FCC RADIO TEST REPORT

FCC ID: 2AFOZF3501

IC: 20622-F3501

Product： MOB Link Safety HUB
Trade Name： Link Safety HUB
Model Name： F3501
Serial Model： N/A
Report No.： UNIA19121108FR-03

Prepared for

FELL Technology AS

Gjellebekkstubben 10 Lierskogen Buskerud 3420 Norway

Prepared by

Shenzhen United Testing Technology Co., Ltd.

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TEST RESULT CERTIFICATION

Applicant's name ..... : FELL Technology AS

Address ..... : Gjellebekkstubben 10 Lierskogen Buskerud 3420 Norway

Manufacture's Name ..... : FELL Technology AS

Address ..... : Gjellebekkstubben 10 Lierskogen Buskerud 3420 Norway

Product description

Product name..... : MOB Link Safety HUB

Trade Mark ..... : Link Safety HUB

Model and/or type reference : F3501

Standards ..... : FCC Rules and Regulations Part 15 Subpart C Section 15.247, ANSI C63.10: 2013, RSS-247 Issue 2: February 2017, RSS-Gen Issue 5 April 2018;

This device described above has been tested by Shenzhen United Testing Technology Co., Ltd., and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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Date of Test ..... :

Date (s) of performance of tests..... : Nov. 15 ~Dec. 06, 2019

Date of Issue..... : Dec. 09, 2019

Test Result..... : Pass

Prepared by: Kahn.Yang

Kahn yang/Editor

Reviewer: Sherwin Qian

Sherwin Qian/Supervisor

Approved & Authorized Signer: liuze

Liuze/Manager

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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
OUT OF BAND EMISSIONS	COMPLIANT
ANTENNA REQUIREMENT	COMPLIANT

1.2 1.1 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 1.2 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

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Equipment	MOB Link Safety HUB
Trade Mark	Link Safety HUB
Model Name	F3501
Serial No.	N/A
Model Difference	N/A
FCC ID	2AFOZF3501
Antenna Type	PCB Antenna
Antenna Gain	2dBi
Frequency Range	802.11b/g/n20: 2412~2462 MHz
Number of Channels	802.11b/g/n20: 11CH
Modulation Type	CCK, OFDM, DBPSK
Power Source	DC 12V from battery
Product HW/SW version	1.0.0/1.0.0
Radio HW/SW version	1.0.0/1.0.0

Table for auxiliary equipment:

Equipment Description	Manufacturer	Model	Serial Number
Notebook	Lenovo	Lenovo G475	GB14477457

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		

2.3 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: SmartRF_Studio_7

2.4 DESCRIPTION OF TEST SETUP

Operation of EUT during Conducted testing:

2.5 MEASUREMENT INSTRUMENTS LIST

Item	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
CONDUCTED EMISSIONS TEST					
1	AMN	Schwarzbeck	NNLK8121	8121370	2020.9.6
2	AMN	ETS	3810/2	00020199	2020.9.6
3	EMI TEST RECEIVER	Rohde&Schwarz	ESCI	101210	2020.9.6
4	AAN	TESEQ	T8-Cat6	38888	2020.9.6
RADIATED EMISSION TEST					
1	Horn Antenna	Sunol	DRH-118	A101415	2020.9.6
2	BicoNILog Antenna	Sunol	JB1 Antenna	A090215	2020.9.6
3	PREAMP	HP	8449B	3008A00160	2020.9.6
4	PREAMP	HP	8447D	2944A07999	2020.9.6
5	EMI TEST RECEIVER	Rohde&Schwarz	ESR3	101891	2020.9.6
6	VECTOR Signal Generator	Rohde&Schwarz	SMU200A	101521	2020.9.6
7	Signal Generator	Agilent	E4421B	MY4335105	2020.9.6
8	MXA Signal Analyzer	Agilent	N9020A	MY50510140	2020.9.6
9	MXA Signal Analyzer	Agilent	N9020A	MY51110104	2020.9.6
10	ANT Tower&Turn table Controller	Champro	EM 1000	60764	2020.9.6
11	Anechoic Chamber	Taihe Maorui	9m*6m*6m	966A0001	2020.9.6
12	Shielding Room	Taihe Maorui	6.4m*4m*3m	643A0001	2020.9.6
13	RF Power sensor	DARE	RPR3006W	15I00041SNO88	2020.9.6
14	RF Power sensor	DARE	RPR3006W	15I00041SNO89	2020.9.6
15	RF power divider	Anritsu	K241B	992289	2020.9.6
16	Wideband radio communication tester	Rohde&Schwarz	CMW500	154987	2020.9.6
17	Biconical antenna	Schwarzbeck	VHA 9103	91032360	2020.9.6
18	Biconical antenna	Schwarzbeck	VHA 9103	91032361	2020.9.6
19	Broadband Hybrid Antennas	Schwarzbeck	VULB9163	VULB9163#958	2020.9.6
20	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1680	2020.9.6
21	Active Receive Loop Antenna	Schwarzbeck	FMZB 1919B	00023	2020.9.6
22	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170651	2020.9.6
23	Microwave Broadband Preamplifier	Schwarzbeck	BBV 9721	100472	2020.9.6
24	Active Loop Antenna	Com-Power	AL-130R	10160009	2020.9.6
25	Power Meter	KEYSIGHT	N1911A	MY50520168	2020.9.6
26	Frequency Meter	VICTOR	VC2000	997406086	2020.9.6
27	DC Power Source	HYELEC	HY5020E	055161818	2020.9.6
Test software					
1	E3	XINHUA	6.101223a	N/A	N/A

3. CONDUCTED EMISSIONS TEST

3.1 Conducted Power Line Emission Limit

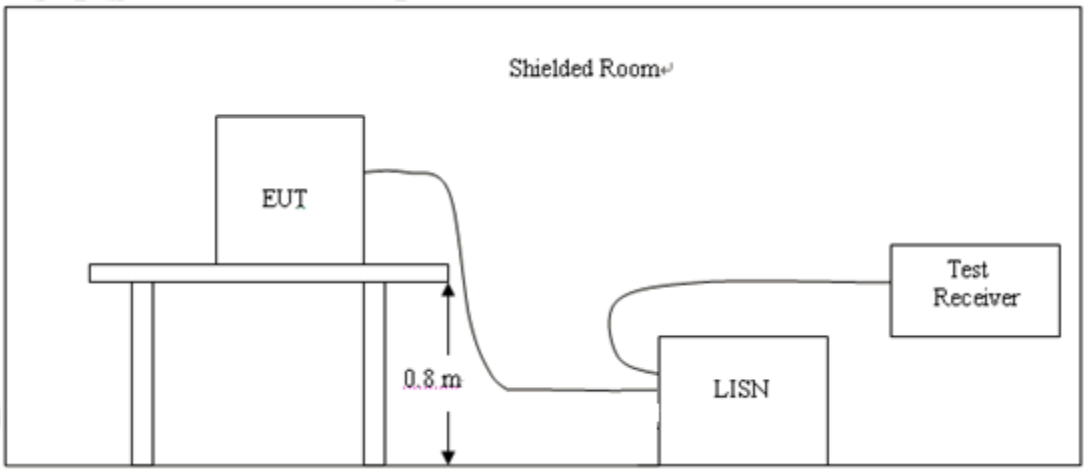
For unintentional device, according to § 15.107(a) & RSS-Gen [8.8] Line Conducted Emission Limits is as following

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

This device is pure battery powered and does not require charging.

4. RADIATED EMISSION TEST

4.1 Radiation Limit

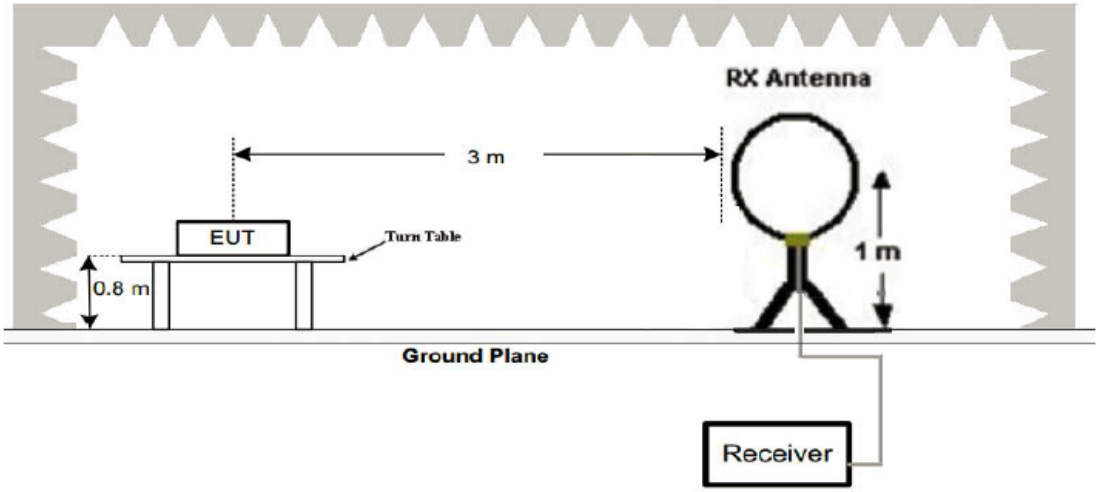
For unintentional device, according to § 15.109(a) & RSS-247 [5.5], except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values：

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

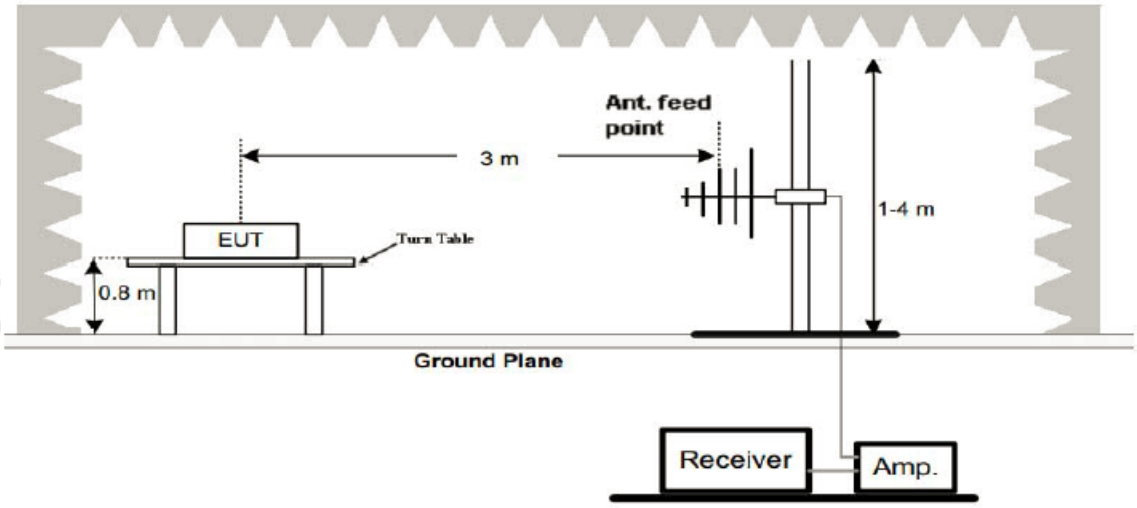
For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

4.2 Test Setup

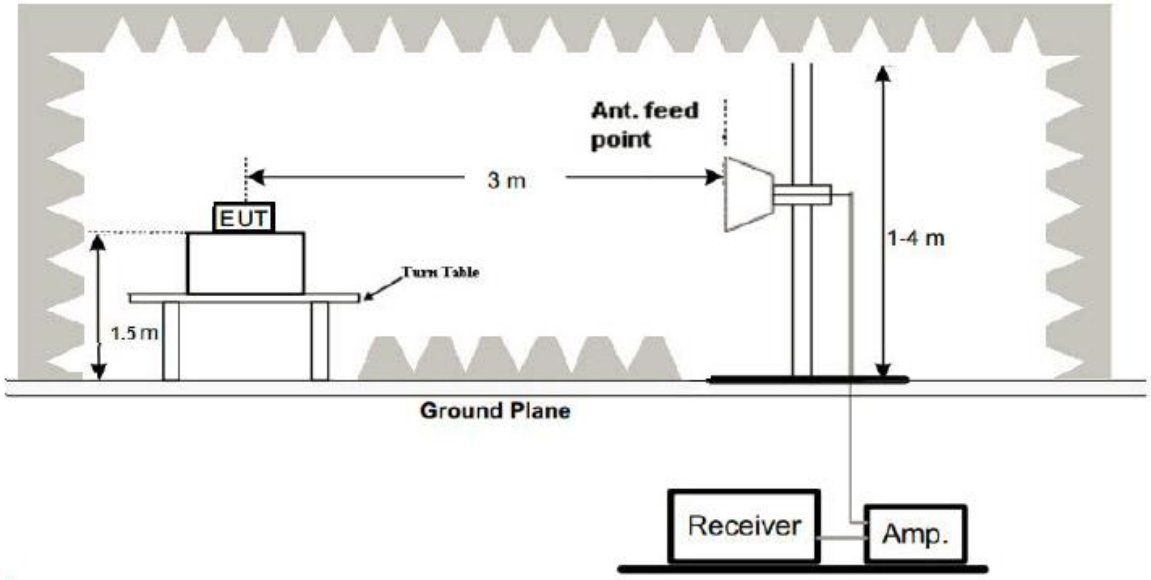
1. Radiated Emission Test-Up Frequency Below 30MHz



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



3. Radiated Emission Test-Up Frequency Above 1GHz



4.3 Test Procedure

1. 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.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The test frequency range from 9KHz to 25GHz per FCC PART 15.33(a).
8. 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 Anternna	1

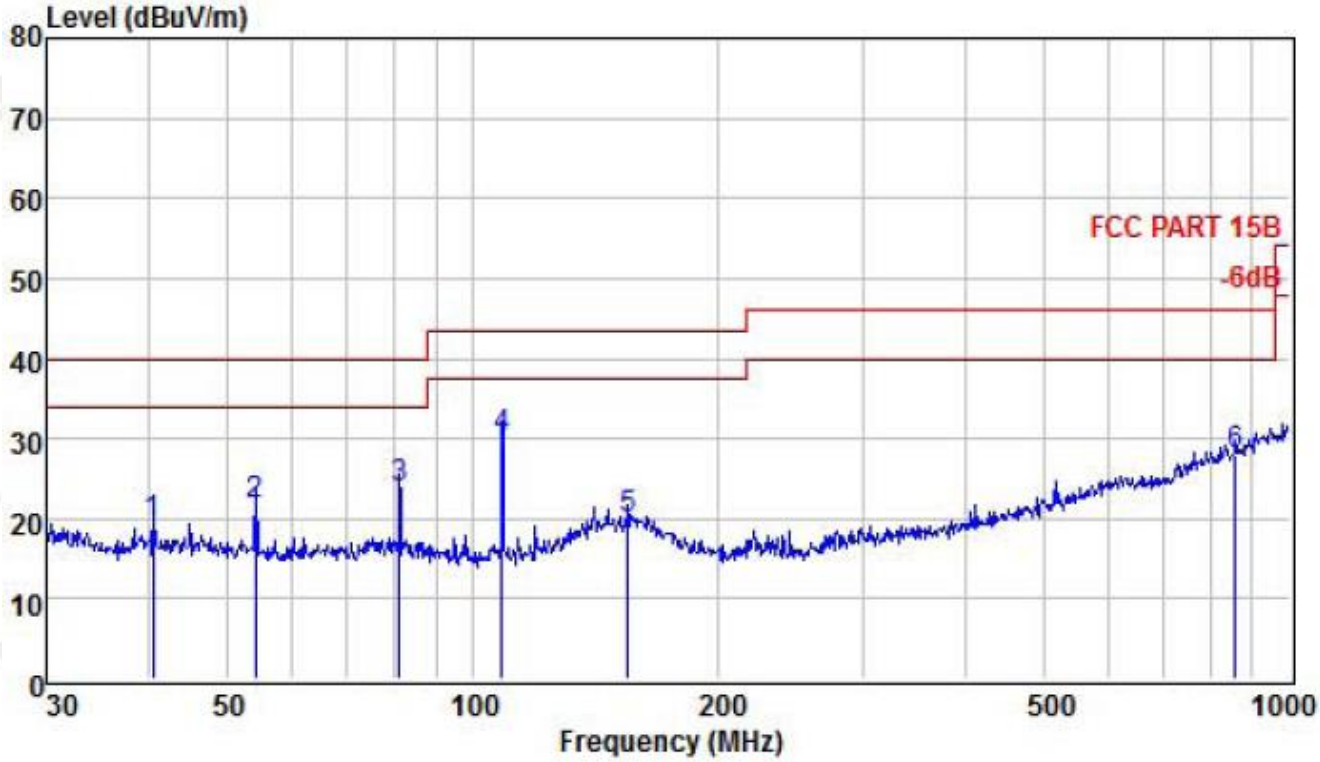
Note:
For battery operated equipment, the equipment tests shall be performed using a new battery.

4.4 Test Result

PASS
Remark:
1. 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.
2. By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that “Z axis” position was the worst, and test data recorded in this report.
3. The BT and WIFI Can't transmit simultaneously.

Below 1GHz Test Results:

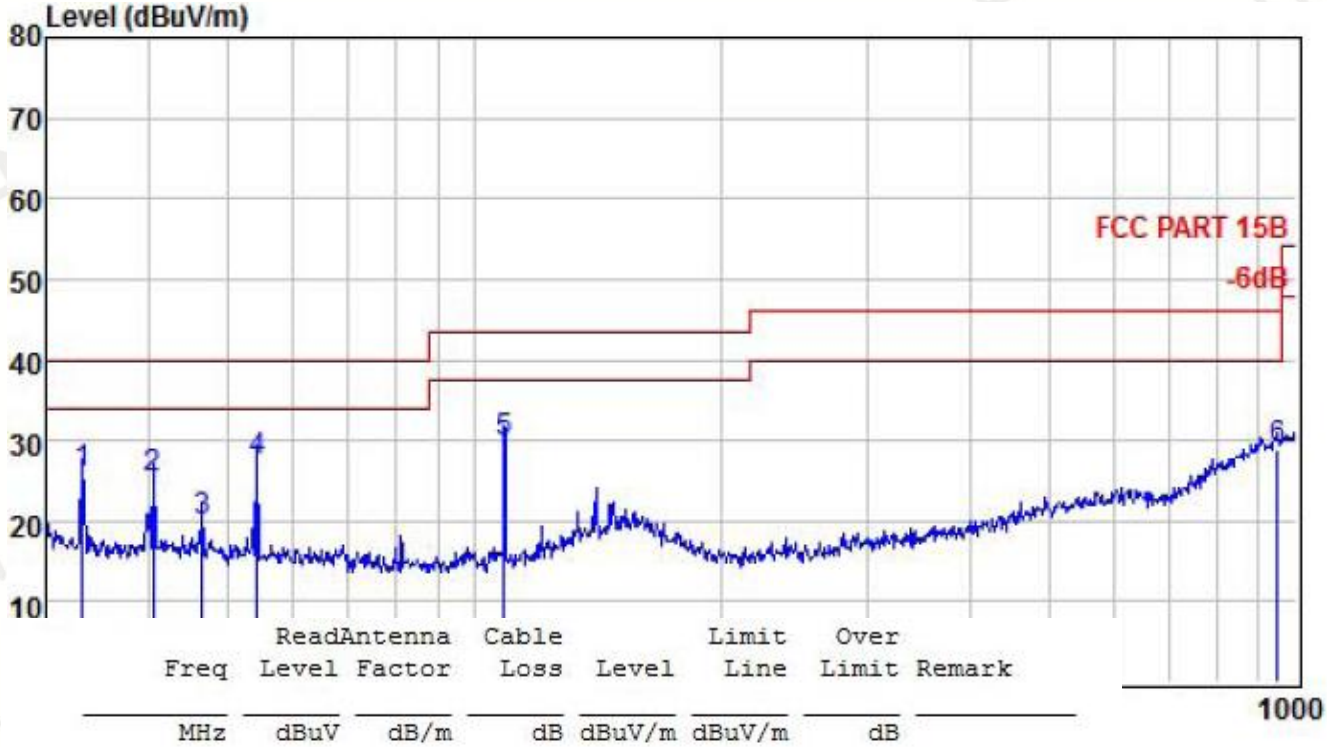
Temperature:	22℃	Relative Humidity:	48%
Test Date:	Jul. 24, 2019	Pressure:	1010hPa
Test Voltage:	DC 12V from battery	Polarization:	Horizontal
Test Mode:	Transmitting mode of 802.11b 2412MHz		



	Freq	Read Level	Antenna Factor	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB	
1	40.56	5.67	13.47	0.13	19.27	40.00	-20.73	QP
2	54.07	9.21	12.53	0.12	21.86	40.00	-18.14	QP
3	81.21	10.52	13.02	0.15	23.69	40.00	-16.31	QP
4	108.27	18.14	11.69	0.18	30.01	43.50	-13.49	QP
5	154.82	4.05	15.58	0.23	19.86	43.50	-23.64	QP
6	857.02	4.40	21.96	1.53	27.89	46.00	-18.11	QP

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

Temperature:	22℃	Relative Humidity:	48%
Test Date:	Jul. 24, 2019	Pressure:	1010hPa
Test Voltage:	DC 12V from battery	Polarization:	Vertical
Test Mode:	Transmitting mode of 802.11b 2412MHz		



	Freq	Read Level	Antenna Factor	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB	
1	79.243	6.10	13.08	0.15	19.33	40.00	-20.67	QP
2	152.664	7.12	15.53	0.23	22.88	43.50	-20.62	QP
3	166.068	14.99	14.73	0.23	29.95	43.50	-13.55	QP
4	181.920	15.03	12.57	0.24	27.84	43.50	-15.66	QP
5	192.419	15.79	11.88	0.29	27.96	43.50	-15.54	QP
6	932.272	3.88	23.03	1.64	28.55	46.00	-17.45	QP

1	33.21	12.03	13.48	0.27	25.78	40.00	-14.22	QP
2	40.56	11.60	13.47	0.13	25.20	40.00	-14.80	QP
3	46.50	6.67	13.16	0.12	19.95	40.00	-20.05	QP
4	54.26	14.84	12.51	0.12	27.47	40.00	-12.53	QP
5	108.27	17.94	11.69	0.18	29.81	43.50	-13.69	QP
6	948.76	4.03	23.30	1.65	28.98	46.00	-17.02	QP

Remark: Absolute Level = Reading Level + Factor, Margin = Absolute Level – Limit
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 1GHz Test Results (802.11b Worst Case):

CH Low (2412MHz)

Horizontal

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4824	61.53	-3.64	57.89	74.00	-16.11	PK
4824	50.12	-3.64	46.48	54.00	-7.52	AV
7236	57.17	-0.95	56.22	74.00	-17.78	PK
7236	44.91	-0.95	43.96	54.00	-10.04	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	60.59	-3.64	56.95	74.00	-17.05	PK
4824	46.33	-3.64	42.69	54.00	-11.31	AV
7236	56.47	-0.95	55.52	74.00	-18.48	PK
7236	43.23	-0.95	42.28	54.00	-11.72	AV
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit						

CH Middle (2437MHz)

Horizontal

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4874	59.57	-3.51	56.06	74.00	-17.94	PK
4874	46.42	-3.51	42.91	54.00	-11.09	AV
7311	59.33	-0.82	58.51	74.00	-15.49	PK
7311	46.67	-0.82	45.85	54.00	-8.15	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	59.32	-3.51	55.81	74.00	-18.19	PK
4874	49.51	-3.51	46.00	54.00	-8.00	AV
7311	55.34	-0.82	54.52	74.00	-19.48	PK
7311	48.62	-0.82	47.80	54.00	-6.20	AV
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit						

CH High (2462MHz)

Horizontal

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4924	60.41	-3.43	56.98	74.00	-17.02	PK
4924	50.01	-3.43	46.58	54.00	-7.42	AV
7386	54.55	-0.75	53.80	74.00	-20.20	PK
7386	47.32	-0.75	46.57	54.00	-7.43	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
4924	58.51	-3.43	55.08	74.00	-18.92	PK
4924	48.32	-3.43	44.89	54.00	-9.11	AV
7386	57.38	-0.75	56.63	74.00	-17.37	PK
7386	45.86	-0.75	45.11	54.00	-8.89	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 1MHz and VBM to 3MHz to measure the peak field strength and set RBW to 1MHz and VBW to 10kHz 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/g/n20 mode at the antenna single; and recored the worst data at 802.11b mode.

Radiated Band Edge Test:

Worst case on 802.11b

Horizontal

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310	56.33	-5.81	50.52	74.00	-23.48	PK
2310	49.58	-5.81	43.77	54.00	-10.23	AV
2390	61.27	-5.84	55.43	74.00	-18.57	PK
2390	50.46	-5.84	44.62	54.00	-9.38	AV
2400	56.51	-5.81	50.70	74.00	-23.30	PK
2400	49.76	-5.81	43.95	54.00	-10.05	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	55.77	-5.81	49.96	74.00	-24.04	PK
2310	50.52	-5.81	44.71	54.00	-9.29	AV
2390	62.47	-5.84	56.63	74.00	-17.37	PK
2390	51.33	-5.84	45.49	54.00	-8.51	AV
2400	63.05	-5.84	57.21	74.00	-16.79	PK
2400	50.23	-5.84	44.39	54.00	-9.61	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	54.67	-5.54	49.13	74.00	-24.87	PK
2483.5	49.74	-5.54	44.20	54.00	-9.80	AV
2500	55.26	-5.72	49.54	74.00	-24.46	PK
2500	50.37	-5.72	44.65	54.00	-9.35	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	55.43	-5.54	49.89	74.00	-24.11	PK
2483.5	50.35	-5.54	44.81	54.00	-9.19	AV
2500	54.92	-5.72	49.20	74.00	-24.80	PK
2500	49.48	-5.72	43.76	54.00	-10.24	AV
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

6. OCCUPIED BANDWIDTH MEASUREMENT

6.1 Test Limit

FCC Part15(15.247), Subpart C & RSS-247 [5.2(1)]				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(2)	Bandwidth	>= 500KHz (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

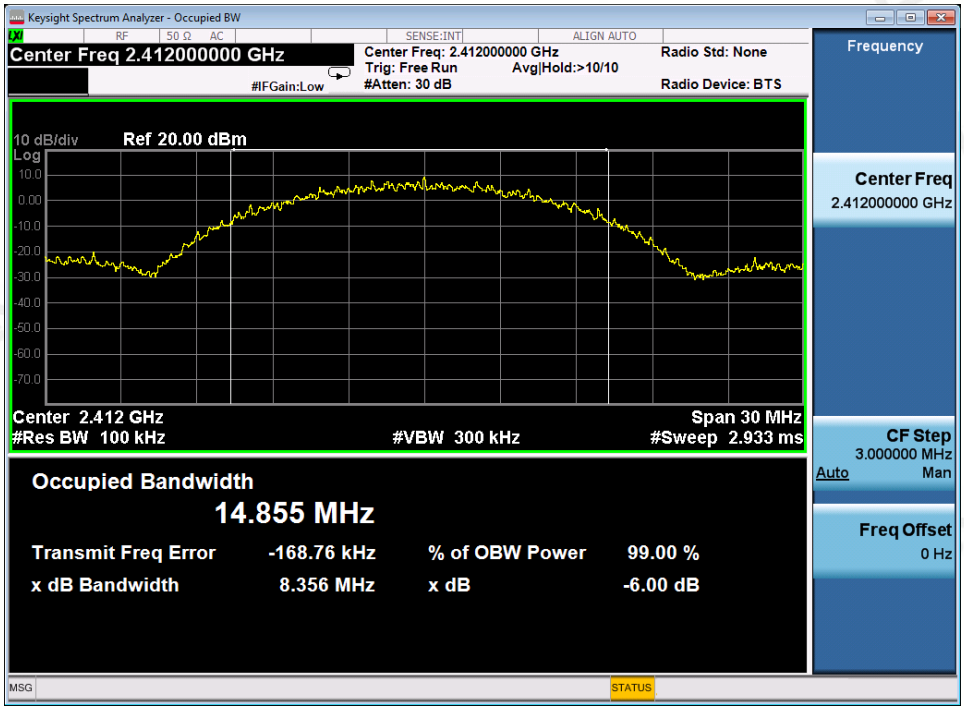
Same as Radiated Emission Measurement

6.4 Test Result

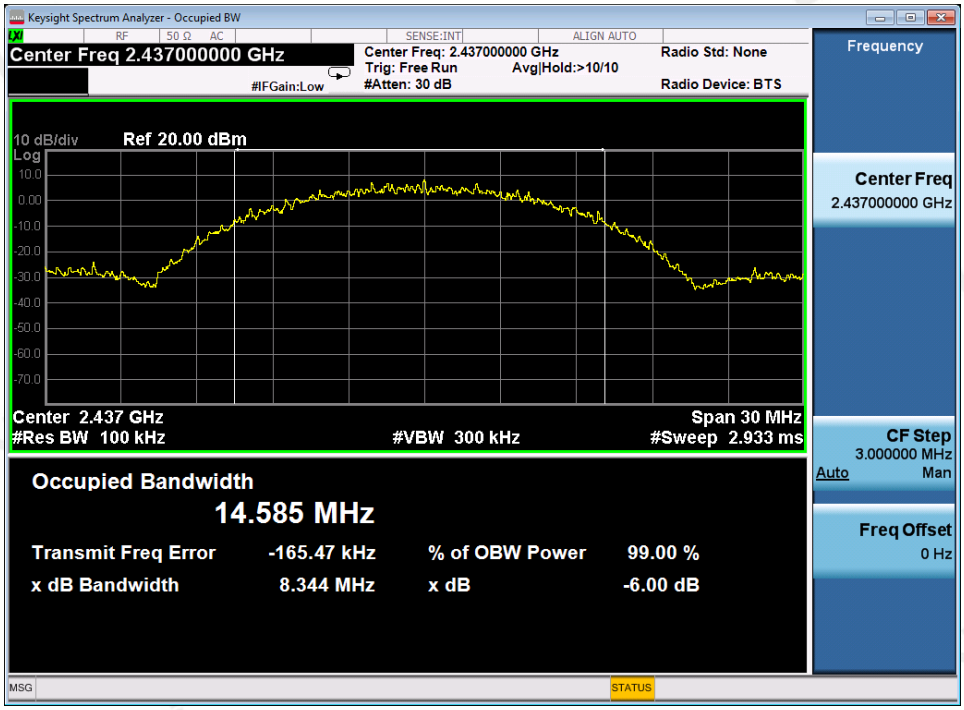
PASS

TX 802.11b Mode		
Frequency (MHz)	6dB Bandwidth (MHz)	Result
2412	8.356	PASS
2437	8.344	PASS
2462	8.338	PASS

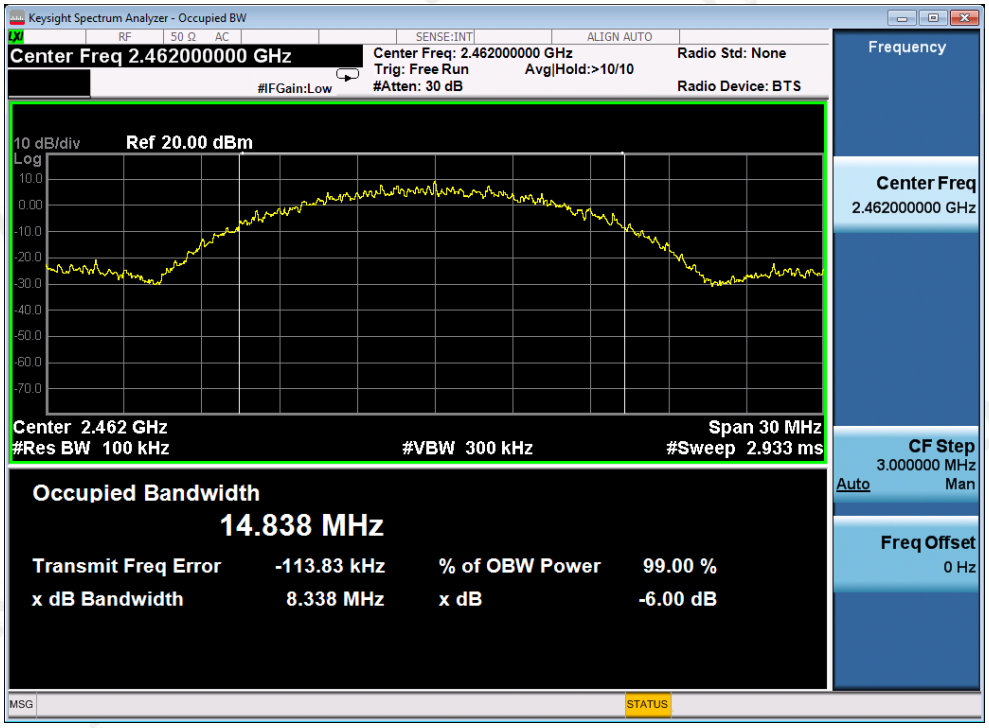
CH: 2412MHz



CH: 2437MHz

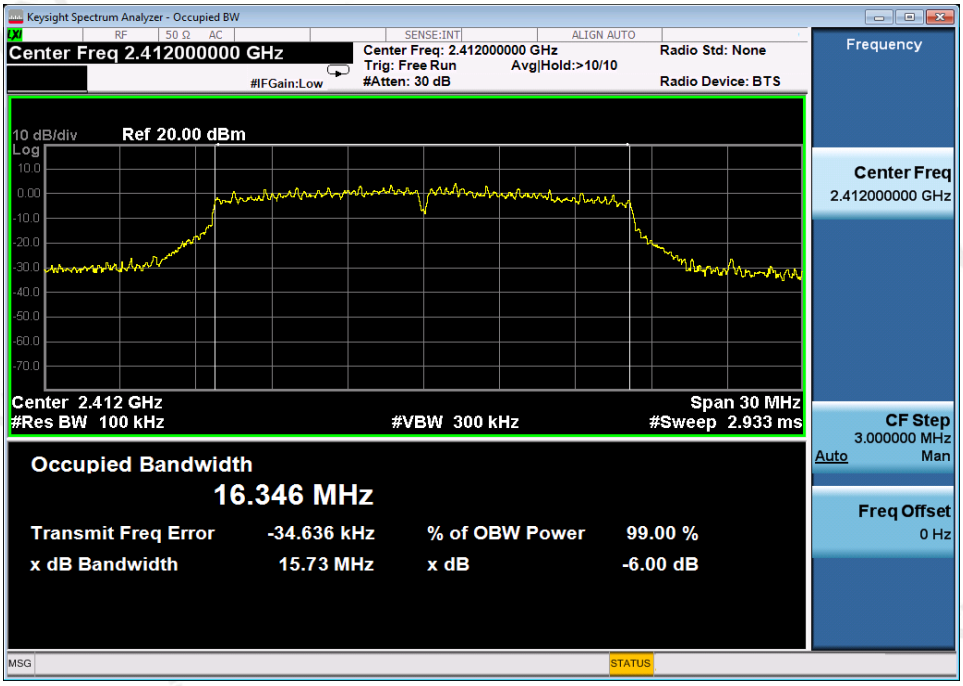


CH: 2462MHz

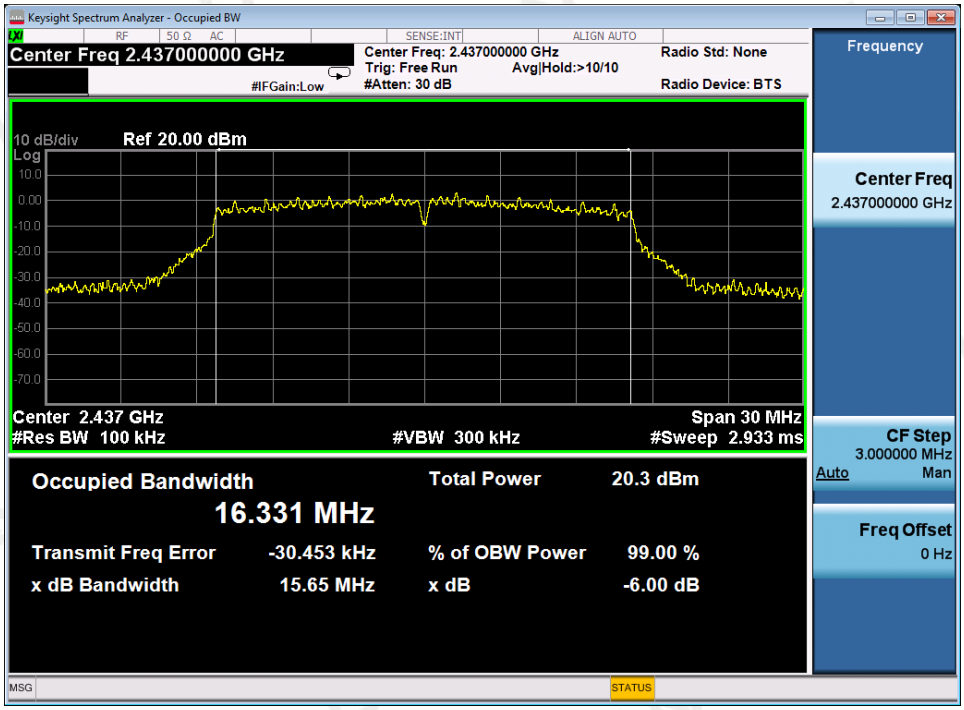


TX 802.11g Mode		
Frequency (MHz)	6dB Bandwidth (MHz)	Result
2412	15.73	PASS
2437	15.65	PASS
2462	15.10	PASS

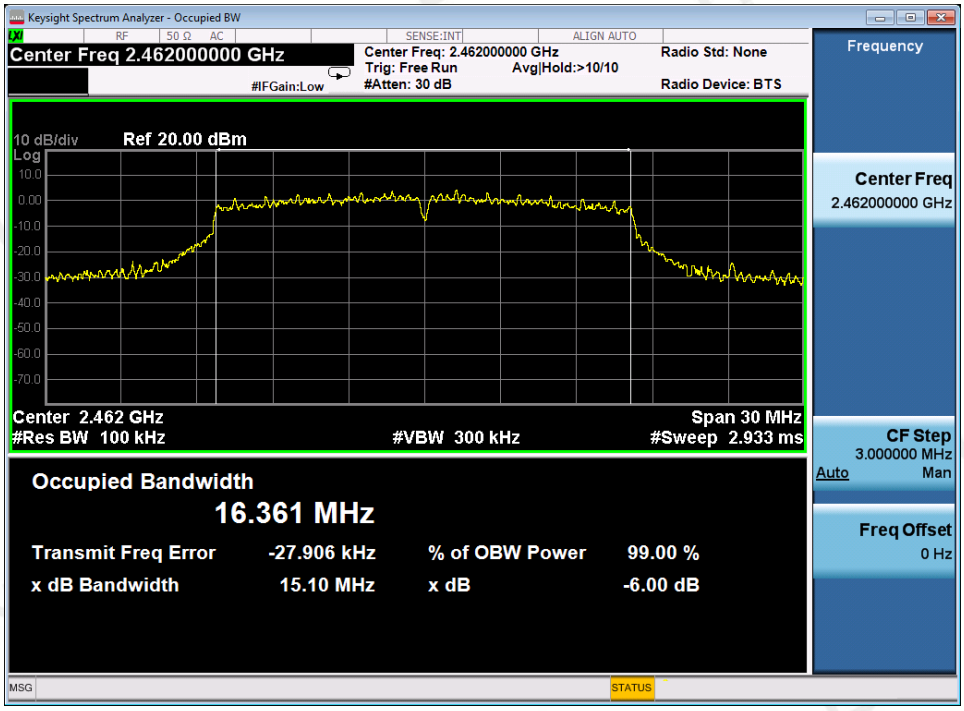
CH: 2412MHz



CH: 2437MHz

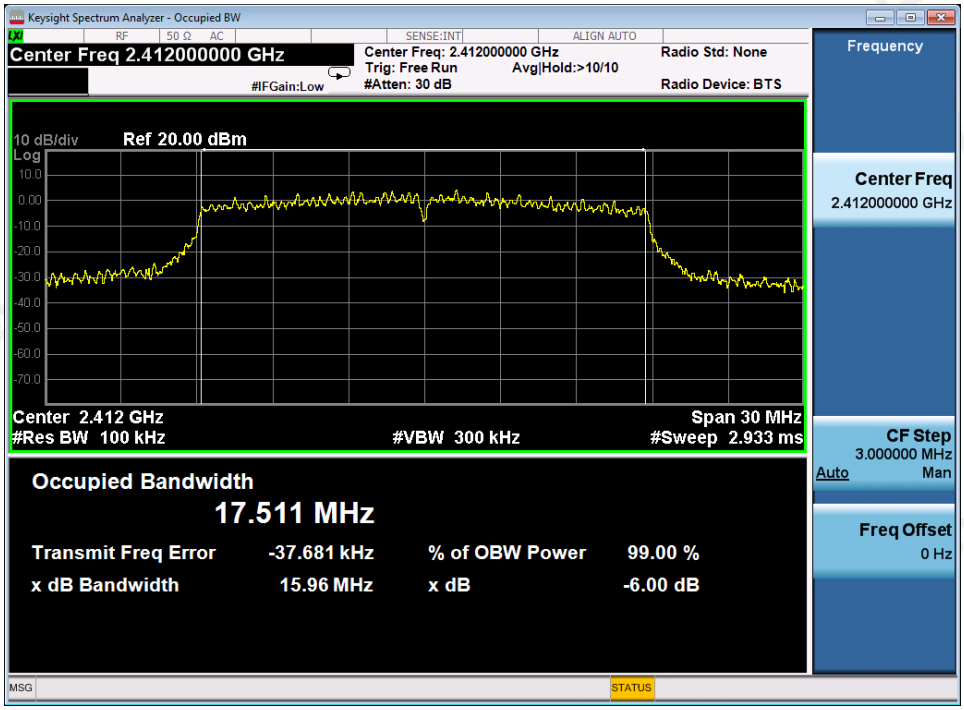


CH: 2462MHz

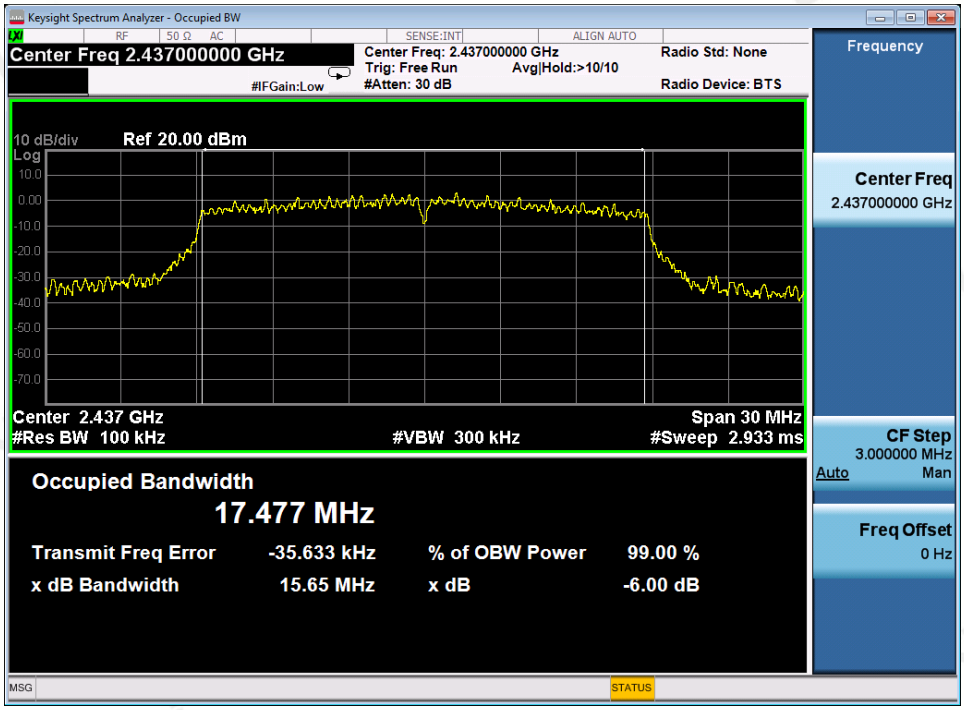


TX 802.11n/HT20 Mode		
Frequency (MHz)	6dB Bandwidth (MHz)	Result
2412	15.96	PASS
2437	15.65	PASS
2462	15.65	PASS

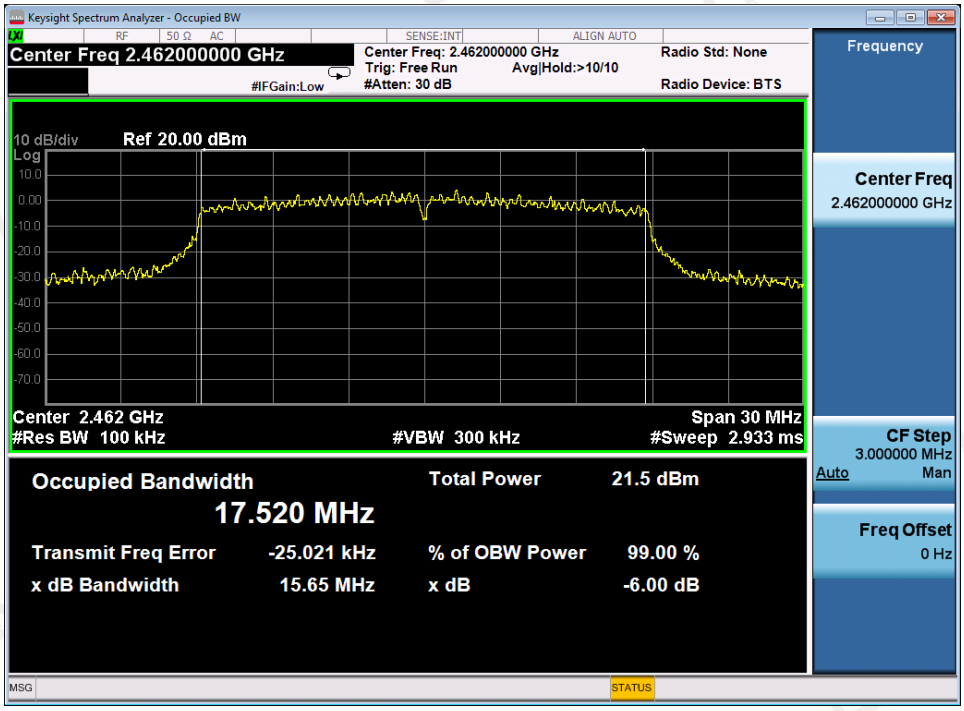
CH: 2412MHz



CH: 2437MHz

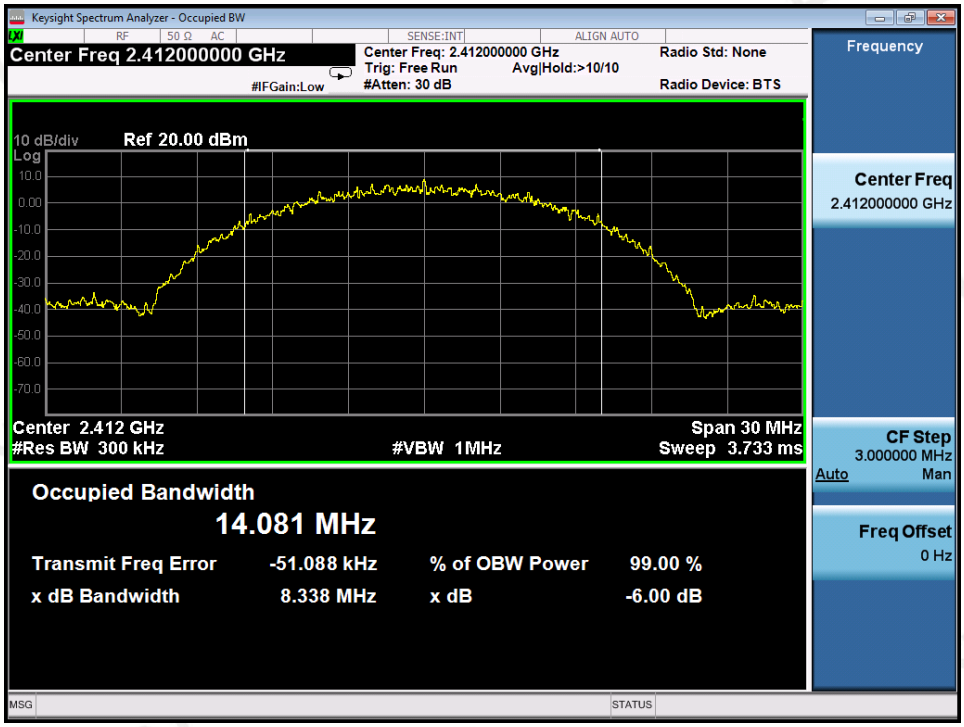


CH: 2462MHz

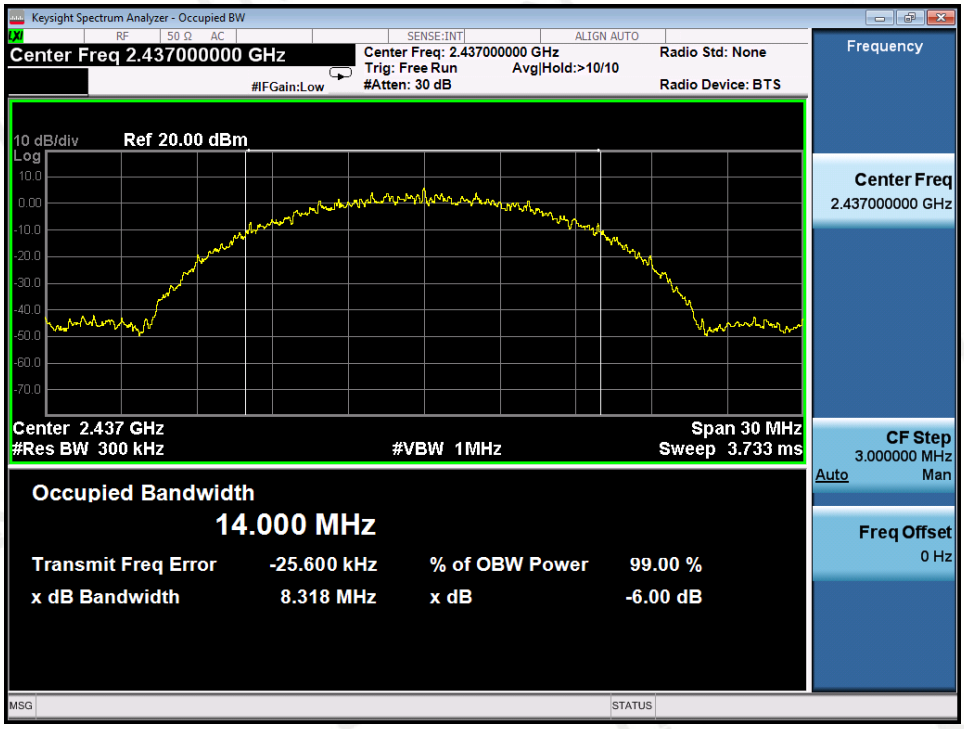


TX 802.11b Mode		
Frequency (MHz)	99% Bandwidth (MHz)	Result
2412	14.081	PASS
2437	14.000	PASS
2462	14.084	PASS

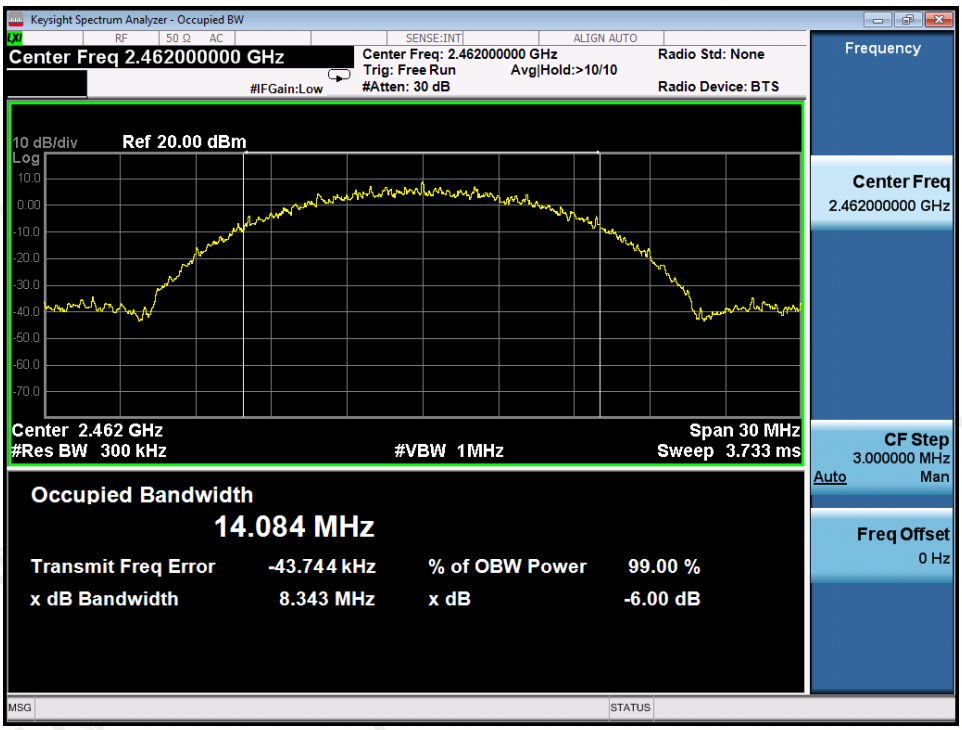
CH: 2412MHz



CH: 2437MHz

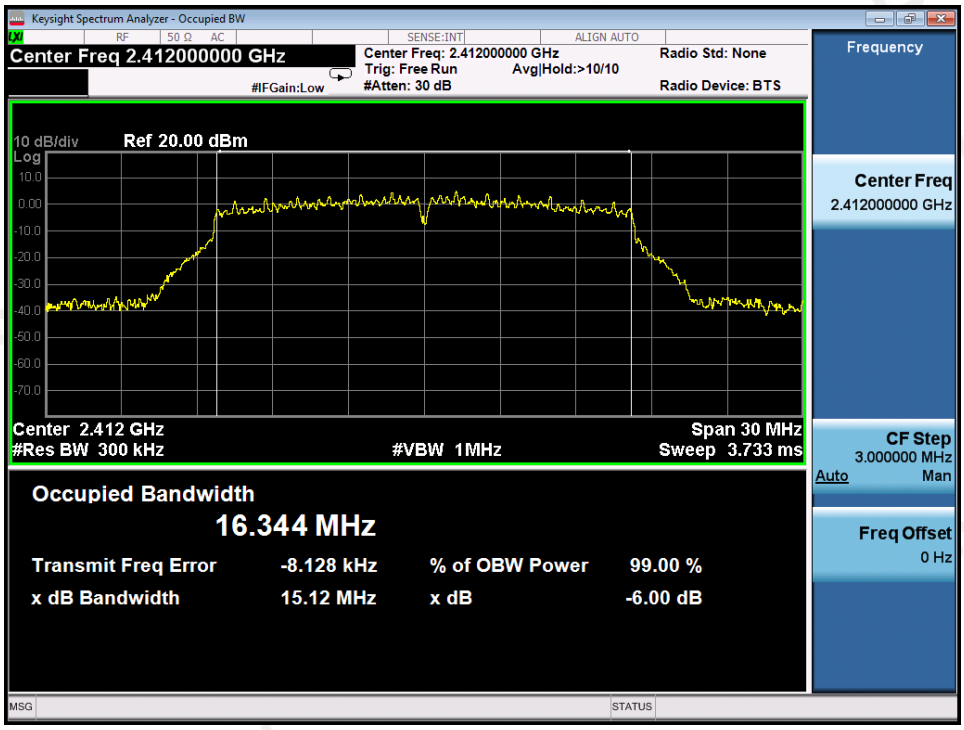


CH: 2462MHz

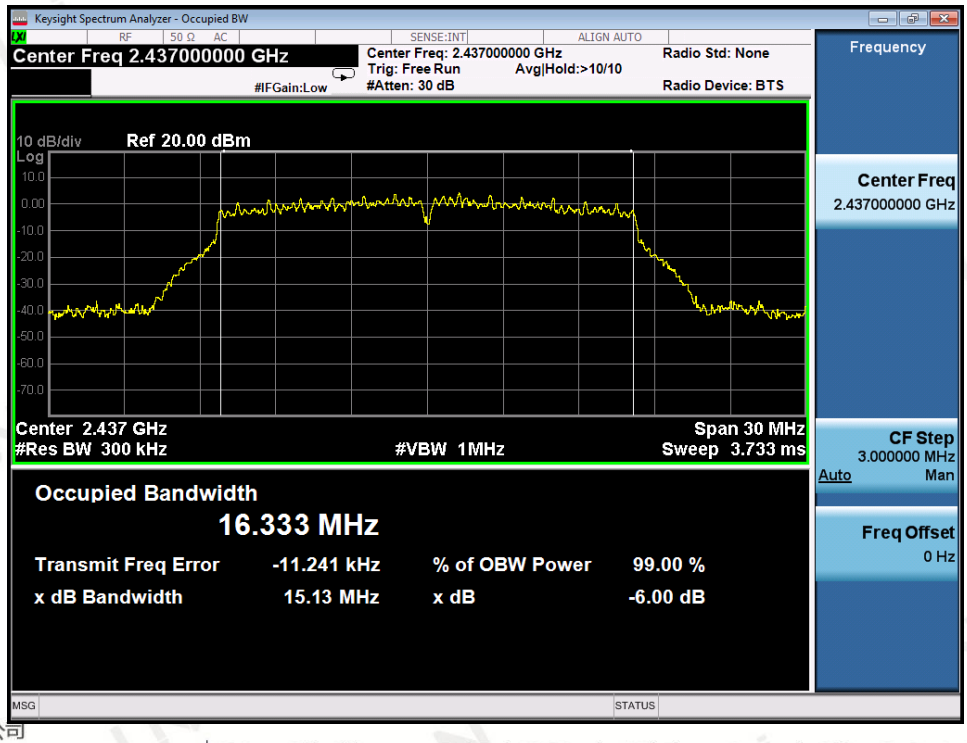


TX 802.11g Mode		
Frequency (MHz)	99% Bandwidth (MHz)	Result
2412	16.344	PASS
2437	16.333	PASS
2462	16.333	PASS

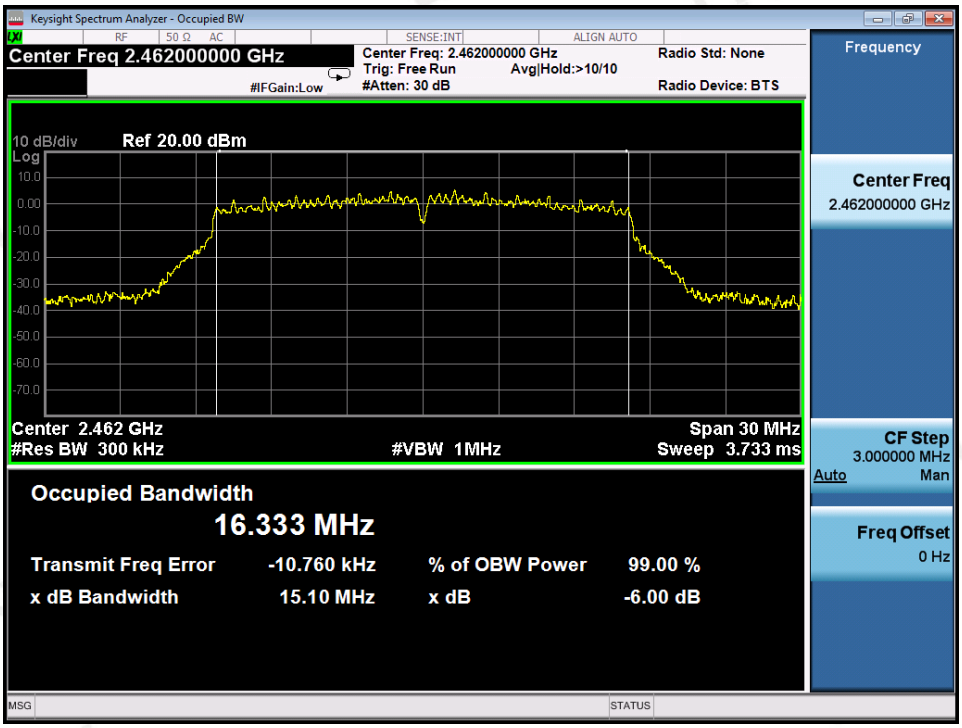
CH: 2412MHz



CH: 2437MHz

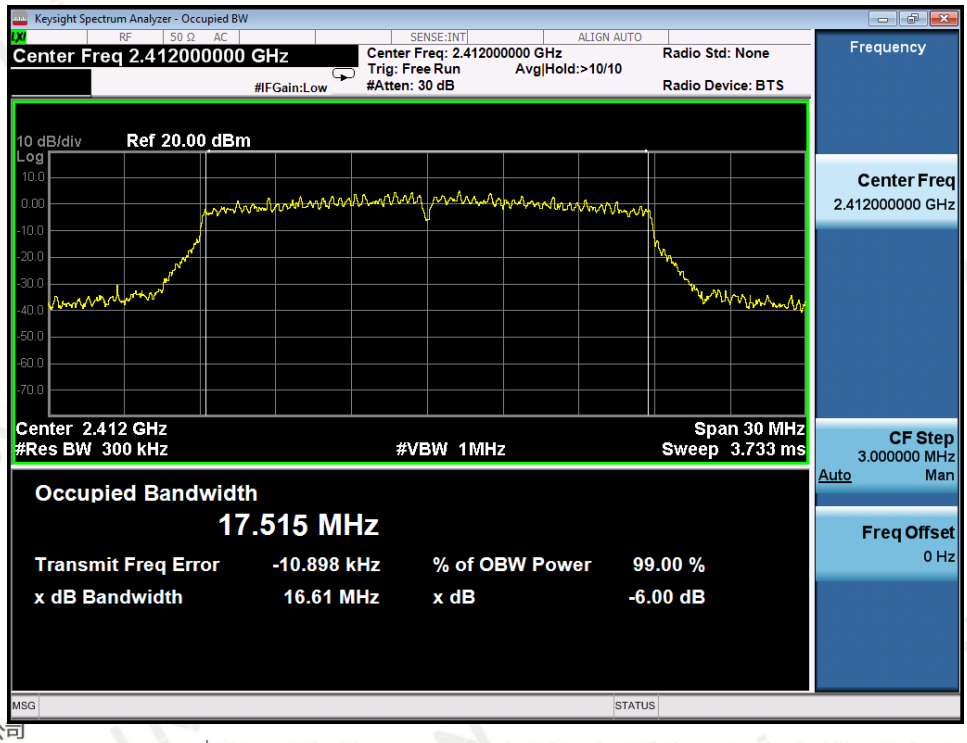


CH: 2462MHz

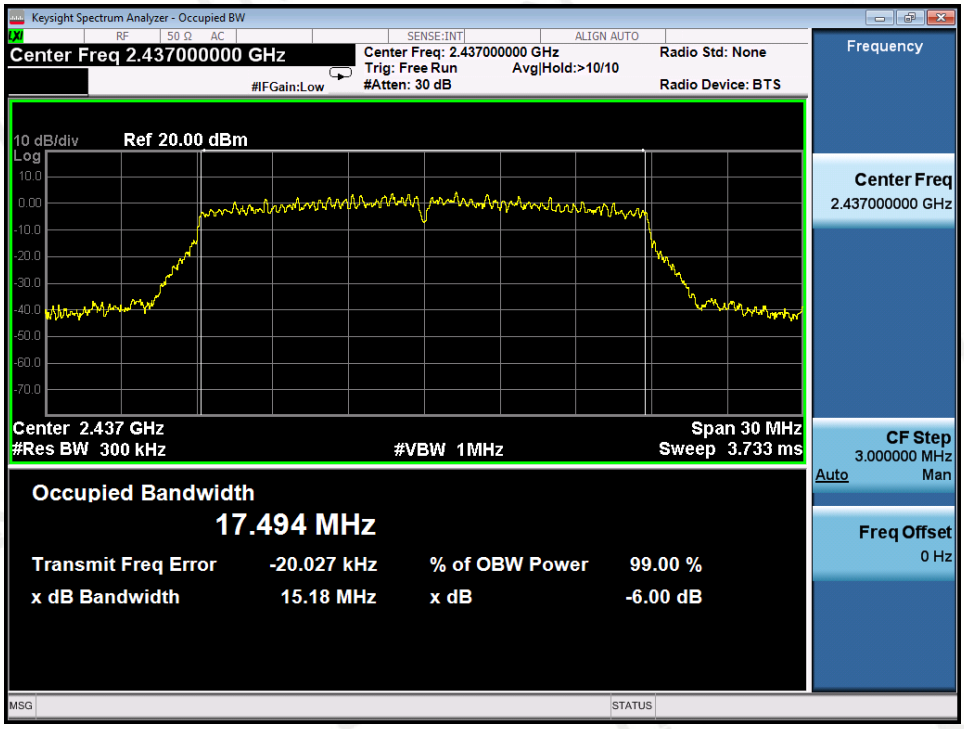


TX 802.11n/HT20 Mode		
Frequency (MHz)	99% Bandwidth (MHz)	Result
2412	17.515	PASS
2437	17.494	PASS
2462	17.474	PASS

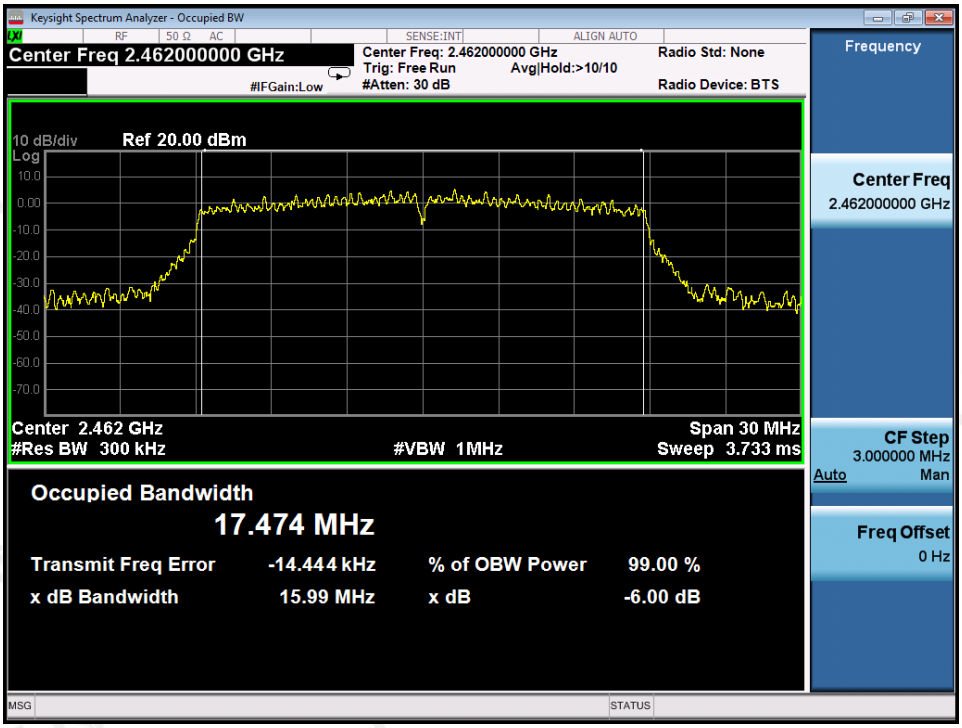
CH: 2412MHz



CH: 2437MHz



CH: 2462MHz



7. POWER SPECTRAL DENSITY TEST

7.1 Test Limit

FCC Part15(15.247), Subpart C & RSS-247 [5.2(2)]				
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

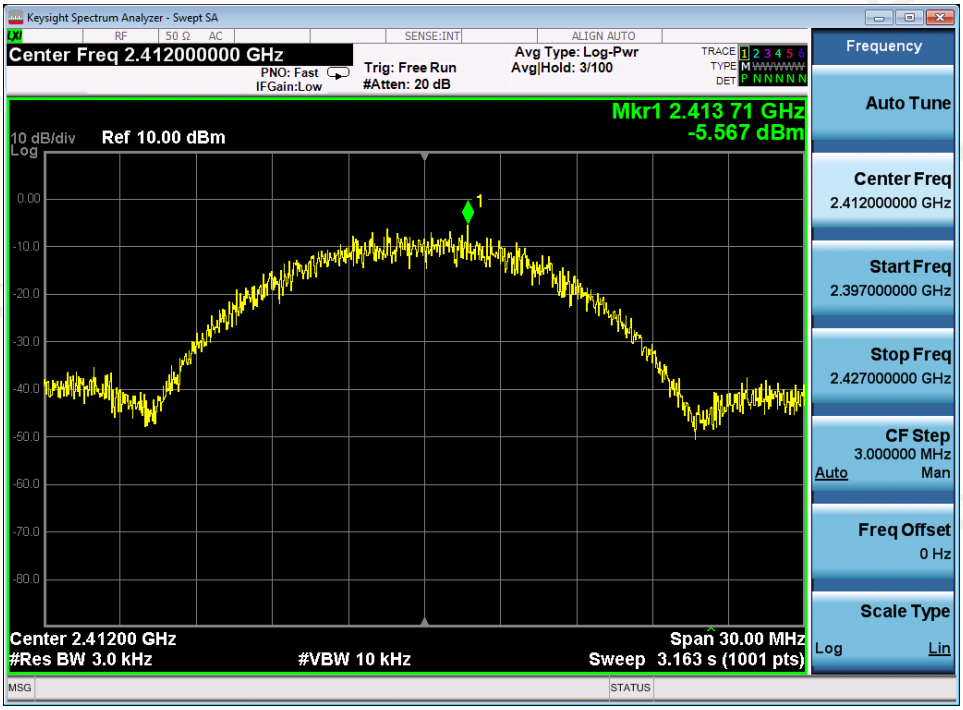
Same as Radiated Emission Measurement

7.4 Test Result

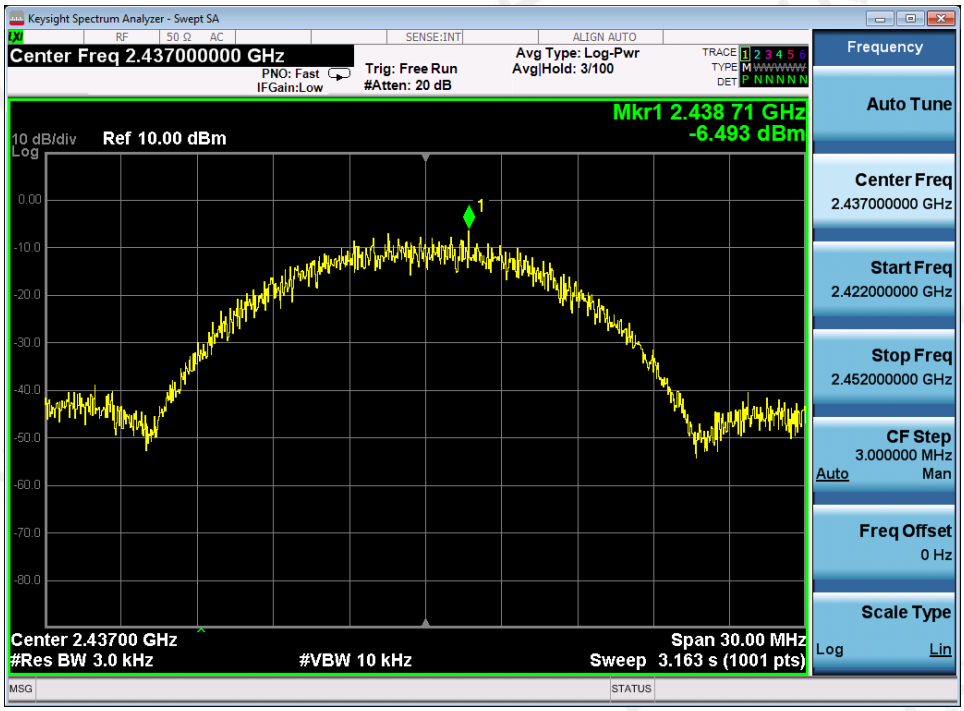
PASS

TX 802.11b Mode			
Frequency (MHz)	Power Density (dBm/3KHz)	Limit (dBm/3KHz)	Result
2412	-5.567	8	PASS
2437	-6.493	8	PASS
2462	-5.576	8	PASS

