



FCC TEST REPORT

Test report
On Behalf of
BYTECH NY INC
For
Dancing Unicorn Bluetooth speaker
Model No.: BY-AU-BS-280-WT
FCC ID: 2AHN6-AUBS280

Prepared for : **BYTECH NY INC**
2585 West 13th Street Brooklyn NY 11223 USA

Prepared By : **Shenzhen HUAK Testing Technology Co., Ltd.**
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Bao'an District, Shenzhen City, China



TEST REPORT

Applicant's name.....: BYTECH NY INC

Address.....: 2585 West 13th Street Brooklyn NY 11223 USA

Manufacture's Name BYTECH NY INC

Address.....: 2585 West 13th Street Brooklyn NY 11223 USA

Product description

Trade Mark: BYTECH

Product name: Dancing Unicorn Bluetooth speaker

Model and/or type reference ..: BY-AU-BS-280-WT

Standards.....: FCC Rules and Regulations Part 15 Subpart C Section 15.247
ANSI C63.10: 2013

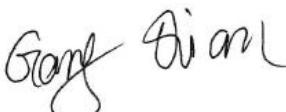
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Date of Test.....:

Date (s) of performance of tests : Jul. 01, 2019 ~. Jul.19, 2019

Date of Issue..... : Jul.19, 2019

Test Result..... : **Pass**

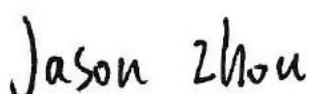
Testing Engineer : 

(Gary Qian)

Technical Manager : 

(Eden Hu)

Authorized Signatory :



(Jason Zhou)



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1. TEST STANDARDS

The tests were performed according to following standards:

[FCC Rules Part 15.247](#): Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

[ANSI C63.10-2013](#): American National Standard for Testing Unlicensed Wireless Devices

[DA 00-705](#): Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems



2. SUMMARY

2.1. Product Description

| | |
|---|--|
| Name of EUT | Dancing Unicorn Bluetooth speaker |
| Trade Mark: | BYTECH |
| Model Number | BY-AU-BS-280-WT |
| List Model: | / |
| Power Rating | DC 3.7V and DC 5V From Adapter |
| Adapter(Auxiliary test Provided by the laborator) | Mode:EP-TA20CBC Input:AC100-240V-50/60Hz, 0.5A Output:DC 5V,2A |
| FCC ID | 2AHN6-AUBS280 |
| Bluetooth FCC Operation frequency | 2402MHz-2480MHz |
| Bluetooth Modulation | GFSK,8DPSK,π/4DQPSK |
| Antenna Type | PCB antenna |
| Antenna gain | 0.0dBi |

2.2. Equipment Under Test

Power supply system utilised

| | | | | | |
|----------------------|---|----------------------------------|----------------------------------|-----------------------|-------------|
| Power supply voltage | : | <input type="radio"/> | 230V / 50 Hz | <input type="radio"/> | 120V / 60Hz |
| | | <input type="radio"/> | 12 V DC | <input type="radio"/> | 24 V DC |
| | | <input checked="" type="radio"/> | Other (specified in blank below) | | |

DC 3.7V and DC 5V From Adapter

2.3. Short description of the Equipment under Test (EUT)

This is a Dancing Unicorn Bluetooth speaker.

For more details, refer to the user's manual of the EUT.



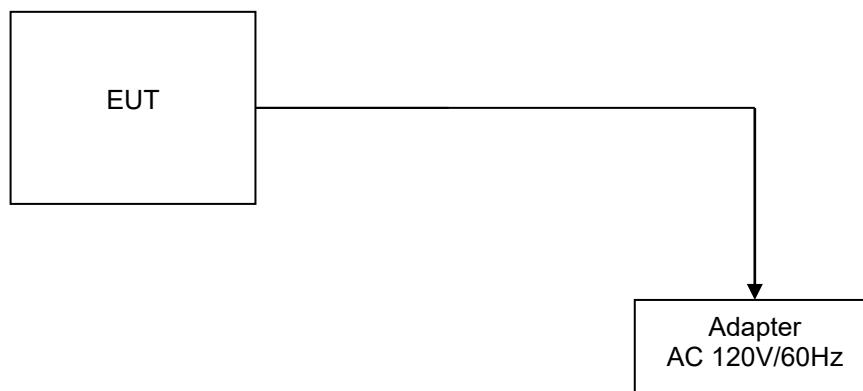
2.4. EUT operation mode

The Applicant provides test software (AT directive) to control the EUT for staying in continuous transmitting and receiving mode for testing .There are 79 channels provided to the EUT. Channel 00/39/78 was selected to test.

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



2.5. Block Diagram of Test Setup



2.6. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: 2AHN6-AUBS280 filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.7. Modifications

No modifications were implemented to meet testing criteria.



3. TEST ENVIRONMENT

3.1. TEST FACILITY

Test Firm : Shenzhen HUAK Testing Technology Co., Ltd.

Address 1F, B2 Building, Junfeng Zhongcheng Zhizao Innovation Park, Fuhai Street, Bao'an District, Shenzhen City, China

3.2. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

| | |
|-----------------------|--------------|
| Temperature: | 15-35 ° C |
| Humidity: | 30-60 % |
| Atmospheric pressure: | 950-1050mbar |

3.3. Summary of measurement results

| Test Specification clause | Test case | Test Mode | Test Channel | Recorded In Report | | Pass | Fail | NA | NP | Remark |
|---------------------------|--|---------------------------|---|---------------------------|---|-------------------------------------|--------------------------|--------------------------|--------------------------|----------|
| §15.247(a)(1) | Carrier Frequency separation | GFSK Π/4DQPSK 8DPSK | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | GFSK Π/4DQPSK 8DPSK | <input checked="" type="checkbox"/> Middle | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.247(a)(1) | Number of Hopping channels | GFSK Π/4DQPSK 8DPSK | <input checked="" type="checkbox"/> Full | GFSK 8DPSK | <input checked="" type="checkbox"/> Full | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.247(a)(1) | Time of Occupancy (dwell time) | GFSK Π/4DQPSK 8DPSK | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | GFSK Π/4DQPSK 8DPSK | <input checked="" type="checkbox"/> Middle | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.247(a)(1) | Spectrum bandwidth of a FHSS system 20dB bandwidth | GFSK Π/4DQPSK 8DPSK | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | GFSK Π/4DQPSK 8DPSK | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.247(b)(1) | Maximum output power | GFSK Π/4DQPSK 8DPSK | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | GFSK Π/4DQPSK 8DPSK | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.247(d) | Band edge compliance conducted | GFSK Π/4DQPSK 8DPSK | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Highest | GFSK Π/4DQPSK 8DPSK | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Highest | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.205 | Band edge compliance radiated | GFSK Π/4DQPSK 8DPSK | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Highest | GFSK | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Highest | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.247(d) | TX spurious emissions conducted | GFSK Π/4DQPSK 8DPSK | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | GFSK Π/4DQPSK 8DPSK | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.247(d) | TX spurious emissions radiated | GFSK Π/4DQPSK 8DPSK | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | GFSK | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.209(a) | TX spurious Emissions radiated Below 1GHz | GFSK Π/4DQPSK 8DPSK | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | GFSK | <input checked="" type="checkbox"/> Middle | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |
| §15.107(a) §15.207 | Conducted Emissions 9KHz-30 MHz | GFSK Π/4DQPSK 8DPSK | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | GFSK | <input checked="" type="checkbox"/> Middle | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies |

Remark:

1. The measurement uncertainty is not included in the test result.
2. NA = Not Applicable; NP = Not Performed
3. We tested all test mode and recorded worst case in report



3.4. Statement of the measurement uncertainty

Measurement Uncertainty

| | |
|---|---------------|
| Conducted Emission Expanded Uncertainty | = 2.23dB, k=2 |
| Radiated emission expanded uncertainty(9kHz-30MHz) | = 3.08dB, k=2 |
| Radiated emission expanded uncertainty(30MHz-1000MHz) | = 4.42dB, k=2 |
| Radiated emission expanded uncertainty(Above 1GHz) | = 4.06dB, k=2 |

3.5. Equipments Used during the Test

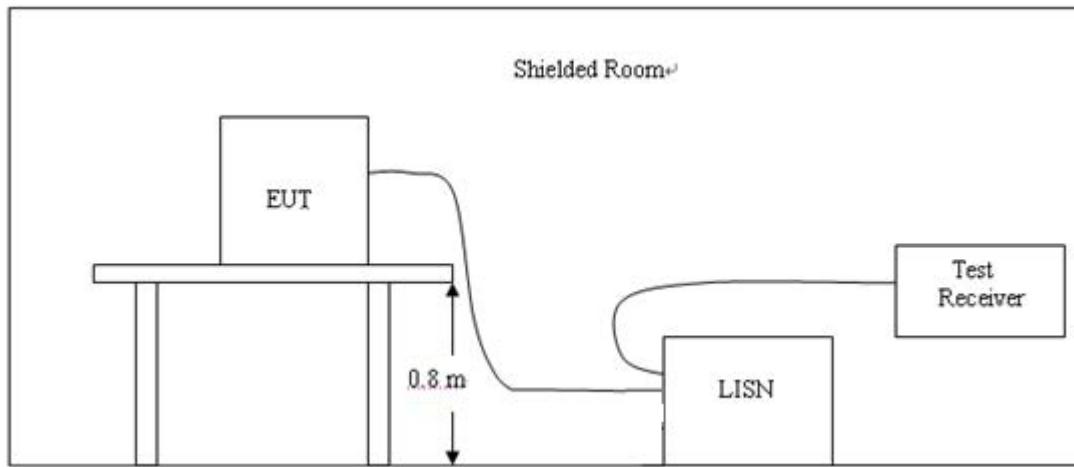
| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|------|---|-----------------|---------------------|------------|---------------|---------------|
| 1. | L.I.S.N. Artificial Mains Network | R&S | ENV216 | HKE-002 | Dec. 28, 2018 | 1 Year |
| 2. | Receiver | R&S | ESCI 7 | HKE-010 | Dec. 28, 2018 | 1 Year |
| 3. | RF automatic control unit | Tonscend | JS0806-2 | HKE-060 | Dec. 28, 2018 | 1 Year |
| 4. | Spectrum analyzer | R&S | FSP40 | HKE-025 | Dec. 28, 2018 | 1 Year |
| 5. | Spectrum analyzer | Agilent | N9020A | HKE-048 | Dec. 28, 2018 | 1 Year |
| 6. | Preamplifier | Schwarzbeck | BBV 9743 | HKE-006 | Dec. 28, 2018 | 1 Year |
| 7. | EMI Test Receiver | Rohde & Schwarz | ESCI 7 | HKE-010 | Dec. 28, 2018 | 1 Year |
| 8. | Bilog Broadband Antenna | Schwarzbeck | VULB9163 | HKE-012 | Dec. 28, 2018 | 1 Year |
| 9. | Loop Antenna | Schwarzbeck | FMZB 1519 B | HKE-014 | Dec. 28, 2018 | 1 Year |
| 10. | Horn Antenna | Schwarzbeck | 9120D | HKE-013 | Dec. 28, 2018 | 1 Year |
| 11. | Pre-amplifier | EMCI | EMC051845 SE | HKE-015 | Dec. 28, 2018 | 1 Year |
| 12. | Pre-amplifier | Agilent | 83051A | HKE-016 | Dec. 28, 2018 | 1 Year |
| 13. | EMI Test Software EZ-EMC | Tonscend | JS1120-B Version | HKE-083 | Dec. 28, 2018 | N/A |
| 14. | Power Sensor | Agilent | E9300A | HKE-086 | Dec. 28, 2018 | 1 Year |
| 15. | Power Sensor | R&S | NRP-Z4 | HKE-091 | Dec. 28, 2018 | 1 Year |
| 16. | Power Meter | R&S | NRVS | HKE-092 | Dec. 28, 2018 | 1 Year |
| 17. | Spectrum analyzer | Agilent | N9020A | HKE-048 | Dec. 28, 2018 | 1 Year |
| 18. | Signal generator | Agilent | N5182A | HKE-029 | Dec. 28, 2018 | 1 Year |
| 19. | Signal Generator | Agilent | 83630A | HKE-028 | Dec. 28, 2018 | 1 Year |
| 20. | Shielded room | Shiel Hong | 4*3*3 | HKE-039 | Dec. 28, 2018 | 3 Year |

Note: 1. The Cal.Interval was one year.

4. TEST CONDITIONS AND RESULTS

4.1. AC Power Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

- 1, The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10.
- 2, Support equipment, if needed, was placed as per ANSI C63.10.
- 3, All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.
- 4, If a EUT received DC power from the USB Port of Notebook PC, the PC's adapter received power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
- 5, All support equipments received AC power from a second LISN, if any.
- 6, The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
- 7, Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.

