

FCC RADIO TEST REPORT

FCC ID: ZXZWFA400

Product : 4 Zone Smart Streamer

Trade Name : N/A

Model Name : WFA400

Serial Model : N/A

Report No. : UNIA2018120728-1FR-01

Prepared for

Dayton Audio Division of Parts Express
725 Pleasant Valley Drive, Springboro, OH 45066

Prepared by

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11. TEST SUMMARY

1.1 TEST PROCEDURES AND RESULTS

DESCRIPTION OF TEST	RESULT
CONDUCTED EMISSIONS TEST	COMPLIANT
RADIATED EMISSION TEST	COMPLIANT
BAND EDGE	COMPLIANT
OCCUPIED BANDWIDTH MEASUREMENT	COMPLIANT
POWER SPECTRAL DENSITY	COMPLIANT
PEAK OUTPUT POWER	COMPLIANT
CONDUCTED BANDEGE MEASUREMENT	COMPLIANT
SPURIOUS RF CONDUCTED EMISSION	COMPLIANT
ANTENNA REQUIREMENT	COMPLIANT

1.2 TEST FACILITY

Test Firm : Shenzhen United Testing Technology Co., Ltd.
 Address : 2F, Annex Bldg, Jiahuangyuan Tech Park, #365 Baotian 1 Rd, Tiegang Community, Xixiang Str, Bao'an District, Shenzhen, China

The testing quality ability of our laboratory meet with "Quality Law of People's Republic of China" Clause 19. The testing quality system of our laboratory meets with ISO/IEC-17025 requirements, which is approved by CNAS. This approval result is accepted by MRA of APLAC.

Our test facility is recognized, certified, or accredited by the following organizations:

CNAS-LAB Code: L6494

The EMC Laboratory has been assessed and in compliance with CNAS-CL01 accreditation criteria for testing Laboratories (identical to ISO/IEC 17025:2017 General Requirements) for the Competence of testing Laboratories.

Designation Number: CN1227

Test Firm Registration Number: 674885

The EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications commission. The acceptance letter from the FCC is maintained in our files.

1.3 MEASUREMENT UNCERTAINTY

Measurement Uncertainty	
Conducted Emission Expanded Uncertainty	= 2.23dB, k=2
Radiated emission expanded uncertainty(9kHz-30MHz)	= 3.08dB, k=2
Radiated emission expanded uncertainty(30MHz-1000MHz)	= 4.42dB, k=2
Radiated emission expanded uncertainty(Above 1GHz)	= 4.06dB, k=2

22. GENERAL INFORMATION

2.1 2.1 GENERAL DESCRIPTION OF EUT

Equipment	4 Zone Smart Streamer
Trade Mark	N/A
Model Name	WFA400
Serial No.	N/A
Model Difference	N/A
FCC ID	ZXZWFA400
Antenna Type	External Antenna
Antenna Gain	Antenna A:1.0 dBi Antenna B:1.0 dBi Antenna C:1.0 dBi Antenna D:1.0 dBi
Directional Gain	$1.0+10*\log(4)=7.02\text{dBi}$
Frequency Range	802.11b/g/n20: 2412~2462 MHz
Number of Channels	802.11b/g/n20: 11CH
Modulation Type	CCK, OFDM, DBPSK, DAPSK
Battery	N/A
Power Source	DC 12V from adapter with AC 120(240)V/60Hz
Adapter Model	M/N: FJ-SW1201500U Input: AC 100-240V, 50/60Hz, 0.6A Max Output: DC 12V, 1500mA

2.2 Carrier Frequency of Channels

Channel List for 802.11b/g/n(20MHz)							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
01	2412	04	2427	07	2442	10	2457
02	2417	05	2432	08	2447	11	2462
03	2422	06	2437	09	2452		

2.2 2.3 Operation of EUT during testing

Operating Mode

The mode is used: Transmitting mode for 802.11b/g/n(20MHz)

Low Channel: 2412MHz

Middle Channel: 2437MHz

High Channel: 2462MHz

Test SW Version: MT7615 QA 0.0.1.85

2.3 2.4 DESCRIPTION OF TEST SETUP

Operation of EUT during Conducted testing:



Operation of EUT during Radiation and Above1GHz Radiation testing:



Table for auxiliary equipment:

Equipment Description	Manufacturer	Model	Calibration Due Date
Adapter	FU JIA	FJ-SW1201500U	N/A

2.4 2.5 MEASUREMENT INSTRUMENTS LIST

Item	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
CONDUCTED EMISSIONS TEST					
1	AMN	Schwarzbeck	NNLK8121	8121370	2019.9.9
2	AMN	ETS	3810/2	00020199	2019.9.9
3	EMI TEST RECEIVER	Rohde&Schwarz	ESCI	101210	2019.9.9
4	AAN	TESEQ	T8-Cat6	38888	2019.9.9
RADIATED EMISSION TEST					
1	Horn Antenna	Sunol	DRH-118	A101415	2019.9.29
2	BicoNILog Antenna	Sunol	JB1 Antenna	A090215	2019.9.29
3	PREAMP	HP	8449B	3008A00160	2019.9.9
4	PREAMP	HP	8447D	2944A07999	2019.9.9
5	EMI TEST RECEIVER	Rohde&Schwarz	ESR3	101891	2019.9.9
6	VECTOR Signal Generator	Rohde&Schwarz	SMU200A	101521	2019.9.28
7	Signal Generator	Agilent	E4421B	MY4335105	2019.9.28
8	MXA Signal Analyzer	Agilent	N9020A	MY50510140	2019.9.28
9	MXA Signal Analyzer	Agilent	N9020A	MY51110104	2019.9.9
10	ANT Tower&Turn table Controller	Champro	EM 1000	60764	2019.9.28
11	Anechoic Chamber	Taihe Maorui	9m*6m*6m	966A0001	2019.9.9
12	Shielding Room	Taihe Maorui	6.4m*4m*3m	643A0001	2019.9.9
13	RF Power sensor	DARE	RPR3006W	15I00041SNO88	2019.3.14
14	RF Power sensor	DARE	RPR3006W	15I00041SNO89	2019.3.14
15	RF power divider	Anritsu	K241B	992289	2019.9.28
16	Wideband radio communication tester	Rohde&Schwarz	CMW500	154987	2019.9.28
17	Biconical antenna	Schwarzbeck	VHA 9103	91032360	2019.9.8
18	Biconical antenna	Schwarzbeck	VHA 9103	91032361	2019.9.8
19	Broadband Hybrid Antennas	Schwarzbeck	VULB9163	VULB9163#958	2019.9.8
20	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1680	2019.1.12
21	Active Receive Loop Antenna	Schwarzbeck	FMZB 1919B	00023	2019.9.8
22	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170651	2019.03.14
23	Microwave Broadband Preamp	Schwarzbeck	BBV 9721	100472	2019.9.8
24	Active Loop Antenna	Com-Power	AL-130R	10160009	2019.05.10
25	Power Meter	KEYSIGHT	N1911A	MY50520168	2019.05.10
26	Frequency Meter	VICTOR	VC2000	997406086	2019.05.10
27	DC Power Source	HYELEC	HY5020E	055161818	2019.05.10
Test software					
1	深圳市优耐检测技术有限公司 E3	XINHUA	6.101223a	N/A	N/A

33. CONDUCTED EMISSIONS TEST

3.1 Conducted Power Line Emission Limit

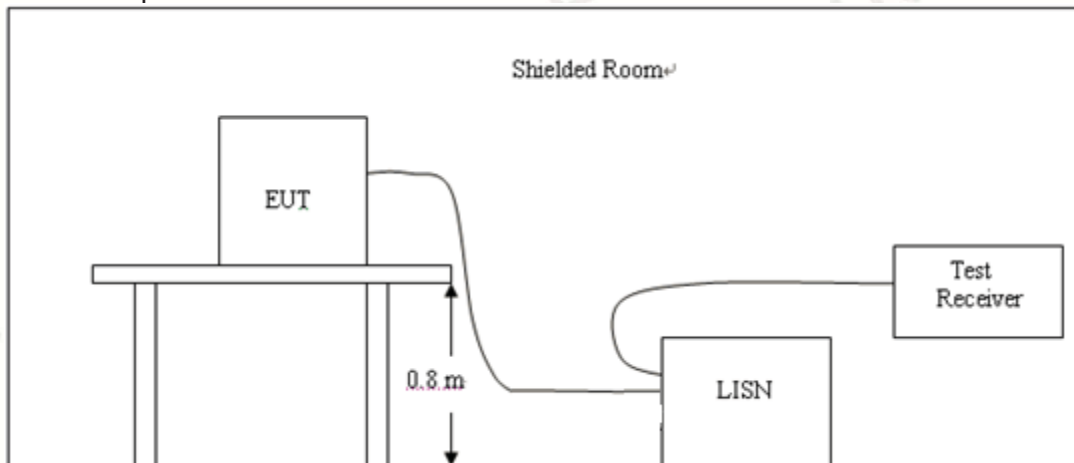
For unintentional device, according to § 15.107(a) Line Conducted Emission Limits is as following

Frequency (MHz)	Maximum RF Line Voltage(dBμV)			
	CLASS A		CLASS B	
	Q.P.	Ave.	Q.P.	Ave.
0.15~0.50	79	66	66~56*	56~46*
0.50~5.00	73	60	56	46
5.00~30.0	73	60	60	50

* Decreasing linearly with the logarithm of the frequency

For intentional device, according to §15.207(a) Line Conducted Emission Limit is same as above table.

3.2 Test Setup



3.3 Test Procedure

- 1, The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. A wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10.
- 2, Support equipment, if needed, was placed as per ANSI C63.10.
- 3, All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.
- 4, If a EUT received DC power from the USB Port of Notebook PC, the PC's adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
- 5, All support equipments received AC power from a second LISN, if any.
- 6, The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
- 7, Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.

