

## FCC TEST REPORT

For

Lionel L.L.C.

WIFI Camera

Model No.: WIFICAM1

Additional Model No.: /

Prepared for : Lionel L.L.C.  
Address : 6301 Performance Drive Concord NC USA 28027

Prepared by : Shenzhen LCS Compliance Testing Laboratory Ltd.  
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Date of receipt of test sample : September 13, 2017  
Number of tested samples : 1  
Serial number : Prototype  
Date of Test : September 13, 2017~October 09, 2017  
Date of Report : October 09, 2017

**FCC TEST REPORT**  
**FCC CFR 47 PART 15 C(15.247): 2016**

**Report Reference No.** ..... : **LCS170619059AE**

Date of Issue ..... : October 09, 2017

**Testing Laboratory Name**..... : **Shenzhen LCS Compliance Testing Laboratory Ltd.**

Address ..... : 1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue,  
 Bao'an District, Shenzhen, Guangdong, China

Testing Location/ Procedure ..... : Full application of Harmonised standards   
 Partial application of Harmonised standards   
 Other standard testing method

**Applicant's Name**..... : **Lionel L.L.C.**

Address ..... : 6301 Performance Drive Concord NC USA 28027

**Test Specification**

Standard..... : FCC CFR 47 PART 15 C(15.247): 2016

**Test Report Form No.** ..... : LCSEMC-1.0

TRF Originator ..... : Shenzhen LCS Compliance Testing Laboratory Ltd.

Master TRF ..... : Dated 2011-03

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**EUT Description**..... : **WIFI Camera**

Trade Mark..... : N/A

Model/ Type reference ..... : WIFICAM1

Ratings ..... : DC 5.0V/2A

Result ..... : **Positive**

**Compiled by:**

*Aking Jim*

Aking Jin/ File administrators

**Supervised by:**

*Dick Su*

Dick Su/ Technique principal

**Approved by:**

*Gavin Liang*

Gavin Liang/ Manager

## FCC -- TEST REPORT

|  |  |
|--|--|
| <b>Test Report No. :</b> <b>LCS170619059AE</b> | <u>October 09, 2017</u><br>Date of issue |
|--|--|

|  |
|--|
| EUT..... : WIFI Camera<br><br>Type / Model..... : WIFICAM1   |
| <b>Applicant..... : Lionel L.L.C.</b><br>Address..... : 6301 Performance Drive Concord NC USA 28027<br>Telephone..... : /<br>Fax..... : /    |
| <b>Manufacturer..... : Lionel L.L.C.</b><br>Address..... : 6301 Performance Drive Concord NC USA 28027<br>Telephone..... : /<br>Fax..... : / |
| <b>Factory..... : Lionel L.L.C.</b><br>Address..... : 6301 Performance Drive Concord NC USA 28027<br>Telephone..... : /<br>Fax..... : /      |

|                    |                 |
|--------------------|-----------------|
| <b>Test Result</b> | <b>Positive</b> |
|--------------------|-----------------|

The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

**Revision History**

| Revision | Issue Date       | Revisions     | Revised By  |
|----------|------------------|---------------|-------------|
| 00       | October 09, 2017 | Initial Issue | Gavin Liang |
|          |                  |               |             |
|          |                  |               |             |

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## 1. GENERAL INFORMATION

### 1.1. Description of Device (EUT)

|                         |  |
|-------------------------|--|
| EUT                     | : WIFI Camera  |
| Model Number            | : WIFICAM1   |
| Model Declaration       | : /  |
| Test Model              | : WIFICAM1   |
| Hardware version        | : 3518EV200_W2_V1.3D170301   |
| Software version        | : 1.9.7 C  |
| Power Supply            | : DC 5.0V/2A for battery   |
| 2.4G WLAN               | : Supported IEEE 802.11b/802.11g/802.11n<br>IEEE 802.11b:2412-2462MHz  |
| Operation frequency     | : IEEE 802.11g:2412-2462MHz<br>IEEE 802.11n HT20:2412-2462MHz<br>IEEE 802.11n HT40:2422-2452MHz<br>IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) |
| Modulation Type         | : IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK)<br>IEEE 802.11n: OFDM (64QAM, 16QAM,QPSK,BPSK)  |
| Channel Number          | : 11 Channels for WIFI 20MHz Bandwidth (IEEE 802.11b/g/n HT20)<br>7 Channels for WIFI 40MHz Bandwidth (IEEE 802.11n HT40)              |
| Antenna Type            | : External antenna   |
| Antenna Gain            | : 2.0dBi (Max.)  |
| Extreme temp. Tolerance | : -10°C to 60°C  |
| Extreme vol. Limits     | : 4.5 VDC to 5.5 VDC (nominal voltage 5.0V)  |

### 1.2. Host System Configuration List and Details

| Manufacturer | Description | Model | Serial Number | Certificate |
|--------------|-------------|-------|---------------|-------------|
| --           | --          | --    | --            | --          |

### 1.3. External I/O Cable

| I/O Port Description | Quantity | Cable |
|----------------------|----------|-------|
| --                   | --       | --    |

### 1.4. Description of Test Facility

CNAS Registration Number. is L4595.  
 FCC Registration Number. is CN5024.  
 Industry Canada Registration Number. is 9642A-1.  
 ESMD Registration Number. is ARCB0108.  
 UL Registration Number. is 100571-492.  
 TUV SUD Registration Number. is SCN1081.  
 TUV RH Registration Number. is UA 50296516-001.  
 NVLAP Registration Code is 600167-0.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

## 1.5. Statement of the Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the LCS quality system acc. To DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

## 1.6. Measurement Uncertainty

| Test Item              | Frequency Range | Uncertainty | Note |
|------------------------|-----------------|-------------|------|
| Radiation Uncertainty  | 9KHz~30MHz      | ±3.10dB     | (1)  |
|                        | 30MHz~200MHz    | ±2.96dB     | (1)  |
|                        | 200MHz~1000MHz  | ±3.10dB     | (1)  |
|                        | 1GHz~26.5GHz    | ±3.80dB     | (1)  |
|                        | 26.5GHz~40GHz   | ±3.90dB     | (1)  |
| Conduction Uncertainty | 150kHz~30MHz    | ±1.63dB     | (1)  |
| Power disturbance      | 30MHz~300MHz    | ±1.60dB     | (1)  |

(1). This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

## 1.7. Description of Test Modes

The EUT has been tested under operating condition.

This test was performed with EUT in X, Y, Z position and the worst case was found when EUT in X position.

Worst-case mode and channel used for 150 KHz-30 MHz power line conducted emissions was the mode and channel with the highest output power, which was determined to be IEEE 802.11b mode (Low Channel).

Worst-case mode and channel used for 9 KHz-1000 MHz radiated emissions was the mode and channel with the highest output power, that was determined to be IEEE 802.11b mode(Low Channel).

AC conducted emission per-test at both AC 120V/60Hz and AC 240V/50Hz, recorded worst case;

AC conducted emission pre-test at power adapter mode;

Worst-Case data rates were utilized from preliminary testing of the Chipset, worst-case data rates used during the testing are as follows:

IEEE 802.11b Mode: 1 Mbps, DSSS.

IEEE 802.11g Mode: 6 Mbps, OFDM.

IEEE 802.11n Mode HT20: MCS0, OFDM.

IEEE 802.11n Mode HT40: MCS7, OFDM.

## Frequency of Channels

## IEEE 802.11b/g/n HT20

| Frequency Band | Channel No. | Frequency(MHz) | Channel No. | Frequency(MHz) |
|----------------|-------------|----------------|-------------|----------------|
| 2412~2462MHz   | 1           | 2412           | 7           | 2442           |
|                | 2           | 2417           | 8           | 2447           |
|                | 3           | 2422           | 9           | 2452           |
|                | 4           | 2427           | 10          | 2457           |
|                | 5           | 2432           | 11          | 2462           |
|                | 6           | 2437           | --          | --             |

## IEEE 802.11n HT40

| Frequency Band | Channel No. | Frequency(MHz) | Channel No. | Frequency(MHz) |
|----------------|-------------|----------------|-------------|----------------|
| 2422~2452MHz   | 1           | --             | 7           | 2442           |
|                | 2           | --             | 8           | 2447           |
|                | 3           | 2422           | 9           | 2452           |
|                | 4           | 2427           | 10          | --             |
|                | 5           | 2432           | 11          | --             |
|                | 6           | 2437           | --          | --             |

The Radio software & hardware version is same as the product software & hardware version in page6.  
The test software is MP Tool, and test configuration of the software shows as below:

| Test mode            | Channel No. | Frequency(MHz) | Software setting value |
|----------------------|-------------|----------------|------------------------|
| IEEE 802.11b         | 1           | 2412           | 17                     |
|                      | 6           | 2437           | 17                     |
|                      | 11          | 2462           | 17                     |
| IEEE 802.11g         | 1           | 2412           | 15                     |
|                      | 6           | 2437           | 15                     |
|                      | 11          | 2462           | 15                     |
| IEEE 802.11n<br>HT20 | 1           | 2412           | 15                     |
|                      | 6           | 2437           | 15                     |
|                      | 11          | 2462           | 15                     |
| IEEE 802.11n<br>HT40 | 3           | 2422           | 14                     |
|                      | 6           | 2437           | 14                     |
|                      | 9           | 2452           | 14                     |



## 2. TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

The radiated testing was performed at an antenna-to-EUT distance of 3 meters. All radiated and conducted emissions measurement was performed at Shenzhen LCS Compliance Testing Laboratory Ltd.

### 2.1. EUT Configuration

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

### 2.2. EUT Exercise

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to FCC's request, Test Procedure KDB558074 D01 DTS Meas. Guidance and ANSI C63.10 are required to be used for this kind of FCC 15.247 digital modulation device.

According to its specifications, the EUT must comply with the requirements of the Section 15.203, 15.205, 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

### 2.3. General Test Procedures

#### 2.3.1 Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using Quasi-peak and average detector modes.

#### 2.3.2 Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.3 of ANSI C63.10-2013.

### 3. SYSTEM TEST CONFIGURATION

#### 3.1. Justification

The system was configured for testing in a continuous transmit condition.

#### 3.2. EUT Exercise Software

The system was configured for 2.4G WLAN testing in a continuous transmits condition and change test channels by software (MP Tool) provided by application.

#### 3.3. Special Accessories

| No. | Equipment     | Manufacturer | Model No. | Serial No. | Length | shielded/<br>unshielded | Notes |
|-----|---------------|--------------|-----------|------------|--------|-------------------------|-------|
| 1   | PC            | Lenovo       | Ideapad   | A131101550 | /      | /                       | DOC   |
| 2   | Power adapter | Lenovo       | CPA-A090  | 36200414   | 1.00m  | unshielded              | DOC   |

#### 3.4. Block Diagram/Schematics

Please refer to the related document

#### 3.5. Equipment Modifications

Shenzhen LCS Compliance Testing Laboratory Ltd. has not done any modification on the EUT.

#### 3.6. Test Setup

Please refer to the test setup photo.

#### 4. SUMMARY OF TEST RESULTS

| Applied Standard: FCC Part 15 Subpart C |   |           |
|---|---|-----------|
| FCC Rules                               | Description of Test                       | Result    |
| /                                       | Duty Cycle                                | Compliant |
| §15.247(b)                              | Maximum Conducted Output Power            | Compliant |
| §15.247(e)                              | Power Spectral Density                    | Compliant |
| §15.247(a)(2)                           | 6dB Bandwidth                             | Compliant |
| §15.247(a)                              | Occupied Bandwidth                        | Compliant |
| §15.209, §15.247(d)                     | Radiated and Conducted Spurious Emissions | Compliant |
| §15.205                                 | Emissions at Restricted Band              | Compliant |
| §15.207(a)                              | AC Mains Conducted Emissions              | N/A*      |
| §15.203                                 | Antenna Requirements                      | Compliant |
| §15.247(i)§2.1093                       | RF Exposure                               | Compliant |

N/A\* - Not Applicable

## 5. TEST RESULT

### 5.1. On Time and Duty Cycle

#### 5.1.1. Standard Applicable

None; for reporting purpose only.

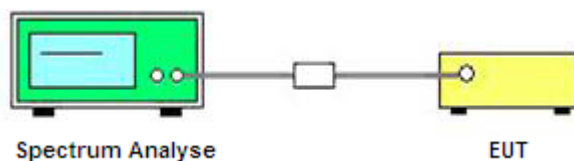
#### 5.1.2. Measuring Instruments and Setting

Please refer to equipment's list in this report. The following table is the setting of the spectrum analyzer.

#### 5.1.3. Test Procedures

1. Set the center frequency of the spectrum analyzer to the transmitting frequency;
2. Set the span=0MHz, RBW=8MHz, VBW=50MHz, Sweep time=5ms;
3. Detector = peak;
4. Trace mode = Single hold.

#### 5.1.4. Test Setup Layout



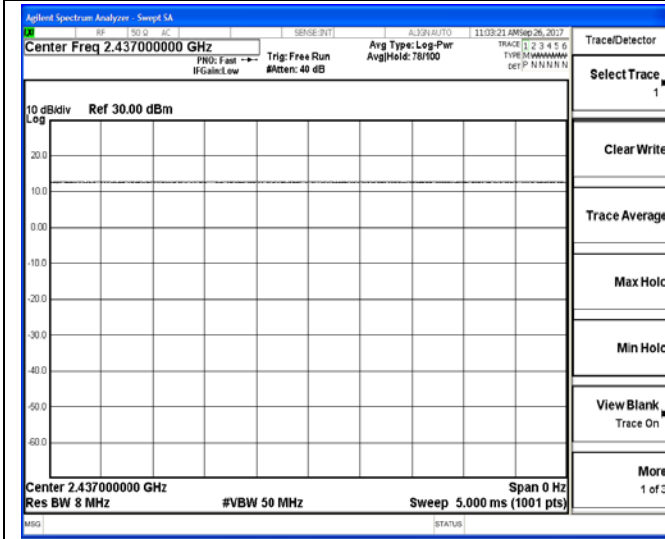
#### 5.1.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

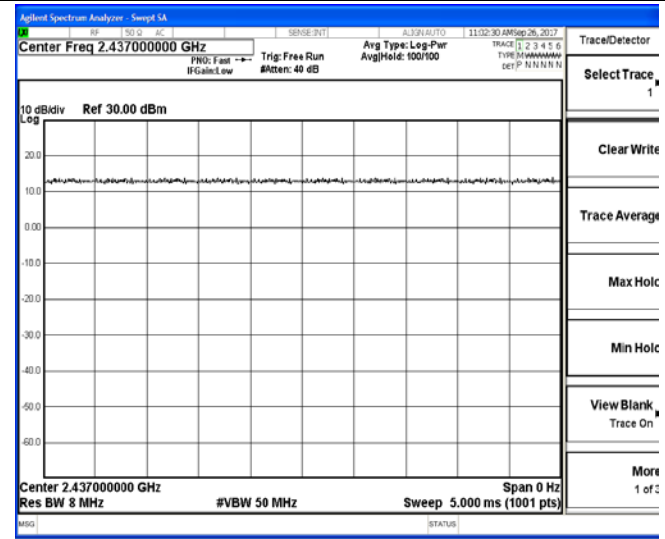
#### 5.1.6. Test result

| Mode              | On Time B (ms) | Period (ms) | Duty Cycle x (Linear) | Duty Cycle (%) | Duty Cycle Correction Factor (dB) | 1/B Minimum VBW(KHz) |
|-------------------|----------------|-------------|-----------------------|----------------|-----------------------------------|----------------------|
| IEEE 802.11b      | 5.0            | 5.0         | 1                     | 100            | 0                                 | 0.01                 |
| IEEE 802.11g      | 5.0            | 5.0         | 1                     | 100            | 0                                 | 0.01                 |
| IEEE 802.11n HT20 | 5.0            | 5.0         | 1                     | 100            | 0                                 | 0.01                 |
| IEEE 802.11n HT40 | 5.0            | 5.0         | 1                     | 100            | 0                                 | 0.01                 |

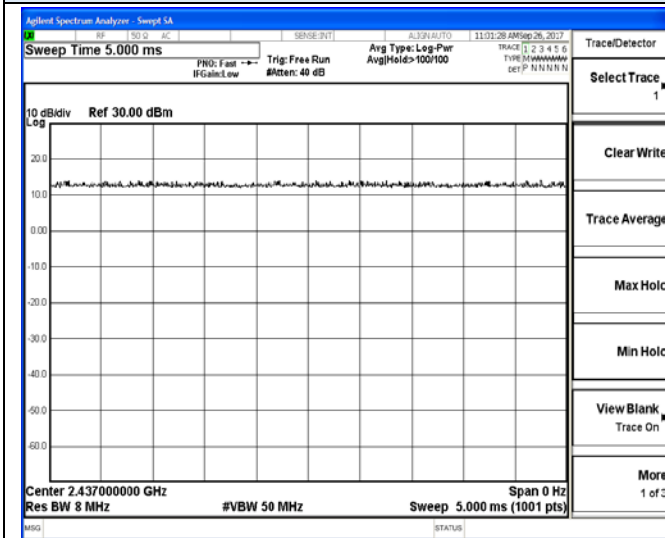
### On Time and Duty Cycle



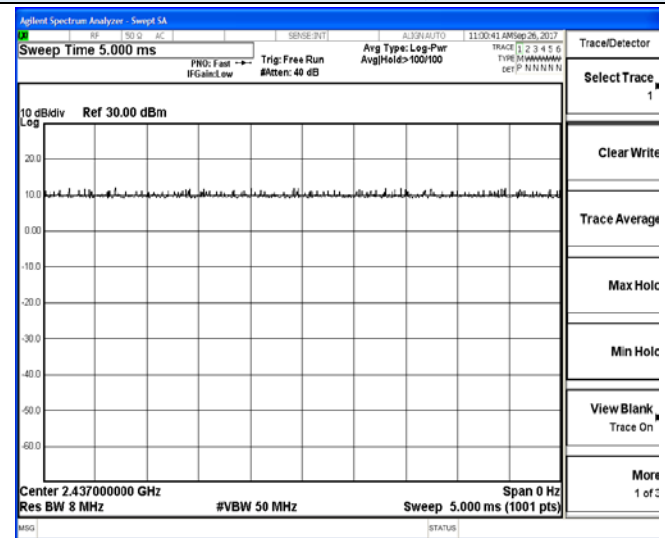
IEEE 802.11b



IEEE 802.11g



IEEE 802.11n HT20



IEEE 802.11n HT40

## 5.2. Maximum Conducted Output Power Measurement

### 5.2.1. Standard Applicable

According to §15.247(b): For systems using digital modulation in the 2400-2483.5 MHz and 5725-5850 MHz band, the limit for maximum peak conducted output power is 30dBm. The limit has to be reduced by the amount in dB that the gain of the antenna exceeds 6dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

Systems operating in the 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi without any corresponding reduction in transmitter peak output power.

### 5.2.2. Measuring Instruments and Setting

Please refer to equipment's list in this report. The following table is the setting of the power meter.

### 5.2.3. Test Procedures

According to KDB558074 D01 DTS Measurement Guidance Section 9.1 Maximum peak conducted output power, 9.1.2 the maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

According to KDB558074 D01 DTS Measurement Guidance Section 9.2 Maximum average conducted output power, 9.2.3.1 Method AVGPM (Measurement using an RF average power meter)

(a) As an alternative to spectrum analyzer or EMI receiver measurements, measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied.

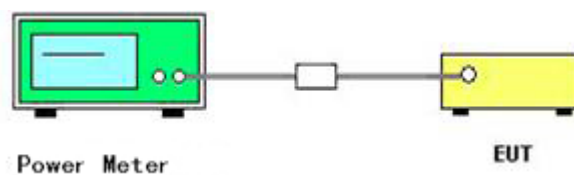
- 1) The EUT is configured to transmit continuously, or to transmit with a constant duty factor.
- 2) At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.
- 3) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.

