

# FCC Test Report

**Client Name** : Shenzhen Radiomaster Technology Co.,Ltd

**Client Address** : 4F Yang Tian Building, Area 72 Xing Dong  
community Xin An Street, Bao An district,  
Shen Zhen city, Guangdong Province, China

**Product Name** : BOXER

**Report Date** : Apr. 03, 2023

**Shenzhen Anbotek Compliance Laboratory Limited**



**Shenzhen Anbotek Compliance Laboratory Limited**

Address: 1/F., Building D, Sogood Science and Technology Park, Sanwei Community,  
Hangcheng Street, Bao'an District, Shenzhen, Guangdong, China.  
Tel: (86) 0755-26066440 Fax: (86) 0755-26014772 Email: service@anbotek.com

**Code: AB-RF-05-b**



Hotline

400-003-0500

www.anbotek.com.cn



# Contents

|                                                    |    |
|----------------------------------------------------|----|
| 1. General Information .....                       | 6  |
| 1.1. Client Information .....                      | 6  |
| 1.2. Description of Device (EUT) .....             | 6  |
| 1.3. Auxiliary Equipment Used During Test .....    | 7  |
| 1.4. Description of Test Configuration .....       | 7  |
| 1.5. Description Of Test Setup .....               | 8  |
| 1.6. Test Equipment List .....                     | 9  |
| 1.7. Measurement Uncertainty .....                 | 10 |
| 1.8. Description of Test Facility .....            | 10 |
| 2. Summary of Test Results .....                   | 11 |
| 3. Conducted Emission Test .....                   | 12 |
| 3.1. Test Standard and Limit .....                 | 12 |
| 3.2. Test Setup .....                              | 12 |
| 3.3. Test Procedure .....                          | 12 |
| 3.4. Test Data .....                               | 12 |
| 4. Radiation Spurious Emission and Band Edge ..... | 15 |
| 4.1. Test Standard and Limit .....                 | 15 |
| 4.2. Test Setup .....                              | 15 |
| 4.3. Test Procedure .....                          | 16 |
| 4.4. Test Data .....                               | 17 |
| 5. Maximum Peak Output Power Test .....            | 25 |
| 5.1. Test Standard and Limit .....                 | 25 |
| 5.2. Test Setup .....                              | 25 |
| 5.3. Test Procedure .....                          | 25 |
| 5.4. Test Data .....                               | 25 |
| 6. 20DB Occupy Bandwidth Test .....                | 26 |
| 6.1. Test Standard .....                           | 26 |
| 6.2. Test Setup .....                              | 26 |
| 6.3. Test Procedure .....                          | 26 |
| 6.4. Test Data .....                               | 26 |
| 7. Carrier Frequency Separation Test .....         | 27 |
| 7.1. Test Standard and Limit .....                 | 27 |
| 7.2. Test Setup .....                              | 27 |
| 7.3. Test Procedure .....                          | 27 |
| 7.4. Test Data .....                               | 27 |
| 8. Number of Hopping Channel Test .....            | 28 |
| 8.1. Test Standard and Limit .....                 | 28 |



|                                                               |    |
|---------------------------------------------------------------|----|
| 8.2. Test Setup .....                                         | 28 |
| 8.3. Test Procedure .....                                     | 28 |
| 8.4. Test Data .....                                          | 28 |
| 9. Dwell Time Test .....                                      | 29 |
| 9.1. Test Standard and Limit .....                            | 29 |
| 9.2. Test Setup .....                                         | 29 |
| 9.3. Test Procedure .....                                     | 29 |
| 9.4. Test Data .....                                          | 29 |
| 10. 100kHz Bandwidth of Frequency Band Edge Requirement ..... | 30 |
| 10.1. Test Standard and Limit .....                           | 30 |
| 10.2. Test Setup .....                                        | 30 |
| 10.3. Test Procedure .....                                    | 30 |
| 10.4. Test Data .....                                         | 30 |
| 11. Antenna Requirement .....                                 | 31 |
| 11.1. Test Standard and Requirement .....                     | 31 |
| 11.2. Antenna Connected Construction .....                    | 31 |
| APPENDIX I -- TEST SETUP PHOTOGRAPH .....                     | 32 |
| APPENDIX II -- EXTERNAL PHOTOGRAPH .....                      | 32 |
| APPENDIX III -- INTERNAL PHOTOGRAPH .....                     | 32 |



# TEST REPORT

Applicant : Shenzhen Radiomaster Technology Co.,Ltd  
Manufacturer : Shenzhen Radiomaster Technology Co.,Ltd  
Product Name : BOXER  
Model No. : BOXER ELRS, BOXER ELRS MAX, BOXER ELRS MAX PRO, BOXER CC2500, BOXER SE, BOXER ELRS PRO, BOXER ELRS LITE, BOXER MAX, BOXER MAXPRO  
Trade Mark : Radiomaster  
Rating(s) : Input: DC 6.6-8.4V  
Test Standard(s) : FCC Part15 Subpart C, Section 15.247  
Test Method(s) : ANSI C63.10: 2020

The device described above is tested by Shenzhen Anbotek 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 Anbotek 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 Anbotek Compliance Laboratory Limited.

Date of receipt

Nov. 22, 2022

Date of Test

Nov. 22 ~Dec. 28, 2022

Prepared by

Ella Liang

(Ella Liang)

Approved & Authorized Signer

Kingkong Jin

(Kingkong Jin)



## Revision History

| Report Version | Description     | Issued Date   |
|----------------|-----------------|---------------|
| R00            | Original Issue. | Apr. 03, 2023 |
|                |                 |               |
|                |                 |               |



## 1. General Information

### 1.1. Client Information

|              |   |                                                                                                                              |
|--------------|---|------------------------------------------------------------------------------------------------------------------------------|
| Applicant    | : | Shenzhen Radiomaster Technology Co.,Ltd                                                                                      |
| Address      | : | 4F Yang Tian Building, Area 72 Xing Dong community Xin An Street, Bao An district, Shen Zhen city, Guangdong Province, China |
| Manufacturer | : | Shenzhen Radiomaster Technology Co.,Ltd                                                                                      |
| Address      | : | 4F Yang Tian Building, Area 72 Xing Dong community Xin An Street, Bao An district, Shen Zhen city, Guangdong Province, China |
| Factory      | : | Shenzhen Radiomaster Technology Co.,Ltd                                                                                      |
| Address      | : | 4F Yang Tian Building, Area 72 Xing Dong community Xin An Street, Bao An district, Shen Zhen city, Guangdong Province, China |

### 1.2. Description of Device (EUT)

|                                                                                                                                     |   |                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product Name                                                                                                                        | : | BOXER                                                                                                                                                                                                                                    |
| Model No.                                                                                                                           | : | BOXER ELRS, BOXER ELRS MAX, BOXER ELRS MAX PRO, BOXER CC2500, BOXER SE, BOXER ELRS PRO, BOXER ELRS LITE, BOXER MAX, BOXER MAXPRO<br>(Note: All samples are the same except for model name, so we prepare "BOXER ELRS" for testing only.) |
| Trade Mark                                                                                                                          | : | Radiomaster                                                                                                                                                                                                                              |
| Test Power Supply                                                                                                                   | : | AC 120V, 60Hz for adapter                                                                                                                                                                                                                |
| Test Sample No.                                                                                                                     | : | 1-2-1(Normal Sample), 1-2-2(Engineering Sample)                                                                                                                                                                                          |
| Adapter                                                                                                                             | : | N.A                                                                                                                                                                                                                                      |
| <b>RF Specification</b>                                                                                                             |   |                                                                                                                                                                                                                                          |
| Operation Mode                                                                                                                      | : | <input checked="" type="checkbox"/> BT BDR <input checked="" type="checkbox"/> BT EDR                                                                                                                                                    |
| Operation Frequency                                                                                                                 | : | 2402~2480MHz                                                                                                                                                                                                                             |
| Number of Channel                                                                                                                   | : | 79 Channels                                                                                                                                                                                                                              |
| Modulation Type                                                                                                                     | : | GFSK, $\pi/4$ -DQPSK, 8-DPSK                                                                                                                                                                                                             |
| Antenna Type                                                                                                                        | : | Ceramic antenna                                                                                                                                                                                                                          |
| Antenna Gain(Peak)                                                                                                                  | : | 1.85 dBi (Provided by customer)                                                                                                                                                                                                          |
| <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

| Description | Rating(s)                                                                                           |
|-------------|-----------------------------------------------------------------------------------------------------|
| Adapter     | M/N: A2023<br>Input: AC 100-240V 0.7A 50-60Hz<br>USB1 Output: DC 5V 2.4A<br>USB2 Output: DC 5V 2.4A |

