



# FCC TEST REPORT

## FCC ID:2AOEA-EVC300

|                                                                               |   |                      |
|-------------------------------------------------------------------------------|---|----------------------|
| Product                                                                       | : | Control Module       |
| Model Name                                                                    | : | EVC300               |
| Additional mode                                                               | : | N/A                  |
| Brand                                                                         | : | EcoNet Controls Inc. |
| Report No.                                                                    | : | PTC20062305601E-FC01 |
| <b>Prepared for</b>                                                           |   |                      |
| EcoNet Controls Inc.                                                          |   |                      |
| 1100 Sutton Dr., Unit 3 Burlington, Ontario Canada                            |   |                      |
|                                                                               |   |                      |
| <b>Prepared by</b>                                                            |   |                      |
| Precise Testing & Certification Co., Ltd                                      |   |                      |
| Building 1, No. 6, Tongxin Road, Dongcheng Street, Dongguan, Guangdong, China |   |                      |



Report No.: PTC20062305601E-FC01

## 1 TEST RESULT CERTIFICATION

Applicant's name : EcoNet Controls Inc.

Address : 1100 Sutton Dr., Unit 3 Burlington, Ontario Canada

Manufacture's name : NIE-TECH CO., LTD.

Address : Room 101 No.2 Four Road, Ludipu Industrial, Humen Town, Dongguan city, China

Product name : Control Module

Model name : EVC300

Additional mode : N/A

Standards : FCC CFR47 Part 15 Section 15.247

Test procedure : ANSI C63.10:2013

Test Date : Jun. 24, 2020 to Jul 2, 2020

Date of Issue : Jul 2, 2020

Test Result : Pass

This device described above has been tested by PTC, 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.

This report shall not be reproduced except in full, without the written approval of PTC, this document may be altered or revised by PTC, personal only, and shall be noted in the revision of the document.

Test Engineer:

A handwritten signature in black ink that reads 'Leo Yang' with a long, sweeping horizontal stroke at the end.

Leo Yang / Engineer

Technical Manager:

A handwritten signature in black ink that appears to read 'Chris Du' in a stylized, cursive script.

Chris Du / Manager



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## 2 Test Summary

| Test Items                  | Test Requirement                 | Result |
|-----------------------------|----------------------------------|--------|
| Conduct Emission            | 15.207                           | PASS   |
| Radiated Spurious Emissions | 15.205(a)<br>15.209<br>15.247(d) | PASS   |
| Conducted Spurious Emission | 15.247(d)                        | PASS   |
| Band edge                   | 15.247(d)<br>15.205(a)           | PASS   |
| 6dB Bandwidth               | 15.247(a)(2)                     | PASS   |
| Maximum Peak Output Power   | 15.247(b)(3)                     | PASS   |
| Power Spectral Density      | 15.247(e)                        | PASS   |
| Antenna Requirement         | 15.203                           | PASS   |

Remark:

N/A: Not Applicable



### 3 General Information

#### 3.1 General Description of E.U.T.

|                      |   |                                                                                          |
|----------------------|---|------------------------------------------------------------------------------------------|
| Product Name         | : | Control Module                                                                           |
| Model Name           | : | EVC300                                                                                   |
| Additional model     | : | N/A                                                                                      |
| Specification        | : | 802.11b/g/n HT20/40                                                                      |
| Operation Frequency  | : | 2412-2462MHz for 802.11b/g; n(HT20)<br>2422-2452MHz for 802.11n(HT40);                   |
| Number of Channel    | : | 11 channels for 802.11b/g; n(HT20)<br>7channels for 802.11n(HT40);                       |
| Type of Modulation   | : | DSSS with DBPSK/DQPSK/CCK for 802.11b;<br>OFDM with BPSK/QPSK/16QAM/64QAM for 802.11g/n; |
| Antenna installation | : | PCB antenna                                                                              |
| Antenna Gain         | : | 3 dBi                                                                                    |
| Power supply         | : | DC 12V, 1A                                                                               |
| Hardware Version     | : | N/A                                                                                      |
| Software Version     | : | N/A                                                                                      |



### 3.2 Channel List

The EUT has been tested under its typical operating condition.

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

Test of channel included the lowest and middle and highest frequency to perform the test, then record on this report.

Those data rates (802.11b: 1 Mbps; 802.11g: 6 Mbps; 802.11n (HT20): MCS0;) were used for all test.

Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Frequency and Channel list for 802.11 b/g/n (HT20/HT40)

| Channel | Frequency<br>(MHz) | Channel | Frequency<br>(MHz) | Channel | Frequency<br>(MHz) |
|---------|--------------------|---------|--------------------|---------|--------------------|
| 1       | 2412               | 5       | 2432               | 9       | 2452               |
| 2       | 2417               | 6       | 2437               | 10      | 2457               |
| 3       | 2422               | 7       | 2442               | 11      | 2462               |
| 4       | 2427               | 8       | 2447               |         |                    |

Test Frequency and Channel for 802.11 b/g/n (HT20/HT40):

| Lowest Frequency |                    | Middle Frequency |                    | Highest Frequency |                    |
|------------------|--------------------|------------------|--------------------|-------------------|--------------------|
| Channel          | Frequency<br>(MHz) | Channel          | Frequency<br>(MHz) | Channel           | Frequency<br>(MHz) |
| 1                | 2412               | 6                | 2437               | 11                | 2462               |
| 3                | 2422               | 6                | 2437               | 9                 | 2452               |



The maximum duty cycle as following table:

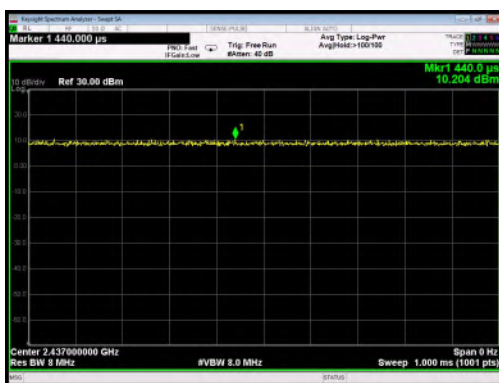
| Test Mode     | Duty Cycle(%) |
|---------------|---------------|
| 802.11b       | 100%          |
| 802.11g       | 100%          |
| 802.11n(HT20) | 100%          |
| 802.11n(HT40) | 100%          |

Test Plots:

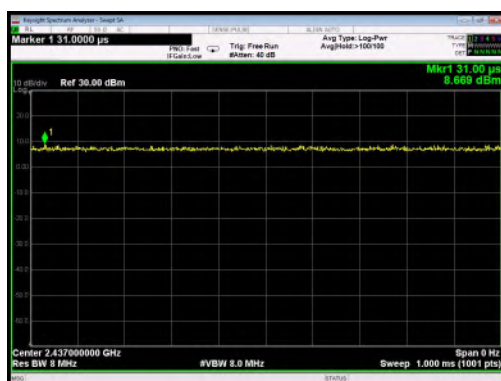
802.11b



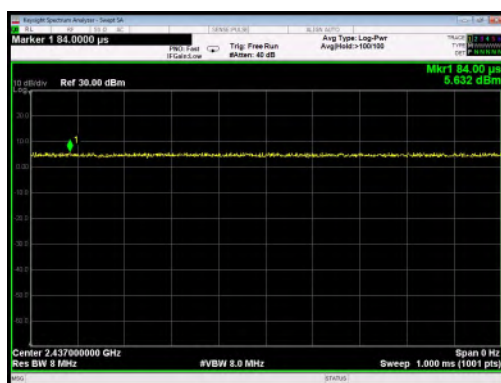
802.11g



802.11n(HT20)



802.11n(HT40)





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### **3.3 Test Site**

Precise Testing & Certification Co., Ltd

Address: Building 1, No. 6, Tongxin Road, Dongcheng Street, Dongguan, Guangdong, China

FCC Registration Number: 790290

A2LA Certificate No.: 4408.01

IC Registration Number: 12191A-1



## 4 Equipment During Test

### 4.1 Equipments List

RF Conducted Test

| Name of Equipment   | Manufacturer | Model   | Serial No.    | Characteristics | Calibration Due |
|---------------------|--------------|---------|---------------|-----------------|-----------------|
| MXG Signal Analyzer | Agilent      | N9020A  | SER MY5111038 | 10Hz-30GHz      | Aug. 21, 2020   |
| Coaxial Cable       | CDS          | 79254   | 46107086      | 10Hz-30GHz      | Aug. 21, 2020   |
| Power Meter         | Anritsu      | ML2495A | 0949003       | 300MHz-40GHz    | Aug. 28, 2020   |
| Power Sensor        | Anritsu      | MA2411B | 0917017       | 300MHz-40GHz    | Aug. 28, 2020   |

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

| Name of Equipment            | Manufacturer  | Model      | Serial No.   | Characteristics | Calibration Due |
|------------------------------|---------------|------------|--------------|-----------------|-----------------|
| EMI Test Receiver            | Rohde&Schwarz | ESCI       | 101417       | 9KHz-3GHz       | Aug. 28, 2020   |
| Loop Antenna                 | Schwarzbeck   | FMZB 1519  | 012          | 9 KHz -30MHz    | Aug. 28, 2020   |
| Bilog Antenna                | SCHWARZBECK   | VULB9160   | 9160-3355    | 25MHz-2GHz      | Aug. 22, 2020   |
| Preamplifier (low frequency) | SCHWARZBECK   | BBV 9475   | 9745-0013    | 1MHz-1GHz       | Aug. 21, 2020   |
| Cable                        | Schwarzbeck   | PLF-100    | 549489       | 9KHz-3GHz       | Aug. 21, 2020   |
| Spectrum Analyzer            | Agilent       | E4407B     | MY45109572   | 9KHz-40GHz      | Aug. 28, 2020   |
| Horn Antenna                 | SCHWARZBECK   | 9120D      | 9120D-1246   | 1GHz-18GHz      | Apr. 13, 2021   |
| Power Amplifier              | LUNAR EM      | LNA1G18-40 | J10100000081 | 1GHz-26.5GHz    | Aug. 21, 2020   |
| Horn Antenna                 | SCHWARZBECK   | BBHA 9170  | 9170-181     | 14GHz-40GHz     | Apr. 13, 2021   |
| Amplifier                    | SCHWARZBECK   | BBV 9721   | 9721-205     | 18GHz-40GHz     | Aug. 21, 2020   |



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|          |     |        |      |              |               |
|----------|-----|--------|------|--------------|---------------|
| Cable    | H+S | CBL-26 | N/A  | 1GHz-26.5GHz | Aug. 21, 2020 |
| RF Cable | R&S | R204   | R21X | 1GHz-40GHz   | Aug. 21, 2020 |

#### Conducted Emissions

| Name of Equipment        | Manufacturer  | Model  | Serial No. | Characteristics | Calibration Due |
|--------------------------|---------------|--------|------------|-----------------|-----------------|
| EMI Test Receiver        | Rohde&Schwarz | ESCI   | 101417     | 9KHz-3GHz       | Aug. 28, 2020   |
| Artificial Mains Network | Rohde&Schwarz | ENV216 | 102453     | 9KHz-300MHz     | Aug. 21, 2020   |
| Artificial Mains Network | Rohde&Schwarz | ENV216 | 101342     | 9KHz-300MHz     | Aug. 21, 2020   |



## 4.2 Measurement Uncertainty

| Parameter                          | Uncertainty              |
|------------------------------------|--------------------------|
| RF output power, conducted         | $\pm 1.0\text{dB}$       |
| Power Spectral Density, conducted  | $\pm 2.2\text{dB}$       |
| Radio Frequency                    | $\pm 1 \times 10^{-6}$   |
| Bandwidth                          | $\pm 1.5 \times 10^{-6}$ |
| Time                               | $\pm 2\%$                |
| Duty Cycle                         | $\pm 2\%$                |
| Temperature                        | $\pm 1^{\circ}\text{C}$  |
| Humidity                           | $\pm 5\%$                |
| DC and low frequency voltages      | $\pm 3\%$                |
| Conducted Emissions (150kHz~30MHz) | $\pm 3.64\text{dB}$      |
| Radiated Emission(30MHz~1GHz)      | $\pm 5.03\text{dB}$      |
| Radiated Emission(1GHz~25GHz)      | $\pm 4.74\text{dB}$      |



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#### 4.3 Description of Support Units

| Equipment     | Model No.N/A                                | Series No. |
|---------------|---------------------------------------------|------------|
| Control Mdule | Input:100-240V~, , 50-60Hz<br>Output:12V/1A | N/A        |

## 5 Conducted Emission

Test Requirement: : FCC CFR 47 Part 15 Section 15.207

Test Method : ANSI C63.10: 2013

Test Result : PASS

Frequency Range : 150kHz to 30MHz

Class/Severity : Class B

### 5.1 E.U.T. Operation

Operating Environment :

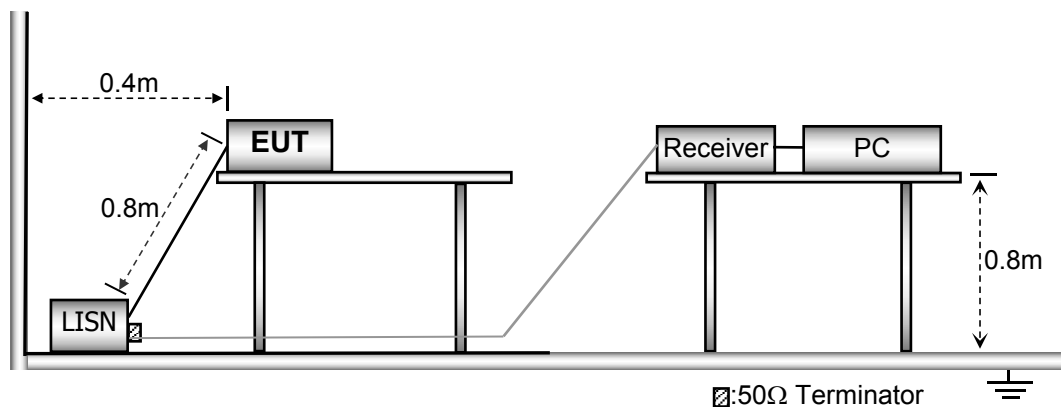
Temperature : 23.9 °C

Humidity : 51.4 % RH

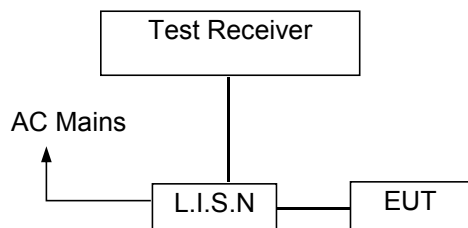
Atmospheric Pressure : 101.21kPa

### 5.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10:2013.



### 5.3 Test SET-UP (Block Diagram of Configuration)



### 5.4 Measurement Procedure

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured was complete.

