# FCC Test Report

| | |
|---|---|
| **Report No.:** | RF180823C25-3 |
| **FCC ID:** | RYK-WPEB263ACNIBT |
| **Test Model:** | WPEB-263ACNI(BT) |
| **Received Date:** | Aug. 23, 2018 |
| **Test Date:** | Oct. 01 ~ Oct. 03, 2018 |
| **Issued Date:** | Oct. 18, 2018 |
| **Applicant:** | SparkLAN Communications, Inc. |
| **Address:** | 8F., No.257, Sec. 2, Tiding Blvd., Neihu District, Taipei City 11493, Taiwan (R.O.C.) |
| **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 Vil., Kwei Shan Dist., Taoyuan City 33383, TAIWAN (R.O.C.) |
| **FCC Registration / Designation Number:** | 788550 / TW0003 |

Testing Laboratory
2021

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## Release Control Record

| Issue No. | Description | Date Issued |
|---|---|---|
| RF180823C25-3 | Original release. | Oct. 18, 2018 |

## 1 Certificate of Conformity

| | |
|---|---|
| **Product:** | 802.11ac/a/b/g/n 2T2R Industrial Grade Wi-Fi / Bluetooth 4.1 Combo Half Mini PCIe Module |
| **Brand:** | SparkLAN |
| **Test Model:** | WPEB-263ACNI(BT) |
| **Sample Status:** | R&D sample |
| **Applicant:** | SparkLAN Communications, Inc. |
| **Test Date:** | Oct. 01 ~ Oct. 03, 2018 |
| **Standards:** | 47 CFR FCC Part 15, Subpart C (Section 15.247)<br>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 RF characteristics under the conditions specified in this report.

**Prepared by :** _____ , **Date:** Oct. 18, 2018
Suntee Liu / Specialist

**Approved by :** _____ , **Date:** Oct. 18, 2018
Bruce Chen / 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. Minimum passing margin is -17.53dB at 0.25953MHz. |
| 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 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 / 15.209 / 15.247(d) | Radiated Emissions and Band Edge Measurement | Pass | Meet the requirement of limit. Minimum passing margin is -4.6dB at 881.50MHz. |
| 15.247(d) | Antenna Port Emission | Pass | Meet the requirement of limit. |
| 15.203 | Antenna Requirement | Pass | Antenna connectors are IPEX MHF 4 at modular side & RP-SMA (M) at antenna side not standard connector. |

Note: If The Frequency Hopping System operating in 2400-2483.5MHz band and the output power less than 125mW. The hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB 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 as specified in CISPR 16-4-2:

| Measurement | Frequency | Expanded Uncertainty (k=2) (±) |
|---|---|---|
| Conducted Emissions at mains ports | 150kHz ~ 30MHz | 2.94 dB |
| Radiated Emissions up to 1 GHz | 30MHz ~ 200MHz | 3.86 dB |
| | 200MHz ~ 1000MHz | 3.87 dB |
| Radiated Emissions above 1 GHz | 1GHz ~ 18GHz | 2.29 dB |
| | 18GHz ~ 40GHz | 2.29 dB |

### 2.2 Modification Record

There were no modifications required for compliance.

## 3 General Information

### 3.1 General Description of EUT

| | |
|---|---|
| Product | 802.11ac/a/b/g/n 2T2R Industrial Grade Wi-Fi / Bluetooth 4.1 Combo Half Mini PCIe Module |
| Brand | SparkLAN |
| Test Model | WPEB-263ACNI(BT) |
| Sample Status | R&D sample |
| Nominal Voltage | 3.3Vdc (host) |
| Modulation Type | GFSK, $\pi$/4-DQPSK, 8DPSK |
| Modulation Technology | FHSS |
| Transfer Rate | 1/2/3Mbps |
| Operating Frequency | 2402~2480MHz |
| Number of Channel | 79 |
| Output Power | 2.594mW |
| Antenna Type | Refer to Note |
| Antenna Connector | Refer to Note |
| Accessory Device | Antenna |
| Cable Supplied | NA |

Note:

1. The EUT uses following antenna.

| No. | Transmitter Circuit | Brand | Model | Antenna Type | 2.4G gain with cable loss (dBi) | 5G gain with cable loss (dBi) | Connector Type |
|---|---|---|---|---|---|---|---|
| 1 | Chain(0)<br>Chain(1) | Sparklan | AD-301N | Dipole | 4.4 | B1&2: 5.2<br>B3&4: 5.8 | IPEX MHF 4 at modular side & RP-SMA (M) at antenna side |
| 2 | Chain(0)<br>Chain(1) | Sparklan | AD-103AG | Dipole | 2.02 | B1&2: 1.93<br>B3&4: 2.03 | |
| 3 | Chain(0)<br>Chain(1) | Sparklan | AD-305N | Dipole | 5.0 | 5.0 | |
| 4 | Chain(0)<br>Chain(1) | Sparklan | AD-303N | Dipole | 3.0 | 3.0 | |
| 5 | Chain(0)<br>Chain(1) | Sparklan | AD-302N | Dipole | 3.0 | 2.0 | |

* The 5dBi with 2.4GHz max. gain is chosen for final tests.
  The 5.8dBi with 5GHz max. gain is chosen for final tests.

2. 2.4GHz & 5GHz technologies cannot transmit at same time.
   WLAN & BT technologies cannot transmit at same time

### 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≥1G | RE<1G | PLC | APCM | |
| - | √ | √ | √ | √ | - |

Where RE≥1G: Radiated Emission above 1GHz & Bandedge Measurement RE<1G: Radiated Emission below 1GHz

PLC: Power Line Conducted Emission APCM: Antenna Port Conducted Measurement

Radiated Emission Test (Above 1GHz):

☒ 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 | Pakcet Type | Remark |
|---|---|---|---|---|---|---|
| - | 0 to 78 | 0, 39, 78 | FHSS | GFSK | DH5 | - |
| | 0 to 78 | 0, 39, 78 | FHSS | 8DPSK | 3DH5 | - |

Radiated Emission Test (Below 1GHz):

☒ 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 | Pakcet Type | Remark |
|---|---|---|---|---|---|---|
| - | 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 | Pakcet Type | Remark |
|---|---|---|---|---|---|---|
| - | 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 | Pakcet Type | Remark |
|---|---|---|---|---|---|---|
| - | 0 to 78 | 0, 39, 78 | FHSS | GFSK | DH5 | - |
| | 0 to 78 | 0, 39, 78 | FHSS | 8DPSK | 3DH5 | - |

Test Condition:

| Applicable to | Environmental Conditions | Input Power (system) | Tested by |
|---|---|---|---|
| RE≥1G | 24deg. C, 65%RH | 120Vac, 60Hz | Willy Cheng |
| RE<1G | 22deg. C, 67%RH | 120Vac, 60Hz | Willy Cheng |
| PLC | 22deg. C, 66%RH | 120Vac, 60Hz | Willy Cheng |
| APCM | 25deg. C, 60%RH | 120Vac, 60Hz | Alan Wu |

### 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.

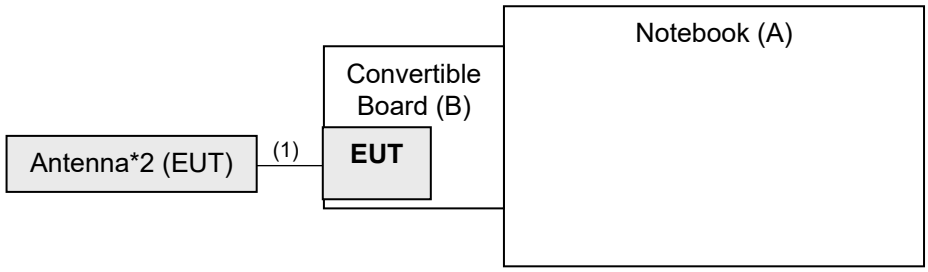
| ID | Product | Brand | Model No. | Serial No. | FCC ID | Remarks |
|---|---|---|---|---|---|---|
| A. | Notebook | DELL | E5420 | BPQ7MQ1 | FCC DoC Approved | - |
| B. | Convertible Board | NA | NA | NA | NA | - |

Note:

1. All power cords of the above support units are non-shielded (1.8m).

| ID | Descriptions | Qty. | Length (m) | Shielding (Yes/No) | Cores (Qty.) | Remarks |
|---|---|---|---|---|---|---|
| 1. | Antenna cable | 2 | 0.5 | N | 0 | Provided by manufacturer |

#### 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)**
ANSI C63.10:2013

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

# 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 20dB 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 1000MHz, 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 20dB under any condition of modulation.

