

# TEST REPORT

Reference No..... : WTS14S0312655E  
FCC ID ..... : SJ8-CA630HR  
Applicant..... : RDI Technology (Shenzhen) Co., Ltd.  
Address..... : Building C1, Xintang Industrial Park East Baishixia, Fuyong, Baoan, Shenzhen, PRC.  
Manufacturer ..... : The same as above  
Address..... : The same as above  
Product Name..... : Digital Wireless Camera  
Model No..... : CA630HR  
Standards..... : FCC CFR47 Part 15 Section 15.247:2012  
Date of Receipt sample .... : Apr.01, 2014  
Date of Test ..... : Apr.02~04, 2014  
Date of Issue..... : Apr.11, 2014  
Test Result..... : **Pass \***

**\*Remarks:**

The results shown in this test report refer only to the sample(s) tested; this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

**Prepared By:**

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## 2 Test Summary

| Test Items                                                        | Test Requirement                 | Result |
|-------------------------------------------------------------------|----------------------------------|--------|
| Conduct Emission                                                  | 15.207                           | PASS   |
| Radiated Spurious Emissions                                       | 15.205(a)<br>15.209<br>15.247(d) | PASS   |
| Band edge                                                         | 15.247(d)<br>15.205(a)           | PASS   |
| 20dB Bandwidth                                                    | 15.247(a)(1)                     | PASS   |
| Maximum Peak Output Power                                         | 15.247(b)(1)                     | PASS   |
| Frequency Separation                                              | 15.247(a)(1)                     | PASS   |
| Number of Hopping Frequency                                       | 15.247(a)(1)(iii)                | PASS   |
| Dwell time                                                        | 15.247(a)(1)(iii)                | PASS   |
| Maximum Permissible Exposure<br>(Exposure of Humans to RF Fields) | 1.1307(b)(1)                     | PASS   |

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## 4 General Information

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

|                       |                                           |
|-----------------------|-------------------------------------------|
| Product Name          | : Digital Wireless Camera                 |
| Model No.             | : CA630HR                                 |
| Operation Frequency   | : 2402MHz ~ 2480MHz, 40 channels in total |
| Type of Modulation    | : GFSK                                    |
| The lowest oscillator | : 32.768kHz                               |
| Antenna installation  | : Monopole antenna                        |
| Antenna Gain          | : 2dBi                                    |

### 4.2 Details of E.U.T.

|                |                                                                              |
|----------------|------------------------------------------------------------------------------|
| Technical Data | :DC 9V, 600mA powered by adapter<br>(Adapter Input: 100-240V~50/60Hz, 200mA) |
| Adapter        | : Csec, M/N:CS6D090060FUF                                                    |

### 4.3 Channel List

| Channel No. | Frequency (MHz) | Channel No. | Frequency (MHz) | Channel No. | Frequency (MHz) |
|-------------|-----------------|-------------|-----------------|-------------|-----------------|
| 1           | 2402            | 15          | 2430            | 29          | 2458            |
| 2           | 2404            | 16          | 2432            | 30          | 2460            |
| 3           | 2406            | 17          | 2434            | 31          | 2462            |
| 4           | 2408            | 18          | 2436            | 32          | 2464            |
| 5           | 2410            | 19          | 2438            | 33          | 2466            |
| 6           | 2412            | 20          | 2440            | 34          | 2468            |
| 7           | 2414            | 21          | 2442            | 35          | 2470            |
| 8           | 2416            | 22          | 2444            | 36          | 2472            |
| 9           | 2418            | 23          | 2446            | 37          | 2474            |
| 10          | 2420            | 24          | 2448            | 38          | 2476            |
| 11          | 2422            | 25          | 2450            | 39          | 2478            |
| 12          | 2424            | 26          | 2452            | 40          | 2480            |
| 13          | 2426            | 27          | 2454            | -           | -               |
| 14          | 2428            | 28          | 2456            | -           | -               |

#### 4.4 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

| Test mode    | Low channel | Middle channel | High channel |
|--------------|-------------|----------------|--------------|
| Transmitting | 2402MHz     | 2440MHz        | 2480MHz      |

#### 4.5 Test Facility

The test facility has a test site registered with the following organizations:

- **IC – Registration No.: 7760A-1**

Waltek Services (Shenzhen) Co., Ltd. has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files.

Registration 7760A-1, July 12, 2012.

- **FCC – Registration No.: 880581**

Waltek Services (Shenzhen) Co., Ltd. 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 880581, May 26, 2011.

## 5 Equipment Used during Test

### 5.1 Equipments List

| Conducted Emissions                              |                            |                      |               |                 |                       |                      |
|--------------------------------------------------|----------------------------|----------------------|---------------|-----------------|-----------------------|----------------------|
| Item                                             | Equipment                  | Manufacturer         | Model No.     | Serial No.      | Last Calibration Date | Calibration Due Date |
| 1.                                               | EMI Test Receiver          | R&S                  | ESCI          | 101155          | Sep.18,2013           | Sep.17,2014          |
| 2.                                               | LISN                       | SCHWARZBECK          | NSLK 8128     | 8128-289        | Sep.18,2013           | Sep.17,2014          |
| 3.                                               | Limiter                    | York                 | MTS-IMP-136   | 261115-001-0024 | Sep.18,2013           | Sep.17,2014          |
| 4.                                               | Cable                      | LARGE                | RF300         | -               | Sep.18,2013           | Sep.17,2014          |
| 3m Semi-anechoic Chamber for Radiation Emissions |                            |                      |               |                 |                       |                      |
| Item                                             | Equipment                  | Manufacturer         | Model No.     | Serial No.      | Last Calibration Date | Calibration Due Date |
| 1                                                | EMC Analyzer               | Agilent              | E7405A        | MY45114943      | Sep.18,2013           | Sep.17,2014          |
| 2                                                | Active Loop Antenna        | Beijing Dazhi        | ZN30900A      | -               | Sep.18,2013           | Sep.17,2014          |
| 3                                                | Trilog Broadband Antenna   | SCHWARZBECK          | VULB9163      | 336             | Apr.20,2013           | Apr.19,2014          |
| 4                                                | Coaxial Cable (below 1GHz) | Top                  | TYPE16(13M)   | -               | Sep.18,2013           | Sep.17,2014          |
| 5                                                | Broad-band Horn Antenna    | SCHWARZBECK          | BBHA 9120 D   | 667             | Apr.20,2013           | Apr.19,2014          |
| 6                                                | Broadband Preamplifier     | COMPLIANCE DIRECTION | PAP-1G18      | 2004            | Mar.17,2014           | Mar.16,2015          |
| 7                                                | Coaxial Cable (above 1GHz) | Top                  | 1000MHZ-25GHz | EW02014-7       | Apr.20,2013           | Apr.19,2014          |
| 8                                                | Broad-band Horn Antenna    | SCHWARZBECK          | BBHA 9170     | 335             | Apr.20,2013           | Apr.19,2014          |

### 5.2 Measurement Uncertainty

| Parameter                         | Uncertainty                                 |
|-----------------------------------|---------------------------------------------|
| Radio Frequency                   | $\pm 1 \times 10^{-6}$                      |
| RF Power                          | $\pm 1.0$ dB                                |
| RF Power Density                  | $\pm 2.2$ dB                                |
| Radiated Spurious Emissions test  | $\pm 5.03$ dB (Bilog antenna 30M~1000MHz)   |
|                                   | $\pm 5.47$ dB (Horn antenna 1000M~25000MHz) |
| Conducted Spurious Emissions test | $\pm 3.64$ dB (AC mains 150KHz~30MHz)       |

### 5.3 Test Equipment Calibration

All the test equipments used are valid and calibrated by CEPREI Certification Body that address is No.110 Dongguan Zhuang RD. Guangzhou, P.R.China.

## 6 Conducted Emission

|                   |                                                                                                                        |
|-------------------|------------------------------------------------------------------------------------------------------------------------|
| Test Requirement: | FCC CFR 47 Part 15 Section 15.207                                                                                      |
| Test Method:      | ANSI C63.4:2003                                                                                                        |
| Test Result:      | PASS                                                                                                                   |
| Frequency Range:  | 150kHz to 30MHz                                                                                                        |
| Class/Severity:   | Class B                                                                                                                |
| Limit:            | 66-56 dB $\mu$ V between 0.15MHz & 0.5MHz<br>56 dB $\mu$ V between 0.5MHz & 5MHz<br>60 dB $\mu$ V between 5MHz & 30MHz |
| Detector:         | Peak for pre-scan (9kHz Resolution Bandwidth)                                                                          |

### 6.1 E.U.T. Operation

Operating Environment :

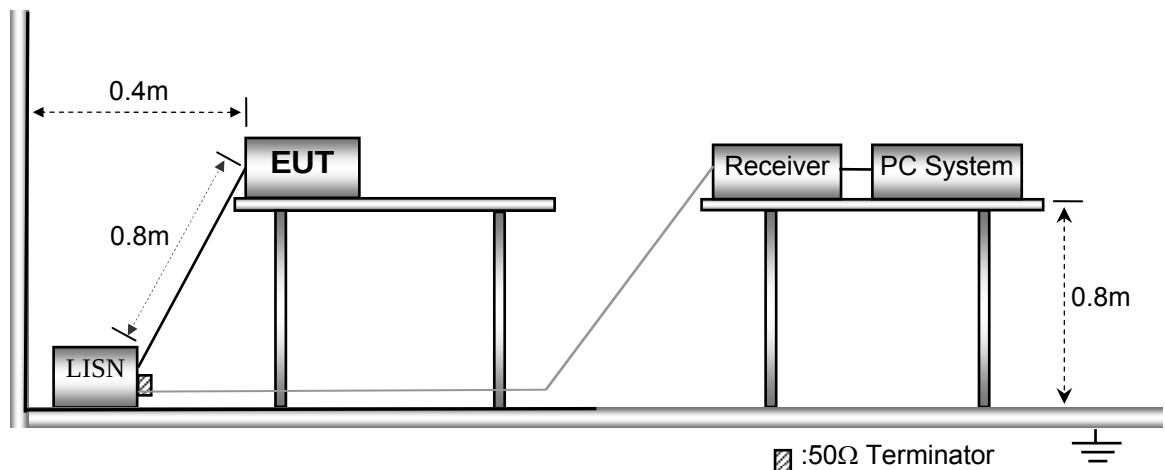
|                       |           |
|-----------------------|-----------|
| Temperature:          | 22.6 °C   |
| Humidity:             | 52.5 % RH |
| Atmospheric Pressure: | 101.2kPa  |

EUT Operation :

The test was performed in transmitting mode, the test data were shown in the report.