AC Power Conducted Emission Limit

For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following :

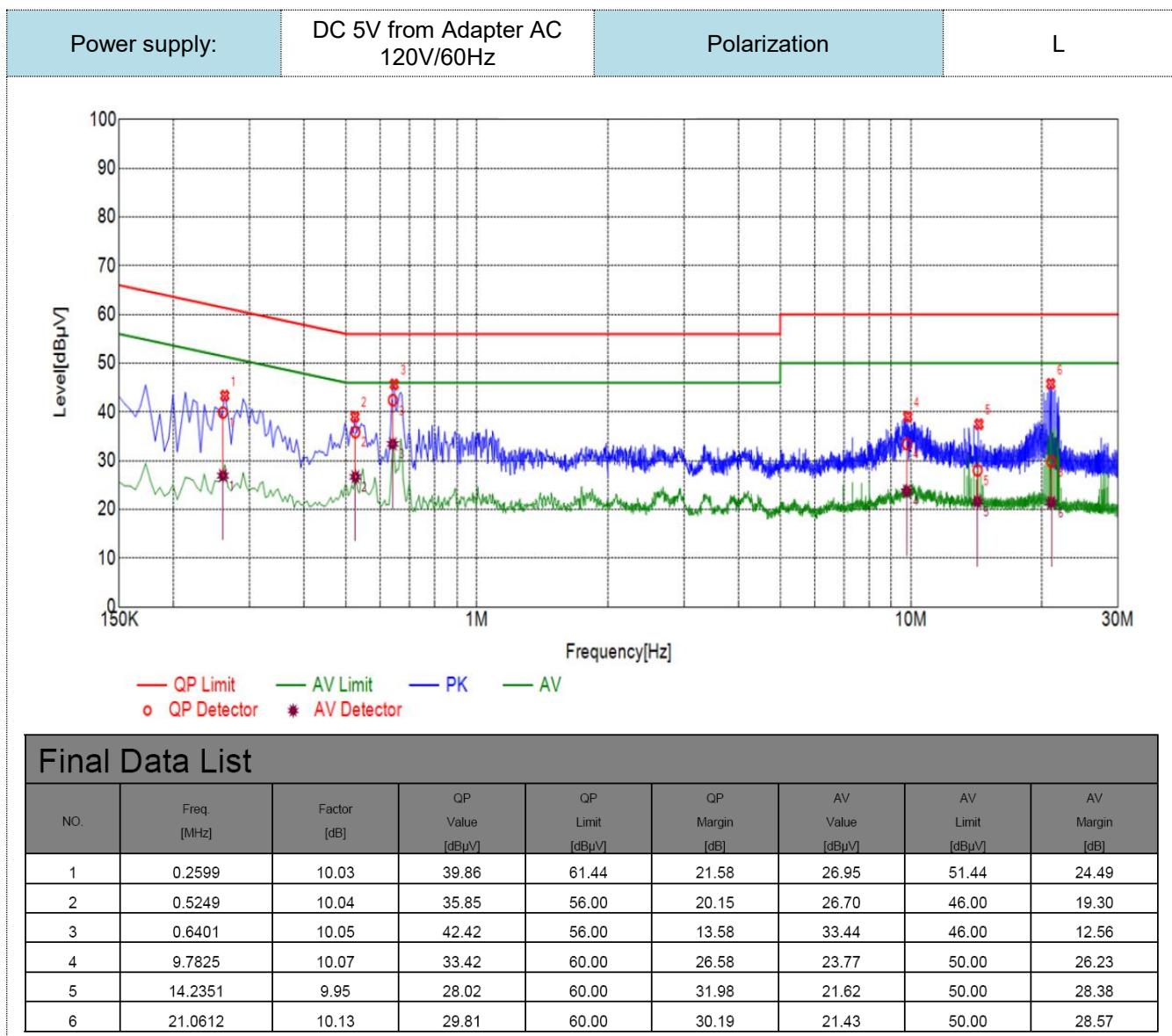
| Frequency range (MHz) | Limit (dBuV) | |
|-----------------------|--------------|-----------|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

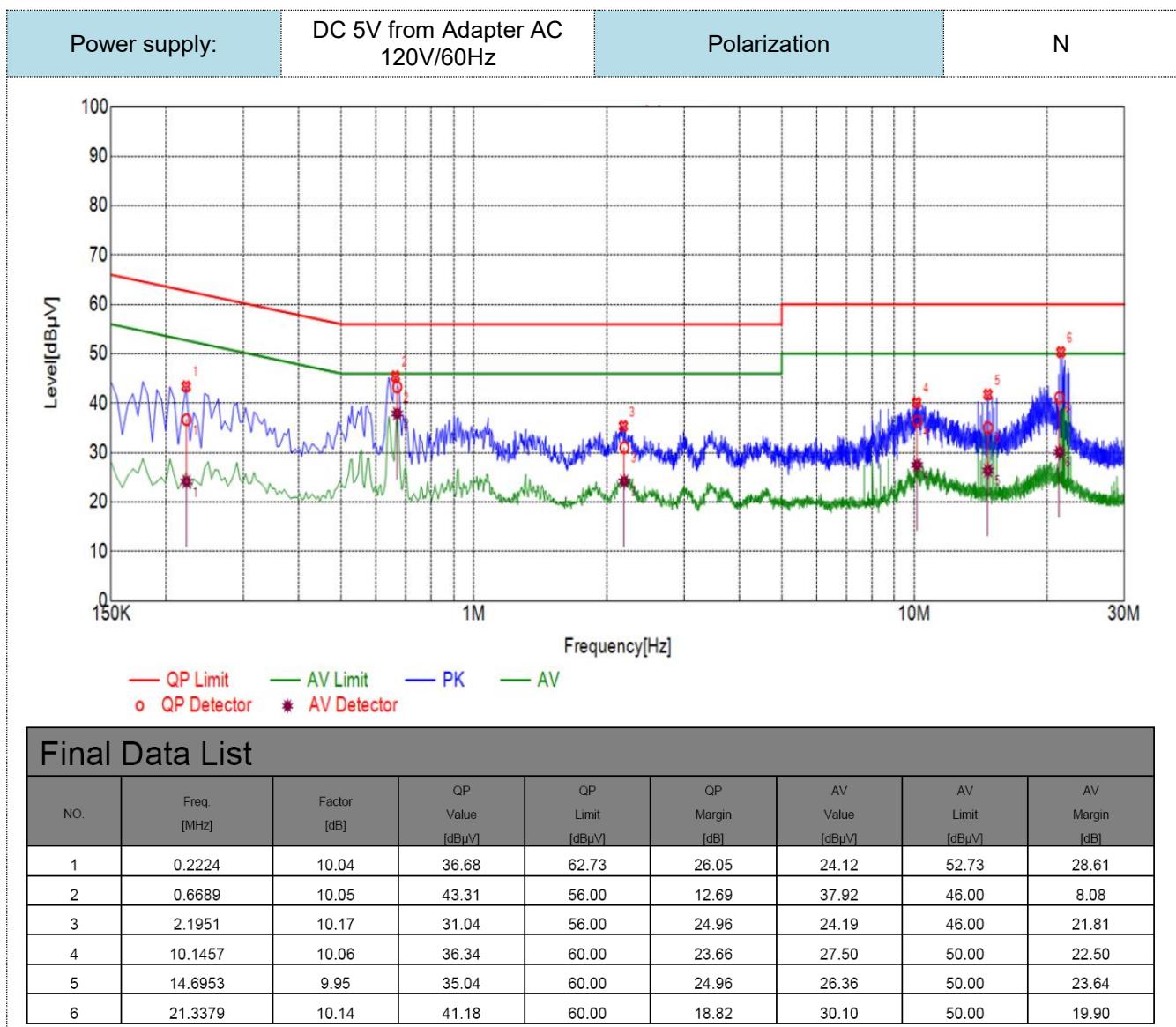
* Decreases with the logarithm of the frequency.

TEST RESULTS

Remark:

1. All modes of GFSK, Pi/4 DQPSK, and 8DPSK were test at Low, Middle, and High channel; only the worst result of GFSK Middle Channel was reported as below:
2. Both 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz power supply have been tested, only the worst result of 120 VAC, 60 Hz was reported as below::

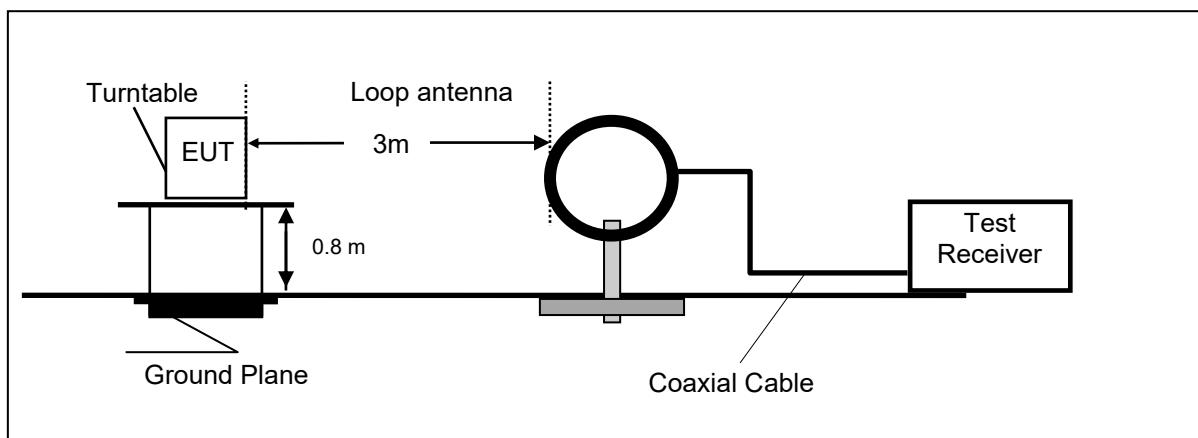




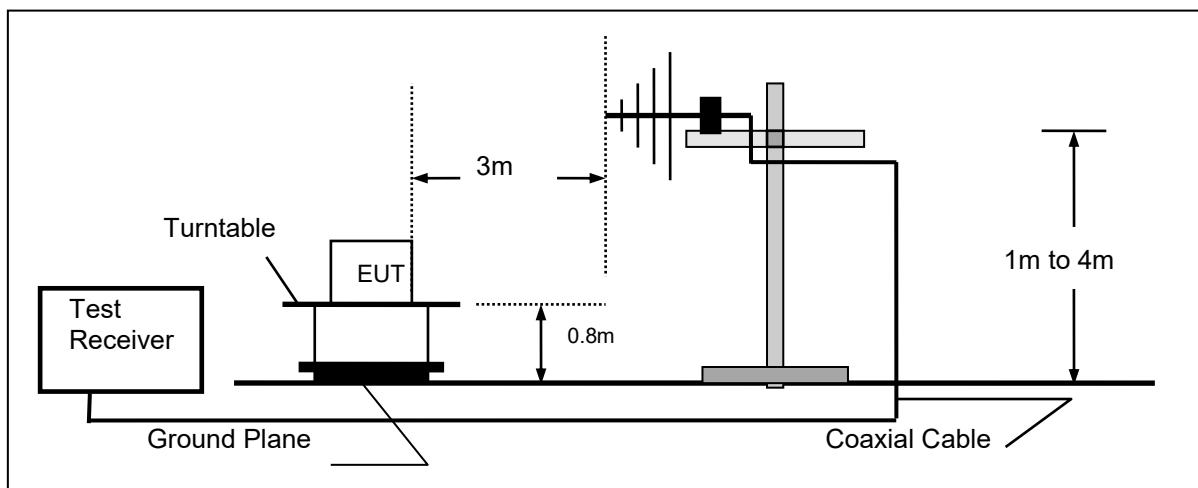
4.2. Radiated Emission

TEST CONFIGURATION

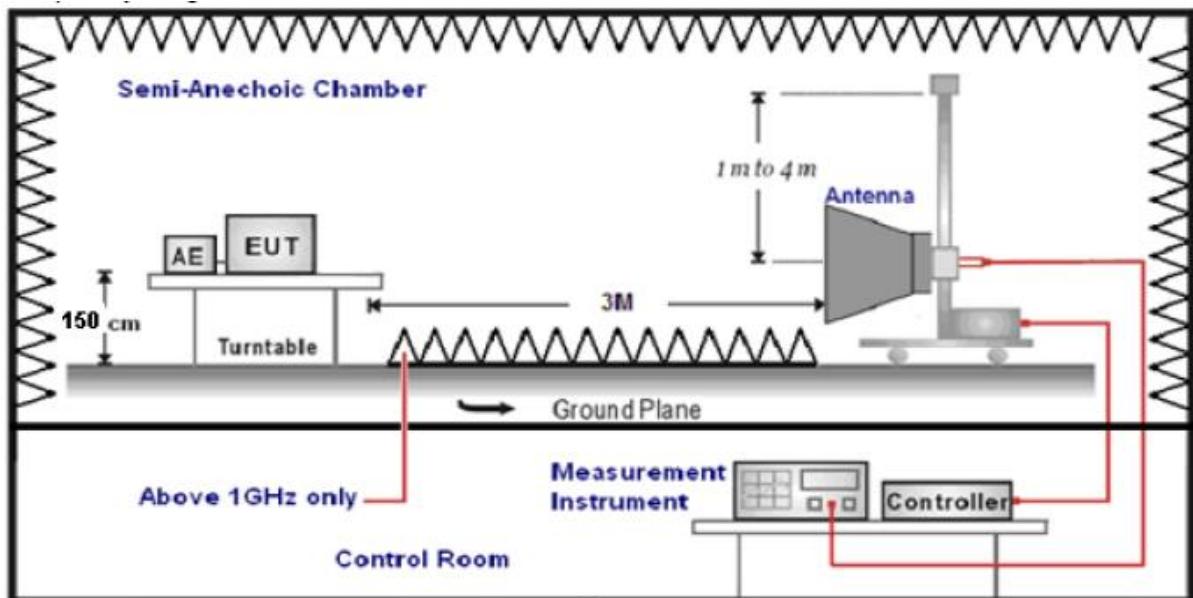
Frequency range 9 KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz





TEST PROCEDURE

1. The EUT was placed on a turn table which is 12mm above ground plane when testing frequency range 9 KHz –25GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0°C to 360°C to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. The EUT minimum operation frequency was 32.768KHz and maximum operation frequency was 2480MHz.so radiated emission test frequency band from 9KHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

| Test Frequency range | Test Antenna Type | Test Distance |
|----------------------|----------------------------|---------------|
| 9KHz-30MHz | Active Loop Antenna | 3 |
| 30MHz-1GHz | Ultra-Broadband Antenna | 3 |
| 1GHz-18GHz | Double Ridged Horn Antenna | 3 |
| 18GHz-25GHz | Horn Antenna | 1 |

7. Setting test receiver/spectrum as following table states:

| Test Frequency range | Test Receiver/Spectrum Setting | Detector |
|----------------------|---|----------|
| 9KHz-150KHz | RBW=200Hz/VBW=3KHz,Sweep time=Auto | QP |
| 150KHz-30MHz | RBW=9KHz/VBW=100KHz,Sweep time=Auto | QP |
| 30MHz-1GHz | RBW=120KHz/VBW=1000KHz,Sweep time=Auto | QP |
| 1GHz-40GHz | Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto | Peak |

Field Strength Calculation

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

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

| | |
|---------------------------|--|
| Where FS = Field Strength | CL = Cable Attenuation Factor (Cable Loss) |
| RA = Reading Amplitude | AG = Amplifier Gain |
| AF = Antenna Factor | |

$$Transd = AF + CL - AG$$

RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the100kHz bandwidth within the band that contains the highest level of desired power.

The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

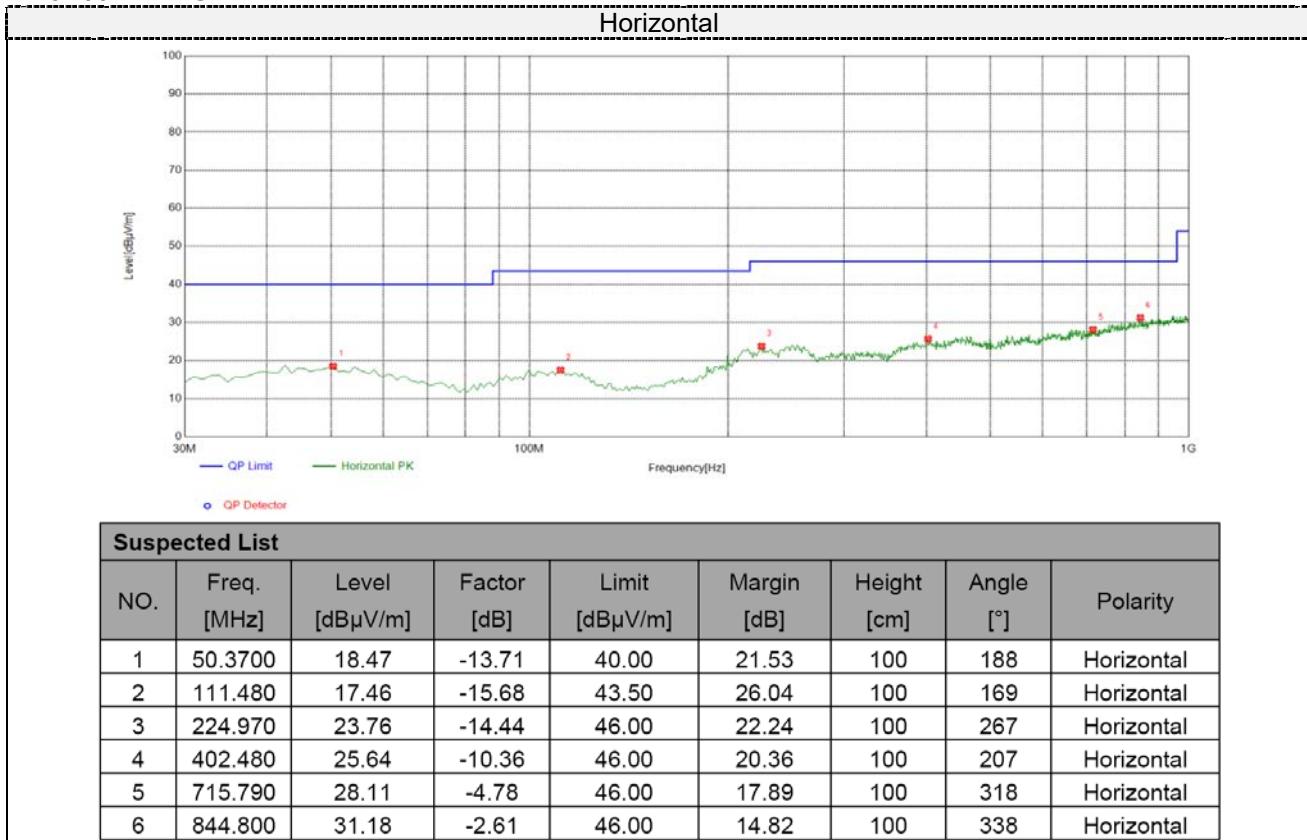
| Frequency (MHz) | Distance (Meters) | Radiated (dB μ V/m) | Radiated (μ V/m) |
|-----------------|-------------------|----------------------------------|-----------------------|
| 0.009-0.49 | 3 | 20log(2400/F(KHz))+40log(300/3) | 2400/F(KHz) |
| 0.49-1.705 | 3 | 20log(24000/F(KHz))+ 40log(30/3) | 24000/F(KHz) |
| 1.705-30 | 3 | 20log(30)+ 40log(30/3) | 30 |
| 30-88 | 3 | 40.0 | 100 |
| 88-216 | 3 | 43.5 | 150 |
| 216-960 | 3 | 46.0 | 200 |
| Above 960 | 3 | 54.0 | 500 |

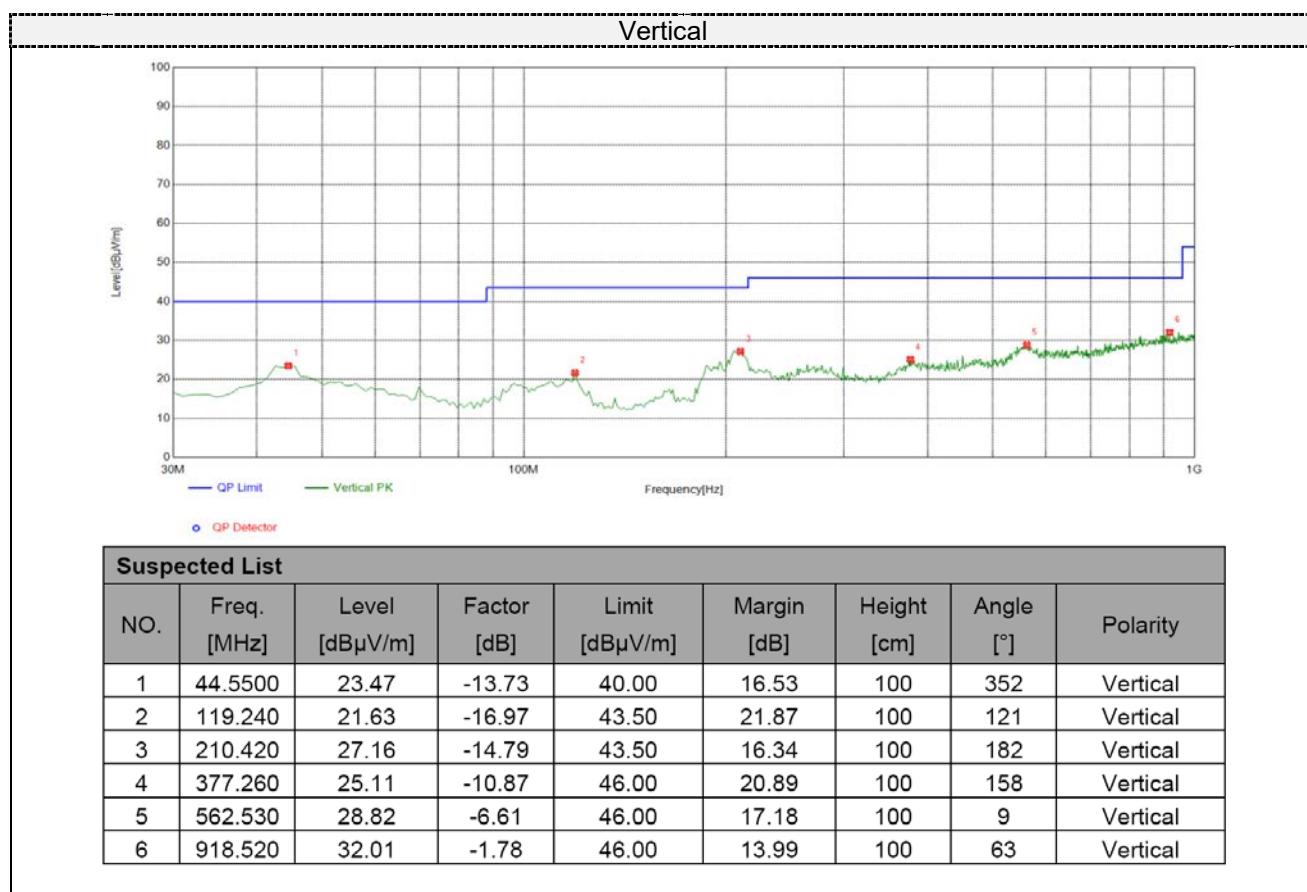
**TEST RESULTS**

Remark: For test below 1GHz all modes of GFSK, Pi/4 DQPSK, and 8DPSK were test at Low, Middle, and High channel; only the worst result of GFSK Middle Channel was reported as below:

For 9 KHz-30MHz

| Frequency (MHz) | Corrected Reading (dB μ V/m)@3m | FCC Limit (dB μ V/m) @3m | Margin (dB) | Detector | Result |
|-----------------|-------------------------------------|------------------------------|-------------|----------|--------|
| 0.38 | 46.35 | 96.01 | 49.66 | QP | PASS |
| 1.55 | 52.19 | 63.80 | 11.61 | QP | PASS |
| 19.68 | 56.42 | 69.54 | 13.12 | QP | PASS |
| 24.62 | 40.79 | 69.54 | 28.75 | QP | PASS |

For 30MHz-1GHz



**For 1GHz to 25GHz**

Remark: For test above 1GHz GFSK, Pi/4 DQPSK, and 8DPSK were test at Low, Middle, and High channel; only the worst result of GFSK was reported as below:

CH Low (2402MHz)**Horizontal:**

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------|----------------|------------------|
| 4804 | 62.17 | -3.64 | 58.53 | 74 | -15.47 | peak |
| 4804 | 48.05 | -3.64 | 44.41 | 54 | -9.59 | Avg |
| 7206 | 56.39 | -0.95 | 55.44 | 74 | -18.56 | peak |
| 7206 | 45.21 | -0.95 | 44.26 | 54 | -9.74 | Avg |
| --- | --- | --- | --- | --- | --- | --- |
| --- | --- | --- | --- | --- | --- | --- |

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Vertical:

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------|----------------|------------------|
| 4804 | 62.42 | -3.64 | 58.78 | 74 | -15.22 | peak |
| 4804 | 48.35 | -3.64 | 44.71 | 54 | -9.29 | Avg |
| 7206 | 57.58 | -0.95 | 56.63 | 74 | -17.37 | peak |
| 7206 | 44.39 | -0.95 | 43.44 | 54 | -10.56 | Avg |
| --- | --- | --- | --- | --- | --- | --- |
| --- | --- | --- | --- | --- | --- | --- |

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.



CH Middle (2441MHz)

Horizontal:

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|------------------|
| 4882 | 62.02 | -3.51 | 58.51 | 74 | -15.49 | peak |
| 4882 | 45.96 | -3.51 | 42.45 | 54 | -11.55 | Avg |
| 7326 | 57.05 | -0.82 | 56.23 | 74 | -17.77 | peak |
| 7326 | 42.83 | -0.82 | 42.01 | 54 | -11.99 | Avg |
| --- | --- | --- | --- | --- | --- | --- |
| --- | --- | --- | --- | --- | --- | --- |

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Vertical:

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|------------------|
| 4882 | 63.25 | -3.51 | 59.74 | 74 | -14.26 | peak |
| 4882 | 47.37 | -3.51 | 43.86 | 54 | -10.14 | Avg |
| 7326 | 57.29 | -0.82 | 56.47 | 74 | -17.53 | peak |
| 7326 | 43.26 | -0.82 | 42.44 | 54 | -11.56 | Avg |
| --- | --- | --- | --- | --- | --- | --- |
| --- | --- | --- | --- | --- | --- | --- |

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.



