FCC&IC RADIO TEST REPORT

FCC ID: 2AZYD-KD5801

Product： Indoor Exercise Bike

Trade Name： MBH

Model Name： KD5801

Serial Model： M-5819

Report No.： UNIA21042704ER-01

Prepared for

Shandong MBH Fitness Co. ,Ltd.

Economy and DevelopmentZone, Ningjin County,Dezhou, Shandong,China,25340

Prepared by

Shenzhen United Testing Technology Co., Ltd.

2F, Annex Bldg, Jiahuangyuan Tech Park, #365 Baotian 1 Rd, Tiegang Community, Xixiang Str, Bao'an District, Shenzhen, China

TEST RESULT CERTIFICATION

Applicant's name	:	Shandong MBH Fitness Co. ,Ltd.
Address	:	Economy and DevelopmentZone, Ningjin County,Dezhou, Shandong,China,253400
Manufacture's Name	:	Shandong MBH Fitness Co. ,Ltd.
Address	:	Economy and DevelopmentZone, Ningjin County,Dezhou, Shandong,China,253400

Product description

Product name	:	Indoor Exercise Bike
Trade Mark	:	MBH
Model and/or type reference	:	KD5801
Standards	:	FCC Rules and Regulations Part 15 Subpart C Section 15.247 ANSI C63.10: 2013

This device described above has been tested by Shenzhen United Testing Technology Co., Ltd., and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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Date of Test.....:

Date (s) of performance of tests	:	Apr. 27, 2021 ~ May 11, 2021
Date of Issue	:	May 11, 2021
Test Result	:	Pass

Prepared by: Bob liao

Bob liao/Editor

Reviewer: kahn.yang

Kahn yang/Supervisor

Approved & Authorized Signer: liuze

Liuze/Manager

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1. TEST SUMMARY

1.1 TEST PROCEDURES AND RESULTS

DESCRIPTION OF TEST	STANDARD	RESULT
Bandwidth	FCC Part 15: 15.247(a)(1) ANSI C63.10: Clause 6.9	COMPLIANT
Carrier Frequency Separation Test	FCC Part 15: 15.247(a)(1)	COMPLIANT
Number Of Hopping Frequency	FCC Part 15: 15.247(a)(1)(iii)	COMPLIANT
Dwell Time Test	FCC Part 15: 15.247(a)(1)(iii)	COMPLIANT
Maximum Output Power	FCC Part 15: 15.247(b)(1)	COMPLIANT
Band Edge Emission	FCC Part 15: 15.247(d)	COMPLIANT
Radiated Spurious Emissions	FCC Part 15.205 / 15.209	COMPLIANT
Antenna requirement	FCC Part 15: 15.203	COMPLIANT
Conducted Emission	FCC Part 15.207	N/A

1.2 TEST FACILITY

Test Firm : Shenzhen United Testing Technology Co., Ltd.

Address : 2F, Annex Bldg, Jiahuangyuan Tech Park, #365 Baotian 1 Rd, Tiegang Community, Xixiang Str, Bao'an District, Shenzhen, China

The testing quality ability of our laboratory meet with "Quality Law of People's Republic of China" Clause 19.The testing quality system of our laboratory meets with ISO/IEC-17025 requirements. This approval result is accepted by MRA of APLAC.

Our test facility is recognized, certified, or accredited by the following organizations:

A2LA Certificate Number: 4747.01

The EMC Laboratory has been accredited by A2LA, and in compliance with ISO/IEC 17025:2017 General Requirements for testing Laboratories.

FCC Registration Number: 674885

The EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications commission.

IC Registration Number: 21947

The EMC Laboratory has been registered and fully described in a report filed with the (IC) Industry Canada.

1.3 MEASUREMENT UNCERTAINTY

Measurement Uncertainty		
Conducted Emission Expanded Uncertainty	=	2.23dB, k=2
Radiated emission expanded uncertainty(9kHz-30MHz)	=	3.08dB, k=2
Radiated emission expanded uncertainty(30MHz-1000MHz)	=	4.42dB, k=2
Radiated emission expanded uncertainty(Above 1GHz)	=	4.06dB, k=2

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Equipment	Indoor Exercise Bike
Trade Mark	MBH
Model Name	KD5801
Serial No.	M-5819
Model Difference	Exterior mechanical shape is slightly different.
FCC ID	2AZYD-KD5801
Antenna Type	PCB Antenna
Antenna Gain	1.0dBi
Frequency Range	2402-2480MHz
Number of Channels	79
Modulation Type	GFSK, π/4-DQPSK, 8DPSK
Battery	N/A
Power Source	DC 3.0V from battery
Adapter	N/A

2.2 Carrier Frequency of Channels

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

2.3 Operation of EUT during testing

Operating Mode
Test software Version: nRFgo
Power Parameters: 5
Note: According exploratory test, EUT will have maximum output power in those data rate, so those data rate were used for all test.

The mode is used:
Transmitting mode for TX GFSK, π/4-DQPSK, 8DPSK running at 1,2,3Mbps
Low Channel: 2402MHz
Middle Channel: 2441MHz
High Channel: 2480MHz

2.4 DESCRIPTION OF TEST SETUP

Operation of EUT during Conducted testing:

N/A

Operation of EUT during Radiation and Above1GHz Radiation testing:

EUT

Table for auxiliary equipment:

Equipment Description	Manufacturer	Model	Calibration Due Date
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A

2.5 MEASUREMENT INSTRUMENTS LIST

Item	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
CONDUCTED EMISSIONS TEST					
1	AMN	Schwarzbeck	NNLK8121	8121370	2021.9.9
2	AMN	ETS	3810/2	00020199	2021.9.9
3	EMI TEST RECEIVER	Rohde&Schwarz	ESCI	101210	2021.9.9
4	AAN	TESEQ	T8-Cat6	38888	2021.9.9
RADIATED EMISSION TEST					
1	Horn Antenna	Sunol	DRH-118	A101415	2021.9.9
2	BicoNILog Antenna	Sunol	JB1 Antenna	A090215	2021.9.9
3	PREAMP	HP	8449B	3008A00160	2021.9.9
4	PREAMP	HP	8447D	2944A07999	2021.9.9
5	EMI TEST RECEIVER	Rohde&Schwarz	ESR3	101891	2021.9.9
6	VECTOR Signal Generator	Rohde&Schwarz	SMU200A	101521	2021.9.28
7	Signal Generator	Agilent	E4421B	MY4335105	2021.9.28
8	MXA Signal Analyzer	Agilent	N9020A	MY50510140	2021.9.28
9	MXA Signal Analyzer	Agilent	N9020A	MY51110104	2021.9.9
10	ANT Tower&Turn table Controller	Champro	EM 1000	60764	2021.9.28
11	Anechoic Chamber	Taihe Maorui	9m*6m*6m	966A0001	2021.9.9
12	Shielding Room	Taihe Maorui	6.4m*4m*3m	643A0001	2021.9.9
13	RF Power sensor	DARE	RPR3006W	15I00041SNO88	2022.3.14
14	RF Power sensor	DARE	RPR3006W	15I00041SNO89	2022.3.14

15	RF power divider	Anritsu	K241B	992289	2021.9.28
16	Wideband radio communication tester	Rohde&Schwarz	CMW500	154987	2021.9.28
17	Biconical antenna	Schwarzbeck	VHA 9103	91032360	2021.9.8
18	Biconical antenna	Schwarzbeck	VHA 9103	91032361	2021.9.8
19	Broadband Hybrid Antennas	Schwarzbeck	VULB9163	VULB9163#958	2021.9.8
20	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1680	2022.1.12
21	Active Receive Loop Antenna	Schwarzbeck	FMZB 1919B	00023	2021.9.8
22	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170651	2022.03.14
23	Microwave Broadband Preamplifier	Schwarzbeck	BBV 9721	100472	2021.9.8
24	Active Loop Antenna	Com-Power	AL-130R	10160009	2021.05.10
25	Power Meter	KEYSIGHT	N1911A	MY50520168	2021.05.10
26	Frequency Meter	VICTOR	VC2000	997406086	2021.05.10
27	DC Power Source	HYELEC	HY5020E	055161818	2021.05.10
24*	Active Loop Antenna	Com-Power	AL-130R	10160009	2022.05.09
25*	Power Meter	KEYSIGHT	N1911A	MY50520168	2022.05.09
26*	Frequency Meter	VICTOR	VC2000	997406086	2022.05.09
27*	DC Power Source	HYELEC	HY5020E	055161818	2022.05.09

3. CONDUCTED EMISSIONS TEST

3.1 Conducted Power Line Emission Limit

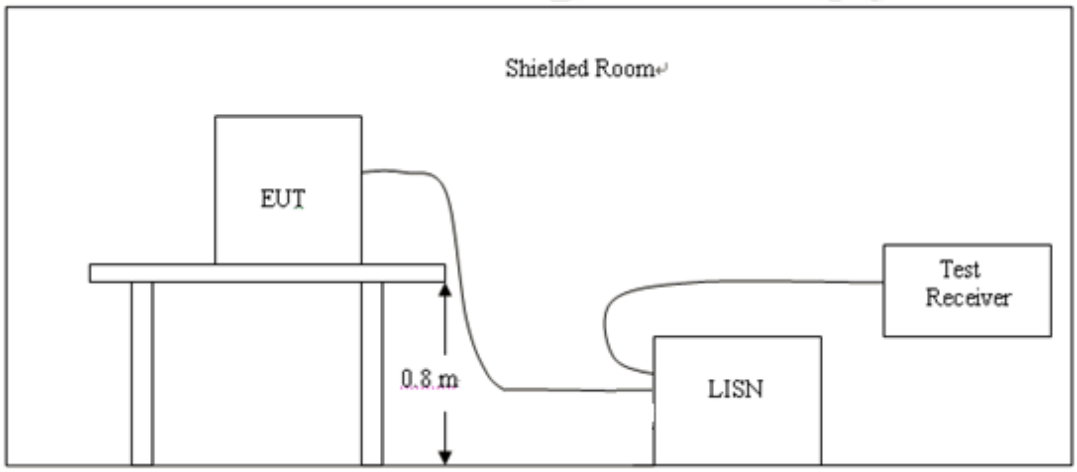
For unintentional device, according to § 15.107(a) Line Conducted Emission Limits is as following

Frequency (MHz)	Maximum RF Line Voltage(dB V)			
	CLASS A		CLASS B	
	Q.P.	Ave.	Q.P.	Ave.
0.15~0.50	79	66	66~56*	56~46*
0.50~5.00	73	60	56	46
5.00~30.0	73	60	60	50

* Decreasing linearly with the logarithm of the frequency

For intentional device, according to §15.207(a) Line Conducted Emission Limit is same as above table.

3.2 Test Setup



3.3 Test Procedure

1, The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. A wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10.
2, Support equipment, if needed, was placed as per ANSI C63.10.
3, All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.
4, If a EUT received DC power from the USB Port of Notebook PC, the PC's adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5, All support equipments received AC power from a second LISN, if any.
6, The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7, Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.

3.4 Test Result

Pass

Remark:

1. All modes were tested at AC 120V and 240V, only the worst result of AC 120V was reported.
2. All modes were tested at Low, Middle, and High channel, only the worst result of 802.11b Low Channel was reported as below:

Temperature:	24℃	Relative Humidity:	48%
Test Date:	N/A	Pressure:	1010hPa
Test Voltage:	N/A	Phase:	Line
Test Mode:	TX (1Mbps) CH00 (worst case)		

Not Applicable.

Remark: Factor = Insertion Loss + Cable Loss, Result = Reading + Factor, Margin = Result – Limit.

Temperature:	24℃	Relative Humidity:	48%
Test Date:	N/A	Pressure:	1010hPa
Test Voltage:	N/A	Phase:	Neutral
Test Mode:	TX (1Mbps) CH00 (worst case)		

Not Applicable.

Remark: Factor = Insertion Loss + Cable Loss, Result = Reading + Factor, Margin = Result – Limit.

4 RADIATED EMISSION TEST

4.1 Radiation Limit

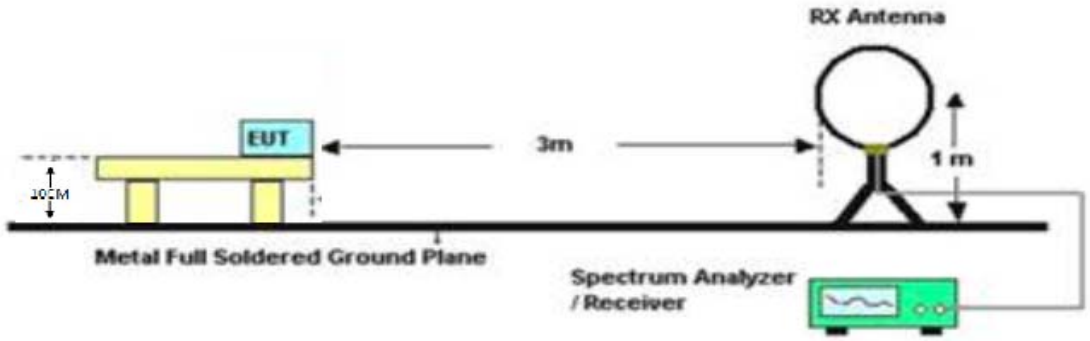
For unintentional device, according to § 15.109(a), except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values：

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
30-88	3	40	100
88-216	3	43.5	150
216-960	3	46	200
Above 960	3	54	500

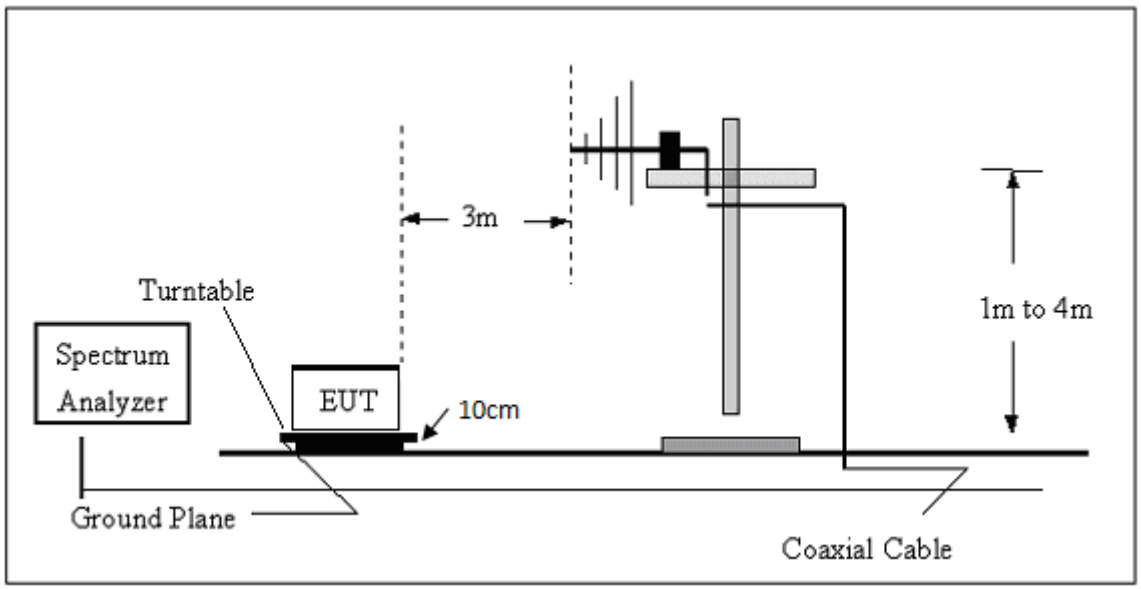
For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

4.2 Test Setup

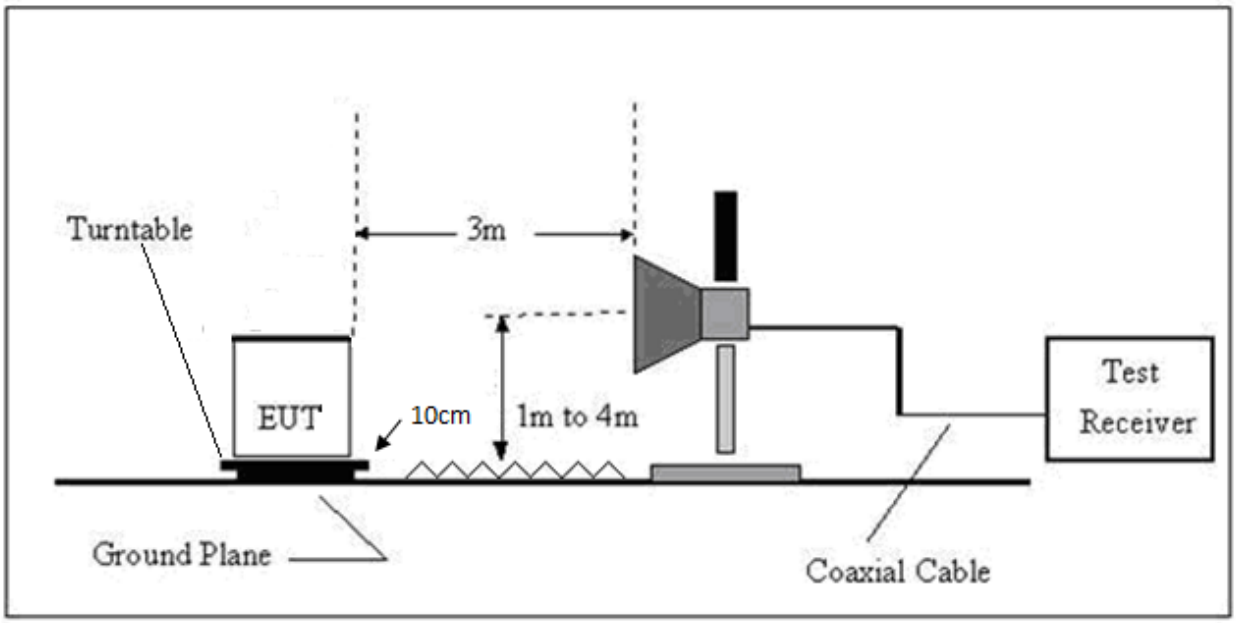
1. Radiated Emission Test-Up Frequency Below 30MHz



2. Radiated Emission Test-Up Frequency 30MHz~1GHz



3. Radiated Emission Test-Up Frequency Above 1GHz



4.3 Test Procedure

1. Below 1GHz measurement the EUT is placed on turntable which is 10cm above ground plane. And above 1GHz measurement EUT was placed on low permittivity and low tangent turn table which is 10cm above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The test frequency range from 9KHz to 25GHz per FCC PART 15.33(a).

