



# **JAPAN Radio Test Report**

## **WLAN 2.4GHz Band**

**APPLICANT** : Texas Instruments Incorporated

**PRODUCT NAME** : 2.4GHz Wi-Fi® Module

**MODEL NAME** : CC3220MODASF12MON,  
CC3220MODASM2MON,  
CC3220MODSF12MOB,  
CC3220MODSM2MOB

**TYPE EMISSIONS** : 14M2G1D (DSSS\_802.11b) ;  
16M9G1D/D1D (OFDM\_802.11g) ;  
18M2G1D/D1D (OFDM\_802.11n\_HT20)

**DECLARATION** : 3.50 mW/MHz (DSSS\_802.11b) ;  
**OUTPUT POWER** : 2.50 mW/MHz (OFDM\_802.11g) ;  
2.50 mW/MHz (OFDM\_802.11n\_HT20)

**STANDARD** : Article 49-20 and the relevant articles of the  
Ordinance Regulating Radio Equipment

**TEST** : MIC Notice No.88 Appendix No.43  
**PROCEDURE**



The product sample received on Mar. 16, 2017 and completely tested on May 26, 2017. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures given in MIC Notice No.88 Appendix No.43 and shown to be compliant with the applicable technical standards. Article 2 Paragraph 1 Item 19 of the Certificate Ordinance of the Radio Law indicates the classification of the specified radio equipment.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

*Louis Wu*

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Review by: Louis Wu

*Jones Tsai*

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Approved by: Jones Tsai / Manager

**SPORTON INTERNATIONAL INC.**

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SPORTON INTERNATIONAL INC.

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Report Version : Rev. 01

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## TABLE OF CONTENTS

|  |           |
|--|-----------|
| <b>REVISION HISTORY .....</b>  | <b>4</b>  |
| <b>SUMMARY OF TEST RESULT .....</b>  | <b>5</b>  |
| <b>1 GENERAL DESCRIPTION .....</b>   | <b>6</b>  |
| 1.1 Applicant .....  | 6         |
| 1.2 Manufacturer .....   | 6         |
| 1.3 Feature of Equipment Under Test .....  | 7         |
| 1.4 Modification of EUT .....  | 9         |
| 1.5 Testing Site .....   | 10        |
| 1.6 Applied Standards .....  | 10        |
| 1.7 Ancillary Equipment List .....   | 10        |
| <b>2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST .....</b>                              | <b>11</b> |
| 2.1 Carrier Frequency Channel .....  | 11        |
| 2.2 EUT Operation Test Setup .....   | 11        |
| <b>3 TEST RESULT .....</b>   | <b>12</b> |
| 3.1 Frequency Tolerance Measurement .....  | 12        |
| 3.2 Occupied Bandwidth and Spread-spectrum Bandwidth / Spread Factor Measurement ..... | 13        |
| 3.3 Unwanted Emission Intensity Measurement .....                                      | 15        |
| 3.4 RF Output Power / Tolerance .....  | 17        |
| 3.5 Limitation of Collateral Emission of Receiver Measurement .....                    | 19        |
| 3.6 Transmission Antenna Gain (EIRP Antenna Power) Measurement .....                   | 21        |
| 3.7 Transmission Radiation Angle Width (3dB Beamwidth) Measurement .....               | 23        |
| 3.8 Radio Interference Prevention Capability Measurement .....                         | 25        |
| 3.9 Carrier Sense .....  | 26        |
| 3.10 Construction Protection Confirmation Method .....                                 | 27        |
| <b>4 LIST OF MEASURING EQUIPMENT .....</b>   | <b>28</b> |
| <b>APPENDIX A. SETUP PHOTOGRAPHS</b>   |           |
| <b>APPENDIX B. TEST RESULTS</b>  |           |
| <b>APPENDIX C. TEST PLOTS</b>  |           |



## REVISION HISTORY

| REPORT NO. | VERSION | DESCRIPTION             | ISSUED DATE   |
|------------|---------|-------------------------|---------------|
| JR731625   | Rev. 01 | Initial issue of report | Jun. 10, 2017 |
|            |         |                         |               |
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|            |         |                         |               |
|            |         |                         |               |

## SUMMARY OF TEST RESULT

| Report Section | Description  | Result |
|----------------|--|--------|
| 3.1            | Frequency Tolerance  | Pass   |
| 3.2            | Occupied Bandwidth and Spread-spectrum Bandwidth / Spread Factor | Pass   |
| 3.3            | Unwanted Emission Intensity                                      | Pass   |
| 3.4            | RF Output Power / Tolerance                                      | Pass   |
| 3.5            | Limitation of Collateral Emission of Receiver                    | Pass   |
| 3.6            | Transmission Antenna Gain<br>(EIRP Antenna Power)                | N/A    |
| 3.7            | Transmission Radiation Angle Width<br>(3dB Beam width)           | N/A    |
| 3.8            | Radio Interference Prevention Capability                         | Pass   |
| 3.9            | Carrier Sense Function   | N/A    |
| 3.10           | Construction Protection Confirmation                             | Pass   |



# **1 General Description**

## **1.1 Applicant**

**Texas Instruments Incorporated**  
12500 TI BLVD., Dallas Texas, 75243

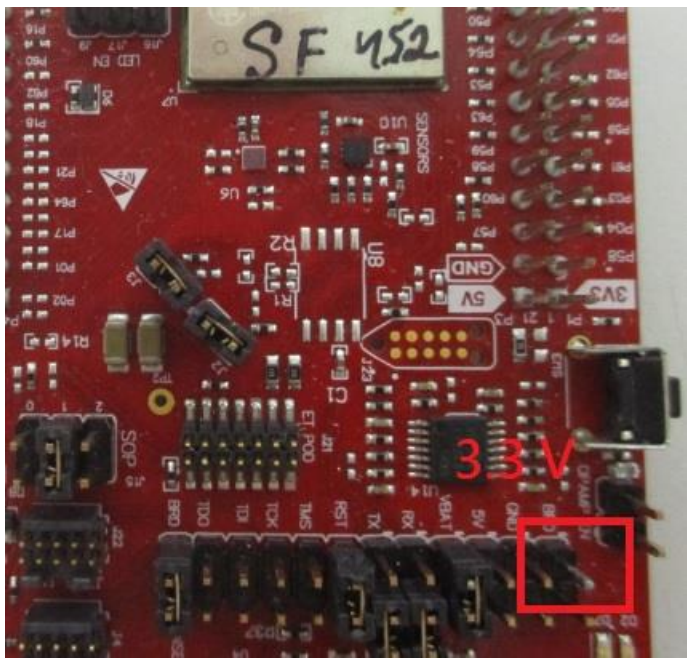
## **1.2 Manufacturer**

**Texas Instruments Incorporated**  
12500 TI BLVD., Dallas Texas, 75243

### 1.3 Feature of Equipment Under Test

| Product Feature & Specification    |  |               |
|------------------------------------|--|---------------|
| Product Name                       | 2.4GHz Wi-Fi® Module   |               |
| Model Name                         | CC3220MODASF12MON,<br>CC3220MODASM2MON,<br>CC3220MODSF12MOB,<br>CC3220MODSM2MOB  |               |
| Support Category / Frequency Range | Article 2-1-19 / 2400MHz ~ 2483.5MHz   |               |
| WLAN Type of Modulation            | <input checked="" type="checkbox"/> Direct Spreading (DS)<br><input checked="" type="checkbox"/> Orthogonal frequency-division multiplexing (OFDM)<br><input type="checkbox"/> Frequency Hopping (FH)    |               |
| RF Technology                      | <input checked="" type="checkbox"/> 802.11b <input checked="" type="checkbox"/> 802.11g<br><input checked="" type="checkbox"/> 802.11n-HT20<br><input type="checkbox"/> 802.11n-HT40                     |               |
| Number of Channels                 | 20MHz System   | 13            |
| Channel Spacing                    | 5 MHz  |               |
| Declaration RF Output Power        | 3.50 mW/MHz (DSSS 802.11b mode)<br>2.50 mW/MHz (OFDM 802.11g mode)<br>2.50 mW/MHz (OFDM 802.11n_HT20 mode)   |               |
| Antenna Power (E.I.R.P)            | 10.941 dBm/MHz (DSSS 802.11b mode)<br>9.479 dBm/MHz (OFDM 802.11g mode)<br>9.479 dBm/MHz (OFDM 802.11n_HT20 mode)  |               |
| Type of Modulation                 | <input checked="" type="checkbox"/> BPSK <input checked="" type="checkbox"/> QPSK <input checked="" type="checkbox"/> 16QAM <input checked="" type="checkbox"/> 64QAM<br><input type="checkbox"/> 256QAM |               |
| Power Source <sup>NOTE</sup>       | <input type="checkbox"/> Commercial power  | AC 100 ~ 240V |
|                                    | <input checked="" type="checkbox"/> External Power Source  | DC 5.0V,      |
|                                    | <input checked="" type="checkbox"/> External Power Source  | DC 3.3V,      |
|                                    | <input type="checkbox"/> UM battery  | DC 1.2V       |

**NOTE:** When EUT be operated at  $\pm 10\%$  from the normal supply voltage, the supply voltage of RF part was varied within  $\pm 1\%$ . All test cases were done under the normal supply voltage.

| Power Supply voltage<br>5.00 Vdc (Nominal)  | Power Supply voltage<br>5.50 Vdc (+10%) | Power Supply voltage<br>4.50 Vdc (-10%) |
|---|---|---|
| 3.3   | 3.3                                     | 3.3                                     |
| Measurement point   |   |   |
|  |   |   |

| Antenna Information |                |                                       |                     |                       |
|---------------------|----------------|---------------------------------------|---------------------|-----------------------|
| Item                | Brand Name     | Antenna Type                          | Device Name         | Peak Gain<br>(2.4GHz) |
| 1.                  | FoxCon         | PCB                                   | T77H533             | 2.5 dBi               |
| 2.                  | Ethertronics   | Dipole                                | 1000423             | -0.6 dBi              |
| 3.                  | LSR            | Rubber Whip /<br>Dipole               | 001-0012            | 2 dBi                 |
| 4.                  |                |                                       | 080-0013            | 2 dBi                 |
| 5.                  |                |                                       | 080-0014            | 2 dBi                 |
| 6.                  |                | PIFA                                  | 001-0016            | 2.5 dBi               |
| 7.                  |                |                                       | 001-0021            | 2.5 dBi               |
| 8.                  | Laird          | PCB                                   | CAF94504            | 2 dBi                 |
| 9.                  |                |                                       | CAF94505            | 2 dBi                 |
| 10.                 | Pulse          | Ceramic Chip                          | W3006               | 3.2 dBi               |
| 11.                 | ACX            | Multilayer Chip                       | AT3216-BR2R7HAA     | 0.5 dBi               |
| 12.                 |                |                                       | AT312-T2R4PAA       | 1.5 dBi               |
| 13.                 | CUSTOM ANTENNA | Inverted F                            | CUSTOM ANTENNA      | 3.3 dBi               |
| 14.                 | TDK            | Multilayer<br>Ceramic Chip<br>Antenna | ANT016008LCD2442MA1 | 1.6 dBi               |
| 15.                 |                |                                       | ANT016008LCD2442MA2 | 2.5 dBi               |
| 16.                 | Mitsubishi     | Chip Antenna                          | AM03DP-ST01         | 1.6 dBi               |
| 17.                 | Material       | Antenna Unit                          | UB18CP-100ST01      | -1.0 dBi              |



| Antenna Information |                       |                                 |                     |                    |
|---------------------|-----------------------|---------------------------------|---------------------|--------------------|
| Item                | Brand Name            | Antenna Type                    | Device Name         | Peak Gain (2.4GHz) |
| 18.                 | Taiyo Yuden           | Chip Antenna / Herical Monopole | AF216M245001        | 1.5 dBi            |
| 19.                 |                       | Chip Antenna / Monopole Type    | AH212M245001        | 1.3 dBi            |
| 20.                 |                       |                                 | AH316M245001        | 1.9 dBi            |
| 21.                 | Antenna Technology    | Dipole                          | AA2402SPU           | 2.0 dBi            |
| 22.                 |                       |                                 | AA2402RSPU          | 2.0 dBi            |
| 23.                 |                       |                                 | AA2402A-UFLLP       | 2.0 dBi            |
| 24.                 |                       |                                 | AA2402AU-UFLLP      | 2.0 dBi            |
| 25.                 | Staf                  | Mono-pole                       | 1019-016            | 2.14 dBi           |
| 26.                 |                       |                                 | 1019-017            | 2.14 dBi           |
| 27.                 |                       |                                 | 1019-018            | 2.14 dBi           |
| 28.                 |                       |                                 | 1019-019            | 2.14 dBi           |
| 29.                 | Map Electronics       | Rubber Whip                     | MEIWX-2411SAXX-2400 | 2.0 dBi            |
| 30.                 |                       |                                 | MEIWX-2411RSXX-2400 | 2.0 dBi            |
| 31.                 |                       |                                 | MEIWX-1511RSXX-2400 | 5.0 dBi            |
| 32.                 |                       |                                 | MEIWX-151XSAXX-2400 | 5.0 dBi            |
| 33.                 |                       |                                 | MEIWX-1451RSXX-2400 | 4.0 dBi            |
| 34.                 |                       |                                 | MEIWX-282XSAXX-2400 | 2.0 dBi            |
| 35.                 |                       |                                 | MEIWX-282XRSXX-2400 | 2.0 dBi            |
| 36.                 |                       |                                 | MEIWF-HP01RS2X-2400 | 2.0 dBi            |
| 37.                 | Yageo                 | Chip                            | ANT3216A063R2400A   | 1.69 dBi           |
| 38.                 | Mag Layers Scientific | Chip                            | LTA-3216-2G4S3-A1   | 1 dBi              |
| 39.                 |                       |                                 | LTA-3216-2G4S3-A3   | 2 dBi              |
| 40.                 | Advantech             | Rubber Whip / Dipole            | AN2450-5706RS       | 2.38 dBi           |
| 41.                 |                       | Rubber Whip / Dipole            | AN2450-5010BRS      | 5.03 dBi           |
| 42.                 |                       | Rubber Whip / Dipole            | AN2450-92K01BRS     | 5.03 dBi           |
| 43.                 |                       | Rubber Whip / Dipole            | R-AN2400-5701RS     | 3.3 dBi            |
| 44.                 |                       | Rubber Whip / Dipole            | AC0104158R00        | 5.5 dBi            |

**Remark:** The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

## 1.4 Modification of EUT

No modifications are made to the EUT during all test items.