(b) If the transmitter does not transmit continuously, measure the duty cycle (x) of the transmitter output signal as described in Section 6.0.

(c) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.

(d) Adjust the measurement in dBm by adding  $10\log(1/x)$ , where x is the duty cycle to the measurement result.

### 5.2.4. Test Setup Layout



### 5.2.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

## 5.2.6. Test Result of Maximum Conducted Output Power

|               |           |                |                  |
|---------------|-----------|----------------|------------------|
| Temperature   | 25°C      | Humidity       | 60%              |
| Test Engineer | Aking Jin | Configurations | IEEE 802.11b/g/n |

| Test Mode         | Channel | Frequency (MHz) | Measured Peak Output Power (dBm) | Measured Average Output Power (dBm) | Limits (dBm) | Verdict |
|-------------------|---------|-----------------|----------------------------------|-------------------------------------|--------------|---------|
| IEEE 802.11b      | 1       | 2412            | 17.54                            | 15.59                               | 30           | PASS    |
|                   | 6       | 2437            | 17.65                            | 15.65                               |              |         |
|                   | 11      | 2462            | 17.21                            | 15.38                               |              |         |
| IEEE 802.11g      | 1       | 2412            | 15.49                            | 12.16                               | 30           | PASS    |
|                   | 6       | 2437            | 15.83                            | 12.41                               |              |         |
|                   | 11      | 2462            | 15.70                            | 12.35                               |              |         |
| IEEE 802.11n HT20 | 1       | 2412            | 14.62                            | 11.22                               | 30           | PASS    |
|                   | 6       | 2437            | 14.54                            | 11.15                               |              |         |
|                   | 11      | 2462            | 14.56                            | 11.18                               |              |         |
| IEEE 802.11n HT40 | 3       | 2422            | 14.10                            | 10.01                               | 30           | PASS    |
|                   | 6       | 2437            | 14.11                            | 10.01                               |              |         |
|                   | 9       | 2452            | 14.21                            | 10.09                               |              |         |

**Remark:**

1. Measured output power at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20; 13.5Mbps at IEEE 802.11n HT40;
4. Average power is for report only;

### 5.3. Power Spectral Density Measurement

#### 5.3.1. Standard Applicable

According to §15.247(e): For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

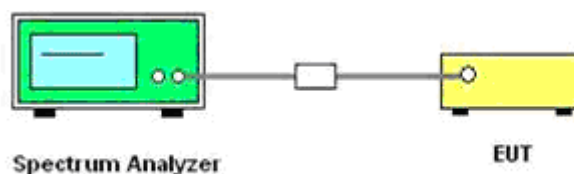
#### 5.3.2. Measuring Instruments and Setting

Please refer to equipment's list in this report. The following table is the setting of Spectrum Analyzer.

#### 5.3.3. Test Procedures

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. The power was monitored at the coupler port with a Spectrum Analyzer. The power level was set to the maximum level.
3. Set the RBW = 100 kHz.
4. Set the VBW  $\geq 3 \times$  RBW
5. Set the span to 1.5 times the DTS channel bandwidth.
6. Detector = peak.
7. Sweep time = auto couple.
8. Trace mode = max hold.
9. Allow trace to fully stabilize.
10. Use the peak marker function to determine the maximum power level.
11. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.
12. The resulting peak PSD level shall not be great than 8dBm.

#### 5.3.4. Test Setup Layout



#### 5.3.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.



## 5.3.6. Test Result of Power Spectral Density

|               |           |                |                  |
|---------------|-----------|----------------|------------------|
| Temperature   | 25°C      | Humidity       | 60%              |
| Test Engineer | Aking Jin | Configurations | IEEE 802.11b/g/n |

| Test Mode         | Channel | Frequency (MHz) | Measured Peak Power Spectral Density (dBm/100KHz) | Limits (dBm/3KHz) | Verdict |
|-------------------|---------|-----------------|---|-------------------|---------|
| IEEE 802.11b      | 1       | 2412            | 3.969   | 8                 | PASS    |
|                   | 6       | 2437            | 3.689   |                   |         |
|                   | 11      | 2462            | 4.298   |                   |         |
| IEEE 802.11g      | 1       | 2412            | -3.561  | 8                 | PASS    |
|                   | 6       | 2437            | -3.286  |                   |         |
|                   | 11      | 2462            | -3.317  |                   |         |
| IEEE 802.11n HT20 | 1       | 2412            | -4.533  | 8                 | PASS    |
|                   | 6       | 2437            | -3.921  |                   |         |
|                   | 11      | 2462            | -3.658  |                   |         |
| IEEE 802.11n HT40 | 3       | 2422            | -7.205  | 8                 | PASS    |
|                   | 6       | 2437            | -7.290  |                   |         |
|                   | 9       | 2452            | -6.888  |                   |         |

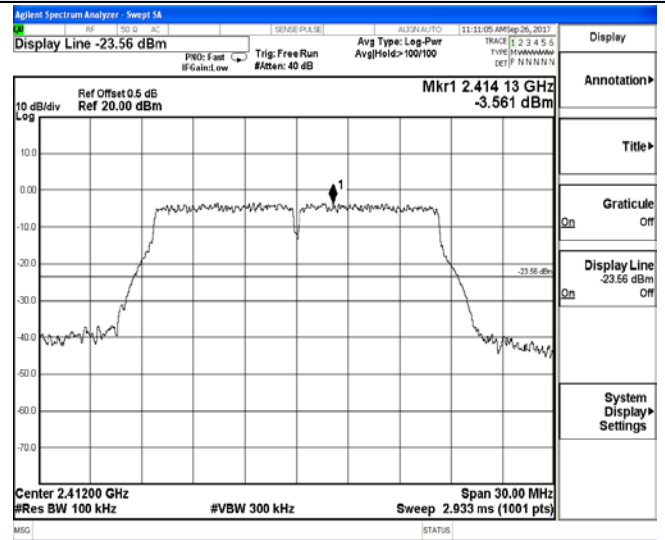
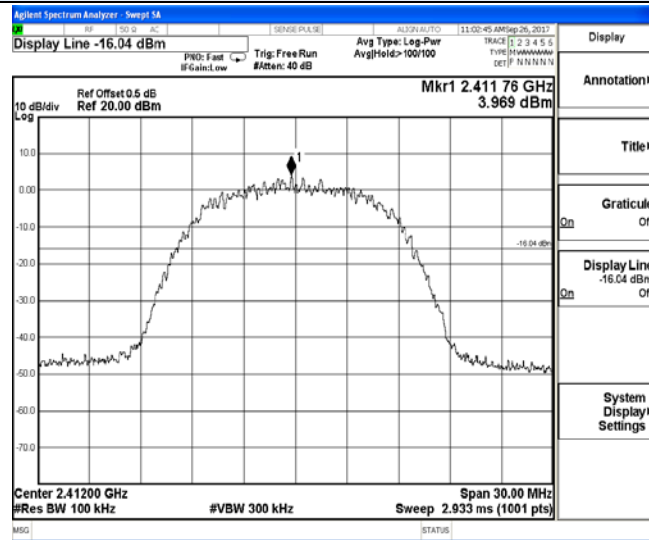
*Remark:*

1. Measured power spectrum density at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20; 13.5Mbps at IEEE 802.11n HT40;
4. Please refer to following plots;

Peak Power Spectrum Density

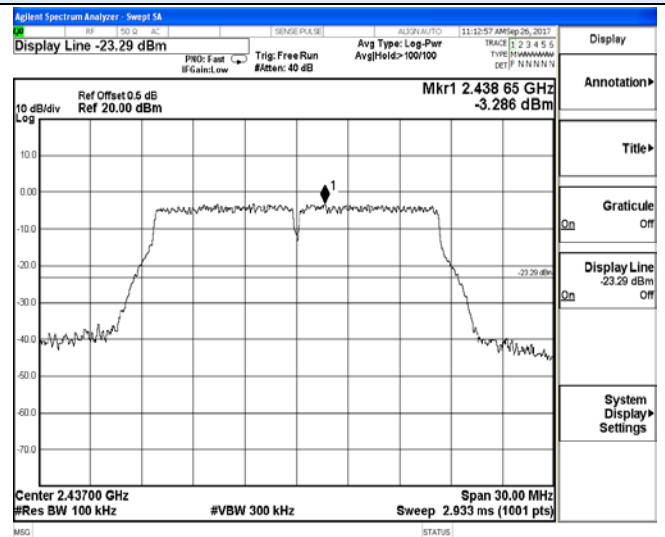
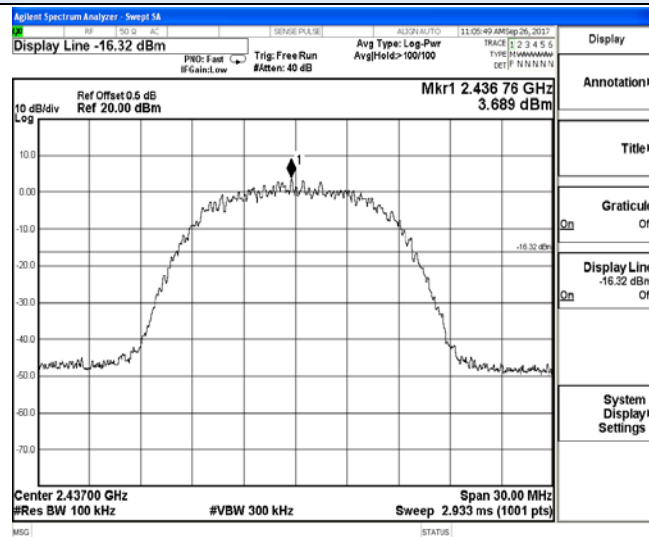
IEEE 802.11b

IEEE 802.11g



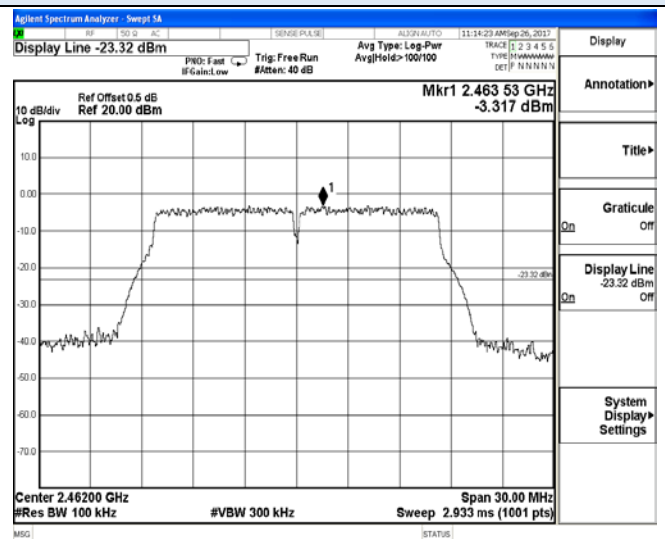
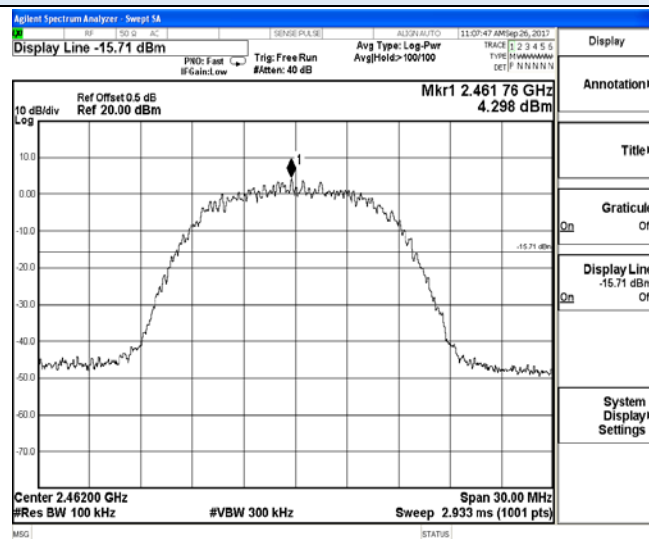
Channel 1 / 2412 MHz

Channel 1 / 2412 MHz



Channel 6 / 2437 MHz

Channel 6 / 2437 MHz



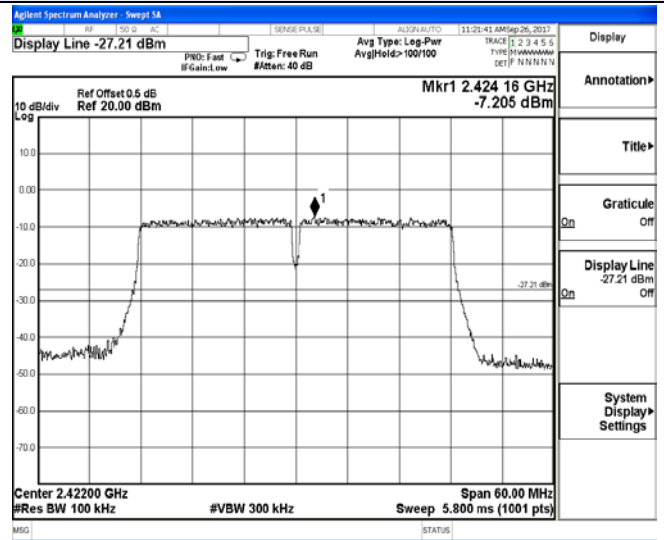
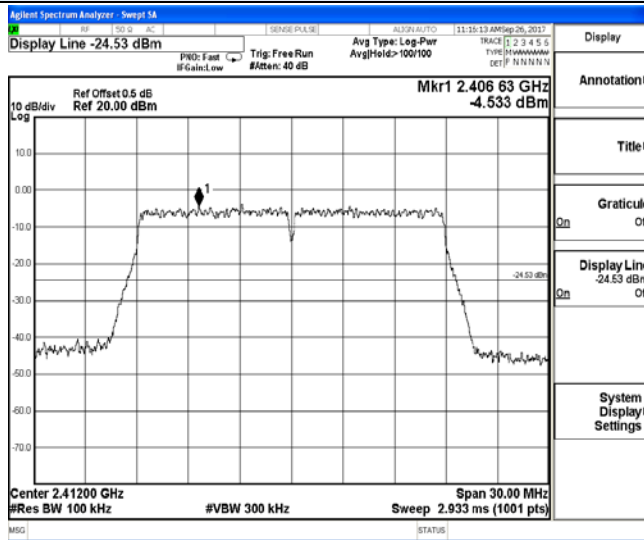
Channel 11 / 2462 MHz

Channel 11 / 2462 MHz

Peak Power Spectrum Density

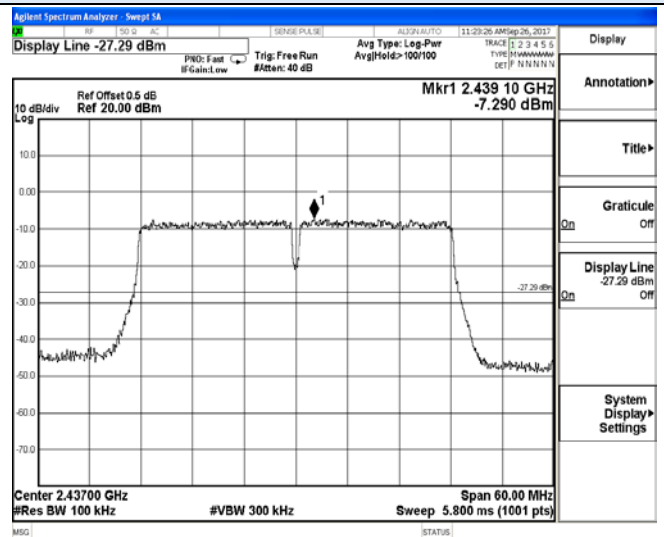
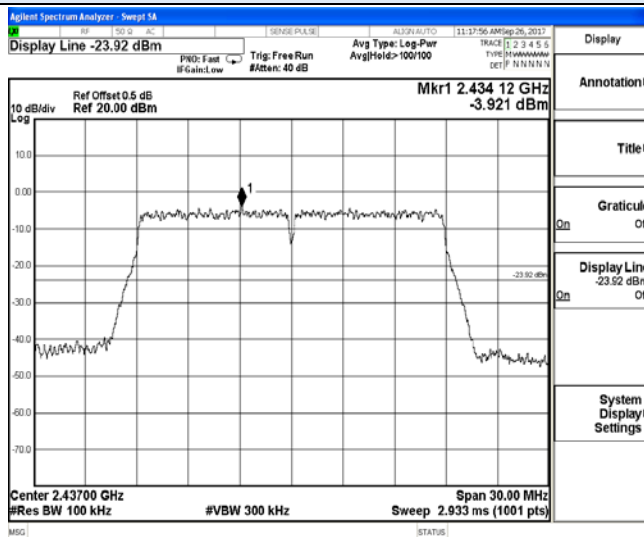
IEEE 802.11n HT20

IEEE 802.11n HT40



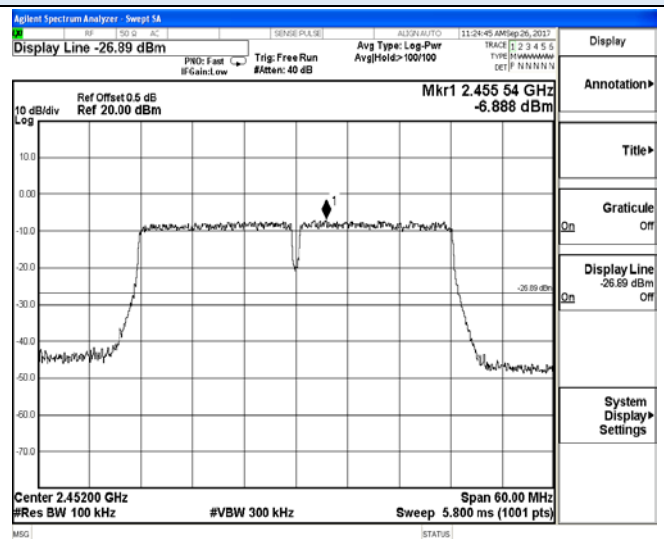
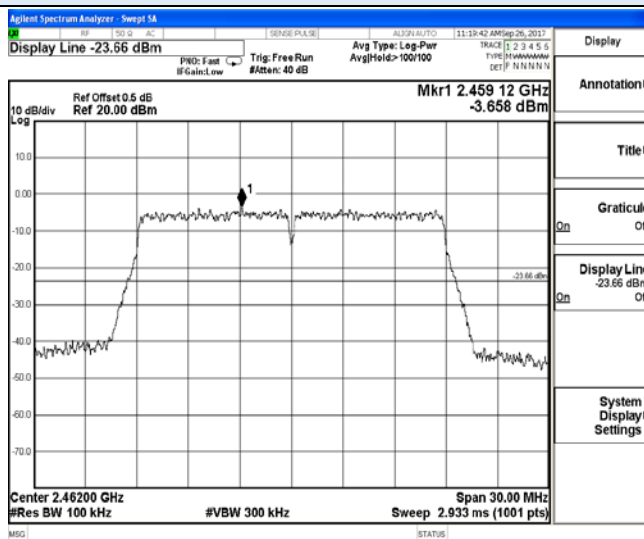
Channel 1 / 2412 MHz

Channel 3 / 2422 MHz



Channel 6 / 2437 MHz

Channel 6 / 2437 MHz



Channel 11 / 2462 MHz

Channel 9 / 2452 MHz

### 5.4. 6 dB Spectrum Bandwidth Measurement

#### 5.4.1. Standard Applicable

According to §15.247(a) (2): For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

#### 5.4.2. Measuring Instruments and Setting

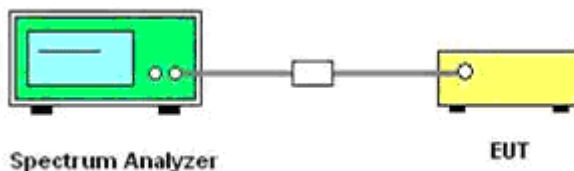
Please refer to equipment's list in this report. The following table is the setting of the Spectrum Analyzer.

| Spectrum Parameter | Setting  |
|--------------------|----------|
| Attenuation        | Auto     |
| Span Frequency     | > RBW    |
| Detector           | Peak     |
| Trace              | Max Hold |
| Sweep Time         | 100ms    |

#### 5.4.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
2. The resolution bandwidth and the video bandwidth were set according to KDB558074.
3. Measured the spectrum width with power higher than 6dB below carrier.

