



REPORT No.: SZ18070269W02

# TEST REPORT

**APPLICANT** : Anker Innovations Limited

**PRODUCT NAME** : eufy Security SpaceView

**MODEL NAME** : T8300-M

**BRAND NAME** : eufy Security

**FCC ID** : 2AOKB-T8300M

**STANDARD(S)** : 47 CFR Part 15 Subpart C

**TEST DATE** : 2018-07-30 to 2018-08-13

**ISSUE DATE** : 2018-08-13

Tested by:

Tu Ya'nan

Tu Ya'nan (Test Engineer)

Approved by:

Peng Huarui

Peng Huarui ( Supervisor )

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| Change History |            |                   |
|----------------|------------|-------------------|
| Issue          | Date       | Reason for change |
| 1.0            | 2018-08-13 | First edition     |
|                |            |                   |



# 1. Technical Information

**Note:** Provide by applicant.

## 1.1. Applicant and Manufacturer Information

|                              |                                                                           |
|------------------------------|---------------------------------------------------------------------------|
| <b>Applicant:</b>            | Anker Innovations Limited                                                 |
| <b>Applicant Address:</b>    | Room 1318-19,Hollywood Plaza,610 Nathan Road, Mongkok, Kowloon, Hong Kong |
| <b>Manufacturer:</b>         | Anker Innovations Limited                                                 |
| <b>Manufacturer Address:</b> | Room 1318-19,Hollywood Plaza,610 Nathan Road, Mongkok, Kowloon, Hong Kong |

## 1.2. Equipment Under Test (EUT) Description

|                                   |                               |
|-----------------------------------|-------------------------------|
| <b>Product Name:</b>              | eufy Security SpaceView       |
| <b>Serial No:</b>                 | (N/A, marked #1 by test site) |
| <b>Hardware Version:</b>          | V1.0                          |
| <b>Software Version:</b>          | V1.0                          |
| <b>Modulation Type:</b>           | FHSS (GFSK)                   |
| <b>Operating Frequency Range:</b> | 2410MHz – 2477MHz             |
| <b>Channel Number:</b>            | 23                            |
| <b>Antenna Type:</b>              | Monopole Antenna              |
| <b>Antenna Gain:</b>              | 1.0 dBi                       |

**Note 1:** The lowest, middle, highest channel numbers of the EUT used and tested in this report are separately 1 (2410MHz), 11 (2441MHz) and 23 (2477MHz)..

**Note 2:** For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.



### 1.3.The channel number and frequency of EUT

| Channel  | Frequency<br>(MHz) | Channel   | Frequency<br>(MHz) | Channel   | Frequency<br>(MHz) |
|----------|--------------------|-----------|--------------------|-----------|--------------------|
| <b>1</b> | <b>2410</b>        | <b>11</b> | <b>2441</b>        | 21        | 2471               |
| 2        | 2414               | 12        | 2444               | 22        | 2474               |
| 3        | 2417               | 13        | 2447               | <b>23</b> | <b>2477</b>        |
| 4        | 2420               | 14        | 2450               |           |                    |
| 5        | 2423               | 15        | 2453               |           |                    |
| 6        | 2426               | 13        | 2456               |           |                    |
| 7        | 2429               | 17        | 2459               |           |                    |
| 8        | 2432               | 18        | 2462               |           |                    |
| 9        | 2435               | 19        | 2465               |           |                    |
| 10       | 2438               | 20        | 2468               |           |                    |



## 1.4. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C for the EUT FCC ID Certification:

| No | Identity                         | Document Title          |
|----|----------------------------------|-------------------------|
| 1  | 47 CFR Part 15 (10-1-15 Edition) | Radio Frequency Devices |

Test detailed items/section required by FCC rules and results are as below:

| No. | Section in CFR 47 | Description                    | Test Date       | Test Engineer  | Result |
|-----|-------------------|--------------------------------|-----------------|----------------|--------|
| 1   | 15.203            | Antenna Requirement            | N/A             | N/A            | PASS   |
| 2   | 15.247(a)         | Number of Hopping Frequency    | Jul 30, 2018    | Tu Ya'nan      | PASS   |
| 3   | 15.247(b)         | Peak Output Power              | Jul 30, 2018    | Tu Ya'nan      | PASS   |
| 4   | 15.247(a)         | 20dB Bandwidth                 | Jul 30, 2018    | Tu Ya'nan      | PASS   |
| 5   | 15.247(a)         | Carrier Frequency Separation   | Jul 30, 2018    | Tu Ya'nan      | PASS   |
| 6   | 15.247(a)         | Time of Occupancy (Dwell time) | Jul 30, 2018    | Tu Ya'nan      | PASS   |
| 7   | 15.247(d)         | Conducted Spurious Emission    | Jul 30, 2018    | Tu Ya'nan      | PASS   |
| 8   | 15.207            | Conducted Emission             | Aug 02, 2018    | Zheng Fengjian | PASS   |
| 9   | 15.247(d)         | Restricted Frequency Bands     | Aug 01&13, 2018 | Zheng Fengjian | PASS   |
| 10  | 15.209, 15.247(d) | Radiated Emission              | Aug 08, 2018    | Zheng Fengjian | PASS   |

**Note 1:** The tests were performed according to the method of measurements prescribed in ANSI C63.10-2013.

## 1.5. Environmental Conditions

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

|                             |         |
|-----------------------------|---------|
| Temperature (°C):           | 15 - 35 |
| Relative Humidity (%):      | 30 -60  |
| Atmospheric Pressure (kPa): | 86-106  |

## 2. 47 CFR Part 15C Requirements

### 2.1. Antenna requirement

#### 2.1.1. Applicable Standard

According to FCC 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. 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.

#### 2.1.2. Result: Compliant

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

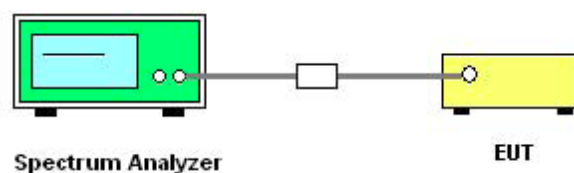
### 2.2. Number of Hopping Frequency

#### 2.2.1. Requirement

According to FCC §15.247(a)(1)(iii), frequency hopping systems operating in the 2400MHz to 2483.5MHz bands shall use at least 15 hopping frequencies.

#### 2.2.2. Test Description

##### A. Test Setup:



The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

##### B. Equipments List:

Please reference ANNEX A(1.5).

### 2.2.3. 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

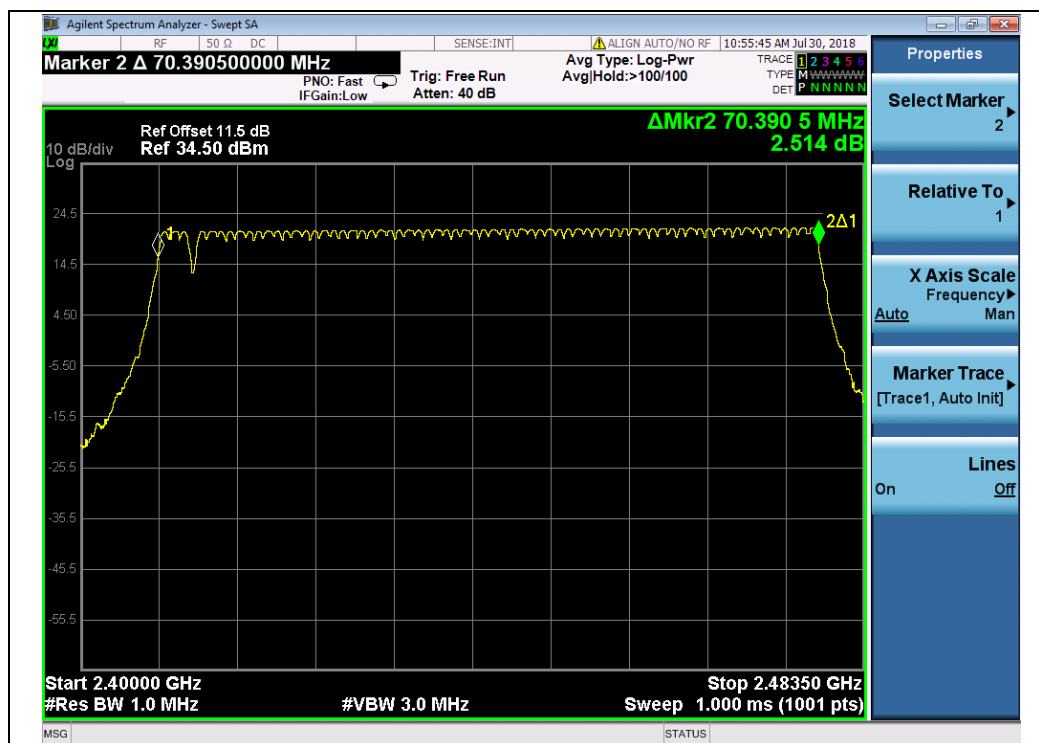
Allow the trace to stabilize

### 2.2.4. Test Result

#### A. Test Verdict:

| Test Mode | Frequency Block (MHz) | Measured Channel Numbers | Min. Limit | Verdict |
|-----------|-----------------------|--------------------------|------------|---------|
| GFSK      | 2400 - 2483.5         | 23                       | 15         | PASS    |

#### B. Test Plots:



(GFSK)

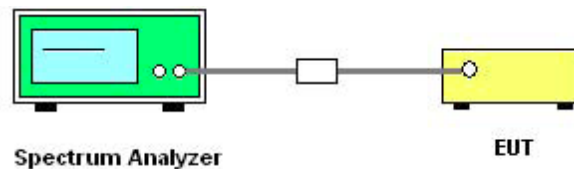
## 2.3. Peak Output Power

### 2.3.1. Requirement

According to FCC §15.247(b)(1), for frequency hopping systems that operates in the 2400MHz to 2483.5MHz band employing at least 75 hopping channels, the maximum peak output power of the intentional radiator shall not exceed 1Watt. For all other frequency hopping systems in the 2400MHz to 2483.5MHz band, it is 0.125Watts.

### 2.3.2. Test Description

#### A. Test Setup:



The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

#### B. Equipments List:

Please refer ANNEX A(1.5).

### 2.3.3. Test Result

#### GFSK Mode

| Channel | Frequency (MHz) | Measured Output Peak Power |       | Limit |       | Verdict |
|---------|-----------------|----------------------------|-------|-------|-------|---------|
|         |                 | dBm                        | W     | dBm   | W     |         |
| 1       | 2410            | 20.54                      | 0.113 | 20.97 | 0.125 | PASS    |
| 11      | 2441            | 20.75                      | 0.119 |       |       | PASS    |
| 23      | 2477            | 20.79                      | 0.120 |       |       | PASS    |

| Channel | Frequency (MHz) | Measured Output Average Power |       | Limit |       | Verdict |
|---------|-----------------|-------------------------------|-------|-------|-------|---------|
|         |                 | dBm                           | W     | dBm   | W     |         |
| 1       | 2410            | 13.04                         | 0.020 | 20.97 | 0.125 | PASS    |
| 11      | 2441            | 13.18                         | 0.021 |       |       | PASS    |
| 23      | 2477            | 13.21                         | 0.021 |       |       | PASS    |

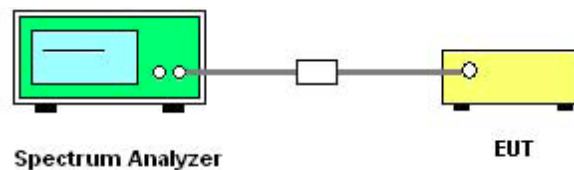
## 2.4. 20dB Bandwidth

### 2.4.1. Definition

According to FCC §15.247(a)(1), the 20dB bandwidth is known as the 99% emission bandwidth, or 20dB bandwidth ( $10 \cdot \log 1\% = 20\text{dB}$ ) taking the total RF output power.

