



RADIO TEST REPORT

Report No: STS1906032W01

Issued for

suzhou kewo trading company Ltd

Room 615,Building D,Fan Hua centerXiang Cheng  
district,Suzhou city Jiangsu Province China

|                |                 |
|----------------|-----------------|
| Product Name:  | TABLET PC       |
| Brand Name:    | N/A             |
| Model Name:    | Q88             |
| Series Model:  | N/A             |
| FCC ID:        | 2ATNUQ88        |
| Test Standard: | FCC Part 15.247 |

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**TEST RESULT CERTIFICATION**

Applicant's Name .....: suzhou kewo trading company Ltd

Address .....: Room 615,Building D,Fan Hua centerXiang Cheng district,  
Suzhou city Jiangsu Province China

Manufacture's Name .....: Shenzhen Zhixingsheng Electronic Co.,Ltd

Address .....: F/4, East Zone No.8 ,F Building ,High And New Industrial Park  
ShangXue, Ji Hua Road, BanTian, LongGang District, Shenzhen,  
China

**Product Description**

Product Name .....: TABLET PC

Brand Name .....: N/A

Model Name .....: Q88

Series Model .....: N/A

Test Standards .....: FCC Part15.247

Test Procedure .....: ANSI C63.10-2013

This device described above has been tested by STS, the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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**Date of Test.....:**

Date (s) of performance of tests.: 11 June 2019~05 July 2019

Date of Issue .....: 06 July 2019

Test Result .....: Pass

Testing Engineer :

(Chris Chen)

Technical Manager :

(Sunday Hu)

Authorized Signatory :

(Vita Li)





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**Revision History**

| Rev. | Issue Date   | Report NO.    | Effect Page | Contents      |
|------|--------------|---------------|-------------|---------------|
| 00   | 06 July 2019 | STS1906032W01 | ALL         | Initial Issue |
|      |              |               |             |               |





## 1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:  
KDB 558074 D01 15.247 Meas Guidance v05r02

| FCC Part 15.247, Subpart C    |                                         |          |        |
|-------------------------------|-----------------------------------------|----------|--------|
| Standard Section              | Test Item                               | Judgment | Remark |
| 15.207                        | Conducted Emission                      | PASS     | --     |
| 15.247(a)(1)                  | Hopping Channel Separation              | PASS     | --     |
| 15.247(a)(1)&(b)(1)           | Output Power                            | PASS     | --     |
| 15.247©                       | Radiated Spurious Emission              | PASS     | --     |
| 15.247(d)                     | Conducted Spurious & Band Edge Emission | PASS     | --     |
| 15.247(a)(iii)                | Number of Hopping Frequency             | PASS     | --     |
| 15.247(a)(iii)                | Dwell Time                              | PASS     | --     |
| 15.247(a)(1)                  | Bandwidth                               | PASS     | --     |
| 15.205                        | Restricted Band Edge Emission           | PASS     | --     |
| Part 15.247(d)/part 15.209(a) | Band Edge Emission                      | PASS     | --     |
| 15.203                        | Antenna Requirement                     | PASS     | --     |

### NOTE:

(1) "N/A" denotes test is not applicable in this Test Report

(2) All tests are according to ANSI C63.10-2013



### 1.1 TEST FACTORY

Shenzhen STS Test Services Co., Ltd.

Add. : 1/F., Building B, Zhuoke Science Park, No.190, Chongqing Road,  
Fuyong Street, Bao'an District, Shenzhen, Guangdong, China

FCC test Firm Registration Number: 625569

A2LA Certificate No.: 4338.01;

### 1.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement  $y \pm U$ , where expended uncertainty  $U$  is based on a standard uncertainty multiplied by a coverage factor of  $k=2$ , providing a level of confidence of approximately **95** %.

| No. | Item                                | Uncertainty         |
|-----|-------------------------------------|---------------------|
| 1   | RF output power, conducted          | $\pm 0.71\text{Db}$ |
| 2   | Unwanted Emissions, conducted       | $\pm 0.63\text{Db}$ |
| 3   | All emissions, radiated 30-200MHz   | $\pm 3.43\text{Db}$ |
| 4   | All emissions, radiated 200MHz-1GHz | $\pm 3.57\text{Db}$ |
| 5   | All emissions, radiated >1G         | $\pm 4.13\text{Db}$ |
| 6   | Conducted Emission (9KHz-150KHz)    | $\pm 3.18\text{Db}$ |
| 7   | Conducted Emission (150KHz-30MHz)   | $\pm 2.70\text{Db}$ |



## 2. GENERAL INFORMATION

### 2.1 GENERAL DESCRIPTION OF THE EUT

|                         |                                                                                            |
|-------------------------|--------------------------------------------------------------------------------------------|
| Product Name            | TABLET PC                                                                                  |
| Trade Name              | N/A                                                                                        |
| Model Name              | Q88                                                                                        |
| Series Model            | N/A                                                                                        |
| Model Difference        | N/A                                                                                        |
| Channel List            | Please refer to the Note 2.                                                                |
| Bluetooth               | Frequency: 2402 – 2480 MHz<br>Modulation: GFSK(1Mbps), $\pi/4$ -DQPSK(2Mbps), 8DPSK(3Mbps) |
| Bluetooth Version       | 2.1                                                                                        |
| Bluetooth Configuration | BR+EDR                                                                                     |
| Adapter                 | Input: 100-240V~50/60Hz<br>Output: 5V 2A                                                   |
| Battery                 | Rated Voltage: 3.7V<br>Charge Limit: 4.2V<br>Capacity: 1800mAh                             |
| Hardware version number | ET_Q8_V4.0_190215                                                                          |
| Software version number | astar_rtl8703bs_mtp-eng 4.4.2 KVT49L 20190313<br>test-keys                                 |
| Connecting I/O Port(s)  | Please refer to the User's Manual                                                          |

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.





2.

| Channel List |                 |         |                 |         |                 |
|--------------|-----------------|---------|-----------------|---------|-----------------|
| Channel      | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| 00           | 2402            | 27      | 2429            | 54      | 2456            |
| 01           | 2403            | 28      | 2430            | 55      | 2457            |
| 02           | 2404            | 29      | 2431            | 56      | 2458            |
| 03           | 2405            | 30      | 2432            | 57      | 2459            |
| 04           | 2406            | 31      | 2433            | 58      | 2460            |
| 05           | 2407            | 32      | 2434            | 59      | 2461            |
| 06           | 2408            | 33      | 2435            | 60      | 2462            |
| 07           | 2409            | 34      | 2436            | 61      | 2463            |
| 08           | 2410            | 35      | 2437            | 62      | 2464            |
| 09           | 2411            | 36      | 2438            | 63      | 2465            |
| 10           | 2412            | 37      | 2439            | 64      | 2466            |
| 11           | 2413            | 38      | 2440            | 65      | 2467            |
| 12           | 2414            | 39      | 2441            | 66      | 2468            |
| 13           | 2415            | 40      | 2442            | 67      | 2469            |
| 14           | 2416            | 41      | 2443            | 68      | 2470            |
| 15           | 2417            | 42      | 2444            | 69      | 2471            |
| 16           | 2418            | 43      | 2445            | 70      | 2472            |
| 17           | 2419            | 44      | 2446            | 71      | 2473            |
| 18           | 2420            | 45      | 2447            | 72      | 2474            |
| 19           | 2421            | 46      | 2448            | 73      | 2475            |
| 20           | 2422            | 47      | 2449            | 74      | 2476            |
| 21           | 2423            | 48      | 2450            | 75      | 2477            |
| 22           | 2424            | 49      | 2451            | 76      | 2478            |
| 23           | 2425            | 50      | 2452            | 77      | 2479            |
| 24           | 2426            | 51      | 2453            | 78      | 2480            |
| 25           | 2427            | 52      | 2454            |         |                 |
| 26           | 2428            | 53      | 2455            |         |                 |

3. Table for Filed Antenna

| Ant. | Brand | Model Name | Antenna Type | Connector | Gain (dBi) | NOTE       |
|------|-------|------------|--------------|-----------|------------|------------|
| 1    | N/A   | Q88        | PIFA         | N/A       | 2dBi       | BT Antenna |



## 2.2 DESCRIPTION OF THE TEST MODES

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

| Worst Mode | Description | Data Rate/Modulation   |
|------------|-------------|------------------------|
| Mode 1     | TX CH00     | 1Mbps/GFSK             |
| Mode 2     | TX CH39     | 1Mbps/GFSK             |
| Mode 3     | TX CH78     | 1Mbps/GFSK             |
| Mode 4     | TX CH00     | 2 Mbps/ $\pi/4$ -DQPSK |
| Mode 5     | TX CH39     | 2 Mbps/ $\pi/4$ -DQPSK |
| Mode 6     | TX CH78     | 2 Mbps/ $\pi/4$ -DQPSK |
| Mode7      | TX CH00     | 3 Mbps/8DPSK           |
| Mode 8     | TX CH39     | 3 Mbps/8DPSK           |
| Mode 9     | TX CH78     | 3 Mbps/8DPSK           |

Note:

(1) The measurements are performed at all Bit Rate of Transmitter, the worst data was reported

(2) We have be tested for all avaiable U.S. voltage and frequencies(For 120V,50/60Hz and 240V, 50/60Hz) for which the device is capable of operation, and the worst case of 120V/60Hz is shown in the report

For AC Conducted Emission

| Test Case             |                         |
|-----------------------|-------------------------|
| AC Conducted Emission | Mode 10 : Keeping BT TX |

## 2.3 FREQUENCY HOPPING SYSTEM REQUIREMENTS

(1)Standard and Limit

According to FCC Part 15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.



## (2)EUT Pseudorandom Frequency Hopping Sequence

Pseudorandom Frequency Hopping Sequence Table as below:

Channel: 03, 14, 11, 35, 43, 37, 50, 61, 77, 55, 71, 02, 23, 07, 27, 39, 54, 46, 48, 15, 63, 62, 67, 25, 31, 12, 28, 19, 60, 42, 57, 74, 16, 05, 18, 30, 45, 08, 24, 40, 56, 34, 51, 72, 09, 01, 64, 22, 33, 41, 32, 47, 65, 73, 53, 69, 06, 17, 04, 20, 36, 52, 38, 66, 70, 78, 68, 76, 21, 29, 10, 26, 49, 00, 58, 44, 59, 75, 13, etc.

The system receiving have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

## (3)Frequency Hopping System

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule.

This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

This device was tested with a bluetooth system receiver to check that the device maintained hopping synchronization, and the device complied with these requirements FCC Part 15.247 rule.

## 2.4 TABLE OF PARAMETERS OF TEXT SOFTWARE SETTING

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters of FHSS.

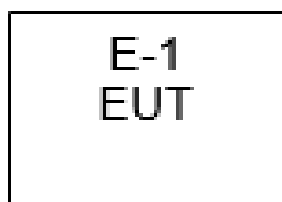
| Test software Version                             | Test program: Bluetooth                                             |                                                                     |                                                                     |
|---------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------|
| Frequency                                         | 2402 MHz                                                            | 2441 MHz                                                            | 2480 MHz                                                            |
| (Power control software)<br>Parameters(1/2/3Mbps) | Power class:<br>1 M rate:4:27<br>2 M rate:11:183<br>3 M rate:15:339 | Power class:<br>1 M rate:4:27<br>2 M rate:11:183<br>3 M rate:15:339 | Power class:<br>1 M rate:4:27<br>2 M rate:11:183<br>3 M rate:15:339 |



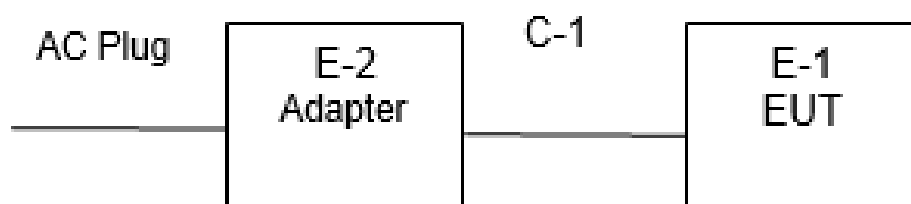
## 2.5 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters of FHSS

### Radiated Spurious Emission Test



### Conducted Emission Test





## 2.6 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

### Necessary accessories

| Item | Equipment | Mfr/Brand | Model/Type No. | Serial No. | Note |
|------|-----------|-----------|----------------|------------|------|
| E-2  | Adapter   | ADAPTER   | YSD-023        | N/A        | N/A  |
| C-1  | DC Cable  | N/A       | 100cm          | N/A        | N/A  |
|      |           |           |                |            |      |
|      |           |           |                |            |      |

### Support units

| Item | Equipment | Mfr/Brand | Model/Type No. | Serial No. | Note |
|------|-----------|-----------|----------------|------------|------|
| N/A  | N/A       | N/A       | N/A            | N/A        | N/A  |
|      |           |           |                |            |      |
|      |           |           |                |            |      |
|      |           |           |                |            |      |

### Note:

- (1) The support equipment was authorized by Declaration of Confirmation.
- (2) For detachable type I/O cable should be specified the length in cm in 『Length』 column.
- (3) “YES” is means “shielded” “with core”; “NO” is means “unshielded” “without core”.



## 2.7 EQUIPMENTS LIST

## Radiation Test equipment

| Kind of Equipment                | Manufacturer | Type No.                   | Serial No.       | Last calibration | Calibrated until |
|----------------------------------|--------------|----------------------------|------------------|------------------|------------------|
| Test Receiver                    | R&S          | ESCI                       | 101427           | 2018.10.13       | 2019.10.12       |
| Signal Analyzer                  | Agilent      | N9020A                     | MY51110105       | 2019.03.02       | 2020.03.01       |
| Active loop Antenna              | ZHINAN       | ZN30900C                   | 16035            | 2018.03.11       | 2021.03.10       |
| Bilog Antenna                    | TESEQ        | CBL6111D                   | 34678            | 2017.11.02       | 2020.11.1        |
| Horn Antenna                     | SCHWARZBECK  | BBHA<br>9120D(1201)        | 9120D-1343       | 2018.10.19       | 2021.10.18       |
| SHF-EHF Horn Antenna (18G-40GHz) | A-INFO       | LB-180400-KF               | J211020657       | 2018.03.11       | 2021.03.10       |
| Pre-Amplifier(0.1M-3GHz)         | EM           | EM330                      | 060665           | 2018.10.13       | 2019.10.12       |
| Pre-Amplifier (1G-18GHz)         | SKET         | LNPA-01018G-45             | SK201808090<br>1 | 2018.10.13       | 2019.10.12       |
| Temperature & Humidity           | HH660        | Mieo                       | N/A              | 2018.10.11       | 2019.10.10       |
| turn table                       | EM           | SC100_1                    | 60531            | N/A              | N/A              |
| Antenna mast                     | EM           | SC100                      | N/A              | N/A              | N/A              |
| Test SW                          | FARAD        | EZ-EMC(Ver.STSLAB-03A1 RE) |                  |                  |                  |

## Conduction Test equipment

| Kind of Equipment      | Manufacturer | Type No.                   | Serial No. | Last calibration | Calibrated until |
|------------------------|--------------|----------------------------|------------|------------------|------------------|
| Test Receiver          | R&S          | ESCI                       | 101427     | 2018.10.13       | 2019.10.12       |
| LISN                   | R&S          | ENV216                     | 101242     | 2018.10.11       | 2019.10.10       |
| LISN                   | EMCO         | 3810/2NM                   | 23625      | 2018.10.11       | 2019.10.10       |
| Temperature & Humidity | HH660        | Mieo                       | N/A        | 2018.10.11       | 2019.10.10       |
| Test SW                | FARAD        | EZ-EMC(Ver.STSLAB-03A1 CE) |            |                  |                  |

## RF Connected Test

| Kind of Equipment      | Manufacturer | Type No.        | Serial No.    | Last calibration | Calibrated until |
|------------------------|--------------|-----------------|---------------|------------------|------------------|
| USB RF power sensor    | DARE         | RPR3006W        | 15I00041SNO03 | 2018.10.13       | 2019.10.12       |
| Signal Analyzer        | Agilent      | N9020A          | MY49100060    | 2018.10.13       | 2019.10.12       |
| Temperature & Humidity | HH660        | Mieo            | N/A           | 2018.10.11       | 2019.10.10       |
| Test SW                | FARAD        | LZ-RF /LzRf-3A3 |               |                  |                  |



### 3. EMC EMISSION TEST

#### 3.1 CONDUCTED EMISSION MEASUREMENT

##### 3.1.1 POWER LINE CONDUCTED EMISSION LIMITS

Operating frequency band. In case the emission fall within the restricted band specified on Part 207(a) limit in the table below has to be followed.

| FREQUENCY (MHz) | Conducted Emissionlimit (dBUV) |           |
|-----------------|--------------------------------|-----------|
|                 | Quasi-peak                     | Average   |
| 0.15 -0.5       | 66 - 56 *                      | 56 - 46 * |
| 0.50 -5.0       | 56.00                          | 46.00     |
| 5.0 -30.0       | 60.00                          | 50.00     |

Note:

- (1) The tighter limit applies at the band edges.
- (2) The limit of " \* " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

The following table is the setting of the receiver

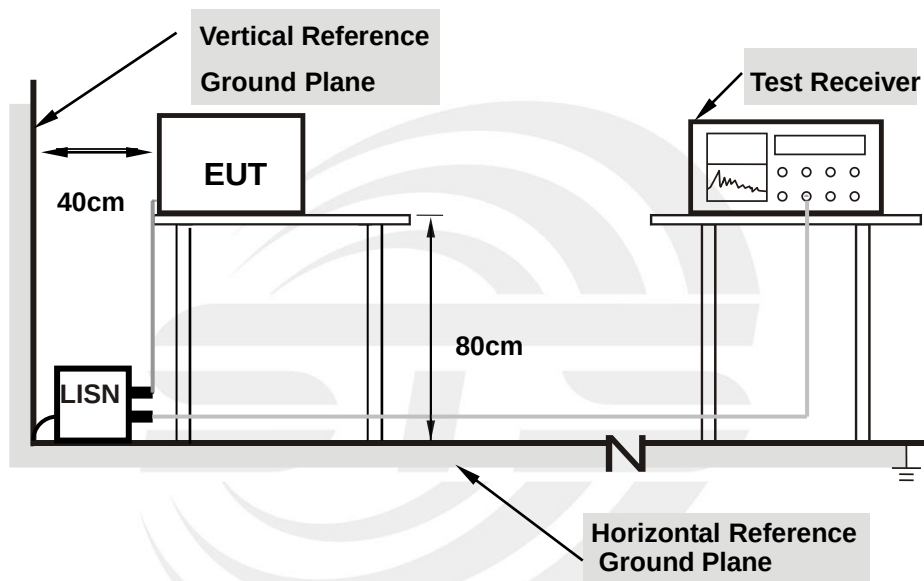
| Receiver Parameters | Setting  |
|---------------------|----------|
| Attenuation         | 10 dB    |
| Start Frequency     | 0.15 MHz |
| Stop Frequency      | 30 MHz   |
| IF Bandwidth        | 9 kHz    |



### 3.1.2 TEST PROCEDURE

- The EUT was 0.8 meters from the horizontal ground plane and 0.4 meters from the vertical ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- LISN at least 80 cm from nearest part of EUT chassis.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

### 3.1.3 TEST SETUP



**Note:** 1.Support units were connected to second LISN.  
 2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

### 3.1.4 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.





## 3.1.5 TEST RESULT

|               |              |                    |     |
|---------------|--------------|--------------------|-----|
| Temperature:  | 26.5℃        | Relative Humidity: | 63% |
| Test Voltage: | AC 120V/60Hz | Phase:             | L   |
| Test Mode:    | Mode 10      |                    |     |

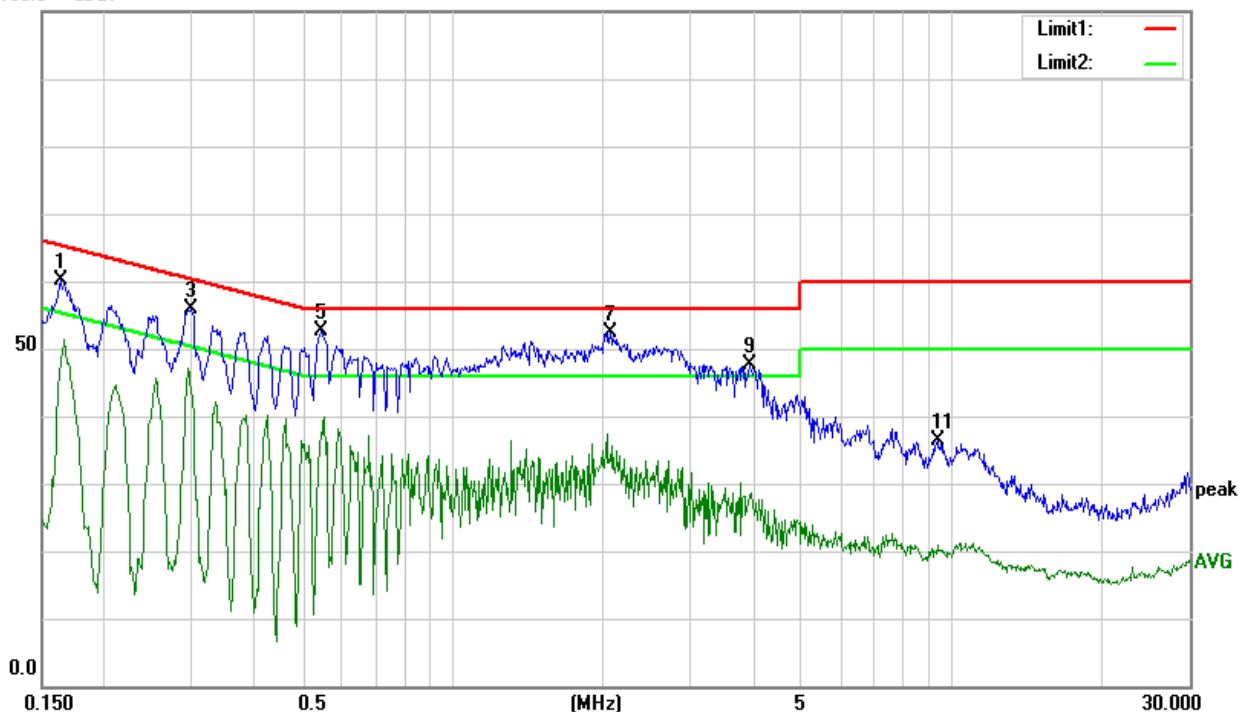
| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct<br>Factor(dB) | Result<br>(dBuV) | Limit<br>(dBuV) | Margin<br>(dB) | Remark |
|-----|--------------------|-------------------|-----------------------|------------------|-----------------|----------------|--------|
| 1   | 0.1633             | 39.86             | 20.23                 | 60.09            | 65.29           | -5.20          | OP     |
| 2   | 0.1633             | 31.04             | 20.23                 | 51.27            | 55.29           | -4.02          | AVG    |
| 3   | 0.2987             | 35.05             | 20.71                 | 55.76            | 60.28           | -4.52          | OP     |
| 4   | 0.2987             | 26.49             | 20.71                 | 47.20            | 50.28           | -3.08          | AVG    |
| 5   | 0.5460             | 32.21             | 20.43                 | 52.64            | 56.00           | -3.36          | OP     |
| 6   | 0.5460             | 19.45             | 20.43                 | 39.88            | 46.00           | -6.12          | AVG    |
| 7   | 2.0740             | 32.36             | 20.05                 | 52.41            | 56.00           | -3.59          | OP     |
| 8   | 2.0740             | 17.36             | 20.05                 | 37.41            | 46.00           | -8.59          | AVG    |
| 9   | 3.9420             | 27.62             | 19.95                 | 47.57            | 56.00           | -8.43          | OP     |
| 10  | 3.9420             | 8.70              | 19.95                 | 28.65            | 46.00           | -17.35         | AVG    |
| 11  | 9.3540             | 16.28             | 20.09                 | 36.37            | 60.00           | -23.63         | OP     |
| 12  | 9.3540             | 1.00              | 20.09                 | 21.09            | 50.00           | -28.91         | AVG    |

