

FCC UNII REPORT

Certification

Applicant Name: SAMSUNG Electronics Co., Ltd.	Date of Issue: April 29, 2019
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	Report No.: HCT-RF-1904-FC032

FCC ID: A3LSMT725C

APPLICANT: SAMSUNG Electronics Co., Ltd.

According to the Evaluation report, all of the data contained herein is reused from the reference
FCC ID : A3LSMT725 report.

Model: SM-T725C
EUT Type: Tablet
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. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance.



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Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-1904-FC032	April 29, 2019	- First Approval Report

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1. GENERAL INFORMATION

EUT DESCRIPTION

Model	SM-T725C	
EUT Type	Tablet	
Power Supply	DC 3.85 V	
Battery Information	Model: EB-BT725ABU Type: Li-ion battery	
Travel Adapter Information	Model : EP-TA200 Manufacture: SOLUM	
Keyboard Information	Model : EJ-FT720 Manufacture: SAMSUNG	
Charging Doc Information	Model : EE-D3200 Manufacture: SAMSUNG	
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 Specification	Antenna type: Metal Peak Gain : -6.4 dBi(UNII 1, 2A)/ -6.5dBi(UNII 2C)/ -6.3(UNII 3)	
Straddle channel	Supported	
TDWR Band	Supported	
Dynamic Frequency Selection	Slave without radar detection	
Date(s) of Tests	January 17, 2019 ~ March 18, 2019 / April 1,2019 ~ April 29,2019	

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	17.64	0.058
UNII2A		17.93	0.062
UNII2C		18.25	0.067
UNII3		17.74	0.059
UNII1	802.11n (HT20)	17.58	0.057
UNII2A		17.89	0.061
UNII2C		18.20	0.066
UNII3		17.96	0.062
UNII1	802.11ac (VHT20)	16.98	0.050
UNII2A		17.36	0.054
UNII2C		17.40	0.055
UNII3		17.28	0.053
UNII1	802.11n (HT40)	16.79	0.048
UNII2A		17.16	0.052
UNII2C		16.89	0.049
UNII3		16.75	0.047
UNII1	802.11ac (VHT40)	16.82	0.048
UNII2A		17.22	0.053
UNII2C		16.86	0.049
UNII3		16.69	0.047
UNII1	802.11ac (VHT80)	13.13	0.021
UNII2A		14.12	0.026
UNII2C		16.89	0.049
UNII3		16.76	0.047

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 6.6.5 of ANSI C63.10. (Version: 2013)

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.

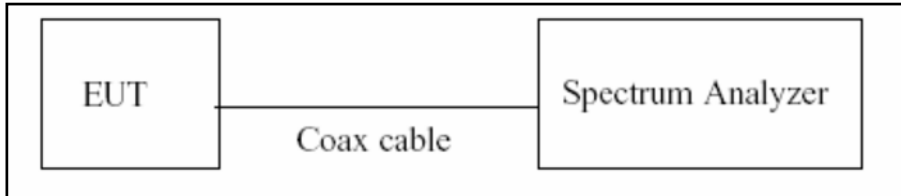
The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (\pm 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.

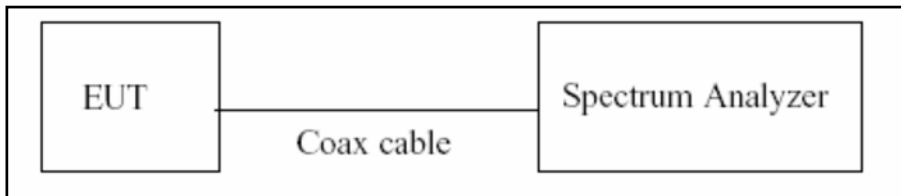
1. RBW = 8 MHz (the largest available value)
2. VBW = 8 MHz (\geq RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure T_{total} and T_{on}
8. Calculate Duty Cycle = T_{on} / T_{total} and Duty Cycle Factor = $10 \cdot \log(1 / \text{Duty Cycle})$

8.2. 6dB Bandwidth & 26dB Bandwidth

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 $\geq 3 \times$ 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 level 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.

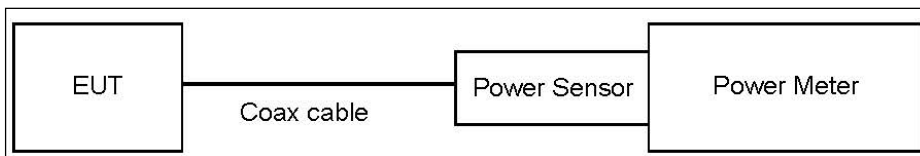
8.3. Output Power Measurement

Limit

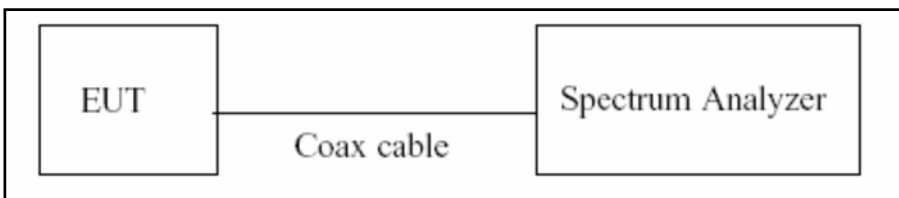
Band	Limit
UNII 1	- Master : Not exceed 1 W(=30dBm) - Slave : Not exceed 250 mW(=23.98 dBm)
UNII 2A, 2C	Not exceed the lesser of 250 mW or 11 dBm + 10 log B, (where B is the 26 dB emission bandwidth in megahertz.)
UNII 3	Not exceed 1 W(=30dBm)

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 $10\log(1/x)$, where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

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	11.1
UNII 2A	11.1
UNII 2C	11.1
UNII 3	11.1

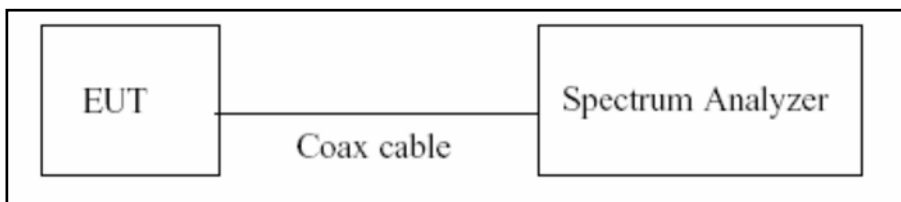
(Actual value of loss for the attenuator and cable combination)

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	11.1
UNII 2A	11.1
UNII 2C	11.1
UNII 3	11.1

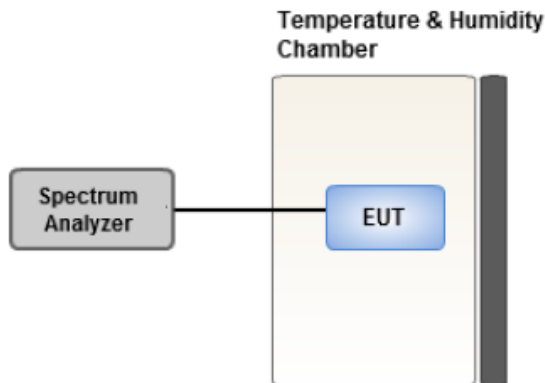
(Actual value of loss for the attenuator and cable combination)

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 °C and 50 °C.
2. The temperature was incremented by 10 °C 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 battery 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 μ H/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Limits (dB μ V)	
	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

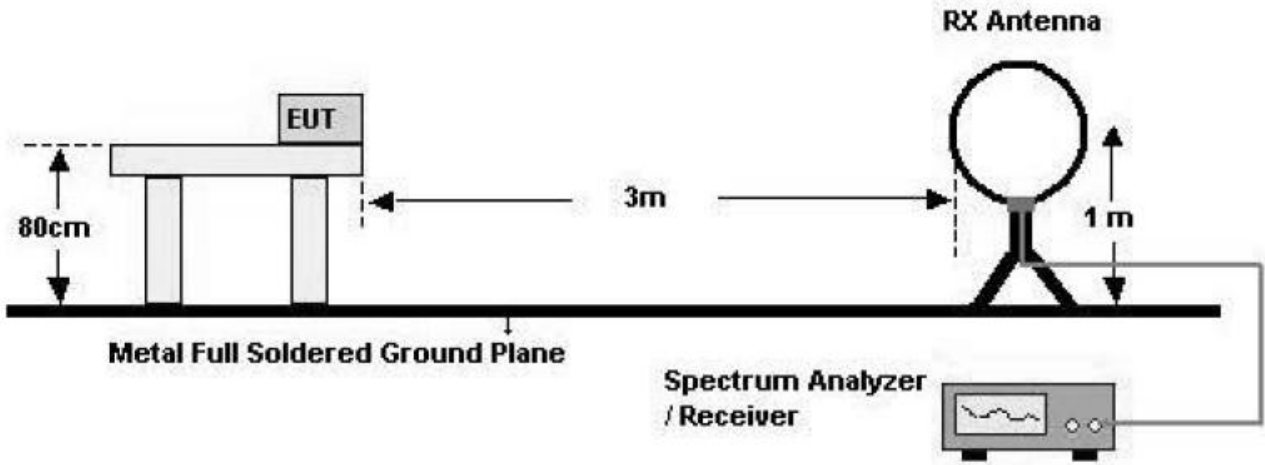
Limit

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.

