



MEASUREMENT REPORT

FCC PART 15.247 / ISSED RSS-247 Bluetooth

FCC ID: H8N-ASK8822
IC: 1353A-ASK8822
Applicant: Askey Computer Corp.

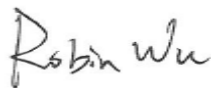
Application Type: Certification
Product: WIFI+BT Combo Module
Model No.: ASK8822
Brand Name: ASKEY
FCC Classification: FCC Part 15 Spread Spectrum Transmitter (DSS)
FCC Rule Part(s): Part15 Subpart C (Section 15.247)
ISED Rule(s): RSS-247 Issue 2, RSS-GEN Issue 5
Test Procedure(s): ANSI C63.10-2013, KDB 558074 D01v05r02
Test Date: August 07 ~ 21, 2020

Reviewed By:



(Kevin Guo)

Approved By:



(Robin Wu)



The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. Test results reported herein relate only to the item(s) tested.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Suzhou) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date	Note
2006RSU028-U1	Rev. 01	Initial Report	08-31-2020	Valid

CONTENTS

Description	Page
1. INTRODUCTION	7
1.1. Scope	7
1.2. MRT Test Location	7
2. PRODUCT INFORMATION	8
2.1. Equipment Description.....	8
2.2. Product Specification Subjective to this Standard	8
2.3. Operation Frequency / Channel List	9
2.4. Description of Available Antennas	10
2.5. Description of Antenna	10
2.6. Pseudorandom Frequency Hopping Sequence.....	11
2.7. Test Mode	11
2.8. Configuration of Test System.....	12
2.9. Test System Details.....	12
2.10. Test Software	12
2.11. Test Environment Condition	12
2.12. Duty Cycle	13
2.13. EMI Suppression Device(s)/Modifications.....	13
2.14. Labeling Requirements.....	14
3. ANTENNA REQUIREMENTS.....	15
4. TEST EQUIPMENT CALIBRATION DATE.....	16
5. MEASUREMENT UNCERTAINTY.....	18
6. TEST RESULT	19
6.1. Summary	19
6.2. Occupied Bandwidth Measurement	20
6.2.1. Test Limit	20
6.2.2. Test Procedure used.....	20
6.2.3. Test Setting.....	20
6.2.4. Test Setup.....	21
6.2.5. Test Result.....	22
6.3. Output Power Measurement.....	26
6.3.1. Test Limit	26
6.3.2. Test Procedure Used	26
6.3.3. Test Setting.....	26
6.3.4. Test Setup.....	26

6.3.5.	Test Result	27
6.4.	Carrier Frequency Separation Measurement	31
6.4.1.	Test Limit	31
6.4.2.	Test Procedure Used	31
6.4.3.	Test Setting	31
6.4.4.	Test Setup.....	31
6.4.5.	Test Result	32
6.5.	Number of Hopping Channels Measurement	36
6.5.1.	Test Limit	36
6.5.2.	Test Procedure Used	36
6.5.3.	Test Settintg	36
6.5.4.	Test Setup.....	36
6.5.5.	Test Result	37
6.6.	Time of Occupancy Measurement	40
6.6.1.	Test Limit	40
6.6.2.	Test Procedure Used	40
6.6.3.	Test Settintg	40
6.6.4.	Test Setup.....	41
6.6.5.	Test Result	42
6.7.	Band-edge Compliance Measurement.....	44
6.7.1.	Test Limit	44
6.7.2.	Test Procedure Used	44
6.7.3.	Test Setting	44
6.7.4.	Test Setup.....	45
6.7.5.	Test Result	46
6.8.	Conducted Spurious Emissions Measurement.....	49
6.8.1.	Test Limit	49
6.8.2.	Test Procedure Used	49
6.8.3.	Test Setting	49
6.8.4.	Test Setup.....	50
6.8.5.	Test Result	51
6.9.	Radiated Spurious Emission Measurement	55
6.9.1.	Test Limit	55
6.9.2.	Test Procedure Used	55
6.9.3.	Test Setting	55
6.9.4.	Test Setup.....	57
6.9.5.	Test Result	58
6.10.	Radiated Restricted Band Edge Measurement	69
6.10.1.	Test Limit	69

6.10.2.	Test Procedure Used	72
6.10.3.	Test Setting.....	72
6.10.4.	Test Setup.....	73
6.10.5.	Test Result.....	74
6.11.	AC Conducted Emissions Measurement.....	98
6.11.1.	Test Limit	98
6.11.2.	Test Setup.....	98
6.11.3.	Test Result.....	99
7.	CONCLUSION.....	101
	Appendix A - Test Setup Photograph	102
	Appendix B - EUT Photograph.....	103

General Information

Applicant:	Askey Computer Corp.
Applicant Address:	10F, No.119, JIANKANG RD., ZHONGHE DIST., NEW TAIPEI CITY, TAIWAN
Manufacturer:	Askey Computer Corp.
Manufacturer Address:	10F, No.119, JIANKANG RD., ZHONGHE DIST., NEW TAIPEI CITY, TAIWAN
Test Site:	MRT Technology (Suzhou) Co., Ltd
Test Site Address:	D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China

Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Tian'edang Rd., Suzhou, China.

- MRT facility is an FCC accredited testing laboratory (MRT Designation No. CN1166) on the FCC website.
- MRT facility is an ISED recognized testing laboratory (MRT Reg. No. CN0001) on the ISED website.
- MRT facility is a VCCI registered (R-20025, G-20034, C-20020, T-20020) test laboratory with the site description on file at VCCI Council.
- MRT Lab is accredited to ISO 17025 by the A2LA under the A2LA Program (Cert. No. 3628.01) and CNAS under the CNAS Program (Cert. No. L10551) in EMC, Safety, Radio, Telecommunications and SAR testing.

1. INTRODUCTION

1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada and Certification and Engineering Bureau.

1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taihu Lake. These measurement tests were conducted at the MRT Technology (Suzhou) Co., Ltd. Facility located at D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China. The measurement facility compliant with the test site requirements specified in ANSI C63.4-2014.



2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name:	WIFI+BT Combo Module
Model No.:	ASK8822
PMN & HVIN:	ASK8822
Brand Name:	ASKEY
Wi-Fi Specification:	802.11a/b/g/n/ac
Bluetooth Specification:	v4.2 dual mode
Serial No.:	G1A9A007625BD493 F00

2.2. Product Specification Subjective to this Standard

Operating Frequency:	2402~2480MHz
Channel Number:	79
Type of modulation:	GFSK, PI/4 DQPSK, 8DPSK
Data Rate:	1Mbps, 2Mbps, 3Mbps

Note: The test data contained in this report pertains only to the emissions due to the EUT's Bluetooth transmitter.

- 15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.
- 15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate its channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.
- 15.247(h): The EUT employs Adaptive Frequency Hopping (AFH) which identifies sources of interference namely devices operating in 802.11 WLAN and excludes them from the list of available channels. The process of re-mapping reduces the number of test channels from 79 channels to a minimum number of 20 channels.

2.3. Operation Frequency / Channel List

Channel	Frequency	Channel	Frequency	Channel	Frequency
00	2402 MHz	01	2403 MHz	02	2404 MHz
03	2405 MHz	04	2406 MHz	05	2407 MHz
06	2408 MHz	07	2409 MHz	08	2410 MHz
09	2411 MHz	10	2412 MHz	11	2413 MHz
12	2414 MHz	13	2415 MHz	14	2416 MHz
15	2417 MHz	16	2418 MHz	17	2419 MHz
18	2420 MHz	19	2421 MHz	20	2422 MHz
21	2423 MHz	22	2424 MHz	23	2425 MHz
24	2426 MHz	25	2427 MHz	26	2428 MHz
27	2429 MHz	28	2430 MHz	29	2431 MHz
30	2432 MHz	31	2433 MHz	32	2434 MHz
33	2435 MHz	34	2436 MHz	35	2437 MHz
36	2438 MHz	37	2439 MHz	38	2440 MHz
39	2441 MHz	40	2442 MHz	41	2443 MHz
42	2444 MHz	43	2445 MHz	44	2446 MHz
45	2447 MHz	46	2448 MHz	47	2449 MHz
48	2450 MHz	49	2451 MHz	50	2452 MHz
51	2453 MHz	52	2454 MHz	53	2455 MHz
54	2456 MHz	55	2457 MHz	56	2458 MHz
57	2459 MHz	58	2460 MHz	59	2461 MHz
60	2462 MHz	61	2463 MHz	62	2464 MHz
63	2465 MHz	64	2466 MHz	65	2467 MHz
66	2468 MHz	67	2469 MHz	68	2470 MHz
69	2471 MHz	70	2472 MHz	71	2473 MHz
72	2474 MHz	73	2475 MHz	74	2476 MHz
75	2477 MHz	76	2478 MHz	77	2479 MHz
78	2480 MHz	-	-	-	-

2.4. Description of Available Antennas

Antenna Type	Frequency Band (GHz)	Tx Paths	Per Chain Max Antenna Gain (dBi)		Directional Gain (dBi)	
			Ant 0	Ant 1	For Power	For PSD
Wi-Fi Internal Antenna						
PIFA	2412 ~ 2462	2	2.40	1.98	2.40	5.41
	5150 ~ 5825	2	4.34	3.14	4.34	7.35
Bluetooth Internal Antenna						
PIFA	2402 ~ 2480	1	1.98		--	

Note:

The EUT supports Cyclic Delay Diversity (CDD) technology and CDD signals are correlated.

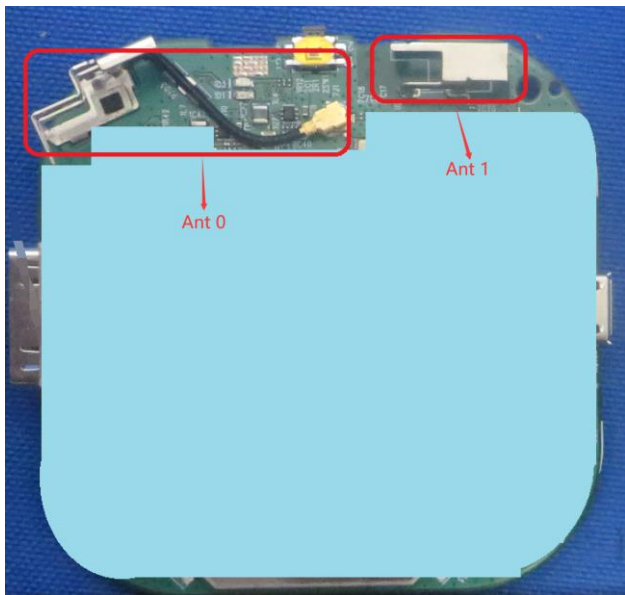
For CDD transmissions, directional gain is calculated as follows, $N_{ANT} = 2$, $N_{SS} = 1$.

If all antennas have the same gain, G_{ANT} , Directional gain = $G_{ANT} + \text{Array Gain}$, where Array Gain is as follows.

- For power spectral density (PSD) measurements on all devices,
Array Gain = $10 \log (N_{ANT}/ N_{SS})$ dB = 3.01;
- For power measurements on IEEE 802.11 devices,
Array Gain = 0 dB for $N_{ANT} \leq 4$;

If antenna gains are not equal, Directional gain may be calculated by using the formulas applicable to equal gain antennas with G_{ANT} set equal to the gain of the antenna having the highest gain.

