Certificate #5055.02

TEST REPORT FOR
BLUETOOTH TESTING

Report No.: SRTC2024-9004(F)-24052101(D)

Product Name: i1421-sw

Product ID: i1421-sw

Brand Name: BARROT

Applicant: BARROT TECHNOLOGY CO., LTD.

Manufacturer: BARROT TECHNOLOGY CO., LTD.

Specification: FCC Part 15 Subpart C (2023)

FCC ID: 2AOXV-I1421-SW-A

The State Radio_monitoring_center Testing Center (SRTC)

15th Building, No.30Shixing Street, Shijingshan District, Beijing, P.R.China

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1. GENERAL INFORMATION

1.1 Notes of the test report

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1.2 Information about the testing laboratory

Company:	The State Radio_monitoring_center Testing Center (SRTC)
Test Site 1:	15th Building, No.30 Shixing Street, Shijingshan District
Test Site 2:	No.80, Zhaojiachang, Beizang, Daxing District
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Designation Number:	CN1267
Registration number:	239125

1.3 Applicant’s details

Company:	BARROT TECHNOLOGY CO., LTD.
Address:	A1009, Block A, Jia Hua Building, No.9 Shangdisanjie St, Haidian District, Beijing
City:	Beijing
Country or Region:	China
Contacted person:	Kerlwin Qiu
Tel:	18612671878
Email:	bluetooth@barrot.com.cn

1.4 Manufacturer’s details

Company:	BARROT TECHNOLOGY CO., LTD.
Address:	A1009, Block A, Jia Hua Building, No.9 Shangdisanjie St, Haidian District, Beijing
City:	Beijing
Country or Region:	China
Contacted person:	Kerlwin Qiu
Tel:	18612671878
Email:	bluetooth@barrot.com.cn

1.5 Test Environment

Date of Receipt of test sample at SRTC:	2024/5/22
Testing Start Date:	2024/5/23
Testing End Date:	2024/6/13

Environmental Data:	Temperature (°C)	Humidity (%)
Ambient	25	40
Maximum Extreme	85	---
Minimum Extreme	-40	---

Normal Supply Voltage (V d.c.):	3.3
Maximum Extreme Supply Voltage (V d.c.):	3.6
Minimum Extreme Supply Voltage (V d.c.):	3.0

2 DESCRIPTION OF THE DEVICE UNDER TEST

2.1 Final Equipment Build Status

Frequency Range:	2.402GHz~2.480GHz
Number of Channel:	79
Modulation Type:	GFSK, π/4DQPSK, 8DPSK
Duplex Mode:	TDD
Channel Spacing:	1MHz
Data Rate:	1Mbps, 2 Mbps, 3 Mbps
Power Supply:	DC supply
Software Revision:	/
Hardware Revision:	/
IMEI:	NA
Antenna type**:**	Refer to Note1
Antenna connector**:**	Refer to Note1

Declaration of product difference
The product,
i1421-sw has two versions: i1421-sw single antenna, i1421-sw double antenna
They are all equal to each other and they are all the same of the product design with eachother.
i1421-sw single antenna, i1421-sw double antenna have the same external appearance Peripherals, software, features, function, etc"
Only because of the market purpose, the device needs two versions.

Antenna requirement (FCC Part 15.203)

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

•The antenna(s) of the EUT are permanently attached.

•There are no provisions for connection to an external antenna.

Note1: The antenna provide to the EUT, please refer to the following table:

Brand	Model	Antenna gain	Frequency band	Antenna type	Connecter Type
N/A	N/A	3dBi(max)	2.4GHz~2.4835GHz	Rod antenna	N/A
The antenna gain is provided by the customer and involved in the calculation and influence of the test results. Our laboratory takes the value declared by the customer as the criterion, and the customer is responsible for the antenna gain value. Manufacturers ensure that their designs will not be modified by the user or third party's arbitrary antenna parameters and performance.					

2.2Description of Test Modes

79 channels are provided to this EUT:

CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)
0	2402	16	2418	32	2434	48	2450	64	2466
1	2403	17	2419	33	2435	49	2451	65	2467
2	2404	18	2420	34	2436	50	2452	66	2468
3	2405	19	2421	35	2437	51	2453	67	2469
4	2406	20	2422	36	2438	52	2454	68	2470
5	2407	21	2423	37	2439	53	2455	69	2471
6	2408	22	2424	38	2440	54	2456	70	2472
7	2409	23	2425	39	2441	55	2457	71	2473
8	2410	24	2426	40	2442	56	2458	72	2474
9	2411	25	2427	41	2443	57	2459	73	2475
10	2412	26	2428	42	2444	58	2460	74	2476
11	2413	27	2429	43	2445	59	2461	75	2477
12	2414	28	2430	44	2446	60	2462	76	2478
13	2415	29	2431	45	2447	61	2463	77	2479
14	2416	30	2432	46	2448	62	2464	78	2480
15	2417	31	2433	47	2449	63	2465		

2.2.1 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE≥1G	RE<1G	PLC	APCM	-
GFSK, π/4DQPSK, 8DPSK	√	√	√	√	-

Where
RE ≥ 1G: Radiated Emission above 1GHz
RE<1G: Radiated Emission below 1GHz

PLC: Power Line Conducted Emission
APCM: Antenna Port Conducted Measurement

Radiated Emission Test (Above 1GHz):

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 78	39	GFSK, π/4DQPSK, 8DPSK	1Mbps, 2 Mbps, 3 Mbps

Radiated Emission Test (Below 1GHz):

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 78	39	GFSK, π/4DQPSK, 8DPSK	1Mbps, 2 Mbps, 3 Mbps

Power Line Conducted Emission Test:

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 78	39	GFSK, π/4DQPSK, 8DPSK	1Mbps, 2 Mbps, 3 Mbps

Antenna Port Conducted Measurement:

This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.

Pre-Scan has been conducted to determine the worst-case mode from all possible

combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 78	0, 39, 78	GFSK, π/4DQPSK, 8DPSK	1Mbps, 2 Mbps, 3 Mbps

2.3 Duty Cycle of Test Signal

Modulation Type	Duty Cycle	Correction Factor(dB)
GFSK(DH5)	100.00%	0.00
π/4DQPSK(DH5)	100.00%	0.00
8DPSK(DH5)	100.00%	0.00

2.4 EUT operating conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

2.5 Support Equipment

The following support equipment was used to exercise the DUT during testing:N/A

3 REFERENCE SPECIFICATION

Specification	Version	Title
FCC Part15 Subpart C	2023	Intentional radiators
ANSI C63.10	2013	Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
KDB 558074D01 v05r02	April 2, 2019	Guidance for compliance measurements on Digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules

4 KEY TO NOTES AND RESULT CODES

Code	Meaning
PASS	Test result shows that the requirements of the relevant specification have been met.
FAIL	Test result shows that the requirements of the relevant specification have not been met.
N/T	Test case is not tested.

5 RESULT SUMMARY

No.	Test case	Reference	Verdict	Test Site
1	20dB Bandwidth	15.247(a)(1)(iii)	Pass	1
2	Channel Separation	15.247(a)(1)	Pass	1
3	Peak Transmitter Output Power	15.247(b)(1)	Pass	1
4	Dwell Time	15.247(a)(1)(iii)	Pass	1
5	Number of Hopping Frequencies	15.247(a)(1)(iii)	Pass	1
6	Conducted out of band emission measurement	15.247(d)	Pass	1
7	Antenna requirement	15.203	Pass(refer to section 2.1)	1

Note:The device is designed according to specifications of SIG，So it has a full support to Medium access protocol and fully compliant with the KDB558074 standard. The device is compliant Pseudorandom hopping, Equal hopping frequency, receiver bandwidth synchronize and have same bandwidth with transmitted signal. And the ability to have adaptive hopping when encountering other signals.

Test Site 1: 15th Building, No.30 Shixing Street, Shijingshan District

This Test Report Is Approved by: Mr. Peng Zhen	Review by: Mr. Li Bin
Tested and Issued by: Mr. LiangXisheng	Approved date: 20240613

No.	Test case	Reference	Verdict	Test Site
8	Band-edge	15.247(d)	Pass	2
9	Spurious Radiated Emissions	15.205/15.209	Pass	2
10	AC Power line Conducted Emission	15.207	Pass	2

Note: The device is designed according to specifications of SIG，So it has a full support to Medium access protocol and fully compliant with the KDB558074 standard. The device is compliant Pseudorandom hopping, Equal hopping frequency, receiver bandwidth synchronize and have same bandwidth with transmitted signal. And the ability to have adaptive hopping when encountering other signals.

Test Site 2: No.80, Zhaojiachang, Beizang, Daxing District

This Test Report Is Approved by: Mr. Liu Wei	Review by: Mr. Guo Yu
Tested and Issued by: Mr. Dong Qifeng	Approved date: 20240613

6 TEST RESULT

6.1 20dB Bandwidth

6.1.1 Test limit

FCC Part15.247 (a.1.iii)
The bandwidth at 20dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

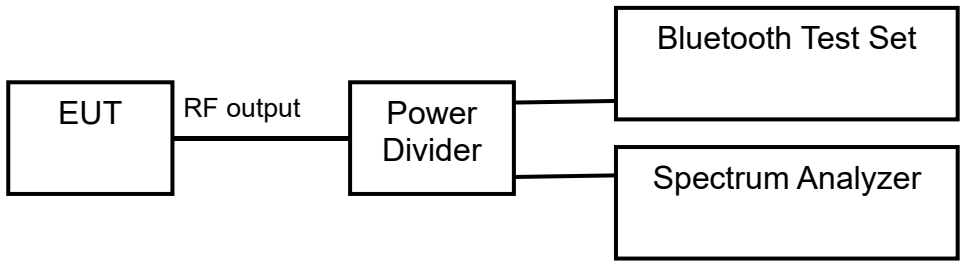
6.1.2 Test Procedure Used

ANSI C63.10-2013 – Section 6.9.2

6.1.3 Test settings

1.The signal analyzers' automatic bandwidth measurement capability of the spectrum analyzer was used to perform the 20dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 20. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2.RBW = 1 – 5% OBW
3.VBW ≥ 3 x RBW
4.Reference level set to keep signal from exceeding maximum input mixer level for linear operation.
5.Detector = Peak
6.Trace mode = max hold
7.Sweep = auto couple
8.The trace was allowed to stabilize

6.1.4 Test Setup



6.1.5 Test result

The test results are shown in Appendix A.

6.2 Channel Separation

6.2.1 Test limit

FCC Part15.247 (a)(1)
Measurement is made with EUT operating in hopping mode. The minimum permissible channel separation for this system is 2/3 the value of the 20dB BW.