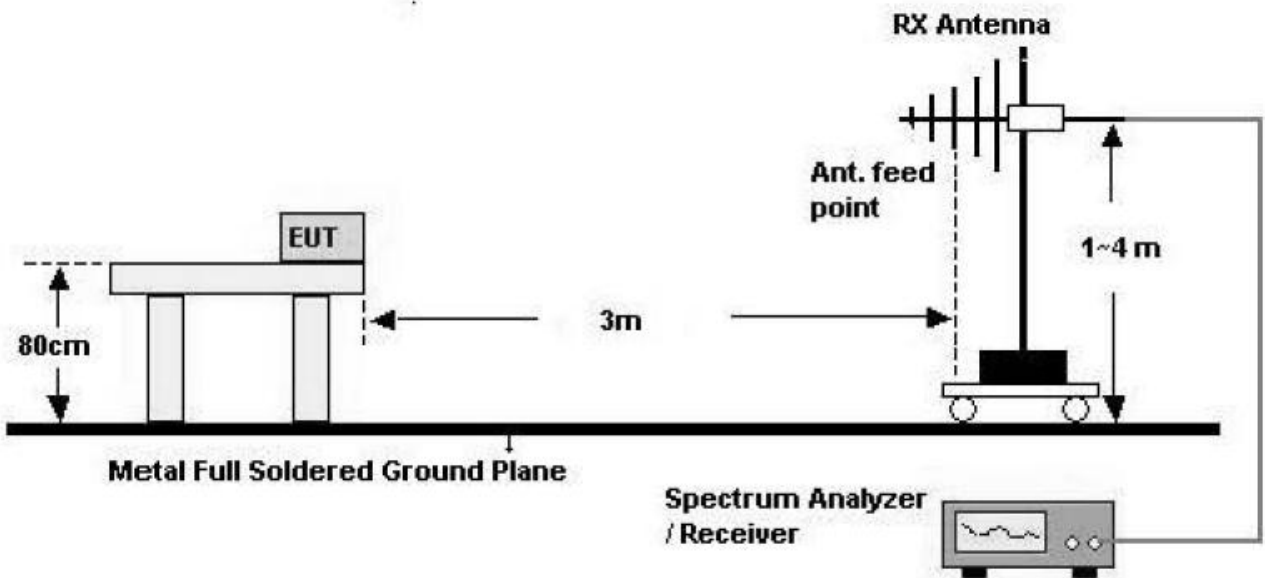
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

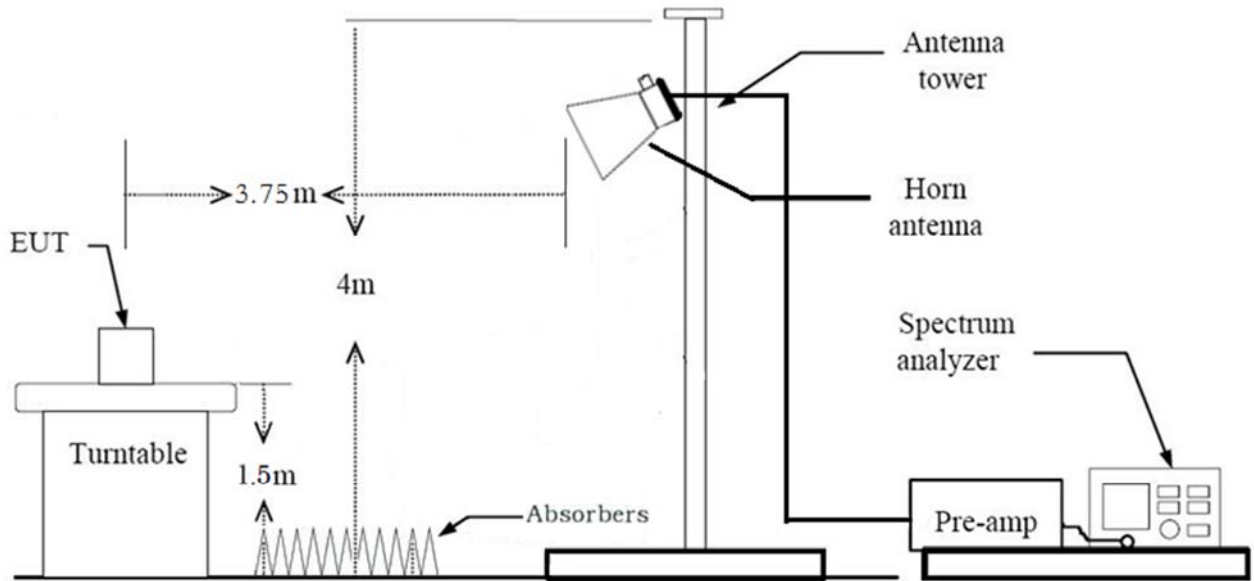
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



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) = $40 \cdot \log(3 \text{ m}/300 \text{ m}) = - 80 \text{ dB}$
Measurement Distance : 3 m
7. Distance Correction Factor(0.490 MHz – 30 MHz) = $40 \cdot \log(3 \text{ m}/30 \text{ m}) = - 40 \text{ dB}$
Measurement Distance : 3 m
8. Spectrum Setting
 - Frequency Range = 9 kHz ~ 30 MHz
 - Detector = Peak
 - Trace = Maxhold
 - RBW = 9 kHz
 - VBW $\geq 3 \cdot$ 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 OFS 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 $\geq 3 \cdot$ 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 = $20 \cdot \log(\text{test distance} / \text{specific distance})$ (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 \geq 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 \geq 98 percent) = $\text{VBW} \leq \text{RBW}/100$ (i.e., 10 kHz) but not less than 10 Hz.
- VBW(Duty cycle is $<$ 98 percent) = $\text{VBW} \geq 1/T$, 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 minimum 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 = $20 \cdot \log(\text{test distance} / \text{specific distance})$ (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 \geq 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 \geq 98 percent) = $\text{VBW} \leq \text{RBW}/100$ (i.e., 10 kHz) but not less than 10 Hz.
- VBW(Duty cycle is $<$ 98 percent) = $\text{VBW} \geq 1/T$, 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 minimum 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	0.975	0.112	1000
802.11n(HT20)	MCS 0	0.973	0.119	1000
802.11n(HT40)	MCS 0	0.950	0.224	3000
802.11ac(VHT20)	MCS 0	0.973	0.119	1000
802.11ac(VHT40)	MCS 0	0.950	0.221	3000
802.11ac(VHT80)	MCS 0	0.902	0.446	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(Keyboard, Charging Doc, 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 + External accessories(Keyboard, Charging Doc, Earphone, etc)+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

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	0.975	0.112
	9	0.961	0.998	0.963	0.163
	12	0.727	0.766	0.949	0.225
	18	0.493	0.529	0.931	0.308
	24	0.376	0.413	0.911	0.404
	36	0.256	0.292	0.876	0.576
	48	0.200	0.236	0.848	0.714
	54	0.180	0.216	0.832	0.798

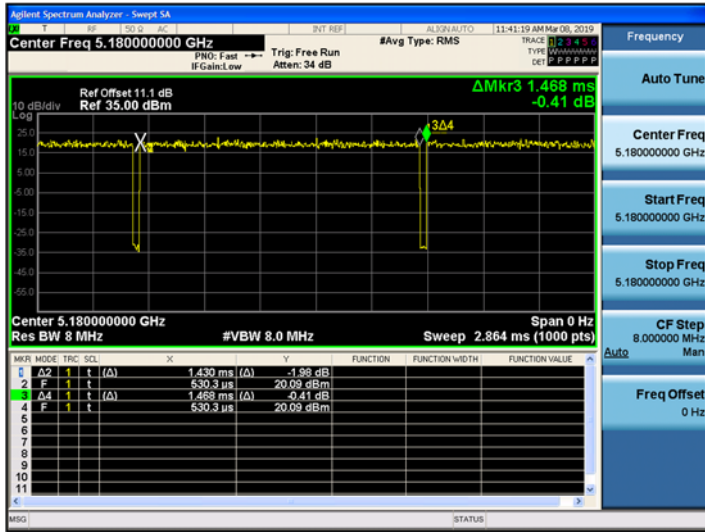
Mode	MCS Index	T _{on} (ms)	T _{total} (ms)	Duty Cycle	Duty Cycle Factor(dB)
802.11n (HT20)	0	1.339	1.376	0.973	0.119
	1	0.688	0.726	0.947	0.234
	2	0.472	0.509	0.928	0.325
	3	0.364	0.401	0.907	0.425
	4	0.256	0.292	0.876	0.575
	5	0.200	0.236	0.847	0.722
	6	0.184	0.220	0.836	0.781
	7	0.168	0.204	0.822	0.849
802.11n (HT40)	0	0.664	0.700	0.950	0.224
	1	0.353	0.388	0.909	0.413
	2	0.249	0.285	0.874	0.586
	3	0.197	0.233	0.846	0.725
	4	0.145	0.180	0.802	0.956
	5	0.117	0.152	0.766	1.157
	6	0.109	0.144	0.756	1.218
	7	0.101	0.136	0.739	1.314

Mode	MCS Index	T _{on} (ms)	T _{total} (ms)	Duty Cycle	Duty Cycle Factor(dB)
802.11ac (VHT20)	0	1.347	1.385	0.973	0.119
	1	0.697	0.733	0.950	0.223
	2	0.477	0.513	0.929	0.322
	3	0.368	0.406	0.908	0.420
	4	0.260	0.296	0.879	0.562
	5	0.204	0.240	0.849	0.710
	6	0.188	0.225	0.839	0.764
	7	0.172	0.208	0.826	0.830
	8	0.152	0.188	0.810	0.917
802.11ac (VHT40)	0	0.673	0.708	0.950	0.221
	1	0.356	0.392	0.910	0.409
	2	0.253	0.288	0.878	0.567
	3	0.201	0.236	0.851	0.702
	4	0.149	0.184	0.807	0.932
	5	0.121	0.156	0.772	1.122
	6	0.112	0.148	0.757	1.210
	7	0.105	0.140	0.750	1.249
	8	0.097	0.132	0.735	1.338
	9	0.089	0.124	0.718	1.440
802.11ac (VHT80)	0	0.332	0.368	0.902	0.446
	1	0.188	0.224	0.840	0.758
	2	0.140	0.176	0.796	0.991
	3	0.116	0.152	0.764	1.170
	4	0.092	0.128	0.717	1.444
	5	0.080	0.116	0.691	1.606
	6	0.076	0.112	0.679	1.684
	7	0.072	0.108	0.667	1.761
	8	0.068	0.104	0.654	1.845
	9	0.064	0.100	0.640	1.938

