

# TEST REPORT

## CERTIFICATE OF CONFORMITY

**Standard:** 47 CFR FCC Part 15, Subpart C (Section 15.247)

**Report No.:** RFBEOA-WTW-P22040911

**FCC ID:** BYG-ADRM13

**Model No.:** ADRM13

**Received Date:** 2022/3/28

**Test Date:** 2022/5/12 ~ 2022/5/23

**Issued Date:** 2022/6/22

**Applicant:** Sangean Electronics Inc.

**Address:** No. 18, Lane 7, Li-De Street, Chung Ho District, New Taipei City, 235, Taiwan

**Issued By:** Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch  
Lin Kou Laboratories

**Lab Address:** No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan

**Test Location:** No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan

**FCC Registration /** 198487 / TW2021

**Designation Number:**

**Approved by:**

*Jeremy Lin*

Jeremy Lin / Project Engineer

**, Date:**

2022/6/22

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Prepared by : Annie Chang / Senior Specialist

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## Release Control Record

| Issue No.            | Description       | Date Issued |
|----------------------|-------------------|-------------|
| RFBEOA-WTW-P22040911 | Original release. | 2022/6/22   |

## 1 Certificate

**Product:** Cordless Radio with Lantern

**Brand:** Makita

**Test Model:** ADRM13

**Sample Status:** Engineering sample

**Applicant:** Sangean Electronics Inc.

**Test Date:** 2022/5/12 ~ 2022/5/23

**Standard:** 47 CFR FCC Part 15, Subpart C (Section 15.247)

**Measurement** ANSI C63.10-2013

**procedure:** KDB 558074 D01 15.247 Meas Guidance v05r02

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

## 2 Summary of Test Results

| 47 CFR FCC Part 15, Subpart C (Section 15.247) |                                  |        |                                                   |
|------------------------------------------------|----------------------------------|--------|---------------------------------------------------|
| Standard / Clause                              | Test Item                        | Result | Remark                                            |
| 15.247 (a)(1)                                  | RF Output Power                  | Pass   | Meet the requirement of limit.                    |
| 15.247(a)(1) (iii)                             | Number of Hopping Frequency Used | Pass   | Meet the requirement of limit.                    |
| 15.247(a)(1) (iii)                             | Dwell Time on Each Channel       | Pass   | Meet the requirement of limit.                    |
| 15.247(a)(1)                                   | Hopping Channel Separation       | Pass   | Meet the requirement of limit.                    |
| 15.247(a)(1)                                   | 20 dB Bandwidth                  | Pass   | Refer to note 1                                   |
| 15.247(d)                                      | Conducted Out of Band Emissions  | Pass   | Meet the requirement of limit.                    |
| 15.205 /<br>15.209 /<br>15.247(d)              | Unwanted Emissions below 1 GHz   | Pass   | Minimum passing margin is -17.6 dB at 208.00 MHz  |
| 15.205 /<br>15.209 /<br>15.247(d)              | Unwanted Emissions above 1 GHz   | Pass   | Minimum passing margin is -12.7 dB at 2390.00 MHz |
| 15.203                                         | Antenna Requirement              | Pass   | No antenna connector is used.                     |

### Notes:

1. If the Frequency Hopping System operating in 2400-2483.5 MHz band and the output power less than 125 mW. The hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of hopping channel whichever is greater.
2. Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

### 2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

| Parameter                       | Specification   | Uncertainty |
|---------------------------------|-----------------|-------------|
| Conducted Out of Band Emissions | 9 kHz ~ 40 GHz  | 2.63 dB     |
| Unwanted Emissions below 1 GHz  | 9 kHz ~ 30 MHz  | 2.38 dB     |
|                                 | 30 MHz ~ 1 GHz  | 5.62 dB     |
| Unwanted Emissions above 1 GHz  | 1 GHz ~ 6 GHz   | 4.61 dB     |
|                                 | 6 GHz ~ 18 GHz  | 5.41 dB     |
|                                 | 18 GHz ~ 40 GHz | 5.14 dB     |

The other instruments specified are routine verified to remain within the calibrated levels, no measurement uncertainty is required to be calculated.

### 2.2 Supplementary Information

There is not any deviation from the test standards for the test method, and no modifications required for compliance.

### 3 General Information

#### 3.1 General Description

|                       |                                                           |
|-----------------------|-----------------------------------------------------------|
| Product               | Cordless Radio with Lantern                               |
| Brand                 | Makita                                                    |
| Test Model            | ADRM13                                                    |
| Status of EUT         | Engineering sample                                        |
| Power Supply Rating   | 14.4Vdc & 18Vdc from battery                              |
| Modulation Type       | GFSK, $\pi/4$ -DQPSK, 8DPSK                               |
| Modulation Technology | FHSS                                                      |
| Transfer Rate         | Up to 3 Mbps                                              |
| Operating Frequency   | 2402 ~ 2480 MHz                                           |
| Number of Channel     | 79                                                        |
| Output Power          | Peak: 1.517 mW (1.81 dBm)<br>Average: 1.455 mW (1.63 dBm) |

Note:

1. The EUT is a Cordless Radio with Lantern with Bluetooth technology.
2. The EUT consumes power from the following battery. (For support unit only)

| Battery   |                                          |
|-----------|------------------------------------------|
| Battery 1 | Makita, BL1860B (18Vdc, 6000mAh, 108Wh)  |
| Battery 2 | Makita, BL1830B (18Vdc, 3.0Ah, 54Wh)     |
| Battery 3 | Makita, BL1815N (18Vdc, 1.5Ah, 27Wh)     |
| Battery 4 | Makita, BL1460B (14.4Vdc, 6.0Ah, 87Wh)   |
| Battery 5 | Makita, BL1430B (14.4Vdc, 3000mAh, 44Wh) |
| Battery 6 | Makita, BL1415N (14.4Vdc, 1.5Ah, 22Wh)   |

3. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or User's Manual.

#### 3.2 Antenna Description of EUT

The antenna information is listed as below.

| Antenna Type | Gain (dBi) | Connector Type |
|--------------|------------|----------------|
| PCB          | 1.927      | N/A            |

\*The above Antenna information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications, the laboratory shall not be held responsible.

### 3.3 Channel List

79 channels are provided for BT-EDR:

| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|---------|-----------------|---------|-----------------|
| 0       | 2402            | 20      | 2422            | 40      | 2442            | 60      | 2462            |
| 1       | 2403            | 21      | 2423            | 41      | 2443            | 61      | 2463            |
| 2       | 2404            | 22      | 2424            | 42      | 2444            | 62      | 2464            |
| 3       | 2405            | 23      | 2425            | 43      | 2445            | 63      | 2465            |
| 4       | 2406            | 24      | 2426            | 44      | 2446            | 64      | 2466            |
| 5       | 2407            | 25      | 2427            | 45      | 2447            | 65      | 2467            |
| 6       | 2408            | 26      | 2428            | 46      | 2448            | 66      | 2468            |
| 7       | 2409            | 27      | 2429            | 47      | 2449            | 67      | 2469            |
| 8       | 2410            | 28      | 2430            | 48      | 2450            | 68      | 2470            |
| 9       | 2411            | 29      | 2431            | 49      | 2451            | 69      | 2471            |
| 10      | 2412            | 30      | 2432            | 50      | 2452            | 70      | 2472            |
| 11      | 2413            | 31      | 2433            | 51      | 2453            | 71      | 2473            |
| 12      | 2414            | 32      | 2434            | 52      | 2454            | 72      | 2474            |
| 13      | 2415            | 33      | 2435            | 53      | 2455            | 73      | 2475            |
| 14      | 2416            | 34      | 2436            | 54      | 2456            | 74      | 2476            |
| 15      | 2417            | 35      | 2437            | 55      | 2457            | 75      | 2477            |
| 16      | 2418            | 36      | 2438            | 56      | 2458            | 76      | 2478            |
| 17      | 2419            | 37      | 2439            | 57      | 2459            | 77      | 2479            |
| 18      | 2420            | 38      | 2440            | 58      | 2460            | 78      | 2480            |
| 19      | 2421            | 39      | 2441            | 59      | 2461            |         |                 |



### 3.4 Test Mode Applicability and Tested Channel Detail

|             |                                                                                                                                       |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Pre-Scan:   | EUT can be used in the following ways: XYZ 3-axis. Pre-scan in these ways and find the worst case as a representative test condition. |
| Worst Case: | X/ Y/ Z Worst Condition: Z Axis for Unwanted Emission above 1GHz and Unwanted Emission below 1GHz.                                    |

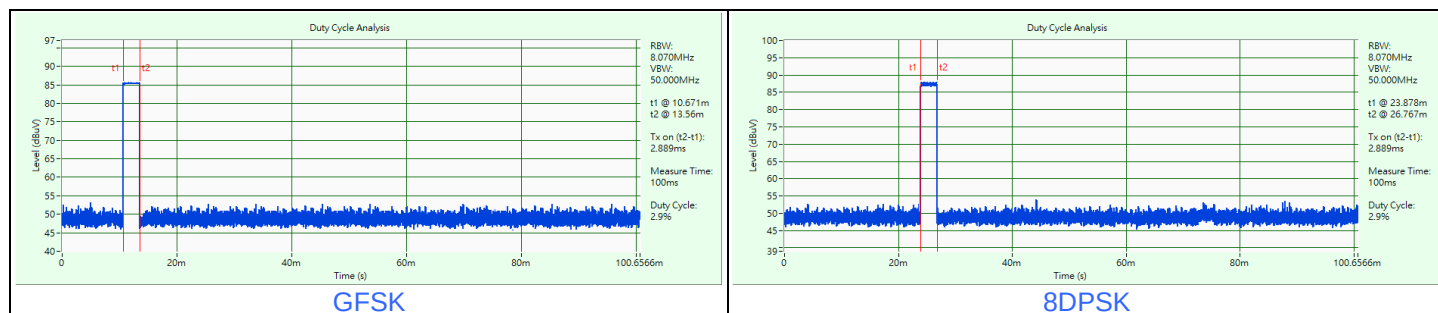
Following channel(s) was (were) selected for the final test as listed below:

| Test Item                                                          | Tested Channel | Modulation | Data Rate Parameter |
|--------------------------------------------------------------------|----------------|------------|---------------------|
| Unwanted Emissions below 1 GHz                                     | 78             | GFSK       | DH5                 |
| Unwanted Emissions above 1 GHz                                     | 0, 39, 78      | GFSK       | DH5                 |
|                                                                    |                | 8DPSK      | 3DH5                |
| RF Output Power                                                    | 0, 39, 78      | GFSK       | DH5                 |
|                                                                    |                | 8DPSK      | 3DH5                |
| Hopping Channel Separation / 20 dB Bandwidth                       | 0, 39, 78      | GFSK       | DH5                 |
|                                                                    |                | 8DPSK      | 3DH5                |
| Number of Hopping Frequency Used / Conducted Out of Band Emissions | 0, 39, 78      | GFSK       | DH5                 |
|                                                                    |                | 8DPSK      | 3DH5                |
| Dwell Time on Each Channel                                         | Hopping mode   | GFSK       | DH1, DH3, DH5       |
|                                                                    | Hopping mode   | 8DPSK      | 3HD1, 3DH3, 3DH5    |

### 3.5 Duty Cycle of Test Signal

**GFSK:** Duty cycle = 2.889 ms / 100 ms x 100% = 2.9%

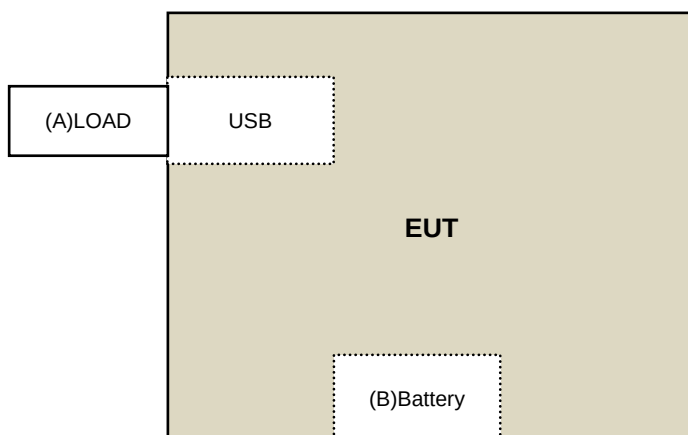
**8DPSK:** Duty cycle = 2.889 ms / 100 ms x 100% = 2.9%



### 3.6 Test Program Used and Operation Descriptions

Controlling software (ISRT v2.1.26.4422) has been activated to set the EUT under transmission condition continuously at specific channel frequency.

