

## Partial FCC Test Report

**Report No.:** RF170602C23-1

**FCC ID:** GKR-CAX00WB

**Test Model:** QCNFA425

**Received Date:** Jun. 02, 2017

**Test Date:** Jun. 20, 2017 ~ Jun. 22, 2017

**Issued Date:** Jun. 28, 2017

**Applicant:** COMPAL ELECTRONICS, INC.

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**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 )

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**Test Location (2):** No.215, Sec. 3, Beixin Rd., Xindian Dist., New Taipei City 231, Taiwan, R.O.C



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### Release Control Record

| Issue No.     | Description      | Date Issued   |
|---------------|------------------|---------------|
| RF170602C23-1 | Original Release | Jun. 28, 2017 |

## 1 Certificate of Conformity

**Product:** Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 1216 Type Card

**Brand:** Qualcomm Atheros

**Test Model:** QCNFA425

**Sample Status:** Identical Prototype

**Applicant:** COMPAL ELECTRONICS, INC.

**Test Date:** Jun. 20, 2017 ~ Jun. 22, 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 :** Evonne Liu, **Date:** Jun. 28, 2017  
Evonne Liu / Specialist

**Approved by :** David Huang, **Date:** Jun. 28, 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 -14.58 dB at 0.53404 MHz. |
| 15.247(a)(1)(iii)                              | Number of Hopping Frequency Used                                                                              | N/A    | Refer to Note                                                                         |
| 15.247(a)(1)(iii)                              | Dwell Time on Each Channel                                                                                    | N/A    | Refer to Note                                                                         |
| 15.247(a)(1)                                   | 1. Hopping Channel Separation<br>2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System | N/A    | Refer to Note                                                                         |
| 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 -12.54 dB at 2485.92 MHz. |
| 15.247(d)                                      | Band Edge Measurement                                                                                         | N/A    | Refer to Note                                                                         |
| 15.247(d)                                      | Antenna Port Emission                                                                                         | N/A    | Refer to Note                                                                         |
| 15.203                                         | Antenna Requirement                                                                                           | N/A    | Refer to Note                                                                         |

Note: Test items for AC Power Conducted Emission, Radiated Emissions, and Conducted Power were performed for this report. For other test data, please refer to BV CPS Report No.: RF150401E01-2 for module (Brand: Qualcomm Atheros, Model: QCNFA425).

### 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   | 2.0153 dB                      |
|                                    | 200 MHz ~ 1000 MHz | 2.0224 dB                      |
| Radiated Emissions above 1 GHz     | 1 GHz ~ 18 GHz     | 1.0121 dB                      |
|                                    | 18 GHz ~ 40 GHz    | 1.1508 dB                      |

### 2.2 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 General Description of EUT

|                            |                                                            |
|----------------------------|------------------------------------------------------------|
| <b>Product</b>             | Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 1216 Type Card |
| <b>Brand</b>               | Qualcomm Atheros                                           |
| <b>Test Model</b>          | QCNFA425                                                   |
| <b>Status of EUT</b>       | Identical Prototype                                        |
| <b>Power Supply Rating</b> | 5.0 Vdc (Host equipment)                                   |
| <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>Antenna Type</b>        | Refer to BV CPS Report No.: RF150401E01-2                  |
| <b>Antenna Connector</b>   | Refer to BV CPS Report No.: RF150401E01-2                  |
| <b>Accessory Device</b>    | N/A                                                        |
| <b>Data Cable Supplied</b> | N/A                                                        |

Note:

- The EUT is authorized for use in specific End-product. Please refer to below for more details.

| Product       | Brand  | Model                                               | Antenna Type                    |
|---------------|--------|-----------------------------------------------------|---------------------------------|
| Rugged Tablet | COMPAL | CAXA0 ;<br>CXXXXXX-CAXA0-XXXXXX-XXXX<br>(X:0~9,A~Z) | PIFA antenna with 0.24 dBi gain |

- The End-product contains following accessory devices.

| Product        | Brand            | Model       | Description                                                         |
|----------------|------------------|-------------|---------------------------------------------------------------------|
| Adapter        | DELTA            | ADP-65JH HB | I/P: 100-240 Vac, 1.5 A<br>O/P: 19 Vdc, 3.42 A<br>0.9 m power cable |
| Battery        | Getac            | CAX00       | 7.2 Vdc, 3950 mAh                                                   |
| BT/WLAN Module | Qualcomm Atheros | QCNFA425    | Chip factory: AZWAVE, AW-CM251NF                                    |

- 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  $\pi/4$ -DQPSK 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 **X-plane**.