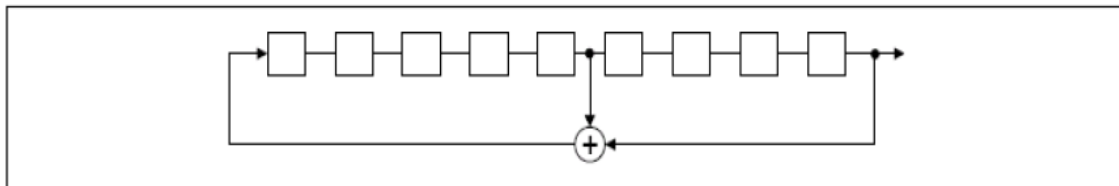
2.5. Description of Antenna

Wi-Fi & Bluetooth Antenna		
Software Control Port	Ant 0 (Wi-Fi)	Ant 1 (Wi-Fi & Bluetooth)
		
Note: A temporary RF connector to test conveniently in Ant 1 was provided by manufacturer		

2.6. Pseudorandom Frequency Hopping Sequence

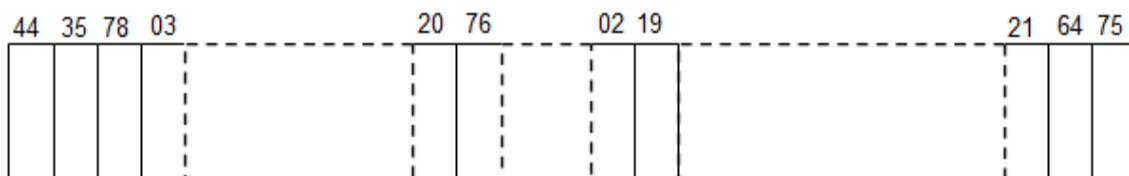
The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONES; i.e. the shift register is initialized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

The system receivers have input bandwidths that match the hopping channel bandwidths of their Corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

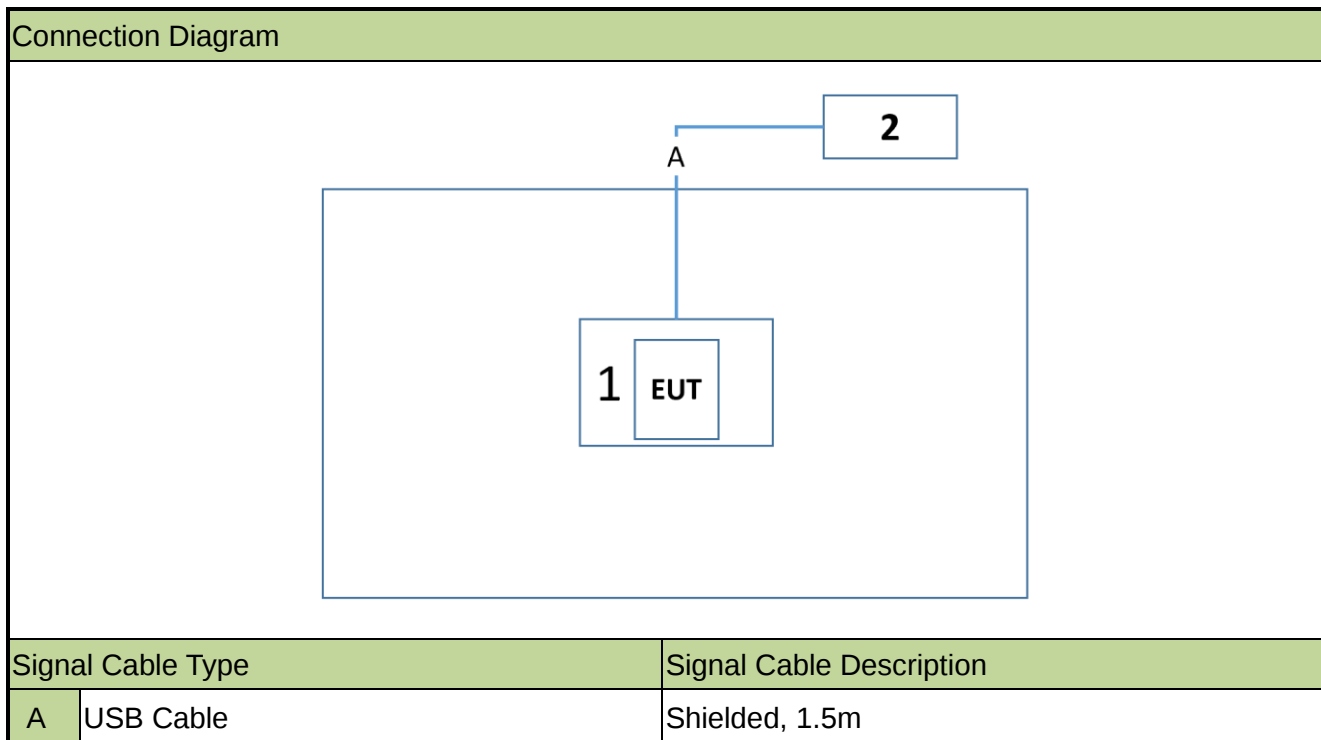
2.7. Test Mode

Test Mode	Mode 1: Transmit by DH5
	Mode 2: Transmit by 2DH5
	Mode 3: Transmit by 3DH5

Note: EUT is as a stand-alone device when the test is processing, but a test fixture will be used as a tool.

2.8. Configuration of Test System

The measurement procedures and appropriate EUT setup described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) was used in the measurement.



2.9. Test System Details

The types for all equipments, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product	Manufacturer	Model No.	Serial No.	Description
1 Test Fixture	ASKEY	N/A	N/A	As a power and signal control board
2 Notebook	DELL	Vostro 3300	DN62SP1	Non-Shielded, 1.8m

2.10. Test Software

The test utility software used during testing was “Realtek Bluetooth RF Test Tool”, and the RTLBTAPP version was 5.2.2.34.

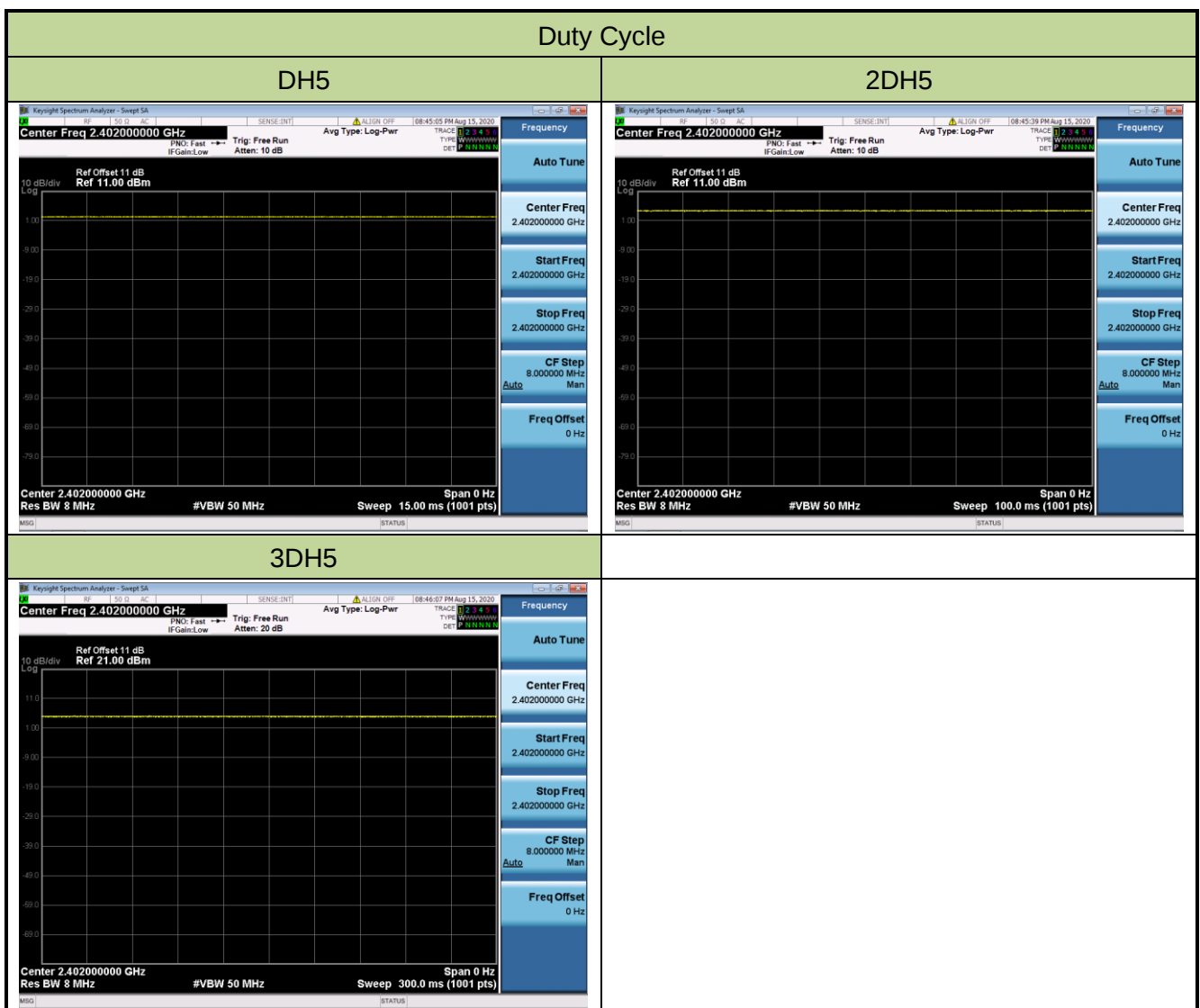
2.11. Test Environment Condition

Ambient Temperature	15°C~35°C
Relative Humidity	20%RH ~75%RH

2.12. Duty Cycle

The maximum achievable duty cycle was determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Test Mode	Duty Cycle
DH5	100%
2DH5	100%
3DH5	100%



2.13. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

2.14. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase.

However, when the device is so small wherein placement of the label with specified statement is not practical, only the FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

RSS-Gen Issue 5 Section 4

In addition to complying with the applicable RSSs and RSP-100, each unit of a product model (i.e. of a radio apparatus) shall meet the labelling requirements set out in this section prior to being marketed in Canada or imported into Canada.

For information regarding the labelling option, see Section 4.1, 4.2, 4.3 4.4. The label for the certified product represents the manufacturer's or importer's compliance with Innovation, Science and Economic Development Canada's (ISED) regulatory requirements.

Please see attachment for IC label and label location.

3. ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:

“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.”

Conclusion:

The unit complies with the requirement of §15.203.

4. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions - SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR3	MRTSUE06185	1 year	2021/01/18
Two-Line V-Network	R&S	ENV 216	MRTSUE06002	1 year	2021/06/11
Two-Line V-Network	R&S	ENV 216	MRTSUE06003	1 year	2021/06/11
Thermohygrometer	Testo	608-H1	MRTSUE06404	1 year	2021/07/26

Radiated Emissions - AC2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2021/01/18
PXA Signal Analyzer	Keysight	9030B	MRTSUE06395	1 year	2020/09/03
Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2020/11/13
Bilog Period Antenna	Schwarzbeck	VULB 9168	MRTSUE06172	1 year	2021/04/03
Broad Band Horn Antenna	Schwarzbeck	BBHA 9120D	MRTSUE06023	1 year	2020/10/13
Broad Band Horn Antenna	Schwarzbeck	BBHA 9170	MRTSUE06597	1 year	2020/12/17
Microwave System Amplifier	Agilent	83017A	MRTSUE06076	1 year	2020/11/15
Preamplifier	Schwarzbeck	BBV 9721	MRTSUE06121	1 year	2021/06/11
Thermohygrometer	Testo	608-H1	MRTSUE06403	1 year	2021/07/26
Anechoic Chamber	TDK	Chamber-AC2	MRTSUE06212	1 year	2021/04/30

Radiated Emission - AC2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Keysight	N9038A	MRTSUE06125	1 year	2021/07/02
Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2020/11/13
Bilog Period Antenna	Schwarzbeck	VULB 9162	MRTSUE06022	1 year	2020/10/13
Horn Antenna	Schwarzbeck	BBHA9120D	MRTSUE06171	1 year	2020/10/27
Broad Band Horn Antenna	Schwarzbeck	BBHA 9170	MRTSUE06597	1 year	2020/12/17
Broadband Coaxial Preamplifier	Schwarzbeck	BBV 9718	MRTSUE06176	1 year	2020/11/15
Preamplifier	Schwarzbeck	BBV 9721	MRTSUE06121	1 year	2021/06/11
Temperature/Humidity Meter	Minggao	ETH529	MRTSUE06170	1 year	2020/12/15
Anechoic Chamber	RIKEN	Chamber-AC2	MRTSUE06213	1 year	2021/04/30

Conducted Test Equipment - TR3

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EXA Signal Analyzer	Agilent	N9020A	MRTSUE06106	1 year	2021/04/14
EXA Signal Analyzer	Keysight	N9010B	MRTSUE06452	1 year	2021/01/08
Signal Analyzer	R&S	FSV40	MRTSUE06218	1 year	2021/04/14
Power Meter	Agilent	U2021XA	MRTSUE06030	1 year	2020/11/18
USB wideband power sensor	Keysight	U2021XA	MRTSUE06446	1 year	2021/06/11
USB wideband power sensor	Keysight	U2021XA	MRTSUE06447	1 year	2021/06/11
Bluetooth Test Set	Anritsu	MT8852B-042	MRTSUE06389	1 year	2021/06/11
Audio Analyzer	Agilent	U8903B	MRTSUE06143	1 year	2021/06/11
Modulation Analyzer	HP	8901A	MRTSUE06098	1 year	2020/10/10
Wideband Radio Communication Tester	R&S	CMW 500	MRTSUE06243	1 year	2020/11/07
DC Power Supply	GWINSTEK	DPS-3303C	MRTSUE06064	N/A	N/A
Attenuator	MVE	6dB	MRTSUE06534	1 year	2020/12/12
Attenuator	MVE	10dB	MRTSUE06543	1 year	2020/12/12
Temperature & Humidity Chamber	BAOYT	BYH-150CL	MRTSUE06051	1 year	2020/11/07
Thermohygrometer	testo	608-H1	MRTSUE06401	1 year	2021/07/26

Software	Version	Function
EMI Software	V3	EMI Test Software

5. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

Conducted Emission Measurement
Measurement Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 9kHz~150kHz: 3.74dB 150kHz~30MHz: 3.44dB
Radiated Disturbance
Measurement Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): Horizontal: 9KHz~300MHz: 5.04dB 300MHz~1GHz: 4.95dB 1GHz~6GHz: 6.40dB Vertical: 9KHz~300MHz: 5.24dB 300MHz~1GHz: 6.03dB 1GHz~40GHz: 6.40dB
Spurious Emissions, Conducted
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 0.78dB
Output Power
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 1.13dB
Power Spectrum Density
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 1.15dB
Occupied Bandwidth
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 0.28%

6. TEST RESULT

6.1. Summary

FCC Part Section(s)	ISED Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(1)	RSS-247 [5.1]	20dB Bandwidth	N/A	Conducted	Pass	Section 6.2
N/A	RSS-Gen [6.7]	99% Bandwidth	N/A		Pass	
15.247(b)(1)	RSS-247 [5.4(b)]	Peak Transmitter Output Power	<1 Watt (30dBm) if > 75 non- overlapping channels used & EIRP ≤ 4Watt (36dBm)		Pass	Section 6.3
15.247(a)(1)	RSS-247 [5.1]	Channel Separation	> 2/3 of 20 dB BW for systems with Output Power < 125mW (21dBm)		Pass	Section 6.4
15.247(a)(1)(iii)	RSS-247 [5.1]	Number of Channels	> 15 Channels		Pass	Section 6.5
15.247(a)(1)(iii)	RSS-247 [5.1]	Time of Occupancy	< 0.4 sec in 31.6 sec period		Pass	Section 6.6
15.247(d)	RSS-247 [5.5]	Band Edge / out- of-Band Emissions	20dBc		Pass	Section 6.7 Section 6.8
15.205, 15.209	RSS-247 [5.5]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209	Radiated	Pass	Section 6.9 Section 6.10
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz - 30MHz	< FCC 15.207 limits	Line Conducted	Pass	Section 6.11

Notes:

- 1) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
- 2) All modes of operation and data rates were investigated. For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst-case emissions.

6.2. Occupied Bandwidth Measurement

6.2.1. Test Limit

N/A

6.2.2. Test Procedure used

ANSI C63.10-2013 - Section 6.9.2 (20dB Bandwidth)

ANSI C63.10-2013 - Section 6.9.3 (99% bandwidth)

6.2.3. Test Setting

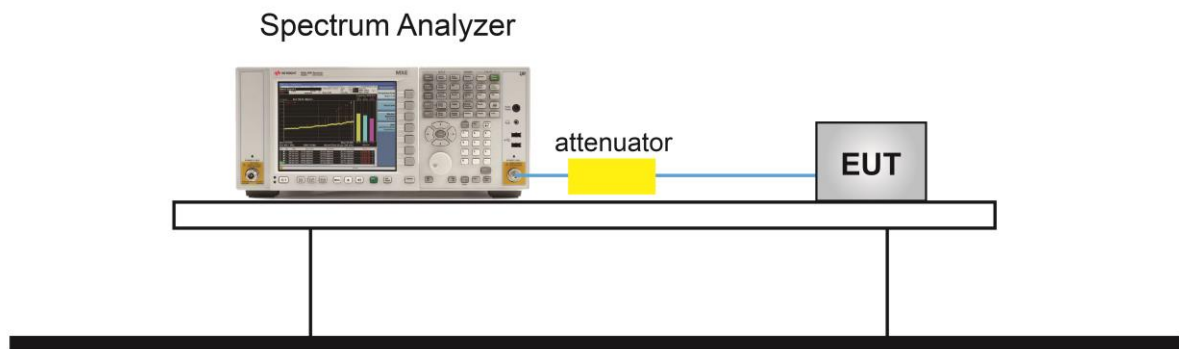
For 20dB Bandwidth

1. Set RBW $\geq 1\%$ to 5% of the 20dB bandwidth
2. VBW = approximately three times RBW
3. Span = approximately 2 to 5 times the 20dB bandwidth, centered on a hopping channel
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace to stabilize
8. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

For 99% Bandwidth

1. Span = 1.5 times to 5 times the OBW
2. Set RBW = 1% to 5% the OBW
3. VBW $\geq 3 \times$ RBW
4. Detector = Peak
5. Trace mode = Max hold
6. Sweep = Auto couple
7. Allow the trace was allowed to stabilize

6.2.4. Test Setup



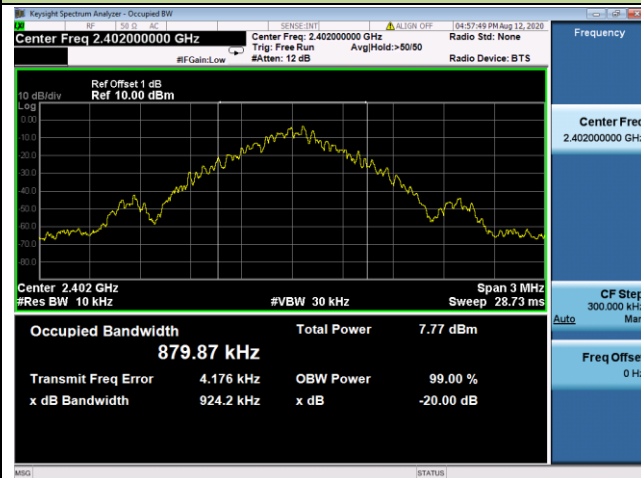
6.2.5. Test Result

Product	WIFI+BT Combo Module	Test Engineer	Amy Zhang
Test Date	2020/08/12~2020/08/21	Test Site	SR5

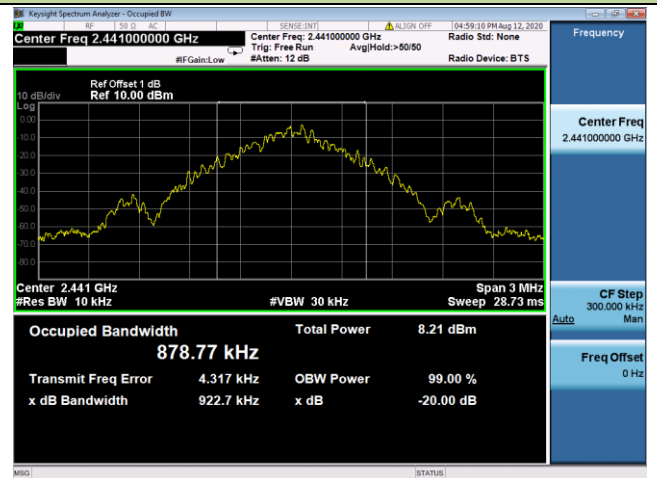
Test Mode	Channel No.	Frequency (MHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)	Result
DH5	00	2402	924.2	879.9	Pass
DH5	39	2441	922.7	878.8	Pass
DH5	78	2480	923.4	879.9	Pass
2DH5	00	2402	1341.0	1188.7	Pass
2DH5	39	2441	1341.0	1189.0	Pass
2DH5	78	2480	1341.0	1189.1	Pass
3DH5	00	2402	1341.0	1192.5	Pass
3DH5	39	2441	1341.0	1192.2	Pass
3DH5	78	2480	1341.0	1193.6	Pass

DH5 20dB Bandwidth

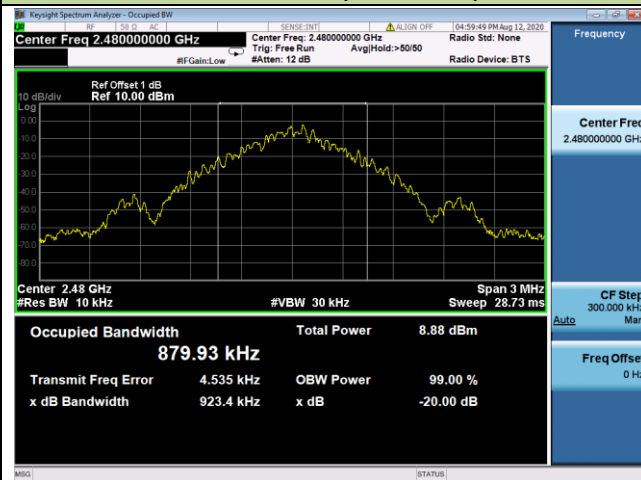
Channel 00 (2402MHz)