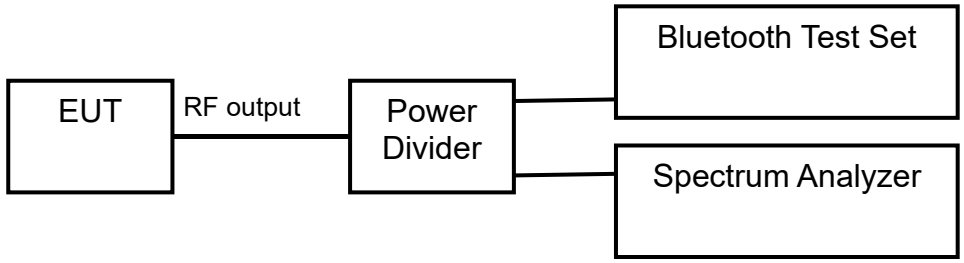
6.2.2 Test Procedure Used

ANSI C63.10-2013 – Section 7.8.2

6.2.3 Test Settings

1. Span = Wide enough to capture peaks of two adjacent channels
2. RBW = 30% of channel spacing. Adjust as necessary to best identify center of each individual channel
3. VBW ≥ RBW
4. Sweep = Auto
5. Detector = Peak
6. Trace mode = max hold
7. The trace was allowed to stabilize.
8. Marker-delta function used to determine separation between peaks of the adjacent channels

6.2.4 Test Setup



6.2.5 Test result

The test results are shown in Appendix A.

6.3 Peak Transmitter Output Power

6.3.1 Test limit

FCC Part15.247(b)(1)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band:1watt.

Used conversion factor: Limit (dBm) = 10 log (Limit (W)/1mW) ➔

Modulation type	GFSK	π/4DQPSK	8DPSK
Maximum Output Power	30.0dBm	30.0dBm	30.0dBm

For all other frequency hopping systems in the 2400-2483.5 MHz band:0.125 watts.

Used conversion factor: Limit (dBm) = 10 log (Limit (W)/1mW) ➔

Modulation type	GFSK	π/4DQPSK	8DPSK
Maximum Output Power	21.0dBm	21.0dBm	21.0dBm

6.3.2 Test Procedure Used

ANSI C63.10-2013 – Section 7.8.5

ANSI C63.10-2013 – Section 11.9.2.3.2 method AVGPM-G

6.3.3 Test Settings

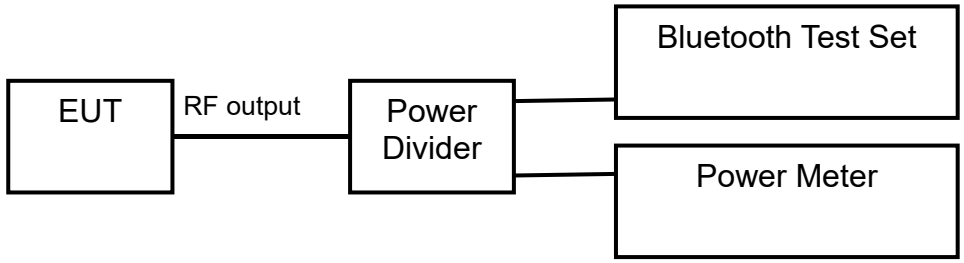
Peak Power Measurement

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than the occupied bandwidth.

Method AVGPM-G (Average Power Measurement)

Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter. The trace was averaged over 100 traces to obtain the final measured average power.

6.3.4 Test Setup



6.3.5 Test result

The test results are shown in Appendix A.

6.4 Dwell Time

6.4.1 Test Description

The Equipment under Test (EUT) was set up in a shielded room to perform the dwell time measurements.
The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss.
The time slot length is measured of three different packet types which are available in the Bluetooth technology. Those are DH1, DH3 and DH5 packets. The dwell time is calculated by:
Dwell time = time slot length * hop rate * 31.6/ number of hopping channels with:
- hop rate=1600/2 * 1/s for DH1 packets =800
- hop rate=1600/4 * 1/s for DH3 packets =400
- hop rate=1600/6 * 1/s for DH5 packets =266.67
- Number of hopping channels=79
- 31.6 s=0.4 seconds multiplied by the number of hopping channels=0.4s * 79

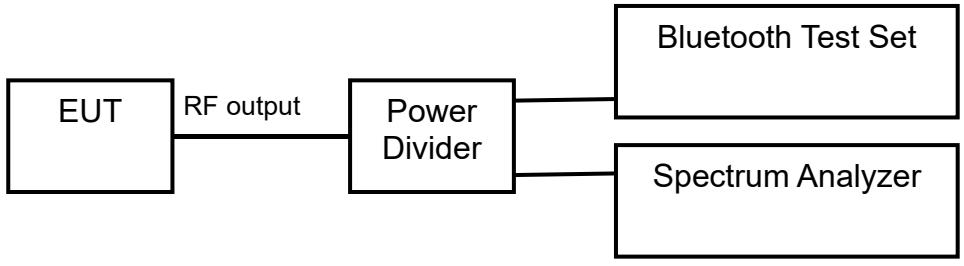
6.4.2 Test limit

FCC Part15.247(a)(1)(iii)
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 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.

6.4.3 Test Settings

ANSI C63.10-2013 Section 7.8.4
1. Span = zero span, centered on a hopping channel
2. RBW ≤ channel spacing and >> 1/T, where T is expected dwell time per channel
3. Sweep = as necessary to capture entire dwell time. Second plot may be required to demonstrate two successive hops on a channel
4. Trigger is set with appropriate trigger delay to place pulse near the center of the plot
5. Detector = peak
6. Trace mode = max hold
7. Marker-delta function used to determine transmit time per hop

6.4.4 Test Setup



6.4.5 Test result

The test results are shown in Appendix A.

6.5 Number of Hopping Frequencies

6.5.1 Test Description

The Equipment under Test (EUT) was set up in a shielded room to perform the number of hopping frequencies measurement. The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss.

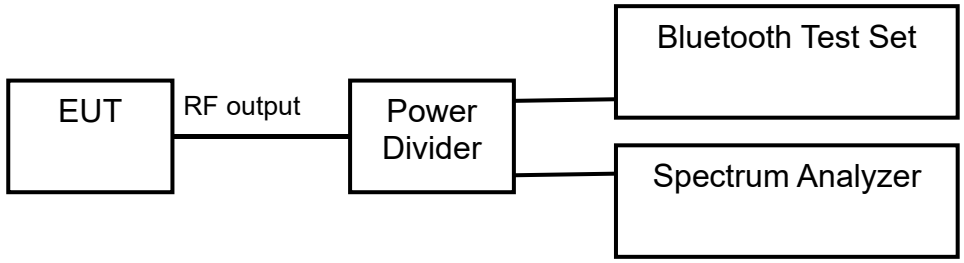
6.5.2 Test limit

FCC Part15.247 (a) (1) (iii)
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

6.5.3 Test Settings

ANSI C63.10-2013 Section 7.8.3
1. Span = frequency of band of operation (divided into two plots)
2. RBW < 30% of channel spacing or 20dB bandwidth, whichever is smaller.
3. VBW ≥ RBW
4. Sweep = auto
5. Detector = peak
6. Trace mode = max hold
7. Trace was allowed to stabilize

6.5.4 Test Setup



6.5.5 Test result

The test results are shown in Appendix A.

6.6 Conducted out of band emission measurement

6.6.1 Test limit

FCC Part15.247 (d)
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

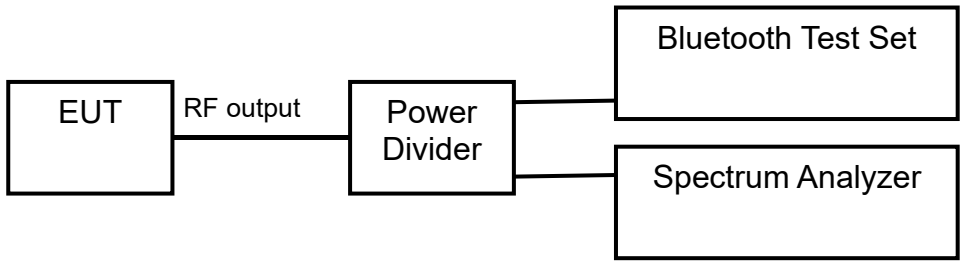
6.6.2 Test Procedure Used

ANSI C63.10-2013 – Section 7.8.8

6.6.3 Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 26GHz
2. RBW = 1MHz* (See note below)
3. VBW = 3MHz
4. Detector = Peak
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

6.6.4 Test Setup



6.6.5 Test result

The test results are shown in Appendix A .

The spectrum plots are attached on the following images. D1 line indicates thehighest level, D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

6.7 Band-edge measurement

6.7.1 Test limit

FCC Part15.247 (d)
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

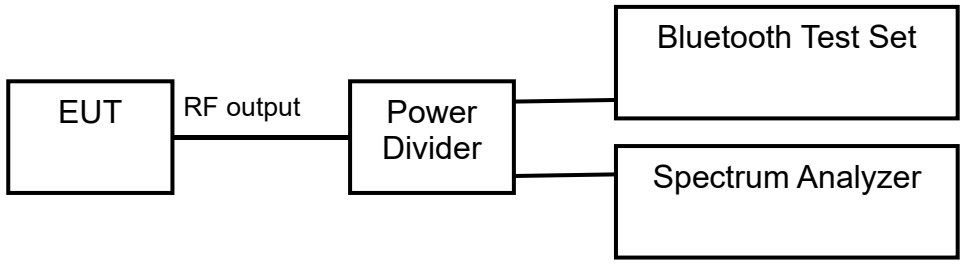
6.7.2 Test Procedure Used

ANSI C63.10-2013 – Section 6.10.4

6.7.3 Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW = 100kHz
4. VBW = 300kHz
5. Detector = Peak
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = max hold
8. Sweep time = auto couple
9. The trace was allowed to stabilize

6.7.4 Test Setup



6.7.6 Test result

The test results are shown in Appendix A.
The spectrum plots are attached on the following images. D1 line indicates thehighest level, D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

6.8 Spurious Radiated Emissions

6.8.1 Test Description

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at maximum power and at the appropriate frequencies. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

6.8.2 Test limit

Part15.205, 15.209, 15.247(d)

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in below Table per Section 15.209. The spectrum shall be investigated from the lowest radio frequency signal generated in the device.