#### **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                  | $\pi/4$ -DQPSK  | 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           | 78             | FHSS                  | $\pi/4$ -DQPSK  | 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           | 78             | FHSS                  | $\pi/4$ -DQPSK  | 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 | Charles Hsiao |
| RE<1G         | 25 deg. C, 65 % RH       | 120 Vac, 60 Hz | Charles Hsiao |
| PLC           | 25 deg. C, 65 % RH       | 120 Vac, 60 Hz | Getaz Yang    |
| APCM          | 25 deg. C, 65 % RH       | 5.0 Vdc        | Getaz Yang    |

### 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.

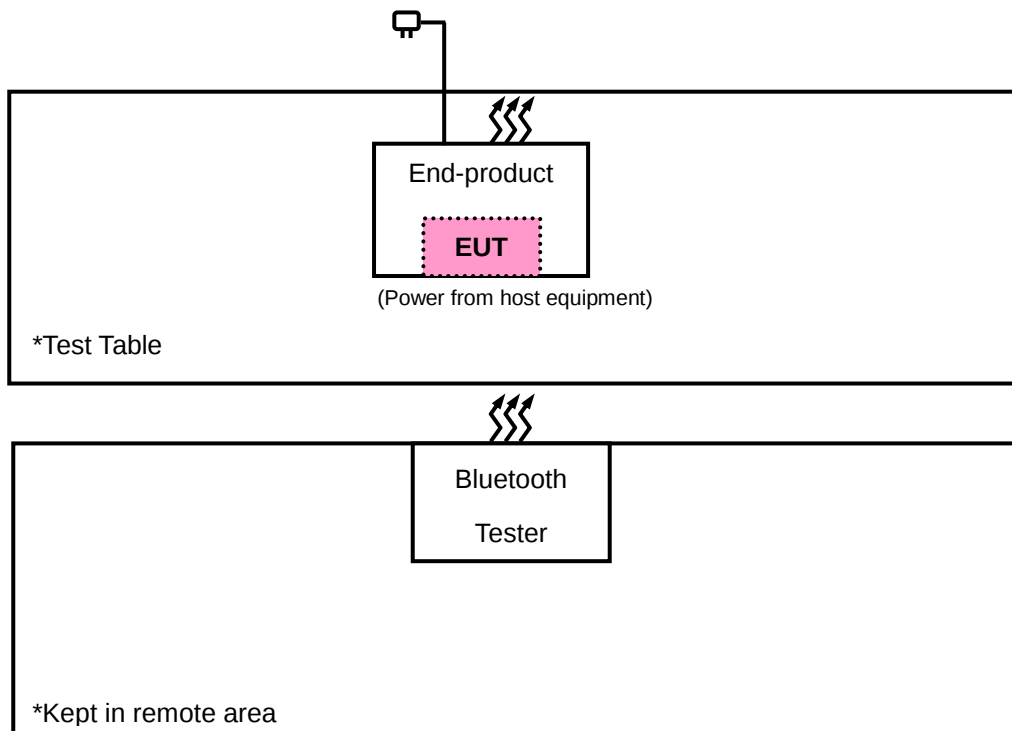
| No. | Product          | Brand | Model No. | Serial No. | FCC ID |
|-----|------------------|-------|-----------|------------|--------|
| 1.  | Bluetooth Tester | R&S   | CBT       | 100980     | N/A    |