Channel 39 (2441MHz)

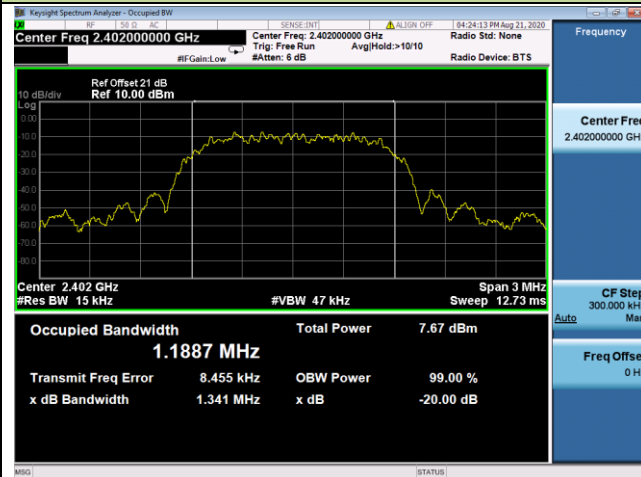


Channel 78 (2480MHz)

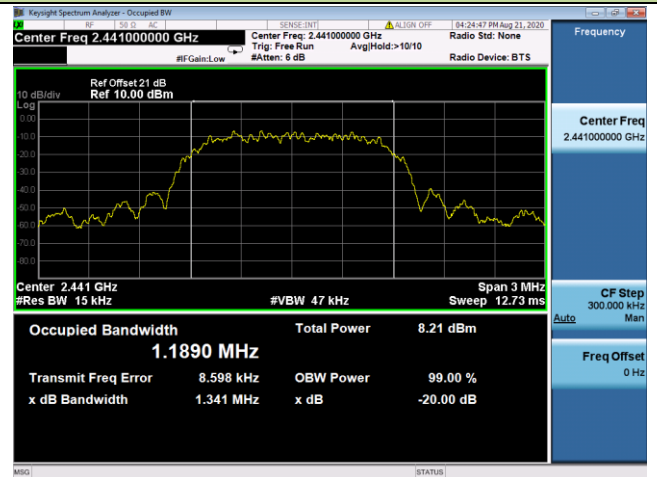


2DH5 20dB Bandwidth

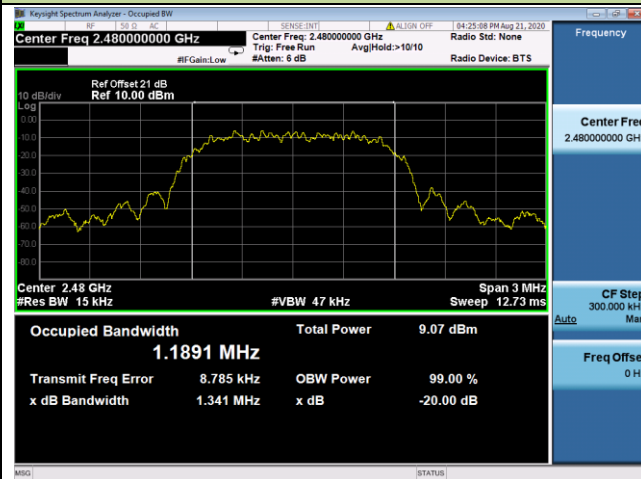
Channel 00 (2402MHz)



Channel 39 (2441MHz)

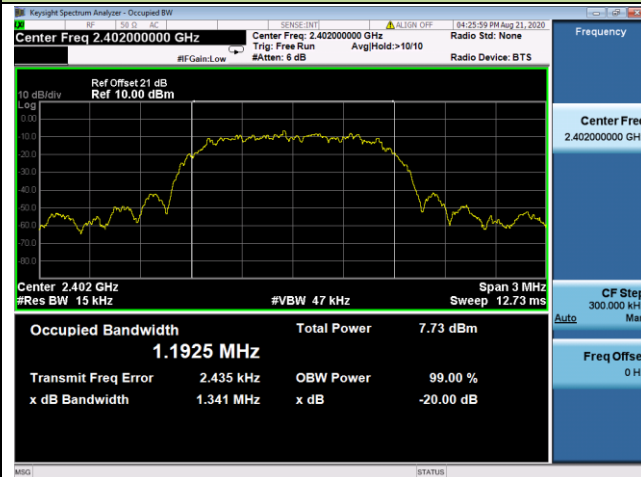


Channel 78 (2480MHz)

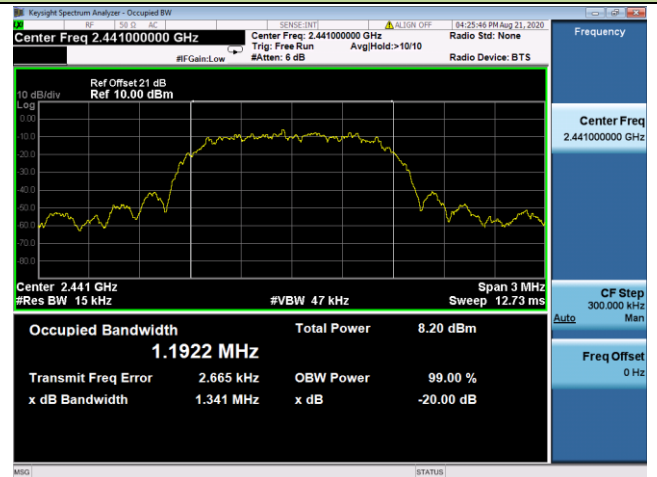


3DH5 20dB Bandwidth

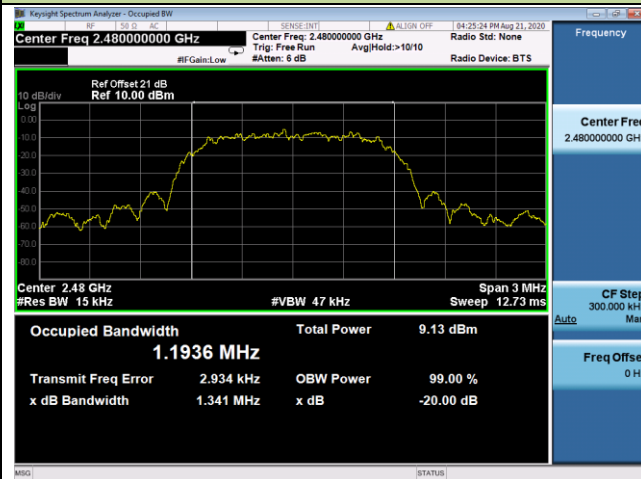
Channel 00 (2402MHz)



Channel 39 (2441MHz)



Channel 78 (2480MHz)



6.3. Output Power Measurement

6.3.1. Test Limit

For frequency hopping systems operating in the 2400-2483.5MHz band employing at least 75 non-overlapping hopping channels: 1watt (30dBm). For all other frequency hopping systems in the 2400-2483.5MHz band: 0.125 watt (21dBm)

The e.i.r.p. shall not exceed 4 watt (36dBm).

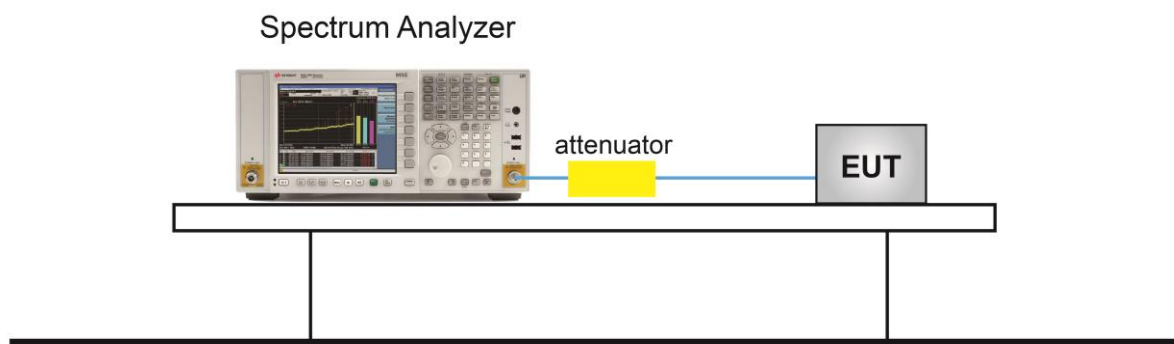
6.3.2. Test Procedure Used

ANSI C63.10-2013 - Section 7.8.5

6.3.3. Test Setting

1. Set RBW $\geq$ the 20 dB bandwidth of the emission being measured.
2. VBW $\geq$ RBW
3. Span = approximately five times the 20dB bandwidth, centered on a hopping channel
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace to stabilize, Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power (don't forget added the external attenuation and cable loss)

6.3.4. Test Setup



6.3.5. Test Result

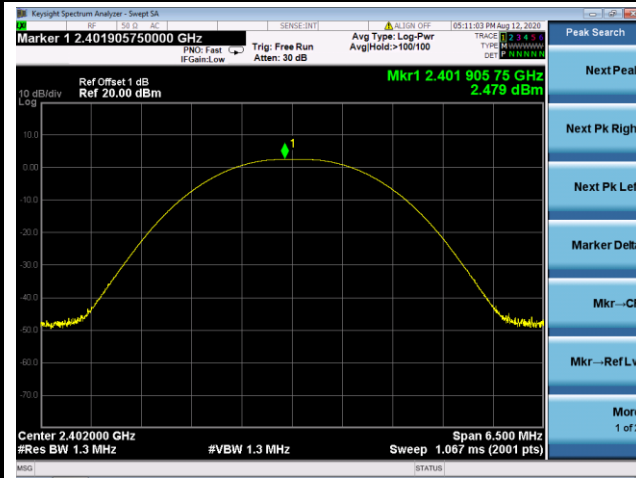
Product	WIFI+BT Combo Module	Test Engineer	Amy Zhang
Test Date	2020/08/12	Test Site	SR5

Test Mode	Channel No.	Frequency (MHz)	Peak Power (dBm)	Peak Power Limit (dBm)	E.I.R.P (dBm)	E.I.R.P Limit (dBm)
DH5	00	2402	2.48	≤ 30	4.46	≤ 36.00
DH5	39	2441	2.81	≤ 30	4.79	≤ 36.00
DH5	78	2480	3.62	≤ 30	5.60	≤ 36.00
2DH5	00	2402	4.44	≤ 30	6.42	≤ 36.00
2DH5	39	2441	4.75	≤ 30	6.73	≤ 36.00
2DH5	78	2480	5.58	≤ 30	7.56	≤ 36.00
3DH5	00	2402	4.94	≤ 30	6.92	≤ 36.00
3DH5	39	2441	5.20	≤ 30	7.18	≤ 36.00
3DH5	78	2480	6.04	≤ 30	8.02	≤ 36.00

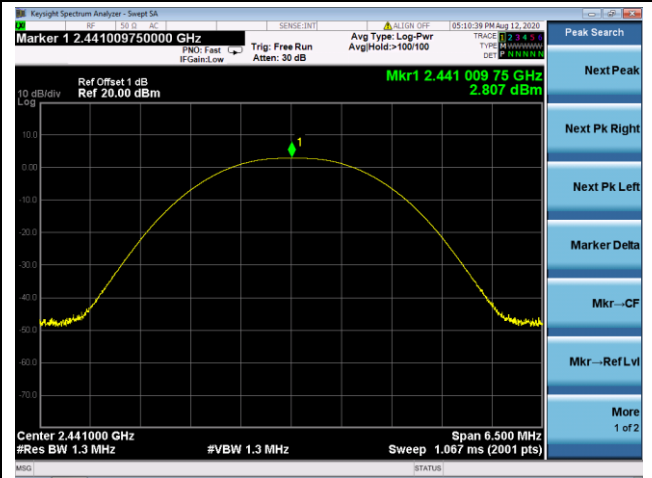
Note: E.I.R.P (dBm) = Peak Power (dBm) + Antenna Gain (dBi), Antenna Gain = 1.98dBi.

