

FCC BT REPORT

Certification

| | |
|--|---|
| Applicant Name: HYUNDAI MOBIS CO., LTD. | Date of Issue: September 21, 2016 |
| Address: 203, Teheran-ro, Gangnam-gu, Seoul, Korea (135-977) | Test Site/Location: HCT CO., LTD., 74,Seoicheon-ro 578beon-gil,Majang-myeo,Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA |
| | Report No.: HCT-R-1609-F022 |
| | HCT FRN: 0005866421 |
| | IC Recognition No.: 5944A-5 |

| | |
|------------------|---------------------------|
| FCC ID | : TQ8-ATBB0J0AN |
| APPLICANT | : HYUNDAI MOBIS CO., LTD. |

| | |
|------------------------------|---|
| Model(s): | ATBB0J0AN |
| EUT Type: | Car Audio System |
| Max. RF Output Power: | 4.80 dBm (3.02 mW) |
| Frequency Range: | 2402 MHz - 2480 MHz (Bluetooth) |
| Modulation type | GFSK(Normal), π/4DQPSK and 8DPSK(EDR) |
| FCC Classification: | FCC Part 15 Spread Spectrum Transmitter |
| FCC Rule Part(s): | Part 15 subpart C 15.247 |

The measurements shown in this report were made in accordance with the procedures specified in §2.947. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

HCT CO., LTD. Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998,21 U.S. C.853(a)

Report prepared by
: Seul Ki Lee

Test engineer of RF Team

Approved by
: Jong Seok Lee

Manager of RF Team

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Version

| TEST REPORT NO. | DATE | DESCRIPTION |
|------------------------|--------------------|-------------------------|
| HCT-R-1609-F022 | September 21, 2016 | - First Approval Report |
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1. GENERAL INFORMATION

Applicant: HYUNDAI MOBIS CO., LTD.
Address: 203, Teheran-ro, Gangnam-gu, Seoul, Korea (135-977)
FCC ID: TQ8-ATBB0J0AN
EUT Type: Car Audio System
Model (s): ATBB0J0AN
Date(s) of Tests: July 26, 2016 ~ September 19, 2016
Place of Tests: HCT Co., Ltd.
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea

2. EUT DESCRIPTION

| | |
|------------------------------|--|
| Model | ATBB0J0AN |
| EUT Type | Car Audio System |
| Power Supply | DC 12 V |
| Frequency Range | 2402 MHz - 2480 MHz (Bluetooth) |
| Max. RF Output Power: | 4.80 dBm (3.02 mW) |
| BT Operating Mode | Normal, EDR, AFH |
| Modulation Type | GFSK(Normal), π/4DQPSK and 8DPSK(EDR) |
| Modulation Technique | FHSS |
| Number of Channels | 79Channels, Minimum 20 Channels(AFH) |
| Antenna Specification | Manufacturer: PARTRON Co.,Ltd Antenna type: Dielectric Chip Antenna Peak Gain : 2.29 dBi |

* 15.247 Requirements for Bluetooth transmitter

- This Bluetooth module has been tested by a Bluetooth Qualification Lab, and we confirm the following:
 - 1) This system is hopping pseudo-randomly.
 - 2) Each frequency is used equally on the average by each transmitter.
 - 3) The receiver input bandwidths that match the hopping channel bandwidths of their corresponding transmitters
 - 4) The receiver shifts frequencies in synchronization with the transmitted signals.
 - 15.247(g): The system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this Section 15.247 should the transmitter be presented with a continuous data (or information) stream.
 - 15.247(h): The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

3. TEST METHODOLOGY

The measurement procedure described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) is used in the measurement of the test device.

3.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

3.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

3.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1GHz. Above 1GHz with 1.5m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3.75 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 8 of ANSI C63.10. (Version: 2013). To record the final measurements, the analyzer detector function was set to CISPR quasi-peak mode and the bandwidth of the spectrum analyzer was set to 120 kHz for frequencies below 1 GHz or 1 MHz for frequencies above 1 GHz. For average measurements above 1 GHz, the analyzer was set to peak detector with a reduced VBW setting(RBW = 1 MHz, VBW = 1/T Hz, where T = Pulse width).

Conducted Antenna Terminal

See Section from 7.8.2 to 7.8.8.(ANSI 63.10-2013)

3.4 DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel low, mid and high with highest data rate (worst case) is chosen for full testing.

4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.

Especitally, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2006).

5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated July 07, 2015 (Registration Number: 90661)

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

6. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 shall be considered sufficient to comply with the provisions of this section."

* The antennas of this E.U.T are permanently attached.

*The E.U.T Complies with the requirement of §15.203

7. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4:2014.

All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95 % level of confidence. The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

| Parameter | Expanded Uncertainty ($\pm \text{dB}$) |
|--|--|
| Conducted Disturbance (150 kHz ~ 30 MHz) | 1.82 |
| Radiated Disturbance (9 kHz ~ 30 MHz) | 3.40 |
| Radiated Disturbance (30 MHz ~ 1 GHz) | 4.80 |
| Radiated Disturbance (1 GHz ~ 18 GHz) | 6.07 |

8. SUMMARY OF TEST RESULTS

| Test Description | FCC Part Section(s) | Test Limit | Test Condition | Test Result |
|-------------------------------------|----------------------------|---|----------------|-------------|
| 20 dB Bandwidth | §15.247(a)(1)(ii) or (iii) | N/A | CONDUCTED | PASS |
| Occupied Bandwidth | N/A | N/A | | N/A |
| Conducted Maximum Peak Output Power | §15.247(b)(1) | < 1 W if \geq 75 non-overlapping hopping channels used < 0.125 W if < 75 non-overlapping hopping channels used | | PASS |
| Carrier Frequency Separation | §15.247(a)(1) | >25 kHz or >2/3 of the 20dB BW | | PASS |
| Number of Hopping Frequencies | §15.247(a)(1)(iii) | \geq 15 | | PASS |
| Time of Occupancy | §15.247(a)(1)(iii) | <400 ms | | PASS |
| Conducted Spurious Emissions | §15.247(d) | > 20 dB for all out-of band emissions | | PASS |
| Band Edge(Out of Band Emissions) | §15.247(d) | > 20 dB for all out-of band emissions | | PASS |
| AC Power line Conducted Emissions | §15.207(a) | cf. Section 8.7 | | PASS |
| Radiated Spurious Emissions | §15.247(d), 15.205, 15.209 | cf. Section 8.6.2 | RADIATED | PASS |
| Radiated Restricted Band Edge | §15.247(d), 15.205, 15.209 | cf. Section 8.6.3 | | PASS |

9. TEST RESULT

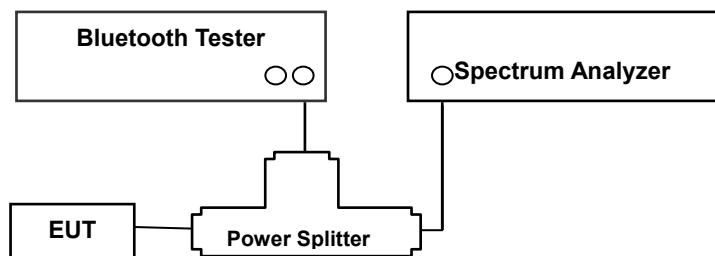
9.1 PEAK POWER

LIMIT

The maximum peak 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 W. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 W.
2. The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

Test Configuration



TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer. The Spectrum Analyzer is set to the peak detector mode. This test is performed with hopping off.

