TCT 通测检测
TESTING CENTRE TECHNOLOGY

# TEST REPORT

**FCC ID: 2AUWK-TANKX**

**Product: MOBILE PHONE**

**Model No.: Tank X**

**Additional Model No.: N/A**

**Trade Mark: CELLSTAR**

**Report No.: TCT200817E018**

**Issued Date: Sep. 08, 2020**

Issued for:

**Mdc Corp**

**2920 nw 72 ave, Miami, Florida 33122, United States**

Issued By:

**Shenzhen Tongce Testing Lab.**
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# 1. Test Certification

| | |
|---|---|
| **Product:** | MOBILE PHONE |
| **Model No.:** | Tank X |
| **Additional Model:** | N/A |
| **Trade Mark:** | **CELLSTAR** |
| **Applicant:** | Mdc Corp |
| **Address:** | 2920 nw 72 ave, Miami, Florida 33122, United States |
| **Manufacturer:** | Mdc Corp |
| **Address:** | 2920 nw 72 ave, Miami, Florida 33122, United States |
| **Date of Test:** | Aug. 18, 2020 – Sep. 07, 2020 |
| **Applicable Standards:** | FCC CFR Title 47 Part 15 Subpart C Section 15.247<br>FCC KDB 558074 D01 15.247 Meas Guidance v05r02<br>ANSI C63.10:2013 |

*The above equipment has been tested by Shenzhen Tongce Testing Lab. and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product/system, which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.*

| | | | |
|---|---|---|---|
| ***Tested By:*** | ***Rleo*** | ***Date:*** | ***Sep. 07, 2020*** |
| ***Reviewed By:*** | ***Beryl Zhao*** | ***Date:*** | ***Sep. 08, 2020*** |
| ***Approved By:*** | ***Tomsin*** | ***Date:*** | ***Sep. 08, 2020*** |

## 2. Test Result Summary

| Requirement | CFR 47 Section | 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 |
| Radiated Emission | §15.205/§15.209 | PASS |
| Band Edge | §15.247(d) | PASS |

***Note:***

*1. PASS: Test item meets the requirement.*

*2. Fail: Test item does not meet the requirement.*

*3. N/A: Test case does not apply to the test object.*

*4. The test result judgment is decided by the limit of test standard.*

# 3. EUT Description

| | |
|---|---|
| **Product Name:** | MOBILE PHONE |
| **Model :** | Tank X |
| **Additional Model:** | N/A |
| **Trade Mark:** | **CELLSTAR** |
| **Bluetooth version:** | V3.0 |
| **Operation Frequency:** | 2402MHz~2480MHz |
| **Transfer Rate:** | 1/2/3 Mbits/s |
| **Number of Channel:** | 79 |
| **Modulation Type:** | GFSK, π/4-DQPSK, 8DPSK |
| **Modulation Technology:** | FHSS |
| **Antenna Type:** | Internal Antenna |
| **Antenna Gain:** | -0.5dBi |
| **Power Supply:** | Rechargeable Li-ion Battery DC 3.7V |
| **AC adapter:** | Adapter Information:<br>MODEL: Tank X<br>INPUT: AC 100-240V, 50/60Hz, 0.15A<br>OUTPUT: DC 5.0V, 1A |

***Note:*** *The antenna gain listed in this report is provided by applicant, and the test laboratory is not responsible for this parameter.*

**Operation Frequency each of channel for GFSK, π/4-DQPSK, 8DPSK**

| Channel | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---|---|---|---|---|---|---|---|
| 0 | 2402MHz | 20 | 2422MHz | 40 | 2442MHz | 60 | 2462MHz |
| 1 | 2403MHz | 21 | 2423MHz | 41 | 2443MHz | 61 | 2463MHz |
| … | … | … | … | … | … | … | … |
| 10 | 2412MHz | 30 | 2432MHz | 50 | 2452MHz | 70 | 2472MHz |
| 11 | 2413MHz | 31 | 2433MHz | 51 | 2453MHz | 71 | 2473MHz |
| … | … | … | … | … | … | … | … |
| 18 | 2420MHz | 38 | 2440MHz | 58 | 2460MHz | 78 | 2480MHz |
| 19 | 2421MHz | 39 | 2441MHz | 59 | 2461MHz | - | |
| Remark: Channel 0, 39 &78 have been tested for GFSK, π/4-DQPSK, 8DPSK modulation mode. | | | | | | | |

# 4. General Information

## 4.1. Test environment and mode

| Operating Environment: | | |
|---|---|---|
| Condition | Conducted Emission | Radiated Emission |
| Temperature: | 25.0 °C | 25.0 °C |
| Humidity: | 55 % RH | 55 % RH |
| Atmospheric Pressure: | 1010 mbar | 1010 mbar |
| Test Mode: | | |
| Engineering mode: | Dialing command number:#*8888*# enter ebgineering mode,and then connect CMW500 and spectrum by tee connector. All Settings are via CMW500( windows defauit). BT Power level setting: default. Keep the EUT in continuous transmitting by select channel and modulations with Fully-charged battery | |
| The sample was placed 0.8m & 1.5m for the measurement below & above 1GHz above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case( Z axis) are shown in Test Results of the following pages. | | |

## 4.2. Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

| Equipment | Model No. | Serial No. | FCC ID | Trade Name |
|---|---|---|---|---|
| / | / | / | / | / |

***Note:***

*1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.*

*2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.*

*3. For conducted measurements (Output Power, 20dB Occupied Bandwidth, Carrier Frequencies Separation, Hopping Channel Number, Dwell Time, Spurious Emissions), the antenna of EUT is connected to the test equipment via temporary antenna connector, the antenna connector is soldered on the antenna port of EUT, and the temporary antenna connector is listed in the Test Instruments.*

# 5. Facilities and Accreditations

## 5.1. Facilities

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

- FCC - Registration No.: 645098
  Shenzhen Tongce Testing Lab
  The 3m Semi-anechoic chamber has been registered and fully described in a report with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.
- IC - Registration No.: 10668A-1
  The 3m Semi-anechoic chamber of Shenzhen TCT Testing Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing

## 5.2. Location

Shenzhen Tongce Testing Lab
Address: 1B/F., Building 1, Yibaolai Industrial Park, Qiaotou, Fuyong, Baoan District, Shenzhen, Guangdong, China
Tel: 86-755-27673339

## 5.3. Measurement Uncertainty

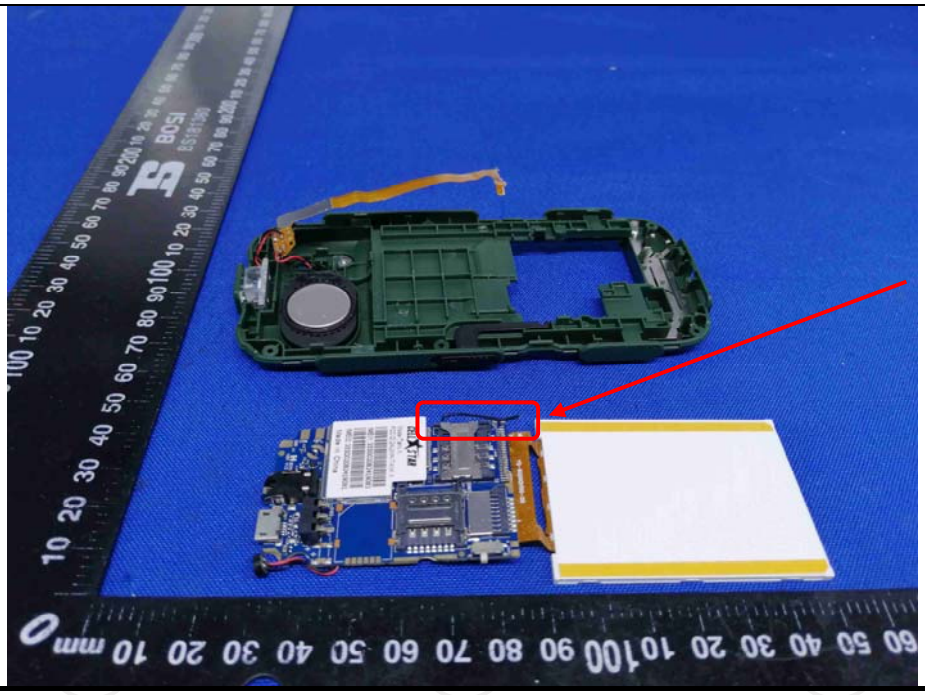
The reported uncertainty of measurement y ± U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95 %.

| No. | Item | MU |
|---|---|---|
| 1 | Conducted Emission | ±2.56dB |
| 2 | RF power, conducted | ±0.12dB |
| 3 | Spurious emissions, conducted | ±0.11dB |
| 4 | All emissions, radiated(<1G) | ±3.92dB |
| 5 | All emissions, radiated(>1G) | ±4.28dB |
| 6 | Temperature | ±0.1°C |
| 7 | Humidity | ±1.0% |

# 6. Test Results and Measurement Data

## 6.1. Antenna requirement

| **Standard requirement:** | FCC Part15 C Section 15.203 /247(c) |
|---|---|
| 15.203 requirement:<br>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.<br>15.247(c) (1)(i) requirement:<br>(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. | |
| **E.U.T Antenna:** | |
| The Bluetooth antenna is internal antenna which permanently attached, and the best case gain of the antenna is -0.5dBi. | |



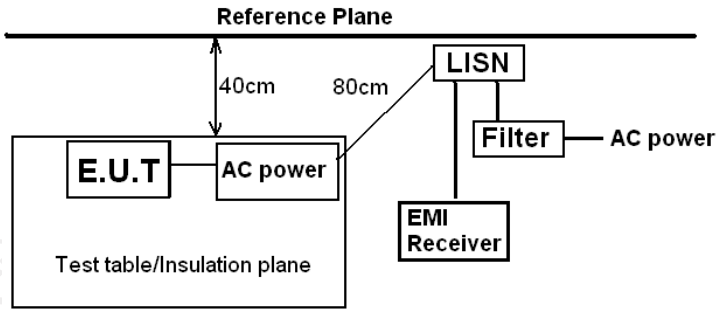
## 6.2. Conducted Emission

### 6.2.1. Test Specification

| | |
|---|---|
| **Test Requirement:** | FCC Part15 C Section 15.207 |
| **Test Method:** | ANSI C63.10:2013 |
| **Frequency Range:** | 150 kHz to 30 MHz |
| **Receiver setup:** | RBW=9 kHz, VBW=30 kHz, Sweep time=auto |
| **Limits:** | |

| 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 |

**Test Setup:**




*Remark:*
*E.U.T: Equipment Under Test*
*LISN: Line Impedence Stabilization Network*
*Test table height=0.8m*

| | |
|---|---|
| **Test Mode:** | Refer to item 4.1 |
| **Test Procedure:** | 1. The E.U.T is connected to an adapter through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment.<br>2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs).<br>3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10:2013 on conducted measurement. |
| **Test Result:** | PASS |