Remark:

1. All readings are Quasi-Peak and Average values.

2. Margin = Result (Result = Reading + Factor) – Limit

100.0 dBuV





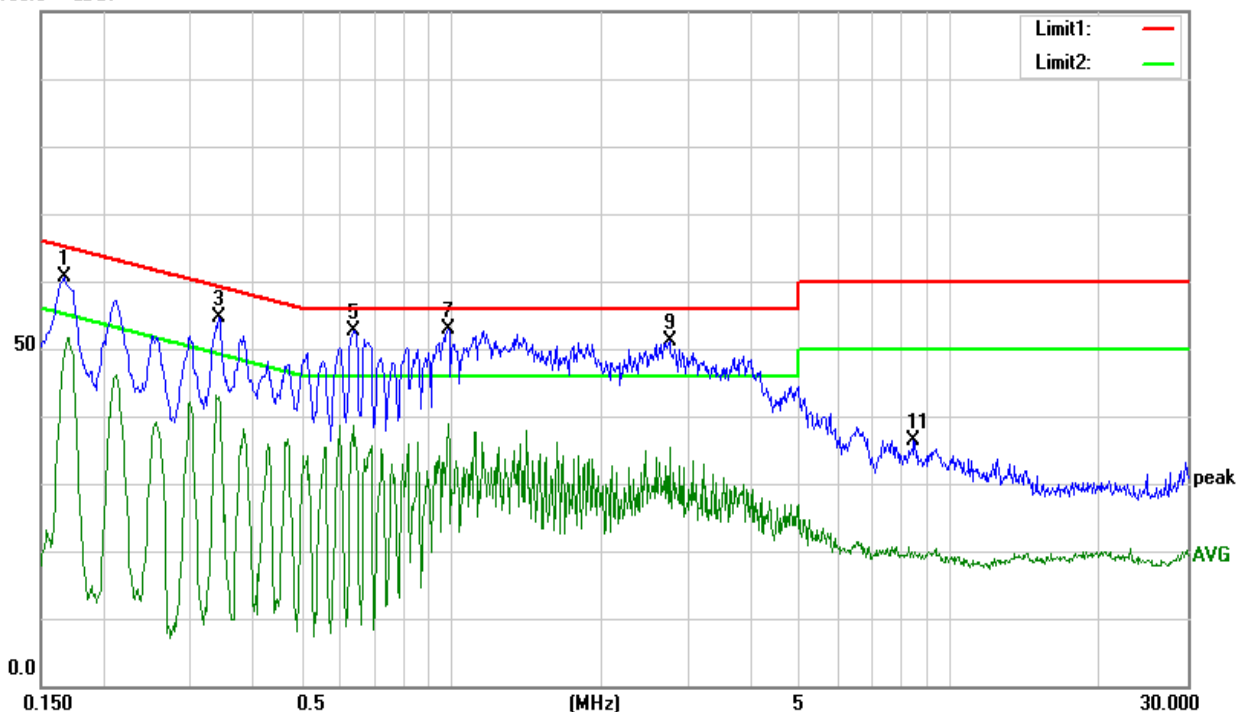
|               |              |                    |     |
|---------------|--------------|--------------------|-----|
| Temperature:  | 26.5℃        | Relative Humidity: | 63% |
| Test Voltage: | AC 120V/60Hz | Phase:             | N   |
| Test Mode:    | Mode 10      |                    |     |

| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct<br>Factor(dB) | Result<br>(dBuV) | Limit<br>(dBuV) | Margin<br>(dB) | Remark |
|-----|--------------------|-------------------|-----------------------|------------------|-----------------|----------------|--------|
| 1   | 0.1668             | 40.37             | 20.23                 | 60.60            | 65.12           | -4.52          | OP     |
| 2   | 0.1668             | 31.49             | 20.23                 | 51.72            | 55.12           | -3.40          | AVG    |
| 3   | 0.3420             | 34.08             | 20.62                 | 54.70            | 59.15           | -4.45          | OP     |
| 4   | 0.3420             | 22.52             | 20.62                 | 43.14            | 49.15           | -6.01          | AVG    |
| 5   | 0.6340             | 32.42             | 20.33                 | 52.75            | 56.00           | -3.25          | OP     |
| 6   | 0.6340             | 18.34             | 20.33                 | 38.67            | 46.00           | -7.33          | AVG    |
| 7   | 0.9860             | 32.62             | 20.16                 | 52.78            | 56.00           | -3.22          | OP     |
| 8   | 0.9860             | 18.61             | 20.16                 | 38.77            | 46.00           | -7.23          | AVG    |
| 9   | 2.7500             | 31.05             | 20.01                 | 51.06            | 56.00           | -4.94          | OP     |
| 10  | 2.7500             | 15.30             | 20.01                 | 35.31            | 46.00           | -10.69         | AVG    |
| 11  | 8.4660             | 16.36             | 20.02                 | 36.38            | 60.00           | -23.62         | OP     |
| 12  | 8.4660             | 0.64              | 20.02                 | 20.66            | 50.00           | -29.34         | AVG    |

Remark:

1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result = Reading + Factor) – Limit

100.0 dBuV





### 3.2 RADIATED EMISSION MEASUREMENT

#### 3.2.1 RADIATED EMISSION LIMITS

In any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the Restricted band specified on Part15.205(a)&209(a) limit in the table and according to ANSI C63.10-2013 below has to be followed

#### LIMITS OF RADIATED EMISSION MEASUREMENT (0.009MHz - 1000MHz)

| Frequencies<br>(MHz) | Field Strength<br>(micorvolts/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                                |

#### LIMITS OF RADIATED EMISSION MEASUREMENT (1GHz-25 GHz)

| FREQUENCY (MHz) | (dBuV/m) (at 3M) |         |
|-----------------|------------------|---------|
|                 | PEAK             | AVERAGE |
| Above 1000      | 74               | 54      |

Notes:

- (1) The limit for radiated test was performed according to FCC PART 15C.
- (2) The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20log Emission level (uV/m).

#### For Radiated Emission

| Spectrum Parameter                    | Setting                         |
|---------------------------------------|---------------------------------|
| Attenuation                           | Auto                            |
| Detector                              | Peak/AV                         |
| Start Frequency                       | 1000 MHz(Peak/AV)               |
| Stop Frequency                        | 10th carrier hamonic(Peak/AV)   |
| RB / VB (emission in restricted band) | PK=1MHz / 1MHz, AV=1 MHz /10 Hz |

#### For Band edge

| Spectrum Parameter                    | Setting                                                                |
|---------------------------------------|------------------------------------------------------------------------|
| Detector                              | Peak/AV                                                                |
| Start/Stop Frequency                  | Lower Band Edge: 2300 to 2403 MHz<br>Upper Band Edge: 2479 to 2500 MHz |
| RB / VB (emission in restricted band) | PK=1MHz / 1MHz, AV=1 MHz / 10 Hz                                       |



| Receiver Parameter     | Setting                              |
|------------------------|--------------------------------------|
| Attenuation            | Auto                                 |
| Start ~ Stop Frequency | 9kHz~90kHz / RB 200Hz for PK & AV    |
| Start ~ Stop Frequency | 90kHz~110kHz / RB 200Hz for QP       |
| Start ~ Stop Frequency | 110kHz~490kHz / RB 200Hz for PK & AV |
| Start ~ Stop Frequency | 490kHz~30MHz / RB 9kHz for QP        |
| Start ~ Stop Frequency | 30MHz~1000MHz / RB 120kHz for QP     |

### 3.2.2 TEST PROCEDURE

- The measuring distance of at 3 m shall be used for measurements at frequency 0.009MHz up to 1GHz, and above 1GHz.
- The EUT was placed on the top of a rotating table 0.8 meters (above 1GHz is 1.5 m) above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- The height of the equipment shall be 0.8 m (above 1GHz is 1.5 m); the height of the test antenna shall vary between 1 m to 4 m. horizontal and vertical polarizations of the antenna are set to make the measurement.
- The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then QuasiPeak detector mode re-measured.
- If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

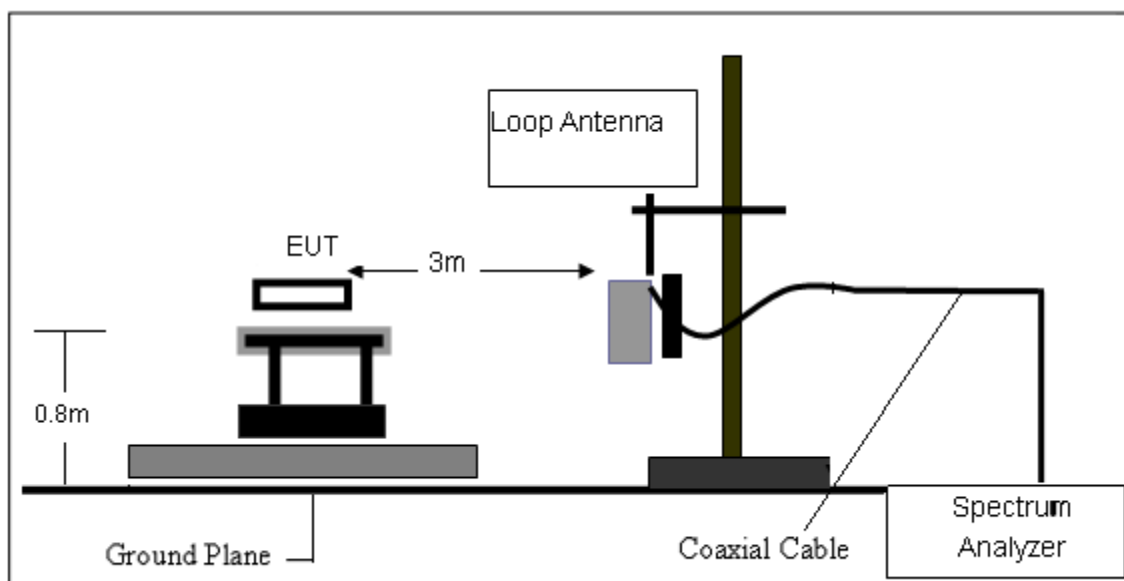
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported

### 3.2.3 DEVIATION FROM TEST STANDARD

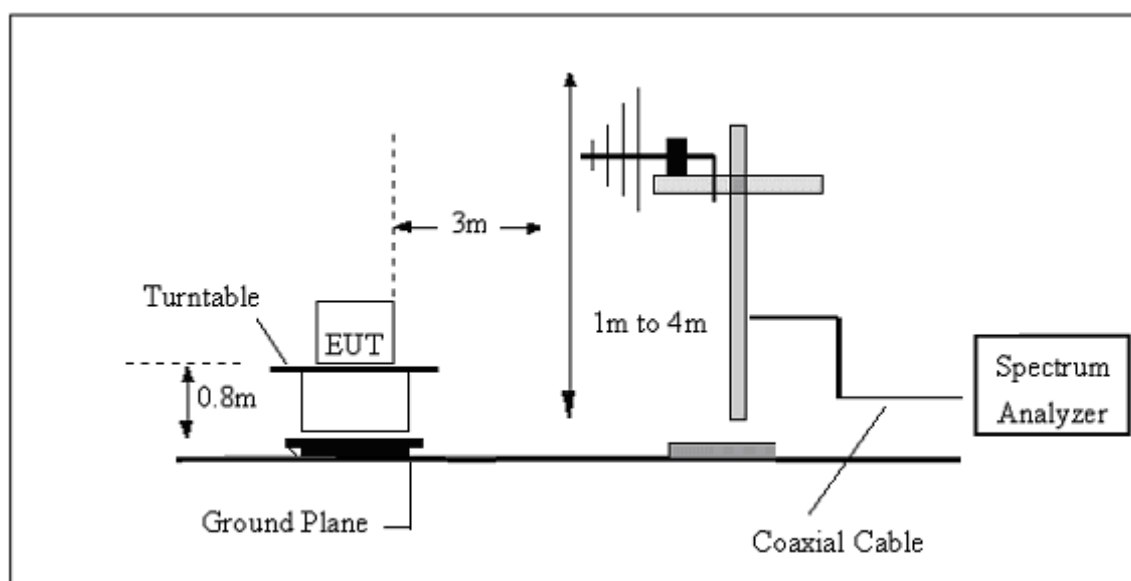
No deviation

### 3.2.4 TESTSETUP

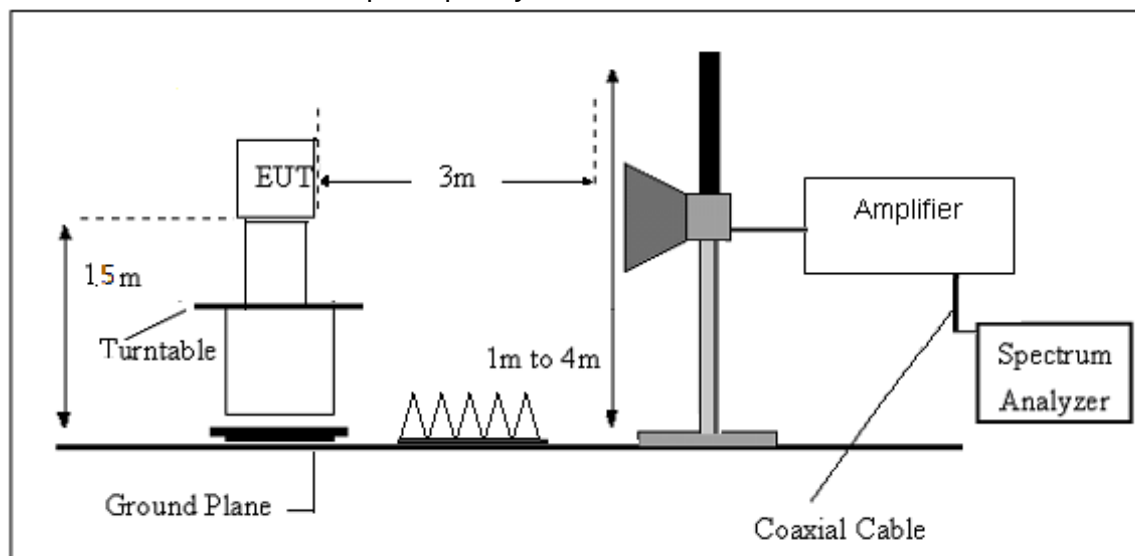
#### (A) Radiated Emission Test-Up Frequency Below 30MHz



#### (B) Radiated Emission Test-Up Frequency 30MHz~1GHz



### (C) Radiated Emission Test-Up Frequency Above 1GHz



#### 3.2.5 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

#### 3.2.6 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where

FS = Field Strength

CL = Cable Attenuation Factor (Cable Loss)

RA = Reading Amplitude

AG = Amplifier Gain

AF = Antenna Factor

For example

| Frequency<br>(MHz) | FS<br>(dBμV/m) | RA<br>(dBμV/m) | AF<br>(dB) | CL<br>(dB) | AG<br>(dB) | Factor<br>(dB) |
|--------------------|----------------|----------------|------------|------------|------------|----------------|
| 300                | 40             | 58.1           | 12.2       | 1.6        | 31.9       | -18.1          |

$$\text{Factor} = \text{AF} + \text{CL} - \text{AG}$$



## 3.2.7 TEST RESULTS

(9KHz-30MHz)

|               |                      |                    |         |
|---------------|----------------------|--------------------|---------|
| Temperature:  | 22.7°C               | Relative Humidity: | 61%     |
| Test Voltage: | DC 3.7V from battery | Test Mode:         | TX Mode |

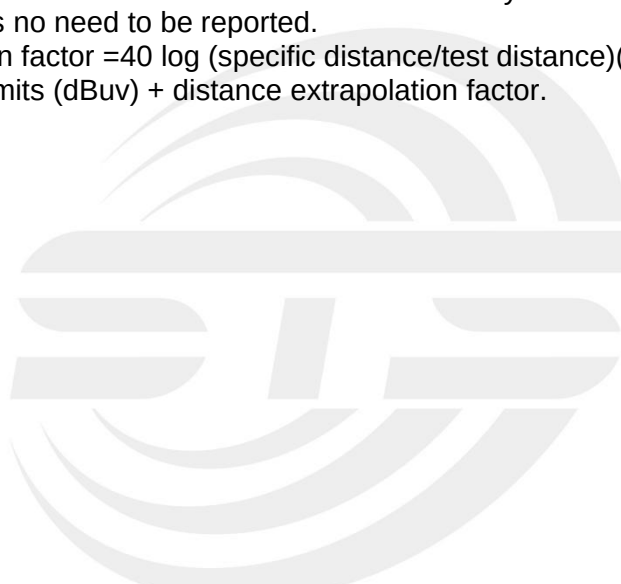
| Freq. | Reading  | Limit    | Margin | State | Test Result |
|-------|----------|----------|--------|-------|-------------|
| (MHz) | (dBuV/m) | (dBuV/m) | (dB)   | P/F   |             |
| --    | --       | --       | --     | --    | PASS        |
| --    | --       | --       | --     | --    | PASS        |

## Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Distance extrapolation factor =  $40 \log (\text{specific distance/test distance})$ (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.





(30MHz-1000MHz)

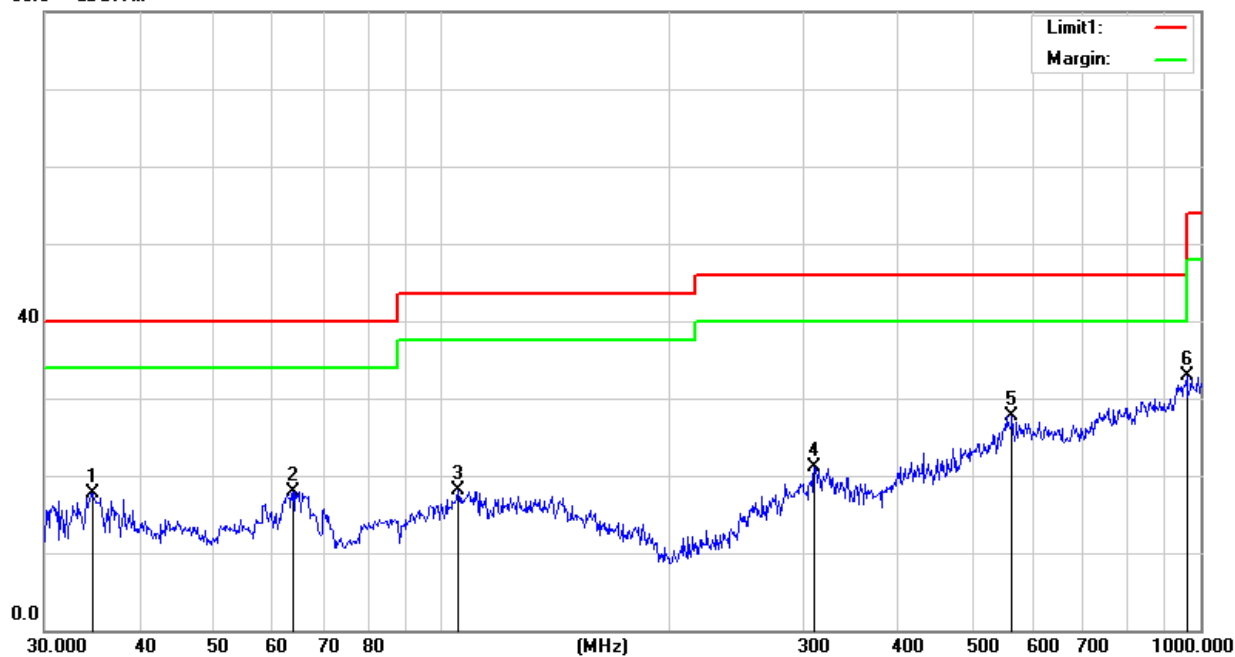
|               |                                              |                    |            |
|---------------|----------------------------------------------|--------------------|------------|
| Temperature:  | 22.7°C                                       | Relative Humidity: | 61%        |
| Test Voltage: | DC 3.7V from battery                         | Phase:             | Horizontal |
| Test Mode:    | Mode 1/2/3/4/5/6/7/8/9(Mode 1-1M worst mode) |                    |            |

| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct<br>Factor(dB/<br>m) | Result<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Remark |
|-----|--------------------|-------------------|-----------------------------|--------------------|-------------------|----------------|--------|
| 1   | 34.7601            | 32.56             | -14.82                      | 17.74              | 40.00             | -22.26         | QP     |
| 2   | 63.7588            | 43.38             | -25.45                      | 17.93              | 40.00             | -22.07         | QP     |
| 3   | 105.2716           | 37.70             | -19.66                      | 18.04              | 43.50             | -25.46         | QP     |
| 4   | 309.9977           | 36.51             | -15.34                      | 21.17              | 46.00             | -24.83         | QP     |
| 5   | 564.6390           | 34.97             | -7.17                       | 27.80              | 46.00             | -18.20         | QP     |
| 6   | 958.7943           | 33.40             | -0.52                       | 32.88              | 46.00             | -13.12         | QP     |

Remark:

1. Margin = Result (Result =Reading + Factor)–Limit

80.0 dBuV/m







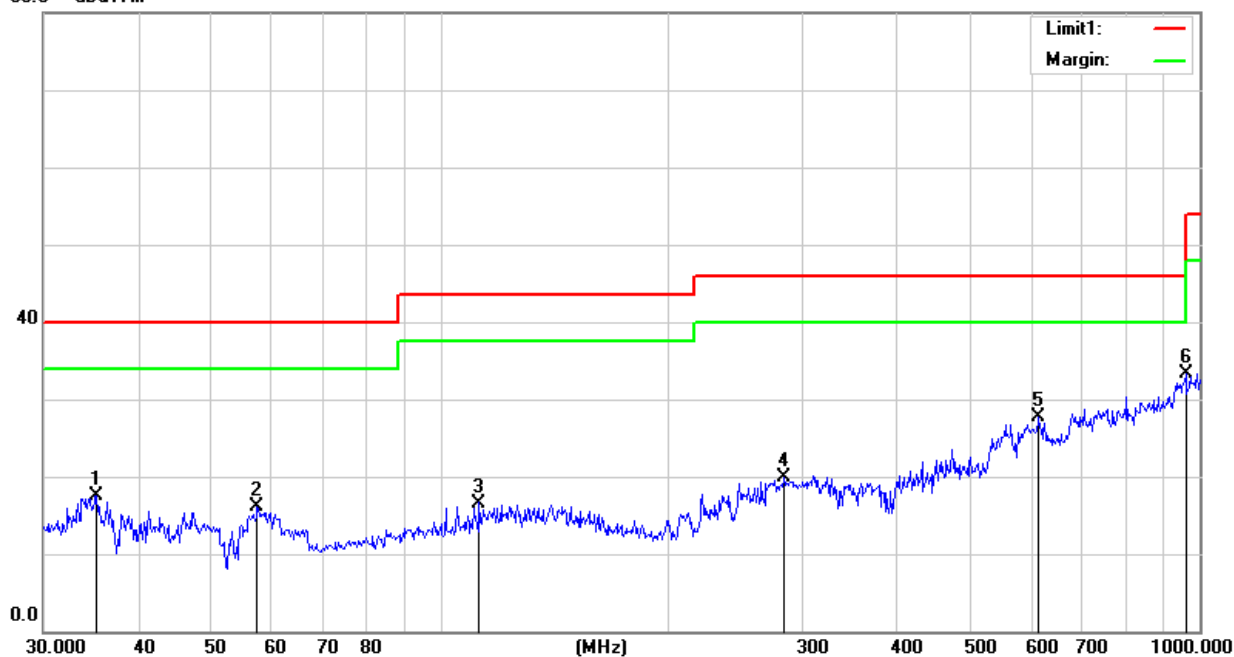
|               |                                              |                    |          |
|---------------|----------------------------------------------|--------------------|----------|
| Temperature:  | 22.7°C                                       | Relative Humidity: | 61%      |
| Test Voltage: | DC 3.7V from battery                         | Phase:             | Vertical |
| Test Mode:    | Mode 1/2/3/4/5/6/7/8/9(Mode 1-1M worst mode) |                    |          |

| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct<br>Factor(dB/<br>m) | Result<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Remark |
|-----|--------------------|-------------------|-----------------------------|--------------------|-------------------|----------------|--------|
| 1   | 35.2511            | 32.62             | -15.11                      | 17.51              | 40.00             | -22.49         | QP     |
| 2   | 57.3922            | 41.26             | -25.22                      | 16.04              | 40.00             | -23.96         | QP     |
| 3   | 112.5242           | 35.51             | -18.91                      | 16.60              | 43.50             | -26.90         | QP     |
| 4   | 283.9791           | 36.09             | -16.19                      | 19.90              | 46.00             | -26.10         | QP     |
| 5   | 614.2142           | 34.89             | -7.26                       | 27.63              | 46.00             | -18.37         | QP     |
| 6   | 958.7943           | 33.90             | -0.52                       | 33.38              | 46.00             | -12.62         | QP     |

Remark:

1. Margin = Result (Result =Reading + Factor )-Limit

80.0 dBuV/m





## (1GHz~25GHz) Restricted band and Spurious emission Requirements

## 8DPSK

| Frequency<br>(MHz)        | Meter<br>Reading<br>(dBμV) | Amplifier<br>(dB) | Loss<br>(dB) | Antenna<br>Factor<br>(dB/m) | Orrected<br>Factor<br>(dB) | Emission<br>Level<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) | Detector<br>Type | Comment    |
|---------------------------|----------------------------|-------------------|--------------|-----------------------------|----------------------------|-------------------------------|--------------------|----------------|------------------|------------|
| Low Channel (2402 MHz)    |                            |                   |              |                             |                            |                               |                    |                |                  |            |
| 3264.66                   | 61.18                      | 44.70             | 6.70         | 28.20                       | -9.80                      | 51.38                         | 74.00              | -22.62         | PK               | Vertical   |
| 3264.66                   | 50.08                      | 44.70             | 6.70         | 28.20                       | -9.80                      | 40.28                         | 54.00              | -13.72         | AV               | Vertical   |
| 3264.59                   | 61.00                      | 44.70             | 6.70         | 28.20                       | -9.80                      | 51.20                         | 74.00              | -22.80         | PK               | Horizontal |
| 3264.59                   | 50.45                      | 44.70             | 6.70         | 28.20                       | -9.80                      | 40.65                         | 54.00              | -13.35         | AV               | Horizontal |
| 4804.55                   | 59.44                      | 44.20             | 9.04         | 31.60                       | -3.56                      | 55.88                         | 74.00              | -18.12         | PK               | Vertical   |
| 4804.55                   | 49.99                      | 44.20             | 9.04         | 31.60                       | -3.56                      | 46.43                         | 54.00              | -7.57          | AV               | Vertical   |
| 4804.43                   | 58.15                      | 44.20             | 9.04         | 31.60                       | -3.56                      | 54.59                         | 74.00              | -19.41         | PK               | Horizontal |
| 4804.43                   | 50.45                      | 44.20             | 9.04         | 31.60                       | -3.56                      | 46.89                         | 54.00              | -7.11          | AV               | Horizontal |
| 5359.69                   | 48.82                      | 44.20             | 9.86         | 32.00                       | -2.34                      | 46.48                         | 74.00              | -27.52         | PK               | Vertical   |
| 5359.69                   | 39.61                      | 44.20             | 9.86         | 32.00                       | -2.34                      | 37.27                         | 54.00              | -16.73         | AV               | Vertical   |
| 5359.70                   | 47.43                      | 44.20             | 9.86         | 32.00                       | -2.34                      | 45.09                         | 74.00              | -28.91         | PK               | Horizontal |
| 5359.70                   | 38.04                      | 44.20             | 9.86         | 32.00                       | -2.34                      | 35.70                         | 54.00              | -18.30         | AV               | Horizontal |
| 7205.98                   | 53.66                      | 43.50             | 11.40        | 35.50                       | 3.40                       | 57.06                         | 74.00              | -16.94         | PK               | Vertical   |
| 7205.98                   | 43.64                      | 43.50             | 11.40        | 35.50                       | 3.40                       | 47.04                         | 54.00              | -6.96          | AV               | Vertical   |
| 7205.76                   | 54.13                      | 43.50             | 11.40        | 35.50                       | 3.40                       | 57.53                         | 74.00              | -16.47         | PK               | Horizontal |
| 7205.76                   | 44.35                      | 43.50             | 11.40        | 35.50                       | 3.40                       | 47.75                         | 54.00              | -6.25          | AV               | Horizontal |
| Middle Channel (2441 MHz) |                            |                   |              |                             |                            |                               |                    |                |                  |            |
| 3264.73                   | 61.84                      | 44.70             | 6.70         | 28.20                       | -9.80                      | 52.04                         | 74.00              | -21.96         | PK               | Vertical   |
| 3264.73                   | 50.73                      | 44.70             | 6.70         | 28.20                       | -9.80                      | 40.93                         | 54.00              | -13.07         | AV               | Vertical   |
| 3264.65                   | 60.88                      | 44.70             | 6.70         | 28.20                       | -9.80                      | 51.08                         | 74.00              | -22.92         | PK               | Horizontal |
| 3264.65                   | 50.87                      | 44.70             | 6.70         | 28.20                       | -9.80                      | 41.07                         | 54.00              | -12.93         | AV               | Horizontal |
| 4882.57                   | 58.33                      | 44.20             | 9.04         | 31.60                       | -3.56                      | 54.77                         | 74.00              | -19.23         | PK               | Vertical   |
| 4882.57                   | 50.26                      | 44.20             | 9.04         | 31.60                       | -3.56                      | 46.70                         | 54.00              | -7.30          | AV               | Vertical   |
| 4882.46                   | 58.96                      | 44.20             | 9.04         | 31.60                       | -3.56                      | 55.40                         | 74.00              | -18.60         | PK               | Horizontal |
| 4882.46                   | 49.64                      | 44.20             | 9.04         | 31.60                       | -3.56                      | 46.08                         | 54.00              | -7.92          | AV               | Horizontal |
| 5359.79                   | 48.90                      | 44.20             | 9.86         | 32.00                       | -2.34                      | 46.56                         | 74.00              | -27.44         | PK               | Vertical   |
| 5359.79                   | 39.04                      | 44.20             | 9.86         | 32.00                       | -2.34                      | 36.70                         | 54.00              | -17.30         | AV               | Vertical   |
| 5359.86                   | 47.15                      | 44.20             | 9.86         | 32.00                       | -2.34                      | 44.81                         | 74.00              | -29.19         | PK               | Horizontal |
| 5359.86                   | 39.27                      | 44.20             | 9.86         | 32.00                       | -2.34                      | 36.93                         | 54.00              | -17.07         | AV               | Horizontal |
| 7323.84                   | 53.88                      | 43.50             | 11.40        | 35.50                       | 3.40                       | 57.28                         | 74.00              | -16.72         | PK               | Vertical   |
| 7323.84                   | 44.84                      | 43.50             | 11.40        | 35.50                       | 3.40                       | 48.24                         | 54.00              | -5.76          | AV               | Vertical   |
| 7323.82                   | 54.50                      | 43.50             | 11.40        | 35.50                       | 3.40                       | 57.90                         | 74.00              | -16.10         | PK               | Horizontal |
| 7323.82                   | 44.66                      | 43.50             | 11.40        | 35.50                       | 3.40                       | 48.06                         | 54.00              | -5.94          | AV               | Horizontal |



| High Channel (2480 MHz) |       |       |       |       |       |       |       |        |    |            |
|-------------------------|-------|-------|-------|-------|-------|-------|-------|--------|----|------------|
| 3264.78                 | 61.50 | 44.70 | 6.70  | 28.20 | -9.80 | 51.70 | 74.00 | -22.30 | PK | Vertical   |
| 3264.78                 | 50.01 | 44.70 | 6.70  | 28.20 | -9.80 | 40.21 | 54.00 | -13.79 | AV | Vertical   |
| 3264.80                 | 61.07 | 44.70 | 6.70  | 28.20 | -9.80 | 51.27 | 74.00 | -22.73 | PK | Horizontal |
| 3264.80                 | 50.99 | 44.70 | 6.70  | 28.20 | -9.80 | 41.19 | 54.00 | -12.81 | AV | Horizontal |
| 4960.44                 | 58.95 | 44.20 | 9.04  | 31.60 | -3.56 | 55.39 | 74.00 | -18.61 | PK | Vertical   |
| 4960.44                 | 49.37 | 44.20 | 9.04  | 31.60 | -3.56 | 45.81 | 54.00 | -8.19  | AV | Vertical   |
| 4960.48                 | 59.27 | 44.20 | 9.04  | 31.60 | -3.56 | 55.71 | 74.00 | -18.29 | PK | Horizontal |
| 4960.48                 | 49.83 | 44.20 | 9.04  | 31.60 | -3.56 | 46.27 | 54.00 | -7.73  | AV | Horizontal |
| 5359.71                 | 49.05 | 44.20 | 9.86  | 32.00 | -2.34 | 46.71 | 74.00 | -27.29 | PK | Vertical   |
| 5359.71                 | 40.05 | 44.20 | 9.86  | 32.00 | -2.34 | 37.71 | 54.00 | -16.29 | AV | Vertical   |
| 5359.73                 | 47.22 | 44.20 | 9.86  | 32.00 | -2.34 | 44.88 | 74.00 | -29.12 | PK | Horizontal |
| 5359.73                 | 38.38 | 44.20 | 9.86  | 32.00 | -2.34 | 36.04 | 54.00 | -17.96 | AV | Horizontal |
| 7439.82                 | 53.85 | 43.50 | 11.40 | 35.50 | 3.40  | 57.25 | 74.00 | -16.75 | PK | Vertical   |
| 7439.82                 | 43.53 | 43.50 | 11.40 | 35.50 | 3.40  | 46.93 | 54.00 | -7.07  | AV | Vertical   |
| 7439.82                 | 53.83 | 43.50 | 11.40 | 35.50 | 3.40  | 57.23 | 74.00 | -16.77 | PK | Horizontal |
| 7439.82                 | 43.54 | 43.50 | 11.40 | 35.50 | 3.40  | 46.94 | 54.00 | -7.06  | AV | Horizontal |

Note:

1) Scan with GFSK,  $\pi/4$ -DQPSK, 8DPSK, the worst case is 8DPSK Mode

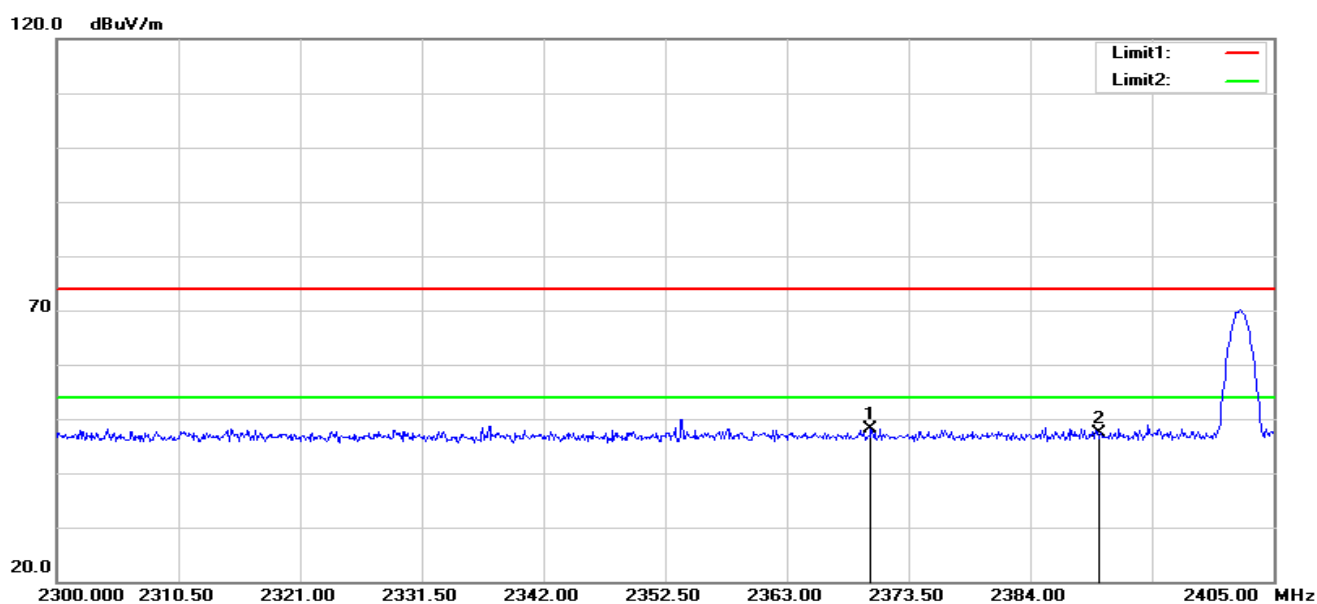
2) Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Emission Level = Reading + Factor

3) The frequency emission of peak points that did not show above the forms are at least 20dB below the limit, the frequency emission is mainly from the environment noise.

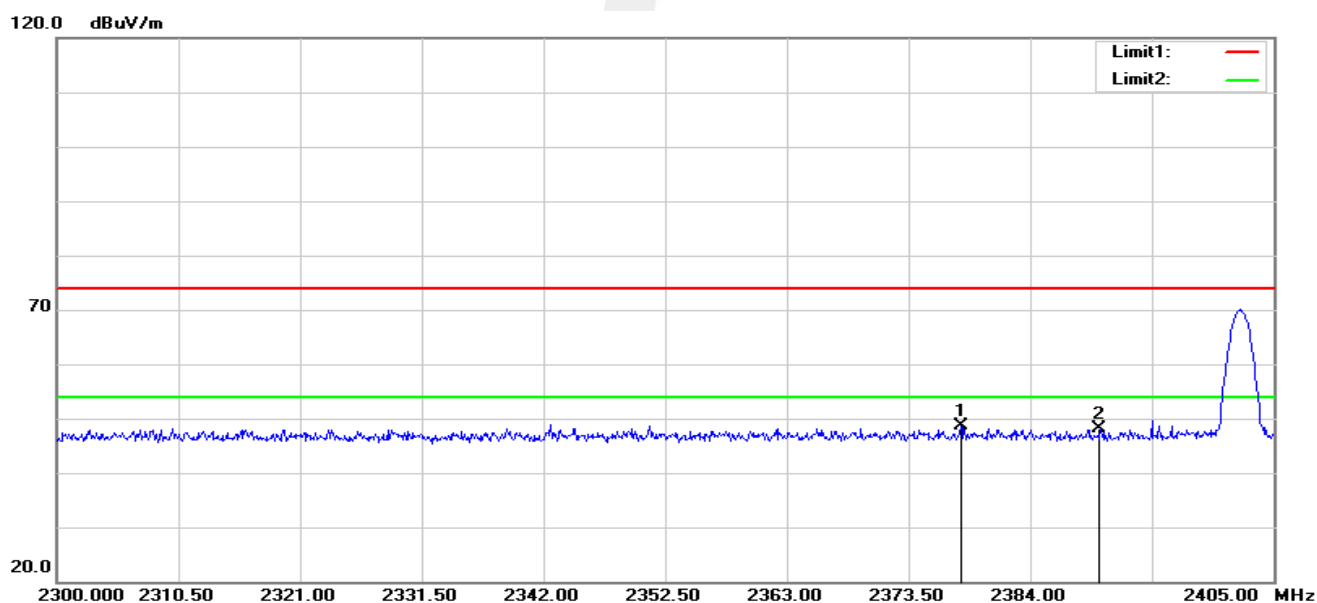


## Restricted band Requirements

8DPSK-Low  
Horizontal

| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct<br>Factor(dB/m) | Result<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Remark |
|-----|--------------------|-------------------|-------------------------|--------------------|-------------------|----------------|--------|
| 1   | 2370.245           | 58.92             | -10.88                  | 48.04              | 74.00             | -25.96         | peak   |
| 2   | 2390.000           | 58.08             | -10.75                  | 47.33              | 74.00             | -26.67         | peak   |

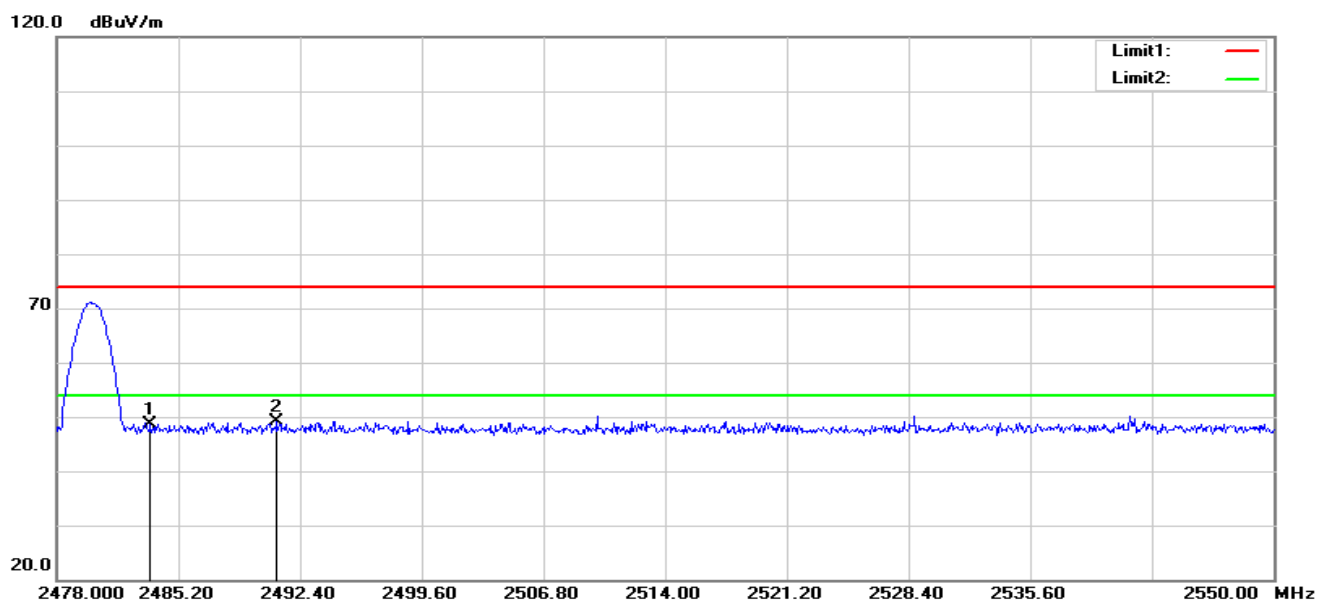
## Vertical



| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct<br>Factor(dB/m) | Result<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Remark |
|-----|--------------------|-------------------|-------------------------|--------------------|-------------------|----------------|--------|
| 1   | 2378.015           | 59.55             | -10.83                  | 48.72              | 74.00             | -25.28         | peak   |
| 2   | 2390.000           | 58.91             | -10.75                  | 48.16              | 74.00             | -25.84         | peak   |

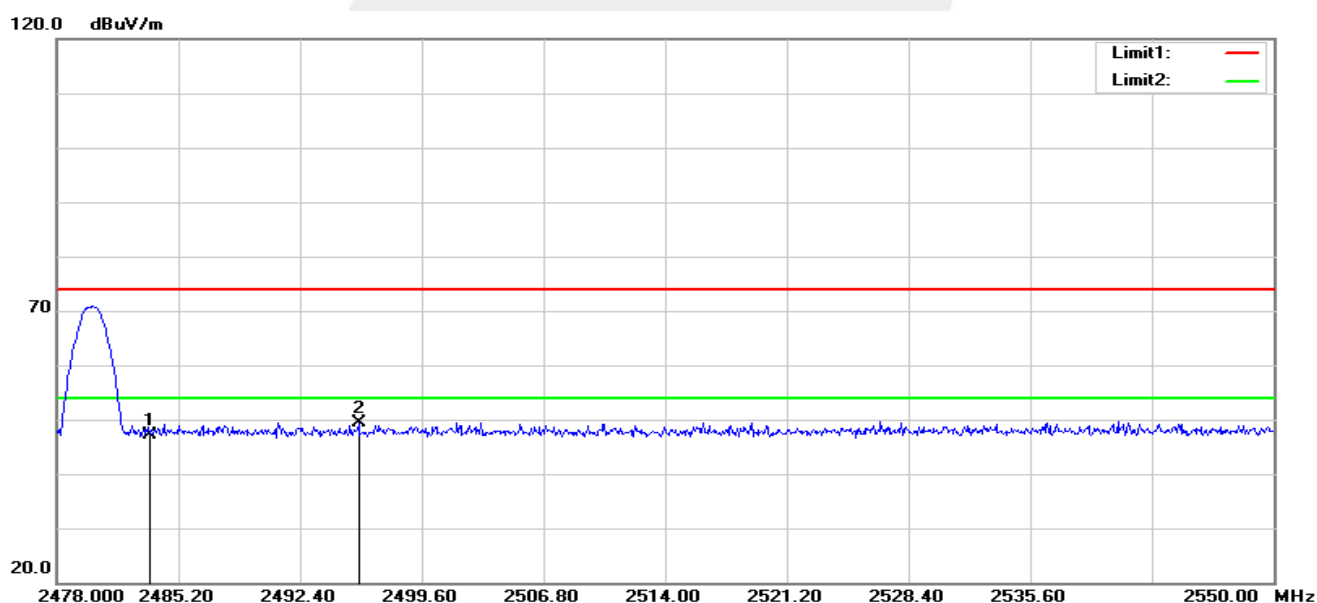


### 8DPSK-High Horizontal



| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----|-----------------|----------------|----------------------|-----------------|----------------|-------------|--------|
| 1   | 2483.500        | 58.87          | -10.29               | 48.58           | 74.00          | -25.42      | peak   |
| 2   | 2491.032        | 59.48          | -10.25               | 49.23           | 74.00          | -24.77      | peak   |

### Vertical



| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----|-----------------|----------------|----------------------|-----------------|----------------|-------------|--------|
| 1   | 2483.500        | 57.33          | -10.29               | 47.04           | 74.00          | -26.96      | peak   |
| 2   | 2495.856        | 59.63          | -10.23               | 49.40           | 74.00          | -24.60      | peak   |

Note: GFSK,  $\pi/4$ -DQPSK, 8DPSK of the nohopping and hopping mode all have been test, the worst case is 8DPSK of the nohopping mode, this report only show the worst case.