### 4.1.2 Test Instruments

| Description & Manufacturer | Model No. | Serial No. | Cal. Date | Cal. Due |
|---|---|---|---|---|
| Test Receiver<br>ROHDE & SCHWARZ | ESIB7 | 100187 | May 29, 2018 | May 28, 2019 |
| Spectrum Analyzer<br>ROHDE & SCHWARZ | FSP40 | 100041 | Dec. 12, 2017 | Dec. 11, 2018 |
| BILOG Antenna<br>SCHWARZBECK | VULB9168 | 9168-171 | Dec. 11, 2017 | Dec. 10, 2018 |
| HORN Antenna<br>SCHWARZBECK | 9120D | 209 | Dec. 13, 2017 | Dec. 12, 2018 |
| HORN Antenna<br>SCHWARZBECK | BBHA 9170 | BBHA9170241 | Dec. 01, 2017 | Nov. 30, 2018 |
| Loop Antenna<br>EMCI | EM-6879 | 269 | Sep. 07, 2018 | Sep. 06, 2019 |
| Preamplifier<br>Agilent<br>(Below 1GHz) | 8447D | 2944A10738 | Aug. 21, 2018 | Aug. 20, 2019 |
| Preamplifier<br>Agilent<br>(Above 1GHz) | 8449B | 3008A02465 | Apr. 03, 2018 | Apr. 02, 2019 |
| RF signal cable<br>HUBER+SUHNER | SUCOFLEX 104 | Cable-CH3-03<br>(223653/4) | Aug. 21, 2018 | Aug. 20, 2019 |
| RF signal cable<br>HUBER+SUHNER&<br>EMCI | SUCOFLEX<br>104&EMC104-SM-S<br>M-8000 | Cable-CH3-03<br>(309224+170907) | Aug. 21, 2018 | Aug. 20, 2019 |
| Software<br>BV ADT | ADT_Radiated_<br>V7.6.15.9.5 | NA | NA | NA |
| Antenna Tower<br>inn-co GmbH | MA 4000 | 013303 | NA | NA |
| Antenna Tower Controller<br>BV ADT | AT100 | AT93021702 | NA | NA |
| Turn Table<br>BV ADT | TT100 | TT93021702 | NA | NA |
| Turn Table Controller<br>BV ADT | SC100 | SC93021702 | NA | NA |
| Boresight Antenna Fixture | FBA-01 | FBA-SIP01 | NA | NA |
| USB Wideband Power Sensor<br>KEYSIGHT | U2021XA | MY55050005/MY5519<br>0004/MY55190007/MY<br>55210005 | Jul. 17, 2018 | Jul. 16, 2019 |

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 3.
3. The horn antenna and preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
4. The FCC Designation Number is TW0003. The number will be varied with the Lab location and scope as attached.
5. The IC Site Registration No. is IC 7450F-3.

### 4.1.3 Test Procedures

**For Radiated emission below 30MHz**

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

**For Radiated emission above 30MHz**

a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) 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 detect 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:

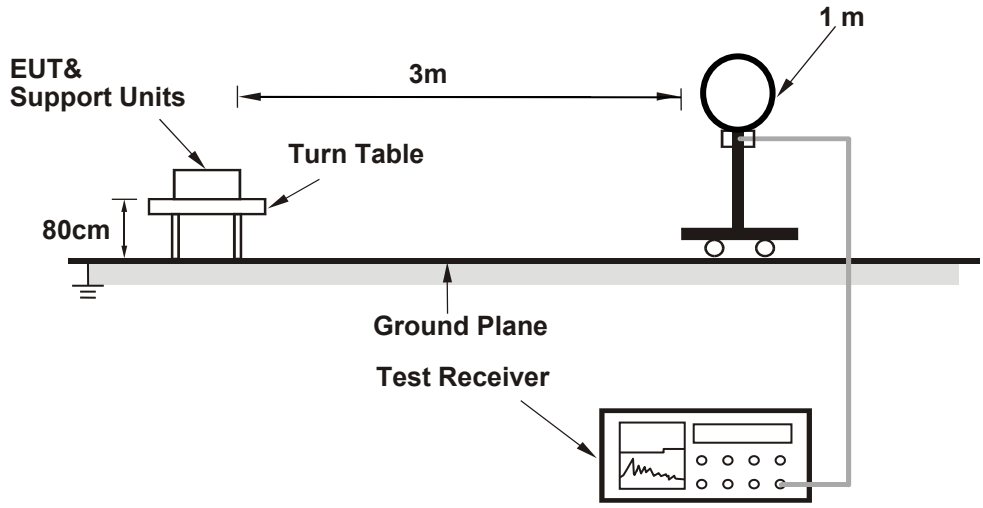
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.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

### 4.1.4 Deviation from Test Standard

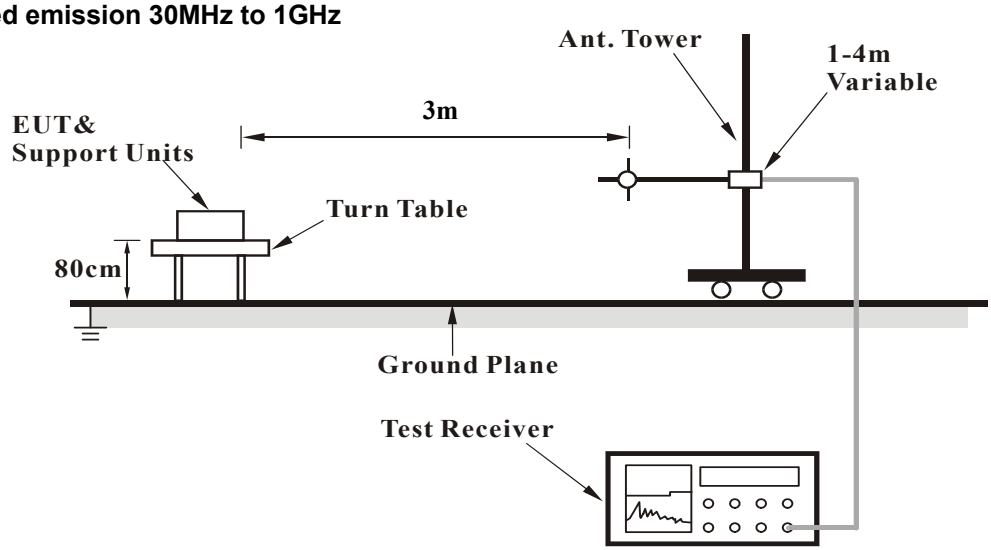
No deviation.

### 4.1.5 Test Setup

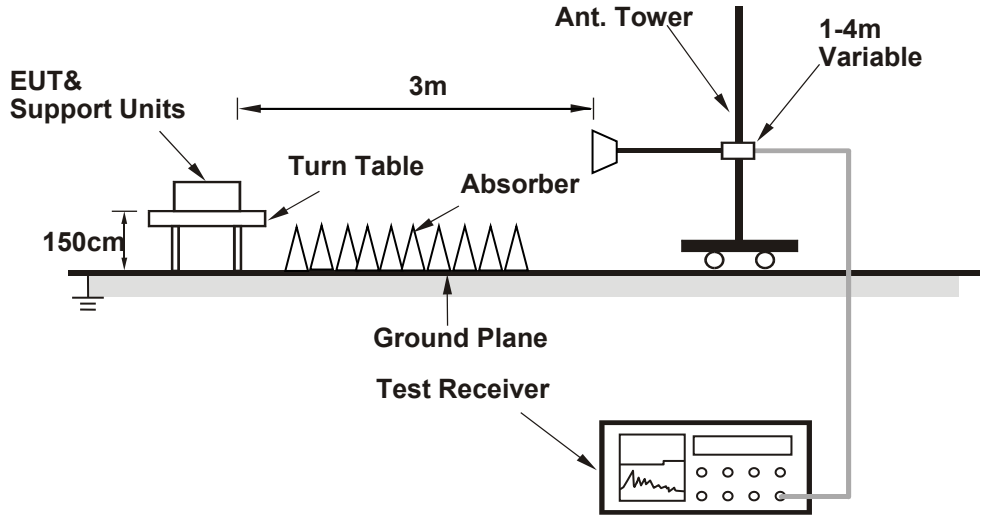
**For Radiated emission below 30MHz**




**For Radiated emission 30MHz to 1GHz**



**For Radiated emission above 1GHz**




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

### 4.1.6 EUT Operating Conditions

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

### 4.1.7 Test Results

Above 1GHz data:

GFSK

| CHANNEL | TX Channel 0 | DETECTOR FUNCTION | Peak (PK)<br>Average (AV) |
|---|---|---|---|
| FREQUENCY RANGE | 1GHz ~ 25GHz | | |

| ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
| 1 | 2390.00 | 59.3 PK | 74.0 | -14.7 | 1.92 H | 26 | 26.3 | 33.0 |
| 2 | 2390.00 | 47.2 AV | 54.0 | -6.8 | 1.92 H | 26 | 14.2 | 33.0 |
| 3 | *2402.00 | 90.3 PK | | | 1.76 H | 13 | 57.4 | 32.9 |
| 4 | *2402.00 | 89.3 AV | | | 1.76 H | 13 | 56.4 | 32.9 |
| 5 | 4804.00 | 45.2 PK | 74.0 | -28.8 | 3.23 H | 326 | 41.7 | 3.5 |
| 6 | 4804.00 | 32.3 AV | 54.0 | -21.7 | 3.23 H | 326 | 28.8 | 3.5 |
| ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M | | | | | | | | |
| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
| 1 | 2390.00 | 59.1 PK | 74.0 | -14.9 | 1.83 V | 106 | 26.1 | 33.0 |
| 2 | 2390.00 | 47.5 AV | 54.0 | -6.5 | 1.83 V | 106 | 14.5 | 33.0 |
| 3 | *2402.00 | 102.6 PK | | | 1.68 V | 170 | 69.7 | 32.9 |
| 4 | *2402.00 | 101.8 AV | | | 1.68 V | 170 | 68.9 | 32.9 |
| 5 | 4804.00 | 47.8 PK | 74.0 | -26.2 | 3.24 V | 329 | 44.3 | 3.5 |
| 6 | 4804.00 | 38.3 AV | 54.0 | -15.7 | 3.24 V | 329 | 34.8 | 3.5 |

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

| CHANNEL | TX Channel 39 | DETECTOR FUNCTION | Peak (PK)<br>Average (AV) |
|---|---|---|---|
| FREQUENCY RANGE | 1GHz ~ 25GHz | | |

| ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
| 1 | *2441.00 | 89.4 PK | | | 1.63 H | 20 | 56.5 | 32.9 |
| 2 | *2441.00 | 88.4 AV | | | 1.63 H | 20 | 55.5 | 32.9 |
| 3 | 4882.00 | 45.5 PK | 74.0 | -28.5 | 3.30 H | 319 | 42.3 | 3.2 |
| 4 | 4882.00 | 32.1 AV | 54.0 | -21.9 | 3.30 H | 319 | 28.9 | 3.2 |
| ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M | | | | | | | | |
| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
| 1 | *2441.00 | 101.9 PK | | | 1.54 V | 139 | 69.0 | 32.9 |
| 2 | *2441.00 | 101.1 AV | | | 1.54 V | 139 | 68.2 | 32.9 |
| 3 | 4882.00 | 49.2 PK | 74.0 | -24.8 | 3.26 V | 331 | 46.0 | 3.2 |
| 4 | 4882.00 | 40.5 AV | 54.0 | -13.5 | 3.26 V | 331 | 37.3 | 3.2 |

