REPORT No. : XM20050003W02

TEST REPORT

MANUFACTURER	:	HATCH BABY, INC
PRODUCT NAME	:	Hatch Restore
MODEL NAME	:	Restore01
BRAND NAME	:	Hatch
FCC ID	:	2AFYZ-RESTORE01
STANDARD(S)	:	47 CFR Part 15 Subpart C
RECEIPT DATE	:	2020-05-07
TEST DATE	:	2020-05-11 ~ 2020-05-17
ISSUE DATE	:	2020-05-21

Edited by : Bowers Zeng

Bowers Zeng(Test engineer)

Review by:

Elvis Wang(Auditor)

Approved by:

Anne Liu (Supervisor)

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DIRECTORY

Change History		
Version	**Date**	**Reason for change**
1.0	2020-05-21	First edition

1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

Applicant:	HATCH BABY, INC
Applicant Address:	3525 Alameda de las Pulgas, Suite D, Menlo Park CA 94025
Manufacturer:	Xiamen Hualian Electronics Corp,. LTD.
Manufacturer Address:	No.502, Qianpu Road, Siming District, Xiamen, China

1.2. Equipment Under Test (EUT) Description

Product Name:	Hatch Restore
Serial No:	(N/A, marked #1 by test site)
Hardware Version:	30-HBW24F
Software Version:	N/A
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:	2dBi

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	15.203	Hopping Mechanism	N/A	N/A	PASS
3	15.247(a)	Number of Hopping Frequency	May 14, 2020	Elvis Wang	PASS
4	15.247(b)	Peak Output Power	May 14, 2020	Elvis Wang	PASS
5	15.247(a)	20dB Bandwidth	May 14, 2020	Elvis Wang	PASS
6	15.247(a)	Carrier Frequency Separation	May 14, 2020	Elvis Wang	PASS
7	15.247(a)	Time of Occupancy (Dwell time)	May 14, 2020	Elvis Wang	PASS
8	15.247(d)	Conducted Spurious Emission and Band Edge	May 14, 2020	Elvis Wang	PASS
9	15.247(d)	Restricted Frequency Bands	May 12, 2020	Yaming Luo	PASS
10	15.209, 15.247(d)	Radiated Emission	May 13, 2020	Yaming Luo	PASS
11	15.207	Conducted Emission	May 15, 2020	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. Hopping Mechanism

2.2.1. Requirement

According to FCC §15.247(a)(1), a frequency hopping spread spectrum system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

According to FCC §15.247(h), the incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. 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.

2.2.2. Result: Compliant

The hopping mechanism of the EUT is in compliance with the document **"Bluetooth core specification v5.1".**

2.3. Number of Hopping Frequency

2.3.1. 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.

2.3.2. 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.

2.3.3. 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).

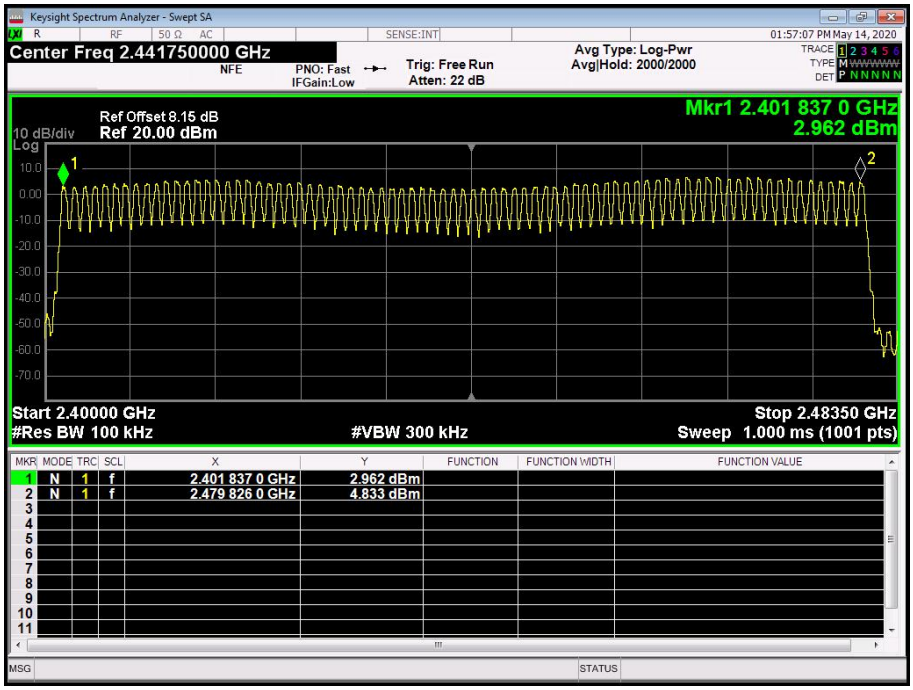
2.3.4. Test Result

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.

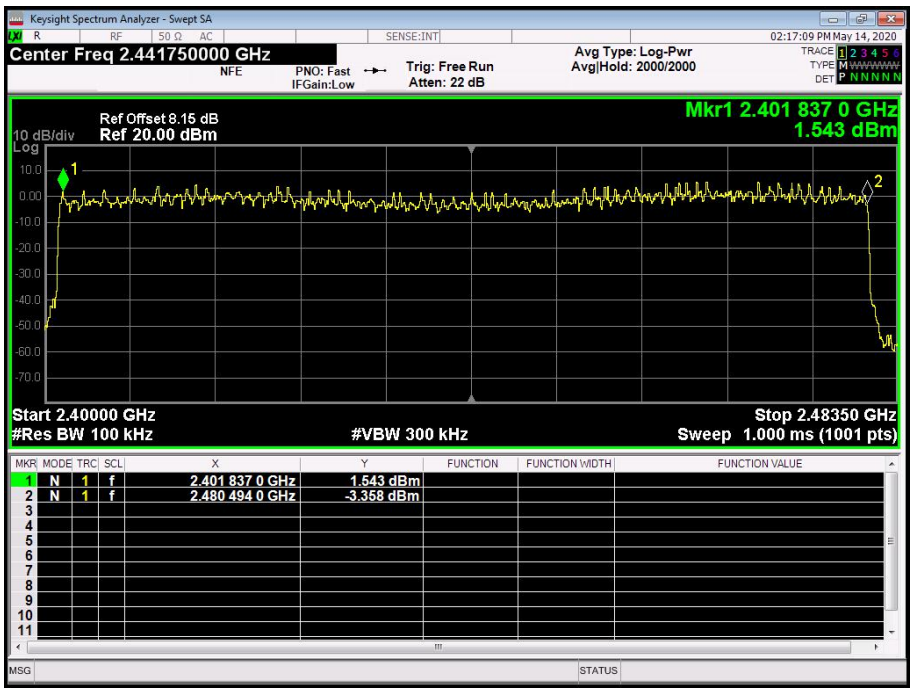
A. Test Verdict:

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

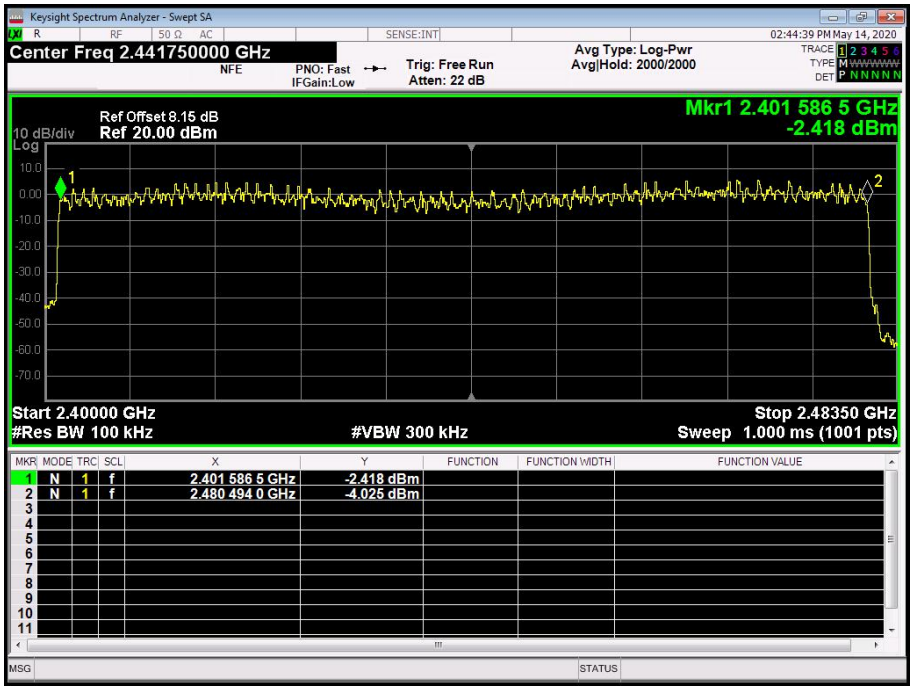
B. Test Plots:



(GFSK)



(π/4-DQPSK)



(8- DPSK)

2.4. Peak Output Power

2.4.1. 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.

2.4.2. 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

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.

2.4.4. Test Result

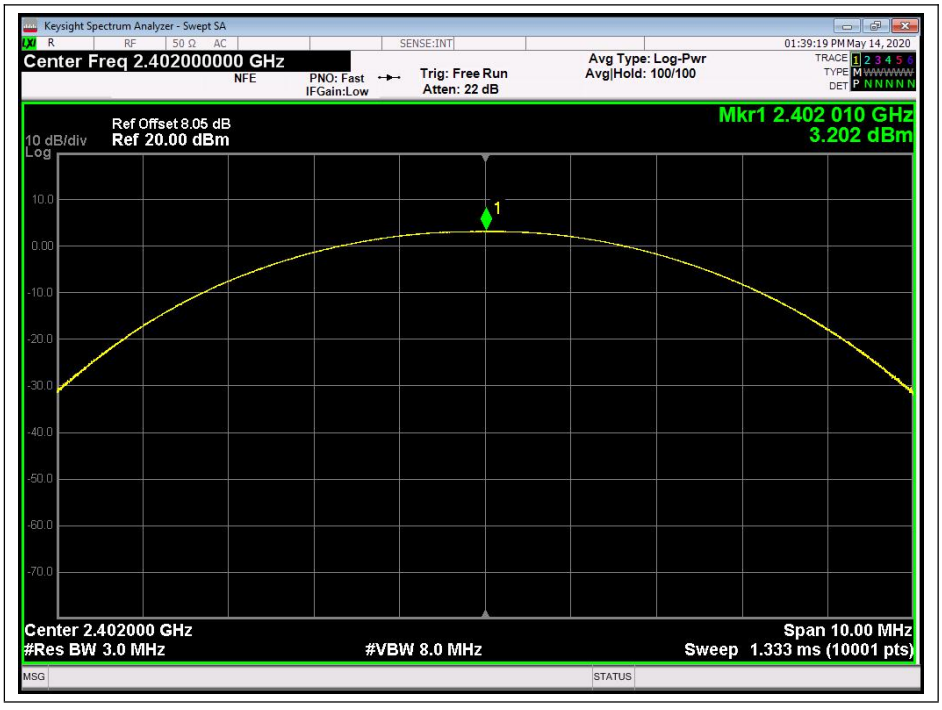
The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the module.