## 4. CONDUCTED SPURIOUS & BAND EDGE EMISSION

### 4.1 LIMIT

According to FCC section 15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

### 4.2 TEST PROCEDURE

| Spectrum Parameter                    | Setting                         |
|---------------------------------------|---------------------------------|
| Detector                              | Peak                            |
| Start/Stop Frequency                  | 30 MHz to 10th carrier harmonic |
| RB / VB (emission in restricted band) | 100 KHz/300 KHz                 |
| Trace-Mode:                           | Max hold                        |

For Band edge

| Spectrum Parameter                    | Setting                                                             |
|---------------------------------------|---------------------------------------------------------------------|
| Detector                              | Peak                                                                |
| Start/Stop Frequency                  | Lower Band Edge: 2300– 2403 MHz<br>Upper Band Edge: 2479 – 2500 MHz |
| RB / VB (emission in restricted band) | 100 KHz/300 KHz                                                     |
| Trace-Mode:                           | Max hold                                                            |

Remark: Hopping on and Hopping off mode all have been tested, only worst case hopping off is reported.

### 4.3 TEST SETUP



The EUT is connected to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

### 4.4 EUT OPERATION CONDITIONS

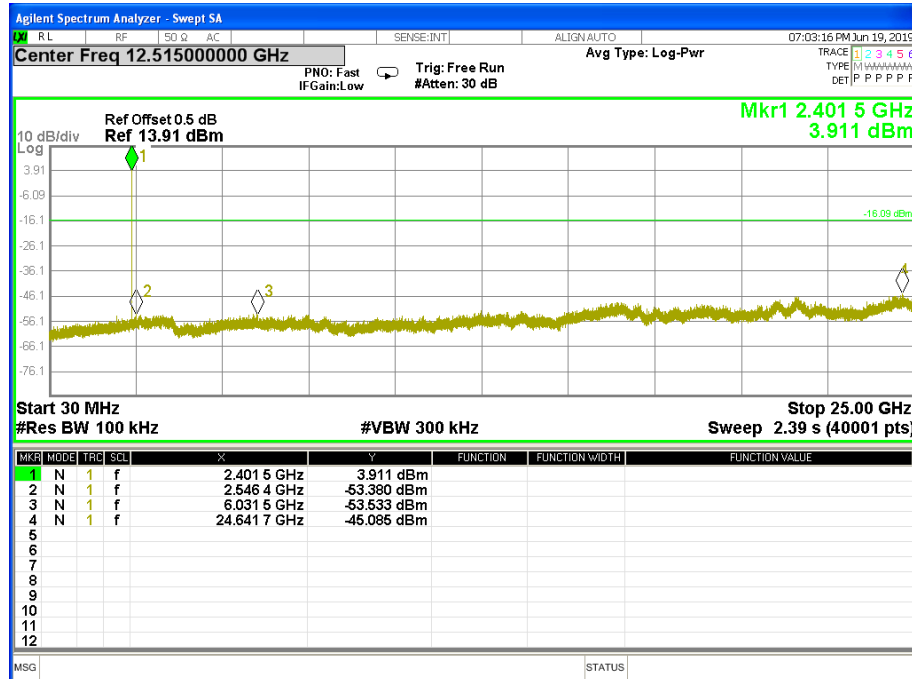
The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.



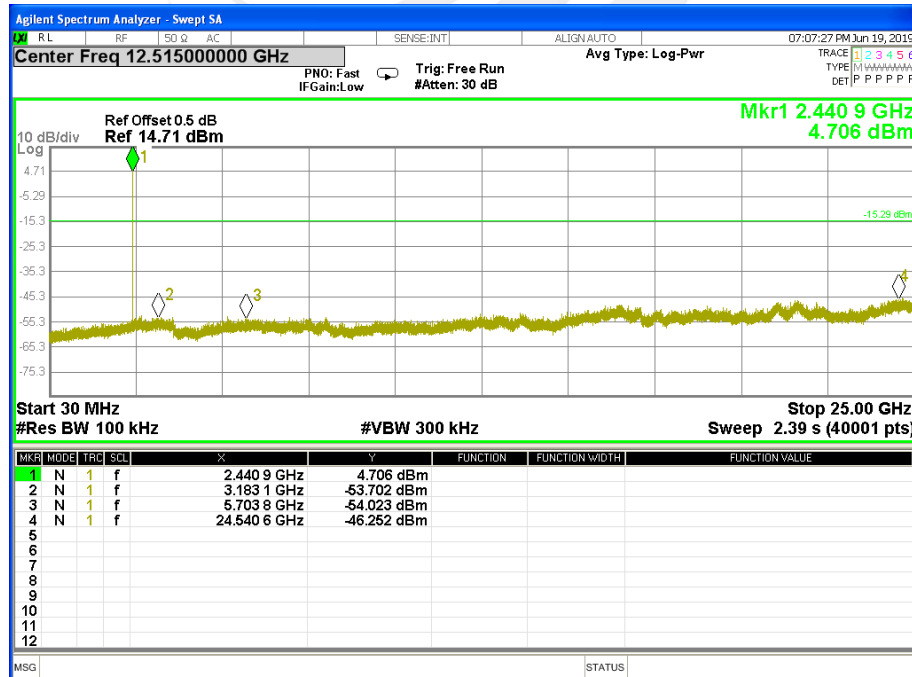
## 4.5 TEST RESULTS

|              |                         |                    |                      |
|--------------|-------------------------|--------------------|----------------------|
| Temperature: | 25°C                    | Relative Humidity: | 50%                  |
| Test Mode:   | GFSK(1Mbps)-00/39/78 CH | Test Voltage:      | DC 3.7V from battery |

00 CH

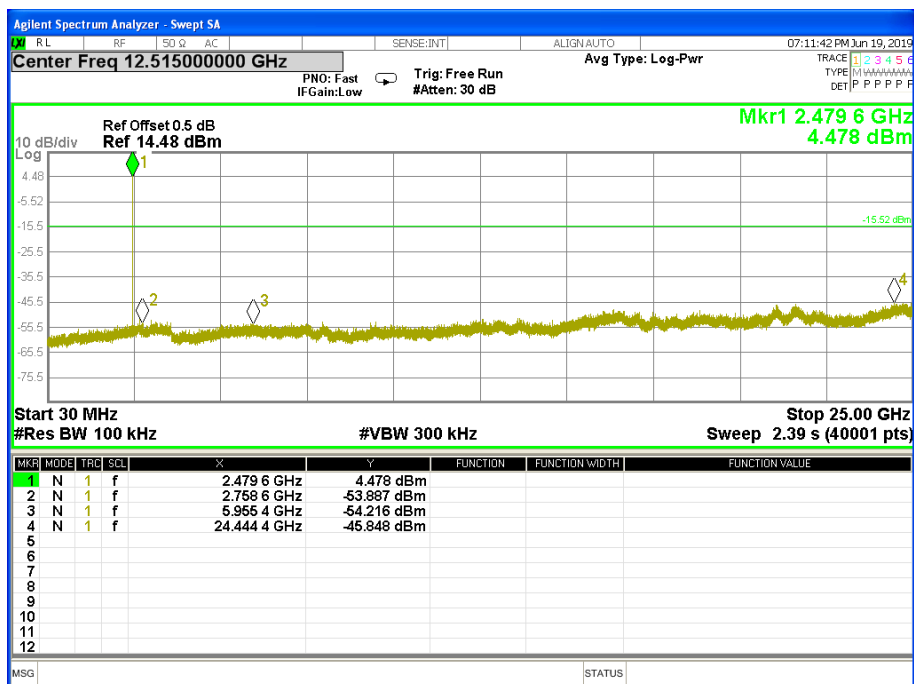


39 CH





78 CH

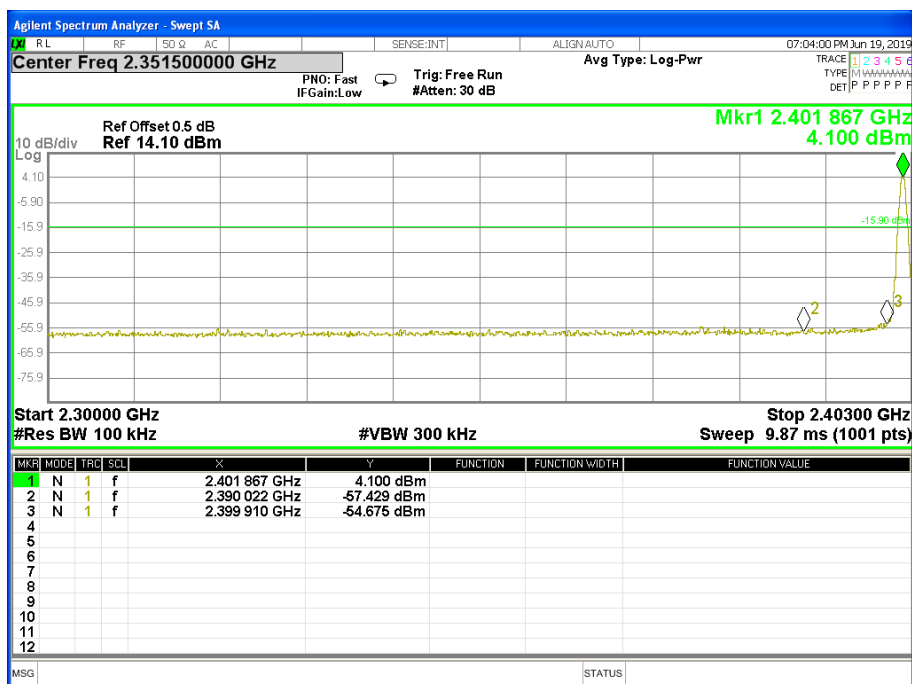




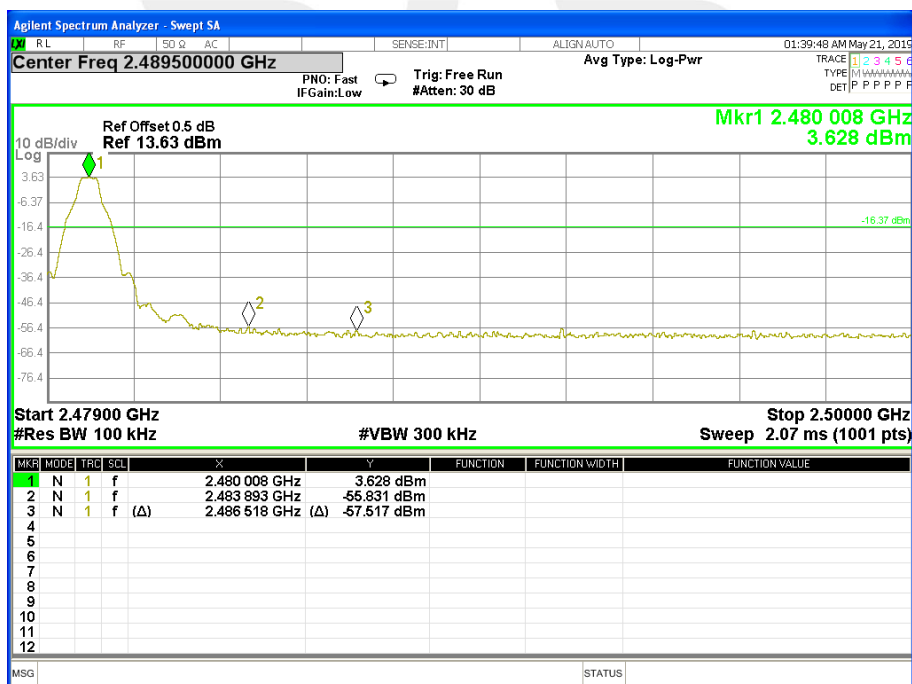


For Band edge

00 CH



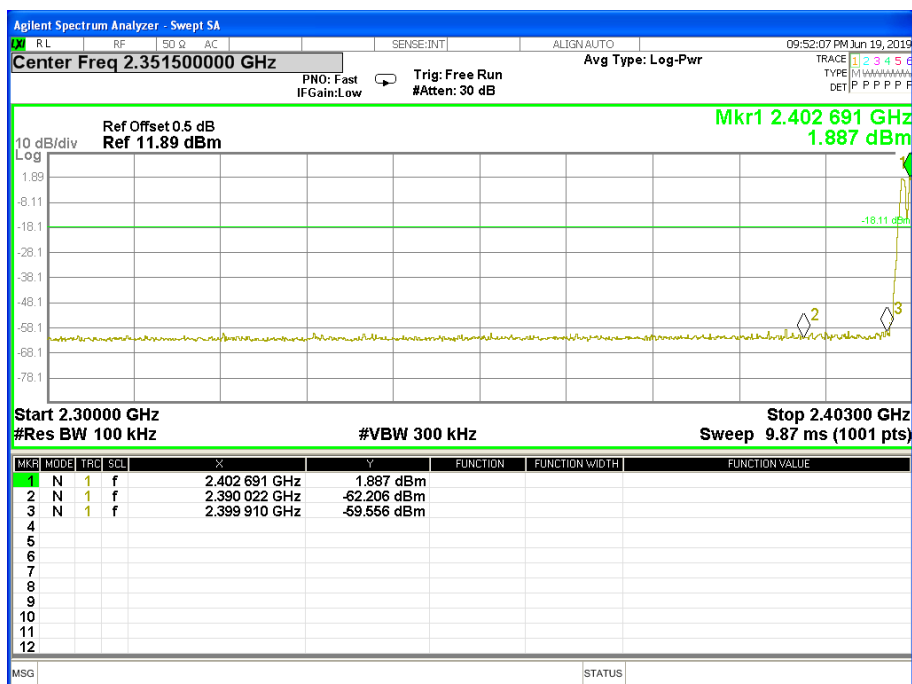
78 CH



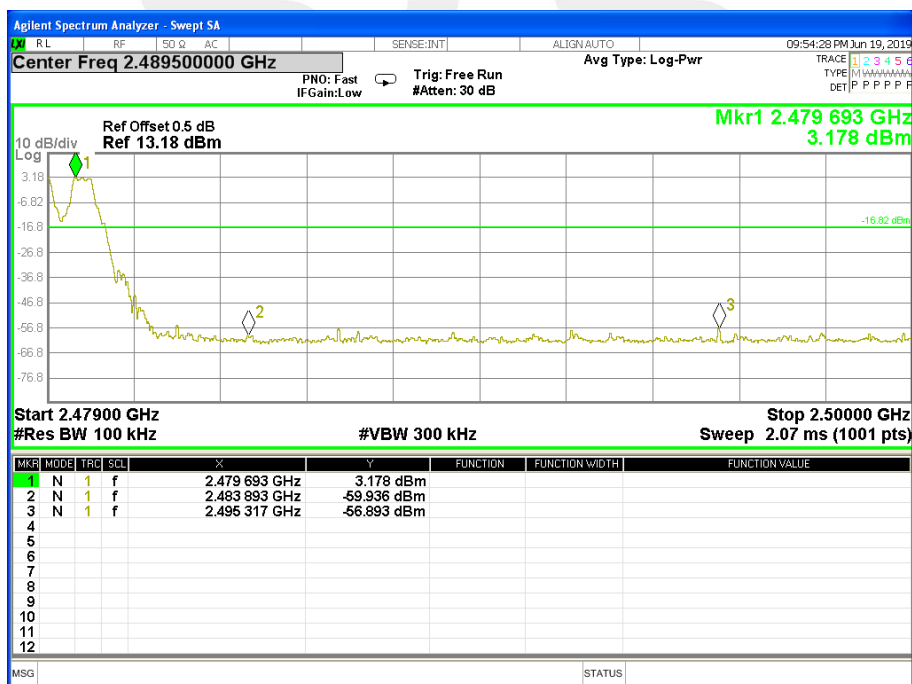


For Hopping Band edge

00 CH



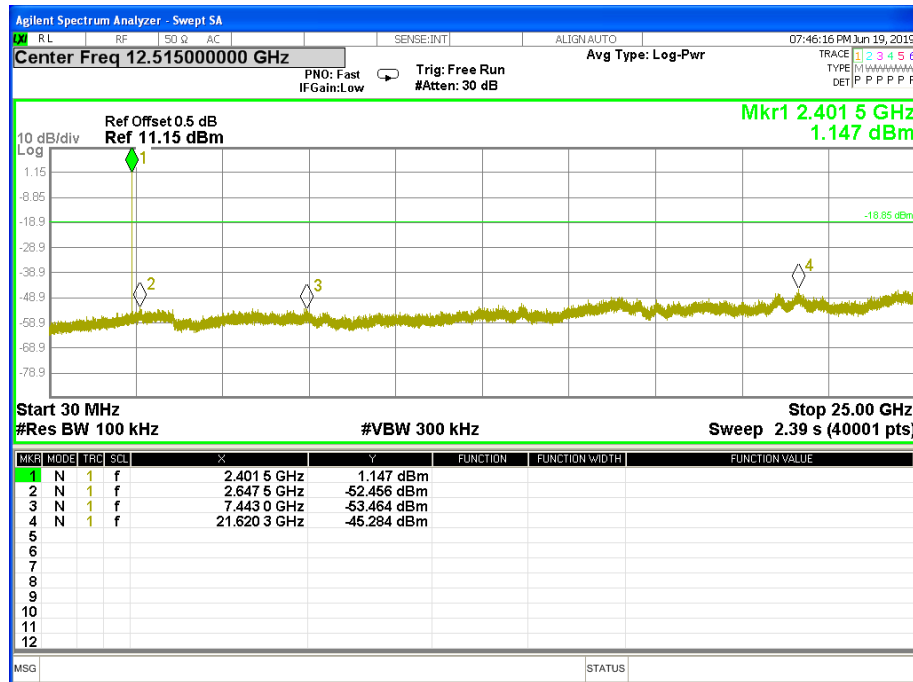
78 CH



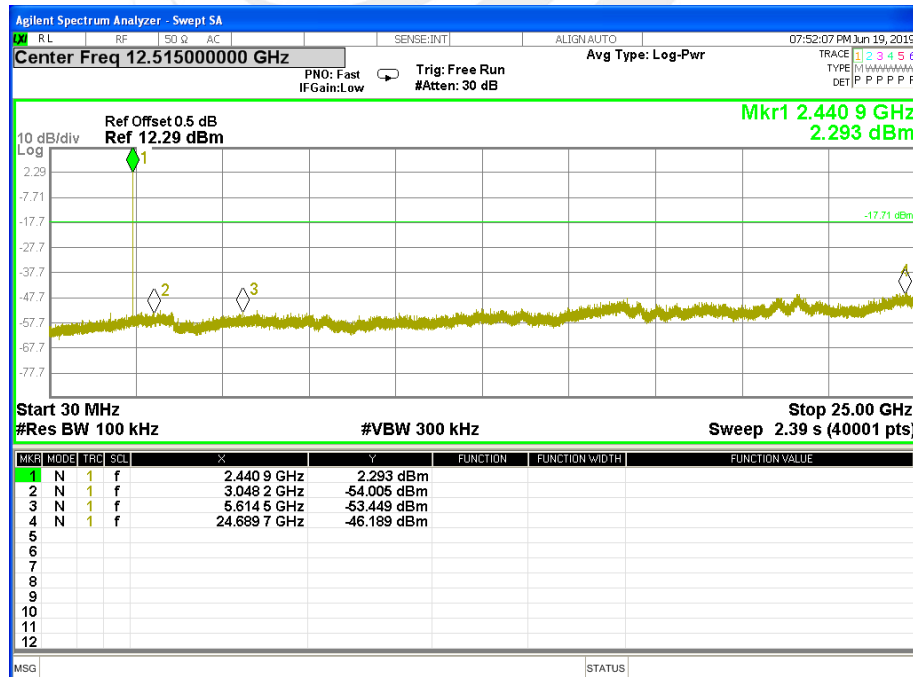


|              |                                       |                    |                      |
|--------------|---------------------------------------|--------------------|----------------------|
| Temperature: | 25°C                                  | Relative Humidity: | 50%                  |
| Test Mode:   | $\pi/4$ -DQPSK(2Mbps)-<br>00/39/78 CH | Test Voltage:      | DC 3.7V from battery |