### 6.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.4:2003.

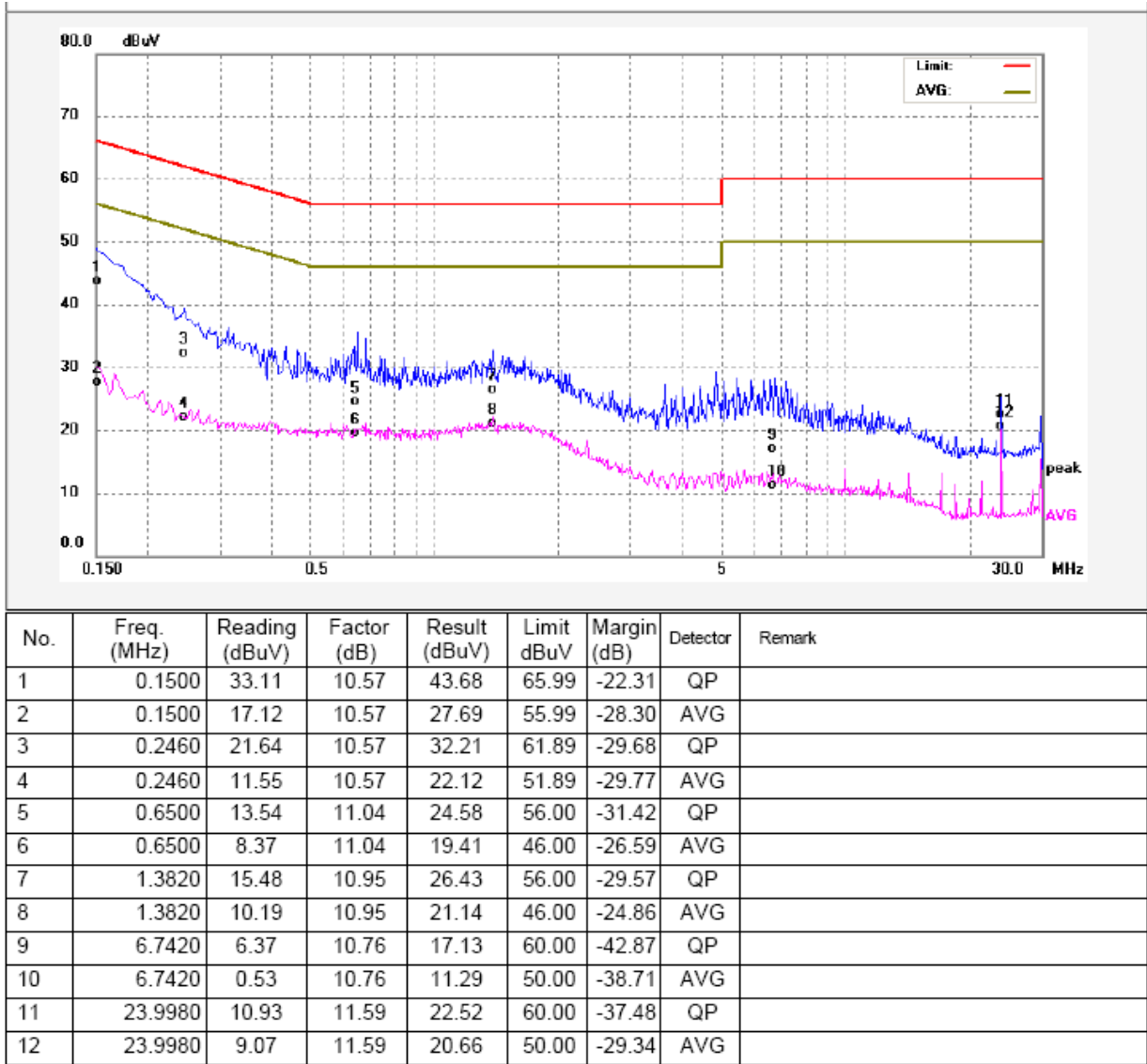


### 6.3 Measurement Description

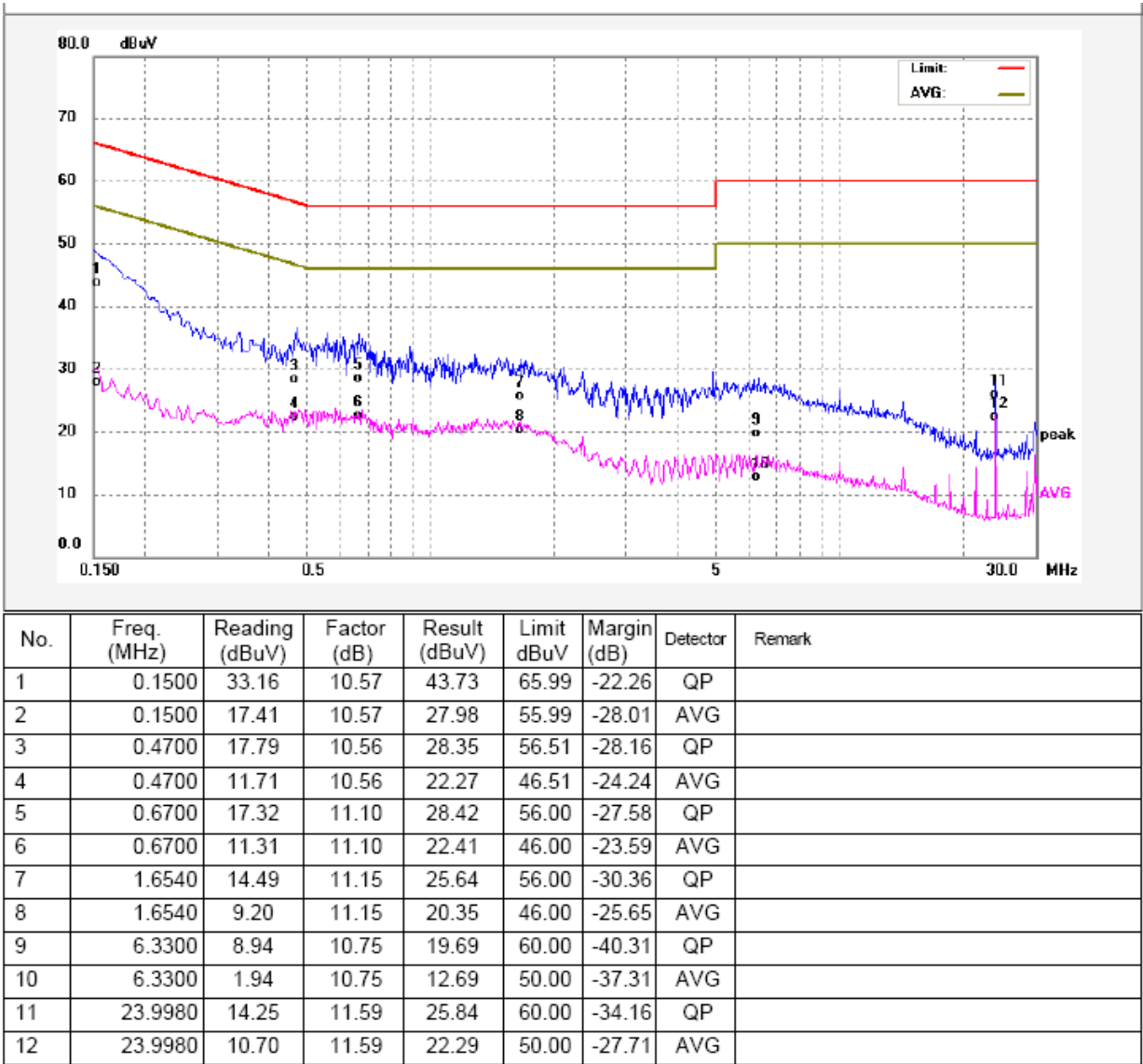
The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

6.4 Conducted Emission Test Result

Live line:



Neutral line:



## 7 Radiated Spurious Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.209 & 15.247

Test Method: DA 00-705

Test Result: PASS

Measurement Distance: 3m

Limit:

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

### 7.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

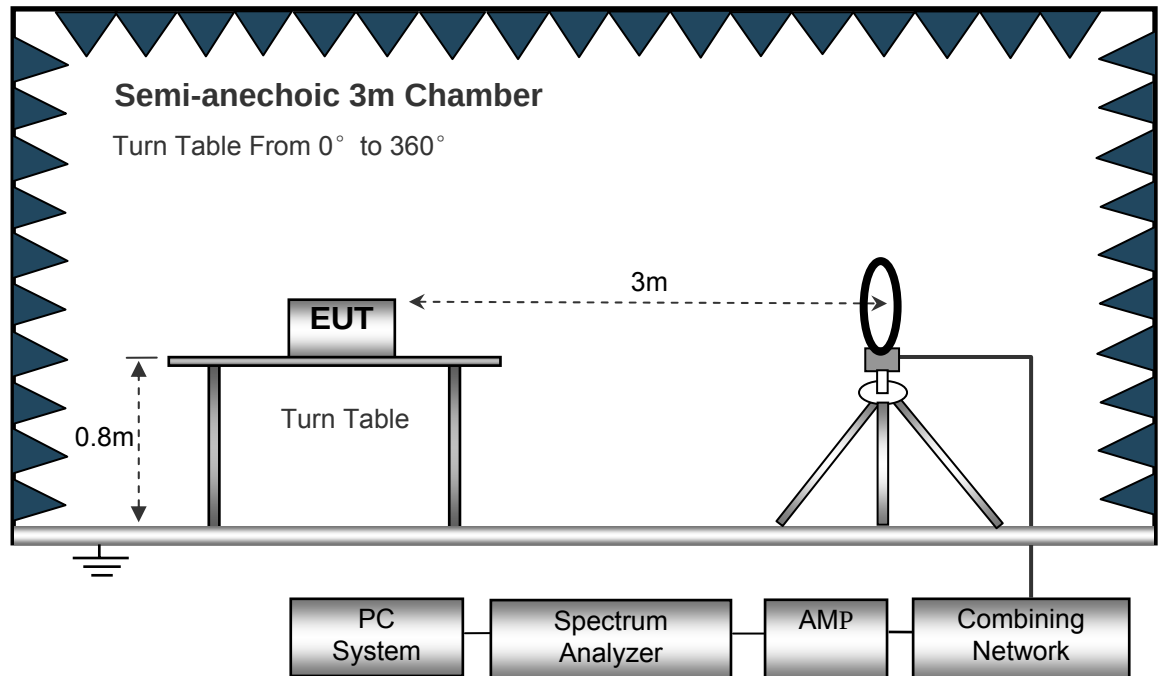
EUT Operation :

The test was performed in transmitting mode, the test data were shown in the report.

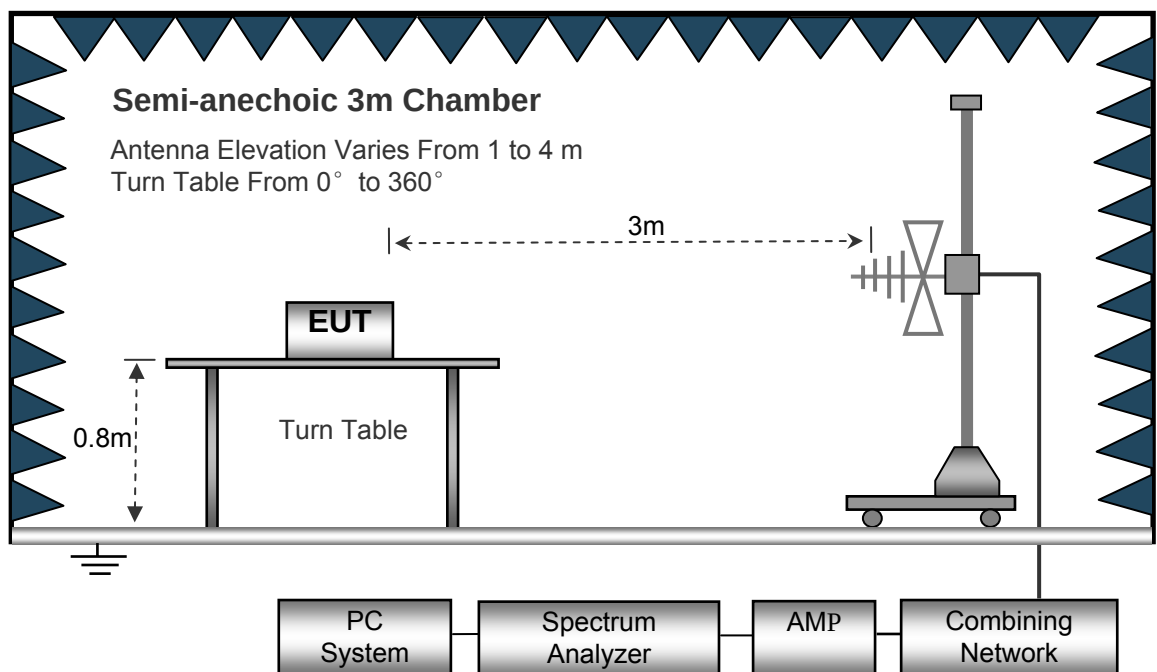
## 7.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.4: 2003.

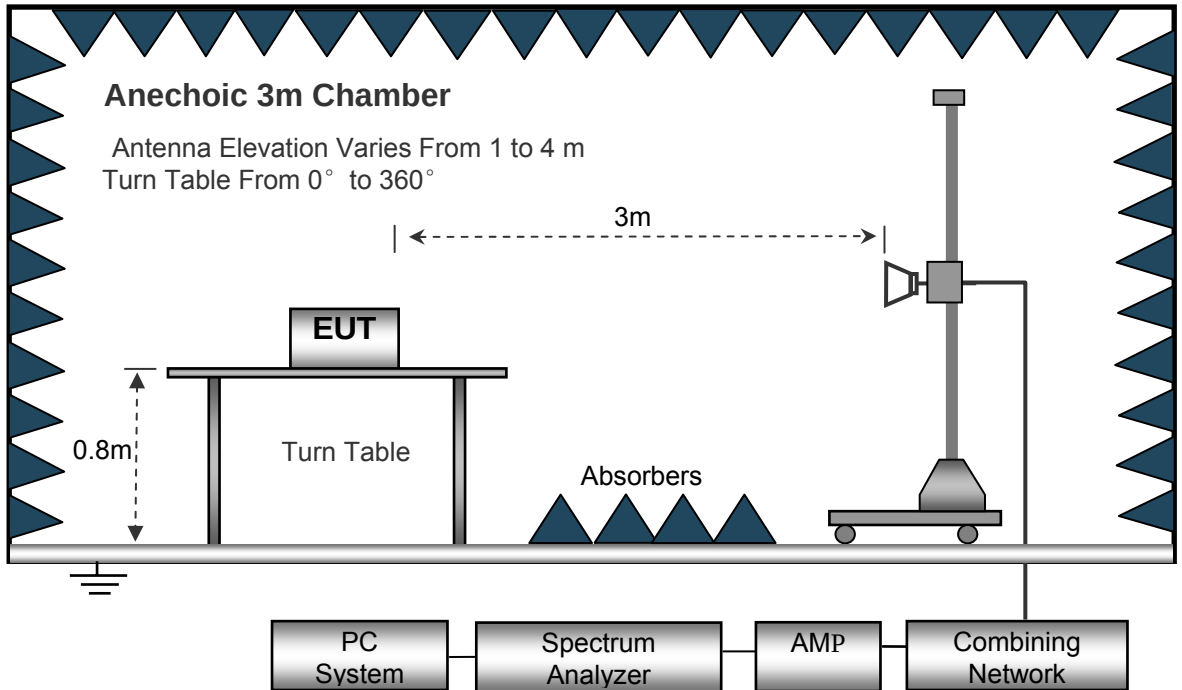
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



### 7.3 Spectrum Analyser Setup

Below 30MHz

Sweep Speed ..... Auto  
IF Bandwidth..... 10kHz  
Video Bandwidth..... 10kHz  
Resolution Bandwidth..... 10kHz

30MHz ~ 1GHz

Sweep Speed ..... Auto  
Detector ..... PK  
Resolution Bandwidth..... 100kHz  
Video Bandwidth..... 300kHz

Above 1GHz

Sweep Speed ..... Auto  
Detector ..... PK  
Resolution Bandwidth..... 1MHz  
Video Bandwidth..... 3MHz  
Detector ..... Ave.  
Resolution Bandwidth..... 1MHz  
Video Bandwidth..... 10Hz

