

## FCC Test Report

**Report No.:** RF170719C43

**FCC ID:** ASU-SUR2000

**Test Model:** SUR-2000XXX (X can be 0-9, a-z, A-Z, -, or blank)  
(Refer to item 3.1 for more details)

**Series Model:** REM-2000XXX (X can be 0-9, a-z, A-Z, -, or blank)  
REM-2000XXX (X can be 0-9, a-z, A-Z, -, or blank)  
(Refer to item 3.1 for more details)

**Received Date:** Jul. 19, 2017

**Test Date:** Aug. 16, 2017 ~ Aug. 25, 2017

**Issued Date:** Sep. 04, 2017

**Applicant:** Savant Systems LLC

**Address:** 45 Perseverance Way Hyannis MA, 02601 USA

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

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

**Test Location:** No. 19, Hwa Ya 2nd Rd, Wen Hwa Tsuen, Kwei Shan Hsiang, Taoyuan  
Hsien 333, Taiwan, R.O.C.



This report is for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence, provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents. Unless specific mention, the uncertainty of measurement has been explicitly taken into account to declare the compliance or non-compliance to the specification.

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### Release Control Record

| Issue No.   | Description      | Date Issued   |
|-------------|------------------|---------------|
| RF170719C43 | Original Release | Sep. 04, 2017 |

## 1 Certificate of Conformity

**Product:** Savant WIFI Touch Remote

**Brand:** Savant

**Test Model:** SUR-2000XXX (X can be 0-9, a-z, A-Z, -, or blank)  
(Refer to item 3.1 for more details)

**Series Model:** REM-2000XXX (X can be 0-9, a-z, A-Z, -, or blank)  
REM-2000XXX (X can be 0-9, a-z, A-Z, -, or blank)  
(Refer to item 3.1 for more details)

**Sample Status:** Identical Prototype

**Applicant:** Savant Systems LLC

**Test Date:** Aug. 16, 2017 ~ Aug. 25, 2017

**Standards:** 47 CFR FCC Part 15, Subpart C (Section 15.247)  
ANSI C63.10:2013

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 EMC characteristics under the conditions specified in this report.

**Prepared by :** Gina Liu , **Date:** Sep. 04, 2017  
Gina Liu / Specialist

**Approved by :** David Huang , **Date:** Sep. 04, 2017  
David Huang / Project Engineer

## 2 Summary of Test Results

| 47 CFR FCC Part 15, Subpart C (Section 15.247) |                                                                                                               |        |                                                                                       |
|------------------------------------------------|---------------------------------------------------------------------------------------------------------------|--------|---------------------------------------------------------------------------------------|
| FCC Clause                                     | Test Item                                                                                                     | Result | Remarks                                                                               |
| 15.207                                         | AC Power Conducted Emission                                                                                   | Pass   | Meet the requirement of limit.<br>Minimum passing margin is -14.27 dB at 0.57796 MHz. |
| 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)                                   | 1. Hopping Channel Separation<br>2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System | Pass   | Meet the requirement of limit.                                                        |
| 15.247(b)                                      | Maximum Peak Output Power                                                                                     | Pass   | Meet the requirement of limit.                                                        |
| 15.205 & 209                                   | Radiated Emissions                                                                                            | Pass   | Meet the requirement of limit.<br>Minimum passing margin is -2.79 dB at 401.51 MHz.   |
| 15.247(d)                                      | Band Edge Measurement                                                                                         | Pass   | Meet the requirement of limit.                                                        |
| 15.247(d)                                      | Antenna Port Emission                                                                                         | Pass   | Meet the requirement of limit.                                                        |
| 15.203                                         | Antenna Requirement                                                                                           | Pass   | No antenna connector is used.                                                         |

**Note:** 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.

### 2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT:

The listed uncertainties are the worst case uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

| Measurement                        | Frequency          | Expanded Uncertainty (k=2) (±) |
|------------------------------------|--------------------|--------------------------------|
| Conducted Emissions at mains ports | 150 kHz ~ 30 MHz   | 2.44 dB                        |
| Radiated Emissions up to 1 GHz     | 30 MHz ~ 200 MHz   | 2.93 dB                        |
|                                    | 200 MHz ~ 1000 MHz | 2.95 dB                        |
| Radiated Emissions above 1 GHz     | 1 GHz ~ 18 GHz     | 2.26 dB                        |
|                                    | 18 GHz ~ 40 GHz    | 1.94 dB                        |

### 2.2 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 General Description of EUT

|                            |                                                                                                                                                                                                                          |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Product</b>             | Savant WIFI Touch Remote                                                                                                                                                                                                 |
| <b>Brand</b>               | Savant                                                                                                                                                                                                                   |
| <b>Test Model</b>          | SUR-2000XXX (X can be 0-9, a-z, A-Z, -, or blank)                                                                                                                                                                        |
| <b>Series Model</b>        | REM-2000XXX (X can be 0-9, a-z, A-Z, -, or blank)<br>REM-2000XXX (X can be 0-9, a-z, A-Z, -, or blank)                                                                                                                   |
| <b>Model Difference</b>    | SUR-2000XXX (X can be 0-9, a-z, A-Z, -, or blank) - Model Number<br>REM-2000XXX (X can be 0-9, a-z, A-Z, -, or blank) - Sell SKU Domestic<br>REM-2000IXXX (X can be 0-9, a-z, A-Z, -, or blank) - Sell SKU International |
| <b>Status of EUT</b>       | Identical Prototype                                                                                                                                                                                                      |
| <b>Power Supply Rating</b> | 5.0 Vdc (adapter)<br>3.7 Vdc (Li-ion battery)                                                                                                                                                                            |
| <b>Modulation Type</b>     | GFSK, $\pi/4$ -DQPSK, 8DPSK                                                                                                                                                                                              |
| <b>Transfer Rate</b>       | 1/2/3 Mbps                                                                                                                                                                                                               |
| <b>Operating Frequency</b> | 2402 ~ 2480 MHz                                                                                                                                                                                                          |
| <b>Number of Channel</b>   | 79                                                                                                                                                                                                                       |
| <b>Output Power</b>        | 8.570 mW                                                                                                                                                                                                                 |
| <b>Antenna Type</b>        | PIFA antenna with -2.15 dBi gain                                                                                                                                                                                         |
| <b>Antenna Connector</b>   | N/A                                                                                                                                                                                                                      |
| <b>Accessory Device</b>    | Refer to Note as below                                                                                                                                                                                                   |
| <b>Data Cable Supplied</b> | Refer to Note as below                                                                                                                                                                                                   |

Note:

1. The EUT contains following accessory devices.

| Product   | Brand                        | Model                      | Description                                         |
|-----------|------------------------------|----------------------------|-----------------------------------------------------|
| Adapter   | Dee Van Electronics Co., Ltd | DSA-10PFL-05 FUS<br>050200 | I/P: 90-264 Vac, 47-63 Hz, 0.3 A<br>O/P: 5 Vdc, 2 A |
| Battery   | GETAC                        | GETAC                      | 3.7 Vdc, 2200 mAh                                   |
| Ducking   | SAVANT                       | QCA6234                    | --                                                  |
| WLAN Chip | Qualcomm Atheros             | QCA6234                    | --                                                  |

2. 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 Description of Test Modes

79 channels are provided to this EUT:

| Channel | Freq. (MHz) | Channel | Freq. (MHz) | Channel | Freq. (MHz) | Channel | Freq. (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        |         |             |

### 3.2.1 Test Mode Applicability and Tested Channel Detail

| EUT Configure Mode | Applicable To |       |     |      | Description |
|--------------------|---------------|-------|-----|------|-------------|
|                    | RE $\geq$ 1G  | RE<1G | PLC | APCM |             |
| -                  | √             | √     | √   | √    | -           |

Where **RE $\geq$ 1G**: Radiated Emission above 1 GHz

**RE<1G**: Radiated Emission below 1 GHz

**PLC**: Power Line Conducted Emission

**APCM**: Antenna Port Conducted Measurement

**Note:**

1. For Radiated emission test, pre-tested GFSK,  $\pi/4$ -DQPSK, 8DPSK modulation type and found GFSK was the worse, therefore chosen for the final test and presented in the test report.
2. The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Z-plane**.
3. "-" means no effect.

#### **Radiated Emission Test (Above 1 GHz):**

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

| EUT Configure Mode | Available Channel | Tested Channel | Modulation Technology | Modulation Type | Packet Type |
|--------------------|-------------------|----------------|-----------------------|-----------------|-------------|
| -                  | 0 to 78           | 0, 39, 78      | FHSS                  | GFSK            | DH5         |

#### **Radiated Emission Test (Below 1 GHz):**

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

| EUT Configure Mode | Available Channel | Tested Channel | Modulation Technology | Modulation Type | Packet Type |
|--------------------|-------------------|----------------|-----------------------|-----------------|-------------|
| -                  | 0 to 78           | 39             | FHSS                  | GFSK            | DH5         |

#### **Power Line Conducted Emission Test:**

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

| EUT Configure Mode | Available Channel | Tested Channel | Modulation Technology | Modulation Type | Packet Type |
|--------------------|-------------------|----------------|-----------------------|-----------------|-------------|
| -                  | 0 to 78           | 39             | FHSS                  | GFSK            | DH5         |

### Antenna Port Conducted Measurement:

- ☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

| EUT Configure Mode | Available Channel | Tested Channel | Modulation Technology | Modulation Type | Packet Type |
|--------------------|-------------------|----------------|-----------------------|-----------------|-------------|
| -                  | 0 to 78           | 0, 39, 78      | FHSS                  | GFSK            | DH5         |
| -                  | 0 to 78           | 0, 39, 78      | FHSS                  | $\pi/4$ -DQPSK  | DH5         |
| -                  | 0 to 78           | 0, 39, 78      | FHSS                  | 8DPSK           | DH5         |

### Test Condition:

| Applicable To | Environmental Conditions | Input Power    | Tested by   |
|---------------|--------------------------|----------------|-------------|
| RE $\geq$ 1G  | 25 deg. C, 65 % RH       | 120 Vac, 60 Hz | Getaz Yang  |
| RE<1G         | 25 deg. C, 65 % RH       | 120 Vac, 60 Hz | Getaz Yang  |
| PLC           | 25 deg. C, 65 % RH       | 120 Vac, 60 Hz | Han Wu      |
| APCM          | 25 deg. C, 65 % RH       | 3.7 Vdc        | Carlos Chen |

### 3.3 Description of 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.

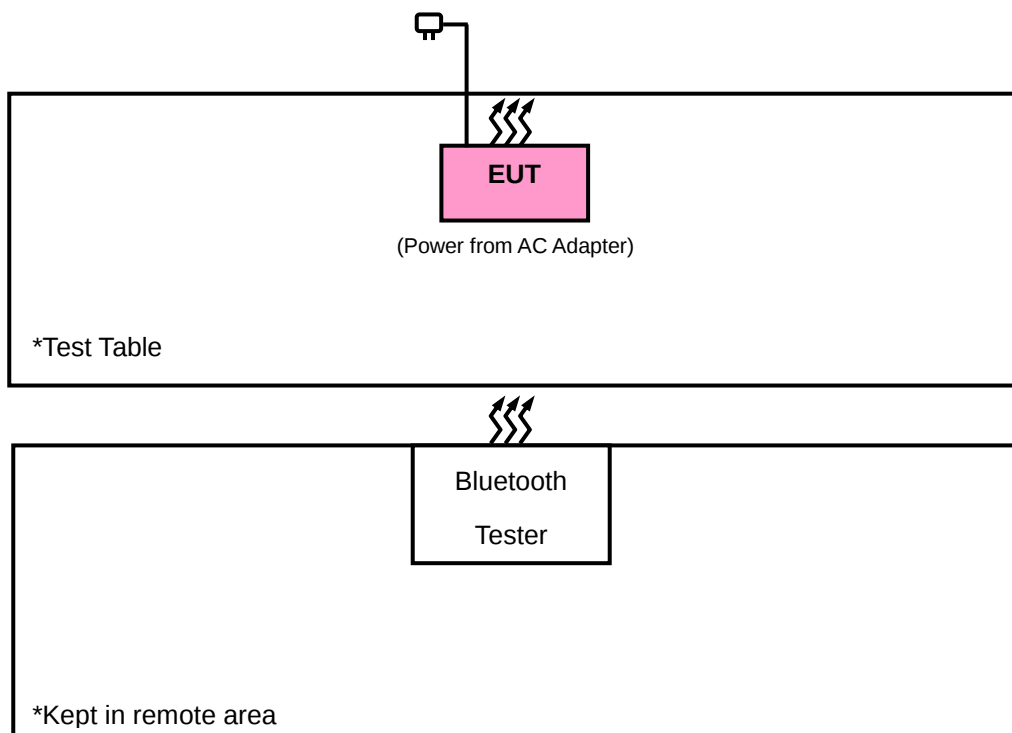
| No. | Product          | Brand | Model No. | Serial No. | FCC ID |
|-----|------------------|-------|-----------|------------|--------|
| 1.  | Bluetooth Tester | R&S   | CBT       | 100980     | N/A    |

| No. | Signal Cable Description Of The Above Support Units |
|-----|-----------------------------------------------------|
| 1.  | N/A                                                 |

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Item 1 acted as communication partner to transfer data.

