



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:** Multi-mode Wireless Keyboard  
**Model Name:** K356 (refer to section 2.3)  
**Brand Name:** **UGREEN**  
**FCC ID:** 2AQI5-K356  
**Test Standard:** 47 CFR Part 15 Subpart C  
(refer to section 3.1)  
**Sample Arrival Date:** Nov. 29, 2023  
**Test Date:** Nov. 30, 2023 - Dec. 06, 2023  
**Date of Issue:** Dec. 19, 2023

**ISSUED BY:**

Shenzhen BALUN Technology Co., Ltd.

**Tested by:** Julie Zhu**Checked by:** Ye Hongji**Approved by:** Hanson Lin

(Vice General Manager)

### Revision History

| Version        | Issue Date           | Revisions            |
|----------------|----------------------|----------------------|
| <u>Rev. 01</u> | <u>Dec. 19, 2023</u> | <u>Initial Issue</u> |

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# 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 |
| Accreditation Certificate | The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196.                                                                                        |

## 2 PRODUCT INFORMATION

### 2.1 Applicant Information

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

### 2.2 Manufacturer Information

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

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

|                                           |                                                                                                                                                                      |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EUT Name                                  | Multi-mode Wireless Keyboard                                                                                                                                         |
| Model Name Under Test                     | K356                                                                                                                                                                 |
| Series Model Name                         | 35307, 35308, 35309, 35072, 35073                                                                                                                                    |
| Description of Model name differentiation | All models are same with electrical parameters and internal circuit structure, but only differ in color and model name. (this information provided by the applicant) |
| Hardware Version                          | V1.1                                                                                                                                                                 |
| Software Version                          | J0B                                                                                                                                                                  |
| Dimensions (Approx.)                      | N/A                                                                                                                                                                  |
| Weight (Approx.)                          | N/A                                                                                                                                                                  |

## 2.4 Technical Information

|                                   |                                |
|-----------------------------------|--------------------------------|
| Network and Wireless connectivity | Bluetooth (BLE), 2.4G ISM Band |
|-----------------------------------|--------------------------------|

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

|                          |                                                                                                                          |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------|
| Modulation Technology    | FHSS                                                                                                                     |
| Modulation Type          | GFSK                                                                                                                     |
| Product Type             | <input type="checkbox"/> Mobile<br><input checked="" type="checkbox"/> Portable<br><input type="checkbox"/> Fix Location |
| Transfer Rate            | 1 Mbps                                                                                                                   |
| Frequency Range          | The frequency range used is 2402 MHz – 2480 MHz;<br>The frequency block is 2400 MHz to 2483.5 MHz.                       |
| Number of Channel        | 40                                                                                                                       |
| Tested Channel           | Low channel (2402 MHz), Middle channel(2440 MHz), High channel (2480 MHz)                                                |
| Antenna Type             | PCB Antenna                                                                                                              |
| Antenna Gain             | -1.46 dBi                                                                                                                |
| Adaptive or non-adaptive | Non-Adaptive                                                                                                             |
| The Max RF Output power  | -0.14 dBm                                                                                                                |

### Channel List

| Number | Frequency (MHz) | Number | Frequency (MHz) | Number | Frequency (MHz) |
|--------|-----------------|--------|-----------------|--------|-----------------|
| 1      | 2402(Low)       | 15     | 2430            | 29     | 2458            |
| 2      | 2404            | 16     | 2432            | 30     | 2460            |
| 3      | 2406            | 17     | 2434            | 31     | 2462            |
| 4      | 2408            | 18     | 2436            | 32     | 2464            |
| 5      | 2410            | 19     | 2438            | 33     | 2466            |
| 6      | 2412            | 20     | 2440(Middle)    | 34     | 2468            |
| 7      | 2414            | 21     | 2442            | 35     | 2470            |
| 8      | 2416            | 22     | 2444            | 36     | 2472            |
| 9      | 2418            | 23     | 2446            | 37     | 2474            |
| 10     | 2420            | 24     | 2448            | 38     | 2476            |
| 11     | 2422            | 25     | 2450            | 39     | 2478            |
| 12     | 2424            | 26     | 2452            | 40     | 2480(High)      |
| 13     | 2426            | 27     | 2454            | --     | --              |
| 14     | 2428            | 28     | 2456            | --     | --              |

Note: The modulation is GFSK with FHSS, there are total 40 channels (frequency range is 2402-2480MHz, channel step is 2MHz, totally 40 channels). In this report, the equipment select the lowest, middle and highest channel from 40 channels, Which are 2402 MHz, 2440 MHz and 2480 MHz. The more information please refer to the manufacturer's instructions.

### 3 SUMMARY OF TEST RESULTS

#### 3.1 Test Standards

| No.    | Identity                                      | Document Title                                                                                                                                                                           |
|--------|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | 47 CFR Part 15, Subpart C                     | Intentional radiators of radio frequency equipment                                                                                                                                       |
| 2      | ANSI C63.10-2013                              | American National Standard for Testing Unlicensed Wireless Devices                                                                                                                       |
| 3<br>☆ | KDB 558074 D01 15.247<br>Meas Guidance v05r02 | Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules |

#### 3.2 Verdict

| No. | Description                                            | FCC Part No.        | Test Result | Verdict              |
|-----|--------------------------------------------------------|---------------------|-------------|----------------------|
| 1   | Antenna Requirement                                    | 15.203              | --          | Pass <sup>Note</sup> |
| 2   | Number of Hopping Frequency                            | 15.247(a)           | 5.2.4       | Pass                 |
| 3   | Peak Output Power                                      | 15.247(b)           | 5.3.4       | Pass                 |
| 4   | Occupied Bandwidth                                     | 15.247(a)           | 5.4.4       | Pass                 |
| 5   | Hopping Frequency Separation                           | 15.247(a)           | 5.5.4       | Pass                 |
| 6   | Time of Occupancy (Dwell time)                         | 15.247(a)           | 5.6.4       | Pass                 |
| 7   | Conducted Spurious Emission& Authorized-band band-edge | 15.247(d)           | 5.7.4       | Pass                 |
| 8   | Conducted Emission                                     | 15.207              | 5.8.4       | Pass                 |
| 9   | Radiated Spurious Emission                             | 15.209<br>15.247(d) | 5.9.4       | Pass                 |
| 10  | Band Edge (Restricted-band band-edge)                  | 15.209<br>15.247(d) | 5.10.4      | Pass                 |

Note: The EUT has a permanently and irreplaceable attached antenna, which complies with the requirement FCC 15.203.

## 4 GENERAL TEST CONFIGURATIONS

### 4.1 Test Environments

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

|                            |                         |                    |
|----------------------------|-------------------------|--------------------|
| Relative Humidity          | 47% to 63%              |                    |
| Atmospheric Pressure       | 100 kPa to 102 kPa      |                    |
| Temperature                | NT (Normal Temperature) | +21.9°C to +23.3°C |
| Working Voltage of the EUT | NV (Normal Voltage)     | 3.0 V              |

### 4.2 Test Equipment List

| Description         | Manufacturer               | Model             | Serial No.  | Cal. Date  | Cal. Due   |
|---------------------|----------------------------|-------------------|-------------|------------|------------|
| Spectrum Analyzer   | KEYSIGHT                   | N9020A            | MY50330200  | 2023.05.16 | 2024.05.15 |
| Spectrum Analyzer   | ROHDE&SCHWARZ              | FSV-40            | 101544      | 2022.12.28 | 2023.12.27 |
| Spectrum Analyzer   | KEYSIGHT                   | N9020A            | MY52510065  | 2023.09.05 | 2024.09.04 |
| Signaling Unit      | ROHDE&SCHWARZ              | CMW500            | 171150      | 2023.06.19 | 2024.06.18 |
| Test Antenna-Horn   | SCHWARZBECK                | BBHA 9120D        | 01631       | 2022.02.03 | 2025.02.02 |
| Test Antenna-Horn   | A-INFO                     | LB-180400KF       | J211060273  | 2021.07.02 | 2024.07.01 |
| Anechoic Chamber    | RAINFORD                   | 9m*6m*6m          | 144         | 2022.02.19 | 2024.09.03 |
| Amplifier           | COM-MV                     | ZT30-1000M        | 18110850    | 2023.09.05 | 2024.09.04 |
| Amplifier           | COM-MV                     | LSCX_LNA1-12G-01  | 180602      | 2023.09.05 | 2024.09.04 |
| Amplifier           | COM-MV                     | XKu_LNA7-18G-01   | 180601      | 2023.09.05 | 2024.09.04 |
| Amplifier           | COM-MV                     | KA LNA18 40G-01   | 18050001    | 2022.12.07 | 2023.12.06 |
| EMI Receiver        | Agilent                    | N9038A            | MY55330120  | 2023.09.05 | 2024.09.04 |
| Test Antenna-Bi-Log | SCHWARZBECK                | VULB 9168         | 9168-00867  | 2022.04.12 | 2025.04.11 |
| Anechoic Chamber    | YiHeng                     | 9m*6m*6m          | 142         | 2022.02.19 | 2024.08.18 |
| Amplifier           | COM-MV                     | ZT30-1000M        | B2017119081 | 2023.09.05 | 2024.09.04 |
| EMI Receiver        | ROHDE&SCHWARZ              | ESRP              | 101036      | 2023.09.05 | 2024.09.04 |
| Test Antenna-Loop   | SCHWARZBECK                | FMZB 1519         | 1519-037    | 2021.04.16 | 2024.04.15 |
| Anechoic Chamber    | EMC Electronic Co., Ltd    | 20.10*11.60*7.35m | 130         | 2021.08.15 | 2024.08.14 |
| EMI Receiver        | KEYSIGHT                   | N9010B            | MY57110309  | 2023.09.05 | 2024.09.04 |
| LISN                | SCHWARZBECK                | NSLK 8127         | 8127-687    | 2023.05.16 | 2024.05.15 |
| Shielded Enclosure  | YiHeng Electronic Co., Ltd | 3.5m*3.1m*2.8m    | 112         | 2022.02.19 | 2025.02.18 |

### 4.3 Test Software List

| Description | Manufacturer | Software Version | Serial No. | Applicable test Setup               |
|-------------|--------------|------------------|------------|-------------------------------------|
| BL410R      | BALUN        | V2.1.1.488       | N/A        | The section 4.5.1                   |
| BL410E      | BALUN        | V22.930          | N/A        | The section 4.5.2&4.5.3&4.5.4&4.5.5 |

### 4.4 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 |
|-----------------------------------|-------------|
| Occupied Channel Bandwidth        | 2.8%        |
| RF output power, conducted        | 1.28 dB     |
| Power Spectral Density, conducted | 1.30 dB     |
| Unwanted Emissions, conducted     | 1.84 dB     |
| All emissions, radiated           | 5.36 dB     |
| Temperature                       | 0.8°C       |
| Humidity                          | 4%          |

### 4.5 Description of Test Setup

#### 4.5.1. For Antenna Port Test

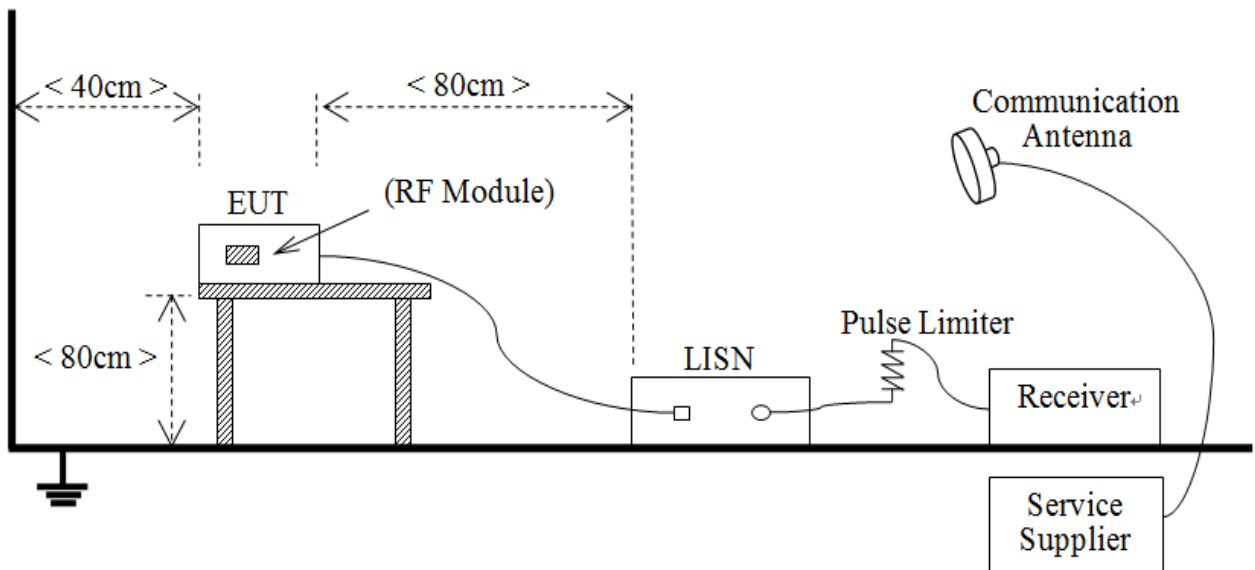
Conducted value (dBm) = Measurement value (dBm) + cable loss (dB)

For example: the measurement value is 10 dBm and the cable 0.5dBm used, then the final result of EUT:  
Conducted value (dBm) = 10 dBm + 0.5 dB = 10.5 dBm



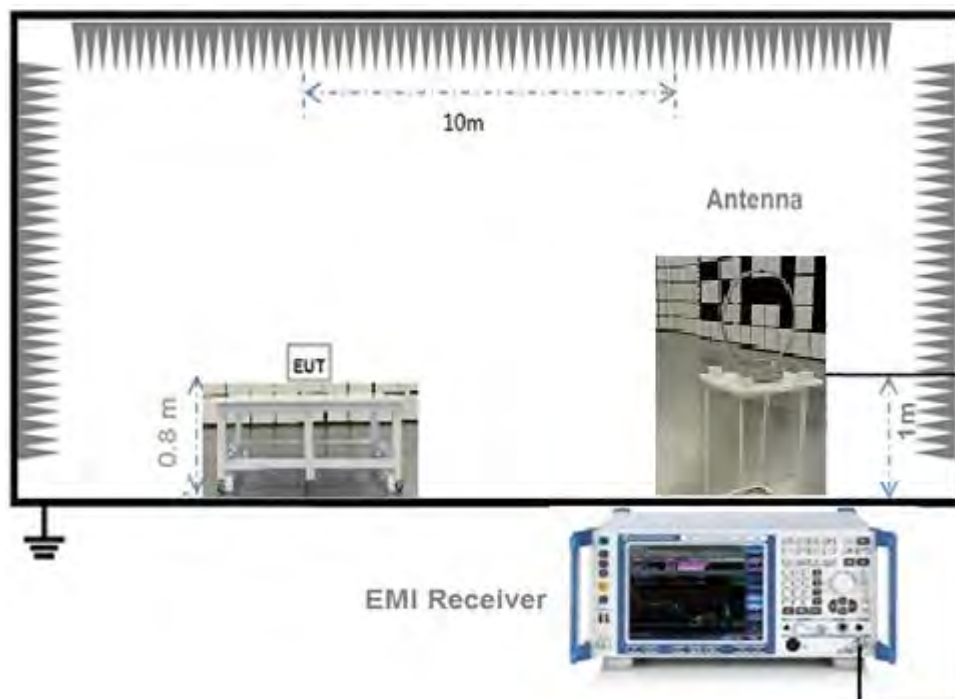
(Diagram 1)

