



中国认可  
国际互认  
检测  
**TESTING**  
**CNAS L6791**

# TEST REPORT

**Applicant:** Ugreen Group Limited  
**Address:** Ugreen Building, Longcheng Industrial Park,  
Longguanxi Road, Longhua, ShenZhen, China  
**Equipment Type:** Bluetooth Adapter  
**Model Name:** CM749 (refer to section 2.4)  
**Brand Name:** **UGREEN**  
**Test Standard:** MIC Notice No.88 Appendix No.43  
Ordinance of MPT No.37, 1981:  
Article 2 paragraph 1 item (19)  
**Sample Arrival Date:** Sep. 15, 2023  
**Test Date:** Sep. 19, 2023 - Oct. 17, 2023  
**Date of Issue:** Oct. 26, 2023

**ISSUED BY:**

Shenzhen BALUN Technology Co., Ltd.



**Tested by:** Julie Zhu

**Checked by:** Ye Hongji

**Approved by:** Liao Jianming  
(Technical Director)

*Julie Zhu*

*Ye Hongji*

*Liao Jianming*

### Revision History

| Version        | Issue Date           | Revisions            |
|----------------|----------------------|----------------------|
| <u>Rev. 01</u> | <u>Oct. 26, 2023</u> | <u>Initial Issue</u> |

### TABLE OF CONTENTS

|                                                                          |    |
|--------------------------------------------------------------------------|----|
| 1. GENERAL INFORMATION .....                                             | 4  |
| 1.1 Test Laboratory .....                                                | 4  |
| 1.2 Test Location .....                                                  | 4  |
| 2. PRODUCT INFORMATION .....                                             | 5  |
| 2.1 Applicant Information .....                                          | 5  |
| 2.2 Manufacturer Information .....                                       | 5  |
| 2.3 Factory Information .....                                            | 5  |
| 2.4 General Description for Equipment under Test (EUT) .....             | 5  |
| 2.5 Technical Information .....                                          | 6  |
| 3. SUMMARY OF TEST RESULTS .....                                         | 7  |
| 3.1 MEASUREMENT UNCERTAINTY .....                                        | 8  |
| 4. GENERAL TEST CONFIGURATIONS .....                                     | 9  |
| 4.1 Test Environment Conditions .....                                    | 9  |
| 4.2 Test Equipment List .....                                            | 10 |
| 4.3 Description of Test Setup .....                                      | 11 |
| 5. TEST ITEMS .....                                                      | 13 |
| 5.1 Frequency Error Measurement .....                                    | 13 |
| 5.2 Occupied Bandwidth and Spread-spectrum Bandwidth/Factor .....        | 18 |
| 5.3 The frequency retention time .....                                   | 28 |
| 5.4 Unwanted Emission Intensity Measurement .....                        | 33 |
| 5.5 Antenna Power Error Measurement .....                                | 50 |
| 5.6 Limitation of Collateral Emission of Receiver Measurement .....      | 56 |
| 5.7 Transmission Antenna Gain (EIRP Antenna Power) Measurement .....     | 73 |
| 5.8 Transmission Radiation Angle Width (3dB Beamwidth) Measurement ..... | 75 |

|         |                                                           |    |
|---------|-----------------------------------------------------------|----|
| 5.9     | Radio Interference Prevention Capability Measurement..... | 76 |
| 5.10    | Construction Protection Confirmation Method.....          | 77 |
| ANNEX A | TEST SETUP PHOTOS.....                                    | 78 |
| 1       | Conducted Test Photo.....                                 | 78 |
| ANNEX B | EUT EXTERNAL PHOTOS.....                                  | 79 |
| ANNEX C | EUT INTERNAL PHOTOS.....                                  | 83 |

## 1. GENERAL INFORMATION

### 1.1 Test Laboratory

|              |                                                                                                                              |
|--------------|------------------------------------------------------------------------------------------------------------------------------|
| Name         | Shenzhen BALUN Technology Co., Ltd.                                                                                          |
| Address      | Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China |
| Phone Number | +86 755 6685 0100                                                                                                            |

### 1.2 Test Location

|          |                                                                                                                                                                                                                         |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Name     | Shenzhen BALUN Technology Co., Ltd.                                                                                                                                                                                     |
| Location | <input checked="" type="checkbox"/> Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China                                                        |
|          | <input type="checkbox"/> 1/F, Building B, Ganghongji High-tech Intelligent Industrial Park, No. 1008, Songbai Road, Yangguang Community, Xili Sub-district, Nanshan District, Shenzhen, Guangdong Province, P. R. China |

## 2. PRODUCT INFORMATION

### 2.1 Applicant Information

|           |                                                                                       |
|-----------|---------------------------------------------------------------------------------------|
| Applicant | Ugreen Group Limited                                                                  |
| Address   | Ugreen Building, Longcheng Industrial Park, Longguanxi Road, Longhua, ShenZhen, China |

### 2.2 Manufacturer Information

|              |                                                                                       |
|--------------|---------------------------------------------------------------------------------------|
| Manufacturer | Ugreen Group Limited                                                                  |
| Address      | Ugreen Building, Longcheng Industrial Park, Longguanxi Road, Longhua, ShenZhen, China |

### 2.3 Factory Information

|         |                                                                                                                                                                                                  |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Factory | SHENZHEN ZHIZE TECHNOLOGY CO., LTD                                                                                                                                                               |
| Address | Floor 1, 2, 3 and 4, No. 13; No. 5 1st floor, 2nd floor, zone B, 3rd floor, 4th floor, Langkou Industrial Park, Langkou Community, Dalang Street, Longhua District, Shenzhen, Guangdong Province |

### 2.4 General Description for Equipment under Test (EUT)

|                                           |                                                                                                                                                            |
|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EUT Name                                  | Bluetooth Adapter                                                                                                                                          |
| Model Name Under Test                     | CM749                                                                                                                                                      |
| Series Model Name                         | 35059                                                                                                                                                      |
| Description of Model name differentiation | All models are same with electrical parameters and internal circuit structure, but only differ in model name. (this information provided by the applicant) |
| Hardware Version                          | V2                                                                                                                                                         |
| Software Version                          | V1.0                                                                                                                                                       |
| Dimensions (Approx.)                      | N/A                                                                                                                                                        |
| Weight (Approx.)                          | N/A                                                                                                                                                        |

## 2.5 Technical Information

|                                   |                        |
|-----------------------------------|------------------------|
| Network and Wireless connectivity | Bluetooth (BR+EDR+BLE) |
|-----------------------------------|------------------------|

The requirement for the following technical information of the EUT was tested in this report:

|                                                                  |                                                                                                                                                                                                      |
|------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulation Technology                                            | Bluetooth (For Classic): FHSS<br>Bluetooth Low Energy: Digital modulation method other than orthogonal frequency division multiplexing (OFDM) or spread spectrum method                              |
| Modulation Type                                                  | Bluetooth(For Classic): GFSK, $\pi/4$ -DQPSK, 8-DPSK<br>Bluetooth Low Energy: GFSK                                                                                                                   |
| Transfer Rate                                                    | DH5: 1 Mbps<br>2DH5: 2 Mbps<br>3DH5: 3 Mbps<br>BLE: 1 Mbps<br>BLE: 2 Mbps                                                                                                                            |
| Frequency Range                                                  | The frequency range used is 2402MHz - 2480MHz;<br>The frequency block is 2400MHz to 2483.5MHz.                                                                                                       |
| Number of Channel                                                | Bluetooth (For Classic): 79 (at intervals of 1 MHz)<br>Bluetooth Low Energy: 40 (at intervals of 2 MHz) <sup>note1</sup>                                                                             |
| Tested Channel                                                   | Bluetooth (For Classic): 0 (2402 MHz), 39 (2441 MHz), 78 (2480 MHz)<br>Bluetooth Low Energy:<br>1Mbps 0 (2402 MHz), 19 (2440 MHz), 39 (2480 MHz)<br>2Mbps 1 (2404 MHz), 19 (2440 MHz), 38 (2478 MHz) |
| Antenna Type                                                     | Dipole Antenna                                                                                                                                                                                       |
| Antenna Gain                                                     | 1.54 dBi (In test items related to antenna gain, the final results reflect this figure. This value is provided by the applicant.)                                                                    |
| Whether to support AFH mode in Classic Bluetooth                 | The EUT does need to measure AFH occupied bandwidth, spread bandwidth and output power density (total power divided by spread bandwidth)                                                             |
| Declare Max rated power density                                  | Bluetooth (For Classic): 0.3000 mW/MHz;                                                                                                                                                              |
| Declare Max rated power                                          | Bluetooth Low Energy: 5.0000 mW                                                                                                                                                                      |
| About the Product                                                | Only the Bluetooth was tested in this report.                                                                                                                                                        |
| Note1: 2Mbps does not support Channel 0, Channel 12, Channel 39. |                                                                                                                                                                                                      |

### 3. SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

| Part | Description                                                           | Channel<br>(BT for Classic) | Channel<br>(BLE) | Test Mode                                       | Data Rate<br>(Mbps)    | Verdict              |
|------|-----------------------------------------------------------------------|-----------------------------|------------------|-------------------------------------------------|------------------------|----------------------|
| 5.1  | Frequency Error                                                       | Low/Middle/High             | Low/Middle/High  | un-modulation                                   | /                      | Pass                 |
| 5.2  | Occupied<br>Bandwidth and<br>Spread-spectrum<br>Bandwidth /<br>Factor | Hopping Mode<br>AFH Mode    | Low/Middle/High  | GFSK,<br>$\pi/4$ -DQPSK,<br>8DPSK,<br>GFSK(BLE) | 1/2/3;<br>1/2<br>(BLE) | Pass                 |
| 5.3  | The frequency<br>retention time                                       | Hopping Mode                | N/A              | GFSK,<br>$\pi/4$ -DQPSK,<br>8DPSK               | 1/2/3                  | Pass                 |
| 5.4  | Unwanted<br>Emission<br>Intensity                                     | Low/Middle/High             | Low/Middle/High  | GFSK,<br>$\pi/4$ -DQPSK,<br>8DPSK,<br>GFSK(BLE) | 1/2/3;<br>1/2<br>(BLE) | Pass                 |
| 5.5  | Antenna Power<br>Error                                                | Hopping Mode<br>AFH Mode    | Low/Middle/High  | GFSK,<br>$\pi/4$ -DQPSK,<br>8DPSK,<br>GFSK(BLE) | 1/2/3;<br>1/2<br>(BLE) | Pass                 |
| 5.6  | Limitation of<br>Collateral<br>Emission of<br>Receiver                | Low/Middle/High             | Low/Middle/High  | GFSK,<br>$\pi/4$ -DQPSK,<br>8DPSK,<br>GFSK(BLE) | 1/2/3;<br>1/2<br>(BLE) | Pass                 |
| 5.7  | Transmission<br>Antenna Gain<br>(EIRP Antenna<br>Power)               | N/A                         | N/A              | N/A                                             | N/A                    | N/A <sup>Note2</sup> |
| 5.8  | Transmission<br>Radiation Angle<br>Width (3dB<br>Beamwidth)           | N/A                         | N/A              | N/A                                             | N/A                    | N/A <sup>Note2</sup> |
| 5.9  | Radio<br>Interference<br>Prevention<br>Capability                     | ---                         | ---              | ---                                             | ---                    | Pass                 |
| 5.10 | Construction<br>Protection<br>Confirmation                            | ---                         | ---              | ---                                             | ---                    | Pass                 |

Note 1: The tests were performed according to the method of measurements prescribed in MIC Notice No.88 Appendix No.43.

Note 2: When the EIRP is less than 12.14 dBm/MHz, it is not necessary.

### 3.1 MEASUREMENT UNCERTAINTY

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

| Parameters                                           | Uncertainty                        |
|------------------------------------------------------|------------------------------------|
| Frequency Error / 99% & 90% Bandwidth                | $(3.2 \times f \times 10^{-6})$ Hz |
| Antenna Power                                        | 1.82 dB                            |
| TX-RX Spurious Emissions                             | 1.84 dB                            |
| Transmission Antenna Gain                            | 5.36 dB                            |
| Temperature                                          | 0.8°C                              |
| Humidity                                             | 4%                                 |
| DC / AC Power Source                                 | 0.04%                              |
| Note: " $f$ " is the nominal signal frequency in Hz. |                                    |

## 4. GENERAL TEST CONFIGURATIONS

### 4.1 Test Environment Conditions

During the measurement, the normal environment conditions were within the listed ranges:

|                            |                     |       |
|----------------------------|---------------------|-------|
| Relative Humidity (%)      | 55% to 59%          |       |
| Atmospheric Pressure (kPa) | 86 kPa to 106 kPa   |       |
| Temperature                | +22.6°C to +23.4°C  |       |
| Working Voltage of the EUT | NV (Normal Voltage) | 5.0 V |

Note: When the input voltage deviation from the external power supply is  $\pm 10\%$ , and the voltage deviation provided to the radio part of the EUT (excluding the power circuit) is kept within  $\pm 1\%$ , only the normal voltage is used for testing.

Voltage fluctuation results:

The measuring point is a component with schematic number:

| External power supply | Rated operating voltage of EUT | Actual measured voltage of EUT | $\pm 1\%$ voltage operating range |
|-----------------------|--------------------------------|--------------------------------|-----------------------------------|
| 4.500 V               | 3.300 V                        | 3.269                          | 3.267 V~3.333 V                   |
| 5.000 V               | 3.300 V                        | 3.270                          | 3.267 V~3.333 V                   |
| 5.500 V               | 3.300 V                        | 3.269                          | 3.267 V~3.333 V                   |

## 4.2 Test Equipment List

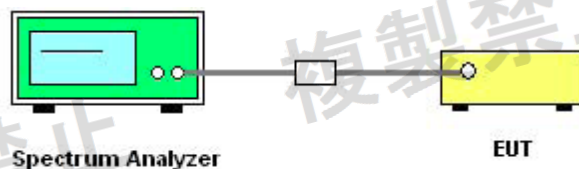
| Description       | Manufacturer    | Model   | Serial No.         | Calibration Company                                        | Calibration Address                                                                                                  | Calibration By | Cal. Date  | Cal. Due   | Calibration Method |
|-------------------|-----------------|---------|--------------------|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|----------------|------------|------------|--------------------|
| Spectrum Analyzer | KEYSIGHT        | N9020A  | MY50330200         | Shenzhen Academy of Metrology & Quality Inspection         | 92 Longzhu Avenue, Nanshan District, Shenzhen, Guangdong, China                                                      | HuanJun        | 2023.05.16 | 2024.05.15 | c)                 |
| Power Sensor      | KEYSIGHT        | U2063XA | MY58000251         | Ti Testing & Certification Group Co., Ltd. Shenzhen Branch | 103, Building B, Ganghongji High tech Intelligent Industrial Park, No. 1008 Songbai Road, Nanshan District, Shenzhen | LiWengeng      | 2023.07.12 | 2024.07.11 | c)                 |
| Signaling Unit    | ROHDE & SCHWARZ | CMW500  | 142028             | Shenzhen Academy of Metrology & Quality Inspection         | 92 Longzhu Avenue, Nanshan District, Shenzhen, Guangdong, China                                                      | HuanJun        | 2023.05.16 | 2024.05.15 | c)                 |
| Multimeter        | CEM             | DT-9915 | 12104971           | GUANGZHOU NEM METROLOGY & TEST TECHNOLOGY CO., LTD.        | 2/F., Building 1, No.176, Hedong Road, Liwan District, Guangzhou, Guangdong, China                                   | LiXiang        | 2022.12.28 | 2023.12.27 | c)                 |
| DC Power Supply   | ITECH           | IT6720  | 600103010717610007 | GUANGZHOU NEM METROLOGY & TEST TECHNOLOGY CO., LTD.        | 2/F., Building 1, No.176, Hedong Road, Liwan District, Guangzhou, Guangdong, China                                   | LiXiang        | 2023.07.25 | 2024.07.24 | c)                 |

### Note:

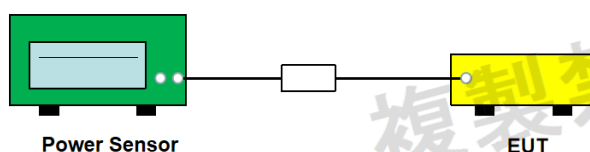
- Calibration conducted by the National Institute of Information and Communications Technology (NICT) (hereinafter referred to as "NICT") or a designated calibration agency under Article 102-18 paragraph (1)
- Correction conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Law (Law No. 51 of 1992)
- Calibration conducted in foreign countries, which shall be equivalent to the calibration conducted by the NICT or a designated calibration agency under Article 102-18 paragraph (1)
- Calibration conducted by using measuring instruments and other equipment listed in the right column of Table No. 3 attached hereto, which shall have been given any of calibration, etc. listed above from a) to c)

### 4.3 Description of Test Setup

#### 4.3.1 For Antenna Port Test

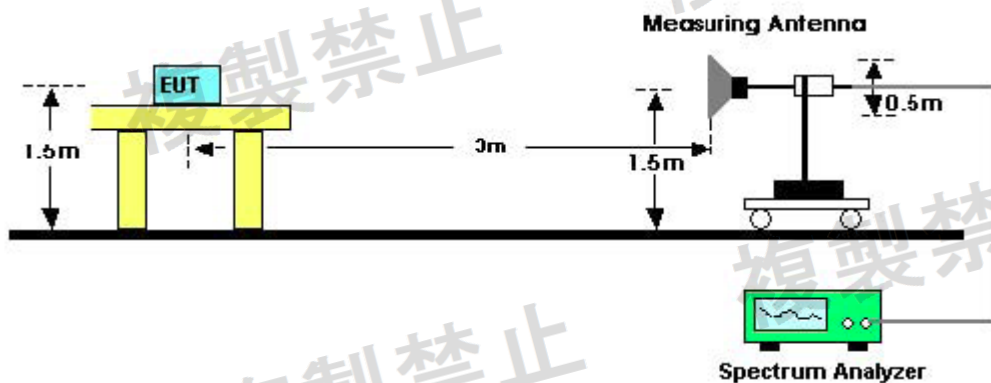


(Diagram 1)

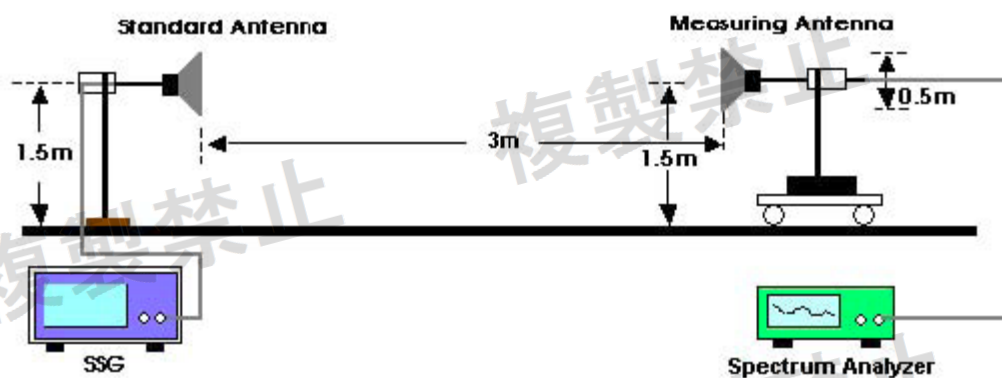


(Diagram 2)

#### 4.3.2 For EIRP Antenna Power Test

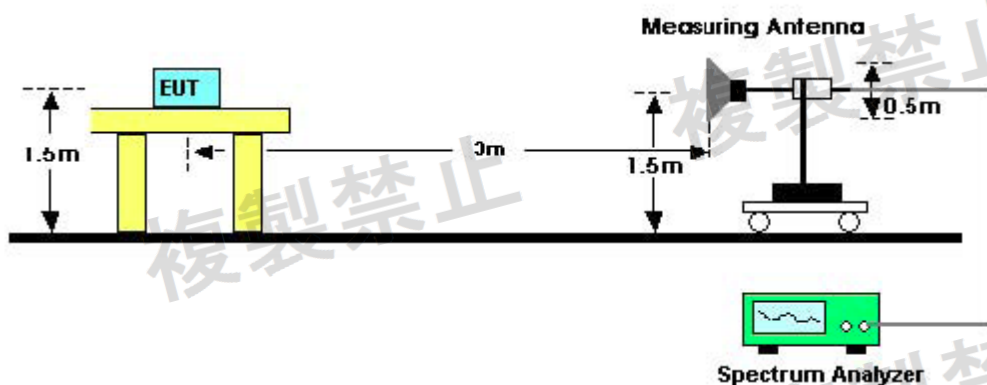


(Diagram 3)



(Diagram 4)

#### 4.3.3 For 3dB Beamwidth Test



(Diagram 5)

## 5. TEST ITEMS

### 5.1 Frequency Error Measurement

#### 5.1.1 Limit

| Item                | Limits            |
|---------------------|-------------------|
| Frequency Tolerance | $\leq \pm 50$ ppm |

#### 5.1.2 Test Setup

See section 4.3.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

#### 5.1.3 Test Procedure

- 1 Frequency accuracy of SA shall be less than 10% of limits tolerance (5 ppm)
- 2 Setting of SA is following as: RB:1 kHz / VB:3 kHz / SPAN: 100 kHz
- 3 Center Frequency: The center frequency of testing for EUT
- 4 Sweep time: Auto
- 5 Sweep mode: Continuous sweep
- 6 Detect mode: Positive peak
- 7 Mark function: Frequency Counter (Resolution 100 Hz)
- 8 EUT have transmitted absence of modulation signal and fixed channelize. f is using the mark cursor to mark the peak frequency value, fc is declaring of channel frequency. Then the frequency error formula is  $(f-f_c)/f_c \times 10^6$  ppm and the limit is less than  $\pm 50$  ppm

#### 5.1.4 Test Deviation

There is no deviation with the original standard.

#### 5.1.5 EUT Operation during Test

The EUT was placed on the test table and programmed in un-modulation function.

## 5.1.6 Test Result

## Test Data for Bluetooth (Classic)

| Test Mode   | Test Voltage | Frequency (MHz) | Test Frequency (MHz) | Frequency Error (ppm) | Limit (ppm) | Refer to Plot | Verdict |
|-------------|--------------|-----------------|----------------------|-----------------------|-------------|---------------|---------|
| Unmodulated | NV           | 2402            | 2401.970988          | -12.08                | $\pm 50$    | A.1.1         | Pass    |
|             |              | 2441            | 2440.970025          | -12.28                | $\pm 50$    | A.1.2         | Pass    |
|             |              | 2480            | 2479.969113          | -12.45                | $\pm 50$    | A.1.3         | Pass    |

## Test Data for GSKF (BLE 1Mbps)

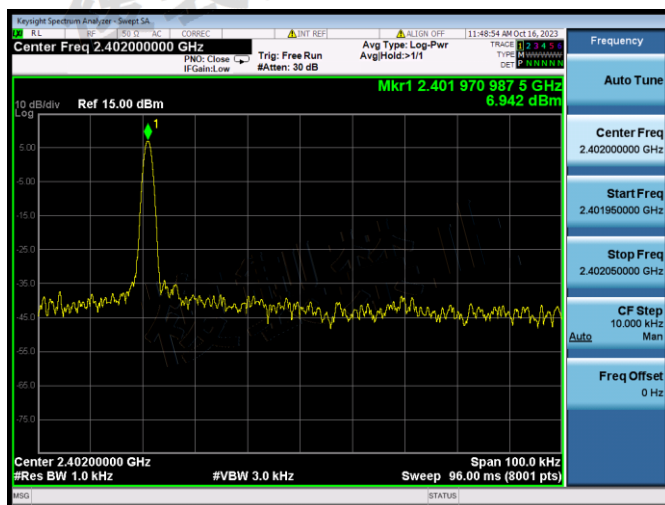
| Test Mode   | Test Voltage | Frequency (MHz) | Test Frequency (MHz) | Frequency Error (ppm) | Limit (ppm) | Refer to Plot | Verdict |
|-------------|--------------|-----------------|----------------------|-----------------------|-------------|---------------|---------|
| Unmodulated | NV           | 2402            | 2401.970224          | -12.40                | $\pm 50$    | A.1.4         | Pass    |
|             |              | 2440            | 2439.971724          | -11.59                | $\pm 50$    | A.1.5         | Pass    |
|             |              | 2480            | 2479.970864          | -11.75                | $\pm 50$    | A.1.6         | Pass    |

## Test Data for GSKF (BLE 2Mbps)

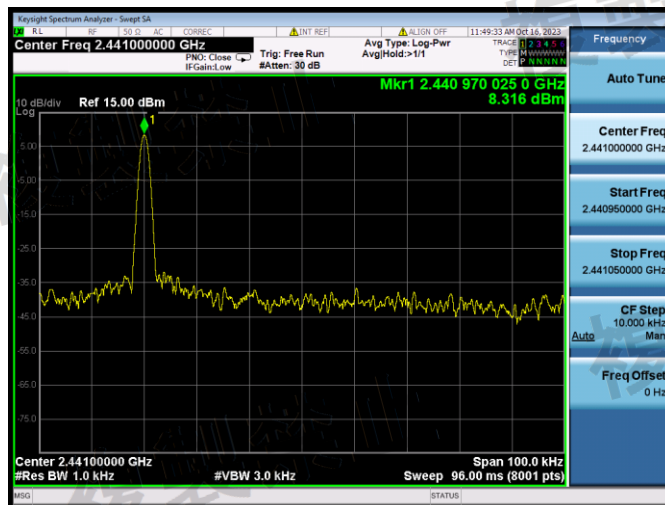
| Test Mode   | Test Voltage | Frequency (MHz) | Test Frequency (MHz) | Frequency Error (ppm) | Limit (ppm) | Refer to Plot | Verdict |
|-------------|--------------|-----------------|----------------------|-----------------------|-------------|---------------|---------|
| Unmodulated | NV           | 2404            | 2403.971444          | -11.88                | $\pm 50$    | A.1.7         | Pass    |
|             |              | 2440            | 2439.970864          | -11.94                | $\pm 50$    | A.1.8         | Pass    |
|             |              | 2478            | 2477.970124          | -12.06                | $\pm 50$    | A.1.9         | Pass    |

