

**FCC PART 15C TEST REPORT FOR CERTIFICATION**

On Behalf of

American Lighting Inc.

\*\*\*\*\*

**FCC ID: 2BBPR208050030**

|                                                                                                                                                                                                                                                                                                                                                          |                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| <b>Report Type:</b><br>Original report                                                                                                                                                                                                                                                                                                                   | <b>Product Type:</b><br>Wireless Switch |
| <b>Test Engineer:</b> <u>Clint Chen</u> <i>Clint Chen</i>                                                                                                                                                                                                                                                                                                |                                         |
| <b>Report Number:</b> <u>STDNB-230517F-001</u>                                                                                                                                                                                                                                                                                                           |                                         |
| <b>Report Date:</b> <u>2023-06-30</u>                                                                                                                                                                                                                                                                                                                    |                                         |
| <b>Reviewed By:</b> <u>Philip Guo</u> <i>Philip Guo</i>                                                                                                                                                                                                                                                                                                  |                                         |
| <b>Prepared By:</b> STANDARD-TECH TESTING SERVICES<br>Standard-Tech Building, No. 6 Guanhong Road<br>Guangzhou Science City, Guangzhou City, Guangdong<br>Province, Guangzhou 510663, People's Republic of China<br>Tel: +86-20-32290320 /32290719<br>Fax: +86-20-32290422 /32290556<br><a href="http://www.standard-tech.com">www.standard-tech.com</a> |                                         |

The device described above is tested by STANDARD-TECH TESTING SERVICES. to confirm comply with all the FCC Part 15 Subpart C requirements. The test results are contained in this test report and STANDARD-TECH TESTING SERVICES is assumed full responsibility for the accuracy and completeness of these tests. Also, this report shows that the Equipment Under Test (EUT) is to be technically compliant with the FCC requirements. This Report is made under FCC Part 2.1074. No modifications were required during testing to bring this product into compliance. This report applies to above tested sample only. This report shall not be reproduced in part without written approval of STANDARD-TECH TESTING SERVICES.

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# 1. SUMMARY OF STANDARDS AND RESULTS

## 1.1. Description of Standards and Results

The EUT has been tested according to the applicable standards as referenced below.

| <b>EMISSION</b>                 |                                            |                |
|---------------------------------|--------------------------------------------|----------------|
| <b>Description of Test Item</b> | <b>Standard</b>                            | <b>Results</b> |
| Power Line Conducted Emission   | FCC Part 15: 15.207                        | PASS           |
| Radiated Emission               | FCC Part 15: 15.209<br>FCC Part 15: 15.205 | PASS           |
| Band Edge Compliance            | FCC Part 15: 15.247(d)                     | PASS           |
| Conducted spurious emissions    | FCC Part 15: 15.247(d)                     | PASS           |
| 6dB Bandwidth Test              | FCC Part 15: 15.247(a)                     | PASS           |
| Peak Output Power               | FCC Part 15: 15.247(b)                     | PASS           |
| Power Spectral Density          | FCC Part 15: 15.247(e)                     | PASS           |
| Antenna requirement             | FCC Part 15: 15.203                        | PASS           |

## 2. GENERAL INFORMATION

### 2.1. Description of Equipment Under Test

|                           |                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Applicant</b>          | Hera GmbH & Co. KG                                                                                                                                                                                                                                                                                                                                               |
| <b>Address</b>            | Dieselstrasse 9, DE-32130 Enger, Germany                                                                                                                                                                                                                                                                                                                         |
| <b>Manufacturer</b>       | NINGBO TECHNIC LIGHTING CO.,LTD                                                                                                                                                                                                                                                                                                                                  |
| <b>Address</b>            | NO.8,Caiyuan Road, YuYao City, ZheJiang Province, China                                                                                                                                                                                                                                                                                                          |
| <b>Factory</b>            | NINGBO TECHNIC LIGHTING CO.,LTD                                                                                                                                                                                                                                                                                                                                  |
| <b>Address</b>            | NO.8,Caiyuan Road, YuYao City, ZheJiang Province, China                                                                                                                                                                                                                                                                                                          |
| <b>Product</b>            | Wireless Switch                                                                                                                                                                                                                                                                                                                                                  |
| <b>Model No.</b>          | Wireless-T, Wireless-O                                                                                                                                                                                                                                                                                                                                           |
| <b>Remark</b>             | 1.The above models use the same wireless module.<br>2.This product uses the kinetic energy module instead of the traditional battery to power the system, and the magnet on the kinetic energy module will be pushed during the button press process, so that the coil inside the module can generate induced voltage to realize the power supply of the system. |
| <b>Power Adapter</b>      | N/A                                                                                                                                                                                                                                                                                                                                                              |
| <b>Sample Type</b>        | Prototype production                                                                                                                                                                                                                                                                                                                                             |
| <b>SN:</b>                | STD230517NB-1(T), STD230517NB-2(O)                                                                                                                                                                                                                                                                                                                               |
| <b>Date of Receipt</b>    | 2023/06/20                                                                                                                                                                                                                                                                                                                                                       |
| <b>Date of Test</b>       | 2023/06/20-2023/06/28                                                                                                                                                                                                                                                                                                                                            |
| <b>Test Power Supply:</b> | 3.3Vdc                                                                                                                                                                                                                                                                                                                                                           |

## 2.2.Feature of Equipment Under Test

| <b>Product Feature &amp; Specification</b> |                                     |
|--------------------------------------------|-------------------------------------|
| <b>RF module</b>                           |                                     |
| Hardware version                           | N/A                                 |
| Software version                           | N/A                                 |
| Modulation Type                            | GFSK                                |
| Operating Frequency Range                  | The frequency range used is 2440MHz |

### Antenna System

| <b>RF module</b>  |                    |
|-------------------|--------------------|
| Type of Antenna   | PCB Antenna        |
| Antenna number    | 1                  |
| Antenna Peak Gain | Peak Gain: 2.39dBi |

## 2.3.Tested Supporting System Details

RF Test Tool: /

1. Use the UART serial board to connect the RF module correctly; 3.3V —>VCC;  
GND —>GND;
2. Connect the UART serial board to the computer
3. Click Keystroke to enter the test
4. Perform all tests at the default power level

### Support Equipment List and Details

| <b>Manufacturer</b> | <b>Description</b> | <b>Model</b> | <b>Serial Number</b> |
|---------------------|--------------------|--------------|----------------------|
| Lenovo              | Notebook           | X220i        | 428632C              |
| Lenovo              | Adapter            | 42T4420      | N322                 |
| N/A                 | USB adaptor        | 94V-0        | 932                  |

### External I/O Cable

| <b>Cable Description</b> | <b>Length (m)</b> | <b>From Port</b> | <b>To</b>   |
|--------------------------|-------------------|------------------|-------------|
| Data Cable               | 0.1               | EUT              | Debug Board |

## 2.4. Test Information

|                        |             |
|------------------------|-------------|
| <b>Frequency (MHz)</b> | <b>2440</b> |
|------------------------|-------------|

## 2.5. Equipments Used during the Test

### Conducted Emissions

| Item | Equipment         | Manufacturer    | Model No. | Serial No. | Last Cal.  | Cal. Interval |
|------|-------------------|-----------------|-----------|------------|------------|---------------|
| 1.   | Shielding Room    | AUDIX           | N/A       | N/A        | 2021/07/27 | 3 Year        |
| 2.   | EMI Test Receiver | Rohde & Schwarz | ESR7      | 101487     | 2022/04/01 | 2 Year        |
| 3.   | V-LISN            | Rohde & Schwarz | NNLK 8122 | 8122-00128 | 2022/03/31 | 2 Year        |
| 4.   | RF Cable          | YuanDao         | RG223     | N/A        | 2023/04/13 | 1 Year        |
| 5.   | Test Software     | AUDIX           | e3        | N/A        | N/A        | N/A           |

Note: N/A means Not applicable.

### For frequency range 30MHz~1000MHz (In 3m Anechoic Chamber)

| Item | Equipment                     | Manufacturer | Model No. | Serial No. | Last Cal.  | Cal. Interval |
|------|-------------------------------|--------------|-----------|------------|------------|---------------|
| 1.   | Semi-anechoic chamber         | AUDIX        | N/A       | N/A        | 2021/07/27 | 3 Year        |
| 2.   | EMI Test Receiver             | R&S          | ESR7      | 101487     | 2022/04/01 | 2 Year        |
| 3.   | Biconical Logarithmic Antenna | SCHWARDZBECK | VULB 9162 | 9162-104   | 2022/04/10 | 2 Year        |
| 4.   | Cable Line                    | PEWC         | CFD400NL  | N/A        | 2023/04/13 | 1 Year        |
| 5.   | Loop Antenna                  | Beijing Daze | ZN30900C  | 1062       | 2023/01/19 | 1 Year        |
| 6.   | Test Software                 | AUDIX        | e3        | N/A        | N/A        | 1 Year        |

Note: N/A means Not applicable.

**For frequency range above 1GHz (In 3m Anechoic Chamber)**

| Item | Equipment              | Manufacturer | Model No.            | Serial No.   | Last Cal.  | Cal. Interval |
|------|------------------------|--------------|----------------------|--------------|------------|---------------|
| 1    | Semi-anechoic chamber  | AUDIX        | N/A                  | N/A          | 2021/07/27 | 3 Year        |
| 2    | Spectrum Analyzer      | R&S          | FSP                  | 100615       | 2022/04/01 | 2 Year        |
| 3    | Horn Antenna           | SCHWARDZBECK | BBHA 9170            | 895          | 2023/01/19 | 1 Year        |
| 4    | Horn Antenna           | SCHWARDZBECK | BBHA 9120 D          | 9120D-1515   | 2022/04/06 | 2 Year        |
| 5    | Broadband Preamplifier | SCHWARDZBECK | BBV9718              | 9718-269     | 2022/01/14 | 2 Year        |
| 6    | Broadband Preamplifier | SKET         | LNPA-1840            | SK2019121201 | 2022/01/20 | 2 Year        |
| 7    | RF Cable               | SKET         | RC-40G-K-M /K-M-0.6M | N/A          | 2022/07/05 | 1 Year        |
| 8    | RF Cable               | SKET         | RC-40G-K-M /K-M-0.6M | N/A          | 2022/07/05 | 1 Year        |
| 9    | Test Software          | AUDIX        | e3                   | N/A          | N/A        | N/A           |

Note: N/A means Not applicable.

**RF Conducted Test**

| Item | Equipment         | Manufacturer | Model No. | Serial No. | Last Cal.  | Cal. Interval |
|------|-------------------|--------------|-----------|------------|------------|---------------|
| 1.   | Spectrum Analyzer | R&S          | FSP       | 100615     | 2022/04/01 | 2 Year        |
| 2.   | RF Cable          | STD          | /         | /          | /          | /             |

## 2.6. Test Facility

### Site Description

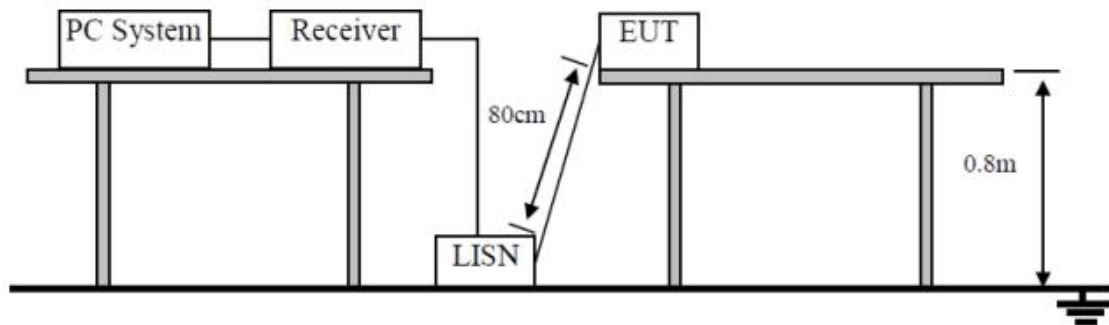
|              |                                                                                                                                                                                                   |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Name of Firm | : STANDARD-TECH TESTING SERVICES<br>Standard-Tech Building, No. 6 Guanhong Road<br>Guangzhou Science City, Guangzhou City,<br>Guangdong Province, Guangzhou 510663,<br>People's Republic of China |
| A2LA         | : Certificate No.: 4703.01                                                                                                                                                                        |
| EMC Lab.     | Certificated by Industry Canada<br>: Registration Number: 20901<br>Valid Date: 2024/02/29<br><br>Certificated by FCC USA.<br>: Designation No.: CN1222<br>Valid Date: 2024/02/29                  |

## 2.7.Measurement Uncertainty (95% confidence levels, k=2)

| Test Item                                                            | Uncertainty                    |
|----------------------------------------------------------------------|--------------------------------|
| Uncertainty for Conduction emission test<br>in No. 1 Conduction      | 2.90dB(150KHz to 30MHz)        |
| Uncertainty for Radiation Emission test<br>in 3m chamber             | 5.34dB(30M~1GHz, Distance: 3m) |
| Uncertainty for Radiation Emission test<br>in 3m chamber(1GHz-40GHz) | 4.14dB(1~6GHz, Distance: 3m)   |
|                                                                      | 4.60dB(6~18GHz, Distance: 3m)  |
|                                                                      | 4.94dB(18~40GHz, Distance: 3m) |
| Uncertainty for Output power test                                    | 1.34dB                         |
| Uncertainty for Bandwidth test                                       | 92.3kHz                        |

### 3. POWER LINE CONDUCTED EMISSION TEST

#### 3.1. Block Diagram of Test Setup



#### 3.2. Power Line Conducted Emission Test Limits

| Frequency       | Maximum RF Line Voltage          |                               |
|-----------------|----------------------------------|-------------------------------|
|                 | Quasi-Peak Level<br>dB( $\mu$ V) | Average Level<br>dB( $\mu$ V) |
| 150kHz ~ 500kHz | 66 ~ 56*                         | 56 ~ 46*                      |
| 500kHz ~ 5MHz   | 56                               | 46                            |
| 5MHz ~ 30MHz    | 60                               | 50                            |

Notes: 1. \* Decreasing linearly with logarithm of frequency.

2. The lower limit shall apply at the transition frequencies.

#### 3.3. Test Procedure

The EUT was placed on a non-metallic table, 80cm above the ground plane. The EUT Power Via PC connected to the power mains through a line impedance stabilization network (V-LISN). This provides a 50 ohm coupling impedance for the EUT (Please refer the block diagram of the test setup and photographs). The 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 ANSI C63.10: 2013 on Conducted Emission Test.

The bandwidth of test receiver (R & S ESR7) is set at 9kHz.

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

#### 3.4. Power Line Conducted Emission Test Result

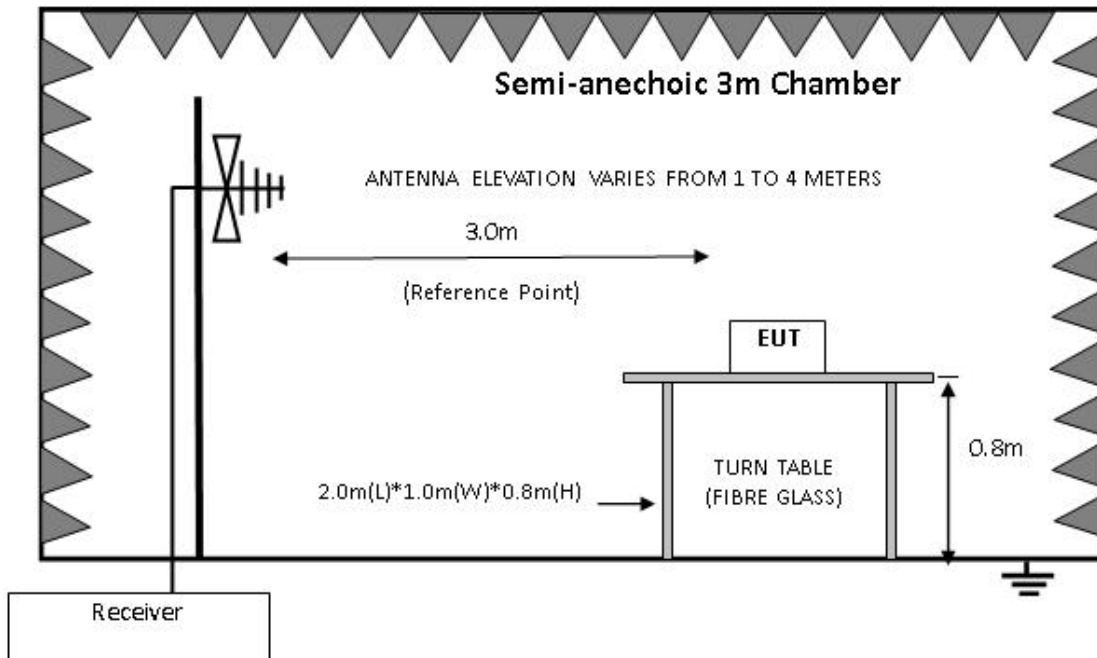
N/A

Note: The sample is DC powered, so Conducted Emission Test is exempt.