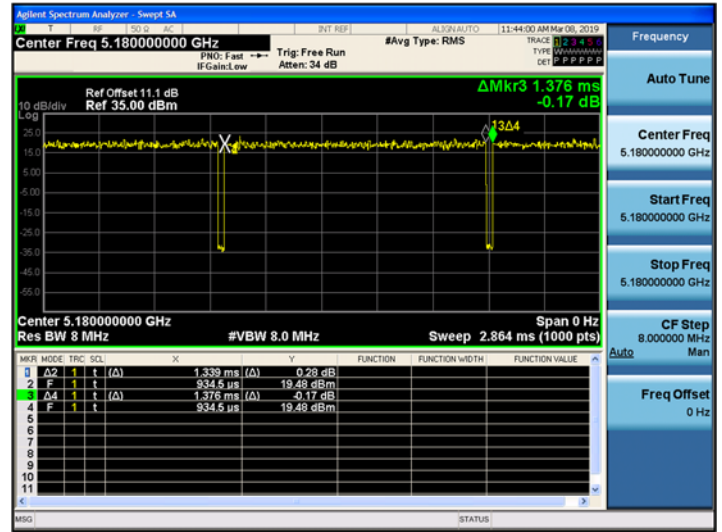
Note:

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

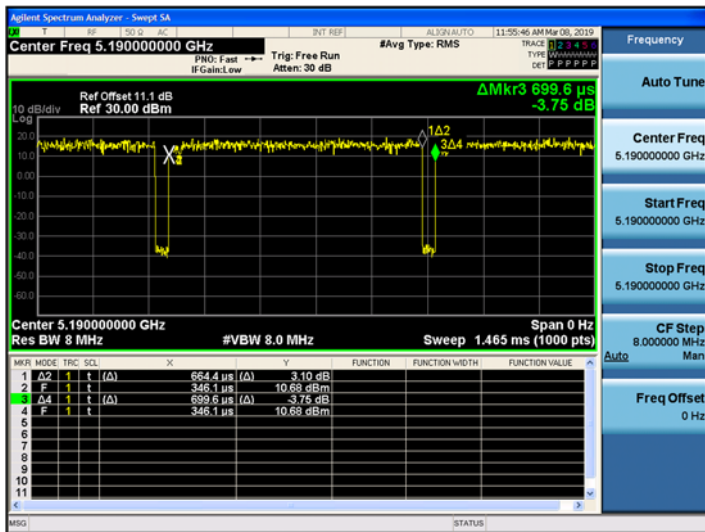
802.11a



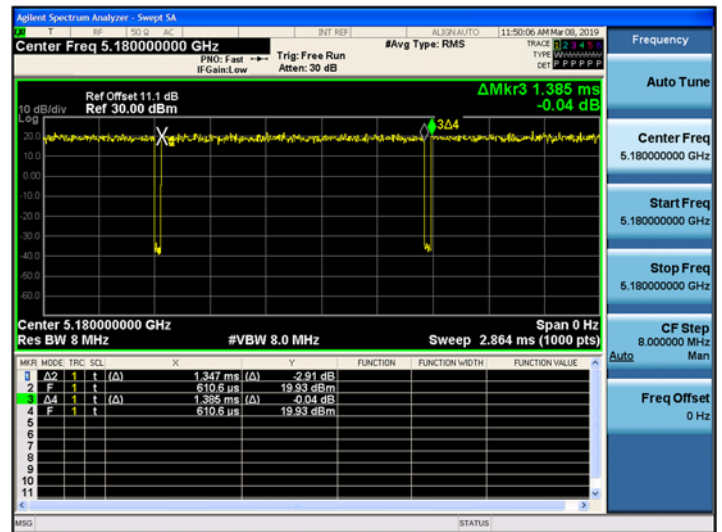
802.11n(HT20)



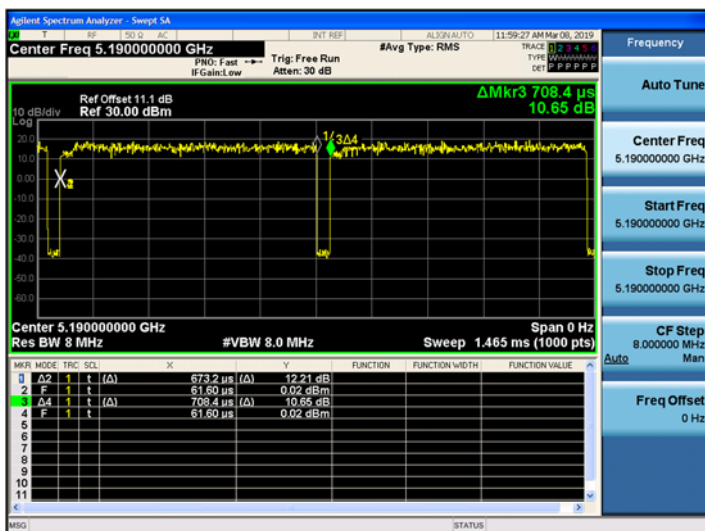
802.11n(HT40)



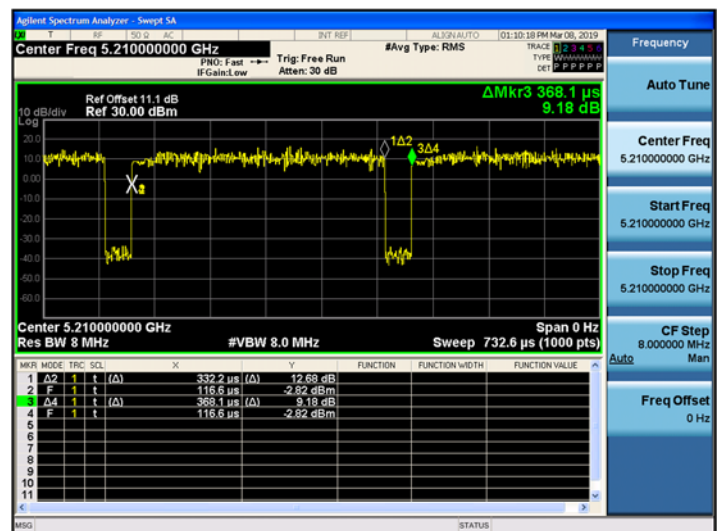
802.11ac(VHT20)



802.11ac(VHT40)



802.11ac(VHT80)



10.2 26 dB BANDWIDTH

802.11a Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5180	36	25.82	16.945
5200	40	25.07	16.709
5240	48	24.92	16.734
5260	52	24.18	16.677
5300	60	22.54	16.636
5320	64	22.59	16.643
5500	100	21.39	16.562
5600	120	21.10	16.513
5720	144	21.39	16.517
5745	149	21.48	16.518
5785	157	21.11	16.549
5825	165	22.61	16.559

802.11n(HT20) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5180	36	25.34	17.873
5200	40	23.74	17.831
5240	48	23.89	17.833
5260	52	24.28	17.824
5300	60	23.20	17.822
5320	64	23.40	17.853
5500	100	21.93	17.722
5600	120	21.09	17.719
5720	144	22.10	17.751
5745	149	21.95	17.716
5785	157	22.47	17.735
5825	165	23.30	17.787

802.11n(HT40) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5190	38	40.95	36.197
5230	46	41.40	36.332
5270	54	41.41	36.281
5310	62	41.25	36.228
5510	102	40.79	36.219
5590	118	41.49	36.213
5710	142	40.72	36.223
5755	151	40.93	36.219
5795	159	40.72	36.287

802.11ac(VHT20) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5180	36	23.18	17.770
5200	40	23.32	17.832
5240	48	23.04	17.757
5260	52	23.08	17.754
5300	60	22.63	17.746
5320	64	22.86	17.724
5500	100	22.11	17.727
5600	120	21.69	17.680
5720	144	21.67	17.685
5745	149	22.20	17.715
5785	157	22.48	17.708
5825	165	22.56	17.733

802.11ac(VHT40) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5190	38	40.96	36.231
5230	46	41.74	36.278
5270	54	47.87	36.290
5310	62	40.65	36.223
5510	102	40.71	36.189
5590	118	41.17	36.280
5710	142	41.09	36.199
5755	151	41.25	36.250
5795	159	41.06	36.208

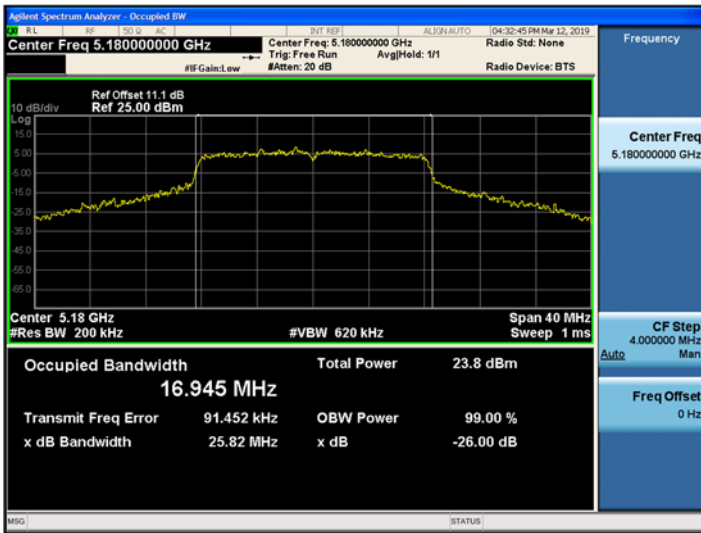
802.11ac(VHT80) Mode		26dB Bandwidth [MHz]	99% bandwidth [MHz]
Frequency [MHz]	Channel No.		
5210	42	83.20	75.666
5290	58	83.13	75.612
5530	106	82.77	75.661
5610	122	83.61	75.642
5690	138	96.29	75.716
5775	155	83.30	75.709

■ Test Plots(802.11a)

