# FCC TEST REPORT

# FCC ID:2AWN3RBVFFJA

| | | |
|---|---|---|
| Product | : | Robotic Vacuum Cleaner |
| Model Name | : | BDXRBV660 |
| Additional mode | : | N/A |
| Brand | : | BLACK+DECKER |
| Report No. | : | PTC20073105401E-FC02 |

**Prepared for**

CT Nova Limited

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**Prepared by**

Precise Testing & Certification Co., Ltd

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

# 1 TEST RESULT CERTIFICATION

| | | |
|---|---|---|
| Applicant's name | : | CT Nova Limited |
| Address | : | 6/F, Building 20E, Phase 3, Hong Kong Science Park, 20 Science Park East Avenue, Shatin, New Territories, Hong Kong |
| Manufacture's name | : | Matsutek Enterprises Co., Ltd. |
| Address | : | 2F,No. 2, Lane 15, Ziqiang St., Tu Cheng Dist., New Taipei City, Taiwan 23678 |
| Product name | : | Robotic Vacuum Cleaner |
| Model name | : | BDXRBV660 |
| Standards | : | FCC CFR47 Part 15 Section 15.247 |
| Test procedure | : | ANSI C63.10:2013 |
| Test Date | : | Aug 17, 2020 to Aug 24, 2020 |
| Date of Issue | : | Aug 24, 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.

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Test Engineer:

Leo Yang

Leo Yang / Engineer

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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:<br>N/A: Not Applicable | | |

# 3 General Information

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

| | | |
|---|---|---|
| Product Name | : | Robotic Vacuum Cleaner |
| Model Name | : | BDXRBV660 |
| Additional model | : | N/A |
| Specification | : | 802.11b/g/n HT20 |
| Operation Frequency | : | 2412-2462MHz for 802.11b/g;/ n(HT20) |
| Number of Channel | : | 11 channels for 802.11b/g; n(HT20) |
| 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 | : | 0 dBi |
| Power supply | : | Adapter model:ZD24W200120US<br>Input:AC100-240V 50/60HZ<br>Output:DC 20V<br>Battery:14.6v 2500mAh |
| 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)

| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (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):

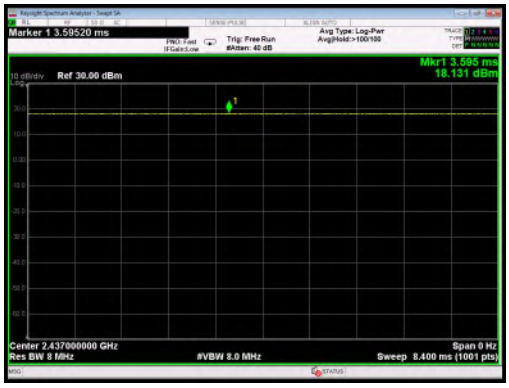
| Lowest Frequency | | Middle Frequency | | Highest Frequency | |
|---|---|---|---|---|---|
| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| 1 | 2412 | 6 | 2437 | 11 | 2462 |
| / | / | / | / | / | / |

The maximum duty cycle as following table:

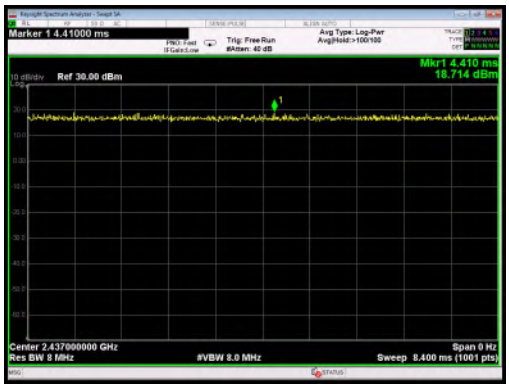
| Test Mode | Duty Cycle(%) |
|---|---|
| 802.11b | 100% |
| 802.11g | 100% |
| 802.11n(HT20) | 100% |

Test Plots:

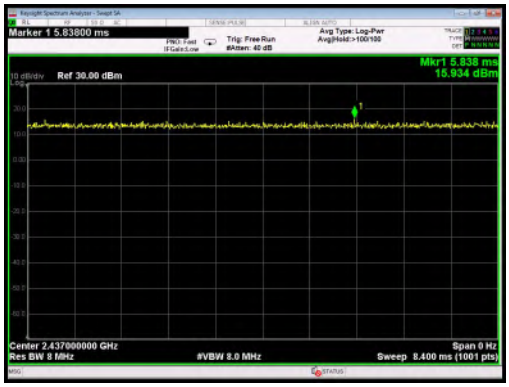
802.11b




802.11g




802.11n(HT20)


Marker 1 5.83800 ms
Trig: Free Run
#Atten: 40 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
Mkr1 5.838 ms
15.934 dBm
10 dB/div
Ref 30.00 dBm
Center 2.437000000 GHz
Res BW 8 MHz
#VBW 8.0 MHz
Span 0 Hz
Sweep 8.400 ms (1001 pts)

## 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, 2021 |
| Coaxial Cable | CDS | 79254 | 46107086 | 10Hz-30GHz | Aug. 21, 2021 |
| Power Meter | Anritsu | ML2495A | 0949003 | 300MHz-40GHz | Aug. 28, 2021 |
| Power Sensor | Anritsu | MA2411B | 0917017 | 300MHz-40GHz | Aug. 28, 2021 |

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, 2021 |
| Loop Antenna | Schwarzbeck | FMZB 1519 | 012 | 9 KHz -30MHz | Aug. 28, 2021 |
| Bilog Antenna | SCHWARZBECK | VULB9160 | 9160-3355 | 25MHz-2GHz | Aug. 22, 2021 |
| Preamplifier (low frequency) | SCHWARZBECK | BBV 9475 | 9745-0013 | 1MHz-1GHz | Aug. 21, 2021 |
| Cable | Schwarzbeck | PLF-100 | 549489 | 9KHz-3GHz | Aug. 21, 2021 |
| Spectrum Analyzer | Agilent | E4407B | MY45109572 | 9KHz-40GHz | Aug. 28, 2021 |
| Horn Antenna | SCHWARZBECK | 9120D | 9120D-1246 | 1GHz-18GHz | Apr. 13, 2021 |
| Power Amplifier | LUNAR EM | LNA1G18-40 | J10100000081 | 1GHz-26.5GHz | Aug. 21, 2021 |
| Horn Antenna | SCHWARZBECK | BBHA 9170 | 9170-181 | 14GHz-40GHz | Apr. 13, 2021 |
| Amplifier | SCHWARZBECK | BBV 9721 | 9721-205 | 18GHz-40GHz | Aug. 21, 2021 |

| | | | | | |
|---|---|---|---|---|---|
| Cable | H+S | CBL-26 | N/A | 1GHz-26.5GHz | Aug. 21, 2021 |
| RF Cable | R&S | R204 | R21X | 1GHz-40GHz | Aug. 21, 2021 |

Conducted Emissions

| **Name of Equipment** | **Manufacturer** | **Model** | **Serial No.** | **Characteristics** | **Calibration Due** |
|---|---|---|---|---|---|
| EMI Test Receiver | Rohde&Schwarz | ESCI | 101417 | 9KHz-3GHz | Aug. 28, 2021 |
| Artificial Mains Network | Rohde&Schwarz | ENV216 | 102453 | 9KHz-300MHz | Aug. 21, 2021 |
| Artificial Mains Network | Rohde&Schwarz | ENV216 | 101342 | 9KHz-300MHz | Aug. 21, 2021 |

## 4.2 Measurement Uncertainty

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

## 4.3 Description of Support Units

| Equipment | Model No. | Series No. |
|---|---|---|
| Adapter | Model:ZD24W200120US<br>Input:100-240V<br>Output:DC 20V | 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 |

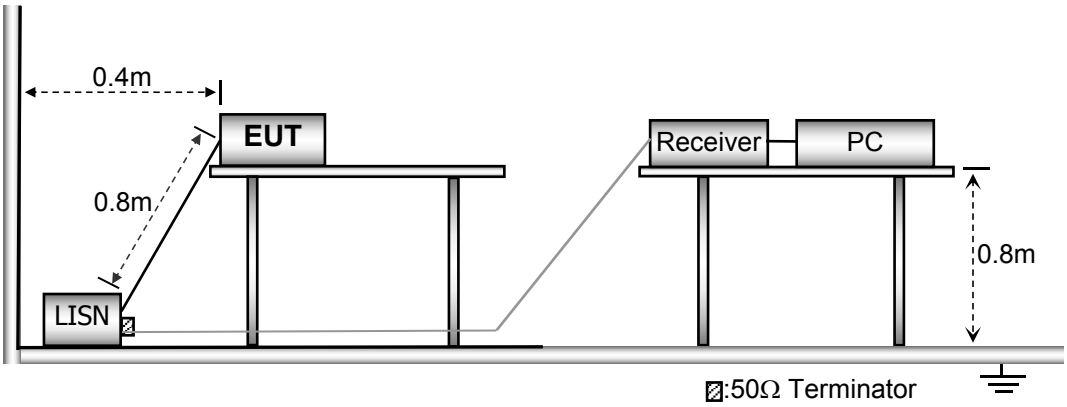
## 5.1 E.U.T. Operation

Operating Environment :

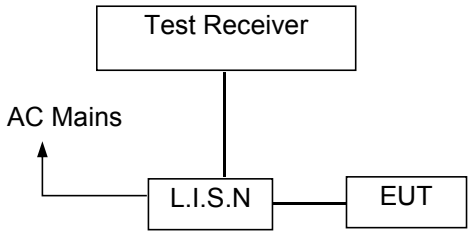
| | | |
|---|---|---|
| Temperature | : | 23.9 °C |
| Humidity | : | 51.4 % RH |
| Atmospheric Pressure | : | 101.21kPa |

## 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.

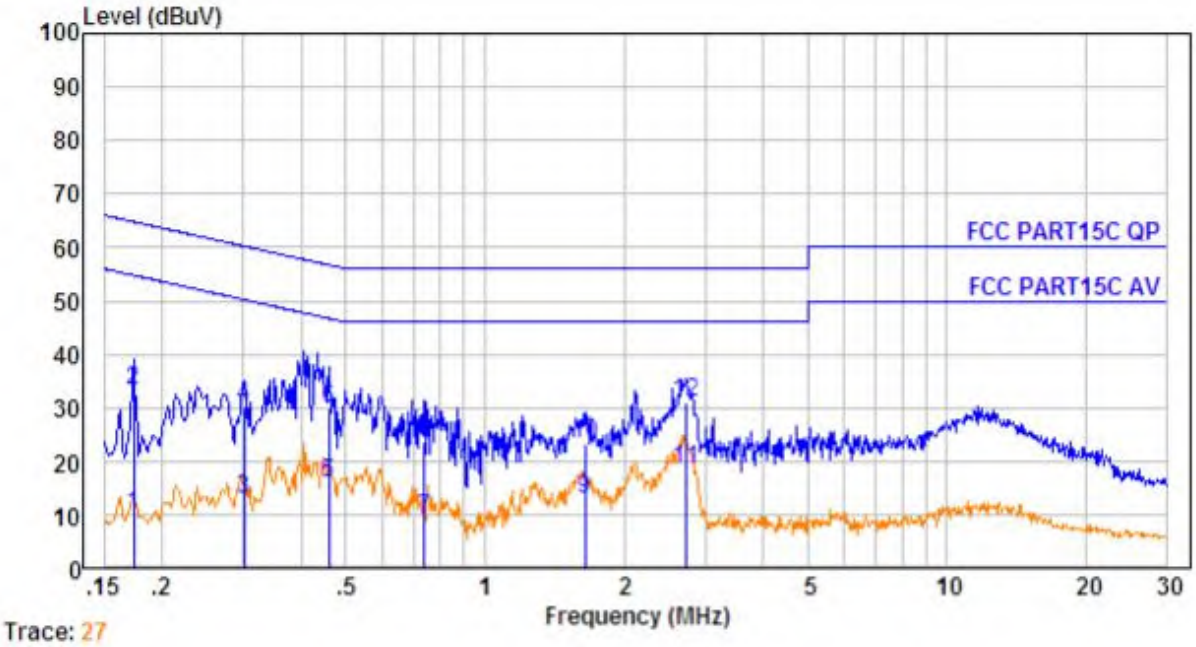
## 5.7 Conducted Emission Test Result

Pass.

The conducted emission at 120V and 240V has been evaluated. All modulation modes have passed the test, and the emission at 120V represents the worst mode (TX 802.11b low channel). The data is recorded on the following page. Other modulation methods are not Limit Exceeded.