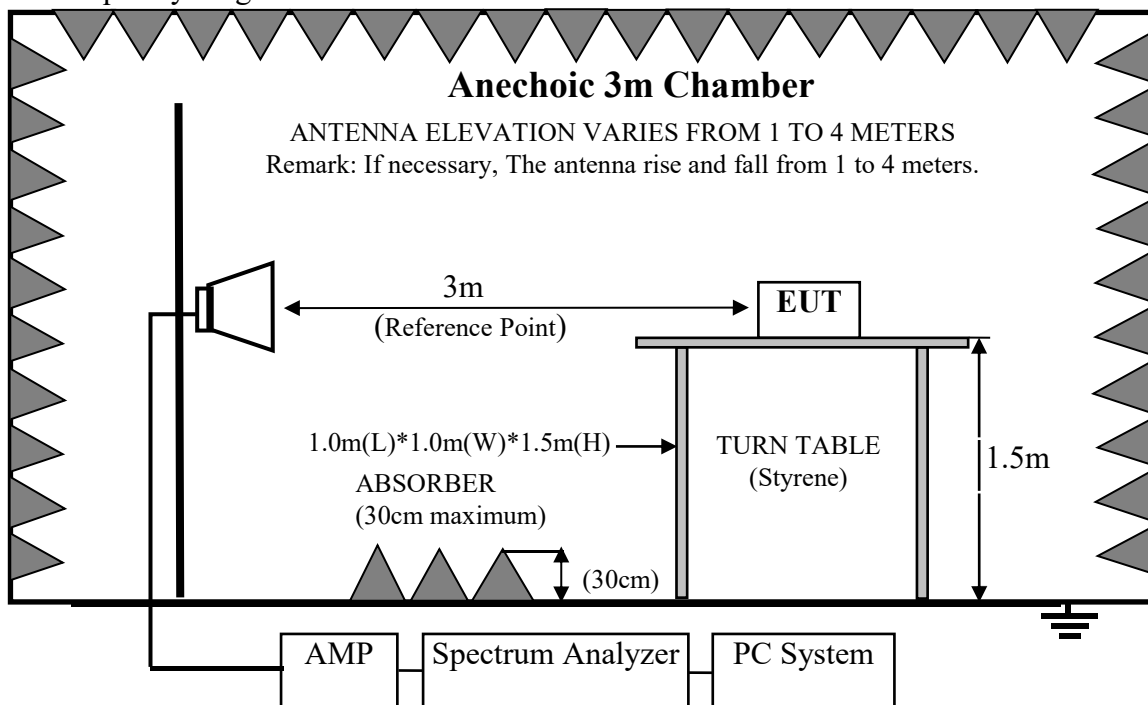
## 4. RADIATED EMISSION TEST

### 4.1. Block Diagram of Test Setup

For frequency range 30MHz-1000MHz



For frequency range above 1GHz



## 4.2. Radiated Emission Limit

### 15.247&209 limits

| FREQUENCY<br>MHz | DISTANCE<br>Meters | FIELD STRENGTHS LIMIT                                                                             |                                   |
|------------------|--------------------|---------------------------------------------------------------------------------------------------|-----------------------------------|
|                  |                    | $\mu\text{V/m}$                                                                                   | $\text{dB}(\mu\text{V})/\text{m}$ |
| 30 ~ 88          | 3                  | 100                                                                                               | 40.0                              |
| 88 ~ 216         | 3                  | 150                                                                                               | 43.5                              |
| 216 ~ 960        | 3                  | 200                                                                                               | 46.0                              |
| 960 ~ 1000       | 3                  | 500                                                                                               | 54.0                              |
| Above 1000       | 3                  | 74.0 $\text{dB}(\mu\text{V})/\text{m}$ (Peak)<br>54.0 $\text{dB}(\mu\text{V})/\text{m}$ (Average) |                                   |

- Remark: (1) Emission level  $\text{dB}\mu\text{V} = 20 \log$  Emission level  $\mu\text{V/m}$   
 (2) The smaller limit shall apply at the cross point between two frequency bands.  
 (3) Distance is the distance in meters between the measuring instrument, antenna and the closest point of any part of the device or system.

### 15.205 Restricted bands of operation

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

All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits.

## 4.3. Test Procedure

### Frequency below 30MHz:

The EUT setup on the turn table which has 0.8m height to the ground. The turn table rotated 360 degrees and antenna fixed to 1 m to find the maximum emission level. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

EUT and its simulators are placed on a turn table, which is 0.8 meter high above ground for frequency 30MHz~1000MHz, 1.5 meter high above ground for frequency above 1GHz and put the absorbing with 2.4m(L)\*2.4m(W)\*0.3m(H) on the ground . The turn table can rotate 360 degrees to determine the position of the maximum emission level. Power on the EUT and let it working in test mode, then test it. 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 between 1 meter and 4 meters to find out the maximum emission level. Broadband antenna

(calibrated bilog antenna) is used as receiving antenna for frequency 30MHz~1000MHz, and the Horn antenna is used as receiving antenna for frequency above 1GHz. Both horizontal and vertical polarization of the antenna is set on Test. In order to find the maximum emission levels, all of the interface cables must be manipulated according to ANSI C63.10-2013 on radiated emission Test.

The bandwidth of the EMI test receiver (R&S ESR7) is set at 120kHz for frequency range from 30MHz to 1000 MHz.

The bandwidth of the Spectrum's VBW is set at 3MHz and RBW is set at 1MHz for peak emissions measurement above 1GHz and 1MHz RBW, 10Hz VBW for average emissions measure above 1GHz

#### 4.4. Radiated Emission Test Results

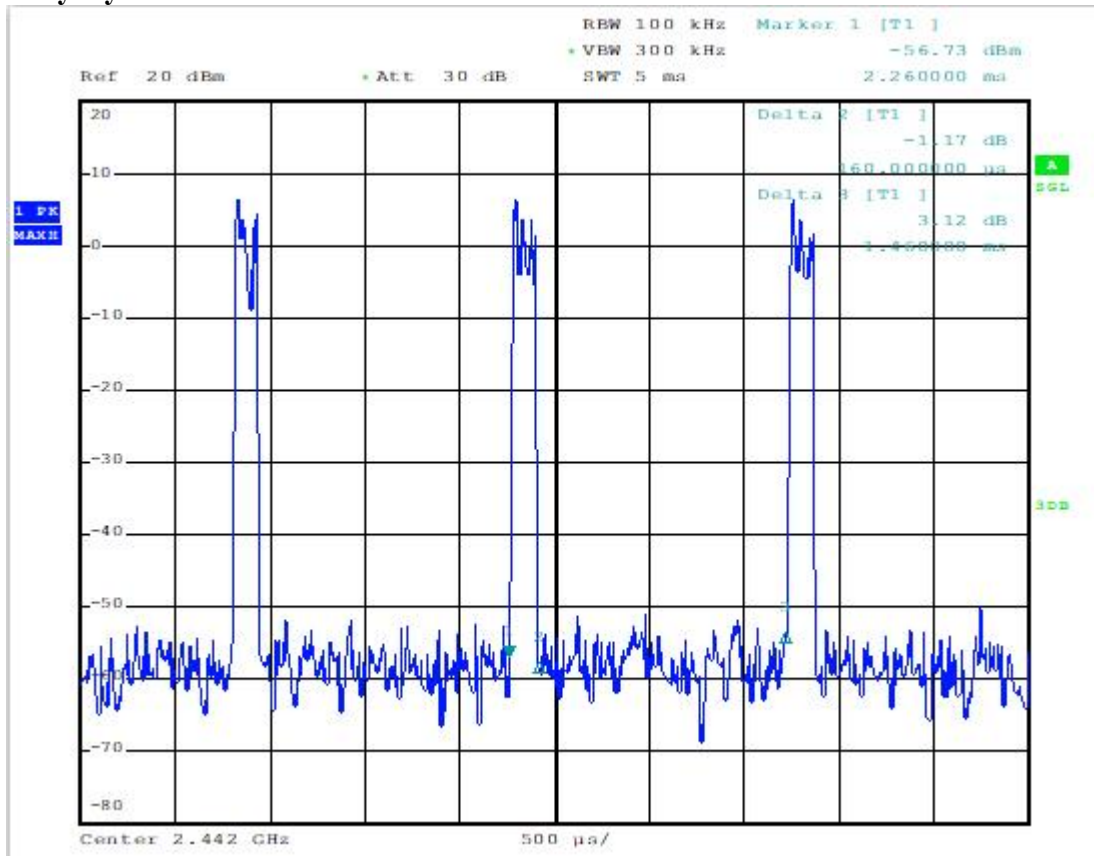
**PASS.**

Note 1: Final Level= Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor

Note 2: The emissions (9kHz~30MHz) not reported for there is no emission be found.