## 1.5 Testing Site

|                    |   |
|--------------------|---|
| Test Site          | SPORTON INTERNATIONAL INC.  |
| Test Site Location | No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park,<br>Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C.<br>TEL: +886-3-3273456 / FAX: +886-3-3284978 |
| Test Site No.      | Sporton Site No.:<br>TH02-HY  |

| Test Items                 | Uncertainty                        | Remark         |
|----------------------------|------------------------------------|----------------|
| Occupied Channel Bandwidth | $\pm 0.49 \%$                      | Confidence 95% |
| RF output power, conducted | $\pm 0.61 \text{ dB}$              | Confidence 95% |
| Power density, conducted   | $\pm 0.60 \text{ dB}$              | Confidence 95% |
| Temperature                | $\pm 0.8 \text{ }^{\circ}\text{C}$ | Confidence 95% |
| Humidity                   | $\pm 3 \%$                         | Confidence 95% |
| Time                       | $\pm 0.33 \%$                      | Confidence 95% |

## 1.6 Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- Article 49-20 and the relevant articles of the Ordinance Regulating Radio Equipment

**Remark:**

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. The measurement was implemented in accordance with MIC Notice No. 88 Appendix No. 43.

## 1.7 Ancillary Equipment List

None.

## 2 Test Configuration of Equipment Under Test

### 2.1 Carrier Frequency Channel

| Channel | Frequency<br>(MHz) |
|---------|--------------------|
| 1       | 2412               |
| 2       | 2417               |
| 3       | 2422               |
| 4       | 2427               |
| 5       | 2432               |
| 6       | 2437               |
| 7       | 2442               |
| 8       | 2447               |
| 9       | 2452               |
| 10      | 2457               |
| 11      | 2462               |
| 12      | 2467               |
| 13      | 2472               |

### 2.2 EUT Operation Test Setup

During testing, RF test program provided by the customer was used to control the operating channel as well as the output power level.

### 3 Test Result

#### 3.1 Frequency Tolerance Measurement

##### 3.1.1 Limit

| Item                | Limits |
|---------------------|--------|
| Frequency Tolerance | ≤50ppm |

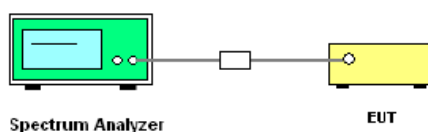
##### 3.1.2 Measuring Instruments

See list of measuring instruments of this test report.

##### 3.1.3 Test Procedure

1. Frequency accuracy of instrument shall be less than 10% of limits tolerance (5ppm).
2. Two methods for the item
  - a. CW Tone method
    - i. Setting of SA is following as: RBW:1kHz / VBW:30kHz.
    - ii. Maker Max. level to get measuring frequency f.
  - b. 10dB down method
    - i. Setting of SA is following as: RBW:100kHz / VBW: 100kHz / Trace: MaxHold
    - ii. Display line Level = Max. level – 10dB to place two markers, highest(fH) and lowest(fL) frequency
    - iii. Determine measuring frequency  $f = (f_H + f_L) / 2$
3. The frequency tolerance test case is directly measured using spectrum analyzer. Then the frequency error formula is  $(f - f_c) / f_c \times 10^6$  ppm and the limit is less than ±50ppm.

##### 3.1.4 Test Setup



##### 3.1.5 Test Deviation

There is no deviation with the original standard.

##### 3.1.6 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

##### 3.1.7 Test Result of Frequency Tolerance

Please refer to Appendix B.

## 3.2 Occupied Bandwidth and Spread-spectrum Bandwidth / Spread Factor Measurement

### 3.2.1 Limit

| Item                | Limits   |
|---------------------|--|
| Occupied Band Width | DS $\leq$ 26MHz; Others $\leq$ 26MHz<br>OFDM (For BW=20MHz) $\leq$ 26MHz<br>OFDM (For BW=40MHz) $\leq$ 38MHz |
| Spreading Bandwidth | DS $\geq$ 500 kHz  |

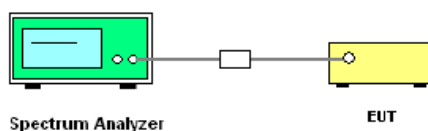
### 3.2.2 Measuring Instruments

See list of measuring instruments of this test report.

### 3.2.3 Test Procedures

1. Setting of SA is following as: RBW: 300KHz / VBW:300KHz / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold.
2. EUT have transmitted each modulation signal and fixed channelize (For DSSS or OFDM Device). SA set to 99% of occupied bandwidth to measure occupied bandwidth. The limit is less than 26MHz (For DSSS or OFDM Device).
3. SA set to 90% of occupied bandwidth to measure Spread Spectrum Bandwidth and must greater than 500kHz.
4. Spread Spectrum Factor = Spread Spectrum Bandwidth / modulation rate of EUT.
5. Spread Spectrum Factor limit is greater than 5.

### 3.2.4 Test Setup





### **3.2.5 Test Deviation**

There is no deviation with the original standard.

### **3.2.6 EUT Operation during Test**

The EUT was programmed to be in continuously transmitting mode.

### **3.2.7 Test Result of Occupied Bandwidth and Spread-spectrum Bandwidth / Spread Factor Measurement**

Please refer to Appendix B.

### 3.3 Unwanted Emission Intensity Measurement

#### 3.3.1 Limit

| Item                 | Limits  |
|----------------------|---|
| Tx Spurious Emission | $\leq 2.5 \mu\text{W}$ ( $2387\text{MHz} > f ; 2496.5\text{MHz} < f$ )                            |
|                      | $\leq 25 \mu\text{W}$   |
|                      | ( $2387\text{MHz} \leq f < 2400\text{MHz}$ ) and ( $2483.5\text{MHz} < f \leq 2496.5\text{MHz}$ ) |

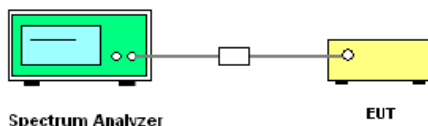
#### 3.3.2 Measuring Instruments

See list of measuring instruments of this test report.

#### 3.3.3 Test Procedures

1. EUT have transmitted the maximum power and fixed channelize.
2. Setting of SA is following as: RBW:1MHz / VBW:1MHz above 1GHz, Sweep time: Auto / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold.
3. Setting of SA is following as: RBW:100KHz / VBW:100KHz under 1GHz, Sweep time: Auto / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold.
4. Setting of SA is following as 30MHz and stop frequency 2387MHz Then to mark peak reading value + cable loss shall be less than 2.5 $\mu\text{W}$ .
5. SA adjusted to start frequency 2387MHz and stop frequency 2400MHz. Then to mark peak reading value + cable loss shall be less than 25 $\mu\text{W}$ .
6. SA adjusted to start frequency 2483.5MHz and stop frequency 2496.5MHz Then to mark peak reading value + cable loss shall be less than 25 $\mu\text{W}$ .
7. SA adjusted to start frequency 2496.5MHz and stop frequency 12500MHz Then to mark peak reading value + cable loss shall be less than 2.5 $\mu\text{W}$ .
8. If the Result\_Value is over the requirement, take total sum of 1MHz band centered at the spur frequency like ACLP measurement as Result\_Value.

#### 3.3.4 Test Setup





### **3.3.5 Test Deviation**

There is no deviation with the original standard.

### **3.3.6 EUT Operation during Test**

The EUT was programmed to be in continuously transmitting mode.

### **3.3.7 Test Result of Unwanted Emission Intensity**

Please refer to Appendix B.



### 3.4 RF Output Power / Tolerance

#### 3.4.1 Limit

| Item                  | Limits   |
|-----------------------|--|
| Antenna Power Density | $\leq 10\text{mW/MHz}$ (OFDM,DS from 2400~2483.5MHz)<br>$\leq 10\text{mW}$ (Other from 2400~2483.5MHz) |
| Antenna Power Error   | +20%, -80% (Base on manufacturer declare antenna power density)  |

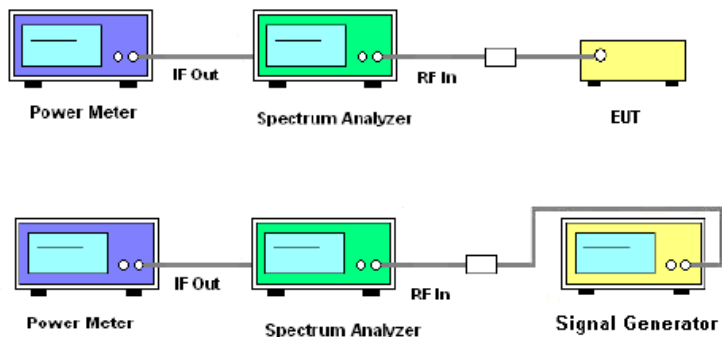
#### 3.4.2 Measuring Instruments

See list of measuring instruments of this test report.

#### 3.4.3 Test Procedures

1. A power meter is connected on the IF output port of the spectrum analyzer.
2. Adjust the spectrum analyzer to have the center frequency the same with the measured carrier.  
RBW=VBW=1MHz, detector mode is positive peak. Turn off the averaging function and use zero span.
3. The calibrating signal power shall be reduced to 0 dBm and it shall be verified that the power meter reading also reduces by 10 dB.
4. Connect the equipment to be measured. Using the following settings of the spectrum analyzer in combination with "max hold" function, find the frequency of highest power output in the power envelope: center frequency equal to operating frequency; RBW & VBW: 1 MHz; detector mode: positive peak; averaging: off; span: 3 times the spectrum width; amplitude: adjust for middle of the instrument's range. The frequency found shall be recorded.
5. Set the center frequency of the spectrum analyzer to the found frequency and switch to zero span. The power meter indicates the measured power density "E".
6. Remove the EUT and put the replacing standard signal generator (SSG). Set the standard signal generator (SSG) at same frequency and transmit on, then set SSG output power at  $P_t$  to give the equivalent output level of "E".
7. Calculate antenna power density by the formula below  $PD = P_t + 10 \cdot \log(1/x)$ .  
x: The duty cycle of the EUT in continuously transmitting mode  
 $P_t$ : Output power of the SSG
8. Antenna Power Error is definition that actual measure antenna power tolerance between + 20% to - 80% power range that base on manufacturer declare the conducted power density.

### 3.4.4 Test Setup



### 3.4.5 Test Deviation

There is no deviation with the original standard.

### 3.4.6 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

### 3.4.7 Test Result of RF Output Power / Tolerance

Please refer to Appendix B.

### 3.5 Limitation of Collateral Emission of Receiver Measurement

#### 3.5.1 Limit

| Item                 | Limits                                      |
|----------------------|---|
| Rx Spurious Emission | $\leq 4\text{nW}$ ( $f < 1\text{GHz}$ )     |
|                      | $\leq 20\text{nW}$ ( $1\text{GHz} \leq f$ ) |

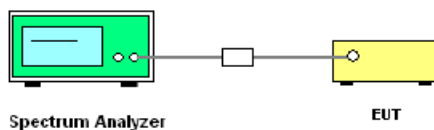
#### 3.5.2 Measuring Instruments

See list of measuring instruments of this test report.