00 CH

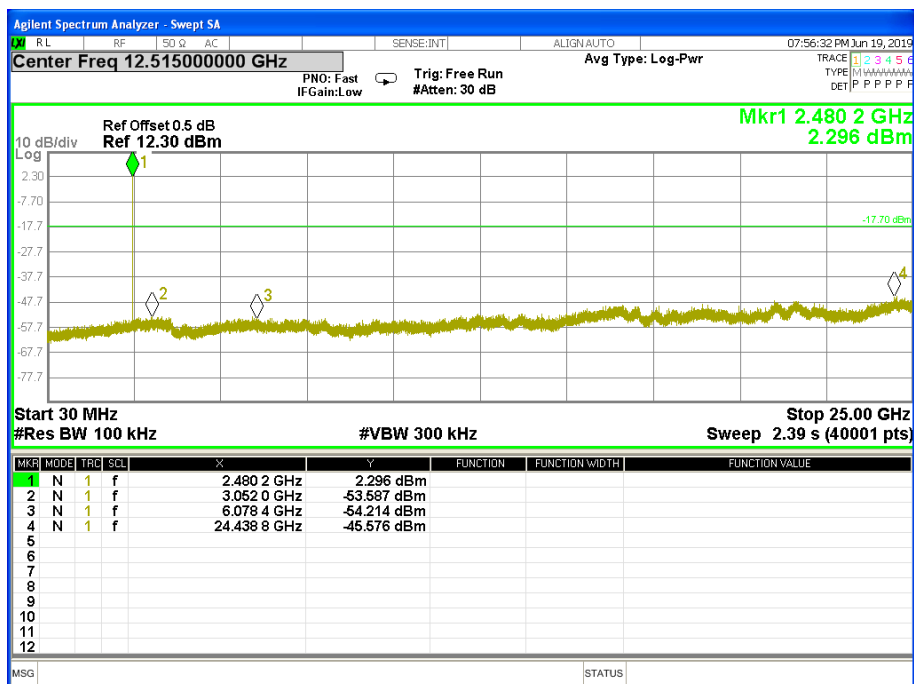


39 CH





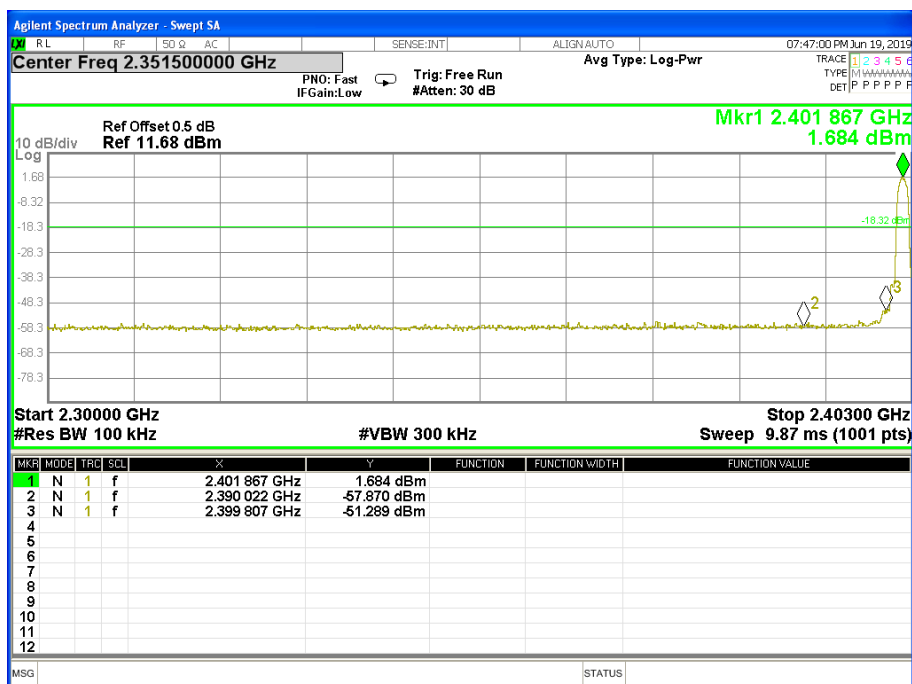
78 CH



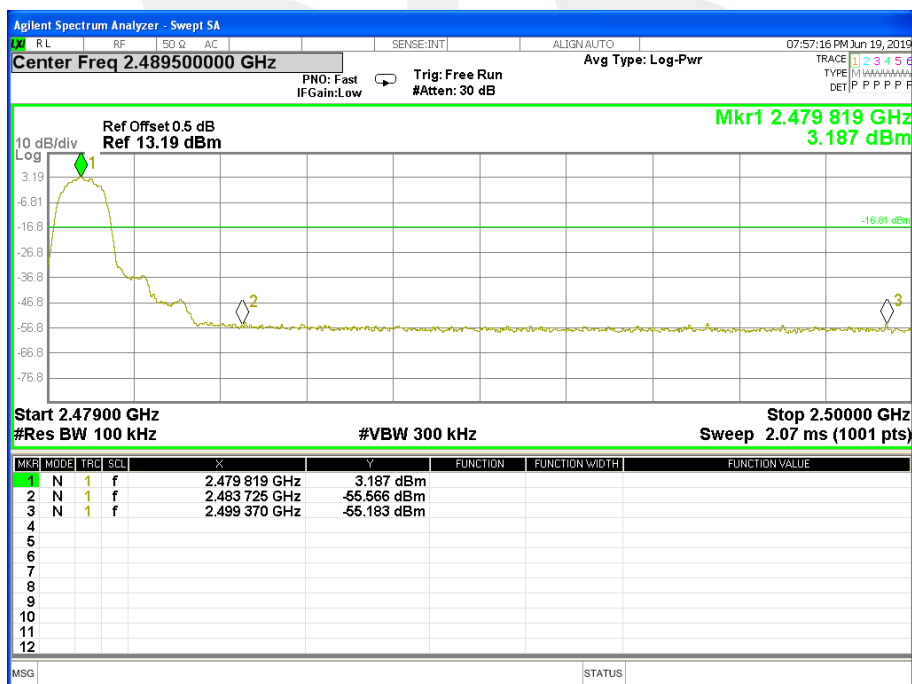


For Band edge

00 CH



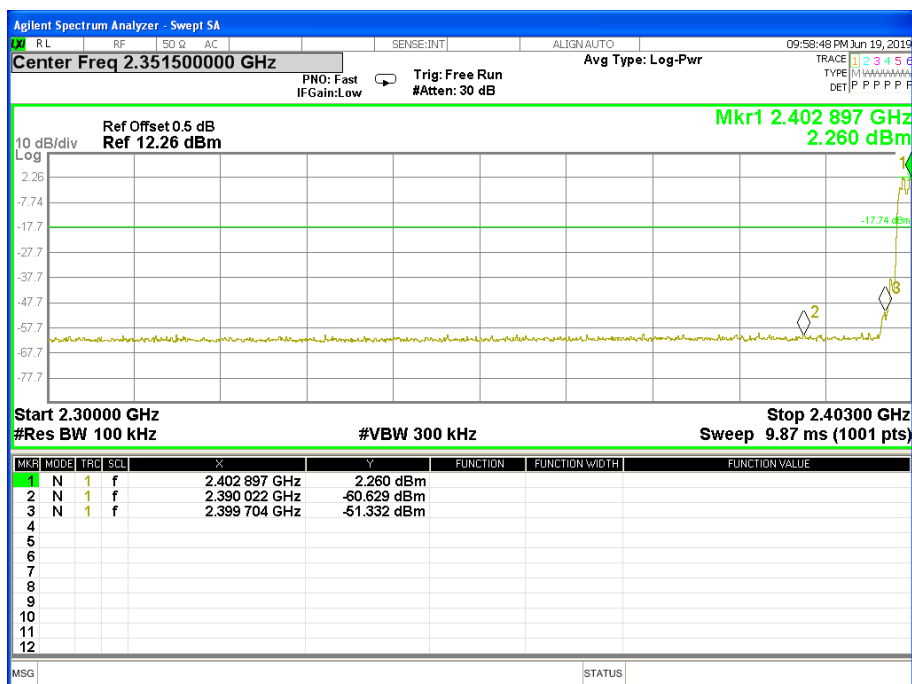
78 CH



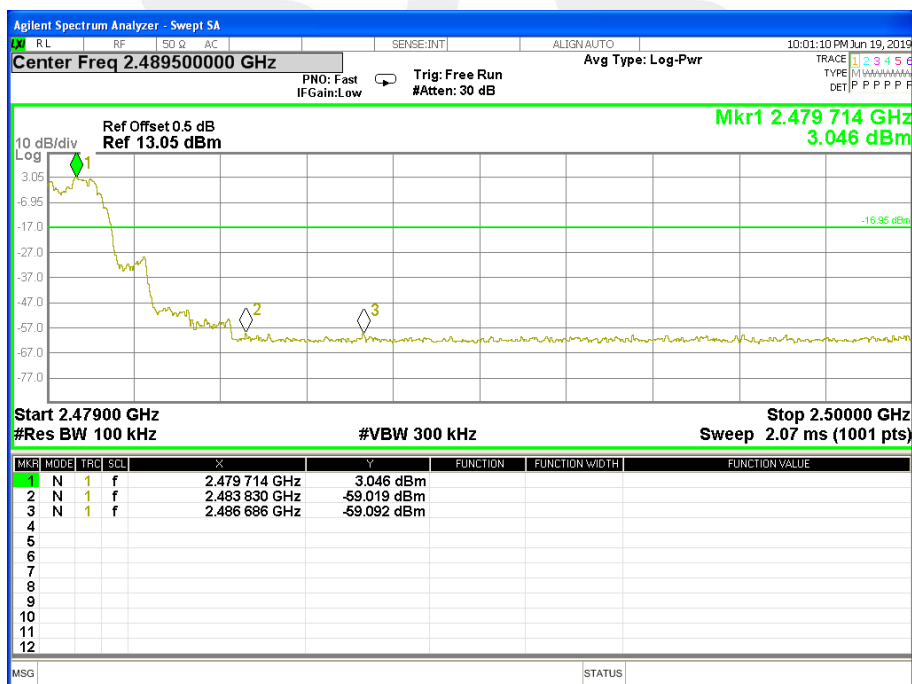


For Hopping Band edge

00 CH



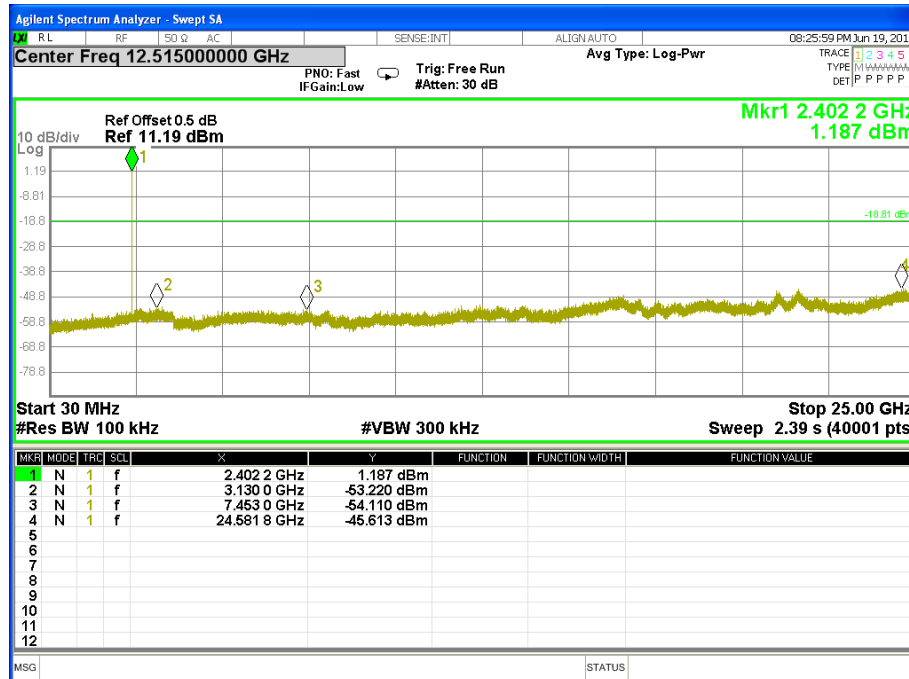
78 CH



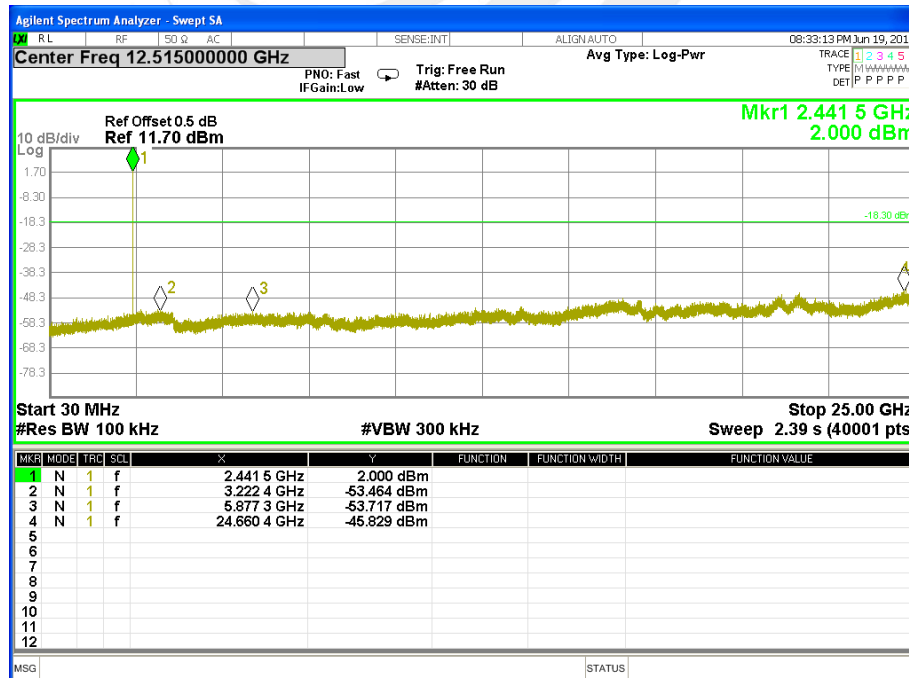


|              |                           |                    |                      |
|--------------|---------------------------|--------------------|----------------------|
| Temperature: | 25°C                      | Relative Humidity: | 50%                  |
| Test Mode:   | 8DPSK(3Mbps) -00/39/78 CH | Test Voltage:      | DC 3.7V from battery |

00 CH

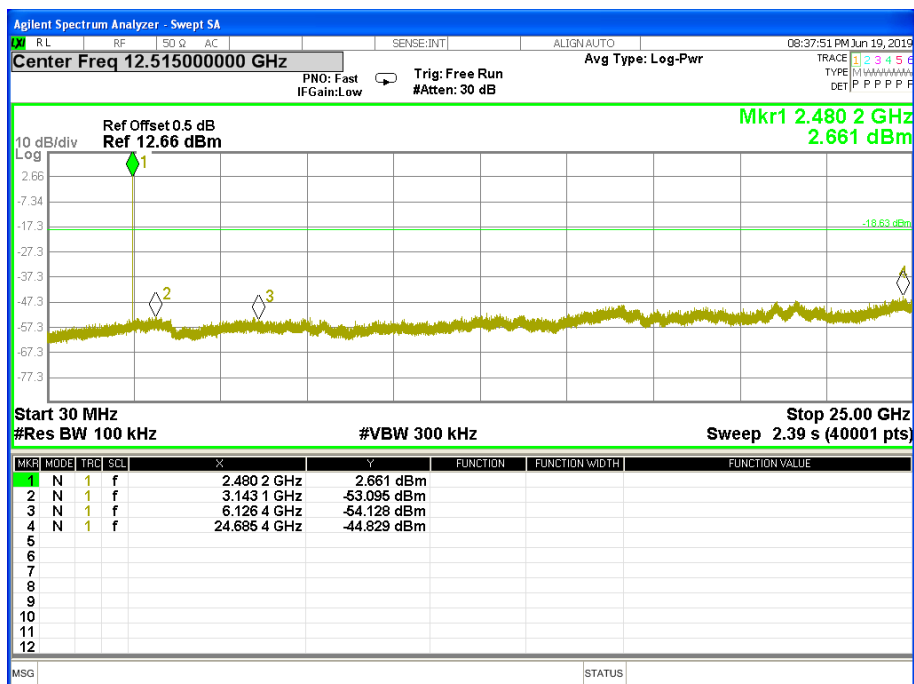


39 CH





78 CH

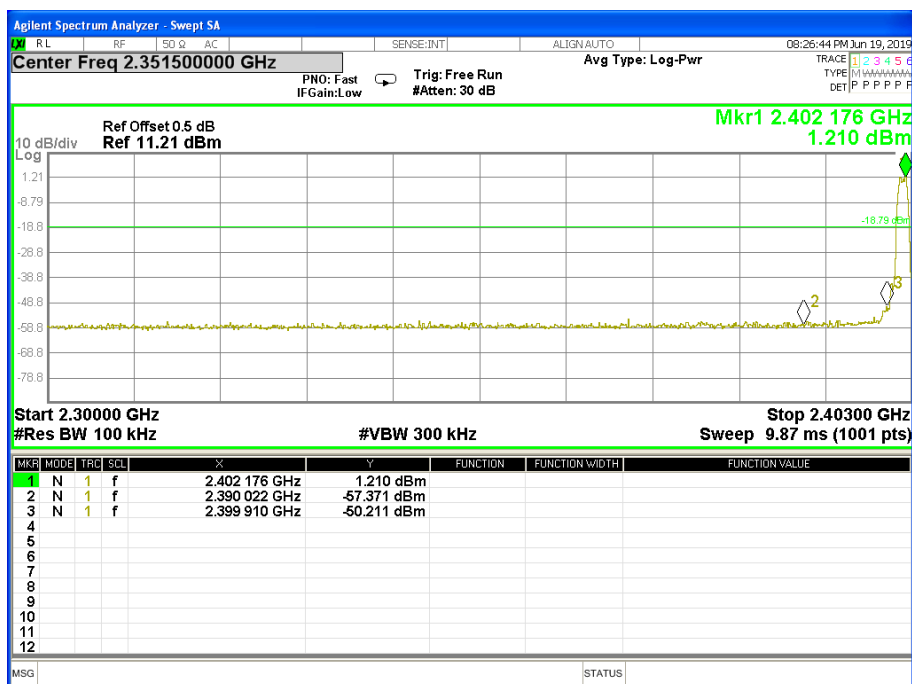




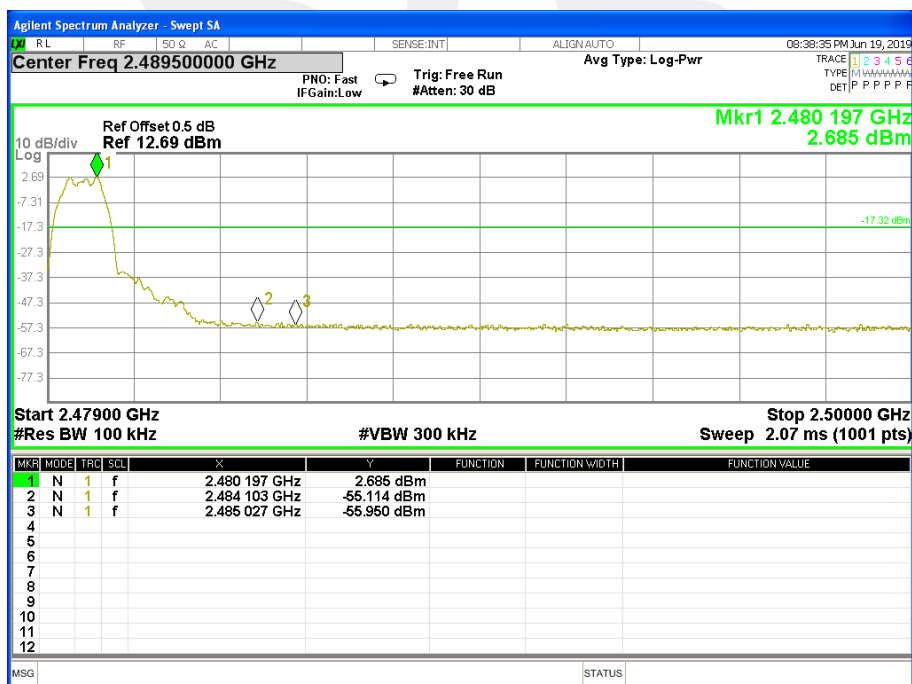


For Band edge

00 CH



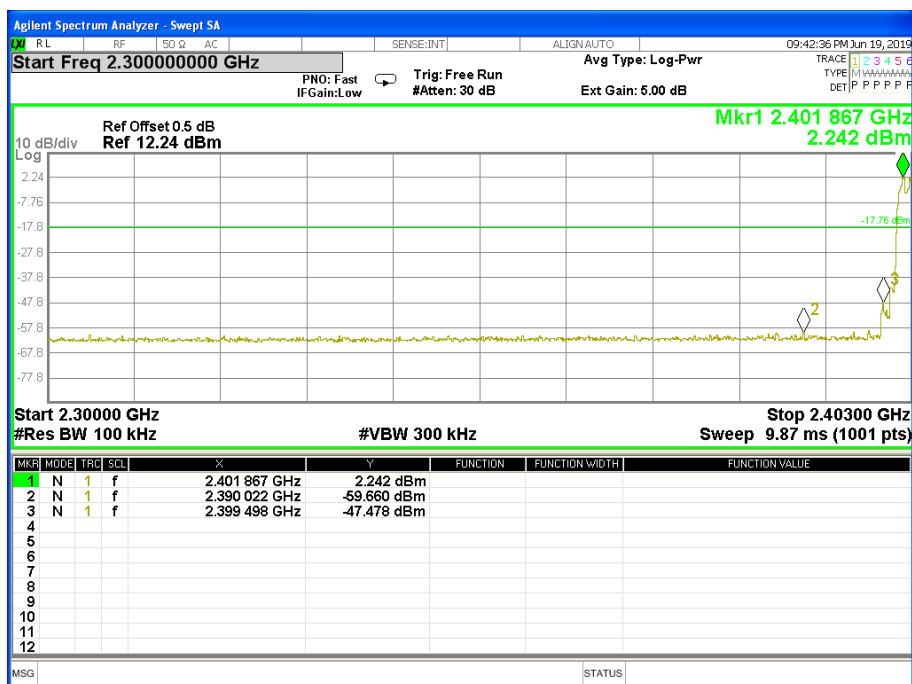
78 CH



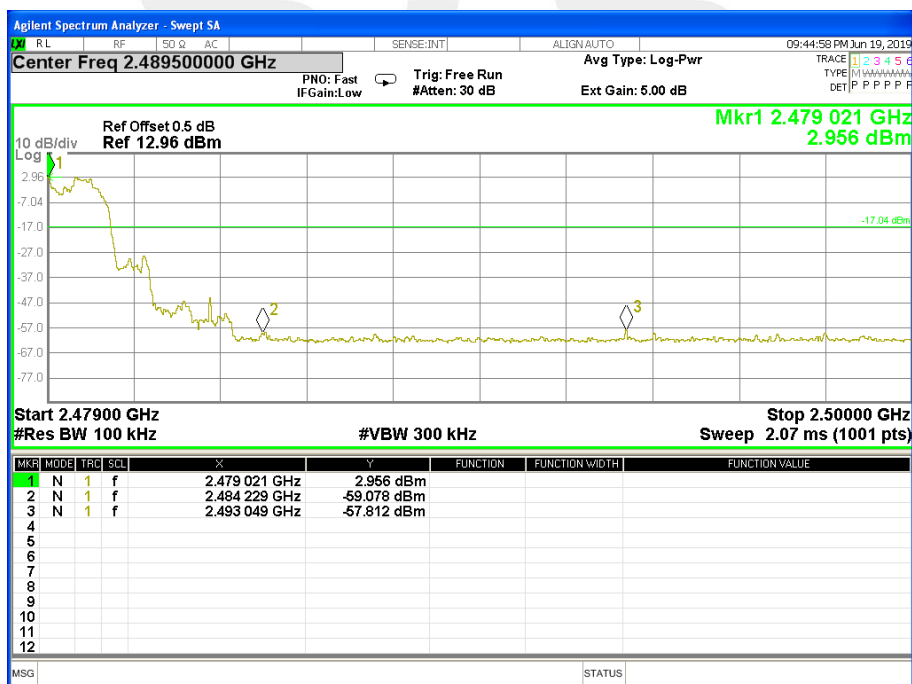


For Hopping Band edge

00 CH



78 CH





## 5. NUMBER OF HOPPING CHANNEL

### 5.1 LIMIT

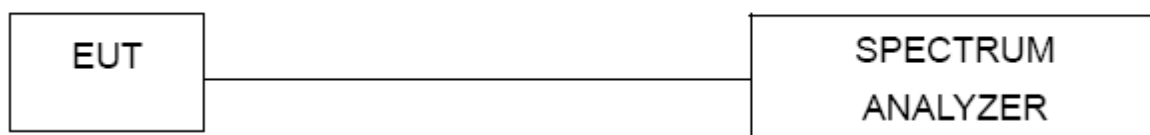
| FCC Part 15.247, Subpart C |                           |           |                      |        |
|----------------------------|---------------------------|-----------|----------------------|--------|
| Section                    | Test Item                 | Limit     | FrequencyRange (MHz) | Result |
| 15.247 (a)(1)(iii)         | Number of Hopping Channel | $\geq 15$ | 2400-2483.5          | PASS   |

| Spectrum Parameters | Setting                    |
|---------------------|----------------------------|
| Attenuation         | Auto                       |
| Span Frequency      | > Operating FrequencyRange |
| RB                  | 300KHz                     |
| VB                  | 300KHz                     |
| Detector            | Peak                       |
| Trace               | Max Hold                   |
| Sweep Time          | Auto                       |

### 5.2 TEST PROCEDURE

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
- Spectrum Setting: RBW= 300KHz, VBW=300KHz, Sweep time = Auto.