| 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. Items 1 acted as communication partners 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 Technologies          | N9038A          | MY51210114                                                        | Sep. 09, 2016       | Sep. 08, 2017           |
| Spectrum Analyzer<br>ROHDE & SCHWARZ           | FSU43           | 101261                                                            | Dec. 13, 2016       | Dec. 12, 2017           |
| BILOG Antenna<br>SCHWARZBECK                   | VULB9168        | 9168-472                                                          | Dec. 16, 2016       | Dec. 15, 2017           |
| HORN Antenna<br>ETS-Lindgren                   | 3117            | 00143293                                                          | Dec. 29, 2016       | Dec. 28, 2017           |
| Bluetooth Tester                               | CBT             | 100980                                                            | Apr. 19, 2017       | Apr. 18, 2018           |
| Loop Antenna                                   | EM-6879         | 269                                                               | Aug. 11, 2016       | Aug. 10, 2017           |
| Agilent Communications<br>Tester-Wireless      | 8960 Series 10  | MY53201073                                                        | Jul. 03, 2015       | Jul. 02, 2017           |
| Preamplifier<br>Agilent                        | 310N            | 187226                                                            | Jun. 24, 2016       | Jun. 23, 2017           |
| Preamplifier<br>Agilent                        | 83017A          | MY39501357                                                        | Jun. 24, 2016       | Jun. 23, 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>ETS-LINDGREN                | 5D-FB           | Cable-CH1-01(R<br>FC-SMS-100-SM<br>S-120+RFC-SMS<br>-100-SMS-400) | Jun. 24, 2016       | Jun. 23, 2017           |
| RF signal cable<br>ETS-LINDGREN                | 8D-FB           | Cable-CH1-02(R<br>FC-SMS-100-SM<br>S-24)                          | Jun. 24, 2016       | Jun. 23, 2017           |
| Software<br>BV ADT                             | E3<br>8.130425b | NA                                                                | NA                  | NA                      |
| Antenna Tower<br>MF                            | NA              | NA                                                                | NA                  | NA                      |
| Turn Table<br>MF                               | NA              | NA                                                                | NA                  | NA                      |
| Antenna Tower & Turn<br>Table Controller<br>MF | MF-7802         | NA                                                                | NA                  | NA                      |
| Fixed Attenuator<br>Mini-Circuits              | BW-N10W5+       | NA                                                                | Jul. 08, 2016       | Jul. 07, 2017           |

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 HsinTien Chamber 1.

3. The horn antenna and preamplifier (model: 83017A) are used only for the measurement of emission frequency above 1 GHz if tested.

4. The FCC Site Registration No. is 149147.

5. The IC Site Registration No. is IC7450I-1.

#### 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:**

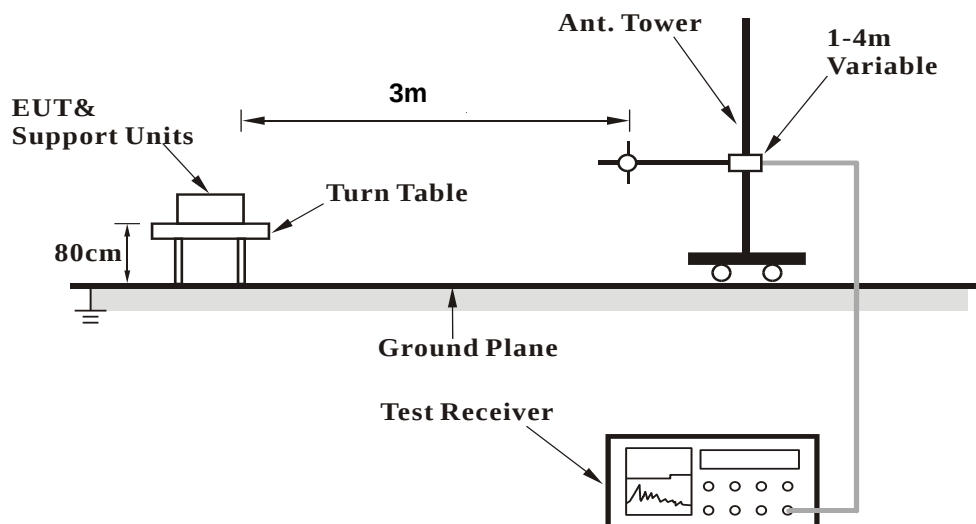
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz & 360 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1/T (Duty cycle < 98 %) for Average 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