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

| CHANNEL | TX Channel 78 | DETECTOR FUNCTION | Peak (PK)<br>Average (AV) |
|---|---|---|---|
| FREQUENCY RANGE | 1GHz ~ 25GHz | | |

| ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
| 1 | *2480.00 | 88.9 PK | | | 1.83 H | 13 | 56.2 | 32.7 |
| 2 | *2480.00 | 87.9 AV | | | 1.83 H | 13 | 55.2 | 32.7 |
| 3 | 2483.50 | 59.2 PK | 74.0 | -14.8 | 1.92 H | 26 | 26.5 | 32.7 |
| 4 | 2483.50 | 47.1 AV | 54.0 | -6.9 | 1.92 H | 26 | 14.4 | 32.7 |
| 5 | 4960.00 | 47.5 PK | 74.0 | -26.5 | 3.15 H | 332 | 44.1 | 3.4 |
| 6 | 4960.00 | 34.1 AV | 54.0 | -19.9 | 3.15 H | 332 | 30.7 | 3.4 |
| ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M | | | | | | | | |
| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
| 1 | *2480.00 | 101.5 PK | | | 1.65 V | 158 | 68.8 | 32.7 |
| 2 | *2480.00 | 100.7 AV | | | 1.65 V | 158 | 68.0 | 32.7 |
| 3 | 2483.50 | 59.7 PK | 74.0 | -14.3 | 1.55 V | 169 | 27.0 | 32.7 |
| 4 | 2483.50 | 47.2 AV | 54.0 | -6.8 | 1.55 V | 169 | 14.5 | 32.7 |
| 5 | 4960.00 | 54.2 PK | 74.0 | -19.8 | 3.08 V | 287 | 50.8 | 3.4 |
| 6 | 4960.00 | 44.0 AV | 54.0 | -10.0 | 3.08 V | 287 | 40.6 | 3.4 |

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

8DPSK

| CHANNEL | TX Channel 0 | DETECTOR FUNCTION | Peak (PK)<br>Average (AV) |
|---|---|---|---|
| FREQUENCY RANGE | 1GHz ~ 25GHz | | |

| ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
| 1 | 2390.00 | 59.0 PK | 74.0 | -15.0 | 2.88 H | 312 | 26.0 | 33.0 |
| 2 | 2390.00 | 47.1 AV | 54.0 | -6.9 | 2.88 H | 312 | 14.1 | 33.0 |
| 3 | *2402.00 | 87.3 PK | | | 3.00 H | 325 | 54.4 | 32.9 |
| 4 | *2402.00 | 83.0 AV | | | 3.00 H | 325 | 50.1 | 32.9 |
| 5 | 4804.00 | 45.7 PK | 74.0 | -28.3 | 2.74 H | 325 | 42.2 | 3.5 |
| 6 | 4804.00 | 33.1 AV | 54.0 | -20.9 | 2.74 H | 325 | 29.6 | 3.5 |
| ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M | | | | | | | | |
| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
| 1 | 2390.00 | 59.3 PK | 74.0 | -14.7 | 1.74 V | 28 | 26.3 | 33.0 |
| 2 | 2390.00 | 47.2 AV | 54.0 | -6.8 | 1.74 V | 28 | 14.2 | 33.0 |
| 3 | *2402.00 | 99.3 PK | | | 1.66 V | 41 | 66.4 | 32.9 |
| 4 | *2402.00 | 95.2 AV | | | 1.66 V | 41 | 62.3 | 32.9 |
| 5 | 4804.00 | 45.6 PK | 74.0 | -28.4 | 2.76 V | 358 | 42.1 | 3.5 |
| 6 | 4804.00 | 33.3 AV | 54.0 | -20.7 | 2.76 V | 358 | 29.8 | 3.5 |

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

| CHANNEL | TX Channel 39 | DETECTOR FUNCTION | Peak (PK)<br>Average (AV) |
|---|---|---|---|
| FREQUENCY RANGE | 1GHz ~ 25GHz | | |

| ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
| 1 | *2441.00 | 87.8 PK | | | 3.02 H | 318 | 54.9 | 32.9 |
| 2 | *2441.00 | 83.0 AV | | | 3.02 H | 318 | 50.1 | 32.9 |
| 3 | 4882.00 | 46.0 PK | 74.0 | -28.0 | 2.98 H | 321 | 42.8 | 3.2 |
| 4 | 4882.00 | 32.9 AV | 54.0 | -21.1 | 2.98 H | 321 | 29.7 | 3.2 |
| ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M | | | | | | | | |
| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
| 1 | *2441.00 | 100.0 PK | | | 1.28 V | 156 | 67.1 | 32.9 |
| 2 | *2441.00 | 95.7 AV | | | 1.28 V | 156 | 62.8 | 32.9 |
| 3 | 4882.00 | 47.4 PK | 74.0 | -26.6 | 3.16 V | 270 | 44.2 | 3.2 |
| 4 | 4882.00 | 34.9 AV | 54.0 | -19.1 | 3.16 V | 270 | 31.7 | 3.2 |

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

| CHANNEL | TX Channel 78 | DETECTOR FUNCTION | Peak (PK)<br>Average (AV) |
|---|---|---|---|
| FREQUENCY RANGE | 1GHz ~ 25GHz | | |

| ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
| 1 | *2480.00 | 87.5 PK | | | 3.69 H | 329 | 54.8 | 32.7 |
| 2 | *2480.00 | 83.0 AV | | | 3.69 H | 329 | 50.3 | 32.7 |
| 3 | 2483.50 | 59.8 PK | 74.0 | -14.2 | 3.23 H | 296 | 27.1 | 32.7 |
| 4 | 2483.50 | 47.2 AV | 54.0 | -6.8 | 3.23 H | 296 | 14.5 | 32.7 |
| 5 | 4960.00 | 46.8 PK | 74.0 | -27.2 | 2.54 H | 316 | 43.4 | 3.4 |
| 6 | 4960.00 | 33.4 AV | 54.0 | -20.6 | 2.54 H | 316 | 30.0 | 3.4 |
| ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M | | | | | | | | |
| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
| 1 | *2480.00 | 99.5 PK | | | 1.65 V | 168 | 66.8 | 32.7 |
| 2 | *2480.00 | 95.2 AV | | | 1.65 V | 168 | 62.5 | 32.7 |
| 3 | 2483.50 | 59.7 PK | 74.0 | -14.3 | 1.72 V | 199 | 27.0 | 32.7 |
| 4 | 2483.50 | 47.2 AV | 54.0 | -6.8 | 1.72 V | 199 | 14.5 | 32.7 |
| 5 | 4960.00 | 48.0 PK | 74.0 | -26.0 | 3.38 V | 221 | 44.6 | 3.4 |
| 6 | 4960.00 | 35.4 AV | 54.0 | -18.6 | 3.38 V | 221 | 32.0 | 3.4 |

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

Below 1GHz worst-case data:

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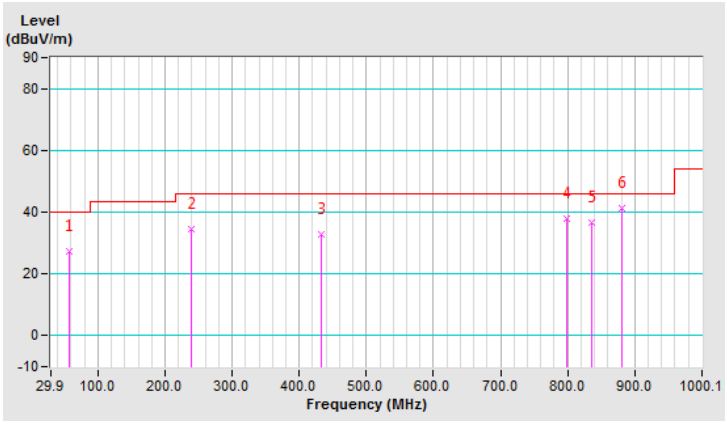
| CHANNEL | TX Channel 39 | DETECTOR FUNCTION | Quasi-Peak (QP) |
|---|---|---|---|
| FREQUENCY RANGE | 9kHz ~ 1GHz | | |

| ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
| 1 | 57.12 | 27.5 QP | 40.0 | -12.5 | 1.99 H | 91 | 37.1 | -9.6 |
| 2 | 239.88 | 34.5 QP | 46.0 | -11.5 | 1.49 H | 4 | 44.6 | -10.1 |
| 3 | 432.37 | 32.6 QP | 46.0 | -13.4 | 1.99 H | 78 | 37.1 | -4.5 |
| 4 | 797.89 | 37.8 QP | 46.0 | -8.2 | 1.00 H | 57 | 35.5 | 2.3 |
| 5 | 834.84 | 36.8 QP | 46.0 | -9.2 | 1.49 H | 55 | 33.9 | 2.9 |
| **6** | **881.50** | **41.4 QP** | **46.0** | **-4.6** | **1.00 H** | **89** | **37.8** | **3.6** |

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
4. Margin value = Emission Level – Limit value
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20dB below the permissible value to be report.

