FCC TEST REPORT

Test report
On Behalf of
Xunison Ltd
For
X-brain Smart gateway
Model No.: XUS100, XEU100

FCC ID: 2AP2F-XUS100

Prepared for : **Xunison Ltd**
25th Kilcarbery Business Park, Upper Nangor Road, Dublin 22, Ireland

Prepared By : **Shenzhen HUAK Testing Technology Co., Ltd.**
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Date of Test: **June 10, 2018~August 31, 2018**
Date of Report: **August 31, 2018**
Report Number: **HUAK180824890E2**

TEST RESULT CERTIFICATION

Applicant's name ..... :	**Xunison Ltd**
Address ..... :	25th Kilcarbery Business Park, Upper Nangor Road, Dublin 22, Ireland
Manufacture's Name ..... :	**Xunison Ltd**
Address ..... :	25th Kilcarbery Business Park, Upper Nangor Road, Dublin 22, Ireland

Product description

Trade Mark:	Xunison
Product name ..... :	X-brain Smart gateway
Model and/or type reference :	XUS100, XEU100
Standards..... :	FCC Rules and Regulations Part 15 Subpart E Section 15.407 ANSI C63.10: 2013

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Date of Test ..... :	
Date (s) of performance of tests..... :	June 10, 2018~August 31, 2018
Date of Issue ..... :	August 31, 2018
Test Result..... :	**Pass**

Testing Engineer : Gary Qian

(Gary Qian)

Technical Manager : Eden Hu

(Eden Hu)

Authorized Signatory : Jason Zhou

(Jason Zhou)

Revision History

Revision	Issue Date	Revisions	Revised By
000	August 31, 2018	Initial Issue	Jason Zhou

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1. GENERAL INFORMATION

1.1. Description of Device (EUT)

EUT	: X-brain Smart gateway
Model Number	: XUS100, XEU100
Model Declaration	: PCB board, structure and internal of these model(s) are the same, Only models name is different for these models.
Test Model	: XUS100
Power Supply	: DC 12.0V by adapter
Hardware version	: V2
Software version	: 7.1.2
Z-Wave	
Channel Number	: Channel 1: 908.4MHz / Channel 2: 916MHz
Modulation Technology	: FSK
Antenna Type And Gain	: Internal Antenna 0.5dBi[Antenna 0]
2.4G Band RF Function	
Channel Number	: Channel 1: 2405MHz / Channel 2: 2413MHz Channel 3: 2422MHz / Channel 4: 2430MHz Channel 5: 2440MHz / Channel 6: 2450MHz Channel 7: 2460MHz / Channel 8: 2470MHz
Modulation Technology	: GFSK
Antenna Type And Gain	: Internal Antenna 0.0dBi[Antenna 1]
Bluetooth	
Bluetooth Version	: V4.1
Frequency Range	: 2402-2480MHz
Channel Number	: 79 Channels for Bluetooth V3.0(DSS) 40 Channels for Bluetooth V4.1(DTS)
Modulation Technology	: GFSK, π/4-DQPSK, 8-DPSK for Bluetooth V3.0(DSS) GFSK for Bluetooth V4.1(DTS)
Data Rates	: Bluetooth V3.0(DSS): 1~3Mbps Bluetooth V4.1(DTS): 1Mbps
Antenna Type And Gain	: Internal Antenna 0.0dBi[Antenna 2]
Wlan	
WLAN	: Supported IEEE 802.11a/b/g/n/ac
WLAN FCC Operation Frequency	: IEEE 802.11b:2412-2462MHz IEEE 802.11g:2412-2462MHz IEEE 802.11n HT20:2412-2462MHz / 5180-5240MHz / 5745-5825MHz IEEE 802.11n HT40:2422-2452MHz / 5190-5230MHz / 5755-5795MHz IEEE 802.11a: 5180-5240MHz / 5745-5825MHz IEEE 802.11ac VHT20: 5180-5240MHz / 5745-5825MHz IEEE 802.11ac VHT40: 5190-5230MHz / 5755-5795MHz IEEE 802.11ac VHT80: 5210MHz / 5775MHz
WLAN Channel Number	: 11 Channels for 2412-2462MHz(IEEE 802.11b/g/n HT20) 7 Channels for 2422-2452MHz(IEEE 802.11n HT40)

		4 Channels for 5180-5240MHz (IEEE 802.11a/ac VHT20/n HT20) 2 Channels for 5190-5230MHz (IEEE 802.11ac VHT40/n HT40) 1 Channels for 5210MHz (IEEE 802.11ac VHT80) 5 Channels for 5745-5825MHz(IEEE 802.11a/ac VHT20/n HT20) 2 Channels for 5755-5795MHz(IEEE 802.11ac VHT40/n HT40) 1 Channels for 5775MHz(IEEE 802.11ac VHT80)
WLAN Modulation Technology	:	IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11g: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11a: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11ac: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)
Antenna Type And Gain	:	Three Antennas: Internal Antenna 3 and Antenna 4: 3.81dBi(Max.), for TX/RX (WLAN 2.4G Band), Internal Antenna 5 and Antenna 6: 4.03 dBi(Max.), for TX/RX (WLAN 5G Band) 802.11n(2.4G Band) support 2T2R.[Antenna 3 and Antenna 4] 802.11n/ac(5G Band) support 2T2R.[Antenna 5 and Antenna 6]
Directional Gain	:	6.81 dBi for MIMO(2.4G Band) 7.03 dBi for MIMO(5G Band)

Note: Antenna postion refer to EUT Photos.

1.2. Host System Configuration List and Details

Manufacturer	Description	Model	Serial Number	Certificate
SUNUN	Adapter	SA18H-120 150U	A18-124	N/A

1.3. External I/O Port

I/O Port Description	Quantity	Cable
USB Port	2	1m, unshielded
HDMI Port	1	1.5m, unshielded
Lan Port	3	1.5m,shielded

1.4. Description of Test Facility

Designation Number: CN1229
Test Firm Registration Number: 616276

The 3m-Semi anechoic test site fulfills CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010

1.5. Statement of the Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the HUAK quality system acc. To DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

1.6. Measurement Uncertainty

Test Item		Frequency Range	Uncertainty	Note
Radiation Uncertainty	:	9KHz~30MHz	±3.08dB	(1)
		30MHz~1000MHz	±4.42dB	(1)
		1GHz~40GHz	±4.06dB	(1)
Conduction Uncertainty	:	150kHz~30MHz	±2.23dB	(1)

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

1.7. Description of Test Modes

The EUT has been tested under operating condition.

Worst-case mode and channel used for 150 kHz-30 MHz power line conducted emissions was the mode and channel with the highest output power that was determined to be IEEE 802.11a mode (High Channel).

Worst-case mode and channel used for 9kHz-1000 MHz radiated emissions was the mode and channel with the highest output power, that was determined to be IEEE 802.11a mode(High Channel).

Worst-Case data rates were utilized from preliminary testing of the Chipset, worst-case data rates used during the testing are as follows:

IEEE 802.11a Mode : 6 Mbps, OFDM.
IEEE 802.11ac VHT20 Mode: MCS0
IEEE 802.11n HT20 Mode: MCS0, OFDM.
IEEE 802.11ac VHT40 Mode: MCS0, OFDM.
IEEE 802.11n HT40 Mode: MCS0, OFDM.
IEEE 802.11ac VHT80 Mode: MCS0, OFDM.

Antenna & Bandwidth

Antenna	Single (Port.1)			Two (Port.1 + Port.2)		
Bandwidth Mode	20MHz	40MHz	80MHz	20MHz	40MHz	80MHz
IEEE 802.11a	☐	☐	☐	☑	☐	☐
IEEE 802.11n	☐	☐	☐	☑	☑	☐
IEEE 802.11ac	☐	☐	☐	☑	☑	☑

2. TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

The radiated testing was performed at an antenna-to-EUT distance of 3 meters. All radiated and conducted emissions measurement was performed at Shenzhen HUAK Testing Technology Co., Ltd.

2.1. 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.

2.2. 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 FCC's request, Test Procedure 789033 D02 General UNII Test Procedures New Rules v02r01 and KDB 662911 are required to be used for this kind of FCC 15.407 UII device.

According to its specifications, the EUT must comply with the requirements of the Section 15.203, 15.205, 15.207, 15.209 and 15.407 under the FCC Rules Part 15 Subpart E

2.3. General Test Procedures

2.3.1 Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using Quasi-peak and average detector modes.

2.3.2 Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m 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 maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.3 of ANSI C63.10-2013

3. SYSTEM TEST CONFIGURATION

3.1. Justification

The system was configured for testing in a continuous transmits condition.

3.2. EUT Exercise Software

The system was configured for testing in a continuous transmits condition and change test channels by software (QATest Application) provided by application.

3.3. Special Accessories

No.	Equipment	Manufacturer	Model No.	Serial No.	Length	shielded/ unshielded	Notes
1	TV	AOC	280LM00003	JVVGJA000307	/	/	/
2	PC	ASUS	K43S	X16-96081	/	/	/

3.4. Block Diagram/Schematics

Please refer to the related document

3.5. Equipment Modifications

Shenzhen HUAK Testing Technology Co., Ltd. has not done any modification on the EUT.

3.6. Test Setup

Please refer to the test setup photo.

4. SUMMARY OF TEST RESULTS

Applied Standard: FCC Part 15 Subpart E		
FCC Rules	**Description of Test**	**Result**
§15.407(a)	Maximum Conducted Output Power	Compliant
§15.407(a)	Power Spectral Density	Compliant
§15.407(a)	26dB Bandwidth	Compliant
§15.407(a)	99% Occupied Bandwidth	Compliant
§15.407(b)	Radiated Emissions	Compliant
§15.407(b)	Band edge Emissions	Compliant
§15.205	Emissions at Restricted Band	Compliant
§15.407(g)	Frequency Stability	N/A
§15.207(a)	Line Conducted Emissions	Compliant
§15.203	Antenna Requirements	Compliant
§2.1093	RF Exposure	Compliant

Note: The customer declared frequency stability is better than 20ppm which ensures that the signal remains in the allocated bands under all operational conditions stated in the user manual.

5. TEST RESULT

5.1. On Time and Duty Cycle

5.1.1. Standard Applicable

None; for reporting purpose only.

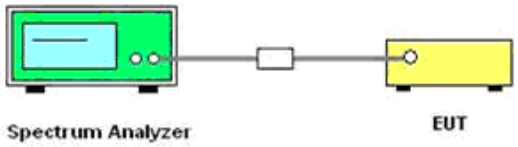
5.1.2. Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of the spectrum analyzer.

5.1.3. Test Procedures

1. Set the centre frequency of the spectrum analyzer to the transmitting frequency;
2. Set the span=0MHz, RBW=10MHz, VBW=10MHz, Sweep time=5ms;
3. Detector = peak;
4. Trace mode = Single hold.

5.1.4. Test Setup Layout



5.1.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

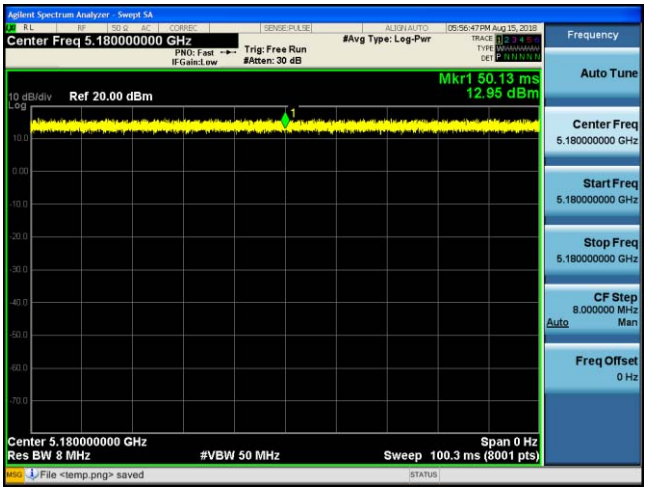
5.1.6. Test result

Mode	On Time B (ms)	Period (ms)	Duty Cycle x (Linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW(KHz)
IEEE 802.11a	100	100	1	100	0	0.010
IEEE 802.11n HT20	100	100	1	100	0	0.010
IEEE 802.11ac HT20	100	100	1	100	0	0.010
IEEE 802.11n HT40	100	100	1	100	0	0.010
IEEE 802.11ac HT40	100	100	1	100	0	0.010
IEEE 802.11ac HT80	100	100	1	100	0	0.010

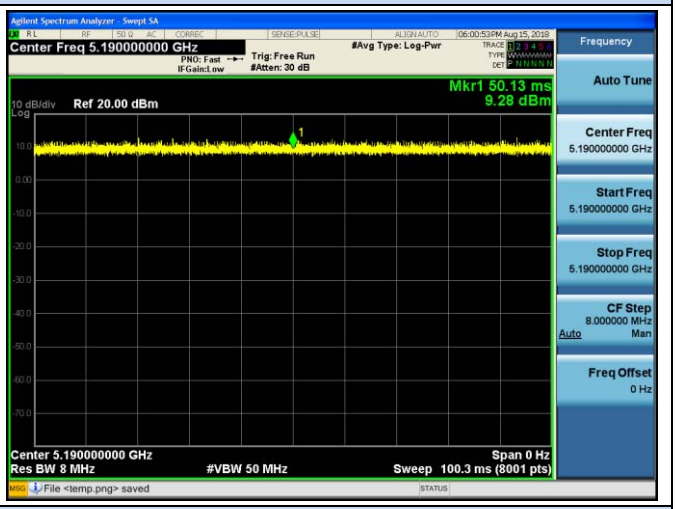
On Time and Duty Cycle

IEEE 802.11a

IEEE 802.11n HT20

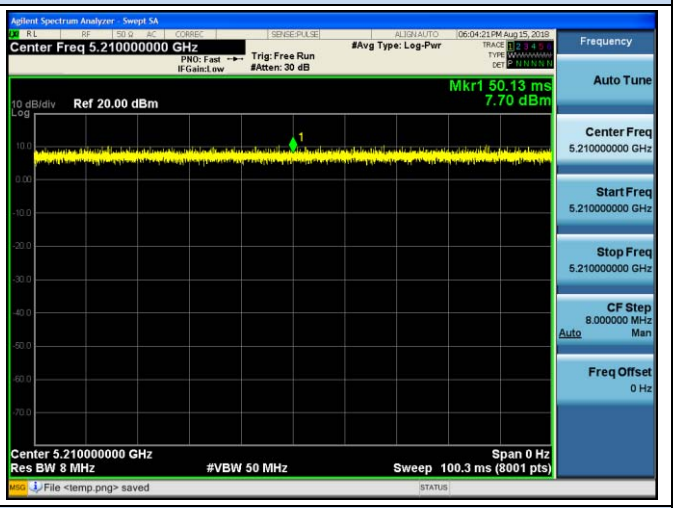


IEEE 802.11ac VHT20



IEEE 802.11n HT40

IEEE 802.11ac VHT40



IEEE 802.11ac VHT80

5.2. Maximum Conducted Output Power Measurement

5.2.1. Standard Applicable

(1) For the band 5.15-5.25 GHz.