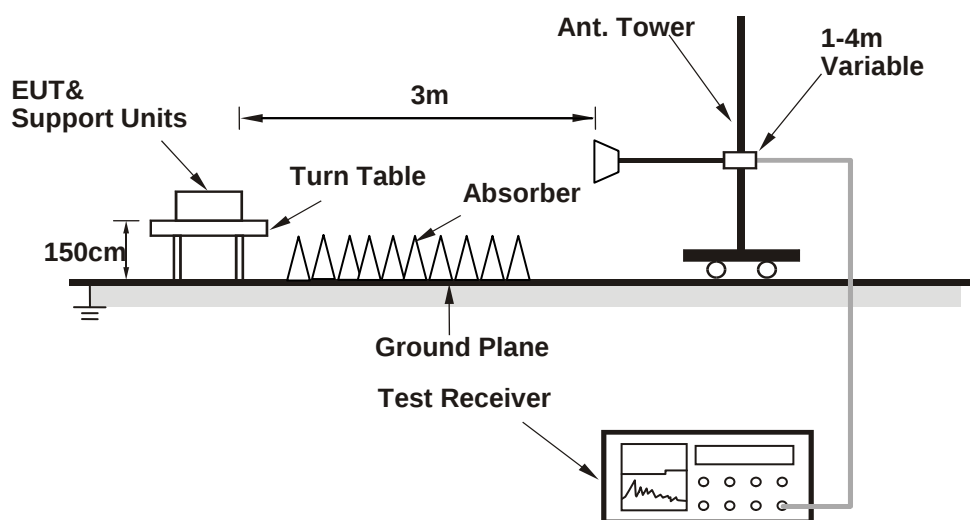
No deviation.

#### 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 :

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

| 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          | Charles Hsiao             |

| 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  |
| 2389.65                                             | 40.55                   | 38.84             | 54             | -13.45      | 31.8                  | 5.4             | 35.49              | 271                 | 293                  | Average |
| 2389.65                                             | 51.82                   | 50.11             | 74             | -22.18      | 31.8                  | 5.4             | 35.49              | 271                 | 293                  | Peak    |
| 2402                                                | 97.2                    | 95.47             |                |             | 31.8                  | 5.4             | 35.47              | 271                 | 293                  | Average |
| 2402                                                | 102.91                  | 101.18            |                |             | 31.8                  | 5.4             | 35.47              | 271                 | 293                  | Peak    |
| 4804                                                | 40.1                    | 32.01             | 54             | -13.9       | 33.96                 | 8.25            | 34.12              | 136                 | 207                  | Average |
| 4804                                                | 46.99                   | 38.9              | 74             | -27.01      | 33.96                 | 8.25            | 34.12              | 136                 | 207                  | 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  |
| 2389.92                                             | 40.52                   | 38.79             | 54             | -13.48      | 31.8                  | 5.4             | 35.47              | 102                 | 324                  | Average |
| 2389.92                                             | 52.07                   | 50.34             | 74             | -21.93      | 31.8                  | 5.4             | 35.47              | 102                 | 324                  | Peak    |
| 2402                                                | 95.47                   | 93.74             |                |             | 31.8                  | 5.4             | 35.47              | 102                 | 324                  | Average |
| 2402                                                | 100.54                  | 98.81             |                |             | 31.8                  | 5.4             | 35.47              | 102                 | 324                  | Peak    |
| 4804                                                | 39.88                   | 31.79             | 54             | -14.12      | 33.96                 | 8.25            | 34.12              | 135                 | 254                  | Average |
| 4804                                                | 48.82                   | 40.73             | 74             | -25.18      | 33.96                 | 8.25            | 34.12              | 135                 | 254                  | 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          | Charles Hsiao             |

| 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  |
| 2374                                                | 40.14                   | 38.48             | 54             | -13.86      | 31.78                 | 5.37            | 35.49              | 271                 | 293                  | Average |
| 2374                                                | 51.22                   | 49.56             | 74             | -22.78      | 31.78                 | 5.37            | 35.49              | 271                 | 293                  | Peak    |
| 2441                                                | 97.35                   | 95.48             |                |             | 31.85                 | 5.46            | 35.44              | 271                 | 293                  | Average |
| 2441                                                | 102.73                  | 100.86            |                |             | 31.85                 | 5.46            | 35.44              | 271                 | 293                  | Peak    |
| 2488.36                                             | 41.09                   | 39.08             | 54             | -12.91      | 31.9                  | 5.53            | 35.42              | 271                 | 293                  | Average |
| 2488.36                                             | 52.21                   | 50.2              | 74             | -21.79      | 31.9                  | 5.53            | 35.42              | 271                 | 293                  | 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  |
| 2384.25                                             | 40.42                   | 38.73             | 54             | -13.58      | 31.78                 | 5.4             | 35.49              | 102                 | 324                  | Average |
| 2384.25                                             | 51.16                   | 49.47             | 74             | -22.84      | 31.78                 | 5.4             | 35.49              | 102                 | 324                  | Peak    |
| 2441                                                | 95.35                   | 93.48             |                |             | 31.85                 | 5.46            | 35.44              | 102                 | 324                  | Average |
| 2441                                                | 100.35                  | 98.48             |                |             | 31.85                 | 5.46            | 35.44              | 102                 | 324                  | Peak    |
| 2484                                                | 41.07                   | 39.11             | 54             | -12.93      | 31.88                 | 5.5             | 35.42              | 102                 | 324                  | Average |
| 2484                                                | 52.79                   | 50.83             | 74             | -21.21      | 31.88                 | 5.5             | 35.42              | 102                 | 324                  | 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          | Charles Hsiao             |

