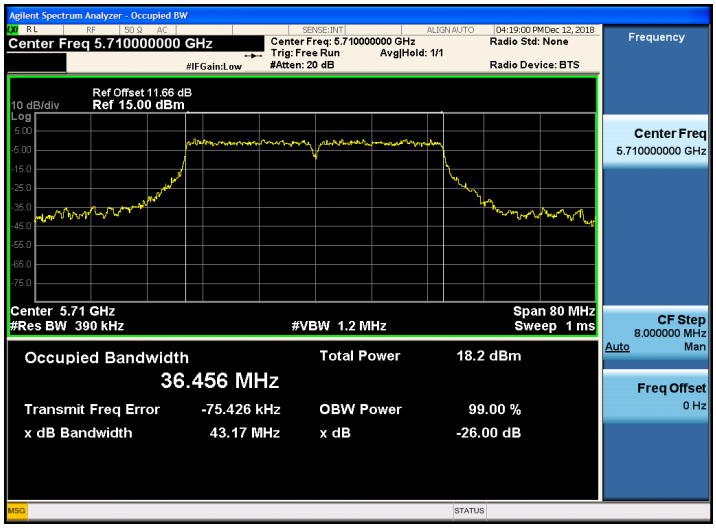
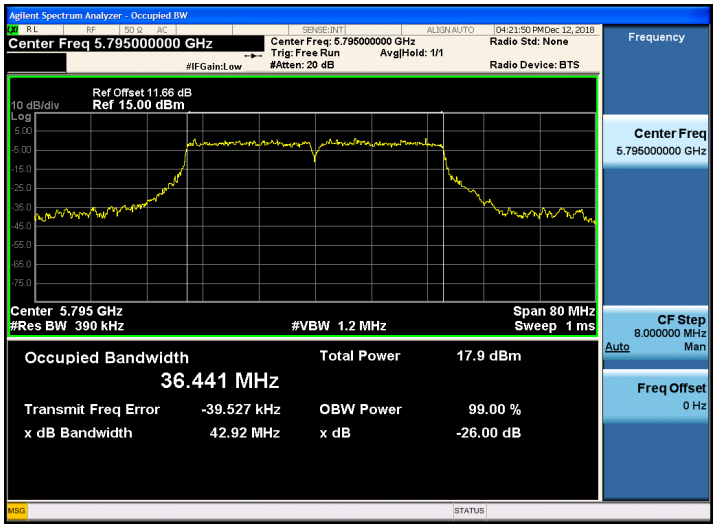
In order to simplify the report, attached plots were only the most wide channel.

802.11n_HT20 UNII 1 BAND 26dB Bandwidth(CH 36)	802.11n_HT20 UNII 2A BAND 26dB Bandwidth(CH 64)
	
802.11n_HT20 UNII 2C BAND 26dB Bandwidth(CH 100)	**802.11n_HT20 UNII 3 BAND 26dB Bandwidth(CH 165)**
	

▣ Test Plots(802.11n(HT40))

Note:

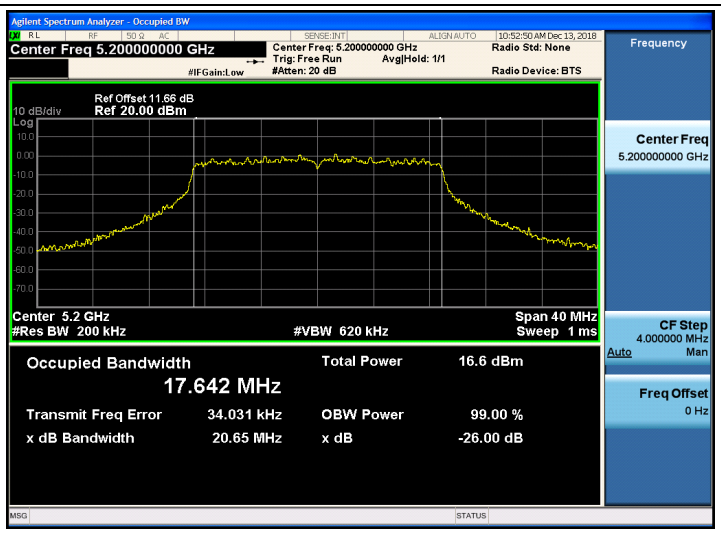
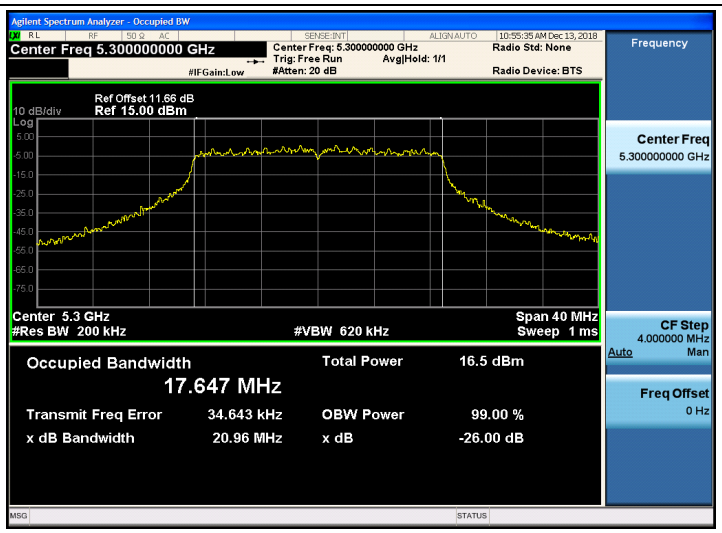
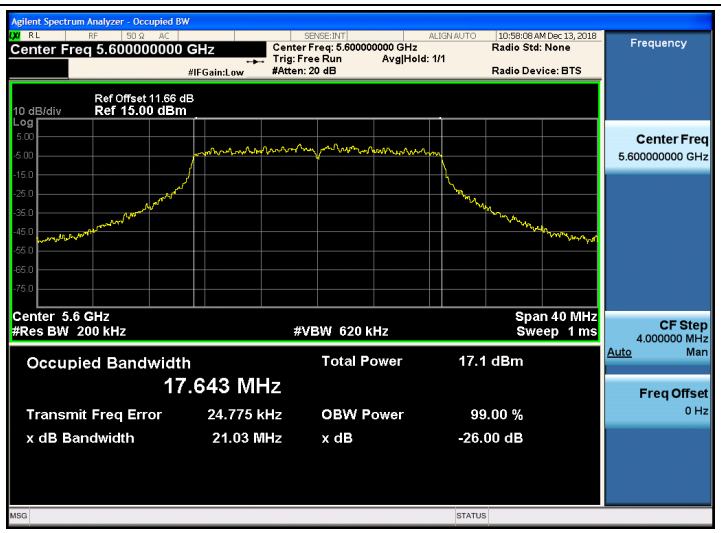
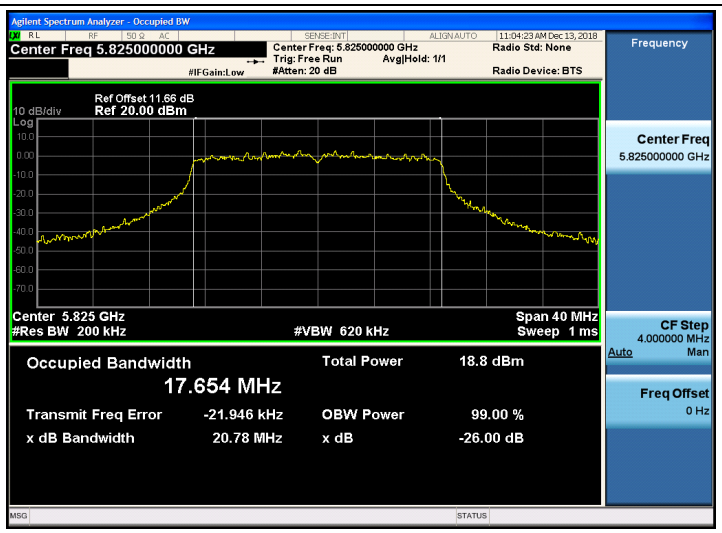
In order to simplify the report, attached plots were only the most wide channel.