### 6.2.2. Test Instruments

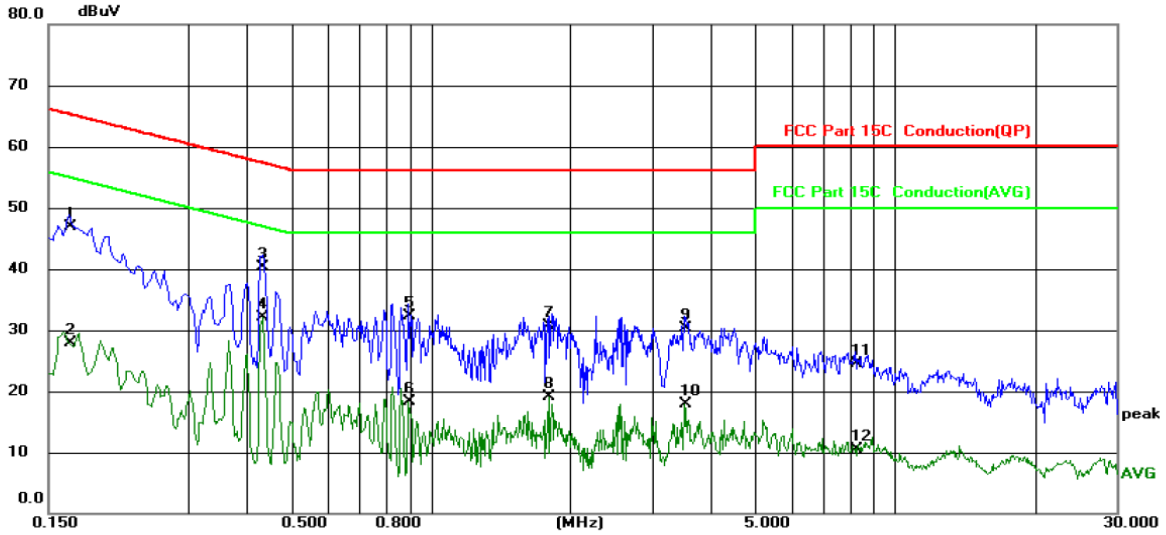
| Conducted Emission Shielding Room Test Site (843) | | | | |
|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model** | **Serial Number** | **Calibration Due** |
| Test Receiver | R&S | ESCI3 | 100898 | Jul. 27, 2021 |
| LISN | Schwarzbeck | NSLK 8126 | 8126453 | Sep. 11, 2020 |
| Line-5 | TCT | CE-05 | N/A | Sep. 02, 2021 |
| EMI Test Software | Shurple Technology | EZ-EMC | N/A | N/A |

***Note:*** *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

### 6.2.3. Test data

**Please refer to following diagram for individual**

**Conducted Emission on Line Terminal of the power line (150 kHz to 30MHz)**



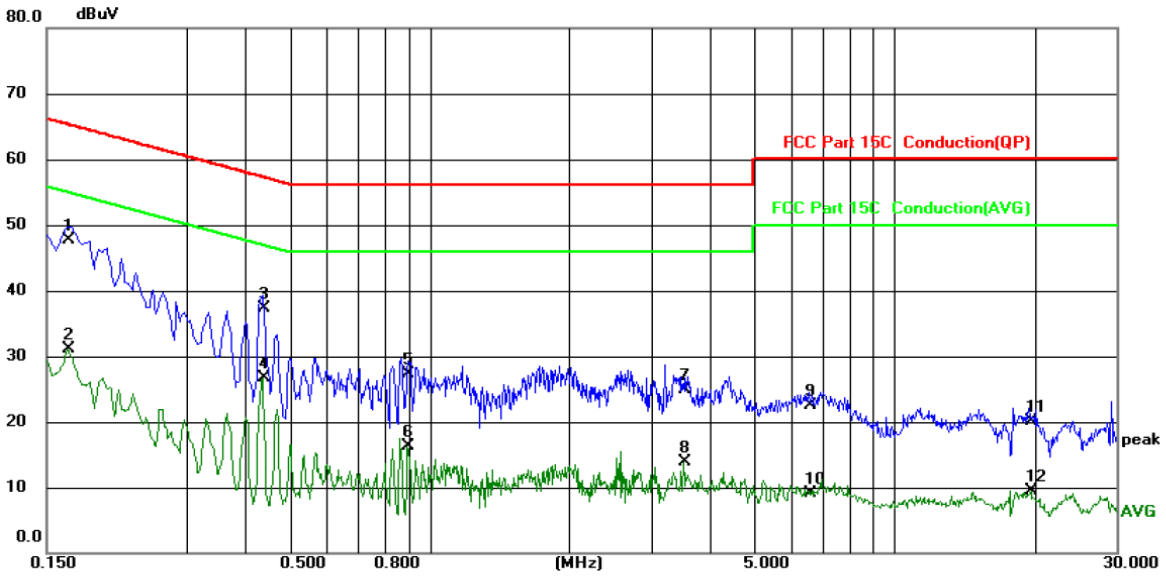

| | | | |
|---|---|---|---|
| Site | Phase: L1 | Temperature: | 25 (C) |
| Limit: FCC Part 15C Conduction(QP) | Power: AC 120V/60Hz | Humidity: | 55 %RH |

| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector | Comment |
| 1 | | 0.1660 | 36.67 | 10.22 | 46.89 | 65.16 | -18.27 | QP | |
| 2 | | 0.1660 | 17.71 | 10.22 | 27.93 | 55.16 | -27.23 | AVG | |
| 3 | | 0.4340 | 29.99 | 10.22 | 40.21 | 57.18 | -16.97 | QP | |
| 4 | * | 0.4340 | 21.95 | 10.22 | 32.17 | 47.18 | -15.01 | AVG | |
| 5 | | 0.8980 | 22.01 | 10.32 | 32.33 | 56.00 | -23.67 | QP | |
| 6 | | 0.8980 | 8.07 | 10.32 | 18.39 | 46.00 | -27.61 | AVG | |
| 7 | | 1.7940 | 20.35 | 10.43 | 30.78 | 56.00 | -25.22 | QP | |
| 8 | | 1.7940 | 8.69 | 10.43 | 19.12 | 46.00 | -26.88 | AVG | |
| 9 | | 3.5180 | 19.79 | 10.47 | 30.26 | 56.00 | -25.74 | QP | |
| 10 | | 3.5180 | 7.36 | 10.47 | 17.83 | 46.00 | -28.17 | AVG | |
| 11 | | 8.2340 | 13.99 | 10.53 | 24.52 | 60.00 | -35.48 | QP | |
| 12 | | 8.2340 | -0.07 | 10.53 | 10.46 | 50.00 | -39.54 | AVG | |

***Note:***

*Freq. = Emission frequency in MHz*
*Reading level (dBμV) = Receiver reading*
*Corr. Factor (dB) = LISN factor + Cable loss*
*Measurement (dBμV) = Reading level (dBμV) + Corr. Factor (dB)*
*Limit (dBμV) = Limit stated in standard*
*Margin (dB) = Measurement (dBμV) – Limits (dBμV)*
*Q.P. =Quasi-Peak*
*AVG =average*
** is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz*

## Conducted Emission on Neutral Terminal of the power line (150 kHz to 30MHz)




| | | | |
|---|---|---|---|
| Site | Phase: N | Temperature: | 25 (C) |
| Limit: FCC Part 15C Conduction(QP) | Power: AC 120V/60Hz | Humidity: | 55 %RH |

| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector | Comment |
| 1 | * | 0.1660 | 37.51 | 10.22 | 47.73 | 65.16 | -17.43 | QP | |
| 2 | | 0.1660 | 20.90 | 10.22 | 31.12 | 55.16 | -24.04 | AVG | |
| 3 | | 0.4380 | 27.12 | 10.22 | 37.34 | 57.10 | -19.76 | QP | |
| 4 | | 0.4380 | 16.42 | 10.22 | 26.64 | 47.10 | -20.46 | AVG | |
| 5 | | 0.8980 | 16.94 | 10.32 | 27.26 | 56.00 | -28.74 | QP | |
| 6 | | 0.8980 | 6.02 | 10.32 | 16.34 | 46.00 | -29.66 | AVG | |
| 7 | | 3.5260 | 14.43 | 10.47 | 24.90 | 56.00 | -31.10 | QP | |
| 8 | | 3.5260 | 3.41 | 10.47 | 13.88 | 46.00 | -32.12 | AVG | |
| 9 | | 6.5620 | 12.05 | 10.51 | 22.56 | 60.00 | -37.44 | QP | |
| 10 | | 6.5620 | -1.35 | 10.51 | 9.16 | 50.00 | -40.84 | AVG | |
| 11 | | 19.7060 | 8.98 | 11.06 | 20.04 | 60.00 | -39.96 | QP | |
| 12 | | 19.7060 | -1.62 | 11.06 | 9.44 | 50.00 | -40.56 | AVG | |

***Note1:***

*Freq. = Emission frequency in MHz*

*Reading level (dBμV) = Receiver reading*

*Corr. Factor (dB) = LISN factor + Cable loss*

*Measurement (dBμV) = Reading level (dBμV) + Corr. Factor (dB)*

*Limit (dBμV) = Limit stated in standard*

*Margin (dB) = Measurement (dBμV) – Limits (dBμV)*

*Q.P. =Quasi-Peak AVG =average*

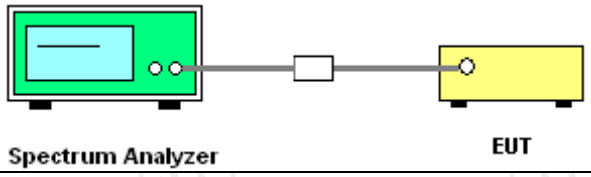
** is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz.*