CH High (2480MHz)

Horizontal:

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|------------------|
| 4960 | 60.18 | -3.43 | 56.75 | 74 | -17.25 | peak |
| 4960 | 45.37 | -3.43 | 41.94 | 54 | -12.06 | AVG |
| 7440 | 55.45 | -0.75 | 54.7 | 74 | -19.3 | peak |
| 7440 | 42.06 | -0.75 | 41.31 | 54 | -12.69 | AVG |
| --- | --- | --- | --- | --- | --- | --- |
| --- | --- | --- | --- | --- | --- | --- |

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Vertical:

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|------------------|
| 4960 | 62.37 | -3.43 | 58.94 | 74 | -15.06 | peak |
| 4960 | 47.23 | -3.43 | 43.8 | 54 | -10.2 | AVG |
| 7440 | 57.26 | -0.75 | 56.51 | 74 | -17.49 | peak |
| 7440 | 45.13 | -0.75 | 44.38 | 54 | -9.62 | AVG |
| --- | --- | --- | --- | --- | --- | --- |
| --- | --- | --- | --- | --- | --- | --- |

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

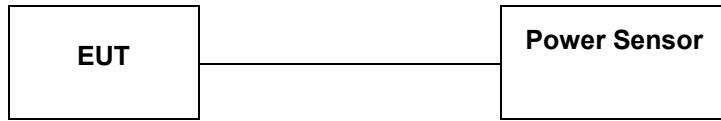
Remark:

- (1) Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (2) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed.



4.3. Maximum Peak Output Power

TEST CONFIGURATION



TEST PROCEDURE

According to ANSI C63.10:2013 Maximum peak conducted output power for HFSS devices:

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the HFSS bandwidth and shall utilize a fast-responding diode detector.

LIMIT

For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

TEST RESULTS

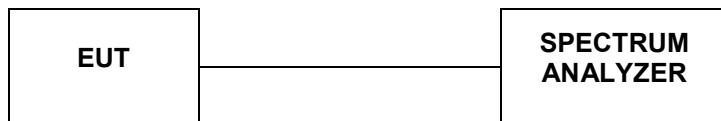
| Type | Channel | Peak Output power (dBm) | Limit (dBm) | Result |
|---------------|---------|-------------------------|-------------|--------|
| GFSK | 00 | 3.487 | 21 | Pass |
| | 39 | 3.592 | | |
| | 78 | 3.674 | | |
| $\pi/4$ DQPSK | 00 | 3.176 | 21 | Pass |
| | 39 | 3.313 | | |
| | 78 | 3.372 | | |
| 8DPSK | 00 | 3.315 | 21 | Pass |
| | 39 | 3.457 | | |
| | 78 | 3.555 | | |

Note: 1.The test results including the cable lose.



4.4. 20dB Bandwidth

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=30 KHz and VBW=100KHz. The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

LIMIT

For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwith.

TEST RESULTS

| Modulation | Channel | 20dB bandwidth (MHz) | 99% OBW (MHz) | Result |
|---------------|---------|----------------------|---------------|--------|
| GFSK | CH00 | 0.9675 | 0.88594 | Pass |
| | CH39 | 0.9619 | 0.88514 | |
| | CH78 | 0.9638 | 0.88912 | |
| $\pi/4$ DQPSK | CH00 | 1.288 | 1.1743 | Pass |
| | CH39 | 1.291 | 1.1809 | |
| | CH78 | 1.291 | 1.1724 | |
| 8DPSK | CH00 | 1.305 | 1.1829 | Pass |
| | CH39 | 1.295 | 1.1891 | |
| | CH78 | 1.292 | 1.1842 | |



GFSK Modulation



CH00



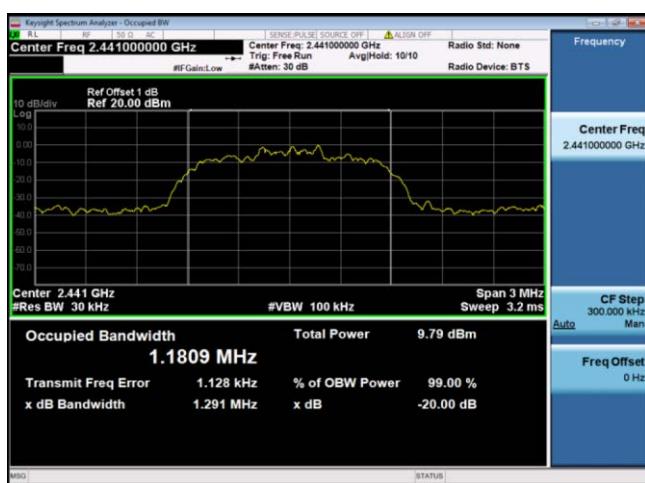
CH39



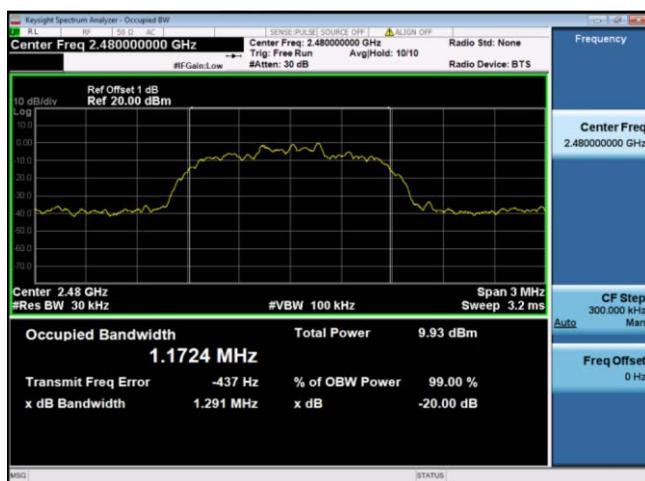
CH78

*π/4DQPSK Modulation*

CH00



CH39



CH78



8DPSK Modulation



CH00



CH39

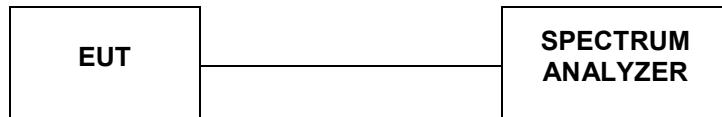


CH78



4.5. Frequency Separation

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=30 KHz and VBW=100KHz.

LIMIT

According to 15.247(a)(1),frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the $2/3 * 20$ dB bandwidth of the hopping channel, whichever is greater.

TEST RESULTS

4.5.1 GFSK Test Mode

| Modulation | Channel | Channel Separation (MHz) | Limit(MHz) | Result |
|---------------|---------|--------------------------|--------------------------------|--------|
| GFSK | CH38 | 0.903 | $2/3 * 20$ dB BW or 20dB BW | Pass |
| | CH39 | | | |
| $\pi/4$ DQPSK | CH38 | 0.920 | $2/3 * 20$ dB BW or 20dB BW | Pass |
| | CH39 | | | |
| 8DPSK | CH38 | 1.007 | $2/3 * 20$ dB BW or 20dB BW | Pass |
| | CH39 | | | |

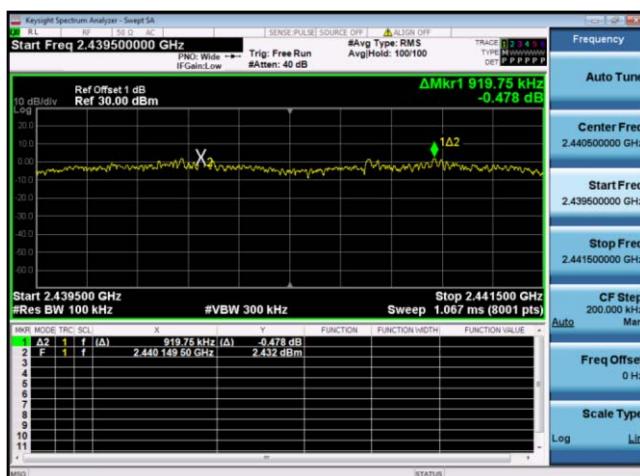
Remark: We have tested all mode at high, middle and low channel, and recorded worst case at middle



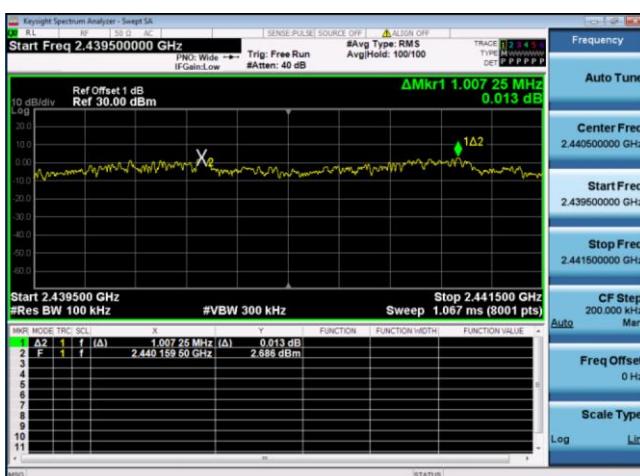
GFSK Modulation



$\pi/4$ DQPSK Modulation



8DPSK Modulation



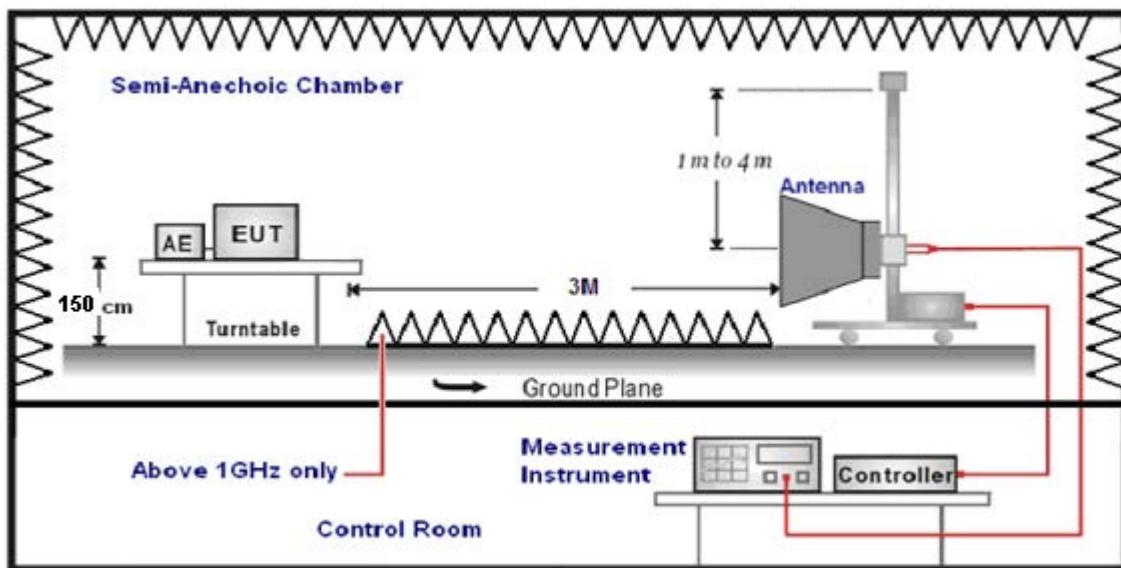
4.6. Band Edge Compliance of RF Emission

TEST REQUIREMENT

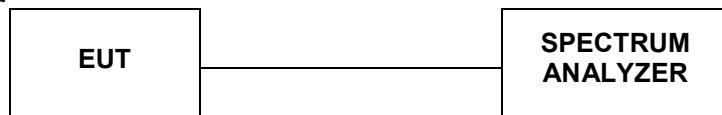
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST CONFIGURATION

For Radiated



For Conducted



TEST PROCEDURE

1. The EUT was placed on a turn table which is 1.5m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0°C to 360°C to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed..
5. The distance between test antenna and EUT was 3 meter:
6. Setting test receiver/spectrum as following table states:

| Test Frequency range | Test Receiver/Spectrum Setting | Detector |
|----------------------|---|----------|
| 1GHz-40GHz | Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto | Peak |

LIMIT

Below -20dB of the highest emission level in operating band.

Radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)

**TEST RESULTS****4.6.1 For Radiated Bandedge Measurement**

Remark: GFSK, Pi/4 DQPSK and 8DPSK all have been tested, only worse case GFSK is reported.