## Test Plots for Bluetooth (Classic)

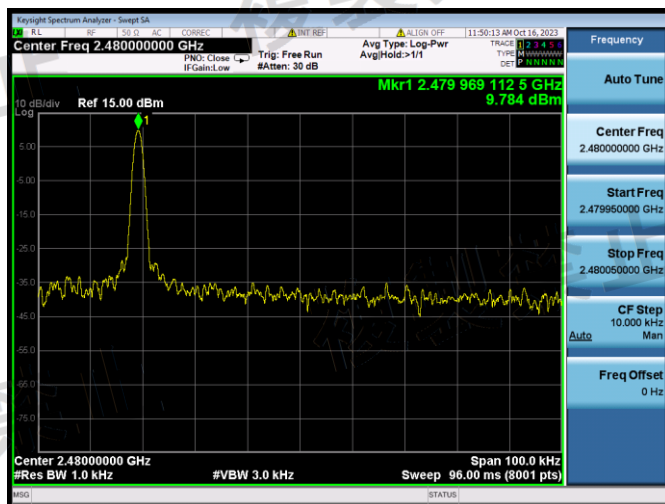
## A.1.1 NV 2402 Channel



## A.1.2 NV 2441 Channel

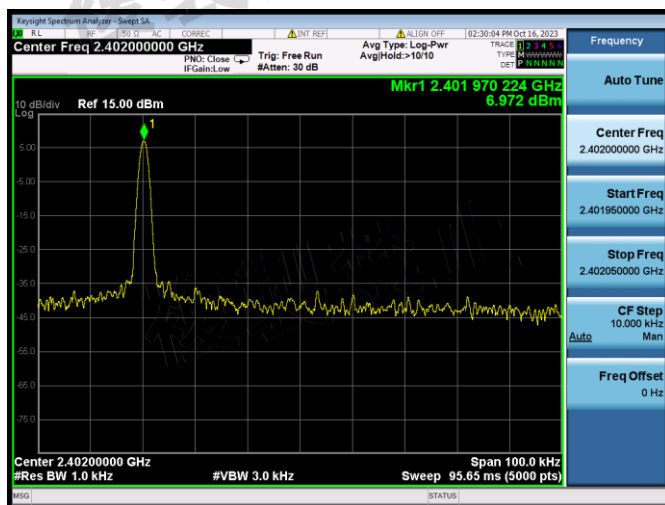


## A.1.3 NV 2480 Channel

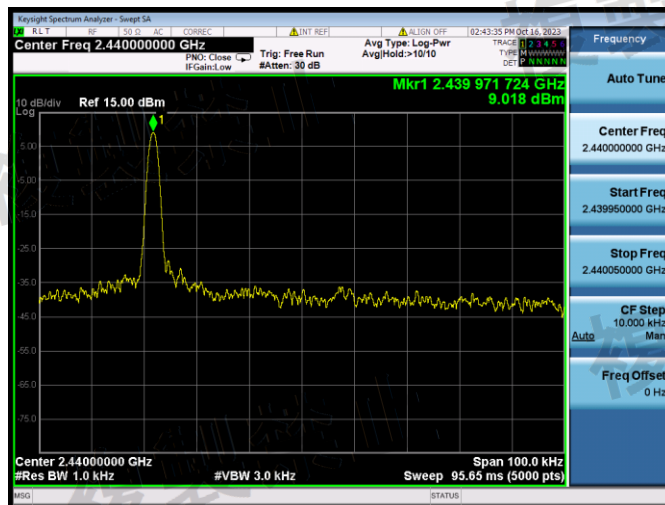


## Test Plots for GSKF (BLE 1Mbps)

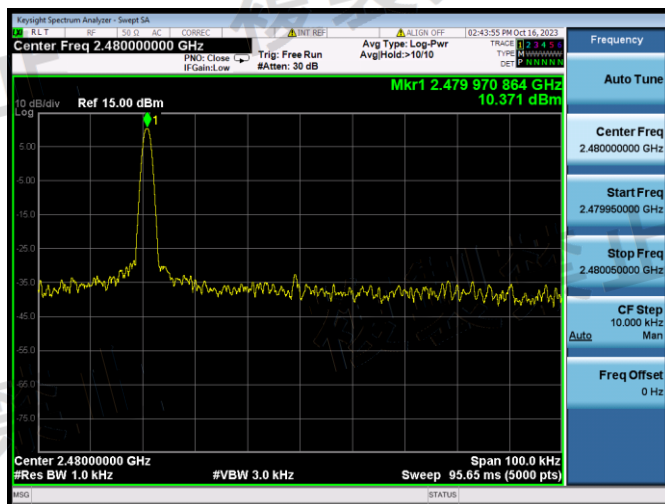
## A.1.4 NV 2402 Channel



## A.1.5 NV 2440 Channel

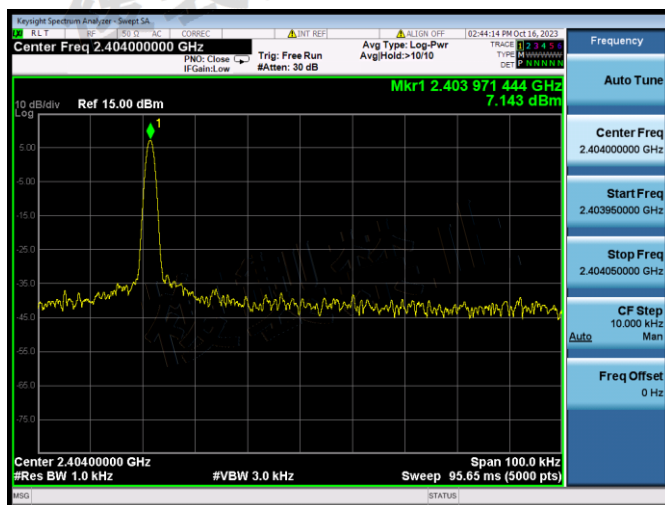


## A.1.6 NV 2480 Channel

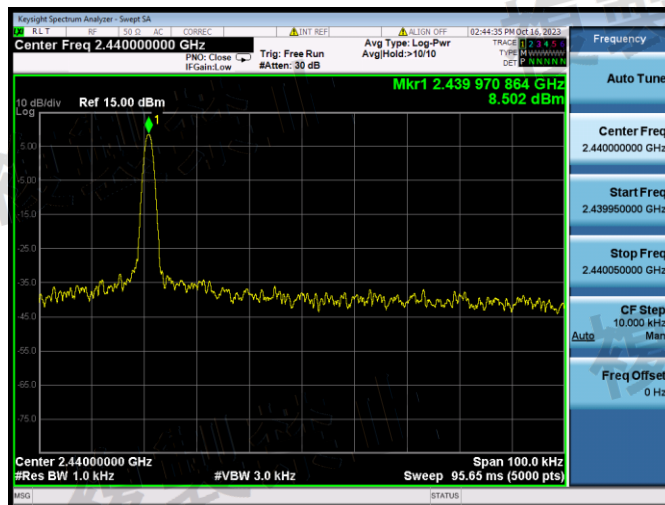


## Test Plots for GSKF (BLE 2Mbps)

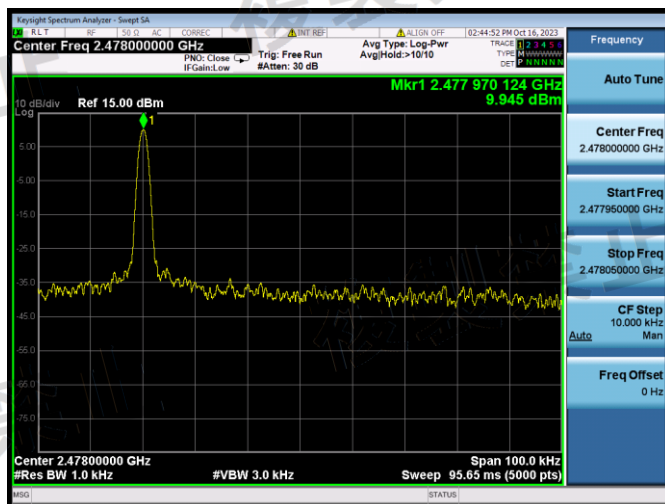
A.1.7 NV 2404 Channel



A.1.8 NV 2440 Channel



A.1.9 NV 2478 Channel



## 5.2 Occupied Bandwidth and Spread-spectrum Bandwidth/Factor

### 5.2.1 Limit

| Item                      | Limits                                                                         |
|---------------------------|--------------------------------------------------------------------------------|
| Occupied Band Width       | FHSS $\leq$ 83.5MHz; OFDM $\leq$ 40MHz, DSSS $\leq$ 26MHz; Others $\leq$ 26MHz |
| Spread-spectrum Bandwidth | $\geq$ 500 kHz (FHSS, DSSS)                                                    |

### 5.2.2 Test Setup

See section 4.3.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

### 5.2.3 Test Procedure

- Set the spectrum analyzer as follows:
  - Center frequency: Test frequency
  - Span: Approximately 2 to 3.5 times nominal bandwidth
  - Resolution bandwidth: Approximately 3% or less nominal bandwidth
  - Video bandwidth: equivalent to resolvable bandwidth
  - Sweep time: auto
  - Sweep mode: Continuous sweep
  - Detection: Positive peak
  - Trace mode: Maximum hold
- After repeating sweeps until the display shows steady data, store the values at all data points into the computer array variables.
- Convert the dB values at all data points to antilogarithm on the power dimension.
- Obtain sum total of the power at all data points, and store it as "total power".
- Accumulate the power at each data point sequentially upward from the lowest frequency and obtain the limit data point where the accumulated power becomes 0.5% (5% for spreading bandwidth) of the "total power". Then convert the limit data point into frequency and store it as "lower limit frequency".
- Accumulate the power at each data point sequentially downward from the highest frequency and obtain the limit data point where the accumulated power becomes 0.5% (5% for spreading bandwidth) of the "total power". Then convert the limit data point into frequency and store it as "upper limit frequency".
- Spread Spectrum Factor = Spread Spectrum Bandwidth / modulation rate of EUT.

### 5.2.4 Test Deviation

There is no deviation with the original standard.

### 5.2.5 EUT Operation during Test

The EUT was programmed to be in continuous transmit, channel-hopping mode.

## 5.2.6 Test Result

## Test Data for Bluetooth (Classic)

| Results of Occupied Bandwidth        | MODE           | Test Voltage | Measured 99% Occupied Bandwidth (MHz)        |                                       |                        | Occupied Bandwidth Limit (MHz) | Refer to Plot | Verdict |
|--------------------------------------|----------------|--------------|----------------------------------------------|---------------------------------------|------------------------|--------------------------------|---------------|---------|
|                                      | GFSK           | NV           | 78.66                                        |                                       |                        | ≤ 83.5                         | A.2.1         | Pass    |
|                                      | $\pi/4$ -DQPSK |              | 78.78                                        |                                       |                        | ≤ 83.5                         | A.2.2         | Pass    |
|                                      | 8-DPSK         |              | 78.76                                        |                                       |                        | ≤ 83.5                         | A.2.3         | Pass    |
| Results of Spread-spectrum Bandwidth | MODE           | Test Voltage | Measured 90% Spread-spectrum Bandwidth (MHz) | Spread-spectrum Bandwidth Limit (MHz) | Spread Spectrum Factor | Spread Spectrum Factor Limit   | Refer to Plot | Verdict |
|                                      | GFSK           | NV           | 70.93                                        | ≥ 0.5                                 | 70.93                  | ≥ 5                            | A.2.4         | Pass    |
|                                      | $\pi/4$ -DQPSK |              | 71.21                                        | ≥ 0.5                                 | 71.21                  | ≥ 5                            | A.2.5         | Pass    |
|                                      | 8-DPSK         |              | 70.88                                        | ≥ 0.5                                 | 70.88                  | ≥ 5                            | A.2.6         | Pass    |

## Test Data for AFH Mode

| Results of Occupied Bandwidth        | MODE           | Test Voltage | Measured 99% Occupied Bandwidth (MHz)        |                                       |                        | Occupied Bandwidth Limit (MHz) | Refer to Plot | Verdict |
|--------------------------------------|----------------|--------------|----------------------------------------------|---------------------------------------|------------------------|--------------------------------|---------------|---------|
|                                      | GFSK           | NV           | 20.50                                        |                                       |                        | ≤ 83.5                         | A.2.7         | Pass    |
|                                      | $\pi/4$ -DQPSK |              | 20.82                                        |                                       |                        | ≤ 83.5                         | A.2.8         | Pass    |
|                                      | 8-DPSK         |              | 20.75                                        |                                       |                        | ≤ 83.5                         | A.2.9         | Pass    |
| Results of Spread-spectrum Bandwidth | MODE           | Test Voltage | Measured 90% Spread-spectrum Bandwidth (MHz) | Spread-spectrum Bandwidth Limit (MHz) | Spread Spectrum Factor | Spread Spectrum Factor Limit   | Refer to Plot | Verdict |
|                                      | GFSK           | NV           | 18.48                                        | ≥ 0.5                                 | 18.48                  | ≥ 5                            | A.2.10        | Pass    |
|                                      | $\pi/4$ -DQPSK |              | 18.64                                        | ≥ 0.5                                 | 18.64                  | ≥ 5                            | A.2.11        | Pass    |
|                                      | 8-DPSK         |              | 18.63                                        | ≥ 0.5                                 | 18.63                  | ≥ 5                            | A.2.12        | Pass    |

Test Data for GSFK (BLE 1Mbps)

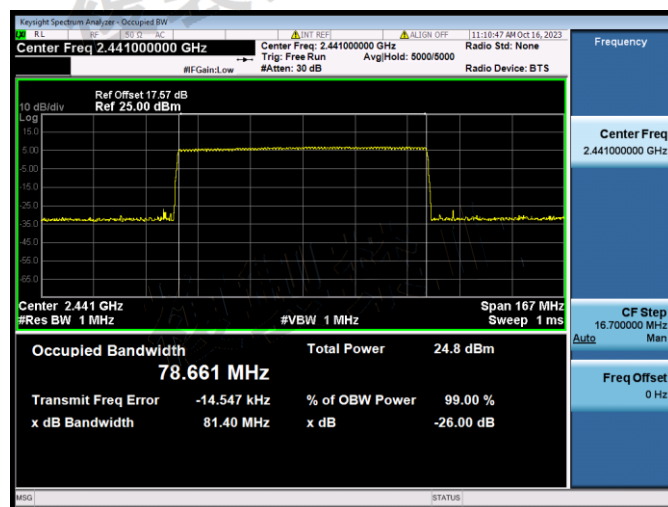
| Results of Occupied Bandwidth | Channel | Test Voltage | Measured 99% Occupied Bandwidth (MHz) | Occupied Bandwidth Limit (MHz) | Refer to Plot | Verdict |
|-------------------------------|---------|--------------|---------------------------------------|--------------------------------|---------------|---------|
|                               | Low     | NV           | 1.06                                  | $\leq 26$                      | A.2.13        | Pass    |
|                               | Middle  |              | 1.06                                  | $\leq 26$                      | A.2.14        | Pass    |
|                               | High    |              | 1.06                                  | $\leq 26$                      | A.2.15        | Pass    |

Test Data for GSFK (BLE 2Mbps)

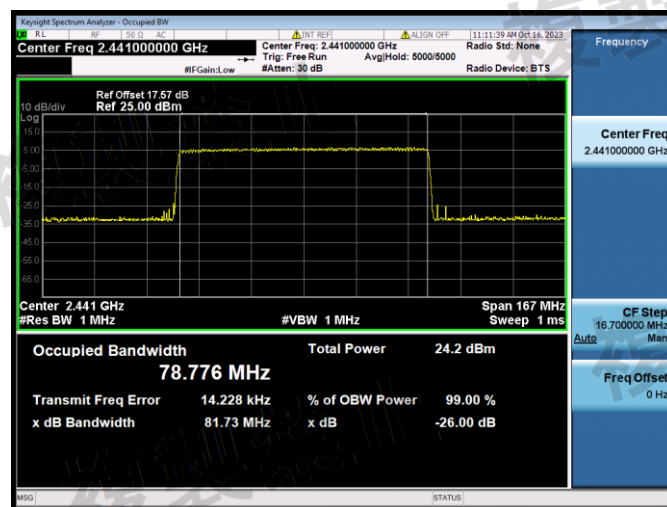
| Results of Occupied Bandwidth | Channel | Test Voltage | Measured 99% Occupied Bandwidth (MHz) | Occupied Bandwidth Limit (MHz) | Refer to Plot | Verdict |
|-------------------------------|---------|--------------|---------------------------------------|--------------------------------|---------------|---------|
|                               | Low     | NV           | 1.92                                  | $\leq 26$                      | A.2.16        | Pass    |
|                               | Middle  |              | 1.92                                  | $\leq 26$                      | A.2.17        | Pass    |
|                               | High    |              | 1.92                                  | $\leq 26$                      | A.2.18        | Pass    |

## Test Plots (Occupied Bandwidth)

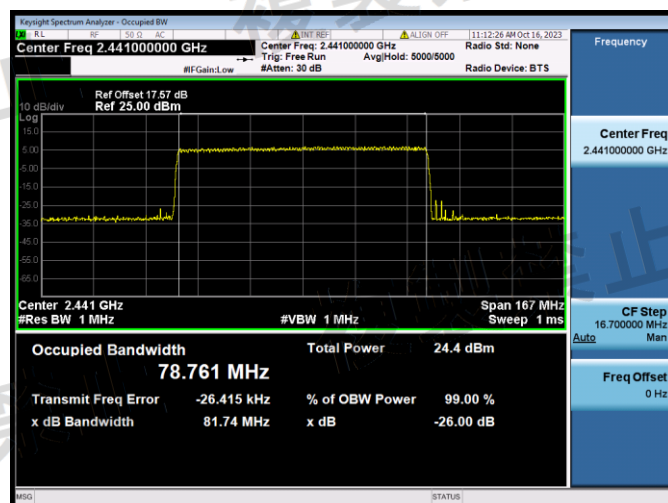
### A.2.1 GFSK NV



### A.2.2 $\pi/4$ -DQPSK NV

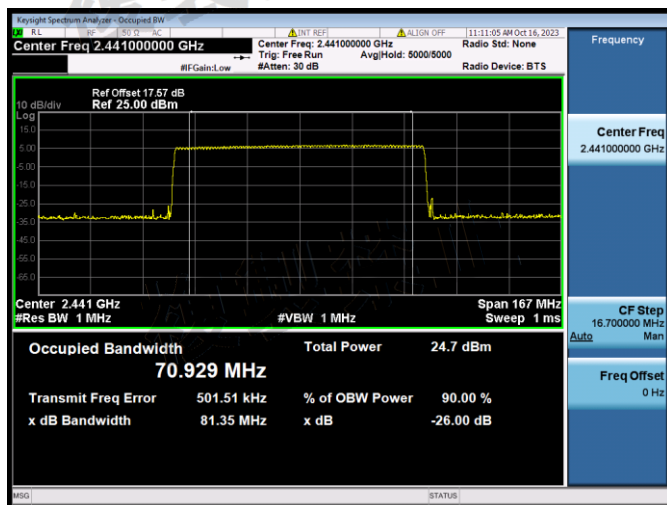
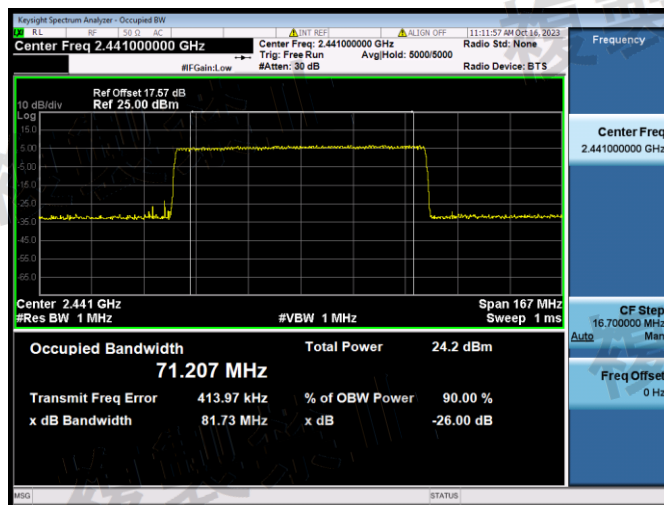


### A.2.3 8-DPSK NV

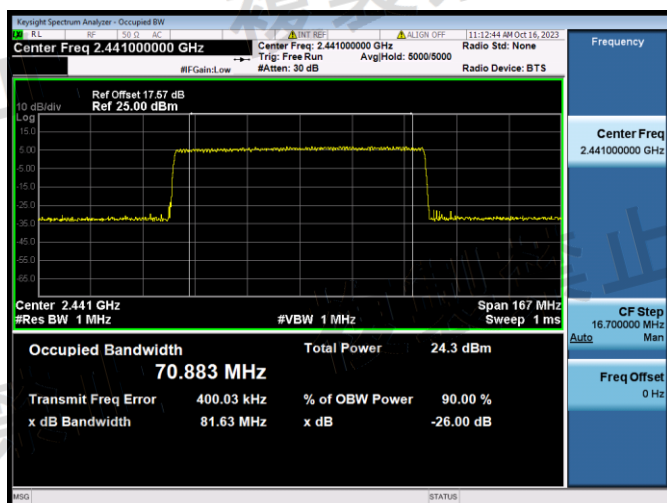


## Test Plots (Spread-spectrum Bandwidth)

## A.2.4 GFSK NV

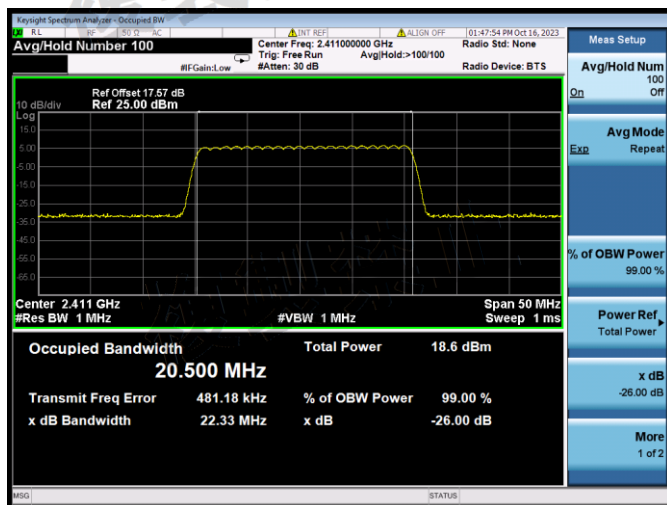
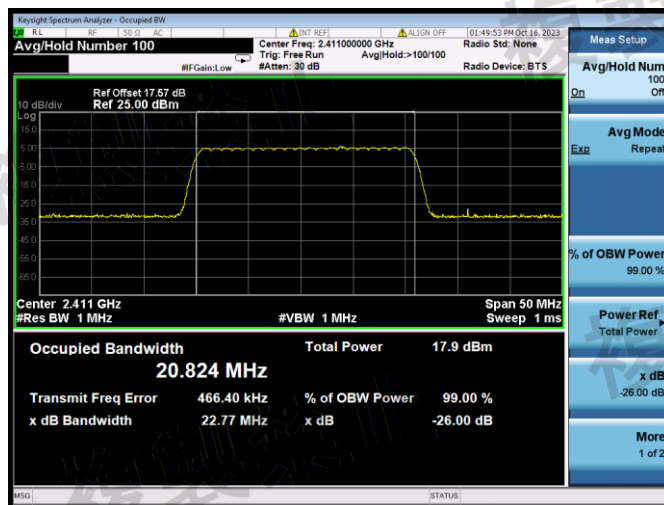
A.2.5  $\pi/4$ -DQPSK NV

## A.2.6 8-DPSK NV

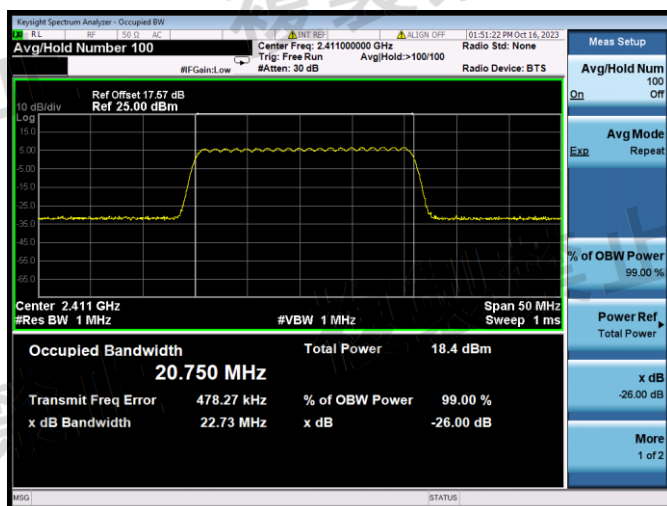


## Test Plots (Occupied Bandwidth)-AFH Mode

## A.2.7 GFSK NV

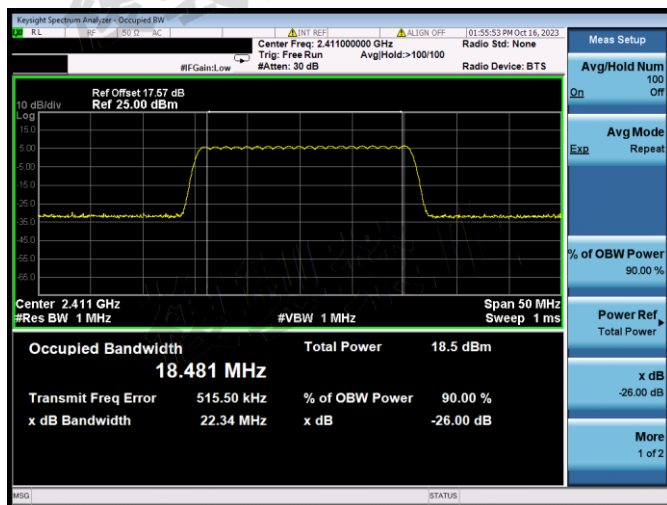
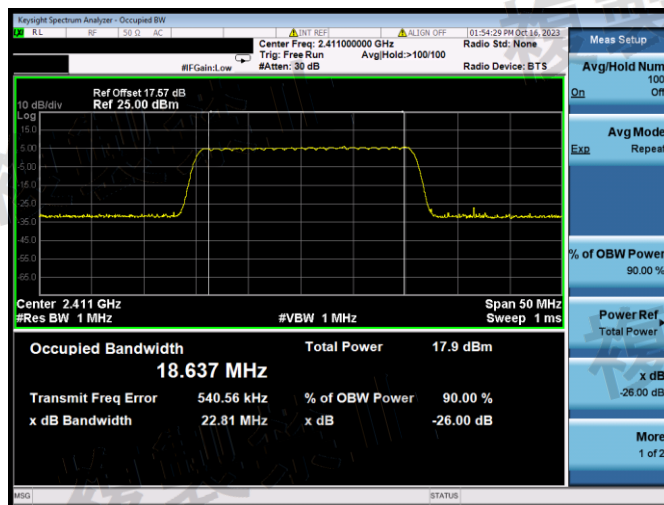
A.2.8  $\pi/4$ -DQPSK NV

## A.2.9 8-DPSK NV

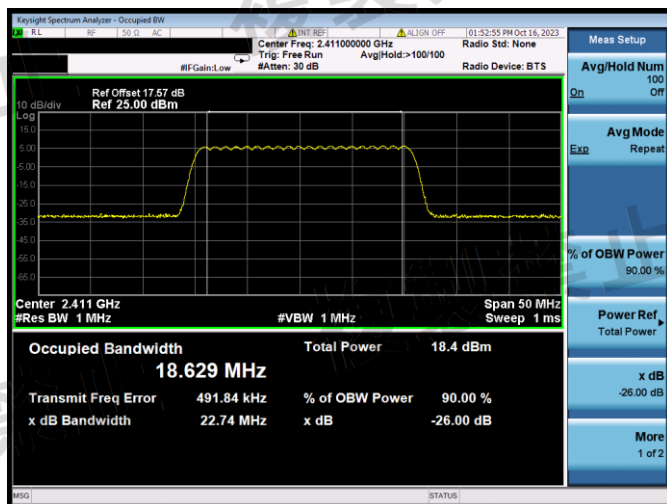


## Test Plots (Spread-spectrum Bandwidth)-AFH Mode

## A.2.10 GFSK NV

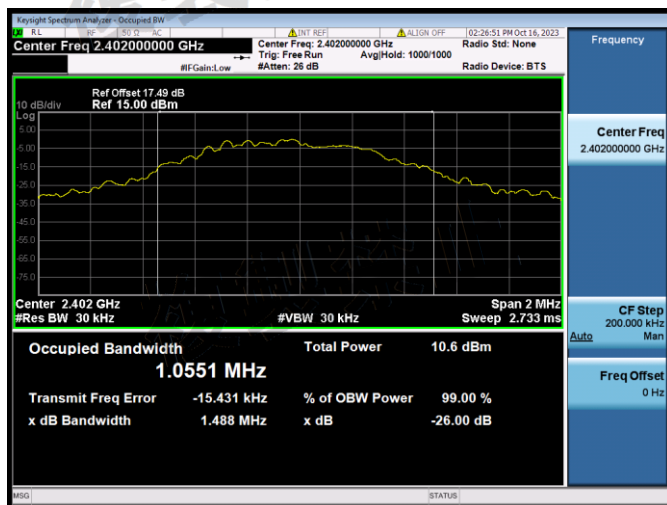
A.2.11  $\pi/4$ -DQPSK NV

## A.2.12 8-DPSK NV

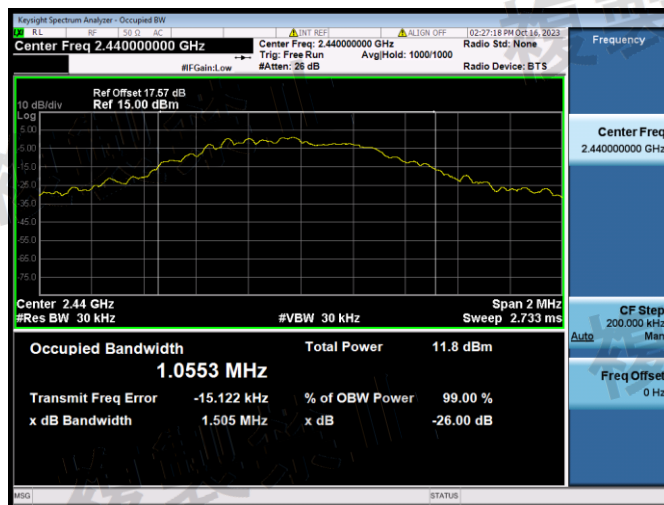


## Test Plots for GSKF (BLE 1Mbps)

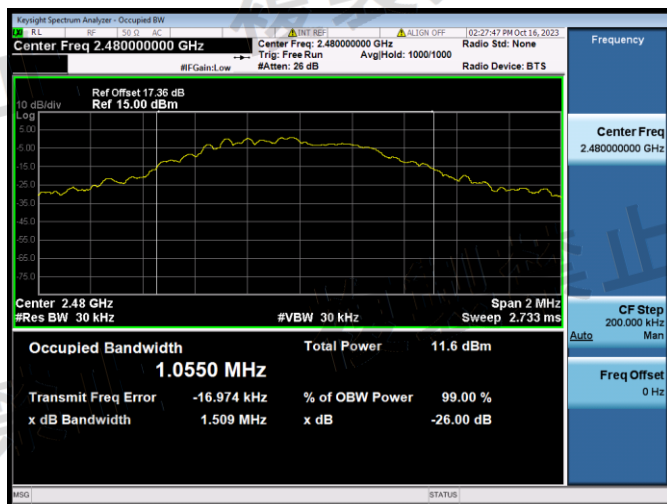
A.2.13 Low Channel NV



A.2.14 Middle Channel NV

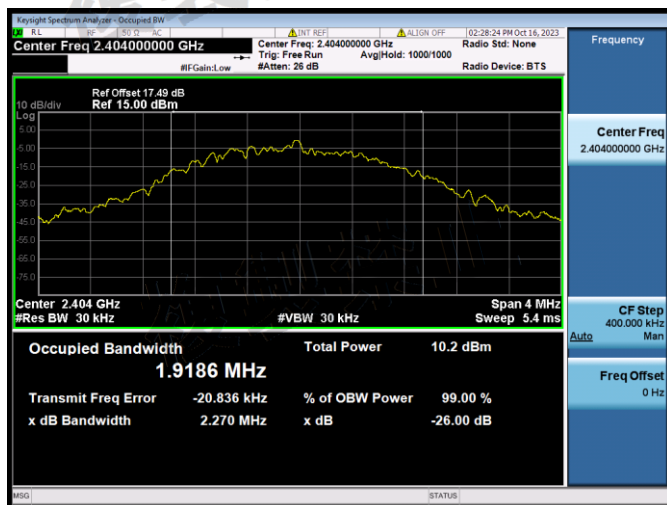


A.2.15 High Channel NV

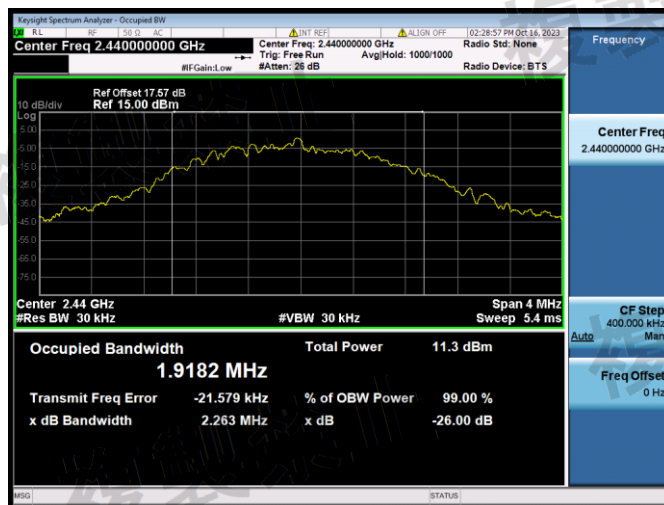


## Test Plots for GSKF (BLE 2Mbps)

A.2.16 Low Channel NV



A.2.17 Middle Channel NV



A.2.18 High Channel NV



### 5.3 The frequency retention time

#### 5.3.1 Limit

| Item           | Limits                                                                                                                                                                                                                                                                                                |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| retention time | For the radio equipment that uses the frequency hopping method excluding a combination of the spread spectrum method and OFDM, the total sum of the frequency retention time in any frequency within the time obtained by multiplying the diffusion rate by 0.4 second shall be 0.4 second or shorter |

#### 5.3.2 Test Setup

See section 4.3.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

#### 5.3.3 Measuring Instruments and setting

Spectrum analyzer setting up is as follows.