#### 3.3.1 Configuration of System under Test



### 3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

**FCC Part 15, Subpart C (15.247)**

**FCC Public Notice DA 00-705**

ANSI C63.10-2013

All test items have been performed and recorded as per the above standards.

**Note:** The EUT has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (DoC).  
The test report has been issued separately.

## 4 Test Types and Results

### 4.1 Radiated Emission and Bandedge Measurement

#### 4.1.1 Limits of Radiated Emission and Bandedge Measurement

Radiated emissions 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 (MHz) | Field Strength (microvolts/meter) | Measurement Distance (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                             |

**Note:**

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.

#### 4.1.2 Test Instruments

| Description & Manufacturer                     | Model No.      | Serial No.          | Date of Calibration | Due Date of Calibration |
|------------------------------------------------|----------------|---------------------|---------------------|-------------------------|
| Test Receiver<br>Agilent                       | N9038A         | MY51210203          | Feb. 17, 2017       | Feb. 16, 2018           |
| Spectrum Analyzer<br>Agilent                   | N9010A         | MY52220314          | Dec. 16, 2016       | Dec. 15, 2017           |
| Spectrum Analyzer<br>ROHDE & SCHWARZ           | FSU43          | 101261              | Dec. 13, 2016       | Dec. 12, 2017           |
| BILOG Antenna<br>SCHWARZBECK                   | VULB9168       | 9168-472            | Dec. 26, 2016       | Dec. 27, 2017           |
| HORN Antenna<br>SCHWARZBECK                    | BBHA 9120 D    | 9120D-969           | Dec. 12, 2016       | Dec. 13, 2017           |
| HORN Antenna<br>SCHWARZBECK                    | BBHA 9170      | 9170-480            | Dec. 14, 2016       | Dec. 13, 2017           |
| Loop Antenna                                   | HLA 6121       | 45745               | May 19, 2017        | May 18, 2018            |
| Bluetooth Tester                               | CBT            | 100980              | Jun. 28, 2017       | Jun. 27, 2019           |
| Preamplifier<br>EMCI                           | EMC 012645     | 980115              | Oct. 21, 2016       | Oct. 20, 2017           |
| Preamplifier<br>EMCI                           | EMC 184045     | 980116              | Oct. 21, 2016       | Oct. 20, 2017           |
| Preamplifier<br>EMCI                           | EMC 330H       | 980112              | Oct. 21, 2016       | Oct. 20, 2017           |
| Power Meter<br>Anritsu                         | ML2495A        | 1232002             | Sep. 08, 2016       | Sep. 07, 2017           |
| Power Sensor<br>Anritsu                        | MA2411B        | 1207325             | Sep. 08, 2016       | Sep. 07, 2017           |
| RF signal cable<br>HUBER+SUHNNER               | SUCOFLEX 104   | 309219/4<br>2950114 | Oct. 21, 2016       | Oct. 20, 2017           |
| RF signal cable<br>HUBER+SUHNNER               | SUCOFLEX 104   | 250130/4            | Oct. 21, 2016       | Oct. 20, 2017           |
| RF Coaxial Cable<br>Worken                     | 8D-FB          | Cable-Ch10-01       | Oct. 21, 2016       | Oct. 20, 2017           |
| Software<br>BV ADT                             | E3<br>6.120103 | NA                  | NA                  | NA                      |
| Antenna Tower<br>MF                            | MFA-440H       | NA                  | NA                  | NA                      |
| Turn Table<br>MF                               | MFT-201SS      | NA                  | NA                  | NA                      |
| Antenna Tower & Turn<br>Table Controller<br>MF | MF-7802        | NA                  | NA                  | NA                      |

- Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 10.
3. The horn antenna and preamplifier (model: EMC 184045) are used only for the measurement of emission frequency above 1 GHz if tested.
4. The IC Site Registration No. is IC7450F-10.

#### 4.1.3 Test Procedures

- a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1 GHz) / 1.5 meters (for above 1 GHz) 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.
- f. The test-receiver system was set to peak and average detected 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.

**Note:**

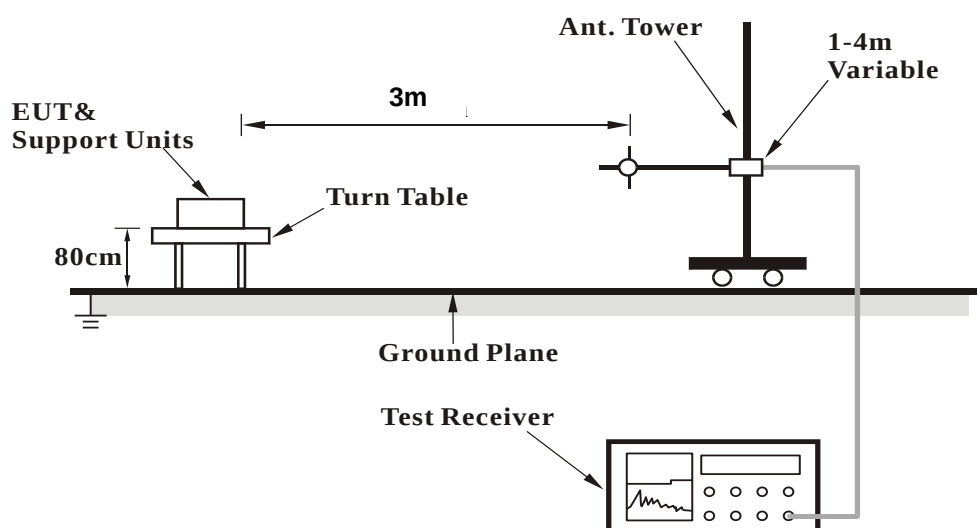
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz & 360 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1/T for Average (Duty cycle < 98 %) detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz (Duty cycle ≥ 98 %) for Average detection (AV) at frequency above 1 GHz.
5. All modes of operation were investigated and the worst-case emissions are reported.

#### 4.1.4 Deviation from Test Standard

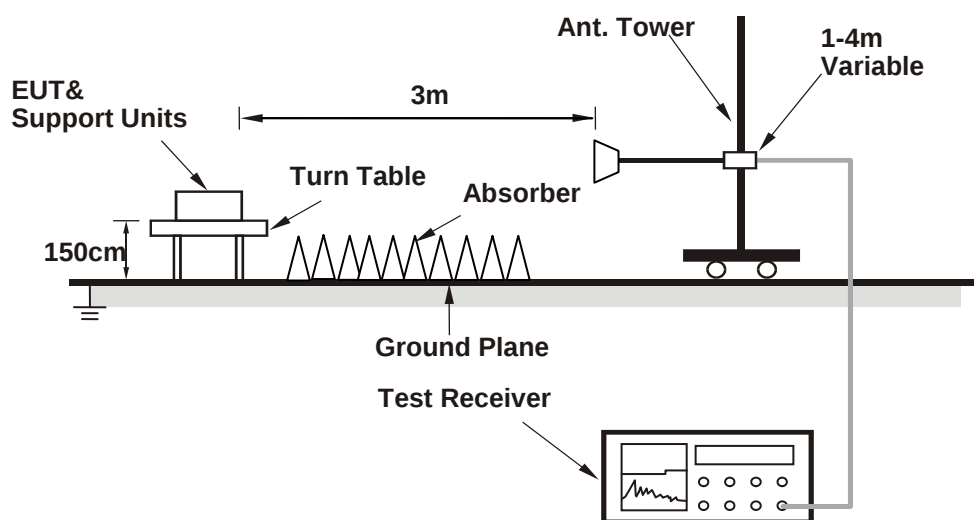
No deviation.

#### 4.1.5 Test Set Up

##### <Frequency Range below 1 GHz>



##### <Frequency Range above 1 GHz>



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

#### 4.1.6 EUT Operating Conditions

Set the EUT under transmission condition continuously at specific channel frequency.

#### 4.1.7 Test Results

#### ABOVE 1 GHz DATA :

#### GFSK

| EUT Test Condition       |                    | Measurement Detail |                           |
|--------------------------|--------------------|--------------------|---------------------------|
| Channel                  | Channel 0          | Frequency Range    | 1 GHz ~ 25 GHz            |
| Input Power              | 120 Vac, 60 Hz     | Detector Function  | Peak (PK)<br>Average (AV) |
| Environmental Conditions | 25 deg. C, 65 % RH | Tested By          | Getaz Yang                |

| Antenna Polarity & Test Distance: Horizontal at 3 m |                         |                   |                |             |                       |                 |                    |                     |                      |         |
|-----------------------------------------------------|-------------------------|-------------------|----------------|-------------|-----------------------|-----------------|--------------------|---------------------|----------------------|---------|
| Frequency (MHz)                                     | Emission Level (dBuV/m) | Read Level (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Antenna Height (cm) | Table Angle (Degree) | Remark  |
| 2375.97                                             | 33.49                   | 39.79             | 54             | -20.51      | 26.86                 | 4.34            | 37.5               | 173                 | 142                  | Average |
| 2382.36                                             | 47.77                   | 54.06             | 74             | -26.23      | 26.86                 | 4.35            | 37.5               | 173                 | 142                  | Peak    |
| 2402                                                | 73.67                   | 79.91             |                |             | 26.91                 | 4.37            | 37.52              | 173                 | 142                  | Average |
| 2402                                                | 84.63                   | 90.87             |                |             | 26.91                 | 4.37            | 37.52              | 173                 | 142                  | Peak    |
| 4804                                                | 31.09                   | 46.23             | 54             | -22.91      | 30.97                 | 6.79            | 52.9               | 148                 | 214                  | Average |
| 4804                                                | 44.18                   | 59.32             | 74             | -29.82      | 30.97                 | 6.79            | 52.9               | 148                 | 214                  | Peak    |
| Antenna Polarity & Test Distance: Vertical at 3 m   |                         |                   |                |             |                       |                 |                    |                     |                      |         |
| Frequency (MHz)                                     | Emission Level (dBuV/m) | Read Level (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Antenna Height (cm) | Table Angle (Degree) | Remark  |
| 2316.57                                             | 47.33                   | 53.85             | 74             | -26.67      | 26.67                 | 4.28            | 37.47              | 122                 | 233                  | Peak    |
| 2375.97                                             | 34.01                   | 40.31             | 54             | -19.99      | 26.86                 | 4.34            | 37.5               | 122                 | 233                  | Average |
| 2402                                                | 75.83                   | 82.07             |                |             | 26.91                 | 4.37            | 37.52              | 122                 | 233                  | Average |
| 2402                                                | 86.44                   | 92.68             |                |             | 26.91                 | 4.37            | 37.52              | 122                 | 233                  | Peak    |
| 4804                                                | 31.49                   | 46.83             | 54             | -22.51      | 30.97                 | 6.79            | 53.1               | 119                 | 294                  | Average |
| 4804                                                | 44.54                   | 59.88             | 74             | -29.46      | 30.97                 | 6.79            | 53.1               | 119                 | 294                  | Peak    |

#### Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2402 MHz: Fundamental frequency.

| EUT Test Condition       |                    | Measurement Detail |                           |
|--------------------------|--------------------|--------------------|---------------------------|
| Channel                  | Channel 39         | Frequency Range    | 1 GHz ~ 25 GHz            |
| Input Power              | 120 Vac, 60 Hz     | Detector Function  | Peak (PK)<br>Average (AV) |
| Environmental Conditions | 25 deg. C, 65 % RH | Tested By          | Getaz Yang                |

| Antenna Polarity & Test Distance: Horizontal at 3 m |                         |                   |                |             |                       |                 |                    |                     |                      |         |
|-----------------------------------------------------|-------------------------|-------------------|----------------|-------------|-----------------------|-----------------|--------------------|---------------------|----------------------|---------|
| Frequency (MHz)                                     | Emission Level (dBuV/m) | Read Level (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Antenna Height (cm) | Table Angle (Degree) | Remark  |
| 2345.01                                             | 46.87                   | 53.28             | 74             | -27.13      | 26.77                 | 4.31            | 37.49              | 146                 | 142                  | Peak    |
| 2375.88                                             | 33.66                   | 39.96             | 54             | -20.34      | 26.86                 | 4.34            | 37.5               | 146                 | 142                  | Average |
| 2441                                                | 71.84                   | 77.77             |                |             | 27.06                 | 4.4             | 37.39              | 146                 | 142                  | Average |
| 2441                                                | 82.81                   | 88.74             |                |             | 27.06                 | 4.4             | 37.39              | 146                 | 142                  | Peak    |
| 2488.96                                             | 34.32                   | 40.01             | 54             | -19.68      | 27.2                  | 4.43            | 37.32              | 146                 | 142                  | Average |
| 2489.6                                              | 47.63                   | 53.32             | 74             | -26.37      | 27.2                  | 4.43            | 37.32              | 146                 | 142                  | Peak    |
| 4882                                                | 31.43                   | 46.37             | 54             | -22.57      | 31.06                 | 6.86            | 52.86              | 129                 | 67                   | Average |
| 4882                                                | 44.23                   | 59.17             | 74             | -29.77      | 31.06                 | 6.86            | 52.86              | 129                 | 67                   | Peak    |
| Antenna Polarity & Test Distance: Vertical at 3 m   |                         |                   |                |             |                       |                 |                    |                     |                      |         |
| Frequency (MHz)                                     | Emission Level (dBuV/m) | Read Level (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Antenna Height (cm) | Table Angle (Degree) | Remark  |
| 2328.36                                             | 47.65                   | 54.11             | 74             | -26.35      | 26.72                 | 4.29            | 37.47              | 133                 | 238                  | Peak    |
| 2375.88                                             | 34.03                   | 40.33             | 54             | -19.97      | 26.86                 | 4.34            | 37.5               | 133                 | 238                  | Average |
| 2441                                                | 74.48                   | 80.41             |                |             | 27.06                 | 4.4             | 37.39              | 133                 | 238                  | Average |
| 2441                                                | 85.82                   | 91.75             |                |             | 27.06                 | 4.4             | 37.39              | 133                 | 238                  | Peak    |
| 2488.56                                             | 49.25                   | 54.94             | 74             | -24.75      | 27.2                  | 4.43            | 37.32              | 133                 | 238                  | Peak    |
| 2488.96                                             | 34.12                   | 39.81             | 54             | -19.88      | 27.2                  | 4.43            | 37.32              | 133                 | 238                  | Average |
| 4882                                                | 31.7                    | 46.83             | 54             | -22.3       | 31.06                 | 6.86            | 53.05              | 132                 | 41                   | Average |
| 4882                                                | 44.57                   | 59.7              | 74             | -29.43      | 31.06                 | 6.86            | 53.05              | 132                 | 41                   | Peak    |

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2441 MHz: Fundamental frequency.

| EUT Test Condition       |                    | Measurement Detail |                           |
|--------------------------|--------------------|--------------------|---------------------------|
| Channel                  | Channel 78         | Frequency Range    | 1 GHz ~ 25 GHz            |
| Input Power              | 120 Vac, 60 Hz     | Detector Function  | Peak (PK)<br>Average (AV) |
| Environmental Conditions | 25 deg. C, 65 % RH | Tested By          | Getaz Yang                |

| Antenna Polarity & Test Distance: Horizontal at 3 m |                         |                   |                |             |                       |                 |                    |                     |                      |         |
|-----------------------------------------------------|-------------------------|-------------------|----------------|-------------|-----------------------|-----------------|--------------------|---------------------|----------------------|---------|
| Frequency (MHz)                                     | Emission Level (dBuV/m) | Read Level (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Antenna Height (cm) | Table Angle (Degree) | Remark  |
| 2480                                                | 72.51                   | 78.25             |                |             | 27.15                 | 4.43            | 37.32              | 136                 | 149                  | Average |
| 2480                                                | 83.75                   | 89.49             |                |             | 27.15                 | 4.43            | 37.32              | 136                 | 149                  | Peak    |
| 2487.8                                              | 33.94                   | 39.63             | 54             | -20.06      | 27.2                  | 4.43            | 37.32              | 136                 | 149                  | Average |
| 2488.2                                              | 50.85                   | 56.54             | 74             | -23.15      | 27.2                  | 4.43            | 37.32              | 136                 | 149                  | Peak    |
| 4960                                                | 31.61                   | 46.47             | 54             | -22.39      | 31.16                 | 6.9             | 52.92              | 132                 | 203                  | Average |
| 4960                                                | 43.68                   | 58.54             | 74             | -30.32      | 31.16                 | 6.9             | 52.92              | 132                 | 203                  | Peak    |
| Antenna Polarity & Test Distance: Vertical at 3 m   |                         |                   |                |             |                       |                 |                    |                     |                      |         |
| Frequency (MHz)                                     | Emission Level (dBuV/m) | Read Level (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Antenna Height (cm) | Table Angle (Degree) | Remark  |
| 2480                                                | 75.3                    | 81.04             |                |             | 27.15                 | 4.43            | 37.32              | 117                 | 234                  | Average |
| 2480                                                | 86.1                    | 91.84             |                |             | 27.15                 | 4.43            | 37.32              | 117                 | 234                  | Peak    |
| 2487.32                                             | 34.01                   | 39.75             | 54             | -19.99      | 27.15                 | 4.43            | 37.32              | 117                 | 234                  | Average |
| 2488.28                                             | 51.74                   | 57.43             | 74             | -22.26      | 27.2                  | 4.43            | 37.32              | 117                 | 234                  | Peak    |
| 4960                                                | 31.89                   | 46.87             | 54             | -22.11      | 31.16                 | 6.9             | 53.04              | 111                 | 59                   | Average |
| 4960                                                | 43.94                   | 58.92             | 74             | -30.06      | 31.16                 | 6.9             | 53.04              | 111                 | 59                   | Peak    |

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2480 MHz: Fundamental frequency.

### 9 kHz ~ 30 MHz DATA:

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

### 30 MHz ~ 1 GHz WORST-CASE DATA:

| EUT Test Condition       |                    | Measurement Detail |                              |
|--------------------------|--------------------|--------------------|------------------------------|
| Channel                  | Channel 39         | Frequency Range    | 30 MHz ~ 1 GHz               |
| Input Power              | 120 Vac, 60 Hz     | Detector Function  | Peak (PK)<br>Quasi-peak (QP) |
| Environmental Conditions | 25 deg. C, 65 % RH | Tested By          | Getaz Yang                   |

| Antenna Polarity & Test Distance: Horizontal at 3 m |                         |                   |                |             |                       |                 |                    |                     |                      |        |
|-----------------------------------------------------|-------------------------|-------------------|----------------|-------------|-----------------------|-----------------|--------------------|---------------------|----------------------|--------|
| Frequency (MHz)                                     | Emission Level (dBuV/m) | Read Level (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Antenna Height (cm) | Table Angle (Degree) | Remark |
| 73.65                                               | 29.82                   | 51.07             | 40             | -10.18      | 9.81                  | 0.65            | 31.71              | 117                 | 297                  | Peak   |
| 148.34                                              | 35.74                   | 53.75             | 43.5           | -7.76       | 12.64                 | 0.97            | 31.62              | 135                 | 240                  | Peak   |
| 247.28                                              | 42.5                    | 61.58             | 46             | -3.5        | 11.36                 | 1.46            | 31.9               | 117                 | 124                  | QP     |
| 324.88                                              | 41.43                   | 57.97             | 46             | -4.57       | 13.54                 | 1.77            | 31.85              | 134                 | 110                  | QP     |
| 409.27                                              | 42.46                   | 56.82             | 46             | -3.54       | 15.52                 | 2.12            | 32                 | 102                 | 152                  | Peak   |
| 792.42                                              | 30.6                    | 36.25             | 46             | -15.4       | 22.12                 | 3.64            | 31.41              | 119                 | 209                  | Peak   |
| Antenna Polarity & Test Distance: Vertical at 3 m   |                         |                   |                |             |                       |                 |                    |                     |                      |        |
| Frequency (MHz)                                     | Emission Level (dBuV/m) | Read Level (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Antenna Height (cm) | Table Angle (Degree) | Remark |
| 73.65                                               | 34.86                   | 56.11             | 40             | -5.14       | 9.81                  | 0.65            | 31.71              | 104                 | 205                  | QP     |
| 148.34                                              | 38.55                   | 56.56             | 43.5           | -4.95       | 12.64                 | 0.97            | 31.62              | 128                 | 1                    | Peak   |
| 247.28                                              | 39.84                   | 58.92             | 46             | -6.16       | 11.36                 | 1.46            | 31.9               | 105                 | 261                  | Peak   |
| 401.51                                              | 43.21                   | 57.85             | 46             | -2.79       | 15.37                 | 2.09            | 32.1               | 122                 | 153                  | Peak   |
| 597.45                                              | 42.67                   | 52.46             | 46             | -3.33       | 19.54                 | 2.89            | 32.22              | 127                 | 29                   | Peak   |
| 864.2                                               | 30.37                   | 35.36             | 46             | -15.63      | 23.05                 | 3.9             | 31.94              | 100                 | 339                  | Peak   |

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value

## 4.2 Conducted Emission Measurement

### 4.2.1 Limits of Conducted Emission Measurement

| Frequency (MHz) | Conducted Limit (dBuV) |         |
|-----------------|------------------------|---------|
|                 | Quasi-peak             | Average |
| 0.15 - 0.5      | 66 - 56                | 56 - 46 |
| 0.50 - 5.0      | 56                     | 46      |
| 5.0 - 30.0      | 60                     | 50      |

Note: 1. The lower limit shall apply at the transition frequencies.  
 2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.  
 3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

### 4.2.2 Test Instruments

| Description & Manufacturer                  | Model No.                | Serial No.     | Date Of Calibration | Due Date Of Calibration |
|---------------------------------------------|--------------------------|----------------|---------------------|-------------------------|
| Test Receiver<br>ROHDE & SCHWARZ            | ESCI                     | 100613         | Nov. 21, 2016       | Nov. 20, 2017           |
| RF signal cable (with<br>10dB PAD)<br>Woken | 5D-FB                    | Cable-cond1-01 | Dec. 22, 2016       | Dec. 21, 2017           |
| LISN<br>ROHDE & SCHWARZ<br>(EUT)            | ESH3-Z5                  | 835239/001     | Mar. 10, 2017       | Mar. 09, 2018           |
| LISN<br>ROHDE & SCHWARZ<br>(Peripheral)     | ESH3-Z5                  | 100311         | Aug. 15, 2017       | Aug. 14, 2018           |
| Software<br>ADT                             | BV ADT_Cond_<br>V7.3.7.3 | NA             | NA                  | NA                      |

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.  
 2. The test was performed in HwaYa Shielded Room 1.  
 3. The VCCI Site Registration No. is C-2040.