DH5 Output Power

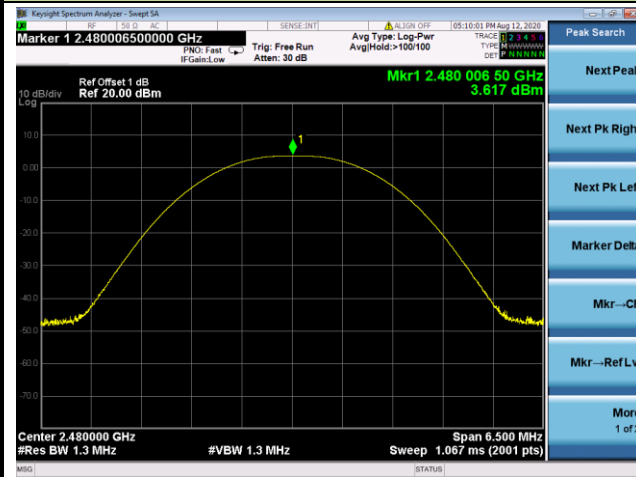
Channel 00 (2402MHz)



Channel 39 (2441MHz)

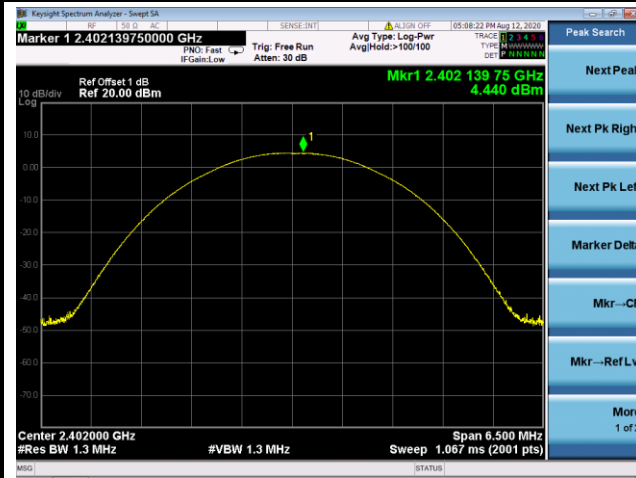


Channel 78 (2480MHz)

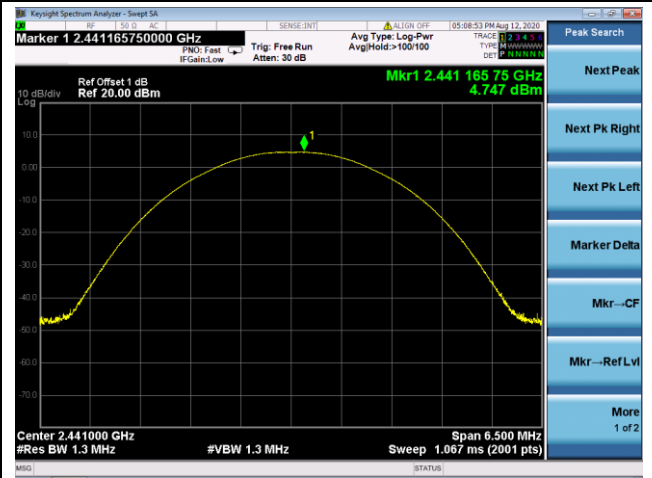


2DH5 Output Power

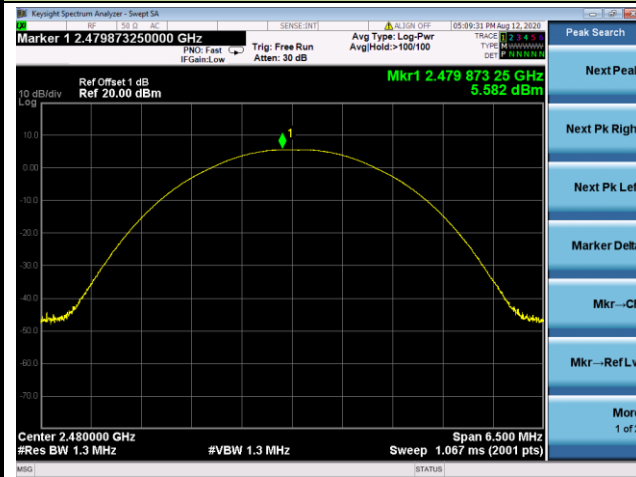
Channel 00 (2402MHz)



Channel 39 (2441MHz)

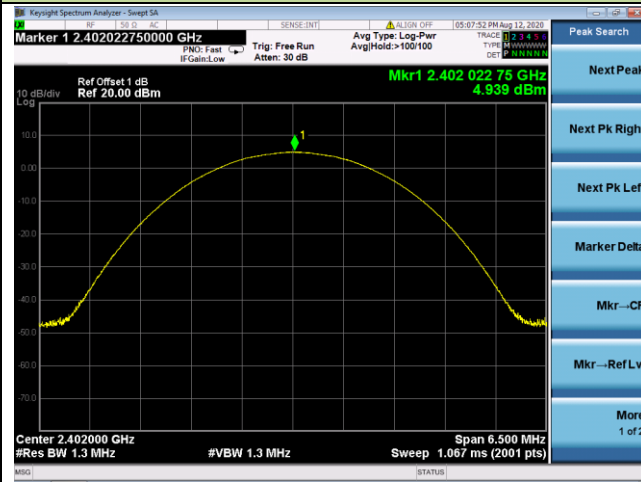


Channel 78 (2480MHz)

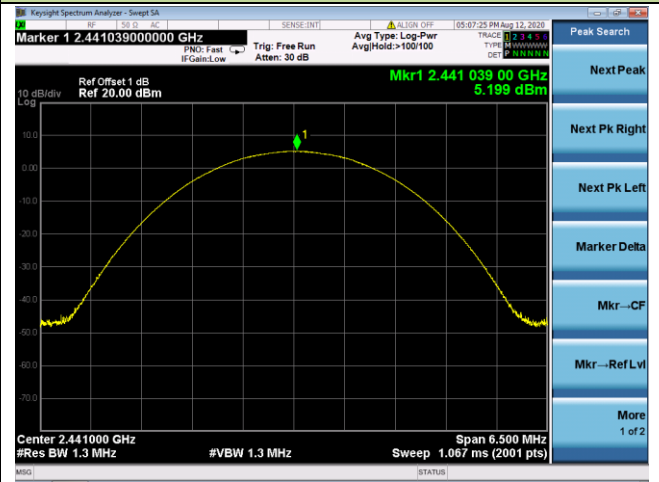


3DH5 Output Power

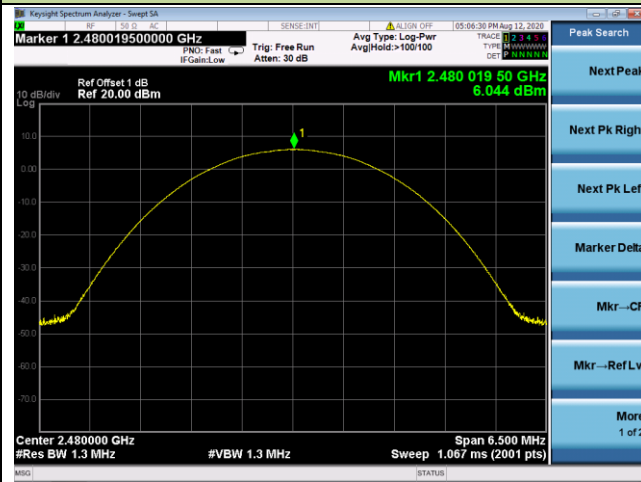
Channel 00 (2402MHz)



Channel 39 (2441MHz)



Channel 78 (2480MHz)



6.4. Carrier Frequency Separation Measurement

6.4.1. Test Limit

The minimum permissible channel separation for this system is $\frac{2}{3}$ the value of the 20dB BW.

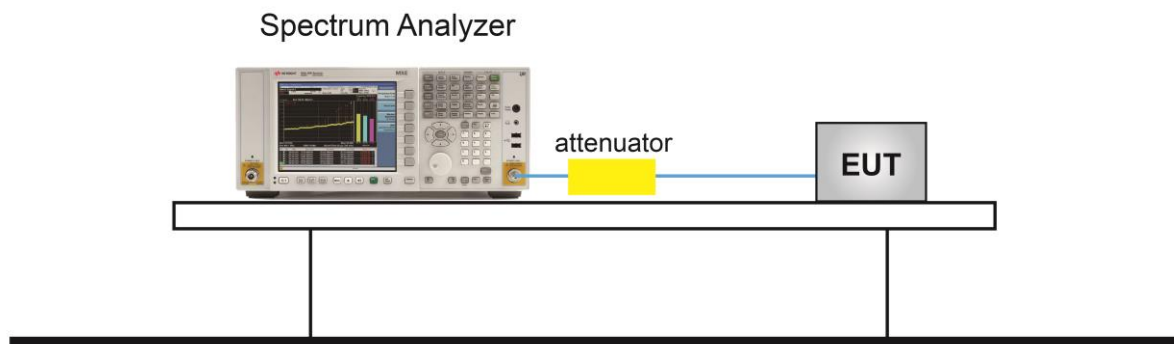
6.4.2. Test Procedure Used

ANSI C63.10-2013 - Section 7.8.2

6.4.3. Test Setting

1. Span = wide enough to capture the peaks of two adjacent channels.
2. 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 time = Auto couple
5. Detector = Peak
6. Trace mode = Max hold
7. Allowed the trace to stabilize
8. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

6.4.4. Test Setup



6.4.5. Test Result

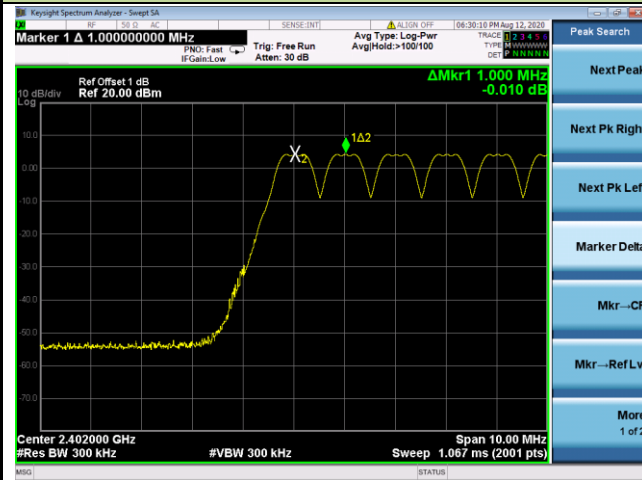
Product	WIFI+BT Combo Module	Test Engineer	Amy Zhang
Test Date	2020/08/12	Test Site	SR5

