FCC/ISED TEST REPORT

Test report
On Behalf of
Shenzhen SEI Robotics Co., Ltd.
For
4K Set top box
Model No.: IPA1114HDW-02,SN6BBAX(X=A TO Z) [for FCC]
IPA1114HDW-02, SN6BBAO [for ISED]

FCC ID: 2AOVU-SN6BBAX
IC: 25669-IPA1114HDW

Prepared for :	**Shenzhen SEI Robotics Co., Ltd.** 501, Block A, Productivity Building #5 Hi-tech Middle 2nd Road, Nanshan District, Shenzhen, China
Prepared By :	**Shenzhen HUAK Testing Technology Co., Ltd.** **1F, B2 Building, Junfeng Zhongcheng Zhizao Innovation Park, Fuhai Street, Bao'an District, Shenzhen City, China**
Date of Test:	**Nov 6, 2019~ Dec 17, 2019**
Date of Report:	**Dec 18, 2019**
Report Number:	**HK1910302722-E1**

TEST RESULT CERTIFICATION

Applicant's name ..... :	**Shenzhen SEI Robotics Co., Ltd.**
Address ..... :	501, Block A, Productivity Building #5 Hi-tech Middle 2nd Road, Nanshan District, Shenzhen, China
Manufacture's Name ..... :	**LIAN TECH Co., Ltd.**
Address ..... :	Workshop CN-05-06, lot Cn-05,Van Trung Industrial Park, Viet Yen District, Bac Giang Province,Vietnam
Product description	
Trade Mark ..... :	eSTREAM4K
Product name ..... :	4K Set top box
Model and/or type reference :	Refer to page1
Standards ..... :	FCC Rules and Regulations Part 15 Subpart C Section 15.247 RSS 247 Issue 2, February 2017 RSS GEN Issue 5, March 2019 ANSI C63.10: 2013

Date of Test ..... :	
Date (s) of performance of tests ..... :	Nov 6, 2019~ Dec 17, 2019
Date of Issue ..... :	Dec 18, 2019
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
00	Dec 18, 2019	Initial Issue	Jason Zhou

TABLE OF CONTENTS

1.GENERAL INFORMATION

1.1. Description of Device (EUT)

EUT	:	4K Set top box
Model Number	:	Refer to page1
Model Declaration	:	All the same except for the shape and color of cover.
Test Model	:	IPA1114HDW-02
Power Supply	:	DC 5V by adapter
Hardware version	:	SMB.207.05
Software version	:	android9.0
Bluetooth Version	:	V5.0+EDR
Channel Number	:	79 Channels for Bluetooth EDR(DSS) 40 Channels for Bluetooth BLE(DTS)
Modulation Technology	:	GFSK, π/4-DQPSK, 8-DPSK for Bluetooth EDR(DSS) GFSK for Bluetooth BLE(DTS)
Data Rates	:	Bluetooth EDR(DSS): 1~3Mbps;Bluetooth BLE(DTS): 1Mbps
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: 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) 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 1: 2.88 dBi(Max.), for TX/RX (WLAN 2.4G Band), 2.56 dBi(Max.), for TX/RX (WLAN 5.2G Band) 3.27 dBi(Max.), for TX/RX (WLAN 5.8G Band) Internal Antenna 2: 2.83 dBi(Max.), for TX/RX (WLAN 2.4G Band), 6.39 dBi(Max.), for TX/RX (WLAN 5.2G Band) 5.93 dBi(Max.), for TX/RX (WLAN 5.8G Band) Internal Antenna 3: 1.43 dBi(Max.), for TX/RX (Bluetooth),
Directional Gain	:	5.87 dBi for MIMO(2.4G Band) 7.82dBi for MIMO(5.2G Band) 7.81 dBi for MIMO(5.8G Band)

Note: Antenna position refer to EUT Photos.

1.2. Host System Configuration List and Details

Manufacturer	Description	Model	Serial Number	Certificate
SUNUN	Adapter	SA12V-050200U	N/A	N/A
Aohai	Adapter	A912-050200W-US1	N/A	N/A

1.3. External I/O Cable

I/O Port Description	Quantity	Cable
USB Port	2	N/A
HDMI Port	1	N/A
LAN Port	1	N/A
DC Port	1	N/A
OPTICAL Port	1	N/A
AV OUT Port	1	N/A
MICRO SD Port	1	N/A

1.4. Description of Test Facility

Designation Number: CN1229
Test Firm Registration Number: 616276

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

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.

AC power line conducted emission pre-test at both at AC 120V/60Hz and AC 240V/50Hz modes, recorded worst case.

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 **802.11n HT20 mode(Middle Channel, Chain 1+Chain 2).**

Worst-case mode and channel used for 9 KHz-1000 MHz radiated emissions was the mode and channel with the highest output power, that was determined to be **802.11n HT20 mode(Middle Channel, Chain 1+Chain 2).**

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

IEEE 802.11b Mode: 1 Mbps, DSSS.
IEEE 802.11g Mode: 6 Mbps, OFDM.
IEEE 802.11n Mode HT20: MCS0, OFDM.

Antenna & Bandwidth

Antenna	Antenna 1		Antenna 2		Simultaneously
Bandwidth Mode	20MHz	40MHz	20MHz	40MHz	/
IEEE 802.11b	☑	☐	☑	☐	☐
IEEE 802.11g	☑	☐	☑	☐	☐
IEEE 802.11n	☑	☐	☑	☐	☑

Channel List & Frequency

IEEE 802.11b/g/n HT20

Frequency Band	Channel No.	Frequency(MHz)	Channel No.	Frequency(MHz)
2412~2462MHz	1	2412	7	2442
	2	2417	8	2447
	3	2422	9	2452
	4	2427	10	2457
	5	2432	11	2462
	6	2437	--	--

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 KDB 558074 D01 DTS Meas Guidance v05r02 and KDB 662911 D01 Multiple Transmitter Output v02r01 are required to be used for this kind of FCC 15.247 digital modulation device.

According to its specifications, the EUT must comply with the requirements of the Section 15.203, 15.205, 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

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 (Ampak.apk) provided by application.

3.3. Special Accessories

No.	Equipment	Manufacturer	Model No.	Serial No.	Length	shielded/ unshielded	Notes
1	TV	AOC	280LM00003	JVVGJA000307	/	/	/

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

FCC Rules	ISED Rules	Description of Test	Result
/	/	Duty Cycle	Compliant
§15.247(b)	RSS-247 5.4	Maximum Conducted Output Power	Compliant
§15.247(e)	RSS-247 5.2	Power Spectral Density	Compliant
§15.247(a)(2)	RSS-247 5.2	6dB Bandwidth	Compliant
/	RSS-Gen 4.6	Occupied Bandwidth	Compliant
§15.209, §15.247(d)	RSS-247 5.5 RSS-Gen 8.9	Radiated and Conducted Spurious Emissions	Compliant
§15.205	RSS-247 5.5 RSS-Gen 8.10	Emissions at Restricted Band	Compliant
§15.207(a)	RSS-Gen 8.8	Conducted Emissions	Compliant
§15.203	/	Antenna Requirements	Compliant
§15.247(i)§2.1093	RSS-102	RF Exposure	Compliant

5. TEST RESULT

5.1. On Time and Duty Cycle

5.1.1. Standard Applicable

None; for reporting purpose only.

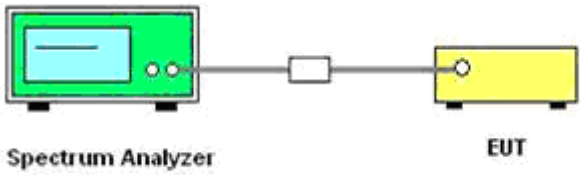
5.1.2. Measuring Instruments and Setting

Please refer to equipment's 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

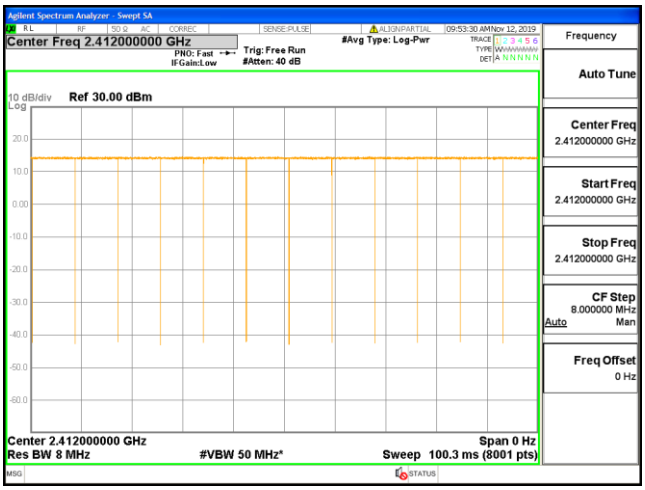
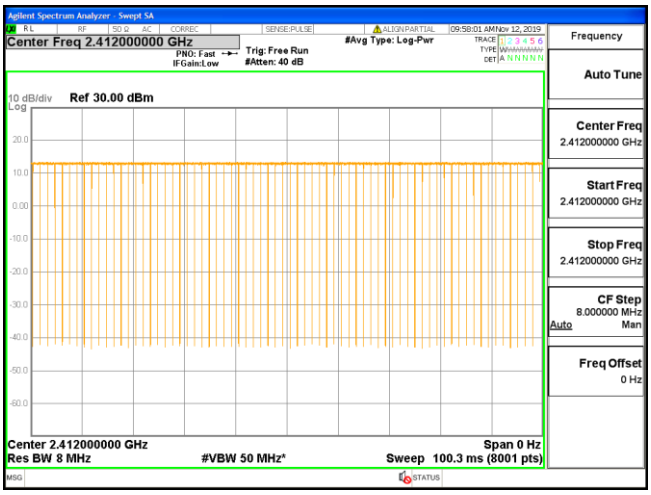
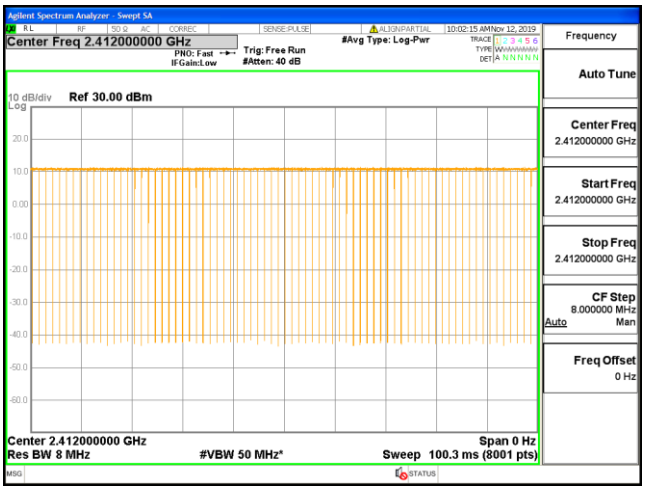
The EUT was programmed to be in continuously transmitting mode.

5.1.6. Test result

Mode	On Time Points	Total Sweep points	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (KHz)
IEEE 802.11b	7980	8001	99.74	0.00	0.12
IEEE 802.11g	7955	8001	99.43	0.00	0.72
IEEE 802.11n HT20	7826	8001	97.81	0.10	0.76

Remark:

1. Measured duty cycle for WLAN at antenna 0 and antenna 1 port, the two antenna ports results were same, just recorded results at antenna 0;

On Time and Duty Cycle	
	
IEEE 802.11b	*IEEE 802.11g*
	/
IEEE 802.11n HT20	/

5.2. Maximum Conducted Output Power Measurement

5.2.1. Standard Applicable

According to §15.247(b): For systems using digital modulation in the 2400-2483.5 MHz and 5725-5850 MHz band, the limit for maximum peak conducted output power is 30dBm. The limited has to be reduced by the amount in dB that the gain of the antenna exceeds 6dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

Systems operating in the 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi without any corresponding reduction in transmitter peak output power.

5.2.2. Measuring Instruments and Setting

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

5.2.3. Test Procedures

According to KDB558074 D01 DTS Measurement Guidance Section 9.1 Maximum peak conducted output power, 9.1.2 the maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

According to KDB558074 D01 DTS Measurement Guidance Section 9.2 Maximum average conducted output power, 9.2.3.1 Method AVGPM (Measurement using an RF average power meter)

(a) As an alternative to spectrum analyzer or EMI receiver measurements, 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.