GFSK Mode

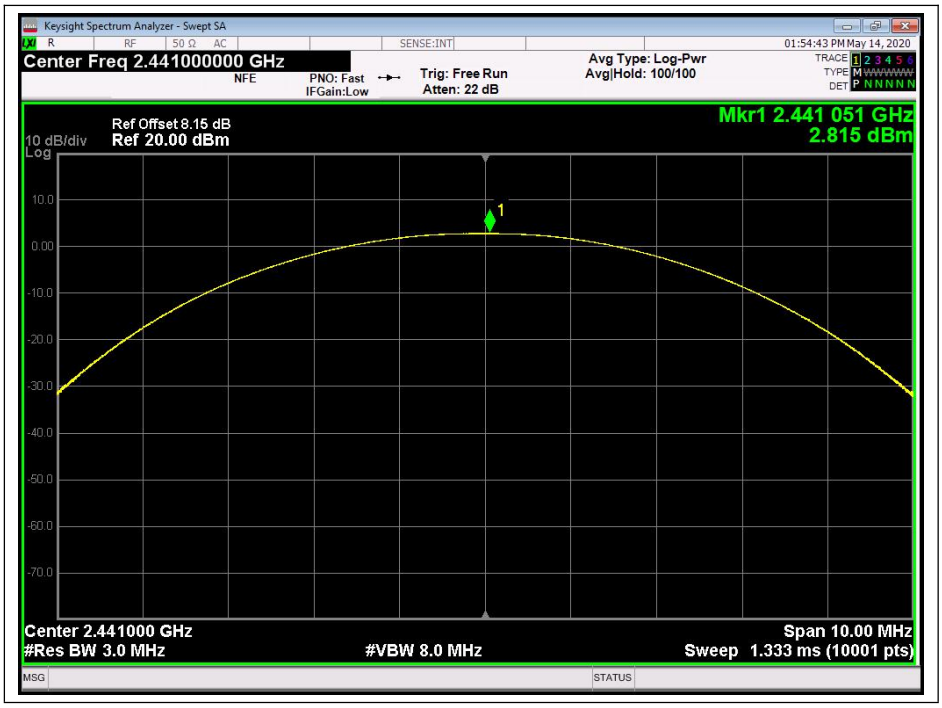
A. Test Verdict:

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
0	2402	3.202	0.002	21	0.125	PASS
39	2441	2.815	0.002			PASS
78	2480	5.172	0.003			PASS

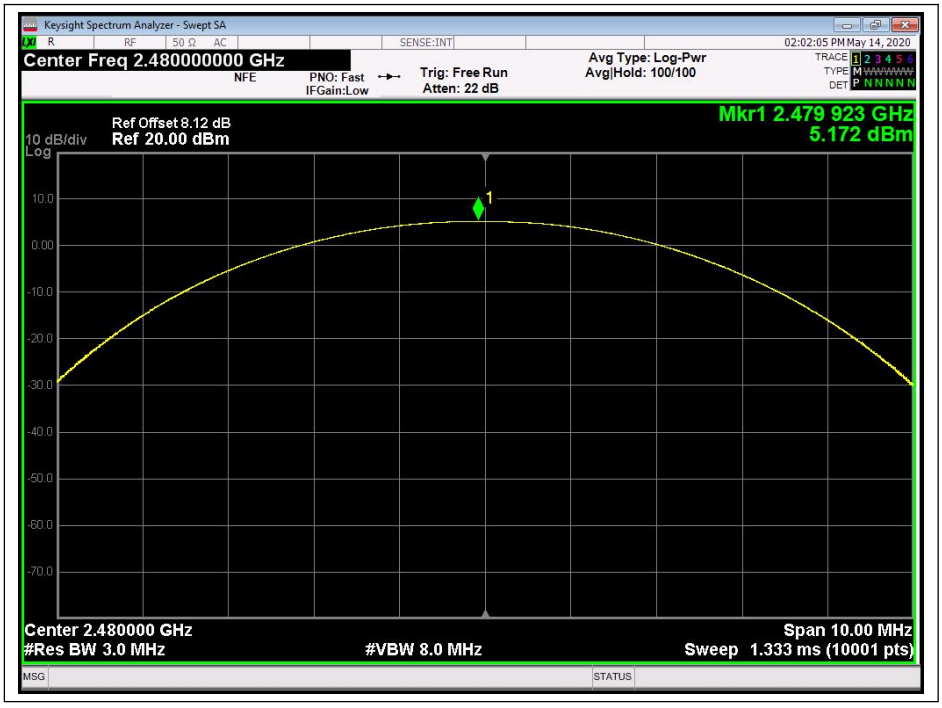
B. Test Plots:



(GFSK, Channel 0, 2402MHz)



(GFSK, Channel 39, 2441MHz)



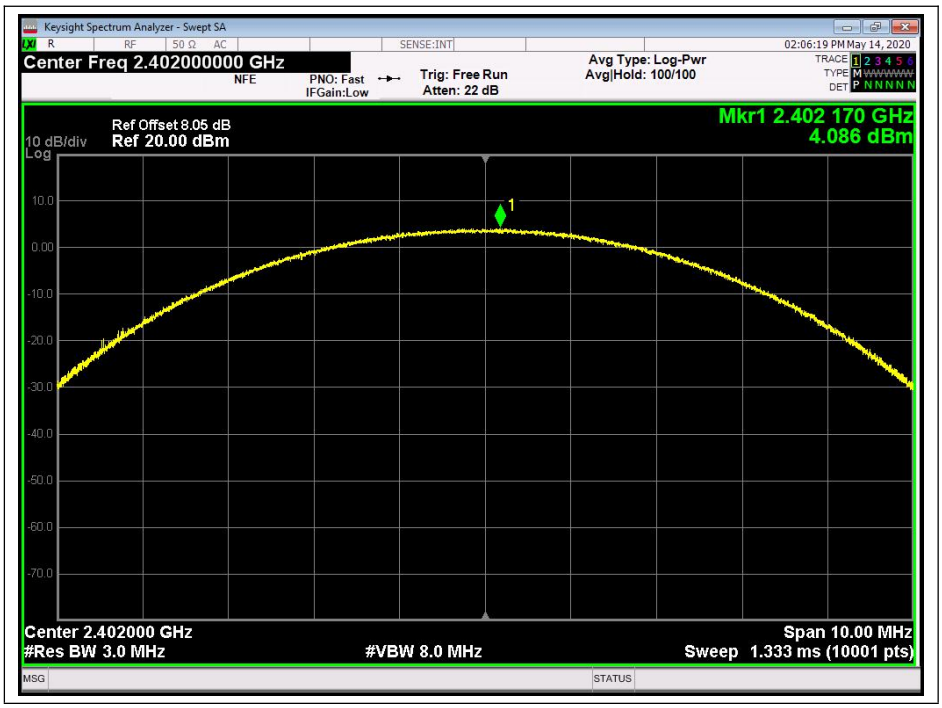
(GFSK, Channel 78, 2480MHz)

π/4-DQPSK Mode

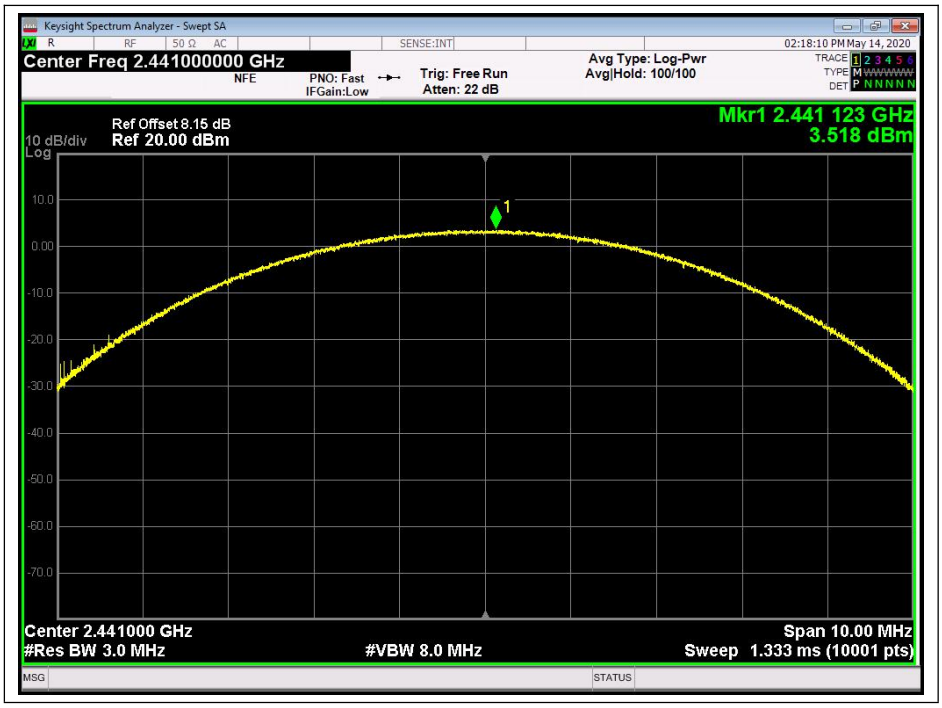
A. Test Verdict:

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
0	2402	4.086	0.003	21	0.125	PASS
39	2441	3.518	0.002			PASS
78	2480	5.835	0.004			PASS