## 7.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.

## 7.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Limit}$$

## 7.6 Summary of Test Results

### Test Frequency: Below 30MHz

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

### Test Frequency: 30MHz ~ 18GHz

Test mode: transmitting mode

| Frequency        | Receiver Reading | Detector    | Turn table Angle | RX Antenna |       | Corrected Factor | Corrected Amplitude | Limit    | Margin |
|------------------|------------------|-------------|------------------|------------|-------|------------------|---------------------|----------|--------|
|                  |                  |             |                  | Height     | Polar |                  |                     |          |        |
| (MHz)            | (dBμV)           | (PK/QP/Ave) | Degree           | (m)        | (H/V) | (dB/m)           | (dBμV/m)            | (dBμV/m) | (dB)   |
| GFSK Low Channel |                  |             |                  |            |       |                  |                     |          |        |
| 199.10           | 23.12            | QP          | 315              | 1.2        | H     | 11.13            | 34.25               | 40.00    | -5.75  |
| 199.10           | 19.69            | QP          | 35               | 1.4        | V     | 11.13            | 30.82               | 40.00    | -9.18  |
| 4804.00          | 52.90            | PK          | 74               | 1.5        | V     | -1.06            | 51.84               | 74.00    | -22.16 |
| 4804.00          | 43.28            | Ave         | 74               | 1.5        | V     | -1.06            | 42.22               | 54.00    | -11.78 |
| 7206.00          | 41.81            | PK          | 9                | 1.3        | H     | 1.33             | 43.14               | 74.00    | -30.86 |
| 7206.00          | 38.28            | Ave         | 9                | 1.3        | H     | 1.33             | 39.61               | 54.00    | -14.39 |
| 2314.65          | 45.06            | PK          | 270              | 1.3        | V     | -13.19           | 31.87               | 74.00    | -42.13 |
| 2314.65          | 39.61            | Ave         | 270              | 1.3        | V     | -13.19           | 26.42               | 54.00    | -27.58 |
| 2382.40          | 42.90            | PK          | 325              | 1.2        | H     | -13.14           | 29.76               | 74.00    | -44.24 |
| 2382.40          | 37.39            | Ave         | 325              | 1.2        | H     | -13.14           | 24.25               | 54.00    | -29.75 |
| 2489.28          | 43.86            | PK          | 356              | 1.6        | V     | -13.08           | 30.78               | 74.00    | -43.22 |
| 2489.28          | 36.73            | Ave         | 356              | 1.6        | V     | -13.08           | 23.65               | 54.00    | -30.35 |

| Frequency           | Receiver Reading | Detector    | Turn table Angle | RX Antenna |       | Corrected Factor | Corrected Amplitude | Limit    | Margin |
|---------------------|------------------|-------------|------------------|------------|-------|------------------|---------------------|----------|--------|
|                     |                  |             |                  | Height     | Polar |                  |                     |          |        |
| (MHz)               | (dBμV)           | (PK/QP/Ave) | Degree           | (m)        | (H/V) | (dB/m)           | (dBμV/m)            | (dBμV/m) | (dB)   |
| GFSK Middle Channel |                  |             |                  |            |       |                  |                     |          |        |
| 199.10              | 23.75            | QP          | 15               | 1.7        | H     | 11.13            | 34.88               | 40.00    | -5.12  |
| 199.10              | 19.49            | QP          | 118              | 1.4        | V     | 11.13            | 30.62               | 40.00    | -9.38  |
| 4880.00             | 53.23            | PK          | 311              | 1.5        | V     | -0.62            | 52.61               | 74.00    | -21.39 |
| 4880.00             | 44.21            | Ave         | 311              | 1.5        | V     | -0.62            | 43.59               | 54.00    | -10.41 |
| 7320.00             | 40.66            | PK          | 288              | 1.2        | H     | 2.21             | 42.87               | 74.00    | -31.13 |
| 7320.00             | 37.35            | Ave         | 288              | 1.2        | H     | 2.21             | 39.56               | 54.00    | -14.44 |
| 2334.82             | 45.54            | PK          | 205              | 1.4        | V     | -13.19           | 32.35               | 74.00    | -41.65 |
| 2334.82             | 37.16            | Ave         | 205              | 1.4        | V     | -13.19           | 23.97               | 54.00    | -30.03 |
| 2361.47             | 42.19            | PK          | 259              | 1.4        | H     | -13.14           | 29.05               | 74.00    | -44.95 |
| 2361.47             | 38.60            | Ave         | 259              | 1.4        | H     | -13.14           | 25.46               | 54.00    | -28.54 |
| 2497.01             | 44.63            | PK          | 209              | 2.0        | V     | -13.08           | 31.55               | 74.00    | -42.45 |
| 2497.01             | 37.69            | Ave         | 209              | 2.0        | V     | -13.08           | 24.61               | 54.00    | -29.39 |

| Frequency         | Receiver Reading | Detector    | Turn table Angle | RX Antenna |       | Corrected Factor | Corrected Amplitude | Limit    | Margin |
|-------------------|------------------|-------------|------------------|------------|-------|------------------|---------------------|----------|--------|
|                   |                  |             |                  | Height     | Polar |                  |                     |          |        |
| (MHz)             | (dBμV)           | (PK/QP/Ave) | Degree           | (m)        | (H/V) | (dB/m)           | (dBμV/m)            | (dBμV/m) | (dB)   |
| GFSK High Channel |                  |             |                  |            |       |                  |                     |          |        |
| 199.10            | 23.14            | QP          | 209              | 1.5        | H     | 11.13            | 34.27               | 40.00    | -5.73  |
| 199.10            | 20.74            | QP          | 86               | 1.5        | V     | 11.13            | 31.87               | 40.00    | -8.13  |
| 4960.00           | 52.83            | PK          | 128              | 1.2        | V     | -0.24            | 52.59               | 74.00    | -21.41 |
| 4960.00           | 44.85            | Ave         | 128              | 1.2        | V     | -0.24            | 44.61               | 54.00    | -9.39  |
| 7440.00           | 40.25            | PK          | 140              | 1.2        | H     | 2.84             | 43.09               | 74.00    | -30.91 |
| 7440.00           | 38.73            | Ave         | 140              | 1.2        | H     | 2.84             | 41.57               | 54.00    | -12.43 |
| 2311.92           | 45.04            | PK          | 113              | 1.4        | V     | -13.19           | 31.85               | 74.00    | -42.15 |
| 2311.92           | 39.03            | Ave         | 113              | 1.4        | V     | -13.19           | 25.84               | 54.00    | -28.16 |
| 2382.79           | 44.07            | PK          | 163              | 1.6        | H     | -13.14           | 30.93               | 74.00    | -43.07 |
| 2382.79           | 38.75            | Ave         | 163              | 1.6        | H     | -13.14           | 25.61               | 54.00    | -28.39 |
| 2492.26           | 43.98            | PK          | 109              | 1.9        | V     | -13.08           | 30.90               | 74.00    | -43.10 |
| 2492.26           | 37.38            | Ave         | 109              | 1.9        | V     | -13.08           | 24.30               | 54.00    | -29.70 |

**Test Frequency: Above 18GHz**

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

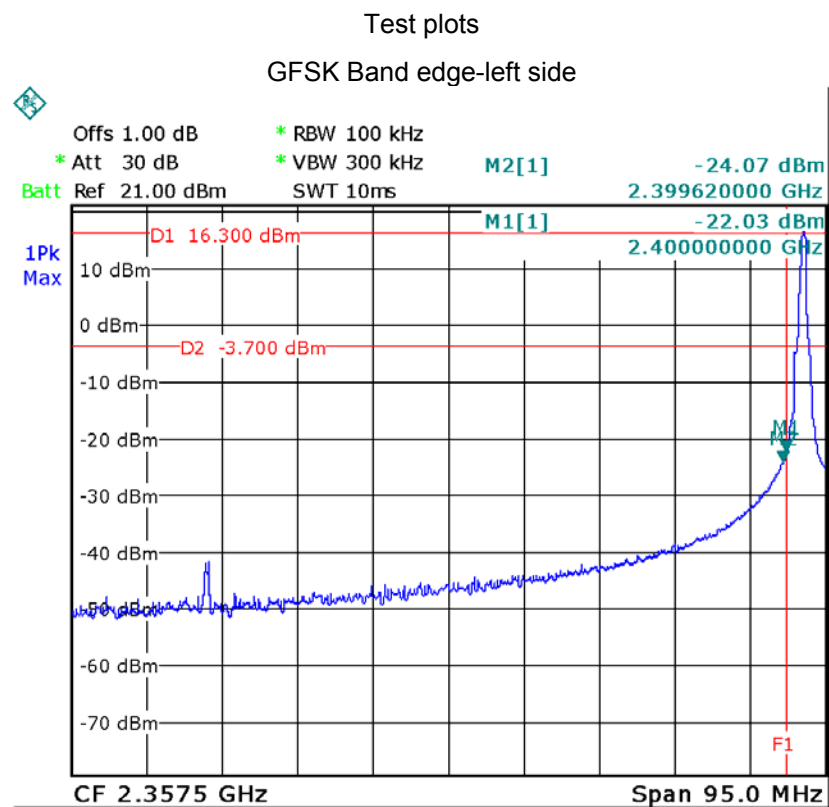
## 8 Band Edge Measurement

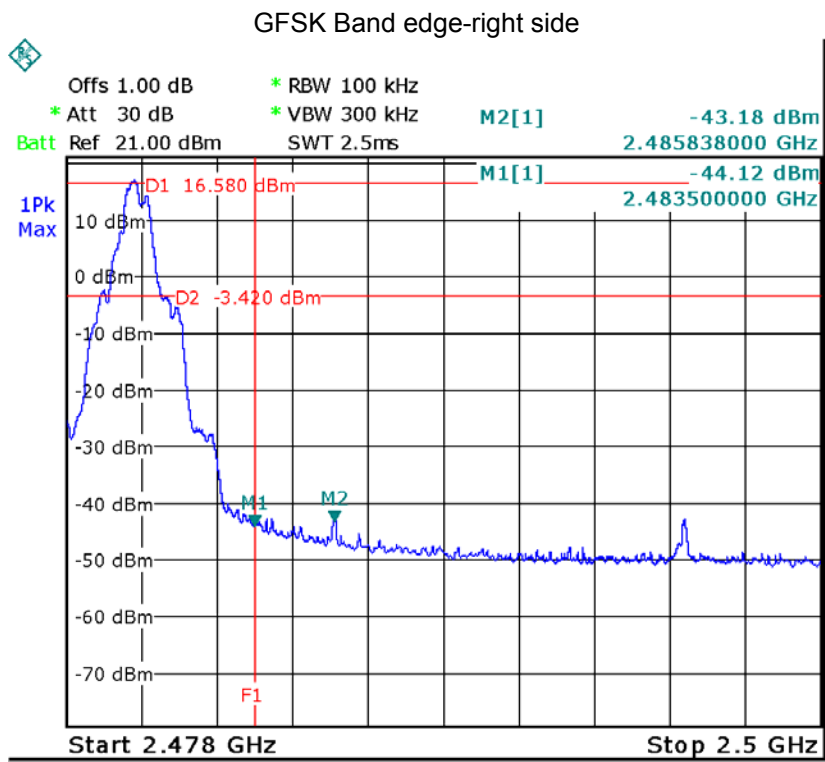
|                   |                                                                                                                                                                                                                                   |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement: | Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)). |
| Test Method:      | DA 00-705                                                                                                                                                                                                                         |
| Test Mode:        | Transmitting                                                                                                                                                                                                                      |

### 8.1 Test Procedure

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

### 8.2 Test Result





## 9 20 dB Bandwidth Measurement

Test Requirement: FCC CFR47 Part 15 Section 15.247  
 Test Method: DA 00-705  
 Test Mode: Test in fixing operating frequency at low, Middle, high channel.

### 9.1 Test Procedure

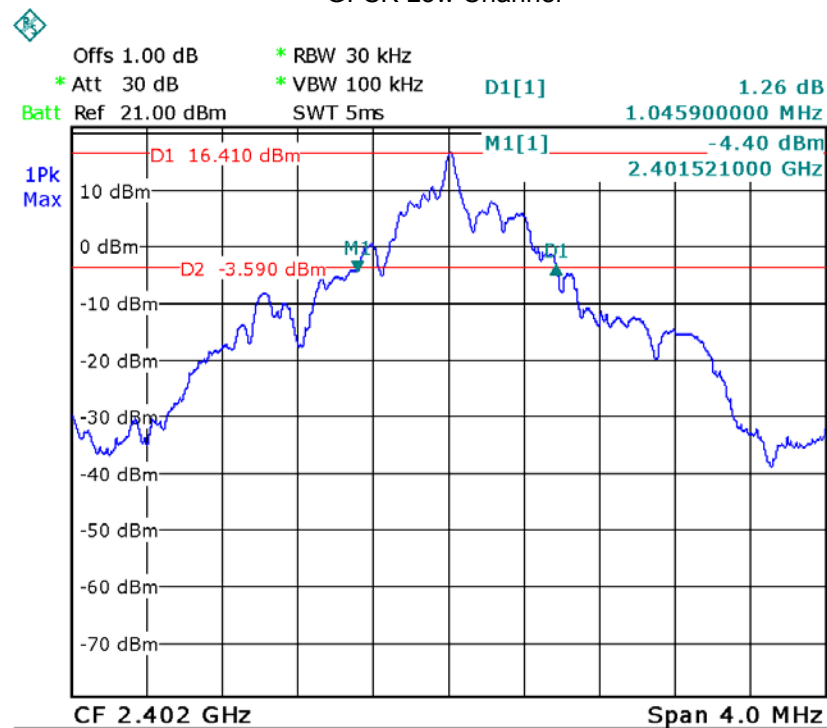
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 30kHz, VBW = 100kHz