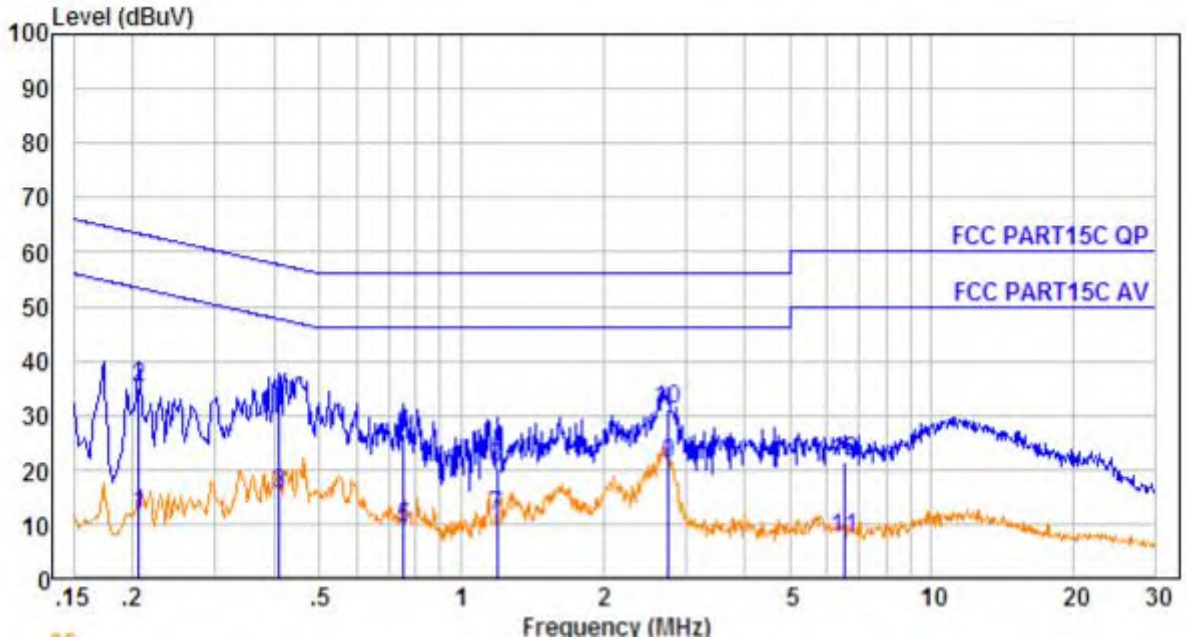
Please refer to the following pages.

Line- AC 120V/60Hz




| No. | Freq MHz | Cable Loss dB | AMN Factor dB | Receiver Reading dBuV | Emission Level dBuV | Limit dBuV | Over Limit dB | Remark |
|---|---|---|---|---|---|---|---|---|
| 1. | 0.174 | 0.24 | 9.59 | 0.25 | 10.08 | 54.77 | -44.69 | Average |
| 2. | 0.174 | 0.24 | 9.59 | 23.24 | 33.07 | 64.77 | -31.70 | QP |
| 3. | 0.302 | 0.37 | 9.60 | 3.07 | 13.04 | 50.19 | -37.15 | Average |
| 4. | 0.302 | 0.37 | 9.60 | 20.14 | 30.11 | 60.19 | -30.08 | QP |
| 5. | 0.459 | 0.42 | 9.61 | 5.71 | 15.74 | 46.71 | -30.97 | Average |
| 6. | 0.459 | 0.42 | 9.61 | 19.93 | 29.96 | 56.71 | -26.75 | QP |
| 7. | 0.739 | 0.44 | 9.61 | -0.80 | 9.25 | 46.00 | -36.75 | Average |
| 8. | 0.739 | 0.44 | 9.61 | 13.69 | 23.74 | 56.00 | -32.26 | QP |
| 9. | 1.645 | 0.47 | 9.61 | 2.97 | 13.05 | 46.00 | -32.95 | Average |
| 10. | 1.645 | 0.47 | 9.61 | 13.10 | 23.18 | 56.00 | -32.82 | QP |
| 11. | 2.736 | 0.47 | 9.62 | 8.39 | 18.48 | 46.00 | -27.52 | Average |
| 12. | 2.736 | 0.47 | 9.62 | 20.91 | 31.00 | 56.00 | -25.00 | QP |

Neutral-AC 120V/60Hz




| No. | Freq MHz | Cable Loss dB | AMN Factor dB | Receiver Reading dBuV | Emission Level dBuV | Limit dBuV | Over Limit dB | Remark |
|---|---|---|---|---|---|---|---|---|
| 1. | 0.206 | 0.29 | 9.61 | 1.96 | 11.86 | 53.36 | -41.50 | Average |
| 2. | 0.206 | 0.29 | 9.61 | 25.19 | 35.09 | 63.36 | -28.27 | QP |
| 3. | 0.410 | 0.41 | 9.63 | 5.54 | 15.58 | 47.64 | -32.06 | Average |
| 4. | 0.410 | 0.41 | 9.63 | 22.81 | 32.85 | 57.64 | -24.79 | QP |
| 5. | 0.755 | 0.44 | 9.64 | -0.98 | 9.10 | 46.00 | -36.90 | Average |
| 6. | 0.755 | 0.44 | 9.64 | 16.49 | 26.57 | 56.00 | -29.43 | QP |
| 7. | 1.191 | 0.46 | 9.64 | 1.28 | 11.38 | 46.00 | -34.62 | Average |
| 8. | 1.191 | 0.46 | 9.64 | 10.35 | 20.45 | 56.00 | -35.55 | QP |
| 9. | 2.765 | 0.47 | 9.66 | 10.85 | 20.98 | 46.00 | -25.02 | Average |
| 10. | 2.765 | 0.47 | 9.66 | 20.72 | 30.85 | 56.00 | -25.15 | QP |
| 11. | 6.557 | 0.54 | 9.75 | -3.03 | 7.26 | 50.00 | -42.74 | Average |
| 12. | 6.557 | 0.54 | 9.75 | 11.23 | 21.52 | 60.00 | -38.48 | QP |

# 6 Radiated Spurious Emissions

Test Requirement : FCC CFR47 Part 15 Section 15.209 & 15.247& 15.205(a)

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(kHz) | 300 | 10000 * 2400/F(kHz) | $20\log^{(2400/F(kHz))} + 80$ |
| 0.490 ~ 1.705 | 24000/F(kHz) | 30 | 100 * 24000/F(kHz) | $20\log^{(24000/F(kHz))} + 40$ |
| 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: : 24.3 °C

Humidity: : 52 % RH

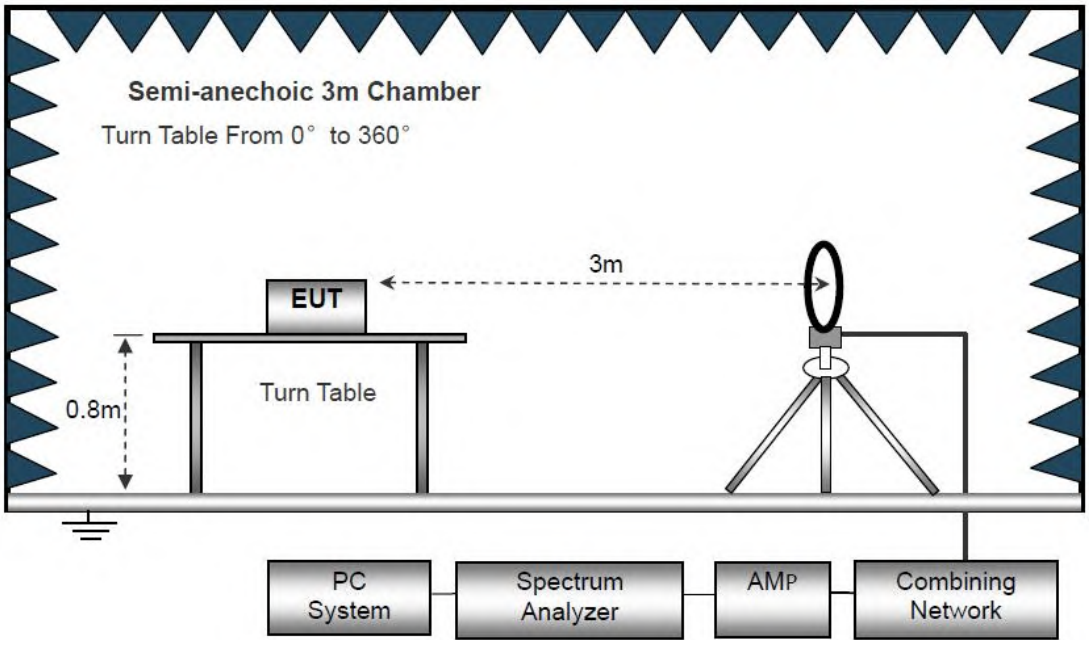
Atmospheric Pressure: : 101.3kPa

Test Voltage : DC 14.6V

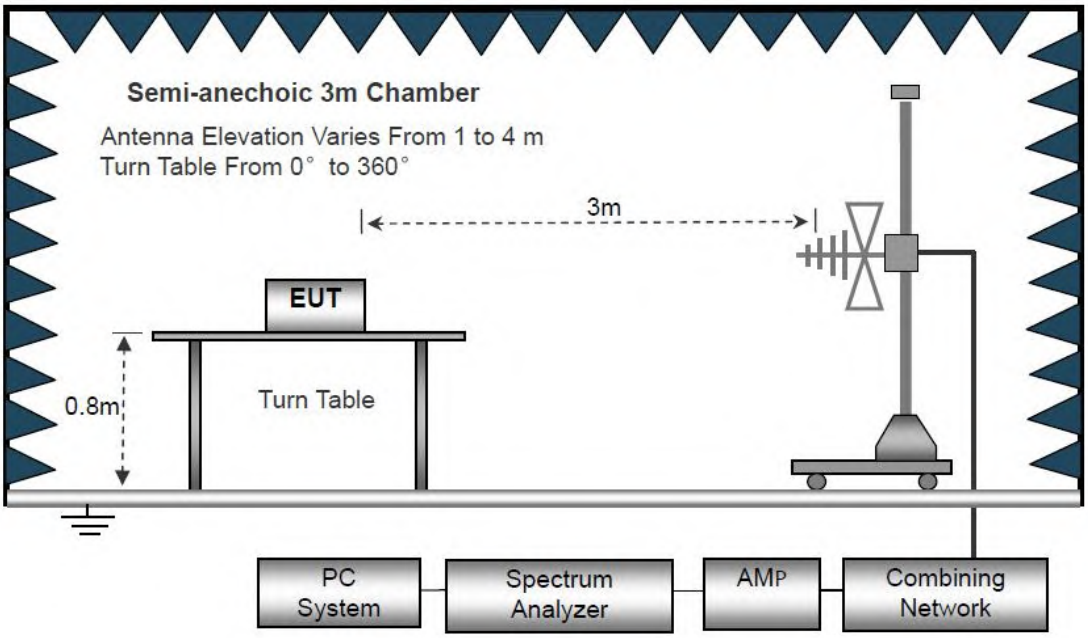
## 6.2 Test Setup

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

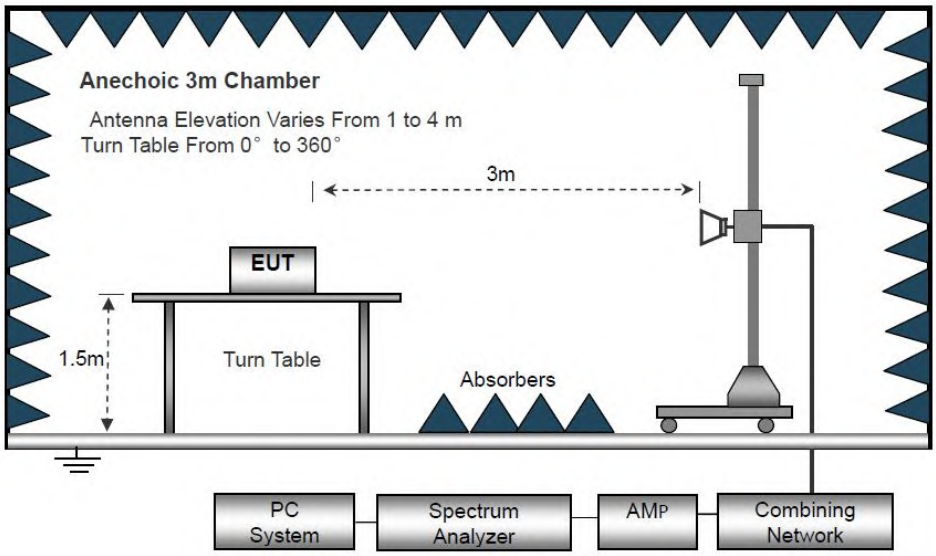
The test setup for emission measurement below 30MHz




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. (MHz) | Ant.Pol. H/V | Emission Level (dBuV/m) | Limit 3m (dBuV/m) | Over (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.