Note:
For battery operated equipment, the equipment tests shall be performed using a new battery.

4.4 Test Result

PASS
Remark:

1. All modes of mode were tested at Low, Middle, and High channel, and only the worst result of GFSK (1Mbps) Low Channel was reported for below 1GHz test.
2. By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that “Z axis” position was the worst, and test data recorded in this report.

Below 30M

Temperature:	22℃	Relative Humidity:	48%
Test Date:	2021-04-22	Pressure:	1010hPa
Test Voltage:	DC3.0V	Polarization:	Horizontal
Test Mode:	TX (1Mbps) CH00 (worst case)		

Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	P
--	--	--	--	P

Note:

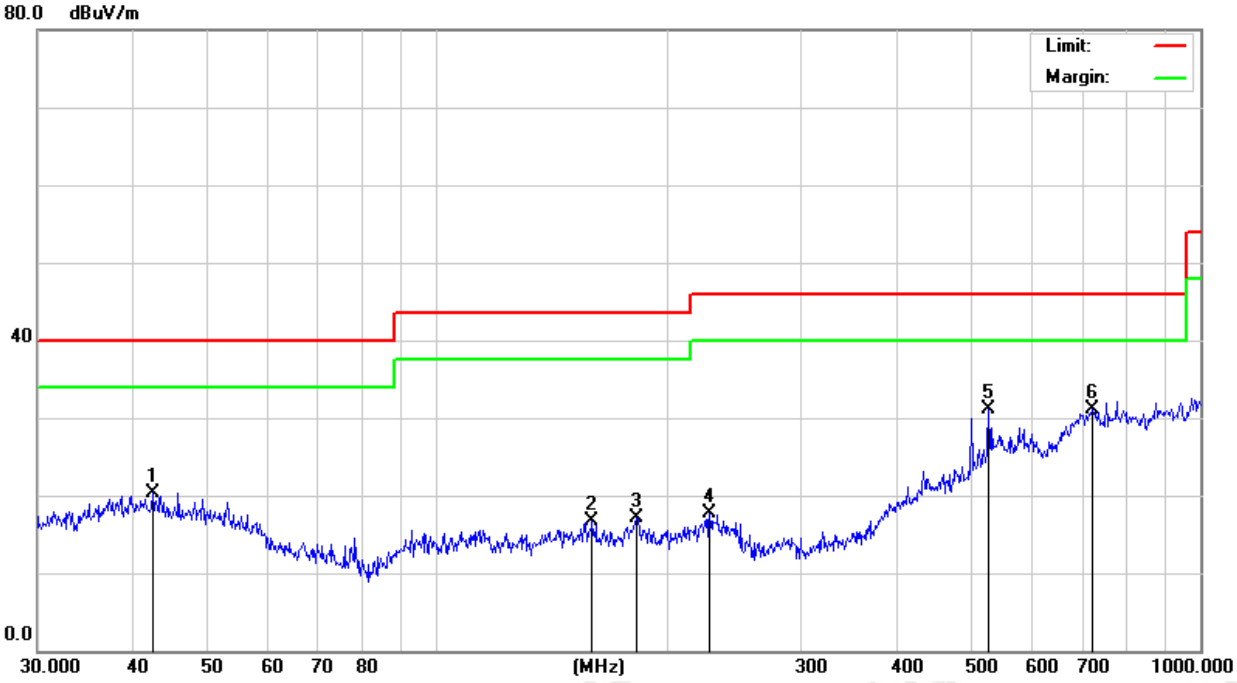
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Distance extrapolation factor =20 log (specific distance/test distance)(dB);

Limit line = specific limits(dBuv) + distance extrapolation factor

Below 1GHz Test Results:

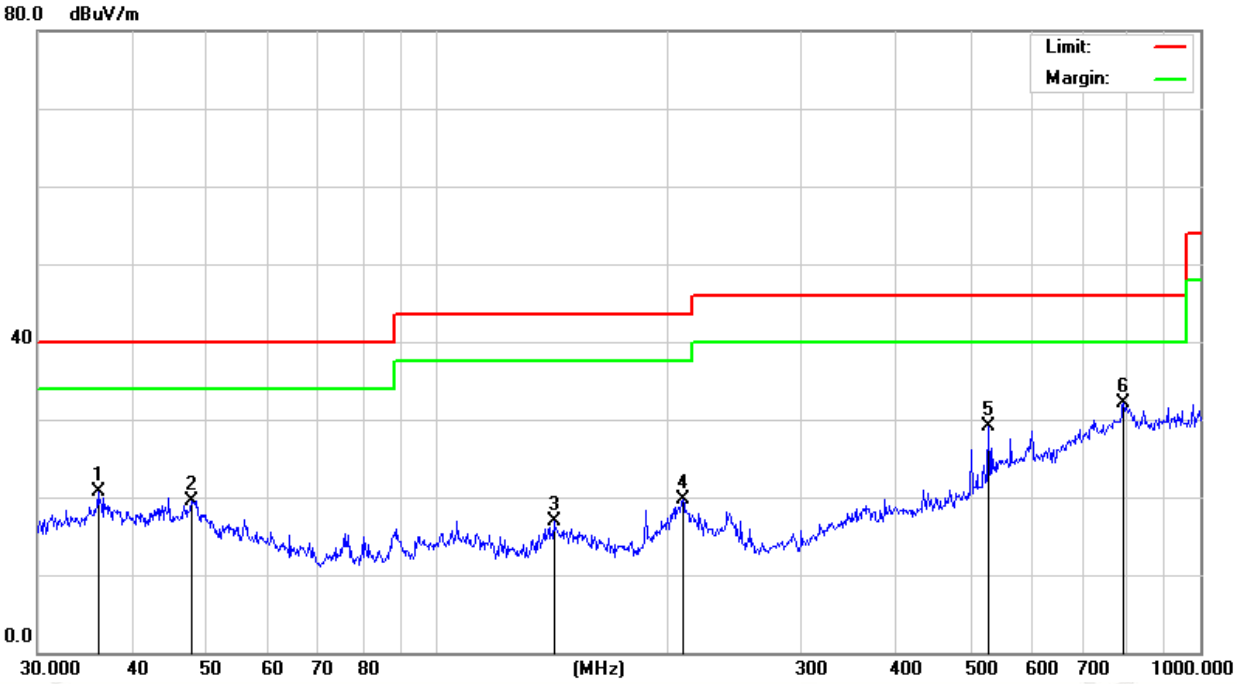
Temperature:	22℃	Relative Humidity:	48%
Test Date:	2021-04-22	Pressure:	1010hPa
Test Voltage:	DC3.0V	Polarization:	Horizontal
Test Mode:	TX (1Mbps) CH00 (worst case)		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		42.4508	22.18	-1.94	20.24	40.00	-19.76	peak
2		159.7844	23.25	-6.54	16.71	43.50	-26.79	peak
3		182.5592	22.38	-5.33	17.05	43.50	-26.45	peak
4		227.6906	24.17	-6.44	17.73	46.00	-28.27	peak
5	*	528.2458	27.36	3.83	31.19	46.00	-14.81	peak
6		721.7259	23.73	7.34	31.07	46.00	-14.93	peak

Remark: Absolute Level = Reading Level + Factor, Margin = Absolute Level – Limit
Factor = Ant. Factor + Cable Loss – Pre-amplifier

Temperature:	22℃	Relative Humidity:	48%
Test Date:	2021-04-22	Pressure:	1010hPa
Test Voltage:	DC3.0V	Polarization:	Vertical
Test Mode:	TX (1Mbps) CH00 (worst case)		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		36.0007	25.45	-4.67	20.78	40.00	-19.22	peak
2		47.6586	24.81	-5.34	19.47	40.00	-20.53	peak
3		142.3243	24.29	-7.39	16.90	43.50	-26.60	peak
4		210.0482	23.45	-3.75	19.70	43.50	-23.80	peak
5		528.2458	28.71	0.32	29.03	46.00	-16.97	peak
6	*	793.3960	24.32	7.69	32.01	46.00	-13.99	peak

Remark: Absolute Level = Reading Level + Factor, Margin = Absolute Level – Limit
Factor = Ant. Factor + Cable Loss – Pre-amplifier

Remark:

(1) Measuring frequencies from 9 KHz to the 1 GHz, Radiated emission test from 9KHz to 30MHz was verified, and no any emission was found except system noise floor.

(2) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.

(3) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.

Above 1 GHz Test Results:

EUT：	Indoor Exercise Bike	Model Name ：	KD5801
Temperature：	25 ℃	Test Data	2021-04-22
Pressure：	1010 hPa	Relative Humidity：	60%
Test Mode ：	1Mbps	Test Voltage ：	DC3.0V
Measurement Distance	3 m	Frenqucy Range	1GHz to 25GHz
RBW/VBW	1MHz/1MHz for Peak, 1MHz/10Hz for Average.		

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Remark	Comment
Low Channel (2402 MHz)-Above 1G							
4804.264	59.64	-3.64	56.00	74.00	-18.00	Pk	Vertical
4804.264	41.87	-3.64	38.23	54.00	-15.77	AV	Vertical
7206.117	54.74	-0.95	53.79	74.00	-20.21	Pk	Vertical
7206.117	38.94	-0.95	37.99	54.00	-16.01	AV	Vertical
4804.325	59.67	-3.64	56.03	74.00	-17.97	Pk	Horizontal
4804.325	43.66	-3.64	40.02	54.00	-13.98	AV	Horizontal
7206.157	56.85	-0.95	55.90	74.00	-18.10	Pk	Horizontal
7206.157	39.78	-0.95	38.83	54.00	-15.17	AV	Horizontal
Mid Channel (2441 MHz)-Above 1G							
4882.255	60.97	-3.68	57.29	74.00	-16.71	Pk	Vertical
4882.255	42.03	-3.68	38.35	54.00	-15.65	AV	Vertical
7323.192	58.33	-0.82	57.51	74.00	-16.49	Pk	Vertical
7323.192	42.68	-0.82	41.86	54.00	-12.14	AV	Vertical
4882.241	60.82	-3.68	57.14	74.00	-16.86	Pk	Horizontal
4882.241	42.11	-3.68	38.43	54.00	-15.57	AV	Horizontal
7323.147	58.69	-0.82	57.87	74.00	-16.13	Pk	Horizontal
7323.147	42.15	-0.82	41.33	54.00	-12.67	AV	Horizontal
High Channel (2480 MHz)- Above 1G							
4960.186	61.22	-3.59	57.63	74.00	-16.37	Pk	Vertical
4960.186	43.25	-3.59	39.66	54.00	-14.34	AV	Vertical
7440.199	55.57	-0.68	54.89	74.00	-19.11	Pk	Vertical
7440.199	40.26	-0.68	39.58	54.00	-14.42	AV	Vertical
4960.166	60.48	-3.59	56.89	74.00	-17.11	Pk	Horizontal
4960.166	42.49	-3.59	38.90	54.00	-15.10	AV	Horizontal
7440.245	55.64	-0.68	54.96	74.00	-19.04	Pk	Horizontal
7440.245	40.12	-0.68	39.44	54.00	-14.56	AV	Horizontal

Note: Mode 1Mbps is the worst mode.

Remark：
(1) Measuring frequencies from 1 GHz to the 25 GHz.
(2) “F” denotes fundamental frequency; “H” denotes spurious frequency. “E” denotes band edge frequency.
(3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
(4) Data of measurement within this frequency range shown “--- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
(5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for peak measurement with peak detector at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 10Hz for Average measurement with peak detection at frequency above 1GHz.
(6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.

5 BAND EDGE

5.1 Limits

FCC PART 15.247 Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

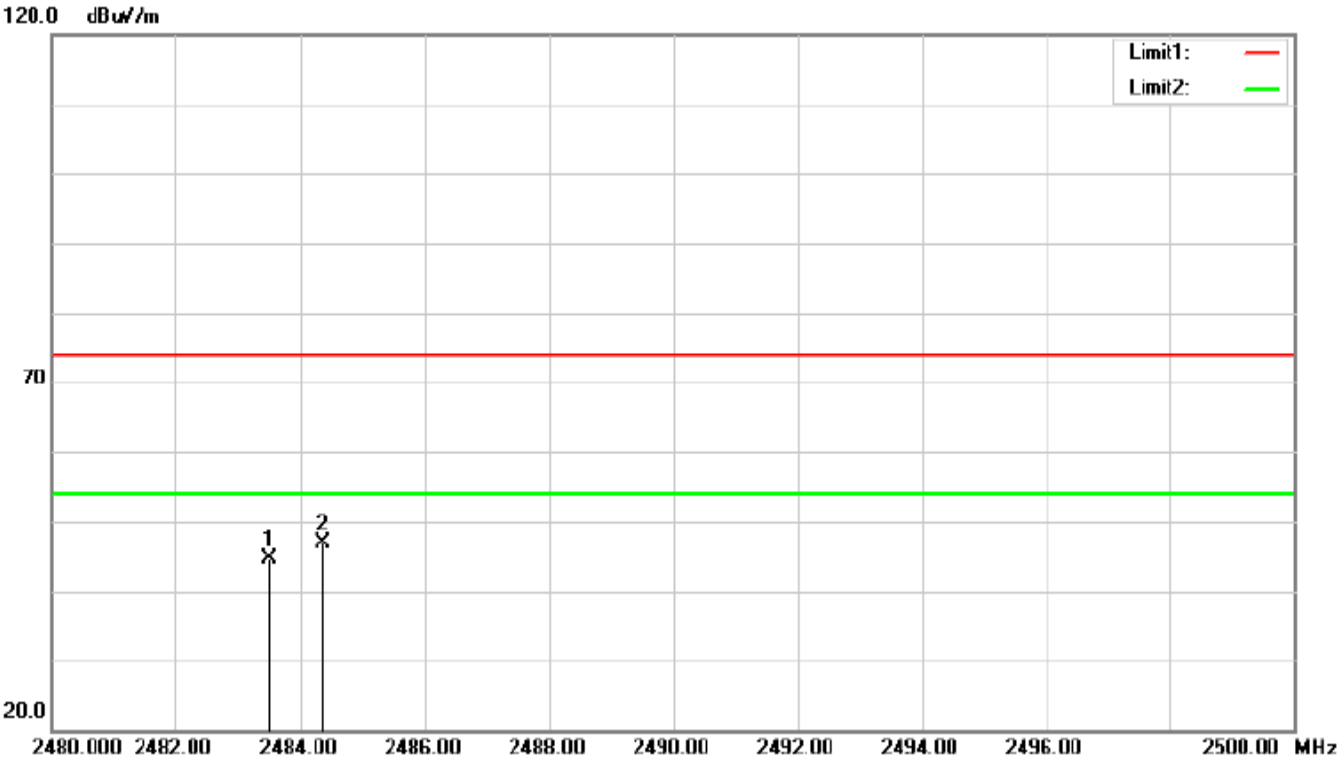
5.2 Test Procedure

The band edge compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW to 100KHz and VBM to 300KHz to measure the peak field strength and set RBW to 1MHz and VBW to 10Hz to measure the average radiated field strength. The conducted RF band edge was measured by using a spectrum analyzer. Set span wide enough to capture the highest in-band emission and the emission at the band edge. Set RBW to 100 KHz and VBW to 300 KHz, to measure the conducted peak band edge.

