FCC&ISED RF TEST REPORT

No. 171200800SHA-002

Applicant	:	Snap Inc. 63 Market Street, Venice, CA 90291, USA
Product Name	:	Wearable video camera
Type/Model	:	002
TEST RESULT	**:**	**PASS**

SUMMARY

The equipment complies with the requirements according to the following standard(s):

47CFR Part 15 (2016): Radio Frequency Devices

ANSI C63.10 (2013): American National Standard for Testing Unlicensed Wireless Devices

RSS-247 Issue 2 (February 2017): Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

RSS-Gen Issue 4 (November 2014): General Requirements for Compliance of Radio Apparatus

Date of issue: March 2, 2018

Prepared by:

Wade Zhang (Project engineer)

Reviewed by:

Daniel Zhao (Reviewer)

Content

Revision History

Issue No.	Version	Description	Date Issued
171200800SHA-002	Rev. 01	Initial issue of report	March 2, 2018

1. General Information

1.1 Identification of the EUT

Equipment	:	Wearable video camera
Type/model	:	002
FCC ID	:	2AIRN-002
IC	:	22922-002
Description of EUT	:	The EUT is a wearable video camera which support WIFI and Bluetooth 4.2 technology, there have only one mode, we tested it and listed the BT(EDR) result in this report.
Rating	:	DC 5V
Port identification	:	NA
Category of EUT	:	Class B
EUT type	:	☒ Table top ☐ Floor standing
Sample received date	:	December 12, 2017
Date of test	:	December 12, 2017 ~ January 9, 2018

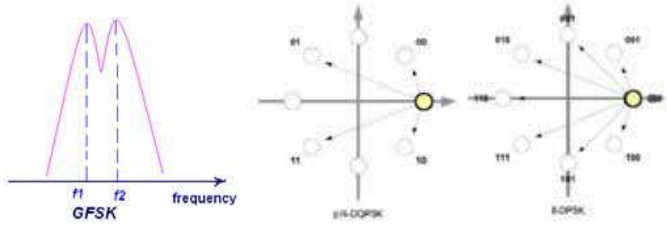
1.2 Technical specification

Operation Frequency Band: 2402 - 2480 MHz

Protocol: BT 4.2 (BR+EDR)

Modulation: GFSK, π/4 DQPSK, 8DPSK

Technology:



Antenna Designation: Internal Monopole antenna, 4.2dBi Peak gain

Channel Description: There are 79 channels in all. The designed channel spacing is 1MHz.

Channel Identifier	Frequency (MHz)
low	2402
middle	2441
high	2480

Antenna Requirement: 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. 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.

The EUT used an internal monopole antenna and used a no-standard electrical connector, so fulfill these requirements.

1.3 Mode of operation during the test / Test peripherals used

While testing the transmitter mode of the EUT, the internal modulation is applied.
All the functions of the host device except the BT module were set on stand-by mode.

The test setting software is offered by the manufactory. The pre-scan for the conducted power with all rates in each modulation and bands was used, and the worst case was found and used in all test cases.

The worst case modulation configuration:

Worst Modulation Used for Conformance Testing			
Bluetooth Mode	**Data Rate**	**Packet Type**	**Worst Mode**
GFSK	BR-1Mbps	DH1,DH3,DH5	**BR-1Mbps DH5** EDR-2Mbps 2DH5 EDR-3Mbps 3DH5
π/4 DQPSK	EDR-2Mbps	2DH1,2DH3,2DH5	
8DPSK	EDR-3Mbps	3DH1,3DH3,3DH5	
Note: The BR-1Mbps DH5 mode was chosen for radiation emission bellow 1GHz and Conducted emission testing as representative in this report.			

The power setting parameter:

The worst case power setting parameter			
Test software Version	CMD Command		
Modulation Mode	2402MHz	2441MHz	2480MHz
BR-1Mbps	0x09	0x09	0x09
EDR-2Mbps	0x09	0x09	0x09
EDR-3Mbps	0x09	0x09	0x09

There have the following test modes:

Radiated test mode:
Mode 1: EUT transmitted signal with internal antenna;

Conducted test mode:
Mode 2: EUT transmitted signal from PCBA RF port connected to SPA directly;

We have verified all test modes, and choose the mode 1 for radiated RF test and mode 2 for conducted RF test as representatively to list the results in this report.