| 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                                                | 97.55                   | 95.59             |                |               | 31.88                 | 5.5             | 35.42              | 209                 | 293                  | Average        |
| 2480                                                | 102.47                  | 100.51            |                |               | 31.88                 | 5.5             | 35.42              | 209                 | 293                  | Peak           |
| <b>2485.92</b>                                      | <b>41.46</b>            | <b>39.47</b>      | <b>54</b>      | <b>-12.54</b> | <b>31.88</b>          | <b>5.53</b>     | <b>35.42</b>       | <b>209</b>          | <b>293</b>           | <b>Average</b> |
| 2485.92                                             | 52.14                   | 50.15             | 74             | -21.86        | 31.88                 | 5.53            | 35.42              | 209                 | 293                  | Peak           |
| 4960                                                | 40.23                   | 31.96             | 54             | -13.77        | 33.99                 | 8.29            | 34.01              | 154                 | 334                  | Average        |
| 4960                                                | 48.27                   | 40                | 74             | -25.73        | 33.99                 | 8.29            | 34.01              | 154                 | 334                  | 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                                                | 95.46                   | 93.5              |                |               | 31.88                 | 5.5             | 35.42              | 102                 | 324                  | Average        |
| 2480                                                | 100.96                  | 99                |                |               | 31.88                 | 5.5             | 35.42              | 102                 | 324                  | Peak           |
| 2499.44                                             | 41.03                   | 39.01             | 54             | -12.97        | 31.9                  | 5.53            | 35.41              | 102                 | 324                  | Average        |
| 2499.44                                             | 52.13                   | 50.11             | 74             | -21.87        | 31.9                  | 5.53            | 35.41              | 102                 | 324                  | Peak           |
| 4960                                                | 40.3                    | 32.03             | 54             | -13.7         | 33.99                 | 8.29            | 34.01              | 130                 | 115                  | Average        |
| 4960                                                | 48.13                   | 39.86             | 74             | -25.87        | 33.99                 | 8.29            | 34.01              | 130                 | 115                  | 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 78         | 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          | Charles Hsiao                |

| 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 |
| 97.77                                               | 24.44                   | 43.29             | 43.5           | -19.06      | 12.02                 | 1.28            | 32.15              | 179                 | 135                  | Peak   |
| 139.62                                              | 22.63                   | 45.09             | 43.5           | -20.87      | 8.43                  | 1.38            | 32.27              | 138                 | 220                  | Peak   |
| 287.04                                              | 27.18                   | 44.46             | 46             | -18.82      | 12.82                 | 2.03            | 32.13              | 195                 | 163                  | Peak   |
| 311.9                                               | 28.08                   | 44.75             | 46             | -17.92      | 13.34                 | 2.11            | 32.12              | 111                 | 118                  | Peak   |
| 594                                                 | 24.43                   | 35.92             | 46             | -21.57      | 17.83                 | 2.87            | 32.19              | 124                 | 307                  | Peak   |
| 744.5                                               | 28.07                   | 37.23             | 46             | -17.93      | 19.76                 | 3.22            | 32.14              | 128                 | 280                  | 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 |
| 55.65                                               | 26.37                   | 43.56             | 40             | -13.63      | 14.14                 | 0.9             | 32.23              | 154                 | 156                  | Peak   |
| 137.73                                              | 19.51                   | 41.85             | 43.5           | -23.99      | 8.54                  | 1.38            | 32.26              | 138                 | 29                   | Peak   |
| 297.84                                              | 28.04                   | 45.12             | 46             | -17.96      | 13.02                 | 2.03            | 32.13              | 180                 | 77                   | Peak   |
| 300                                                 | 27.34                   | 44.39             | 46             | -18.66      | 13.06                 | 2.03            | 32.14              | 154                 | 349                  | Peak   |
| 594                                                 | 20.87                   | 32.36             | 46             | -25.13      | 17.83                 | 2.87            | 32.19              | 193                 | 236                  | Peak   |
| 846.7                                               | 22.77                   | 30.22             | 46             | -23.23      | 20.98                 | 3.38            | 31.81              | 146                 | 227                  | 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/AMN<br>ROHDE & SCHWARZ<br>(EUT)        | ESH3-Z5                  | 835239/001     | Mar. 10, 2017       | Mar. 09, 2018           |
| LISN/AMN<br>ROHDE & SCHWARZ<br>(Peripheral) | ESH3-Z5                  | 100311         | Jul. 28, 2016       | Jul. 27, 2017           |
| Software<br>ADT                             | BV ADT_Conc_<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