### 5.3 TEST SETUP



### 5.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.



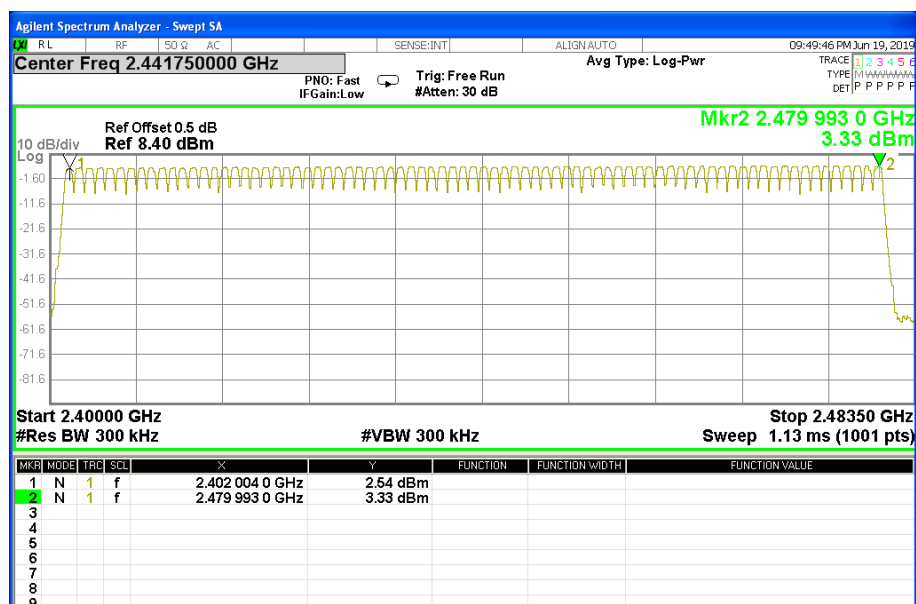
## 5.5 TEST RESULTS

|              |                         |                    |                      |
|--------------|-------------------------|--------------------|----------------------|
| Temperature: | 25°C                    | Relative Humidity: | 60%                  |
| Test Mode:   | Hopping Mode -GFSK Mode | Test Voltage:      | DC 3.7V from battery |

Number of Hopping Channel

79

## Hopping channel





## 6. AVERAGE TIME OF OCCUPANCY

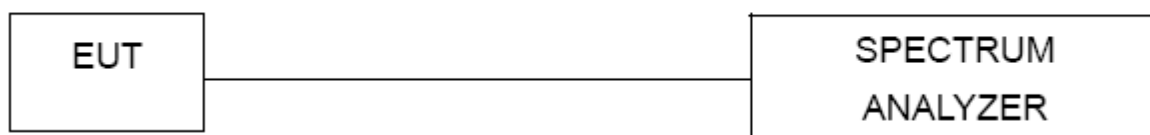
### 6.1 LIMIT

| FCC Part 15.247, Subpart C |                           |        |                       |        |
|----------------------------|---------------------------|--------|-----------------------|--------|
| Section                    | Test Item                 | Limit  | Frequency Range (MHz) | Result |
| 15.247 (a)(1)(iii)         | Average Time of Occupancy | 0.4sec | 2400-2483.5           | PASS   |

### 6.2 TEST PROCEDURE

- The transmitter output (antenna port) was connected to the spectrum analyzer
- Set RBW = 1MHz/VBW = 3MHz.
- Use a video trigger with the trigger level set to enable triggering only on full pulses.
- Sweep Time is more than once pulse time.
- Set the center frequency on any frequency would be measure and set the frequency span to zero span.
- Measure the maximum time duration of one single pulse.
- Set the EUT for DH5, DH3 and DH1 packet transmitting.
- Measure the maximum time duration of one single pulse.
- DH5 Packet permit maximum  $1600 / 79 / 6 = 3.37$  hops per second in each channel (5 time slots RX, 1 time slot TX). So the dwell time is the time duration of the pulse times  $3.37 \times 31.6 = 106.6$  within 31.6 seconds.
- DH3 Packet permit maximum  $1600 / 79 / 4 = 5.06$  hops per second in each channel (3 time slots RX, 1 time slot TX). So the dwell time is the time duration of the pulse times  $5.06 \times 31.6 = 160$  within 31.6 seconds.
- DH1 Packet permit maximum  $1600 / 79 / 2 = 10.12$  hops per second in each channel (1 time slot RX, 1 time slot TX). So the dwell time is the time duration of the pulse times  $10.12 \times 31.6 = 320$  within 31.6 seconds.

### 6.3 TEST SETUP



### 6.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.



## 6.5 TEST RESULTS

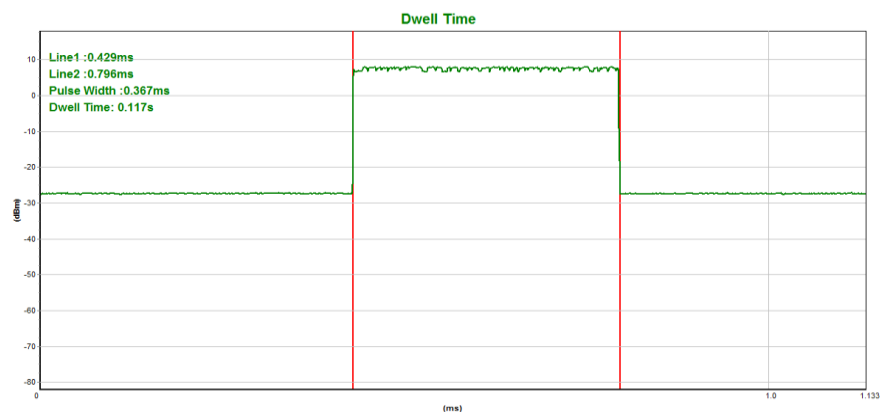
|              |                         |                    |                      |
|--------------|-------------------------|--------------------|----------------------|
| Temperature: | 25°C                    | Relative Humidity: | 50%                  |
| Test Mode:   | GFSK(1Mbps)-DH1/DH3/DH5 | Test Voltage:      | DC 3.7V from battery |

| Data Packet | Channel | pulse time(ms) | Dwell Time(s) | Limits(s) |
|-------------|---------|----------------|---------------|-----------|
| DH1         | middle  | 0.367          | 0.117         | 0.4       |
| DH3         | middle  | 1.631          | 0.261         | 0.4       |
| DH5         | middle  | 2.878          | 0.307         | 0.4       |

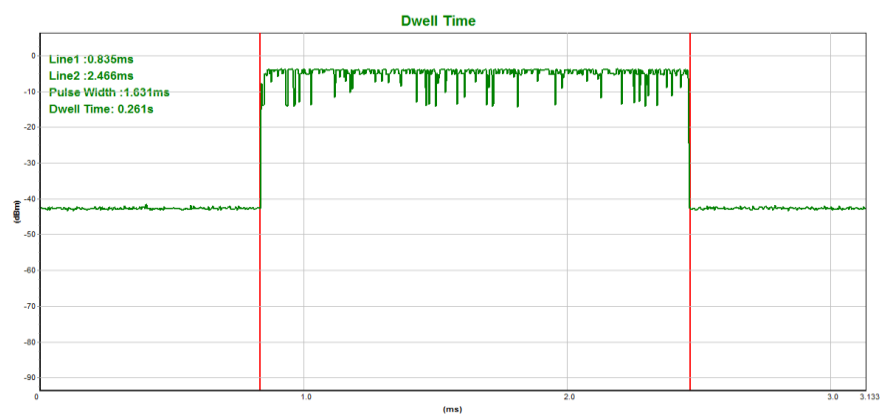




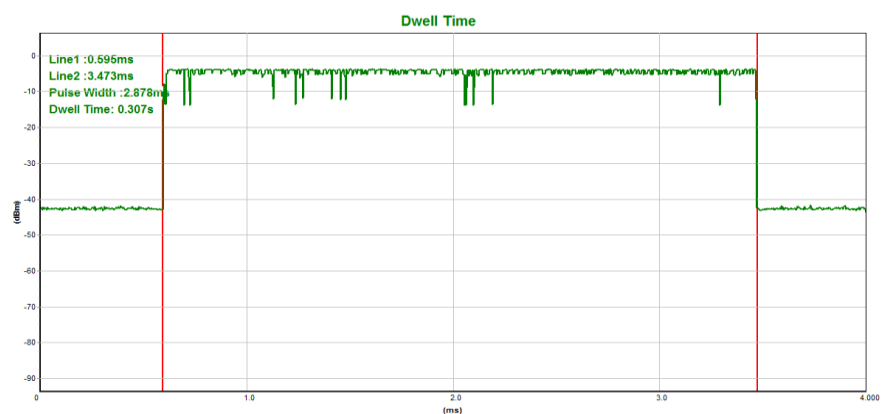
## CH39-DH1



## CH39-DH3



## CH39-DH5





|              |                                          |                    |                      |
|--------------|------------------------------------------|--------------------|----------------------|
| Temperature: | 25°C                                     | Relative Humidity: | 50%                  |
| Test Mode:   | $\pi/4$ -DQPSK(2Mbps)-<br>2DH1/2DH3/2DH5 | Test Voltage:      | DC 3.7V from battery |

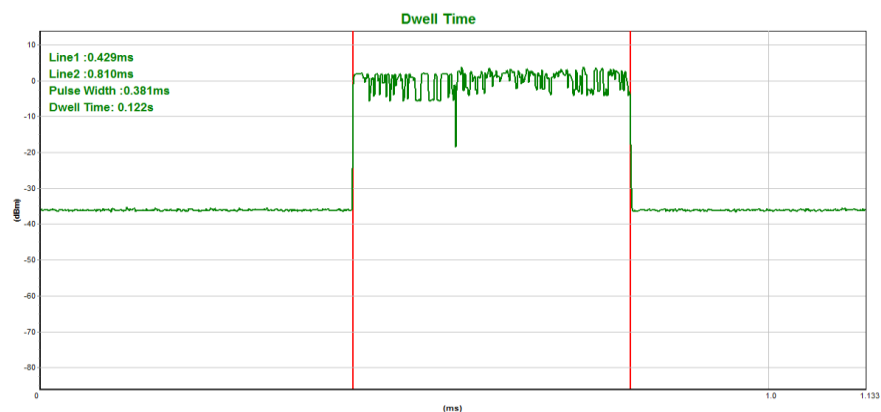
| Data Packet | Channel | pulse time(ms) | Dwell Time(s) | Limits(s) |
|-------------|---------|----------------|---------------|-----------|
| 2DH1        | middle  | 0.381          | 0.122         | 0.4       |
| 2DH3        | middle  | 1.633          | 0.261         | 0.4       |
| 2DH5        | middle  | 2.885          | 0.308         | 0.4       |



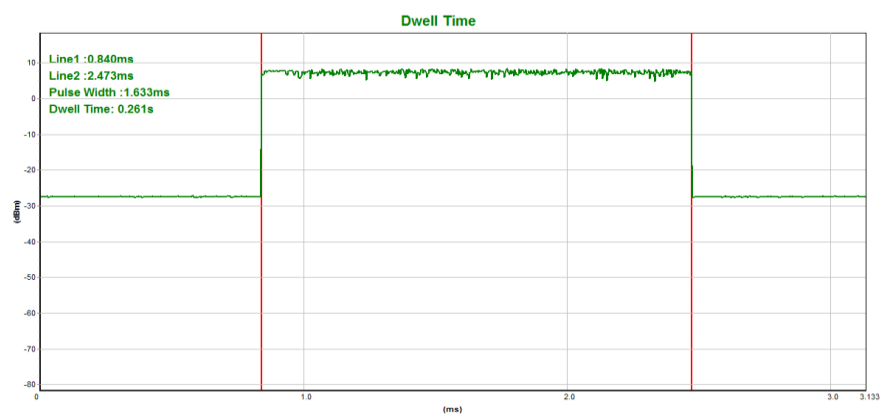




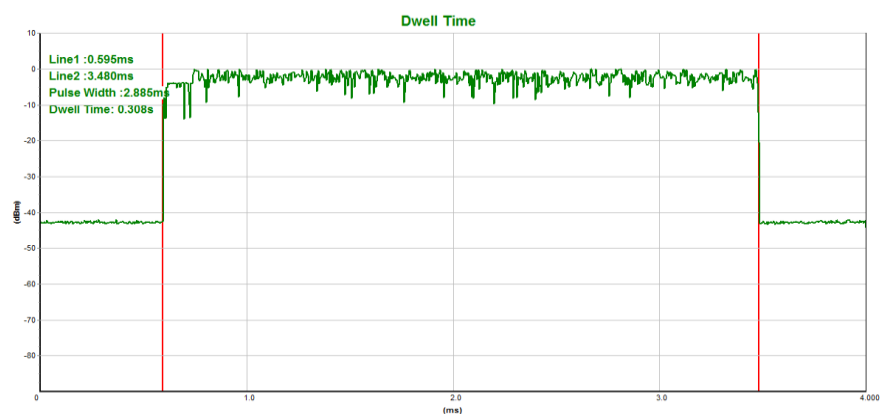
## CH39-2DH1



## CH39-2DH3



## CH39-2DH5





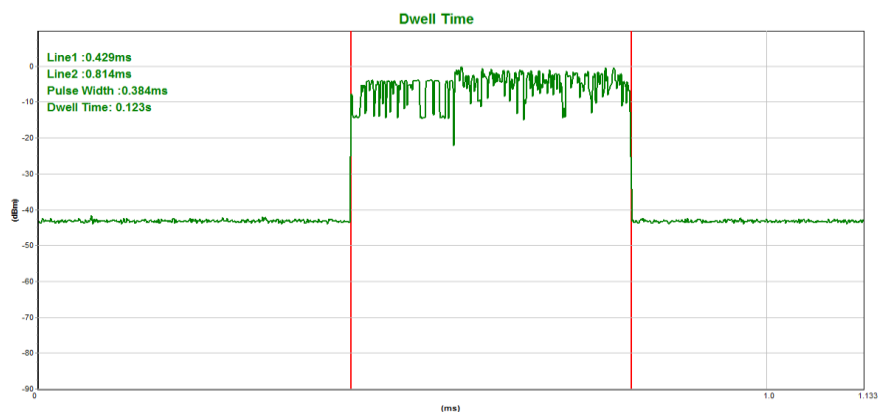
|              |                                 |                    |                      |
|--------------|---------------------------------|--------------------|----------------------|
| Temperature: | 25℃                             | Relative Humidity: | 50%                  |
| Test Mode:   | 8DPSK(3Mbps)-<br>3DH1/3DH3/3DH5 | Test Voltage:      | DC 3.7V from battery |

| Data Packet | Channel | pulse time(ms) | Dwell Time(s) | Limits(s) |
|-------------|---------|----------------|---------------|-----------|
| 3DH1        | middle  | 0.384          | 0.123         | 0.4       |
| 3DH3        | middle  | 1.636          | 0.262         | 0.4       |
| 3DH5        | middle  | 2.889          | 0.308         | 0.4       |

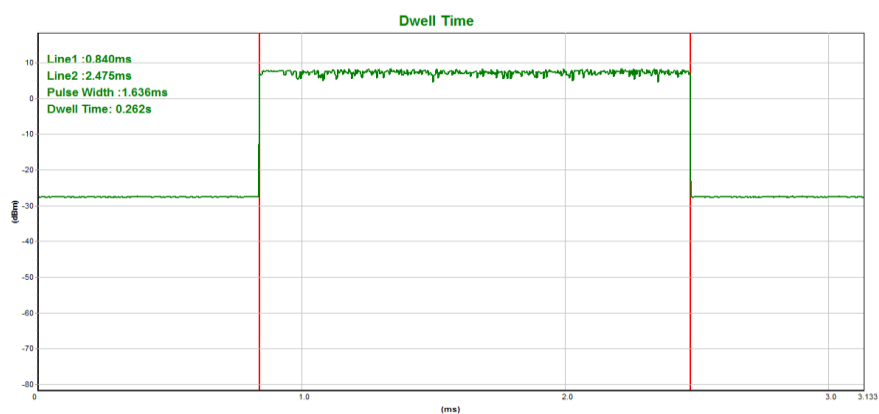




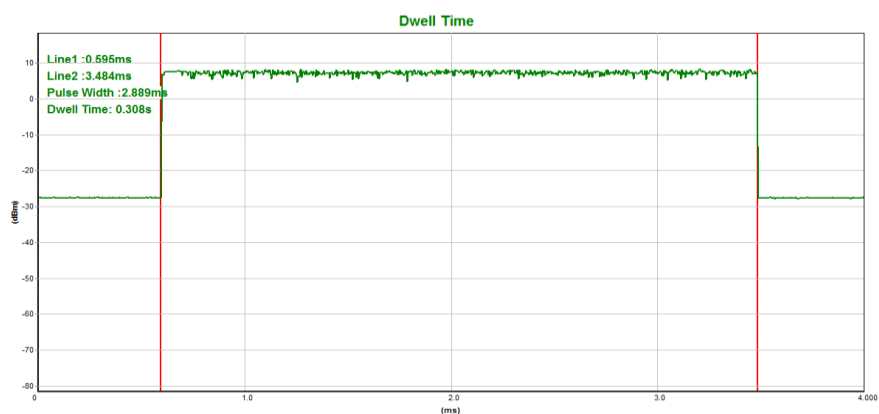
## CH39-3DH1



## CH39-3DH3



## CH39-3DH5



## 7. HOPPING CHANNEL SEPARATION MEASUREMENT

### 7.1 LIMIT

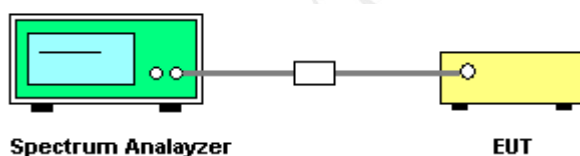
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

| Spectrum Parameter | Setting                                                 |
|--------------------|---------------------------------------------------------|
| Attenuation        | Auto                                                    |
| Span Frequency     | > 20 dB Bandwidth or Channel Separation                 |
| RB                 | 30 kHz (20dB Bandwidth) / 30 kHz (Channel Separation)   |
| VB                 | 100 kHz (20dB Bandwidth) / 100 kHz (Channel Separation) |
| Detector           | Peak                                                    |
| Trace              | Max Hold                                                |
| Sweep Time         | Auto                                                    |

### 7.2 TEST PROCEDURE

- The transmitter output (antenna port) was connected to the spectrum analyser in peak hold mode.
- The resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilised for 20 dB bandwidth measurement.
- The resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilised for channel separation measurement.

