

# FCC TEST REPORT

Client Name : Advantech Co.,Ltd.

Address : No.1, Alley 20, Lane 26, Rueiguang Road, Neihu District,  
Taipei, Taiwan 11491

Product Name : Electronic Shelf Label

Date : Mar. 19, 2020



**Shenzhen Anbotech Compliance Laboratory Limited**



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# TEST REPORT

Applicant : Advantech Co.,Ltd.  
Manufacturer : HangZhou Zkong Networks Co., Ltd.  
Product Name : Electronic Shelf Label  
Model No. : LEO-D52  
Trade Mark : Advantech  
Rating(s) : Input: DC 3V, 2400mA

**Test Standard(s) : FCC Part15 Subpart C 2019, Section 15.247**

**Test Method(s) : ANSI C63.10: 2013, KDB558074 D01 DTS Meas Guidance v05**

The device described above is tested by Shenzhen Anbotech Compliance Laboratory Limited to determine the maximum emission levels emanating from the device and the severe levels of the device can endure and its performance criterion. The measurement results are contained in this test report and Shenzhen Anbotech Compliance Laboratory Limited is assumed full of responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT (Equipment Under Test) is technically compliant with the FCC Part 15 Subpart C requirements.

This report applies to above tested sample only and shall not be reproduced in part without written approval of Shenzhen Anbotech Compliance Laboratory Limited.

Date of Receipt

Nov. 18, 2019

Date of Test

Nov. 18, 2019~Mar. 12, 2020

Prepared By

*Dolly mo*

(Engineer / Dolly Mo)

Reviewer

*Bibo Zhang*

(Supervisor / Bibo Zhang)

Approved & Authorized Signer

*Tom Chen*

(Manager / Tom Chen)

# 1. General Information

## 1.1. Client Information

|              |   |                                                                                                                                        |
|--------------|---|----------------------------------------------------------------------------------------------------------------------------------------|
| Applicant    | : | Advantech Co.,Ltd.                                                                                                                     |
| Address      | : | No.1, Alley 20, Lane 26, Rueiguang Road, Neihu District, Taipei, Taiwan 11491                                                          |
| Manufacturer | : | HangZhou Zkong Networks Co., Ltd.                                                                                                      |
| Address      | : | Room 1208-1210, 17 Block 57, Baiyang Street Science Park Road, Hangzhou Economic and Technological Development Zone, Zhejiang Province |
| Factory      | : | Zhejiang Sunparl Information Technology Co., Ltd                                                                                       |
| Address      | : | No.19, Xinxing Road, Haining Lianhang Economic Zone, Zhejiang, China                                                                   |

## 1.2. Description of Device (EUT)

|                                                                                                                                     |   |                                                 |              |
|-------------------------------------------------------------------------------------------------------------------------------------|---|-------------------------------------------------|--------------|
| Product Name                                                                                                                        | : | Electronic Shelf Label                          |              |
| Model No.                                                                                                                           | : | LEO-D52                                         |              |
| Trade Mark                                                                                                                          | : | Advantech                                       |              |
| Test Power Supply                                                                                                                   | : | DC 3V By Battery                                |              |
| Test Sample No.                                                                                                                     | : | 1-2-1(Normal Sample), 1-2-2(Engineering Sample) |              |
| Product Description                                                                                                                 | : | Operation Frequency:                            | 2402~2480MHz |
|                                                                                                                                     | : | Transfer Rate:                                  | 1 Mbits/s    |
|                                                                                                                                     | : | Number of Channel:                              | 40 Channels  |
|                                                                                                                                     | : | Modulation Type:                                | GFSK         |
|                                                                                                                                     | : | Antenna Type:                                   | PCB Antenna  |
|                                                                                                                                     | : | Antenna Gain(Peak):                             | 3.29 dBi     |
| <b>Remark:</b> 1) For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual. |   |                                                 |              |

### 1.3. Auxiliary Equipment Used During Test

|     |  |
|-----|--|
| N/A |  |
|-----|--|

### 1.4. Description of Test Modes

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

| Pretest Mode | Description |         |
|--------------|-------------|---------|
| Mode 1       | CH00        | TX Only |
| Mode 2       | CH19        |         |
| Mode 3       | CH39        |         |

Note:

- (1) The measurements are performed at the highest, middle, lowest available channels.
- (2) The data rate was set in 1Mbps for radiated emission due to the highest RF output power.

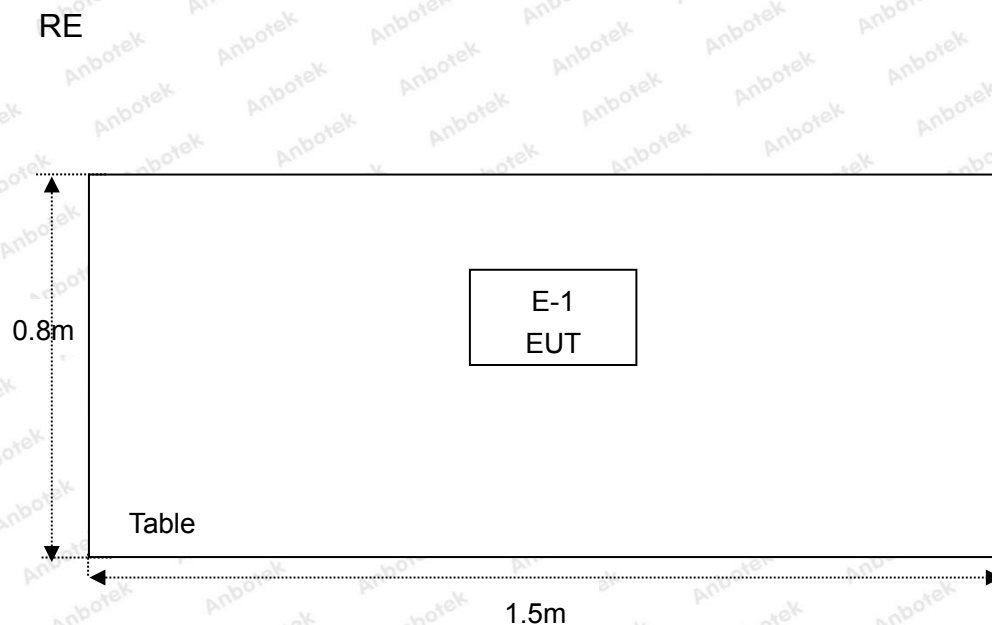
### 1.5. List of channels

| Channel | Freq.<br>(MHz) | Channel | Freq.<br>(MHz) | Channel | Freq.<br>(MHz) | Channel | Freq.<br>(MHz) | Channel | Freq.<br>(MHz) |
|---------|----------------|---------|----------------|---------|----------------|---------|----------------|---------|----------------|
| 00      | 2402           | 09      | 2420           | 18      | 2438           | 27      | 2456           | 36      | 2474           |
| 01      | 2404           | 10      | 2422           | 19      | 2440           | 28      | 2458           | 37      | 2476           |
| 02      | 2406           | 11      | 2424           | 20      | 2442           | 29      | 2460           | 38      | 2478           |
| 03      | 2408           | 12      | 2426           | 21      | 2444           | 30      | 2462           | 39      | 2480           |
| 04      | 2410           | 13      | 2428           | 22      | 2446           | 31      | 2464           |         |                |
| 05      | 2412           | 14      | 2430           | 23      | 2448           | 32      | 2466           |         |                |
| 06      | 2414           | 15      | 2432           | 24      | 2450           | 33      | 2468           |         |                |
| 07      | 2416           | 16      | 2434           | 25      | 2452           | 34      | 2470           |         |                |
| 08      | 2418           | 17      | 2436           | 26      | 2454           | 35      | 2472           |         |                |

Note:

1. The engineering test program was provided and the EUT was programmed to be in continuously transmitting mode.

## 1.6. Description Of Test Setup



## 1.7. Test Equipment List

| Item | Equipment                                   | Manufacturer               | Model No.        | Serial No.    | Last Cal.     | Cal. Interval |
|------|---------------------------------------------|----------------------------|------------------|---------------|---------------|---------------|
| 1.   | L.I.S.N.<br>Artificial Mains<br>Network     | Rohde & Schwarz            | ENV216           | 100055        | Nov. 04, 2019 | 1 Year        |
| 2.   | EMI Test Receiver                           | Rohde & Schwarz            | ESPI3            | 101604        | Nov. 04, 2019 | 1 Year        |
| 3.   | RF Switching Unit                           | Compliance<br>Direction    | RSU-M2           | 38303         | Nov. 04, 2019 | 1 Year        |
| 4.   | MAX Spectrum<br>Analysis                    | Agilent                    | N9020A           | MY51170037    | Nov. 04, 2019 | 1 Year        |
| 5.   | Preamplifier                                | SKET Electronic            | BK1G18G30<br>D   | KD17503       | Nov. 04, 2019 | 1 Year        |
| 6.   | Double Ridged Horn<br>Antenna               | Instruments<br>corporation | GTH-0118         | 351600        | Nov. 01, 2019 | 1 Year        |
| 7.   | Bilog Broadband<br>Antenna                  | Schwarzbeck                | VULB9163         | VULB 9163-289 | Nov. 01, 2019 | 1 Year        |
| 8.   | Loop Antenna                                | Schwarzbeck                | FMZB1519B        | 00053         | Nov. 01, 2019 | 1 Year        |
| 9.   | Horn Antenna                                | A-INFO                     | LB-180400-K<br>F | J211060628    | Nov. 01, 2019 | 1 Year        |
| 10.  | Pre-amplifier                               | SONOMA                     | 310N             | 186860        | Nov. 04, 2019 | 1 Year        |
| 11.  | EMI Test Software<br>EZ-EMC                 | SHURPLE                    | N/A              | N/A           | N/A           | N/A           |
| 12.  | RF Test Control<br>System                   | YIHENG                     | YH3000           | 2017430       | Nov. 04, 2019 | 1 Year        |
| 13.  | Power Sensor                                | DAER                       | RPR3006W         | 15I00041SN045 | Nov. 04, 2019 | 1 Year        |
| 14.  | Power Sensor                                | DAER                       | RPR3006W         | 15I00041SN046 | Nov. 04, 2019 | 1 Year        |
| 15.  | MXA Spectrum<br>Analysis                    | Agilent                    | N9020A           | MY51170037    | Nov. 04, 2019 | 1 Year        |
| 16.  | MXG RF Vector<br>Signal Generator           | Agilent                    | N5182A           | MY48180656    | Nov. 04, 2019 | 1 Year        |
| 17.  | Signal Generator                            | Agilent                    | E4421B           | MY41000743    | Nov. 04, 2019 | 1 Year        |
| 18.  | DC Power Supply                             | LW                         | TPR-6420D        | 374470        | Nov. 04, 2019 | 1 Year        |
| 19.  | Constant<br>Temperature<br>Humidity Chamber | ZHONGJIAN                  | ZJ-KHWS80<br>B   | N/A           | Nov. 04, 2019 | 1 Year        |

### 1.8. Measurement Uncertainty

|                        |   |                          |
|------------------------|---|--------------------------|
| Radiation Uncertainty  | : | Ur = 3.9 dB (Horizontal) |
|                        |   | Ur = 3.8 dB (Vertical)   |
| Conduction Uncertainty | : | Uc = 3.4 dB              |

### 1.9. Description of Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

#### FCC-Registration No.: 184111

Shenzhen Anbotech Compliance Laboratory Limited, EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration No. 184111, September 27, 2019.

#### ISED-Registration No.: 8058A

Shenzhen Anbotech Compliance Laboratory Limited, EMC Laboratory has been registered and fully described in a report filed with the (ISED) Innovation, Science and Economic Development Canada. The acceptance letter from the ISED is maintained in our files. Registration 8058A, March 07, 2019.

#### Test Location

Shenzhen Anbotech Compliance Laboratory Limited.

1/F, Building D, Sogood Science and Technology Park, Sanwei community, Hangcheng Street, Bao'an District, Shenzhen, Guangdong, China.518102

## 2. Summary of Test Results

| Standard Section                                            | Test Item                   | Result |
|-------------------------------------------------------------|-----------------------------|--------|
| 15.203/15.247(c)                                            | Antenna Requirement         | PASS   |
| 15.207                                                      | Conducted Emission          | N/A    |
| 15.205/15.209                                               | Spurious Emission           | PASS   |
| 15.247(b)(3)                                                | Conducted Peak Output Power | PASS   |
| 15.247(a)(2)                                                | 6dB Occupied Bandwidth      | PASS   |
| 15.247(e)                                                   | Power Spectral Density      | PASS   |
| 15.247(d)                                                   | Band Edge                   | PASS   |
| <b>Remark:</b> "N/A" is an abbreviation for Not Applicable. |                             |        |

### 3. Conducted Emission Test

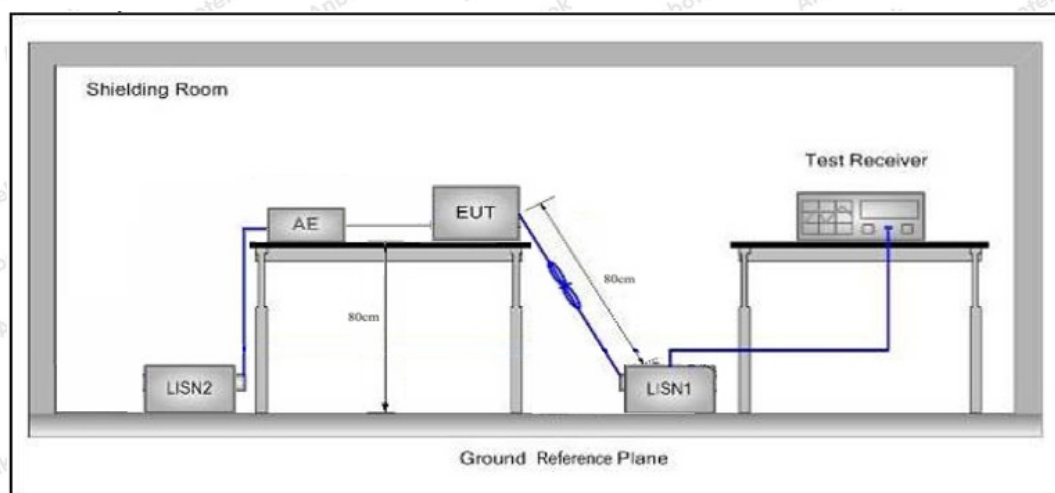
#### 3.1. Test Standard and Limit

| Test Standard | FCC Part15 Section 15.207 |                                |               |
|---------------|---------------------------|--------------------------------|---------------|
| Test Limit    | Frequency                 | Maximum RF Line Voltage (dBuV) |               |
|               |                           | Quasi-peak Level               | Average Level |
|               | 150kHz~500kHz             | 66 ~ 56 *                      | 56 ~ 46 *     |
|               | 500kHz~5MHz               | 56                             | 46            |
|               | 5MHz~30MHz                | 60                             | 50            |

**Remark:** (1) \*Decreasing linearly with logarithm of the frequency.

(2) The lower limit shall apply at the transition frequency.