The Spectrum Analyzer is set to (7.8.5 in ANSI 63.10-2013)

- 1) Span: approximately 5 times the 20 dB bandwidth, centered on a hopping channel
- 2) RBW > the 20 dB bandwidth of the emission being measured
- 3) VBW \geq RBW
- 4) Sweep = Auto
- 5) Detector = Peak
- 6) Trace = Max hold

SAMPLE CALCULATION

$$\begin{aligned} \text{Output Power} &= \text{Spectrum Reading Power} + \text{Power Splitter loss} + \text{Cable loss}(2 \text{ ea}) \\ &= 10 \text{ dBm} + 6 \text{ dB} + 1.5 \text{ dB} = 17.5 \text{ dBm} \end{aligned}$$

Note :

1. Spectrum reading values are not plot data. The power results in plot is already including the actual values of loss for the splitter and cable combination.
2. Spectrum offset = Power Splitter loss + Cable loss

3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. Actual value of loss for the splitter and cable combination is 7.36 dB at 2402 MHz and is 7.44 dB at 2480 MHz. So, 7.4 dB is offset. And the offset gap in the 2.4 GHz range do not affect the conducted peak power final result.

TEST RESULTS

No non-compliance noted

Test Data

| Channel | Frequency (MHz) | Output Power (GFSK) | | Limit (mW) | Result |
|---------|--------------------|------------------------|------|---------------|--------|
| | | (dBm) | (mW) | | |
| Low | 2402 | 3.460 | 2.22 | | PASS |
| Mid | 2441 | 3.230 | 2.10 | 125 | PASS |
| High | 2480 | 3.055 | 2.02 | | PASS |

| Channel | Frequency (MHz) | Output Power (8DPSK) | | Output Power (π/4DQPSK) | | Limit (mW) | Result |
|---------|--------------------|-------------------------|------|----------------------------|------|---------------|--------|
| | | (dBm) | (mW) | (dBm) | (mW) | | |
| Low | 2402 | 4.795 | 3.02 | 4.248 | 2.66 | | PASS |
| Mid | 2441 | 4.593 | 2.88 | 4.038 | 2.53 | 125 | PASS |
| High | 2480 | 4.439 | 2.78 | 3.884 | 2.45 | | PASS |

Test Plots (GFSK)

Peak Power (CH.0)



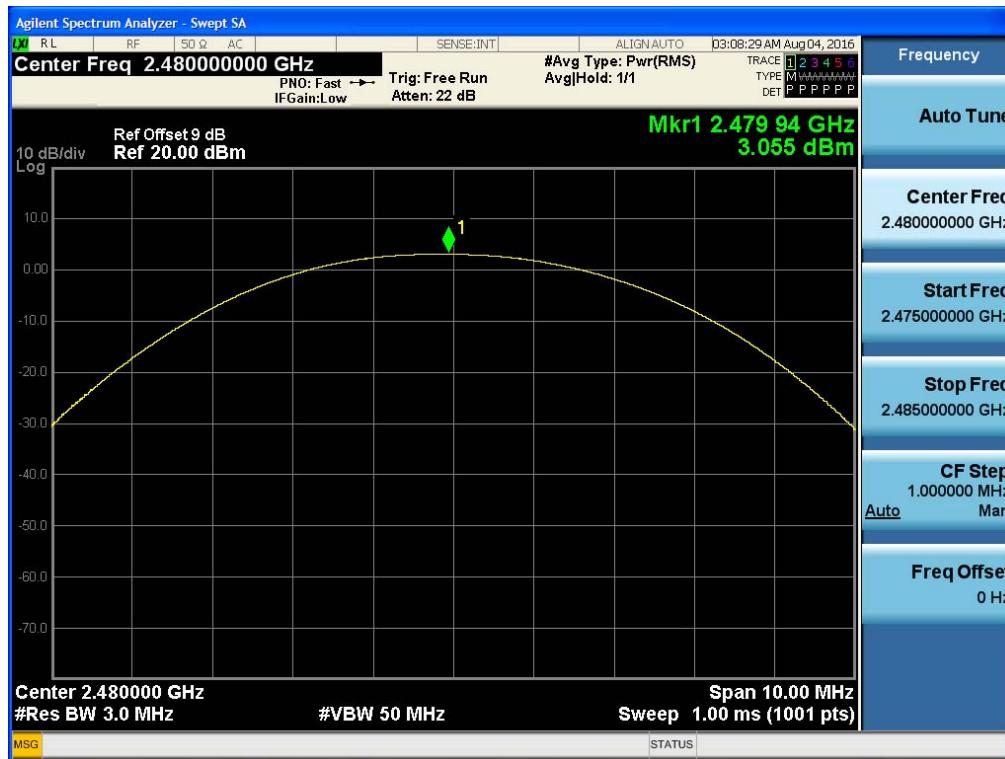
Test Plots (GFSK)

Peak Power (CH.39)



Test Plots (GFSK)

Peak Power (CH.78)



Test Plots (8DPSK)

Peak Power (CH.0)



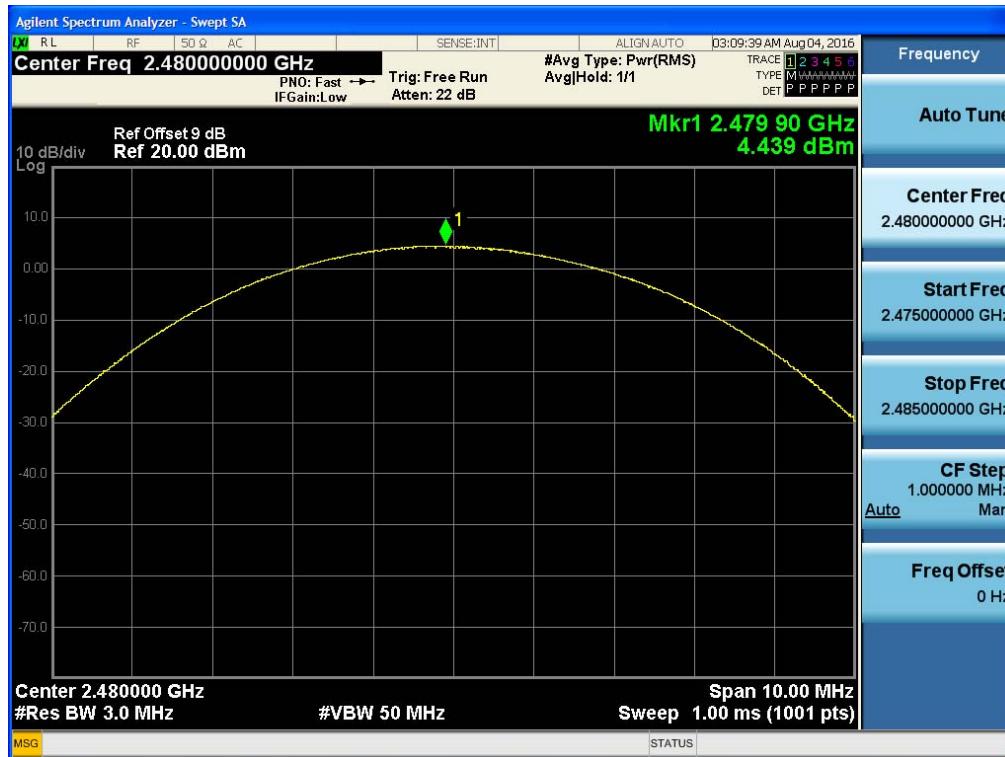
Test Plots (8DPSK)

Peak Power (CH.39)



Test Plots (8DPSK)

Peak Power (CH.78)



Test Plots ($\pi/4$ DQPSK)

Peak Power (CH.0)

Test Plots ($\pi/4$ DQPSK)

Peak Power (CH.39)



Test Plots ($\pi/4$ DQPSK)

Peak Power (CH.78)

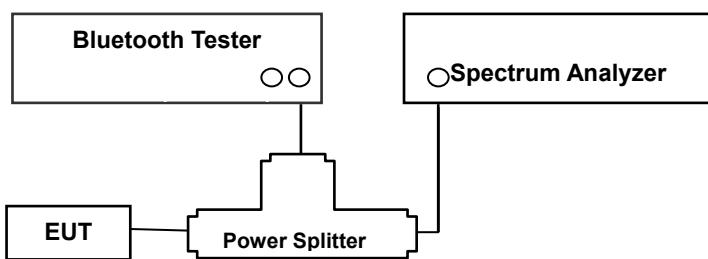


9.2 BAND EDGES

LIMIT

According to §15.247(d), 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.

