HCT CO.,LTD.

74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
TEL: +82-31-645-6300 **FAX: +82-31-645-6401**

FCC UNII REPORT

Certification

Applicant Name:
SAMSUNG Electronics Co., Ltd.

Address:
129, Samsung-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 16677, Rep. of Korea

Date of Issue:
January 30, 2019
Location:
HCT CO., LTD.,
74, Seoicheon-ro 578beon-gil, Majang-myeon,
Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
Report No.: HCT-RF-1901-FC029

FCC ID:	**A3LSMM305F**
APPLICANT:	**SAMSUNG Electronics Co., Ltd.**
Model:	SM-M305M/DS
Additional Model:	SM-M305F/DS, SM-M305F, SM-M305M
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

This report only responds to the tested sample and may not be reproduced, except in full, without written approval of the HCT Co., Ltd.

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-1901-FC029	January 30, 2019	- First Approval Report

Table of Contents

1. GENERAL INFORMATION 5
EUT DESCRIPTION 5
2. MAXIMUM OUTPUT POWER 6
3. TEST METHODOLOGY 7
EUT CONFIGURATION 7
EUT EXERCISE 7
GENERAL TEST PROCEDURES 7
DESCRIPTION OF TEST MODES 7
4. INSTRUMENT CALIBRATION 8
5. FACILITIES AND ACCREDITATIONS 8
5.1 FACILITIES 8
5.2 EQUIPMENT 8
6. ANTENNA REQUIREMENTS 8
7. MEASUREMENT UNCERTAINTY 9
8. DESCRIPTION OF TESTS 10
9. SUMMARY OF TEST RESULTS 26
10. TEST RESULT 27
10.1 DUTY CYCLE 27
10.2 26DB BANDWIDTH 29
10.3 6DB BANDWIDTH 38
10.4 OUTPUT POWER MEASUREMENT 40
10.5 POWER SPECTRAL DENSITY 43
10.6 FREQUENCY STABILITY. 52
10.6.1 20MHz BW 52
10.6.2 40MHz BW 68
10.6.3 80MHz BW 84
10.7 STRADDLE CHANNEL 100
10.7.1 26dB Bandwidth 100
10.7.2 6dB Bandwidth 103
10.7.3 Output Power 106
10.7.4 Power Spectral Density 109
10.8 RADIATED SPURIOUS EMISSIONS 112
10.9 RADIATED RESTRICTED BAND EDGE 162

10.10 POWERLINE CONDUCTED EMISSIONS 1 8 5

11. LIST OF TEST EQUIPMENT 1 8 9

12. ANNEX A_ TEST SETUP PHOTO 1 9 1

1. GENERAL INFORMATION

EUT DESCRIPTION

Model	SM-M305M/DS	
Additional Model	SM-M305F/DS, SM-M305F, SM-M305M	
EUT Type	Mobile Phone	
Power Supply	DC 3.85 V	
Battery Information	Model: EB-BG580ABU Type: Li-ion battery	
Travel Adapter Information	Model : EP-TA200 Manufacture: ELENTEC	
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 Type	LDS	
Antenna Peak gain (dBi)	-0.01 dBi	
Straddle channel	Supported	
TDWR Band	Supported	
Dynamic Frequency Selection	Slave without radar detection	
Date(s) of Tests	January 09, 2019 ~ January 25, 2019	

2. MAXIMUM OUTPUT POWER

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

Band	Mode	RF Output Power (dBm)	RF Output Power (W)
UNII1	802.11a	16.73	0.047
	802.11n (HT20)	16.80	0.048
	802.11n (HT40)	15.85	0.038
	802.11ac (VHT20)	16.66	0.046
	802.11ac (VHT40)	15.73	0.037
	802.11ac (VHT80)	8.99	0.008
UNII2A	802.11a	17.07	0.051
	802.11n (HT20)	17.20	0.053
	802.11n (HT40)	15.52	0.036
	802.11ac (VHT20)	16.76	0.047
	802.11ac (VHT40)	15.51	0.036
	802.11ac (VHT80)	9.04	0.008
UNII2C	802.11a	17.17	0.052
	802.11n (HT20)	17.30	0.054
	802.11n (HT40)	16.11	0.041
	802.11ac (VHT20)	17.19	0.052
	802.11ac (VHT40)	15.93	0.039
	802.11ac (VHT80)	12.98	0.020
UNII3	802.11a	17.25	0.053
	802.11n (HT20)	17.45	0.056
	802.11n (HT40)	15.96	0.039
	802.11ac (VHT20)	17.27	0.053
	802.11ac (VHT40)	15.90	0.039
	802.11ac (VHT80)	12.81	0.019

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.

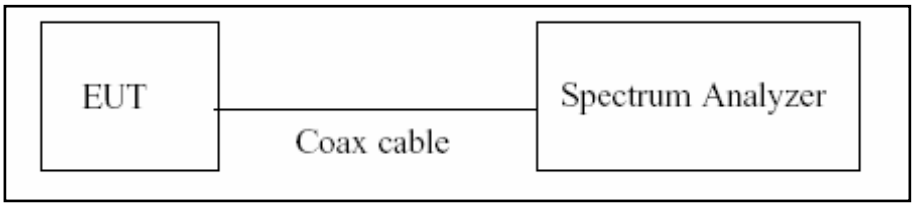
The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

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.

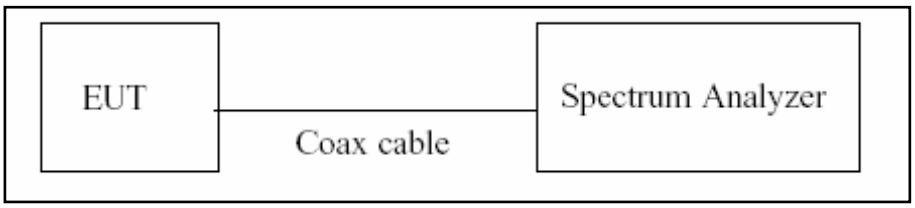
1. RBW = 8 MHz (the largest availble value)
2. VBW = 8 MHz (≥ RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure T_{total} and T_{on}
8. Calculate Duty Cycle = T_{on}/ T_{total} and Duty Cycle Factor = 10*log(1/Duty Cycle)

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.

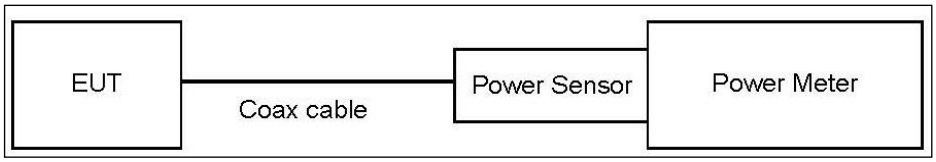
8.3. Output Power Measurement

Limit

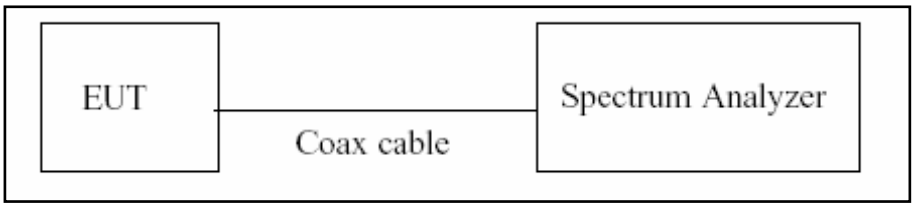
Band	Limit
UNII 1	- Master : Not exceed 1 W(=30dBm) - Slave : Not exceed 250 mW(=23.98 dBm)
UNII 2A, 2C	Not exceed the lesser of 250 mW or 11 dBm + 10 log B, (where B is the 26 dB emission bandwidth in megahertz.)
UNII 3	Not exceed 1 W(=30dBm)

Test Configuration

Power Meter



Spectrum Analyzer(Only Straddle Channel)



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	21.1
UNII 2A	21.1
UNII 2C	21.1
UNII 3	21.1

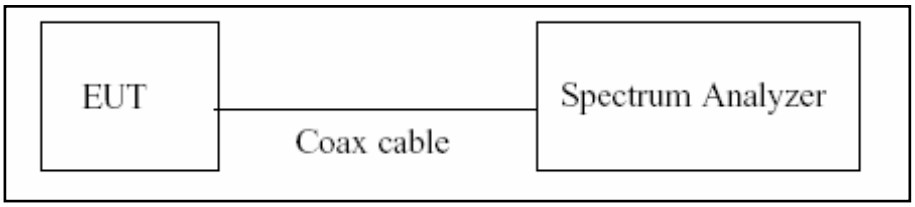
(Actual value of loss for the attenuator and cable combination)

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	21.1
UNII 2A	21.1
UNII 2C	21.1
UNII 3	21.1

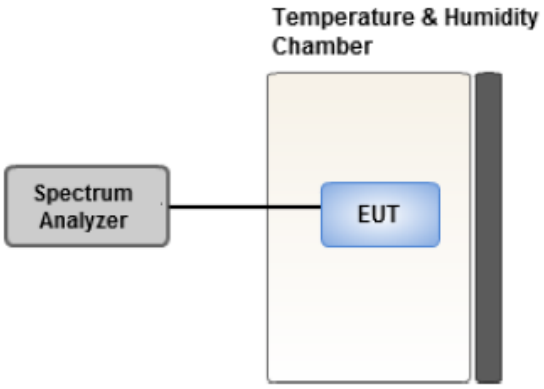
(Actual value of loss for the attenuator and cable combination)

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.