#### 3.5.3 Test Procedures

1. EUT have the continuous reception mode and fixed only one channelize.
2. SA set RBW: 100KHz and VBW: 100KHz. Then adjust to start frequency 30MHz and stop frequency 1000MHz. Search to mark peak reading value + cable loss shall be less than 4nW.
3. SA set RBW: 1MHz and VBW: 1MHz. Then adjust to start frequency 1000MHz and stop frequency 12500MHz. Search to mark peak reading value + cable loss shall be less than 20nW.
4. If power level of lower emissions are more than 1/10 of limit (.0.4nW for  $f < 1\text{GHz}$ , 2nW for  $f \geq 1\text{GHz}$ ), all those are to be indicated in the 2nd and 3rd lines. If others are 1/10 or less more of the limit, no necessary to be indicated.

#### 3.5.4 Test Setup





### **3.5.5 Test Deviation**

There is no deviation with the original standard.

### **3.5.6 EUT Operation during Test**

The EUT was programmed to be in continuously reception mode.

### **3.5.7 Test Result of Limitation of Collateral Emission of Receiver**

Please refer to Appendix B.

## 3.6 Transmission Antenna Gain (EIRP Antenna Power) Measurement

### 3.6.1 Limit

| Item  | Limits   |
|---|--|
| EIRP Power Density  | $\leq 12.14\text{dBm/MHz}$ (OFDM,DS from 2400~2483.5MHz) |
|   | $\leq 12.14\text{dBm}$ (Other from 2400~2483.5MHz)       |
| Remark: This test item will not be applied to EIRP power of EUT is lower than 12.14dBm/MHz. |  |

### 3.6.2 Measuring Instruments

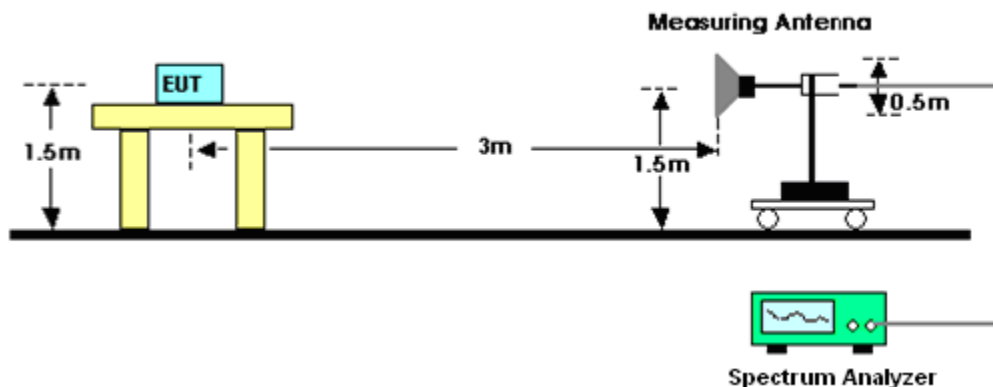
See list of measuring instruments of this test report.

### 3.6.3 Test Procedures

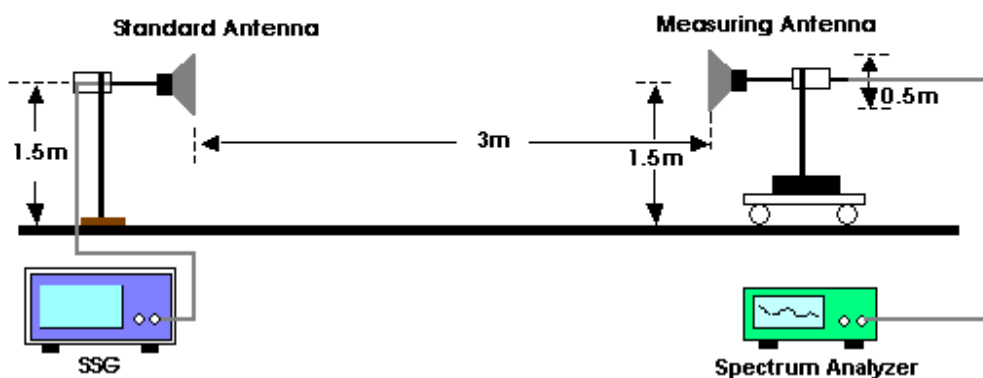
1. Set EUT and measuring antenna at the same height and roughly facing each other.
2. Move the measuring antenna height up and down within  $\pm 50\text{cm}$  of EUT height and swing it to find the maximum output of the measuring antenna. The output level at the spectrum analyzer is read as "E".
3. Remove the EUT from the turn table and put the replacing antenna facing to measuring antenna at same height. Set the standard signal generator (SSG) at same frequency and transmit on then receive the signal.
4. Swing the replacing antenna give a maximum receiving level.
5. Move the measuring antenna height up and down within  $\pm 50\text{cm}$  of replacing antenna height and swing it to find the maximum receiving level.
6. Set SSG output power at  $P_t$  to give the equivalent output level of "E" or calculate  $P_t$  with SSG output which gives the nearest of "E" and difference ( $\pm 1\text{dB}$ ). Record the  $P_t$ .
7. Calculate EIRP by the formula below  $\text{EIRP} = G_t - L + P_t$ .  
Gt: gain of replacing antenna (dBi)  
L: feeder loss between SSG and replacing antenna  
Pt: Output power of the SSG
8. If the antenna for the EUT has circular polarization, sum of V-field and H-field will be result if measuring antenna is linear polarization.

### 3.6.4 Test Setup

<For EUT radiation measurement>



<For standard antenna measurement>



### 3.6.5 Test Deviation

There is no deviation with the original standard.

### 3.6.6 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

### 3.6.7 Test Result of Transmission Antenna Gain (EIRP Antenna Power)

Please refer to Appendix B.

For the antenna gain, please refer to antenna test report.

**Remark: This test item will not be applied to EIRP power of EUT is lower than 12.14dBm/MHz.**

### 3.7 Transmission Radiation Angle Width (3dB Beamwidth) Measurement

#### 3.7.1 Limit

| Item  | Limits  |
|---|---|
| 3dB antenna beamwidth   | $360/A$ (If $A < 1$ ; then $A = 1$ )<br>$A = \{ \text{EIRP Power [dBm/MHz]} - 12.14 \text{ [dBm/MHz]} \text{ for DS, OFDM} \}$ or<br>$\{ \text{E.I.R.P Power [dBm/MHz]} - 6.91 \text{ [dBm/MHz]} \text{ for FH} \}$ |
| Remark: This test item will not be applied to EIRP power of EUT is lower than 12.14dBm/MHz. |   |

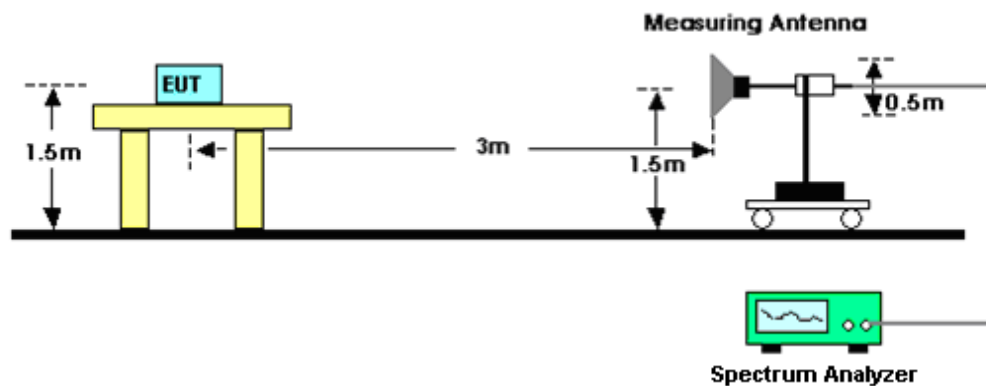
#### 3.7.2 Measuring Instruments

See list of measuring instruments of this test report.

#### 3.7.3 Test Procedures

1. Set EUT and measuring antenna at the same height and roughly facing each other.
2. Set spectrum analyzer with condition in section 3.7.2 and tune reference level to observe receiving signal position.
3. Rotate directions of the EUT horizontally and vertically to find the maximum receiving power.
4. Move the measuring antenna height up and down within  $\pm 50\text{cm}$  of EUT height and swing it to find the maximum output of measuring antenna. The output level at the spectrum analyzer is read as "E".
5. Calculate permitted radiation angle in horizontal and vertical using EIRP measured in another test method.
6. Calculate 3dB antenna beam width by the formula below  $360/A$  (If  $A < 1$ ; then  $A=1$ ).  
 $A = \{ \text{EIRP Power [dBm/MHz]} - 12.14 \text{ [dBm/MHz]} \text{ for DS, OFDM} \}$  or  
 $A = \{ \text{E.I.R.P Power [dBm/MHz]} - 6.91 \text{ [dBm/MHz]} \text{ for FH} \}$

### 3.7.4 Test Setup



### 3.7.5 Test Deviation

There is no deviation with the original standard.

### 3.7.6 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

### 3.7.7 Test Result of Transmission Radiation Angle Width (3dB Beamwidth)

Please refer to Appendix B.

For the antenna gain, please refer to antenna test report.

**Remark: This test item will not be applied to EIRP power of EUT is lower than 12.14dBm/MHz.**



## 3.8 Radio Interference Prevention Capability Measurement

### 3.8.1 Limit

| Item                | Limits    |
|---------------------|-----------|
| Identification code | ≥ 48 bits |

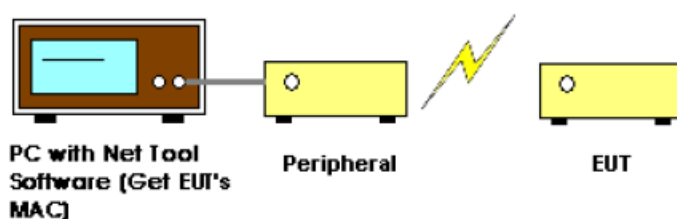
### 3.8.2 Measuring Instruments

See list of measuring instruments of this test report.

### 3.8.3 Test Procedures

1. In the case that the EUT has the function of automatically transmitting the identification code: a. Transmit the predetermined identification codes form EUT. b. Check the transmitted identification codes with the demodulator.
2. In the case of receiving the identification code: a. Transmit the predetermined identification codes form the counterpart. b . Check if communication is normal. c. Transmit the signals other than predetermined ID codes form the counterpart. d. check if the EUT stops the transmission, or if it displays that identification codes are different from the predetermined ones.

### 3.8.4 Test Setup



### 3.8.5 Test Deviation

There is no deviation with the original standard.

### 3.8.6 EUT Operation during Test

The EUT was programmed to be in normal transmitting mode.

### 3.8.7 Test Result of Radio Interference Prevention Capability

Please refer to Appendix B.

## 3.9 Carrier Sense

### 3.9.1 Limit

The radio equipment connected to telecommunication circuit equipment shall be equipped with a device which detects emissions radiated from another radio station and prevents interference, or a device which prevents interference by operation on a receive signal and a signal for diffusion for signal level detection.

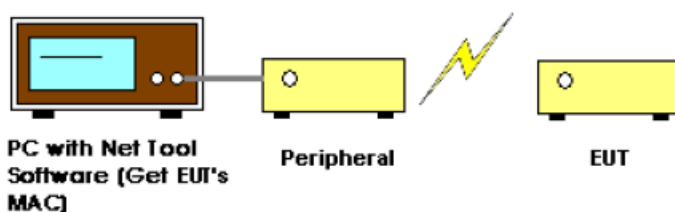
### 3.9.2 Measuring Instruments

See list of measuring instruments of this test report.

### 3.9.3 Test Procedures

1. Set the EUT link with a peripheral, access point 802.11n-HT40
2. Set a signal generator (simulate a radio device which co-exists with EUT) at same frequency channel with a proper signal level (exceeding 100mV/m) output to act as interference signal.
3. Monitor the signal transmission between the EUT and peripheral, while the interference signal presents. The EUT would stop transmitting once it detects interference signal over the air, then record it pass, otherwise, the result is fail.

### 3.9.4 Test Setup



### 3.9.5 Test Deviation

There is no deviation with the original standard.

### 3.9.6 EUT Operation during Test

The EUT was programmed to be in normal transmitting mode.

### 3.9.7 Test Result of Carrier Sense

Not Applicable.