Test Configuration



TEST PROCEDURE

This test is performed with hopping off and hopping on.

The Spectrum Analyzer is set to (6.10.4 in ANSI 63.10-2013)

- 1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
- 2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level.
- 3) Attenuation: Auto (at least 10 dB preferred).
- 4) Sweep time: Coupled.
- 5) RBW: 100 kHz
- 6) VBW: 300 kHz
- 7) Detector: Peak
- 8) Trace: Max hold

TEST RESULTS

See attached.

Note :

1. The results in plot is already including the actual values of loss for the splitter and cable combination.
2. Spectrum offset = Power Splitter loss + Cable loss
3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. Actual value of loss for the splitter and cable combination is 7.36 dB at 2402 MHz and is 7.44 dB at 2480 MHz. So, 7.4 dB is offset. And the offset gap in the 2.4 GHz range do not affect the band edge measurement final result.

Test Data

- Without hopping

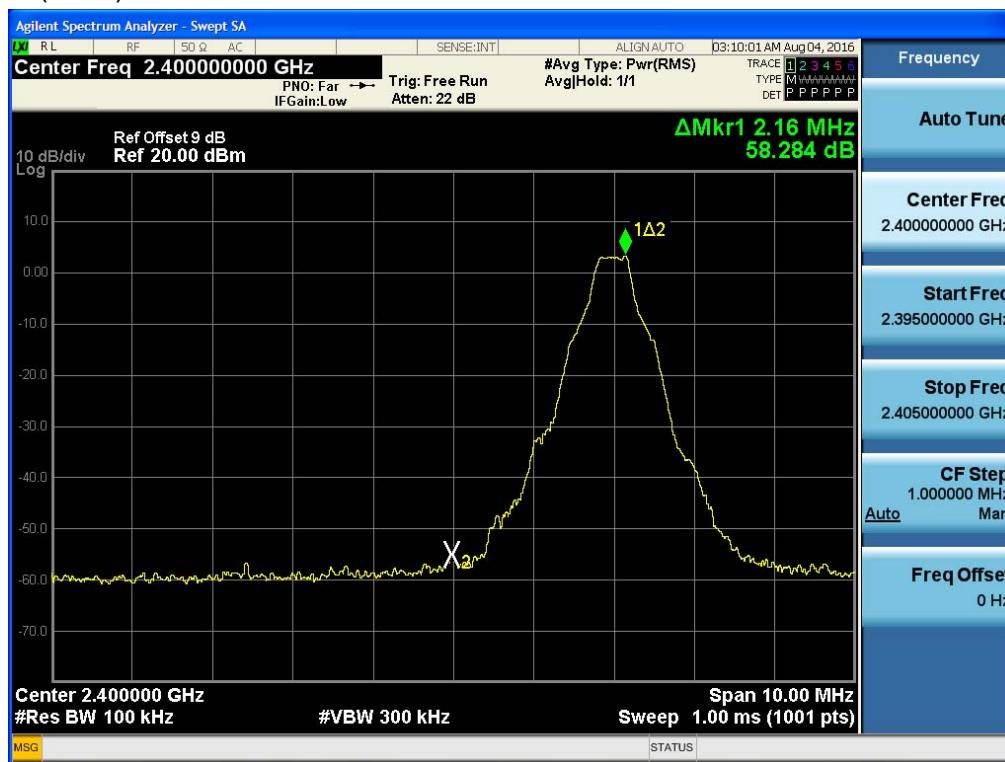
| Outside Frequency Band | GFSK | 8DPSK | $\pi/4$ DQPSK | Limit (dBc) | Margin | | | Result |
|---------------------------|--------|--------|---------------|----------------|---------------|----------------|------------------------|--------|
| | (dB) | (dB) | (dB) | | GFSK (dBc) | 8DPSK (dBc) | $\pi/4$ DQPSK (dBc) | |
| Lower | 58.284 | 59.162 | 55.416 | 20 | 38.28 | 39.16 | 35.42 | PASS |
| Upper | 60.299 | 60.638 | 60.009 | | 40.30 | 40.64 | 40.01 | PASS |

- With hopping

| Outside Frequency Band | GFSK | 8DPSK | $\pi/4$ DQPSK | Limit (dBc) | Margin | | | Result |
|---------------------------|--------|--------|---------------|----------------|---------------|----------------|------------------------|--------|
| | (dB) | (dB) | (dB) | | GFSK (dBc) | 8DPSK (dBc) | $\pi/4$ DQPSK (dBc) | |
| Lower | 56.695 | 58.369 | 58.084 | 20 | 36.70 | 38.37 | 38.08 | PASS |
| Upper | 56.407 | 56.748 | 58.132 | | 36.41 | 36.75 | 38.13 | PASS |

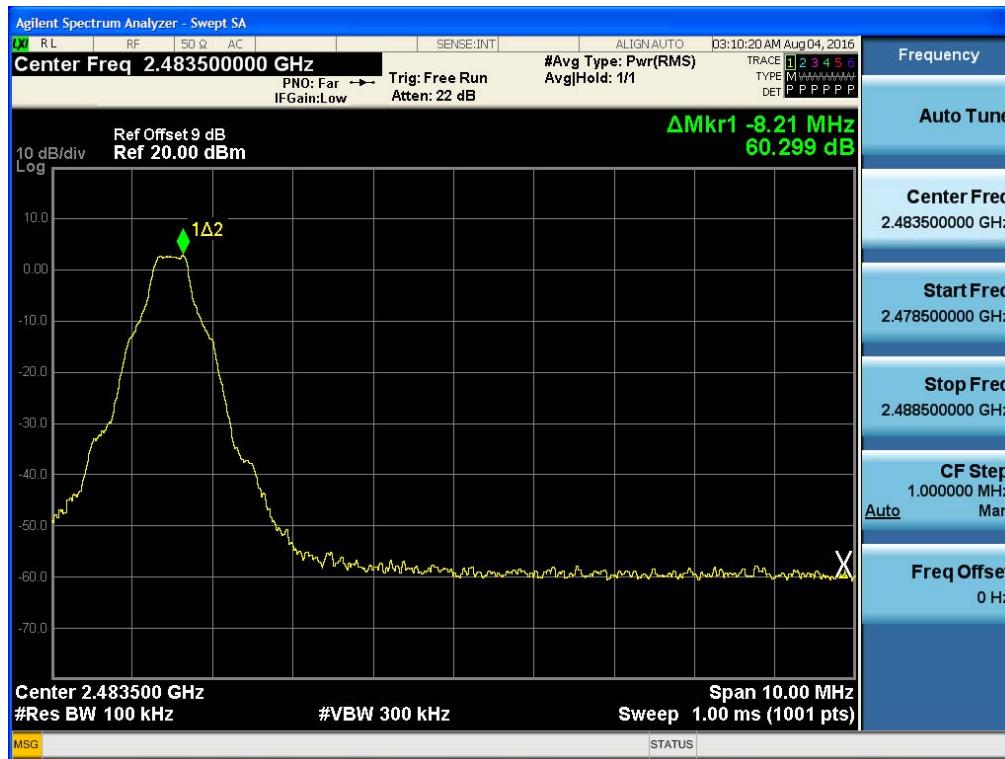
Test Plots without hopping (GFSK)