#### 4.5.2. For AC Power Supply Port Test



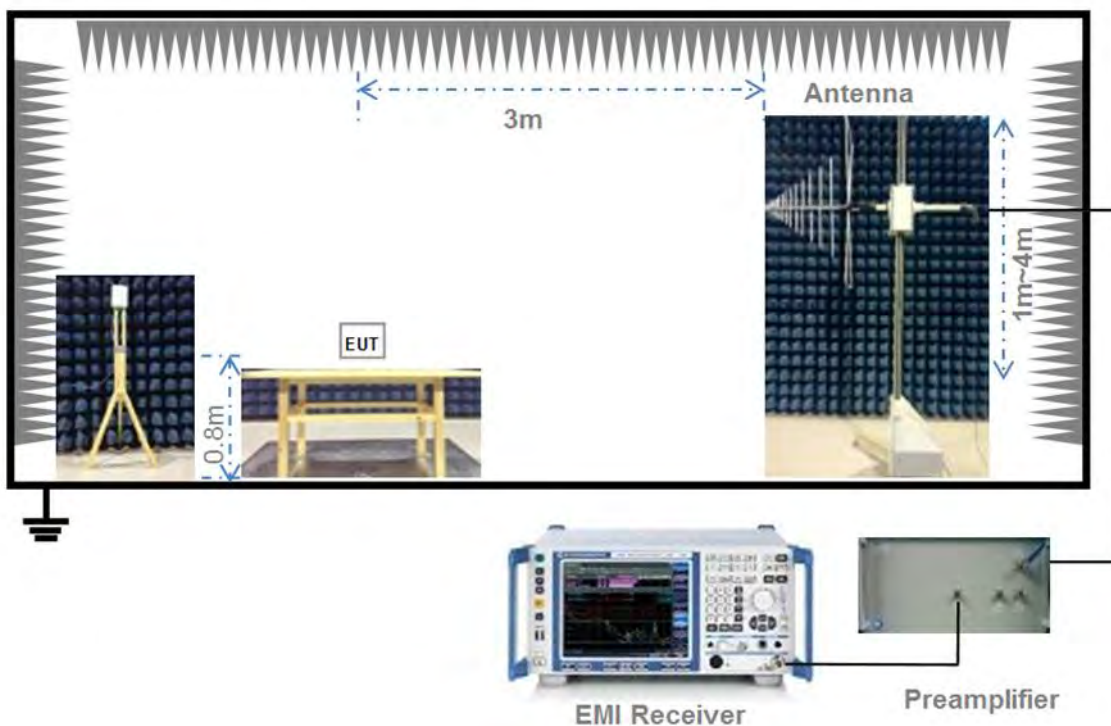
(Diagram 2)

#### 4.5.3. For Radiated Test (Below 30 MHz)



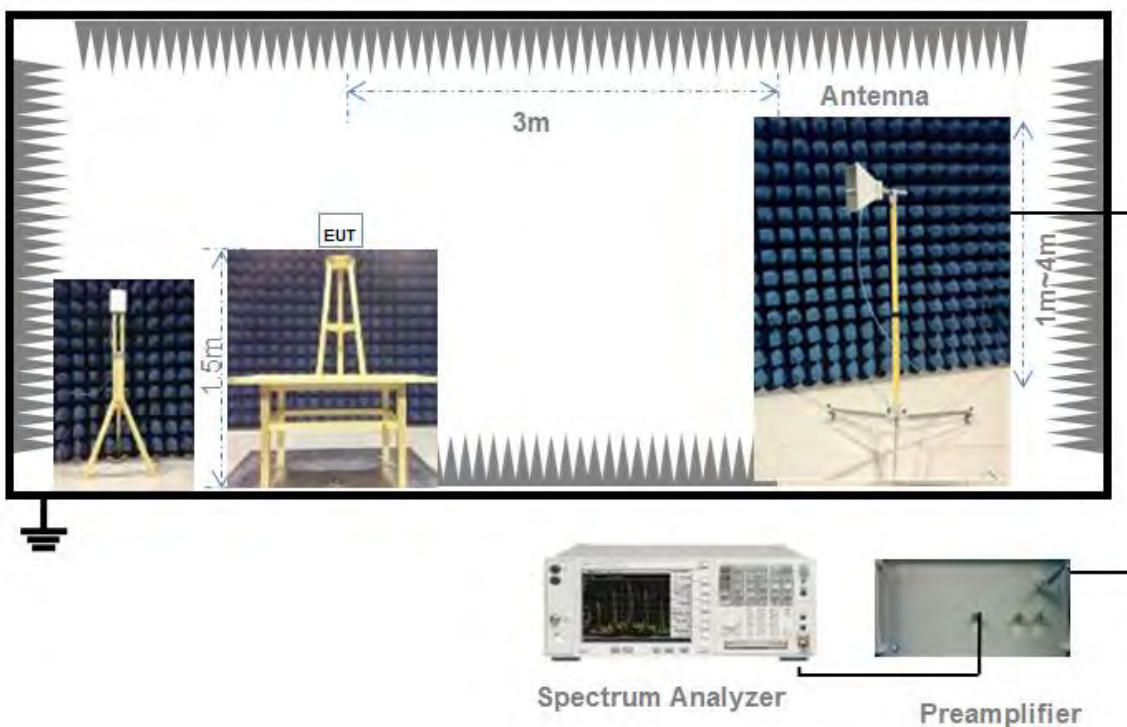
(Diagram 3)

## 4.5.4. For Radiated Test (30 MHz-1 GHz)



(Diagram 4)

## 4.5.5. For Radiated Test (Above 1 GHz)



(Diagram 5)

## 4.6 Measurement Results Explanation Example

### 4.6.1 For conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

### 4.6.2 For radiated band edges and spurious emission test:

Per part 15.35(c), the EUT Bluetooth average emission level could be determined by the peak emission level applying duty cycle correction factor, to represent averaging over the whole pulse train.

The average level is derived from the peak level corrected with "Duty cycle correction factor".

Average Emission Level (dBuV/m) = Peak Emission Level (dBuV/m) + Duty cycle correction factor (dB)

Duty cycle correction factor (dB) =  $20 * \log (\text{Duty cycle})$ .

Duty cycle = on time / 100 milliseconds

On time = dwell time \* hopping number in 100 ms

For example: bluetooth with dwell time 2.9 ms and 3 hops in 100 ms, then

Duty cycle correction factor (dB) =  $20 * \log ((2.9 * 3) / 100) = -21.21 \text{ dB}$

Following shows an average computation example with duty cycle correction factor = -21.21 dB, and the peak emission level is 45.61 dBuV/m.

Example:

Average Emission Level (dBuV/m) = Peak Emission Level (dBuV/m) + duty cycle correction factor (dB)  
=  $45.61 + (-21.21) = 24.4 \text{ (dBuV/m)}$

## 5 TEST ITEMS

### 5.1 Antenna Requirements

#### 5.1.1 Relevant Standards

FCC §15.203 & 15.247(b); RSS-247, 5.4 (6)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of § 15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the FCC rule.

#### 5.1.2 Antenna Anti-Replacement Construction

The Antenna Anti-Replacement as following method:

| Protected Method                        | Description                                                               |
|-----------------------------------------|---------------------------------------------------------------------------|
| The antenna is embedded in the product. | The antenna is welded on the mainboard, can't be replaced by the consumer |

| Reference Documents | Item                                     |
|---------------------|------------------------------------------|
| Photo               | Please refer to the EUT Photo documents. |

#### 5.1.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

## 5.2 Number of Hopping Frequency

### 5.2.1 Limit

FCC §15.247(a) (1) (iii)

Frequency hopping systems operating in the 2400 MHz to 2483.5 MHz bands shall use at least 15 hopping frequencies.

### 5.2.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

### 5.2.3 Test Procedure

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

Span = the frequency band of operation

RBW  $\geq$  1% of the span

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize

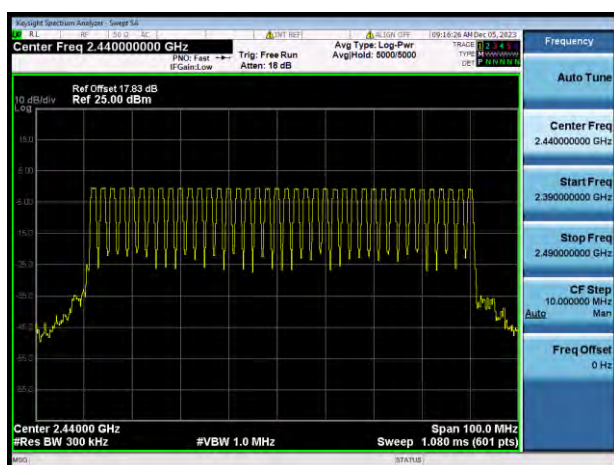
### 5.2.4 Test Result

#### Test Data

| Test Mode | Frequency Block (MHz) | Measured Channel Numbers | Min. Limit | Verdict |
|-----------|-----------------------|--------------------------|------------|---------|
| GFSK      | 2400 - 2483.5         | 40                       | 15         | Pass    |

#### Test plots

GFSK 2.4 GHz ~ 2.4835 GHz



## 5.3 Peak Output Power

### 5.3.1 Test Limit

FCC § 15.247(b)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

### 5.3.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

### 5.3.3 Test Procedure

The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the Module.

Use the following spectrum analyzer settings:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize.

### 5.3.4 Test Result

#### Peak Power Test Data

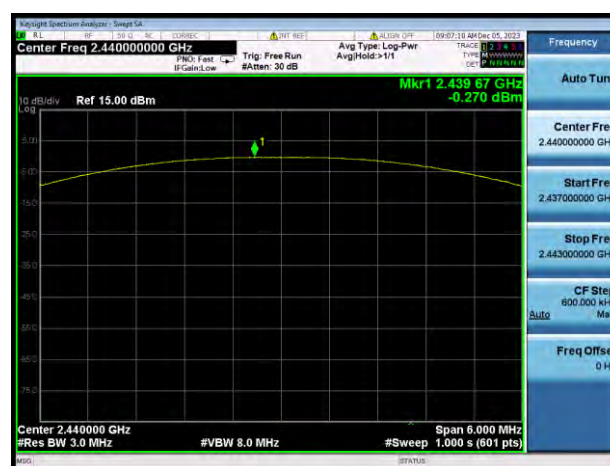
| Channel | Measured Output Peak Power |      | Limit |      | Verdict |
|---------|----------------------------|------|-------|------|---------|
|         | dBm                        | mW   | dBm   | mW   |         |
| Low     | -0.14                      | 0.97 | 30    | 1000 | Pass    |
| Middle  | -0.27                      | 0.94 |       |      | Pass    |
| High    | -0.57                      | 0.88 |       |      | Pass    |

#### Test plots

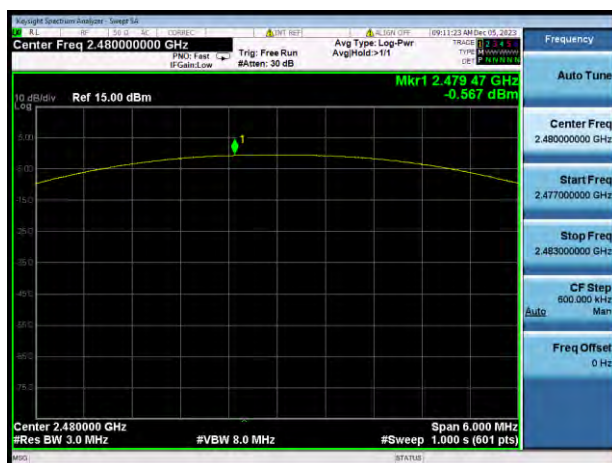
GFSK LOW CHANNEL



GFSK MIDDLE CHANNEL



GFSK HIGH CHANNEL



## 5.4 Occupied Bandwidth

### 5.4.1 Limit

FCC §15.247(a)

Measurement of the 20dB bandwidth of the modulated signal.

### 5.4.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

### 5.4.3 Test Procedure

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW  $\geq$  1% of the 20 dB bandwidth

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate, Allow the trace to stabilize.

## 5.4.4 Test Result

### Test Data

| Test Mode      | GFSK                  |                     |
|----------------|-----------------------|---------------------|
| Channel        | 20 dB Bandwidth (MHz) | 99% Bandwidth (MHz) |
| Low Channel    | 1.095000              | 1.020300            |
| Middle Channel | 1.100000              | 1.023000            |
| High Channel   | 1.100000              | 1.024900            |

### Test plots

#### 20 dB Bandwidth

##### GFSK LOW CHANNEL



##### GFSK MIDDLE CHANNEL



##### GFSK HIGH CHANNEL



## 99% Bandwidth

## GFSK LOW CHANNEL



## GFSK MIDDLE CHANNEL



## GFSK HIGH CHANNEL



## 5.5 Carrier Frequency Separation

### 5.5.1 Limit

FCC §15.247(a)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

### 5.5.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

### 5.5.3 Test Procedure

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

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW)  $\geq$  1% of the span

Video (or Average) Bandwidth (VBW)  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

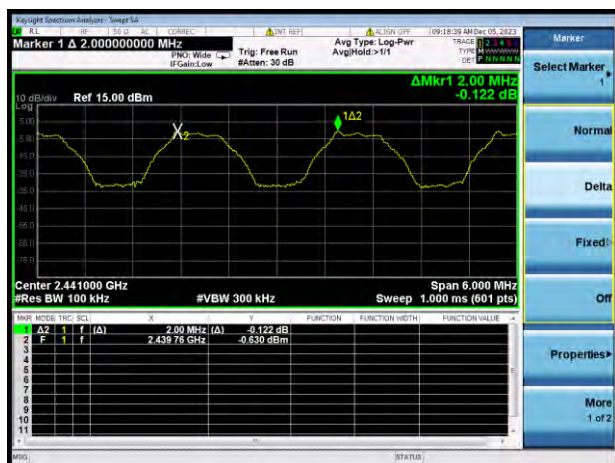
## 5.5.4 Test Result

### Test Data

| Mode | Frequency separation (MHz) | 2/3 of the 20 dB Bandwidth (MHz) | Verdict |
|------|----------------------------|----------------------------------|---------|
| GFSK | 2.000                      | 0.733                            | Pass    |

### Test Plots

#### GFSK



## 5.6 Time of Occupancy (Dwell time)

### 5.6.1 Limit

FCC §15.247(a)

Frequency hopping systems in the 2400 MHz - 2483.5 MHz band shall use at least 15 non-overlapping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

### 5.6.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

### 5.6.3 Test Procedure

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

$$\{\text{Total of Dwell}\} = \{\text{Pulse Time}\} * \{\text{Number of Hopping Frequency in Period}\}$$

$$\{\text{Period}\} = 0.4s * \{\text{Number of Hopping Frequency}\}$$

The middle channels are selected to perform testing to record the dwell time of each occupation measured in this channel, which is called Pulse Time here.