### 3.7 Connection Diagram of EUT and Peripheral Devices



### 3.8 Configuration of Peripheral Devices and Cable Connections

| ID | Product | Brand  | Model No. | Serial No. | FCC ID | Remarks               |
|----|---------|--------|-----------|------------|--------|-----------------------|
| A  | LOAD    | N/A    | N/A       | N/A        | N/A    | Provided by Lab       |
| B  | Battery | Makita | BL1860B   | N/A        | N/A    | Supplied by applicant |

## 4 Test Instruments

The calibration interval of the all test instruments are 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

### 4.1 RF Output Power

| Description<br>Manufacturer                         | Model No. | Serial No.  | Calibrated<br>Date | Calibrated<br>Until |
|-----------------------------------------------------|-----------|-------------|--------------------|---------------------|
| MIMO Powermeasurement Test set<br>(4X4)<br>KEYSIGHT | U2021XA   | U2021XA_001 | 2021/6/16          | 2022/6/15           |
| MXG Vector Signal Generator<br>KEYSIGHT             | N5182B    | MY53052658  | 2022/5/9           | 2023/5/8            |
| Power Meter<br>Anritsu                              | ML2495A   | 1232003     | 2022/1/9           | 2023/1/8            |
| Power Sensor<br>Anritsu                             | MA2411B   | 1207333     | 2022/1/9           | 2023/1/8            |
| Spectrum Analyzer<br>R&S                            | FSV40     | 101544      | 2022/5/9           | 2023/5/8            |
|                                                     |           | 101042      | 2021/9/9           | 2022/9/8            |
| Spectrum Analyzer<br>KEYSIGHT                       | N9030A    | MY54490260  | 2021/7/23          | 2022/7/22           |
| Temperature & Humidity Chamber<br>TERCHY            | MHU-225AU | 920409      | 2021/7/2           | 2022/7/1            |
| True RMS Clamp Meter<br>Fluke                       | 325       | 31130711WS  | 2021/6/2           | 2022/6/1            |

Notes:

1. The test was performed in LK - Oven
2. Tested Date: 2022/5/23

### 4.2 Number of Hopping Frequency Used

Refer to section 4.1 to get information of the instruments.

### 4.3 Dwell Time on Each Channel

Refer to section 4.1 to get information of the instruments.

### 4.4 Hopping Channel Separation

Refer to section 4.1 to get information of the instruments.

### 4.5 20 dB Bandwidth

Refer to section 4.1 to get information of the instruments.

### 4.6 Conducted Out of Band Emissions

Refer to section 4.1 to get information of the instruments.

#### 4.7 Unwanted Emissions below 1 GHz

| Description<br>Manufacturer   | Model No.        | Serial No.   | Calibrated<br>Date | Calibrated<br>Until |
|-------------------------------|------------------|--------------|--------------------|---------------------|
| * LOOP ANTENNA<br>EMCI        | LPA600           | 270          | 2021/9/2           | 2023/9/1            |
| Bi_Log Antenna<br>Schwarzbeck | VULB 9168        | 137          | 2021/10/27         | 2022/10/26          |
| Pre_Amplifier<br>EMCI         | EMC001340        | 980269       | 2021/6/29          | 2022/6/28           |
| Pre_Amplifier<br>HP           | 8447D            | 2432A03504   | 2022/2/17          | 2023/2/16           |
| RF Coaxial Cable<br>Pacific   | 8D-FB            | Cable-CH6-02 | 2021/7/13          | 2022/7/12           |
| Software<br>BVADT             | Radiated_V8.7.08 | N/A          | N/A                | N/A                 |
| Spectrum Analyzer<br>R&S      | FSV40            | 101544       | 2022/5/9           | 2023/5/8            |
| Test Receiver<br>Agilent      | N9038A           | MY51210129   | 2022/4/8           | 2023/4/7            |
|                               |                  | MY51210137   | 2021/6/16          | 2022/6/15           |
| Tower<br>ADT                  | AT100            | 0306         | N/A                | N/A                 |
| Turn Table<br>ADT             | TT100            | 0306         | N/A                | N/A                 |

Notes:

- \* The calibration interval of the above test instruments is 24 months and the calibrations are traceable to NML/ROC and NIST/USA
- The test was performed in Linkou 966 Chamber 6 (CH 6).
- Tested Date: 2022/5/13

#### 4.8 Unwanted Emissions above 1 GHz

| Description<br>Manufacturer               | Model No.               | Serial No.           | Calibrated<br>Date | Calibrated<br>Until |
|-------------------------------------------|-------------------------|----------------------|--------------------|---------------------|
| BandPass Filter<br>MICRO-TRONICS          | BRM17690                | 005                  | 2021/5/28          | 2022/5/27           |
| Boresight antenna tower fixture<br>BV     | BAF-02                  | 6                    | N/A                | N/A                 |
| Highpass filter<br>Wainwright Instruments | WHK 3.1/18G-10SS        | SN 8                 | 2021/5/28          | 2022/5/27           |
| Horn Antenna<br>ETS-Lindgren              | 3117-PA                 | 00215857             | 2021/11/14         | 2022/11/13          |
| Horn Antenna<br>EMCO                      | 3115                    | 00028257             | 2021/11/14         | 2022/11/13          |
|                                           |                         | 00027024             | 2021/11/14         | 2022/11/13          |
| Horn Antenna<br>Schwarzbeck               | BBHA 9170               | 212                  | 2021/10/13         | 2022/10/12          |
| Notch filter<br>MICRO-TRONICS             | BRC50703-01             | 010                  | 2021/5/28          | 2022/5/27           |
| Pre_Amplifier<br>EMCI                     | EMC0126545              | 980076               | 2022/2/17          | 2023/2/16           |
|                                           | EMC184045B              | 980235               | 2022/2/17          | 2023/2/16           |
| Pre-amplifier<br>HP                       | 8449B                   | 3008A01201           | 2022/2/17          | 2023/2/16           |
| Pre-amplifier (18GHz-40GHz)<br>EMCI       | EMC184045B              | 980175               | 2021/9/4           | 2022/9/3            |
| RF Coaxial Cable<br>HUBER SUHNER          | SF-102                  | Cable-CH6-01         | 2021/7/8           | 2022/7/7            |
| RF Coaxial Cable<br>EM                    | EM102-KMKM-3.5+1M       | EM102-KMKM-3.5+1M-01 | 2021/7/8           | 2022/7/7            |
| RF Coaxial Cable<br>WOKEN                 | WC01                    | Cable-CH10-03        | 2021/7/8           | 2022/7/7            |
| RF Coaxial Cable<br>Rosnol                | K1K50-UP0279-K1K50-3000 | Cable-CH10(3m)-04    | 2021/7/8           | 2022/7/7            |
| Software<br>BVADT                         | Radiated_V8.7.08        | N/A                  | N/A                | N/A                 |
| Spectrum Analyzer<br>Agilent              | E4446A                  | MY51100009           | 2021/6/29          | 2022/6/28           |
| Spectrum Analyzer<br>KEYSIGHT             | N9030A                  | MY54490260           | 2021/7/23          | 2022/7/22           |
| Spectrum Analyzer<br>R&S                  | FSV40                   | 101544               | 2022/5/9           | 2023/5/8            |
|                                           |                         | 101042               | 2021/9/9           | 2022/9/8            |
| Test Receiver<br>Agilent                  | N9038A                  | MY51210129           | 2022/4/8           | 2023/4/7            |
|                                           |                         | MY51210137           | 2021/6/16          | 2022/6/15           |
| Tower<br>ADT                              | AT100                   | 0306                 | N/A                | N/A                 |
| Turn Table<br>ADT                         | TT100                   | 0306                 | N/A                | N/A                 |

Notes:

1. The test was performed in Linkou 966 Chamber 6 (CH 6).
2. Tested Date: 2022/5/12

## 5 Limits of Test Items

### 5.1 RF Output Power

The Maximum Output Power Measurement is 125 mW (21 dBm).

### 5.2 Number of Hopping Frequency Used

At least 15 channels frequencies, and should be equally spaced.

### 5.3 Dwell Time on Each Channel

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.

### 5.4 Hopping Channel Separation

At least 25 kHz or two-third of 20 dB hopping channel bandwidth (whichever is greater).

### 5.5 20 dB Bandwidth

Maximum bandwidth is not specified.

### 5.6 Conducted Out of Band Emissions

Below 20 dB of the highest emission level of operating band (in 100 kHz Resolution Bandwidth).

### 5.7 Unwanted Emissions below 1 GHz

Radiated emissions up to 1 GHz which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20 dB below the highest level of the desired power:

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

Notes:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).

## 5.8 Unwanted Emissions above 1 GHz

Radiated emissions above 1 GHz which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20 dB below the highest level of the desired power:

| Frequencies<br>(MHz) | Field Strength<br>(microvolts/meter) | Measurement Distance<br>(meters) |
|----------------------|--------------------------------------|----------------------------------|
| Above 960            | 500                                  | 3                                |

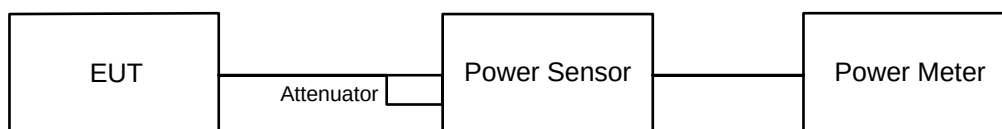
### Notes:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

## 6 Test Arrangements

### 6.1 RF Output Power

#### 6.1.1 Test Setup



#### 6.1.2 Test Procedure

##### Peak Power:

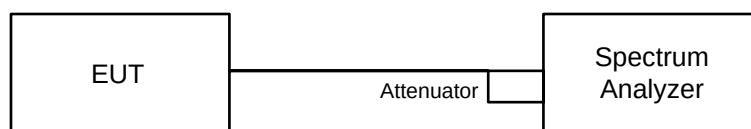
A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

##### Average Power:

Average power sensor was used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

### 6.2 Number of Hopping Frequency Used

#### 6.2.1 Test Setup



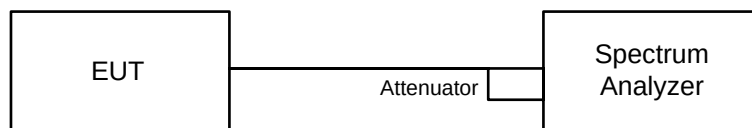
#### 6.2.2 Test Procedure

- Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- 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.
- 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.
- Set the SA on View mode and then plot the result on SA screen.
- Repeat above procedures until all frequencies measured were complete.



### 6.3 Dwell Time on Each Channel

#### 6.3.1 Test Setup



#### 6.3.2 Test Procedure

- Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- 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.
- Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
- Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
- Repeat above procedures until all different time-slot modes have been completed.