### 7.3 TEST SETUP



### 7.4 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.



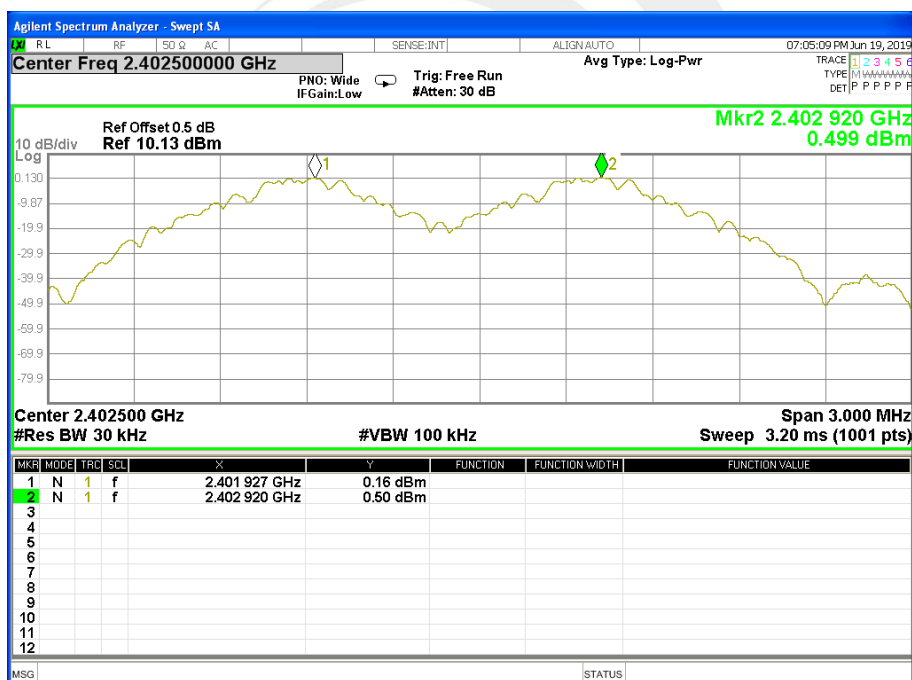
## 7.5 TEST RESULTS

|              |                                          |                    |                      |
|--------------|------------------------------------------|--------------------|----------------------|
| Temperature: | 25°C                                     | Relative Humidity: | 50%                  |
| Test Mode:   | CH00 / CH39 / CH78<br>(GFSK(1Mbps) Mode) | Test Voltage:      | DC 3.7V from battery |

| Frequency | Mark1<br>Frequency<br>(MHz) | Mark2<br>Frequency<br>(MHz) | Ch.<br>Separation<br>(MHz) | Limit (MHz) | Result   |
|-----------|-----------------------------|-----------------------------|----------------------------|-------------|----------|
| 2402 MHz  | 2401.927                    | 2402.920                    | 0.993                      | 0.686       | Complies |
| 2441 MHz  | 2440.915                    | 2441.914                    | 0.999                      | 0.687       | Complies |
| 2480 MHz  | 2478.906                    | 2479.899                    | 0.993                      | 0.686       | Complies |

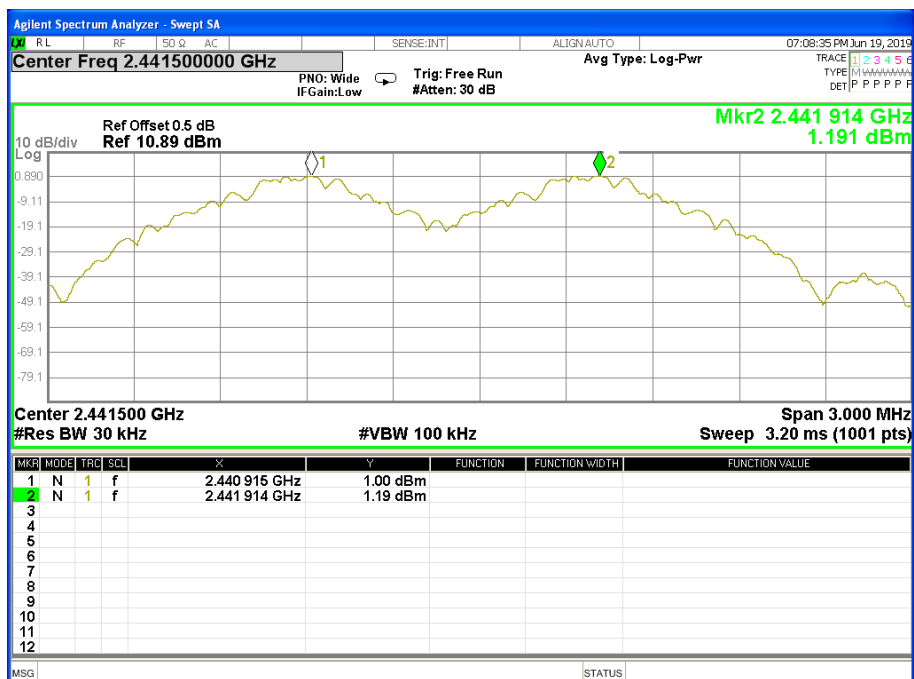
For GFSK: Ch. Separation Limits: > two-thirds 20dB bandwidth

## CH00 -1Mbps

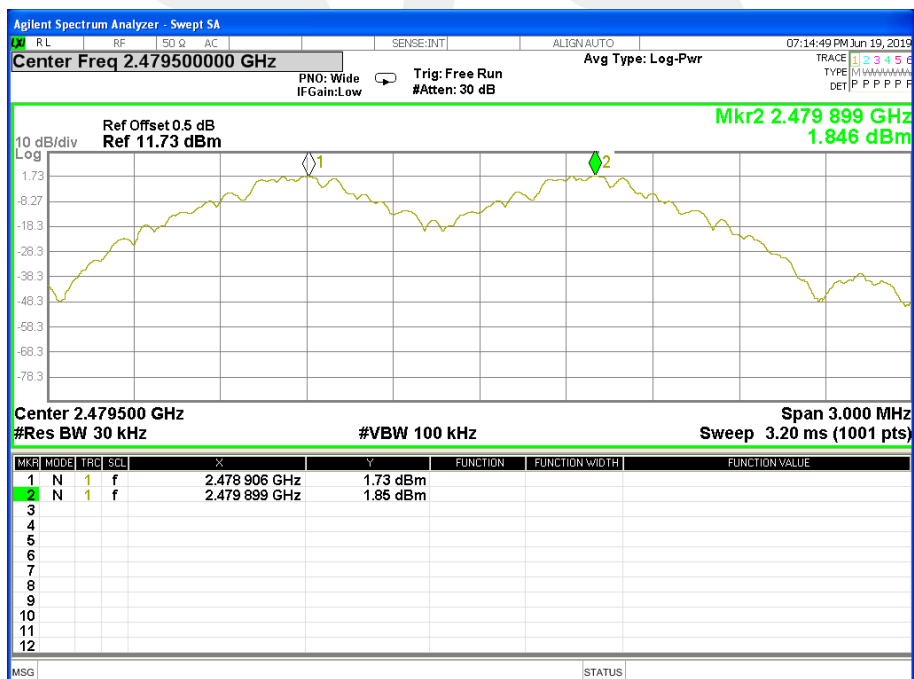




## CH39 -1Mbps



## CH78 -1Mbps



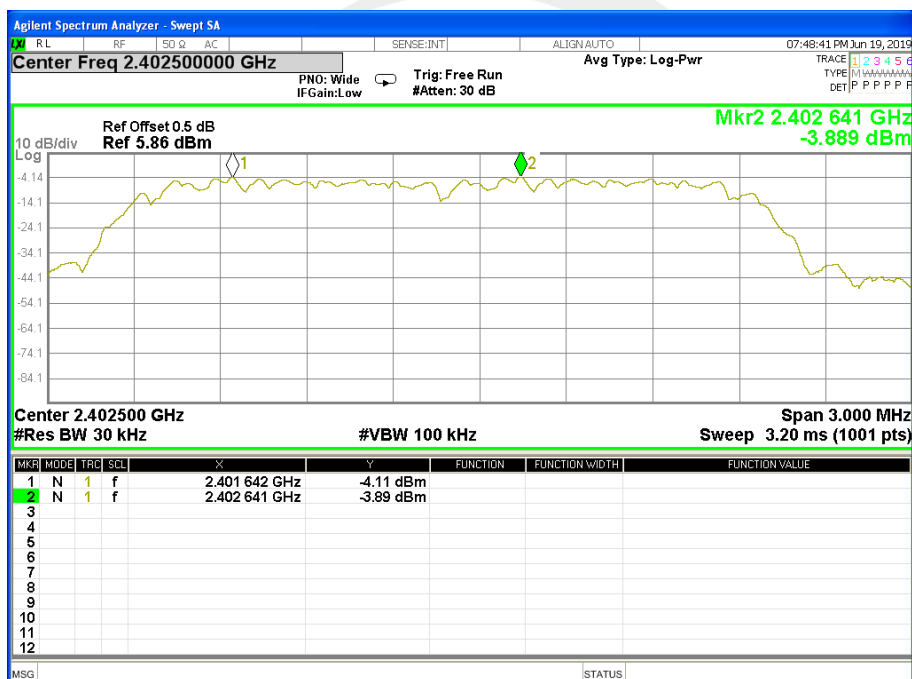


|              |                                                  |                    |                      |
|--------------|--------------------------------------------------|--------------------|----------------------|
| Temperature: | 25°C                                             | Relative Humidity: | 50%                  |
| Test Mode:   | CH00 / CH39 / CH78 ( $\pi/4$ -DQPSK(2Mbps) Mode) | Test Voltage:      | DC 3.7V from battery |

| Frequency | Mark1 Frequency (MHz) | Mark2 Frequency (MHz) | Ch. Separation (MHz) | Limit (MHz) | Result   |
|-----------|-----------------------|-----------------------|----------------------|-------------|----------|
| 2402 MHz  | 2401.642              | 2402.641              | 0.999                | 0.858       | Complies |
| 2441 MHz  | 2440.630              | 2441.632              | 1.002                | 0.858       | Complies |
| 2480 MHz  | 2478.618              | 2479.620              | 1.002                | 0.858       | Complies |

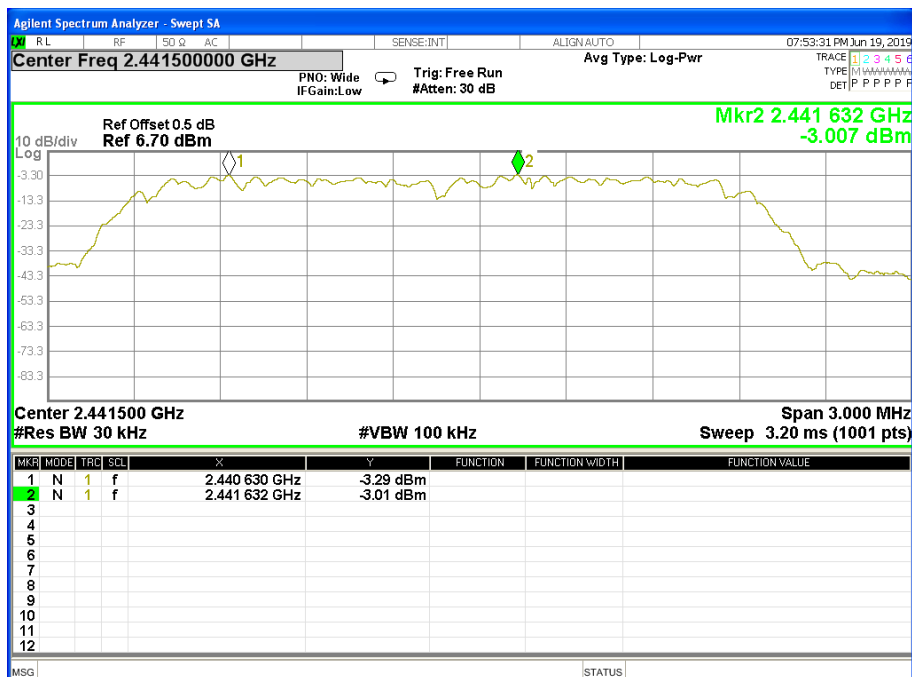
For  $\pi/4$ -DQPSK(2Mbps): Ch. Separation Limits: > two-thirds 20dB bandwidth

### CH00 -2Mbps

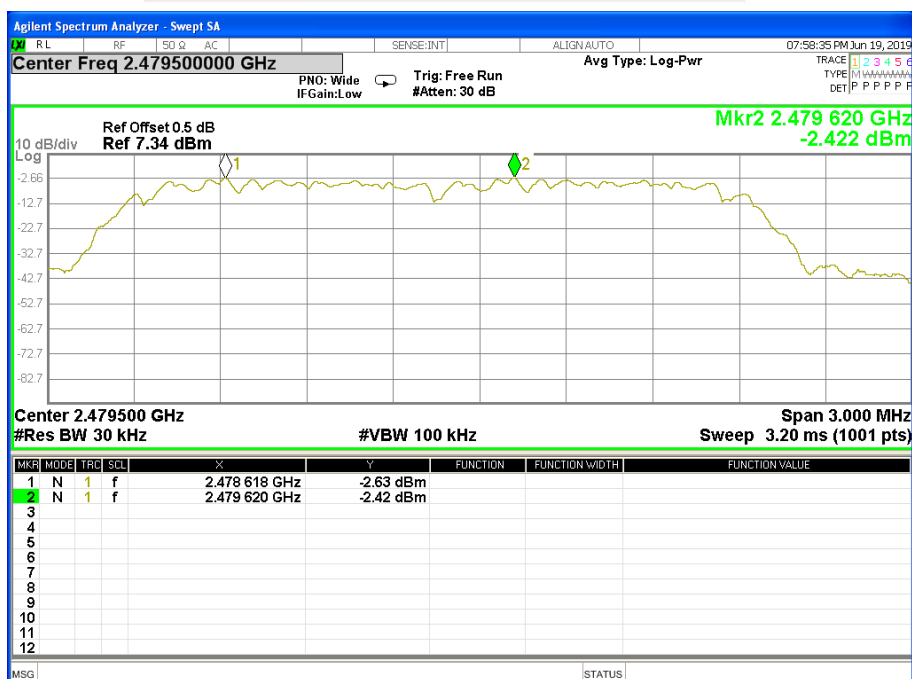




## CH39 -2Mbps



## CH78 -2Mbps





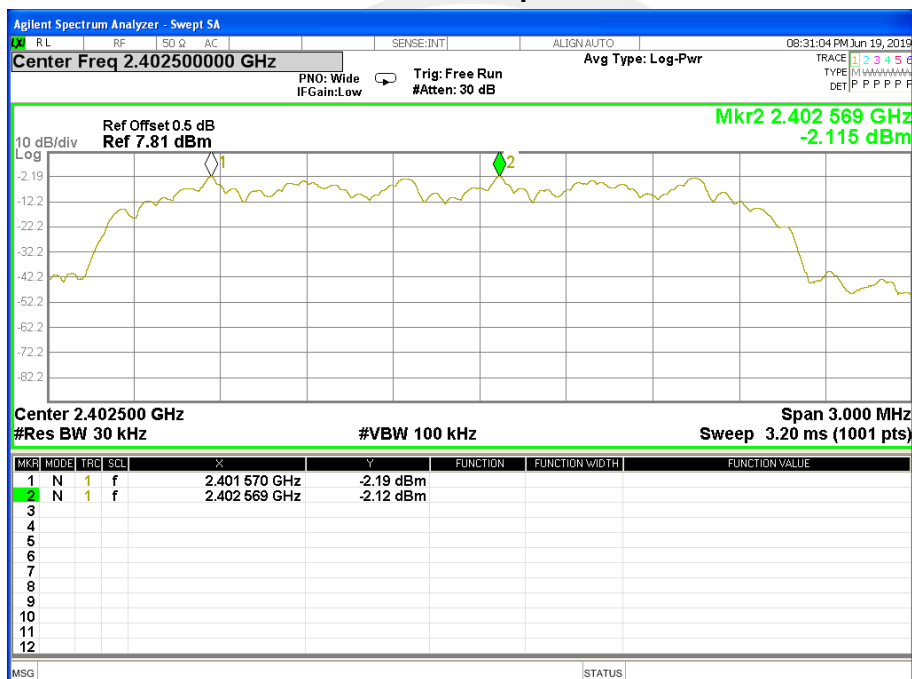


|              |                                          |                    |                      |
|--------------|------------------------------------------|--------------------|----------------------|
| Temperature: | 25°C                                     | Relative Humidity: | 50%                  |
| Test Mode:   | CH00 / CH39 / CH78<br>(8DPSK(3Mbps)Mode) | Test Voltage:      | DC 3.7V from battery |

| Frequency | Mark1<br>Frequency<br>(MHz) | Mark2<br>Frequency<br>(MHz) | Ch.<br>Separation<br>(MHz) | Limit (MHz) | Result   |
|-----------|-----------------------------|-----------------------------|----------------------------|-------------|----------|
| 2402 MHz  | 2401.570                    | 2402.569                    | 0.999                      | 0.903       | Complies |
| 2441 MHz  | 2440.558                    | 2441.557                    | 0.999                      | 0.905       | Complies |
| 2480 MHz  | 2478.546                    | 2479.545                    | 0.999                      | 0.908       | Complies |

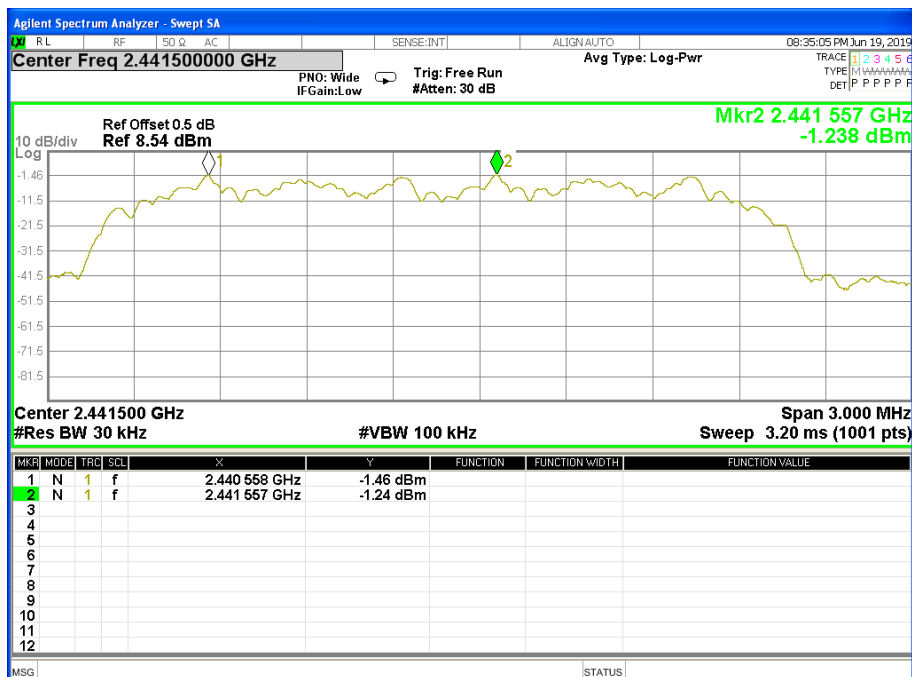
For 8DPSK(3Mbps):Ch. Separation Limits: > two-thirds 20dB bandwidth

### CH00 -3Mbps

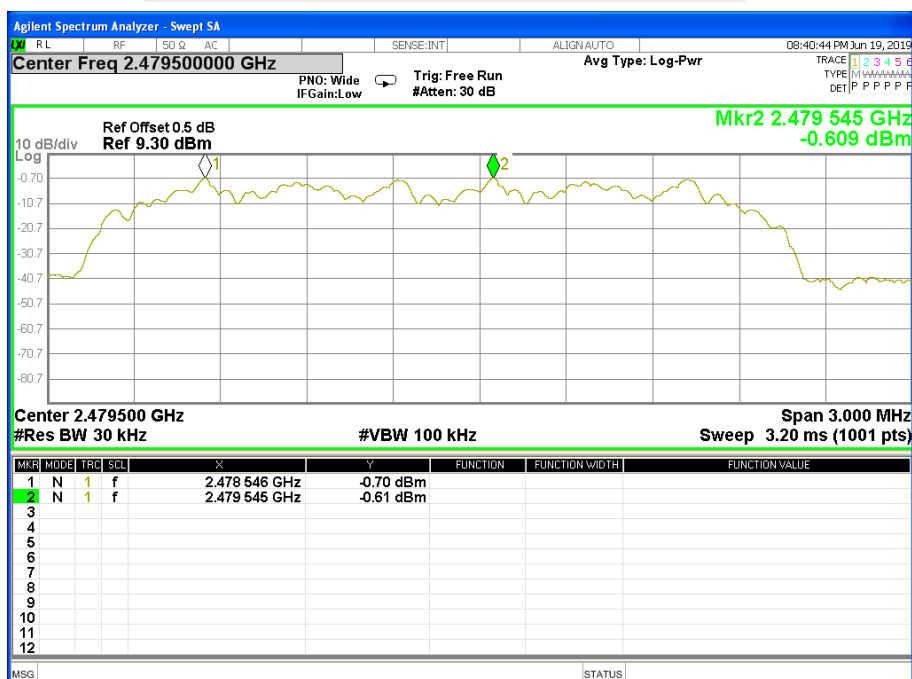




## CH39 -3Mbps



## CH78 -3Mbps





## 8. BANDWIDTH TEST

### 8.1 LIMIT

| FCC Part15 15.247,Subpart C |           |                  |                      |        |
|-----------------------------|-----------|------------------|----------------------|--------|
| Section                     | Test Item | Limit            | FrequencyRange (MHz) | Result |
| 15.247<br>(a)(1)            | Bandwidth | (20dB bandwidth) | 2400-2483.5          | PASS   |

| Spectrum Parameter | Setting                                                 |
|--------------------|---------------------------------------------------------|
| Attenuation        | Auto                                                    |
| Span Frequency     | > Measurement Bandwidth or Channel Separation           |
| RB                 | 30 kHz (20dB Bandwidth) / 30 kHz (Channel Separation)   |
| VB                 | 100 kHz (20dB Bandwidth) / 100 kHz (Channel Separation) |
| Detector           | Peak                                                    |
| Trace              | Max Hold                                                |
| Sweep Time         | Auto                                                    |

### 8.2 TEST PROCEDURE

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
- Spectrum Setting: RBW= 30KHz, VBW=100KHz, Sweep time = Auto.