### 5.6.4 Test Result

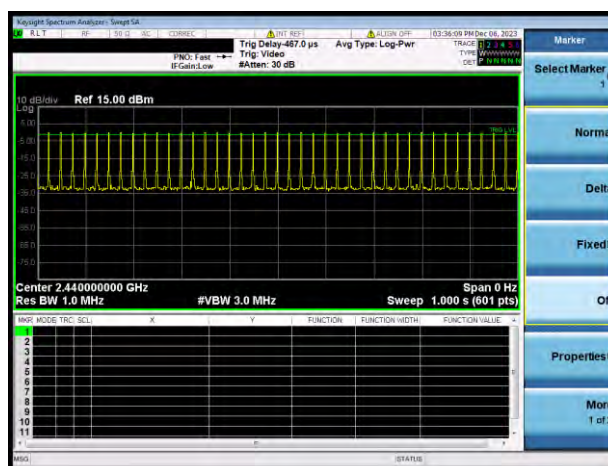
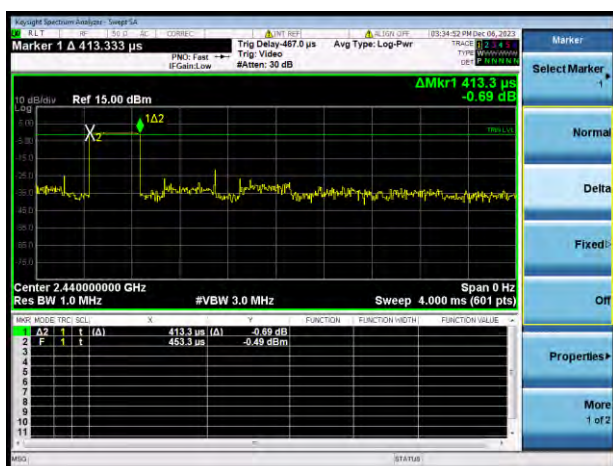
#### Test Data

| GFSK             |                     |             |         |
|------------------|---------------------|-------------|---------|
| Pulse Width (ms) | Total of Dwell (ms) | Limit (sec) | Verdict |
| 0.413            | 264.512             | 0.4         | Pass    |

#### Test Plots

Pulse Width

1s



## 5.7 Conducted Spurious Emission & Authorized-band band-edge

### 5.7.1 Limit

FCC §15.247(d); RSS-247, 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

### 5.7.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

### 5.7.3 Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize

### 5.7.4 Test Result

#### Test Data

GFSK Mode:

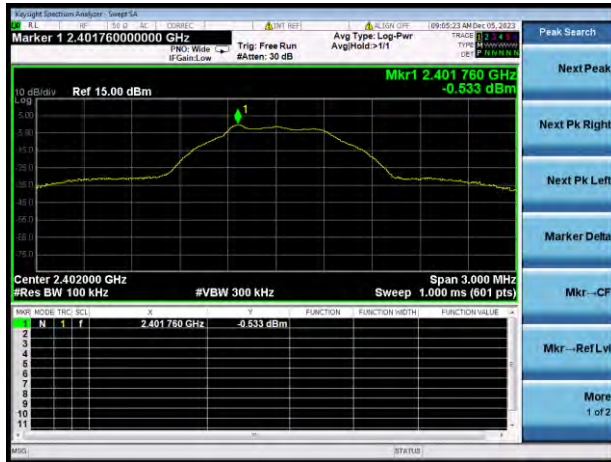
| GFSK    |                                                |               |                            |         |
|---------|------------------------------------------------|---------------|----------------------------|---------|
| Channel | Measured Max.<br>Out of Band<br>Emission (dBm) | Limit (dBm)   |                            | Verdict |
|         |                                                | Carrier Level | Calculated<br>20 dBc Limit |         |
| Low     | -23.96                                         | -0.53         | -20.53                     | Pass    |
| Middle  | -24.22                                         | -0.69         | -20.69                     | Pass    |
| High    | -24.35                                         | -1.00         | -21.00                     | Pass    |

Hopping Mode:

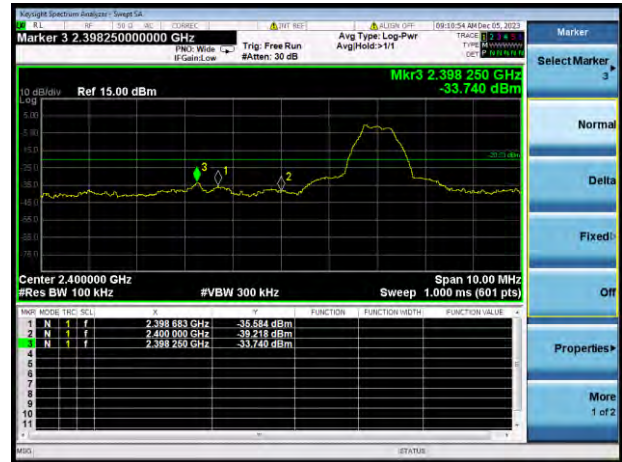
| GFSK    |                                                |               |                            |         |
|---------|------------------------------------------------|---------------|----------------------------|---------|
| Channel | Measured Max.<br>Out of Band<br>Emission (dBm) | Limit (dBm)   |                            | Verdict |
|         |                                                | Carrier Level | Calculated<br>20 dBc Limit |         |
| GFSK    | -23.64                                         | -0.38         | -20.38                     | Pass    |

## Test Plots

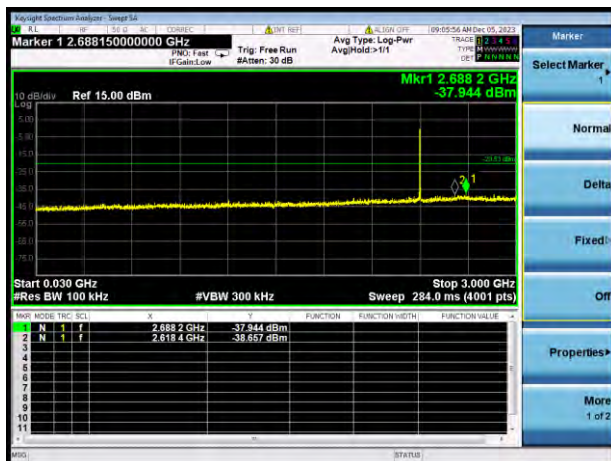
### GFSK LOW CHANNEL, CARRIER LEVEL



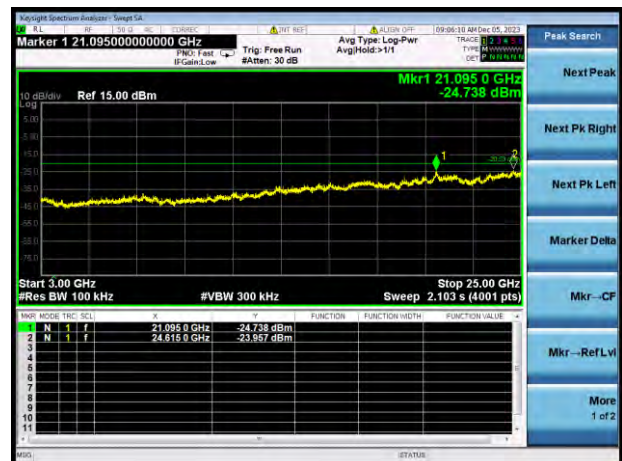
### GFSK LOW CHANNEL, BAND EDGE



### GFSK LOW CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



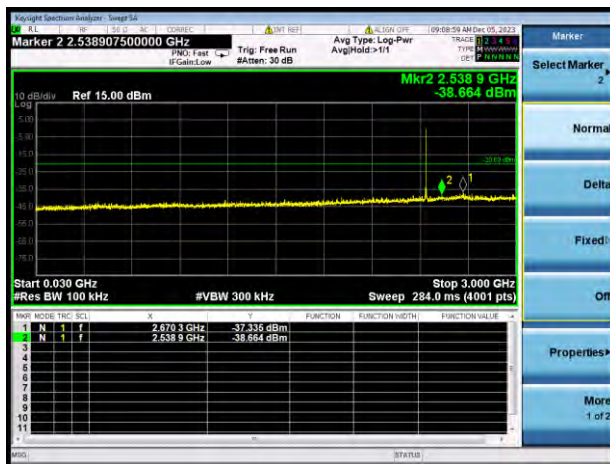
### GFSK LOW CHANNEL, SPURIOUS 3 GHz ~ 25 GHz



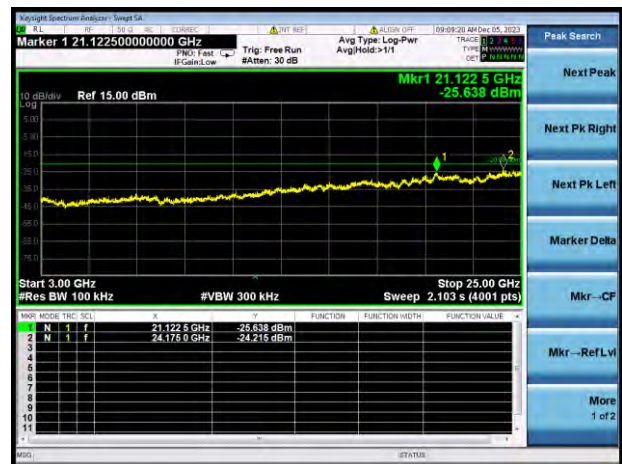
### GFSK MIDDLE CHANNEL, CARRIER LEVEL



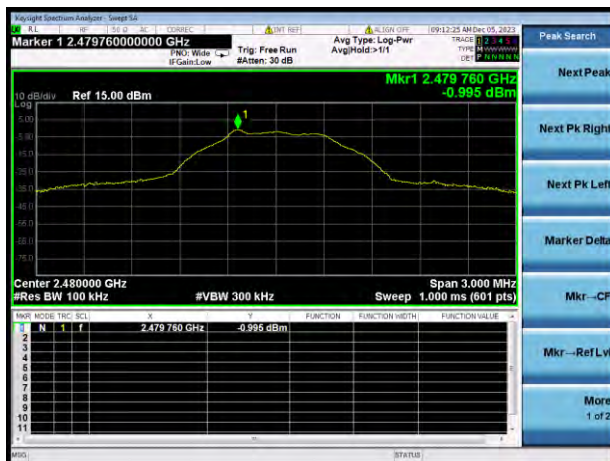
### GFSK MIDDLE CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



### GFSK MIDDLE CHANNEL, SPURIOUS 3 GHz ~ 25 GHz



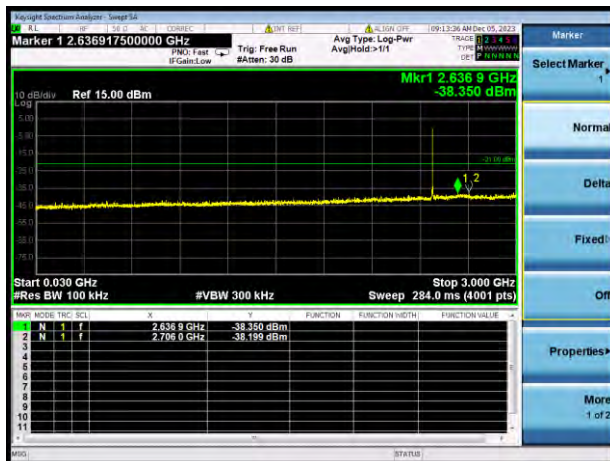
### GFSK HIGH CHANNEL, CARRIER LEVEL



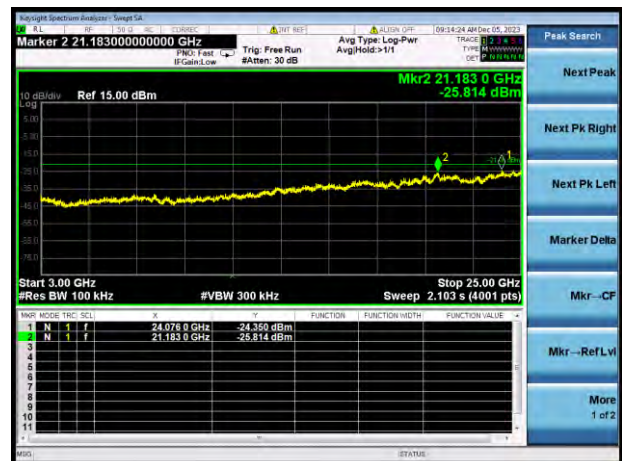
### GFSK HIGH CHANNEL, BAND EDGE



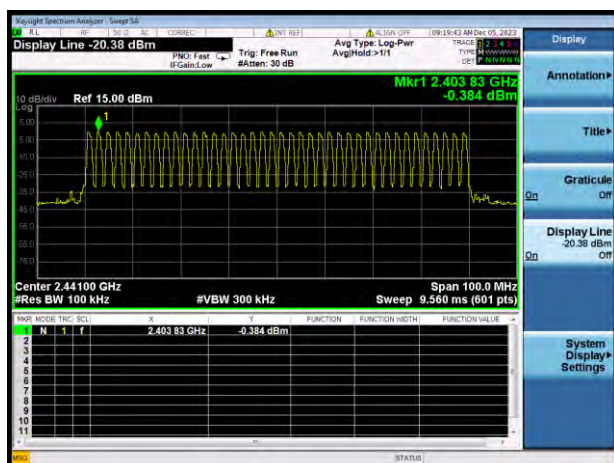
### GFSK HIGH CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



### GFSK HIGH CHANNEL, SPURIOUS 3 GHz ~ 25 GHz



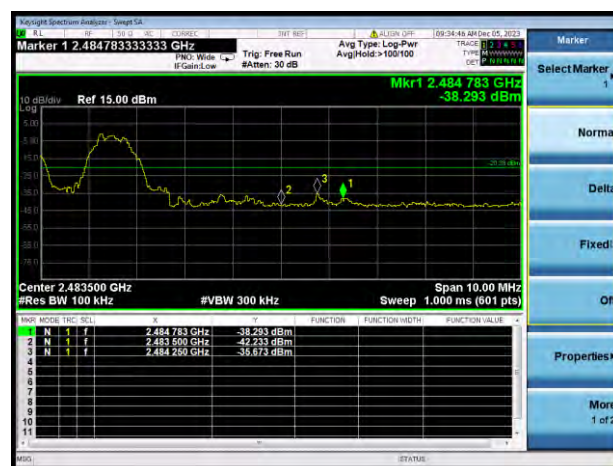
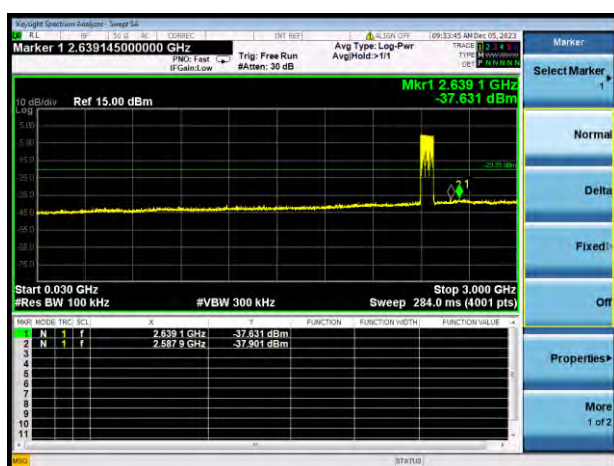
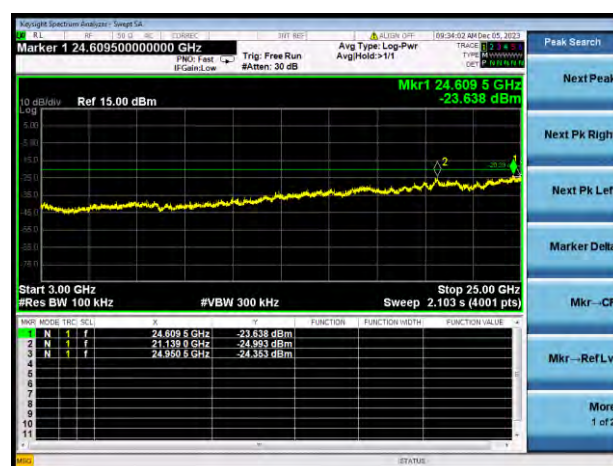
## GFSK HOPPING, CARRIER LEVEL



## GFSK HOPPING BAND EDGE (LOW)



## GFSK HOPPING BAND EDGE (HIGH)

GFSK Hopping Mode, SPURIOUS  
30 MHz ~ 3 GHzGFSK Hopping Mode, SPURIOUS  
3GHz ~ 25 GHz

## 5.8 Conducted Emission

### 5.8.1 Limit

#### FCC §15.207

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 $\mu$ H/50 $\Omega$  line impedance stabilization network (LISN).

| Frequency range (MHz) | Conducted Limit (dB $\mu$ V) |          |
|-----------------------|------------------------------|----------|
|                       | Quai-peak                    | Average  |
| 0.15 - 0.50           | 66 to 56                     | 56 to 46 |
| 0.50 - 5              | 56                           | 46       |
| 0.50 - 30             | 60                           | 50       |

### 5.8.2 Test Setup

See section 4.5.2 for test setup description for the AC power supply port. The photo of test setup please refer to ANNEX A.

