# KSIGN (Guangdong) Testing Co., Ltd.

**K**5IGN<sup>®</sup>

West Side of 1/F., Building C, Zone A, Fuyuan New Factory, Jiujiu Industrial Park, Minzhu,Shatou, Shajing, Bao'an District, Shenzhen, Guangdong, People's Republic of China Tel.: + (86)755-29852678 Fax: + (86)755-29852397 E-mail: info@gdksign.cn Website: www.gdksign.com

| Т  | EST REPORT   |
|--|--|
| Report No:                               | KS2011S02133E  |
| FCC ID······:                            | 2AO94-MK11   |
| Applicant                                | MOKO TECHNOLOGY LIMITED  |
| Address                                  | 2F, Building1,No.37 Xiaxintang Xintang village,Fucheng Street,<br>Longhua District,Shenzhen,Guangdong Province,China   |
| Manufacturer                             | MOKO TECHNOLOHY Ltd  |
| Address                                  | 2F, Building1, No. 37 Xiaxintang Xintang village, Fucheng Street, Longhua District, Shenzhen, Guangdong Province, China  |
| Factory                                  | MOKO TECHNOLOHY Ltd  |
| Address                                  | 2F, Building1, No. 37 Xiaxintang Xintang village, Fucheng Street, Longhua District, Shenzhen, Guangdong Province, China  |
| Product Name:                            | Bluetooth Low Energy Module  |
| Trade Mark                               | 1  |
| Model/Type reference:                    | MK11A  |
| Listed Model(s)                          | I  |
| Standard:                                | FCC CFR Title 47 Part 15 Subpart C Section 15.247  |
| Date of Receipt                          | Nov. 26, 2020  |
| Date of Test Date                        | Nov. 26, 2020~Dec. 21, 2020  |
| Date of issue                            | Dec. 21, 2020  |
| Test result:                             | Pass   |
| Compiled by:<br>(Printed name+signature) | Rory Huang   |
| Supervised by:                           | Floren   |
| (Printed name+signature)                 | Eder Zhan  |
| Approved by:                             |  |
| (Printed name+signature)                 | Cary Luo   |
| Testing Laboratory Name:                 | KSIGN(Guangdong) Testing Co., Ltd.   |
| Address                                  | West Side of 1/F., Building C, Zone A, Fuyuan New Factory, Jiujiu<br>Industrial Park, Minzhu, Shatou, Shajing, Bao'an District, Shenzhen,<br>Guangdong, People's Republic of China |

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# 1. TEST SUMMARY

# 1.1. Test Standards

The tests were performed according to following standards:

FCC Rules Part 15.247: Operation within the bands of 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz.

**KDB 558074 D01** : The measurement guidance provided herein is applicable only to Digital Transmission System (DTS) devices operating in the 902-928 MHz. 2400-2483.5 MHz and/or 5725-5850 MHz bands under § 15.247 of the FCC rules (Title 47 of the Code of Federal Regulations).

ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.

# 1.2. Report version

| Revised No. | Date of issue | Description |
|-------------|---------------|-------------|
| 01          | Dec. 21, 2020 | Original    |



# 1.3. Test Description

| FCC Part 15 Subpart C(15.247)  |                  |        |               |  |  |
|--------------------------------|------------------|--------|---------------|--|--|
|                                | Standard Section | Dessil | T. ( F        |  |  |
| Test Item                      | FCC              | Result | Test Engineer |  |  |
| Antenna Requirement            | 15.203           | Pass   | Rory Huang    |  |  |
| Conducted Emission             | 15.207           | Pass   | Rory Huang    |  |  |
| Restricted Bands               | 15.205           | Pass   | Rory Huang    |  |  |
| Peak Output Power              | 15.247(b)        | Pass   | Rory Huang    |  |  |
| Band Edge Emissions            | 15.247(d)        | Pass   | Rory Huang    |  |  |
| Power Spectral Density         | 15.247(e)        | Pass   | Rory Huang    |  |  |
| Radiated Emission              | 15.205&15.209    | Pass   | Rory Huang    |  |  |
| 6dB Bandwidth                  | 15.247(a)(2)     | Pass   | Rory Huang    |  |  |
| Spurious RF Conducted Emission | 15.247(d)        | Pass   | Rory Huang    |  |  |

### Note:

1. The measurement uncertainty is not included in the test result.



# 1.4. Test Facility

#### Address of the report laboratory

#### KSIGN(Guangdong) Testing Co., Ltd.

West Side of 1/F., Building C, Zone A, Fuyuan New Factory, Jiujiu Industrial Park, Minzhu, Shatou, Shajing, Bao'an District, Shenzhen, Guangdong, People's Republic of China

#### Laboratory accreditation

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

#### CNAS-Lab Code: L13261

KSIGN(Guangdong) Testing Co., Ltd. has been assessed and proved to be in Compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2017 General Requirements) for the Competence of Testing and Calibration Laboratories.

#### A2LA-Lab Cert. No.: 5457.01

KSIGN(Guangdong) Testing Co., Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

#### IC Registration No.: CN0096

The 3m alternate test site of KSIGN(Guangdong) Testing Co., Ltd. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration NO.: CN0096

#### FCC-Registration No.: CN1272

KSIGN(Guangdong) Testing Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.



# 1.5. Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01" Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2 " and is documented in the KSIGN(Guangdong) Testing Co., Ltd. system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device. Below is the best measurement capability for KSIGN(Guangdong) Testing Co., Ltd.

| Test Items                              | Measurement Uncertainty | Notes |  |
|---|-------------------------|-------|--|
| Transmitter power conducted             | 0.42 dB                 | (1)   |  |
| Transmitter power Radiated              | 2.14 dB                 | (1)   |  |
| Conducted spurious emissions 9kHz~40GHz | 1.60 dB                 | (1)   |  |
| Radiated spurious emissions 9kHz~40GHz  | 2.20 dB                 | (1)   |  |
| Conducted Emissions 9kHz~30MHz          | 3.20 dB                 | (1)   |  |
| Radiated Emissions 30~1000MHz           | 4.70 dB                 | (1)   |  |
| Radiated Emissions 1~18GHz              | 5.00 dB                 | (1)   |  |
| Radiated Emissions 18~40GHz             | 5.54 dB                 | (1)   |  |
| Occupied Bandwidth                      | 2.80 dB                 | (1)   |  |

**Note (1):** This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

# 1.6. Environmental conditions

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

| Temperature:       | 15~35°C     |
|--------------------|-------------|
| Relative Humidity: | 30~60 %     |
| Air Pressure:      | 950~1050mba |



# 2. GENERAL INFORMATION

# 2.1. General Description of EUT

| Test Sample Number 1:  | 1-1-1(Normal Sample),1-1-2(Engineering Sample) |
|------------------------|--|
| Product Name:          | Bluetooth Low Energy Module                    |
| Model/Type reference:  | MK11A  |
| Trade Mark:            |  |
| Listed Model(s):       |  |
| Model Difference:      |  |
| Power supply(Work)     | Input:DC 3.3V                                  |
| Hardware version:      | V1.0   |
| Software version:      | V1.0.0   |
| Bluetooth V5.1         |  |
| Modulation:            | GFSK   |
| Operation frequency:   | 2402MHz~2480MHz                                |
| Max Peak Output Power: | 3.88 dBm                                       |
| Channel number:        | 40   |
| Channel separation:    | 2MHz   |
| Antenna type:          | PCB Antenna                                    |
| Antenna gain:          | -0.7dBi  |



# 2.2. Operation state

Operation Frequency List: The EUT has been tested under typical operating condition. The Applicant provides communication tools software to control the EUT for staying in continuous transmitting and receiving mode for testing. BT BLE, 40 channels are provided to the EUT. Channels 00/19/39 were selected for testing. Operation Frequency List:

| Channel | Frequency (MHz) |  |  |
|---------|-----------------|--|--|
| 00      | 2402            |  |  |
| 01      | 2404            |  |  |
|         |                 |  |  |
| 19      | 2440            |  |  |
| 20      | 2442            |  |  |
| 21      | 2444            |  |  |
|         |                 |  |  |
| 38      | 2478            |  |  |
| 39      | 2480            |  |  |

Note: The display in grey were the channel selected for testing.

Test mode

For RF test items:

The engineering test program was provided and enabled to make EUT continuous transmit.

For AC power line conducted emissions:

The EUT was set to connect with the Bluetooth instrument under large package sizes transmission.

For Radiated spurious emissions test item:

The engineering test program was provided and enabled to make EUT continuous transmit. The EUT in each of three orthogonal axis emissions had been tested, but only the worst case (X axis) data recorded in the report.



# 2.3. Measurement Instruments List

|      | Tonscend JS0806-2 Test system          |              |           |            |            |  |  |
|------|--|--------------|-----------|------------|------------|--|--|
| Item | Test Equipment                         | Manufacturer | Model No. | Serial No. | Cal. Until |  |  |
| 1    | Spectrum Analyzer                      | R&S          | FSV40-N   | 101798     | 04/07/2021 |  |  |
| 2    | Vector Signal Generator                | Agilent      | N5182A    | MY50142520 | 04/07/2021 |  |  |
| 3    | Analog Signal Generator                | HP           | 83752A    | 3344A00337 | 04/07/2021 |  |  |
| 4    | Power Sensor                           | Agilent      | E9304A    | MY50390009 | 04/07/2021 |  |  |
| 5    | Power Sensor                           | Agilent      | E9300A    | MY41498315 | 04/07/2021 |  |  |
| 6    | Wideband Radio<br>Communication Tester | R&S          | CMW500    | 157282     | 04/07/2021 |  |  |
| 7    | Climate Chamber                        | Angul        | AGNH80L   | 1903042120 | 04/07/2021 |  |  |
| 8    | Dual Output DC Power Supply            | Agilent      | E3646A    | MY40009992 | 04/07/2021 |  |  |
| 9    | RF Control Unit                        | Tonscend     | JS0806-2  | /          | 04/07/2021 |  |  |

|      | Transmitter spur                              | ious emissions & Re    | ceiver spurious en | nissions   |            |
|------|---|------------------------|--------------------|------------|------------|
| Item | Test Equipment                                | Manufacturer           | Model No.          | Serial No. | Cal. Until |
| 1    | EMI Test Receiver                             | R&S                    | ESR                | 102525     | 04/07/2021 |
| 2    | High Pass Filter                              | Chengdu<br>E-Microwave | OHF-3-18-S         | 0E01901038 | 03/27/2021 |
| 3    | High Pass Filter                              | Chengdu<br>E-Microwave | OHF-6.5-18-S       | 0E01901039 | 03/27/2021 |
| 4    | Spectrum Analyzer                             | HP                     | 8593E              | 3831U02087 | 04/07/2021 |
| 5    | Ultra-Broadband logarithmic<br>period Antenna | Schwarzbeck            | VULB 9163          | 01230      | 03/29/2023 |
| 6    | Loop Antenna                                  | Beijin ZHINAN          | ZN30900C           | 18050      | 03/25/2021 |
| 7    | Spectrum Analyzer                             | R&S                    | FSV40-N            | 101798     | 04/07/2021 |
| 8    | Horn Antenna                                  | Schwarzbeck            | BBHA 9120 D        | 2023       | 03/29/2023 |
| 9    | Pre-Amplifier                                 | Schwarzbeck            | BBV 9745           | 9745#129   | 04/07/2021 |
| 10   | Pre-Amplifier                                 | EMCI                   | EMC051835SE        | 980662     | 04/07/2021 |

| Item | Test Equipment    | Manufacturer | Model No. | Serial No.   | Cal. Until |
|------|-------------------|--------------|-----------|--------------|------------|
| 1    | LISN              | R&S          | ENV432    | 1326.6105.02 | 03/27/2021 |
| 2    | EMI Test Receiver | R&S          | ESR       | 102524       | 04/07/2021 |
| 3    | Manual RF Switch  | JS TOYO      |           | MSW-01/002   | 04/07/2021 |

Note:

The Cal. Interval was one year.
 The cable loss has calculated in test result which connection between each test instruments.

