



# **TEST REPORT**

| : Bullitt Group   |
|-------------------|
| : 4G Mobile Phone |
| : S62             |
| : CAT             |
| : ZL5S62          |
|                   |

- STANDARD(S) : 47 CFR Part 15 Subpart C
- RECEIPT DATE : 2020-10-10
- TEST DATE : 2020-11-11 to 2021-01-26
- **ISSUE DATE** : 2021-02-19

Edited by :

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Elvis Wang

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Kehu-Morlab



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| Change History                 |           |               |  |  |  |
|--------------------------------|-----------|---------------|--|--|--|
| Version Date Reason for change |           |               |  |  |  |
| 1.0                            | 2021-2-19 | First edition |  |  |  |

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## **1.** Technical Information

Note: Provide by applicant.

### 1.1. Applicant and Manufacturer Information

| Applicant:            | Bullitt Group  |
|-----------------------|--|
| Applicant Address:    | One Valpy, Valpy Street, Reading, Berkshire, RG1 1AR, United         |
|                       | Kingdom  |
| Manufacturer:         | Bullitt Group  |
| Manufacturer Address: | One Valpy, Valpy Street, Reading, Berkshire, RG1 1AR, United Kingdom |

### 1.2. Equipment Under Test (EUT) Description

| Product Name:              | 4G Mobile Phone                               |  |  |  |  |  |
|----------------------------|---|--|--|--|--|--|
| Serial No:                 | (N/A, marked #1 by test site)                 |  |  |  |  |  |
| Hardware Version:          | Q190_V1                                       |  |  |  |  |  |
| Software Version:          | LTE_S02111.10_N_S62_0                         |  |  |  |  |  |
|                            | Bluetooth: FHSS                               |  |  |  |  |  |
| Modulation Type:           | GFSK(1Mbps),                                  |  |  |  |  |  |
| modulation Type.           | π/4-DQPSK(EDR 2                               | 2Mbps),                                |  |  |  |  |
|                            | 8-DPSK(EDR 3Mb                                | ps)                                    |  |  |  |  |
| Operating Frequency Range: | The frequency range used is 2402MHz – 2480MHz |  |  |  |  |  |
|                            | (79 channels, at intervals of 1MHz);          |  |  |  |  |  |
| Bluetooth Version:         | Bluetooth classic                             |  |  |  |  |  |
| Antenna Type:              | PIFA Antenna                                  |  |  |  |  |  |
| Antenna Gain:              | 0.18dBi                                       |  |  |  |  |  |
|                            | Battery                                       |  |  |  |  |  |
|                            | Manufacturer:                                 | Hunan Gaoyuan Battery Co., Ltd.        |  |  |  |  |
|                            | Brand Name:                                   | Gaoyuan Battery                        |  |  |  |  |
|                            | Model No.:                                    | XQ6602G                                |  |  |  |  |
| Accessory Information:     | Capacity: 4000mAh                             |  |  |  |  |  |
|                            | Rated Voltage:                                | 3.80V                                  |  |  |  |  |
|                            | Charge Limit:                                 | 4.35V                                  |  |  |  |  |
|                            | AC Adapter                                    |  |  |  |  |  |
|                            | Manufacturer:                                 | Jiangxi Jian Aohai Technology Co.,Ltd. |  |  |  |  |

#### Kehu-Morlab Test Laboratory XIAMEN MORLAB C Unit 101, No.1732 Gangzhong

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| Brand Name:   | AOHAI                    |
|---------------|--------------------------|
| Model No.:    | A138-120150C-US1         |
| Rated Input:  | 100-240V ~ 50/60Hz 0.5A  |
| Rated Output: | 5V=3.0A/9V=2.0A/12V=1.5A |

**Note 1:** The EUT contains Bluetooth Module operating at 2.4GHz ISM band; the frequencies is F(MHz)=2402+1\*n (0<=n<=78). The lowest, middle, highest channel numbers of the Bluetooth Module used and tested in this report are separately 0 (2402MHz), 39 (2441MHz) and 78 (2480MHz).

**Note 2:** The EUT connected to the serial port of the computer with a serial communication cable, we use the dedicated software to control the EUT into the test mode.

**Note 3:** For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.



### 1.3. 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 | Radio Frequency Devices |  |  |  |

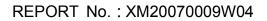
Test detailed items/section required by FCC rules and results are as below:

| No.  | Section in<br>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    | Nov 11, 2020           | Stefan Sun    | PASS   |  |  |
| 3    | 15.247(b)  | Peak Output Power              | Nov 11, 2020           | Stefan Sun    | PASS   |  |  |
| 4    | 15.247(a)  | 20dB Bandwidth                 | Nov 11, 2020           | Stefan Sun    | PASS   |  |  |
| 5    | 15.247(a)  | Carrier Frequency Separation   | Nov 11, 2020           | Stefan Sun    | PASS   |  |  |
|      |  |                                | Jan 11, 2021           |               |        |  |  |
| 6    | 15.247(a)  | Time of Occupancy (Dwell time) | Jan 11, 2021 Stefan Su |               | PASS   |  |  |
| 7    | 15.247(d)  | Conducted Spurious Emission    | Nov 11, 2020           | Stefan Sun    | PASS   |  |  |
|      | 15.247 (u)   | and Band Edge                  | Jan 22, 2021           | Stelan Sun    | FA33   |  |  |
| 8    | 15.247(d)  | Restricted Frequency Bands     | Dec 05, 2020           | Yaming Luo    | PASS   |  |  |
| 9    | 15.209,  | Dedicted Emission              |                        | Versing Lue   | DAGO   |  |  |
| 9    | 15.247(d)  | Radiated Emission              | Dec 05, 2020           | Yaming Luo    | PASS   |  |  |
| 10   | 15.207   | Conducted Emission             | Jan 26, 2021           | Yaming Luo    | PASS   |  |  |
| Note | <b>Note 1:</b> The tests were performed according to the method of measurements prescribed in ANSI |                                |                        |               |        |  |  |
| C63. | 10-2013.   |                                |                        |               |        |  |  |

### **1.4. 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 500hm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

#### 2.2.3. Test Procedure

- a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- c. Set the SA on MaxHold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
- d. Set the SA on View mode and then plot the result on SA screen.
- e. Repeat above procedures until all frequencies measured were complete.

#### B. Equipments List:

Please reference ANNEX B(4).



#### 2.2.4. Test Result

The Bluetooth Module operates at hopping-on test mode; the frequencies number employed is counted to verify the Module's using the number of hopping frequency.