Band Edges (CH.0)



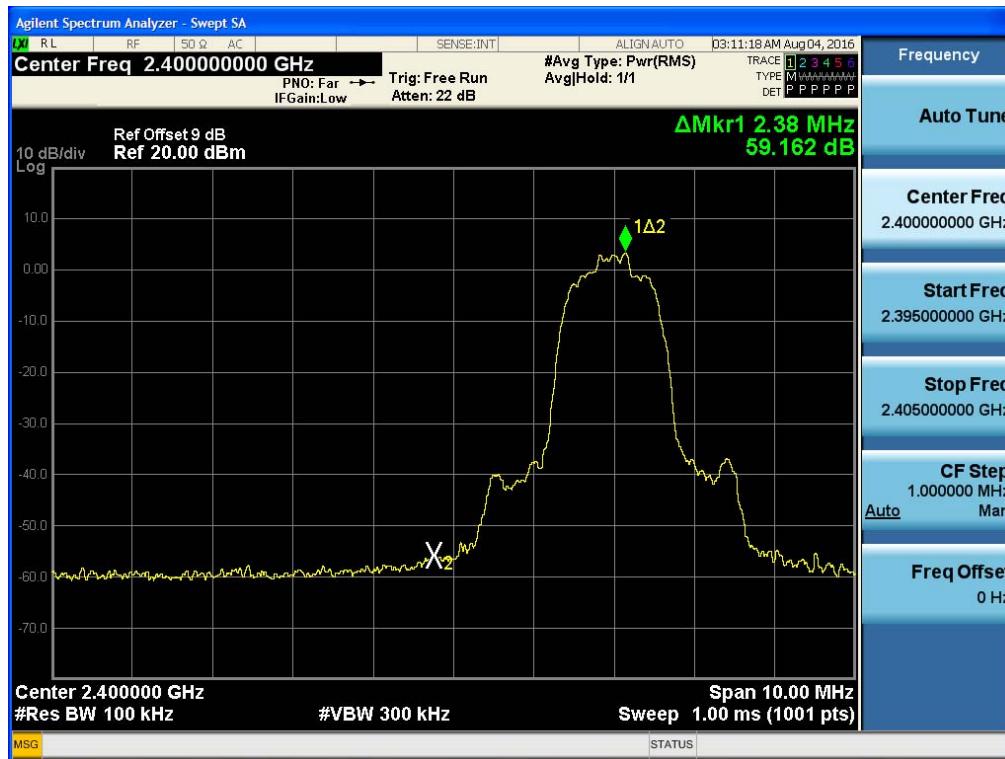
Test Plots without hopping (GFSK)

Band Edges (CH.78)



Test Plots without hopping (8DPSK)

Band Edges (CH.0)



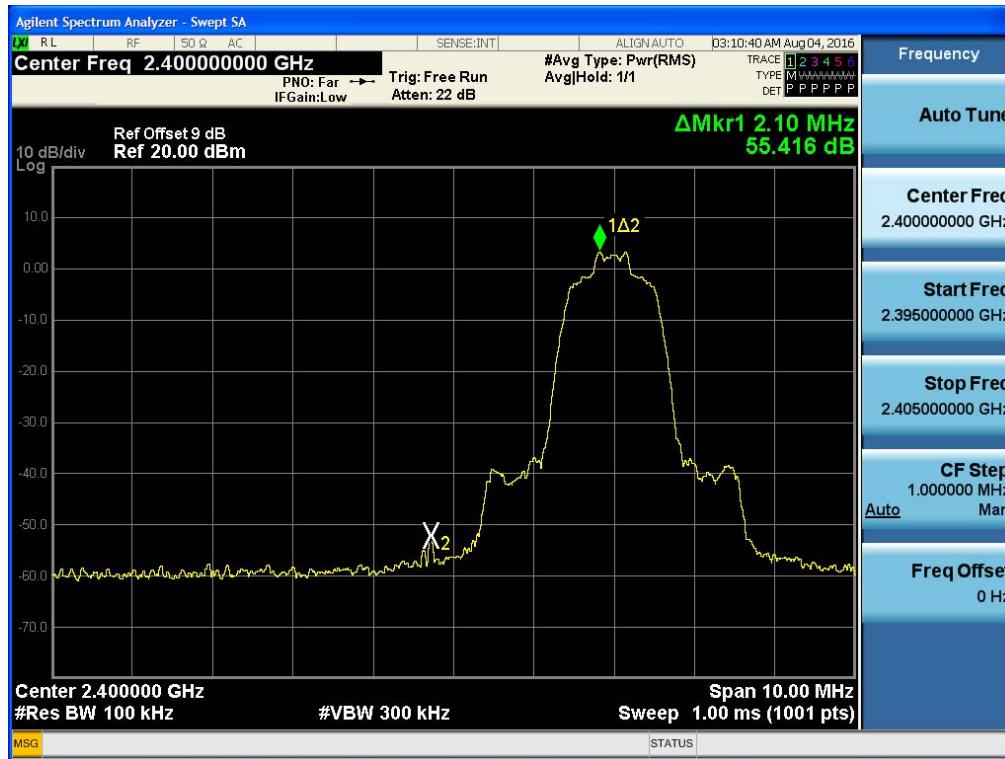
Test Plots without hopping (8DPSK)

Band Edges (CH.78)

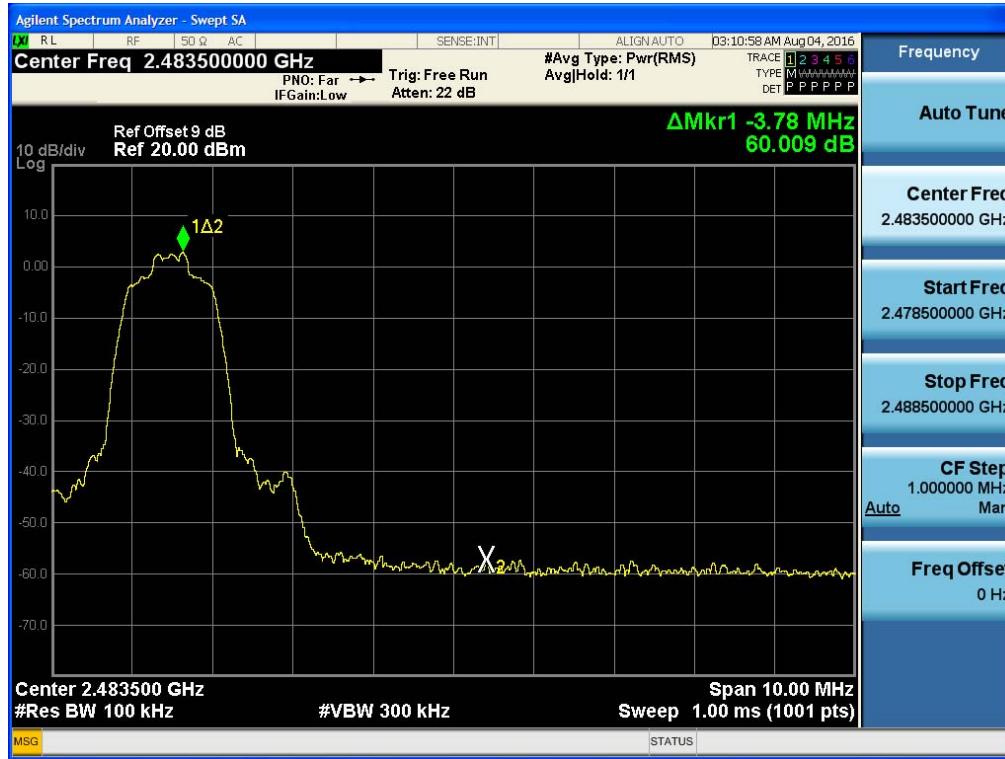


Test Plots without hopping ($\pi/4$ DQPSK)