### 1.4. Description of Test Configuration

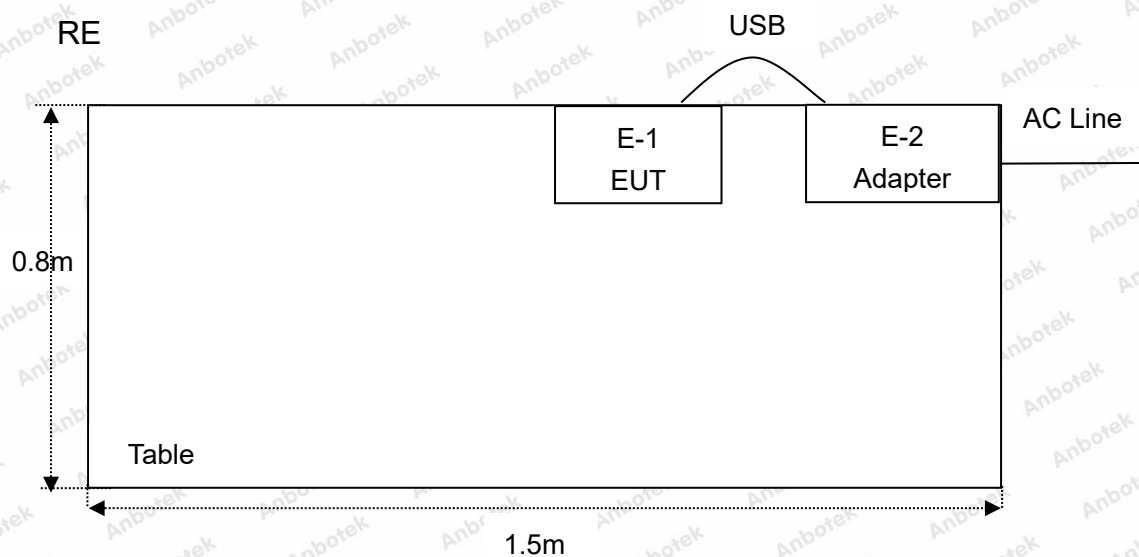
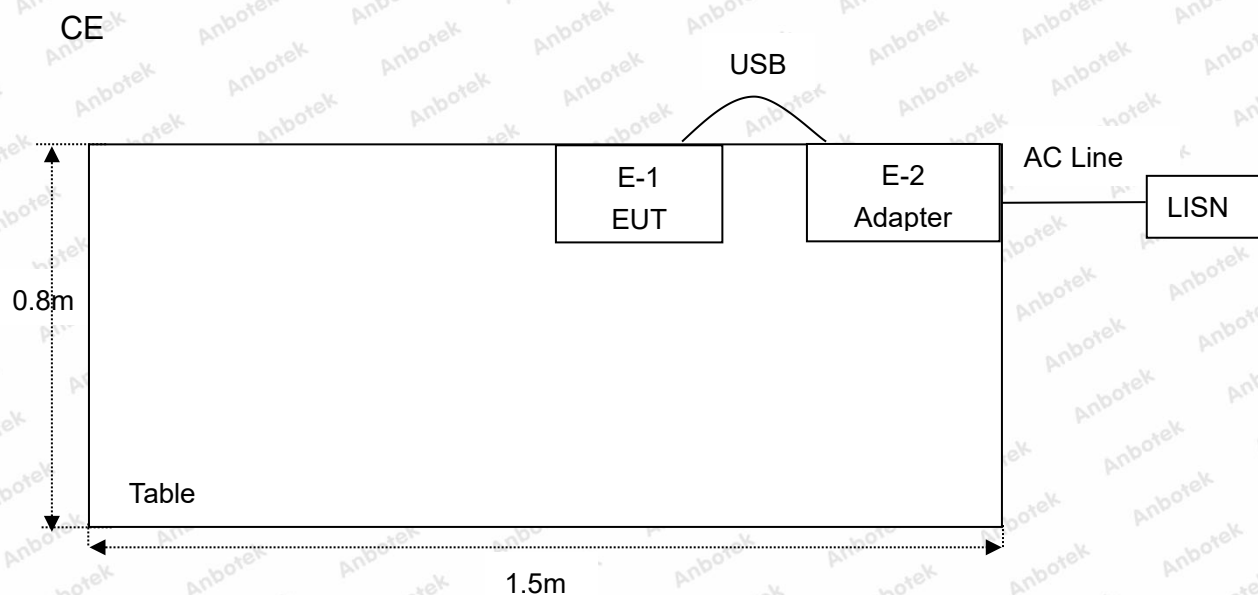
| Channel | Freq.<br>(MHz) | Channel | Freq.<br>(MHz) | Channel | Freq.<br>(MHz) | Channel | Freq.<br>(MHz) | Channel | Freq.<br>(MHz) |
|---------|----------------|---------|----------------|---------|----------------|---------|----------------|---------|----------------|
| 00      | 2402           | 17      | 2419           | 34      | 2436           | 51      | 2453           | 68      | 2470           |
| 01      | 2403           | 18      | 2420           | 35      | 2437           | 52      | 2454           | 69      | 2471           |
| 02      | 2404           | 19      | 2421           | 36      | 2438           | 53      | 2455           | 70      | 2472           |
| 03      | 2405           | 20      | 2422           | 37      | 2439           | 54      | 2456           | 71      | 2473           |
| 04      | 2406           | 21      | 2423           | 38      | 2440           | 55      | 2457           | 72      | 2474           |
| 05      | 2407           | 22      | 2424           | 39      | 2441           | 56      | 2458           | 73      | 2475           |
| 06      | 2408           | 23      | 2425           | 40      | 2442           | 57      | 2459           | 74      | 2476           |
| 07      | 2409           | 24      | 2426           | 41      | 2443           | 58      | 2460           | 75      | 2477           |
| 08      | 2410           | 25      | 2427           | 42      | 2444           | 59      | 2461           | 76      | 2478           |
| 09      | 2411           | 26      | 2428           | 43      | 2445           | 60      | 2462           | 77      | 2479           |
| 10      | 2412           | 27      | 2429           | 44      | 2446           | 61      | 2463           | 78      | 2480           |
| 11      | 2413           | 28      | 2430           | 45      | 2447           | 62      | 2464           |         |                |
| 12      | 2414           | 29      | 2431           | 46      | 2448           | 63      | 2465           |         |                |
| 13      | 2415           | 30      | 2432           | 47      | 2449           | 64      | 2466           |         |                |
| 14      | 2416           | 31      | 2433           | 48      | 2450           | 65      | 2467           |         |                |
| 15      | 2417           | 32      | 2434           | 49      | 2451           | 66      | 2468           |         |                |
| 16      | 2418           | 33      | 2435           | 50      | 2452           | 67      | 2469           |         |                |

**Note:**

1. The engineering test program was provided and the EUT was programmed to be in continuously transmitting mode.
2. EUT was tested with channel 0, 39 and 78.