### 5.8.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

## 5.8.4 Test Result

Note <sup>1</sup>: The EUT was tested in connected the laptop and dongle test mode.

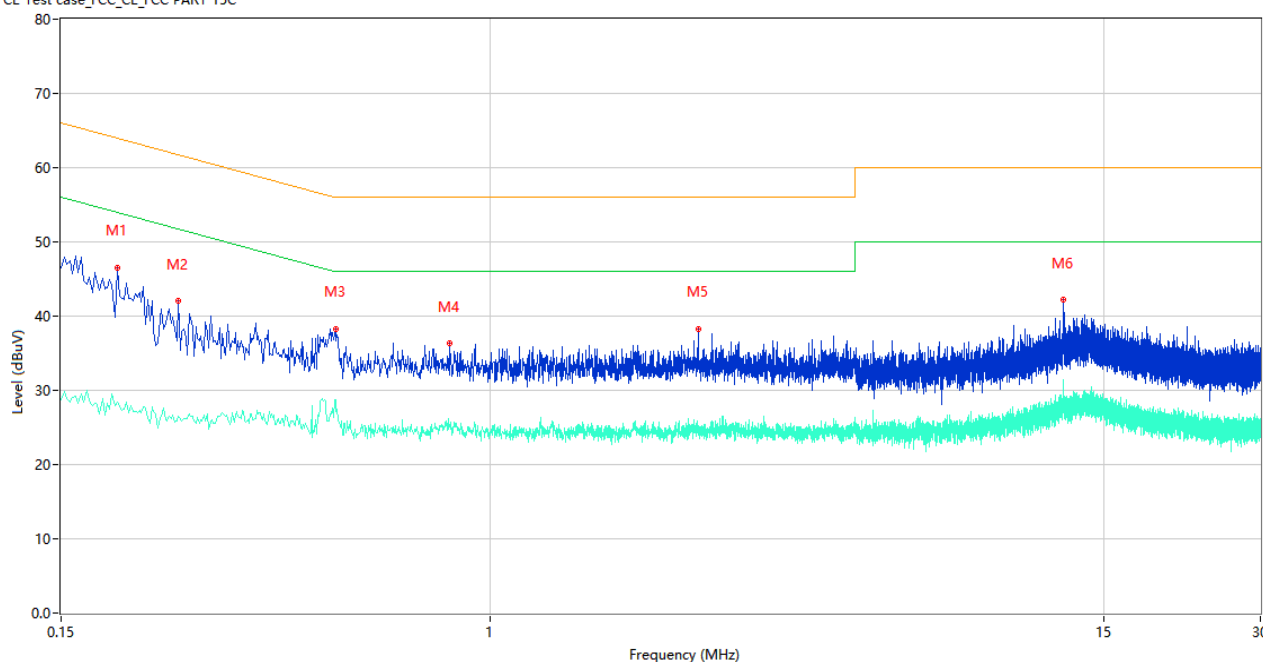
Note <sup>2</sup>: Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 60 Hz and 240 VAC, 50 Hz) for which the device is capable of operation. So, The configuration 120 VAC, 60 Hz and 240 VAC, 50 Hz were tested respectively, but only the worst configuration (120 VAC, 60 Hz ) shown here.

Note <sup>3</sup>: Results (dBuV) = Original reading level of Spectrum Analyzer (dBuV) + Factor (dB)

### Test Data and Plots

#### PHASE L

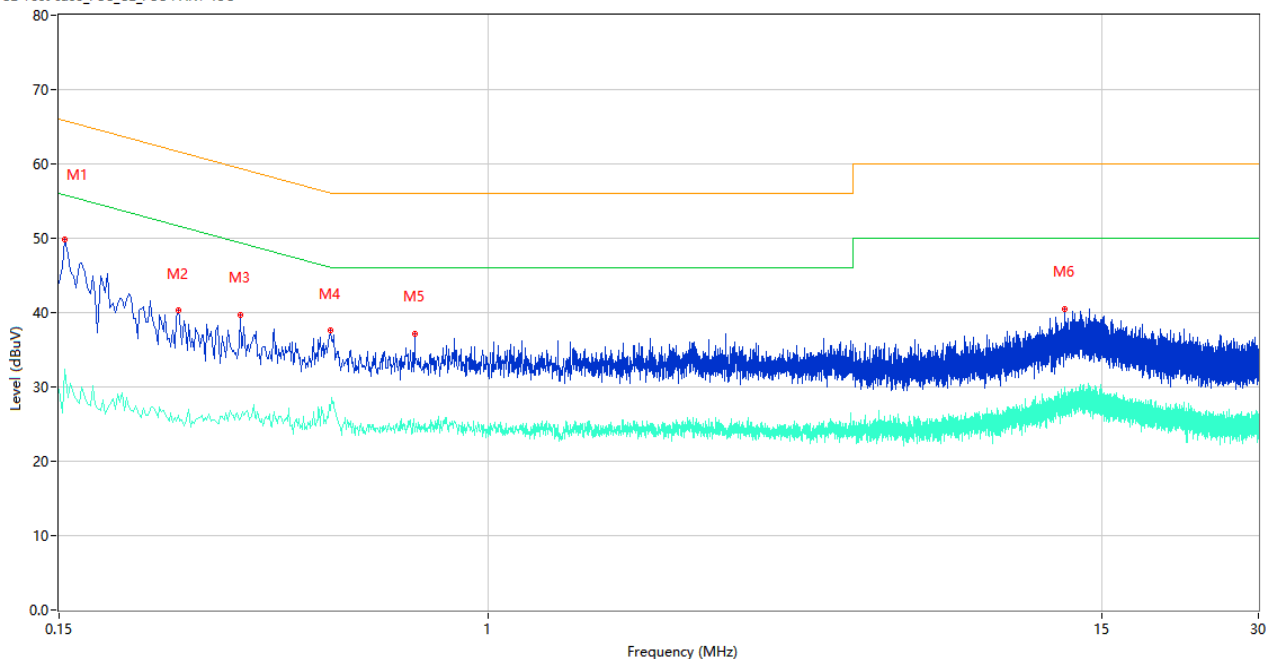
CE Test case\_FCC\_CE\_FCC PART 15C



| No. | Frequency (MHz) | Results (dBuV) | Factor (dB) | Limit (dBuV) | Margin (dB) | Detector | Line | Verdict |
|-----|-----------------|----------------|-------------|--------------|-------------|----------|------|---------|
| 1   | 0.192           | 46.43          | 9.77        | 63.95        | 17.52       | Peak     | L    | Pass    |
| 1** | 0.192           | 28.38          | 9.77        | 53.95        | 25.57       | AV       | L    | Pass    |
| 2   | 0.252           | 42.06          | 9.77        | 61.69        | 19.63       | Peak     | L    | Pass    |
| 2** | 0.252           | 26.53          | 9.77        | 51.69        | 25.16       | AV       | L    | Pass    |
| 3   | 0.504           | 38.29          | 9.98        | 56.00        | 17.71       | Peak     | L    | Pass    |
| 3** | 0.504           | 28.67          | 9.98        | 46.00        | 17.33       | AV       | L    | Pass    |
| 4   | 0.836           | 36.35          | 10.60       | 56.00        | 19.65       | Peak     | L    | Pass    |
| 4** | 0.836           | 25.11          | 10.60       | 46.00        | 20.89       | AV       | L    | Pass    |
| 5   | 2.506           | 38.32          | 10.15       | 56.00        | 17.68       | Peak     | L    | Pass    |
| 5** | 2.506           | 25.03          | 10.15       | 46.00        | 20.97       | AV       | L    | Pass    |
| 6   | 12.554          | 42.17          | 10.69       | 60.00        | 17.83       | Peak     | L    | Pass    |
| 6** | 12.554          | 29.87          | 10.69       | 50.00        | 20.13       | AV       | L    | Pass    |

## PHASE N

CE Test case\_FCC\_CE\_FCC PART 15C



| No. | Frequency (MHz) | Results (dBuV) | Factor (dB) | Limit (dBuV) | Margin (dB) | Detector | Line | Verdict |
|-----|-----------------|----------------|-------------|--------------|-------------|----------|------|---------|
| 1   | 0.154           | 49.84          | 9.78        | 65.78        | 15.94       | Peak     | N    | Pass    |
| 1** | 0.154           | 32.39          | 9.78        | 55.78        | 23.39       | AV       | N    | Pass    |
| 2   | 0.254           | 40.30          | 9.77        | 61.63        | 21.33       | Peak     | N    | Pass    |
| 2** | 0.254           | 26.22          | 9.77        | 51.63        | 25.41       | AV       | N    | Pass    |
| 3   | 0.334           | 39.69          | 10.44       | 59.35        | 19.66       | Peak     | N    | Pass    |
| 3** | 0.334           | 25.79          | 10.44       | 49.35        | 23.56       | AV       | N    | Pass    |
| 4   | 0.498           | 37.55          | 9.98        | 56.03        | 18.48       | Peak     | N    | Pass    |
| 4** | 0.498           | 26.79          | 9.98        | 46.03        | 19.24       | AV       | N    | Pass    |
| 5   | 0.722           | 37.15          | 10.44       | 56.00        | 18.85       | Peak     | N    | Pass    |
| 5** | 0.722           | 24.56          | 10.44       | 46.00        | 21.44       | AV       | N    | Pass    |
| 6   | 12.748          | 40.50          | 10.55       | 60.00        | 19.50       | Peak     | N    | Pass    |
| 6** | 12.748          | 29.87          | 10.55       | 50.00        | 20.13       | AV       | N    | Pass    |

## 5.9 Radiated Spurious Emission

### 5.9.1 Limit

FCC §15.209&15.247(d)

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field Strength (μV/m) | Measurement Distance (m) |
|-----------------|-----------------------|--------------------------|
| 0.009 - 0.490   | 2400/F(kHz)           | 300                      |
| 0.490 - 1.705   | 24000/F(kHz)          | 30                       |
| 1.705 - 30.0    | 30                    | 30                       |
| 30 - 88         | 100                   | 3                        |
| 88 - 216        | 150                   | 3                        |
| 216 - 960       | 200                   | 3                        |
| Above 960       | 500                   | 3                        |

Note:

1. Field Strength (dBμV/m) = 20\*log[Field Strength (μV/m)].
2. In the emission tables above, the tighter limit applies at the band edges.
3. For Above 1000 MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
4. For above 1000 MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).

### 5.9.2 Test Setup

See section 4.5.3 to 4.5.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

### 5.9.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for  $f \geq 1$  GHz, 100 kHz for  $f < 1$  GHz

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

## 5.9.4 Test Result

Note <sup>1</sup>: The symbol of "--" in the table which means not application.

Note <sup>2</sup>: For the test data above 1 GHz, according the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note <sup>3</sup>: The EUT was tested in connected the laptop and dongle test mode.

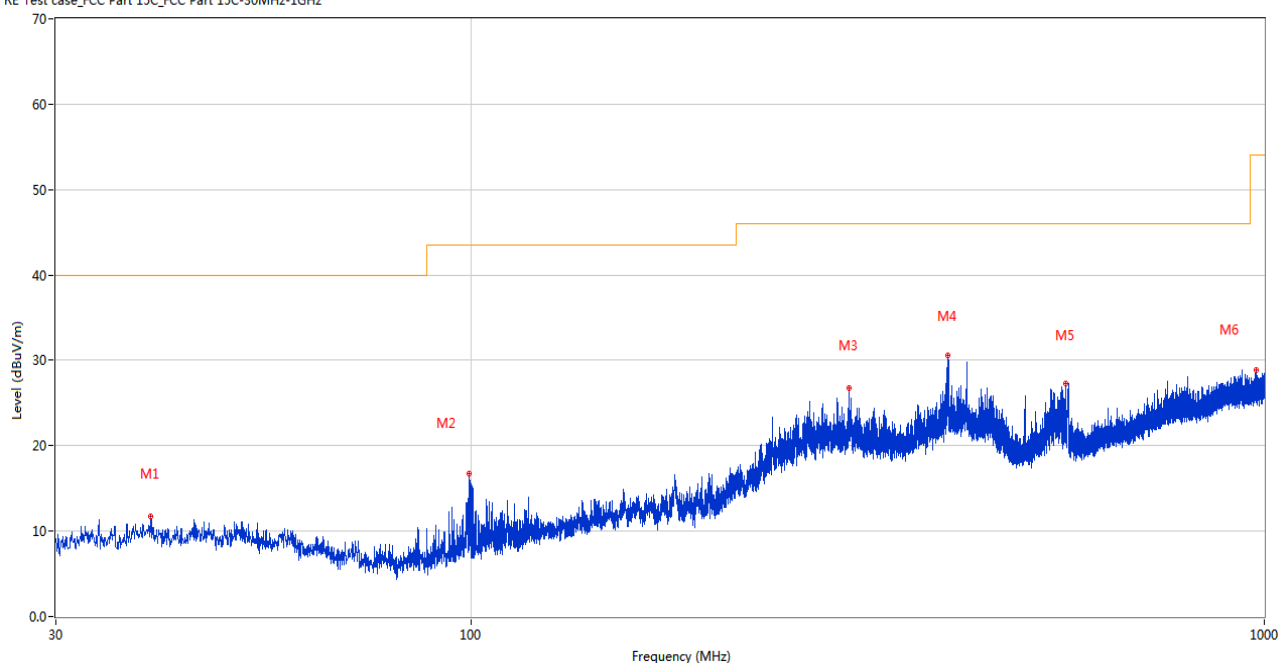
Note <sup>4</sup>: Results (dBuV/m) = Original reading level of Spectrum Analyzer (dBuV/m) + Factor (dB)

The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

### Test Data and Plots

#### 30 MHz to 1 GHz, ANT H

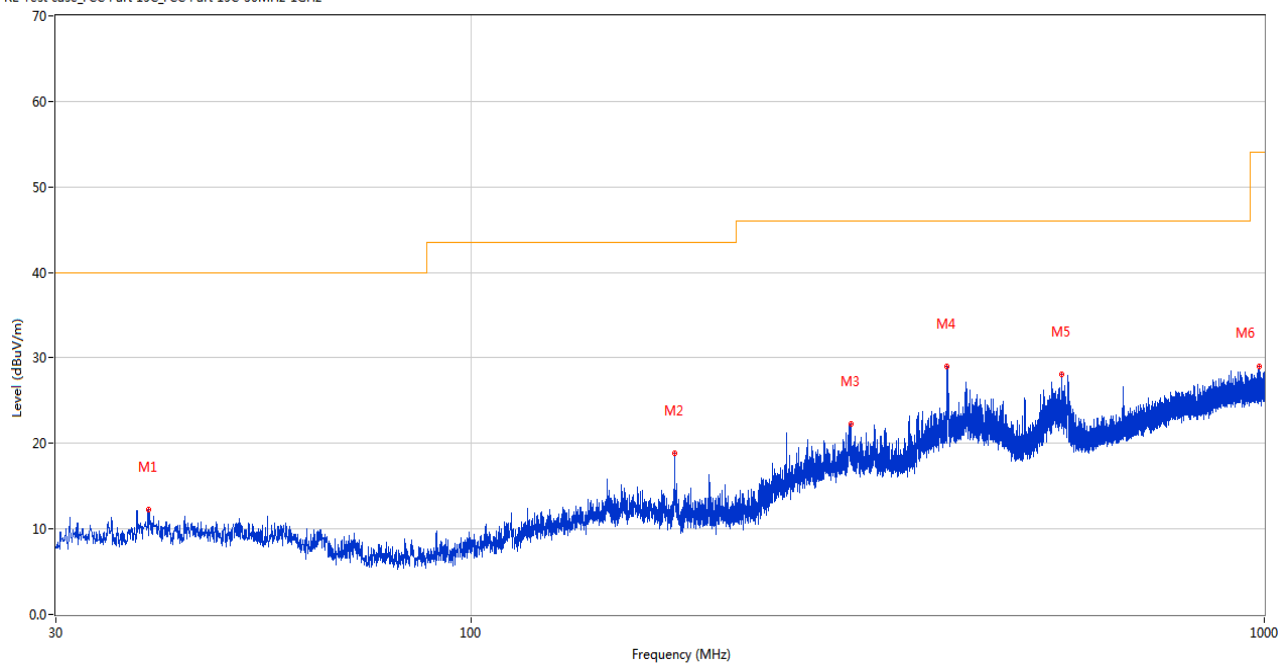
RE Test case\_FCC Part 15C\_FCC Part 15C-30MHz-1GHz



| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Margin (dB) | Detector | Table (Degree) | Height (cm) | Antenna    | Verdict |
|-----|-----------------|------------------|-------------|----------------|-------------|----------|----------------|-------------|------------|---------|
| 1   | 39.458          | 11.70            | -26.49      | 40.0           | 28.30       | Peak     | 201.00         | 100         | Horizontal | Pass    |
| 2   | 99.646          | 16.78            | -29.59      | 43.5           | 26.72       | Peak     | 247.00         | 200         | Horizontal | Pass    |
| 3   | 299.369         | 26.75            | -24.61      | 46.0           | 19.25       | Peak     | 244.00         | 100         | Horizontal | Pass    |
| 4   | 399.279         | 30.61            | -21.37      | 46.0           | 15.39       | Peak     | 98.00          | 100         | Horizontal | Pass    |
| 5   | 562.142         | 27.29            | -17.61      | 46.0           | 18.71       | Peak     | 79.00          | 200         | Horizontal | Pass    |
| 6   | 976.575         | 28.83            | -11.18      | 54.0           | 25.17       | Peak     | 360.00         | 100         | Horizontal | Pass    |