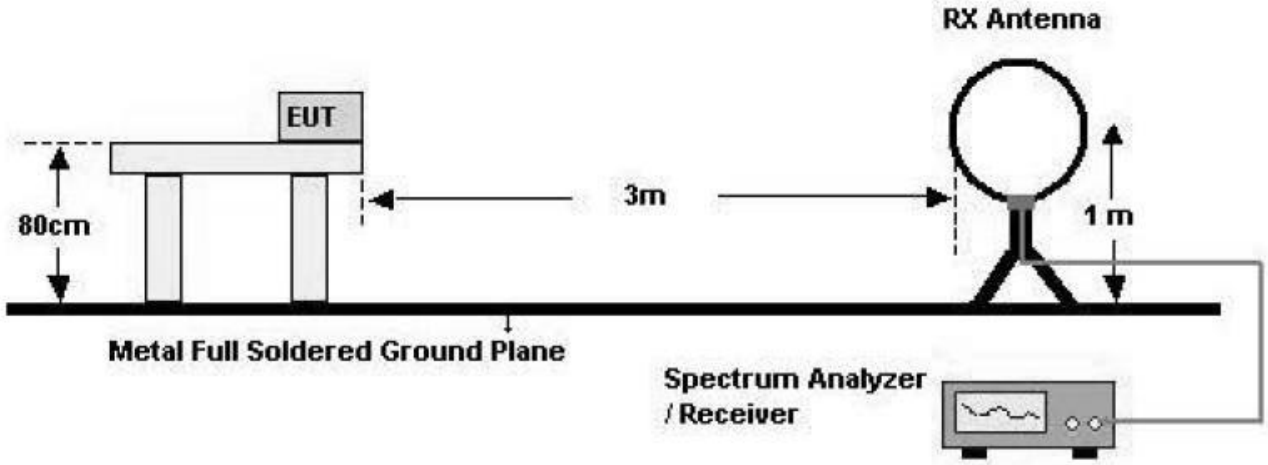
3. UNII 3: All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below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

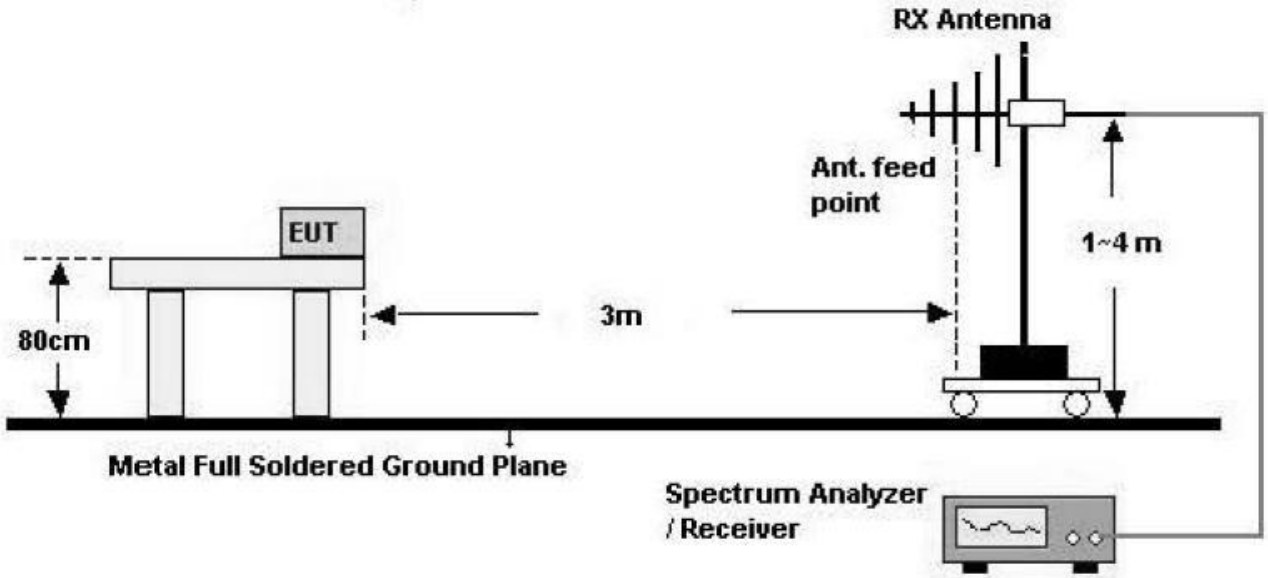
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

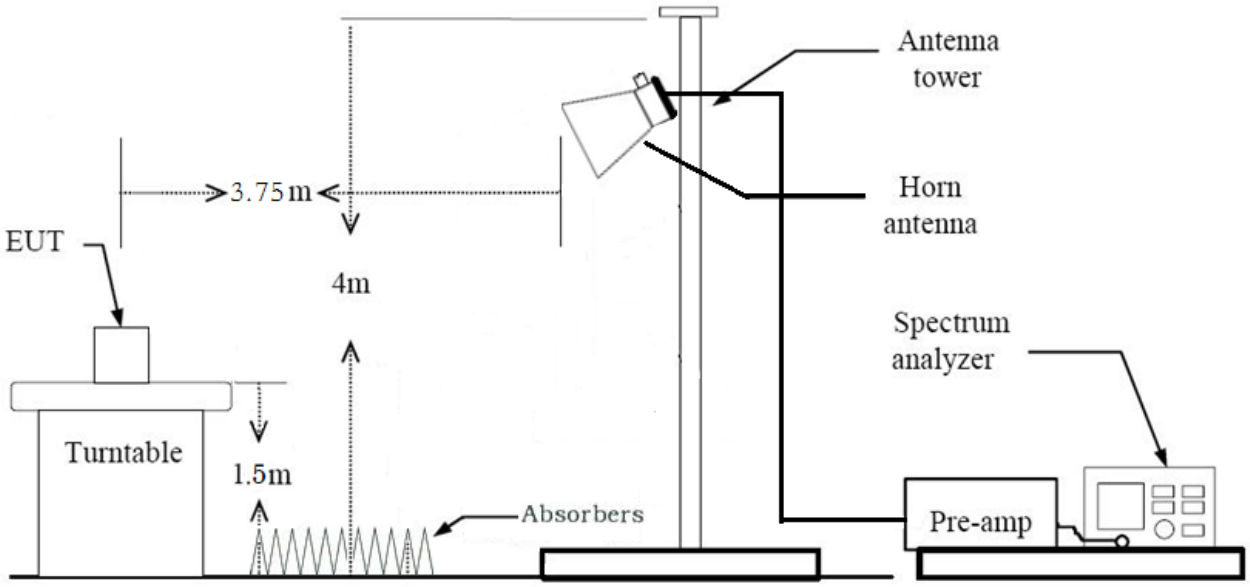
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz


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

Test Procedure of Radiated spurious emissions(Below 30 MHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The loop antenna was placed at a location 3m from the EUT
3. The EUT is placed on a turntable, which is 0.8m above ground plane.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Distance Correction Factor(0.009 MHz – 0.490 MHz) = 40*log(3 m/300 m) = - 80 dB
   Measurement Distance : 3 m
7. Distance Correction Factor(0.490 MHz – 30 MHz) = 40*log(3 m/30 m) = - 40 dB
   Measurement Distance : 3 m
8. Spectrum Setting
   - Frequency Range = 9 kHz ~ 30 MHz
   - Detector = Peak
   - Trace = Maxhold
   - RBW = 9 kHz
   - VBW ≥ 3*RBW
9. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)
10. The test results for below 30 MHz is correlated to an open site.
    The result on OATS is about 2 dB higher than semi-anechoic chamber(10 m chamber)

Test Procedure of Radiated spurious emissions(Below 1GHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The EUT is placed on a turntable, which is 0.8m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. Spectrum Setting
   (1) Measurement Type(Peak):
   - Measured Frequency Range : 30 MHz – 1 GHz
   - Detector = Peak
   - Trace = Maxhold
   - RBW = 100 kHz
   - VBW ≥ 3*RBW

   (2) Measurement Type(Quasi-peak):
   - Measured Frequency Range : 30 MHz – 1 GHz
   - Detector = Quasi-Peak
   - RBW = 120 kHz

   *In general, (1) is used mainly
6. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L)

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)	Duty Cycle	Duty Cycle Factor (dB)	The actual setting value of VBW (Hz)
802.11a	6	0.948	0.232	1000
802.11n(HT20)	MCS 0	0.939	0.273	1000
802.11ac(VHT20)	MCS 0	0.946	0.242	1000
802.11n(HT40)	MCS 0	0.877	0.571	3000
802.11ac(VHT40)	MCS 0	0.877	0.568	3000
802.11ac(VHT80)	MCS 0	0.839	0.760	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. EUT Axis
   - Radiated Spurious Emissions : X
   - Radiated Restricted Band Edge : Z
3. All datarate of operation were investigated and the worst case datarate results are reported
   - 802.11a : 6Mbps
   - 802.11n : MCS0
   - 802.11ac : MCS0

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 : 36 Mbps
   - 802.11n : MCS4
   - 802.11ac : MCS4

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)	Duty Cycle	Duty Cycle Factor (dB)
802.11a	6	0.948	0.232
	9	0.909	0.417
	12	0.886	0.527
	18	0.815	0.887
	24	0.769	1.139
	36	0.682	1.665
	48	0.622	2.060
	54	0.611	2.143