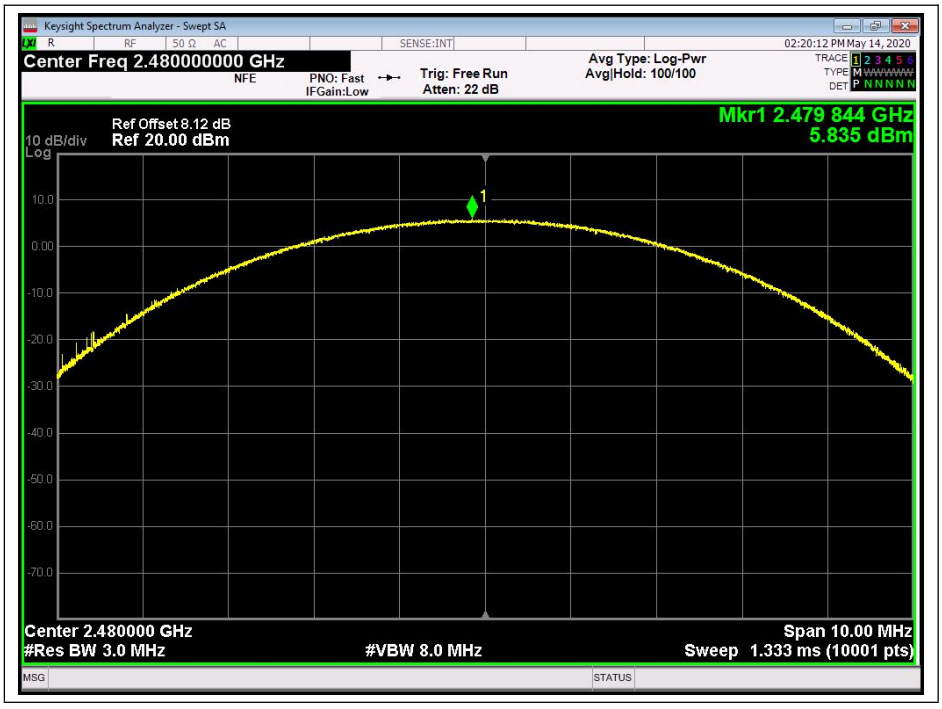
B. Test Plots:



(π/4-DQPSK, Channel 0, 2402MHz)



(π/4-DQPSK, Channel 39, 2441MHz)



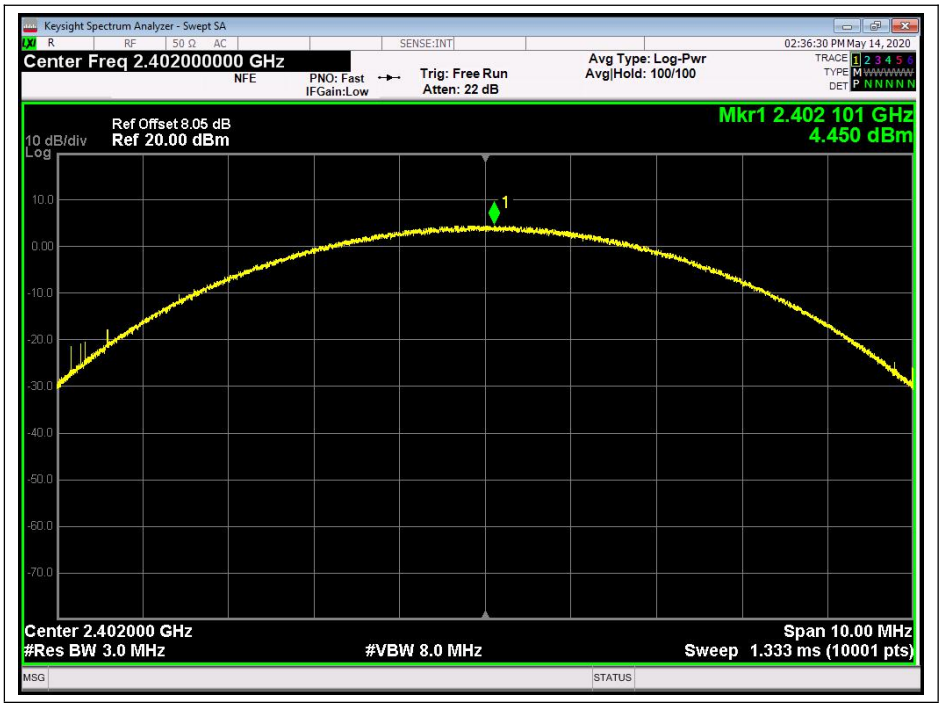
(π/4-DQPSK, Channel 78, 2480MHz)

8-DPSK Mode

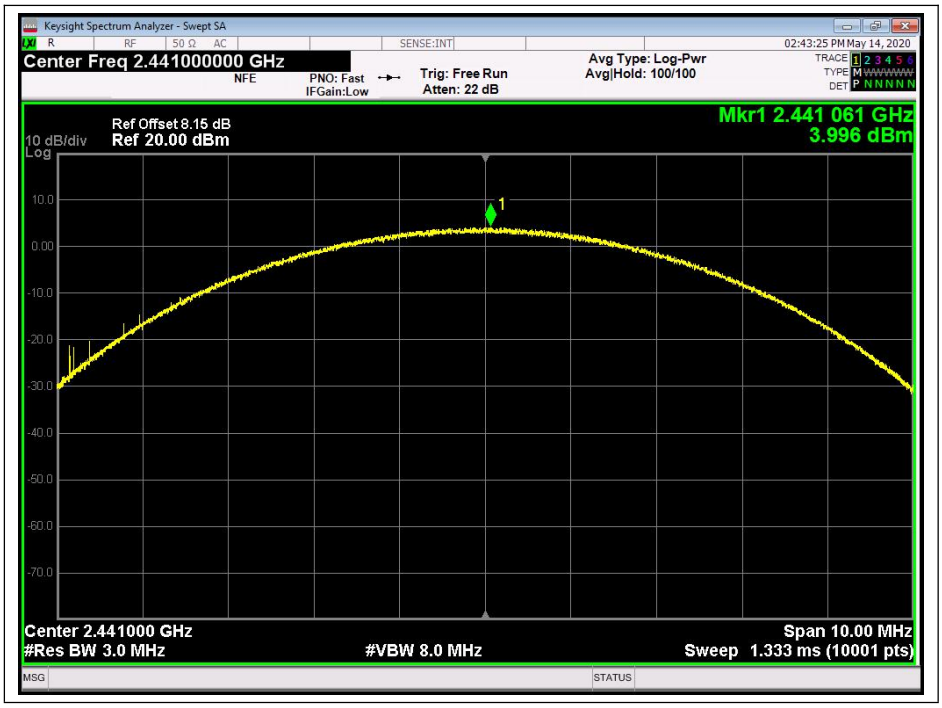
A. Test Verdict:

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
0	2402	4.450	0.003	21	0.125	PASS
39	2441	3.996	0.003			PASS
78	2480	6.162	0.004			PASS

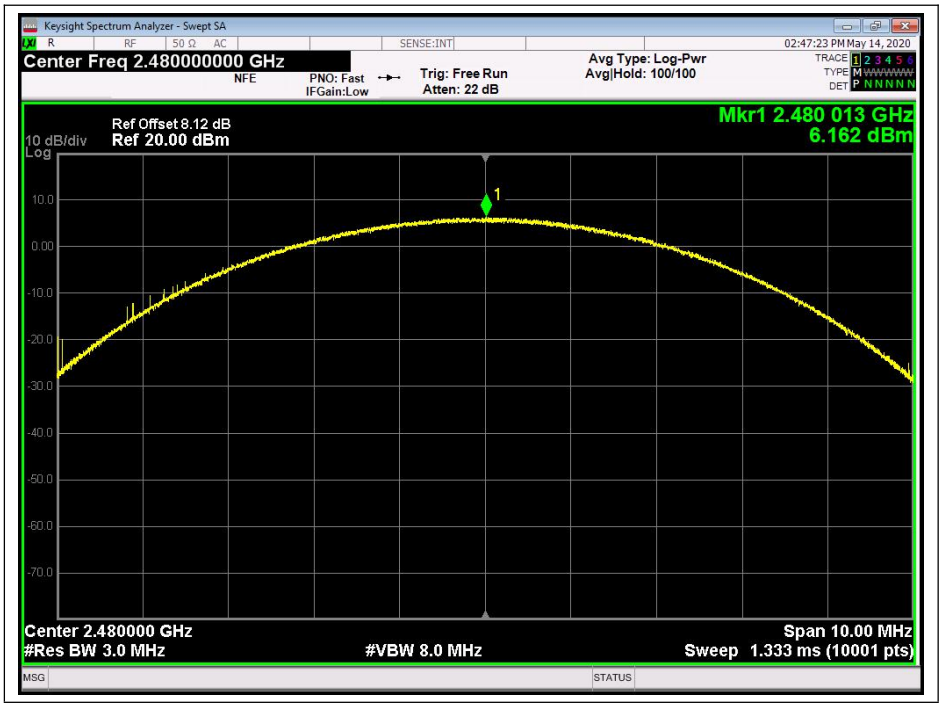
B. Test Plots:



(8-DPSK, Channel 0, 2402MHz)



(8-DPSK, Channel 39, 2441MHz)



(8-DPSK, Channel 78, 2480MHz)

2.5. 20dB Bandwidth

2.5.1. 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.

2.5.2. 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. 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.

2.5.4. Test Result

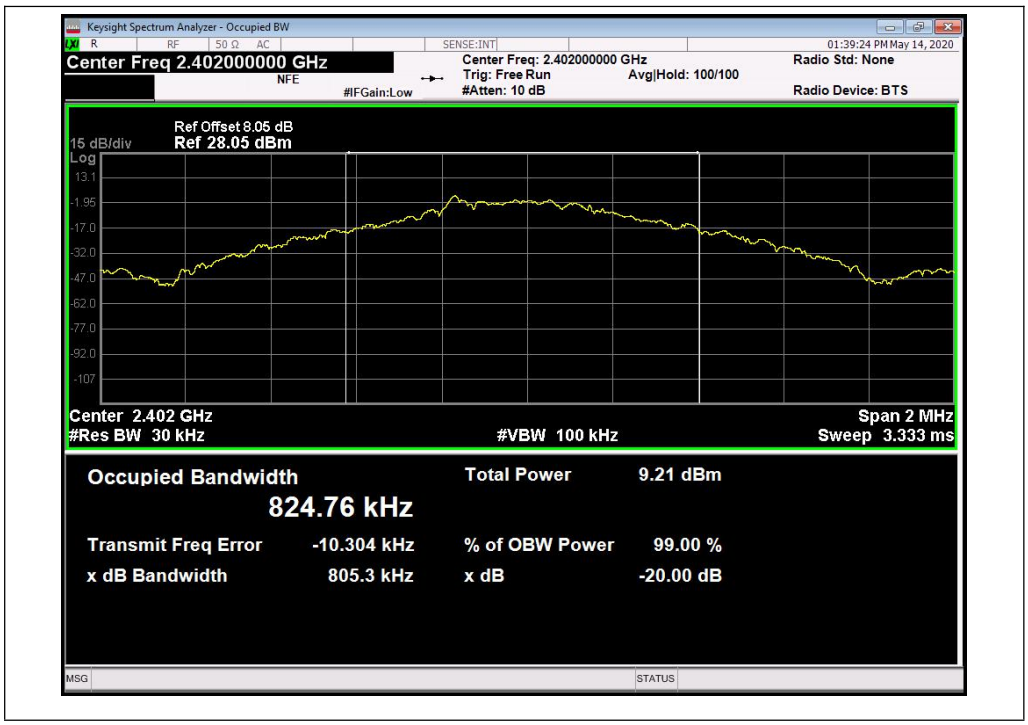
The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to record the 20dB bandwidth of the Module.