***Note2:***

*Measurements were conducted in all three channels (high, middle, low) and three modulation (GFSK, Pi/4 DQPSK, 8DPSK), and the worst case Mode (Middle channel and 8DPSK) was submitted only.*

## 6.3. Conducted Output Power

### 6.3.1. Test Specification

| | |
|---|---|
| **Test Requirement:** | FCC Part15 C Section 15.247 (b)(1) |
| **Test Method:** | KDB 558074 D01 v05r02 |
| **Limit:** | Section 15.247 (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (1) 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 Setup:** |  |
| **Test Mode:** | Transmitting mode with modulation |
| **Test Procedure:** | Use the following spectrum analyzer settings:<br>Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel<br>RBW > the 20 dB bandwidth of the emission being measured VBW ≥ RBW<br>Sweep = auto<br>Detector function = peak<br>Trace = max hold<br>Allow the trace to stabilize.<br>Use the marker-to-peak function to set the marker to the peak of the emission. |
| **Test Result:** | PASS |

### 6.3.2. Test Instruments

| Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | Agilent | N9020A | MY49100619 | Sep. 11, 2020 |
| RF cable (9kHz-26.5GHz) | TCT | RE-06 | N/A | Sep. 11, 2020 |
| Antenna Connector | TCT | RFC-01 | N/A | Sep. 11, 2020 |

***Note:*** *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

### 6.3.3. Test Data

| GFSK mode | | | |
|---|---|---|---|
| Test channel | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest | 6.35 | 30.00 | PASS |
| Middle | 6.97 | 30.00 | PASS |
| Highest | 6.41 | 30.00 | PASS |

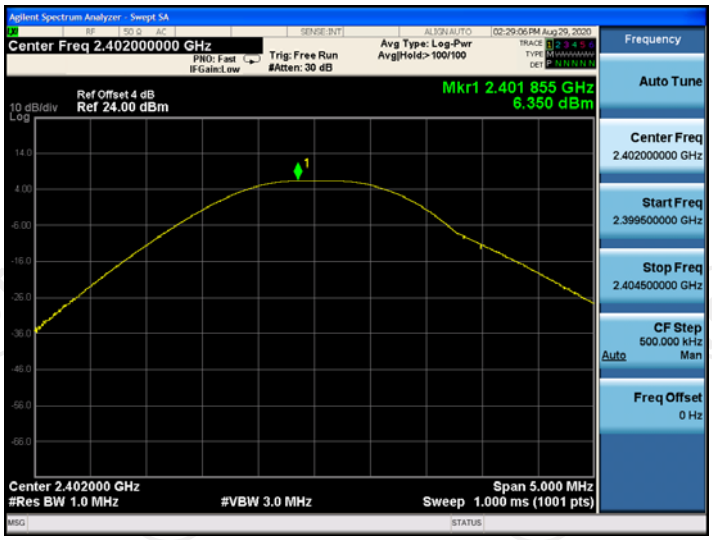
| Pi/4DQPSK mode | | | |
|---|---|---|---|
| Test channel | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest | 7.39 | 21.00 | PASS |
| Middle | 7.86 | 21.00 | PASS |
| Highest | 7.23 | 21.00 | PASS |

| 8DPSK mode | | | |
|---|---|---|---|
| Test channel | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest | 7.72 | 21.00 | PASS |
| Middle | 8.15 | 21.00 | PASS |
| Highest | 7.49 | 21.00 | PASS |

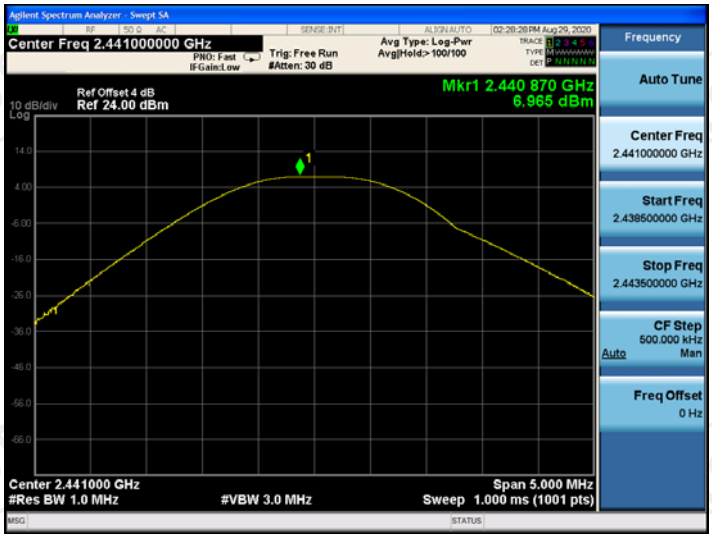
**Test plots as follows:**

**GFSK Modulation**

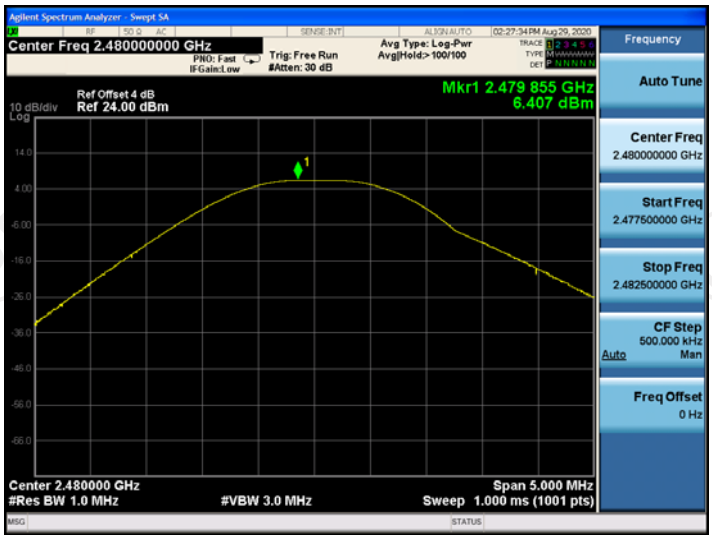
Lowest channel




Middle channel

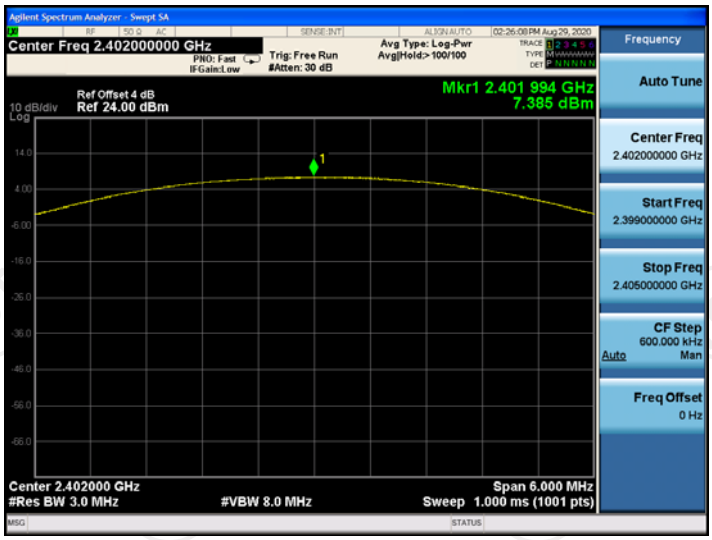



Highest channel

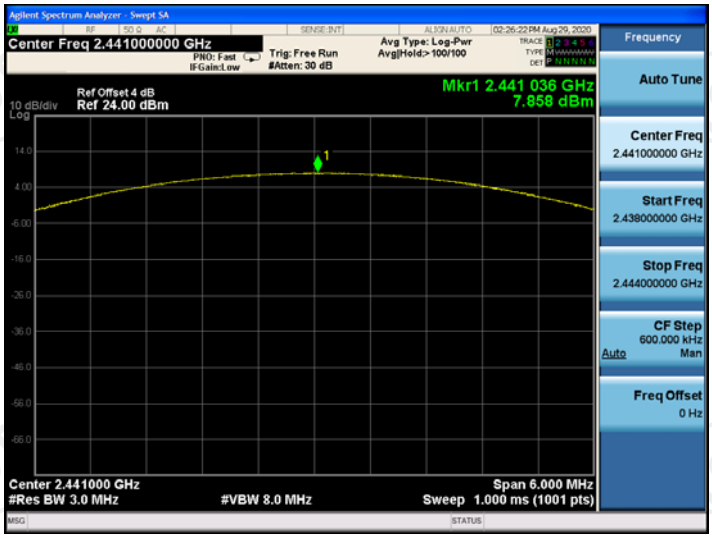


**Pi/4DQPSK Modulation**

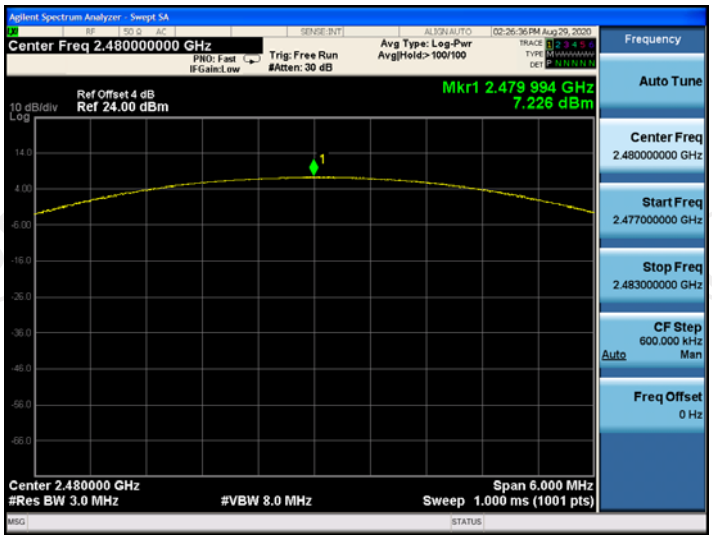
Lowest channel




Middle channel

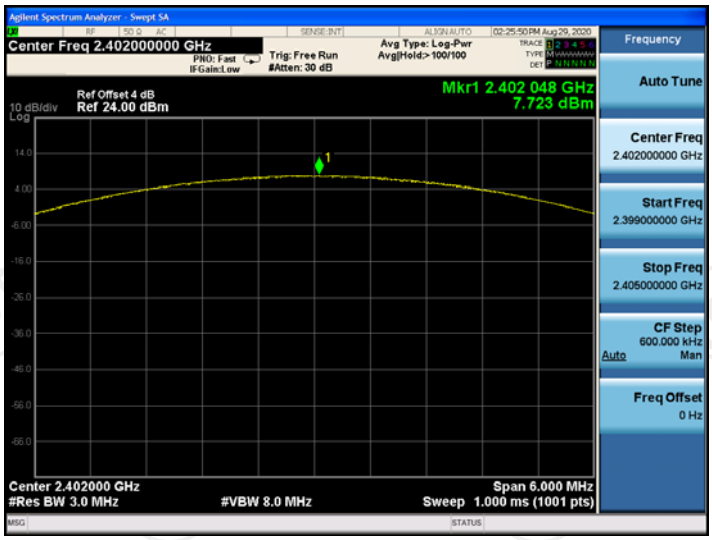



Highest channel

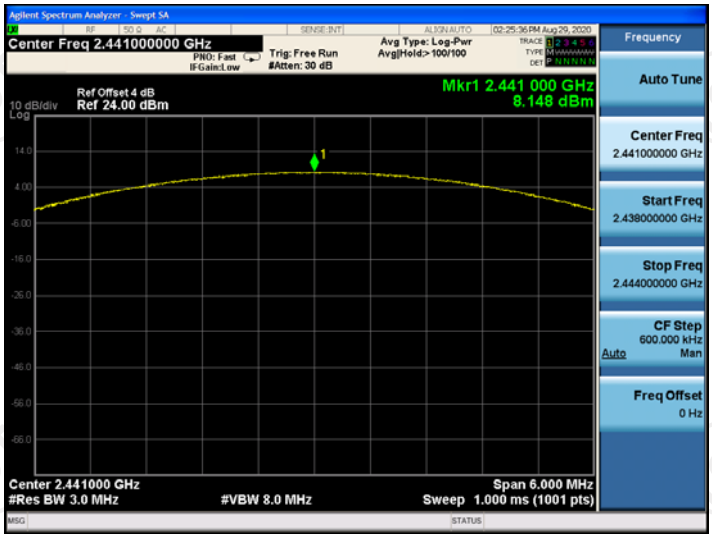


**8DPSK Modulation**

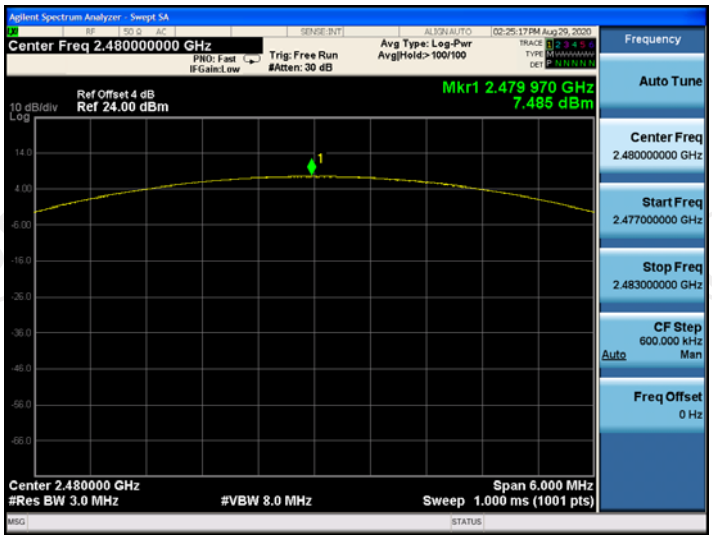
Lowest channel




Middle channel

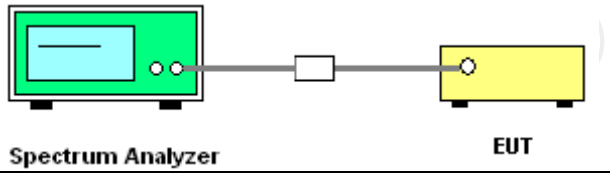



Highest channel



## 6.4. 20dB Occupy Bandwidth

### 6.4.1. Test Specification

| | |
|---|---|
| **Test Requirement:** | FCC Part15 C Section 15.247 (a)(1) |
| **Test Method:** | KDB 558074 D01 v05r02 |
| **Limit:** | N/A |
| **Test Setup:** |  |
| **Test Mode:** | Transmitting mode with modulation |
| **Test Procedure:** | 1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.<br>2. Set to the maximum power setting and enable the EUT transmit continuously.<br>3. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.<br>Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel; 1%≤RBW ≤5% of the 20 dB bandwidth; VBW≥3RBW;<br>Sweep = auto; Detector function = peak; Trace = max hold.<br>4. Measure and record the results in the test report. |
| **Test Result:** | PASS |

### 6.4.2. Test Instruments

| Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | Agilent | N9020A | MY49100619 | Sep. 11, 2020 |
| RF cable (9kHz-26.5GHz) | TCT | RE-06 | N/A | Sep. 11, 2020 |
| Antenna Connector | TCT | RFC-01 | N/A | Sep. 11, 2020 |

***Note:*** *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

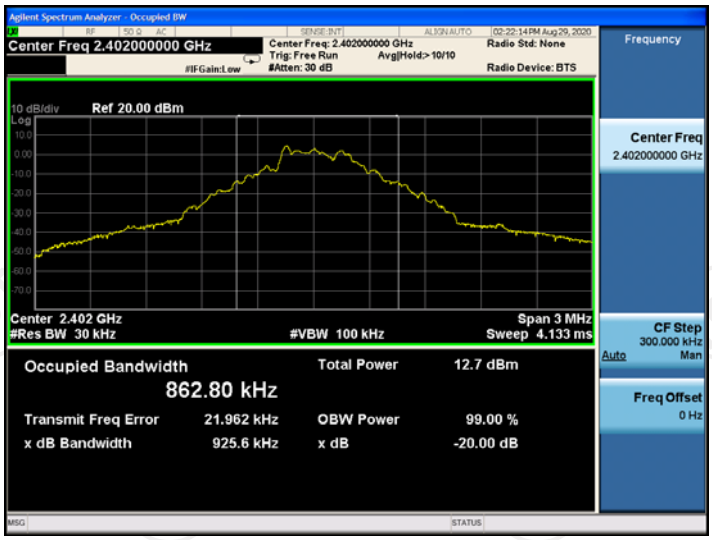
### 6.4.3. Test data

| Test channel | 20dB Occupy Bandwidth (kHz) | | | |
|---|---|---|---|---|
| | GFSK | π/4-DQPSK | 8DPSK | Conclusion |
| Lowest | 862.80 | 1187.80 | 1176.00 | PASS |
| Middle | 862.27 | 1197.40 | 1183.70 | PASS |
| Highest | 863.74 | 1206.50 | 1189.10 | PASS |