### 5.5 Conducted Emission Limit

#### Conducted Emission

| Frequency(MHz) | Quasi-peak | Average |
|----------------|------------|---------|
| 0.15-0.5       | 66-56      | 56-46   |
| 0.5-5.0        | 56         | 46      |
| 5.0-30.0       | 60         | 50      |

#### Note:

1. The lower limit shall apply at the transition frequencies
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

### 5.6 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

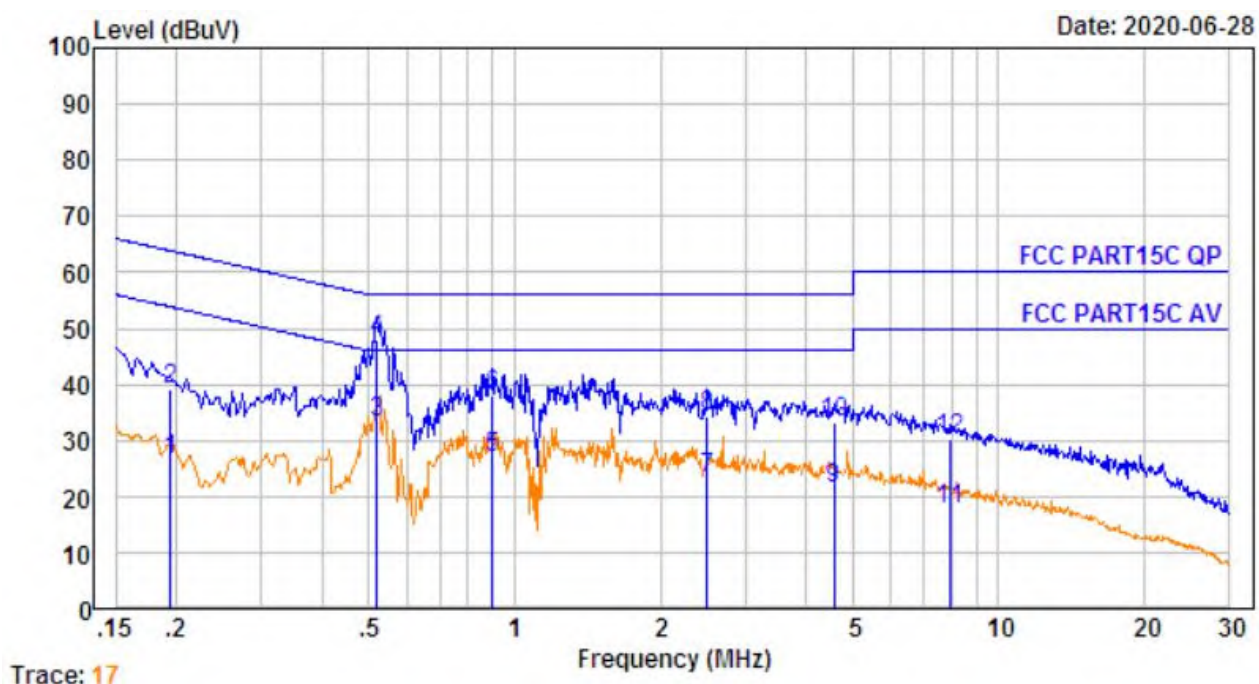
### 5.7 Conducted Emission Test Result

Pass.

Please refer to the following pages.



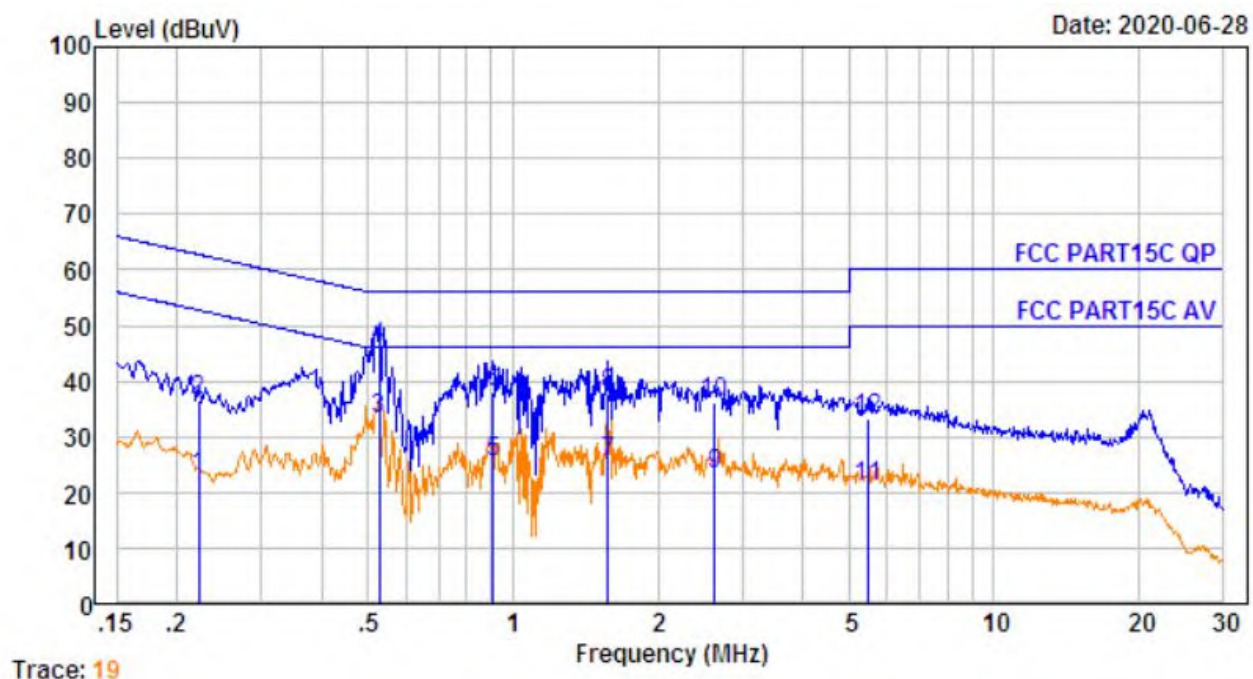
Line- AC 120V/60Hz



| No. | Freq<br>MHz | Cable<br>Loss<br>dB | AMN<br>Factor<br>dB | Receiver<br>Reading<br>dBUV | Emission<br>Level<br>dBUV | Limit<br>dBUV | Over<br>Limit<br>dB | Remark  |
|-----|-------------|---------------------|---------------------|-----------------------------|---------------------------|---------------|---------------------|---------|
| 1.  | 0.194       | 0.27                | 9.59                | 16.53                       | 26.39                     | 53.84         | -27.45              | Average |
| 2.  | 0.194       | 0.27                | 9.59                | 29.31                       | 39.17                     | 63.84         | -24.67              | QP      |
| 3.  | 0.518       | 0.43                | 9.61                | 23.05                       | 33.09                     | 46.00         | -12.91              | Average |
| 4.  | 0.518       | 0.43                | 9.61                | 37.83                       | 47.87                     | 56.00         | -8.13               | QP      |
| 5.  | 0.899       | 0.45                | 9.61                | 16.74                       | 26.80                     | 46.00         | -19.20              | Average |
| 6.  | 0.899       | 0.45                | 9.61                | 27.92                       | 37.98                     | 56.00         | -18.02              | QP      |
| 7.  | 2.500       | 0.47                | 9.62                | 13.01                       | 23.10                     | 46.00         | -22.90              | Average |
| 8.  | 2.500       | 0.47                | 9.62                | 24.06                       | 34.15                     | 56.00         | -21.85              | QP      |
| 9.  | 4.574       | 0.49                | 9.67                | 11.21                       | 21.37                     | 46.00         | -24.63              | Average |
| 10. | 4.574       | 0.49                | 9.67                | 22.88                       | 33.04                     | 56.00         | -22.96              | QP      |
| 11. | 7.977       | 0.55                | 9.74                | 7.58                        | 17.87                     | 50.00         | -32.13              | Average |
| 12. | 7.977       | 0.55                | 9.74                | 19.90                       | 30.19                     | 60.00         | -29.81              | QP      |



Neutral-AC 120V/60Hz



| No. | Freq<br>MHz | Cable<br>Loss<br>dB | AMN<br>Factor<br>dB | Receiver<br>Reading<br>dBUV | Emission<br>Level<br>dBUV | Limit<br>dBUV | Over<br>Limit<br>dB | Remark  |
|-----|-------------|---------------------|---------------------|-----------------------------|---------------------------|---------------|---------------------|---------|
| 1.  | 0.222       | 0.30                | 9.61                | 13.12                       | 23.03                     | 52.74         | -29.71              | Average |
| 2.  | 0.222       | 0.30                | 9.61                | 26.73                       | 36.64                     | 62.74         | -26.10              | QP      |
| 3.  | 0.527       | 0.43                | 9.63                | 23.09                       | 33.15                     | 46.00         | -12.85              | Average |
| 4.  | 0.527       | 0.43                | 9.63                | 36.23                       | 46.29                     | 56.00         | -9.71               | QP      |
| 5.  | 0.909       | 0.45                | 9.64                | 15.32                       | 25.41                     | 46.00         | -20.59              | Average |
| 6.  | 0.909       | 0.45                | 9.64                | 28.02                       | 38.11                     | 56.00         | -17.89              | QP      |
| 7.  | 1.577       | 0.47                | 9.64                | 15.31                       | 25.42                     | 46.00         | -20.58              | Average |
| 8.  | 1.577       | 0.47                | 9.64                | 27.45                       | 37.56                     | 56.00         | -18.44              | QP      |
| 9.  | 2.622       | 0.47                | 9.65                | 13.00                       | 23.12                     | 46.00         | -22.88              | Average |
| 10. | 2.622       | 0.47                | 9.65                | 25.88                       | 36.00                     | 56.00         | -20.00              | QP      |
| 11. | 5.447       | 0.51                | 9.72                | 10.78                       | 21.01                     | 50.00         | -28.99              | Average |
| 12. | 5.447       | 0.51                | 9.72                | 22.81                       | 33.04                     | 60.00         | -26.96              | QP      |



## 6 Radiated Spurious Emissions

Test Requirement : FCC CFR47 Part 15 Section 15.209 & 15.247  
 Test Method : ANSI C63.10:2013  
 Test Result : PASS  
 Measurement Distance : 3m  
 Limit : See the follow table

| Frequency (MHz) | Field Strength        |              | Field Strength Limit at 3m Measurement Dist |                                       |
|-----------------|-----------------------|--------------|---------------------------------------------|---------------------------------------|
|                 | uV/m                  | Distance (m) | uV/m                                        | dBuV/m                                |
| 0.009 ~ 0.490   | $2400/F(\text{kHz})$  | 300          | $10000 * 2400/F(\text{kHz})$                | $20\log^{(2400/F(\text{kHz}))} + 80$  |
| 0.490 ~ 1.705   | $24000/F(\text{kHz})$ | 30           | $100 * 24000/F(\text{kHz})$                 | $20\log^{(24000/F(\text{kHz}))} + 40$ |
| 1.705 ~ 30      | 30                    | 30           | $100 * 30$                                  | $20\log^{(30)} + 40$                  |
| 30 ~ 88         | 100                   | 3            | 100                                         | $20\log^{(100)}$                      |
| 88 ~ 216        | 150                   | 3            | 150                                         | $20\log^{(150)}$                      |
| 216 ~ 960       | 200                   | 3            | 200                                         | $20\log^{(200)}$                      |
| Above 960       | 500                   | 3            | 500                                         | $20\log^{(500)}$                      |

### 6.1 EUT Operation

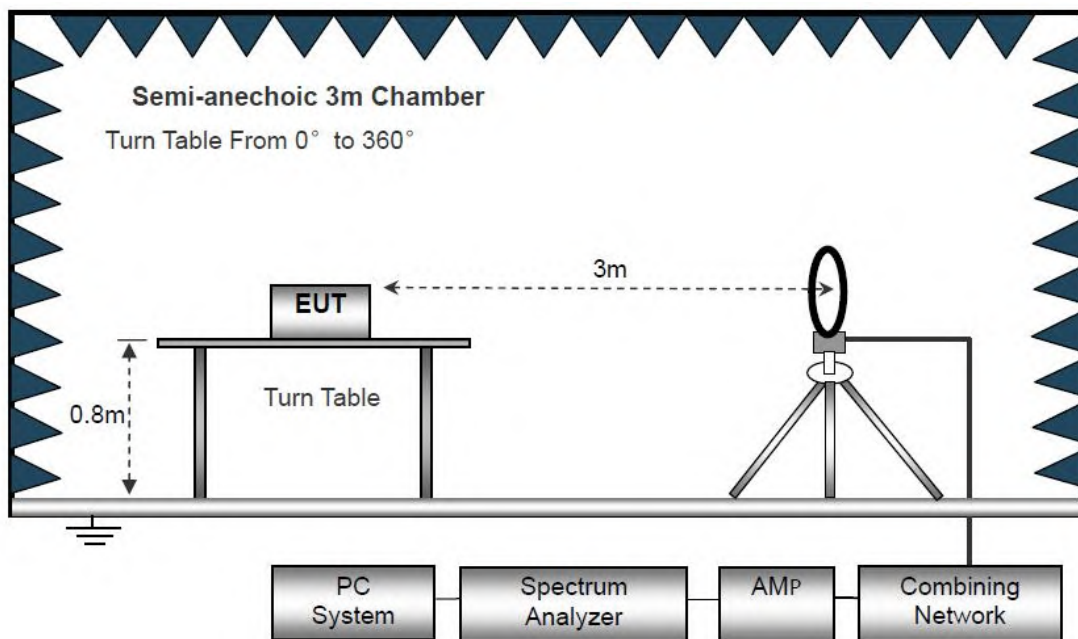
Operating Environment :