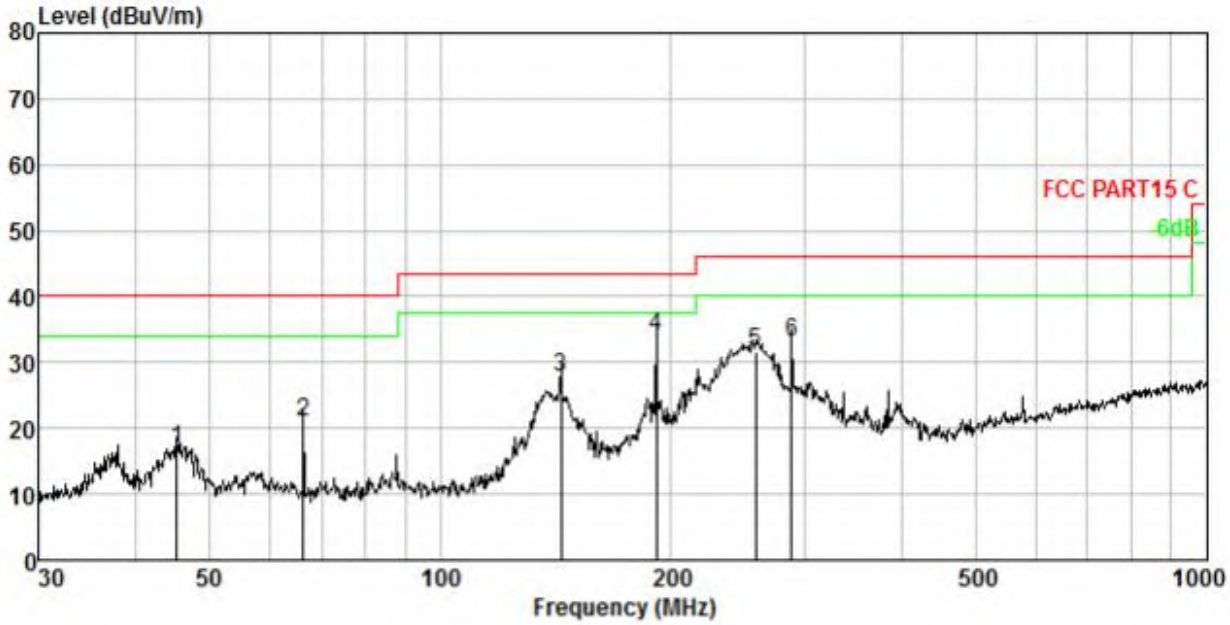
Distance extrapolation factor =40log(Specific distance/ test distance)( dB);
Limit line=Specific limits(dBuV) + distance extrapolation factor.

**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:

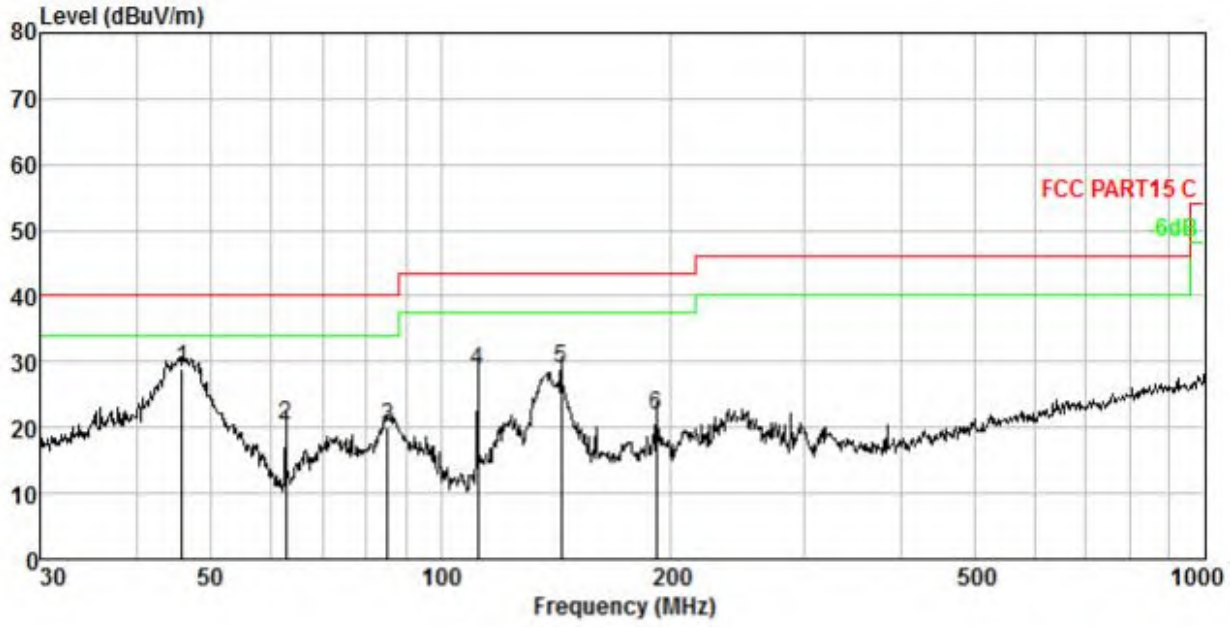
Antenna Polarization: Horizontal




| No. | Freq MHz | Cable Loss dB | ANT Factor dB/m | Receiver Reading dBuV | Preamp Factor dB | Emission Level dBuV/m | Limit dBuV/m | Over Limit dB | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 45.375 | 1.91 | 12.28 | 32.41 | 29.91 | 16.69 | 40.00 | -23.31 | QP |
| 2. | 66.266 | 2.56 | 10.77 | 37.45 | 29.95 | 20.83 | 40.00 | -19.17 | QP |
| 3. | 143.830 | 3.90 | 13.46 | 40.43 | 30.02 | 27.77 | 43.50 | -15.73 | QP |
| 4. | 191.745 | 4.39 | 11.60 | 48.07 | 30.04 | 34.02 | 43.50 | -9.48 | QP |
| 5. | 258.326 | 4.90 | 12.63 | 44.17 | 30.22 | 31.48 | 46.00 | -14.52 | QP |
| 6. | 287.990 | 5.09 | 13.04 | 45.20 | 30.29 | 33.04 | 46.00 | -12.96 | QP |

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

Antenna Polarization: Vertical




| No. | Freq MHz | Cable Loss dB | ANT Factor dB/m | Receiver Reading dBuV | Preamp Factor dB | Emission Level dBuV/m | Limit dBuV/m | Over Limit dB | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 45.855 | 1.93 | 12.26 | 44.54 | 29.92 | 28.81 | 40.00 | -11.19 | QP |
| 2. | 62.651 | 2.47 | 11.32 | 36.51 | 29.94 | 20.36 | 40.00 | -19.64 | QP |
| 3. | 85.298 | 3.00 | 8.73 | 38.21 | 29.97 | 19.97 | 40.00 | -20.03 | QP |
| 4. | 111.738 | 3.46 | 11.02 | 44.26 | 30.00 | 28.74 | 43.50 | -14.76 | QP |
| 5. | 143.830 | 3.90 | 13.46 | 41.46 | 30.02 | 28.80 | 43.50 | -14.70 | QP |
| 6. | 191.745 | 4.39 | 11.60 | 35.92 | 30.04 | 21.87 | 43.50 | -21.63 | 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 | 41.26 | 32.29 | 4.10 | 28.45 | 49.20 | 74.00 | -24.80 | V |
| 7236.00 | 34.83 | 35.99 | 6.22 | 27.83 | 49.21 | 74.00 | -24.79 | V |
| 9648.00 | 33.15 | 38.11 | 7.83 | 25.10 | 53.99 | 74.00 | -20.01 | V |
| 4824.00 | 39.78 | 32.29 | 4.10 | 28.45 | 47.72 | 74.00 | -26.28 | H |
| 7236.00 | 34.50 | 35.99 | 6.22 | 27.83 | 48.88 | 74.00 | -25.12 | H |
| 9648.00 | 32.70 | 38.11 | 7.83 | 25.10 | 53.54 | 74.00 | -20.46 | 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 | 30.27 | 32.29 | 4.10 | 28.45 | 38.21 | 54.00 | -15.79 | V |
| 7236.00 | 23.68 | 35.99 | 6.22 | 27.83 | 38.06 | 54.00 | -15.94 | V |
| 9648.00 | 23.48 | 38.11 | 7.83 | 25.10 | 44.32 | 54.00 | -9.68 | V |
| 4824.00 | 29.27 | 32.29 | 4.10 | 28.45 | 37.21 | 54.00 | -16.79 | H |
| 7236.00 | 23.07 | 35.99 | 6.22 | 27.83 | 37.45 | 54.00 | -16.55 | H |
| 9648.00 | 22.43 | 38.11 | 7.83 | 25.10 | 43.27 | 54.00 | -10.73 | H |

Worst case 802.11b

| Test Mode: 2437 | | | | | Test channel: Middle | | | |
|---|---|---|---|---|---|---|---|---|
| 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. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 4874.00 | 40.15 | 32.35 | 4.12 | 28.44 | 48.18 | 74.00 | -25.82 | V |
| 7311.00 | 34.80 | 36.08 | 6.30 | 27.74 | 49.44 | 74.00 | -24.56 | V |
| 9748.00 | 34.10 | 38.25 | 7.91 | 24.65 | 55.61 | 74.00 | -18.39 | V |
| 4874.00 | 40.51 | 32.35 | 4.12 | 28.44 | 48.54 | 74.00 | -25.46 | H |
| 7311.00 | 33.37 | 36.08 | 6.30 | 27.74 | 48.01 | 74.00 | -25.99 | H |
| 9748.00 | 33.96 | 38.25 | 7.91 | 24.65 | 55.47 | 74.00 | -18.53 | 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 | 30.94 | 32.35 | 4.12 | 28.44 | 38.97 | 54.00 | -15.03 | V |
| 7311.00 | 23.10 | 36.08 | 6.30 | 27.74 | 37.74 | 54.00 | -16.26 | V |
| 9748.00 | 23.33 | 38.25 | 7.91 | 24.65 | 44.84 | 54.00 | -9.16 | V |
| 4874.00 | 30.58 | 32.35 | 4.12 | 28.44 | 38.61 | 54.00 | -15.39 | H |
| 7311.00 | 22.45 | 36.08 | 6.30 | 27.74 | 37.09 | 54.00 | -16.91 | H |
| 9748.00 | 23.66 | 38.25 | 7.91 | 24.65 | 45.17 | 54.00 | -8.83 | H |

Worst case 802.11b

| Test Mode: 2462 | | | | | Test channel: High | | | |
|---|---|---|---|---|---|---|---|---|
| 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. |
| 4924.00 | 46.26 | 32.41 | 4.14 | 28.42 | 54.39 | 74.00 | -19.61 | V |
| 7386.00 | 35.84 | 36.15 | 6.36 | 27.68 | 50.67 | 74.00 | -23.33 | V |
| 9848.00 | 37.65 | 38.35 | 7.97 | 24.33 | 59.64 | 74.00 | -14.36 | V |
| 4924.00 | 45.35 | 32.41 | 4.14 | 28.42 | 53.48 | 74.00 | -20.52 | H |
| 7386.00 | 34.63 | 36.15 | 6.36 | 27.68 | 49.46 | 74.00 | -24.54 | H |
| 9848.00 | 33.78 | 38.35 | 7.97 | 24.33 | 55.77 | 74.00 | -18.23 | 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 | 37.07 | 32.41 | 4.14 | 28.42 | 45.20 | 54.00 | -8.80 | V |
| 7386.00 | 25.73 | 36.15 | 6.36 | 27.68 | 40.56 | 54.00 | -13.44 | V |
| 9848.00 | 26.13 | 38.35 | 7.97 | 24.33 | 48.12 | 54.00 | -5.88 | V |
| 4924.00 | 35.64 | 32.41 | 4.14 | 28.42 | 43.77 | 54.00 | -10.23 | H |
| 7386.00 | 24.00 | 36.15 | 6.36 | 27.68 | 38.83 | 54.00 | -15.17 | H |
| 9848.00 | 23.01 | 38.35 | 7.97 | 24.33 | 45.00 | 54.00 | -9.00 | H |

Note:

1. The testing has been conformed to 10*2462MHz=24620MHz.
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 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 2390.00 | 53.23 | 27.39 | 2.77 | 34.01 | 49.38 | 74.00 | -24.62 | H | Peak |
| 2400.00 | 62.78 | 27.42 | 2.78 | 34.01 | 58.97 | 74.00 | -15.03 | H | |
| 2390.00 | 55.02 | 27.39 | 2.77 | 34.01 | 51.17 | 74.00 | -22.83 | V | |
| 2400.00 | 65.00 | 27.42 | 2.78 | 34.01 | 61.19 | 74.00 | -12.81 | V | |
| 2390.00 | 39.54 | 27.39 | 2.77 | 34.01 | 35.69 | 54.00 | -18.31 | H | Average |
| 2400.00 | 48.00 | 27.42 | 2.78 | 34.01 | 44.19 | 54.00 | -9.81 | H | |
| 2390.00 | 41.48 | 27.39 | 2.77 | 34.01 | 37.63 | 54.00 | -16.37 | V | |
| 2400.00 | 49.25 | 27.42 | 2.78 | 34.01 | 45.44 | 54.00 | -8.56 | 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 | 54.57 | 27.70 | 2.84 | 34.03 | 51.08 | 74.00 | -22.92 | H | Peak |
| 2500.00 | 49.89 | 27.75 | 2.86 | 34.03 | 46.47 | 74.00 | -27.53 | H | |
| 2483.50 | 57.15 | 27.70 | 2.84 | 34.03 | 53.66 | 74.00 | -20.34 | V | |
| 2500.00 | 52.70 | 27.75 | 2.86 | 34.03 | 49.28 | 74.00 | -24.72 | V | |
| 2483.50 | 40.14 | 27.70 | 2.84 | 34.03 | 36.65 | 54.00 | -17.35 | H | Average |
| 2500.00 | 35.94 | 27.75 | 2.86 | 34.03 | 32.52 | 54.00 | -21.48 | H | |
| 2483.50 | 42.23 | 27.70 | 2.84 | 34.03 | 38.74 | 54.00 | -15.26 | V | |
| 2500.00 | 37.88 | 27.75 | 2.86 | 34.03 | 34.46 | 54.00 | -19.54 | 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)). |