Test Peripherals:

Item No.	Name	Band and Model	Description
1	Laptop computer	HP ProBook 6470b	100-240V AC, 50/60Hz FCC DOC
2	AC-DC adaptor	KA25	100-240VAC, DC5V1A FCC VOC
3	RF Board	NA	NA

1.4 Description of Test Facility

Name : Intertek Testing Services Shanghai

Address : Building 86, No. 1198 Qinzhou Road(North), Shanghai 200233, P.R. China

Telephone : 86 21 61278200

Telefax : 86 21 54262353

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

CNAS Accreditation Lab

Registration No. CNAS L0139

FCC Accredited Lab
Designation Number: CN1175

IC Registration Lab

Registration code No.: 2042B-1

VCCI Registration Lab

Registration No.: R-4243, G-845, C-4723, T-2252

NVLAP Accreditation Lab

NVLAP LAB CODE: 200849-0

A2LA Accreditation Lab

Certificate Number: 3309.02

2. Test Specification

2.1 Instrument list

Conducted Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☑	Test Receiver	R&S	ESCS 30	EC 2107	2018-10-18
☑	A.M.N.	R&S	ESH2-Z5	EC 3119	2018-12-01
☑	Shielded room	Zhongyu	-	EC 2838	2019-01-08
Radiated Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☑	Test Receiver	R&S	ESIB 26	EC 3045	2018-10-18
☑	Bilog Antenna	TESEQ	CBL 6112D	EC 4206	2018-05-30
☑	Horn antenna	R&S	HF 906	EC 3049	2018-09-22
☑	Horn antenna	ETS	3117	EC 4792-1	2018-08-23
☑	Horn antenna	TOYO	HAP18-26W	EC 4792-3	2020-07-09
☑	Pre-amplifier	R&S	Pre-amp 18	EC5881	2018-06-19
☑	Semi-anechoic chamber	Albatross project	-	EC 3048	2018-09-08
RF test					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☑	PXA Signal Analyzer	Keysight	N9030A	EC 5338	2018-09-10
☑	Power sensor	Agilent	U2021XA	EC 5338-1	2018-03-03
☑	Vector Signal Generator	Agilent	N5182B	EC 5175	2018-03-06
☑	MXG Analog Signal Generator	Agilent	N5181A	EC 5338-2	2018-03-03
☑	Test Receiver	R&S	ESCI 7	EC 4501	2018-02-23
Additional instrument					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☑	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3323	2018-06-14
☑	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3324	2018-04-09
☑	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3325	2018-03-23
☑	Pressure meter	YM3	Shanghai Mengde	EC 3320	2018-06-28

2.2 Test Standard

47CFR Part 15 (2016)
ANSI C63.10 (2013)
DA 00-705
RSS-247 Issue 2 (February 2017)
RSS-Gen Issue 4 (November 2014)

2.3 Test Summary

This report applies to tested sample only. This report shall not be reproduced in part without written approval of Intertek Testing Service Shanghai Limited.

TEST ITEM	FCC REFERANCE	IC REFERANCE	RESULT
20 dB Bandwidth	15.247(a)(1)	RSS-247 Issue 2 Clause 5	Tested
Carrier Frequency Separation	15.247(a)(1)	RSS-247 Issue 2 Clause 5	Pass
Output power	15.247(b)(1)	RSS-247 Issue 2 Clause 5	Pass
Radiated Spurious Emissions	15.205 & 15.209	RSS-247 Issue 2 Clause 5	Pass
Conducted Spurious Emissions & Band Edge	15.247(d)	RSS-247 Issue 2 Clause 5	Pass
Power line conducted emission	15.207	RSS-Gen Issue 4 Clause 8.8	Pass
Number of Hopping Frequencies	15.247(a)(1)(iii)	RSS-247 Issue 2 Clause 5	Pass
Dwell time	15.247(a)(1)(iii)	RSS-247 Issue 2 Clause 5	Pass
Occupied bandwidth	-	RSS-Gen Issue 4 Clause 6.6	Tested

Notes: 1: NA =Not Applicable

2: This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

2.4 Frequency Hopping System Requirement

Test Requirement: Section 15.247 (a)(1), (g), (h) requirement:

The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom 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.

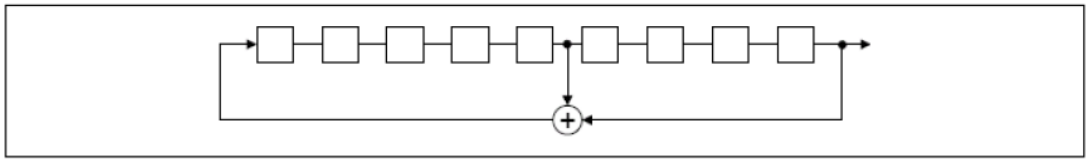
Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

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 hop sets 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.

Compliance for section 15.247(a)(1)

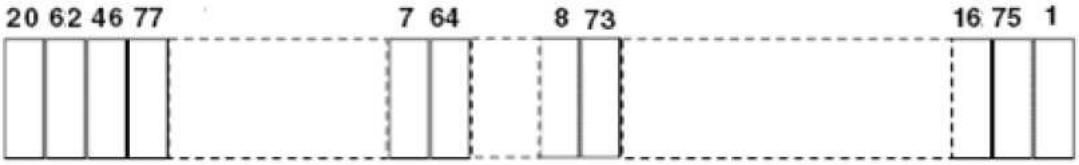
According to Bluetooth Core Specification, the pseudorandom sequence may be generated in a nine stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs;
i.e. the shift register is initialized with nine ones.