#### 5.4.4. Test Setup Layout



#### 5.4.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

## 5.4.6. Test Result of 6dB Spectrum Bandwidth

|               |           |                |                  |
|---------------|-----------|----------------|------------------|
| Temperature   | 25°C      | Humidity       | 60%              |
| Test Engineer | Aking Jin | Configurations | IEEE 802.11b/g/n |

| Test Mode         | Channel | Frequency (MHz) | 6dB Bandwidth (MHz) | Limits (MHz) | Verdict |
|-------------------|---------|-----------------|---------------------|--------------|---------|
| IEEE 802.11b      | 1       | 2412            | 8.904               | 0.500        | PASS    |
|                   | 6       | 2437            | 8.905               |              |         |
|                   | 11      | 2462            | 8.908               |              |         |
| IEEE 802.11g      | 1       | 2412            | 16.620              | 0.500        | PASS    |
|                   | 6       | 2437            | 16.610              |              |         |
|                   | 11      | 2462            | 16.610              |              |         |
| IEEE 802.11n HT20 | 1       | 2412            | 17.840              | 0.500        | PASS    |
|                   | 6       | 2437            | 17.840              |              |         |
|                   | 11      | 2462            | 17.810              |              |         |
| IEEE 802.11n HT40 | 3       | 2422            | 36.520              | 0.500        | PASS    |
|                   | 6       | 2437            | 36.510              |              |         |
|                   | 9       | 2452            | 36.520              |              |         |

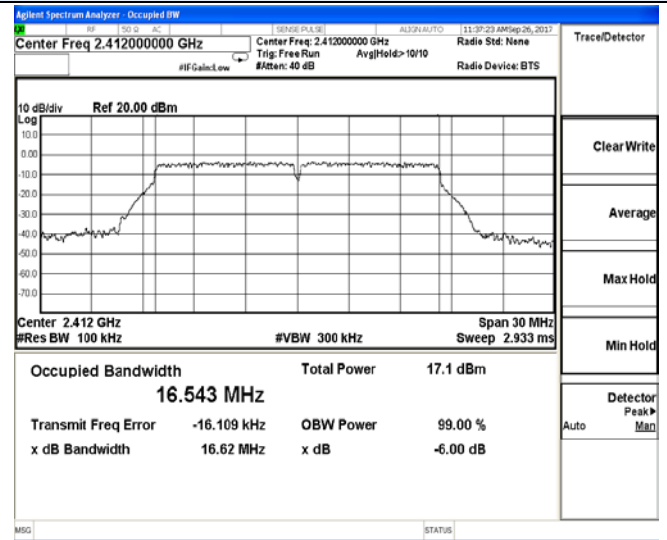
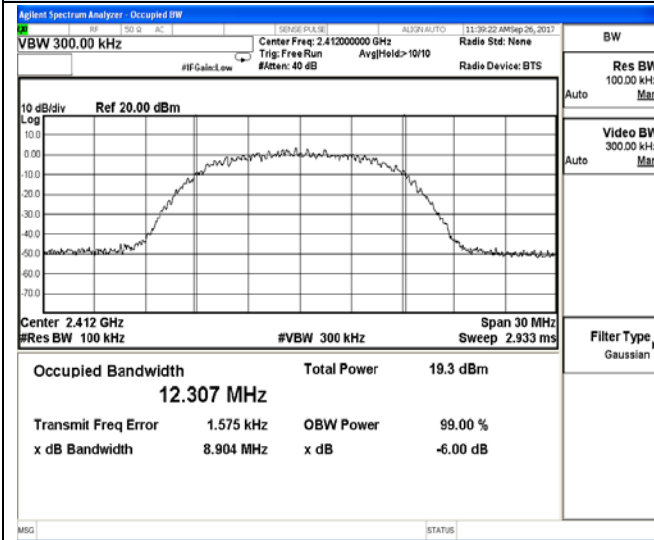
**Remark:**

1. Measured 6dB bandwidth at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20; 13.5Mbps at IEEE 802.11n HT40;
4. Please refer to following plots;

6 dB Bandwidth

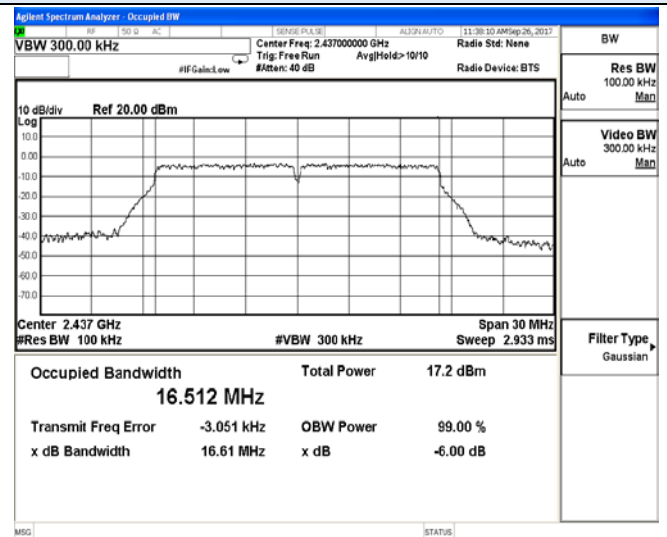
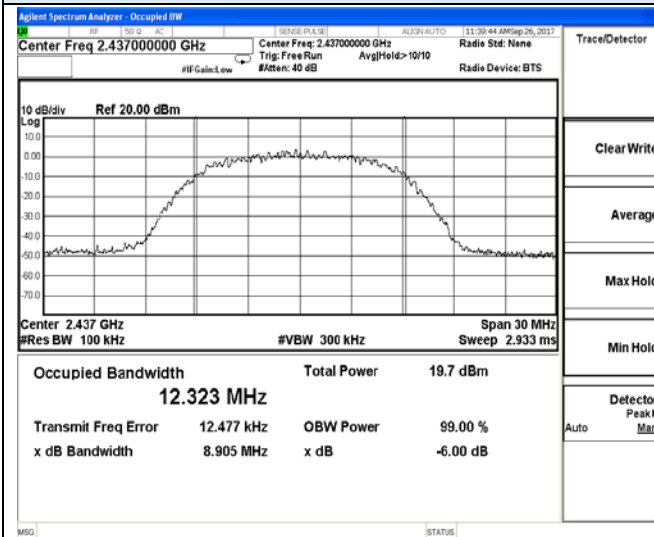
IEEE 802.11b

IEEE 802.11g



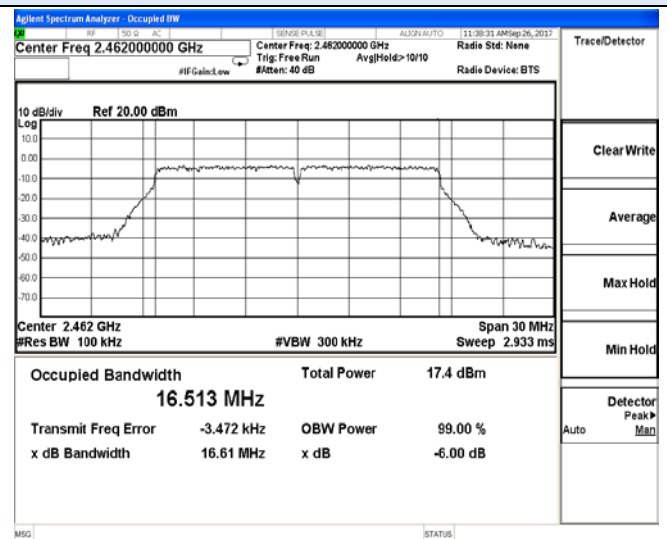
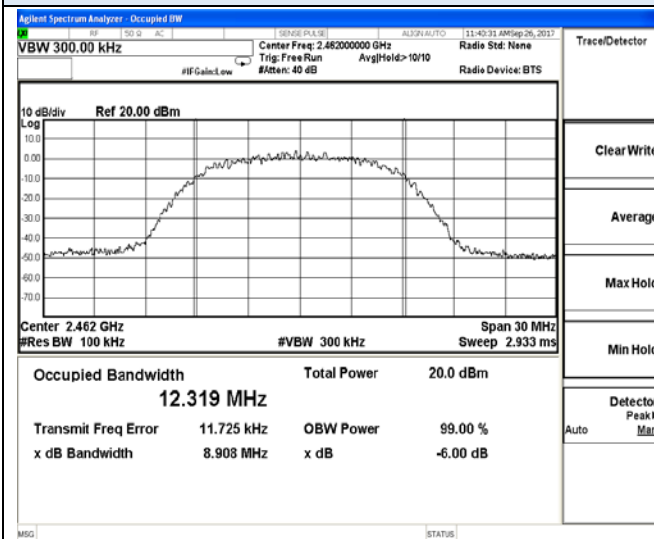
Channel 1 / 2412 MHz

Channel 1 / 2412 MHz



Channel 6 / 2437 MHz

Channel 6 / 2437 MHz



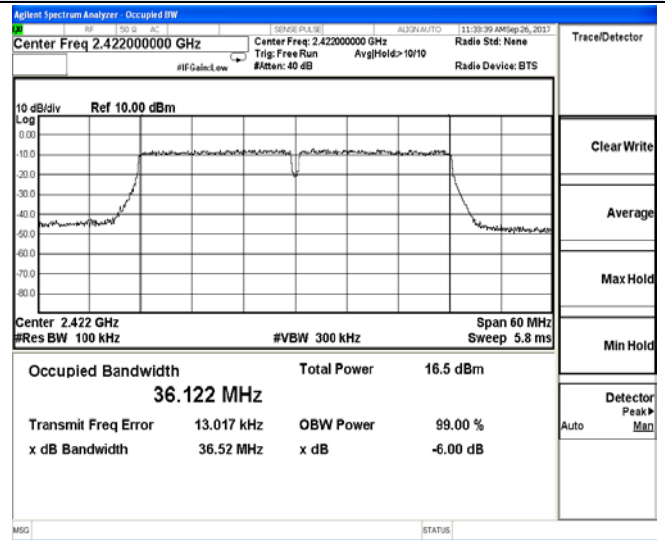
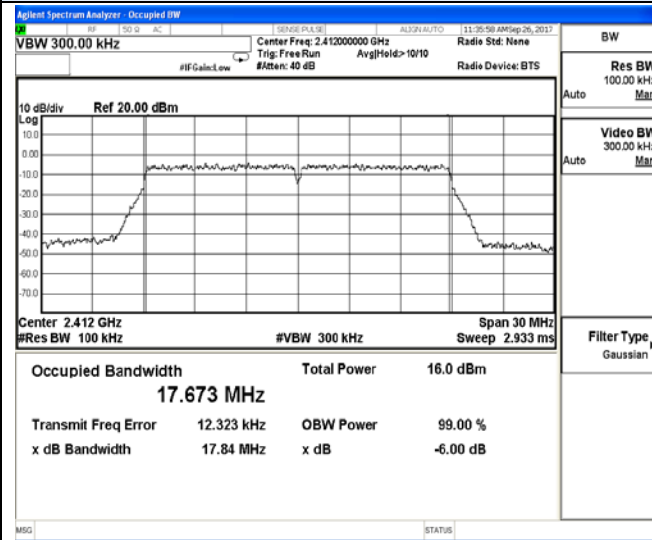
Channel 11 / 2462 MHz

Channel 11 / 2462 MHz

6 dB Bandwidth

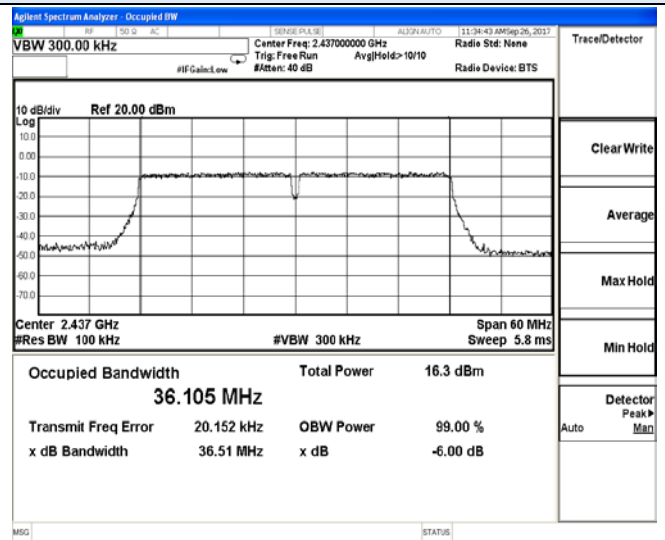
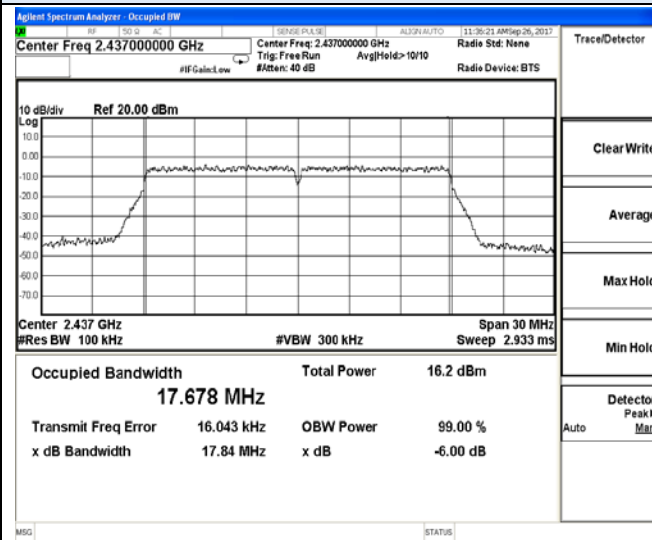
IEEE 802.11n HT20

IEEE 802.11n HT40



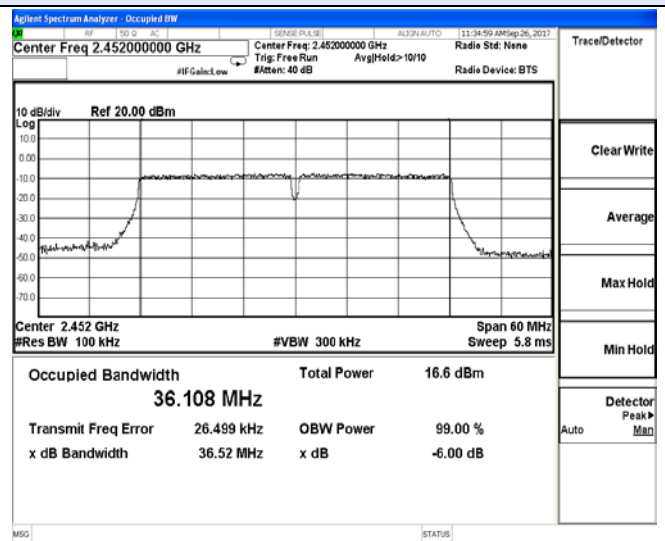
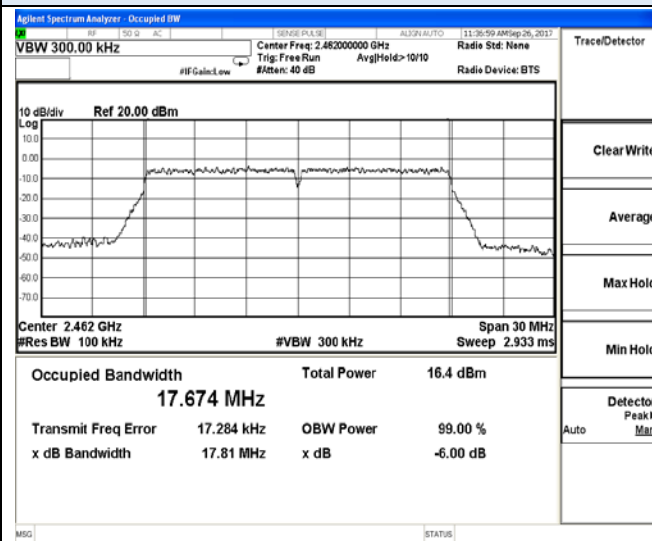
Channel 1 / 2412 MHz

Channel 3 / 2422 MHz



Channel 6 / 2437 MHz

Channel 6 / 2437 MHz



Channel 11 / 2462 MHz

Channel 11 / 2462 MHz



### 5.5. Radiated Emissions Measurement

#### 5.5.1. Standard Applicable

15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| MHz               | MHz                 | MHz           | GHz         |
|-------------------|---------------------|---------------|-------------|
| 0.090-0.110       | 16.42-16.423        | 399.9-410     | 4.5-5.15    |
| \1\ 0.495-0.505   | 16.69475-16.69525   | 608-614       | 5.35-5.46   |
| 2.1735-2.1905     | 16.80425-16.80475   | 960-1240      | 7.25-7.75   |
| 4.125-4.128       | 25.5-25.67          | 1300-1427     | 8.025-8.5   |
| 4.17725-4.17775   | 37.5-38.25          | 1435-1626.5   | 9.0-9.2     |
| 4.20725-4.20775   | 73-74.6             | 1645.5-1646.5 | 9.3-9.5     |
| 6.215-6.218       | 74.8-75.2           | 1660-1710     | 10.6-12.7   |
| 6.26775-6.26825   | 108-121.94          | 1718.8-1722.2 | 13.25-13.4  |
| 6.31175-6.31225   | 123-138             | 2200-2300     | 14.47-14.5  |
| 8.291-8.294       | 149.9-150.05        | 2310-2390     | 15.35-16.2  |
| 8.362-8.366       | 156.52475-156.52525 | 2483.5-2500   | 17.7-21.4   |
| 8.37625-8.38675   | 156.7-156.9         | 2690-2900     | 22.01-23.12 |
| 8.41425-8.41475   | 162.0125-167.17     | 3260-3267     | 23.6-24.0   |
| 12.29-12.293      | 167.72-173.2        | 3332-3339     | 31.2-31.8   |
| 12.51975-12.52025 | 240-285             | 3345.8-3358   | 36.43-36.5  |
| 12.57675-12.57725 | 322-335.4           | 3600-4400     | (2\)        |
| 13.36-13.41       |                     |               |             |

\1\ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

\2\ Above 38.6

According to §15.247 (d): 20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

| Frequencies (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|-------------------|-----------------------------------|-------------------------------|
| 0.009~0.490       | 2400/F(KHz)                       | 300                           |
| 0.490~1.705       | 24000/F(KHz)                      | 30                            |
| 1.705~30.0        | 30                                | 30                            |
| 30~88             | 100                               | 3                             |
| 88~216            | 150                               | 3                             |
| 216~960           | 200                               | 3                             |
| Above 960         | 500                               | 3                             |

#### 5.5.2. Measuring Instruments and Setting

Please refer to equipment's list in this report. The following table is the setting of spectrum analyzer and receiver.

| Spectrum Parameter                        | Setting   |
|---|---|
| Attenuation                               | Auto  |
| Start Frequency                           | 1000 MHz  |
| Stop Frequency                            | 10 <sup>th</sup> carrier harmonic                 |
| RB / VB (Emission in restricted band)     | 1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average |
| RB / VB (Emission in non-restricted band) | 1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average |

| Receiver Parameter     | Setting                                    |
|------------------------|--|
| Attenuation            | Auto                                       |
| Start ~ Stop Frequency | 9kHz~150kHz / RB/VB 200Hz/1KHz for QP/AVG  |
| Start ~ Stop Frequency | 150kHz~30MHz / RB/VB 9kHz/30KHz for QP/AVG |
| Start ~ Stop Frequency | 30MHz~1000MHz / RB/VB 120kHz/1MHz for QP   |



### 5.5.3. Test Procedures

#### 1) Sequence of testing 9 kHz to 30 MHz

##### Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions.