Note 3: The emission levels of other frequencies(test frequency bang is above 1GHz) are very lower than the limit and not show in test report.

## Duty Cycle

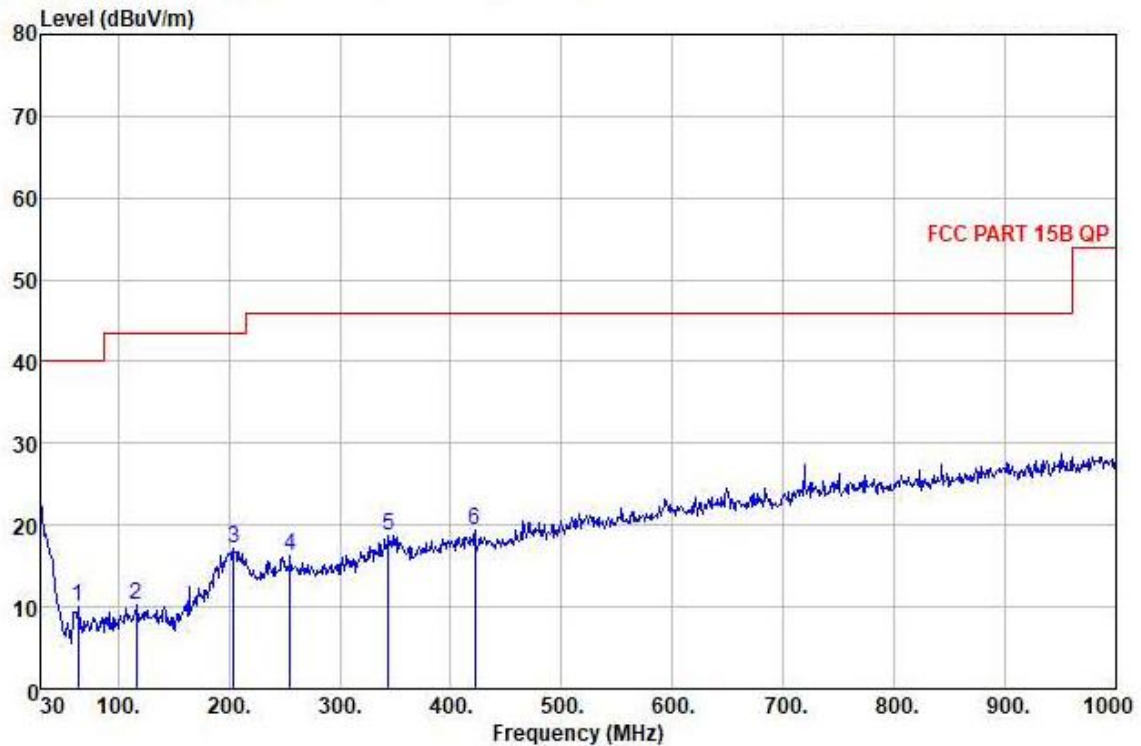


Duty Cycle Factor:  $10\log(1/(160/1460))=9.60$

Frequency: 30MHz~1GHz

Polarization:

Horizontal(Wireless-O)

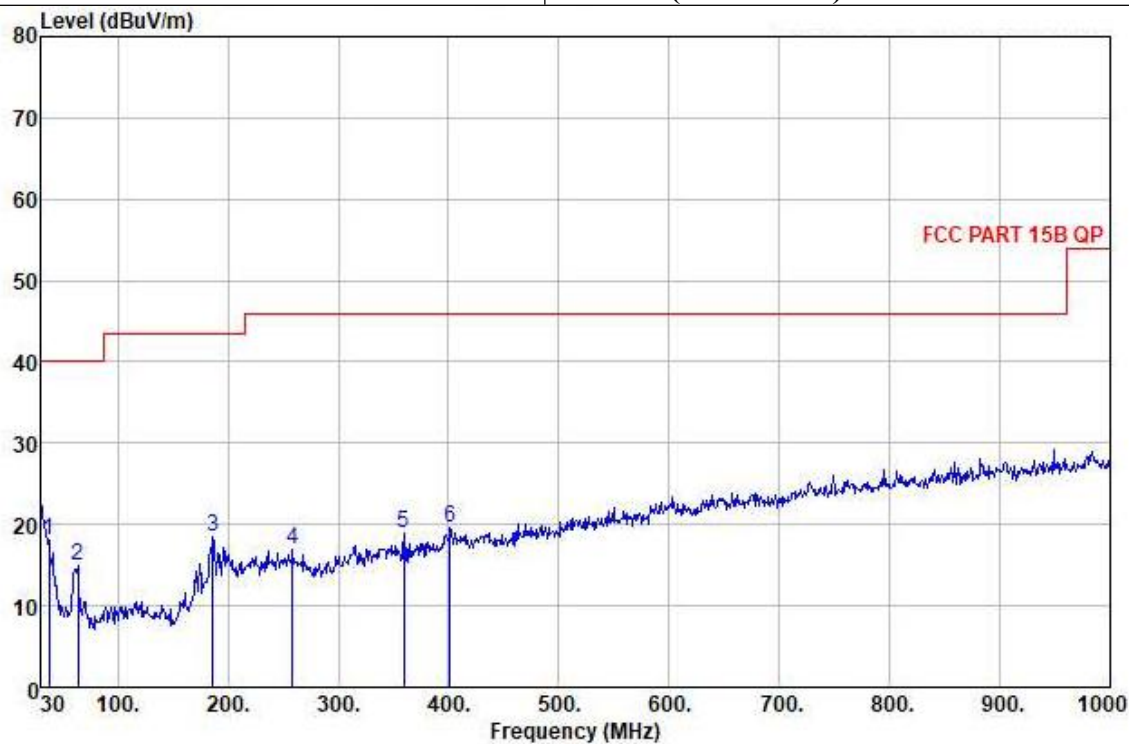


| No. | Freq<br>MHz | Read<br>Level<br>dBuV | Antenna<br>Factor<br>dB | Cable<br>Loss<br>dB | Preamp<br>Factor<br>dB | Level<br>dBuV/m | Limit<br>Line<br>dBuV/m | Over<br>Limit<br>dB | Pol/Phase  | Remark |
|-----|-------------|-----------------------|-------------------------|---------------------|------------------------|-----------------|-------------------------|---------------------|------------|--------|
| 1   | 63.950      | 31.70                 | 5.67                    | 0.93                | 28.24                  | 10.06           | 40.00                   | -29.94              | HORIZONTAL | Peak   |
| 2   | 116.330     | 28.49                 | 9.13                    | 1.27                | 28.54                  | 10.35           | 43.50                   | -33.15              | HORIZONTAL | Peak   |
| 3   | 204.600     | 33.22                 | 10.01                   | 1.73                | 27.71                  | 17.25           | 43.50                   | -26.25              | HORIZONTAL | Peak   |
| 4   | 255.040     | 28.55                 | 13.12                   | 1.95                | 27.45                  | 16.17           | 46.00                   | -29.83              | HORIZONTAL | Peak   |
| 5   | 344.280     | 29.54                 | 14.32                   | 2.26                | 27.34                  | 18.78           | 46.00                   | -27.22              | HORIZONTAL | Peak   |
| 6   | 421.880     | 29.14                 | 15.91                   | 2.53                | 28.11                  | 19.47           | 46.00                   | -26.53              | HORIZONTAL | Peak   |