5.3 Test Result

Operation Mode: TX 1Mbps Mode(Worst case)

Vertical

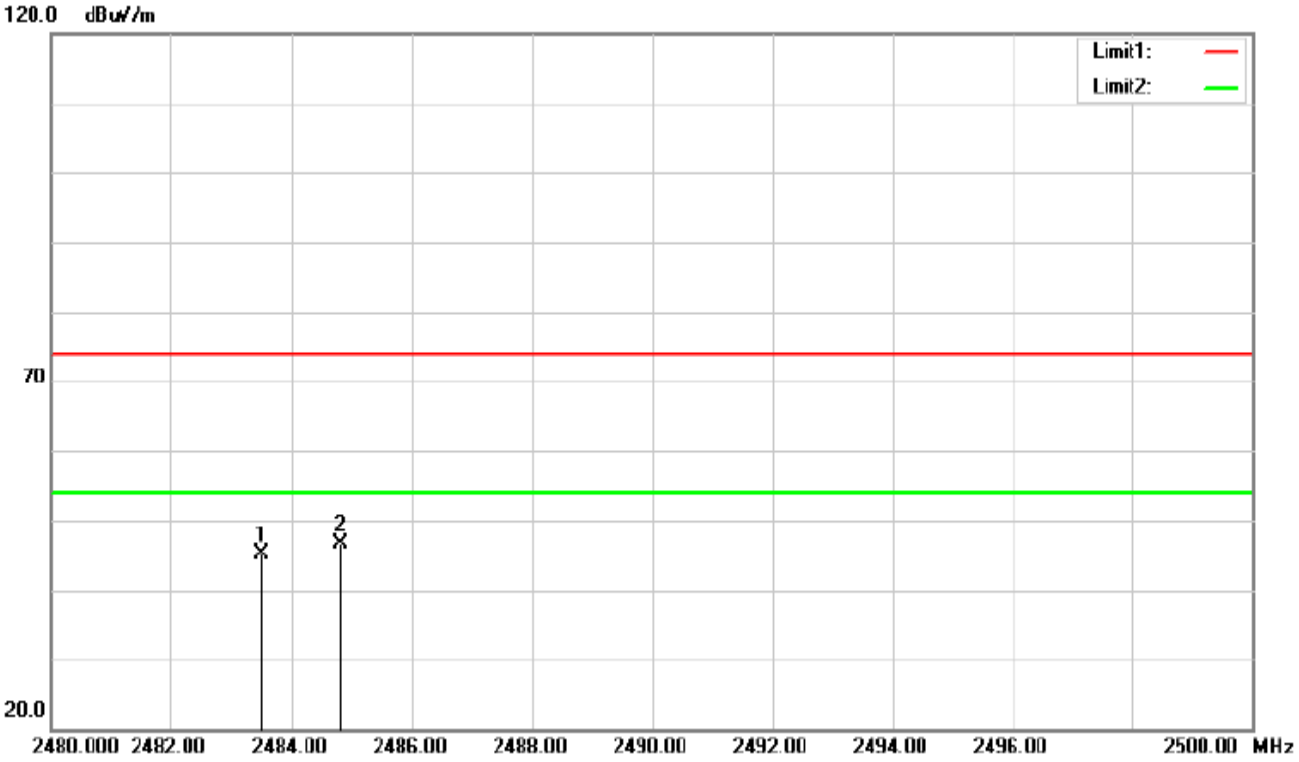


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	55.33	-10.65	44.68	74.00	-29.32	peak
2	2484.360	57.47	-10.65	46.82	74.00	-27.18	peak

Note:1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) − Pre-Amplifier gain (dB).

Horizontal

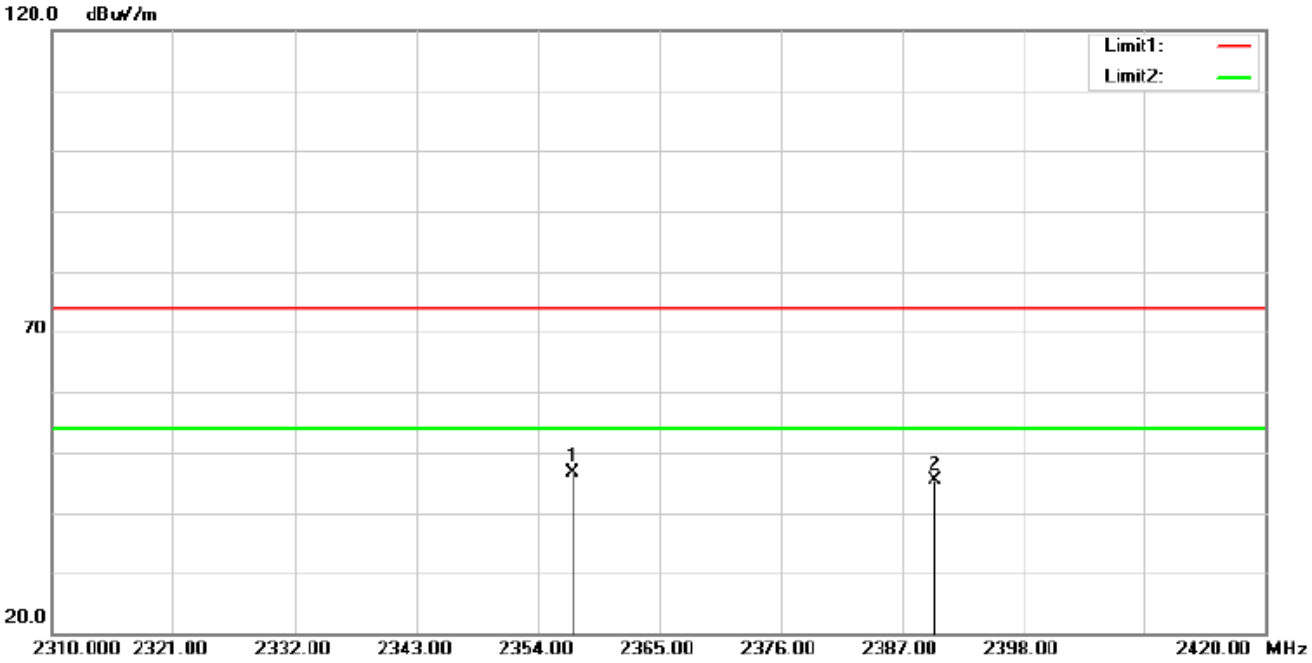


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	55.68	-10.65	45.03	74.00	-28.97	peak
2	2484.800	57.25	-10.65	46.60	74.00	-27.40	peak

Note:1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) − Pre-Amplifier gain (dB).

Horizontal

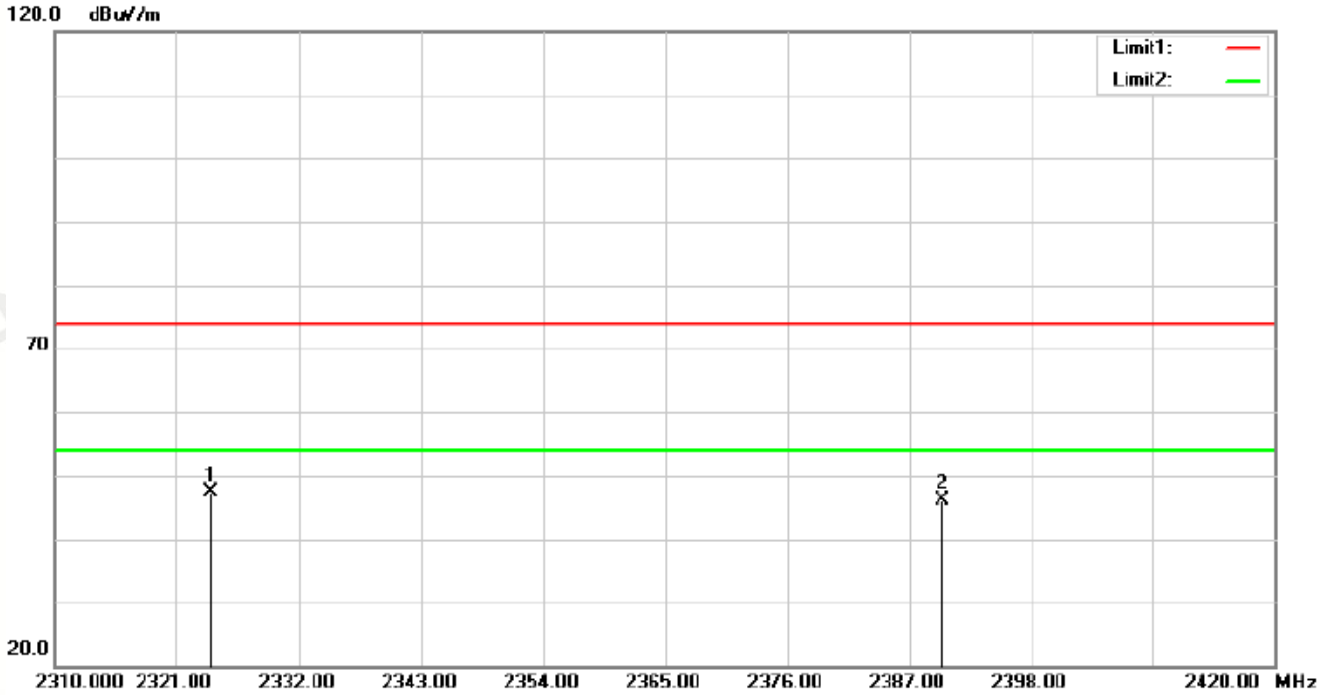


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2357.190	57.45	-10.91	46.54	74.00	-27.46	peak
2	2390.000	56.20	-10.85	45.35	74.00	-28.65	peak

Note:1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) - Pre-Amplifier gain (dB).

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2324.080	58.26	-10.98	47.28	74.00	-26.72	peak
2	2390.000	56.97	-10.85	46.12	74.00	-27.88	peak

Note:1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) − Pre-Amplifier gain (dB).

6 OCCUPIED BANDWIDTH MEASUREMENT

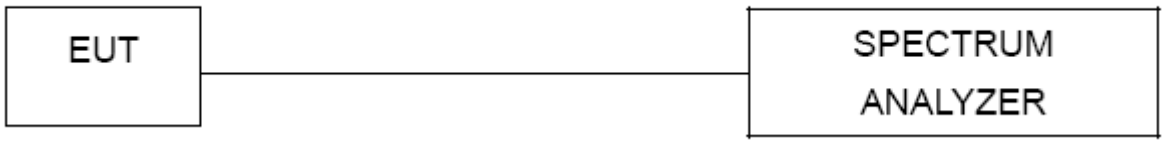
6.1 Test Limit

FCC Part15(15.247), Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(1)	Bandwidth	N	2400-2483.5	PASS

6.2 Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
2. Spectrum Setting: RBW= 30KHz, VBW=100KHz, Sweep time = Auto, Span=3MHz.

6.3 TEST SETUP



6.4 Test Result

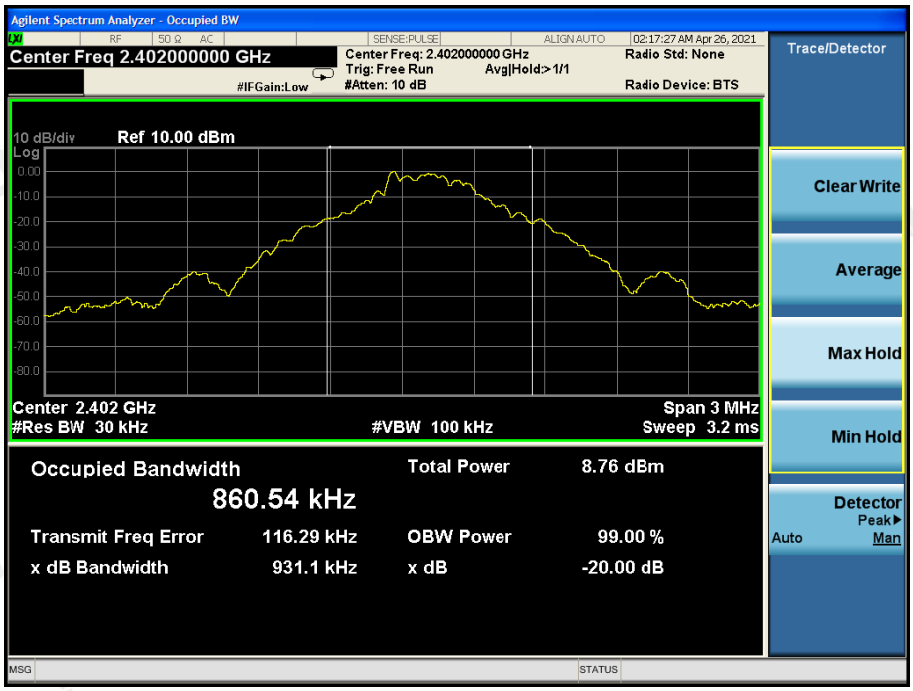
PASS

Mode	Freq (MHz)	20dB (MHz)	99%OBW (MHz)	Conclusion
GFSK	2402	0.931	--	PASS
	2441	0.928	--	PASS
	2480	0.931	--	PASS

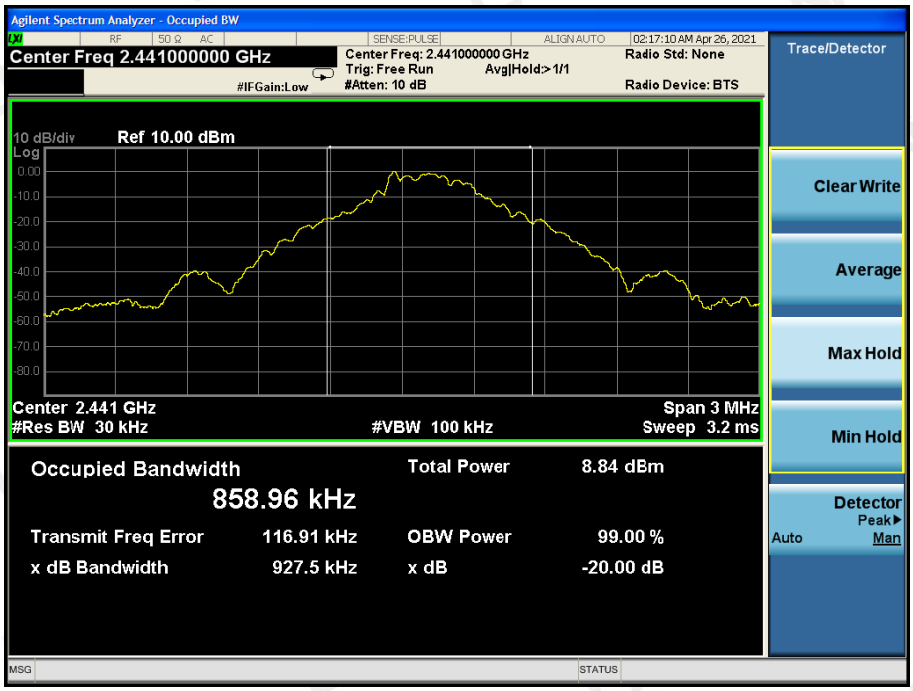
Mode	Freq (MHz)	20dB (MHz)	99%OBW (MHz)	Conclusion
π/4-DQPSK	2402	1.222	--	PASS
	2441	1.222	--	PASS
	2480	1.219	--	PASS

Mode	Freq (MHz)	20dB (MHz)	99%OBW (MHz)	Conclusion
8DPSK	2402	1.214	--	PASS
	2441	1.209	--	PASS
	2480	1.213	--	PASS