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

##### Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna height is 0.8 meter.

--- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

##### Final measurement:

--- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).

--- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

## 2) Sequence of testing 30 MHz to 1 GHz

### Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

### Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 to 3 meter.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

### Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ( $\pm 45^\circ$ ) and antenna movement between 1 and 4 meter.
- The final measurement will be done with QP detector with an EMI receiver.
- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

### 3) Sequence of testing 1 GHz to 18 GHz

#### Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

#### Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height scan range is 1 meter to 2.5 meter.
- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

#### Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ( $\pm 45^\circ$ ) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.
- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

#### 4) Sequence of testing above 18 GHz

##### Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 1 meter.
- The EUT was set into operation.

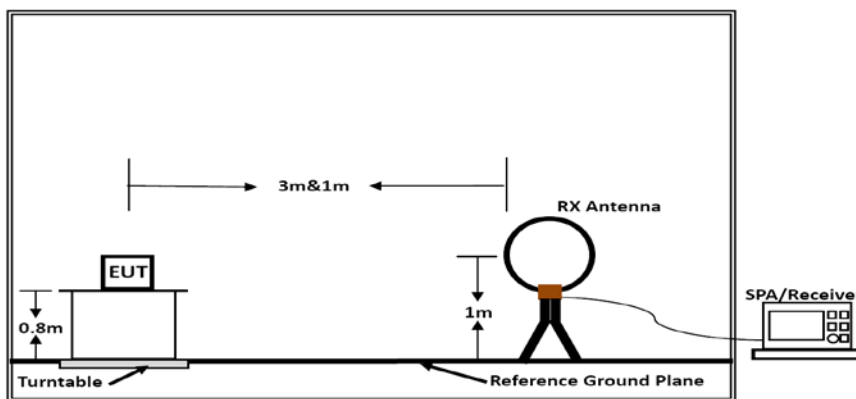
##### Premeasurement:

- The antenna is moved spherical over the EUT in different polarizations of the antenna.

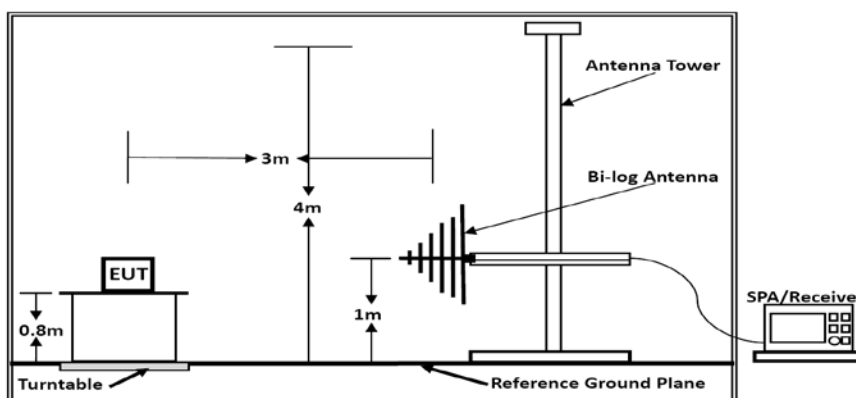
##### Final measurement:

- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.
- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

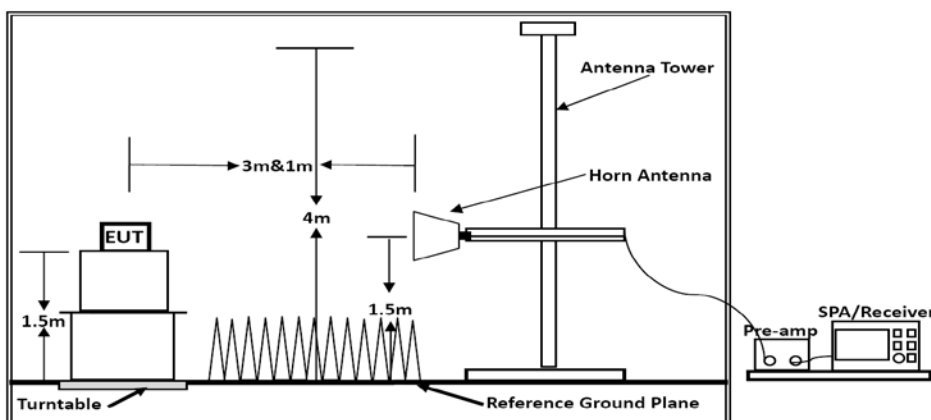
5.5.4. Test Setup Layout



Below 30MHz



Below 1GHz



Above 1GHz

Above 18 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from 3m to 1.5m.

Distance extrapolation factor =  $20 \log (\text{specific distance } [3\text{m}] / \text{test distance } [1.5\text{m}])$  (dB);  
 Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].

5.5.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.5.6. Results of Radiated Emissions (9 KHz~30MHz)

|               |           |                |                  |
|---------------|-----------|----------------|------------------|
| Temperature   | 25 °C     | Humidity       | 60%              |
| Test Engineer | Aking Jin | Configurations | IEEE 802.11b/g/n |

| Freq. (MHz) | Level (dBuV) | Over Limit (dB) | Over Limit (dBuV) | Remark   |
|-------------|--------------|-----------------|-------------------|----------|
| -           | -            | -               | -                 | See Note |

Note:

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

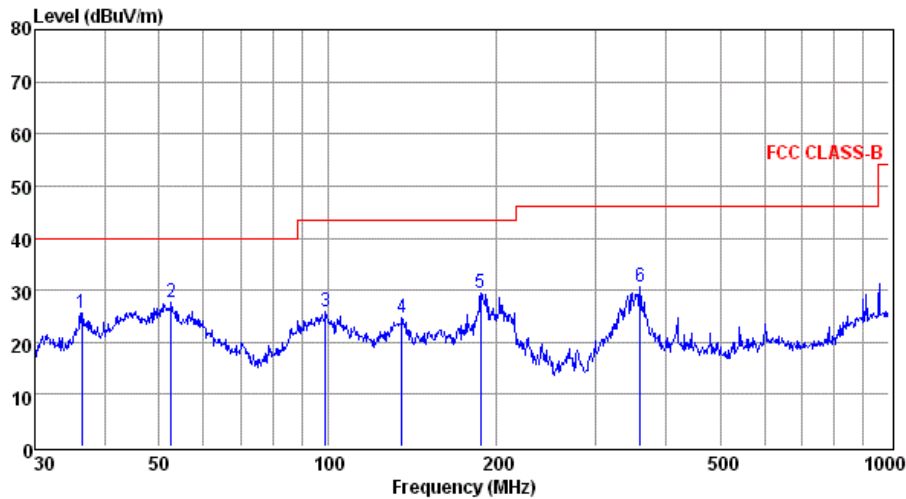
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);  
 Limit line = specific limits (dBuV) + distance extrapolation factor.

5.5.7. Results of Radiated Emissions (30MHz~1GHz)

|               |           |                |                       |
|---------------|-----------|----------------|-----------------------|
| Temperature   | 25 °C     | Humidity       | 60%                   |
| Test Engineer | Aking Jin | Configurations | IEEE 802.11b (Low CH) |

Test result for IEEE 802.11b (Low Channel)

Vertical



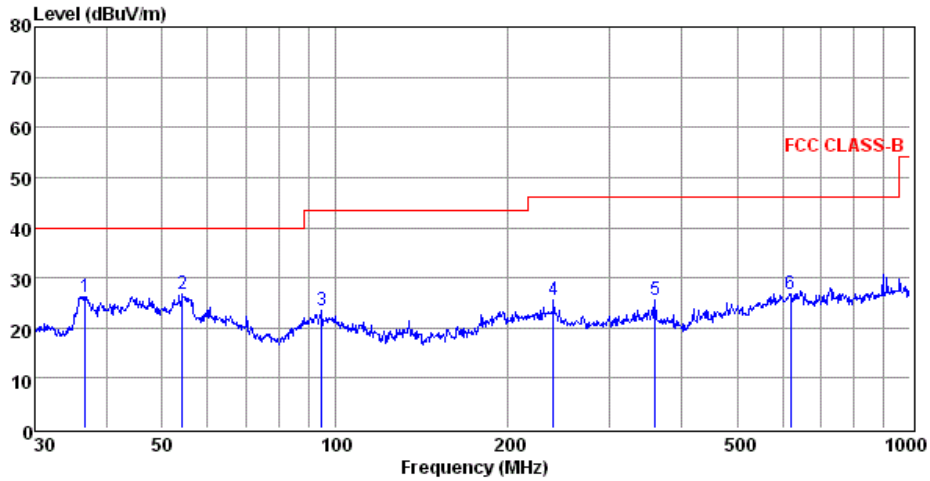
pol:

VERTICAL

|   | Freq   | Reading | CabLos | Antfac | Measured | Limit  | Over   | Remark |
|---|--------|---------|--------|--------|----------|--------|--------|--------|
|   | MHz    | dBuV    | dB     | dB/m   | dBuV/m   | dBuV/m | dB     |        |
| 1 | 36.38  | 12.50   | 0.41   | 12.65  | 25.56    | 40.00  | -14.44 | QP     |
| 2 | 52.58  | 13.96   | 0.46   | 13.13  | 27.55    | 40.00  | -12.45 | QP     |
| 3 | 98.83  | 12.17   | 0.61   | 13.09  | 25.87    | 43.50  | -17.63 | QP     |
| 4 | 135.51 | 15.37   | 0.70   | 8.52   | 24.59    | 43.50  | -18.91 | QP     |
| 5 | 187.10 | 18.12   | 0.98   | 10.30  | 29.40    | 43.50  | -14.10 | QP     |
| 6 | 360.45 | 15.01   | 1.18   | 14.43  | 30.62    | 46.00  | -15.38 | QP     |

- Note: 1. All readings are Quasi-peak values.  
 2. Measured= Reading + Antenna Factor + Cable Loss  
 3. The emission that are 20db below the official limit are not reported

Horizontal



pol: HORIZONTAL

|   | Freq   | Reading | CabLos | Antfac | Measured | Limit  | Over   | Remark |
|---|--------|---------|--------|--------|----------|--------|--------|--------|
|   | MHz    | dBuV    | dB     | dB/m   | dBuV/m   | dBuV/m | dB     |        |
| 1 | 36.77  | 13.14   | 0.41   | 12.75  | 26.30    | 40.00  | -13.70 | QP     |
| 2 | 54.26  | 13.29   | 0.46   | 13.05  | 26.80    | 40.00  | -13.20 | QP     |
| 3 | 94.76  | 10.08   | 0.58   | 12.79  | 23.45    | 43.50  | -20.05 | QP     |
| 4 | 239.99 | 12.35   | 1.01   | 12.09  | 25.45    | 46.00  | -20.55 | QP     |
| 5 | 360.45 | 9.84    | 1.18   | 14.43  | 25.45    | 46.00  | -20.55 | QP     |
| 6 | 620.71 | 6.76    | 1.62   | 18.52  | 26.90    | 46.00  | -19.10 | QP     |

Note: 1. All readings are Quasi-peak values.  
 2. Measured= Reading + Antenna Factor + Cable Loss  
 3. The emission that ate 20db blow the official limit are not reported

Note:

- 1). Pre-scan all mode and recorded the worst case results in this report (IEEE 802.11b (Low Channel)).
- 2). Emission level (dBuV/m) = 20 log Emission level (uV/m).
- 3). Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

## 5.5.8. Results for Radiated Emissions (Above 1GHz)

**Above 1GHz**

IEEE 802.11b

Channel 1 / 2412 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark  | Pol.       |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4824.00   | 54.77        | 33.06          | 35.04        | 3.94         | 56.73           | 74.00        | -17.27    | Peak    | Horizontal |
| 4824.00   | 41.61        | 33.06          | 35.04        | 3.94         | 43.57           | 54.00        | -10.43    | Average | Horizontal |
| 4824.00   | 55.77        | 33.06          | 35.04        | 3.94         | 57.73           | 74.00        | -16.27    | Peak    | Vertical   |
| 4824.00   | 40.24        | 33.06          | 35.04        | 3.94         | 42.20           | 54.00        | -11.80    | Average | Vertical   |

Channel 6 / 2437 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark  | Pol.       |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4874.00   | 56.26        | 33.16          | 35.15        | 3.96         | 58.23           | 74.00        | -15.77    | Peak    | Horizontal |
| 4874.00   | 41.12        | 33.16          | 35.15        | 3.96         | 43.09           | 54.00        | -10.91    | Average | Horizontal |
| 4874.00   | 55.15        | 33.16          | 35.15        | 3.96         | 57.12           | 74.00        | -16.88    | Peak    | Vertical   |
| 4874.00   | 39.62        | 33.16          | 35.15        | 3.96         | 41.59           | 54.00        | -12.41    | Average | Vertical   |

Channel 11 / 2462 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark  | Pol.       |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4924.00   | 59.68        | 33.26          | 35.14        | 3.98         | 61.78           | 74.00        | -12.22    | Peak    | Horizontal |
| 4924.00   | 42.35        | 33.26          | 35.14        | 3.98         | 44.45           | 54.00        | -9.55     | Average | Horizontal |
| 4924.00   | 56.47        | 33.26          | 35.14        | 3.98         | 58.57           | 74.00        | -15.43    | Peak    | Vertical   |
| 4924.00   | 40.29        | 33.26          | 35.14        | 3.98         | 42.39           | 54.00        | -11.61    | Average | Vertical   |

IEEE 802.11g

Channel 1 / 2412 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark  | Pol.       |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4824.00   | 57.80        | 33.06          | 35.04        | 3.94         | 59.76           | 74.00        | -14.24    | Peak    | Horizontal |
| 4824.00   | 41.96        | 33.06          | 35.04        | 3.94         | 43.92           | 54.00        | -10.08    | Average | Horizontal |
| 4824.00   | 55.70        | 33.06          | 35.04        | 3.94         | 57.66           | 74.00        | -16.34    | Peak    | Vertical   |
| 4824.00   | 44.84        | 33.06          | 35.04        | 3.94         | 46.80           | 54.00        | -7.20     | Average | Vertical   |

Channel 6 / 2437 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark  | Pol.       |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4874.00   | 59.64        | 33.16          | 35.15        | 3.96         | 61.61           | 74.00        | -12.39    | Peak    | Horizontal |
| 4874.00   | 43.06        | 33.16          | 35.15        | 3.96         | 45.03           | 54.00        | -8.97     | Average | Horizontal |
| 4874.00   | 56.13        | 33.16          | 35.15        | 3.96         | 58.10           | 74.00        | -15.90    | Peak    | Vertical   |
| 4874.00   | 40.47        | 33.16          | 35.15        | 3.96         | 42.44           | 54.00        | -11.56    | Average | Vertical   |



## Channel 11 / 2462 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark  | Pol.       |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4924.00   | 59.51        | 33.26          | 35.14        | 3.98         | 61.61           | 74.00        | -12.39    | Peak    | Horizontal |
| 4924.00   | 43.64        | 33.26          | 35.14        | 3.98         | 45.74           | 54.00        | -8.26     | Average | Horizontal |
| 4924.00   | 54.89        | 33.26          | 35.14        | 3.98         | 56.99           | 74.00        | -17.01    | Peak    | Vertical   |
| 4924.00   | 40.67        | 33.26          | 35.14        | 3.98         | 42.77           | 54.00        | -11.23    | Average | Vertical   |

## IEEE 802.11n HT20

## Channel 1 / 2412 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark  | Pol.       |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4824.00   | 55.77        | 33.06          | 35.04        | 3.94         | 57.73           | 74.00        | -16.27    | Peak    | Horizontal |
| 4824.00   | 43.40        | 33.06          | 35.04        | 3.94         | 45.36           | 54.00        | -8.64     | Average | Horizontal |
| 4824.00   | 54.61        | 33.06          | 35.04        | 3.94         | 56.57           | 74.00        | -17.43    | Peak    | Vertical   |
| 4824.00   | 41.87        | 33.06          | 35.04        | 3.94         | 43.83           | 54.00        | -10.17    | Average | Vertical   |

## Channel 6 / 2437 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark  | Pol.       |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4874.00   | 59.02        | 33.16          | 35.15        | 3.96         | 60.99           | 74.00        | -13.01    | Peak    | Horizontal |
| 4874.00   | 40.15        | 33.16          | 35.15        | 3.96         | 42.12           | 54.00        | -11.88    | Average | Horizontal |
| 4874.00   | 53.99        | 33.16          | 35.15        | 3.96         | 55.96           | 74.00        | -18.04    | Peak    | Vertical   |
| 4874.00   | 40.03        | 33.16          | 35.15        | 3.96         | 42.00           | 54.00        | -12.00    | Average | Vertical   |

## Channel 11 / 2462 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark  | Pol.       |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4924.00   | 57.00        | 33.26          | 35.14        | 3.98         | 59.10           | 74.00        | -14.90    | Peak    | Horizontal |
| 4924.00   | 43.46        | 33.26          | 35.14        | 3.98         | 45.56           | 54.00        | -8.44     | Average | Horizontal |
| 4924.00   | 55.84        | 33.26          | 35.14        | 3.98         | 57.94           | 74.00        | -16.06    | Peak    | Vertical   |
| 4924.00   | 39.41        | 33.26          | 35.14        | 3.98         | 41.51           | 54.00        | -12.49    | Average | Vertical   |

## IEEE 802.11n HT40

## Channel 3 / 2422 MHz

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark  | Pol.       |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4844.00   | 57.05        | 33.06          | 35.04        | 3.94         | 59.01           | 74.00        | -14.99    | Peak    | Horizontal |
| 4844.00   | 42.09        | 33.06          | 35.04        | 3.94         | 44.05           | 54.00        | -9.95     | Average | Horizontal |
| 4844.00   | 55.41        | 33.06          | 35.04        | 3.94         | 57.37           | 74.00        | -16.63    | Peak    | Vertical   |
| 4844.00   | 43.86        | 33.06          | 35.04        | 3.94         | 45.82           | 54.00        | -8.18     | Average | Vertical   |

*Channel 6 / 2437 MHz*

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark  | Pol.       |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4874.00   | 58.66        | 33.16          | 35.15        | 3.96         | 60.63           | 74.00        | -13.37    | Peak    | Horizontal |
| 4874.00   | 42.79        | 33.16          | 35.15        | 3.96         | 44.76           | 54.00        | -9.24     | Average | Horizontal |
| 4874.00   | 55.06        | 33.16          | 35.15        | 3.96         | 57.03           | 74.00        | -16.97    | Peak    | Vertical   |
| 4874.00   | 40.52        | 33.16          | 35.15        | 3.96         | 42.49           | 54.00        | -11.51    | Average | Vertical   |

*Channel 9 / 2452 MHz*

| Freq. MHz | Reading dBuV | Ant. Fac. dB/m | Pre. Fac. dB | Cab. Loss dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark  | Pol.       |
|-----------|--------------|----------------|--------------|--------------|-----------------|--------------|-----------|---------|------------|
| 4904.00   | 61.35        | 33.26          | 35.14        | 3.98         | 63.45           | 74.00        | -10.55    | Peak    | Horizontal |
| 4904.00   | 45.50        | 33.26          | 35.14        | 3.98         | 47.60           | 54.00        | -6.40     | Average | Horizontal |
| 4904.00   | 53.58        | 33.26          | 35.14        | 3.98         | 55.68           | 74.00        | -18.32    | Peak    | Vertical   |
| 4904.00   | 37.86        | 33.26          | 35.14        | 3.98         | 39.96           | 54.00        | -14.04    | Average | Vertical   |

**Notes:**

1. Measuring frequencies from 9 KHz ~10th harmonic or 26.5GHz (which is less), No emission found between lowest internal used/generated frequency to 30MHz.
2. Radiated emissions measured in frequency range from 9 KHz ~10th harmonic or 26.5GHz (which is less) were made with an instrument using Peak detector mode.
3. Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
4. Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20; 13.5Mbps at IEEE 802.11n HT40;
5. Not recorded emission values from 18 GHz to 25 GHz as emission level at least 20dB lower than emission limit;

## 5.6. Conducted Spurious Emissions and Band Edges Test

### 5.6.1. Standard Applicable

According to §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. Attenuation below the general limits specified in Section 15.209(a) is not required. 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)).