Test Mode	Channel No.	Frequency (MHz)	Limit (kHz)	Result
DH5	00	2402	≥ 616.1	Pass
DH5	39	2441	≥ 615.1	Pass
DH5	78	2480	≥ 615.6	Pass
2DH5	00	2402	≥ 894.0	Pass
2DH5	39	2441	≥ 894.0	Pass
2DH5	78	2480	≥ 894.0	Pass
3DH5	00	2402	≥ 894.0	Pass
3DH5	39	2441	≥ 894.0	Pass
3DH5	78	2480	≥ 894.0	Pass

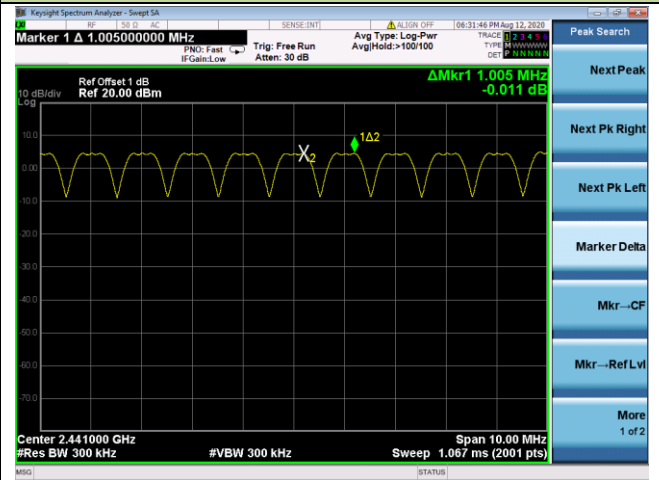
Note: The Limit is 2/3 the value of the 20dB BW.

DH5 Carrier Frequency Separation

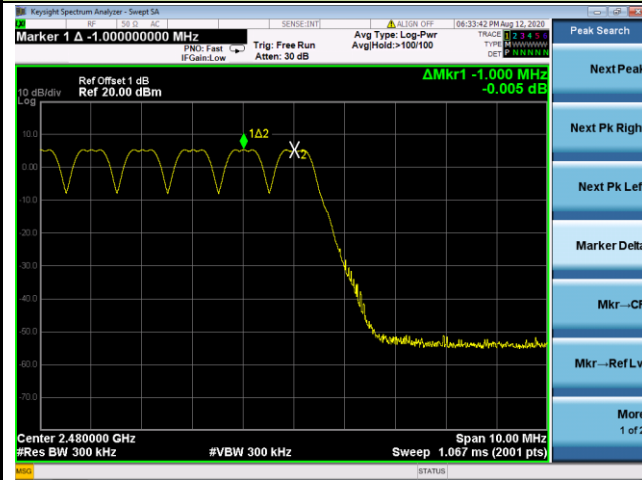
Channel 00 (2402MHz)



Channel 39 (2441MHz)

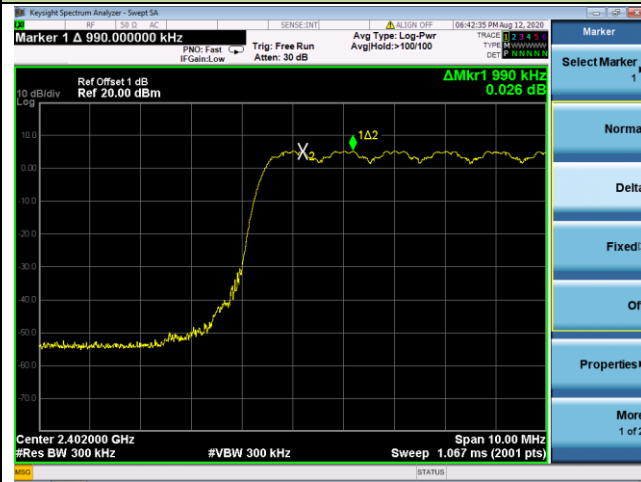


Channel 78 (2480MHz)

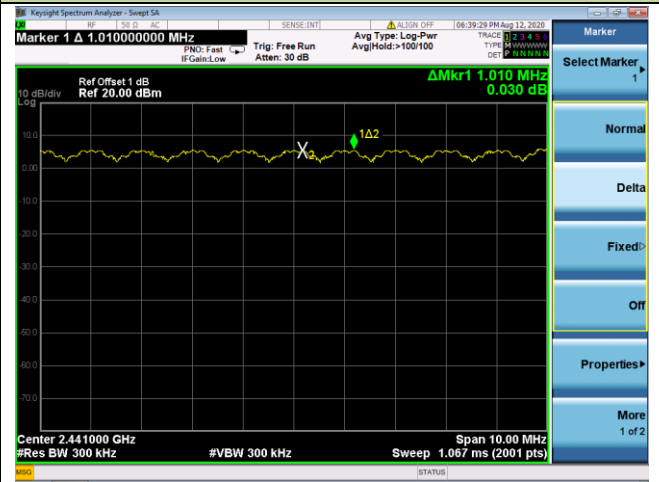


2DH5 Carrier Frequency Separation

Channel 00 (2402MHz)



Channel 39 (2441MHz)

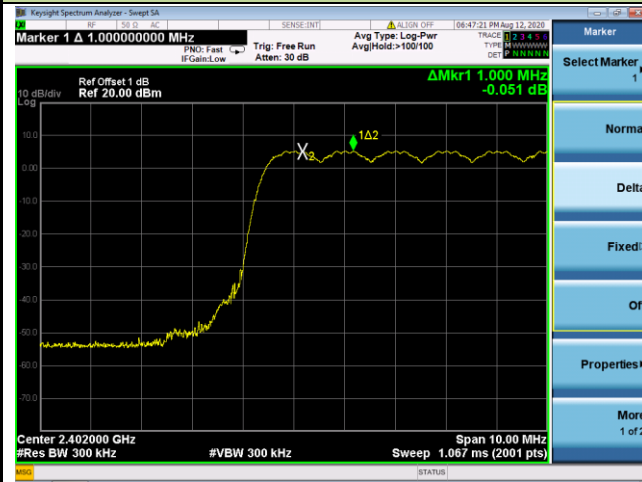


Channel 78 (2480MHz)

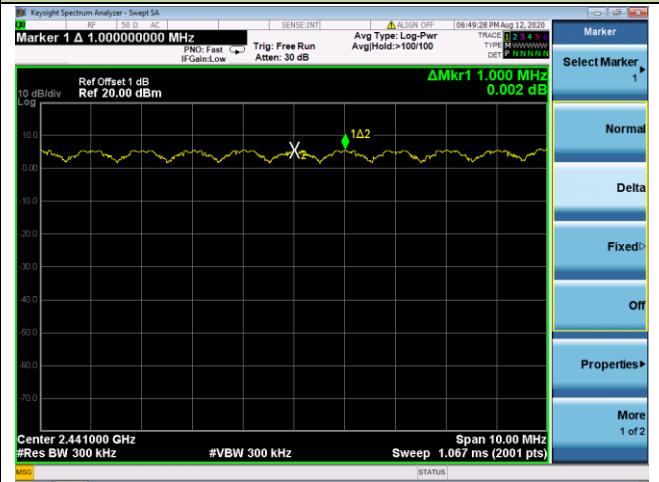


3DH5 Carrier Frequency Separation

Channel 00 (2402MHz)



Channel 39 (2441MHz)



Channel 78 (2480MHz)



6.5. Number of Hopping Channels Measurement

6.5.1. Test Limit

This frequency hopping system must employ a minimum of 15 hopping channels.

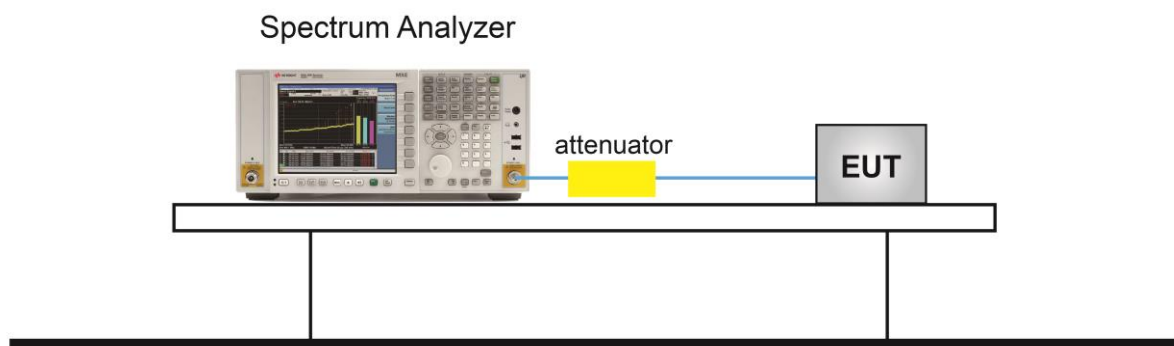
6.5.2. Test Procedure Used

ANSI C63.10-2013 - Section 7.8.3

6.5.3. Test Setting

1. Span = the frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
2. 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 time = Auto couple
5. Detector = Peak
6. Trace mode = Max hold
7. Allow the trace to stabilize

6.5.4. Test Setup



6.5.5. Test Result

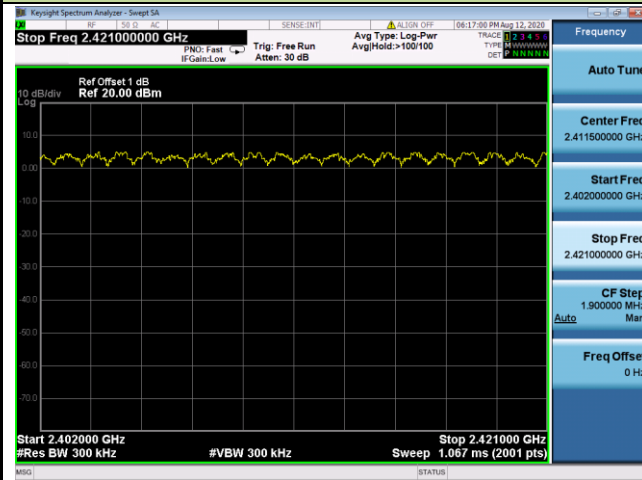
Product	WIFI+BT Combo Module	Test Engineer	Amy Zhang
Test Date	2020/08/12	Test Site	SR5

Test Mode (Hopping)	Channel Numbers	Frequency (MHz)	Limit (Hopping Channels)	Result
DH5	79	2402~2480	≥ 15	Pass
2DH5	79	2402~2480	≥ 15	Pass
3DH5	79	2402~2480	≥ 15	Pass