### 6.4 Hopping Channel Separation

#### 6.4.1 Test Setup

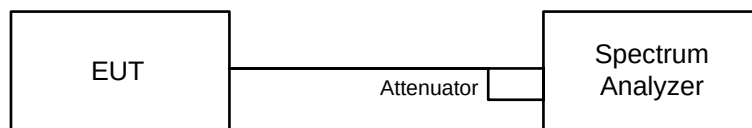


#### 6.4.2 Test Procedure

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

## 6.5 20 dB Bandwidth

### 6.5.1 Test Setup

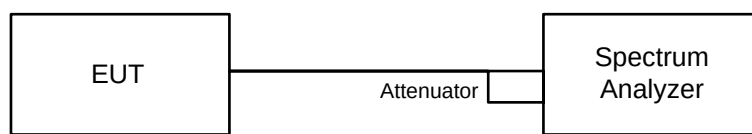


### 6.5.2 Test Procedure

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 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.
- Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
- Repeat above procedures until all frequencies measured were complete.

## 6.6 Conducted Out of Band Emissions

### 6.6.1 Test Setup



### 6.6.2 Test Procedure

#### MEASUREMENT PROCEDURE REF

- Set the RBW = 100 kHz.
- Set the VBW  $\geq$  300 kHz.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

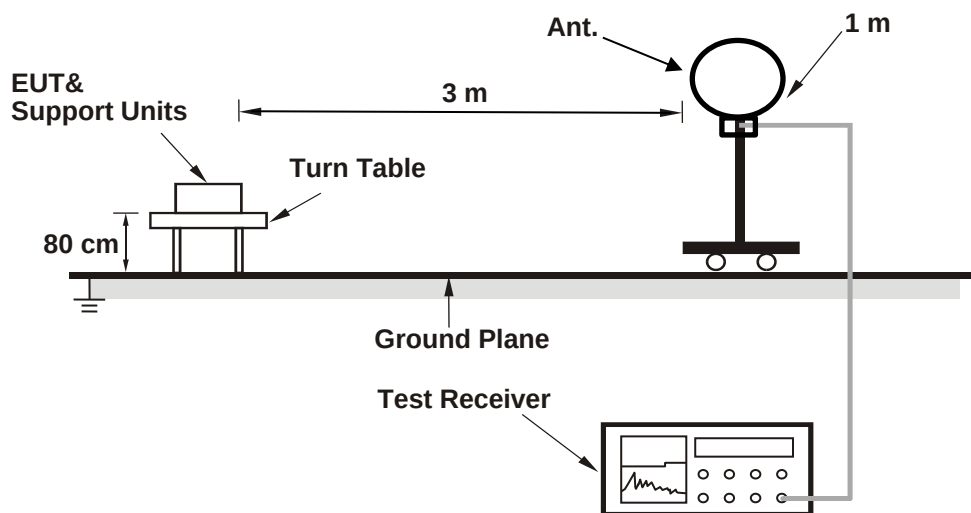
#### MEASUREMENT PROCEDURE OOB

- Set RBW = 100 kHz.
- Set VBW  $\geq$  300 kHz.
- Detector = peak.
- Sweep = auto couple.
- Trace Mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level.

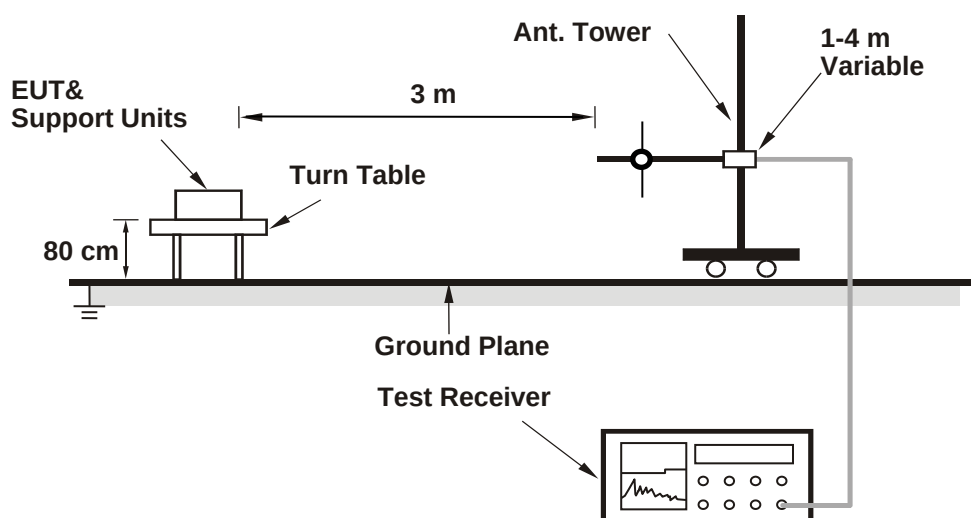
## 6.7 Unwanted Emissions below 1 GHz

### 6.7.1 Test Setup

For Radiated emission below 30 MHz



For Radiated emission above 30 MHz



## 6.7.2 Test Procedure

### For Radiated emission below 30 MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

#### Notes:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9 kHz at frequency below 30 MHz.
2. All modes of operation were investigated and the worst-case emissions are reported.

### For Radiated emission above 30 MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

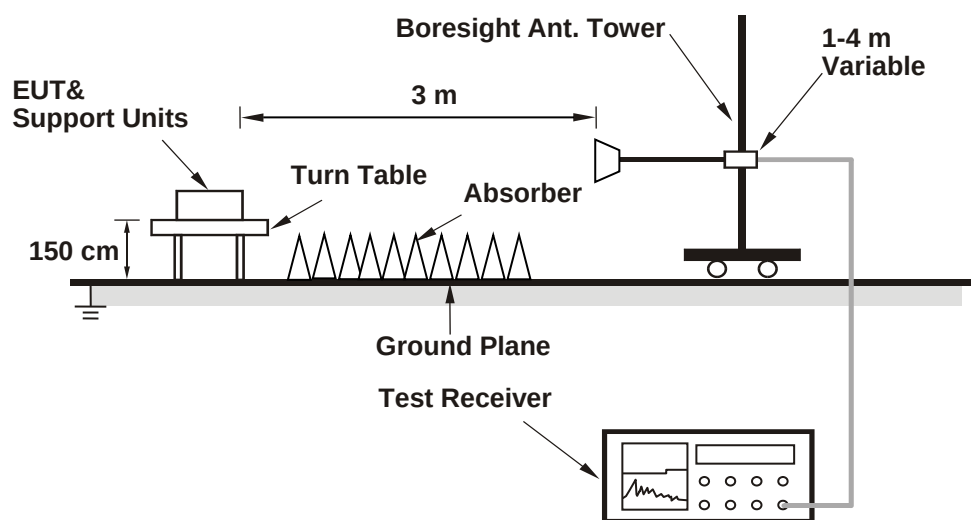
#### Notes:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. All modes of operation were investigated and the worst-case emissions are reported.

## 6.8 Unwanted Emissions above 1 GHz

### 6.8.1 Test Setup

#### For Radiated emission above 1 GHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

### 6.8.2 Test Procedure

- The EUT was placed on the top of a rotating table 1.5 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

#### Notes:

- The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) and Average detection (AV) at frequency above 1 GHz.
- All modes of operation were investigated and the worst-case emissions are reported.

## 7 Test Results of Test Item

### 7.1 RF Output Power

|              |        |                           |              |            |           |
|--------------|--------|---------------------------|--------------|------------|-----------|
| Input Power: | 18 Vdc | Environmental Conditions: | 25°C, 76% RH | Tested By: | Dalen Dai |
|--------------|--------|---------------------------|--------------|------------|-----------|

#### For Peak Power

##### GFSK

| Chan. | Chan. Freq. (MHz) | Peak Power (mW) | Peak Power (dBm) | Power Limit (dBm) | Test Result |
|-------|-------------------|-----------------|------------------|-------------------|-------------|
| 0     | 2402              | 1.435           | 1.57             | 21                | Pass        |
| 39    | 2441              | 1.486           | 1.72             | 21                | Pass        |
| 78    | 2480              | 1.517           | 1.81             | 21                | Pass        |

Note: The antenna gain is 1.927 dBi < 6 dBi, so the output power limit shall not be reduced.

##### 8DPSK

| Chan. | Chan. Freq. (MHz) | Peak Power (mW) | Peak Power (dBm) | Power Limit (dBm) | Test Result |
|-------|-------------------|-----------------|------------------|-------------------|-------------|
| 0     | 2402              | 1.406           | 1.48             | 21                | Pass        |
| 39    | 2441              | 1.435           | 1.57             | 21                | Pass        |
| 78    | 2480              | 1.507           | 1.78             | 21                | Pass        |

Note: The antenna gain is 1.927 dBi < 6 dBi, so the output power limit shall not be reduced.

#### For Average Power

##### GFSK

| Chan. | Chan. Freq. (MHz) | Average Power (mW) | Average Power (dBm) |
|-------|-------------------|--------------------|---------------------|
| 0     | 2402              | 1.371              | 1.37                |
| 39    | 2441              | 1.409              | 1.49                |
| 78    | 2480              | 1.455              | 1.63                |

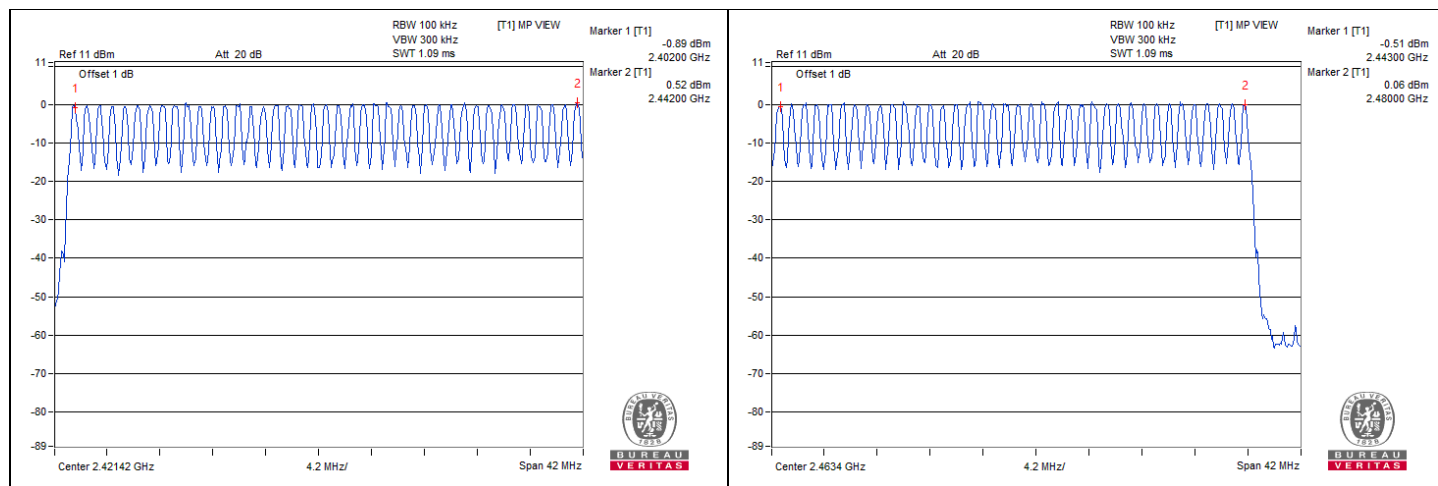
##### 8DPSK

| Chan. | Chan. Freq. (MHz) | Average Power (mW) | Average Power (dBm) |
|-------|-------------------|--------------------|---------------------|
| 0     | 2402              | 1.352              | 1.31                |
| 39    | 2441              | 1.380              | 1.40                |
| 78    | 2480              | 1.435              | 1.57                |