### 5.6.2. Measuring Instruments and Setting

Please refer to equipment's list in this report. The following table is the setting of the spectrum analyzer.

| Spectrum Parameter                        | Setting       |
|---|---------------|
| Detector                                  | Peak          |
| Attenuation                               | Auto          |
| RB / VB (Emission in restricted band)     | 100KHz/300KHz |
| RB / VB (Emission in non-restricted band) | 100KHz/300KHz |

### 5.6.3. Test Procedures

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz

The spectrum from 9 kHz to 26.5GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

### 5.6.4. Test Setup Layout

This test setup layout is the same as that shown in section 5.4.4.

### 5.6.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

### 5.6.6. Test Results of Conducted Spurious Emissions

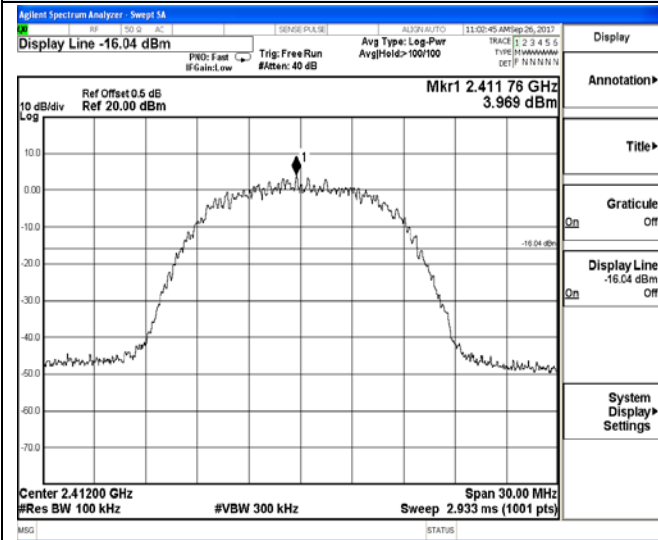
|               |           |                |                  |
|---------------|-----------|----------------|------------------|
| Temperature   | 25°C      | Humidity       | 60%              |
| Test Engineer | Aking Jin | Configurations | IEEE 802.11b/g/n |

| Test Mode         | Channel | Frequency (MHz) | Measured Frequency Range | Spurious RF Conducted Emission (dBc) | Limits (dBc) | Verdict |
|-------------------|---------|-----------------|--------------------------|--------------------------------------|--------------|---------|
| IEEE 802.11b      | 1       | 2412            | 9 KHz – 26.5 GHz         | <-20                                 | 20           | PASS    |
|                   | 6       | 2437            | 9 KHz – 26.5 GHz         | <-20                                 |              |         |
|                   | 11      | 2462            | 9 KHz – 26.5 GHz         | <-20                                 |              |         |
| IEEE 802.11g      | 1       | 2412            | 9 KHz – 26.5 GHz         | <-20                                 | 20           | PASS    |
|                   | 6       | 2437            | 9 KHz – 26.5 GHz         | <-20                                 |              |         |
|                   | 11      | 2462            | 9 KHz – 26.5 GHz         | <-20                                 |              |         |
| IEEE 802.11n HT20 | 1       | 2412            | 9 KHz – 26.5 GHz         | <-20                                 | 20           | PASS    |
|                   | 6       | 2437            | 9 KHz – 26.5 GHz         | <-20                                 |              |         |
|                   | 11      | 2462            | 9 KHz – 26.5 GHz         | <-20                                 |              |         |
| IEEE 802.11n HT40 | 1       | 2412            | 9 KHz – 26.5 GHz         | <-20                                 | 20           | PASS    |
|                   | 6       | 2437            | 9 KHz – 26.5 GHz         | <-20                                 |              |         |
|                   | 11      | 2462            | 9 KHz – 26.5 GHz         | <-20                                 |              |         |

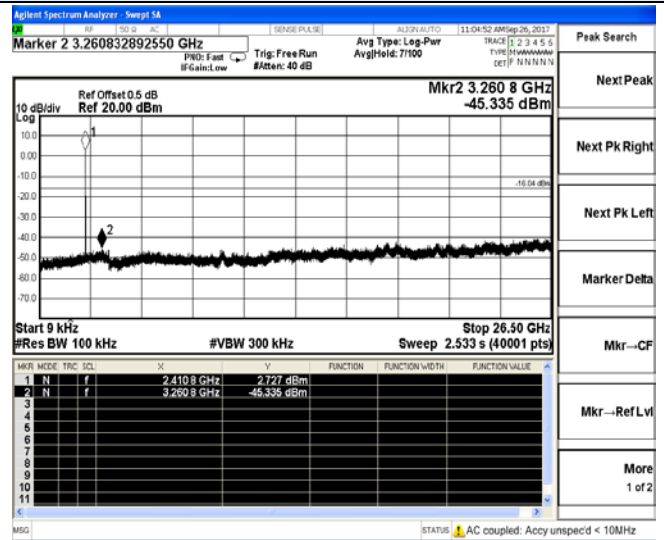
**Remark:**

1. Measured RF conducted spurious emissions at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20; 13.5Mbps at IEEE 802.11n HT40;
4. “---“means that the fundamental frequency not for 15.209 limits requirement.
5. Not recorded values as emission level lower than limit at least 20 dBc;
6. Please refer to following plots;

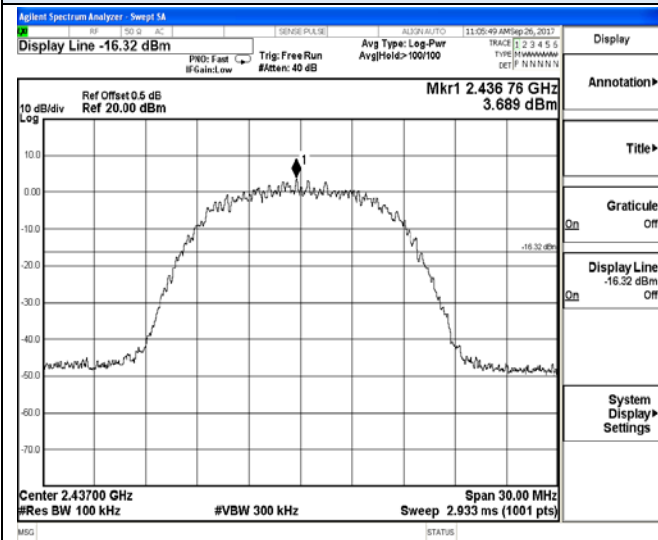
## RF Conducted Spurious Emissions IEEE 802.11b



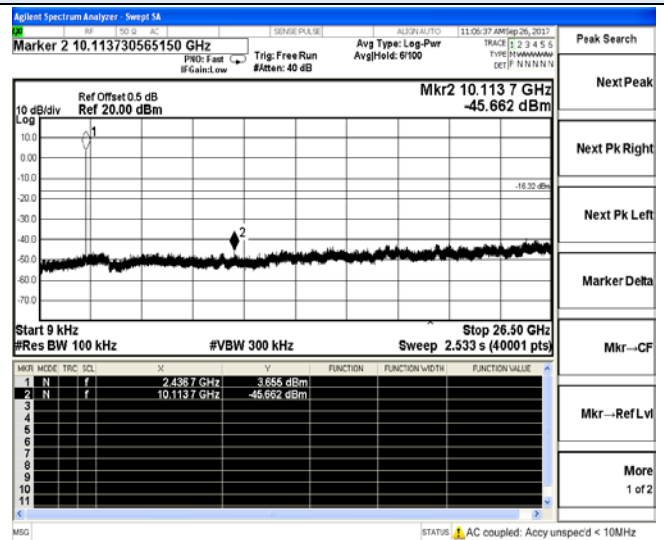
**2397 MHz – 2427 MHz**



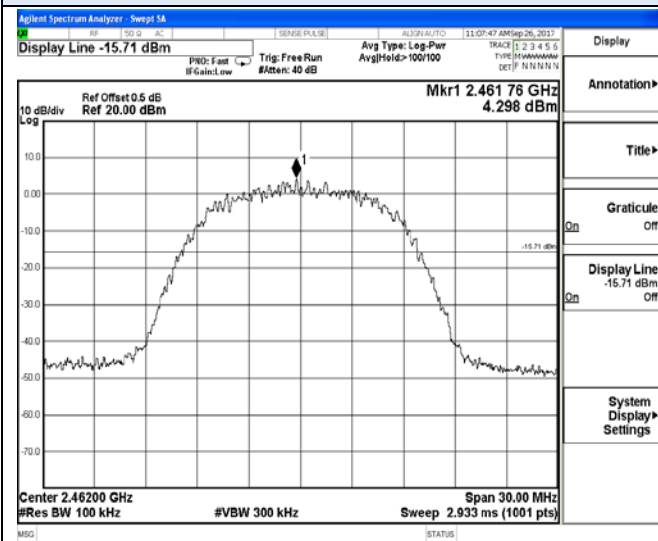
**9 KHz – 26.5 GHz**



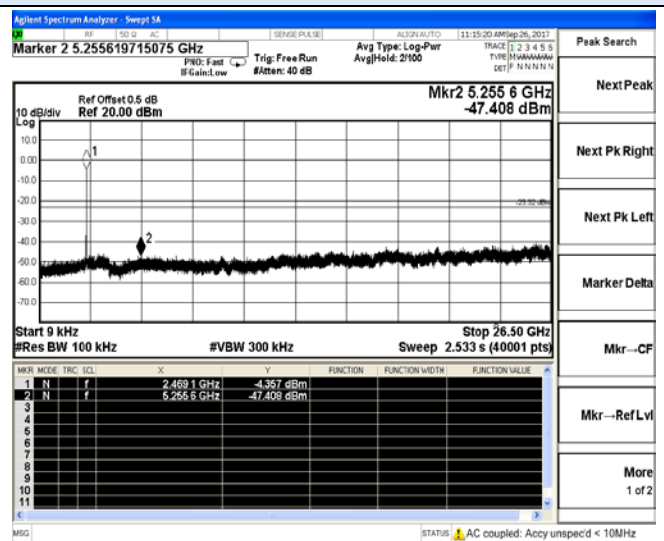
**2422 MHz – 2452 MHz**



**9 KHz – 26.5 GHz**

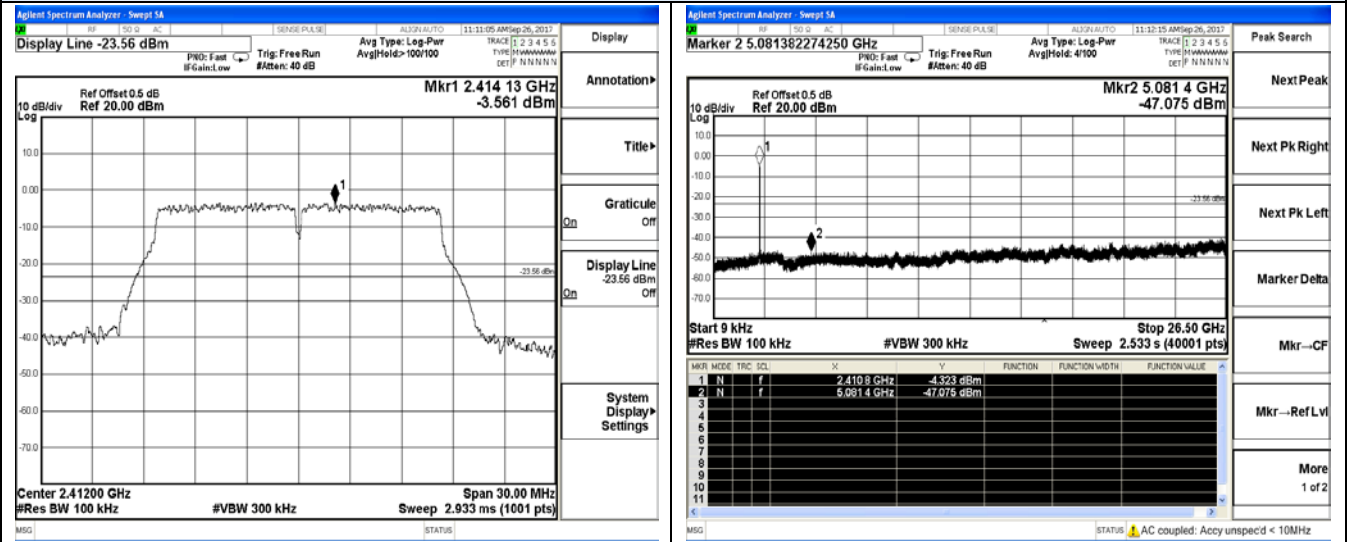


**2447 MHz – 2477 MHz**

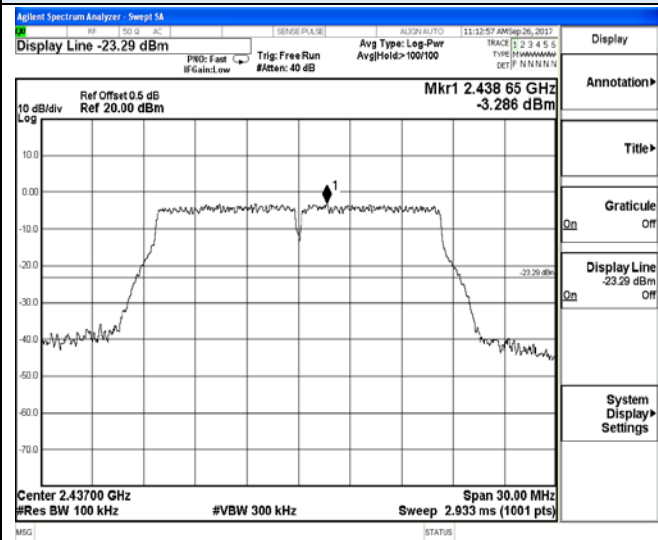


**9 KHz – 26.5 GHz**

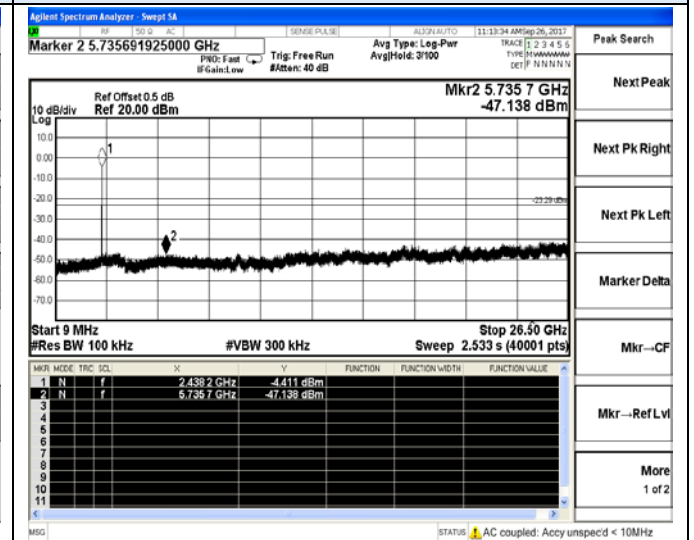
## RF Conducted Spurious Emissions IEEE 802.11g



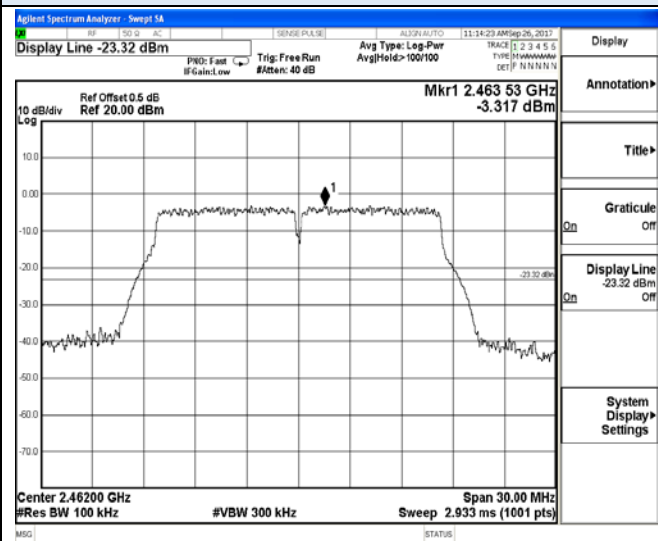
### 2397 MHz – 2427 MHz



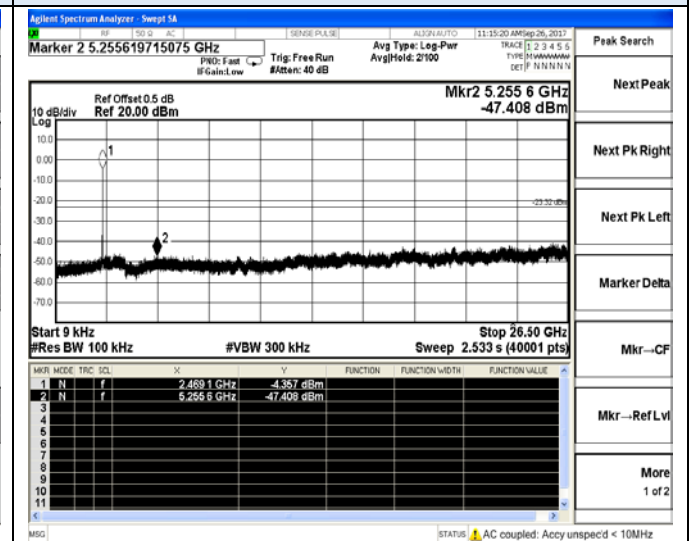
### 9 KHz – 26.5 GHz



### 2422 MHz – 2452 MHz



### 9 KHz – 26.5 GHz

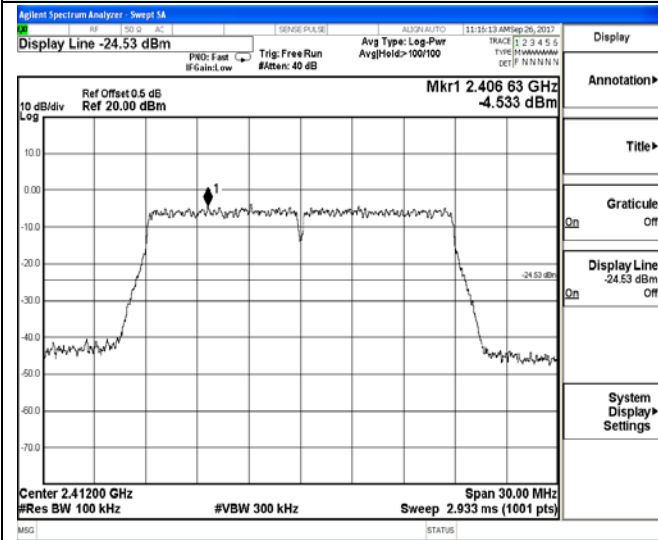


### 2447 MHz – 2477 MHz

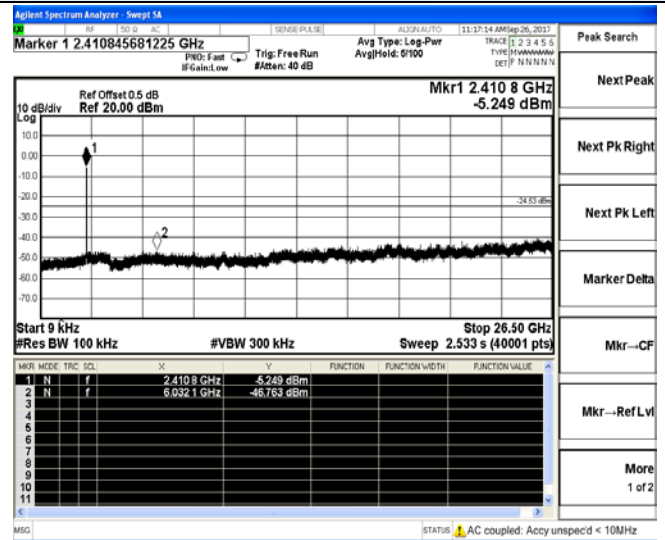
### 9 KHz – 26.5 GHz



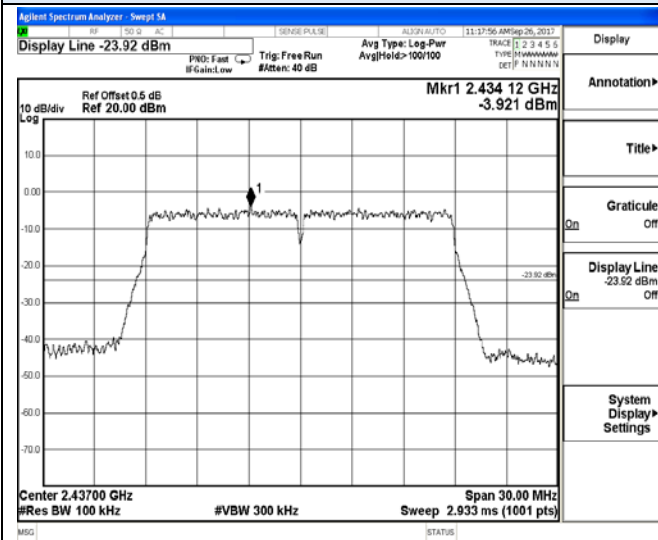
## RF Conducted Spurious Emissions IEEE 802.11n HT20