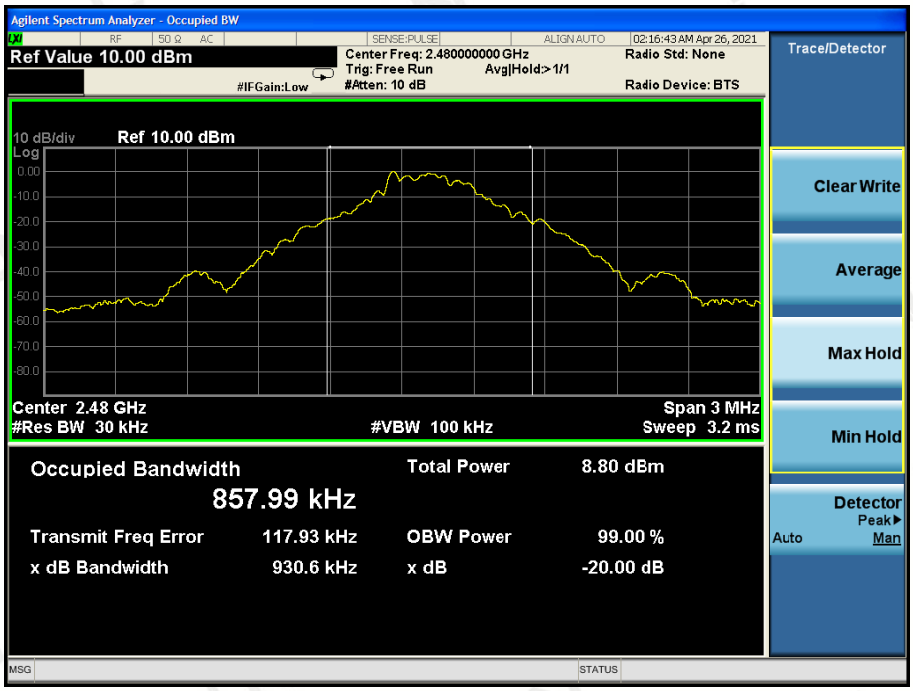
CH: 2402MHz



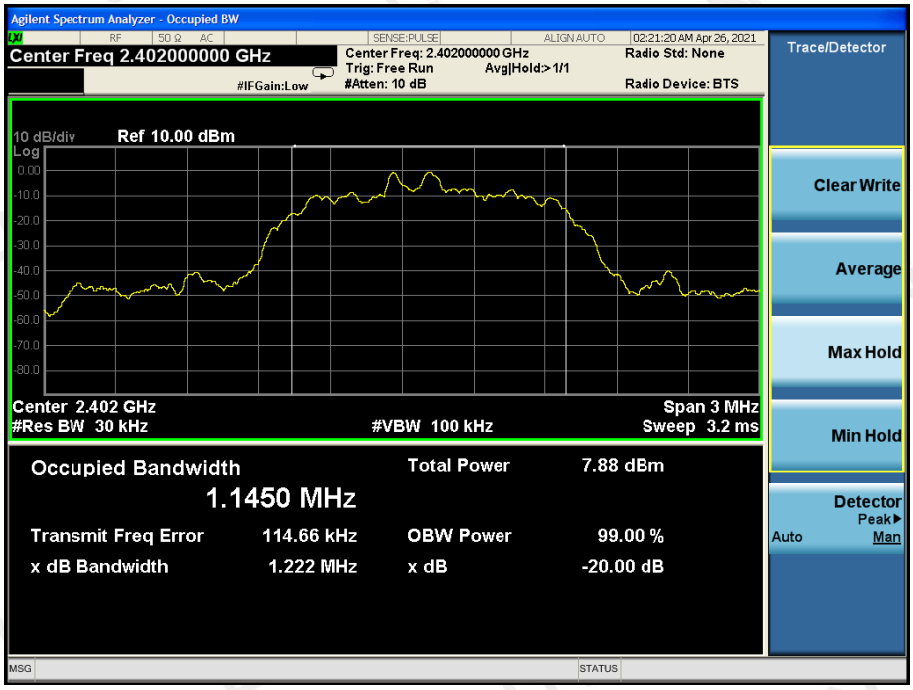
GFSK 2441 MHz



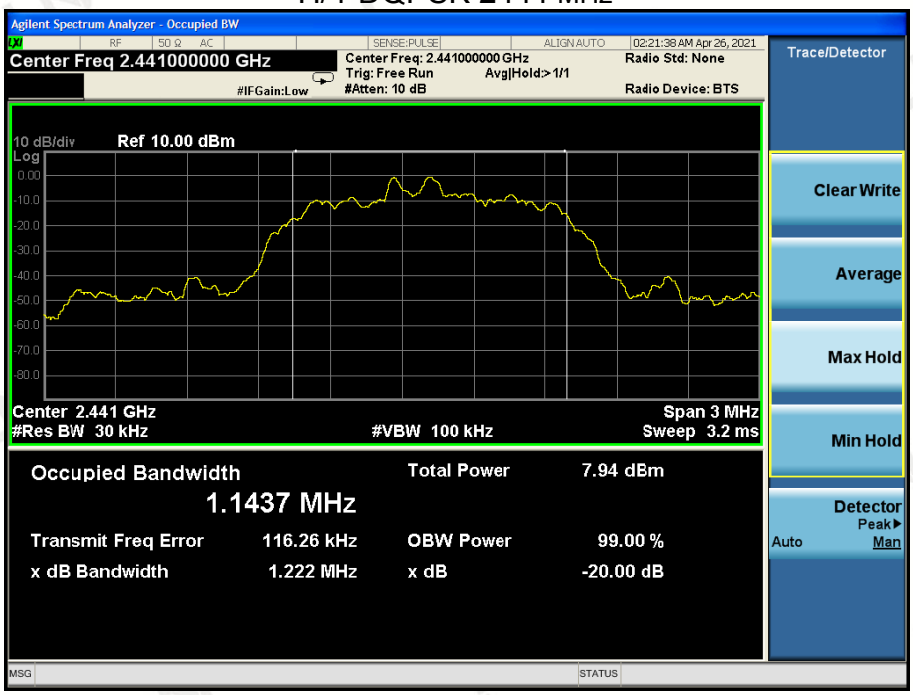
GFSK 2480 MHz



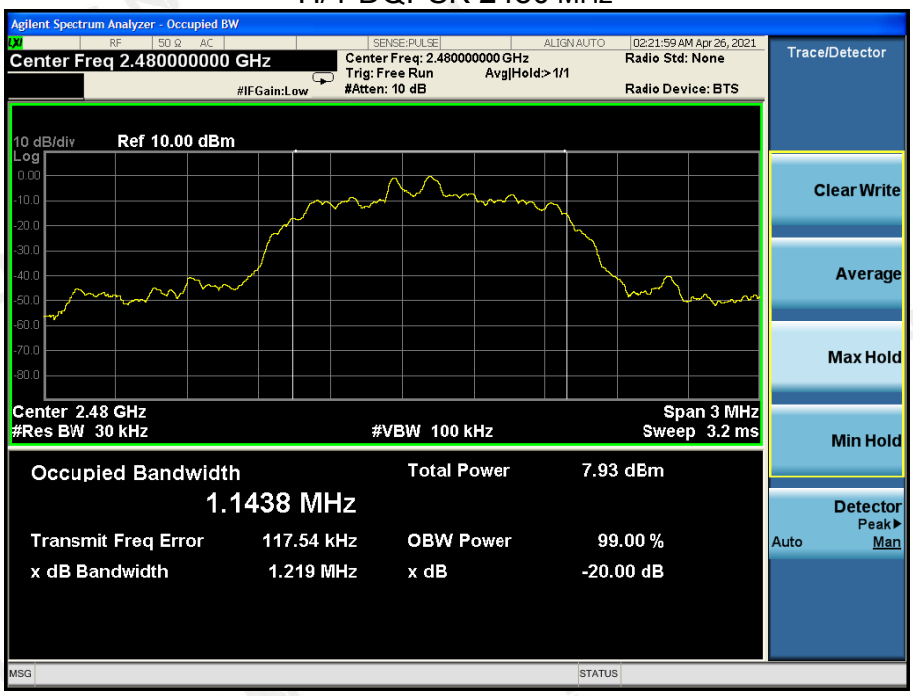
П/4-DQPSK 2402 MHz



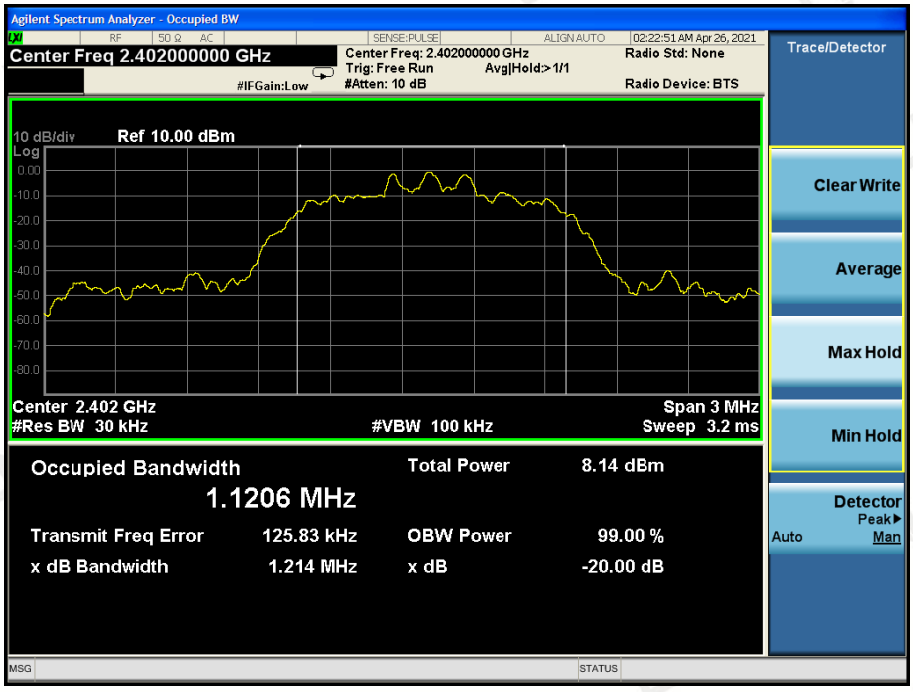
П/4-DQPSK 2441 MHz



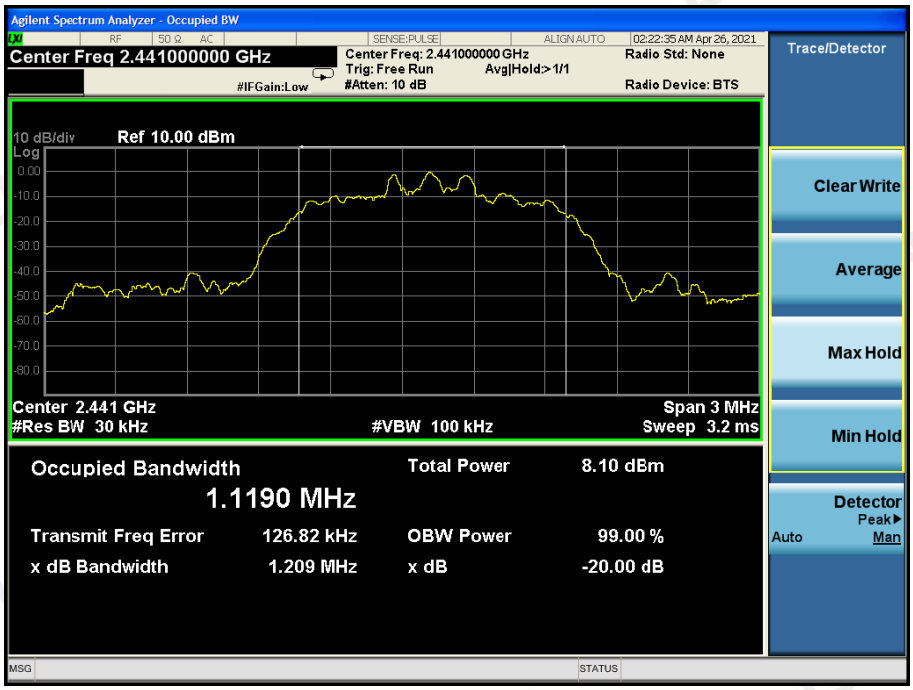
П/4-DQPSK 2480 MHz



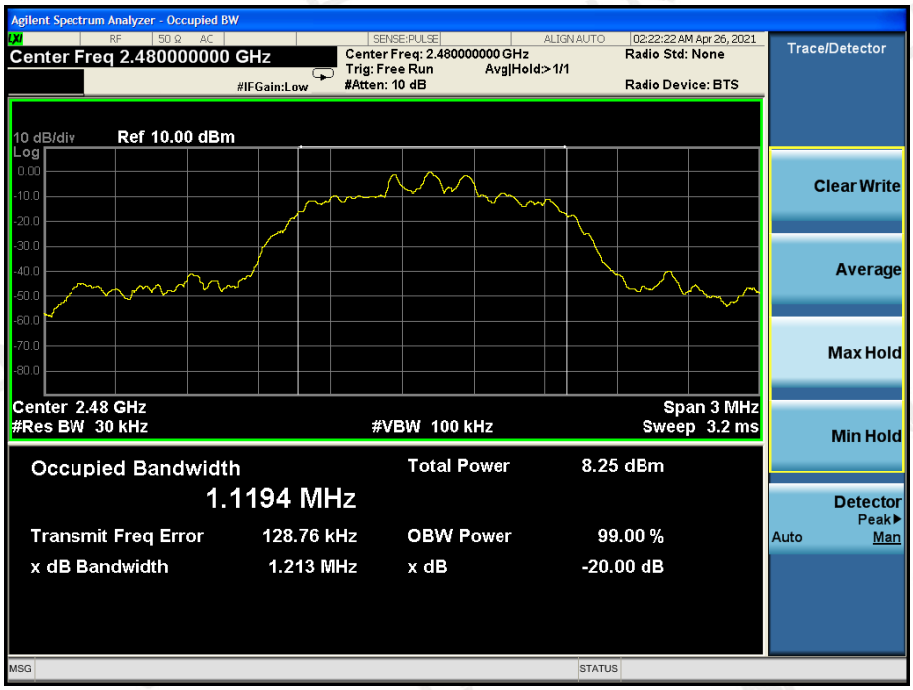
8DPSK 2402 MHz



8DPSK 2441 MHz



8DPSK 2480 MHz



7 CARRIER FREQUENCY SEPARATION TEST

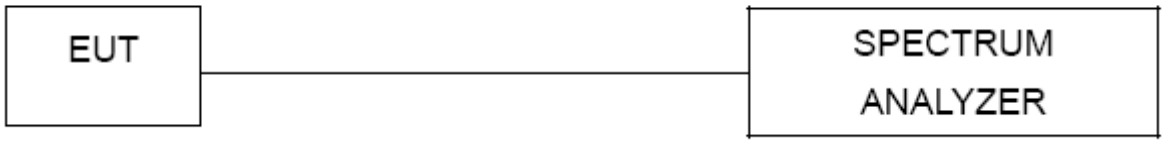
7.1 Test Limit

Section 15.247(a)(1): 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. Alternatively, 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 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudorandomly 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.

7.2 Test Procedure

1. The transmitter output (antenna port) was connected to the spectrum analyser in peak hold mode.
2. The resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilised for 20 dB bandwidth measurement.
3. The resolution bandwidth of 100 kHz and the video bandwidth of 300 kHz were utilised for channel separation measurement.

7.3 TEST SETUP



7.4 Test Result

PASS

GFSK

Channel	Frequency (MHz)	Channel Separation(MHz)	Limit (MHz)	Result
Low	2402	1.002	>(25KHz or 2/3*20dB Bandwidth)	PASS
Middle	2441	1.002	>(25KHz or 2/3*20dB Bandwidth)	PASS
High	2479	0.996	>(25KHz or 2/3*20dB Bandwidth)	PASS

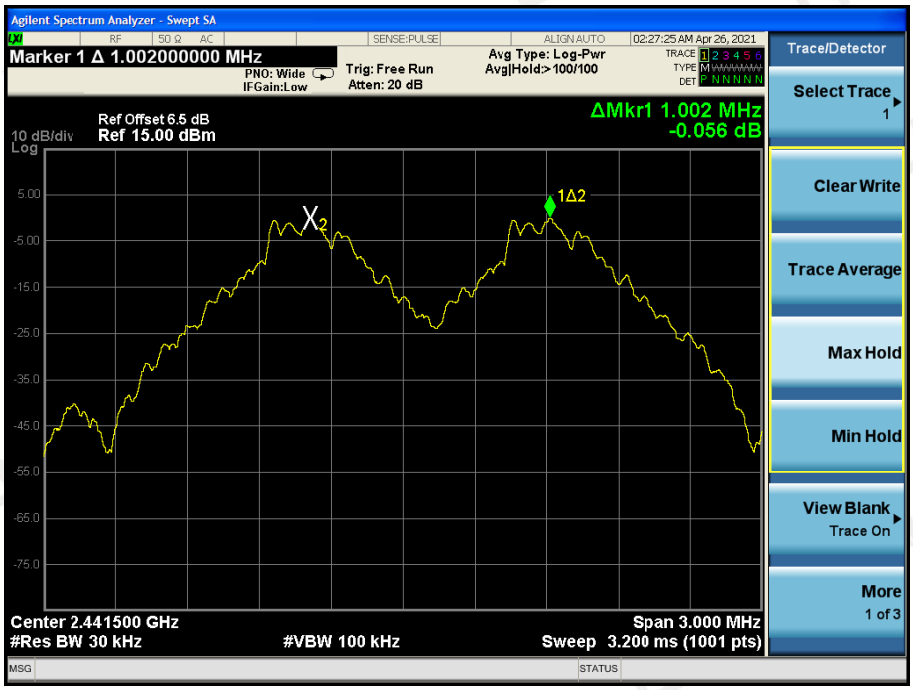
8DPSK

Channel	Frequency (MHz)	Channel Separation(MHz)	Limit (MHz)	Result
Low	2402	0.999	>(25KHz or 2/3*20dB Bandwidth)	PASS
Middle	2441	1.002	>(25KHz or 2/3*20dB Bandwidth)	PASS
High	2479	1.002	>(25KHz or 2/3*20dB Bandwidth)	PASS

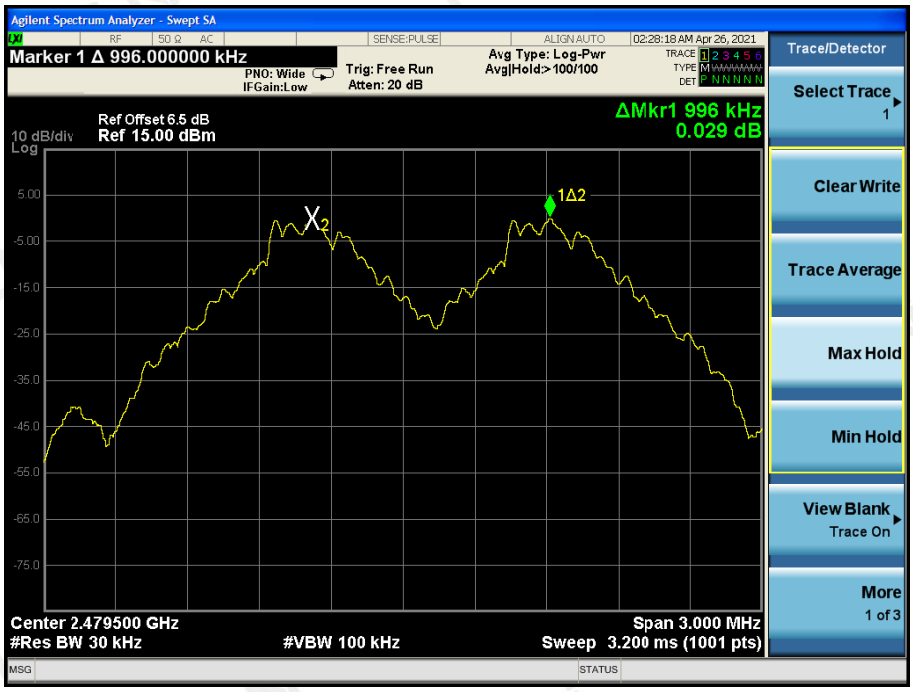
The spectrum analyzer plots are attached as below.