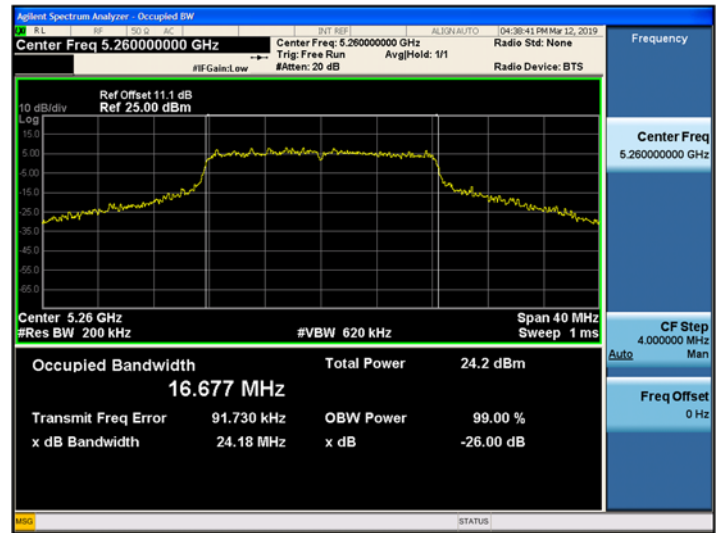
Note:

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

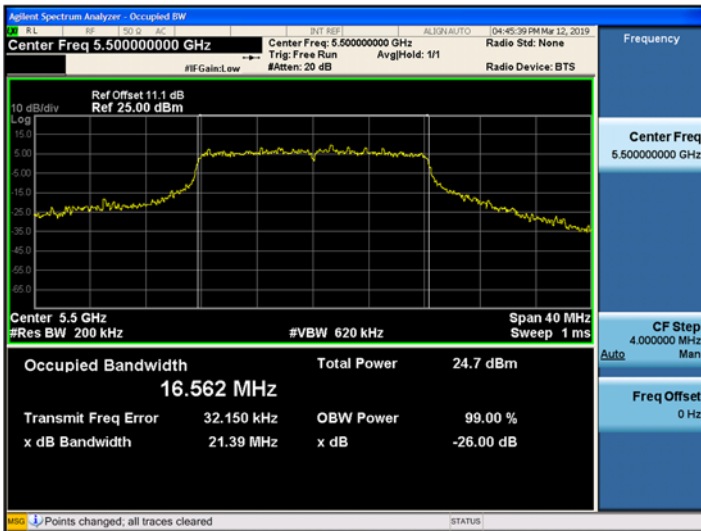
802.11a UNII 1 BAND 26dB Bandwidth (CH 36)



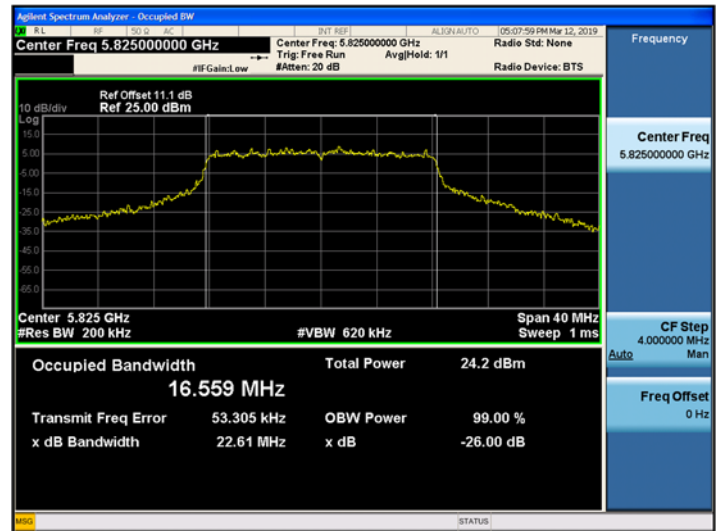
802.11a UNII 2A BAND 26dB Bandwidth (CH 52)



802.11a UNII 2C BAND 26dB Bandwidth (CH100)



802.11a UNII 3 BAND 26dB Bandwidth (CH 165)

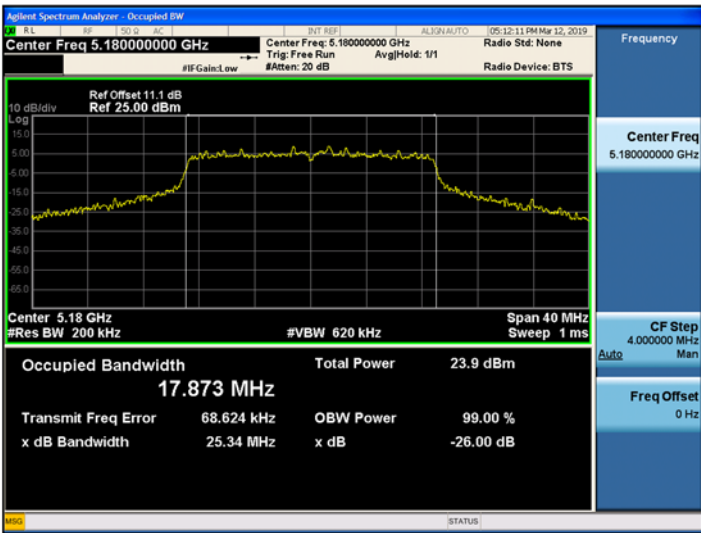


■ Test Plots(802.11n(HT20))

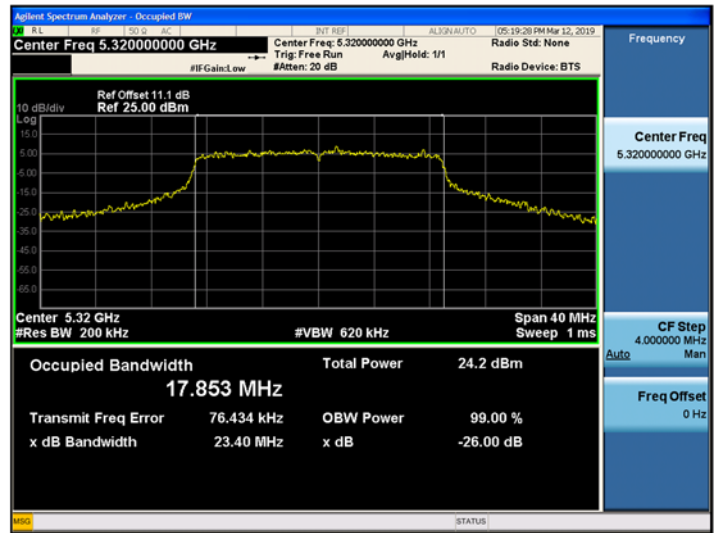
Note:

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

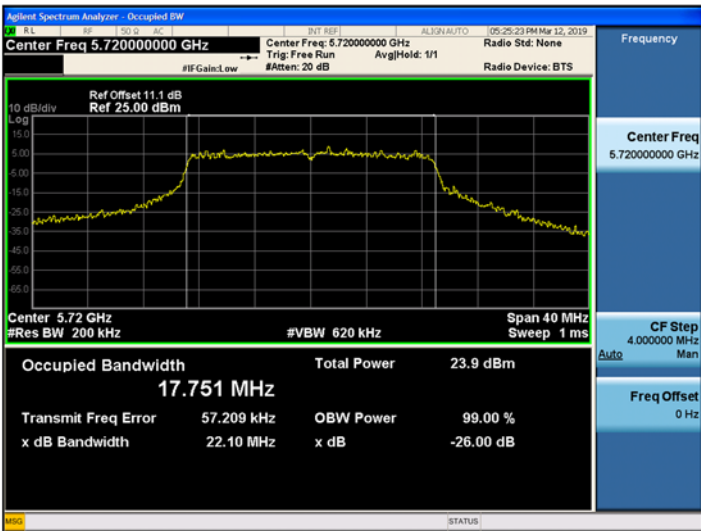
802.11n_HT20 UNII 1 BAND 26dB Bandwidth(CH 36)



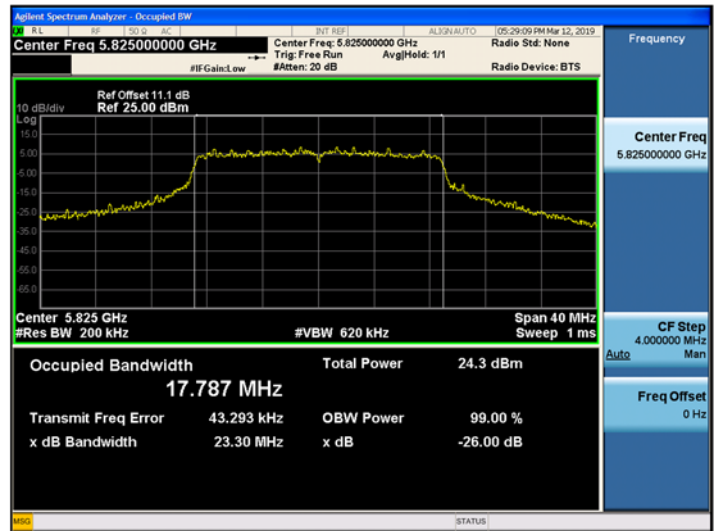
802.11n_HT20 UNII 2A BAND 26dB Bandwidth(CH 64)



802.11n_HT20 UNII 2C BAND 26dB Bandwidth(CH 144)



802.11n_HT20 UNII 3 BAND 26dB Bandwidth(CH 165)

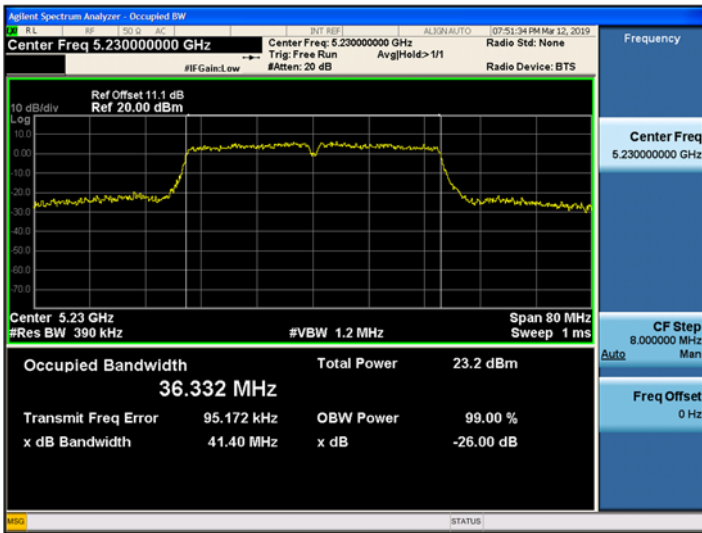


■ Test Plots(802.11n(HT40))