#### 4.2.3 Test Procedures

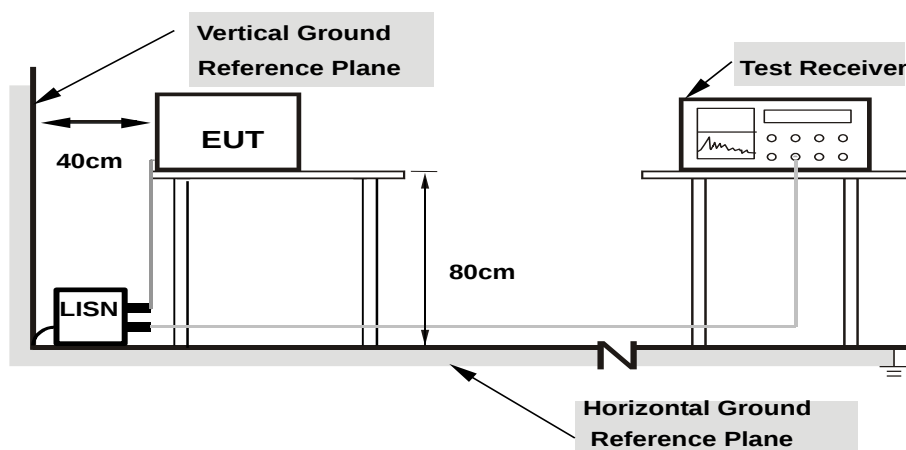
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50 uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched. Emission levels under (Limit – 20 dB) was not recorded.

**Note:** All modes of operation were investigated and the worst-case emissions are reported.

#### 4.2.4 Deviation from Test Standard

No deviation.

#### 4.2.5 Test Setup



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

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

#### 4.2.6 EUT Operating Condition

Set the EUT under transmission condition continuously at specific channel frequency.

#### 4.2.7 Test Results

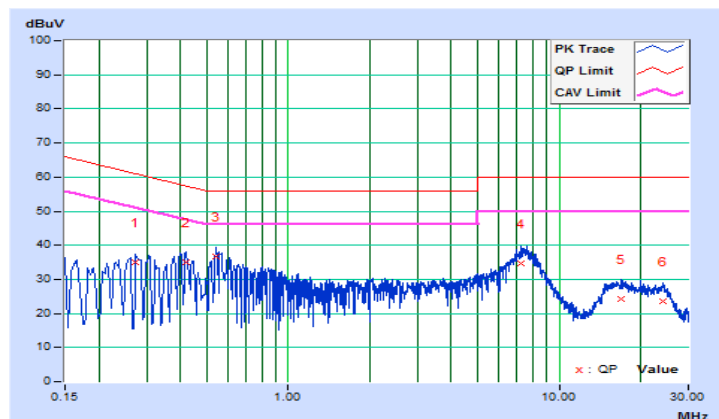
##### CONDUCTED WORST-CASE DATA : GFSK

|                 |                |                                          |                                      |
|-----------------|----------------|------------------------------------------|--------------------------------------|
| Frequency Range | 150kHz ~ 30MHz | Detector Function & Resolution Bandwidth | Quasi-Peak (QP) / Average (AV), 9kHz |
| Input Power     | 120Vac, 60Hz   | Environmental Conditions                 | 26°C, 72%RH                          |
| Tested by       | Han Wu         | Test Date                                | 2017/8/22                            |

| Phase Of Power : Line (L) |                 |                        |                      |       |                       |       |              |       |             |        |
|---------------------------|-----------------|------------------------|----------------------|-------|-----------------------|-------|--------------|-------|-------------|--------|
| No                        | Frequency (MHz) | Correction Factor (dB) | Reading Value (dBuV) |       | Emission Level (dBuV) |       | Limit (dBuV) |       | Margin (dB) |        |
|                           |                 |                        | Q.P.                 | AV.   | Q.P.                  | AV.   | Q.P.         | AV.   | Q.P.        | AV.    |
| 1                         | 0.27422         | 10.38                  | 24.49                | 11.20 | 34.87                 | 21.58 | 60.99        | 50.99 | -26.12      | -29.41 |
| 2                         | 0.41799         | 10.40                  | 24.47                | 11.28 | 34.87                 | 21.68 | 57.49        | 47.49 | -22.62      | -25.81 |
| 3                         | 0.54200         | 10.40                  | 26.27                | 15.02 | 36.67                 | 25.42 | 56.00        | 46.00 | -19.33      | -20.58 |
| 4                         | 7.21400         | 10.71                  | 23.93                | 11.06 | 34.64                 | 21.77 | 60.00        | 50.00 | -25.36      | -28.23 |
| 5                         | 16.94200        | 11.19                  | 12.90                | 2.72  | 24.09                 | 13.91 | 60.00        | 50.00 | -35.91      | -36.09 |
| 6                         | 24.07000        | 11.48                  | 12.21                | 2.53  | 23.69                 | 14.01 | 60.00        | 50.00 | -36.31      | -35.99 |

##### Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

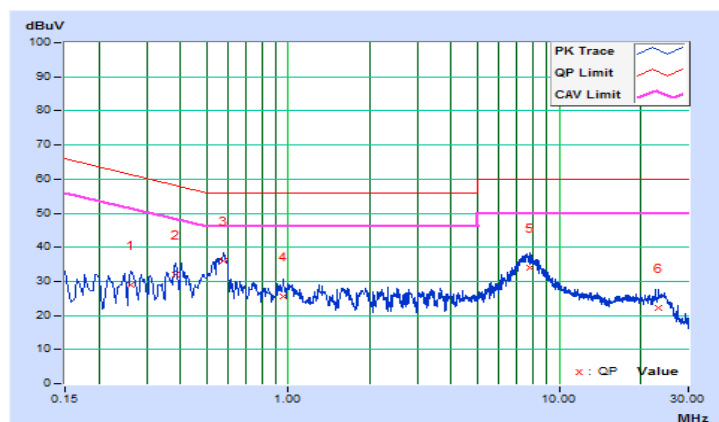


|                 |                |                                          |                                      |
|-----------------|----------------|------------------------------------------|--------------------------------------|
| Frequency Range | 150kHz ~ 30MHz | Detector Function & Resolution Bandwidth | Quasi-Peak (QP) / Average (AV), 9kHz |
| Input Power     | 120Vac, 60Hz   | Environmental Conditions                 | 26°C, 72%RH                          |
| Tested by       | Han Wu         | Test Date                                | 2017/8/22                            |

| Phase Of Power : Neutral (N) |                 |                        |                      |              |                       |              |              |              |               |               |
|------------------------------|-----------------|------------------------|----------------------|--------------|-----------------------|--------------|--------------|--------------|---------------|---------------|
| No                           | Frequency (MHz) | Correction Factor (dB) | Reading Value (dBuV) |              | Emission Level (dBuV) |              | Limit (dBuV) |              | Margin (dB)   |               |
|                              |                 |                        | Q.P.                 | AV.          | Q.P.                  | AV.          | Q.P.         | AV.          | Q.P.          | AV.           |
| 1                            | 0.26221         | 10.15                  | 18.89                | 7.48         | 29.04                 | 17.63        | 61.36        | 51.36        | -32.32        | -33.73        |
| 2                            | 0.38218         | 10.16                  | 21.93                | 13.19        | 32.09                 | 23.35        | 58.23        | 48.23        | -26.14        | -24.88        |
| <b>3</b>                     | <b>0.57796</b>  | <b>10.16</b>           | <b>25.99</b>         | <b>21.57</b> | <b>36.15</b>          | <b>31.73</b> | <b>56.00</b> | <b>46.00</b> | <b>-19.85</b> | <b>-14.27</b> |
| 4                            | 0.95848         | 10.17                  | 15.28                | 8.26         | 25.45                 | 18.43        | 56.00        | 46.00        | -30.55        | -27.57        |
| 5                            | 7.83000         | 10.47                  | 23.49                | 15.45        | 33.96                 | 25.92        | 60.00        | 50.00        | -26.04        | -24.08        |
| 6                            | 23.25800        | 11.03                  | 11.03                | 4.51         | 22.06                 | 15.54        | 60.00        | 50.00        | -37.94        | -34.46        |

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

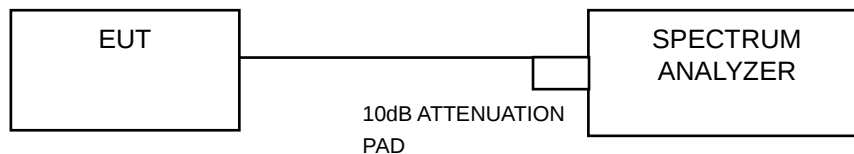


### 4.3 Number of Hopping Frequency Used

#### 4.3.1 Limits of Hopping Frequency Used Measurement

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

#### 4.3.2 Test Setup



#### 4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

#### 4.3.4 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.

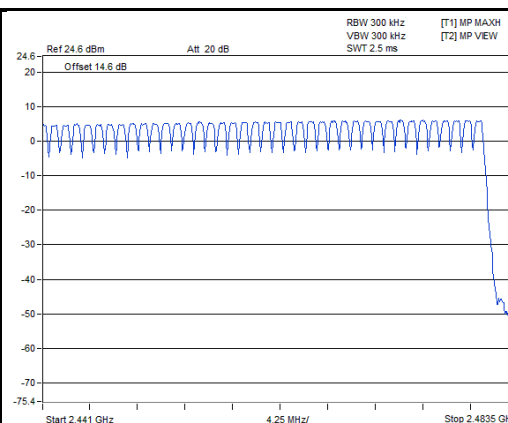
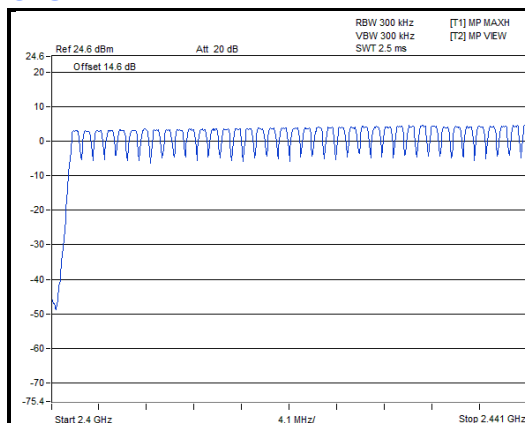
#### 4.3.5 Deviation from Test Standard

No deviation.

#### 4.3.6 Test Results

There are 79 hopping frequencies in the hopping mode. Please refer to next page for the test result. On the plots, it shows that the hopping frequencies are equally spaced.

# GFSK

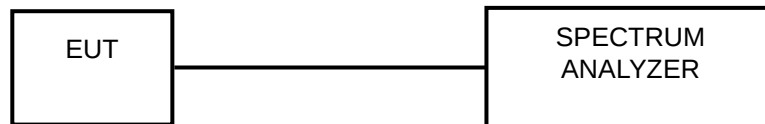


#### 4.4 Dwell Time on Each Channel

##### 4.4.1 Limits of Dwell Time on Each Channel Measurement

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.

##### 4.4.2 Test Setup



##### 4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

##### 4.4.4 Test Procedures

- a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- c. 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.
- d. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
- e. Repeat above procedures until all different time-slot modes have been completed.

##### 4.4.5 Deviation from Test Standard

No deviation.