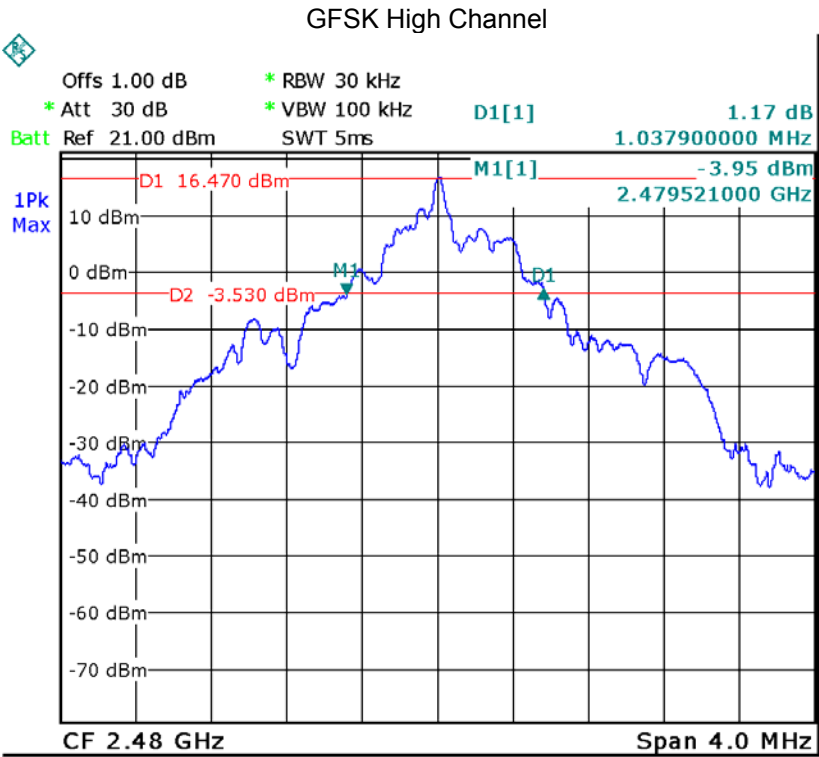
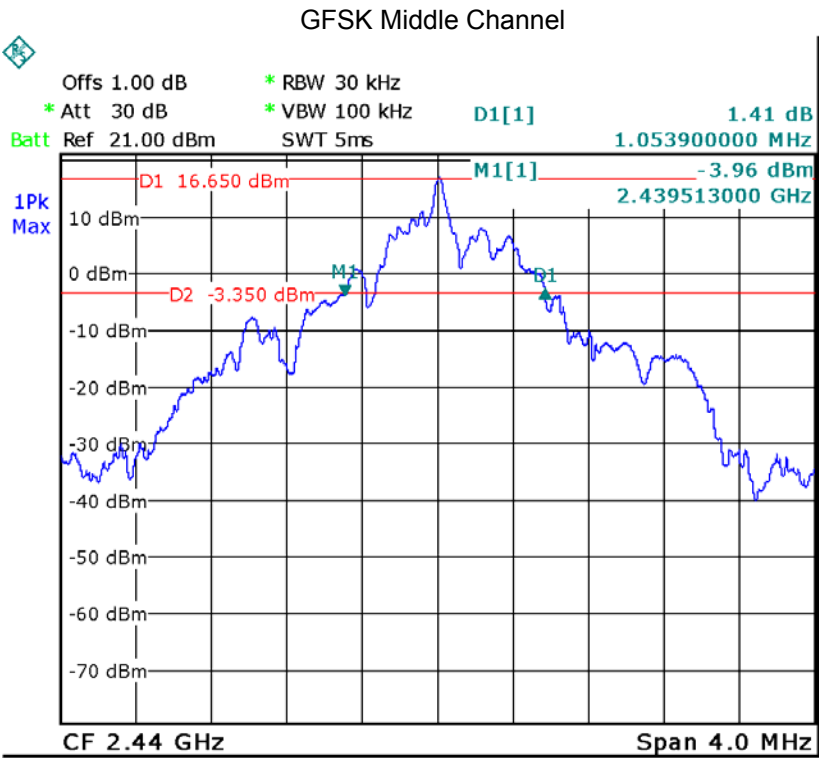
### 9.2 Test Result

| Modulation | Test Channel | Bandwidth |
|------------|--------------|-----------|
| GFSK       | Low          | 1.046MHz  |
| GFSK       | Middle       | 1.054MHz  |
| GFSK       | High         | 1.038MHz  |

Test plots

GFSK Low Channel





## 10 Maximum Peak Output Power

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement: | FCC CFR47 Part 15 Section 15.247                                                                                                                                                                                                                                                                                                                                                                                                  |
| Test Method:      | DA 00-705                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Test Limit:       | Regulation 15.247 (b)(1), For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.<br><br>Refer to the result "Number of Hopping Frequency" of this document. The 0.125watts (20.97 dBm) limit applies. |
| Test mode:        | Test in fixing frequency transmitting mode.                                                                                                                                                                                                                                                                                                                                                                                       |

### 10.1 Test Procedure

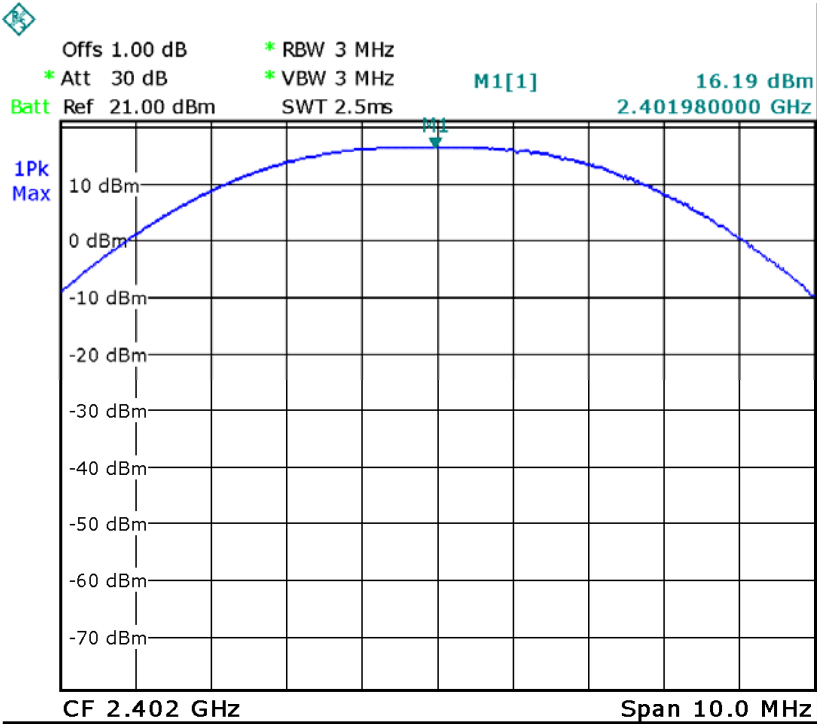
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3 MHz. VBW =3 MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

### 10.2 Test Result

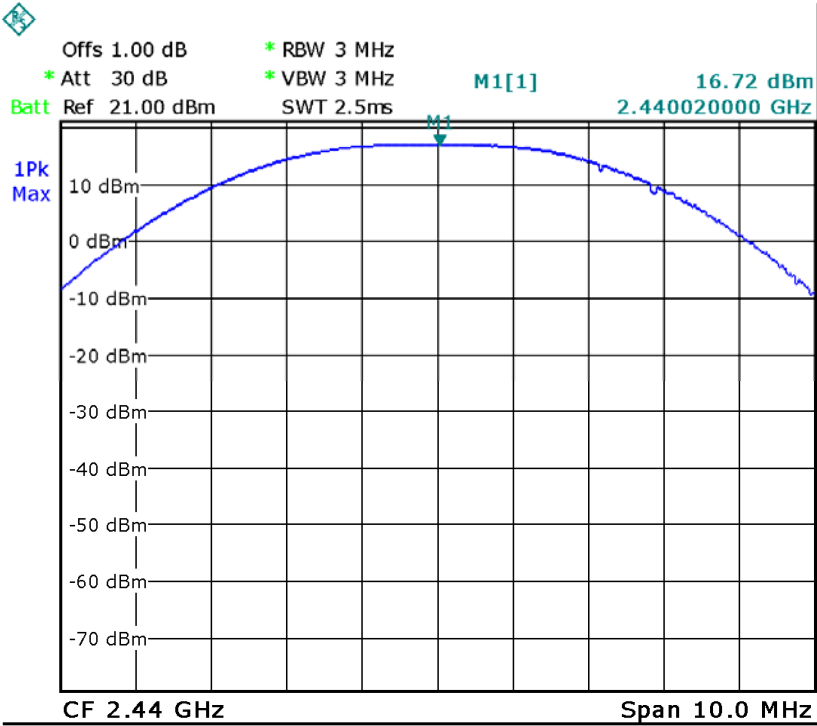
| Modulation | Test Channel | Output Power (dBm) | Limit (dBm) |
|------------|--------------|--------------------|-------------|
| GFSK       | Low          | 16.19              | 20.97       |
| GFSK       | Middle       | 16.72              | 20.97       |
| GFSK       | High         | 16.33              | 20.97       |

Test plots

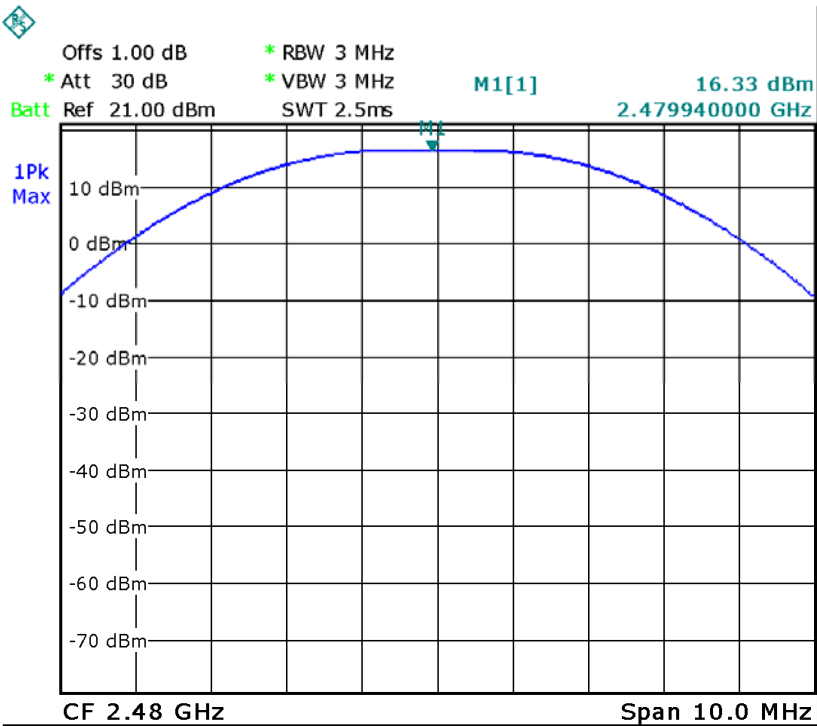
GFSK Low Channel



GFSK Middle Channel



GFSK High Channel



## 11 Hopping Channel Separation

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement: | FCC CFR47 Part 15 Section 15.247                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Test Method:      | DA 00-705                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Test Limit:       | Regulation 15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 1W. |
| Test Mode:        | Test in hopping transmitting operating mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

### 11.1 Test Procedure

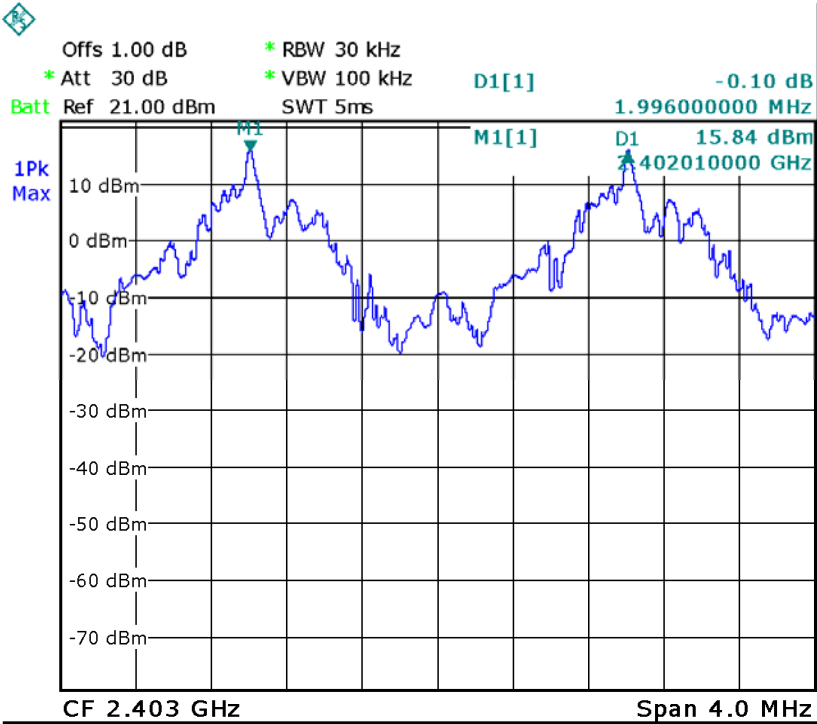
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 30KHz. VBW = 100KHz , Span = 4.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

### 11.2 Test Result

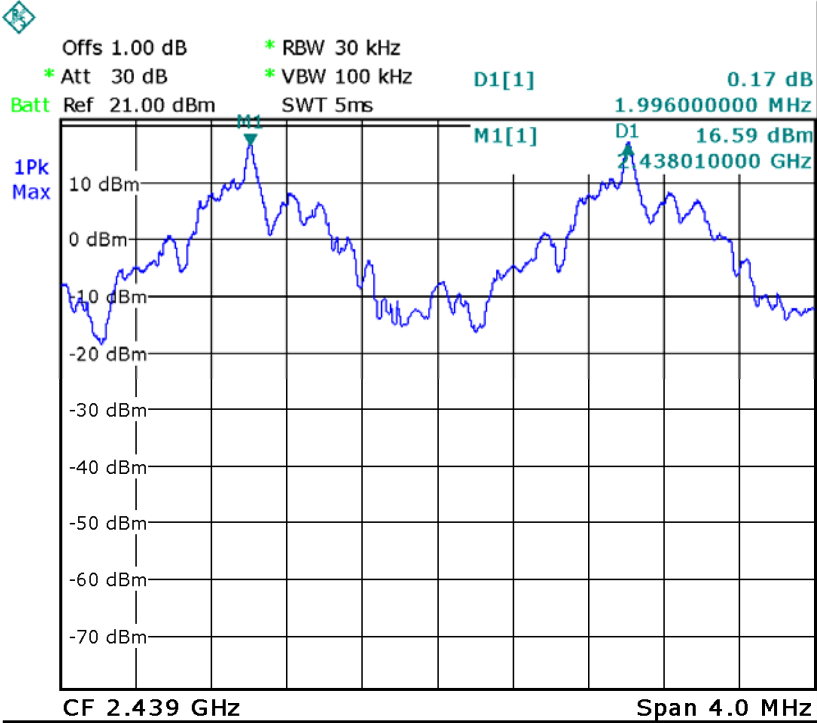
| Modulation | Test Channel | Separation (MHz) | Result |
|------------|--------------|------------------|--------|
| GFSK       | Low          | 1.996            | PASS   |
| GFSK       | Middle       | 1.996            | PASS   |
| GFSK       | High         | 1.996            | PASS   |

