



# TEST REPORT

**Report Reference No.** ..... : **TRE1705023101** R/C.....: 89208

**FCC ID** ..... : **Q5EDP990**

**Applicant's name** ..... : **Kirisun Communications Co., Ltd**

**Address**..... : 3-6F ROBETA Building, No. 1, QiMin Road, Song Ping Shan Area, Science & Industry Park, Nanshan District, Shenzhen 518057, China

**Manufacturer**..... : Kirisun Communications Co., Ltd

**Address**..... : 3-6F ROBETA Building, No. 1, QiMin Road, Song Ping Shan Area, Science & Industry Park, Nanshan District, Shenzhen 518057, China

**Test item description**..... : **DMR Two Way Radio**

**Trade Mark**..... : KIRISUN

**Model/Type reference** ..... : DP990

**Listed Model(s)** ..... : DP995

**Standard** ..... : **FCC CFR Title 47 Part 15 Subpart C Section 15.247**

**Date of receipt of test sample**.....: May 25, 2017

**Date of testing**.....: May 26, 2017 – June 21, 2017

**Date of issue**.....: June 21, 2017

**Result**.....: **PASS**

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Hans Hu

**Testing Laboratory Name** ..... : **Shenzhen Huatongwei International Inspection Co., Ltd.**

**Address**..... : 1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China

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## 1. TEST STANDARDS AND TEST DESCRIPTION

### 1.1. 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

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

### 1.2. Report version

| Version No. | Date of issue | Description |
|-------------|---------------|-------------|
| 00          | June 21, 2017 | Original    |
|             |               |             |
|             |               |             |
|             |               |             |
|             |               |             |

## 2. TEST DESCRIPTION

| Test Item                               | Section in CFR 47 | Result |
|-----------------------------------------|-------------------|--------|
| Antenna Requirement                     | 15.203/15.247 (c) | Pass   |
| AC Power Line Conducted Emission        | 15.207            | Pass   |
| Conducted Peak Output Power             | 15.247 (b)(1)     | Pass   |
| 20dB Occupied Bandwidth                 | 15.247 (a)(1)     | Pass   |
| Carrier Frequencies Separation          | 15.247 (a)(1)     | Pass   |
| Hopping Channel Number                  | 15.247 (a)(1)     | Pass   |
| Dwell Time                              | 15.247 (a)(1)     | Pass   |
| Pseudorandom Frequency Hopping Sequence | 15.247(b)(4)      | Pass   |
| Restricted band                         | 15.247(d)/15.205  | Pass   |
| Radiated Emission                       | 15.247(d)/15.209  | Pass   |

Note: The measurement uncertainty is not included in the test result.

### 3. SUMMARY

#### 3.1. Client Information

|               |                                                                                                                                 |
|---------------|---------------------------------------------------------------------------------------------------------------------------------|
| Applicant:    | Kirisun Communications Co., Ltd                                                                                                 |
| Address:      | 3-6F ROBETA Building, No. 1, QiMin Road, Song Ping Shan Area, Science & Industry Park, Nanshan District, Shenzhen 518057, China |
| Manufacturer: | Kirisun Communications Co., Ltd                                                                                                 |
| Address:      | 3-6F ROBETA Building, No. 1, QiMin Road, Song Ping Shan Area, Science & Industry Park, Nanshan District, Shenzhen 518057, China |

#### 3.2. Product Description

|                      |                                                                                         |
|----------------------|-----------------------------------------------------------------------------------------|
| Name of EUT:         | DMR Two Way Radio                                                                       |
| Trade Mark:          | KIRISUN                                                                                 |
| Model No.:           | DP990                                                                                   |
| Listed Model(s):     | DP995                                                                                   |
| Power supply:        | DC 7.4V                                                                                 |
| Battery information: | Model: KB-990<br>DC 7.4V, 2000mAh                                                       |
| Charger information: | Model: KBC-77Q<br>Input: 12Vd.c., 1000mA<br>Output: 8.4Vd.c., 800mA                     |
| Adapter information: | Model: ZAU-A120100A-04<br>Input: 100-240Va.c., 50/60Hz, 0.4A<br>Output: 12Vd.c., 1000mA |
| <b>Bluetooth</b>     |                                                                                         |
| Version:             | Supported BT3.0+EDR                                                                     |
| Modulation:          | GFSK, $\pi/4$ DQPSK, 8DPSK                                                              |
| Operation frequency: | 2402MHz~2483.5MHz                                                                       |
| Channel number:      | 79                                                                                      |
| Channel separation:  | 1MHz                                                                                    |
| Antenna type:        | External Antenna                                                                        |
| Antenna gain:        | 0dBi                                                                                    |

### 3.3. Operation state

#### ➤ Test frequency list

According to section 15.31(m), regards to the operating frequency range over 10 MHz, must select three channel which were tested. the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, please see the above gray bottom.

| Channel | Frequency (MHz) |
|---------|-----------------|
| 0       | 2402            |
| 1       | 2403            |
| :       | :               |
| 39      | 2441            |
| :       | :               |
| 77      | 2479            |
| 78      | 2480            |

#### ➤ Test mode

|                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------|
| For RF test items                                                                                                             |
| The engineering test program was provided and enabled to make EUT continuous transmit.                                        |
| For AC power line conducted emissions:                                                                                        |
| the EUT was set to connect with the Bluetooth under large package sizes transmission.                                         |
| For RF test axis                                                                                                              |
| EUT in each of three orthogonal axis emissions had been tested ,but only the worst case (X axis) data Recorded in the report. |

### 3.4. EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

- - supplied by the manufacturer
- - supplied by the lab

|  |                |   |
|--|----------------|---|
|  | Manufacturer : | / |
|  | Model No. :    | / |
|  | Manufacturer : | / |
|  | Model No. :    | / |

### 3.5. Modifications

No modifications were implemented to meet testing criteria.

## **4. Test Environment**

### **4.1. Address of the test laboratory**

Laboratory: Shenzhen Huatongwei International Inspection Co., Ltd.

Address: 1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China

Phone: 86-755-26748019 Fax: 86-755-26748089

### **4.2. Test Facility**

The test facility is recognized, certified, or accredited by the following organizations:

#### **CNAS-Lab Code: L1225**

Shenzhen Huatongwei International Inspection Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories.

#### **A2LA-Lab Cert. No.: 3902.01**

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

#### **FCC-Registration No.: 317478**

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Registration 317478.

#### **IC-Registration No.: 5377B**

Two 3m Alternate Test Site of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 5377B.

#### **ACA**

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory can also perform testing for the Australian C-Tick mark as a result of our A2LA accreditation.

### 4.3. Environmental conditions

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

|                    |             |
|--------------------|-------------|
| Temperature:       | 15~35°C     |
| Relative Humidity: | 30~60 %     |
| Air Pressure:      | 950~1050mba |

### 4.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report according to TR-100028-01 "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2" and is documented in the Shenzhen Huatongwei International Inspection Co., Ltd quality system according to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen Huatongwei laboratory is reported:

| Test Items                              | Measurement Uncertainty | Notes |
|-----------------------------------------|-------------------------|-------|
| Transmitter power conducted             | 0.57 dB                 | (1)   |
| Transmitter power Radiated              | 2.20 dB                 | (1)   |
| Conducted spurious emission 9KHz-40 GHz | 1.60 dB                 | (1)   |
| Radiated spurious emission 9KHz-40 GHz  | 2.20 dB                 | (1)   |
| Conducted Emission 9KHz-30MHz           | 3.39 dB                 | (1)   |
| Radiated Emission 30~1000MHz            | 4.24 dB                 | (1)   |
| Radiated Emission 1~18GHz               | 5.16 dB                 | (1)   |
| Radiated Emission 18-40GHz              | 5.54 dB                 | (1)   |
| Occupied Bandwidth                      | 35 Hz                   | (1)   |
| Conducted output power                  | 0.57 dB                 | (1)   |
| Power spectral density                  | 1.80 dB                 | (1)   |

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=1.96$ .

#### 4.5. Equipments Used during the Test

| Line Conducted Emission (AC Main) |                   |              |           |            |            |
|-----------------------------------|-------------------|--------------|-----------|------------|------------|
| Item                              | Test Equipment    | Manufacturer | Model No. | Serial No. | Last Cal.  |
| 1                                 | EMI Test Receiver | R&S          | ESCI      | 101247     | 2016/11/13 |
| 2                                 | Artificial Mains  | Shwarzbeck   | NNLK 8121 | 573        | 2016/11/13 |
| 3                                 | Pulse Limiter     | R&S          | ESH3-Z2   | 101488     | 2016/11/13 |
| 4                                 | Test Software     | R&S          | ES-K1     | N/A        | N/A        |
| 5                                 | Test cable        | ENVIROFLEX   | 3651      | 1101902    | 2016/11/13 |

| Maximum Peak Output Power / Power Spectral Density / 6dB Bandwidth / Band Edge Compliance of RF Emission / Spurious RF Conducted Emission |                              |               |           |            |            |
|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|---------------|-----------|------------|------------|
| Item                                                                                                                                      | Test Equipment               | Manufacturer  | Model No. | Serial No. | Last Cal   |
| 1                                                                                                                                         | Signal and spectrum analyzer | Rohde&Schwarz | FSV40     | 100048     | 2016/11/13 |
| 2                                                                                                                                         | Power Meter                  | Anritsu       | ML2480B   | 100798     | 2016/11/13 |
| 3                                                                                                                                         | Power Sensor                 | Anritsu       | MA2411B   | 100258     | 2016/11/13 |
| 4                                                                                                                                         | Test cable                   | FARPU         | MCX-J     | N/A        | 2016/11/13 |
| 5                                                                                                                                         | Temporary antenna connector  | D-LENP        | NJ-SMAK   | N/A        | 2016/11/13 |