Temperature: : 24.5 °C  
 Humidity: : 52 % RH  
 Atmospheric Pressure: : 101.3kPa  
 Test Voltage : AC 120V/60HZ

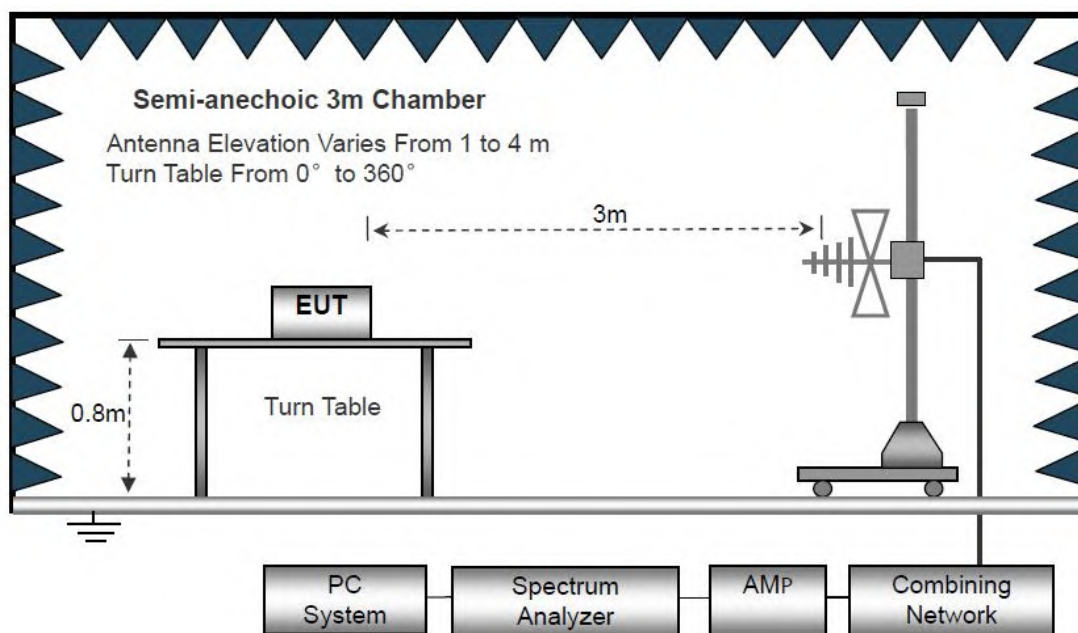
## 6.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site

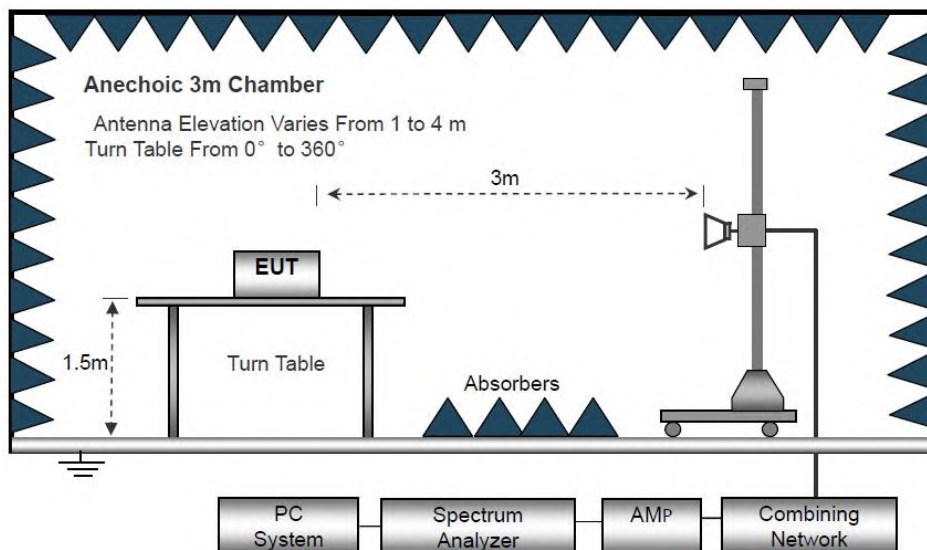
The test setup for emission measurement below 30MHz



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz



### 6.3 Spectrum Analyzer Setup

|                | Frequency    | Detector   | RBW    | VBW    | Remark           |
|----------------|--------------|------------|--------|--------|------------------|
| Receiver Setup | Below 30MHz  | --         | 10kHz  | 10kHz  | --               |
|                | 30MHz ~ 1GHz | Quasi-peak | 120kHz | 300kHz | Quasi-peak Value |
|                | Above 1GHz   | Peak       | 1MHz   | 3MHz   | Peak Value       |
|                |              | RMS        | 1MHz   | 3MHz   | Average Value    |



## 6.4 Test Procedure

1. Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane, And above 1000MHz, The EUT was placed on a styrofoam 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 moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
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 radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.
8. The test above 1GHz must be use the fully anechoic room, and the test below 1GHz use the half anechoic room



## 6.5 Summary of Test Results

### Test Frequency: 9KHz-30MHz

| Freq.<br>(MHz) | Ant.Pol.<br>H/V | Emission Level<br>(dBuV/m) | Limit 3m<br>(dBuV/m) | Over<br>(dB) |
|----------------|-----------------|----------------------------|----------------------|--------------|
| --             | --              | --                         | --                   | >20          |

#### Note:

The amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

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

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

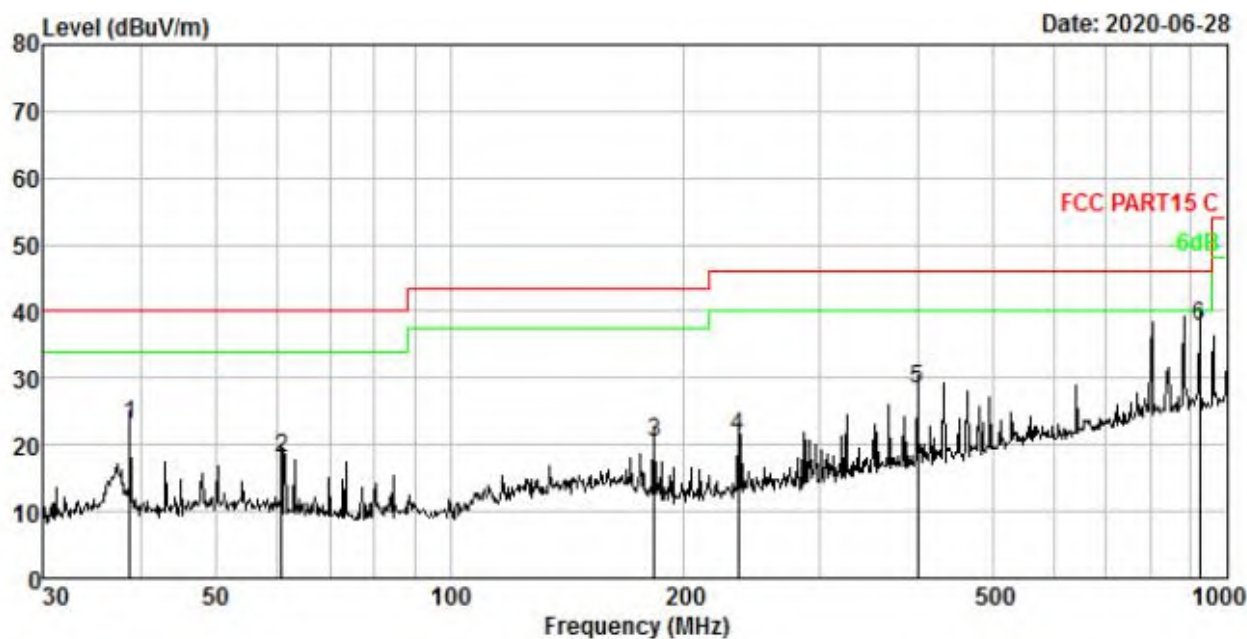
### Test Frequency: 30MHz ~ 1GHz

All the modulation modes were tested the data of the worst mode (TX 802.11b Low Channel) are recorded in the following pages and the others modulation methods do not exceed the limits.

Please refer to the following test plots:



Antenna Polarization: Horizontal

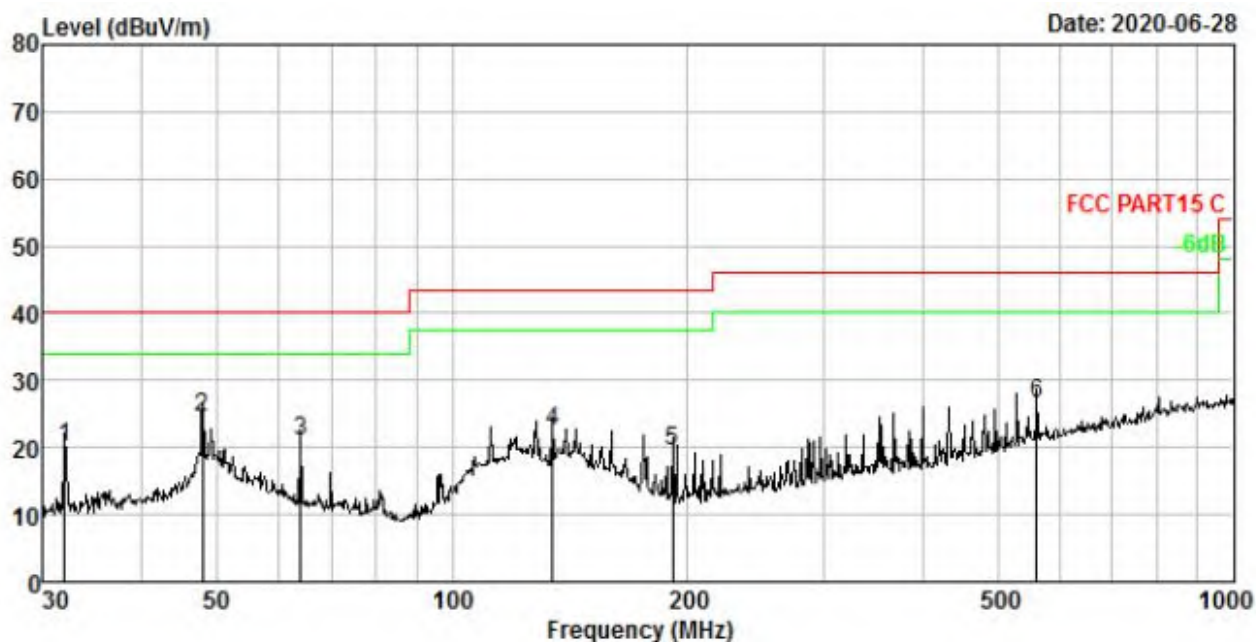


| No. | Freq<br>MHz | Cable<br>Loss<br>dB | ANT<br>Factor<br>dB/m | Receiver<br>Reading<br>dBuV | Preamplifier<br>Factor<br>dB | Emission<br>Level<br>dBuV/m | Limit<br>dBuV/m | Over<br>Limit<br>dB | Remark |
|-----|-------------|---------------------|-----------------------|-----------------------------|------------------------------|-----------------------------|-----------------|---------------------|--------|
| 1.  | 38.752      | 1.64                | 12.12                 | 39.11                       | 29.91                        | 22.96                       | 40.00           | -17.04              | QP     |
| 2.  | 60.704      | 2.41                | 11.60                 | 34.05                       | 29.94                        | 18.12                       | 40.00           | -21.88              | QP     |
| 3.  | 183.201     | 4.31                | 12.25                 | 33.93                       | 30.03                        | 20.46                       | 43.50           | -23.04              | QP     |
| 4.  | 234.991     | 4.74                | 12.08                 | 34.64                       | 30.15                        | 21.31                       | 46.00           | -24.69              | QP     |
| 5.  | 400.432     | 5.66                | 14.81                 | 38.55                       | 30.70                        | 28.32                       | 46.00           | -17.68              | QP     |
| 6.  | 922.516     | 7.09                | 22.19                 | 39.63                       | 31.04                        | 37.87                       | 46.00           | -8.13               | QP     |

Remark: Emission Level = Reading + Cable Loss + ANT Factor - AMP Factor



Antenna Polarization: Vertical



| No. | Freq<br>MHz | Cable<br>Loss<br>dB | ANT<br>Factor<br>dB/m | Receiver<br>Reading<br>dBuV | Preamp<br>Factor<br>dB | Emission<br>Level<br>dBuV/m | Limit<br>dBuV/m | Over<br>Limit<br>dB | Remark |
|-----|-------------|---------------------|-----------------------|-----------------------------|------------------------|-----------------------------|-----------------|---------------------|--------|
| 1.  | 31.955      | 1.31                | 11.90                 | 36.85                       | 29.90                  | 20.16                       | 40.00           | -19.84              | QP     |
| 2.  | 47.994      | 2.01                | 12.18                 | 40.17                       | 29.92                  | 24.44                       | 40.00           | -15.56              | QP     |
| 3.  | 63.983      | 2.50                | 11.14                 | 37.13                       | 29.94                  | 20.83                       | 40.00           | -19.17              | QP     |
| 4.  | 134.559     | 3.78                | 12.97                 | 35.63                       | 30.01                  | 22.37                       | 43.50           | -21.13              | QP     |
| 5.  | 191.745     | 4.39                | 11.60                 | 33.56                       | 30.04                  | 19.51                       | 43.50           | -23.99              | QP     |
| 6.  | 560.693     | 6.23                | 18.54                 | 32.82                       | 30.97                  | 26.62                       | 46.00           | -19.38              | QP     |