Test plots

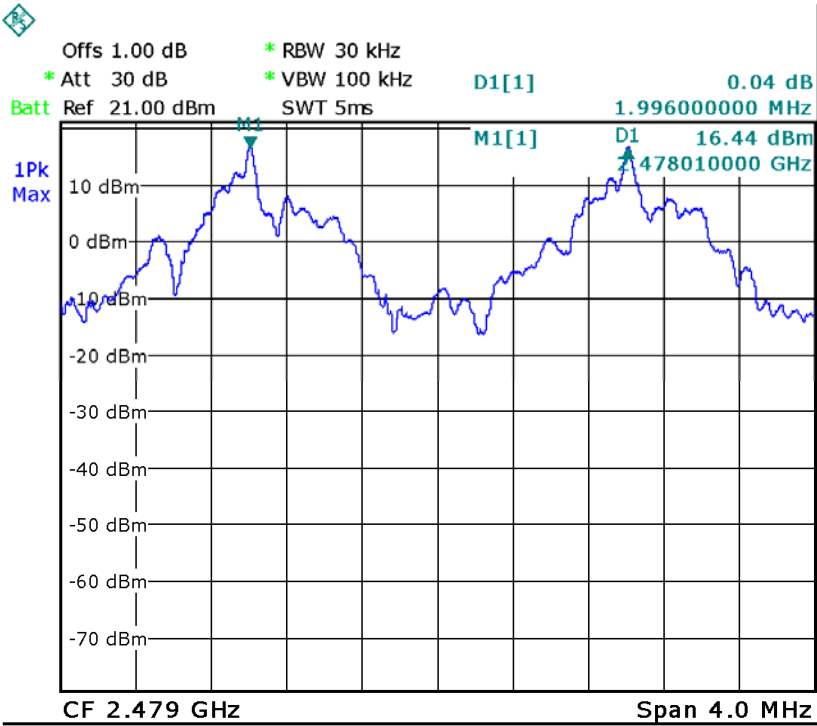
GFSK Low Channel



GFSK Middle Channel



GFSK High Channel



## 12 Number of Hopping Frequency

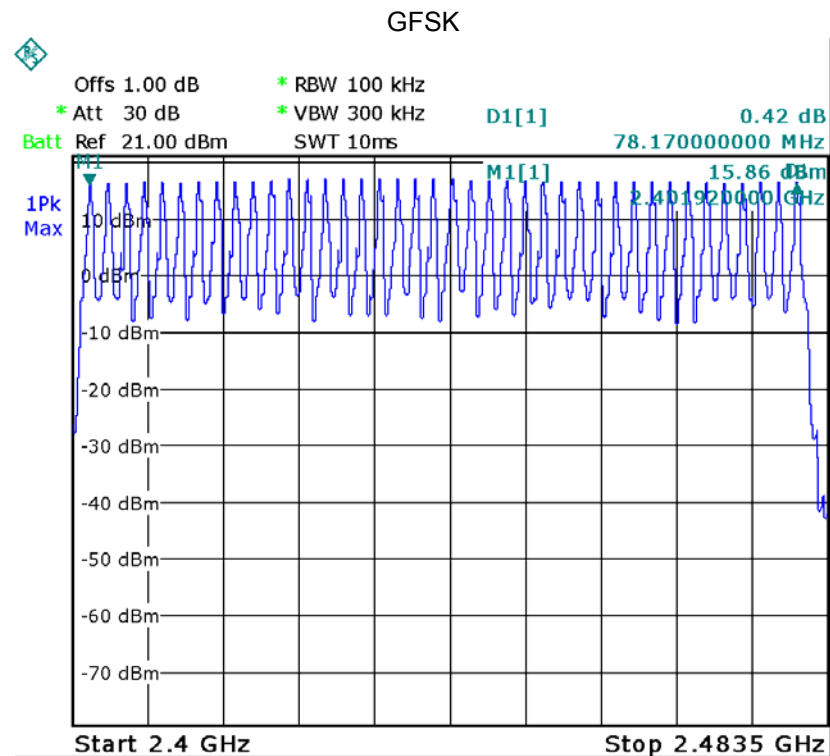
|                   |                                                                                                                     |
|-------------------|---------------------------------------------------------------------------------------------------------------------|
| Test Requirement: | FCC CFR47 Part 15 Section 15.247                                                                                    |
| Test Method:      | DA 00-705                                                                                                           |
| Test Limit:       | Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. |
| Test Mode:        | Test in hopping transmitting operating mode.                                                                        |

### 12.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100KHz. VBW = 300KHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency =2.4835GHz. Sweep=auto;

### 12.2 Test Result

Test Plots: 40 Channels in total



### 13 Dwell Time

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement: | FCC CFR47 Part 15 Section 15.247                                                                                                                                                                                                                                                                                                                                                                                                             |
| Test Method:      | DA 00-705                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Test Limit:       | Regulation 15.247(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used. |
| Test Mode:        | Test in hopping transmitting operating mode.                                                                                                                                                                                                                                                                                                                                                                                                 |

#### 13.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set spectrum analyzer span = 0. Centred on a hopping channel;
3. Set RBW = 1MHz and VBW = 1MHz. Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

#### 13.2 Test Result

The test period:  $T = 0.4(s) * 40 = 16(s)$

So, the Dwell Time can be calculated as follows:

Low channel: Dwell Time  $= 29(\text{times}) / 1(s) * 209(\mu s) * 16(s) = 0.097(s)$

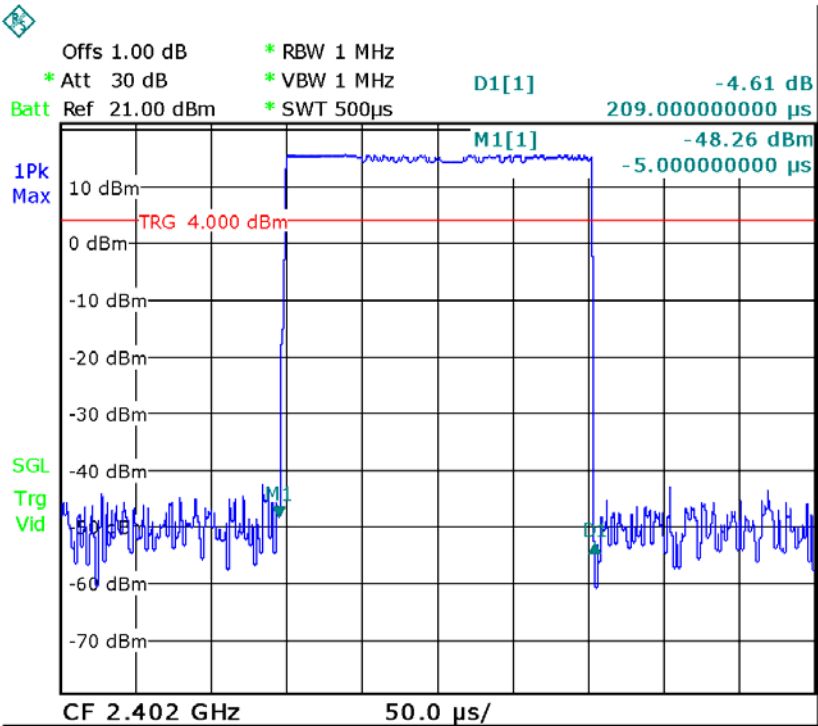
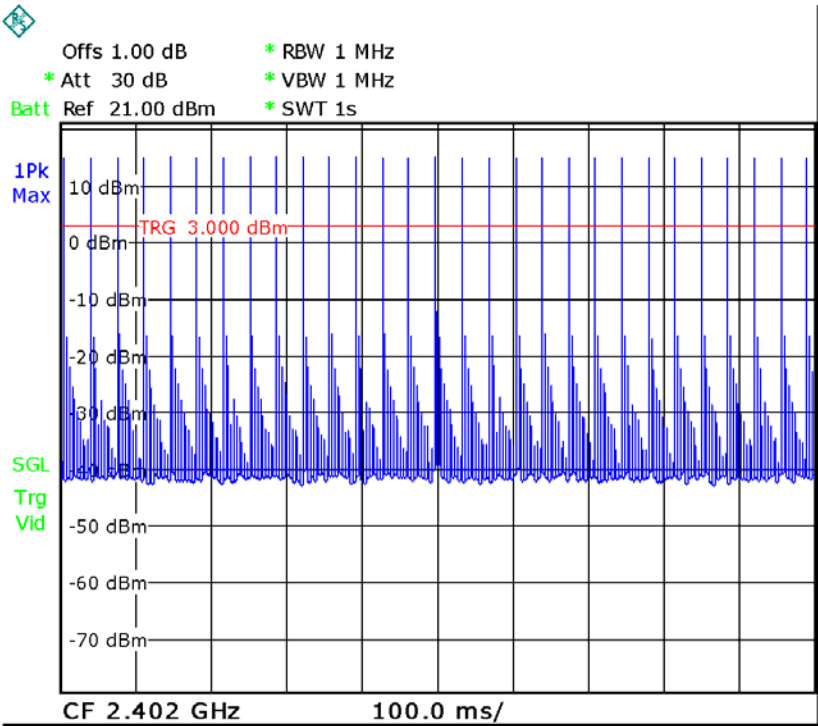
Middle Channel: Dwell Time  $= 28(\text{times}) / 1(s) * 209(\mu s) * 16(s) = 0.094(s)$

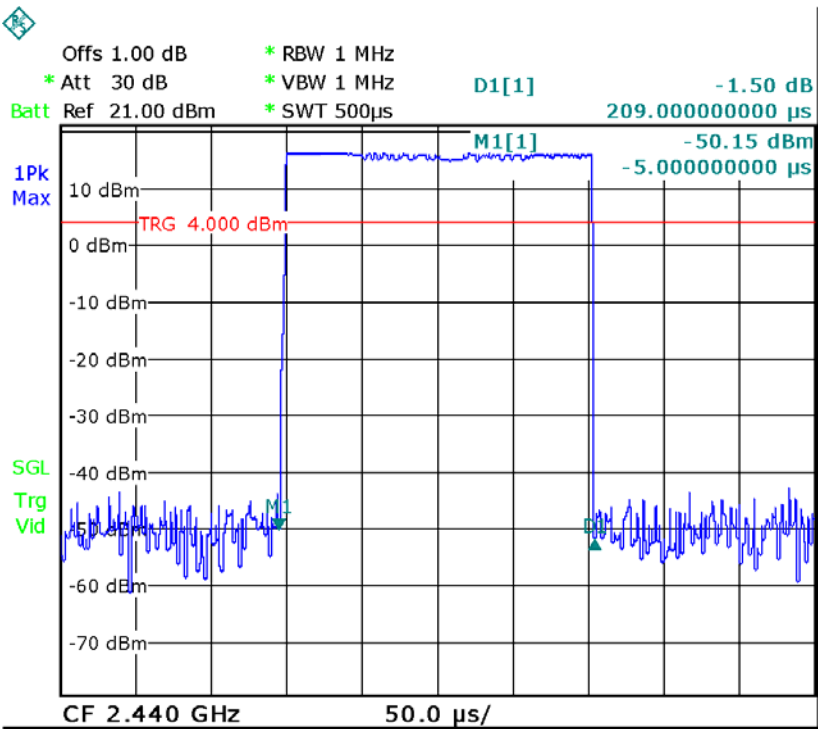
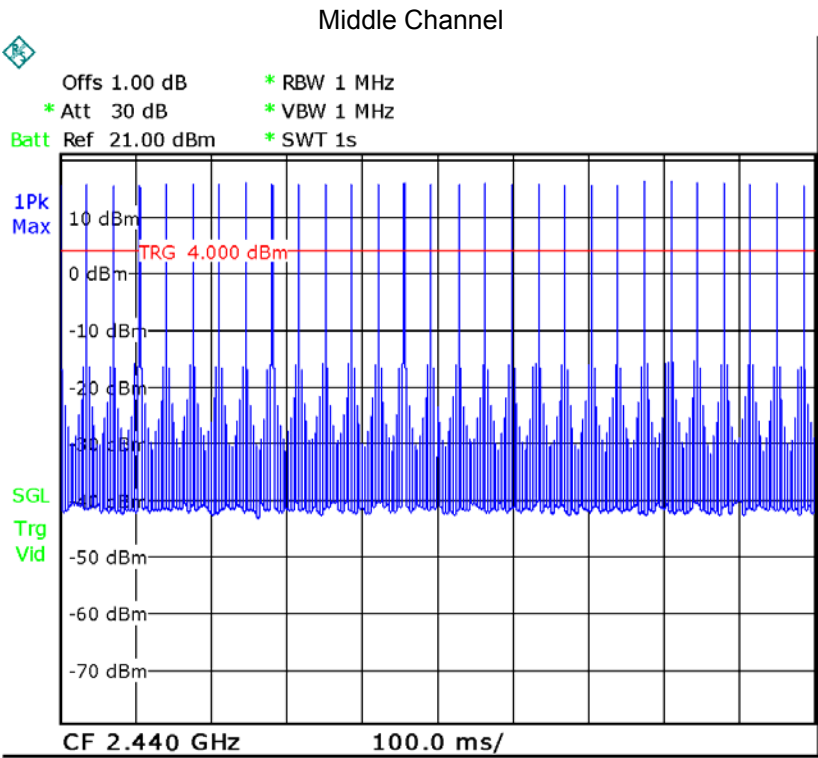
High Channel: Dwell Time  $= 28(\text{times}) / 1(s) * 211(\mu s) * 16(s) = 0.095(s)$