Frequency [MHz]	Field strength [μV/m]	Measured Distance [meters]
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705~30.0	30	30
30～88	100	3
88～216	150	3
216～960	200	3
Above 960	500	3

Radiated Limits

Part15.35(b):

There is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit

Used conversion factor: Limit (dBμV/m) = 20 log (Limit (μV/m)/1μV/m)

Frequency [MHz]	Detector	Unit (dBμV/m)
30～88	Quasi-peak	40.0
88～216	Quasi-peak	43.5
216～960	Quasi-peak	46.0
960～1000	Quasi-peak	54.0
1000～5th harmonic of the highest frequency or 40GHz, whichever is lower	Average	54.0
	Peak	74.0

Conversion Radiated limits

6.8.3 Test Procedure Used

KDB 558074 D01 v05r02 – Section 12.2.7

For Radiated emission below 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. Both X and Y axes of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Quasi-Peak Detect Function and recorded the reading with Maximum Hold Mode.

NOTE:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer complied the following setting:

Frequency	RBW
9-150kHz	200-300Hz
0.15-30MHz	9-10kHz

2. Signals below 30MHz are not recorded in the report because they are lower than the limits by more than 20dB.

For Radiated emission above 30MHz
a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground in chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to quasi-peak detect function and recorded the reading with Maximum Hold Mode when the test frequency is below 1 GHz.
f. The test-receiver system was set to peak and average detector and recorded the reading with Maximum Hold Mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

For the radiated emission test above 1GHz:

Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

NOTE:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Average detection (AV) at frequency above 1GHz. If duty cycle of test signal is < 98%, the duty factor need added to measured value.
4. All modes of operation were investigated and the worst-case emissions are reported.

6.8.4Test Settings

Average Field Strength Measurements per Section 12.2.7 of KDB 558074 (Part 15.35)

Frequency	Detector
＜1000MHz	Quasi-peak
>1000MHz	Peak and average

Peak Field Strength Measurements per Section 12.2.7of KDB 558074 (Part 15.35)

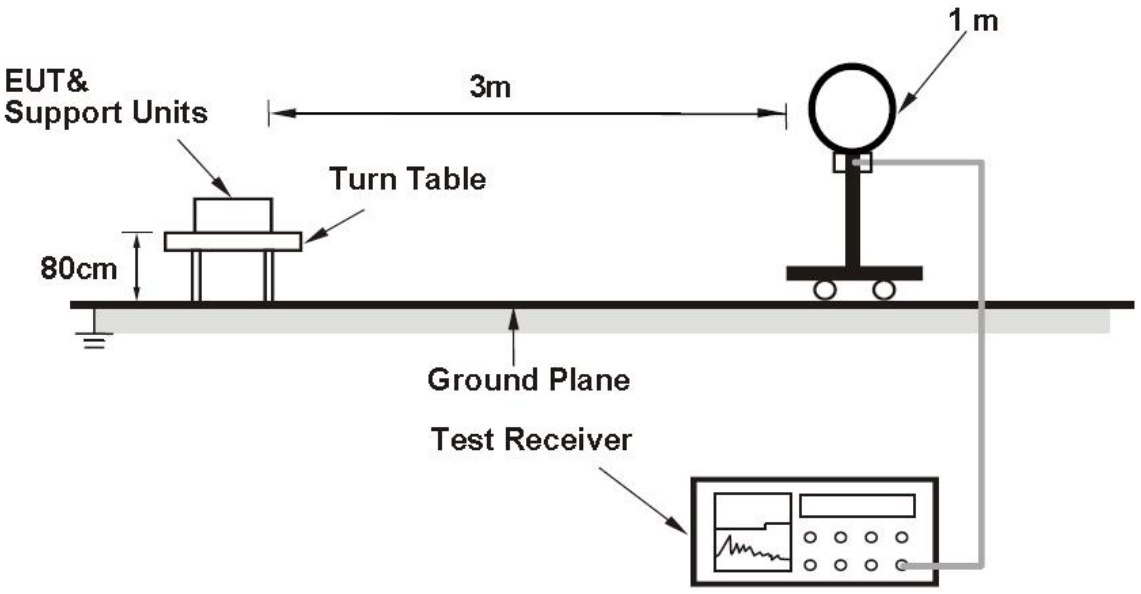
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW is set depending on measurement frequency, as specified in following table

Frequency	RBW
9-150kHz	200-300Hz
0.15-30MHz	9-10kHz
30-1000MHz	100-120kHz
>1000MHz	1MHz

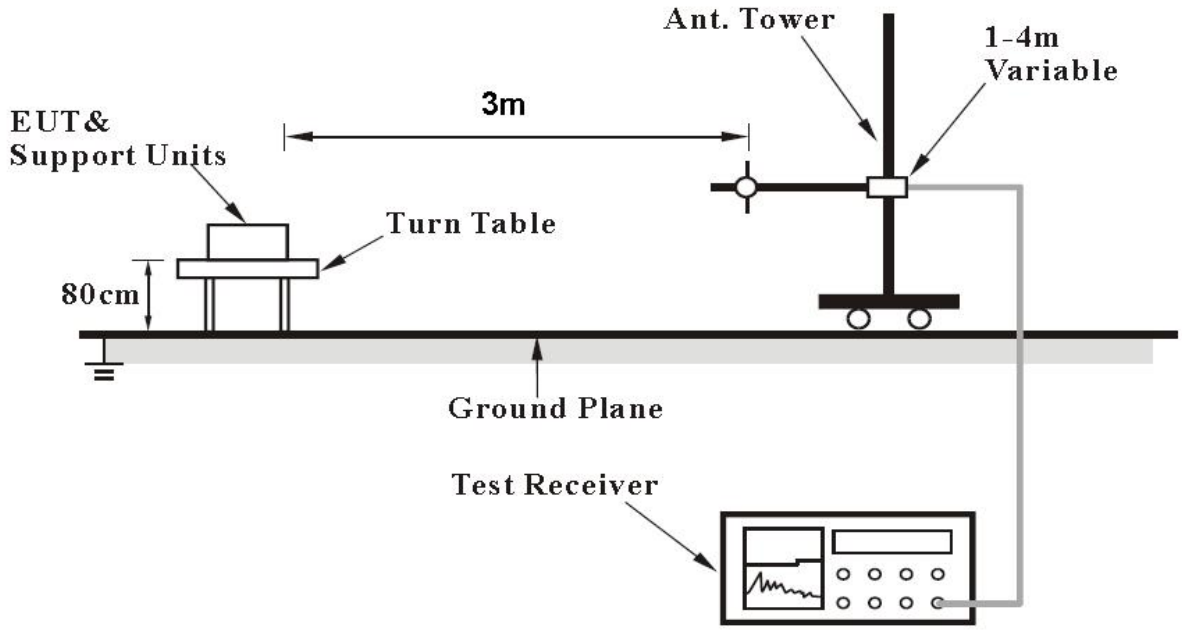
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

6.8.5 Test Setup

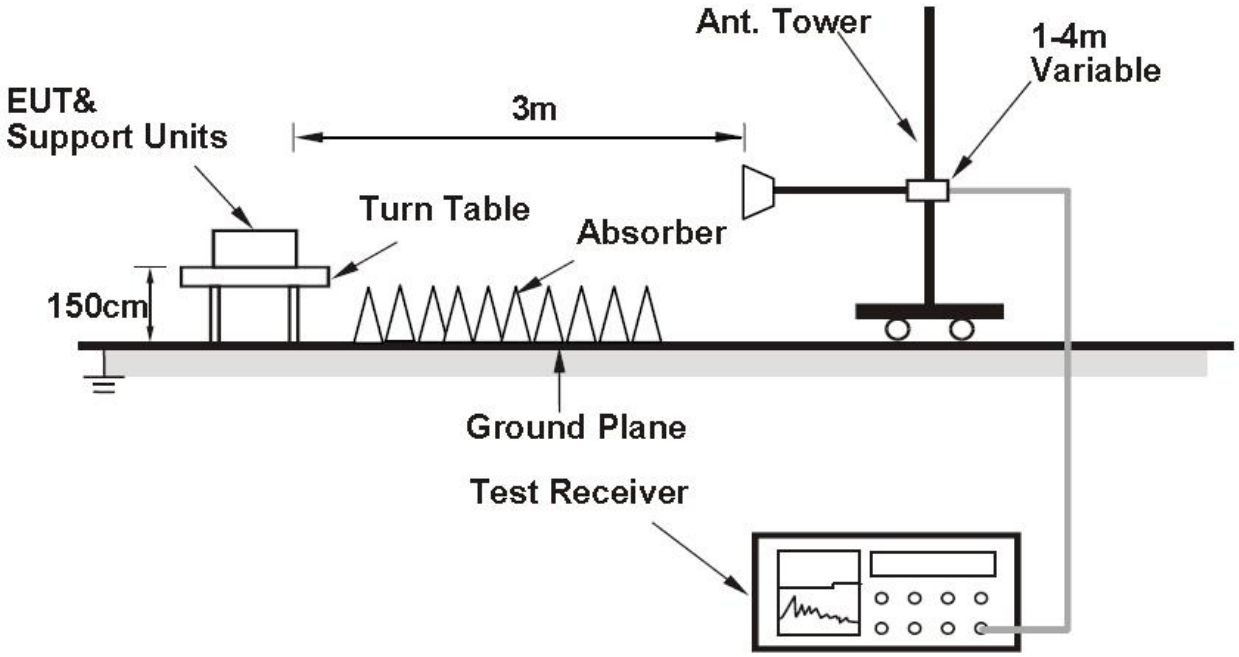
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



6.8.6 Test result

The test results are shown in Appendix B.

6.9 AC Power line Conducted Emission

6.9.1 Test limit

FCC Part15.207

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

The measurement is made according to ANSI C63.10-2013

6.9.2 Test Procedures

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.

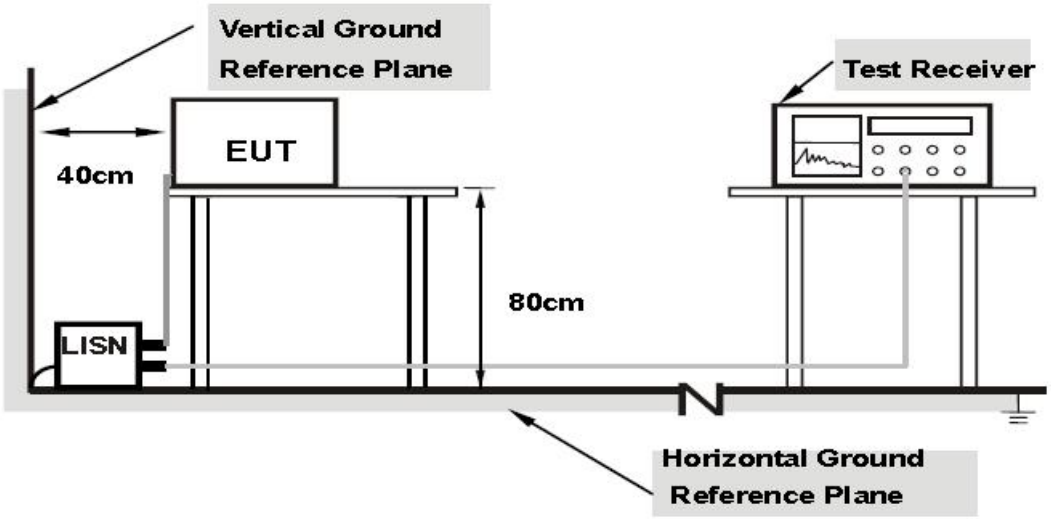
b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

c. The frequency range from 150 kHz to 30MHz was searched. Emission levels under (Limit - 20dB) were not recorded.