Mode	MCS Index	Duty Cycle	Duty Cycle Factor (dB)
802.11n(HT20)	0	0.939	0.273
	1	0.881	0.552
	2	0.806	0.936
	3	0.780	1.081
	4	0.680	1.673
	5	0.645	1.905
	6	0.616	2.106
	7	0.605	2.185
802.11n(HT40)	0	0.877	0.571
	1	0.759	1.195
	2	0.692	1.601
	3	0.640	1.936
	4	0.558	2.533
	5	0.513	2.898
	6	0.486	3.129
	7	0.478	3.208

Mode	MCS Index	Duty Cycle	Duty Cycle Factor (dB)
802.11ac(VHT20)	0	0.946	0.242
	1	0.891	0.501
	2	0.810	0.914
	3	0.781	1.071
	4	0.700	1.549
	5	0.648	1.886
	6	0.629	2.013
	7	0.610	2.146
	8	0.591	2.287
802.11ac(VHT40)	0	0.877	0.568
	1	0.777	1.093
	2	0.695	1.580
	3	0.645	1.905
	4	0.565	2.480
	5	0.521	2.829
	6	0.504	2.972
	7	0.469	3.287
	8	0.467	3.310
	9	0.446	3.511
802.11ac(VHT80)	0	0.839	0.760
	1	0.751	1.243
	2	0.667	1.761
	3	0.608	2.160
	4	0.540	2.679
	5	0.496	3.049
	6	0.473	3.254
	7	0.434	3.627
	8	0.433	3.630
	9	0.406	3.917

10.2 26DB BANDWIDTH

802.11a Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5180	36	21.24	16.461
5200	40	22.16	16.479
5240	48	21.64	16.506
5260	52	24.56	16.527
5300	60	27.45	16.504
5320	64	22.21	16.463
5500	100	29.44	16.630
5600	120	21.46	16.439
5720	144	23.78	16.541
5745	149	26.30	16.506
5785	157	23.11	16.501
5825	165	22.69	16.477

802.11n(HT20) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5180	36	25.01	17.455
5200	40	25.12	17.416
5240	48	26.28	17.533
5260	52	24.36	17.498
5300	60	29.65	17.546
5320	64	24.05	17.443
5500	100	27.58	17.564
5600	120	26.73	17.527
5720	144	25.23	17.523
5745	149	24.25	17.525
5785	157	23.28	17.468
5825	165	24.06	17.505

802.11n(HT40) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5190	38	60.60	37.922
5230	46	70.73	38.123
5270	54	61.02	38.314
5310	62	61.03	38.026
5510	102	66.30	37.897
5590	118	73.60	37.807
5710	142	61.15	38.140
5755	151	65.59	38.298
5795	159	62.02	37.832

802.11ac(VHT20) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5180	36	24.26	17.479
5200	40	25.46	17.501
5240	48	24.76	17.508
5260	52	24.23	17.483
5300	60	25.07	17.496
5320	64	23.09	17.452
5500	100	27.12	17.555
5600	120	26.48	17.553
5720	144	25.16	17.514
5745	149	25.47	17.564
5785	157	24.14	17.491
5825	165	26.81	17.511

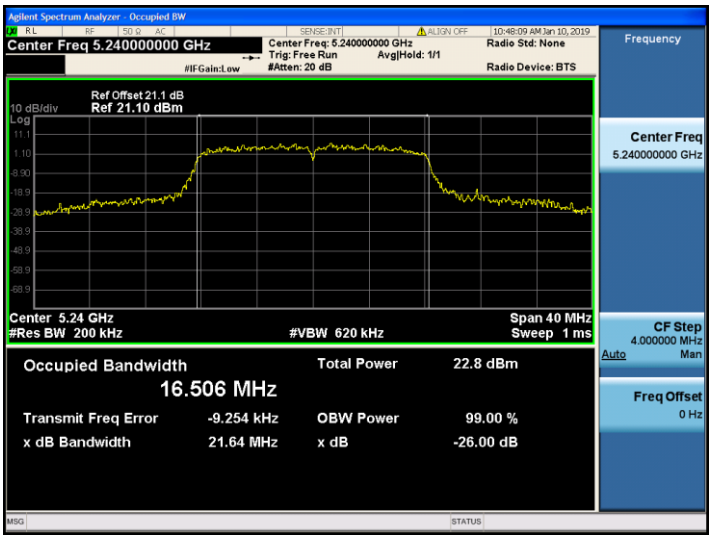
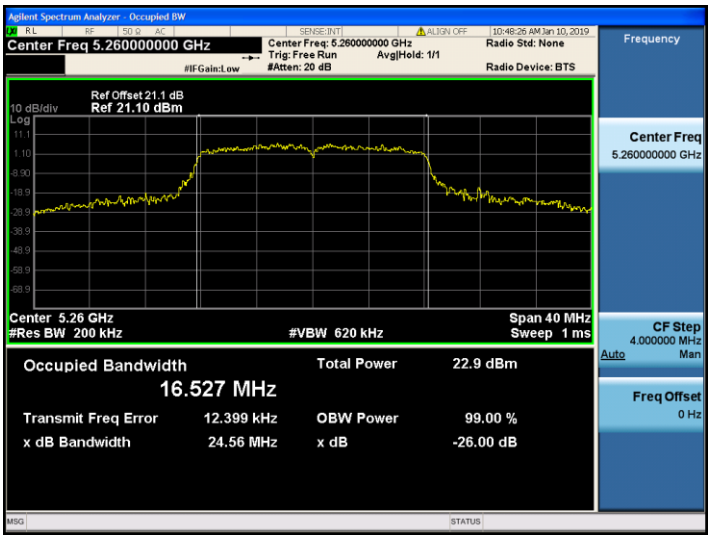
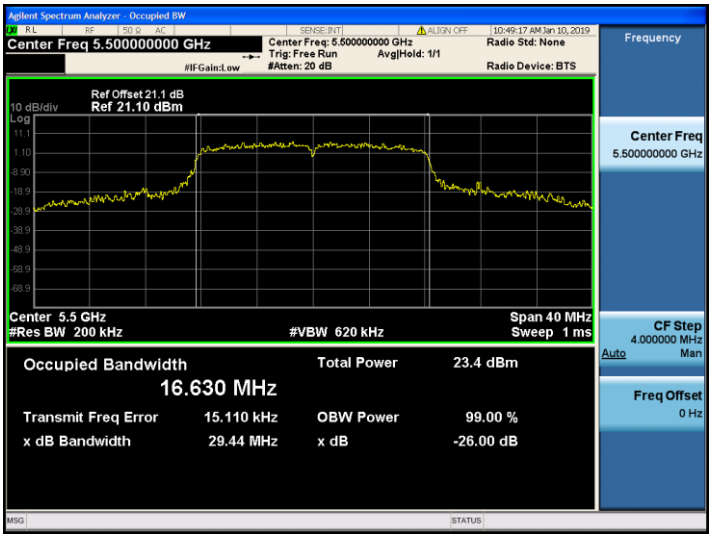
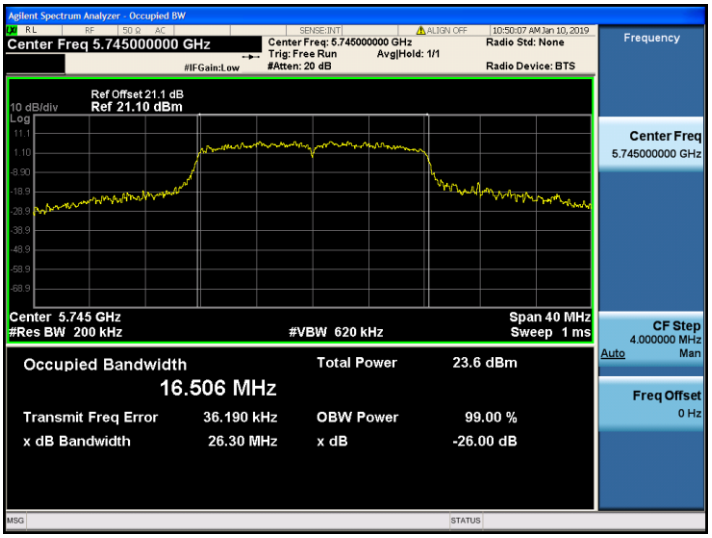
802.11ac(VHT40) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5190	38	49.26	37.897
5230	46	53.89	38.047
5270	54	58.85	37.869
5310	62	53.13	37.933
5510	102	66.26	38.235
5590	118	54.86	37.835
5710	142	60.18	38.177
5755	151	60.33	37.937
5795	159	52.64	37.863

802.11ac(VHT80) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5210	42	83.71	75.588
5290	58	84.26	75.465
5530	106	81.34	75.531
5610	122	104.61	75.594
5690	138	83.35	75.489
5775	155	85.40	75.607

▣ Test Plots(802.11a)

Note:

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

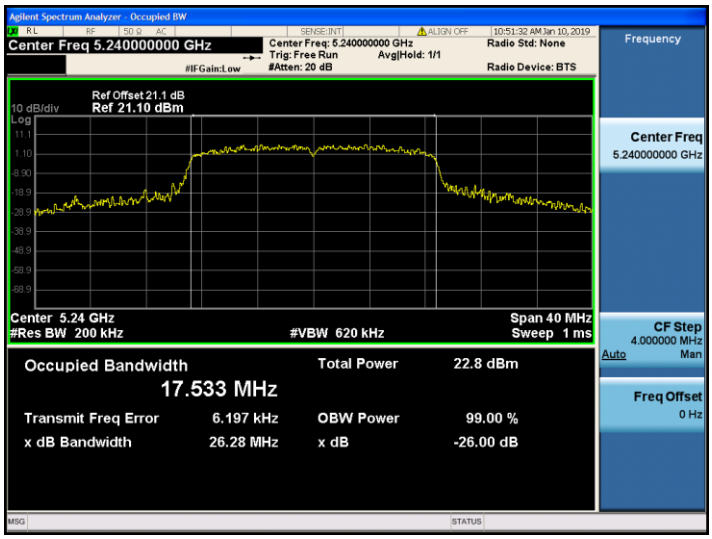
802.11a UNII 1 BAND 26dB Bandwidth (CH 48)	802.11a UNII 2A BAND 26dB Bandwidth (CH 52)
	