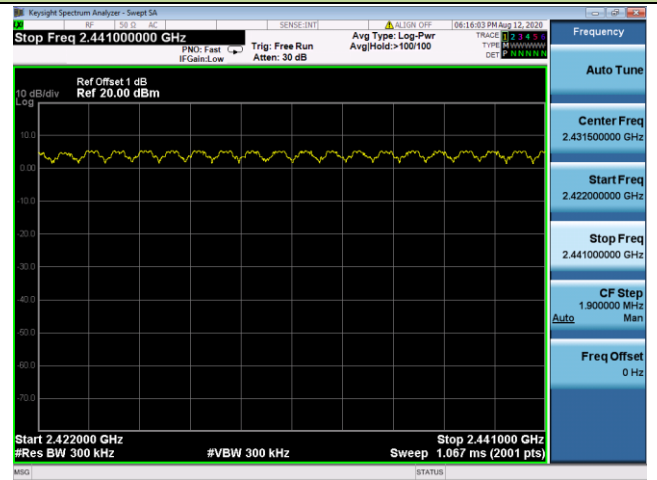


2DH5 Number of Hopping Channels

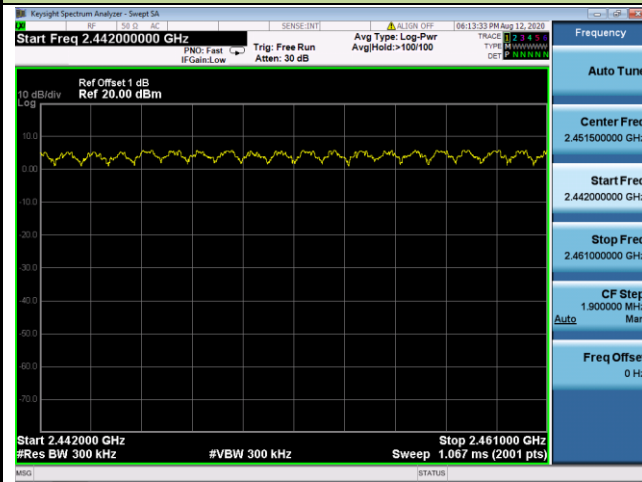
2402 ~ 2421MHz



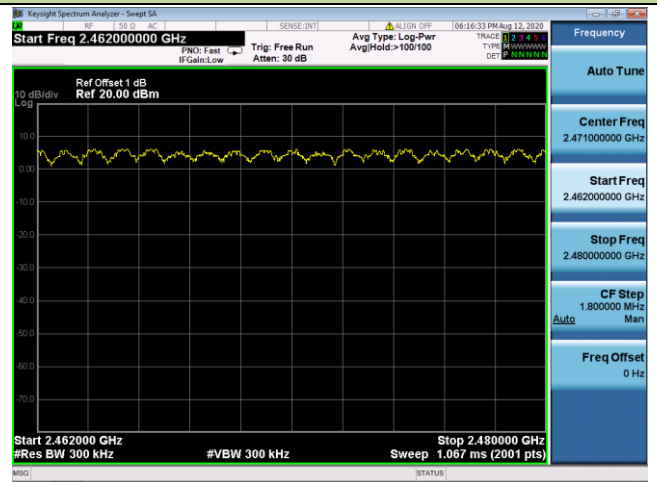
2422 ~ 2441MHz



2442 ~ 2461MHz

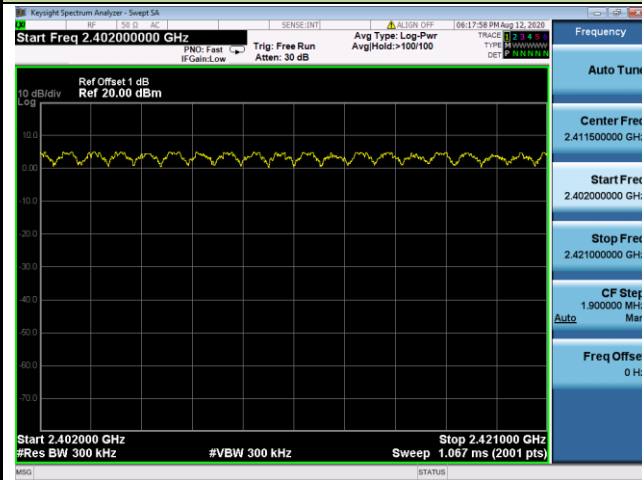


2462 ~ 2480MHz

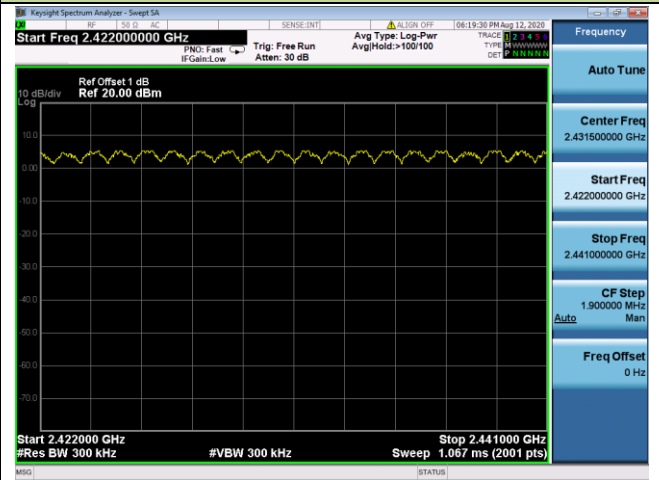


3DH5 Number of Hopping Channels

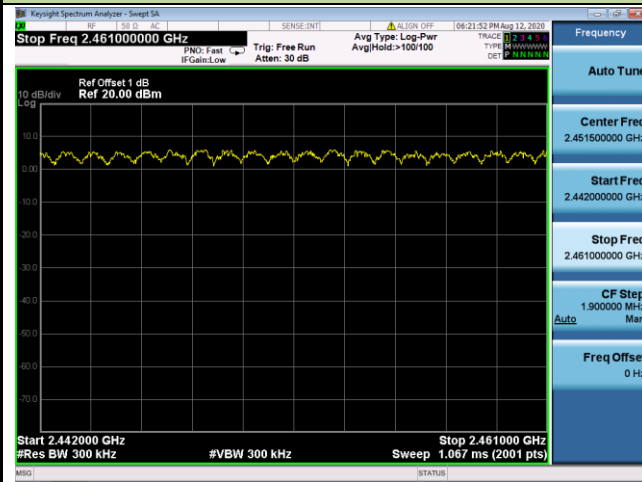
2402 ~ 2421MHz



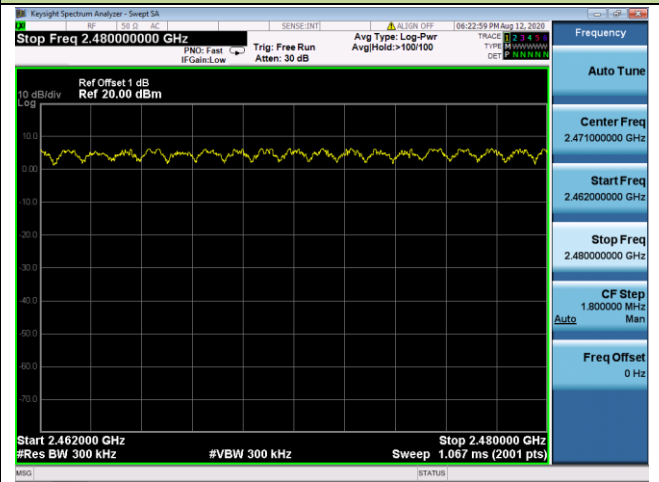
2422 ~ 2441MHz



2442 ~ 2461MHz



2462 ~ 2480MHz



6.6. Time of Occupancy Measurement

6.6.1. Test Limit

The maximum permissible time of occupancy is 400ms within a period of 400ms multiplied by the number of hopping channels employed.

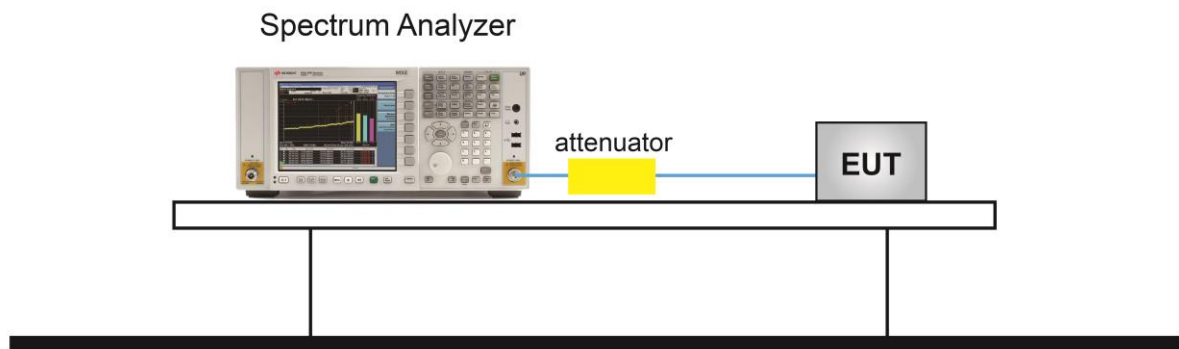
6.6.2. Test Procedure Used

ANSI C63.10-2013 - Section 7.8.4

6.6.3. Test Setting

1. Span = zero span, centered on a hopping channel.
2. RBW shall be $\leq$ channel spacing and where possible RBW should be set $\gg 1/T$, where T is the expected dwell time per channel.
3. VBW $\geq$ RBW
4. Sweep time = as necessary to capture the entire dwell time per hopping channel
5. Detector = Peak
6. Trace mode = max hold
7. Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time. An oscilloscope may be used instead of a spectrum analyzer. The EUT shall show compliance with the appropriate regulatory limit for the number of hopping channels. A plot of the data shall be included in the test report.