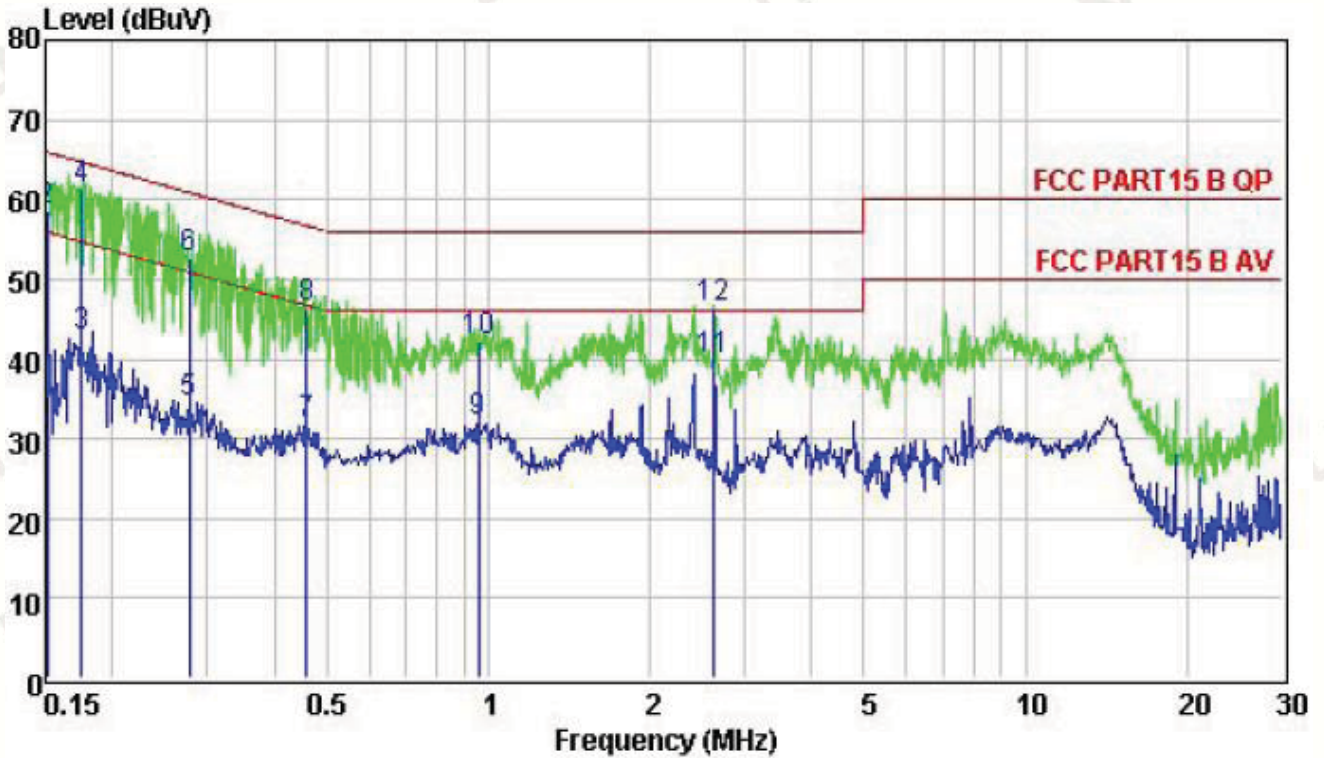
3.4 Test Result

Pass

Remark:

1. All modes were tested at AC 120V and 240V, only the worst result of AC 120V was reported.
2. Remark: We tested at 802.11b/802.11g/802.11n HT20 mode at the antenna single and antenna combination.and recored the worst data at 802.11b mode@Combination of Antenna A, Antenna B, Antenna C and Antenna D in the report.

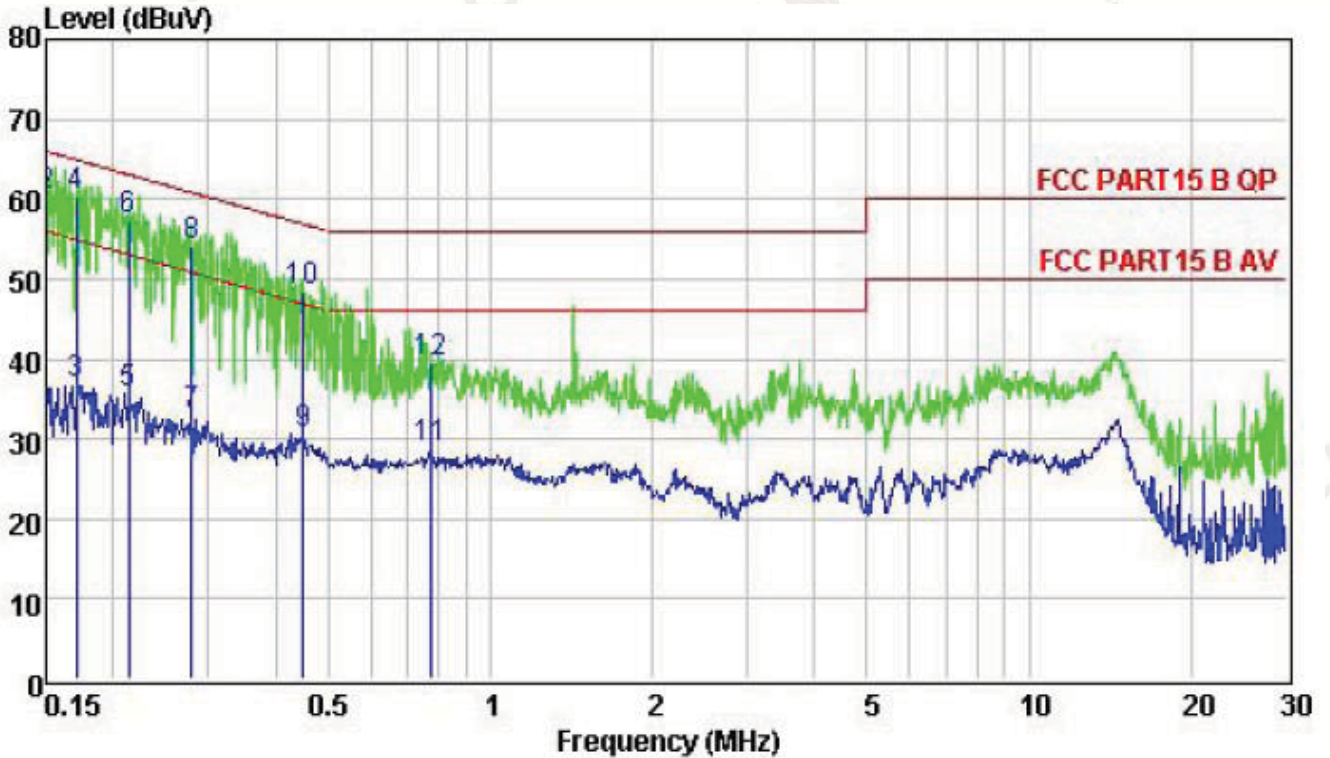
Temperature:	24°C	Relative Humidity:	48%
Test Date:	Nov. 06, 2018	Pressure:	1010hPa
Test Voltage:	AC 120V, 60Hz	Phase:	Line
Test Mode:	Transmitting 802.11b mode for Combination of Antenna A, Antenna B, Antenna C and Antenna D		



	Read Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.151	35.69	9.70	45.39	55.96	-10.57	Average
2	0.151	48.82	9.70	58.52	65.96	-7.44	QP
3	0.175	33.11	9.67	42.78	54.72	-11.94	Average
4	0.175	51.58	9.67	61.25	64.72	-3.47	QP
5	0.277	25.01	9.62	34.63	50.90	-16.27	Average
6	0.277	42.90	9.62	52.52	60.90	-8.38	QP
7	0.459	22.13	9.59	31.72	46.71	-14.99	Average
8	0.459	36.66	9.59	46.25	56.71	-10.46	QP
9	0.958	22.42	9.59	32.01	46.00	-13.99	Average
10	0.958	32.66	9.59	42.25	56.00	-13.75	QP
11	2.636	30.12	9.62	39.74	46.00	-6.26	Average
12	2.636	36.63	9.62	46.25	56.00	-9.75	QP

Remark: Factor = Insertion Loss + Cable Loss, Result = Reading + Factor, Margin = Result – Limit.

Temperature:	24°C	Relative Humidity:	48%
Test Date:	Nov. 06, 2018	Pressure:	1010hPa
Test Voltage:	AC 120V, 60Hz	Phase:	Neutral
Test Mode:	Transmitting 802.11b mode for Combination of Antenna A, Antenna B, Antenna C and Antenna D		



	Read Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.150	26.96	9.45	36.41	56.00	-19.59	Average
2	0.150	51.07	9.45	60.52	66.00	-5.48	QP
3	0.170	27.26	9.50	36.76	54.94	-18.18	Average
4	0.170	51.02	9.50	60.52	64.94	-4.42	QP
5	0.214	26.24	9.57	35.81	53.05	-17.24	Average
6	0.214	47.68	9.57	57.25	63.05	-5.80	QP
7	0.279	23.34	9.58	32.92	50.85	-17.93	Average
8	0.279	44.67	9.58	54.25	60.85	-6.60	QP
9	0.449	21.03	9.59	30.62	46.89	-16.27	Average
10	0.449	38.93	9.59	48.52	56.89	-8.37	QP
11	0.775	19.31	9.60	28.91	46.00	-17.09	Average
12	0.775	29.92	9.60	39.52	56.00	-16.48	QP

Remark: Factor = Insertion Loss + Cable Loss, Result = Reading + Factor, Margin = Result – Limit.

4. RADIATED EMISSION TEST

4.1 Radiation Limit

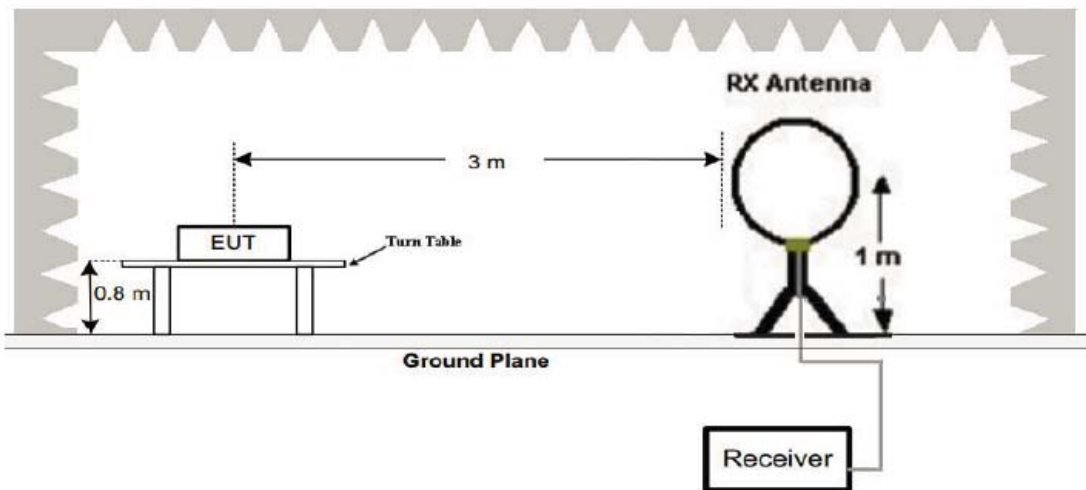
For unintentional device, according to § 15.109(a), except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Distance (Meters)	Radiated (dB μ V/m)	Radiated (μ V/m)
30-88	3	40	100
88-216	3	43.5	150
216-960	3	46	200
Above 960	3	54	500