#### 3.2. Test Setup



#### 3.3. Test Procedure

The EUT system is connected to the power mains through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm coupling impedance for the EUT system. Please refer the block diagram of the test setup and photographs. Both sides of AC line are checked to find out the maximum conducted emission. In order to find the maximum emission levels, the relative positions of equipment and all of the interface cables shall be changed according to FCC ANSI C63.10-2013 on Conducted Emission Measurement.

The bandwidth of test receiver (ESCI) set at 9kHz.

The frequency range from 150kHz to 30MHz is checked.

#### 3.4. Test Data

The EUT is powered by DC 3V By Battery inside, so there is no need to conduct this test.

## 4. Radiation Spurious Emission and Band Edge

### 4.1. Test Standard and Limit

| Test Standard | FCC Part15 C Section 15.209 and 15.205 |                                  |                |            |                          |
|---------------|----------------------------------------|----------------------------------|----------------|------------|--------------------------|
| Test Limit    | Frequency (MHz)                        | Field strength (microvolt/meter) | Limit (dBuV/m) | Remark     | Measurement distance (m) |
|               | 0.009MHz~0.490MHz                      | 2400/F(kHz)                      | -              | -          | 300                      |
|               | 0.490MHz-1.705MHz                      | 24000/F(kHz)                     | -              | -          | 30                       |
|               | 1.705MHz-30MHz                         | 30                               | -              | -          | 30                       |
|               | 30MHz~88MHz                            | 100                              | 40.0           | Quasi-peak | 3                        |
|               | 88MHz~216MHz                           | 150                              | 43.5           | Quasi-peak | 3                        |
|               | 216MHz~960MHz                          | 200                              | 46.0           | Quasi-peak | 3                        |
|               | 960MHz~1000MHz                         | 500                              | 54.0           | Quasi-peak | 3                        |
|               | Above 1000MHz                          | 500                              | 54.0           | Average    | 3                        |
|               |                                        | -                                | 74.0           | Peak       | 3                        |

**Remark:**

(1)The lower limit shall apply at the transition frequency.

(2) 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

### 4.2. Test Setup

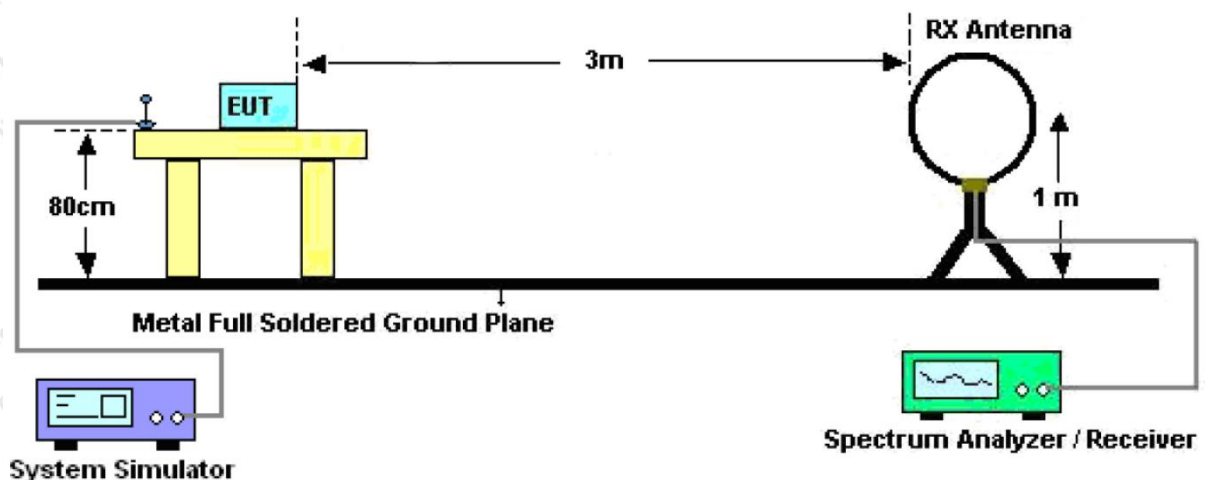


Figure 1. Below 30MHz

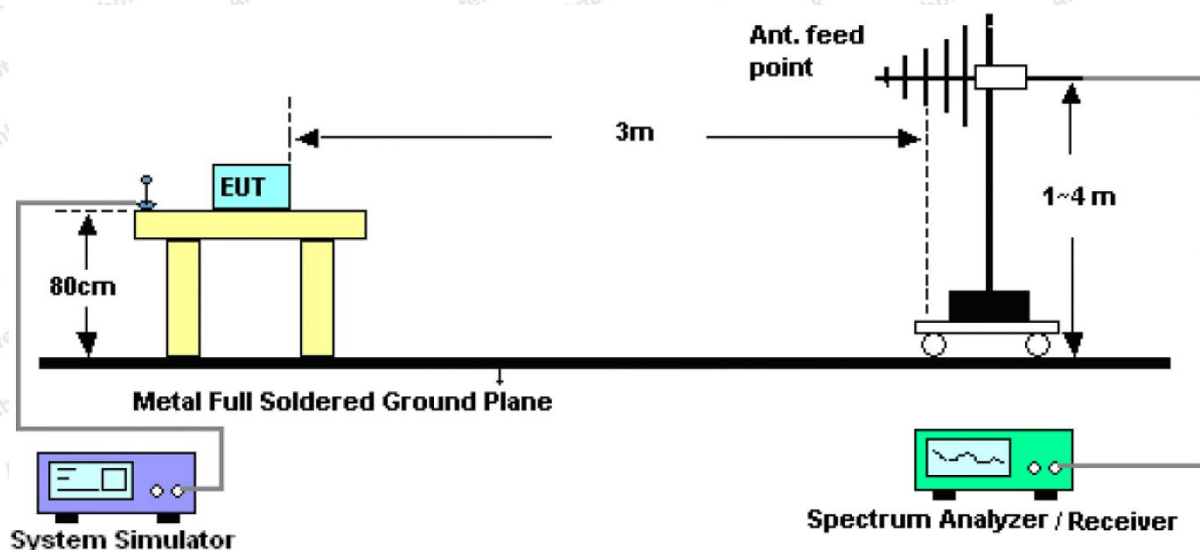


Figure 2. 30MHz to 1GHz

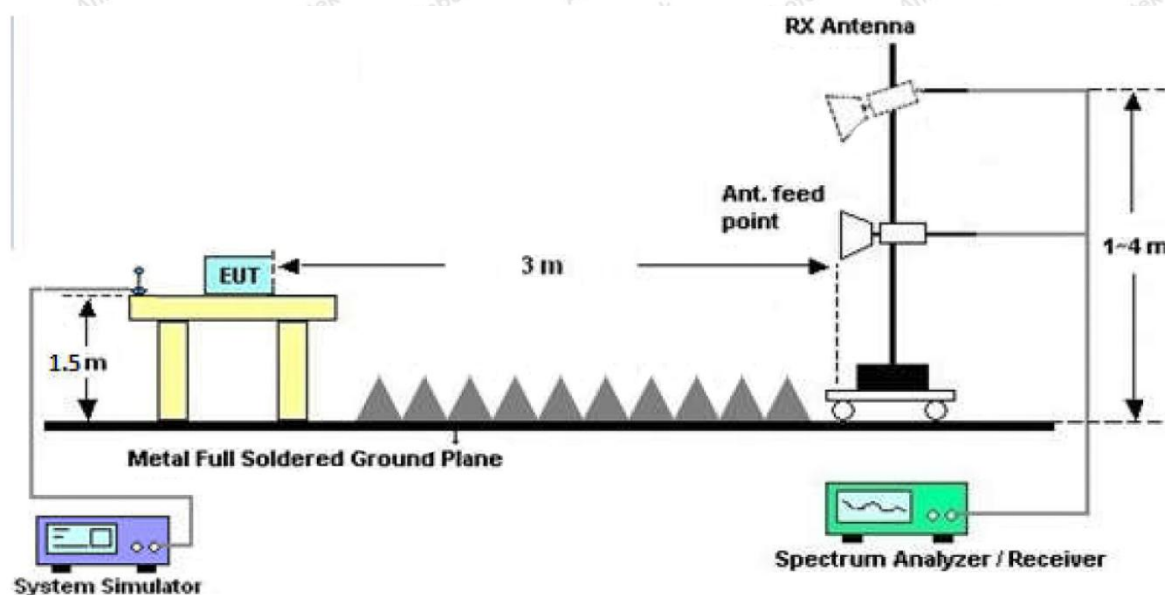


Figure 3. Above 1 GHz

### 4.3. Test Procedure

For below 1GHz: The EUT is placed on a turntable, which is 0.8m above the ground plane.

For above 1GHz: The EUT is placed on a turntable, which is 1.5m above the ground plane.

The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT is set 3 meters away from the receiving antenna which is mounted on a antenna tower. The antenna can be moved up and down from 1 to 4 meters to find out the maximum emission level. Rotated the EUT through three orthogonal axes to determine the maximum emissions, both horizontal and vertical polarization of the antenna are set on test. The EUT is tested in 9\*6\*6 Chamber. The device is evaluated in xyz orientation.

For the radiated emission test above 1GHz:

Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

For 9kHz to 150kHz, Set the spectrum analyzer as:

RBW = 200Hz, VBW = 1kHz, Detector= Quasi-Peak, Trace mode= Max hold, Sweep- auto couple.

For 150kHz to 30MHz, Set the spectrum analyzer as:

RBW = 9KHz, VBW = 30kHz, Detector= Quasi-Peak, Trace mode= Max hold, Sweep- auto couple.

For 30MHz to 1000MHz, Set the spectrum analyzer as:

RBW = 100kHz, VBW = 300kHz, Detector= Quasi-Peak, Trace mode= Max hold, Sweep- auto couple.

For above 1GHz, Set the spectrum analyzer as:

RBW = 1MHz, VBW = 1MHz, Detector= Peak, Trace mode= Max hold, Sweep- auto couple.

RBW = 1MHz, VBW = 10Hz, Detector= Average, Trace mode= Max hold, Sweep- auto couple.

#### 4.4. Test Data

##### PASS

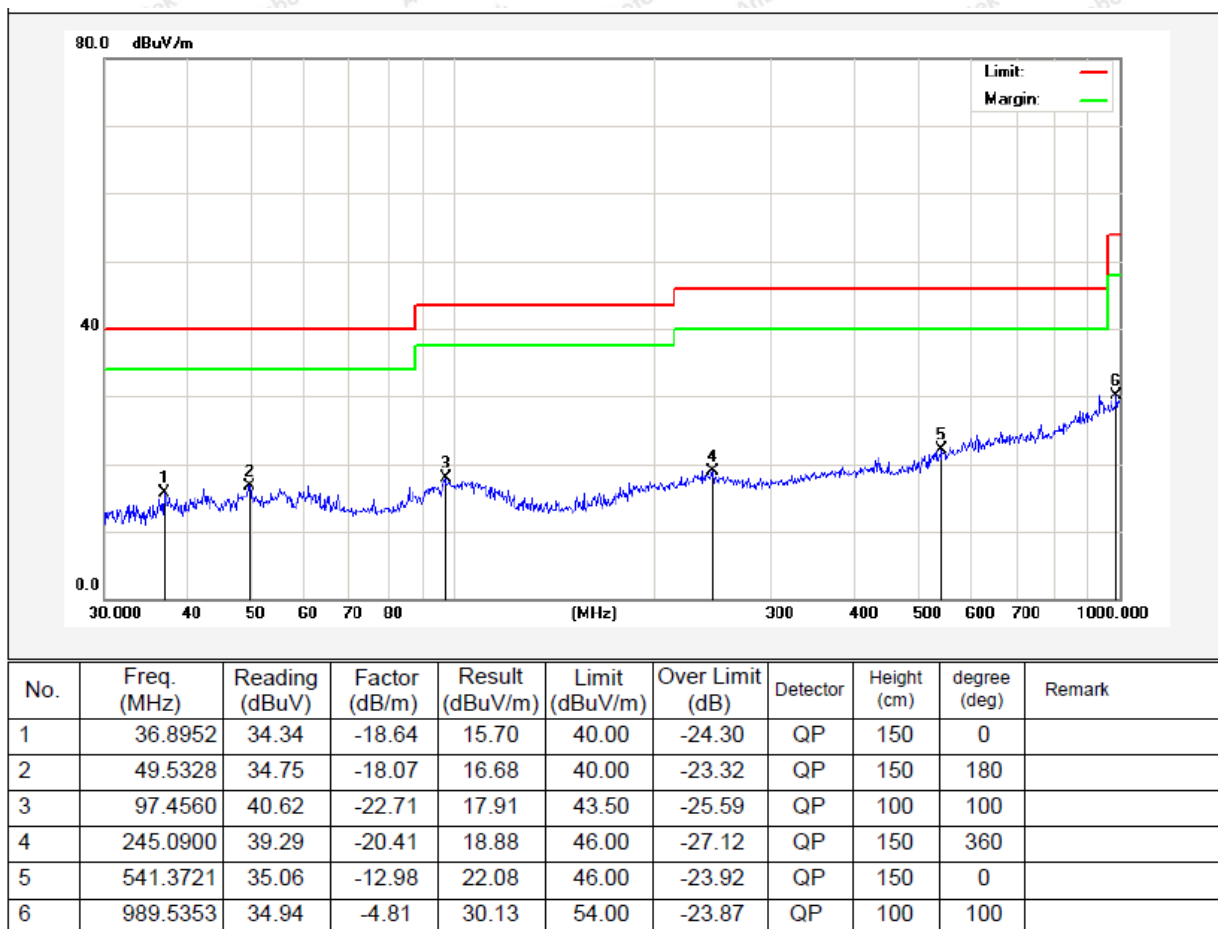
During the test, pre-scan all the modes, and found the Middle channel(TX Only) which is the worst case, only the worst case is recorded in the report.