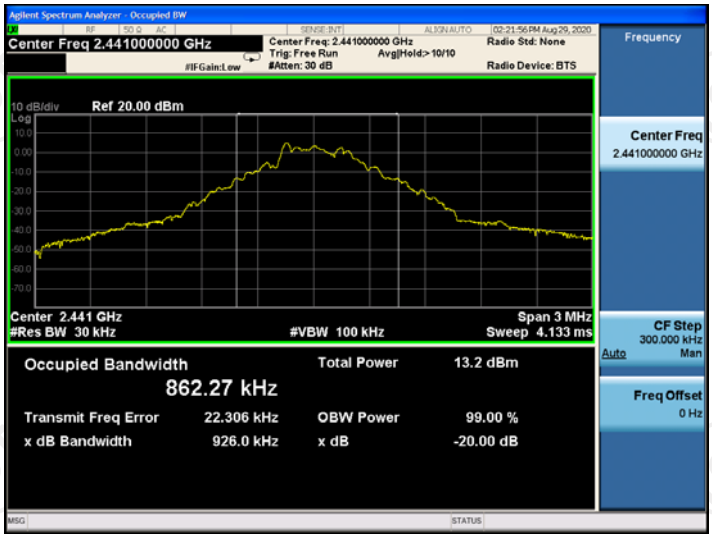
**Test plots as follows:**

**GFSK Modulation**

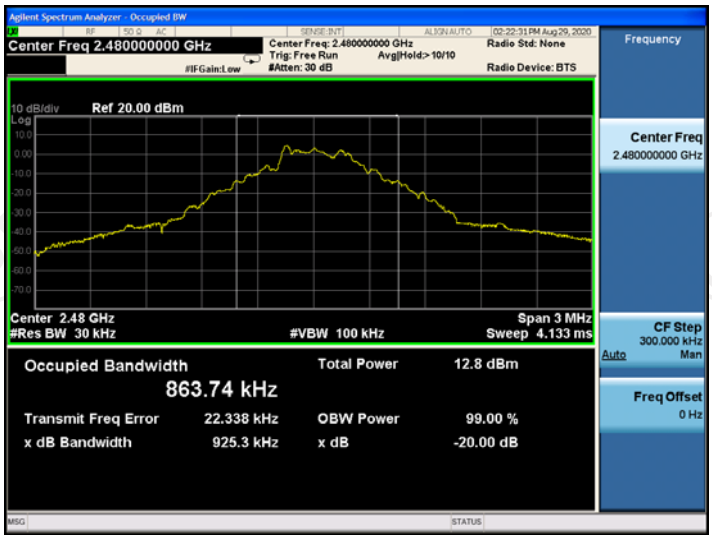
Lowest channel




Middle channel

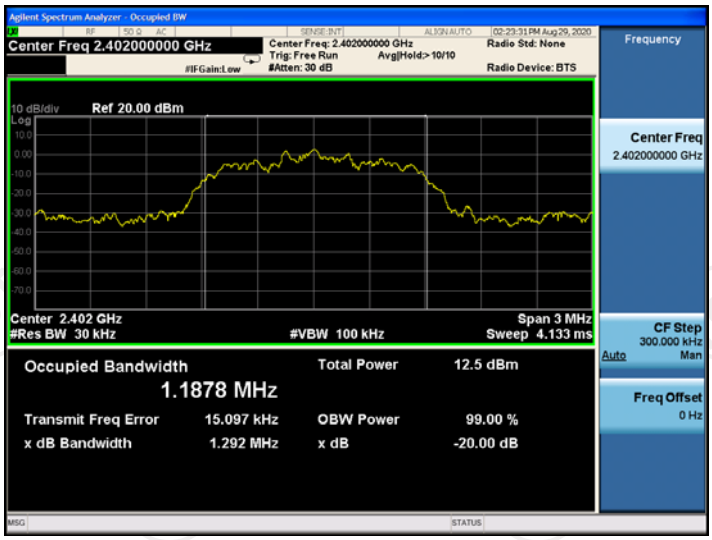



Highest channel

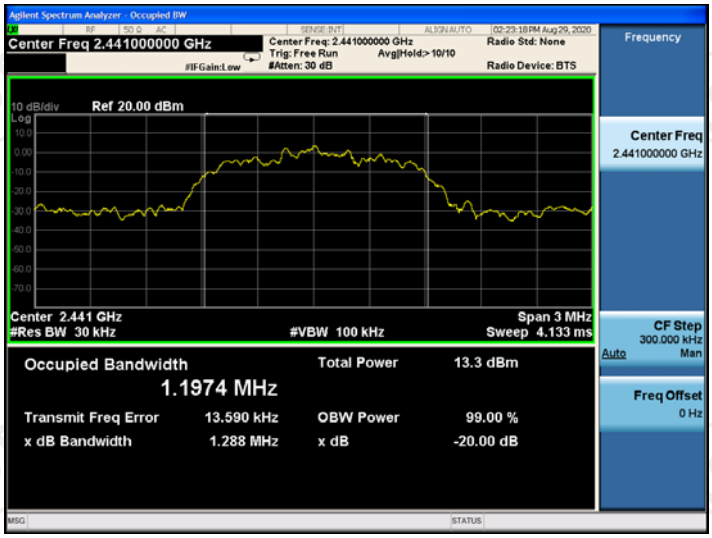


**Pi/4DQPSK Modulation**

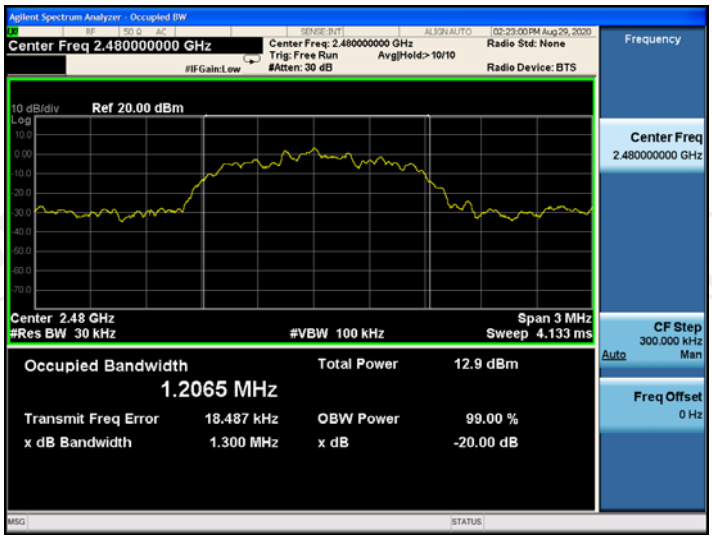
Lowest channel




Middle channel

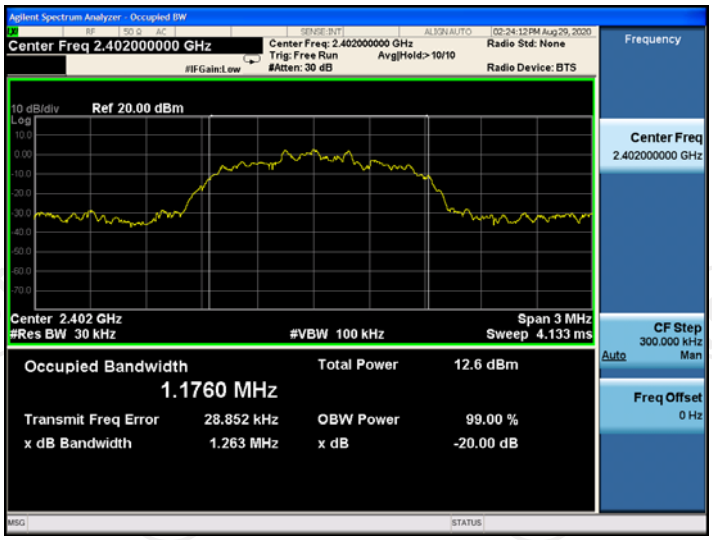



Highest channel

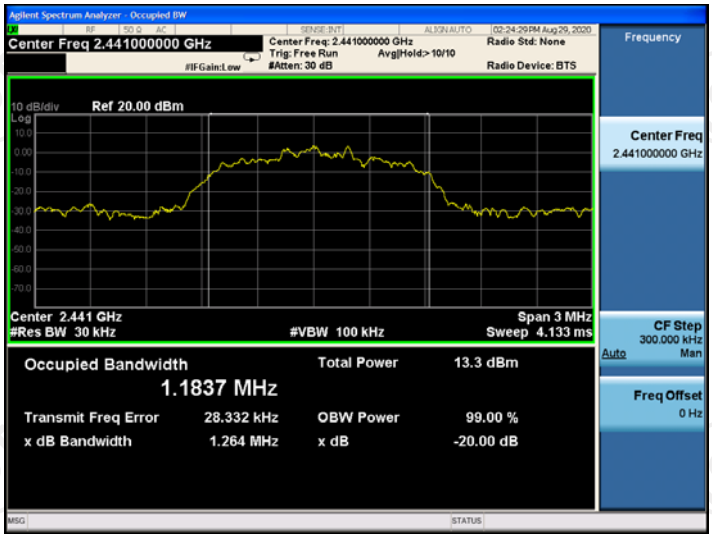


**8DPSK Modulation**

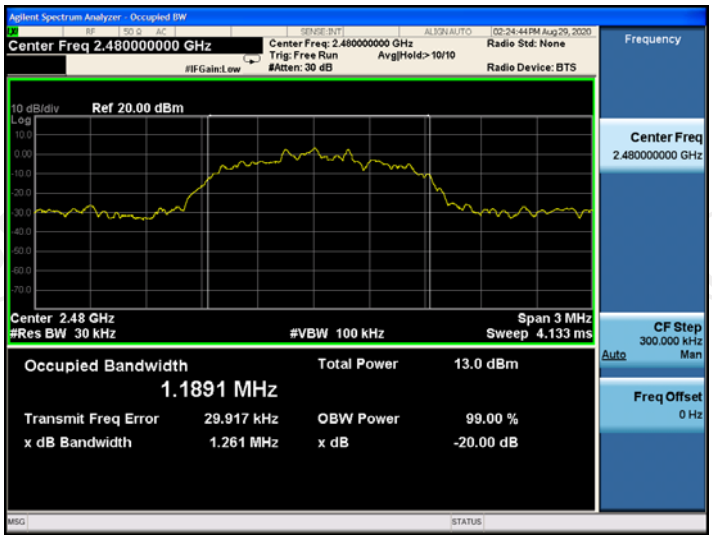
Lowest channel




Middle channel

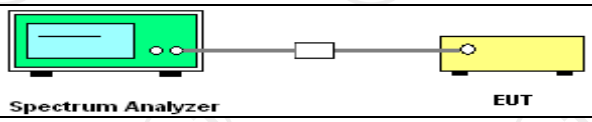



Highest channel



## 6.5. Carrier Frequencies Separation

### 6.5.1. Test Specification

| | |
|---|---|
| **Test Requirement:** | FCC Part15 C Section 15.247 (a)(1) |
| **Test Method:** | KDB 558074 D01 v05r02 |
| **Limit:** | 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. |
| **Test Setup:** |  |
| **Test Mode:** | Hopping mode |
| **Test Procedure:** | 1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.<br>2. Set to the maximum power setting and enable the EUT transmit continuously.<br>3. Enable the EUT hopping function.<br>4. Use the following spectrum analyzer settings:<br>Span = wide enough to capture the peaks of two adjacent channels; RBW is set to approximately 30% of the channel spacing, adjust as necessary to best identify the center of each individual channel;<br>VBW≥RBW; Sweep = auto;<br>Detector function = peak; Trace = max hold.<br>5. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Record the value in report. |
| **Test Result:** | PASS |

### 6.5.2. Test Instruments

| Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | Agilent | N9020A | MY49100619 | Sep. 11, 2020 |
| RF cable (9kHz-26.5GHz) | TCT | RE-06 | N/A | Sep. 11, 2020 |
| Antenna Connector | TCT | RFC-01 | N/A | Sep. 11, 2020 |

***Note:*** *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

### 6.5.3. Test data

| GFSK mode | | | |
|---|---|---|---|
| Test channel | Carrier Frequencies Separation (kHz) | Limit (kHz) | Result |
| Lowest | 1001.00 | *863.74* | PASS |
| Middle | 1000.00 | *863.74* | PASS |
| Highest | 998.00 | *863.74* | PASS |

| Pi/4 DQPSK mode | | | |
|---|---|---|---|
| Test channel | Carrier Frequencies Separation (kHz) | Limit (kHz) | Result |
| Lowest | 1002.00 | *804.33* | PASS |
| Middle | 1002.00 | *804.33* | PASS |
| Highest | 1002.00 | *804.33* | PASS |

| 8DPSK mode | | | |
|---|---|---|---|
| Test channel | Carrier Frequencies Separation (kHz) | Limit (kHz) | Result |
| Lowest | 1002.00 | *792.73* | PASS |
| Middle | 1000.00 | *792.73* | PASS |
| Highest | 1002.00 | *792.73* | PASS |