1) The EUT is configured to transmit continuously, or to transmit with a constant duty factor.

2) At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.

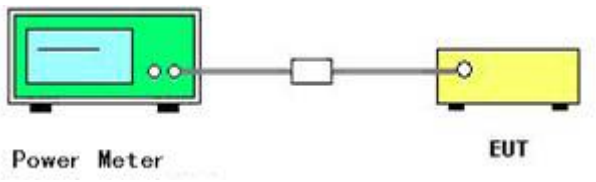
3) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.

(b) If the transmitter does not transmit continuously, measure the duty cycle (x) of the transmitter output signal as described in Section 6.0.

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

(d) Adjust the measurement in dBm by adding 10log (1/x), where x is the duty cycle to the measurement result.

5.2.4. Test Setup Layout



5.2.5. 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	23.6℃	Humidity	52.4%
Test Engineer	Gary Qian	Configurations	IEEE 802.11b/g/n

Test Mode	Channel	Frequency (MHz)	Measured Peak Output Power (dBm)			Limits (dBm)	Verdict
			Antenna 1	Antenna 2	Sum		
IEEE 802.11b	1	2412	17.880	17.675	-/-	30	PASS
	6	2437	18.375	18.294	-/-		
	11	2462	18.280	17.963	-/-		
IEEE 802.11g	1	2412	23.068	22.814	-/-	30	PASS
	6	2437	23.512	23.110	-/-		
	11	2462	23.160	22.977	-/-		
IEEE 802.11n HT20	1	2412	21.117	20.902	24.021	30	PASS
	6	2437	21.424	21.343	24.394		
	11	2462	21.109	21.162	24.146		

Test Mode	Channel	Frequency (MHz)	Measured Average Output Power (dBm)			Limits (dBm)	Verdict
			Antenna 1	Antenna 2	Sum		
IEEE 802.11b	1	2412	14.948	14.791	-/-	30	PASS
	6	2437	15.460	15.219	-/-		
	11	2462	15.363	15.051	-/-		
IEEE 802.11g	1	2412	15.709	15.496	-/-	30	PASS
	6	2437	16.243	15.789	-/-		
	11	2462	15.887	15.631	-/-		
IEEE 802.11n HT20	1	2412	13.840	13.624	16.744	30	PASS
	6	2437	14.070	13.881	16.987		
	11	2462	13.858	13.812	16.845		

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 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20;*
4. *"-/-" means no need measured or sum as cannot work at MIMO mode;*
5. *Average power is for report only;*

5.3. Power Spectral Density Measurement

5.3.1. Standard Applicable

According to §15.247(e): For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.3.2. Measuring Instruments and Setting

Please refer to equipment's 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.

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 = 3 KHz~100 KHz.

4. Set the VBW ≥ 3*RBW

5. Set the span to 1.5 times the DTS channel bandwidth.

6. Detector = peak.

7. Sweep time = auto couple.

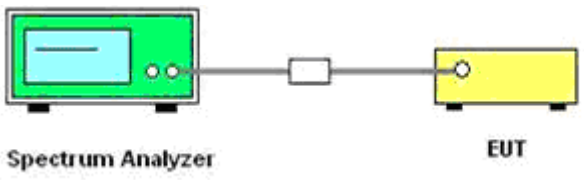
8. Trace mode = max hold.

9. Allow trace to fully stabilize.

10. Use the peak marker function to determine the maximum power level in any 3 kHz band segment within the fundamental EBW.

11. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.3.4. Test Setup Layout



5.3.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

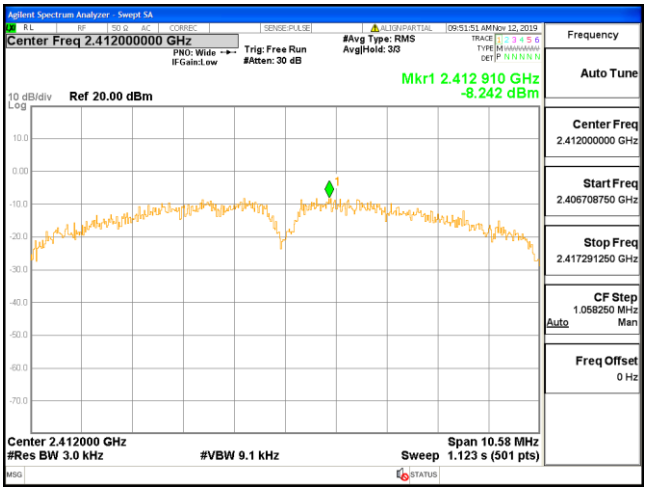
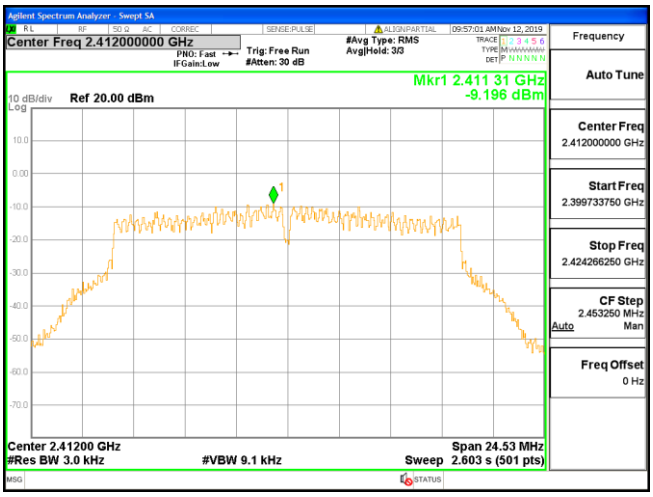
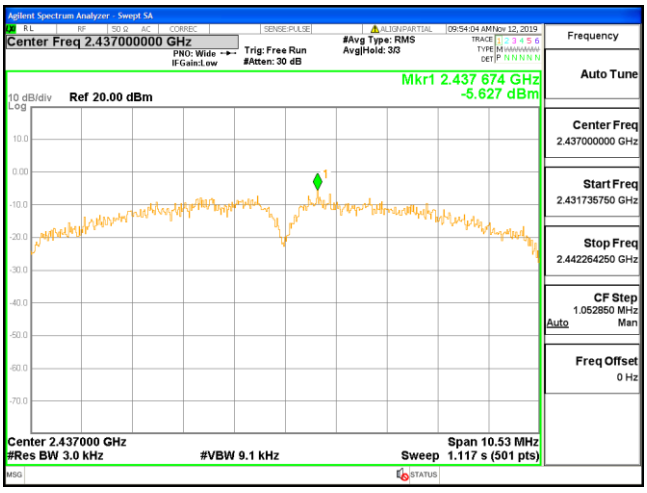
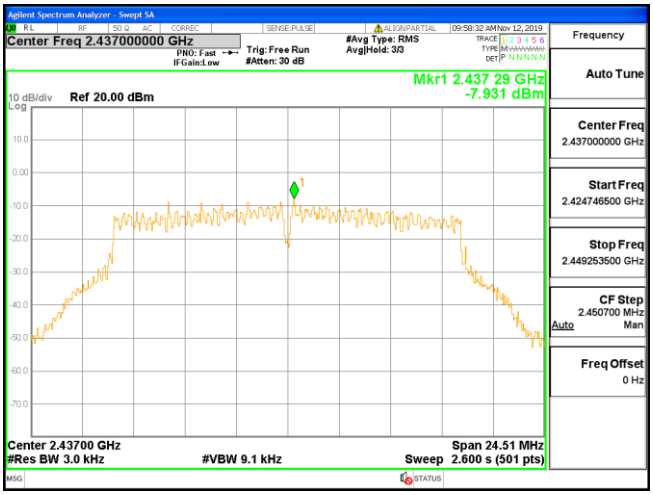
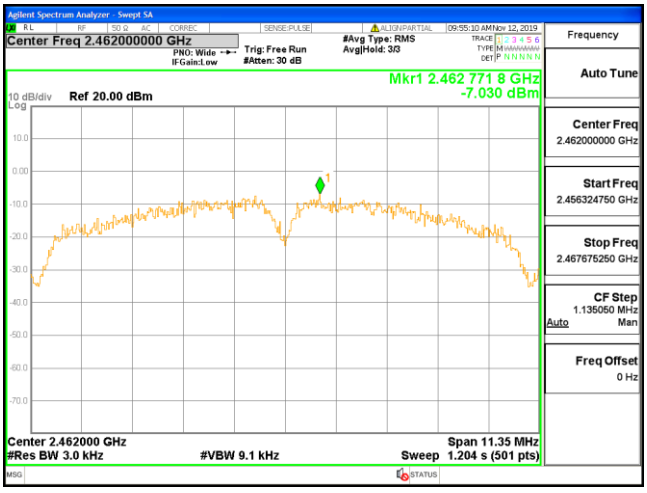
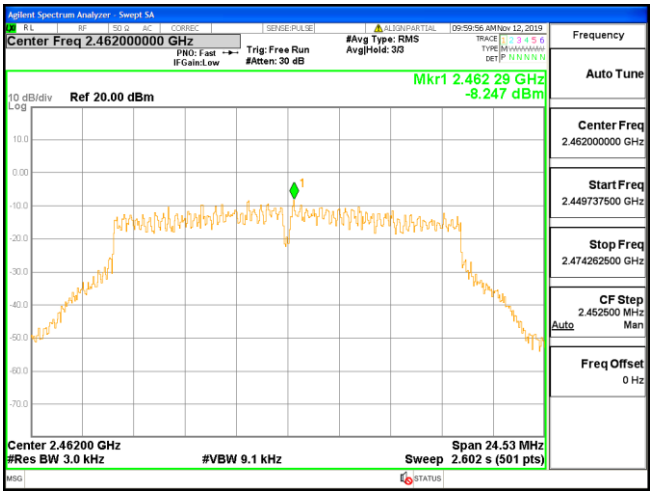
5.3.6. Test Result of Power Spectral Density

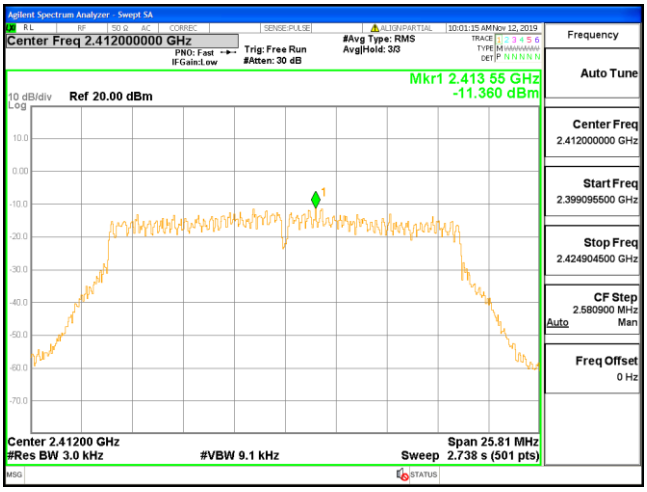
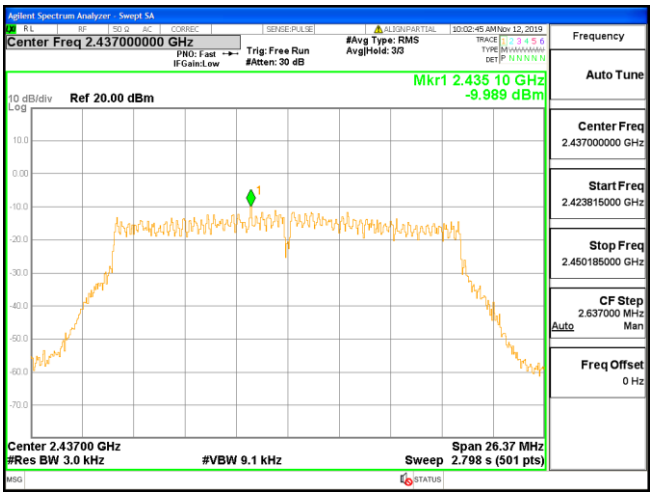
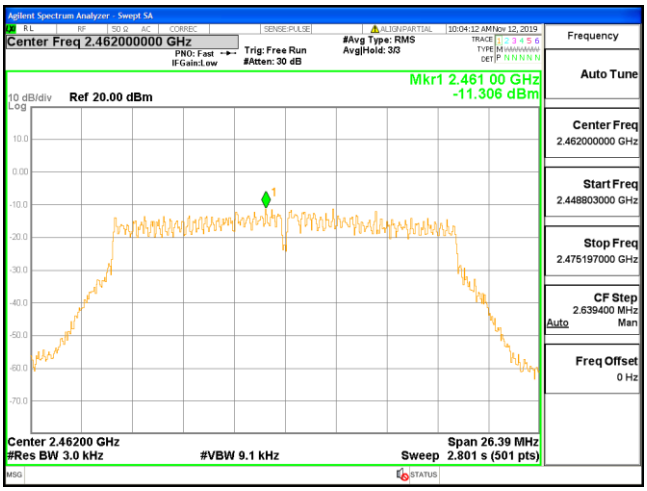
Temperature	23.6℃	Humidity	52.4%
Test Engineer	Gary Qian	Configurations	IEEE 802.11b/g/n