GFSK Mode

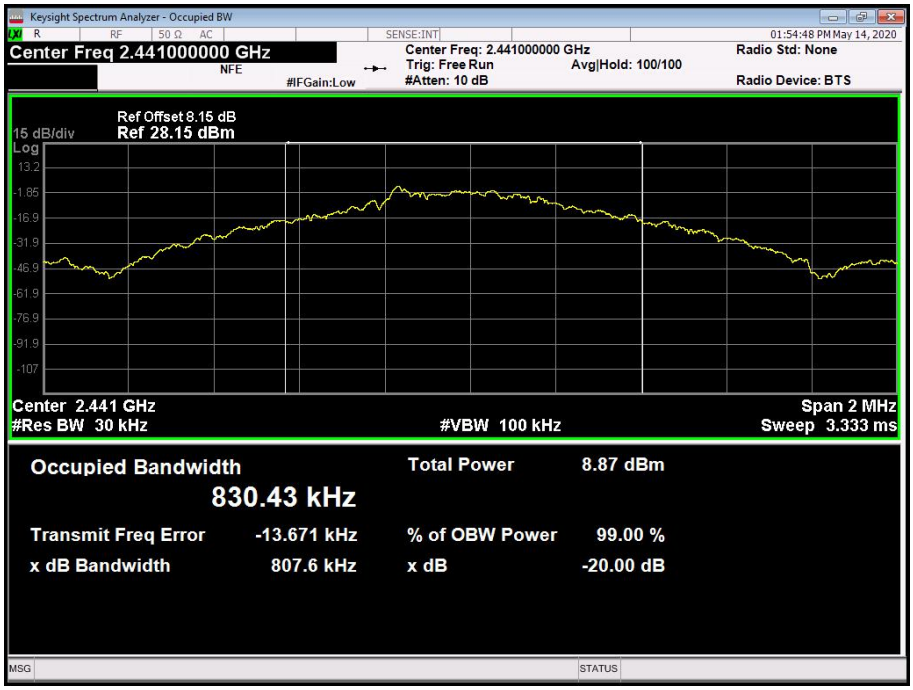
A. Test Verdict:

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Result
0	2402	0.805	PASS
39	2441	0.808	PASS
78	2480	0.937	PASS

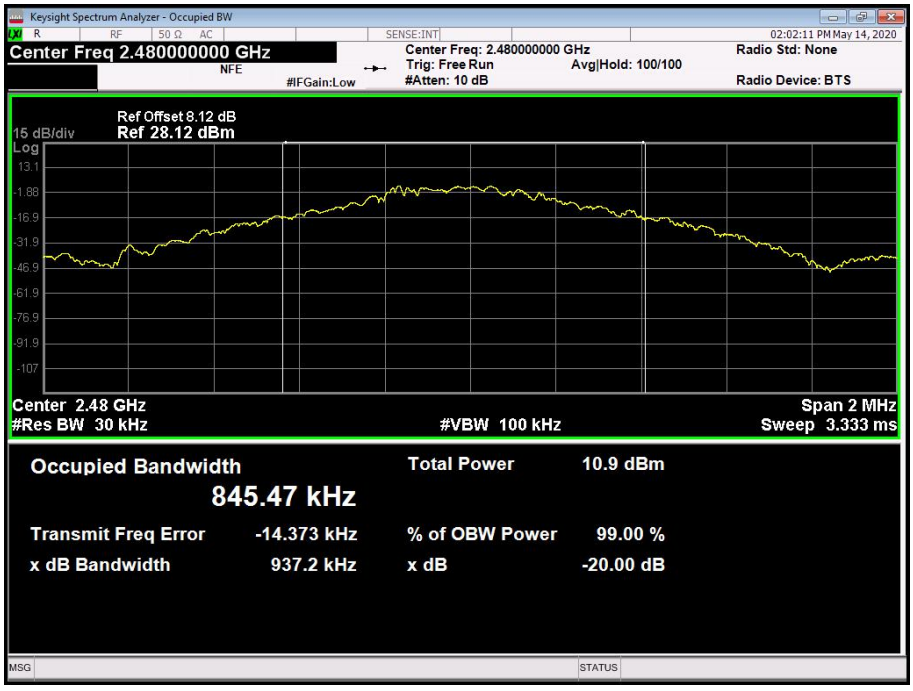
B. Test Plots:



(GFSK, Channel 0, 2402MHz)



(GFSK, Channel 39, 2441MHz)



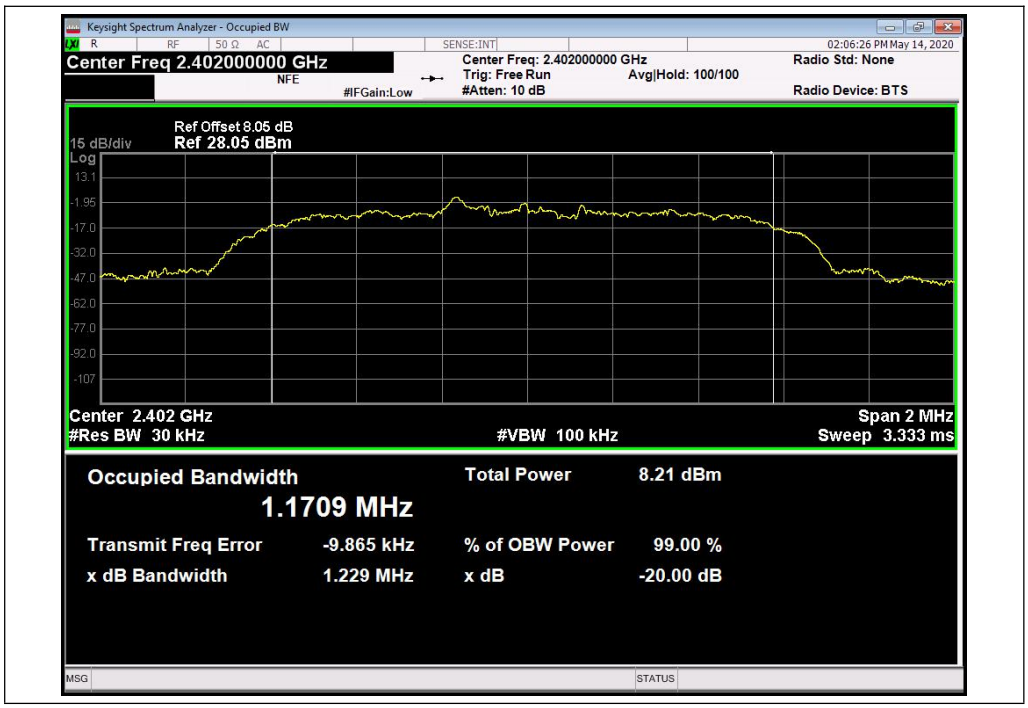
(GFSK, Channel 78, 2480MHz)

π/4-DQPSK Mode

A. Test Verdict:

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Result
0	2402	1.229	PASS
39	2441	1.286	PASS
78	2480	1.253	PASS

B. Test Plots:



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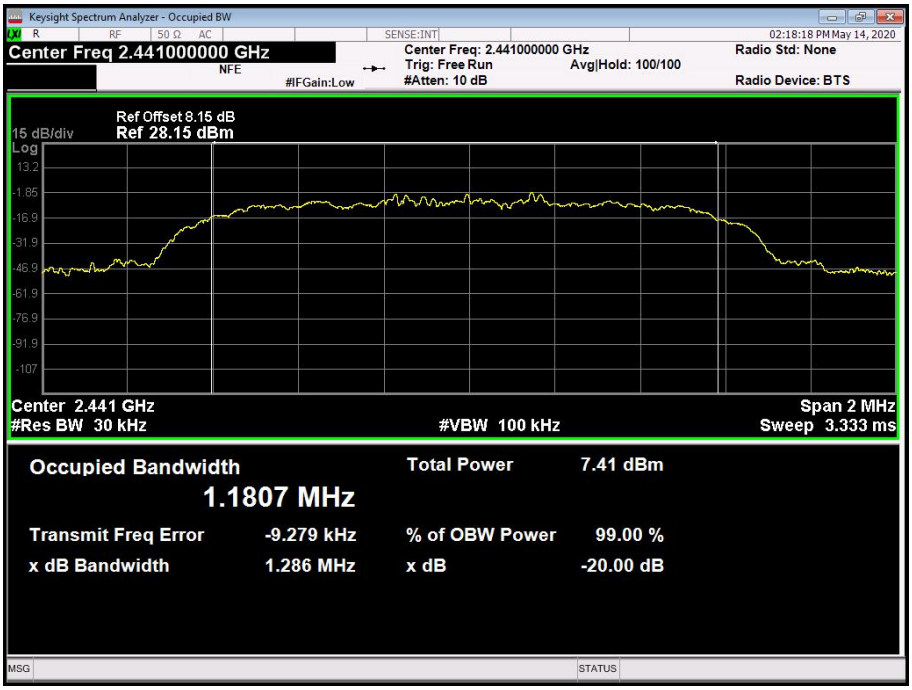
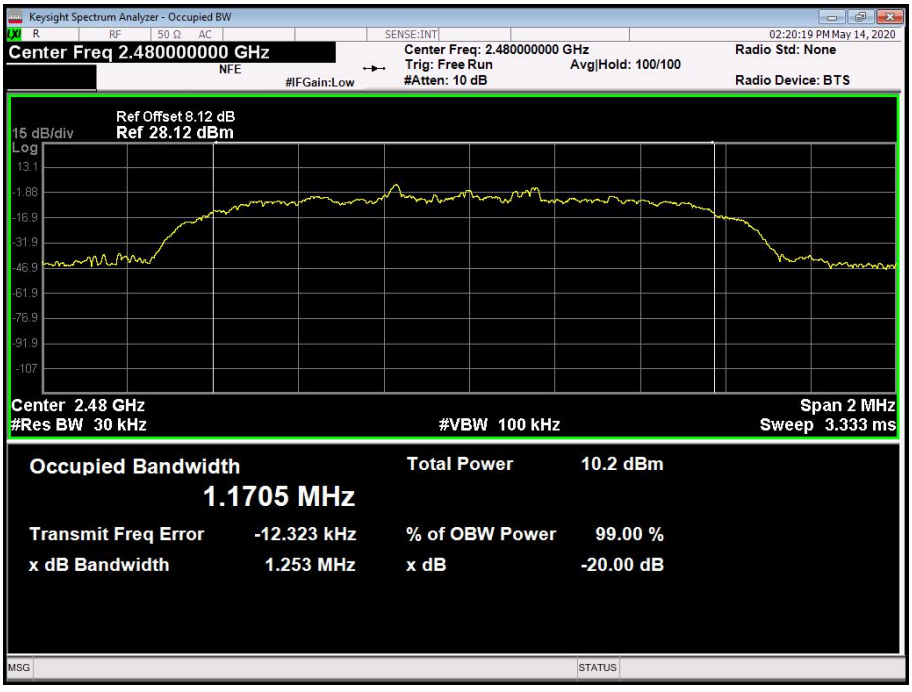