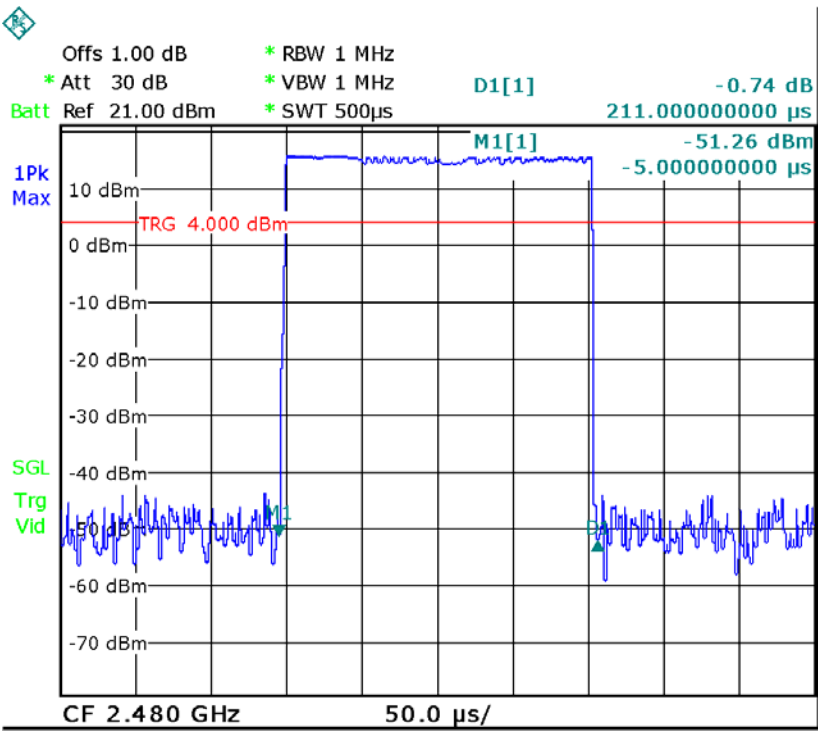
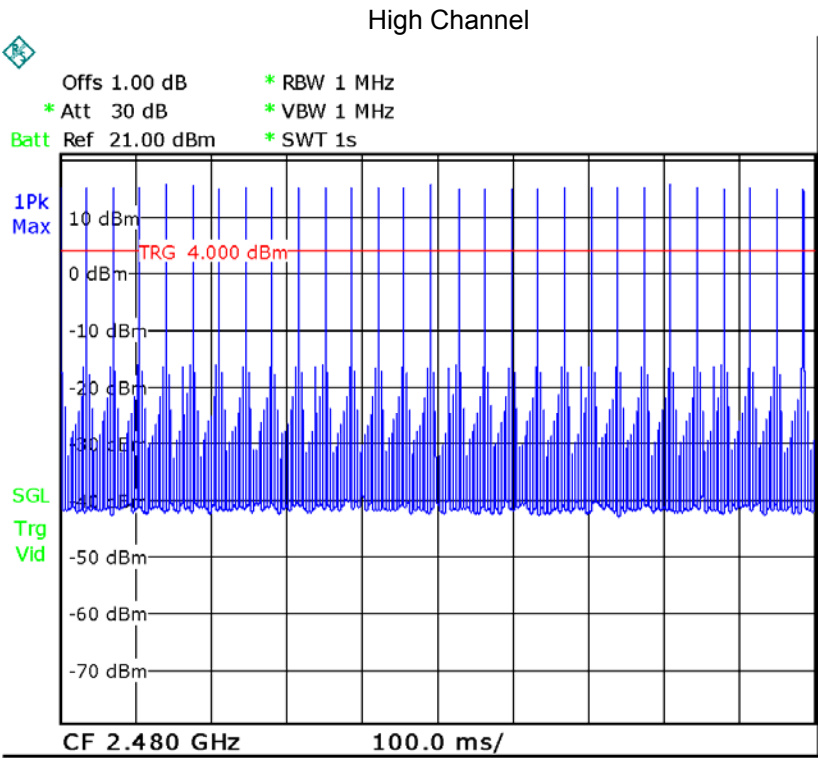
| Frequency | Mkr Delta(ms) | Dwell Time(s) | Limits(s) | Result |
|-----------|---------------|---------------|-----------|--------|
| 2402MHz   | 40.0          | 0.097         | 0.400     | Pass   |
| 2440 MHz  | 40.0          | 0.094         | 0.400     | Pass   |
| 2480MHz   | 40.0          | 0.095         | 0.400     | Pass   |

Test Plots

Low Channel







## **14 Antenna Requirement**

According to the FCC Part 15 Paragraph 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. This product has a Monopole antenna with RP SMA connector (The whorl is non-standard, it only apply to this model), fulfil the requirement of this section.

## 15 RF Exposure

Test Requirement: FCC Part 1.1307

Evaluation Method: FCC Part 2.1091

### 15.1 Requirements

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.2 m normally can be maintained between the user and the device.

### 15.2 The procedures / limit

#### (A) Limits for Occupational / Controlled Exposure

| Frequency Range (MHz) | Electric Field Strength (E) (V/m) | Magnetic Field Strength (H) (A/m) | Power Density (S) (mW/ cm <sup>2</sup> ) | Averaging Time  E  <sup>2</sup> ,  H  <sup>2</sup> or S (minutes) |
|-----------------------|-----------------------------------|-----------------------------------|------------------------------------------|-------------------------------------------------------------------|
| 0.3-3.0               | 614                               | 1.63                              | (100)*                                   | 6                                                                 |
| 3.0-30                | 1842 / f                          | 4.89 / f                          | (900 / f)*                               | 6                                                                 |
| 30-300                | 61.4                              | 0.163                             | 1.0                                      | 6                                                                 |
| 300-1500              |                                   |                                   | F/300                                    | 6                                                                 |
| 1500-100,000          |                                   |                                   | 5                                        | 6                                                                 |

#### (B) Limits for General Population / Uncontrolled Exposure

| Frequency Range (MHz) | Electric Field Strength (E) (V/m) | Magnetic Field Strength (H) (A/m) | Power Density (S) (mW/ cm <sup>2</sup> ) | Averaging Time  E  <sup>2</sup> ,  H  <sup>2</sup> or S (minutes) |
|-----------------------|-----------------------------------|-----------------------------------|------------------------------------------|-------------------------------------------------------------------|
| 0.3-1.34              | 614                               | 1.63                              | (100)*                                   | 30                                                                |
| 1.34-30               | 824/f                             | 2.19/f                            | (180/f)*                                 | 30                                                                |
| 30-300                | 27.5                              | 0.073                             | 0.2                                      | 30                                                                |
| 300-1500              |                                   |                                   | F/1500                                   | 30                                                                |
| 1500-100,000          |                                   |                                   | 1.0                                      | 30                                                                |

Note: f = frequency in MHz ; \*Plane-wave equivalent power density

### 15.3 MPE Calculation Method

$$E \text{ (V/m)} = \frac{\sqrt{30 \times P \times G}}{d} \quad \text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

**E** = Electric field (V/m)

**P** = Peak RF output power (W)

**G** = EUT Antenna numeric gain (numeric)

**d** = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$

From the peak EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained

| Antenna Gain (numeric) | Peak Output Power (dBm) | Peak Output Power (mW) | Power Density (mW/cm <sup>2</sup> ) | Limit of Power Density (mW/cm <sup>2</sup> ) |
|------------------------|-------------------------|------------------------|-------------------------------------|----------------------------------------------|
| 1.585                  | 16.72                   | 46.989                 | 0.015                               | 1                                            |