# 2.5. Test Software

| Software name                           | Model    | Version       |
|---|----------|---------------|
| Conducted emission Measurement Software | EZ-EMC   | EMC-Con 3A1.1 |
| Radiated emission Measurement Software  | EZ-EMC   | FA-03A.2.RE   |
| Bluetooth and WIFI Test System          | JS1120-3 | 2.5.77.0418   |



# 3. TEST ITEM AND RESULTS

# 3.1. Antenna requirement

#### **Requirement**

#### FCC CFR Title 47 Part 15 Subpart C Section 15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

### FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1)(i):

(i) Systems operating in the 2400~2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

#### Test Result

The directional gain of the antenna less than 6dBi, please refer to the EUT internal photographs antenna photo.

Note: The antenna is permanently fixed to the EUT



# 3.2. 6dB Bandwidth

**Limit** 

| Test Item | Limit                        | Frequency Range(MHz) |
|-----------|------------------------------|----------------------|
| Bandwidth | >=500 KHz<br>(6dB bandwidth) | 2400~2483.5          |

Test Configuration

|          | EUT | Spectrum Analyzer |
|----------|-----|-------------------|
| <u> </u> |     |                   |

#### **Test Procedure**

- 1. Connect EUT RF Output port to the Spectrum Analyzer through an RF attenuator.
- 2. The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB.
- 3. The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

#### 4. Spectrum Setting:

6dB bandwidth:

- (1) Set RBW = 100 kHz.
- (2) Set the video bandwidth (VBW) = 3\* RBW.
- (3) Detector = Peak.
- (4) Trace mode = Max hold.
- (5) Sweep = Auto couple.
- (6) Allow the trace to stabilize.

(7) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

NOTE: The EUT was set to continuously transmitting in each mode and low, Middle and high channel for the test.

#### Test Mode

Please refer to the clause 2.3.

#### **Test Results**

# GFSK\_1M

| Test Mode:    | BLE Mode    |                     | AS CONTRACTOR  |
|---------------|-------------|---------------------|----------------|
| Channel frequ | uency (MHz) | 6dB Bandwidth (kHz) | Limit<br>(kHz) |
| 2402          |             | 708                 |                |
| 2440          |             | 720                 | ≧500           |
| 2480          |             | 708                 |                |
|               |             |                     |                |

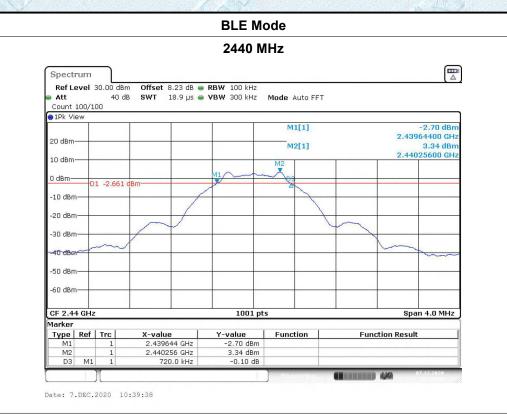
# BLE Mode

#### 2402 MHz

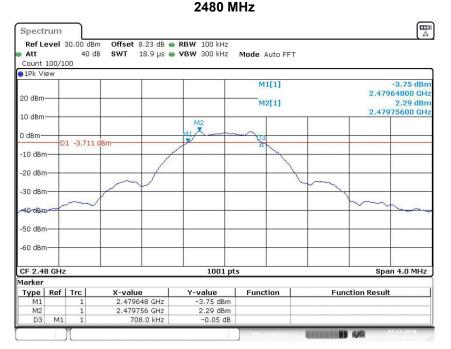
| Att      | ever . | 30.00 dB<br>40 c |                 | VBW 100 kHz  | Mode Auto FF      | т    |              |            |
|----------|--------|------------------|-----------------|--------------|-------------------|------|--------------|------------|
| Count    | 100/1  |                  | 10 3441 10.9 ps | 1011 300 KHZ | HOUE AUTO FF      |      |              |            |
| 1Pk Vi   |        |                  |                 |              |                   |      |              |            |
|          |        |                  |                 |              | M1[1]             |      |              | -2.36 dBr  |
| 20 dBm   |        |                  |                 |              | No. 11 Concession |      | 2.401        | .65200 GH  |
|          |        |                  |                 |              | M2[1]             |      |              | 3.73 dBr   |
| 10 dBm   |        |                  |                 |              | M2                |      | 2.402        | 25600 GH   |
|          |        |                  |                 | MI           | X                 |      |              |            |
| 0 dBm—   | D      | 1 -2.269         | dBm             |              | ~ 63              |      |              |            |
|          |        | 1 2.205          |                 |              | -                 |      |              |            |
| -10 dBm  |        |                  |                 |              | 1                 |      |              |            |
| -20 dBm  |        |                  |                 |              |                   | N.   |              |            |
| -20 UBII |        |                  | m               |              |                   | Im   |              |            |
| -30 dBm  |        |                  |                 |              |                   | 7    |              |            |
|          | -      | ~                |                 |              |                   |      | L            |            |
| 40 dBm   |        |                  |                 |              |                   |      |              |            |
|          |        |                  |                 |              |                   |      |              |            |
| -50 dBm  |        |                  |                 |              |                   |      |              |            |
|          |        |                  |                 |              |                   |      |              |            |
| -60 dBm  |        |                  |                 |              |                   |      |              |            |
| CF 2.4   |        | -                |                 | 1001 pt      | -                 |      |              | n 4.0 MHz  |
| larker   | 72 GH  | 2                |                 | 1001 pt      | 3                 |      | эра          | 11 4.0 MHZ |
|          | Ref    | Trc              | X-value         | Y-value      | Function          | Fun  | ction Result |            |
| M1       |        | 1                | 2.401652 GHz    | -2.36 dBm    |                   | 1 di |              |            |
| M2       |        | 1                | 2.402256 GHz    | 3.73 dBm     |                   |      |              |            |
| D3       | M1     | 1                | 708.0 kHz       | -0.05 dB     |                   |      |              |            |

Date: 7.DEC.2020 10:36:01





**BLE Mode** 



Date: 7.DEC.2020 10:42:55

# GFSK\_2M

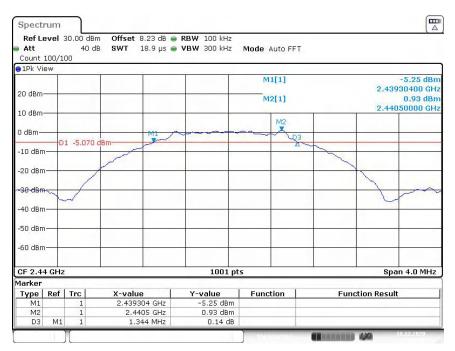
| Test Mode:    | BLE Mode    | 1 Charles and the second s | 999 - Carlo |
|---------------|-------------|--|---|
| Channel frequ | iency (MHz) | 6dB Bandwidth (kHz)  | Limit<br>(kHz)  |
| 240           | 2           | 1.428  |   |
| 2440          |             | 1.344  | ≧500  |
| 2480          |             | 1.408  |   |
|               |             | BLE Mode   |   |

### 2402 MHz

| Att               |       | 30.00 dBr<br>40 d |                           | RBW 100 kHz<br>VBW 300 kHz | Mode Auto FF | т    |   |
|-------------------|-------|-------------------|---------------------------|----------------------------|--------------|------|---|
| Count             | 2.22  | 00                |                           |                            |              |      |   |
| 20 dBm            |       |                   |                           |                            | M1[1]        |      | -4.73 dE<br>2.40128800 G<br>1.34 dE<br>2.40199200 G |
| 10 dBm<br>0 dBm—  |       |                   |                           | MP                         |              |      |   |
| о авт—<br>-10 dBn |       | 1 -4.659          | dBm M1                    |                            | and          | D3   |   |
| 20 dBm            | -     | 1                 |                           |                            |              |      | ~   |
| 30 dBn<br>40 dBn  |       | 1                 |                           |                            |              |      |   |
| 50 dBn            |       |                   |                           |                            |              |      |   |
| -60 dBrr          | -     | _                 |                           |                            |              |      |   |
| CF 2.4            | 02 GH | z                 |                           | 1001 pt:                   | s            |      | Span 4.0 MH   |
| 1arker<br>Type    | Ref   | Trc               | X-value                   | Y-value                    | Function     | Fund | tion Result   |
| M1                |       | 1                 | 2.401288 GHz              | -4.73 dBm                  |              |      |   |
| M2<br>D3          | M1    | 1                 | 2.401992 GHz<br>1.428 MHz | 1.34 dBm<br>0.02 dB        |              |      |   |

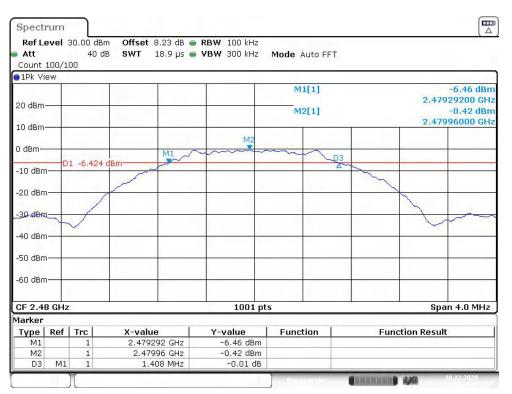
Date: 18.DEC.2020 21:15:10

2440 MHz



Date: 18.DEC.2020 21:20:32

#### 2480 MHz



Date: 18.DEC.2020 21:23:46

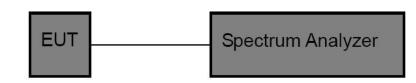


# 3.3. Peak Output Power

Limit

|    | Test Item       | Limit            | Frequency Range(MHz) |
|----|-----------------|------------------|----------------------|
| Pe | ak Output Power | 1 Watt or 30 dBm | 2400~2483.5          |

**Test Configuration** 



#### Test Procedure

1. Connect EUT RF Output port to the Spectrum Analyzer through an RF attenuator..

2. Spectrum Setting:

Peak Detector: RBW≥DTS Bandwidth, VBW≥3\*RBW.