The test results of 9kHz-30MHz was attenuated more than 20dB below the permissible limits, so the results don't record in the report.



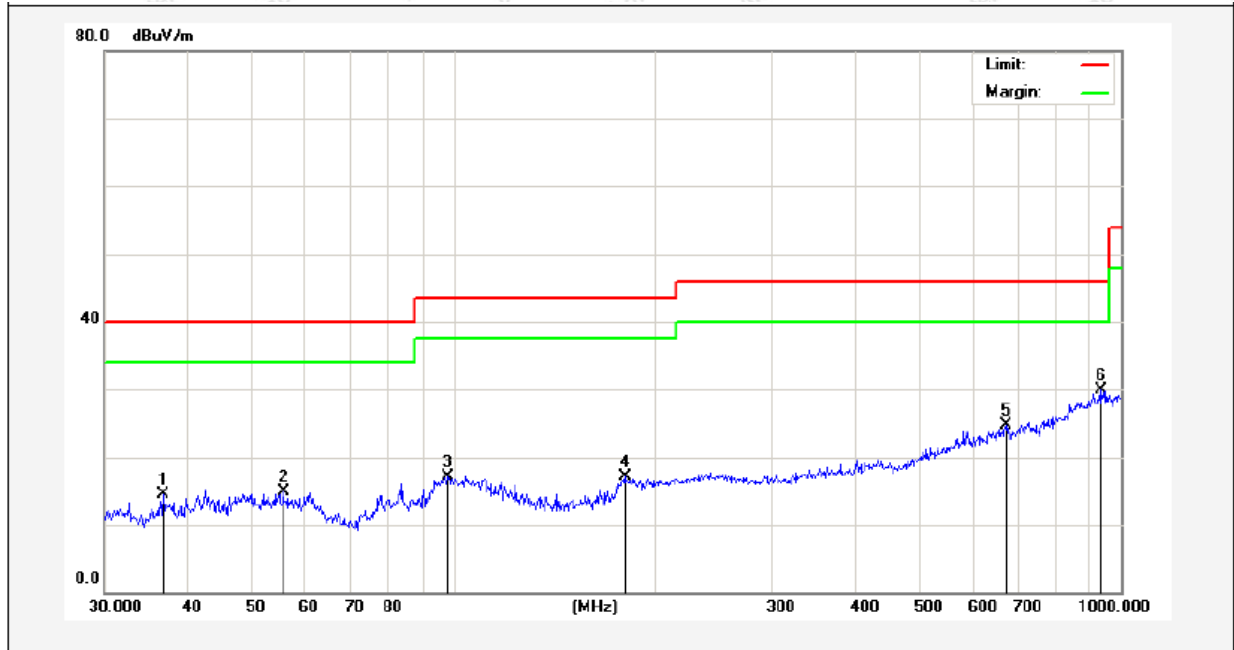
## Test Results (30~1000MHz)

Test Mode: Mode 2  
Power Source: DC 3V By Battery  
Polarization: Horizontal  
Temp.(°C)/Hum.(%RH): 22.2°C/51%RH



**Test Results (30~1000MHz)**

Test Mode: Mode 2  
Power Source: DC 3V By Battery  
Polarization: Vertical  
Temp.(°C)/Hum.(%RH): 22.2°C/51%RH



| No. | Freq. (MHz) | Reading (dBuV) | Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Detector | Height (cm) | degree (deg) | Remark |
|-----|-------------|----------------|---------------|-----------------|----------------|-----------------|----------|-------------|--------------|--------|
| 1   | 36.7661     | 32.15          | -17.68        | 14.47           | 40.00          | -25.53          | QP       | 150         | 0            |        |
| 2   | 55.6094     | 32.08          | -17.24        | 14.84           | 40.00          | -25.16          | QP       | 100         | 0            |        |
| 3   | 98.1419     | 33.83          | -16.66        | 17.17           | 43.50          | -26.33          | QP       | 100         | 300          |        |
| 4   | 180.6484    | 36.11          | -19.10        | 17.01           | 43.50          | -26.49          | QP       | 150         | 100          |        |
| 5   | 672.8444    | 35.05          | -10.38        | 24.67           | 46.00          | -21.33          | QP       | 100         | 0            |        |
| 6   | 935.5461    | 34.71          | -4.76         | 29.95           | 46.00          | -16.05          | QP       | 100         | 100          |        |

## Test Results (1GHz-25GHz)

| Test Mode: CH00 |                   |                       |                 |                    | Test channel: Lowest |                |                 |      |
|-----------------|-------------------|-----------------------|-----------------|--------------------|----------------------|----------------|-----------------|------|
| Peak Value      |                   |                       |                 |                    |                      |                |                 |      |
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m)       | Limit (dBuV/m) | Over Limit (dB) | Pol. |
| 4804.00         | 38.03             | 34.04                 | 6.58            | 34.09              | 44.56                | 74.00          | -29.44          | V    |
| 7206.00         | 32.31             | 37.11                 | 7.73            | 34.50              | 42.65                | 74.00          | -31.35          | V    |
| 9608.00         | 31.90             | 39.31                 | 9.23            | 34.79              | 45.65                | 74.00          | -28.35          | V    |
| 12010.00        | *                 |                       |                 |                    |                      | 74.00          |                 | V    |
| 14412.00        | *                 |                       |                 |                    |                      | 74.00          |                 | V    |
| 4804.00         | 42.47             | 34.04                 | 6.58            | 34.09              | 49.00                | 74.00          | -25.00          | H    |
| 7206.00         | 34.13             | 37.11                 | 7.73            | 34.50              | 44.47                | 74.00          | -29.53          | H    |
| 9608.00         | 31.39             | 39.31                 | 9.23            | 34.79              | 45.14                | 74.00          | -28.86          | H    |
| 12010.00        | *                 |                       |                 |                    |                      | 74.00          |                 | H    |
| 14412.00        | *                 |                       |                 |                    |                      | 74.00          |                 | H    |
| Average Value   |                   |                       |                 |                    |                      |                |                 |      |
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m)       | Limit (dBuV/m) | Over Limit (dB) | Pol. |
| 4804.00         | 26.71             | 34.04                 | 6.58            | 34.09              | 33.24                | 54.00          | -20.76          | V    |
| 7206.00         | 20.92             | 37.11                 | 7.73            | 34.50              | 31.26                | 54.00          | -22.74          | V    |
| 9608.00         | 19.95             | 39.31                 | 9.23            | 34.79              | 33.70                | 54.00          | -20.30          | V    |
| 12010.00        | *                 |                       |                 |                    |                      | 54.00          |                 | V    |
| 14412.00        | *                 |                       |                 |                    |                      | 54.00          |                 | V    |
| 4804.00         | 31.02             | 34.04                 | 6.58            | 34.09              | 37.55                | 54.00          | -16.45          | H    |
| 7206.00         | 23.14             | 37.11                 | 7.73            | 34.50              | 33.48                | 54.00          | -20.52          | H    |
| 9608.00         | 19.74             | 39.31                 | 9.23            | 34.79              | 33.49                | 54.00          | -20.51          | H    |
| 12010.00        | *                 |                       |                 |                    |                      | 54.00          |                 | H    |
| 14412.00        | *                 |                       |                 |                    |                      | 54.00          |                 | H    |

## Test Results (1GHz-25GHz)

| Test Mode: CH19 |                   |                       |                 |                    | Test channel: Middle |                |                 |      |
|-----------------|-------------------|-----------------------|-----------------|--------------------|----------------------|----------------|-----------------|------|
| Peak Value      |                   |                       |                 |                    |                      |                |                 |      |
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m)       | Limit (dBuV/m) | Over Limit (dB) | Pol. |
| 4880.00         | 36.81             | 34.38                 | 6.69            | 34.09              | 43.79                | 74.00          | -30.21          | V    |
| 7320.00         | 31.51             | 37.22                 | 7.78            | 34.53              | 41.98                | 74.00          | -32.02          | V    |
| 9760.00         | 31.18             | 39.46                 | 9.35            | 34.80              | 45.19                | 74.00          | -28.81          | V    |
| 12200.00        | *                 |                       |                 |                    |                      | 74.00          |                 | V    |
| 14640.00        | *                 |                       |                 |                    |                      | 74.00          |                 | V    |
| 4880.00         | 41.00             | 34.38                 | 6.69            | 34.09              | 47.98                | 74.00          | -26.02          | H    |
| 7320.00         | 33.22             | 37.22                 | 7.78            | 34.53              | 43.69                | 74.00          | -30.31          | H    |
| 9760.00         | 30.56             | 39.46                 | 9.35            | 34.80              | 44.57                | 74.00          | -29.43          | H    |
| 12200.00        | *                 |                       |                 |                    |                      | 74.00          |                 | H    |
| 14640.00        | *                 |                       |                 |                    |                      | 74.00          |                 | H    |
| Average Value   |                   |                       |                 |                    |                      |                |                 |      |
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m)       | Limit (dBuV/m) | Over Limit (dB) | Pol. |
| 4880.00         | 25.73             | 34.38                 | 6.69            | 34.09              | 32.71                | 54.00          | -21.29          | V    |
| 7320.00         | 20.25             | 37.22                 | 7.78            | 34.53              | 30.72                | 54.00          | -23.28          | V    |
| 9760.00         | 19.36             | 39.46                 | 9.35            | 34.80              | 33.37                | 54.00          | -20.63          | V    |
| 12200.00        | *                 |                       |                 |                    |                      | 54.00          |                 | V    |
| 14640.00        | *                 |                       |                 |                    |                      | 54.00          |                 | V    |
| 4880.00         | 29.91             | 34.38                 | 6.69            | 34.09              | 36.89                | 54.00          | -17.11          | H    |
| 7320.00         | 22.40             | 37.22                 | 7.78            | 34.53              | 32.87                | 54.00          | -21.13          | H    |
| 9760.00         | 19.05             | 39.46                 | 9.35            | 34.80              | 33.06                | 54.00          | -20.94          | H    |
| 12200.00        | *                 |                       |                 |                    |                      | 54.00          |                 | H    |
| 14640.00        | *                 |                       |                 |                    |                      | 54.00          |                 | H    |