802.11a UNII 2C BAND 26dB Bandwidth (CH100)	**802.11a UNII 3 BAND 26dB Bandwidth (CH 149)**
	

▣ Test Plots(802.11n(HT20))

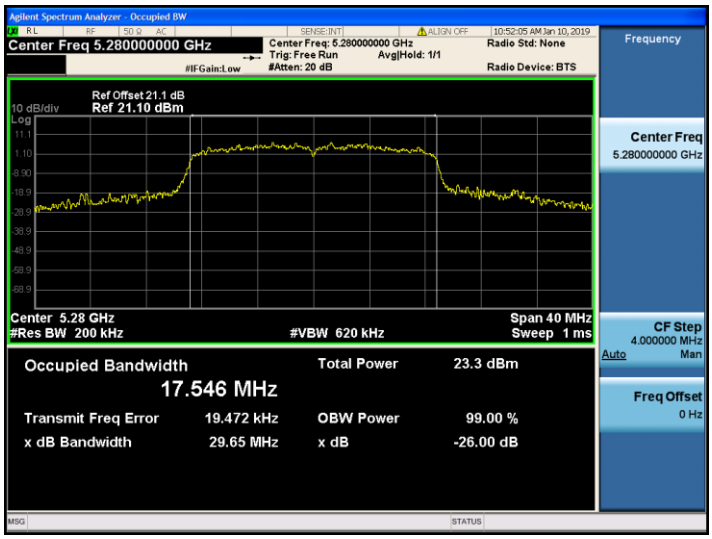
Note:

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

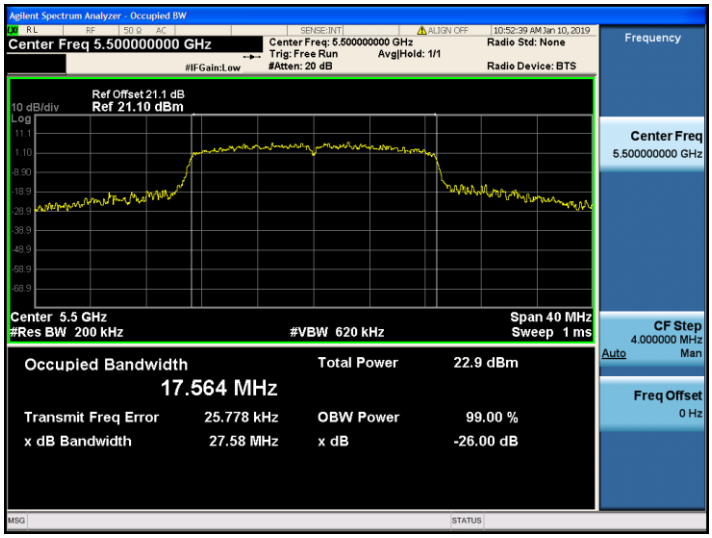
802.11n_HT20 UNII 1 BAND 26dB Bandwidth(CH 48)



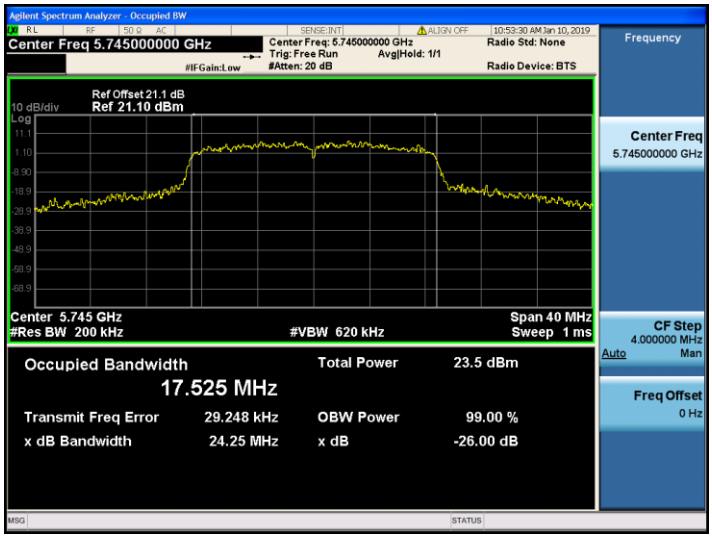
802.11n_HT20 UNII 2A BAND 26dB Bandwidth(CH 56)



802.11n_HT20 UNII 2C BAND 26dB Bandwidth(CH 100)



802.11n_HT20 UNII 3 BAND 26dB Bandwidth(CH 149)

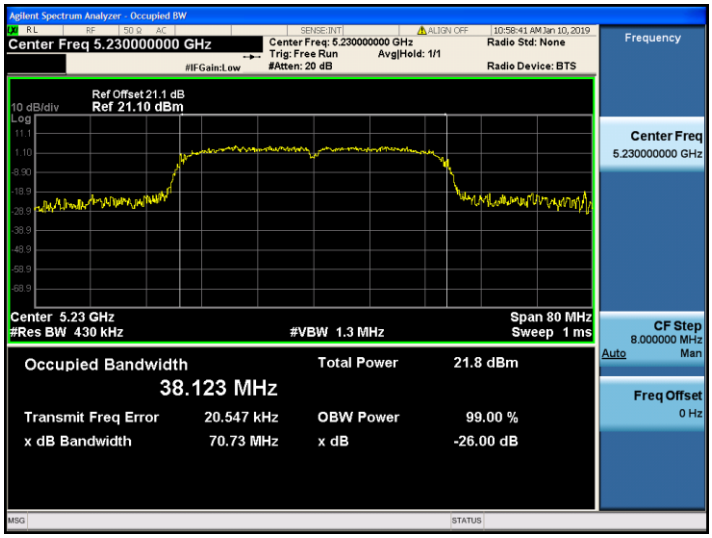


▣ Test Plots(802.11n(HT40))

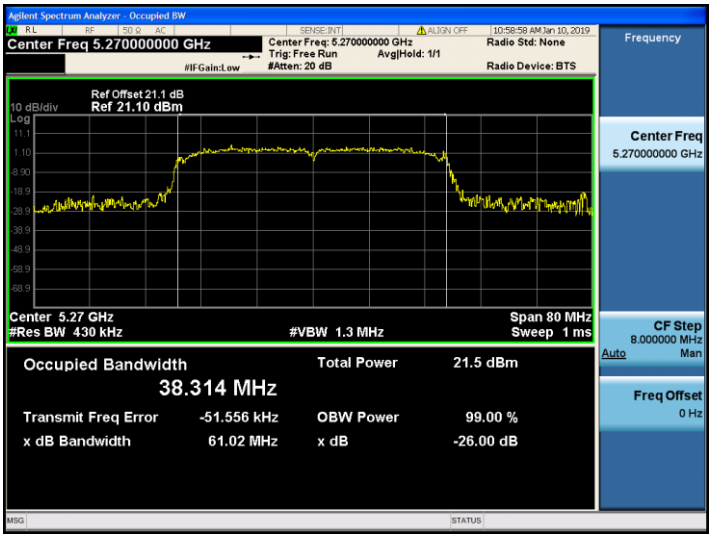
Note:

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

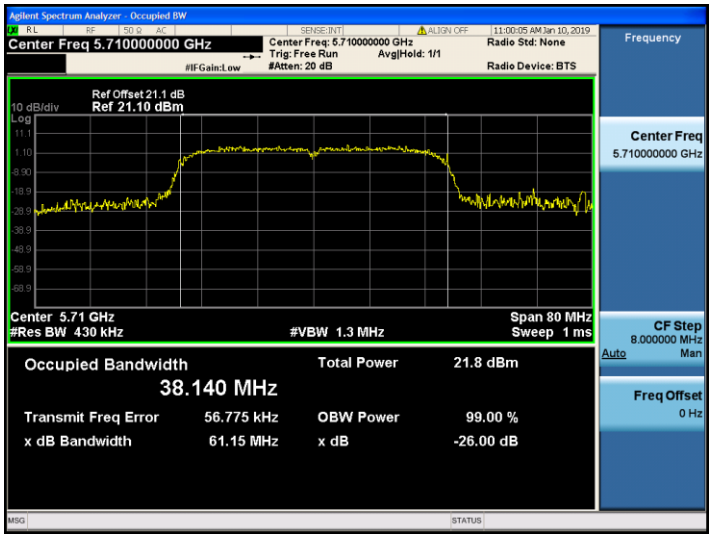
802.11n_HT40 UNII 1 BAND 26dB Bandwidth(CH 46)