NOTE: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

The EUT shall test under the power AC120V/60Hz.

6.9.3 Test Setup



For the actual test configuration, please refer to the attached file (Test Setup Photo).

6.9.4 Test result

The test results are shown in Appendix B.

7 MEASUREMENT UNCERTAINTIES

Items	Uncertainty	
6dB Bandwidth	3kHz	
Peak power output	0.67dB	
Band edge compliance	1.20dB	
Conducted Out of band emission measurement	30MHz～1GHz	2.83dB
	1GHz～12.75GHz	2.50dB
	12.75GHz～25GHz	2.75dB
Spurious Radiated Emissions	30MHz～200MHz	4.88dB
	200MHz～1GHz	4.87dB
	1GHz～18GHz	4.58dB
	18GHz~40GHz	4.35dB
AC Power line Conducted Emission	3.92dB	

8 TEST EQUIPMENTS

No.	Name/ Model	Manufacturer	S/N	Cal date	Cal Due date
1.	Spectrum Analyzer / FSV	ROHDE & SCHWARZ	101065	2023.06.21	2024.06.20
2.	Signal Analyzer / N9020A	Agilent	MY48010771	2024.03.06	2025.03.05
3.	Bluetooth Test Set / MT8852B	Anritsu	1329003	2023.06.21	2024.06.20
4.	Power Divider / 11667A	HP	19632	2023.06.21	2024.06.20
5.	Signal Generator / SMBV100A	R&S	260910	2023.06.21	2024.06.20
6.	Power Meter E4416A	Agilent	MY52370013	2024.03.06	2025.03.05
7.	Power Sensor E9323A	Agilent	MY52150008	2024.03.06	2025.03.05
8.	Temperature chamber / SH241	ESPEC	92013758	2023.06.21	2024.06.20
9.	Fully-Anechoic Chamber / 12.65m×8.03m×7.50m	FRANKONIA	-----	-----	-----
10.	Semi-Anechoic/Chamber / 23.18m×16.88m×9.60m	FRANKONIA	---	-----	-----
11.	Turn table Diameter:1m	FRANKONIA	-----	-----	-----
12.	Turn table Diameter:5m	FRANKONIA	-----	-----	-----
13.	Antenna master FAC(MA4.0)	MATURO	-----	-----	-----
14.	Antenna master SAC(MA4.0)	MATURO	-----	-----	-----
15.	Shielding room / 9.080m×5.255m×3.525m	FRANKONIA	-----	-----	-----
16.	Double-Ridged Waveguide Horn Antenna / HF 907	R&S	100512	2023.06.21	2024.06.20
17.	Double-Ridged Waveguide Horn Antenna / HF 907	R&S	100513	2023.06.21	2024.06.20
18.	Ultra log antenna / HL562	R&S	100016	2023.06.21	2024.06.20
19.	Receive antenna /3160-09	SCHWARZ-BECK	002058-002	2023.06.21	2024.06.20
20.	EMI test receiver / ESI 40	R&S	100015	2023.06.21	2024.06.20
21.	EMI test receiver / ESCS30	R&S	100029	2023.06.21	2024.06.20
22.	Receive antenna / HL562	R&S	100167	2023.06.21	2024.06.20
23.	AMN / ENV216	R&S	3560.6550.12	2023.06.21	2024.06.20
24.	WLAN AP WIA3300-20 (FCC ID: 2AHKT-WIA3300-20)	SKSpruce	8152017060700339	---	---
25.	Notebook E470c	Lenovo	PF10UZW7	---	---
26.	Loop Antenna	R&S	100340	2023.08.21	2024.08.20
27.	FCC auto test system / RT9200BW-2	Radiosky	V2.05	/	/
28.	EMI test software / EMC32	R&S	V10.20.01	/	/

APPENDIX A – TEST DATA OF CONDUCTED EMISSION

BT

1 Duty Cycle and Antenna Gain

Test Mode	Frequency (MHz)	Plot	Duty Cycle	Correction Factor(dB)	Antenna Gain(dBi)
GFSK(DH5)	2402	Fig.1	100.00%	0.00	3.00

Note: Correction Factor=10*log(1/Duty Cycle)

Test Mode	Frequency (MHz)	Plot	Duty Cycle	Correction Factor(dB)	Antenna Gain(dBi)
π/4DQPSK(2DH5)	2402	Fig.2	100.00%	0.00	3.00

Note: Correction Factor=10*log(1/Duty Cycle)

Test Mode	Frequency (MHz)	Plot	Duty Cycle	Correction Factor(dB)	Antenna Gain(dBi)
8DPSK(3DH5)	2402	Fig.3	100.00%	0.00	3.00

Note: Correction Factor=10*log(1/Duty Cycle)

Test Mode: GFSK(DH5)

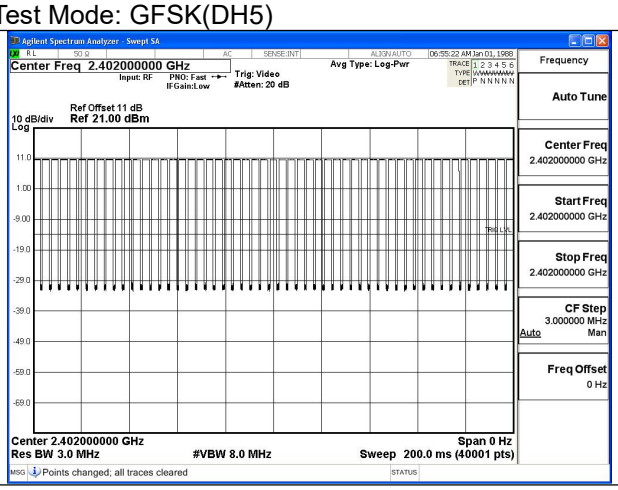


Fig.1

Test Mode: π/4DQPSK(2DH5)

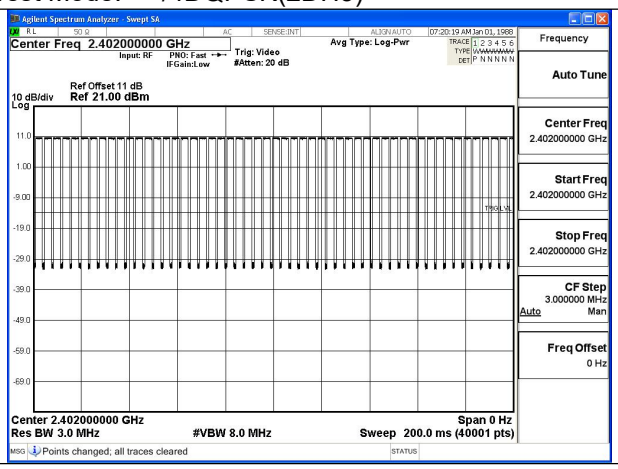


Fig.2

Test Mode: 8DPSK(3DH5)

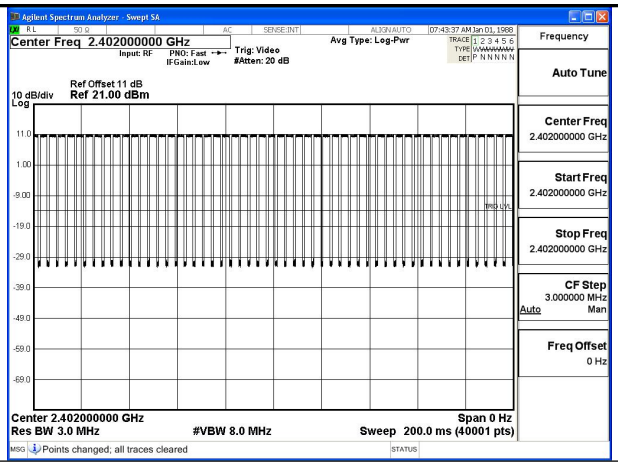


Fig.3

2 EIRP

Conducted Power

Modulation type	Conducted Peak Power(dBm)		
	2402MHz	2441MHz	2480MHz
GFSK(DH5)	10.53	10.49	10.22
π/4DQPSK(2DH5)	10.65	10.55	10.34
8DPSK(3DH5)	10.69	10.68	10.32

Modulation type	Conducted Average Power(dBm)		
	2402MHz	2441MHz	2480MHz
GFSK(DH5)	10.34	9.81	8.33
π/4DQPSK(2DH5)	8.26	8.04	8.64
8DPSK(3DH5)	8.78	8.40	9.02

EIRP

Modulation type	Peak EIRP (dBm)		
	2402MHz	2441MHz	2480MHz
GFSK(DH5)	13.53	13.49	13.22
π/4DQPSK(2DH5)	13.65	13.55	13.34
8DPSK(3DH5)	13.69	13.68	13.32

Modulation type	Average EIRP (dBm)		
	2402MHz	2441MHz	2480MHz
GFSK(DH5)	13.34	12.81	11.33
π/4DQPSK(2DH5)	11.26	11.04	11.64
8DPSK(3DH5)	11.78	11.40	12.02

EIRP (dBm)=Conducted Power(dBm)+Antenna Gain(dBi)

3 Occupied Bandwidth

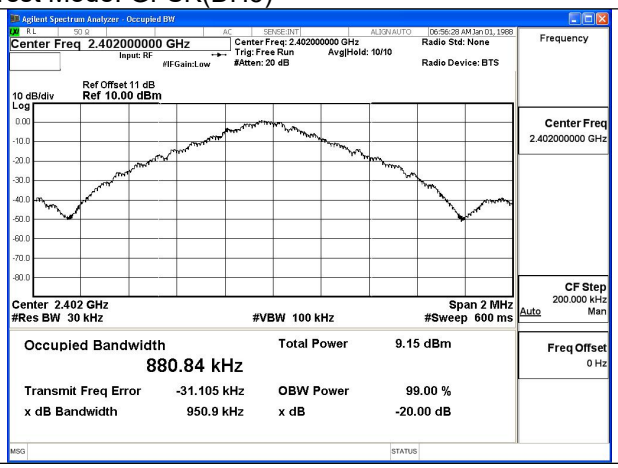
20dB Bandwidth

Test Mode	Carrier frequency (MHz)	20dB Bandwidth(KHz)
GFSK(DH5)	2402	950.9
GFSK(DH5)	2441	949.5
GFSK(DH5)	2480	950.3