### 1.5. Description Of Test Setup



## 1.6. 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        | Oct. 23, 2022 | 1 Year        |
| 2.   | Three Phase V-type<br>Artificial Power<br>Network | CYBERTEK                | EM5040DT          | E215040DT001  | Jul. 05, 2022 | 1 Year        |
| 3.   | EMI Test Receiver                                 | Rohde & Schwarz         | ESCI              | 100627        | Oct. 13, 2022 | 1 Year        |
| 4.   | EMI Test Receiver                                 | Rohde & Schwarz         | ESR26             | 101481        | Oct. 23, 2022 | 1 Year        |
| 5.   | RF Switching Unit                                 | Compliance<br>Direction | RSU-M2            | 38303         | Oct. 22, 2022 | 1 Year        |
| 6.   | MXA Spectrum<br>Analysis                          | Agilent                 | N9020A            | MY51170037    | Oct. 13, 2022 | 1 Year        |
| 7.   | EMI Preamplifier                                  | SKET Electronic         | LNPA-0118G<br>-45 | SKET-PA-002   | Oct. 13, 2022 | 1 Year        |
| 8.   | Double Ridged Horn<br>Antenna                     | SCHWARZBECK             | BBHA 9120D        | 02555         | Oct. 16, 2022 | 3 Year        |
| 9.   | Bilog Broadband<br>Antenna                        | Schwarzbeck             | VULB9163          | VULB 9163-289 | Oct. 23, 2022 | 1 Year        |
| 10.  | Loop Antenna                                      | Schwarzbeck             | FMZB1519B         | 00053         | Oct. 23, 2022 | 1 Year        |
| 11.  | Horn Antenna                                      | A-INFO                  | LB-180400-K<br>F  | J211060628    | Oct. 23, 2022 | 1 Year        |
| 12.  | Pre-amplifier                                     | SONOMA                  | 310N              | 186860        | Oct. 23, 2022 | 1 Year        |
| 13.  | EMI Test Software<br>EZ-EMC                       | SHURPLE                 | N/A               | N/A           | N/A           | N/A           |
| 14.  | MXA Spectrum<br>Analysis                          | KEYSIGHT                | N9020A            | MY53280032    | Oct. 13, 2022 | 1 Year        |
| 15.  | MXG RF Vector<br>Signal Generator                 | Agilent                 | N5182A            | MY48180656    | Oct. 13, 2022 | 1 Year        |
| 16.  | Signal Generator                                  | Agilent                 | E4421B            | MY41000743    | Oct. 13, 2022 | 1 Year        |
| 17.  | DC Power Supply                                   | IVYTECH                 | IV3605            | 1804D360510   | Oct. 22, 2022 | 1 Year        |
| 18.  | Constant<br>Temperature<br>Humidity Chamber       | ZHONGJIAN               | ZJ-KHWS80<br>B    | N/A           | Oct. 19, 2022 | 1 Year        |



### 1.7. Measurement Uncertainty

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

### 1.8. Description of Test Facility

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

#### FCC-Registration No.: 184111

Shenzhen Anbotek 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.

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

Shenzhen Anbotek 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.

#### Test Location

Shenzhen Anbotek 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             | PASS   |
| 15.205/15.209                                               | Spurious Emission              | PASS   |
| 15.247(b)(1)                                                | Conducted Peak Output Power    | PASS   |
| 15.247(a)(1)                                                | 20dB Occupied Bandwidth        | PASS   |
| 15.247(a)(1)                                                | Carrier Frequencies Separation | PASS   |
| 15.247(a)(1)(iii)                                           | Number of Hopping Channel      | PASS   |
| 15.247(a)(1)(iii)                                           | Dwell Time                     | PASS   |
| 15.247(d)                                                   | Band Edge                      | PASS   |
| <b>Remark:</b> "N/A" is an abbreviation for Not Applicable. |                                |        |



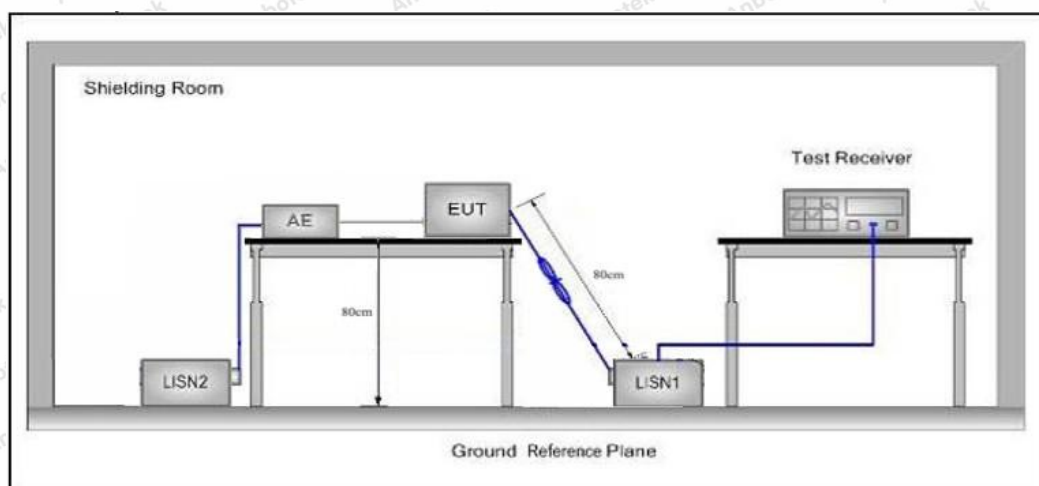
### 3. Conducted Emission Test

#### 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: 2020 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

##### PASS

During the test, pre-scan all modes, only the worst case is recorded in the report.

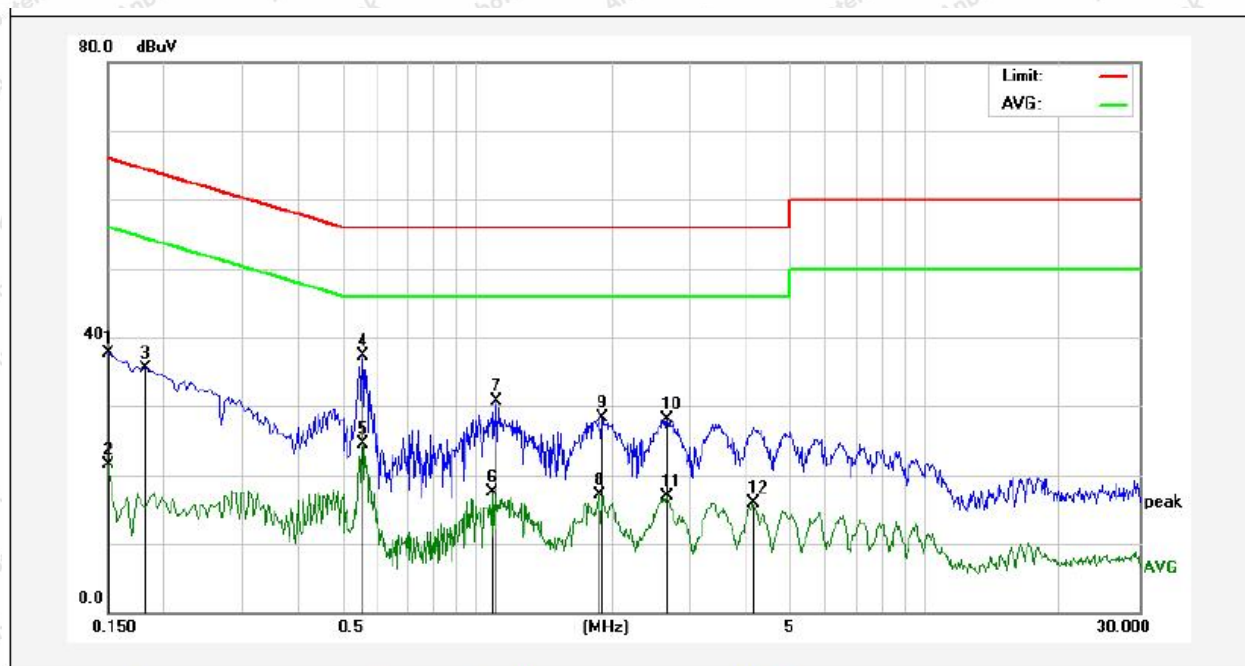
AC conducted emission pre-test at both at AC 120V/60Hz and AC 240V/60Hz modes, recorded worst case AC 120V/60Hz.