Operation Mode: GFSK TX Low channel(2402MHz)

Horizontal (Worst case)

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|------------------|
| 2390 | 56.79 | -5.81 | 50.98 | 74 | -23.02 | peak |
| 2390 | 39.32 | -5.81 | 33.51 | 54 | -20.49 | AVG |

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Vertical:

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|------------------|
| 2390 | 59.12 | -5.81 | 53.31 | 74 | -20.69 | peak |
| 2390 | 42.47 | -5.81 | 36.66 | 54 | -17.34 | AVG |

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Operation Mode: GFSK TX High channel (2480MHz)

Horizontal (Worst case)

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|------------------|
| 2483.5 | 58.21 | -5.65 | 52.56 | 74 | -21.44 | peak |
| 2483.5 | 42.91 | -5.65 | 37.26 | 54 | -16.74 | AVG |

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Vertical:

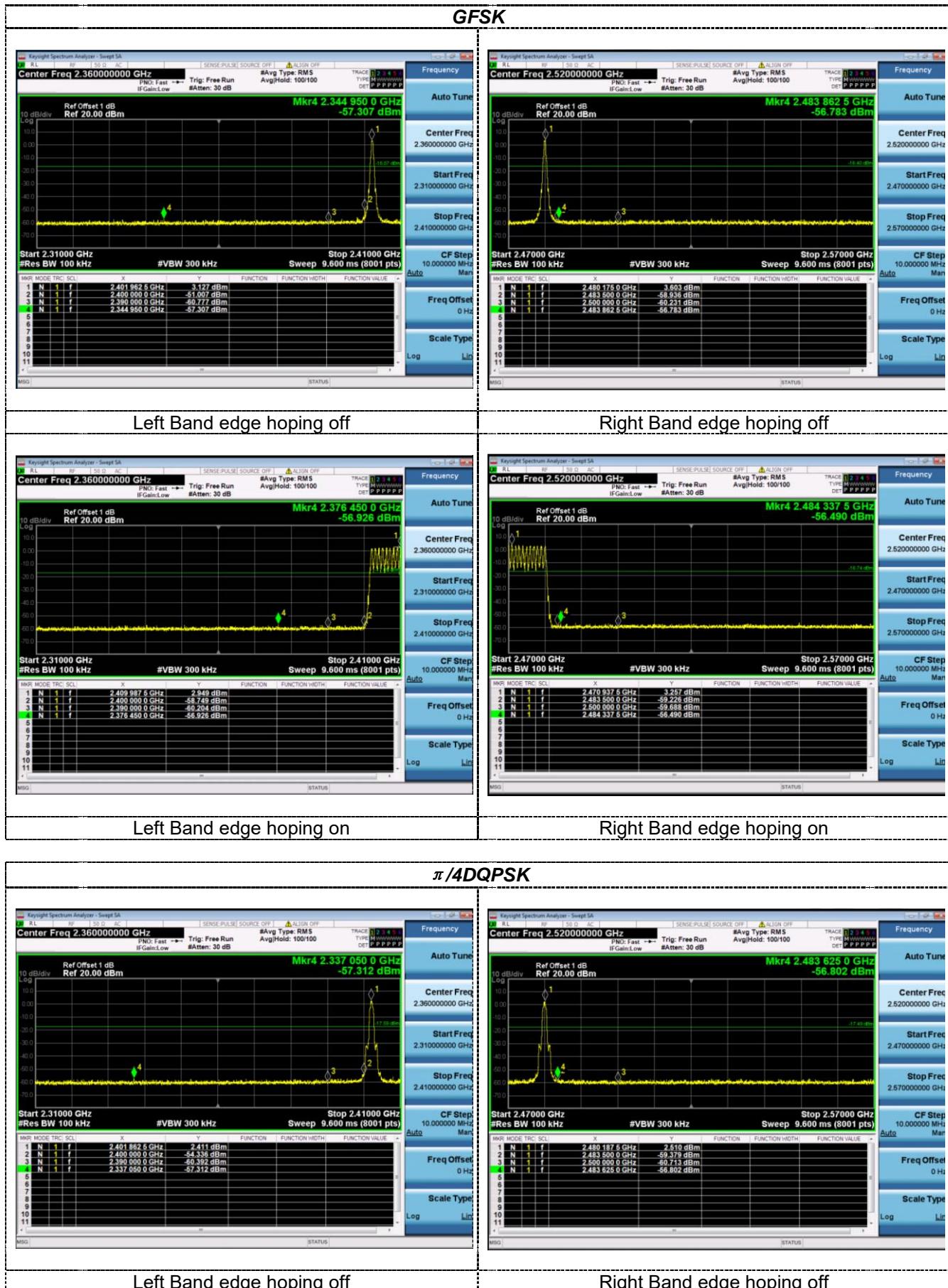
| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|------------------|
| 2483.5 | 60.18 | -5.65 | 54.53 | 74 | -19.47 | peak |
| 2483.5 | 44.52 | -5.65 | 38.87 | 54 | -15.13 | AVG |

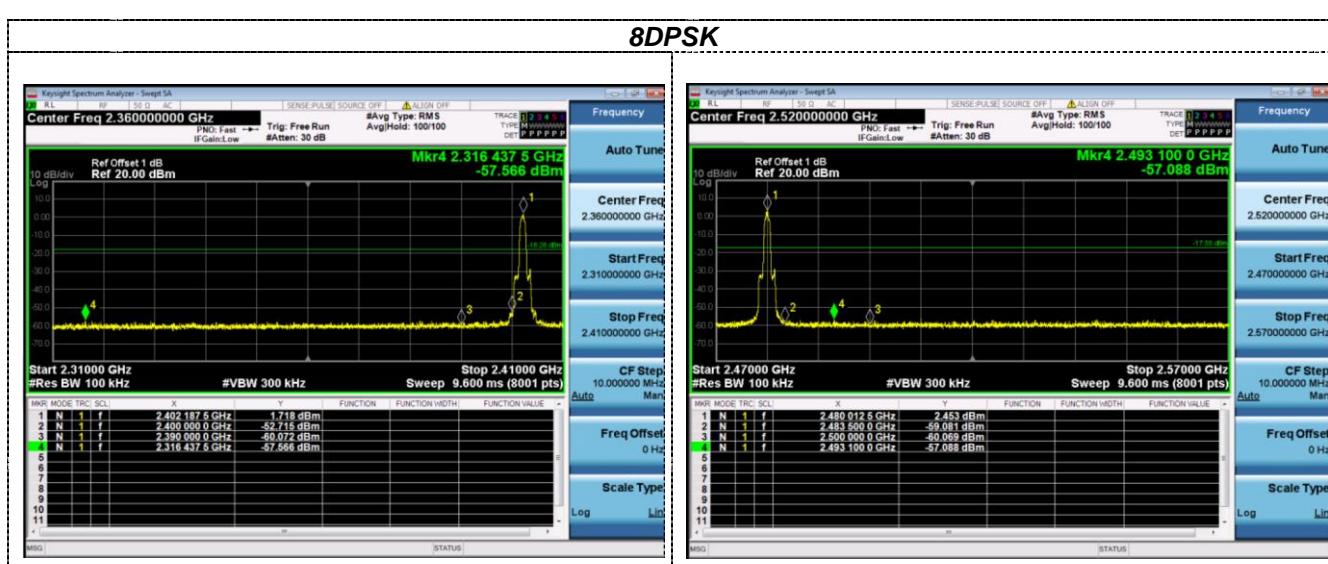
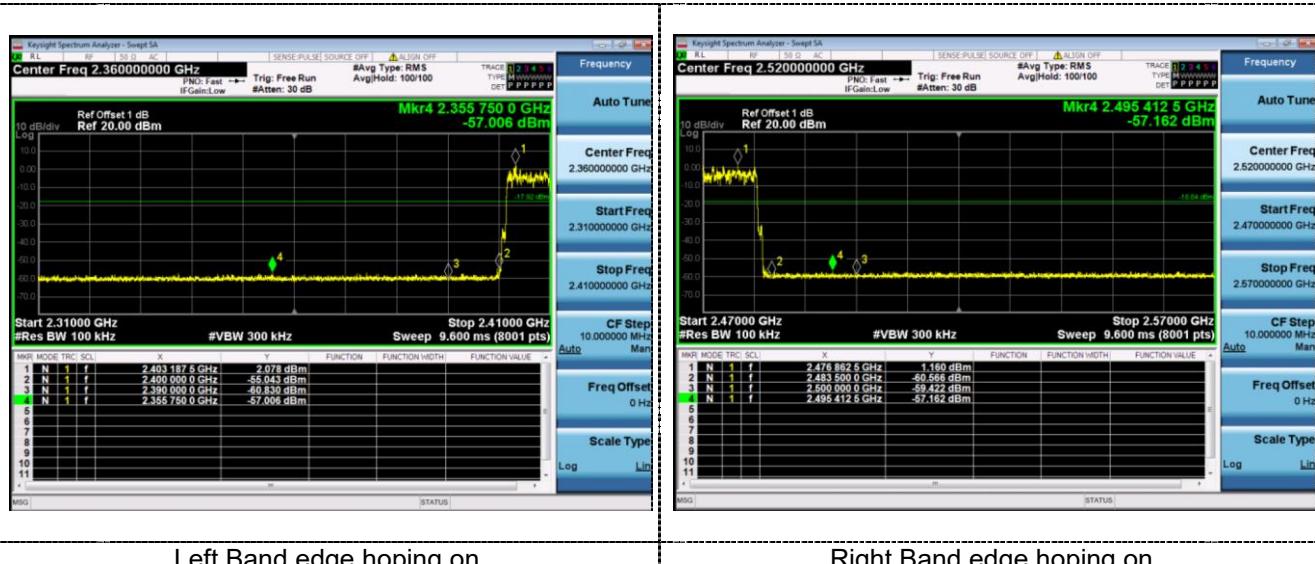
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.



4.6.2 For Conducted Bandedge Measurement

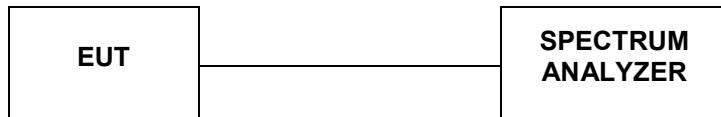






4.7. Spurious RF Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

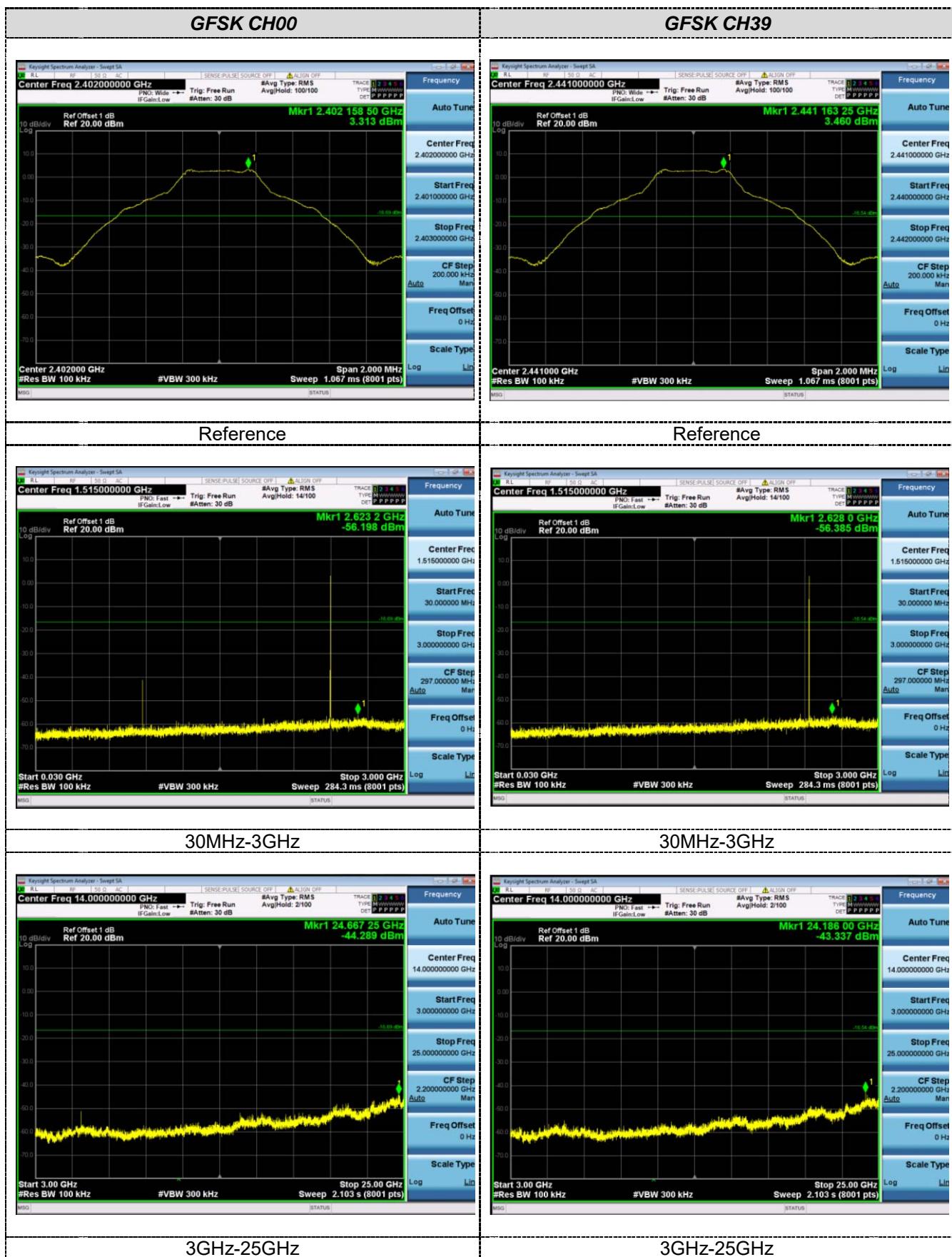
The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2013 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW=100kHz and VBW= 300KHz to measure the peak field strength , and mwasure frequeny range from 9KHz to 25GHz.