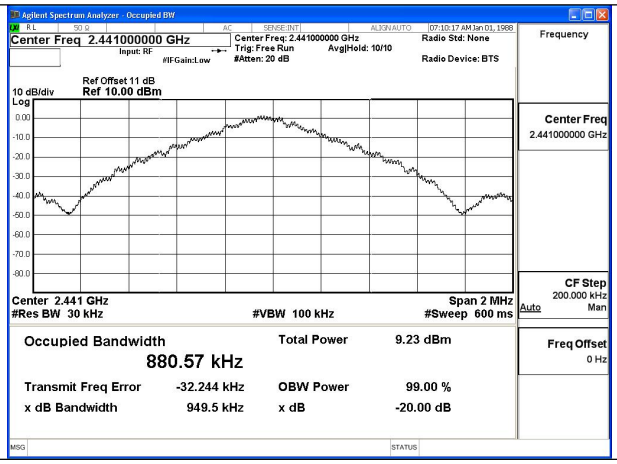
Test Mode	Carrier frequency (MHz)	20dB Bandwidth(KHz)
π/4DQPSK(2DH5)	2402	1396.5
π/4DQPSK(2DH5)	2441	1403.0
π/4DQPSK(2DH5)	2480	1415.3

Test Mode	Carrier frequency (MHz)	20dB Bandwidth(KHz)
8DPSK(3DH5)	2402	1395.9
8DPSK(3DH5)	2441	1407.2
8DPSK(3DH5)	2480	1407.7

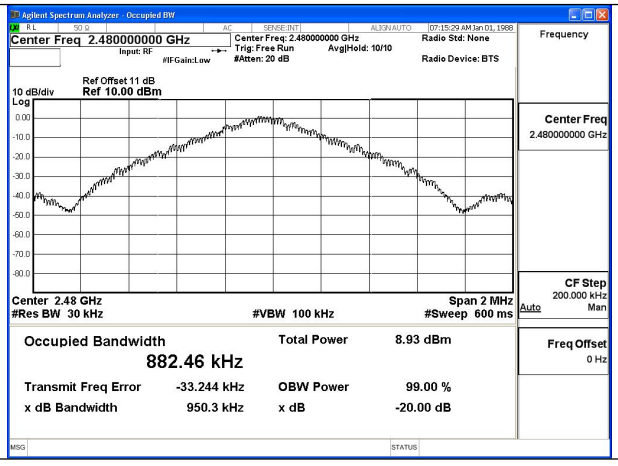
Test Mode: GFSK(DH5)



Test Mode:GFSK(DH5) 2402MHz

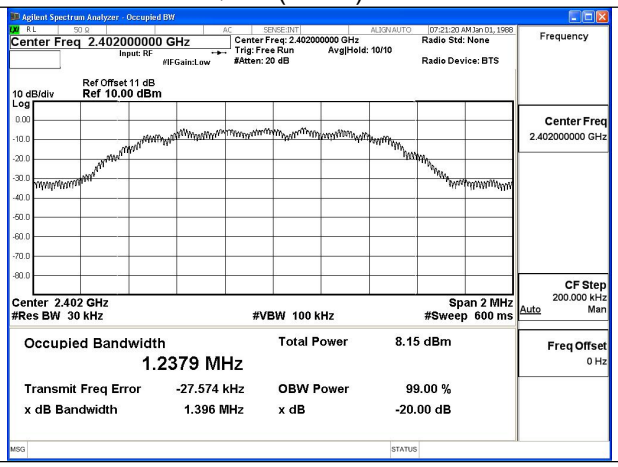


Test Mode:GFSK(DH5) 2441MHz

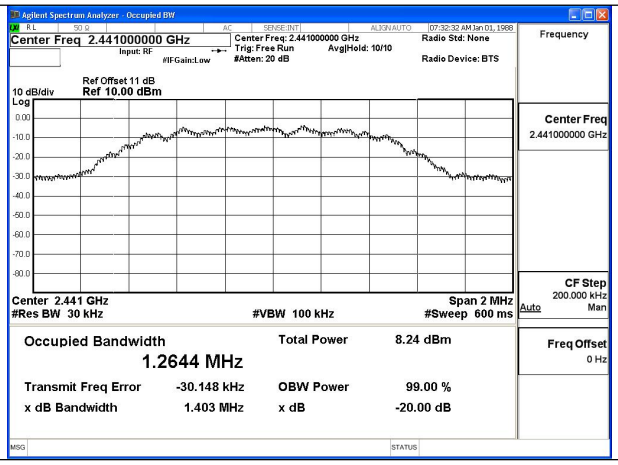


Test Mode:GFSK(DH5) 2480MHz

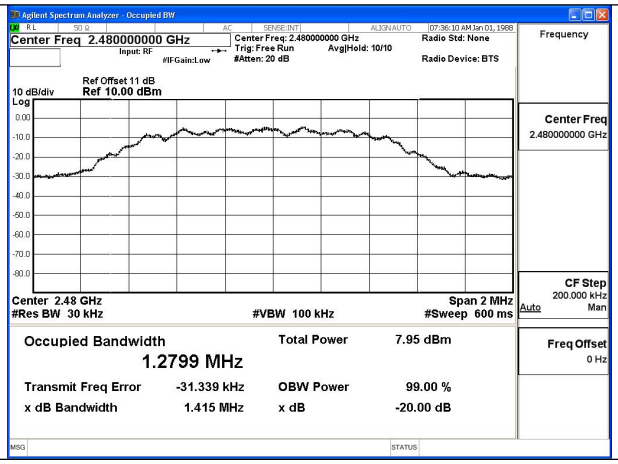
Test Mode: π/4DQPSK(2DH5)



Test Mode:π/4DQPSK(2DH5) 2402MHz

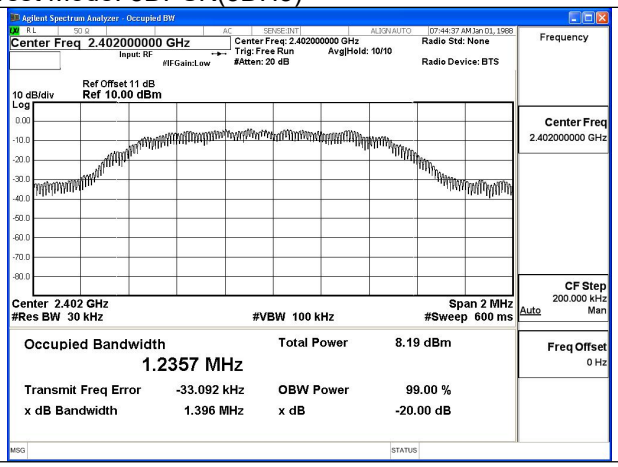


Test Mode:π/4DQPSK(2DH5) 2441MHz

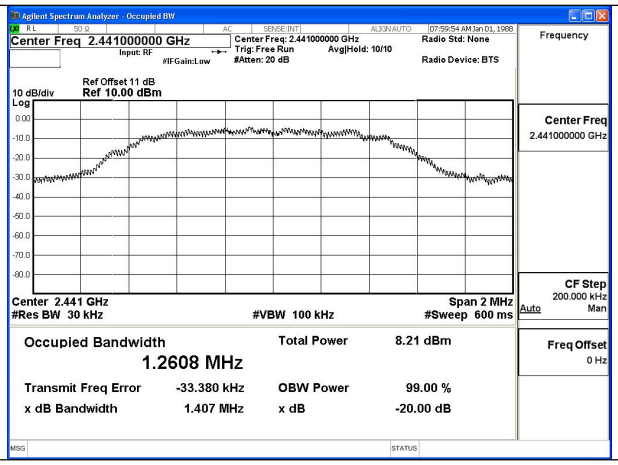


Test Mode:π/4DQPSK(2DH5) 2480MHz

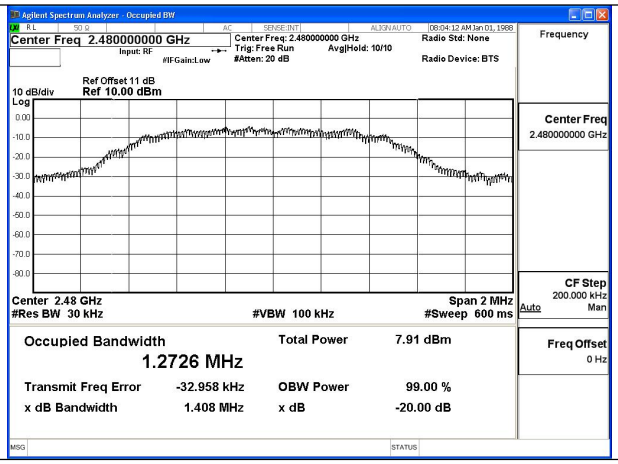
Test Mode: 8DPSK(3DH5)



Test Mode:8DPSK(3DH5) 2402MHz



Test Mode:8DPSK(3DH5) 2441MHz



Test Mode:8DPSK(3DH5) 2480MHz

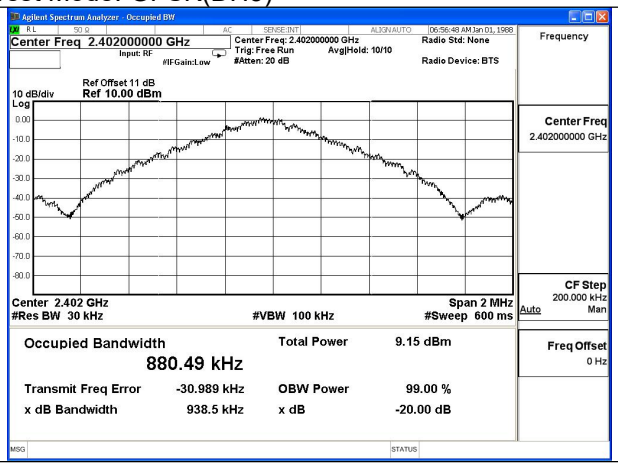
99% Bandwidth

Test Mode	Carrier frequency (MHz)	99% Bandwidth(kHz)
GFSK(DH5)	2402	880.5
GFSK(DH5)	2441	881.2
GFSK(DH5)	2480	882.3