Remark: Emission Level = Reading + Cable Loss + ANT Factor - AMP Factor



# Test Frequency: From 1GHz to 18GHz

Worst case 802.11b

| Test Mode: 2412 |                   |                       |                 |                    | Test channel: Lowest |                |                 |      |
|-----------------|-------------------|-----------------------|-----------------|--------------------|----------------------|----------------|-----------------|------|
| Peak Value      |                   |                       |                 |                    |                      |                |                 |      |
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m)       | Limit (dBuV/m) | Over Limit (dB) | Pol. |
| 4824.00         | 39.99             | 32.29                 | 4.10            | 28.45              | 47.93                | 74.00          | -26.07          | V    |
| 7236.00         | 34.03             | 35.99                 | 6.22            | 27.83              | 48.41                | 74.00          | -25.59          | V    |
| 9648.00         | 32.58             | 38.11                 | 7.83            | 25.10              | 53.42                | 74.00          | -20.58          | V    |
| 4824.00         | 38.71             | 32.29                 | 4.10            | 28.45              | 46.65                | 74.00          | -27.35          | H    |
| 7236.00         | 33.80             | 35.99                 | 6.22            | 27.83              | 48.18                | 74.00          | -25.82          | H    |
| 9648.00         | 32.17             | 38.11                 | 7.83            | 25.10              | 53.01                | 74.00          | -20.99          | H    |
| Average Value   |                   |                       |                 |                    |                      |                |                 |      |
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m)       | Limit (dBuV/m) | Over Limit (dB) | Pol. |
| 4824.00         | 29.10             | 32.29                 | 4.10            | 28.45              | 37.04                | 54.00          | -16.96          | V    |
| 7236.00         | 22.90             | 35.99                 | 6.22            | 27.83              | 37.28                | 54.00          | -16.72          | V    |
| 9648.00         | 22.93             | 38.11                 | 7.83            | 25.10              | 43.77                | 54.00          | -10.23          | V    |
| 4824.00         | 28.26             | 32.29                 | 4.10            | 28.45              | 36.20                | 54.00          | -17.80          | H    |
| 7236.00         | 22.39             | 35.99                 | 6.22            | 27.83              | 36.77                | 54.00          | -17.23          | H    |
| 9648.00         | 21.92             | 38.11                 | 7.83            | 25.10              | 42.76                | 54.00          | -11.24          | H    |

Worst case 802.11b

|                    |                      |                             |                    |                          |                      |                   |                    |      |
|--------------------|----------------------|-----------------------------|--------------------|--------------------------|----------------------|-------------------|--------------------|------|
| Test Mode: 2437    |                      |                             |                    |                          | Test channel: Middle |                   |                    |      |
| Peak Value         |                      |                             |                    |                          |                      |                   |                    |      |
| Frequency<br>(MHz) | Read Level<br>(dBuV) | Antenna<br>Factor<br>(dB/m) | Cable Loss<br>(dB) | Preamp<br>Factor<br>(dB) | Level<br>(dBuV/m)    | Limit<br>(dBuV/m) | Over Limit<br>(dB) | Pol. |



| 4874.00         | 39.10             | 32.35                 | 4.12            | 28.44              | 47.13          | 74.00          | -26.87          | V    |
|-----------------|-------------------|-----------------------|-----------------|--------------------|----------------|----------------|-----------------|------|
| 7311.00         | 34.13             | 36.08                 | 6.30            | 27.74              | 48.77          | 74.00          | -25.23          | V    |
| 9748.00         | 33.62             | 38.25                 | 7.91            | 24.65              | 55.13          | 74.00          | -18.87          | V    |
| 4874.00         | 39.62             | 32.35                 | 4.12            | 28.44              | 47.65          | 74.00          | -26.35          | H    |
| 7311.00         | 32.79             | 36.08                 | 6.30            | 27.74              | 47.43          | 74.00          | -26.57          | H    |
| 9748.00         | 33.52             | 38.25                 | 7.91            | 24.65              | 55.03          | 74.00          | -18.97          | H    |
| Average Value   |                   |                       |                 |                    |                |                |                 |      |
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Pol. |
| 4874.00         | 29.97             | 32.35                 | 4.12            | 28.44              | 38.00          | 54.00          | -16.00          | V    |
| 7311.00         | 22.45             | 36.08                 | 6.30            | 27.74              | 37.09          | 54.00          | -16.91          | V    |
| 9748.00         | 22.88             | 38.25                 | 7.91            | 24.65              | 44.39          | 54.00          | -9.61           | V    |
| 4874.00         | 29.74             | 32.35                 | 4.12            | 28.44              | 37.77          | 54.00          | -16.23          | H    |
| 7311.00         | 21.89             | 36.08                 | 6.30            | 27.74              | 36.53          | 54.00          | -17.47          | H    |
| 9748.00         | 23.24             | 38.25                 | 7.91            | 24.65              | 44.75          | 54.00          | -9.25           | H    |

Worst case 802.11b

|                    |                      |                             |                    |                          |                    |                   |                    |      |
|--------------------|----------------------|-----------------------------|--------------------|--------------------------|--------------------|-------------------|--------------------|------|
| Test Mode: 2462    |                      |                             |                    |                          | Test channel: High |                   |                    |      |
| Peak Value         |                      |                             |                    |                          |                    |                   |                    |      |
| Frequency<br>(MHz) | Read Level<br>(dBuV) | Antenna<br>Factor<br>(dB/m) | Cable Loss<br>(dB) | Preamp<br>Factor<br>(dB) | Level<br>(dBuV/m)  | Limit<br>(dBuV/m) | Over Limit<br>(dB) | Pol. |
| 4924.00            | 44.45                | 32.41                       | 4.14               | 28.42                    | 52.58              | 74.00             | -21.42             | V    |
| 7386.00            | 34.69                | 36.15                       | 6.36               | 27.68                    | 49.52              | 74.00             | -24.48             | V    |
| 9848.00            | 36.84                | 38.35                       | 7.97               | 24.33                    | 58.83              | 74.00             | -15.17             | V    |
| 4924.00            | 43.82                | 32.41                       | 4.14               | 28.42                    | 51.95              | 74.00             | -22.05             | H    |
| 7386.00            | 33.63                | 36.15                       | 6.36               | 27.68                    | 48.46              | 74.00             | -25.54             | H    |
| 9848.00            | 33.02                | 38.35                       | 7.97               | 24.33                    | 55.01              | 74.00             | -18.99             | H    |



| Average Value   |                   |                       |                 |                    |                |                |                 |      |
|-----------------|-------------------|-----------------------|-----------------|--------------------|----------------|----------------|-----------------|------|
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Pol. |
| 4924.00         | 35.40             | 32.41                 | 4.14            | 28.42              | 43.53          | 54.00          | -10.47          | V    |
| 7386.00         | 24.62             | 36.15                 | 6.36            | 27.68              | 39.45          | 54.00          | -14.55          | V    |
| 9848.00         | 25.35             | 38.35                 | 7.97            | 24.33              | 47.34          | 54.00          | -6.66           | V    |
| 4924.00         | 34.21             | 32.41                 | 4.14            | 28.42              | 42.34          | 54.00          | -11.66          | H    |
| 7386.00         | 23.03             | 36.15                 | 6.36            | 27.68              | 37.86          | 54.00          | -16.14          | H    |
| 9848.00         | 22.29             | 38.35                 | 7.97            | 24.33              | 44.28          | 54.00          | -9.72           | H    |

Note:

1. The testing has been conformed to  $10 \times 2462\text{MHz} = 24620\text{MHz}$ .
2. All other emissions more than 30dB below the limit.
3. Factor = Antenna Factor + Cable Loss – Pre-amplifier.  
Emission Level = Reading + Factor  
Margin=Emission Level-Limit
4. X-Axis, Y-Axis and Z-Axis were investigated. The results above show only the worst case.

Spurious Emission in Restricted Band 2310-2390MHz and 2483.5-2500MHz

2.4G WiFi (802.11b/g/n)mode have been tested, and the worst result(802.11g) was report as below

Test Mode: 802.11g Low Channel 2412MHz

| Test Mode: 802.11g Low Channel 2412MHz |                   |                       |                 |                    |                |                |           |              | Test Value |
|----------------------------------------|-------------------|-----------------------|-----------------|--------------------|----------------|----------------|-----------|--------------|------------|
| Frequency (MHz)                        | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit (dBuV/m) | Over (dB) | Polarity H/V |            |
| 2390.00                                | 52.06             | 27.39                 | 2.77            | 34.01              | 48.21          | 74.00          | -25.79    | H            | Peak       |
| 2400.00                                | 61.21             | 27.42                 | 2.78            | 34.01              | 57.40          | 74.00          | -16.60    | H            |            |
| 2390.00                                | 53.77             | 27.39                 | 2.77            | 34.01              | 49.92          | 74.00          | -24.08    | V            |            |
| 2400.00                                | 63.12             | 27.42                 | 2.78            | 34.01              | 59.31          | 74.00          | -14.69    | V            |            |
| 2390.00                                | 38.70             | 27.39                 | 2.77            | 34.01              | 34.85          | 54.00          | -19.15    | H            | Average    |
| 2400.00                                | 47.04             | 27.42                 | 2.78            | 34.01              | 43.23          | 54.00          | -10.77    | H            |            |
| 2390.00                                | 40.56             | 27.39                 | 2.77            | 34.01              | 36.71          | 54.00          | -17.29    | V            |            |
| 2400.00                                | 48.20             | 27.42                 | 2.78            | 34.01              | 44.39          | 54.00          | -9.61     | V            |            |



Test Mode: 802.11g High Channel 2462MHz

| Test Mode: 802.11g High Channel 2462MHz |                   |                       |                 |                    |                |                |           |              |            |
|-----------------------------------------|-------------------|-----------------------|-----------------|--------------------|----------------|----------------|-----------|--------------|------------|
| Frequency (MHz)                         | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit (dBuV/m) | Over (dB) | Polarity H/V | Test Value |
| 2483.50                                 | 52.89             | 27.70                 | 2.84            | 34.03              | 49.40          | 74.00          | -24.60    | H            | Peak       |
| 2500.00                                 | 48.59             | 27.75                 | 2.86            | 34.03              | 45.17          | 74.00          | -28.83    | H            |            |
| 2483.50                                 | 55.24             | 27.70                 | 2.84            | 34.03              | 51.75          | 74.00          | -22.25    | V            |            |
| 2500.00                                 | 51.18             | 27.75                 | 2.86            | 34.03              | 47.76          | 74.00          | -26.24    | V            |            |
| 2483.50                                 | 39.13             | 27.70                 | 2.84            | 34.03              | 35.64          | 54.00          | -18.36    | H            | Average    |
| 2500.00                                 | 35.15             | 27.75                 | 2.86            | 34.03              | 31.73          | 54.00          | -22.27    | H            |            |
| 2483.50                                 | 41.11             | 27.70                 | 2.84            | 34.03              | 37.62          | 54.00          | -16.38    | V            |            |
| 2500.00                                 | 37.05             | 27.75                 | 2.86            | 34.03              | 33.63          | 54.00          | -20.37    | V            |            |

### Test Frequency: From 18GHz to 25GHz

The measurements were more than 20dB below the limit and not reported.



## 7 Conducted Spurious Emission

|                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement | : | FCC CFR47 Part 15 Section 15.247                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Test Method      | : | ANSI C63.10:2013                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Test Limit       | : | Regulation 15.247 (d), 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)). |

### 7.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto  
Detector function = peak, Trace = max hold

### 7.2 Test Result



802.11 b

Low Channel Worstcase mode



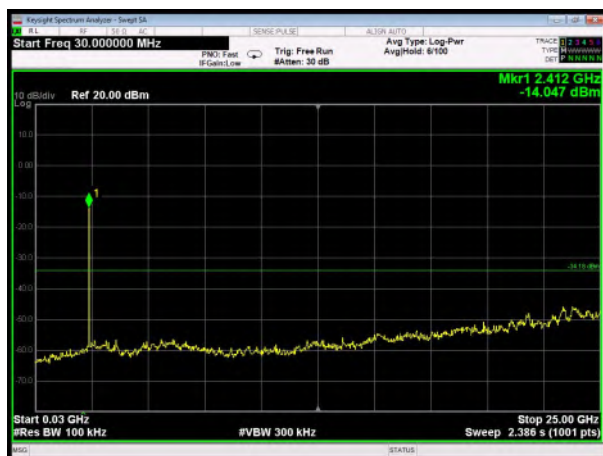
802.11 g

Low Channel Worstcase mode



802.11 HT20

Low Channel Worstcase mode



802.11 HT40

Low Channel Worstcase mode





## 8 Band Edge Measurement

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement | : Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Test Method      | : ANSI C63.10:2013                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Test Limit       | : Regulation 15.247 (d), 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)). |

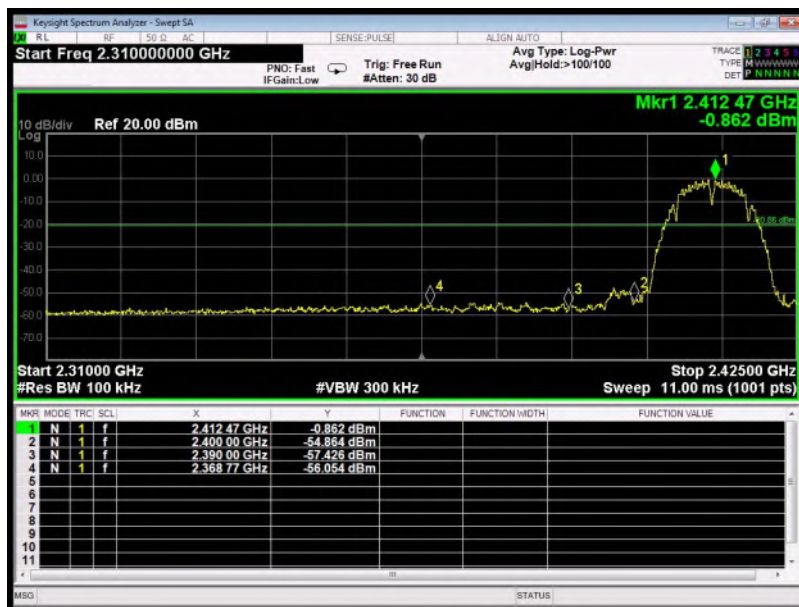
### 8.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto  
Detector function = peak, Trace = max hold