Please to see the following pages.



**Conducted Emission Test Data**

Test Site: 1# Shielded Room  
Operating Condition: GFSK (2402MHz)  
Test Specification: AC 120V, 60Hz for adapter  
Comment: Live Line  
Temp.(°C)/Hum.(%RH): 22.1°C/52%RH



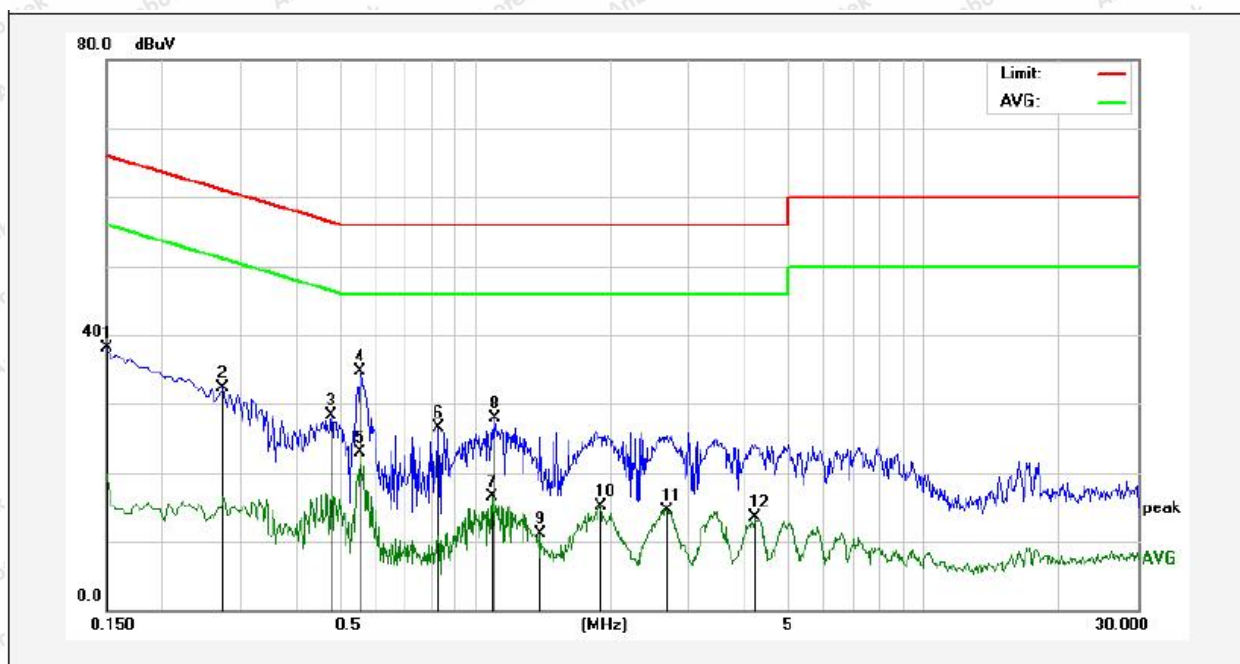
| No. | Freq. (MHz) | Reading (dBuV) | Factor (dB) | Result (dBuV) | Limit (dBuV) | Over Limit (dB) | Detector | Remark |
|-----|-------------|----------------|-------------|---------------|--------------|-----------------|----------|--------|
| 1   | 0.1500      | 27.87          | 9.82        | 37.69         | 65.99        | -28.30          | QP       |        |
| 2   | 0.1500      | 11.72          | 9.82        | 21.54         | 55.99        | -34.45          | AVG      |        |
| 3   | 0.1819      | 25.71          | 9.82        | 35.53         | 64.39        | -28.86          | QP       |        |
| 4   | 0.5580      | 27.36          | 9.86        | 37.22         | 56.00        | -18.78          | QP       |        |
| 5   | 0.5580      | 14.69          | 9.86        | 24.55         | 46.00        | -21.45          | AVG      |        |
| 6   | 1.0820      | 7.68           | 9.86        | 17.54         | 46.00        | -28.46          | AVG      |        |
| 7   | 1.1060      | 20.85          | 9.86        | 30.71         | 56.00        | -25.29          | QP       |        |
| 8   | 1.8740      | 7.21           | 9.85        | 17.06         | 46.00        | -28.94          | AVG      |        |
| 9   | 1.8980      | 18.47          | 9.85        | 28.32         | 56.00        | -27.68          | QP       |        |
| 10  | 2.6500      | 18.26          | 9.85        | 28.11         | 56.00        | -27.89          | QP       |        |
| 11  | 2.6500      | 6.97           | 9.85        | 16.82         | 46.00        | -29.18          | AVG      |        |
| 12  | 4.1180      | 6.06           | 9.85        | 15.91         | 46.00        | -30.09          | AVG      |        |

Note: Result = Reading + Factor Over Limit = Result - Limit



**Conducted Emission Test Data**

Test Site: 1# Shielded Room  
 Operating Condition: GFSK (2402MHz)  
 Test Specification: AC 120V, 60Hz for adapter  
 Comment: Neutral Line  
 Temp.(°C)/Hum.(%RH): 22.1°C/52%RH



| No. | Freq. (MHz) | Reading (dBuV) | Factor (dB) | Result (dBuV) | Limit (dBuV) | Over Limit (dB) | Detector | Remark |
|-----|-------------|----------------|-------------|---------------|--------------|-----------------|----------|--------|
| 1   | 0.1500      | 28.30          | 9.82        | 38.12         | 65.99        | -27.87          | QP       |        |
| 2   | 0.2740      | 22.43          | 9.84        | 32.27         | 60.99        | -28.72          | QP       |        |
| 3   | 0.4780      | 18.49          | 9.85        | 28.34         | 56.37        | -28.03          | QP       |        |
| 4   | 0.5540      | 24.81          | 9.86        | 34.67         | 56.00        | -21.33          | QP       |        |
| 5   | 0.5540      | 12.98          | 9.86        | 22.84         | 46.00        | -23.16          | AVG      |        |
| 6   | 0.8300      | 16.55          | 9.87        | 26.42         | 56.00        | -29.58          | QP       |        |
| 7   | 1.0900      | 6.59           | 9.86        | 16.45         | 46.00        | -29.55          | AVG      |        |
| 8   | 1.1019      | 18.05          | 9.86        | 27.91         | 56.00        | -28.09          | QP       |        |
| 9   | 1.3900      | 1.18           | 9.86        | 11.04         | 46.00        | -34.96          | AVG      |        |
| 10  | 1.8940      | 5.20           | 9.85        | 15.05         | 46.00        | -30.95          | AVG      |        |
| 11  | 2.6700      | 4.74           | 9.85        | 14.59         | 46.00        | -31.41          | AVG      |        |
| 12  | 4.2220      | 3.56           | 9.85        | 13.41         | 46.00        | -32.59          | AVG      |        |

Note: Result = Reading + Factor      Over Limit = Result - Limit



## 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 = 120kHz, 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.