### 3.10 Construction Protection Confirmation Method

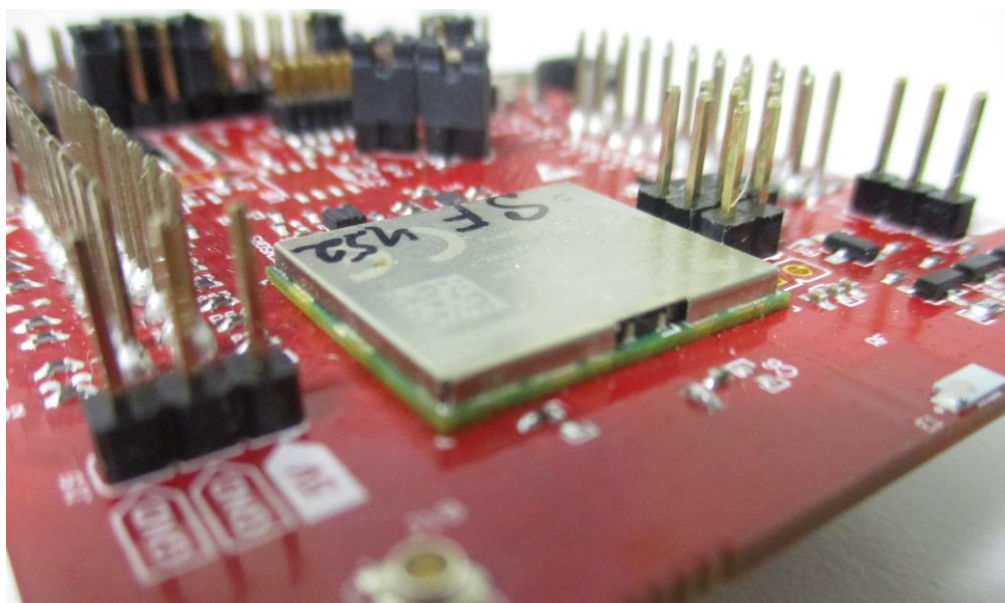
#### 3.10.1 Limit

The high-frequency section and modulation section of the radio equipment except for the antenna system shall not be capable of being opened easily.

#### 3.10.2 Confirmation Method

|                                     |  |
|-------------------------------------|--|
| <input type="checkbox"/>            | Sealed with special screws.  |
| <input type="checkbox"/>            | Plastic chassis is being welded using ultrasonic waves.  |
| <input type="checkbox"/>            | Chassis is glued using a special adhesive.   |
| <input type="checkbox"/>            | Metal covers are spot-fused.   |
| <input type="checkbox"/>            | Cover is specially interlocked.  |
| <input checked="" type="checkbox"/> | RF and Modulation components are covered with shielding case and this shielding case is soldered.              |
| <input type="checkbox"/>            | Shield case is welded at RF and modulation parts, and ID-ROM is welded using the BGA Method.                   |
| <input type="checkbox"/>            | Shield case is welded at RF and modulation parts, and ID-ROM is glued at its lead with a special adhesive.     |
| <input type="checkbox"/>            | Shield case is welded at RF and modulation parts, and ID-ROM is glued with a non-transparent laminating agent. |
| <input type="checkbox"/>            | Other :  |

#### 3.10.3 The Photos of Construction Protection



## 4 List of Measuring Equipment

| Instrument                | Manufacturer    | Model No. | Serial No. | Calibration Date | Test Periods                   | Due Date      | Calibration Body | Calibration Method |
|---------------------------|-----------------|-----------|------------|------------------|--------------------------------|---------------|------------------|--------------------|
| Spectrum Analyzer         | Rohde & Schwarz | FSV 40    | 101397     | Nov. 04, 2016    | Apr. 20, 2017~<br>May 26, 2017 | Nov. 03, 2017 | Rohde & Schwarz  | C                  |
| Signal Generator          | Agilent         | E4438C    | MY49070755 | Sep. 30, 2016    | Apr. 20, 2017~<br>May 26, 2017 | Sep. 29, 2017 | ETC , R.O.C      | C                  |
| Power Meter               | Anritsu         | ML2495A   | 1132003    | Aug. 04, 2016    | Apr. 20, 2017~<br>May 26, 2017 | Aug. 03, 2017 | ETC, R.O.C       | C                  |
| Power Sensor              | Anritsu         | MA2411B   | 1126017    | Aug. 04, 2016    | Apr. 20, 2017~<br>May 26, 2017 | Aug. 03, 2017 | ETC, R.O.C       | C                  |
| Programmable Power Supply | GW Instek       | PSS-2005  | EL890001   | Oct. 03, 2016    | Apr. 20, 2017~<br>May 26, 2017 | Oct. 02, 2017 | GW Instek        | C                  |
| Multimeter                | YFE             | YF-303    | 1317530    | Jan. 05, 2017    | Apr. 20, 2017~<br>May 26, 2017 | Jan. 04, 2018 | ETC , R.O.C      | C                  |

Note: Above test equipment was used and kept valid calibration period during test.

### Calibration Method :

**a)** : Calibration conducted by the National Institute of Information and Communications Technology~  
NICT~ or a designated calibration agency under Article 102-18 paragraph

(1) TELEC Engineering Center, Intertek Japan K.K., Keysight Technologies, Inc~.

**b)** : Correction conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Law (Law No. 51 of 1992)~Japan Calibration Service System~

**c)** : Calibration conducted in foreign countries, which shall be equivalent to the calibration conducted by the NICT or a designated calibration agency under Article 102-18 paragraph

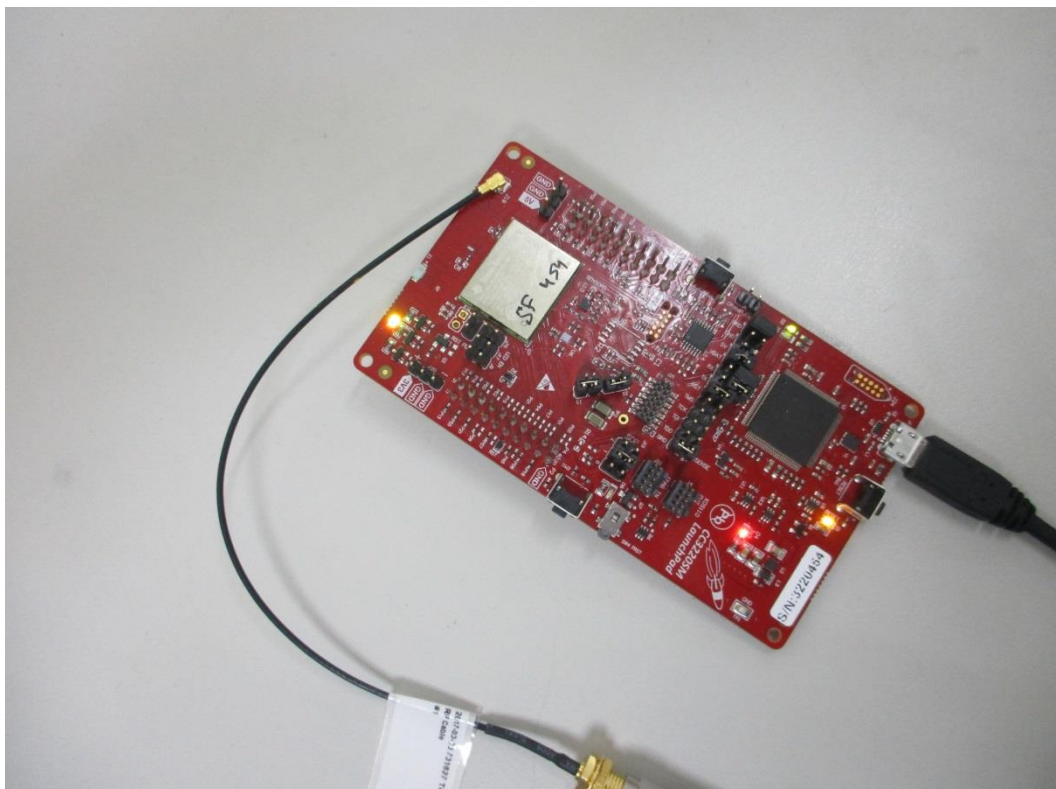
(1)~ TELEC Engineering Center, Intertek Japan K.K., Keysight Technologies, Inc~.

## Appendix A. Setup Photographs

Front View



Near View





## **Appendix B. Test Results**

Please refer to the following pages for test results.



# **1. TEST RESULTS DATA** **WLAN 2.4G Band - 802.11b**

|                          |             |          |
|--------------------------|-------------|----------|
| Environment of Test Room | Temperature | 22~24 °C |
|                          | Humidity    | 51~53 %  |
| Test Engineer            | Kenny Chen  |          |

|                    |         |
|--------------------|---------|
| Modulatoion Type : | DS      |
| Type Emissions :   | 14M2G1D |

|                          |               |                |
|--------------------------|---------------|----------------|
| Peak Antenna Gain        | 5.50          | dBi            |
| Declaration Output Power | 3.50          | mW/MHz         |
| Declaration Output Power | 5.441         | dBm/MHz        |
| <b>E.I.R.P</b>           | <b>10.941</b> | <b>dBm/MHz</b> |
| Input Power Voltage      | 3.30          | VDC            |

|                |             |
|----------------|-------------|
| Antenna System | <b>SISO</b> |
|----------------|-------------|

| Antenna | No. | Type   | Gain |
|---------|-----|--------|------|
|         | 1   | Dipole | 5.50 |
|         | 2   | ---    | ---  |
|         | 3   | ---    | ---  |

|                               |          |             |
|-------------------------------|----------|-------------|
| Tested Circuit Insertion Loss | 24.1     | dB          |
| Burst                         | ON TIME  | 10.580 msec |
|                               | OFF TIME | 21.449 msec |
|                               | Ratio    | 33.033 %    |
| Packet Type (Mode)            | 1Mbps    | mode        |

|   |       |
|---|-------|
| Frequency equal to the transmission rate of the modulation signal (11Mbps mode) | 1.375 |
|---|-------|

Test Category : 2.4GHz Band Wideband Low-Power Data Communication System

Comprehensive operation test

Use the DC Power Supply to adjust voltage.

## **1.1. TEST Results (Normal Voltage)**

|  |        |          |          |          |            |             |
|--|--------|----------|----------|----------|------------|-------------|
| Measurement Frequency                      | MHz    | 2412     | 2442     | 2472     | Regulation | Result      |
| Channel Number                             | Ch.    | 1        | 7        | 13       | -----      | -----       |
| Reading Frequency (TX1)                    | MHz    | 2411.987 | 2441.985 | 2471.984 | -----      | -----       |
| Frequency Tolerance (TX1)                  | ppm    | -5.3897  | -6.1425  | -6.4725  | 50         | <b>PASS</b> |
| Reading Frequency (TX2)                    | MHz    | -----    | -----    | -----    | -----      | -----       |
| Frequency Tolerance (TX2)                  | ppm    | -----    | -----    | -----    | -----      | -----       |
| Reading Frequency (TX3)                    | MHz    | -----    | -----    | -----    | -----      | -----       |
| Frequency Tolerance (TX3)                  | ppm    | -----    | -----    | -----    | -----      | -----       |
| Occupied Bandwidth (TX1)                   | MHz    | 14.11    | 14.18    | 14.11    | 26         | <b>PASS</b> |
| Spread Bandwidth (TX1)                     | MHz    | 9.77     | 9.77     | 9.84     | 0.5        | <b>PASS</b> |
| Occupied Bandwidth (TX2)                   | MHz    | -----    | -----    | -----    | -----      | -----       |
| Spread Bandwidth (TX2)                     | MHz    | -----    | -----    | -----    | -----      | -----       |
| Occupied Bandwidth (TX3)                   | MHz    | -----    | -----    | -----    | -----      | -----       |
| Spread Bandwidth (TX3)                     | MHz    | -----    | -----    | -----    | -----      | -----       |
| RF Output Power (TX1)                      | mW/MHz | 2.919    | 3.001    | 2.906    | -----      | -----       |
| RF Output Power (TX2)                      | mW/MHz | -----    | -----    | -----    | -----      | -----       |
| RF Output Power (TX3)                      | mW/MHz | -----    | -----    | -----    | -----      | -----       |
| RF Output Power (Max)                      | mW/MHz | 2.919    | 3.001    | 2.906    | 10.00      | <b>PASS</b> |
| RF Output Power Tolerance Max(TX1,TX2,TX3) | %      | -16.59   | -14.26   | -16.98   | 20%~80%    | <b>PASS</b> |
| Real Total Output Power (TX1)              | dBm    | 14.01    | 14.26    | 13.94    | -----      | -----       |
| Real Total Output Power (TX2)              | dBm    | -----    | -----    | -----    | -----      | -----       |
| Real Total Output Power (TX3)              | dBm    | -----    | -----    | -----    | -----      | -----       |
| Real Total Output Power (Max)              | dBm    | 14.01    | 14.26    | 13.94    | -----      | -----       |