## 30 MHz to 1 GHz, ANT V

RE Test case\_FCC Part 15C\_FCC Part 15C-30MHz-1GHz



| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Margin (dB) | Detector | Table (Degree) | Height (cm) | Antenna  | Verdict |
|-----|-----------------|------------------|-------------|----------------|-------------|----------|----------------|-------------|----------|---------|
| 1   | 39.215          | 12.20            | -26.53      | 40.0           | 27.80       | Peak     | 12.00          | 200         | Vertical | Pass    |
| 2   | 180.641         | 18.81            | -27.29      | 43.5           | 24.69       | Peak     | 204.00         | 200         | Vertical | Pass    |
| 3   | 301.066         | 22.22            | -24.61      | 46.0           | 23.78       | Peak     | 245.00         | 200         | Vertical | Pass    |
| 4   | 398.600         | 28.97            | -21.42      | 46.0           | 17.03       | Peak     | 349.00         | 100         | Vertical | Pass    |
| 5   | 555.449         | 28.06            | -18.03      | 46.0           | 17.94       | Peak     | 146.00         | 200         | Vertical | Pass    |
| 6   | 984.286         | 29.00            | -11.29      | 54.0           | 25.00       | Peak     | 260.00         | 100         | Vertical | Pass    |

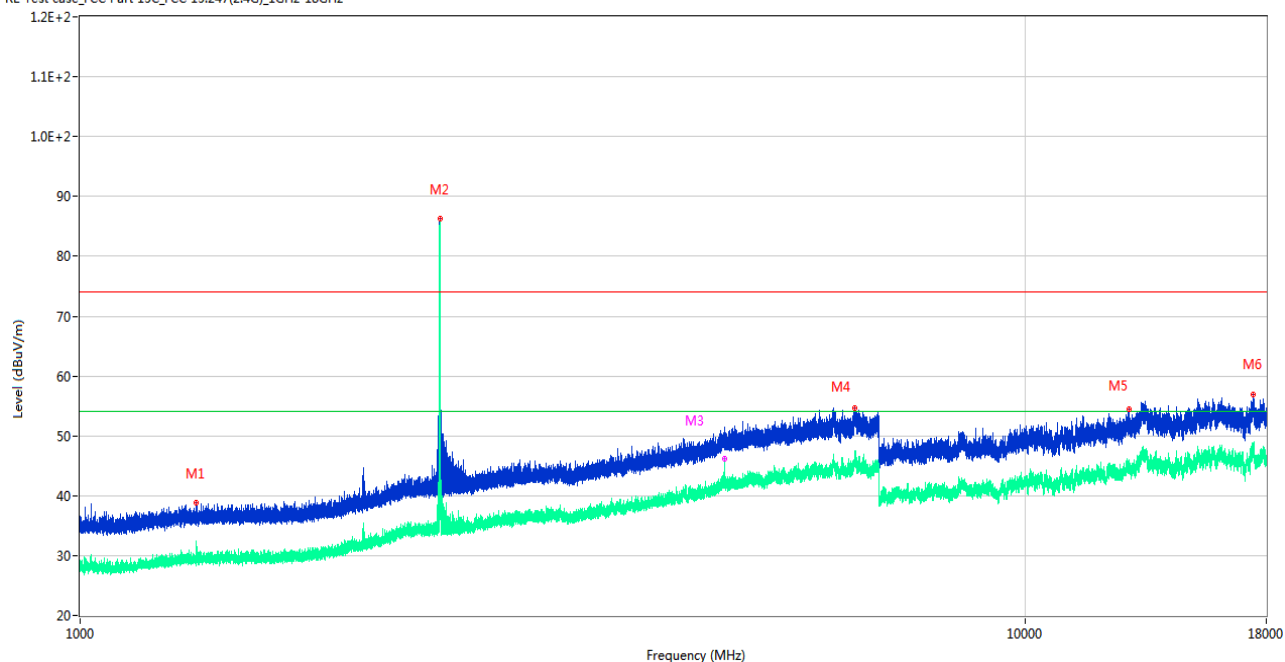
### Test Data and Plots

Note 1: The marked spikes near 2400 MHz with circle should be ignored because they are Fundamental signal.

Note 2: The spurious from 18GHz-25GHz is noise only, do not show on the report.

#### GFSK LOW CHANNEL 1 GHz to 18 GHz, ANT H

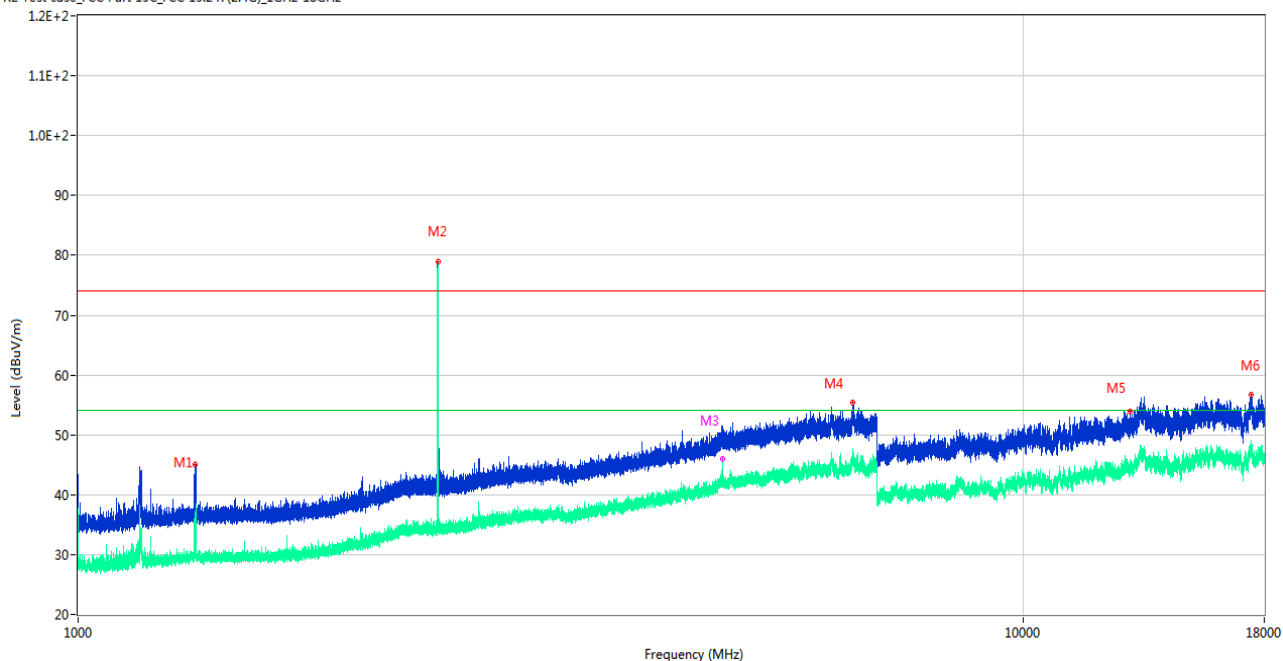
RE Test case\_FCC Part 15C\_FCC 15.247(2.4G)\_1GHz-18GHz



| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Margin (dB) | Detector | Table (Degree) | Height (cm) | Antenna    | Verdict |
|-----|-----------------|------------------|-------------|----------------|-------------|----------|----------------|-------------|------------|---------|
| 1   | 1328.000        | 38.82            | -17.66      | 74.0           | 35.18       | Peak     | 160.00         | 200         | Horizontal | Pass    |
| 1** | 1328.000        | 32.39            | -17.66      | 54.0           | 21.61       | AV       | 160.00         | 200         | Horizontal | Pass    |
| 2   | 2402.200        | 86.25            | -12.43      | 74.0           | -12.25      | Peak     | 240.00         | 200         | Horizontal | N/A     |
| 2** | 2402.200        | 85.91            | -12.43      | 54.0           | -31.91      | AV       | 240.00         | 200         | Horizontal | N/A     |
| 3   | 4804.200        | 51.52            | -3.16       | 74.0           | 22.48       | Peak     | 73.00          | 150         | Horizontal | Pass    |
| 3** | 4804.200        | 46.26            | -3.16       | 54.0           | 7.74        | AV       | 73.00          | 150         | Horizontal | Pass    |
| 4   | 6609.400        | 54.71            | 1.57        | 74.0           | 19.29       | Peak     | 295.00         | 200         | Horizontal | Pass    |
| 4** | 6609.400        | 46.72            | 1.57        | 54.0           | 7.28        | AV       | 295.00         | 200         | Horizontal | Pass    |
| 5   | 12889.650       | 54.43            | 1.58        | 74.0           | 19.57       | Peak     | 340.00         | 100         | Horizontal | Pass    |
| 5** | 12889.650       | 44.67            | 1.58        | 54.0           | 9.33        | AV       | 340.00         | 100         | Horizontal | Pass    |
| 6   | 17420.925       | 56.99            | 3.73        | 74.0           | 17.01       | Peak     | 360.00         | 400         | Horizontal | Pass    |
| 6** | 17420.925       | 48.14            | 3.73        | 54.0           | 5.86        | AV       | 360.00         | 400         | Horizontal | Pass    |

## GFSK LOW CHANNEL 1 GHz to 18 GHz, ANT V

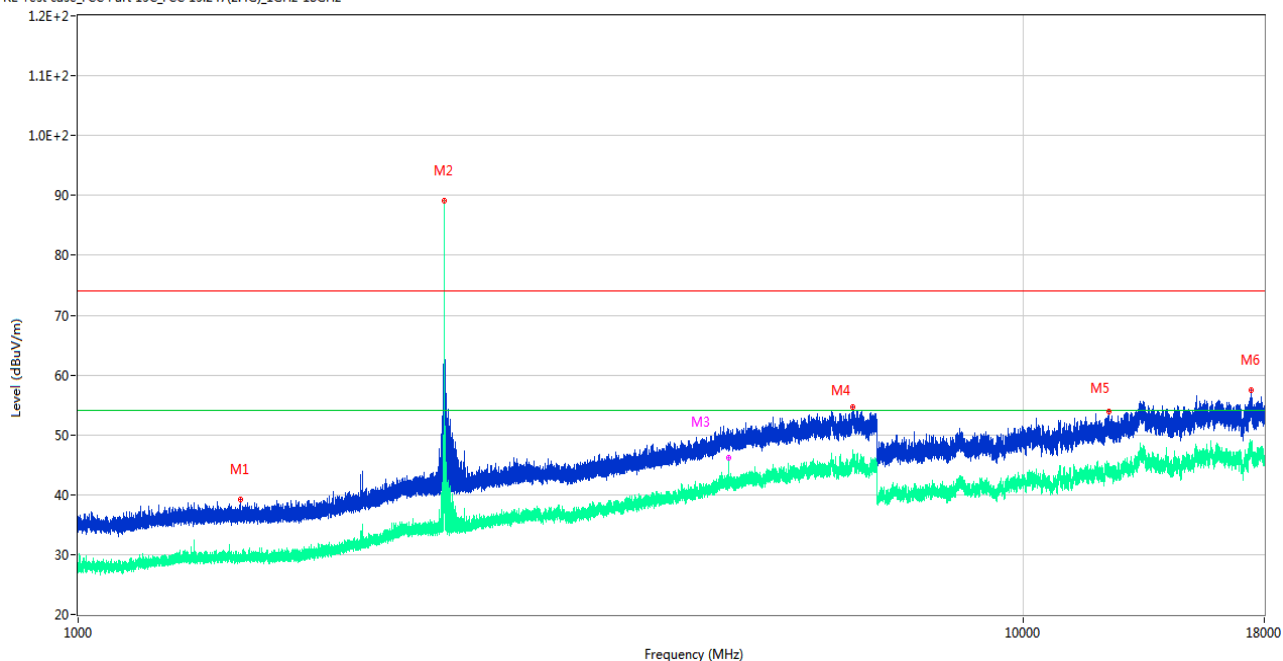
RE Test case\_FCC Part 15C\_FCC 15.247(2.4G)\_1GHz-18GHz



| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Margin (dB) | Detector | Table (Degree) | Height (cm) | Antenna  | Verdict |
|-----|-----------------|------------------|-------------|----------------|-------------|----------|----------------|-------------|----------|---------|
| 1   | 1331.000        | 45.02            | -17.48      | 74.0           | 28.98       | Peak     | 27.00          | 100         | Vertical | Pass    |
| 1** | 1331.000        | 30.86            | -17.48      | 54.0           | 23.14       | AV       | 27.00          | 100         | Vertical | Pass    |
| 2   | 2402.000        | 78.98            | -12.46      | 74.0           | -4.98       | Peak     | 153.00         | 100         | Vertical | N/A     |
| 2** | 2402.000        | 78.87            | -12.46      | 54.0           | -24.87      | AV       | 153.00         | 100         | Vertical | N/A     |
| 3   | 4804.400        | 50.19            | -3.18       | 74.0           | 23.81       | Peak     | 276.00         | 150         | Vertical | Pass    |
| 3** | 4804.400        | 45.93            | -3.18       | 54.0           | 8.07        | AV       | 276.00         | 150         | Vertical | Pass    |
| 4   | 6607.000        | 55.39            | 1.48        | 74.0           | 18.61       | Peak     | 360.00         | 200         | Vertical | Pass    |
| 4** | 6607.000        | 46.20            | 1.48        | 54.0           | 7.80        | AV       | 360.00         | 200         | Vertical | Pass    |
| 5   | 12975.487       | 53.93            | 0.93        | 74.0           | 20.07       | Peak     | 325.00         | 200         | Vertical | Pass    |
| 5** | 12975.487       | 43.95            | 0.93        | 54.0           | 10.05       | AV       | 325.00         | 200         | Vertical | Pass    |
| 6   | 17428.802       | 56.65            | 3.49        | 74.0           | 17.35       | Peak     | 94.00          | 300         | Vertical | Pass    |
| 6** | 17428.802       | 47.56            | 3.49        | 54.0           | 6.44        | AV       | 94.00          | 300         | Vertical | Pass    |