- Number of shift register stages: 9
- Length of pseudo-random sequence: 2^9 -1 = 511 bits
- Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.
According to Bluetooth Core Specification, Bluetooth receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any Bluetooth transmitters and shift frequencies in synchronization with the transmitted signals.

Compliance for section 15.247(g)

According to Bluetooth Core Specification, the Bluetooth system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.

Compliance for section 15.247(h)

According to Bluetooth Core specification, the Bluetooth system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels.
According to the Bluetooth Core specification, the Bluetooth system is designed not have the ability to coordinate with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.

2.5 Measurement uncertainty

The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Test item	Measurement uncertainty
Maximum peak output power	± 0.74dB
Radiated Emissions in restricted frequency bands below 1GHz	± 4.90dB
Radiated Emissions in restricted frequency bands above 1GHz	± 5.02dB
Emission outside the frequency band	± 2.89dB
Power line conducted emission	± 3.19dB

3. 20 dB Bandwidth

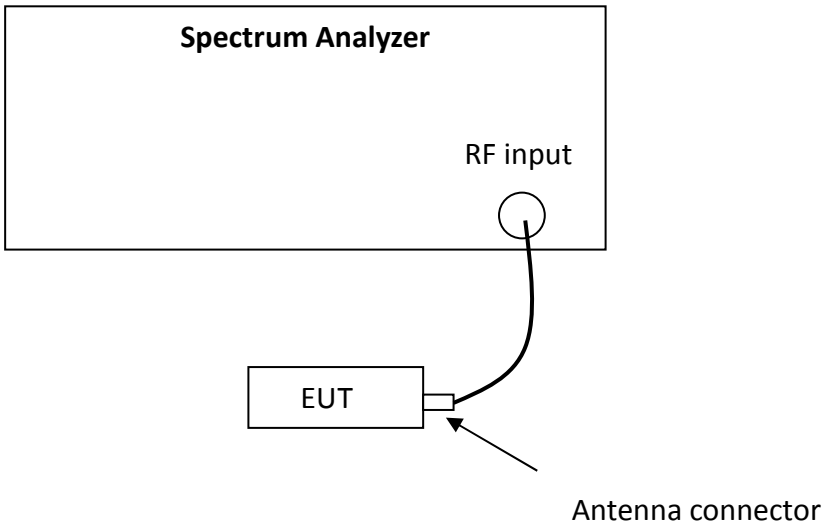
Test result: Tested

3.1 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.

☒ 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 125mW.

3.2 Test Configuration



3.3 Test Procedure and test setup

The 20 bandwidth per FCC §15.247(a)(1) is measured using the Spectrum Analyzer with Span = 2 to 3 times the 20 dB bandwidth, RBW≥1% of the 20 dB bandwidth, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