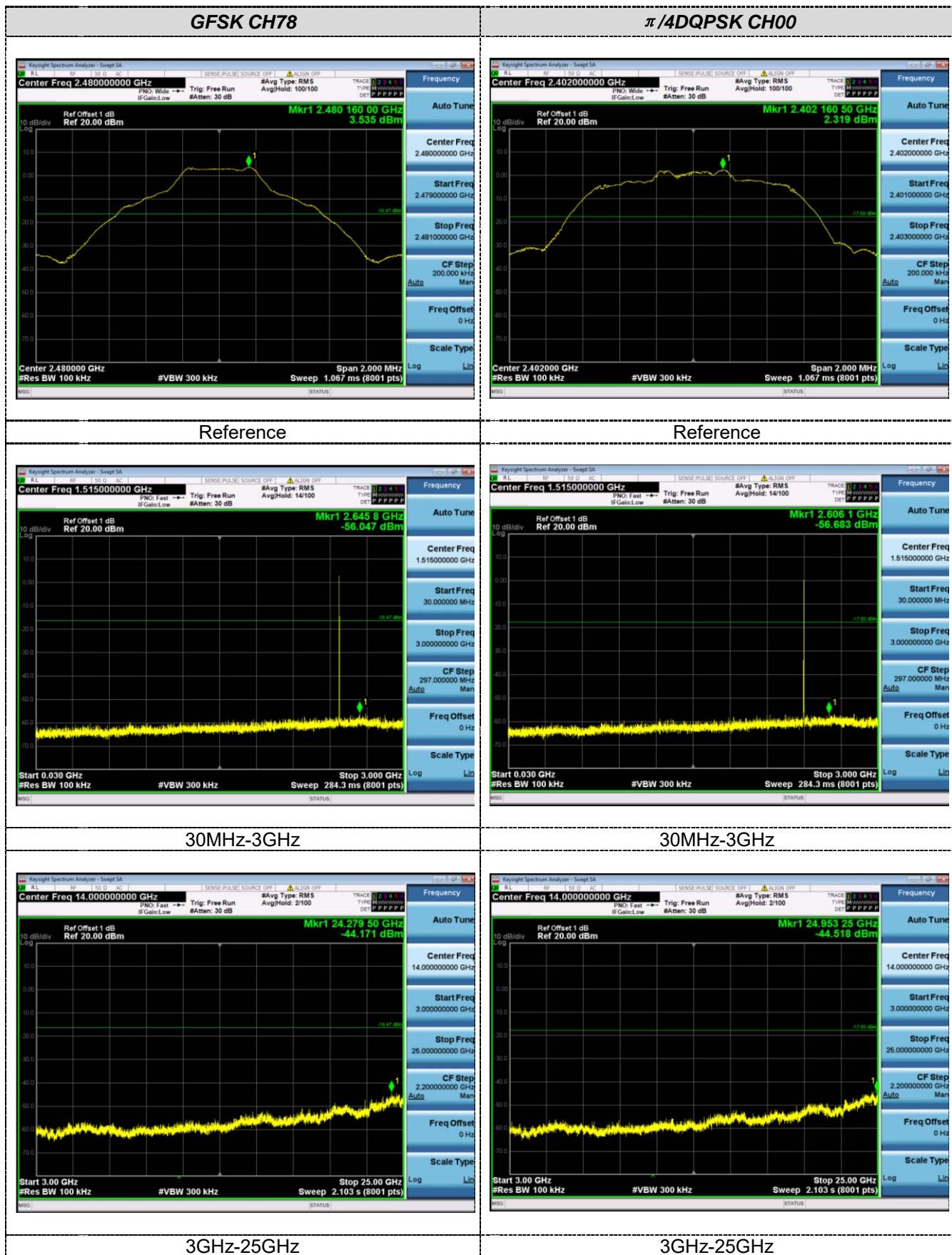
LIMIT

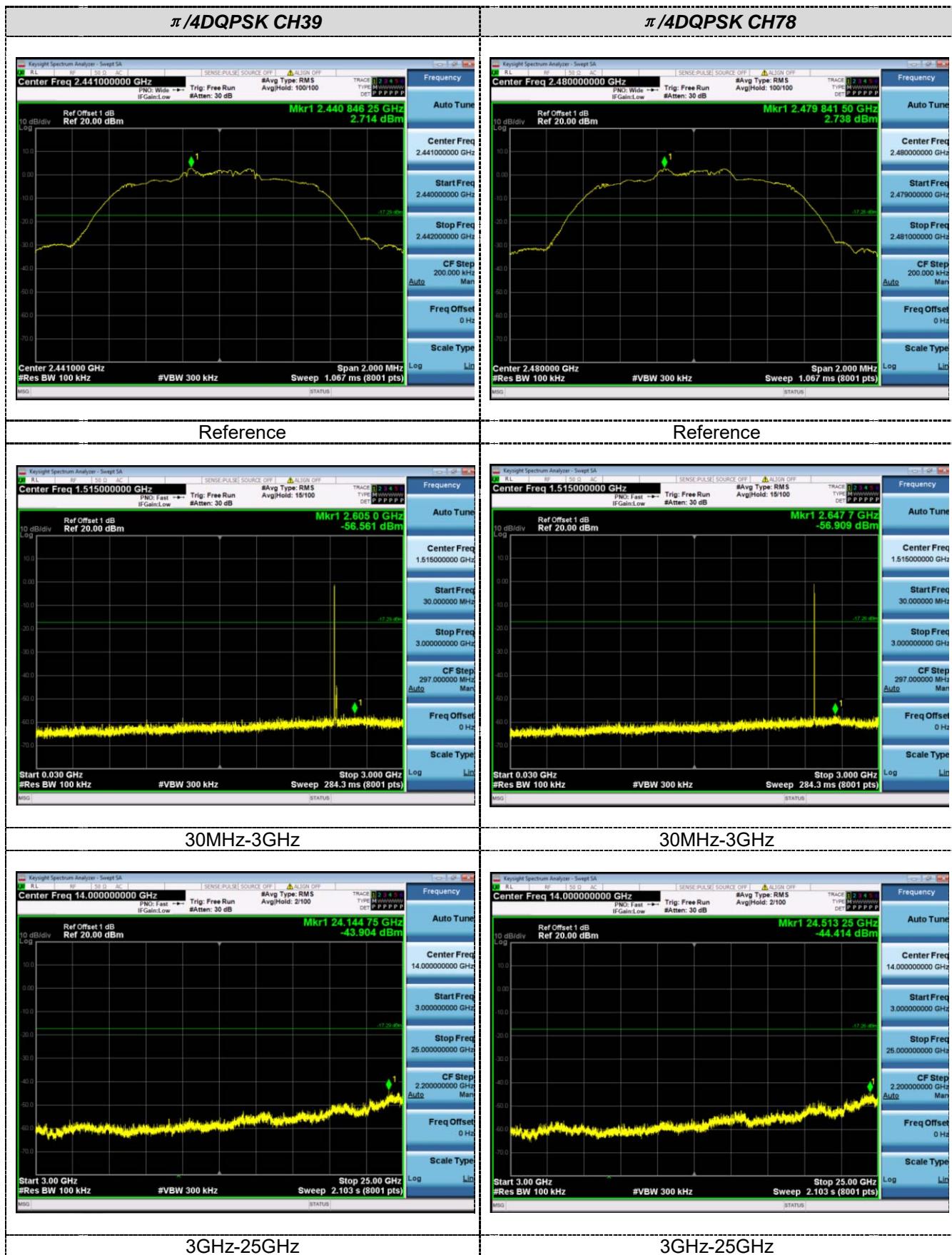
1. Below -20dB of the highest emission level in operating band.
2. Fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209.

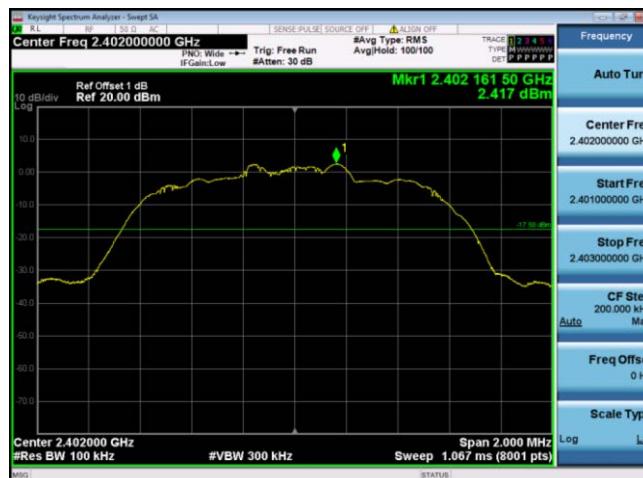
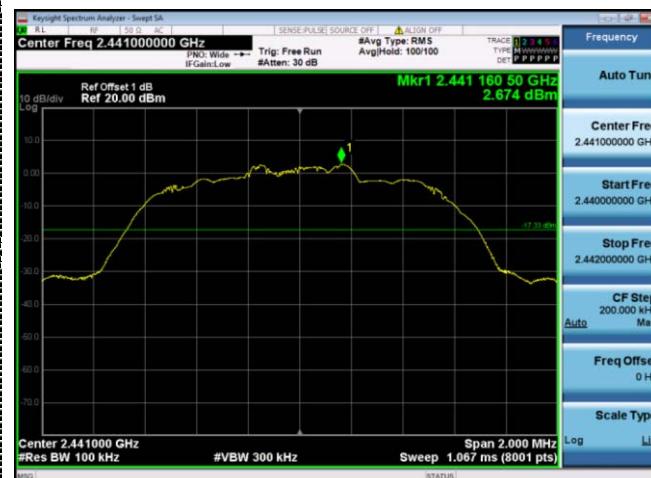
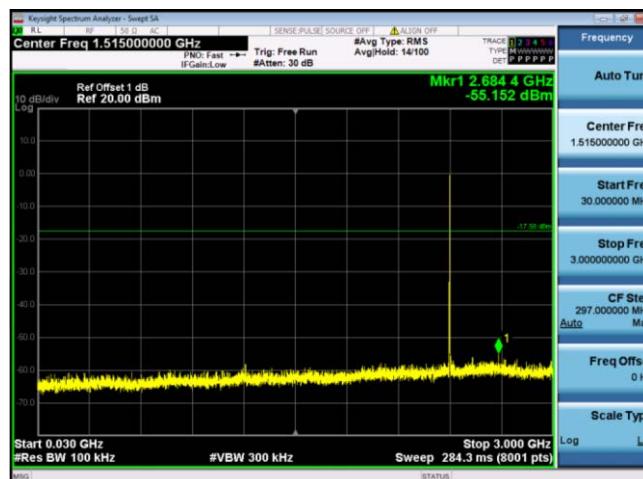
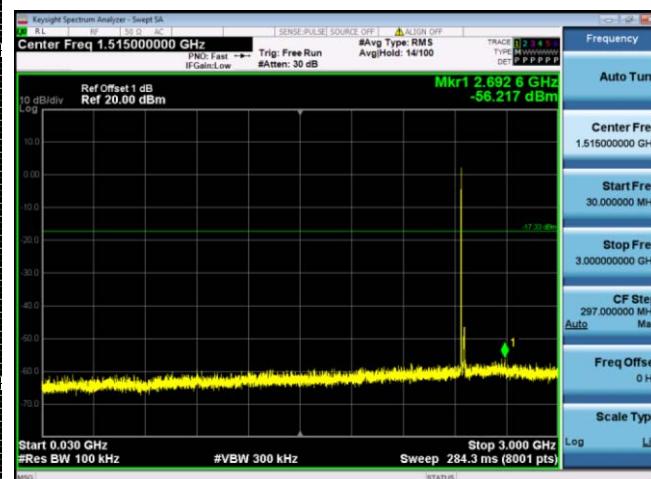
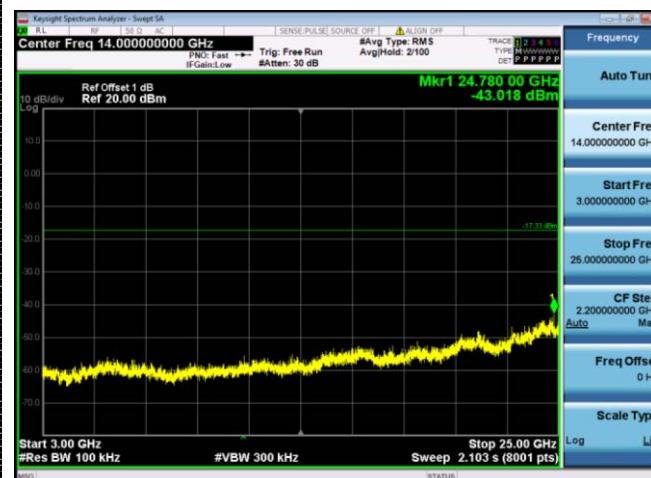
TEST RESULTS