## GFSK MIDDLE CHANNEL 1 GHz to 18 GHz, ANT H

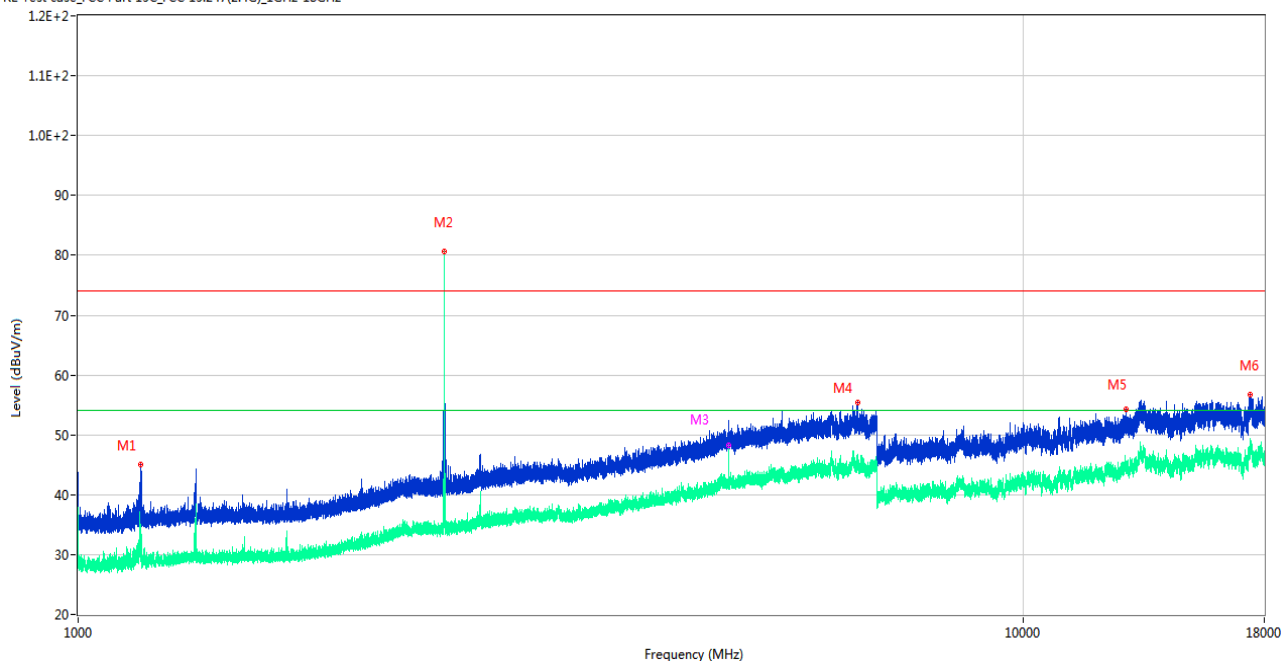
RE Test case\_FCC Part 15C\_FCC 15.247(2.4G)\_1GHz-18GHz



| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Margin (dB) | Detector | Table (Degree) | Height (cm) | Antenna    | Verdict |
|-----|-----------------|------------------|-------------|----------------|-------------|----------|----------------|-------------|------------|---------|
| 1   | 1486.700        | 39.29            | -17.65      | 74.0           | 34.71       | Peak     | 201.00         | 200         | Horizontal | Pass    |
| 1** | 1486.700        | 29.81            | -17.65      | 54.0           | 24.19       | AV       | 201.00         | 200         | Horizontal | Pass    |
| 2   | 2440.000        | 89.16            | -12.41      | 74.0           | -15.16      | Peak     | 249.00         | 200         | Horizontal | N/A     |
| 2** | 2440.000        | 88.81            | -12.41      | 54.0           | -34.81      | AV       | 249.00         | 200         | Horizontal | N/A     |
| 3   | 4880.200        | 50.12            | -3.36       | 74.0           | 23.88       | Peak     | 93.00          | 150         | Horizontal | Pass    |
| 3** | 4880.200        | 46.22            | -3.36       | 54.0           | 7.78        | AV       | 93.00          | 150         | Horizontal | Pass    |
| 4   | 6609.600        | 54.58            | 1.55        | 74.0           | 19.42       | Peak     | 93.00          | 200         | Horizontal | Pass    |
| 4** | 6609.600        | 46.76            | 1.55        | 54.0           | 7.24        | AV       | 93.00          | 200         | Horizontal | Pass    |
| 5   | 12328.813       | 53.83            | 1.42        | 74.0           | 20.17       | Peak     | 292.00         | 100         | Horizontal | Pass    |
| 5** | 12328.813       | 45.14            | 1.42        | 54.0           | 8.86        | AV       | 292.00         | 100         | Horizontal | Pass    |
| 6   | 17428.537       | 57.47            | 3.50        | 74.0           | 16.53       | Peak     | 137.00         | 200         | Horizontal | Pass    |
| 6** | 17428.537       | 47.74            | 3.50        | 54.0           | 6.26        | AV       | 137.00         | 200         | Horizontal | Pass    |

## GFSK MIDDLE CHANNEL 1 GHz to 18 GHz, ANT V

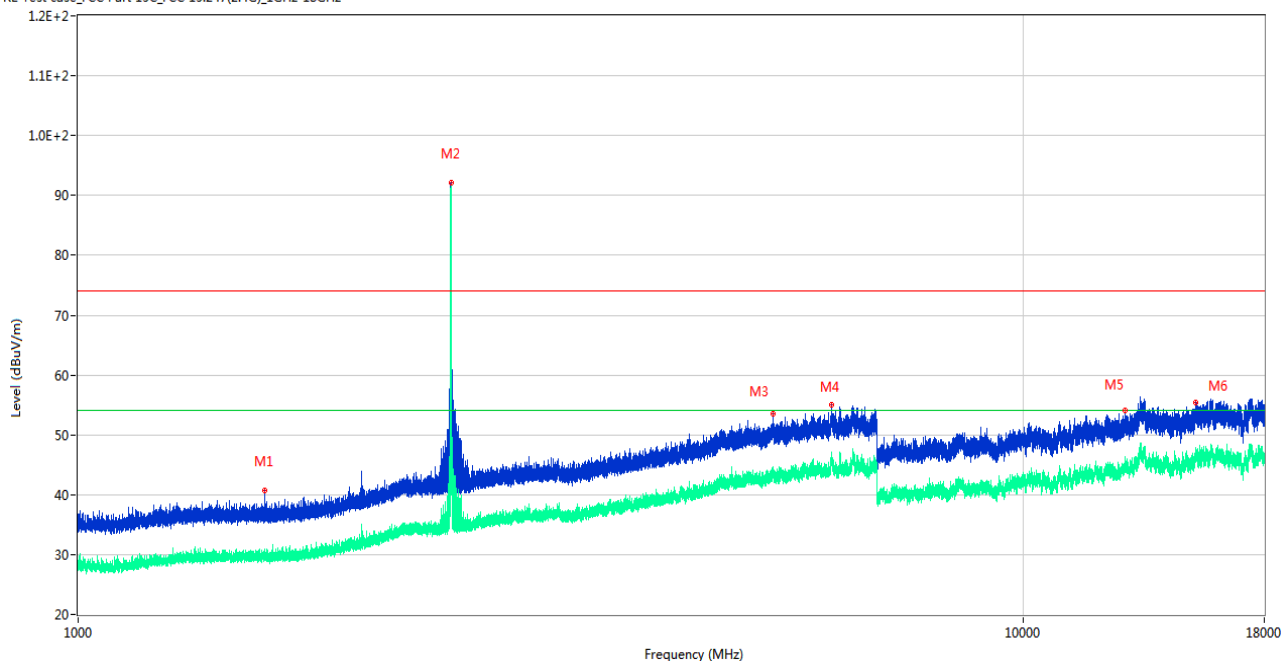
RE Test case\_FCC Part 15C\_FCC 15.247(2.4G)\_1GHz-18GHz



| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Margin (dB) | Detector | Table (Degree) | Height (cm) | Antenna  | Verdict |
|-----|-----------------|------------------|-------------|----------------|-------------|----------|----------------|-------------|----------|---------|
| 1   | 1163.700        | 45.14            | -17.96      | 74.0           | 28.86       | Peak     | 63.00          | 100         | Vertical | Pass    |
| 1** | 1163.700        | 32.37            | -17.96      | 54.0           | 21.63       | AV       | 63.00          | 100         | Vertical | Pass    |
| 2   | 2440.000        | 80.62            | -12.41      | 74.0           | -6.62       | Peak     | 161.00         | 100         | Vertical | N/A     |
| 2** | 2440.000        | 80.51            | -12.41      | 54.0           | -26.51      | AV       | 161.00         | 100         | Vertical | N/A     |
| 3   | 4880.000        | 52.31            | -3.37       | 74.0           | 21.69       | Peak     | 268.00         | 150         | Vertical | Pass    |
| 3** | 4880.000        | 48.30            | -3.37       | 54.0           | 5.70        | AV       | 268.00         | 150         | Vertical | Pass    |
| 4   | 6683.800        | 55.38            | 0.07        | 74.0           | 18.62       | Peak     | 140.00         | 200         | Vertical | Pass    |
| 4** | 6683.800        | 44.80            | 0.07        | 54.0           | 9.20        | AV       | 140.00         | 200         | Vertical | Pass    |
| 5   | 12852.638       | 54.34            | 1.39        | 74.0           | 19.66       | Peak     | 245.00         | 200         | Vertical | Pass    |
| 5** | 12852.638       | 44.50            | 1.39        | 54.0           | 9.50        | AV       | 245.00         | 200         | Vertical | Pass    |
| 6   | 17409.901       | 56.70            | 3.44        | 74.0           | 17.30       | Peak     | 54.00          | 100         | Vertical | Pass    |
| 6** | 17409.901       | 47.76            | 3.44        | 54.0           | 6.24        | AV       | 54.00          | 100         | Vertical | Pass    |

## GFSK HIGH CHANNEL 1 GHz to 18 GHz, ANT H

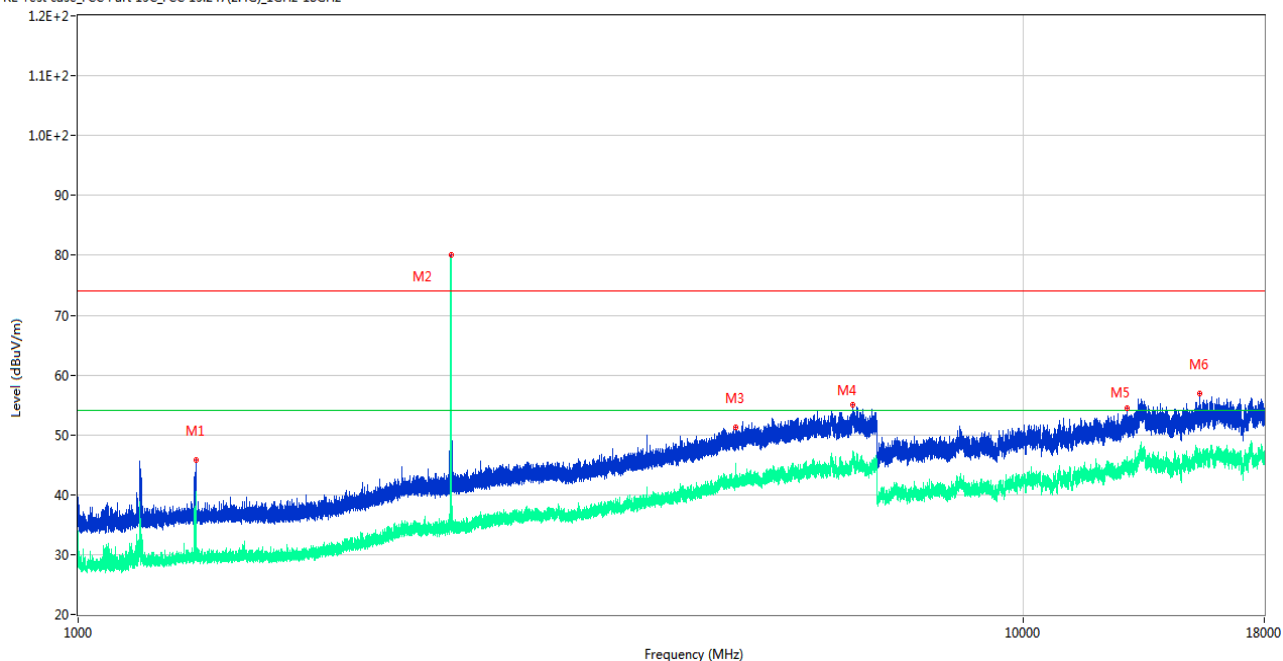
RE Test case\_FCC Part 15C\_FCC 15.247(2.4G)\_1GHz-18GHz



| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Margin (dB) | Detector | Table (Degree) | Height (cm) | Antenna    | Verdict |
|-----|-----------------|------------------|-------------|----------------|-------------|----------|----------------|-------------|------------|---------|
| 1   | 1575.900        | 40.69            | -17.51      | 74.0           | 33.31       | Peak     | 66.00          | 100         | Horizontal | Pass    |
| 1** | 1575.900        | 29.88            | -17.51      | 54.0           | 24.12       | AV       | 66.00          | 100         | Horizontal | Pass    |
| 2   | 2480.000        | 92.09            | -12.02      | 74.0           | -18.09      | Peak     | 248.00         | 100         | Horizontal | N/A     |
| 2** | 2480.000        | 91.72            | -12.02      | 54.0           | -37.72      | AV       | 248.00         | 100         | Horizontal | N/A     |
| 3   | 5437.000        | 53.46            | -1.59       | 74.0           | 20.54       | Peak     | 213.00         | 150         | Horizontal | Pass    |
| 3** | 5437.000        | 43.40            | -1.59       | 54.0           | 10.60       | AV       | 213.00         | 150         | Horizontal | Pass    |
| 4   | 6269.800        | 55.04            | 0.43        | 74.0           | 18.96       | Peak     | 190.00         | 400         | Horizontal | Pass    |
| 4** | 6269.800        | 45.56            | 0.43        | 54.0           | 8.44        | AV       | 190.00         | 400         | Horizontal | Pass    |
| 5   | 12836.888       | 54.11            | 1.29        | 74.0           | 19.89       | Peak     | 189.00         | 200         | Horizontal | Pass    |
| 5** | 12836.888       | 44.43            | 1.29        | 54.0           | 9.57        | AV       | 189.00         | 200         | Horizontal | Pass    |
| 6   | 15229.575       | 55.35            | 0.88        | 74.0           | 18.65       | Peak     | 323.00         | 150         | Horizontal | Pass    |
| 6** | 15229.575       | 46.89            | 0.88        | 54.0           | 7.11        | AV       | 323.00         | 150         | Horizontal | Pass    |

## GFSK HIGH CHANNEL 1 GHz to 18 GHz, ANT V

RE Test case\_FCC Part 15C\_FCC 15.247(2.4G)\_1GHz-18GHz



| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Margin (dB) | Detector | Table (Degree) | Height (cm) | Antenna  | Verdict |
|-----|-----------------|------------------|-------------|----------------|-------------|----------|----------------|-------------|----------|---------|
| 1   | 1332.800        | 45.74            | -17.52      | 74.0           | 28.26       | Peak     | 61.00          | 300         | Vertical | Pass    |
| 1** | 1332.800        | 33.55            | -17.52      | 54.0           | 20.45       | AV       | 61.00          | 300         | Vertical | Pass    |
| 2   | 2480.100        | 80.08            | -12.02      | 74.0           | -6.08       | Peak     | 168.00         | 200         | Vertical | N/A     |
| 2** | 2480.100        | 79.94            | -12.02      | 54.0           | -25.94      | AV       | 168.00         | 200         | Vertical | N/A     |
| 3   | 4963.200        | 51.20            | -2.96       | 74.0           | 22.80       | Peak     | 181.00         | 100         | Vertical | Pass    |
| 3** | 4963.200        | 41.79            | -2.96       | 54.0           | 12.21       | AV       | 181.00         | 100         | Vertical | Pass    |
| 4   | 6604.000        | 55.00            | 1.01        | 74.0           | 19.00       | Peak     | 148.00         | 100         | Vertical | Pass    |
| 4** | 6604.000        | 46.91            | 1.01        | 54.0           | 7.09        | AV       | 148.00         | 100         | Vertical | Pass    |
| 5   | 12895.950       | 54.50            | 1.55        | 74.0           | 19.50       | Peak     | 130.00         | 400         | Vertical | Pass    |
| 5** | 12895.950       | 44.68            | 1.55        | 54.0           | 9.32        | AV       | 130.00         | 400         | Vertical | Pass    |
| 6   | 15396.787       | 56.88            | 0.70        | 74.0           | 17.12       | Peak     | 339.00         | 200         | Vertical | Pass    |
| 6** | 15396.787       | 46.62            | 0.70        | 54.0           | 7.38        | AV       | 339.00         | 200         | Vertical | Pass    |

## 5.10 Band Edge (Restricted-band band-edge)

### 5.10.1 Limit

FCC §15.209&15.247(d)

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

### 5.10.2 Test Setup

See section 4.5.3 to 4.5.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

### 5.10.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for  $f \geq 1$  GHz, 100 kHz for  $f < 1$  GHz

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

### 5.10.4 Test Result

Note <sup>1</sup>: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.

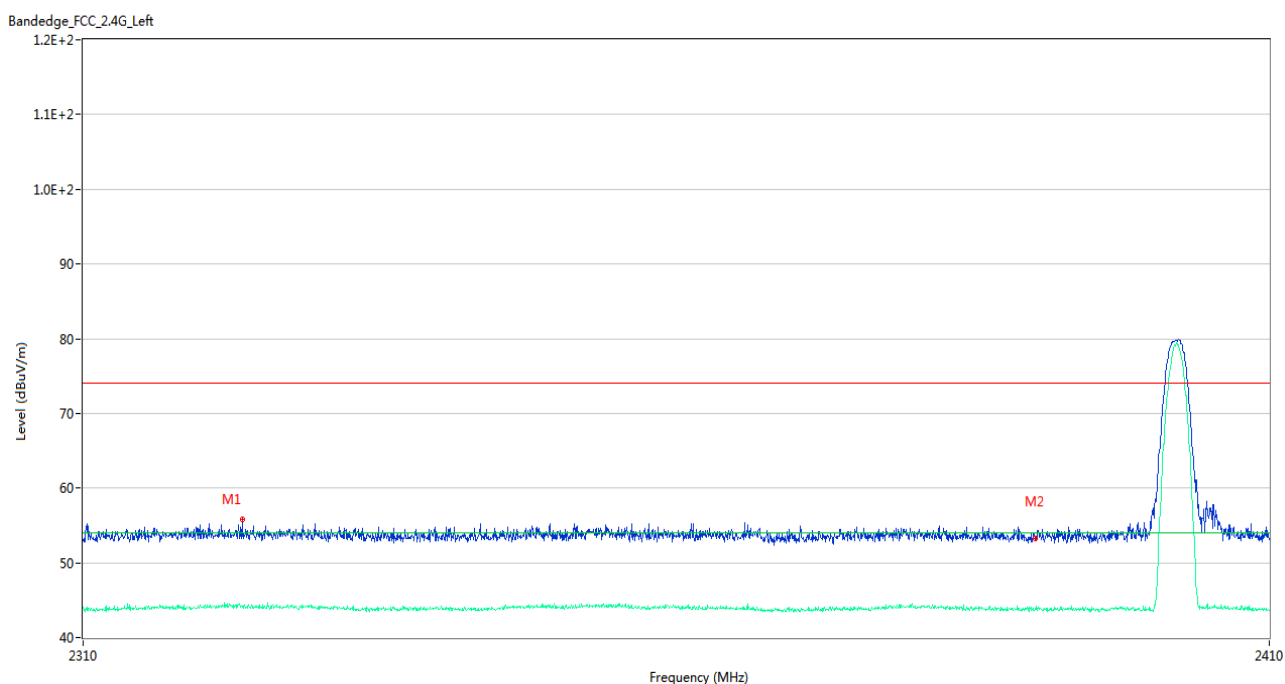
Note <sup>2</sup>: The test data all are tested in the vertical and horizontal antenna which the trace is max hold. So these plots have shown the worst case.

Note <sup>3</sup>: According the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note <sup>4</sup>: The Level (dBuV/m) has been corrected by factor.

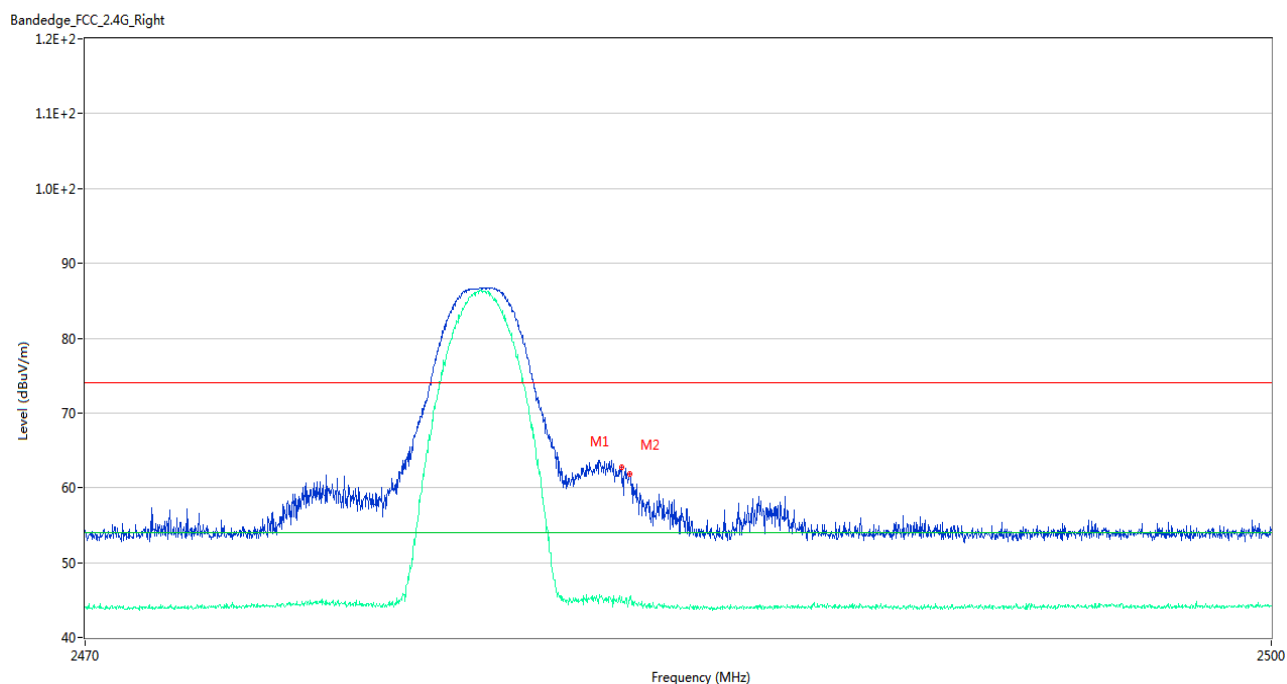
#### Test Data

##### GFSK LOW CHANNEL



| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Margin (dB) | Detector | Table (Degree) | Height (cm) | Antenna    | Verdict |
|-----|-----------------|------------------|-------------|----------------|-------------|----------|----------------|-------------|------------|---------|
| 1   | 2323.150        | 55.89            | -0.65       | 74.0           | 18.11       | Peak     | 222.00         | 200         | Horizontal | Pass    |
| 1** | 2323.150        | 44.19            | -0.65       | 54.0           | 9.81        | AV       | 222.00         | 200         | Horizontal | Pass    |
| 2   | 2389.950        | 53.20            | -0.59       | 74.0           | 20.80       | Peak     | 21.00          | 200         | Horizontal | Pass    |
| 2** | 2389.950        | 43.73            | -0.59       | 54.0           | 10.27       | AV       | 21.00          | 200         | Horizontal | Pass    |

## GFSK HIGH CHANNEL

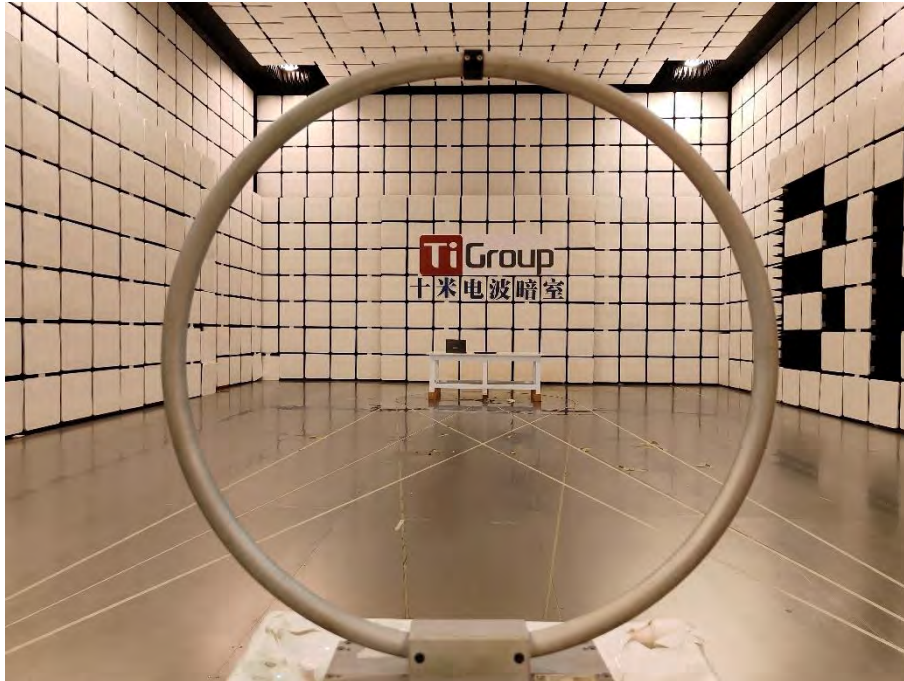


| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Margin (dB) | Detector | Table (Degree) | Height (cm) | Antenna    | Verdict |
|-----|-----------------|------------------|-------------|----------------|-------------|----------|----------------|-------------|------------|---------|
| 1   | 2483.515        | 62.76            | -0.05       | 74.0           | 11.24       | Peak     | 244.00         | 100         | Horizontal | Pass    |
| 1** | 2483.515        | 45.39            | -0.05       | 54.0           | 8.61        | AV       | 244.00         | 100         | Horizontal | Pass    |
| 2   | 2483.725        | 61.91            | -0.07       | 74.0           | 12.09       | Peak     | 254.00         | 150         | Horizontal | Pass    |
| 2** | 2483.725        | 45.04            | -0.07       | 54.0           | 8.96        | AV       | 254.00         | 150         | Horizontal | Pass    |