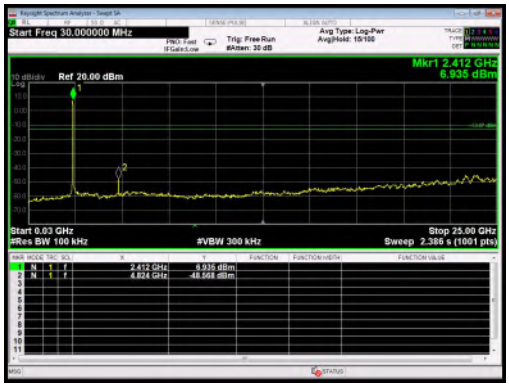
## 7.1 Test Procedure

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

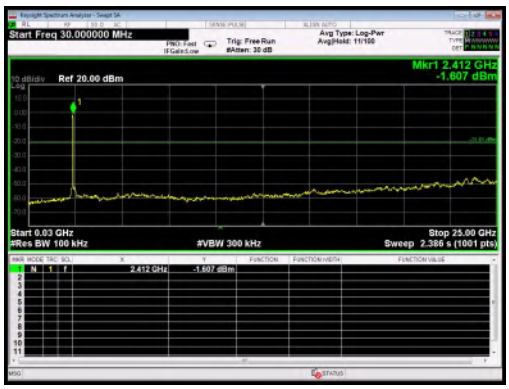
802.11 b

Low Channel Worstcase mode



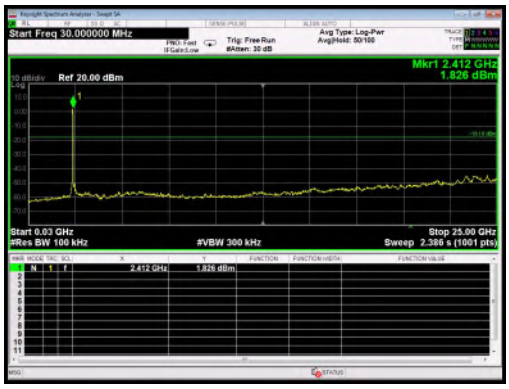

802.11 g

Low Channel Worstcase mode




802.11n - HT20

Low Channel Worstcase mode



# 8 Band Edge Measurement

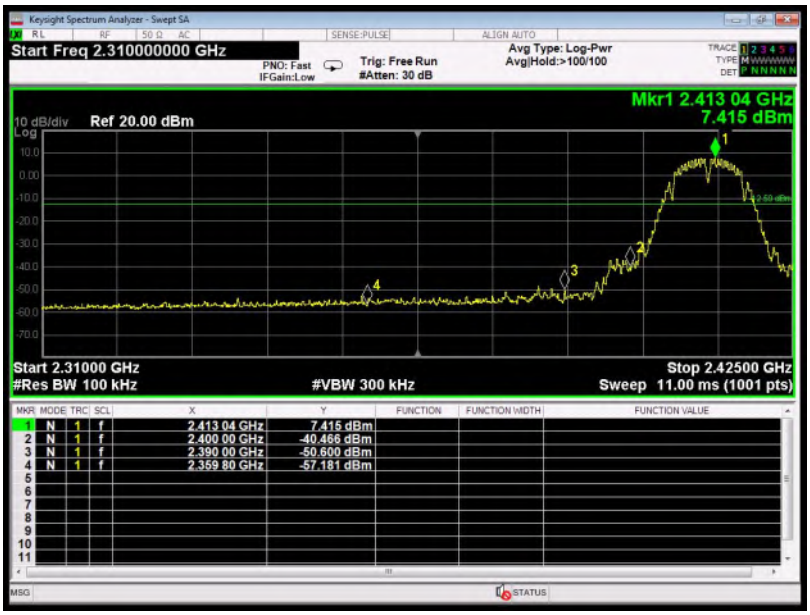
| | | |
|---|---|---|
| Test Requirement | : | Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)). |
| Test Method | : | ANSI C63.10:2013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

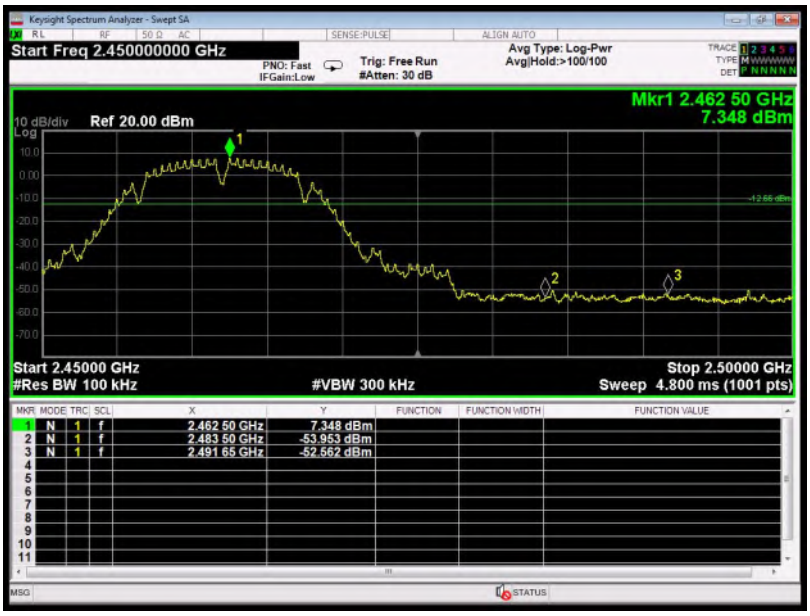
## 8.1 Test Procedure

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

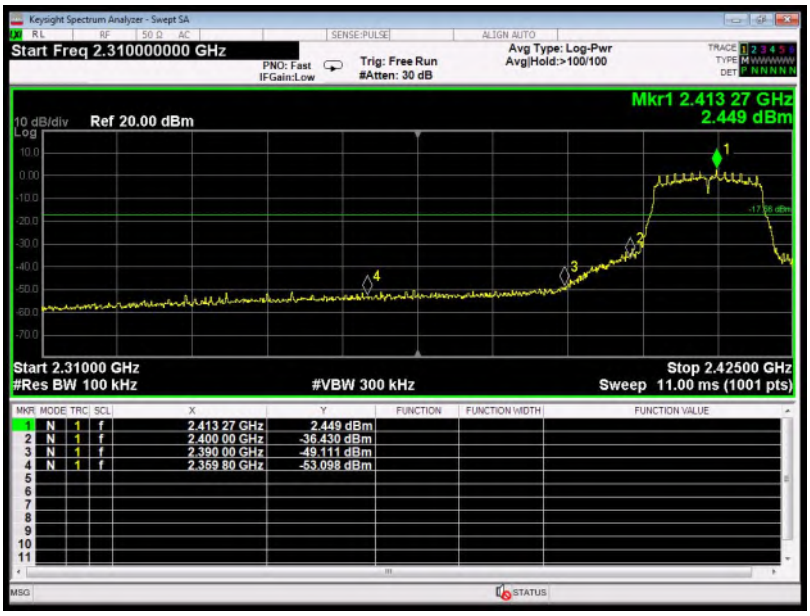
## 8.2 Test Result

802.11b



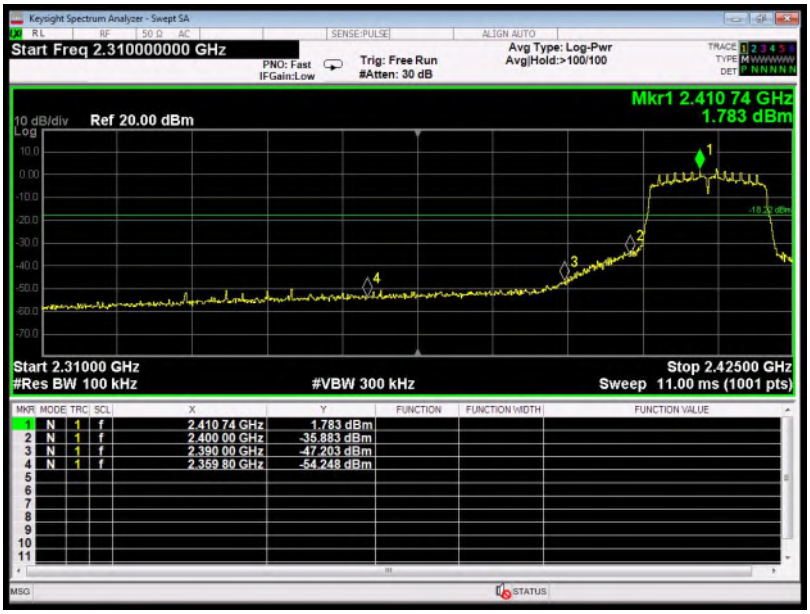



802.11g


Keysight Spectrum Analyzer - Swept SA
Start Freq 2.310000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
Mkr1 2.413 27 GHz
2.449 dBm
10 dB/div
Ref 20.00 dBm
Start 2.31000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.42500 GHz
Sweep 11.00 ms (1001 pts)
1 N 1 f 2.413 27 GHz 2.449 dBm
2 N 1 f 2.400 00 GHz -36.430 dBm
3 N 1 f 2.390 00 GHz -49.111 dBm
4 N 1 f 2.359 80 GHz -53.098 dBm

Keysight Spectrum Analyzer - Swept SA
Start Freq 2.450000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
Mkr1 2.463 30 GHz
3.962 dBm
10 dB/div
Ref 20.00 dBm
Start 2.45000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.50000 GHz
Sweep 4.800 ms (1001 pts)
1 N 1 f 2.463 30 GHz 3.962 dBm
2 N 1 f 2.483 50 GHz -45.815 dBm
3 N 1 f 2.491 65 GHz -47.776 dBm

802.11n-HT20


Keysight Spectrum Analyzer - Swept SA
Start Freq 2.310000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
Mkr1 2.410 74 GHz
1.783 dBm
10 dB/div
Ref 20.00 dBm
Start 2.31000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.42500 GHz
Sweep 11.00 ms (1001 pts)
1 N 1 f 2.410 74 GHz 1.783 dBm
2 N 1 f 2.400 00 GHz -35.883 dBm
3 N 1 f 2.390 00 GHz -47.203 dBm
4 N 1 f 2.359 80 GHz -54.248 dBm

Keysight Spectrum Analyzer - Swept SA
Start Freq 2.450000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
Mkr1 2.463 25 GHz
3.960 dBm
10 dB/div
Ref 20.00 dBm
Start 2.45000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.50000 GHz
Sweep 4.800 ms (1001 pts)
1 N 1 f 2.463 25 GHz 3.960 dBm
2 N 1 f 2.483 50 GHz -44.147 dBm
3 N 1 f 2.491 65 GHz -49.713 dBm

# 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. |

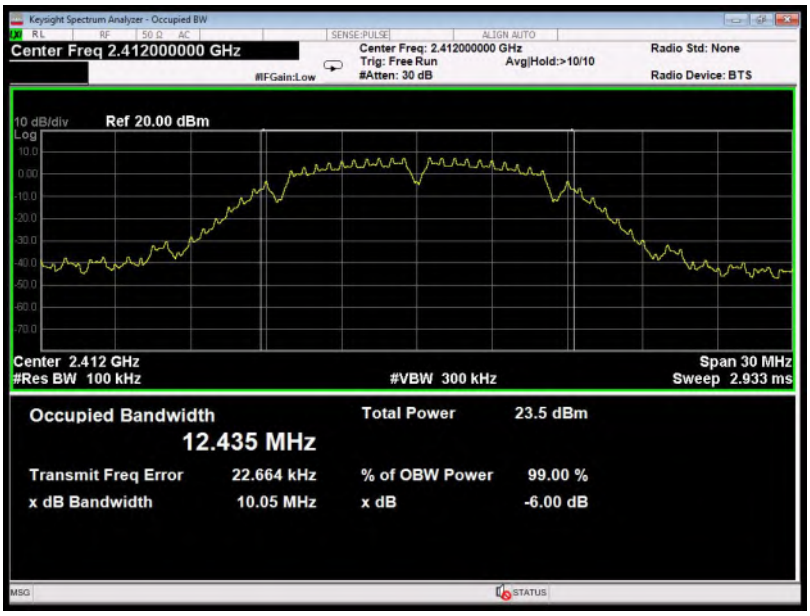
## 9.1 Test Procedure

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

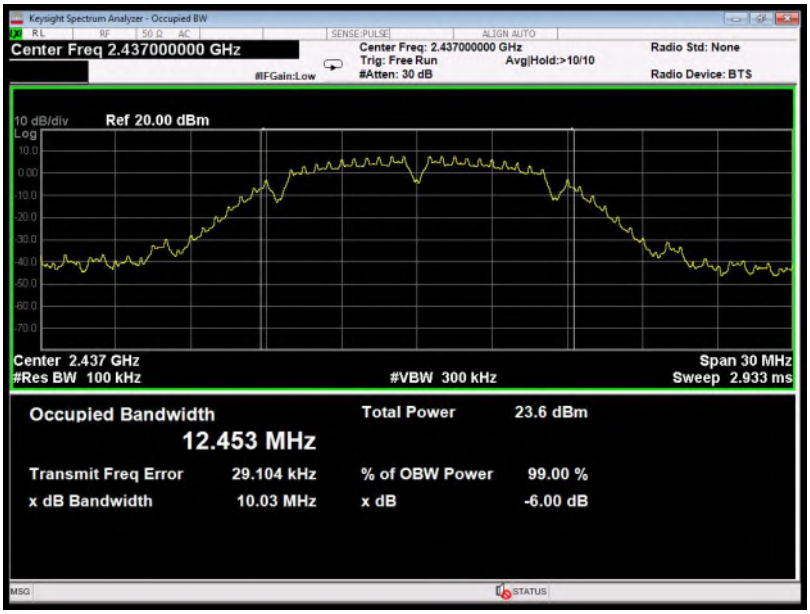
## 9.2 Test Result

| Modulation | Bandwidth(MHz) | | | Limit |
|---|---|---|---|---|
| | Low Channel | Middle Channel | High Channel | |
| 802.11b | 10.05 | 10.03 | 9.572 | ≥500kHz |
| 802.11g | 15.75 | 15.32 | 15.15 | ≥500kHz |
| 802.11n-HT20 | 15.13 | 15.17 | 15.34 | ≥500kHz |