NOTE: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

| Radiated Emission |                         |                   |           |             |            |
|-------------------|-------------------------|-------------------|-----------|-------------|------------|
| Item              | Test Equipment          | Manufacturer      | Model No. | Serial No.  | Last Cal.  |
| 1                 | EMI Test Receiver       | Rohde&Schwarz     | ESI 26    | 100009      | 2016/11/13 |
| 2                 | RF Test Panel           | Rohde&Schwarz     | TS / RSP  | 335015/0017 | N/A        |
| 3                 | EMI Test Software       | Rohde&Schwarz     | ESK1      | N/A         | N/A        |
| 4                 | Loop Antenna            | Rohde&Schwarz     | HZ-9      | 838622\013  | 2016/11/13 |
| 5                 | Ultra-Broadband Antenna | ShwarzBeck        | VULB9163  | 538         | 2016/11/13 |
| 6                 | Horn Antenna            | ShwarzBeck        | 9120D     | 1011        | 2016/11/13 |
| 7                 | Broadband Horn Antenna  | Shwarzbeck        | BBHA9170  | BBHA9170472 | 2016/11/13 |
| 8                 | Preamplifier            | Shwarzbeck        | BBV9742   | 9742-196    | 2016/11/13 |
| 9                 | Broadband Preamplifier  | Shwarzbeck        | BBV 9721  | 9721-102    | 2016/11/13 |
| 10                | Broadband Preamplifier  | Shwarzbeck        | BBV 9718  | 9718-247    | 2016/11/13 |
| 11                | Turn Table              | MATURO            | TT2.0     | /           | N/A        |
| 12                | Antenna Mast            | MATURO            | TAM-4.0-P | /           | N/A        |
| 13                | EMI Test Software       | Audix             | E3        | N/A         | N/A        |
| 14                | Test Software           | R&S               | ES-K1     | N/A         | N/A        |
| 15                | Test cable              | Siva Cables Italy | RG 58A/U  | W14.02      | 2016/11/13 |

The Cal.Interval was one year.

## 5. TEST CONDITIONS AND RESULTS

### 5.1. Antenna requirement

#### Requirement

##### **FCC CFR Title 47 Part 15 Subpart C 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

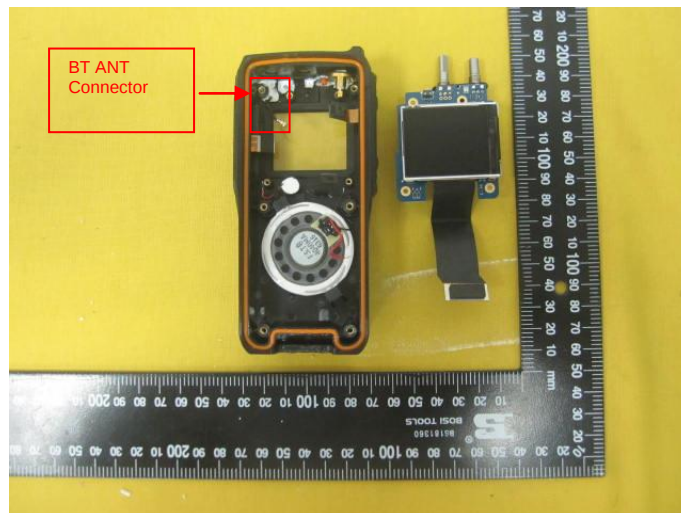
##### **FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1)(i):**

(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

#### TEST RESULTS

☒ **Passed**      ☐ **Not Applicable**

The antenna is external antenna, the best case gain of the antenna is 0dBi, please refer to the below antenna photo.



## 5.2. Conducted Emission (AC Main)

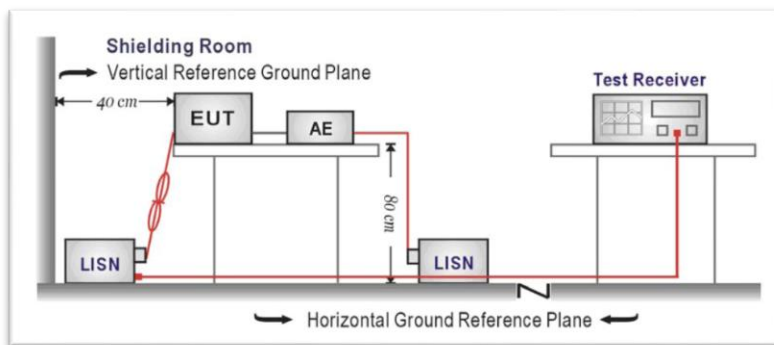
### LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.207:

| 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 CONFIGURATION



### TEST PROCEDURE

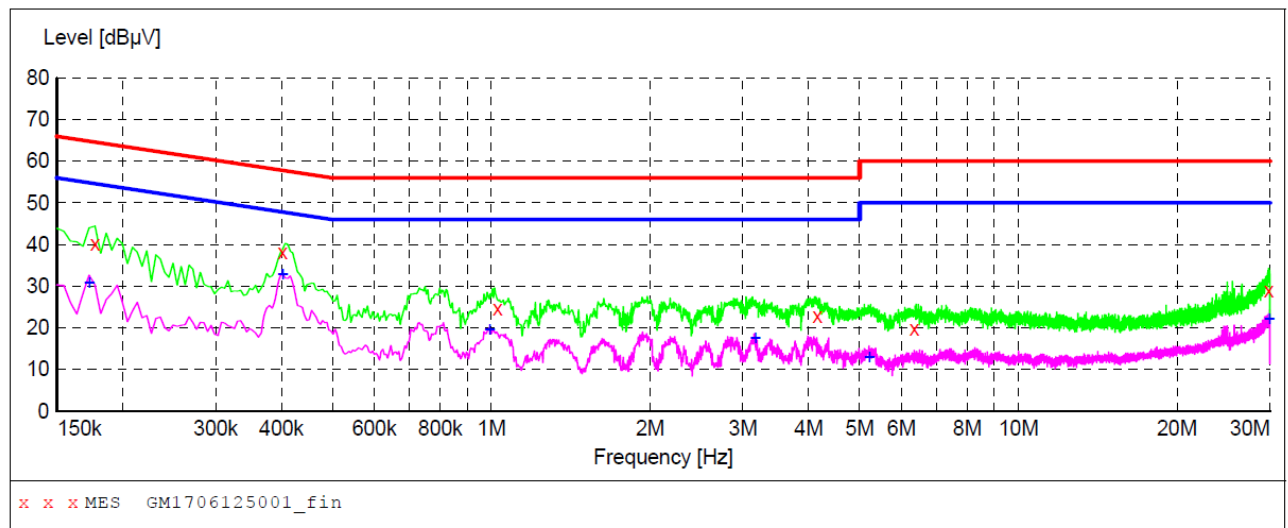
1. The EUT was setup according to ANSI C63.10:2013 for compliance to FCC 47CFR 15.247 requirements.
2. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface.
3. The EUT and simulators are connected to the main power through a line impedance stabilization network (LISN). The LISN provides a 50 ohm /50uH coupling impedance for the measuring equipment.
4. The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs)
5. Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.
6. The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.
7. Conducted emissions were investigated over the frequency range from 0.15 MHz to 30 MHz using a receiver bandwidth of 9 kHz.
8. During the above scans, the emissions were maximized by cable manipulation.