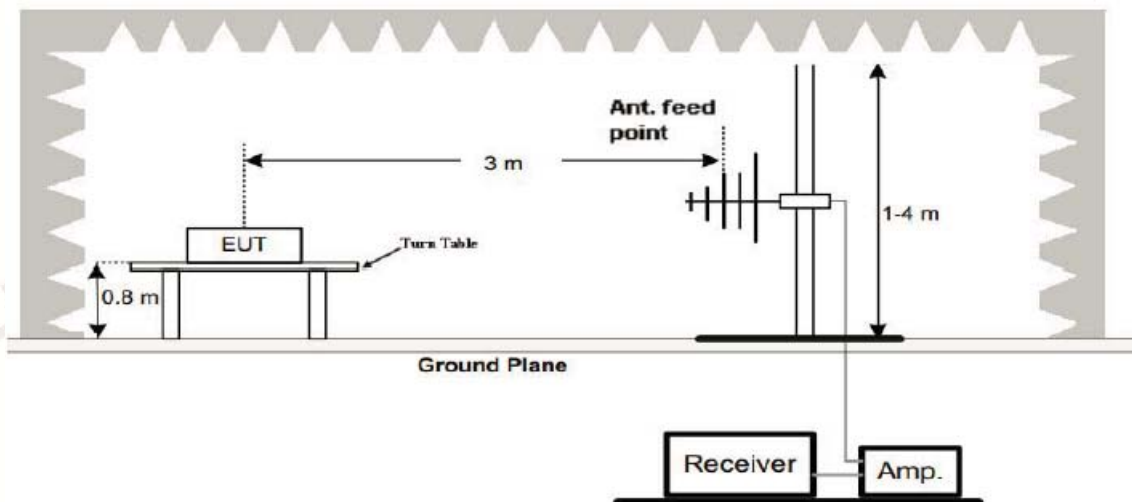
For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

4.2 Test Setup

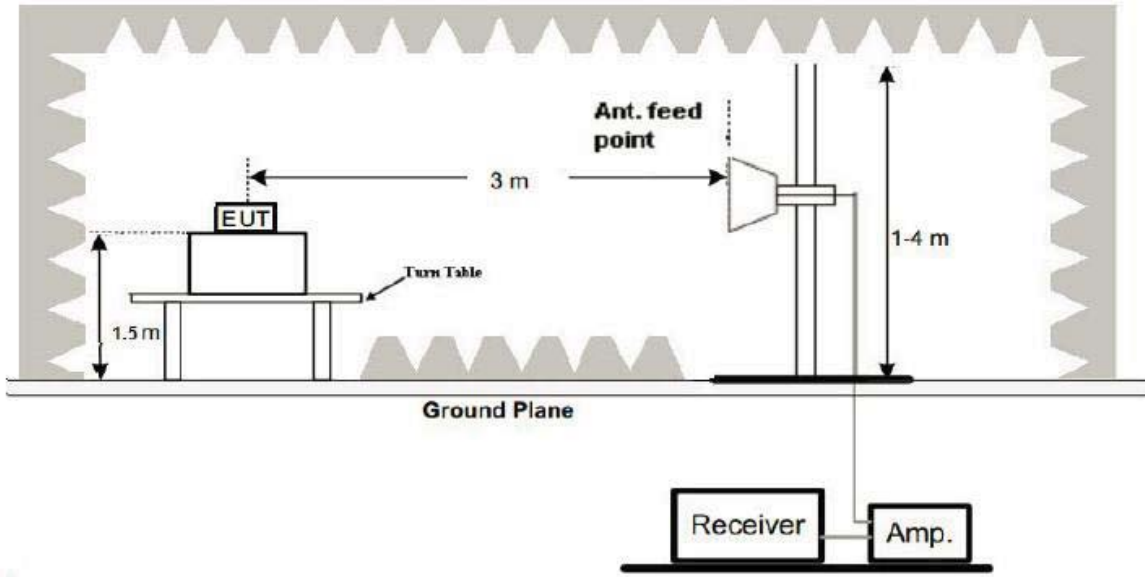
1. Radiated Emission Test-Up Frequency Below 30MHz



2. Radiated Emission Test-Up Frequency 30MHz~1GHz



3. Radiated Emission Test-Up Frequency Above 1GHz



4.3 Test Procedure

- Below 1GHz measurement the EUT is placed on turntable which is 0.8m above ground plane. And above 1GHz measurement EUT was placed on low permittivity and low tangent turn table which is 1.5m above ground plane.
- The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
- EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
- Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- Repeat above procedures until the measurements for all frequencies are complete.
- The test frequency range from 9KHz to 25GHz per FCC PART 15.33(a).
- The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Bilog Antenna	3
1GHz-18GHz	Horn Antenna	3
18GHz-25GHz	Horn Antenna	1

Note:

For battery operated equipment, the equipment tests shall be performed using a new battery.

4.4 Test Result

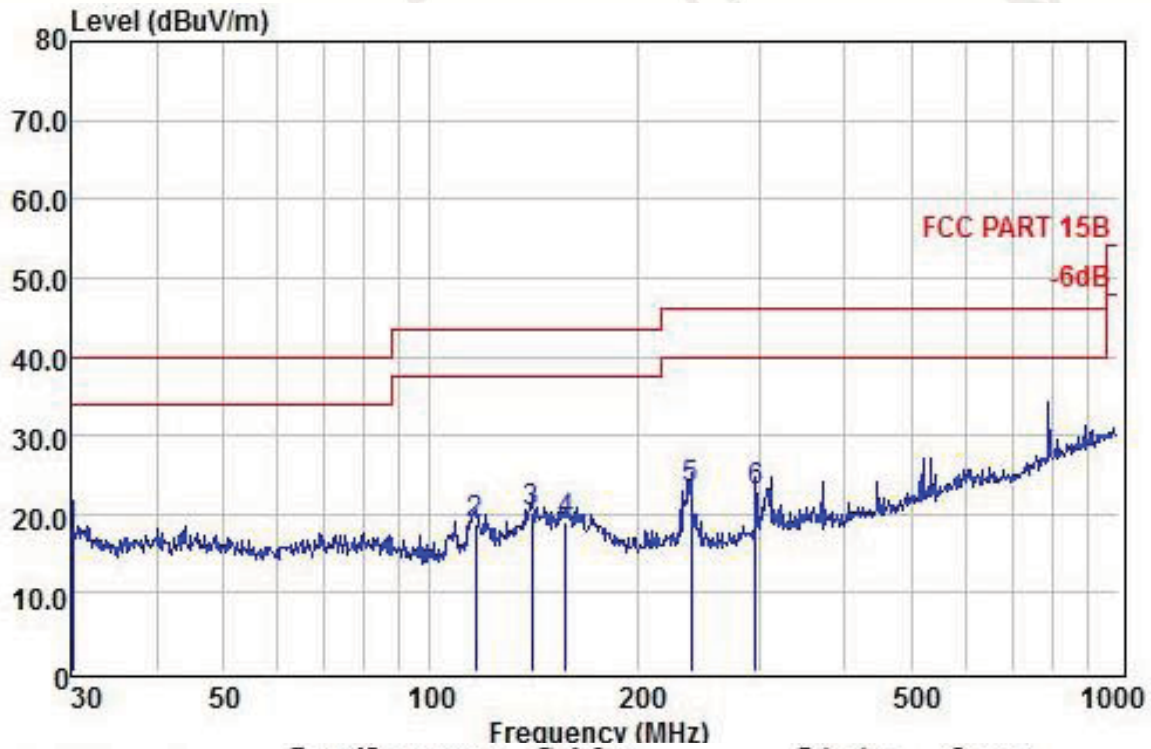
PASS

Remark:

- All modes of 802.11b/g/n20 were test at Low, Middle, and High channel, only the worst result of 802.11b Low Channel was reported for below 1GHz test.
- Remark: We tested at 802.11b/802.11g/802.11n HT20 mode at the antenna single and antenna combination.and recored the worst data at 802.11b mode@Combination of Antenna A, Antenna B, Antenna C and Antenna D in the report.

Below 1GHz Test Results:

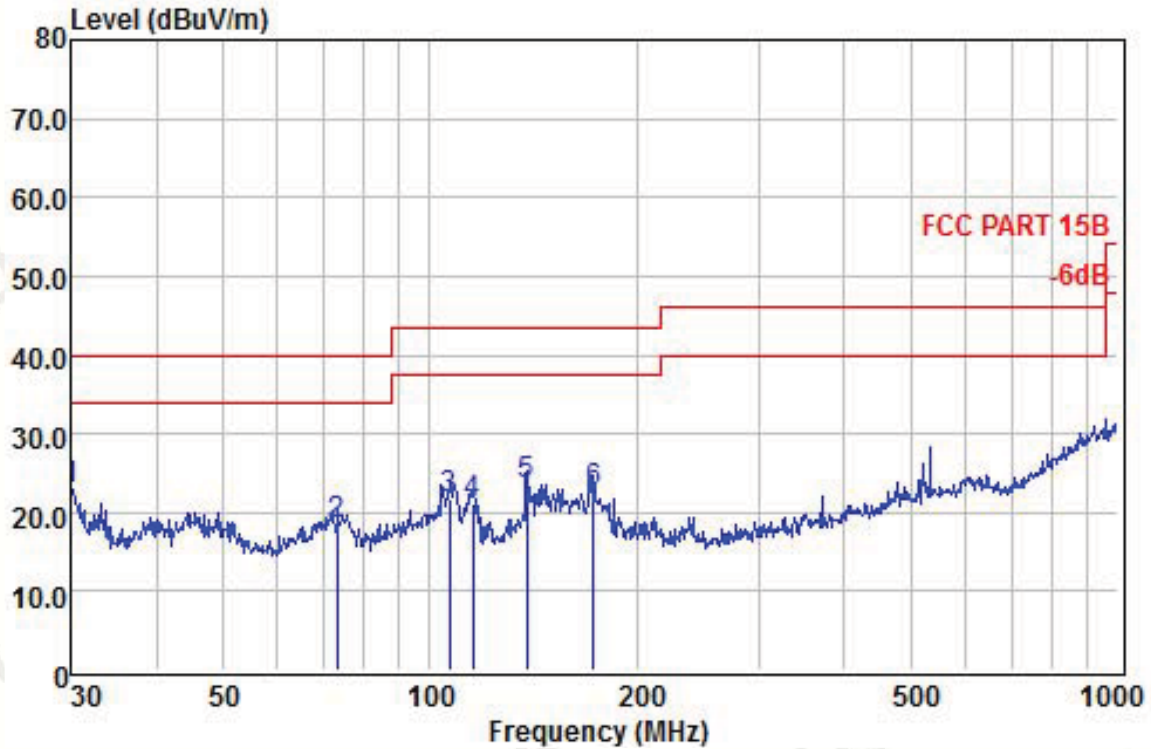
Temperature:	22°C	Relative Humidity:	48%
Test Date:	Nov. 06, 2018	Pressure:	1010hPa
Test Voltage:	AC 120V, 60Hz	Polarization:	Horizontal
Test Mode:	Transmitting 802.11b for Combination of Antenna A, Antenna B, Antenna C and Antenna D		



	Read	Antenna	Cable	Limit	Over			
Freq	Level	Factor	Loss	Line	Limit	Remark		
MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB		
1	30.21	3.08	14.71	0.34	18.13	40.00	-21.87	QP
2	116.54	6.33	12.13	0.20	18.66	43.50	-24.84	QP
3	140.34	4.83	15.21	0.23	20.27	43.50	-23.23	QP
4	157.56	3.06	15.65	0.23	18.94	43.50	-24.56	QP
5	239.15	10.44	12.36	0.40	23.20	46.00	-22.80	QP
6	297.22	9.29	12.85	0.64	22.78	46.00	-23.22	QP

Remark: Absolute Level = Reading Level + Factor, Margin = Absolute Level – Limit
 Factor = Ant. Factor + Cable Loss – Pre-amplifier

Temperature:	22°C	Relative Humidity:	48%
Test Date:	Nov. 06, 2018	Pressure:	1010hPa
Test Voltage:	AC 120V, 60Hz	Polarization:	Vertical
Test Mode:	Transmitting 802.11b for Combination of Antenna A, Antenna B, Antenna C and Antenna D		



	ReadAntenna	Cable	Limit	Over			
Freq	Level	Factor	Loss	Level	Line	Limit	Remark
MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB	
1	30.00	7.82	14.80	0.34	22.96	40.00	-17.04 QP
2	73.36	6.67	11.56	0.14	18.37	40.00	-21.63 QP
3	106.76	9.90	11.60	0.18	21.68	43.50	-21.82 QP
4	115.32	8.75	12.07	0.20	21.02	43.50	-22.48 QP
5	138.39	8.14	15.00	0.23	23.37	43.50	-20.13 QP
6	173.21	8.72	13.67	0.24	22.63	43.50	-20.87 QP

Factor = Ant. Factor + Cable Loss – Pre-amplifier

Remark:

- (1) Measuring frequencies from 9 KHz to the 1 GHz, Radiated emission test from 9KHz to 30MHz was verified, and no any emission was found except system noise floor.
- (2) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
- (3) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.