### 8.3 TEST SETUP



### 8.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

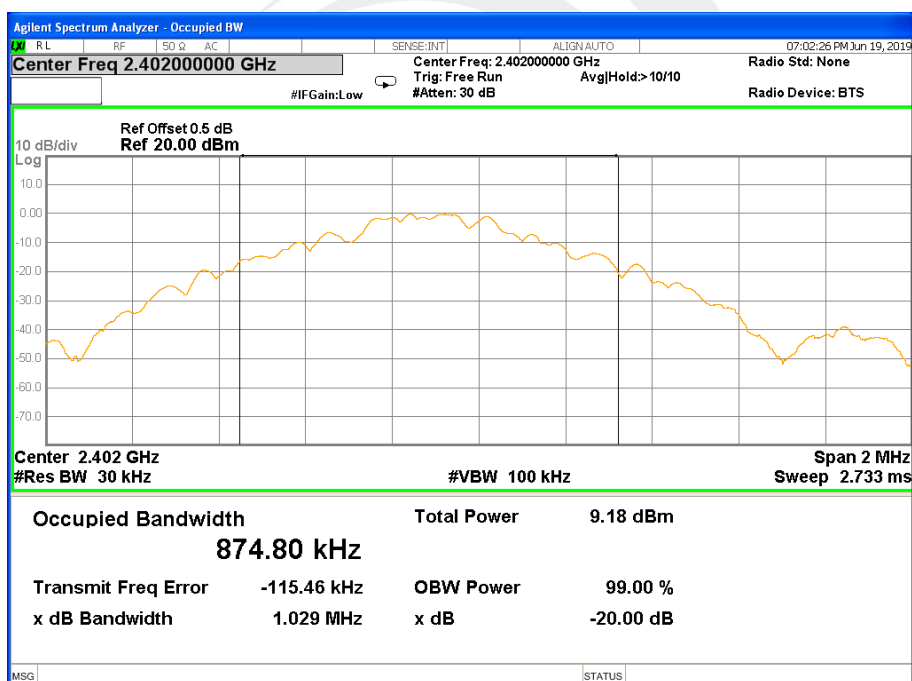


## 8.5 TEST RESULTS

|              |                                  |                    |                      |
|--------------|----------------------------------|--------------------|----------------------|
| Temperature: | 25°C                             | Relative Humidity: | 50%                  |
| Test Mode:   | GFSK(1Mbps)<br>CH00 / CH39 / C78 | Test Voltage:      | DC 3.7V from battery |

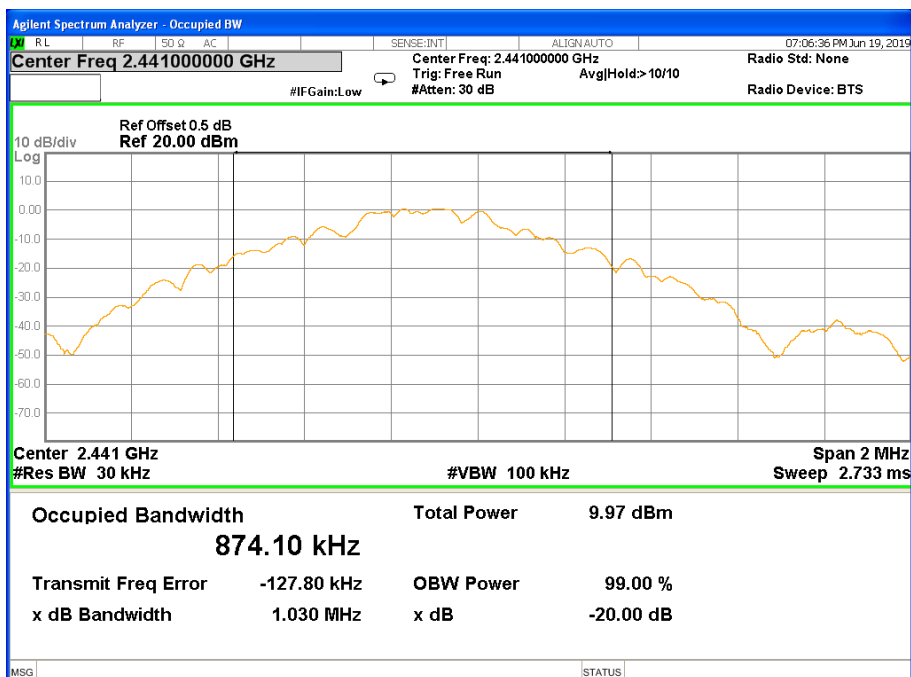
| Frequency | 20dB Bandwidth<br>(MHz) | Result |
|-----------|-------------------------|--------|
| 2402 MHz  | 1.029                   | PASS   |
| 2441 MHz  | 1.030                   | PASS   |
| 2480 MHz  | 1.029                   | PASS   |

## CH00 -1Mbps

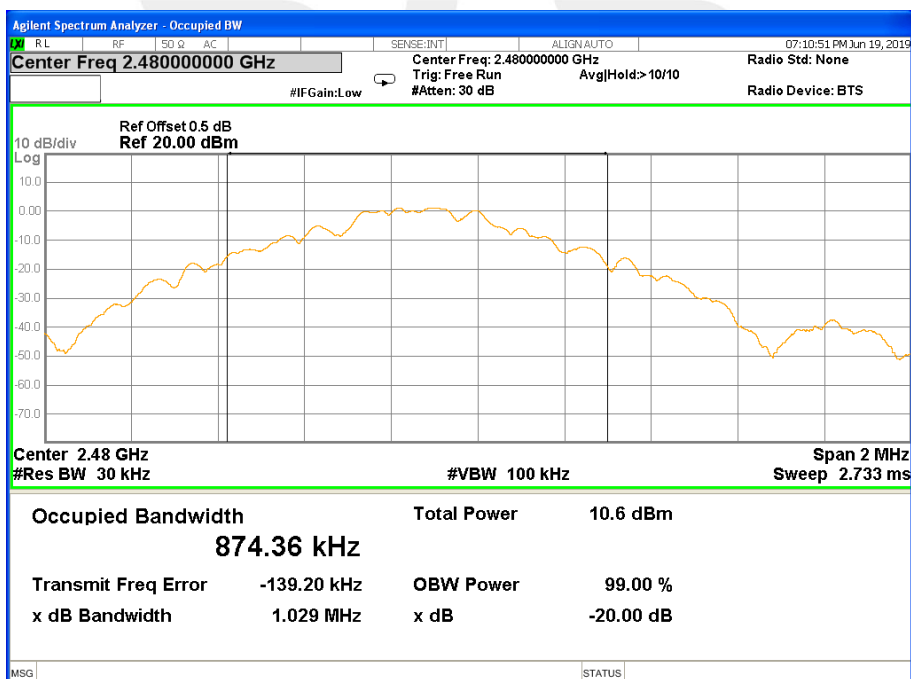




## CH39 -1Mbps



## CH78 -1Mbps

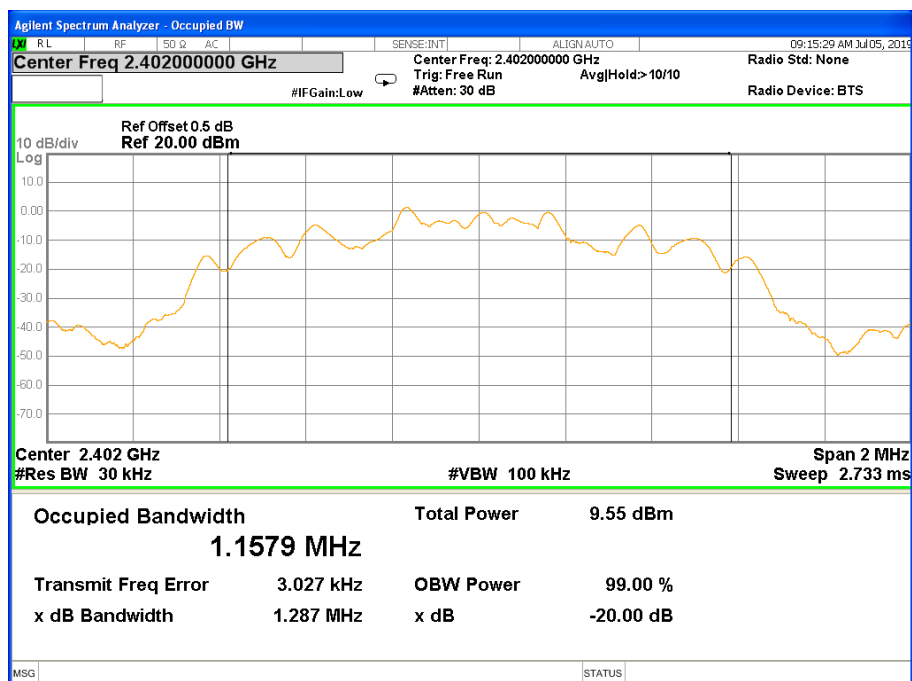




|              |                                            |                    |                      |
|--------------|--------------------------------------------|--------------------|----------------------|
| Temperature: | 25°C                                       | Relative Humidity: | 50%                  |
| Test Mode:   | $\pi/4$ -DQPSK(2Mbps)<br>CH00 / CH39 / C78 | Test Voltage:      | DC 3.7V from battery |

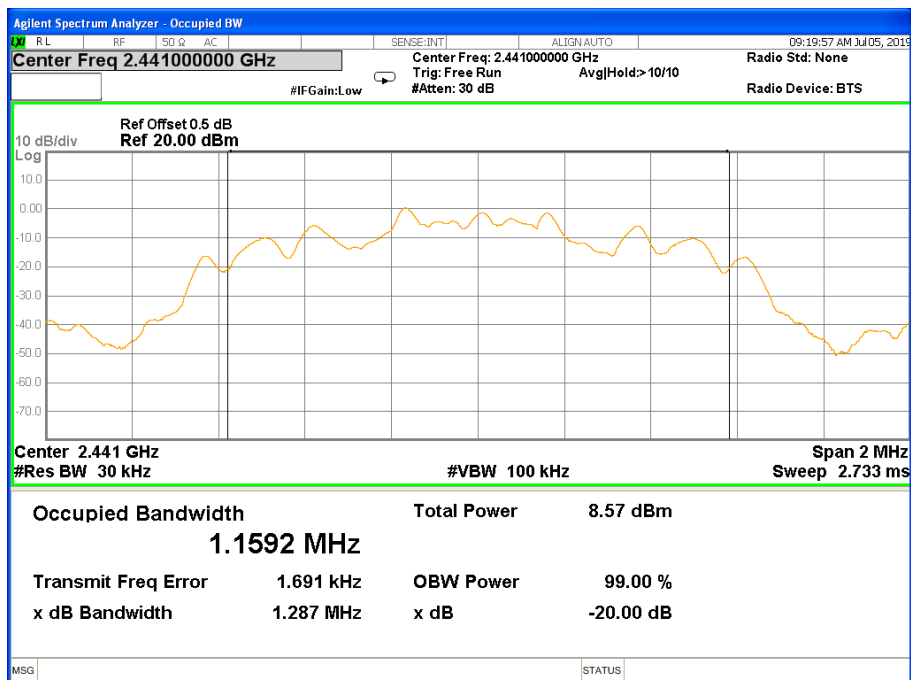
| Frequency | 20dB Bandwidth<br>(MHz) | Result |
|-----------|-------------------------|--------|
| 2402 MHz  | 1.287                   | PASS   |
| 2441 MHz  | 1.287                   | PASS   |
| 2480 MHz  | 1.287                   | PASS   |

## CH00 -2Mbps

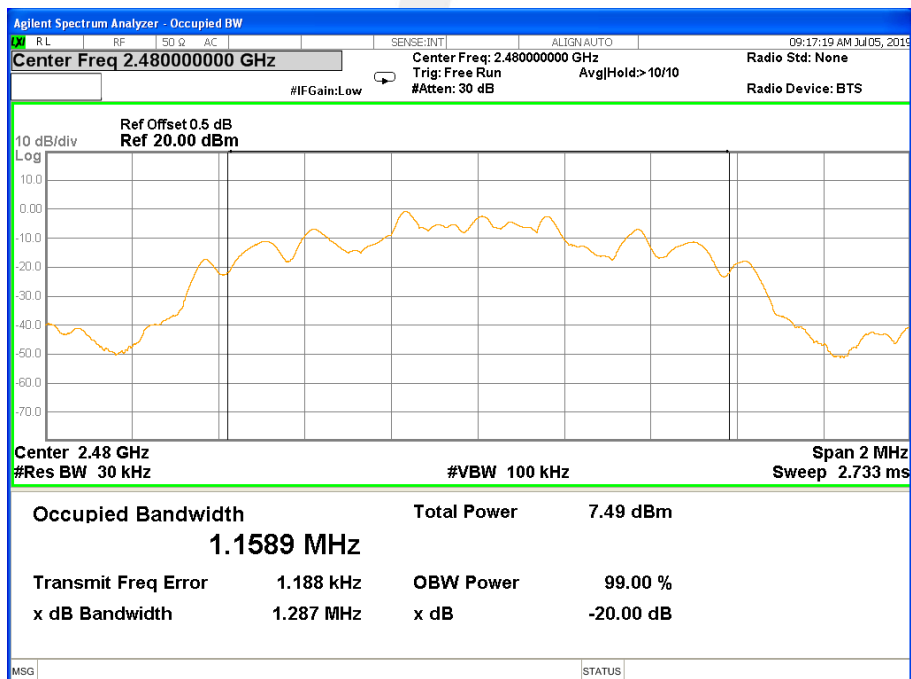




## CH39 -2Mbps



## CH78 -2Mbps

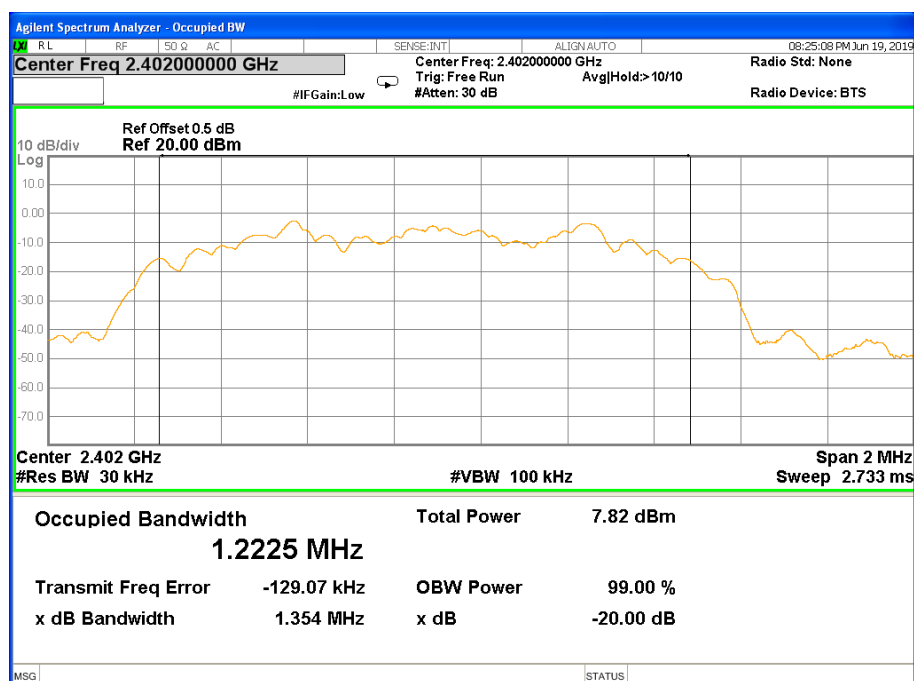




|              |                                    |                    |                      |
|--------------|------------------------------------|--------------------|----------------------|
| Temperature: | 25°C                               | Relative Humidity: | 50%                  |
| Test Mode:   | 8DPSK(3Mbps)<br>CH00 / CH39 / CH78 | Test Voltage:      | DC 3.7V from battery |

| Frequency | 20dB Bandwidth<br>(MHz) | Result |
|-----------|-------------------------|--------|
| 2402 MHz  | 1.354                   | PASS   |
| 2441 MHz  | 1.358                   | PASS   |
| 2480 MHz  | 1.362                   | PASS   |

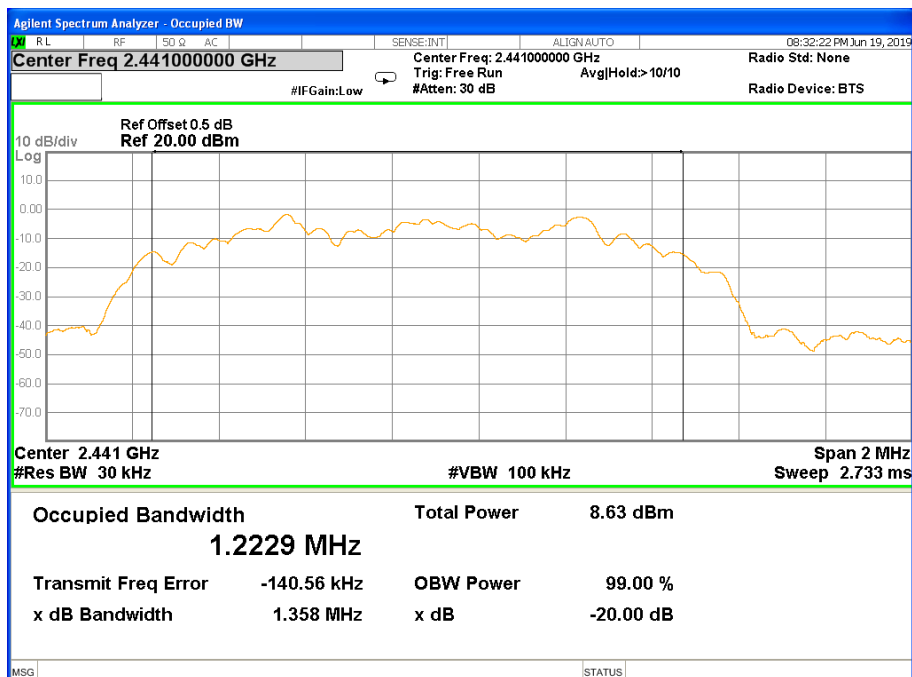
### CH00 -3Mbps



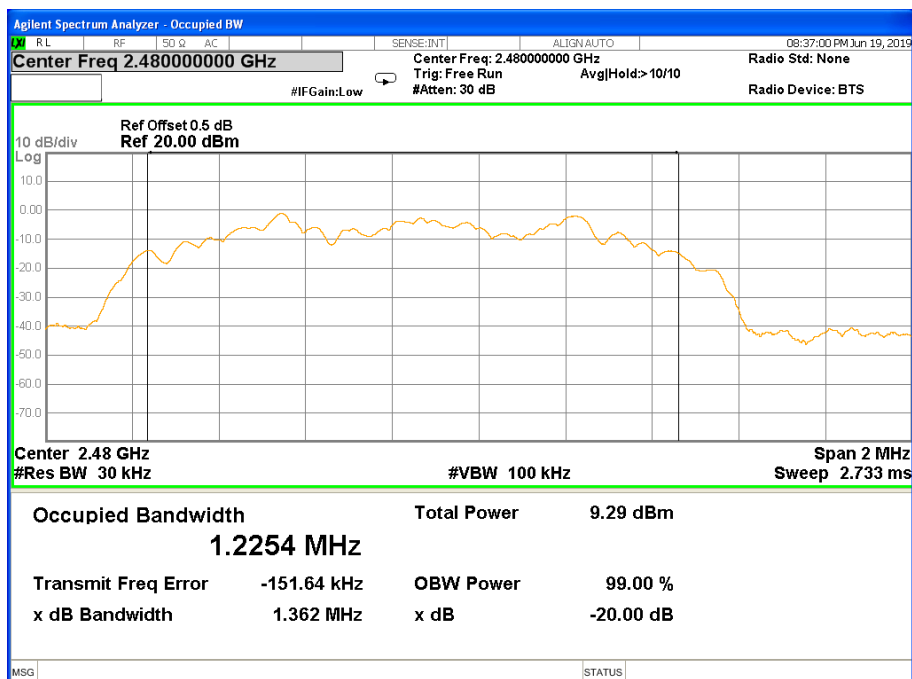




## CH39 -3Mbps



## CH78 -3Mbps





## 9. OUTPUT POWER TEST

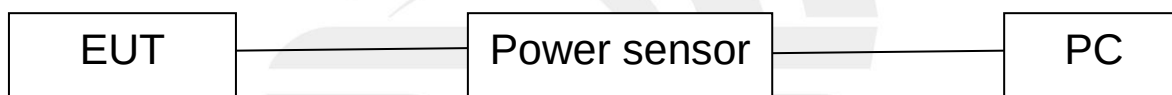
### 9.1 LIMIT

| FCC Part 15.247, Subpart C |              |                                                                                                                            |                       |        |
|----------------------------|--------------|----------------------------------------------------------------------------------------------------------------------------|-----------------------|--------|
| Section                    | Test Item    | Limit                                                                                                                      | Frequency Range (MHz) | Result |
| 15.247<br>(a)(1)&(b)(1)    | Output Power | 1 W or 0.125W                                                                                                              | 2400-2483.5           | PASS   |
|                            |              | if channel separation > 2/3 bandwidth provided the systems operate with an output power no greater than 125 mW (20.97 dBm) |                       |        |

### 9.2 TEST PROCEDURE

- a. The EUT was directly connected to the Power Sensor & PC

### 9.3 TEST SETUP



### 9.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.



## 9.5 TEST RESULTS

|               |                      |                    |     |
|---------------|----------------------|--------------------|-----|
| Temperature:  | 25°C                 | Relative Humidity: | 60% |
| Test Voltage: | DC 3.7V from battery |                    |     |

| Mode     | Channel Number | Frequency (MHz) | Peak Power | Average Power | Limit |
|----------|----------------|-----------------|------------|---------------|-------|
|          |                |                 | (dBm)      | (dBm)         | (dBm) |
| GFSK(1M) | 0              | 2402            | 4.15       | 3.75          | 20.97 |
|          | 39             | 2441            | 5.18       | 4.76          | 20.97 |
|          | 78             | 2480            | 4.86       | 4.38          | 20.97 |

Note: the channel separation >2/3 20dB bandwidth

| Mode               | Channel Number | Frequency (MHz) | Peak Power | Average Power | Limit |
|--------------------|----------------|-----------------|------------|---------------|-------|
|                    |                |                 | (dBm)      | (dBm)         | (dBm) |
| $\pi/4$ -DQPSK(2M) | 0              | 2402            | 4.78       | 1.85          | 20.97 |
|                    | 39             | 2441            | 5.59       | 2.75          | 20.97 |
|                    | 78             | 2480            | 5.65       | 2.97          | 20.97 |

Note: the channel separation >2/3 20dB bandwidth

| Mode       | Channel Number | Frequency (MHz) | Peak Power | Average Power | Limit |
|------------|----------------|-----------------|------------|---------------|-------|
|            |                |                 | (dBm)      | (dBm)         | (dBm) |
| 8-DPSK(3M) | 0              | 2402            | 4.93       | 1.81          | 20.97 |
|            | 39             | 2441            | 5.79       | 2.75          | 20.97 |
|            | 78             | 2480            | 5.78       | 2.88          | 20.97 |

Note: the channel separation >2/3 20dB bandwidth



## 10. ANTENNA REQUIREMENT

### 10.1 STANDARD REQUIREMENT

15.203 requirement: For intentional device, according to 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.

### 10.2 EUT ANTENNA

The EUT antenna is PIFA Antenna. It comply with the standard requirement.





## APPENDIX-PHOTOS OF TEST SETUP

Note: See test photos in setup photo document for the actual connections between Product and support equipment.

※※※※※END OF THE REPORT※※※※※