GFSK 2402MHZ

GFSK 2441MHZ



GFSK 2480MHZ



8DPSK 2402MHZ

8DPSK 2441MHZ

8DPSK 2480MHZ

8 PEAK OUTPUT POWER TEST

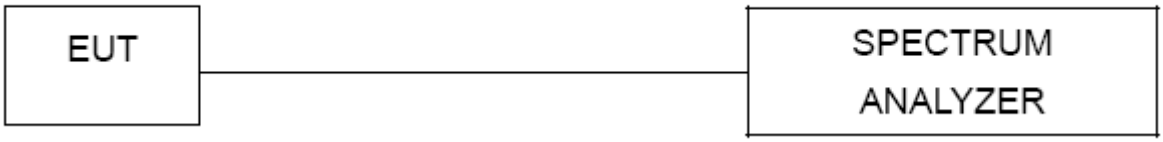
8.1 Test Limit

FCC Part15(15.247), Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(3)	Peak Output Power	1 watt or 30dBm	2400-2483.5	PASS

8.2 Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
2. Spectrum Setting : RBW=1 MHz /3MHz, VBW= 3 MHz /8MHz, Sweep time = Auto.

8.3 TEST SETUP

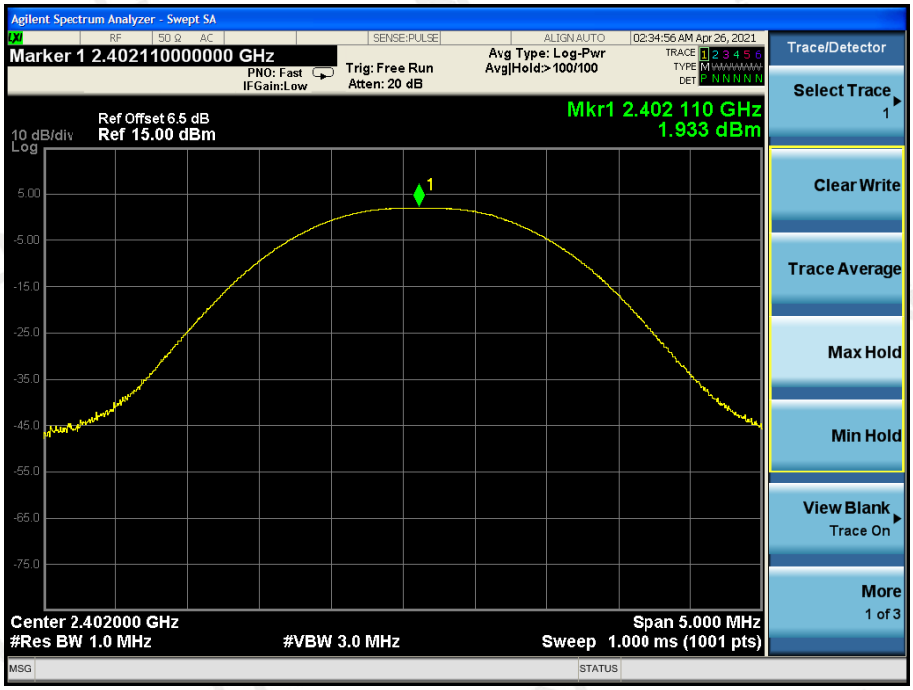


8.4 Test Result

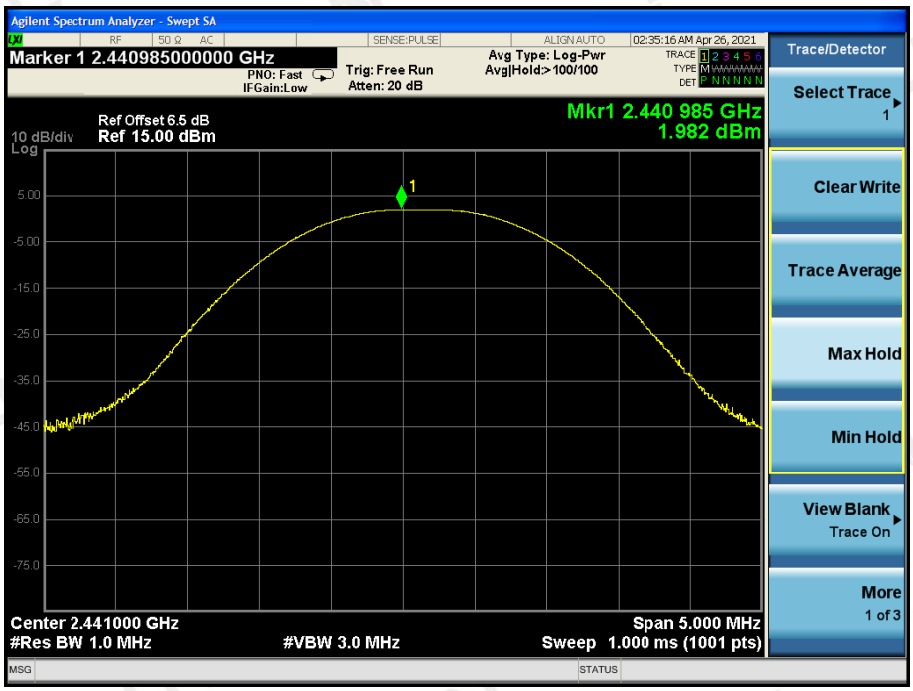
All the test modes completed for test.

EUT Set Mode	Data Rate (Mbp/s)	Frequency (MHz)	Result(dBm) Peak
GFSK	1	2402	1.933
		2441	1.982
		2480	1.949
π/4-DQPSK	2	2402	1.966
		2441	2.017
		2480	1.986
8DPSK	3	2402	2.269
		2441	2.315
		2480	2.299
Limit: 21dBm		Conclusion: PASS	