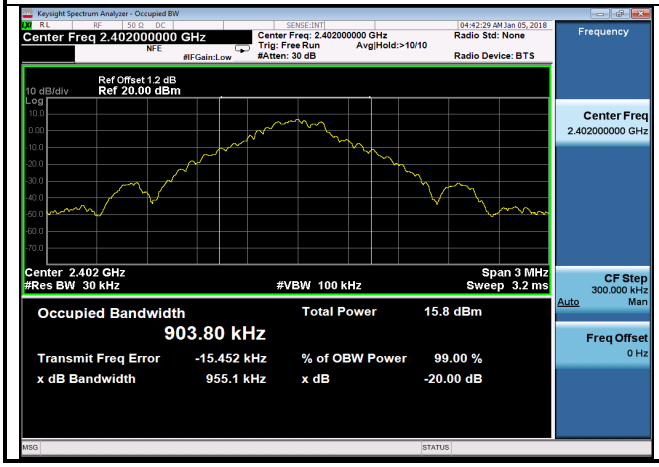
3.4 Test Protocol

Temperature : 25°C

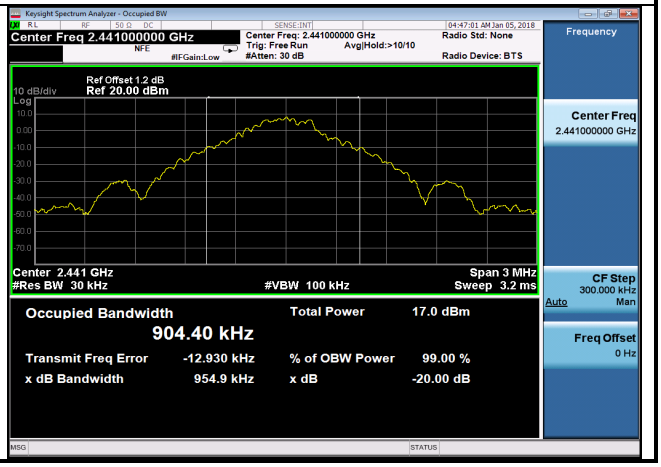
Relative Humidity : 55 %

BT 20dB Bandwidth					
Mode	Test Frequency	Packet Type	20dB Bandwidth(KHz)	Two-thirds of Bandwidth(KHz)	Result
GFSK	2402	DH5	955.1	636.73	Pass
GFSK	2441	DH5	954.9	636.60	Pass
GFSK	2480	DH5	951.9	634.60	Pass
DQPSK	2402	2DH5	1284	856.00	Pass
DQPSK	2441	2DH5	1283	855.33	Pass
DQPSK	2480	2DH5	1284	856.00	Pass
8DPSK	2402	3DH5	1293	862.00	Pass
8DPSK	2441	3DH5	1292	861.33	Pass
8DPSK	2480	3DH5	1293	862.00	Pass