#### A. Test Verdict:

| Test Mode | Frequency Block<br>(MHz) | Measured Channel Numbers | Min. Limit | Verdict |
|-----------|--------------------------|--------------------------|------------|---------|
| GFSK      | 2400 - 2483.5            | 79                       | 15         | PASS    |
| π/4-DQPSK | 2400 - 2483.5            | 79                       | 15         | PASS    |
| 8-DPSK    | 2400 - 2483.5            | 79                       | 15         | PASS    |

#### B. Test Plots:

|  | Gain:Low                  | Atten: 24 d | Run<br>IB  | Avg Hold: 2                  | .000/2000 | D                      |                     |
|--|---------------------------|-------------|------------|------------------------------|-----------|------------------------|---------------------|
| ef Offset 6.66 dB<br>ef 20.00 dBm      | Sumeow                    |             |            |                              | Mkr1      | 2.402 00               | 4 0 GH<br>26 dBn    |
|  |                           |             |            | ┍ <u>п</u> れれれれれ<br>↓↓↓↓↓↓↓↓ |           |                        |                     |
| 0 GHz<br>0 kHz<br><sup>CL</sup> X      | Y                         | V 300 kHz   | TION FUNCT | ION WIDTH                    |           | Stop 2.4<br>1.000 ms ( | 8350 GH<br>1001 pts |
| f 2.402 004 0 GHz<br>f 2.479 993 0 GHz | <u>3.726 (</u><br>7.538 ( |             |            |                              |           |                        |                     |
|  |                           |             |            |                              |           |                        |                     |

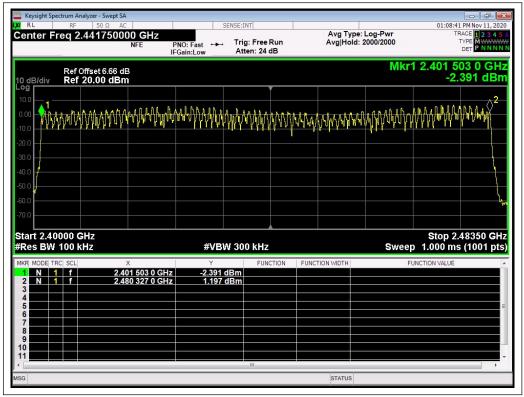
(GFSK)



#### REPORT No. : XM20070009W04

|   |                        | g: Free Run<br>ten: 24 dB | Avg Type<br>Avg Hold:     | : Log-Pwr<br>2000/2000 | 10:39:05 AM Nov 11, 220<br>TRACE 2 3 4 5 5<br>TYPE MWWW<br>DET P NNNN |
|---|------------------------|---------------------------|---------------------------|------------------------|---|
| Ref Offset 6.66 dB Mkr1 2.40  |                        |                           |                           |                        |   |
|   | alatana ana kalana ata |                           | ₩₽₽ <mark>₽</mark> ₩₽₩₽₩₽ | ₰₺₯₰₳₰₳₲₩              |   |
| -20 0<br>-30.0<br>-40.0<br>-60.0  |                        |                           |                           |                        | k   |
| -60.0<br>-70.0<br>Start 2.40000 GHz   |                        |                           |                           |                        | Stop 2.48350 GHz  |
| #Res BW 100 kHz   | #VBW 30                | 0 kHz                     |                           | Sweep                  | 1.000 ms (1001 pts)   |
| MKR N 1 f 2.401 837 0 GHz   2 N 1 f 2.401 837 0 GHz   3 1 f 2.401 837 0 GHz   3 1 f 2.480 494 0 GHz   5 |                        | FUNCTION                  | FUNCTION WIDTH            | FL                     | E   |

#### (π/4-DQPSK)



(8- DPSK)

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### 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 500hm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

#### B. Equipments List:

Please refer ANNEX B(4).

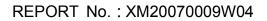
#### 2.3.3. Test procedure

The measured output power was calculated by the reading of the spectrum analyzer and calibration. Following is the test procedure for Peak Output Power test on the spectrum analyzer:

- a) Set analyzer center frequency to channel center frequency.
- b) Set the RBW to 3MHz
- c) Set VBW to 8MHz
- d) Set span to 10MHz
- e) Sweep time to auto couple.
- f) Detector=peak.
- g) Trace mode=max hold.
- h) Allow trace to fully stabilize.

Use peak marker function to determine the peak amplitude level.

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|-----------------|---|----------------------|
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#### 2.3.4. Test Result

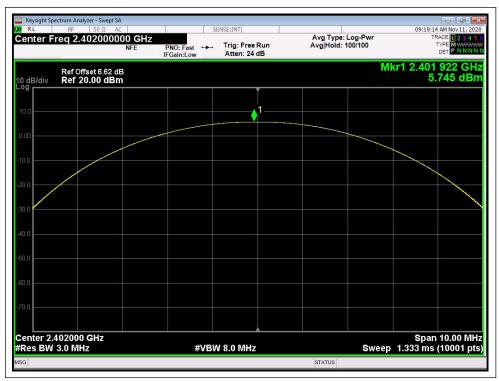
The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the module.

#### GFSK Mode

#### A. Test Verdict:

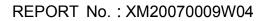
| Frequency |       | Measured Output Peak Power |       | Limit |       | Vardiat |  |
|-----------|-------|----------------------------|-------|-------|-------|---------|--|
| Channel   | (MHz) | dBm                        | W     | dBm   | W     | Verdict |  |
| 0         | 2402  | 5.745                      | 0.004 |       |       | PASS    |  |
| 39        | 2441  | 5.897                      | 0.004 | 21    | 0.125 | PASS    |  |
| 78        | 2480  | 8.309                      | 0.007 |       |       | PASS    |  |

#### B. Test Plots:

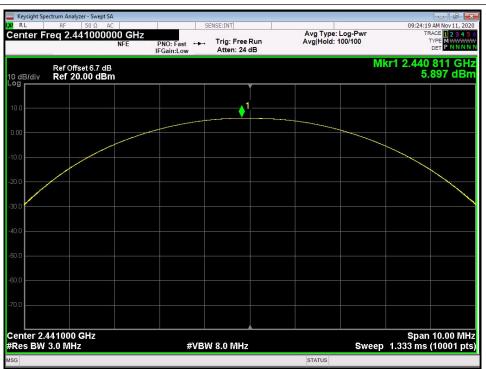


(GFSK, Channel 0, 2402MHz)