Sweep time=Auto.

Detector= Peak.

Trace mode= Maxhold.

Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.

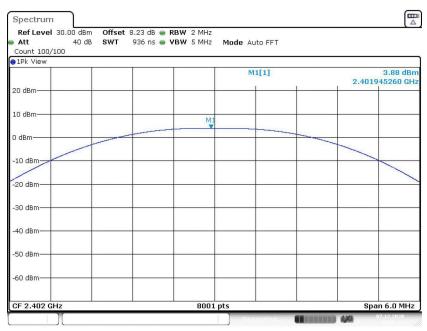
#### Test Mode

Please refer to the clause 2.3.

### Test Result

### GFSK\_1M

| Test Mode:    | BLE Mode    |                   |             |  |
|---------------|-------------|-------------------|-------------|--|
| Channel frequ | iency (MHz) | Test Result (dBm) | Limit (dBm) |  |
| 240           | 2           | 3.88              |             |  |
| 2440          |             | 3.47              | 30          |  |
| 248           | 0           | 2.56              |             |  |
|               | ·           | BLE Mode          |             |  |
|               |             | 2402 MHz          |             |  |

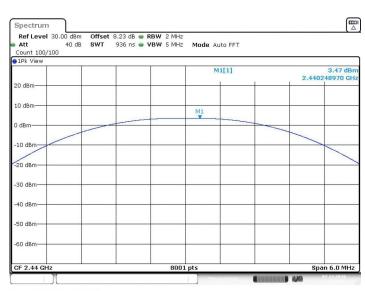


Date: 7.DEC.2020 10:36:19



**BLE Mode** 

#### 2440 MHz



Date: 7.DEC.2020 10:39:56

# **BLE Mode**

#### 2480 MHz

| Count 100/100 | 0 dBm Offset<br>40 dB SWT | 8.23 dB 👄 RB<br>936 ns 👄 VB | Mode Au | ito FFT |              |                    |
|---------------|---------------------------|-----------------------------|---------|---------|--------------|--------------------|
| 1Pk View      |                           |                             | м       | 1[1]    | <br>2.480231 | 2.56 dBr<br>720 GH |
| 20 dBm        |                           |                             |         |         |              |                    |
| 10 dBm        |                           |                             | <br>    |         | <br>         |                    |
| 0 dBm         |                           |                             | <br>M1  |         | <br>         |                    |
| -10 dBm       |                           |                             |         |         |              |                    |
| -20 dBm-      |                           |                             |         |         |              | /                  |
| -30 dBm       |                           |                             |         |         |              |                    |
| -40 dBm       |                           |                             |         |         |              |                    |
| -50 dBm       |                           |                             | <br>    |         | <br>         |                    |
| -60 dBm       |                           |                             |         |         |              |                    |
| -60 dBm       |                           |                             |         |         |              |                    |

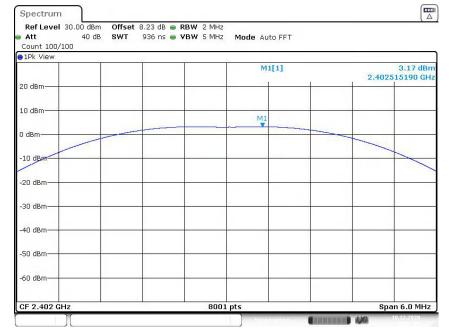
Date: 7.DEC.2020 10:43:13



#### GFSK-2M

| Test Mode:    | BLE Mode   | A                 |             |
|---------------|------------|-------------------|-------------|
| Channel frequ | ency (MHz) | Test Result (dBm) | Limit (dBm) |
| 2402          | 2          | 3.17              |             |
| 2440          |            | 2.71              | 30          |
| 2480          |            | 1.79              |             |
|               | t          | BLE Mode          |             |
|               |            |                   |             |

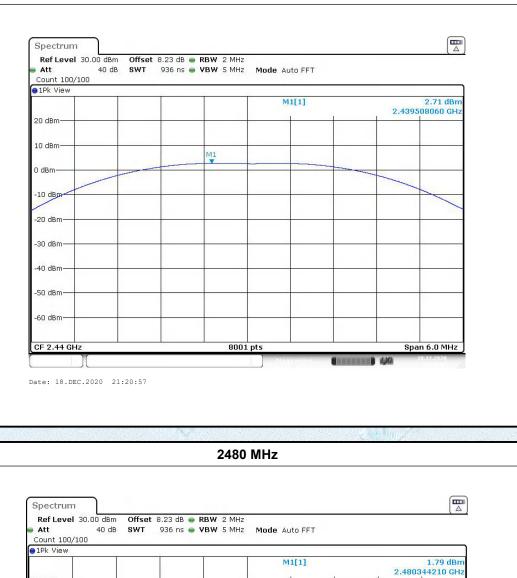




Date: 18.DEC.2020 21:15:36



2440 MHz



M1

\_\_\_\_\_

8001 pts

Span 6.0 MHz

Date: 18.DEC.2020 21:24:11

CF 2.48 GHz

20 dBm-10 dBm-

0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm



# 3.4. Power Spectral Density

#### Limit

| FCC Part 15 Subpart C(15.247) |                    |                      |  |  |
|-------------------------------|--------------------|----------------------|--|--|
| Test Item                     | Limit              | Frequency Range(MHz) |  |  |
| Power Spectral Density        | 8dBm(in any 3 kHz) | 2400~2483.5          |  |  |

### **Test Configuration**

| EUT | <br>Spectrum Analyzer |
|-----|-----------------------|
|     | Y: 27                 |

#### Test Procedure

- 1. Connect EUT RF Output port to the Spectrum Analyzer through an RF attenuator.
- 2. The EUT was directly connected to the Spectrum Analyzer and antenna output port as show in the block diagram above. The measurement according to section 10.b-6.ii of KDB 558074 D01 DTS Meas Guidance v05r02..
- 3. Spectrum Setting:

Set analyser center frequency to DTS channel center frequency. Set the span to 1.5 times the DTS bandwidth. Set the RBW to: 10 kHz Set the VBW to: 30 kHz Detector: peak Sweep time: auto Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.

#### Test Mode

Please refer to the clause 2.3.

#### **Test Result**

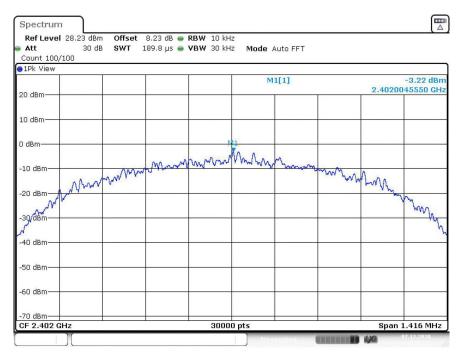
Note:

Power Density(dBm/3kHz)=Power Density(dBm/10kHz)-10\*Log(10/3)

### GFSK\_1M

| Test Mode:          | BLE Mode | • // ·                       | 665                         |                |
|---------------------|----------|------------------------------|-----------------------------|----------------|
| Channel Fre<br>(MHz | • •      | Power Density<br>(dBm/10kHz) | Power Density<br>(dBm/3kHz) | Limit<br>(dBm) |
| 2402                | 2        | -3.22                        | -8.45                       |                |
| 2440                |          | -4.29                        | -9.52                       | 8dBm/3kHz      |
| 2480                | )        | -4.76                        | -9.99                       |                |
|                     |          | BLE Mode                     |                             |                |

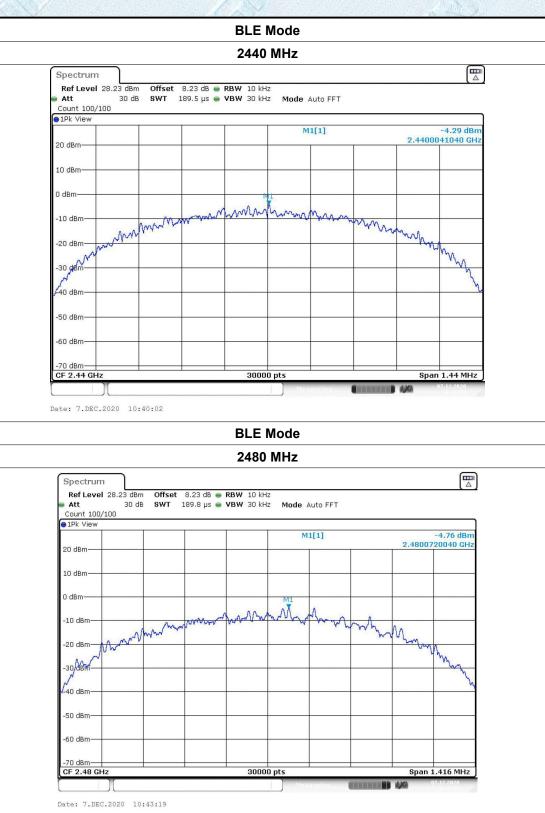
#### 2402 MHz



Date: 7.DEC.2020 10:36:25



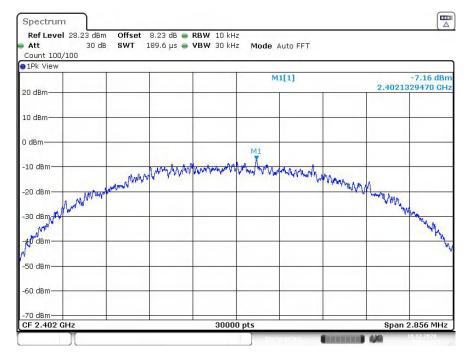
### Page 23 of 52





### GFSK\_2M

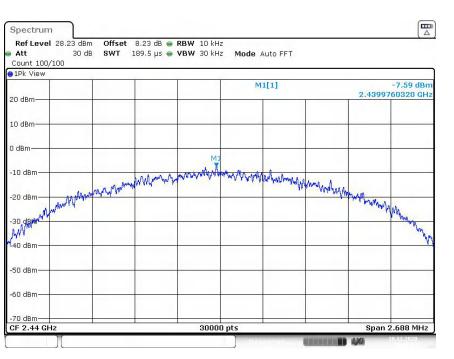
| Test Mode:          | BLE Mode | e / Y                        |                             |                |
|---------------------|----------|------------------------------|-----------------------------|----------------|
| Channel Fre<br>(MHz |          | Power Density<br>(dBm/10kHz) | Power Density<br>(dBm/3kHz) | Limit<br>(dBm) |
| 2402                | 2        | -7.16                        | -12.39                      |                |
| 2440                | )        | -7.59                        | -12.82                      | 8dBm/3kHz      |
| 2480                | )        | -9.94                        | -15.17                      |                |
|                     |          | BLE Mode                     |                             |                |
|                     |          | 2402 MHz                     |                             |                |