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**1.1. TEST Results (Normal Voltage)**

| Measurement Frequency  |                   | MHz    | 2412     | 2442     | 2472     | Regulation | Result |
|--|-------------------|--------|----------|----------|----------|------------|--------|
| Channel Number   |                   | Ch.    | 1        | 7        | 13       | -----      | -----  |
| Unwanted Emission Strength (TX1) for Ch1 ~13   | Under 2387MHz     | μW/MHz | 0.039446 | 0.041591 | 0.045920 | 2.5        | PASS   |
|  |                   | MHz    | 763.877  | 2359.620 | 2374.870 | -----      | -----  |
|  | 2387-2400MHz      | μW/MHz | 0.170216 | 0.043954 | 0.065163 | 25         | PASS   |
|  |                   | MHz    | 2397.508 | 2388.913 | 2395.241 | -----      | -----  |
|  | 2483.5-2496.5MHz  | μW/MHz | 0.072277 | 0.055976 | 0.287078 | 25         | PASS   |
|  |                   | MHz    | 2490.877 | 2491.221 | 2487.343 | -----      | -----  |
|  | 2496.5MHz-12.5GHz | μW/MHz | 0.049204 | 0.054702 | 0.054576 | 2.5        | PASS   |
|  |                   | MHz    | 6881.096 | 6970.118 | 6813.079 | -----      | -----  |
| Unwanted Emission Strength (TX2) for Ch1 ~13   | Under 2387MHz     | μW/MHz | -----    | -----    | -----    | -----      | -----  |
|  |                   | MHz    | -----    | -----    | -----    | -----      | -----  |
|  | 2387-2400MHz      | μW/MHz | -----    | -----    | -----    | -----      | -----  |
|  |                   | MHz    | -----    | -----    | -----    | -----      | -----  |
|  | 2483.5-2496.5MHz  | μW/MHz | -----    | -----    | -----    | -----      | -----  |
|  |                   | MHz    | -----    | -----    | -----    | -----      | -----  |
|  | 2496.5MHz-12.5GHz | μW/MHz | -----    | -----    | -----    | -----      | -----  |
|  |                   | MHz    | -----    | -----    | -----    | -----      | -----  |
| Unwanted Emission Strength (TX3) for Ch1 ~13   | Under 2387MHz     | μW/MHz | -----    | -----    | -----    | -----      | -----  |
|  |                   | MHz    | -----    | -----    | -----    | -----      | -----  |
|  | 2387-2400MHz      | μW/MHz | -----    | -----    | -----    | -----      | -----  |
|  |                   | MHz    | -----    | -----    | -----    | -----      | -----  |
|  | 2483.5-2496.5MHz  | μW/MHz | -----    | -----    | -----    | -----      | -----  |
|  |                   | MHz    | -----    | -----    | -----    | -----      | -----  |
|  | 2496.5MHz-12.5GHz | μW/MHz | -----    | -----    | -----    | -----      | -----  |
|  |                   | MHz    | -----    | -----    | -----    | -----      | -----  |
| Unwanted Emission Strength (TX1+2) or (TX1+2+3) for Ch1 ~13  | Under 2387MHz     | μW/MHz | -----    | -----    | -----    | -----      | -----  |
|  |                   | MHz    | -----    | -----    | -----    | -----      | -----  |
|  | 2387-2400MHz      | μW/MHz | -----    | -----    | -----    | -----      | -----  |
|  |                   | MHz    | -----    | -----    | -----    | -----      | -----  |
|  | 2483.5-2496.5MHz  | μW/MHz | -----    | -----    | -----    | -----      | -----  |
|  |                   | MHz    | -----    | -----    | -----    | -----      | -----  |
|  | 2496.5MHz-12.5GHz | μW/MHz | -----    | -----    | -----    | -----      | -----  |
|  |                   | MHz    | -----    | -----    | -----    | -----      | -----  |
| It should be added up all spurious measurement values within "Reference Bandwidth(=1MHz)" of the same frequency. |                   |        |          |          |          |            |        |
| Secondarily Emitted Radio Wave Strength (RX Spurious) (RX1)  | Under 1GHz        | nW     | 0.021038 | 0.023933 | 0.024044 | 4          | PASS   |
|  |                   | MHz    | 372.909  | 883.660  | 769.115  | -----      | -----  |
|  | 1 - 12.5GHz       | nW     | 0.294442 | 0.322107 | 0.314775 | 20         | PASS   |
|  |                   | MHz    | 6638.843 | 6880.322 | 6651.300 | -----      | -----  |
| Secondarily Emitted Radio Wave Strength (RX Spurious) (RX2)  | Under 1GHz        | nW     | -----    | -----    | -----    | -----      | -----  |
|  |                   | MHz    | -----    | -----    | -----    | -----      | -----  |
|  | 1 - 12.5GHz       | nW     | -----    | -----    | -----    | -----      | -----  |
|  |                   | MHz    | -----    | -----    | -----    | -----      | -----  |
| Secondarily Emitted Radio Wave Strength (RX Spurious) (RX3)  | Under 1GHz        | nW     | -----    | -----    | -----    | -----      | -----  |
|  |                   | MHz    | -----    | -----    | -----    | -----      | -----  |
|  | 1 - 12.5GHz       | nW     | -----    | -----    | -----    | -----      | -----  |
|  |                   | MHz    | -----    | -----    | -----    | -----      | -----  |
| Secondarily Emitted Radio Wave Strength (RX Spurious) (RX1+2) or (RX1+2+3)                                       | Under 1GHz        | nW     | -----    | -----    | -----    | -----      | -----  |
|  |                   |        |          |          |          | -----      | -----  |
|  | 1 - 12.5GHz       | nW     | -----    | -----    | -----    | -----      | -----  |
|  |                   |        |          |          |          | -----      | -----  |
| It should be added up all spurious measurement values within "Reference Bandwidth(=1MHz)" of the same frequency. |                   |        |          |          |          |            |        |
| Spread Factor  |                   | -----  | 7.10     | 7.10     | 7.16     | 5          | PASS   |
| Interference Prevention Function   |                   | -----  | good     |          |          | -----      | PASS   |

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## **2. TEST RESULTS DATA**

### **WLAN 2.4G Band - 802.11g**

|                          |             |          |
|--------------------------|-------------|----------|
| Environment of Test Room | Temperature | 22~24 °C |
|                          | Humidity    | 51~53 %  |
| Test Engineer            | Kenny Chen  |          |

|                   |             |
|-------------------|-------------|
| Modulation Type : | OFDM        |
| Type Emissions :  | 16M9G1D/D1D |

|                          |              |                |
|--------------------------|--------------|----------------|
| Peak Antenna Gain        | 5.50         | dBi            |
| Declaration Output Power | 2.50         | mW/MHz         |
| Declaration Output Power | 3.979        | dBm/MHz        |
| <b>E.I.R.P</b>           | <b>9.479</b> | <b>dBm/MHz</b> |
| Input Power Voltage      | 3.30         | VDC            |

|                |             |
|----------------|-------------|
| Antenna System | <b>SISO</b> |
|----------------|-------------|

| Antenna | No. | Type   | Gain |
|---------|-----|--------|------|
|         | 1   | Dipole | 5.50 |
|         | 2   | ---    | ---  |
|         | 3   | ---    | ---  |

|                               |          |        |      |
|-------------------------------|----------|--------|------|
| Tested Circuit Insertion Loss |          | 24.1   | dB   |
| Burst                         | ON TIME  | 1.884  | msec |
|                               | OFF TIME | 18.116 | msec |
|                               | Ratio    | 9.420  | %    |
| Packet Type (Mode)            |          | 6Mbps  | mode |

Test Category : 2.4GHz Band Wideband Low-Power Data Communication System

Comprehensive operation test

Use the DC Power Supply to adjust voltage.

### **2.1. TEST Results (Normal Voltage)**

|  |        |          |          |          |            |             |
|--|--------|----------|----------|----------|------------|-------------|
| Measurement Frequency                      | MHz    | 2412     | 2442     | 2472     | Regulation | Result      |
| Channel Number                             | Ch.    | 1        | 7        | 13       | -----      | -----       |
| Reading Frequency (TX1)                    | MHz    | 2411.986 | 2441.986 | 2471.984 | -----      | -----       |
| Frequency Tolerance (TX1)                  | ppm    | -5.8043  | -5.7330  | -6.4725  | 50         | <b>PASS</b> |
| Reading Frequency (TX2)                    | MHz    | -----    | -----    | -----    | -----      | -----       |
| Frequency Tolerance (TX2)                  | ppm    | -----    | -----    | -----    | -----      | -----       |
| Reading Frequency (TX3)                    | MHz    | -----    | -----    | -----    | -----      | -----       |
| Frequency Tolerance (TX3)                  | ppm    | -----    | -----    | -----    | -----      | -----       |
| Occupied Bandwidth (TX1)                   | MHz    | 16.57    | 16.64    | 16.93    | 26         | <b>PASS</b> |
| Occupied Bandwidth (TX2)                   | MHz    | -----    | -----    | -----    | -----      | -----       |
| Occupied Bandwidth (TX3)                   | MHz    | -----    | -----    | -----    | -----      | -----       |
| RF Output Power (TX1)                      | mW/MHz | 2.476    | 2.546    | 2.471    | -----      | -----       |
| RF Output Power (TX2)                      | mW/MHz | -----    | -----    | -----    | -----      | -----       |
| RF Output Power (TX3)                      | mW/MHz | -----    | -----    | -----    | -----      | -----       |
| RF Output Power (Max)                      | mW/MHz | 2.476    | 2.546    | 2.471    | 10.00      | <b>PASS</b> |
| RF Output Power Tolerance Max(TX1,TX2,TX3) | %      | -0.95    | 1.83     | -1.18    | 20%~80%    | <b>PASS</b> |
| Real Total Output Power (TX1)              | dBm    | 15.53    | 15.15    | 15.04    | -----      | -----       |
| Real Total Output Power (TX2)              | dBm    | -----    | -----    | -----    | -----      | -----       |
| Real Total Output Power (TX3)              | dBm    | -----    | -----    | -----    | -----      | -----       |
| Real Total Output Power (Max)              | dBm    | 15.53    | 15.15    | 15.04    | -----      | -----       |