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

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

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

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.2.2. Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of the power meter.

5.2.3. Test Procedures

The transmitter output (antenna port) was connected to the power meter.

According to KDB 789033 D02 Section 3 (a) Method PM (Measurement using an RF average power meter):

(i) Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied.

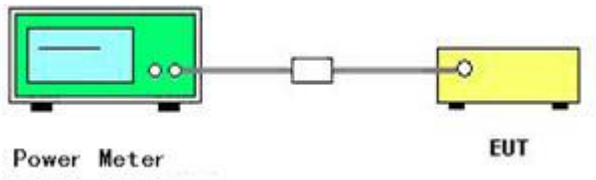
- The EUT is configured to transmit continuously or to transmit with a constant duty cycle.
- At all times when the EUT is transmitting, it must be transmitting at its maximum power control level.
- The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.

(ii) If the transmitter does not transmit continuously, measure the duty cycle, x, of the transmitter output signal as described in section II.B.

(iii) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.

(iv) Adjust the measurement in dBm by adding 10 log (1/x) where x is the duty cycle (e.g., 10 log (1/0.25) if the duty cycle is 25%).

5.2.4. Test Setup Layout



5.1.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.2.6. Test Result of Maximum Conducted Output Power

Temperature	25.1℃	Humidity	52.4%
Test Engineer	Gary Qian	Configurations	IEEE 802.11a/n/ac

Test Mode	Channel	Frequency (MHz)	Measured Conducted Average Power (dBm)			Duty Cycle factor (dB)	Report Average Power (dBm)			Limits (dBm)	Verdict
			Antenna 0	Antenna 1	Sum		Antenna 0	Antenna 1	Sum		
IEEE 802.11a	36	5180	10.97	10.98	/	0.00	10.97	10.98	/	24.00	PASS
	40	5200	11.03	11.28	/	0.00	11.03	11.28	/		
	48	5240	10.63	10.76	/	0.00	10.63	10.76	/		
IEEE 802.11n HT20	36	5180	9.23	9.30	12.28	0.00	9.23	9.30	12.28	22.97	PASS
	40	5200	8.98	9.25	12.13	0.00	8.98	9.25	12.13		
	48	5240	8.97	9.09	12.04	0.00	8.97	9.09	12.04		
IEEE 802.11ac VHT20	36	5180	9.84	10.00	12.93	0.00	9.84	10.00	12.93	22.97	PASS
	40	5200	9.55	9.76	12.66	0.00	9.55	9.76	12.66		
	48	5240	9.53	9.60	12.58	0.00	9.53	9.60	12.58		
IEEE 802.11n HT40	38	5190	9.00	9.10	12.06	0.00	9.00	9.10	12.06	22.97	PASS
	46	5230	9.19	9.36	12.29	0.00	9.19	9.36	12.29		
IEEE 802.11ac VHT40	38	5190	10.25	10.44	13.36	0.00	10.25	10.44	13.36	22.97	PASS
	46	5230	10.36	10.53	13.46	0.00	10.36	10.53	13.46		
IEEE 802.11ac VHT80	42	5210	12.01	12.10	15.06	0.00	12.01	12.10	15.06	22.97	PASS

Remark:

1. *Measured output power at difference data rate for each mode and recorded worst case for each mode.*
2. *Test results including cable loss;*
3. *Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40, IEEE 802.11a VHT20, IEEE 802.11ac VHT40 and IEEE 802.11ac VHT80;*
4. *For MIMO with CCD technology device, The Directional Gain= Gain of individual transmit antennas (dBi) + Array gain; Directional gain = 10 log[$(10^{G1/10} + 10^{G2/10} + \ldots + 10^{GN/10})/N_{ANT}$] dBi,where antenna gains given by G1, G2, …, GN dBi, N_{ANT} is the antennas total Number.*
5. *Directional Gain =7.03 dBi > 6dBi; Limits = 24 – (Directional gain-6) = 24 – (7.03-6)= 22.97 dBm for MIMO Mode.*
6. *Report conducted power = Measured conducted average power + Duty Cycle factor;*

5.3. Power Spectral Density Measurement

5.3.1. Standard Applicable

For 5150~5250MHz

(i) For an outdoor access point operating in the band 5.15 - 5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band.[note1]

(ii) For an indoor access point operating in the band 5.15 - 5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band.[note1]

(iii) For fixed point-to-point access points operating in the band 5.15 - 5.25 GHz, transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi.

(iv) For mobile and portable client devices in the 5.15 - 5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 MHz band. [note1]

Note1: If transmitting antennas of directional gain greater than 6 dBi are used, the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.3.2. Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of Spectrum Analyzer.

5.3.3. Test Procedures

1. The transmitter was connected directly to a Spectrum Analyzer through a directional couple.

2. The power was monitored at the coupler port with a Spectrum Analyzer. The power level was set to the maximum level.

3. Set the RBW = 1MHz.

4. Set the VBW ≥ 3MHz

5. Span=Encompass the entire emissions bandwidth (EBW) of the signal (or, alternatively, the entire 99% occupied bandwidth) of the signal.

6. Number of points in sweep ≥ 2 × span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)

7. Manually set sweep time ≥ 10 × (number of points in sweep) × (total on/off period of the transmitted signal).

8. Set detector = power averaging (rms).

9. Sweep time = auto couple.

10. Trace mode = max hold.

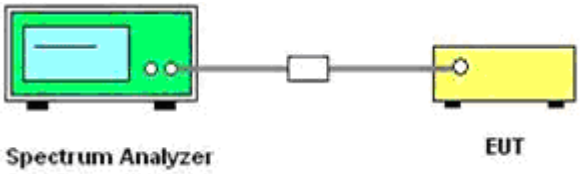
11. Allow trace to fully stabilize.

12. Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument's band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at 1 MHz intervals extending across the EBW (or, alternatively, levels (in power units) at 1 MHz intervals extending across the EBW (or, alternatively,

13. 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 (because the measurement represents an average over both the on and off times of the transmission). For example, add 10 log (1/0.25) = 6 dB if the duty cycle is 25%.

14. Use the peak marker function to determine the maximum power level in any 1MHz band segment within the fundamental EBW.

5.3.4. Test Setup Layout



5.3.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

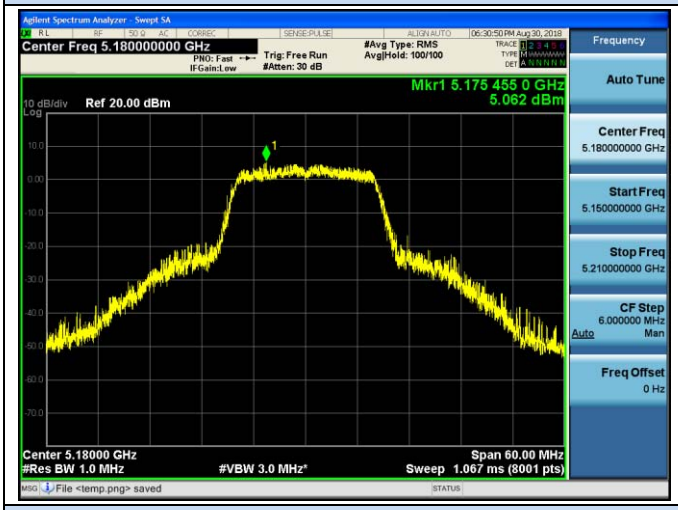
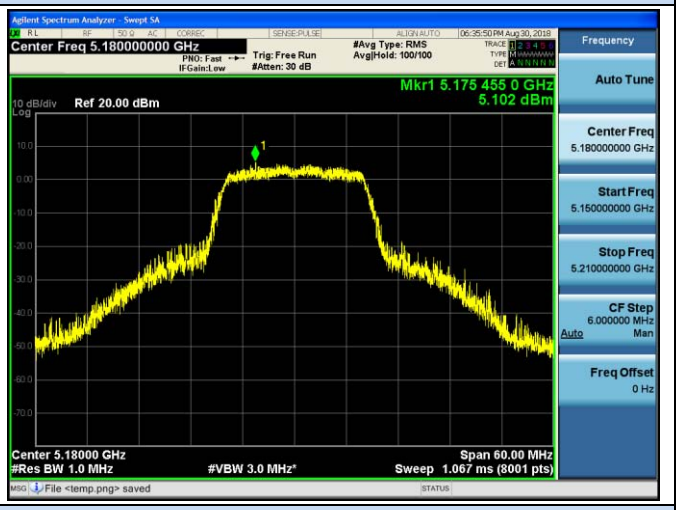
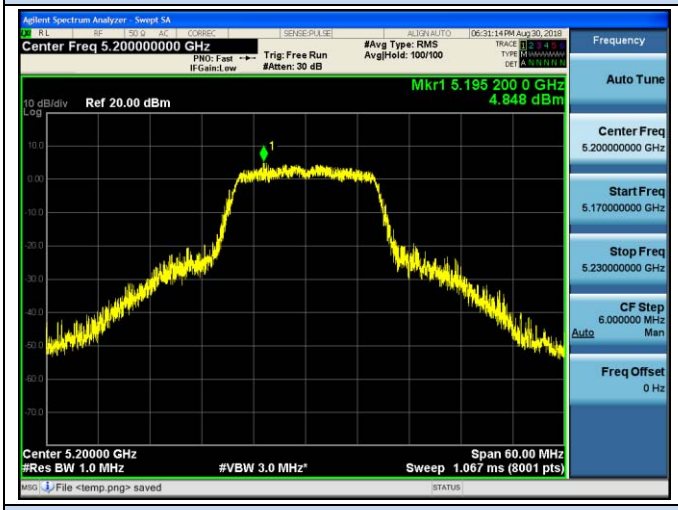
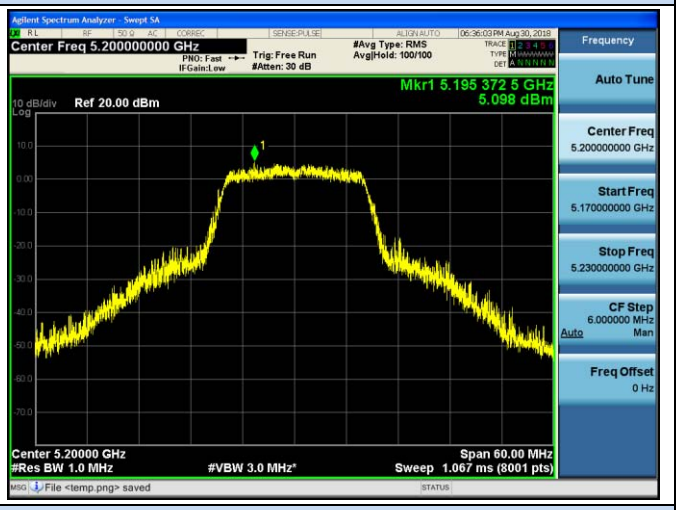
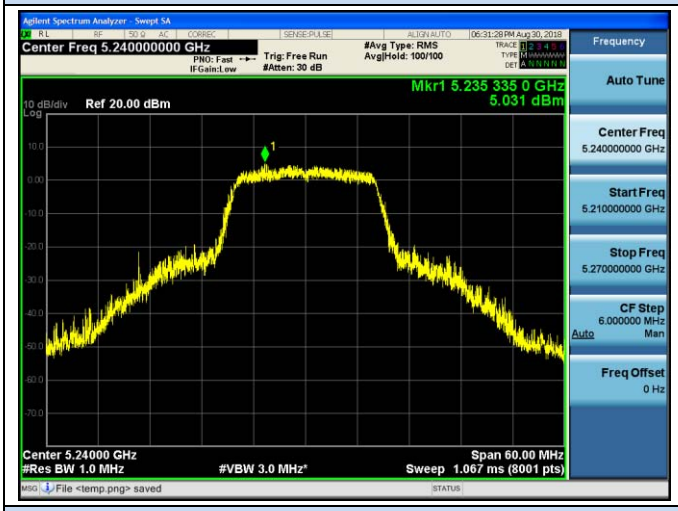
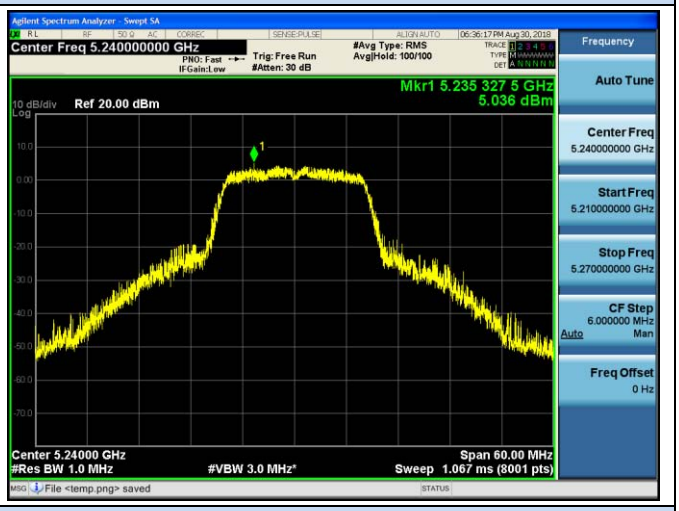
6.3.6. Test Result of Power Spectral Density