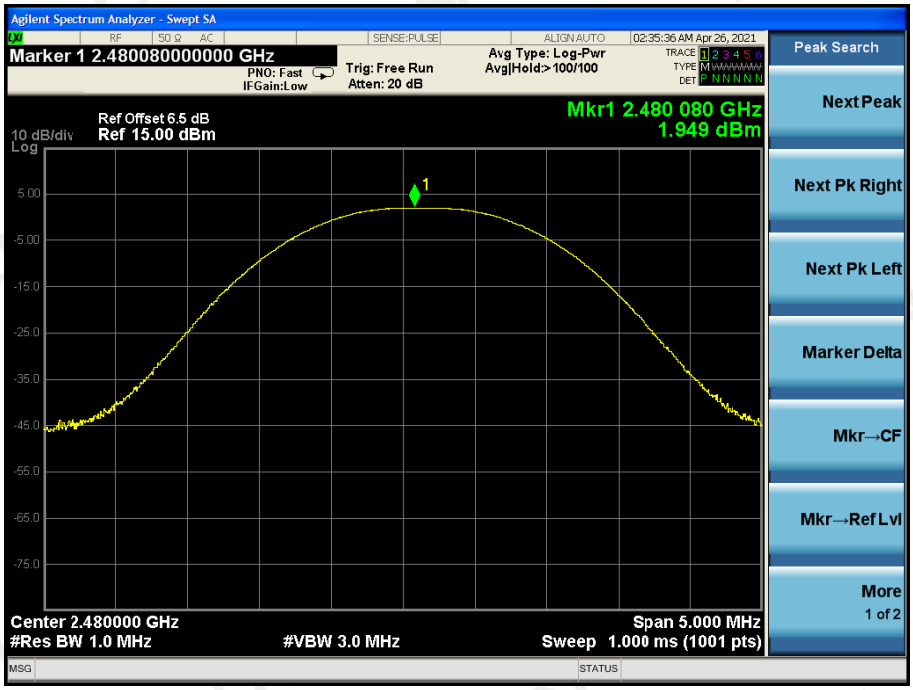
GFSK 2402MHz



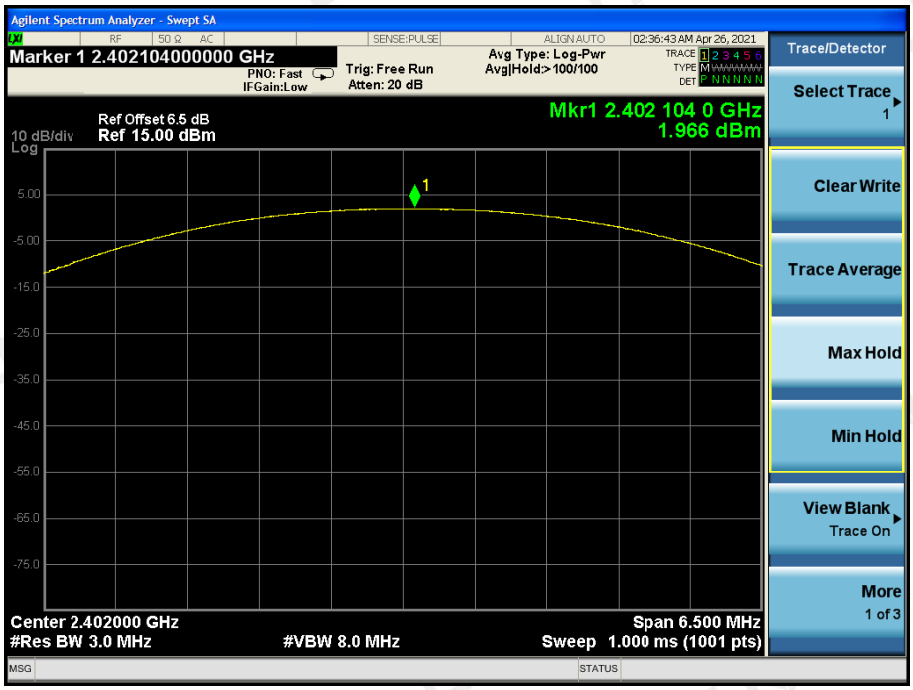
GFSK 2441MHz



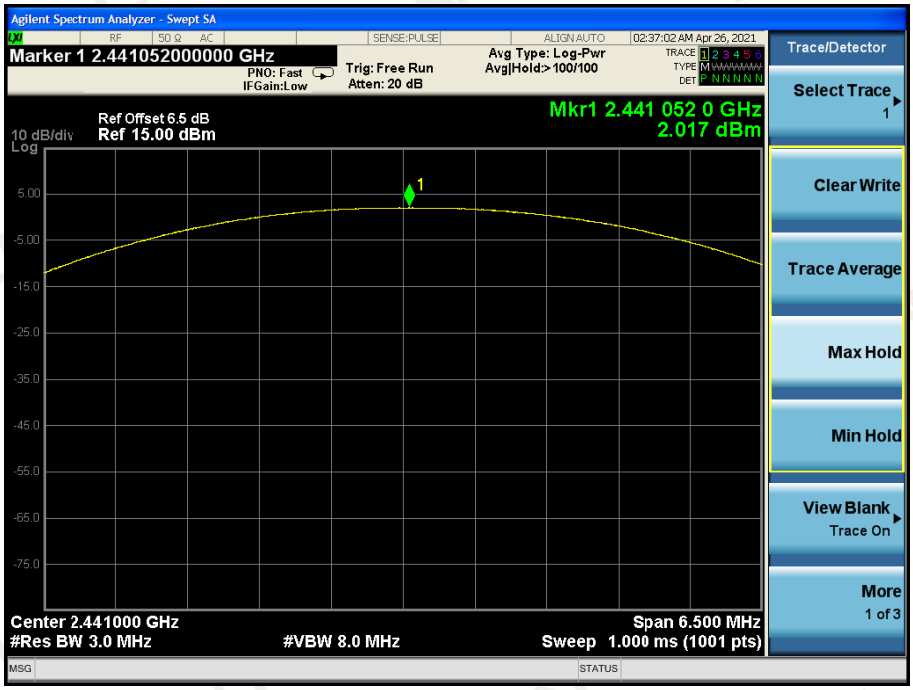
GFSK 2480MHz



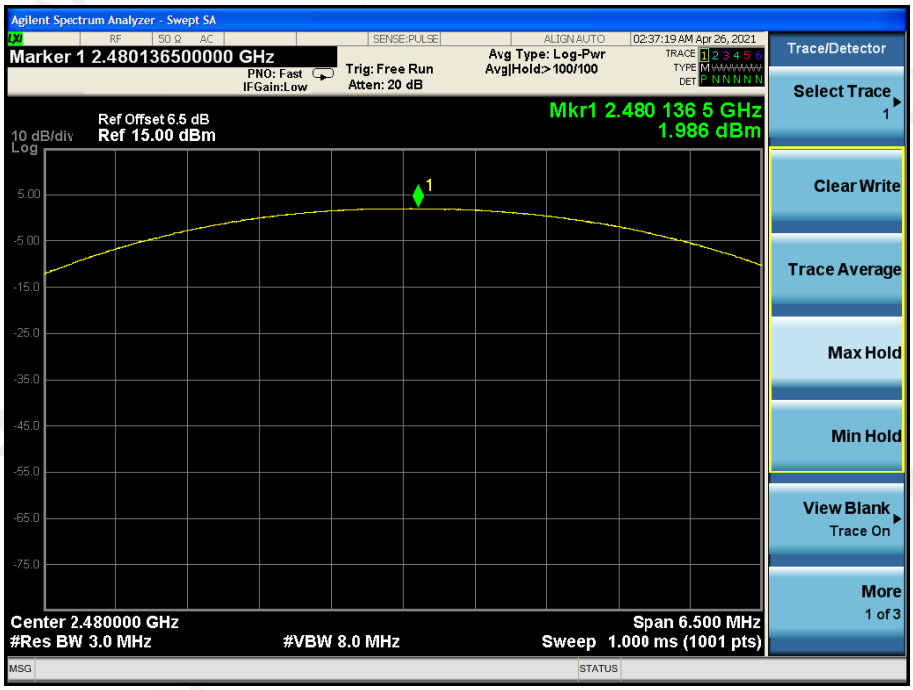
π/4-DQPSK 2402MHz



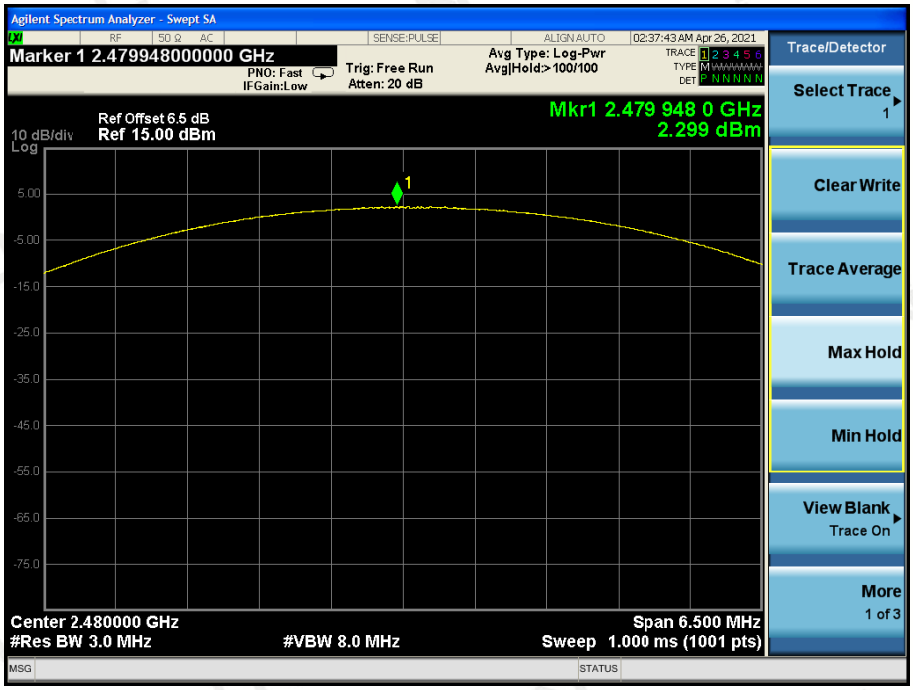
π/4-DQPSK 2441MHz



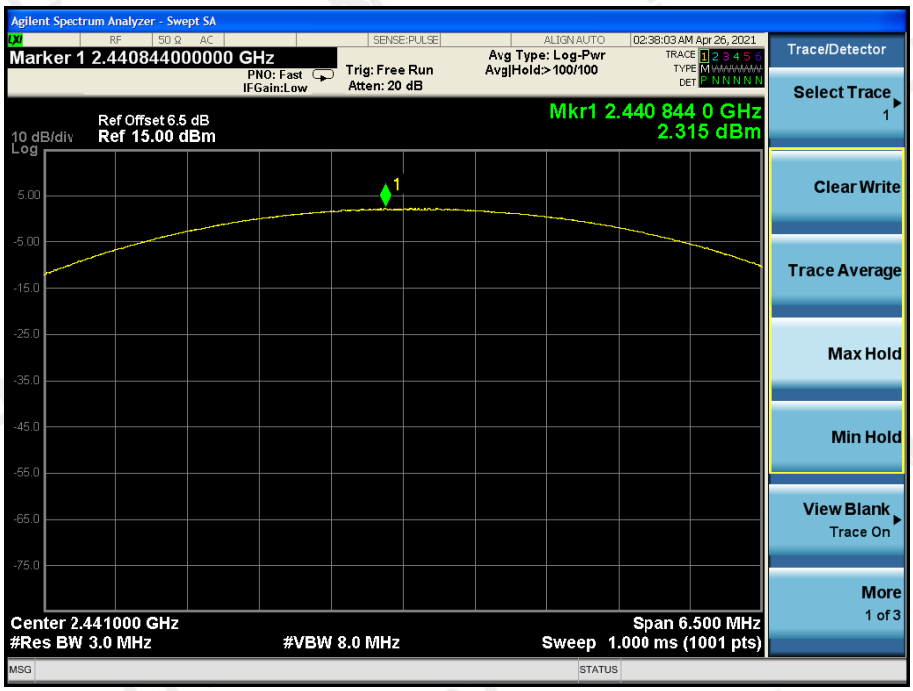
π/4-DQPSK 2480MHz



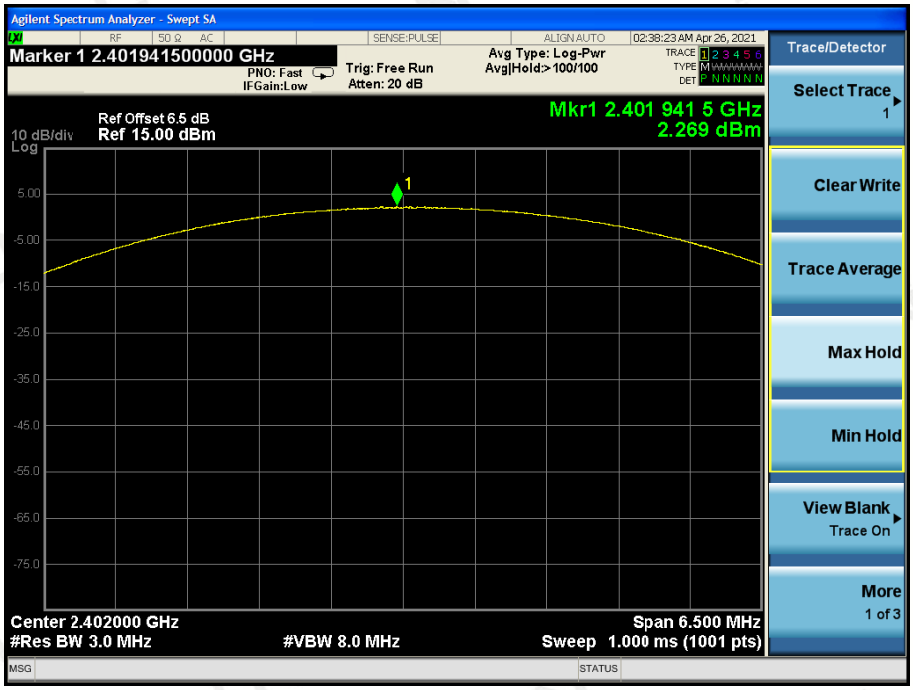
8DPSK 2402MHz



8DPSK 2441MHz



8DPSK 2480MHz



9 NUMBER OF HOPPING FREQUENCY TEST

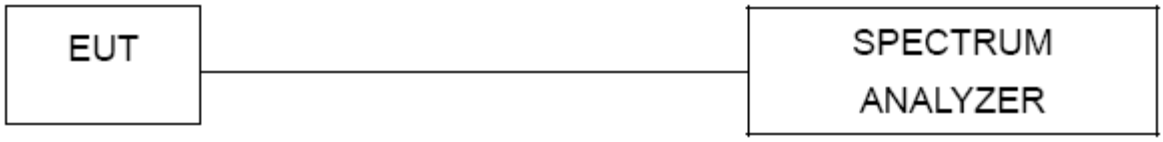
9.1 Test Limit

Section 15.247(a)(1)(iii): Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

9.2 Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
2. Spectrum Setting : RBW= 300KHz, VBW=1 MHz, Sweep time = Auto.

9.3 Test Setup



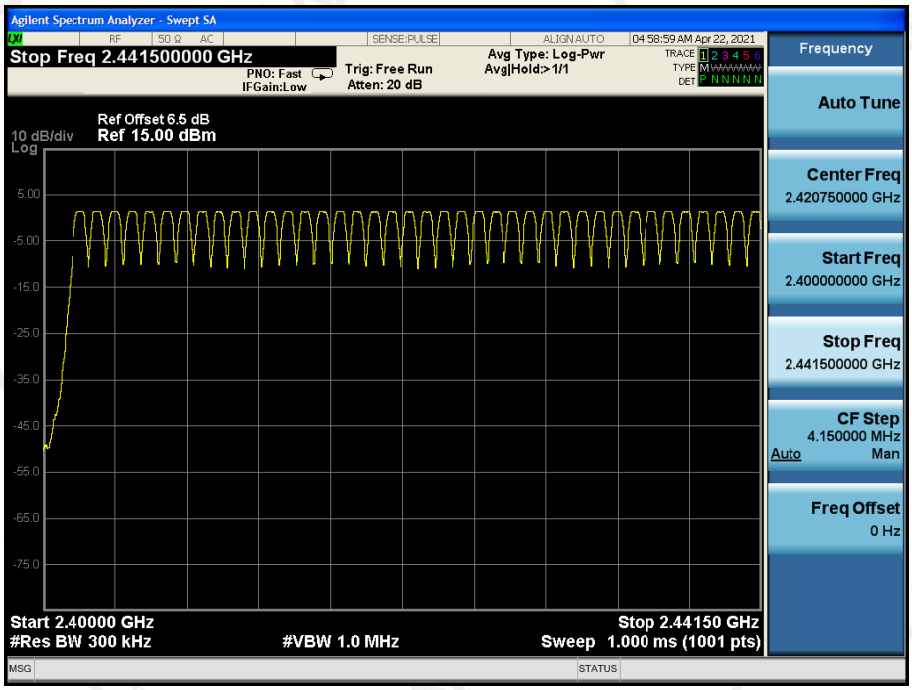
9.4 Test Result

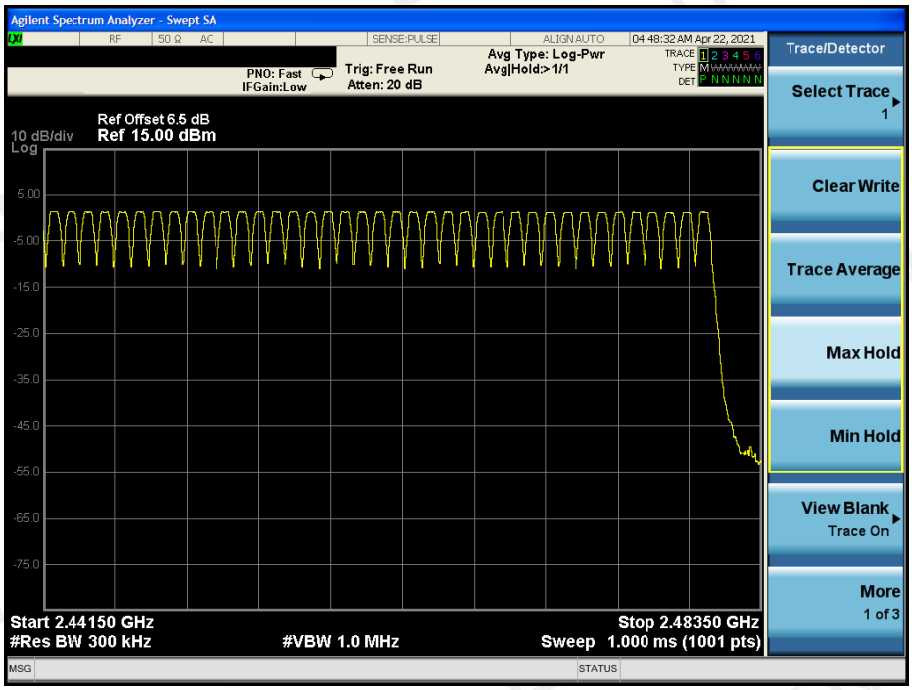
PASS

Total number of hopping channel	Measurement result(CH)	Limit(CH)
	79	≥15

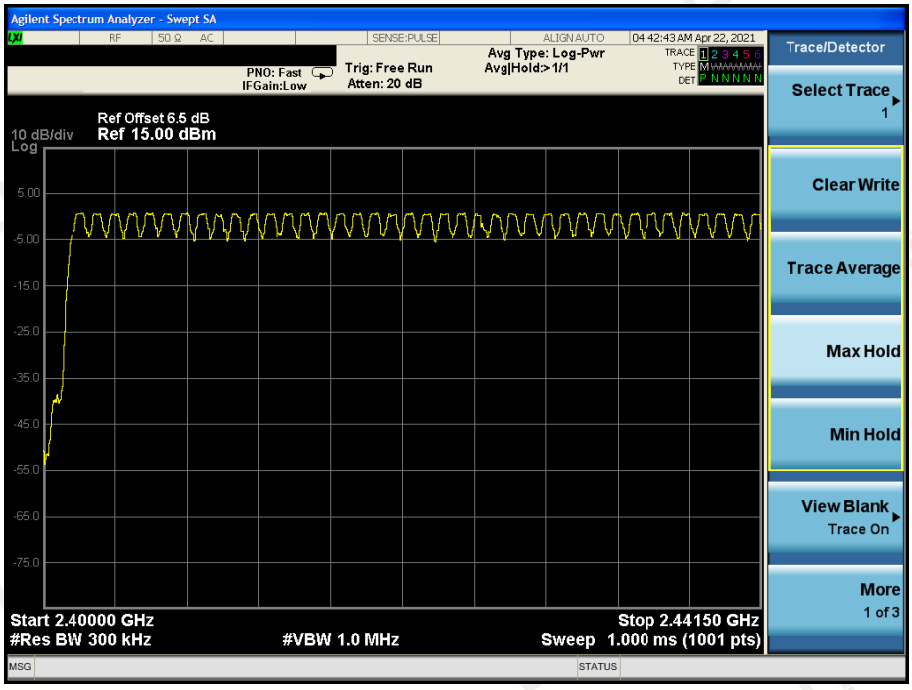
The spectrum analyzer plots are attached as below
GFSK

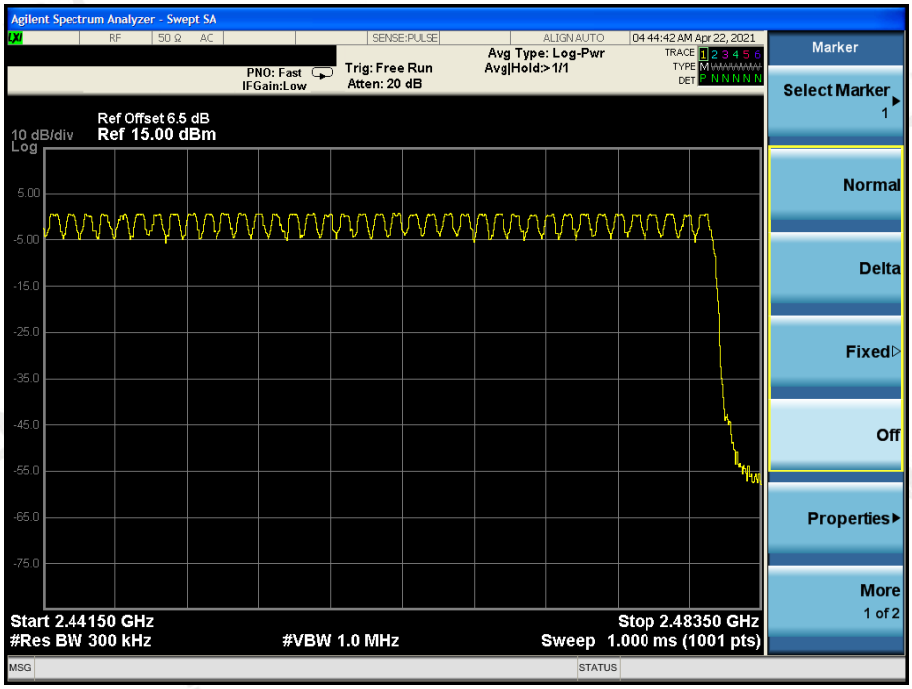
Number of hopping channels





8DPSK


Agilent Spectrum Analyzer - Swept SA
RF 50 Ω AC
SENSE:PULSE
ALIGN AUTO
04:42:43 AM Apr 22, 2021
Avg Type: Log-Pwr
Avg|Hold:>1/1
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Ref Offset 6.5 dB
10 dB/div
Log
Ref 15.00 dBm
5.00
-5.00
-15.0
-25.0
-35.0
-45.0
-55.0
-65.0
-75.0
Start 2.40000 GHz
#Res BW 300 kHz
#VBW 1.0 MHz
Stop 2.44150 GHz
Sweep 1.000 ms (1001 pts)
MSG
STATUS
Trace/Detector
Select Trace 1
Clear Write
Trace Average
Max Hold
Min Hold
View Blank Trace On
More 1 of 3


Agilent Spectrum Analyzer - Swept SA
RF 50 Ω AC
SENSE:PULSE
ALIGN AUTO
04:44:42 AM Apr 22, 2021
Avg Type: Log-Pwr
Avg|Hold:>1/1
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Ref Offset 6.5 dB
10 dB/div
Log
Ref 15.00 dBm
5.00
-5.00
-15.0
-25.0
-35.0
-45.0
-55.0
-65.0
-75.0
Start 2.44150 GHz
#Res BW 300 kHz
#VBW 1.0 MHz
Stop 2.48350 GHz
Sweep 1.000 ms (1001 pts)
MSG
STATUS
Marker
Select Marker 1
Normal
Delta
Fixed
Off
Properties
More 1 of 2

10 DWELL TIME TEST

10.1 Test Limit

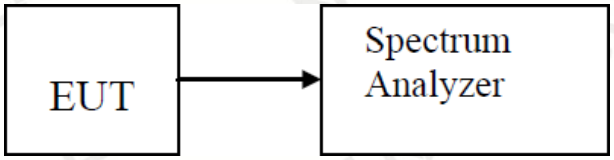
Section 15.247(a)(1)(iii): Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

10.2 Test Procedure

1. The transmitter output (antenna port) was connected to the spectrum analyzer
2. Set RBW of spectrum analyzer to 1MHz and VBW to 1MHz.
3. Use a video trigger with the trigger level set to enable triggering only on full pulses.
4. Sweep Time is more than once pulse time.
5. Set the center frequency on any frequency would be measure and set the frequency span to zero span.
6. Measure the maximum time duration of one single pulse.
7. Set the EUT for DH5, DH3 and DH1 packet transmitting.
8. Measure the maximum time duration of one single pulse.

DH1 Time Slot: Reading * (1600/2)*31.6/(channel number)
DH3 Time Slot: Reading * (1600/4)*31.6/(channel number)
DH5 Time Slot: Reading * (1600/6)*31.6/(channel number)

10.3 Test Setup



10.4 Test Result

PASS

GFSK

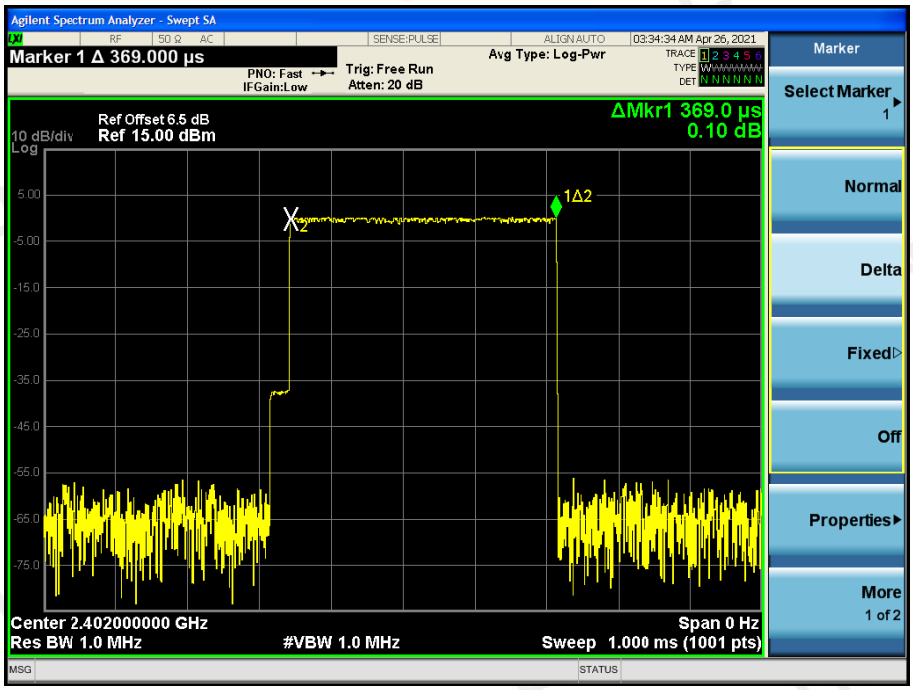
Mode	Channel Frequency (MHz)	Pulse Time (ms)	Dwell Time (ms)	Limit (ms)
DH1	2402	0.369	118.400	400
DH3	2402	1.616	260.000	400
DH5	2402	2.865	306.240	400

8DPSK

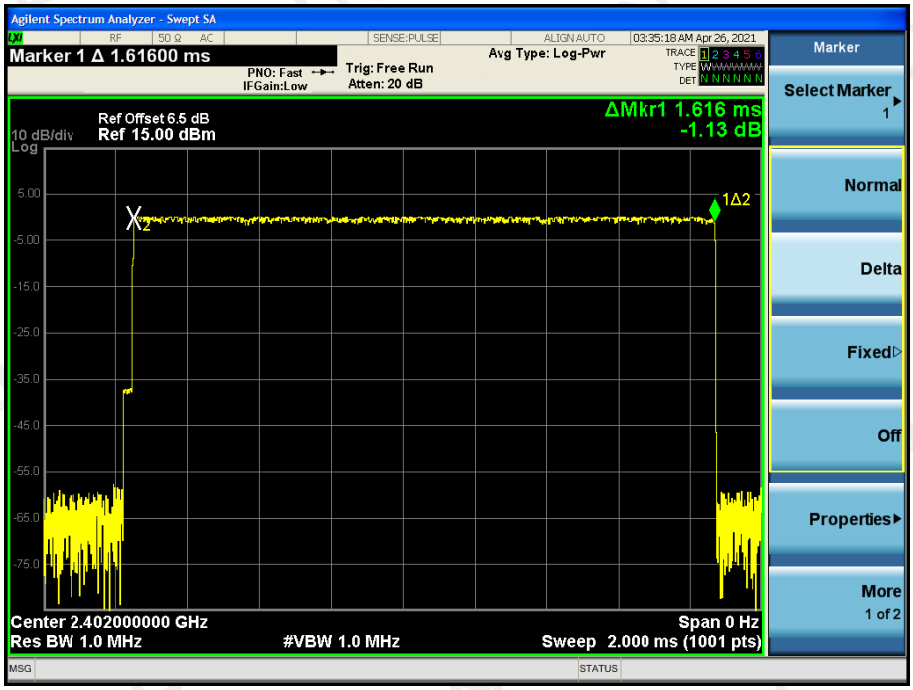
Mode	Channel Frequency (MHz)	Pulse Time (ms)	Dwell Time (ms)	Limit (ms)
DH1	2402	0.378	123.840	400
DH3	2402	1.626	262.080	400
DH5	2402	2.880	308.160	400