Above 1 GHz Test Results:

Record the worst test data for Antenna B in report.

CH Low of 802.11b Mode (2412MHz)

Horizontal:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type
4824	61.87	-3.64	58.23	74	-15.77	PK
4824	51.24	-3.64	47.6	54	-6.40	AV
7236	58.23	-0.95	57.28	74	-16.72	PK
7236	46.99	-0.95	46.04	54	-7.96	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

Vertical:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type
4824	62.17	-3.64	58.53	74	-15.47	PK
4824	50.05	-3.64	46.41	54	-7.59	AV
7236	58.96	-0.95	58.01	74	-15.99	PK
7236	47.12	-0.95	46.17	54	-7.83	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

CH Middle of 802.11b Mode (2437MHz)

Horizontal:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4874	62.12	-3.51	58.61	74	-15.39	PK
4874	50.74	-3.51	47.23	54	-6.77	AV
7311	58.19	-0.82	57.37	74	-16.63	PK
7311	47.63	-0.82	46.81	54	-7.19	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

Vertical:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4874	61.36	-3.51	57.85	74	-16.15	PK
4874	50.69	-3.51	47.18	54	-6.82	AV
7311	58.28	-0.82	57.46	74	-16.54	PK
7311	47.39	-0.82	46.57	54	-7.43	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

CH High of 802.11b Mode (2462MHz)

Horizontal:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type
4924	62.05	-3.43	58.62	74	-15.38	PK
4924	50.49	-3.43	47.06	54	-6.94	AV
7386	58.11	-0.75	57.36	74	-16.64	PK
7386	47.24	-0.75	46.49	54	-7.51	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

Vertical:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type
4924	62.08	-3.43	58.65	74	-15.35	PK
4924	50.17	-3.43	46.74	54	-7.26	AV
7386	58.29	-0.75	57.54	74	-16.46	PK
7386	47.47	-0.75	46.72	54	-7.28	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

Remark :

- (1) Measuring frequencies from 1 GHz to the 25 GHz.
- (2) "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency.
- (3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
- (4) Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for peak measurement with peak detector at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 10Hz for Average measurement with peak detection at frequency above 1GHz.
- (6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.

Record the worst test data for Antenna B in report.

CH Low of 802.11g Mode (2412MHz)

Horizontal:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type
4824	62.89	-3.64	59.25	74	-14.75	PK
4824	50.68	-3.64	47.04	54	-6.96	AV
7236	58.56	-0.95	57.61	74	-16.39	PK
7236	47.42	-0.95	46.47	54	-7.53	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

Vertical:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type
4824	62.71	-3.64	59.07	74	-14.93	PK
4824	50.95	-3.64	47.31	54	-6.69	AV
7236	58.23	-0.95	57.28	74	-16.72	PK
7236	47.38	-0.95	46.43	54	-7.57	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

CH Middle of 802.11g Mode (2437MHz)

Horizontal:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type
4874	61.92	-3.51	58.41	74	-15.59	PK
4874	50.68	-3.51	47.17	54	-6.83	AV
7311	58.32	-0.82	57.50	74	-16.50	PK
7311	47.12	-0.82	46.30	54	-7.70	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

Vertical:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type
4874	62.35	-3.51	58.84	74	-15.16	PK
4874	50.13	-3.51	46.62	54	-7.38	AV
7311	58.23	-0.82	57.41	74	-16.59	PK
7311	47.16	-0.82	46.34	54	-7.66	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

CH High of 802.11g Mode (2462MHz)

Horizontal:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type
4924	62.67	-3.43	59.24	74	-14.76	PK
4924	50.35	-3.43	46.92	54	-7.08	AV
7386	58.27	-0.75	57.52	74	-16.48	PK
7386	47.28	-0.75	46.53	54	-7.47	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

Vertical:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type
4924	62.01	-3.43	58.58	74	-15.42	PK
4924	51.62	-3.43	48.19	54	-5.81	AV
7386	58.92	-0.75	58.17	74	-15.83	PK
7386	47.45	-0.75	46.7	54	-7.3	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

Remark :

- (1) Measuring frequencies from 1 GHz to the 25 GHz.
- (2) "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency.
- (3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
- (4) Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for peak measurement with peak detector at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 10Hz for Average measurement with peak detection at frequency above 1GHz.
- (6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.

Record the worst test data for Combination of Antenna A, Antenna B, Antenna C and Antenna D in the report.

CH Low of 802.11n/H20 Mode (2412MHz)

Horizontal:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4824	62.38	-3.64	58.74	74	-15.26	PK
4824	49.04	-3.64	45.4	54	-8.6	AV
7236	57.25	-0.95	56.3	74	-17.7	PK
7236	47.39	-0.95	46.44	54	-7.56	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

Vertical:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4824	61.36	-3.64	57.72	74	-16.28	PK
4824	50.16	-3.64	46.52	54	-7.48	AV
7236	57.18	-0.95	56.23	74	-17.77	PK
7236	47.29	-0.95	46.34	54	-7.66	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

CH Middle of 802.11n/H20 Mode (2437MHz)

Horizontal:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4874	61.14	-3.51	57.63	74	-16.37	PK
4874	50.85	-3.51	47.34	54	-6.66	AV
7311	56.98	-0.82	56.16	74	-17.84	PK
7311	47.08	-0.82	46.26	54	-7.74	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

Vertical:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4874	62.88	-3.51	59.37	74	-14.63	PK
4874	50.61	-3.51	47.1	54	-6.9	AV
7311	57.12	-0.82	56.3	74	-17.7	PK
7311	47.69	-0.82	46.87	54	-7.13	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

CH High of 802.11n/H20 Mode (2462MHz)

Horizontal:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type
4924	62.90	-3.43	59.47	74	-14.53	PK
4924	50.13	-3.43	46.70	54	-7.30	AV
7386	57.26	-0.75	56.51	74	-17.49	PK
7386	47.36	-0.75	46.61	54	-7.39	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

Vertical:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type
4924	62.87	-3.43	59.44	74	-14.56	PK
4924	50.36	-3.43	46.93	54	-7.07	AV
7386	57.68	-0.75	56.93	74	-17.07	PK
7386	47.89	-0.75	47.14	54	-6.86	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

Remark :

- (1) Measuring frequencies from 1 GHz to the 25 GHz.
- (2) "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency.
- (3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
- (4) Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for peak measurement with peak detector at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 10Hz for Average measurement with peak detection at frequency above 1GHz.
- (6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.

5. BAND EDGE

5.1 Limits

FCC PART 15.247 Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

5.2 Test Procedure

The band edge compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW to 100KHz and VBM to 300KHz to measure the peak field strength and set RBW to 1MHz and VBW to 10Hz to measure the average radiated field strength. The conducted RF band edge was measured by using a spectrum analyzer. Set span wide enough to capture the highest in-band emission and the emission at the band edge. Set RBW to 100 KHz and VBW to 300 KHz, to measure the conducted peak band edge.

5.3 Test Result

PASS

Remark: We tested at 802.11b/802.11g/802.11n HT20 mode at the antenna single and antenna combination.and recored the worst data at 802.11b mode@Combination of Antenna A, Antenna B, Antenna C and Antenna D in the report.

Horizontal:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310	57.25	-5.81	51.44	74	-22.56	PK
2310	/	-5.81	/	54	/	AV
2390	63.14	-5.84	57.3	74	-16.7	PK
2390	49.52	-5.84	43.68	54	-10.32	AV
2400	65.35	-5.84	59.51	74	-14.49	PK
2400	49.45	-5.84	43.61	54	-10.39	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Vertical:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310	56.77	-5.81	50.96	74	-23.04	PK
2310	/	-5.81	/	54	/	AV
2390	65.56	-5.84	59.72	74	-14.28	PK
2390	50.57	-5.84	44.73	54	-9.27	AV
2400	65.95	-5.84	60.11	74	-13.89	PK
2400	49.39	-5.84	43.55	54	-10.45	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Horizontal :

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.5	55.78	-5.54	50.24	74	-23.76	PK
2483.5	/	-5.54	/	54	/	AV
2500	56.38	-5.72	50.69	74	-23.31	PK
2500	/	-5.72	/	54	/	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Vertical:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.5	56.25	-5.54	50.71	74	-23.29	PK
2483.5	/	-5.54	/	54	/	AV
2500	56.64	-5.72	50.92	74	-23.08	PK
2500	/	-5.72	/	54	/	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

6. OCCUPIED BANDWIDTH MEASUREMENT

6.1 Test Limit

FCC Part15(15.247), Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(2)	Bandwidth	$\geq 500\text{KHz}$ (6dB bandwidth)	2400-2483.5	PASS

6.2 Test Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT as normal operation.
3. Based on FCC Part15 C Section 15.247: RBW=100KHz, VBW=300KHz.
4. The useful radiated emission from the EUT was detected by the spectrum analyzer with peak detector.