Date: 18.DEC.2020 21:15:46

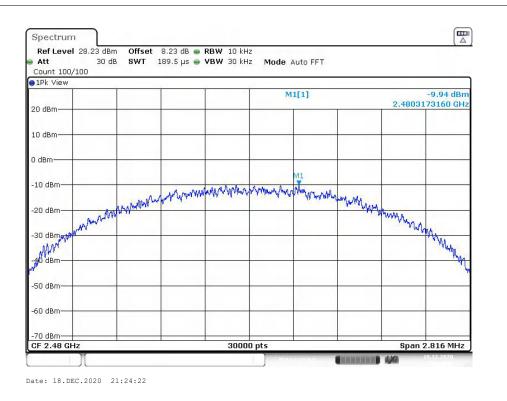


2440 MHz



Date: 18.DEC.2020 21:21:08

2480 MHz





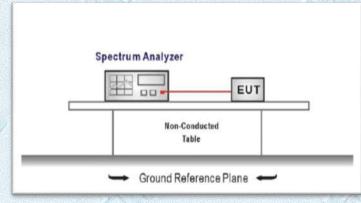
# 3.5. Band edge and Spurious Emission (conducted)

#### Limit

#### FCC CFR Title 47 Part 15 Subpart C Section15.247 (d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.

### **Test Configuration**



### Test Procedure

- 1. Connect EUT RF Output port to the Spectrum Analyzer through an RF attenuator.
- 2. Spectrum Setting:
  - RBW=100KHz
  - VBW=300KHz.
  - Detector function: Peak. Trace: Max hold. Sweep = Auto couple.

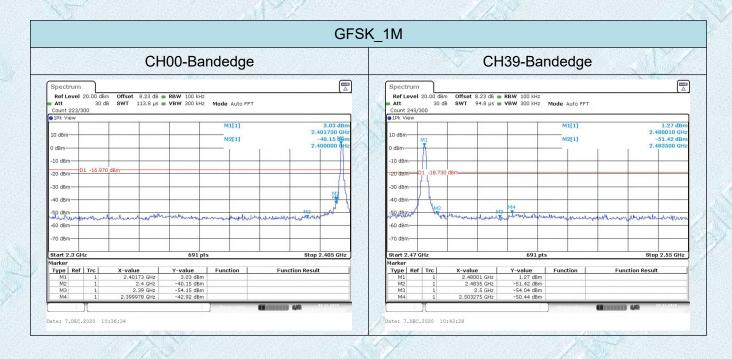
Allow the trace to stabilize.

### **Test Mode**

Please refer to the clause 2.3.



**Test Results** 



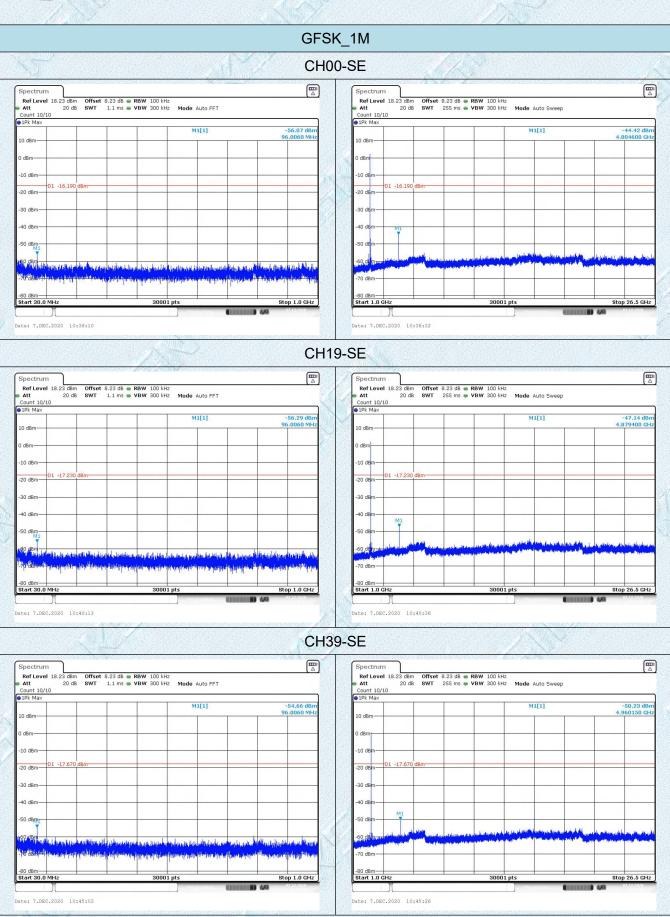
#### GFSK\_2M

|                    | С                                 | H00-Bai  | ndedge                                 | and the second             |                                       |             | Cł                    | 139-Ba                     | ndedge              |                       |                       |
|--------------------|-----------------------------------|--|--|----------------------------|---------------------------------------|-------------|-----------------------|----------------------------|---------------------|-----------------------|-----------------------|
| pectrum            |                                   |  |  |                            | Spectrum                              |             | 1000000000000         |                            |                     |                       | ſ                     |
| Ref Level 20.00 dB | m Offset 8.23 dB<br>B SWT 75.8 µs | <ul> <li>RBW 100 kHz</li> <li>VBW 300 kHz</li> </ul> | Mode Auto FFT                          | (4)                        | Ref Level 20.<br>Att<br>Count 241/300 | 30 dB SW    |                       | RBW 100 kHz<br>VBW 300 kHz | Mode Auto FFT       |                       |                       |
| 1Pk View           |                                   |  |  |                            | O 1Pk View                            |             |                       |                            |                     |                       |                       |
|                    |                                   |  | M1[1]                                  | 1.00 dBm                   |                                       |             |                       |                            | M1[1]               |                       | -0.75 dE              |
| ) dBm              |                                   |  |  | 2.4021740 GHz              | 10 dBm                                |             |                       |                            |                     |                       | 2.479780 G            |
| J ubili            |                                   |  | M2[1]                                  | -30.6§1dBm                 | M1                                    |             |                       |                            | M2[1]               |                       | -52.20 dt             |
| dBm-               |                                   | _  |  | 2.400000 GHz               | 0 dBm                                 |             |                       | _                          |                     |                       | 2.483500 0            |
|                    |                                   |  |  |                            |                                       |             |                       |                            |                     |                       |                       |
| D dBm              |                                   |  |  |                            | -10 dBm                               |             |                       |                            |                     |                       |                       |
| 0 dBm D1 -19.00    | dem                               |  |  |                            | 00 40m                                |             |                       |                            |                     |                       |                       |
| J dBm-01 -19.00    | ubin-                             |  |  |                            | -20 dBm-01                            | -20.750 dBm |                       |                            |                     |                       |                       |
| 0 dBm              |                                   |  |  | Ma                         | -30 dBm                               |             |                       |                            |                     |                       |                       |
| 5 dom              |                                   |  |  | N 7                        | N                                     | 0           |                       |                            |                     |                       |                       |
| 0 dBm              |                                   |  |  |                            | -40 dBm                               |             |                       | -                          |                     |                       |                       |
|                    |                                   |  |  | was well                   | S                                     | 412         |                       | M4                         |                     |                       |                       |
| 0 dBm              | and a some and allow              | 1 A CH I COM I AL INT                                | LALAN LANDAL                           | M3 milion of h             | -59 dent                              | mound       | man make a son a so   | 31 whentheren              | madrial second      | annesthanissing grand | بر المراميل سراري الم |
| 0 dBm              | the the menanega                  | na man name the                                      | 00000000000000000000000000000000000000 |                            | -60 dBm                               |             | - mailward -          |                            | and the state analy | and the second back   | a multi aba aba aba.  |
| U UBIII            |                                   |  |  |                            | -00 dBill                             |             |                       |                            |                     |                       |                       |
| 0 dBm              |                                   |  |  | 2                          | -70 dBm                               |             |                       |                            |                     |                       |                       |
|                    |                                   |  |  |                            |                                       |             |                       |                            |                     |                       |                       |
| art 2.35 GHz       |                                   | 691 pt   |  | Stop 2.405 GHz             | Start 2.47 GHz                        |             |                       | 691 p                      | ts                  |                       | Stop 2.55 G           |
| irker              |                                   |  |  |                            | Marker                                |             |                       |                            |                     |                       |                       |
| ype Ref Trc        | X-value                           | Y-value  | Function                               | Function Result            | Type Ref T                            |             | value                 | Y-value                    | Function            | Function              | Result                |
| M1 1<br>M2 1       | 2.402174 GHz<br>2.4 GHz           | 1.00 dBm<br>-30.65 dBm                               |  |                            | M1<br>M2                              |             | 2.47978 GHz           | -0.75 dBm<br>-52.20 dBm    |                     |                       |                       |
| M2 1<br>M3 1       | 2.4 GHZ<br>2.39 GHZ               | -30.65 dBm<br>-53.42 dBm                             |  |                            | M2<br>M3                              | 1           | 2.4835 GHZ<br>2.5 GHz | -52.20 dBm                 |                     |                       |                       |
| M4 1               | 2.39 GHz<br>2.3999783 GHz         | -32.11 dBm   |  |                            | M4                                    |             | 506522 GHz            | -50.37 dBm                 |                     |                       |                       |
| Y                  |                                   |  | thensuring                             | <b>1 1 1 1 1 1 1 1 1 1</b> | T T                                   |             |                       |                            | transumer           | frames 44             | 18.12.2020            |
|                    |                                   |  | )                                      |                            |                                       |             |                       |                            |                     |                       |                       |
| e: 18.DEC.2020     | 1.16.00                           |  |  |                            | Date: 18.DEC.2                        | 020 21:24:3 | 5                     |                            |                     |                       |                       |