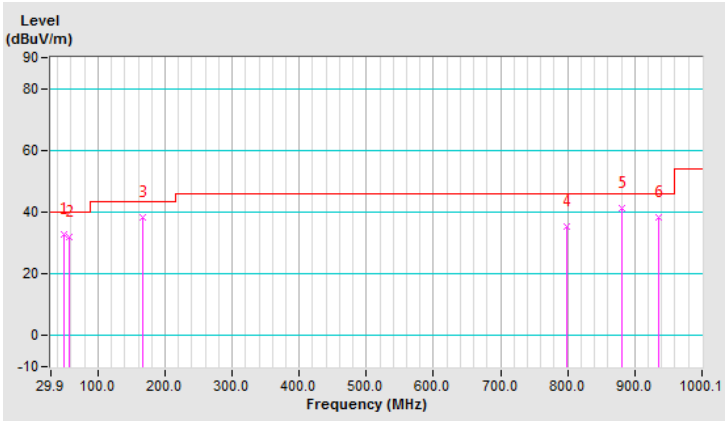


| CHANNEL | TX Channel 39 | DETECTOR FUNCTION | Quasi-Peak (QP) |
|---|---|---|---|
| FREQUENCY RANGE | 9kHz ~ 1GHz | | |

| ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NO. | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
| 1 | 49.34 | 32.7 QP | 40.0 | -7.3 | 1.50 V | 216 | 42.0 | -9.3 |
| 2 | 57.12 | 31.8 QP | 40.0 | -8.2 | 1.01 V | 64 | 41.4 | -9.6 |
| 3 | 166.00 | 38.1 QP | 43.5 | -5.4 | 1.01 V | 85 | 47.1 | -9.0 |
| 4 | 797.89 | 35.5 QP | 46.0 | -10.5 | 1.01 V | 106 | 33.2 | 2.3 |
| 5 | 881.50 | 41.1 QP | 46.0 | -4.9 | 2.00 V | 44 | 37.5 | 3.6 |
| 6 | 935.94 | 38.5 QP | 46.0 | -7.5 | 2.00 V | 133 | 33.6 | 4.9 |

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
4. Margin value = Emission Level – Limit value
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20dB below the permissible value to be report.



## 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 0.50MHz.

### 4.2.2 Test Instruments

| Description & Manufacturer | Model No. | Serial No. | Cal. Date | Cal. Due |
|---|---|---|---|---|
| Test Receiver<br>ROHDE & SCHWARZ | ESR3 | 102412 | Feb. 08, 2018 | Feb. 07, 2019 |
| RF signal cable (with 10dB PAD)<br>Woken | 5D-FB | Cable-cond2-01 | Sep. 05, 2018 | Sep. 04, 2019 |
| LISN<br>ROHDE & SCHWARZ<br>(EUT) | ESH2-Z5 | 100100 | Feb. 05, 2018 | Feb. 04, 2019 |
| LISN<br>ROHDE & SCHWARZ<br>(Peripheral) | ESH3-Z5 | 100312 | Aug. 13, 2018 | Aug. 12, 2019 |
| Software<br>ADT | BV ADT_Cond_<br>V7.3.7.4 | 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 2.
3. The VCCI Site Registration No. is C-2047.

### 4.2.3 Test Procedures

a. 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/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

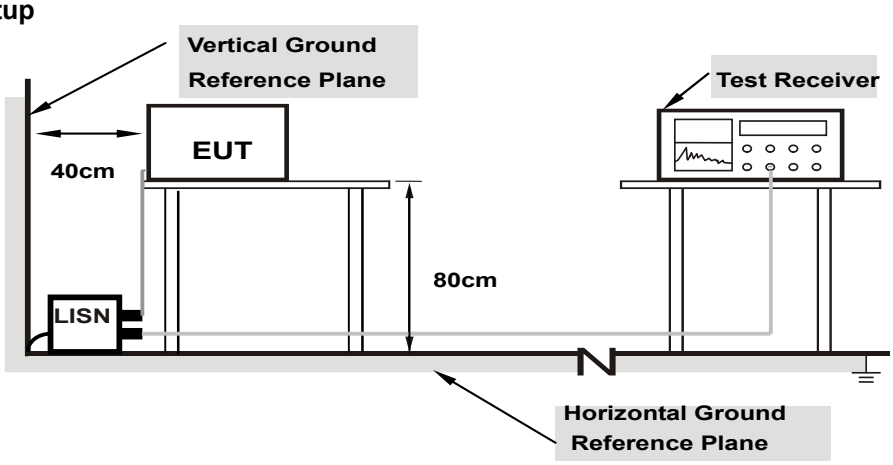
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

Note: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

### 4.2.4 Deviation from Test Standard

No deviation.

### 4.2.5 Test Setup




**Note: 1.Support units were connected to second LISN.**

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

### 4.2.6 EUT Operating Conditions

Same as item 4.1.6.

### 4.2.7 Test Results

Worst-case data:

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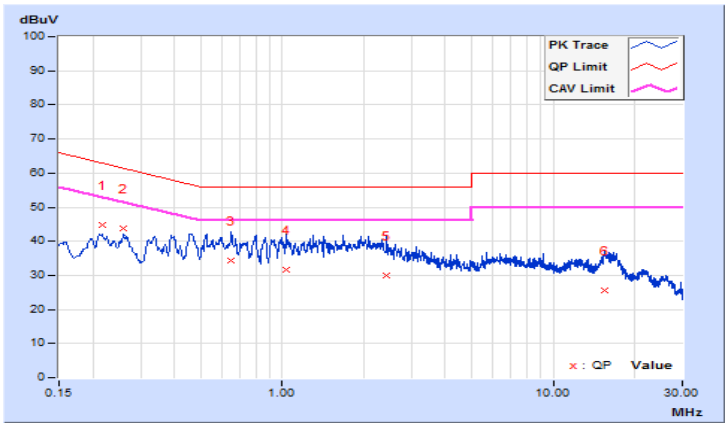
| Phase | Line (L) | Detector Function | Quasi-Peak (QP) / Average (AV) |
|---|---|---|---|
| Channel | TX Channel 39 | | |

| No | Freq. | Corr. Factor | Reading Value | | Emission Level | | Limit | | Margin | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | [dB (uV)] | | [dB (uV)] | | [dB (uV)] | | (dB) | |
| | [MHz] | (dB) | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. |
| 1 | 0.21745 | 10.06 | 34.81 | 18.45 | 44.87 | 28.51 | 62.92 | 52.92 | -18.05 | -24.41 |
| **2** | **0.25953** | **10.06** | **33.86** | **19.06** | **43.92** | **29.12** | **61.45** | **51.45** | **-17.53** | **-22.33** |
| 3 | 0.64950 | 10.06 | 24.23 | 18.17 | 34.29 | 28.23 | 56.00 | 46.00 | -21.71 | -17.77 |
| 4 | 1.03875 | 10.07 | 21.63 | 15.09 | 31.70 | 25.16 | 56.00 | 46.00 | -24.30 | -20.84 |
| 5 | 2.42259 | 10.09 | 19.74 | 12.55 | 29.83 | 22.64 | 56.00 | 46.00 | -26.17 | -23.36 |
| 6 | 15.42525 | 10.42 | 15.26 | 7.93 | 25.68 | 18.35 | 60.00 | 50.00 | -34.32 | -31.65 |

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.

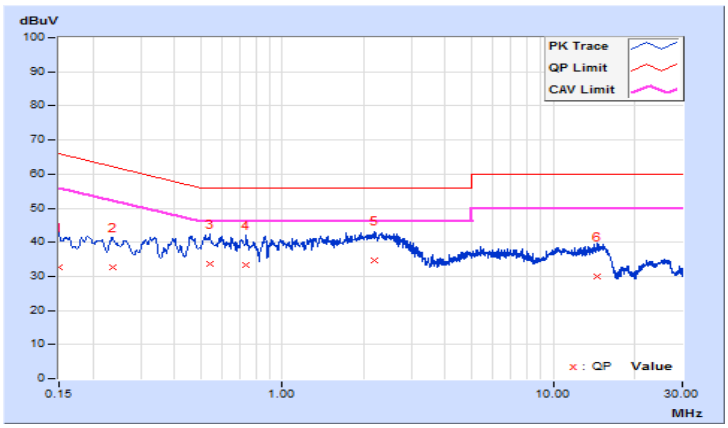


| Phase | Neutral (N) | Detector Function | Quasi-Peak (QP) / Average (AV) |
|---|---|---|---|
| Channel | TX Channel 39 | | |

| No | Freq. | Corr. Factor | Reading Value | | Emission Level | | Limit | | Margin | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | [dB (uV)] | | [dB (uV)] | | [dB (uV)] | | (dB) | |
| | [MHz] | (dB) | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. | Q.P. | AV. |
| 1 | 0.15000 | 10.06 | 22.74 | 13.26 | 32.80 | 23.32 | 66.00 | 56.00 | -33.20 | -32.68 |
| 2 | 0.23600 | 10.07 | 22.61 | 14.95 | 32.68 | 25.02 | 62.24 | 52.24 | -29.56 | -27.22 |
| 3 | 0.53928 | 10.07 | 23.61 | 15.52 | 33.68 | 25.59 | 56.00 | 46.00 | -22.32 | -20.41 |
| 4 | 0.73725 | 10.08 | 23.09 | 17.59 | 33.17 | 27.67 | 56.00 | 46.00 | -22.83 | -18.33 |
| 5 | 2.19075 | 10.10 | 24.57 | 18.19 | 34.67 | 28.29 | 56.00 | 46.00 | -21.33 | -17.71 |
| 6 | 14.52750 | 10.51 | 19.50 | 11.33 | 30.01 | 21.84 | 60.00 | 50.00 | -29.99 | -28.16 |

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

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

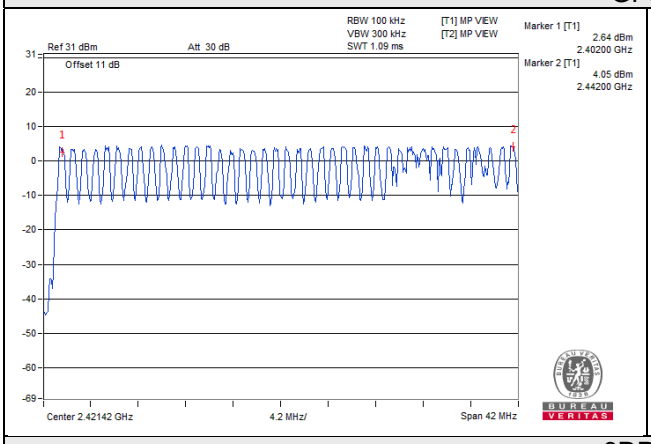
### 4.3.5 Deviation fromTest Standard

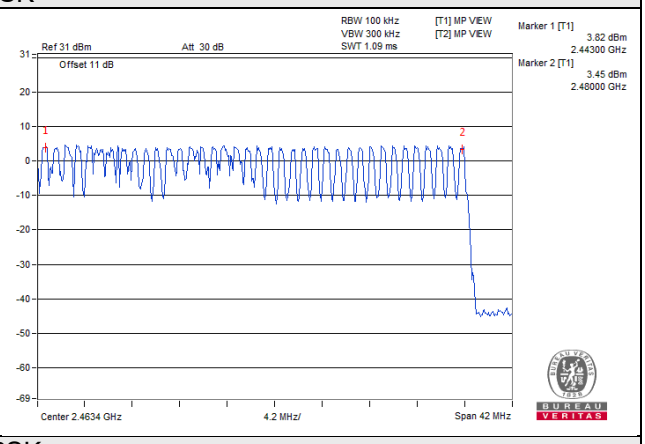
No deviation.