Band Edges (CH.0)

Test Plots without hopping ($\pi/4$ DQPSK)

Band Edges (CH.78)



Test Plots with hopping (GFSK)

Band Edges (CH.0)



Test Plots with hopping (GFSK)

Band Edges (CH.78)



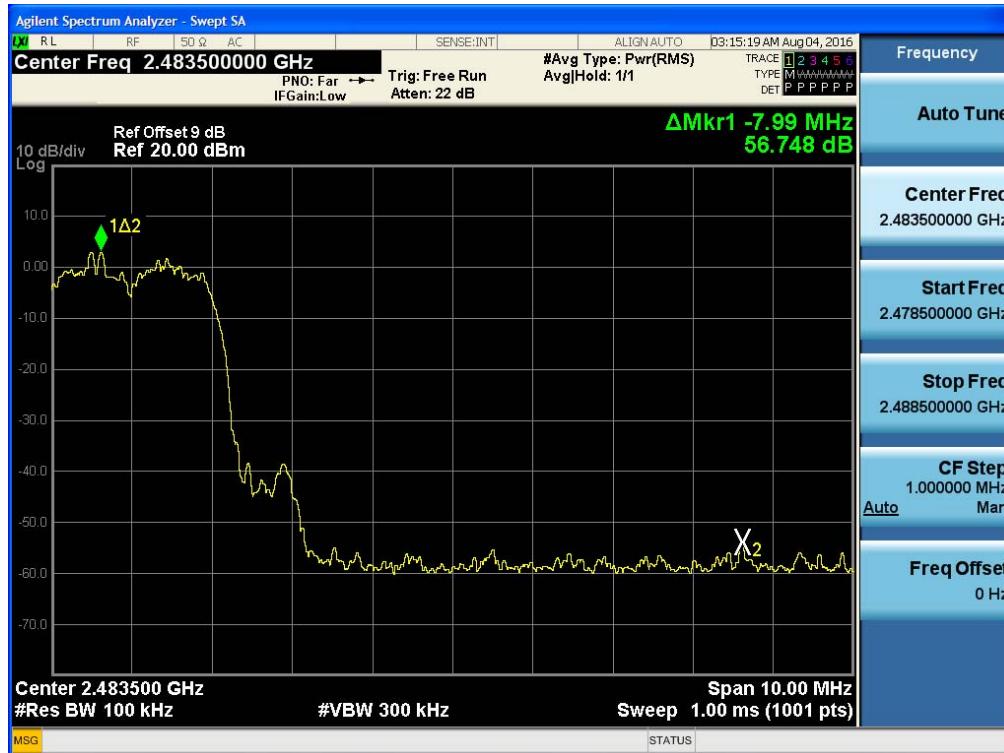
Test Plots with hopping (8DPSK)

Band Edges (CH.0)



Test Plots with hopping (8DPSK)

Band Edges (CH.78)



Test Plots with hopping ($\pi/4$ DQPSK)

Band Edges (CH.0)

Test Plots with hopping ($\pi/4$ DQPSK)

Band Edges (CH.78)

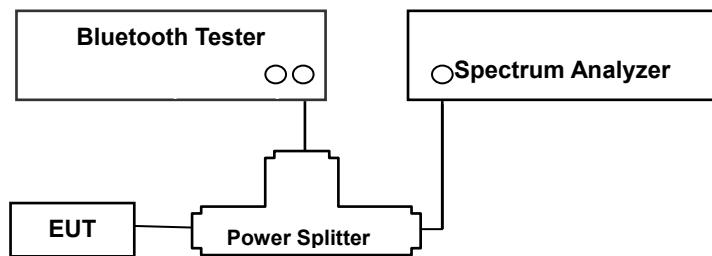


9.3 FREQUENCY SEPARATION / OCCUPIED BANDWIDTH (99% BW)

LIMIT

According to §15.247(a)(1), 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.

Test Configuration



TEST PROCEDURE

The Channel Separation test is performed with hopping on. And the 20 dB Bandwidth test is performed with hopping off.

The Spectrum Analyzer is set to (7.8.2 in ANSI 63.10-2013)

- 1) Span: Wide enough to capture the peaks of two adjacent channels
- 2) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
- 3) VBW \geq RBW
- 4) Sweep: Auto
- 5) Detector: Peak
- 6) Trace: Max hold
- 7) All the trace to stabilize.

Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Compliance of an EUT with the appropriate regulatory limit shall be determined. A plot of the data shall be included in the test report.

TEST RESULTS

No non-compliance noted

Test Data

| Channel Separation (kHz) | | | 20dB Bandwidth (kHz) | | | | Limit (kHz) | Result |
|--------------------------|-------|---------------|----------------------|------|-------|---------------|----------------------------------|--------|
| GFSK | 8DPSK | $\pi/4$ DQPSK | Channel | GFSK | 8DPSK | $\pi/4$ DQPSK | | |
| 984 | 998 | 998 | Low CH | 986 | 1288 | 1277 | >25 or >2/3 of the 20dB BW | Pass |
| | | | Middle CH | 993 | 1283 | 1275 | | |
| | | | High CH | 992 | 1287 | 1276 | | |

Occupied Bandwidth (99% BW)

| 99% BW (kHz) | | | |
|--------------|--------|--------|---------------|
| Channel | GFSK | 8DPSK | $\pi/4$ DQPSK |
| CH.0 | 878.54 | 1156.8 | 1156.2 |
| CH.39 | 878.83 | 1156.3 | 1152.1 |
| CH.78 | 872.20 | 1157.2 | 1151.9 |

Note : We can not know what use channel in AFH mode. So, we can not test in AFH mode. Also, if the test performs some channel in AFH mode, the test result is not different with normal mode.

Test Plots (GFSK)

Channel Separation



Test Plots (8DPSK)

Channel Separation



Test Plots ($\pi/4$ DQPSK)

Channel Separation



Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



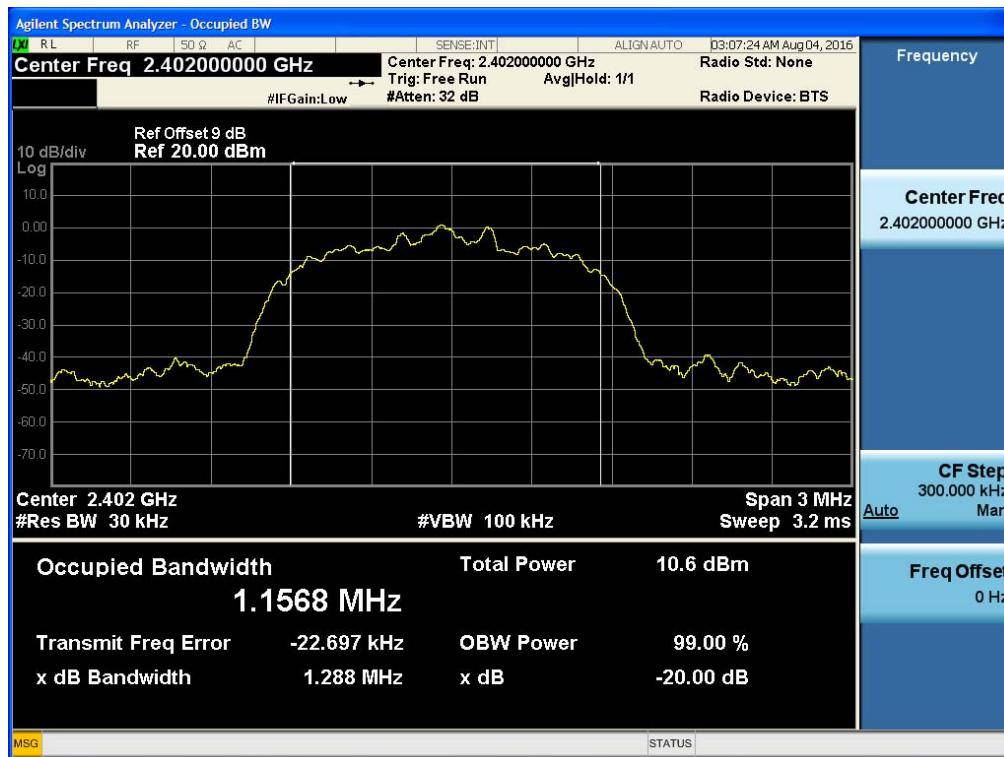
Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)