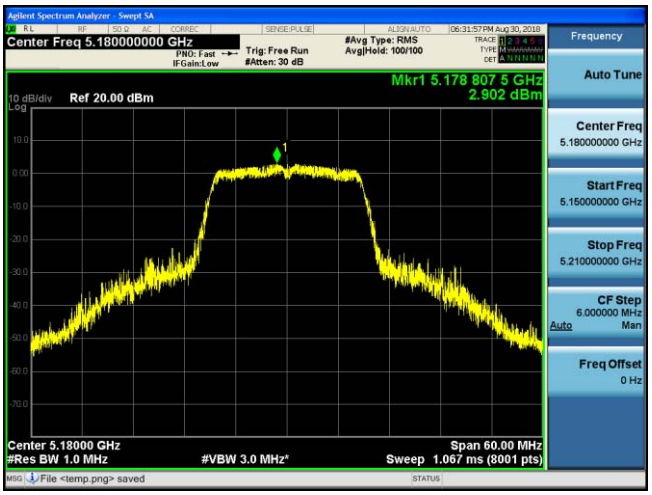
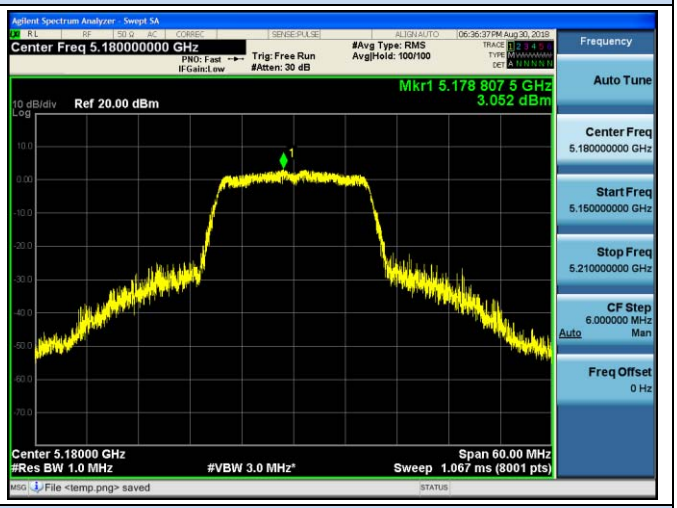
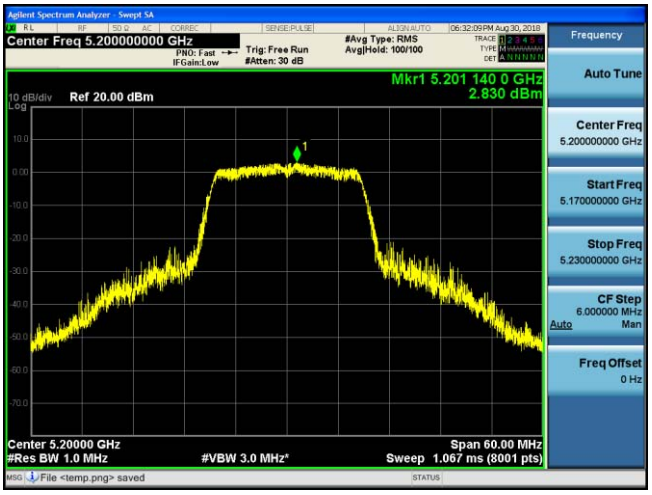
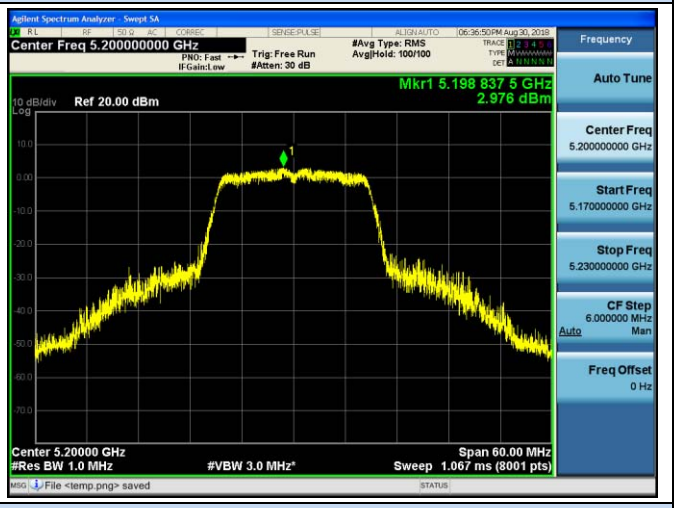
Temperature	25.1℃	Humidity	52.4%
Test Engineer	Gary Qian	Configurations	IEEE 802.11a/n/ac

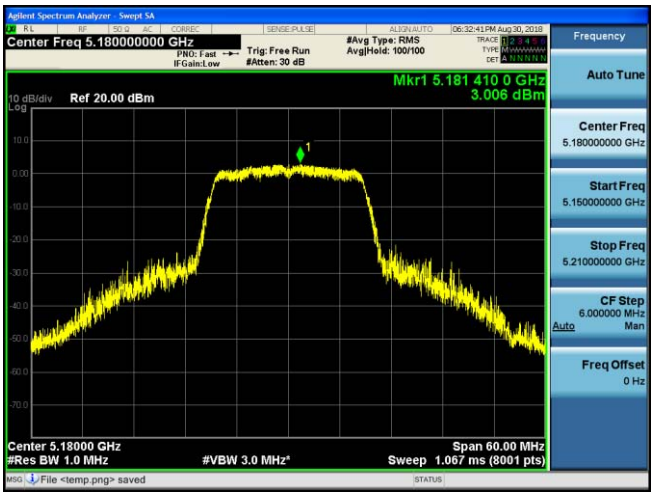
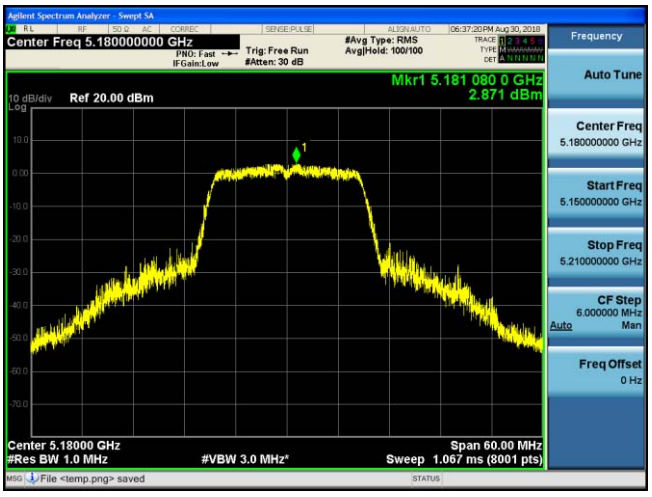
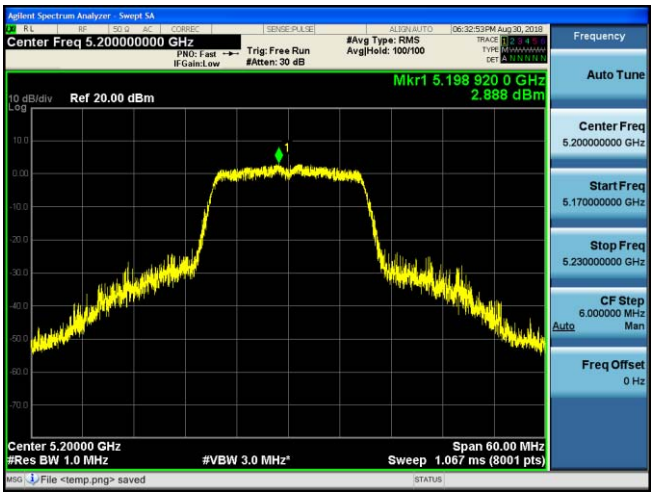
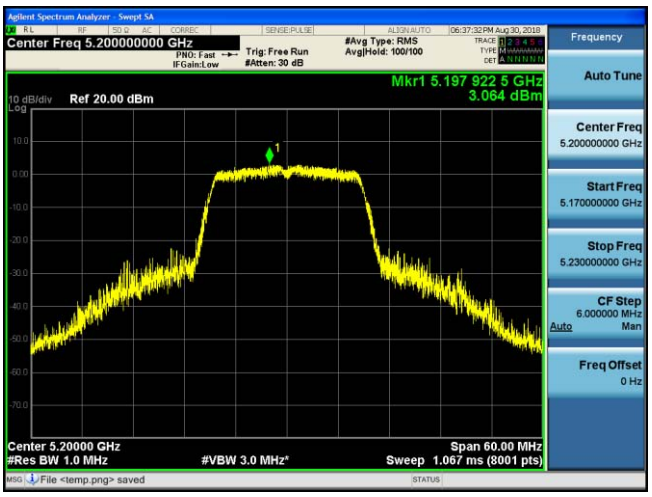
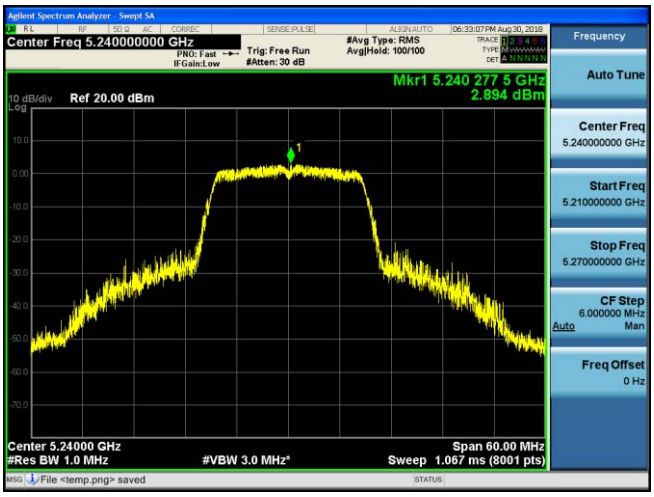
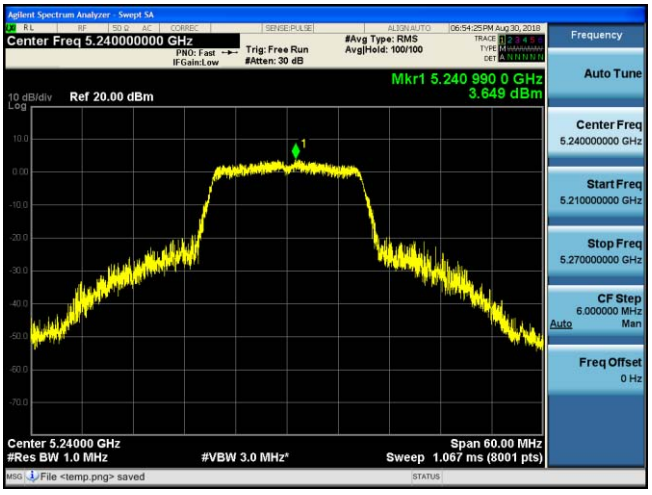
Test Mode	Channel	Frequency (MHz)	Measured Conducted PSD (dBm/MHz)			Array Gain (dB)	Duty Cycle factor (dB)	Report Conducted PSD (dBm/MHz)			PSD Limits (dBm/MHz)	Verdict
			Antenna 0	Antenna 1	Sum			Antenna 0	Antenna 1	Sum		
IEEE 802.11a	36	5180	5.06	5.10	/	0.00	0.00	5.06	5.10	/	11.00	PASS
	40	5200	4.85	5.10	/	0.00	0.00	4.85	5.10	/		
	48	5240	5.03	5.04	/	0.00	0.00	5.03	5.04	/		
IEEE 802.11n HT20	36	5180	2.90	3.05	5.99	3.01	0.00	2.90	3.05	5.99	9.97	PASS
	40	5200	2.83	2.98	5.91	3.01	0.00	2.83	2.98	5.91		
	48	5240	3.01	2.92	5.97	3.01	0.00	3.01	2.92	5.97		
IEEE 802.11ac VHT20	36	5180	3.006	2.871	5.95	3.01	0.00	3.01	2.87	5.95	9.97	PASS
	40	5200	2.888	3.064	5.99	3.01	0.00	2.89	3.06	5.99		
	48	5240	2.894	3.649	6.30	3.01	0.00	2.89	3.65	6.30		
IEEE 802.11n HT40	38	5190	1.02	0.70	3.87	3.01	0.00	1.02	0.70	3.87	9.97	PASS
	46	5230	0.51	0.31	3.42	3.01	0.00	0.51	0.31	3.42		
IEEE 802.11ac VHT40	38	5190	0.57	0.40	3.49	3.01	0.00	0.57	0.40	3.49	9.97	PASS
	46	5230	0.91	0.14	3.55	3.01	0.00	0.91	0.14	3.55		
IEEE 802.11ac VHT80	42	5210	-2.65	-2.52	0.43	3.01	0.00	-2.65	-2.52	0.43	9.97	PASS