Center frequency Hopping test frequency

Sweep bandwidth 0 Hz

Resolvable bandwidth 1 MHz

Video bandwidth equivalent to resolvable bandwidth

Y-axis scale 10 dB/Div.

Sweep time hopping cycle

Sweep mode Single sweep

Trigger condition Video trigger

Detection mode Positive peak

#### 5.3.4 Test procedure

- (1) Set the spectrum analyzer according to the above 2 and wait the hopping signal with the hopping frequency.
- (2) Read the maximum level of the residence time of the hopping frequency at hopping cycle using marker etc. from the trace on the display and confirm that it is shorter than 0.4sec.
- (3) By means of the method same to the above (2), read the sum of the residence time of the hopping frequency at hopping cycle.
- (4) Calculate the total of frequency residence time of the hopping frequency as follows.
  1. Total = (0.4s x diffusion rate / hopping cycle) x sum of the residence time of (3)
  2. There, "diffusion rate" is a value of the diffusion bandwidth divided by a frequency equal to transmitting velocity of modulation signal.

### 5.3.5 Test Result

The average time of occupancy on any channel within the Period can be calculated with formulas:

$$\{\text{Total of Dwell}\} = \{\text{Period}\} / \{\text{Number of Hopping Frequency}\} * \{\text{Duty Cycle}\}$$

$$\{\text{Period}\} = 0.4s * \{\text{Spread Spectrum Factor}\}$$

#### Test Data

GFSK Mode:

| Package Mode | Test Voltage | On Time (ms) | On+Off Time (ms) | Duty Cycle | Total of Dwell (ms) | Limit (ms) | Refer to Plot | Verdict |
|--------------|--------------|--------------|------------------|------------|---------------------|------------|---------------|---------|
| DH1          | NV           | 0.383        | 2.497            | 0.153      | 55.014              | ≤400       | A.3.1         | Pass    |
| DH3          |              | 1.631        | 3.745            | 0.436      | 156.408             | ≤400       | A.3.2         | Pass    |
| DH5          |              | 2.889        | 5.003            | 0.577      | 207.383             | ≤400       | A.3.3         | Pass    |

π/4-DQPSK Mode:

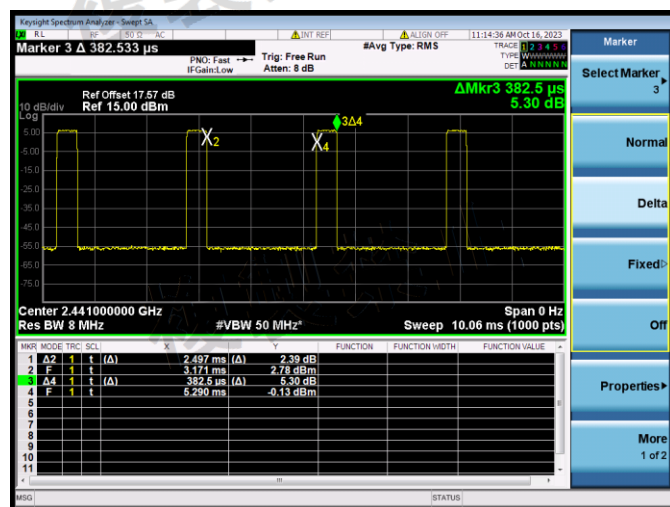
| Package Mode | Test Voltage | On Time (ms) | On+Off Time (ms) | Duty Cycle | Total of Dwell (ms) | Limit (ms) | Refer to Plot | Verdict |
|--------------|--------------|--------------|------------------|------------|---------------------|------------|---------------|---------|
| 2-DH1        | NV           | 0.393        | 2.497            | 0.157      | 56.688              | ≤400       | A.3.4         | Pass    |
| 2-DH3        |              | 1.641        | 3.755            | 0.437      | 157.563             | ≤400       | A.3.5         | Pass    |
| 2-DH5        |              | 2.889        | 5.003            | 0.577      | 208.196             | ≤400       | A.3.6         | Pass    |

8-DPSK Mode:

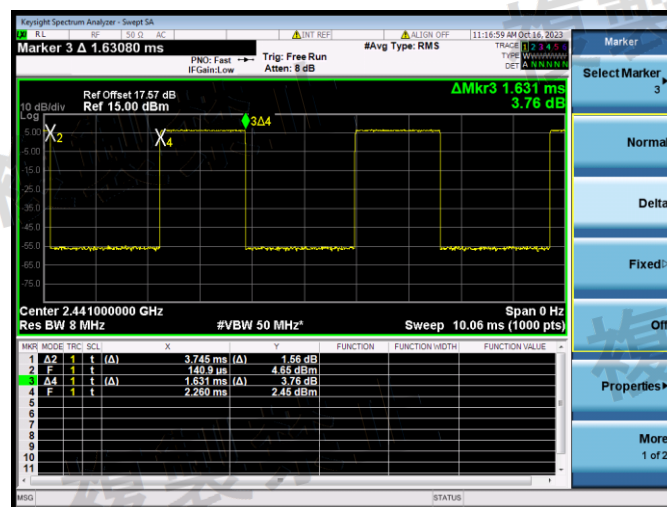
| Package Mode | Test Voltage | On Time (ms) | On+Off Time (ms) | Duty Cycle | Total of Dwell (ms) | Limit (ms) | Refer to Plot | Verdict |
|--------------|--------------|--------------|------------------|------------|---------------------|------------|---------------|---------|
| 3-DH1        | NV           | 0.383        | 2.497            | 0.153      | 54.978              | ≤400       | A.3.7         | Pass    |
| 3-DH3        |              | 1.641        | 3.755            | 0.437      | 156.846             | ≤400       | A.3.8         | Pass    |
| 3-DH5        |              | 2.879        | 4.993            | 0.577      | 206.945             | ≤400       | A.3.9         | Pass    |

## Test Plots

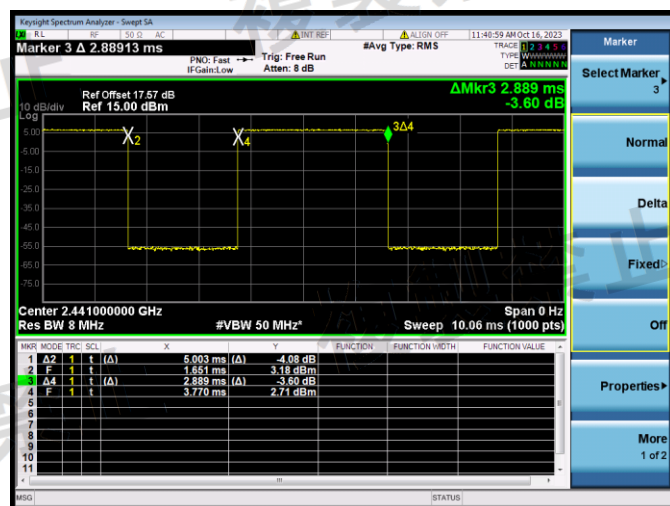
A.3.1. GFSK DH1 NV

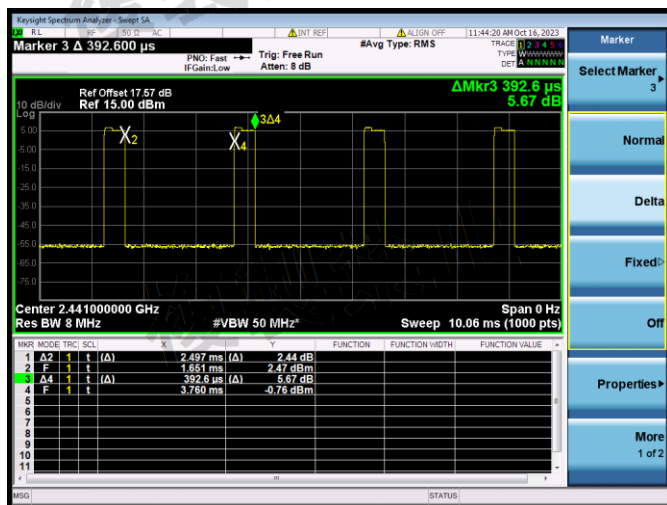
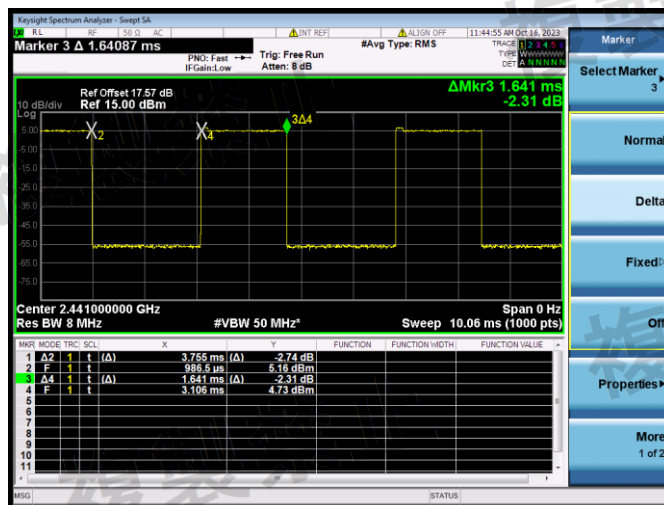
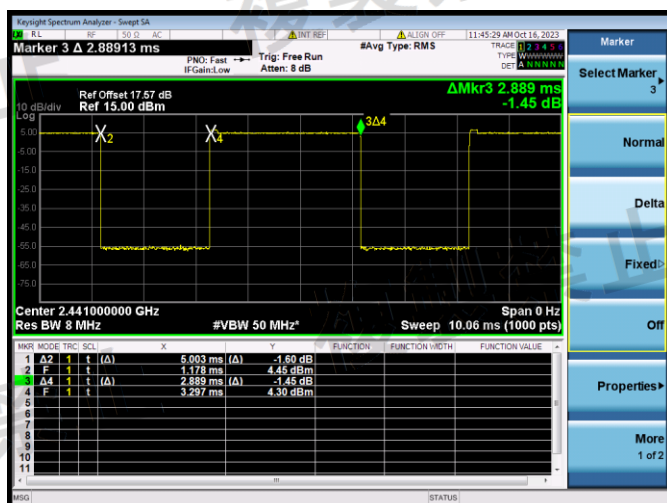


A.3.2. GFSK DH3 NV

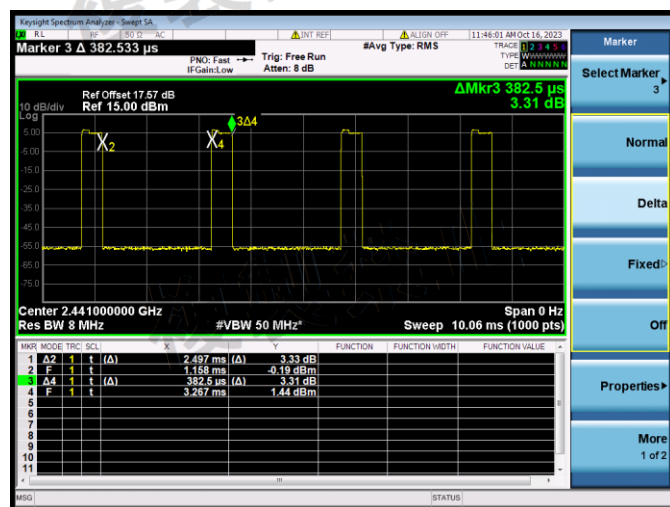


A.3.3. GFSK DH5 NV

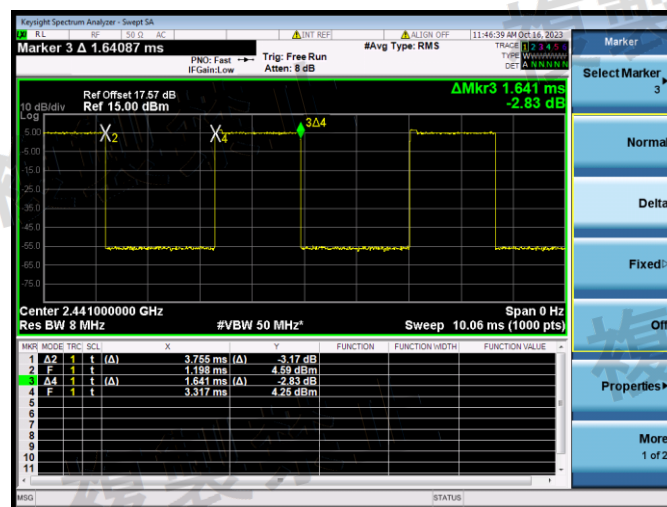


A.3.4.  $\pi/4$ -DQPSK 2-DH1 NVA.3.5.  $\pi/4$ -DQPSK 2-DH3 NVA.3.6.  $\pi/4$ -DQPSK 2-DH5NV

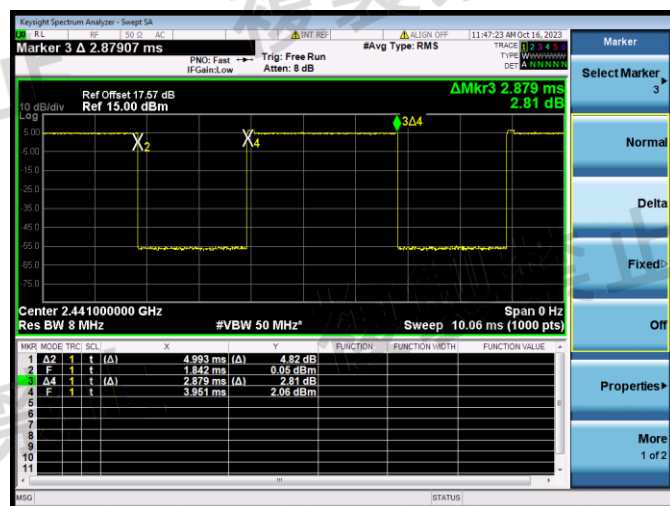
## A.3.7. 8-DPSK 3-DH1 NV



## A.3.8. 8-DPSK 3-DH3 NV



## A.3.9. 8-DPSK 3-DH5 NV



## 5.4 Unwanted Emission Intensity Measurement

### 5.4.1 Limit

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

### 5.4.2 Test Setup

See section 4.3.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

### 5.4.3 Test Procedure

- 1 The EUT is placed in transmit mode at maximum power/modulation at a fixed channel.
- 2 Setting of SA is following as: RBW/VBW = 1MHz; / AT: 10dB / Ref: 0dBm / Sweep time: Auto / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold
- 3 Setting of SA is following as 30 MHz and stop frequency 2387 MHz Then to mark peak reading value + cable loss shall be less than 2.5  $\mu\text{W}$
- 4 SA adjusted to start frequency 2387 MHz and stop frequency 2400 MHz. Then to mark peak reading value + cable loss shall be less than 25  $\mu\text{W}$ .
- 5 SA adjusted to start frequency 2483.5 MHz and stop frequency 2496.5 MHz Then to mark peak reading value + cable loss shall be less than 25  $\mu\text{W}$
- 6 SA adjusted to start frequency 2496.5 MHz and stop frequency 12500 MHz Then to mark peak reading value + cable loss shall be less than 2.5  $\mu\text{W}$
- 7 Measure side band spurious as follows: For 2.4 GHz band: 2374 MHz~2400 MHz and 2483.5 MHz~2509.5 MHz RBW = VBW = 30 kHz, Result\_Value = Measured\_Value + 15.2 [dBm]
- 8 If the Result\_Value is over the requirement, take total sum of 1MHz band centered at the spur frequency like ACLP measurement as Result\_Value.

### 5.4.4 Test Deviation

There is no deviation with the original standard.

### 5.4.5 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

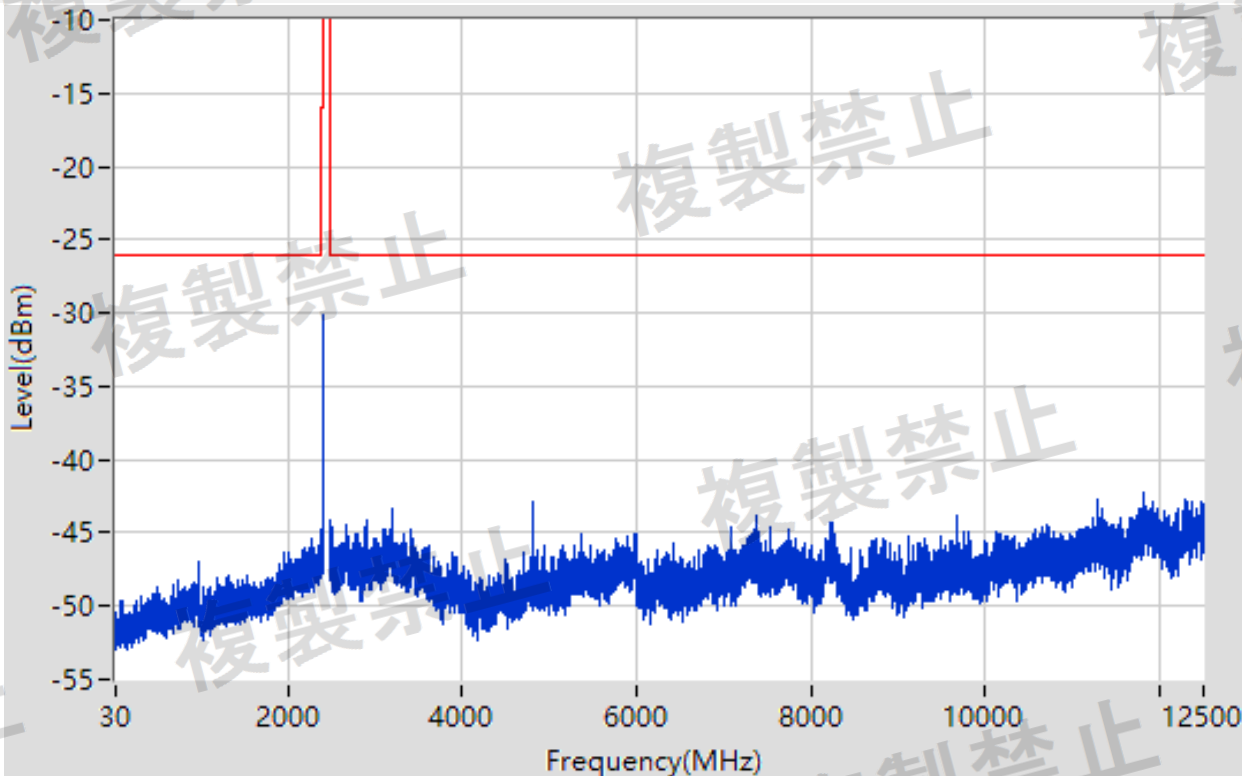
## 5.4.6 Test Result

## Test Data

| Mode                | Channel | Test Voltage | Refer to Plot | Verdict |
|---------------------|---------|--------------|---------------|---------|
| GFSK                | Low     | NV           | A.4.1         | Pass    |
|                     | Middle  |              | A.4.2         | Pass    |
|                     | High    |              | A.4.3         | Pass    |
| $\pi/4$ -DQPSK      | Low     | NV           | A.4.4         | Pass    |
|                     | Middle  |              | A.4.5         | Pass    |
|                     | High    |              | A.4.6         | Pass    |
| 8-DPSK              | Low     | NV           | A.4.7         | Pass    |
|                     | Middle  |              | A.4.8         | Pass    |
|                     | High    |              | A.4.9         | Pass    |
| GFSK<br>(BLE 1Mbps) | Low     | NV           | A.4.10        | Pass    |
|                     | Middle  |              | A.4.11        | Pass    |
|                     | High    |              | A.4.12        | Pass    |
| GFSK<br>(BLE 2Mbps) | Low     | NV           | A.4.13        | Pass    |
|                     | Middle  |              | A.4.14        | Pass    |
|                     | High    |              | A.4.15        | Pass    |

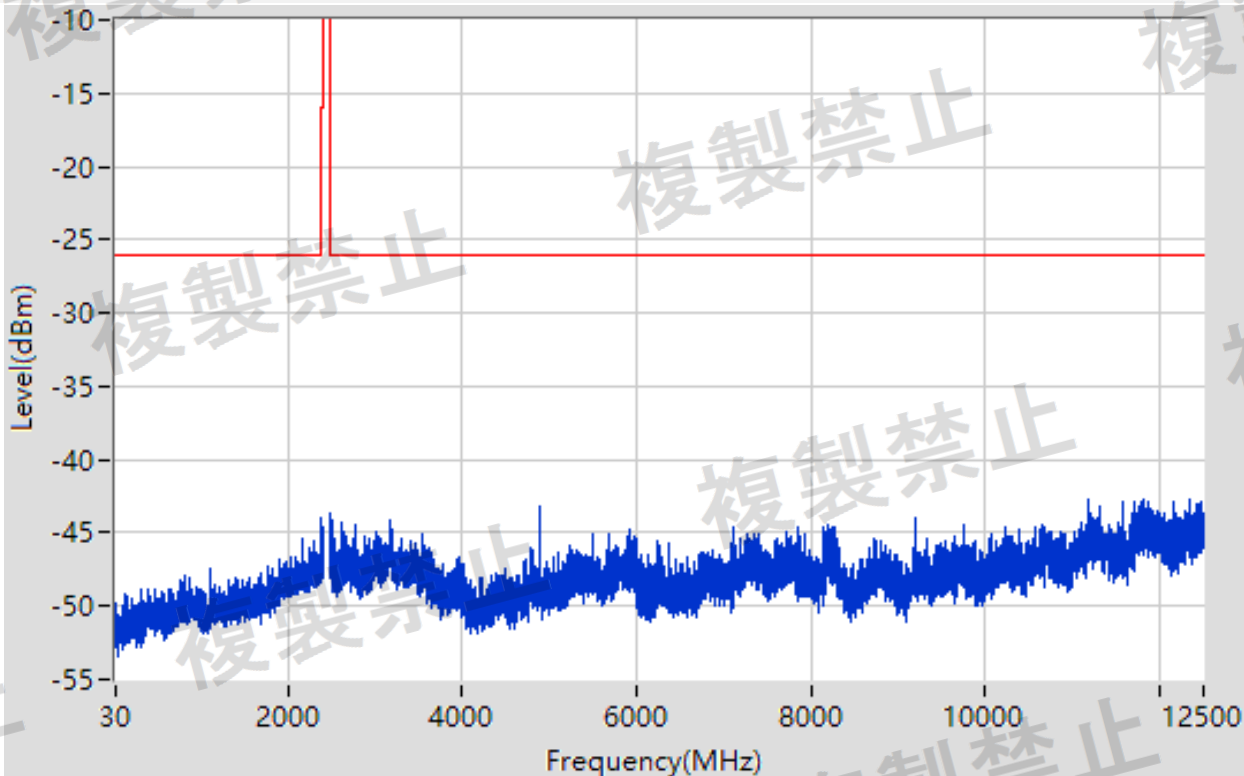
## Test Plots

## A.4.1 GFSK NV Low Channel



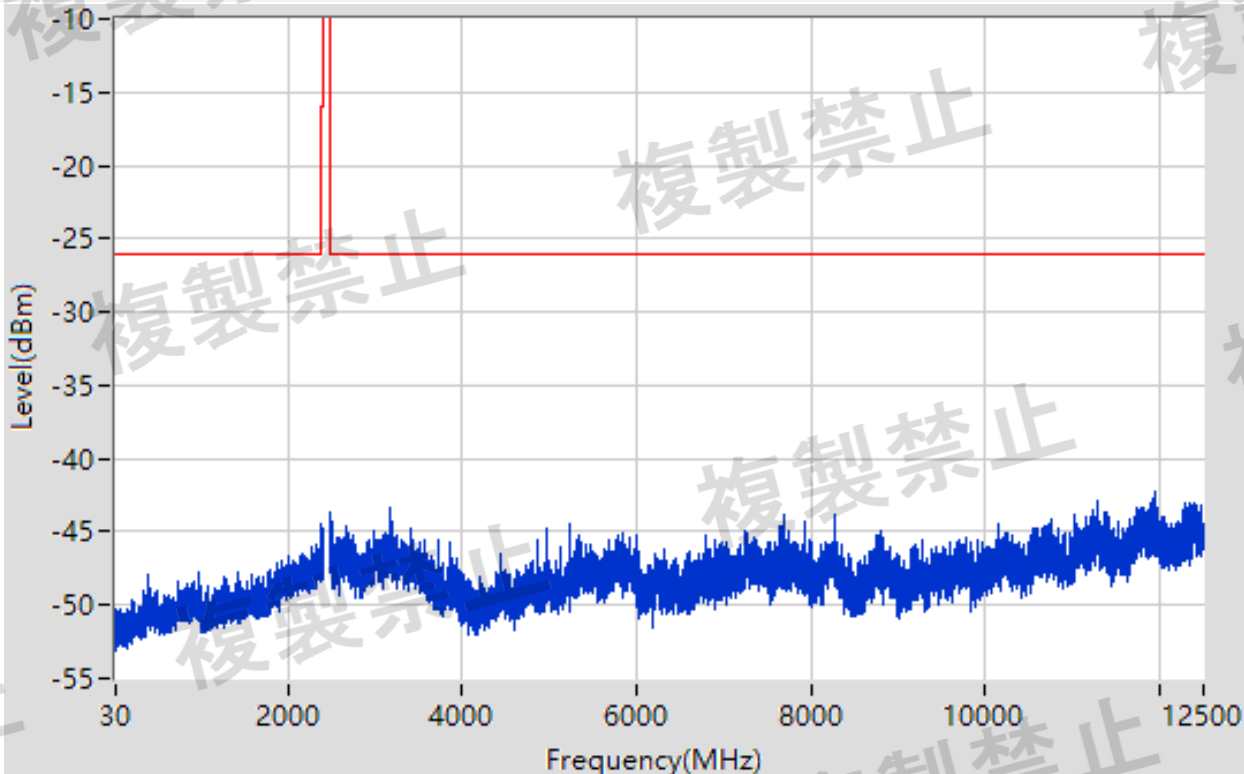
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 1         | Peak     | 984             | -47         | -26         | Pass    | 971         |
| 1000                  | 2374                 | 1         | Peak     | 2279            | -45.48      | -26         | Pass    | 1375        |
| 2374                  | 2387                 | 1         | Peak     | 2375.43         | -45.11      | -26         | Pass    | 601         |
| 2387                  | 2400                 | 1         | Peak     | 2400            | -30.16      | -16         | Pass    | 601         |
| 2483.5                | 2496.5               | 1         | Peak     | 2495.958        | -44.2       | -16         | Pass    | 601         |
| 2496.5                | 2509.5               | 1         | Peak     | 2502.242        | -44.64      | -26         | Pass    | 601         |
| 2509.5                | 6000                 | 1         | Peak     | 4803.829        | -42.92      | -26         | Pass    | 3491        |
| 6000                  | 12500                | 1         | Peak     | 11809           | -42.28      | -26         | Pass    | 6501        |