802.11n_HT40 UNII 1 BAND 26dB Bandwidth(CH 46)	802.11n_HT40 UNII 2A BAND 26dB Bandwidth (CH 62)
	
802.11n_HT40 UNII 2C BAND 26dB Bandwidth(CH 142)	**802.11n_HT40 UNII 3 BAND 26dB Bandwidth (CH 159)**
	

▣ Test Plots(802.11ac(VHT20))

Note:

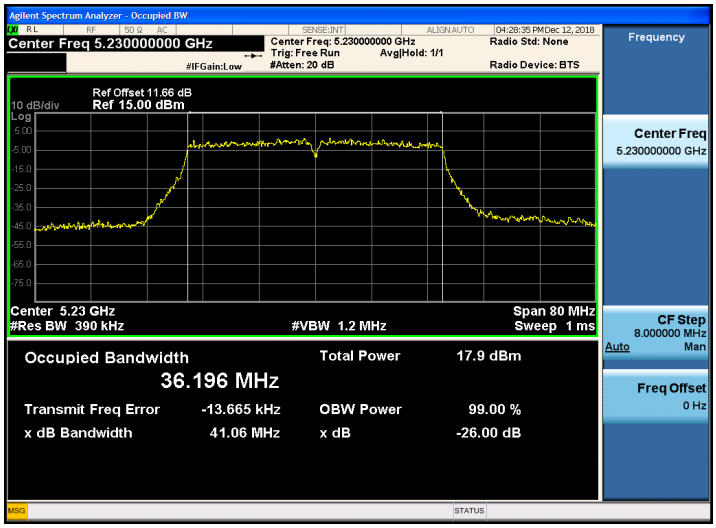
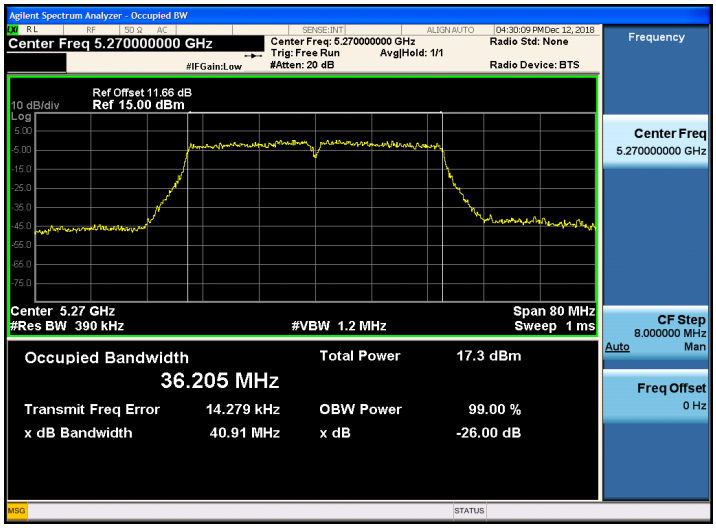
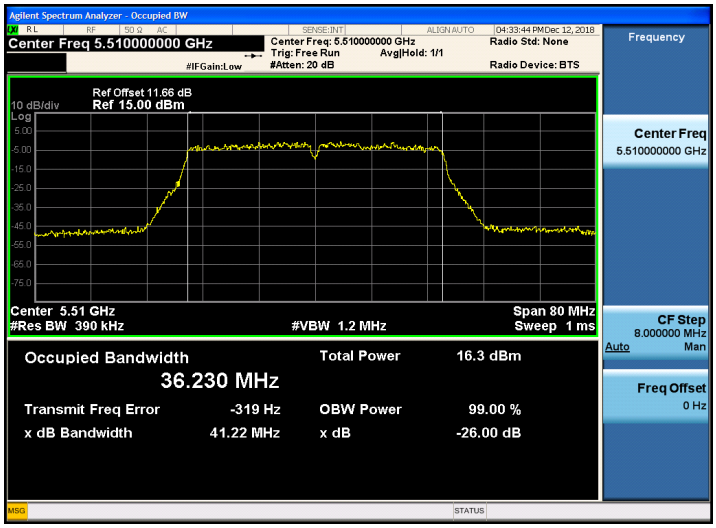
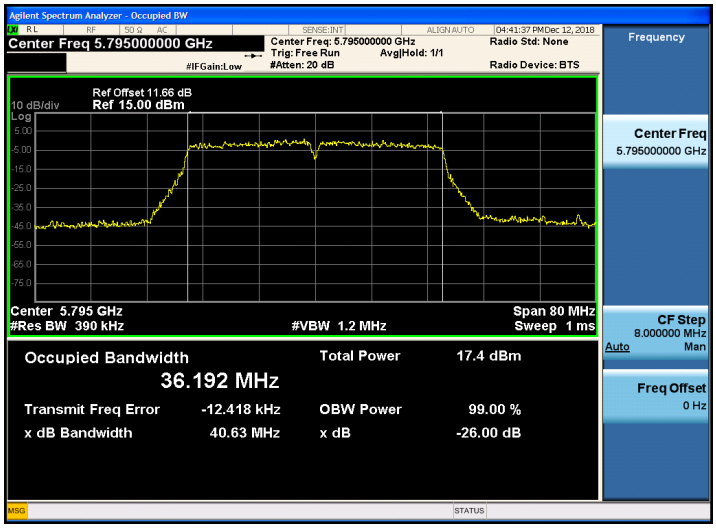
In order to simplify the report, attached plots were only the most wide channel.