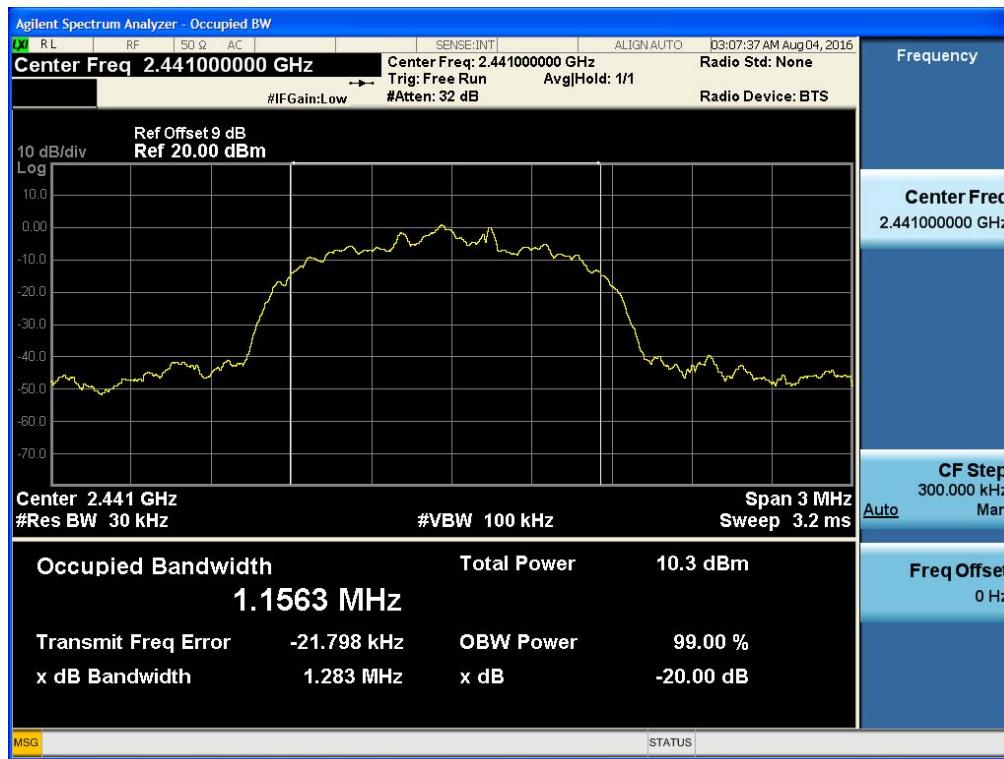
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



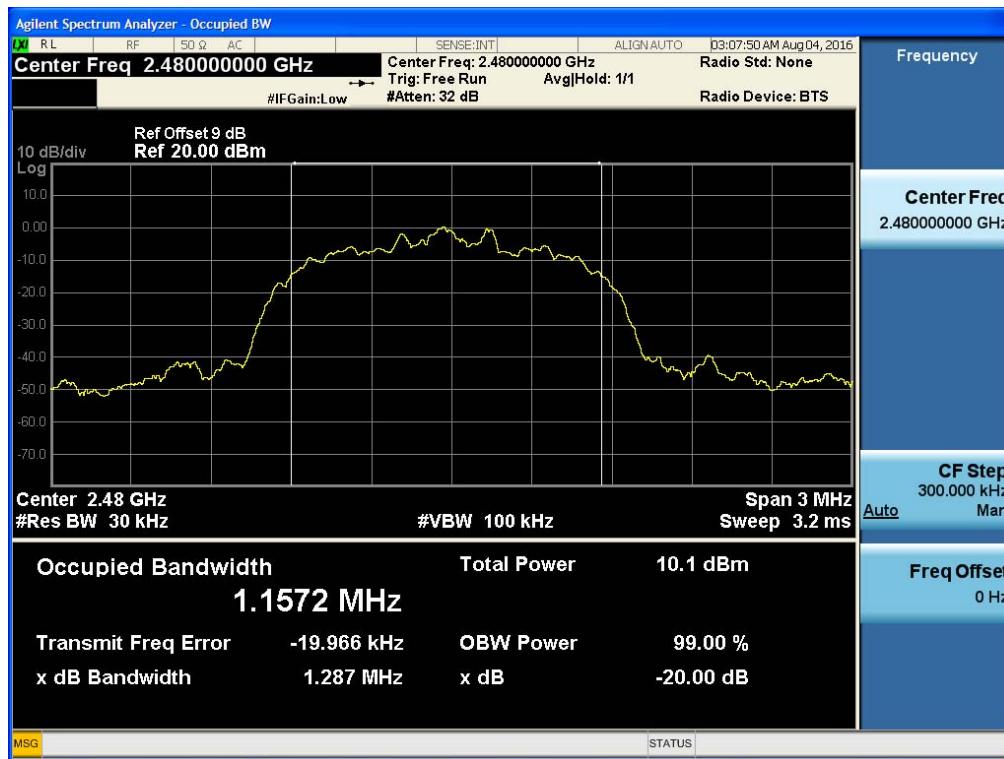
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



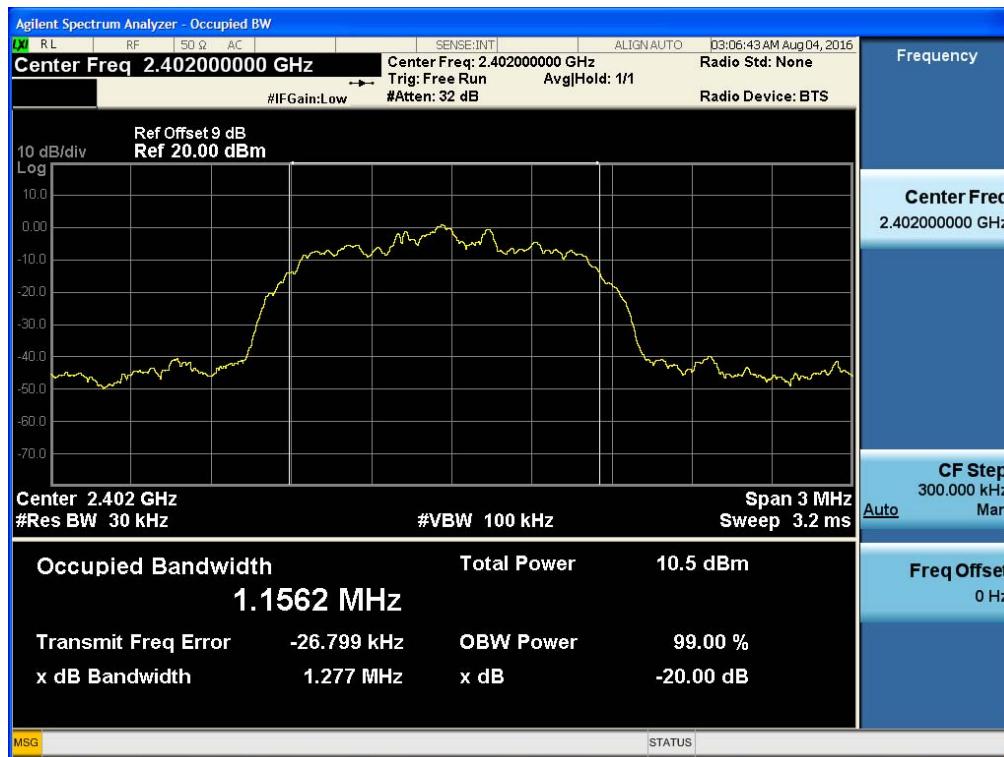
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)