## 7.2 Number of Hopping Frequency Used

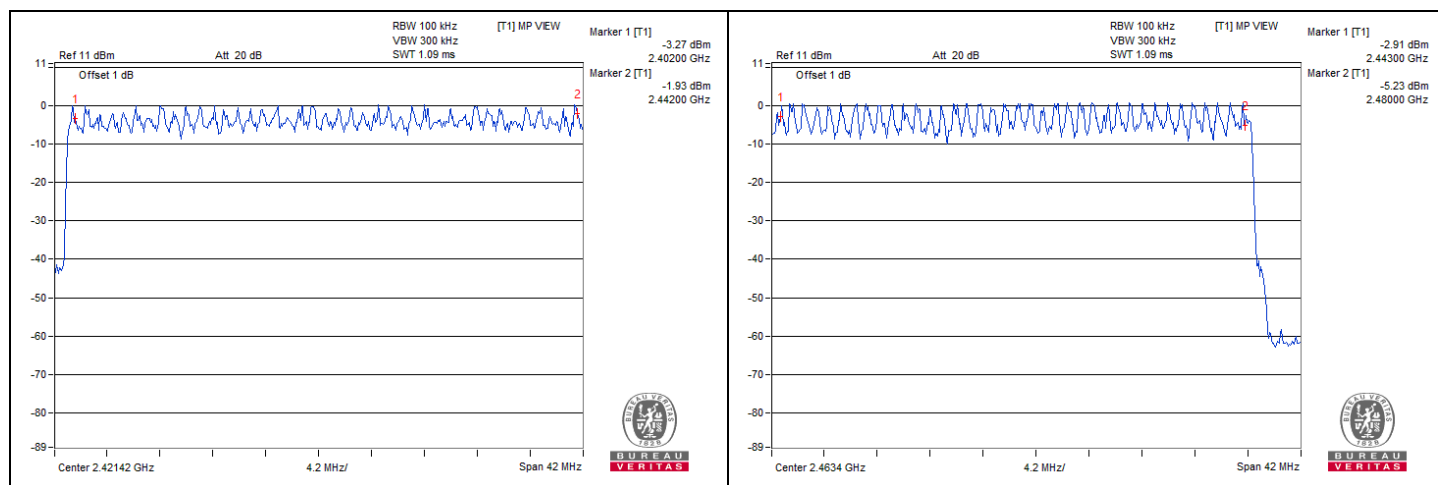
|              |        |                           |              |            |           |
|--------------|--------|---------------------------|--------------|------------|-----------|
| Input Power: | 18 Vdc | Environmental Conditions: | 25°C, 76% RH | Tested By: | Dalen Dai |
|--------------|--------|---------------------------|--------------|------------|-----------|

### GFSK



Note: There are 79 hopping frequencies in the hopping mode. On the plots, it shows that the hopping frequencies are equally spaced.

### 8DPSK



Note: There are 79 hopping frequencies in the hopping mode. On the plots, it shows that the hopping frequencies are equally spaced.

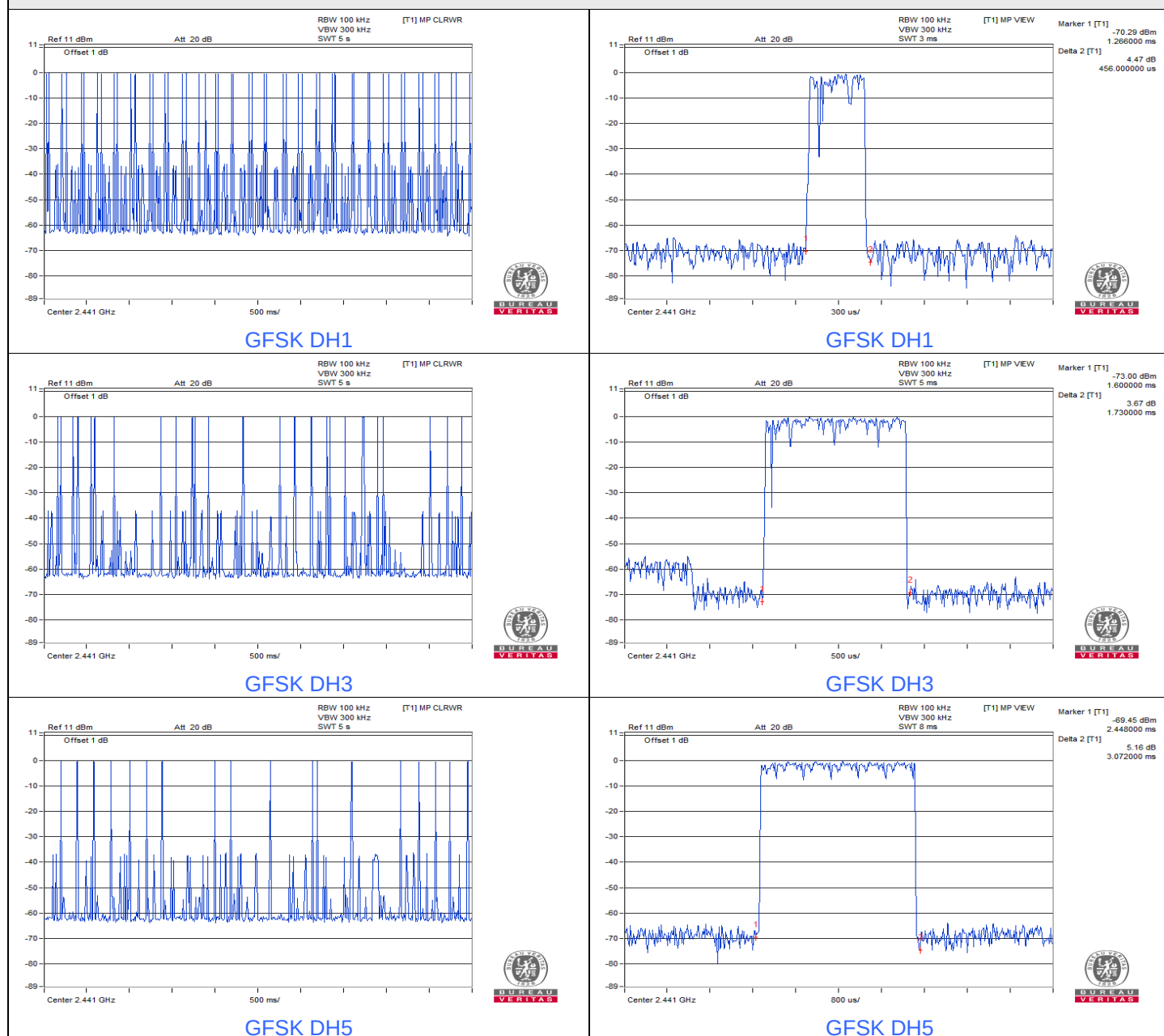
### 7.3 Dwell Time on Each Channel

|              |        |                           |              |            |           |
|--------------|--------|---------------------------|--------------|------------|-----------|
| Input Power: | 18 Vdc | Environmental Conditions: | 25°C, 76% RH | Tested By: | Dalen Dai |
|--------------|--------|---------------------------|--------------|------------|-----------|

#### GFSK

| Mode | Number of transmission in 31.6 sec    | Length of transmission time (msec) | Result (msec) | Limit (msec) | Test Result |
|------|---------------------------------------|------------------------------------|---------------|--------------|-------------|
| DH1  | 51 (times / 5 sec) * 6.32 = 323 times | 0.456                              | 147.29        | 400          | Pass        |
| DH3  | 25 (times / 5 sec) * 6.32 = 158 times | 1.73                               | 273.34        | 400          | Pass        |
| DH5  | 18 (times / 5 sec) * 6.32 = 114 times | 3.072                              | 350.21        | 400          | Pass        |

#### Spectrum plots of Dwell Time





# 8DPSK

| Mode | Number of transmission in 31.6 sec    | Length of transmission time (msec) | Result (msec) | Limit (msec) | Test Result |
|------|---------------------------------------|------------------------------------|---------------|--------------|-------------|
| 3DH1 | 50 (times / 5 sec) * 6.32 = 316 times | 0.432                              | 136.51        | 400          | Pass        |
| 3DH3 | 27 (times / 5 sec) * 6.32 = 171 times | 1.74                               | 297.54        | 400          | Pass        |
| 3DH5 | 17 (times / 5 sec) * 6.32 = 108 times | 2.976                              | 321.41        | 400          | Pass        |

## Spectrum plots of Dwell Time



## 7.4 Hopping Channel Separation

|              |        |                           |              |            |           |
|--------------|--------|---------------------------|--------------|------------|-----------|
| Input Power: | 18 Vdc | Environmental Conditions: | 25°C, 76% RH | Tested By: | Dalen Dai |
|--------------|--------|---------------------------|--------------|------------|-----------|

### GFSK

| Channel | Frequency (MHz) | Hopping Channel Separation (MHz) | Minimum Limit (MHz) | Test Result |
|---------|-----------------|----------------------------------|---------------------|-------------|
| 0       | 2402            | 1                                | 0.63                | Pass        |
| 39      | 2441            | 1                                | 0.64                | Pass        |
| 78      | 2480            | 1                                | 0.63                | Pass        |

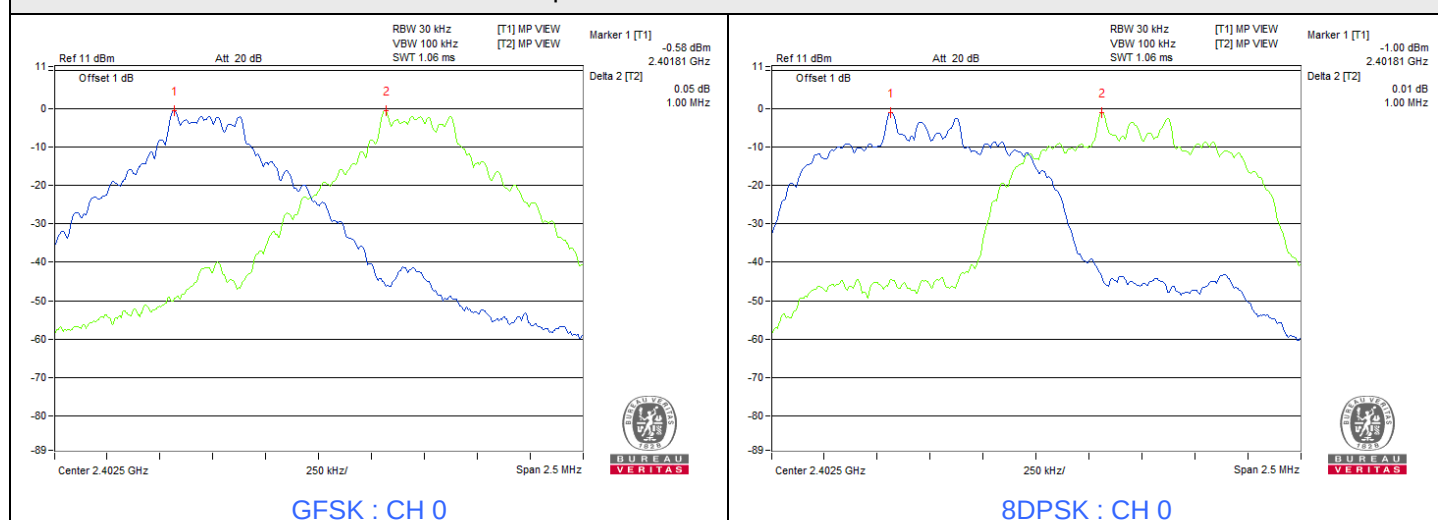
Note: The minimum limit is two-third 20dB bandwidth.