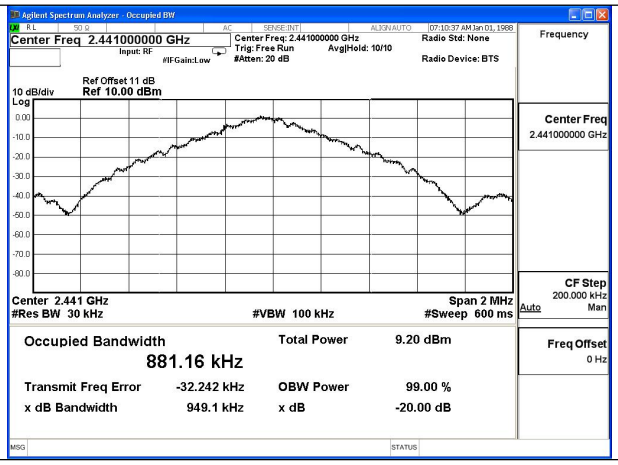
Test Mode	Carrier frequency (MHz)	99% Bandwidth(kHz)
π/4DQPSK(2DH5)	2402	1238.1
π/4DQPSK(2DH5)	2441	1264.3
π/4DQPSK(2DH5)	2480	1279.3

Test Mode	Carrier frequency (MHz)	99% Bandwidth(kHz)
8DPSK(3DH5)	2402	1237.4
8DPSK(3DH5)	2441	1261.0
8DPSK(3DH5)	2480	1272.8

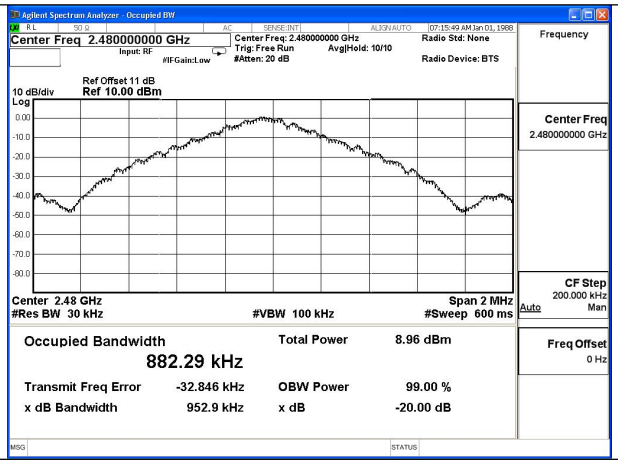
Test Mode: GFSK(DH5)



Test Mode:GFSK(DH5) 2402MHz

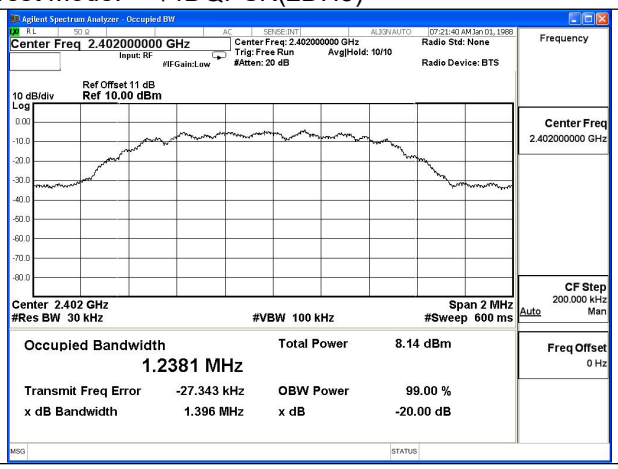


Test Mode:GFSK(DH5) 2441MHz

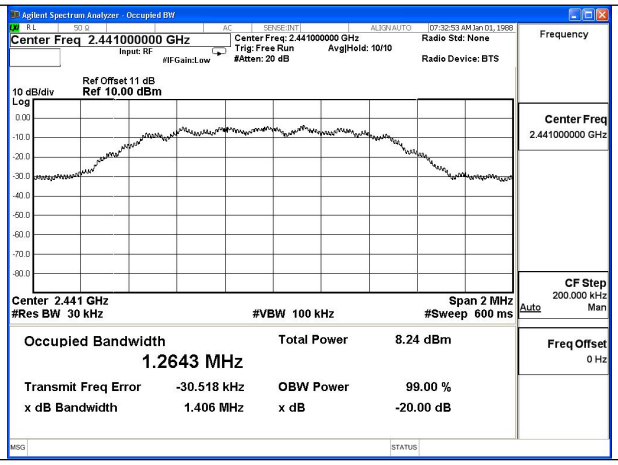


Test Mode:GFSK(DH5) 2480MHz

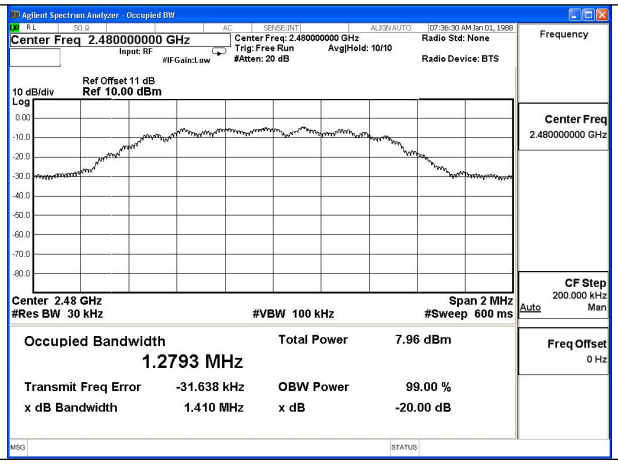
Test Mode: π/4DQPSK(2DH5)



Test Mode:π/4DQPSK(2DH5) 2402MHz

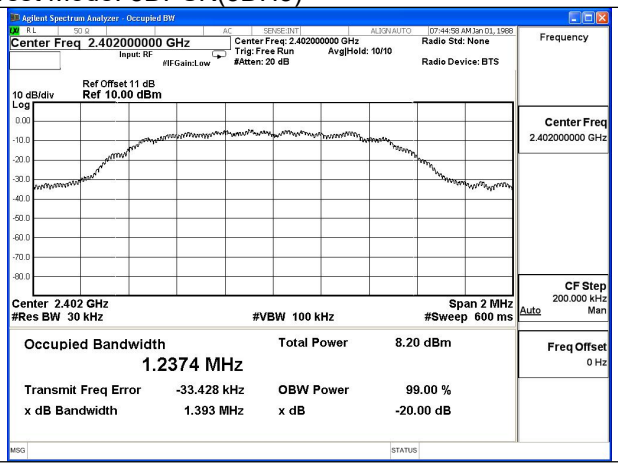


Test Mode:π/4DQPSK(2DH5) 2441MHz

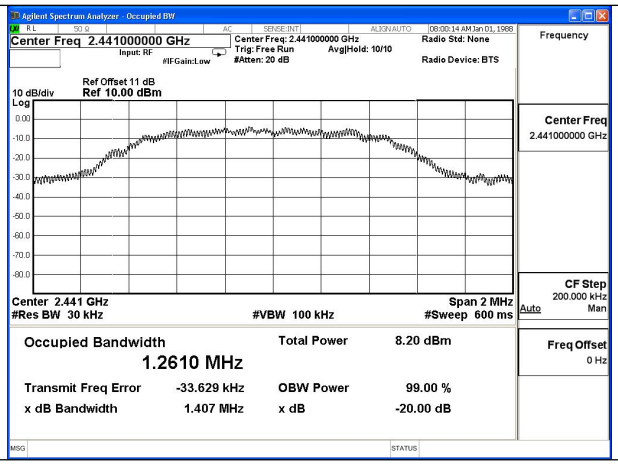


Test Mode:π/4DQPSK(2DH5) 2480MHz

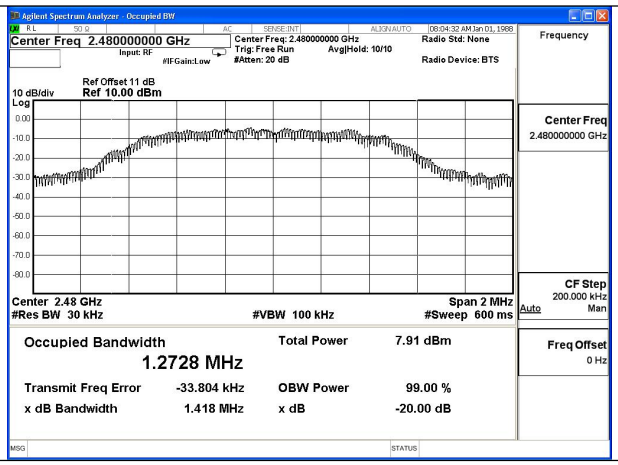
Test Mode: 8DPSK(3DH5)