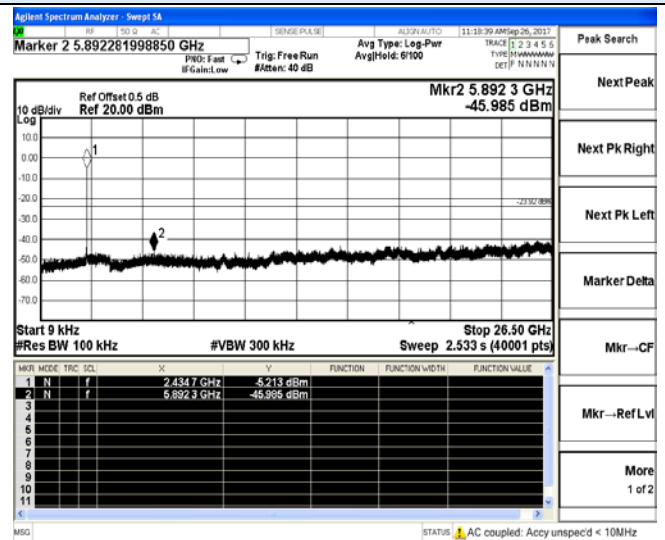
**2397 MHz – 2427 MHz**



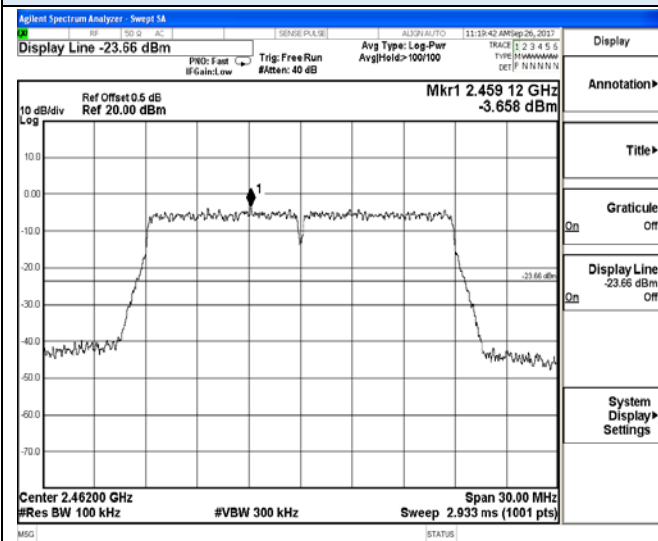
**9 KHz – 26.5 GHz**



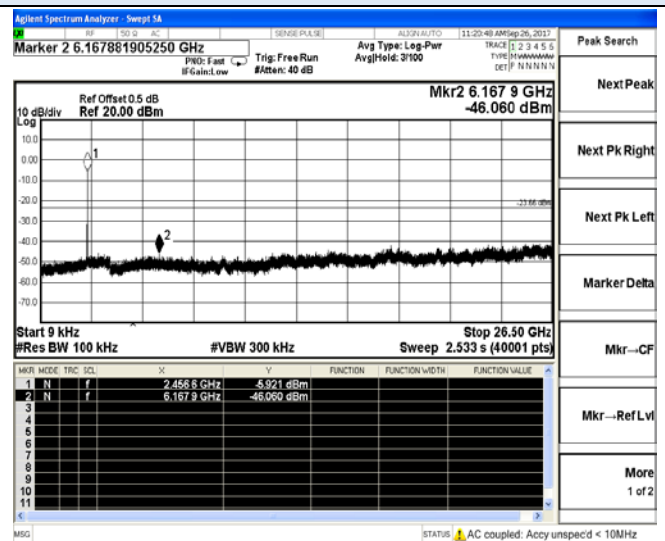
**2422 MHz – 2452 MHz**



**9 KHz – 26.5 GHz**

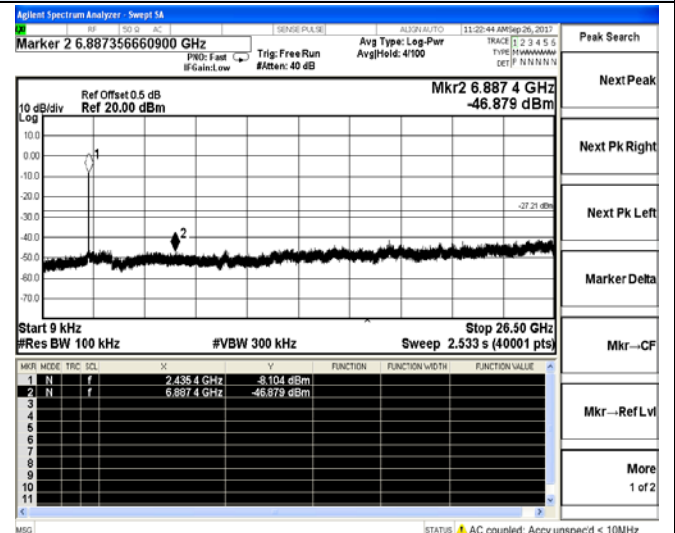
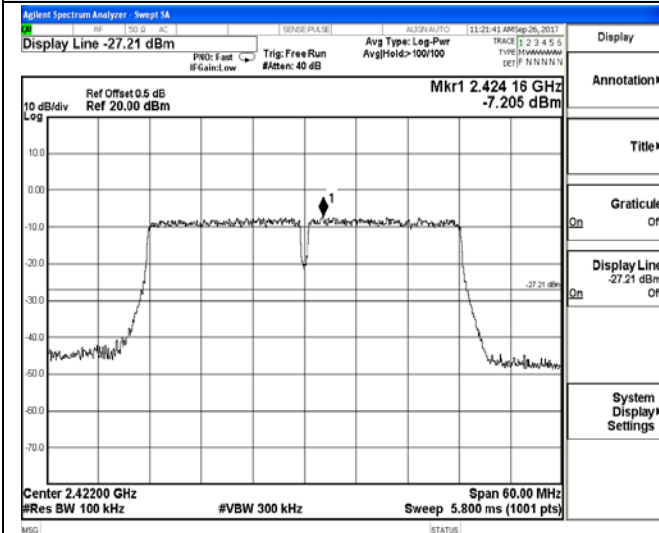


**2447 MHz – 2477 MHz**

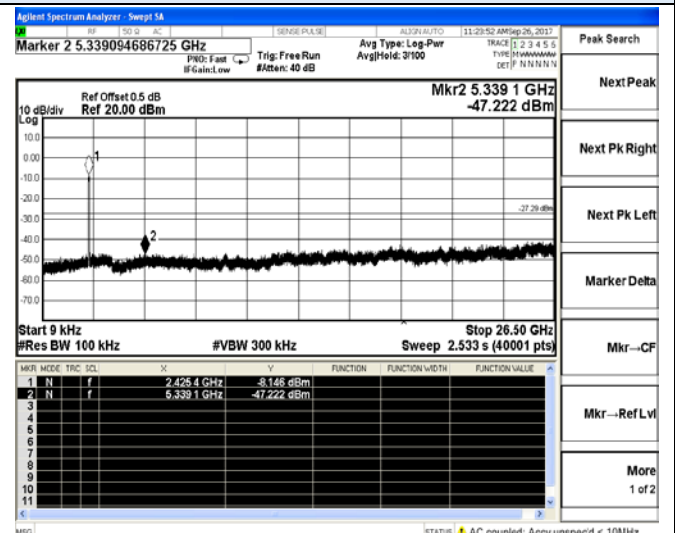
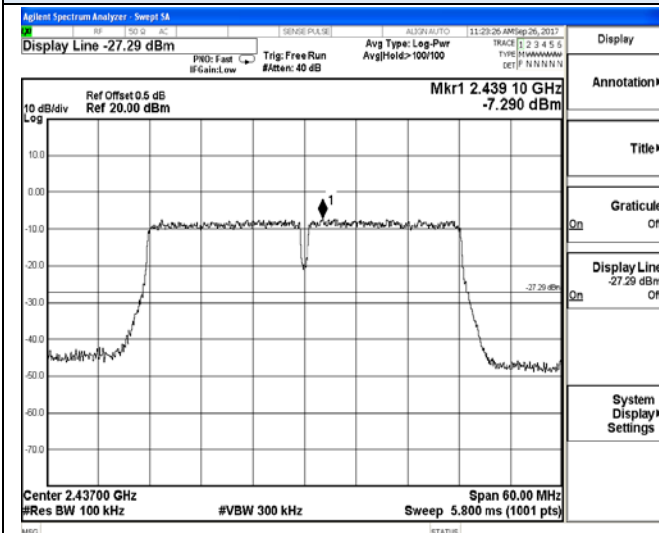


**9 KHz – 26.5 GHz**

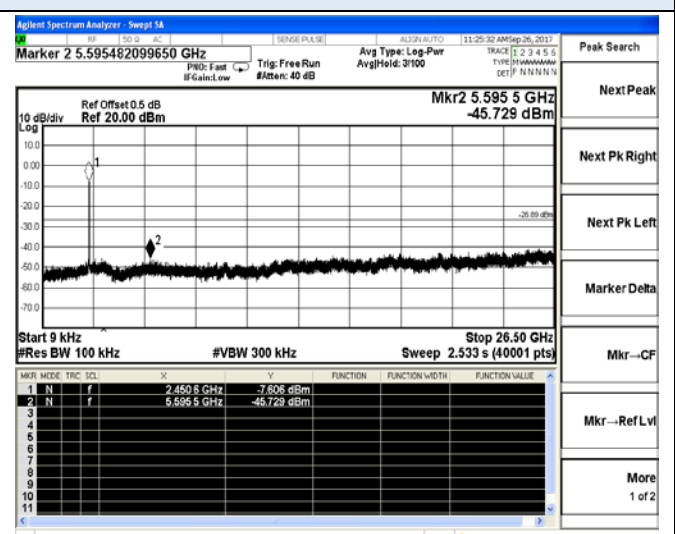
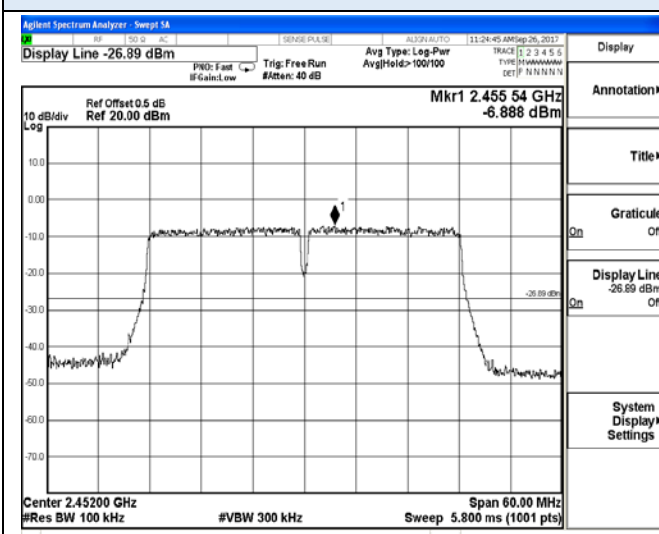
## RF Conducted Spurious Emissions IEEE 802.11n HT40



### 2392 MHz – 2452 MHz



### 2407 MHz – 2467 MHz



### 2422 MHz – 2482 MHz

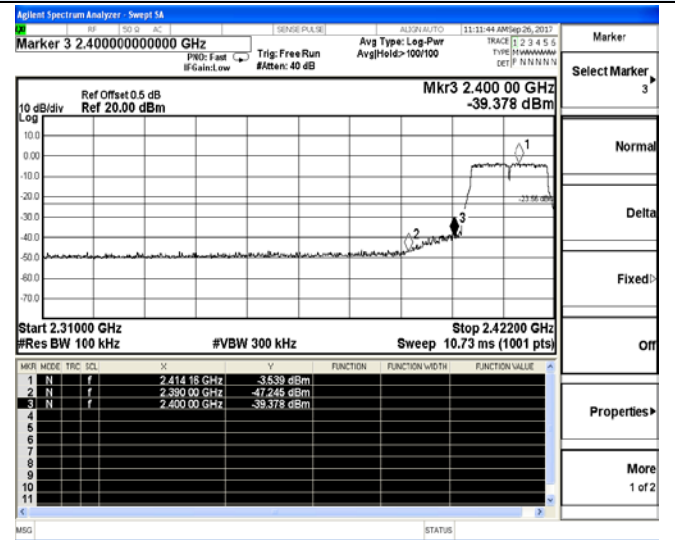
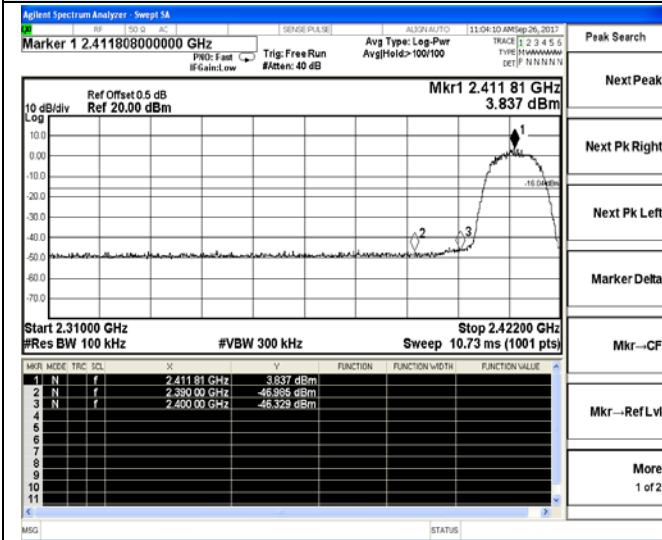
### 9 KHz – 26.5 GHz



RF Conducted Spurious Emissions

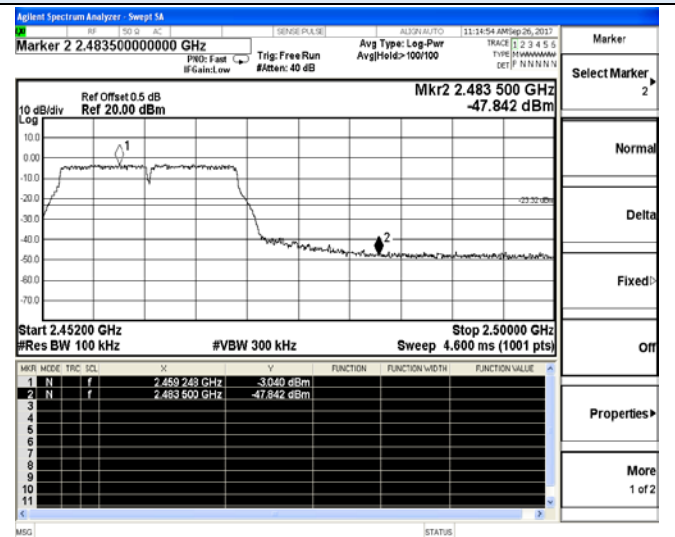
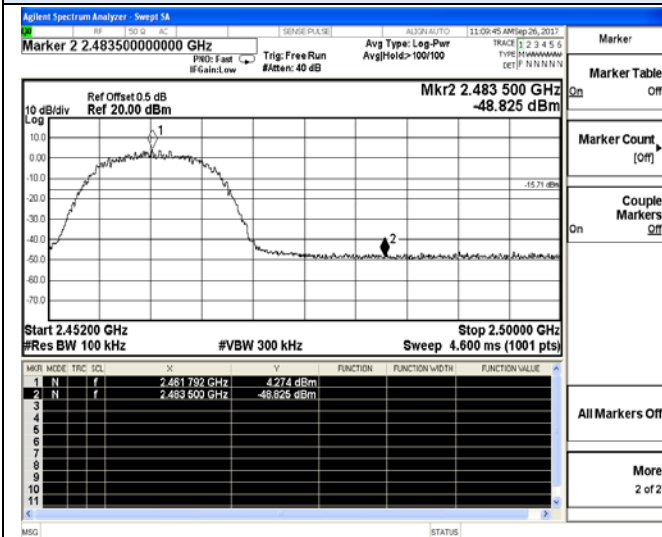
IEEE 802.11b