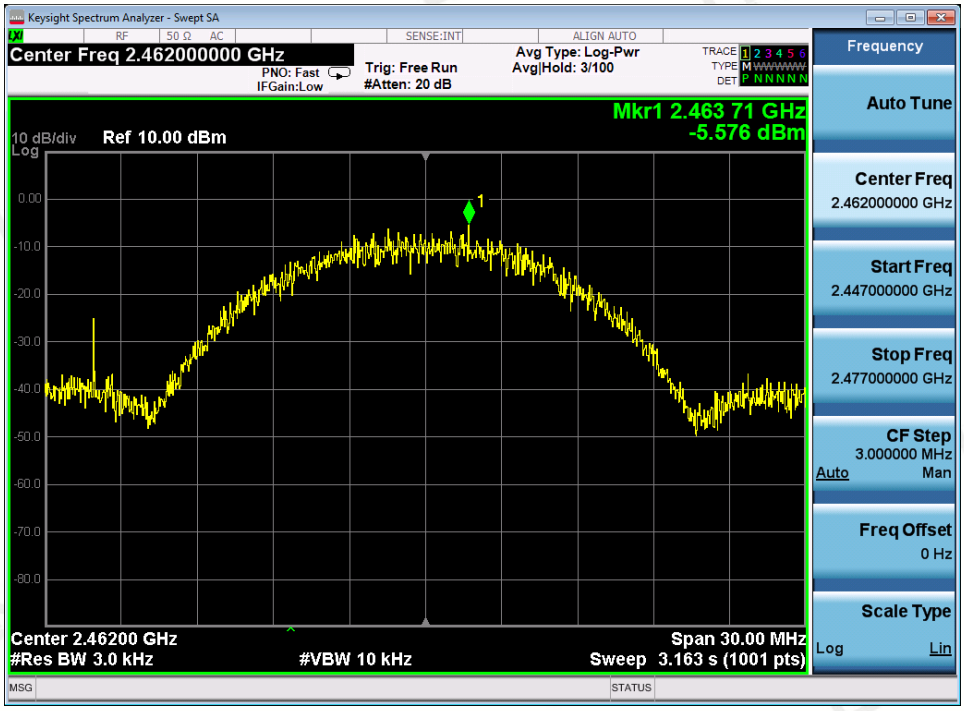
CH: 2412MHz



CH: 2437MHz

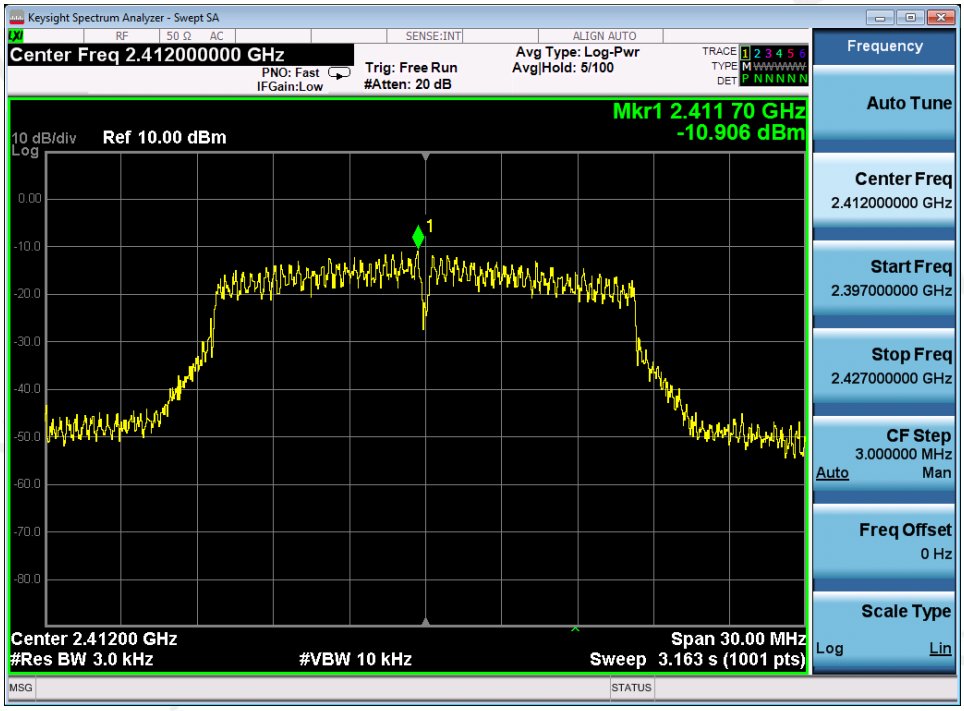


CH: 2462MHz

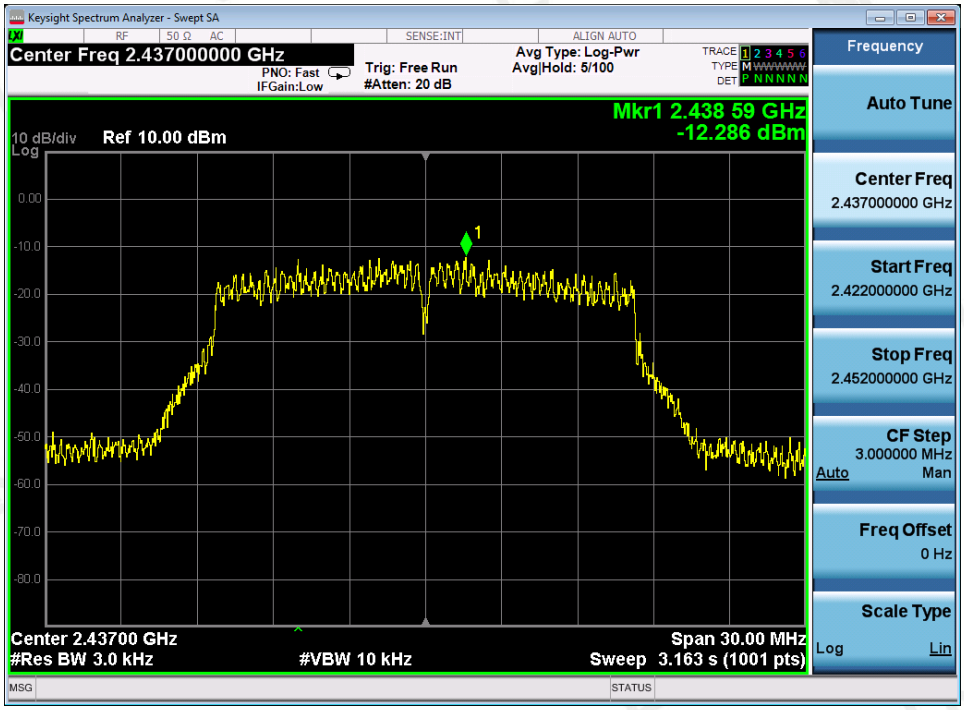


TX 802.11g Mode			
Frequency (MHz)	Power Density (dBm/3KHz)	Limit (dBm/3KHz)	Result
2412	-10.906	8	PASS
2437	-12.286	8	PASS
2462	-11.386	8	PASS

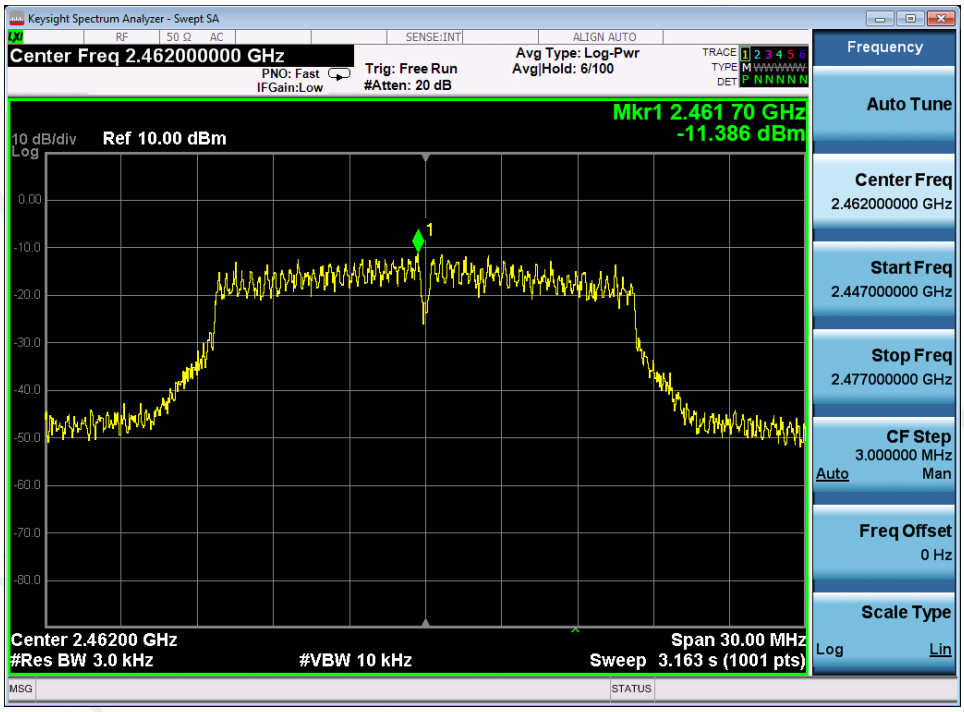
CH: 2412MHz



CH: 2437MHz

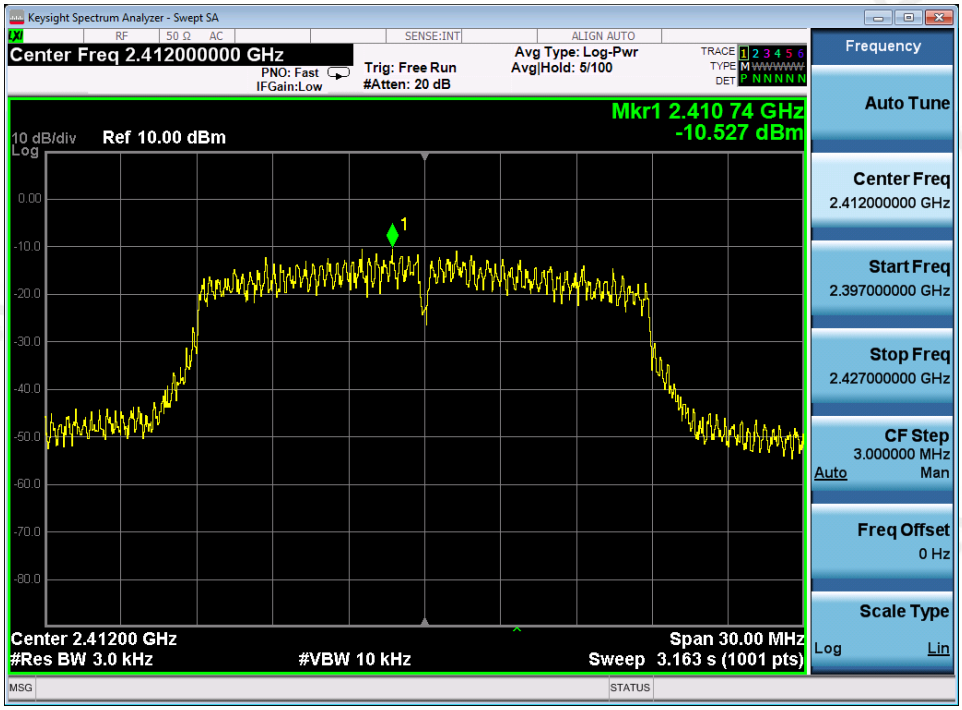


CH: 2462MHz

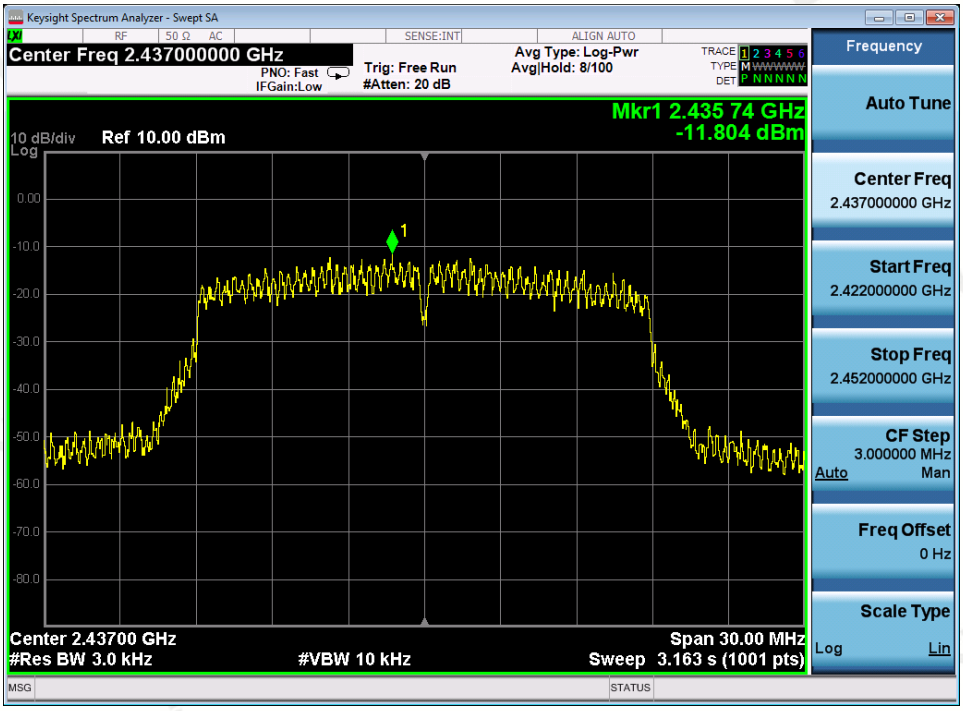


TX 802.11n/HT20 Mode			
Frequency (MHz)	Power Density (dBm/3KHz)	Limit (dBm/3KHz)	Result
2412	-10.527	8	PASS
2437	-11.804	8	PASS
2462	-10.316	8	PASS

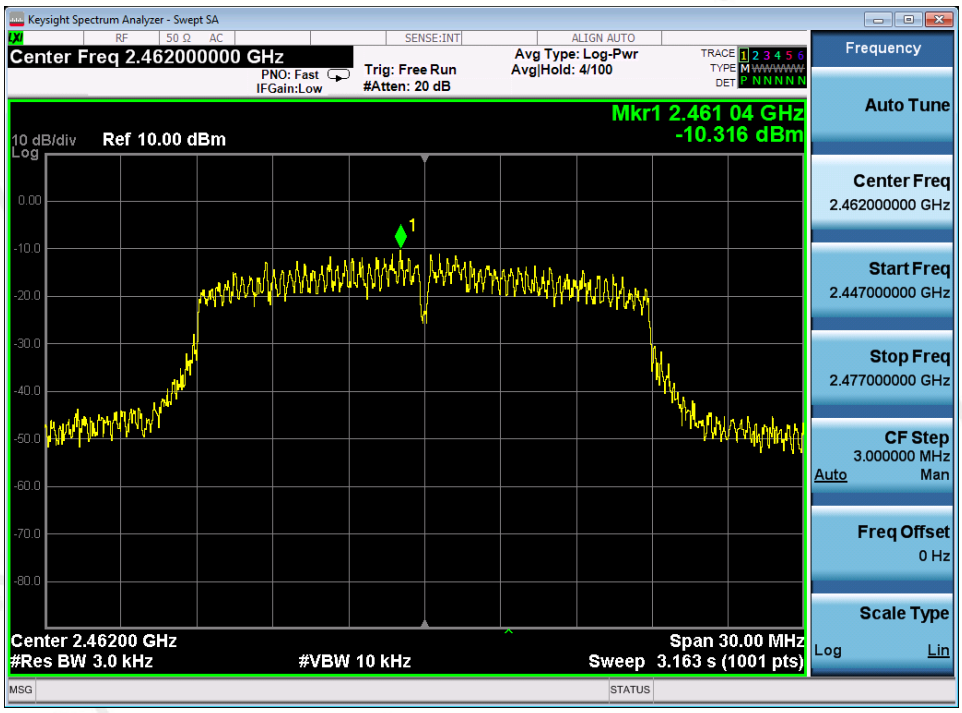
CH: 2412MHz



CH: 2437MHz



CH: 2462MHz


Keysight Spectrum Analyzer - Swept SA
Center Freq 2.462000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 4/100
Mkr1 2.461 04 GHz
-10.316 dBm
10 dB/div
Log
Ref 10.00 dBm
Center 2.46200 GHz
#Res BW 3.0 kHz
#VBW 10 kHz
Span 30.00 MHz
Sweep 3.163 s (1001 pts)
Frequency
Auto Tune
Center Freq
2.462000000 GHz
Start Freq
2.447000000 GHz
Stop Freq
2.477000000 GHz
CF Step
3.000000 MHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin

8. PEAK OUTPUT POWER TEST

8.1 Test Limit

FCC Part15(15.247), Subpart C & RSS-247 [5.3(4)]				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(3)	Peak Output Power	1 watt or 30dBm	2400-2483.5	PASS

8.2 Test Procedure

1. The EUT was directly connected to the Power meter.

8.3 Measurement Equipment Used

Same as Radiated Emission Measurement

8.4 Test Result

PASS
All the test modes completed for test.