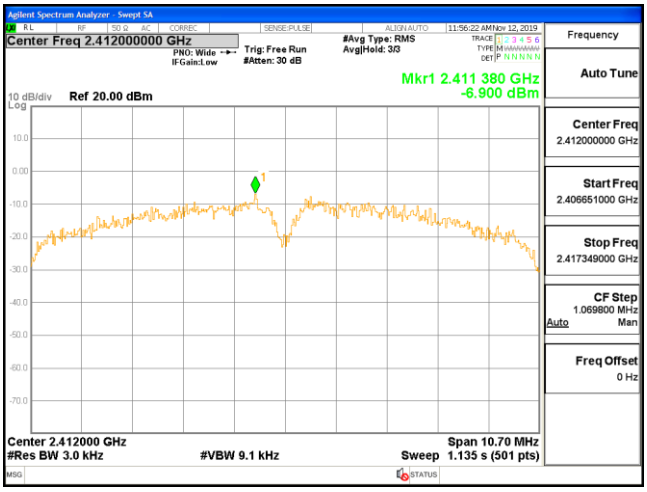
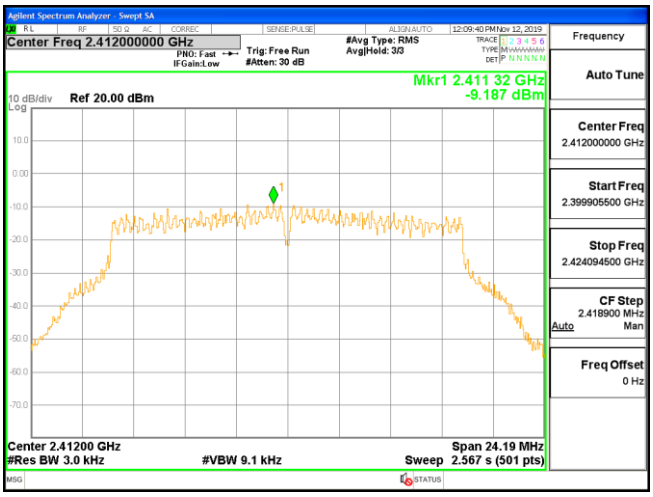
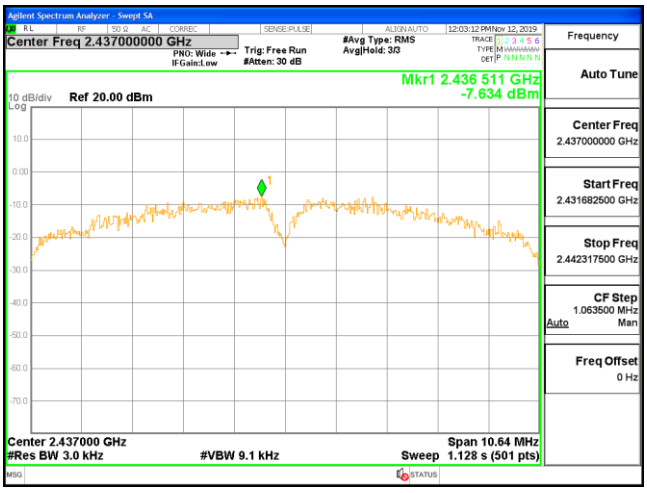
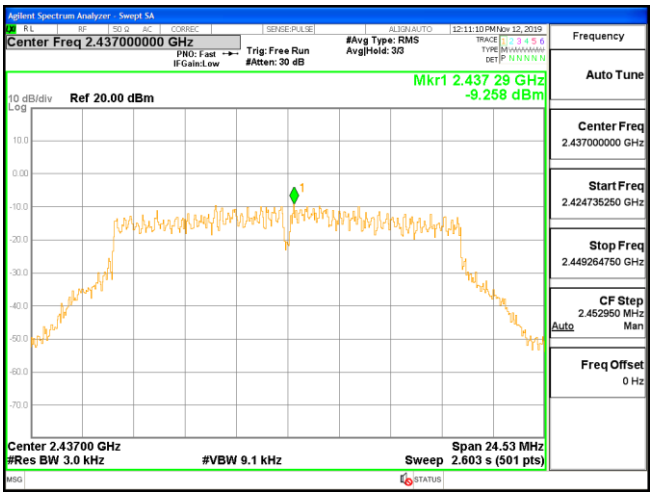
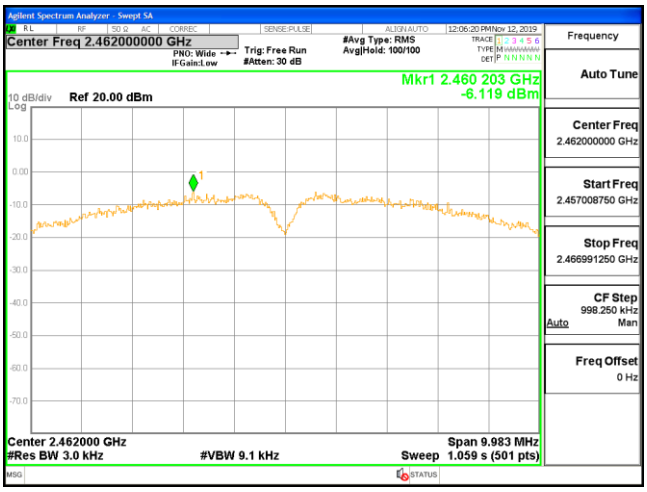
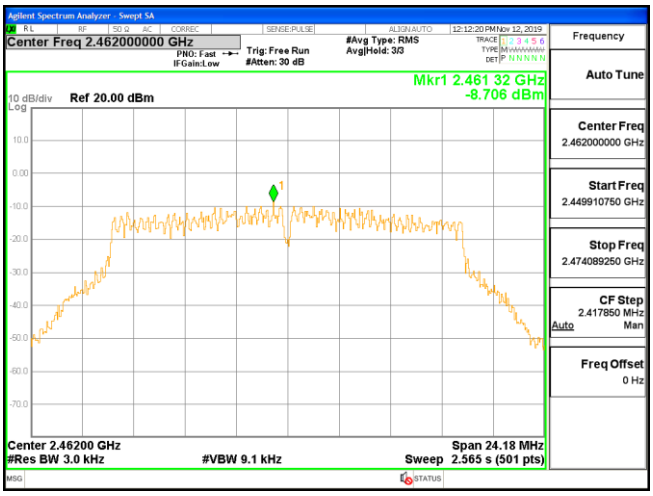
Test Mode	Channel	Frequency (MHz)	Measured Peak Power Spectral Density (dBm/3KHz)			Convert Factor	Report Peak Power Spectral Density	Directional Gain	Limits (dBm/3KHz)	Verdict
			Antenna 1	Antenna 2	Sum					
IEEE 802.11b	1	2412	-8.242	-6.900	-/-	0.00	-6.90	-/-	8.00	PASS
	6	2437	-5.627	-7.634	-/-	0.00	-5.63	-/-		
	11	2462	-7.03	-6.119	-/-	0.00	-6.12	-/-		
IEEE 802.11g	1	2412	-9.196	-9.187	-/-	0.00	-9.19	-/-	8.00	PASS
	6	2437	-7.931	-9.258	-/-	0.00	-7.93	-/-		
	11	2462	-8.247	-8.706	-/-	0.00	-8.25	-/-		
IEEE 802.11n HT20	1	2412	-11.360	-10.882	-8.10	0.10	-8.00	6.32	7.68	PASS
	6	2437	-9.989	-10.987	-7.45	0.10	-7.35	6.32		
	11	2462	-11.306	-10.622	-7.94	0.10	-7.93	6.32		

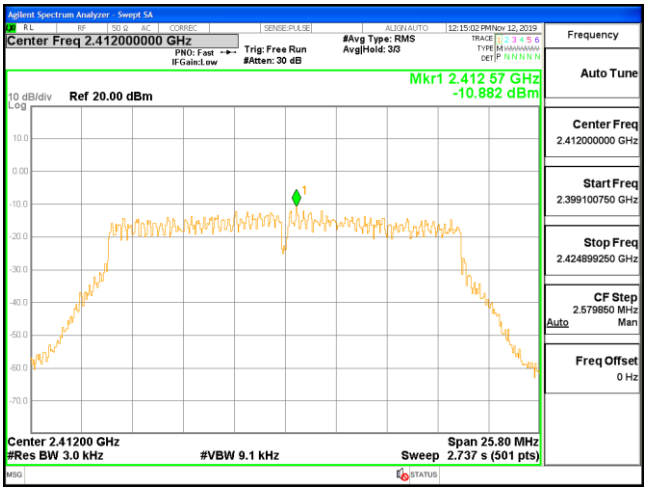
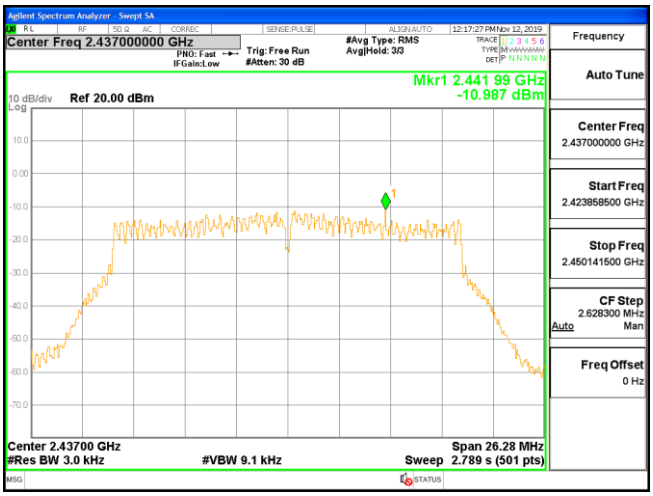
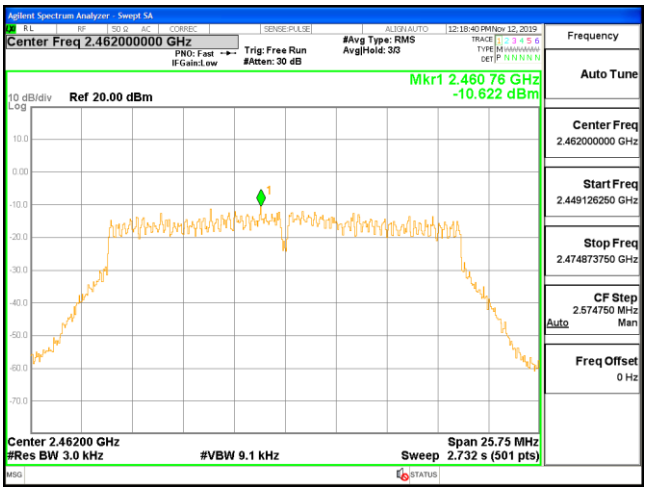
Remark:

1. *Measured peak 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 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20;*
4. *Please refer to following plots;*
5. *For MIMO with CCD technology device, The Directional Gain= Gain of individual transmit antennas (dBi) + Array gain;*
   Directional gain = 10 log[($10^{G1/10}$ + $10^{G2/10}$ + … + $10^{GN/10}$)/N_{ANT}] dBi,where antenna gains given by G1, G2, …, GN dBi, N_{ANT} is the antennas total Number.
6. *"-/-" means no need measured or sum as cannot work at MIMO mode;*