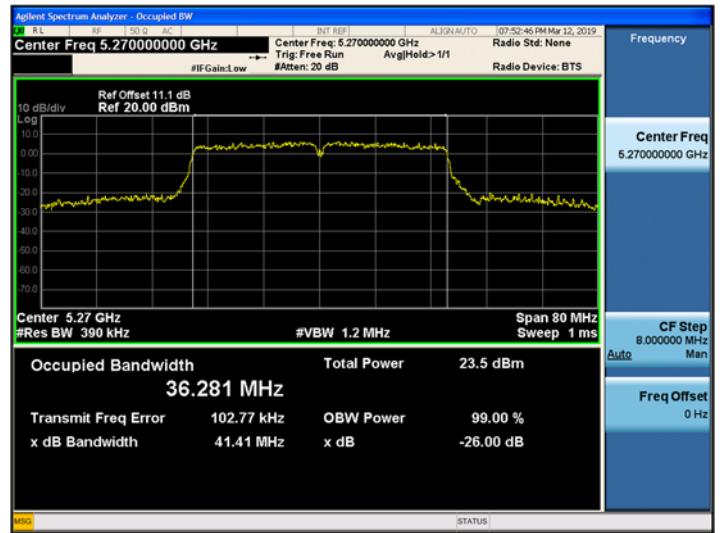
Note:

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

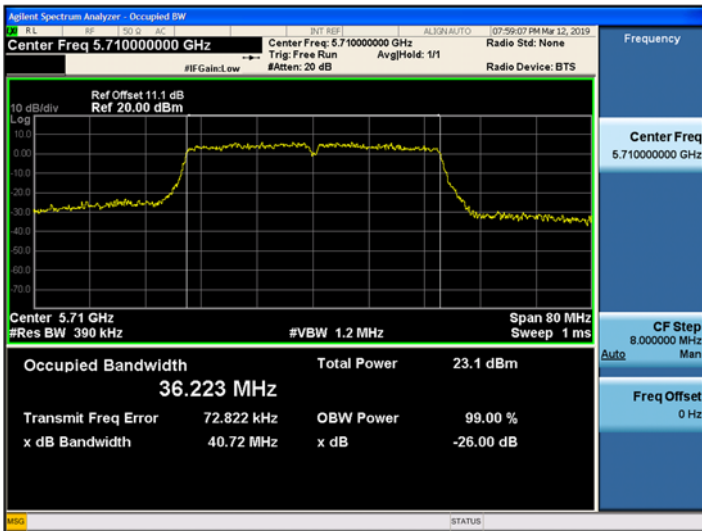
802.11n_HT40 UNII 1 BAND 26dB Bandwidth(CH 46)



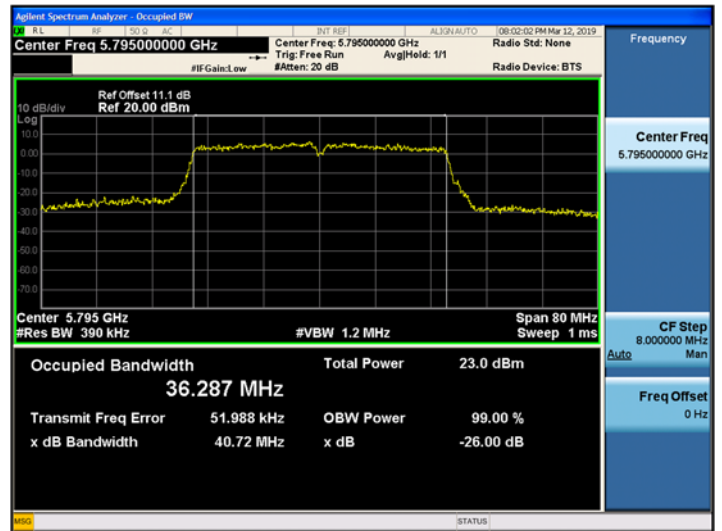
802.11n_HT40 UNII 2A BAND 26dB Bandwidth (CH 54)



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



802.11n_HT40 UNII 3 BAND 26dB Bandwidth (CH 159)

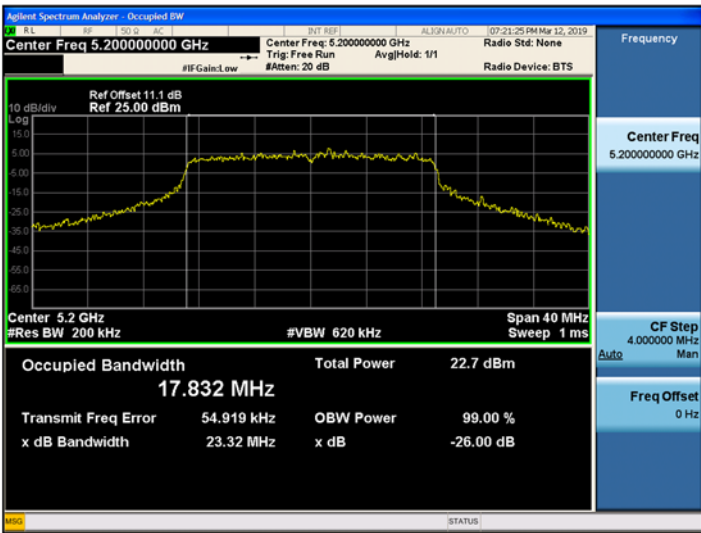


Test Plots(802.11ac(VHT20))

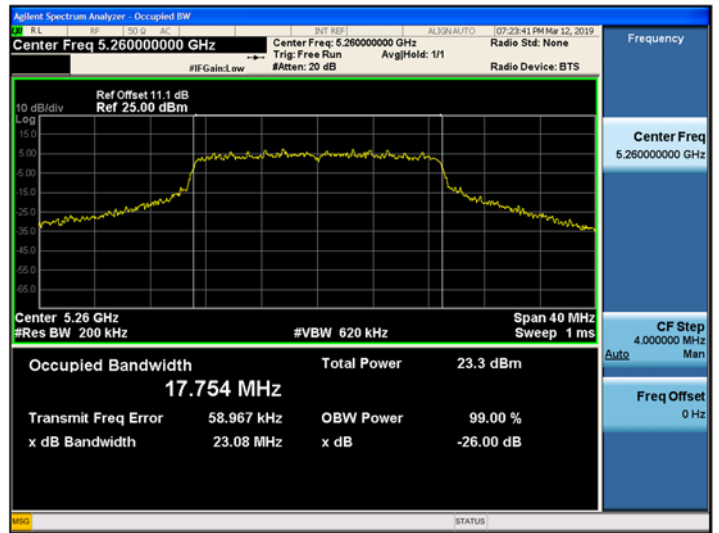
Note:

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

802.11ac_VHT20 UNII 1 BAND 26dB Bandwidth(CH 40)



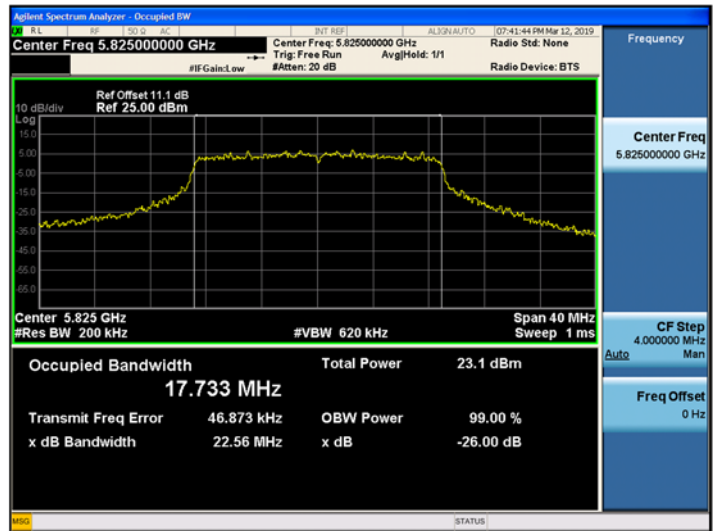
802.11ac_VHT20 UNII 2A BAND 26dB Bandwidth(CH 52)



802.11ac_VHT20 UNII 2C BAND 26dB Bandwidth(CH 100)



