TEST REPORT

MANUFACTURER	:	Bullitt Group
PRODUCT NAME	:	4G Mobile Phone
MODEL NAME	:	S62
BRAND NAME	:	CAT
FCC ID	:	ZL5S62
STANDARD(S)	:	47 CFR Part 15 Subpart C
RECEIPT DATE	:	2020-10-10
TEST DATE	:	2020-11-11 to 2021-01-26
ISSUE DATE	:	2021-02-19

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DIRECTORY

Change History		
Version	Date	Reason for change
1.0	2021-2-19	First edition

1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

Applicant:	Bullitt Group
Applicant Address:	One Valpy, Valpy Street, Reading, Berkshire, RG1 1AR, United Kingdom
Manufacturer:	Bullitt Group
Manufacturer Address:	One Valpy, Valpy Street, Reading, Berkshire, RG1 1AR, United Kingdom

1.2. Equipment Under Test (EUT) Description

Product Name:	4G Mobile Phone	
Serial No:	(N/A, marked #1 by test site)	
Hardware Version:	Q190_V1	
Software Version:	LTE_S02111.10_N_S62_0	
Modulation Type:	Bluetooth: FHSS GFSK(1Mbps), π/4-DQPSK(EDR 2Mbps), 8-DPSK(EDR 3Mbps)	
Operating Frequency Range:	The frequency range used is 2402MHz – 2480MHz (79 channels, at intervals of 1MHz);	
Bluetooth Version:	Bluetooth classic	
Antenna Type:	PIFA Antenna	
Antenna Gain:	0.18dBi	
Accessory Information:	Battery	
	Manufacturer:	Hunan Gaoyuan Battery Co., Ltd.
	Brand Name:	Gaoyuan Battery
	Model No.:	XQ6602G
	Capacity:	4000mAh
	Rated Voltage:	3.80V
	Charge Limit:	4.35V
	AC Adapter	
	Manufacturer:	Jiangxi Jian Aohai Technology Co.,Ltd.

	Brand Name:	AOHAI
	Model No.:	A138-120150C-US1
	Rated Input:	100-240V ~ 50/60Hz 0.5A
	Rated Output:	5V⎓3.0A/9V⎓2.0A/12V⎓1.5A

Note 1: The EUT contains Bluetooth Module operating at 2.4GHz ISM band; the frequencies is F(MHz)=2402+1*n (0<=n<=78). The lowest, middle, highest channel numbers of the Bluetooth Module used and tested in this report are separately 0 (2402MHz), 39 (2441MHz) and 78 (2480MHz).

Note 2: The EUT connected to the serial port of the computer with a serial communication cable, we use the dedicated software to control the EUT into the test mode.

Note 3: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

1.3. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C for the EUT FCC ID Certification:

No	Identity	Document Title
1	47 CFR Part 15	Radio Frequency Devices

Test detailed items/section required by FCC rules and results are as below:

No.	Section in CFR 47	Description	Test Date	Test Engineer	Result
1	15.203	Antenna Requirement	N/A	N/A	PASS
2	15.247(a)	Number of Hopping Frequency	Nov 11, 2020	Stefan Sun	PASS
3	15.247(b)	Peak Output Power	Nov 11, 2020	Stefan Sun	PASS
4	15.247(a)	20dB Bandwidth	Nov 11, 2020	Stefan Sun	PASS
5	15.247(a)	Carrier Frequency Separation	Nov 11, 2020 Jan 11, 2021	Stefan Sun	PASS
6	15.247(a)	Time of Occupancy (Dwell time)	Jan 11, 2021	Stefan Sun	PASS
7	15.247(d)	Conducted Spurious Emission and Band Edge	Nov 11, 2020 Jan 22, 2021	Stefan Sun	PASS
8	15.247(d)	Restricted Frequency Bands	Dec 05, 2020	Yaming Luo	PASS
9	15.209, 15.247(d)	Radiated Emission	Dec 05, 2020	Yaming Luo	PASS
10	15.207	Conducted Emission	Jan 26, 2021	Yaming Luo	PASS
Note 1: The tests were performed according to the method of measurements prescribed in ANSI C63.10-2013.					

1.4. Environmental Conditions

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

Temperature (°C):	15 - 35
Relative Humidity (%):	30 - 60
Atmospheric Pressure (kPa):	86 - 106

2. 47 CFR Part 15C Requirements

2.1. Antenna requirement

2.1.1. Applicable Standard

According to FCC 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 shall be considered sufficient to comply with the provisions of this section.

2.1.2. Result: Compliant

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

2.2. Number of Hopping Frequency

2.2.1. Requirement

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

2.2.2. Test Description

A. Test Setup:

The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

2.2.3. Test Procedure

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

B. Equipments List:

Please reference ANNEX B(4).

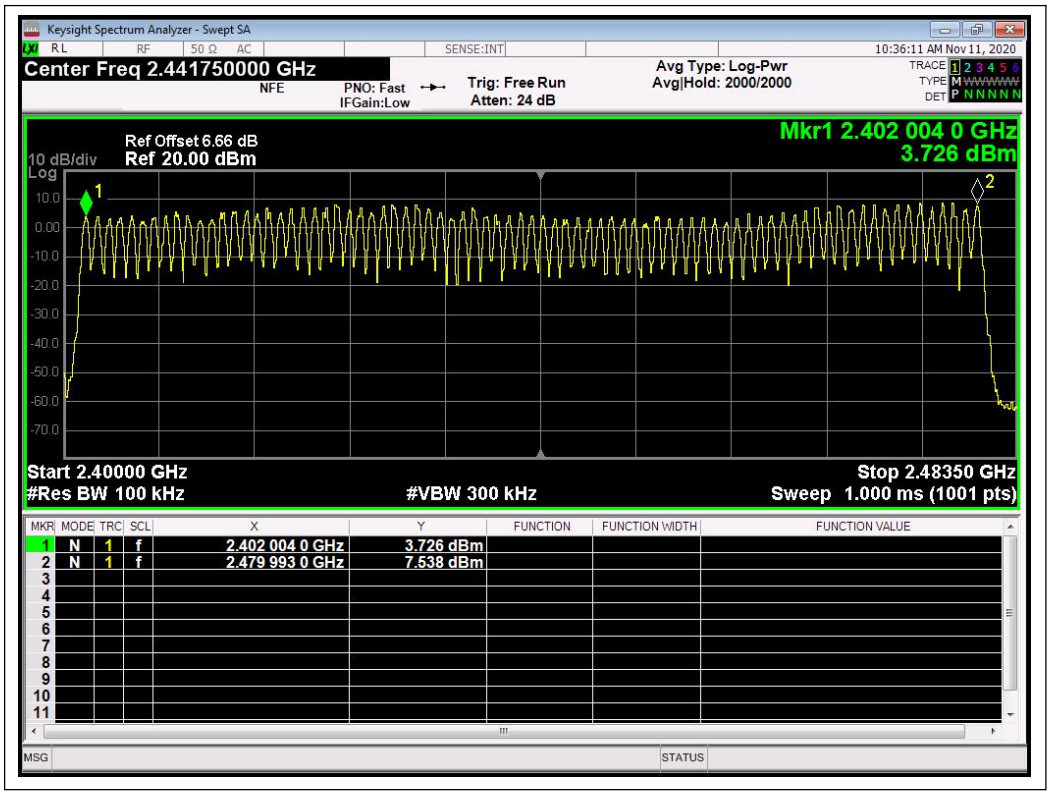
2.2.4. Test Result

The Bluetooth Module operates at hopping-on test mode; the frequencies number employed is counted to verify the Module's using the number of hopping frequency.

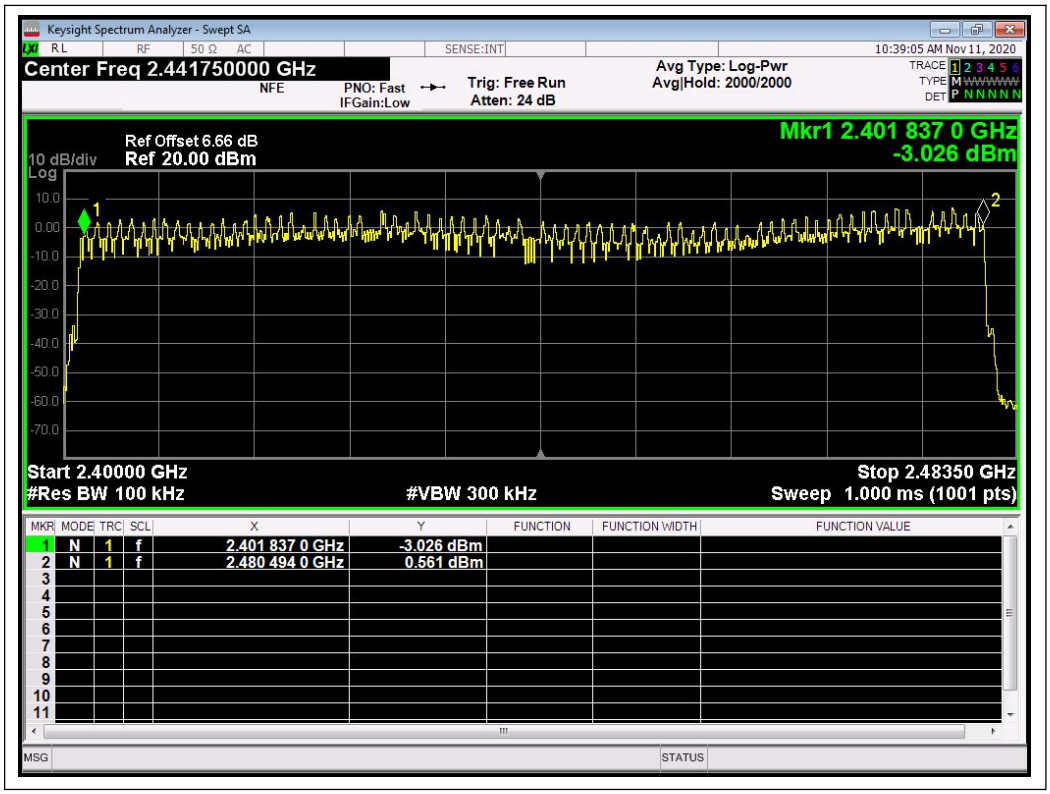
A. Test Verdict:

Test Mode	Frequency Block (MHz)	Measured Channel Numbers	Min. Limit	Verdict
GFSK	2400 - 2483.5	79	15	PASS
π/4-DQPSK	2400 - 2483.5	79	15	PASS
8-DPSK	2400 - 2483.5	79	15	PASS

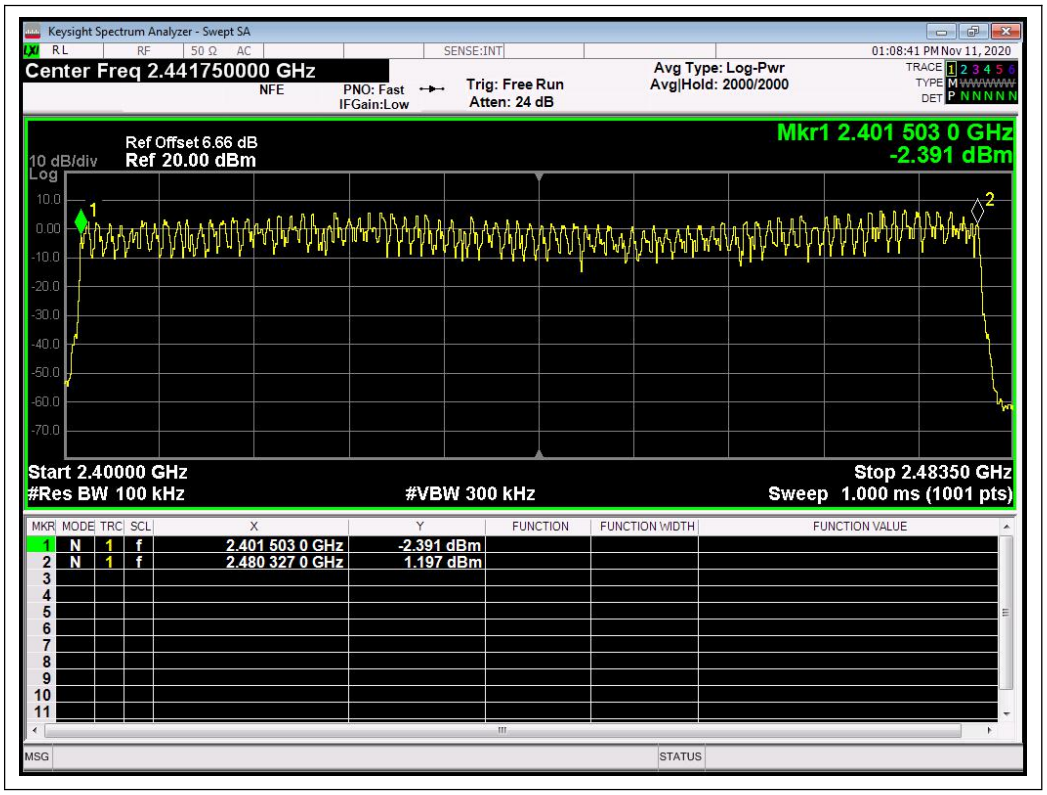
B. Test Plots:



(GFSK)



(π/4-DQPSK)



(8- DPSK)

2.3. Peak Output Power

2.3.1. Requirement

According to FCC §15.247(b)(1), for frequency hopping systems that operates in the 2400MHz to 2483.5MHz band employing at least 75 hopping channels, the maximum peak output power of the intentional radiator shall not exceed 1Watt. For all other frequency hopping systems in the 2400MHz to 2483.5MHz band, it is 0.125Watts.