TX 802.11b Mode			
Test Channel	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)	LIMIT (dBm)
CH01	2412	14.33	30
CH06	2437	13.57	30
CH11	2462	13.78	30
TX 802.11g Mode			
CH01	2412	13.18	30
CH06	2437	13.55	30
CH11	2462	13.70	30
TX 802.11n20 Mode			
CH01	2412	13.44	30
CH06	2437	13.51	30
CH11	2462	13.98	30

9. OUT OF BAND EMISSIONS TEST

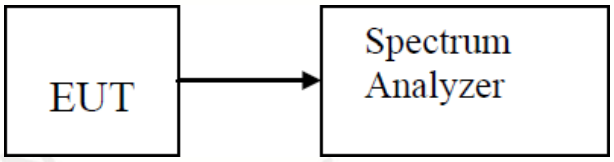
9.1 Test Limit

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.

9.2 Test Procedure

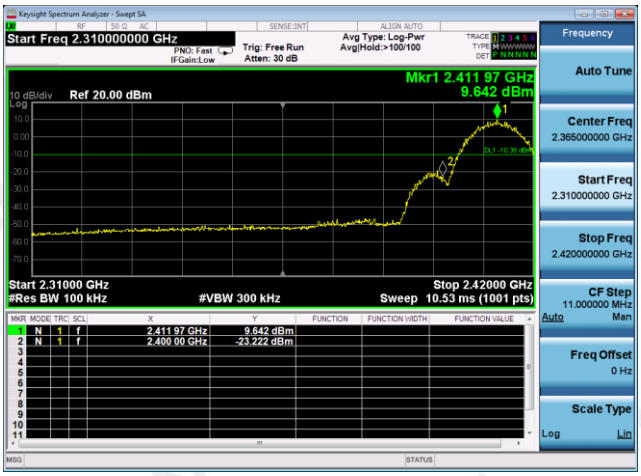
1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT as TX operation and connect directly to the spectrum analyzer.
3. Based on FCC Part15 C Section 15.247: RBW=100KHz, VBW=300KHz.
4. Set detected by the spectrum analyzer with peak detector.

9.3 Test Setup



9.4 Test Result

PASS

802.11b			
Frequency (MHz)	Delta Peak to Band emission (dBc)	Limit (dBc)	Verdict
2400.00	32.864	20	PASS
2483.50	62.495	20	PASS
			
2412		2462	

802.11g			
Frequency (MHz)	Delta Peak to Band emission (dBc)	Limit (dBc)	Verdict
2400.00	26.89	20	PASS
2483.05	37.535	20	PASS

2412

2462

802.11n HT20			
Frequency (MHz)	Delta Peak to Band emission (dBc)	Limit (dBc)	Verdict
2400.00	26.04	20	PASS
2483.50	36.422	20	PASS

2412

2462

10. SPURIOUS RF CONDUCTED EMISSION

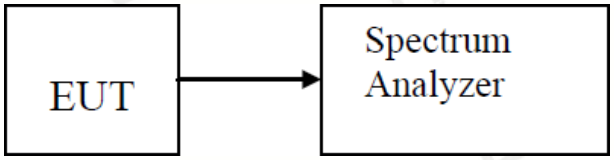
10.1 Test Limit

1. Below -20dB of the highest emission level in operating band.
2. Fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209.
3. For below 30MHz,For 9KHz-150kHz,150K-10MHz,We use the RBW 1KHz,10KHz, So the limit need to calculated by “10lg(BW1/BW2)“. for example For9KHz-150kHz,RBW 1KHz, The Limit= the highest emission level-20-10log(100/1)= the highest emission level-40.

10.2 Test Procedure

The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2013, For 9KHz-150kHz, Set RBW=1kHz and VBW= 3KHz; For 150KHz-10MHz, Set RBW=10kHz and VBW= 30KHz:For 10MHz-25GHz ,Set RBW=100kHz and VBW= 300KHz in order to measure the peak field strength, and mwasure frequeny range from 9KHz to 25GHz.

10.3 Test Setup

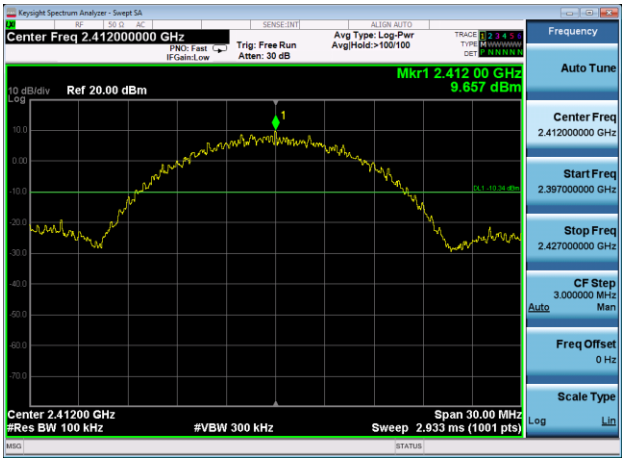


10.4 Test Result

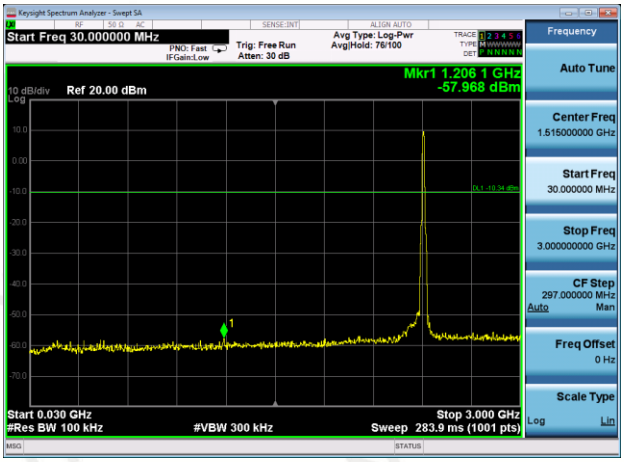
PASS

Remark: The measurement frequency range is from 9KHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandege measurement data. and record the worstest data for 802.11b in report .

Test Mode:	802.11b	Test channel :	01



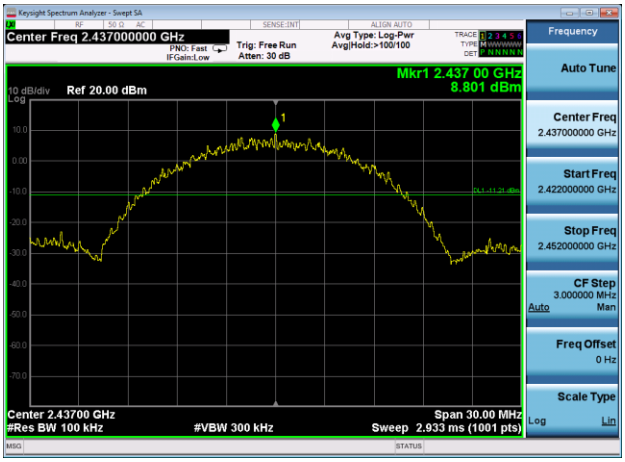
Channel 01



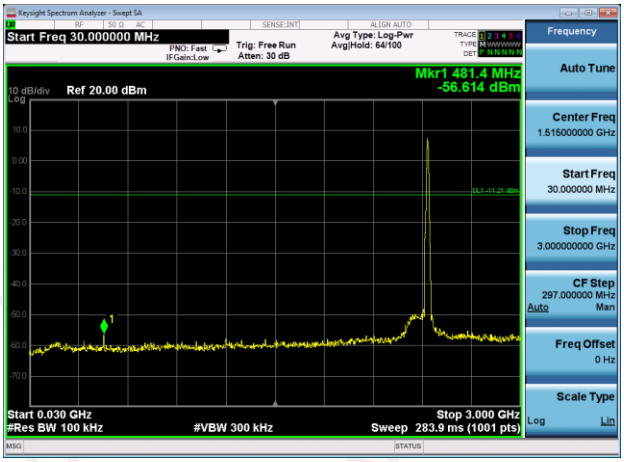
30MHz ~3GHz

3GHz~25GHz

Test Mode:	802.11b	Test channel :	06



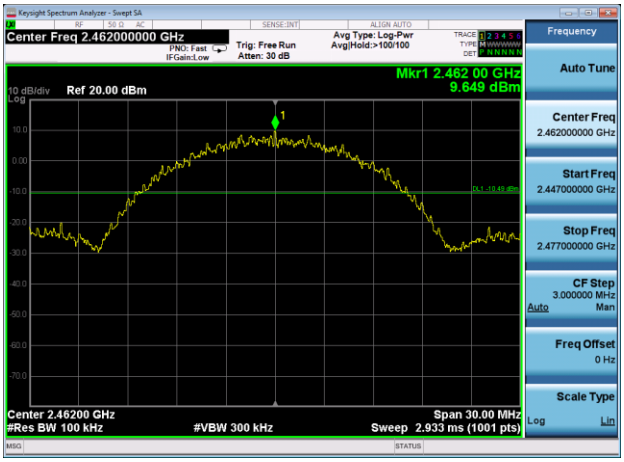
Channel 06



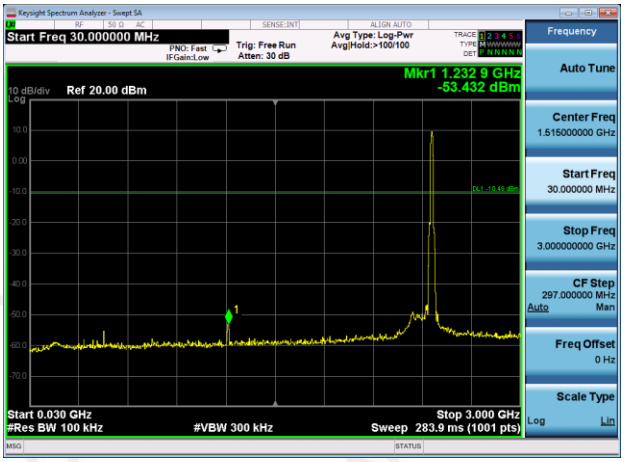
30MHz ~3GHz

3GHz~25GHz

Test Mode:	802.11b	Test channel :	11



Channel 11



30MHz ~3GHz

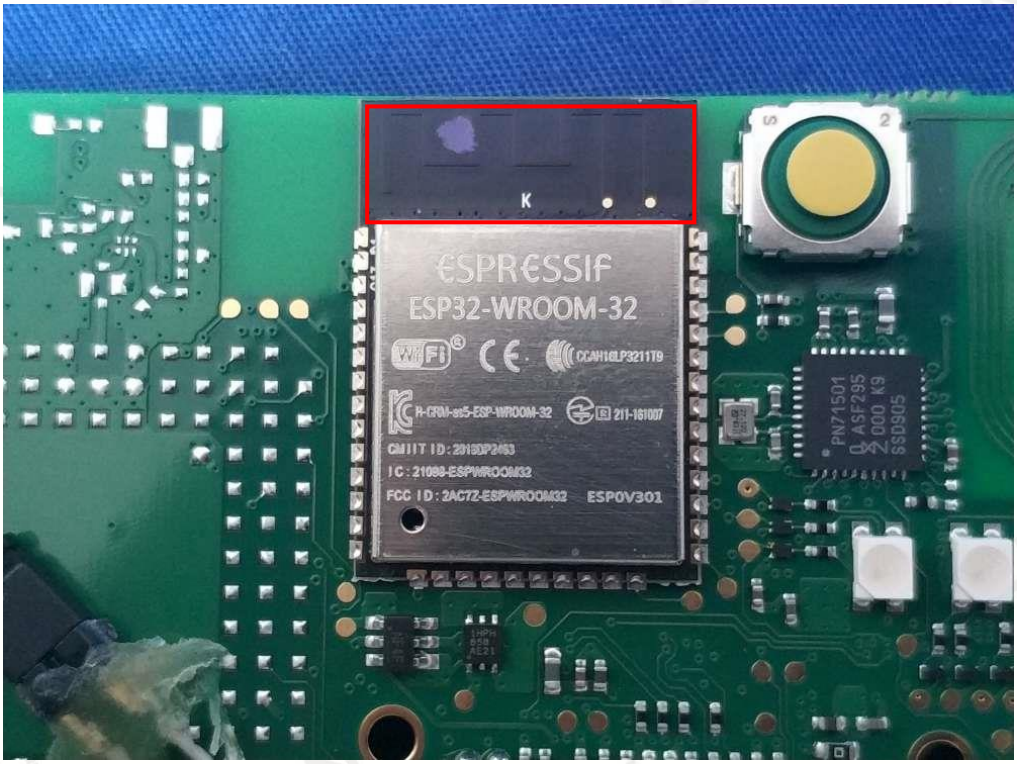
3GHz~25GHz

11. ANTENNA REQUIREMENT

Standard Applicable:
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.

Antenna Connected Construction
The antenna used in this product is an Internal Antenna, The directional gains of antenna used for transmitting is 2dBi.

ANTENNA:



12. PHOTOGRAPH OF TEST

12.1 Radiated Emission (Below 1G)

12.2 Radiated Emission (Above 1G)

End of Report