### 8DPSK

| Channel | Frequency (MHz) | Hopping Channel Separation (MHz) | Minimum Limit (MHz) | Test Result |
|---------|-----------------|----------------------------------|---------------------|-------------|
| 0       | 2402            | 1                                | 0.84                | Pass        |
| 39      | 2441            | 1                                | 0.84                | Pass        |
| 78      | 2480            | 1                                | 0.85                | Pass        |

Note: The minimum limit is two-third 20dB bandwidth.

Spectrum Plot of Minimum Value



## 7.5 20 dB Bandwidth

|              |        |                           |              |            |           |
|--------------|--------|---------------------------|--------------|------------|-----------|
| Input Power: | 18 Vdc | Environmental Conditions: | 25°C, 76% RH | Tested By: | Dalen Dai |
|--------------|--------|---------------------------|--------------|------------|-----------|

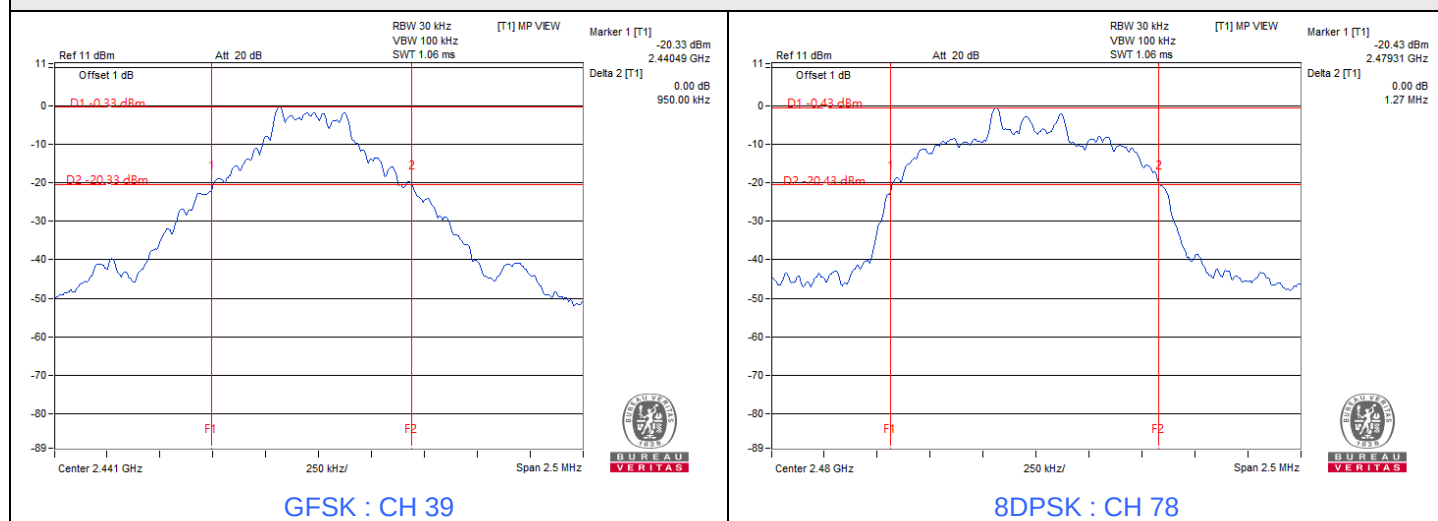
### GFSK

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) |
|---------|-----------------|----------------------|
| 0       | 2402            | 0.94                 |
| 39      | 2441            | 0.95                 |
| 78      | 2480            | 0.94                 |

### 8DPSK

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) |
|---------|-----------------|----------------------|
| 0       | 2402            | 1.26                 |
| 39      | 2441            | 1.26                 |
| 78      | 2480            | 1.27                 |

Spectrum Plot of Maximum Value



## 7.6 Conducted Out of Band Emissions

|              |        |                           |              |            |           |
|--------------|--------|---------------------------|--------------|------------|-----------|
| Input Power: | 18 Vdc | Environmental Conditions: | 25°C, 76% RH | Tested By: | Dalen Dai |
|--------------|--------|---------------------------|--------------|------------|-----------|

### GFSK



# 8DPSK



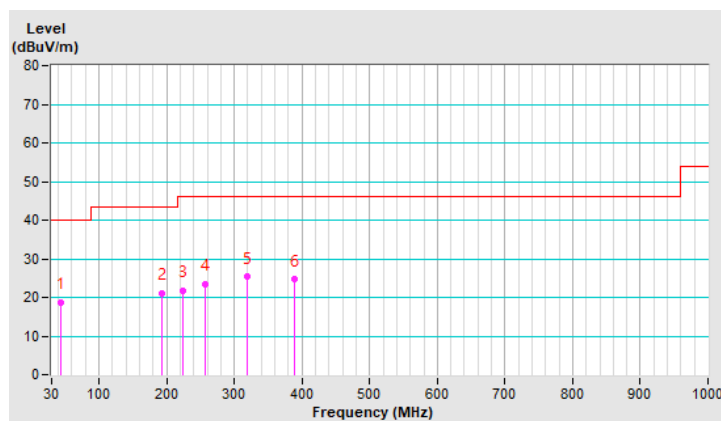
## 7.7 Unwanted Emissions below 1 GHz

|                 |               |                               |                  |
|-----------------|---------------|-------------------------------|------------------|
| RF Mode         | TX BT GFSK    | Channel                       | CH 78 : 2480 MHz |
| Frequency Range | 9 kHz ~ 1 GHz | Detector Function & Bandwidth | (QP) RB = 120kHz |
| Input Power     | 18 Vdc        | Environmental Conditions      | 22°C, 60% RH     |
| Tested By       | Jed Wu        |                               |                  |

| Antenna Polarity & Test Distance : Horizontal at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|------------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                   | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                    | 42.80           | 18.7 QP                 | 40.0           | -21.3       | 1.05 H             | 97                   | 27.6             | -8.9                     |
| 2                                                    | 191.99          | 21.0 QP                 | 43.5           | -22.5       | 1.48 H             | 276                  | 31.3             | -10.3                    |
| 3                                                    | 224.00          | 21.8 QP                 | 46.0           | -24.2       | 1.53 H             | 295                  | 32.1             | -10.3                    |
| 4                                                    | 256.01          | 23.4 QP                 | 46.0           | -22.6       | 1.73 H             | 104                  | 31.1             | -7.7                     |
| 5                                                    | 319.98          | 25.3 QP                 | 46.0           | -20.7       | 1.96 H             | 7                    | 30.4             | -5.1                     |
| 6                                                    | 389.09          | 24.6 QP                 | 46.0           | -21.4       | 1.22 H             | 360                  | 28.4             | -3.8                     |

### Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30 MHz ~ 1 GHz.
5. The emission levels were very low against the limit of frequency range 9 kHz ~ 30 MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.

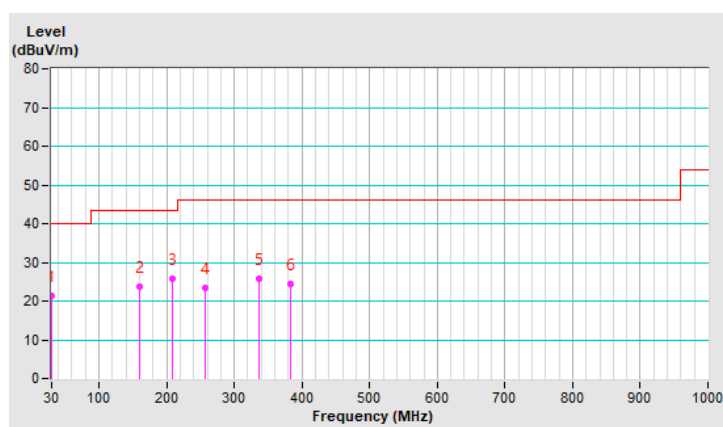


|                 |               |                               |                  |
|-----------------|---------------|-------------------------------|------------------|
| RF Mode         | TX BT GFSK    | Channel                       | CH 78 : 2480 MHz |
| Frequency Range | 9 kHz ~ 1 GHz | Detector Function & Bandwidth | (QP) RB = 120kHz |
| Input Power     | 18 Vdc        | Environmental Conditions      | 22°C, 60% RH     |
| Tested By       | Jed Wu        |                               |                  |

| Antenna Polarity & Test Distance : Vertical at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|----------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                 | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                  | 30.58           | 21.3 QP                 | 40.0           | -18.7       | 1.35 V             | 131                  | 31.7             | -10.4                    |
| 2                                                  | 159.98          | 23.7 QP                 | 43.5           | -19.8       | 1.46 V             | 359                  | 31.6             | -7.9                     |
| 3                                                  | 208.00          | 25.9 QP                 | 43.5           | -17.6       | 1.87 V             | 22                   | 36.2             | -10.3                    |
| 4                                                  | 256.01          | 23.5 QP                 | 46.0           | -22.5       | 1.96 V             | 337                  | 31.2             | -7.7                     |
| 5                                                  | 335.99          | 25.8 QP                 | 46.0           | -20.2       | 1.22 V             | 99                   | 30.7             | -4.9                     |
| 6                                                  | 383.56          | 24.4 QP                 | 46.0           | -21.6       | 1.08 V             | 199                  | 28.4             | -4.0                     |

#### Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30 MHz ~ 1 GHz.
5. The emission levels were very low against the limit of frequency range 9 kHz ~ 30 MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.



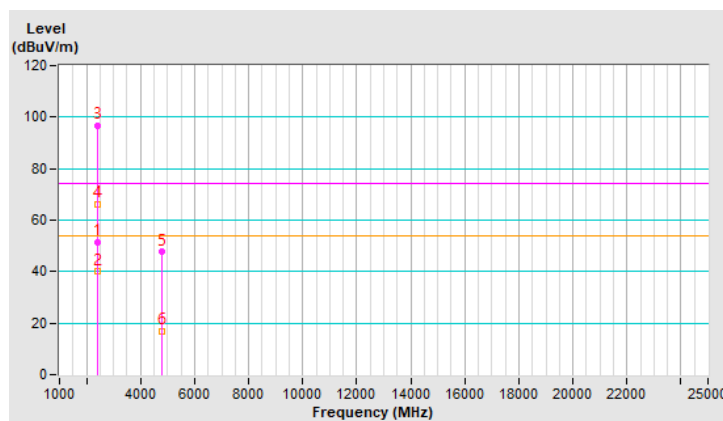
## 7.8 Unwanted Emissions above 1 GHz

|                 |                |                               |                                                                     |
|-----------------|----------------|-------------------------------|---------------------------------------------------------------------|
| RF Mode         | TX BT GFSK     | Channel                       | CH 0 : 2402 MHz                                                     |
| Frequency Range | 1 GHz ~ 25 GHz | Detector Function & Bandwidth | (PK) RB = 1 MHz, VB = 3 MHz<br>(AV) RB = 1 MHz, VB = 3 MHz<br>(RMS) |
| Input Power     | 18 Vdc         | Environmental Conditions      | 22°C, 60% RH                                                        |
| Tested By       | Jed Wu         |                               |                                                                     |

| Antenna Polarity & Test Distance : Horizontal at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|------------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                   | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                    | 2390.00         | 51.3 PK                 | 74.0           | -22.7       | 1.06 H             | 260                  | 53.6             | -2.3                     |
| 2                                                    | 2390.00         | 40.0 AV                 | 54.0           | -14.0       | 1.06 H             | 260                  | 42.3             | -2.3                     |
| 3                                                    | *2402.00        | 96.8 PK                 |                |             | 1.06 H             | 260                  | 99.1             | -2.3                     |
| 4                                                    | *2402.00        | 66.0 AV                 |                |             | 1.06 H             | 260                  | 68.3             | -2.3                     |
| 5                                                    | 4804.00         | 47.6 PK                 | 74.0           | -26.4       | 3.11 H             | 192                  | 42.1             | 5.5                      |
| 6                                                    | 4804.00         | 16.8 AV                 | 54.0           | -37.2       | 3.11 H             | 192                  | 11.3             | 5.5                      |

### Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.
6. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty cycle correction factor is calculated from following formula:  
 $20 \log(\text{Duty cycle}) = 20 \log(2.889 \text{ ms} / 100 \text{ ms}) = -30.8 \text{ dB}$



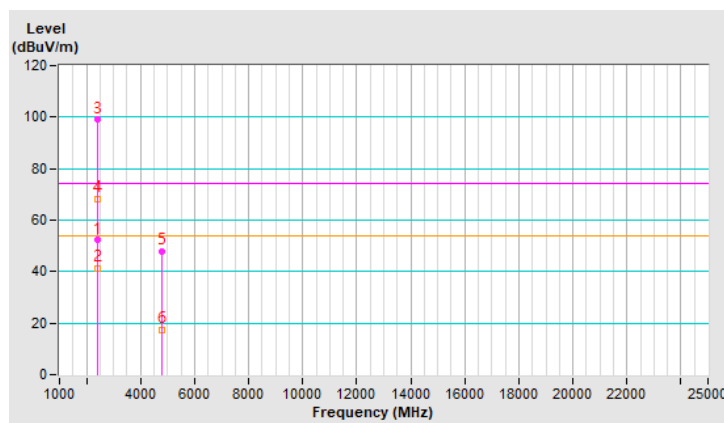


|                 |                |                               |                                                                     |
|-----------------|----------------|-------------------------------|---------------------------------------------------------------------|
| RF Mode         | TX BT GFSK     | Channel                       | CH 0 : 2402 MHz                                                     |
| Frequency Range | 1 GHz ~ 25 GHz | Detector Function & Bandwidth | (PK) RB = 1 MHz, VB = 3 MHz<br>(AV) RB = 1 MHz, VB = 3 MHz<br>(RMS) |
| Input Power     | 18 Vdc         | Environmental Conditions      | 22°C, 60% RH                                                        |
| Tested By       | Jed Wu         |                               |                                                                     |

| Antenna Polarity & Test Distance : Vertical at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|----------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                 | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                  | 2390.00         | 52.2 PK                 | 74.0           | -21.8       | 1.48 V             | 204                  | 54.5             | -2.3                     |
| 2                                                  | 2390.00         | 41.2 AV                 | 54.0           | -12.8       | 1.48 V             | 204                  | 43.5             | -2.3                     |
| 3                                                  | *2402.00        | 98.9 PK                 |                |             | 1.48 V             | 204                  | 101.2            | -2.3                     |
| 4                                                  | *2402.00        | 68.1 AV                 |                |             | 1.48 V             | 204                  | 70.4             | -2.3                     |
| 5                                                  | 4804.00         | 48.0 PK                 | 74.0           | -26.0       | 1.51 V             | 48                   | 42.5             | 5.5                      |
| 6                                                  | 4804.00         | 17.2 AV                 | 54.0           | -36.8       | 1.51 V             | 48                   | 11.7             | 5.5                      |

#### Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.
6. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty cycle correction factor is calculated from following formula:  
 $20 \log(\text{Duty cycle}) = 20 \log(2.889 \text{ ms} / 100 \text{ ms}) = -30.8 \text{ dB}$

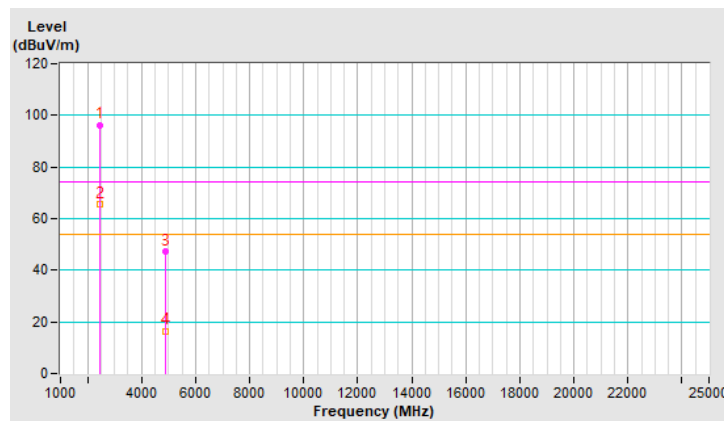


|                 |                |                               |                                                                     |
|-----------------|----------------|-------------------------------|---------------------------------------------------------------------|
| RF Mode         | TX BT GFSK     | Channel                       | CH 39 : 2441 MHz                                                    |
| Frequency Range | 1 GHz ~ 25 GHz | Detector Function & Bandwidth | (PK) RB = 1 MHz, VB = 3 MHz<br>(AV) RB = 1 MHz, VB = 3 MHz<br>(RMS) |
| Input Power     | 18 Vdc         | Environmental Conditions      | 22°C, 60% RH                                                        |
| Tested By       | Jed Wu         |                               |                                                                     |

| Antenna Polarity & Test Distance : Horizontal at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|------------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                   | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                    | *2441.00        | 96.2 PK                 |                |             | 1.04 H             | 265                  | 98.4             | -2.2                     |
| 2                                                    | *2441.00        | 65.4 AV                 |                |             | 1.04 H             | 265                  | 67.6             | -2.2                     |
| 3                                                    | 4882.00         | 47.1 PK                 | 74.0           | -26.9       | 3.03 H             | 189                  | 41.5             | 5.6                      |
| 4                                                    | 4882.00         | 16.3 AV                 | 54.0           | -37.7       | 3.03 H             | 189                  | 10.7             | 5.6                      |

#### Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.
6. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty cycle correction factor is calculated from following formula:  
 $20 \log(\text{Duty cycle}) = 20 \log(2.889 \text{ ms} / 100 \text{ ms}) = -30.8 \text{ dB}$

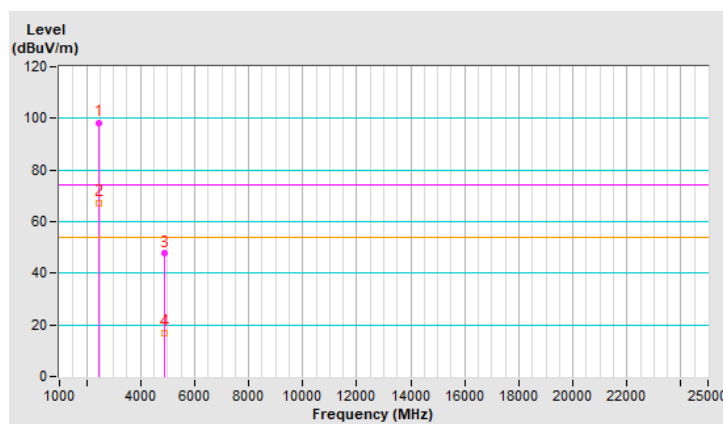


|                 |                |                               |                                                                     |
|-----------------|----------------|-------------------------------|---------------------------------------------------------------------|
| RF Mode         | TX BT GFSK     | Channel                       | CH 39 : 2441 MHz                                                    |
| Frequency Range | 1 GHz ~ 25 GHz | Detector Function & Bandwidth | (PK) RB = 1 MHz, VB = 3 MHz<br>(AV) RB = 1 MHz, VB = 3 MHz<br>(RMS) |
| Input Power     | 18 Vdc         | Environmental Conditions      | 22°C, 60% RH                                                        |
| Tested By       | Jed Wu         |                               |                                                                     |

| Antenna Polarity & Test Distance : Vertical at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|----------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                 | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                  | *2441.00        | 98.0 PK                 |                |             | 1.45 V             | 203                  | 100.2            | -2.2                     |
| 2                                                  | *2441.00        | 67.2 AV                 |                |             | 1.45 V             | 203                  | 69.4             | -2.2                     |
| 3                                                  | 4882.00         | 47.6 PK                 | 74.0           | -26.4       | 1.58 V             | 53                   | 42.0             | 5.6                      |
| 4                                                  | 4882.00         | 16.8 AV                 | 54.0           | -37.2       | 1.58 V             | 53                   | 11.2             | 5.6                      |

#### Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.
6. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty cycle correction factor is calculated from following formula:  
 $20 \log(\text{Duty cycle}) = 20 \log(2.889 \text{ ms} / 100 \text{ ms}) = -30.8 \text{ dB}$

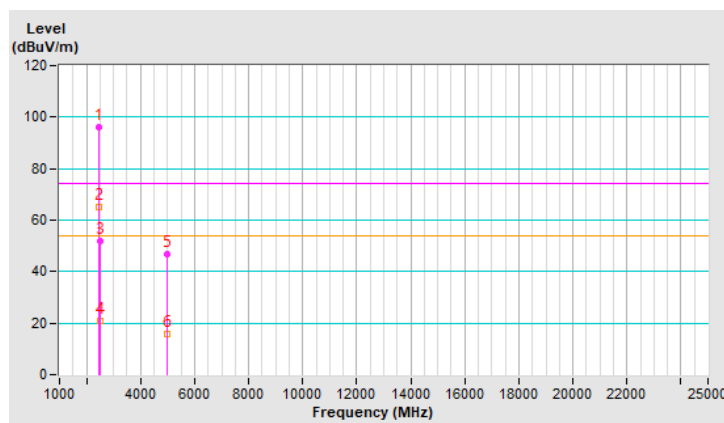


|                 |                |                               |                                                                     |
|-----------------|----------------|-------------------------------|---------------------------------------------------------------------|
| RF Mode         | TX BT GFSK     | Channel                       | CH 78 : 2480 MHz                                                    |
| Frequency Range | 1 GHz ~ 25 GHz | Detector Function & Bandwidth | (PK) RB = 1 MHz, VB = 3 MHz<br>(AV) RB = 1 MHz, VB = 3 MHz<br>(RMS) |
| Input Power     | 18 Vdc         | Environmental Conditions      | 22°C, 60% RH                                                        |
| Tested By       | Jed Wu         |                               |                                                                     |

| Antenna Polarity & Test Distance : Horizontal at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|------------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                   | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                    | *2480.00        | 96.1 PK                 |                |             | 1.08 H             | 265                  | 98.2             | -2.1                     |
| 2                                                    | *2480.00        | 65.3 AV                 |                |             | 1.08 H             | 265                  | 67.4             | -2.1                     |
| 3                                                    | 2483.50         | 51.9 PK                 | 74.0           | -22.1       | 1.08 H             | 265                  | 54.0             | -2.1                     |
| 4                                                    | 2483.50         | 21.1 AV                 | 54.0           | -32.9       | 1.08 H             | 265                  | 23.2             | -2.1                     |
| 5                                                    | 4960.00         | 46.7 PK                 | 74.0           | -27.3       | 2.99 H             | 201                  | 41.0             | 5.7                      |
| 6                                                    | 4960.00         | 15.9 AV                 | 54.0           | -38.1       | 2.99 H             | 201                  | 10.2             | 5.7                      |

#### Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.
6. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty cycle correction factor is calculated from following formula:  
 $20 \log(\text{Duty cycle}) = 20 \log(2.889 \text{ ms} / 100 \text{ ms}) = -30.8 \text{ dB}$