6.3 Measurement Equipment Used

Same as Radiated Emission Measurement

6.4 Test Result

PASS

ANT A

Type	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
802.11b	01	10.05	≥500	Pass
	06	10.05		
	11	10.08		
802.11g	01	15.12	≥500	Pass
	06	15.11		
	11	15.12		
802.11nHT20	01	15.12	≥500	Pass
	06	15.11		
	11	15.12		

ANT B

Type	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
802.11b	01	10.03	≥500	Pass
	06	9.564		
	11	9.119		
802.11g	01	15.11	≥500	Pass
	06	15.11		
	11	15.11		
802.11nHT20	01	15.11	≥500	Pass
	06	15.11		
	11	15.11		

ANT C

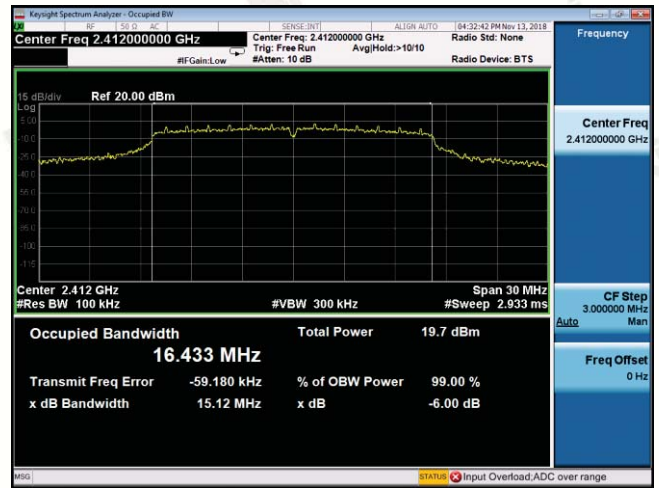
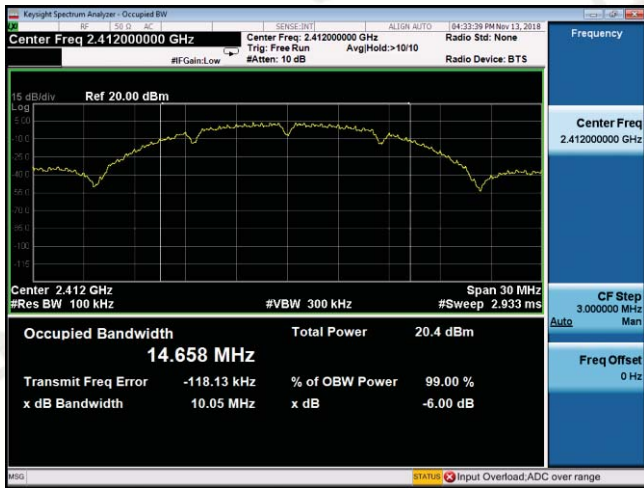
Type	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
802.11b	01	9.096	≥500	Pass
	06	10.01		
	11	10.02		
802.11g	01	15.10	≥500	Pass
	06	15.10		
	11	15.12		
802.11nHT20	01	15.11	≥500	Pass
	06	15.11		
	11	15.11		

ANT D

Type	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
802.11b	01	9.586	≥500	Pass
	06	9.548		
	11	9.569		
802.11g	01	15.10	≥500	Pass
	06	15.09		
	11	15.12		
802.11nHT20	01	15.68	≥500	Pass
	06	15.65		
	11	15.66		

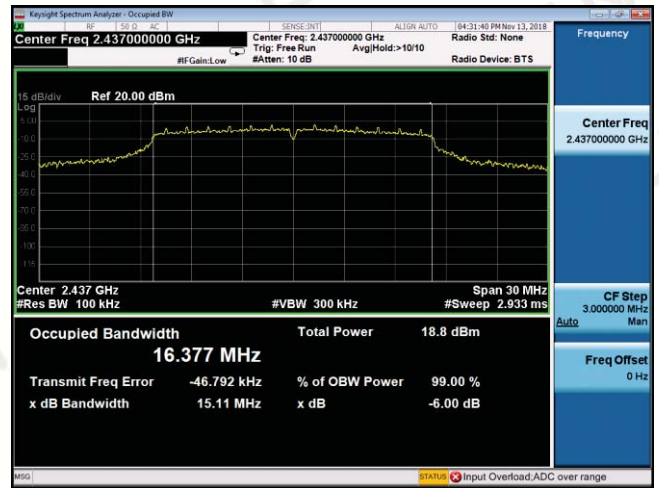
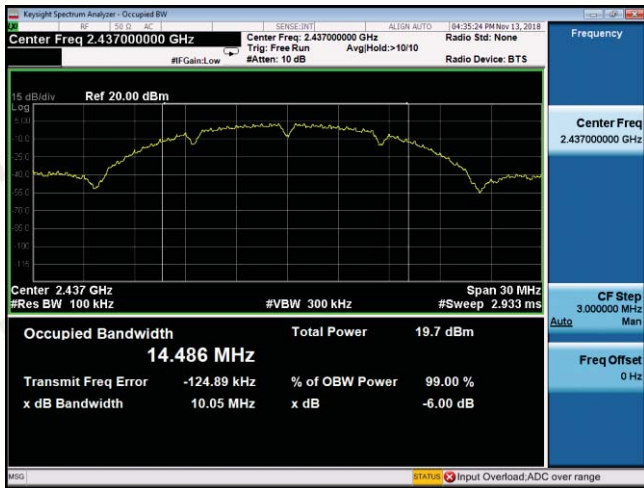
ANT A 802.11b

ANT A 802.11g



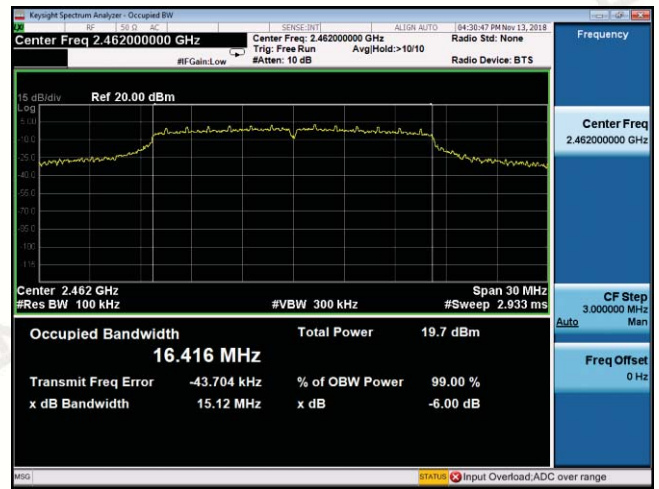
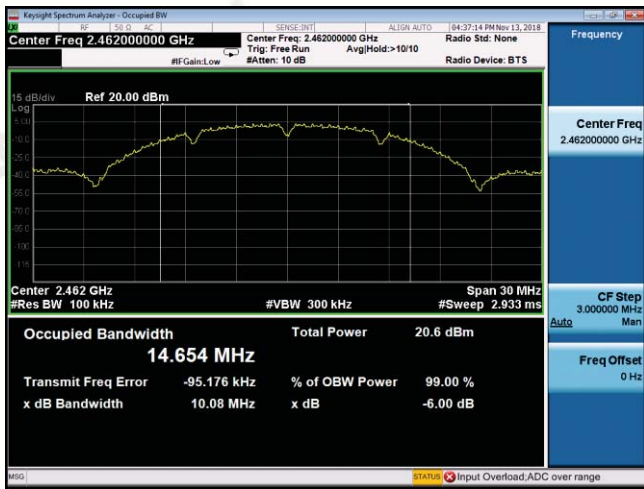
CH01

CH01



CH06

CH06

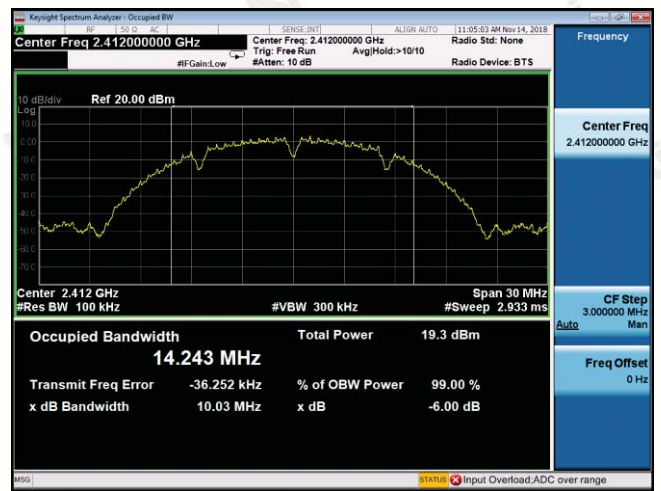
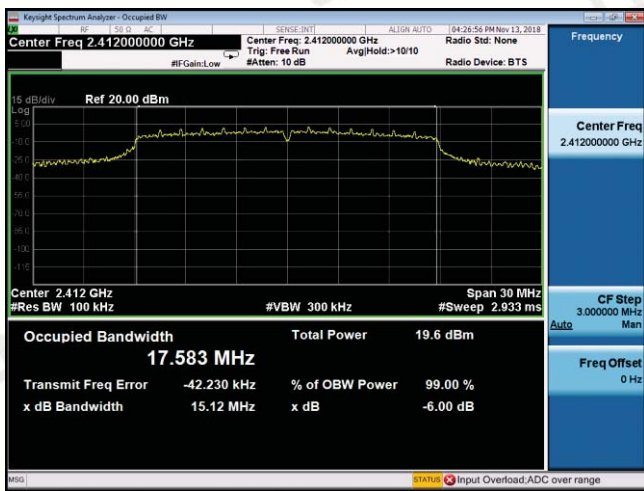


CH11

CH11

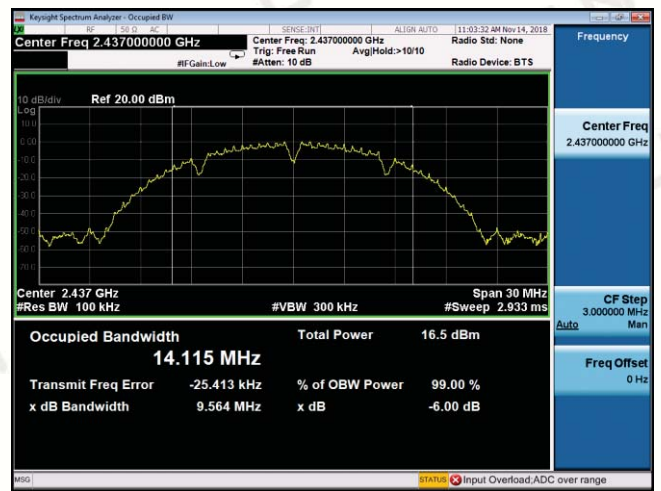
ANT A 802.11n HT20

ANT B 802.11b



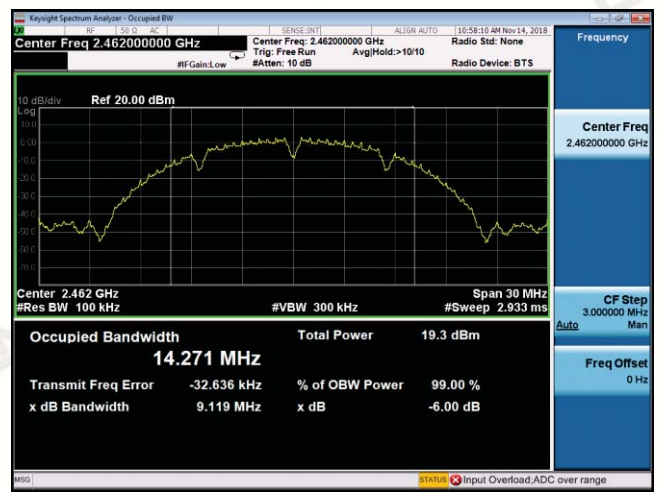
CH01

CH01



CH06

CH06

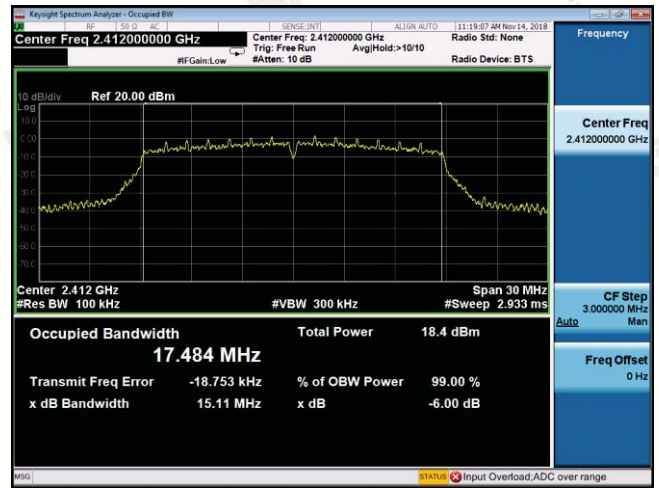
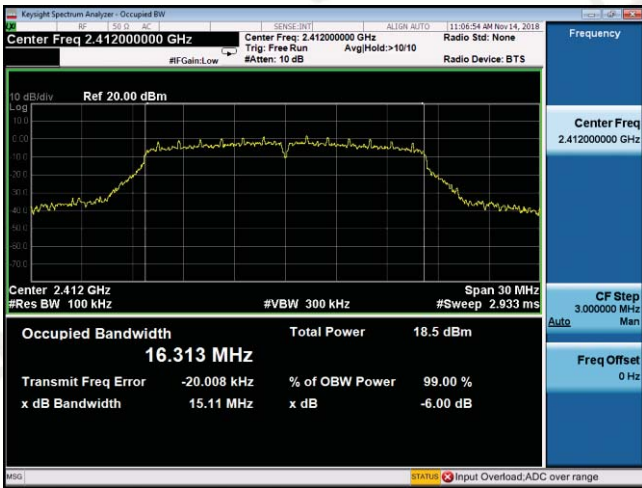


CH11

CH11

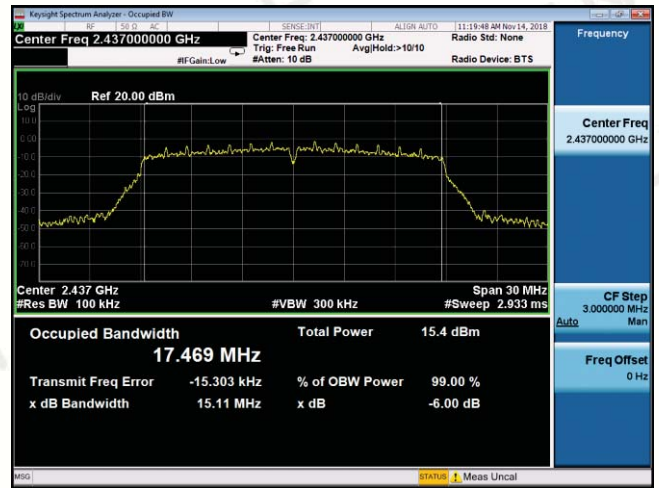
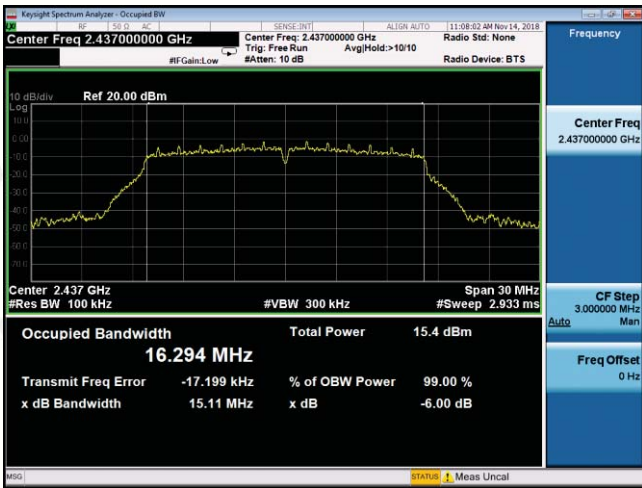
ANT B 802.11g

ANT B 802.11n HT20



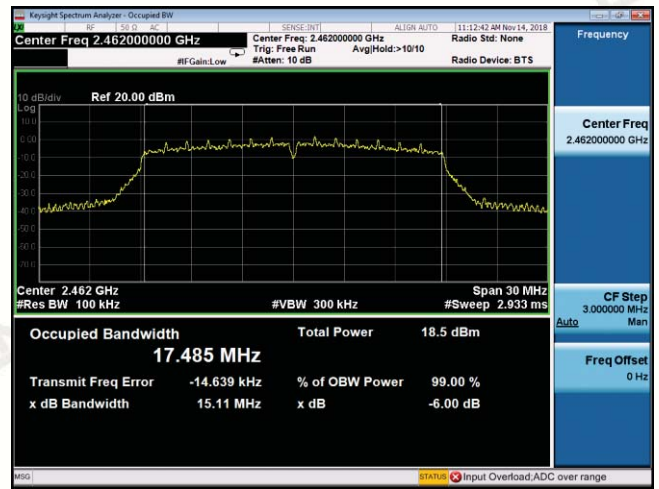
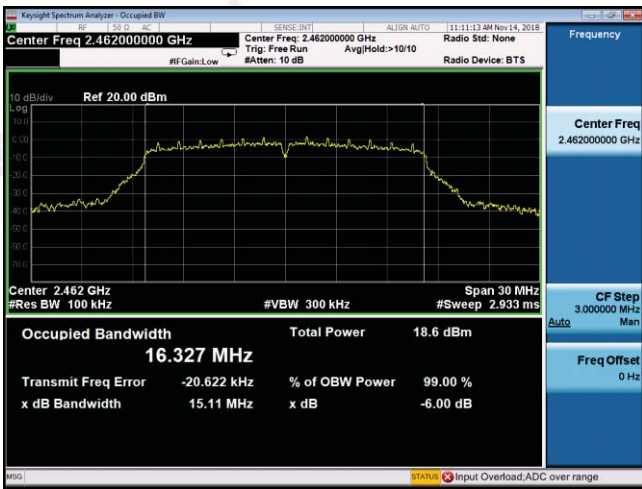
CH01

CH01



CH06

CH06

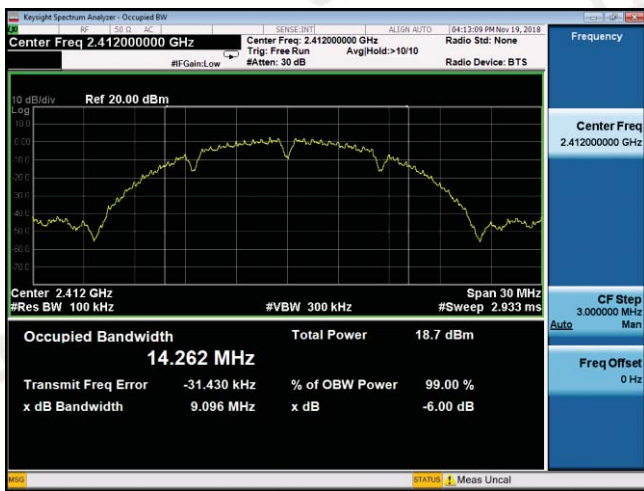


CH11

CH11

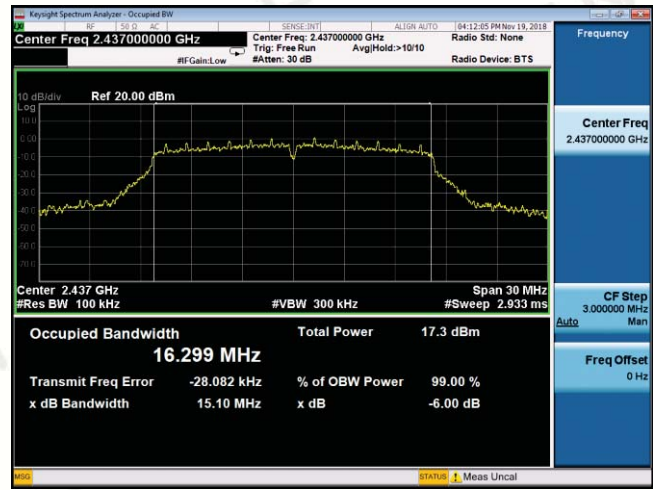
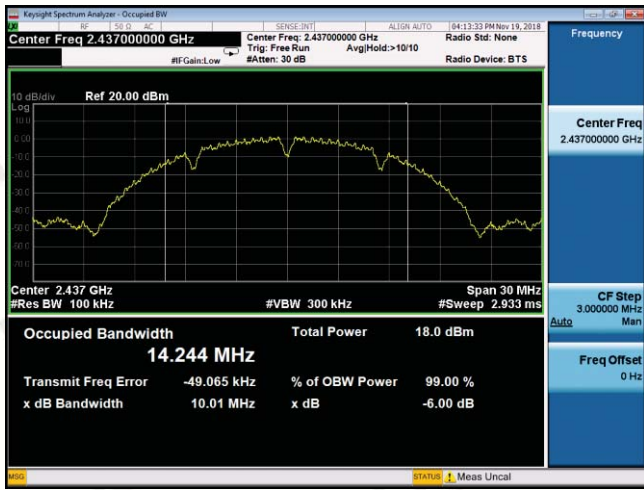
ANT C 802.11b

ANT C 802.11g



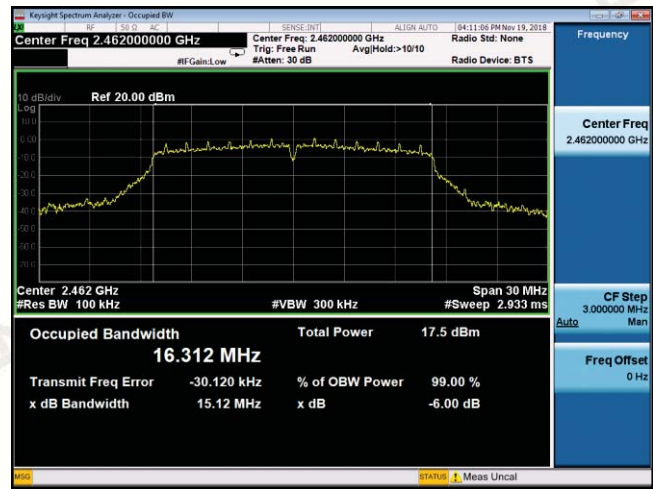
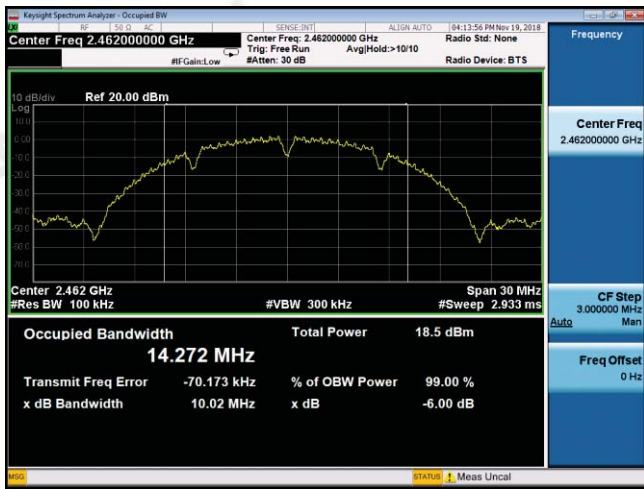
CH01