(π/4-DQPSK, Channel 39, 2441MHz)



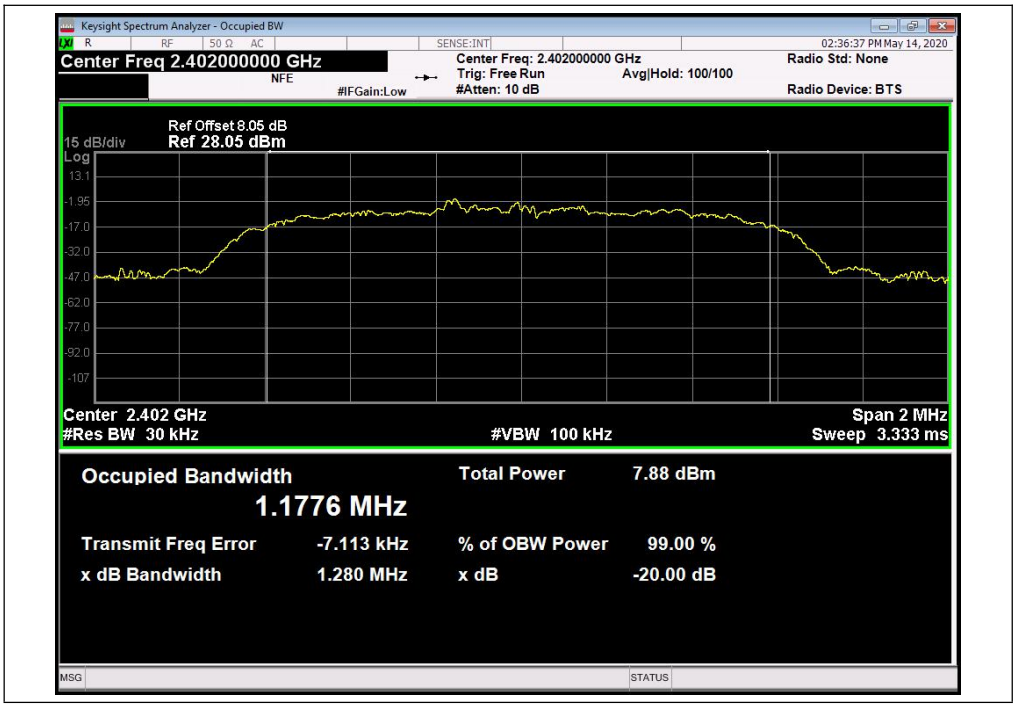
(π/4-DQPSK, Channel 78, 2480MHz)

8-DPSK Mode

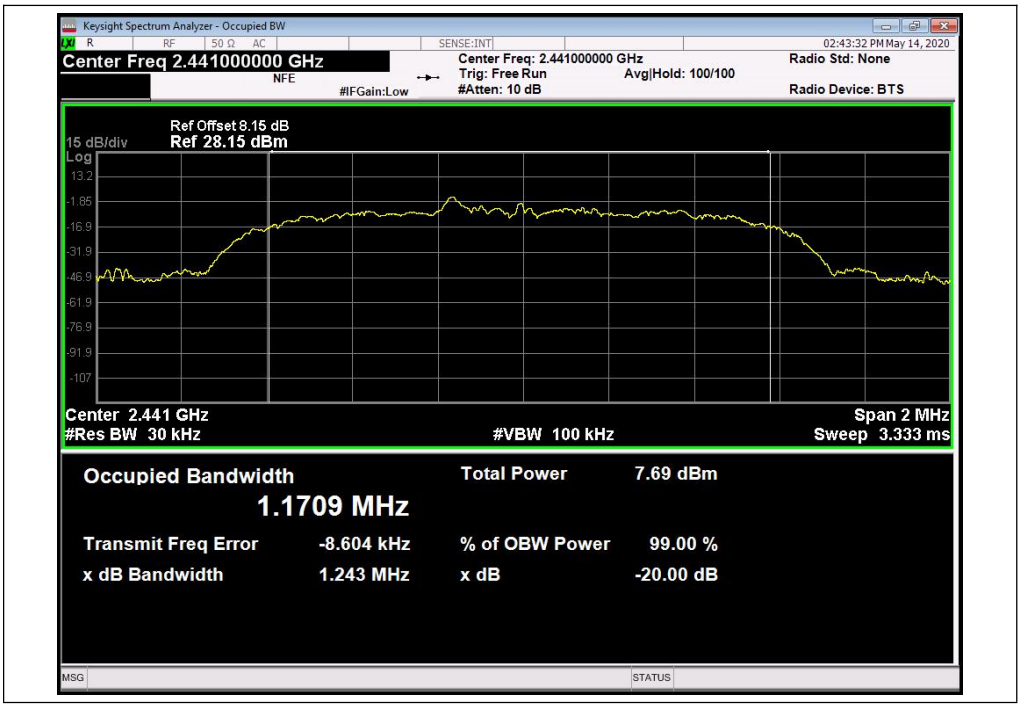
A. Test Verdict:

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Result
0	2402	1.280	PASS
39	2441	1.243	PASS
78	2480	1.240	PASS

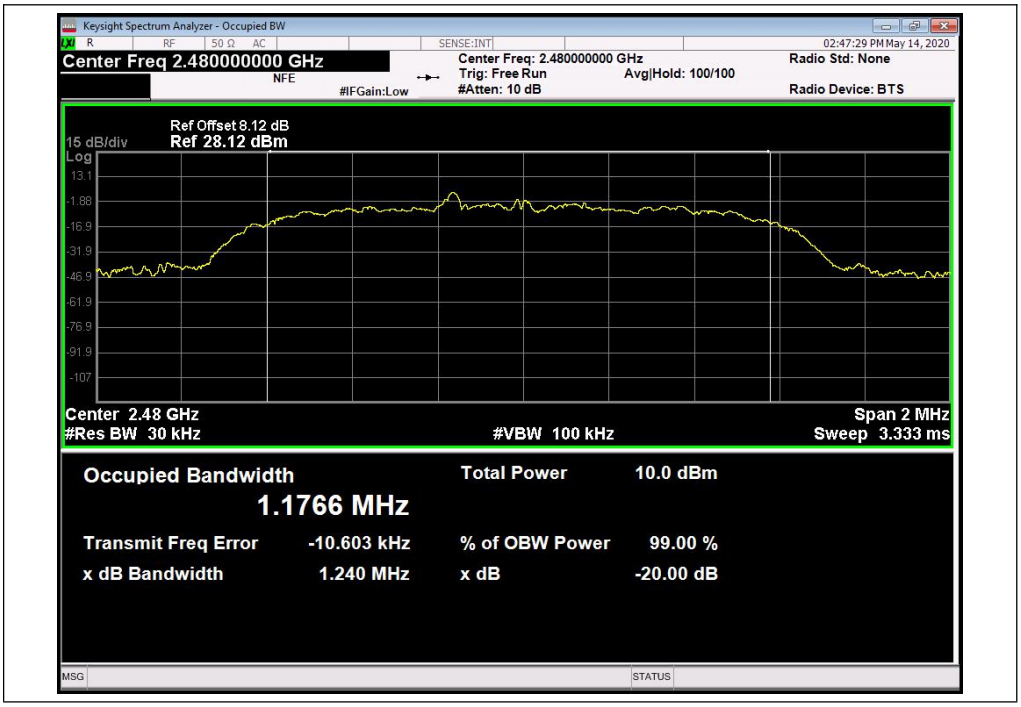
B. Test Plots:



(8-DPSK, Channel 0, 2402MHz)



(8-DPSK, Channel 39, 2441MHz)



(8-DPSK, Channel 78, 2480MHz)

2.6. Carried Frequency Separation

2.6.1. 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.

2.6.2. 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.

B. Equipments List:

Please refer ANNEX B(4).

2.6.3. Test Procedure

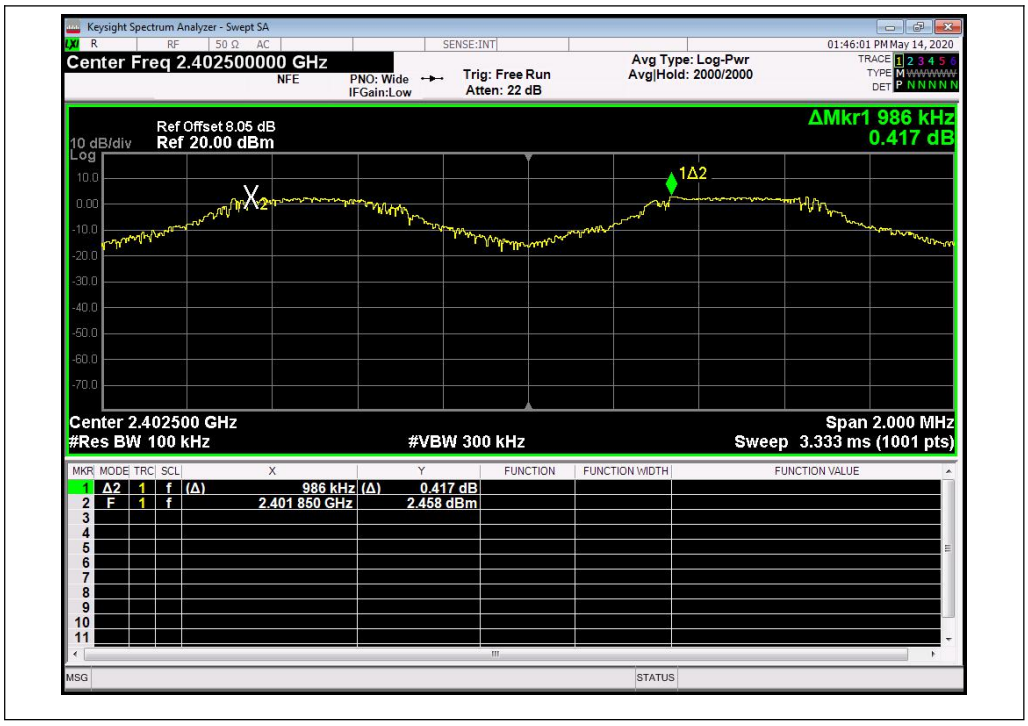
a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
c. By using the MaxHold function 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.