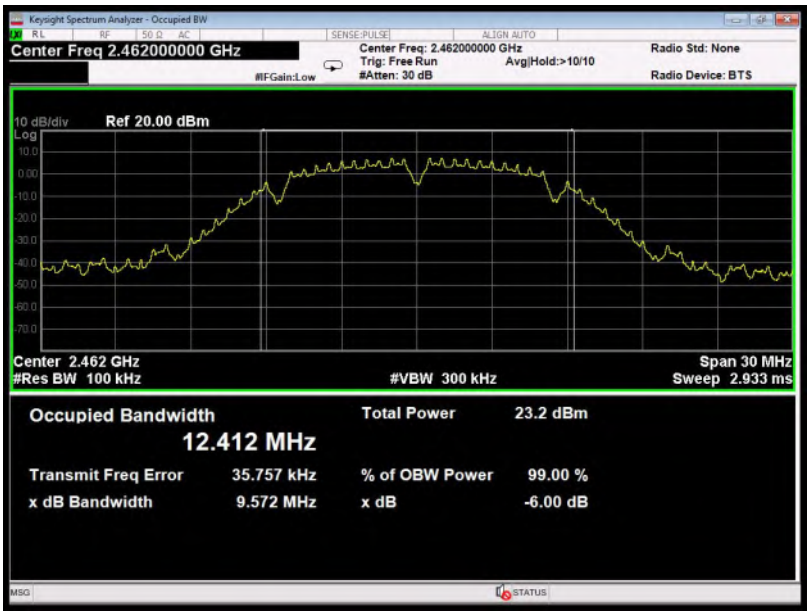
802.11b Low Channel



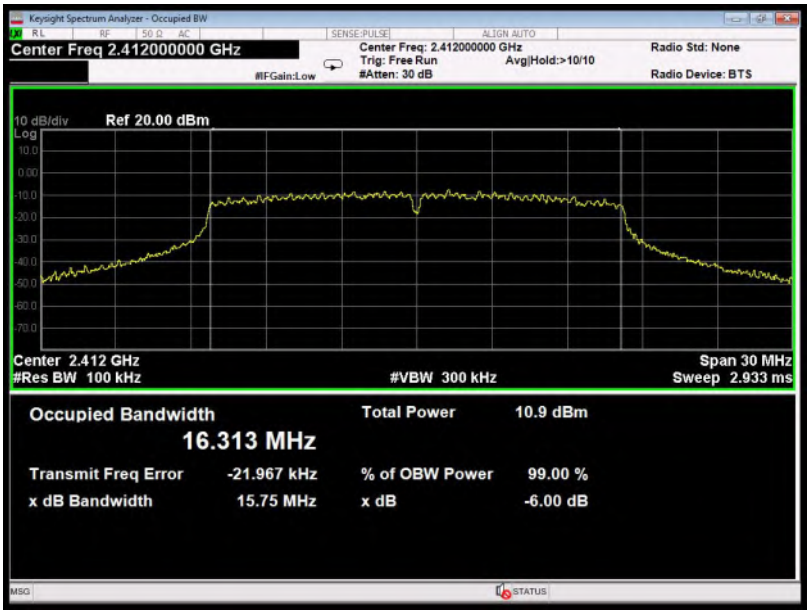

802.11b Middle Channel



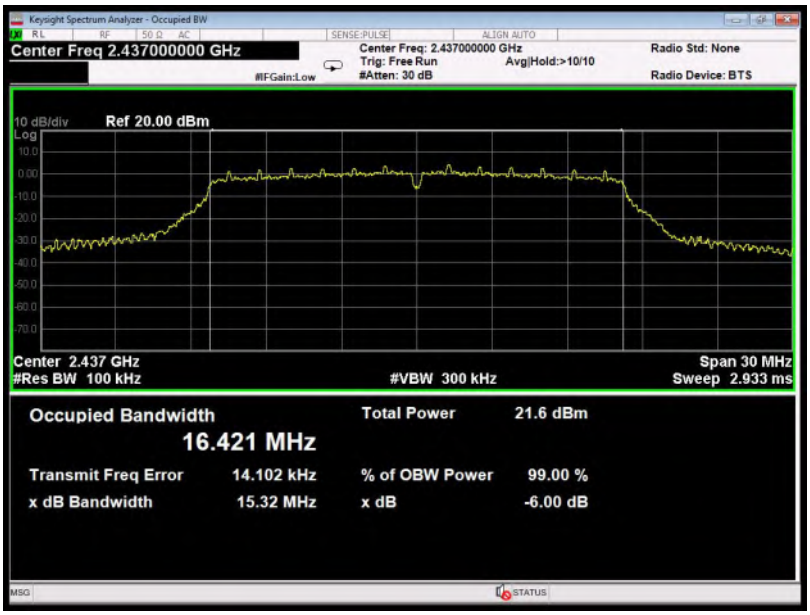
802.11b High Channel



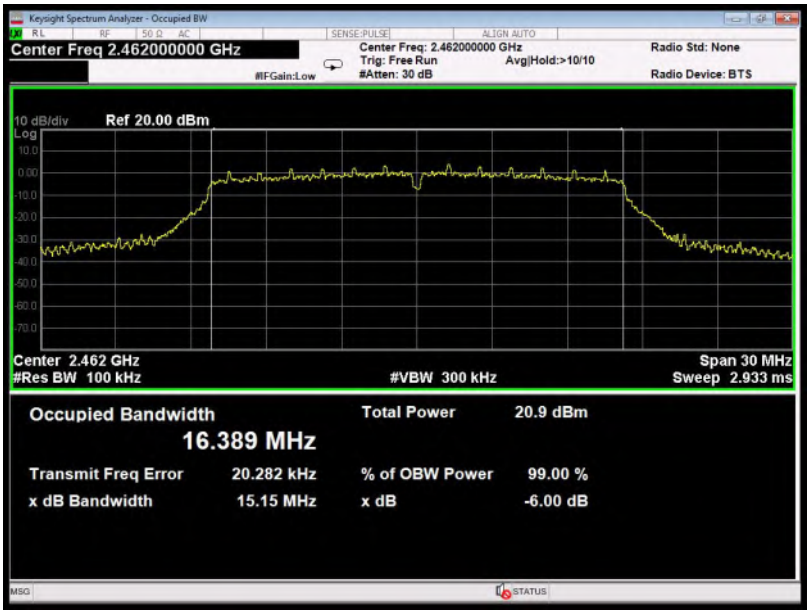

802.11g Low Channel



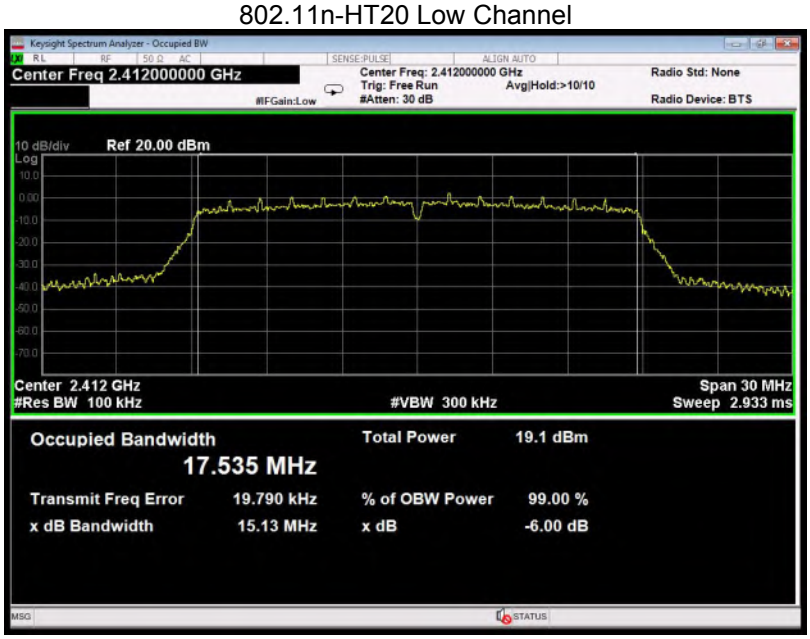
802.11g Middle Channel



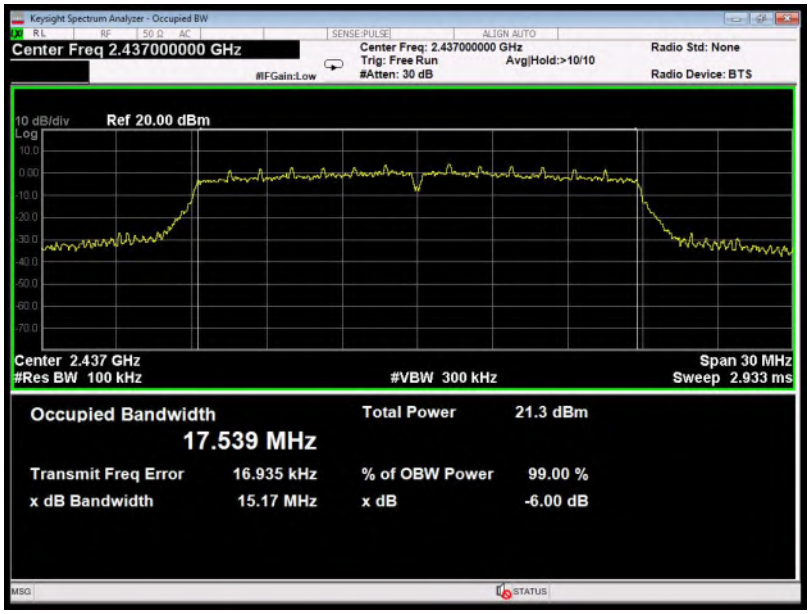

802.11g High Channel



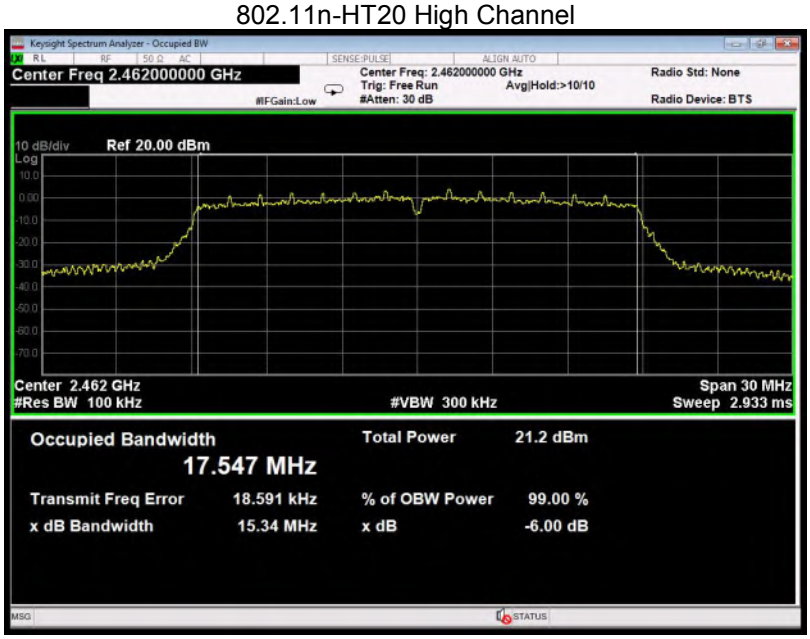
802.11n-HT20 Low Channel




802.11n-HT20 Middle Channel



802.11n-HT20 High Channel



# 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 | 18.61 | 18.67 | 18.60 | 1W(30dBm) |
| 802.11g | 16.19 | 15.15 | 15.19 | 1W(30dBm) |
| 802.11n-HT20 | 12.99 | 14.23 | 14.25 | 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