Power Spectral Density	
Antenna 1	Antenna 1
IEEE 802.11b	IEEE 802.11g
	
Channel 1 / 2412 MHz	Channel 1 / 2412 MHz
	
Channel 6 / 2437 MHz	Channel 6 / 2437 MHz
	
Channel 11 / 2462 MHz	Channel 11 / 2462 MHz

Power Spectral Density	
Antenna 1	
IEEE 802.11n HT20	
	
Channel 1 / 2412 MHz	*Channel 6 / 2437 MHz*
	/
Channel 11 / 2462 MHz	*/*

Power Spectral Density	
Antenna 2	*Antenna 2*
IEEE 802.11b	*IEEE 802.11g*
	
Channel 1 / 2412 MHz	*Channel 1 / 2412 MHz*
	
Channel 6 / 2437 MHz	*Channel 6 / 2437 MHz*
	
Channel 11 / 2462 MHz	*Channel 11 / 2462 MHz*

Power Spectral Density	
Antenna 2	
IEEE 802.11n HT20	
	
Channel 1 / 2412 MHz	*Channel 6 / 2437 MHz*
	/
Channel 11 / 2462 MHz	/

5.4. 6 dB Spectrum Bandwidth & 99% Bandwidth Measurement

5.4.1. Standard Applicable

According to §15.247(a) (2): For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

5.4.2. Measuring Instruments and Setting

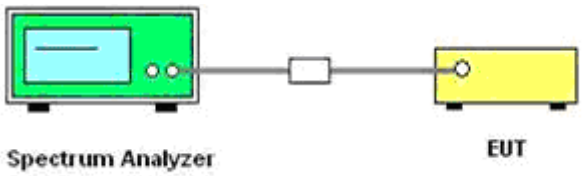
Please refer to equipments list in this report. The following table is the setting of the Spectrum Analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> RBW
Detector	Peak
Trace	Max Hold
Sweep Time	100ms

5.4.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
2. The resolution bandwidth and the video bandwidth were set according to KDB558074.
3. Measured the spectrum width with power higher than 6dB 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.

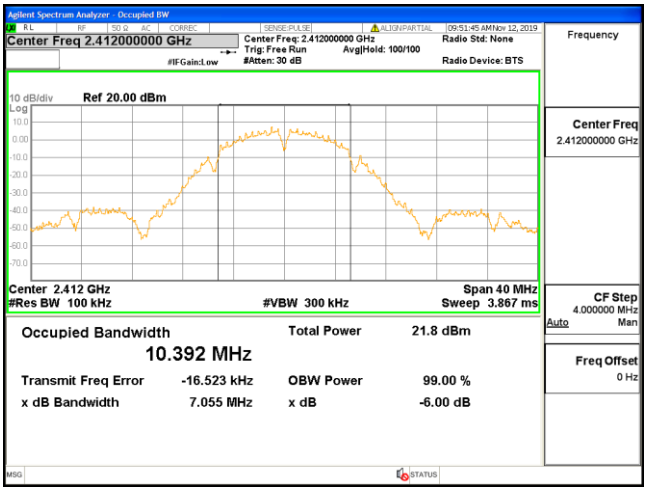
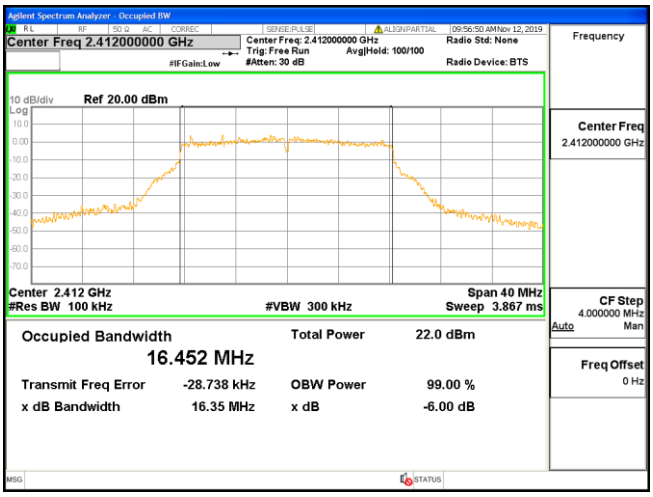
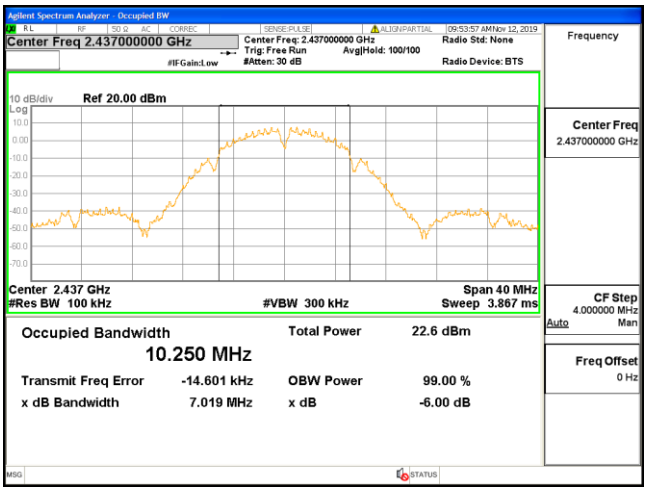
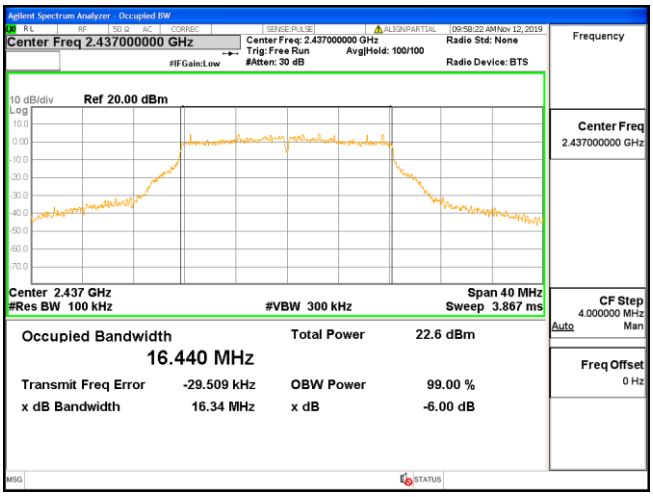
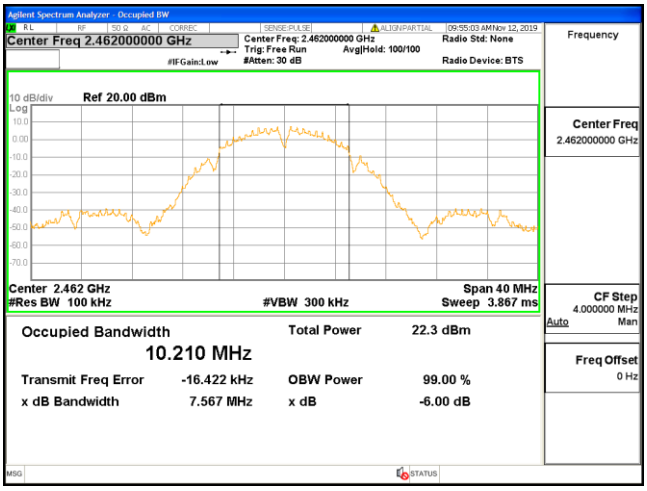
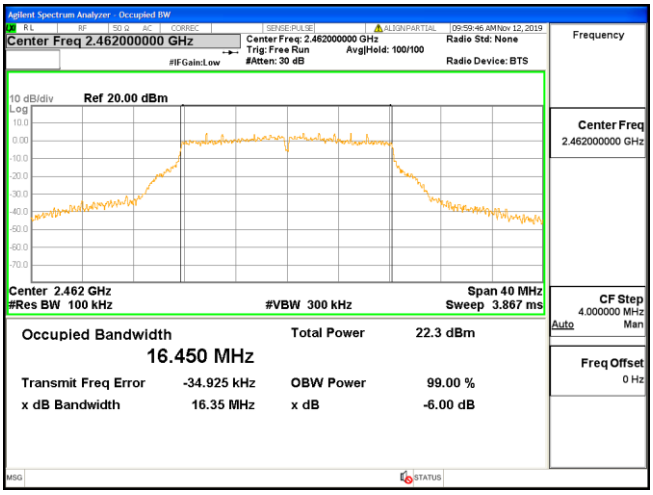
5.4.6. Test Result of 6dB Spectrum Bandwidth

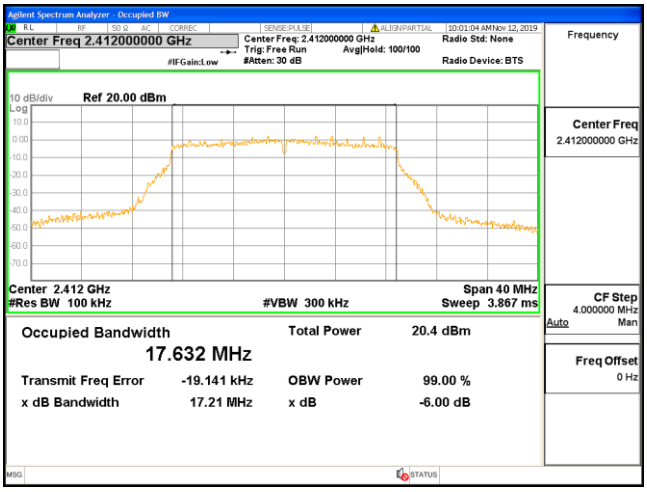
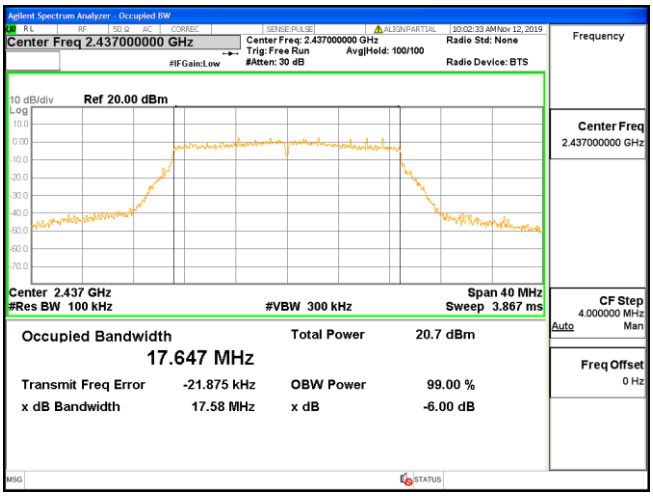
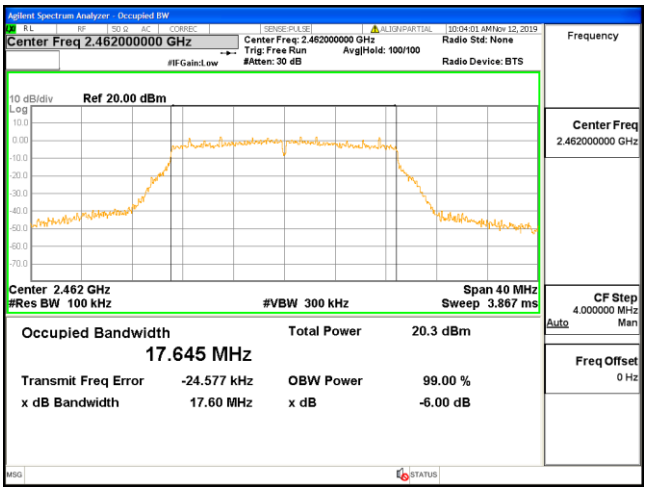
Temperature	23.6℃	Humidity	52.4%
Test Engineer	Gary Qian	Configurations	IEEE 802.11b/g/n