20dB Bandwidth：GFSK,2402Mhz,DH5

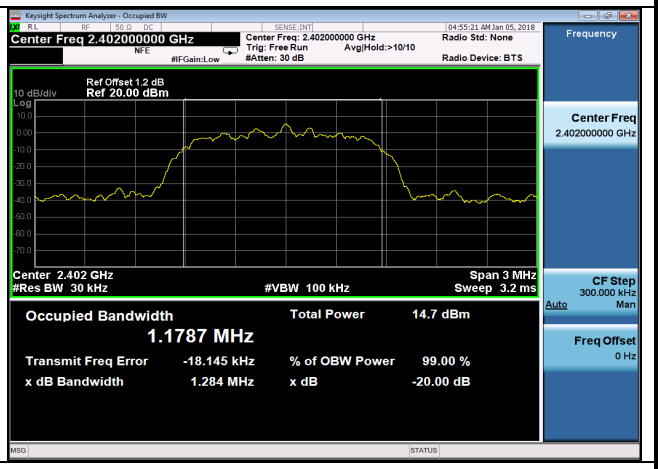


20dB Bandwidth：GFSK,2441Mhz,DH5

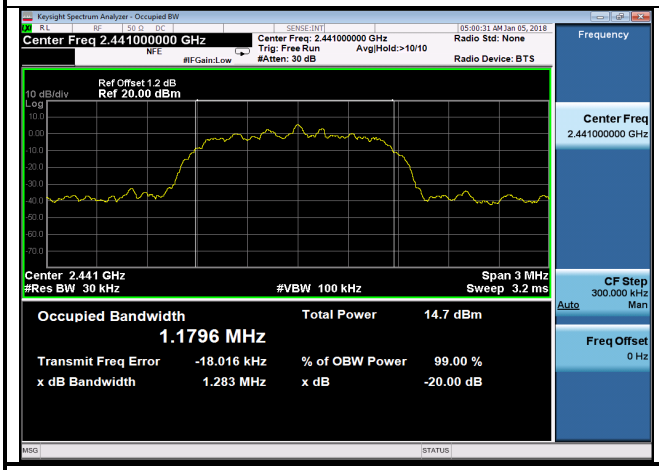


20dB Bandwidth：GFSK,2480Mhz,DH5

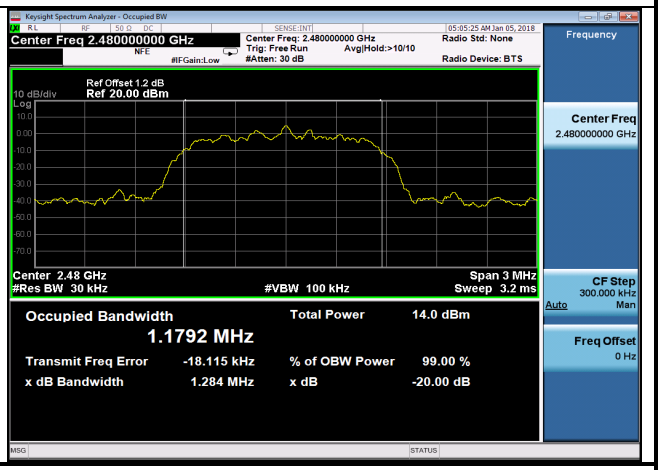
20dB Bandwidth：DQPSK,2402Mhz,2DH5



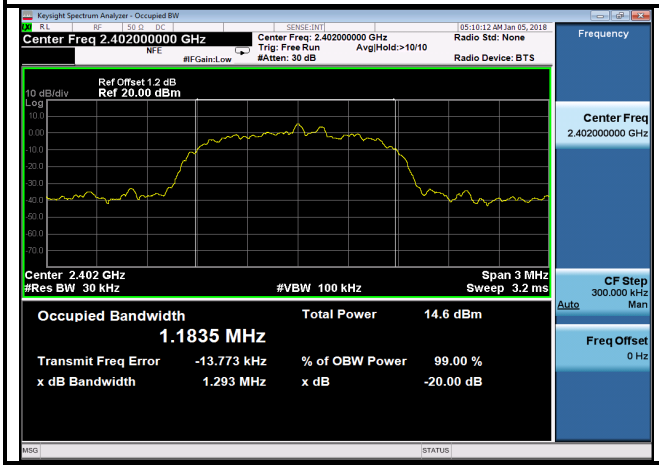
20dB Bandwidth：DQPSK,2441Mhz,2DH5



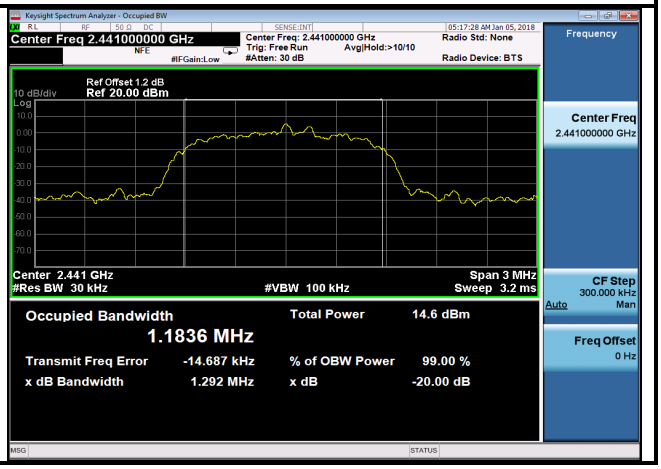
20dB Bandwidth：DQPSK,2480Mhz,2DH5

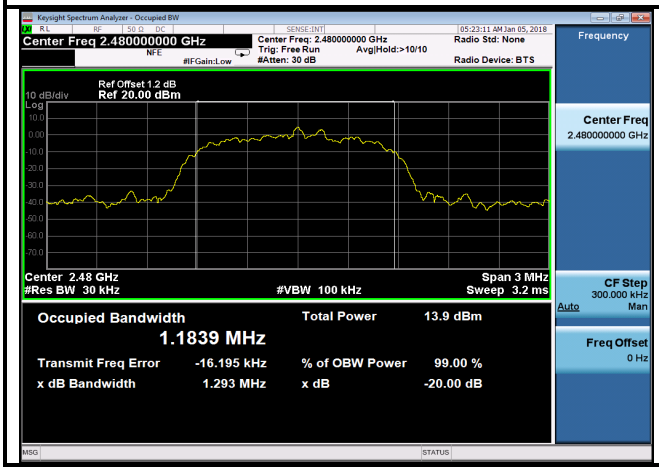


20dB Bandwidth：8DPSK,2402Mhz,3DH5



20dB Bandwidth：8DPSK,2441Mhz,3DH5



20dB Bandwidth：8DPSK,2480Mhz,3DH5	
	

4. Carrier Frequency Separation

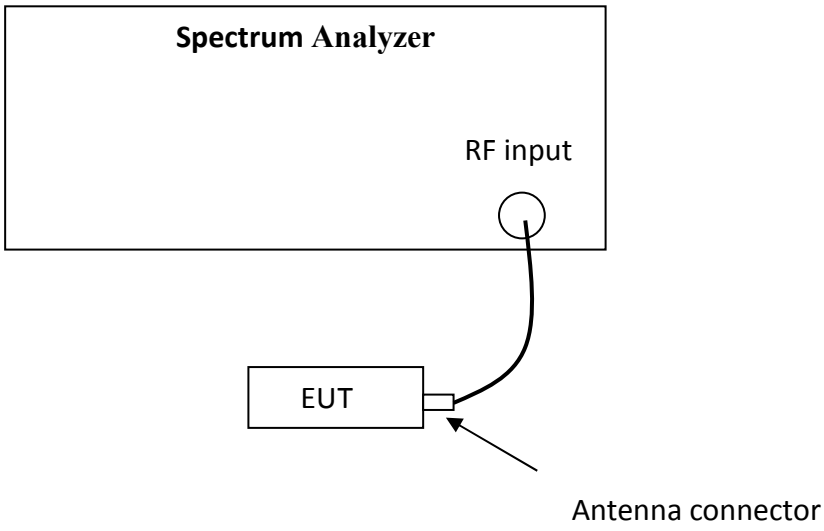
Test result: Pass

4.1 Limit

☐ Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

☒ 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 125mW.