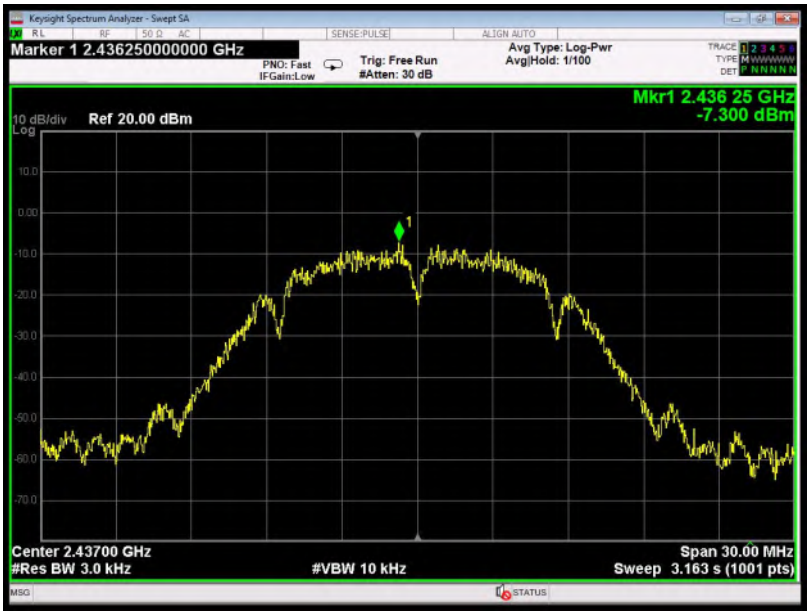
1. Connect the antenna port(s) to the spectrum analyzer input.
2. Configure the spectrum analyzer as shown below:
   Center frequency=DTS channel center frequency
   Span = 1.5 times the DTS bandwidth
   RBW = 3KHz, VBW = 10KHz
   Sweep time = auto couple
   Detector = peak
   Trace mode =max hold
3. 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 | -5.789 | -7.300 | -5.960 | 8dBm/3kHz |
| 802.11g | -10.731 | -9.825 | -11.229 | 8dBm/3kHz |
| 802.11n-HT20 | -12.904 | -11.732 | -11.552 | 8dBm/3kHz |

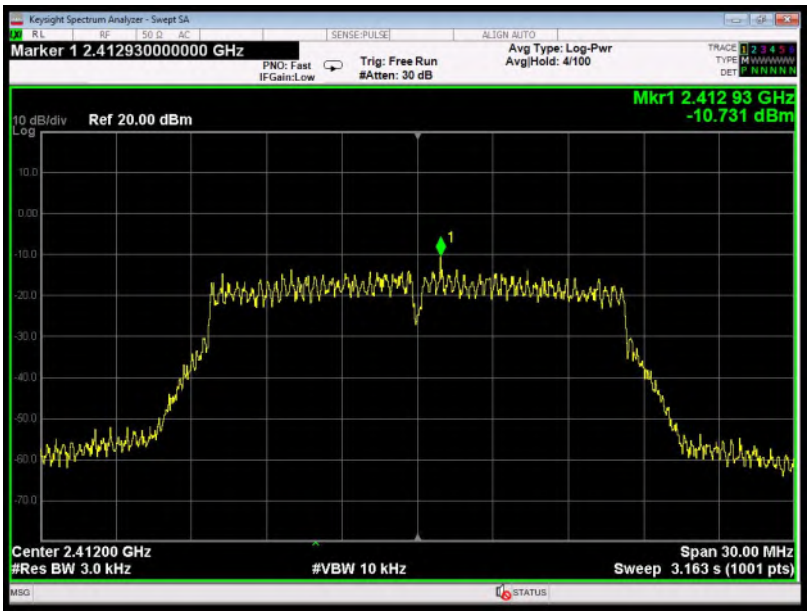
802.11b Low Channel

802.11b Middle Channel

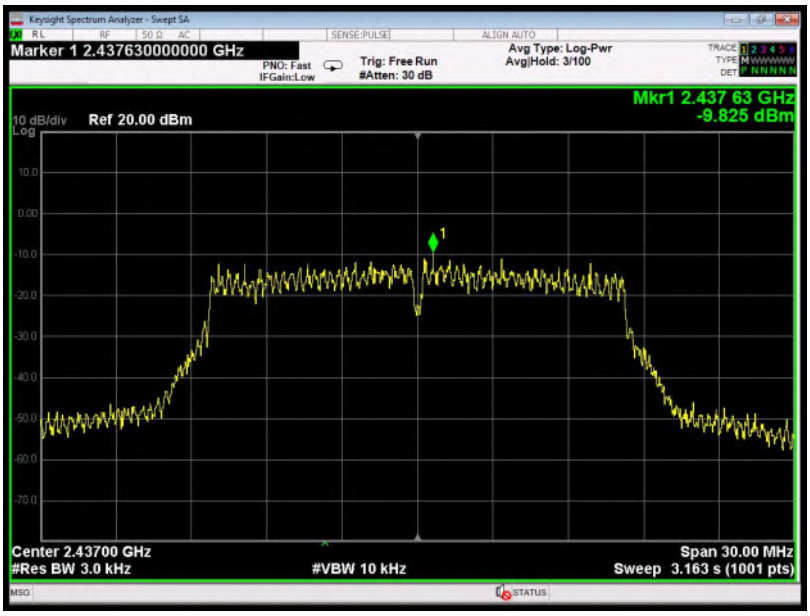


802.11b High Channel

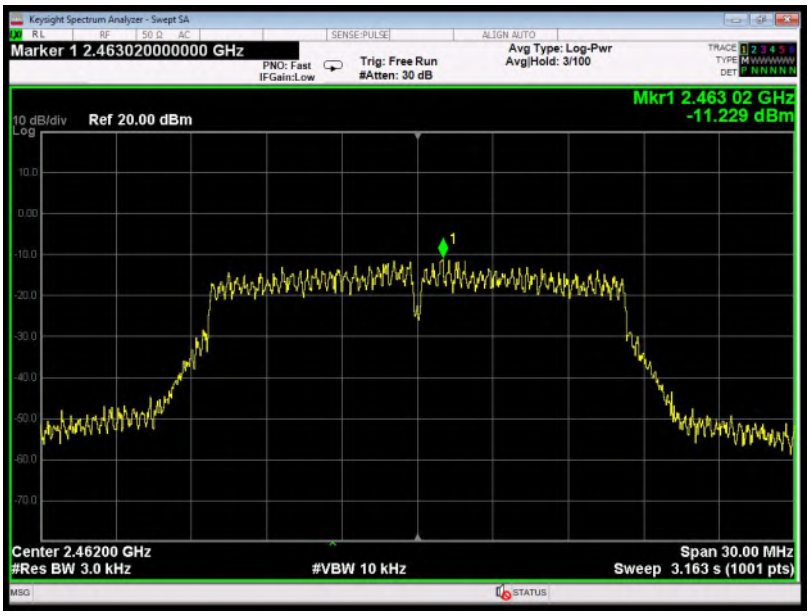
802.11g Low Channel



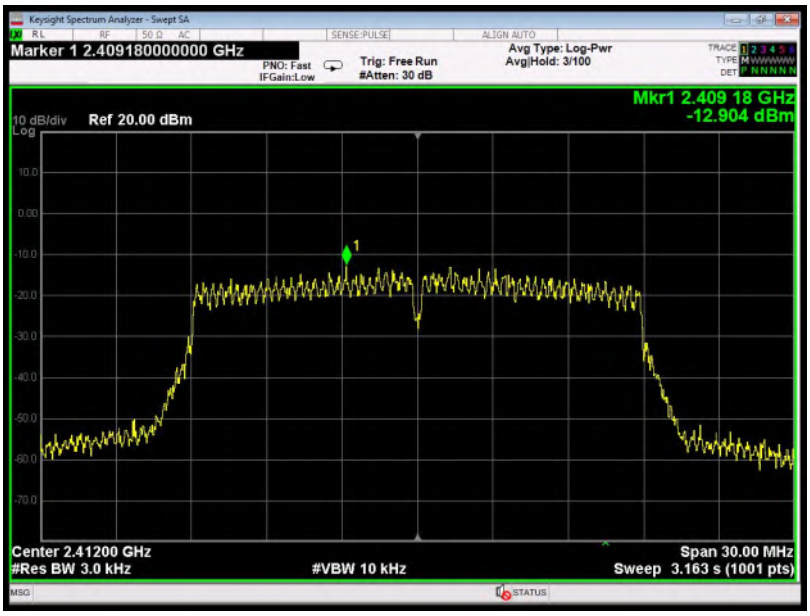
802.11g Middle Channel



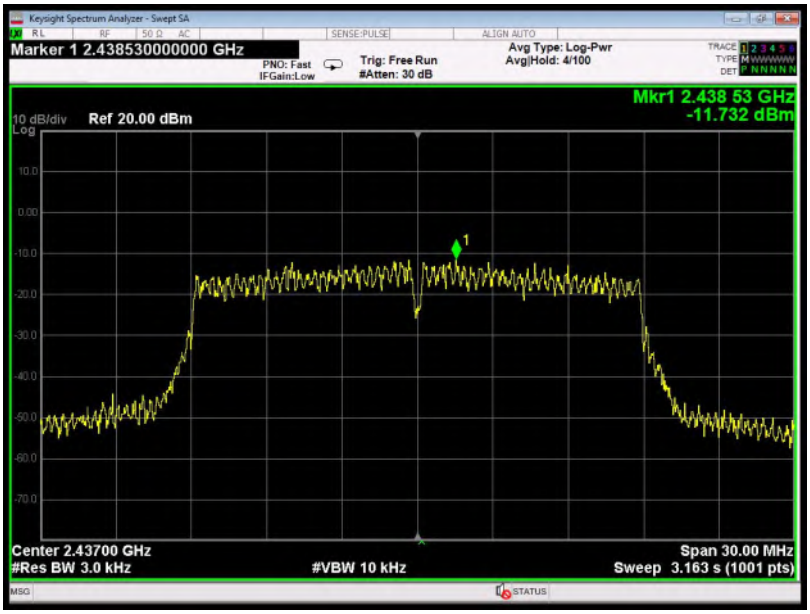

802.11g High Channel



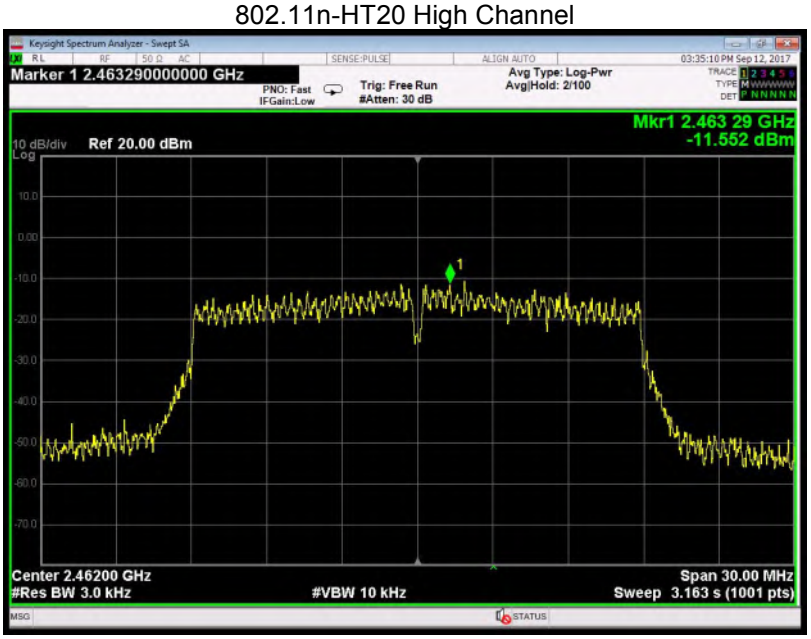
802.11n-HT20 Low Channel




802.11n-HT20 Middle Channel



802.11n-HT20 High Channel



# 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.

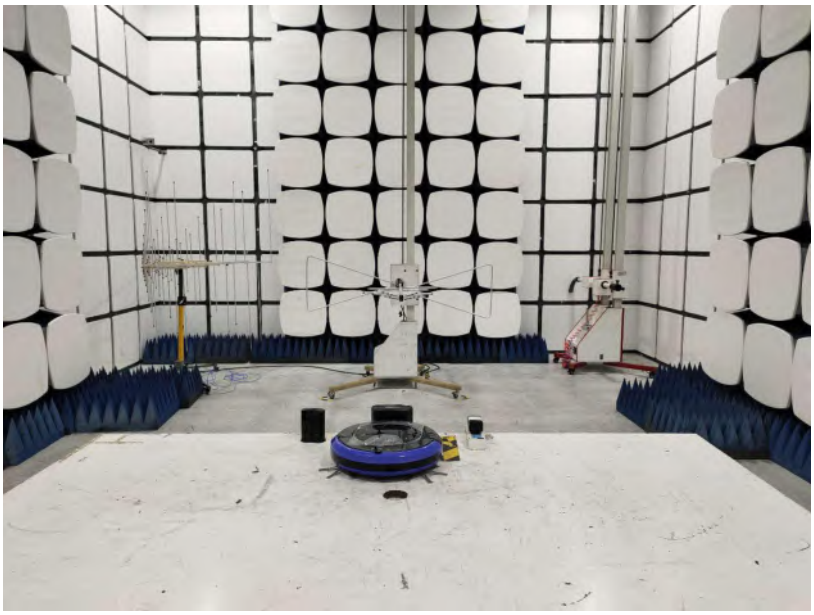
## 12.2 Result

The EUT'S antenna, permanent attached antenna,is PCB Antenna. The antenna's gain is 0 dBi and meets the requirement.