#### 4.4.6 Test Results

##### GFSK

| Mode | Number of transmission in a 31.6 (79 Hopping*0.4) | Length of transmission time (msec) | Result (msec) | Limit (sec) |
|------|---------------------------------------------------|------------------------------------|---------------|-------------|
| DH1  | 50 (times / 5 sec) * 6.32 = 316 times             | 0.438                              | 138.41        | 0.4         |
| DH3  | 26 (times / 5 sec) * 6.32 = 164.32 times          | 1.674                              | 275.07        | 0.4         |
| DH5  | 18 (times / 5 sec) * 6.32 = 113.76 times          | 2.98                               | 339           | 0.4         |

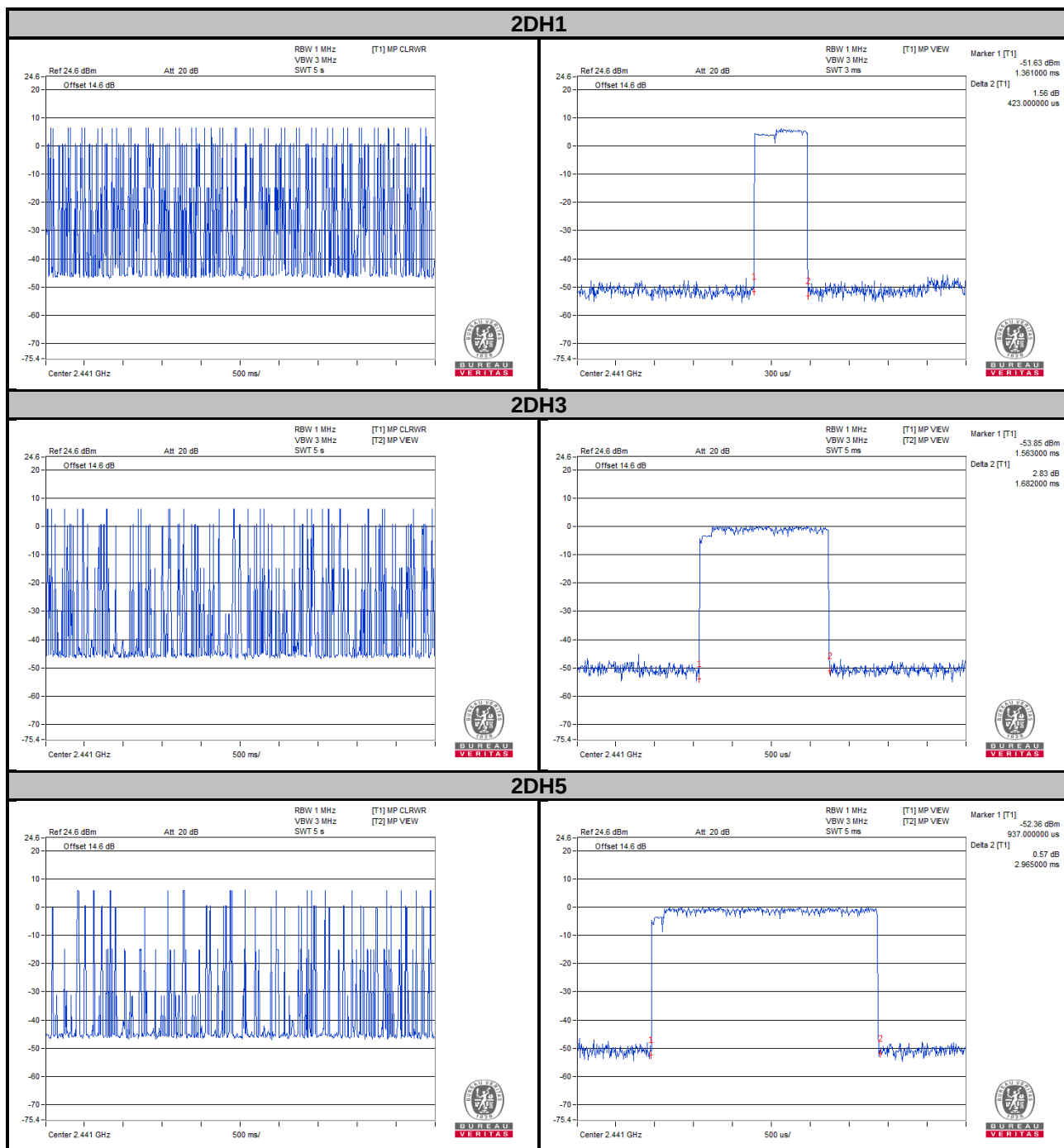
**Note:** Test plots of the transmitting time slot are shown as below.



## 

| Mode | Number of transmission in a 31.6 (79 Hopping*0.4) | Length of transmission time (msec) | Result (msec) | Limit (sec) |
|------|---------------------------------------------------|------------------------------------|---------------|-------------|
| 2DH1 | 50 (times / 5 sec) * 6.32 = 316 times             | 0.423                              | 133.67        | 0.4         |
| 2DH3 | 27 (times / 5 sec) * 6.32 = 170.64 times          | 1.682                              | 287.02        | 0.4         |
| 2DH5 | 17 (times / 5 sec) * 6.32 = 107.44 times          | 2.965                              | 318.56        | 0.4         |

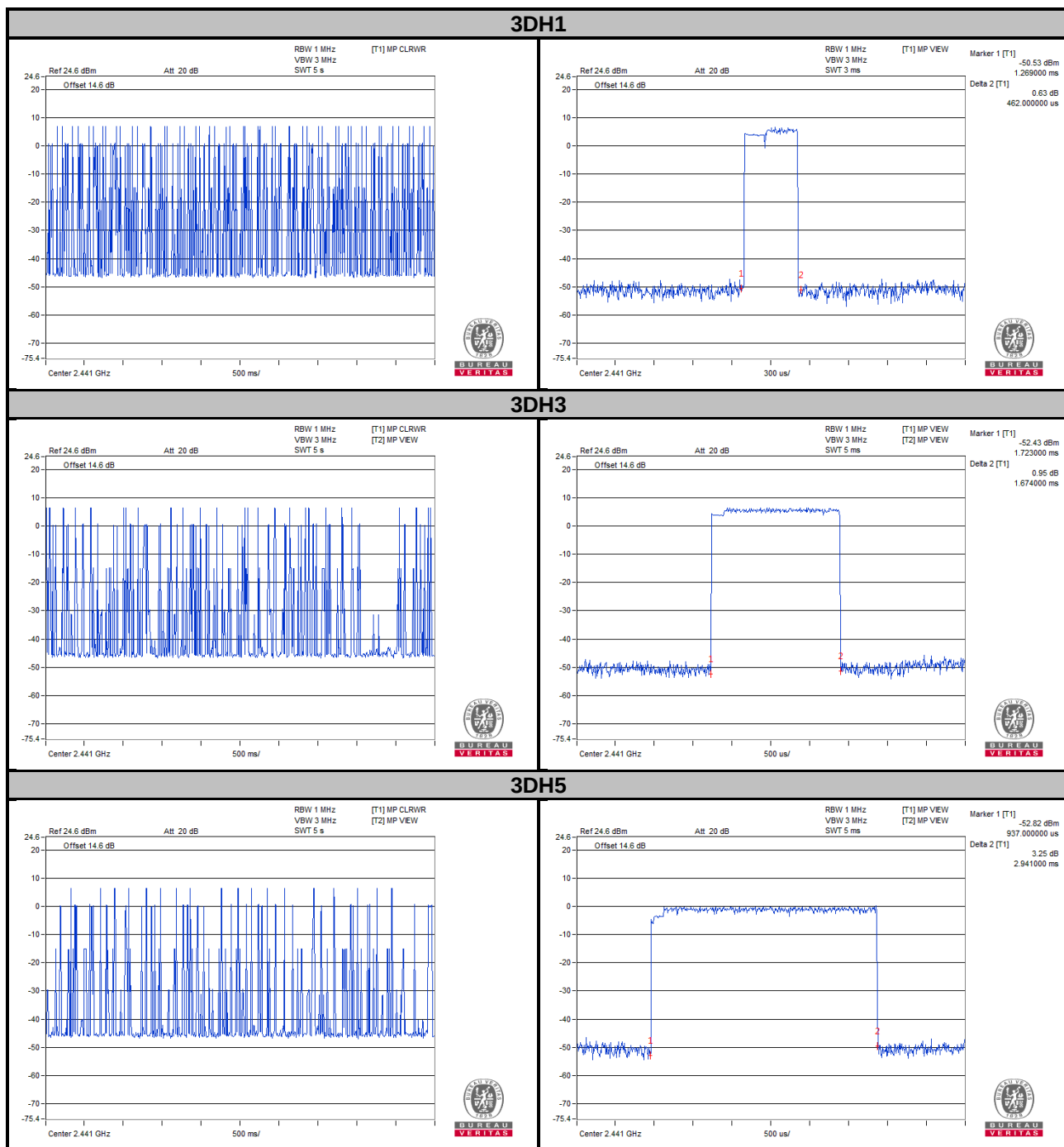
**Note:** Test plots of the transmitting time slot are shown as below.



## 8DPSK

| Mode | Number of transmission in a 31.6 (79 Hopping*0.4) | Length of transmission time (msec) | Result (msec) | Limit (sec) |
|------|---------------------------------------------------|------------------------------------|---------------|-------------|
| 3DH1 | 50 (times / 5 sec) * 6.32 = 316 times             | 0.462                              | 145.99        | 0.4         |
| 3DH3 | 25 (times / 5 sec) * 6.32 = 158 times             | 1.674                              | 264.49        | 0.4         |
| 3DH5 | 18 (times / 5 sec) * 6.32 = 113.76 times          | 2.941                              | 334.57        | 0.4         |

**Note:** Test plots of the transmitting time slot are shown as below.

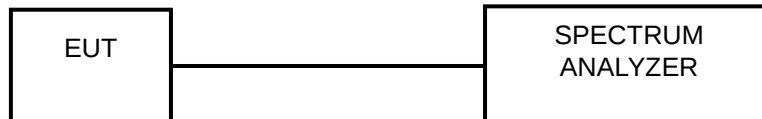


## 4.5 Channel Bandwidth

### 4.5.1 Limits of Channel Bandwidth Measurement

For frequency hopping system operating in the 2400-2483.5 MHz, if the 20 dB bandwidth of hopping channel is greater than 25 kHz, two-thirds 20 dB bandwidth of hopping channel shall be a minimum limit for the hopping channel separation.

### 4.5.2 Test Setup



### 4.5.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.5.4 Test Procedure

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

### 4.5.5 Deviation from Test Standard

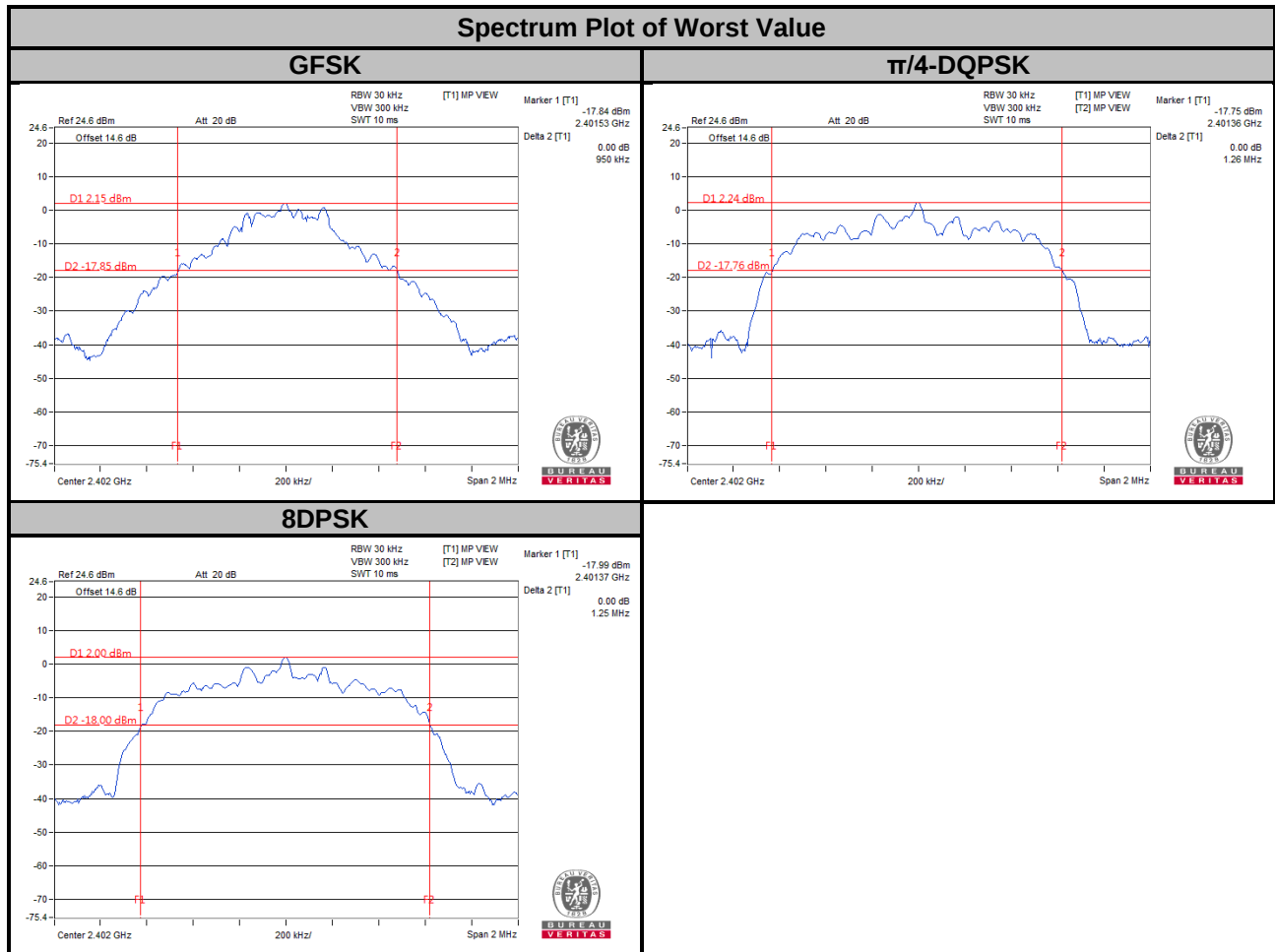
No deviation.

### 4.5.6 EUT Operating Condition

The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

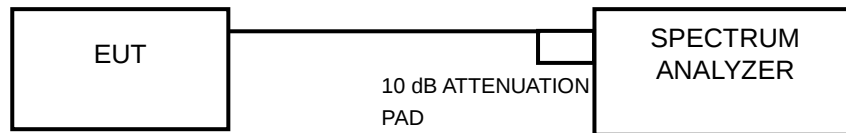
#### 4.5.7 Test Results

| Channel | Frequency (MHz) | 20 dB Bandwidth (MHz) |                |       |
|---------|-----------------|-----------------------|----------------|-------|
|         |                 | GFSK                  | $\pi/4$ -DQPSK | 8DPSK |
| 0       | 2402            | 0.95                  | 1.26           | 1.25  |
| 39      | 2441            | 0.94                  | 1.26           | 1.25  |
| 78      | 2480            | 0.94                  | 1.26           | 1.25  |



## 4.6 Occupied Bandwidth Measurement

### 4.6.1 Test Setup



### 4.6.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument

### 4.6.3 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1 % to 5 % of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth and set the detector to PEAK. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 % of the total mean power of a given emission.

### 4.6.4 Deviation from Test Standard

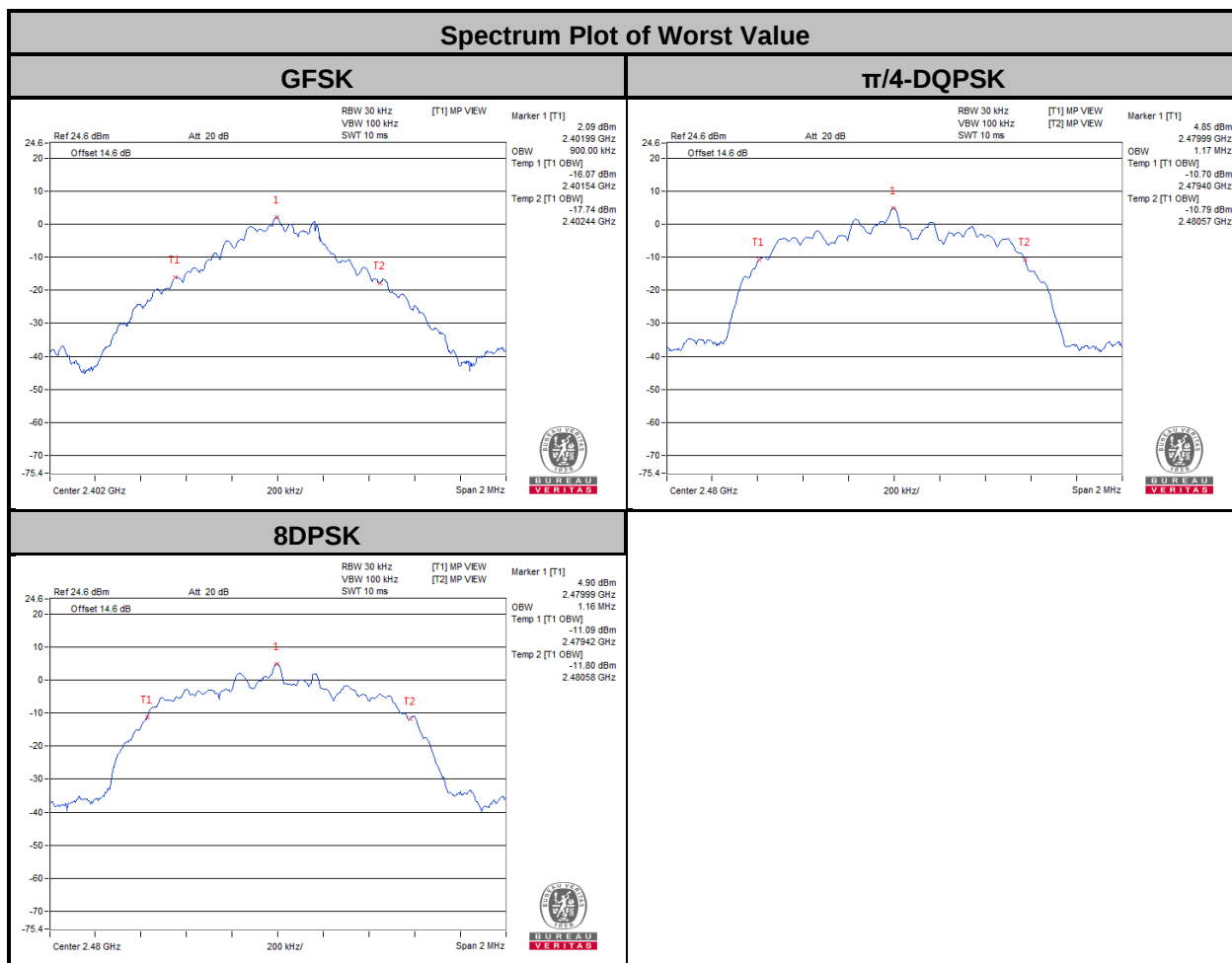
No deviation.

### 4.6.5 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

#### 4.6.6 Test Results

| Channel | Frequency (MHz) | Occupied Bandwidth (MHz) |                |       |
|---------|-----------------|--------------------------|----------------|-------|
|         |                 | GFSK                     | $\pi/4$ -DQPSK | 8DPSK |
| 0       | 2402            | 0.90                     | 1.16           | 1.15  |
| 39      | 2441            | 0.90                     | 1.16           | 1.15  |
| 78      | 2480            | 0.89                     | 1.17           | 1.16  |

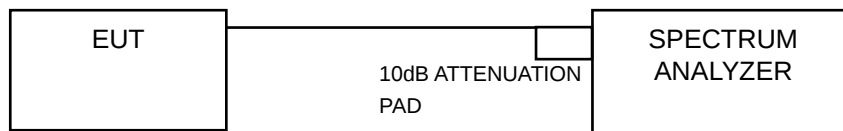


## 4.7 Hopping Channel Separation

### 4.7.1 Limits of Hopping Channel Separation Measurement

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

### 4.7.2 Test Setup



### 4.7.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.7.4 Test Procedure

#### Measurement Procedure REF

- 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.

### 4.7.5 Deviation from Test Standard

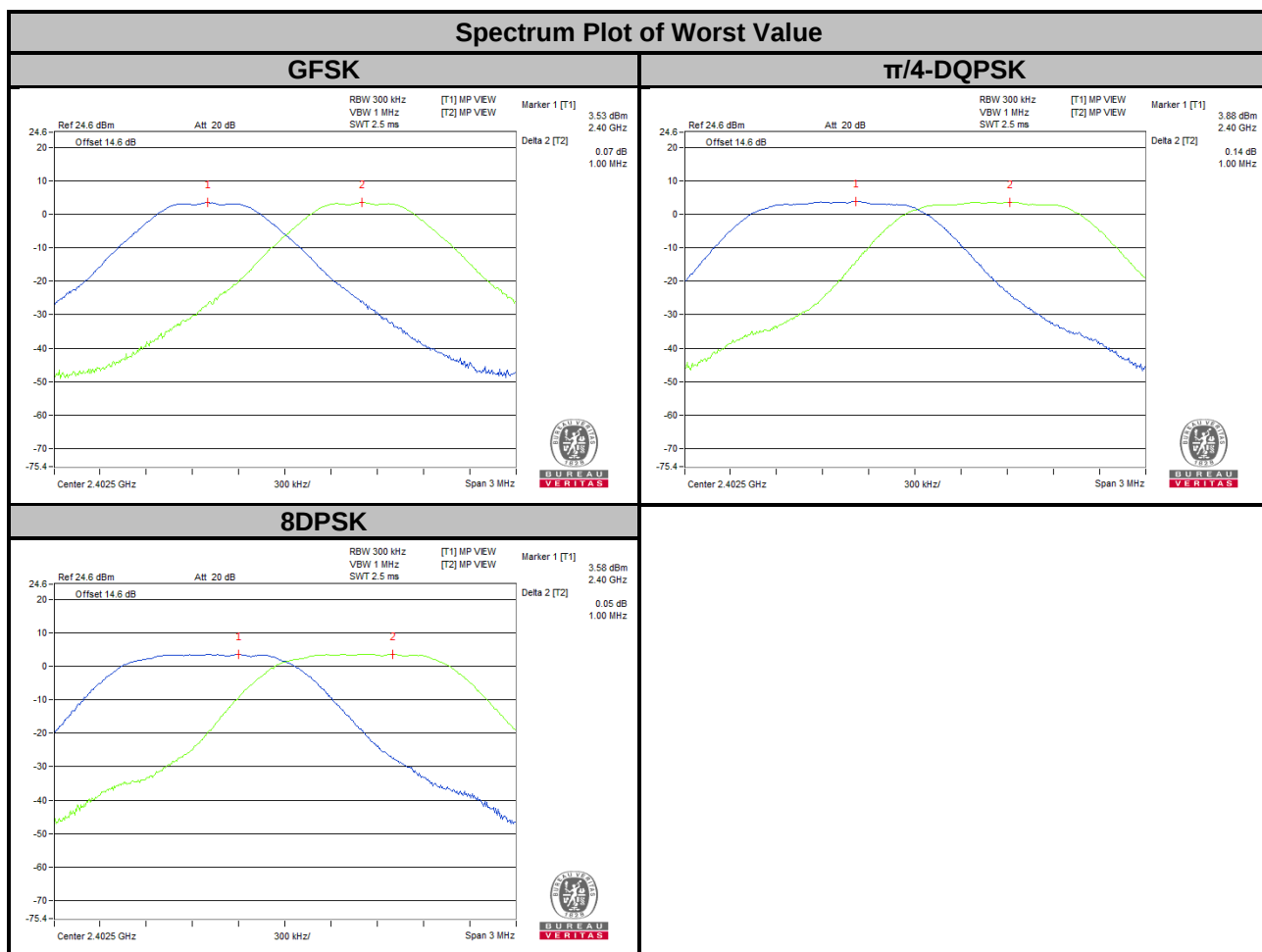
No deviation.