2.6.4. Test Result

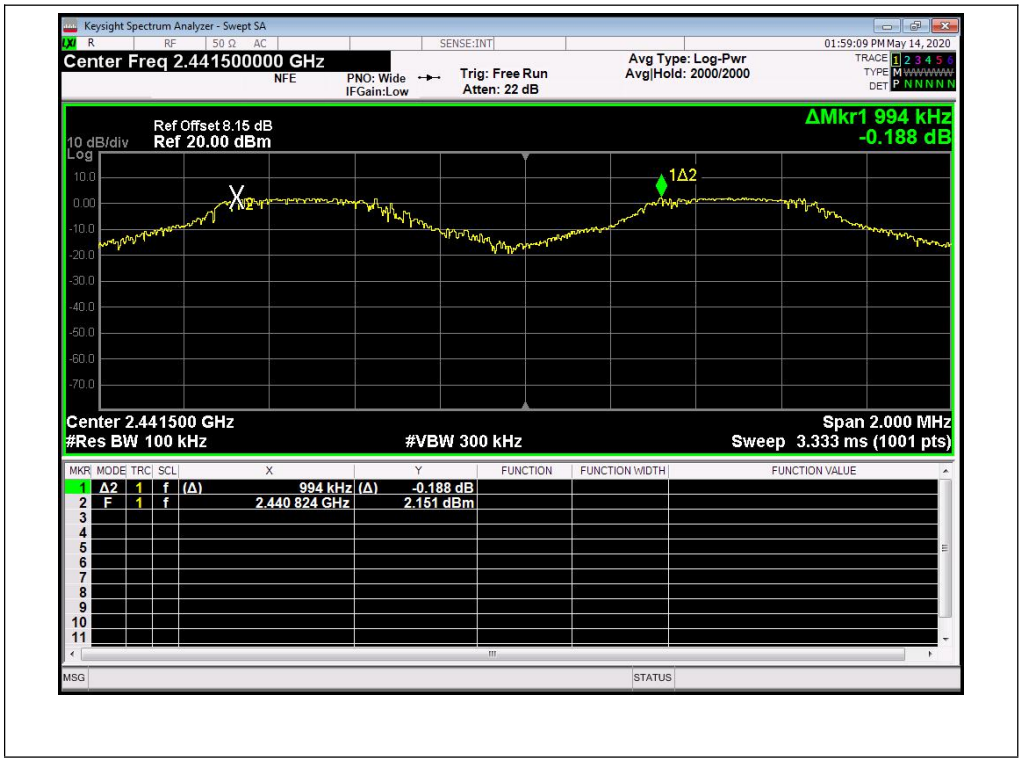
The Bluetooth Module operates at hopping-on test mode. For any adjacent channels (e.g. the channel 39 and 40 as showed below), the Module does have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel (refer to section 2.4.4), 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	0.986	0.805	0.537	PASS
	39 and 40	0.994	0.808	0.539	PASS
	77 and 78	0.832	0.937	0.625	PASS
π/4-DQPSK	0 and 1	1.002	1.229	0.819	PASS
	39 and 40	1.004	1.286	0.857	PASS
	77 and 78	1.004	1.253	0.835	PASS
8-DPSK	0 and 1	0.992	1.280	0.853	PASS
	39 and 40	0.996	1.243	0.829	PASS
	77 and 78	1.000	1.240	0.827	PASS
Note 1:Min. Limit is equal to the two-thirds of the 20dB bandwidth					

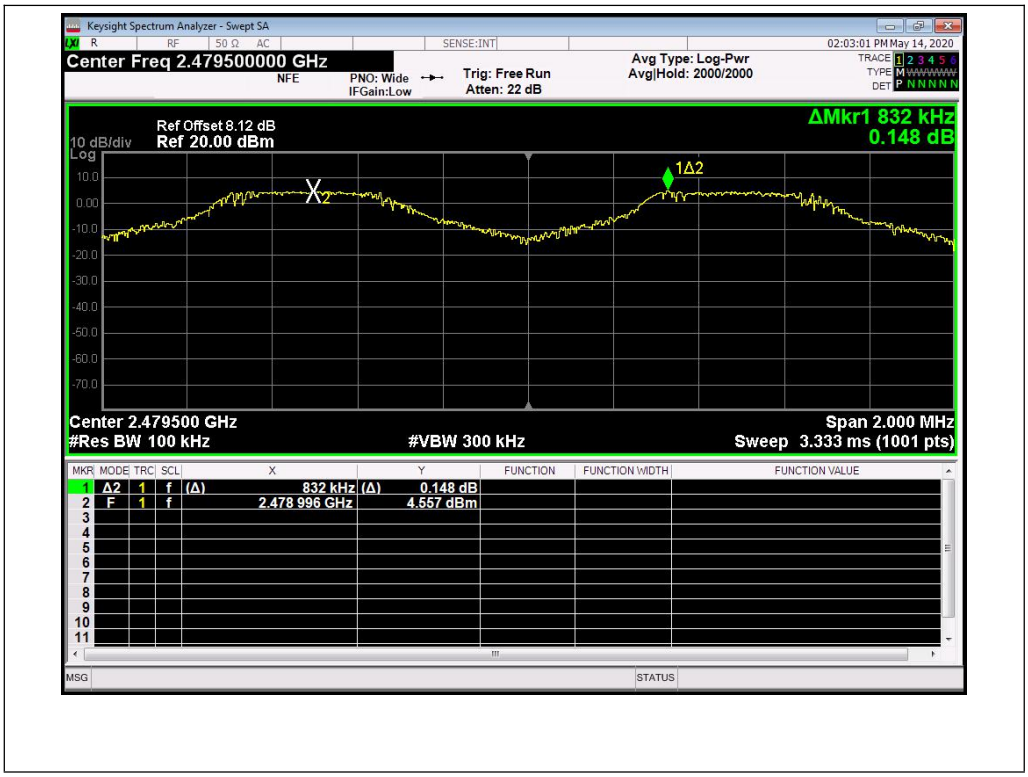
Test Plots



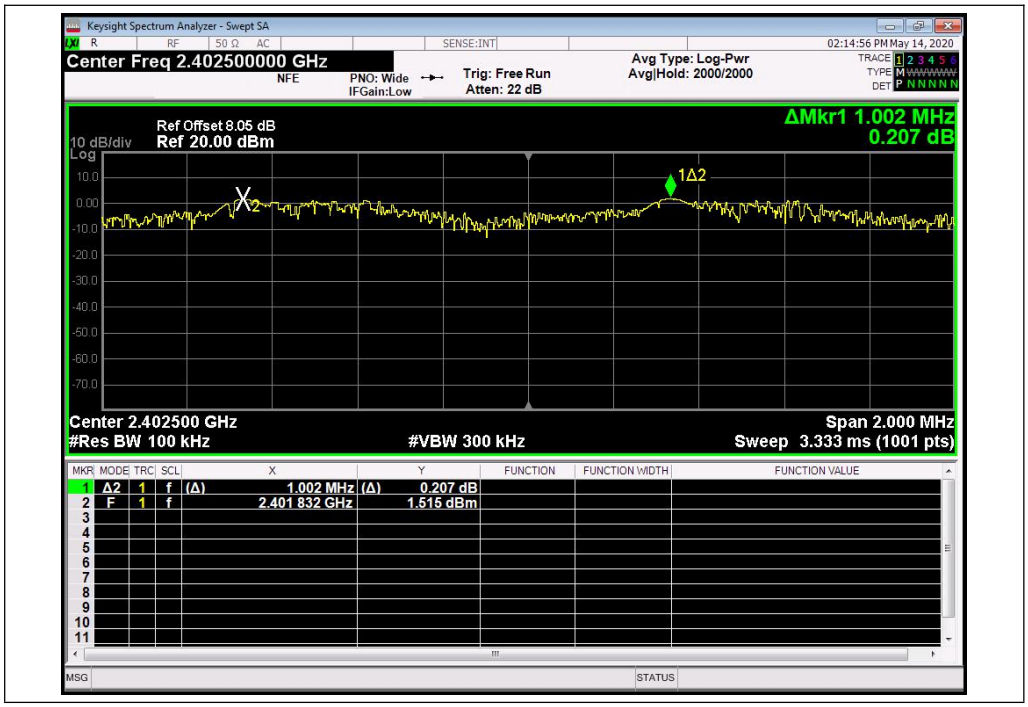
(GFSK, Channel 0 and 1, 2402MHz)



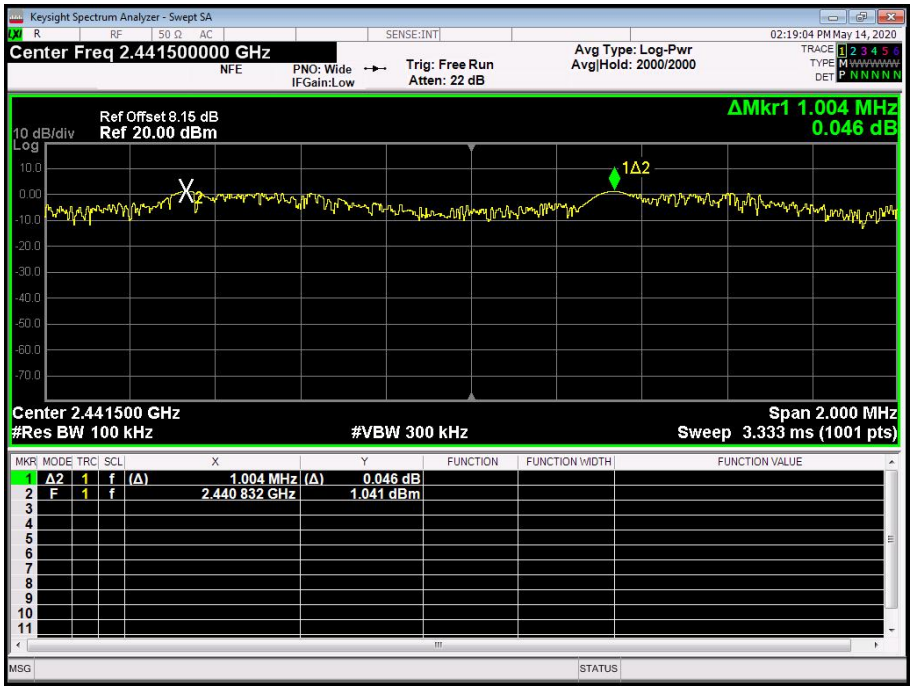
(GFSK, Channel 39 and 40, 2441MHz)