## Test Results (1GHz-25GHz)

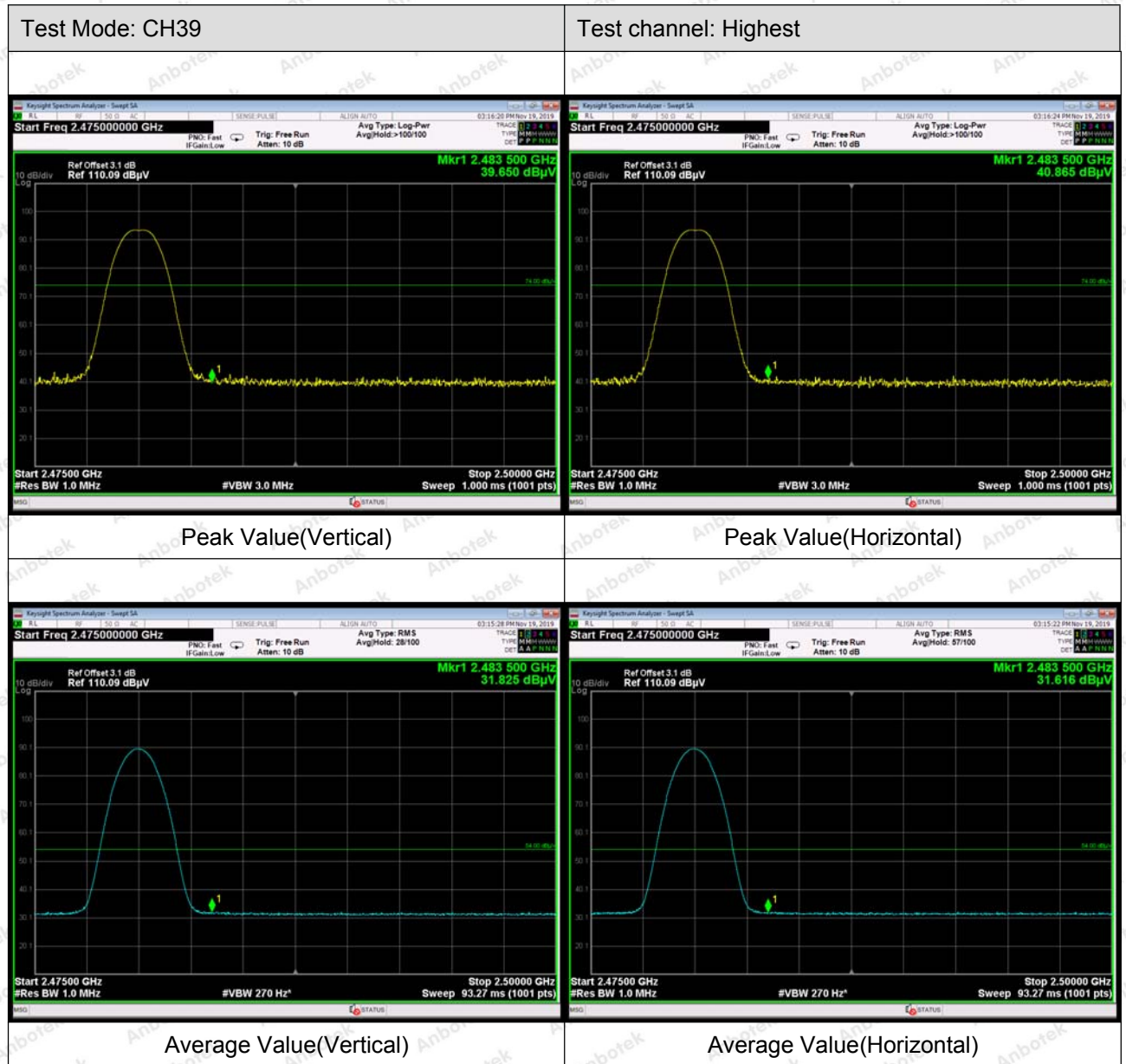
| Test Mode: CH39 |                   |                       |                 |                    | Test channel: Highest |                |                 |      |
|-----------------|-------------------|-----------------------|-----------------|--------------------|-----------------------|----------------|-----------------|------|
| Peak Value      |                   |                       |                 |                    |                       |                |                 |      |
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m)        | Limit (dBuV/m) | Over Limit (dB) | Pol. |
| 4960.00         | 36.26             | 34.72                 | 6.79            | 34.09              | 43.68                 | 74.00          | -30.32          | V    |
| 7440.00         | 31.14             | 37.34                 | 7.82            | 34.57              | 41.73                 | 74.00          | -32.27          | V    |
| 9920.00         | 30.85             | 39.62                 | 9.46            | 34.81              | 45.12                 | 74.00          | -28.88          | V    |
| 12400.00        | *                 |                       |                 |                    |                       | 74.00          |                 | V    |
| 14880.00        | *                 |                       |                 |                    |                       | 74.00          |                 | V    |
| 4960.00         | 40.34             | 34.72                 | 6.79            | 34.09              | 47.76                 | 74.00          | -26.24          | H    |
| 7440.00         | 32.80             | 37.34                 | 7.82            | 34.57              | 43.39                 | 74.00          | -30.61          | H    |
| 9920.00         | 30.18             | 39.62                 | 9.46            | 34.81              | 44.45                 | 74.00          | -29.55          | H    |
| 12400.00        | *                 |                       |                 |                    |                       | 74.00          |                 | H    |
| 14880.00        | *                 |                       |                 |                    |                       | 74.00          |                 | H    |
| Average Value   |                   |                       |                 |                    |                       |                |                 |      |
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m)        | Limit (dBuV/m) | Over Limit (dB) | Pol. |
| 4960.00         | 25.33             | 34.72                 | 6.79            | 34.09              | 32.75                 | 54.00          | -21.25          | V    |
| 7440.00         | 19.98             | 37.34                 | 7.82            | 34.57              | 30.57                 | 54.00          | -23.43          | V    |
| 9920.00         | 19.12             | 39.62                 | 9.46            | 34.81              | 33.39                 | 54.00          | -20.61          | V    |
| 12400.00        | *                 |                       |                 |                    |                       | 54.00          |                 | V    |
| 14880.00        | *                 |                       |                 |                    |                       | 54.00          |                 | V    |
| 4960.00         | 29.45             | 34.72                 | 6.79            | 34.09              | 36.87                 | 54.00          | -17.13          | H    |
| 7440.00         | 22.09             | 37.34                 | 7.82            | 34.57              | 32.68                 | 54.00          | -21.32          | H    |
| 9920.00         | 18.77             | 39.62                 | 9.46            | 34.81              | 33.04                 | 54.00          | -20.96          | H    |
| 12400.00        | *                 |                       |                 |                    |                       | 54.00          |                 | H    |
| 14880.00        | *                 |                       |                 |                    |                       | 54.00          |                 | H    |

Remark:

1. Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. "\*" means the test results were attenuated more than 20dB below the permissible limits, so the results don't record in the report.

**Radiated Band Edge:**





Remark:

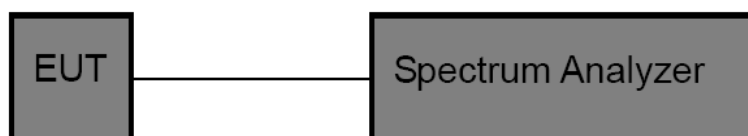
1. Level = Receiver Read level + Antenna Factor + Cable Loss – Pre-amplifier Factor

## 5. Maximum Peak Output Power Test

### 5.1. Test Standard and Limit

|               |                                    |
|---------------|------------------------------------|
| Test Standard | FCC Part15 C Section 15.247 (b)(3) |
| Test Limit    | 30dBm                              |

### 5.2. Test Setup



### 5.3. Test Procedure

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

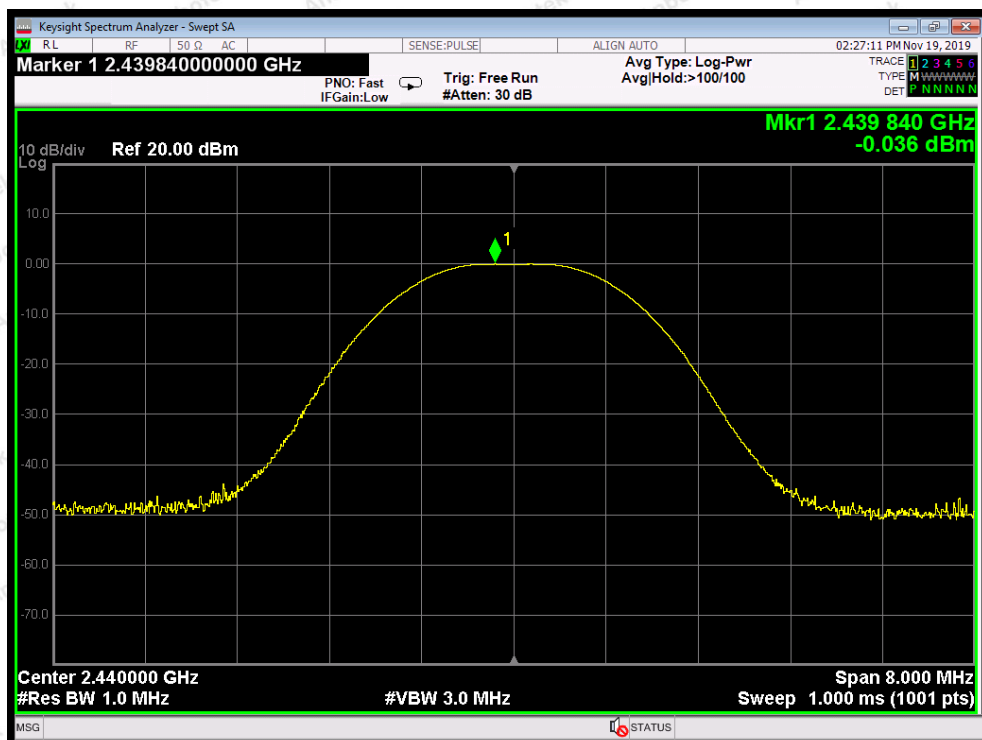
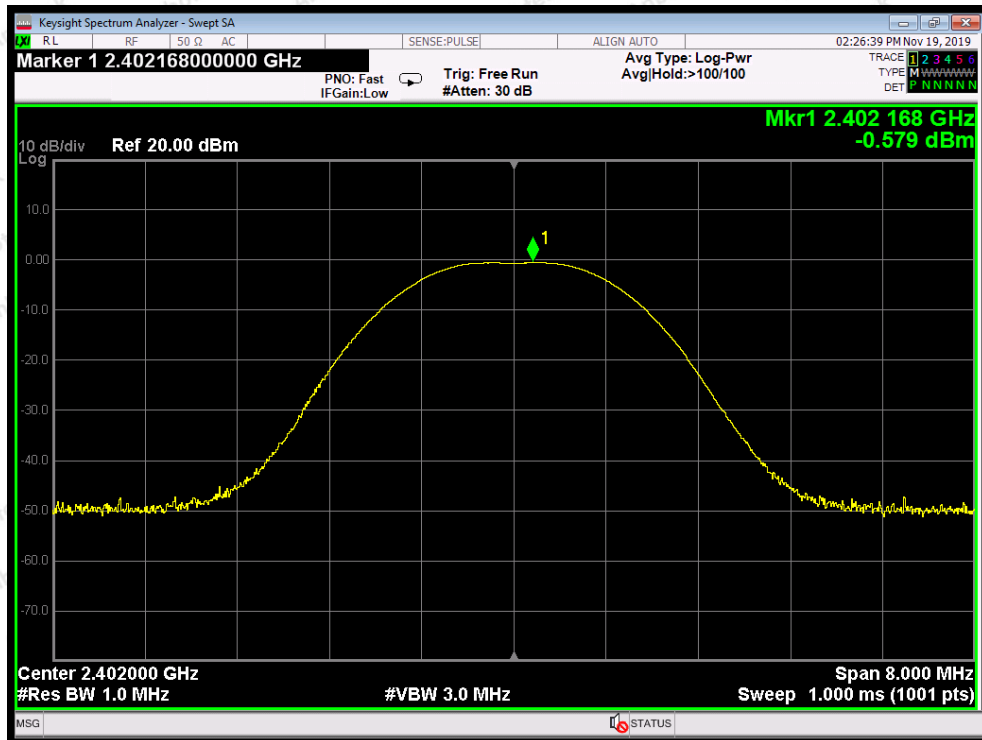
1. Set the RBW  $\geq$  DTS bandwidth.
2. Set the VBW  $\geq 3 \times$  RBW.
3. Set the span  $\geq 3 \times$  RBW.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use peak marker function to determine the peak amplitude level.

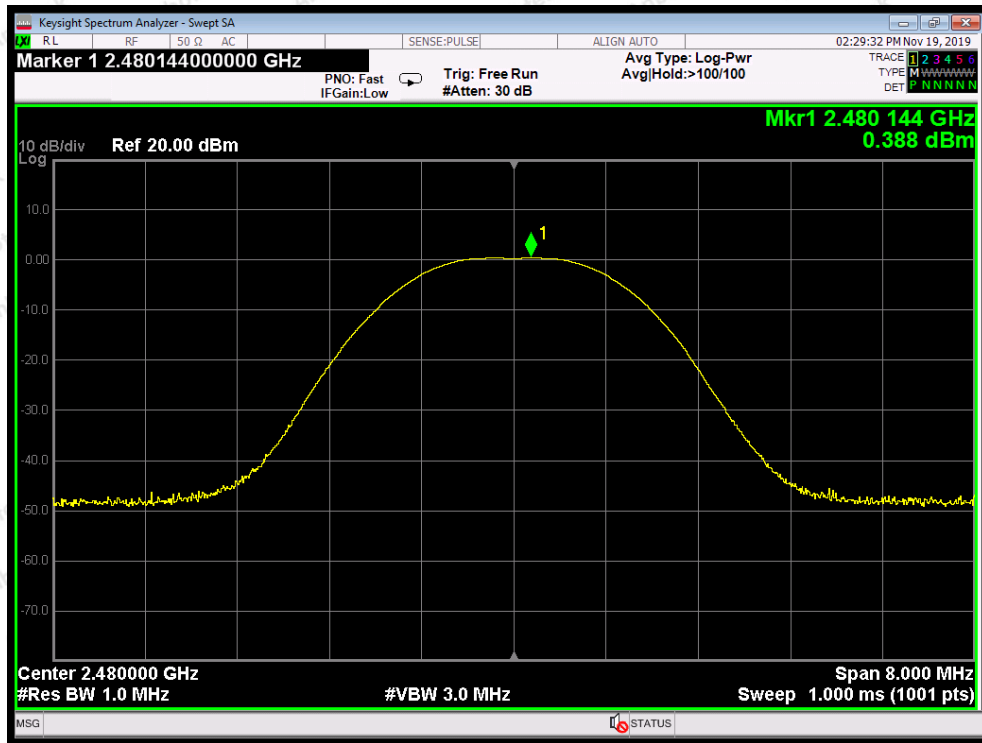
### 5.4. Test Data

|              |   |                        |
|--------------|---|------------------------|
| Test Item    | : | Max. peak output power |
| Test Voltage | : | DC 3V By Battery       |
| Test Result  | : | PASS                   |

|             |   |                  |
|-------------|---|------------------|
| Test Mode   | : | CH Low ~ CH High |
| Temperature | : | 24°C             |
| Humidity    | : | 55%RH            |

| Channel Frequency (MHz) | Peak Power output (dBm) | Limit (dBm) | Results |
|-------------------------|-------------------------|-------------|---------|
| 2402                    | -0.579                  | 30          | PASS    |
| 2440                    | -0.036                  | 30          | PASS    |
| 2480                    | 0.388                   | 30          | PASS    |





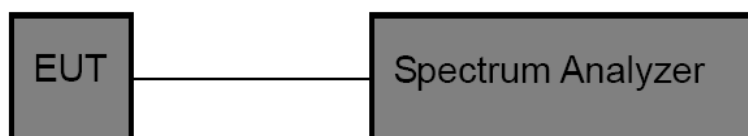
CH: High

## 6. 6DB Occupy Bandwidth Test

### 6.1. Test Standard and Limit

|               |                                    |
|---------------|------------------------------------|
| Test Standard | FCC Part15 C Section 15.247 (a)(2) |
| Test Limit    | >500kHz                            |