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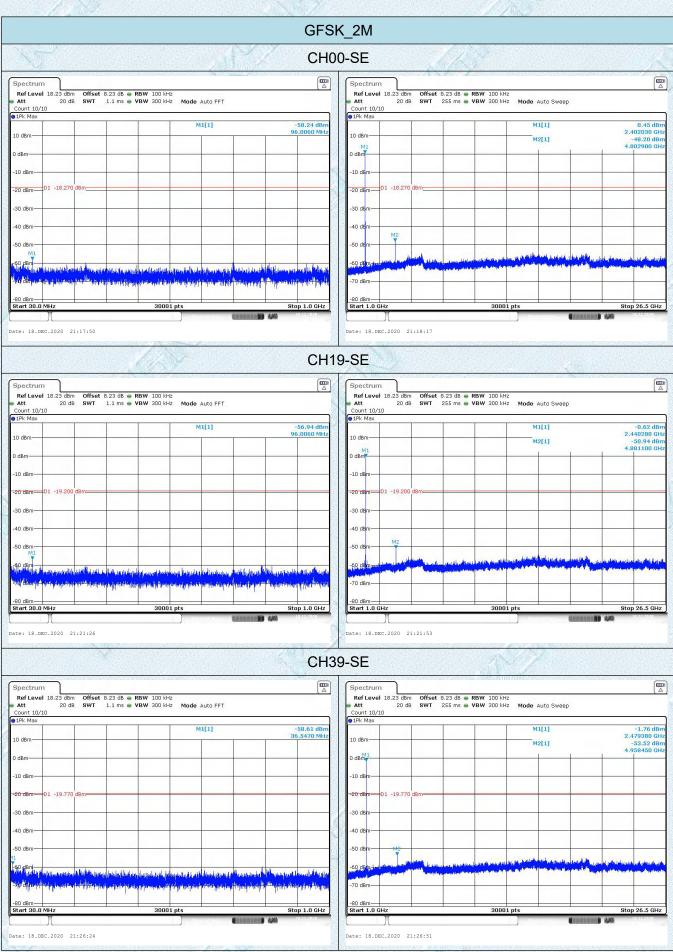
#### Report No.:KS2011S02133E





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#### Report No.:KS2011S02133E





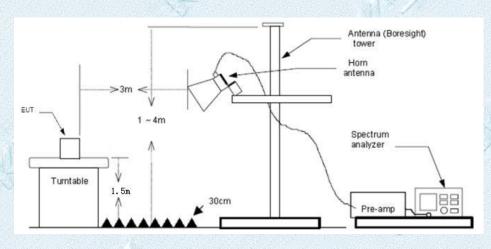
# 3.6. Band Edge Emissions(Radiated)

### Limit

| Restricted Frequency Band | (dBuV/ | m)(at 3m) |
|---------------------------|--------|-----------|
| (MHz)                     | Peak   | Average   |
| 2310 ~2390                | 74     | 54        |
| 2483.5 ~2500              | 74     | 54        |

Note: All restriction bands have been tested, only the worst case is reported.

### **Test Configuration**



### Test Procedure

- 1. The EUT was setup and tested according to ANSI C63.10:2013 requirements.
- 2. The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
- 3. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
- 4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.
- The receiver set as follow: RBW=1MHz, VBW=3MHz PEAK detector for Peak value. RBW=1MHz, VBW=10Hz with PEAK Detector for Average Value.

### Test Mode

Please refer to the clause 2.2.

### Test Results

Note:

(1)Measurement = Reading level + Correct Factor

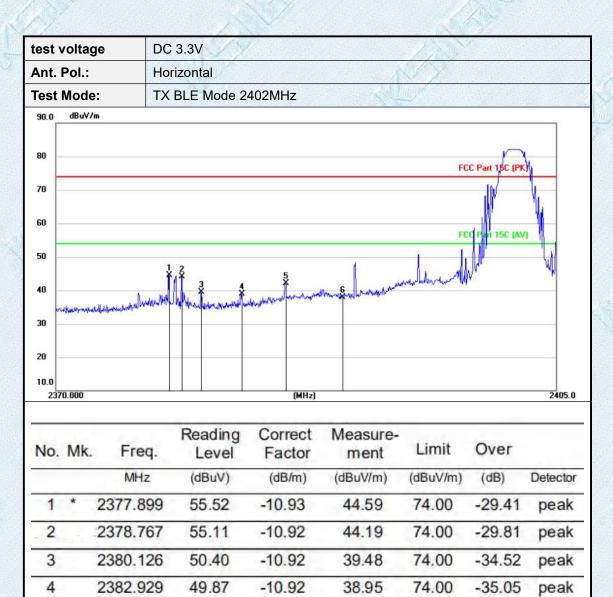
(2)Correct Factor=Antenna Factor + Cable Loss -Preamplifier Factor

(3)All modulation modes were tested, and only the worst data of GFSK\_1M was recorded in the report.



5

6



42.10

37.88

74.00

74.00

-31.90

-36.12

peak

peak

Emission Level= Read Level+ Correct Factor

53.02

48.80

-10.92

-10.92

2386.006

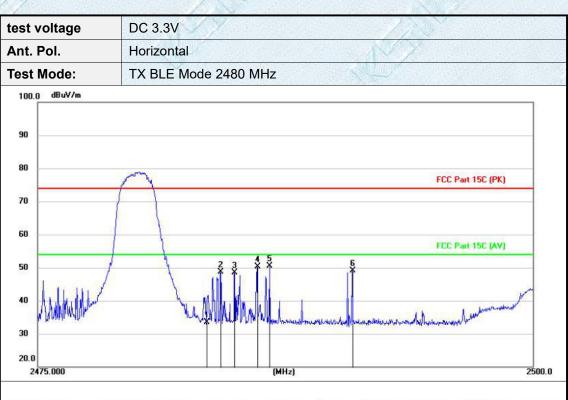
2390.000

KSIGN®

| test v      | oltag   | je DC            | 3.3V                     |           |                       | and the  |               |          |
|-------------|---|------------------|--------------------------|-----------|-----------------------|----------|---------------|----------|
| Ant.        | t. Pol. Vertical  |                  |                          |           |                       |          |               |          |
| Test        | Test Mode:     TX BLE Mode 2402MHz       100.0     dBwV/m |                  |                          |           |                       |          |               |          |
| 100.0       | dBuV∕r  | n                |                          |           |                       |          |               |          |
| 90          |   |                  |                          |           |                       |          |               | _        |
| 80          |   |                  |                          |           |                       | FCC      | Part 15C (PK) |          |
| 70          |   |                  |                          |           |                       |          |               |          |
| 60 -        |   |                  |                          |           |                       |          | 1             |          |
| 50          |   |                  |                          |           |                       | FCC      | 15C (AV)      | Via      |
| 40          |   | 1 <sup>2</sup> 3 | 4                        | 5         | 1                     | 1 MM     |               | ΨĮ       |
| 14          | Northerhore   | Jeren March      | Herr Judge Manuscription | Justimmum | www. Sullinger denter | Winner   |               |          |
| 30          |   |                  |                          |           |                       |          |               |          |
| 20.0<br>237 | 0.000   |                  |                          | (MHz)     |                       |          |               | 2405.0   |
|             |   |                  | Reading                  | Correct   | Measure-              |          |               |          |
| No.         | Mk.   | Freq.            | Level                    | Factor    | ment                  | Limit    | Over          |          |
|             | -   | MHz              | (dBuV)                   | (dB/m)    | (dBuV/m)              | (dBuV/m) | (dB)          | Detector |
| 1           |   | 2373.195         | 50.22                    | -10.93    | 39.29                 | 74.00    | -34.71        | peak     |
| 2           | *   | 2376.423         | 51.56                    | -10.93    | 40.63                 | 74.00    | -33.37        | peak     |
| 3           |   | 2377.501         | 50.65                    | -10.93    | 39.72                 | 74.00    | -34.28        | peak     |
| 4           |   | 2379.394         | 50.77                    | -10.92    | 39.85                 | 74.00    | -34.15        | peak     |
| 5           |   | 2384.052         | 50.30                    | -10.92    | 39.38                 | 74.00    | -34.62        | peak     |
| 6           |   | 2390.000         | 46.84                    | -10.92    | 35.92                 | 74.00    | -38.08        | peak     |

Emission Level= Read Level+ Correct Factor

KSIGN



| No. | Mk. | Freq.    | Reading<br>Level | Correct<br>Factor | Measure-<br>ment | Limit    | Over   |          |
|-----|-----|----------|------------------|-------------------|------------------|----------|--------|----------|
|     |     | MHz      | (dBuV)           | (dB/m)            | (dBuV/m)         | (dBuV/m) | (dB)   | Detector |
| 1   |     | 2483.500 | 44.39            | -10.88            | 33.51            | 74.00    | -40.49 | peak     |
| 2   |     | 2484.205 | 59.49            | -10.88            | 48.61            | 74.00    | -25.39 | peak     |
| 3   | - 1 | 2484.915 | 59.42            | -10.88            | 48.54            | 74.00    | -25.46 | peak     |
| 4   | -   | 2486.060 | 61.24            | -10.88            | 50.36            | 74.00    | -23.64 | peak     |
| 5   | *   | 2486.670 | 61.42            | -10.88            | 50.54            | 74.00    | -23.46 | peak     |
| 6   | -   | 2490.863 | 60.09            | -10.89            | 49.20            | 74.00    | -24.80 | peak     |

Emission Level= Read Level+ Correct Factor

KSIGN

| est vo         | oltage  | DC 3.3V   |             |
|----------------|---------|---|-------------|
| Ant. P         | ol.     | Vertical  |             |
| est N          | /lode:  | TX BLE Mode 2480 MHz  |             |
| 00.0           | dBuV/m  |   |             |
| 90             |         |   |             |
| 0              |         | FCC Part 150  | C (PK)      |
| 70             |         |   |             |
| .0             |         | FCC Part 150  |             |
|                |         |   |             |
|                | million | MWINH When I bound wind and an and and and and and and and an | advance and |
| 30             |         |   | 20-010      |
| 20.0<br>2475.0 | 000     | (MHz)   | 2500        |
|                |         | (a)   | 0           |
| No.            | Mk.     | Reading Correct Measure-<br>Freq. Level Factor ment Limit Ove | r           |
|                |         |   |             |

| No. | Mk. | Freq.    | Level  | Factor | ment     | Limit    | Over   |          |
|-----|-----|----------|--------|--------|----------|----------|--------|----------|
|     |     | MHz      | (dBuV) | (dB/m) | (dBuV/m) | (dBuV/m) | (dB)   | Detector |
| 1   |     | 2483.500 | 52.23  | -10.88 | 41.35    | 74.00    | -32.65 | peak     |
| 2   | *   | 2485.122 | 61.08  | -10.88 | 50.20    | 74.00    | -23.80 | peak     |
| 3   |     | 2486.190 | 60.98  | -10.88 | 50.10    | 74.00    | -23.90 | peak     |
| 4   |     | 2486.590 | 60.61  | -10.88 | 49.73    | 74.00    | -24.27 | peak     |
| 5   |     | 2491.668 | 59.88  | -10.89 | 48.99    | 74.00    | -25.01 | peak     |
| 6   |     | 2494.520 | 56.89  | -10.87 | 46.02    | 74.00    | -27.98 | peak     |

Emission Level= Read Level+ Correct Factor

# 3.7. Spurious Emission (Radiated)

### <u>Limit</u>

### Radiated Emission Limits (9 kHz~1000 MHz)

| Frequency<br>(MHz) | Field Strength<br>(microvolt/meter) | Measurement Distance<br>(meters) |
|--------------------|-------------------------------------|----------------------------------|
| 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                                |

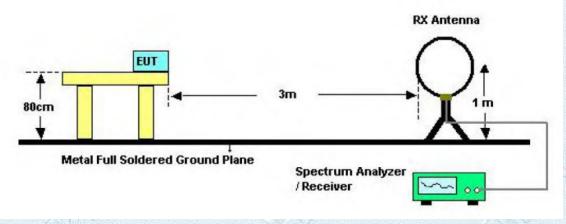
### Radiated Emission Limit (Above 1000MHz)

| Frequency  | Distance Meters(at 3m) |         |  |  |  |  |
|------------|------------------------|---------|--|--|--|--|
| (MHz)      | Peak                   | Average |  |  |  |  |
| Above 1000 | 74                     | 54      |  |  |  |  |

#### Note:

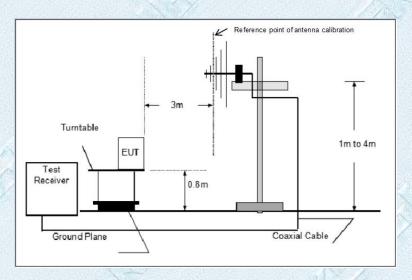
- (1) The tighter limit applies at the band edges.
- (2) Emission Level (dBuV/m)=20log Emission Level (uV/m).