For average measurement: use duty cycle correction factor method (DCCF)

Average level = Peak level + DCCF

#### 4.4. Test Data

##### PASS

During the test, Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the X-axis is the worst case.

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

During the test, pre-scan all modes, only the worst case is recorded in the report.



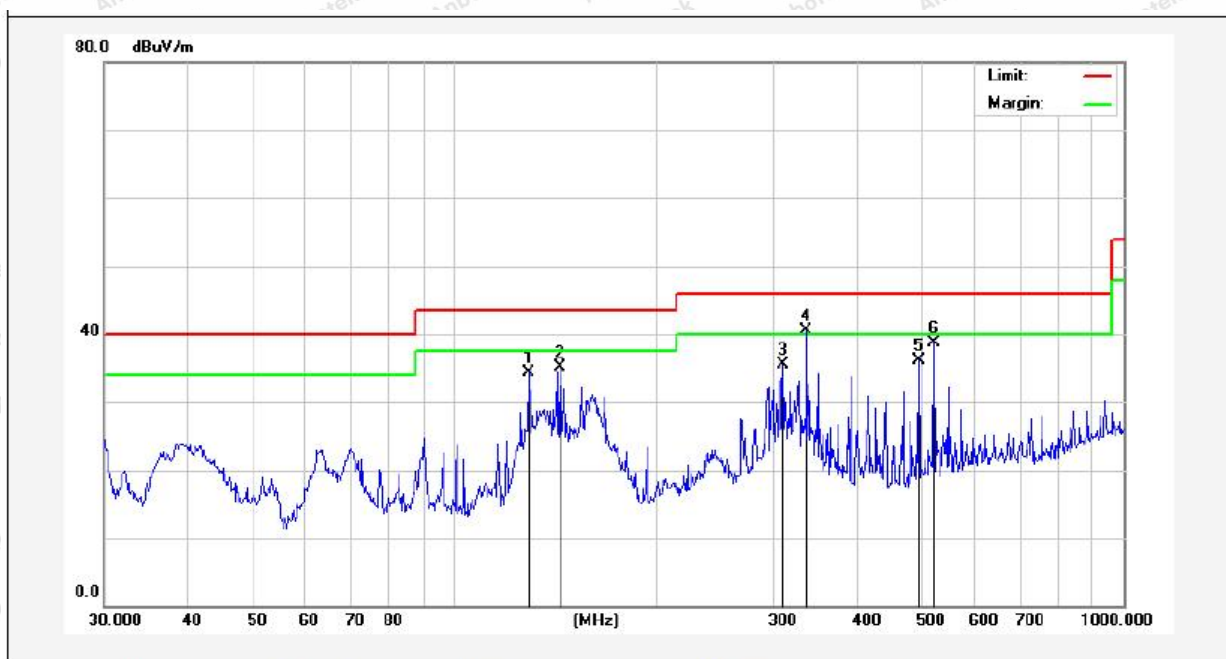
## Test Results (30~1000MHz)

Test Mode: GFSK (2402MHz)

Power Source: AC 120V, 60Hz for adapter

Polarization: Vertical

Temp.(°C)/Hum.(%RH): 22.1°C/52%RH



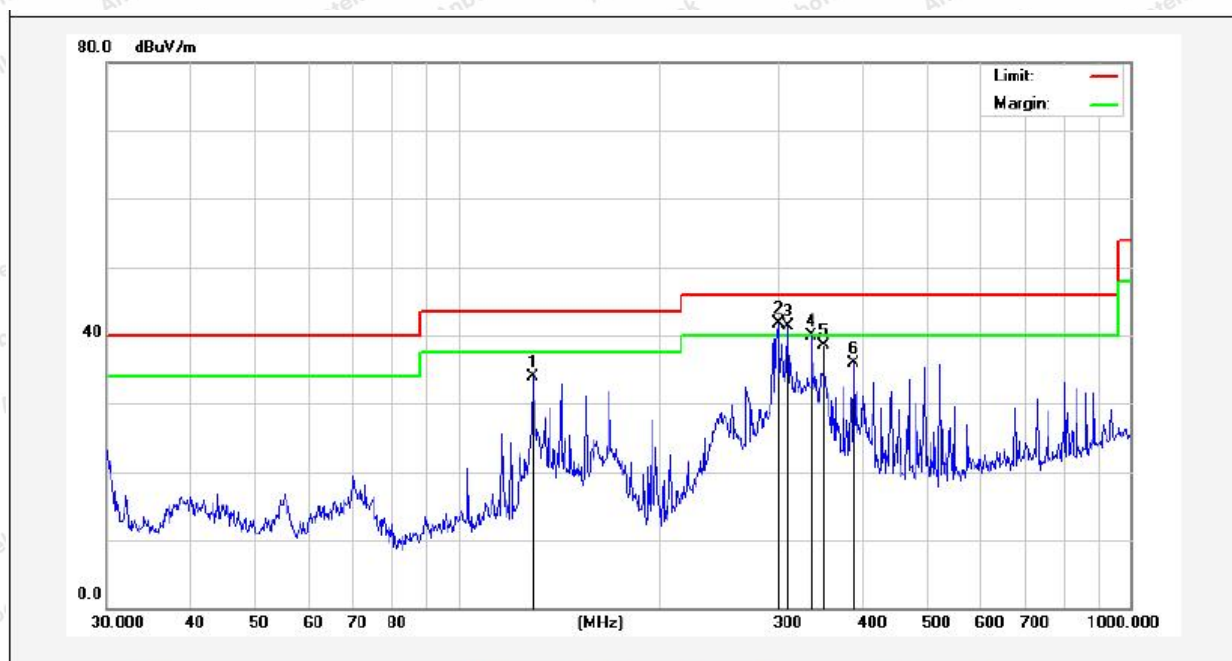
| No. | Freq. (MHz) | Reading (dBuV) | Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Detector | Height (cm) | degree (deg) | Remark |
|-----|-------------|----------------|---------------|-----------------|----------------|-----------------|----------|-------------|--------------|--------|
| 1   | 129.0146    | 55.59          | -21.32        | 34.27           | 43.50          | -9.23           | QP       |             |              |        |
| 2   | 143.8295    | 57.20          | -22.15        | 35.05           | 43.50          | -8.45           | QP       |             |              |        |
| 3   | 309.9977    | 51.48          | -16.00        | 35.48           | 46.00          | -10.52          | QP       |             |              |        |
| 4   | 336.0352    | 55.81          | -15.35        | 40.46           | 46.00          | -5.54           | QP       |             |              |        |
| 5   | 494.1984    | 48.53          | -12.39        | 36.14           | 46.00          | -9.86           | QP       |             |              |        |
| 6   | 520.8882    | 50.83          | -12.03        | 38.80           | 46.00          | -7.20           | QP       |             |              |        |