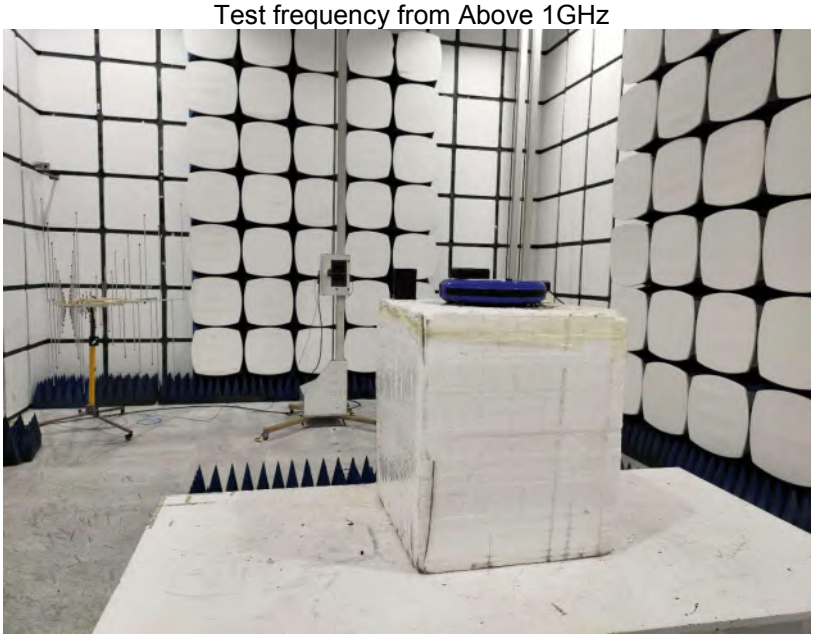
# 13 Test Setup

Conducted Emissions

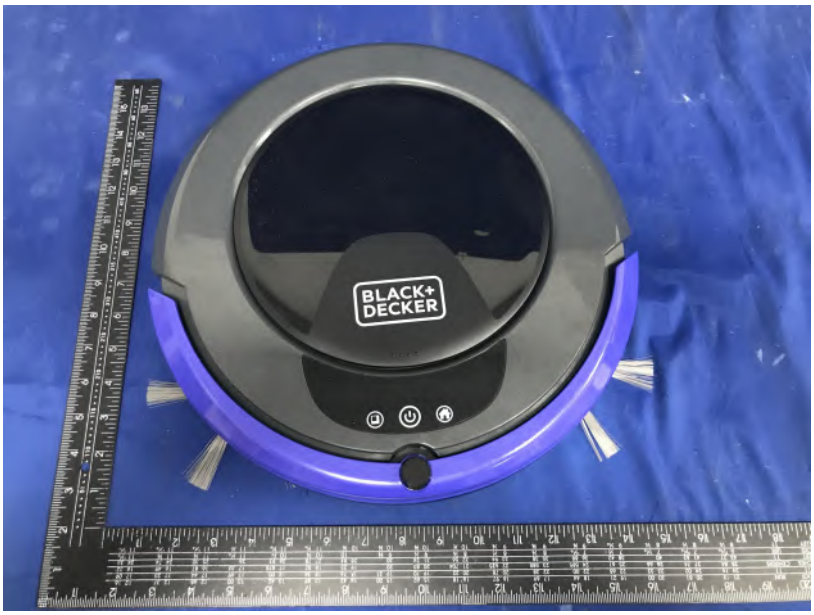
Radiated Spurious Emissions
From 30MHz-1000MHz