### 2.4.2. Test Description

#### A. Test Setup:



The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

#### B. Equipments List:

Please refer ANNEX A(1.5).

### 2.4.3. 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



#### 2.4.4. Test Result

##### GFSK Mode

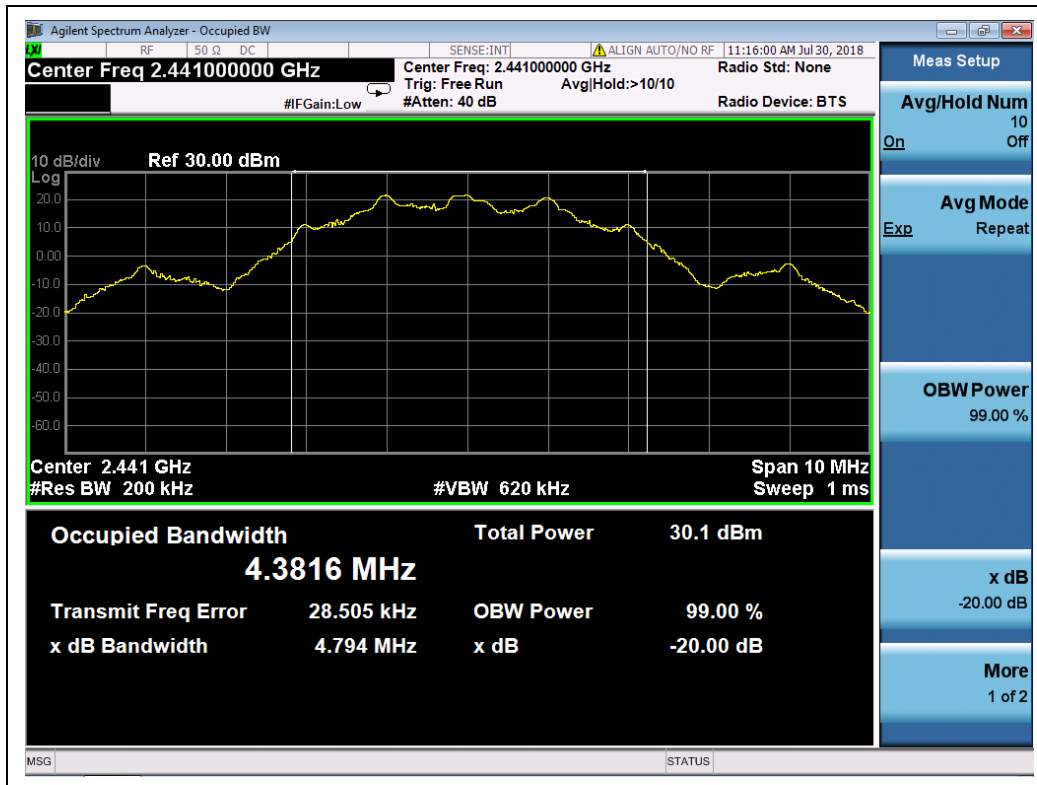
##### A. Test Verdict:

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) | Result |
|---------|-----------------|----------------------|--------|
| 1       | 2410            | 4.713                | PASS   |
| 11      | 2441            | 4.794                | PASS   |
| 23      | 2477            | 4.766                | PASS   |

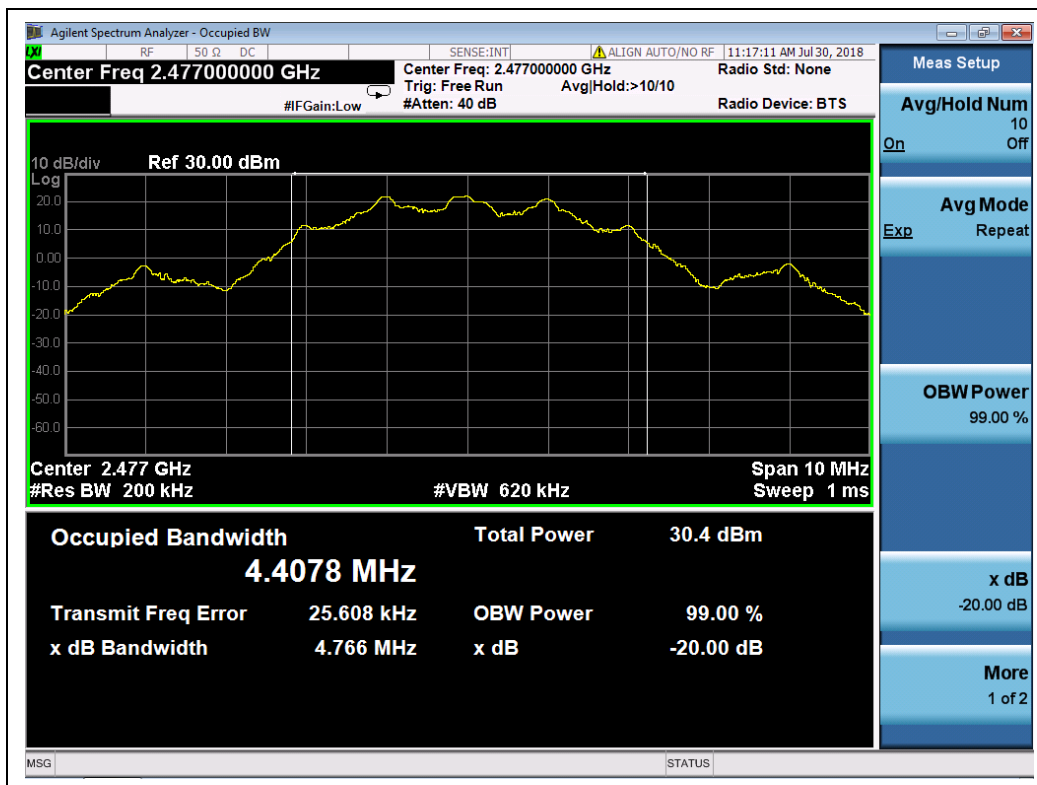
##### B. Test Plots:



(GFSK, Channel 1, 2410MHz)



(GFSK, Channel 11, 2441MHz)



(GFSK, Channel 23, 2477MHz)

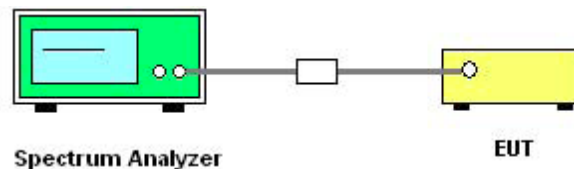
## 2.5. Carried Frequency Separation

### 2.5.1. Definition

According to FCC §15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

### 2.5.2. Test Description

#### A. Test Setup:



The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

#### B. Equipments List:

Please refer ANNEX A(1.5).

### 2.5.3. 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

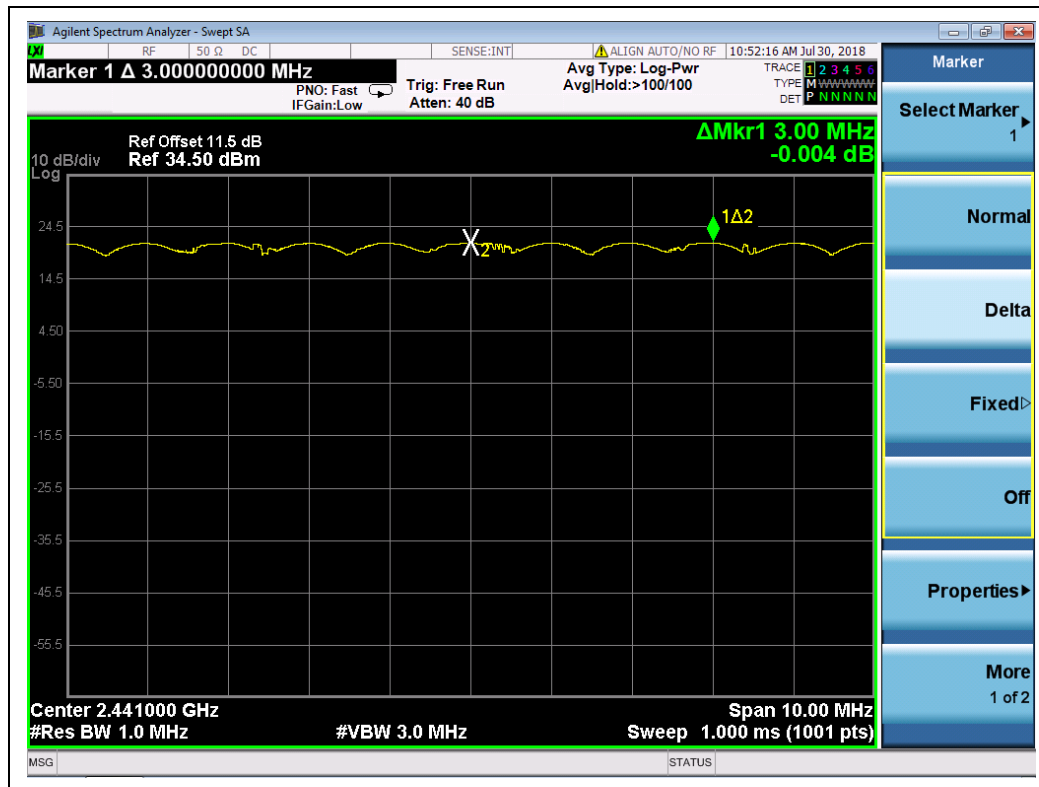
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.



#### 2.5.4. Test Result

The EUT operates at hopping-on test mode. For any adjacent channels (e.g. the channel 39 and 40 as showed below), the Module does have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel (refer to section 2.4.4), whichever is greater. So, the verdict is PASSING.

| Test Mode | Measured Channel Numbers | Carried Frequency Separation(MHz) | 20dB bandwidth (MHz) | Min. Limit                       | Verdict |
|-----------|--------------------------|-----------------------------------|----------------------|----------------------------------|---------|
| GFSK      | 11 and 12                | 3.00                              | 4.713                | two-thirds of the 20dB bandwidth | PASS    |



(GFSK)

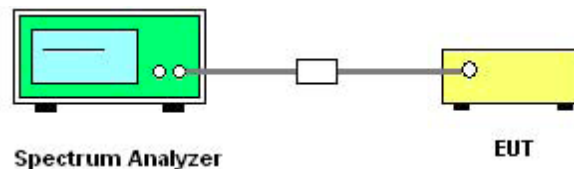
## 2.6. Time of Occupancy (Dwell time)

### 2.6.1. Requirement

According to FCC §15.247(a) (1) (iii), frequency hopping systems in the 2400 - 2483.5MHz 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.

### 2.6.2. Test Description

#### A. Test Setup:



The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

#### B. Equipments List:

Please refer ANNEX A(1.5).

### 2.6.3. Test Procedure

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 9.2 second scan, to enable resolution of each occurrence. The average time of occupancy in the specified 9.2 second period (23 channel \* 0.4 s) is equal to  $10 * (\# \text{ of pulses in } 0.92 \text{ s}) * \text{pulse width}$ .