2.3.2. Test Description

A. Test Setup:

The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

B. Equipments List:

Please refer ANNEX B(4).

2.3.3. Test procedure

The measured output power was calculated by the reading of the spectrum analyzer and calibration. Following is the test procedure for Peak Output Power test on the spectrum analyzer:

a) Set analyzer center frequency to channel center frequency.
b) Set the RBW to 3MHz
c) Set VBW to 8MHz
d) Set span to 10MHz
e) Sweep time to auto couple.
f) Detector=peak.
g) Trace mode=max hold.
h) Allow trace to fully stabilize.

Use peak marker function to determine the peak amplitude level.

2.3.4. Test Result

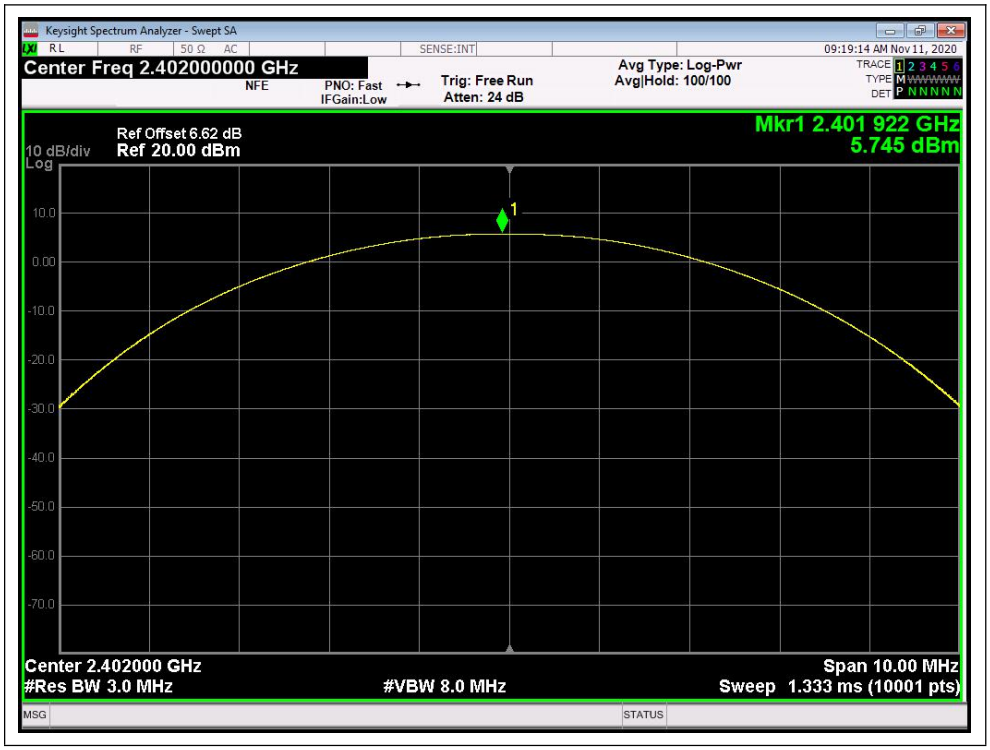
The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the module.

GFSK Mode

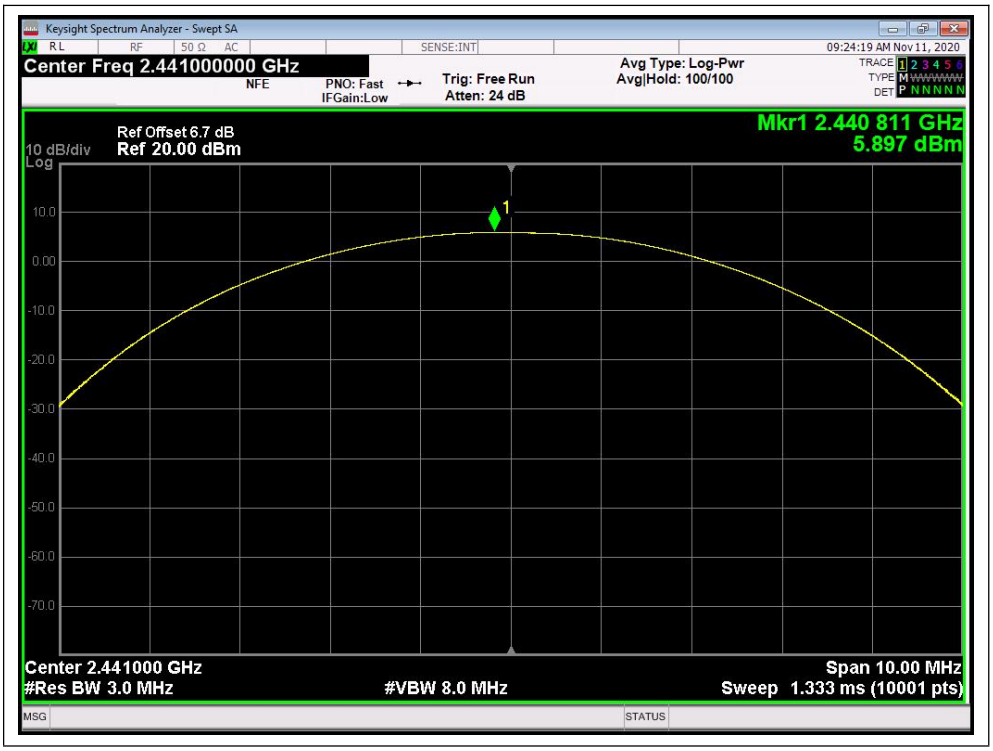
A. Test Verdict:

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
0	2402	5.745	0.004	21	0.125	PASS
39	2441	5.897	0.004			PASS
78	2480	8.309	0.007			PASS

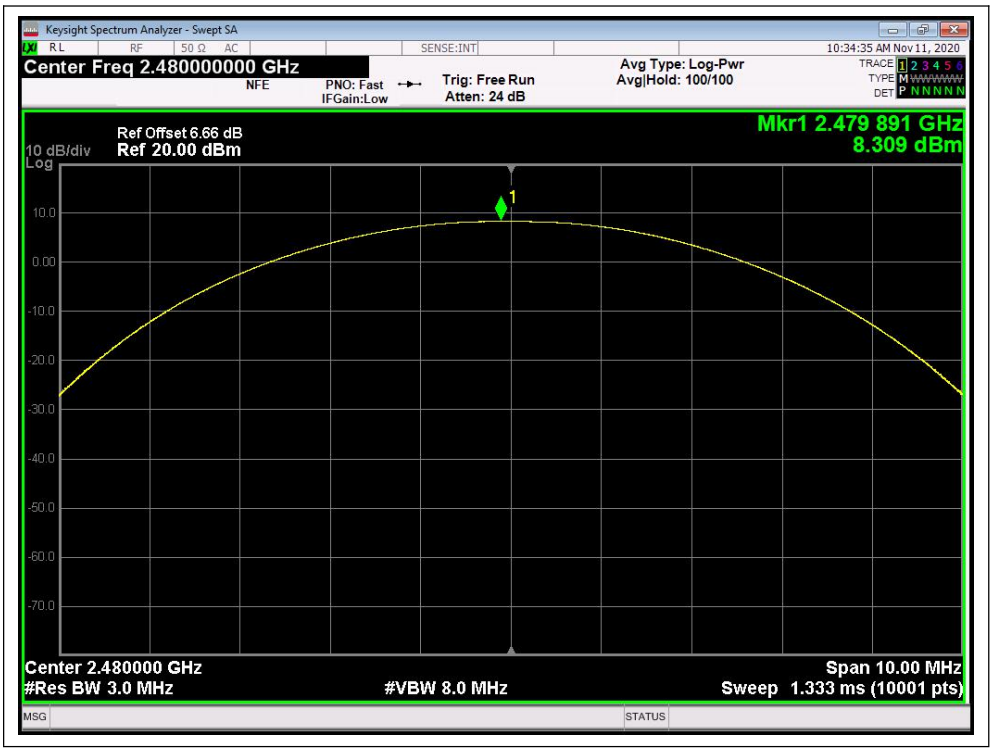
B. Test Plots:



(GFSK, Channel 0, 2402MHz)



(GFSK, Channel 39, 2441MHz)



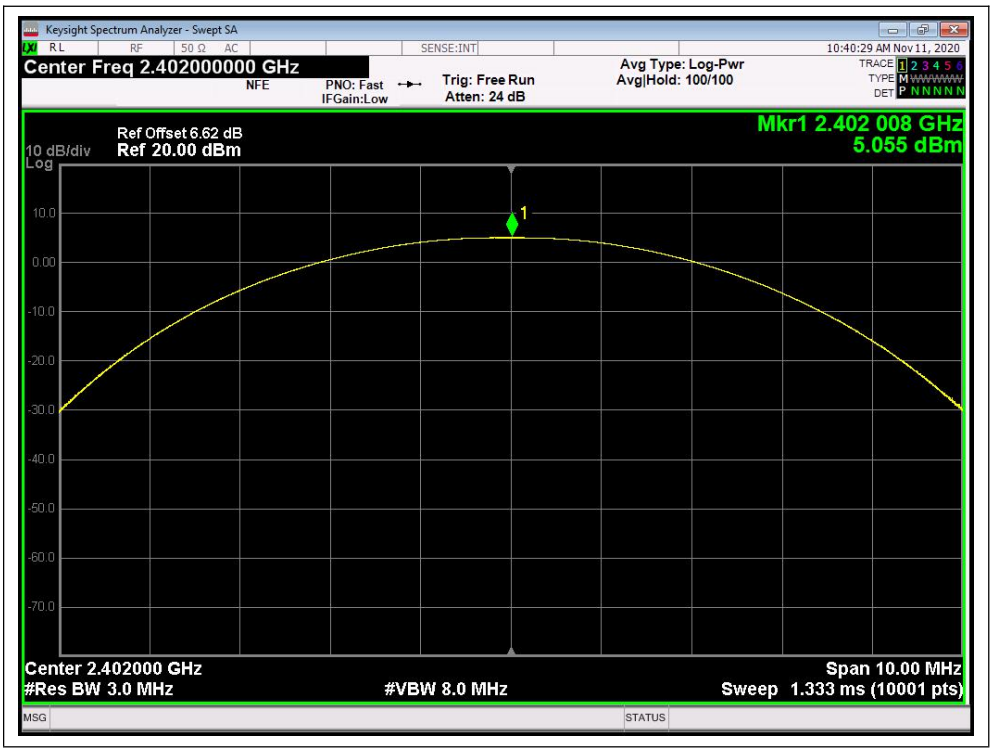
(GFSK, Channel 78, 2480MHz)