### 6.2. Test Setup



### 6.3. Test Procedure

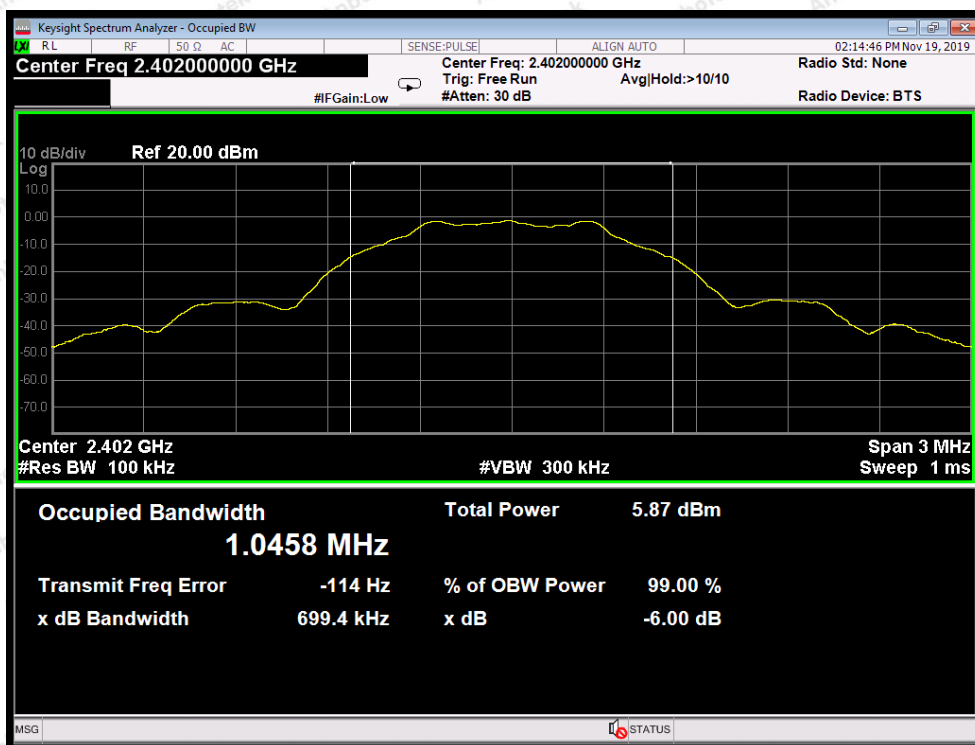
1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as:  
RBW = 100kHz, VBW $\geq$ 3\*RBW =300kHz,  
Detector= Peak  
Trace mode= Max hold.  
Sweep- auto couple.
4. Mark the peak frequency and -6dB (upper and lower) frequency.
5. Repeat until all the rest channels are investigated.

### 6.4. Test Data

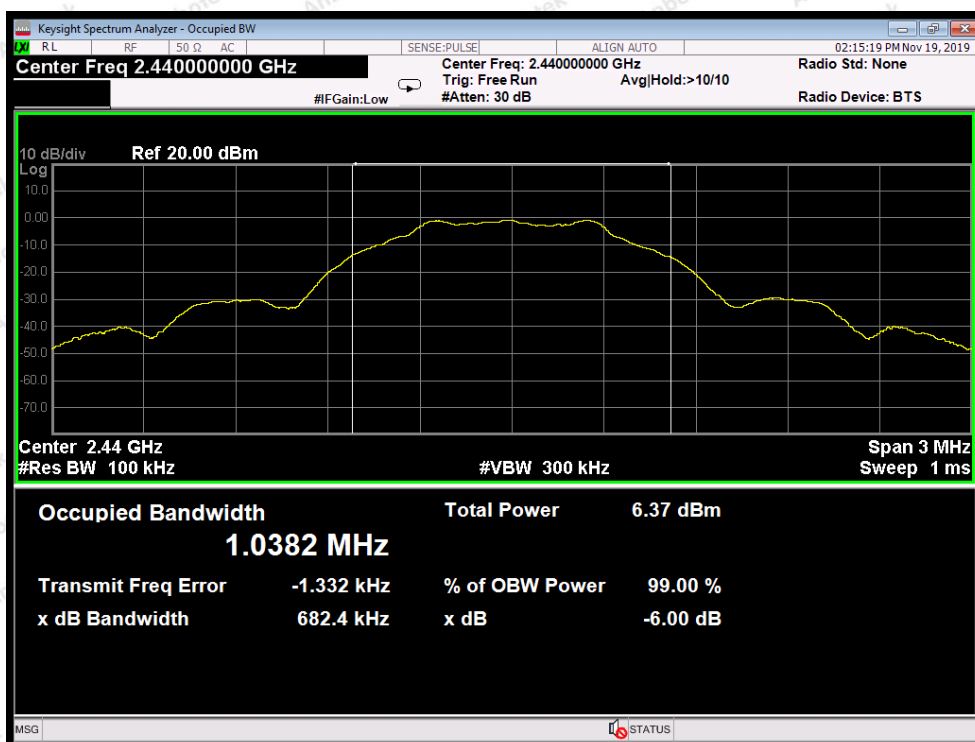
Test Item : 6dB Bandwidth  
Test Voltage : DC 3V By Battery  
Test Result : PASS

Test Mode : CH Low ~ CH High  
Temperature : 24℃  
Humidity : 55%RH

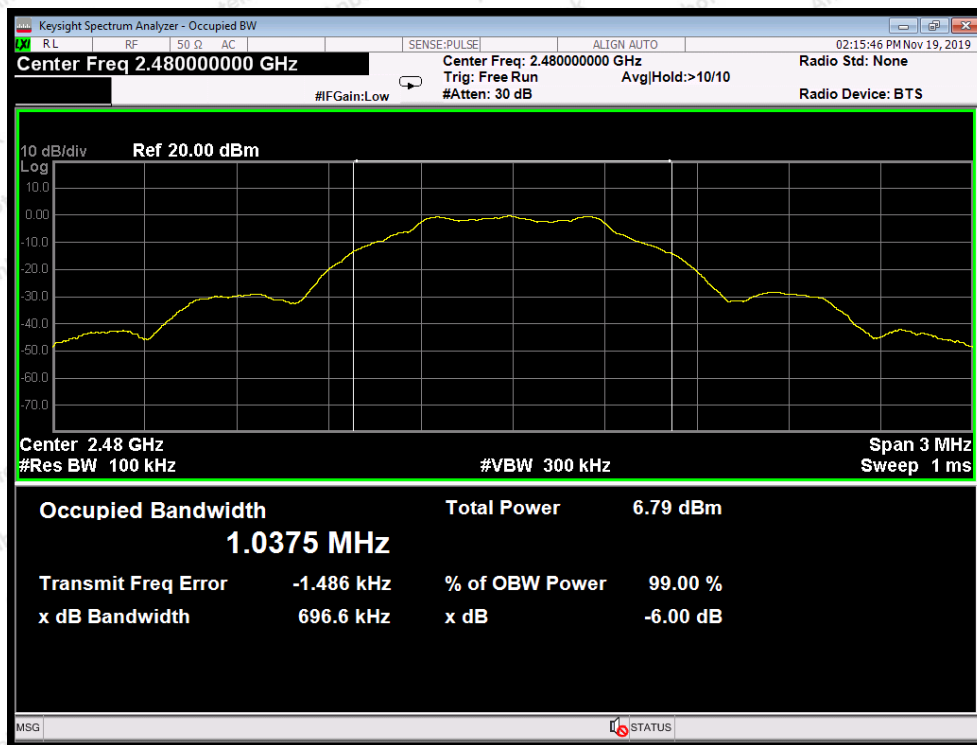
| Channel | Frequency(MHz) | Bandwidth (kHz) | Limit (kHz) | Results |
|---------|----------------|-----------------|-------------|---------|
| Low     | 2402           | 699.4           | >500        | PASS    |
| Middle  | 2440           | 682.4           |             | PASS    |
| High    | 2480           | 696.6           |             | PASS    |



CH: Low



CH: Middle



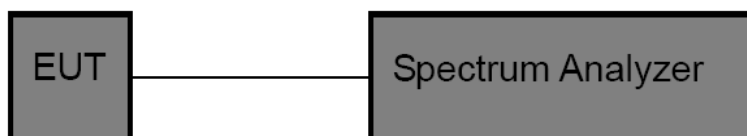
CH: High

## 7. Power Spectral Density Test

### 7.1. Test Standard and Limit

|               |                                 |
|---------------|---------------------------------|
| Test Standard | FCC Part15 C Section 15.247 (e) |
| Test Limit    | 8dBm                            |

### 7.2. Test Setup



### 7.3. Test Procedure

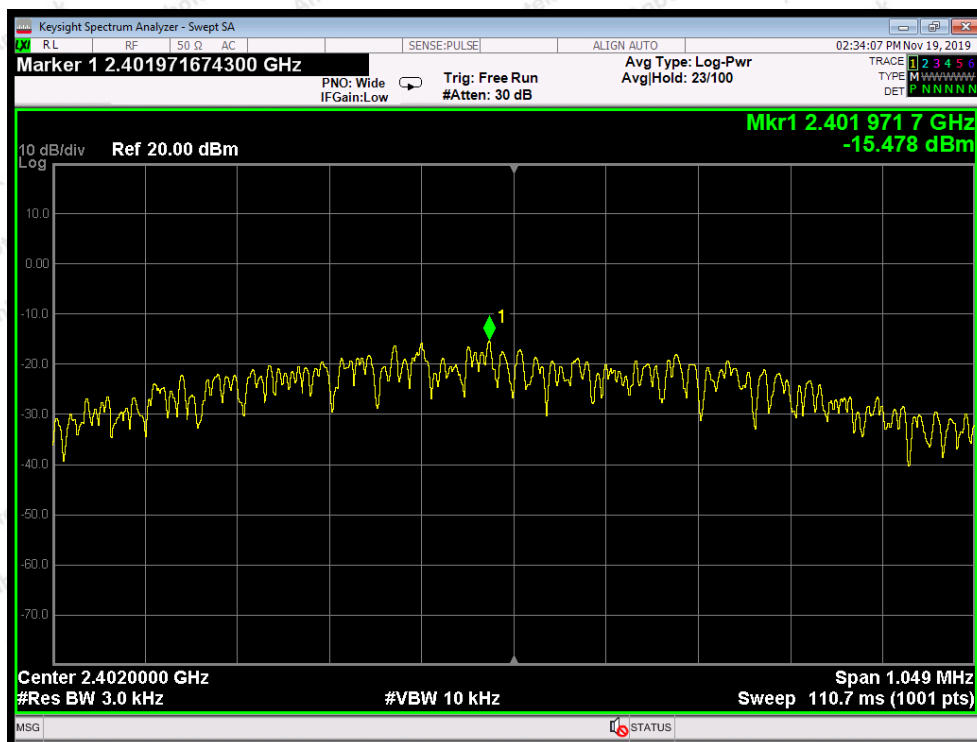
1. Place the EUT on the table and set it in transmitting mode. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
2. Set the spectrum analyzer as RBW = 3kHz, VBW = 10kHz, Span = 1.5xDTS BW
3. Record the max. reading.
4. Repeat the above procedure until the measurements for all frequencies are completed.

### 7.4. Test Data

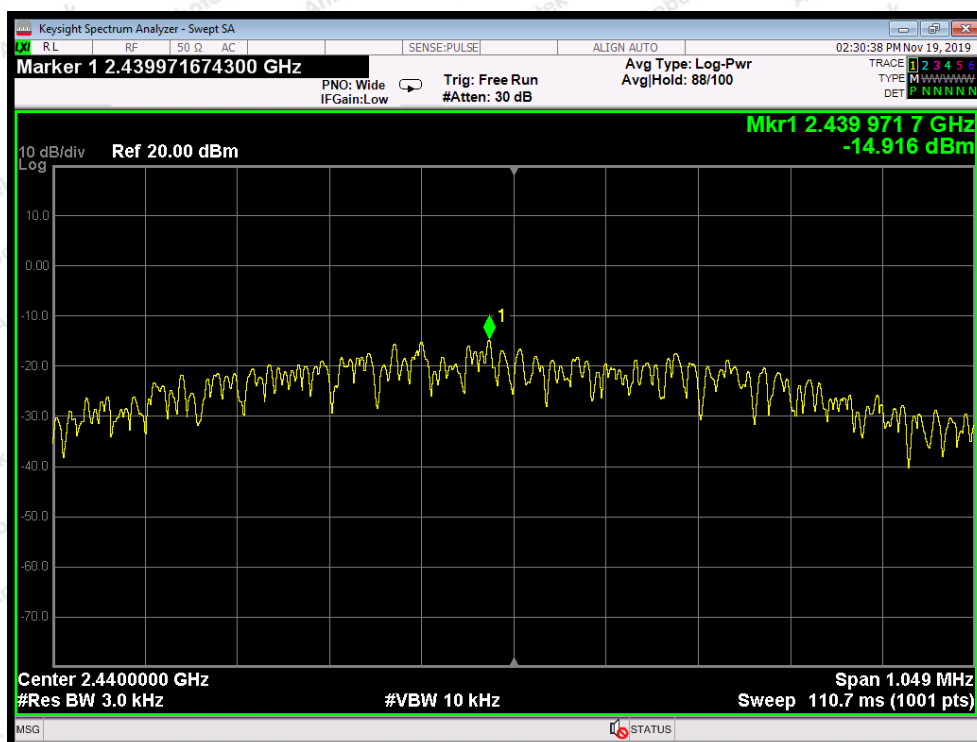
Test Item : Power Spectral Density  
 Test Voltage : DC 3V By Battery  
 Test Result : PASS