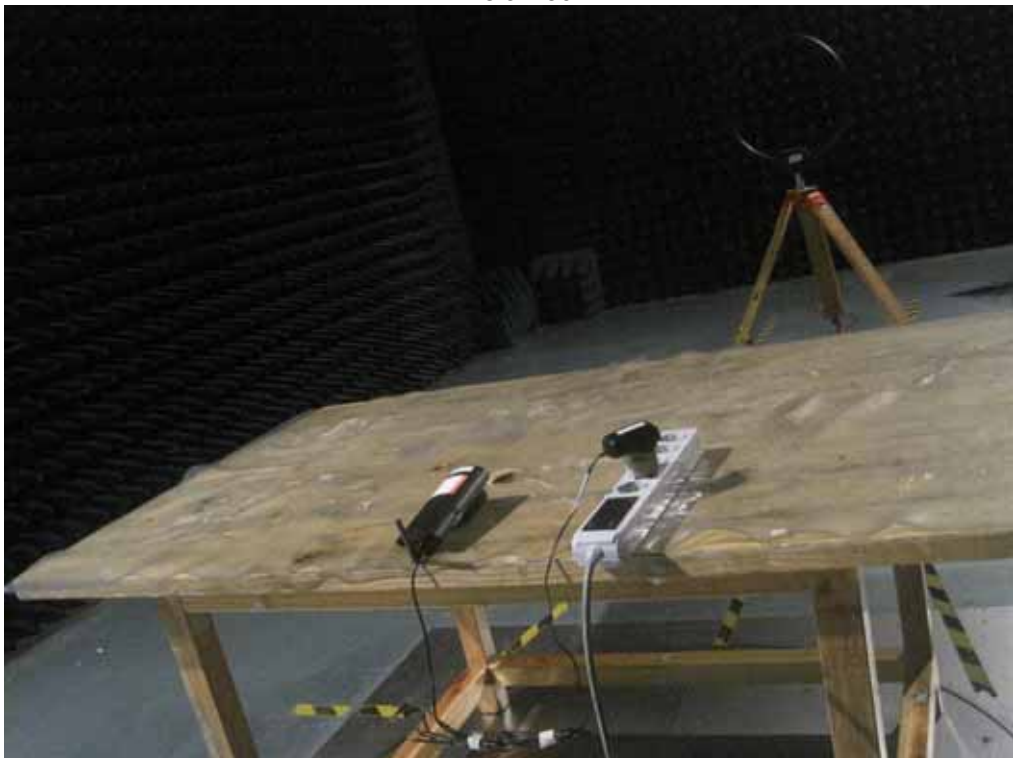
## 16 Photographs – Test Setup

### 16.1 Photograph – Conducted Emission Test Setup

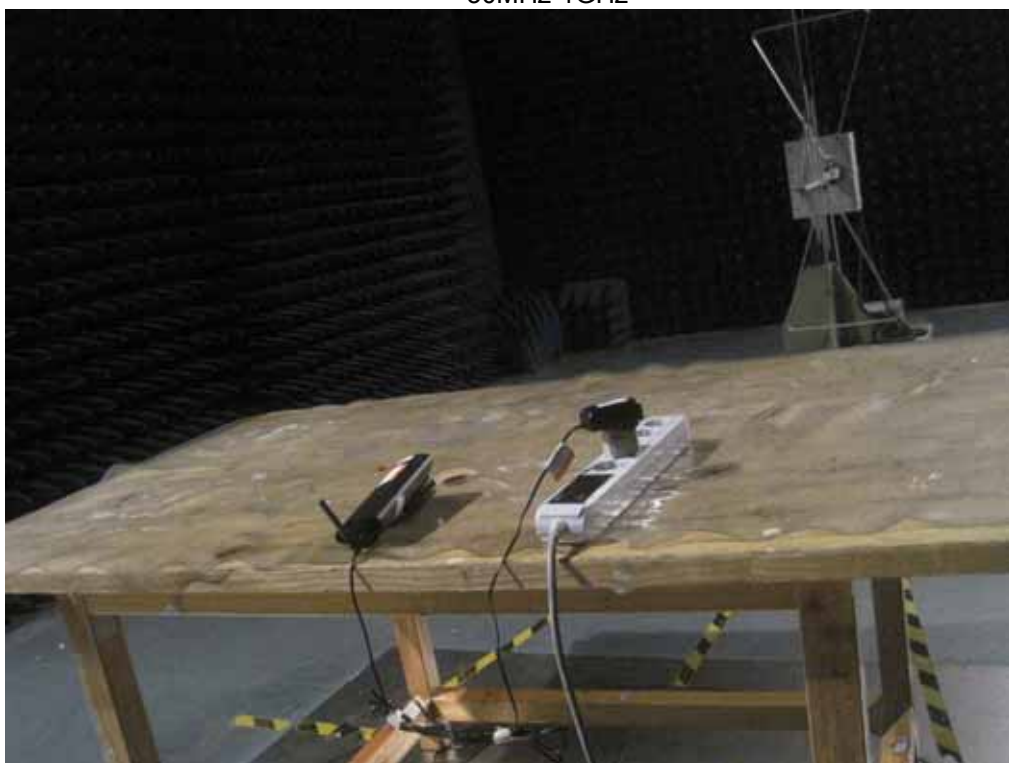


### 16.2 Photograph – Radiation Spurious Emission Test Setup

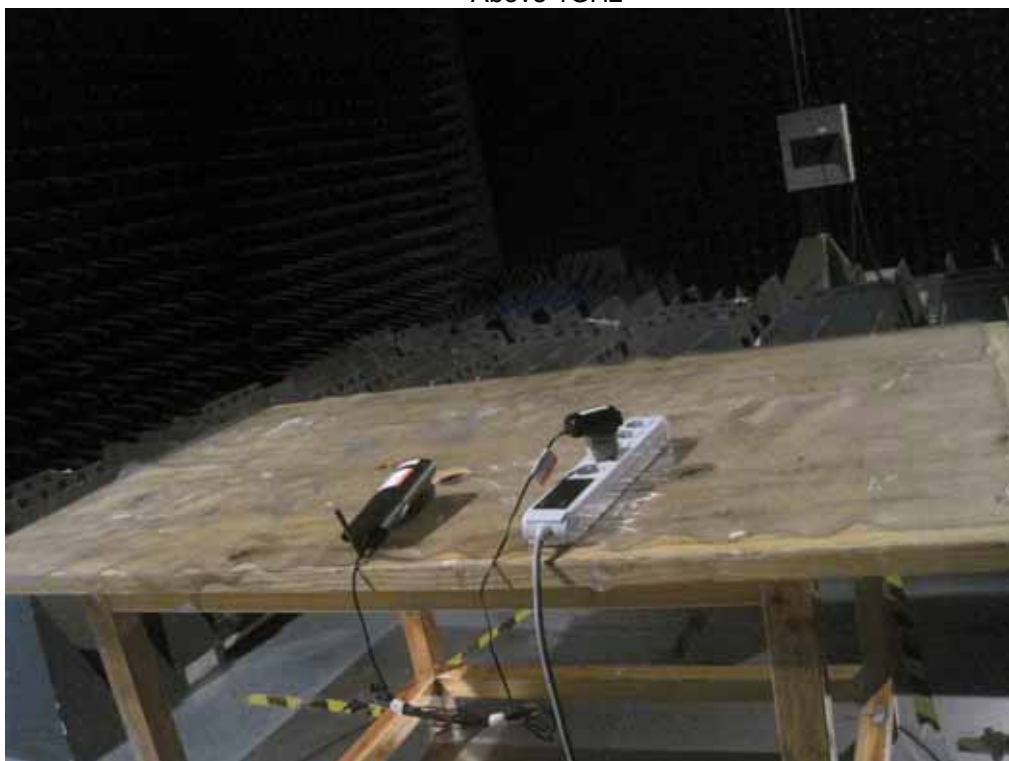
Below 30MHz



30MHz-1GHz



Above 1GHz

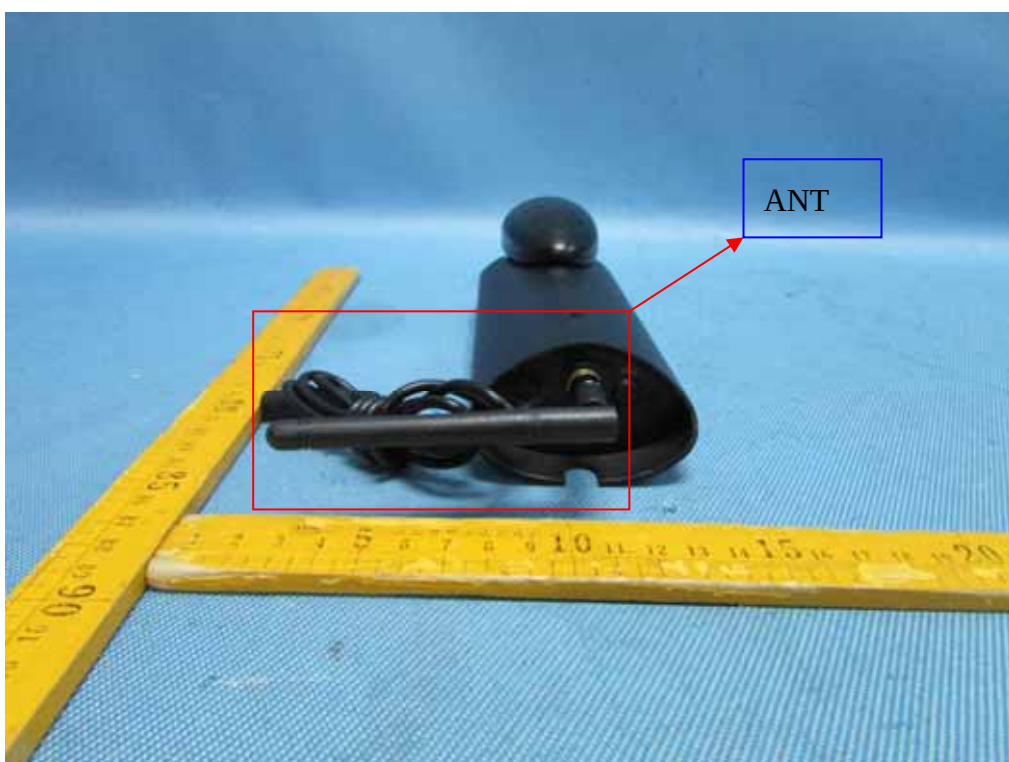


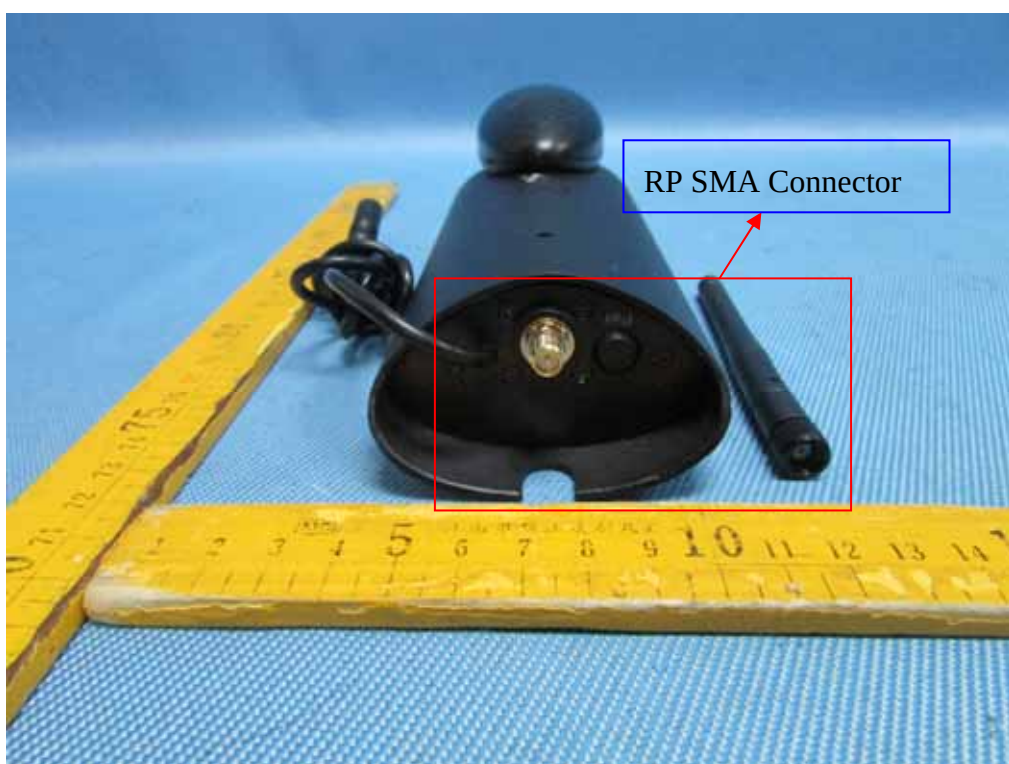
## 17 Photographs - Constructional Details

### 17.1 External View





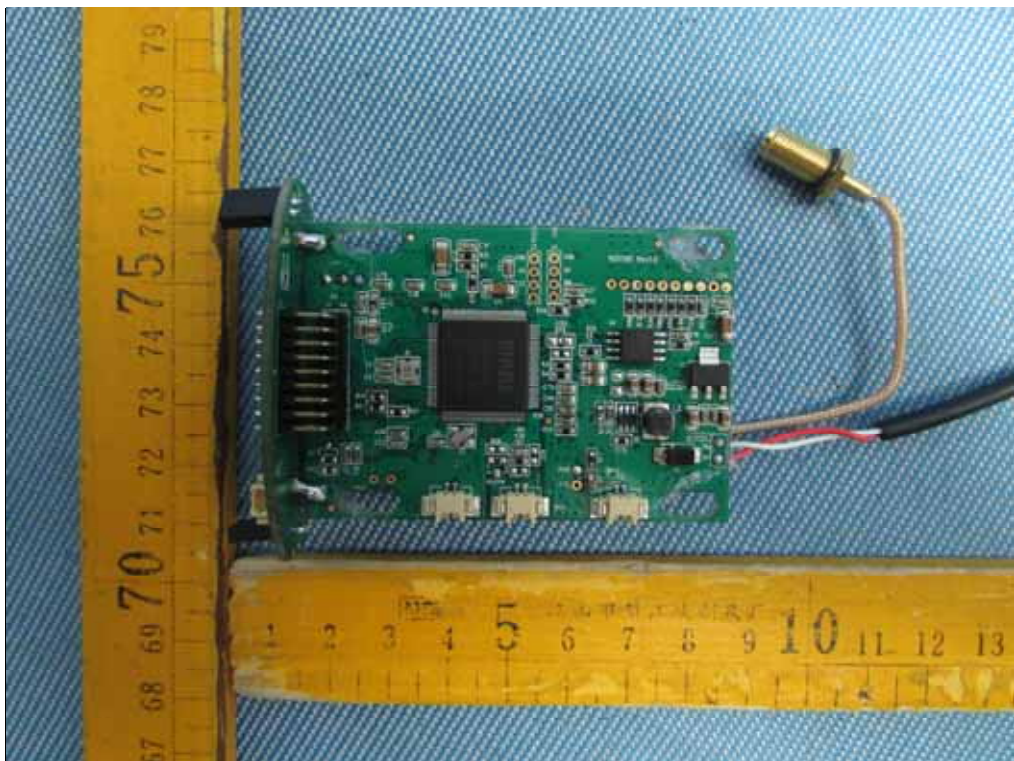
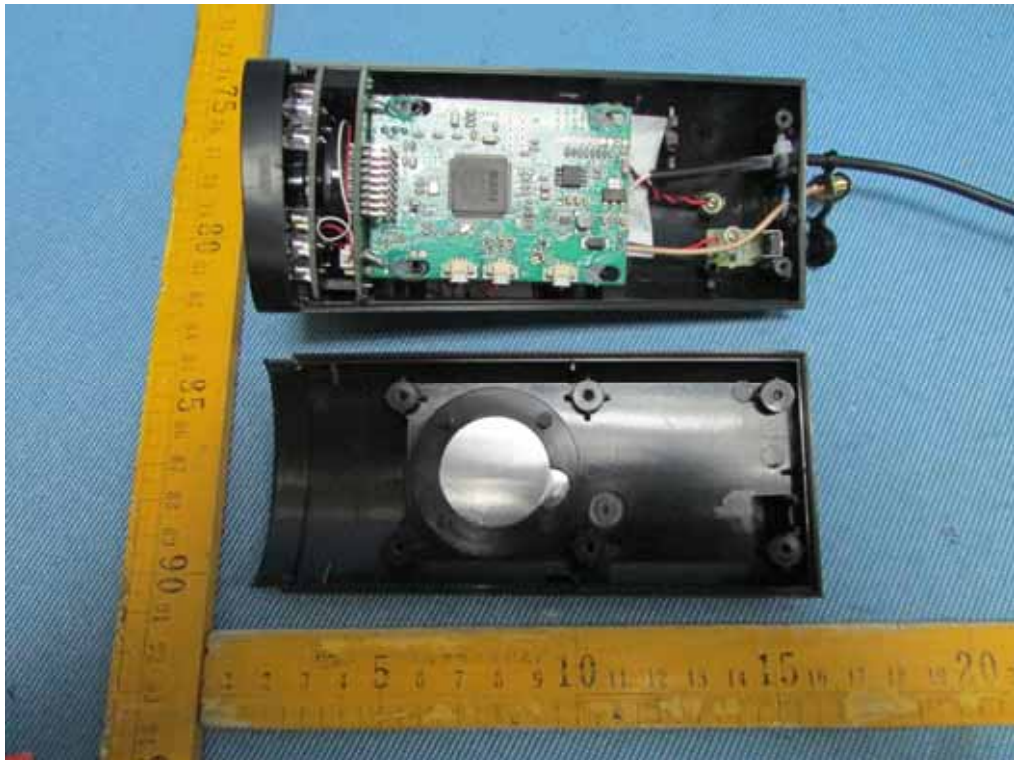


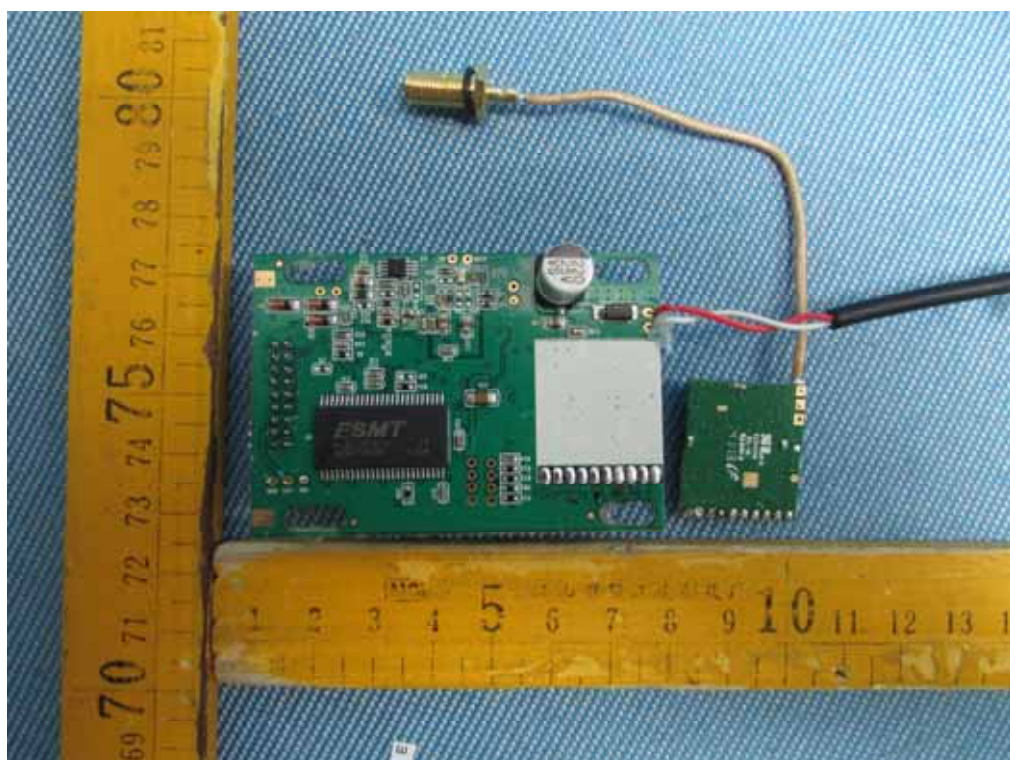
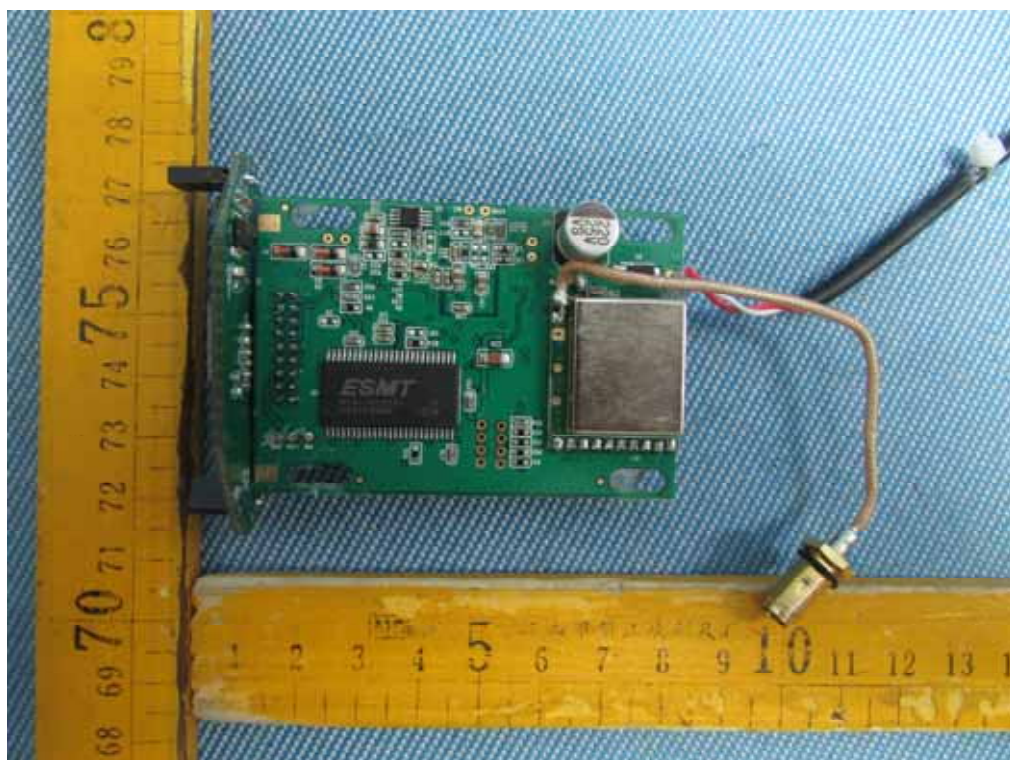