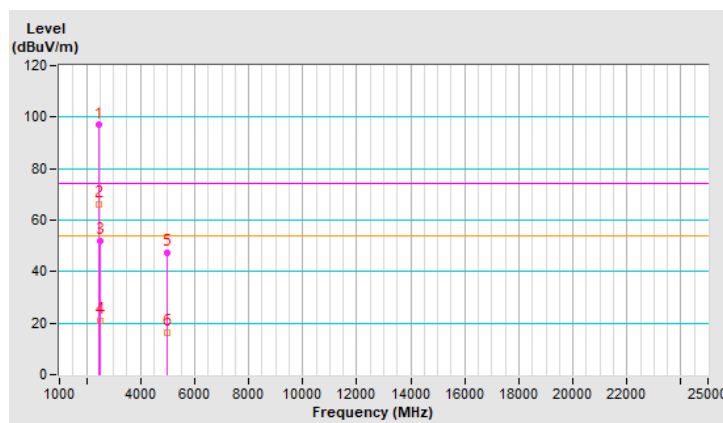


|                 |                |                               |                                                                     |
|-----------------|----------------|-------------------------------|---------------------------------------------------------------------|
| RF Mode         | TX BT GFSK     | Channel                       | CH 78 : 2480 MHz                                                    |
| Frequency Range | 1 GHz ~ 25 GHz | Detector Function & Bandwidth | (PK) RB = 1 MHz, VB = 3 MHz<br>(AV) RB = 1 MHz, VB = 3 MHz<br>(RMS) |
| Input Power     | 18 Vdc         | Environmental Conditions      | 22°C, 60% RH                                                        |
| Tested By       | Jed Wu         |                               |                                                                     |

| Antenna Polarity & Test Distance : Vertical at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|----------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                 | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                  | *2480.00        | 96.9 PK                 |                |             | 1.29 V             | 213                  | 99.0             | -2.1                     |
| 2                                                  | *2480.00        | 66.1 AV                 |                |             | 1.29 V             | 213                  | 68.2             | -2.1                     |
| 3                                                  | 2483.50         | 51.9 PK                 | 74.0           | -22.1       | 1.29 V             | 213                  | 54.0             | -2.1                     |
| 4                                                  | 2483.50         | 21.1 AV                 | 54.0           | -32.9       | 1.29 V             | 213                  | 23.2             | -2.1                     |
| 5                                                  | 4960.00         | 47.3 PK                 | 74.0           | -26.7       | 1.53 V             | 39                   | 41.6             | 5.7                      |
| 6                                                  | 4960.00         | 16.5 AV                 | 54.0           | -37.5       | 1.53 V             | 39                   | 10.8             | 5.7                      |

#### Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.
6. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty cycle correction factor is calculated from following formula:  
 $20 \log(\text{Duty cycle}) = 20 \log(2.889 \text{ ms} / 100 \text{ ms}) = -30.8 \text{ dB}$

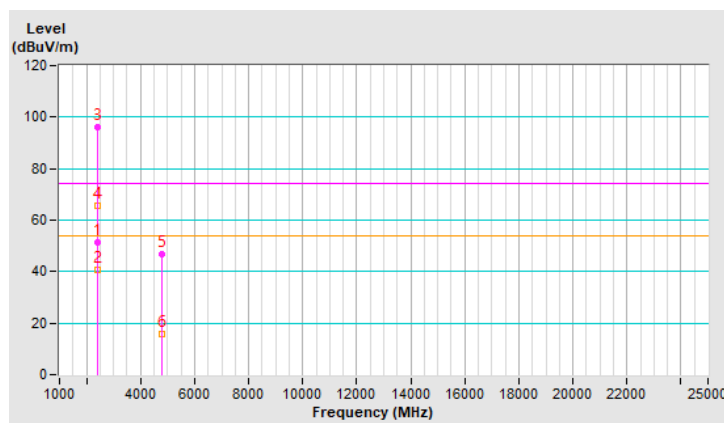


|                 |                |                               |                                                                     |
|-----------------|----------------|-------------------------------|---------------------------------------------------------------------|
| RF Mode         | TX BT 8DPSK    | Channel                       | CH 0 : 2402 MHz                                                     |
| Frequency Range | 1 GHz ~ 25 GHz | Detector Function & Bandwidth | (PK) RB = 1 MHz, VB = 3 MHz<br>(AV) RB = 1 MHz, VB = 3 MHz<br>(RMS) |
| Input Power     | 18 Vdc         | Environmental Conditions      | 22°C, 60% RH                                                        |
| Tested By       | Jed Wu         |                               |                                                                     |

| Antenna Polarity & Test Distance : Horizontal at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|------------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                   | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                    | 2390.00         | 51.4 PK                 | 74.0           | -22.6       | 1.70 H             | 276                  | 53.7             | -2.3                     |
| 2                                                    | 2390.00         | 40.8 AV                 | 54.0           | -13.2       | 1.70 H             | 276                  | 43.1             | -2.3                     |
| 3                                                    | *2402.00        | 96.3 PK                 |                |             | 1.70 H             | 276                  | 98.6             | -2.3                     |
| 4                                                    | *2402.00        | 65.5 AV                 |                |             | 1.70 H             | 276                  | 67.8             | -2.3                     |
| 5                                                    | 4804.00         | 46.8 PK                 | 74.0           | -27.2       | 3.09 H             | 286                  | 41.3             | 5.5                      |
| 6                                                    | 4804.00         | 16.0 AV                 | 54.0           | -38.0       | 3.09 H             | 286                  | 10.5             | 5.5                      |

#### Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.
6. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty cycle correction factor is calculated from following formula:  
 $20 \log(\text{Duty cycle}) = 20 \log(2.889 \text{ ms} / 100 \text{ ms}) = -30.8 \text{ dB}$

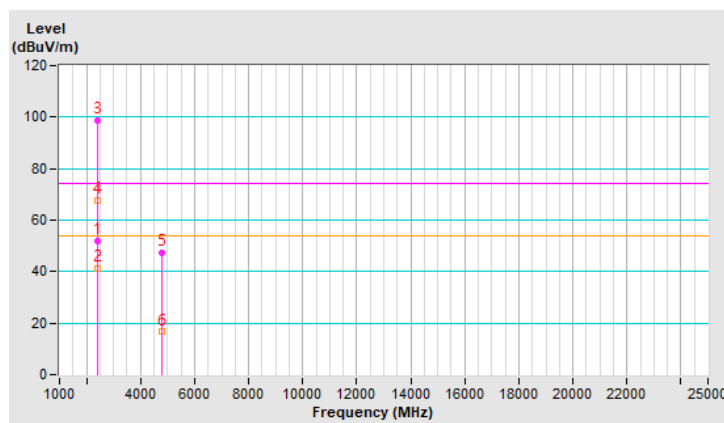


|                 |                |                               |                                                                     |
|-----------------|----------------|-------------------------------|---------------------------------------------------------------------|
| RF Mode         | TX BT 8DPSK    | Channel                       | CH 0 : 2402 MHz                                                     |
| Frequency Range | 1 GHz ~ 25 GHz | Detector Function & Bandwidth | (PK) RB = 1 MHz, VB = 3 MHz<br>(AV) RB = 1 MHz, VB = 3 MHz<br>(RMS) |
| Input Power     | 18 Vdc         | Environmental Conditions      | 22°C, 60% RH                                                        |
| Tested By       | Jed Wu         |                               |                                                                     |

| Antenna Polarity & Test Distance : Vertical at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|----------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                 | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                  | 2390.00         | 52.0 PK                 | 74.0           | -22.0       | 1.00 V             | 213                  | 54.3             | -2.3                     |
| 2                                                  | 2390.00         | 41.3 AV                 | 54.0           | -12.7       | 1.00 V             | 213                  | 43.6             | -2.3                     |
| 3                                                  | *2402.00        | 98.7 PK                 |                |             | 1.00 V             | 213                  | 101.0            | -2.3                     |
| 4                                                  | *2402.00        | 67.9 AV                 |                |             | 1.00 V             | 213                  | 70.2             | -2.3                     |
| 5                                                  | 4804.00         | 47.3 PK                 | 74.0           | -26.7       | 1.51 V             | 157                  | 41.8             | 5.5                      |
| 6                                                  | 4804.00         | 16.5 AV                 | 54.0           | -37.5       | 1.51 V             | 157                  | 11.0             | 5.5                      |

#### Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.
6. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty cycle correction factor is calculated from following formula:  
 $20 \log(\text{Duty cycle}) = 20 \log(2.889 \text{ ms} / 100 \text{ ms}) = -30.8 \text{ dB}$

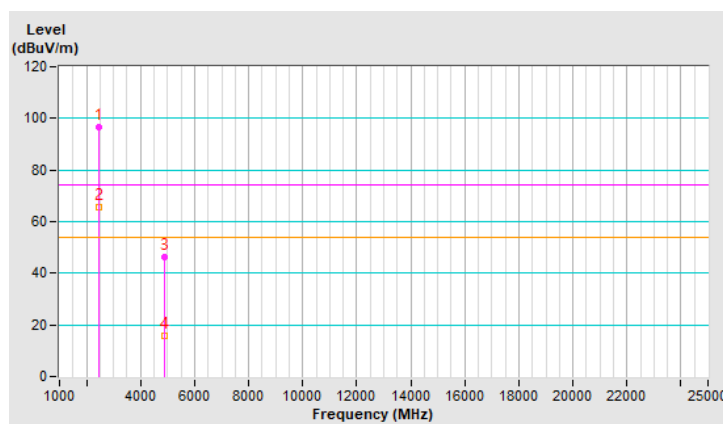


|                 |                |                               |                                                                     |
|-----------------|----------------|-------------------------------|---------------------------------------------------------------------|
| RF Mode         | TX BT 8DPSK    | Channel                       | CH 39 : 2441 MHz                                                    |
| Frequency Range | 1 GHz ~ 25 GHz | Detector Function & Bandwidth | (PK) RB = 1 MHz, VB = 3 MHz<br>(AV) RB = 1 MHz, VB = 3 MHz<br>(RMS) |
| Input Power     | 18 Vdc         | Environmental Conditions      | 22°C, 60% RH                                                        |
| Tested By       | Jed Wu         |                               |                                                                     |

| Antenna Polarity & Test Distance : Horizontal at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|------------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                   | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                    | *2441.00        | 96.5 PK                 |                |             | 1.68 H             | 271                  | 98.7             | -2.2                     |
| 2                                                    | *2441.00        | 65.7 AV                 |                |             | 1.68 H             | 271                  | 67.9             | -2.2                     |
| 3                                                    | 4882.00         | 46.4 PK                 | 74.0           | -27.6       | 3.10 H             | 281                  | 40.8             | 5.6                      |
| 4                                                    | 4882.00         | 15.6 AV                 | 54.0           | -38.4       | 3.10 H             | 281                  | 10.0             | 5.6                      |

#### Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.
6. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty cycle correction factor is calculated from following formula:  
 $20 \log(\text{Duty cycle}) = 20 \log(2.889 \text{ ms} / 100 \text{ ms}) = -30.8 \text{ dB}$