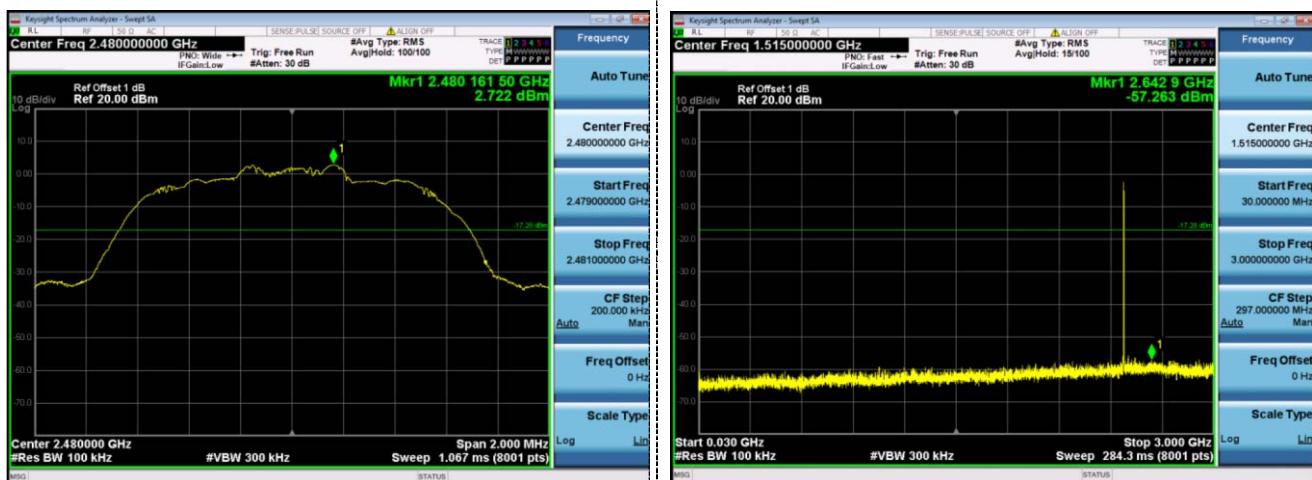
Remark: The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandege measurement data.







**8DPSK CH00****8DPSK CH39****Reference****Reference****30MHz-3GHz****30MHz-3GHz****3GHz-25GHz****3GHz-25GHz**

**8DPSK CH78****Reference**

30MHz-3GHz

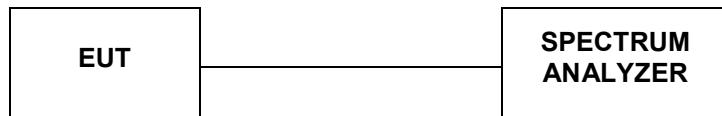


3GHz-25GHz



4.8. Number of hopping frequency

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. Set spectrum analyzer start 2400MHz to 2483.5MHz with RBW=1MHz and VBW=3MHz.

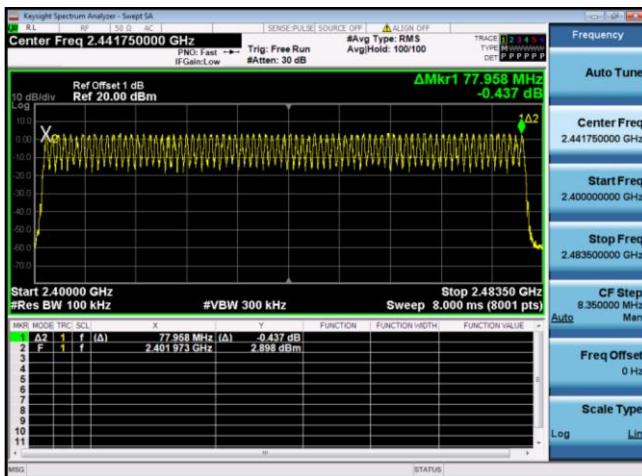
LIMIT

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

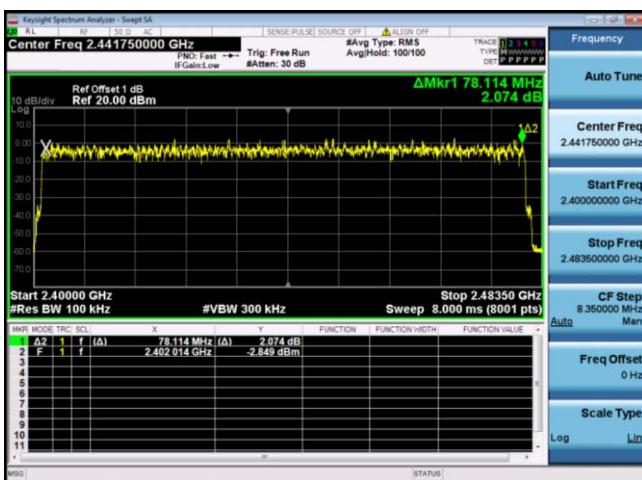
| Modulation | Number of Hopping Channel | Limit | Result |
|------------|---------------------------|-------|--------|
| GFSK | 79 | ≥15 | Pass |
| π/4 DQPSK | 79 | | |
| 8DPSK | 79 | | |



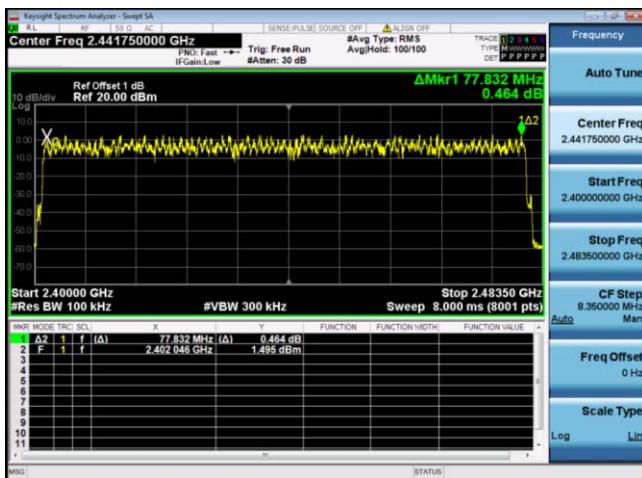
GFSK Modulation



$\pi/4$ DQPSK Modulation



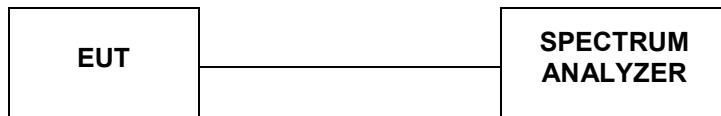
8DPSK Modulation





4.9. Time Of Occupancy(Dwell Time)

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with RBW=1MHz and VBW=3MHz,Span=0Hz.

LIMIT

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a pe-riod of 0.4 seconds multiplied by the number of hopping channels employed.

TEST RESULTS

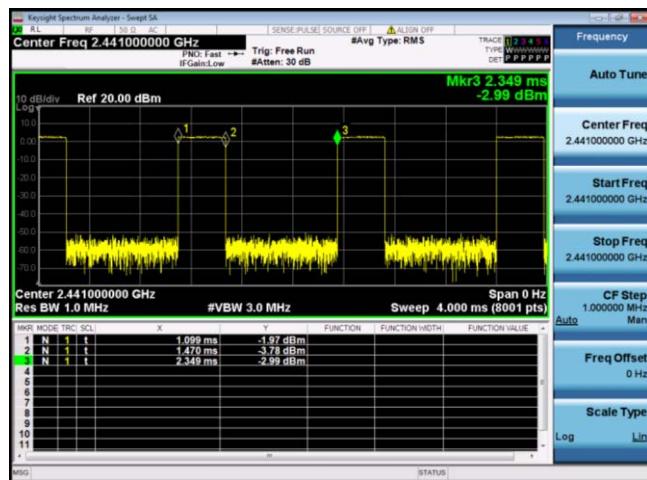
| Modulation | Packet | Pulse time (ms) | Dwell time (second) | Limit (second) | Result |
|---------------|--------|-----------------|---------------------|----------------|--------|
| GFSK | DH1 | 0.371 | 0.119 | 0.40 | Pass |
| | DH3 | 1.626 | 0.260 | | |
| | DH5 | 2.875 | 0.307 | | |
| $\pi/4$ DQPSK | 2DH1 | 0.402 | 0.129 | 0.40 | Pass |
| | 2DH3 | 1.651 | 0.264 | | |
| | 2DH5 | 2.877 | 0.307 | | |
| 8DSPSK | 3-DH1 | 0.380 | 0.122 | 0.40 | Pass |
| | 3-DH3 | 1.575 | 0.252 | | |
| | 3-DH5 | 2.879 | 0.307 | | |

Note:

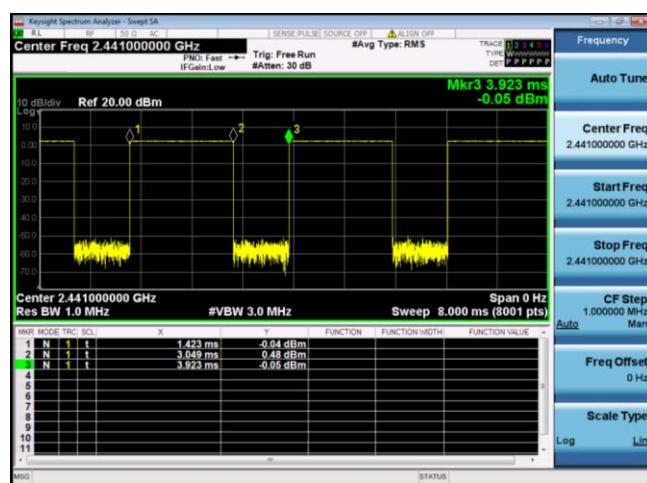
1. We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.
2. Dwell time=Pulse time (ms) \times (1600 \div 2 \div 79) \times 31.6 Second for DH1, 2-DH1, 3-DH1
Dwell time=Pulse time (ms) \times (1600 \div 4 \div 79) \times 31.6 Second for DH3, 2-DH3, 3-DH3
Dwell time=Pulse time (ms) \times (1600 \div 6 \div 79) \times 31.6 Second for DH5, 2-DH5, 3-DH5