## ANNEX A TEST SETUP PHOTOS

### 1 Radiated Test Photo

Below 30MHz



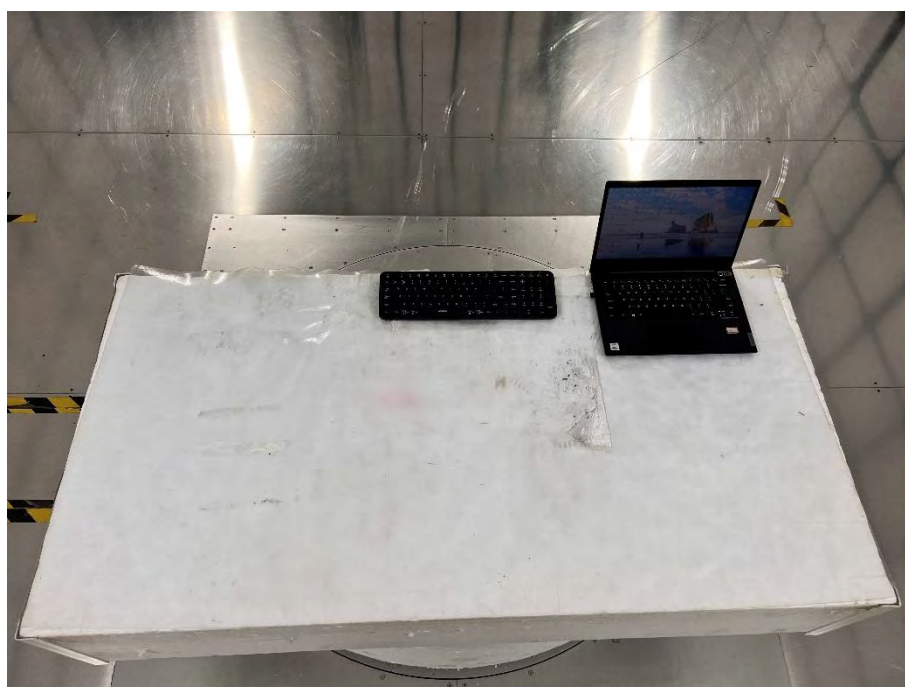
Close-up



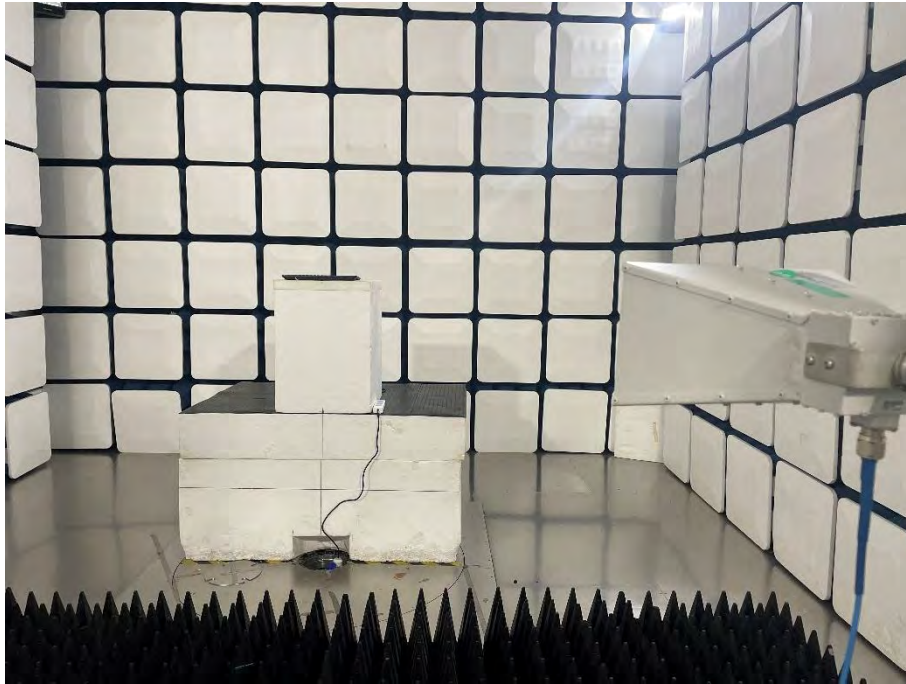
30MHz-1GHz



Close-up



Above 1GHz



Close-up



## 2 Conducted Test Photo

Conducted Test

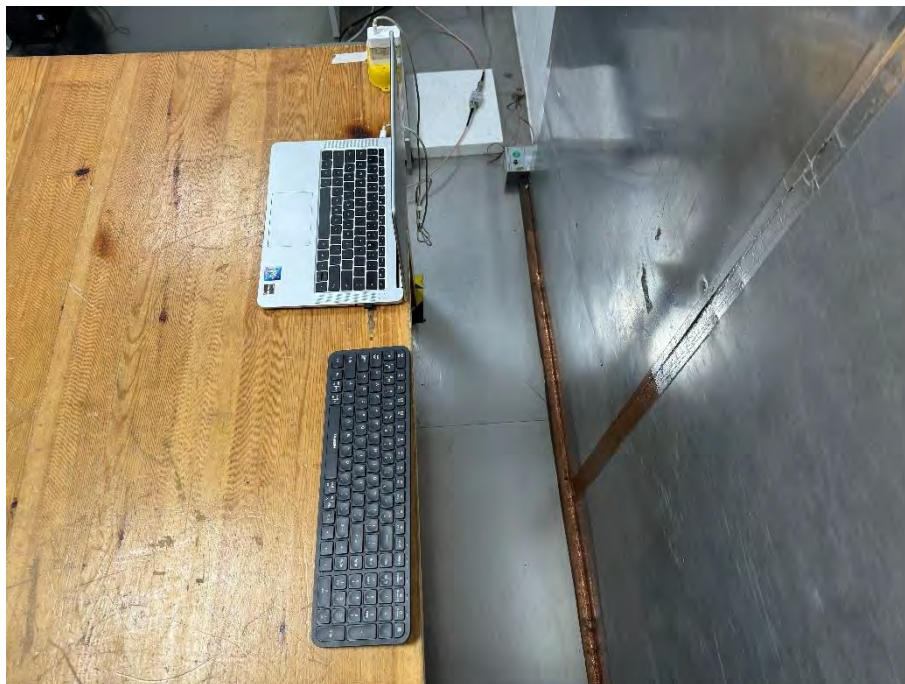


## 3 Conducted Emissions

Test Photo 1

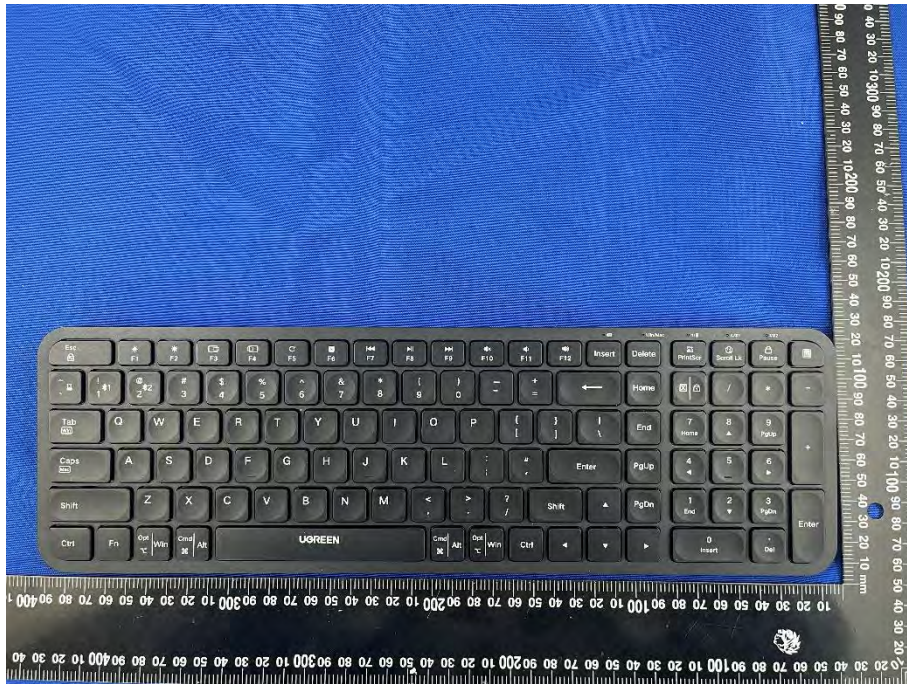


Test Photo 2

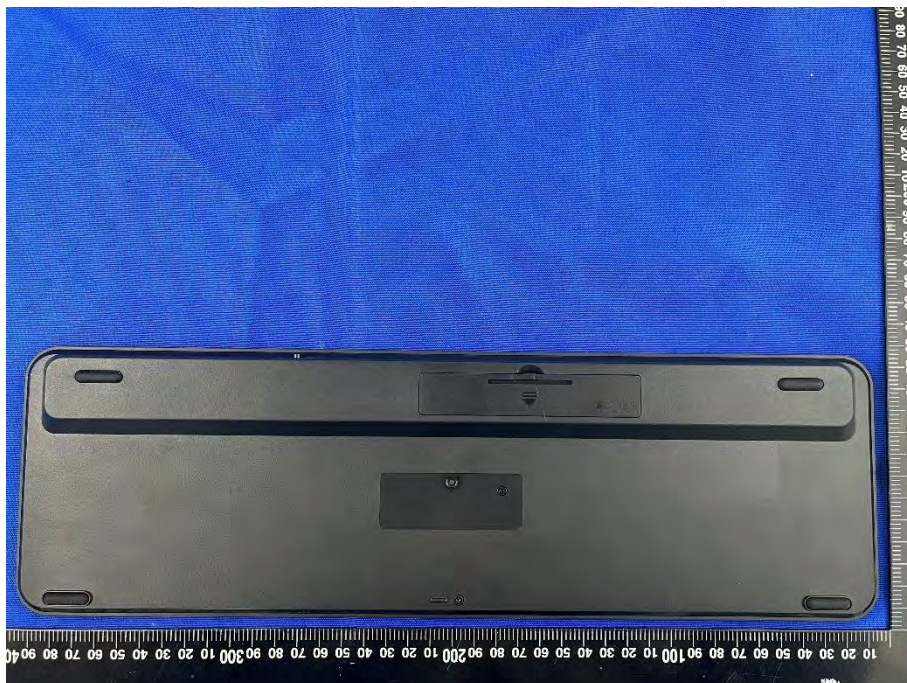


## ANNEX B EUT EXTERNAL PHOTOS

FRONT VIEW OF EUT



REAR VIEW OF EUT



LEFT VIEW OF EUT



RIGHT VIEW OF EUT



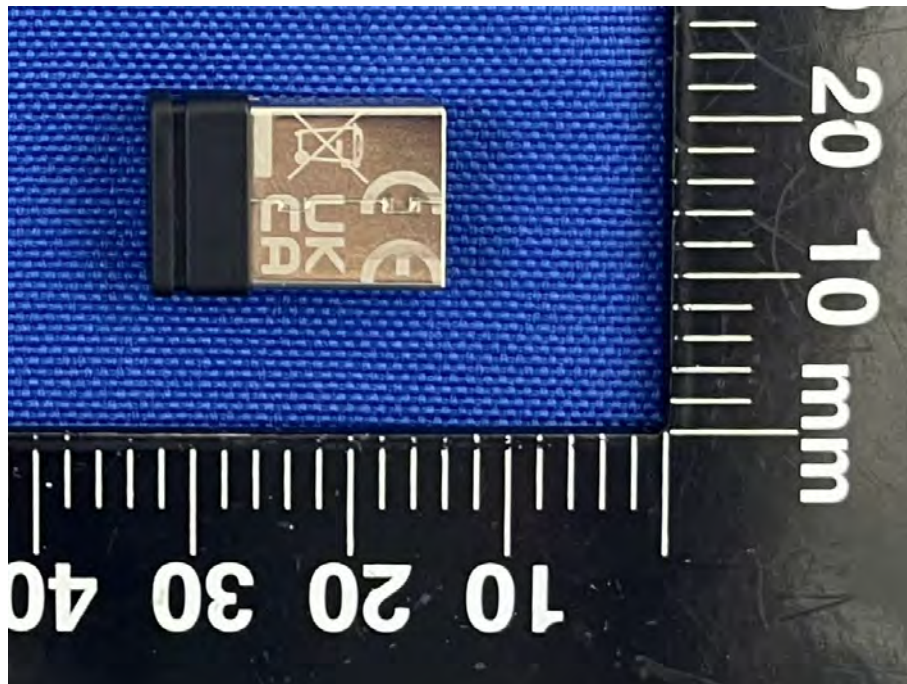
## TOP VIEW OF EUT



## BOTTOM VIEW OF EUT



### Accessory-Dongle

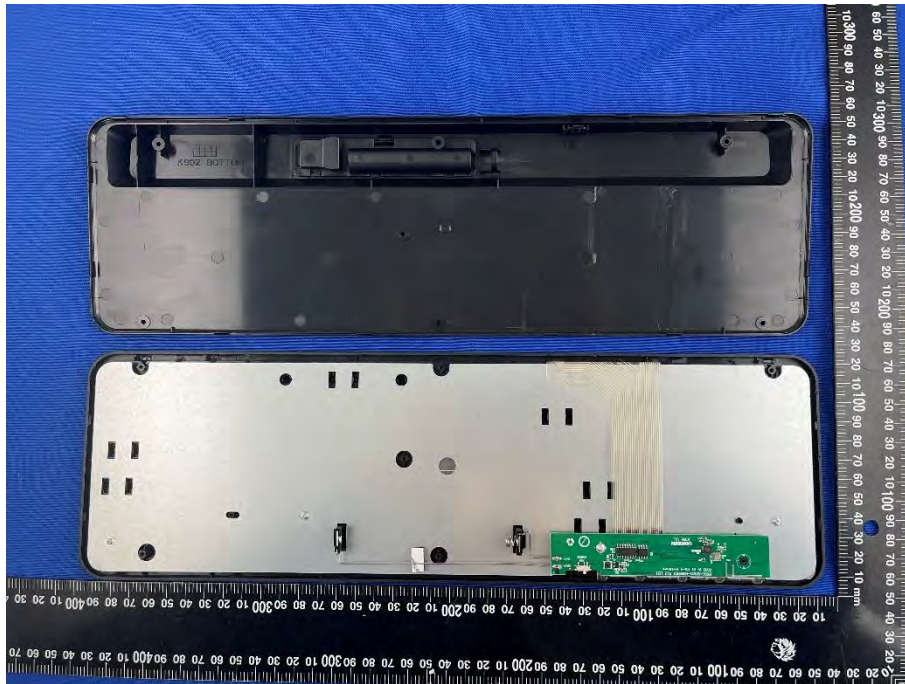


### FRONT VIEW OF EUT

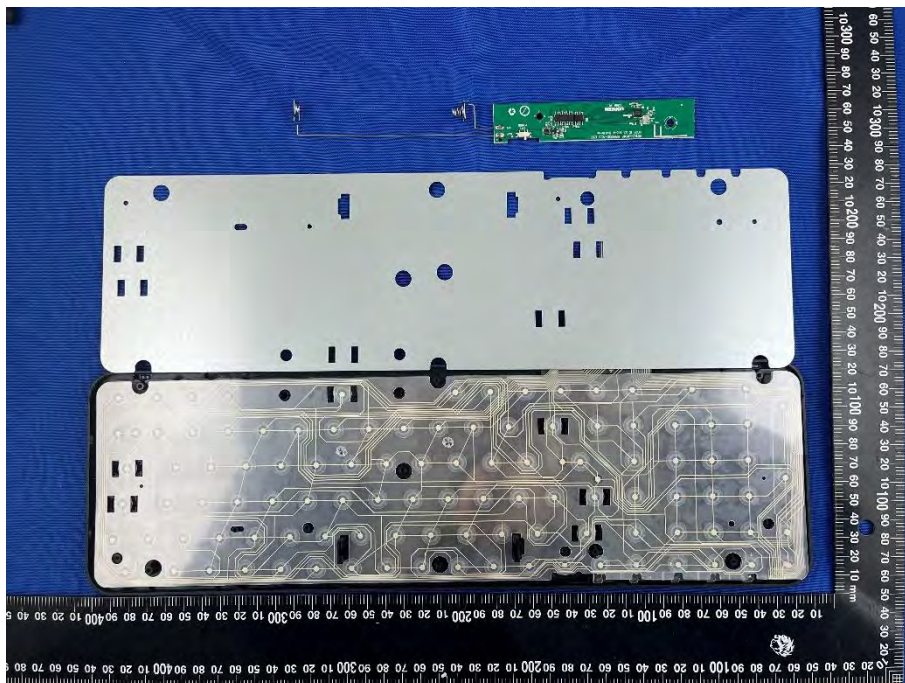


## ANNEX C EUT INTERNAL PHOTOS

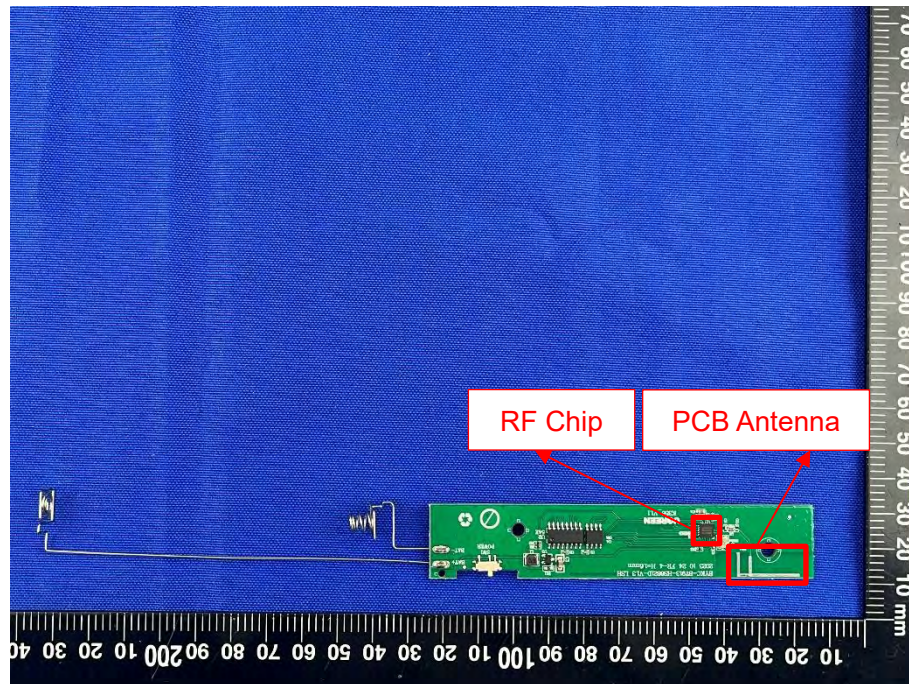
EUT UNCOVER VIEW 1



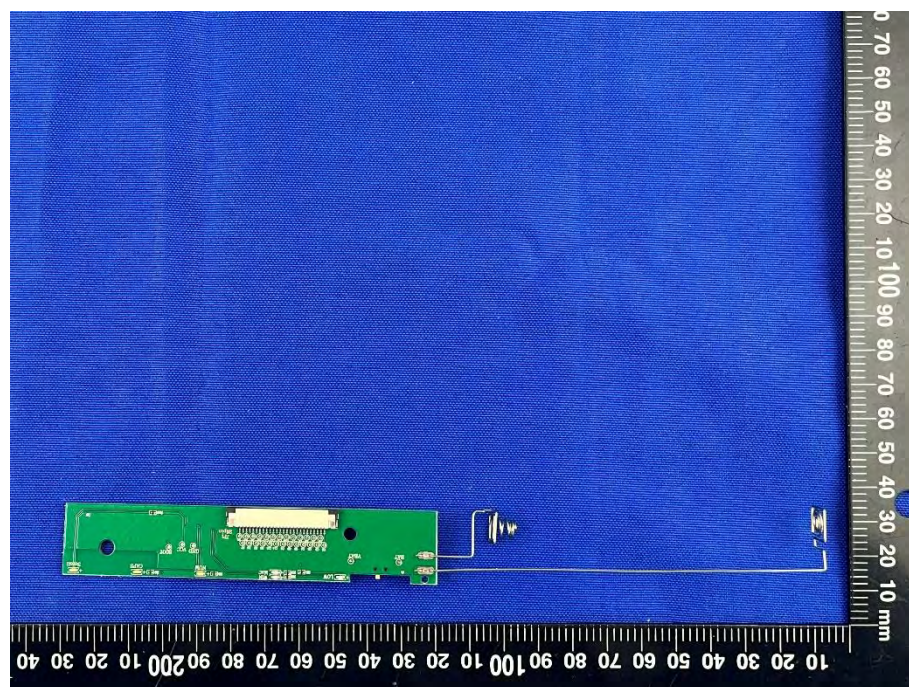
EUT UNCOVER VIEW 2



### MAIN BOARD TOP VIEW



### MAIN BOARD REAR VIEW



## Statement

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--END OF REPORT--