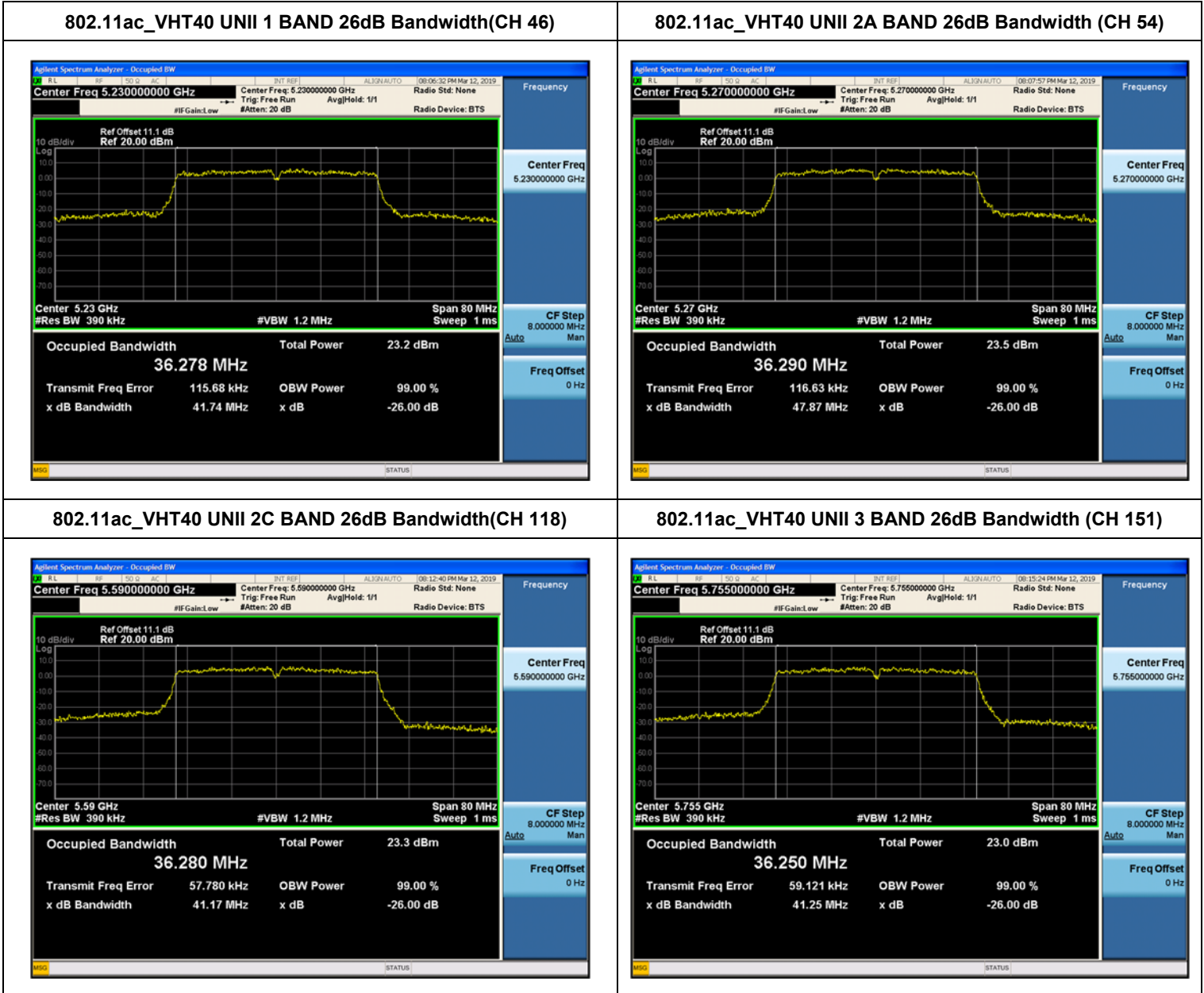
802.11ac_VHT20 UNII 3 BAND 26dB Bandwidth(CH 165)



Test Plots(802.11ac(VHT40))

Note:

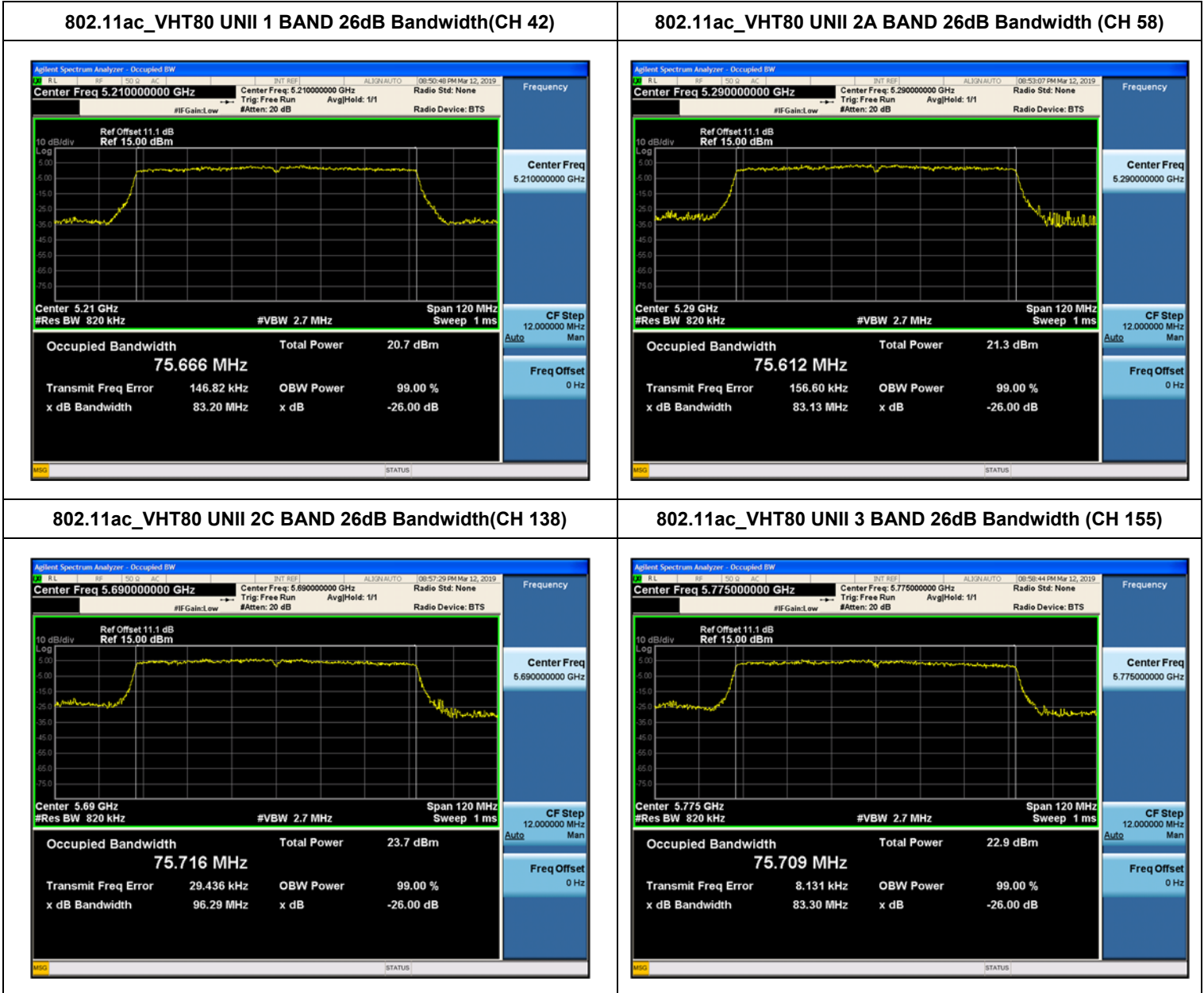
In order to simplify the report, attached plots were only the most wide channel.



Test Plots(802.11ac(VHT80))

Note:

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



10.3 6 dB BANDWIDTH

802.11a Mode		Measured Bandwidth [MHz]	Limit [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5745	149	14.51	> 0.5	Pass
5785	157	14.26	> 0.5	Pass
5825	165	15.19	> 0.5	Pass

802.11n(HT20) Mode		Measured Bandwidth [MHz]	Limit [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5745	149	15.14	> 0.5	Pass
5785	157	15.41	> 0.5	Pass
5825	165	16.91	> 0.5	Pass

802.11n(HT40) Mode		Measured Bandwidth [MHz]	Limit [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5755	151	35.32	> 0.5	Pass
5795	159	35.85	> 0.5	Pass

802.11ac(VHT20) Mode		Measured Bandwidth [MHz]	Limit [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5745	149	15.11	> 0.5	Pass
5785	157	15.53	> 0.5	Pass
5825	165	13.01	> 0.5	Pass

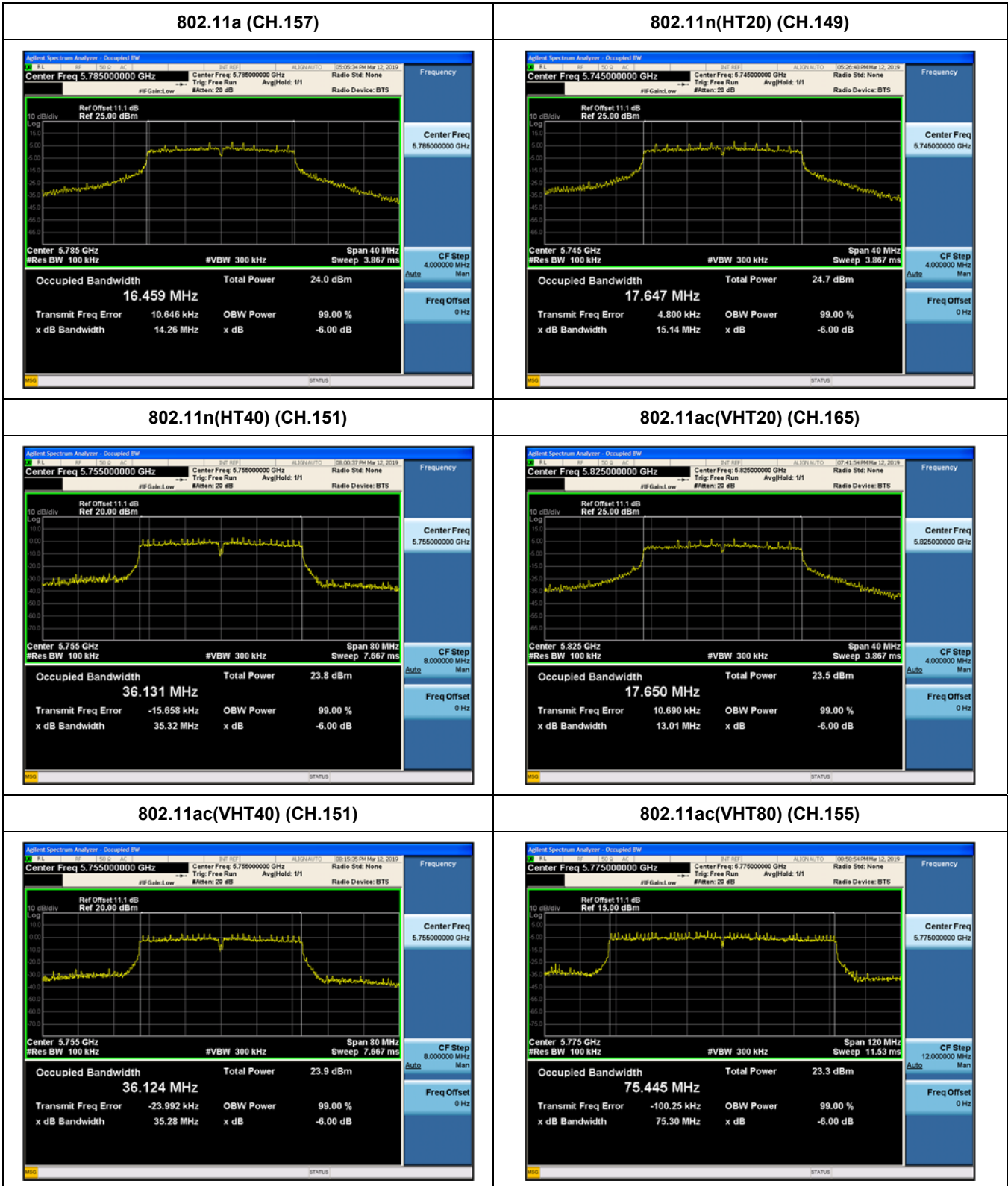
802.11ac(VHT40) Mode		Measured Bandwidth [MHz]	Limit [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5755	151	35.28	> 0.5	Pass
5795	159	35.45	> 0.5	Pass