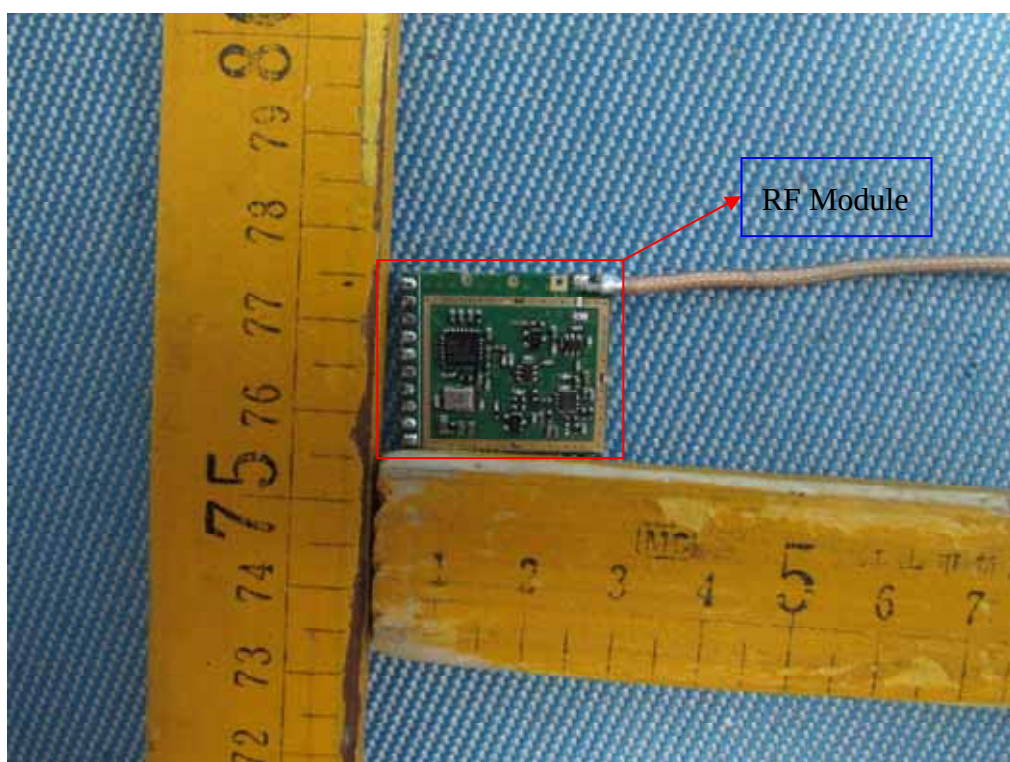
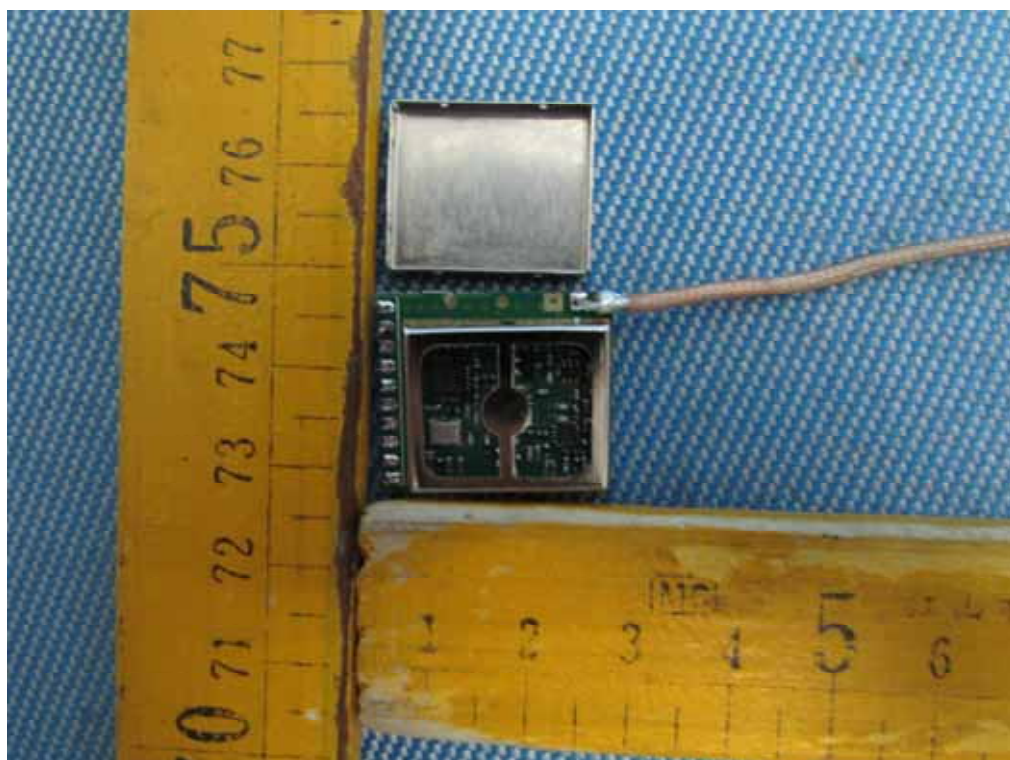


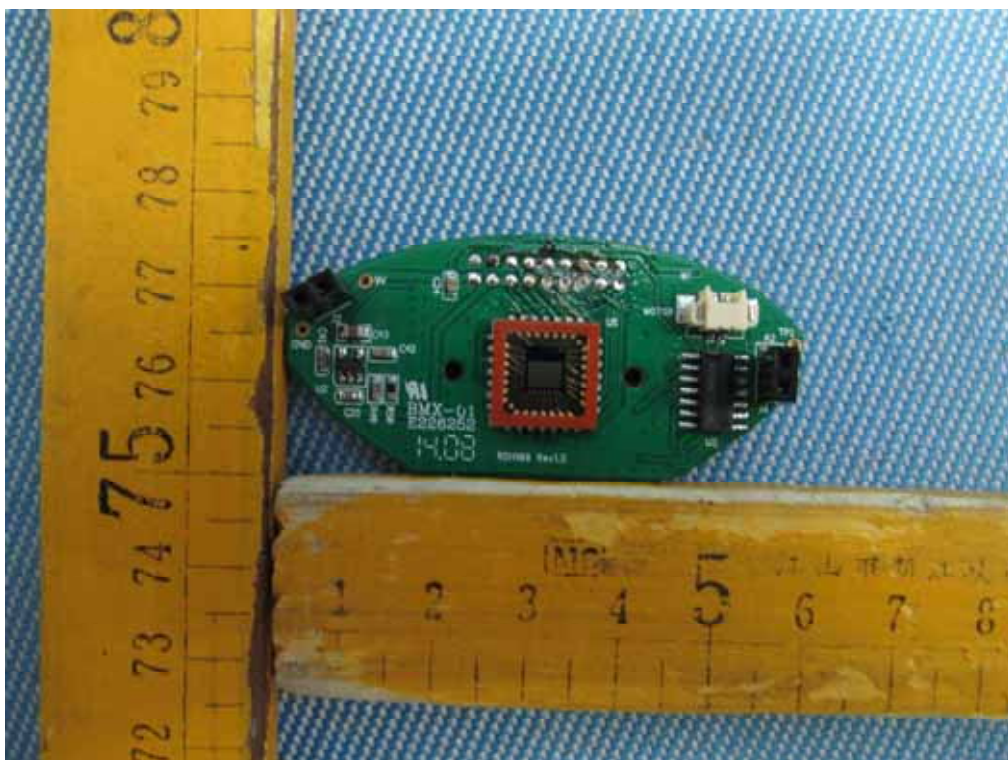
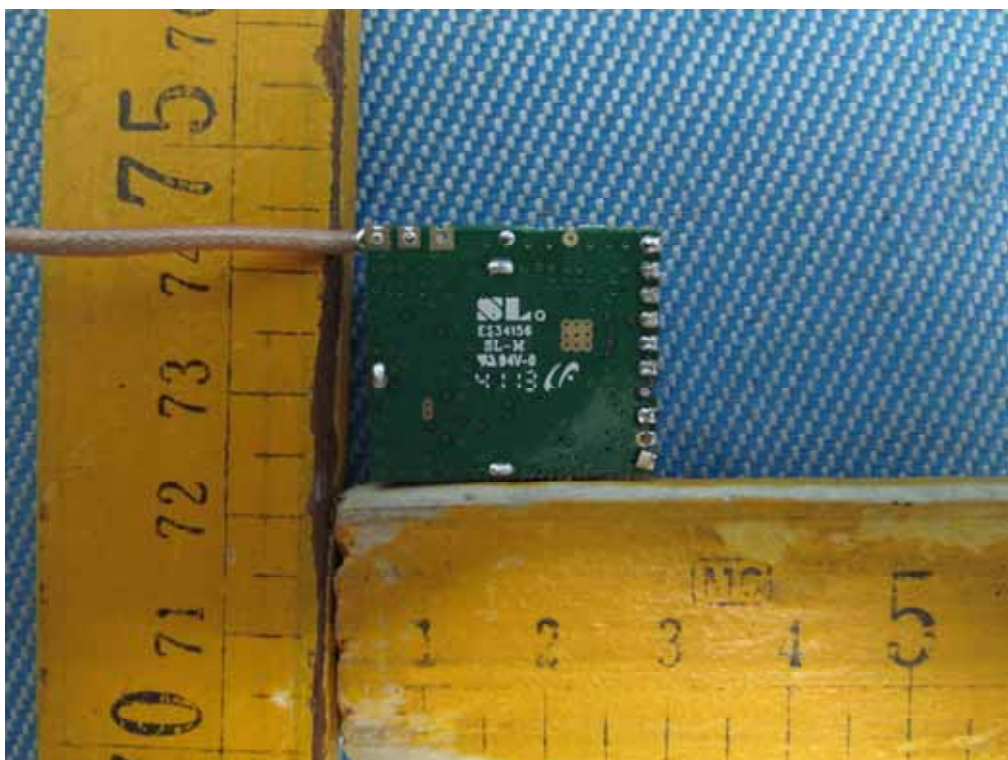


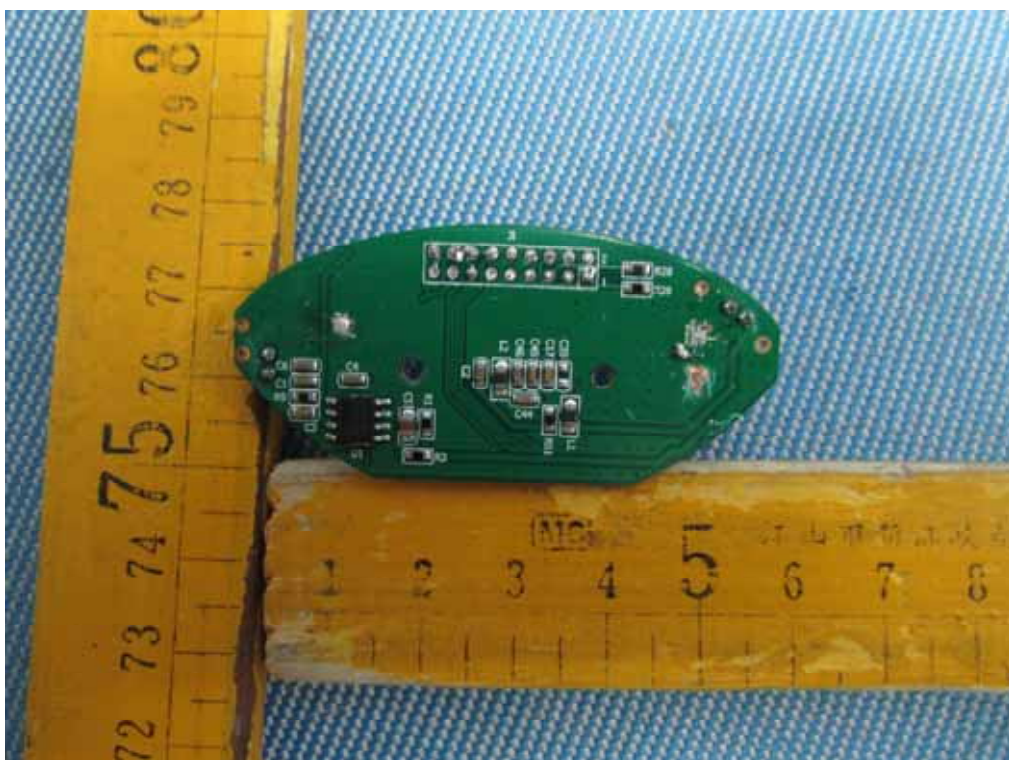
## 17.2 Internal View













===== End of Report =====