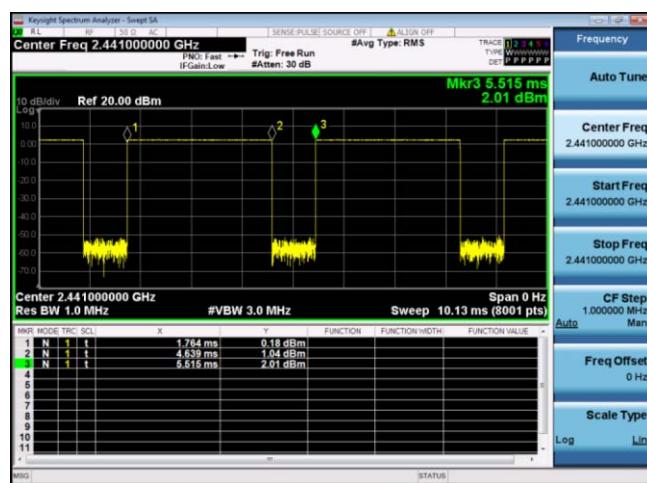
GFSK Modulation



DH1



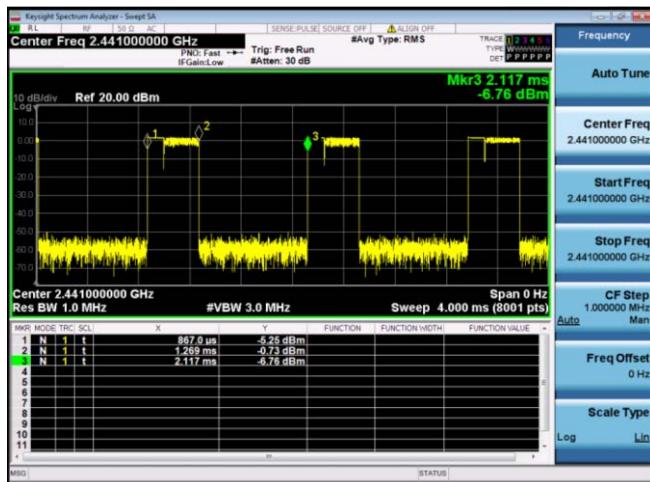
DH3



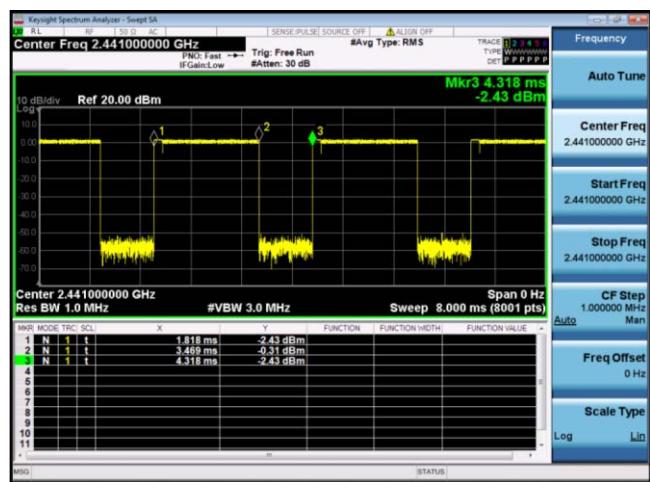
DH5



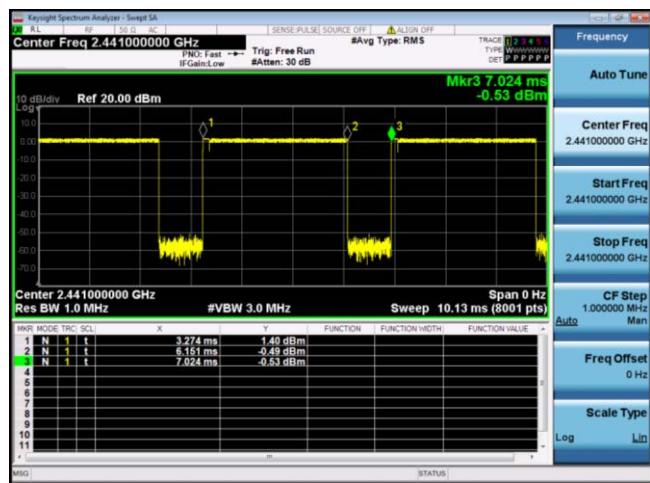
π/4DQPSK Modulation



2-DH1



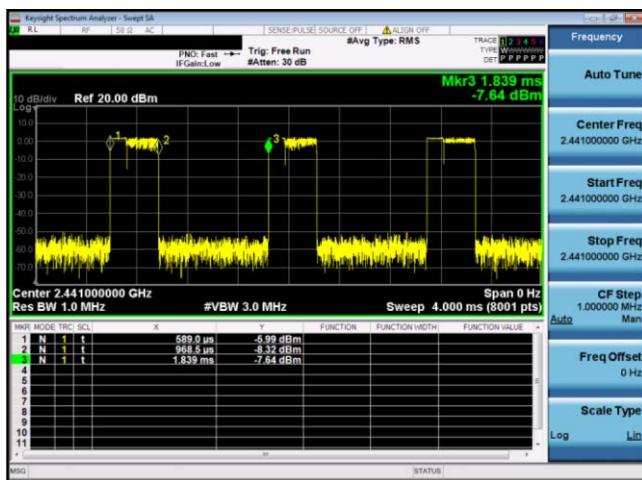
2-DH3



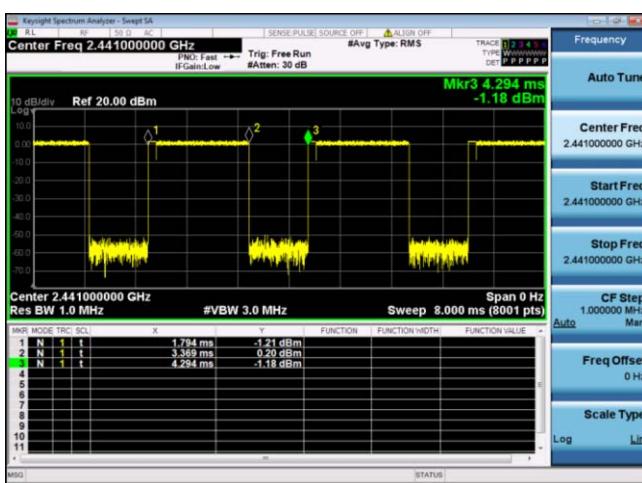
2-DH5



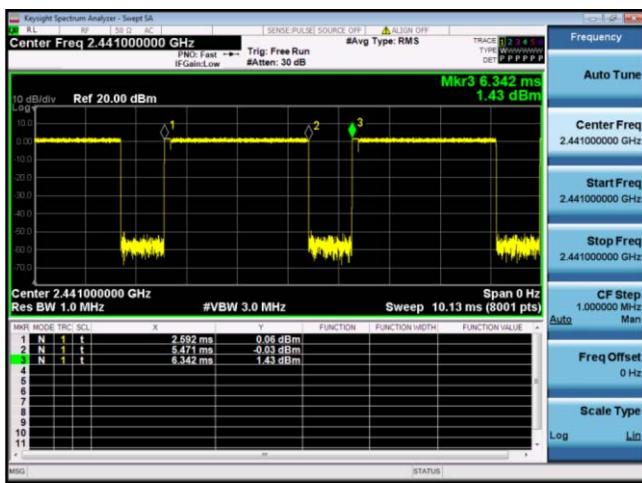
8DPSK Modulation



3-DH1



3-DH3



3-DH5

4.10. Pseudorandom Frequency Hopping Sequence

TEST APPLICABLE

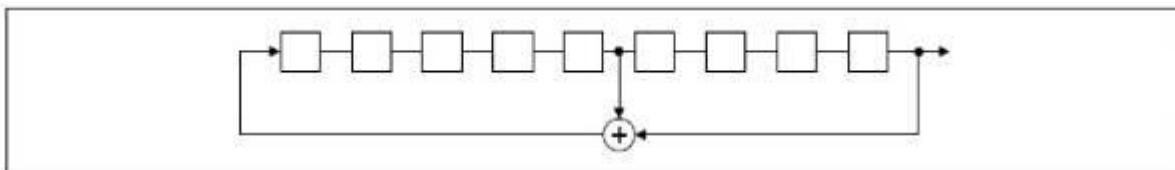
For 47 CFR Part 15C section 15.247 (a)(1) requirement:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

EUT Pseudorandom Frequency Hopping Sequence Requirement

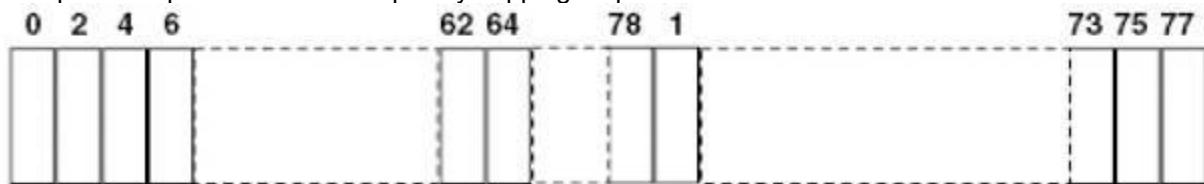
The pseudorandom frequency hopping sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones, for example: the shift register is initialized with nine ones.

- Number of shift register stages: 9
- Length of pseudo-random sequence: $2^9 - 1 = 511$ bits
- Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of pseudorandom frequency hopping sequence as follows:



Each frequency used equally one the average by each transmitter.

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



4.11. Antenna Requirement

Standard Applicable

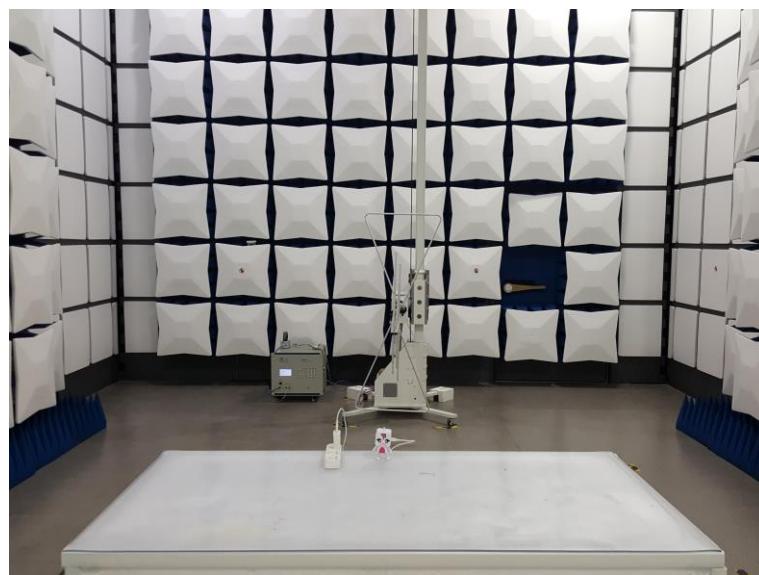
For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to FCC 47 CFR Section 15.247 (c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

Antenna Information

The antenna is PCB antenna ,The directional gains of antenna used for transmitting is 0.00 dBi.

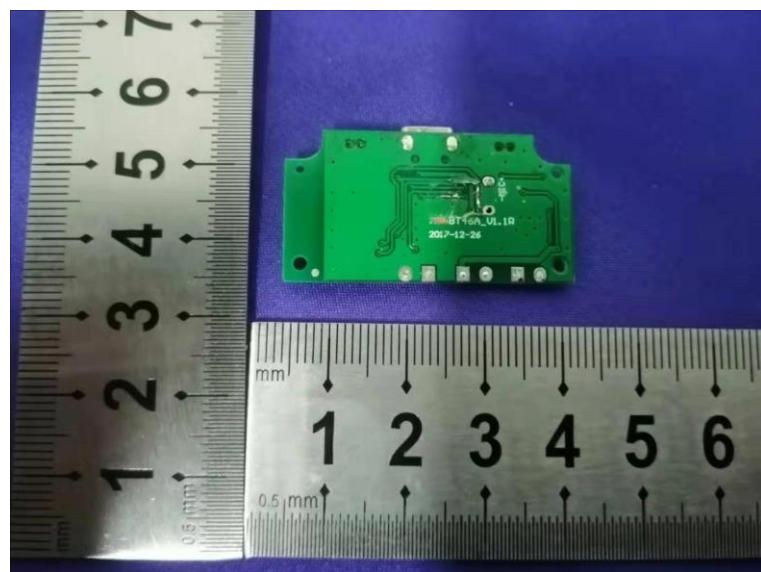
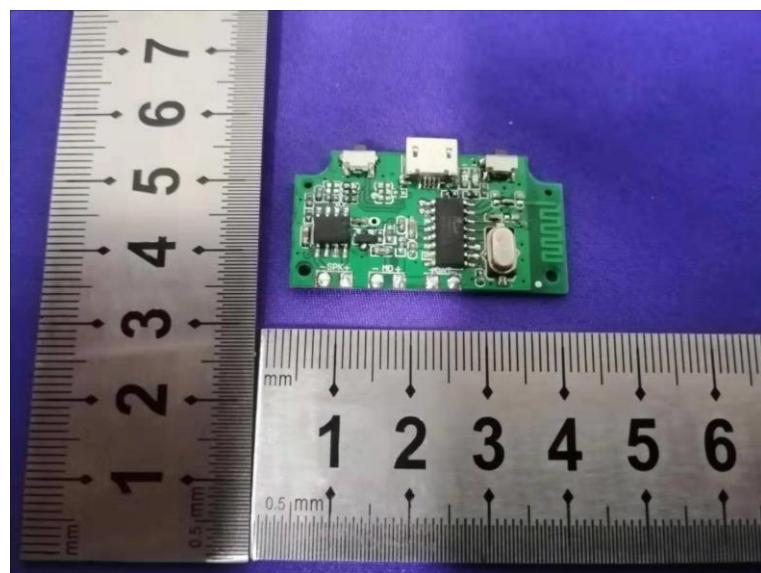
5. Test Setup Photos of the EUT

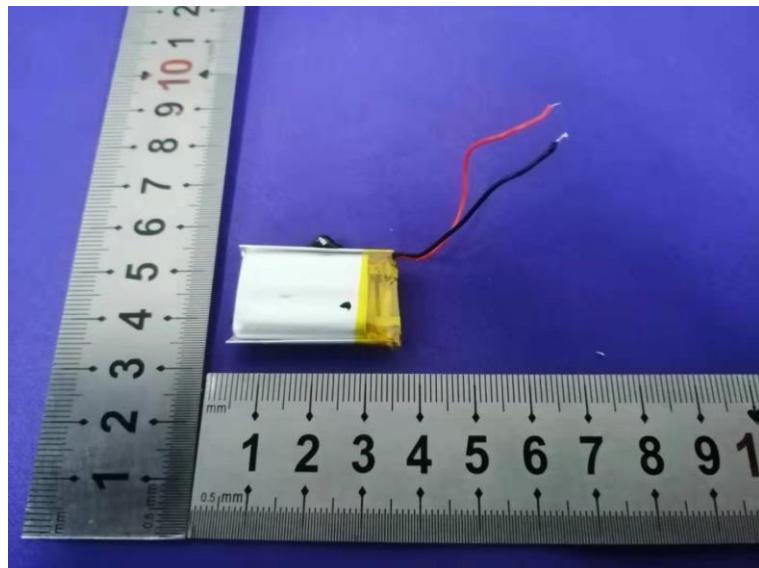


6. Photos of the EUT









.....End of Report.....