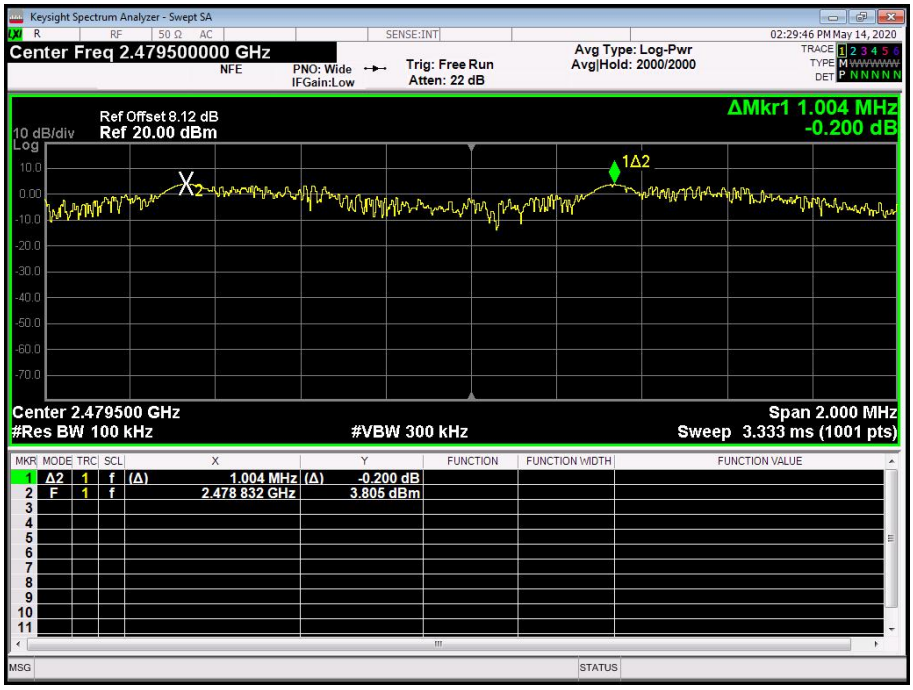
(GFSK, Channel 77 and 78, 2480MHz)



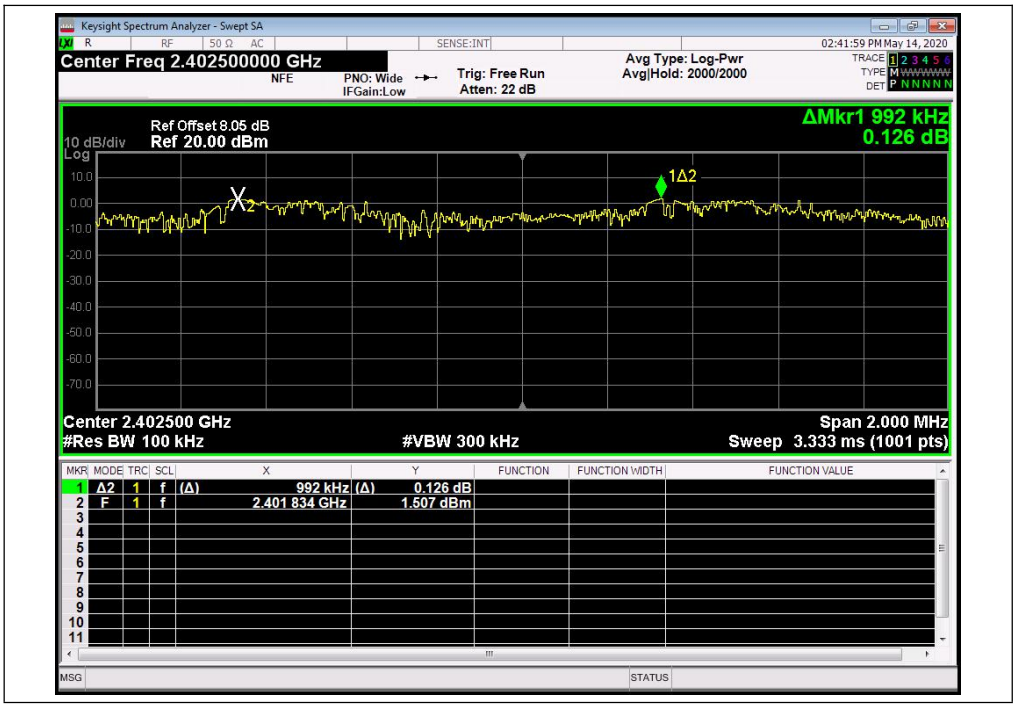
(π/4-DQPSK, Channel 0 and 1, 2402MHz)



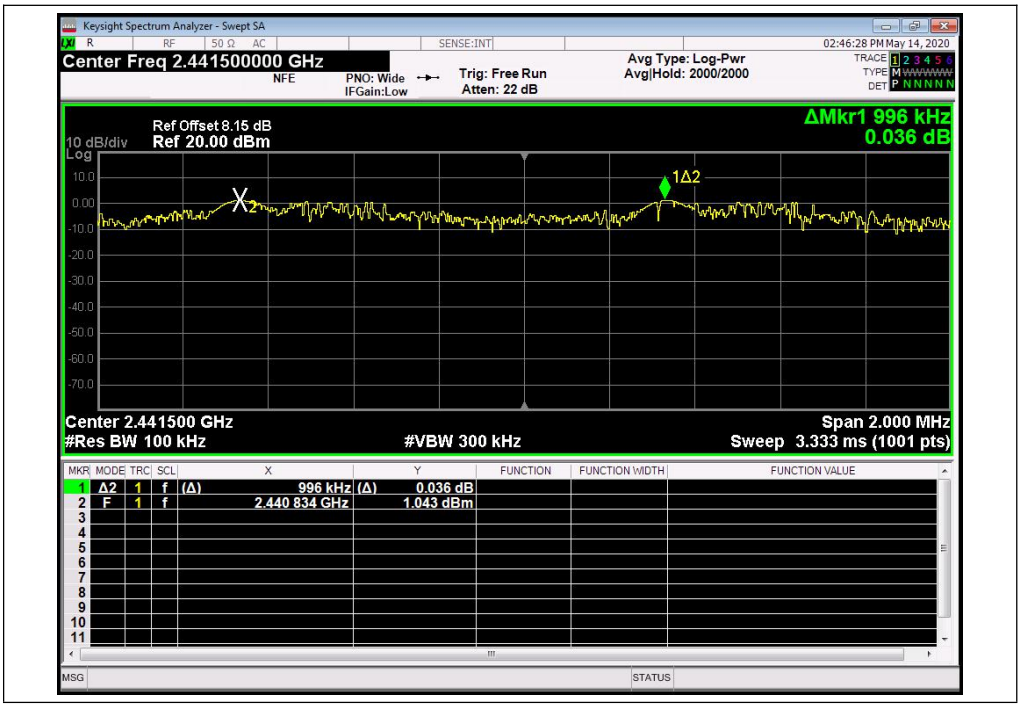
(π/4-DQPSK, Channel 39 and 40, 2441MHz)



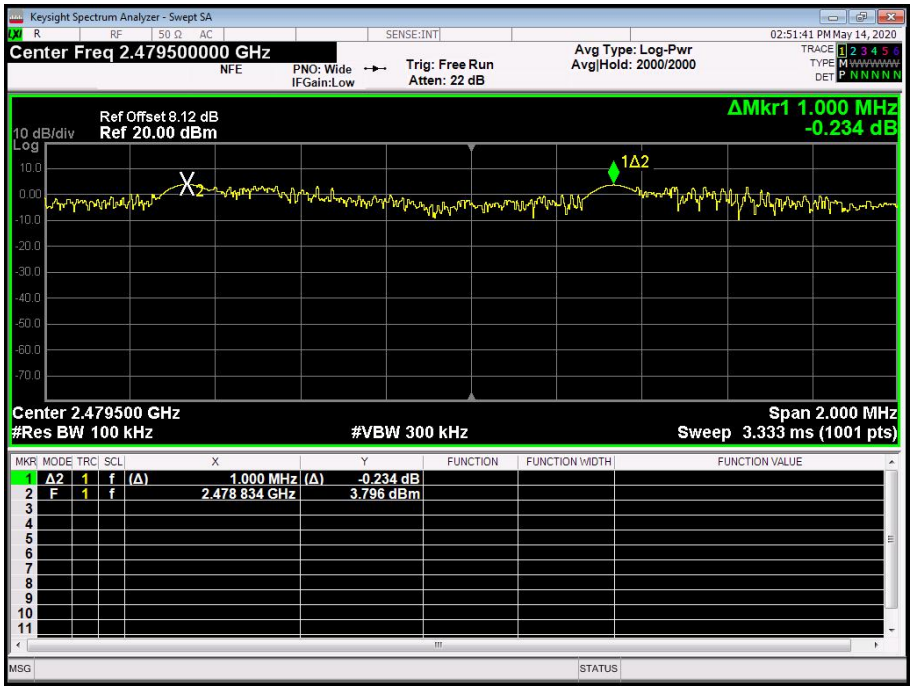
(π/4-DQPSK, Channel 77 and 78, 2480MHz)



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



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



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

2.7. Time of Occupancy (Dwell time)

2.7.1. 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.

2.7.2. 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.

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).

2.7.3. Test Result

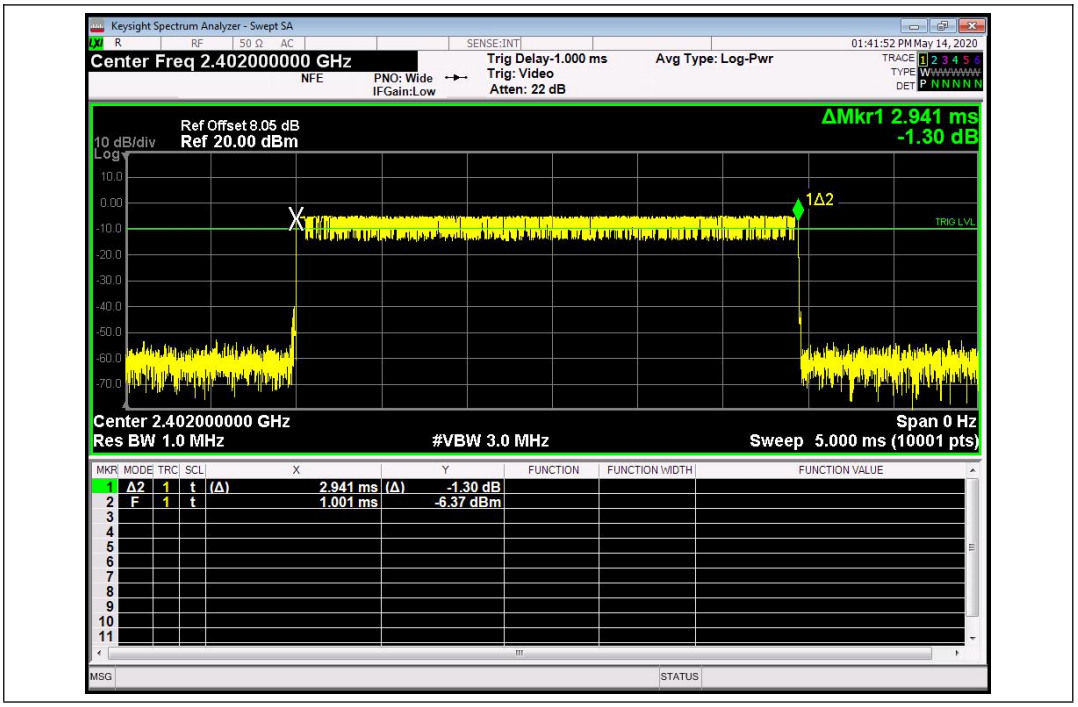
For time of occupancy, all of mode were tested separately, we only recorded the worst test result(DH5/2DH5/3DH5) in this report.