### TEST MODE:

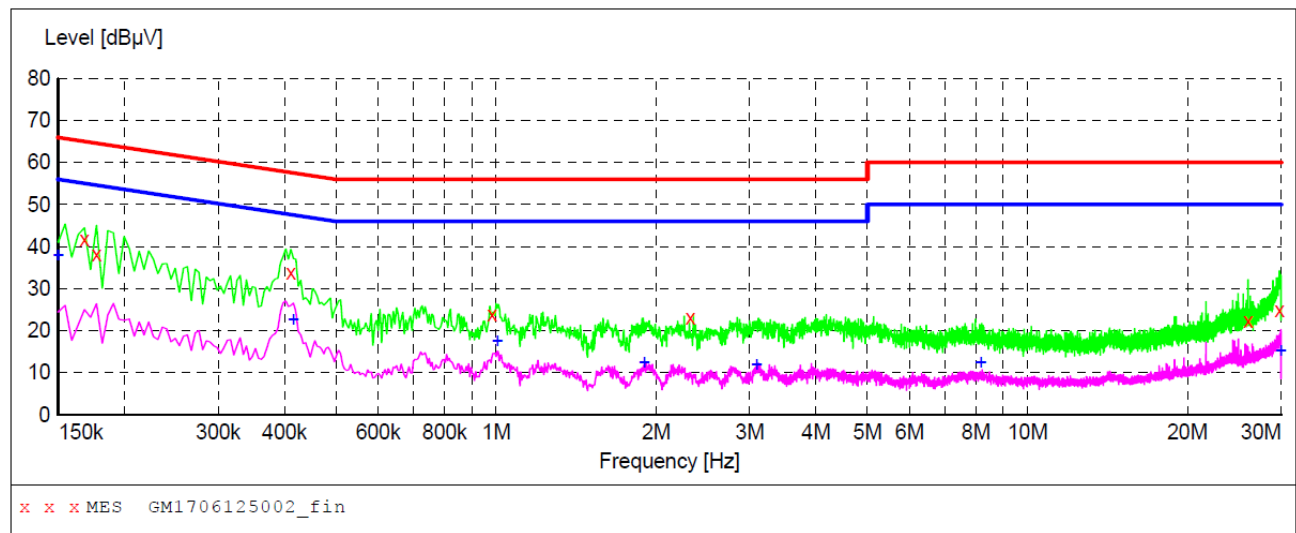
Please refer to the clause 3.3

### TEST RESULTS

☒ Passed ☐ Not Applicable



| Frequency<br>MHz | Level<br>dBμV | Transd<br>dB | Limit<br>dBμV | Margin<br>dB | Detector | Line | PE  |
|------------------|---------------|--------------|---------------|--------------|----------|------|-----|
| 0.177000         | 40.30         | 10.4         | 65            | 24.3         | QP       | L1   | GND |
| 0.402000         | 38.20         | 10.2         | 58            | 19.6         | QP       | L1   | GND |
| 1.027500         | 24.60         | 10.2         | 56            | 31.4         | QP       | L1   | GND |
| 4.159500         | 22.90         | 10.3         | 56            | 33.1         | QP       | L1   | GND |
| 6.355500         | 19.70         | 10.3         | 60            | 40.3         | QP       | L1   | GND |
| 29.859000        | 29.10         | 10.8         | 60            | 30.9         | QP       | L1   | GND |
| Frequency<br>MHz | Level<br>dBμV | Transd<br>dB | Limit<br>dBμV | Margin<br>dB | Detector | Line | PE  |
| 0.172500         | 30.90         | 10.4         | 55            | 23.9         | AV       | L1   | GND |
| 0.402000         | 32.90         | 10.2         | 48            | 14.9         | AV       | L1   | GND |
| 0.991500         | 19.50         | 10.2         | 46            | 26.5         | AV       | L1   | GND |
| 3.165000         | 17.40         | 10.2         | 46            | 28.6         | AV       | L1   | GND |
| 5.208000         | 13.00         | 10.3         | 50            | 37.0         | AV       | L1   | GND |
| 29.940000        | 22.20         | 10.8         | 50            | 27.8         | AV       | L1   | GND |



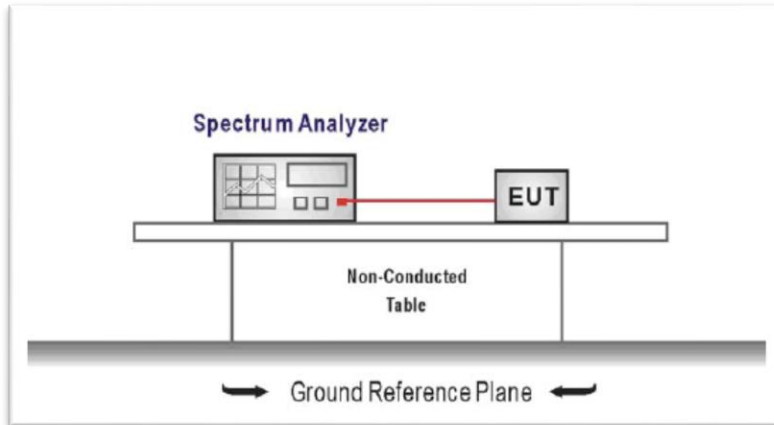
| Frequency<br>MHz | Level<br>dBμV | Transd<br>dB | Limit<br>dBμV | Margin<br>dB | Detector | Line | PE  |
|------------------|---------------|--------------|---------------|--------------|----------|------|-----|
| 0.168000         | 41.70         | 10.4         | 65            | 23.4         | QP       | N    | GND |
| 0.177000         | 38.20         | 10.4         | 65            | 26.4         | QP       | N    | GND |
| 0.411000         | 33.80         | 10.2         | 58            | 23.8         | QP       | N    | GND |
| 0.982500         | 23.80         | 10.2         | 56            | 32.2         | QP       | N    | GND |
| 2.323500         | 23.20         | 10.2         | 56            | 32.8         | QP       | N    | GND |
| 26.016000        | 22.40         | 10.7         | 60            | 37.6         | QP       | N    | GND |
| 29.832000        | 24.80         | 10.8         | 60            | 35.2         | QP       | N    | GND |
| Frequency<br>MHz | Level<br>dBμV | Transd<br>dB | Limit<br>dBμV | Margin<br>dB | Detector | Line | PE  |
| 0.150000         | 37.90         | 10.4         | 56            | 18.1         | AV       | N    | GND |
| 0.415500         | 22.60         | 10.2         | 48            | 24.9         | AV       | N    | GND |
| 1.005000         | 17.60         | 10.2         | 46            | 28.4         | AV       | N    | GND |
| 1.900500         | 12.50         | 10.2         | 46            | 33.5         | AV       | N    | GND |
| 3.088500         | 11.90         | 10.2         | 46            | 34.1         | AV       | N    | GND |
| 8.178000         | 12.40         | 10.5         | 50            | 37.6         | AV       | N    | GND |
| 29.989500        | 15.20         | 10.8         | 50            | 34.8         | AV       | N    | GND |

### 5.3. Conducted Peak Output Power

#### LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (b)(3): **30dBm**

#### TEST CONFIGURATION



#### TEST PROCEDURE

1. The transmitter output was connected to the spectrum analyzer through an attenuator, the pathloss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:  
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel  
RBW  $\geq$  the 20 dB bandwidth of the emission being measured, VBW  $\geq$  RBW  
Sweep = auto, Detector function = peak, Trace = max hold
4. Measure and record the results in the test report.

#### TEST MODE:

Please refer to the clause 3.3

#### TEST RESULTS

☒ Passed ☐ Not Applicable

| Modulation type | Channel | Output power (dBm) | Limit (dBm) | Result |
|-----------------|---------|--------------------|-------------|--------|
| GFSK            | 00      | -0.24              | 30.00       | Pass   |
|                 | 39      | 2.14               |             |        |
|                 | 78      | 2.13               |             |        |
| $\pi/4$ DQPSK   | 00      | -4.64              | 30.00       | Pass   |
|                 | 39      | -1.95              |             |        |
|                 | 78      | -2.20              |             |        |
| 8DPSK           | 00      | -3.61              | 30.00       | Pass   |
|                 | 39      | -1.05              |             |        |
|                 | 78      | -1.72              |             |        |



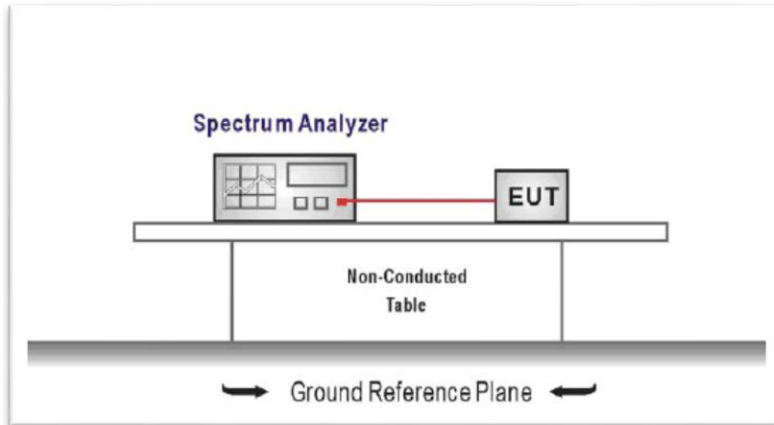


## 5.4. 20dB Emission Bandwidth

### LIMIT

N/A

### TEST CONFIGURATION



### TEST PROCEDURE

1. The transmitter output was connected to the spectrum analyzer through an attenuator, the pathloss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:  
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel  
RBW  $\geq 1\%$  of the 20 dB bandwidth, VBW  $\geq$  RBW  
Sweep = auto, Detector function = peak, Trace = max hold
4. Measure and record the results in the test report.

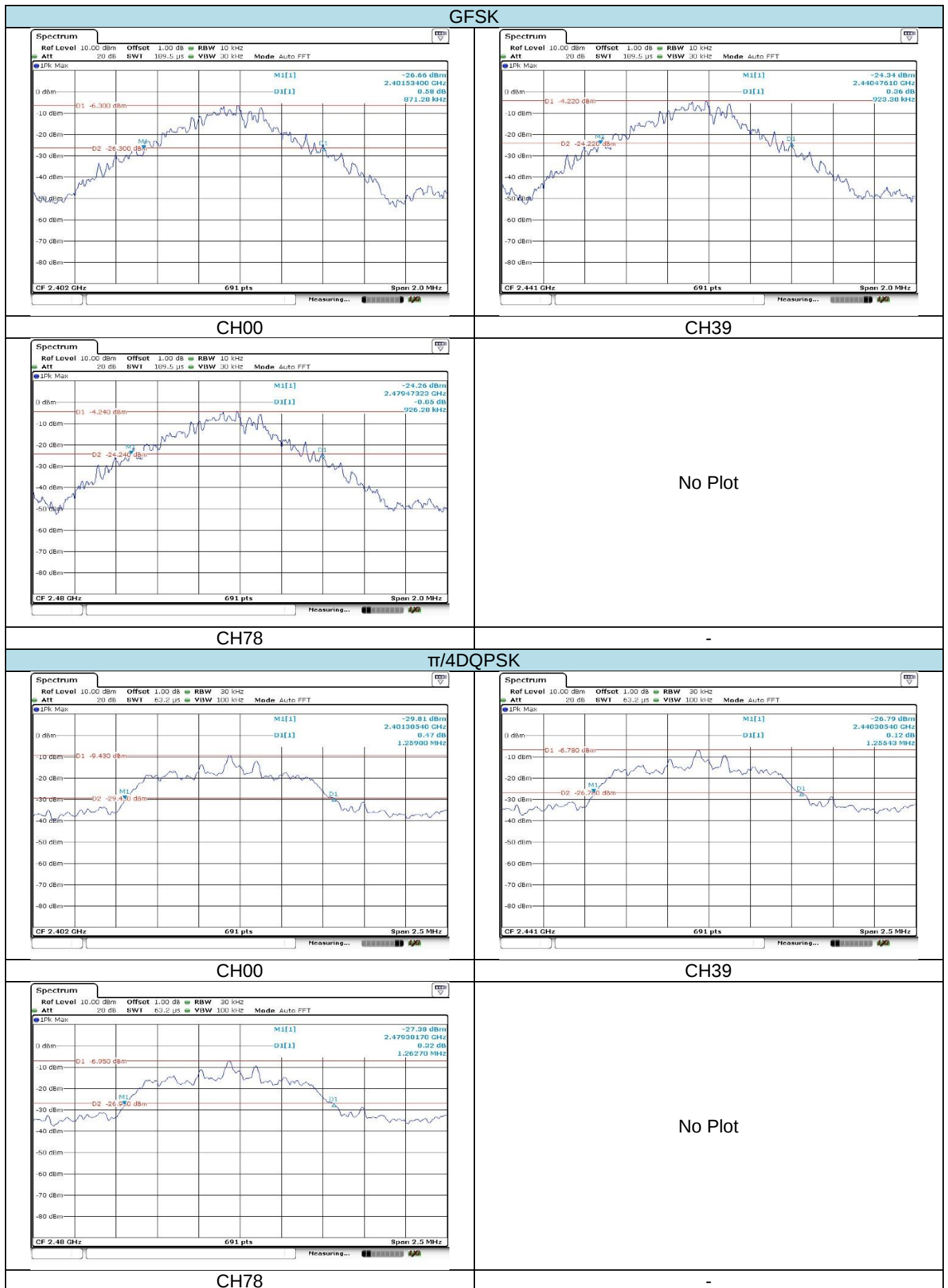
### TEST MODE:

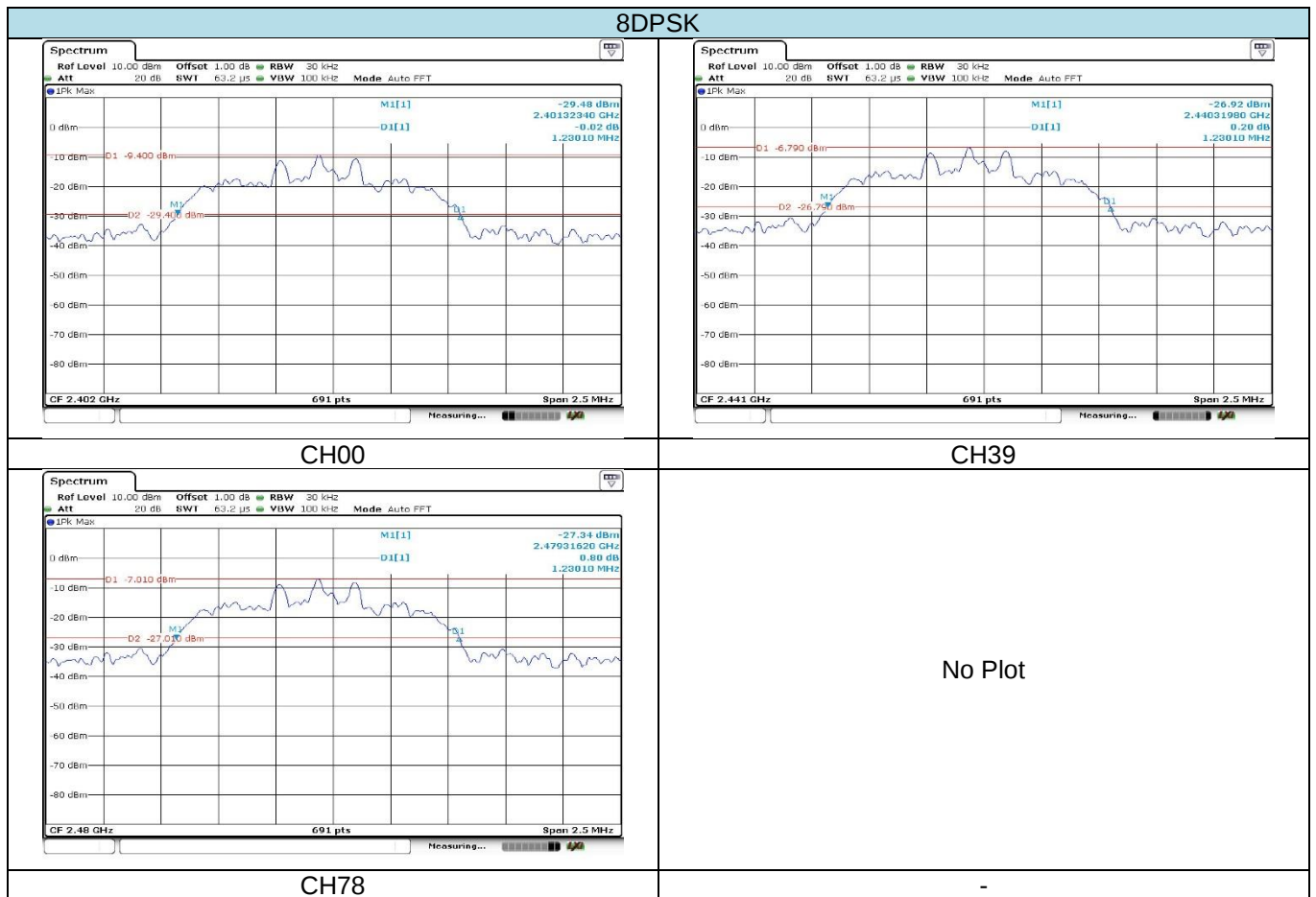
Please refer to the clause 3.3

### TEST RESULTS

☒ Passed      ☐ Not Applicable

| Modulation type | Channel | 20dB Bandwidth (MHz) | Limit (MHz) | Result |
|-----------------|---------|----------------------|-------------|--------|
| GFSK            | 00      | 0.871                | -           | Pass   |
|                 | 39      | 0.923                |             |        |
|                 | 78      | 0.926                |             |        |
| $\pi/4$ DQPSK   | 00      | 1.259                | -           | Pass   |
|                 | 39      | 1.255                |             |        |
|                 | 78      | 1.263                |             |        |
| 8DPSK           | 00      | 1.230                | -           | Pass   |
|                 | 39      | 1.230                |             |        |
|                 | 78      | 1.230                |             |        |





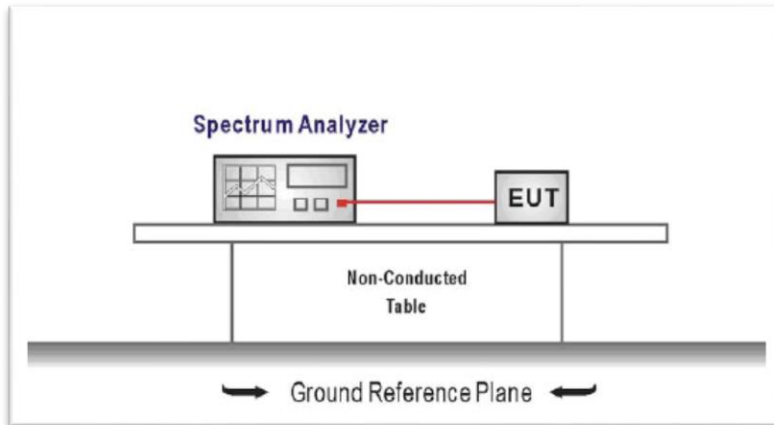
## 5.5. Carrier Frequencies Separation

### LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(1):

frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the  $2/3 \times 20\text{dB}$  bandwidth of the hopping channel, whichever is greater.

### TEST CONFIGURATION



### TEST PROCEDURE

1. The transmitter output was connected to the spectrum analyzer through an attenuator, the pathloss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:  
Span = wide enough to capture the peaks of two adjacent channels  
RBW  $\geq 1\%$  of the span, VBW  $\geq$  RBW  
Sweep = auto, Detector function = peak, Trace = max hold
4. Measure and record the results in the test report.

### TEST MODE:

Please refer to the clause 3.3

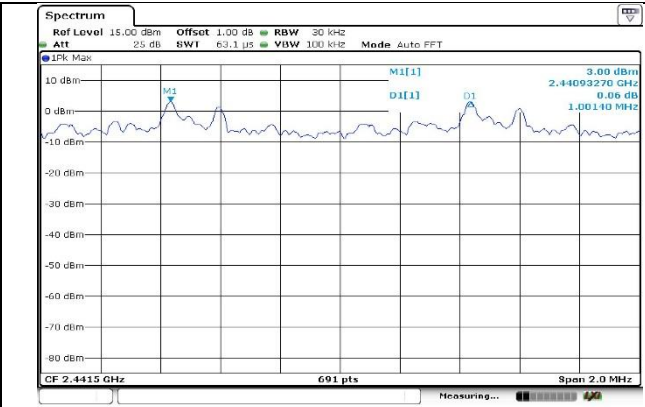
### TEST RESULTS

☒ Passed ☐ Not Applicable

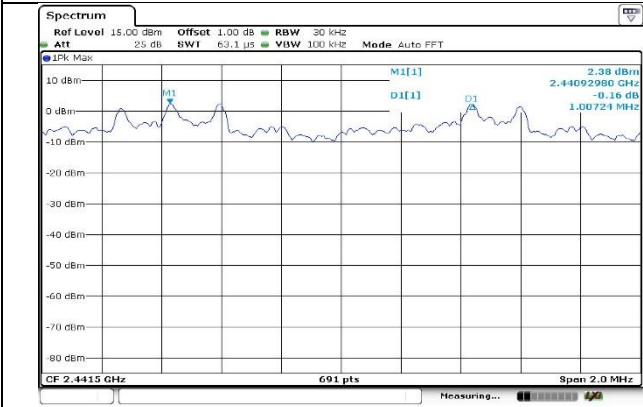
| Modulation type | Channel | Carrier Frequencies Separation (MHz) | Limit (MHz) | Result |
|-----------------|---------|--------------------------------------|-------------|--------|
| GFSK            | 39      | 1.001                                | 0.617       | Pass   |
| $\pi/4$ DQPSK   | 39      | 1.001                                | 0.842       | Pass   |
| 8DPSK           | 39      | 1.007                                | 0.820       | Pass   |



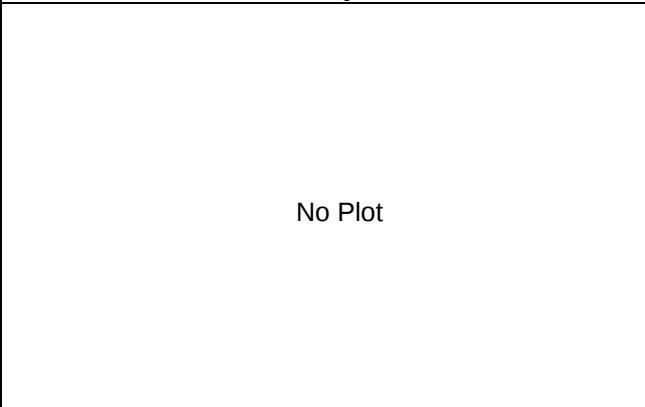
GFSK



$\pi/4$ DQPSK



8DPSK



-

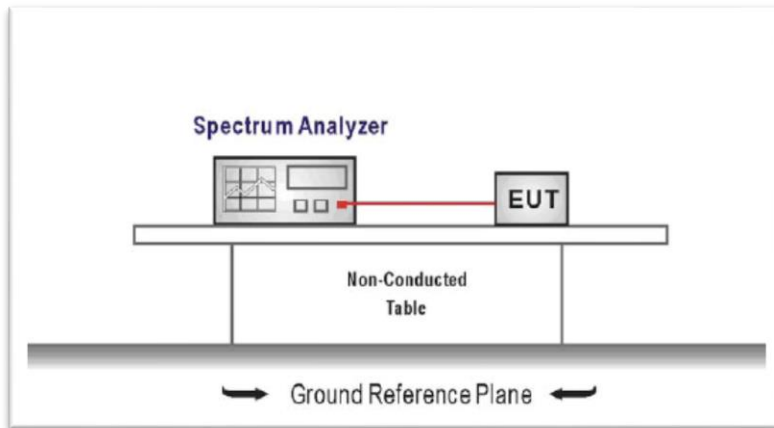
## 5.6. Hopping Channel Number

### LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(1):

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

### TEST CONFIGURATION



### TEST PROCEDURE

1. The transmitter output was connected to the spectrum analyzer through an attenuator, the pathloss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:  
Span = the frequency band of operation  
RBW  $\geq 1\%$  of the span, VBW  $\geq$  RBW  
Sweep = auto, Detector function = peak, Trace = max hold
4. Measure and record the results in the test report.

### TEST MODE:

Please refer to the clause 3.3

### TEST RESULTS

☒ Passed ☐ Not Applicable

| Modulation type | Channel number | Limit | Result |
|-----------------|----------------|-------|--------|
| GFSK            | 79             | 15.00 | Pass   |
| $\pi/4$ DQPSK   | 79             |       |        |
| 8DPSK           | 79             |       |        |



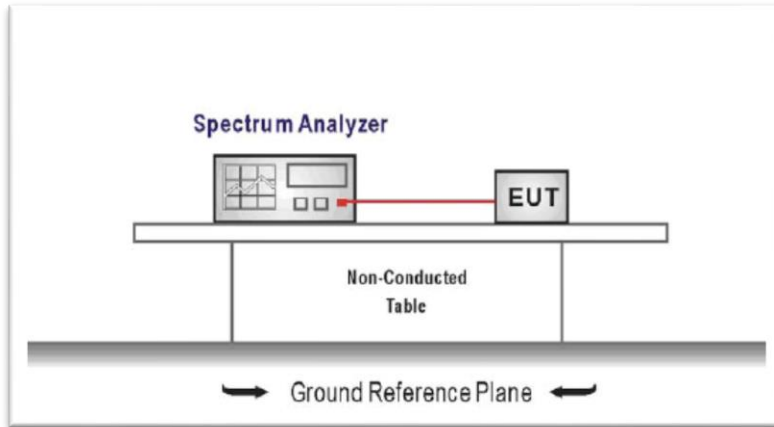
## 5.7. Dwell Time

### LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(1):

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 CONFIGURATION



### TEST PROCEDURE

1. The transmitter output was connected to the spectrum analyzer through an attenuator, the pathloss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:  
Span = zero span, centered on a hopping channel, RBW= 1 MHz, VBW≥RBW  
Sweep = as necessary to capture the entire dwell time per hopping channel,  
Detector function = peak, Trace = max hold
4. Measure and record the results in the test report.

### TEST MODE:

Please refer to the clause 3.3

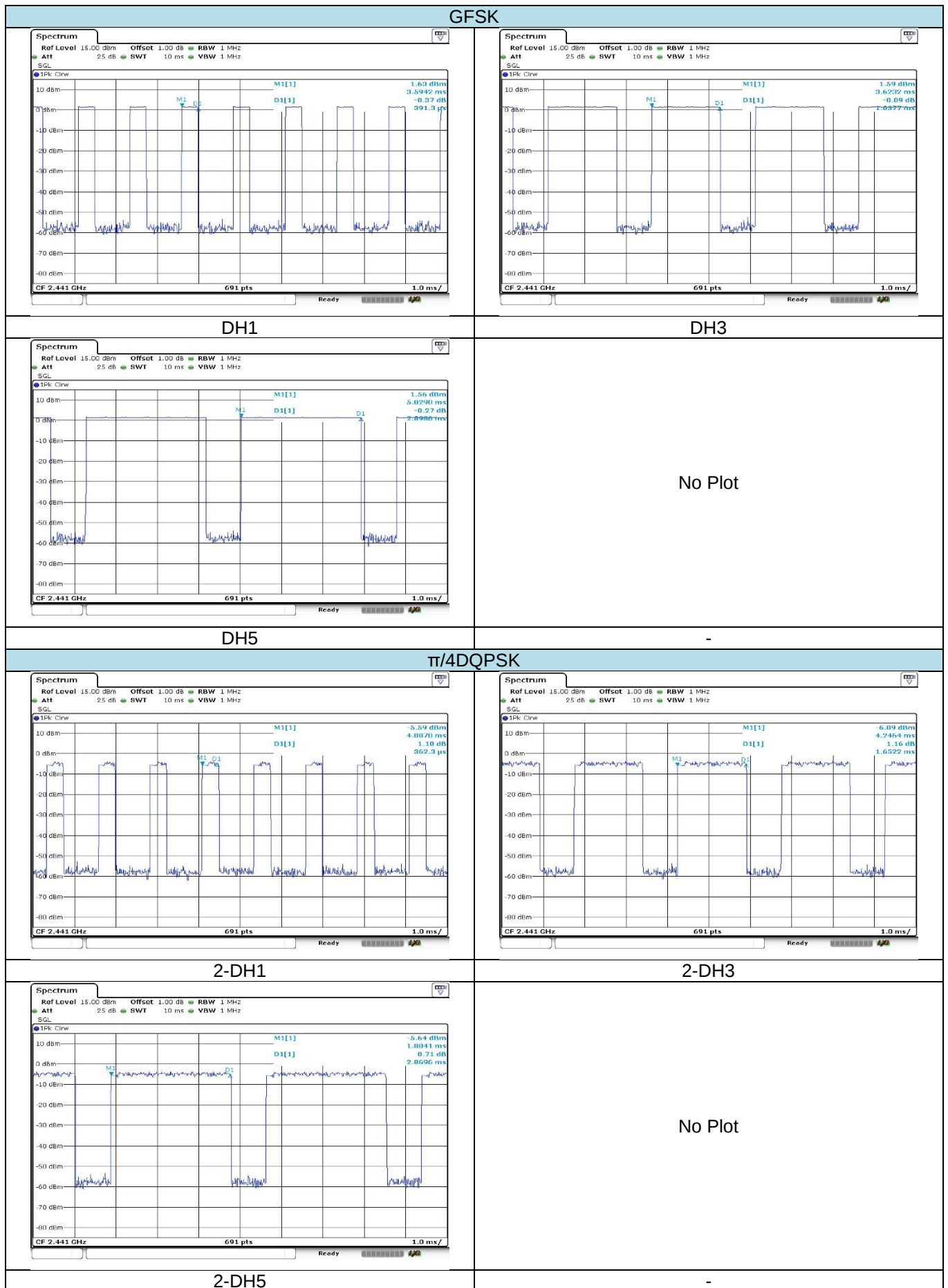
### TEST RESULTS

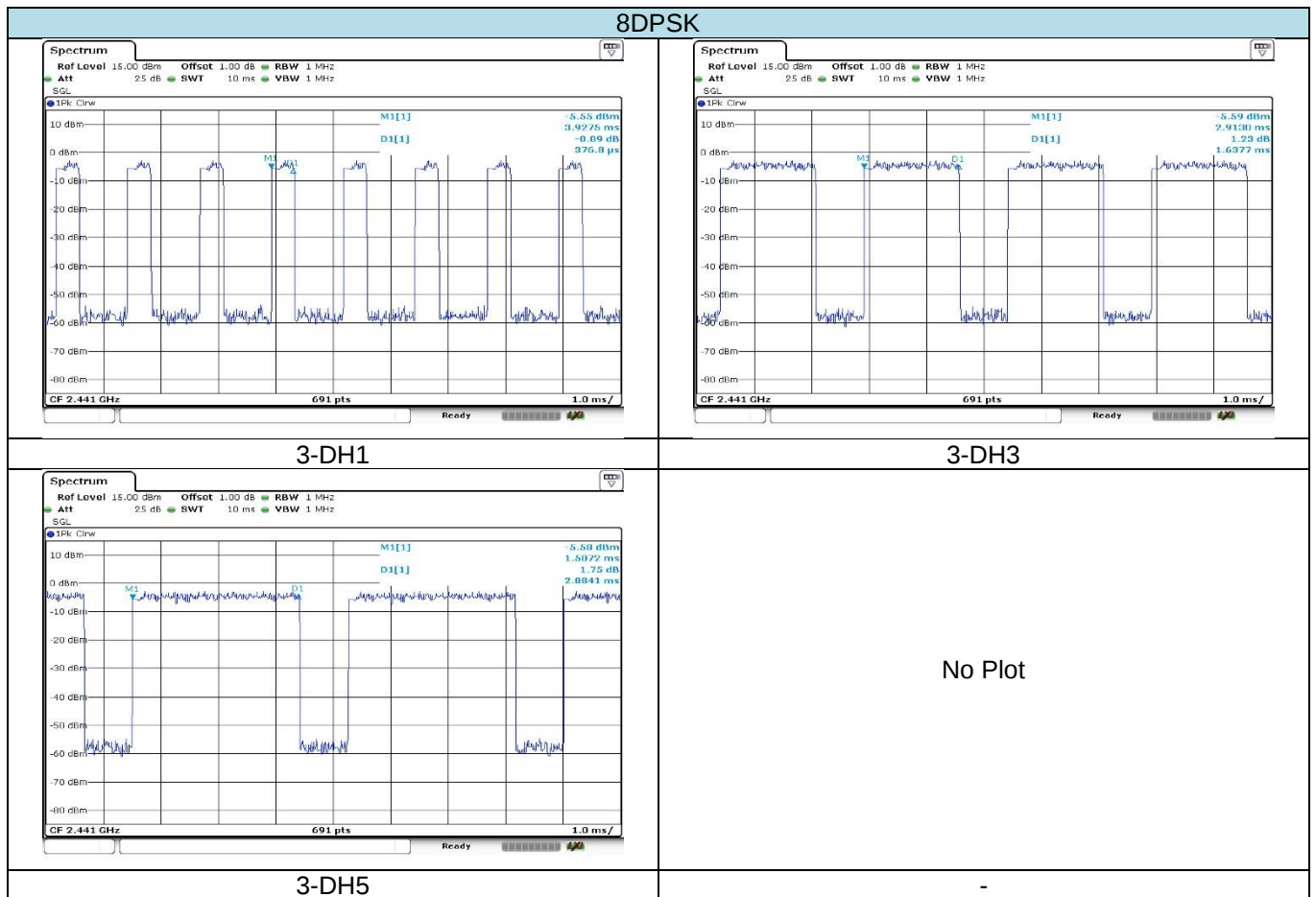
☒ Passed      ☐ Not Applicable

| Modulation type | Channel | Dwell time (Second) | Limit (Second) | Result |
|-----------------|---------|---------------------|----------------|--------|
| GFSK            | DH1     | 0.125               | 0.40           | Pass   |
|                 | DH3     | 0.262               |                |        |
|                 | DH5     | 0.309               |                |        |
| π/4DQPSK        | 2-DH1   | 0.116               | 0.40           | Pass   |
|                 | 2-DH3   | 0.264               |                |        |
|                 | 2-DH5   | 0.306               |                |        |
| 8DPSK           | 3-DH1   | 0.121               | 0.40           | Pass   |
|                 | 3-DH3   | 0.262               |                |        |
|                 | 3-DH5   | 0.308               |                |        |

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) × (1600 ÷ 2 ÷ 79) ×31.6 Second for DH1, 2-DH1, 3-DH1  
Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second for DH3, 2-DH3, 3-DH3  
Dwell time=Pulse time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second for DH5, 2-DH5, 3-DH5





## 5.8. Pseudorandom Frequency Hopping Sequence

### LIMIT

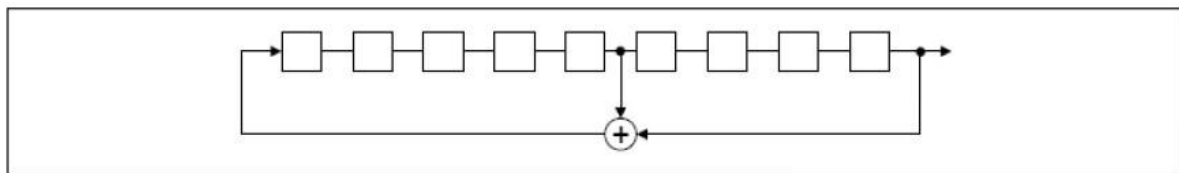
FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(1):

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping 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 hop-ping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

### TEST RESULTS

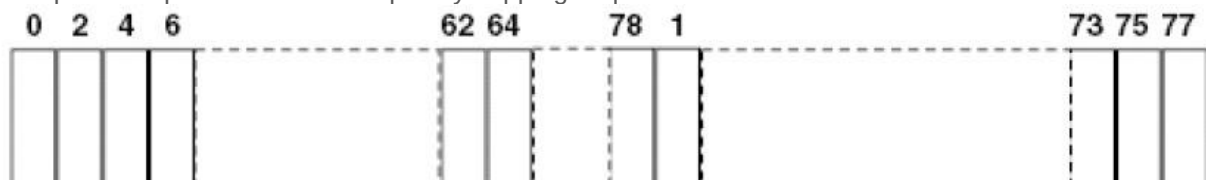
The pseudorandom frequency hopping sequence may be generated in a nine-stage shift register whose 5<sup>th</sup> and 9<sup>th</sup> stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive 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 on the average by each transmitter.

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

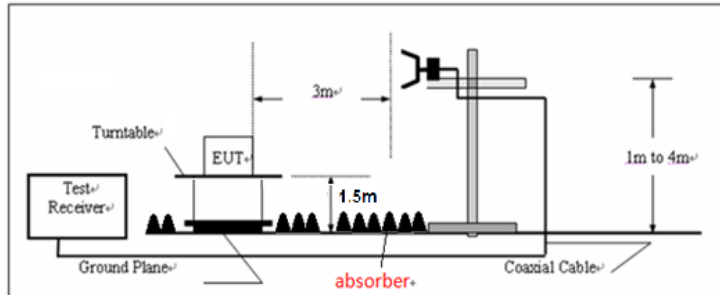
## 5.9. Restricted band (radiated)

### LIMIT

#### **FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d):**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, 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



### TEST PROCEDURE

1. The EUT was setup and tested according to ANSI C63.10:2013 for compliance to FCC 47CFR 15.247 requirements.
2. The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.
5. The receiver set as follow:  
 RBW=1MHz, VBW=3MHz Peak detector for Peak value  
 RBW=1MHz, VBW=10Hz Peak detector for Average value.

### TEST MODE:

Please refer to the clause 3.3

### TEST RESULTS

☒ Passed      ☐ Not Applicable

Note:

- 1) Final level = Read level + Antenna Factor + Cable Loss - Preamp Factor
- 2) Have pre-scan all modulation mode, found the GFSK modulation which it was worst case, so only the worst case's data on the test report.

| CH00            |                   |                       |                 |                          |                |                     |                   |              |            |
|-----------------|-------------------|-----------------------|-----------------|--------------------------|----------------|---------------------|-------------------|--------------|------------|
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamplifier Factor (dB) | Level (dBuV/m) | Limit Line (dBuV/m) | Margin Limit (dB) | Polarization | Test value |
| 2389.02         | 46.46             | 27.53                 | 6.81            | 37.24                    | 43.56          | 74.00               | -30.44            | Vertical     | Peak       |
| 2389.35         | 45.21             | 27.53                 | 6.81            | 37.24                    | 42.31          | 74.00               | -31.69            | Horizontal   |            |
| 2386.47         | 36.19             | 27.53                 | 6.81            | 37.24                    | 33.29          | 54.00               | -20.71            | Vertical     | Average    |
| 2386.29         | 35.35             | 27.53                 | 6.81            | 37.24                    | 32.45          | 54.00               | -21.55            | Horizontal   |            |

| CH78            |                   |                       |                 |                          |                |                     |                   |              |            |
|-----------------|-------------------|-----------------------|-----------------|--------------------------|----------------|---------------------|-------------------|--------------|------------|
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamplifier Factor (dB) | Level (dBuV/m) | Limit Line (dBuV/m) | Margin Limit (dB) | Polarization | Test value |
| 2485.68         | 55.58             | 27.85                 | 6.96            | 37.92                    | 52.47          | 74.00               | -21.53            | Vertical     | Peak       |
| 2482.75         | 53.96             | 27.85                 | 6.96            | 37.92                    | 50.85          | 74.00               | -23.15            | Horizontal   |            |
| 2482.97         | 46.58             | 27.85                 | 6.96            | 37.92                    | 43.47          | 54.00               | -10.53            | Vertical     | Average    |
| 2482.36         | 45.06             | 27.85                 | 6.96            | 37.92                    | 41.95          | 54.00               | -12.05            | Horizontal   |            |