Level=Read Level + Antenna Factor + Cable Loss - Preamp Factor

**Polarization:**

**Vertical(Wireless-O)**

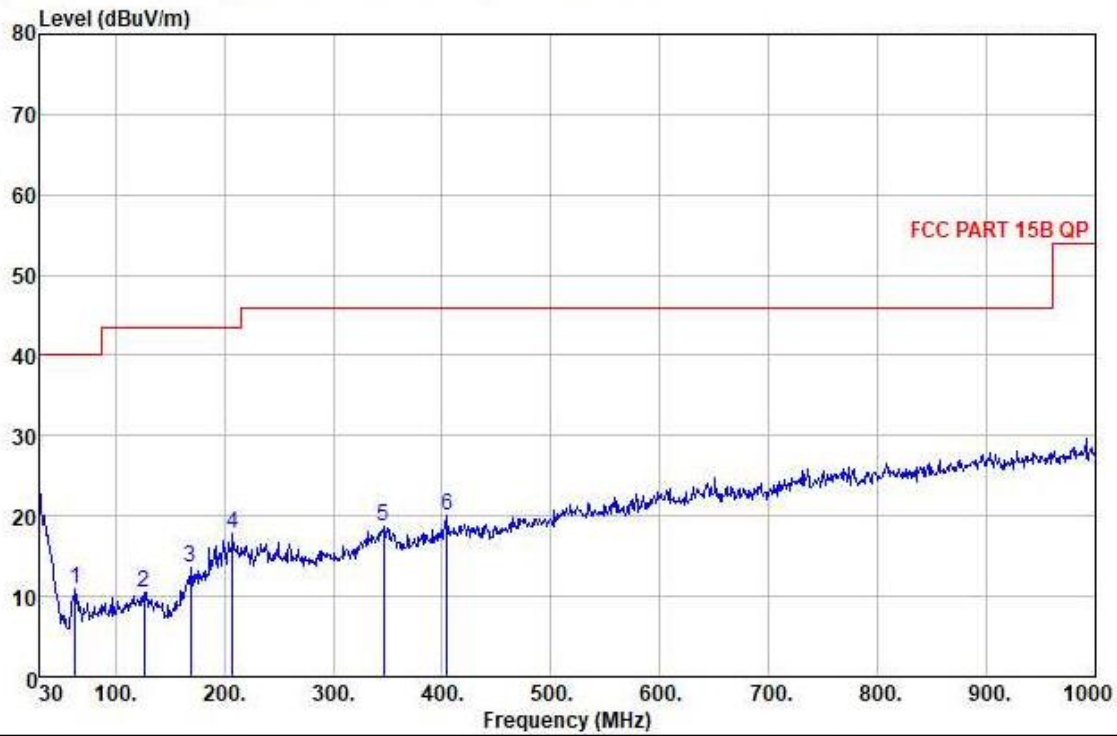


| No. | Freq<br>MHz | Read<br>Level<br>dBuV | Antenna<br>Factor<br>dB | Cable<br>Loss<br>dB | Preamp<br>Factor<br>dB | Level<br>dBuV/m | Limit<br>Line<br>dBuV/m | Over<br>Limit<br>dB | Pol/Phase | Remark |
|-----|-------------|-----------------------|-------------------------|---------------------|------------------------|-----------------|-------------------------|---------------------|-----------|--------|
| 1   | 37.760      | 28.22                 | 17.39                   | 0.70                | 28.32                  | 17.99           | 40.00                   | -22.01              | VERTICAL  | Peak   |
| 2   | 63.950      | 36.56                 | 5.67                    | 0.93                | 28.24                  | 14.92           | 40.00                   | -25.08              | VERTICAL  | Peak   |
| 3   | 186.170     | 35.01                 | 9.63                    | 1.64                | 27.68                  | 18.60           | 43.50                   | -24.90              | VERTICAL  | Peak   |
| 4   | 258.920     | 29.48                 | 13.14                   | 1.96                | 27.57                  | 17.01           | 46.00                   | -28.99              | VERTICAL  | Peak   |
| 5   | 359.800     | 29.60                 | 14.68                   | 2.31                | 27.74                  | 18.85           | 46.00                   | -27.15              | VERTICAL  | Peak   |
| 6   | 401.510     | 29.64                 | 15.62                   | 2.46                | 28.19                  | 19.53           | 46.00                   | -26.47              | VERTICAL  | Peak   |

**Level=Read Level + Antenna Factor + Cable Loss - Preamp Factor**

**Polarization:**

**Horizontal(Wireless-T)**

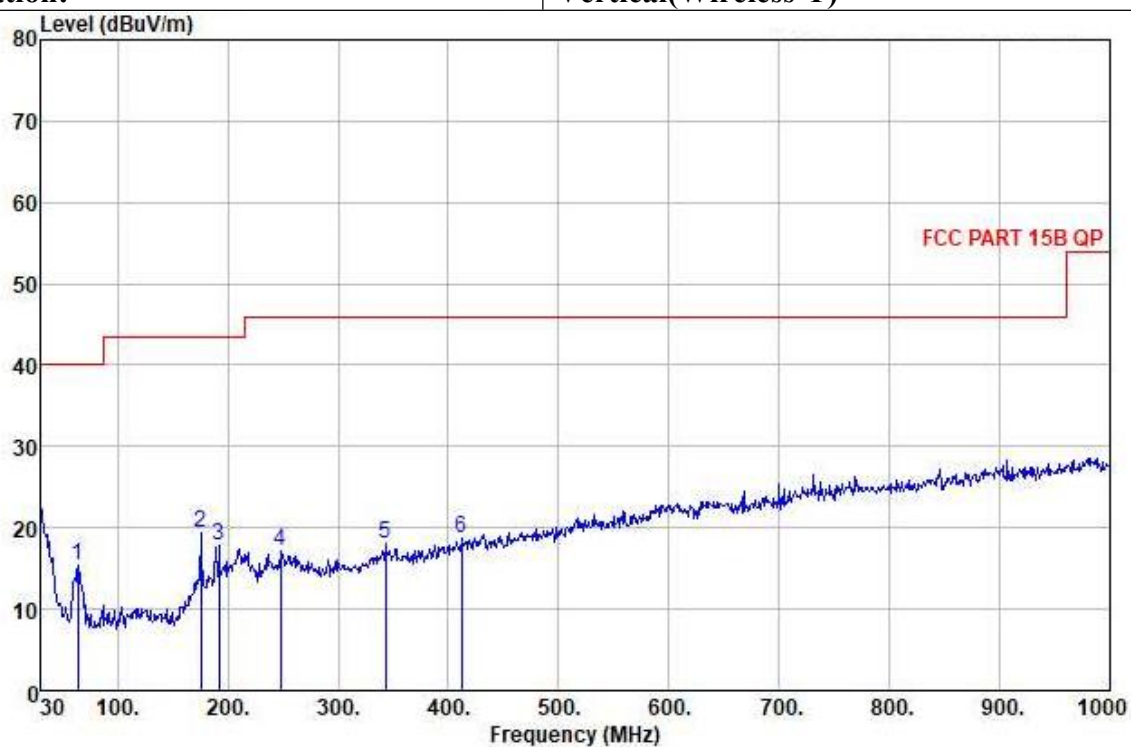


| No. | Freq<br>MHz | Read<br>Level<br>dBuV | Antenna<br>Factor<br>dB | Cable<br>Loss<br>dB | Preamp<br>Factor<br>dB | Level<br>dBuV/m | Limit<br>Line<br>dBuV/m | Over<br>Limit<br>dB | Pol/Phase  | Remark |
|-----|-------------|-----------------------|-------------------------|---------------------|------------------------|-----------------|-------------------------|---------------------|------------|--------|
| 1   | 62.980      | 32.84                 | 5.40                    | 0.92                | 28.23                  | 10.93           | 40.00                   | -29.07              | HORIZONTAL | Peak   |
| 2   | 126.030     | 28.75                 | 8.94                    | 1.33                | 28.44                  | 10.58           | 43.50                   | -32.92              | HORIZONTAL | Peak   |
| 3   | 168.710     | 31.87                 | 8.70                    | 1.55                | 28.45                  | 13.67           | 43.50                   | -29.83              | HORIZONTAL | Peak   |
| 4   | 207.510     | 33.54                 | 10.21                   | 1.74                | 27.60                  | 17.89           | 43.50                   | -25.61              | HORIZONTAL | Peak   |
| 5   | 346.220     | 29.40                 | 14.36                   | 2.27                | 27.33                  | 18.70           | 46.00                   | -27.30              | HORIZONTAL | Peak   |
| 6   | 404.420     | 30.17                 | 15.66                   | 2.47                | 28.18                  | 20.12           | 46.00                   | -25.88              | HORIZONTAL | Peak   |