### **Test Configuration**

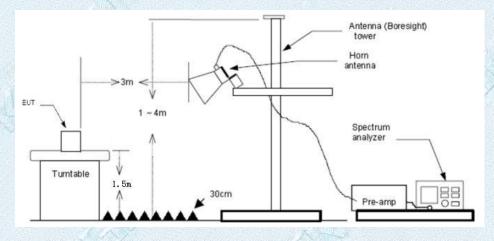


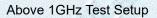
Below 30MHz Test Setup





Below 1000MHz Test Setup





### Test Procedure

- 1. The EUT was setup and tested according to ANSI C63.10:2013
- 2. The EUT is placed on a turn table which is 0.8 meter above ground for below 1 GHz, and 1.5 m for above 1 GHz. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
- 3. The EUT was set 3 meters from the receiving antenna, which was mounted on the top of a variable height antenna tower.
- 4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
- 5. Set to the maximum power setting and enable the EUT transmit continuously.
- 6. Use the following spectrum analyzer settings
  - (1) Span shall wide enough to fully capture the emission being measured;
  - (2) Below 1 GHz:
  - RBW=120 kHz, VBW=300 kHz, Sweep=auto, Detector function=peak, Trace=max hold;

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.

(3) From 1 GHz to 10<sup>th</sup> harmonic:

RBW=1MHz, VBW=3MHz Peak detector for Peak value.

RBW=1MHz, VBW=10Hz Peak detector for Average value.



#### Test Mode

Please refer to the clause 2.3.

#### Test Result

#### 9 KHz~30 MHz and 18GHz~25GHz

From 9 KHz~30 MHz and 18GHz~25GHz: Conclusion: PASS

#### Note:

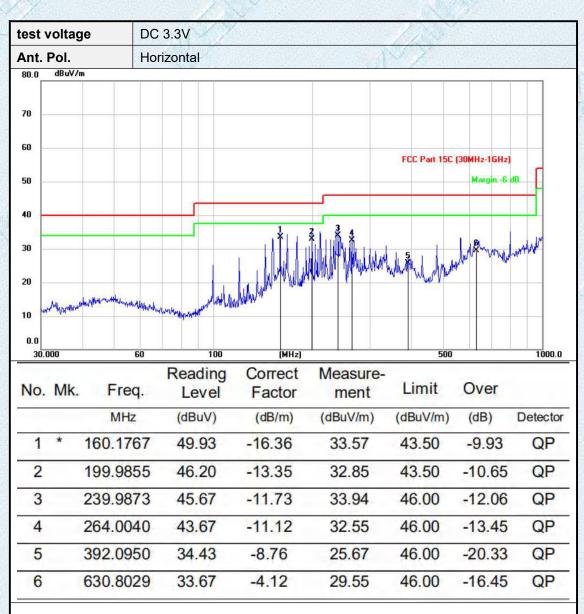
- 1) Measurement = Reading level + Correct Factor Correct Factor=Antenna Factor + Cable Loss -Preamplifier Factor
- 2) The peak level is lower than average limit(54 dBuV/m), this data is the too weak instrument of signal is unable to test.
- 3) The emission levels of other frequencies are very lower than the limit and not show in test report.
- 4) The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
- 5) Pre-scan CH00, CH19 and CH39 modulation, and found the GFSK\_1M\_ CH00 which it is worse case for 30MHz-1GHz, so only show the test data for worse case.

#### **BELOW 30MHZ**

No emission found between lowest internal used/generated frequencies to 30MHz.

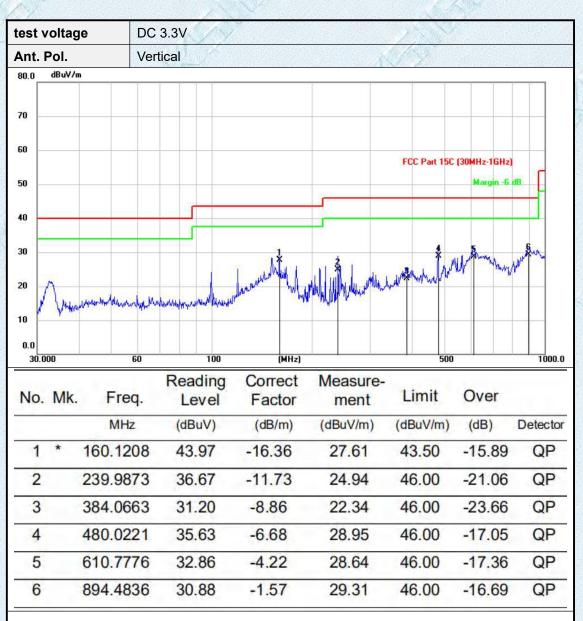


30MHz-1GHz



Emission Level= Read Level+ Correct Factor

KSIGN



Emission Level= Read Level+ Correct Factor

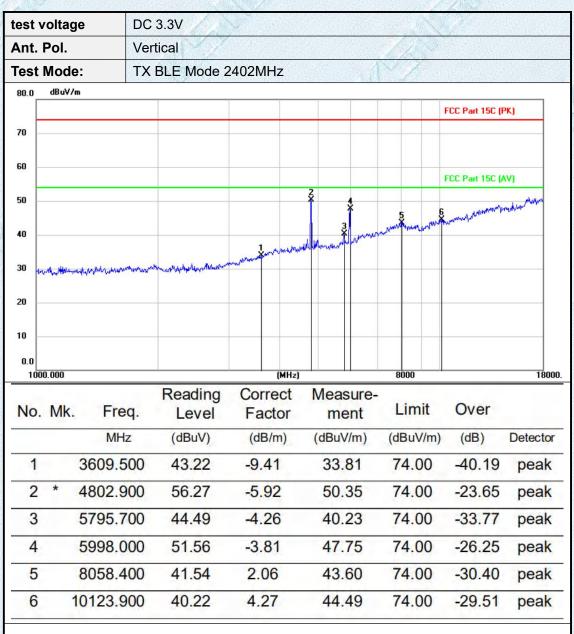


Adobe 1GHz

| test voltage                       |                       | ge                               | DC 3                           | 3.3V                                       |  | 1   | V X  |                                    |                                 |  |
|------------------------------------|-----------------------|----------------------------------|--------------------------------|--|--|---|--|------------------------------------|---------------------------------|--|
| Ant. Pol.                          |                       |                                  | Horizontal                     |  |  |   |  |                                    |                                 |  |
| Test I                             |                       |                                  | TX E                           | BLE Mode 2                                 | 402MHz   |   |  |                                    |                                 |  |
| 80.0                               | dBuV∕ı                | 'n                               |                                |  |  |   |  |                                    |                                 |  |
| _                                  |                       |                                  |                                |  |  |   | F  | FCC Part 15C (PK                   | )                               |  |
| 70                                 |                       |                                  |                                |  |  |   |  |                                    |                                 |  |
| 60                                 |                       |                                  |                                |  |  |   |  |                                    |                                 |  |
|                                    |                       |                                  |                                |  |  |   |  | FCC Part 15C (AV                   |                                 |  |
| 50                                 |                       |                                  |                                |  |  | 3   | F 6  | wolk-plant-harmond                 | humanit                         |  |
| 40                                 |                       |                                  |                                |  | 1.   | t well all  | Martin and Martin                            | ken langt hiv                      |                                 |  |
|                                    |                       |                                  |                                |  |  | an and a start of the start of |  |                                    |                                 |  |
| 30 Marta                           | <i>and the states</i> | -the and the second second       | whenhau                        | where the south and the south and the      | Manual .   |   |  |                                    |                                 |  |
| 20                                 |                       |                                  |                                |  |  |   |  |                                    |                                 |  |
|                                    |                       |                                  |                                |  |  |   |  |                                    |                                 |  |
|                                    |                       |                                  |                                |  |  |   |  |                                    |                                 |  |
| 10                                 |                       |                                  |                                |  |  |   |  |                                    |                                 |  |
| 0.0                                |                       |                                  |                                |  |  |   |  |                                    |                                 |  |
|                                    | .000                  |                                  |                                | Pooding                                    | (MHz)  | Maggurga  | 8000   |                                    | 1800                            |  |
| 0.0                                |                       | . Fre                            | eq.                            | Reading<br>Level                           | (MH2)<br>Correct<br>Factor                             | Measure-<br>ment  |  | Over                               | 1800                            |  |
| 0.0                                |                       | Fre<br>M⊦                        | · ·                            | 0  | Correct  |   |  |                                    | 1800<br>Detecto                 |  |
| 0.0                                |                       |                                  | łz                             | Level                                      | Correct<br>Factor                                      | ment  | Limit  |                                    |                                 |  |
| 0.0<br>1000.<br>No.                |                       | MH                               | Hz<br>300                      | Level<br>(dBuV)                            | Correct<br>Factor<br>(dB/m)                            | ment<br>(dBuV/m)  | Limit<br>(dBuV/m)                            | (dB)                               | Detecto                         |  |
| 0.0<br>1000.<br>No.                |                       | MH<br>4500.3                     | 1z<br>300<br>000               | Level<br>(dBuV)<br>45.26                   | Correct<br>Factor<br>(dB/m)<br>-6.75                   | ment<br>(dBuV/m)<br>38.51   | Limit<br>(dBuV/m)<br>74.00                   | (dB)<br>-35.49                     | Detecto                         |  |
| 0.0<br>1000.<br>No.                | Mk                    | MH<br>4500.3<br>4689.0           | 1z<br>300<br>000<br>600        | Level<br>(dBuV)<br>45.26<br>42.72          | Correct<br>Factor<br>(dB/m)<br>-6.75<br>-6.23          | ment<br>(dBuV/m)<br>38.51<br>36.49  | Limit<br>(dBuV/m)<br>74.00<br>74.00          | (dB)<br>-35.49<br>-37.51           | Detecto<br>peal<br>peal         |  |
| 0.0<br>1000.<br>No.<br>1<br>2<br>3 | Mk                    | MH<br>4500.3<br>4689.0<br>4804.0 | Hz<br>300<br>000<br>600<br>700 | Level<br>(dBuV)<br>45.26<br>42.72<br>55.46 | Correct<br>Factor<br>(dB/m)<br>-6.75<br>-6.23<br>-5.92 | ment<br>(dBuV/m)<br>38.51<br>36.49<br>49.54   | Limit<br>(dBuV/m)<br>74.00<br>74.00<br>74.00 | (dB)<br>-35.49<br>-37.51<br>-24.46 | Detecto<br>peal<br>peal<br>peal |  |