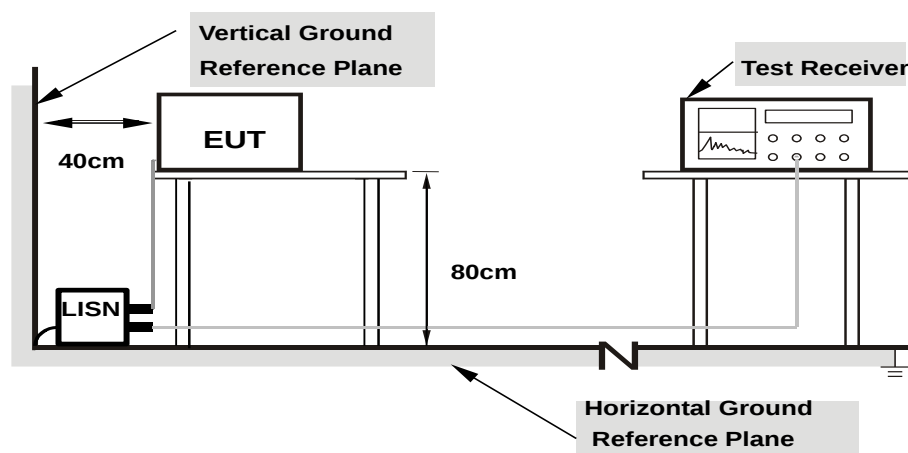
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50 uH of coupling 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

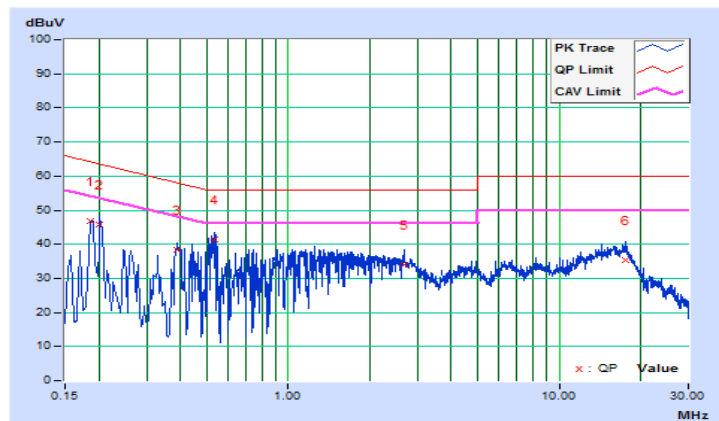
##### CONDUCTED WORST-CASE DATA : $\pi/4$ -DQPSK

|                 |                |                                          |                                      |
|-----------------|----------------|------------------------------------------|--------------------------------------|
| Frequency Range | 150kHz ~ 30MHz | Detector Function & Resolution Bandwidth | Quasi-Peak (QP) / Average (AV), 9kHz |
| Input Power     | 120Vac, 60Hz   | Environmental Conditions                 | 25°C, 65%RH                          |
| Tested by       | Getaz Yang     | Test Date                                | 2017/6/20                            |