π/4-DQPSK Mode

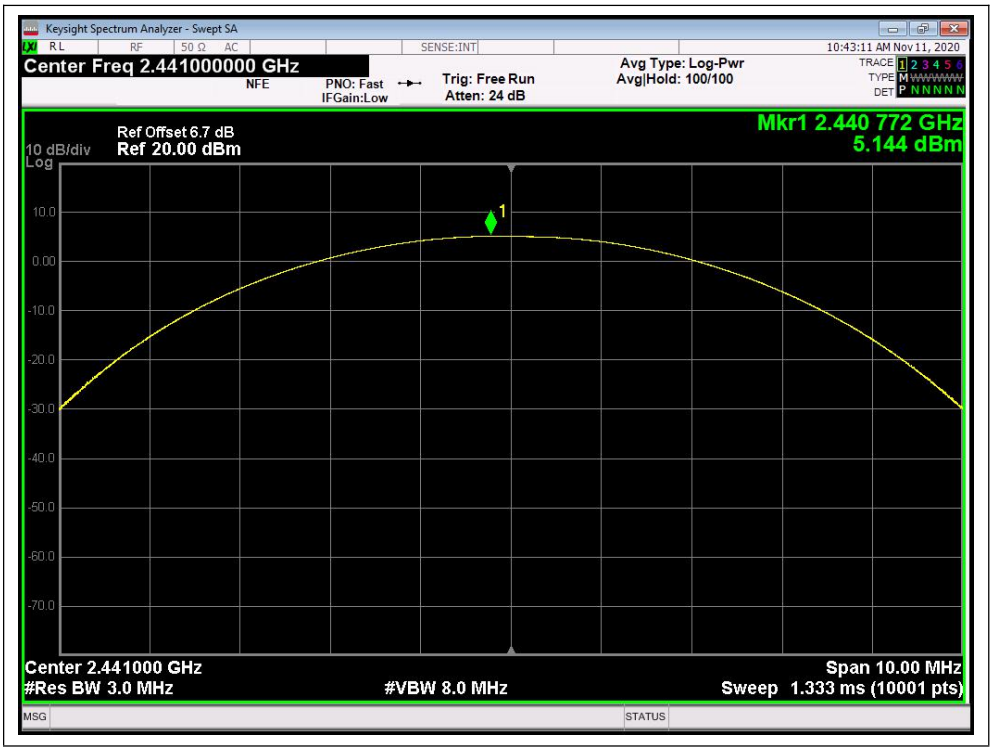
A. Test Verdict:

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
0	2402	5.055	0.003	21	0.125	PASS
39	2441	5.144	0.003			PASS
78	2480	8.305	0.007			PASS

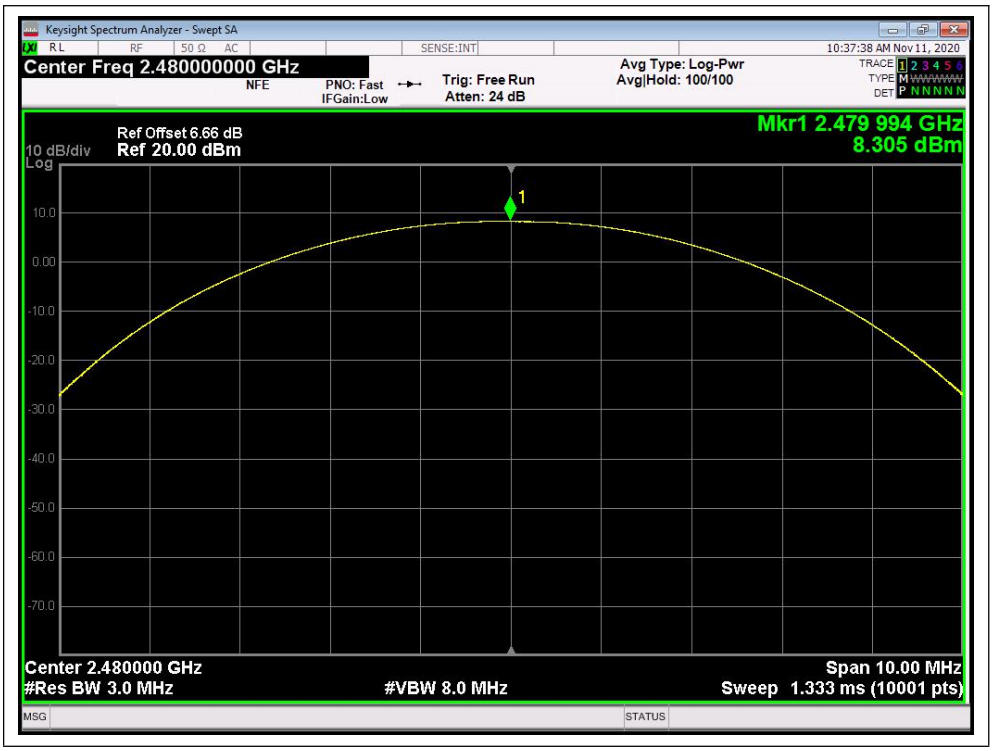
B. Test Plots:



(π/4-DQPSK, Channel 0, 2402MHz)



(π/4-DQPSK, Channel 39, 2441MHz)



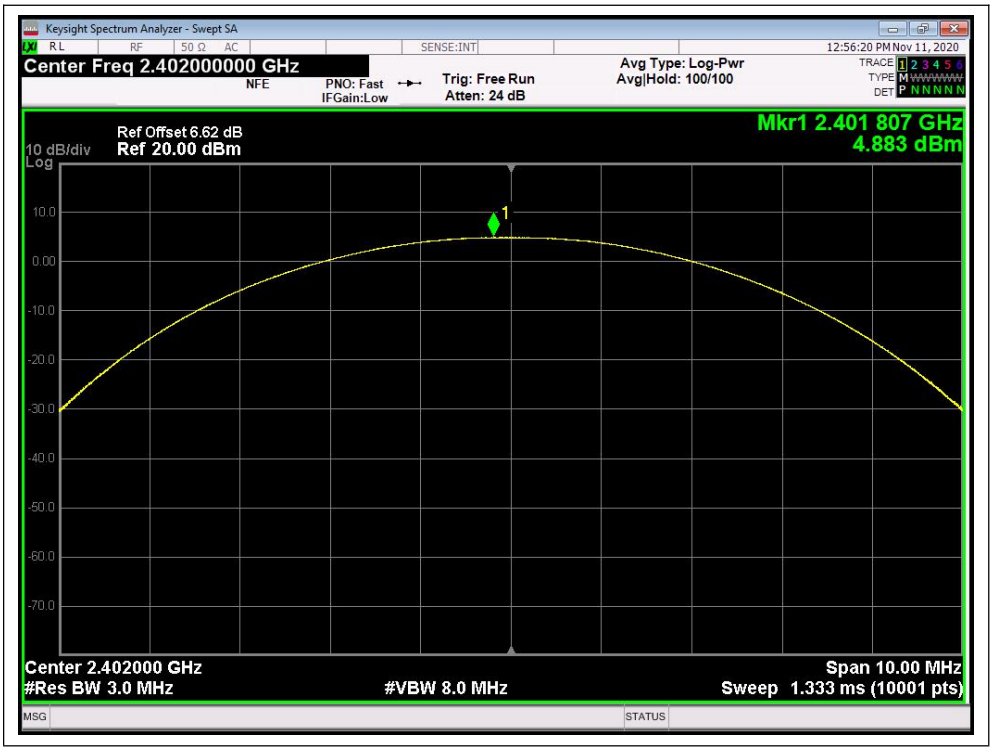
(π/4-DQPSK, Channel 78, 2480MHz)

8-DPSK Mode

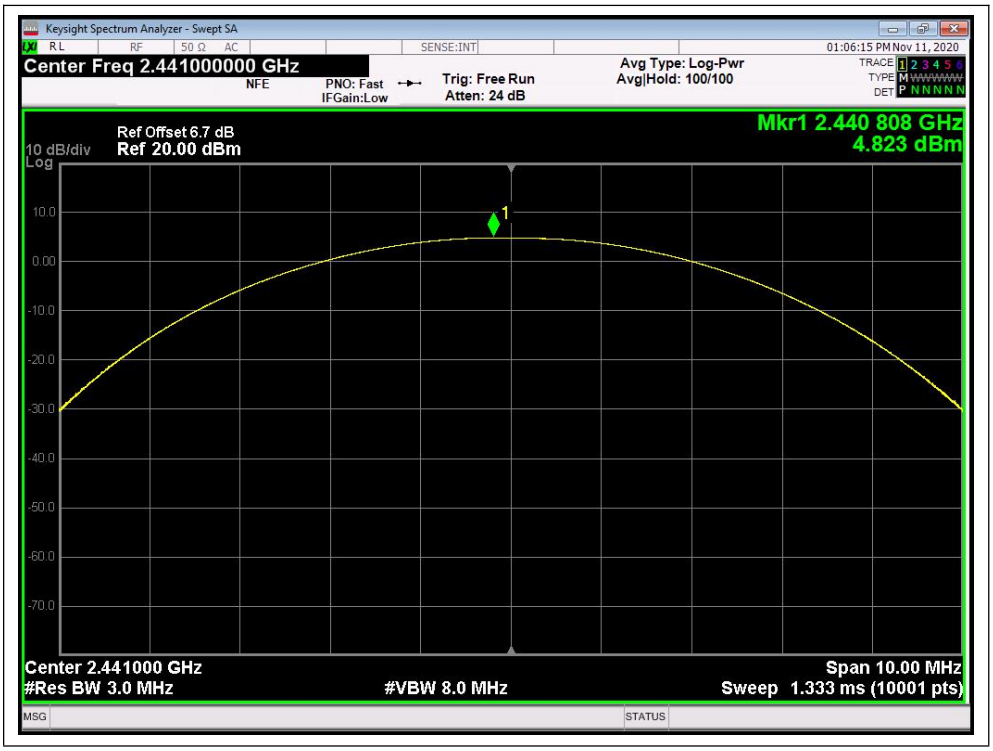
A. Test Verdict:

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
0	2402	4.883	0.003	21	0.125	PASS
39	2441	4.823	0.003			PASS
78	2480	8.054	0.006			PASS

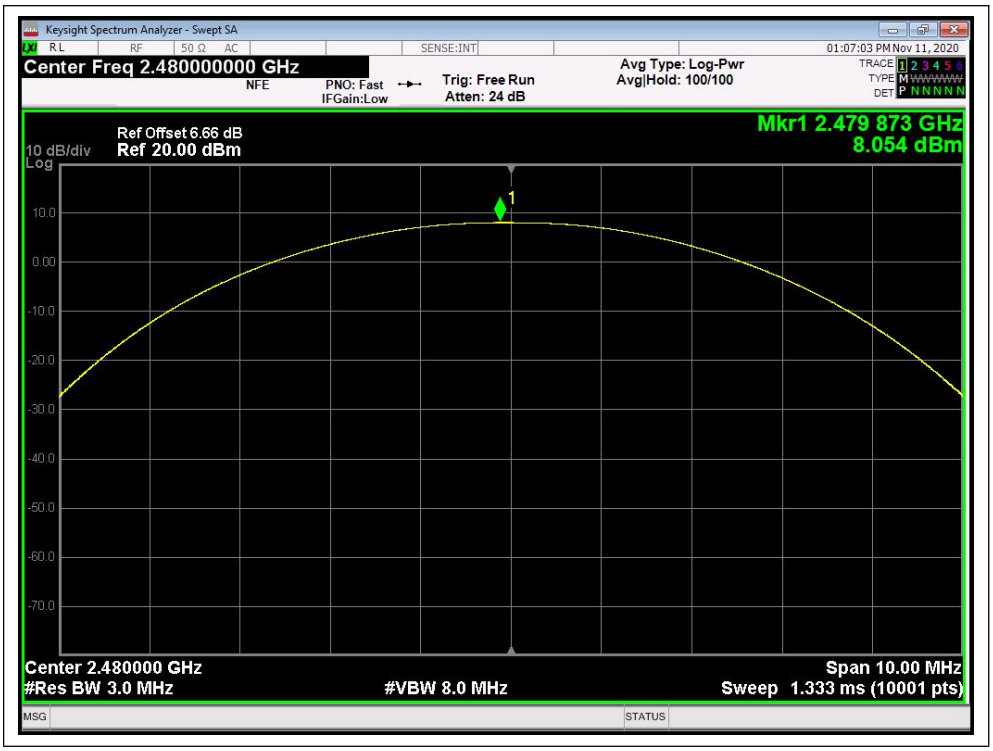
B. Test Plots:



(8-DPSK, Channel 0, 2402MHz)



(8-DPSK, Channel 39, 2441MHz)



(8-DPSK, Channel 78, 2480MHz)

2.4. 20dB Bandwidth

2.4.1. Definition

According to FCC §15.247(a)(1), the 20dB bandwidth is known as the 99% emission bandwidth, or 20dB bandwidth (10*log1% = 20dB) taking the total RF output power.

2.4.2. Test Description

A. Test Setup:

The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

B. Equipments List:

Please refer ANNEX B(4).

2.4.3. Test procedure

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
c. Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.
d. Reapeat above procedures until all frequencies measured were complete.