## 8.2 Test Result

802.11b



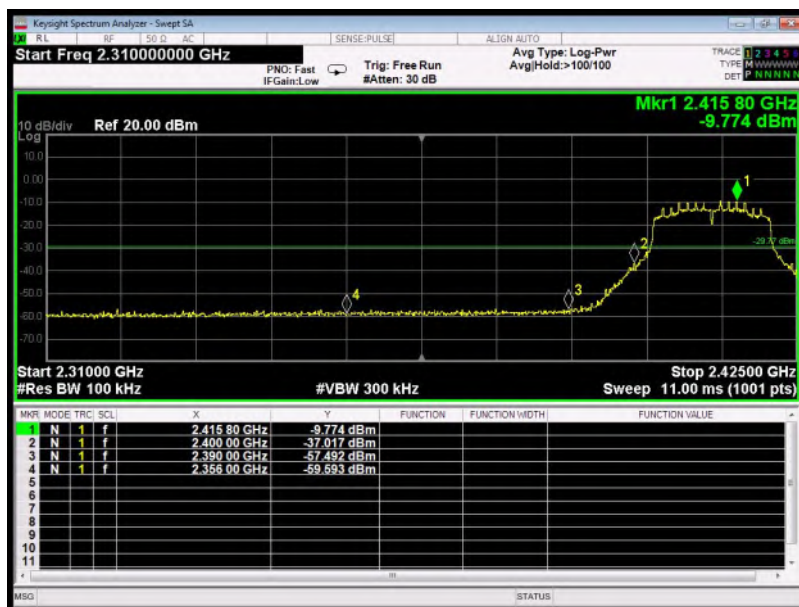


802.11g





802.11n-HT20





802.11n-HT40





## 9 6dB Bandwidth Measurement

Test Requirement : FCC CFR47 Part 15 Section 15.247

Test Method : ANSI C63.10:2013

Test Limit : Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### 9.1 Test Procedure

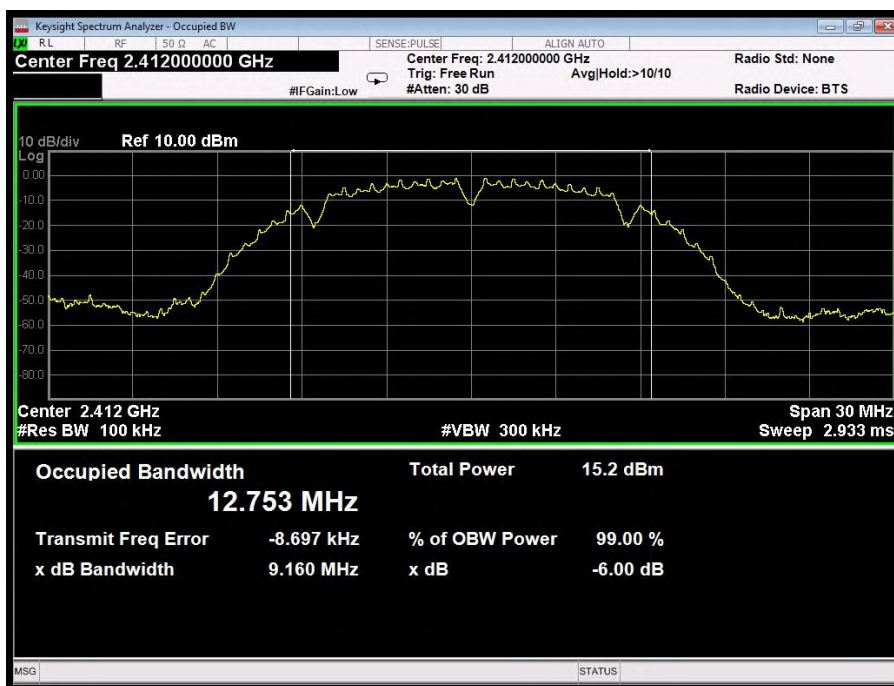
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz

### 9.2 Test Result

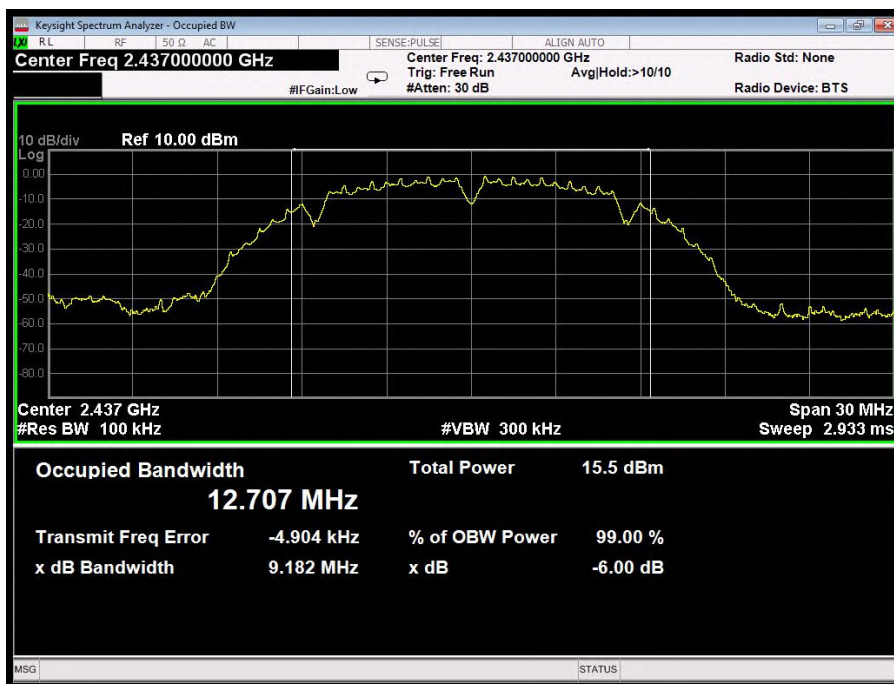
| Modulation   | Bandwidth(MHz) |                |              | Limit   |
|--------------|----------------|----------------|--------------|---------|
|              | Low Channel    | Middle Channel | High Channel |         |
| 802.11b      | 9.160          | 9.182          | 9.150        | ≥500kHz |
| 802.11g      | 15.14          | 15.14          | 15.14        | ≥500kHz |
| 802.11n-HT20 | 15.16          | 15.15          | 15.15        | ≥500kHz |
| 802.11n-HT40 | 35.16          | 35.16          | 35.16        | ≥500kHz |