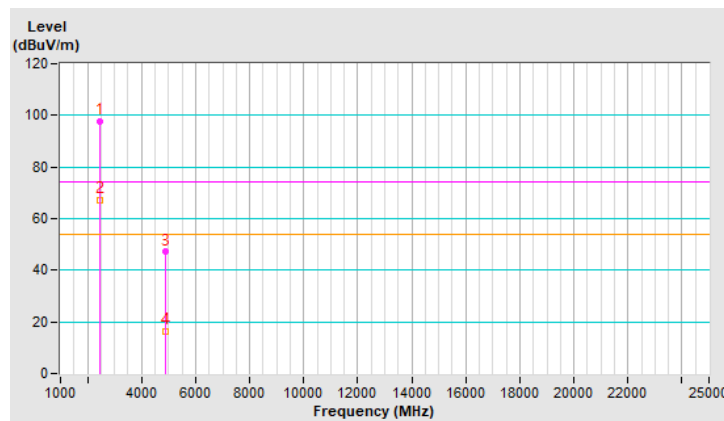


|                 |                |                               |                                                                     |
|-----------------|----------------|-------------------------------|---------------------------------------------------------------------|
| RF Mode         | TX BT 8DPSK    | Channel                       | CH 39 : 2441 MHz                                                    |
| Frequency Range | 1 GHz ~ 25 GHz | Detector Function & Bandwidth | (PK) RB = 1 MHz, VB = 3 MHz<br>(AV) RB = 1 MHz, VB = 3 MHz<br>(RMS) |
| Input Power     | 18 Vdc         | Environmental Conditions      | 22°C, 60% RH                                                        |
| Tested By       | Jed Wu         |                               |                                                                     |

| Antenna Polarity & Test Distance : Vertical at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|----------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                 | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                  | *2441.00        | 97.8 PK                 |                |             | 1.45 V             | 202                  | 100.0            | -2.2                     |
| 2                                                  | *2441.00        | 67.0 AV                 |                |             | 1.45 V             | 202                  | 69.2             | -2.2                     |
| 3                                                  | 4882.00         | 47.1 PK                 | 74.0           | -26.9       | 1.52 V             | 159                  | 41.5             | 5.6                      |
| 4                                                  | 4882.00         | 16.3 AV                 | 54.0           | -37.7       | 1.52 V             | 159                  | 10.7             | 5.6                      |

#### Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.
6. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty cycle correction factor is calculated from following formula:  
 $20 \log(\text{Duty cycle}) = 20 \log(2.889 \text{ ms} / 100 \text{ ms}) = -30.8 \text{ dB}$

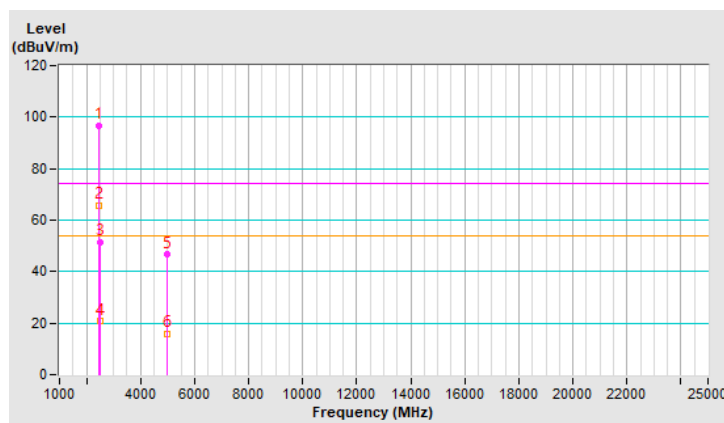


|                 |                |                               |                                                                     |
|-----------------|----------------|-------------------------------|---------------------------------------------------------------------|
| RF Mode         | TX BT 8DPSK    | Channel                       | CH 78 : 2480 MHz                                                    |
| Frequency Range | 1 GHz ~ 25 GHz | Detector Function & Bandwidth | (PK) RB = 1 MHz, VB = 3 MHz<br>(AV) RB = 1 MHz, VB = 3 MHz<br>(RMS) |
| Input Power     | 18 Vdc         | Environmental Conditions      | 22°C, 60% RH                                                        |
| Tested By       | Jed Wu         |                               |                                                                     |

| Antenna Polarity & Test Distance : Horizontal at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|------------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                   | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                    | *2480.00        | 96.6 PK                 |                |             | 1.67 H             | 257                  | 98.7             | -2.1                     |
| 2                                                    | *2480.00        | 65.8 AV                 |                |             | 1.67 H             | 257                  | 67.9             | -2.1                     |
| 3                                                    | 2483.50         | 51.4 PK                 | 74.0           | -22.6       | 1.67 H             | 257                  | 53.5             | -2.1                     |
| 4                                                    | 2483.50         | 20.6 AV                 | 54.0           | -33.4       | 1.67 H             | 257                  | 22.7             | -2.1                     |
| 5                                                    | 4960.00         | 46.6 PK                 | 74.0           | -27.4       | 3.06 H             | 288                  | 40.9             | 5.7                      |
| 6                                                    | 4960.00         | 15.8 AV                 | 54.0           | -38.2       | 3.06 H             | 288                  | 10.1             | 5.7                      |

#### Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.
6. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty cycle correction factor is calculated from following formula:  
 $20 \log(\text{Duty cycle}) = 20 \log(2.889 \text{ ms} / 100 \text{ ms}) = -30.8 \text{ dB}$

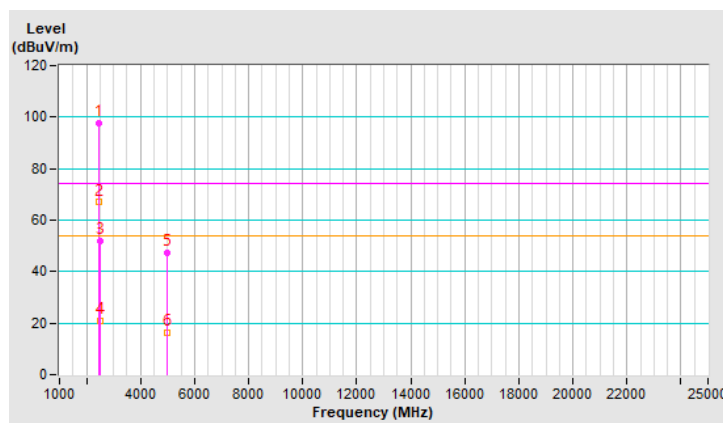


|                 |                |                               |                                                                     |
|-----------------|----------------|-------------------------------|---------------------------------------------------------------------|
| RF Mode         | TX BT 8DPSK    | Channel                       | CH 78 : 2480 MHz                                                    |
| Frequency Range | 1 GHz ~ 25 GHz | Detector Function & Bandwidth | (PK) RB = 1 MHz, VB = 3 MHz<br>(AV) RB = 1 MHz, VB = 3 MHz<br>(RMS) |
| Input Power     | 18 Vdc         | Environmental Conditions      | 22°C, 60% RH                                                        |
| Tested By       | Jed Wu         |                               |                                                                     |

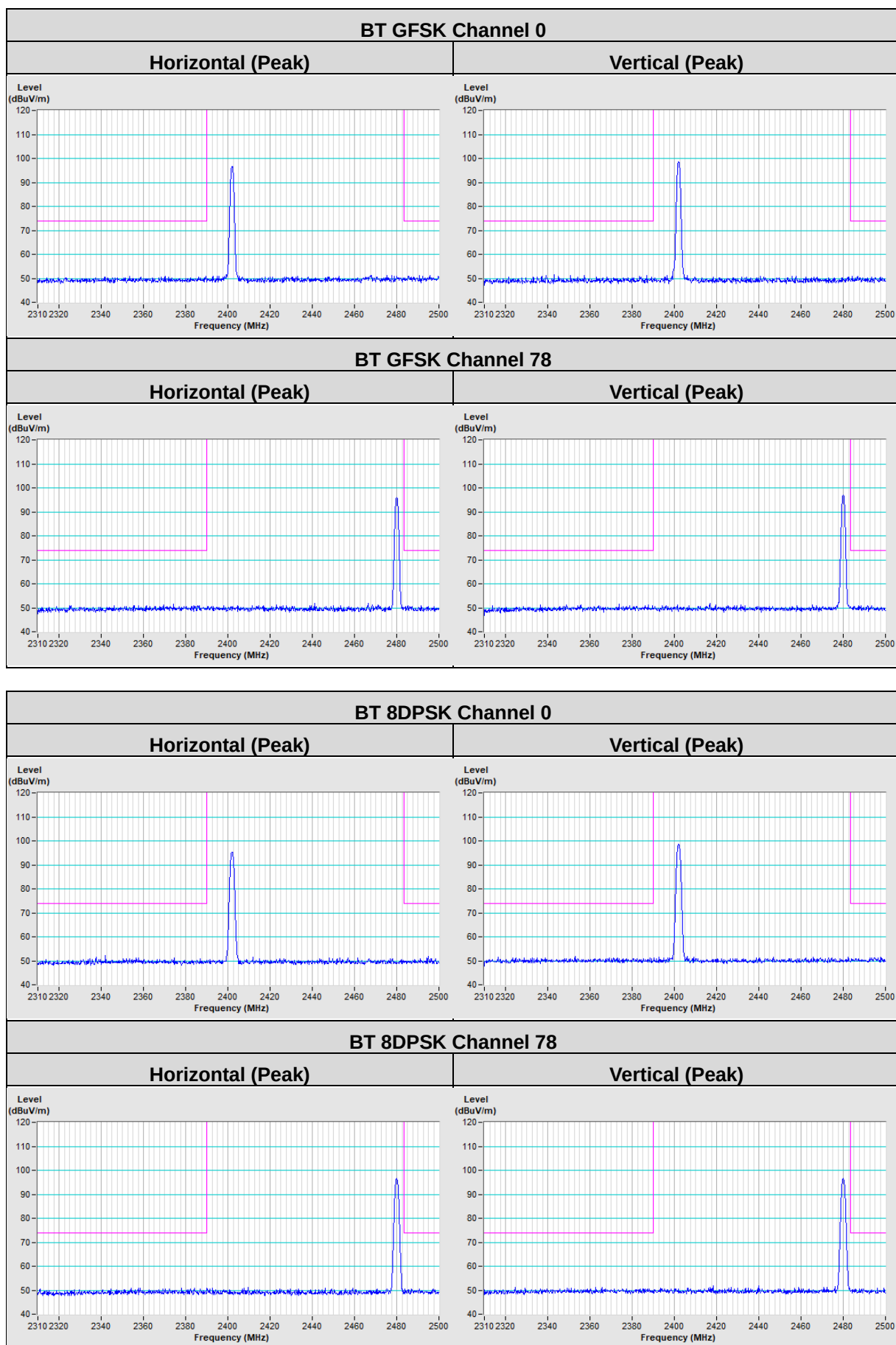
| Antenna Polarity & Test Distance : Vertical at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|----------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                 | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                  | *2480.00        | 97.7 PK                 |                |             | 1.12 V             | 203                  | 99.8             | -2.1                     |
| 2                                                  | *2480.00        | 66.9 AV                 |                |             | 1.12 V             | 203                  | 69.0             | -2.1                     |
| 3                                                  | 2483.50         | 51.8 PK                 | 74.0           | -22.2       | 1.12 V             | 203                  | 53.9             | -2.1                     |
| 4                                                  | 2483.50         | 21.0 AV                 | 54.0           | -33.0       | 1.12 V             | 203                  | 23.1             | -2.1                     |
| 5                                                  | 4960.00         | 47.3 PK                 | 74.0           | -26.7       | 1.49 V             | 155                  | 41.6             | 5.7                      |
| 6                                                  | 4960.00         | 16.5 AV                 | 54.0           | -37.5       | 1.49 V             | 155                  | 10.8             | 5.7                      |

#### Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.
6. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty cycle correction factor is calculated from following formula:  
 $20 \log(\text{Duty cycle}) = 20 \log(2.889 \text{ ms} / 100 \text{ ms}) = -30.8 \text{ dB}$



## Plot of Band Edge



## 8 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo)

## 9 Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

**Lin Kou EMC/RF Lab**

Tel: 886-2-26052180

Fax: 886-2-26051924

**Hsin Chu EMC/RF/Telecom Lab**

Tel: 886-3-6668565

Fax: 886-3-6668323

**Hwa Ya EMC/RF/Safety Lab**

Tel: 886-3-3183232

Fax: 886-3-3270892

**Email:** [service.adt@bureauveritas.com](mailto:service.adt@bureauveritas.com)

**Web Site:** <http://ee.bureauveritas.com.tw>

The address and road map of all our labs can be found in our web site also.

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