## A.4.2 GFSK NV Middle Channel

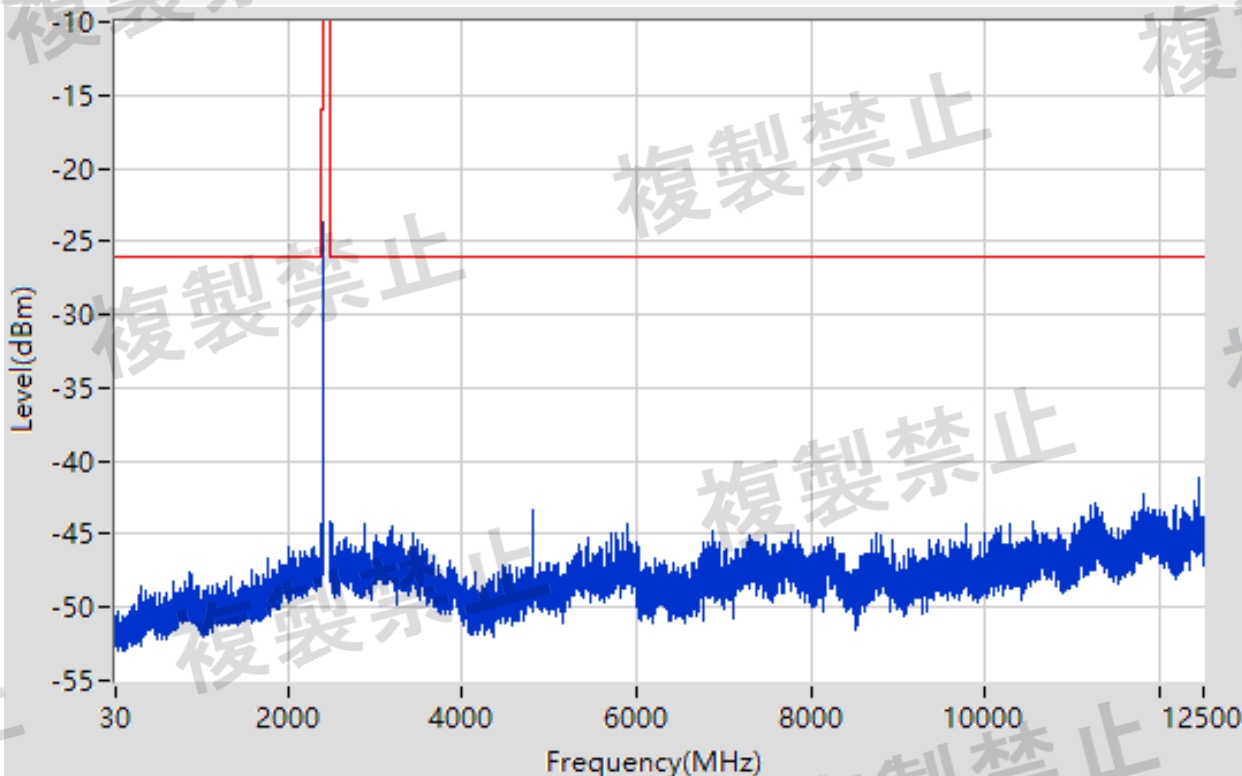


| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 1         | Peak     | 834             | -47.97      | -26         | Pass    | 971         |
| 1000                  | 2374                 | 1         | Peak     | 2158            | -45.46      | -26         | Pass    | 1375        |
| 2374                  | 2387                 | 1         | Peak     | 2383.187        | -45.03      | -26         | Pass    | 601         |
| 2387                  | 2400                 | 1         | Peak     | 2390.402        | -44         | -16         | Pass    | 601         |
| 2483.5                | 2496.5               | 1         | Peak     | 2496.023        | -43.67      | -16         | Pass    | 601         |
| 2496.5                | 2509.5               | 1         | Peak     | 2508.893        | -44.17      | -26         | Pass    | 601         |
| 2509.5                | 6000                 | 1         | Peak     | 4880.84         | -43.27      | -26         | Pass    | 3491        |
| 6000                  | 12500                | 1         | Peak     | 11167           | -42.73      | -26         | Pass    | 6501        |

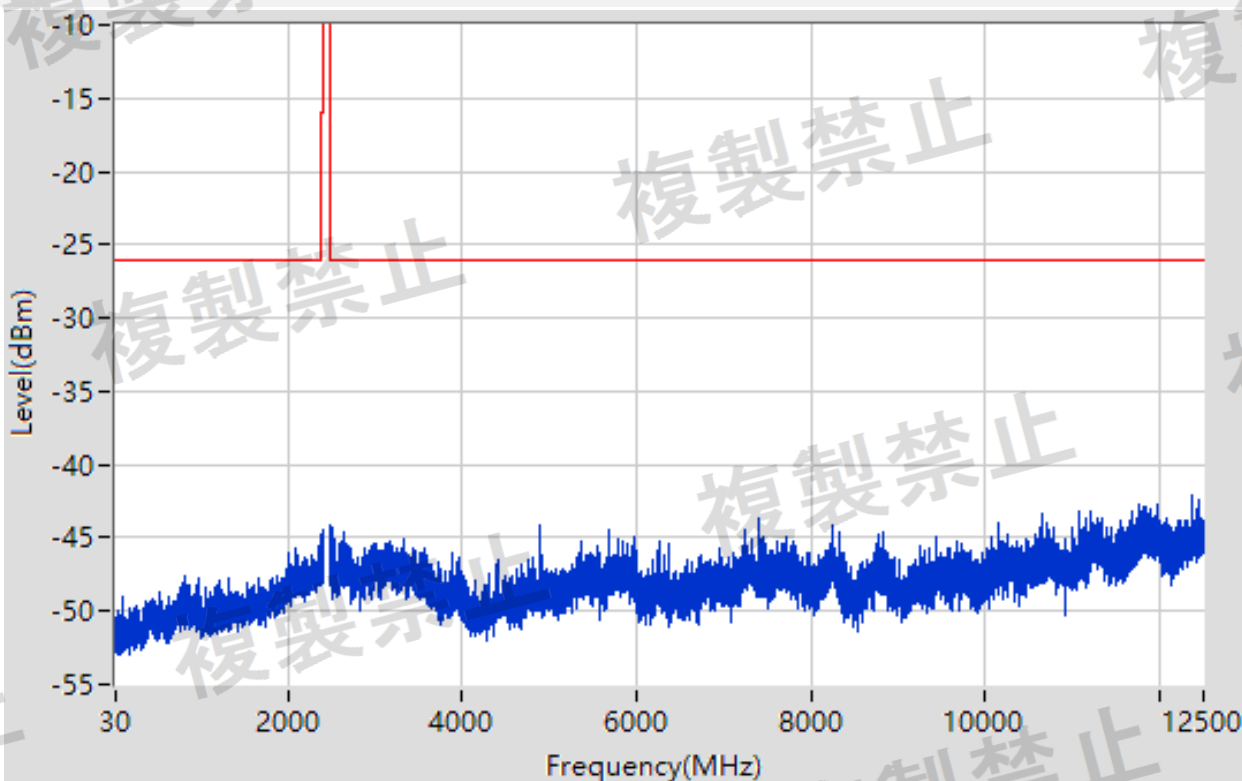
## A.4.3 GFSK NV High Channel



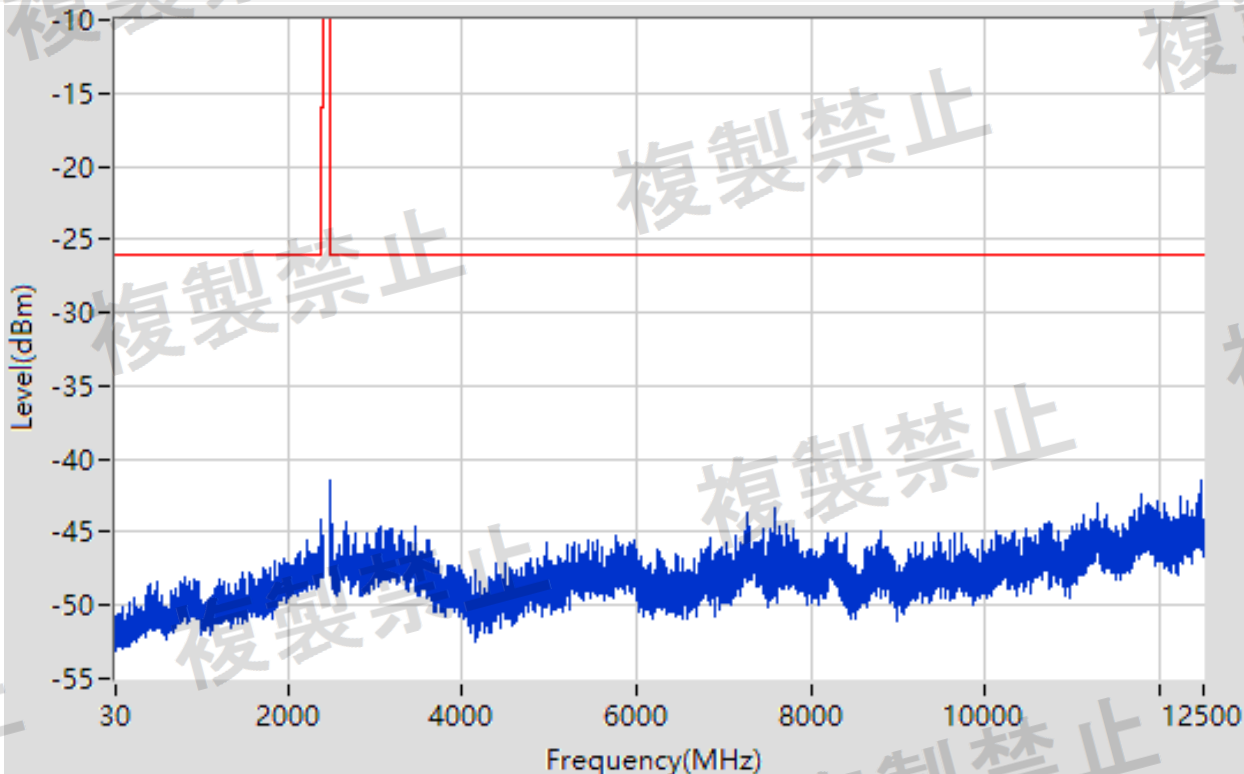
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 1         | Peak     | 975             | -47.8       | -26         | Pass    | 971         |
| 1000                  | 2374                 | 1         | Peak     | 2329            | -45.89      | -26         | Pass    | 1375        |
| 2374                  | 2387                 | 1         | Peak     | 2380.998        | -44.62      | -26         | Pass    | 601         |
| 2387                  | 2400                 | 1         | Peak     | 2387.693        | -44.48      | -16         | Pass    | 601         |
| 2483.5                | 2496.5               | 1         | Peak     | 2496.067        | -43.7       | -16         | Pass    | 601         |
| 2496.5                | 2509.5               | 1         | Peak     | 2503.953        | -44.36      | -26         | Pass    | 601         |
| 2509.5                | 6000                 | 1         | Peak     | 3179.596        | -43.41      | -26         | Pass    | 3491        |
| 6000                  | 12500                | 1         | Peak     | 11951           | -42.31      | -26         | Pass    | 6501        |

A.4.4  $\pi/4$ -DQPSK NV Low Channel

| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 1         | Peak     | 870             | -47.6       | -26         | Pass    | 971         |
| 1000                  | 2374                 | 1         | Peak     | 2019            | -45.91      | -26         | Pass    | 1375        |
| 2374                  | 2387                 | 1         | Peak     | 2374.39         | -44.3       | -26         | Pass    | 601         |
| 2387                  | 2400                 | 1         | Peak     | 2400            | -23.67      | -16         | Pass    | 601         |
| 2483.5                | 2496.5               | 1         | Peak     | 2495.807        | -44.1       | -16         | Pass    | 601         |
| 2496.5                | 2509.5               | 1         | Peak     | 2503.672        | -44.25      | -26         | Pass    | 601         |
| 2509.5                | 6000                 | 1         | Peak     | 4803.829        | -43.4       | -26         | Pass    | 3491        |
| 6000                  | 12500                | 1         | Peak     | 12452           | -41.1       | -26         | Pass    | 6501        |

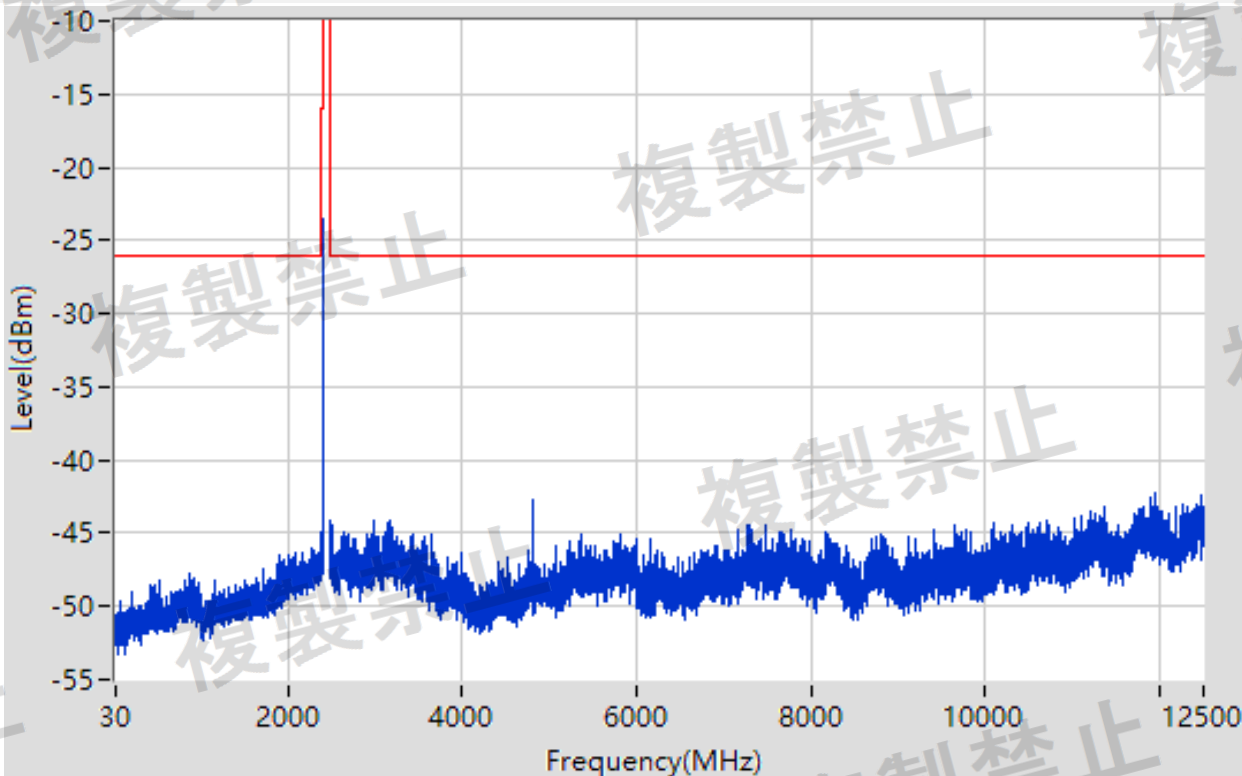
A.4.5  $\pi/4$ -DQPSK NV Middle Channel

| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 1         | Peak     | 817             | -47.57      | -26         | Pass    | 971         |
| 1000                  | 2374                 | 1         | Peak     | 2364            | -45.6       | -26         | Pass    | 1375        |
| 2374                  | 2387                 | 1         | Peak     | 2378.117        | -44.79      | -26         | Pass    | 601         |
| 2387                  | 2400                 | 1         | Peak     | 2395.948        | -44.47      | -16         | Pass    | 601         |
| 2483.5                | 2496.5               | 1         | Peak     | 2496.262        | -44.16      | -16         | Pass    | 601         |
| 2496.5                | 2509.5               | 1         | Peak     | 2504.777        | -44.37      | -26         | Pass    | 601         |
| 2509.5                | 6000                 | 1         | Peak     | 4882.84         | -44.14      | -26         | Pass    | 3491        |
| 6000                  | 12500                | 1         | Peak     | 12377           | -42.15      | -26         | Pass    | 6501        |

A.4.6  $\pi/4$ -DQPSK NV High Channel

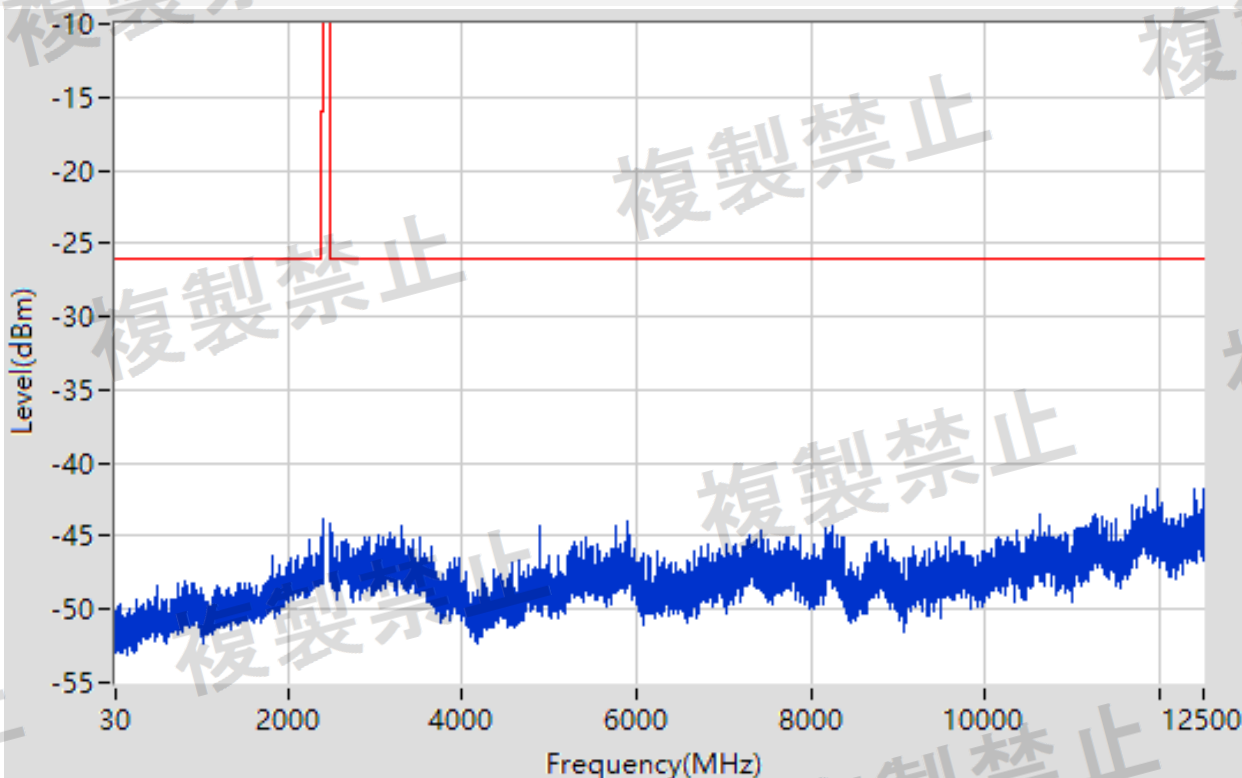
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 1         | Peak     | 825             | -48.07      | -26         | Pass    | 971         |
| 1000                  | 2374                 | 1         | Peak     | 2236            | -45.62      | -26         | Pass    | 1375        |
| 2374                  | 2387                 | 1         | Peak     | 2377.618        | -44.98      | -26         | Pass    | 601         |
| 2387                  | 2400                 | 1         | Peak     | 2388.95         | -44.22      | -16         | Pass    | 601         |
| 2483.5                | 2496.5               | 1         | Peak     | 2483.587        | -41.5       | -16         | Pass    | 601         |
| 2496.5                | 2509.5               | 1         | Peak     | 2503.78         | -44.44      | -26         | Pass    | 601         |
| 2509.5                | 6000                 | 1         | Peak     | 2662.522        | -44.34      | -26         | Pass    | 3491        |
| 6000                  | 12500                | 1         | Peak     | 12469           | -41.48      | -26         | Pass    | 6501        |

## A.4.7 8-DPSK NV Low Channel



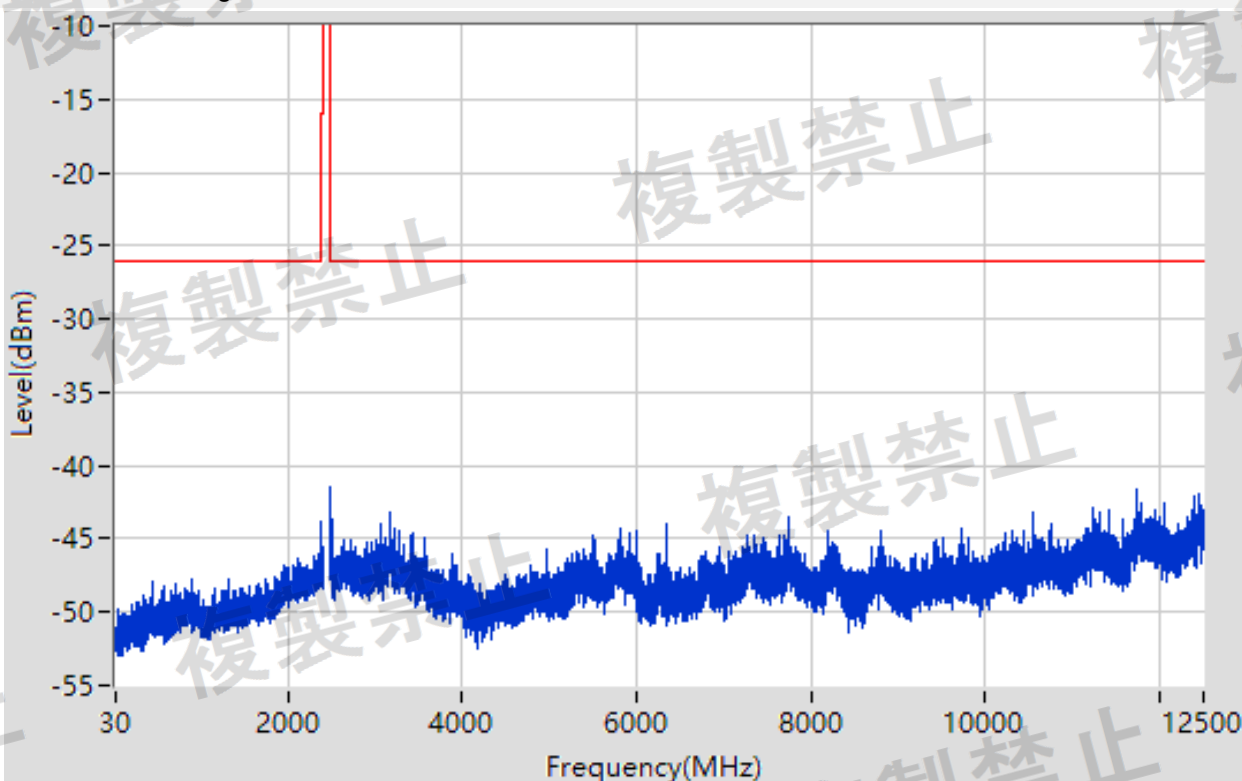
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 1         | Peak     | 880             | -47.83      | -26         | Pass    | 971         |
| 1000                  | 2374                 | 1         | Peak     | 2281            | -46.05      | -26         | Pass    | 1375        |
| 2374                  | 2387                 | 1         | Peak     | 2374.823        | -45.1       | -26         | Pass    | 601         |
| 2387                  | 2400                 | 1         | Peak     | 2400            | -23.59      | -16         | Pass    | 601         |
| 2483.5                | 2496.5               | 1         | Peak     | 2495.763        | -44.08      | -16         | Pass    | 601         |
| 2496.5                | 2509.5               | 1         | Peak     | 2498.168        | -44.24      | -26         | Pass    | 601         |
| 2509.5                | 6000                 | 1         | Peak     | 4803.829        | -42.71      | -26         | Pass    | 3491        |
| 6000                  | 12500                | 1         | Peak     | 11946           | -42.25      | -26         | Pass    | 6501        |

## A.4.8 8-DPSK NV Middle Channel



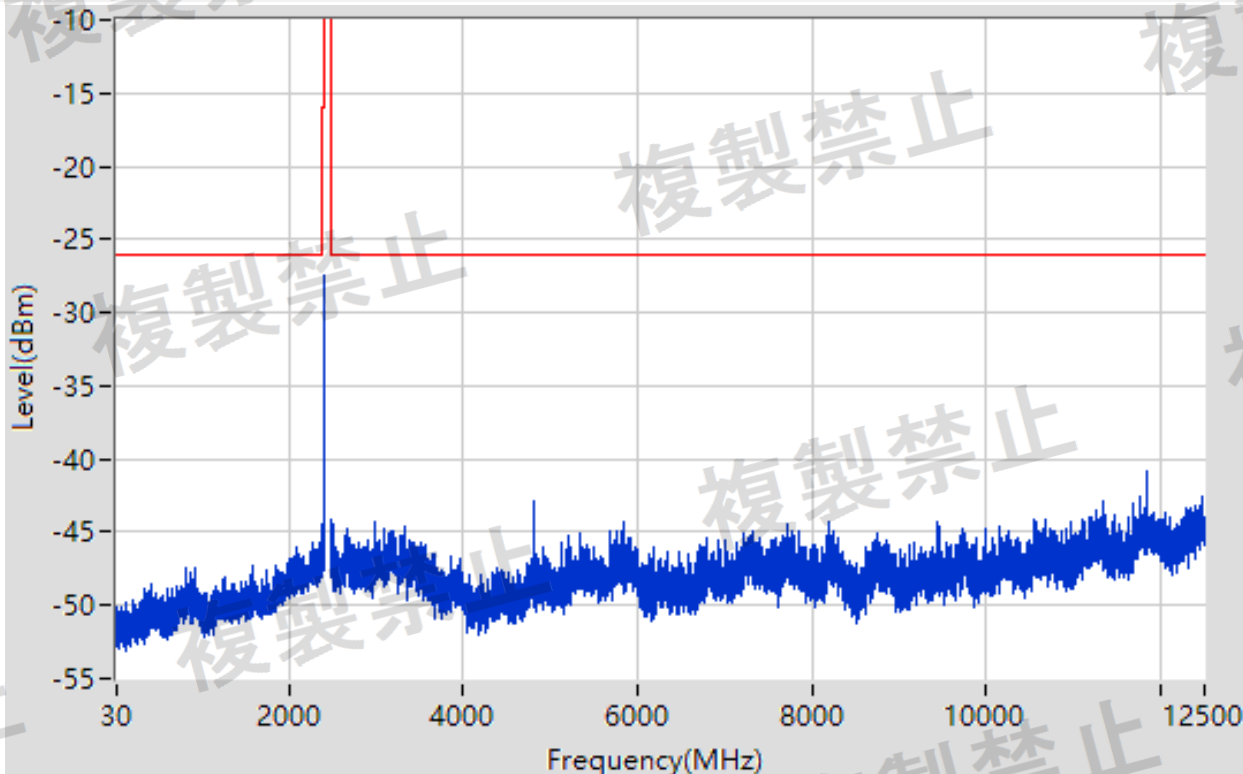
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 1         | Peak     | 829             | -48.1       | -26         | Pass    | 971         |
| 1000                  | 2374                 | 1         | Peak     | 2256            | -45.21      | -26         | Pass    | 1375        |
| 2374                  | 2387                 | 1         | Peak     | 2382.558        | -45.09      | -26         | Pass    | 601         |
| 2387                  | 2400                 | 1         | Peak     | 2399.112        | -43.76      | -16         | Pass    | 601         |
| 2483.5                | 2496.5               | 1         | Peak     | 2496.002        | -44.07      | -16         | Pass    | 601         |
| 2496.5                | 2509.5               | 1         | Peak     | 2503.303        | -44.77      | -26         | Pass    | 601         |
| 2509.5                | 6000                 | 1         | Peak     | 5881.983        | -44.05      | -26         | Pass    | 3491        |
| 6000                  | 12500                | 1         | Peak     | 12488           | -41.71      | -26         | Pass    | 6501        |