CH01



CH06

CH06

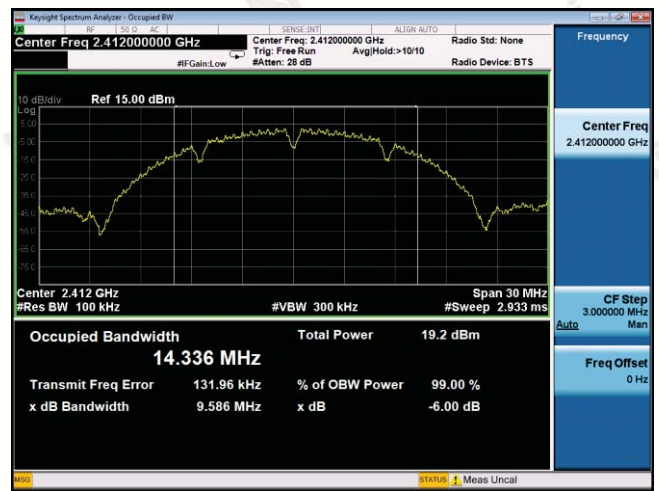
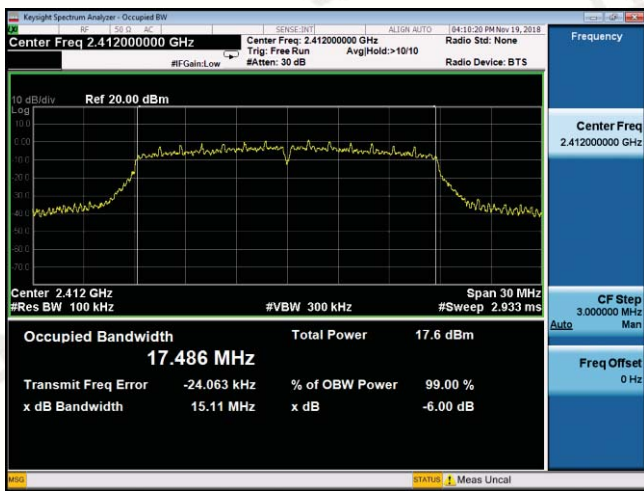


CH11

CH11

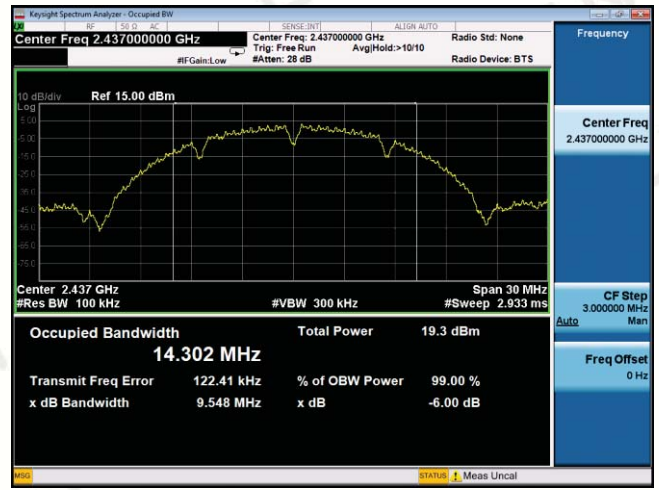
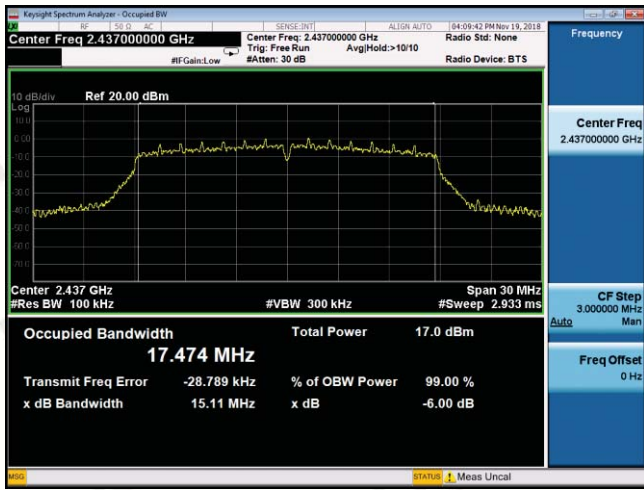
ANT C 802.11n HT20

ANT D 802.11b



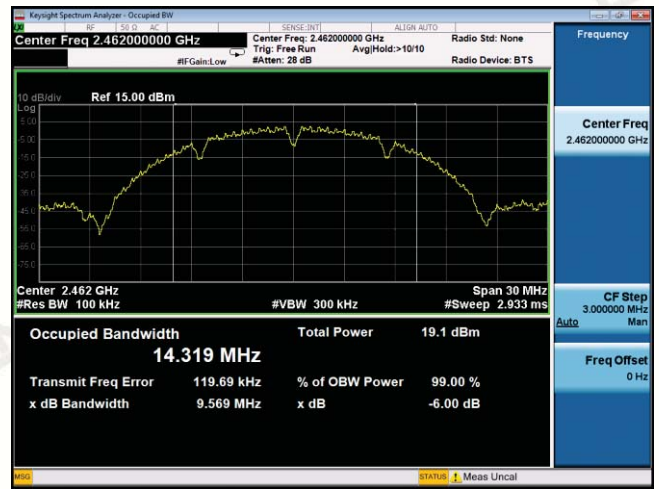
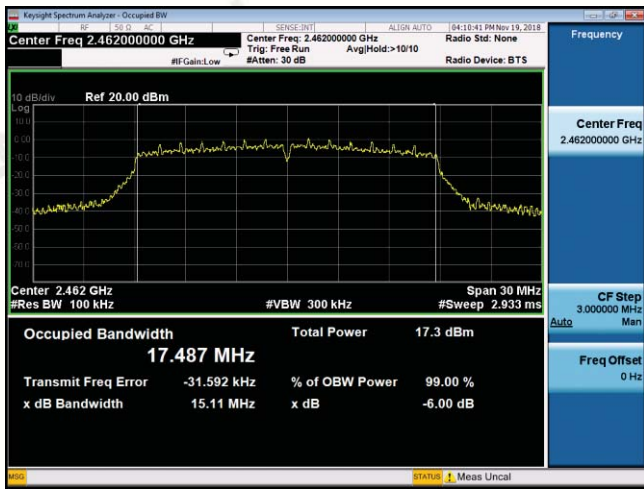
CH01

CH01



CH06

CH06

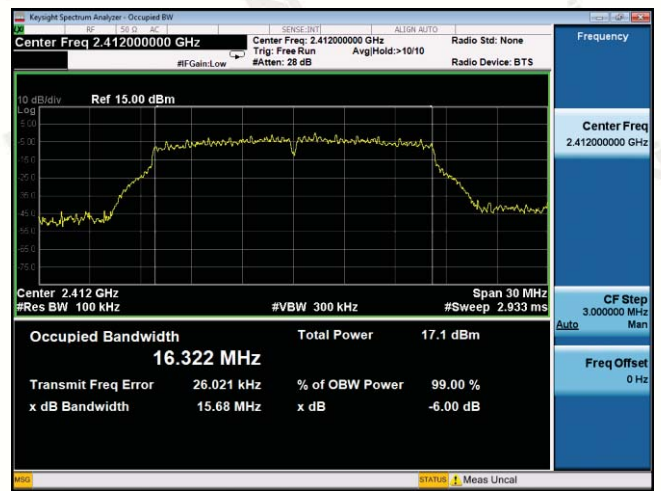
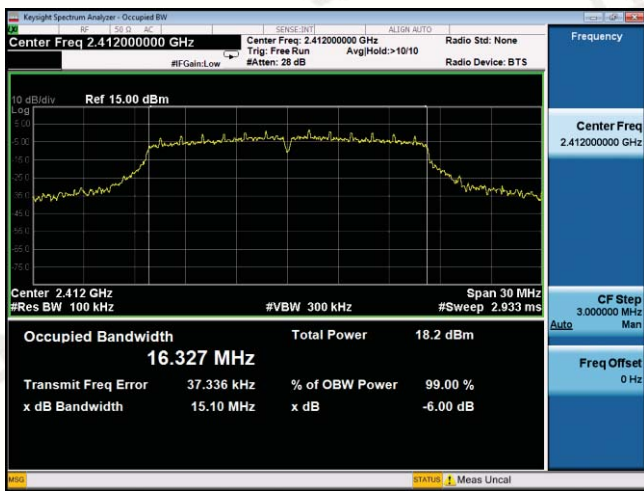


CH11

CH11

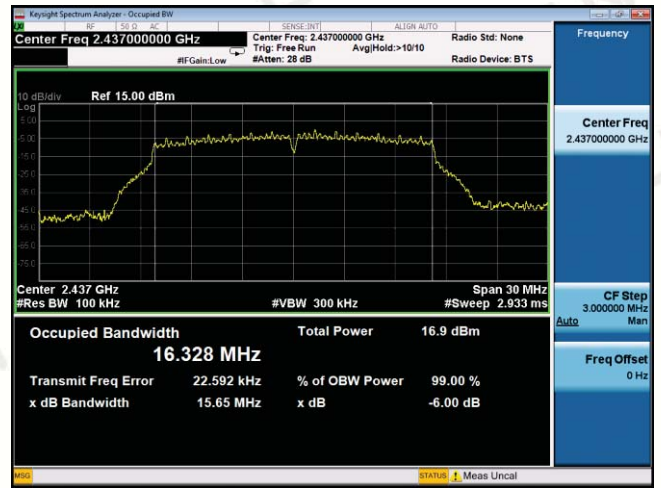
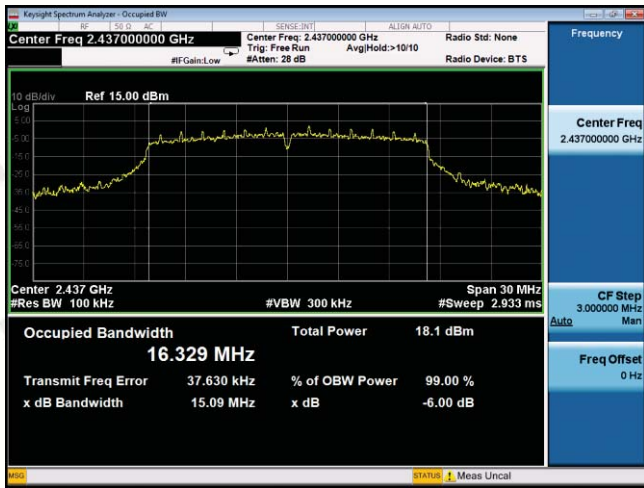
ANT D 802.11g

ANT D 802.11n HT20



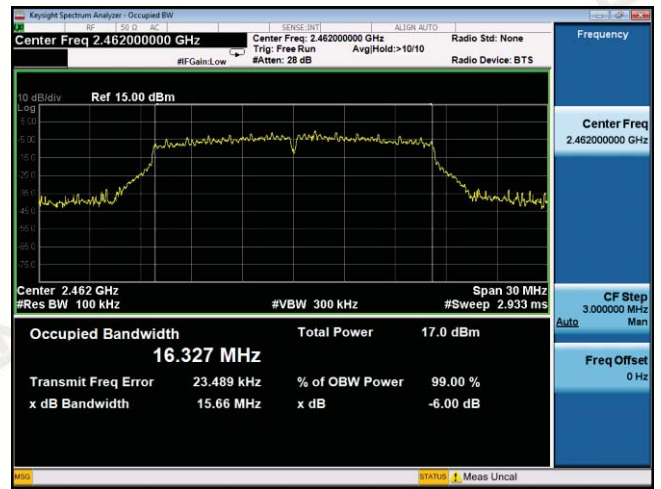
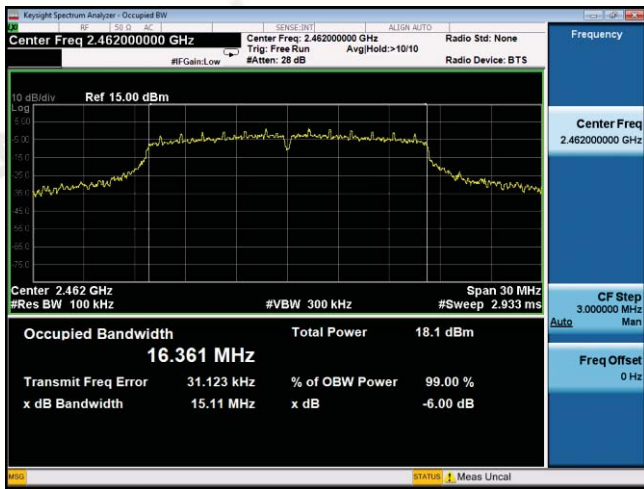
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7. POWER SPECTRAL DENSITY TEST

7.1 Test Limit

FCC Part15(15.247), Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247	Power Spectral Density	8 dBm (in any 3KHz)	2400-2483.5	PASS

7.2 Test Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT as normal operation.
3. Based on FCC Part15 C Section 15.247: RBW=3KHz, VBW=10KHz.
4. The useful radiated emission from the EUT was detected by the spectrum analyzer with peak detector.

7.3 Measurement Equipment Used

Same as Radiated Emission Measurement

7.4 Test Result

PASS

Type	Channel	Power Spectral Density (dBm/3KHz)	Power Spectral Density (dBm/3KHz)	Power Spectral Density (dBm/3KHz)	Power Spectral Density (dBm/3KHz)	Power Spectral Density Total(dBm/3KHz)	Limit (dBm/3KHz)	Result
		ANT A	ANT B	ANT C	ANT D			
802.11b	01	-10.987	-9.954	-13.717	-14.568	-5.88	6.98	Pass
	06	-12.981	-13.880	-12.948	-14.052	-4.72		
	11	-10.273	-10.063	-14.075	-14.637	-5.75		
802.11g	01	-13.380	-11.166	-14.470	-16.029	-7.37	6.98	Pass
	06	-14.678	-14.691	-15.181	-16.687	-9.22		
	11	-14.120	-10.975	-14.643	-15.735	-7.46		
802.11n(HT20)	01	-12.250	-9.613	-14.764	-15.256	-6.34	6.98	Pass
	06	-14.467	-12.819	-15.825	-15.469	-8.46		
	11	-12.943	-11.768	-14.040	-15.342	-7.30		

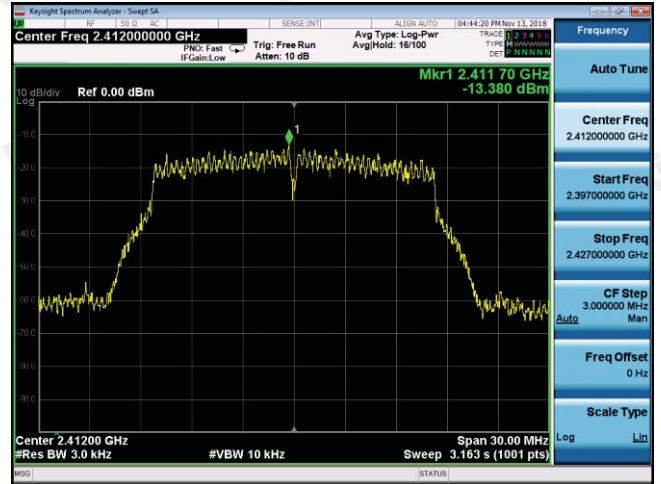
Note:

- 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). 802.11b ,802.11g mode,802.11n(20) mode the ANT A, ANT B, ANT C and ANT D can TX and RX at the same time;
- 4). Directional gain=GANT +10log(N)dbi =1.0+10log4=7.02dbi;
- 5). For MIMO with CCD technology device, The Directional Gain= Gain of individual transmit antennas (dBi) + Array gain; Array gain = 10 log (Nant), where Nant is the number of transmit antennas.

ANT A 802.11b



ANT A 802.11g



CH01



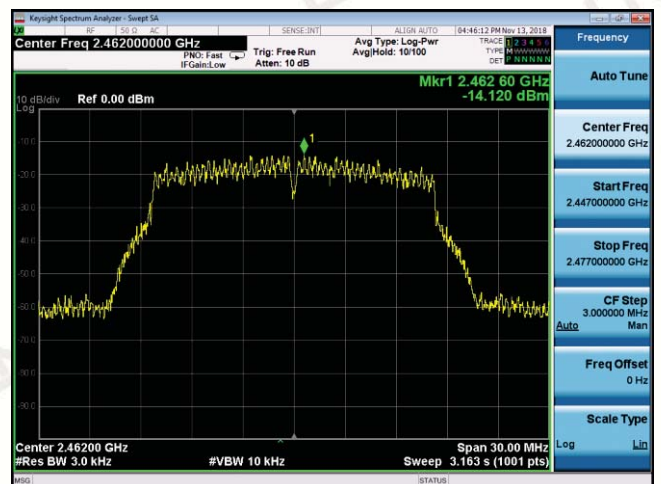
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CH11



CH11



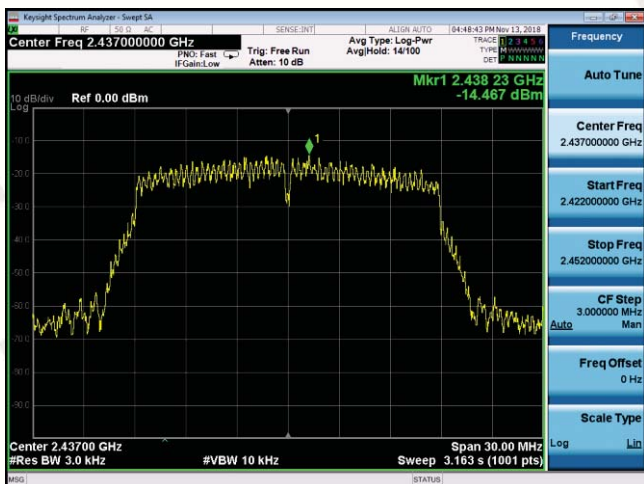
ANT A 802.11 nHT20

ANT B 802.11b



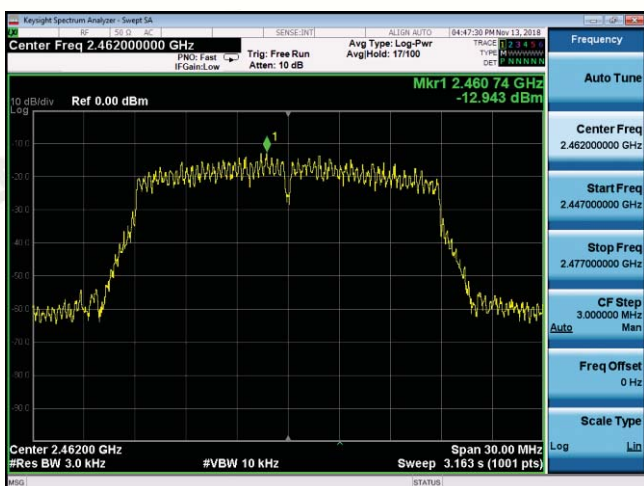
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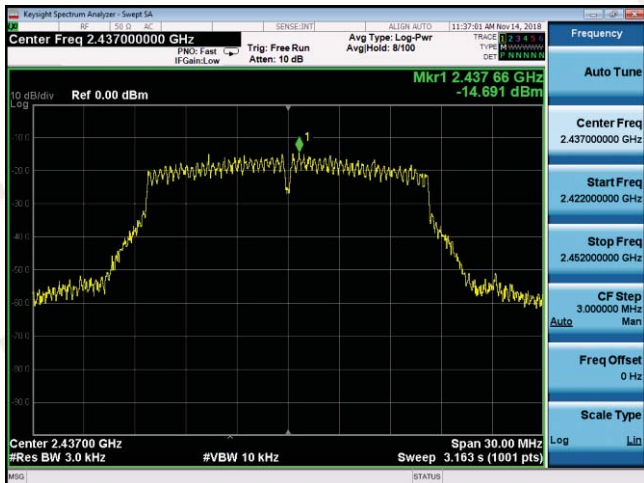
ANT B 802.11g



ANT B 802.11 nHT20



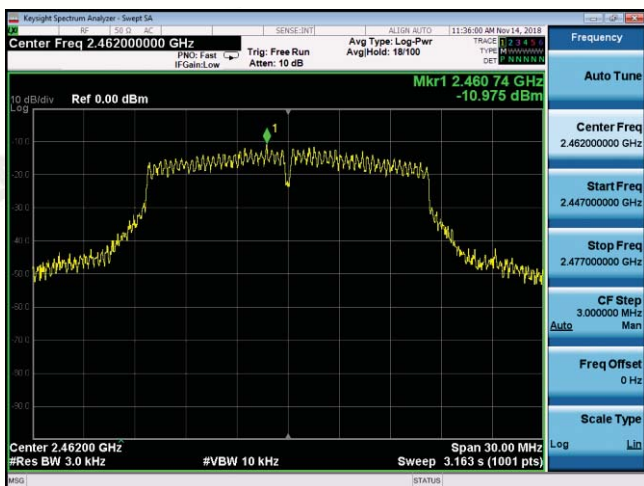
CH01



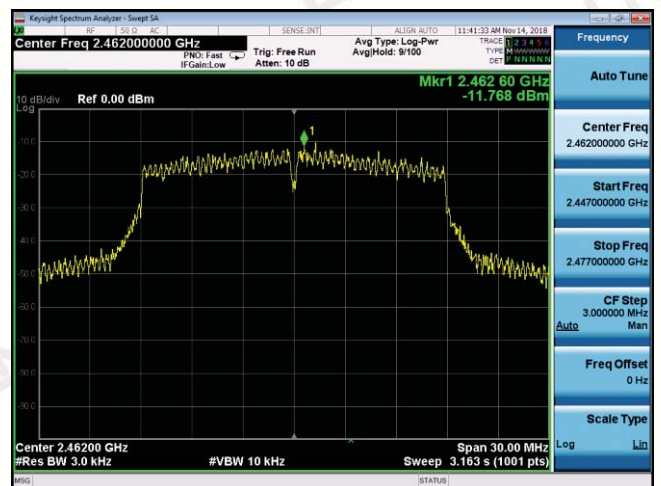
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