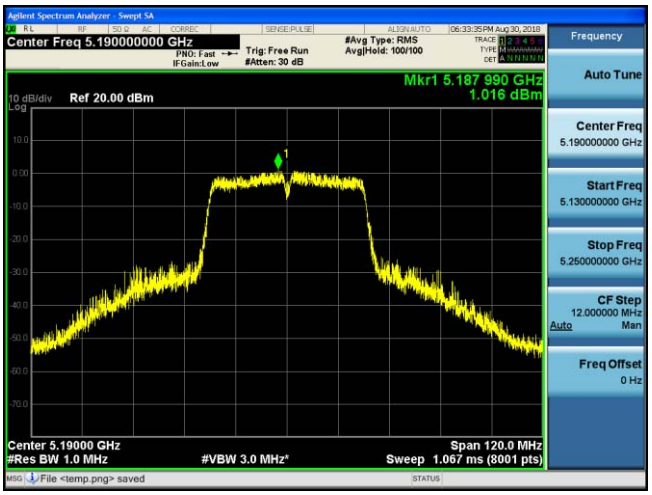
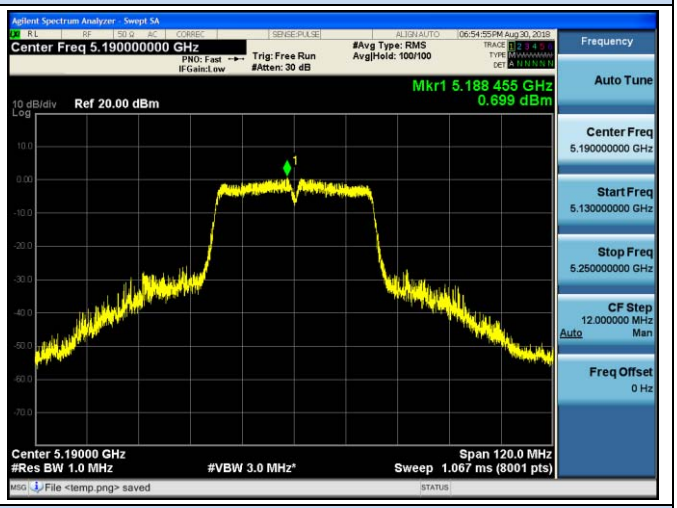
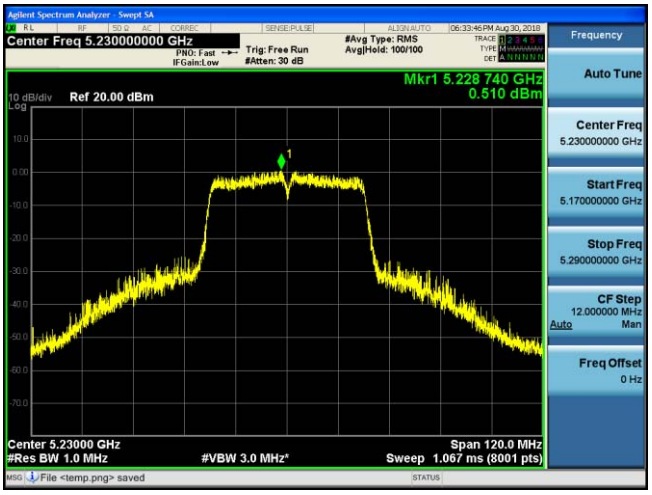
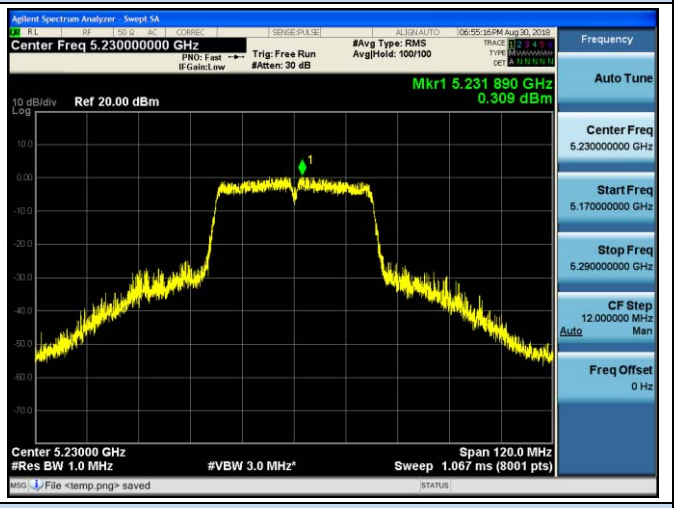
Remark:

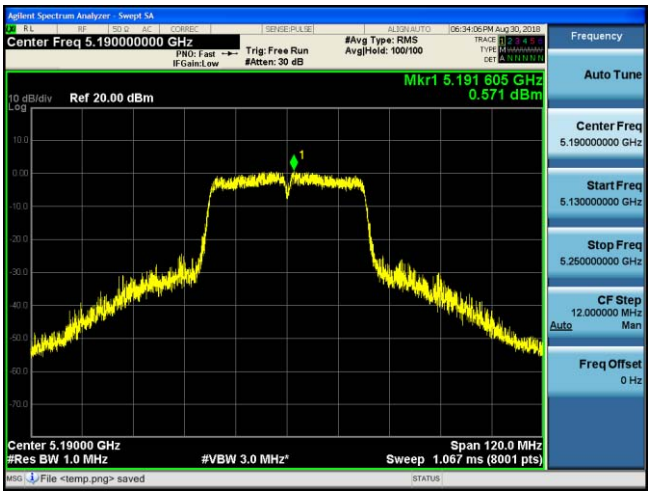
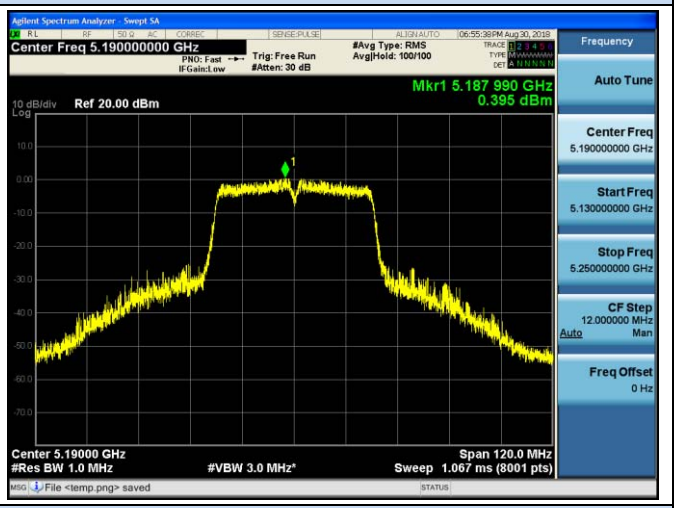
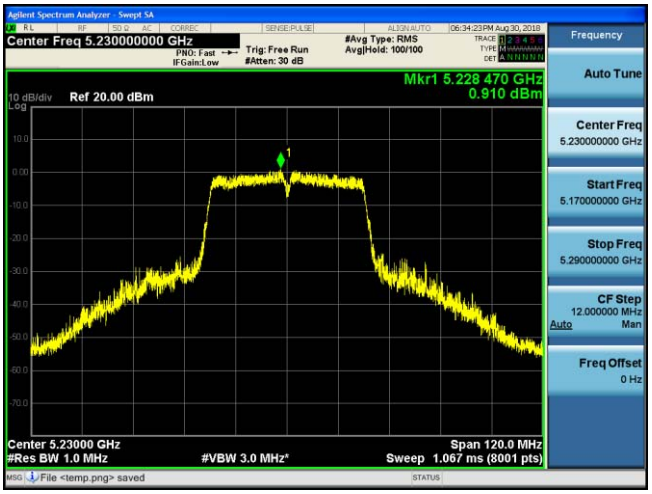
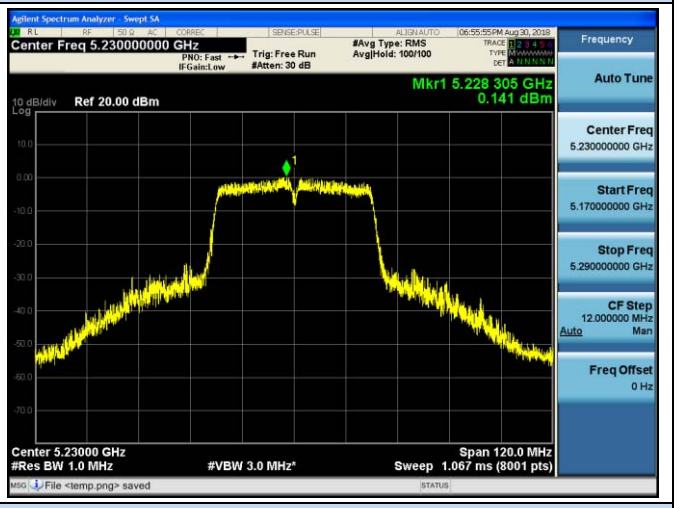
1. *Measured power spectrum density at difference data rate for each mode and recorded worst case for each mode.*
2. *Test results including cable loss;*
3. *Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40, IEEE 802.11a VHT20, IEEE 802.11ac VHT40 and IEEE 802.11ac VHT80;*
4. *For MIMO with CCD technology device:*
   Directional gain = 10 log[$(10^{G1/10} + 10^{G2/10} + \ldots + 10^{GN/10})/N_{ANT}$] dBi,where antenna gains given by G1, G2, …, GN dBi, N_{ANT} is the antennas total Number
5. *Directional Gain =7.03 dBi > 6dBi; Limits = 11 – (Directional gain-6) = 11 – (7.03-6)= 9.97 dBm for MIMO Mode.*
6. *Report conducted PSD = Measured conducted PSD + Duty Cycle factor;*
7. *Please refer to following test plots;*

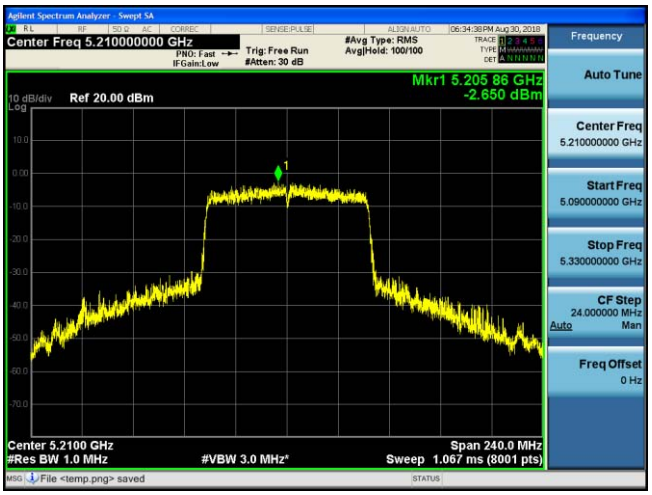
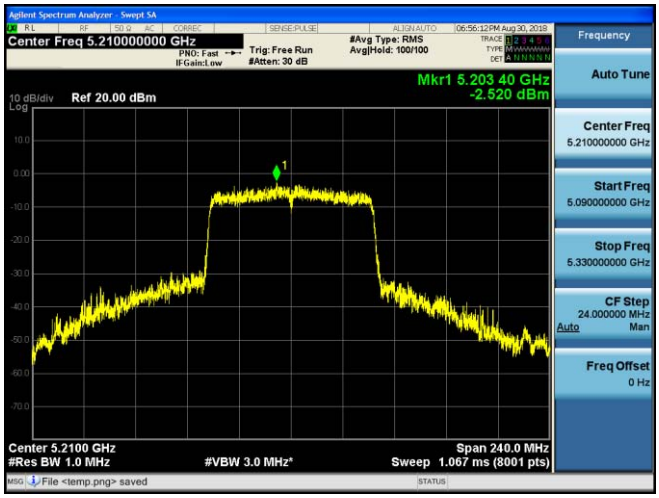
Power Spectrum Density	
IEEE 802.11a	
Antenna Chain 0	Antenna Chain 1
	
Channel 36 / 5180 MHz	Channel 36 / 5180 MHz
	
Channel 40 / 5200 MHz	Channel 40 / 5200 MHz
	
Channel 48 / 5240 MHz	Channel 48 / 5240 MHz

Power Spectrum Density	
IEEE 802.11n HT20	
Antenna Chain 0	Antenna Chain 1
	
Channel 36 / 5180 MHz	Channel 36 / 5180 MHz
	
Channel 40 / 5200 MHz	Channel 40 / 5200 MHz
Channel 48 / 5240 MHz	Channel 48 / 5240 MHz

Power Spectrum Density	
IEEE 802.11ac VHT20	
Antenna Chain 0	Antenna Chain 1
	
Channel 36 / 5180 MHz	Channel 36 / 5180 MHz
	
Channel 40 / 5200 MHz	Channel 40 / 5200 MHz
	
Channel 48 / 5240 MHz	Channel 48 / 5240 MHz

Power Spectrum Density	
IEEE 802.11n HT40	
Antenna Chain 0	Antenna Chain 1
	
Channel 38 / 5190 MHz	Channel 38 / 5190 MHz
	
Channel 46 / 5230 MHz	Channel 46 / 5230 MHz

Power Spectrum Density	
IEEE 802.11ac VHT40	
Antenna Chain 0	Antenna Chain 1
	
Channel 38 / 5190 MHz	Channel 38 / 5190 MHz
	
Channel 46 / 5230 MHz	Channel 46 / 5230 MHz

Power Spectrum Density	
IEEE 802.11ac VHT80	
Antenna Chain 0	Antenna Chain 1
	
Channel 48 / 5210 MHz	Channel 48 / 5210 MHz

5.4. 99% Occupied Bandwidth and 26dB Emission Bandwidth Measurement

5.4.1. Standard Applicable

No restriction limits. But resolution bandwidth within band edge measurement is 1% of the 99% occupied bandwidth.