Test Mode : CH Low ~ CH High  
 Temperature : 24℃  
 Humidity : 55%RH

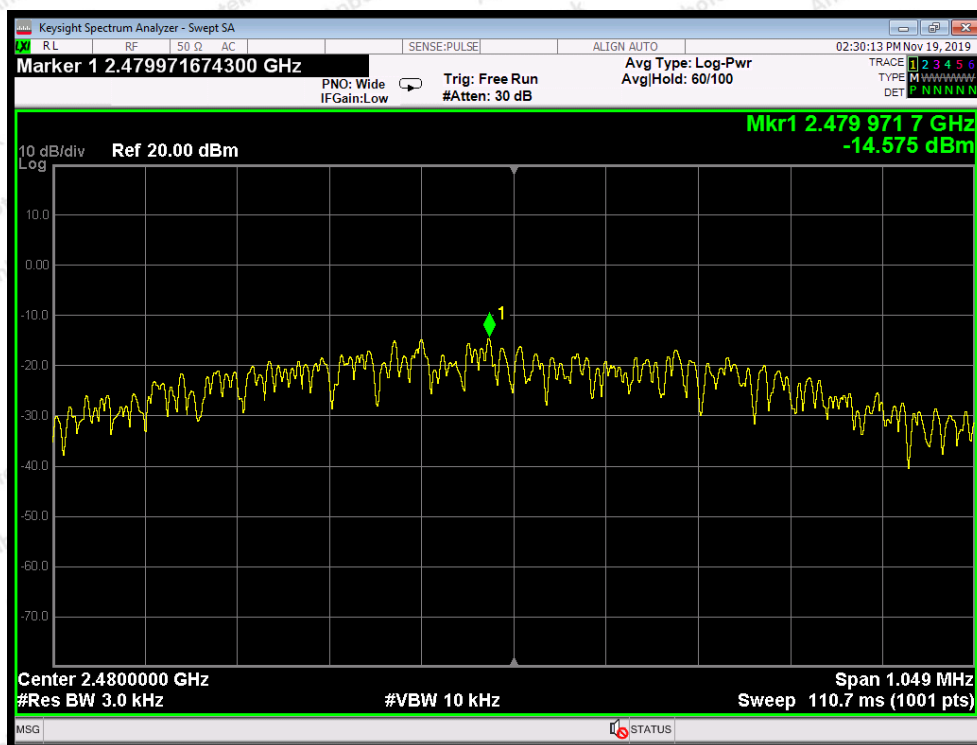
| Channel | Frequency (MHz) | PSD (dBm/3KHz) | Limit (dBm/3KHz) | Results |
|---------|-----------------|----------------|------------------|---------|
| Low     | 2402            | -15.478        | 8.00             | PASS    |
| Middle  | 2440            | -14.916        | 8.00             | PASS    |
| High    | 2480            | -14.575        | 8.00             | PASS    |



CH: Low



CH: Middle



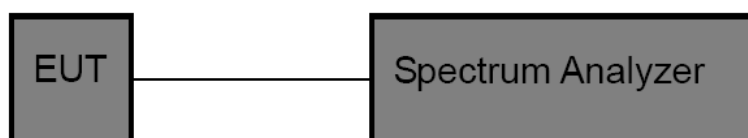
CH: High

## 8. 100kHz Bandwidth of Frequency Band Edge Requirement

### 8.1. Test Standard and Limit

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Standard | FCC Part15 C Section 15.247 (d)                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Test Limit    | in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, 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). |

### 8.2. Test Setup



### 8.3. Test Procedure

Using the following spectrum analyzer setting:

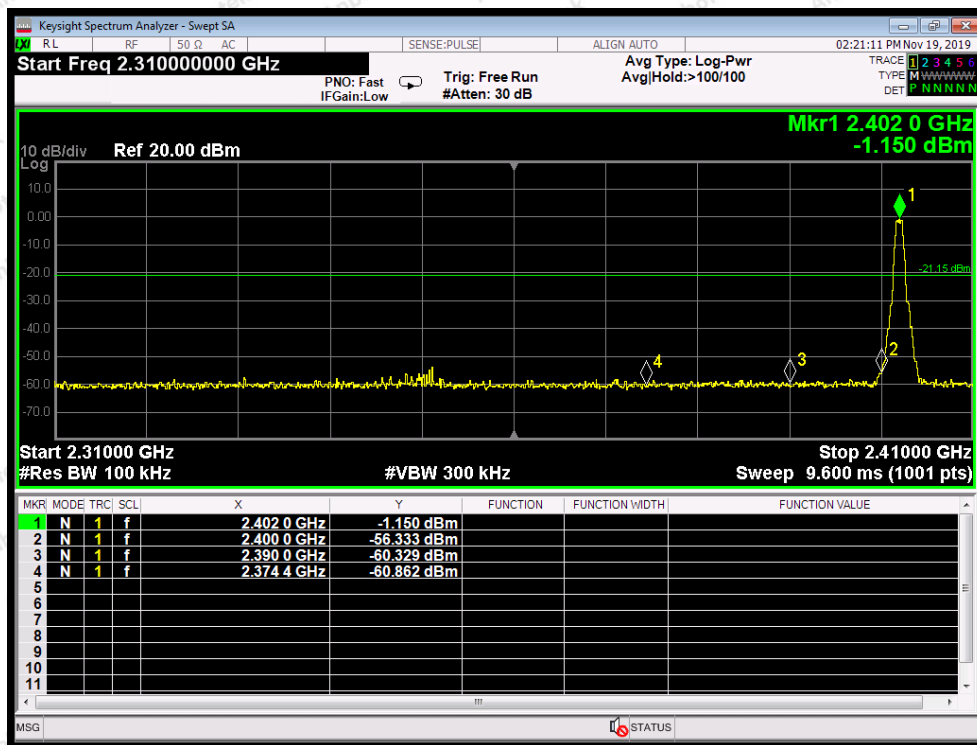
1. Set the RBW = 100KHz.
2. Set the VBW = 300KHz.
3. Sweep time = auto couple.
4. Detector function = peak.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.

### 8.4. Test Data

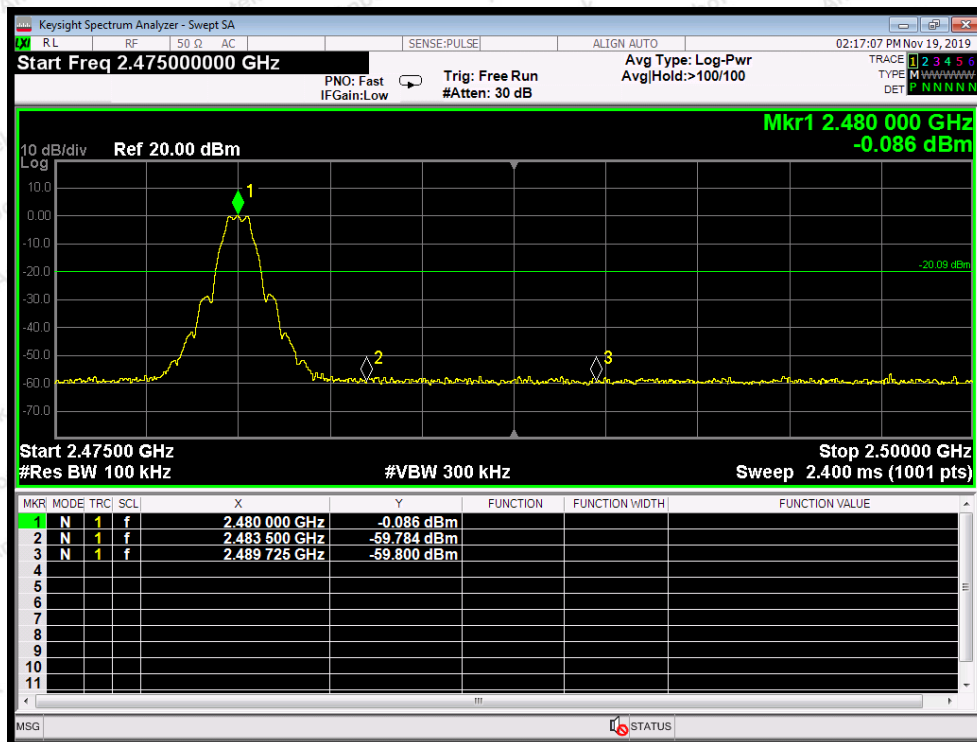
Test Item : Band edge  
 Test Voltage : DC 3V By Battery  
 Test Result : PASS

Test Mode : CH Low ~ CH High  
 Temperature : 24℃  
 Humidity : 55%RH

| Frequency Band (MHz) | Delta Peak to Band Emission (dBc) | Limit (dBc) | Results |
|----------------------|-----------------------------------|-------------|---------|
| 2400                 | 55.183                            | >20         | PASS    |
| 2483.5               | 59.698                            | >20         | PASS    |

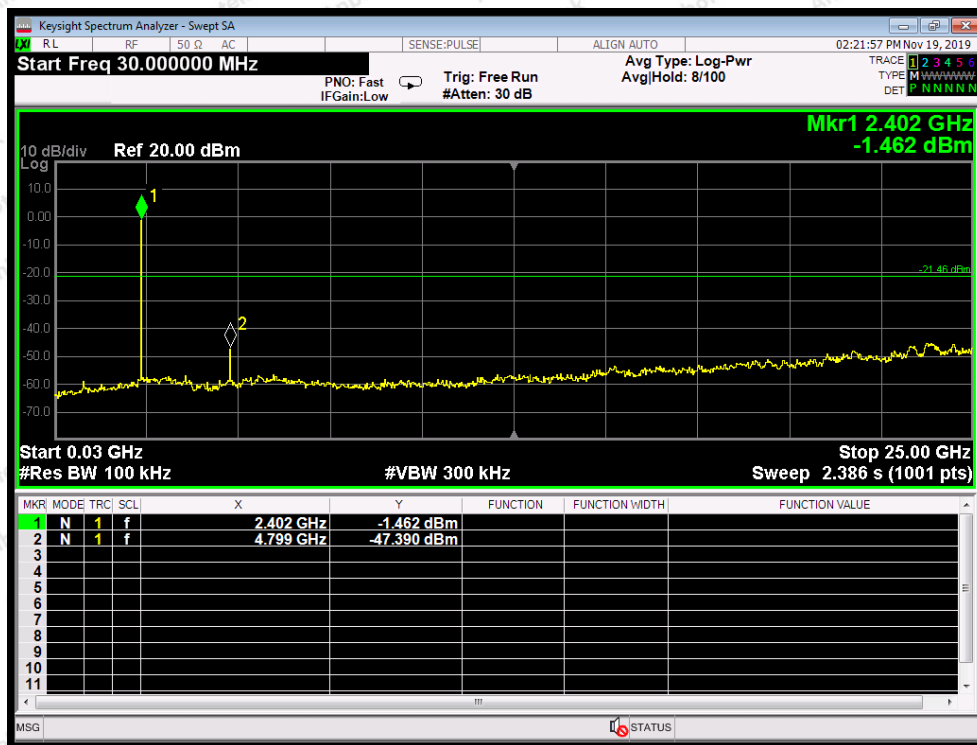


CH: Low

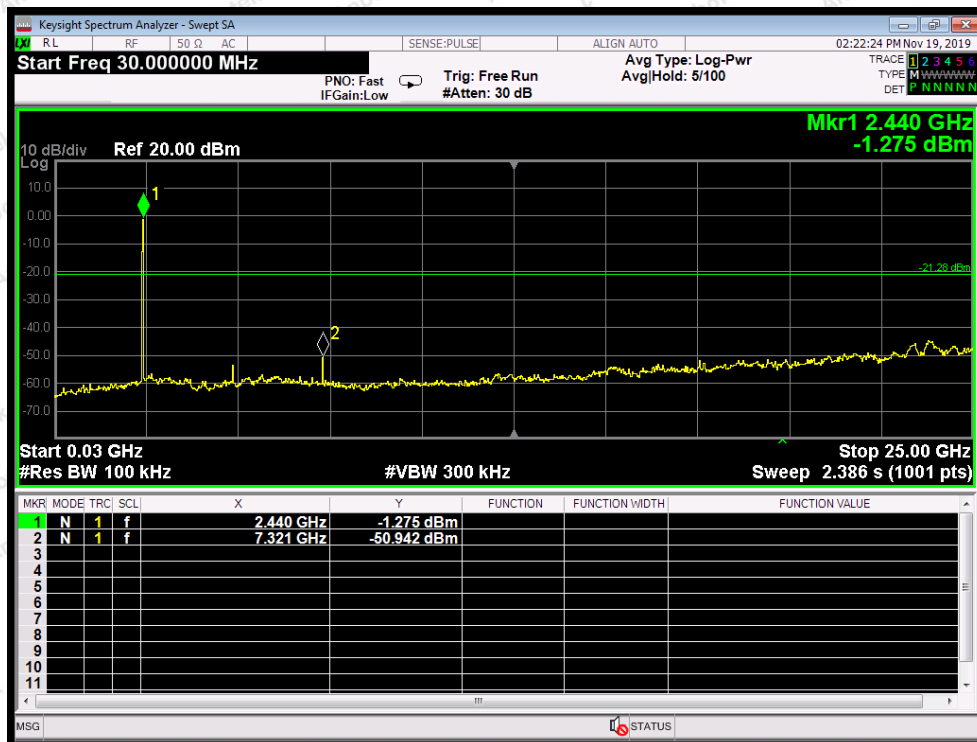


CH: High

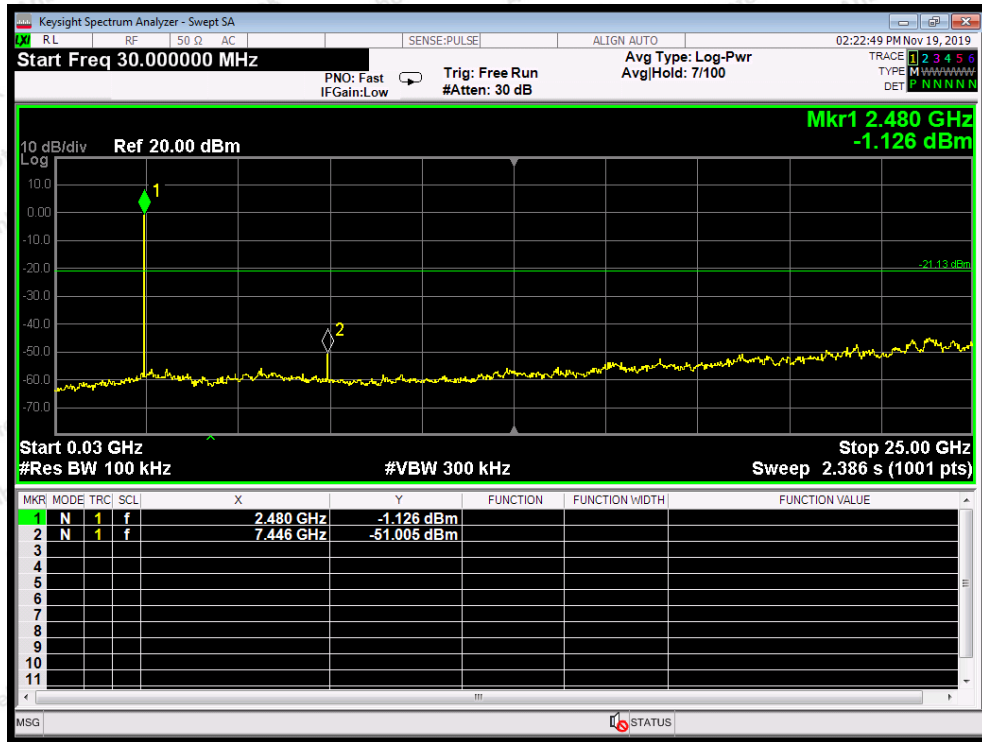
Conducted Emission Method



CH: Low



CH: Middle



CH: High

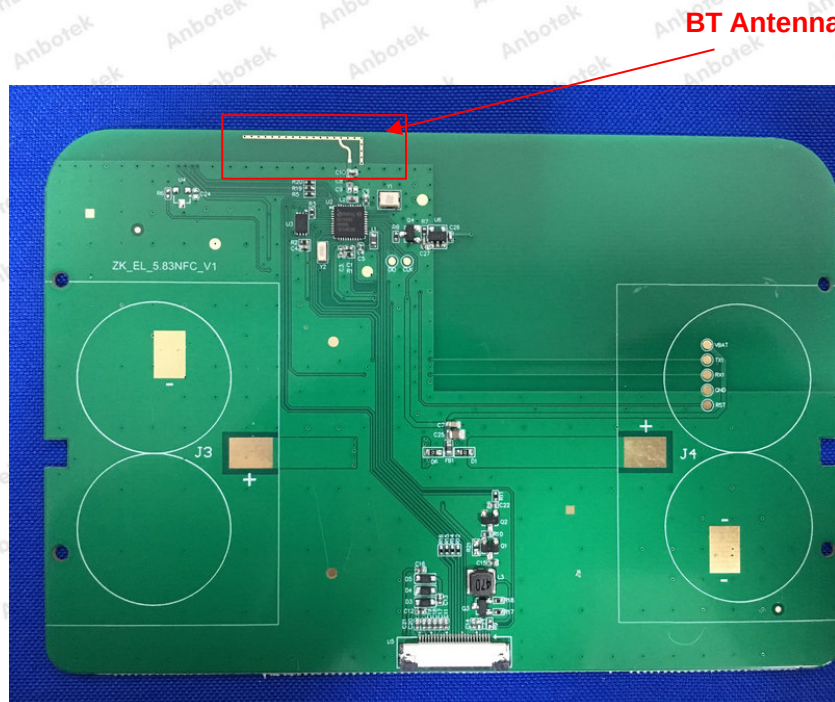
## 9. Antenna Requirement

### 9.1. Test Standard and Requirement

| Test Standard | FCC Part15 Section 15.203 /247(c)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Requirement   | <p>1) 15.203 requirement:<br/>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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.</p> <p>2) 15.247(c) (1)(i) requirement:<br/>Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.</p> |

### 9.2. Antenna Connected Construction

The antenna is a PCB Antenna which permanently attached, and the best case gain of the antenna is 3.29 dBi. It complies with the standard requirement.



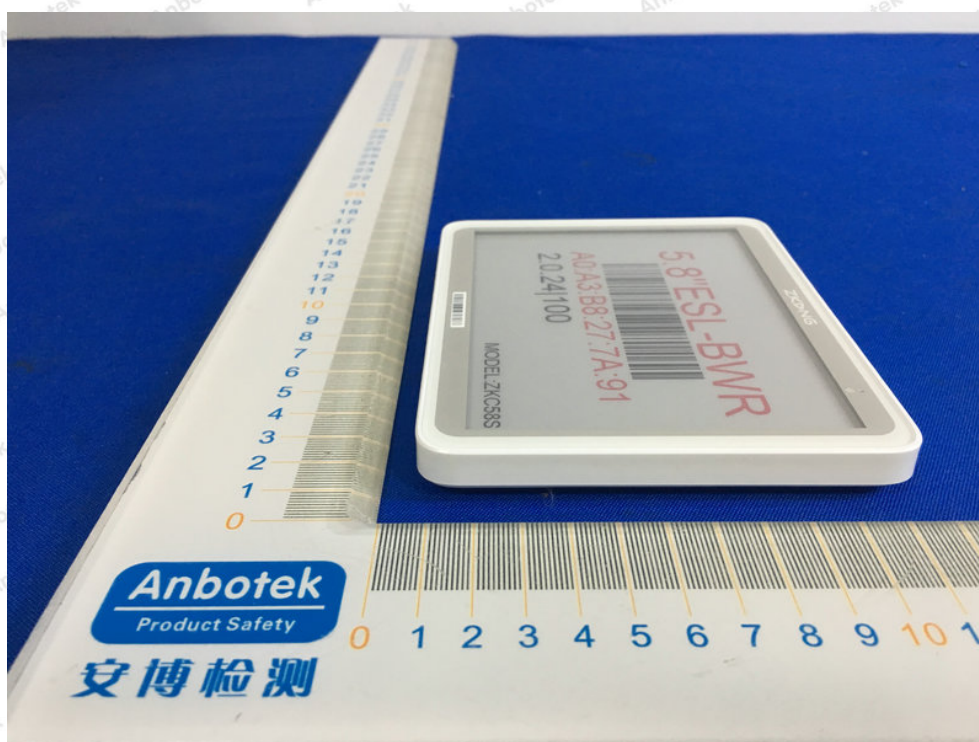
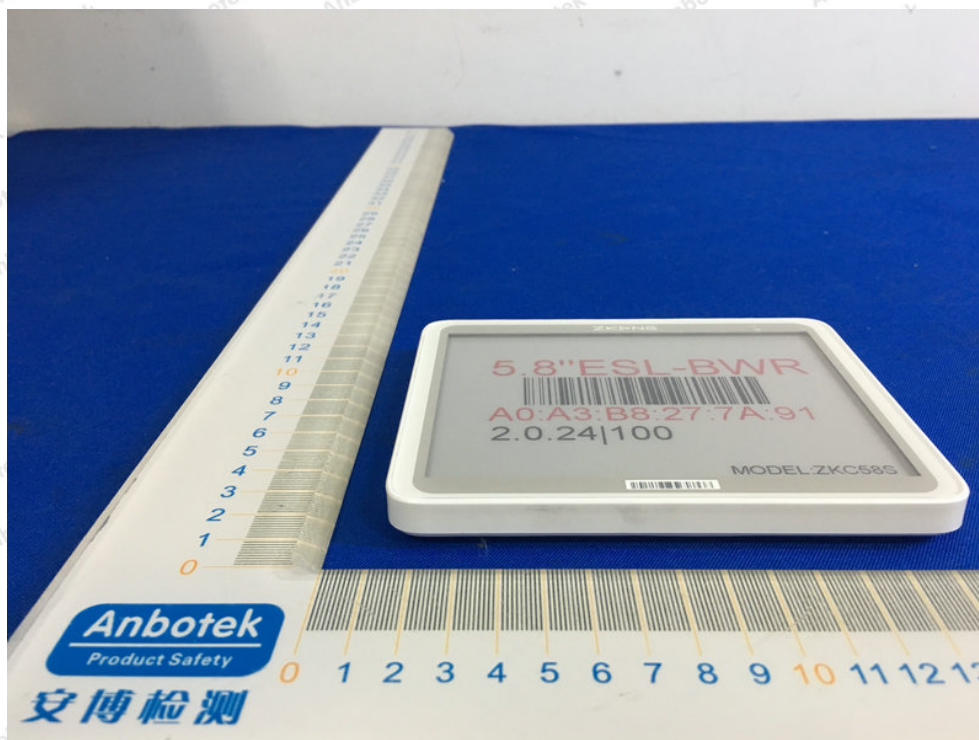
## APPENDIX I -- TEST SETUP PHOTOGRAPH

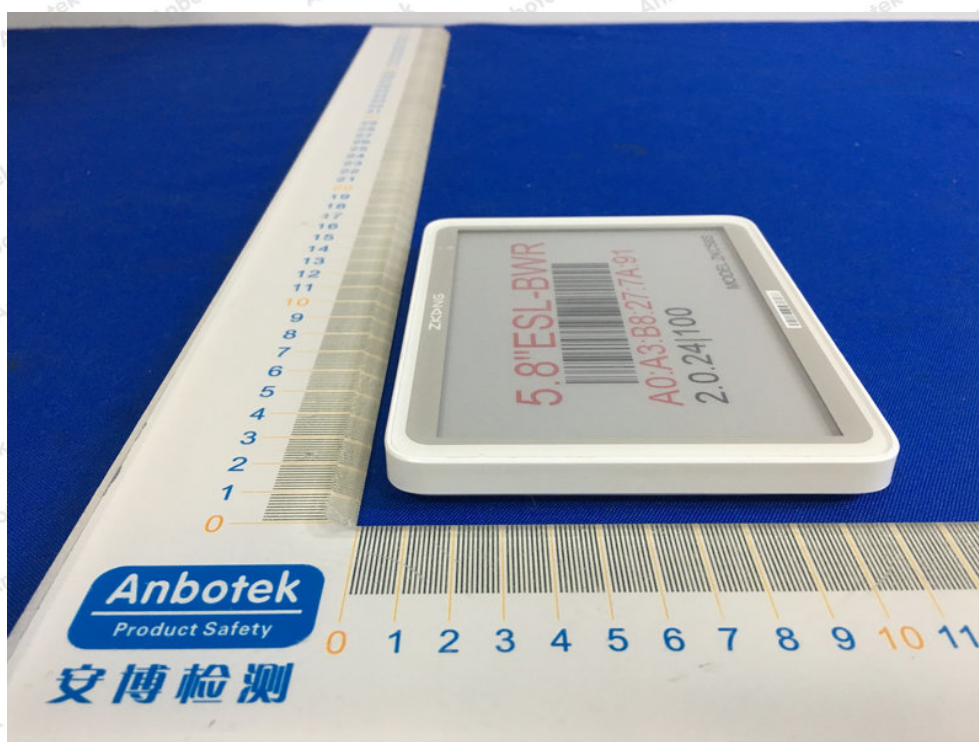
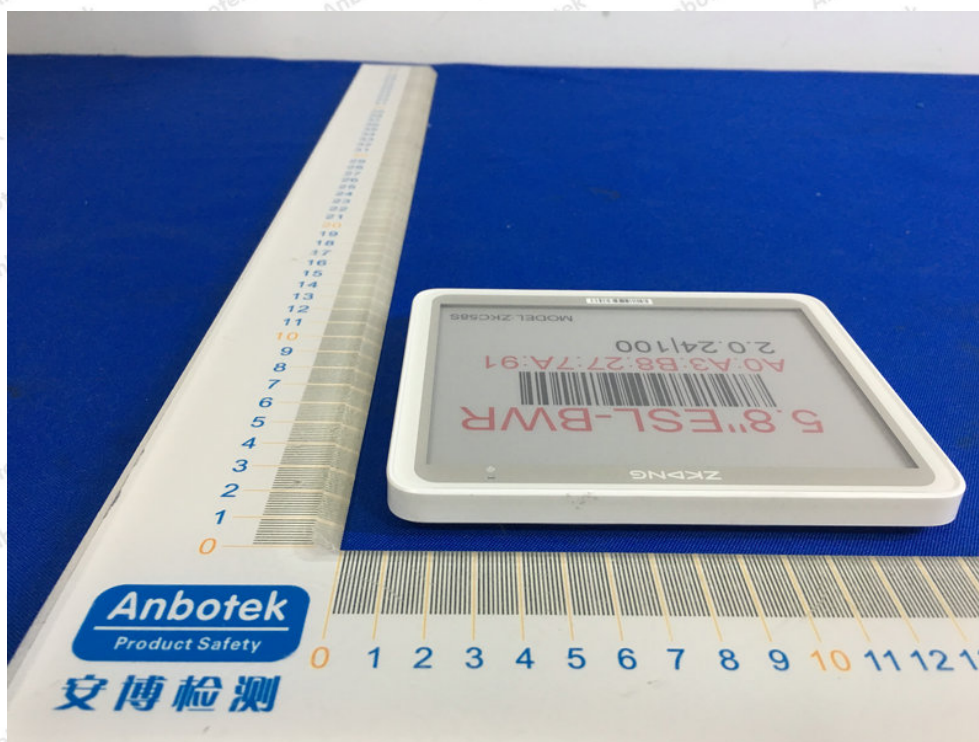
Photo of Radiation Emission Test