Test Mode:8DPSK(3DH5) 2402MHz



Test Mode:8DPSK(3DH5) 2441MHz

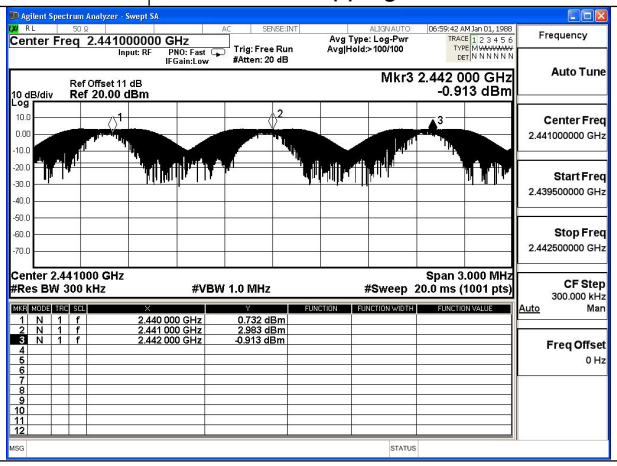


Test Mode:8DPSK(3DH5) 2480MHz

4 Hopping Frequency Separation

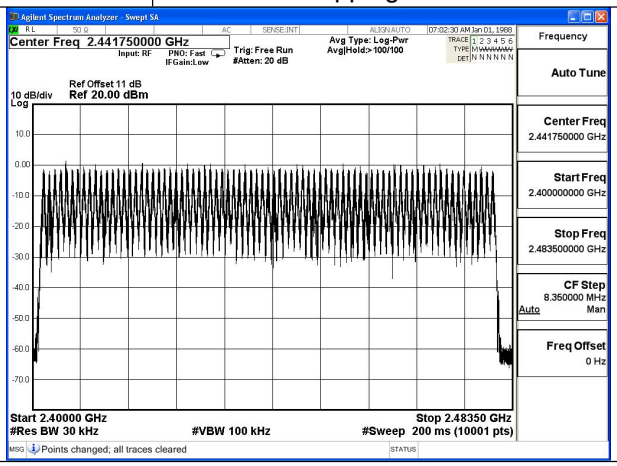
Channel separation

Test Mode	Op-mode	Channel separation (MHz)
GFSK(DH5)	Hopping mode	1



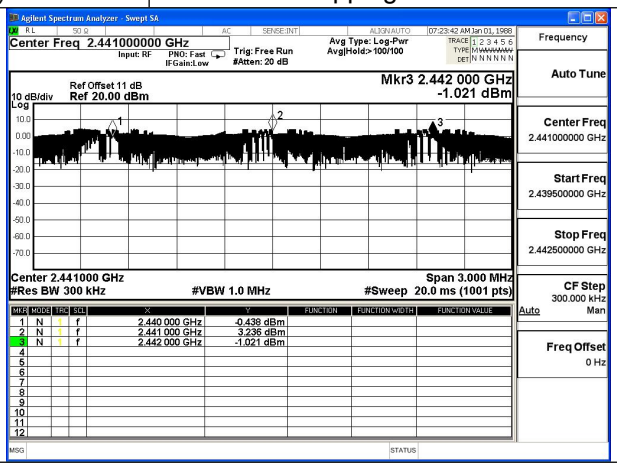
Number of Hopping Frequencies

Test Mode	Op-mode	Result
GFSK(DH5)	Hopping mode	79



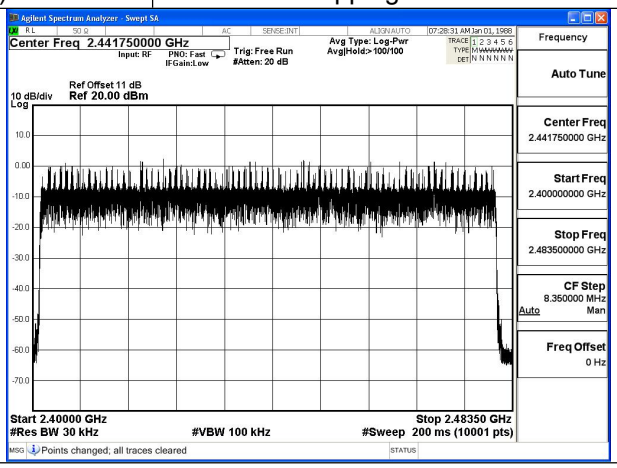
Channel separation

Test Mode	Op-mode	Channel separation (MHz)
π/4DQPSK(2DH5)	Hopping mode	1



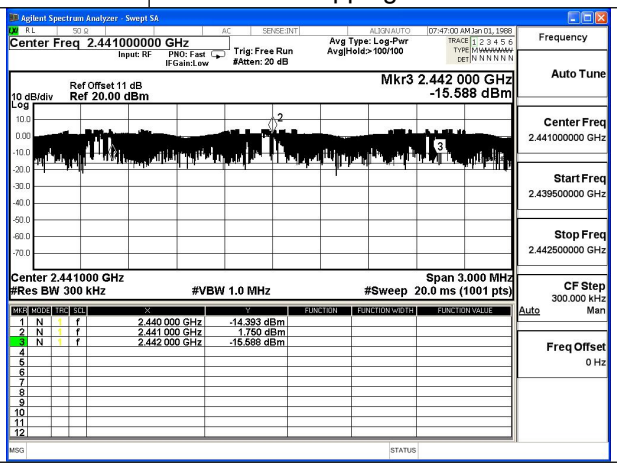
Number of Hopping Frequencies

Test Mode	Op-mode	Result
π/4DQPSK(2DH5)	Hopping mode	79



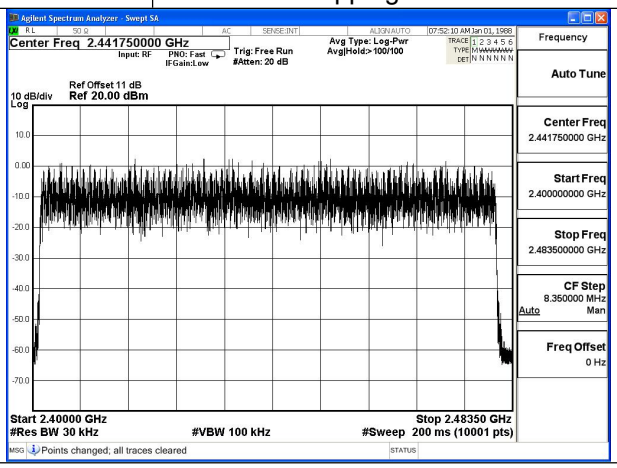
Channel separation

Test Mode	Op-mode	Channel separation (MHz)
8DPSK(3DH5)	Hopping mode	1



Number of Hopping Frequencies

Test Mode	Op-mode	Result
8DPSK(3DH5)	Hopping mode	79



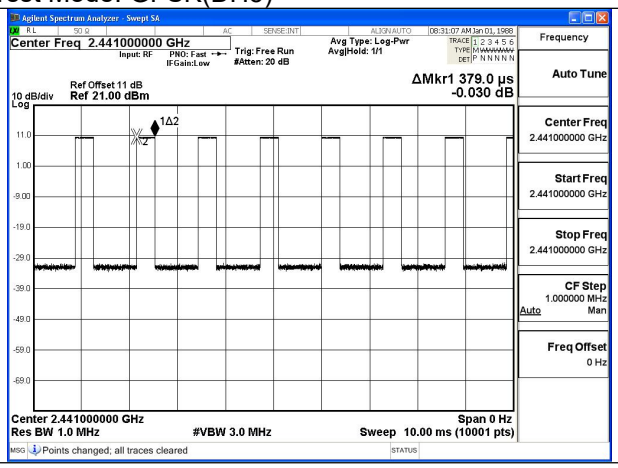
5 Dwell Time

Test Mode	Packet type	Time slot length(μs)	Dwell time	Dwell time(ms)
GFSK(DH1)	DH1	379	Time slot length *31.6*16000/2/79	121.3
GFSK(DH3)	DH3	1620	Time slot length *31.6*16000/4/79	259.2
GFSK(DH5)	DH5	2870	Time slot length *31.6*16000/6/79	306.1

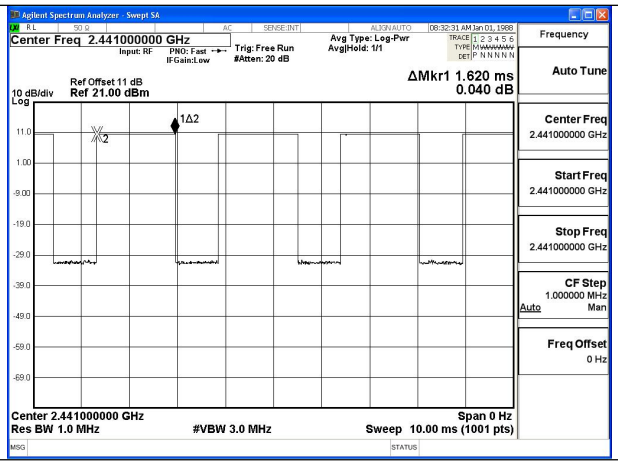
Test Mode	Packet type	Time slot length(μs)	Dwell time	Dwell time(ms)
π/4DQPSK(2DH1)	2DH1	386	Time slot length *31.6*16000/2/79	123.5
π/4DQPSK(2DH3)	2DH3	1620	Time slot length *31.6*16000/4/79	259.2
π/4DQPSK(2DH5)	2DH5	2870	Time slot length *31.6*16000/6/79	306.1

Test Mode	Packet type	Time slot length(μs)	Dwell time	Dwell time(ms)
8DPSK(3DH1)	3DH1	360	Time slot length *31.6*16000/2/79	115.2
8DPSK(3DH3)	3DH3	1620	Time slot length *31.6*16000/4/79	259.2
8DPSK(3DH5)	3DH5	2870	Time slot length *31.6*16000/6/79	306.1

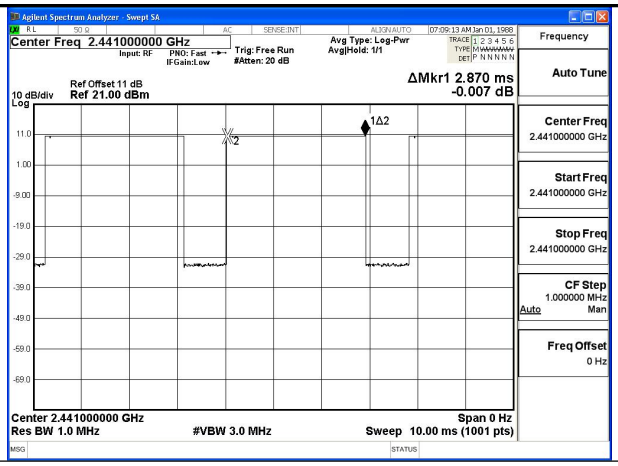
Test Mode: GFSK(DH5)



Test Mode:GFSK(DH1) 2441MHz

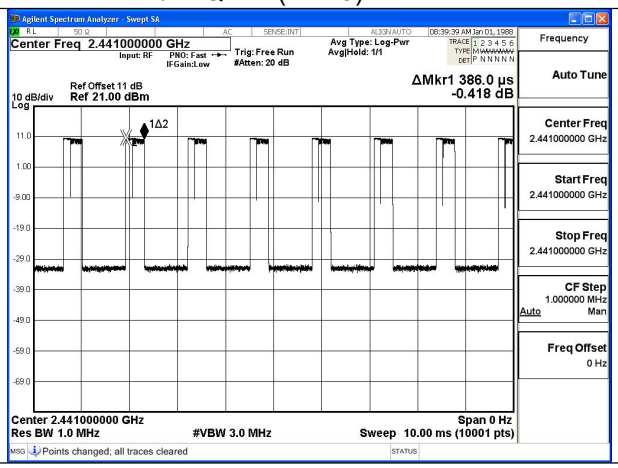


Test Mode:GFSK(DH3) 2441MHz

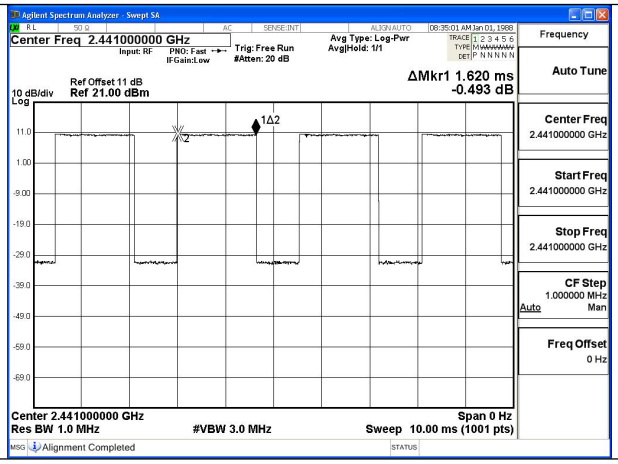


Test Mode:GFSK(DH5) 2441MHz

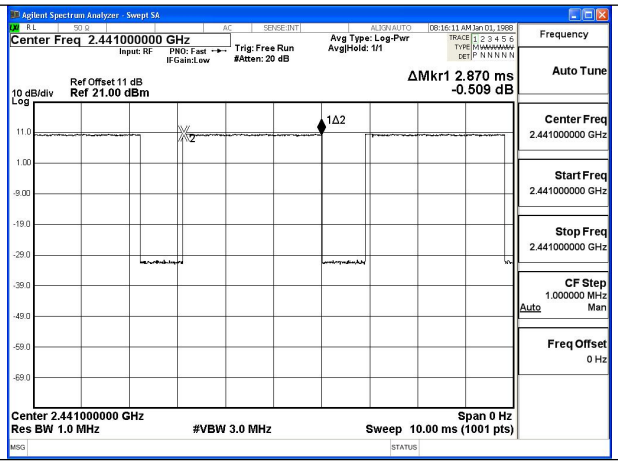
Test Mode: π/4DQPSK(2DH5)



Test Mode:π/4DQPSK(2DH1) 2441MHz

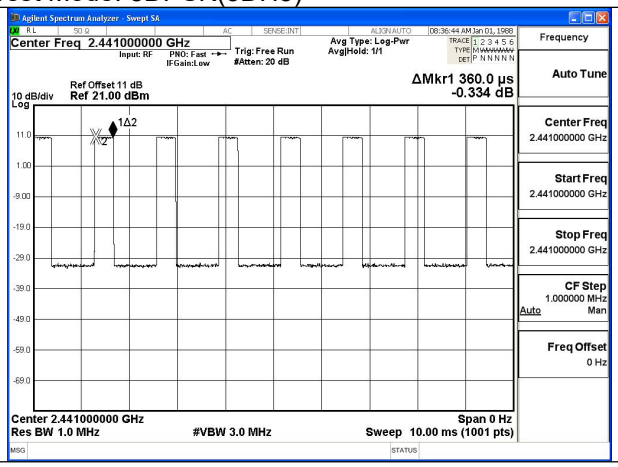


Test Mode:π/4DQPSK(2DH3) 2441MHz

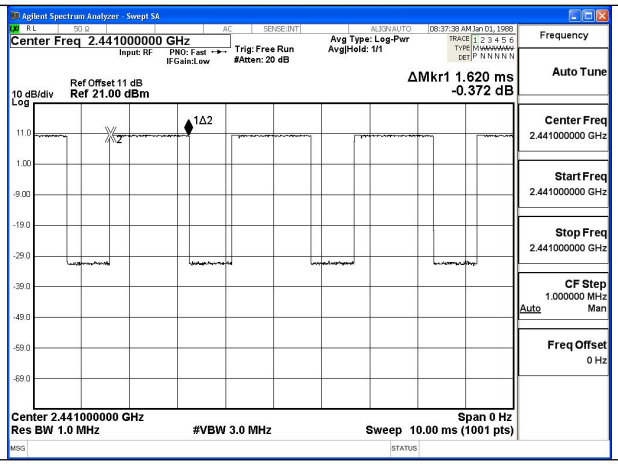


Test Mode:π/4DQPSK(2DH5) 2441MHz

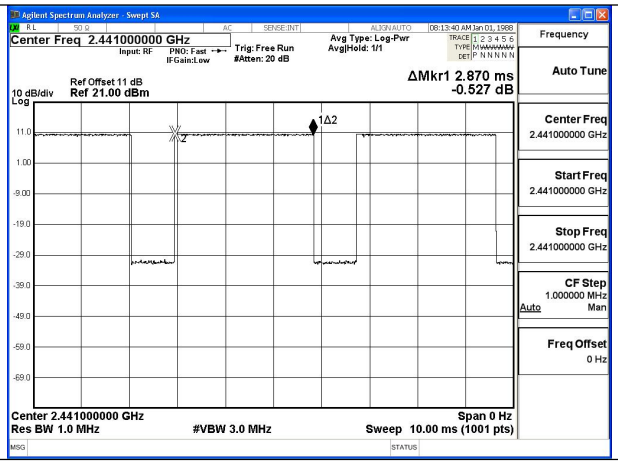
Test Mode: 8DPSK(3DH5)



Test Mode:8DPSK(3DH1) 2441MHz



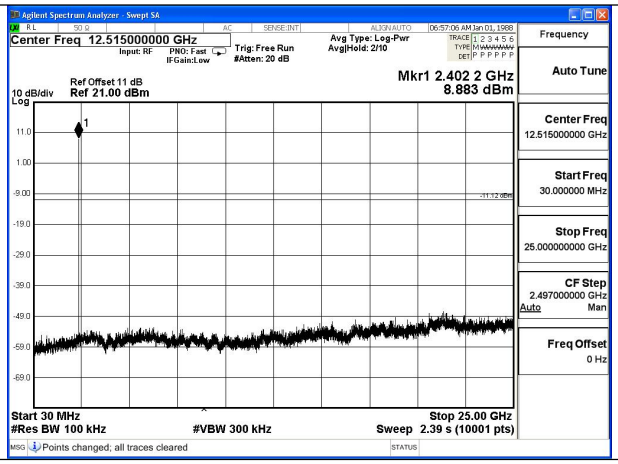
Test Mode:8DPSK(3DH3) 2441MHz



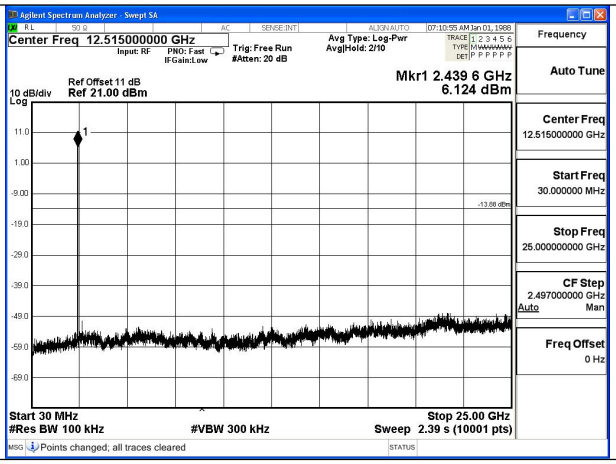
Test Mode:8DPSK(3DH5) 2441MHz

6 Conducted Out of band emission measurement

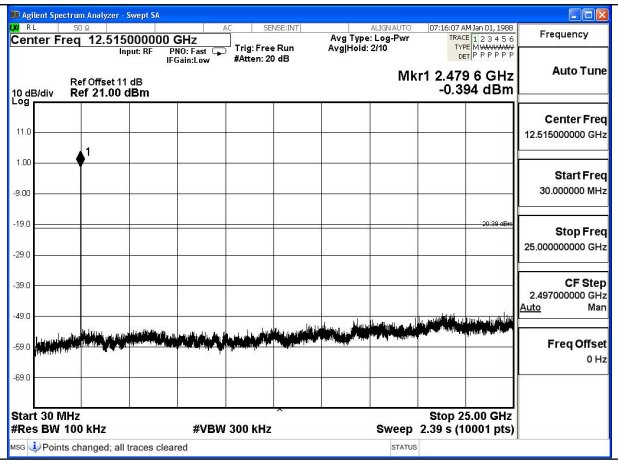
Test Mode: GFSK



CH0(Hopping off)

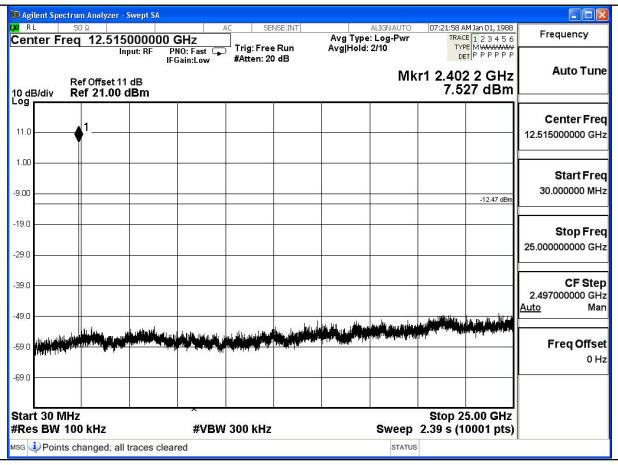


CH39(Hopping off)

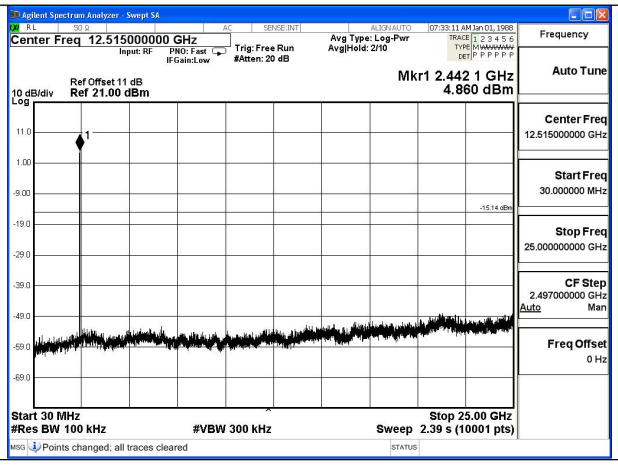


CH78(Hopping off)

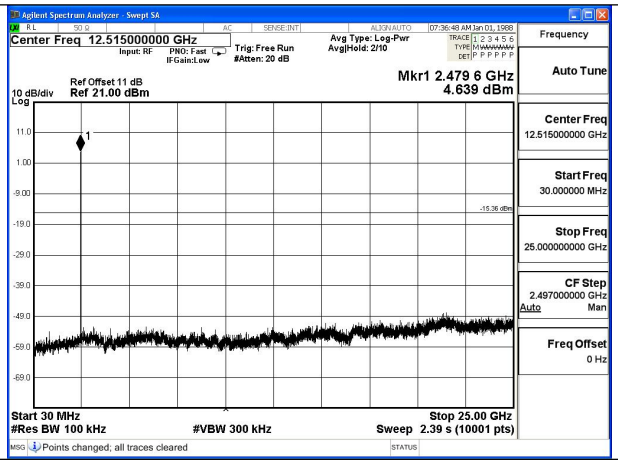
Test Mode: π/4DQPSK



CH0(Hopping off)



CH39(Hopping off)



CH78(Hopping off)