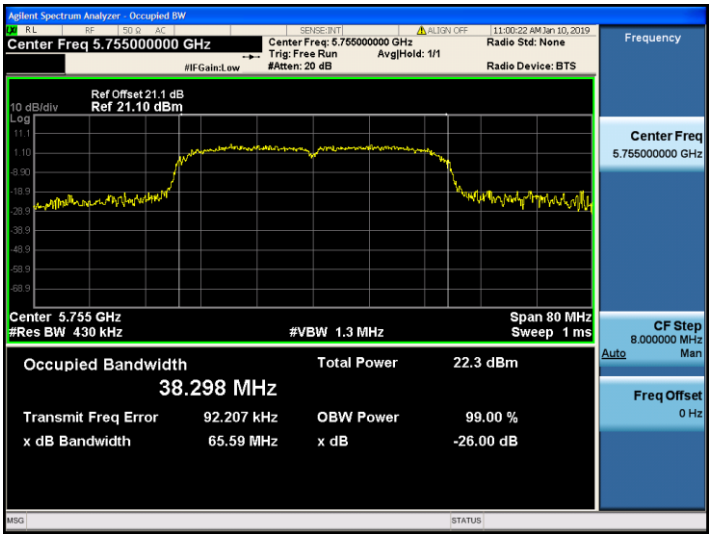
802.11n_HT40 UNII 2A BAND 26dB Bandwidth (CH 54)



802.11n_HT40 UNII 2C BAND 26dB Bandwidth(CH 142)



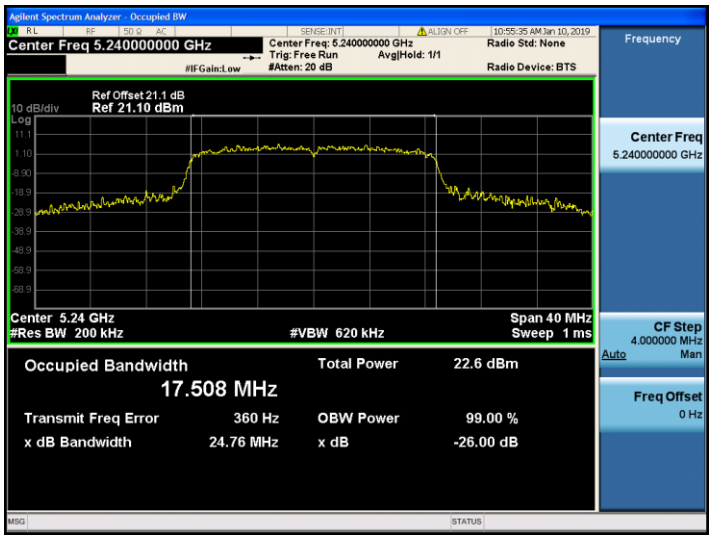
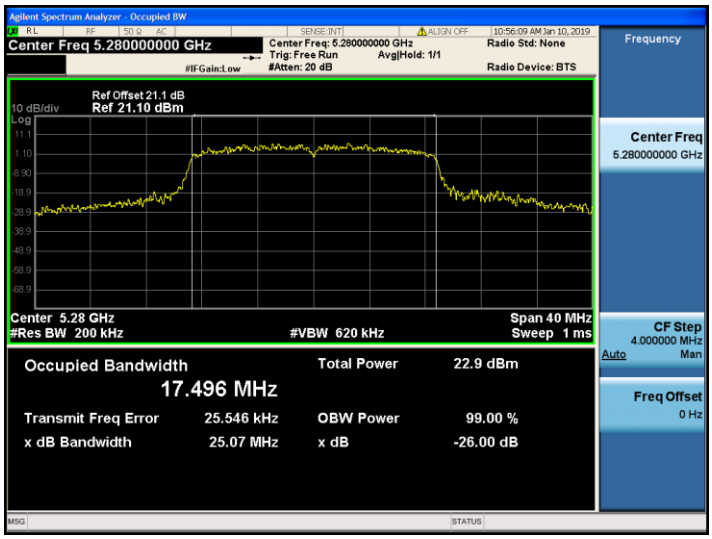
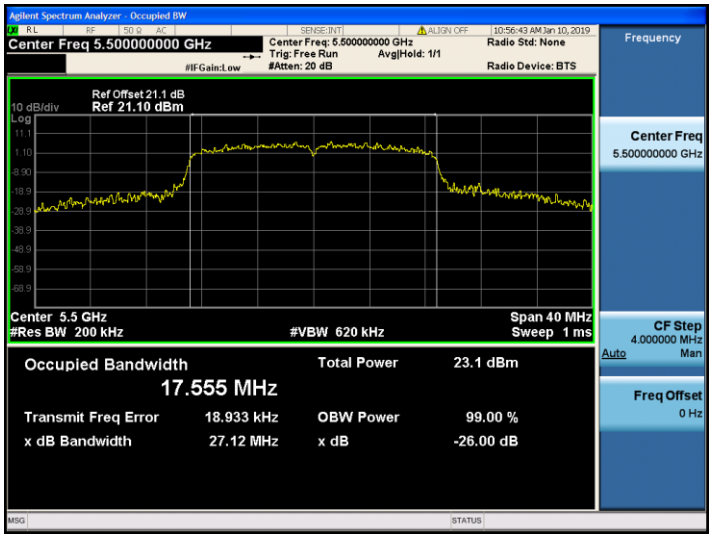
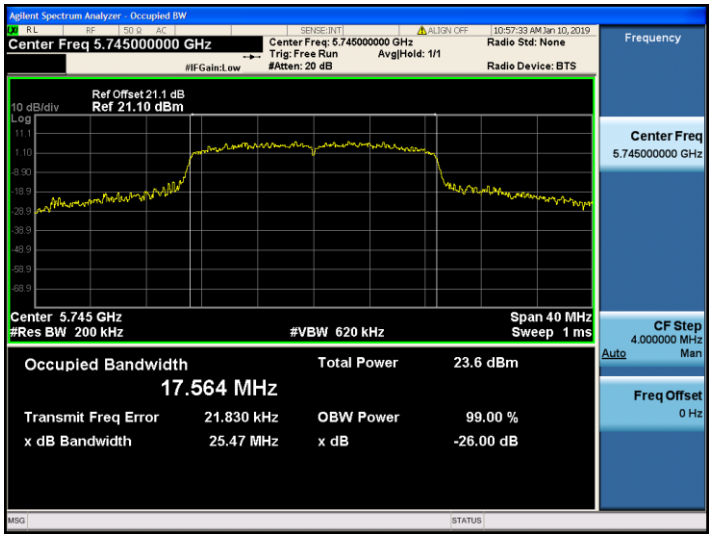
802.11n_HT40 UNII 3 BAND 26dB Bandwidth (CH 151)



▣ Test Plots(802.11ac(VHT20))

Note:

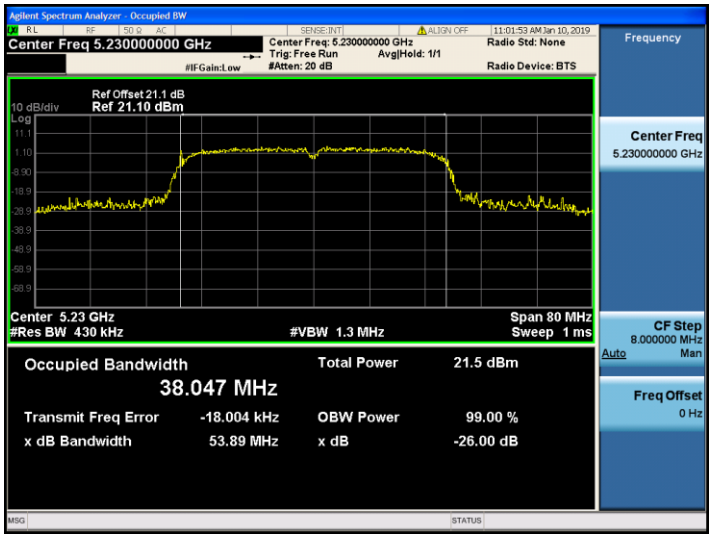
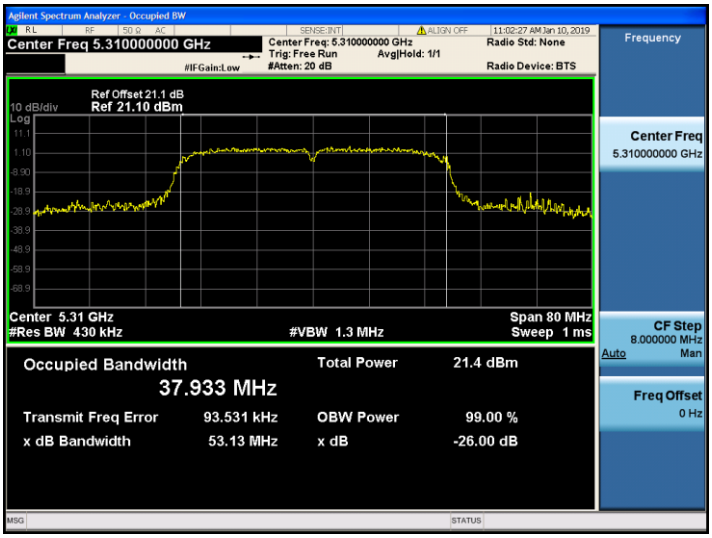
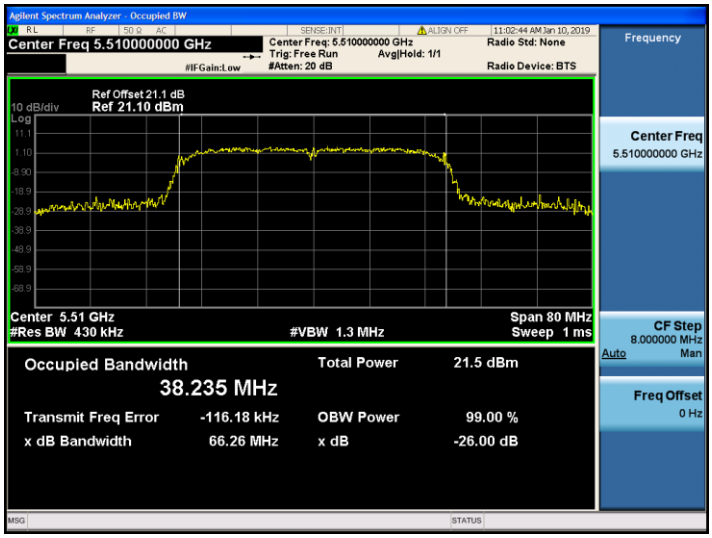
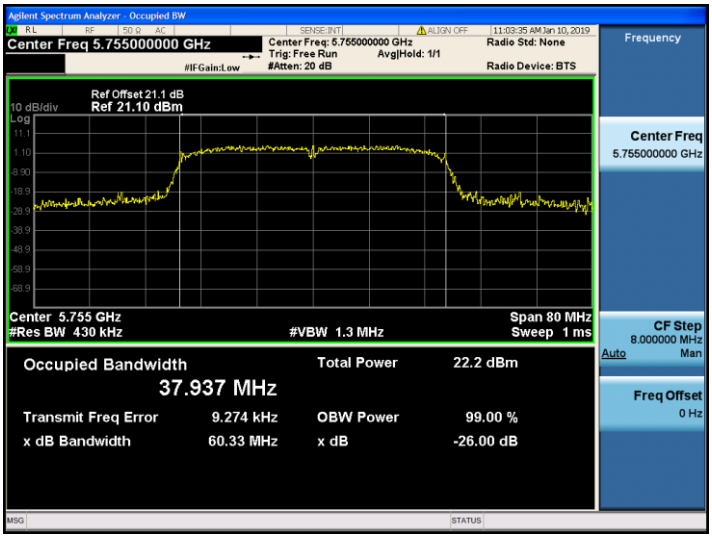
In order to simplify the report, attached plots were only the most wide channel.