Note: Result = Reading + Factor    Over Limit = Result - Limit



## Test Results (30~1000MHz)

Test Mode: GFSK (2402MHz)  
Power Source: AC 120V, 60Hz for adapter  
Polarization: Horizontal  
Temp.(°C)/Hum.(%RH): 22.1°C/52%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   | 129.0146    | 56.54          | -22.64        | 33.90           | 43.50          | -9.60           | QP       |             |              |        |
| 2   | 299.3158    | 58.85          | -17.22        | 41.63           | 46.00          | -4.37           | QP       |             |              |        |
| 3   | 309.9977    | 58.32          | -16.92        | 41.40           | 46.00          | -4.60           | QP       |             |              |        |
| 4   | 336.0350    | 56.24          | -16.32        | 39.92           | 46.00          | -6.08           | QP       |             |              |        |
| 5   | 349.2500    | 54.45          | -16.01        | 38.44           | 46.00          | -7.56           | QP       |             |              |        |
| 6   | 387.9920    | 52.07          | -16.10        | 35.97           | 46.00          | -10.03          | QP       |             |              |        |

Note: Result = Reading + Factor    Over Limit = Result - Limit



## Test Results (1GHz-25GHz)

|                    |                   |                  |                      |                        |                    |              |
|--------------------|-------------------|------------------|----------------------|------------------------|--------------------|--------------|
| Test Mode: CH00    |                   |                  | Test channel: Lowest |                        |                    |              |
| Peak value:        |                   |                  |                      |                        |                    |              |
| Frequency<br>(MHz) | Reading<br>(dBuV) | Factor<br>(dB/m) | Result<br>(dBuV/m)   | Limit Line<br>(dBuV/m) | Over Limit<br>(dB) | polarization |
| 4804.00            | 27.40             | 15.27            | 42.67                | 74.00                  | -31.33             | Vertical     |
| 7206.00            | 28.53             | 18.09            | 46.62                | 74.00                  | -27.38             | Vertical     |
| 9608.00            | 29.43             | 23.76            | 53.19                | 74.00                  | -20.81             | Vertical     |
| 12010.00           | *                 |                  |                      | 74.00                  |                    | Vertical     |
| 14412.00           | *                 |                  |                      | 74.00                  |                    | Vertical     |
| 4804.00            | 27.76             | 15.27            | 43.03                | 74.00                  | -30.97             | Horizontal   |
| 7206.00            | 28.78             | 18.09            | 46.87                | 74.00                  | -27.13             | Horizontal   |
| 9608.00            | 28.34             | 23.76            | 52.10                | 74.00                  | -21.90             | Horizontal   |
| 12010.00           | *                 |                  |                      | 74.00                  |                    | Horizontal   |
| 14412.00           | *                 |                  |                      | 74.00                  |                    | Horizontal   |
| Average value:     |                   |                  |                      |                        |                    |              |
| Frequency<br>(MHz) | Reading<br>(dBuV) | Factor<br>(dB/m) | Result<br>(dBuV/m)   | Limit<br>(dBuV/m)      | Over Limit<br>(dB) | polarization |
| 4804.00            | 16.78             | 15.27            | 32.05                | 54.00                  | -21.95             | Vertical     |
| 7206.00            | 17.56             | 18.09            | 35.65                | 54.00                  | -18.35             | Vertical     |
| 9608.00            | 18.45             | 23.76            | 42.21                | 54.00                  | -11.79             | Vertical     |
| 12010.00           | *                 |                  |                      | 54.00                  |                    | Vertical     |
| 14412.00           | *                 |                  |                      | 54.00                  |                    | Vertical     |
| 4804.00            | 16.11             | 15.27            | 31.38                | 54.00                  | -22.62             | Horizontal   |
| 7206.00            | 17.84             | 18.09            | 35.93                | 54.00                  | -18.07             | Horizontal   |
| 9608.00            | 17.65             | 23.76            | 41.41                | 54.00                  | -12.59             | Horizontal   |
| 12010.00           | *                 |                  |                      | 54.00                  |                    | Horizontal   |
| 14412.00           | *                 |                  |                      | 54.00                  |                    | Horizontal   |



## Test Results (1GHz-25GHz)

|                    |                   |                  |                      |                        |                    |              |
|--------------------|-------------------|------------------|----------------------|------------------------|--------------------|--------------|
| Test Mode: CH39    |                   |                  | Test channel: Middle |                        |                    |              |
| Peak value:        |                   |                  |                      |                        |                    |              |
| Frequency<br>(MHz) | Reading<br>(dBuV) | Factor<br>(dB/m) | Result<br>(dBuV/m)   | Limit Line<br>(dBuV/m) | Over Limit<br>(dB) | polarization |
| 4882.00            | 27.42             | 15.42            | 42.84                | 74.00                  | -31.16             | Vertical     |
| 7323.00            | 28.38             | 18.02            | 46.40                | 74.00                  | -27.60             | Vertical     |
| 9764.00            | 28.44             | 23.80            | 52.24                | 74.00                  | -21.76             | Vertical     |
| 12205.00           | *                 |                  |                      | 74.00                  |                    | Vertical     |
| 14646.00           | *                 |                  |                      | 74.00                  |                    | Vertical     |
| 4882.00            | 27.46             | 15.42            | 42.88                | 74.00                  | -31.12             | Horizontal   |
| 7323.00            | 28.77             | 18.02            | 46.79                | 74.00                  | -27.21             | Horizontal   |
| 9764.00            | 28.04             | 23.80            | 51.84                | 74.00                  | -22.16             | Horizontal   |
| 12205.00           | *                 |                  |                      | 74.00                  |                    | Horizontal   |
| 14646.00           | *                 |                  |                      | 74.00                  |                    | Horizontal   |
| Average value:     |                   |                  |                      |                        |                    |              |
| Frequency<br>(MHz) | Reading<br>(dBuV) | Factor<br>(dB/m) | Result<br>(dBuV/m)   | Limit<br>(dBuV/m)      | Over Limit<br>(dB) | polarization |
| 4882.00            | 16.51             | 15.42            | 31.93                | 54.00                  | -22.07             | Vertical     |
| 7323.00            | 17.66             | 18.02            | 35.68                | 54.00                  | -18.32             | Vertical     |
| 9764.00            | 18.31             | 23.80            | 42.11                | 54.00                  | -11.89             | Vertical     |
| 12205.00           | *                 |                  |                      | 54.00                  |                    | Vertical     |
| 14646.00           | *                 |                  |                      | 54.00                  |                    | Vertical     |
| 4882.00            | 16.02             | 15.42            | 31.44                | 54.00                  | -22.56             | Horizontal   |
| 7323.00            | 17.40             | 18.02            | 35.42                | 54.00                  | -18.58             | Horizontal   |
| 9764.00            | 18.16             | 23.80            | 41.96                | 54.00                  | -12.04             | Horizontal   |
| 12205.00           | *                 |                  |                      | 54.00                  |                    | Horizontal   |
| 14646.00           | *                 |                  |                      | 54.00                  |                    | Horizontal   |