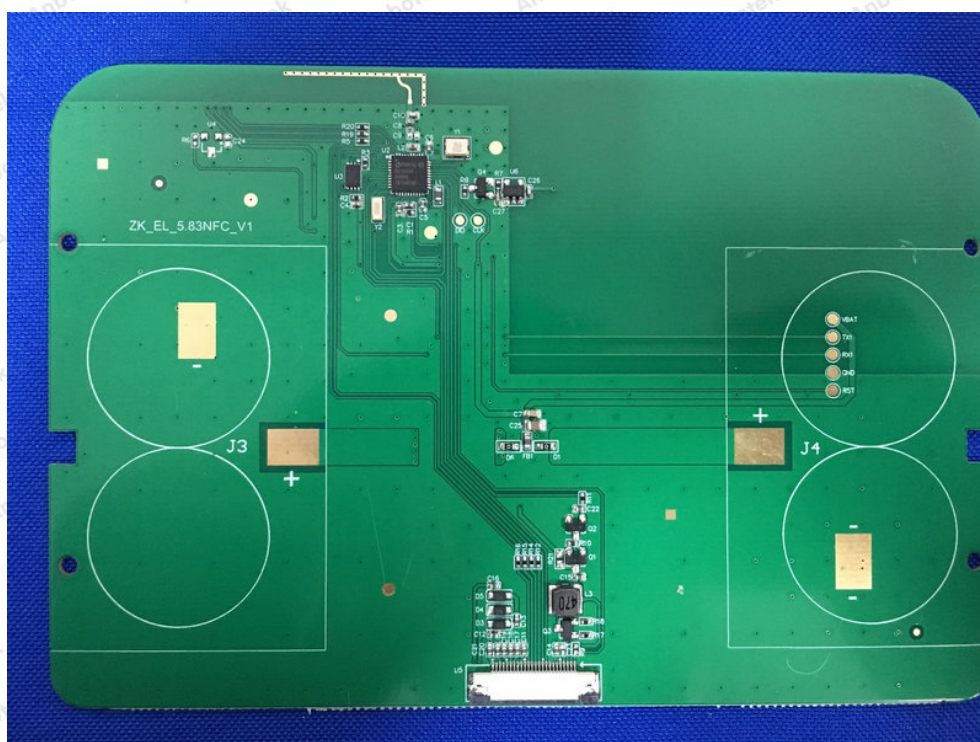
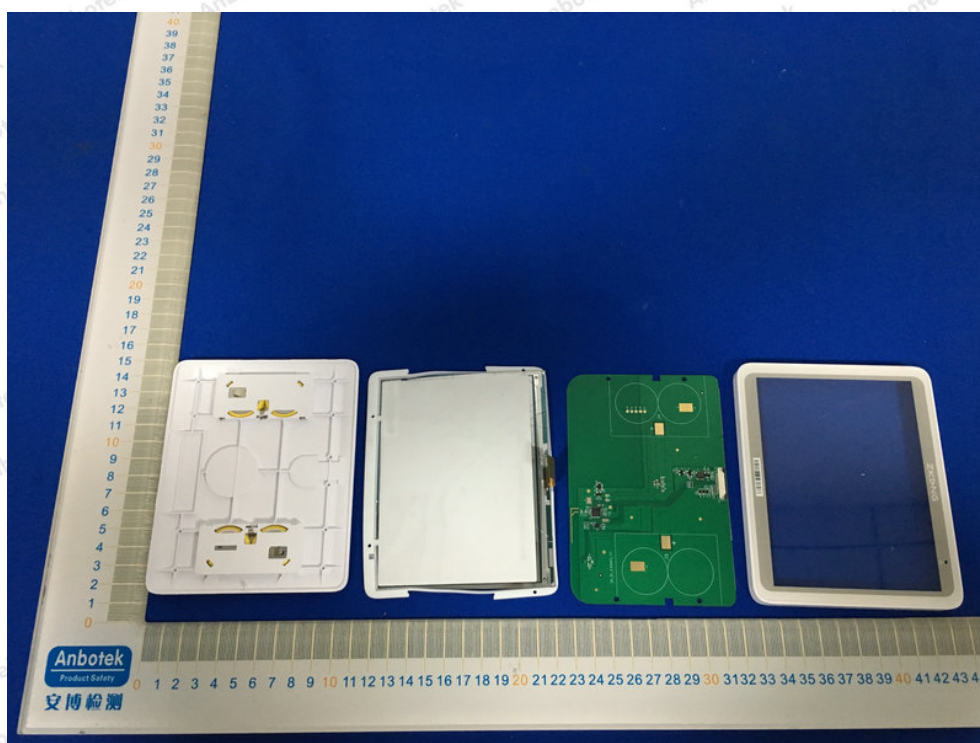


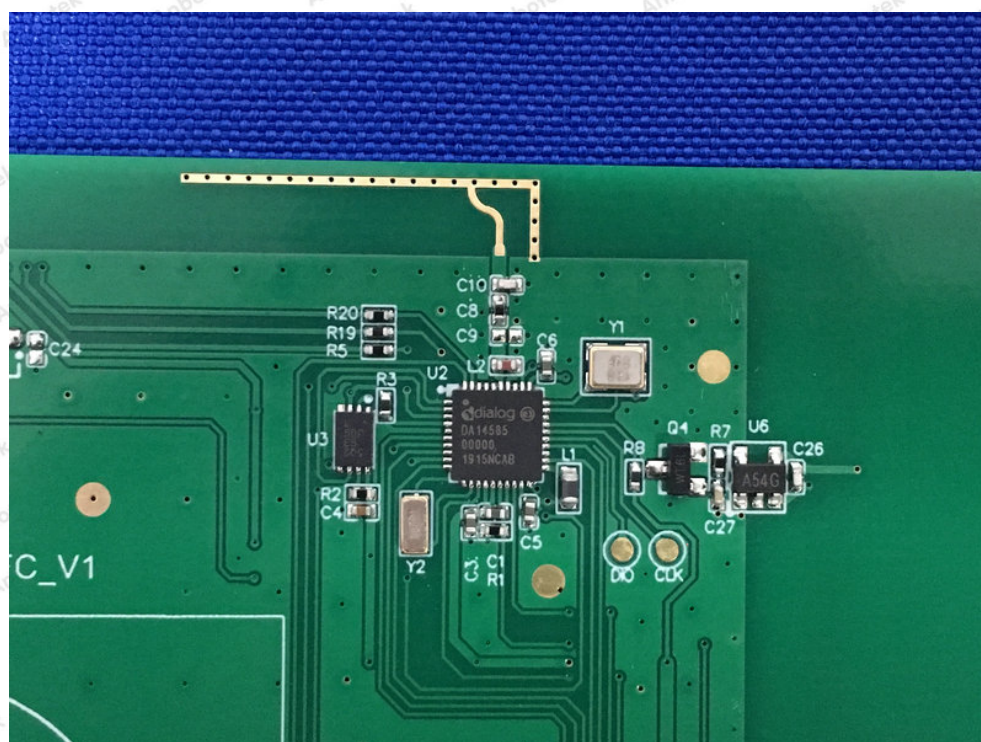
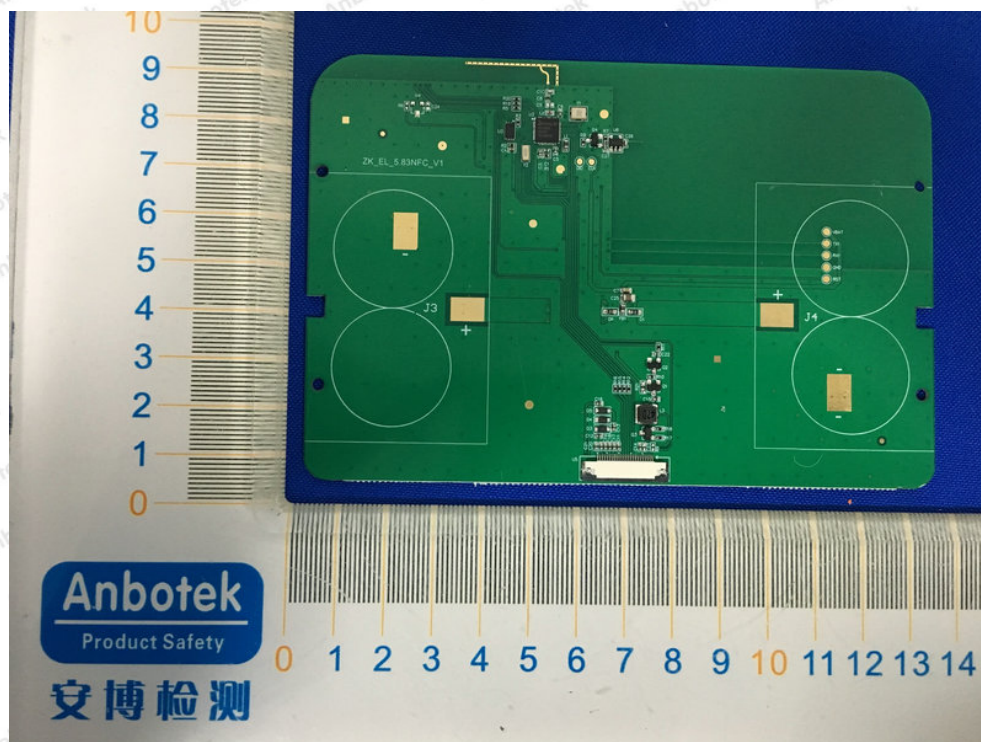
## APPENDIX II -- EXTERNAL PHOTOGRAPH

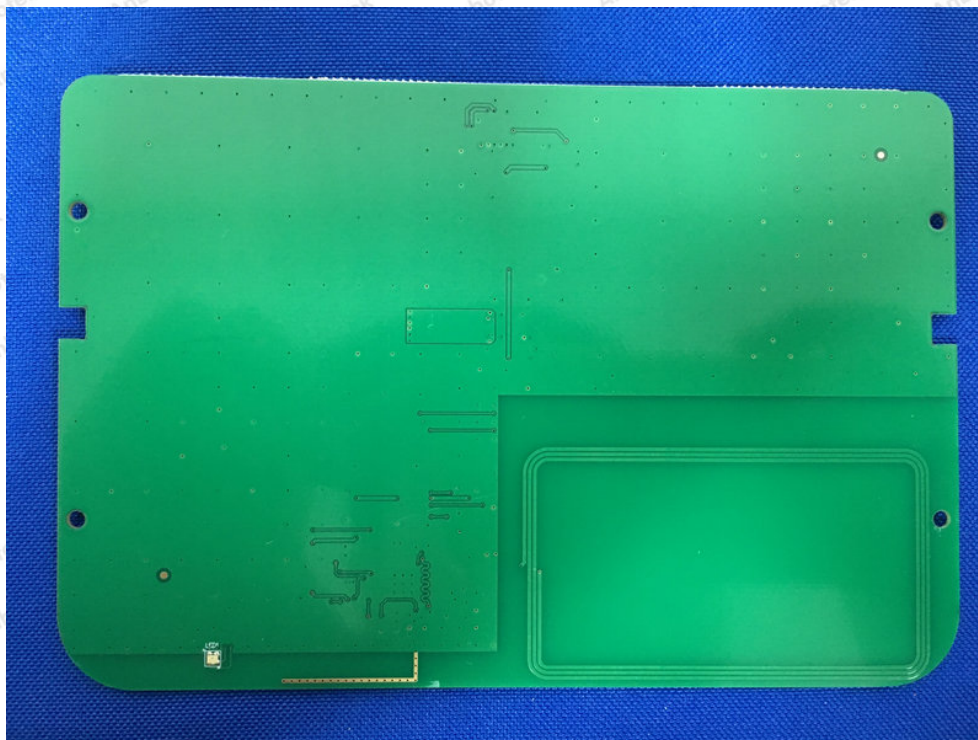


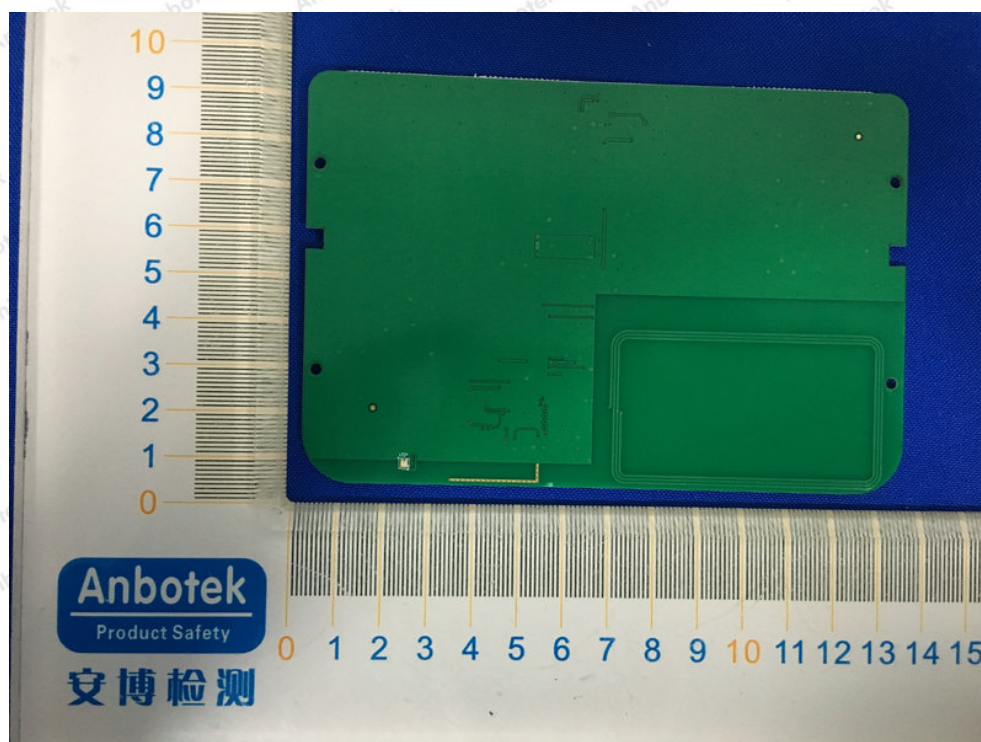




**APPENDIX III -- INTERNAL PHOTOGRAPH**







----- End of Report -----