5.4.2. Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of the Spectrum Analyzer.

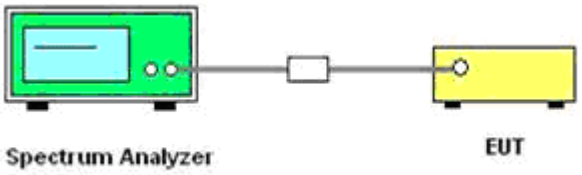
Spectrum Parameter	Setting
Attenuation	Auto
Span	> 26dB Bandwidth
Detector	Peak
Trace	Max Hold
Sweep Time	100ms

5

5.4.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
2. Set the RBW = approximately 1% of the emission bandwidth.
3. Set the VBW ≥ 3 * RBW
4. Measured the spectrum width with power higher than 26dB below carrier.

5.4.4. Test Setup Layout



5.4.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.4.6. Test Result of 99% Occupied Bandwidth and 26dB Emission Bandwidth

Temperature	25.1℃	Humidity	52.4%
Test Engineer	Gary Qian	Configurations	IEEE 802.11a/n/ac

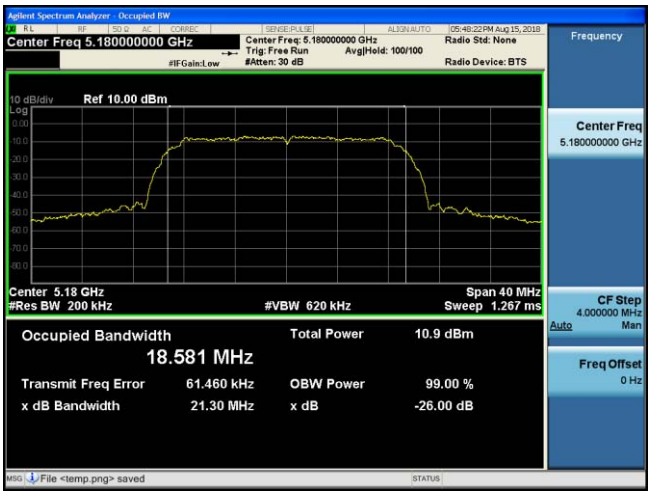
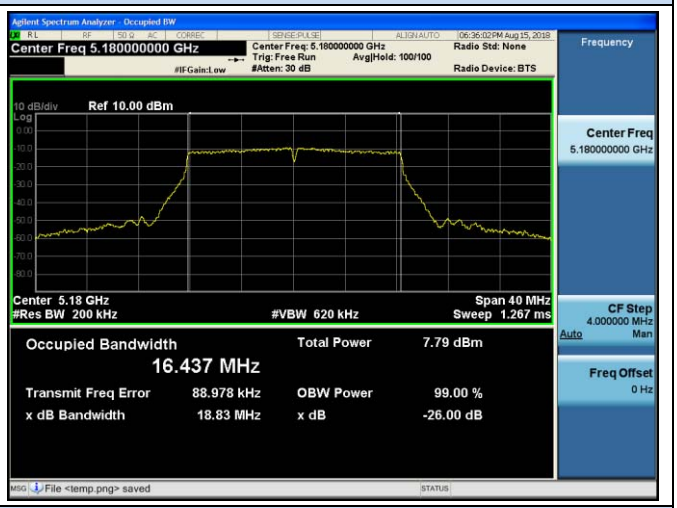
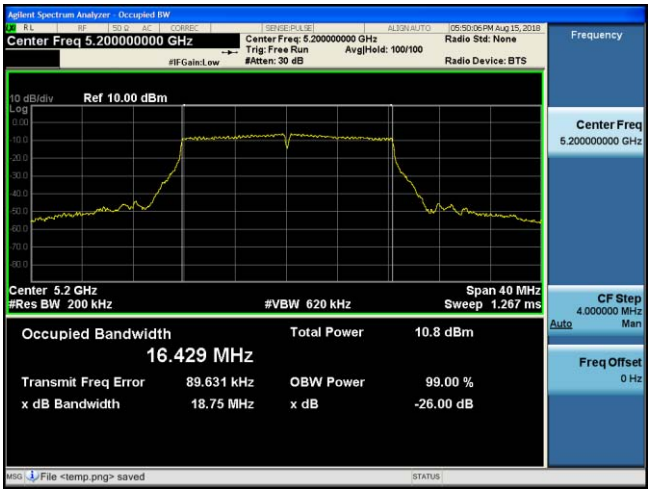
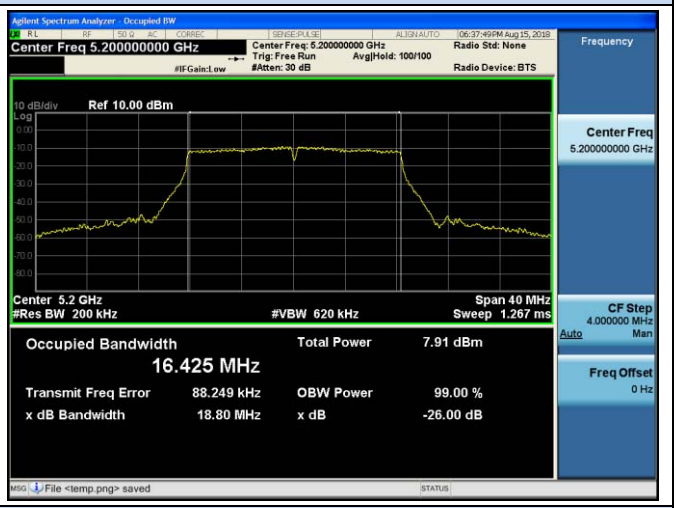
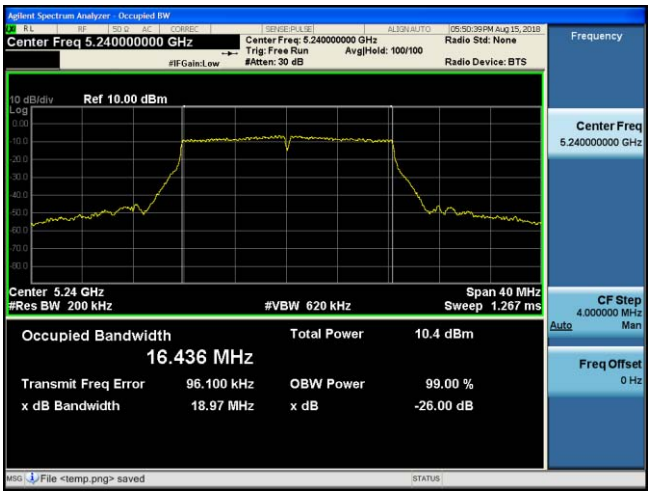
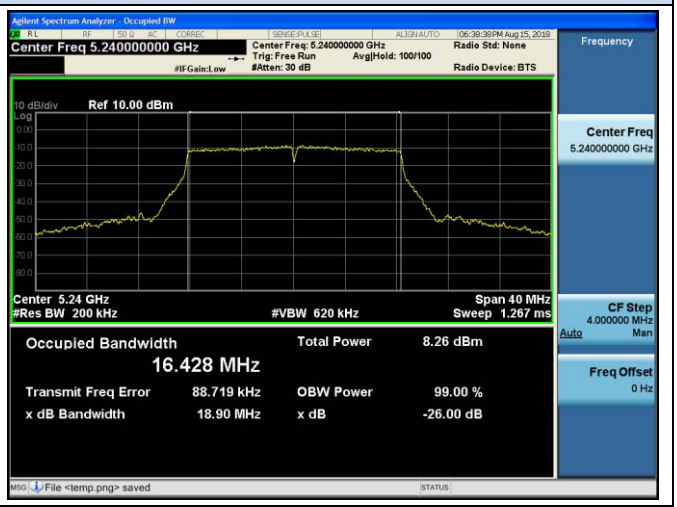
Test Mode	Channel	Frequency (MHz)	26dB Bandwidth (MHz)		99% Bandwidth (MHz)		Limits (MHz)	Verdict
			Antenna 0	Antenna 1	Antenna 0	Antenna 1		
IEEE 802.11a	36	5180	21.30	18.831	18.63	16.52	No Limit	PASS
	40	5200	18.75	18.798	16.53	16.53		
	48	5240	18.98	18.902	16.53	16.52		
IEEE 802.11n HT20	36	5180	19.43	19.501	17.67	17.67	No Limit	PASS
	40	5200	19.52	19.456	17.67	17.66		
	48	5240	19.40	19.421	17.67	17.67		
IEEE 802.11ac VHT20	36	5180	19.46	19.606	17.67	17.67	No Limit	PASS
	40	5200	19.52	19.622	17.67	17.68		
	48	5240	19.51	19.642	17.66	17.69		
IEEE 802.11n HT40	38	5190	38.59	38.976	36.12	36.19	No Limit	PASS
	46	5230	38.31	39.368	36.12	36.17		
IEEE 802.11ac VHT40	38	5190	39.25	38.537	36.16	36.16	No Limit	PASS
	46	5230	39.24	39.068	36.18	36.16		
IEEE 802.11ac VHT80	42	5210	78.92	80.001	75.10	75.34	No Limit	PASS

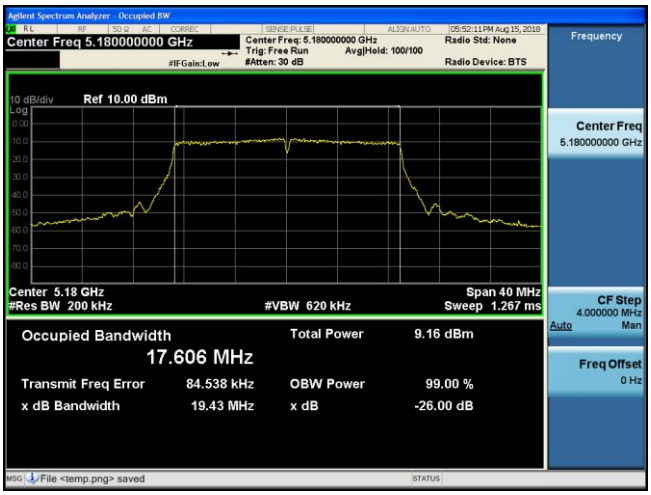
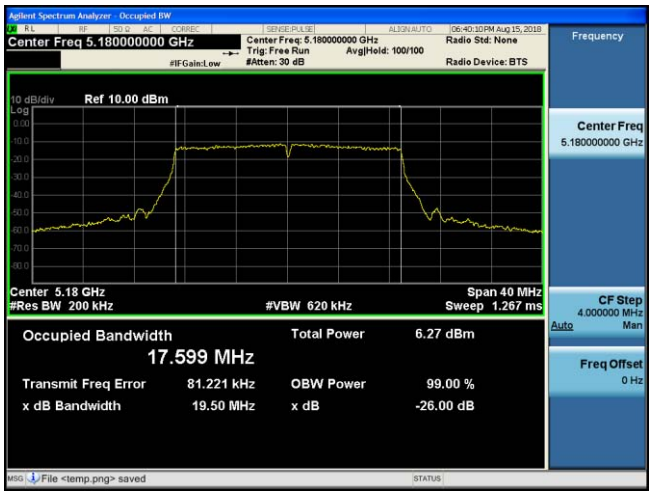
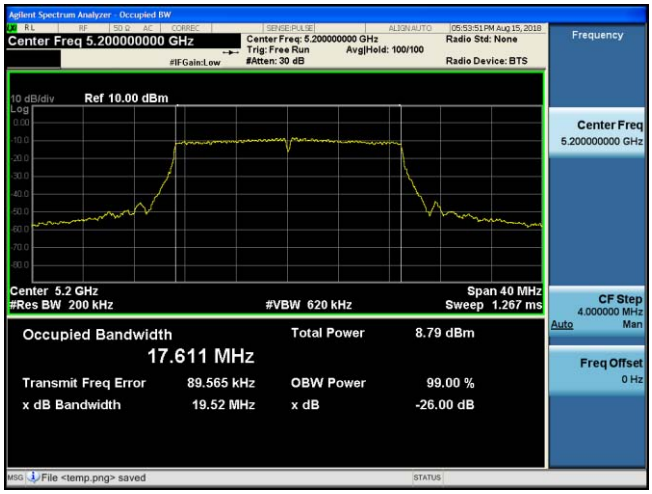
Remark:

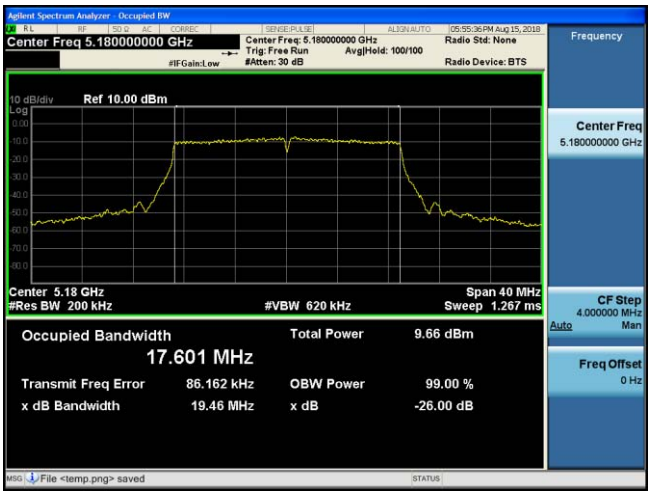
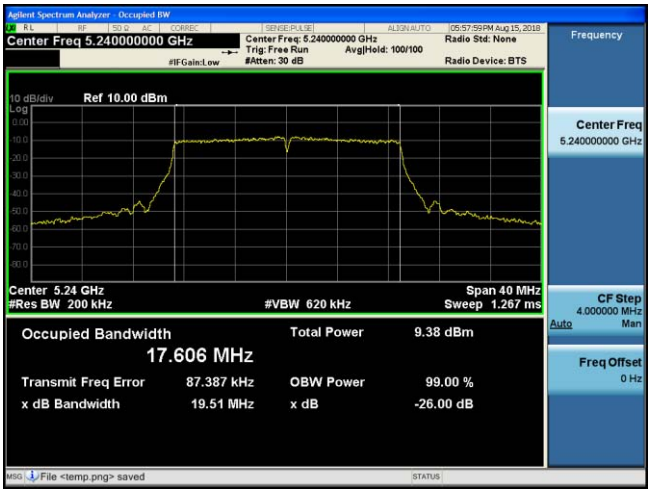
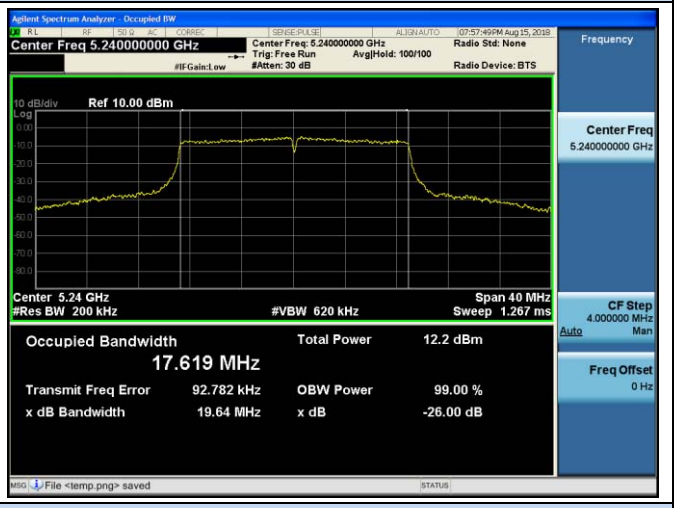
1. *Measured 99% and 26dB bandwidth at difference data rate for each mode and recorded worst case for each mode.*
2. *Test results including cable loss;*
3. *Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40, IEEE 802.11a VHT20, IEEE 802.11ac VHT40 and IEEE 802.11ac VHT80;*
4. *Please refer to following test plots;*

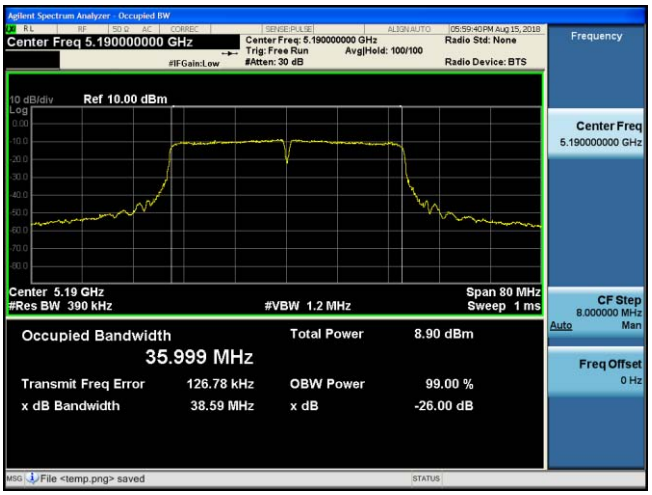
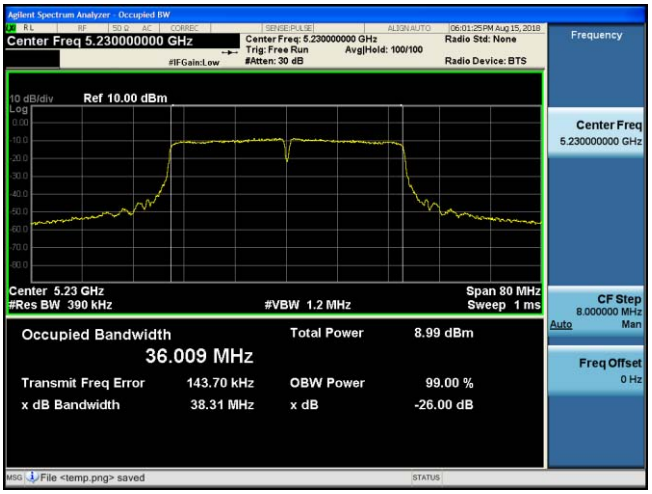
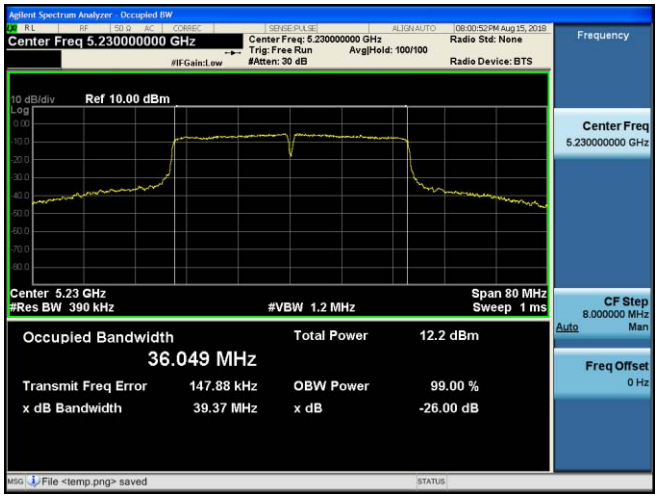
26dB Emission Bandwidth

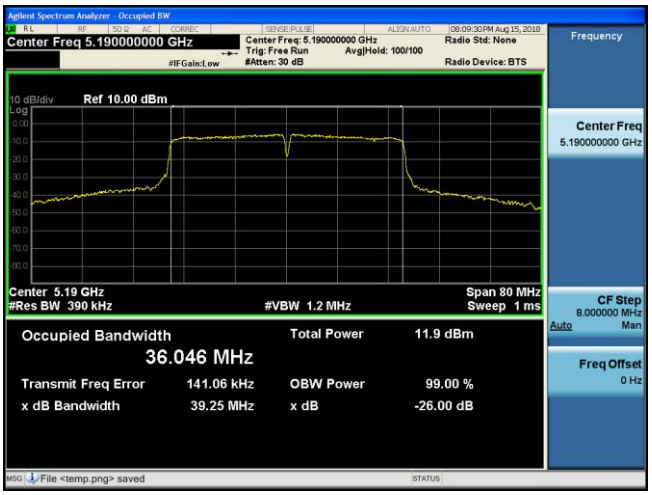
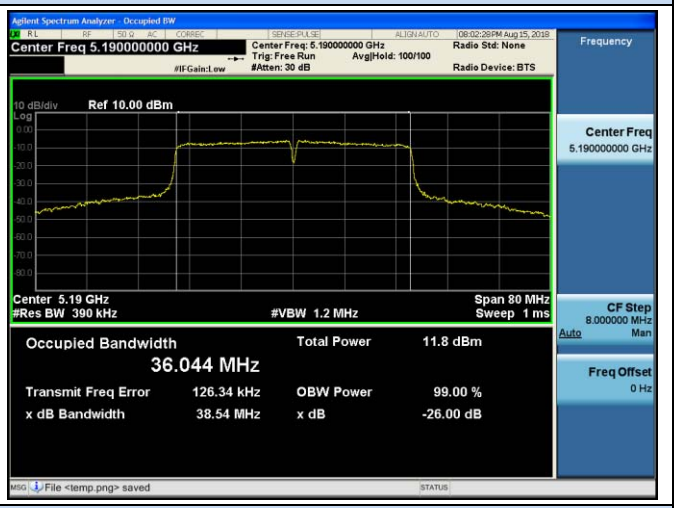
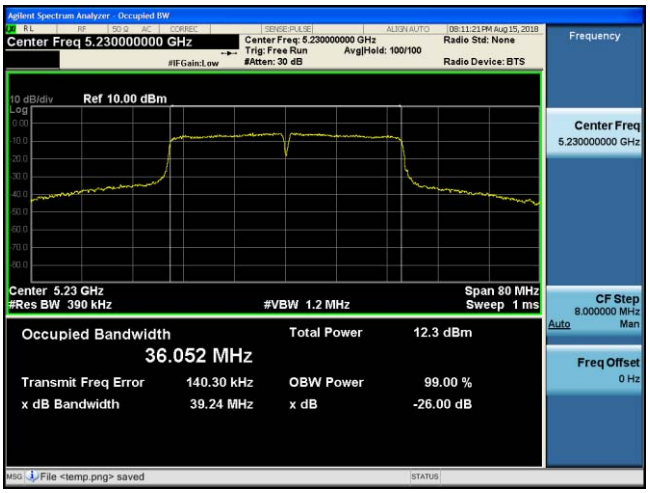
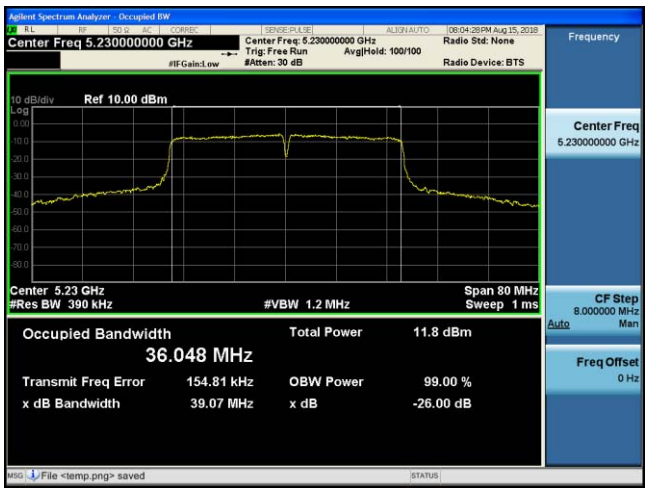
IEEE 802.11a