**Level=Read Level + Antenna Factor + Cable Loss - Preamp Factor**

**Polarization:**

**Vertical(Wireless-T)**



| No. | Freq<br>MHz | Read<br>Level<br>dBuV | Antenna<br>Factor<br>dB | Cable<br>Loss<br>dB | Preamp<br>Factor<br>dB | Level<br>dBuV/m | Limit<br>dBuV/m | Over<br>Limit<br>dB | Pol/Phase | Remark |
|-----|-------------|-----------------------|-------------------------|---------------------|------------------------|-----------------|-----------------|---------------------|-----------|--------|
| 1   | 63.950      | 36.98                 | 5.67                    | 0.93                | 28.24                  | 15.34           | 40.00           | -24.66              | VERTICAL  | Peak   |
| 2   | 175.500     | 36.75                 | 9.24                    | 1.59                | 28.11                  | 19.47           | 43.50           | -24.03              | VERTICAL  | Peak   |
| 3   | 191.990     | 34.08                 | 9.66                    | 1.67                | 27.66                  | 17.75           | 43.50           | -25.75              | VERTICAL  | Peak   |
| 4   | 248.250     | 29.56                 | 12.98                   | 1.92                | 27.28                  | 17.18           | 46.00           | -28.82              | VERTICAL  | Peak   |
| 5   | 343.310     | 28.74                 | 14.30                   | 2.26                | 27.35                  | 17.95           | 46.00           | -28.05              | VERTICAL  | Peak   |
| 6   | 412.180     | 28.66                 | 15.77                   | 2.49                | 28.15                  | 18.77           | 46.00           | -27.23              | VERTICAL  | Peak   |

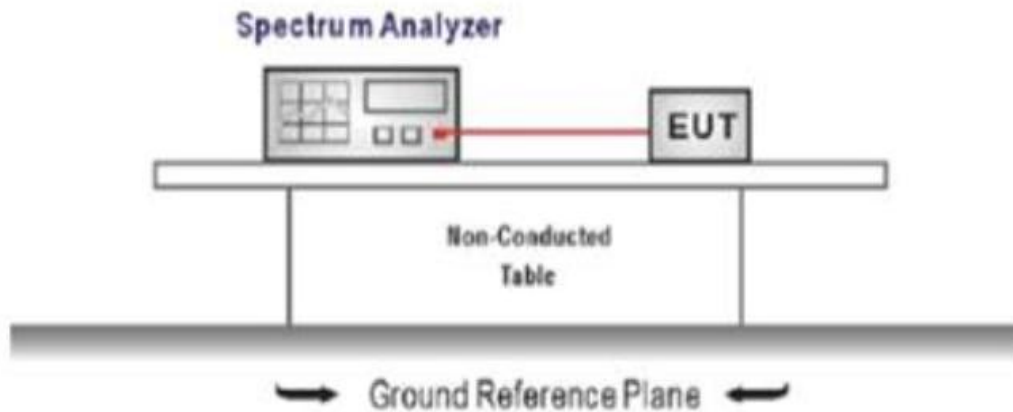
**Level=Read Level + Antenna Factor + Cable Loss - Preamp Factor**

Frequency: 1GHz~25GHz

| GFSK       |      |          |        | (Wireless-T) |        |            |            |         |
|------------|------|----------|--------|--------------|--------|------------|------------|---------|
| Horizontal | Freq |          | Level  | Read Level   | Factor | Limit Line | Over Limit | Remark  |
|            | MHz  |          | dBuV/m | dBuV         | dB/m   | dBuV/m     | dB         |         |
|            | 1    | 3482.00  | 41.59  | 44.19        | -2.60  | 74.00      | -32.41     | Peak    |
|            | 2    | 5216.00  | 49.84  | 47.33        | 2.51   | 74.00      | -24.16     | Peak    |
|            | 3    | 6984.00  | 40.39  | 31.92        | 8.47   | 74.00      | -33.61     | Peak    |
|            | 4    | 9942.00  | 43.44  | 30.72        | 12.72  | 74.00      | -30.56     | Peak    |
|            | Freq |          | Level  | Read Level   | Factor | Limit Line | Over Limit | Remark  |
|            | MHz  |          | dBuV/m | dBuV         | dB/m   | dBuV/m     | dB         |         |
|            | 1    | 3482.00  | 30.61  | 33.21        | -2.60  | 54.00      | -23.39     | Average |
|            | 2    | 5216.00  | 31.57  | 29.06        | 2.51   | 54.00      | -22.43     | Average |
| Vertical   | 3    | 7120.00  | 28.85  | 20.03        | 8.82   | 54.00      | -25.15     | Average |
|            | 4    | 9432.00  | 33.06  | 20.44        | 12.62  | 54.00      | -20.94     | Average |
|            | Freq |          | Level  | Read Level   | Factor | Limit Line | Over Limit | Remark  |
|            | MHz  |          | dBuV/m | dBuV         | dB/m   | dBuV/m     | dB         |         |
|            | 1    | 3431.00  | 39.38  | 42.07        | -2.69  | 74.00      | -34.62     | Peak    |
|            | 2    | 5250.00  | 56.88  | 54.27        | 2.61   | 74.00      | -17.12     | Peak    |
|            | 3    | 7664.00  | 40.70  | 30.75        | 9.95   | 74.00      | -33.30     | Peak    |
|            | 4    | 9330.00  | 43.89  | 31.42        | 12.47  | 74.00      | -30.11     | Peak    |
|            | Freq |          | Level  | Read Level   | Factor | Limit Line | Over Limit | Remark  |
|            | MHz  |          | dBuV/m | dBuV         | dB/m   | dBuV/m     | dB         |         |
|            | 1    | 3431.00  | 30.65  | 33.34        | -2.69  | 54.00      | -23.35     | Average |
|            | 2    | 5250.00  | 36.88  | 34.27        | 2.61   | 54.00      | -17.12     | Average |
|            | 3    | 7868.00  | 30.45  | 20.25        | 10.20  | 54.00      | -23.55     | Average |
|            | 4    | 11030.00 | 34.77  | 19.40        | 15.37  | 54.00      | -19.23     | Average |

## 5. CONDUCTED SPURIOUS EMISSIONS

### 5.1. Block Diagram of Test Setup



### 5.2. Limit

In any 100kHz 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.

### 5.3. Test Procedure

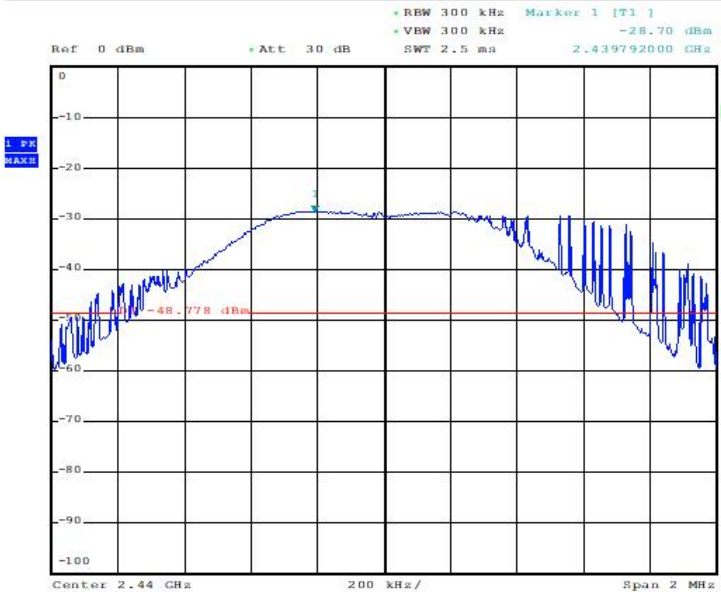
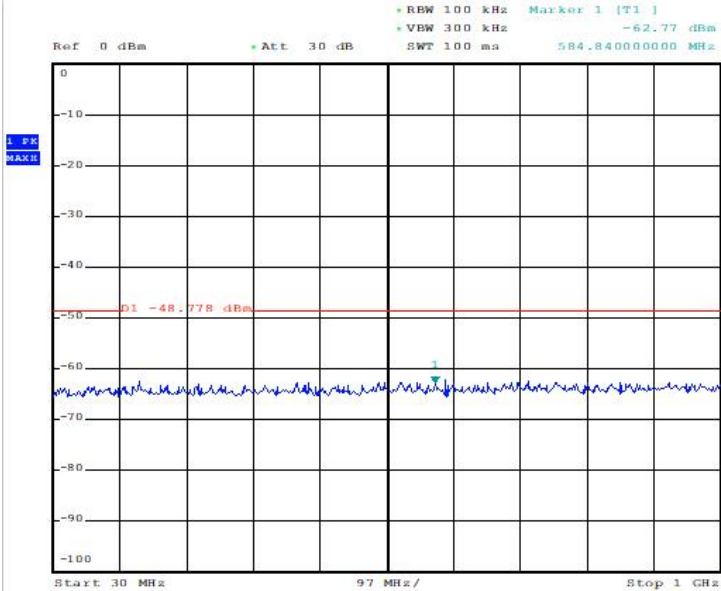
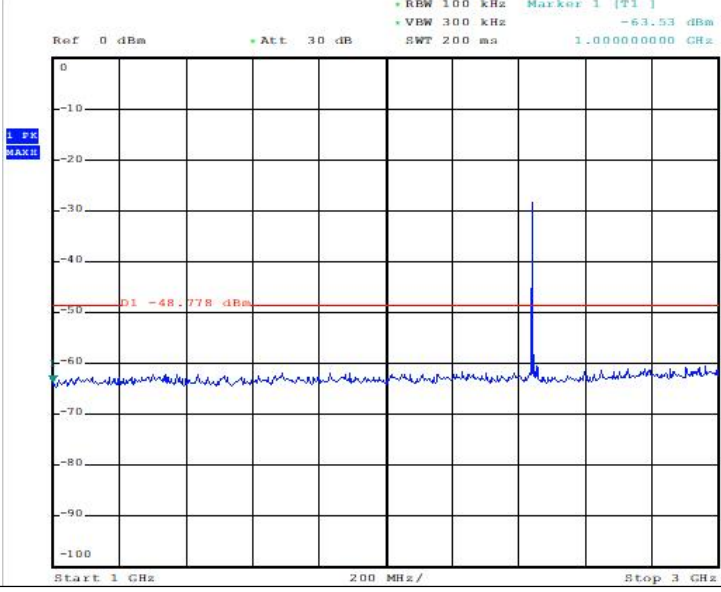
Use the test method described in ANSI C63.10:

The transmitter output was connected to a spectrum analyzer, The resolution bandwidth is set to 100 kHz, The video bandwidth is set to 300 kHz and measure all the emissions with peak detector.

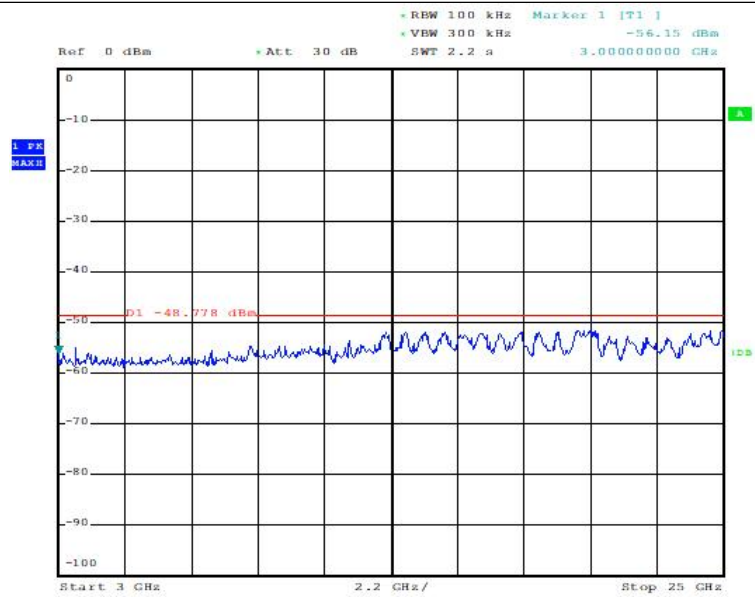
Note: The cable loss and attenuator loss were offset into spectrum analyzer as an amplitude offset.

### 5.4. Test result

**PASS** (The testing data was attached in the next pages.)

| Test Item:      | SE | Type: | GFSK                                                                                 |
|-----------------|----|-------|--------------------------------------------------------------------------------------|
| Reference level |    |       |    |
| 30MHz-1GMHz     |    |       |   |
| 1GHz-3GHz       |    |       |  |

Above 3GHz



## 6. BAND EDGE COMPLIANCE TEST

### 6.1.Limit

All the lower and upper band-edges emissions appearing within 2310MHz to 2390MHz and 2483.5MHz to 2500MHz restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions outside operation frequency band 2400MHz to 2483.5MHz shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits.

### 6.2.Test Procedure

Use the test method described in ANSI C63.10 clause 6.10:

1. The EUT is placed on a turntable, which is 1.5m above the ground plane and worked at highest radiated power.
2. The turntable was rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4. Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
  - (a) PEAK: RBW=1MHz; VBW=3MHz; Sweep=AUTO
  - (b) AVERAGE: RBW=1MHz; VBW=10Hz; Sweep=AUTO

### 6.3.Test Results

Pass (The testing data was attached in the next pages.)

| GFSK       |   | 2440MHz |        |            |        |            |            |         |
|------------|---|---------|--------|------------|--------|------------|------------|---------|
| Horizontal |   | Freq    | Level  | Read Level | Factor | Limit Line | Over Limit | Remark  |
|            |   | MHz     | dBuV/m | dBuV       | dB/m   | dBuV/m     | dB         |         |
|            | 1 | 2310.00 | 34.69  | 38.55      | -3.86  | 74.00      | -39.31     | Peak    |
|            | 2 | 2390.00 | 35.76  | 39.59      | -3.83  | 74.00      | -38.24     | Peak    |
|            |   | Freq    | Level  | Read Level | Factor | Limit Line | Over Limit | Remark  |
|            |   | MHz     | dBuV/m | dBuV       | dB/m   | dBuV/m     | dB         |         |
|            | 1 | 2310.00 | 21.46  | 25.32      | -3.86  | 54.00      | -32.54     | Average |
|            | 2 | 2390.00 | 24.00  | 27.83      | -3.83  | 54.00      | -30.00     | Average |

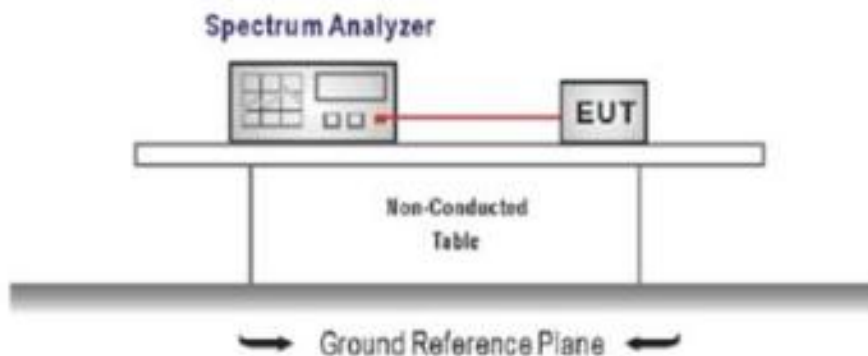
| GFSK     |   | 2440MHz |        |            |        |            |            |         |
|----------|---|---------|--------|------------|--------|------------|------------|---------|
| Vertical |   | Freq    | Level  | Read Level | Factor | Limit Line | Over Limit | Remark  |
|          |   | MHz     | dBuV/m | dBuV       | dB/m   | dBuV/m     | dB         |         |
|          | 1 | 2310.00 | 36.37  | 40.23      | -3.86  | 74.00      | -37.63     | Peak    |
|          | 2 | 2390.00 | 34.06  | 37.89      | -3.83  | 74.00      | -39.94     | Peak    |
|          |   | Freq    | Level  | Read Level | Factor | Limit Line | Over Limit | Remark  |
|          |   | MHz     | dBuV/m | dBuV       | dB/m   | dBuV/m     | dB         |         |
|          | 1 | 2310.00 | 21.40  | 25.26      | -3.86  | 54.00      | -32.60     | Average |
|          | 2 | 2390.00 | 24.39  | 28.22      | -3.83  | 54.00      | -29.61     | Average |

| GFSK       |   | 2440MHz |        |            |        |            |            |         |
|------------|---|---------|--------|------------|--------|------------|------------|---------|
| Horizontal |   | Freq    | Level  | Read Level | Factor | Limit Line | Over Limit | Remark  |
|            |   | MHz     | dBuV/m | dBuV       | dB/m   | dBuV/m     | dB         |         |
|            |   |         |        |            |        |            |            |         |
|            | 1 | 2483.50 | 47.47  | 51.25      | -3.78  | 74.00      | -26.53     | Peak    |
|            | 2 | 2500.00 | 38.56  | 42.33      | -3.77  | 74.00      | -35.44     | Peak    |
|            |   | Freq    | Level  | Read Level | Factor | Limit Line | Over Limit | Remark  |
|            |   | MHz     | dBuV/m | dBuV       | dB/m   | dBuV/m     | dB         |         |
|            |   |         |        |            |        |            |            |         |
|            | 1 | 2483.50 | 26.87  | 30.65      | -3.78  | 54.00      | -27.13     | Average |
|            | 2 | 2500.00 | 23.17  | 26.94      | -3.77  | 54.00      | -30.83     | Average |

| GFSK     |   | 2440MHz |        |            |        |            |            |         |
|----------|---|---------|--------|------------|--------|------------|------------|---------|
| Vertical |   | Freq    | Level  | Read Level | Factor | Limit Line | Over Limit | Remark  |
|          |   | MHz     | dBuV/m | dBuV       | dB/m   | dBuV/m     | dB         |         |
|          |   |         |        |            |        |            |            |         |
|          | 1 | 2483.50 | 45.85  | 49.63      | -3.78  | 74.00      | -28.15     | Peak    |
|          | 2 | 2500.00 | 38.87  | 42.64      | -3.77  | 74.00      | -35.13     | Peak    |
|          |   | Freq    | Level  | Read Level | Factor | Limit Line | Over Limit | Remark  |
|          |   | MHz     | dBuV/m | dBuV       | dB/m   | dBuV/m     | dB         |         |
|          |   |         |        |            |        |            |            |         |
|          | 1 | 2483.50 | 26.38  | 30.16      | -3.78  | 54.00      | -27.62     | Average |
|          | 2 | 2500.00 | 26.09  | 29.86      | -3.77  | 54.00      | -27.91     | Average |