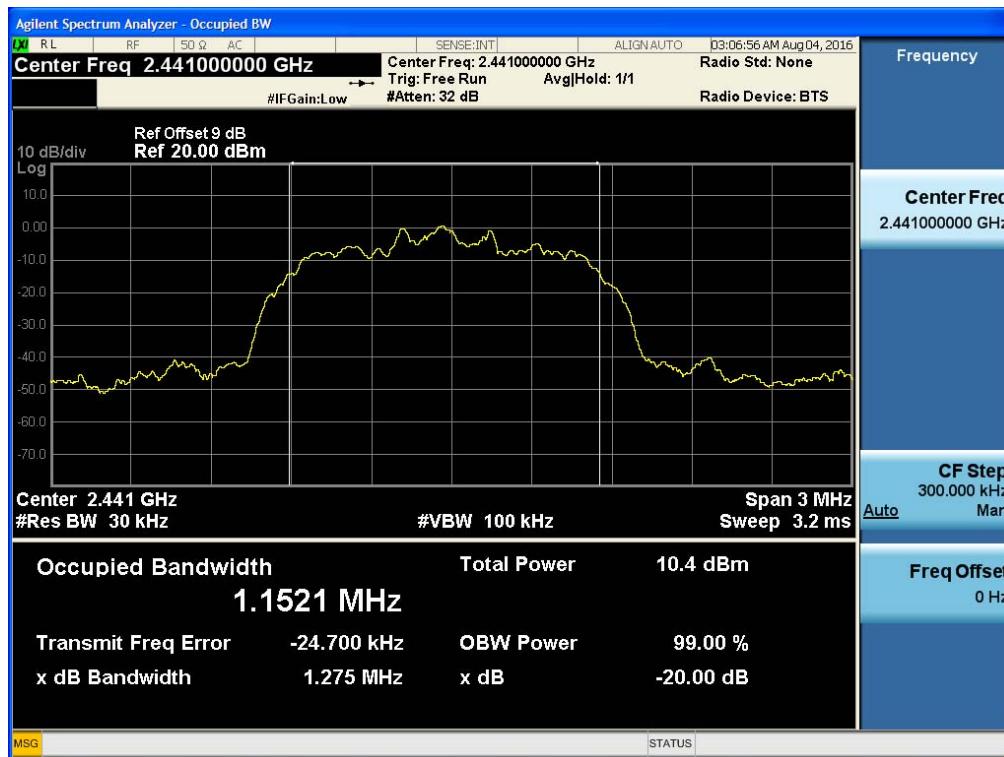


Test Plots ($\pi/4$ DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)

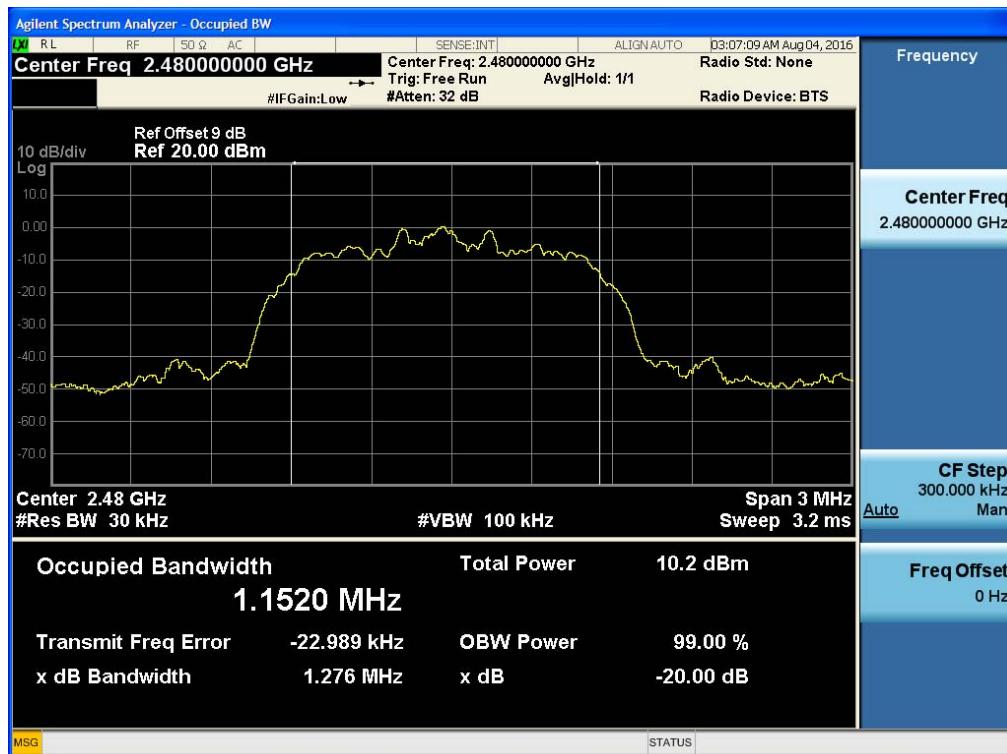
Test Plots ($\pi/4$ DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



Test Plots ($\pi/4$ DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)

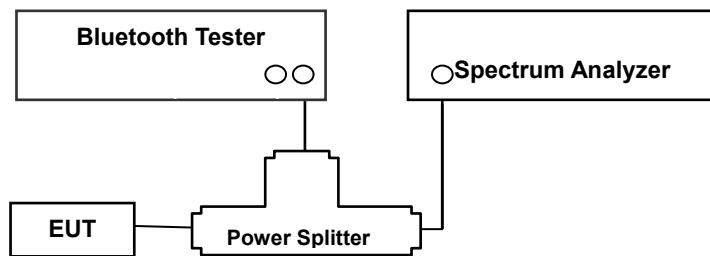


9.4 NUMBER OF HOPPING FREQUENCY

LIMIT

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400 MHz ~ 2483.5 MHz bands shall use at least 15 hopping frequencies.

Test Configuration



TEST PROCEDURE

The Bluetooth frequency hopping function of the EUT was enabled.

The Spectrum Analyzer is set to (7.8.3 in ANSI 63.10-2013)

- 1) Span: the frequency band of operation
- 2) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
- 3) VBW \geq RBW
- 4) Sweep: Auto
- 5) Detector: Peak
- 6) Trace: Max hold
- 7) Allow the trace to stabilize.