4.2 Test Configuration



4.3 Test Procedure and test setup

The Carrier Frequency Separation per FCC §15.247(a)(1) is measured using the Spectrum Analyzer with Span can capture two adjacent channels, RBW≥1% of the span, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

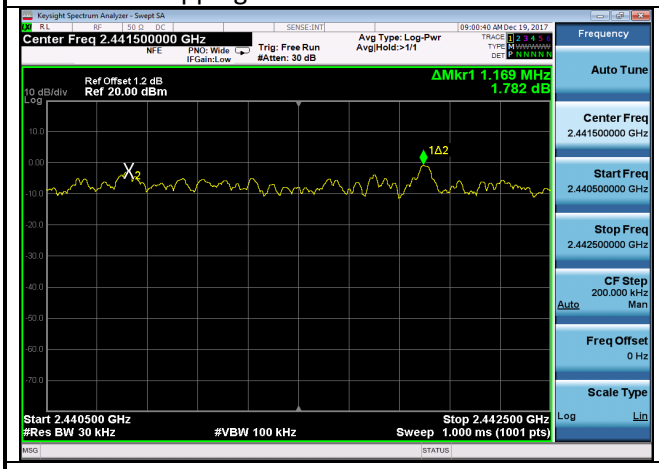
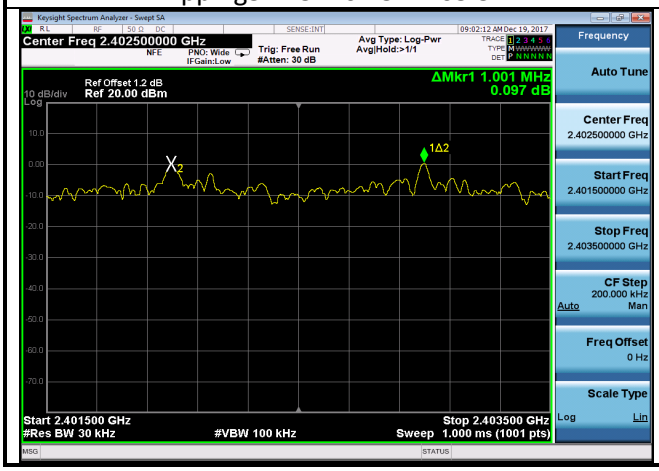
4.4 Test Protocol

Temperature : 25°C

Relative Humidity : 55 %

BT Carrier Frequency Separation					
Mode	Test Frequency	Packet Type	Range(MHz~MHz)	Sepration(kHz)	Result
GFSK	Hopping	DH5	2401.5Mhz~2403.5Mhz	1045	Pass
GFSK	Hopping	DH5	2440.5Mhz~2442.5Mhz	1037	Pass
GFSK	Hopping	DH5	2478.5Mhz~2480.5Mhz	1073	Pass
DQPSK	Hopping	2DH5	2401.5Mhz~2403.5Mhz	997	Pass
DQPSK	Hopping	2DH5	2440.5Mhz~2442.5Mhz	1169	Pass
DQPSK	Hopping	2DH5	2478.5Mhz~2480.5Mhz	1171	Pass
8DPSK	Hopping	3DH5	2401.5Mhz~2403.5Mhz	1001	Pass
8DPSK	Hopping	3DH5	2440.5Mhz~2442.5Mhz	1085	Pass
8DPSK	Hopping	3DH5	2478.5Mhz~2480.5Mhz	1031	Pass

Carrier Frequency Separation：GFSK,HoppingDH52401.5~2403.5	Carrier Frequency Separation：GFSK,HoppingDH52440.5~2442.5
	

Carrier Frequency Separation：GFSK,HoppingDH52478.5~2480.5	Carrier Frequency Separation：DQPSK,Hopping2DH52401.5~2403.5
	
Carrier Frequency Separation：DQPSK,Hopping2DH52440.5~2442.5	Carrier Frequency Separation：DQPSK,Hopping2DH52478.5~2480.5
	
Carrier Frequency Separation：8DPSK,Hopping3DH52401.5~2403.5	Carrier Frequency Separation：8DPSK,Hopping3DH52440.5~2442.5
	