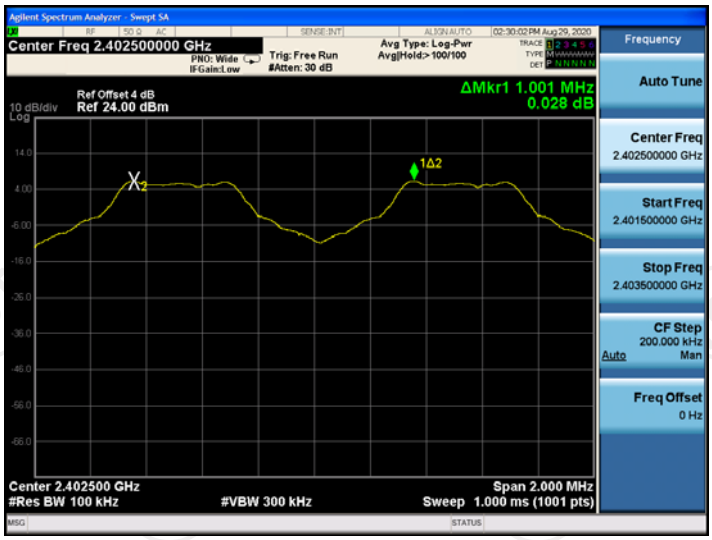
***Note: According to section 6.4***

| *Mode* | *20dB bandwidth (kHz) (worse case)* | *Limit (kHz) (Carrier Frequencies Separation)* |
|---|---|---|
| *GFSK* | *863.74* | *863.74* |
| *π/4-DQPSK* | *1206.50* | *804.33* |
| *8DPSK* | *1189.10* | *792.73* |