802.11ac(VHT80) Mode		Measured Bandwidth [MHz]	Limit [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5775	155	75.30	> 0.5	Pass

Test Plots

Note:

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



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	17.5	17.21	0.308	17.52	23.98
5200	40	17.5	17.12	0.308	17.43	23.98
5240	48	17.5	17.33	0.308	17.64	23.98
5260	52	17.5	17.43	0.308	17.74	23.98
5300	60	17.5	17.62	0.308	17.93	23.98
5320	64	17.5	17.59	0.308	17.90	23.98
5500	100	17.5	17.94	0.308	18.25	23.98
5600	120	17.5	17.45	0.308	17.76	23.98
5720	144	18.0	17.33	0.308	17.64	23.98
5745	149	18.5	17.39	0.308	17.70	30.00
5785	157	18.5	17.10	0.308	17.41	30.00
5825	165	19.0	17.43	0.308	17.74	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	17.5	17.05	0.425	17.48	23.98
5200	40	17.5	16.96	0.425	17.39	23.98
5240	48	17.5	17.15	0.425	17.58	23.98
5260	52	17.5	17.36	0.425	17.79	23.98
5300	60	17.5	17.46	0.425	17.89	23.98
5320	64	17.5	17.44	0.425	17.87	23.98
5500	100	17.5	17.77	0.425	18.20	23.98
5600	120	18.0	17.59	0.425	18.02	23.98
5720	144	18.5	17.43	0.425	17.86	23.98
5745	149	19.0	17.53	0.425	17.96	30.00
5785	157	19.0	17.38	0.425	17.81	30.00
5825	165	19.5	17.34	0.425	17.77	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	14.5	14.25	0.586	14.84	23.98
5230	46	16.5	16.38	0.413	16.79	23.98
5270	54	16.5	16.75	0.413	17.16	23.98
5310	62	15.5	15.98	0.413	16.39	23.98
5510	102	14.5	15.00	0.413	15.41	23.98
5590	118	16.5	16.48	0.413	16.89	23.98
5710	142	17.0	16.52	0.224	16.74	23.98
5755	151	17.5	16.16	0.586	16.75	30.00
5795	159	17.5	16.21	0.413	16.62	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	16.5	16.44	0.420	16.86	23.98
5200	40	16.5	16.42	0.322	16.74	23.98
5240	48	16.5	16.56	0.420	16.98	23.98
5260	52	16.5	16.82	0.322	17.14	23.98
5300	60	16.5	16.94	0.420	17.36	23.98
5320	64	16.5	16.76	0.562	17.32	23.98
5500	100	16.5	17.08	0.322	17.40	23.98
5600	120	17.0	16.92	0.420	17.34	23.98
5720	144	17.5	16.65	0.420	17.07	23.98
5745	149	18.0	16.86	0.420	17.28	30.00
5785	157	18.0	16.83	0.322	17.15	30.00
5825	165	18.0	16.56	0.420	16.98	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	14.5	14.40	0.409	14.81	23.98
5230	46	16.5	16.41	0.409	16.82	23.98
5270	54	16.5	16.81	0.409	17.22	23.98
5310	62	15.0	15.52	0.567	16.09	23.98
5510	102	14.5	14.87	0.567	15.44	23.98
5590	118	16.5	16.45	0.409	16.86	23.98
5710	142	17.0	16.18	0.409	16.59	23.98
5755	151	17.5	16.12	0.567	16.69	30.00
5795	159	17.5	16.25	0.409	16.66	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	12.5	11.37	1.761	13.13	23.98
5290	58	13.0	12.68	1.444	14.12	23.98
5530	106	12.5	11.71	1.938	13.65	23.98
5610	122	16.5	14.95	1.938	16.89	23.98
5690	138	16.5	14.68	1.938	16.62	23.98
5775	155	17.5	14.82	1.938	16.76	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	6.855	0.308	7.163	11
5200	40	6.524	0.308	6.832	11
5240	48	6.968	0.308	7.276	11
5260	52	7.111	0.308	7.419	11
5300	60	7.444	0.308	7.752	11
5320	64	7.391	0.308	7.699	11
5500	100	7.510	0.308	7.818	11
5600	120	7.418	0.308	7.726	11
5720	144	7.028	0.308	7.336	11
5745	149	4.392	0.308	4.700	30
5785	157	4.208	0.308	4.516	30
5825	165	4.261	0.308	4.569	30

802.11n(20MHz) Mode		Measured PSD [dBm]	Duty Cycle Factor (dB)	Total PSD [dBm]	Limit (dBm)
Frequency [MHz]	Channel No.				
5180	36	6.627	0.425	7.052	11
5200	40	6.359	0.425	6.784	11
5240	48	6.831	0.425	7.256	11
5260	52	7.033	0.425	7.458	11
5300	60	7.258	0.425	7.683	11
5320	64	7.025	0.425	7.450	11
5500	100	7.309	0.425	7.734	11
5600	120	7.330	0.425	7.755	11
5720	144	7.096	0.425	7.521	11
5745	149	4.371	0.425	4.796	30
5785	157	4.273	0.425	4.698	30
5825	165	4.145	0.425	4.570	30

802.11n(40MHz) Mode		Measured PSD [dBm]	Duty Cycle Factor (dB)	Total PSD [dBm]	Limit (dBm)
Frequency [MHz]	Channel No.				
5190	38	0.398	0.586	0.984	11
5230	46	2.532	0.413	2.945	11
5270	54	2.870	0.413	3.283	11
5310	62	2.040	0.413	2.453	11
5510	102	0.976	0.413	1.389	11
5590	118	2.608	0.413	3.021	11
5710	142	2.284	0.224	2.508	11
5755	151	-0.479	0.586	0.107	30
5795	159	-0.267	0.413	0.146	30

802.11ac(20MHz) Mode		Measured PSD [dBm]	Duty Cycle Factor (dB)	Total PSD [dBm]	Limit (dBm)
Frequency [MHz]	Channel No.				
5180	36	5.644	0.420	6.064	11
5200	40	5.708	0.322	6.030	11
5240	48	5.803	0.420	6.223	11
5260	52	6.197	0.322	6.519	11
5300	60	6.398	0.420	6.818	11
5320	64	5.220	0.562	5.782	11
5500	100	6.352	0.322	6.674	11
5600	120	6.342	0.322	6.664	11
5720	144	5.829	0.420	6.249	11
5745	149	3.547	0.420	3.967	30
5785	157	3.586	0.322	3.908	30
5825	165	3.385	0.420	3.805	30

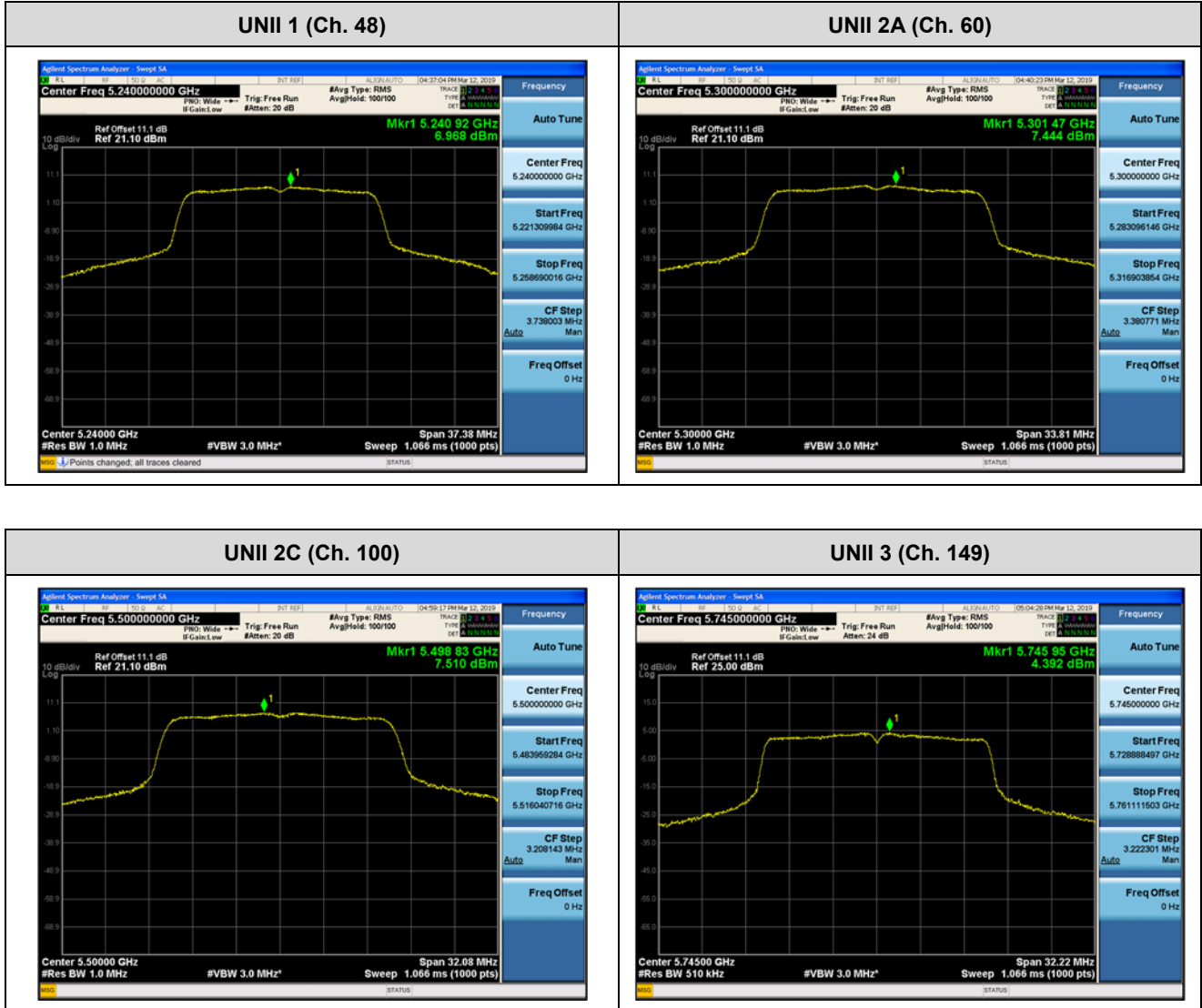
802.11ac(40MHz) Mode		Measured PSD [dBm]	Duty Cycle Factor (dB)	Total PSD [dBm]	Limit (dBm)
Frequency [MHz]	Channel No.				
5190	38	0.584	0.409	0.993	11
5230	46	2.677	0.409	3.086	11
5270	54	2.948	0.409	3.357	11
5310	62	1.709	0.567	2.276	11
5510	102	1.107	0.567	1.674	11
5590	118	2.314	0.409	2.723	11
5710	142	2.216	0.409	2.625	11
5755	151	-0.608	0.567	-0.041	30
5795	159	-0.543	0.409	-0.134	30