**2.1. TEST Results (Normal Voltage)**

| Measurement Frequency  |                  | MHz         | 2412     | 2442     | 2472     | Regulation | Result |
|--|------------------|-------------|----------|----------|----------|------------|--------|
| Channel Number   |                  | Ch.         | 1        | 7        | 13       | ----       | ----   |
| Unwanted Emission Strength (TX1) for Ch1 ~13   | Under 2387MHz    | μW/MHz      | 0.179061 | 0.048641 | 0.066069 | 2.5        | PASS   |
|  |                  | MHz         | 2386.653 | 2357.541 | 2373.484 | ----       | ----   |
|  | 2387-2400MHz     | μW/MHz      | 4.064433 | 0.070307 | 0.091411 | 25         | PASS   |
|  |                  | MHz         | 2399.893 | 2399.769 | 2398.386 | ----       | ----   |
|  | 2483.5-2496.5MHz | μW/MHz      | 0.118850 | 0.060814 | 3.630781 | 25         | PASS   |
|  |                  | MHz         | 2489.857 | 2492.534 | 2483.711 | ----       | ----   |
| 2496.5MHz-12.5GHz  | μW/MHz           | 0.046345    | 0.048306 | 0.144544 | 2.5      | PASS       |        |
|  | MHz              | 6752.064    | 6585.022 | 2497.000 | ----     | ----       |        |
| Unwanted Emission Strength (TX2) for Ch1 ~ 13  | Under 2387MHz    | μW/MHz      | ----     | ----     | ----     | ----       | ----   |
|  |                  | MHz         | ----     | ----     | ----     | ----       | ----   |
|  | 2387-2400MHz     | μW/MHz      | ----     | ----     | ----     | ----       | ----   |
|  |                  | MHz         | ----     | ----     | ----     | ----       | ----   |
|  | 2483.5-2496.5MHz | μW/MHz      | ----     | ----     | ----     | ----       | ----   |
|  |                  | MHz         | ----     | ----     | ----     | ----       | ----   |
| 2496.5MHz-12.5GHz  | μW/MHz           | ----        | ----     | ----     | ----     | ----       |        |
|  | MHz              | ----        | ----     | ----     | ----     | ----       |        |
| Unwanted Emission Strength (TX3) for Ch1 ~ 13  | Under 2387MHz    | μW/MHz      | ----     | ----     | ----     | ----       | ----   |
|  |                  | MHz         | ----     | ----     | ----     | ----       | ----   |
|  | 2387-2400MHz     | μW/MHz      | ----     | ----     | ----     | ----       | ----   |
|  |                  | MHz         | ----     | ----     | ----     | ----       | ----   |
|  | 2483.5-2496.5MHz | μW/MHz      | ----     | ----     | ----     | ----       | ----   |
|  |                  | MHz         | ----     | ----     | ----     | ----       | ----   |
| 2496.5MHz-12.5GHz  | μW/MHz           | ----        | ----     | ----     | ----     | ----       |        |
|  | MHz              | ----        | ----     | ----     | ----     | ----       |        |
| Unwanted Emission Strength (TX1+2) or (TX1+2+3) for Ch1 ~13  | Under 2387MHz    | μW/MHz      | ----     | ----     | ----     | ----       | ----   |
|  |                  | MHz         | ----     | ----     | ----     | ----       | ----   |
|  | 2387-2400MHz     | μW/MHz      | ----     | ----     | ----     | ----       | ----   |
|  |                  | MHz         | ----     | ----     | ----     | ----       | ----   |
|  | 2483.5-2496.5MHz | μW/MHz      | ----     | ----     | ----     | ----       | ----   |
|  |                  | MHz         | ----     | ----     | ----     | ----       | ----   |
| 2496.5MHz-12.5GHz  | μW/MHz           | ----        | ----     | ----     | ----     | ----       |        |
|  | MHz              | ----        | ----     | ----     | ----     | ----       |        |
| It should be added up all spurious measurement values within "Reference Bandwidth(=1MHz)" of the same frequency. |                  |             |          |          |          |            |        |
| Secondarily Emitted Radio Wave Strength (RX Spurious) (RX1)  | Under 1GHz       | nW          | 0.030903 | 0.020941 | 0.021928 | 4          | PASS   |
|  |                  | MHz         | 931.767  | 747.195  | 759.998  | ----       | ----   |
|  | 1 - 12.5GHz      | nW          | 0.282488 | 0.337287 | 0.281838 | 20         | PASS   |
|  |                  | MHz         | 6999.146 | 6627.344 | 6768.207 | ----       | ----   |
| Secondarily Emitted Radio Wave Strength (RX Spurious) (RX2)  | Under 1GHz       | nW          | ----     | ----     | ----     | ----       | ----   |
|  |                  | MHz         | ----     | ----     | ----     | ----       | ----   |
|  | 1 - 12.5GHz      | nW          | ----     | ----     | ----     | ----       | ----   |
|  |                  | MHz         | ----     | ----     | ----     | ----       | ----   |
| Secondarily Emitted Radio Wave Strength (RX Spurious) (RX3)  | Under 1GHz       | nW          | ----     | ----     | ----     | ----       | ----   |
|  |                  | MHz         | ----     | ----     | ----     | ----       | ----   |
|  | 1 - 12.5GHz      | nW          | ----     | ----     | ----     | ----       | ----   |
|  |                  | MHz         | ----     | ----     | ----     | ----       | ----   |
| Secondarily Emitted Radio Wave Strength (RX Spurious) (RX1+2) or (RX1+2+3)                                       | Under 1GHz       | nW          | ----     | ----     | ----     | ----       | ----   |
|  |                  | <div></div> |          |          |          | ----       | ----   |
|  | 1 - 12.5GHz      | nW          | ----     | ----     | ----     | ----       | ----   |
|  |                  | <div></div> |          |          |          | ----       | ----   |
| It should be added up all spurious measurement values within "Reference Bandwidth(=1MHz)" of the same frequency. |                  |             |          |          |          |            |        |
| Interference Prevention Function   |                  | ----        | good     |          |          | ----       | PASS   |

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### **3. TEST RESULTS DATA** **WLAN 2.4G Band - 802.11n-HT20**

|                          |             |          |
|--------------------------|-------------|----------|
| Environment of Test Room | Temperature | 22~24 °C |
|                          | Humidity    | 51~53 %  |
| Test Engineer            | Kenny Chen  |          |

|                   |             |
|-------------------|-------------|
| Modulation Type : | OFDM        |
| Type Emissions :  | 18M2G1D/D1D |

|                          |              |                |
|--------------------------|--------------|----------------|
| Peak Antenna Gain        | 5.50         | dBi            |
| Declaration Output Power | 2.50         | mW/MHz         |
| Declaration Output Power | 3.979        | dBm/MHz        |
| <b>E.I.R.P</b>           | <b>9.479</b> | <b>dBm/MHz</b> |
| Input Power Voltage      | 3.30         | VDC            |

|                |             |
|----------------|-------------|
| Antenna System | <b>SISO</b> |
|----------------|-------------|

| Antenna | No. | Type   | Gain |
|---------|-----|--------|------|
|         | 1   | Dipole | 5.50 |
|         | 2   | ---    | ---  |
|         | 3   | ---    | ---  |

|                               |          |        |      |
|-------------------------------|----------|--------|------|
| Tested Circuit Insertion Loss |          | 24.1   | dB   |
| Burst                         | ON TIME  | 1.761  | msec |
|                               | OFF TIME | 18.313 | msec |
|                               | Ratio    | 8.773  | %    |
| Packet Type (Mode)            |          | MCS0   | mode |

Test Category : 2.4GHz Band Wideband Low-Power Data Communication System

Comprehensive operation test

Use the DC Power Supply to adjust voltage.

#### **3.1. TEST Results (Normal Voltage)**

|  |        |          |          |          |            |             |
|--|--------|----------|----------|----------|------------|-------------|
| Measurement Frequency                      | MHz    | 2412     | 2442     | 2472     | Regulation | Result      |
| Channel Number                             | Ch.    | 1        | 7        | 13       | -----      | -----       |
| Reading Frequency (TX1)                    | MHz    | 2411.984 | 2441.987 | 2471.984 | -----      | -----       |
| Frequency Tolerance (TX1)                  | ppm    | -6.6335  | -5.3235  | -6.4725  | 50         | <b>PASS</b> |
| Reading Frequency (TX2)                    | MHz    | -----    | -----    | -----    | -----      | -----       |
| Frequency Tolerance (TX2)                  | ppm    | -----    | -----    | -----    | -----      | -----       |
| Reading Frequency (TX3)                    | MHz    | -----    | -----    | -----    | -----      | -----       |
| Frequency Tolerance (TX3)                  | ppm    | -----    | -----    | -----    | -----      | -----       |
| Occupied Bandwidth (TX1)                   | MHz    | 17.87    | 18.16    | 17.80    | 26         | <b>PASS</b> |
| Occupied Bandwidth (TX2)                   | MHz    | -----    | -----    | -----    | -----      | -----       |
| Occupied Bandwidth (TX3)                   | MHz    | -----    | -----    | -----    | -----      | -----       |
| RF Output Power (TX1)                      | mW/MHz | 2.221    | 2.246    | 2.076    | -----      | -----       |
| RF Output Power (TX2)                      | mW/MHz | -----    | -----    | -----    | -----      | -----       |
| RF Output Power (TX3)                      | mW/MHz | -----    | -----    | -----    | -----      | -----       |
| RF Output Power (Max)                      | mW/MHz | 2.221    | 2.246    | 2.076    | 10.00      | <b>PASS</b> |
| RF Output Power Tolerance Max(TX1,TX2,TX3) | %      | -11.17   | -10.16   | -16.96   | 20%~80%    | <b>PASS</b> |
| Real Total Output Power (TX1)              | dBm    | 15.52    | 15.16    | 14.63    | -----      | -----       |
| Real Total Output Power (TX2)              | dBm    | -----    | -----    | -----    | -----      | -----       |
| Real Total Output Power (TX3)              | dBm    | -----    | -----    | -----    | -----      | -----       |
| Real Total Output Power (Max)              | dBm    | 15.52    | 15.16    | 14.63    | -----      | -----       |

**3.1. TEST Results (Normal Voltage)**

| Measurement Frequency  |  | MHz    | 2412     | 2442     | 2472     | Regulation | Result |
|--|--|--------|----------|----------|----------|------------|--------|
| Channel Number   |  | Ch.    | 1        | 7        | 13       | ----       | ----   |
| Unwanted Emission Strength (TX1) for Ch1 ~13   | Under 2387MHz  | μW/MHz | 0.260615 | 0.055208 | 0.046559 | 2.5        | PASS   |
|  |  | MHz    | 2386.653 | 2358.234 | 2355.462 | ----       | ----   |
|  | 2387-2400MHz   | μW/MHz | 2.055891 | 0.058345 | 0.068865 | 25         | PASS   |
|  |  | MHz    | 2399.302 | 2398.282 | 2399.276 | ----       | ----   |
|  | 2483.5-2496.5MHz   | μW/MHz | 0.082414 | 0.067143 | 1.584893 | 25         | PASS   |
|  |  | MHz    | 2487.525 | 2488.850 | 2483.672 | ----       | ----   |
|  | 2496.5MHz-12.5GHz  | μW/MHz | 0.051168 | 0.052000 | 0.069663 | 2.5        | PASS   |
|  |  | MHz    | 6851.088 | 6827.082 | 2497.000 | ----       | ----   |
| Unwanted Emission Strength (TX2) for Ch1 ~ 13  | Under 2387MHz  | μW/MHz | ----     | ----     | ----     | ----       | ----   |
|  |  | MHz    | ----     | ----     | ----     | ----       | ----   |
|  | 2387-2400MHz   | μW/MHz | ----     | ----     | ----     | ----       | ----   |
|  |  | MHz    | ----     | ----     | ----     | ----       | ----   |
|  | 2483.5-2496.5MHz   | μW/MHz | ----     | ----     | ----     | ----       | ----   |
|  |  | MHz    | ----     | ----     | ----     | ----       | ----   |
|  | 2496.5MHz-12.5GHz  | μW/MHz | ----     | ----     | ----     | ----       | ----   |
|  |  | MHz    | ----     | ----     | ----     | ----       | ----   |
| Unwanted Emission Strength (TX3) for Ch1 ~ 13  | Under 2387MHz  | μW/MHz | ----     | ----     | ----     | ----       | ----   |
|  |  | MHz    | ----     | ----     | ----     | ----       | ----   |
|  | 2387-2400MHz   | μW/MHz | ----     | ----     | ----     | ----       | ----   |
|  |  | MHz    | ----     | ----     | ----     | ----       | ----   |
|  | 2483.5-2496.5MHz   | μW/MHz | ----     | ----     | ----     | ----       | ----   |
|  |  | MHz    | ----     | ----     | ----     | ----       | ----   |
|  | 2496.5MHz-12.5GHz  | μW/MHz | ----     | ----     | ----     | ----       | ----   |
|  |  | MHz    | ----     | ----     | ----     | ----       | ----   |
| Unwanted Emission Strength (TX1+2) or (TX1+2+3) for Ch1 ~13  | Under 2387MHz  | μW/MHz | ----     | ----     | ----     | ----       | ----   |
|  |  | MHz    | ----     | ----     | ----     | ----       | ----   |
|  | 2387-2400MHz   | μW/MHz | ----     | ----     | ----     | ----       | ----   |
|  |  | MHz    | ----     | ----     | ----     | ----       | ----   |
|  | 2483.5-2496.5MHz   | μW/MHz | ----     | ----     | ----     | ----       | ----   |
|  |  | MHz    | ----     | ----     | ----     | ----       | ----   |
|  | 2496.5MHz-12.5GHz  | μW/MHz | ----     | ----     | ----     | ----       | ----   |
|  |  | MHz    | ----     | ----     | ----     | ----       | ----   |
| It should be added up all spurious measurement values within "Reference Bandwidth(=1MHz)" of the same frequency. |  |        |          |          |          |            |        |
| Secondarily Emitted Radio Wave Strength (RX Spurious) (RX1)  | Under 1GHz   | nW     | 0.019320 | 0.023878 | 0.021727 | 4          | PASS   |
|  |  | MHz    | 978.129  | 668.245  | 972.018  | ----       | ----   |
|  | 1 - 12.5GHz  | nW     | 0.292415 | 0.287740 | 0.321366 | 20         | PASS   |
|  |  | MHz    | 6634.051 | 6596.679 | 6997.229 | ----       | ----   |
| Secondarily Emitted Radio Wave Strength (RX Spurious) (RX2)  | Under 1GHz   | nW     | ----     | ----     | ----     | ----       | ----   |
|  |  | MHz    | ----     | ----     | ----     | ----       | ----   |
|  | 1 - 12.5GHz  | nW     | ----     | ----     | ----     | ----       | ----   |
|  |  | MHz    | ----     | ----     | ----     | ----       | ----   |
| Secondarily Emitted Radio Wave Strength (RX Spurious) (RX3)  | Under 1GHz   | nW     | ----     | ----     | ----     | ----       | ----   |
|  |  | MHz    | ----     | ----     | ----     | ----       | ----   |
|  | 1 - 12.5GHz  | nW     | ----     | ----     | ----     | ----       | ----   |
|  |  | MHz    | ----     | ----     | ----     | ----       | ----   |
| Secondarily Emitted Radio Wave Strength (RX Spurious) (RX1+2) or (RX1+2+3)                                       | Under 1GHz   | nW     | ----     | ----     | ----     | ----       | ----   |
|  |  |        |          |          |          | ----       | ----   |
|  | 1 - 12.5GHz  | nW     | ----     | ----     | ----     | ----       | ----   |
|  |  |        |          |          |          | ----       | ----   |
|  | It should be added up all spurious measurement values within "Reference Bandwidth(=1MHz)" of the same frequency. |        |          |          |          |            |        |
| Interference Prevention Function   |  | ----   | good     |          |          | ----       | PASS   |