### 802.11b Low Channel

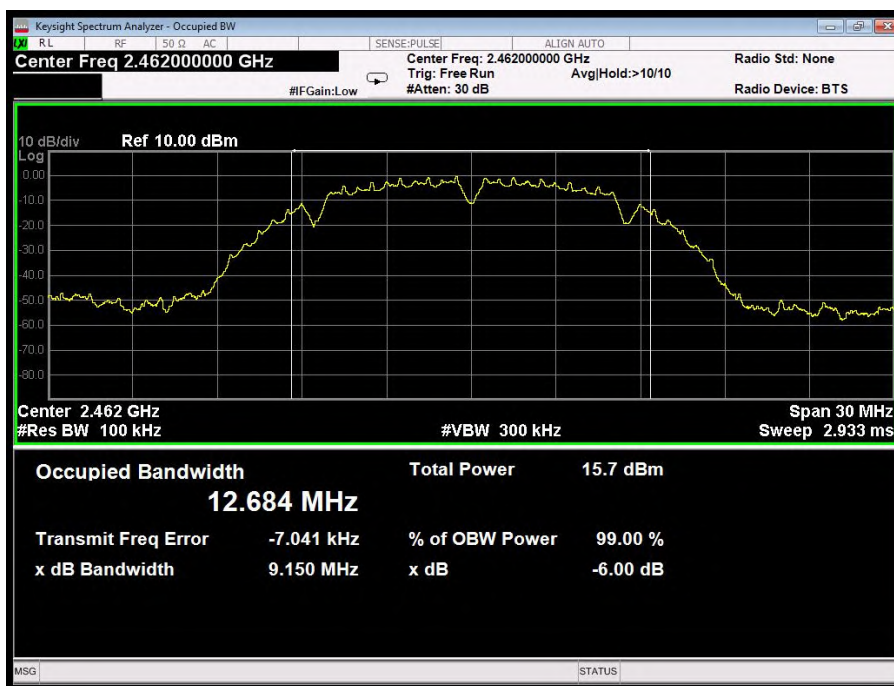


### 802.11b Middle Channel

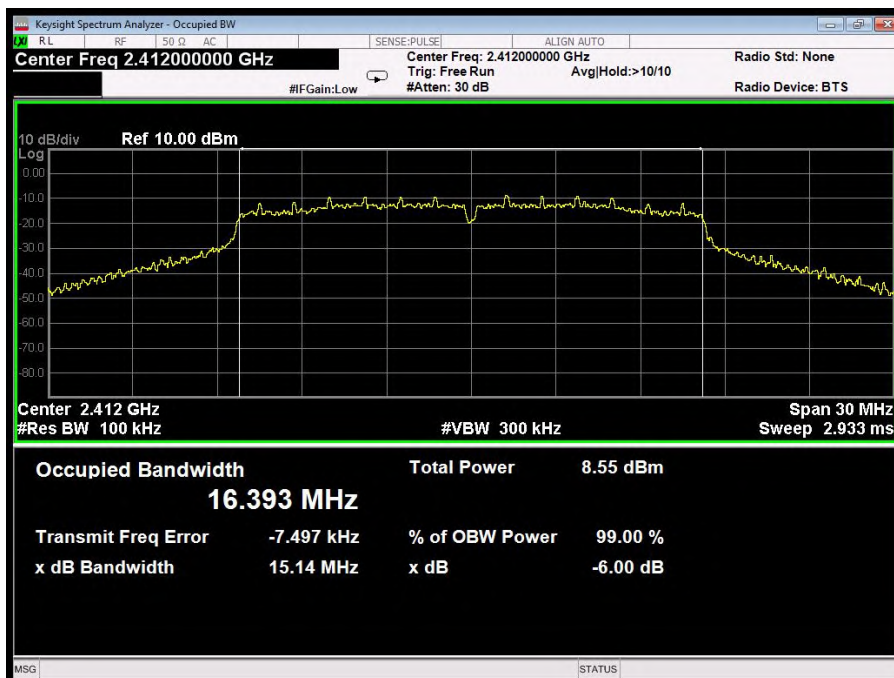




### 802.11b High Channel

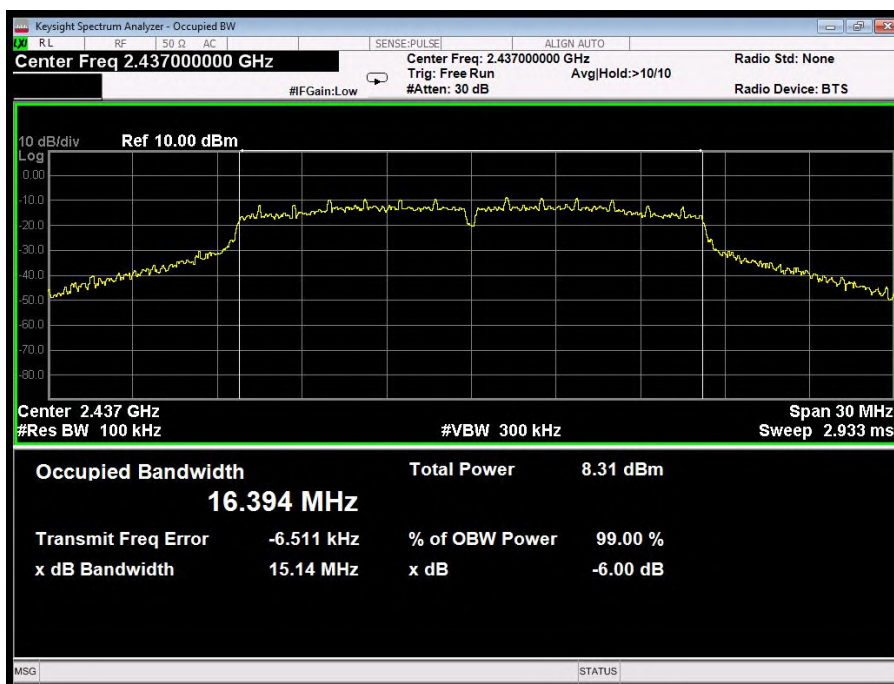


### 802.11g Low Channel

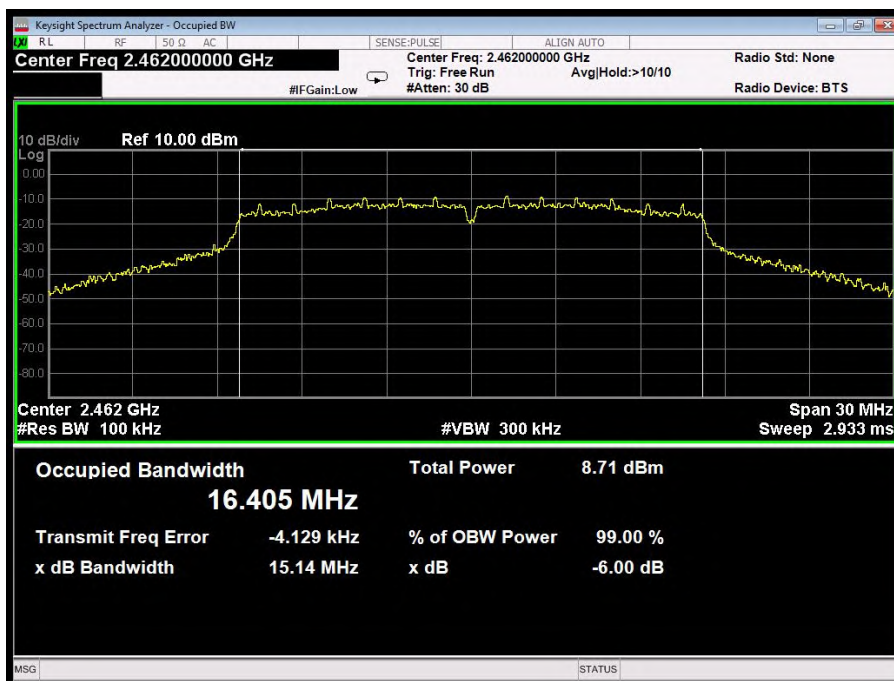




### 802.11g Middle Channel

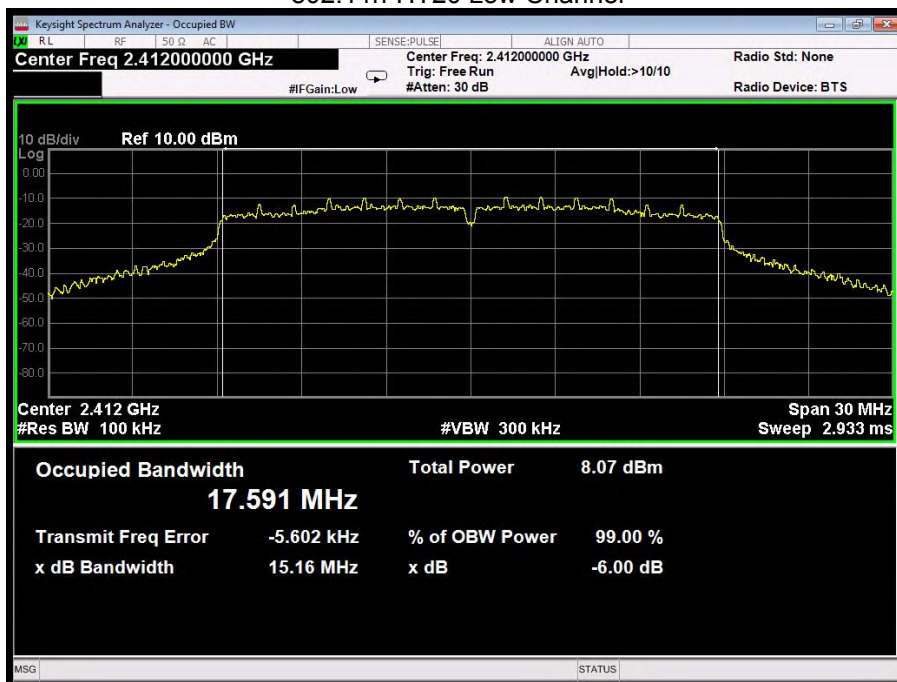


### 802.11g High Channel

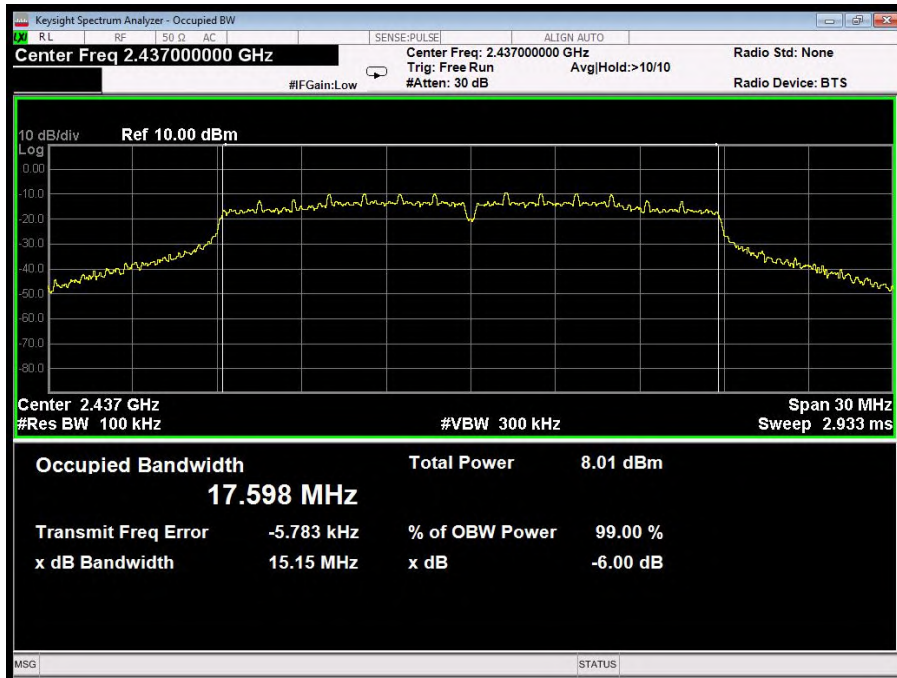




### 802.11n-HT20 Low Channel

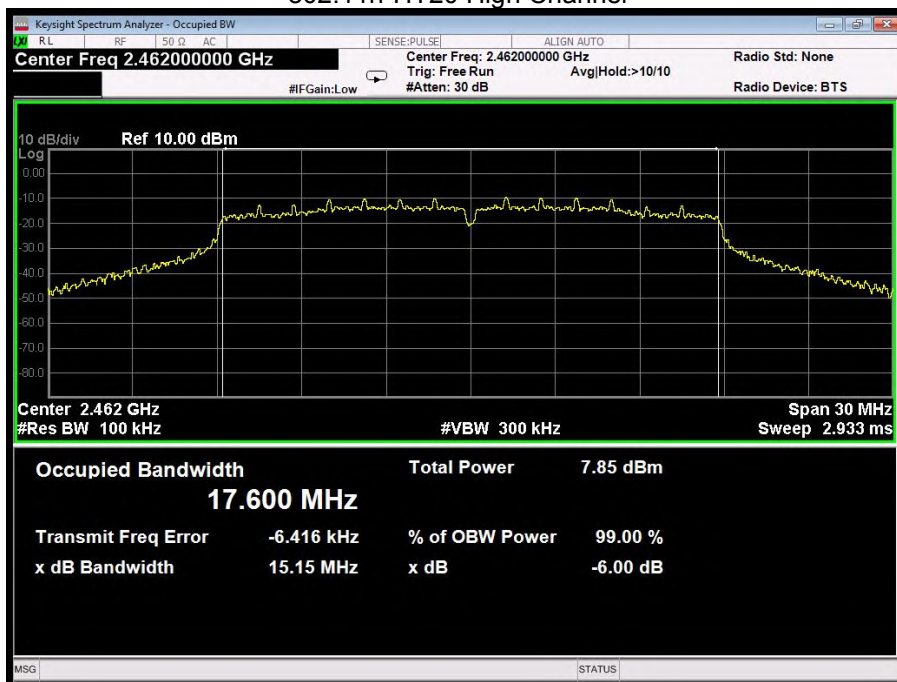


### 802.11n-HT20 Middle Channel

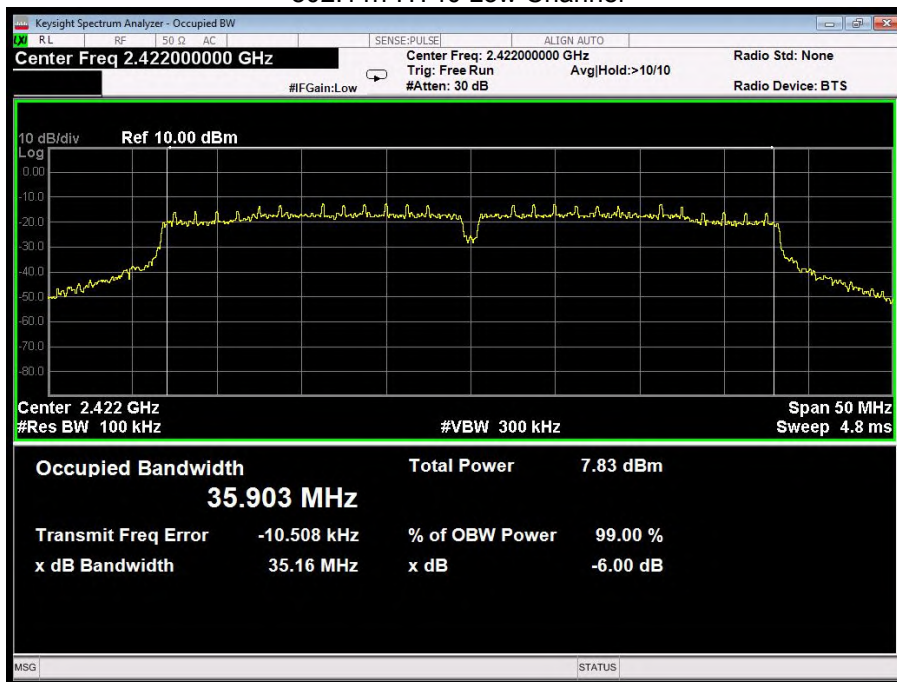




### 802.11n-HT20 High Channel

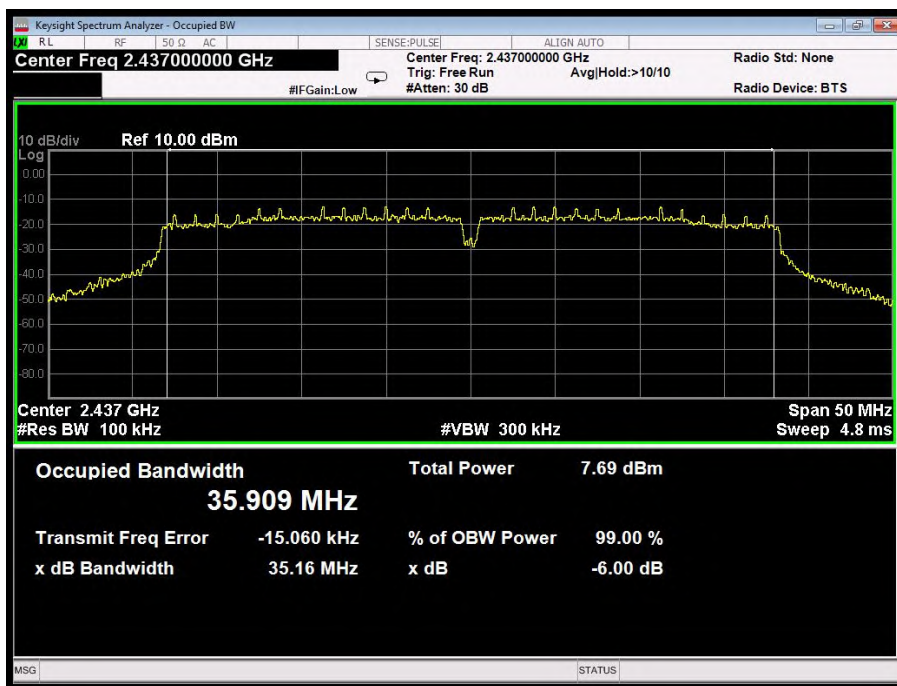


### 802.11n-HT40 Low Channel

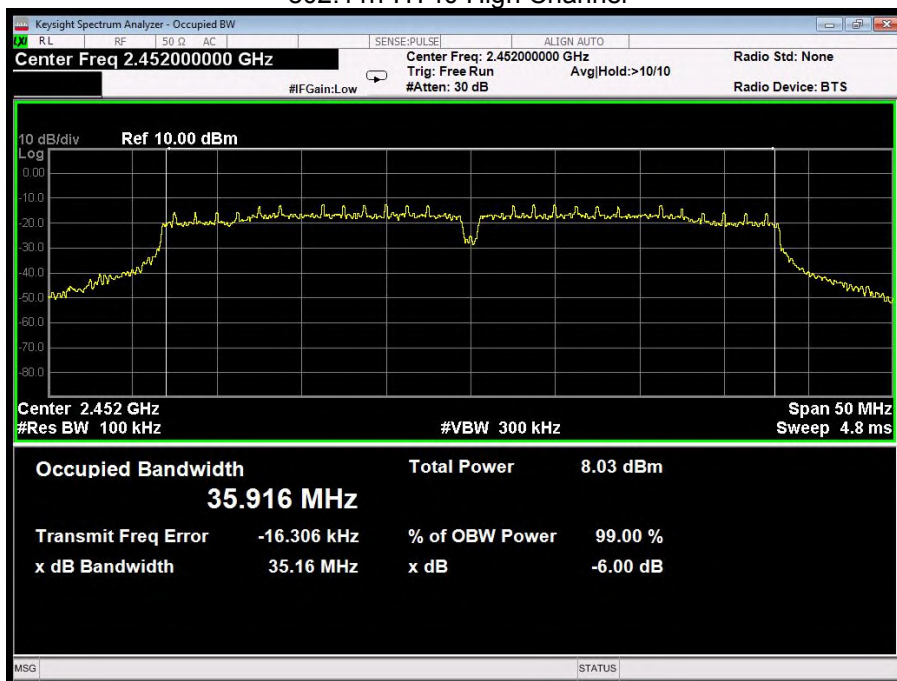




### 802.11n-HT40 Middle Channel



### 802.11n-HT40 High Channel





## 10 Maximum Peak Output Power

|                  |   |                                                                                                                                                                                                                                                                                             |
|------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement | : | FCC CFR47 Part 15 Section 15.247                                                                                                                                                                                                                                                            |
| Test Method      | : | ANSI C63.10:2013                                                                                                                                                                                                                                                                            |
| Test Limit       | : | Regulation 15.247 (b)(3), For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. |

### 10.1 Test Procedure

1. The testing follows the Measurement Procedure of FCC KDB No. 558074 D01 15.247 Meas Guidance v05 section 8.3.1.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.

### 10.2 Test Result

| Modulation   | Maximum Peak Output Power (dBm) |                |              | Limit     |
|--------------|---------------------------------|----------------|--------------|-----------|
|              | Low Channel                     | Middle Channel | High Channel |           |
| 802.11b      | 10.88                           | 11.20          | 11.52        | 1W(30dBm) |
| 802.11g      | 8.00                            | 8.23           | 8.59         | 1W(30dBm) |
| 802.11n-HT20 | 7.57                            | 7.79           | 7.59         | 1W(30dBm) |
| 802.11n-HT40 | 7.34                            | 7.68           | 7.69         | 1W(30dBm) |



## 11 Power Spectral density

|                  |                                                                                                                                                                                                                                                                                                                                |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement | : FCC CFR47 Part 15 Section 15.247                                                                                                                                                                                                                                                                                             |
| Test Method      | : ANSI C63.10:2013                                                                                                                                                                                                                                                                                                             |
| Test Limit       | : Regulation 15.247(f) The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. |

### 11.1 Test Procedure

1. Connect the antenna port(s) to the spectrum analyzer input.
2. Configure the spectrum analyzer as shown below:  
Center frequency=DTS channel center frequency  
Span = 1.5 times the DTS bandwidth  
RBW = 3KHz, VBW = 10KHz  
Sweep time = auto couple  
Detector = peak  
Trace mode =max hold
3. Place the radio in continuous transmit mode, allow the trace to stabilize, view the transmitter wave form on the spectrum analyzer.
4. Use the peak marker function to determine the maximum amplitude level within the RBW.
5. If measured value exceeds limit, reduce RBW(no less than 3KHz) and repeat.