IEEE 802.11g



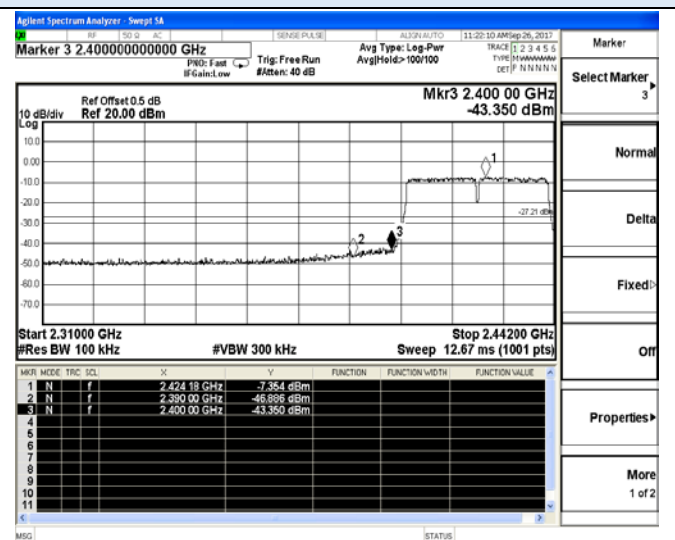
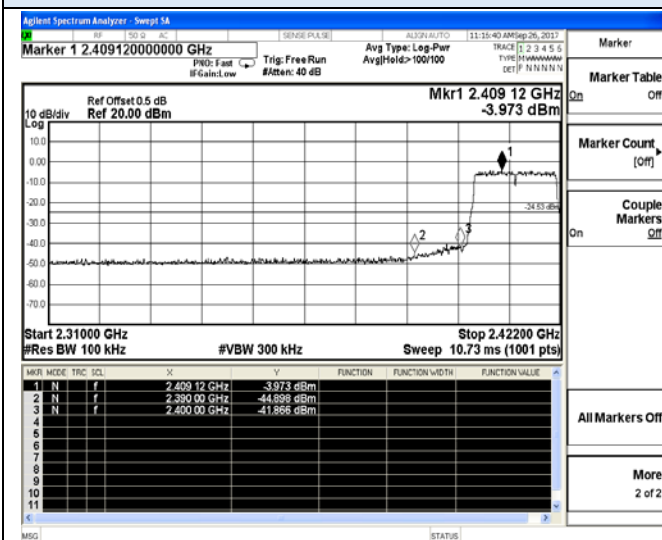
Channel 1 / 2412 MHz

Channel 1 / 2412 MHz



Channel 11 / 2462 MHz  
IEEE 802.11n HT20

Channel 11 / 2462 MHz  
IEEE 802.11n HT40



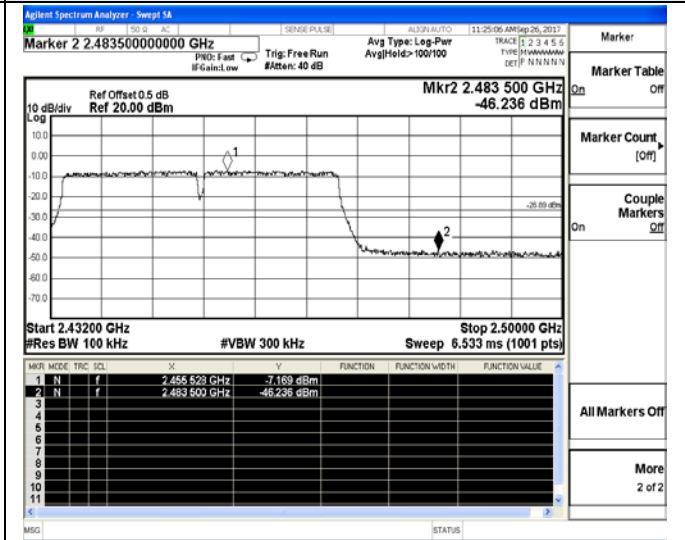
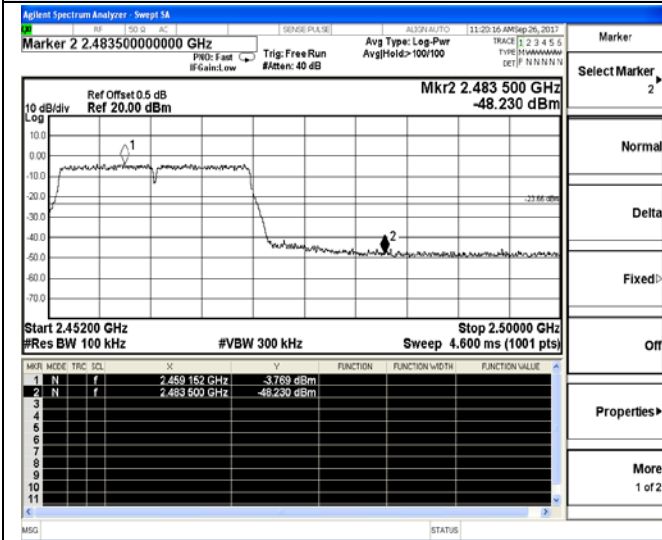
Channel 1 / 2412 MHz

Channel 3 / 2452 MHz

RF Conducted Spurious Emissions

IEEE 802.11n HT20

IEEE 802.11n HT40



Channel 11 / 2462 MHz

Channel 9 / 2452 MHz

### 5.7. AC Power line conducted emissions

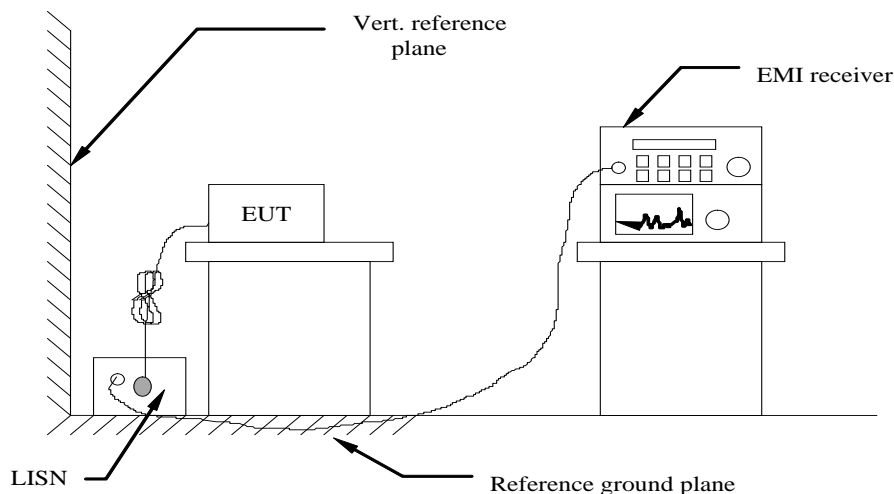
#### 5.7.1 Standard Applicable

According to §15.207 (a): For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range are listed as follows:

| Frequency Range (MHz) | Limits (dBµV) |          |
|-----------------------|---------------|----------|
|                       | Quasi-peak    | Average  |
| 0.15 to 0.50          | 66 to 56      | 56 to 46 |
| 0.50 to 5             | 56            | 46       |
| 5 to 30               | 60            | 50       |

\* Decreasing linearly with the logarithm of the frequency

#### 5.7.2 Block Diagram of Test Setup



#### 5.7.3 Test Results

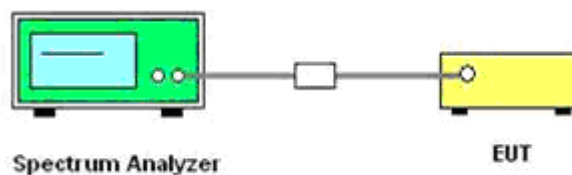
Not Applicable, the device was powered by DC battery.

## 5.8. Band-edge measurements for radiated emissions

### 5.8.1 Standard Applicable

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 20dB 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 20dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### 5.8.2. Test Setup Layout



### 5.8.3. Measuring Instruments and Setting

Please refer to equipment list in this report. The following table is the setting of Spectrum Analyzer.

### 5.8.4. Test Procedures

According to KDB 558074 D01 for Antenna-port conducted measurement. Antenna-port conducted measurements may also be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious emissions is required.

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to an EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge, for Radiated emissions restricted band RBW=1MHz, VBW=3MHz for peak detector and RBW=1MHz, VBW=1/B for AV detector.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.
6. Measure the conducted output power (in dBm) using the detector specified by the appropriate regulatory agency (see 12.2.2, 12.2.3, and 12.2.4 for guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).
7. Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)
8. Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies  $\leq 30$  MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies  $> 1000$  MHz).
9. For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).
10. Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:

$$E = \text{EIRP} - 20\log D + 104.77 = \text{EIRP} + 95.23$$

Where:

E = electric field strength in dB $\mu$ V/m,

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EIRP = equivalent isotropic radiated power in dBm

D = specified measurement distance in meters.

11. Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.
12. Compare the resultant electric field strength level to the applicable regulatory limit.
13. Perform radiated spurious emission test duress until all measured frequencies were complete.

#### 5.8.5 Test Results

| <b>IEEE 802.11b</b> |                       |                    |                               |  |          |                |         |
|---------------------|-----------------------|--------------------|-------------------------------|--|----------|----------------|---------|
| Frequency (MHz)     | Conducted Power (dBm) | Antenna Gain (dBi) | Ground Reflection Factor (dB) | Covert Radiated E Level At 3m (dBuV/m) | Detector | Limit (dBuV/m) | Verdict |
| 2310.000            | -40.989               | 2.000              | 0.000                         | 56.239                                 | Peak     | 74.00          | PASS    |
| 2310.000            | -51.431               | 2.000              | 0.000                         | 45.797                                 | AV       | 54.00          | PASS    |
| 2390.000            | -40.509               | 2.000              | 0.000                         | 56.719                                 | Peak     | 74.00          | PASS    |
| 2390.000            | -50.839               | 2.000              | 0.000                         | 46.389                                 | AV       | 54.00          | PASS    |
| 2483.500            | -39.464               | 2.000              | 0.000                         | 57.764                                 | Peak     | 74.00          | PASS    |
| 2483.500            | -50.717               | 2.000              | 0.000                         | 46.511                                 | AV       | 54.00          | PASS    |
| 2500.000            | -39.826               | 2.000              | 0.000                         | 57.402                                 | Peak     | 74.00          | PASS    |
| 2500.000            | -50.678               | 2.000              | 0.000                         | 46.550                                 | AV       | 54.00          | PASS    |

| <b>IEEE 802.11g</b> |                       |                    |                               |  |          |                |         |
|---------------------|-----------------------|--------------------|-------------------------------|--|----------|----------------|---------|
| Frequency (MHz)     | Conducted Power (dBm) | Antenna Gain (dBi) | Ground Reflection Factor (dB) | Covert Radiated E Level At 3m (dBuV/m) | Detector | Limit (dBuV/m) | Verdict |
| 2310.000            | -41.106               | 2.000              | 0.000                         | 56.122                                 | Peak     | 74.00          | PASS    |
| 2310.000            | -51.329               | 2.000              | 0.000                         | 45.899                                 | AV       | 54.00          | PASS    |
| 2390.000            | -33.508               | 2.000              | 0.000                         | 63.720                                 | Peak     | 74.00          | PASS    |
| 2390.000            | -48.407               | 2.000              | 0.000                         | 48.821                                 | AV       | 54.00          | PASS    |
| 2483.500            | -38.954               | 2.000              | 0.000                         | 58.274                                 | Peak     | 74.00          | PASS    |
| 2483.500            | -49.788               | 2.000              | 0.000                         | 47.440                                 | AV       | 54.00          | PASS    |
| 2500.000            | -37.787               | 2.000              | 0.000                         | 59.441                                 | Peak     | 74.00          | PASS    |
| 2500.000            | -50.216               | 2.000              | 0.000                         | 47.012                                 | AV       | 54.00          | PASS    |

| <b>IEEE 802.11n HT20</b> |                       |                    |                               |  |          |                |         |
|--------------------------|-----------------------|--------------------|-------------------------------|--|----------|----------------|---------|
| Frequency (MHz)          | Conducted Power (dBm) | Antenna Gain (dBi) | Ground Reflection Factor (dB) | Covert Radiated E Level At 3m (dBuV/m) | Detector | Limit (dBuV/m) | Verdict |
| 2310.000                 | -40.024               | 2.000              | 0.000                         | 57.204                                 | Peak     | 74.00          | PASS    |
| 2310.000                 | -51.402               | 2.000              | 0.000                         | 45.826                                 | AV       | 54.00          | PASS    |
| 2390.000                 | -30.494               | 2.000              | 0.000                         | 66.734                                 | Peak     | 74.00          | PASS    |
| 2390.000                 | -49.079               | 2.000              | 0.000                         | 48.149                                 | AV       | 54.00          | PASS    |
| 2483.500                 | -39.078               | 2.000              | 0.000                         | 58.150                                 | Peak     | 74.00          | PASS    |
| 2483.500                 | -49.767               | 2.000              | 0.000                         | 47.461                                 | AV       | 54.00          | PASS    |
| 2500.000                 | -38.855               | 2.000              | 0.000                         | 58.373                                 | Peak     | 74.00          | PASS    |
| 2500.000                 | -50.161               | 2.000              | 0.000                         | 47.067                                 | AV       | 54.00          | PASS    |

| <b>IEEE 802.11n HT40</b> |                       |                    |                               |  |          |                |         |
|--------------------------|-----------------------|--------------------|-------------------------------|--|----------|----------------|---------|
| Frequency (MHz)          | Conducted Power (dBm) | Antenna Gain (dBi) | Ground Reflection Factor (dB) | Covert Radiated E Level At 3m (dBuV/m) | Detector | Limit (dBuV/m) | Verdict |
| 2310.000                 | -40.288               | 2.000              | 0.000                         | 56.940                                 | Peak     | 74.00          | PASS    |
| 2310.000                 | -51.415               | 2.000              | 0.000                         | 45.813                                 | AV       | 54.00          | PASS    |
| 2390.000                 | -35.816               | 2.000              | 0.000                         | 61.412                                 | Peak     | 74.00          | PASS    |
| 2390.000                 | -47.704               | 2.000              | 0.000                         | 49.524                                 | AV       | 54.00          | PASS    |
| 2483.500                 | -35.967               | 2.000              | 0.000                         | 61.261                                 | Peak     | 74.00          | PASS    |
| 2483.500                 | -49.354               | 2.000              | 0.000                         | 47.874                                 | AV       | 54.00          | PASS    |
| 2500.000                 | -38.236               | 2.000              | 0.000                         | 58.992                                 | Peak     | 74.00          | PASS    |
| 2500.000                 | -49.949               | 2.000              | 0.000                         | 47.279                                 | AV       | 54.00          | PASS    |

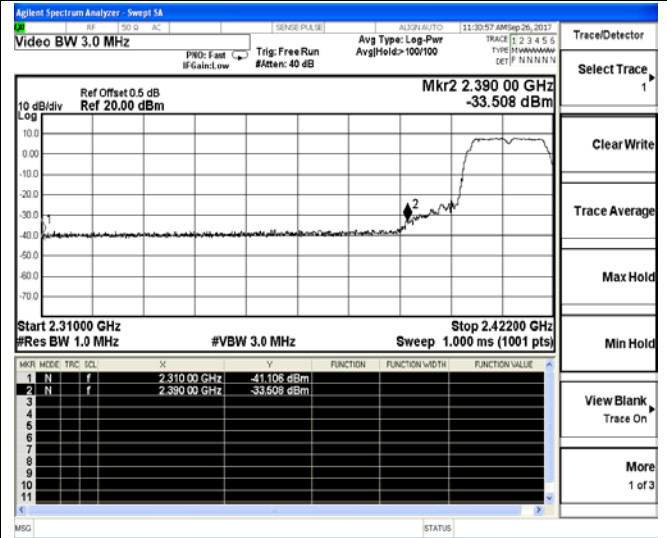
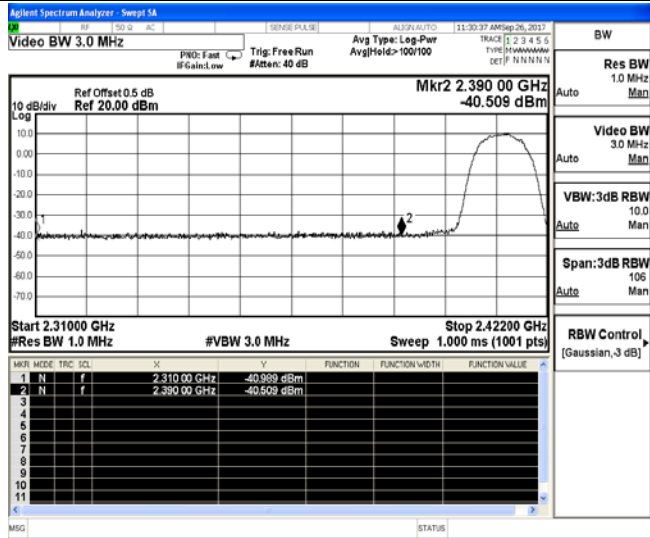
**Remark:**

1. Measured Band-edge measurement for radiated at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20; 13.5Mbps at IEEE 802.11n HT40;
4. “---“means that the fundamental frequency not for 15.209 limits requirement.
5. No need measure Average values if Peak values meets Average limits;
6. Please refer to following plots;

Band-edge measurements for radiated emissions

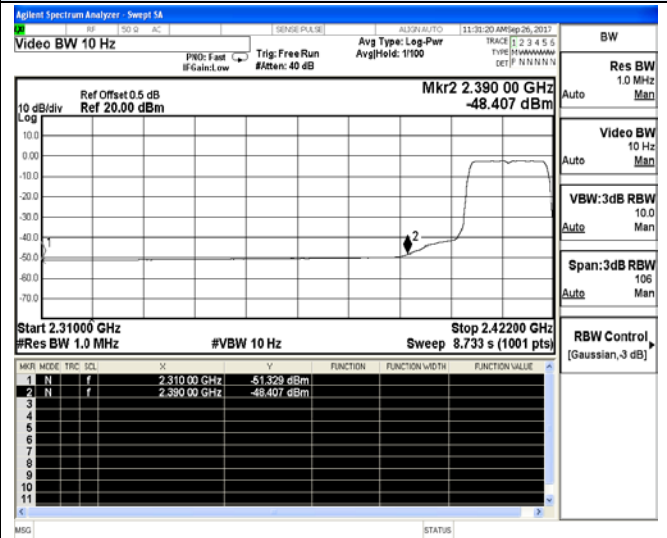
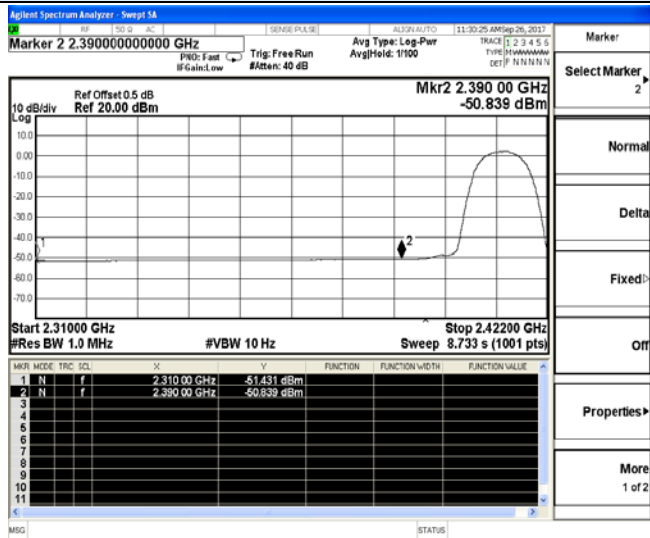
IEEE 802.11b