802.11ac_VHT20 UNII 1 BAND 26dB Bandwidth(CH 40)	802.11ac_VHT20 UNII 2A BAND 26dB Bandwidth(CH 60)
	
802.11ac_VHT20 UNII 2C BAND 26dB Bandwidth(CH 120)	**802.11ac_VHT20 UNII 3 BAND 26dB Bandwidth(CH 165)**
	

▣ Test Plots(802.11ac(VHT40))

Note:

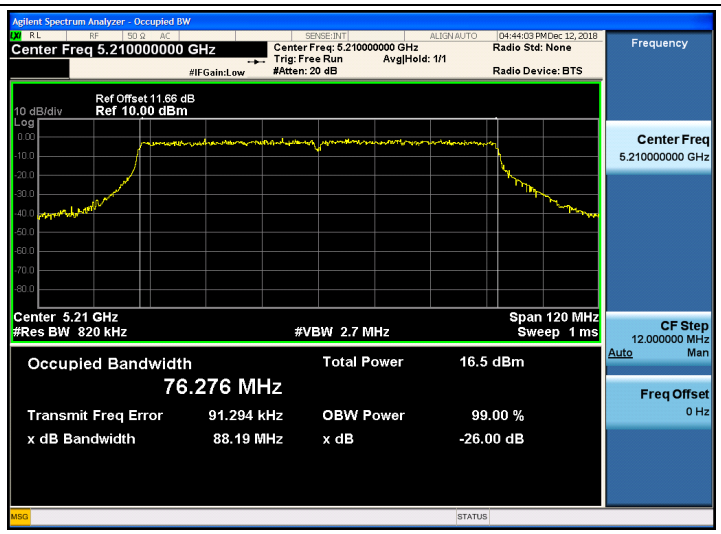
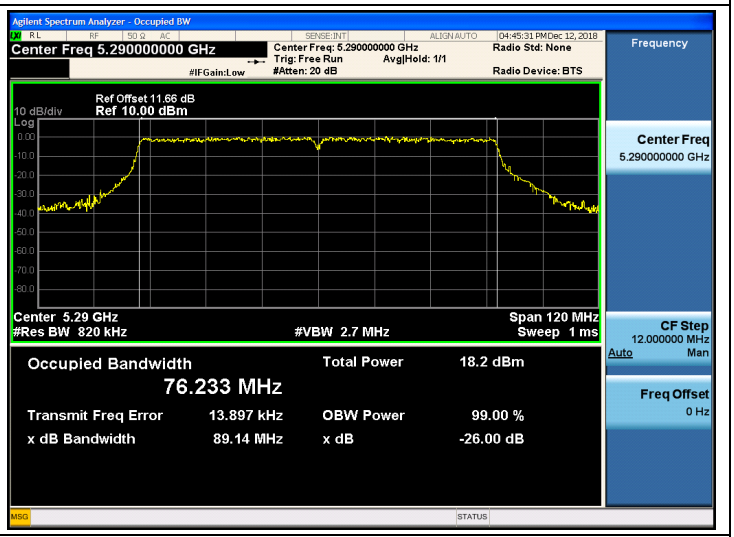
In order to simplify the report, attached plots were only the most wide channel.

802.11ac_VHT40 UNII 1 BAND 26dB Bandwidth(CH 46)	802.11ac_VHT40 UNII 2A BAND 26dB Bandwidth (CH 54)
	
802.11ac_VHT40 UNII 2C BAND 26dB Bandwidth(CH 102)	**802.11ac_VHT40 UNII 3 BAND 26dB Bandwidth (CH 159)**
	

▣ Test Plots(802.11ac(VHT80))

Note:

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

802.11ac_VHT80 UNII 1 BAND 26dB Bandwidth(CH 42)	802.11ac_VHT80 UNII 2A BAND 26dB Bandwidth (CH 58)
	
802.11ac_VHT80 UNII 2C BAND 26dB Bandwidth(CH 138)	**802.11ac_VHT80 UNII 3 BAND 26dB Bandwidth (CH 155)**