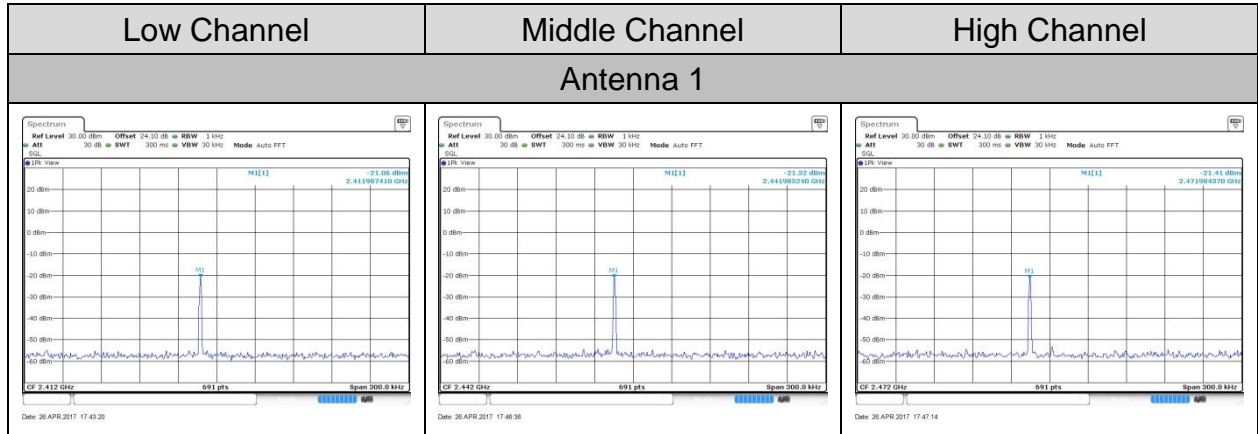
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## Appendix C. Test Plots

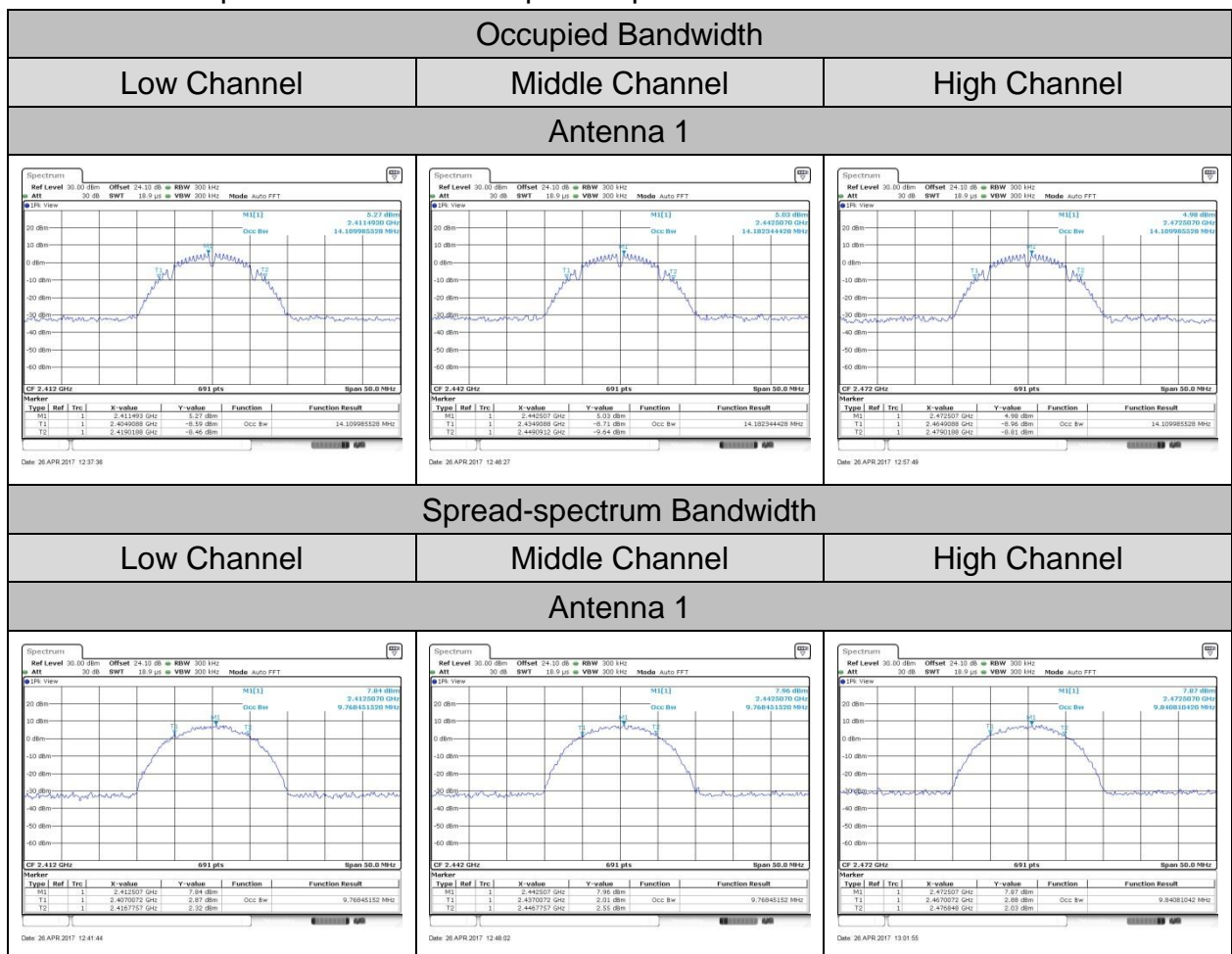
### C.1. 2.4GHz Band\_NV

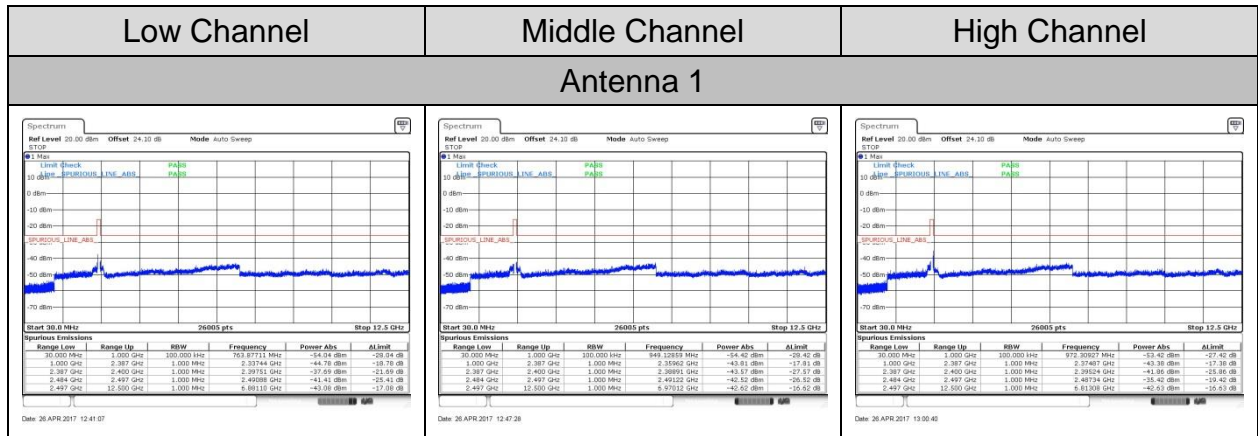
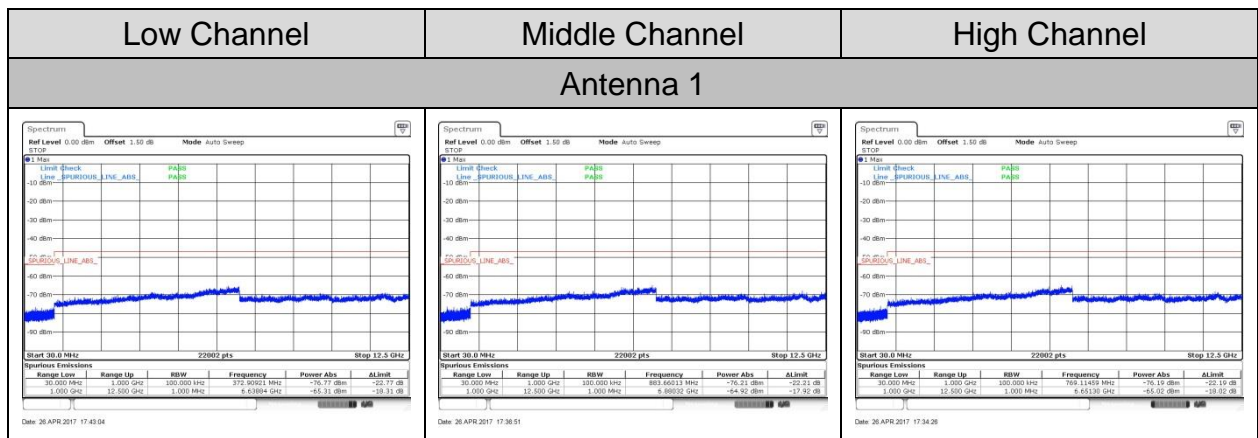
#### C.1.1. 802.11b

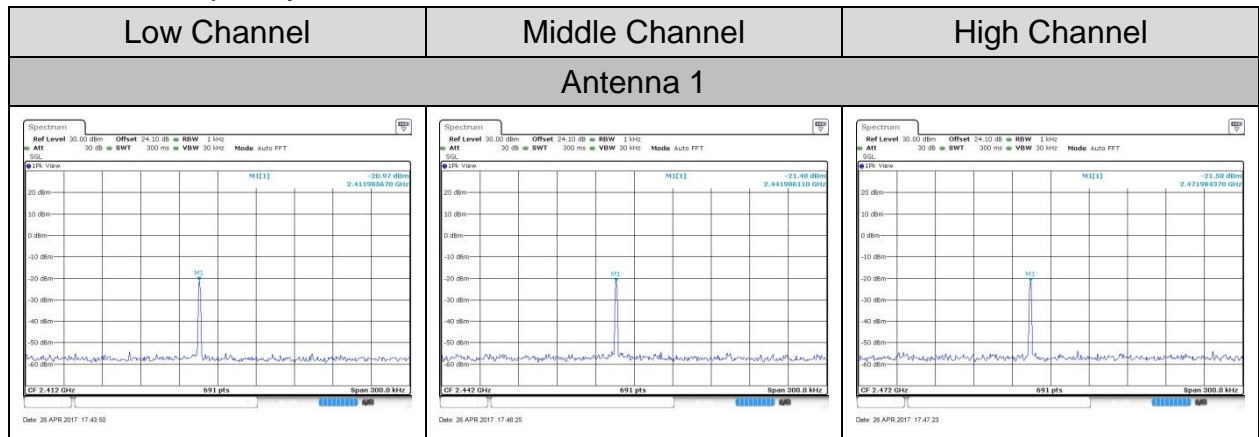
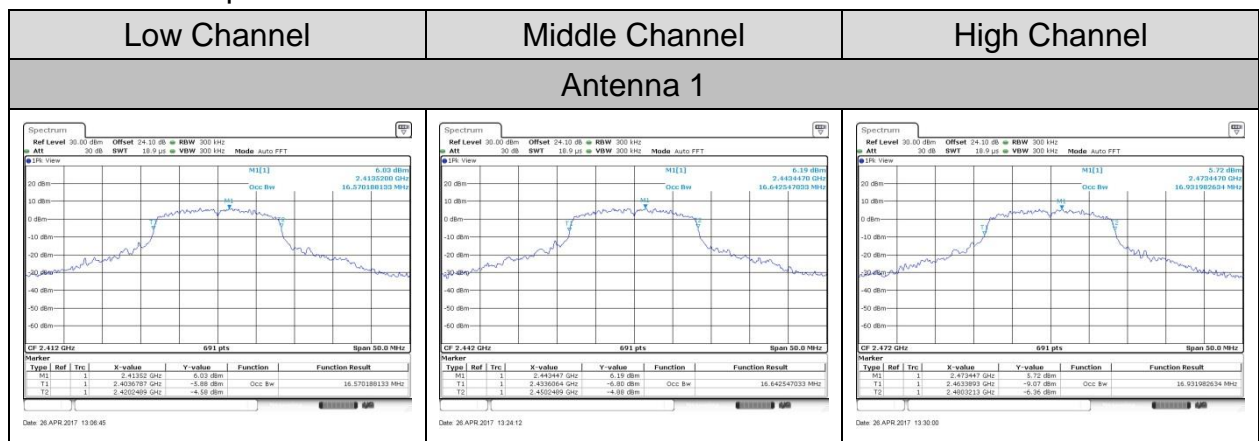
##### i. Frequency Tolerance