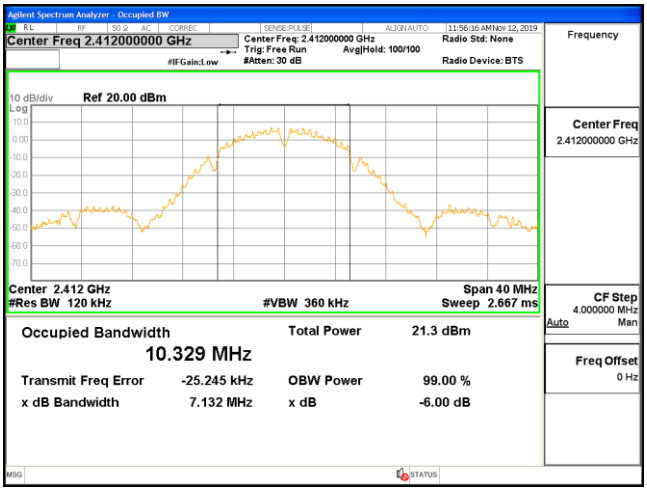
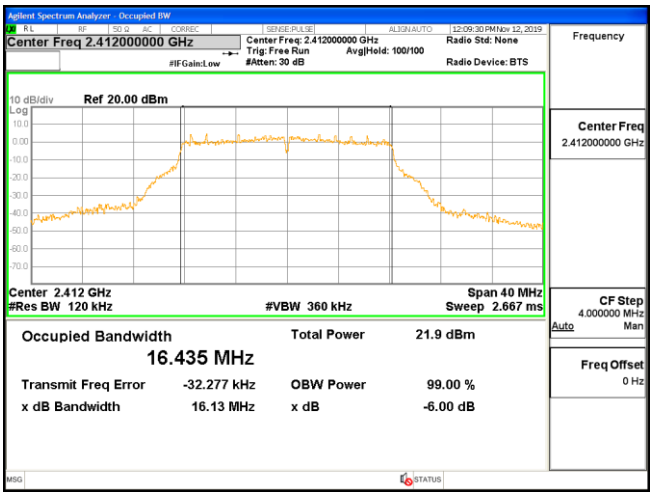
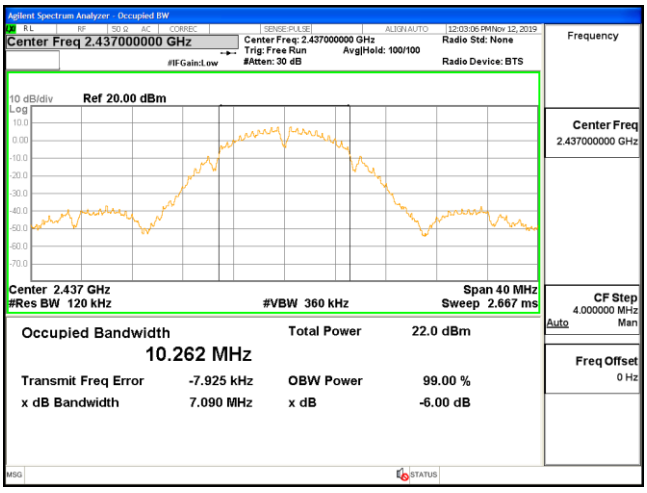
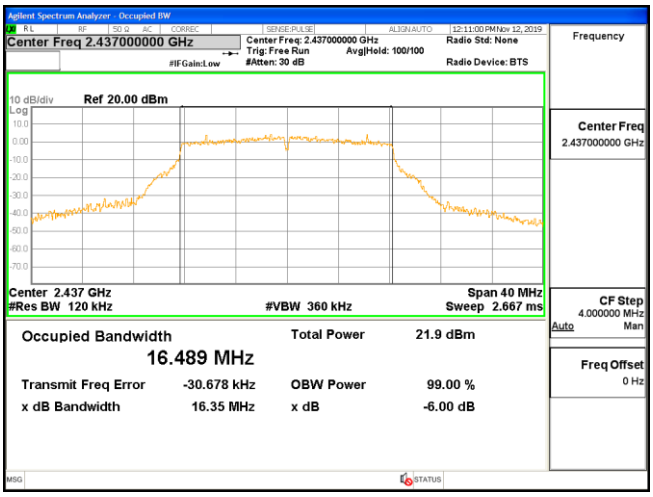
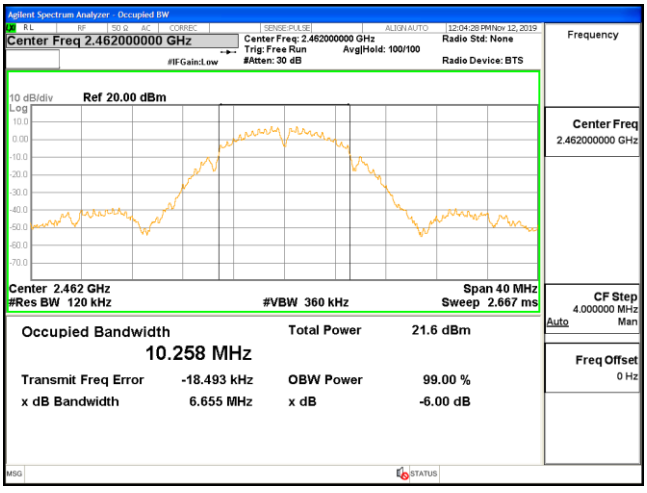
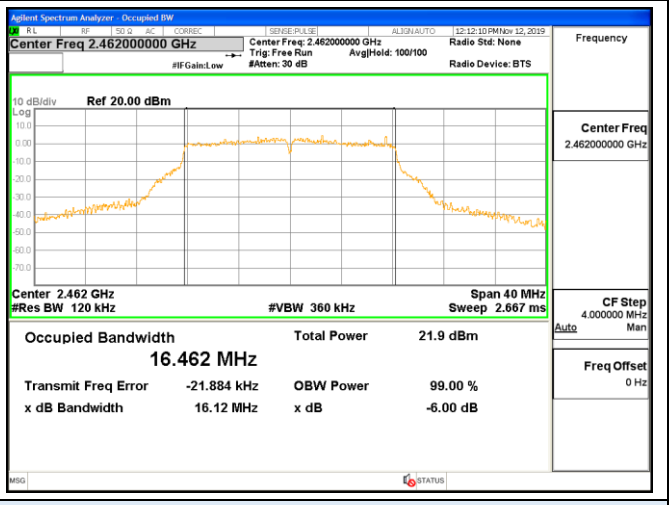
Test Mode	Channel	Frequency (MHz)	99% Bandwidth (MHz)		6dB Bandwidth (MHz)		Limits (MHz)	Verdict
			Antenna 1	Antenna 2	Antenna 1	Antenna 2		
IEEE 802.11b	1	2412	11.514	10.623	7.06	7.13	0.500	PASS
	6	2437	11.903	10.570	7.02	7.09		
	11	2462	11.828	10.547	7.57	6.66		
IEEE 802.11g	1	2412	17.278	17.043	16.36	16.13	0.500	PASS
	6	2437	17.361	17.052	16.34	16.35		
	11	2462	17.265	17.105	16.35	16.12		
IEEE 802.11n HT20	1	2412	17.986	18.106	17.21	17.20	0.500	PASS
	6	2437	18.120	18.141	17.58	17.52		
	11	2462	18.069	18.101	17.60	17.17		

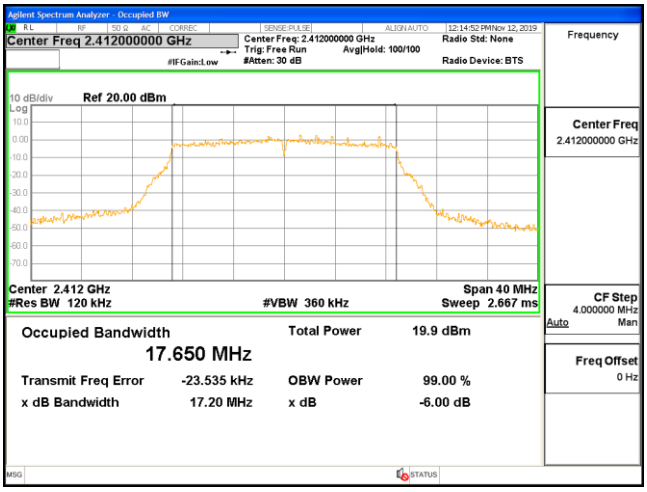
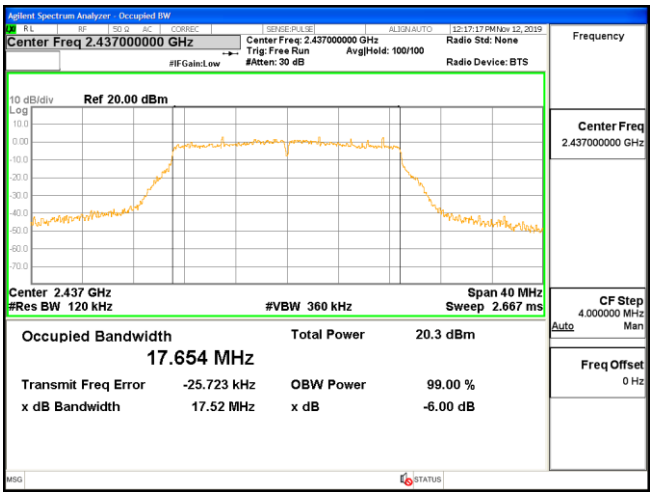
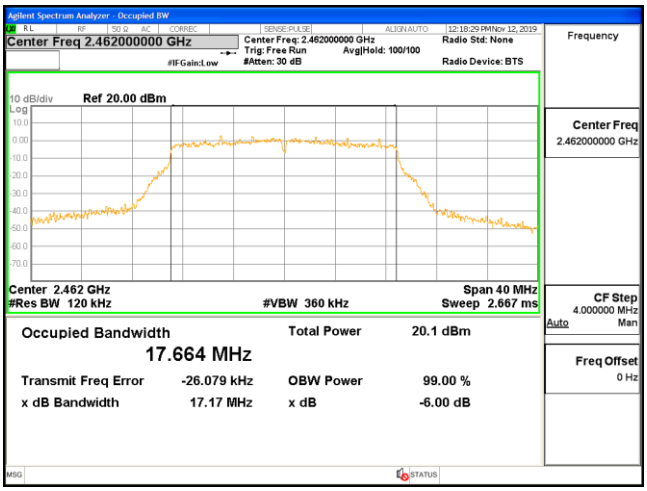
Remark:

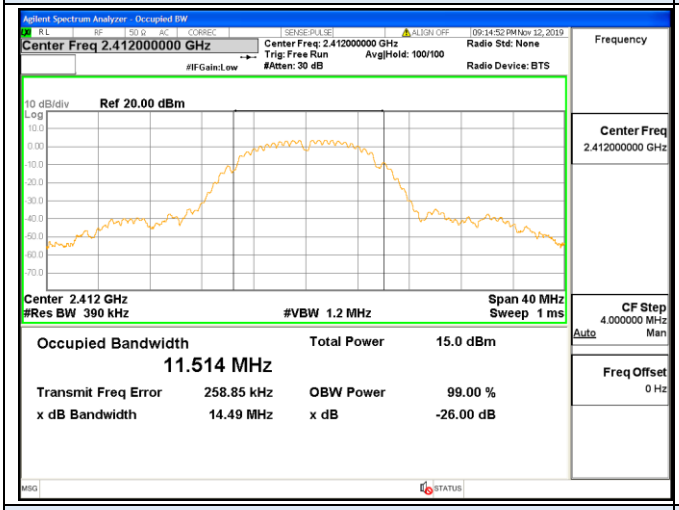
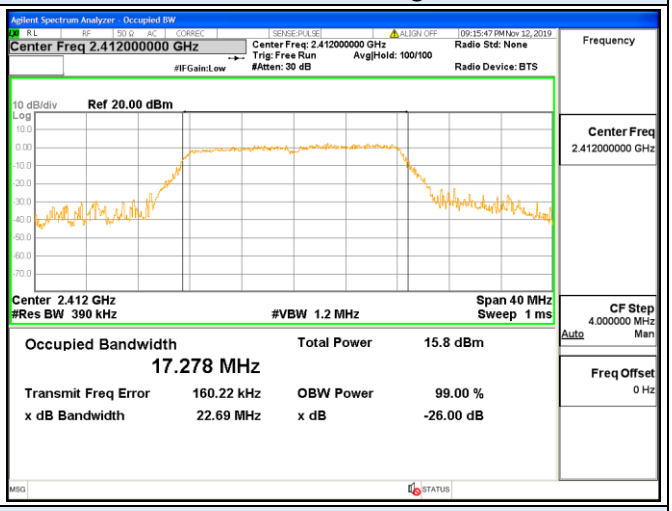
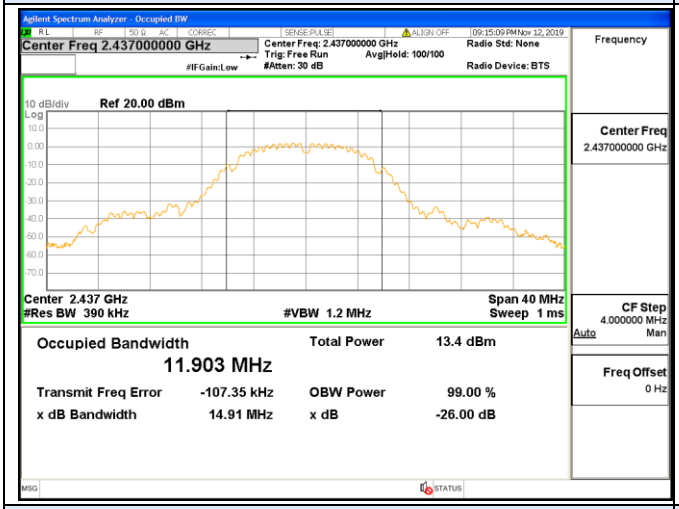
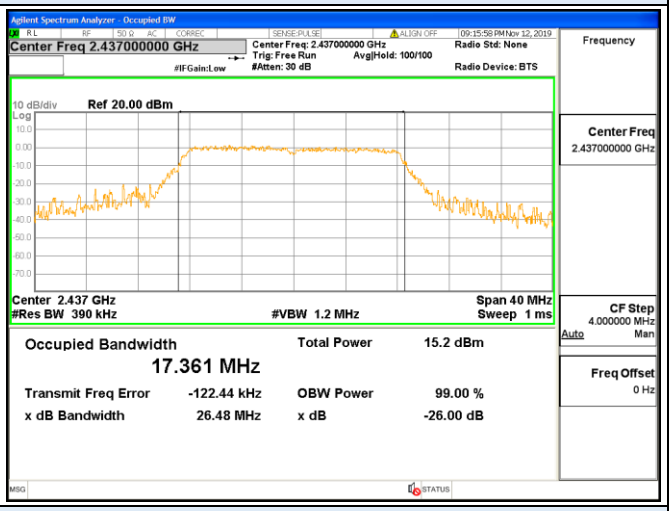
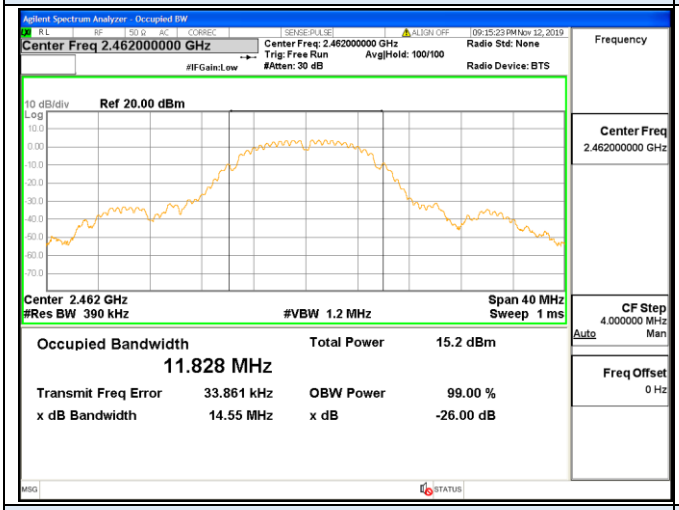
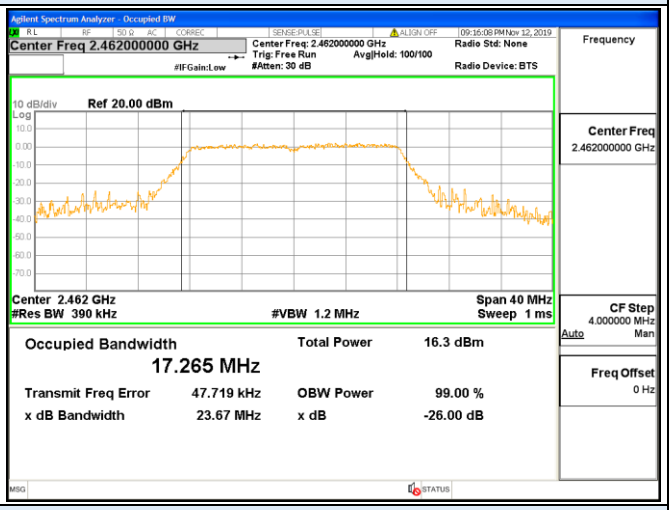
1. *Measured 6dB Bandwidth at difference data rate for each mode and recorded worst case for each mode.*
2. *Test results including cable loss;*
3. *Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20;*
4. *Please refer to following plots;*
5. *Limits is only applicable for 6dB Bandwidth.*

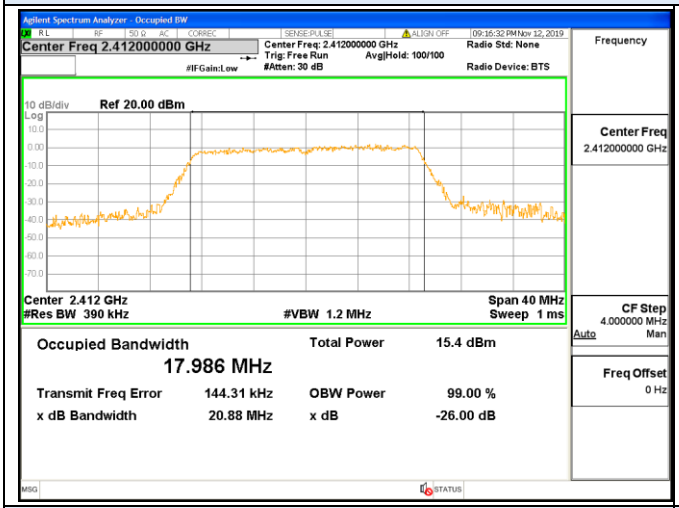
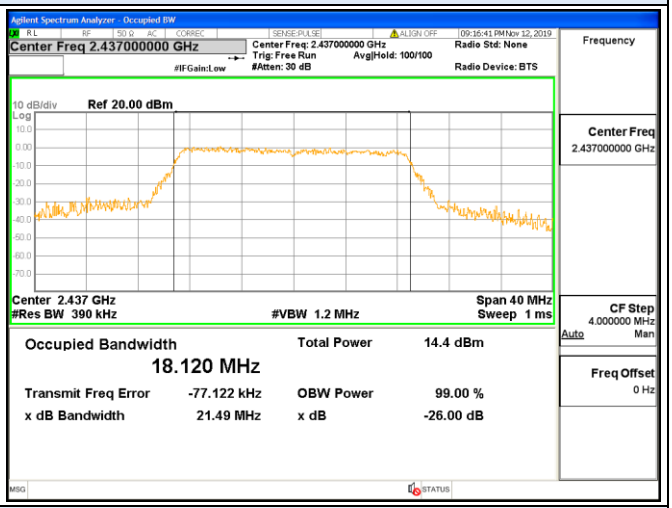
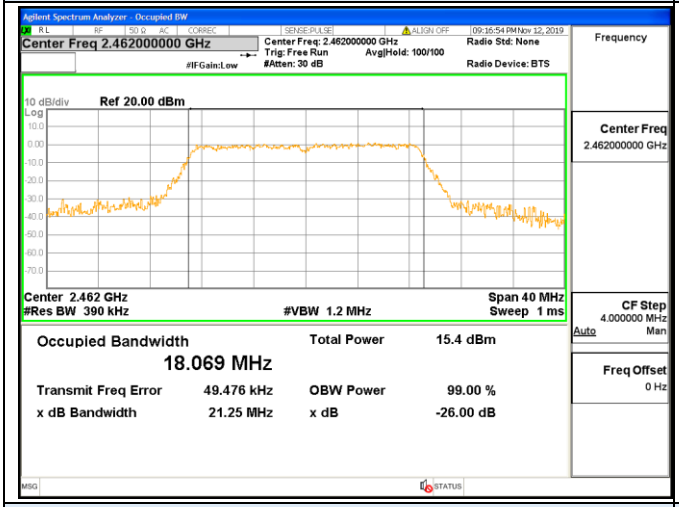
6 dB Bandwidth	
Antenna 1	
IEEE 802.11b	IEEE 802.11g
	
Channel 1 / 2412 MHz	Channel 1 / 2412 MHz
	
Channel 6 / 2437 MHz	Channel 6 / 2437 MHz
	
Channel 11 / 2462 MHz	Channel 11 / 2462 MHz

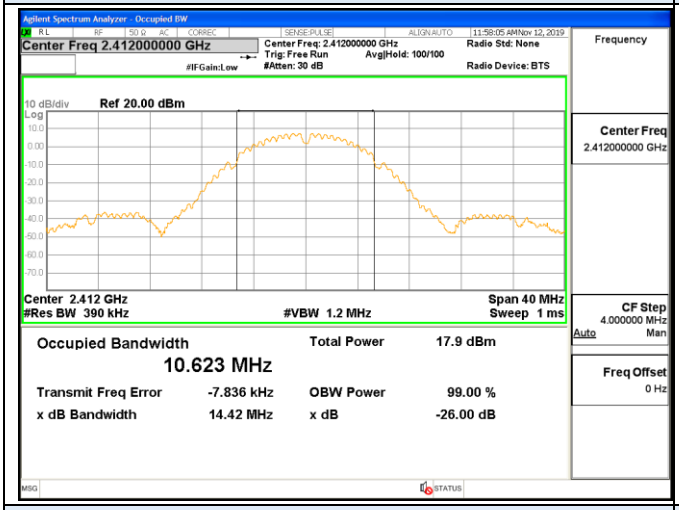
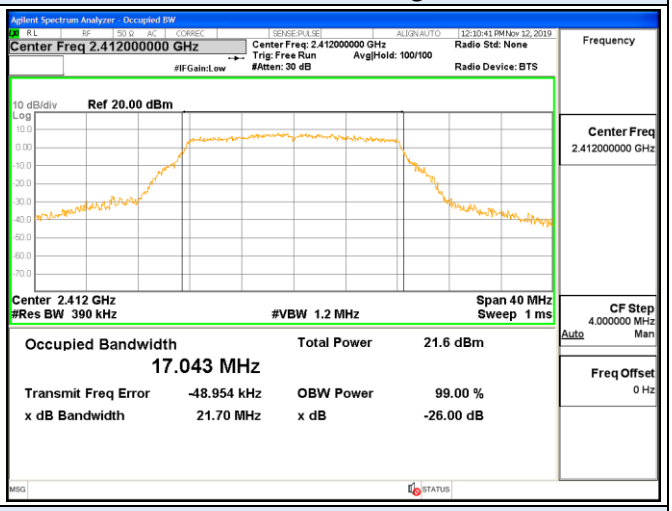
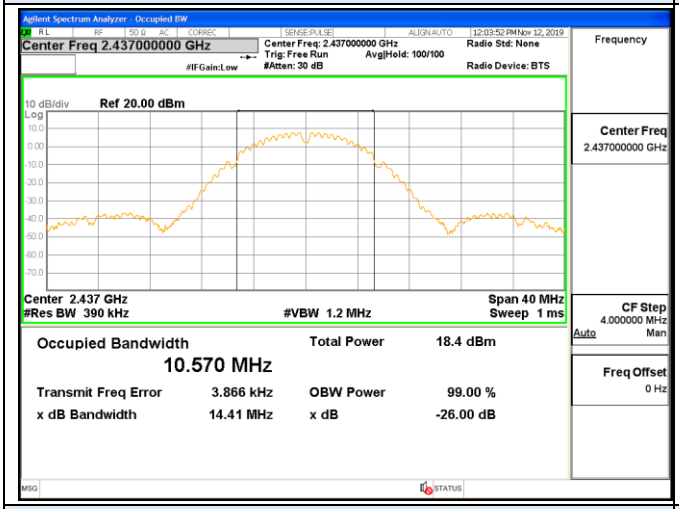
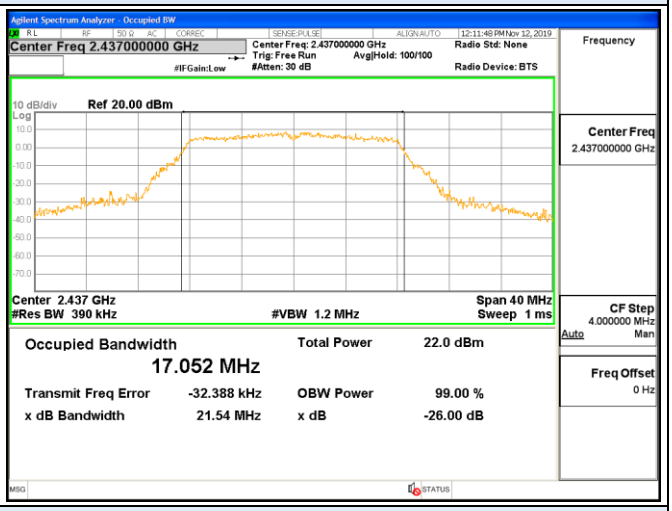
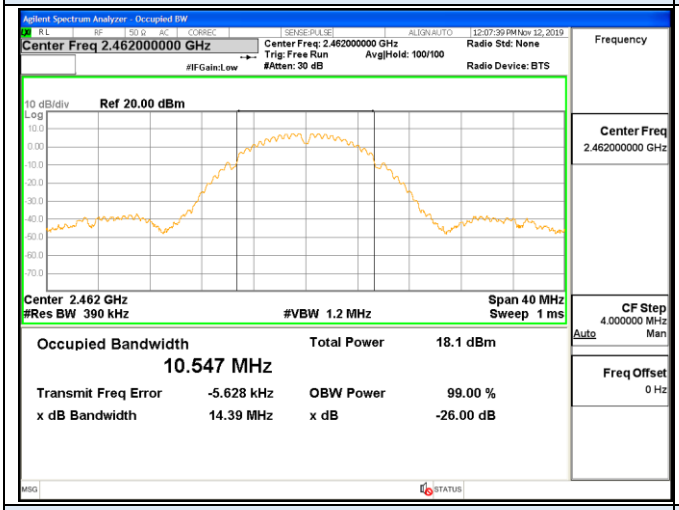
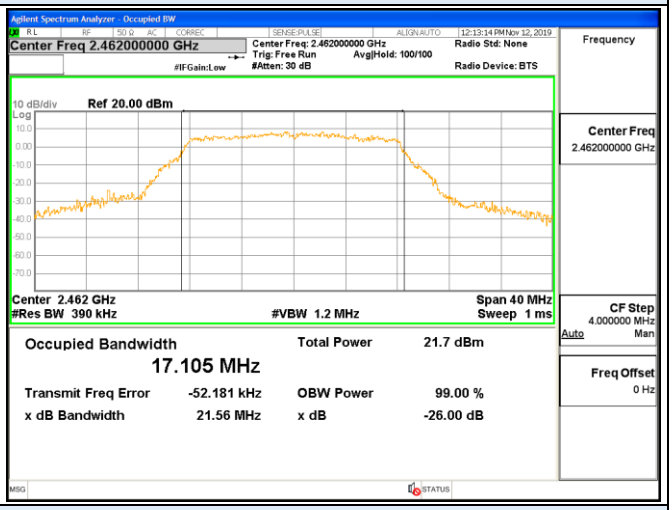
6 dB Bandwidth	
Antenna 1	
IEEE 802.11n HT20	
	