802.11ac_VHT20 UNII 1 BAND 26dB Bandwidth(CH 48)	802.11ac_VHT20 UNII 2A BAND 26dB Bandwidth(CH 56)
	
802.11ac_VHT20 UNII 2C BAND 26dB Bandwidth(CH 100)	**802.11ac_VHT20 UNII 3 BAND 26dB Bandwidth(CH 149)**
	

▣ Test Plots(802.11ac(VHT40))

Note:

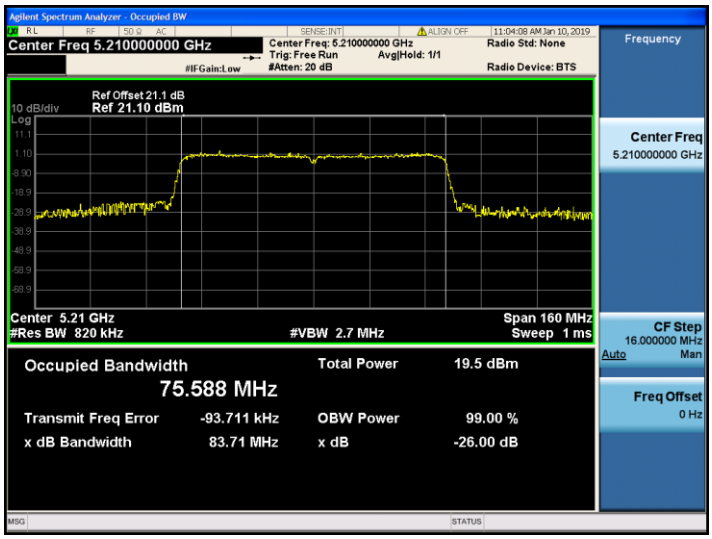
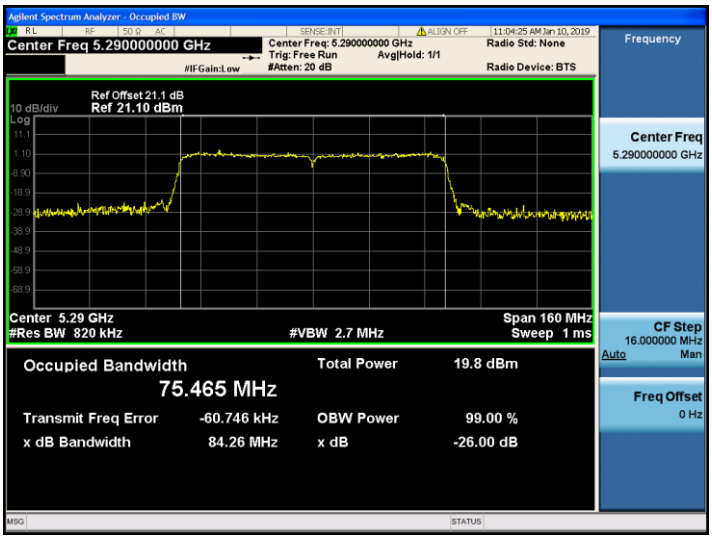
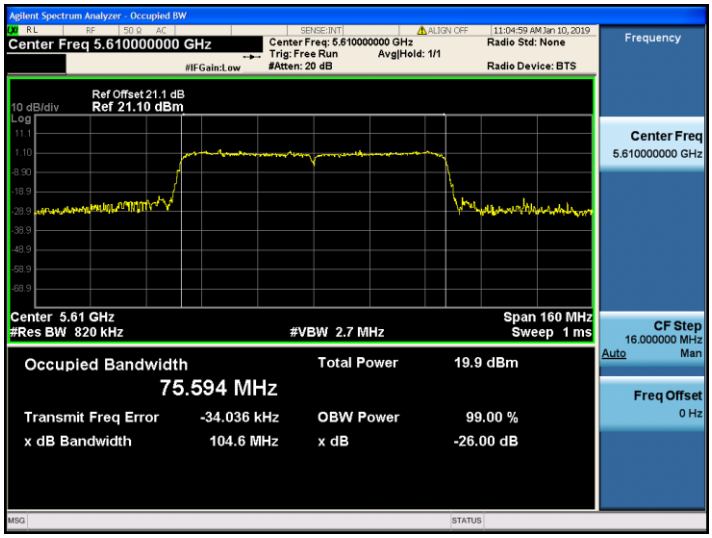
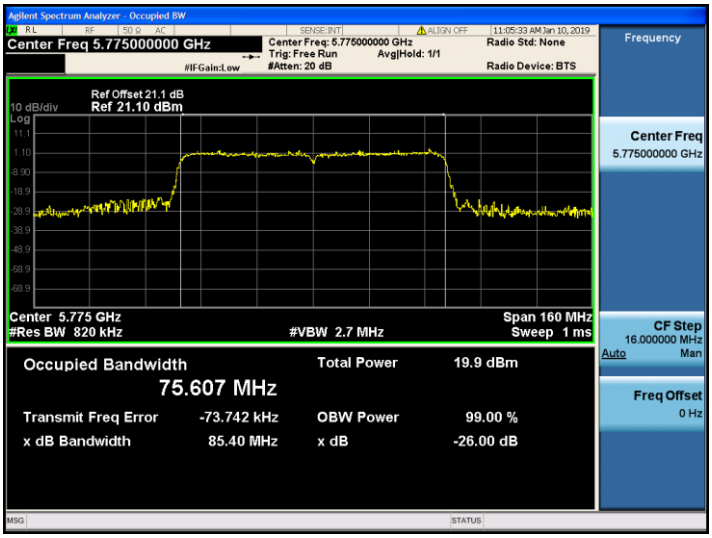
In order to simplify the report, attached plots were only the most wide channel.

802.11ac_VHT40 UNII 1 BAND 26dB Bandwidth(CH 46)	802.11ac_VHT40 UNII 2A BAND 26dB Bandwidth (CH 62)
	
802.11ac_VHT40 UNII 2C BAND 26dB Bandwidth(CH 102)	**802.11ac_VHT40 UNII 3 BAND 26dB Bandwidth (CH 151)**
	

▣ 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 122)	**802.11ac_VHT80 UNII 3 BAND 26dB Bandwidth (CH 155)**
	

10.3 6DB BANDWIDTH

802.11a Mode		Measured Bandwidth [MHz]	Limit [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5745	149	15.16	> 0.5	Pass
5785	157	15.78	> 0.5	Pass
5825	165	15.65	> 0.5	Pass

802.11n(HT20) Mode		Measured Bandwidth [MHz]	Limit [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5745	149	15.13	> 0.5	Pass
5785	157	15.35	> 0.5	Pass
5825	165	15.31	> 0.5	Pass

802.11n(HT40) Mode		Measured Bandwidth [MHz]	Limit [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5755	151	34.16	> 0.5	Pass
5795	159	35.17	> 0.5	Pass

802.11ac(VHT20) Mode		Measured Bandwidth [MHz]	Limit [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5745	149	15.12	> 0.5	Pass
5785	157	14.78	> 0.5	Pass
5825	165	15.16	> 0.5	Pass

802.11ac(VHT40) Mode		Measured Bandwidth [MHz]	Limit [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5755	151	35.17	> 0.5	Pass
5795	159	34.16	> 0.5	Pass