The spectrum analyzer plots are attached as below:

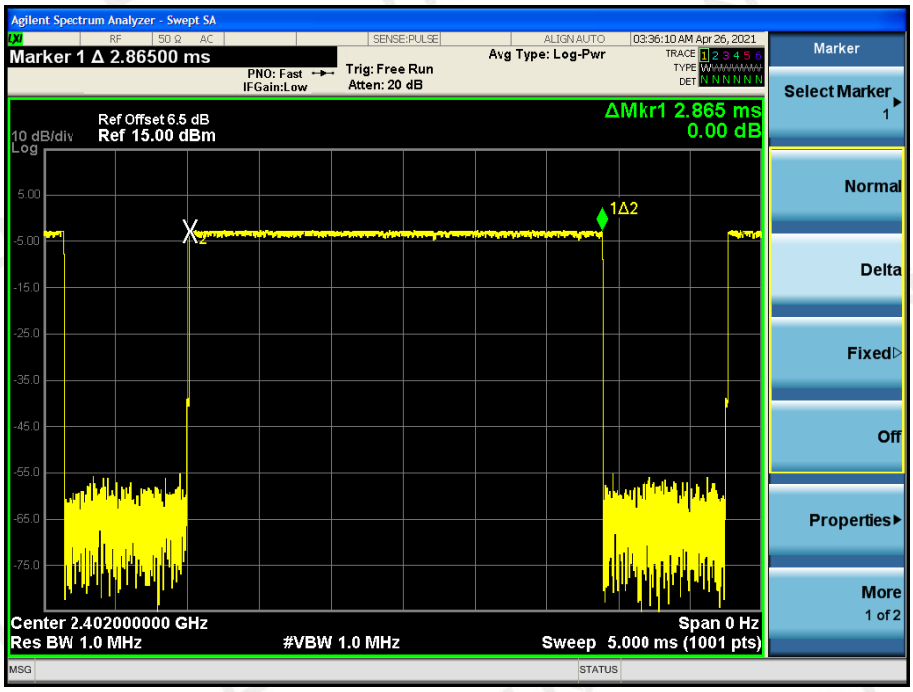
GFSK DH1



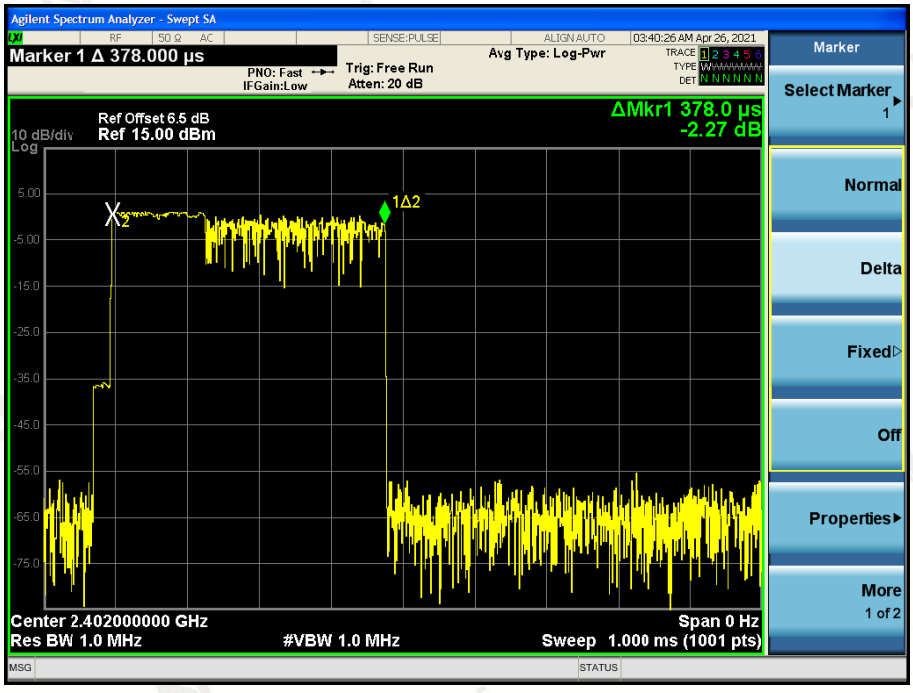
GFSK DH3



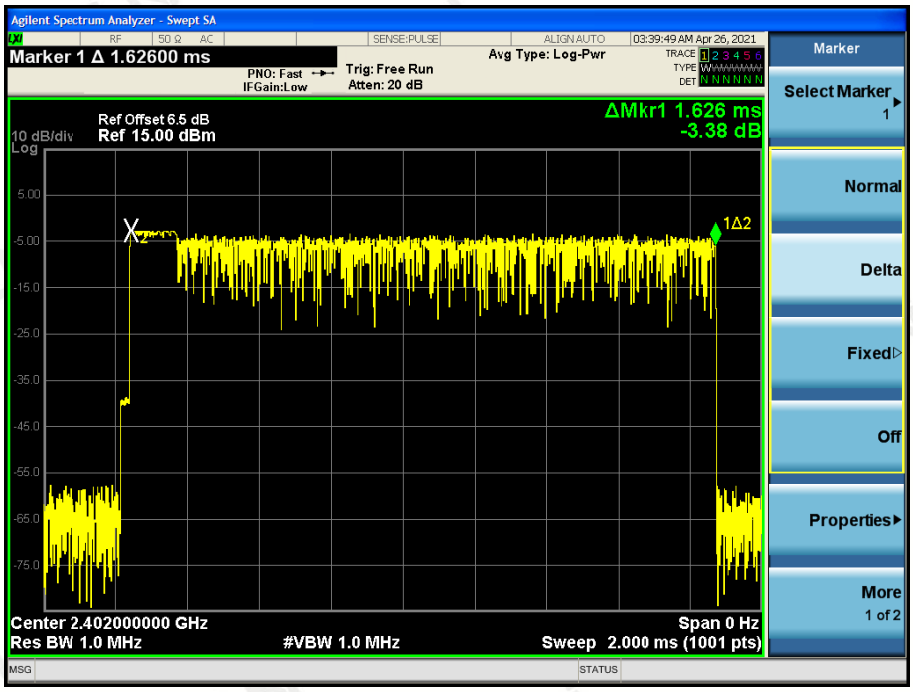
GFSK DH5



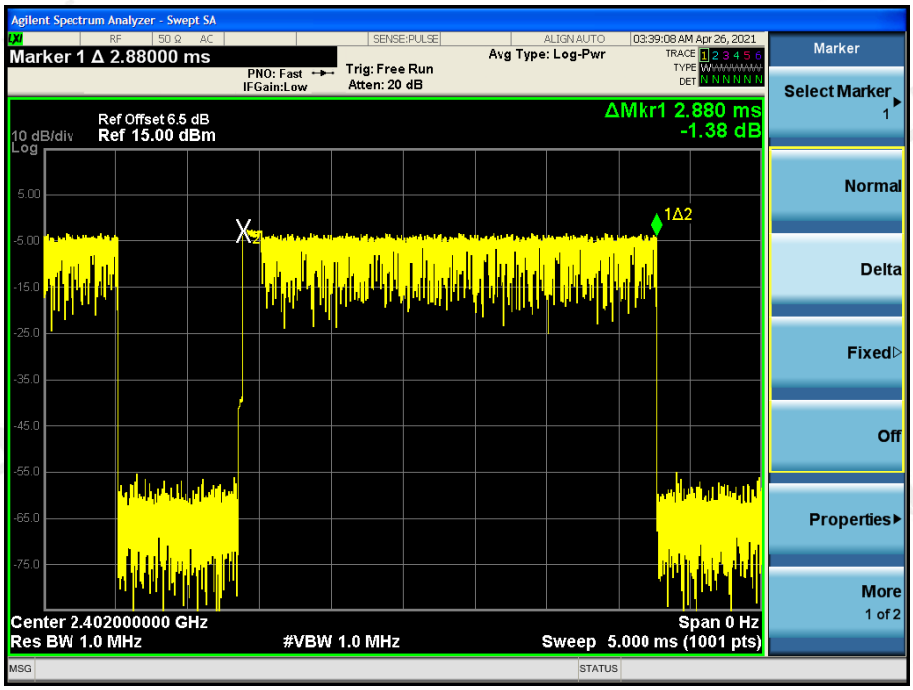
8DPSK DH1



8DPSK DH3



8DPSK DH5



11 OUT OF BAND EMISSIONS TEST

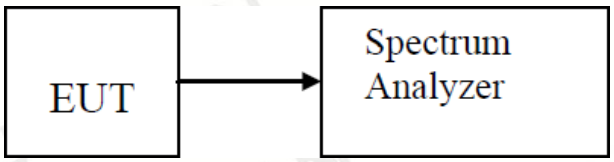
11.1 Test Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

11.2 Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
2. Spectrum Setting : RBW= 100KHz, VBW=300KHz, Sweep time = Auto.

11.3 Test Setup



9.4 Test Result

PASS

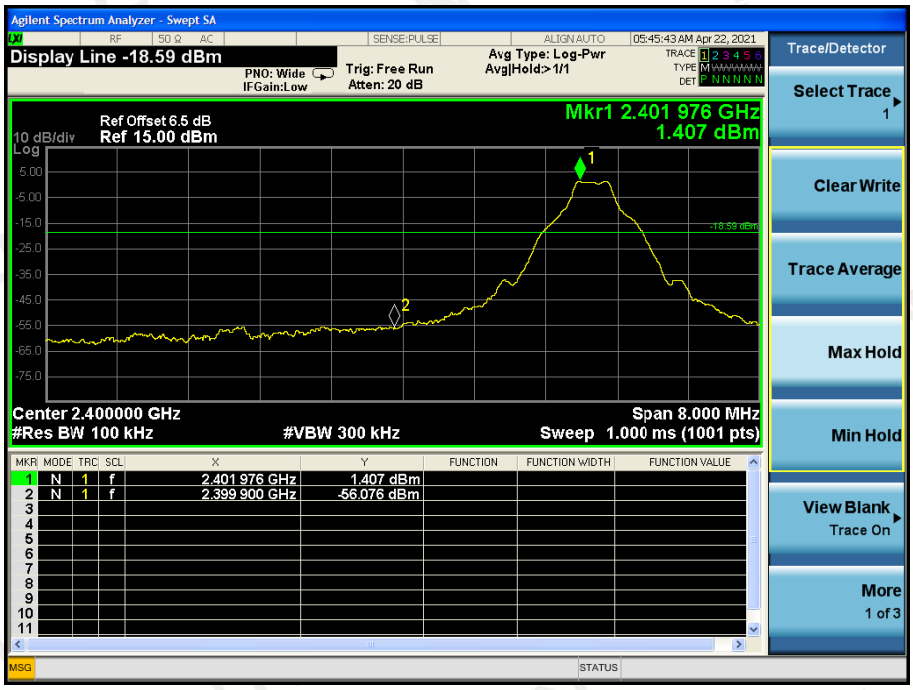
Frequency Band	Delta Peak to band emission (dBc)	＞Limit (dBc)	Result
GFSK Non-hopping			
2400	57.483	20	Pass
2483.5	56.330	20	Pass

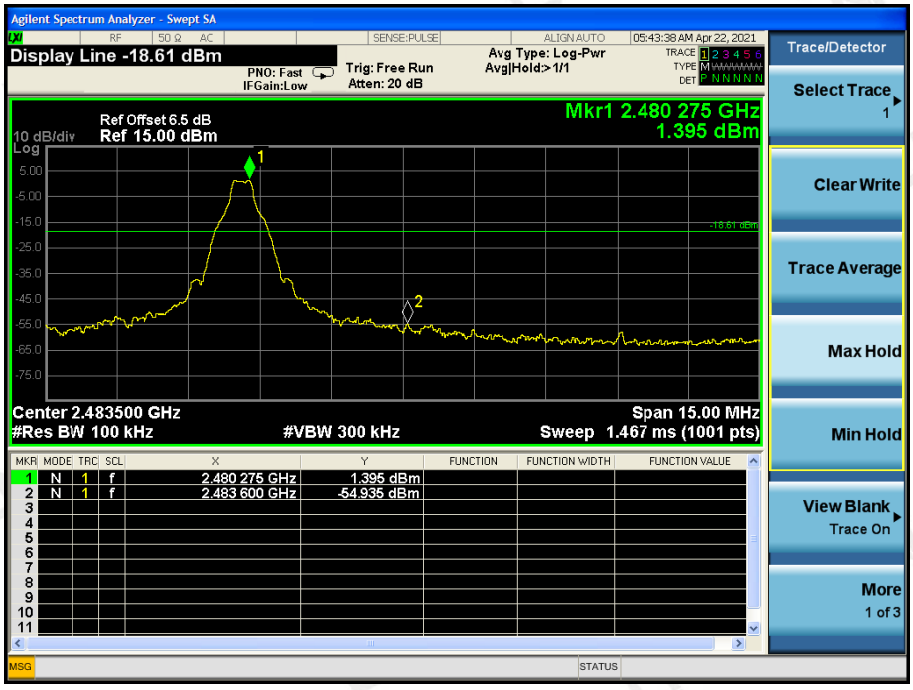
Frequency Band	Delta Peak to band emission (dBc)	＞Limit (dBc)	Result
GFSK hopping			
2400	57.392	20	Pass
2483.5	58.105	20	Pass

Frequency Band	Delta Peak to band emission (dBc)	＞Limit (dBc)	Result
8DPSK Non-hopping			
2400	56.162	20	Pass
2483.5	59.180	20	Pass

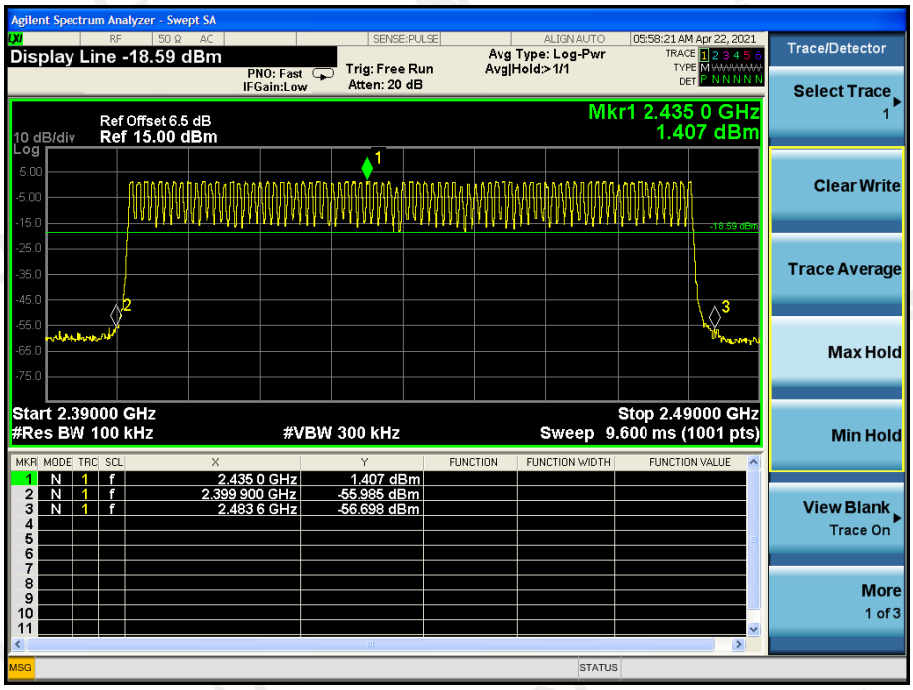
Frequency Band	Delta Peak to band emission (dBc)	＞Limit (dBc)	Result
8DPSK hopping			
2400	58.498	20	Pass
2483.5	56.477	20	Pass