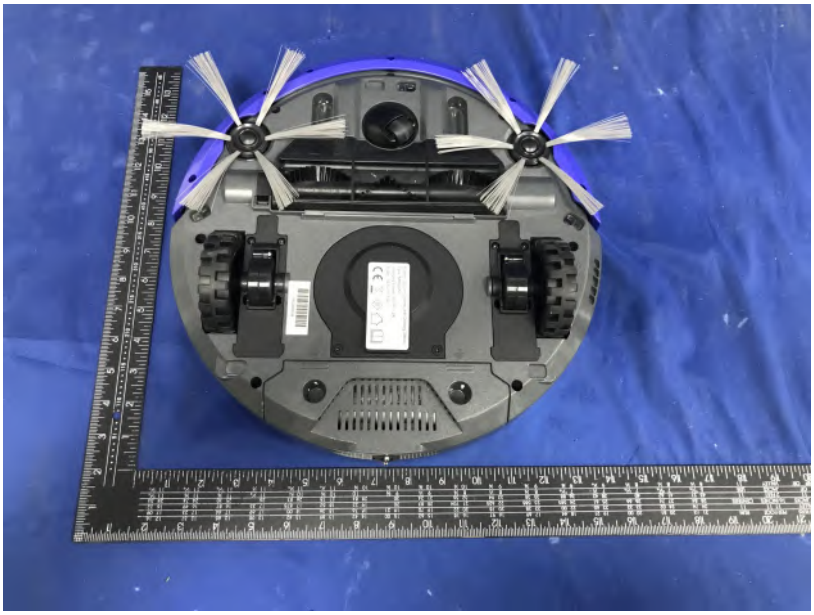


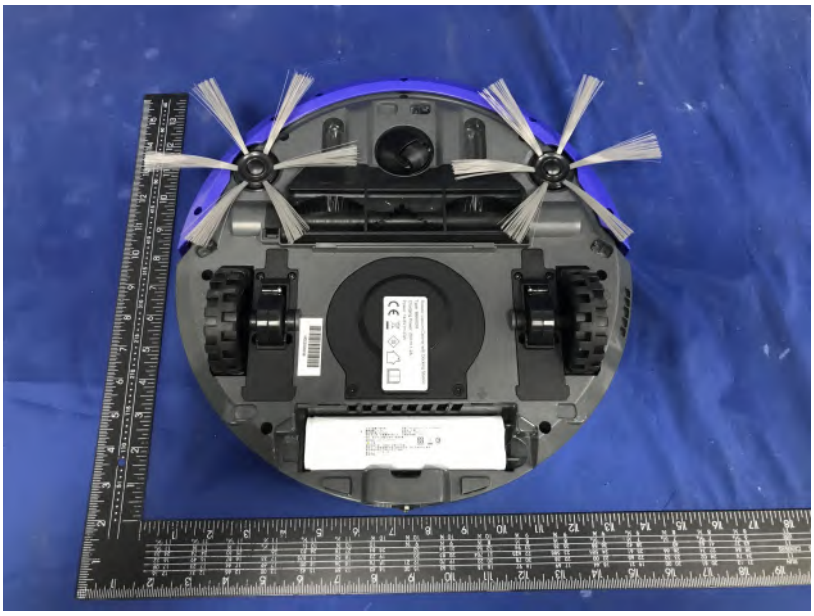
Test frequency from Above 1GHz



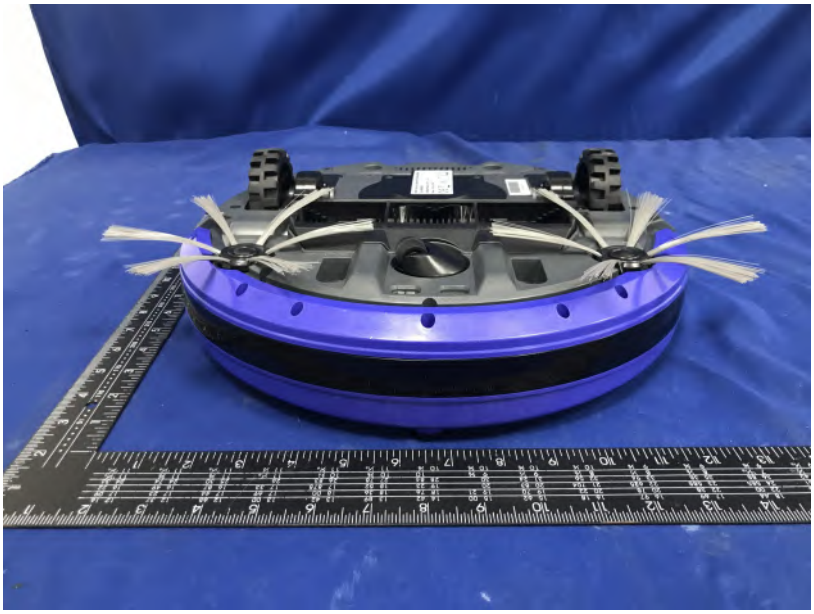
# 14 EUT PHOTOS

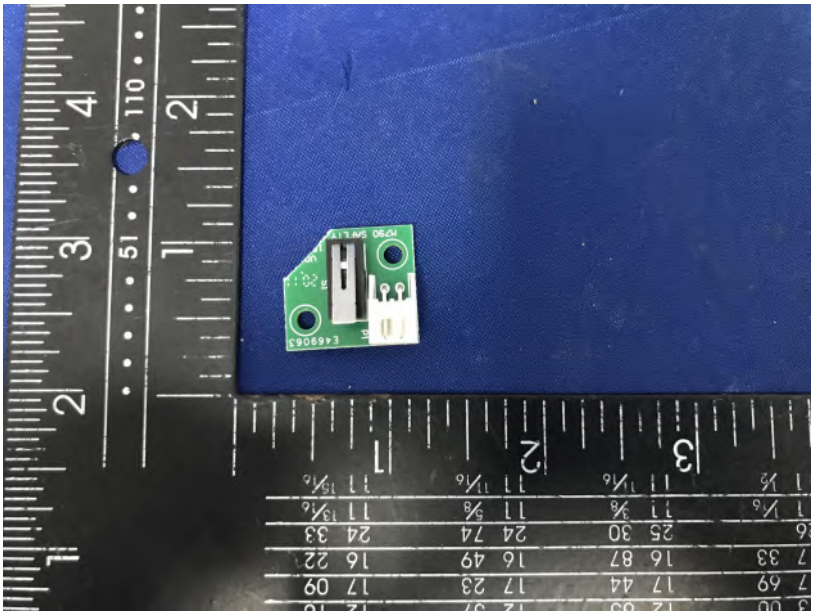

BLACK+
DECKER

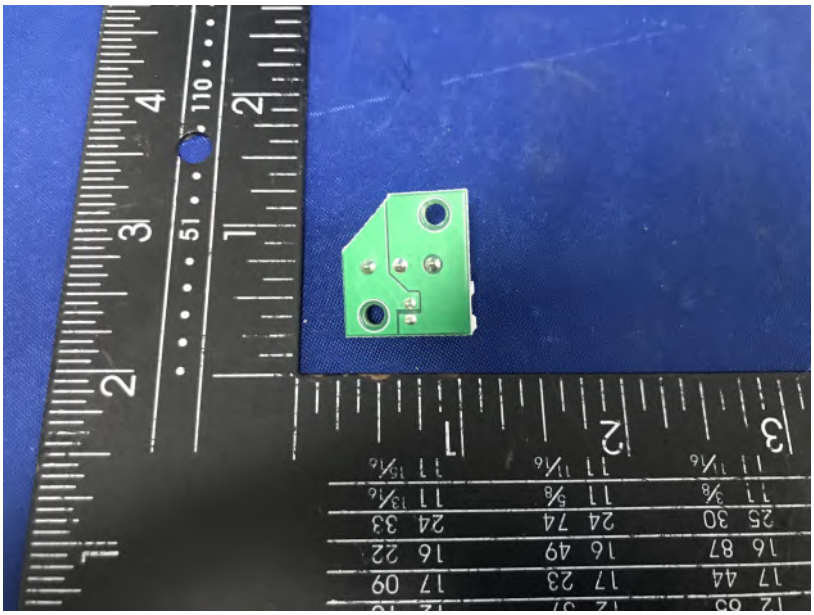


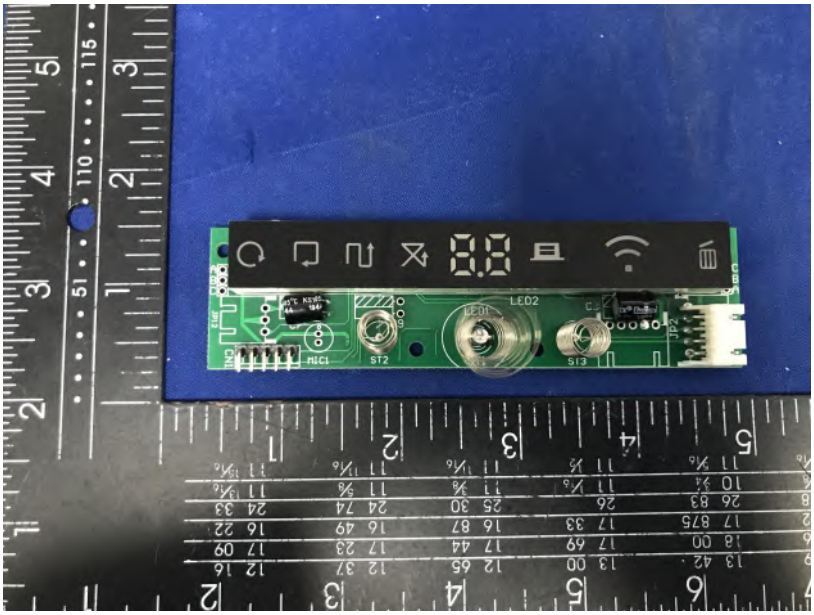


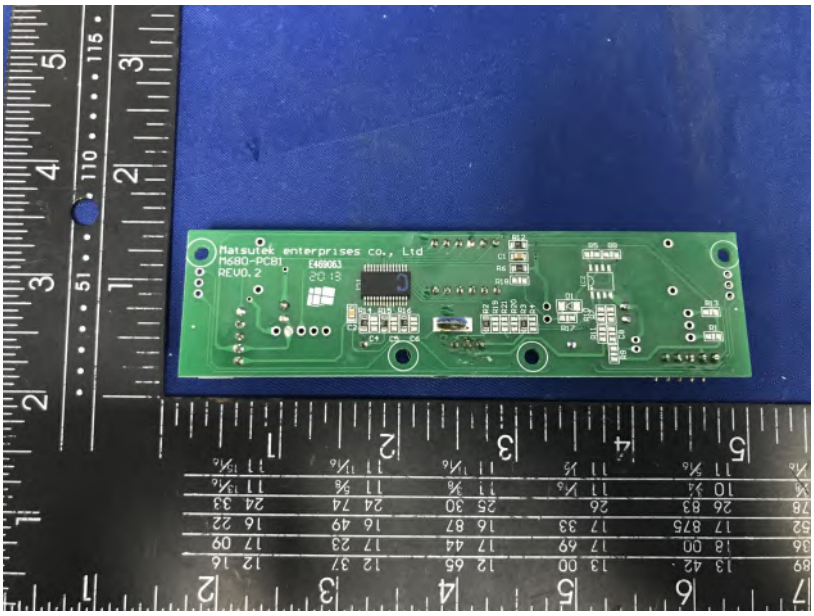
可充式鋰離子電池組
標稱電壓：14.6V
額定電容量：2500mAh
委制/進口商：松廣實業有限公司
地址：新北市土城區自強街15巷2號2樓
服務電話：+886-2-22697388
注意：
電池更換不當，可能會引起爆炸的危險。
請與本公司服務處聯絡或就近經銷商洽談，進行更換相同的電池
電池壽命後請交至電池回收中心處理。
製造年月：2020年03月
製造序號：
型號：INR18650 4S1P 14.6V 2500mAh
原產地：中國
電池代碼：41NR19/65
充電限制電壓：16.5V
R38413

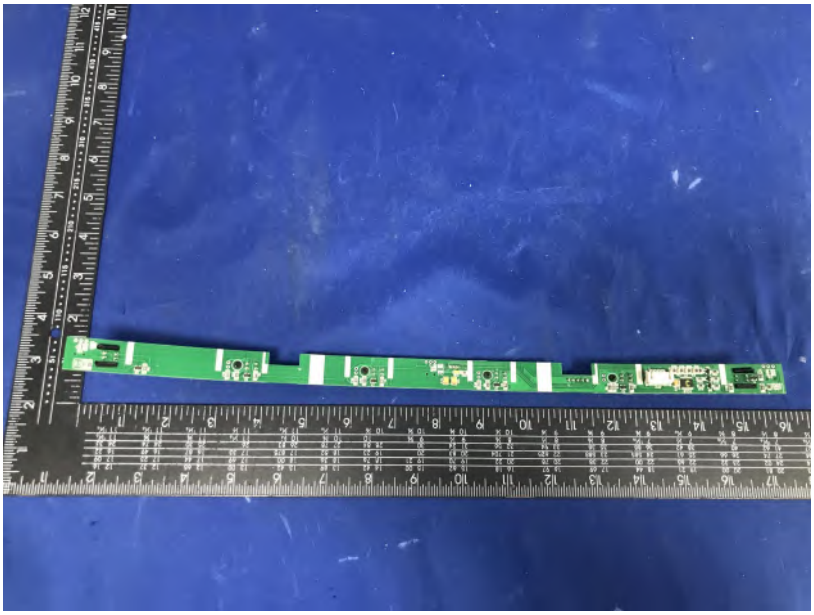


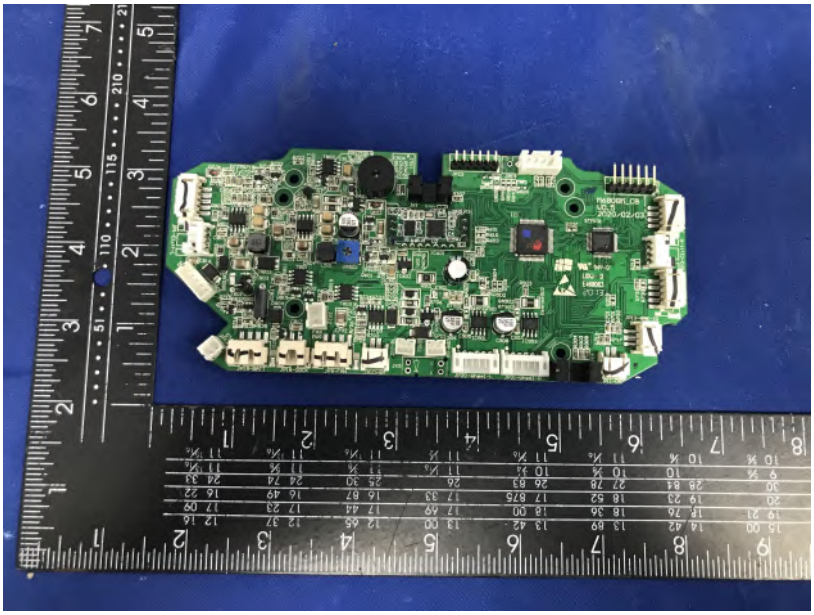


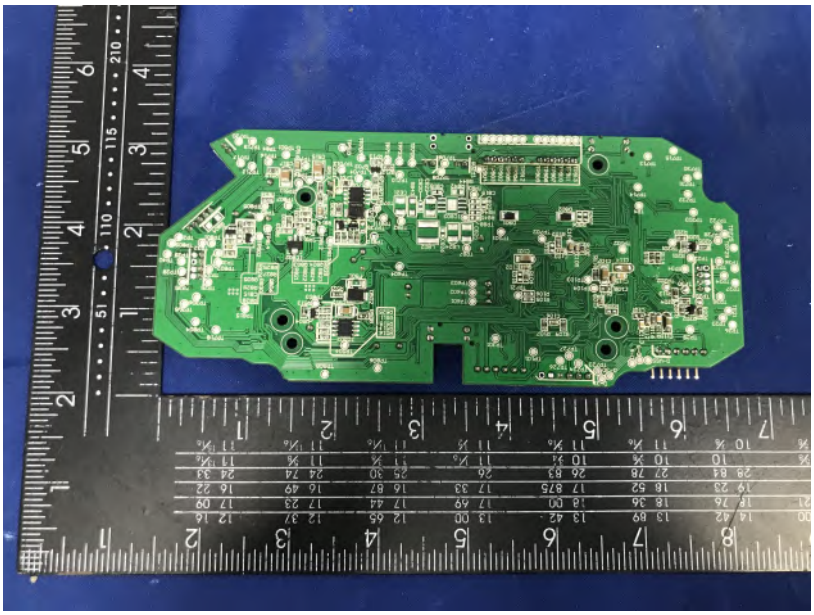


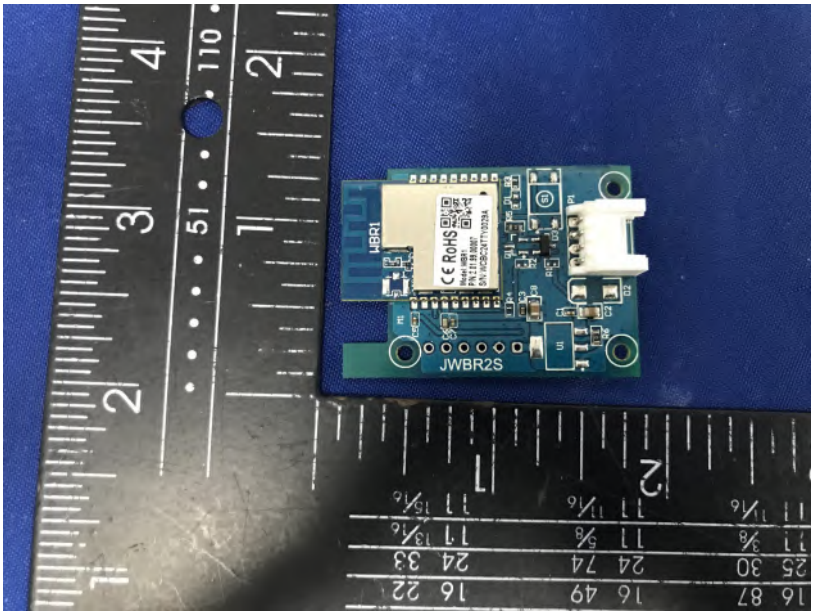

LED2
ST2
ST3


Matsutek enterprises co., Ltd
M680-PCB1
REV0.2
E469063
2013





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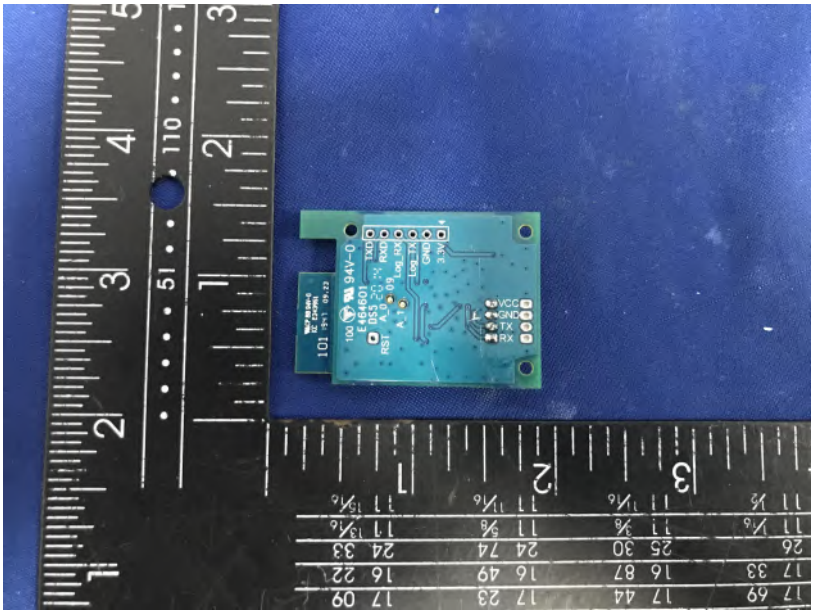
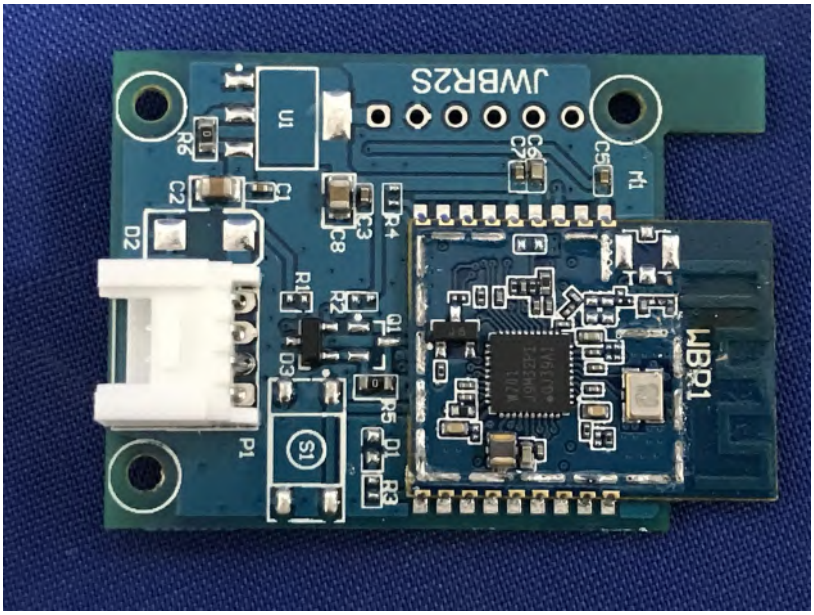
HBR1






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