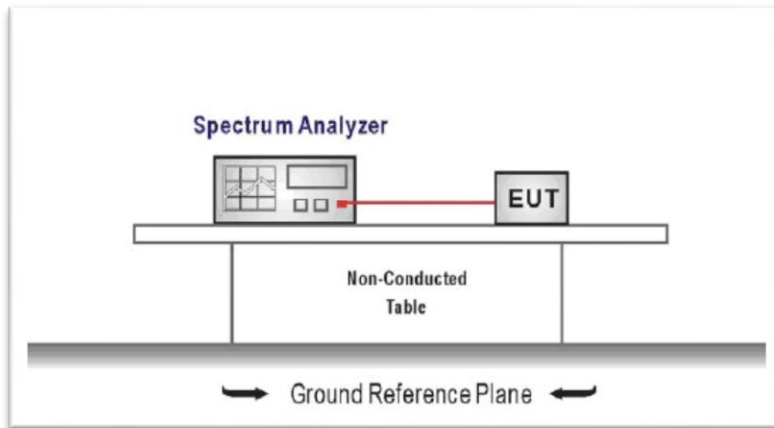
## 5.10. Bandedge and Spurious Emission (conducted)

### LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.

### TEST CONFIGURATION



### TEST PROCEDURE

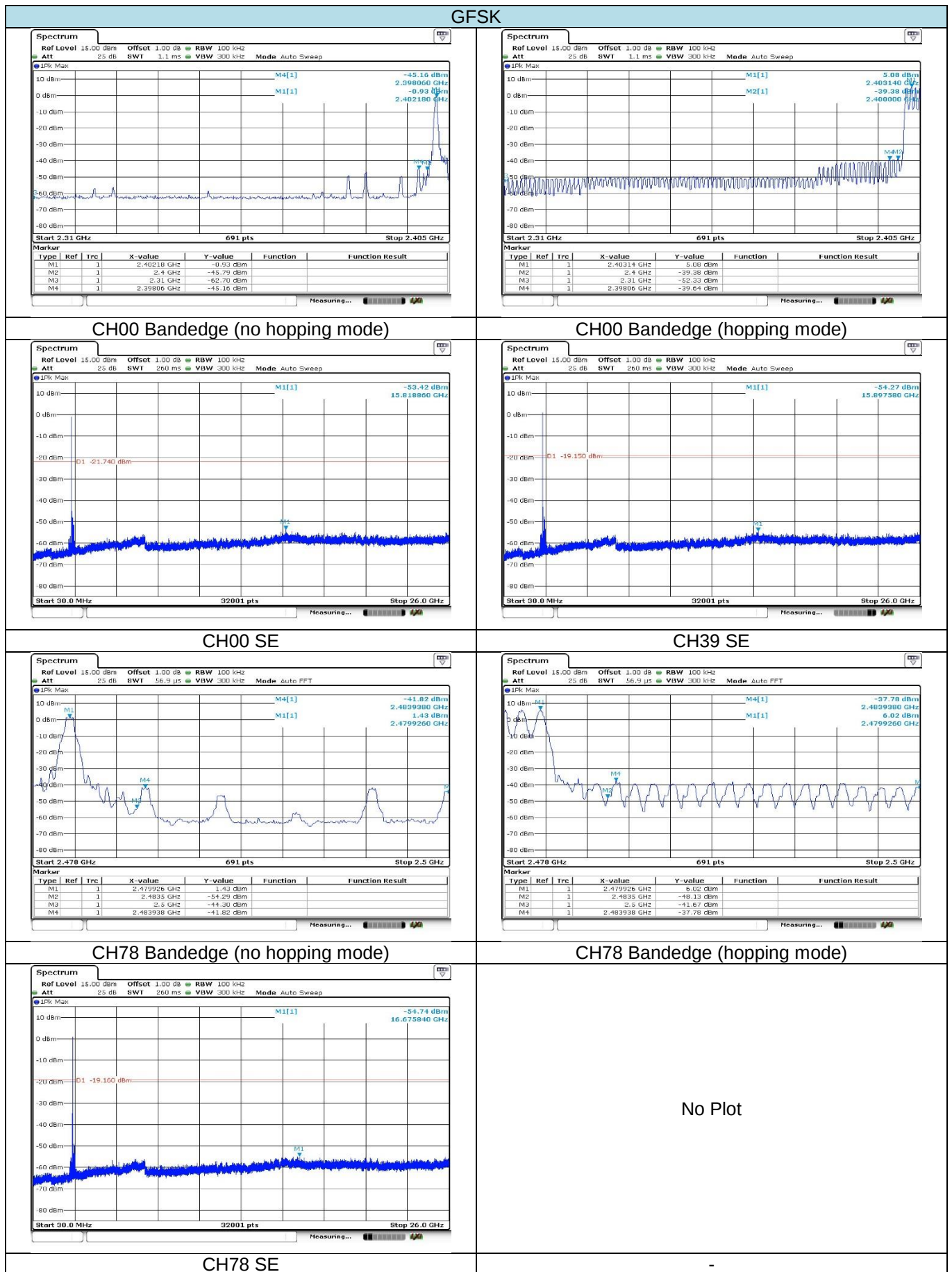
1. The transmitter output was connected to the spectrum analyzer through an attenuator, the pathloss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:  
RBW= 100 KHz, VBW $\geq$ RBW  
Sweep = auto, Detector function = peak, Trace = max hold
4. Measure and record the results in the test report.

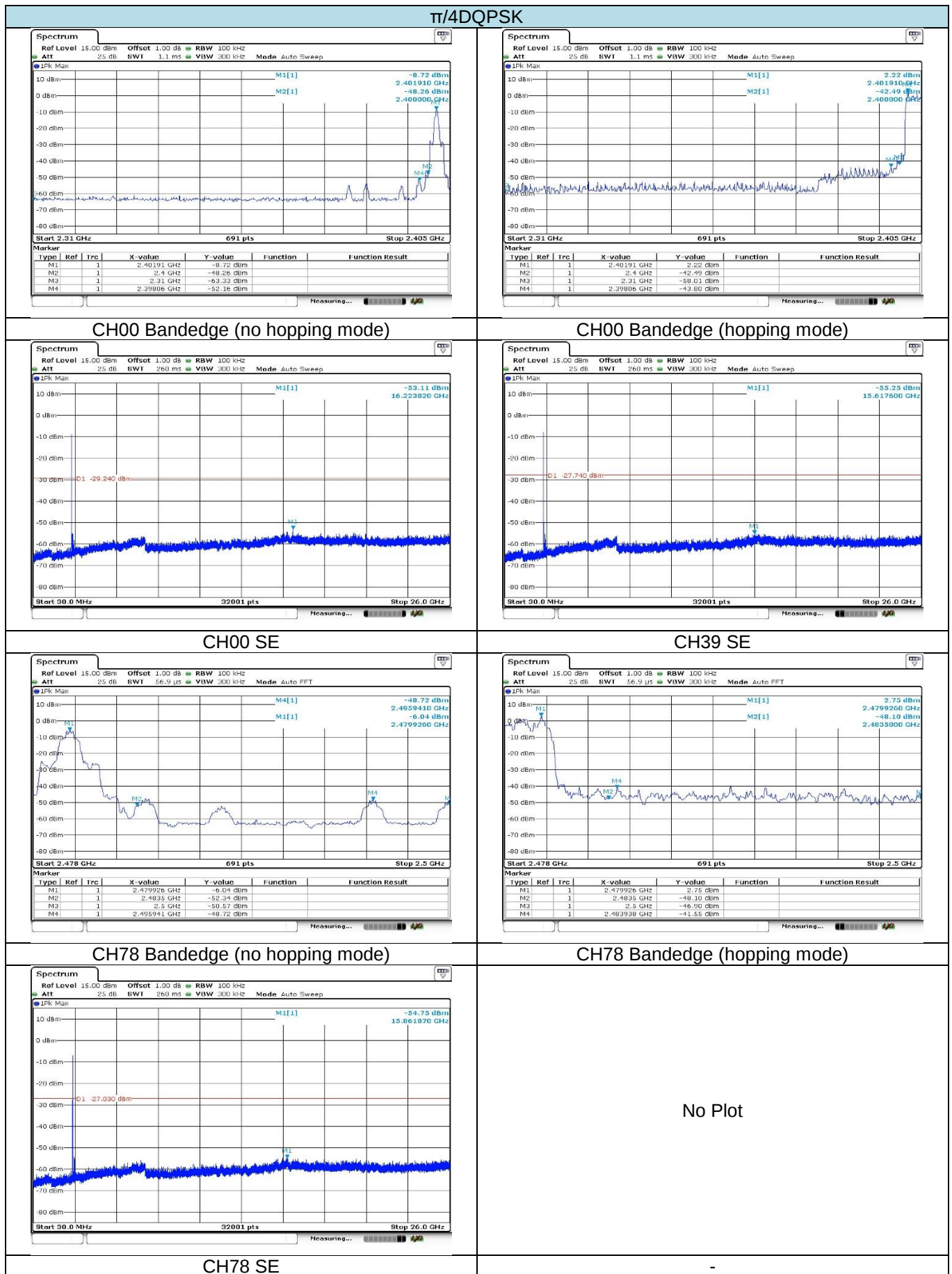
### TEST MODE:

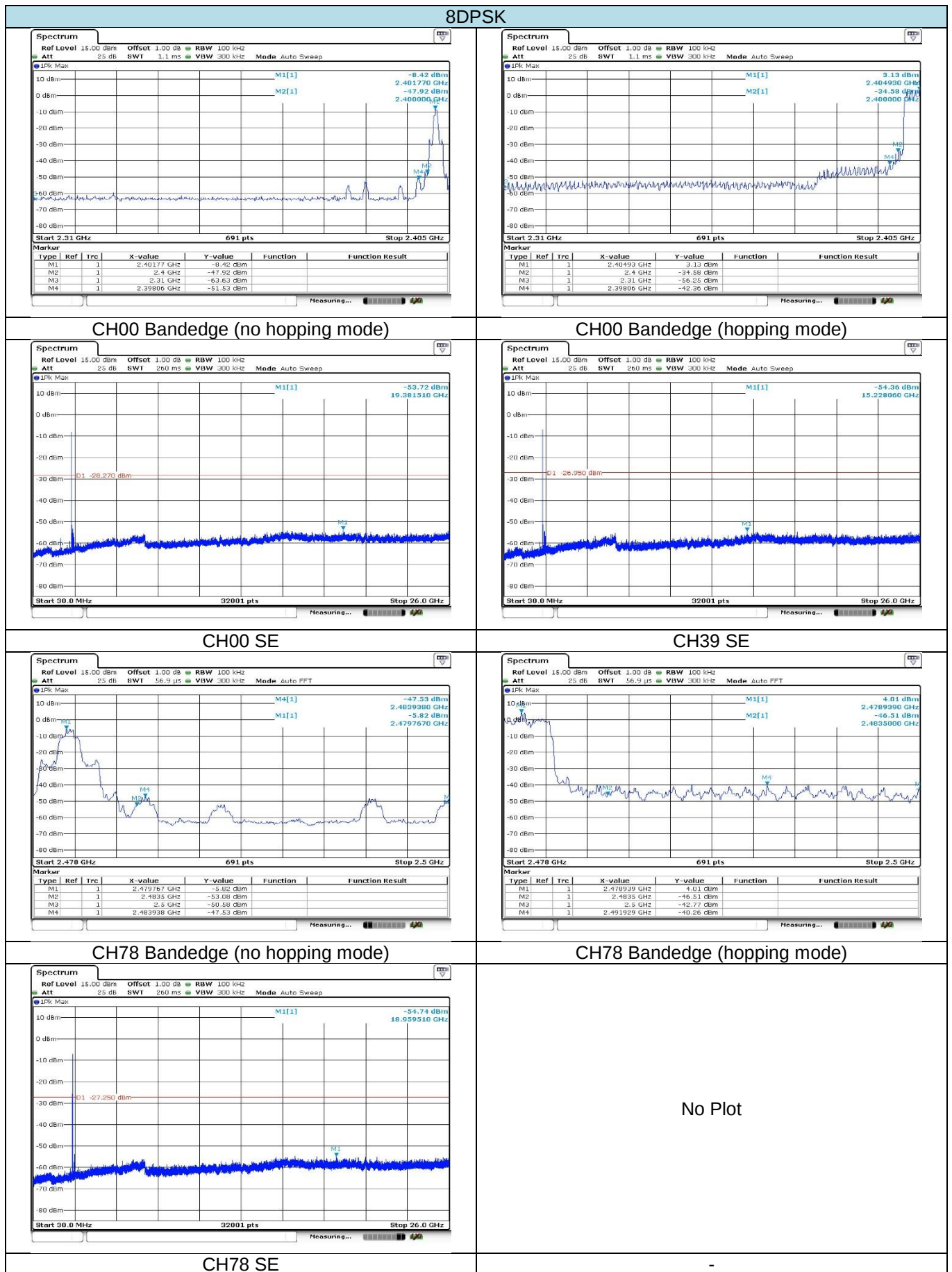
Please refer to the clause 3.3

### TEST RESULTS

☒ Passed ☐ Not Applicable







## 5.11. Spurious Emission (radiated)

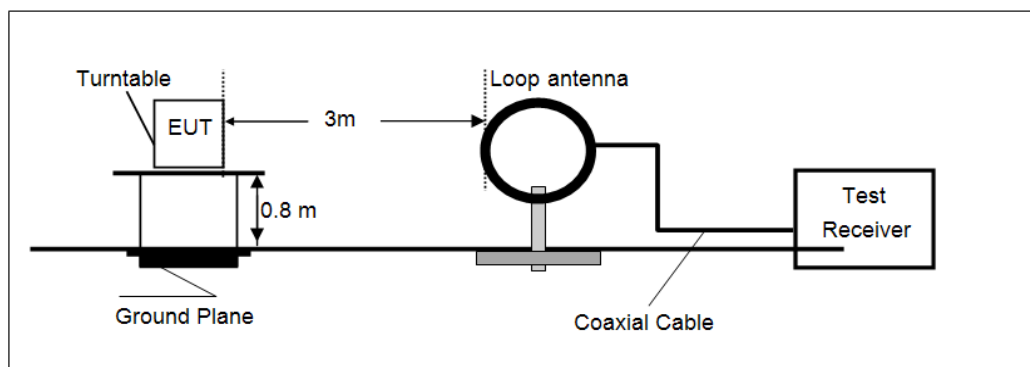
### LIMIT

#### FCC CFR Title 47 Part 15 Subpart C Section 15.209

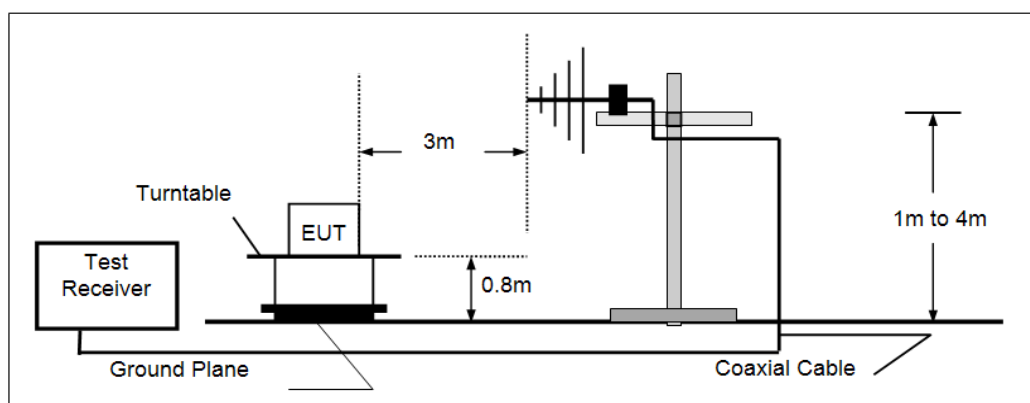
| Frequency           | Limit (dBuV/m @3m) | Value      |
|---------------------|--------------------|------------|
| 0.009 MHz-0.09MHz   | 88.52-68.52        | Average    |
| 0.09MHz-0.11MHz     | 68.52-66.78        | Quasi-peak |
| 0.11MHz-0.49 MHz    | 66.78-53.80        | Average    |
| 0.49 MHz -1.705 MHz | 53.80-42.97        | Quasi-peak |
| 1.705 MHz -30 MHz   | 49.54              | Quasi-peak |
| 30MHz-88MHz         | 40.00              | Quasi-peak |
| 88MHz-216MHz        | 43.50              | Quasi-peak |
| 216MHz-960MHz       | 46.00              | Quasi-peak |
| 960MHz-1GHz         | 54.00              | Quasi-peak |
| Above 1GHz          | 54.00              | Average    |
|                     | 74.00              | Peak       |

### TEST CONFIGURATION

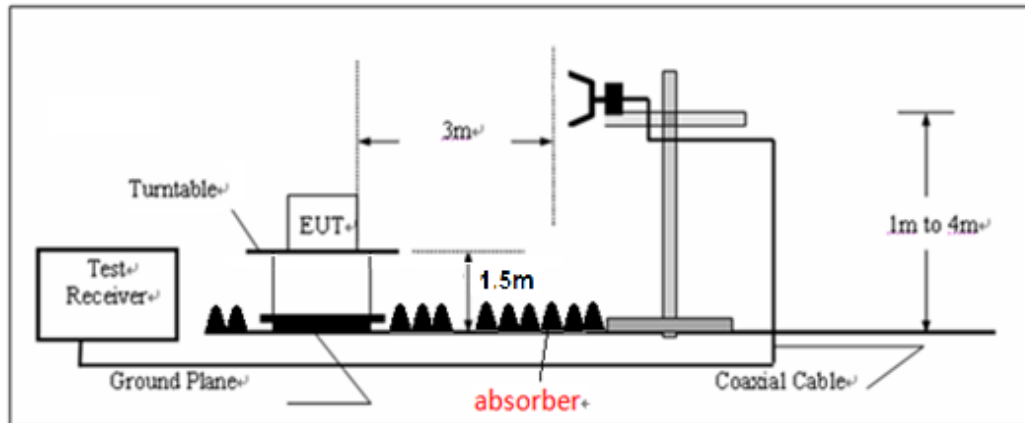
#### ➤ 9KHz ~30MHz



#### ➤ 30MHz ~ 1GHz



## ➤ Above 1GHz

**TEST PROCEDURE**

1. The EUT was tested according to ANSI C63.10:2013 for compliance to FCC 47CFR 15.247 requirements.
2. The EUT is placed on a turn table which is 0.8 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna.
5. Use the following spectrum analyzer settings
  - (1) Span shall wide enough to fully capture the emission being measured;
  - (2) Below 1GHz, RBW=120KHz, VBW=300KHz, Sweep=auto, Detector function=peak, Trace=max hold; If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
  - (3) Above 1GHz, RBW=1MHz, VBW=3MHz Peak detector for Peak value  
RBW=1MHz, VBW=10Hz Peak detector for Average value.

**TEST MODE:**

Please refer to the clause 3.3

**TEST RESULTS**

☒ Passed      ☐ Not Applicable

Note:

- 1) Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
- 2) “\*”, means this data is too weak instrument of signal is unable to test.
- 3) The emission levels of other frequencies are very lower than the limit and not show in test report.
- 4) Have pre-scan all modulation mode, found the GFSK modulation which it was worst case, so only the worst case's data on the test report.

➤ **9kHz ~ 30MHz**

The EUT was pre-scanned the frequency band (9KHz~30MHz), found the radiated level lower than the limit, so don't show on the report.