Channel 1 / 2412 MHz	Channel 6 / 2437 MHz
	/
Channel 11 / 2462 MHz	/

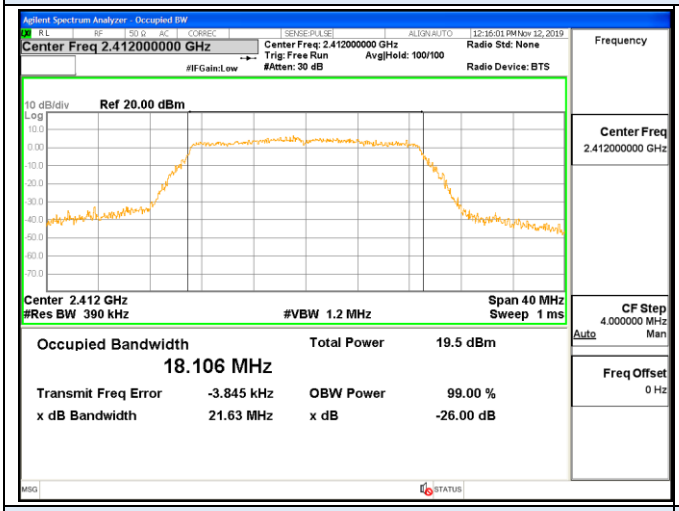
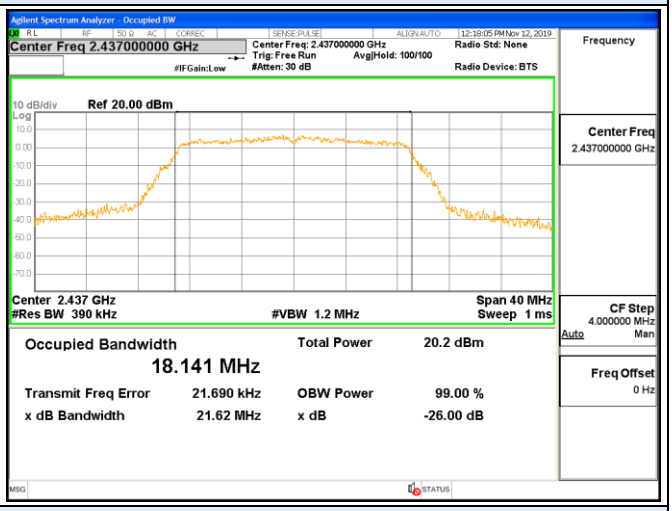
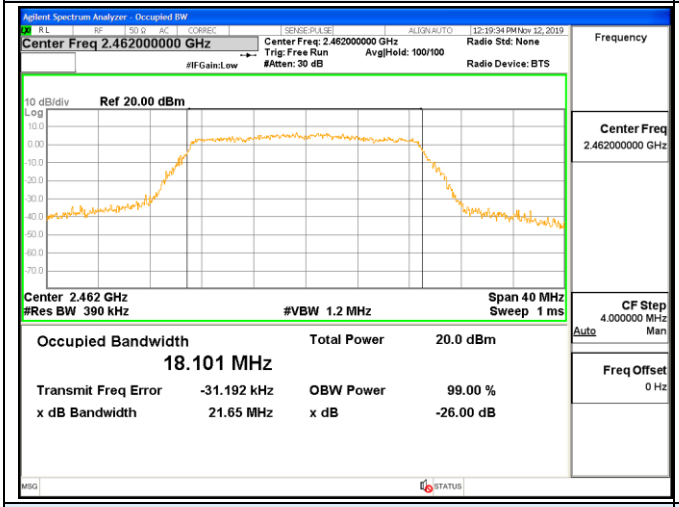
6 dB Bandwidth	
Antenna 2	Antenna 2
IEEE 802.11b	IEEE 802.11g
	
Channel 1 / 2412 MHz	Channel 1 / 2412 MHz
	
Channel 6 / 2437 MHz	Channel 6 / 2437 MHz
	
Channel 11 / 2462 MHz	Channel 11 / 2462 MHz

6 dB Bandwidth	
Antenna 2	
IEEE 802.11n HT20	
	
Channel 1 / 2412 MHz	Channel 6 / 2437 MHz
	/
Channel 11 / 2462 MHz	/

99% Occupied Bandwidth	
Antenna 1	
IEEE 802.11b	IEEE 802.11g
	
Channel 1 / 2412 MHz	Channel 1 / 2412 MHz
	
Channel 6 / 2437 MHz	Channel 6 / 2437 MHz
	
Channel 11 / 2462 MHz	Channel 11 / 2462 MHz

99% Occupied Bandwidth	
Antenna 1	
IEEE 802.11n HT20	
	
Channel 1 / 2412 MHz	*Channel 6 / 2437 MHz*
	/
Channel 11 / 2462 MHz	/

99% Occupied Bandwidth	
Antenna 2	Antenna 2
IEEE 802.11b	IEEE 802.11g
	
Channel 1 / 2412 MHz	Channel 1 / 2412 MHz
	
Channel 6 / 2437 MHz	Channel 6 / 2437 MHz
	
Channel 11 / 2462 MHz	Channel 11 / 2462 MHz

99% Occupied Bandwidth	
Antenna 2	
IEEE 802.11n HT20	
	
Channel 1 / 2412 MHz	*Channel 6 / 2437 MHz*
	/
Channel 11 / 2462 MHz	/

5.5. Radiated Emissions Measurement

5.5.1. Standard Applicable

15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
\1\ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293.	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(\2\)
13.36-13.41			

\1\ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

\2\ Above 38.6

According to §15.247 (d): 20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

5.5.2. Measuring Instruments and Setting

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

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10^{th} carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average
RB / VB (Emission in non-restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB/VB 200Hz/1KHz for QP/AVG
Start ~ Stop Frequency	150kHz~30MHz / RB/VB 9kHz/30KHz for QP/AVG
Start ~ Stop Frequency	30MHz~1000MHz / RB/VB 120kHz/1MHz for QP

5.5.3. Test Procedures

1) Sequence of testing 9 kHz to 30 MHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions.

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna height is 1.5 meter.

--- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

--- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).

--- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

2) Sequence of testing 30 MHz to 1 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height changes from 1 to 3 meter.

--- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter.

--- The final measurement will be done with QP detector with an EMI receiver.

--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

3) Sequence of testing 1 GHz to 18 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height scan range is 1 meter to 2.5 meter.

--- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.

--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

4) Sequence of testing above 18 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 1 meter.

--- The EUT was set into operation.

Premeasurement:

--- The antenna is moved spherical over the EUT in different polarizations of the antenna.

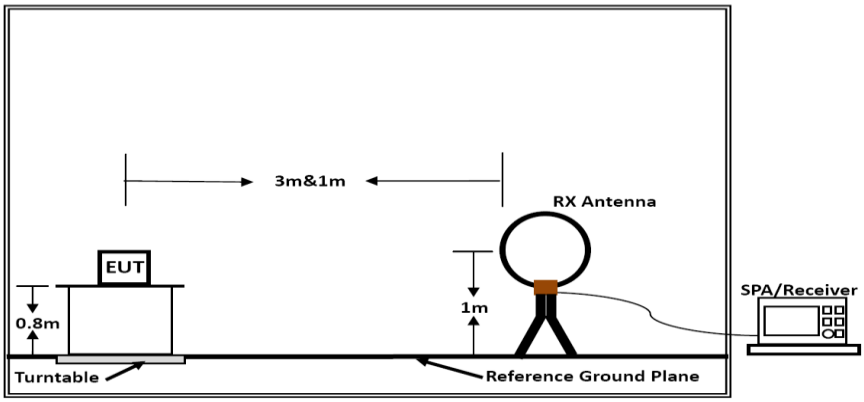
Final measurement:

--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.

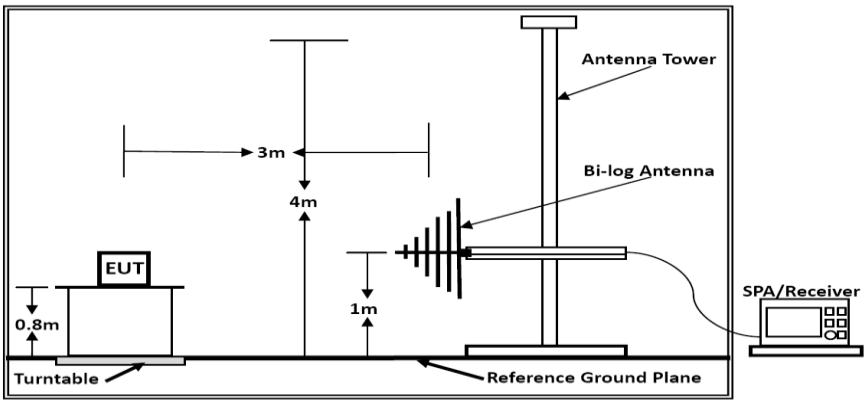
--- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

5.5.4. Test Setup Layout

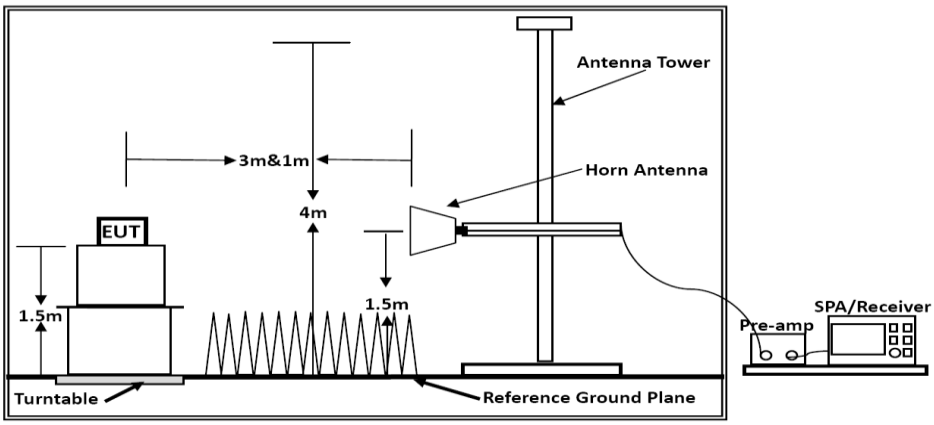
For radiated emissions below 30MHz



Below 30MHz



Below 1GHz



Above 1GHz

Above 18 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade form 3m to 1m.