### 4.3.6 Test Results

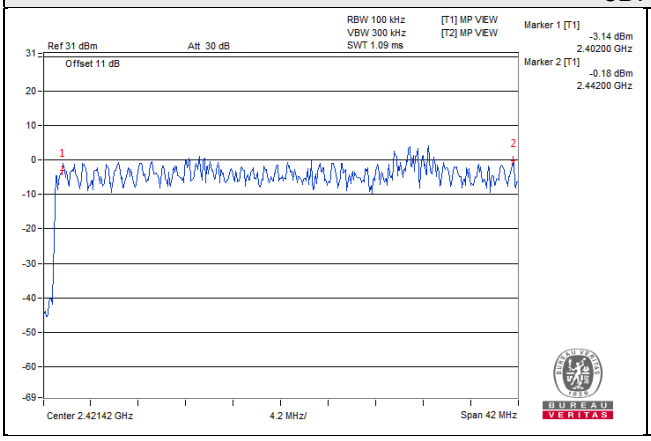
There are 79 hopping frequencies in the hopping mode. Please refer to next page for the test result. On the plots, it shows that the hopping frequencies are equally spaced.

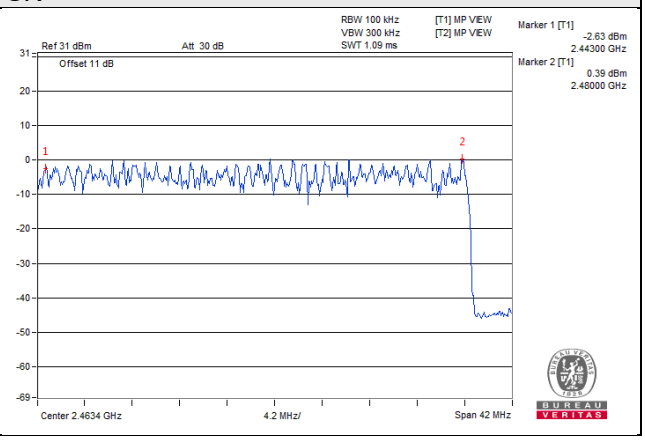
## GFSK


RBW 100 kHz
VBW 300 kHz
SWT 1.09 ms
[T1] MP VIEW
[T2] MP VIEW
Ref 31 dBm
Att 30 dB
Offset 11 dB
Marker 1 [T1]
2.64 dBm
2.40200 GHz
Marker 2 [T1]
4.05 dBm
2.44200 GHz
Center 2.42142 GHz
4.2 MHz/
Span 42 MHz


RBW 100 kHz
VBW 300 kHz
SWT 1.09 ms
[T1] MP VIEW
[T2] MP VIEW
Ref 31 dBm
Att 30 dB
Offset 11 dB
Marker 1 [T1]
3.82 dBm
2.44300 GHz
Marker 2 [T1]
3.45 dBm
2.48000 GHz
Center 2.4634 GHz
4.2 MHz/
Span 42 MHz

## 8DPSK


RBW 100 kHz
VBW 300 kHz
SWT 1.09 ms
[T1] MP VIEW
[T2] MP VIEW
Ref 31 dBm
Att 30 dB
Offset 11 dB
Marker 1 [T1]
-3.14 dBm
2.40200 GHz
Marker 2 [T1]
-0.18 dBm
2.44200 GHz
Center 2.42142 GHz
4.2 MHz/
Span 42 MHz


RBW 100 kHz
VBW 300 kHz
SWT 1.09 ms
[T1] MP VIEW
[T2] MP VIEW
Ref 31 dBm
Att 30 dB
Offset 11 dB
Marker 1 [T1]
-2.63 dBm
2.44300 GHz
Marker 2 [T1]
0.39 dBm
2.48000 GHz
Center 2.4634 GHz
4.2 MHz/
Span 42 MHz

## 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.

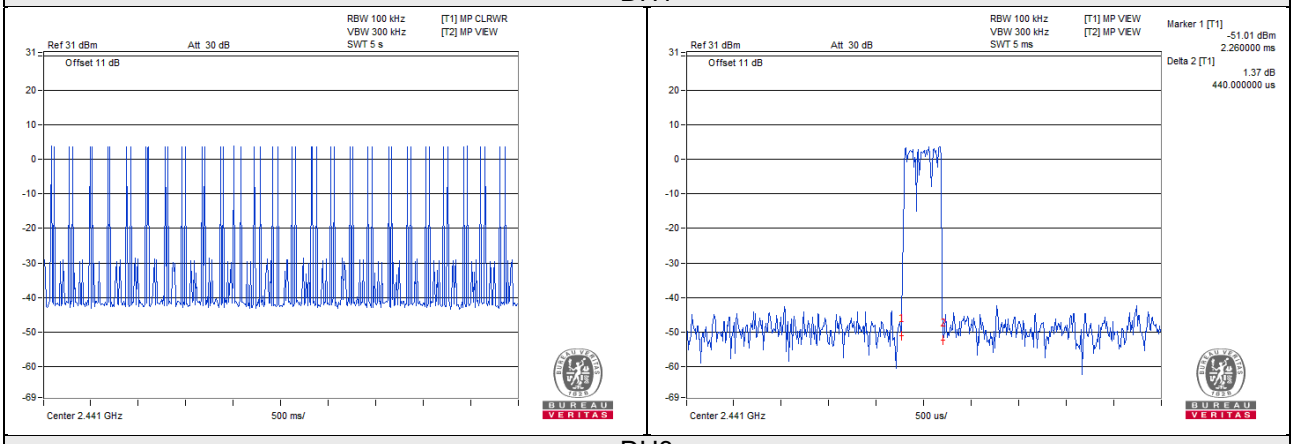
### 4.4.6 Test Results

GFSK

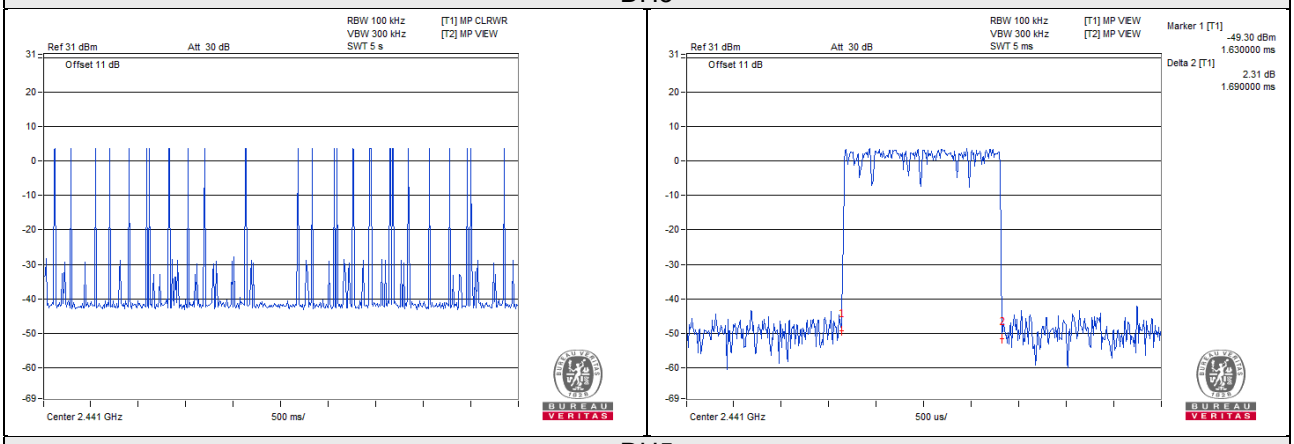
| Mode | Number of transmission in a 31.6 (79Hopping*0.4) | Length of transmission time (msec) | Result (msec) | Limit (msec) |
|---|---|---|---|---|
| DH1 | 50 (times / 5 sec) * 6.32 = 316 times | 0.44 | 139.04 | 400 |
| DH3 | 25 (times / 5 sec) * 6.32 = 158 times | 1.69 | 267.02 | 400 |
| DH5 | 17 (times / 5 sec) * 6.32 = 107.44 times | 2.98 | 320.17 | 400 |