## A.4.9 8-DPSK NV High Channel



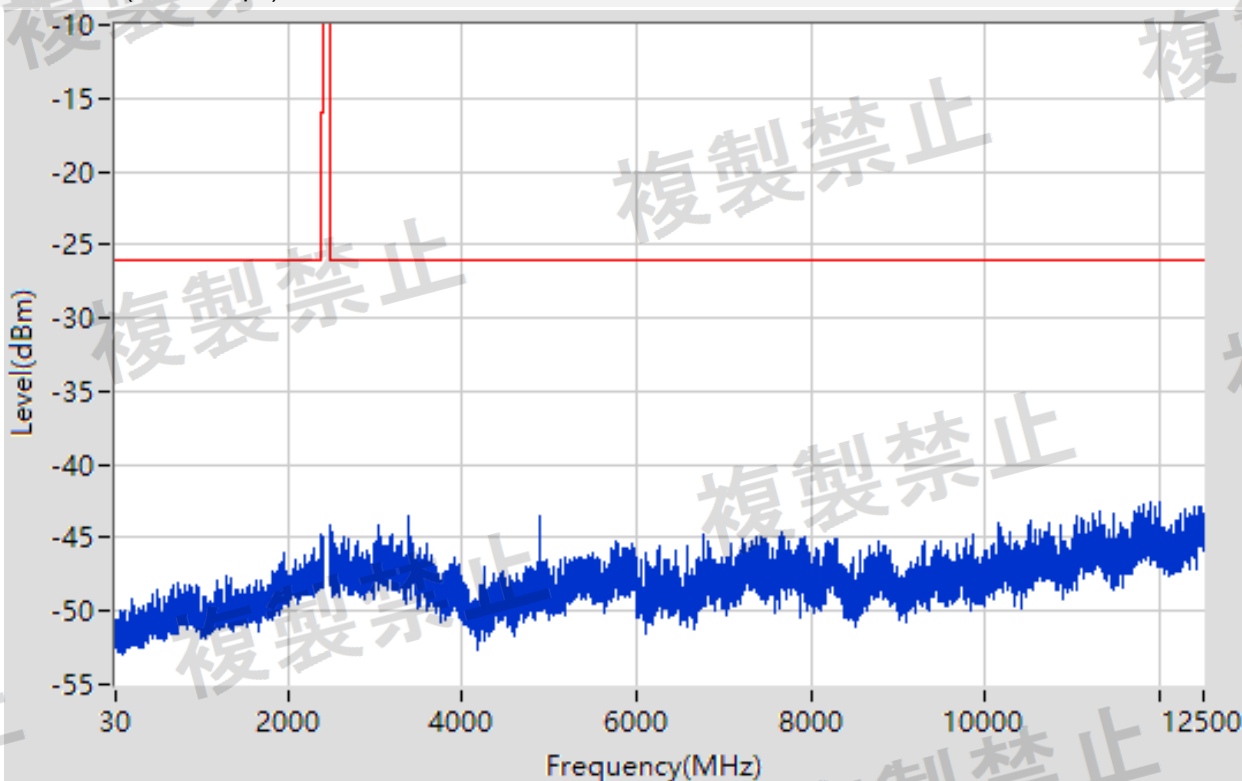
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 1         | Peak     | 896             | -47.81      | -26         | Pass    | 971         |
| 1000                  | 2374                 | 1         | Peak     | 2361            | -45.97      | -26         | Pass    | 1375        |
| 2374                  | 2387                 | 1         | Peak     | 2377.445        | -43.85      | -26         | Pass    | 601         |
| 2387                  | 2400                 | 1         | Peak     | 2390.423        | -44.87      | -16         | Pass    | 601         |
| 2483.5                | 2496.5               | 1         | Peak     | 2483.565        | -41.52      | -16         | Pass    | 601         |
| 2496.5                | 2509.5               | 1         | Peak     | 2507.767        | -43.66      | -26         | Pass    | 601         |
| 2509.5                | 6000                 | 1         | Peak     | 3181.596        | -43.27      | -26         | Pass    | 3491        |
| 6000                  | 12500                | 1         | Peak     | 11735           | -41.68      | -26         | Pass    | 6501        |

## A.4.10 GFSK (BLE 1Mbps) NV Low Channel



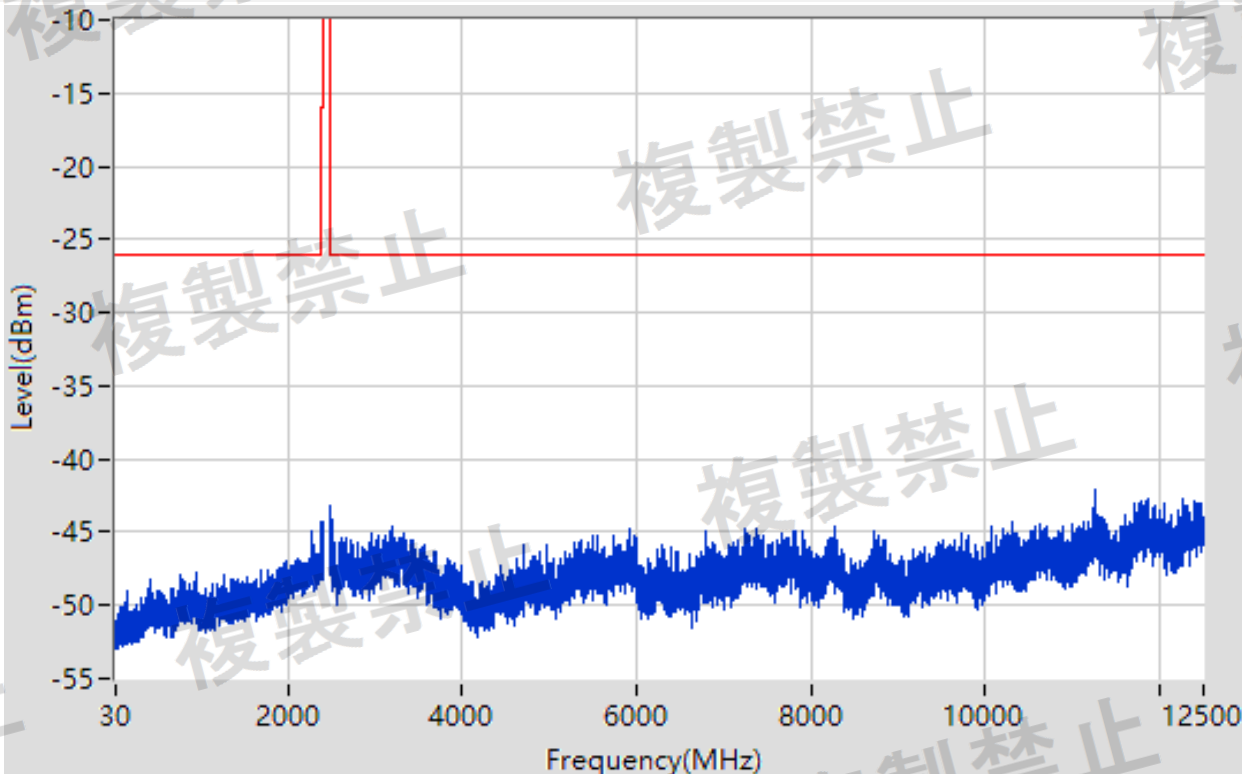
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 1         | Peak     | 933             | -47.44      | -26         | Pass    | 971         |
| 1000                  | 2374                 | 1         | Peak     | 2281            | -45.78      | -26         | Pass    | 1375        |
| 2374                  | 2387                 | 1         | Peak     | 2379.048        | -44.83      | -26         | Pass    | 601         |
| 2387                  | 2400                 | 1         | Peak     | 2400            | -27.53      | -16         | Pass    | 601         |
| 2483.5                | 2496.5               | 1         | Peak     | 2495.893        | -44.2       | -16         | Pass    | 601         |
| 2496.5                | 2509.5               | 1         | Peak     | 2508.027        | -44.46      | -26         | Pass    | 601         |
| 2509.5                | 6000                 | 1         | Peak     | 4803.829        | -42.96      | -26         | Pass    | 3491        |
| 6000                  | 12500                | 1         | Peak     | 11840           | -40.85      | -26         | Pass    | 6501        |

## A.4.11 GFSK (BLE 1Mbps) NV Middle Channel



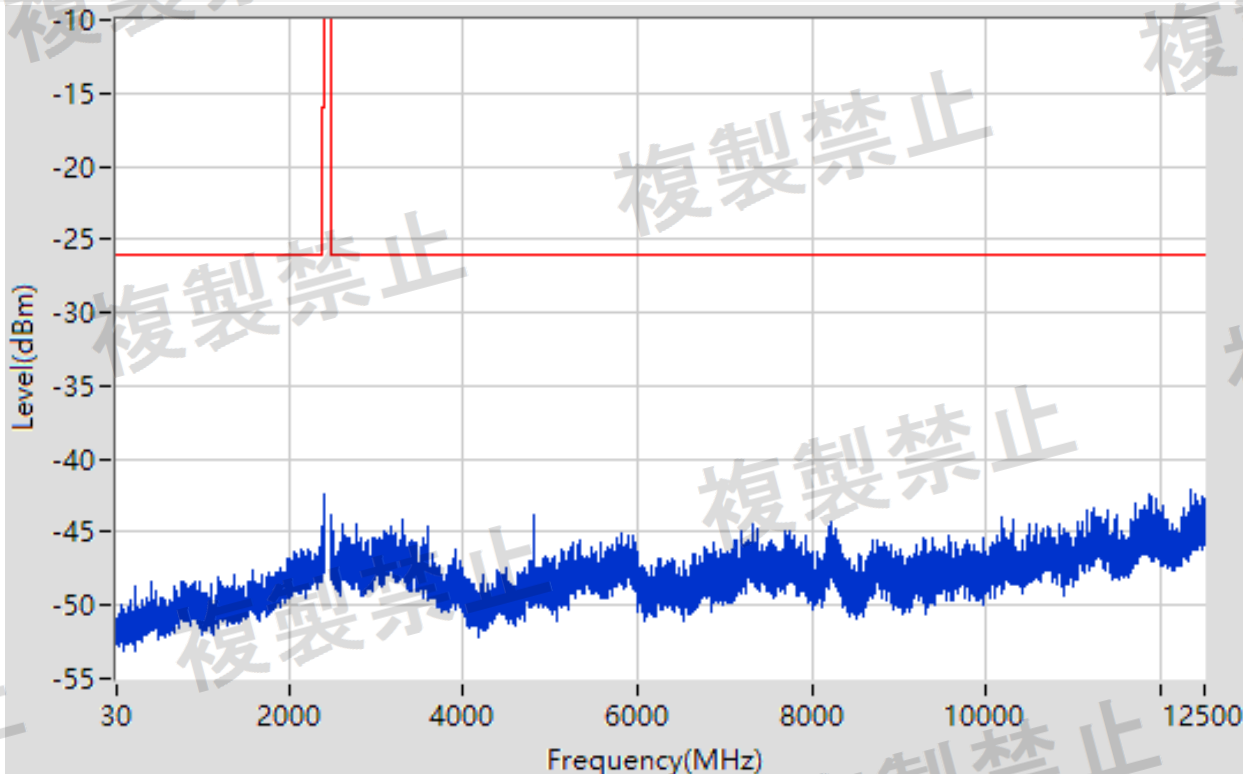
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 1         | Peak     | 740             | -48.05      | -26         | Pass    | 971         |
| 1000                  | 2374                 | 1         | Peak     | 2291            | -45.66      | -26         | Pass    | 1375        |
| 2374                  | 2387                 | 1         | Peak     | 2380.955        | -45.04      | -26         | Pass    | 601         |
| 2387                  | 2400                 | 1         | Peak     | 2389.188        | -44.77      | -16         | Pass    | 601         |
| 2483.5                | 2496.5               | 1         | Peak     | 2496.435        | -44.16      | -16         | Pass    | 601         |
| 2496.5                | 2509.5               | 1         | Peak     | 2499.317        | -44.58      | -26         | Pass    | 601         |
| 2509.5                | 6000                 | 1         | Peak     | 4880.84         | -43.5       | -26         | Pass    | 3491        |
| 6000                  | 12500                | 1         | Peak     | 11881           | -42.58      | -26         | Pass    | 6501        |

## A.4.12 GFSK (BLE 1Mbps) NV High Channel



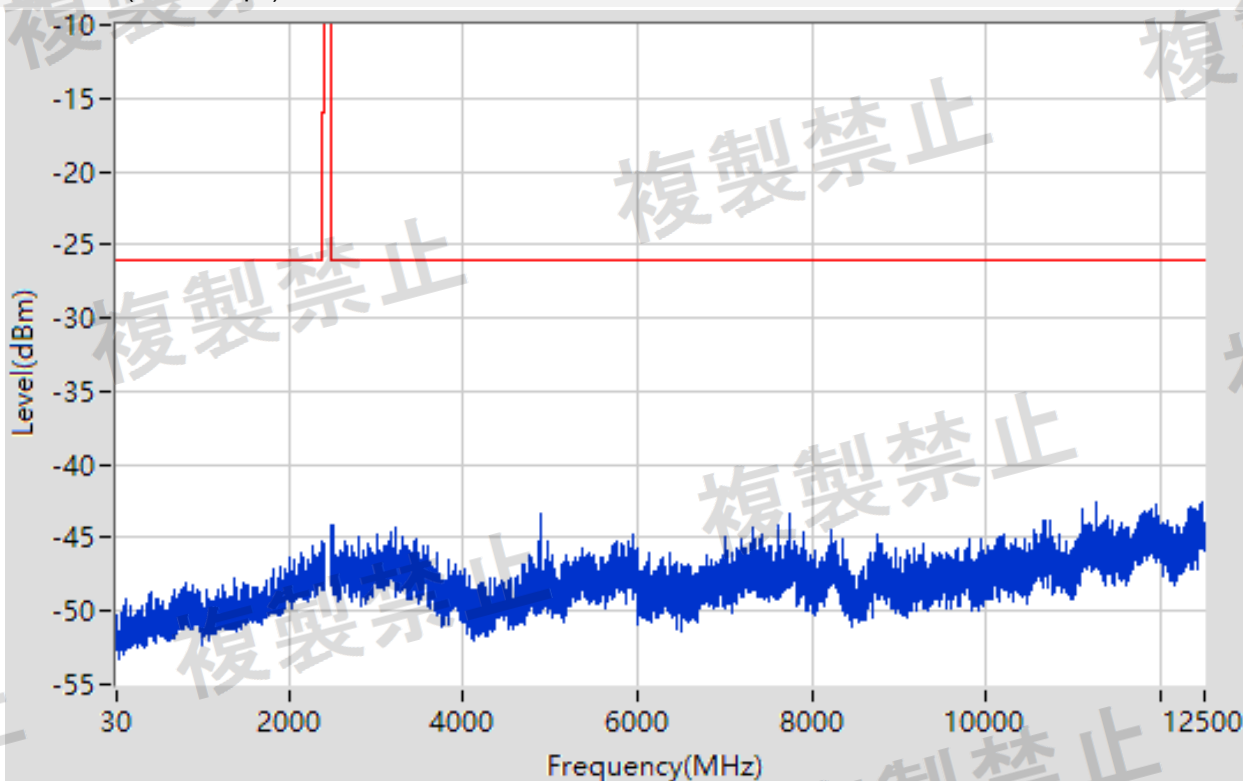
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 1         | Peak     | 945             | -47.8       | -26         | Pass    | 971         |
| 1000                  | 2374                 | 1         | Peak     | 2285            | -44.89      | -26         | Pass    | 1375        |
| 2374                  | 2387                 | 1         | Peak     | 2384.725        | -44.74      | -26         | Pass    | 601         |
| 2387                  | 2400                 | 1         | Peak     | 2392.178        | -44.31      | -16         | Pass    | 601         |
| 2483.5                | 2496.5               | 1         | Peak     | 2484.215        | -43.23      | -16         | Pass    | 601         |
| 2496.5                | 2509.5               | 1         | Peak     | 2504.105        | -44.18      | -26         | Pass    | 601         |
| 2509.5                | 6000                 | 1         | Peak     | 3199.599        | -44.54      | -26         | Pass    | 3491        |
| 6000                  | 12500                | 1         | Peak     | 11258           | -42.03      | -26         | Pass    | 6501        |

## A.4.13 GFSK (BLE 2Mbps) NV Low Channel



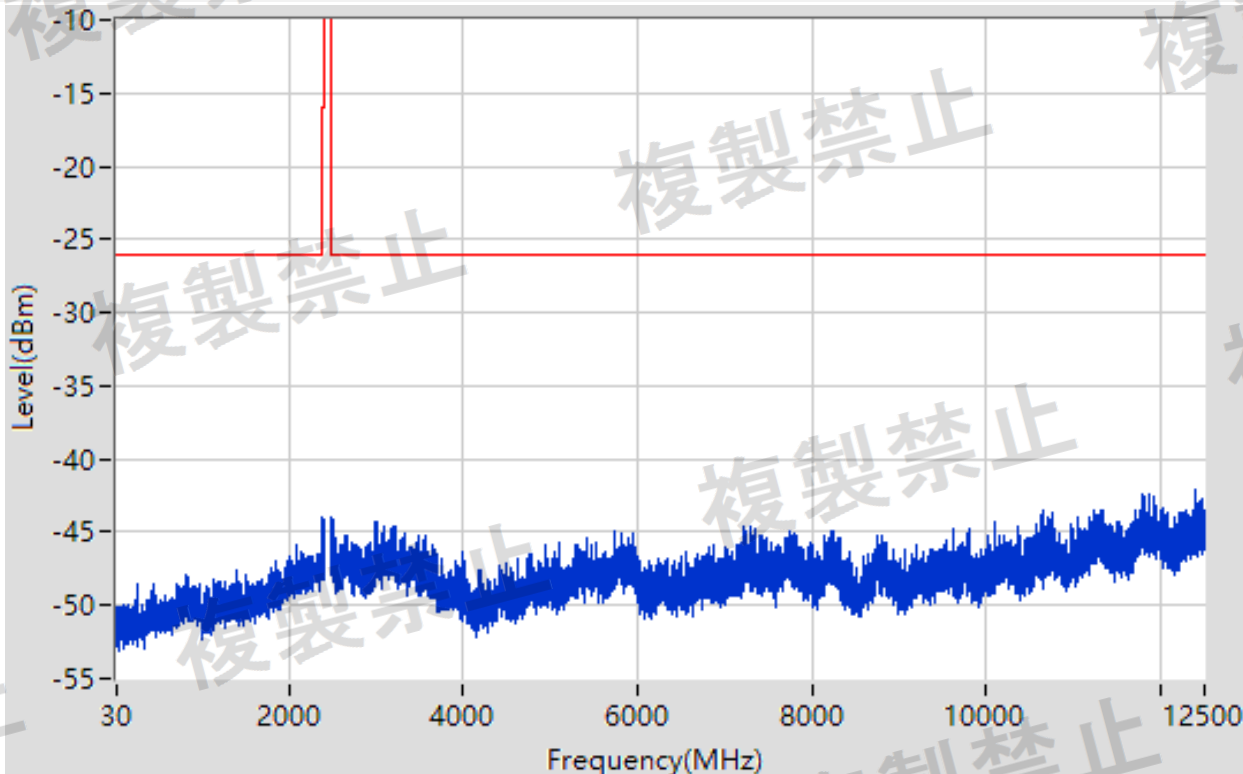
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 1         | Peak     | 927             | -48.36      | -26         | Pass    | 971         |
| 1000                  | 2374                 | 1         | Peak     | 2365            | -46.04      | -26         | Pass    | 1375        |
| 2374                  | 2387                 | 1         | Peak     | 2386.87         | -44.84      | -26         | Pass    | 601         |
| 2387                  | 2400                 | 1         | Peak     | 2399.957        | -42.44      | -16         | Pass    | 601         |
| 2483.5                | 2496.5               | 1         | Peak     | 2495.937        | -43.76      | -16         | Pass    | 601         |
| 2496.5                | 2509.5               | 1         | Peak     | 2499.057        | -44.93      | -26         | Pass    | 601         |
| 2509.5                | 6000                 | 1         | Peak     | 4807.829        | -43.79      | -26         | Pass    | 3491        |
| 6000                  | 12500                | 1         | Peak     | 12334           | -42.04      | -26         | Pass    | 6501        |

## A.4.14 GFSK (BLE 2Mbps) NV Middle Channel



| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 1         | Peak     | 827             | -48.05      | -26         | Pass    | 971         |
| 1000                  | 2374                 | 1         | Peak     | 2285            | -45.62      | -26         | Pass    | 1375        |
| 2374                  | 2387                 | 1         | Peak     | 2384.617        | -45.25      | -26         | Pass    | 601         |
| 2387                  | 2400                 | 1         | Peak     | 2399.913        | -45.37      | -16         | Pass    | 601         |
| 2483.5                | 2496.5               | 1         | Peak     | 2495.98         | -44.07      | -16         | Pass    | 601         |
| 2496.5                | 2509.5               | 1         | Peak     | 2507.615        | -44.18      | -26         | Pass    | 601         |
| 2509.5                | 6000                 | 1         | Peak     | 4878.839        | -43.42      | -26         | Pass    | 3491        |
| 6000                  | 12500                | 1         | Peak     | 11259           | -42.5       | -26         | Pass    | 6501        |

## A.4.15 GFSK (BLE 2Mbps) NV High Channel



| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 1         | Peak     | 827             | -47.95      | -26         | Pass    | 971         |
| 1000                  | 2374                 | 1         | Peak     | 2089            | -45.9       | -26         | Pass    | 1375        |
| 2374                  | 2387                 | 1         | Peak     | 2383.468        | -44.26      | -26         | Pass    | 601         |
| 2387                  | 2400                 | 1         | Peak     | 2387.173        | -44.03      | -16         | Pass    | 601         |
| 2483.5                | 2496.5               | 1         | Peak     | 2495.958        | -43.92      | -16         | Pass    | 601         |
| 2496.5                | 2509.5               | 1         | Peak     | 2502.09         | -44.12      | -26         | Pass    | 601         |
| 2509.5                | 6000                 | 1         | Peak     | 2987.568        | -44.28      | -26         | Pass    | 3491        |
| 6000                  | 12500                | 1         | Peak     | 12395           | -42.13      | -26         | Pass    | 6501        |

## 5.5 Antenna Power Error Measurement

### 5.5.1 Limit

| Item                  | Limits                                                                                                                                                                                                                                                                                                          |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Antenna Power Density | a) FH, FH+DS, or FH+OFDM form 2427 - 2470.75 MHz: $\leq 3$ mW/MHz<br>b) DS but other than a) from 2400~2483.5 MHz: $\leq 10$ mW/MHz<br>c) OFDM, but other than a): For OCB of 26MHz or less: $\leq 10$ mW/MHz<br>For OCB of over 26 MHz to 40 MHz: $\leq 5$ mw/MHz<br>d) Other than a), b) and c): $\leq 10$ mW |
| Antenna Power Error   | +20%, -80% (Base on manufacturer declare antenna power density)                                                                                                                                                                                                                                                 |

### 5.5.2 Test Setup

See section 4.3.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

### 5.5.3 Test Procedure

- Setting of SA is following as: RB:1 MHz / VB: 3 MHz / SPAN: About twice the occupied frequency bandwidth / AT: 10 dB Ref: 10 dBm / Sweep time: Minimum time for guaranteed measurement accuracy/Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold/Trigger condition: Free run.
- Setting of SA is following as: RB:1 MHz / VB: 1 MHz / SPAN: 0 Hz/ AT: 10 dB Ref: 10 dBm / Sweep Mode: Continuous sweep
- Those using frequency hopping method (including DSSS or composite method with OFDM):
  - Confirming in the submitted document that the frequency hopping intervals in the frequency distribution of frequency hopping are equal intervals of 1 MHz or less, and that the probability of occurrence at each hopping frequency is uniform, and that the probability of occurrence at each hopping frequency is uniform. If it is, it is implemented by the following method.
    - Connect a high frequency power meter to the output of the dummy load (attenuator) and measure the total power.
    - Divide the total power by the spreading bandwidth to calculate the average power per 1 MHz.
    - Antenna power shall be as follows:
      - Value of b for continuous wave
      - For burst wave Average power in burst is calculated from the value of b and the transmission time rate.
  - If the frequency distribution of frequency hopping or the probability of occurrence at each hopping frequency is not uniform, set the spectrum analyzer as in 1 to search for the frequency that gives the maximum antenna power, and then perform spectrum analysis. Set the device as in 2, and measure the antenna power at the frequency that gives the maximum power.

#### 4 In the case of those using OFDM or DSSS

- (1) Set the spectrum analyzer as in according to the above 1
- (2) After repeating the sweep until no change is observed in the display, measure the frequency at which the power per 1 MHz gives the maximum value.
- (3) Set the spectrum analyzer as in according to the above 2
- (4) Connect the high frequency power meter to the IF output terminal of the spectrum analyzer.
- (5) Antenna power shall be as follows:
  - a. For continuous wave
  - b. Burst wave Calculated average power in a burst from values corrected in the same way as for continuous waves and the transmission time rate

(6) In the case of using the orthogonal frequency division multiplexing system, when there are multiple subcarrier modulation systems, measure the antenna power at each time and take the largest value as the measured value.

#### 5 In the case of items using other methods

- (1) Connect a high-frequency power meter to the output of the dummy load (attenuator) and measure the total power.
- (2) Antenna power shall be as follows:
  - a. Value of a for continuous wave
  - b. Burst wave The average power in the burst is calculated from the value of (a) and the transmission time rate.

6 Antenna Power Error is definition that actual measure antenna power tolerance between +20% to - 80% power range that base on manufacturer declare the conducted power density.

#### 5.5.4 Test Deviation

There is no deviation with the original standard.