| 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                         | 0.18617         | 10.36                  | 36.50                | 18.93        | 46.86                 | 29.29        | 64.21        | 54.21        | -17.35        | -24.92        |
| 2                         | 0.20201         | 10.37                  | 35.55                | 21.72        | 45.92                 | 32.09        | 63.53        | 53.53        | -17.61        | -21.44        |
| 3                         | 0.39032         | 10.40                  | 28.07                | 16.91        | 38.47                 | 27.31        | 58.06        | 48.06        | -19.59        | -20.75        |
| <b>4</b>                  | <b>0.53404</b>  | <b>10.40</b>           | <b>31.02</b>         | <b>17.17</b> | <b>41.42</b>          | <b>27.57</b> | <b>56.00</b> | <b>46.00</b> | <b>-14.58</b> | <b>-18.43</b> |
| 5                         | 2.67804         | 10.50                  | 23.65                | 11.49        | 34.15                 | 21.99        | 56.00        | 46.00        | -21.85        | -24.01        |
| 6                         | 17.67800        | 11.23                  | 24.09                | 16.01        | 35.32                 | 27.24        | 60.00        | 50.00        | -24.68        | -22.76        |

#### 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

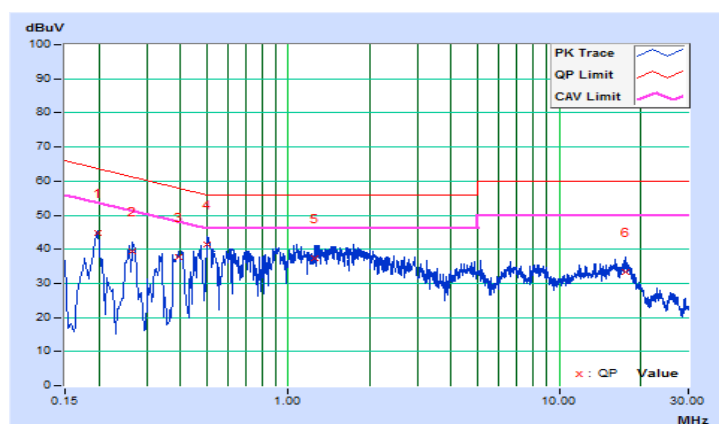


|                 |                |                                          |                                      |
|-----------------|----------------|------------------------------------------|--------------------------------------|
| Frequency Range | 150kHz ~ 30MHz | Detector Function & Resolution Bandwidth | Quasi-Peak (QP) / Average (AV), 9kHz |
| Input Power     | 120Vac, 60Hz   | Environmental Conditions                 | 25°C, 65%RH                          |
| Tested by       | Getaz Yang     | Test Date                                | 2017/6/20                            |

| 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                            | 0.19800         | 10.14                  | 34.60                | 21.85 | 44.74                 | 31.99 | 63.69        | 53.69 | -18.95      | -21.70 |
| 2                            | 0.26639         | 10.15                  | 29.25                | 17.46 | 39.40                 | 27.61 | 61.23        | 51.23 | -21.83      | -23.62 |
| 3                            | 0.39400         | 10.16                  | 27.60                | 16.36 | 37.76                 | 26.52 | 57.98        | 47.98 | -20.22      | -21.46 |
| 4                            | 0.50264         | 10.16                  | 31.10                | 17.06 | 41.26                 | 27.22 | 56.00        | 46.00 | -14.74      | -18.78 |
| 5                            | 1.25398         | 10.19                  | 27.31                | 12.56 | 37.50                 | 22.75 | 56.00        | 46.00 | -18.50      | -23.25 |
| 6                            | 17.51000        | 10.86                  | 22.51                | 14.41 | 33.37                 | 25.27 | 60.00        | 50.00 | -26.63      | -24.73 |

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

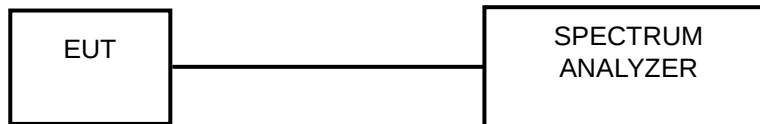


### 4.3 Maximum Output Power

#### 4.3.1 Limits of Maximum Output Power Measurement

The Maximum Output Power Measurement is 125 mW.