Carrier Frequency Separation：8DPSK,Hopping 3DH52478.5~2480.5	
	

5. Maximum peak output power

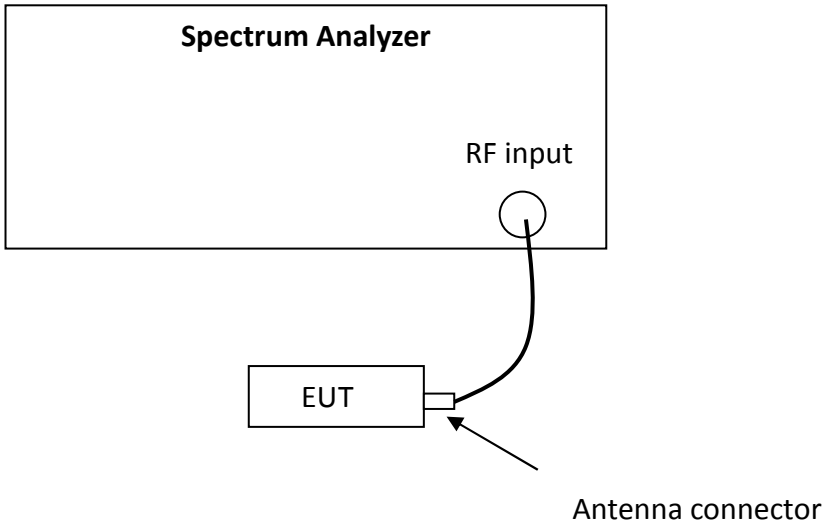
Test result: Pass

5.1 Test limit

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
If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

5.2 Test Configuration



5.3 Test procedure and test setup

The power output per FCC §15.247(b) is measured using the Spectrum Analyzer with Span = 5 times the 20 dB bandwidth, RBW≥ the 20 dB bandwidth, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