## Test Results (1GHz-25GHz)

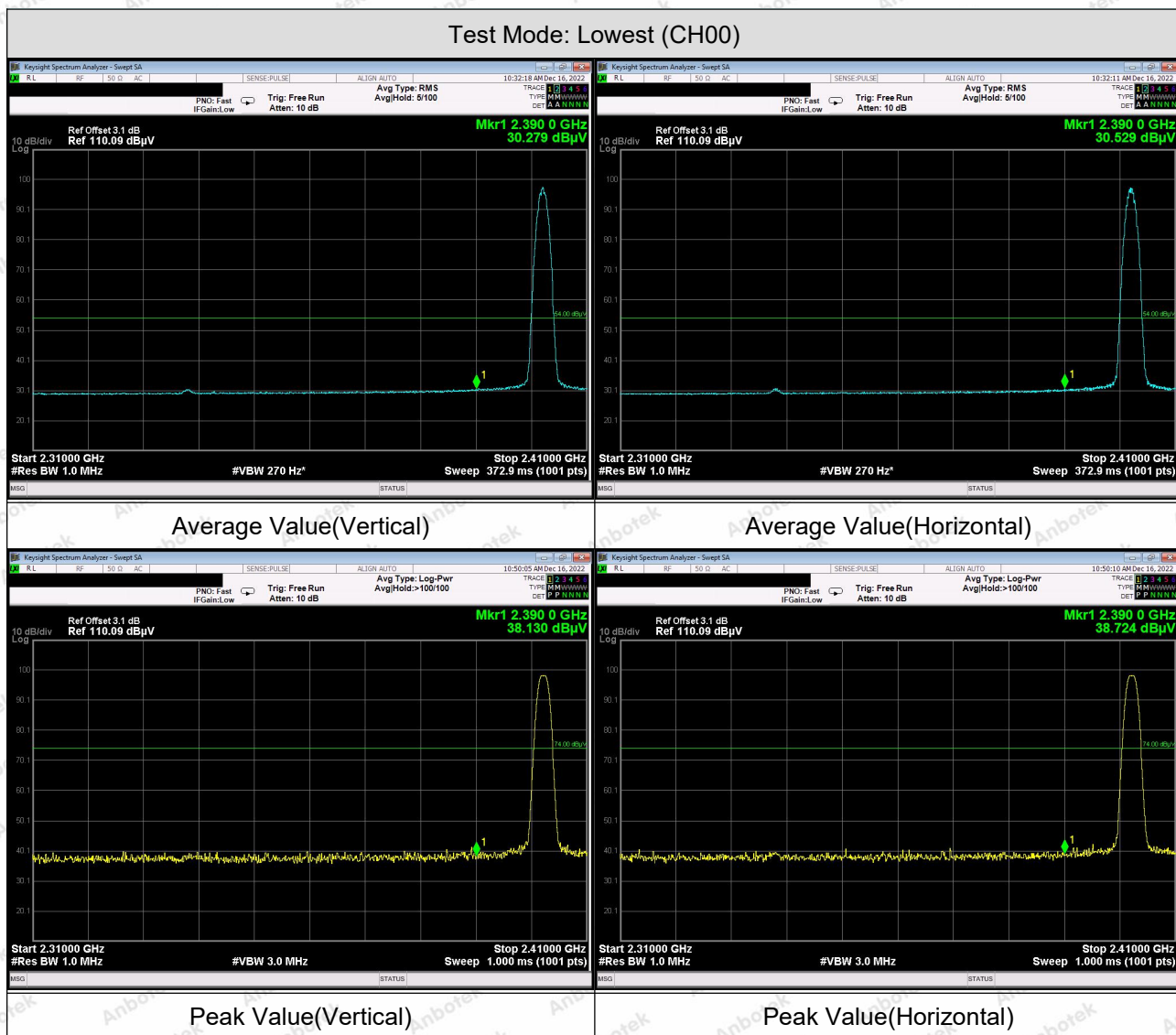
|                    |                   |                  |                       |                        |                    |              |
|--------------------|-------------------|------------------|-----------------------|------------------------|--------------------|--------------|
| Test Mode: CH78    |                   |                  | Test channel: Highest |                        |                    |              |
| Peak value:        |                   |                  |                       |                        |                    |              |
| Frequency<br>(MHz) | Reading<br>(dBuV) | Factor<br>(dB/m) | Result<br>(dBuV/m)    | Limit Line<br>(dBuV/m) | Over Limit<br>(dB) | polarization |
| 4960.00            | 27.69             | 15.58            | 43.27                 | 74.00                  | -30.73             | Vertical     |
| 7440.00            | 28.39             | 17.93            | 46.32                 | 74.00                  | -27.68             | Vertical     |
| 9920.00            | 28.99             | 23.83            | 52.82                 | 74.00                  | -21.18             | Vertical     |
| 12400.00           | *                 |                  |                       | 74.00                  |                    | Vertical     |
| 14880.00           | *                 |                  |                       | 74.00                  |                    | Vertical     |
| 4960.00            | 27.53             | 15.58            | 43.11                 | 74.00                  | -30.89             | Horizontal   |
| 7440.00            | 28.80             | 17.93            | 46.73                 | 74.00                  | -27.27             | Horizontal   |
| 9920.00            | 28.72             | 23.83            | 52.55                 | 74.00                  | -21.45             | Horizontal   |
| 12400.00           | *                 |                  |                       | 74.00                  |                    | Horizontal   |
| 14880.00           | *                 |                  |                       | 74.00                  |                    | Horizontal   |
| Average value:     |                   |                  |                       |                        |                    |              |
| Frequency<br>(MHz) | Reading<br>(dBuV) | Factor<br>(dB/m) | Result<br>(dBuV/m)    | Limit<br>(dBuV/m)      | Over Limit<br>(dB) | polarization |
| 4960.00            | 17.63             | 15.58            | 33.21                 | 54.00                  | -20.79             | Vertical     |
| 7440.00            | 18.67             | 17.93            | 36.60                 | 54.00                  | -17.40             | Vertical     |
| 9920.00            | 18.86             | 23.83            | 42.69                 | 54.00                  | -11.31             | Vertical     |
| 12400.00           | *                 |                  |                       | 54.00                  |                    | Vertical     |
| 14880.00           | *                 |                  |                       | 54.00                  |                    | Vertical     |
| 4960.00            | 17.46             | 15.58            | 33.04                 | 54.00                  | -20.96             | Horizontal   |
| 7440.00            | 18.77             | 17.93            | 36.70                 | 54.00                  | -17.30             | Horizontal   |
| 9920.00            | 18.06             | 23.83            | 41.89                 | 54.00                  | -12.11             | Horizontal   |
| 12400.00           | *                 |                  |                       | 54.00                  |                    | Horizontal   |
| 14880.00           | *                 |                  |                       | 54.00                  |                    | Horizontal   |