#### 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 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.

#### 4.3.5 Deviation from Test Standard

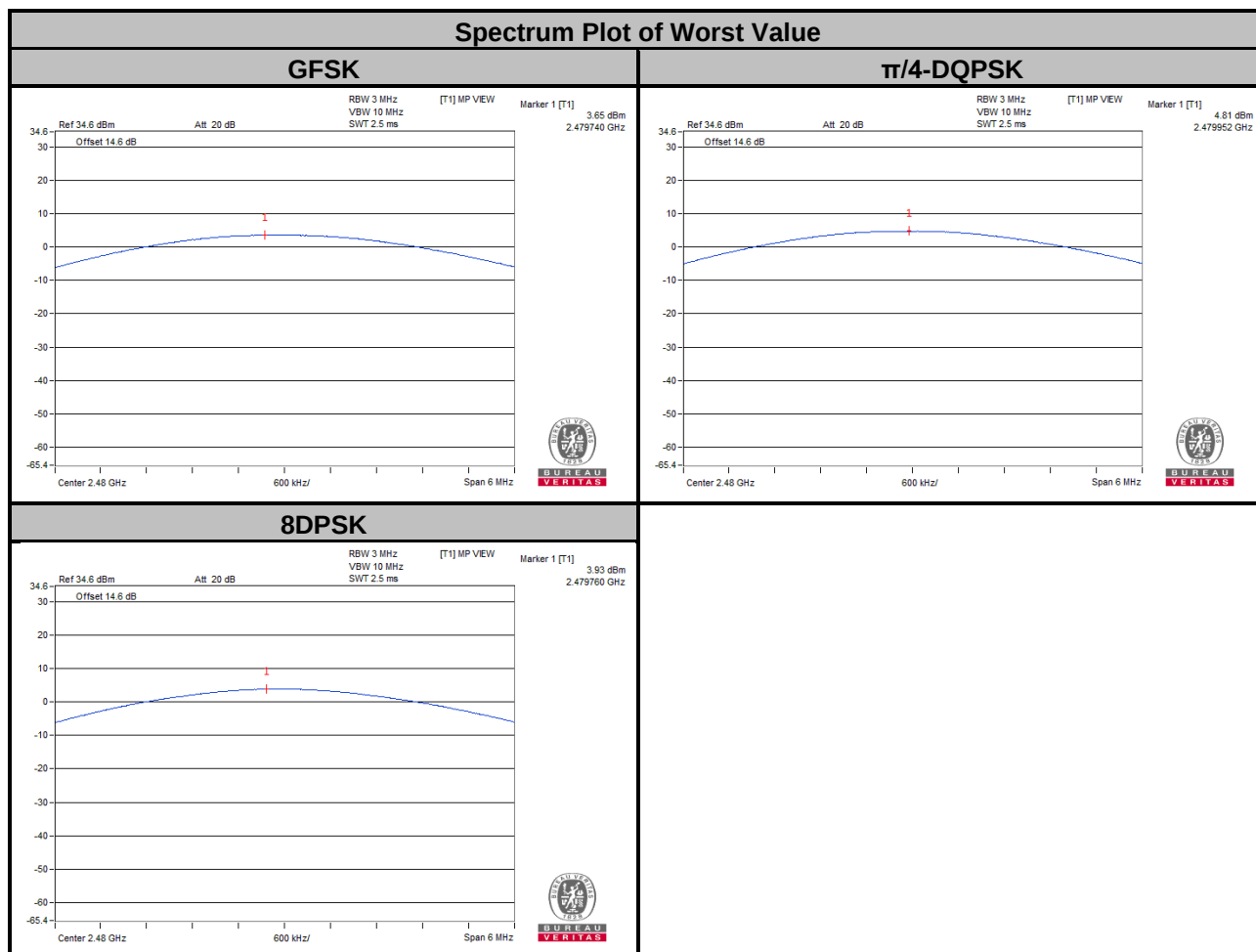
No deviation.

#### 4.3.6 EUT Operating Condition

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

#### 4.3.7 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        | 2.014             | 2.594          | 2.133 | 3.04               | 4.14           | 3.29  | 125              | Pass        |
| 39      | 2441        | 2.234             | 2.944          | 2.399 | 3.49               | 4.69           | 3.80  | 125              | Pass        |
| 78      | 2480        | 2.317             | 3.027          | 2.472 | 3.65               | 4.81           | 3.93  | 125              | Pass        |



## 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 accredited and approved according to ISO/IEC 17025.

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

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

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