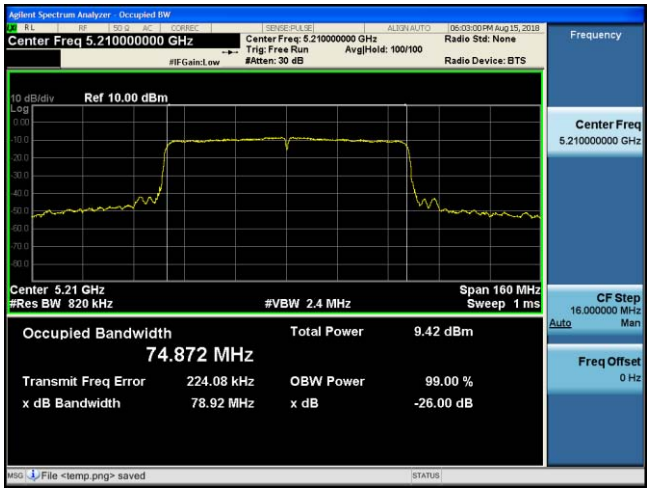
Antenna Chain 0	Antenna Chain 1
	
Channel 36 / 5180 MHz	Channel 36 / 5180 MHz
	
Channel 40 / 5200 MHz	Channel 40 / 5200 MHz
	
Channel 48 / 5240 MHz	Channel 48 / 5240 MHz

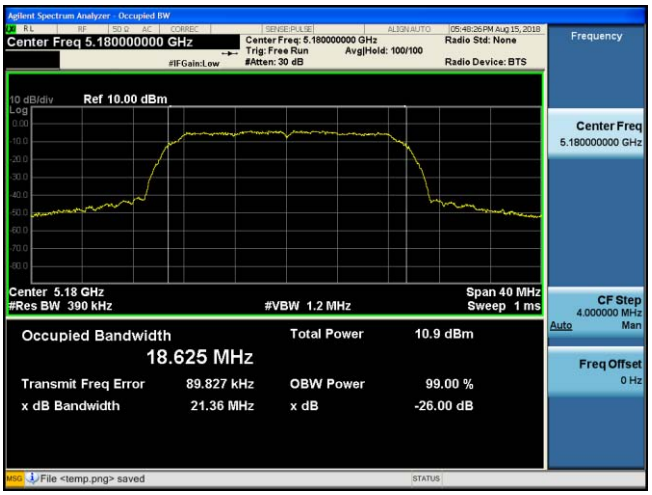
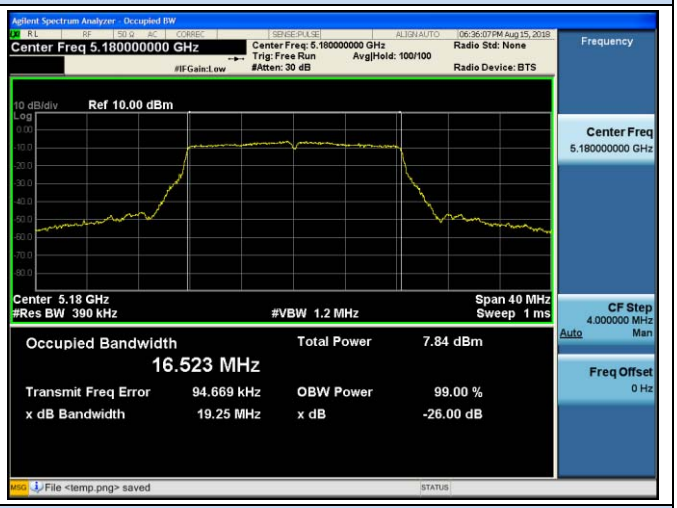
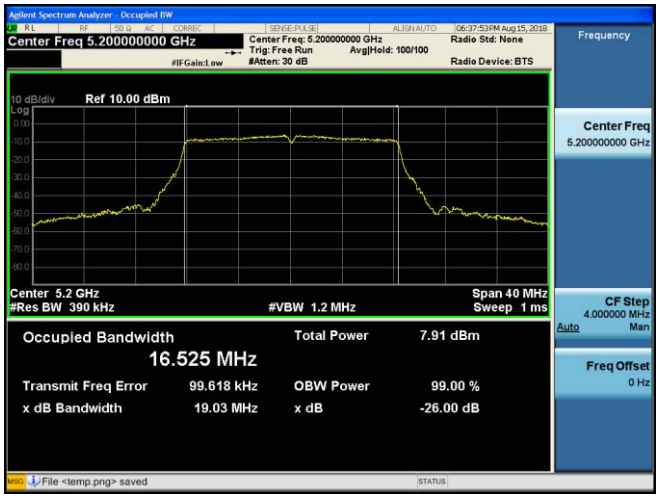
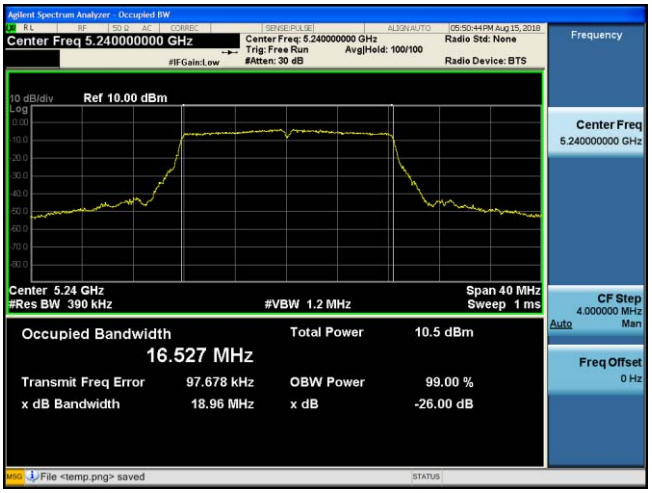
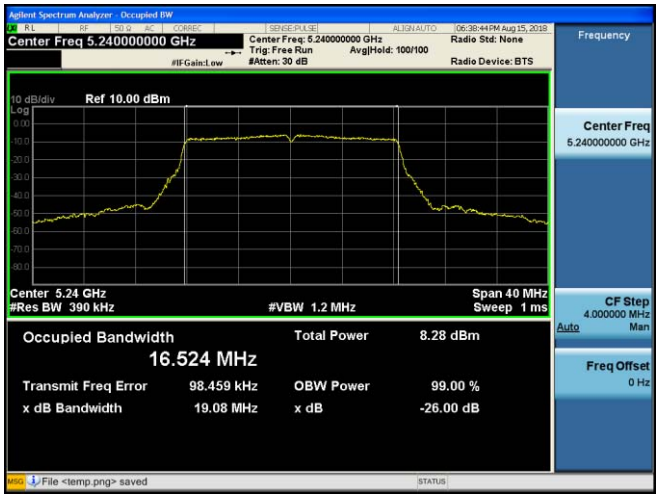
26dB Emission Bandwidth	
IEEE 802.11n HT20	
Antenna Chain 0	Antenna Chain 1
	
Channel 36 / 5180 MHz	Channel 36 / 5180 MHz
	
Channel 40 / 5200 MHz	Channel 40 / 5200 MHz
Channel 48 / 5240 MHz	Channel 48 / 5240 MHz

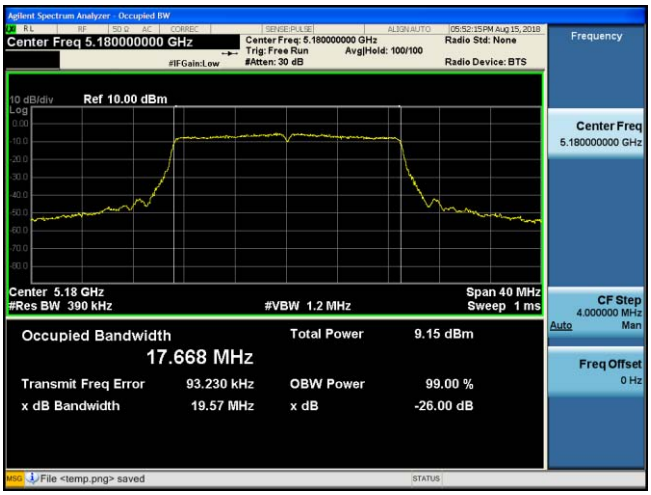
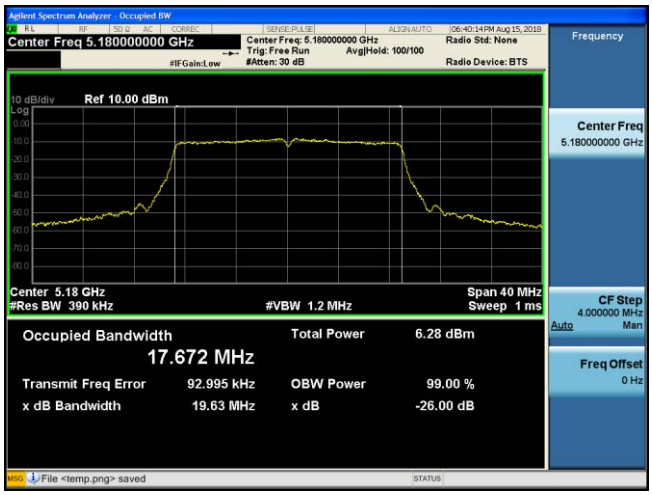
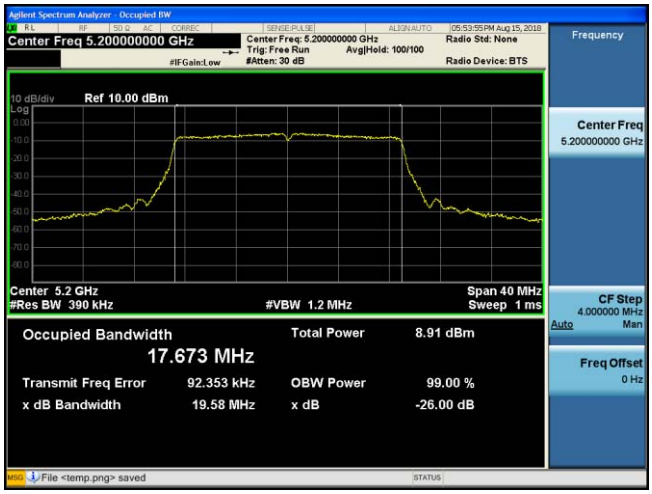
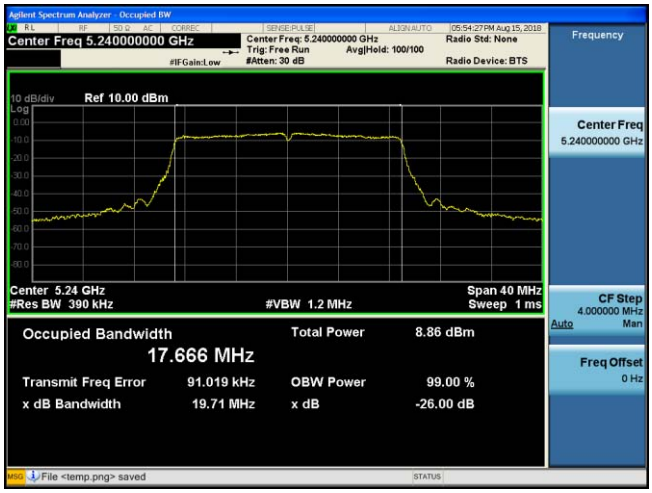
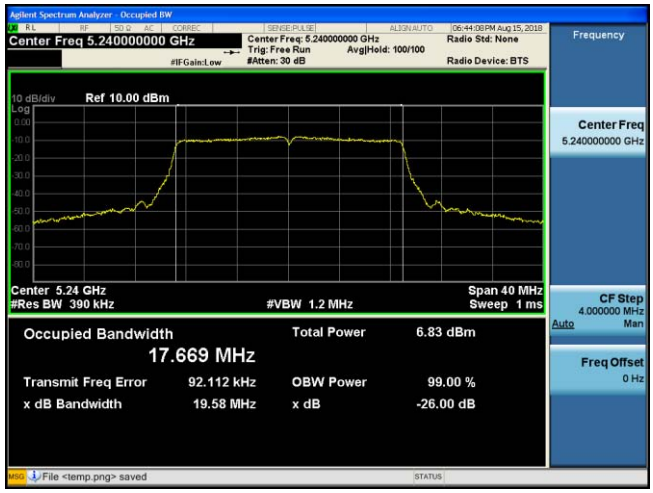
26dB Emission Bandwidth	
IEEE 802.11ac VHT20	
Antenna Chain 0	Antenna Chain 1
	
Channel 36 / 5180 MHz	Channel 36 / 5180 MHz
Channel 40 / 5200 MHz	Channel 40 / 5200 MHz
	
Channel 48 / 5240 MHz	Channel 48 / 5240 MHz

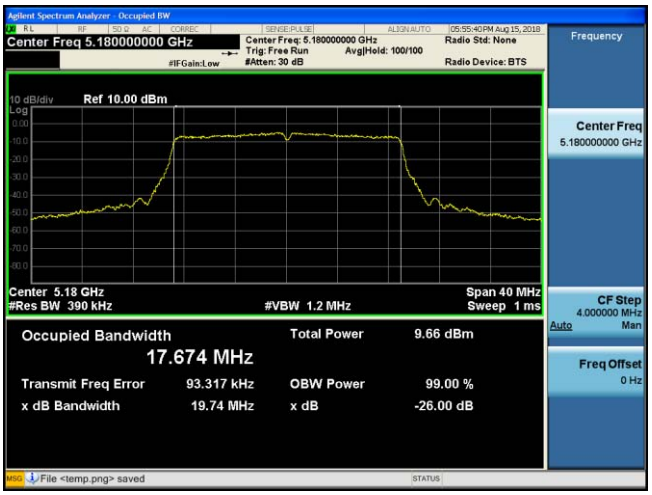
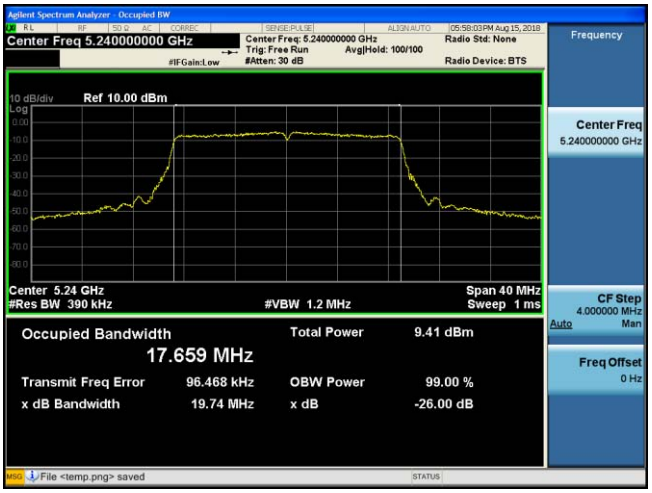
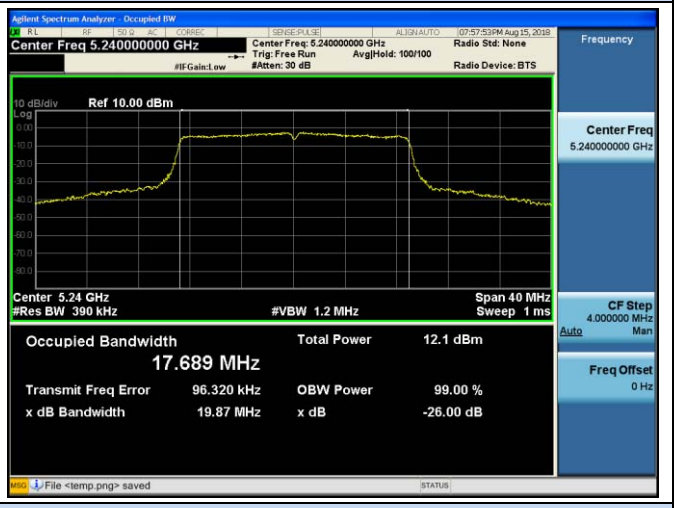
26dB Emission Bandwidth	
IEEE 802.11n HT40	
Antenna Chain 0	Antenna Chain 1
	