#### 5.5.5 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

## 5.5.6 Test Result

GFSK Test Result

Duty cycle = 1.000

Antenna Power=power value (dBm)+10\*LOG10(1/Duty Cycle)) dBm+Cable Loss dBm

Antenna Power Density PD = Antenna Power mW / Spread Spectrum Bandwidth MHz

Manufacturer declares the rated power density = 0.0700 mW/MHz

| Test Mode | Test Voltage | power value (dBm) | Antenna Power (dBm) | Antenna Power (mW) | Antenna Power Density PD (mW / MHz) | Antenna Power Error | Upper Limit (%) | Lower Limit (%) | Verdict |
|-----------|--------------|-------------------|---------------------|--------------------|-------------------------------------|---------------------|-----------------|-----------------|---------|
| GFSK      | NV           | 6.89              | 6.89                | 4.8865             | 0.0689                              | -1.58%              | 20              | -80             | Pass    |

## EIRP Antenna Power

| Test Mode | Test Voltage | Measured EIRP (dBm/ MHz) | Limit (dBm/MHz) | Verdict |
|-----------|--------------|--------------------------|-----------------|---------|
| GFSK      | NV           | -10.08                   | 6.91            | Pass    |

 $\pi/4$ -DQPSK Test Result

Duty cycle = 1.000

Antenna Power=power value (dBm)+10\*LOG10(1/Duty Cycle)) dBm+Cable Loss dBm

Antenna Power Density PD = Antenna Power mW / Spread Spectrum Bandwidth MHz

Manufacturer declares the rated power density = 0.0500 mW/MHz

| Test Mode      | Test Voltage | power value (dBm) | Antenna Power (dBm) | Antenna Power (mW) | Antenna Power Density PD (mW / MHz) | Antenna Power Error | Upper Limit (%) | Lower Limit (%) | Verdict |
|----------------|--------------|-------------------|---------------------|--------------------|-------------------------------------|---------------------|-----------------|-----------------|---------|
| $\pi/4$ -DQPSK | NV           | 5.23              | 5.23                | 3.3343             | 0.0468                              | -6.35%              | 20              | -80             | Pass    |

## EIRP Antenna Power

| Test Mode      | Test Voltage | Measured EIRP (dBm/ MHz) | Limit (dBm/MHz) | Verdict |
|----------------|--------------|--------------------------|-----------------|---------|
| $\pi/4$ -DQPSK | NV           | -11.76                   | 6.91            | Pass    |

8-DPSK Test Result

Duty cycle = 1.000

Antenna Power=power value (dBm)+10\*LOG10(1/Duty Cycle)) dBm+Cable Loss dBm

Antenna Power Density PD = Antenna Power mW / Spread Spectrum Bandwidth MHz

Manufacturer declares the rated power density = 0.0500 mW/MHz

| Test Mode | Test Voltage | power value (dBm) | Antenna Power (dBm) | Antenna Power (mW) | Antenna Power Density PD (mW / MHz) | Antenna Power Error | Upper Limit (%) | Lower Limit (%) | Verdict |
|-----------|--------------|-------------------|---------------------|--------------------|-------------------------------------|---------------------|-----------------|-----------------|---------|
| 8-DPSK    | NV           | 5.19              | 5.19                | 3.3037             | 0.0466                              | -6.78%              | 20              | -80             | Pass    |

## EIRP Antenna Power

| Test Mode | Test Voltage | Measured EIRP (dBm/ MHz) | Limit (dBm/MHz) | Verdict |
|-----------|--------------|--------------------------|-----------------|---------|
| 8-DPSK    | NV           | -11.78                   | 6.91            | Pass    |

GFSK (AFH Mode) Test Result

Duty cycle = 1.000

Antenna Power=power value (dBm)+10\*LOG10(1/Duty Cycle)) dBm+Cable Loss dBm

Antenna Power Density PD = Antenna Power mW / Spread Spectrum Bandwidth MHz

Manufacturer declares the rated power density = 0.3000 mW/MHz

| Test Mode | Test Voltage | power value (dBm) | Antenna Power (dBm) | Antenna Power (mW) | Antenna Power Density PD (mW / MHz) | Antenna Power Error | Upper Limit (%) | Lower Limit (%) | Verdict |
|-----------|--------------|-------------------|---------------------|--------------------|-------------------------------------|---------------------|-----------------|-----------------|---------|
| GFSK      | NV           | 6.41              | 6.41                | 4.3752             | 0.2367                              | -21.09%             | 20              | -80             | Pass    |

## EIRP Antenna Power

| Test Mode | Test Voltage | Measured EIRP (dBm/ MHz) | Limit (dBm/MHz) | Verdict |
|-----------|--------------|--------------------------|-----------------|---------|
| GFSK      | NV           | -4.72                    | 6.91            | Pass    |

$\pi/4$ -DQPSK (AFH Mode) Test Result

Duty cycle = 1.000

Antenna Power=power value (dBm)+10\*LOG10(1/Duty Cycle)) dBm+Cable Loss dBm

Antenna Power Density PD = Antenna Power mW / Spread Spectrum Bandwidth MHz

Manufacturer declares the rated power density = 0.2000 mW/MHz

| Test Mode      | Test Voltage | power value (dBm) | Antenna Power (dBm) | Antenna Power (mW) | Antenna Power Density PD (mW / MHz) | Antenna Power Error | Upper Limit (%) | Lower Limit (%) | Verdict |
|----------------|--------------|-------------------|---------------------|--------------------|-------------------------------------|---------------------|-----------------|-----------------|---------|
| $\pi/4$ -DQPSK | NV           | 5.10              | 5.10                | 3.2359             | 0.1736                              | -13.19%             | 20              | -80             | Pass    |

## EIRP Antenna Power

| Test Mode      | Test Voltage | Measured EIRP (dBm/ MHz) | Limit (dBm/MHz) | Verdict |
|----------------|--------------|--------------------------|-----------------|---------|
| $\pi/4$ -DQPSK | NV           | -6.06                    | 6.91            | Pass    |

8-DPSK (AFH Mode) Test Result

Duty cycle = 1.000

Antenna Power=power value (dBm)+10\*LOG10(1/Duty Cycle)) dBm+Cable Loss dBm

Antenna Power Density PD = Antenna Power mW / Spread Spectrum Bandwidth MHz

Manufacturer declares the rated power density = 0.2000 mW/MHz

| Test Mode | Test Voltage | power value (dBm) | Antenna Power (dBm) | Antenna Power (mW) | Antenna Power Density PD (mW / MHz) | Antenna Power Error | Upper Limit (%) | Lower Limit (%) | Verdict |
|-----------|--------------|-------------------|---------------------|--------------------|-------------------------------------|---------------------|-----------------|-----------------|---------|
| 8-DPSK    | NV           | 5.06              | 5.06                | 3.2063             | 0.1721                              | -13.94%             | 20              | -80             | Pass    |

## EIRP Antenna Power

| Test Mode | Test Voltage | Measured EIRP (dBm/ MHz) | Limit (dBm/MHz) | Verdict |
|-----------|--------------|--------------------------|-----------------|---------|
| 8-DPSK    | NV           | -6.10                    | 6.91            | Pass    |

GFSK (BLE 1Mbps) Test Result

Duty cycle = 1.000

Manufacturer declares the rated power = 5.0000 mW

| Test Channel | Test Voltage | power value (dBm) | Antenna Power (dBm) | Antenna Power (mW) | Antenna Power Error | Upper Limit (%) | Lower Limit (%) | Verdict |
|--------------|--------------|-------------------|---------------------|--------------------|---------------------|-----------------|-----------------|---------|
| Low          | NV           | 5.61              | 5.61                | 3.6392             | -27.22%             | 20              | -80             | Pass    |
| Middle       |              | 6.45              | 6.45                | 4.4167             | -11.67%             | 20              | -80             | Pass    |
| High         |              | 6.26              | 6.26                | 4.2267             | -15.47%             | 20              | -80             | Pass    |

## EIRP Antenna Power

| Channel | Test Voltage | Frequency (MHz) | Measured EIRP (dBm) | Limit (dBm) | Verdict |
|---------|--------------|-----------------|---------------------|-------------|---------|
| Low     | NV           | 2402            | 7.15                | 12.14       | Pass    |
| Middle  |              | 2440            | 7.99                |             | Pass    |
| High    |              | 2480            | 7.80                |             | Pass    |

GFSK (BLE 2Mbps) Test Result

Duty cycle = 1.000

Manufacturer declares the rated power = 5.0000 mW

| Test Channel | Test Voltage | power value (dBm) | Antenna Power (dBm) | Antenna Power (mW) | Antenna Power Error | Upper Limit (%) | Lower Limit (%) | Verdict |
|--------------|--------------|-------------------|---------------------|--------------------|---------------------|-----------------|-----------------|---------|
| Low          | NV           | 4.71              | 4.71                | 2.9587             | -40.83%             | 20              | -80             | Pass    |
| Middle       |              | 5.67              | 5.67                | 3.6864             | -26.27%             | 20              | -80             | Pass    |
| High         |              | 5.53              | 5.53                | 3.5760             | -28.48%             | 20              | -80             | Pass    |

## EIRP Antenna Power

| Channel | Test Voltage | Frequency (MHz) | Measured EIRP (dBm) | Limit (dBm) | Verdict |
|---------|--------------|-----------------|---------------------|-------------|---------|
| Low     | NV           | 2404            | 6.25                | 12.14       | Pass    |
| Middle  |              | 2440            | 7.21                |             | Pass    |
| High    |              | 2478            | 7.07                |             | Pass    |

## 5.6 Limitation of Collateral Emission of Receiver Measurement

### 5.6.1 Limit

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

### 5.6.2 Test Setup

See section 4.3.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

### 5.6.3 Test Procedure

- 1 The EUT is placed in Rx mode and set to a fixed channel.
- 2 Setting of SA is following as RB / VB: 100 kHz (below 1GHz emissions) / 1 MHz (above 1GHz emissions) / AT:10 dB / Ref: 0dBm / Sweep time: Auto / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold
- 3 SA set RB: 100 kHz and VB: 100 kHz. Then adjust to start frequency 30 MHz and stop frequency 1000 MHz. Search to mark peak reading value + cable loss shall be less than 4 nW
- 4 SA set RB: 1 MHz and VB: 1 MHz. Then adjust to start frequency 1000 MHz and stop frequency 12500 MHz. Search to mark peak reading value + cable loss shall be less than 20 nW
- 5 If power level of lower emissions are more than 1/10 of limit (0.4nW for  $f < 1\text{GHz}$ , 2 nW for  $f \geq 1\text{GHz}$ ), all those are to be indicated in the 2nd and 3rd lines. If others are 1/10 or less more of the limit, no necessary to be indicated

### 5.6.4 Test Deviation

There is no deviation with the original standard.

### 5.6.5 EUT Operation during Test

The EUT was programmed to be in continuously receiving mode.

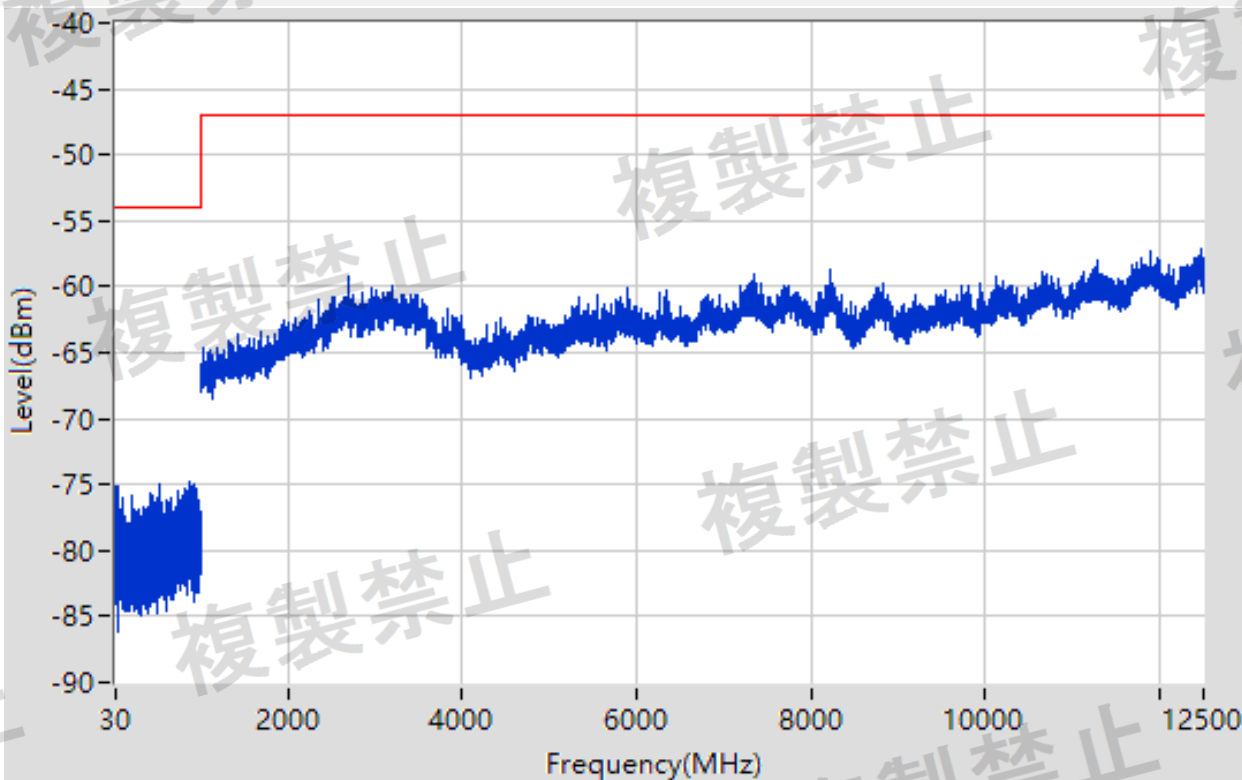
## 5.6.6 Test Result

## Test Data

| Mode                | Channel | Test Voltage | Refer to Plot | Verdict |
|---------------------|---------|--------------|---------------|---------|
| GFSK                | Low     | NV           | A.6.1         | Pass    |
|                     | Middle  |              | A.6.2         | Pass    |
|                     | High    |              | A.6.3         | Pass    |
| $\pi/4$ -DQPSK      | Low     | NV           | A.6.4         | Pass    |
|                     | Middle  |              | A.6.5         | Pass    |
|                     | High    |              | A.6.6         | Pass    |
| 8-DPSK              | Low     | NV           | A.6.7         | Pass    |
|                     | Middle  |              | A.6.8         | Pass    |
|                     | High    |              | A.6.9         | Pass    |
| GFSK<br>(BLE 1Mbps) | Low     | NV           | A.6.10        | Pass    |
|                     | Middle  |              | A.6.11        | Pass    |
|                     | High    |              | A.6.12        | Pass    |
| GFSK<br>(BLE 2Mbps) | Low     | NV           | A.6.13        | Pass    |
|                     | Middle  |              | A.6.14        | Pass    |
|                     | High    |              | A.6.15        | Pass    |

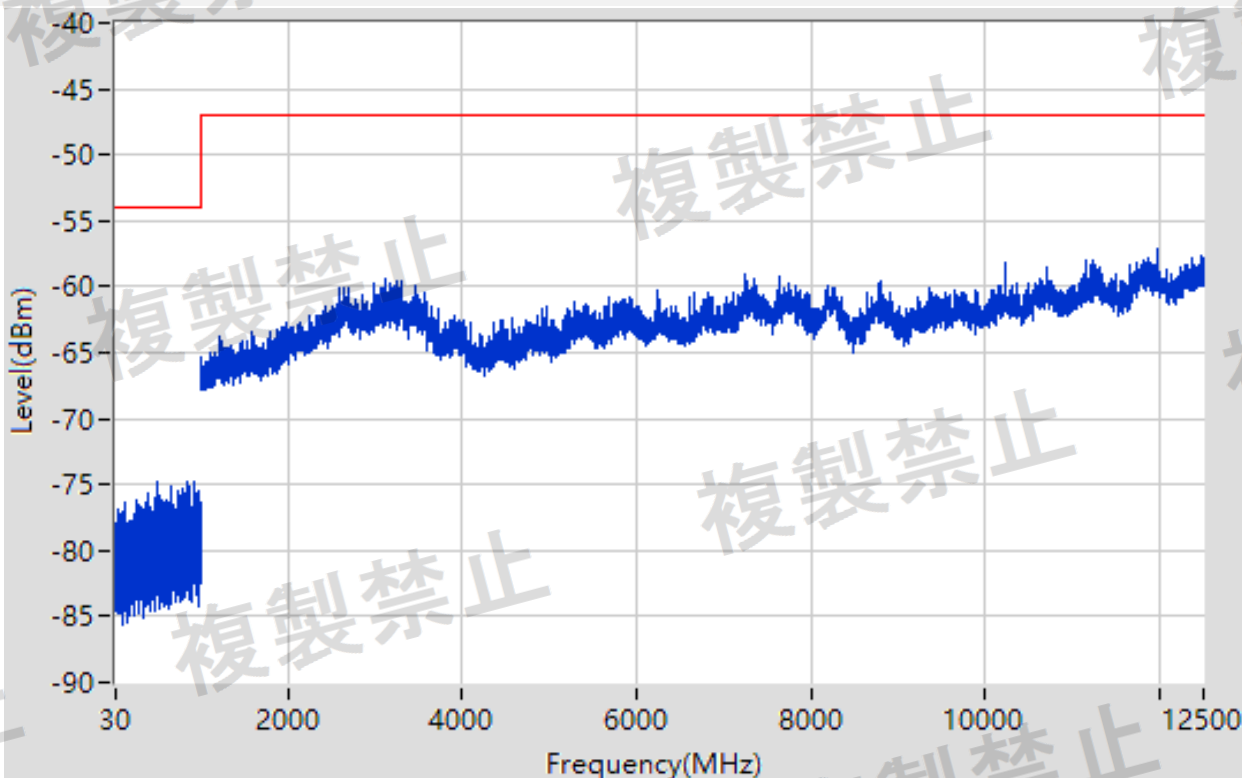
## Test Plots

## A.6.1 GFSK NV Low Channel



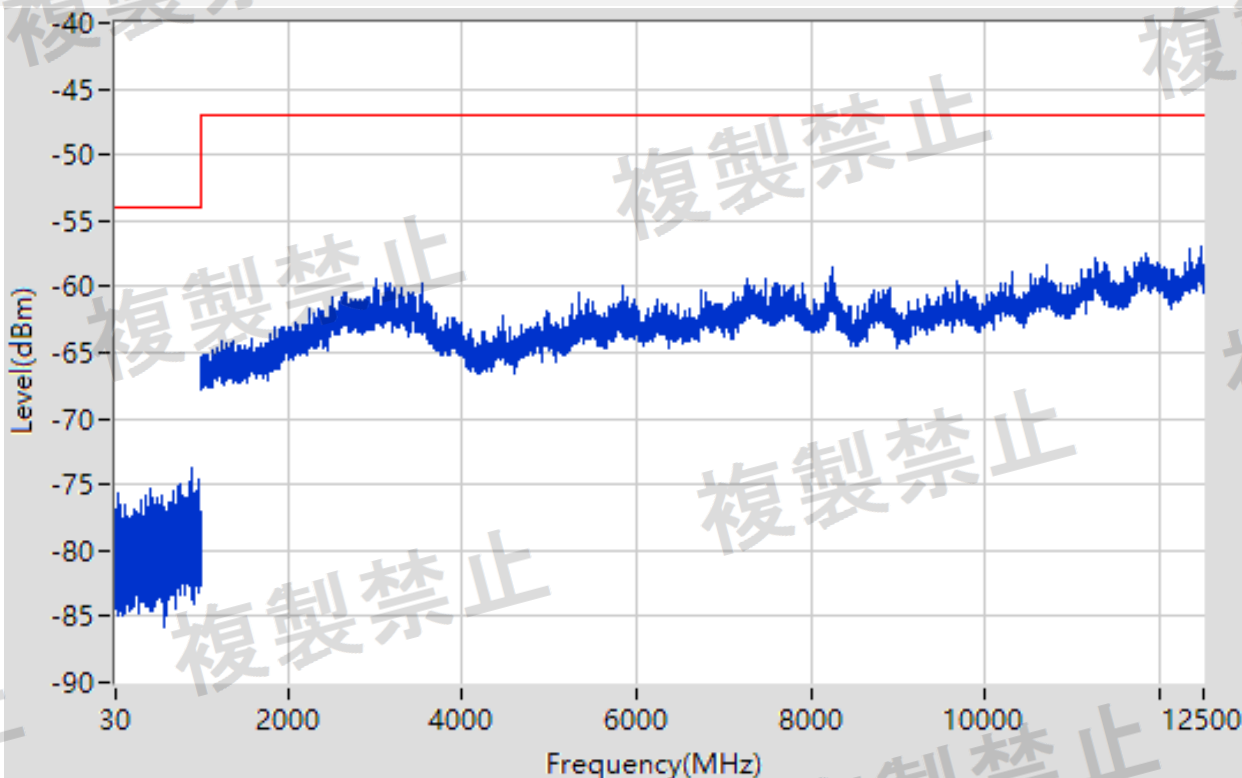
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 0.1       | Peak     | 880.69          | -74.77      | -54         | Pass    | 8001        |
| 1000                  | 6000                 | 1         | Peak     | 2705            | -59.2       | -47         | Pass    | 4001        |
| 6000                  | 12500                | 1         | Peak     | 12477.25        | -57.06      | -47         | Pass    | 4001        |

## A.6.2 GFSK NV Middle Channel

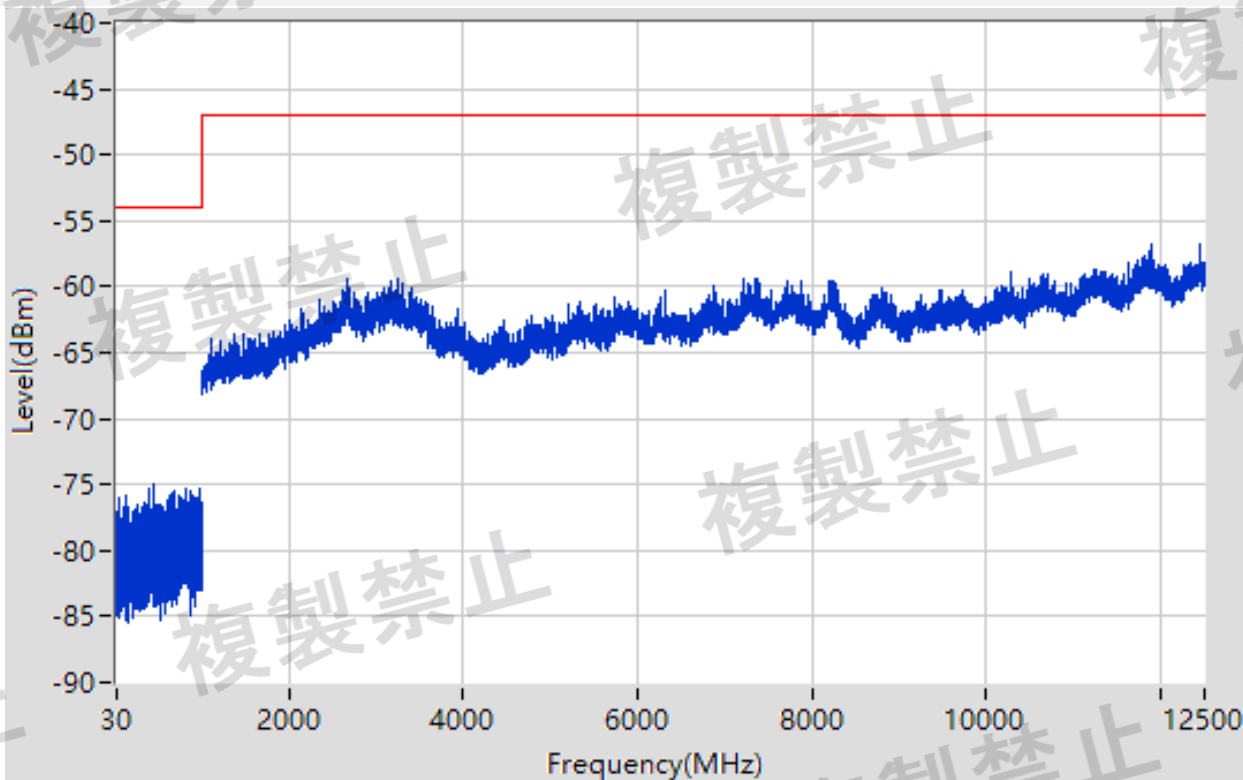


| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 0.1       | Peak     | 501.056         | -74.74      | -54         | Pass    | 8001        |
| 1000                  | 6000                 | 1         | Peak     | 3125            | -59.45      | -47         | Pass    | 4001        |
| 6000                  | 12500                | 1         | Peak     | 11967           | -57.18      | -47         | Pass    | 4001        |

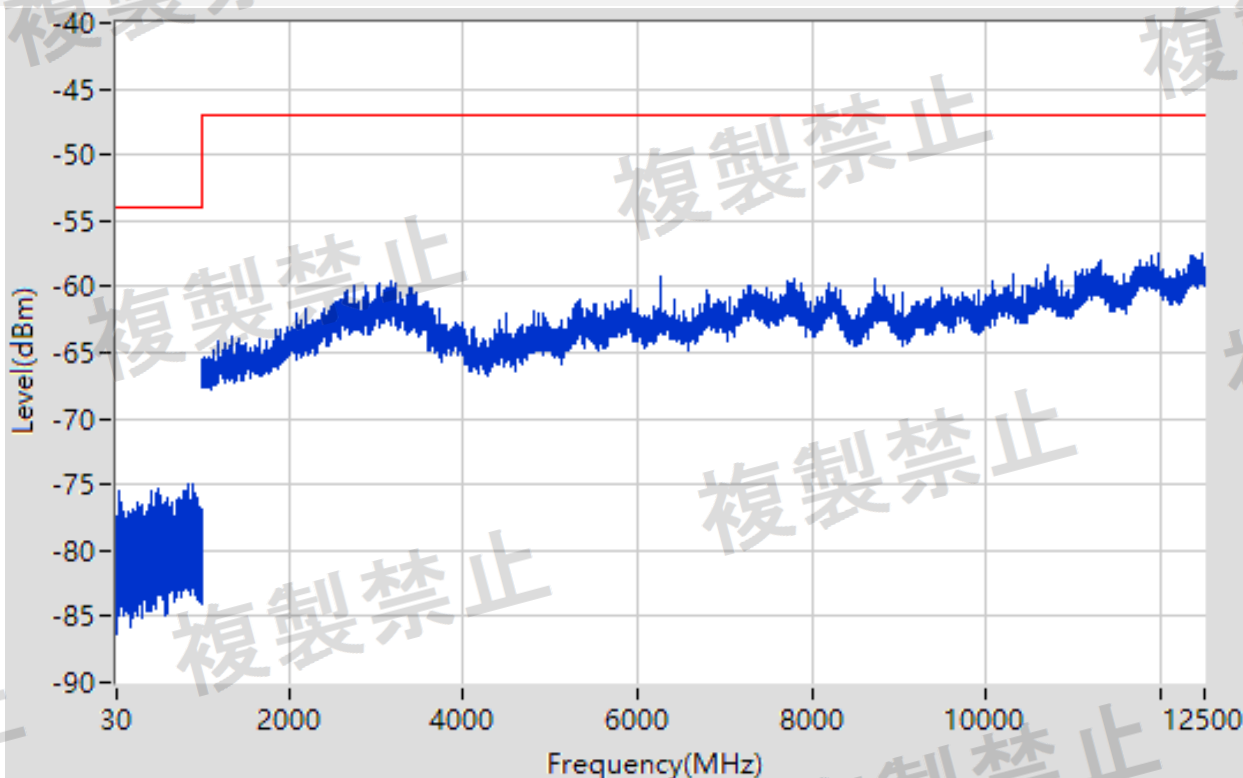
## A.6.3 GFSK NV High Channel



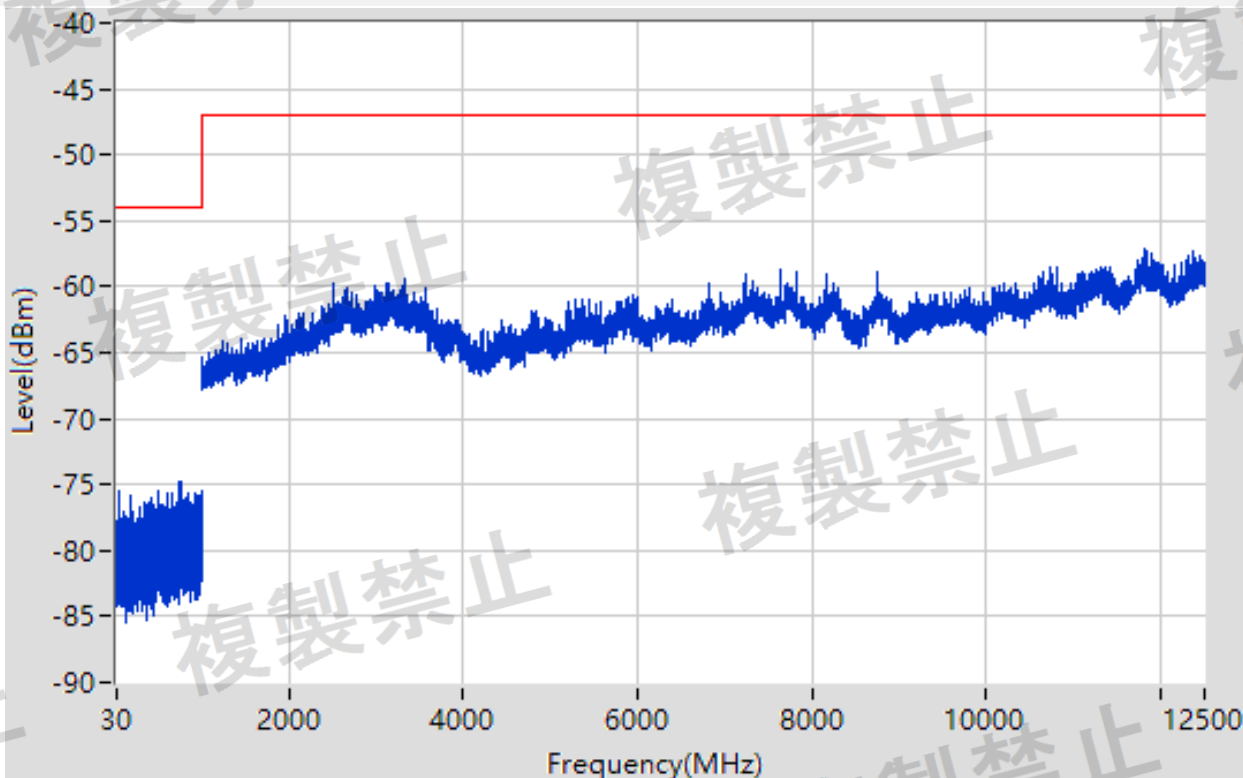
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 0.1       | Peak     | 902.273         | -73.73      | -54         | Pass    | 8001        |
| 1000                  | 6000                 | 1         | Peak     | 3026.25         | -59.49      | -47         | Pass    | 4001        |
| 6000                  | 12500                | 1         | Peak     | 12464.25        | -56.97      | -47         | Pass    | 4001        |

A.6.4  $\pi/4$ -DQPSK NV Low Channel

| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 0.1       | Peak     | 460.801         | -74.91      | -54         | Pass    | 8001        |
| 1000                  | 6000                 | 1         | Peak     | 2671.25         | -59.33      | -47         | Pass    | 4001        |
| 6000                  | 12500                | 1         | Peak     | 12439.875       | -56.7       | -47         | Pass    | 4001        |

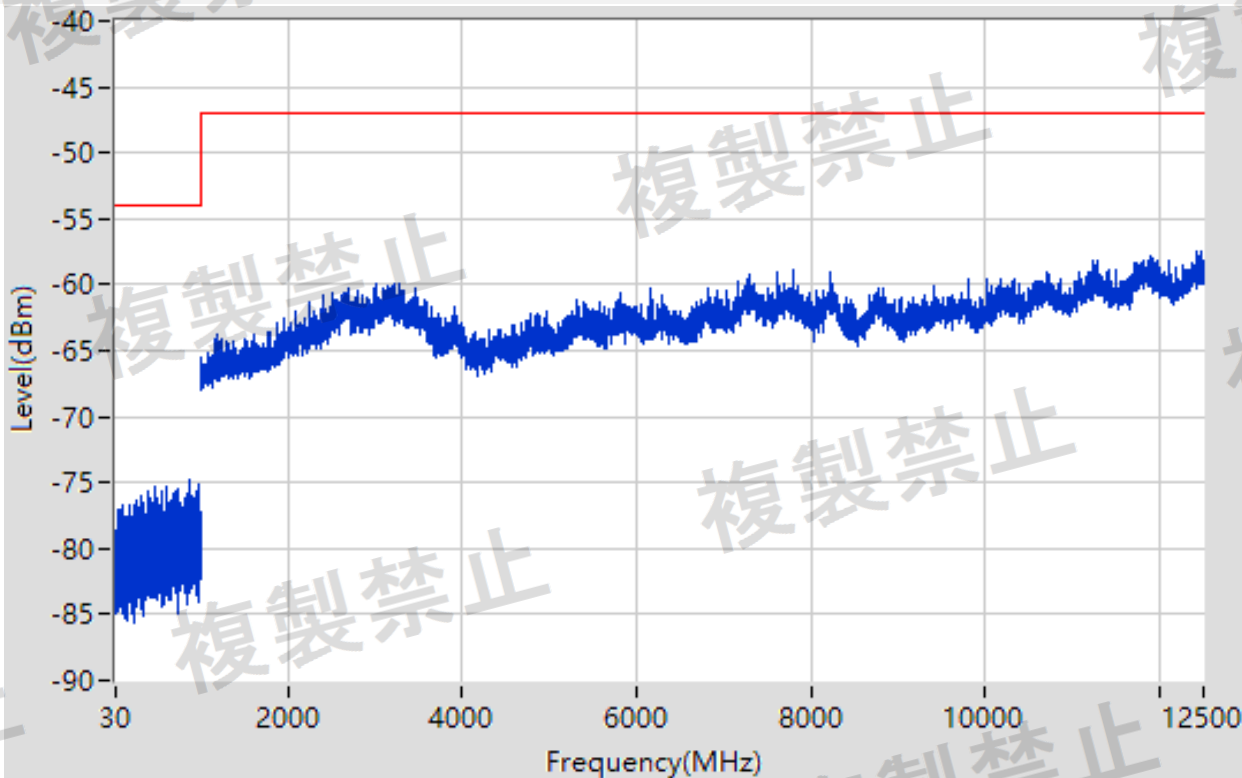
A.6.5  $\pi/4$ -DQPSK NV Middle Channel

| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 0.1       | Peak     | 838.01          | -74.99      | -54         | Pass    | 8001        |
| 1000                  | 6000                 | 1         | Peak     | 3183.75         | -59.65      | -47         | Pass    | 4001        |
| 6000                  | 12500                | 1         | Peak     | 12480.5         | -57.56      | -47         | Pass    | 4001        |