2.4.4. Test Result

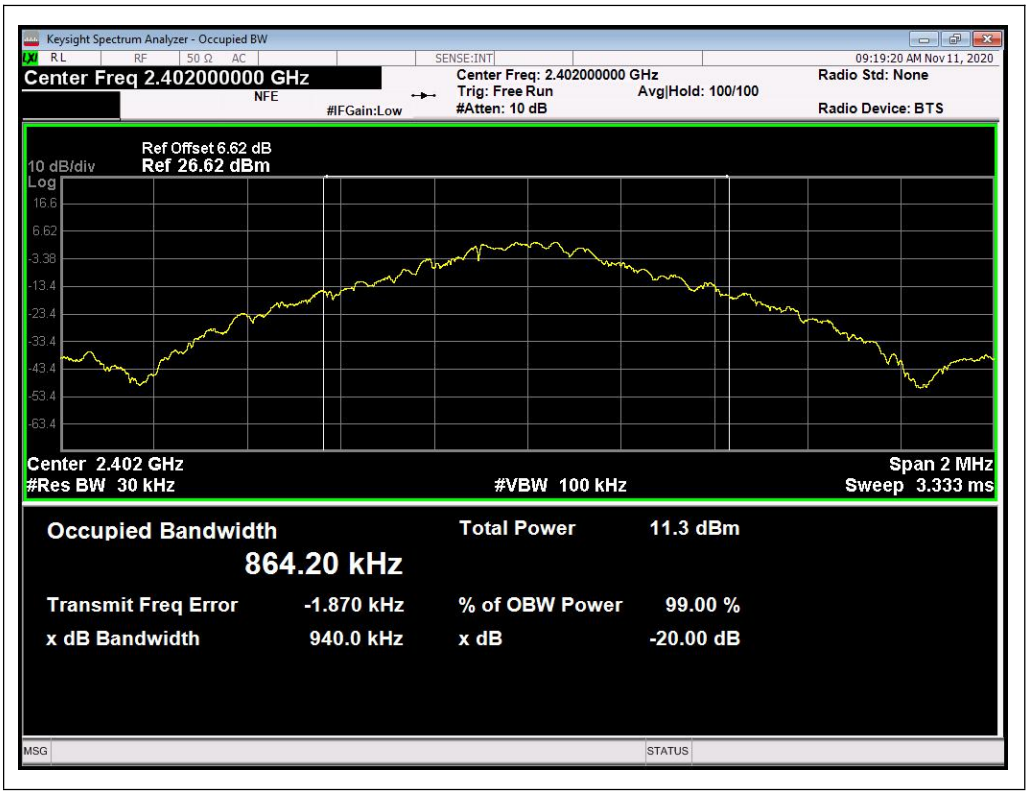
The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to record the 20dB bandwidth of the Module.

GFSK Mode

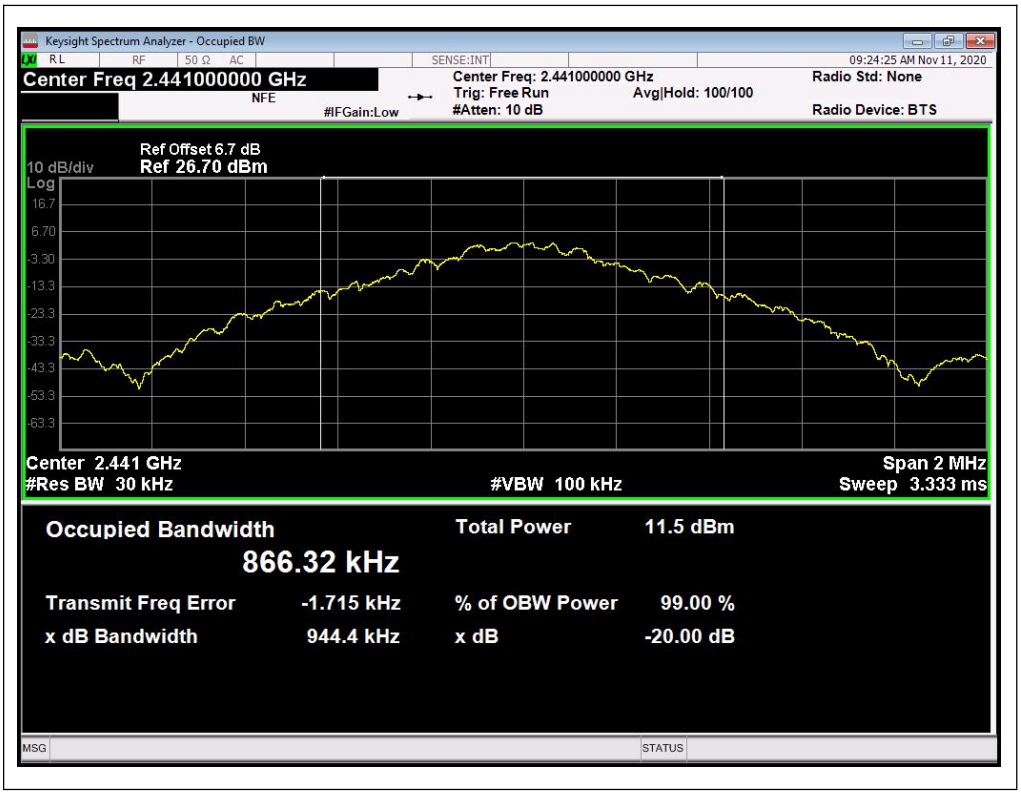
A. Test Verdict:

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Result
0	2402	0.940	PASS
39	2441	0.944	PASS
78	2480	0.944	PASS

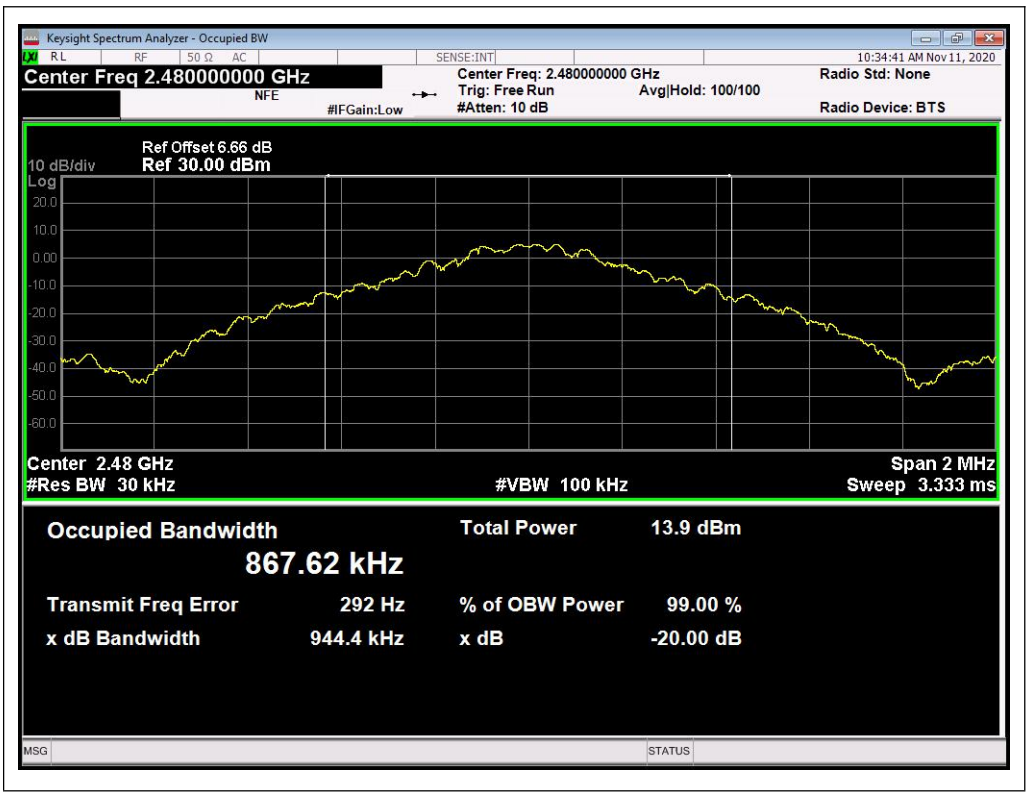
B. Test Plots:



(GFSK, Channel 0, 2402MHz)



(GFSK, Channel 39, 2441MHz)



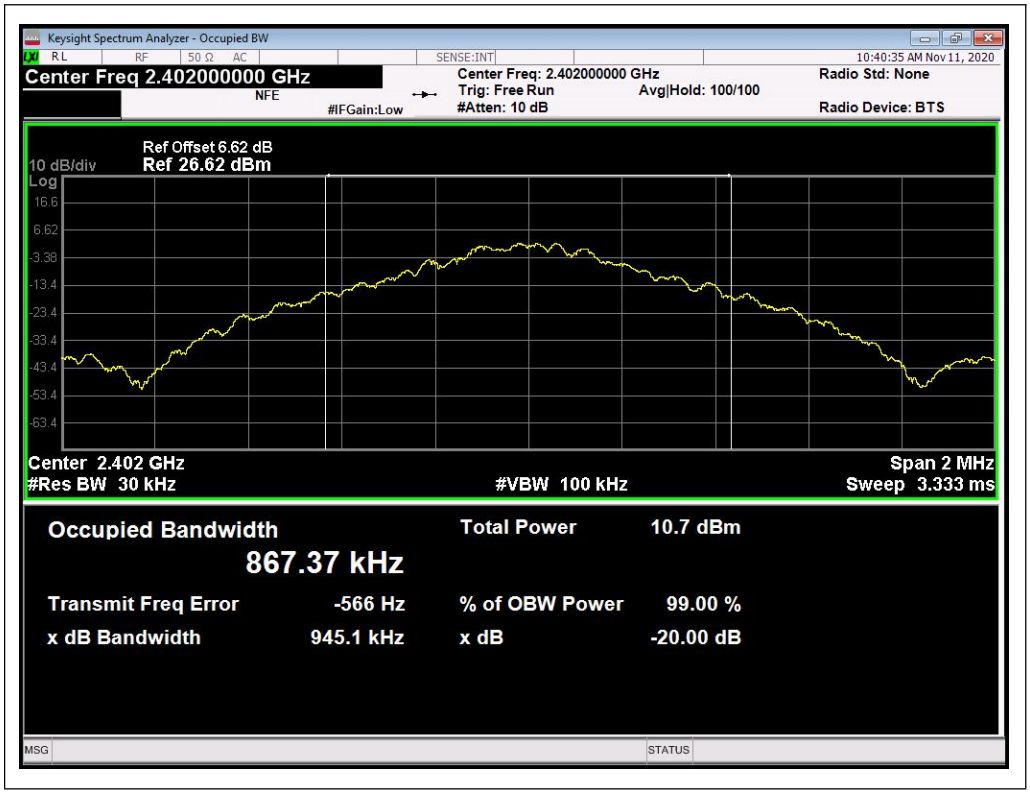
(GFSK, Channel 78, 2480MHz)

π/4-DQPSK Mode

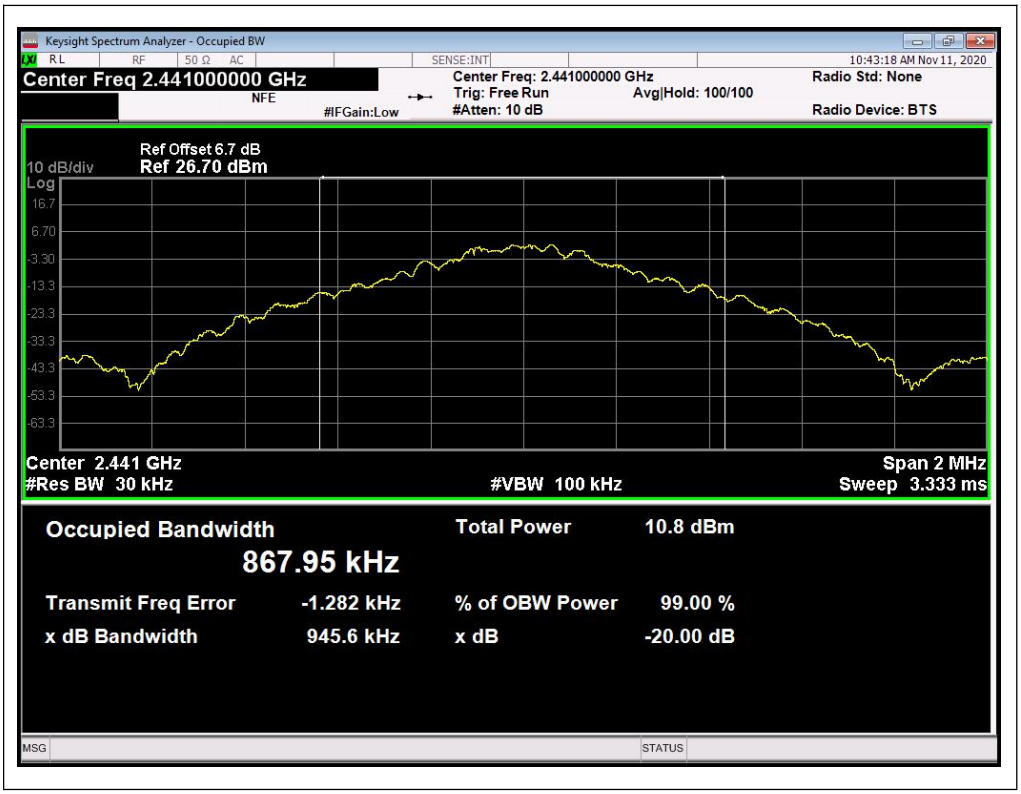
A. Test Verdict:

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Result
0	2402	0.945	PASS
39	2441	0.946	PASS
78	2480	0.946	PASS

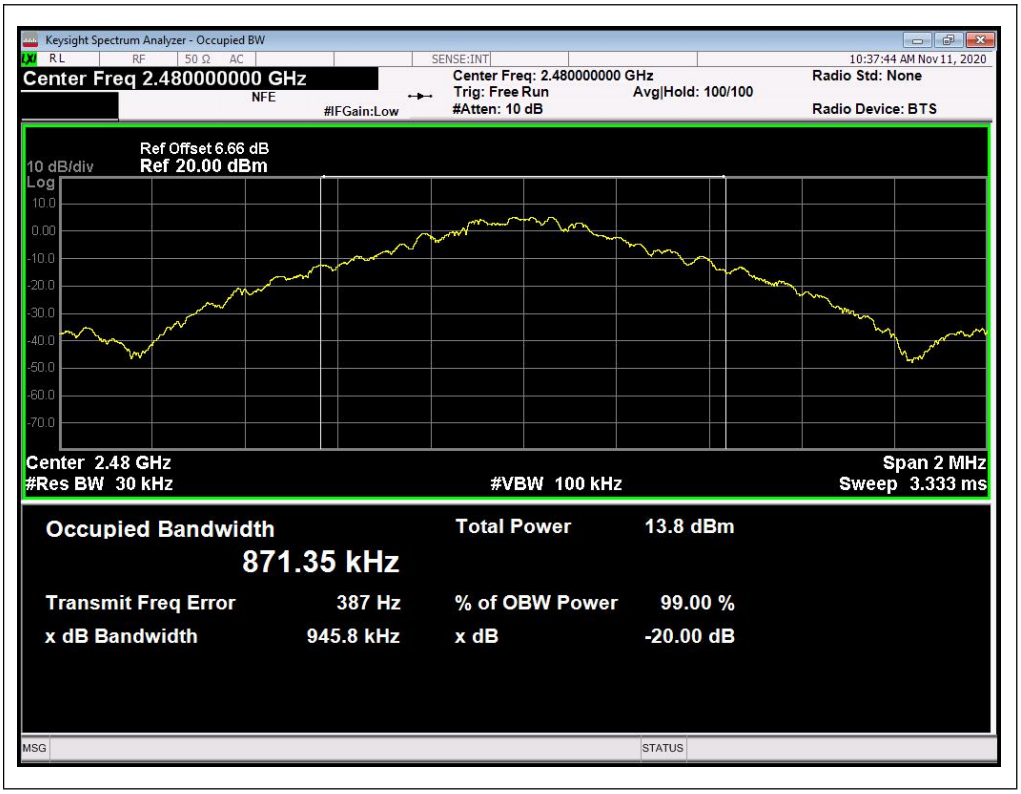
B. Test Plots:



(π/4-DQPSK, Channel 0, 2402MHz)



(π/4-DQPSK, Channel 39, 2441MHz)



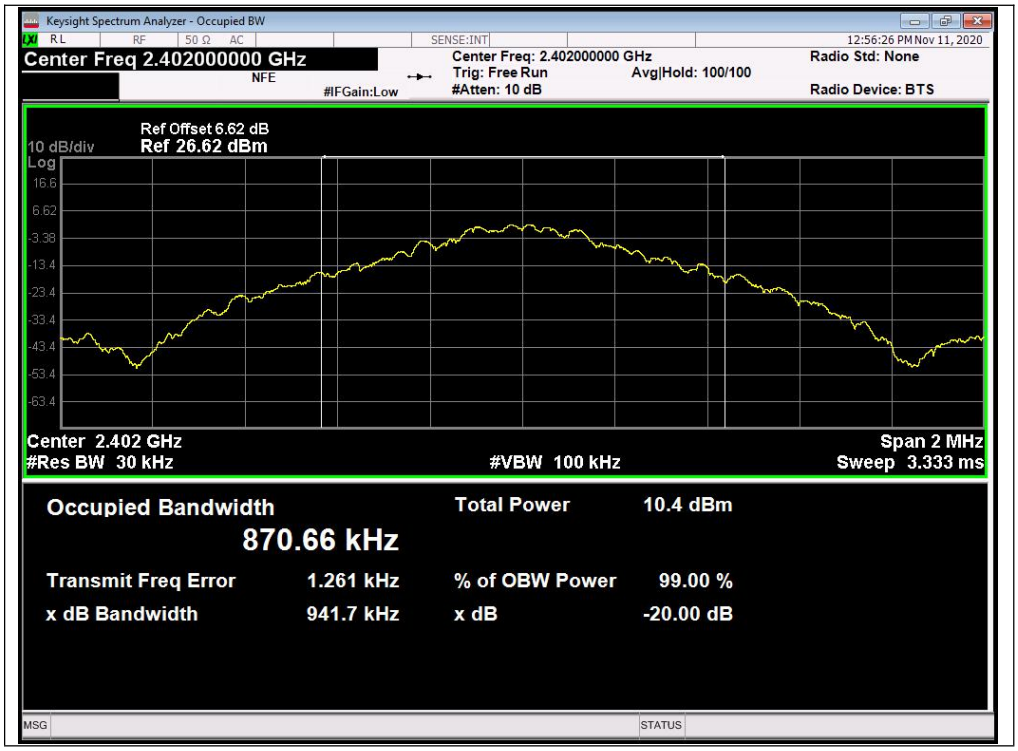
(π/4-DQPSK, Channel 78, 2480MHz)

8-DPSK Mode

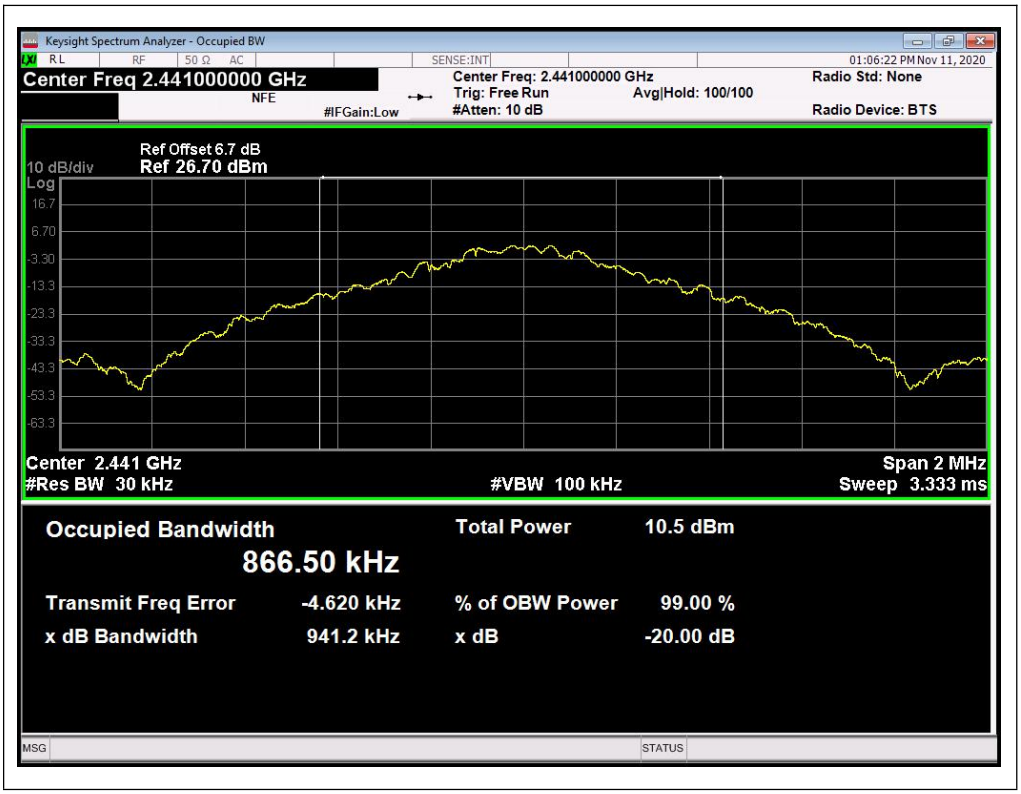
A. Test Verdict:

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Result
0	2402	0.942	PASS
39	2441	0.941	PASS
78	2480	0.948	PASS

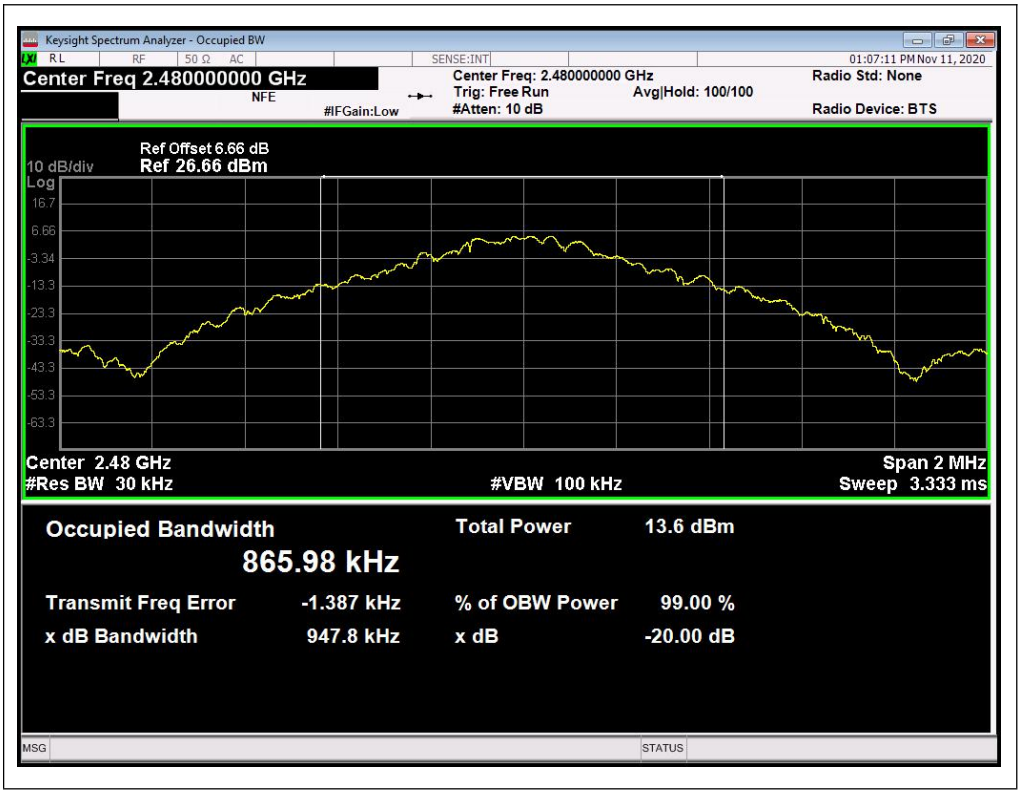
B. Test Plots:



(8-DPSK, Channel 0, 2402MHz)



(8-DPSK, Channel 39, 2441MHz)



(8-DPSK, Channel 78, 2480MHz)

2.5. Carried Frequency Separation

2.5.1. Definition

According to FCC §15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

2.5.2. Test Description

A. Test Setup:

The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

B. Equipments List:

Please refer ANNEX B(4).