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

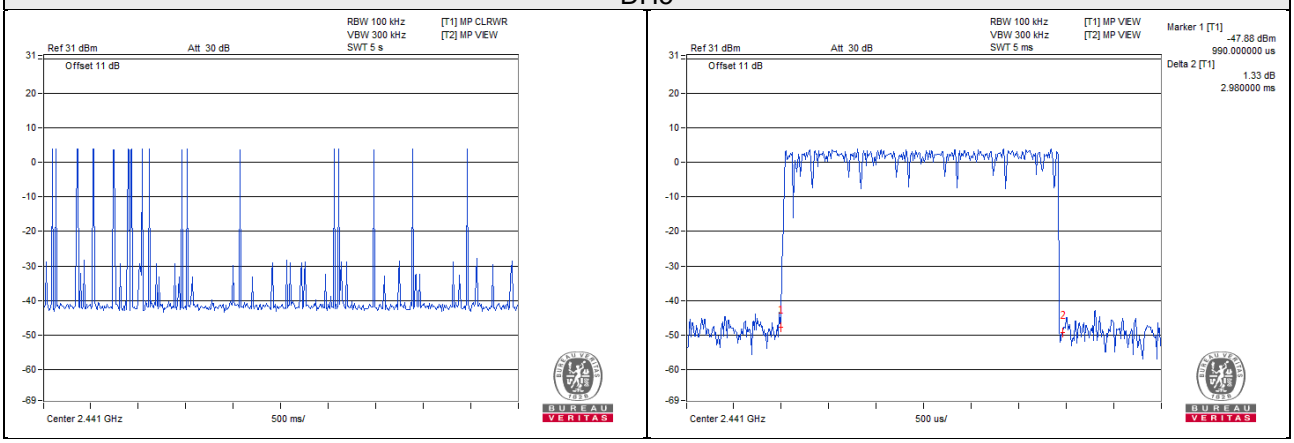
DH1




DH3




DH5

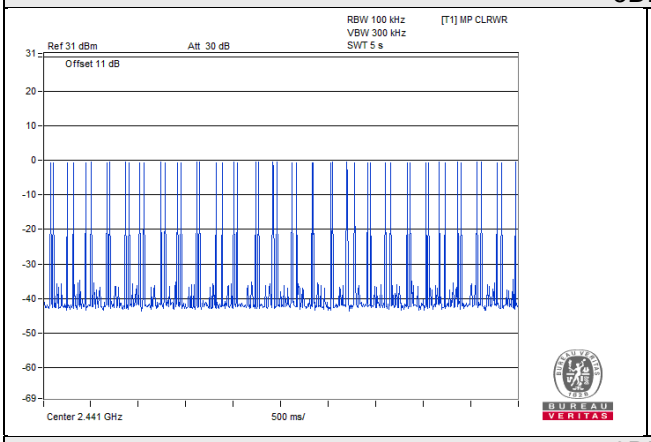


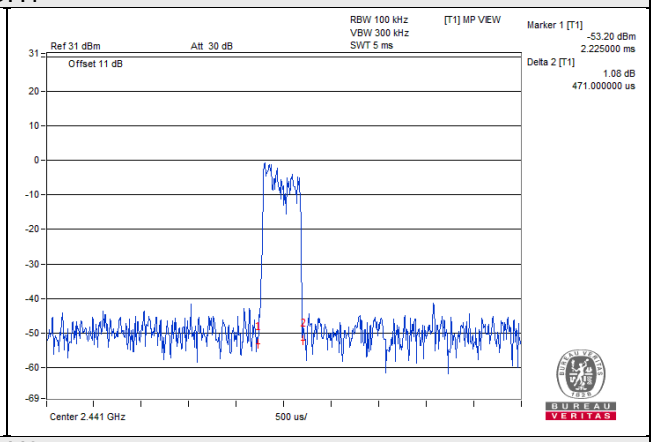
8DPSK

| Mode | Number of transmission in a 31.6 (79Hopping*0.4) | Length of transmission time (msec) | Result (msec) | Limit (msec) |
|---|---|---|---|---|
| 3DH1 | 51 (times / 5 sec) * 6.32 = 322.32 times | 0.471 | 151.81 | 400 |
| 3DH3 | 26 (times / 5 sec) * 6.32 = 164.32 times | 1.703 | 279.84 | 400 |
| 3DH5 | 17 (times / 5 sec) * 6.32 = 107.44 times | 2.942 | 316.09 | 400 |

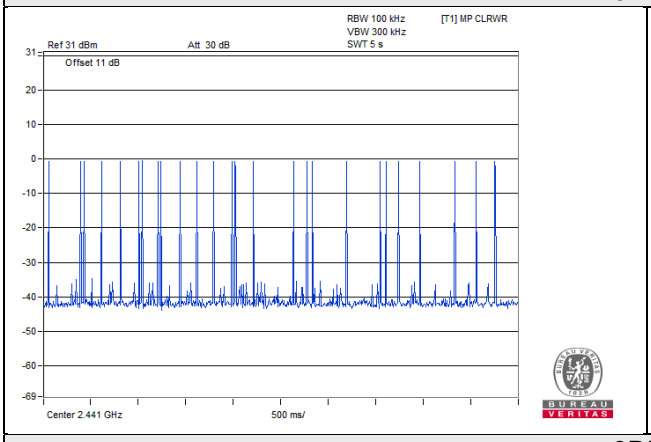
Note: Test plots of the transmitting time slot are shown as below.

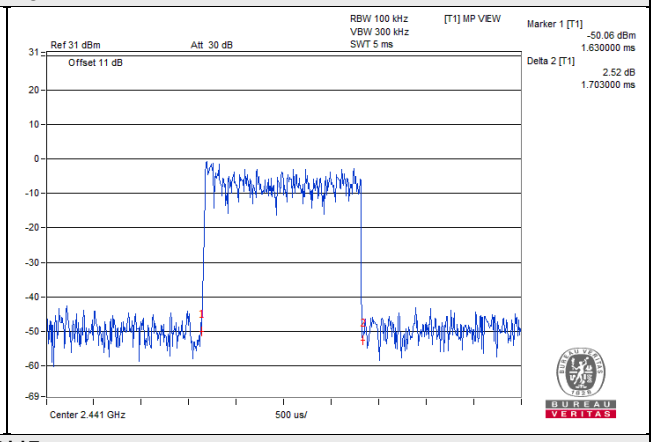
3DH1



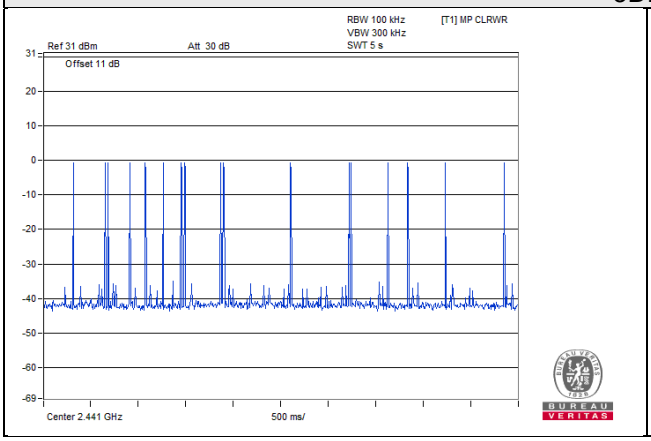



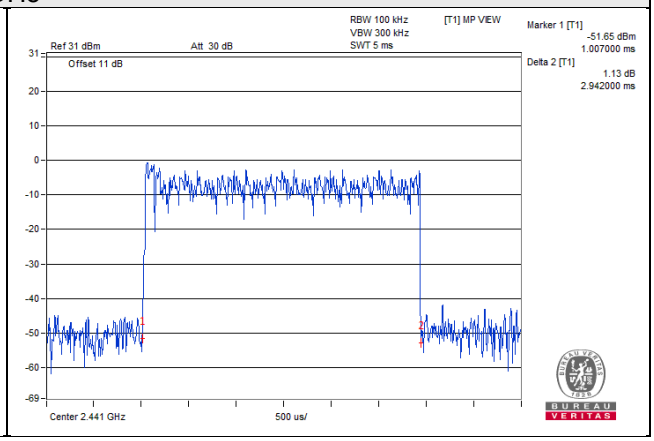

3DH3




3DH5



## 4.5 Channel Bandwidth

### 4.5.1 Limits of Channel Bandwidth Measurement

For frequency hopping system operating in the 2400-2483.5MHz, If the 20dB bandwidth of hopping channel is greater than 25kHz, two-thirds 20dBbandwidth of hopping channel shell 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 20dB 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

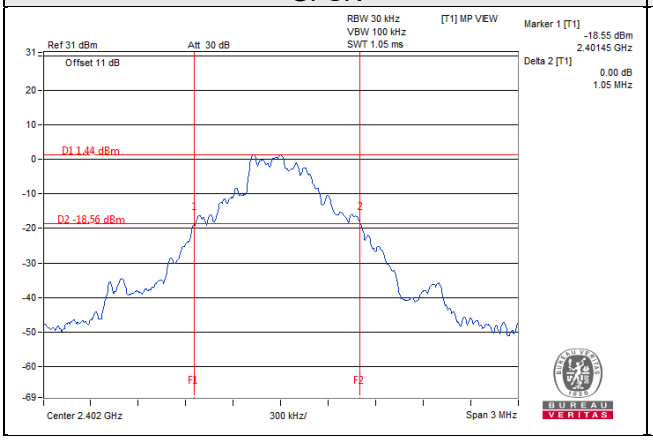
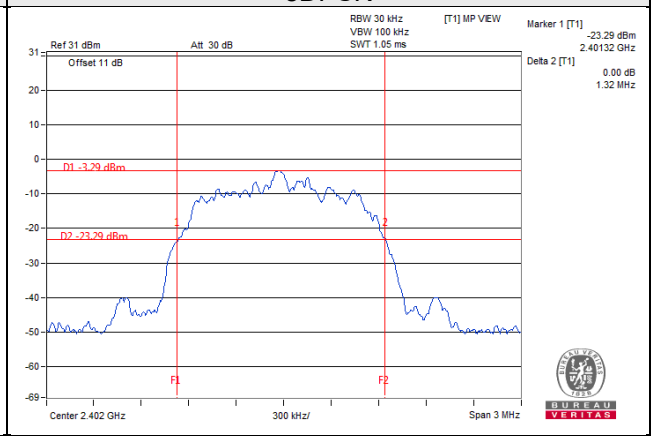
No deviation.