**Test plots as follows:**

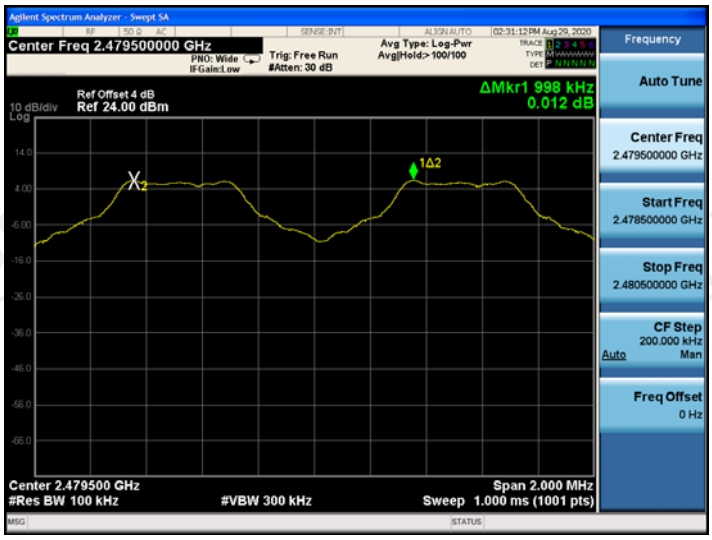
**GFSK Modulation**

Lowest channel



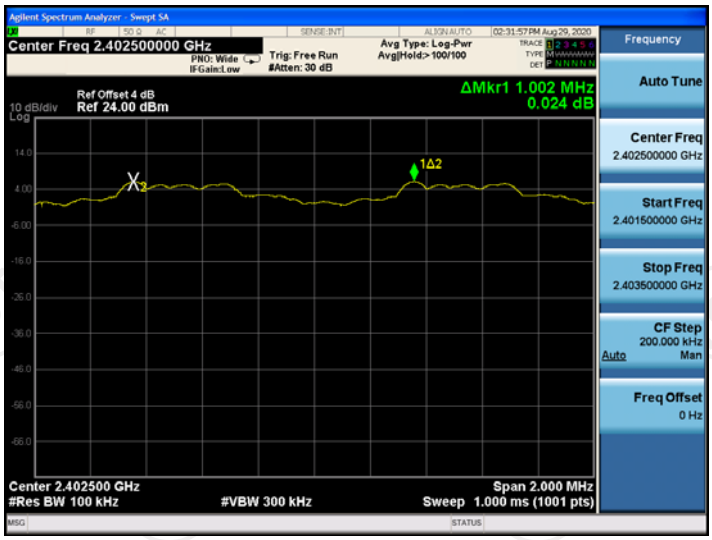

Middle channel

Highest channel

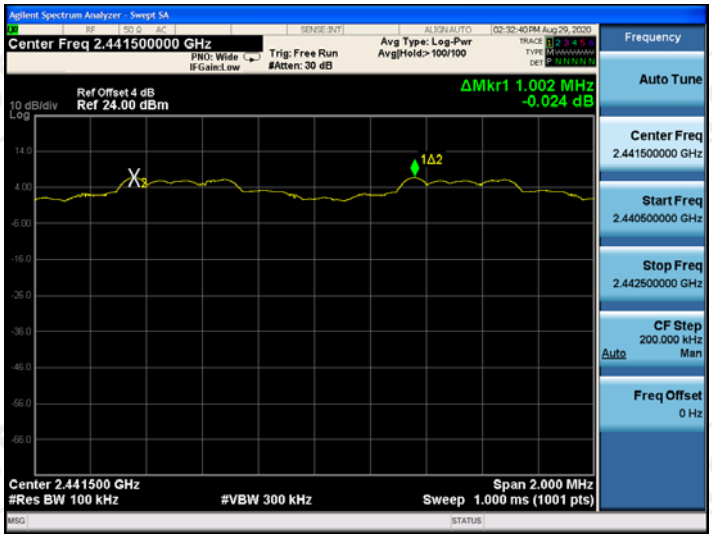


**Pi/4DQPSK Modulation**

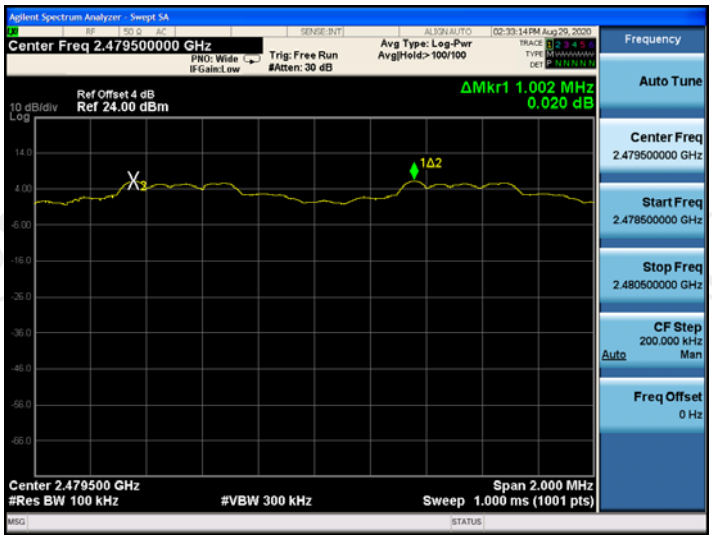
Lowest channel




Middle channel

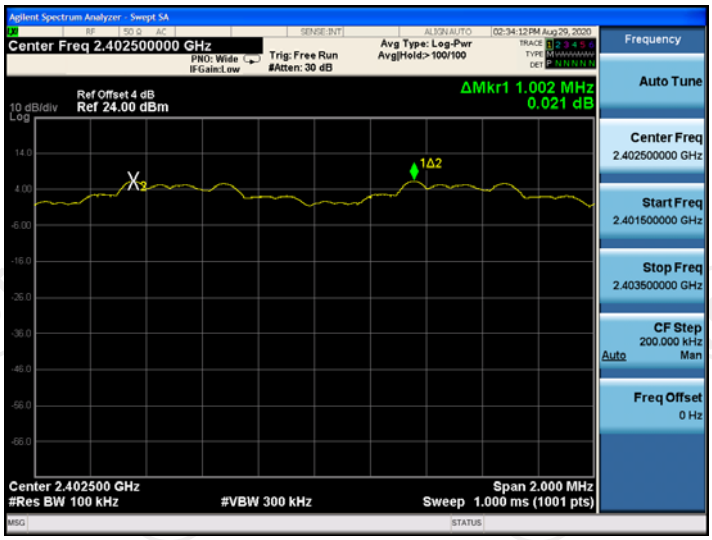



Highest channel

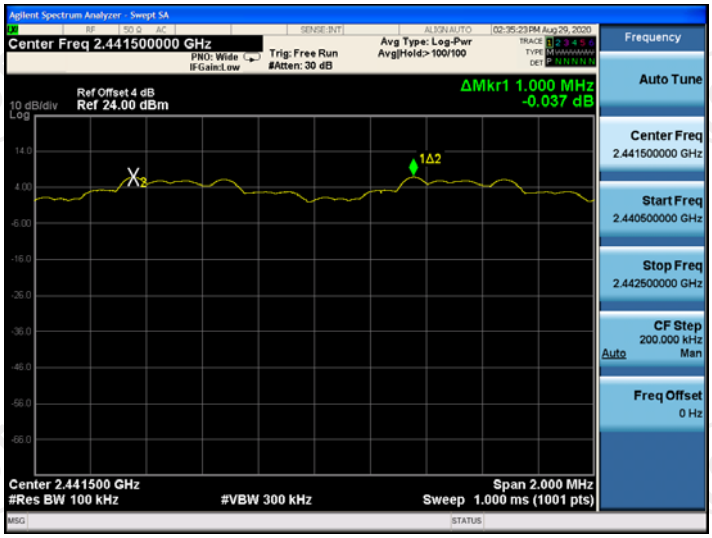


**8DPSK Modulation**

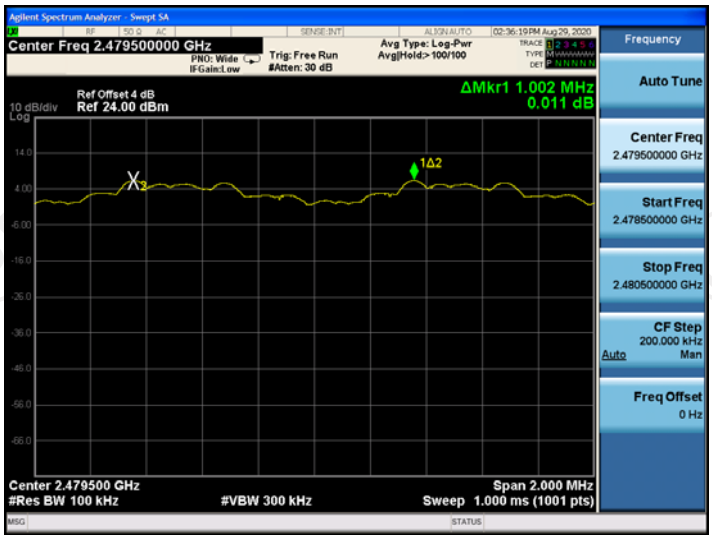
Lowest channel




Middle channel

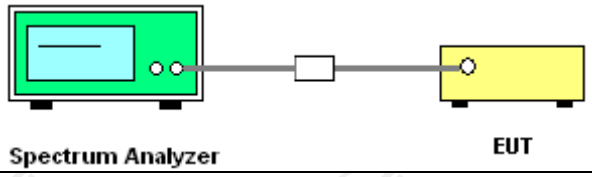



Highest channel



## 6.6. Hopping Channel Number

### 6.6.1. Test Specification

| | |
|---|---|
| **Test Requirement:** | FCC Part15 C Section 15.247 (a)(1) |
| **Test Method:** | KDB 558074 D01 v05r02 |
| **Limit:** | Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. |
| **Test Setup:** |  |
| **Test Mode:** | Hopping mode |
| **Test Procedure:** | 1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.<br>2. Set to the maximum power setting and enable the EUT transmit continuously.<br>3. Enable the EUT hopping function.<br>4. Use the following spectrum analyzer settings: Span = the frequency band of operation; set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller; VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold.<br>5. The number of hopping frequency used is defined as the number of total channel.<br>6. Record the measurement data in report. |
| **Test Result:** | PASS |

### 6.6.2. Test Instruments

| Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | Agilent | N9020A | MY49100619 | Sep. 11, 2020 |
| RF cable (9kHz-26.5GHz) | TCT | RE-06 | N/A | Sep. 11, 2020 |
| Antenna Connector | TCT | RFC-01 | N/A | Sep. 11, 2020 |

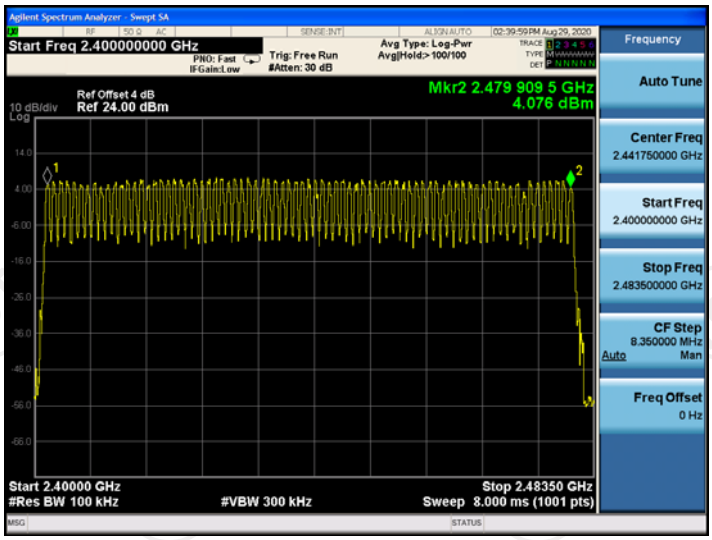
***Note:*** *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

### 6.6.3. Test data

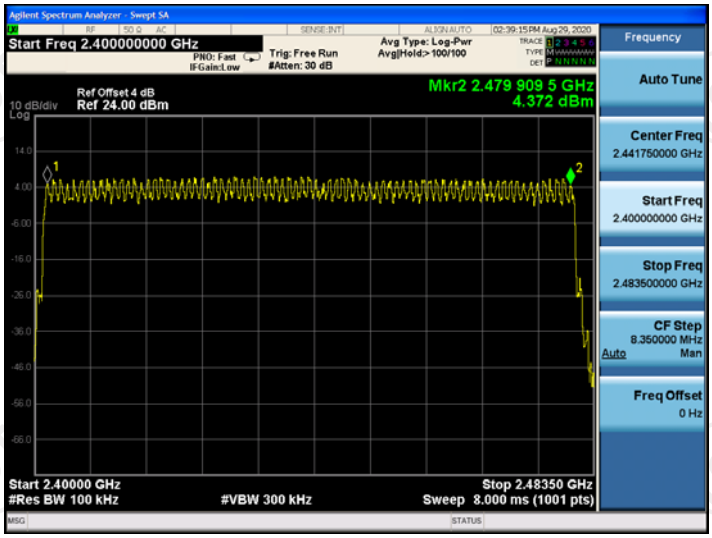
| Mode | Hopping channel numbers | Limit | Result |
|---|---|---|---|
| GFSK, Pi/4DQPSK, 8DPSK | 79 | 15 | PASS |

**Test plots as follows:**

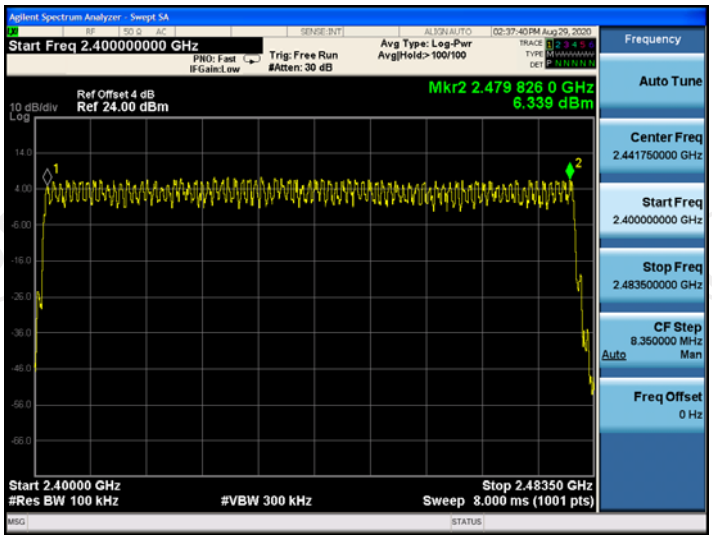
GFSK




Pi/4DQPSK

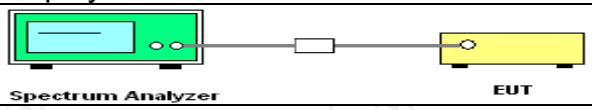



8DPSK



## 6.7. Dwell Time

### 6.7.1. Test Specification

| | |
|---|---|
| **Test Requirement:** | FCC Part15 C Section 15.247 (a)(1) |
| **Test Method:** | KDB 558074 D01 v05r02 |
| **Limit:** | The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. |
| **Test Setup:** |  |
| **Test Mode:** | Hopping mode |
| **Test Procedure:** | 1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.<br>2. Set to the maximum power setting and enable the EUT transmit continuously.<br>3. Enable the EUT hopping function.<br>4. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel; VBW≥RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = clear write.<br>5. Measure and record the results in the test report. |
| **Test Result:** | PASS |

### 6.7.2. Test Instruments

| Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|---|---|---|---|---|
| Spectrum Analyzer | Agilent | N9020A | MY49100619 | Sep. 11, 2020 |
| RF cable (9kHz-26.5GHz) | TCT | RE-06 | N/A | Sep. 11, 2020 |
| Antenna Connector | TCT | RFC-01 | N/A | Sep. 11, 2020 |

***Note:*** *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

### 6.7.3. Test Data

| Mode | Packet | Hops Over Occupancy Time (hops) | Package Transfer Time (ms) | Dwell time (second) | Limit (second) | Result |
|---|---|---|---|---|---|---|
| GFSK | DH1 | 320 | 0.413 | 0.132 | 0.4 | PASS |
| GFSK | DH3 | 160 | 1.695 | 0.271 | 0.4 | PASS |
| GFSK | DH5 | 106.67 | 2.940 | 0.314 | 0.4 | PASS |
| Pi/4 DQPSK | 2-DH1 | 320 | 0.408 | 0.131 | 0.4 | PASS |
| Pi/4 DQPSK | 2-DH3 | 160 | 1.674 | 0.268 | 0.4 | PASS |
| Pi/4 DQPSK | 2-DH5 | 106.67 | 2.936 | 0.313 | 0.4 | PASS |
| 8DPSK | 3-DH1 | 320 | 0.422 | 0.135 | 0.4 | PASS |
| 8DPSK | 3-DH3 | 160 | 1.674 | 0.268 | 0.4 | PASS |
| 8DPSK | 3-DH5 | 106.67 | 2.924 | 0.312 | 0.4 | PASS |

***Note:*** *1. In normal mode, hopping rate is 1600 hops/s with 6 slots in 79 hopping channels.*

*For DH1, With channel hopping rate (1600 / 2 / 79) in Occupancy Time Limit (0.4 x 79) (s), Hops Over Occupancy Time comes to (1600 / 2 / 79) x (0.4 x 79) = 320 hops*

*For DH3, With channel hopping rate (1600 / 4 / 79) in Occupancy Time Limit (0.4 x 79) (s), Hops Over Occupancy Time comes to (1600 / 4 / 79) x (0.4 x 79) = 160 hops*