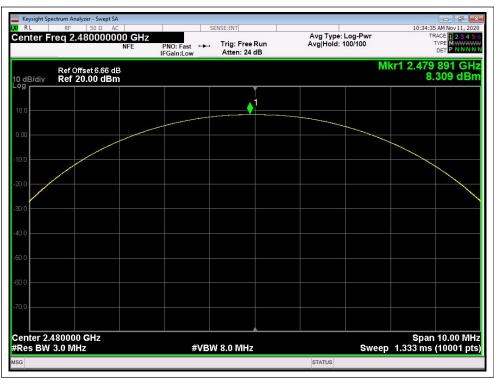
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#### (GFSK, Channel 39, 2441MHz)



#### (GFSK, Channel 78, 2480MHz)

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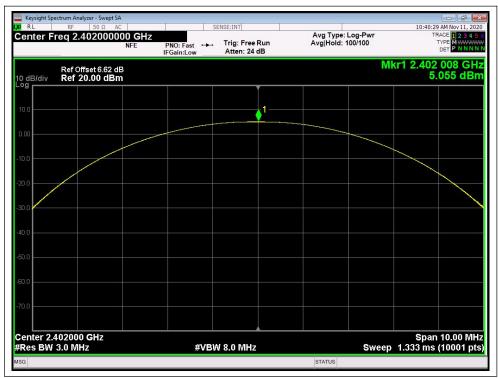


#### $\pi/4$ -DQPSK Mode

#### A. Test Verdict:

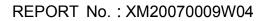
| Channel |       | Measured Output Peak Power |       | Limit |       | Verdict |  |
|---------|-------|----------------------------|-------|-------|-------|---------|--|
| Channel | (MHz) | dBm                        | W     | dBm   | W     | veruici |  |
| 0       | 2402  | 5.055                      | 0.003 |       |       | PASS    |  |
| 39      | 2441  | 5.144                      | 0.003 | 21    | 0.125 | PASS    |  |
| 78      | 2480  | 8.305                      | 0.007 | ]     |       | PASS    |  |

#### B. Test Plots:

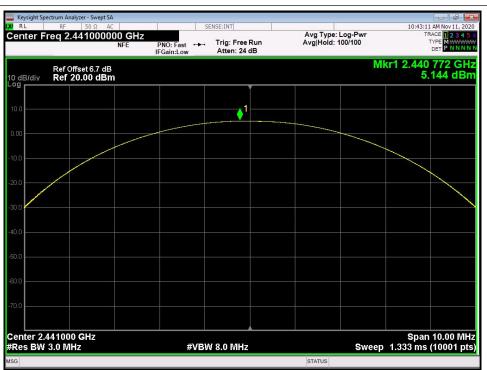


(π/4-DQPSK, Channel 0, 2402MHz)

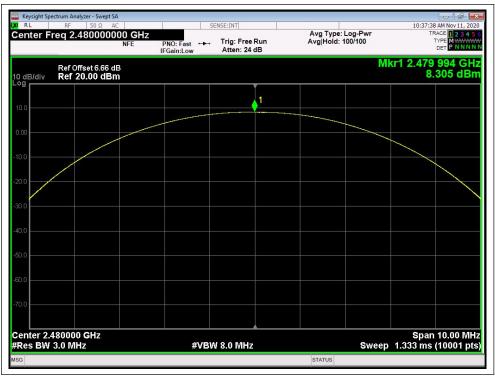
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(π/4-DQPSK, Channel 39, 2441MHz)



(π/4-DQPSK, Channel 78, 2480MHz)

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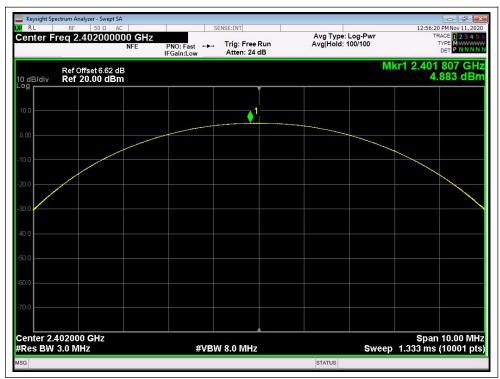


#### 8-DPSK Mode

#### A. Test Verdict:

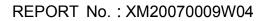
| Channel Frequency |       | Measured Output Peak Power |       | Limit |       | Verdict |  |
|-------------------|-------|----------------------------|-------|-------|-------|---------|--|
| Channel           | (MHz) | dBm                        | W     | dBm   | W     | veruici |  |
| 0                 | 2402  | 4.883                      | 0.003 |       |       | PASS    |  |
| 39                | 2441  | 4.823                      | 0.003 | 21    | 0.125 | PASS    |  |
| 78                | 2480  | 8.054                      | 0.006 | ]     |       | PASS    |  |

#### B. Test Plots:

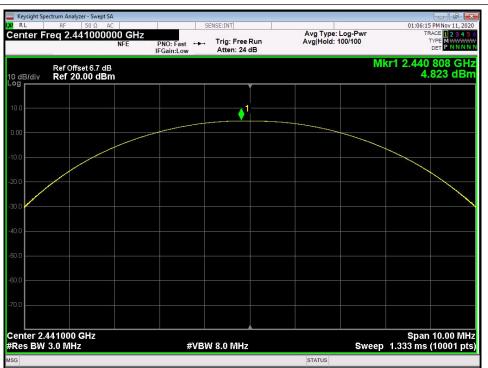


(8-DPSK, Channel 0, 2402MHz)

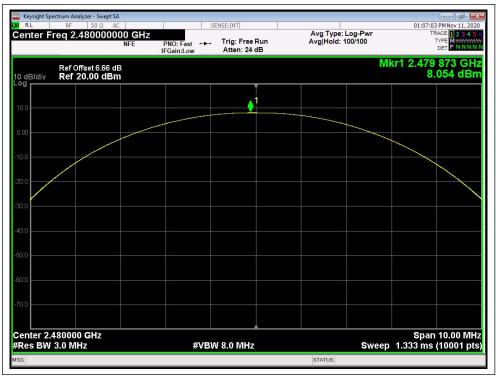
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(8-DPSK, Channel 39, 2441MHz)



(8-DPSK, Channel 78, 2480MHz)

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#### 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\*log1% = 20dB) 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 500hm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

#### B. Equipments List:

Please refer ANNEX B(4).