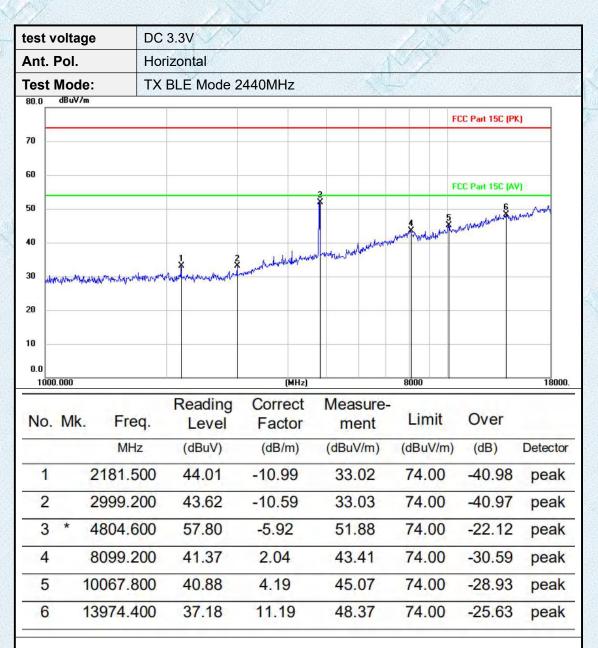
Emission Level= Read Level+ Correct Factor





Emission Level= Read Level+ Correct Factor

KSIGN



Emission Level= Read Level+ Correct Factor



| est v       | voltag  | je                               | DC 3                           | 3.3V                                       |  | 1   | S/Y                                 |                                    |                      |
|-------------|---------|----------------------------------|--------------------------------|--|--|---|-------------------------------------|------------------------------------|----------------------|
| Ant. I      | Pol.    |                                  | Vert                           | ical                                       |  | 1. A.L.                                     |                                     |                                    |                      |
| Test I      | Mode    | ə:                               | TX E                           | BLE Mode 24                                | 440MHz                                       |   |                                     |                                    |                      |
| 80.0 dBu¥/m |         |                                  |                                |  |  |   |                                     | FCC Part 15C (PI                   | n                    |
| 70          |         |                                  |                                |  |  |   |                                     |                                    | N                    |
| 60          |         |                                  |                                |  |  |   |                                     |                                    |                      |
|             |         |                                  |                                |  |  |   |                                     | FCC Part 15C (A)                   |                      |
| 50          |         |                                  |                                |  |  | 2<br>A Antonio de presidentes               | 4 5                                 | Martin                             | normal               |
| 40          |         |                                  |                                |  |  |   | and har working                     | MAYEN                              |                      |
|             |         |                                  |                                |  | * mound which                                | a whote water and pres                      |                                     |                                    |                      |
| 30 🙏        | Annonan | completelle                      | holenour                       | an white a part with the                   |  |   |                                     |                                    |                      |
| 20          |         |                                  |                                |  |  |   |                                     |                                    |                      |
| 10          |         |                                  |                                |  |  |   |                                     |                                    |                      |
| 0.0         |         |                                  |                                |  |  |   |                                     |                                    |                      |
| 100 A       | .000    |                                  | 1                              |  | (MHz)  | 4   | 8000                                |                                    | 18000                |
| 1000        |         |                                  |                                |  |  |   |                                     |                                    |                      |
|             | . Mk    | . Fre                            | eq.                            | Reading<br>Level                           | Correct<br>Factor                            | Measure-<br>ment                            | Limit                               | Over                               |                      |
|             |         | . Fre<br>M⊦                      |                                |  |  | 111   | Limit<br>(dBuV/m)                   |                                    | Detector             |
|             |         | 10                               | łz                             | Level                                      | Factor                                       | ment  |                                     |                                    | Detector<br>peak     |
| No.         | . Mk    | MH                               | Iz<br>800                      | Level<br>(dBuV)                            | Factor<br>(dB/m)                             | ment<br>(dBuV/m)                            | (dBuV/m)                            | (dB)                               | 10000000000          |
| No.         | . Mk    | MF<br>3199.8                     | Iz<br>800<br>600               | Level<br>(dBuV)<br>44.32                   | Factor<br>(dB/m)<br>-10.23                   | ment<br>(dBuV/m)<br>34.09                   | (dBuV/m)<br>74.00                   | (dB)<br>-39.91                     | peak                 |
| No.         | . Mk    | MH<br>3199.8<br>4804.0           | 1z<br>800<br>600<br>500        | Level<br>(dBuV)<br>44.32<br>56.22          | Factor<br>(dB/m)<br>-10.23<br>-5.92          | ment<br>(dBuV/m)<br>34.09<br>50.30          | (dBuV/m)<br>74.00<br>74.00          | (dB)<br>-39.91<br>-23.70           | peak<br>peak         |
| No.         | . Mk    | MH<br>3199.8<br>4804.6<br>5989.8 | 1z<br>800<br>600<br>500<br>100 | Level<br>(dBuV)<br>44.32<br>56.22<br>51.11 | Factor<br>(dB/m)<br>-10.23<br>-5.92<br>-3.82 | ment<br>(dBuV/m)<br>34.09<br>50.30<br>47.29 | (dBuV/m)<br>74.00<br>74.00<br>74.00 | (dB)<br>-39.91<br>-23.70<br>-26.71 | peak<br>peak<br>peak |

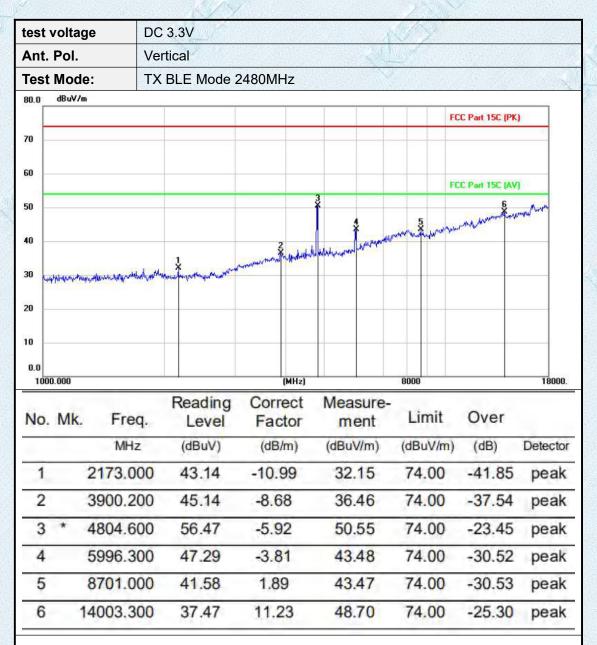
Emission Level= Read Level+ Correct Factor

KSIGN

| test voltage DC 3 |            | DC 3.         | 3V                  |   |                                  | all the second   |               |                    |   |  |
|-------------------|------------|---------------|---------------------|---|----------------------------------|------------------|---------------|--------------------|---|--|
| Ant. Pol. Hori    |            | Horizo        | ontal               |   |                                  |                  |               |                    |   |  |
| Test              | Мос        | de:           | TX BLE Mode 2480MHz |   |                                  |                  |               |                    |   |  |
| 80.0              | dBu        | √/m           |                     |   |                                  |                  |               | FCC Part 15C (P    | <b>'K</b> ]   |  |
| 70                |            |               |                     |   |                                  |                  |               |                    |   |  |
| 60                |            |               |                     |   |                                  |                  |               | FCC Part 15C (A    | M   |  |
| 50                |            |               |                     |   |                                  | X                | 5             | www.www.www.w      | and the second se |  |
| 40                |            |               |                     |   | *                                | Munatorner       | June Stranger | and a construction |   |  |
| 30                | refeiturit | whateholistic | an applications     | how have a second and the second s | and a star and a star and a star |                  | _             |                    |   |  |
| 20                |            |               |                     |   |                                  |                  |               |                    |   |  |
| 10                |            |               |                     |   |                                  |                  |               |                    |   |  |
| 0.0<br>10         | 00.000     |               |                     |   | (MHz)                            |                  | 8000          |                    | 18000   |  |
| No.               | Mk         | . Fre         |                     | Reading<br>Level  | Correct<br>Factor                | Measure-<br>ment | Limit         | Over               |   |  |
|                   |            | MH            | z                   | (dBuV)  | (dB/m)                           | (dBuV/m)         | (dBuV/m)      | (dB)               | Detector  |  |
| 1                 |            | 4299.7        | 00                  | 46.27   | -7.42                            | 38.85            | 74.00         | -35.15             | peak  |  |
| 2                 |            | 4500.3        | 00                  | 46.13   | -6.75                            | 39.38            | 74.00         | -34.62             | peak  |  |
| 3                 | *          | 4804.6        | 00                  | 57.72   | -5.92                            | 51.80            | 74.00         | -22.20             | peak  |  |
|                   |            | 5979.3        | 00                  | 44.36   | -3.84                            | 40.52            | 74.00         | -33.48             | peak  |  |
| 4                 |            | 140 410       |                     |   |                                  |                  |               |                    |   |  |
| 4                 |            | 8083.9        | 00                  | 42.09   | 2.05                             | 44.14            | 74.00         | -29.86             | peak  |  |

Emission Level= Read Level+ Correct Factor





#### Emission Level= Read Level+ Correct Factor

Note:All modulation modes were tested, and only the worst data of GFSK\_1M was recorded in the report.