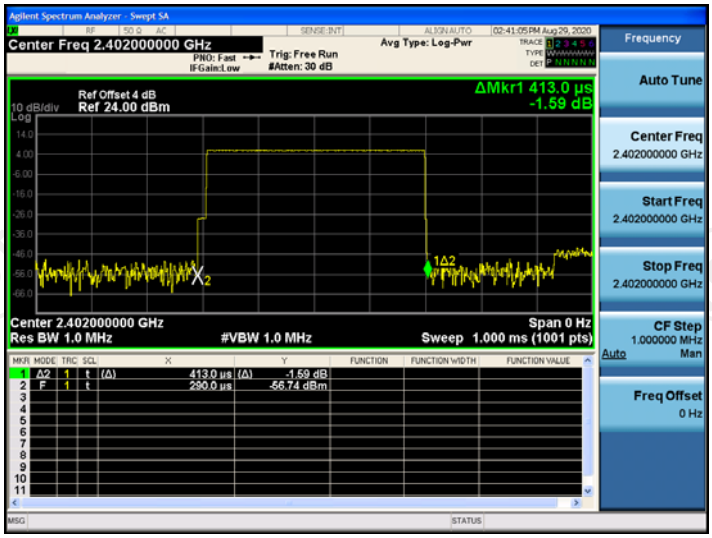
*For DH5, With channel hopping rate (1600 / 6 / 79) in Occupancy Time Limit (0.4 x 79) (s), Hops Over Occupancy Time comes to (1600 / 6 / 79) x (0.4 x 79) = 106.67 hops*

*2. Dwell Time(s) = Hops Over Occupancy Time (hops) x Package Transfer Time*

**Test plots as follows:**

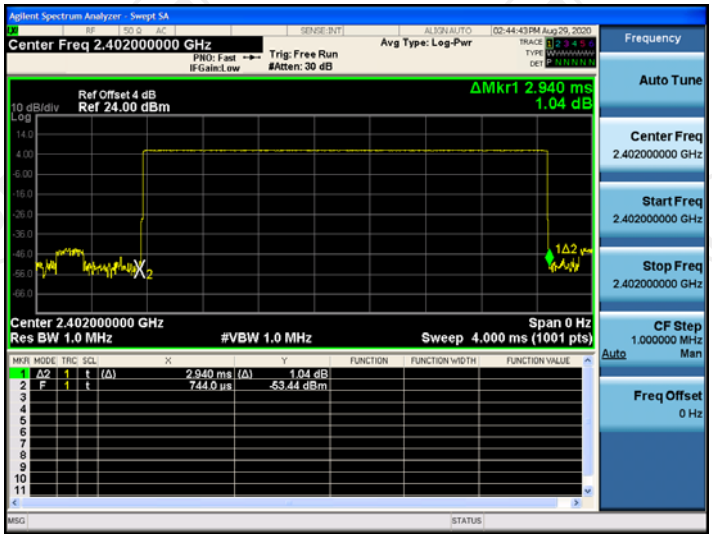
GFSK

DH1



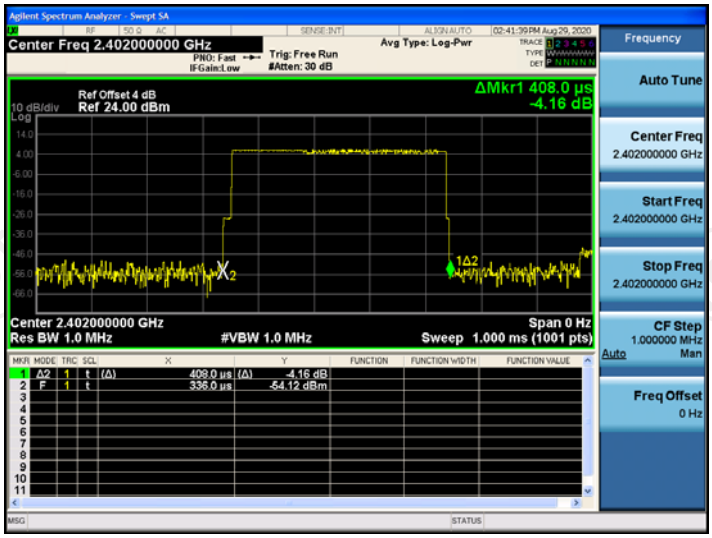

DH3

DH5

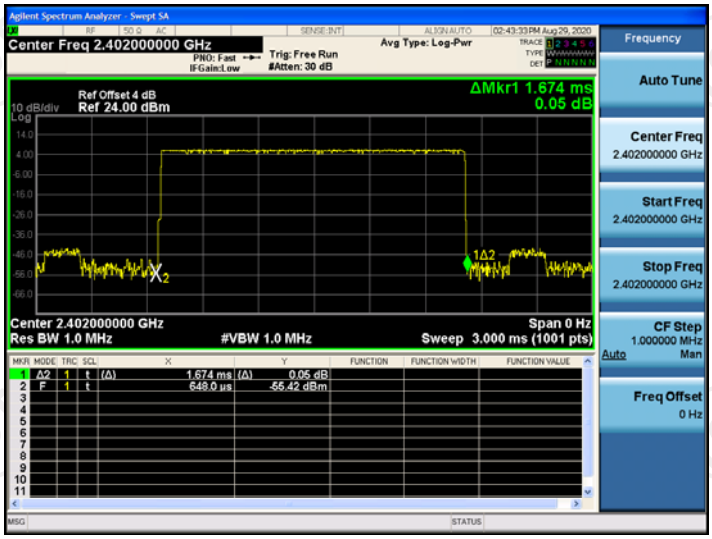


Pi/4DQPSK

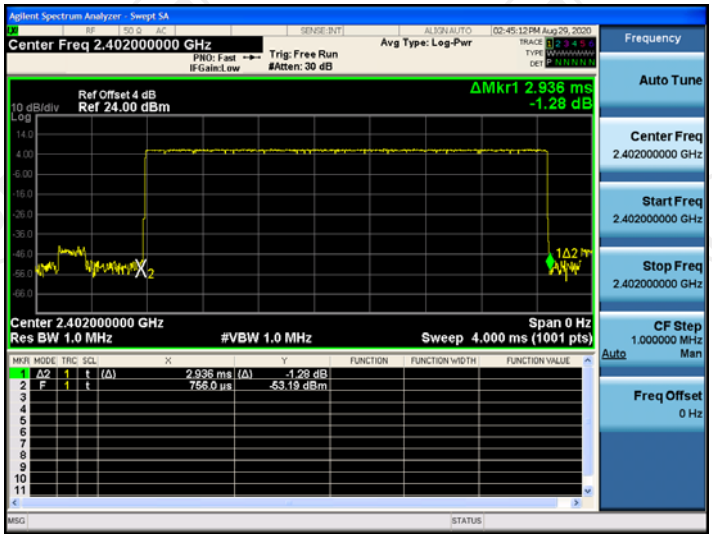
2-DH1




2-DH3

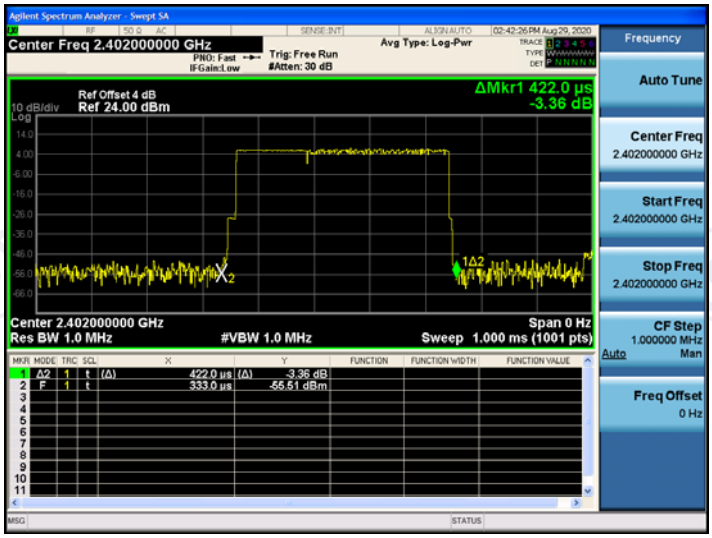



2-DH5

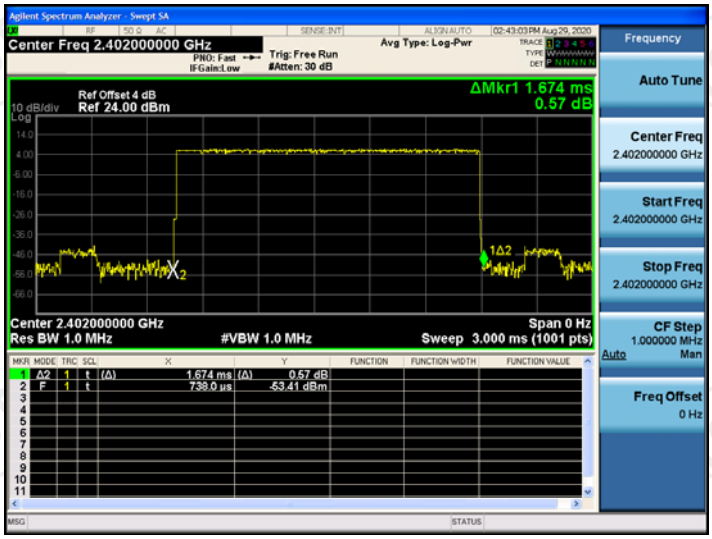


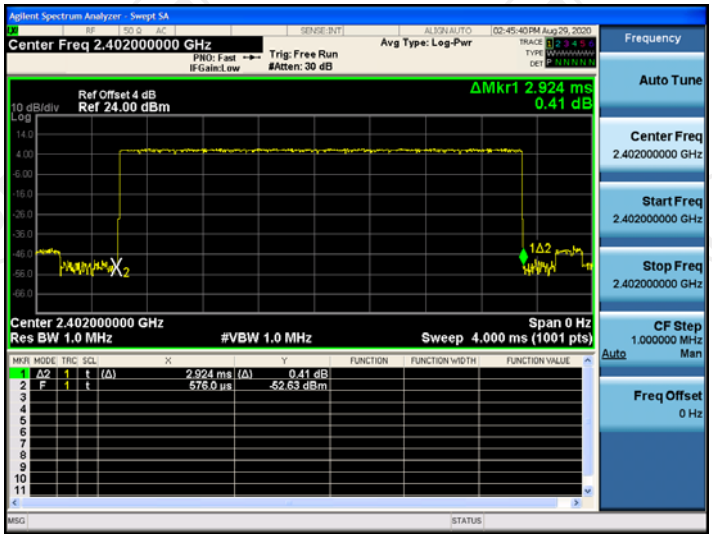
8DPSK

3-DH1




3-DH3




3-DH5