A.6.6  $\pi/4$ -DQPSK NV High Channel

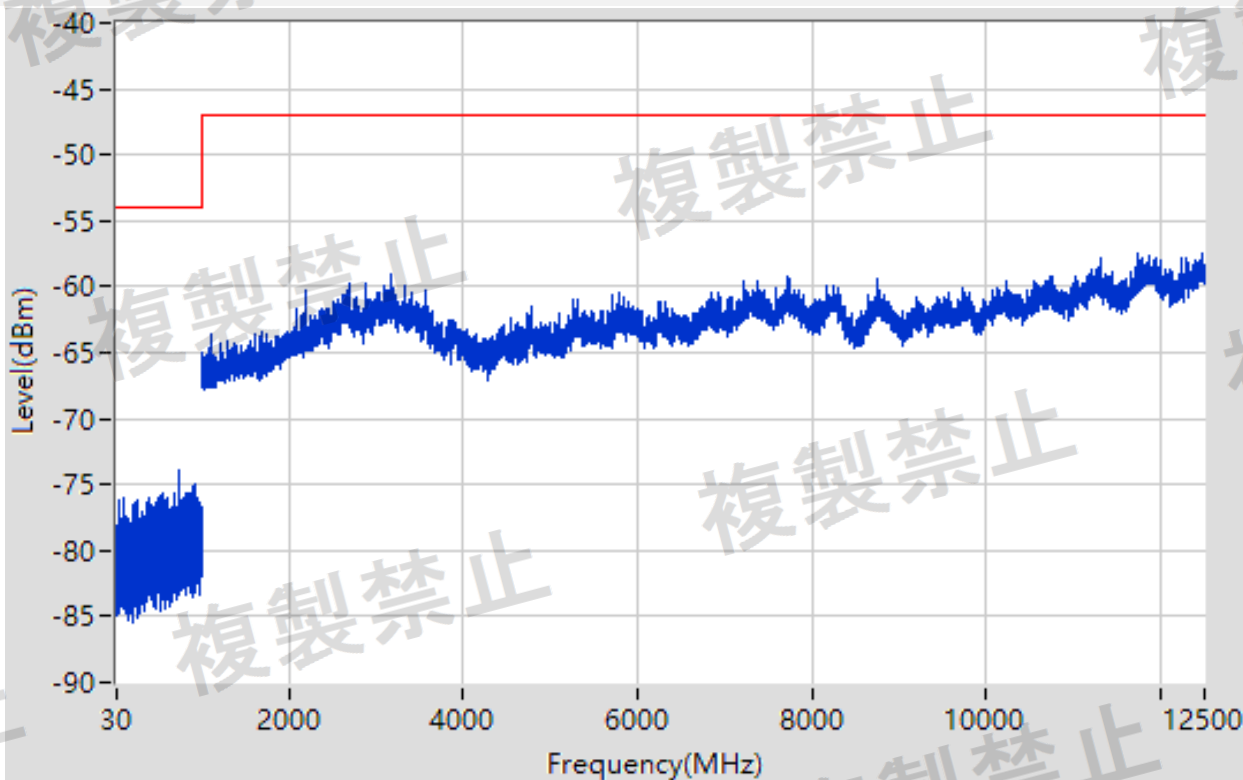
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 0.1       | Peak     | 735.675         | -74.71      | -54         | Pass    | 8001        |
| 1000                  | 6000                 | 1         | Peak     | 3330            | -59.47      | -47         | Pass    | 4001        |
| 6000                  | 12500                | 1         | Peak     | 11806.125       | -57.17      | -47         | Pass    | 4001        |

## A.6.7 8-DPSK NV Low Channel



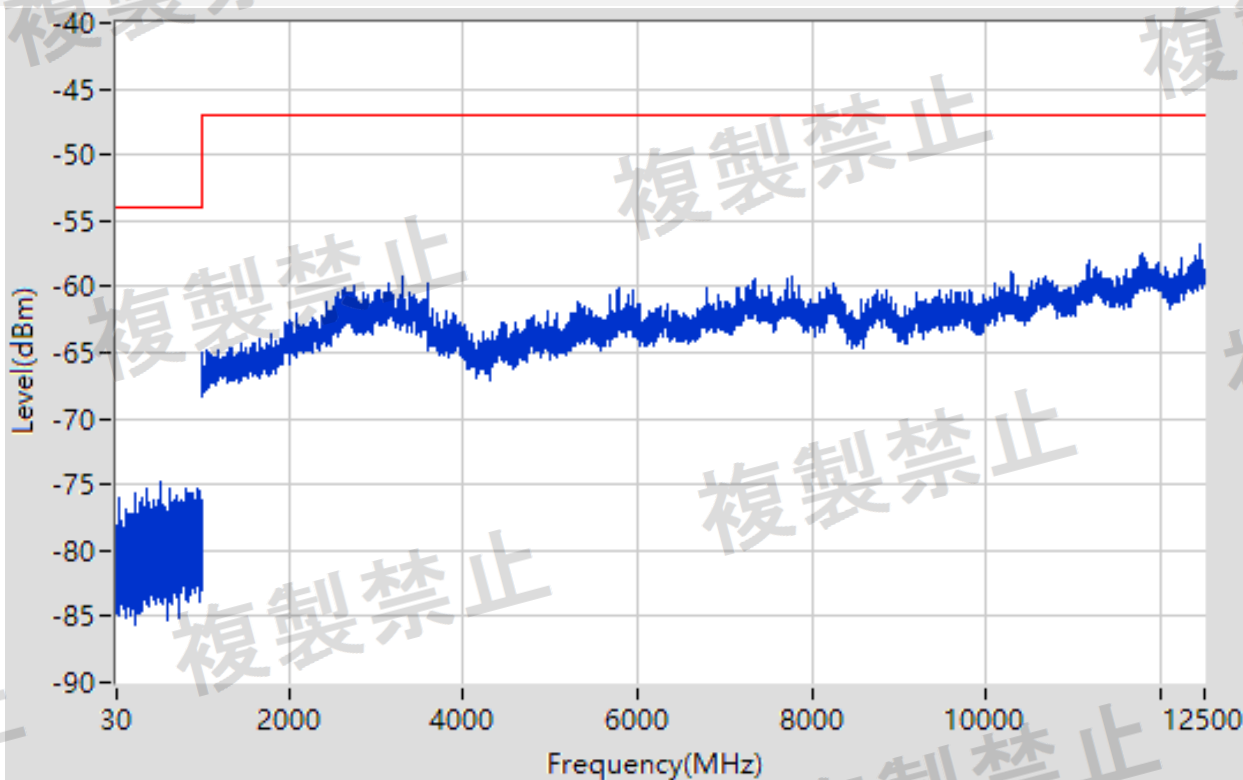
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 0.1       | Peak     | 867.838         | -74.75      | -54         | Pass    | 8001        |
| 1000                  | 6000                 | 1         | Peak     | 3006.25         | -59.92      | -47         | Pass    | 4001        |
| 6000                  | 12500                | 1         | Peak     | 12467.5         | -57.48      | -47         | Pass    | 4001        |

## A.6.8 8-DPSK NV Middle Channel



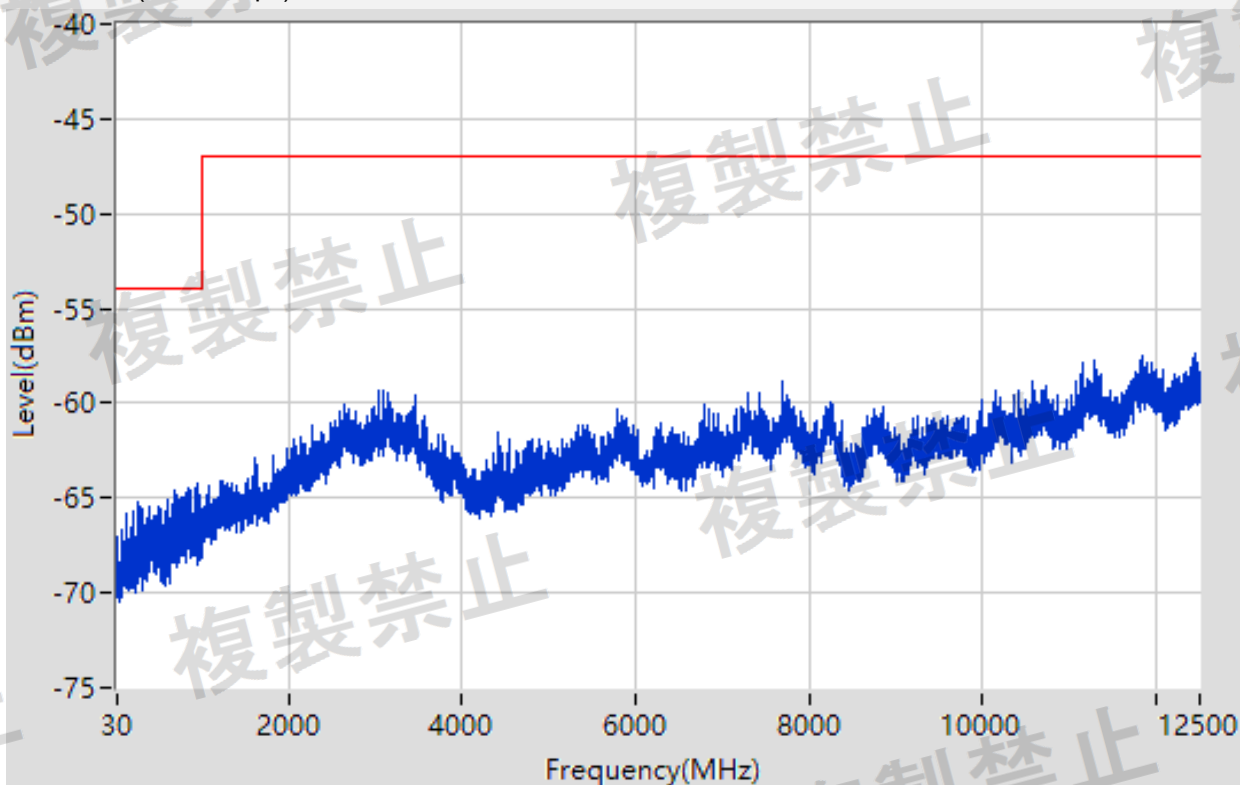
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 0.1       | Peak     | 750.589         | -73.98      | -54         | Pass    | 8001        |
| 1000                  | 6000                 | 1         | Peak     | 3180            | -59.04      | -47         | Pass    | 4001        |
| 6000                  | 12500                | 1         | Peak     | 12464.25        | -57.46      | -47         | Pass    | 4001        |

## A.6.9 8-DPSK NV High Channel



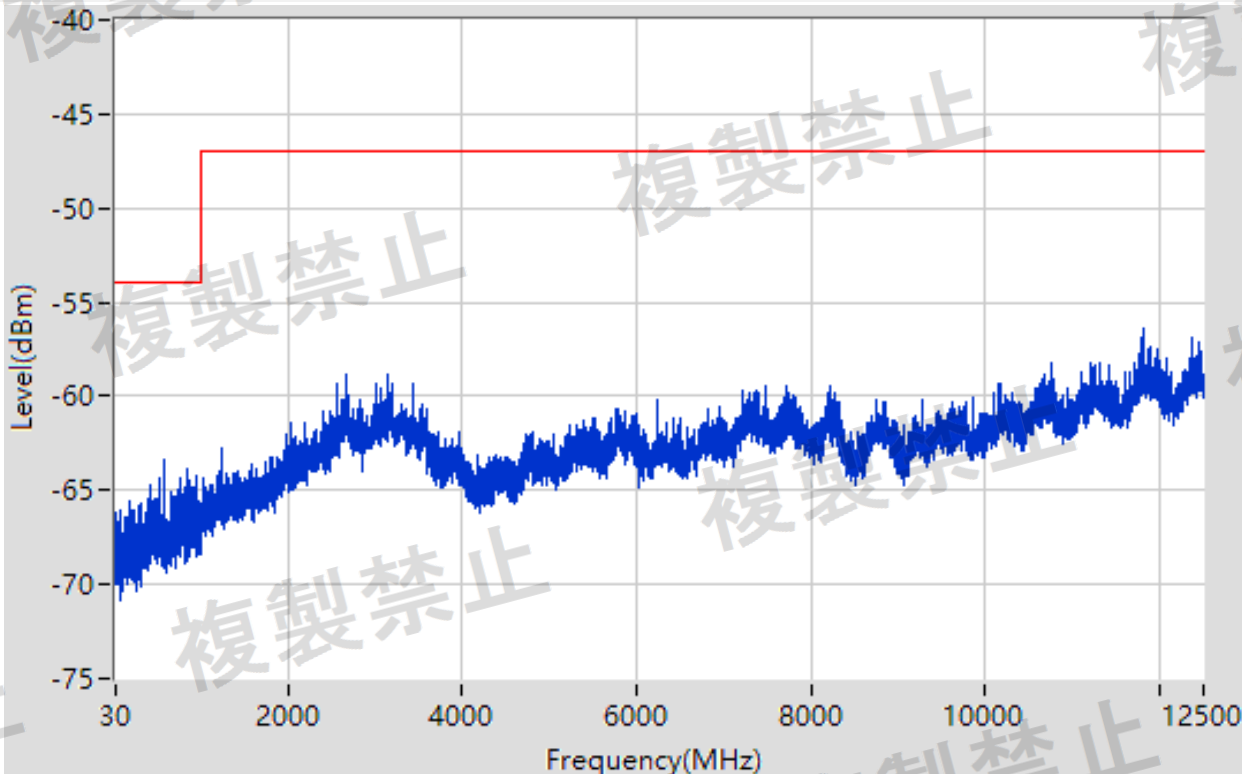
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 0.1       | Peak     | 534.764         | -74.81      | -54         | Pass    | 8001        |
| 1000                  | 6000                 | 1         | Peak     | 3306.25         | -59.15      | -47         | Pass    | 4001        |
| 6000                  | 12500                | 1         | Peak     | 12439.875       | -56.75      | -47         | Pass    | 4001        |

## A.6.10 GFSK (BLE 1Mbps) NV Low Channel



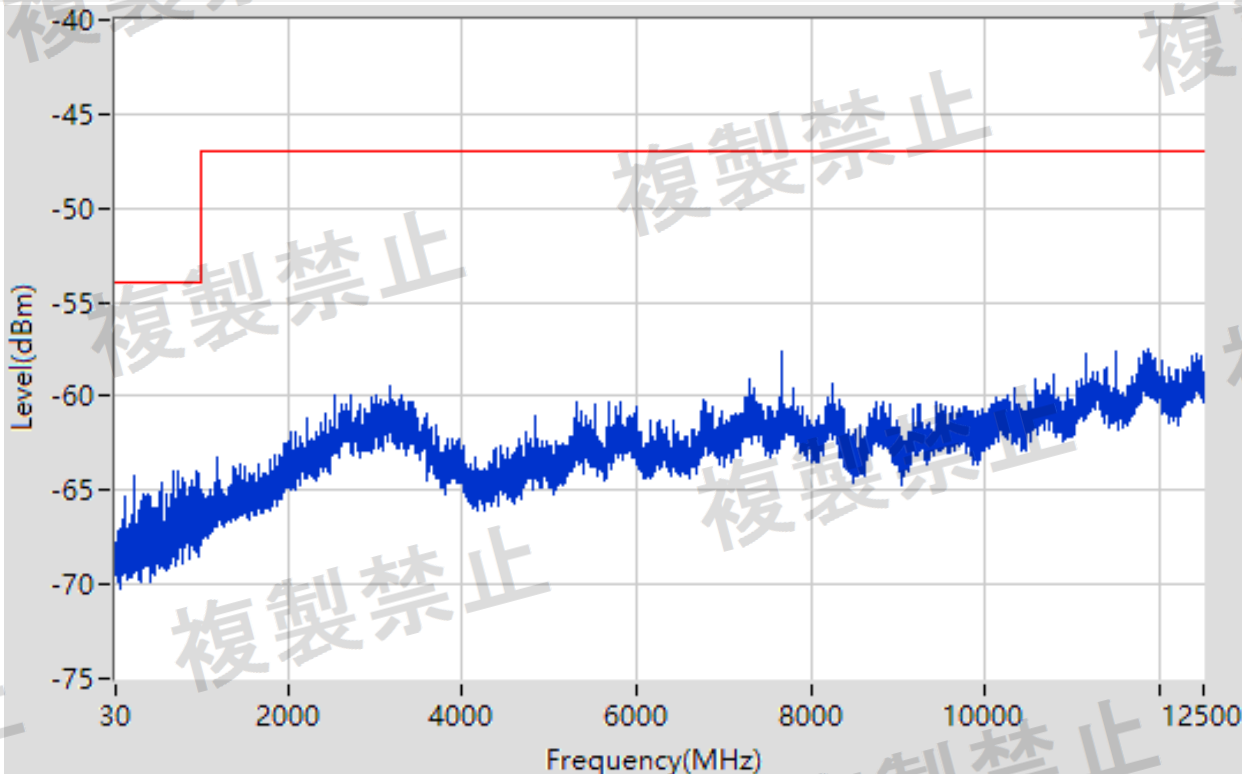
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 0.1       | Peak     | 951.5           | -64.27      | -54         | Pass    | 1001        |
| 1000                  | 6000                 | 1         | Peak     | 3101.25         | -59.31      | -47         | Pass    | 4001        |
| 6000                  | 12500                | 1         | Peak     | 12439.875       | -57.4       | -47         | Pass    | 4001        |

## A.6.11 GFSK (BLE 1Mbps) NV Middle Channel



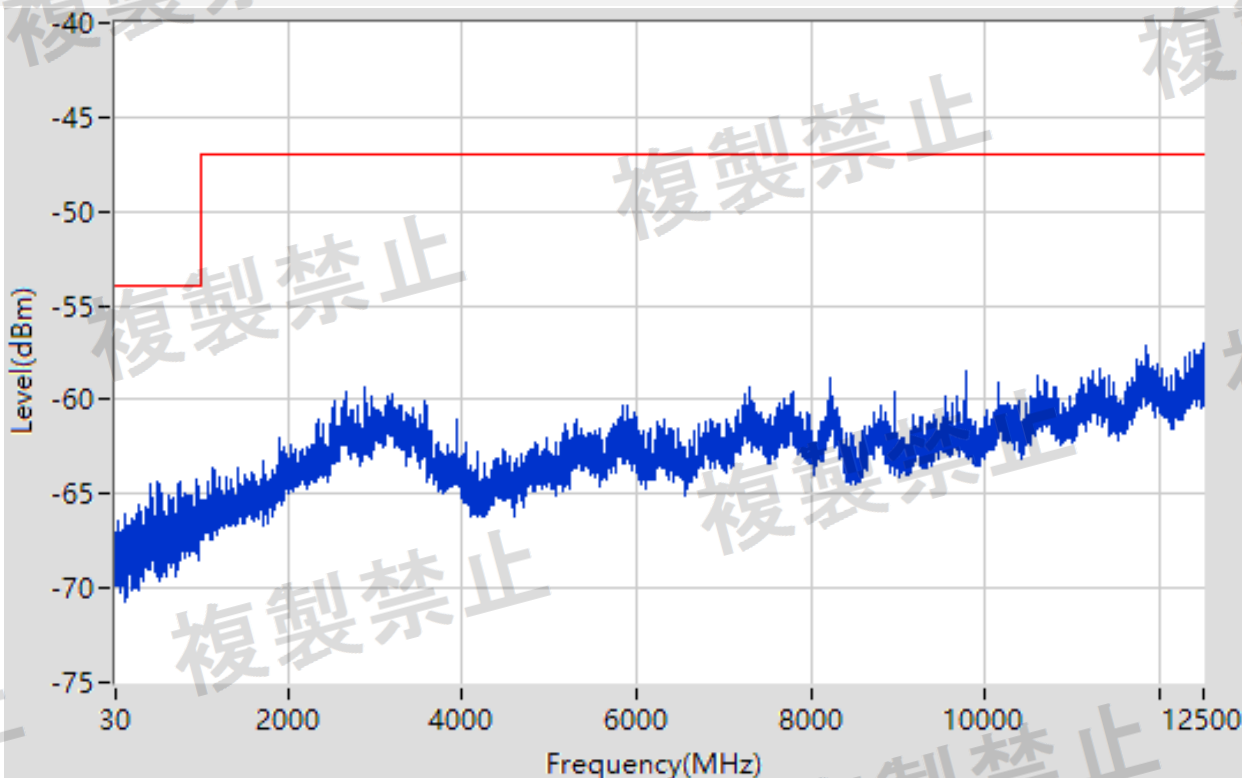
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 0.1       | Peak     | 573.2           | -63.37      | -54         | Pass    | 1001        |
| 1000                  | 6000                 | 1         | Peak     | 3150            | -58.79      | -47         | Pass    | 4001        |
| 6000                  | 12500                | 1         | Peak     | 11817.5         | -56.37      | -47         | Pass    | 4001        |

## A.6.12 GFSK (BLE 1Mbps) NV High Channel



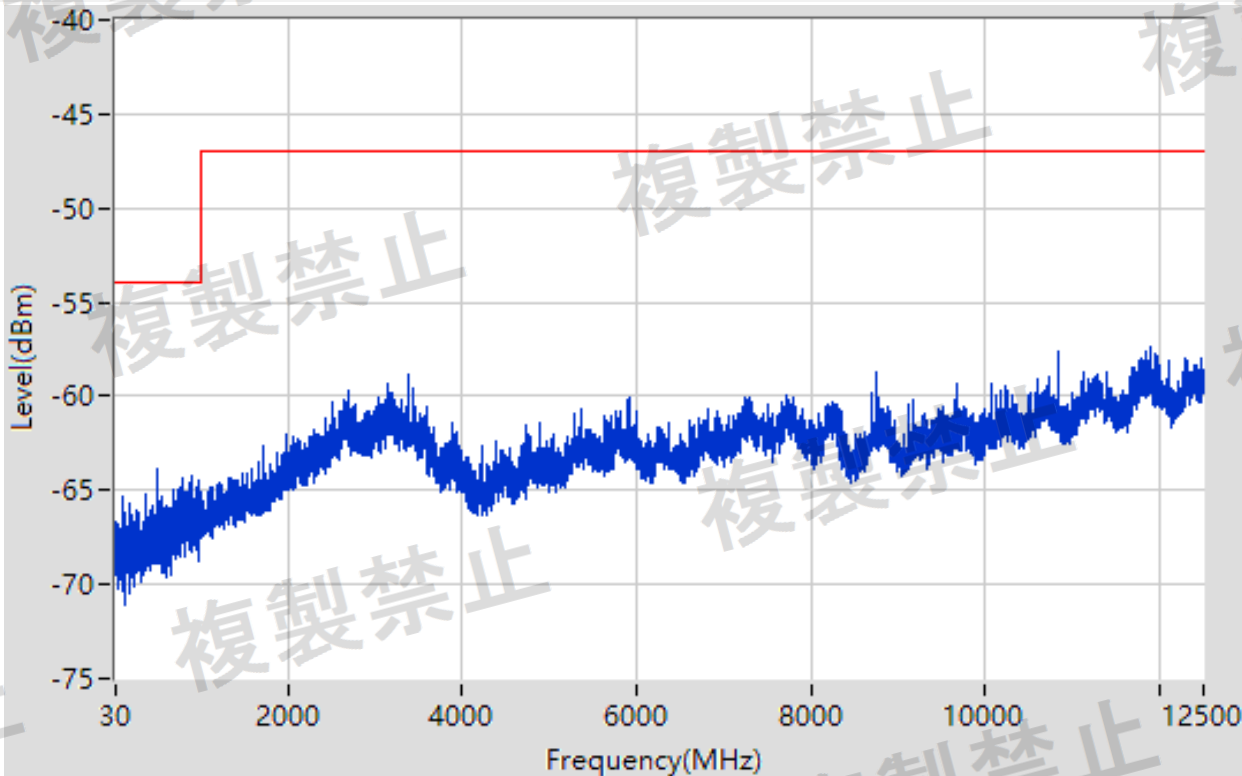
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 0.1       | Peak     | 745.86          | -63.99      | -54         | Pass    | 1001        |
| 1000                  | 6000                 | 1         | Peak     | 3180            | -59.46      | -47         | Pass    | 4001        |
| 6000                  | 12500                | 1         | Peak     | 11864.625       | -57.52      | -47         | Pass    | 4001        |

## A.6.13 GFSK (BLE 2Mbps) NV Low Channel



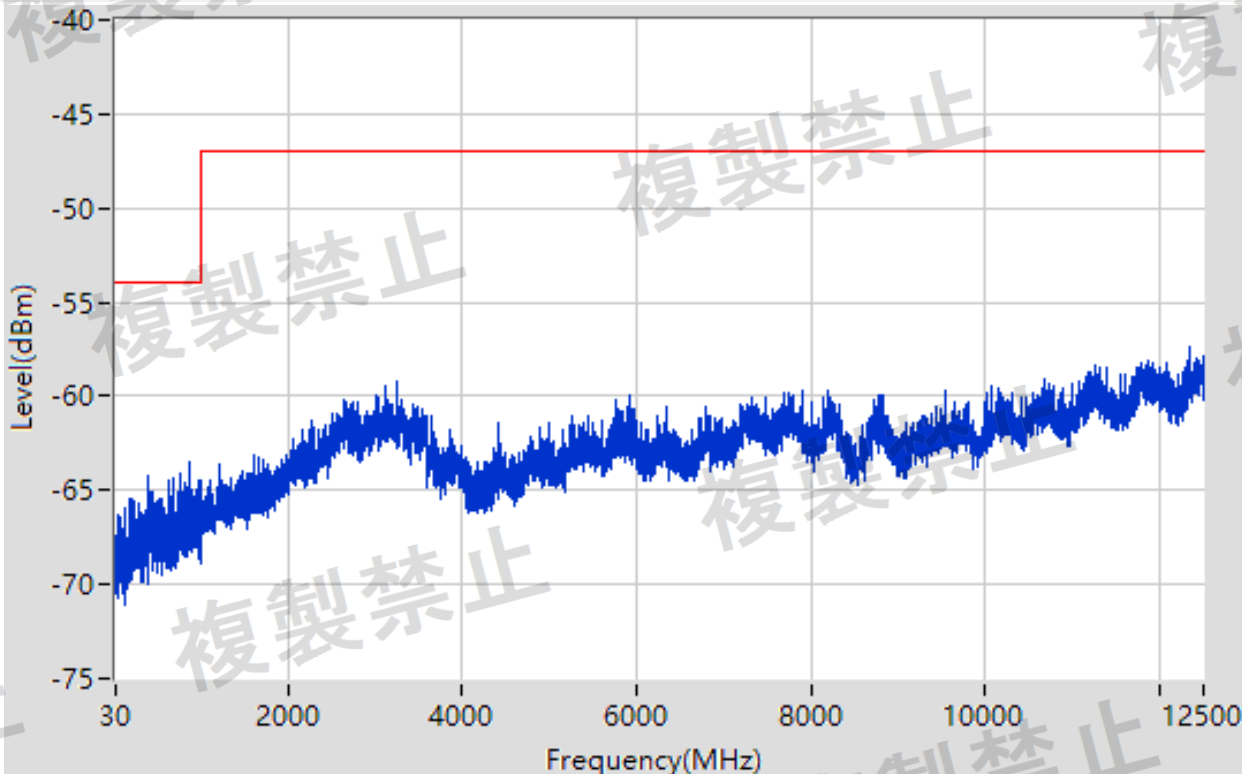
| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 0.1       | Peak     | 947.62          | -64.23      | -54         | Pass    | 1001        |
| 1000                  | 6000                 | 1         | Peak     | 2873.75         | -59.35      | -47         | Pass    | 4001        |
| 6000                  | 12500                | 1         | Peak     | 12496.75        | -57.01      | -47         | Pass    | 4001        |

## A.6.14 GFSK (BLE 2Mbps) NV Middle Channel



| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 0.1       | Peak     | 504.33          | -63.9       | -54         | Pass    | 1001        |
| 1000                  | 6000                 | 1         | Peak     | 3390            | -58.89      | -47         | Pass    | 4001        |
| 6000                  | 12500                | 1         | Peak     | 11889           | -57.35      | -47         | Pass    | 4001        |

## A.6.15 GFSK (BLE 2Mbps) NV High Channel



| Start Frequency (MHz) | Stop Frequency (MHz) | RBW (MHz) | Detector | Frequency (MHz) | Power (dBm) | Limit (dBm) | Verdict | Sweep Point |
|-----------------------|----------------------|-----------|----------|-----------------|-------------|-------------|---------|-------------|
| 30                    | 1000                 | 0.1       | Peak     | 884.57          | -63.48      | -54         | Pass    | 1001        |
| 1000                  | 6000                 | 1         | Peak     | 3261.25         | -59.16      | -47         | Pass    | 4001        |
| 6000                  | 12500                | 1         | Peak     | 12335.875       | -57.4       | -47         | Pass    | 4001        |

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

### 5.7.1 Limit

| Item                                                                                         | Non-directional antennal limits                                                                                                           | Directional antennal limits                                                                                                                |
|----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| EIRP Power Density                                                                           | a) FH, FH+DS, or FH+OFDM form 2427 - 2470.75 MHz:<br>$\leq 6.91$ dBm/MHz                                                                  | a) FH, FH+DS, or FH+OFDM form 2427 - 2470.75 MHz:<br>$\leq 16.91$ dBm/MHz                                                                  |
|                                                                                              | b) DS but other than a) from 2400~2483.5 MHz:<br>$\leq 12.14$ dBm/MHz                                                                     | b) DS but other than a) from 2400~2483.5 MHz:<br>$\leq 22.14$ dBm/MHz                                                                      |
|                                                                                              | c) OFDM, but other than a):<br>For OCB of 26MHz or less:<br>$\leq 12.14$ dBm/MHz<br>For OCB of over 26 MHz to 40 MHz: $\leq 9.14$ dBm/MHz | c) OFDM, but other than a):<br>For OCB of 26MHz or less:<br>$\leq 22.14$ dBm/MHz<br>For OCB of over 26 MHz to 40 MHz: $\leq 19.14$ dBm/MHz |
|                                                                                              | d) Other than a), b) and c): $\leq 12.14$ dBm                                                                                             | d) Other than a), b) and c): $\leq 22.14$ dBm                                                                                              |
| Note: This test item is not applied to EUT with EIRP Antenna power lower than 12.14 dBm/MHz. |                                                                                                                                           |                                                                                                                                            |

### 5.7.2 Test Setup

See section 4.3.3 for test setup description for the antenna port.