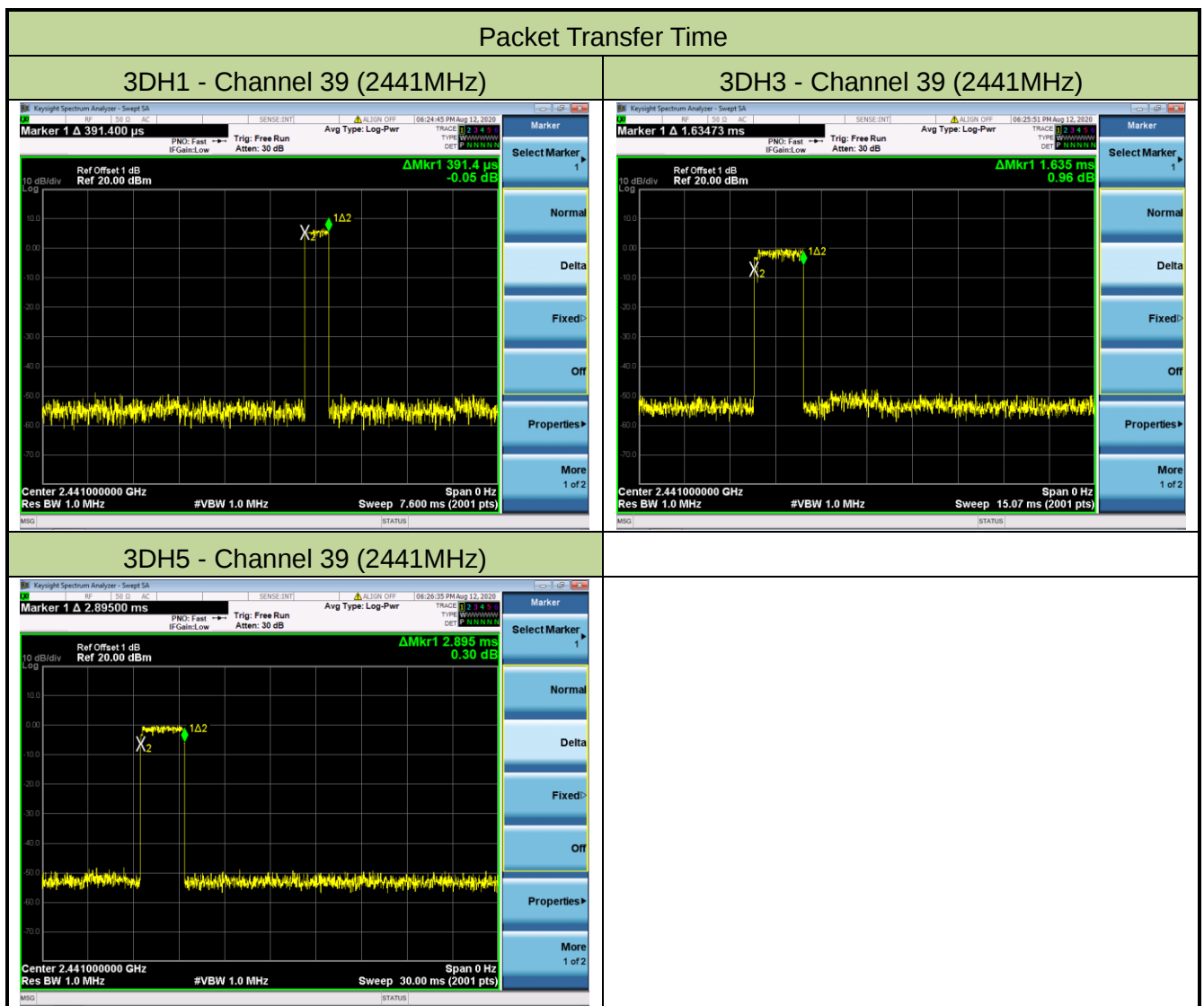
6.6.4. Test Setup



6.6.5. Test Result

Product	WIFI+BT Combo Module	Test Engineer	Amy Zhang
Test Date	2020/08/12	Test Site	SR5

Test Mode	Channel No.	Frequency (MHz)	Hops Over Occupancy Time (Hops)	Packet Transfer Time (ms)	Time of Occupancy (ms)	Limit (ms)	Result
3DH1	39	2441	320	0.391	125.12	≤ 400	Pass
3DH3	39	2441	160	1.635	261.60	≤ 400	Pass
3DH5	39	2441	107	2.895	309.77	≤ 400	Pass



Note 1: According the Bluetooth Standard Specification, the nominal hop rate is 1600 hops/s. All Bluetooth unit participating in the piconet are time and hop synchronized to the channel.
Hops Over Occupancy Time in 31.6s for 3DH1 = $1600 / 2 / 79 * 31.6 = 320$.

Hops Over Occupancy Time in 31.6s for 3DH3 = $1600 / 4 / 79 * 31.6 = 160$.

Hops Over Occupancy Time in 31.6s for 3DH5 = $1600 / 6 / 79 * 31.6 = 107$.

Note 2: Time of Occupancy = Packet Transfer Time * Hops Over Occupancy Time in 31.6s.

6.7. Band-edge Compliance Measurement

6.7.1. Test Limit

The maximum permissible emission level is 20dBc. Any emissions were lying outside of the emission bandwidth and in authorized band edges to a field strength limit specified in Section 15.209 of the Title 47 CFR.

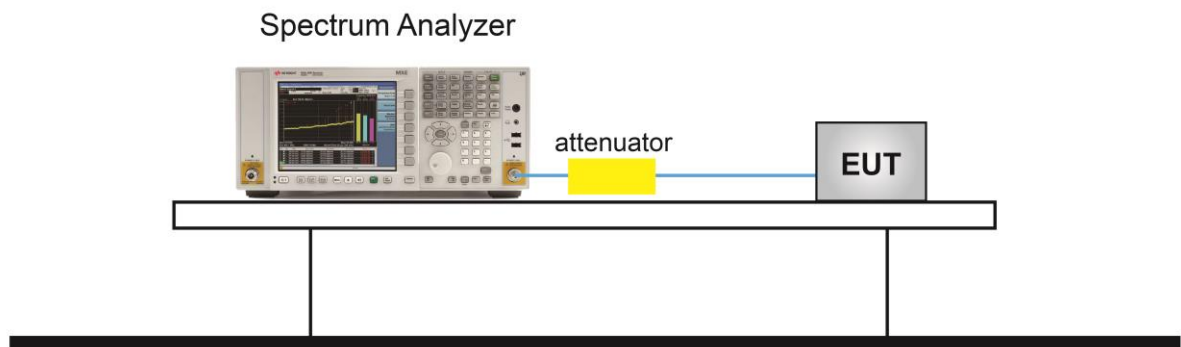
6.7.2. Test Procedure Used

ANSI C63.10-2013 - Section 6.10.4

6.7.3. Test Setting

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. RBW = 100kHz
3. VBW = 300kHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize
8. Allow the trace to stabilize. Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission.

6.7.4. Test Setup



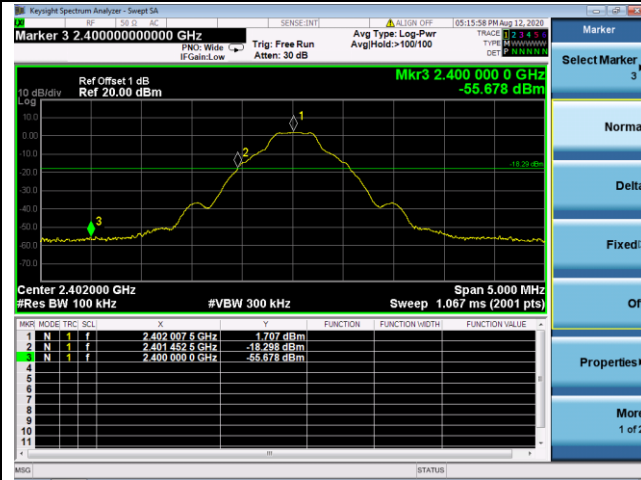
6.7.5. Test Result

Product	WIFI+BT Combo Module	Test Engineer	Amy Zhang
Test Date	2020/08/12	Test Site	SR5

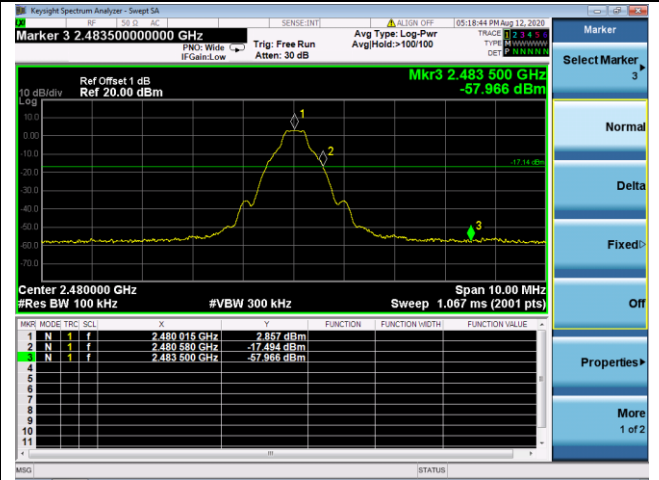
Test Mode	Channel No.	Frequency (MHz)	Limit	Result
DH5	00	2402	20dBc	Pass
DH5	78	2480	20dBc	Pass
2DH5	00	2402	20dBc	Pass
2DH5	78	2480	20dBc	Pass
3DH5	00	2402	20dBc	Pass
3DH5	78	2480	20dBc	Pass

Band-edge Compliance

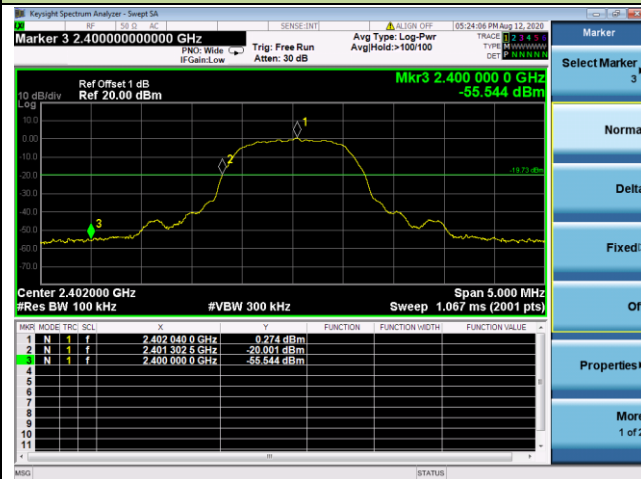
DH5 - Channel 00 (2402MHz)



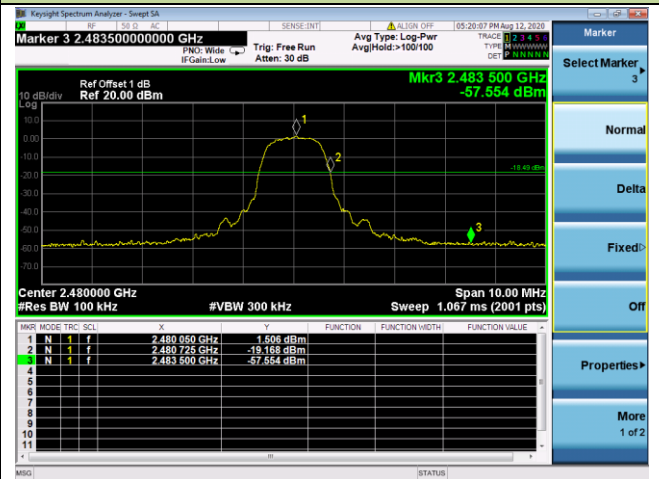
DH5 - Channel 78 (2480MHz)



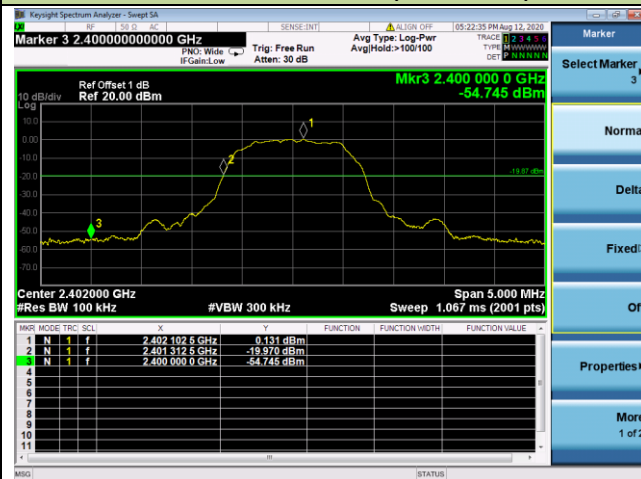
2DH5 - Channel 00 (2402MHz)



2DH5 - Channel 78 (2480MHz)



3DH5 - Channel 00 (2402MHz)



3DH5 - Channel 78 (2480MHz)