### 11.2 Test Result

| Modulation   | Power Spectral density (dBm/3kHz) |                |              | Limit     |
|--------------|-----------------------------------|----------------|--------------|-----------|
|              | Low Channel                       | Middle Channel | High Channel |           |
| 802.11b      | -15.871                           | -15.744        | -15.057      | 8dBm/3kHz |
| 802.11g      | -23.913                           | -23.420        | -23.331      | 8dBm/3kHz |
| 802.11n-HT20 | -24.142                           | -24.440        | -22.358      | 8dBm/3kHz |
| 802.11n-HT40 | -27.459                           | -27.868        | -26.359      | 8dBm/3kHz |



### 802.11b Low Channel



### 802.11b Middle Channel

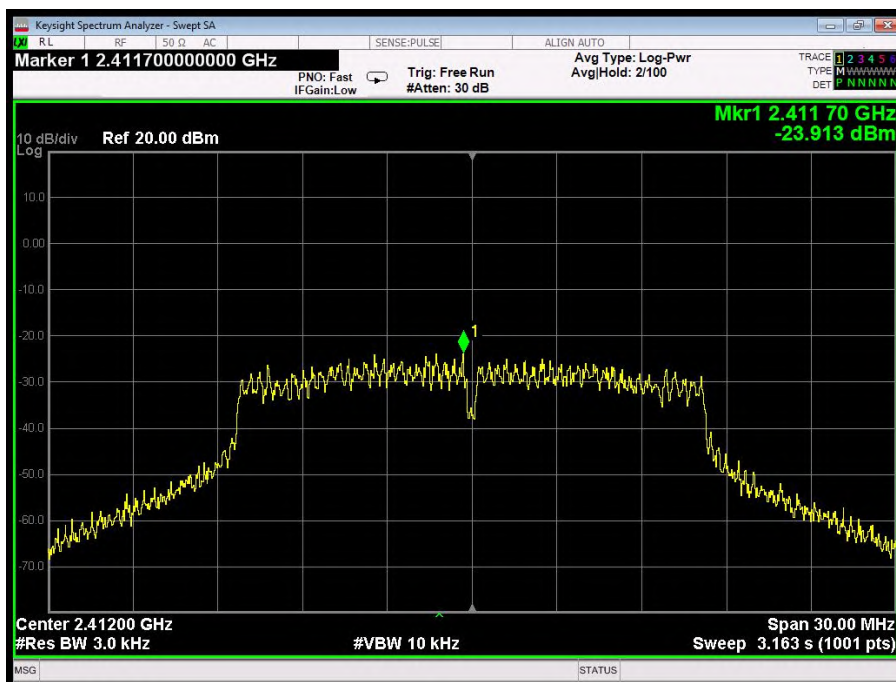




### 802.11b High Channel

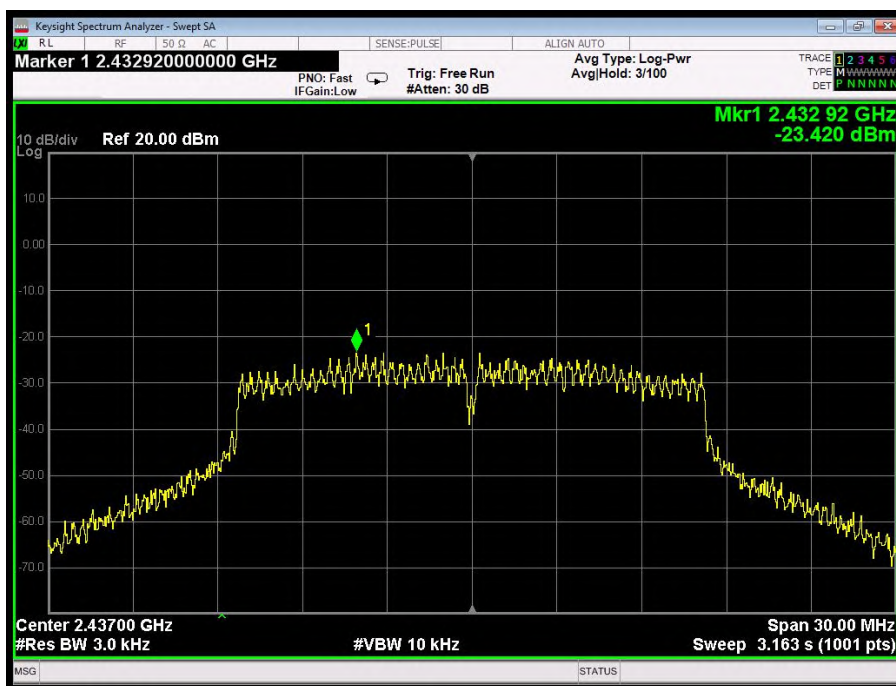


### 802.11g Low Channel

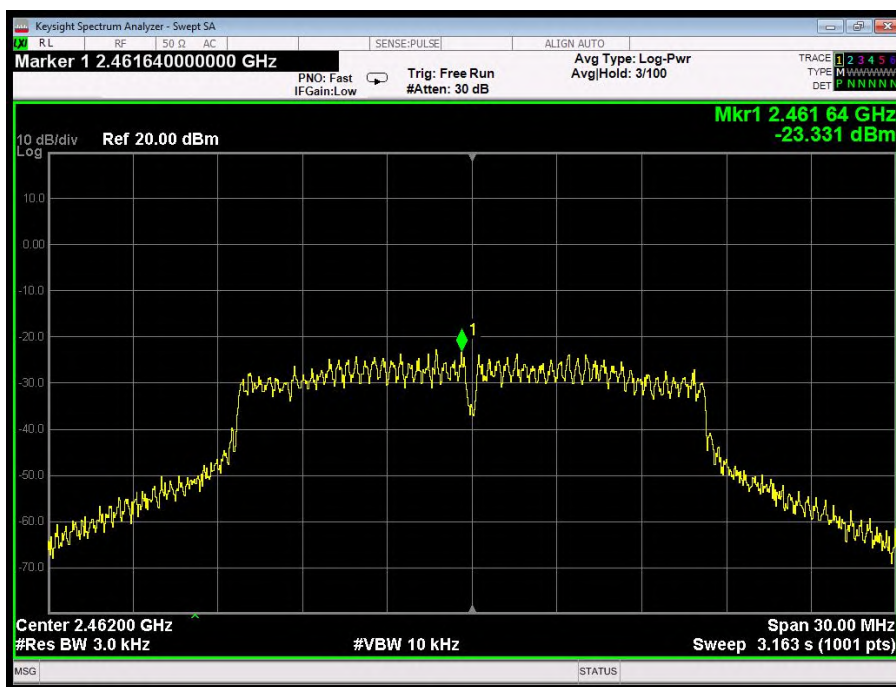




### 802.11g Middle Channel

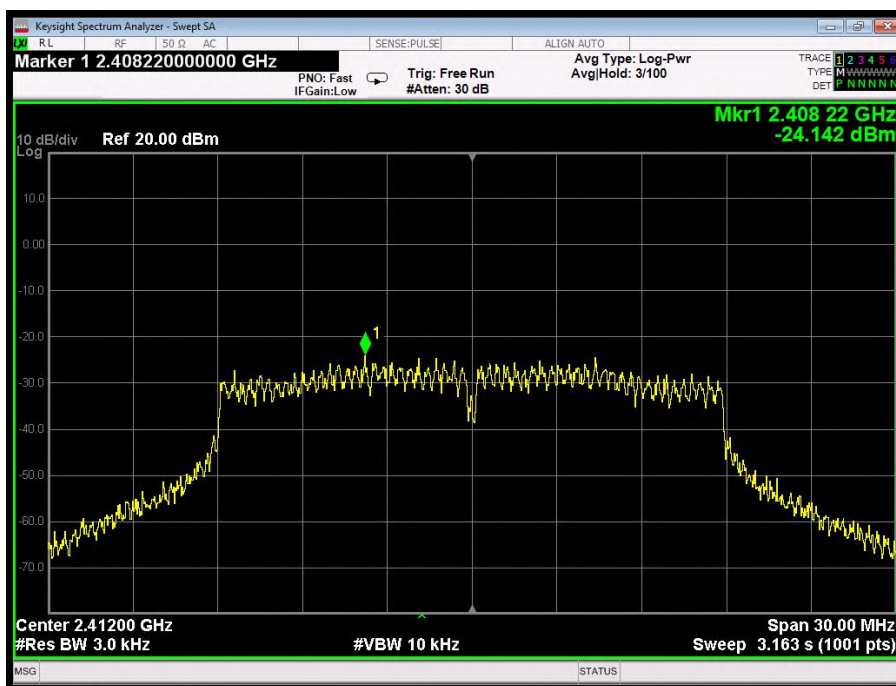


### 802.11g High Channel

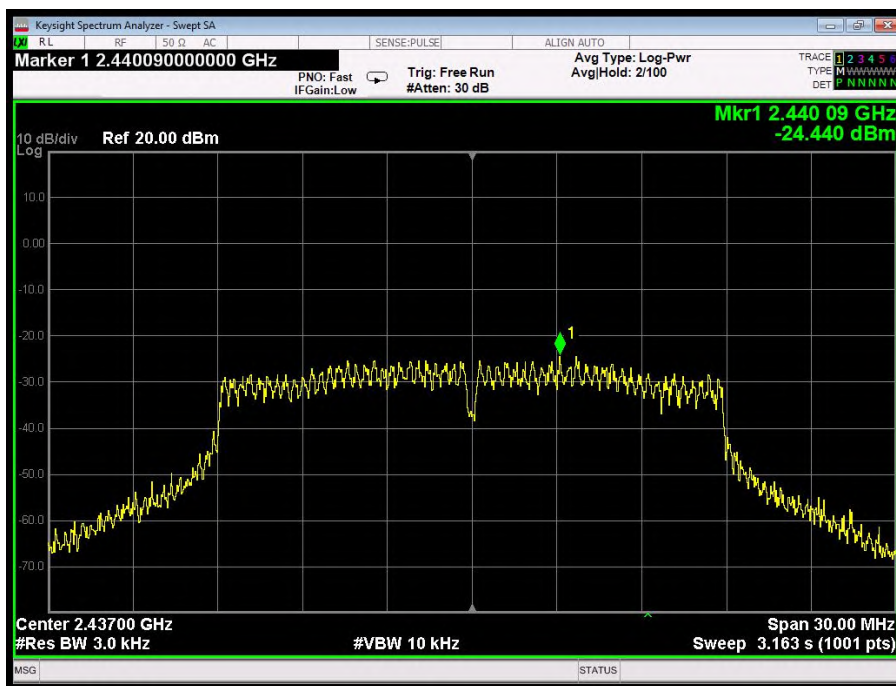