#### 4.7.6 Test Results

| Channel | Freq. (MHz) | Adjacent Channel Separation (MHz) |                |       | 20 dB Bandwidth (MHz) |                |       | Minimum Limit (MHz) |                |       | Pass / Fail |
|---------|-------------|-----------------------------------|----------------|-------|-----------------------|----------------|-------|---------------------|----------------|-------|-------------|
|         |             | GFSK                              | $\pi/4$ -DQPSK | 8DPSK | GFSK                  | $\pi/4$ -DQPSK | 8DPSK | GFSK                | $\pi/4$ -DQPSK | 8DPSK |             |
| 0       | 2402        | 1.00                              | 1.00           | 1.00  | 0.95                  | 1.26           | 1.25  | 0.64                | 0.84           | 0.84  | Pass        |
| 39      | 2441        | 1.00                              | 1.00           | 1.00  | 0.94                  | 1.26           | 1.25  | 0.63                | 0.84           | 0.84  | Pass        |
| 78      | 2480        | 1.00                              | 1.00           | 1.00  | 0.94                  | 1.26           | 1.25  | 0.63                | 0.84           | 0.84  | Pass        |

#### Note:

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

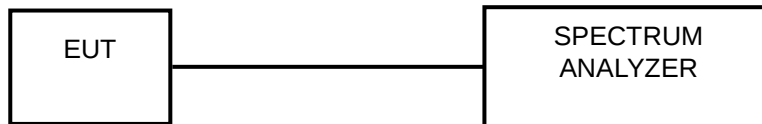


## 4.8 Maximum Output Power

### 4.8.1 Limits of Maximum Output Power Measurement

The Maximum Output Power Measurement is 125 mW.

### 4.8.2 Test Setup



### 4.8.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.8.4 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.
- The center frequency of the spectrum analyzer is set to the fundamental frequency and using 3 MHz RBW and 10 MHz VBW.
- Measure the captured power within the band and recording the plot.
- Repeat above procedures until all frequencies required were complete.

### 4.8.5 Deviation from Test Standard

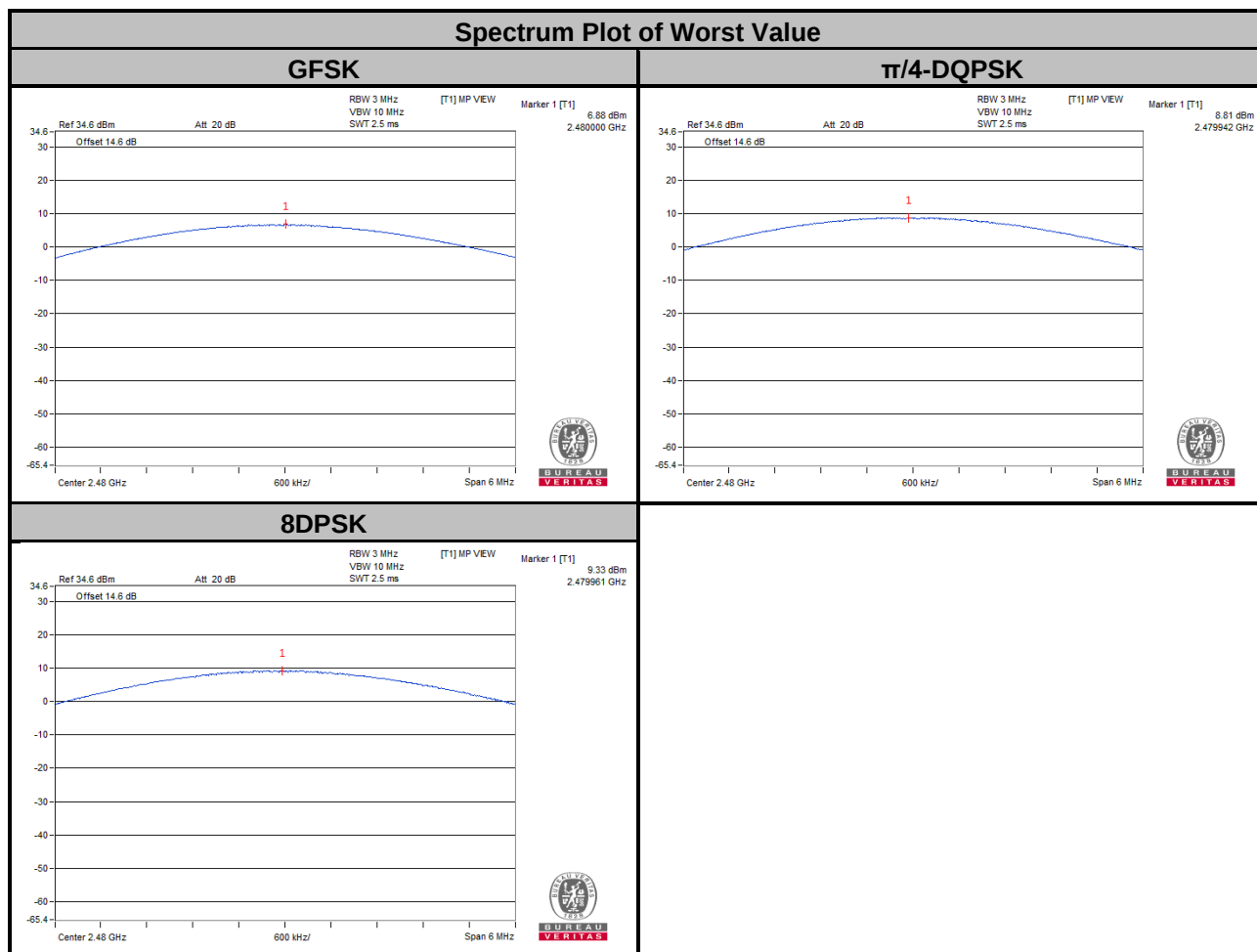
No deviation.

### 4.8.6 EUT Operating Condition

The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

#### 4.8.7 Test Results

| Channel | Freq. (MHz) | Output Power (mW) |                |       | Output Power (dBm) |                |       | Power Limit (mW) | Pass / Fail |
|---------|-------------|-------------------|----------------|-------|--------------------|----------------|-------|------------------|-------------|
|         |             | GFSK              | $\pi/4$ -DQPSK | 8DPSK | GFSK               | $\pi/4$ -DQPSK | 8DPSK |                  |             |
| 0       | 2402        | 2.541             | 4.385          | 5.093 | 4.05               | 6.42           | 7.07  | 125              | Pass        |
| 39      | 2441        | 3.639             | 5.929          | 6.998 | 5.61               | 7.73           | 8.45  | 125              | Pass        |
| 78      | 2480        | 4.875             | 7.603          | 8.570 | 6.88               | 8.81           | 9.33  | 125              | Pass        |



## **4.9 Conducted Out of Band Emission Measurement**

### **4.9.1 Limits Of Conducted Out Of Band Emission Measurement**

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

### **4.9.2 Test Instruments**

Refer to section 4.1.2 to get information of above instrument.

### **4.9.3 Test Procedure**

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

### **4.9.4 Deviation from Test Standard**

No deviation.

### **4.9.5 EUT Operating Condition**

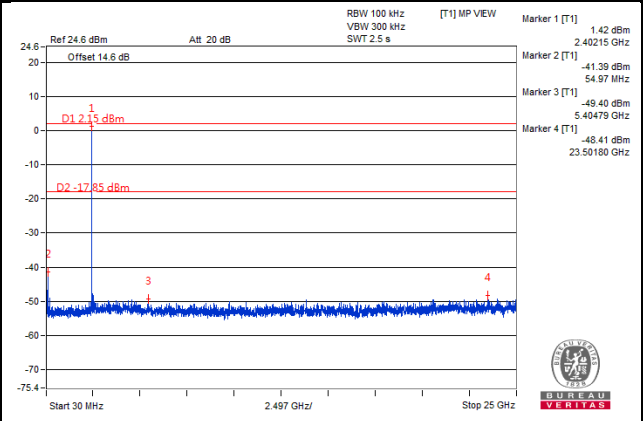
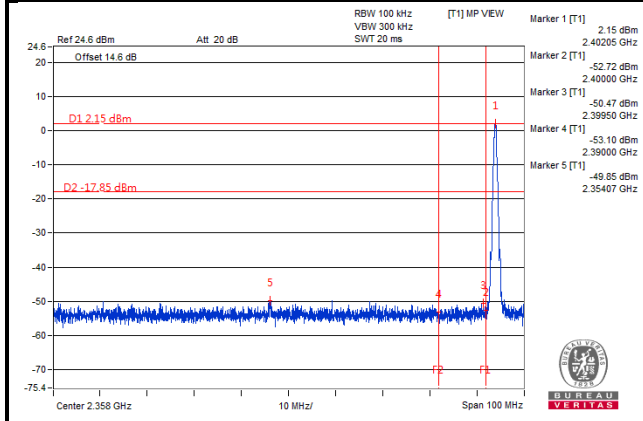
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

### **4.9.6 Test Results**

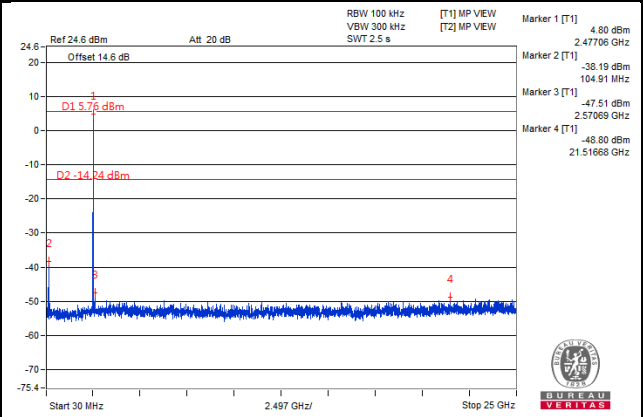
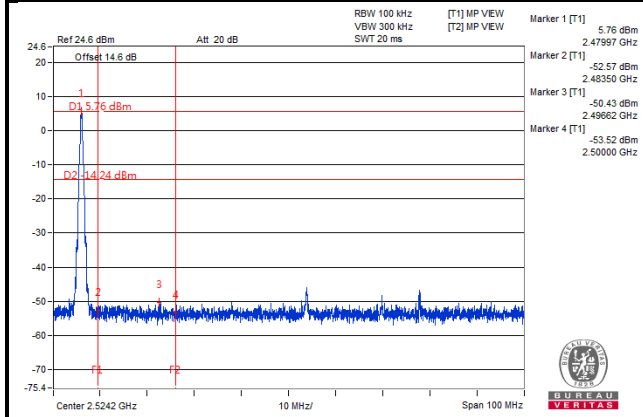
The spectrum plots are attached on the following images. D1 line indicates the highest level, D2 line indicates the 20 dB offset below D1. It shows compliance with the requirement.