### 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) | 20dB Bandwidth (MHz) | |
|---|---|---|---|
| | | GFSK | 8DPSK |
| 0 | 2402 | 1.05 | 1.32 |
| 39 | 2441 | 1.05 | 1.32 |
| 78 | 2480 | 1.04 | 1.32 |

| Spectrum Plot of Worst Value | |
|---|---|
| GFSK | 8DPSK |
|  |  |

## 4.6 Hopping Channel Separation

### 4.6.1 Limits of Hopping Channel Separation Measurement

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

### 4.6.2 Test Setup

### 4.6.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.6.4 Test Procedure

Measurement Procedure REF

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

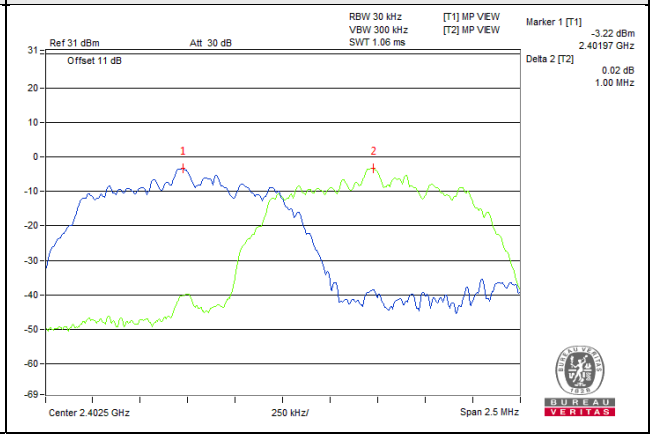
### 4.6.5 Deviation from Test Standard

No deviation.

### 4.6.6 Test Results

| Channel | Frequency (MHz) | Adjacent Channel Separation (MHz) | | 20dB Bandwidth (MHz) | | Minimum Limit (MHz) | | Pass / Fail |
|---|---|---|---|---|---|---|---|---|
| | | GFSK | 8DPSK | GFSK | 8DPSK | GFSK | 8DPSK | |
| 0 | 2402 | 1.00 | 1.00 | 1.05 | 1.32 | 0.70 | 0.88 | Pass |
| 39 | 2441 | 1.00 | 1.00 | 1.05 | 1.32 | 0.70 | 0.88 | Pass |
| 78 | 2480 | 1.00 | 1.00 | 1.04 | 1.32 | 0.70 | 0.88 | Pass |

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

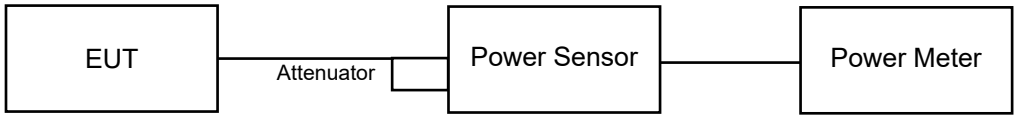
| Spectrum Plot of Worst Value | |
|---|---|
| GFSK | 8DPSK |
| |  |

## 4.7 Maximum Output Power

### 4.7.1 Limits of Maximum Output Power Measurement

The Maximum Output Power Measurement is 125mW.

### 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

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

### 4.7.5 Deviation fromTest Standard

No deviation.

### 4.7.6 EUT Operating Condition

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

### 4.7.7 Test Results

| Channel | Frequency (MHz) | Peak Power (mW) | | Peak Power (dBm) | | Power Limit (mW) | Pass / Fail |
|---|---|---|---|---|---|---|---|
| | | GFSK | 8DPSK | GFSK | 8DPSK | | |
| 0 | 2402 | 2.449 | 1.754 | 3.89 | 2.44 | 125 | Pass |
| 39 | 2441 | **2.594** | 1.828 | 4.14 | 2.62 | 125 | Pass |
| 78 | 2480 | 2.576 | 2.099 | 4.11 | 3.22 | 125 | Pass |

## 4.8 Conducted Out of Band Emission Measurement

### 4.8.1 Limits Of Conducted Out Of Band Emission Measurement

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

### 4.8.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.8.3 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.

### 4.8.4 Deviation from Test Standard

No deviation.

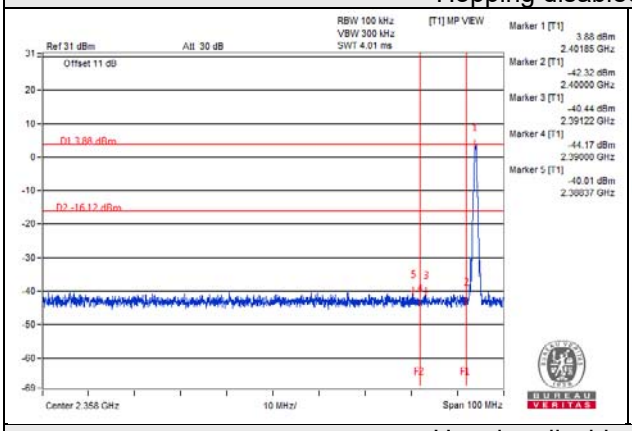
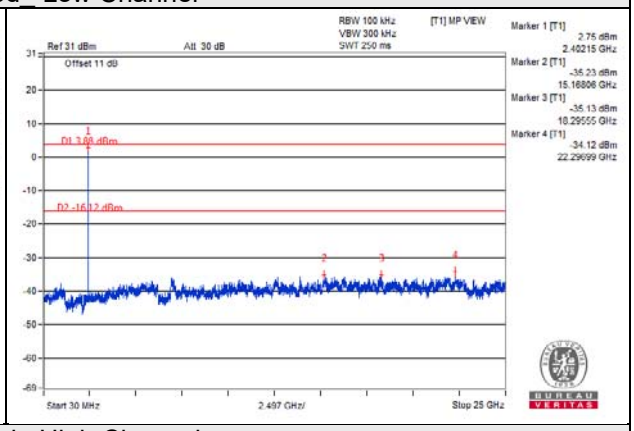
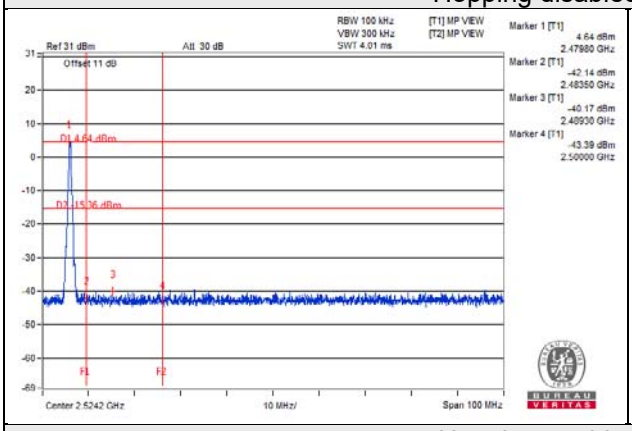
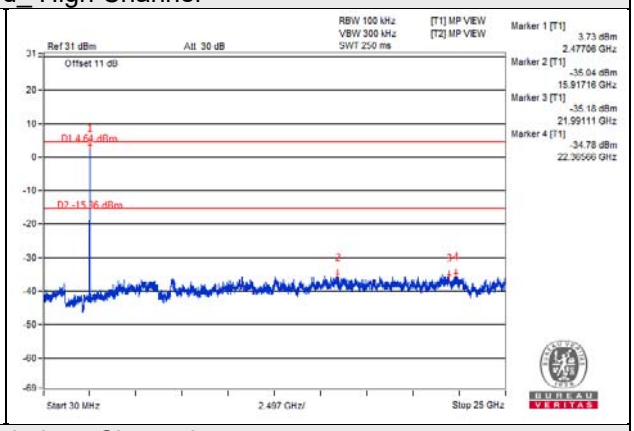
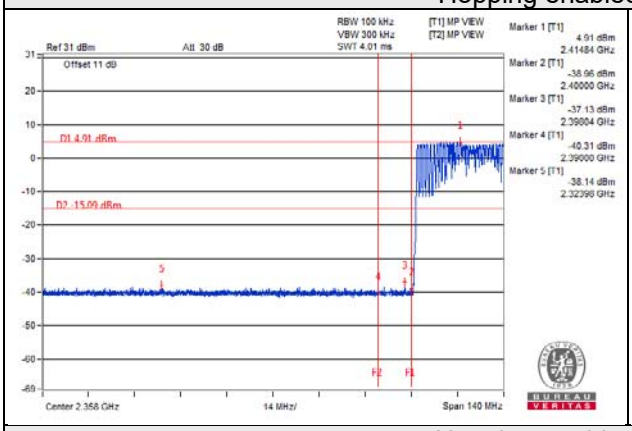
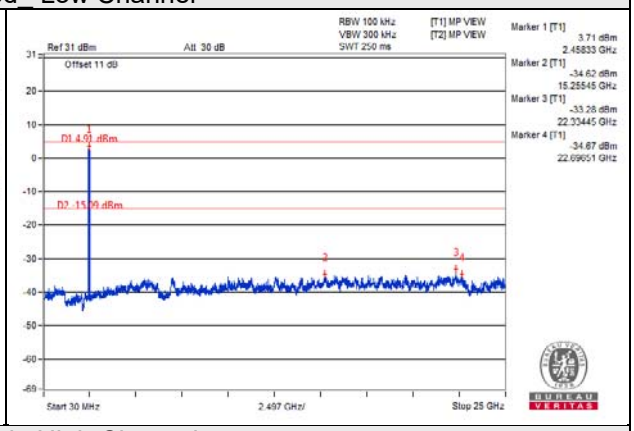
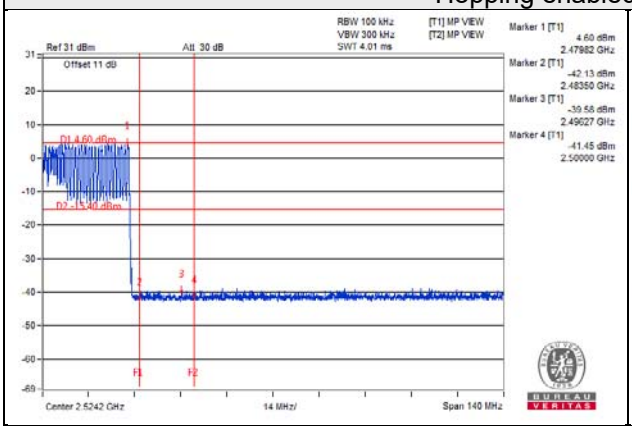
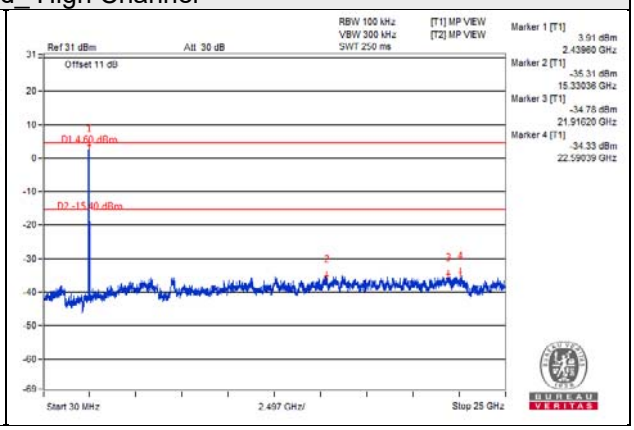
### 4.8.5 EUT Operating Condition

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

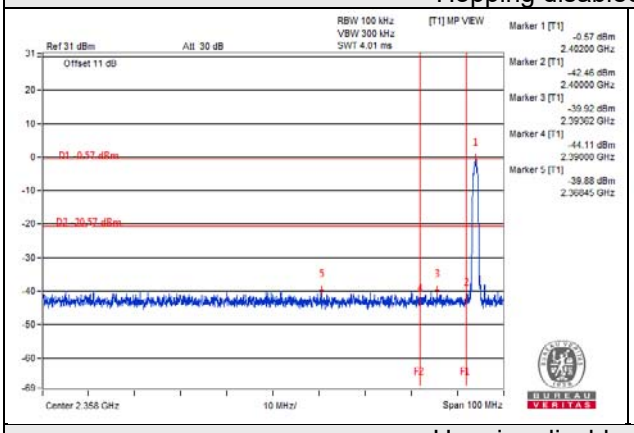
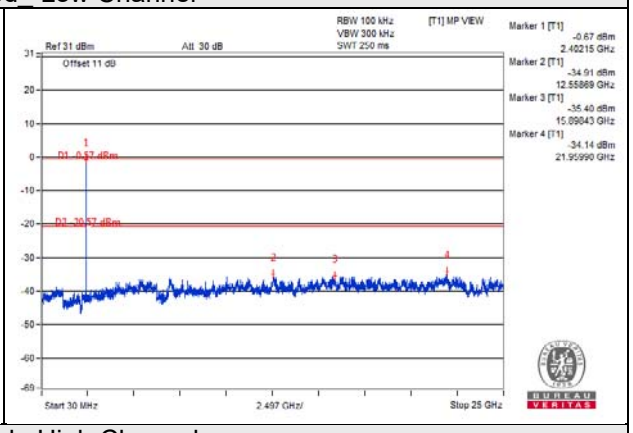
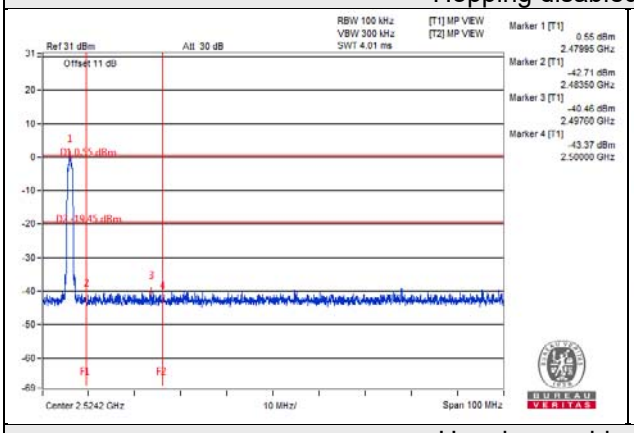
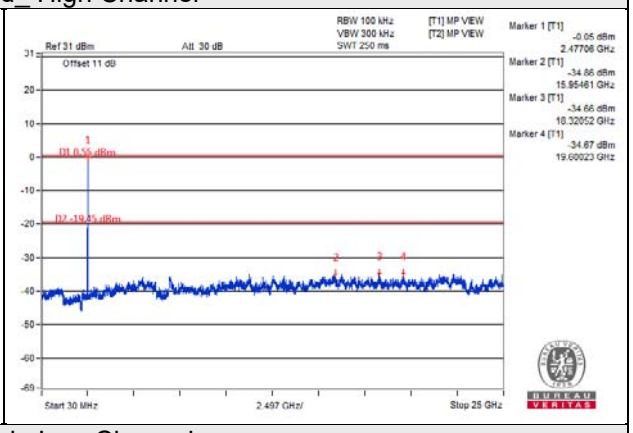
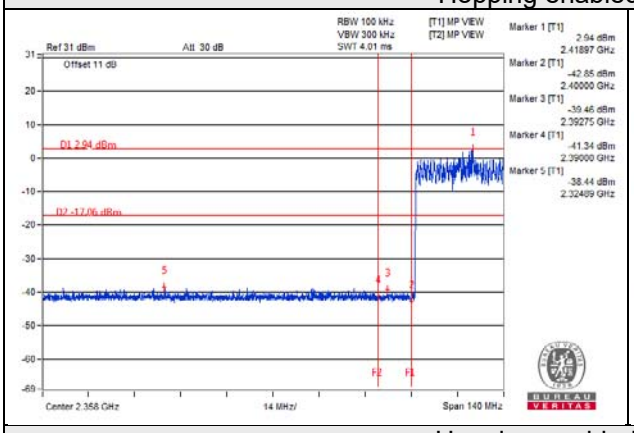
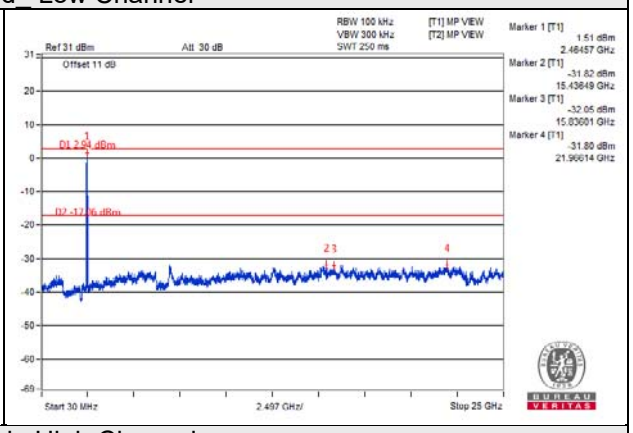
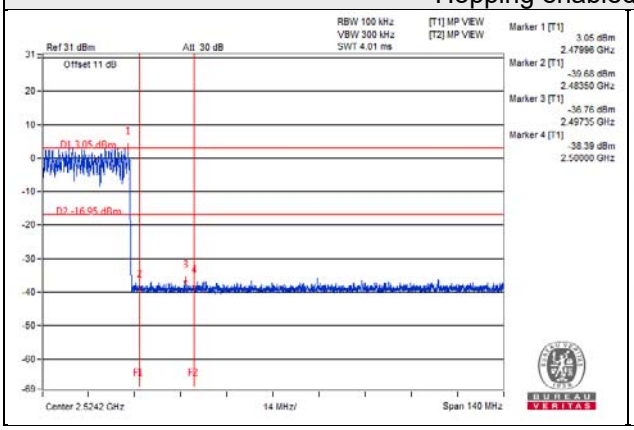
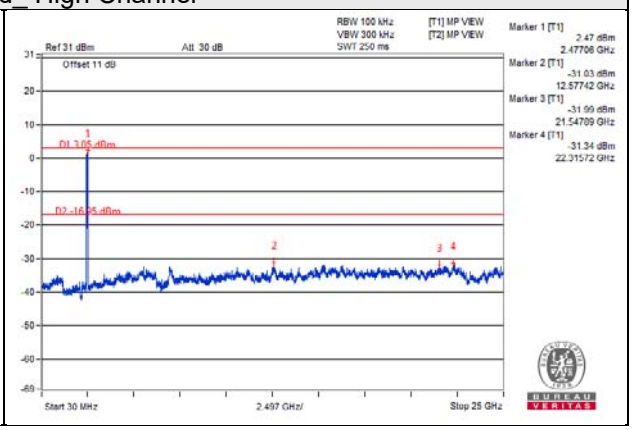
### 4.8.6 Test Results

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

GFSK

| Hopping disabled_ Low Channel | |
|---|---|
|  |  |
| **Hopping disabled_ High Channel** | |
|  |  |
| **Hopping enabled_ Low Channel** | |
|  |  |
| **Hopping enabled_ High Channel** | |
|  |  |

## 8DPSK

| Hopping disabled_ Low Channel | |
|---|---|
|  |  |
| **Hopping disabled_ High Channel** | |
|  |  |
| **Hopping enabled_ Low Channel** | |
|  |  |
| **Hopping enabled_ High 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 and approved 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 Lab**
Tel: 886-3-3183232
Fax: 886-3-3270892

**Email:** service.adt@tw.bureauveritas.com
**Web Site:** www.bureauveritas-adt.com


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

**--- END ---**