2.5.3. Test Procedure

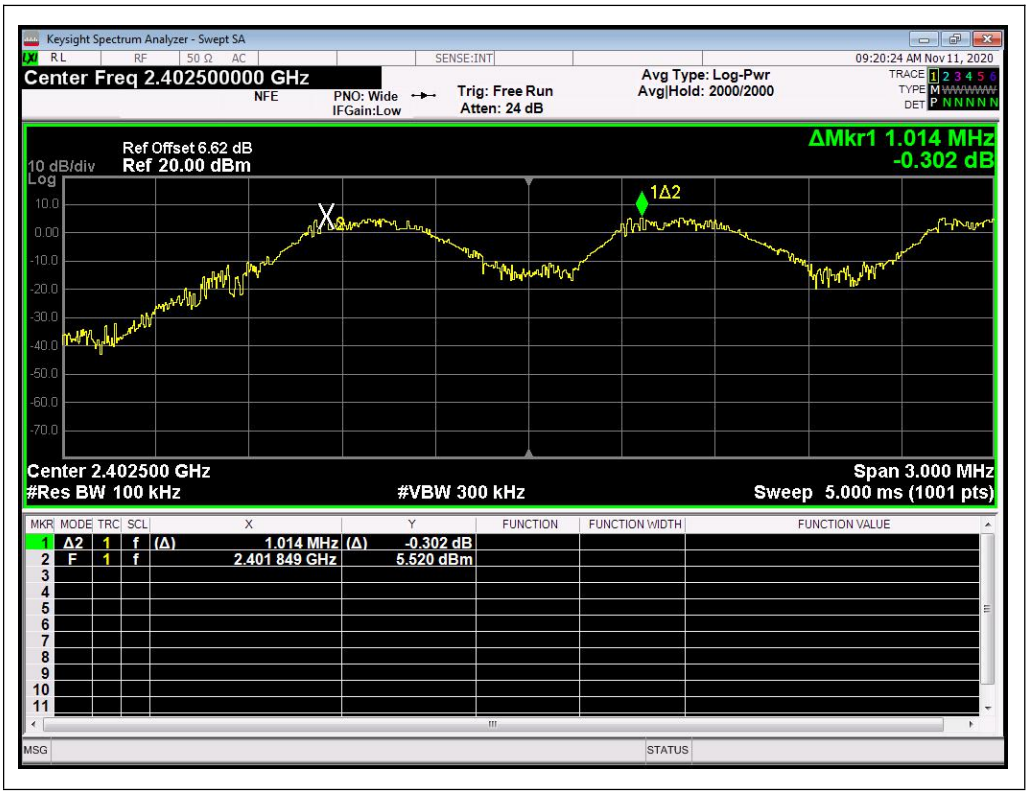
a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
c. By using the MaxHold function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

2.5.4. Test Result

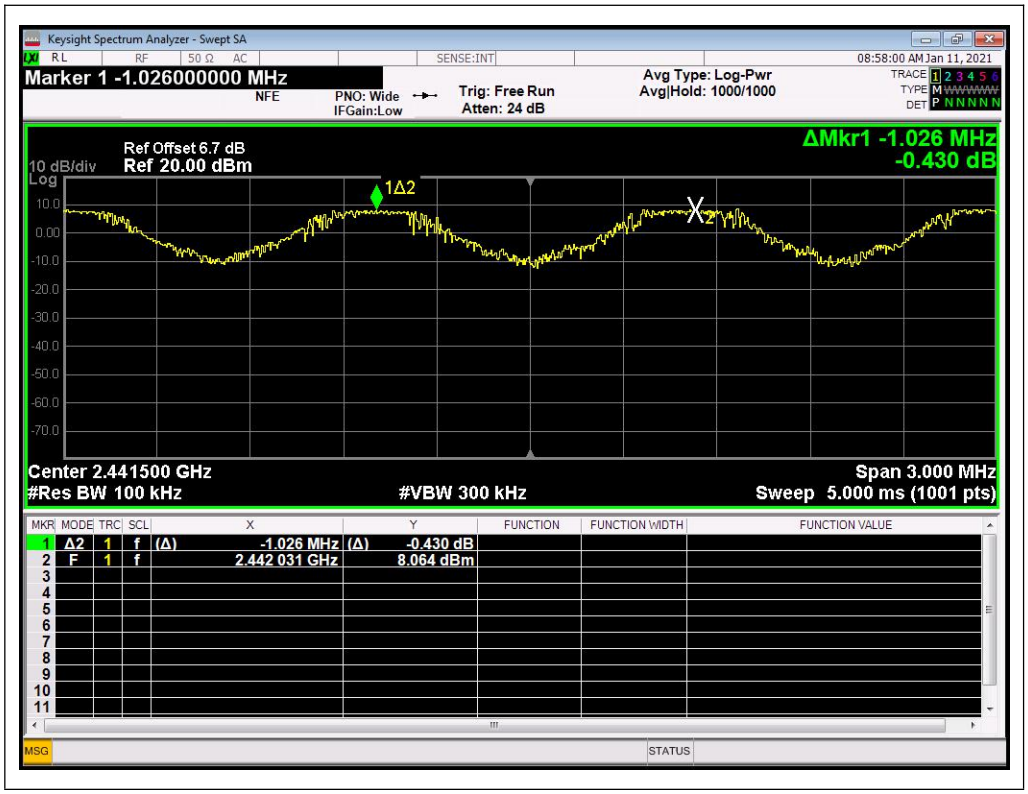
The Bluetooth Module operates at hopping-on test mode. For any adjacent channels (e.g. the channel 39 and 40 as showed below), the Module does have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel (refer to section 2.4.4), whichever is greater. So, the verdict is PASS.

Test Mode	Measured Channel Numbers	Carried Frequency Separation (MHz)	20dB bandwidth (MHz)	Min. Limit$_{Note1}$ (MHz)	Verdict
GFSK	0 and 1	1.014	0.940	0.627	PASS
	39 and 40	1.026	0.944	0.629	PASS
	77 and 78	1.008	0.944	0.629	PASS
π/4-DQPSK	0 and 1	0.987	0.945	0.630	PASS
	39 and 40	1.035	0.946	0.631	PASS
	77 and 78	1.023	0.946	0.631	PASS
8-DPSK	0 and 1	1.155	0.942	0.628	PASS
	39 and 40	1.131	0.941	0.627	PASS
	77 and 78	1.146	0.948	0.632	PASS
Note 1:Min. Limit is equal to the two-thirds of the 20dB bandwidth					

Test Plots

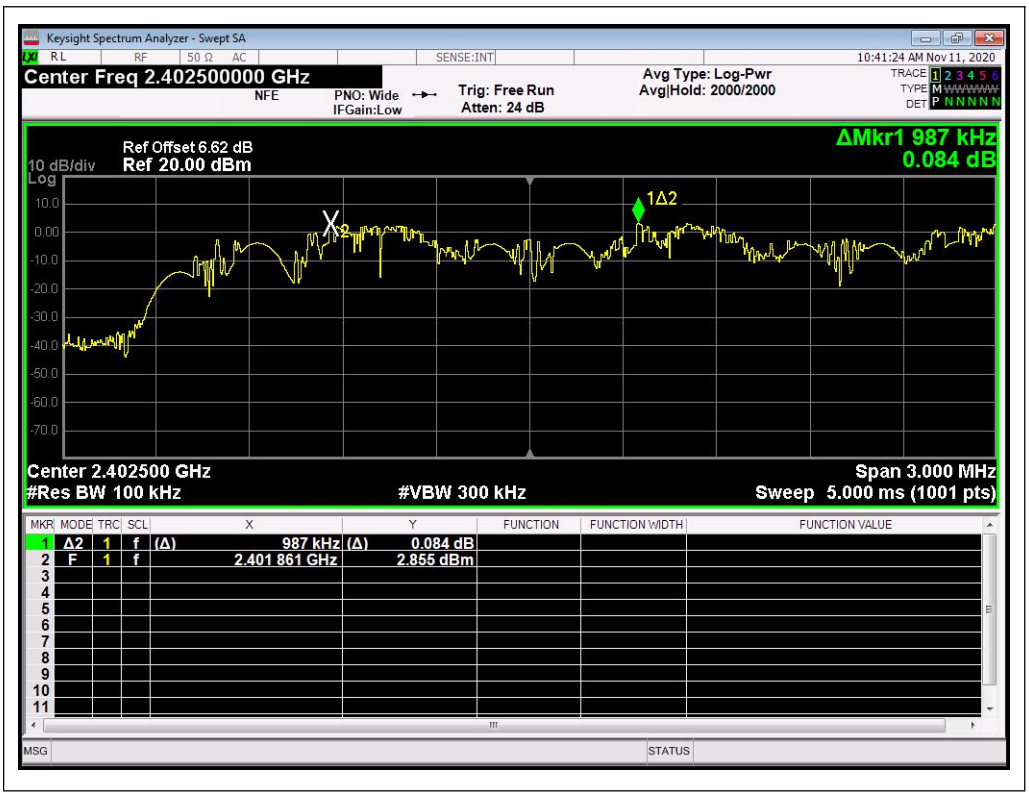


(GFSK, Channel 0 and 1, 2402MHz)

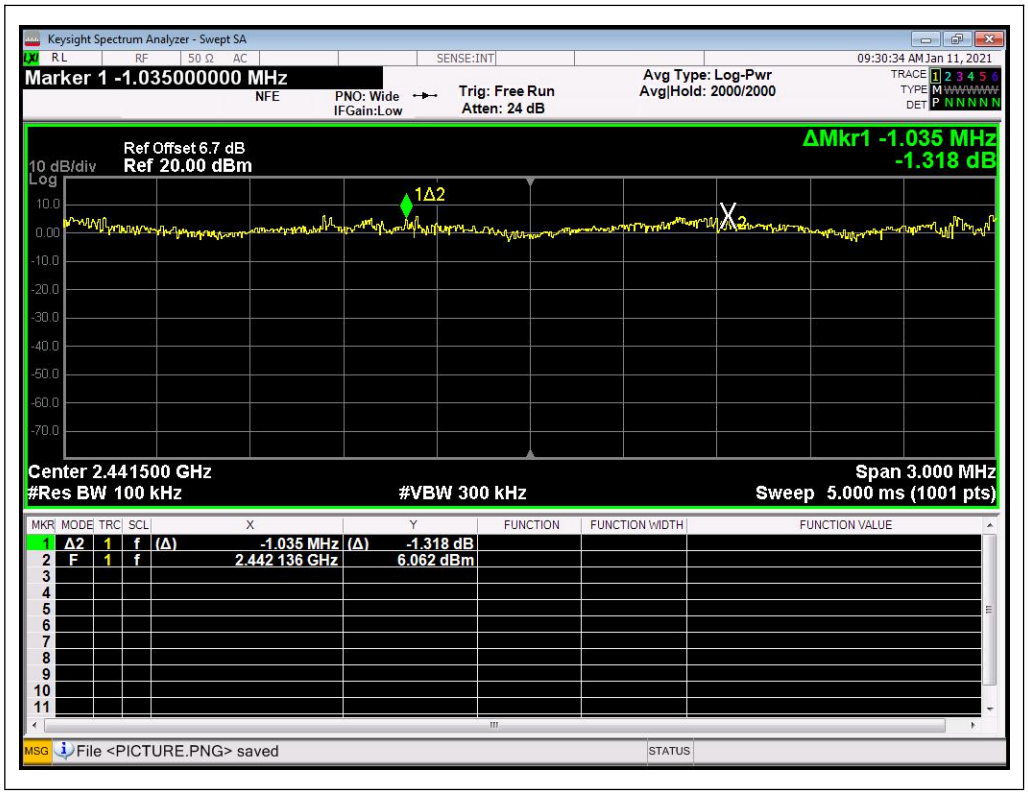


(GFSK, Channel 39 and 40, 2441MHz)

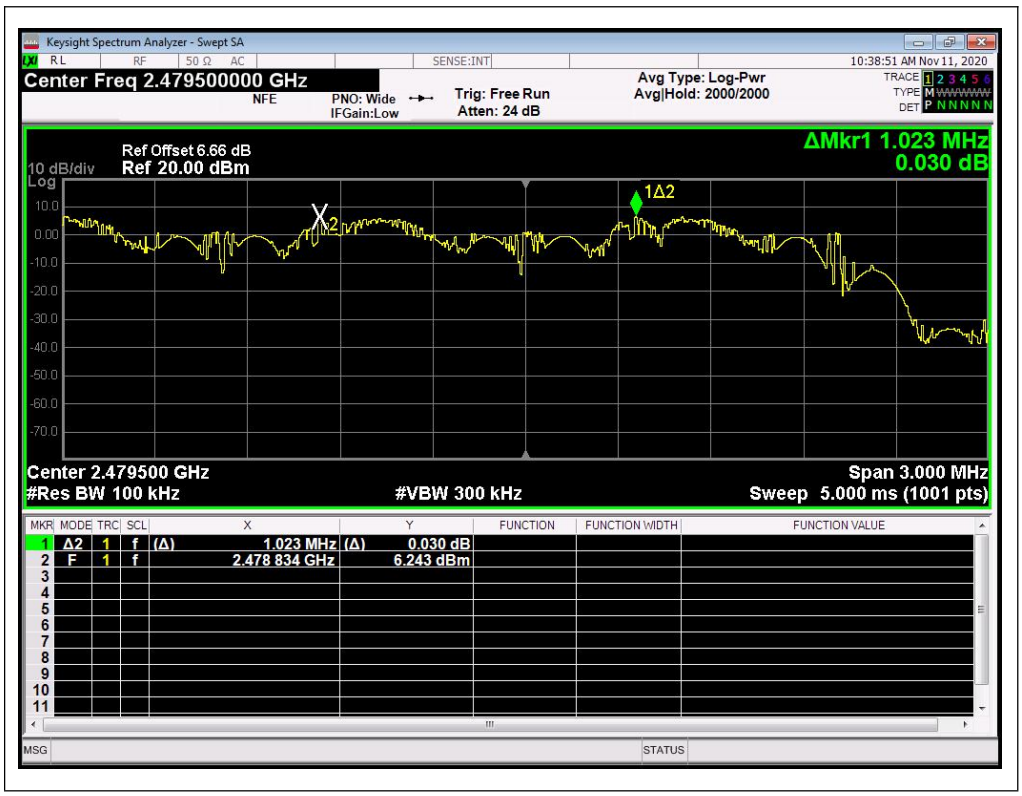
(GFSK, Channel 77 and 78, 2480MHz)