#### 2.4.3. Test procedure

- a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- c. Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.
- d. Reapeat above procedures until all frequencies measured were complete.





#### 2.4.4. Test Result

The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to record the 20dB bandwidth of the Module.

#### **GFSK Mode**

#### A. Test Verdict:

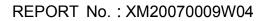
| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) | Result |
|---------|-----------------|----------------------|--------|
| 0       | 2402            | 0.940                | PASS   |
| 39      | 2441            | 0.944                | PASS   |
| 78      | 2480            | 0.944                | PASS   |

#### B. Test Plots:



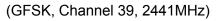
(GFSK, Channel 0, 2402MHz)







| Keysight Spectrum Analyzer - Occupied BW            |                         |   |                            |  |
|---|-------------------------|---|----------------------------|--|
| X RF 50 Ω AC   Center Freq 2.441000000 NI           |                         | SENSE:INT<br>Center Freq: 2.44100000<br>Trig: Free Run<br>#Atten: 10 dB | 0 GHz<br>Avg Hold: 100/100 | 09:24:25 AM Nov 11, 2020<br>Radio Std: None<br>Radio Device: BTS |
| Ref Offset 6.7 dB<br>10 dB/div Ref 26.70 dBm<br>Log |                         |   |                            |  |
| 16.7<br>6.70  |                         |   |                            |  |
| -3.30   |                         |   | m                          |  |
| -23.3   |                         |   |                            | North and  |
| -43.3   |                         |   |                            |  |
| -63.3<br>Center 2.441 GHz<br>#Res BW 30 kHz         |                         | #VBW 100 kH   |                            | Span 2 MHz<br>Sweep 3.333 ms                                     |
| Occupied Bandwidt                                   |                         | Total Power   | 11.5 dBm                   | Gweep 3.333 ms   |
| 8<br>Transmit Freq Error                            | 66.32 kHz<br>-1.715 kHz | % of OBW Powe   | r 99.00 %                  |  |
| x dB Bandwidth                                      | 944.4 kHz               | x dB  | -20.00 dB                  |  |
|   |                         |   |                            |  |
| MSG   |                         |   | STATUS                     |  |





(GFSK, Channel 78, 2480MHz)

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#### $\pi/4$ -DQPSK Mode

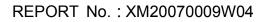
#### A. Test Verdict:

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) | Result |
|---------|-----------------|----------------------|--------|
| 0       | 2402            | 0.945                | PASS   |
| 39      | 2441            | 0.946                | PASS   |
| 78      | 2480            | 0.946                | PASS   |

#### B. Test Plots:

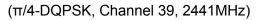


(π/4-DQPSK, Channel 0, 2402MHz)











(π/4-DQPSK, Channel 78, 2480MHz)

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#### 8-DPSK Mode

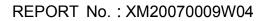
#### A. Test Verdict:

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) | Result |
|---------|-----------------|----------------------|--------|
| 0       | 2402            | 0.942                | PASS   |
| 39      | 2441            | 0.941                | PASS   |
| 78      | 2480            | 0.948                | PASS   |

#### B. Test Plots:



(8-DPSK, Channel 0, 2402MHz)





| Keysight Spectrum Ana           | alyzer - Occupied BW                  |             |  |                   |                                |
|---------------------------------|---------------------------------------|-------------|--|-------------------|--------------------------------|
| KA RL RF                        | 50 Ω AC                               |             | SENSE:INT                                  |                   | 01:06:22 PM Nov 11, 2020       |
| Center Freq 2.                  | 441000000 G                           |             | Center Freq: 2.441000000<br>Trig: Free Run | Avg Hold: 100/100 | Radio Std: None                |
|                                 | NFL                                   | #IFGain:Low | #Atten: 10 dB                              |                   | Radio Device: BTS              |
|                                 | f Offset 6.7 dB<br>f <b>26.70 dBm</b> | (           |  |                   |                                |
| 16.7                            |                                       |             |  |                   |                                |
| 6.70                            |                                       | <u></u>     |  |                   |                                |
| -3.30                           |                                       |             | warman and a second                        |                   |                                |
| -13.3                           |                                       | m           |  | m                 | 9                              |
| -23.3                           | source -                              |             |  | and the second    | mm                             |
| -33.3                           | ~                                     |             |  |                   | m                              |
| -43.3                           |                                       | <u></u>     |  |                   | har                            |
| -53.3                           |                                       |             |  |                   |                                |
| -63.3                           |                                       | - 2         |  |                   | б                              |
| Center 2.441 G<br>#Res BW 30 kF |                                       |             | #VBW 100 kH;                               | z                 | Span 2 MHz<br>Sweep   3.333 ms |
| Occupied                        | Bandwidth                             |             | Total Power                                | 10.5 dBm          |                                |
|                                 |                                       | 6.50 kHz    |  |                   |                                |
| Transmit Fre                    | eq Error                              | -4.620 kHz  | % of OBW Power                             | 99.00 %           |                                |
| x dB Bandw                      | idth                                  | 941.2 kHz   | x dB                                       | -20.00 dB         |                                |
|                                 |                                       |             |  |                   |                                |
|                                 |                                       |             |  |                   |                                |
| ISG                             |                                       |             |  | STATUS            |                                |

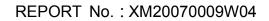




(8-DPSK, Channel 78, 2480MHz)

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### 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 500hm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

#### B. Equipments List:

Please refer ANNEX B(4).

#### 2.5.3. Test Procedure

- a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
- c. By using the MaxHold function record the separation of two adjacent channels.
- d. Measure the frequency difference of these two adjacent channels by SA mark function. And then plot the result on SA screen.
- e. Repeat above procedures until all frequencies measured were complete.