#### 2.6.4.1 GFSK Mode

| Pulse Width (seconds) | Number of pulse in 0.92 seconds | Number of pulse in 9.2 seconds | Dwell Time in 9.2 seconds (sec) | Limit (sec) | Verdict |
|-----------------------|---------------------------------|--------------------------------|---------------------------------|-------------|---------|
| 0.00037               | 19                              | 190                            | 0.0703                          | 0.4         | PASS    |

Agilent Spectrum Analyzer - Swept SA

RF 50 Ω DC SENSE:INT ALIGN AUTO/NO RF 10:48:12 AM Jul 30, 2018

Marker 1  $\Delta$  370.000  $\mu$ s

PNO: Fast  $\rightarrow$  Trig: Free Run  
IFGain:Low Atten: 30 dB

Avg Type: Log-Pwr

TRACE 1 2 3 4 5 6  
TYPE W  
DET P

Ref Offset 11.5 dB  
Ref 30.00 dBm

10 dB/div  
Log

$\Delta$ Mkr1 370.0  $\mu$ s  
0.86 dB

Center 2.441000000 GHz  
Res BW 5 MHz

#VBW 5.0 MHz

Span 0 Hz  
Sweep 10.00 ms (1001 pts)

MSG STATUS

Marker

Select Marker 1

Normal

Delta

Fixed

Off

Properties

More 1 of 2



(GFSK)

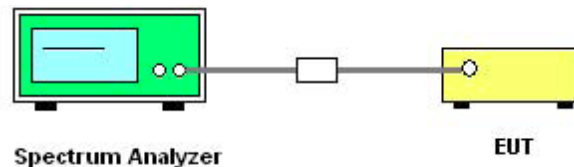
## 2.7. Conducted Spurious Emissions

### 2.7.1. Requirement

According to FCC §15.247(d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

### 2.7.2. Test Description

#### A. Test Setup:



The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

#### B. Equipments List:

Please refer ANNEX A(1.5).

### 2.7.3. 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.



## 2.7.4. Test Result

The EUT operates at hopping-off test mode. The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions.

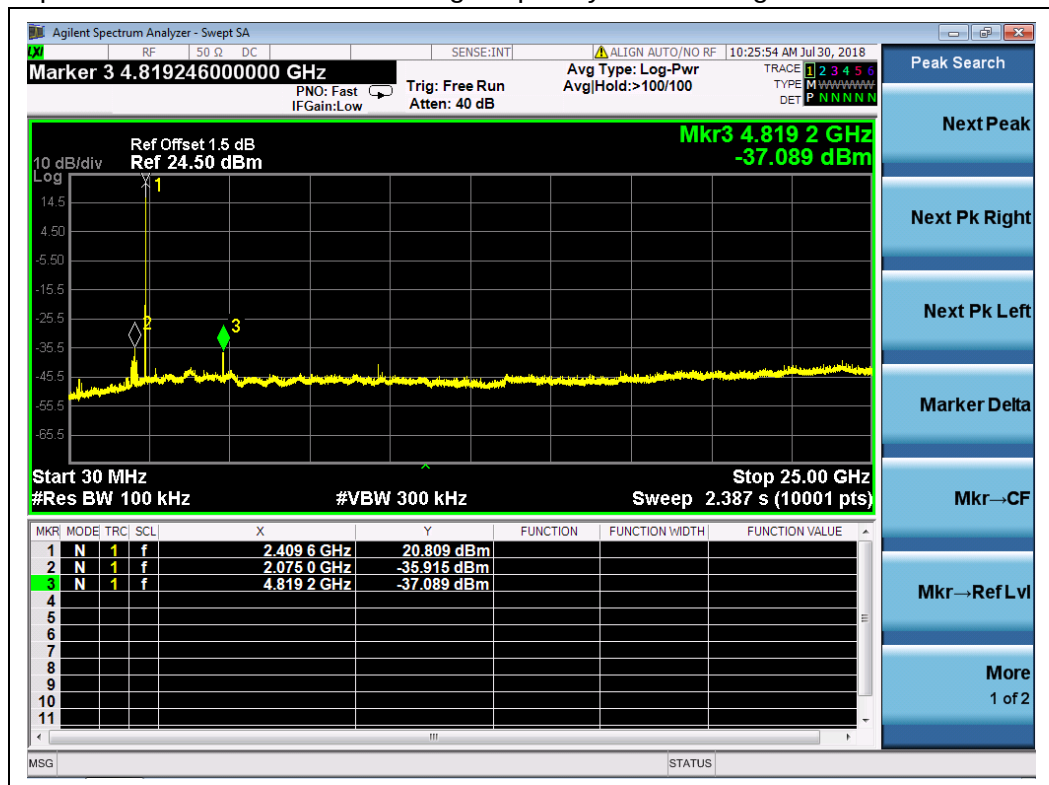
### GFSK Mode

#### A. Test Verdict:

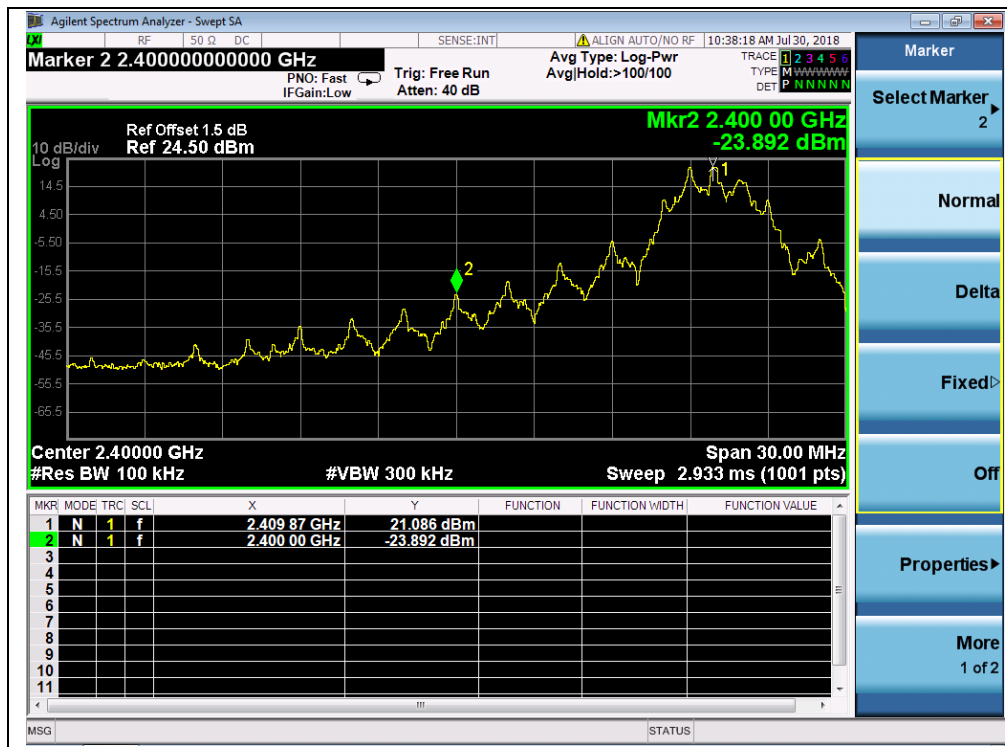
| Channel | Frequency (MHz) | Measured Max. Out of Band Emission (dBm) | Limit (dBm)   |                         | Verdict |
|---------|-----------------|------------------------------------------|---------------|-------------------------|---------|
|         |                 |                                          | Carrier Level | Calculated -20dBc Limit |         |
| 1       | 2410            | -37.09                                   | 20.81         | 0.81                    | PASS    |
| 11      | 2441            | -36.97                                   | 21.15         | 1.15                    | PASS    |
| 23      | 2477            | -36.29                                   | 21.63         | 1.63                    | PASS    |

#### B. Test Plots:

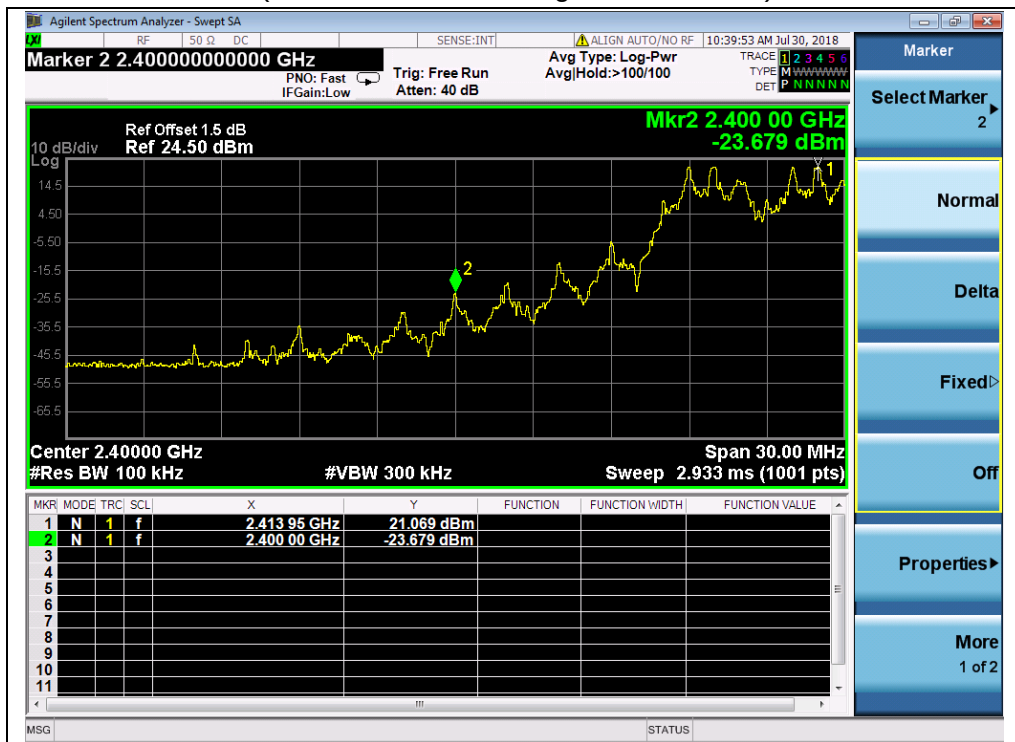
**Note:** The power of the Module transmitting frequency should be ignored.



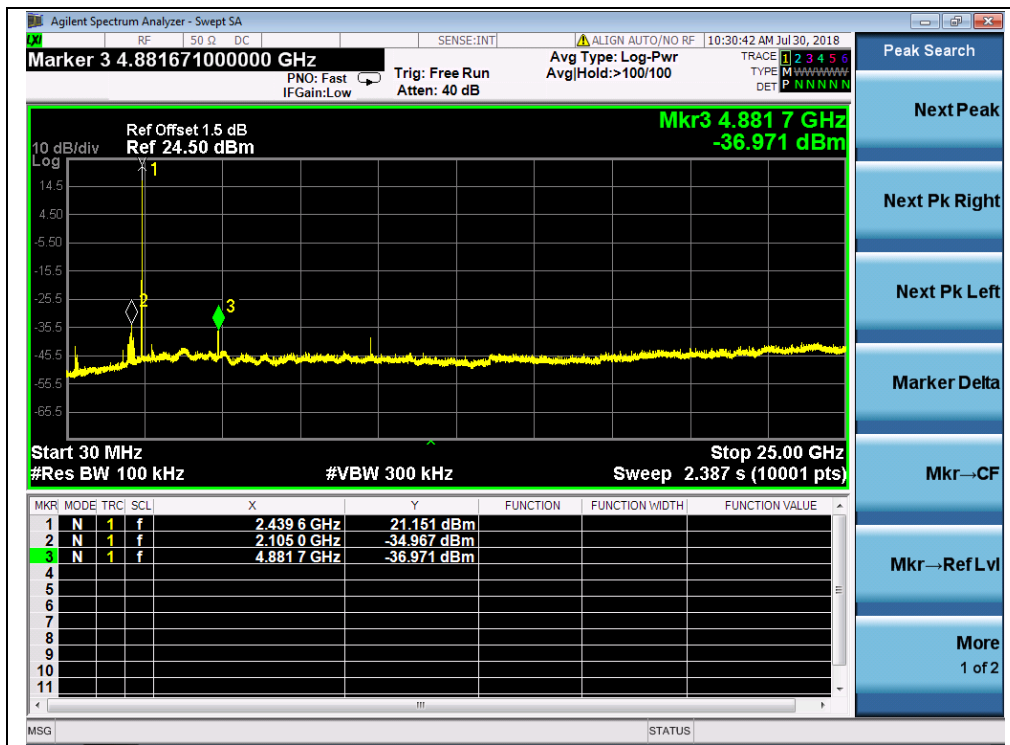
(Channel = 1, 30MHz to 25GHz, GFSK Mode)



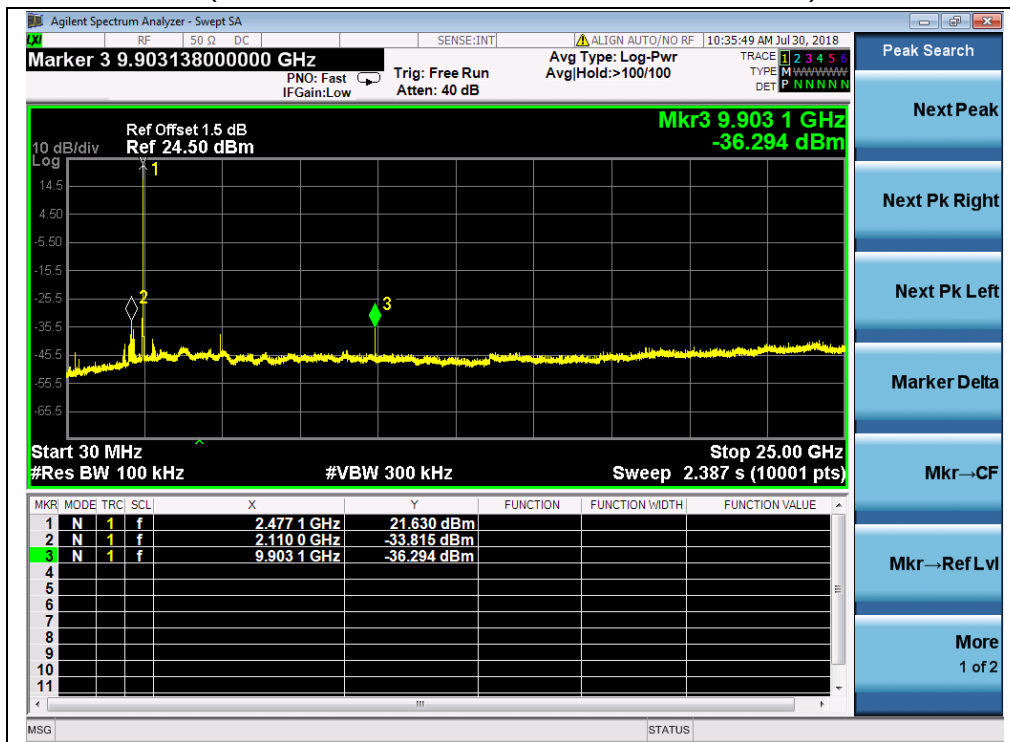
(Channel = 1, Band edge, GFSK Mode)



(Channel = 1, Band edge with hopping on, GFSK Mode)



(Channel = 11, 30MHz to 25GHz, GFSK Mode)



(Channel = 23, 30MHz to 25GHz, GFSK Mode)



(Channel = 23, Band edge, GFSK Mode)



(Channel = 23, Band edge with hopping on, GFSK Mode)

## 2.8. Conducted Emission

### 2.8.1. Requirement

According to FCC section 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 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50 $\mu$ H/50 $\Omega$  line impedance stabilization network (LISN).

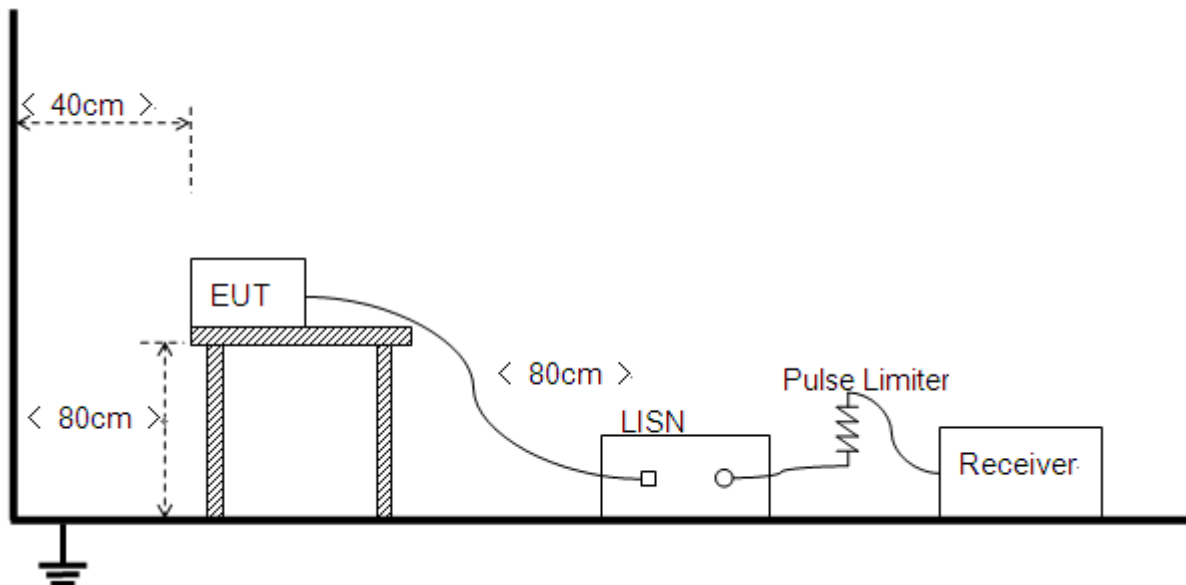
| Frequency<br>(MHz) | range | Conducted Limit (dB $\mu$ V) |          |
|--------------------|-------|------------------------------|----------|
|                    |       | Quai-peak                    | Average  |
| 0.15 - 0.50        |       | 66 to 56                     | 56 to 46 |
| 0.50 -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

#### NOTE:

- The lower limit shall apply at the band edges.
- The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

### 2.8.2. Test Description

#### A. Test Setup:



The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.10: 2013.



The factors of the site are calibrated to correct the reading. During the measurement, the Bluetooth EUT is activated and controlled by the Bluetooth Service Supplier (SS) via a Common Antenna, and is set to operate under hopping-on test mode transmitting 339 bytes DH5 packages at maximum power.

**B. Equipments List:**

Please reference ANNEX A(1.5).

**2.8.3. Test Result**

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.

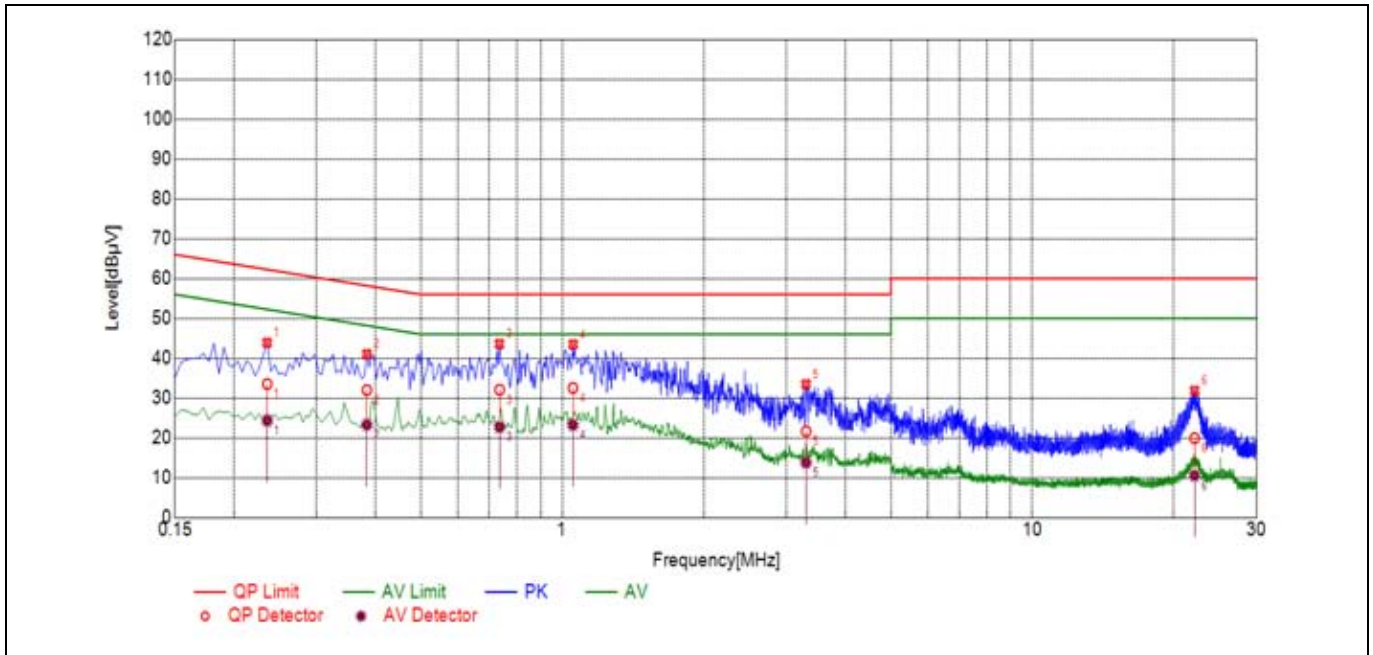
**Note:** Both of the test voltage AC 120V/60Hz and AC 230V/50Hz were considered and tested respectively, only the results of the worst case AC 120V/60Hz were recorded in this report.

**A. Test setup:**

The EUT configuration of the emission tests is EUT + Link.

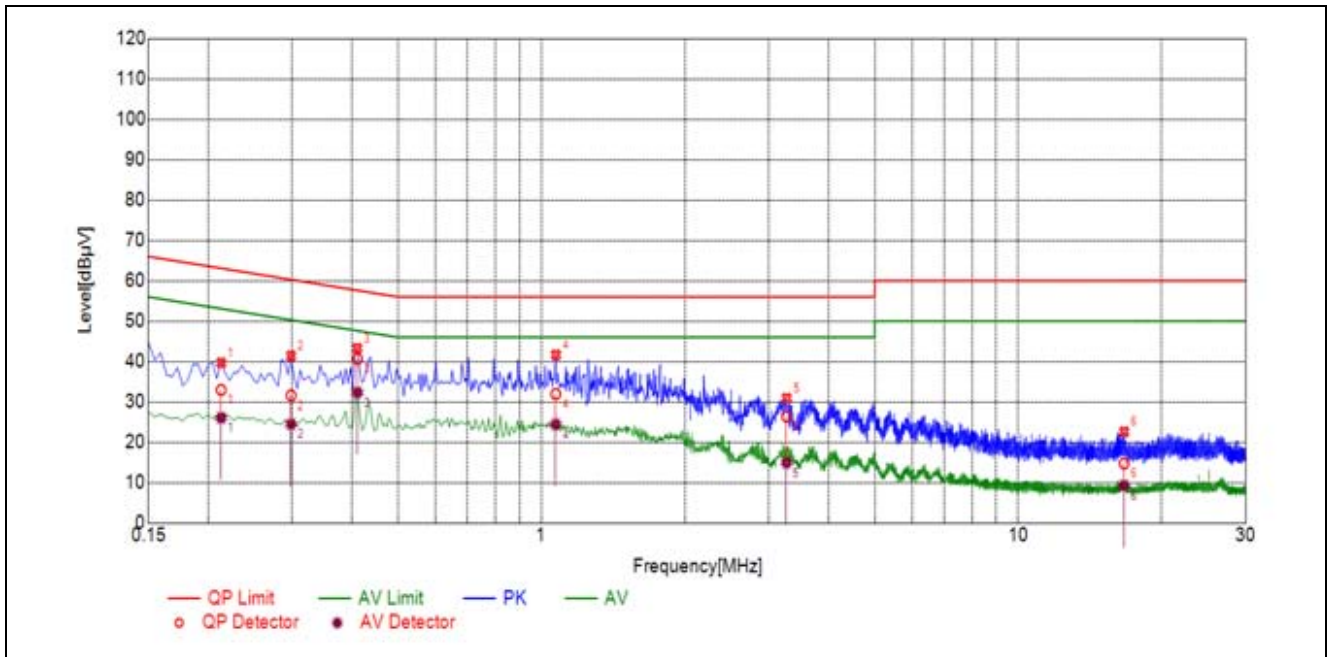
**Note:** The test voltage is AC 120V/60Hz.

## B. Test Plots:



(Plot A: L Phase)

| NO. | Fre.<br>(MHz) | Emission Level (dBμV) |         | Limit (dBμV) |         | Power-line | Verdict |
|-----|---------------|-----------------------|---------|--------------|---------|------------|---------|
|     |               | Quai-peak             | Average | Quai-peak    | Average |            |         |
| 1   | 0.2356        | 33.53                 | 24.31   | 62.25        | 52.25   | Line       | PASS    |
| 2   | 0.3838        | 31.99                 | 23.31   | 58.20        | 48.20   |            | PASS    |
| 3   | 0.7354        | 32.09                 | 22.69   | 56.00        | 46.00   |            | PASS    |
| 4   | 1.0535        | 32.54                 | 23.24   | 56.00        | 46.00   |            | PASS    |
| 5   | 3.3014        | 21.69                 | 13.79   | 56.00        | 46.00   |            | PASS    |
| 6   | 22.1442       | 19.93                 | 10.57   | 60.00        | 50.00   |            | PASS    |



(Plot B: N Phase)

| NO. | Fre.<br>(MHz) | Emission Level (dBμV) |         | Limit (dBμV) |         | Power-line | Verdict |
|-----|---------------|-----------------------|---------|--------------|---------|------------|---------|
|     |               | Quai-peak             | Average | Quai-peak    | Average |            |         |
| 1   | 0.2129        | 32.97                 | 26.06   | 63.09        | 53.09   | Neutral    | PASS    |
| 2   | 0.2985        | 31.62                 | 24.48   | 60.28        | 50.28   |            | PASS    |
| 3   | 0.4112        | 40.68                 | 32.34   | 57.62        | 47.62   |            | PASS    |
| 4   | 1.0715        | 31.98                 | 24.44   | 56.00        | 46.00   |            | PASS    |
| 5   | 3.2656        | 26.36                 | 14.94   | 56.00        | 46.00   |            | PASS    |
| 6   | 16.6674       | 14.75                 | 9.31    | 60.00        | 50.00   |            | PASS    |

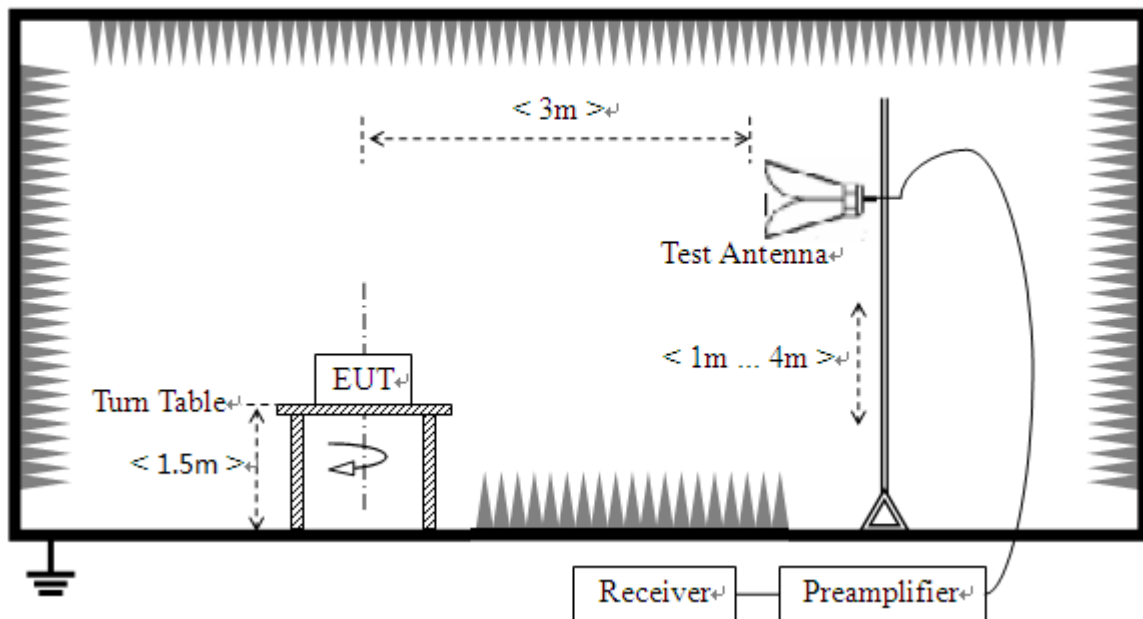
## 2.9. Restricted Frequency Bands

### 2.9.1. Requirement

According to FCC section 15.247(d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, In addition, radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a).

### 2.9.2. Test Description

#### A. Test Setup:



The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.

For the Test Antenna:

Horn Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength.

#### B. Equipments List:

Please refer ANNEX A(1.5).



### 2.9.3. Test Procedure

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for  $f \geq 1\text{GHz}$ , 100 KHz for  $f < 1\text{GHz}$

VBW = 3 MHz

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize.

### 2.9.4. Test Result

The lowest and highest channels are tested to verify Restricted Frequency Bands.

The measurement results are obtained as below:

$$E [\text{dB}\mu\text{V/m}] = U_R + A_T + A_{\text{Factor}} [\text{dB}]; AT = L_{\text{Cable loss}} [\text{dB}] - G_{\text{preamp}} [\text{dB}]$$

AT: Total correction Factor except Antenna

UR: Receiver Reading

Gpreamp: Preamplifier Gain

AFactor: Antenna Factor at 3m

For average measurement: Use duty cycle correction factor method per 15.35(c)

Duty cycle = On Time/100ms

$$\text{On Time} = N_1 * L_1 + N_2 * L_2 + \dots + N_{n-1} * L_{N-1} + N_n * L_n$$

Where  $N_1$  is number of type 1 pulses,  $L_1$  is length of type 1 pulses, etc.

The average levels were calculated from the peak level corrected with duty cycle correction factor (-38.42dB) derived from  $20\log(\text{dwell time}/100\text{ms})$ . This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

**Note:** Restricted Frequency Bands were performed when antenna was at vertical and horizontal polarity, and only the worse test condition (Vertical) was recorded in this test report.



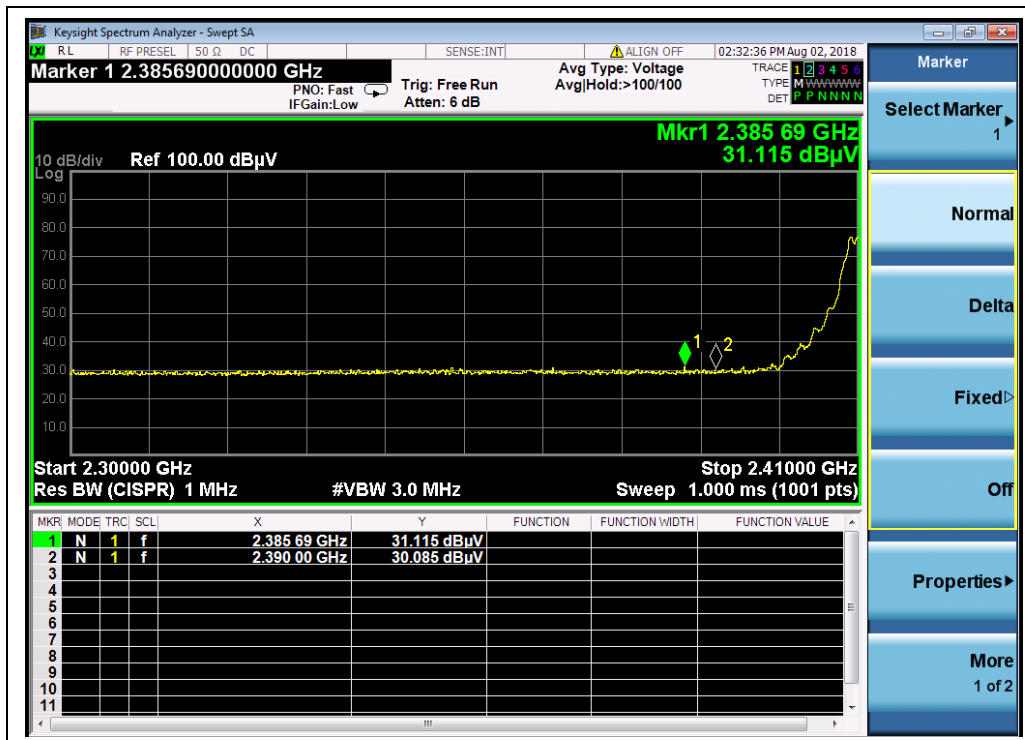
## GFSK Mode

### A. Test Verdict:

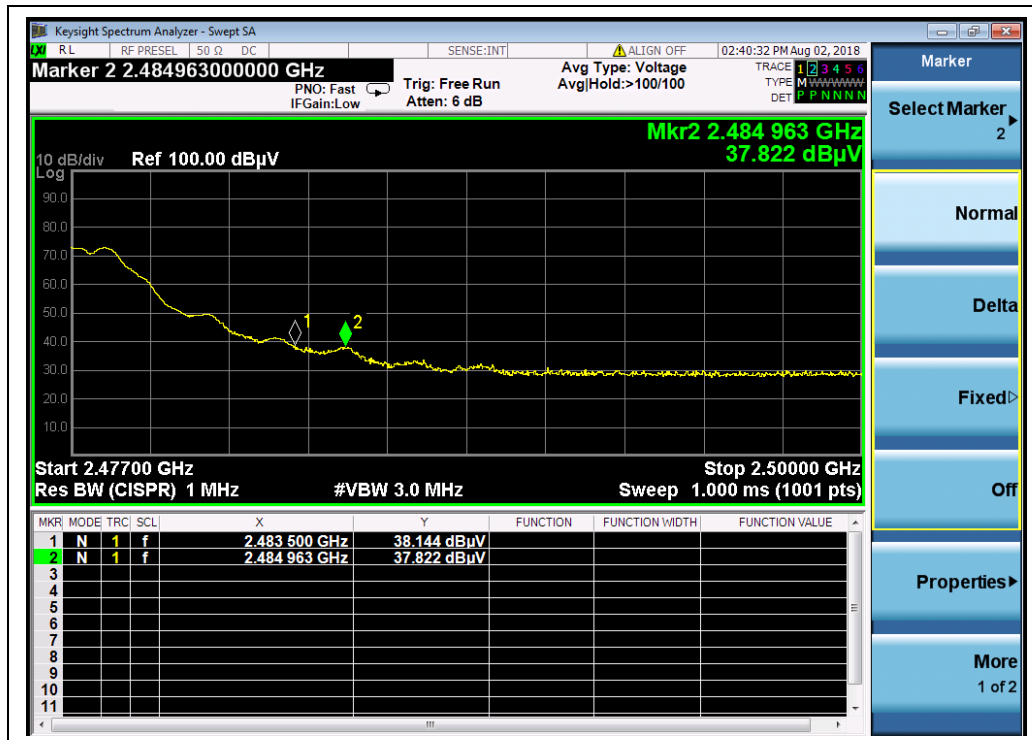
| Peak Measurement Value |                 |          |                               |            |                      |                          |                |
|------------------------|-----------------|----------|-------------------------------|------------|----------------------|--------------------------|----------------|
| Channel                | Frequency (MHz) | Detector | Receiver Reading $U_R$ (dBuV) | $A_T$ (dB) | $A_{Factor}$ (dB@3m) | Max. Emission E (dBuV/m) | Limit (dBuV/m) |
|                        |                 | PK/ AV   |                               |            |                      |                          |                |
| 1                      | 2385.69         | PK       | 31.12                         | -11.73     | 32.56                | 51.95                    | 74             |
| 23                     | 2484.96         | PK       | 37.82                         | -11.73     | 32.56                | 58.65                    | 74             |

| Average Measurement Value |                 |          |                     |                |                          |                |
|---------------------------|-----------------|----------|---------------------|----------------|--------------------------|----------------|
| Channel                   | Frequency (MHz) | Detector | Peak Value (dBuV/m) | AV Factor (dB) | Max. Emission E (dBuV/m) | Limit (dBuV/m) |
|                           |                 | PK/ AV   |                     |                |                          |                |
| 1                         | 2385.69         | PK       | 51.95               | -38.42         | 13.53                    | 54             |
| 23                        | 2484.96         | PK       | 58.65               | -38.42         | 20.23                    | 54             |

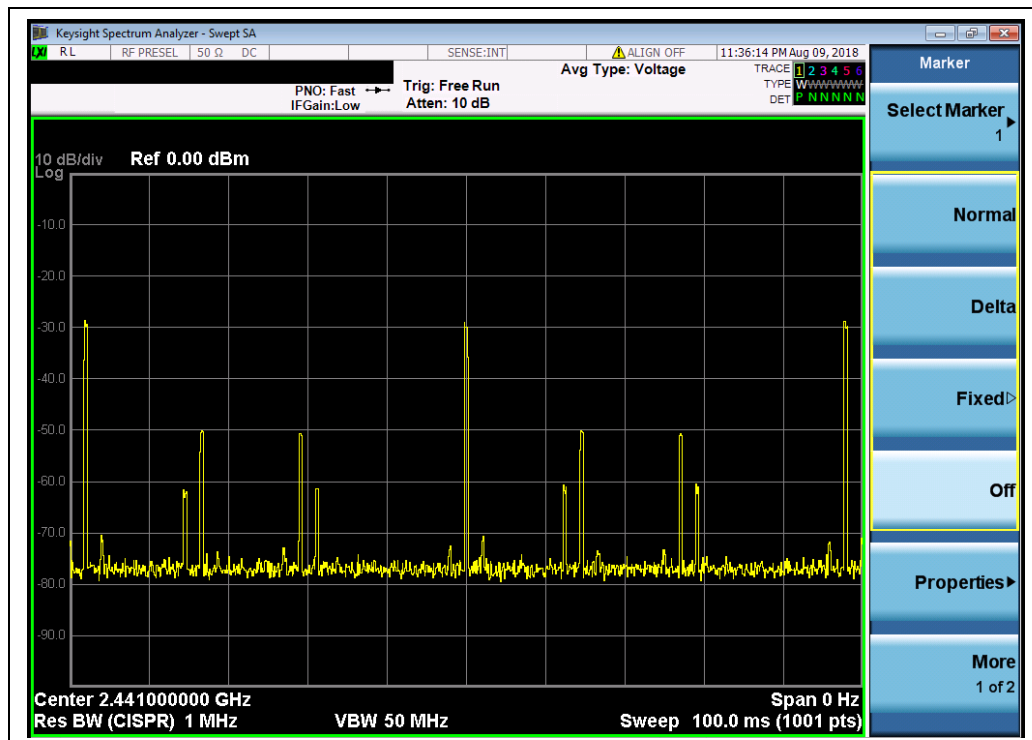
### B. Test Plots:



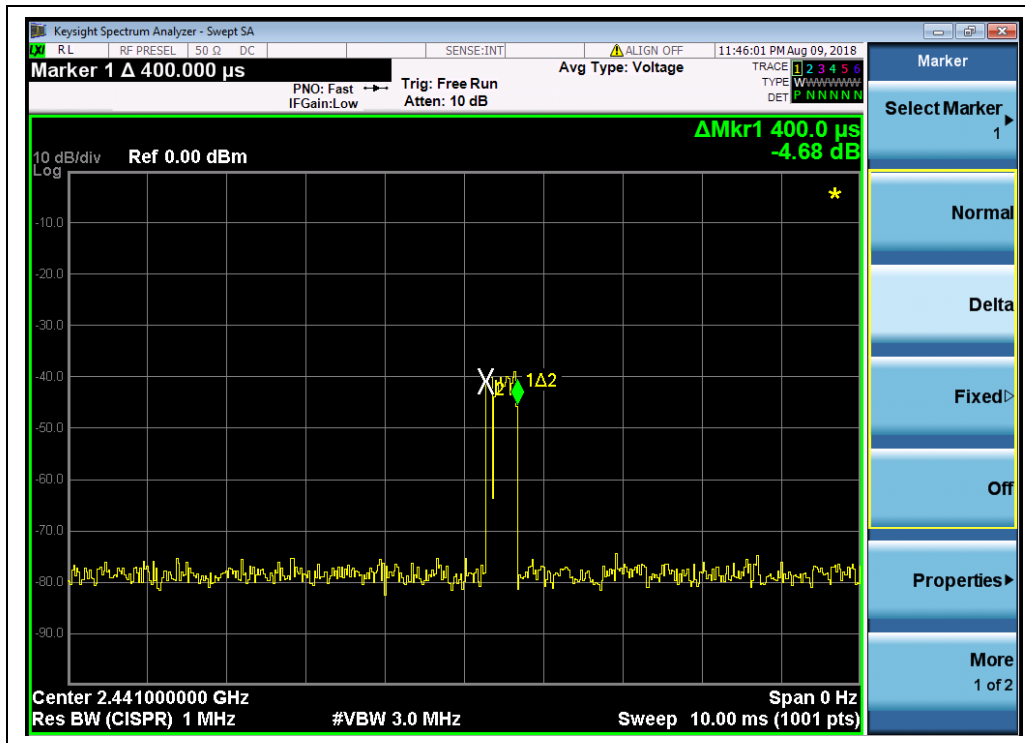
(Channel = 1, PEAK, GFSK)



(Channel = 23, PEAK, GFSK)



(Number of pulses in 100ms)



(Length of one pulse)

Note 1: Worst case Duty cycle = on time/100ms =  $3 \times 0.4 / 100 = 0.012$

Note 2: Worst case Duty cycle correction factor =  $20 \times \log(\text{Duty cycle}) = -38.42$

## 2.10. Radiated Emission

### 2.10.1. Requirement

According to FCC section 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 ( $\mu\text{V/m}$ ) | 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:**

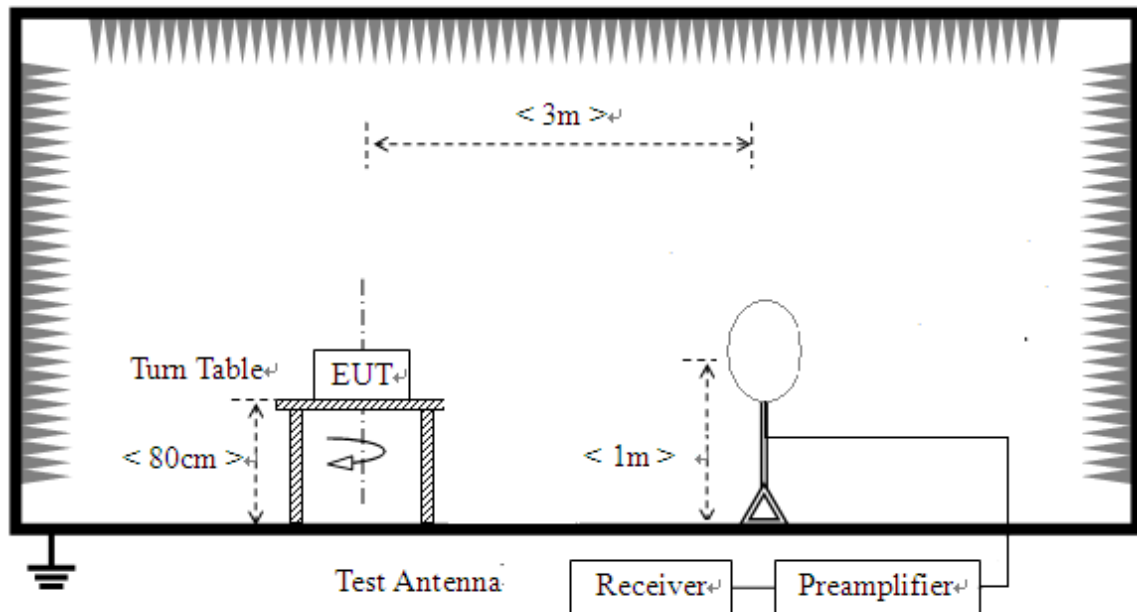
1. For Above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
2. For above 1000MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK)

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table)

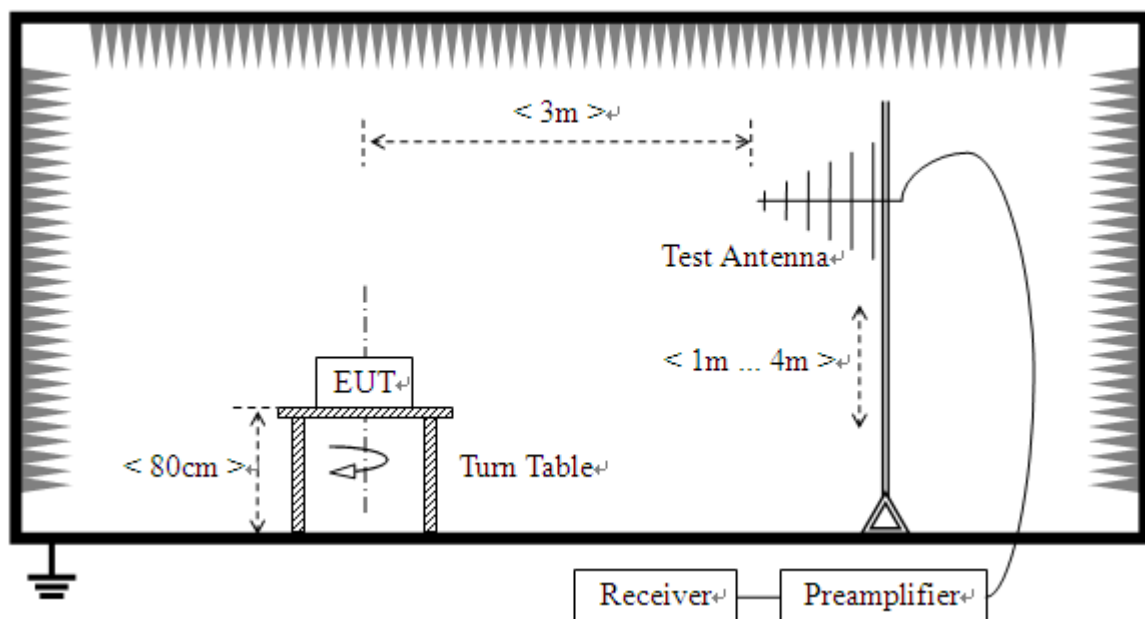
## 2.10.2. Test Description

### A. Test Setup:

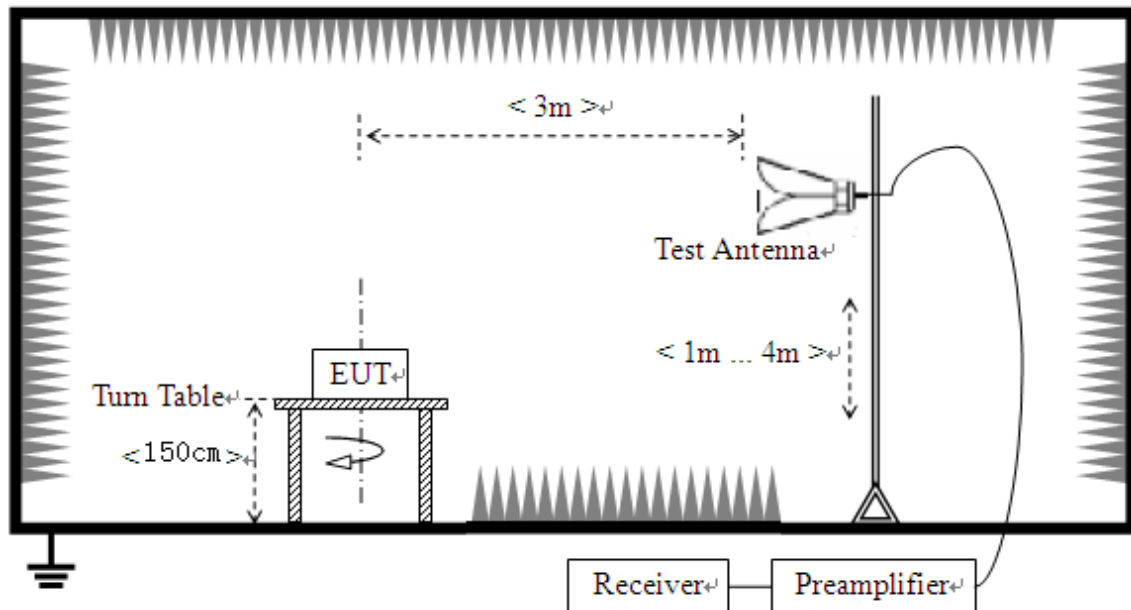
- 1) For radiated emissions from 9kHz to 30MHz



- 2) For radiated emissions from 30MHz to 1GHz



### 3) For radiated emissions above 1GHz



The RF absorbing material used on the reference ground plane and on the turntable have a maximum height (thickness) of 30 cm (12 in) and have a minimum-rated attenuation of 20 dB at all frequencies from 1 GHz to 18 GHz.

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4dB according to the standards: ANSI C63.10 (2013). For radiated emissions below or equal to 1GHz, the EUT was set-up on insulator 80cm above the Ground Plane, For radiated emissions above 1GHz, The EUT was set-up on insulator 150cm above the Ground Plane. The set-up and test methods were according to ANSI C63.10.

The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.

For the Test Antenna:

(a) In the frequency range of 9kHz to 30MHz, magnetic field is measured with Loop Test Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.

(b) In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) and Horn Test Antenna (above 1GHz) are used. Place the test antenna at 3m away from area of the EUT, while keeping the test antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The test antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed



at the emission source for receiving the maximum signal. The final test antenna elevation shall be that which maximizes the emissions. The test antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. The emission levels at both horizontal and vertical polarizations should be tested.

#### **B. Equipments List:**

Please reference ANNEX A(1.5).

#### **2.10.3. Test Procedure**

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



#### 2.10.4. Test Result

According to ANSI C63.10, because of peak detection will yield amplitudes equal to or greater than amplitudes measured with the quasi-peak (or average) detector, the measurement data from a spectrum analyzer peak detector will represent the worst-case results, if the peak measured value complies with the quasi-peak limit, it is unnecessary to perform an quasi-peak measurement.

The measurement results are obtained as below:

$$E [\text{dB}\mu\text{V/m}] = U_R + A_T + A_{\text{Factor}} [\text{dB}]; A_T = L_{\text{Cable loss}} [\text{dB}] - G_{\text{preamp}} [\text{dB}]$$

$A_T$ : Total correction Factor except Antenna

$U_R$ : Receiver Reading

$G_{\text{preamp}}$ : Preamplifier Gain

$A_{\text{Factor}}$ : Antenna Factor at 3m

During the test, the total correction Factor  $A_T$  and  $A_{\text{Factor}}$  were built in test software.

For average measurement: Use duty cycle correction factor method per 15.35(c)

Duty cycle = On Time/100ms

$$\text{On Time} = N_1 * L_1 + N_2 * L_2 + \dots + N_{n-1} * L_{n-1} + N_n * L_n$$

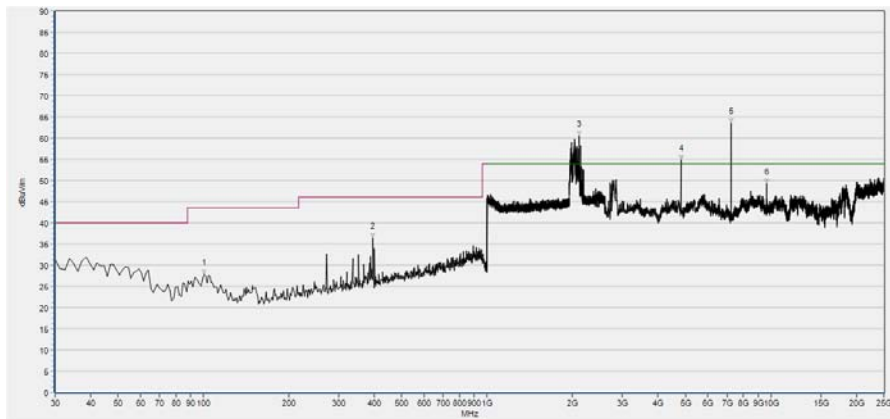
Where  $N_1$  is number of type 1 pulses,  $L_1$  is length of type 1 pulses, etc.

The average levels were calculated from the peak level corrected with duty cycle correction factor (-38.42dB) derived from  $20\log(\text{dwell time}/100\text{ms})$ . This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

**Note1:** All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

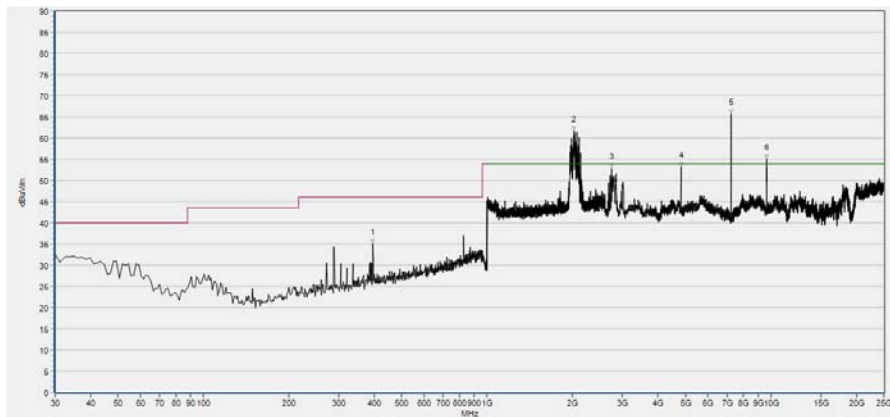
**Note2:** For the frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

**Note3:** For the frequency, which started from 25GHz to 40GHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

**GFSK Mode****Plots for Channel = 1**

| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna    | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 100.413    | 27.79       | N/A         | N/A         | N/A               | 43.50             | N/A               | Horizontal | PASS    |
| 395.419    | 36.51       | N/A         | N/A         | N/A               | 46.00             | N/A               | Horizontal | PASS    |
| 2105.900   | 61.95       | N/A         | 39.86       | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 4815.967   | 54.90       | N/A         | 16.49       | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 7227.460   | 63.54       | N/A         | 25.13       | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 9634.879   | 49.37       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

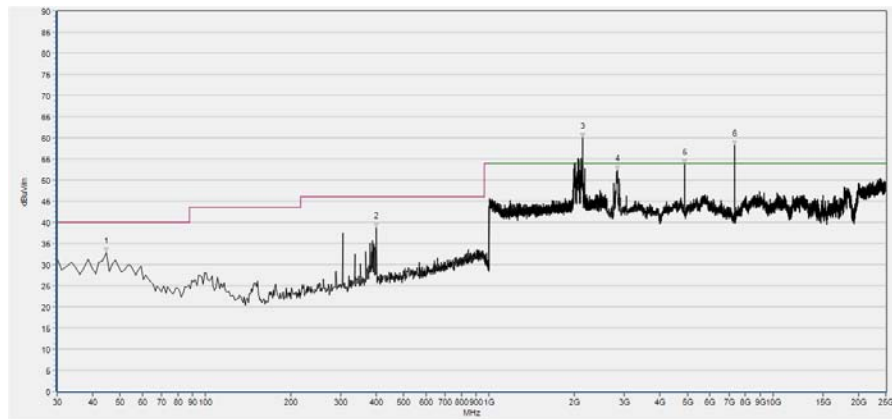
(30MHz to 25GHz, Antenna Horizontal, GFSK, channel 1)



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna  | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 395.419    | 35.03       | N/A         | N/A         | N/A               | 46.00             | N/A               | Vertical | PASS    |
| 2025.690   | 61.58       | N/A         | 38.62       | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 2746.645   | 52.91       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 4815.967   | 53.24       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 7227.460   | 65.67       | N/A         | 27.26       | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 9634.879   | 54.99       | N/A         | 16.58       | 74.00             | N/A               | 54.00             | Vertical | PASS    |

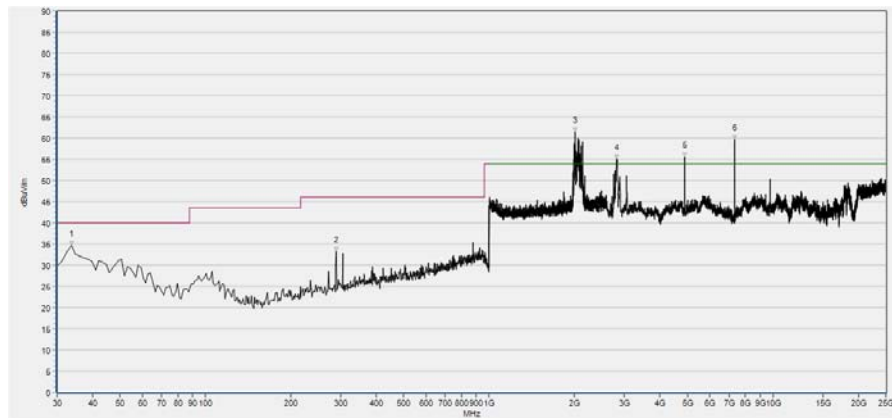
(30MHz to 25GHz, Antenna Vertical, GFSK, channel 1)

### Plot for Channel = 11



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna    | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 44.568     | 32.88       | N/A         | N/A         | N/A               | 40.00             | N/A               | Horizontal | PASS    |
| 400.275    | 38.70       | N/A         | N/A         | N/A               | 46.00             | N/A               | Horizontal | PASS    |
| 2136.455   | 59.97       | N/A         | 37.61       | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 2832.188   | 52.24       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 4881.142   | 53.74       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 7321.149   | 58.23       | N/A         | 19.82       | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

(30MHz to 25GHz, Antenna Horizontal, GFSK, channel 11)

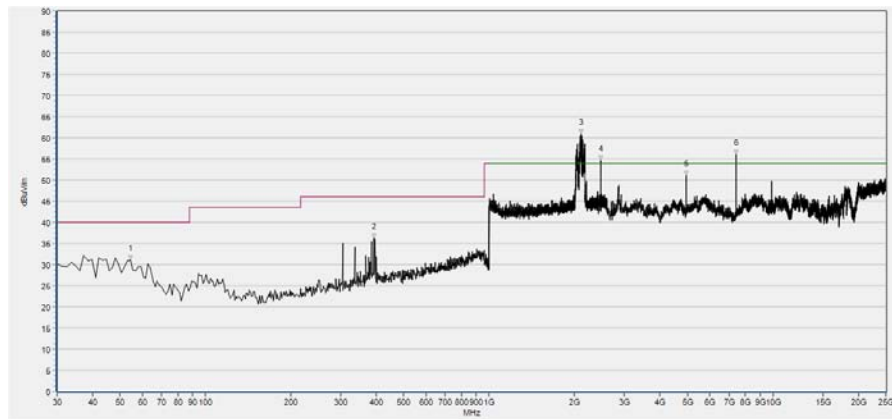


| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna  | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 33.642     | 34.63       | N/A         | N/A         | N/A               | 40.00             | N/A               | Vertical | PASS    |
| 288.586    | 33.15       | N/A         | N/A         | N/A               | 46.00             | N/A               | Vertical | PASS    |
| 2008.403   | 61.45       | N/A         | 39.33       | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 2807.747   | 54.98       | N/A         | 32.14       | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 4881.142   | 55.53       | N/A         | 17.12       | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 7321.149   | 59.69       | N/A         | 21.28       | 74.00             | N/A               | 54.00             | Vertical | PASS    |

(30MHz to 25GHz, Antenna Vertical, GFSK, channel 11)

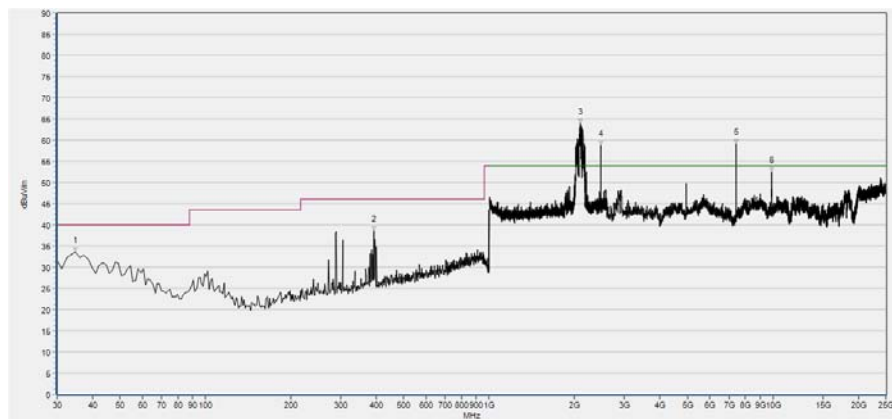


## Plot for Channel = 23



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna    | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|------------|---------|
| 54.280     | 31.11       | N/A         | N/A         | N/A               | 40.00             | N/A               | Horizontal | PASS    |
| 391.777    | 36.20       | N/A         | N/A         | N/A               | 46.00             | N/A               | Horizontal | PASS    |
| 2107.643   | 60.88       | N/A         | 39.24       | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 2477.790   | 54.59       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | N/A     |
| 4950.391   | 51.03       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Horizontal | PASS    |
| 7427.059   | 55.99       | N/A         | 17.58       | 74.00             | N/A               | 54.00             | Horizontal | PASS    |

(30MHz to 25GHz, Antenna Horizontal, GFSK, channel 23)



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna  | Verdict |
|------------|-------------|-------------|-------------|-------------------|-------------------|-------------------|----------|---------|
| 34.856     | 33.66       | N/A         | N/A         | N/A               | 40.00             | N/A               | Vertical | PASS    |
| 391.777    | 38.62       | N/A         | N/A         | N/A               | 46.00             | N/A               | Vertical | PASS    |
| 2096.759   | 63.89       | N/A         | 37.68       | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 2477.790   | 58.78       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | N/A     |
| 7431.133   | 59.13       | N/A         | 20.72       | 74.00             | N/A               | 54.00             | Vertical | PASS    |
| 9903.728   | 52.49       | N/A         | N/A         | 74.00             | N/A               | 54.00             | Vertical | PASS    |

(30MHz to 25GHz, Antenna Vertical, GFSK, channel 23)

## Annex A Test Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for test performed on the EUT as specified in CISPR 16-1-2:

| Test items                     | Uncertainty |
|--------------------------------|-------------|
| Number of Hopping Frequency    | ±5%         |
| Peak Output Power              | ±2.22dB     |
| 20dB Bandwidth                 | ±5%         |
| Carrier Frequency Separation   | ±5%         |
| Time of Occupancy (Dwell time) | ±5%         |
| Conducted Spurious Emission    | ±2.77 dB    |
| Restricted Frequency Bands     | ±5%         |
| Radiated Emission              | ±2.95dB     |
| Conducted Emission             | ±2.44dB     |

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



## Annex B Testing Laboratory Information

### 1. Identification of the Responsible Testing Laboratory

|                                      |                                                                                                                                  |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <b>Company Name:</b>                 | Shenzhen Morlab Communications Technology Co., Ltd.                                                                              |
| <b>Department:</b>                   | Morlab Laboratory                                                                                                                |
| <b>Address:</b>                      | FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, Guangdong Province, P. R. China |
| <b>Responsible Test Lab Manager:</b> | Mr. Su Feng                                                                                                                      |
| <b>Telephone:</b>                    | +86 755 36698555                                                                                                                 |
| <b>Facsimile:</b>                    | +86 755 36698525                                                                                                                 |

### 2. Identification of the Responsible Testing Location

|                 |                                                                                                                                  |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------|
| <b>Name:</b>    | Shenzhen Morlab Communications Technology Co., Ltd.<br>Morlab Laboratory                                                         |
| <b>Address:</b> | FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, Guangdong Province, P. R. China |

### 3. Facilities and Accreditations

All measurement facilities used to collect the measurement data are located at FL.3, Building A, FeiYang Science Park, Block 67, BaoAn District, Shenzhen, 518101 P. R. China. The test site is constructed in conformance with the requirements of ANSI C63.10-2013 and CISPR Publication 22; the FCC designation number is CN1192, the test firm registration number is 226174.



#### 4. Test Equipments Utilized

##### 4.1 Conducted Test Equipments

| Equipment Name         | Serial No. | Type    | Manufacturer | Cal. Date  | Cal. Due   |
|------------------------|------------|---------|--------------|------------|------------|
| Bluetooth Base Station | 6K00006210 | MT8852B | Anritsu      | 2018.04.17 | 2019.04.16 |
| Power Splitter         | NW521      | 1506A   | Weinschel    | 2018.04.17 | 2019.04.16 |
| Attenuator 1           | (N/A.)     | 10dB    | Resnet       | 2018.04.17 | 2019.04.16 |
| Attenuator 2           | (N/A.)     | 3dB     | Resnet       | 2018.04.17 | 2019.04.16 |
| EXA Signal Analyzer    | MY53470836 | N9010A  | Agilent      | 2017.12.03 | 2018.12.02 |
| RF cable (30MHz-26GHz) | CB01       | RF01    | Morlab       | N/A        | N/A        |
| Coaxial cable          | CB02       | RF02    | Morlab       | N/A        | N/A        |
| SMA connector          | CN01       | RF03    | HUBER-SUHNER | N/A        | N/A        |

##### 4.2 Conducted Emission Test Equipments

| Equipment Name                   | Serial No. | Type        | Manufacturer | Cal. Date  | Cal. Due   |
|----------------------------------|------------|-------------|--------------|------------|------------|
| Receiver                         | MY56400093 | N9038A      | KEYSIGHT     | 2018.05.08 | 2019.05.07 |
| LISN                             | 812744     | NSLK 8127   | Schwarzbeck  | 2018.05.08 | 2019.05.07 |
| Pulse Limiter (20dB)             | 9391       | VTSD 9561-D | Schwarzbeck  | 2018.05.08 | 2019.05.07 |
| Coaxial cable(BNC) (30MHz-26GHz) | CB01       | EMC01       | Morlab       | N/A        | N/A        |

##### 4.3 Auxiliary Test Equipment

| Equipment Name | Model No. | Brand Name | Manufacturer | Cal.Date | Cal. Due |
|----------------|-----------|------------|--------------|----------|----------|
| Computer       | T430i     | Think Pad  | Lenovo       | N/A      | N/A      |

##### 4.4 List of Software Used

| Description      | Manufacturer | Software Version |
|------------------|--------------|------------------|
| Test system      | Tonscend     | V2.6             |
| Power Panel      | Agilent      | V3.8             |
| MORLAB EMCR V1.2 | MORLAB       | V 1.0            |

**4.5 Radiated Test Equipments**

| Equipment Name                       | Serial No. | Type       | Manufacturer   | Cal. Date  | Cal. Due   |
|--------------------------------------|------------|------------|----------------|------------|------------|
| Receiver                             | MY54130016 | N9038A     | Agilent        | 2018.05.08 | 2019.05.07 |
| Test Antenna - Bi-Log                | 9163-519   | VULB 9163  | Schwarzbeck    | 2018.05.08 | 2019.05.07 |
| Test Antenna - Horn                  | 9170C-531  | BBHA9170   | Schwarzbeck    | 2017.09.13 | 2018.09.12 |
| Test Antenna - Loop                  | 1519-022   | FMZB1519   | Schwarzbeck    | 2018.03.03 | 2019.03.02 |
| Test Antenna - Horn                  | 01774      | BBHA 9120D | Schwarzbeck    | 2017.09.13 | 2018.09.12 |
| Coaxial cable (N male) (9KHz-30MHz)  | CB04       | EMC04      | Morlab         | N/A        | N/A        |
| Coaxial cable (N male) (30MHz-26GHz) | CB02       | EMC02      | Morlab         | N/A        | N/A        |
| Coaxial cable (N male) (30MHz-26GHz) | CB03       | EMC03      | Morlab         | N/A        | N/A        |
| 1-18GHz pre-Amplifier                | MA02       | TS-PR18    | Rohde& Schwarz | 2018.05.08 | 2019.05.07 |
| 18-26.5GHz pre-Amplifier             | MA03       | TS-PR18    | Rohde& Schwarz | 2018.05.08 | 2019.05.07 |
| Anechoic Chamber                     | N/A        | 9m*6m*6m   | CRT            | 2017.11.19 | 2020.11.18 |

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