(π/4-DQPSK, Channel 0 and 1, 2402MHz)

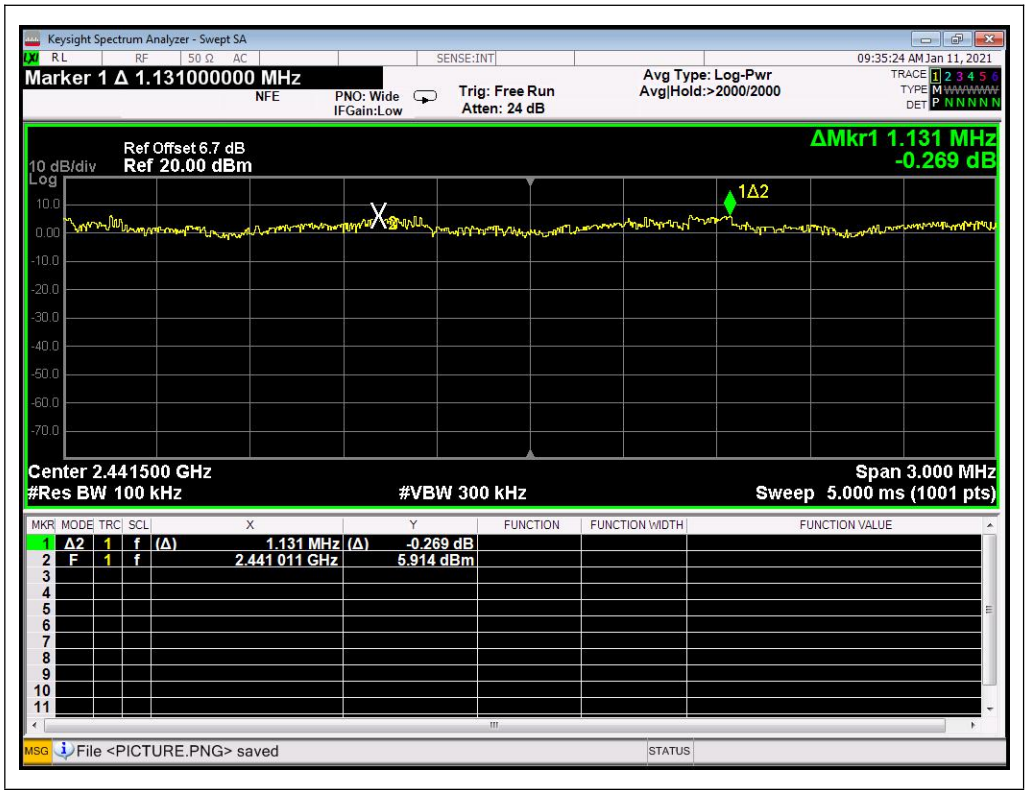


(π/4-DQPSK, Channel 39 and 40, 2441MHz)

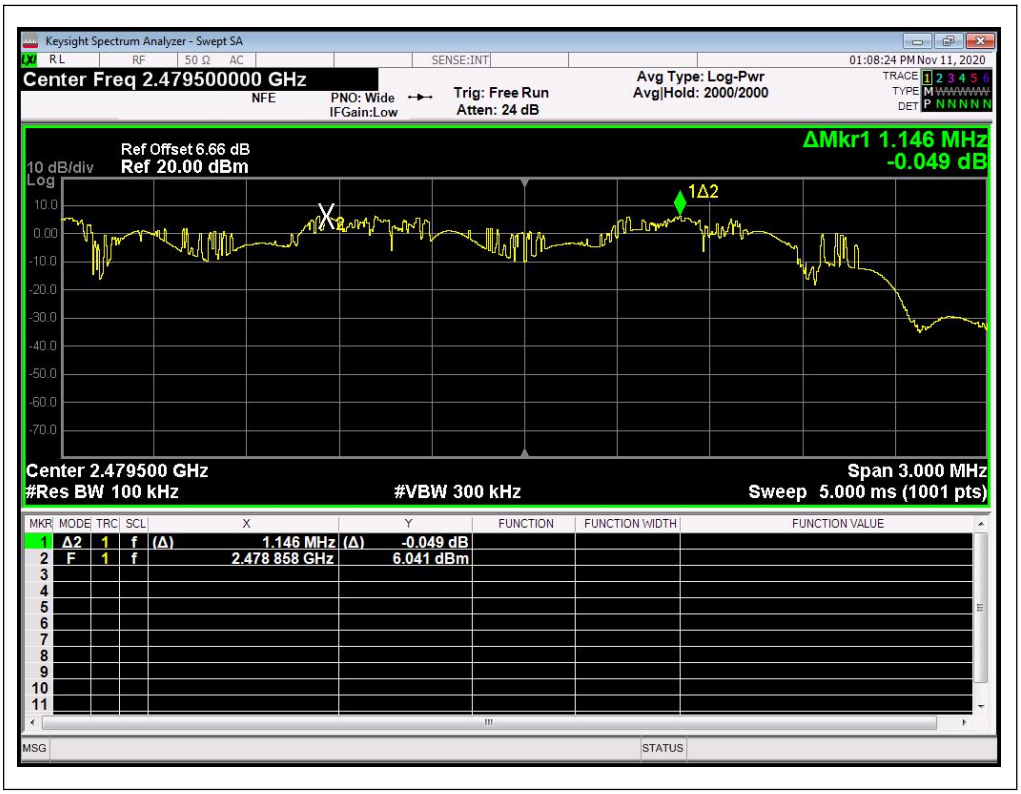


(π/4-DQPSK, Channel 77 and 78, 2480MHz)

(8-DPSK, Channel 0 and 1, 2402MHz)



(8-DPSK, Channel 39 and 40, 2441MHz)



(8-DPSK, Channel 77 and 78, 2480MHz)

2.6. Time of Occupancy (Dwell time)

2.6.1. Requirement

According to FCC §15.247(a) (1) (iii), frequency hopping systems in the 2400 - 2483.5MHz band shall use at least 15 non-overlapping channels. 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

2.6.2. Test Description

A. Test Setup:

The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

The EUT was working in channel hopping; Spectrum SPAN was set as 0. Sweep was set as 0.4 * channel no.(s), the quantity of pulse was get from single sweep. In addition, the time of single pulses was tested.

Dwell time = time slot length * hop rate / number of hopping channels * 31.6s
Hop rate = 1600/s

B. Equipments List:

Please refer ANNEX B(4).

2.6.3. Test Result

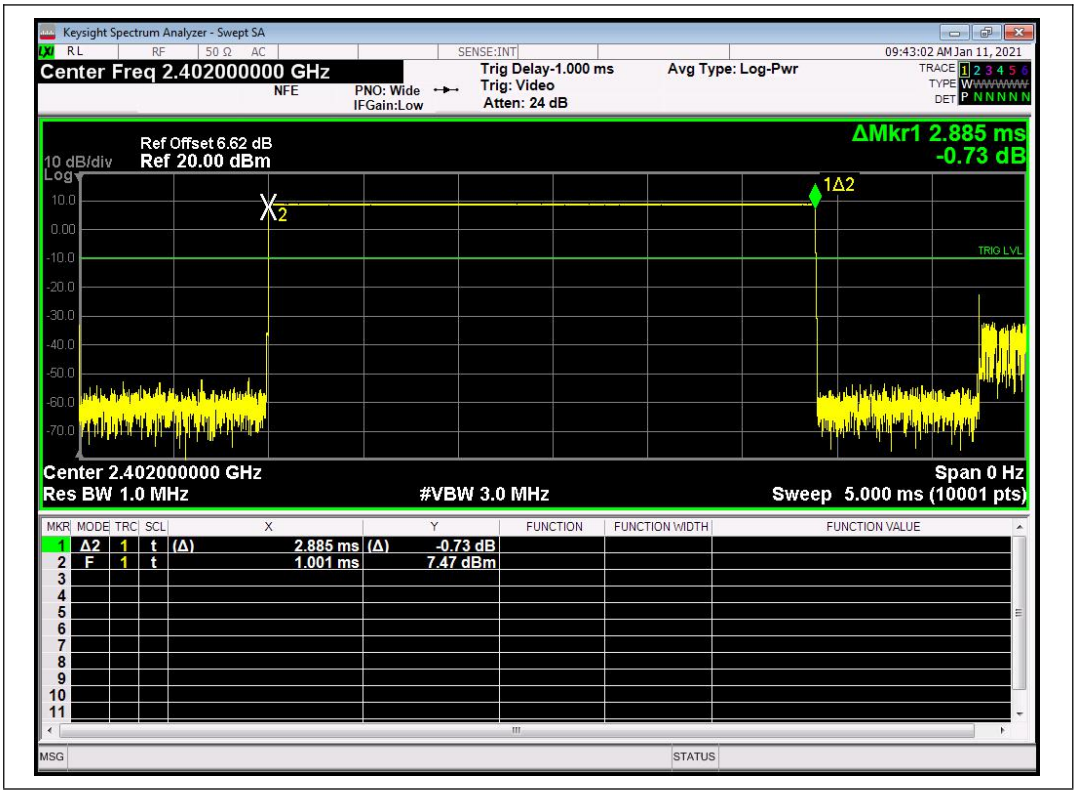
For time of occupancy, all of mode were tested separately, we only recorded the worst test result(DH5/2DH5/3DH5) in this report.

GFSK Mode

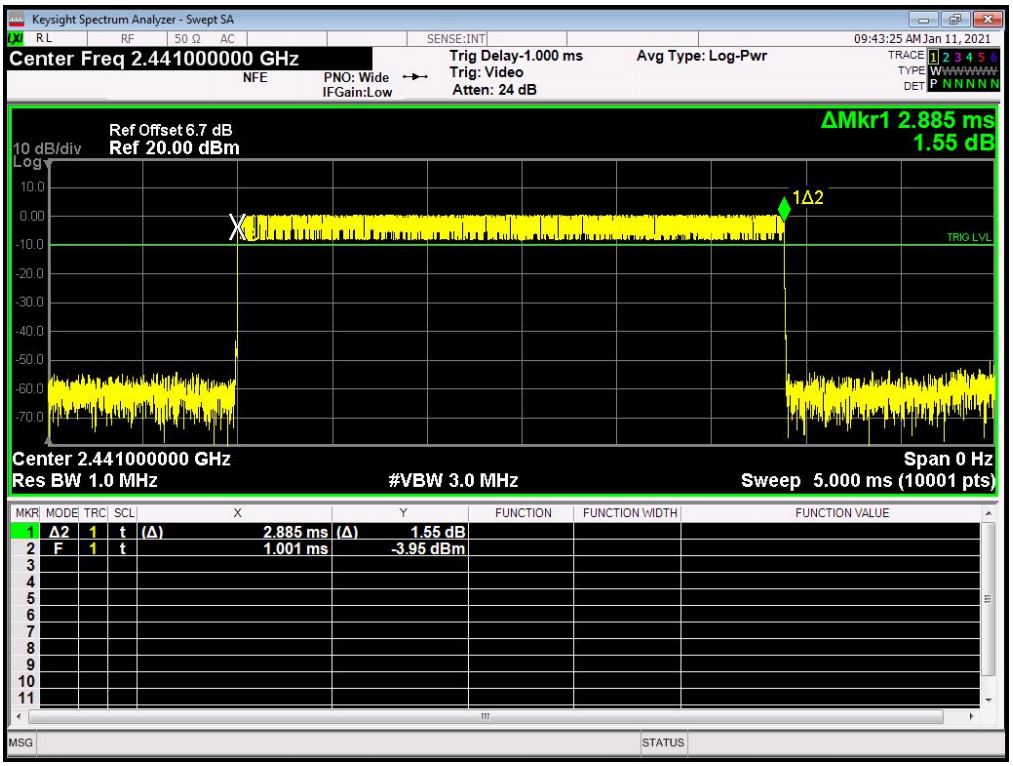
A. Test Verdict:

Mode	Frequency (MHz)	Pulse Width (ms)	Dwell Time (ms)	Limit (sec)	Verdict
DH1	2402	2.885	273.498	0.4	PASS
	2441	2.884	273.451		PASS
	2480	2.884	273.451		PASS

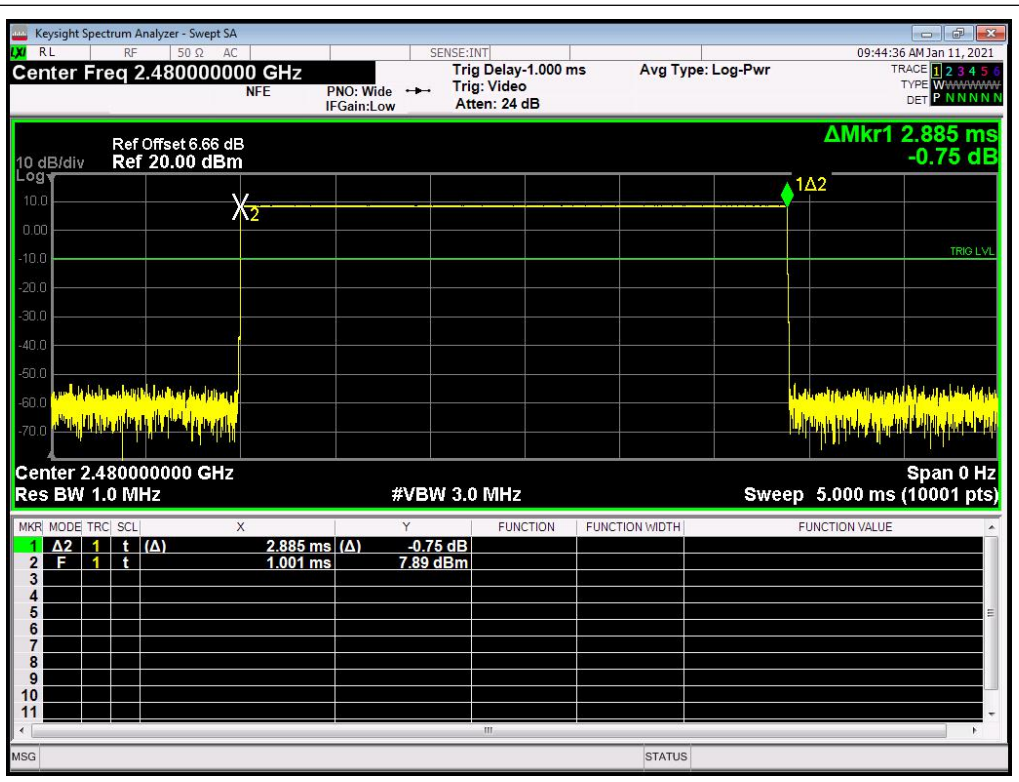
B. Test Plots:



(DH1_2402MHz, GFSK)



(DH1_2441M, GFSK)



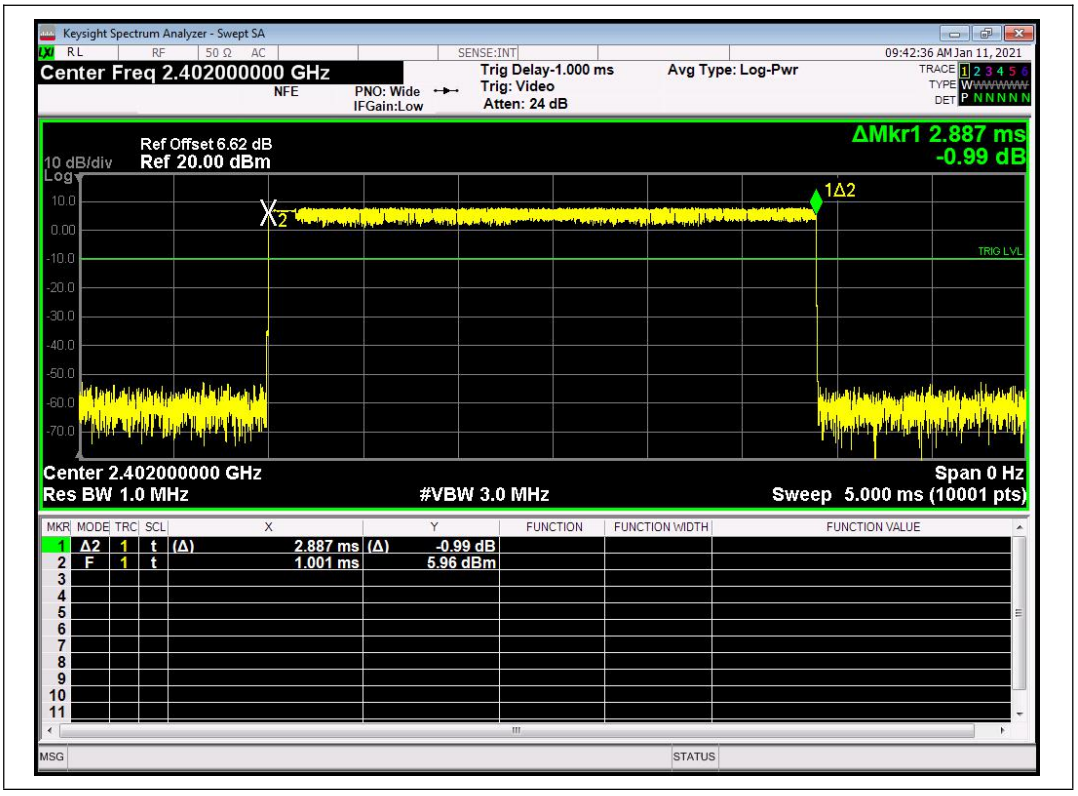
(DH1_2480M, GFSK)

π/4-DQPSK Mode

A. Test Verdict:

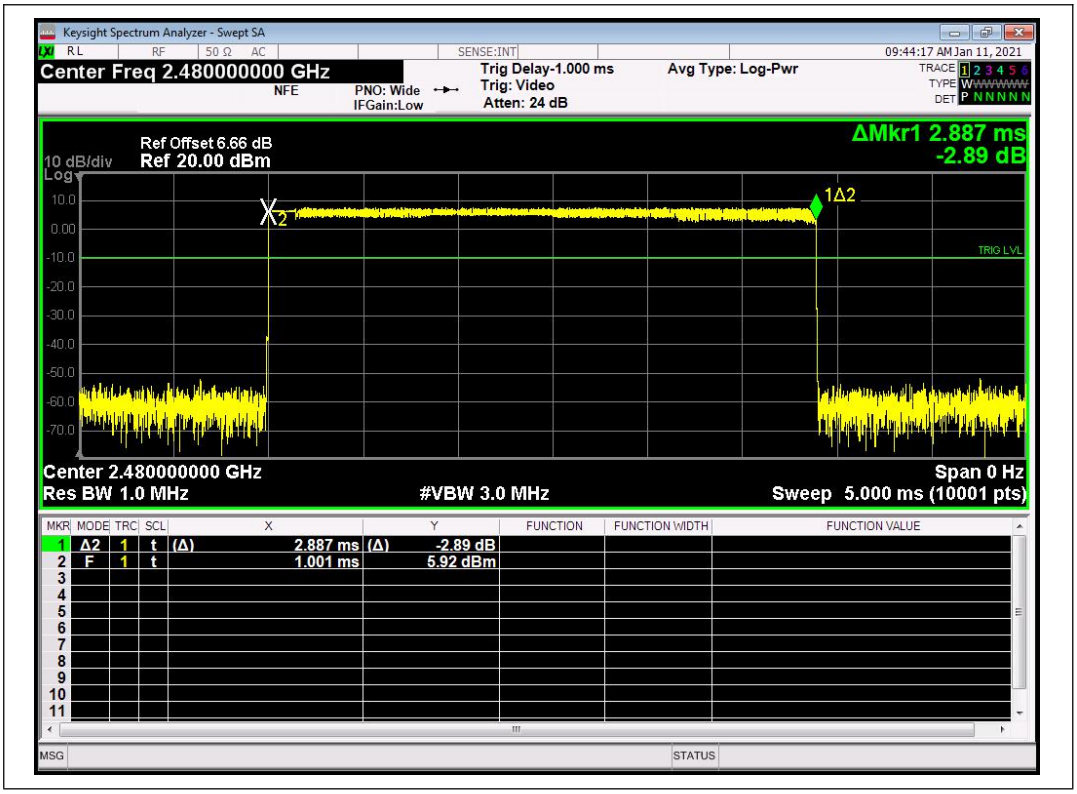
Mode	Frequency (MHz)	Pulse Width (ms)	Dwell Time (ms)	Limit (sec)	Verdict
2DH1	2402	2.887	273.640	0.4	PASS
	2441	2.874	272.455		PASS
	2480	2.887	273.640		PASS

B. Test Plots:



(2DH1_2402M, π/4-DQPSK)

(2DH1_2441M, π/4-DQPSK)



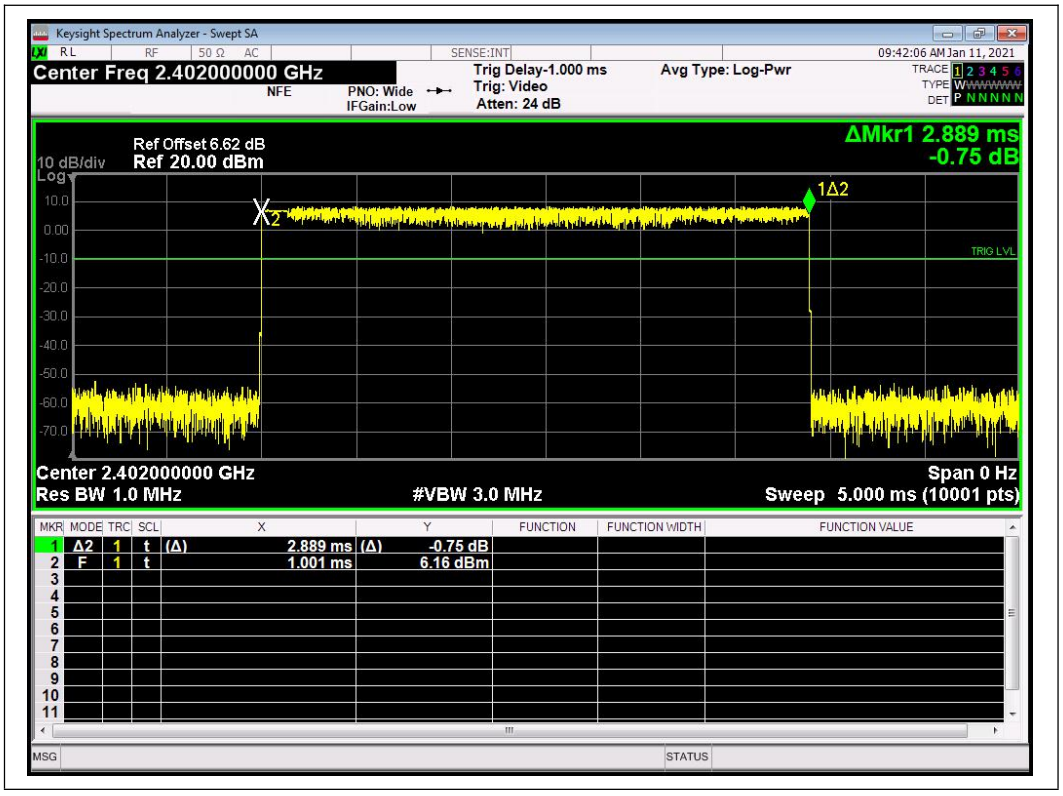
(2DH1_2480M, π/4-DQPSK)

8-DPSK mode

A. Test Verdict:

Mode	Frequency (MHz)	Pulse Width (ms)	Dwell Time (ms)	Limit (sec)	Verdict
3DH1	2402	2.889	273.830	0.4	PASS
	2441	2.874	272.455		PASS
	2480	2.874	272.455		PASS

B. Test Plots:



(3DH1_2402M, 8-DQPSK)

(3DH1_2441M, 8-DQPSK)

(3DH1_2480M, 8-DQPSK)

2.7. Conducted Spurious Emissions and Band Edge

2.7.1. Requirement

According to FCC §15.247(d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

2.7.2. Test Description

A. Test Setup:

The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

B. Equipments List:

Please refer ANNEX B(4).

2.7.3. Test Procedure

The transmitter output was connected to the spectrum analyzer via a low lose cable. Set both RBW and VBW of spectrum analyzer to 100kHz and 300kHz with suitable frequency span including 100 MHz bandwidth from band edge. The band edges was measured and recorded.

2.7.4. Test Result

The Bluetooth Module operates at hopping-off test mode. The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions.

GFSK Mode