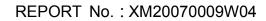
#### 2.5.4. Test Result

The Bluetooth Module 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 PASS.

|                 | Measured            | Carried Frequency       | 20dB        | Min. Limit <sub>Note1</sub> |         |
|-----------------|---------------------|-------------------------|-------------|-----------------------------|---------|
| Test Mode       | Channel             | Separation              | bandwidth   |                             | Verdict |
|                 | Numbers             | (MHz)                   | (MHz)       | (MHz)                       |         |
|                 | 0 and 1             | 1.014                   | 0.940       | 0.627                       | PASS    |
| GFSK            | 39 and 40           | 1.026                   | 0.944       | 0.629                       | PASS    |
|                 | 77 and 78           | 1.008                   | 0.944       | 0.629                       | PASS    |
|                 | 0 and 1             | 0.987                   | 0.945       | 0.630                       | PASS    |
| π/4-DQPSK       | 39 and 40           | 1.035                   | 0.946       | 0.631                       | PASS    |
|                 | 77 and 78           | 1.023                   | 0.946       | 0.631                       | PASS    |
|                 | 0 and 1             | 1.155                   | 0.942       | 0.628                       | PASS    |
| 8-DPSK          | 39 and 40           | 1.131                   | 0.941       | 0.627                       | PASS    |
|                 | 77 and 78           | 1.146                   | 0.948       | 0.632                       | PASS    |
| Note 1:Min. Lin | nit is equal to the | e two-thirds of the 20d | B bandwidth |                             | 1       |

**Test Plots** 

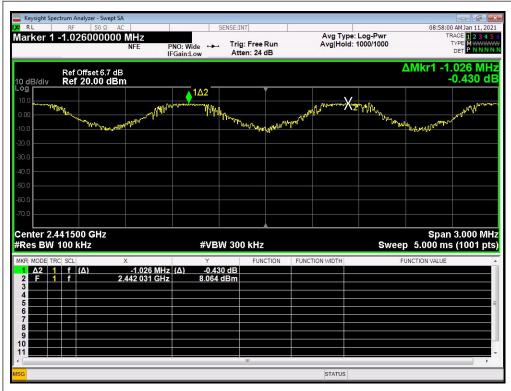
XIAMEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. Unit 101, No.1732 Gangzhong Road, Xiamen Area, Pilot Free Trade Zone (Fujian), P. R. China





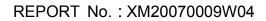
Keysight Spectrum Analyzer - Swept SA 09:20:24 AM Nov 11, 20 RI Center Freq 2.402500000 GHz Avg Type: Log-Pwr Avg|Hold: 2000/2000 Trig: Free Run Atten: 24 dB PNO: Wide IFGain:Low ΔMkr1 1.014 MH -0.302 dE Ref Offset 6.62 dB Ref 20.00 dBm ▲1∆2 Name him 12m May all all more and and and L'Angertante haber way Span 3.000 MHz Sweep 5.000 ms (1001 pts) Center 2.402500 GHz #Res BW 100 kHz #VBW 300 kHz FUNCTION WIDTH 1.014 MHz (Δ) 2.401 849 GHz (A) -0.302 dB 5.520 dBm STATUS

#### (GFSK, Channel 0 and 1, 2402MHz)



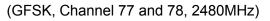
(GFSK, Channel 39 and 40, 2441MHz)

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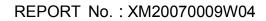






(π/4-DQPSK, Channel 0 and 1, 2402MHz)

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Keysight Spectrum Analyze 09:30:34 AM Jan 11, 2021 SENSE:INT Marker 1 -1.035000000 MHz Avg Type: Log-Pwr Avg|Hold: 2000/2000 RACE Trig: Free Run Atten: 24 dB PNO: Wide IFGain:Low ΔMkr1 -1.035 MH Ref Offset 6.7 dB Ref 20.00 dBm -1.318 dE 0 dB/di 1Δ2 willing Center 2.441500 GHz #Res BW 100 kHz Span 3.000 MHz Sweep 5.000 ms (1001 pts) #VBW 300 kHz FUNCTION f (Δ) -1.035 MHz (Δ) 2.442 136 GHz -1.318 dB 6.062 dBm File <PICTURE.PNG> saved STATUS





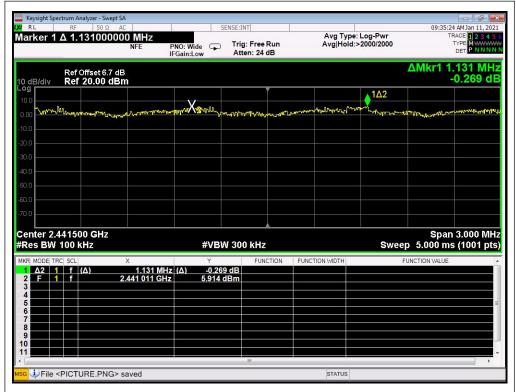
(π/4-DQPSK, Channel 77 and 78, 2480MHz)

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Keysight Spectrum Analyzer - Swept SA R 12:57:23 PM Nov 11, 2 Center Freq 2.402500000 GHz Avg Type: Log-Pwr Avg|Hold: 2000/2000 Trig: Free Run Atten: 24 dB PNO: Wide IFGain:Low -ΔMkr1 1.155 MHz -0.183 dE Ref Offset 6.62 dB Ref 20.00 dBm og 142 MX 1 Minan MM 1 J M MM 1 Y. Center 2.402500 GHz #Res BW 100 kHz Span 3.000 MHz Sweep 5.000 ms (1001 pts) #VBW 300 kHz -0.183 dB 2.950 dBm 1 f 1 f 1.155 MHz 2.401 849 GHz

#### (8-DPSK, Channel 0 and 1, 2402MHz)



(8-DPSK, Channel 39 and 40, 2441MHz)

Kehu-Morlab<br/>Test LaboratoryXIAMEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd.TeUnit 101, No.1732 Gangzhong Road, Xiamen Area, Pilot Free Trade Zone (Fujian), P. R. ChinaFa



| Keysight Spectrum Analyzer - Swept SA<br>R L RF 50 Ω AC | SENSE:                 | NT                        |                                   | 01-09-2                | 4 PM Nov 11, 20                          |
|---|------------------------|---------------------------|-----------------------------------|------------------------|--|
| enter Freq 2.479500000 GHz                              | PNO: Wide Tri          | g: Free Run<br>ten: 24 dB | Avg Type: Log-<br>Avg Hold: 2000/ | Pwr T                  | RACE 1 2 3 4<br>TYPE MWWW<br>DET P N N N |
| Ref Offset 6.66 dB<br>dB/div Ref 20.00 dBm              |                        |                           |                                   | ΔMkr1 1                | .146 MH<br>-0.049 d                      |
| 99<br>  | X                      |                           | 1∆2                               |                        |  |
|   | 12 and parts           | W.M.                      |                                   | m hall                 |  |
| 0   |                        |                           |                                   |                        | how                                      |
| 0   |                        |                           |                                   |                        |  |
| .0  |                        |                           |                                   | 5<br>5                 |  |
| enter 2.479500 GHz<br>tes BW 100 kHz                    | #VBW 30                | 0 kHz                     |                                   | Span<br>Sweep 5.000 ms | 3.000 M<br>s (1001 pi                    |
|   | Υ<br>1Hz (Δ) -0.049 dB | FUNCTION F                | UNCTION WIDTH                     | FUNCTION VALUE         |  |
| F 1 f 2.478 858 0                                       |                        |                           |                                   |                        |  |
|   |                        |                           |                                   |                        |  |
|   |                        |                           |                                   |                        |  |
|   |                        |                           |                                   |                        |  |
|   |                        |                           |                                   |                        |  |
|   |                        |                           |                                   |                        |  |
|   |                        |                           |                                   |                        |  |
|   |                        | m.                        |                                   |                        |  |

(8-DPSK, Channel 77 and 78, 2480MHz)



### 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 500hm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

The EUT was working in channel hopping; Spectrum SPAN was set as 0. Sweep was set as 0.4 \* channel no.(s), the quantity of pulse was get from single sweep. In addition, the time of single pulses was tested.

Dwell time = time slot length \* hop rate / number of hopping channels \* 31.6s Hop rate = 1600/s

#### B. Equipments List:

Please refer ANNEX B(4).



#### 2.6.3. Test Result

For time of occupancy, all of mode were tested separately, we only recorded the worst test result(DH5/2DH5/3DH5) in this report.

**GFSK Mode** 

#### A. Test Verdict:

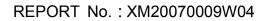
| Mode | Frequency<br>(MHz) | Pulse Width<br>(ms) | Dwell Time<br>(ms) | Limit<br>(sec) | Verdict |
|------|--------------------|---------------------|--------------------|----------------|---------|
|      | 2402               | 2.885               | 273.498            |                | PASS    |
| DH1  | 2441               | 2.884               | 273.451            | 0.4            | PASS    |
|      | 2480               | 2.884               | 273.451            |                | PASS    |

#### B. Test Plots:

| RL RF  | 50 Ω AC                      | SENSE:I                  | nt<br>g Delay-1.000 n                     | Δ <b>Τ</b>     | pe: Log-Pwr | 09:43:02 AM Jan 11, 2021<br>TRACE 1 2 3 4 5                    |
|--|------------------------------|--------------------------|---|----------------|-------------|--|
| enter Freq 2.4                                 |                              | O Wide ++ Tri            | g Delay-1.000 n<br>g: Video<br>ten: 24 dB | is Avgiy       | pe: Log-Pwr | TYPE WWWWW<br>DET PNNNN  |
| dB/div Ref 2                                   | set 6.62 dB<br>0.00 dBm      |                          |   |                | 8           | ΔMkr1 2.885 ms<br>-0.73 dE                                     |
| o.o  |                              |                          |   |                | _1Δ2        |  |
| .00  | X2                           |                          |   |                |             |  |
| 0.0  |                              |                          |   |                |             | TRIG LVL   |
| 0.0  |                              |                          |   |                |             |  |
|  |                              |                          |   |                |             |  |
|  |                              |                          |   |                |             |  |
|  |                              |                          |   |                |             |  |
| n n midis indentiti de Harri                   | s has a dealers              |                          |   |                | ունգի       | isted the difference of the                                    |
| p.o. <mark>patrik liste kul ali talik l</mark> | <mark>K ka luhisina d</mark> |                          |   |                | اربي بريانا | r <mark>a selit, sin, hall alia, hall a tari a su pi</mark> li |
|  |                              |                          |   |                |             |  |
| enter 2.402000<br>es BW 1.0 MHz                |                              | #VBW 3.0                 | ) MHz                                     |                | Sweep 5     | Span 0 Ha<br>000 ms (10001 pts.                                |
| KR MODE TRC SCL                                | X                            | Y                        | FUNCTION                                  | FUNCTION WIDTH | FUNC        | TION VALUE   |
| 1 Δ2 1 t (Δ΄<br>2 F 1 t                        | ) 2.885 ms<br>1.001 ms       | (Δ) -0.73 dB<br>7.47 dBm |   |                |             |  |
|  |                              |                          |   |                |             |  |
|  |                              |                          |   |                |             |  |
| 5  |                              |                          |   | <u>.</u>       |             | E  |
| 4<br>5<br>6<br>7                               |                              |                          |   |                |             |  |
| 3<br>4<br>5<br>6<br>7<br>7<br>8<br>9           |                              |                          |   |                |             |  |
| 4<br>5<br>6<br>7<br>8                          |                              |                          |   |                |             |  |

(DH1\_2402MHz, GFSK)

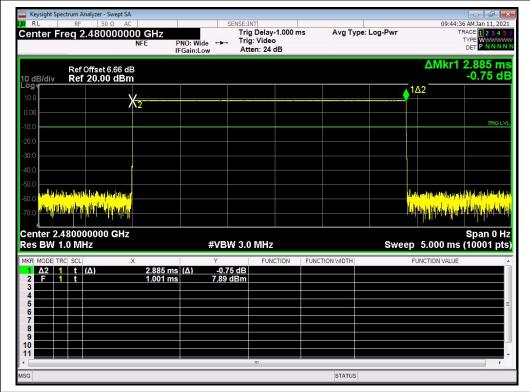






| RL RF   | Analyzer - Swept SA<br>50 Ω AC     | SENSE                              | E:INT  |               | 09                           | 🕞   |
|---|------------------------------------|------------------------------------|--|---------------|------------------------------|---|
|   | 2.441000000 GHz                    | PNO: Wide                          | rig Delay-1.000 ms<br>rig: Video<br>Atten: 24 dB | Avg Type: Lo  |                              | TRACE 1 2 3 4<br>TYPE WWWW<br>DET P N N N |
| Ref<br>dB/div <b>R</b> ef   | Offset 6.7 dB<br>f 20.00 dBm       |                                    |  |               | ΔMk                          | r1 2.885 m<br>1.55 d                      |
|   |                                    |                                    |  |               | 1Δ2                          |   |
| 00  | Xullar                             |                                    |  |               |                              | TRIG L                                    |
|   |                                    |                                    |  |               |                              |   |
|   |                                    |                                    |  |               |                              |   |
| ).0   |                                    |                                    |  |               |                              |   |
| ).0<br>10 <mark>diagathtayatatht</mark>                                 | مر مع مع من من الألوا والألوا والم |                                    |  |               | ikon sidelitada (1910)       | Andre Issailling Lather                   |
| o.o <mark>Alperal (1986)</mark>   | alitiyy (t. Alex, it., p. 147)     |                                    |  |               | <mark> 4  80  50   80</mark> |   |
| enter 2.4410<br>es BW 1.0 M   |                                    | #VBW 3                             | 8.0 MHz  |               | Sweep 5.000                  | Span 0  <br>ms (10001 p                   |
| 55 DVV 1.0 IVI  |                                    | Y                                  |  | INCTION WIDTH | FUNCTION VA                  | ALUE                                      |
| R MODE TRC SCL  |                                    |                                    |  |               |                              |   |
| R MODE TRC SCL<br>A2 1 t<br>2 F 1 t                                     |                                    | 5 ms (Δ) 1.55 dl<br>1 ms -3.95 dBn |  |               |                              |   |
| R MODE TRC SCL<br>A2 1 t<br>F 1 t<br>1 1                                | (Δ) 2.885                          |                                    |  |               |                              |   |
| R MODE TRC SCL  | (Δ) 2.885                          |                                    |  |               |                              |   |
| MODE TRC SCL <b>A2</b> 1 t <b>F</b> 1 t <b>5</b> 5 5 <b>7 6 7 8 6 7</b> | (Δ) 2.885                          |                                    |  |               |                              |   |
| MODE TRC SCL <b>A2</b> 1 t <b>F</b> 1 t <b>5</b> 5 5 <b>7 2 5</b>       | (Δ) 2.885                          |                                    |  |               |                              |   |

### (DH1\_2441M, GFSK)



(DH1\_2480M, GFSK)

Kehu-Morlab<br/>Test LaboratoryXIAMEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd.TelevisionUnit 101, No.1732 Gangzhong Road, Xiamen Area, Pilot Free Trade Zone (Fujian), P. R. ChinaFile

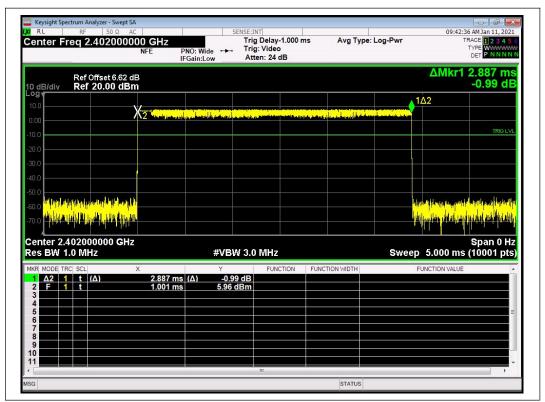


#### $\pi/4$ -DQPSK Mode

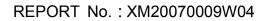
#### A. Test Verdict:

| Mode | Frequency<br>(MHz) | Pulse Width<br>(ms) | Dwell Time<br>(ms) | Limit<br>(sec) | Verdict |
|------|--------------------|---------------------|--------------------|----------------|---------|
|      | 2402               | 2.887               | 273.640            |                | PASS    |
| 2DH1 | 2441               | 2.874               | 272.455            | 0.4            | PASS    |
|      | 2480               | 2.887               | 273.640            |                | PASS    |

#### B. Test Plots:



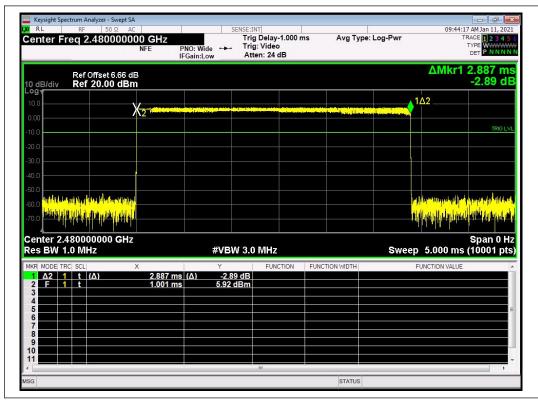
(2DH1\_2402M, π/4-DQPSK)





| RL RF<br>enter Freq 2.44   | 50 Ω AC<br>41000000 GHz   |                                  | SENSE:INT<br>Trig Delay-1.000 ms<br>Trig: Video | Avg Type       | : Log-Pwr | 09:43:43 AM Jai<br>TRACE<br>TYPE   | 234   |
|--|---|----------------------------------|---|----------------|-----------|--|---|
|  | NFE   | PNO: Wide                        | Atten: 24 dB                                    |                |           | DET  | NNN   |
| dB/div Ref 20  | set 6.7 dB<br>).00 dBm  |                                  |   |                |           | ΔMkr1 2.87<br>1.7  | 74 m<br>71 d                                |
| 9 <b>9</b>   |   |                                  |   |                | 14        | Δ2   |   |
| .00  | Xaabiiti  |                                  |   |                |           |  | TRIG L                                      |
| ).0  |   | <mark>dalahirkan se bisik</mark> |   |                |           |  | TRIGL                                       |
| ).0  |   |                                  |   |                |           |  |   |
| 0.0  | 2   |                                  |   |                |           | ð  |   |
|  |   |                                  |   |                |           | 8  |   |
|  |   |                                  |   |                |           |  |   |
| 0.0<br>141 Manufacture at the second   |   |                                  |   |                |           | المتاحض واللقان محسا المالية والمح   |   |
| o.o<br>o.o<br>o.o <mark>Hidisudu aski as</mark>  | , se bale alte addi   |                                  |   |                |           | na fila da las las principals da substituti<br>Novas terro II. Instrum V. Parta - Vista  | ddadad)<br><mark>Hol<sup>h</sup>lari</mark> |
| 0.0<br>141 Manufacture at the second   |   |                                  |   |                |           | in the life of the could be a set of the set |   |
| 2.0<br>11/10/14/14/14/14/14/14/14/14/14/14/14/14/14/   | Del durd<br>del |                                  |   |                |           | Spa  | n 0 I                                       |
| 2.0<br>00<br>00<br>enter 2.4410000<br>es BW 1.0 MHz  |   |                                  | W 3.0 MHz                                       |                |           | 5.000 ms (100  | un 0 H<br>01 pt                             |
| 2.0<br>00<br>00<br>enter 2.4410000<br>es BW 1.0 MHz  | X   | Y                                | FUNCTION  | FUNCTION WIDTH |           | Spa<br>5.000 ms (100   | n 0 H<br>01 pt                              |
| 0 0    | X   | Υ<br>ms (Δ) 1.7                  |   | FUNCTION WIDTH |           | 5.000 ms (100  | n 0 H<br>01 pi                              |
| 0.0 10 | ×<br>2.874  | Υ<br>ms (Δ) 1.7                  | FUNCTION  | FUNCTION WIDTH |           | 5.000 ms (100  | n 0 I<br>01 p                               |
| (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)  | ×<br>2.874  | Υ<br>ms (Δ) 1.7                  | FUNCTION  | FUNCTION WIDTH |           | 5.000 ms (100  | n 0 H<br>01 pi                              |
| 0 0    | ×<br>2.874  | Υ<br>ms (Δ) 1.7                  | FUNCTION  | FUNCTION WIDTH |           | 5.000 ms (100  | n 0 H                                       |
| 0 0    | ×<br>2.874  | Υ<br>ms (Δ) 1.7                  | FUNCTION  | FUNCTION WIDTH |           | 5.000 ms (100  | un 0 I<br>01 p                              |

(2DH1\_2441M, π/4-DQPSK)



(2DH1\_2480M, π/4-DQPSK)

Kehu-Morlab Test Laboratory

**XIAMEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd.** Unit 101, No.1732 Gangzhong Road, Xiamen Area, Pilot Free Trade Zone (Fujian), P. R. China

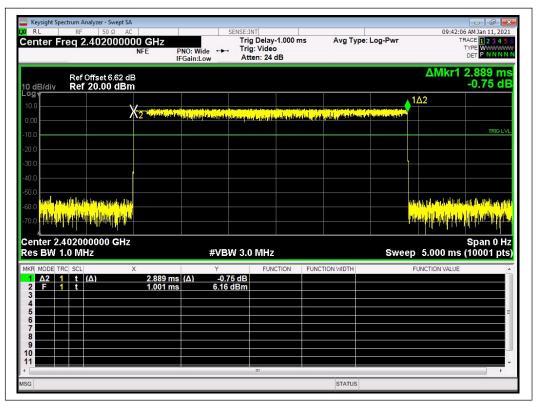


#### 8-DPSK mode

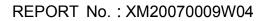
#### A. Test Verdict:

| Mode | Frequency<br>(MHz) | Pulse<br>Width<br>(ms) | Dwell Time<br>(ms) | Limit<br>(sec) | Verdict |
|------|--------------------|------------------------|--------------------|----------------|---------|
|      | 2402               | 2.889                  | 273.830            |                | PASS    |
| 3DH1 | 2441               | 2.874                  | 272.455            | 0.4            | PASS    |
|      | 2480               | 2.874                  | 272.455            |                | PASS    |

#### B. Test Plots:

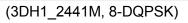


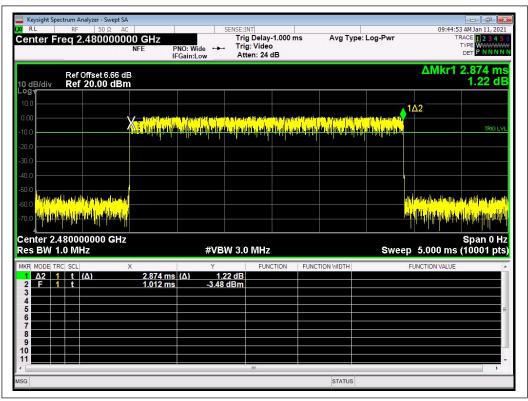
(3DH1\_2402M, 8-DQPSK)





| Variate Ca                           | ectrum Analyzer - Swe   | -1.54                       |                  |  |                                   |  |   |   |
|--------------------------------------|---|-----------------------------|------------------|--|-----------------------------------|--|---|---|
| XI RL                                | RF 50 Ω   | AC                          | SENSE            |  |                                   |  |   | AM Jan 11, 202  |
| Center F                             | req 2.44100   | NFE I                       | NO Wide ++ T     | rig Delay-1.000 ms<br>rig: Video<br>Atten: 24 dB                     | Avg Type:                         | Log-Pwr  |   | RACE 1 2 3 4 5<br>TYPE W  |
| 10 dB/div<br>Log                     | Ref Offset 6.7<br>Ref 20.00 d   |                             |                  |  |                                   |  | ∆Mkr1   | 2.874 ms<br>1.56 dE   |
| 10.0                                 |   |                             |                  |  | 2 - 0 - 7 - 7 - 7 - 7 - 7 - 7 - 7 | l terre a ser se se se 🔴 👘                         | Δ2  |   |
| -10.0                                |   | Xellini                     |                  | and all and and the local data<br>And the local data from the source |                                   |  | 0<br>   | TRIG LVI  |
| -20.0                                |   |                             |                  |  |                                   |  |   |   |
| -40.0                                |   |                             |                  |  |                                   |  |   |   |
| -50.0<br>-60.0 <mark>([[1]</mark> ]) | and the House of the second   | huy                         |                  |  |                                   | 110  | and the first of the | an a la state de la state d |
| -70.0                                |   |                             |                  |  |                                   | <mark>                                     </mark> | <mark>elulų įkristo isteria</mark> .  | i popular de la del de de la de   |
| Center 2.<br>Res BW 1                | 441000000 G<br>I.0 MHz  | Hz                          | #VBW 3           | .0 MHz   |                                   | Sweep  | 5.000 ms  | Span 0 H<br>(10001 pts  |
|                                      | A CONTRACTOR OF | X 0.074                     | γ<br>(Δ) 1.56 dE | FUNCTION   | FUNCTION WIDTH                    | F  | UNCTION VALUE   |   |
| 2 F 1                                |   | <u>2.874 ms</u><br>1.012 ms |                  |  |                                   |  |   |   |
| 4                                    |   |                             |                  |  |                                   |  |   |   |
| 6                                    |   |                             |                  |  |                                   |  |   |   |
| 8                                    |   |                             |                  |  |                                   |  |   |   |
| 9                                    |   |                             |                  |  |                                   |  |   |   |
| 11 <u> </u>                          |   |                             |                  | m  |                                   |  |   | Þ   |
| SG                                   |   |                             |                  |  | STATUS                            |  |   |   |





(3DH1\_2480M, 8-DQPSK)

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### 2.7. Conducted Spurious Emissions and Band Edge

#### 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 500hm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

#### B. Equipments List:

Please refer ANNEX B(4).

#### 2.7.3. Test Procedure

The transmitter output was connected to the spectrum analyzer via a low lose cable. Set both RBW and VBW of spectrum analyzer to 100kHz and 300kHz with suitable frequency span including 100 MHz bandwidth from band edge. The band edges was measured and recorded.



#### 2.7.4. Test Result

The Bluetooth Module 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**



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