Channel 38 / 5190 MHz	Channel 38 / 5190 MHz
	
Channel 46 / 5230 MHz	Channel 46 / 5230 MHz

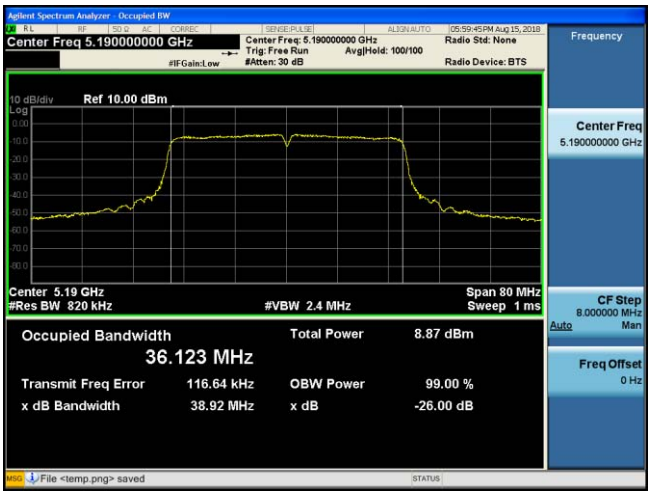
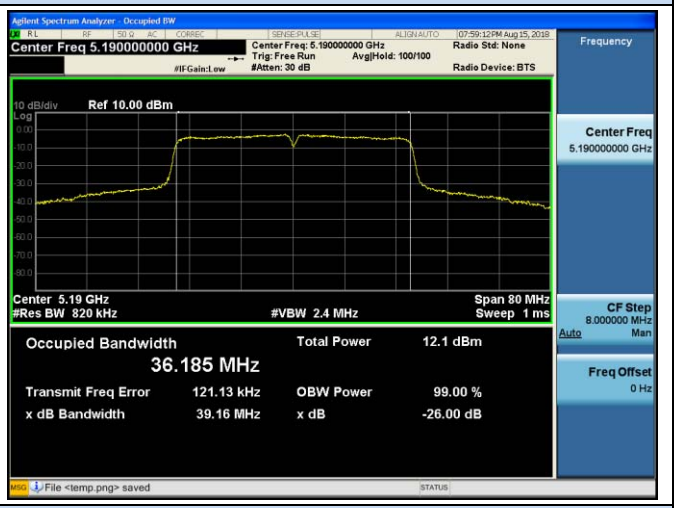
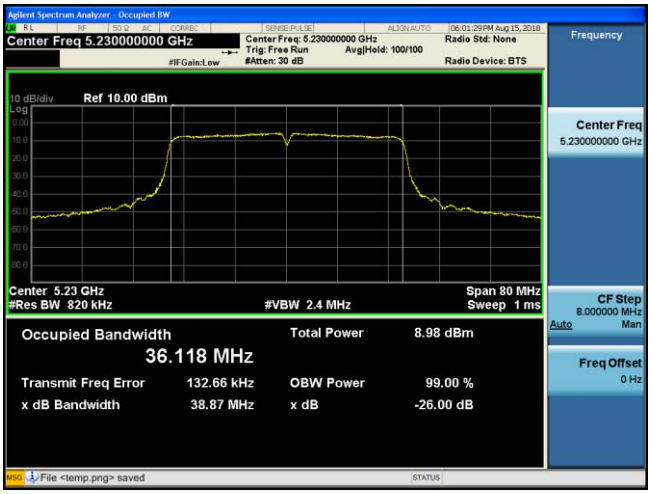
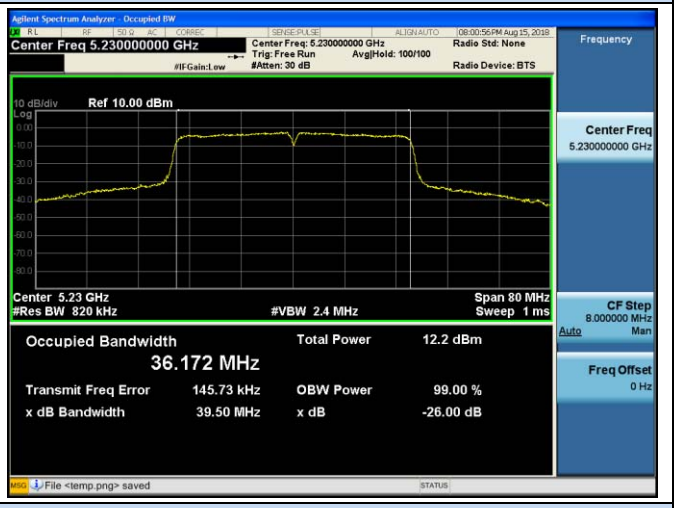
26dB Emission Bandwidth	
IEEE 802.11ac VHT40	
Antenna Chain 0	Antenna Chain 1
	
Channel 38 / 5190 MHz	Channel 38 / 5190 MHz
	
Channel 46 / 5230 MHz	Channel 46 / 5230 MHz

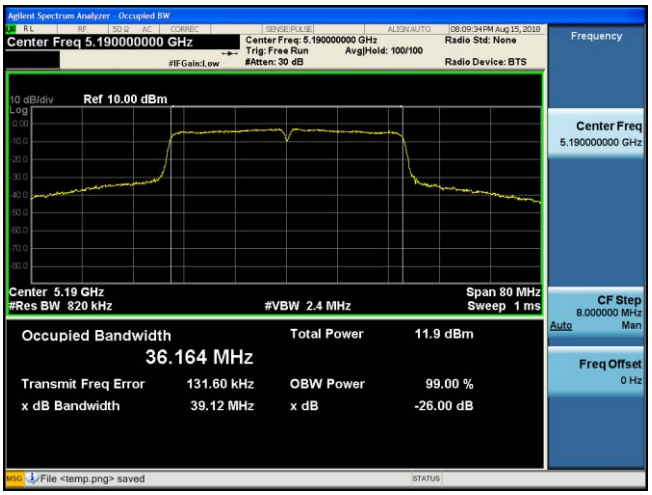
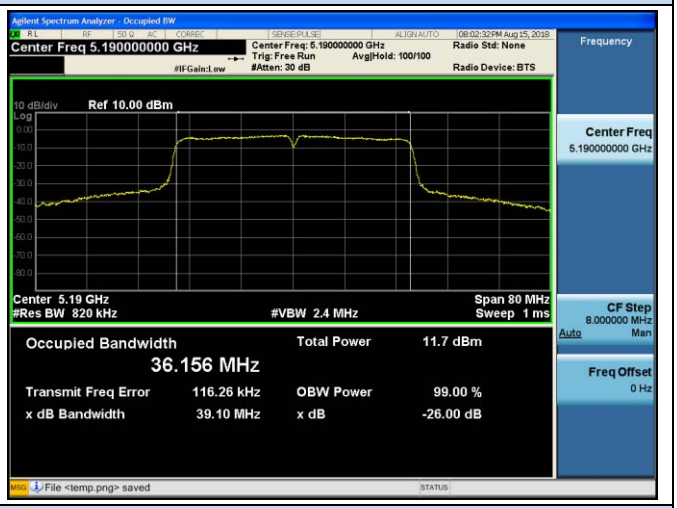
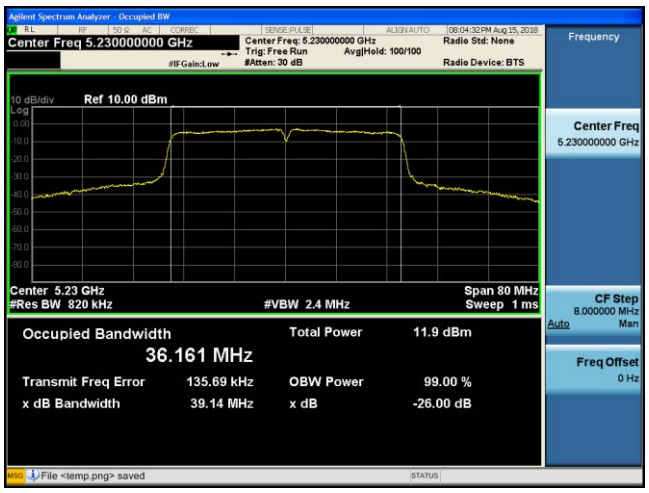
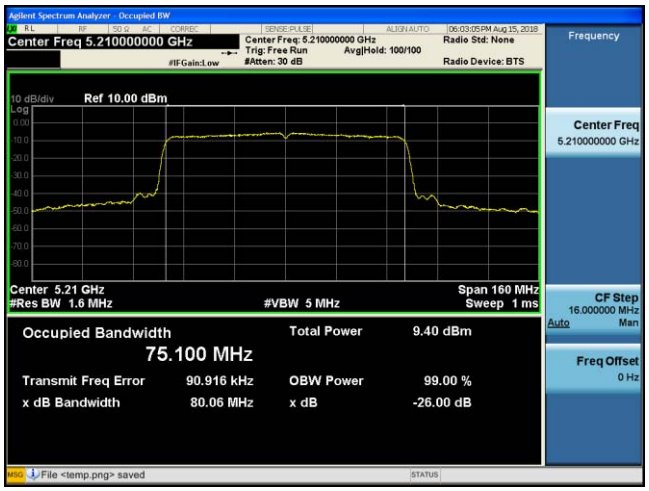
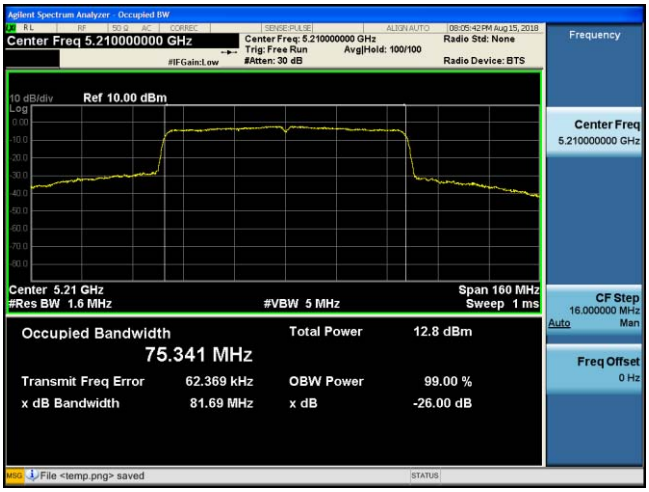
26dB Emission Bandwidth	
IEEE 802.11ac VHT80	
Antenna Chain 0	Antenna Chain 1
	
Channel 42 / 5210 MHz	Channel 42 / 5210 MHz

99% Occupied Bandwidth	
IEEE 802.11a	
Antenna Chain 0	Antenna Chain 1
	
Channel 36 / 5180 MHz	Channel 36 / 5180 MHz
	
Channel 40 / 5200 MHz	Channel 40 / 5200 MHz
	
Channel 48 / 5240 MHz	Channel 48 / 5240 MHz

99% Occupied Bandwidth	
IEEE 802.11n HT20	
Antenna Chain 0	Antenna Chain 1
	
Channel 36 / 5180 MHz	Channel 36 / 5180 MHz
	
Channel 40 / 5200 MHz	Channel 40 / 5200 MHz
	
Channel 48 / 5240 MHz	Channel 48 / 5240 MHz

99% Occupied Bandwidth	
IEEE 802.11ac VHT20	
Antenna Chain 0	Antenna Chain 1
	
Channel 36 / 5180 MHz	Channel 36 / 5180 MHz
Channel 40 / 5200 MHz	Channel 40 / 5200 MHz
	
Channel 48 / 5240 MHz	Channel 48 / 5240 MHz

99% Occupied Bandwidth	
IEEE 802.11n HT40	
Antenna Chain 0	Antenna Chain 1
	
Channel 38 / 5190 MHz	Channel 38 / 5190 MHz
	
Channel 46 / 5230 MHz	Channel 46 / 5230 MHz

99% Occupied Bandwidth	
IEEE 802.11ac VHT40	
Antenna Chain 0	Antenna Chain 1
	
Channel 38 / 5190 MHz	Channel 38 / 5190 MHz
	
Channel 46 / 5230 MHz	Channel 46 / 5230 MHz

99% Occupied Bandwidth	
IEEE 802.11ac VHT80	
Antenna Chain 0	Antenna Chain 1