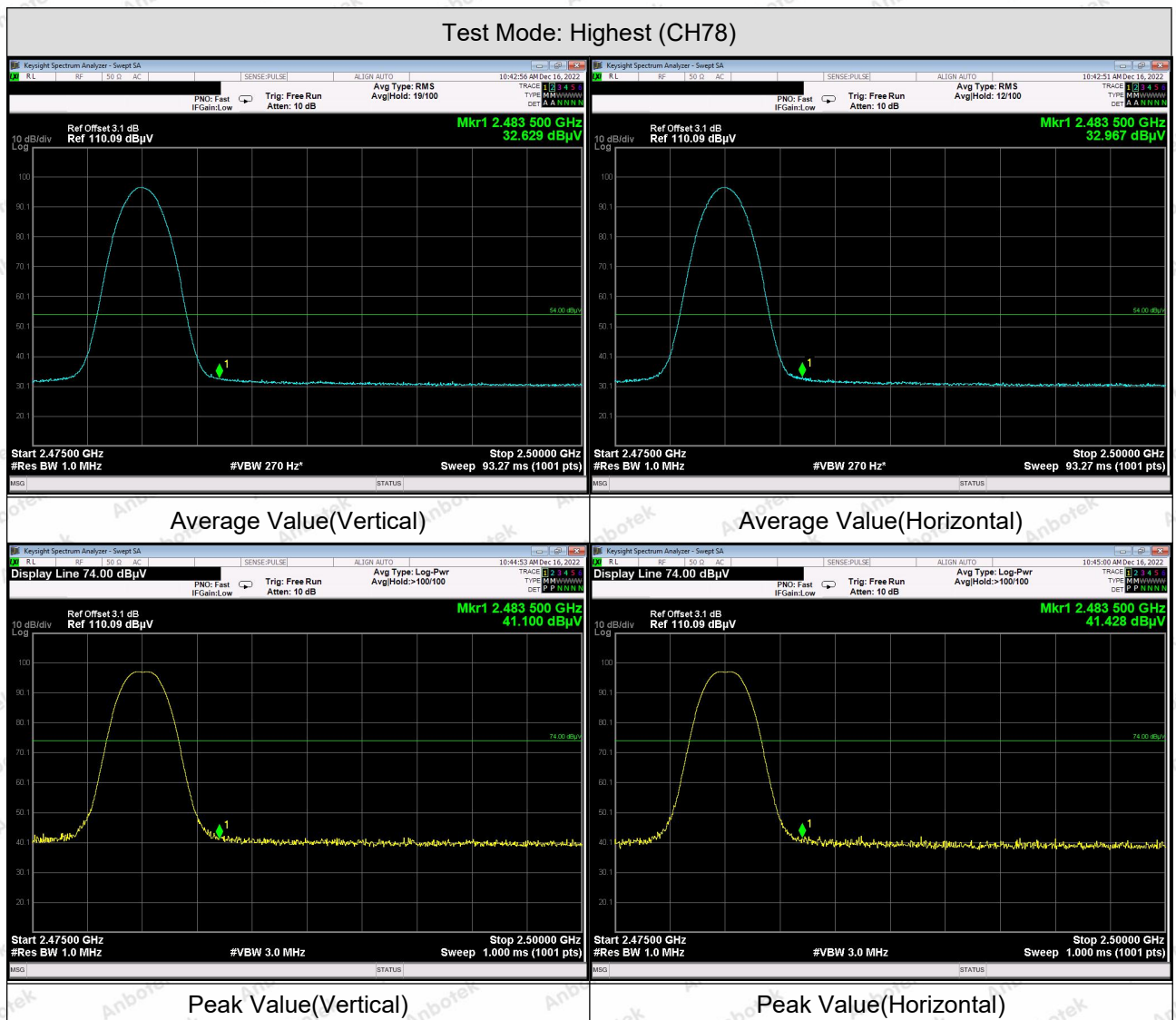
## Remark:

1. During the test, pre-scan the GFSK,  $\pi/4$ QPSK, 8DPSK modulation, and found the GFSK modulation is worse case, the report only record this mode.
2. Result = Reading + Factor
3. "\*" 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. During the test, pre-scan the GFSK,  $\pi/4$ QPSK, 8DPSK modulation, and found the GFSK modulation is worse case, the report only record this mode.



## 5. Maximum Peak Output Power Test

### 5.1. Test Standard and Limit

|               |                                                                                                                                                                                                                                                                                    |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Standard | FCC Part15 C Section 15.247 (b)(1)                                                                                                                                                                                                                                                 |
| Test Limit    | 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. |

### 5.2. Test Setup



### 5.3. Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above,
2. Spectrum Setting:
  - RBW > the 20 dB bandwidth of the emission being measured
  - Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
  - VBW ≥ RBW
  - Sweep = auto
  - Detector function = peak
  - Trace = max hold

### 5.4. Test Data

Pass

Please refer to Appendix C of the Appendix Test Data.

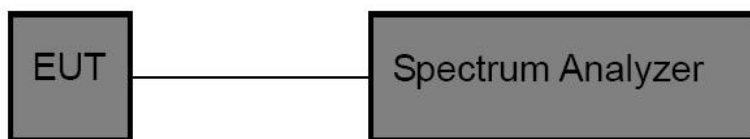


## 6. 20DB Occupy Bandwidth Test

### 6.1. Test Standard

|               |                                    |
|---------------|------------------------------------|
| Test Standard | FCC Part15 C Section 15.247 (a)(1) |
|---------------|------------------------------------|

### 6.2. Test Setup



### 6.3. Test Procedure

Using the following spectrum analyzer settings:

1. Span= approximately 2 to 3 times the 20dB bandwidth, centered on a hopping channel.
2. Set the RBW  $\geq 1\%$  of the 20 dB bandwidth.
3. Set the VBW  $\geq$  RBW
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

### 6.4. Test Data

Pass

Please refer to Appendix A of the Appendix Test Data.



## 7. Carrier Frequency Separation Test

### 7.1. Test Standard and Limit

|               |                                                                               |
|---------------|-------------------------------------------------------------------------------|
| Test Standard | FCC Part15 C Section 15.247 (a)(1)                                            |
| Test Limit    | 2/3 of the 20dB bandwidth base on the transmission power is less than 0.125W. |

### 7.2. Test Setup



### 7.3. Test Procedure

The EUT must have its hopping function enabled. Using the following spectrum analyzer settings:

1. Span= Wide enough to capture the peaks of two adjacent channels
2. Set the RBW =approximately 30% of the channel spacing.
3. Set the VBW  $\geq$  RBW.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

### 7.4. Test Data

Pass

Please refer to Appendix D of the Appendix Test Data.



## 8. Number of Hopping Channel Test

### 8.1. Test Standard and Limit

|               |                                         |
|---------------|-----------------------------------------|
| Test Standard | FCC Part15 C Section 15.247 (a)(1)(iii) |
| Test Limit    | >15 channels                            |

### 8.2. Test Setup



### 8.3. Test Procedure

The EUT must have its hopping function enabled. Using the following spectrum analyzer setting:

1. Span= the frequency band of operation
2. Set the RBW = less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
3. Set the VBW  $\geq$  RBW.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

### 8.4. Test Data

Pass

Please refer to Appendix F of the Appendix Test Data.



## 9. Dwell Time Test

### 9.1. Test Standard and Limit

|               |                                         |
|---------------|-----------------------------------------|
| Test Standard | FCC Part15 C Section 15.247 (a)(1)(iii) |
| Test Limit    | 0.4 s                                   |

### 9.2. Test Setup



### 9.3. Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span= zero span, centered on a hopping channel
2. Set the RBW = 1 MHz.
3. Set the VBW  $\geq$  RBW.
4. Sweep time = as necessary to capture the entire dwell time per hopping channel.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

### 9.4. Test Data

Pass

Please refer to Appendix E of the Appendix Test Data.

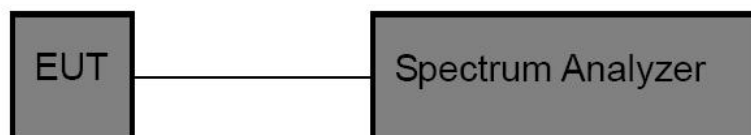


## 10. 100kHz Bandwidth of Frequency Band Edge Requirement

### 10.1. 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). |

### 10.2. Test Setup



### 10.3. Test Procedure

The EUT must have its hopping/Non-hopping function enabled. 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.

### 10.4. Test Data

Pass

Please refer to Appendix G & Appendix H of the Appendix Test Data.



## 11. Antenna Requirement

### 11.1. 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> |

### 11.2. Antenna Connected Construction

The antenna is Ceramic antenna which permanently attached, and the best case gain of the antenna is 1.85dBi. It complies with the standard requirement.



## **APPENDIX I -- TEST SETUP PHOTOGRAPH**

Please refer to separated files Appendix I -- Test Setup Photograph

## **APPENDIX II -- EXTERNAL PHOTOGRAPH**

Please refer to separated files Appendix II -- External Photograph

## **APPENDIX III -- INTERNAL PHOTOGRAPH**

Please refer to separated files Appendix III -- Internal Photograph

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