802.11ac(80MHz) Mode		Measured PSD [dBm]	Duty Cycle Factor (dB)	Total PSD [dBm]	Limit (dBm)
Frequency [MHz]	Channel No.				
5210	42	-5.369	1.761	-3.608	11
5290	58	-4.362	1.444	-2.918	11
5530	106	-5.437	1.938	-3.499	11
5610	122	-1.551	1.938	0.387	11
5690	138	-1.758	1.938	0.180	11
5775	155	-4.916	1.938	-2.978	30

■ Test Plots(802.11a)

Note:

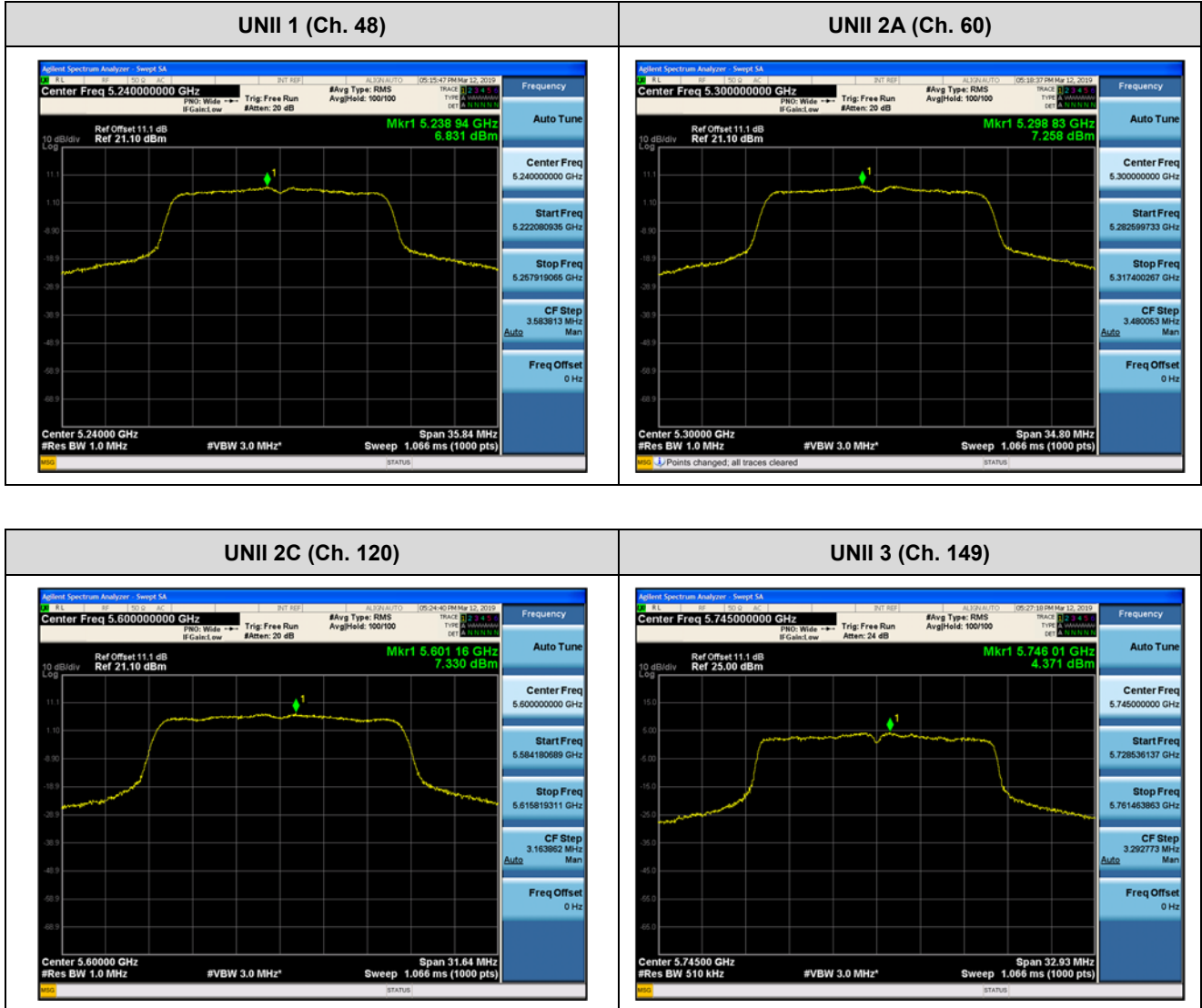
In order to simplify the report, attached plots were only channel of highest power.



Test Plots(802.11n(HT20))

Note:

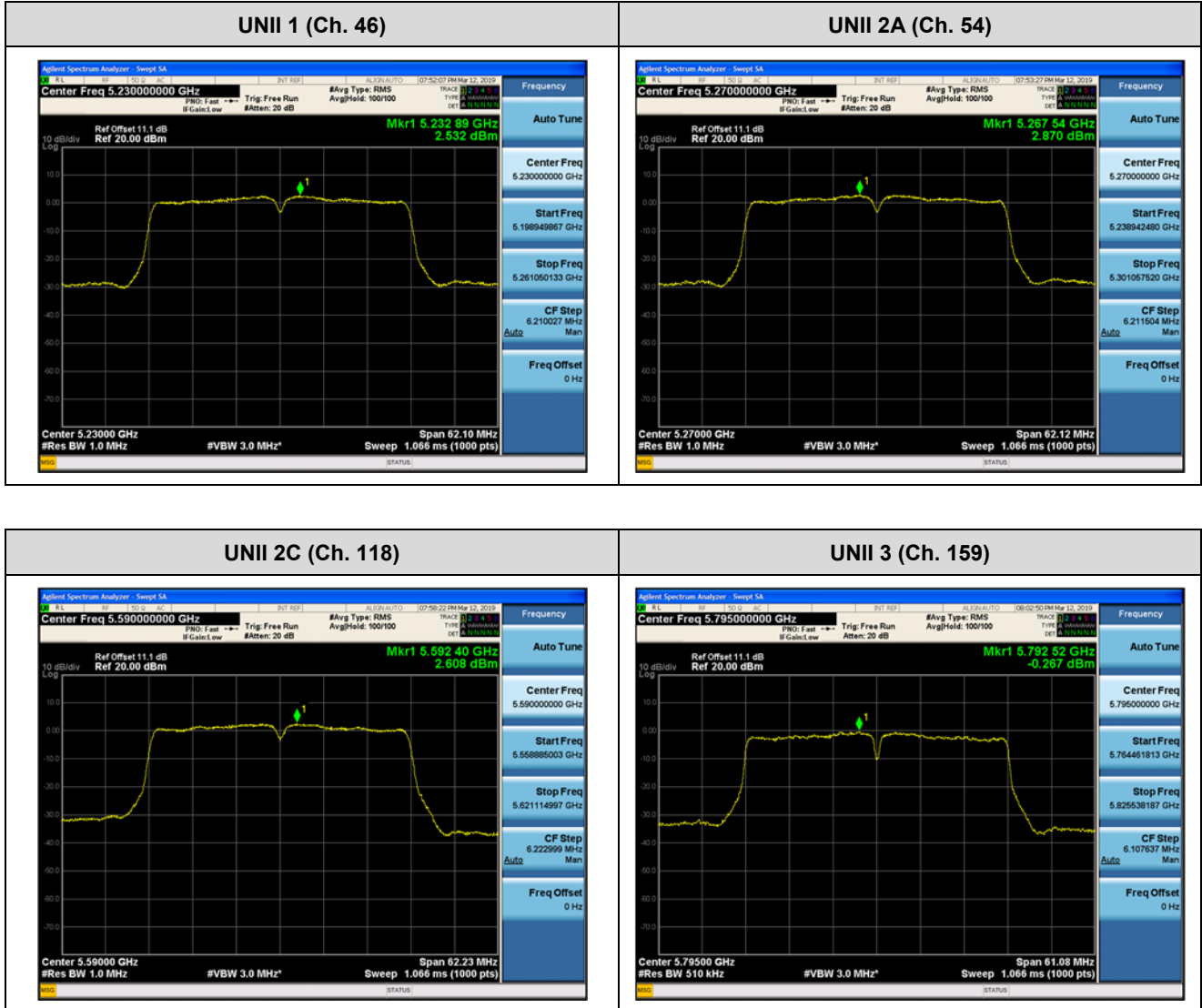
In order to simplify the report, attached plots were only channel of highest power.



■ Test Plots(802.11n(HT40))

Note:

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



■ Test Plots(802.11ac(VHT20))

Note:

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