Distance extrapolation factor = 20 log (specific distanc [3m] / test distance [1m]) (dB);
Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].

5.5.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.5.6. Results of Radiated Emissions (9 KHz~30MHz)

Temperature	23.5℃	Humidity	56.2%
Test Engineer	Gary Qian	Configurations	IEEE 802.11b/g/n
Test Date	Nov. 12, 2019		

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Over Limit (dBuV)	Remark
-	-	-	-	See Note

Note:

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor = 40 log (specific distance / test distance) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

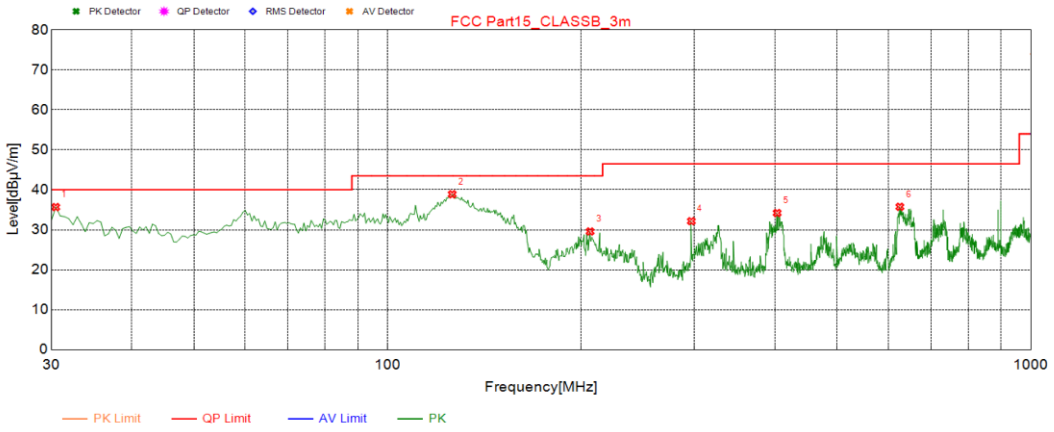
5.5.7. Results of Radiated Emissions (30MHz~1GHz)

Temperature	23.5℃	Humidity	56.2%
Test Engineer	Gary Qian	Configurations	802.11n HT20 Middle Channel, Chain 1+Chain 2
Test Date	Nov. 12, 2019		

The Worst Test result for 802.11n HT20 (Middle Channel) @Chain 1+Chain 2

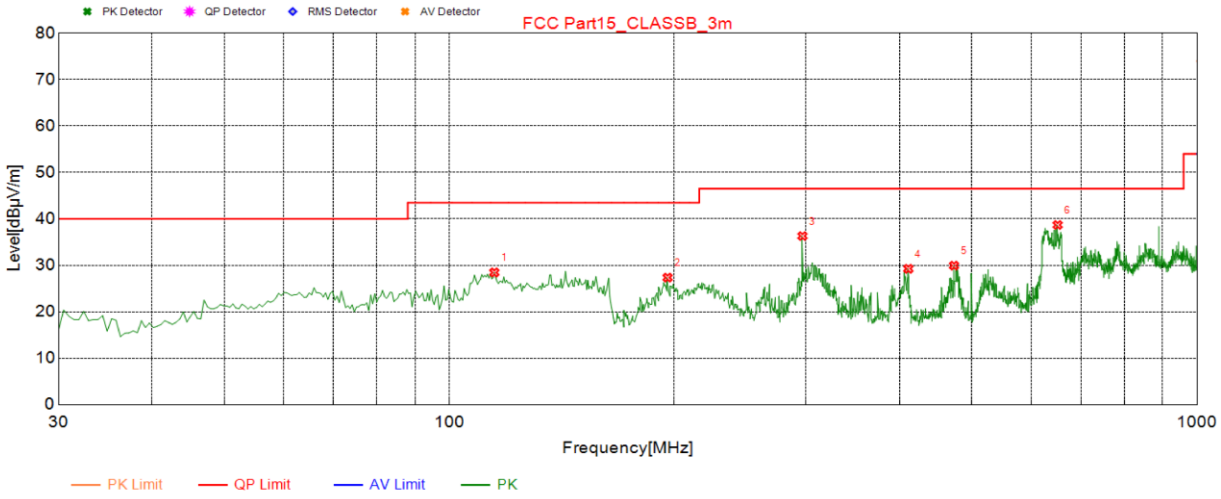
With Adapter(model: SA12V-050200U)

Vertical



Suspected List								
NO.	Freq. [MHz]	Result Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle[°]	Polarity
1	30.485	35.67	-16.21	40.00	4.33	100	77	Vertical
2	126.030	38.88	-18.50	43.50	4.62	100	10	Vertical
3	206.540	29.56	-15.24	43.50	13.94	100	349	Vertical
4	296.750	32.15	-12.88	46.50	14.35	100	262	Vertical
5	403.450	34.19	-9.97	46.50	12.31	100	358	Vertical
6	626.065	35.74	-5.27	46.50	10.76	100	309	Vertical

Horizontal

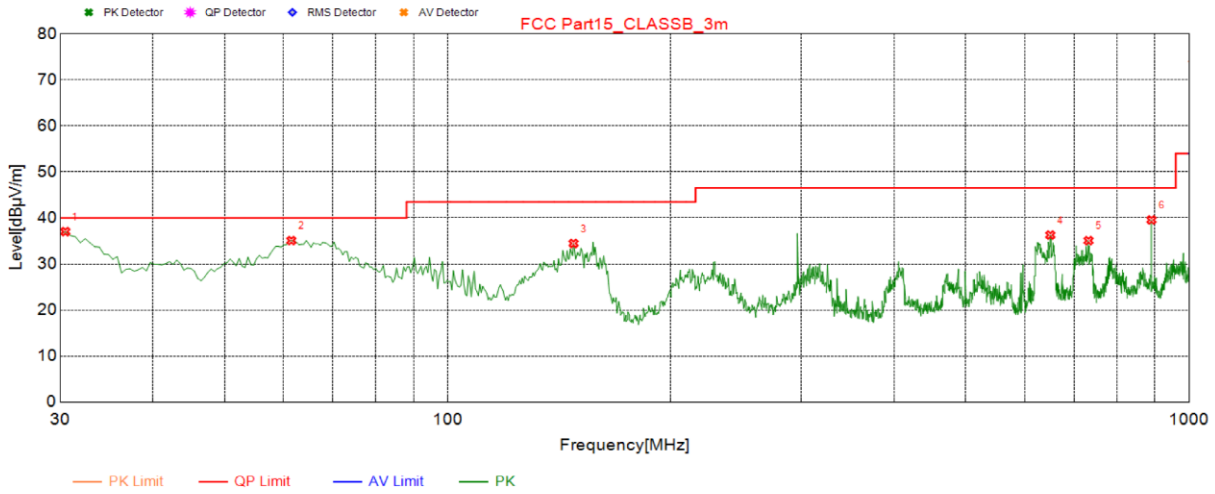


Suspected List								
NO.	Freq. [MHz]	Result Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle[°]	Polarity
1	114.875	28.45	-16.81	43.50	15.05	100	9	Horizontal
2	195.870	27.36	-15.85	43.50	16.14	100	52	Horizontal
3	296.750	36.29	-12.88	46.50	10.21	100	320	Horizontal
4	411.210	29.24	-9.82	46.50	17.26	100	218	Horizontal
5	473.290	29.92	-8.59	46.50	16.58	100	12	Horizontal
6	651.285	38.7	-4.95	46.50	7.80	100	0	Horizontal

Note:
1). Pre-scan all modes and recorded the worst case results in this report (IEEE 802.11n HT20 (Middle Channel) @ Chain 1+Chain 2
2). Emission level (dBuV/m) = 20 log Emission level (uV/m).
3). Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

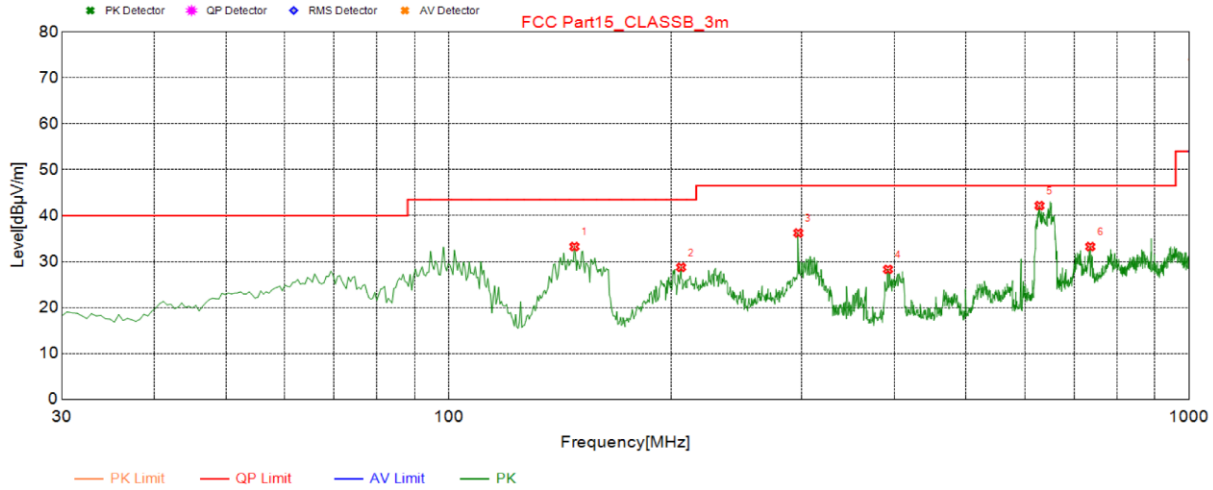
With Adapter(model: A912-050200W-US1)

Vertical



Suspected List								
NO.	Freq. [MHz]	Result Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle[°]	Polarity
1	30.485	37.02	-16.21	40.00	2.98	100	30	Vertical
2	61.525	35.08	-16.04	40.00	4.92	100	357	Vertical
3	147.855	34.45	-19.18	43.50	9.05	100	2	Vertical
4	650.315	36.29	-4.97	46.50	10.21	100	33	Vertical
5	732.280	35.07	-3.88	46.50	11.43	100	21	Vertical
6	890.390	39.57	-1.21	46.50	6.93	100	205	Vertical

Horizontal



Suspected List								
NO.	Freq. [MHz]	Result Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle[°]	Polarity
1	147.855	33.25	-19.18	43.50	10.25	100	266	Horizontal
2	206.055	28.75	-15.25	43.50	14.75	100	32	Horizontal
3	296.750	36.23	-12.88	46.50	10.27	100	81	Horizontal
4	392.295	28.3	-10.24	46.50	18.20	100	344	Horizontal
5	628.490	42.17	-5.24	46.50	4.33	100	341	Horizontal
6	736.160	33.25	-3.83	46.50	13.25	100	353	Horizontal

Note:
1). Pre-scan all modes and recorded the worst case results in this report (IEEE 802.11n HT20 (Middle Channel) @ Chain 1+Chain 2
2). Emission level (dBuV/m) = 20 log Emission level (uV/m).
3). Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.