TEST RESULTS

No non-compliance noted

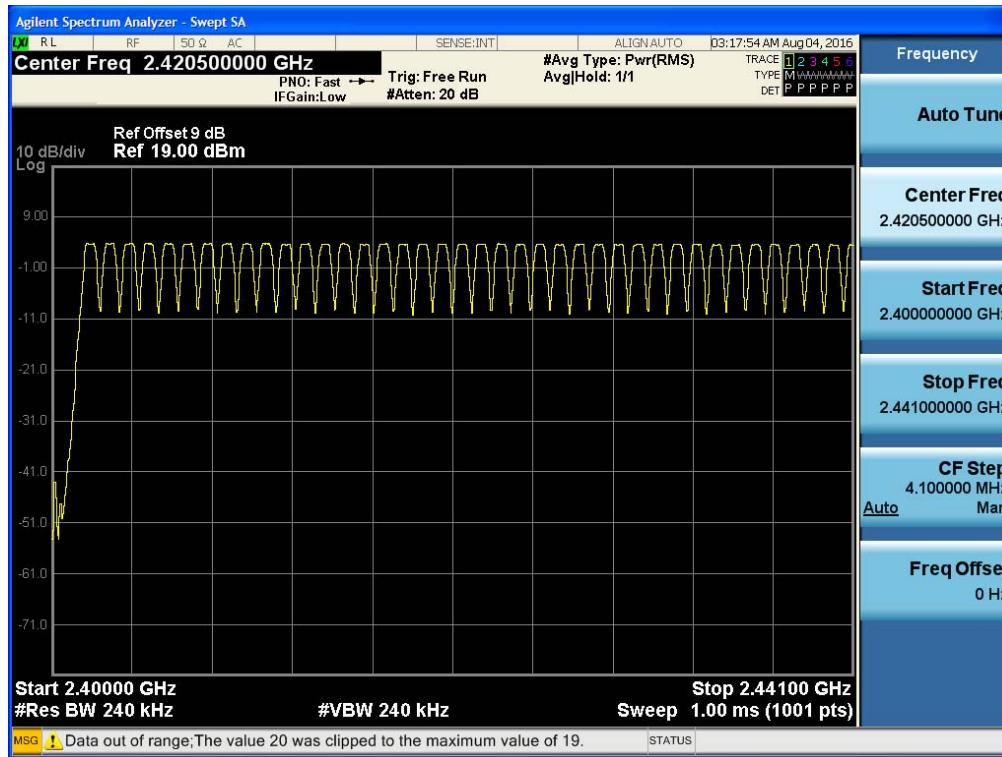
Test Data

| Result (No. of CH) | | | Limit | Result |
|--------------------|-------|---------------|-------|--------|
| GFSK | 8DPSK | $\pi/4$ DQPSK | | |
| 79 | 79 | 79 | >15 | Pass |

Note : In case of AFH mode, minimum number of hopping channels is 20.

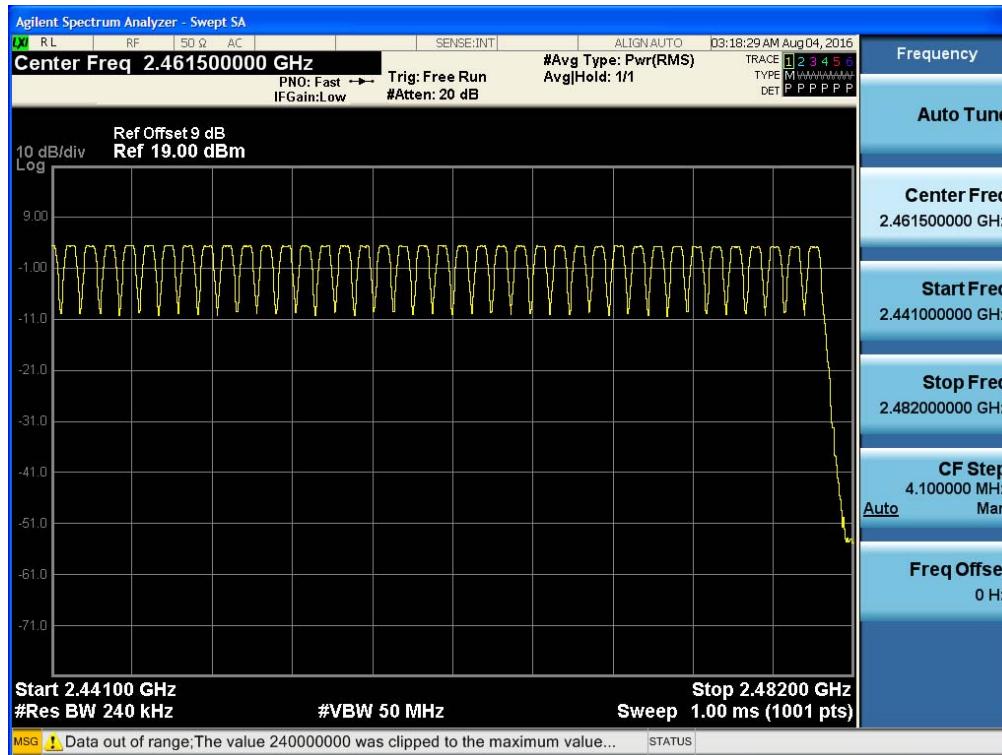
Test Plots (GFSK)

Number of Channels (2.4 GHz - 2.441 GHz)



Test Plots (GFSK)

Number of Channels (2.441 GHz - 2.4835 GHz)



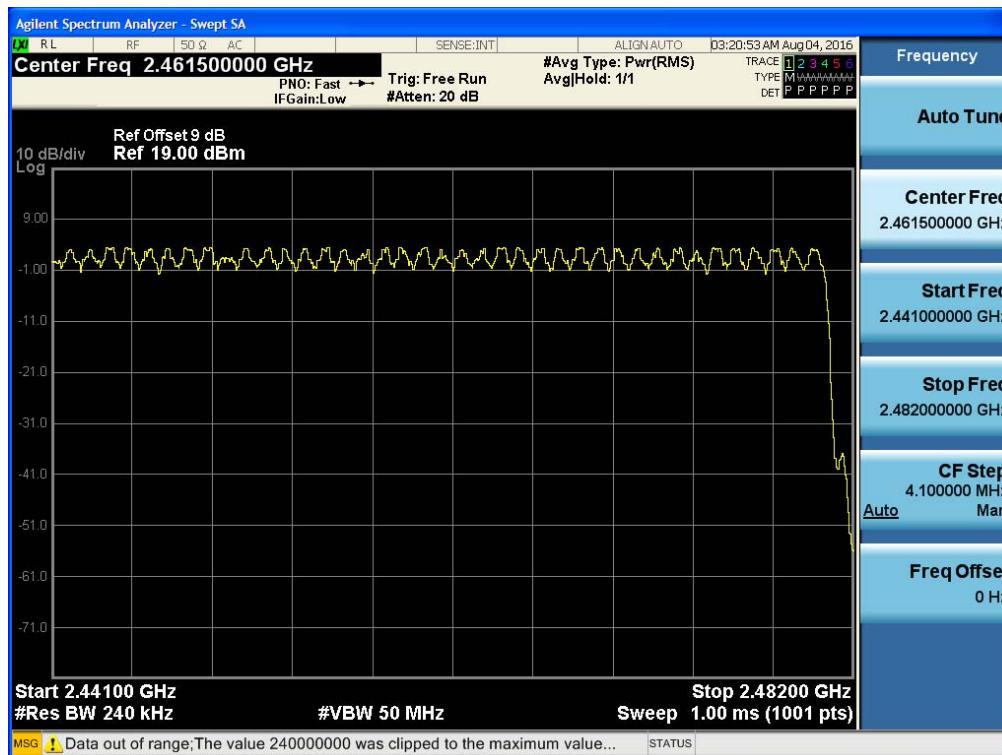
Test Plots (8DPSK)

Number of Channels (2.4 GHz - 2.441 GHz)



Test Plots (8DPSK)

Number of Channels (2.441 GHz - 2.4835 GHz)



Test Plots ($\pi/4$ DQPSK)

Number of Channels (2.4 GHz - 2.441 GHz)

Test Plots ($\pi/4$ DQPSK)

Number of Channels (2.441 GHz - 2.4835 GHz)