# GFSK

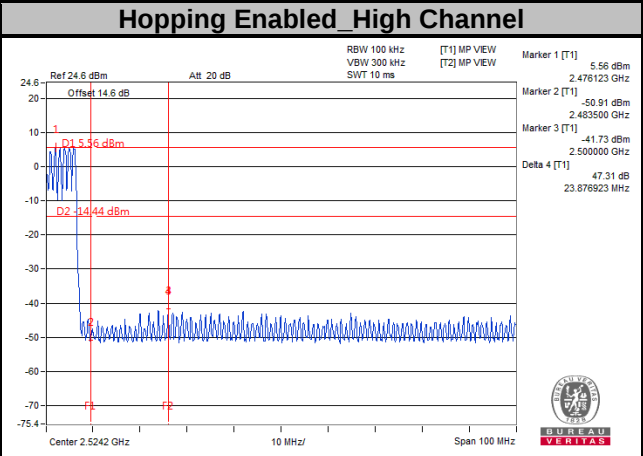
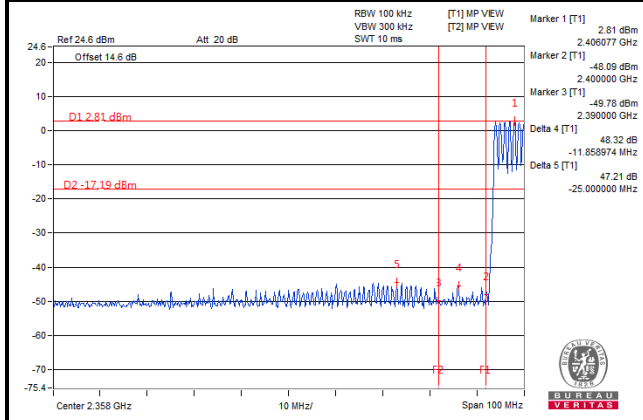
## Hopping Disabled\_Low Channel



## Hopping Disabled\_High Channel

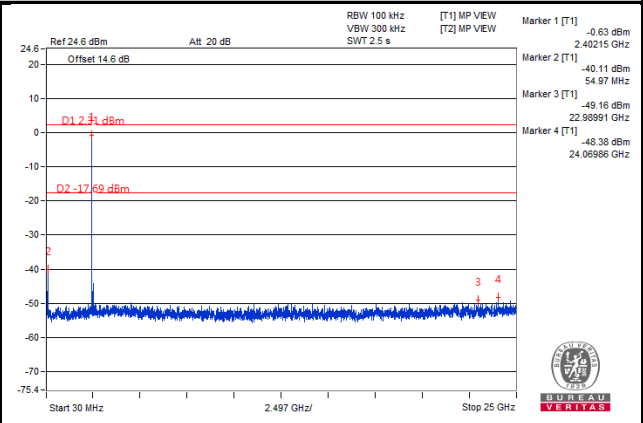
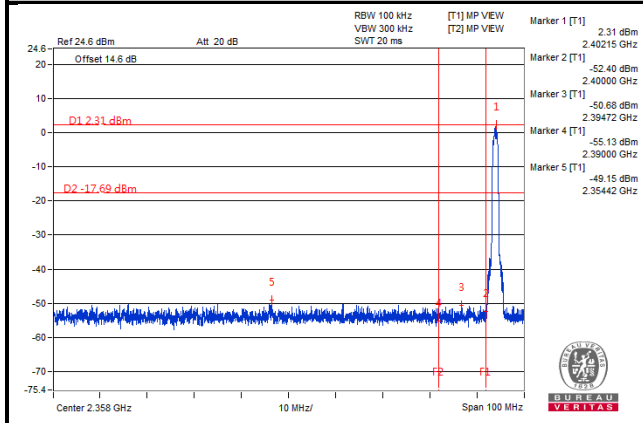


## Hopping Enabled\_Low Channel

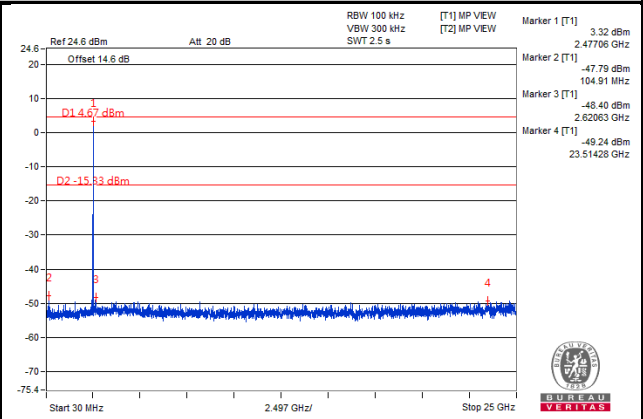
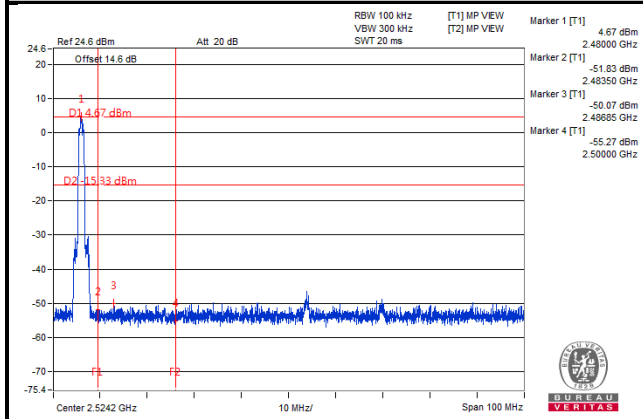


# $\pi/4$ -DQPSK

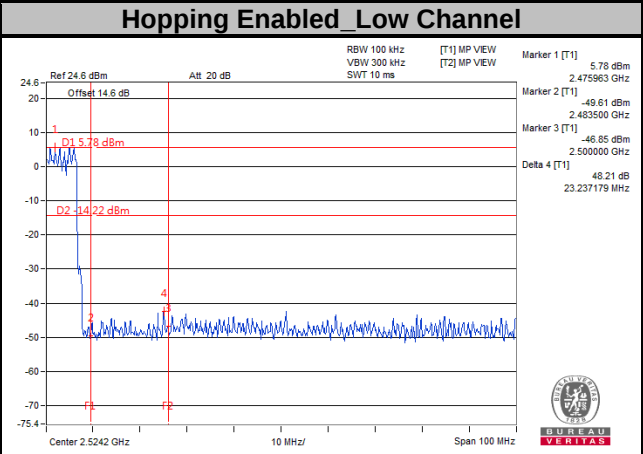
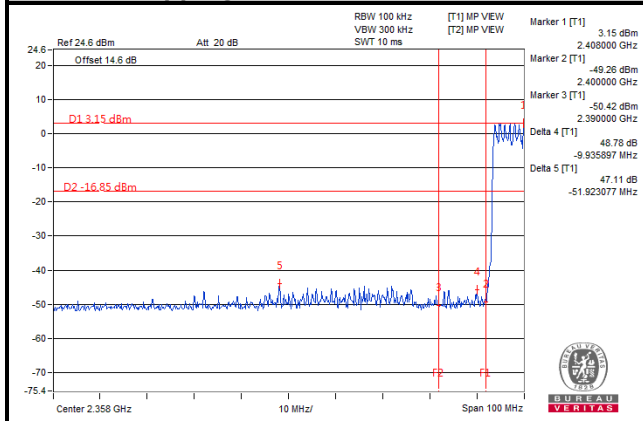
## Hopping Disabled\_Low Channel



## Hopping Disabled\_High Channel

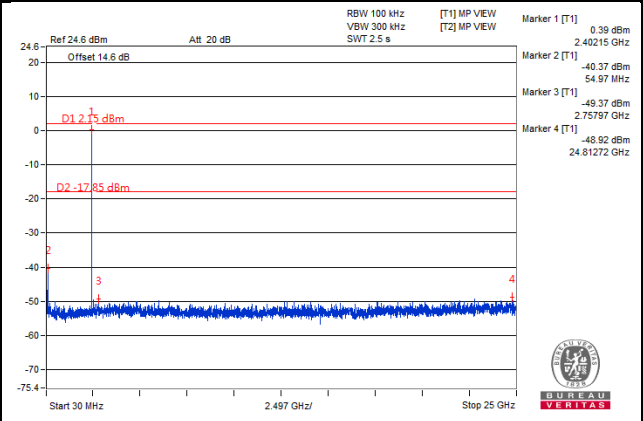
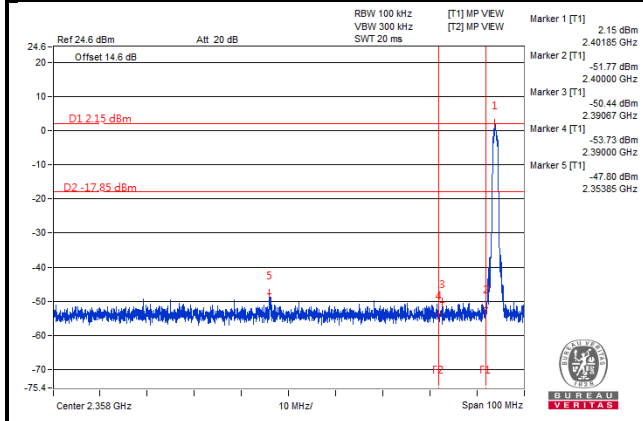


## Hopping Enabled\_Low Channel

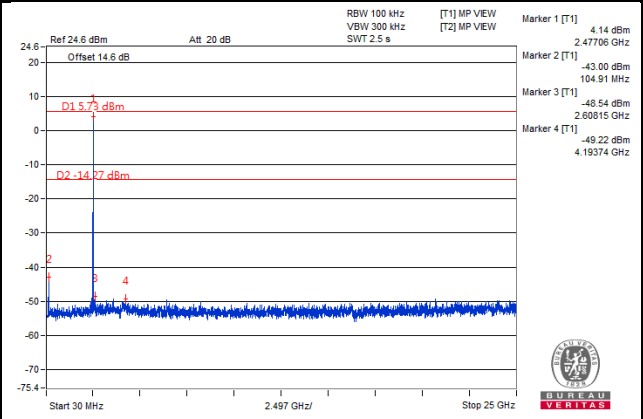
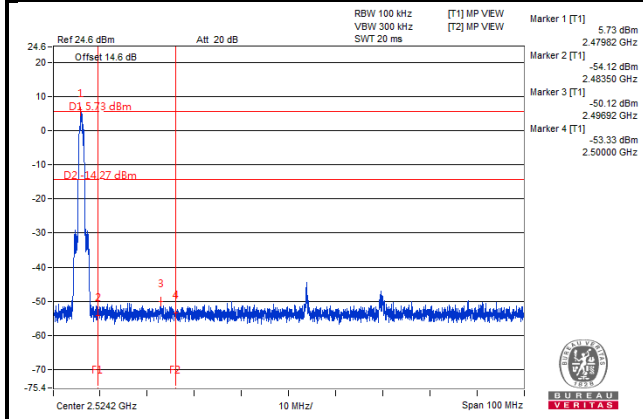


# 8DPSK

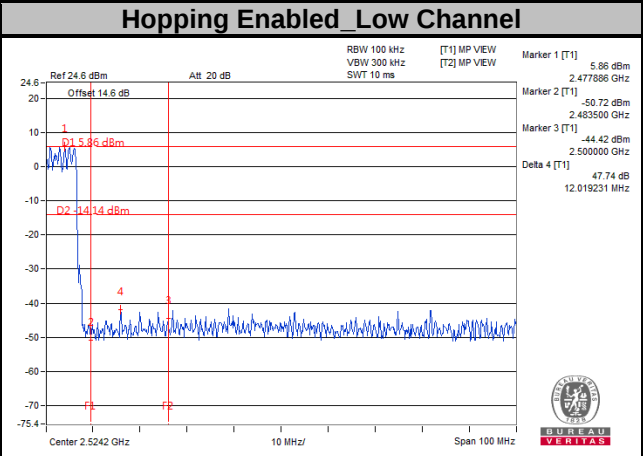
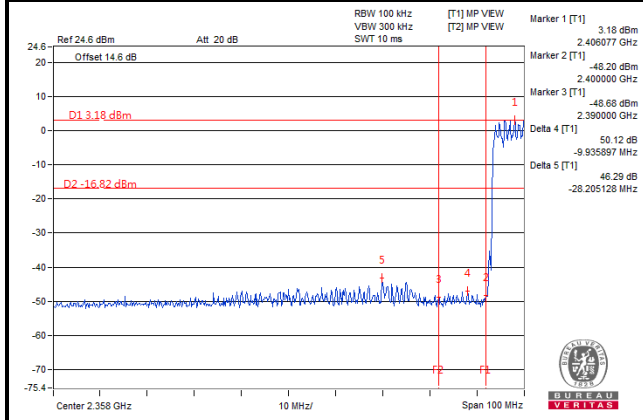
## Hopping Disabled\_Low Channel



## Hopping Disabled\_High Channel



## Hopping Enabled\_Low Channel



## 5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

## Appendix – Information on 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:

**Linko 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**

Tel: 886-3-3183232

Fax: 886-3-3270892

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

**Web Site:** [www.bureauveritas-adt.com](http://www.bureauveritas-adt.com)

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

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