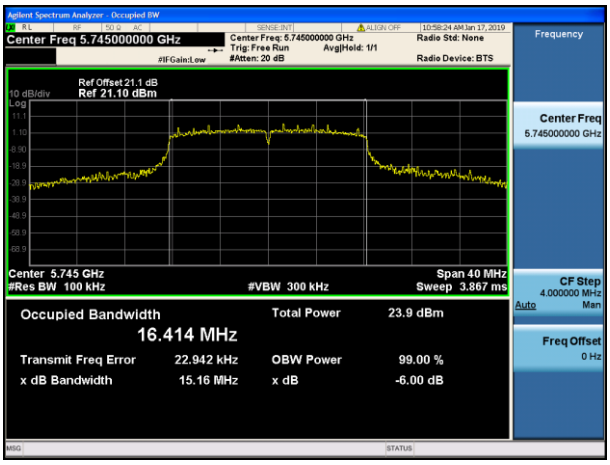
802.11ac(VHT80) Mode		Measured Bandwidth [MHz]	Limit [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5775	155	75.25	> 0.5	Pass

▣ Test Plots

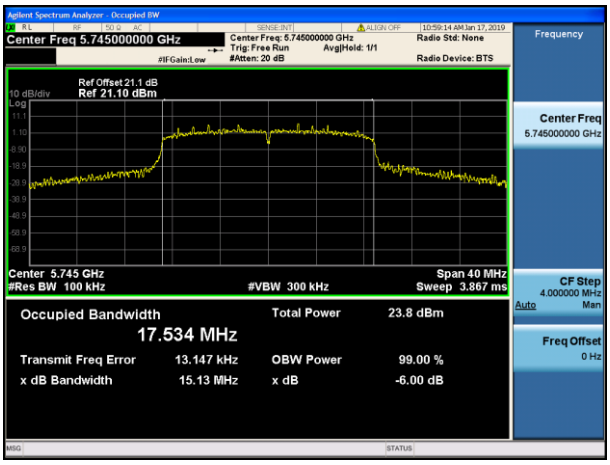
Note:

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

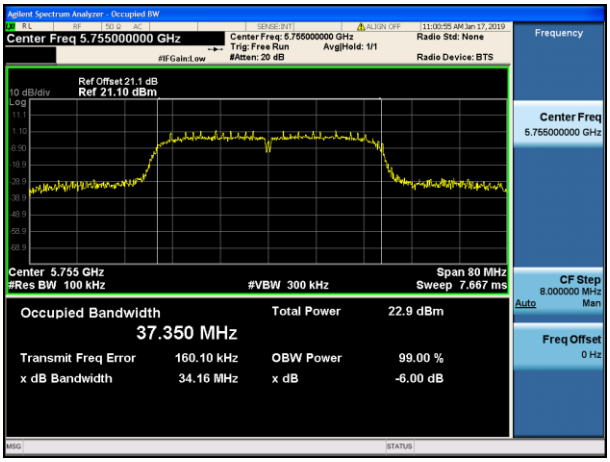
802.11a (CH.149)



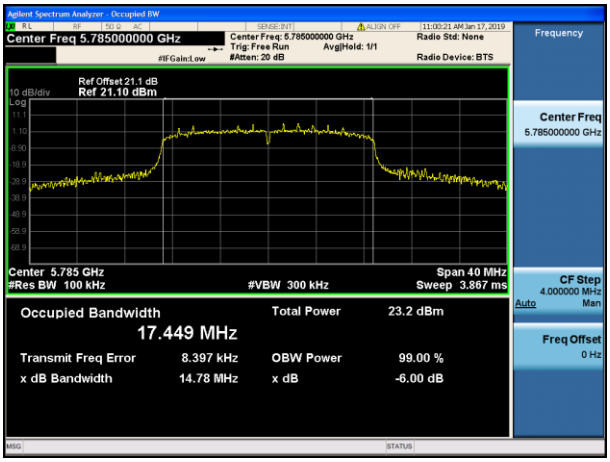
802.11n(HT20) (CH.149)



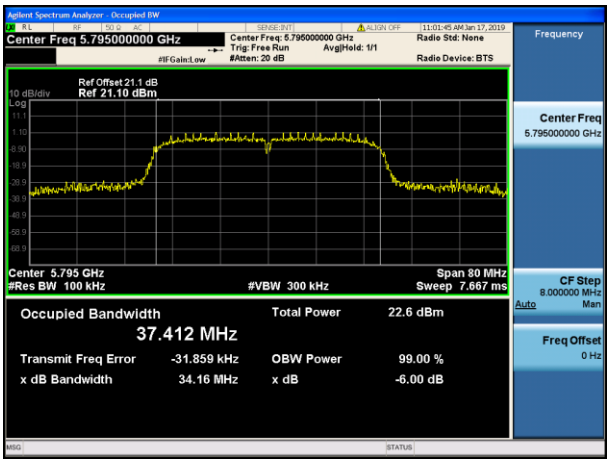
802.11n(HT40) (CH.151)



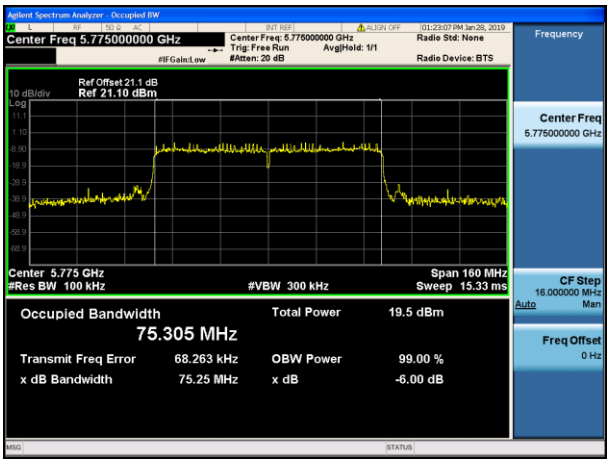
802.11ac(VHT20) (CH.157)



802.11ac(VHT40) (CH.159)



802.11ac(VHT80) (CH.155)



10.4 OUTPUT POWER MEASUREMENT

802.11a Mode		Power Level Setting	Measured Power [dBm]	Duty Cycle Factor (dB)	Total Power [dBm]	Limit (dBm)
Frequency [MHz]	Channel No.					
5180	36	17	13.72	1.665	15.39	23.98
5200	40		14.69	1.665	16.36	23.98
5240	48		15.07	1.665	16.73	23.98
5260	52		14.93	1.665	16.59	23.98
5280	56		15.41	1.665	17.07	23.98
5320	64		14.86	1.665	16.52	23.98
5500	100		15.24	1.665	16.90	23.98
5600	120		14.95	1.665	16.62	23.98
5720	144		15.51	1.665	17.17	23.98
5745	149		15.59	1.665	17.25	30.00
5785	157		15.04	1.665	16.70	30.00
5825	165		14.89	1.665	16.56	30.00

802.11n(20MHz) Mode		Power Level Setting	Measured Power [dBm]	Duty Cycle Factor (dB)	Total Power [dBm]	Limit (dBm)
Frequency [MHz]	Channel No.					
5180	36	17	14.56	1.673	16.23	23.98
5200	40		14.94	1.673	16.61	23.98
5240	48		15.13	1.673	16.80	23.98
5260	52		15.07	1.673	16.74	23.98
5280	56		15.53	1.673	17.20	23.98
5320	64		14.97	1.673	16.65	23.98
5500	100	14	12.87	1.673	14.54	23.98
5600	120	17	14.91	1.673	16.59	23.98
5720	144		15.62	1.673	17.30	23.98
5745	149		15.78	1.673	17.45	30.00
5785	157		15.22	1.673	16.90	30.00
5825	165		15.00	1.673	16.67	30.00

802.11n(40MHz) Mode		Power Level Setting	Measured Power [dBm]	Duty Cycle Factor (dB)	Total Power [dBm]	Limit (dBm)
Frequency [MHz]	Channel No.					
5190	38	13	10.89	2.533	13.42	23.98
5230	46	16	13.32	2.533	15.85	23.98
5270	54		12.99	2.533	15.52	23.98
5310	62	11	8.94	2.533	11.47	23.98
5510	102	9	6.80	2.533	9.33	23.98
5590	118	16	12.52	2.533	15.06	23.98
5710	142		13.57	2.533	16.11	23.98
5755	151		13.43	2.533	15.96	30.00
5795	159		12.87	2.533	15.40	30.00

802.11ac(20MHz) Mode		Power Level Setting	Measured Power [dBm]	Duty Cycle Factor (dB)	Total Power [dBm]	Limit (dBm)
Frequency [MHz]	Channel No.					
5180	36	17	14.44	1.549	15.99	23.98
5200	40		14.90	1.549	16.45	23.98
5240	48		15.11	1.549	16.66	23.98
5260	52		14.92	1.549	16.47	23.98
5280	56		15.22	1.549	16.76	23.98
5320	64		14.94	1.549	16.49	23.98
5500	100	14	12.84	1.549	14.39	23.98
5600	120	17	15.03	1.549	16.58	23.98
5720	144		15.64	1.549	17.19	23.98
5745	149		15.72	1.549	17.27	30.00
5785	157		15.12	1.549	16.67	30.00
5825	165		15.01	1.549	16.56	30.00

802.11ac(40MHz) Mode		Power Level Setting	Measured Power [dBm]	Duty Cycle Factor (dB)	Total Power [dBm]	Limit (dBm)
Frequency [MHz]	Channel No.					
5190	38	13	10.72	2.480	13.20	23.98
5230	46	16	13.25	2.480	15.73	23.98
5270	54		13.03	2.480	15.51	23.98
5310	62	11	8.99	2.480	11.47	23.98
5510	102	9	6.98	2.480	9.46	23.98
5590	118	16	12.58	2.480	15.06	23.98
5710	142		13.45	2.480	15.93	23.98
5755	151		13.42	2.480	15.90	30.00
5795	159		13.03	2.480	15.51	30.00