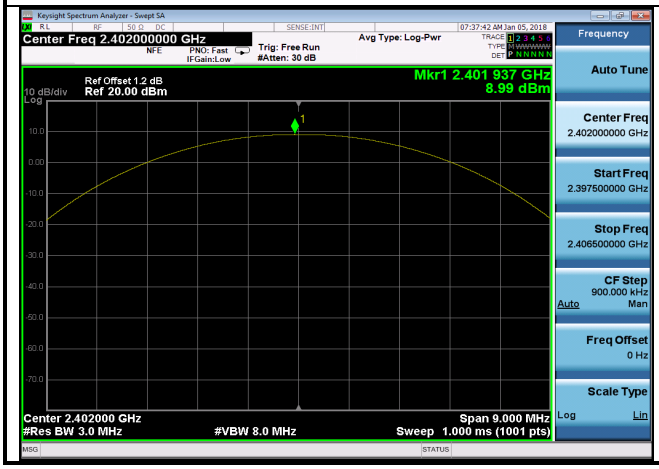
5.4 Test protocol

Temperature : 25 °C

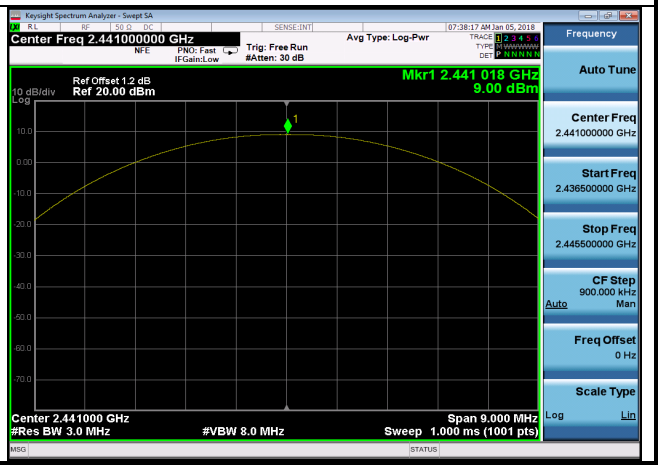
Relative Humidity : 55 %

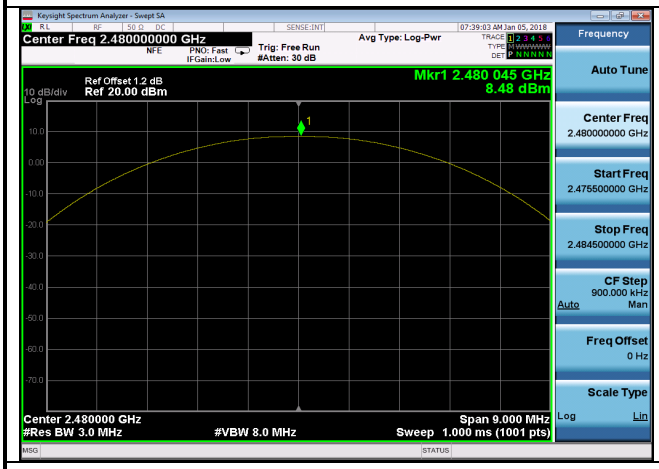
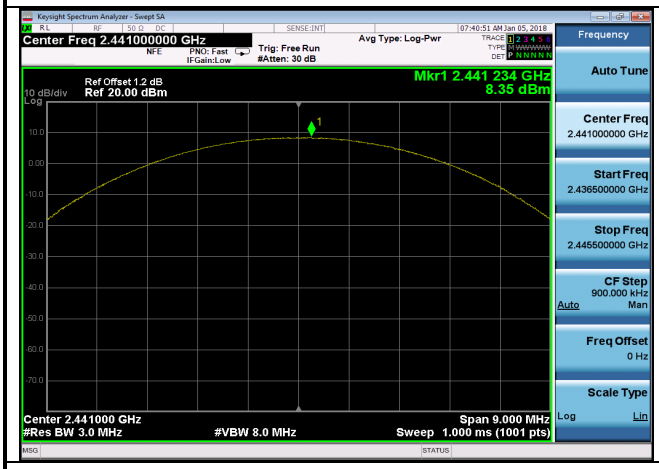
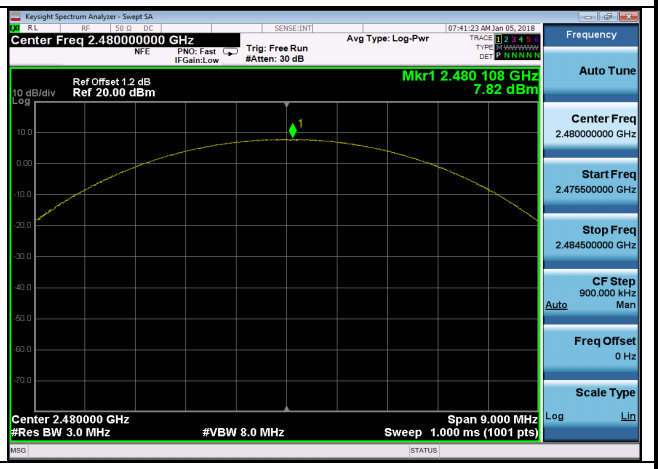
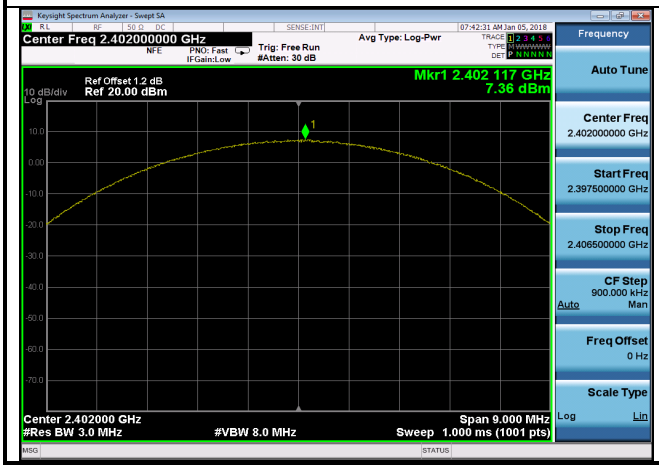
BT Maximum Output Power				
Mode	Test Frequency	Packet Type	Power(dBm)	Result
GFSK	2402	DH5	8.99	Pass
GFSK	2441	DH5	9.00	Pass
GFSK	2480	DH5	8.48	Pass
DQPSK	2402	2DH5	8.30	Pass
DQPSK	2441	2DH5	8.35	Pass
DQPSK	2480	2DH5	7.82	Pass
8DPSK	2402	3DH5	7.36	Pass
8DPSK	2441	3DH5	7.37	Pass
8DPSK	2480	3DH5	6.78	Pass

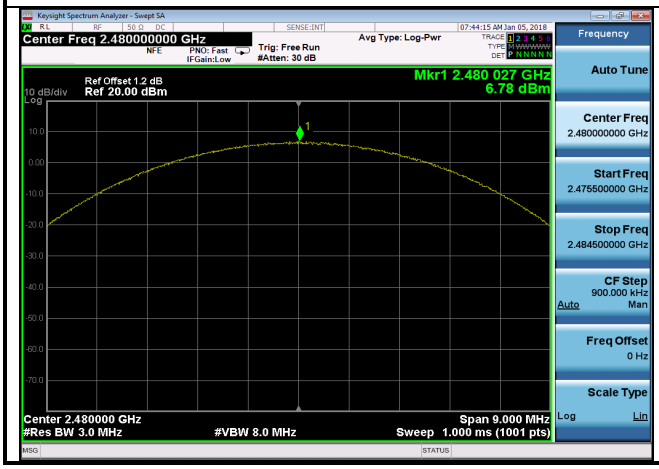
Output Power：GFSK,2402MHz,DH5



Output Power：GFSK,2441MHz,DH5



Output Power：GFSK,2480MHz,DH5	Output Power：DQPSK,2402MHz,2DH5
	
Output Power：DQPSK,2441MHz,2DH5	Output Power：DQPSK,2480MHz,2DH5
	
Output Power：8DPSK,2402MHz,3DH5	Output Power：8DPSK,2441MHz,3DH5
	

Output Power：8DPSK,2480MHz,3DH5	
	

Conclusion: The maximum EIRP = 9.0dBm+4.2dBi = 13.2dBm = 0.021W which is lower than the limit of 4W listed in RSS-247.