### 3.8. Conducted Emission

#### Limit

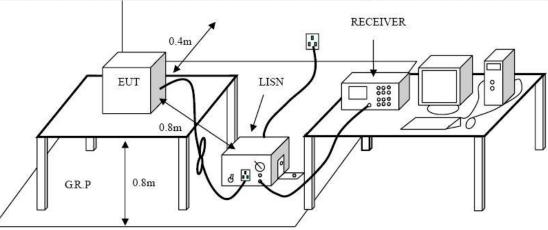
#### **Conducted Emission Test Limit**

| Frequency     | Maximum RF Line Voltage (dBµV) |               |  |  |
|---------------|--------------------------------|---------------|--|--|
| Frequency     | Quasi-peak Level               | Average Level |  |  |
| 150kHz~500kHz | 66 ~ 56 *                      | 56~46*        |  |  |
| 500kHz~5MHz   | 56                             | 46            |  |  |
| 5MHz~30MHz    | 60                             | 50            |  |  |

#### Notes:

- (1) \*Decreasing linearly with logarithm of the frequency.
- (2) The lower limit shall apply at the transition frequencies.
- (3) The limit decrease in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

#### Test Configuration



#### Test Procedure

- 1. The EUT was setup according to ANSI C63.10:2013 requirements.
- 2. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface.
- 3. The EUT and simulators are connected to the main power through a line impedances stabilization network (LISN). The LISN provides a 50ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs)
- 4. Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.
- 5. The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.
- 6. Conducted Emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.
- 7. During the above scans, the emissions were maximized by cable manipulation.

#### Test Mode:

Please refer to the clause 2.3.

#### Test Results



| est voltage | AC 12   | 20V/60Hz                               | ×                         |                      | 128   |                             |          |  |  |  |
|-------------|---------|--|---------------------------|----------------------|-------|-----------------------------|----------|--|--|--|
| Ferminal:   | Line    | Line                                   |                           |                      |       |                             |          |  |  |  |
| 80.0 dBuV   |         |  |                           |                      |       |                             |          |  |  |  |
| 70          |         |  |                           |                      |       |                             |          |  |  |  |
| 60          |         |  |                           | -                    | FC    | C Part 15 C (QP)            | _        |  |  |  |
| 50          |         |  |                           |                      | FCC   | Part 15 C (AVG)             | _        |  |  |  |
| 40 Annt     |         |  |                           | - Phile              |       |                             |          |  |  |  |
| 30 MA       | Munning | manulatedeeman                         | mour de la farmante       | to the second second | W X2  | an many many preserver have | 4        |  |  |  |
| 20          | mmith   | manulatidesensed<br>physican also have | hips and a second and the | town when            | WN    | and young                   | peak     |  |  |  |
| 10          |         |  |                           |                      |       |                             | AVG      |  |  |  |
| 0           |         |  |                           |                      |       |                             |          |  |  |  |
| -10         |         |  |                           |                      |       |                             |          |  |  |  |
| -20         |         |  | (MHz)                     |                      |       |                             | 30.000   |  |  |  |
|             | 14.1    | Reading                                | Correct                   | Measure-             |       |                             |          |  |  |  |
| No. Mk.     | Freq.   | Level                                  | Factor                    | ment                 | Limit | Over                        |          |  |  |  |
|             | MHz     | dBuV                                   | dB                        | dBuV                 | dBuV  | dB                          | Detector |  |  |  |
| 1 *         | 0.1539  | 37.35                                  | 10.82                     | 48.17                | 65.79 | -17.62                      | QP       |  |  |  |
| 2           | 0.1539  | 21.76                                  | 10.82                     | 32.58                | 55.79 | -23.21                      | AVG      |  |  |  |
| 3           | 0.1980  | 29.73                                  | 10.88                     | 40.61                | 63.69 | -23.08                      | QP       |  |  |  |
| 4           | 0.1980  | 17.09                                  | 10.88                     | 27.97                | 53.69 | -25.72                      | AVG      |  |  |  |
| 5           | 0.4900  | 21.55                                  | 10.91                     | 32.46                | 56.17 | -23.71                      | QP       |  |  |  |
| 6           | 0.4900  | 13.35                                  | 10.91                     | 24.26                | 46.17 | -21.91                      | AVG      |  |  |  |
| 7           | 1.9060  | 17.53                                  | 10.88                     | 28.41                | 56.00 | -27.59                      | QP       |  |  |  |
| 8           | 1.9060  | 11.71                                  | 10.88                     | 22.59                | 46.00 | -23.41                      | AVG      |  |  |  |
| 9           | 4.1500  | 23.43                                  | 10.96                     | 34.39                | 56.00 | -21.61                      | QP       |  |  |  |
| 10          | 4.1500  | 16.82                                  | 10.96                     | 27.78                | 46.00 | -18.22                      | AVG      |  |  |  |
| 11          | 9.4620  | 20.57                                  | 10.96                     | 31.53                | 60.00 | -28.47                      | QP       |  |  |  |
| 12          | 9.4620  | 14.91                                  | 10.96                     | 25.87                | 50.00 | -24.13                      | AVG      |  |  |  |

Remarks:

1.Measurement = Reading Level+ Correct Factor 2.Over = Measurement -Limit

| test v        | oltage | AC 1       | 20V/60Hz                 |                            |                    | 6/18   |                  |          |
|---------------|--------|------------|--------------------------|----------------------------|--------------------|--------|------------------|----------|
| <b>Ferm</b> i | inal:  | Neuti      | ral 🦷                    |                            | N/                 |        |                  |          |
| 80.0          | dBuV   |            |                          |                            |                    |        |                  |          |
| 70            |        |            |                          |                            |                    |        |                  |          |
| 60            |        |            |                          |                            |                    | E      | CC Part 15 C (QI | PJ       |
| -             |        |            |                          |                            |                    | FC     | C Part 15 C (AVI | 3)       |
| 50 ¥          | m      |            |                          |                            | _                  |        |                  |          |
| 40            | www    | Mummu an   |                          |                            | -                  |        |                  |          |
| 30            | M      | WWWWWWWWWW | A A . married            | Surff Martin               | Mun your           | 12     | kingungenheiter  | niny     |
| 20            | WW     | Mmunty     | here have been and and a | Selond with the second way | much and the state | my May | wanter           | pea      |
| 10            |        | "UN        | white and                |                            |                    | V PW   |                  | AVE      |
| 0             |        |            |                          |                            |                    |        |                  |          |
| -10           |        |            |                          |                            |                    |        |                  |          |
| -20           |        |            |                          |                            |                    |        |                  |          |
| 0.15          | 0      |            | Reading                  | (MHz)<br>Correct           | Measure            |        |                  | 30.00    |
| No.           | Mk.    | Freq.      | Level                    | Factor                     | ment               | Limit  | Over             |          |
|               |        | MHz        | dBuV                     | dB                         | dBuV               | dBuV   | dB               | Detector |
| 1             | *      | 0.1620     | 35.27                    | 10.84                      | 46.11              | 65.36  | -19.25           | QP       |
| 2             |        | 0.1620     | 15.83                    | 10.84                      | 26.67              | 55.36  | -28.69           | AVG      |
| 3             |        | 0.4780     | 19.00                    | 10.88                      | 29.88              | 56.37  | -26.49           | QP       |
| 4             |        | 0.4780     | 11.23                    | 10.88                      | 22.11              | 46.37  | -24.26           | AVG      |
| 5             |        | 1.2540     | 13.83                    | 10.88                      | 24.71              | 56.00  | -31.29           | QP       |
| 6             |        | 1.2540     | 8.59                     | 10.88                      | 19.47              | 46.00  | -26.53           | AVG      |
| 7             |        | 1.9460     | 17.69                    | 10.88                      | 28.57              | 56.00  | -27.43           | QP       |
| 8             |        | 1.9460     | 12.20                    | 10.88                      | 23.08              | 46.00  | -22.92           | AVG      |
| 9             |        | 4.2860     | 18.72                    | 10.95                      | 29.67              | 56.00  | -26.33           | QP       |
| 10            |        | 4.2860     | 11.71                    | 10.95                      | 22.66              | 46.00  | -23.34           | AVG      |
| 11            |        | 8.9980     | 18.58                    | 10.93                      | 29.51              | 60.00  | -30.49           | QP       |
| 12            |        | 8.9980     | 13.03                    | 10.93                      | 23.96              | 50.00  | -26.04           | AVG      |

Remarks:

1.Measurement = Reading Level+ Correct Factor 2.Over = Measurement -Limit



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## **4.EUT TEST PHOTOS**

Radiated Measurement (Below 1GHz)



#### Radiated Measurement (Above 1GHz)

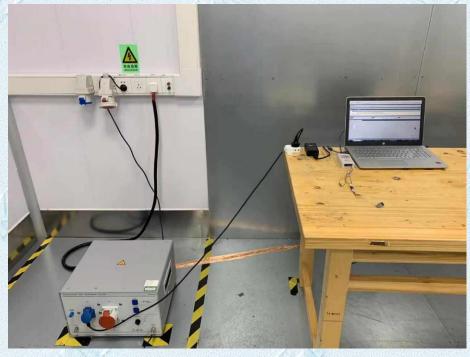








#### CONDUCTED EMISSION TEST SETUP

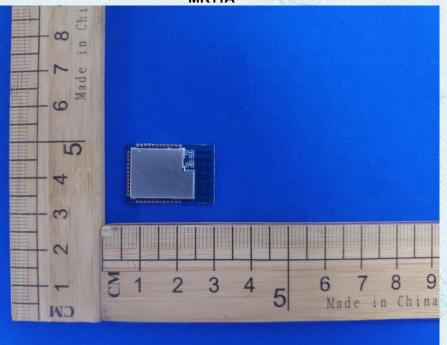


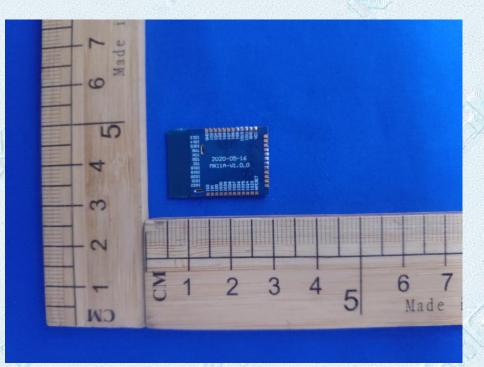


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## **5.PHOTOGRAPHS OF EUT CONSTRUCTIONAL**

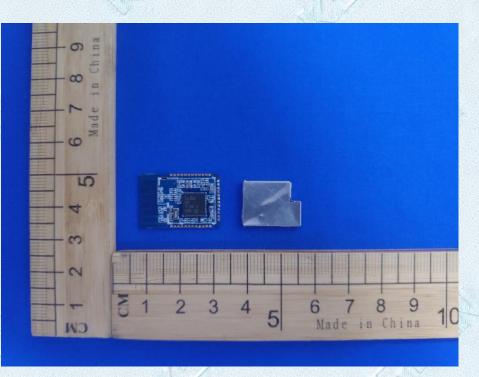
# External Photographs

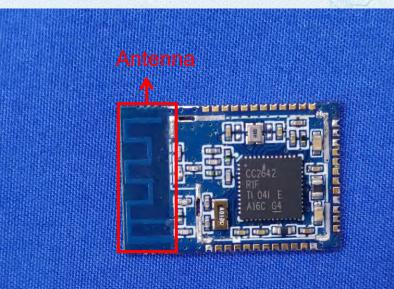






## **Internal Photographs**





#### \*\*\*\*\*THE END\*\*\*\*\*