802.11ac(80MHz) Mode		Power Level Setting	Measured Power [dBm]	Duty Cycle Factor (dB)	Total Power [dBm]	Limit (dBm)
Frequency [MHz]	Channel No.					
5210	42	9	6.31	2.679	8.99	23.98
5290	58		6.36	2.679	9.04	23.98
5530	106		5.91	2.679	8.59	23.98
5610	122	13	9.99	2.679	12.67	23.98
5690	138		10.31	2.679	12.98	23.98
5775	155		10.13	2.679	12.81	30.00

10.5 POWER SPECTRAL DENSITY

802.11a Mode		Measured PSD [dBm]	Duty Cycle Factor (dB)	Total PSD [dBm]	Limit (dBm)
Frequency [MHz]	Channel No.				
5180	36	4.641	1.665	6.306	11
5200	40	4.472	1.665	6.137	11
5240	48	5.059	1.665	6.724	11
5260	52	4.710	1.665	6.375	11
5280	56	5.671	1.665	7.336	11
5320	64	4.531	1.665	6.196	11
5500	100	5.482	1.665	7.147	11
5600	120	4.976	1.665	6.641	11
5720	144	5.462	1.665	7.127	11
5745	149	3.068	1.665	4.733	30
5785	157	2.199	1.665	3.864	30
5825	165	2.386	1.665	4.051	30

802.11n(20MHz) Mode		Measured PSD [dBm]	Duty Cycle Factor (dB)	Total PSD [dBm]	Limit (dBm)
Frequency [MHz]	Channel No.				
5180	36	4.291	1.673	5.964	11
5200	40	4.867	1.673	6.540	11
5240	48	5.192	1.673	6.865	11
5260	52	5.056	1.673	6.729	11
5280	56	5.463	1.673	7.136	11
5320	64	4.474	1.673	6.147	11
5500	100	2.908	1.673	4.581	11
5600	120	4.789	1.673	6.462	11
5720	144	5.128	1.673	7.011	11
5745	149	2.460	1.673	4.481	30
5785	157	2.064	1.673	3.737	30
5825	165	1.778	1.673	3.451	30

802.11n(40MHz) Mode		Measured PSD [dBm]	Duty Cycle Factor (dB)	Total PSD [dBm]	Limit (dBm)
Frequency [MHz]	Channel No.				
5190	38	-2.362	2.533	0.171	11
5230	46	-0.573	2.533	1.960	11
5270	54	-0.837	2.533	1.696	11
5310	62	-4.523	2.533	-1.990	11
5510	102	-6.351	2.533	-3.818	11
5590	118	-0.732	2.533	1.801	11
5710	142	-0.108	2.533	2.425	11
5755	151	-2.661	2.533	-0.128	30
5795	159	-3.072	2.533	-0.539	30

802.11ac(20MHz) Mode		Measured PSD [dBm]	Duty Cycle Factor (dB)	Total PSD [dBm]	Limit (dBm)
Frequency [MHz]	Channel No.				
5180	36	4.274	1.549	5.823	11
5200	40	4.561	1.549	6.110	11
5240	48	4.807	1.549	6.356	11
5260	52	4.996	1.549	6.545	11
5280	56	4.977	1.549	6.526	11
5320	64	4.813	1.549	6.362	11
5500	100	2.653	1.549	4.202	11
5600	120	4.819	1.549	6.368	11
5720	144	5.386	1.549	6.935	11
5745	149	2.911	1.549	4.460	30
5785	157	1.885	1.549	3.434	30
5825	165	1.773	1.549	3.322	30

802.11ac(40MHz) Mode		Measured PSD [dBm]	Duty Cycle Factor (dB)	Total PSD [dBm]	Limit (dBm)
Frequency [MHz]	Channel No.				
5190	38	-2.374	2.480	0.106	11
5230	46	-0.411	2.480	2.069	11
5270	54	-0.627	2.480	1.853	11
5310	62	-4.084	2.480	-1.604	11
5510	102	-6.177	2.480	-3.697	11
5590	118	-0.749	2.480	1.731	11
5710	142	-0.323	2.480	2.157	11
5755	151	-2.205	2.480	0.275	30
5795	159	-3.040	2.480	-0.560	30

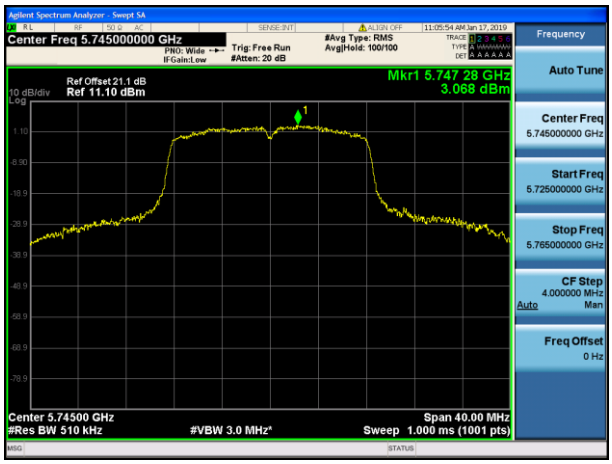
802.11ac(80MHz) Mode		Measured PSD [dBm]	Duty Cycle Factor (dB)	Total PSD [dBm]	Limit (dBm)
Frequency [MHz]	Channel No.				
5210	42	-11.179	2.679	-8.500	11
5290	58	-10.728	2.679	-8.049	11
5530	106	-11.544	2.679	-8.865	11
5610	122	-7.585	2.679	-4.906	11
5690	138	-7.630	2.679	-4.951	11
5775	155	-10.153	2.679	-7.474	30

▣ Test Plots(802.11a)

Note:

In order to simplify the report, attached plots were only channel of highest power.

UNII 1 (Ch. 48)	UNII 2A (Ch. 56)

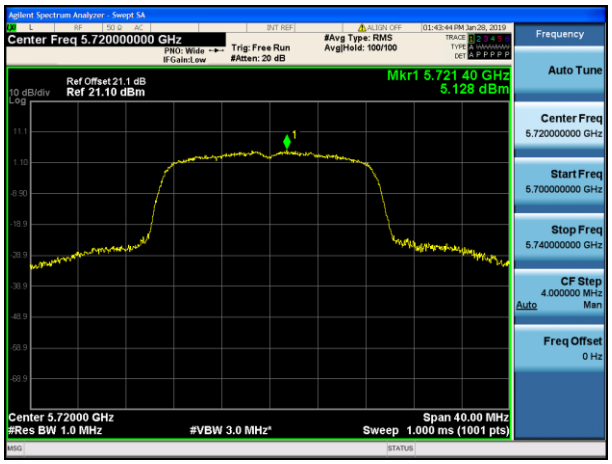
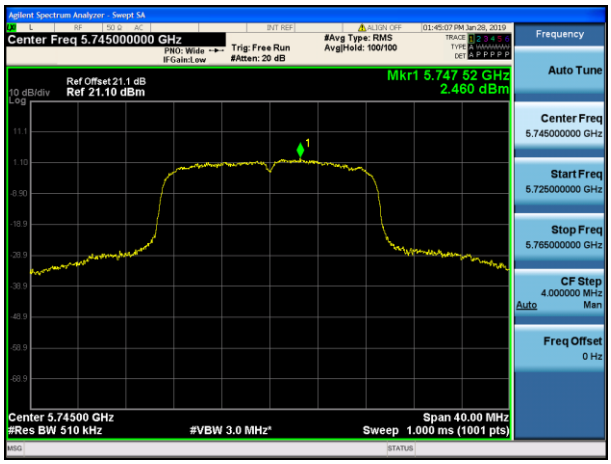
UNII 2C (Ch. 100)	UNII 3 (Ch. 149)
	

▣ Test Plots(802.11n(HT20))

Note:

In order to simplify the report, attached plots were only channel of highest power.

UNII 1 (Ch. 48)	UNII 2A (Ch. 56)

UNII 2C (Ch. 144)	UNII 3 (Ch. 149)
	

▣ Test Plots(802.11n(HT40))

Note:

In order to simplify the report, attached plots were only channel of highest power.

UNII 1 (Ch. 46)	UNII 2A (Ch. 54)

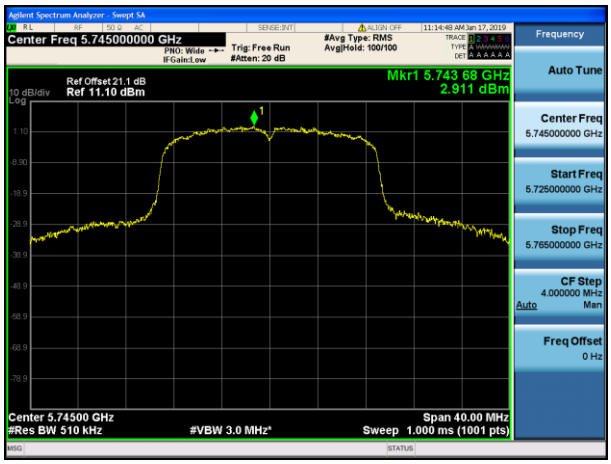
UNII 2C (Ch. 142)	UNII 3 (Ch. 151)

▣ Test Plots(802.11ac(VHT20))

Note:

In order to simplify the report, attached plots were only channel of highest power.

UNII 1 (Ch. 48)	UNII 2A (Ch. 52)

UNII 2C (Ch. 144)	UNII 3 (Ch. 149)
	

▣ Test Plots(802.11ac(VHT40))

Note:

In order to simplify the report, attached plots were only channel of highest power.

UNII 1 (Ch. 46)	UNII 2A (Ch. 54)

UNII 2C (Ch. 142)	UNII 3 (Ch. 151)