GFSK Mode

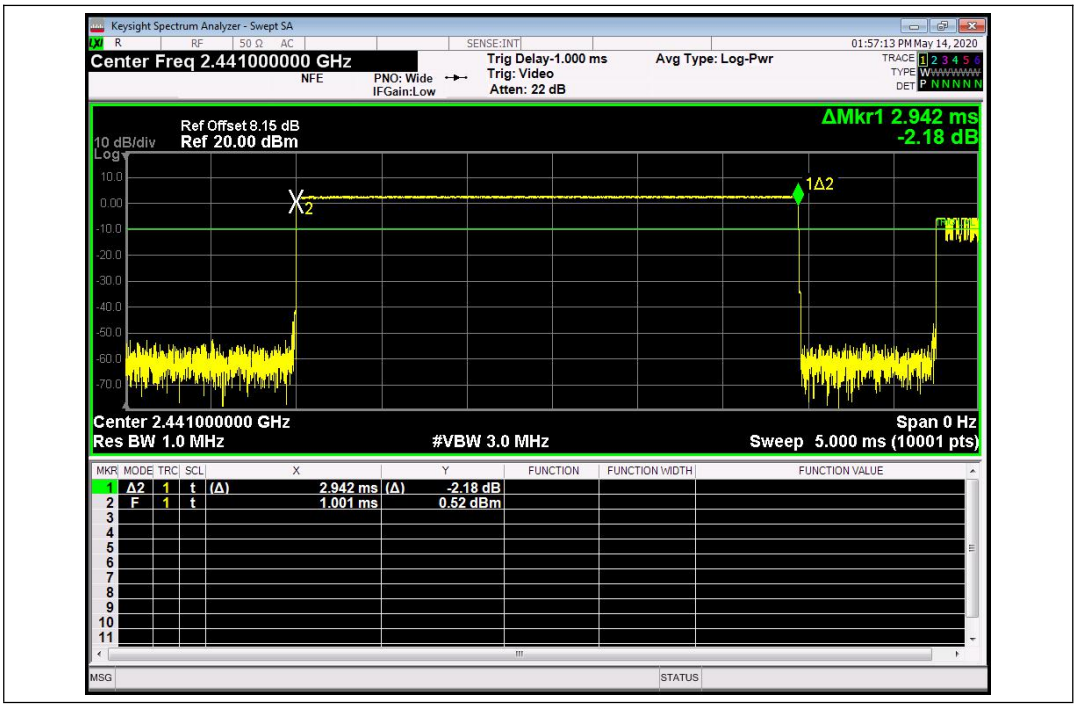
A. Test Verdict:

Mode	Frequency (MHz)	Pulse Width (ms)	Dwell Time (ms)	Limit (sec)	Verdict
DH5	2402	2.941	313.707	0.4	PASS
	2441	2.942	313.813		PASS
	2480	2.941	313.707		PASS

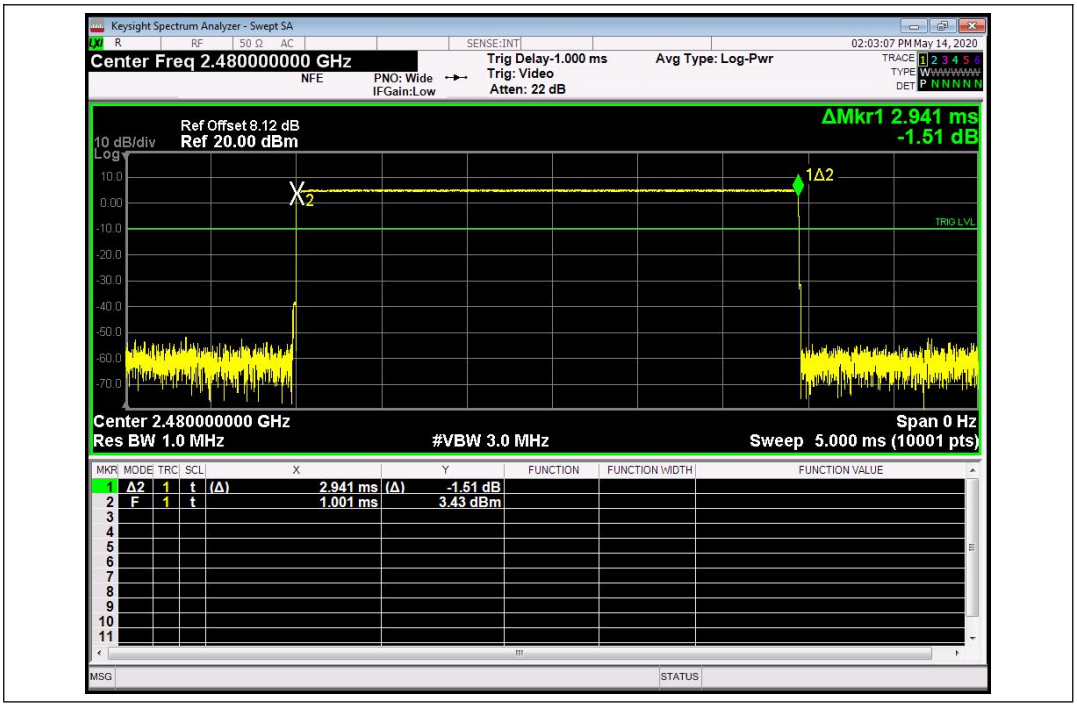
B. Test Plots:



(DH5_2402MHz, GFSK)



(DH5_2441M, GFSK)



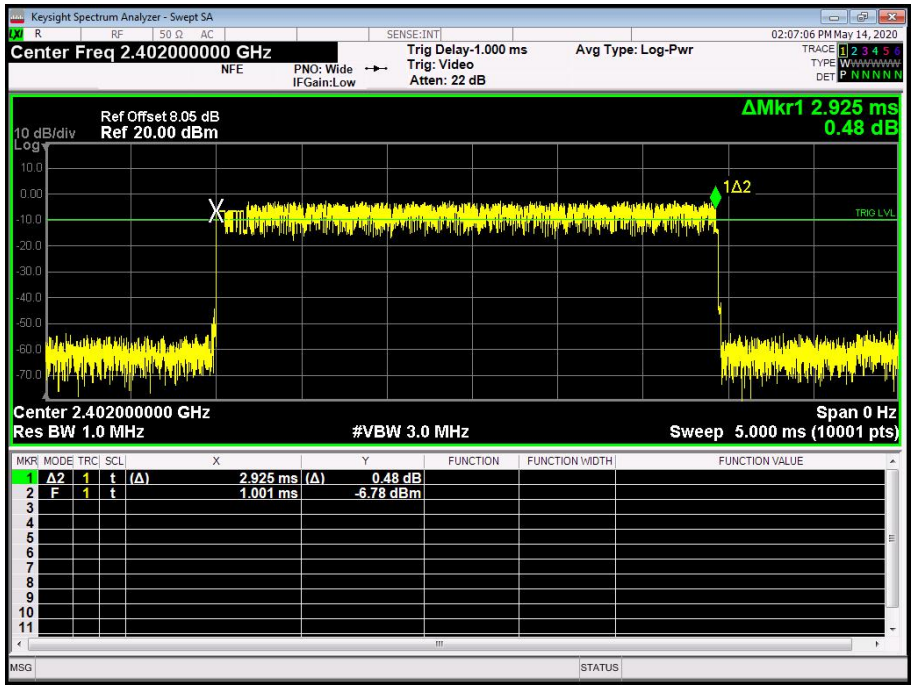
(DH5_2480M, GFSK)

π/4-DQPSK Mode

A. Test Verdict:

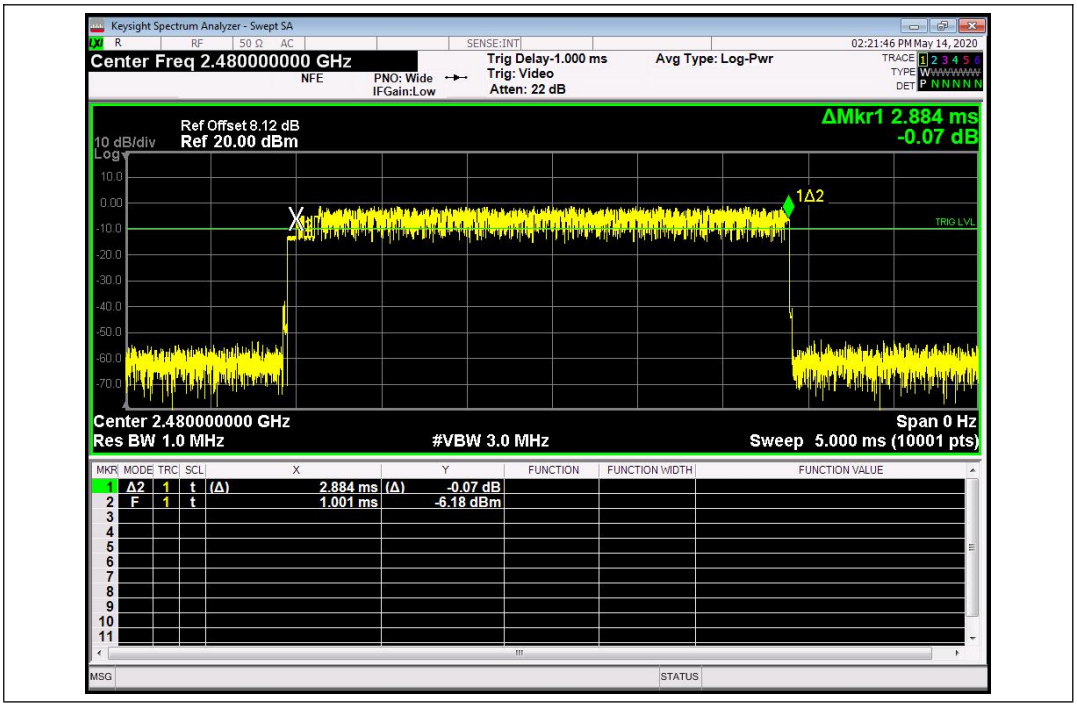
Mode	Frequency (MHz)	Pulse Width (ms)	Dwell Time (ms)	Limit (sec)	Verdict
2DH5	2402	2.924	307.200	0.4	PASS
	2441	2.875	306.667		PASS
	2480	2.884	307.627		PASS

B. Test Plots:



(2DH5_2402M, π/4-DQPSK)

(2DH5_2441M, π/4-DQPSK)



(2DH5_2480M, π/4-DQPSK)

8-DPSK mode

A. Test Verdict: