

FCC TEST REPORT (WIFI)

for

YICHEN (SHENZHEN) TECHNOLOGY CO., LTD

Wi-Fi Range Extender

Model Number: JWA-AC2320M

Serial Number: JWA-AC2323M, WRAC1200

FCC ID: 2AJSTJWA-AC2320M

Prepared for : YICHEN (SHENZHEN) TECHNOLOGY CO., LTD
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Report No. : 17KWE025074F

Date of Test : Jan. 20 ~ Feb. 15, 2017

Date of Report : Feb.16, 2017

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Keyway Testing Technology Co., Ltd.

Applicant:	YICHEN (SHENZHEN) TECHNOLOGY CO., LTD		
Address:	23/F, Block C1, Nanshan I Park, No. 1001, Xueyuan Road, Taoyuan Street, Nanshan District, Shenzhen, China		
Manufacturer:	YICHEN (SHENZHEN) TECHNOLOGY CO., LTD		
Address:	23/F, Block C1, Nanshan I Park, No. 1001, Xueyuan Road, Taoyuan Street, Nanshan District, Shenzhen, China		
E.U.T:	Wi-Fi Range Extender		
Model Number:	JWA-AC2320M		
Serial Model:	JWA-AC2323M, WRAC1200		
Trade Name:		Serial No.:	-----
Date of Receipt:	Jan. 18, 2017	Date of Test:	Jan. 20 ~ Feb.15, 2017
Test Specification:	FCC Part 15, Subpart 15.247: Oct. 1, 2016 ANSI C63.10:2013 KDB558074 D01 DTS Meas Guidance v03r05		
Test Result:	The equipment under test was found to be compliance with the requirements of the standards applied.		
Issue Date: Feb. 16, 2017			
Tested by:	Reviewed by:	Approved by:	
			
Keven Wu / Engineer	Mark Li / Supervisor	Andy Gao / Supervisor	
Other Aspects:	None.		
Abbreviations: OK/P=passed fail/F=failed n.a/N=not applicable E.U.T=equipment under tested			
This test report is based on a single evaluation of one sample of above mentioned products. It is not permitted to be duplicated in extracts without written approval of Keyway Testing Technology Co., Ltd.			

1.TEST SUMMARY

Test Items	Test Requirement	Result
Conducted Emissions	15.207	PASS
Radiated Emissions	15.205(a)/15.209/15.247(d)	PASS
6dB&99% Bandwidth	15.247(a)(2)	PASS
Power density	15.247(e)	PASS
Maximum Peak Output Power	15.247(b)	PASS
Duty Cycle	15.207	PASS
Emissions from out of band	15.247(d)	PASS
Antenna Requirement	15.203	PASS

2.GENERAL PRODUCT INFORMATION

2.1. Product Function

Refer to Technical Construction Form and User Manual.

2.2. Description of Device (EUT)

Product Name:	Wi-Fi Range Extender
Model No.:	JWA-AC2320M
Serial Model:	JWA-AC2323M, WRAC1200
Model Difference	All the models are the same circuit and RF module, except the model names and colour.
Operation Frequency:	2412MHz~2462MHz (802.11b/802.11g/802.11n(HT20)) 2422MHz~2452MHz (802.11n(H40))
Channel numbers:	11 for 802.11b/802.11g/802.11n(HT20) ,7 for 802.11n(H40)
Modulation technology:	Direct Sequence Spread Spectrum (DSSS) for (IEEE 802.11b) Orthogonal Frequency Division Multiplexing(OFDM) for (IEEE 802.11g/802.11n)
Data speed (IEEE 802.11b):	1Mbps, 2Mbps, 5.5Mbps, 11Mbps
Data speed (IEEE 802.11g):	6Mbps, 9Mbps, 12Mbps, 18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps
Data speed (IEEE 802.11n):	Up to 150Mbps
Antenna Type:	PIFA antenna
Antenna gain:	2.86 dBi
Power supply:	AC 100-240V, 50/60Hz, 0.3A

2.3. Independent Operation Modes

The basic operation modes are:

2.3.1. EUT work WFI TX mode, and frequency as below:

Mode 1	802.11b	Frequency
		2412MHz
		2437MHz
		2462MHz
Mode 2	802.11g	2412MHz
		2437MHz
		2462MHz
Mode 3	802.11n(HT20)	2412MHz
		2437MHz
		2462MHz
Mode 4	802.11n(HT40)	2422MHz
		2437MHz
		2452MHz
Mode 5	Link Mode	

Remark: 802.11b mode:1Mbps, 802.11g mode:6Mbps, 802.11n(HT20) mode:MCS0, 802.11n(HT40) mode:MCS0. The software "RFTestTool" was used for testing, which was provided by manufacturer.

2.4. Test Supporting System

None.

2.5. Test Sites

2.5.1. Test Facilities

Lab Qualifications : Certificated by Industry Canada
Registration No.: 9868A
Date of registration: December 8, 2011

Certificated by FCC, USA
Registration No.: 370994
Date of registration: February 21, 2012

Certificated by CNAS China
Registration No.: CNAS L5783
Date of registration: August 8, 2012

2.6. List of Test and Measurement Instruments

2.6.1. For conducted emission at the mains terminals test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESCI	101156	Apr. 09,16	Apr. 09,17
Artificial Mains Network	Rohde&Schwarz	ENV216	101315	Apr. 09,16	Apr. 09,17
RF Cable	FUJIKURA	3D-2W	944 Cable	Apr. 09,16	Apr. 09,17

2.6.2. For radiated emission test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESCI	101156	Apr. 09,16	Apr. 09,17
Bilog Antenna	ETS-LINDGREEN	3142D	135452	Apr. 09,16	Apr. 09,17
Spectrum Analyzer	Agilent	E4411B	MY4511304	Apr. 09,16	Apr. 09,17
3m Semi-anechoic Chamber	ETS-LINDGREEN	966	KW01	Apr. 09,16	Apr. 09,17
Signal Amplifier	SONOMA	310	187016	Apr. 09,16	Apr. 09,17
Signal Amplifier	Agilent	8449B	3008A00251	Apr. 09,16	Apr. 09,17
RF Cable	IMRO	IMRO-400	966 Cable 1#	N/A	N/A
MULTI-DEVICE Controller	ETS-LINDGREEN	2090	126913	N/A	N/A
Horn Antenna	SCHWARZBECK	BBHA9170	9170-068	Apr. 09,16	Apr. 09,17
Spectrum Analyzer	Agilent	E4408B	MY44211125	Apr. 09,16	Apr. 09,17
High Pass filter	Micro	HPM50111	324216	Apr. 09,16	Apr. 09,17
Constant temperature and humidity box	GF	GTH-800-40-1P	MAA9906-005	Apr. 09,16	Apr. 09,17
Attenuation	MCE	24-10-34	BN9258	Apr. 02,16	Apr. 02,17
Loop Antenna	ARA	PLA-1030/B	1029	Apr. 02,16	Apr. 02,17
Power Meter	Anritsu	ML2495A	1204003	Apr. 24,16	Apr. 24,17
Power Sensor	Anritsu	MA2411B	1126150	Apr. 24,16	Apr. 24,17

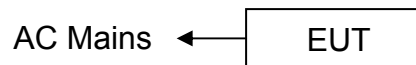
3. TEST SET-UP AND OPERATION MODES

3.1. Principle of Configuration Selection

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the Operating Instructions.

3.2. Block Diagram of Test Set-up

System Diagram of Connections between EUT and Simulators



(EUT: Wi-Fi Range Extender)

3.3. Special Accessories and Auxiliary Equipment

None.

3.4. Countermeasures to Achieve EMC Compliance

None.

4. EMISSION TEST RESULTS

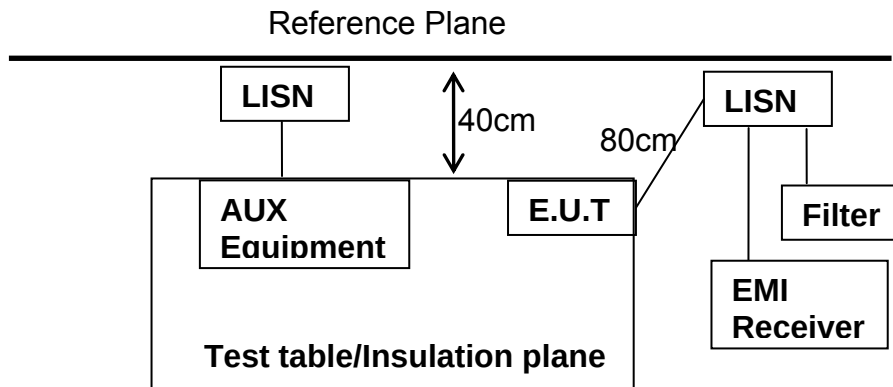
4.1. Conducted Emission at the Mains Terminals Test

4.1.1. Limit 15.209 limits

Frequency MHz	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50
NOTE: 1.The lower limit shall apply at the transition frequencies. 2.The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.		

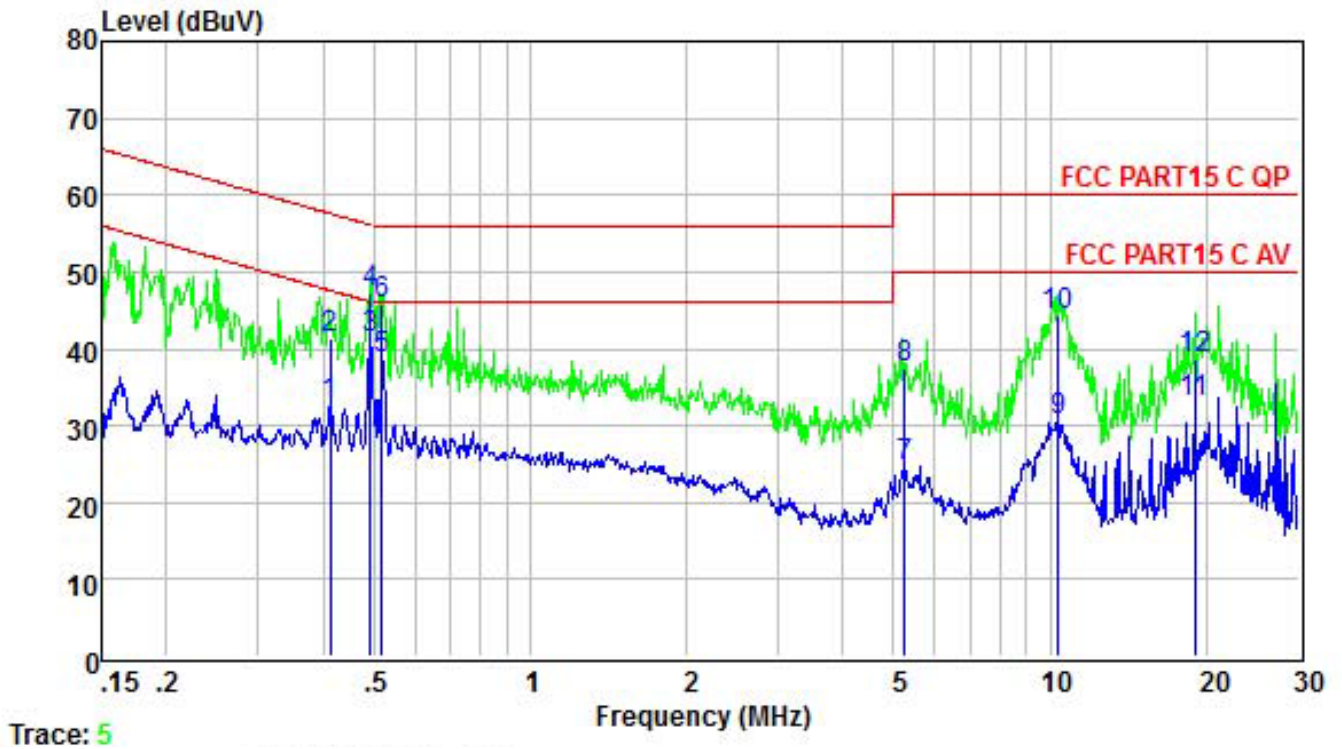
4.1.2. Test Setup

- 1.The EUT was put on a wooden table which was 0.8 m high above the ground and connected to the AC mains through the Artificial Mains Network (AMN). Where the mains cable supplied by the manufacture was longer than 0.8 m, the excess was folded back and forth parallel to the cable at the center so as to form a bundle no longer than 0.4 m.
- 2.The EUT was kept 0.4 m from any other earthed conducting surface. Both sides of AC line were checked to find out the maximum conducted emission levels according to the test procedure during the conducted emission test.
- 3.The frequency range from 150 kHz to 30 MHz was investigated.
- 4.The bandwidth of the test receiver was set at 9 kHz.
- 5.Pretest for all mode, and the test data of the worst case condition(s) was reported on the following page.



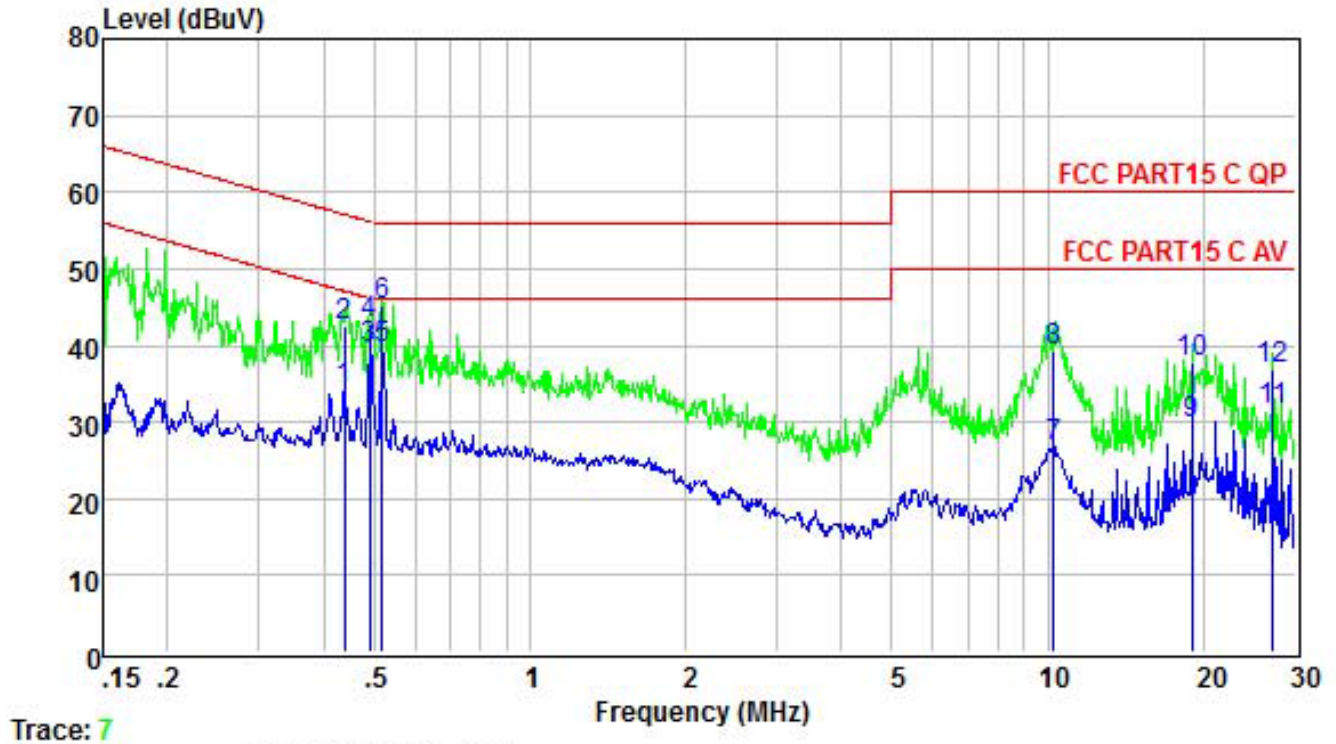
Remark: E.U.T. :Equipment Under Test
 LISN: Line Impedance Stabilization Network
 Test table height: 0.8m.

EUT :	Wi-Fi Range Extender	Model Name :	JWA-AC2320M
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	L
Test Voltage :	AC 120V/60Hz	Test Mode :	Mode 5



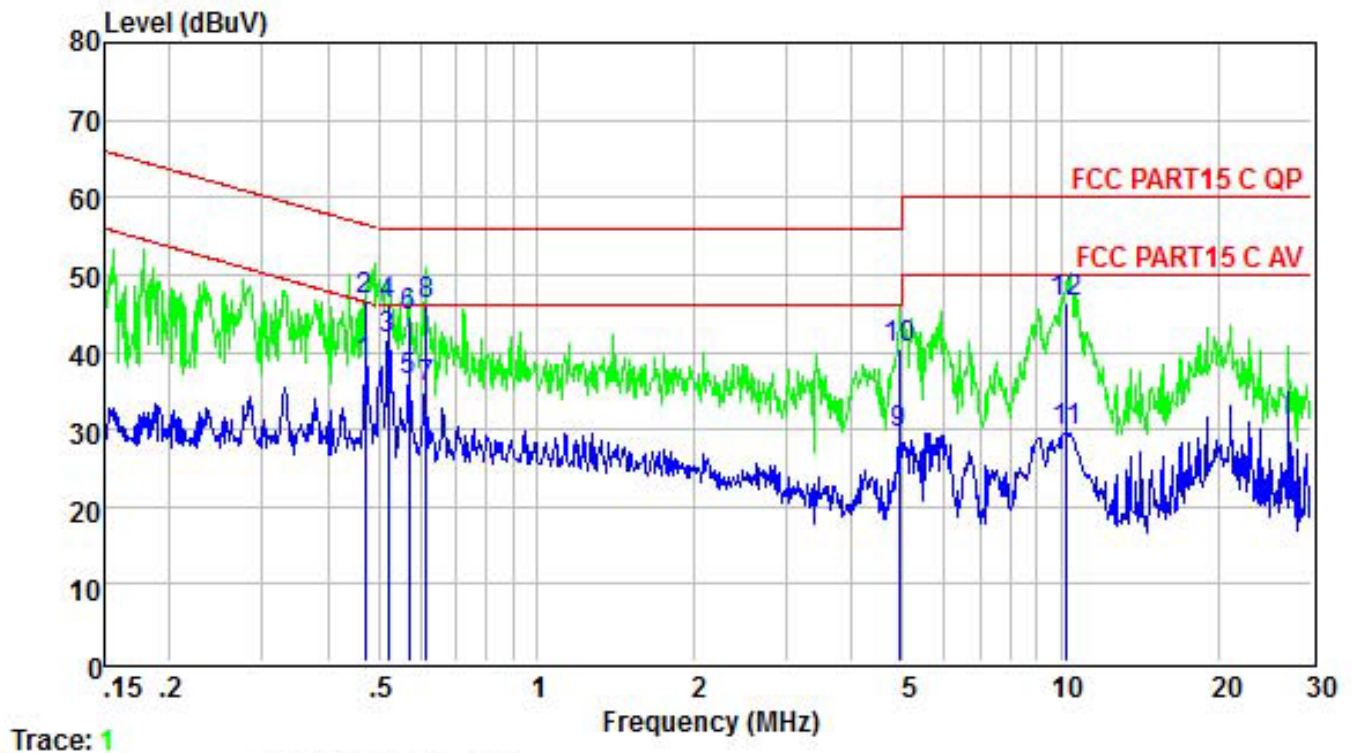
	Freq	Level	Limit	Over	Remark
	MHz	dBuV	Line	Limit	
			dBuV	dB	
1	0.413	32.74	47.59	-14.85	Average
2	0.413	41.20	57.59	-16.39	QP
3	0.494	41.45	46.10	-4.65	Average
4	0.494	47.30	56.10	-8.80	QP
5	0.518	38.70	46.00	-7.30	Average
6	0.518	45.90	56.00	-10.10	QP
7	5.249	24.57	50.00	-25.43	Average
8	5.249	37.60	60.00	-22.40	QP
9	10.342	30.57	50.00	-19.43	Average
10	10.342	44.20	60.00	-15.80	QP
11	18.920	33.14	50.00	-16.86	Average
12	18.920	38.60	60.00	-21.40	QP

EUT :	Wi-Fi Range Extender	Model Name :	JWA-AC2320M
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	N
Test Voltage :	AC 120V/60Hz	Test Mode :	Mode 5



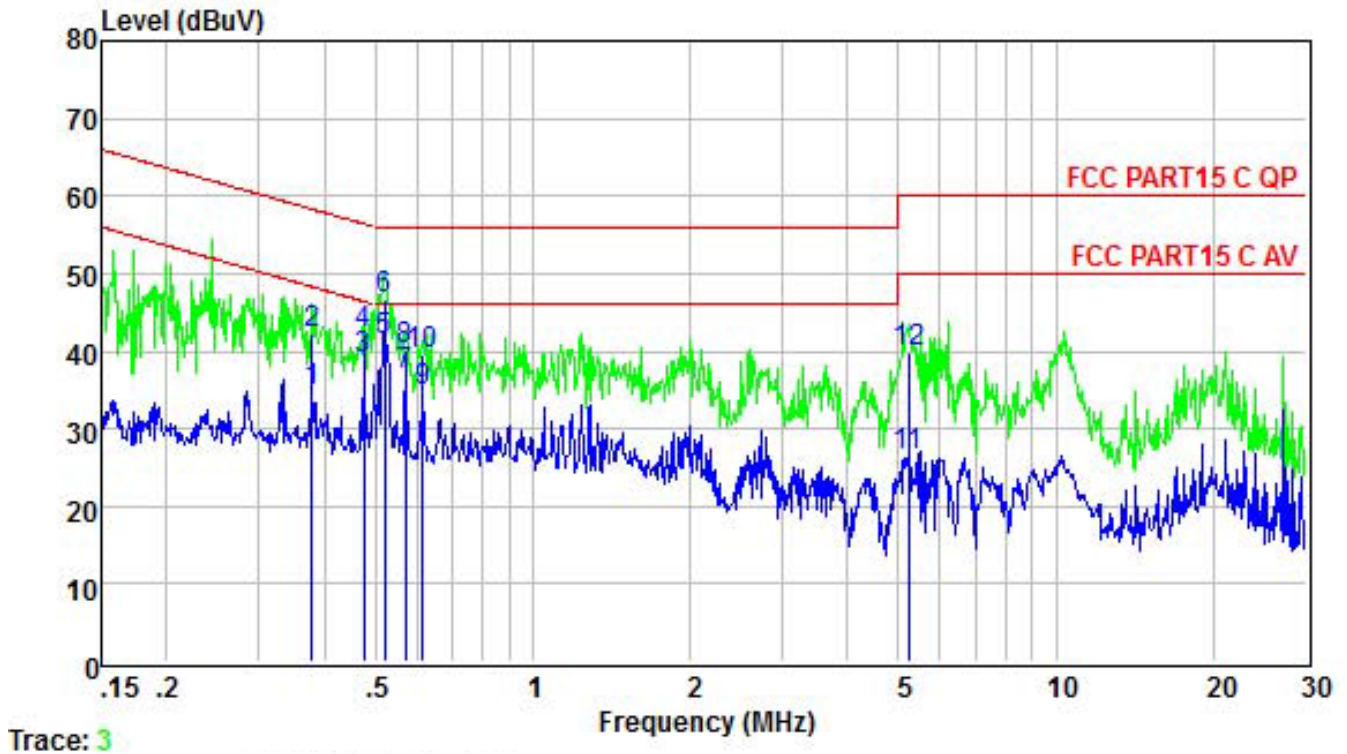
	Freq	Level	Limit	Over	Remark
	MHz	dBuV	Line	Limit	
			dBuV	dB	
1	0.440	34.16	47.07	-12.91	Average
2	0.440	42.60	57.07	-14.47	QP
3	0.491	39.67	46.14	-6.47	Average
4	0.491	42.80	56.14	-13.34	QP
5	0.518	39.42	46.00	-6.58	Average
6	0.518	45.10	56.00	-10.90	QP
7	10.233	26.91	50.00	-23.09	Average
8	10.233	39.30	60.00	-20.70	QP
9	18.920	29.75	50.00	-20.25	Average
10	18.920	37.70	60.00	-22.30	QP
11	27.127	31.61	50.00	-18.39	Average
12	27.127	36.90	60.00	-23.10	QP

EUT :	Wi-Fi Range Extender	Model Name :	JWA-AC2320M
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	L
Test Voltage :	AC 240V/60Hz	Test Mode :	Mode 5



	Freq	Level	Limit	Over	Remark
	MHz	dBuV	Line	Limit	
			dBuV	dB	
1	0.471	38.30	46.49	-8.19	Average
2	0.471	46.80	56.49	-9.69	QP
3	0.521	41.60	46.00	-4.40	Average
4	0.521	46.20	56.00	-9.80	QP
5	0.570	36.20	46.00	-9.80	Average
6	0.570	44.70	56.00	-11.30	QP
7	0.617	35.30	46.00	-10.70	Average
8	0.617	46.10	56.00	-9.90	QP
9	4.926	29.57	46.00	-16.43	Average
10	4.926	40.30	56.00	-15.70	QP
11	10.233	29.89	50.00	-20.11	Average
12	10.233	46.30	60.00	-13.70	QP

EUT :	Wi-Fi Range Extender	Model Name :	JWA-AC2320M
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	N
Test Voltage :	AC 240V/60Hz	Test Mode :	Mode 5



	Freq	Level	Limit	Over	Remark
	MHz	dBuV	Line	Limit	
			dBuV	dB	
1	0.379	34.81	48.30	-13.49	Average
2	0.379	42.30	58.30	-16.00	QP
3	0.476	39.11	46.41	-7.30	Average
4	0.476	42.30	56.41	-14.11	QP
5	0.521	41.30	46.00	-4.70	Average
6	0.521	46.80	56.00	-9.20	QP
7	0.570	36.86	46.00	-9.14	Average
8	0.570	40.20	56.00	-15.80	QP
9	0.617	34.76	46.00	-11.24	Average
10	0.617	39.60	56.00	-16.40	QP
11	5.221	26.60	50.00	-23.40	Average
12	5.221	39.80	60.00	-20.20	QP

4.2. Radiated Emission Test

4.2.1. Limit 15.209 limits

Frequency MHZ	Distance Meters	Filed Strengths Limit	
		$\mu\text{V}/\text{m}$	$\text{dB}(\mu\text{V})/\text{m}$
30~88	3	100	40.0
88~216	3	150	43.5
216~960	3	200	46.0
960~1000	3	500	54.0
Above 1000	3	74.0dB(μV)/m(Peak) 54.0dB(μV)/m(Average)	

4.2.2. Restricted bands of operation

MHz	MHz	MHz	GHz
0.009-0.110	16.42-16.423	399.9-410	4.5-5.15
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	
All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits.			

4.2.3. Test setup

The EUT was placed on a turn table which was 0.8 m (above 1GHz, the high was 1.5m) above the ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was set 3 m away from the receiving antenna which was mounted on an antenna tower. The measuring antenna moved up and down to find out the maximum emission level. It moved from 1 m to 4 m for both horizontal and vertical polarizations.

The EUT was tested in the Chamber Site. It was pre-scanned with a Peak detector from the spectrum, and all the final readings from the test receiver were measured with the Quasi-Peak detector.

The bandwidth of the EMI test receiver is set at 120kHz for frequency range from 30MHz to 1000 MHz.

The bandwidth of the Spectrum's VBW is set at 3MHz and RBW is set at 1MHz for peak emissions measurement above 1GHz and 1MHz RBW, 10Hz VBW for average emissions measure above 1GHz, Both PK and AV measure, PK detector is used.

The frequency range from 30MHz to 10th harmonic (25GHz) are checked. And no any emissions were found from 18GHz to 25 GHz, so the radiated emissions from 18GHz to 25GHz were not record.

Notes: 1. Emission Level = Antenna Factor + Cable Loss + Meter Reading-Preamp Factor.

2. Measurement Uncertainty: ± 3.2 dB at a level of confidence of 95%.

3. For emissions above 1GHz, if peak level comply with average limit, then the average level is deemed to comply with average limit.

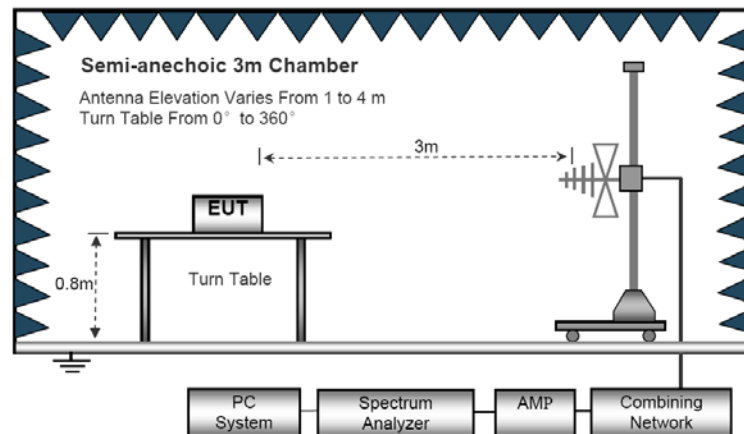
4. For emissions below 1GHz, pretest for all mode, The test data of the worst case condition(s) was reported on the following pages.

5. For Both PK and AV value above 1GHz, PK detector is used.

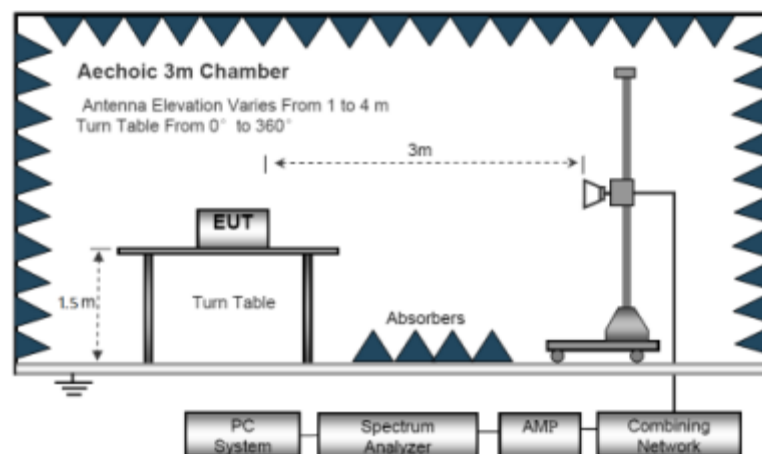
6. EUT Pre-scan X/Y/Z orientation, only worst case is presented in the report (Z orientation).

Radiated Emission Test-Up

Below 1GHz



Above 1GHz



EUT :	Wi-Fi Range Extender	Model Name :	JWA-AC2320M
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010hPa	Test Mode :	Mode 5
Test Voltage :	AC 120V/60Hz		

Below 30MHz

Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	P
--	--	--	--	P

Note:

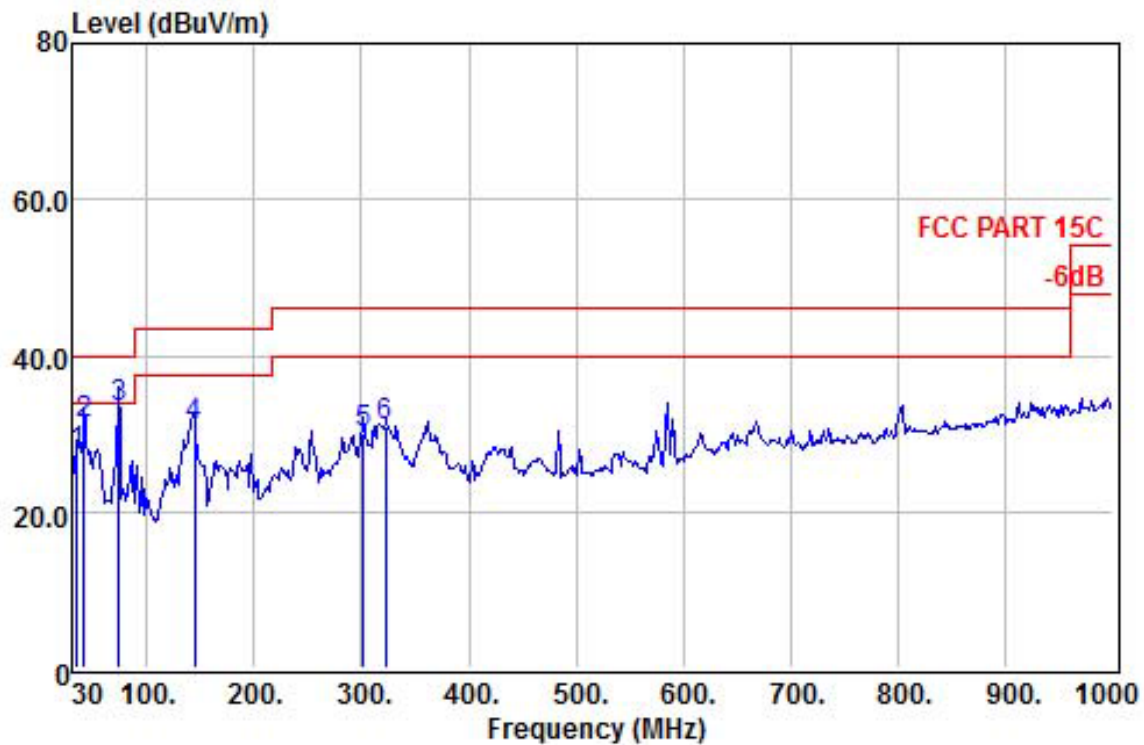
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Distance extrapolation factor = $40 \log (\text{specific distance/test distance})$ (dB);

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

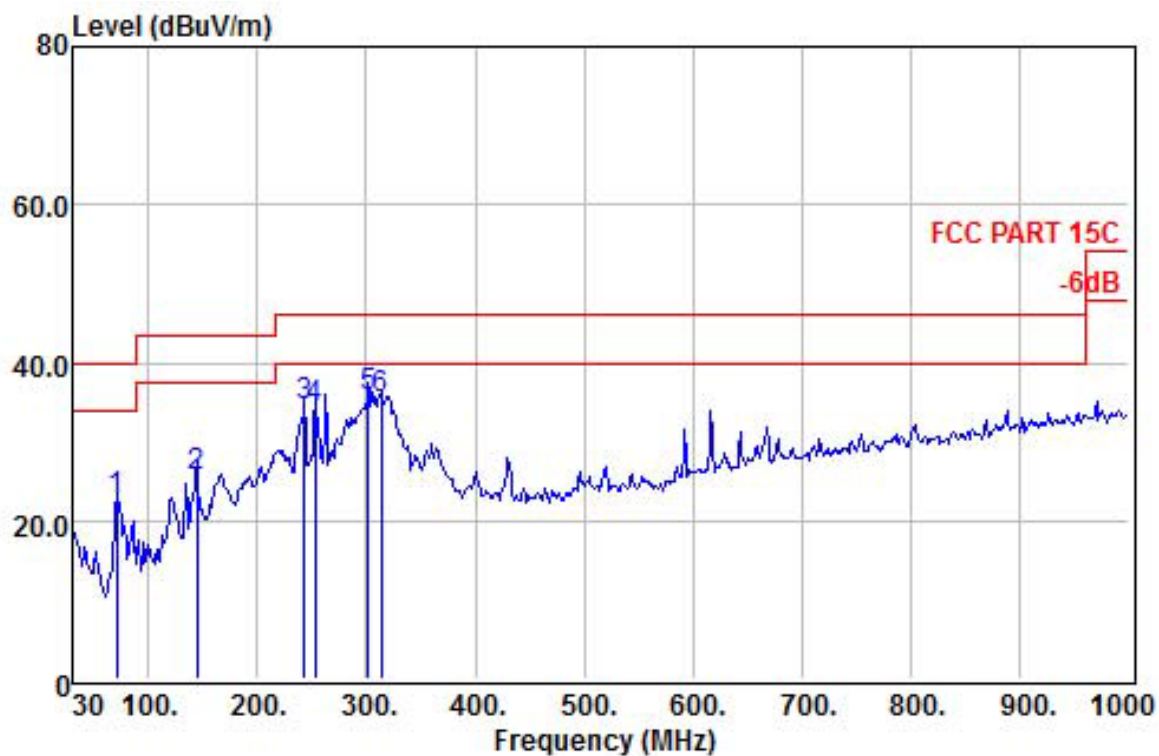
Below 1GHz			
EUT :	Wi-Fi Range Extender	Model Name :	JWA-AC2320M
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010hPa	Test Mode :	Mode 1
Test Voltage :	AC 120V/60Hz		

Vertical



		Preamp	Antenna	Read	Cable		Limit	Over	
	Freq	Factor	Factor	Level	Loss	Level	Line	Limit	Remark
	MHz	dB	dB/m	dBuV	dB	dBuV/m	dBuV/m	dB	
1	34.85	31.38	15.94	42.11	0.56	27.23	40.00	-12.77	QP
2	41.64	31.38	12.23	49.77	0.56	31.18	40.00	-8.82	QP
3	73.65	31.33	7.68	56.11	0.85	33.31	40.00	-6.69	QP
4	144.46	31.23	8.67	52.15	1.22	30.81	43.50	-12.69	QP
5	301.60	30.92	13.84	45.31	1.94	30.17	46.00	-15.83	QP
6	322.94	30.83	14.44	45.21	2.02	30.84	46.00	-15.16	QP

Horizontal



	Preamp	Antenna	Read	Cable	Limit	Over	
Freq	Factor	Factor	Level	Loss	Line	Limit	Remark
MHz	dB	dB/m	dBuV	dB	dBuV/m	dBuV/m	dB
1	70.74	31.32	7.54	45.53	0.85	22.60	40.00 -17.40 QP
2	144.46	31.23	8.67	46.87	1.22	25.53	43.50 -17.97 QP
3	243.40	30.95	12.72	51.13	1.61	34.51	46.00 -11.49 QP
4	253.10	30.97	12.91	50.47	1.70	34.11	46.00 -11.89 QP
5	301.60	30.92	13.84	50.73	1.94	35.59	46.00 -10.41 QP
6	313.24	30.89	14.17	50.10	1.94	35.32	46.00 -10.68 QP

Note: 1. Absolute Level= Reading Level + antenna Factor + cable loss - Preamp factor,
 2. Over Limit= Absolute Level – Limit;
 3. “802.11b” mode is the worst mode, only the worst case is presented in the report .

Above 1GHz			
EUT :	Wi-Fi Range Extender	Model Name :	JWA-AC2320M
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010hPa	Test Mode :	Mode 1
Test Voltage :	AC 120V/60HZ		

Polar (H/V)	Frequency	Meter Reading	Antenna Factor	Cable loss	Preamp factor	Emission Level	Limits	Margin	Remark
	(MHz)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	
TX-2412									
V	4824	31.86	31.99	12.01	27.50	48.36	54	-5.64	Average
V	4824	45.33	31.99	12.01	27.50	61.83	74	-12.17	Peak
V	7236	36.59	25.31	16.61	27.95	50.56	74	-23.44	Peak
H	4824	31.39	31.99	12.01	27.50	47.89	54	-6.11	Average
H	4824	43.63	31.99	12.01	27.50	60.13	74	-13.87	Peak
H	7236	37.68	25.31	16.61	27.95	51.65	74	-22.35	Peak
TX-2437									
V	4874	32.48	32.11	12.14	27.53	49.2	54	-4.8	Average
V	4874	42.79	32.11	12.14	27.53	59.51	74	-14.49	Peak
V	7311	36.35	24.32	16.62	27.96	49.33	74	-24.67	Peak
H	4874	32.49	32.11	12.14	27.53	49.21	54	-4.79	Average
H	4874	41.65	32.11	12.14	27.53	58.37	74	-15.63	Peak
H	7311	36.48	24.32	16.62	27.96	49.46	74	-24.54	Peak
TX-2462									
V	4924	30.29	32.23	12.28	27.56	47.24	54	-6.76	Average
V	4924	42.46	32.23	12.28	27.56	59.41	74	-14.59	Peak
V	7386	35.65	24.36	16.62	27.98	48.65	74	-25.35	Peak
H	4924	29.77	32.23	12.28	27.56	46.72	54	-7.28	Average
H	4924	42.96	32.23	12.28	27.56	59.91	74	-14.09	Peak
H	7386	36.51	24.36	16.62	27.98	49.51	74	-24.49	Peak

Note: 1. "802.11b" mode is the worst mode.

2. When PK value is lower than the Average value limit, average didn't record.

3. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has not to be reported.

Spurious Emission in Restricted Band (1-25G) :

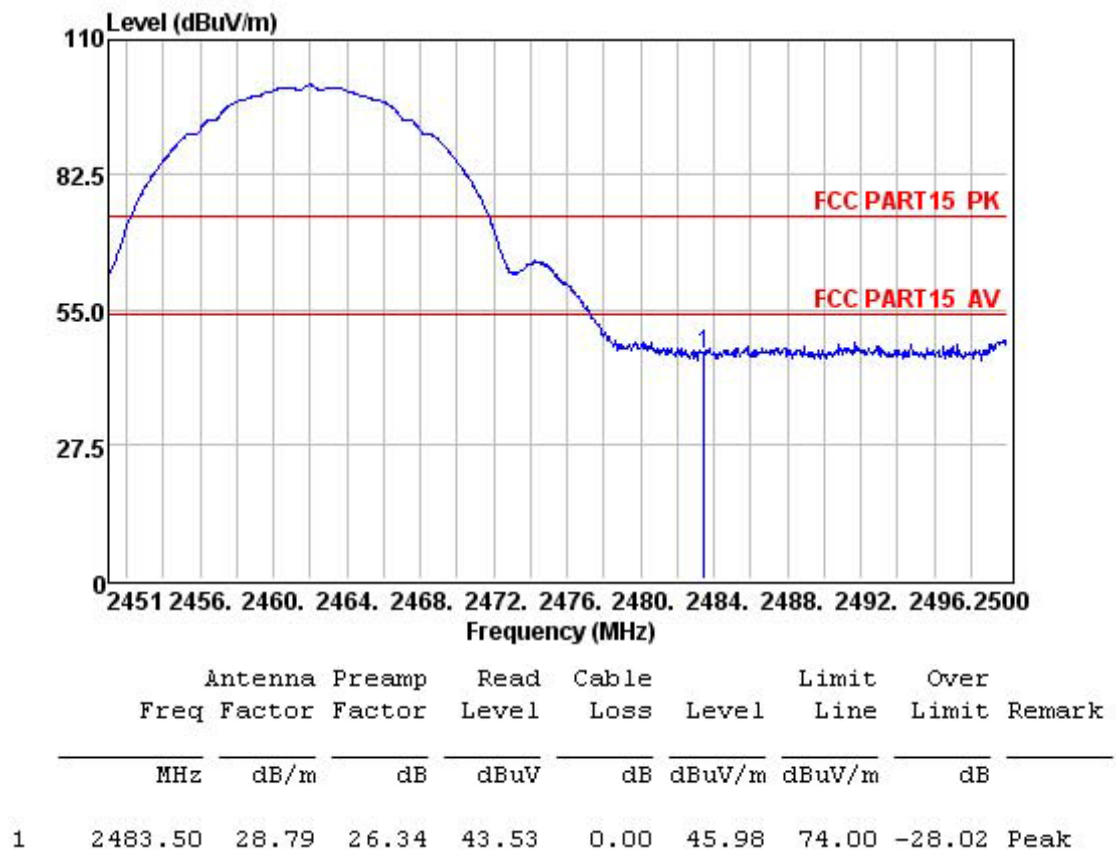
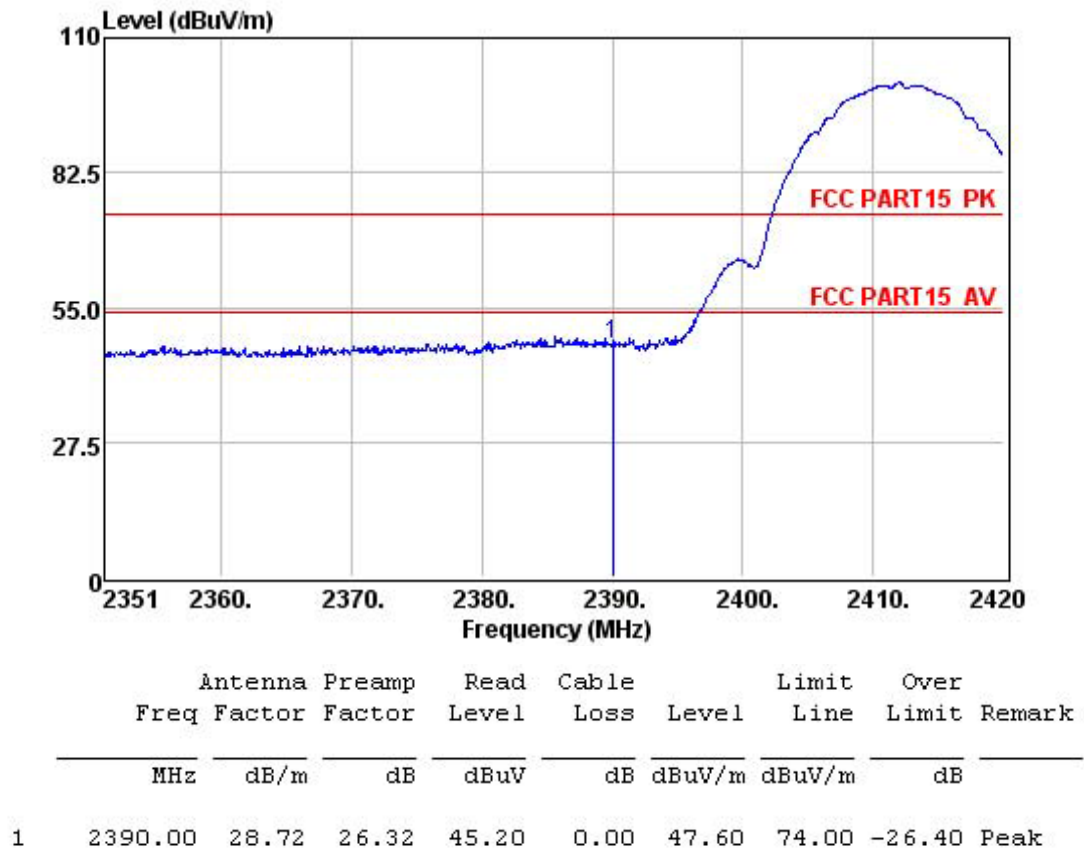
All the modulation modes have been tested and all other emissions more than 20dB below the limit, the worst result was report as below:

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable loss (dB)	Preamp factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
802.11b									
V	3264	31.39	30.26	9.96	26.63	44.98	74	-29.02	Pk
H	3264	32.35	30.26	9.96	26.63	45.94	74	-28.06	PK
V	3336	32.13	30.33	9.96	26.66	45.76	74	-28.24	Pk
H	3336	31.59	30.33	9.96	26.66	45.22	74	-28.78	PK
V	4100	34.72	31.64	10.61	27.06	49.91	74	-24.09	Pk
H	4100	33.48	31.64	10.61	27.06	48.67	74	-25.33	PK
V	11764	32.68	26.64	17.32	28.98	47.66	74	-26.34	Pk
H	11764	33.53	26.64	17.32	28.98	48.51	74	-25.49	PK
V	17732	32.44	26.27	22.01	30.39	50.33	74	-23.67	Pk
H	17732	32.56	26.27	22.01	30.39	50.45	74	-23.55	PK
802.11g									
V	3264	33.23	30.26	9.96	26.63	46.82	74	-27.18	Pk
H	3264	32.58	30.26	9.96	26.63	46.17	74	-27.83	PK
V	3336	32.48	30.33	9.96	26.66	46.11	74	-27.89	Pk
H	3336	31.63	30.33	9.96	26.66	45.26	74	-28.74	PK
V	4100	34.52	31.64	10.61	27.06	49.71	74	-24.29	Pk
H	4100	32.59	31.64	10.61	27.06	47.78	74	-26.22	PK
V	11764	31.35	26.64	17.32	28.98	46.33	74	-27.67	Pk
H	11764	32.75	26.64	17.32	28.98	47.73	74	-26.27	PK
V	17732	31.53	26.27	22.01	30.39	49.42	74	-24.58	Pk
H	17732	32.67	26.27	22.01	30.39	50.56	74	-23.44	PK
802.11n(20)									
V	3264	30.53	30.26	9.96	26.63	44.12	74	-29.88	Pk
H	3264	30.66	30.26	9.96	26.63	44.25	74	-29.75	PK
V	3336	32.85	30.33	9.96	26.66	46.48	74	-27.52	Pk
H	3336	32.56	30.33	9.96	26.66	46.19	74	-27.81	PK
V	4100	33.83	31.64	10.61	27.06	49.02	74	-24.98	Pk
H	4100	31.42	31.64	10.61	27.06	46.61	74	-27.39	PK
V	11764	32.85	26.64	17.32	28.98	47.83	74	-26.17	Pk
H	11764	32.76	26.64	17.32	28.98	47.74	74	-26.26	PK
V	17732	30.36	26.27	22.01	30.39	48.25	74	-25.75	Pk
H	17732	30.62	26.27	22.01	30.39	48.51	74	-25.49	PK
802.11n(40)									
V	3264	32.24	30.26	9.96	26.63	45.83	74	-28.17	Pk
H	3264	32.59	30.26	9.96	26.63	46.18	74	-27.82	PK
V	3336	32.28	30.33	9.96	26.66	45.91	74	-28.09	Pk
H	3336	33.65	30.33	9.96	26.66	47.28	74	-26.72	PK
V	4100	32.45	31.64	10.61	27.06	47.64	74	-26.36	Pk
H	4100	32.75	31.64	10.61	27.06	47.94	74	-26.06	PK
V	11764	32.56	26.64	17.32	28.98	47.54	74	-26.46	Pk
H	11764	32.46	26.64	17.32	28.98	47.44	74	-26.56	PK
V	17732	30.57	26.27	22.01	30.39	48.46	74	-25.54	Pk
H	17732	29.19	26.27	22.01	30.39	47.08	74	-26.92	PK

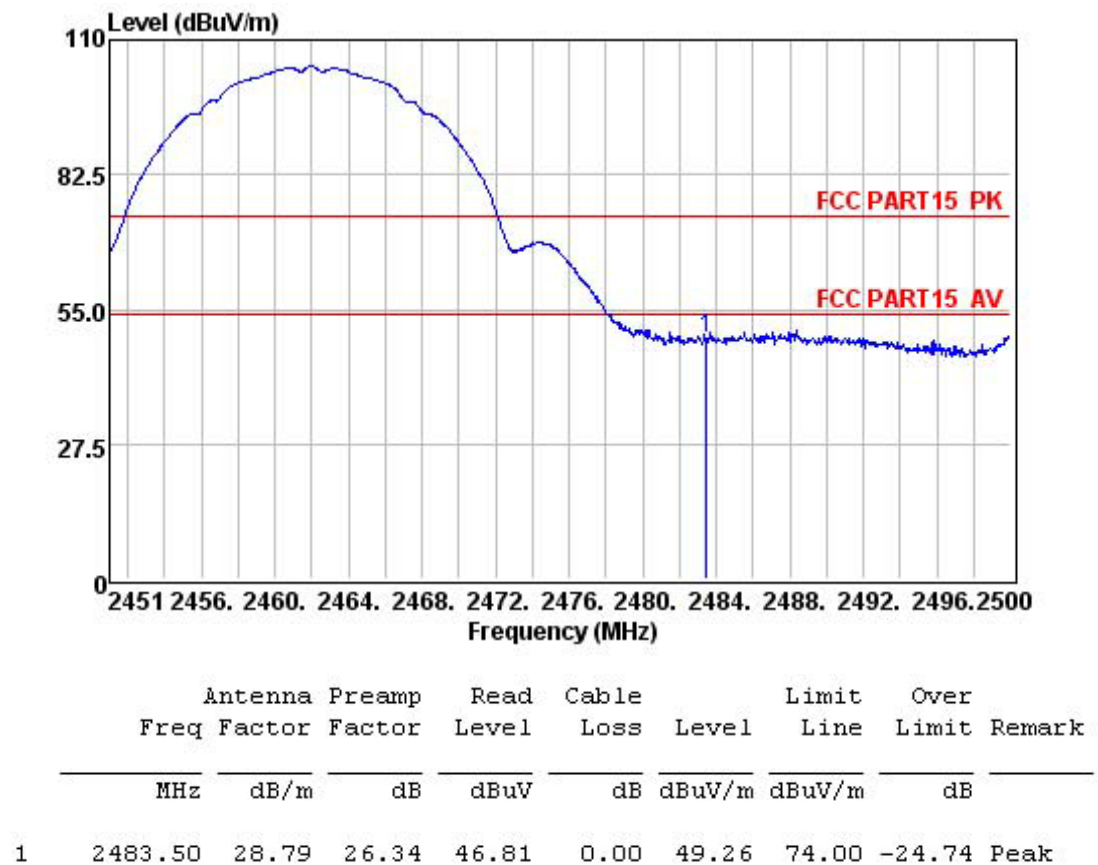
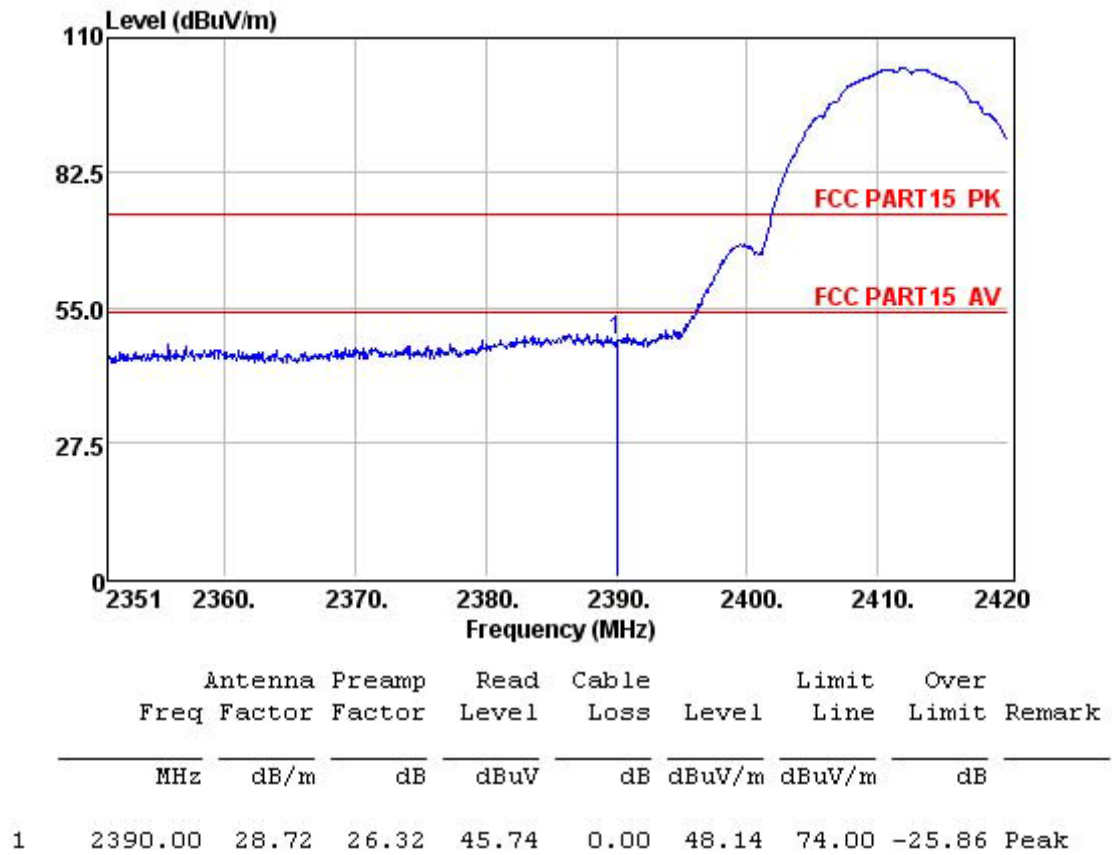
If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.

Spurious Emission in Band Edge:

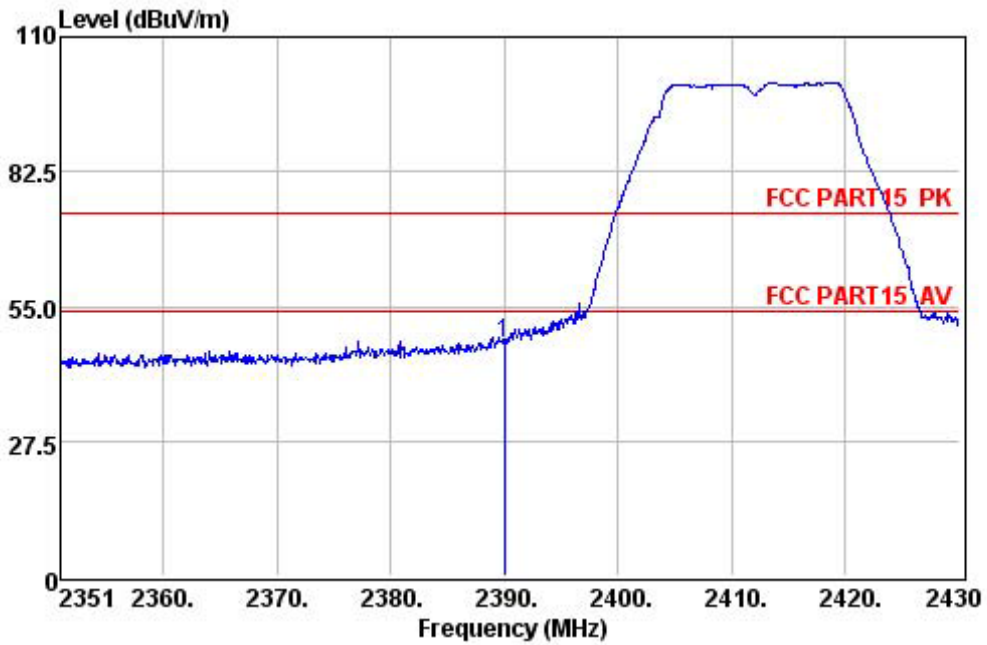
802.11b- Vertical



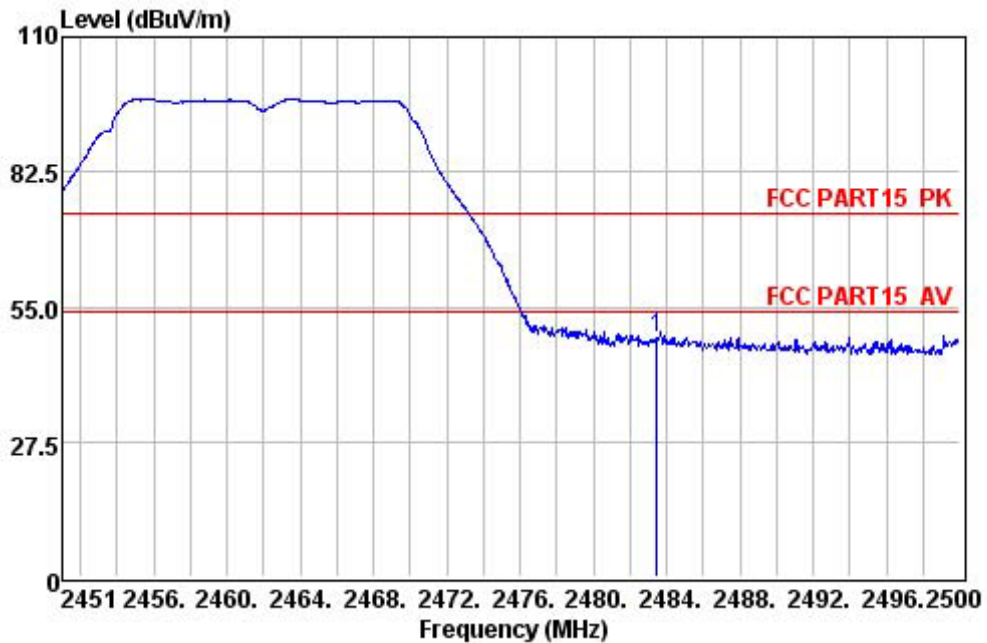
802.11b- Horizontal



802.11g- Vertical

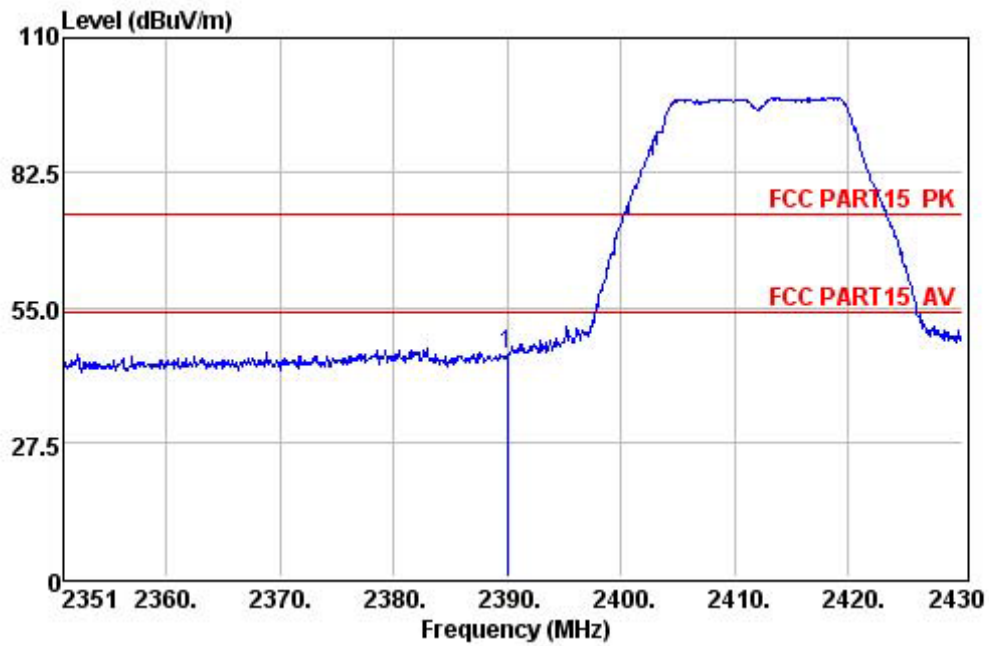


	Antenna Freq	Preamplifier Factor	Preamp Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dB	dBuV	dB	dBuV/m	dBuV/m	dB	
1	2390.00	28.72	26.32	44.88	0.00	47.28	74.00	-26.72	Peak

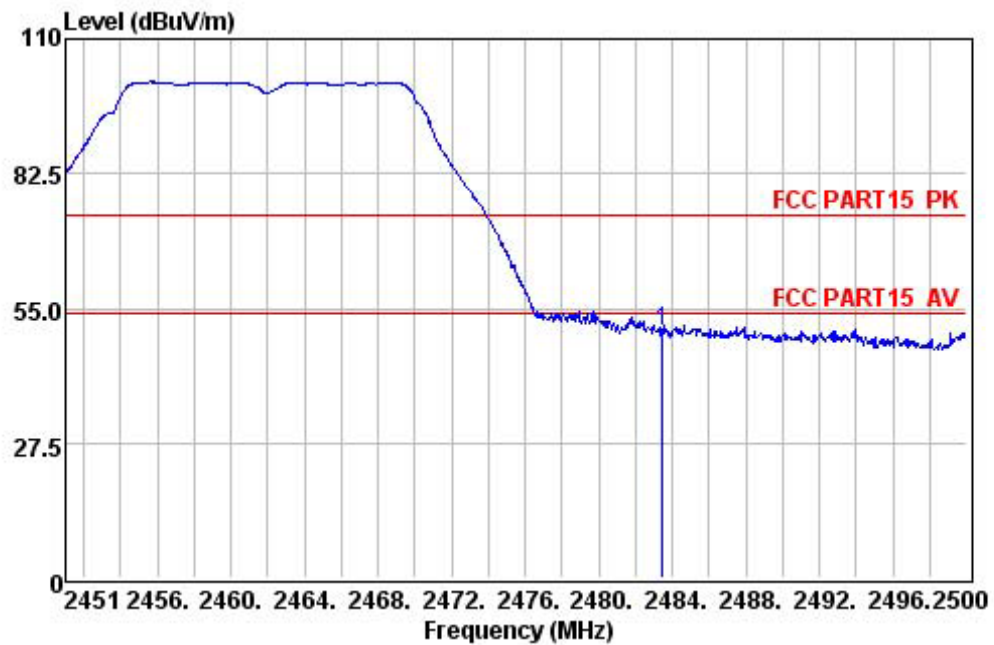


	Antenna Freq	Preamplifier Factor	Preamp Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dB	dBuV	dB	dBuV/m	dBuV/m	dB	
1	2483.50	28.79	26.34	46.11	0.00	48.56	74.00	-25.44	Peak

802.11g- Horizontal

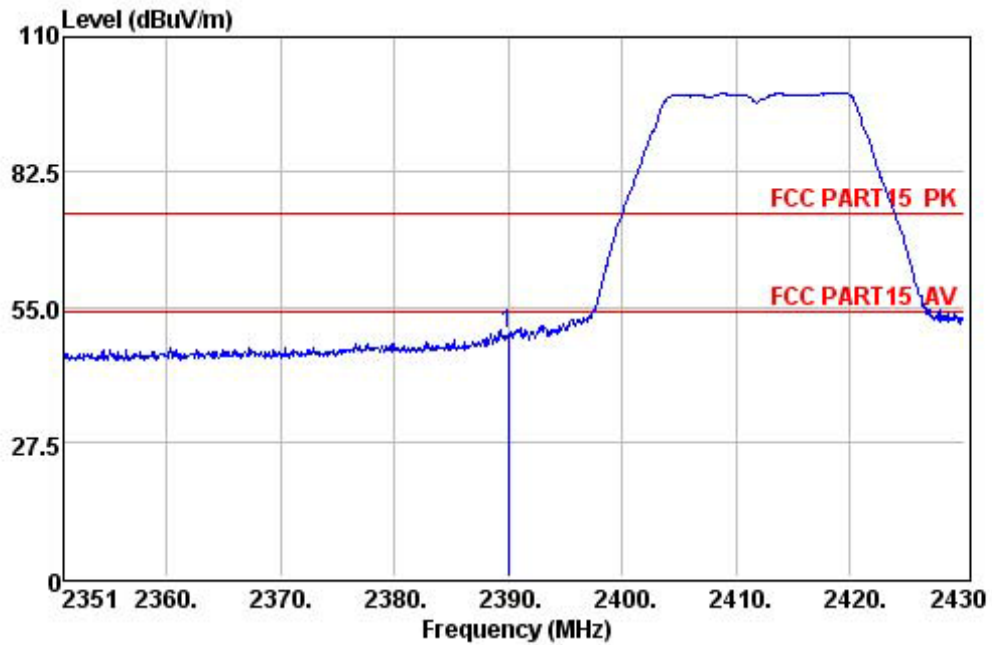


	Antenna Freq	Preamplifier Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	2390.00	28.72	26.32	42.98	0.00	45.38	74.00	-28.62 Peak

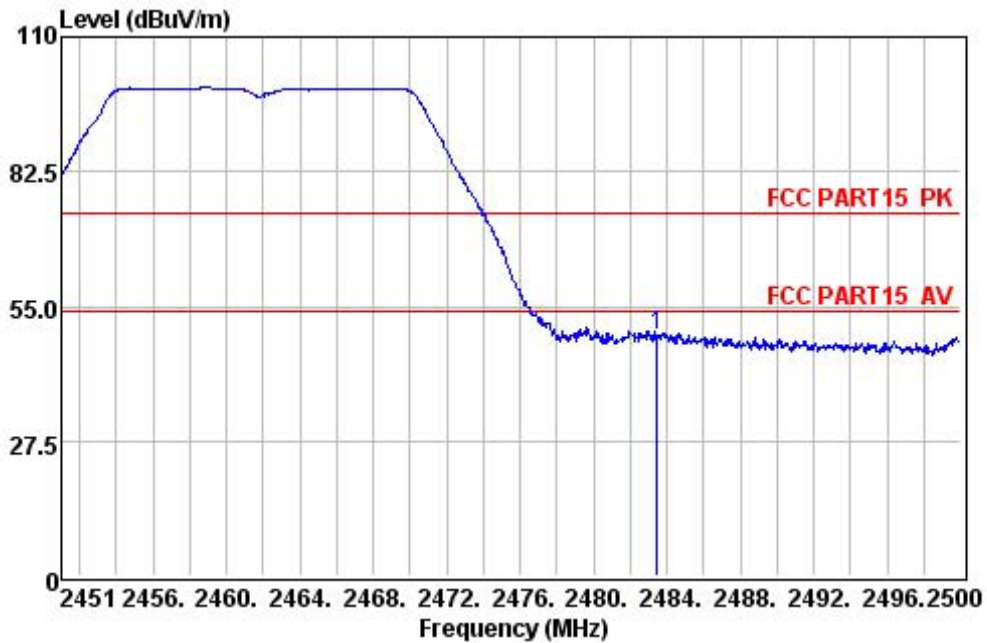


	Antenna Freq	Preamplifier Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	2483.50	28.79	26.34	47.73	0.00	50.18	74.00	-23.82 Peak

802.11n(20)- Vertical

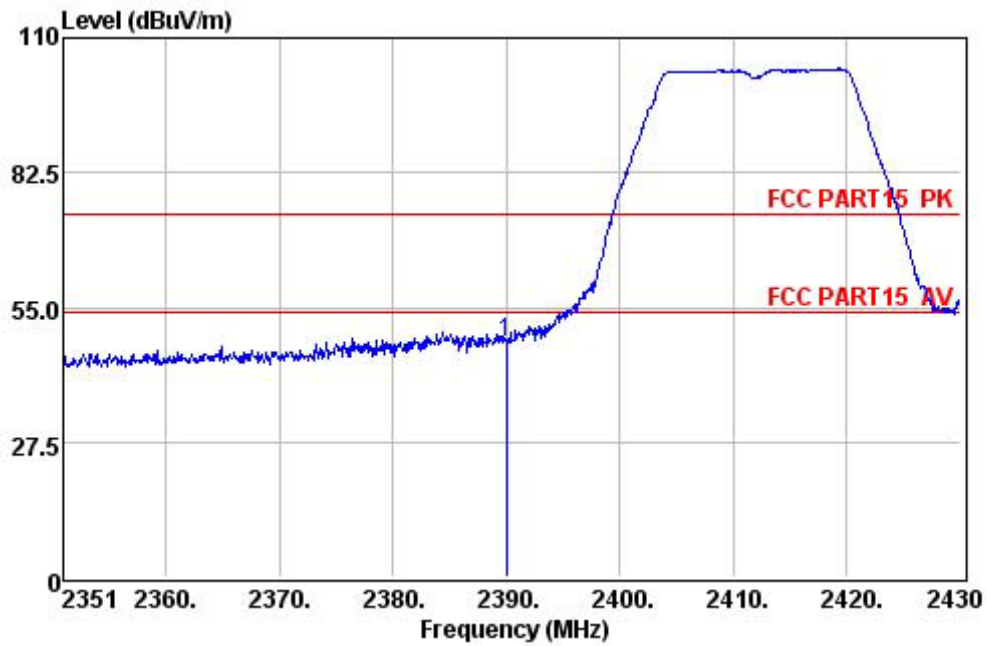


	Antenna Freq	Preamp Factor	Preamp Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dB	dBuV	dB	dBuV/m	dBuV/m	dB	
1	2390.00	28.72	26.32	46.97	0.00	49.37	74.00	-24.63	Peak

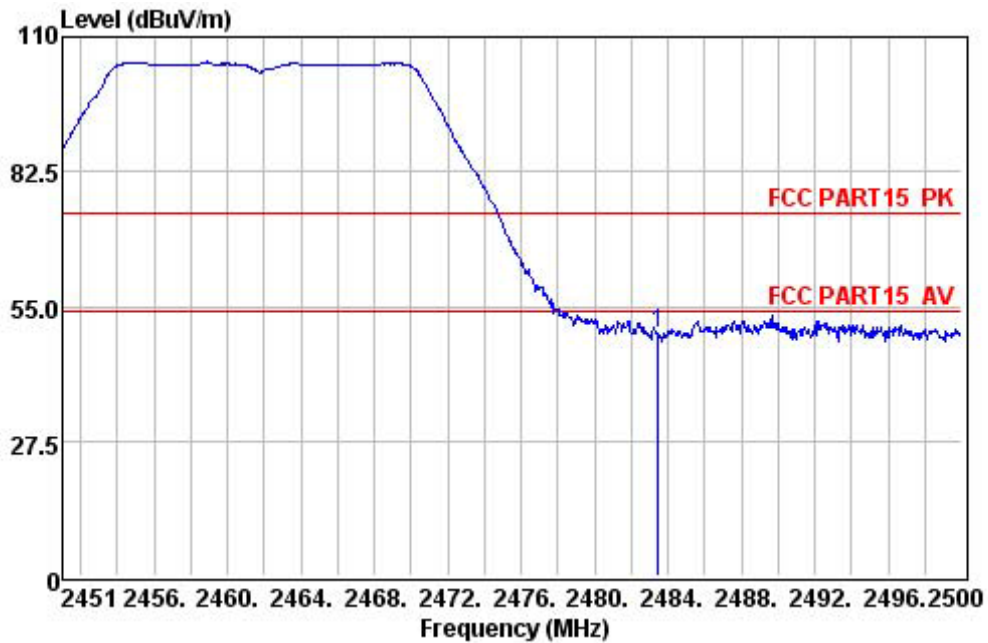


	Antenna Freq	Preamp Factor	Preamp Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dB	dBuV	dB	dBuV/m	dBuV/m	dB	
1	2483.50	28.79	26.34	46.71	0.00	49.16	74.00	-24.84	Peak

802.11n(20)- Horizontal

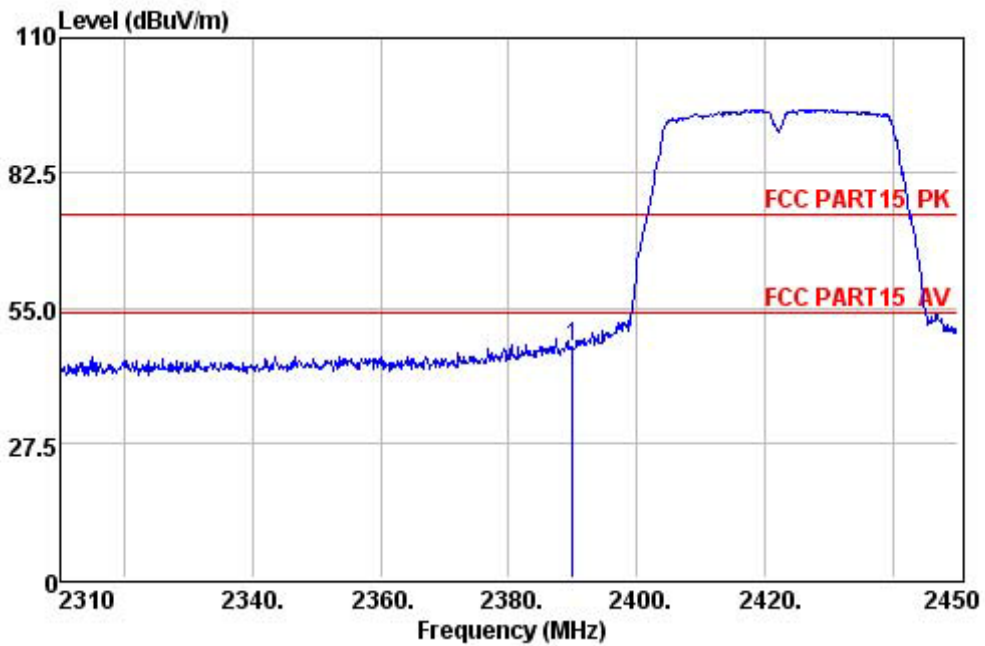


	Antenna Freq	Preamplifier Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	2390.00	28.72	26.32	45.44	0.00	47.84	74.00	-26.16 Peak

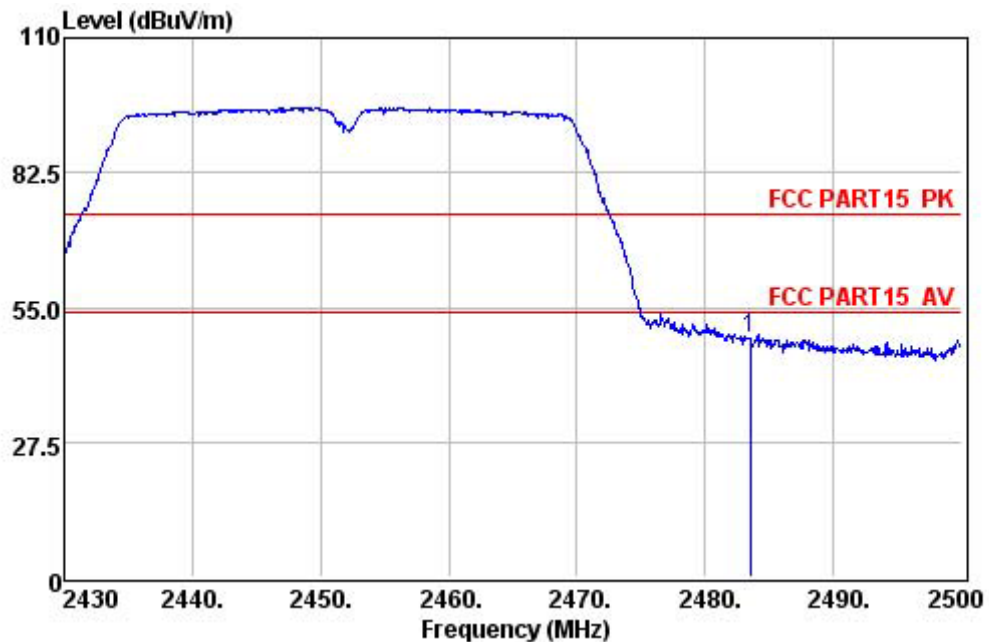


	Antenna Freq	Preamplifier Factor	Read Level	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	2483.50	28.79	26.34	46.87	0.00	49.32	74.00	-24.68 Peak

802.11n(40)- Vertical

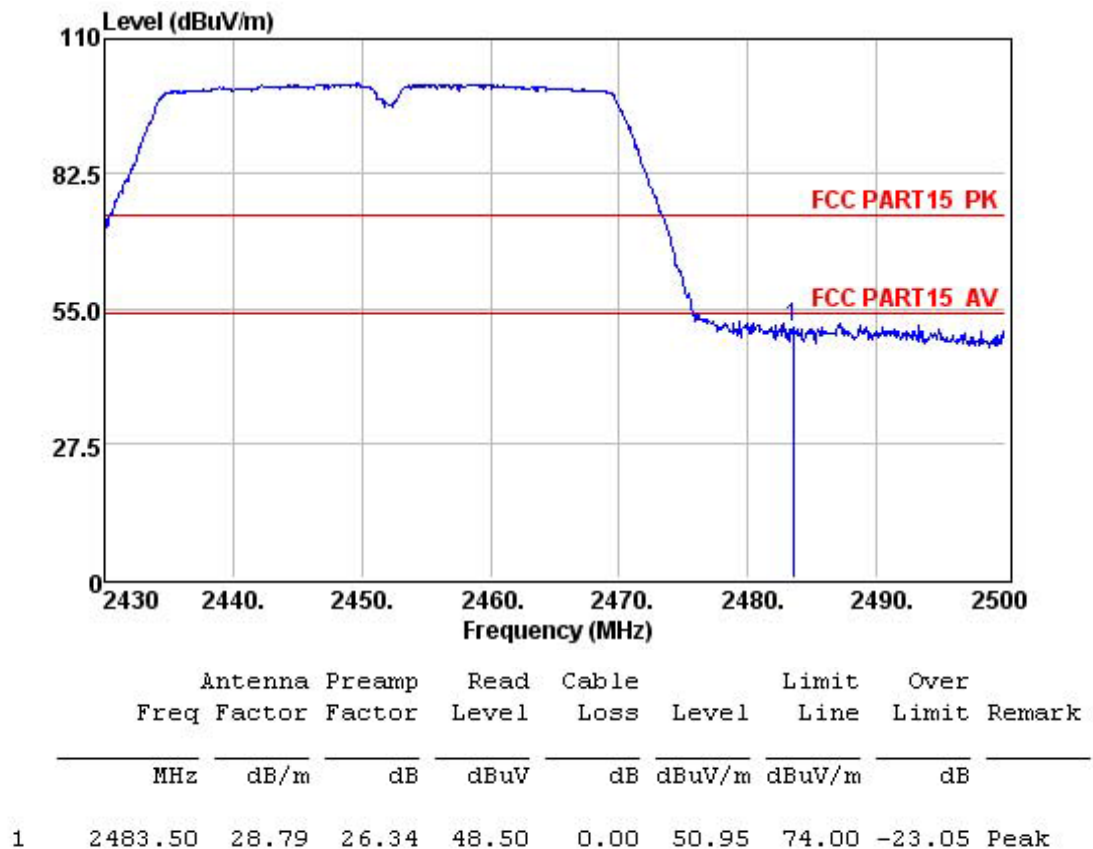
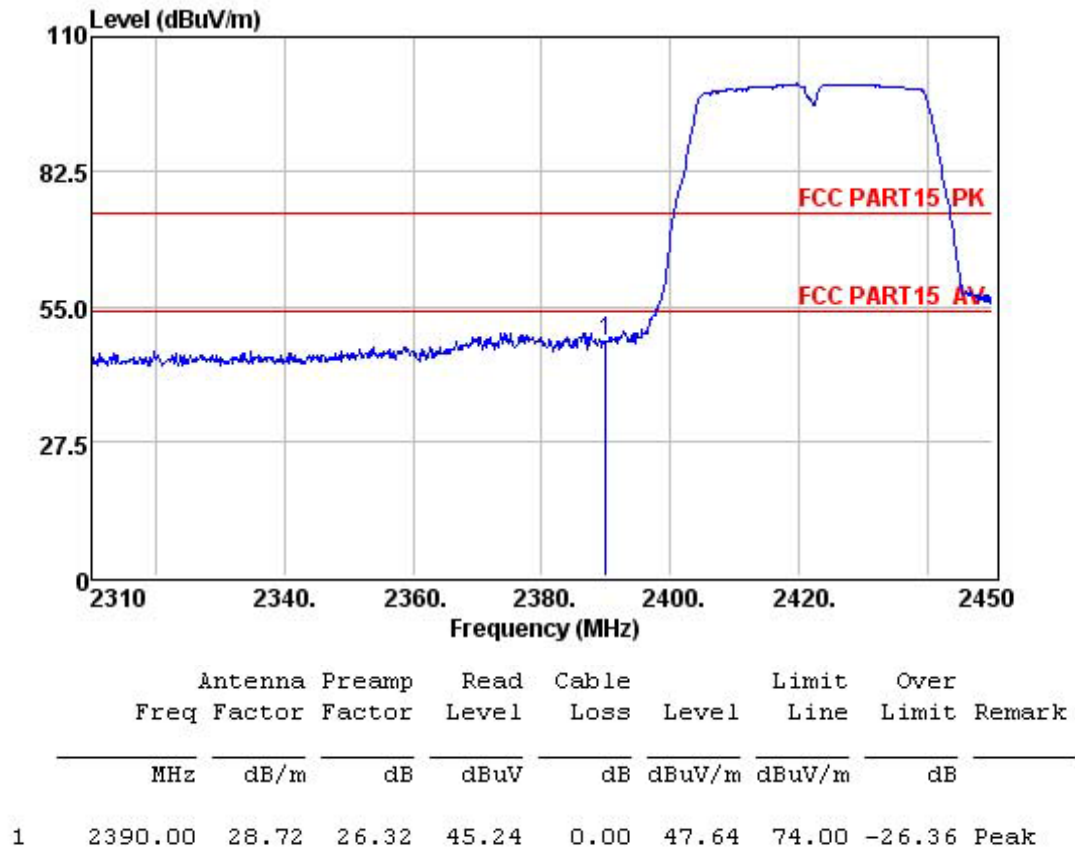


	Antenna Freq	Preamp Factor	Read Level	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dB/m	dB	dB	dBuV/m	dBuV/m	dB
1	2390.00	28.72	26.32	44.66	0.00	47.06	74.00 -26.94 Peak



	Antenna Freq	Preamp Factor	Read Level	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dB/m	dB	dB	dBuV/m	dBuV/m	dB
1	2483.50	28.79	26.34	46.12	0.00	48.57	74.00 -25.43 Peak

802.11n(40)- Horizontal

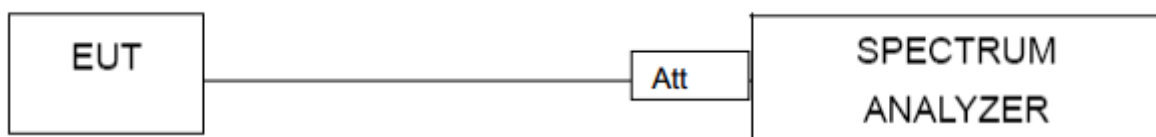


5. BAND EDGE COMPLIANCE TEST

5.1. Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see §15.205(c)).

5.2. Test setup



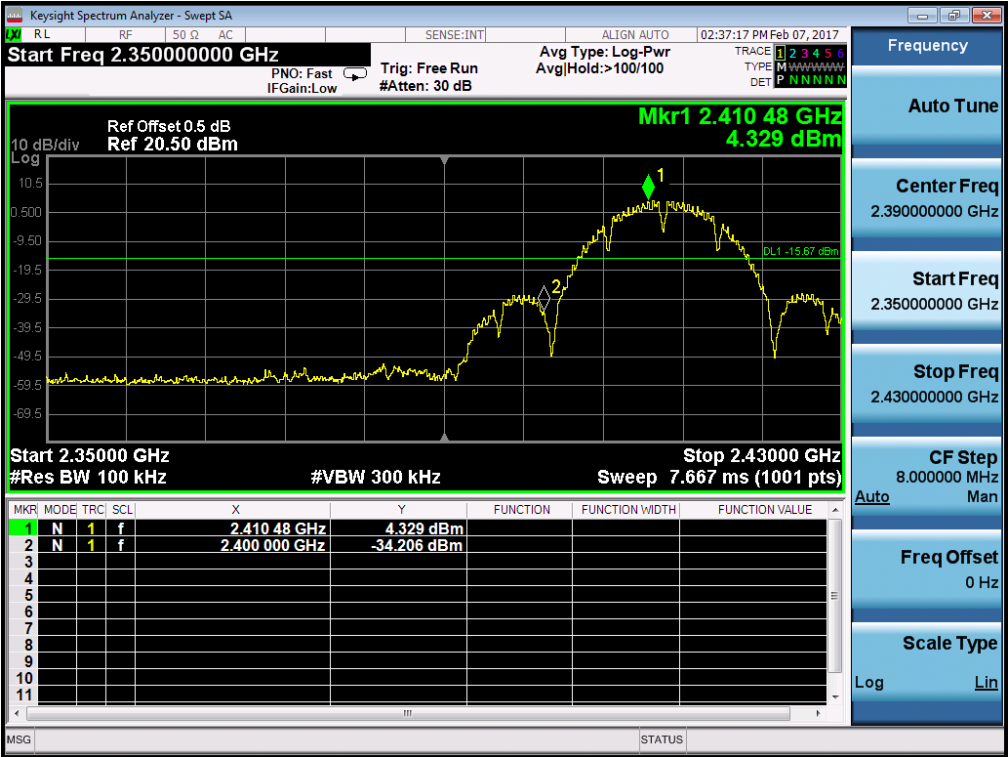
5.3. Test Procedure

- a) Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- b) Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
- c) Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
- d) Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
- e) Repeat above procedures until all measured frequencies were complete.

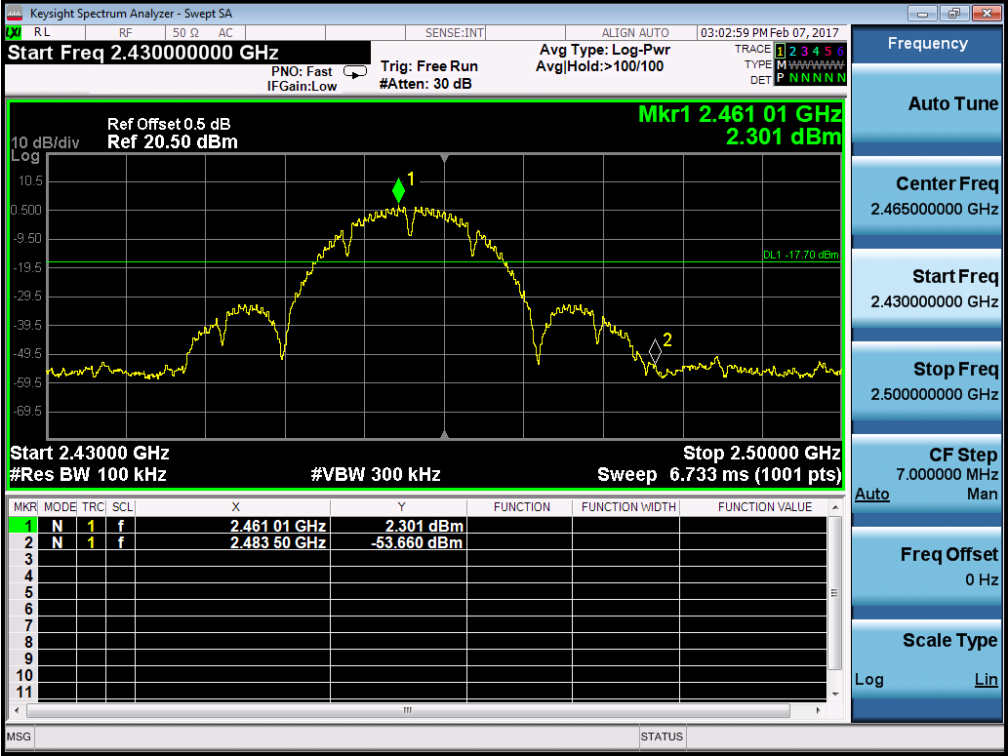
Conduction band-edge

Frequency Band MHz	Delta Peak to band emission (dBc)	> Limit (dBc)	Result
802.11b mode			
2400	38.535	20	Pass
2483.5	55.961	20	Pass
802.11g mode			
2400	26.705	20	Pass
2483.5	39.819	20	Pass
802.11n-HT20 mode			
2400	25.509	20	Pass
2483.5	37.123	20	Pass
802.11n-HT40 mode			
2400	27.152	20	Pass
2483.5	33.247	20	Pass

802.11b: Band Edge, Left Side



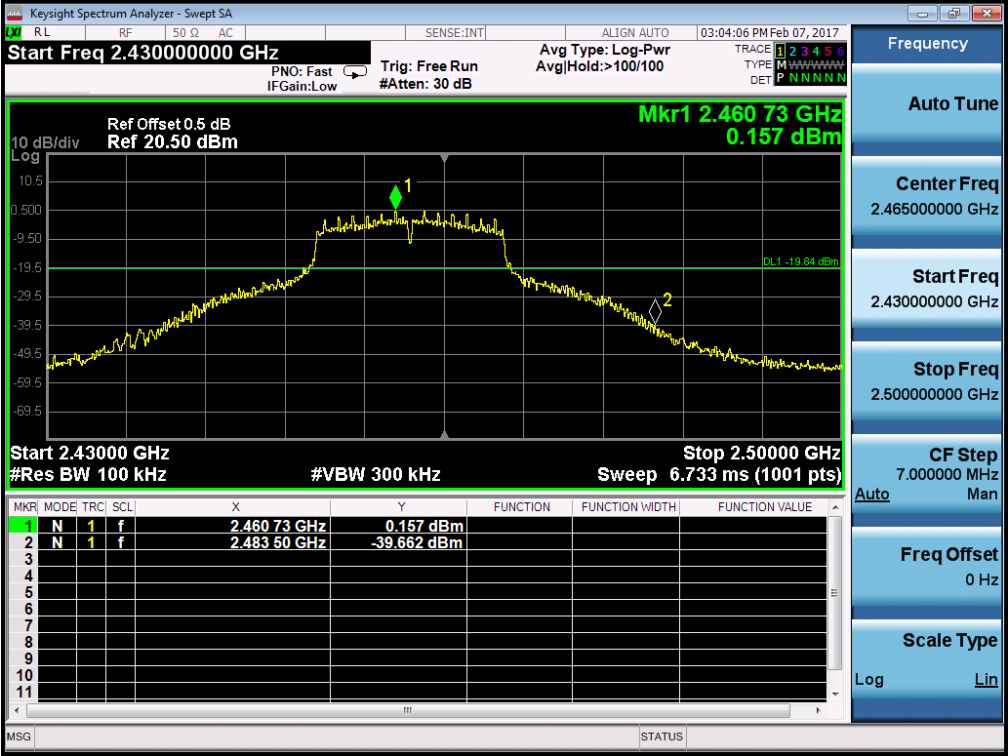
802.11b: Band Edge, Right Side



802.11g: Band Edge, Left Side



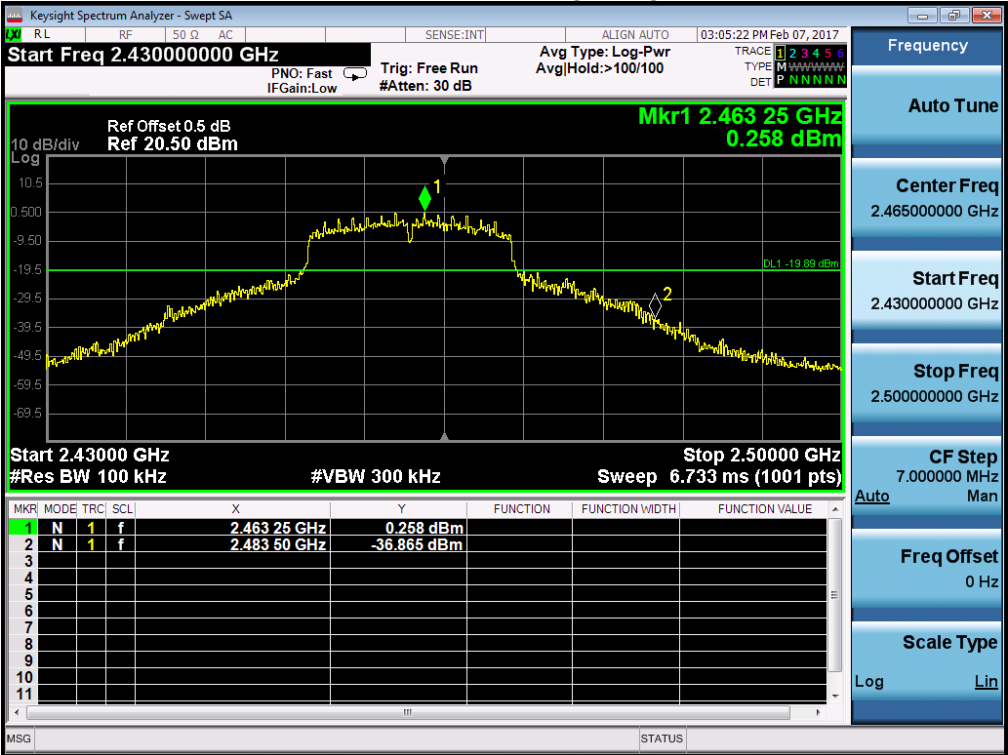
802.11g: Band Edge, Right Side



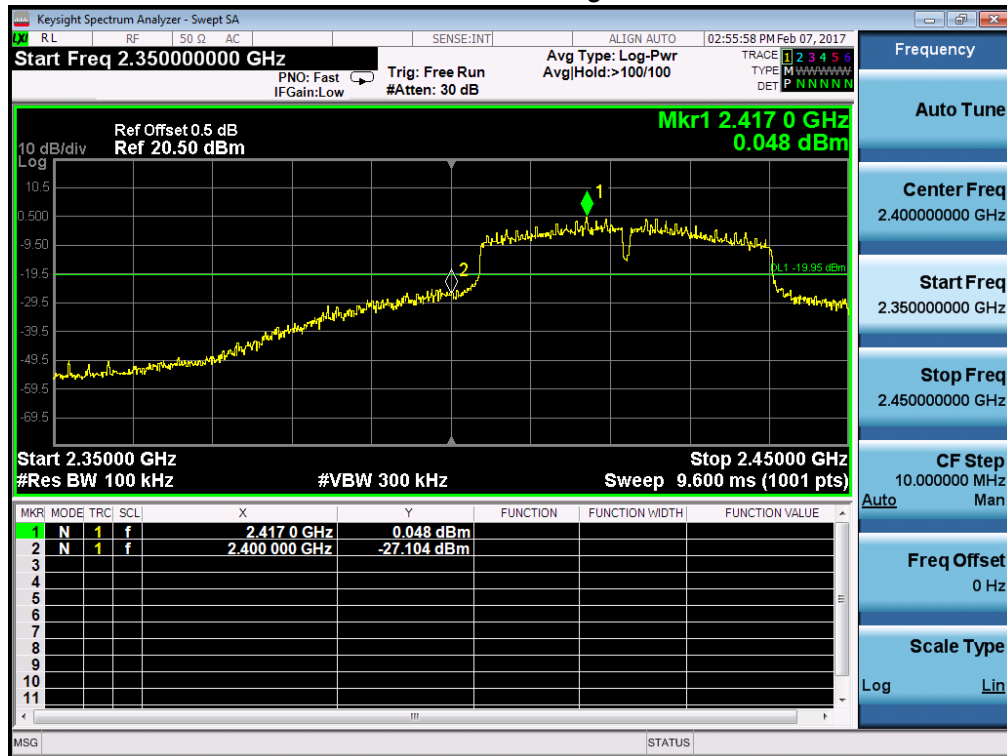
802.11n-HT20: Band Edge, Left Side



802.11n-HT20: Band Edge, Right Side



802.11n-HT40: Band Edge, Left Side



802.11n-HT40: Band Edge, Right Side



6. BANDWIDTH TEST

6.1. Limits

For direct sequence systems, the minimum 6dB bandwidth shall be at least 500kHz

6.2. Test Procedure

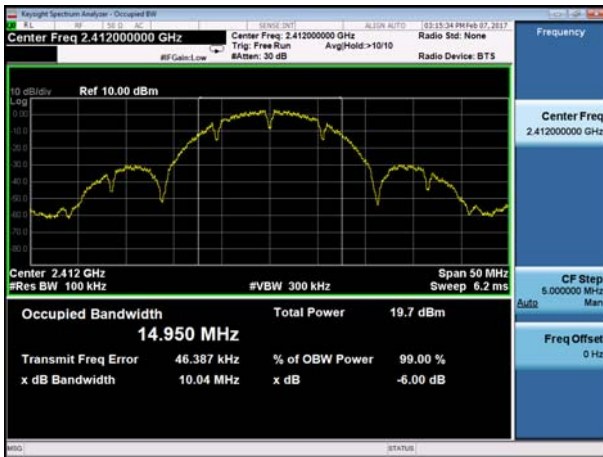
1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Test data:

	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
802.11b	2412	10.04	>0.5	Pass
	2437	9.15	>0.5	Pass
	2462	10.05	>0.5	Pass
802.11g	2412	15.10	>0.5	Pass
	2437	15.29	>0.5	Pass
	2462	15.13	>0.5	Pass
802.11n (HT20)	2412	15.10	>0.5	Pass
	2437	16.06	>0.5	Pass
	2462	15.72	>0.5	Pass
802.11n (HT40)	2422	31.28	>0.5	Pass
	2437	32.54	>0.5	Pass
	2452	35.27	>0.5	Pass

Test plot as follows:
6dB bandwidth

802.11b 2412MHz



802.11g 2412MHz



802.11b 2437MHz



802.11g 2437MHz



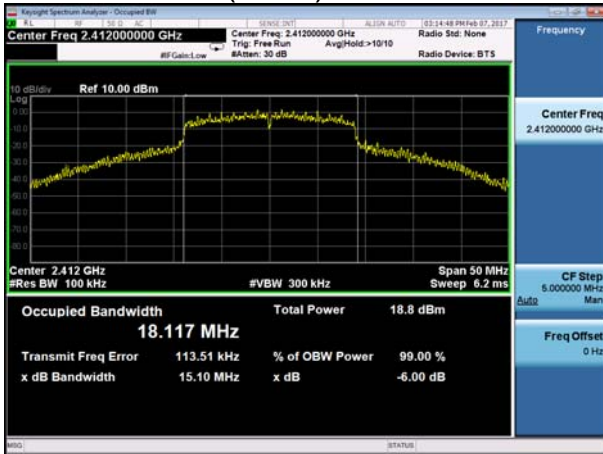
802.11b 2462MHz



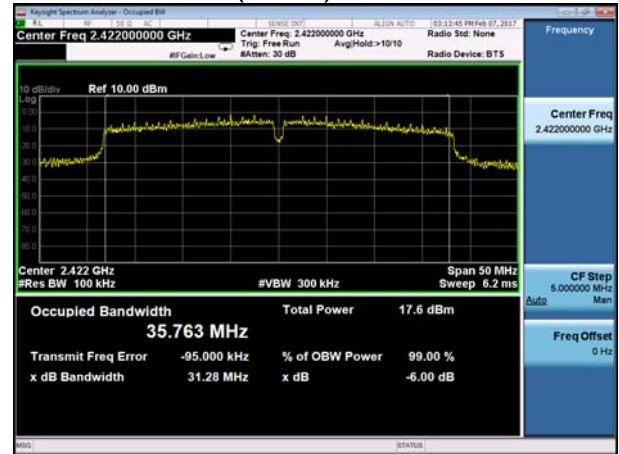
802.11g 2462MHz



802.11n (HT20) 2412MHz



802.11n (HT40) 2422MHz



802.11n (HT20) 2437MHz



802.11n (HT40) 2437MHz



802.11n(HT20) 2462MHz



802.11n (HT40)2452MHz



7. OUTPUT POWER TEST

7.1. Limits

For systems using digital modulation in the 2400~2483.5MHz, The output power shall not exceed 1W (30dBm)

7.2. Test setup

1. The Transmitter output (antenna port) was connected to the power meter.
2. Turn on the EUT and power meter and then record the power value.
3. Repeat above procedures on all channels needed to be tested.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.



7.3. Test result

Test Channel	Frequency	Maximum Conducted Output Power	LIMIT
	(MHz)	(dBm)	dBm
TX 802.11b Mode			
CH01	2412	11.11	30
CH06	2437	11.13	30
CH11	2462	11.17	30
TX 802.11g Mode			
CH01	2412	10.21	30
CH06	2437	10.25	30
CH11	2462	10.39	30
TX 802.11n(20) Mode			
CH01	2412	9.37	30
CH06	2437	9.25	30
CH11	2462	9.38	30
TX 802.11n(40) Mode			
CH03	2422	8.28	30
CH06	2437	8.27	30
CH09	2452	8.14	30

Note: For power test the duty cycle is 100% in continuous transmitting mode.

8. DUTY CYCLE

8.1. Test Procedure

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set $RBW \geq OBW$ if possible; otherwise, set RBW to the largest available value. Set $VBW \geq RBW$. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are $> 50/T$ and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if $T \leq 16.7$ microseconds.)

The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.

The path loss was compensated to the results for each measurement.

Set to the maximum power setting and enable the EUT transmit continuously.

The EUT was operating in controlled its channel.

Use the following spectrum analyzer settings:

Span = Zero Span

RBW = 8MHz

VBW = 50MHz

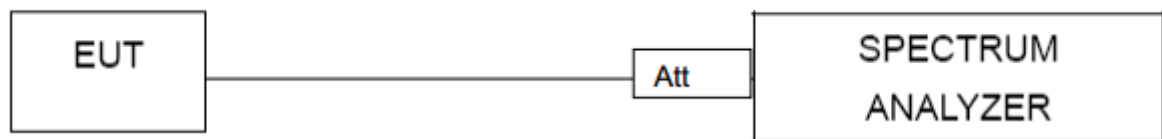
Number of points in Sweep > 100

Detector function = peak

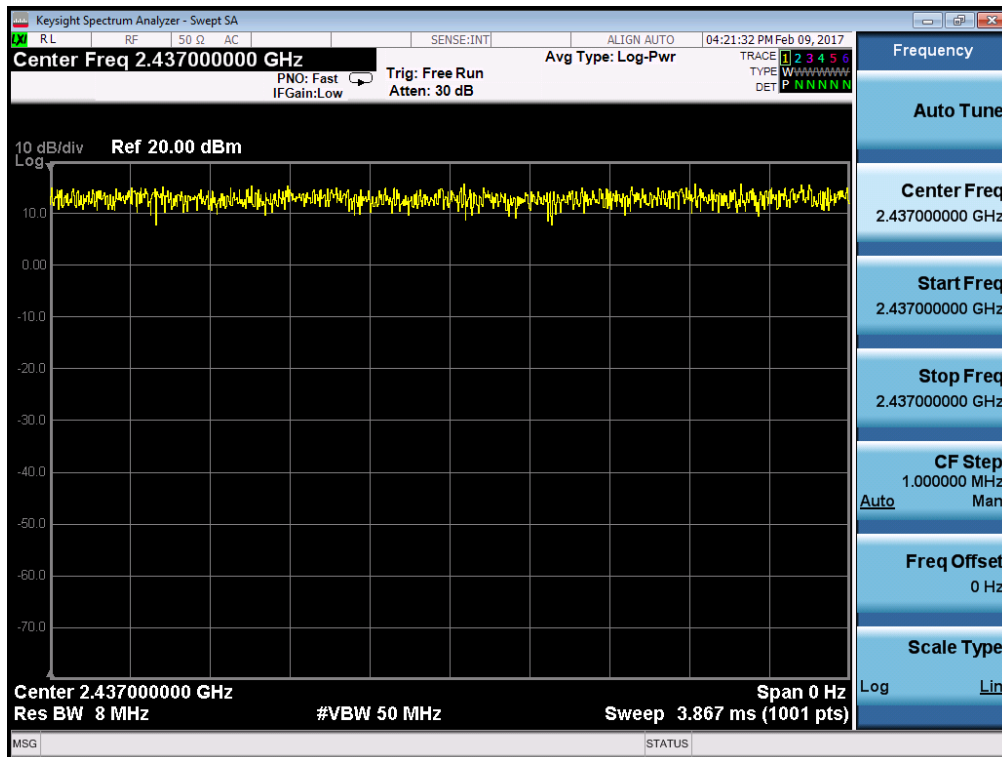
Trace = Clear write Measure T_{total} and T_{on}

Calculate Duty Cycle = T_{on} / T_{total} and Duty Cycle Factor = $10 \cdot \log(1/\text{Duty Cycle})$

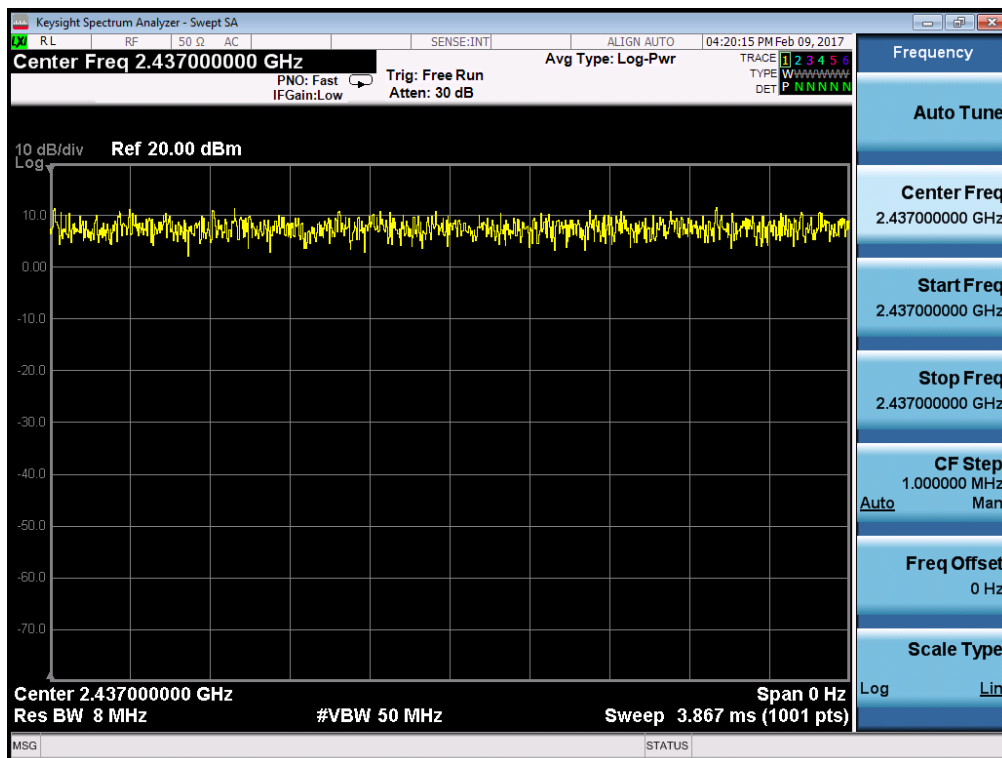
8.2. Test Setup



Test plot of Duty Cycle for 802.11b



Test plot of Duty Cycle for 802.11g



9. POWER SPECTRAL DENSITY TEST

9.1. Limits

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

9.2. Test setup

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
4. Set the VBW $\geq 3 \text{ RBW}$.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

9.3. Test result

	Channel Frequency (MHz)	Power density (dBm/3kHz)	Limit (dBm/3kHz)	Result
802.11b	2412	-11.674	8	Pass
	2437	-12.993	8	Pass
	2462	-14.188	8	Pass
802.11g	2412	-13.232	8	Pass
	2437	-14.744	8	Pass
	2462	-16.870	8	Pass
802.11n (HT20)	2412	-11.996	8	Pass
	2437	-13.546	8	Pass
	2462	-14.865	8	Pass
802.11n (HT40)	2422	-16.965	8	Pass
	2437	-17.440	8	Pass
	2452	-18.531	8	Pass

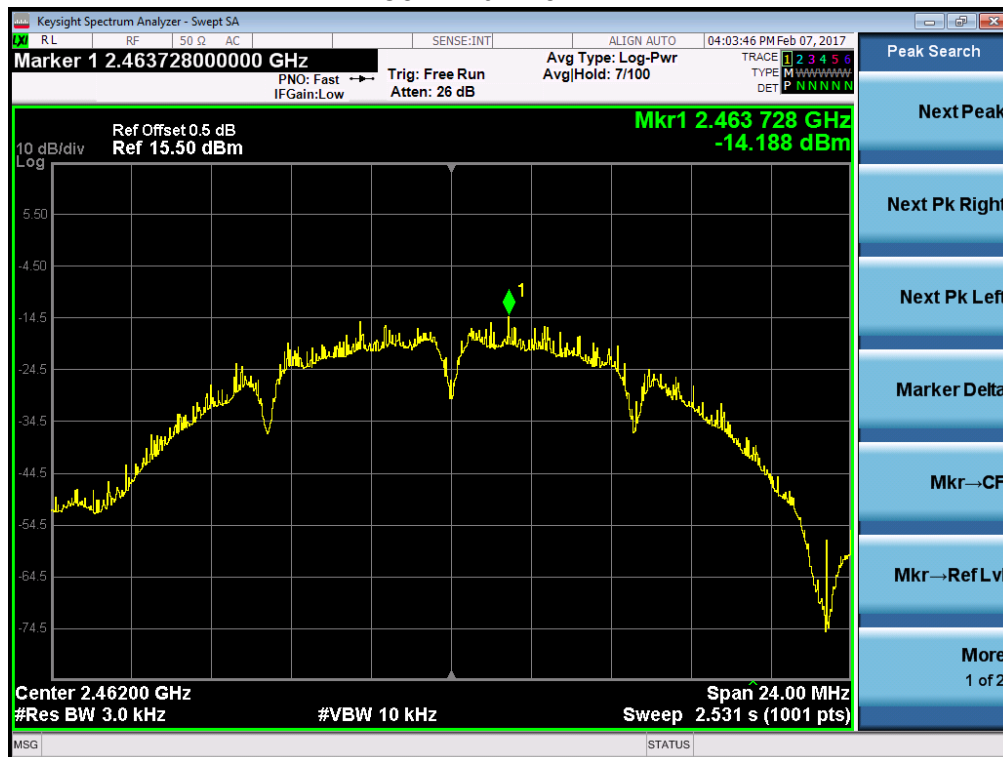
802.11b 2412MHz



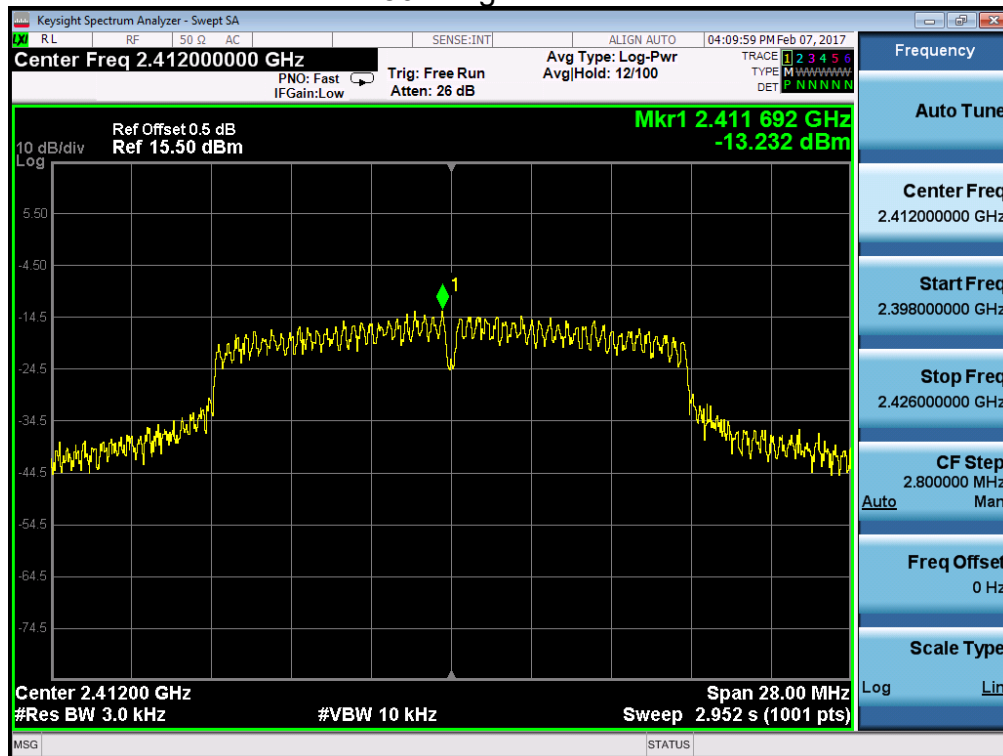
802.11b 2437MHz



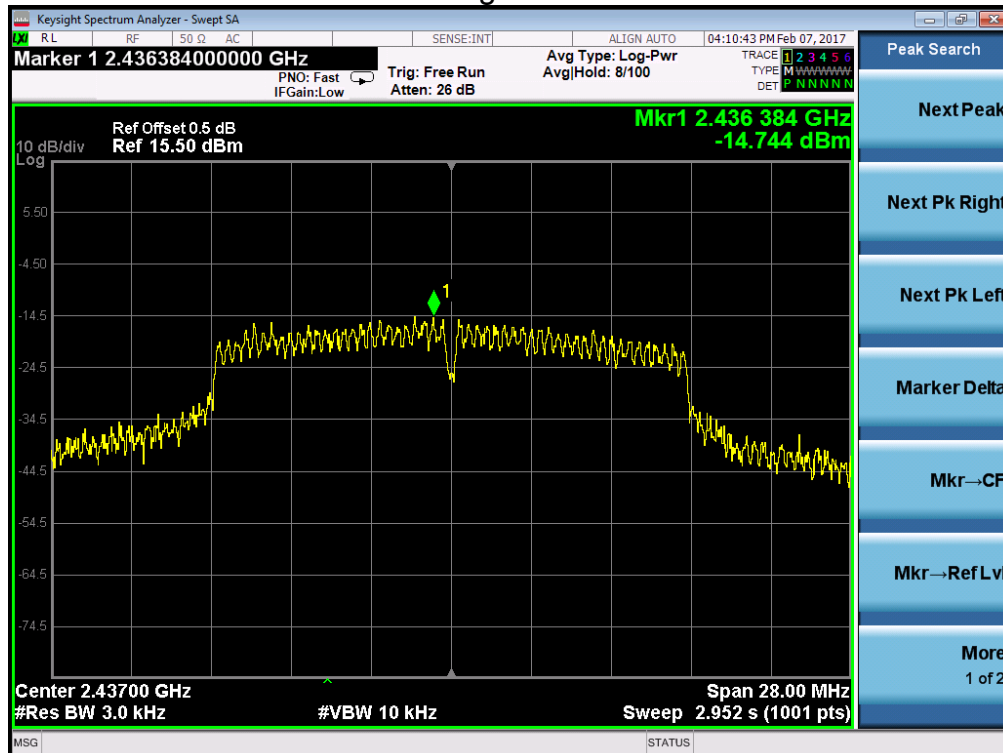
802.11b 2462MHz



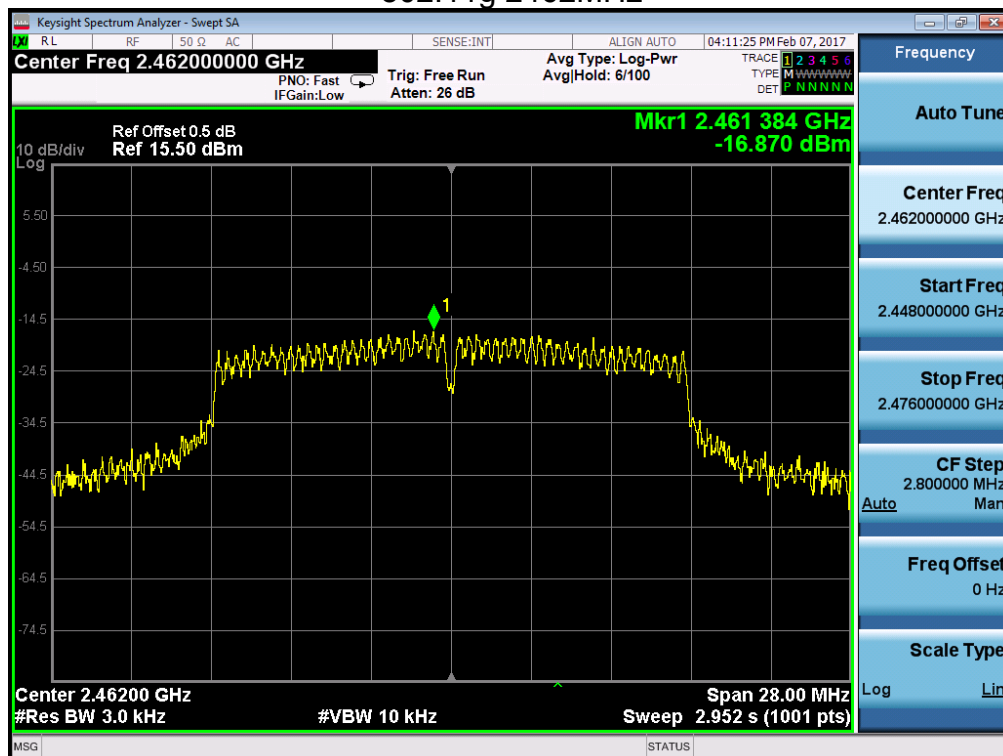
802.11g 2412MHz



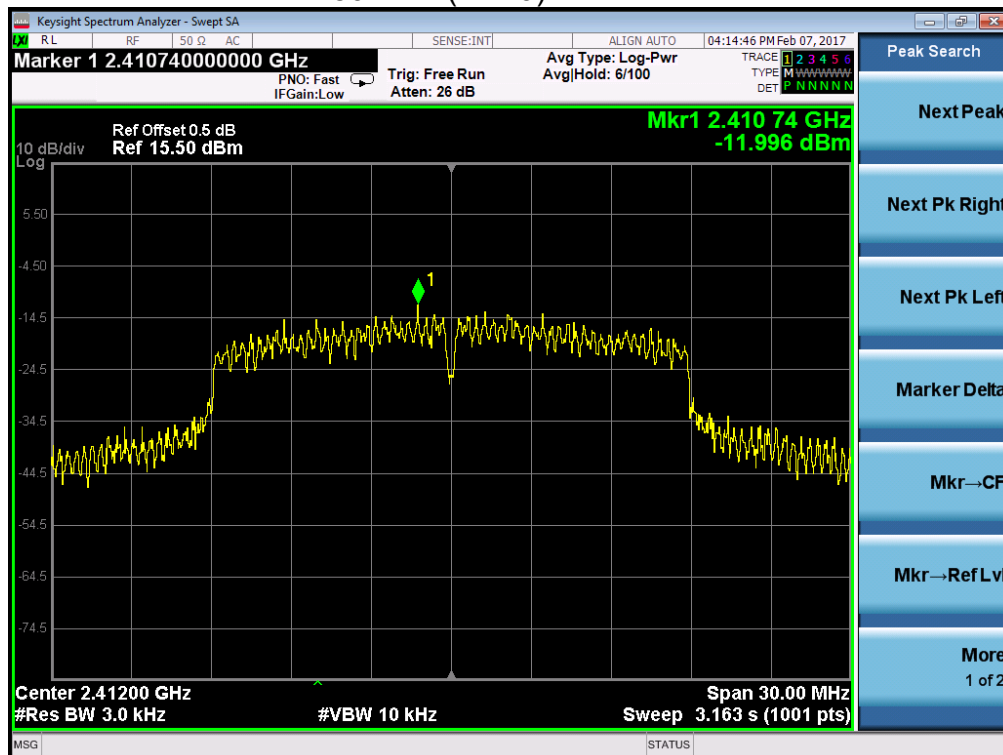
802.11g 2437MHz



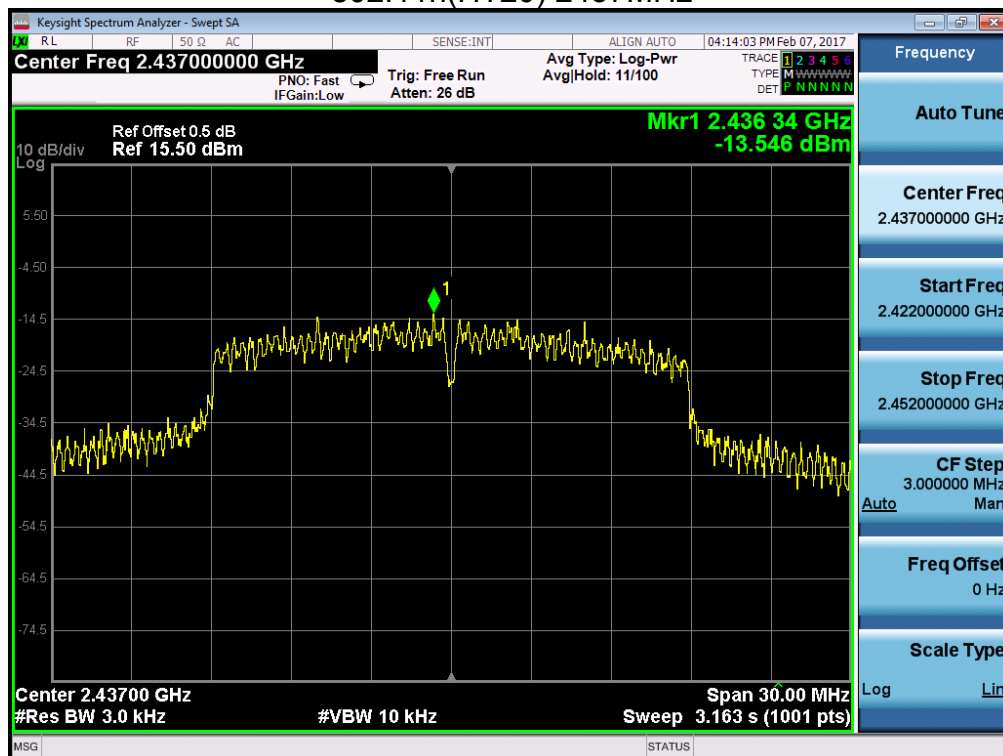
802.11g 2462MHz



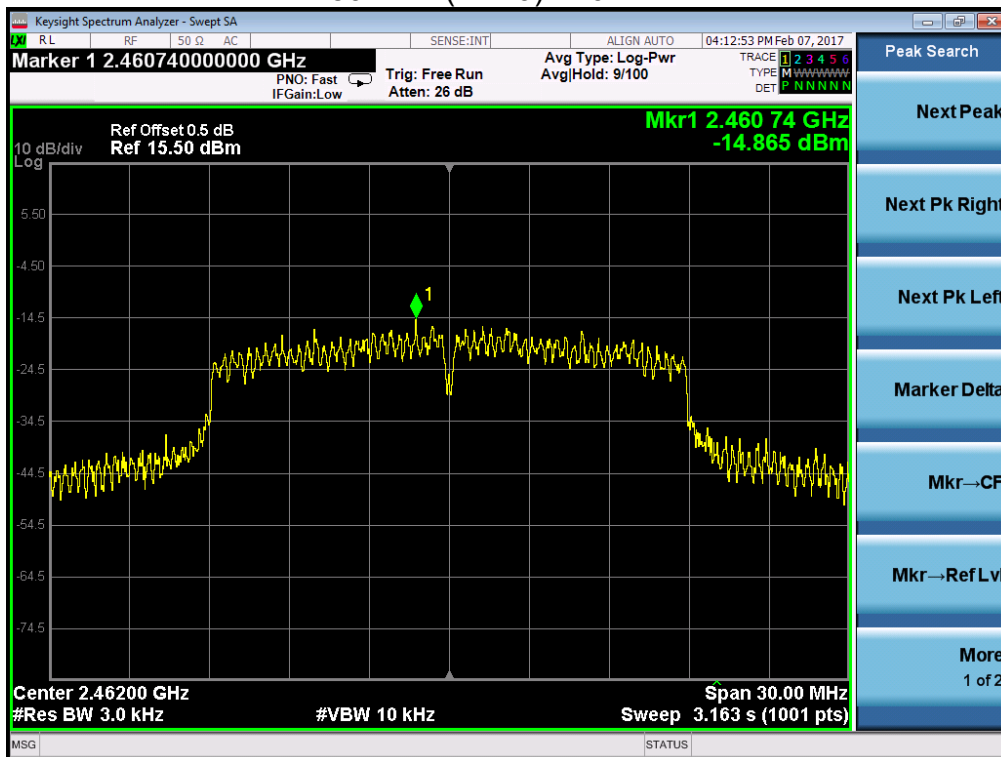
802.11n(HT20) 2412MHz



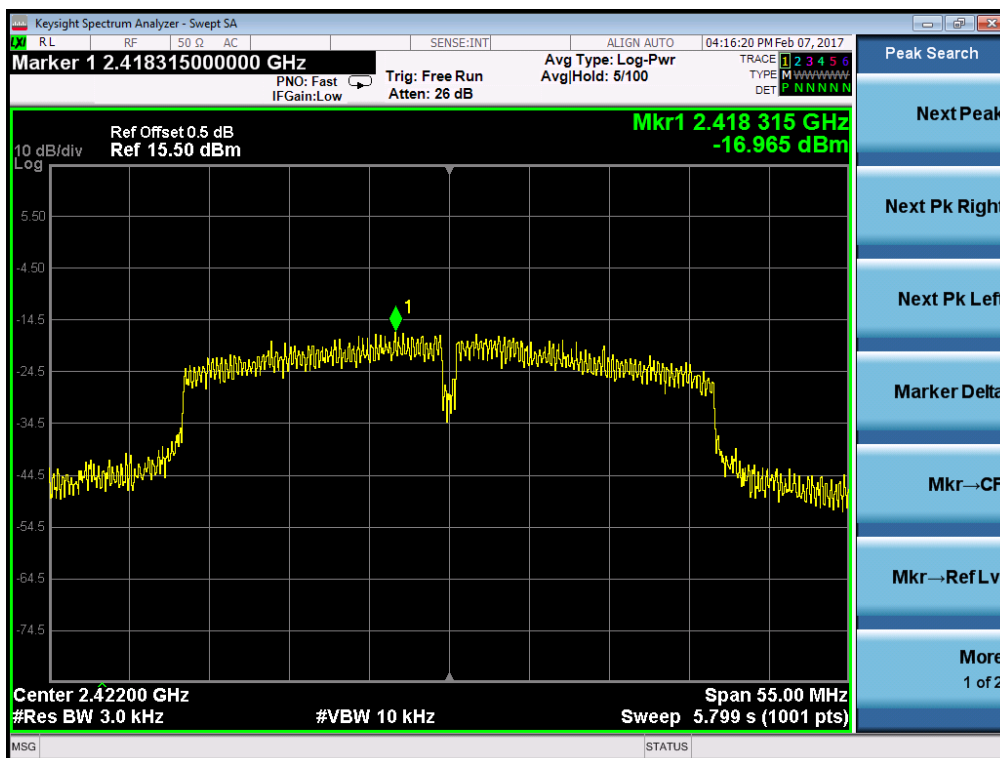
802.11n(HT20) 2437MHz



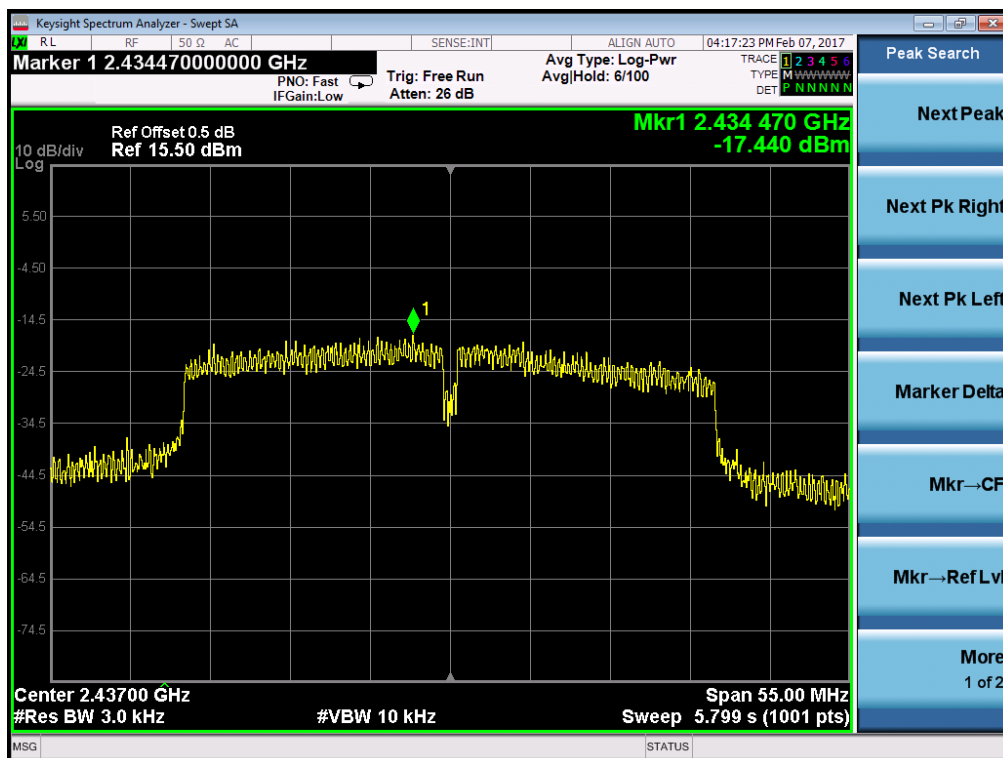
802.11n(HT20) 2462MHz



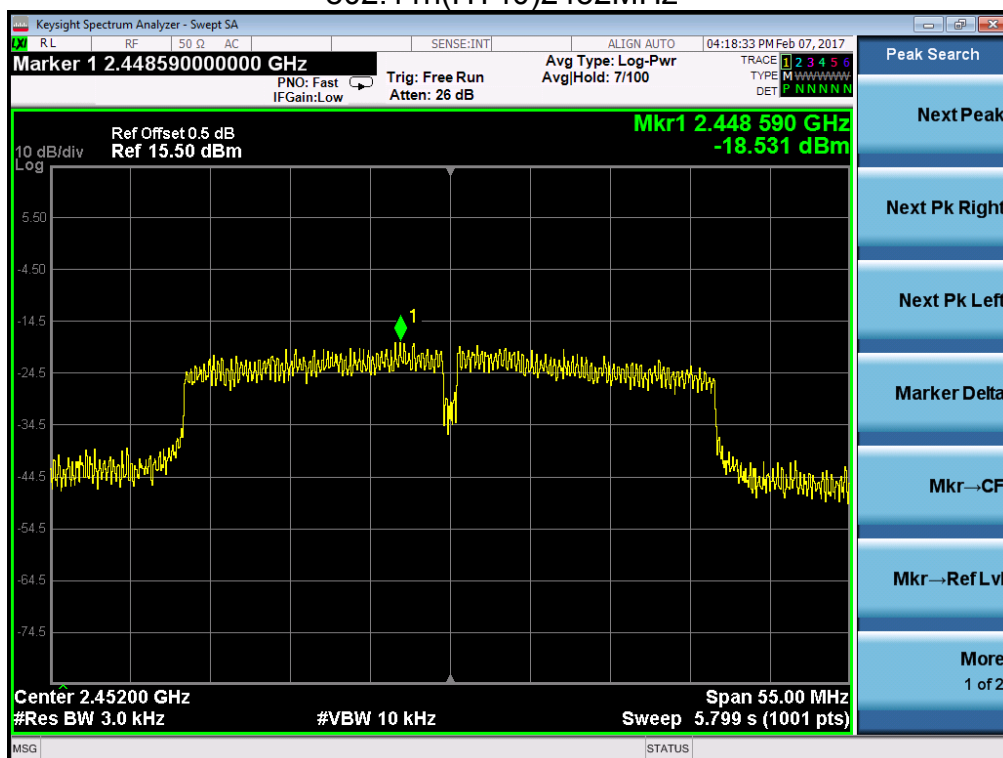
802.11n(HT40) 2422MHz



802.11n(HT40) 2437MHz



802.11n(HT40)2452MHz



10. ANTENNA REQUIREMENTS

10.1. Limits

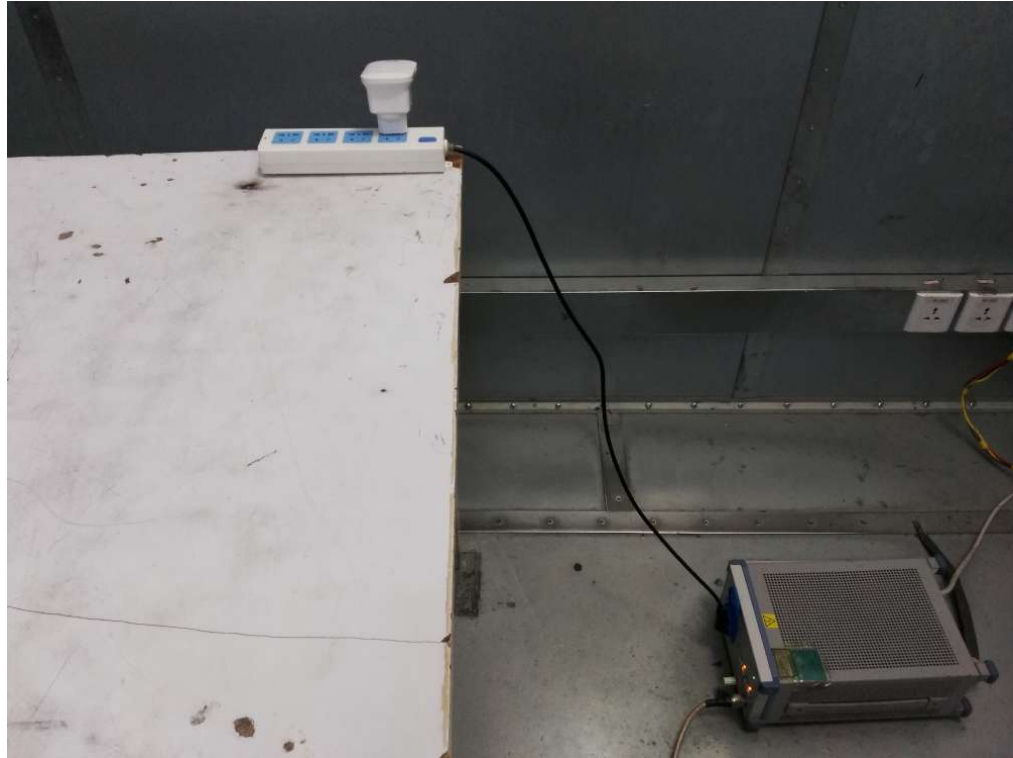
For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

10.2. Result

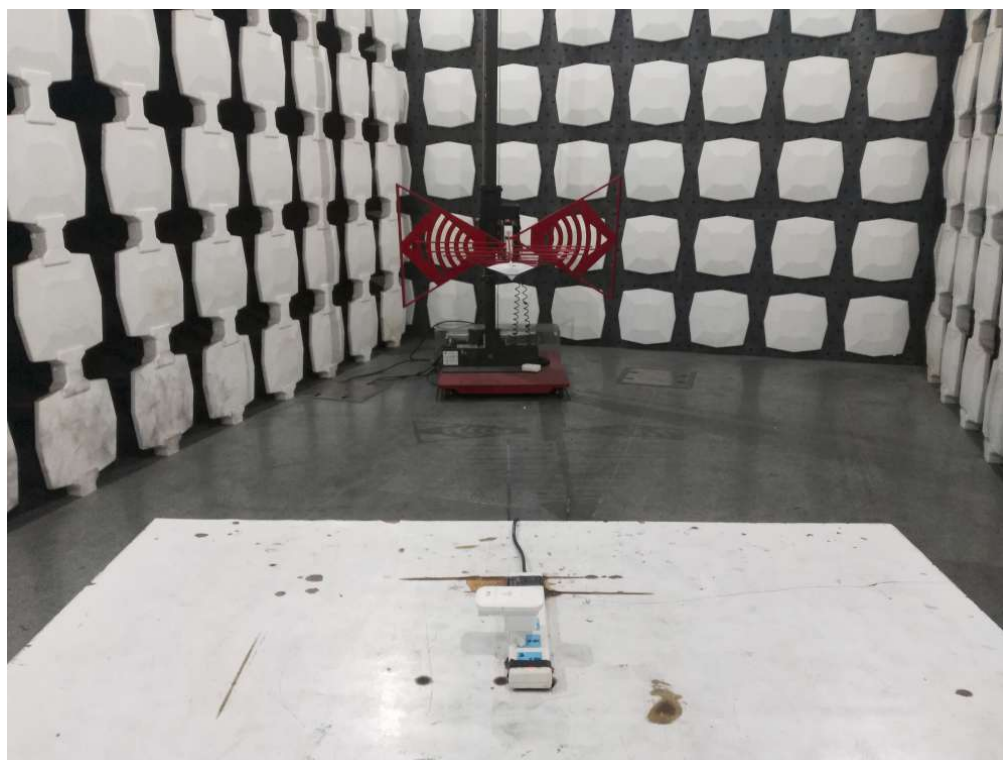
The antennas used for this product is PIFA antenna and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is 2.86dBi.

11. PHOTOGRAPHS OF TEST SET-UP

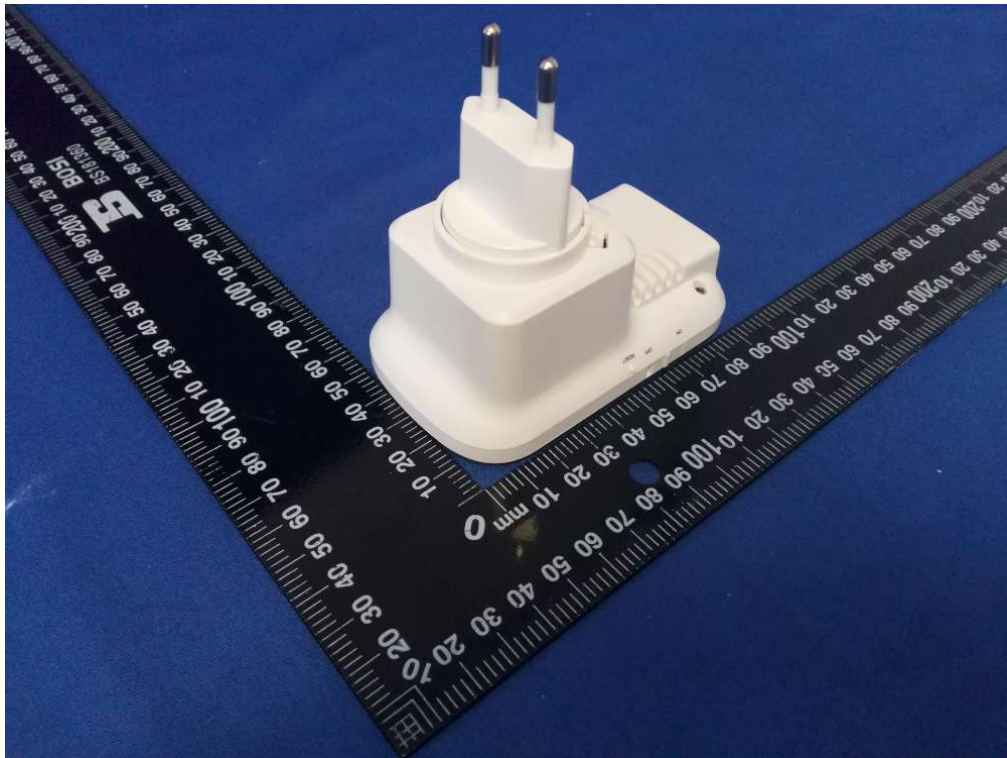
Conducted Emission



Radiated Emission Test



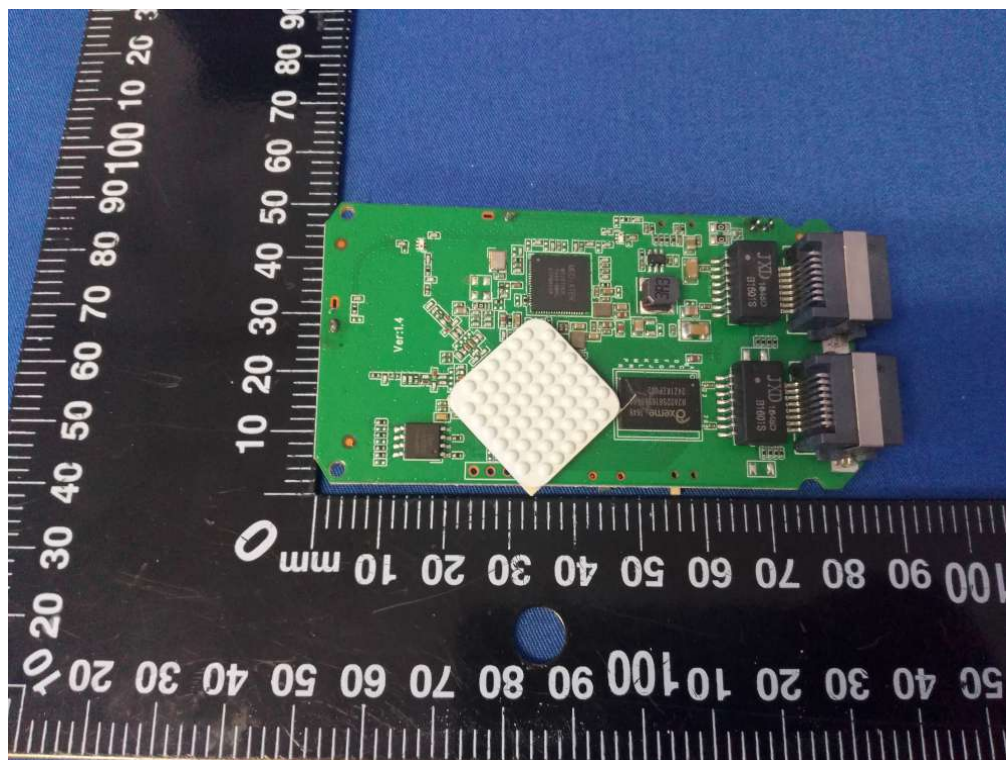
12. PHOTOGRAPHS OF THE EUT

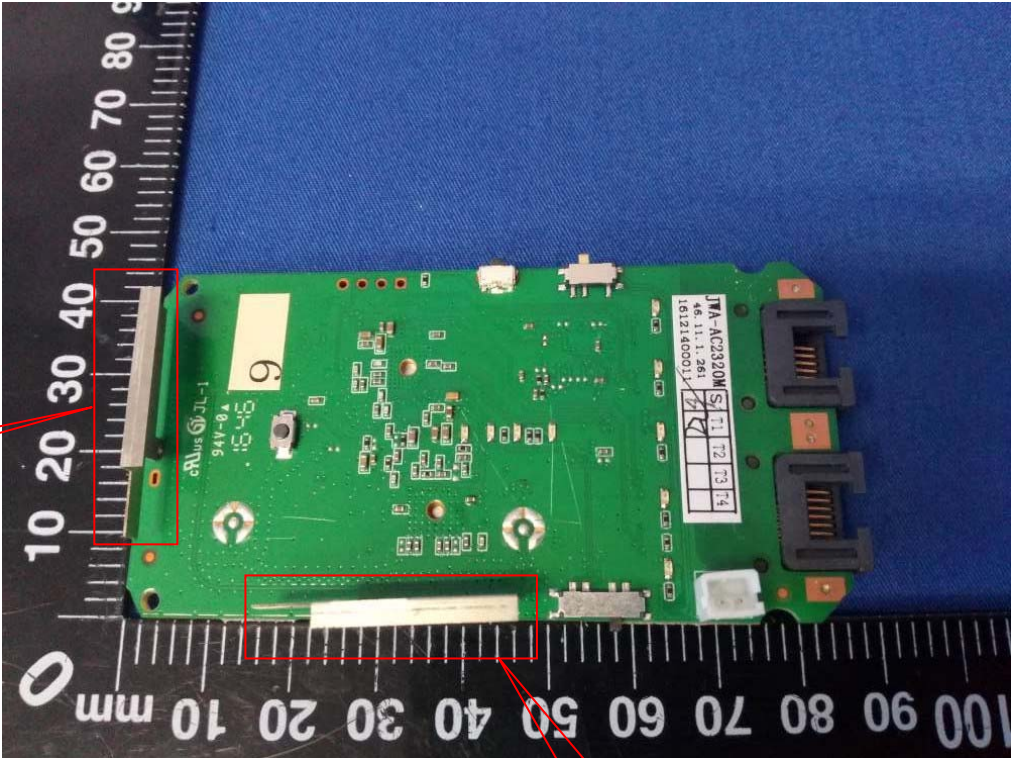






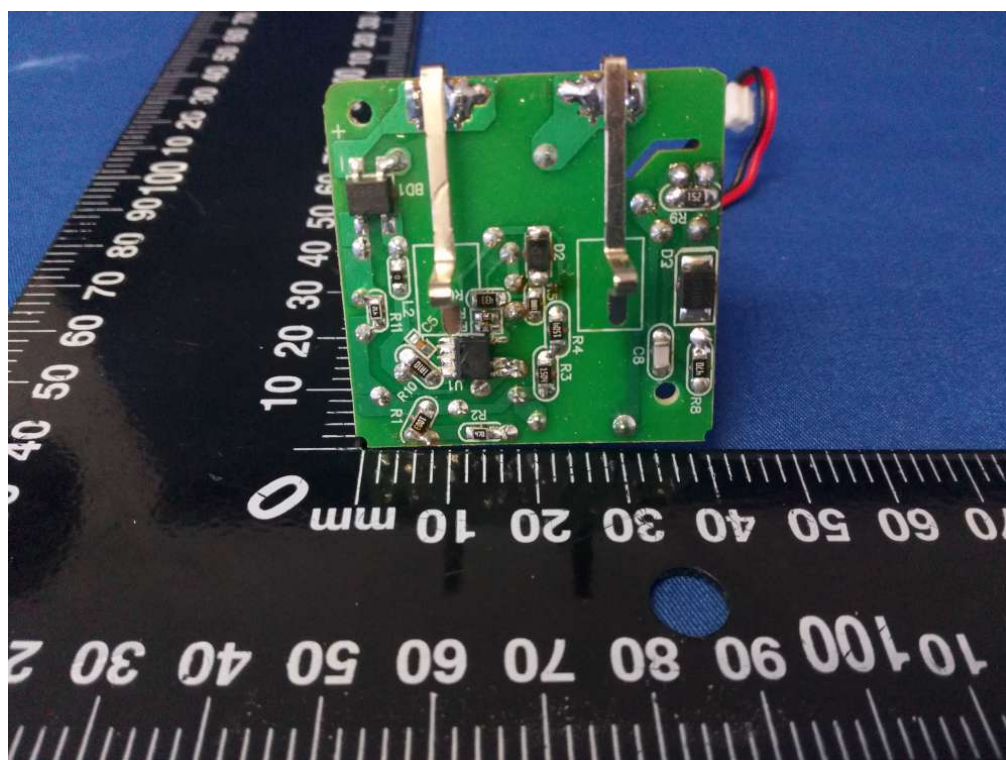






2.4G Antenna

5G Antenna



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