## 7. 6dB Bandwidth Test

### 7.1. Block Diagram of Test Setup



### 7.2. Limit

For direct sequence systems, the minimum 6dB bandwidth shall be at least 500kHz

### 7.3. Test Procedure

Use the test method described in ANSI C63.10 Section 11.8.2:

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW)  $\geq 3 \times$  RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

### 7.4. Test Results

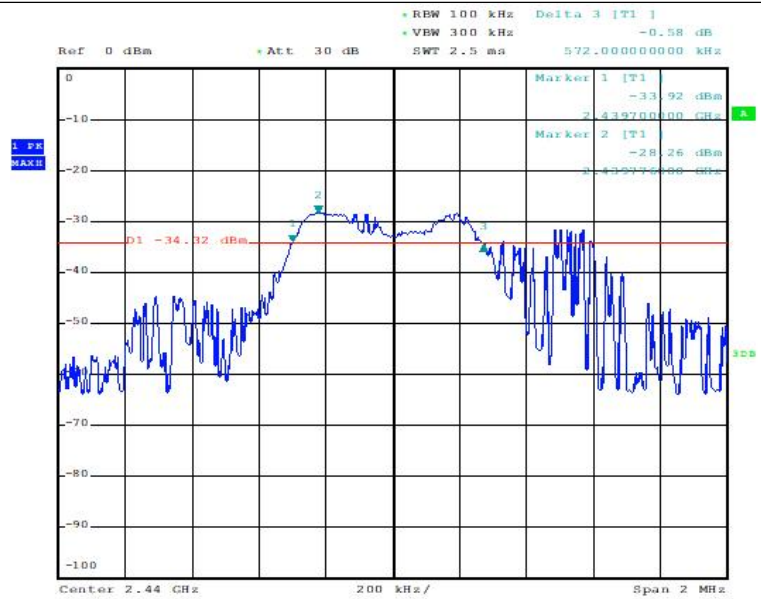
**Pass**

| Test Mode        | Frequency<br>(MHz) | -6dB bandwidth<br>(MHz) | Limit<br>(KHz) |
|------------------|--------------------|-------------------------|----------------|
| GFSK             | 2440               | 0.572                   | $\cong 500$    |
| Conclusion: PASS |                    |                         |                |

Type:

GFSK

2440MHz



## 8. OUTPUT POWER TEST

### 8.1.Limit (FCC Part 15C 15.247 b(3))

For systems using digital modulation in the 2400—2483.5MHz, The Peak output Power shall not exceed 1W(30dBm), As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level.

### 8.2.Test Procedure

- 1, Connected the EUT's antenna port to Spectrum Analyzer.
- 2, Use the test method described in ANSI C63.10:
  - 1) Set span to at least 1.5 times the OBW.
  - 2) Set RBW = 1% to 5% of the OBW, not to exceed 1 MHz.
  - 3) Set VBW  $\geq [3 \times \text{RBW}]$ .
  - 4) Sweep time = auto.
  - 5) Detector = peak
  - 6) Trace mode = max hold
  - 7) Allow trace to fully stabilize; Use peak marker function to determine the peak amplitude level.

Note: The cable loss needs to be compensated into the data.

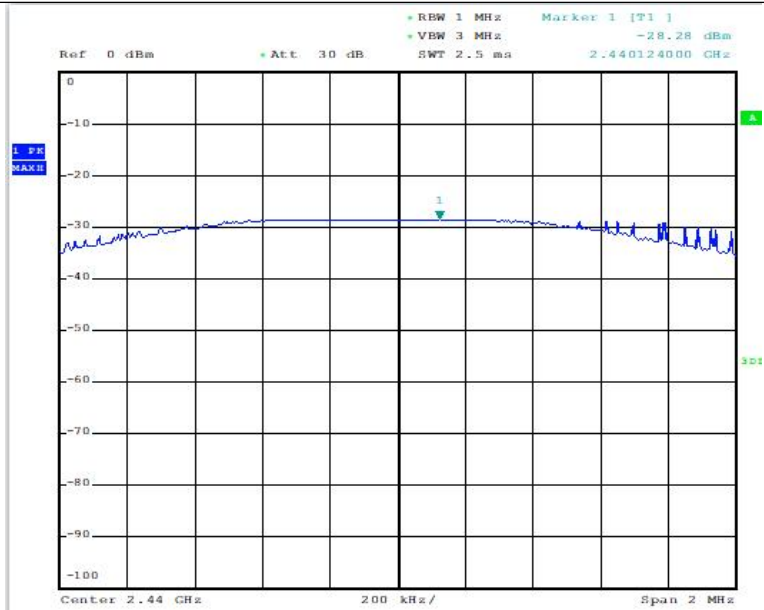
### 8.3.Test Results

| Pass               |              |          |       |     |
|--------------------|--------------|----------|-------|-----|
| Frequency<br>(MHz) | Output power |          | Limit |     |
|                    | (dBm)        | (W)      | (dBm) | (W) |
| 2440               | -28.28       | 1.49E-06 | 30    | 1   |

Type:

GFSK

2440MHz



## 9. POWER SPECTRAL DENSITY TEST

### 9.1.Limit

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

### 9.2.Test Procedure

Use the test method described in ANSI C63.10 clause 11.10.2:

- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS bandwidth.
- c) Set the RBW to  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
- d) Set the VBW  $\geq [3 \times \text{RBW}]$ .
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

### 9.3.Test Results

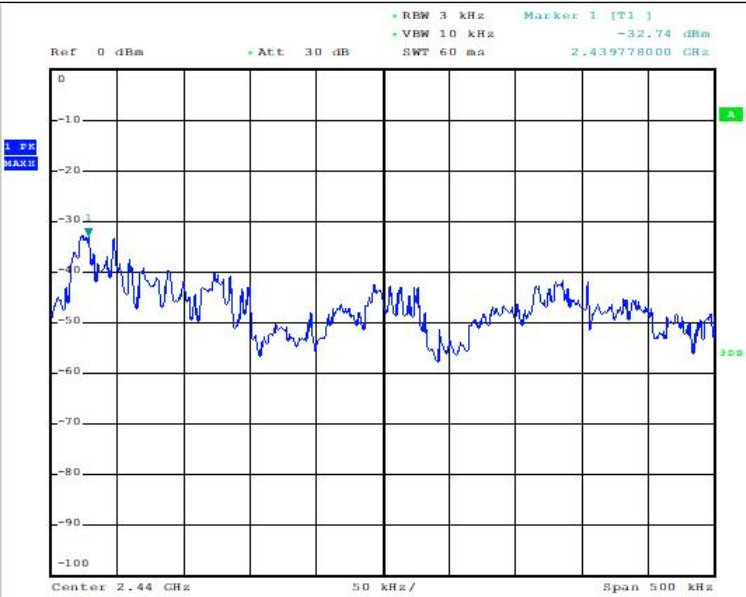
**Pass**

| Frequency(MHz)   | Power density<br>(dBm/3KHz) | Limit<br>(dBm/3KHz) |
|------------------|-----------------------------|---------------------|
| 2440             | -32.74                      | 8                   |
| Conclusion: PASS |                             |                     |

Type:

GFSK

2440MHz



## 10.ANTENNA REQUIREMENT

### 10.1. Standard Applicable

For intentional device, according to FCC 47 CFR Section 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. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

### 10.2. Antenna Connected Construction

The antennas used for this product are PCB antenna that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is 2.39dBi.

.....**End of Report**.....