### 802.11n-HT20 Low Channel

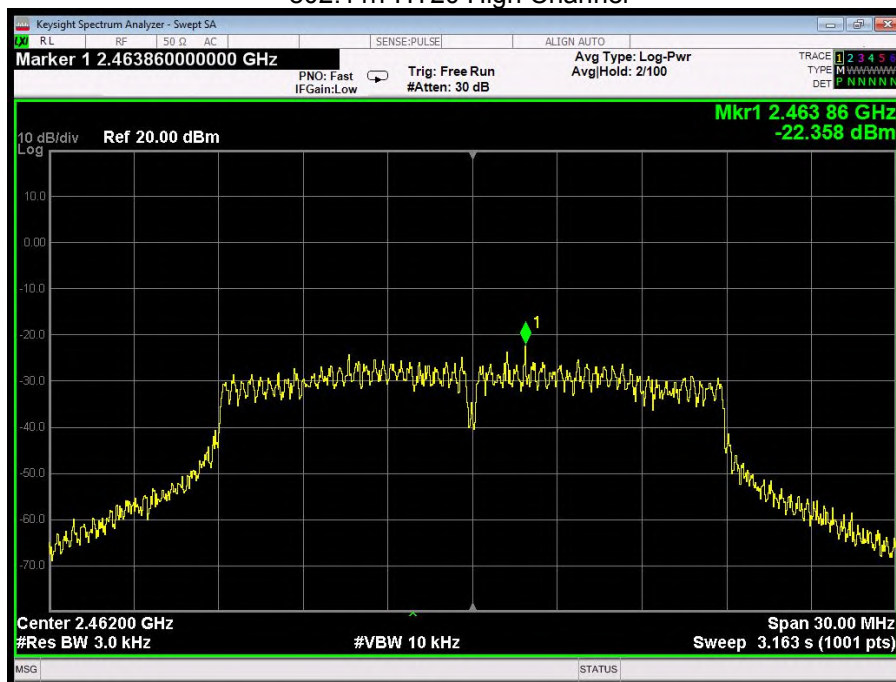


### 802.11n-HT20 Middle Channel

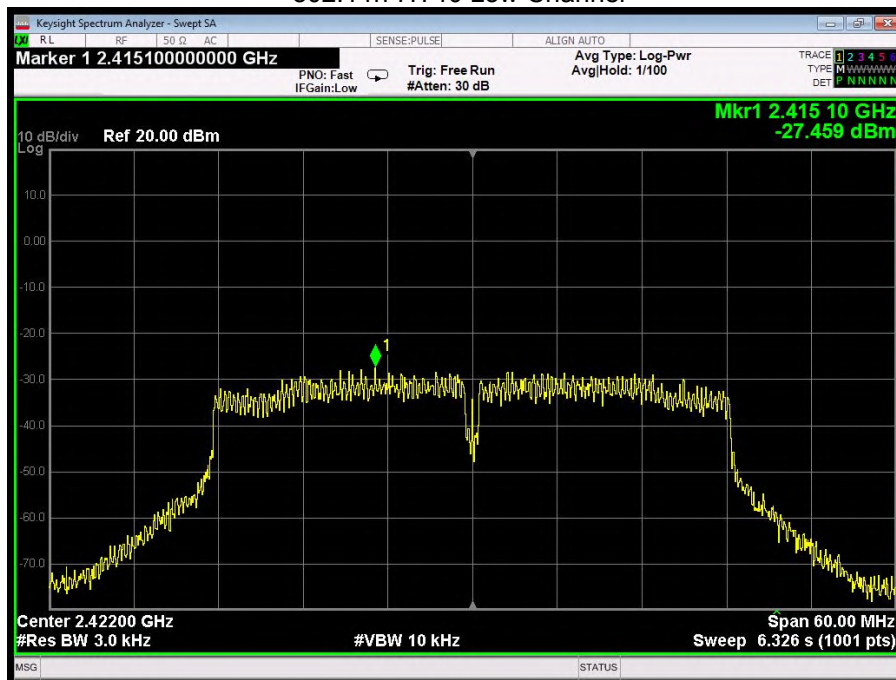




### 802.11n-HT20 High Channel

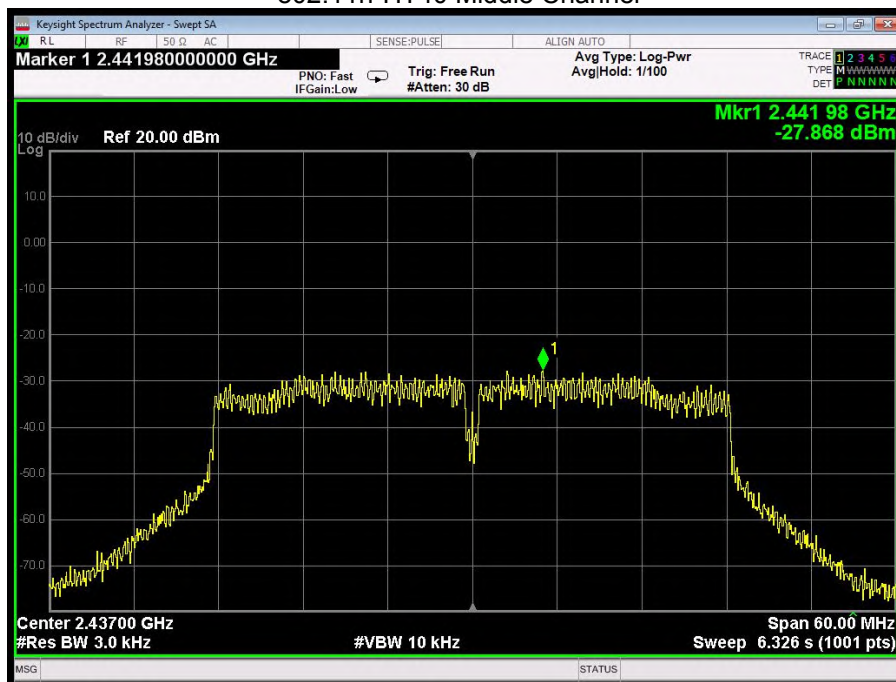


### 802.11n-HT40 Low Channel

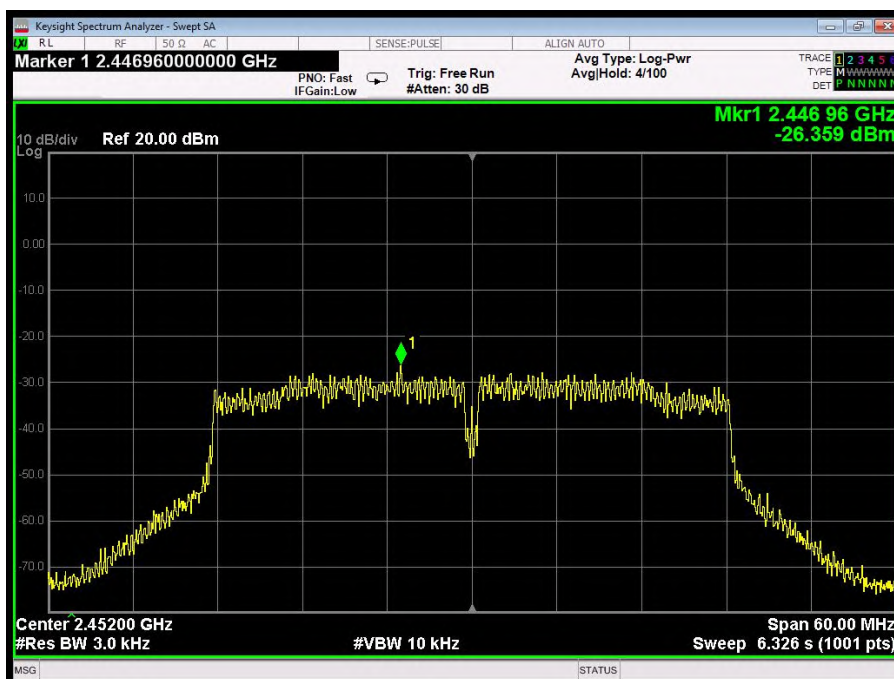




### 802.11n-HT40 Middle Channel



### 802.11n-HT40 High Channel





## **12 Antenna Application**

### **12.1 Antenna Requirement**

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.

### **12.2 Result**

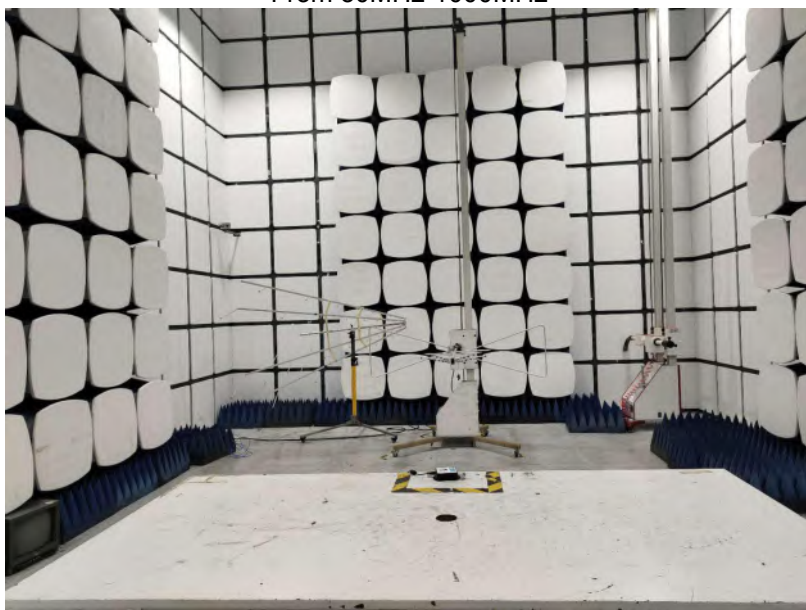
The EUT'S antenna, permanent attached antenna, is PCB Antenna. The antenna's gain is 3 dBi and meets the requirement.

## 13 Test Setup

Conducted Emissions



Radiated Spurious Emissions  
From 30MHz-1000MHz



Test frequency from Above 1GHz

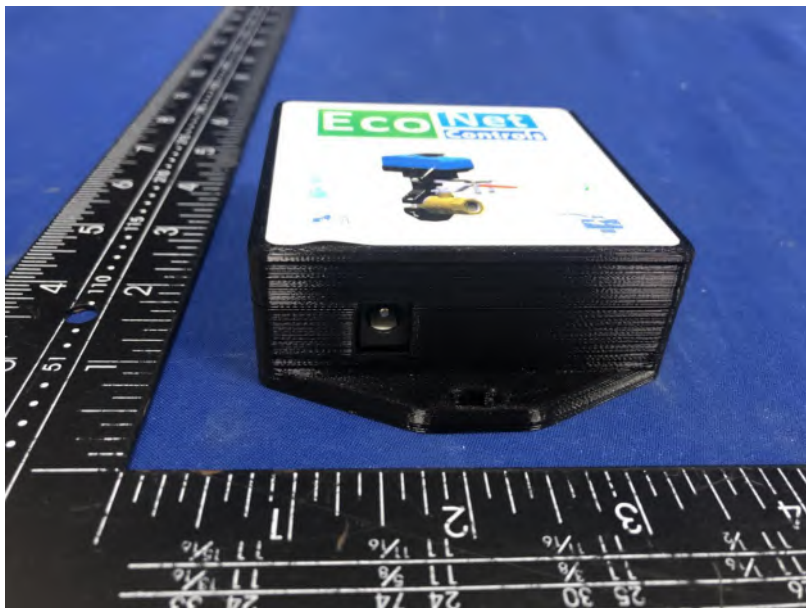


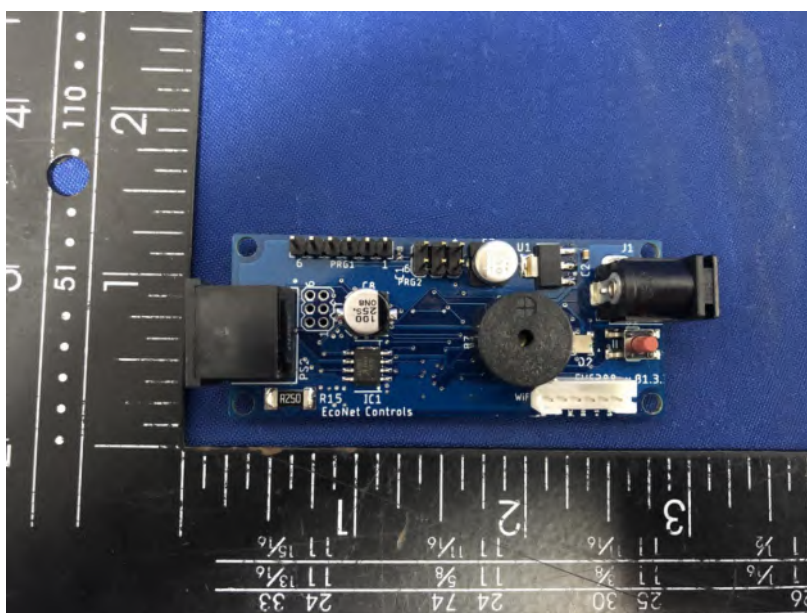


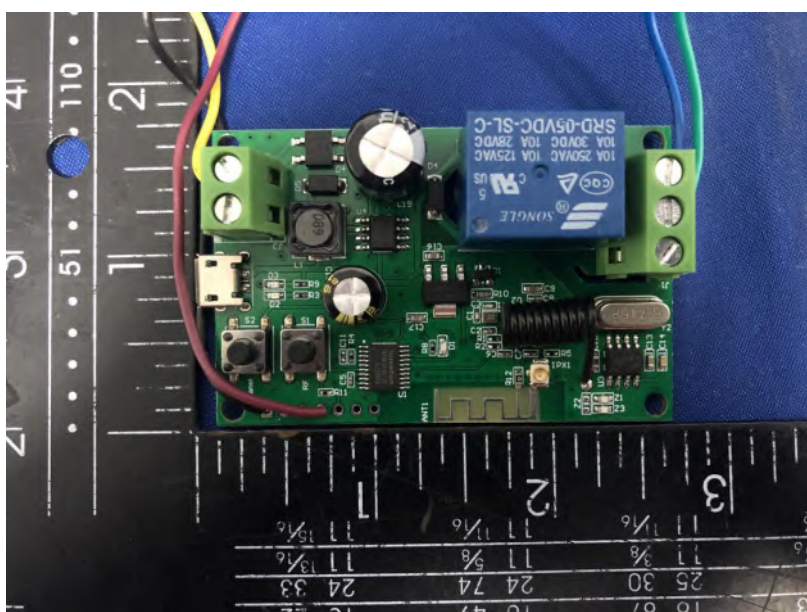
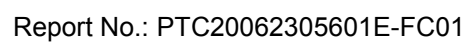
## 14 EUT PHOTOS

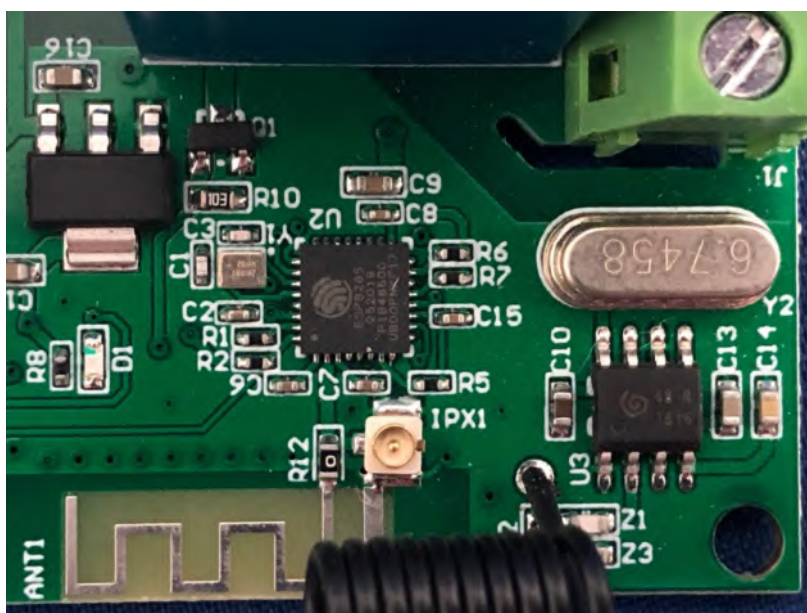
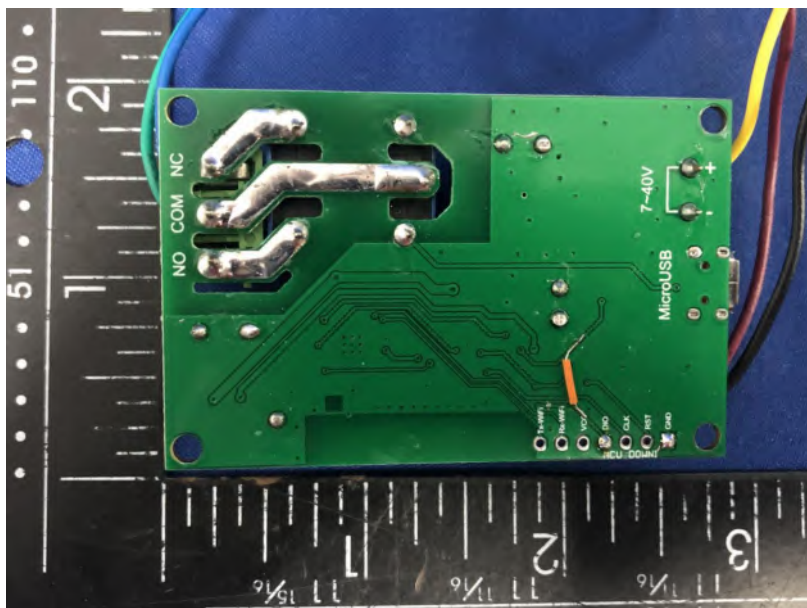












\*\*\*\*\*THE END REPORT\*\*\*\*\*