### 5.7.3 Test Procedure

- 1 Set EUT and measuring antenna at the same height and roughly facing each other.
- 2 Set spectrum analyzer with RBW=1MHz, VBW=1MHz, Detector=Peak, Trace mode=Max Hold, and tune reference level to observe receiving signal position.
- 3 Move the measuring antenna height up and down within  $\pm 50$ cm of EUT height and swing it to find the maximum output of the measuring antenna. The output level at the spectrum analyzer is read as "E".
- 4 Remove the EUT from the turn table and put the replacing antenna facing to measuring antenna at same height. Set the standard signal generator (SSG) at same frequency and transmit on then receive the signal
- 5 Swing the replacing antenna give a maximum receiving level.
- 6 Move the measuring antenna height up and down within  $\pm 50$ cm of replacing antenna height and swing it to find the maximum receiving level.
- 7 Set SSG output power at Pt to give the equivalent output level of "E" or calculate Pt with SSG output which gives the nearest of "E" and difference ( $\pm 1$ dB). Record the Pt.
- 8 Calculate EIRP by the formula below  $EIRP = G_t - L + P_t$ .

Gt: gain of replacing antenna (dBi)

L: feeder loss between SSG and replacing antenna

Pt: Output power of the SSG

- 9 If the antenna for the EUT has circular polarization, sum of V-field and H-field will be result if measuring antenna is linear polarization.

#### 5.7.4 Test Deviation

There is no deviation with the original standard.

#### 5.7.5 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

#### 5.7.6 Test Result

Note: Not applicable.

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

### 5.8.1 Limit

| Item                                                                                         | Limits                                                                                                                                                      |
|----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3dB antenna beam width                                                                       | $360/A$ (If $A < 1$ ; then $A = 1$ ) $A = \{\text{EIRP Power [mW]} / 16.36 \text{ for DS, OFDM}\}$ or $A = \{\text{EIRP Power [mW]} / 4.9 \text{ for FH}\}$ |
| Note: This test item is not applied to EUT with EIRP Antenna power lower than 12.14 dBm/MHz. |                                                                                                                                                             |

### 5.8.2 Test Setup

See section 4.3.3 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

### 5.8.3 Test Procedure

- 1 Set EUT and measuring antenna at the same height and roughly facing each other.
- 2 Set spectrum analyzer with RBW=1 MHz, VBW=1 KHz, Y scale=5 dB, Detector=Peak, Trace mode=Max Hold, and tune reference level to observe receiving signal position.
- 3 Rotate directions of the EUT horizontally and vertically to find the maximum receiving power.
- 4 Move the measuring antenna height up and down within  $\pm 50\text{cm}$  of EUT height and swing it to find the maximum output of measuring antenna. The output level at the spectrum analyzer is read as "E"
- 5 Calculate permitted radiation angle in horizontal and vertical using EIRP measured in another test method.
- 6 Calculate 3dB antenna beam width by the formula below  $360/A$  (If  $A < 1$ ; then  $A = 1$ ).  $A = \{\text{EIRP Power [mW]} / 16.36 \text{ for DS, OFDM}\}$  or  $A = \{\text{EIRP Power [mW]} / 4.9 \text{ for FH}\}$

### 5.8.4 Test Deviation

There is no deviation with the original standard.

### 5.8.5 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

### 5.8.6 Test Result

Note: Not applicable.

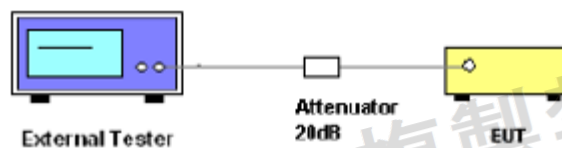
## 5.9 Radio Interference Prevention Capability Measurement

### 5.9.1 Limit

| Item           | Limits         |
|----------------|----------------|
| Identification | $\geq 48$ bits |

### 5.9.2 Test Setup

The photo of test setup please refer to ANNEX A.



### 5.9.3 Test Procedure

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

### 5.9.4 Test Deviation

There is no deviation with the original standard.

### 5.9.5 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

### 5.9.6 Test Result

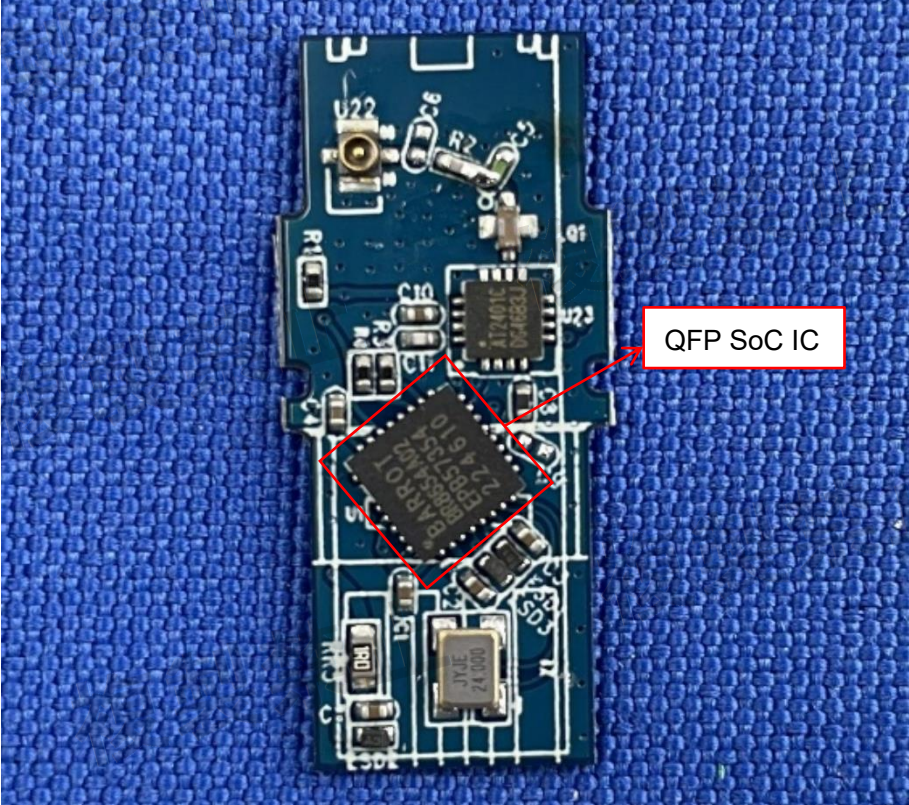
| Test Voltage | Test Result (ID Code) | Verdict |
|--------------|-----------------------|---------|
| NV           | GOOD                  | Pass    |

#### Test Data

BD Address: 047F0E901101

## 5.10 Construction Protection Confirmation Method

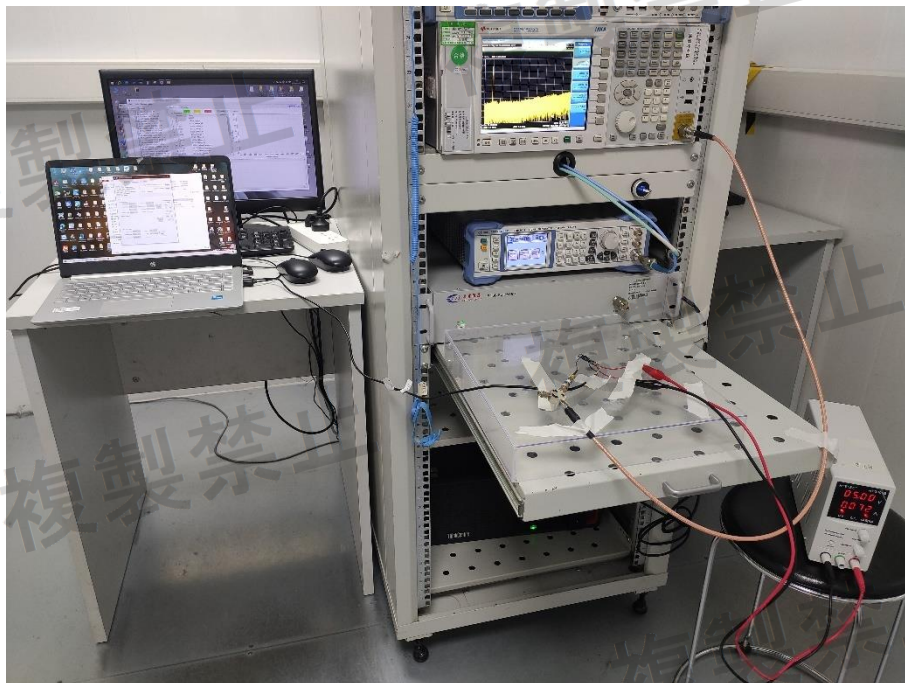
The RF and modulation portions are protected against illegal modification as following method:

| Protected Method     | Description                                                                                                        |
|----------------------|--------------------------------------------------------------------------------------------------------------------|
| Structure protection | The RF Module is QFP SoC IC, and RF part is mounted on PCB with surface mount technology, can't be easily modified |
| Reference Photo      |                                 |
|                      |                                                                                                                    |

## ANNEX A TEST SETUP PHOTOS

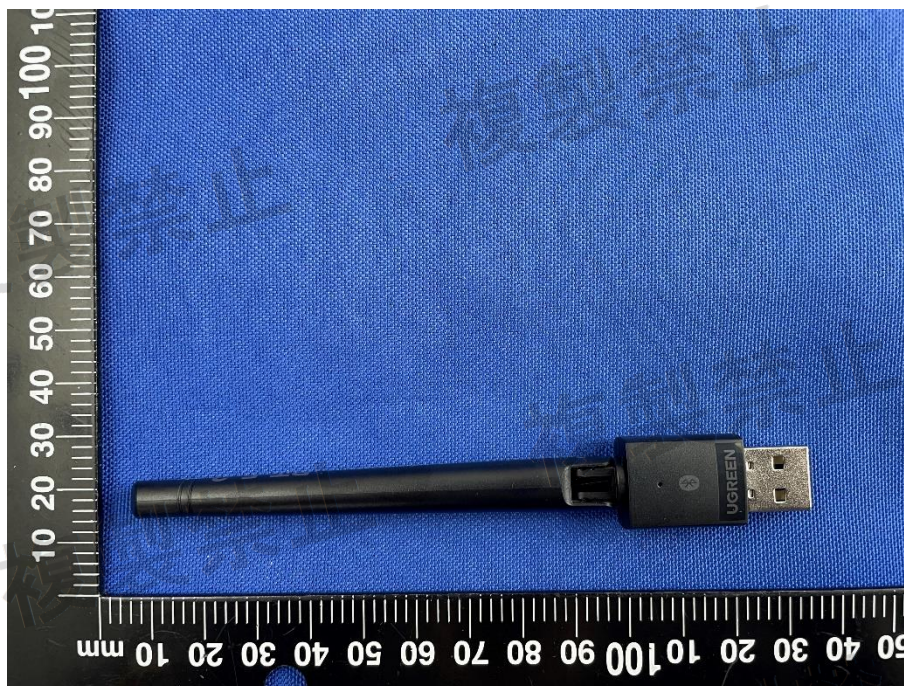
### 1 Conducted Test Photo

Conducted Test



## ANNEX B EUT EXTERNAL PHOTOS

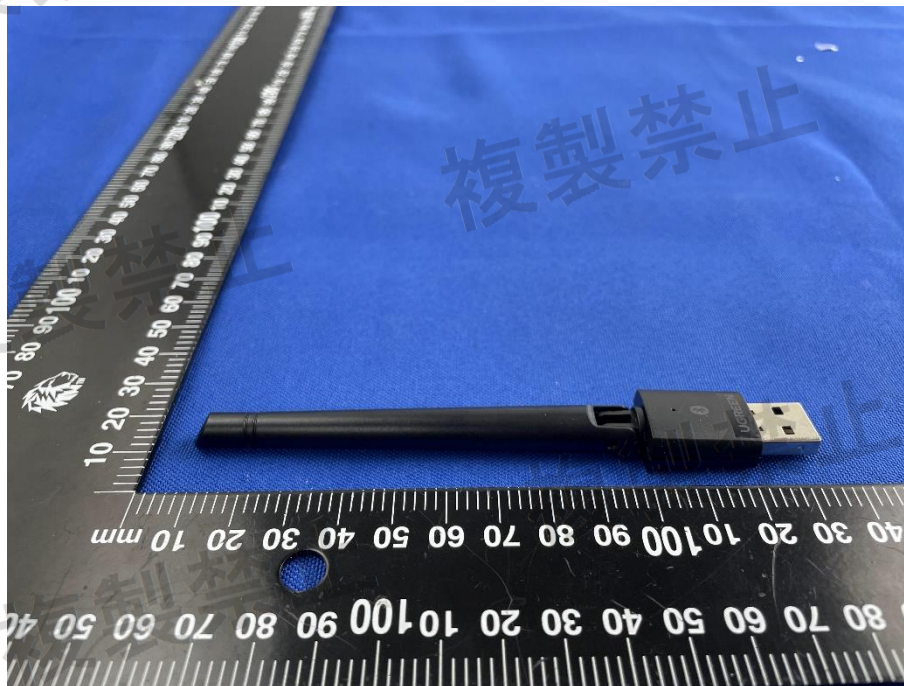
FRONT VIEW OF EUT



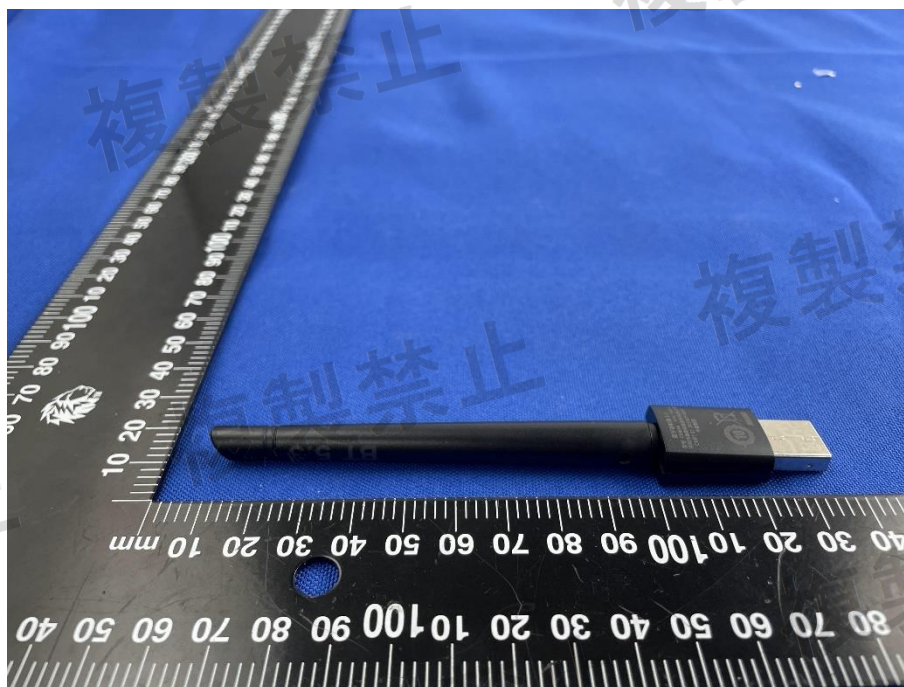
REAR VIEW OF EUT



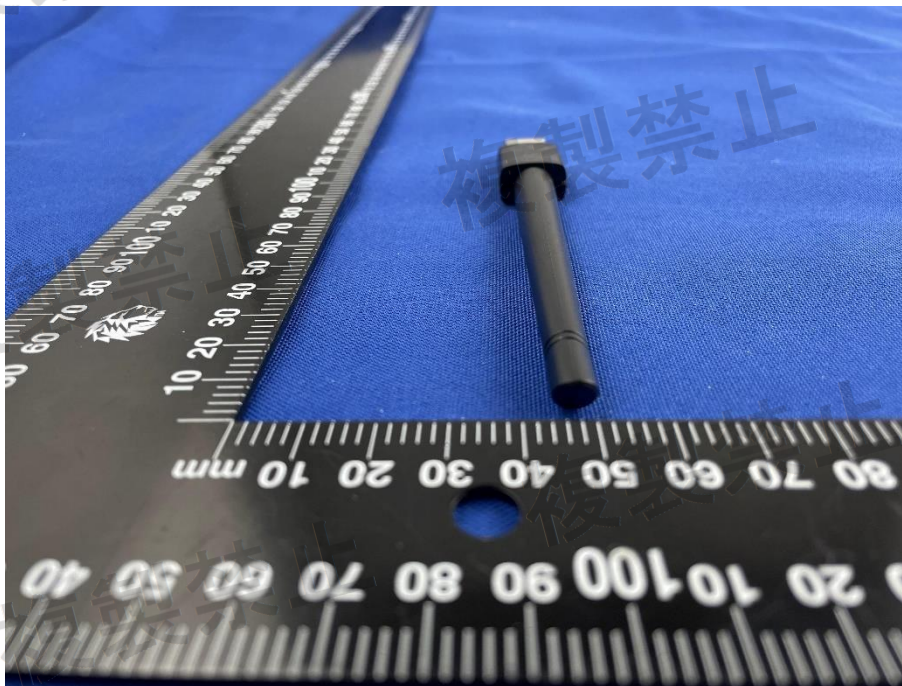
LEFT VIEW OF EUT



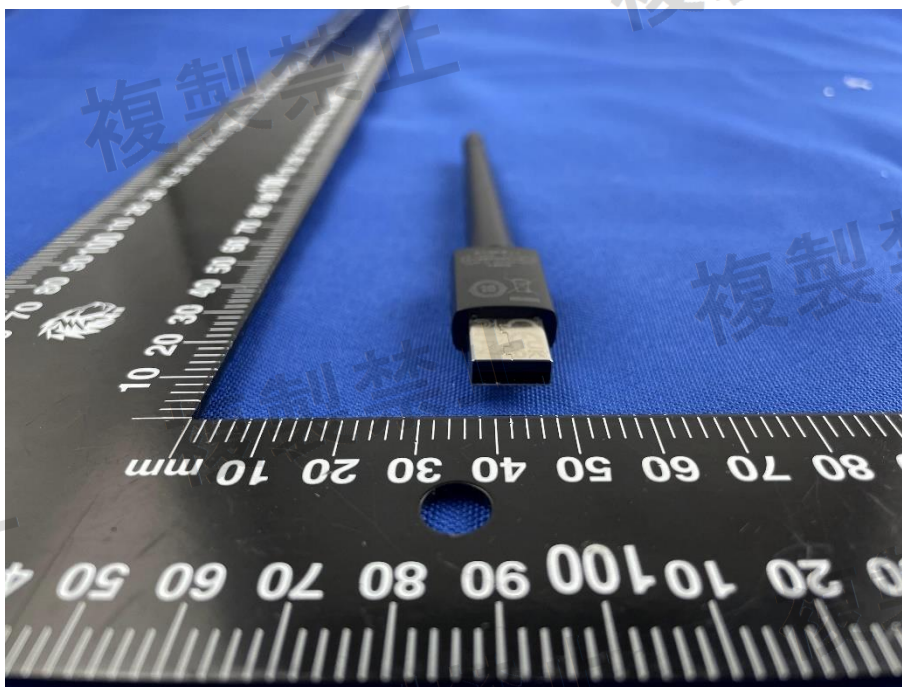
RIGHT VIEW OF EUT



TOP VIEW OF EUT



BOTTOM VIEW OF EUT

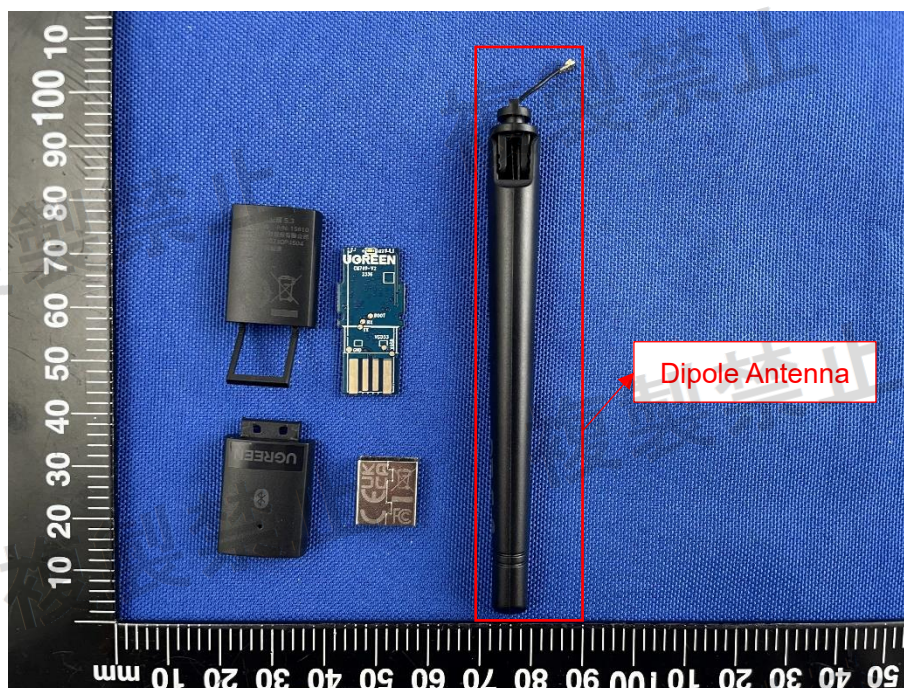


CLOSE-UP

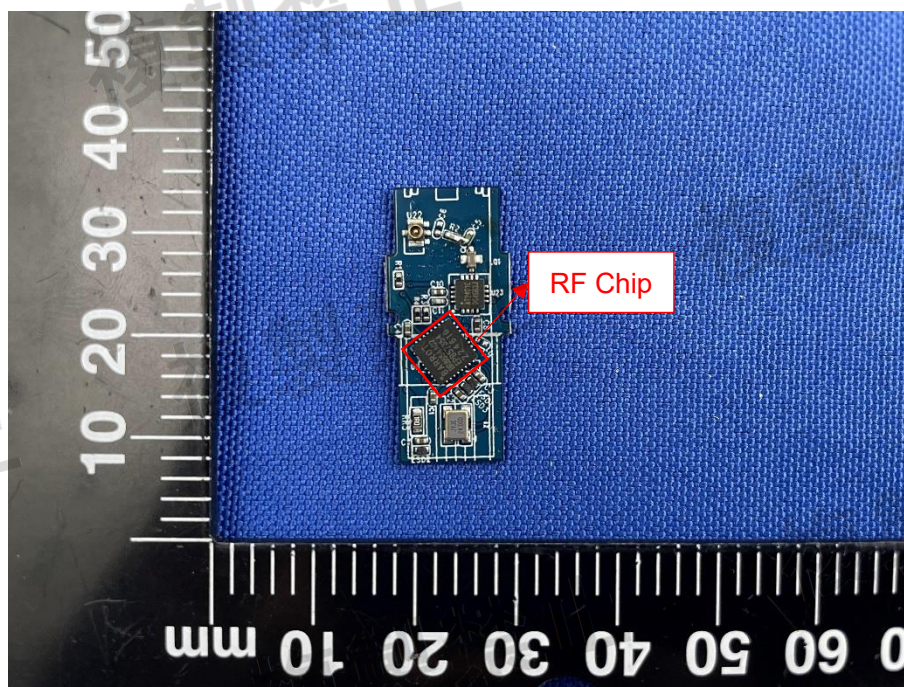


## ANNEX C EUT INTERNAL PHOTOS

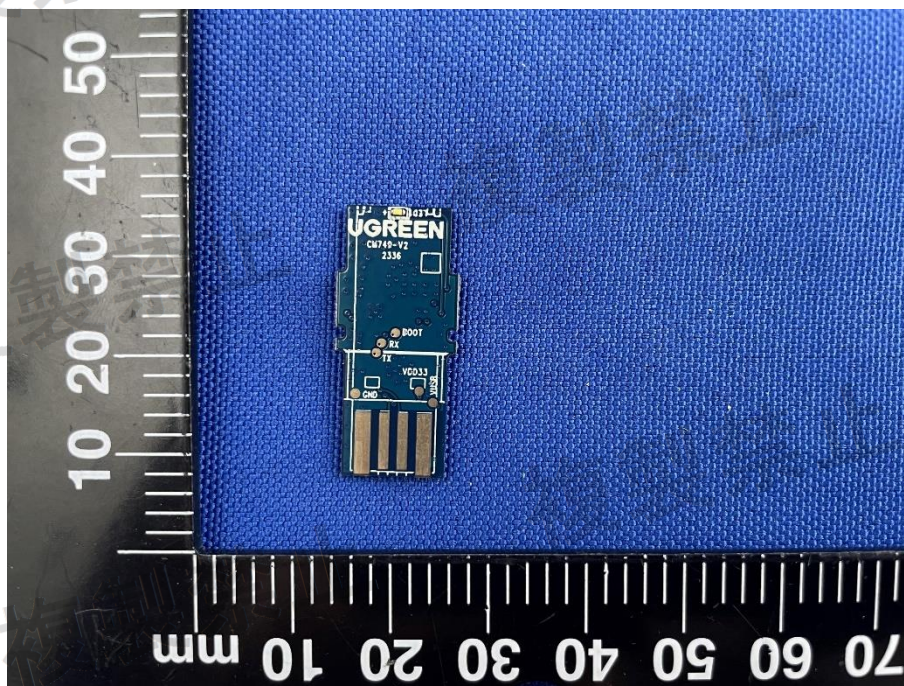
EUT UNCOVER VIEW 1



MAIN BOARD TOP VIEW



MAIN BOARD REAR VIEW



## Statement

1. The laboratory guarantees the scientificity, accuracy and impartiality of the test, and is responsible for all the information in the report, except the information provided by the customer. The customer is responsible for the impact of the information provided on the validity of the results.
2. The report without China inspection body and laboratory Mandatory Approval (CMA) mark has no effect of proving to the society.
3. For the report with CNAS mark or A2LA mark, the items marked with "☆" are not within the accredited scope.
4. This report is invalid if it is altered, without the signature of the testing and approval personnel, or without the "inspection and testing dedicated stamp" or test report stamp.
5. The test data and results are only valid for the tested samples provided by the customer.
6. This report shall not be partially reproduced without the written permission of the laboratory.
7. Any objection shall be raised to the laboratory within 30 days after receiving the report.

--END OF REPORT--