##### ii. Occupied Bandwidth and Spread-spectrum Bandwidth



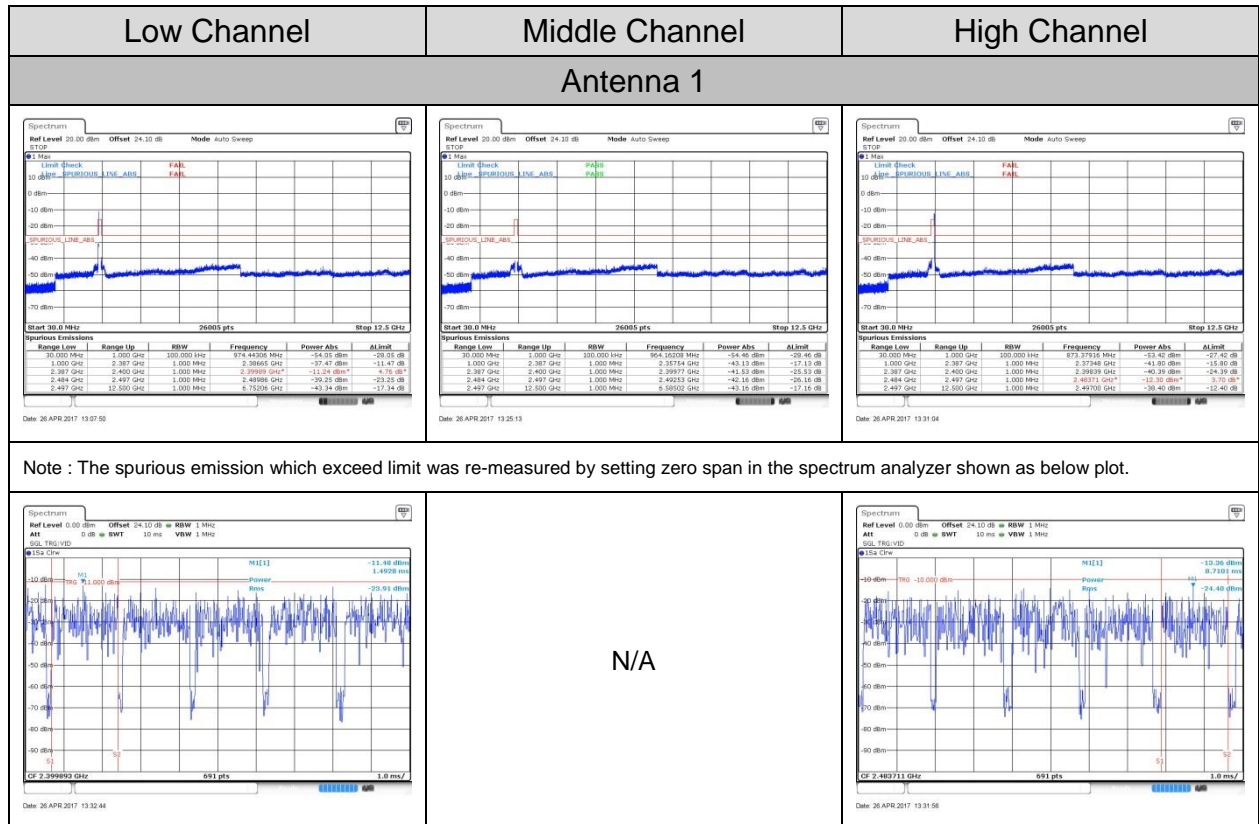
**iii. Unwanted Emission Intensity**

**iv. Limitation of Collateral Emission of Receiver**


**C.1.2. 802.11g**
**i. Frequency Tolerance**

**ii. Occupied Bandwidth**


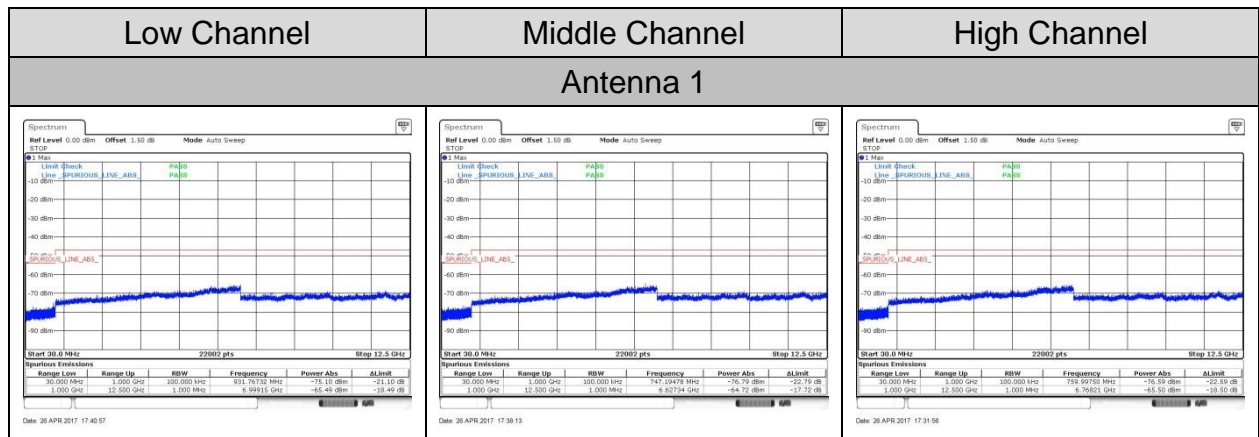




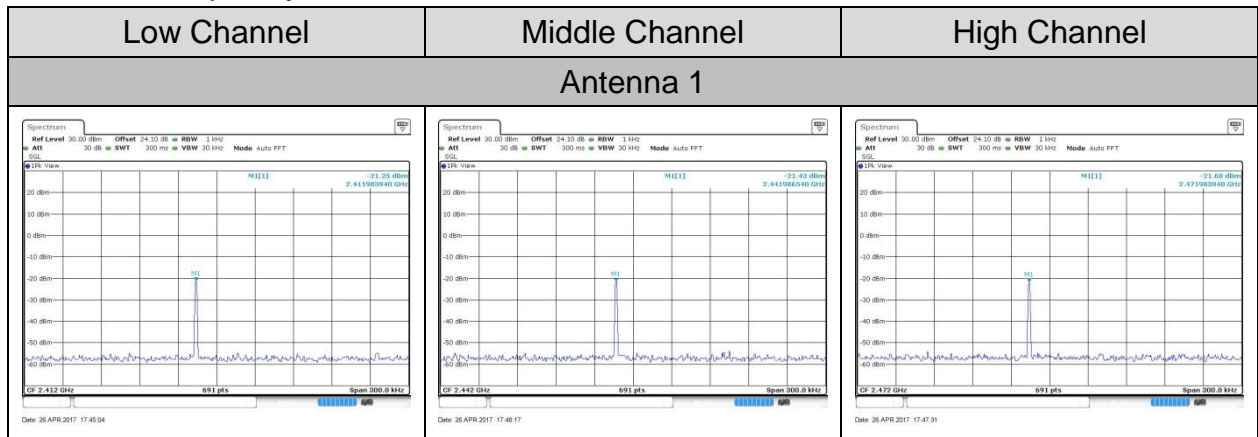
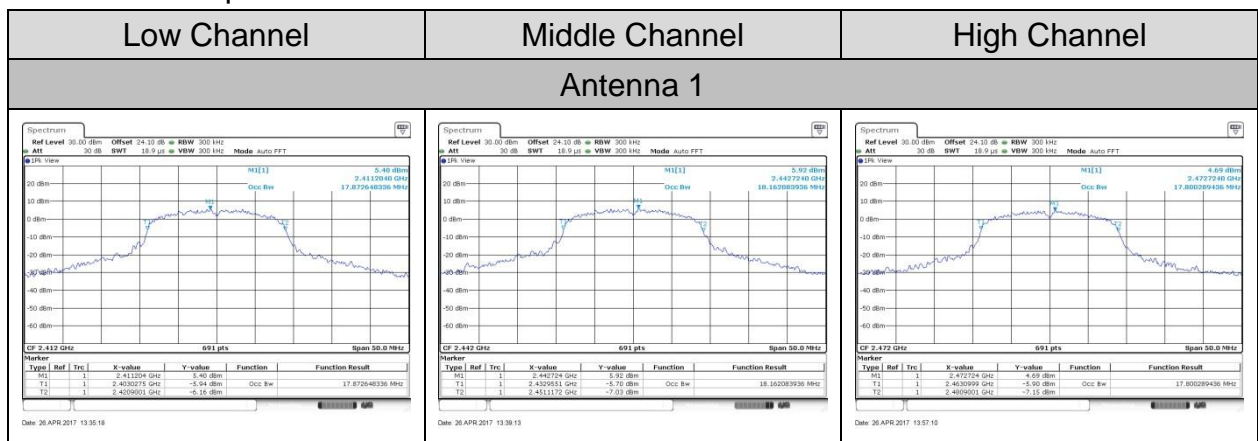
## iii. Unwanted Emission Intensity



## iv. Limitation of Collateral Emission of Receiver

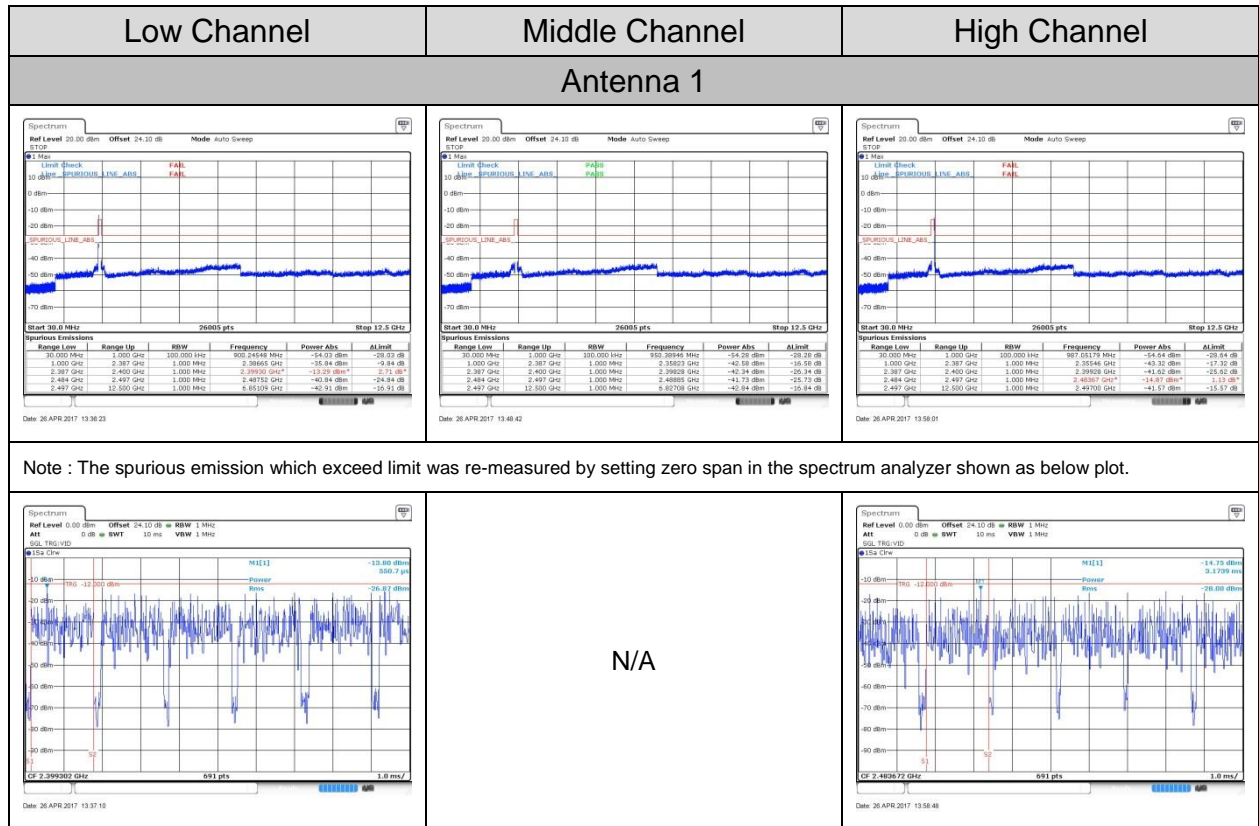




**C.1.3. 802.11n-HT20**
**i. Frequency Tolerance**

**ii. Occupied Bandwidth**




iii. Unwanted Emission Intensity



iv. Limitation of Collateral Emission of Receiver