IEEE 802.11g



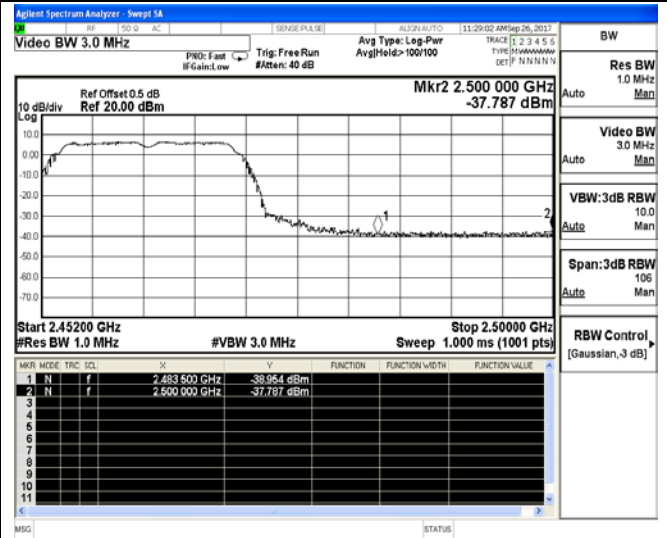
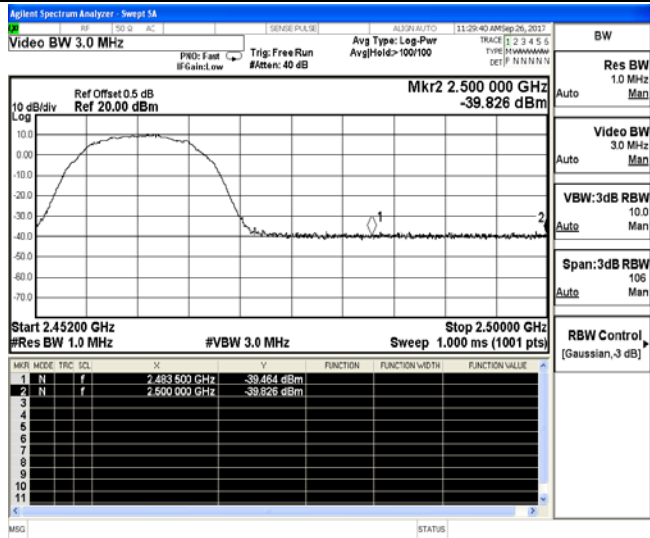
Channel 1 / 2412 MHz – Peak

Channel 1 / 2412 MHz – Peak



Channel 1 / 2412 MHz – Average

Channel 1 / 2412 MHz – Average



Channel 11 / 2412 MHz – Peak

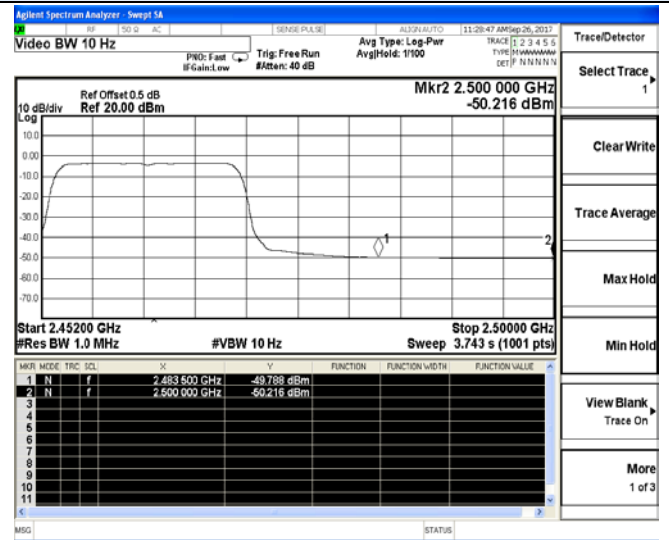
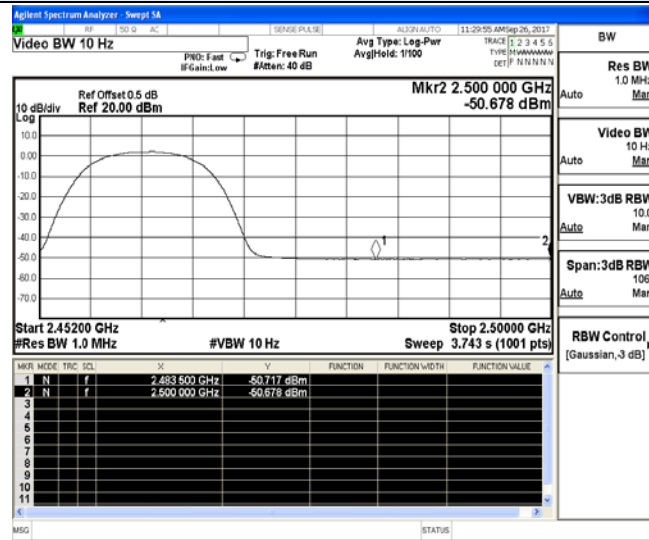
Channel 11 / 2412 MHz – Peak



Band-edge measurements for conducted emissions

IEEE 802.11b

IEEE 802.11g

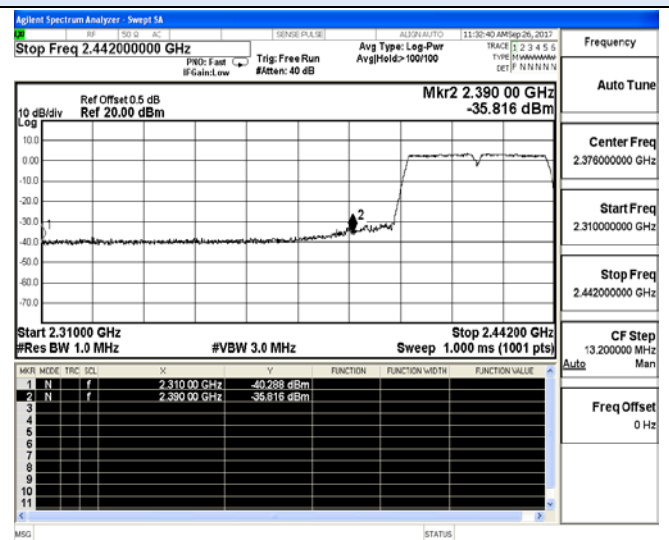
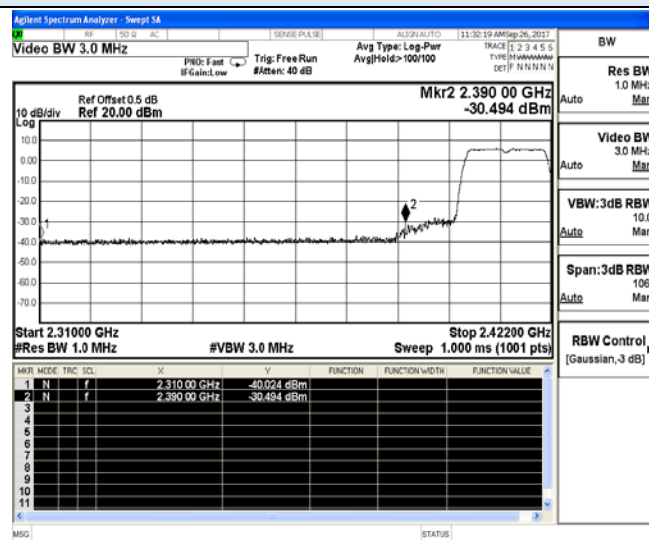


Channel 11 / 2462 MHz – Average

Channel 11 / 2462 MHz – Average

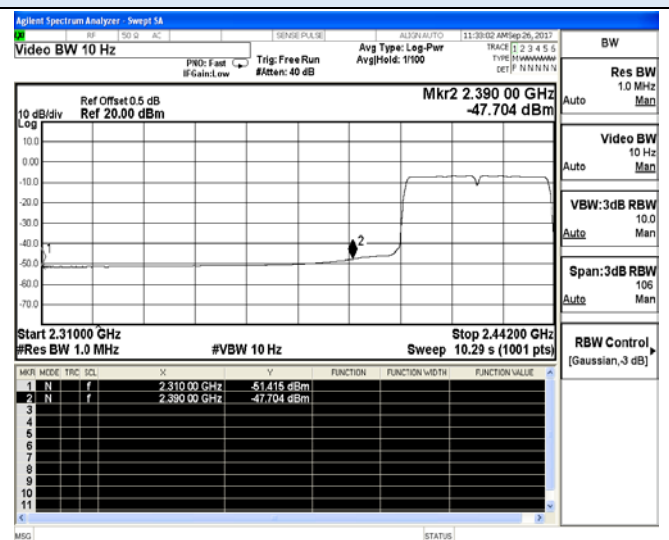
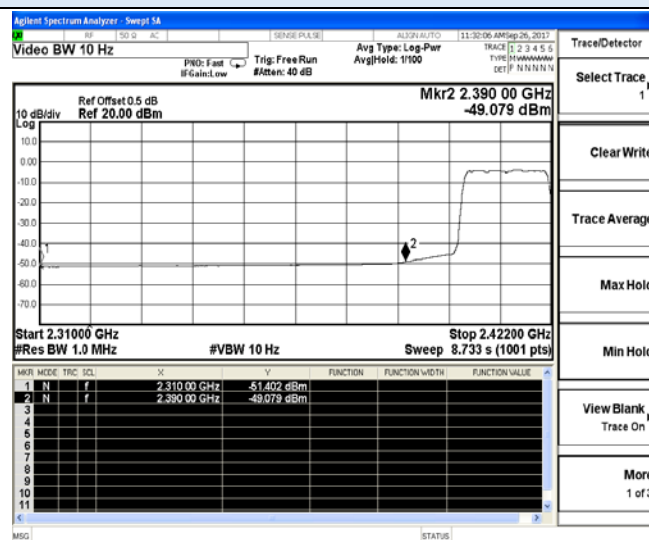
IEEE 802.11n HT20

IEEE 802.11n HT40



Channel 1 / 2412 MHz – Peak

Channel 3 / 2422 MHz – Peak



Channel 1 / 2412 MHz – Average

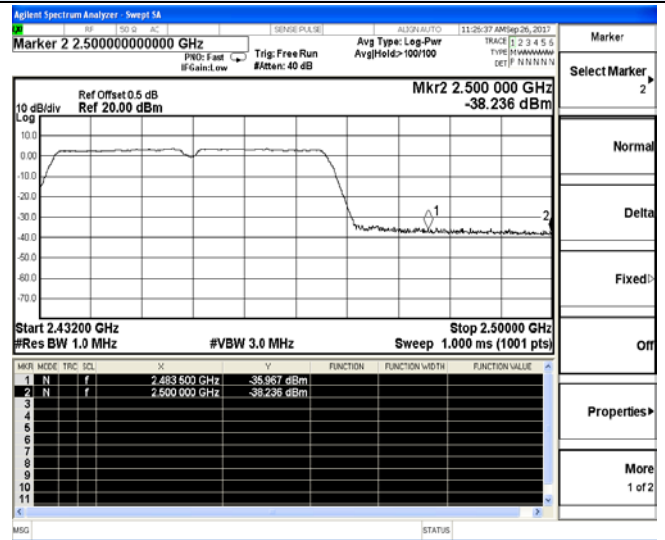
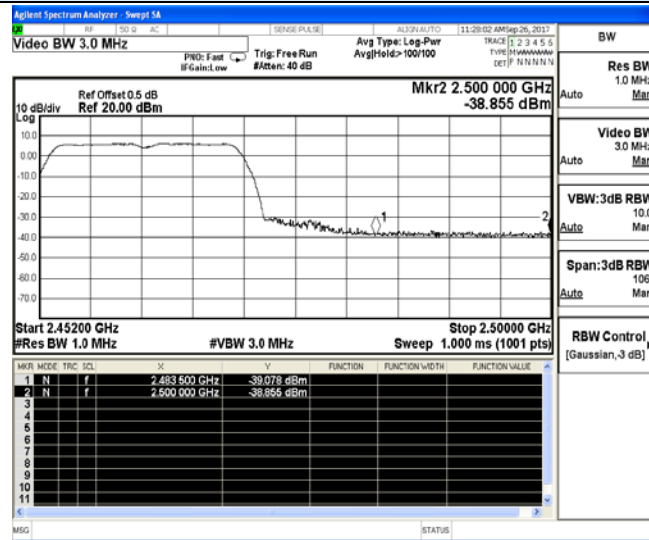
Channel 3 / 2422 MHz – Average



Band-edge measurements for conducted emissions

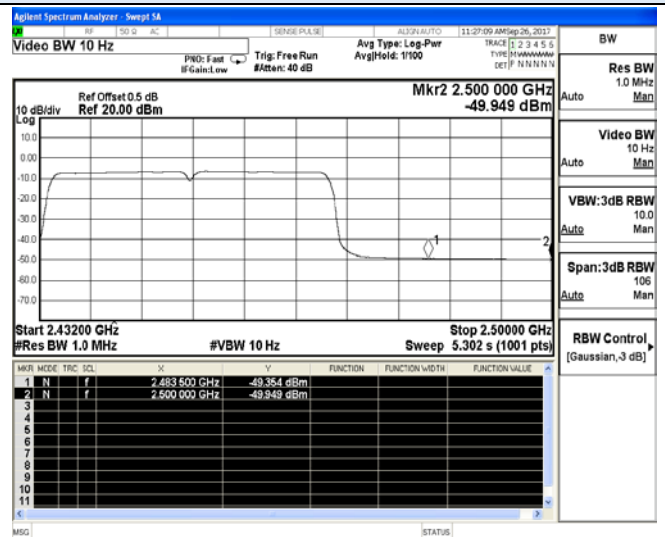
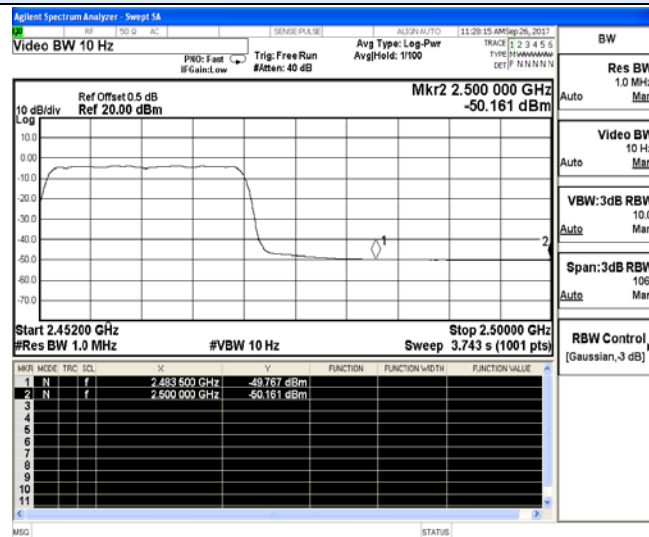
IEEE 802.11n HT20

IEEE 802.11n HT40



Channel 11 / 2462 MHz – Peak

Channel 9 / 2452 MHz – Peak



Channel 11 / 2462 MHz – Average

Channel 9 / 2452 MHz – Average

## 5.9. Antenna Requirements

### 5.9.1 Standard Applicable

According to antenna requirement of §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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

And according to §15.247(4) (1), system operating in the 2400-2483.5MHz bands that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

### 5.9.2 Antenna Connected Construction

#### 5.9.2.1. Standard Applicable

According to § 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.

#### 5.9.2.2. Antenna Connector Construction

The gains of antenna used for transmitting is 2.0dBi, and the antenna is external antenna and R-SMA antenna connector meets FCC §15.203 antenna requirement. Please see EUT photo for details.

#### 5.9.2.3. Results: Compliance.

##### Measurement

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module.

Conducted power refers ANSI C63.10:2013 Output power test procedure for DTS devices.

Radiated power refers to ANSI C63.10:2013 Radiated emissions tests.

##### Measurement parameters

| Measurement parameter |          |
|-----------------------|----------|
| Detector:             | Peak     |
| Sweep Time:           | Auto     |
| Resolution bandwidth: | 1MHz     |
| Video bandwidth:      | 3MHz     |
| Trace-Mode:           | Max hold |

Note: The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module. For normal WLAN devices, the IEEE 802.11b mode is used.

**Limits**

|              |      |
|--------------|------|
| FCC          | ISED |
| Antenna Gain |      |
| 6 dBi        |      |

| T <sub>nom</sub>  | V <sub>nom</sub> | lowest channel<br>2412 MHz | middle channel<br>2437 MHz         | highest channel<br>2462 MHz |
|---|------------------|----------------------------|------------------------------------|-----------------------------|
| Conducted power [dBm]<br>Measured with<br>DSSS modulation |                  | 10.006                     | 10.247                             | 9.978                       |
| Radiated power [dBm]<br>Measured with<br>DSSS modulation  |                  | 11.277                     | 12.142                             | 11.642                      |
| Gain [dBi] Calculated                                     |                  | 1.271                      | 1.895                              | 1.664                       |
| Measurement uncertainty                                   |                  |                            | ± 1.6 dB (cond.) / ± 3.8 dB (rad.) |                             |

## 6. LIST OF MEASURING EQUIPMENTS

| Item | Equipment                            | Manufacturer      | Model No.    | Serial No.          | Last Cal.  | Next Cal.  |
|------|--------------------------------------|-------------------|--------------|---------------------|------------|------------|
| 1    | Power Meter                          | R&S               | NRVS         | 100444              | 2017-06-17 | 2018-06-16 |
| 2    | Power Sensor                         | R&S               | NRV-Z81      | 100458              | 2017-06-17 | 2018-06-16 |
| 3    | Power Sensor                         | R&S               | NRV-Z32      | 10057               | 2017-06-17 | 2018-06-16 |
| 4    | ESA-E SERIES<br>SPECTRUM<br>ANALYZER | Agilent           | E4407B       | MY41440754          | 2016-11-18 | 2017-11-17 |
| 5    | MXA Signal Analyzer                  | Agilent           | N9020A       | MY49100040          | 2017-06-17 | 2018-06-16 |
| 6    | SPECTRUM<br>ANALYZER                 | R&S               | FSP          | 100503              | 2017-06-17 | 2018-06-16 |
| 7    | 3m Semi Anechoic<br>Chamber          | SIDT<br>FRANKONIA | SAC-3M       | 03CH03-HY           | 2017-06-17 | 2018-06-16 |
| 8    | Positioning Controller               | MF                | MF-7082      | /                   | 2017-06-17 | 2018-06-16 |
| 9    | EMI Test Software                    | AUDIX             | E3           | N/A                 | 2017-06-17 | 2018-06-16 |
| 10   | EMI Test Receiver                    | R&S               | ESR 7        | 101181              | 2017-06-17 | 2018-06-16 |
| 11   | AMPLIFIER                            | QuieTek           | QTK-A2525G   | CHM10809065         | 2016-11-18 | 2017-11-17 |
| 12   | Active Loop Antenna                  | SCHWARZBECK       | FMZB 1519B   | 00005               | 2017-06-23 | 2018-06-22 |
| 13   | By-log Antenna                       | SCHWARZBECK       | VULB9163     | 9163-470            | 2017-05-02 | 2018-05-01 |
| 14   | Horn Antenna                         | EMCO              | 3115         | 6741                | 2017-06-23 | 2018-06-22 |
| 15   | RF Cable-R03m                        | Jye Bao           | RG142        | CB021               | 2017-06-17 | 2018-06-16 |
| 16   | RF Cable-HIGH                        | SUHNER            | SUCOFLEX 106 | 03CH03-HY           | 2017-06-17 | 2018-06-16 |
| 17   | TEST RECEIVER                        | R&S               | ESCI         | 101142              | 2017-06-17 | 2018-06-16 |
| 18   | RF Cable-CON                         | UTIFLEX           | 3102-26886-4 | CB049               | 2017-06-17 | 2018-06-16 |
| 19   | 10dB Attenuator                      | SCHWARZBECK       | MTS-IMP136   | 261115-001-00<br>32 | 2017-06-17 | 2018-06-16 |
| 20   | Artificial Mains                     | R&S               | ENV216       | 101288              | 2017-06-17 | 2018-06-16 |

Note: All equipment is calibrated through GUANGZHOU LISAI CALIBRATION AND TEST CO.,LTD.

## **7. TEST SETUP PHOTOGRAPHS OF EUT**

Please refer to separated files for Test Setup Photos of the EUT.

## **8. EXTERIOR PHOTOGRAPHS OF THE EUT**

Please refer to separated files for External Photos of the EUT.

## **9. INTERIOR PHOTOGRAPHS OF THE EUT**

Please refer to separated files for Internal Photos of the EUT.

-----THE END OF REPORT-----