GFSK Non-hopping

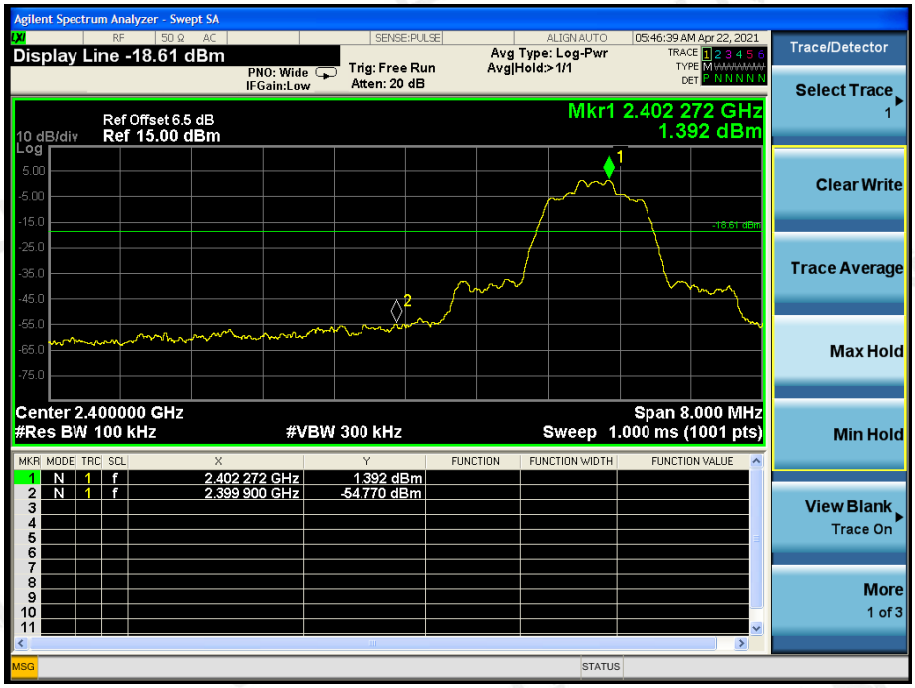


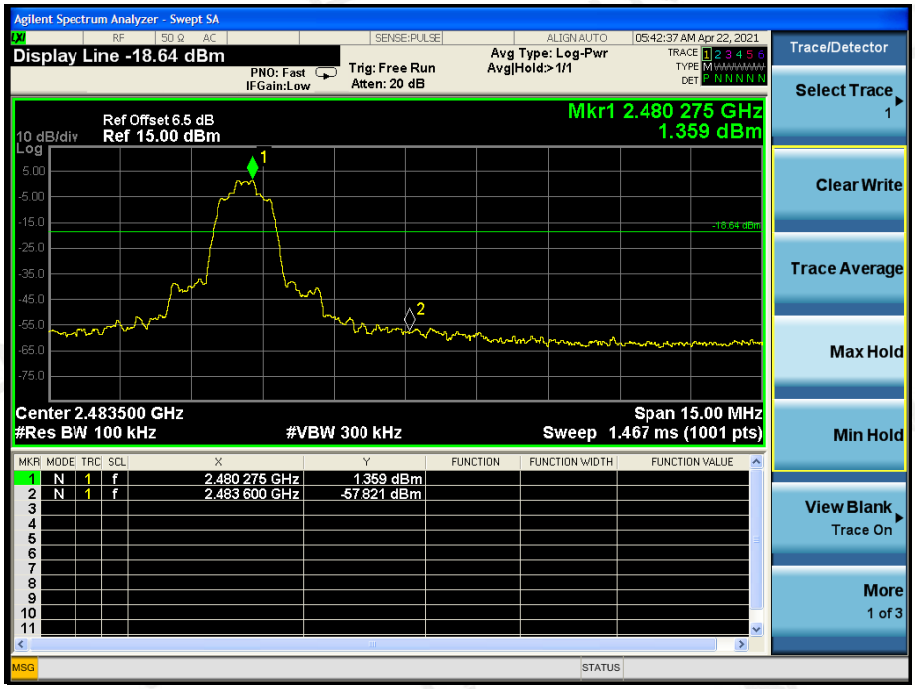


GFSK Hopping

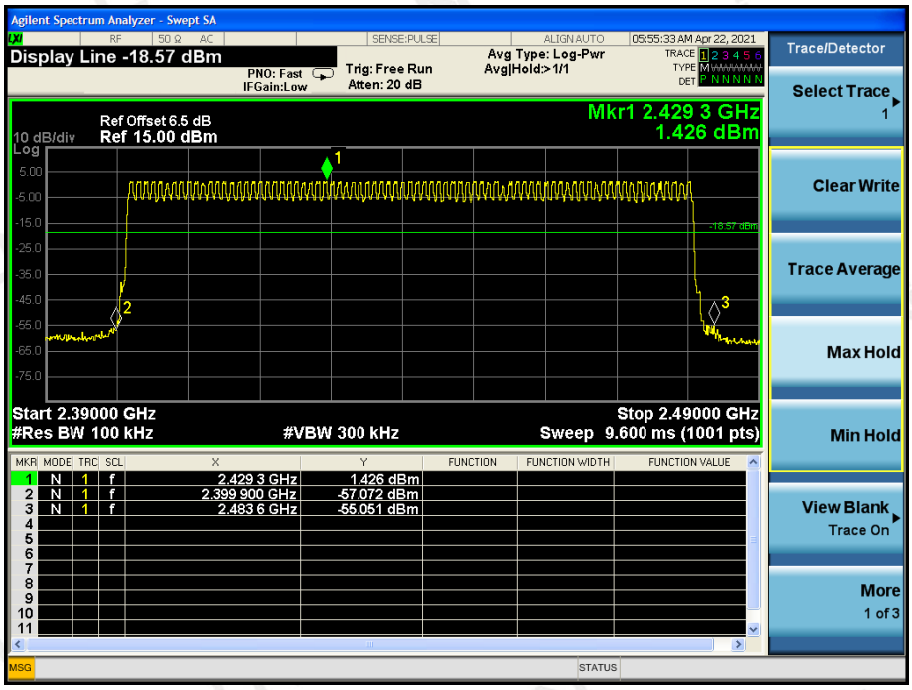


8DPSK Non-hopping

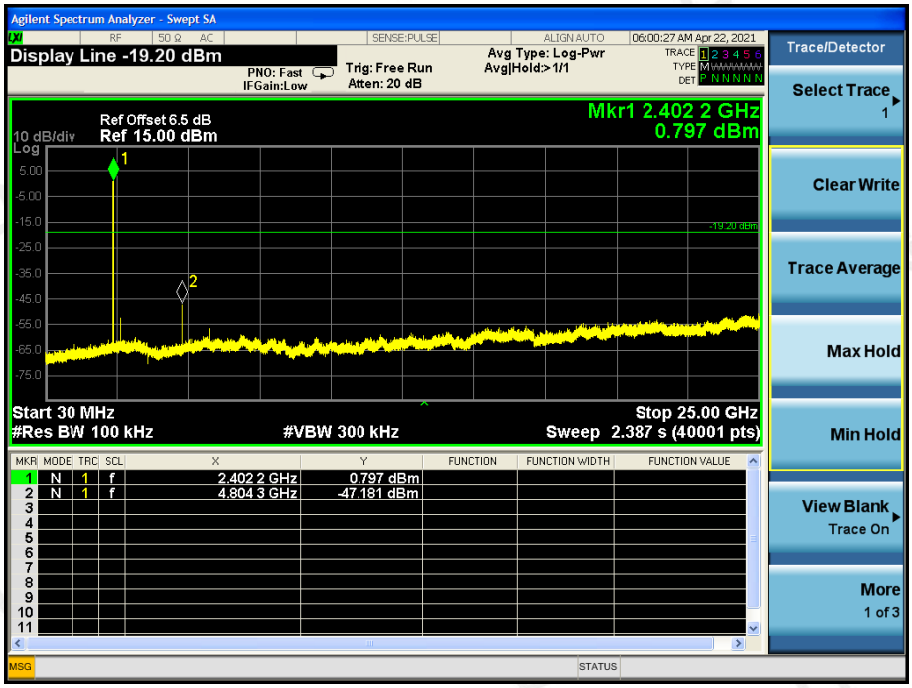




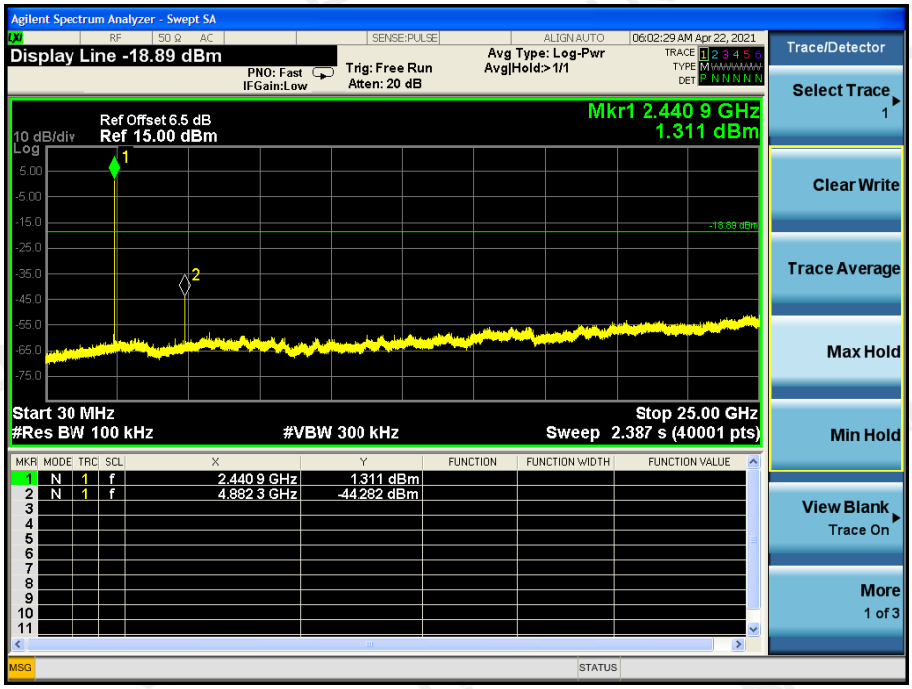
8DPSK Hopping



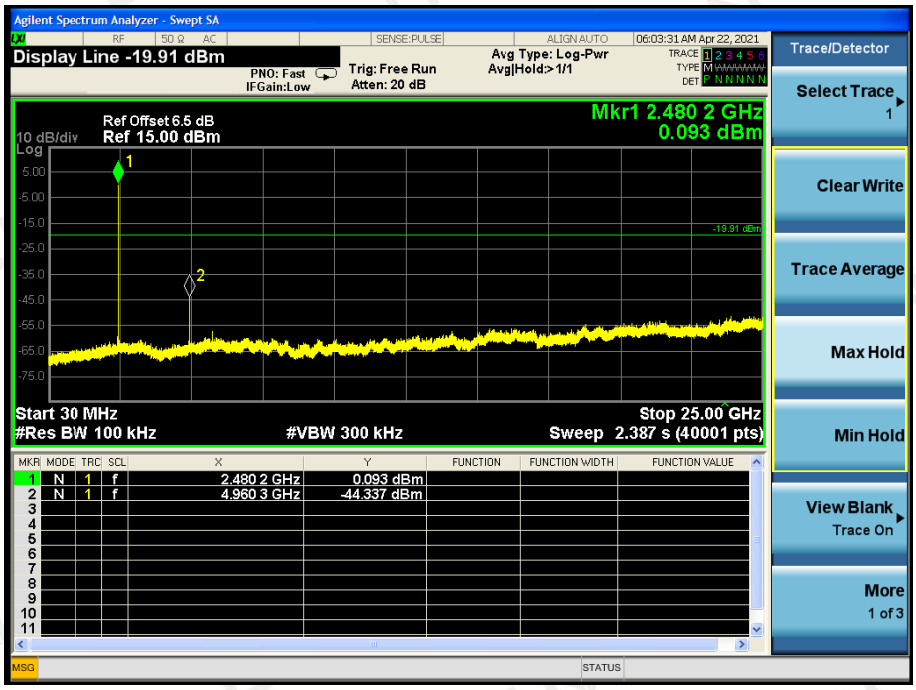
GFSK 2402MHz



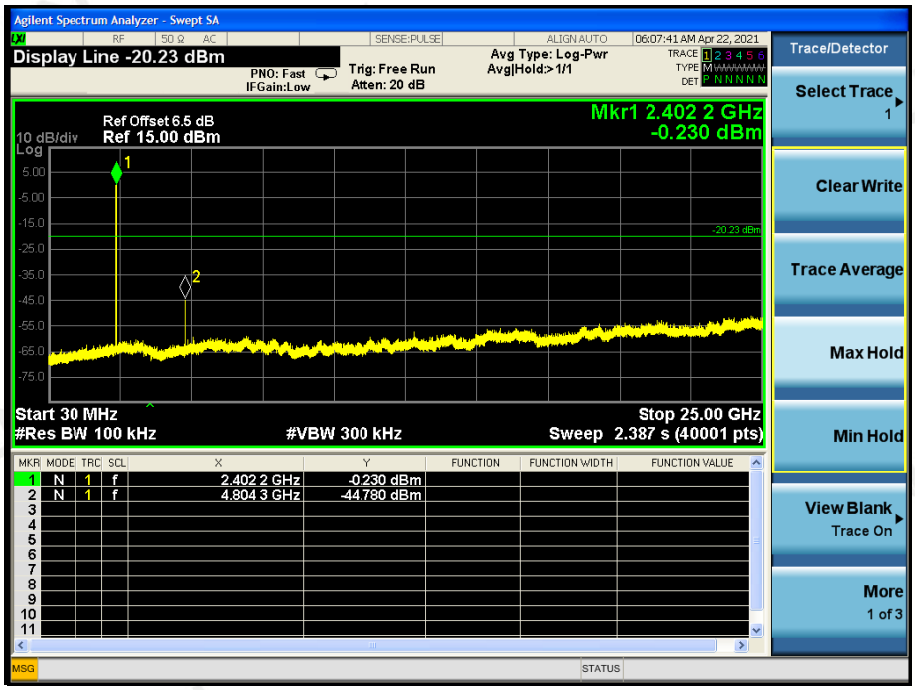
GFSK 2441MHz



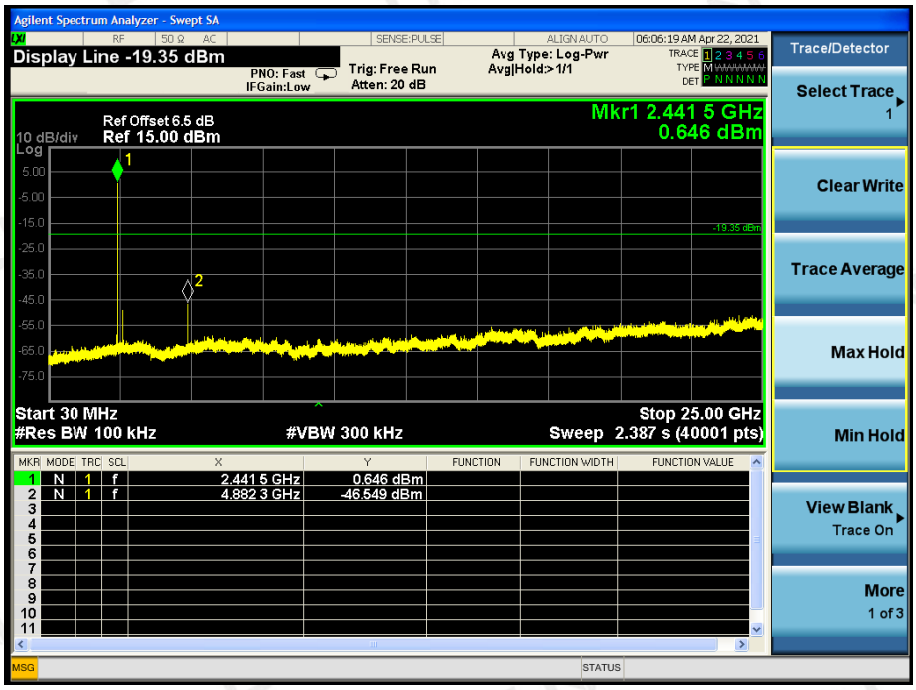
GFSK 2480MHz



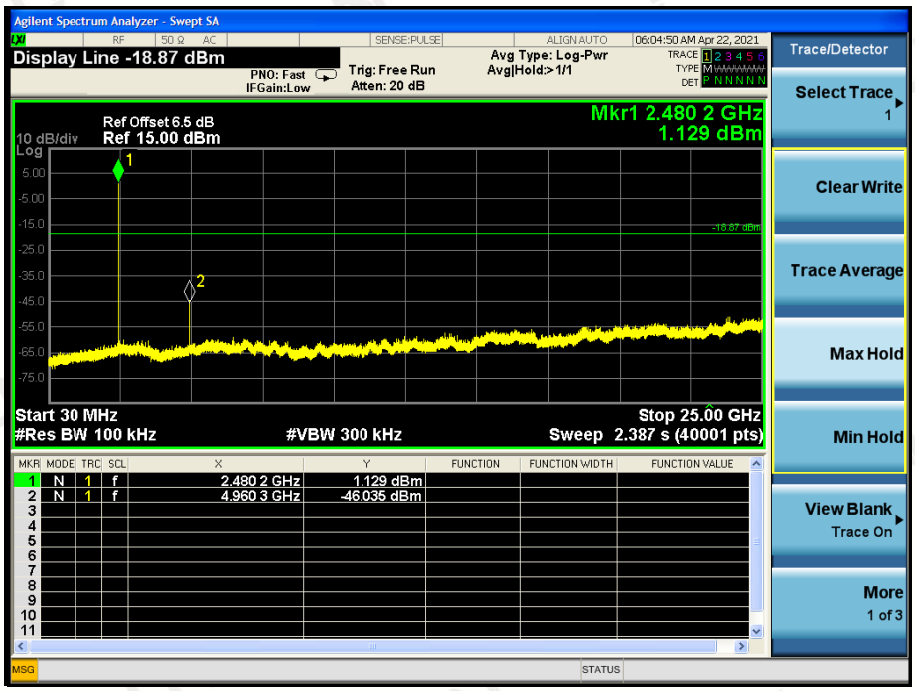
8DPSK 2402MHz



8DPSK 2441MHz



8DPSK 2480MHz

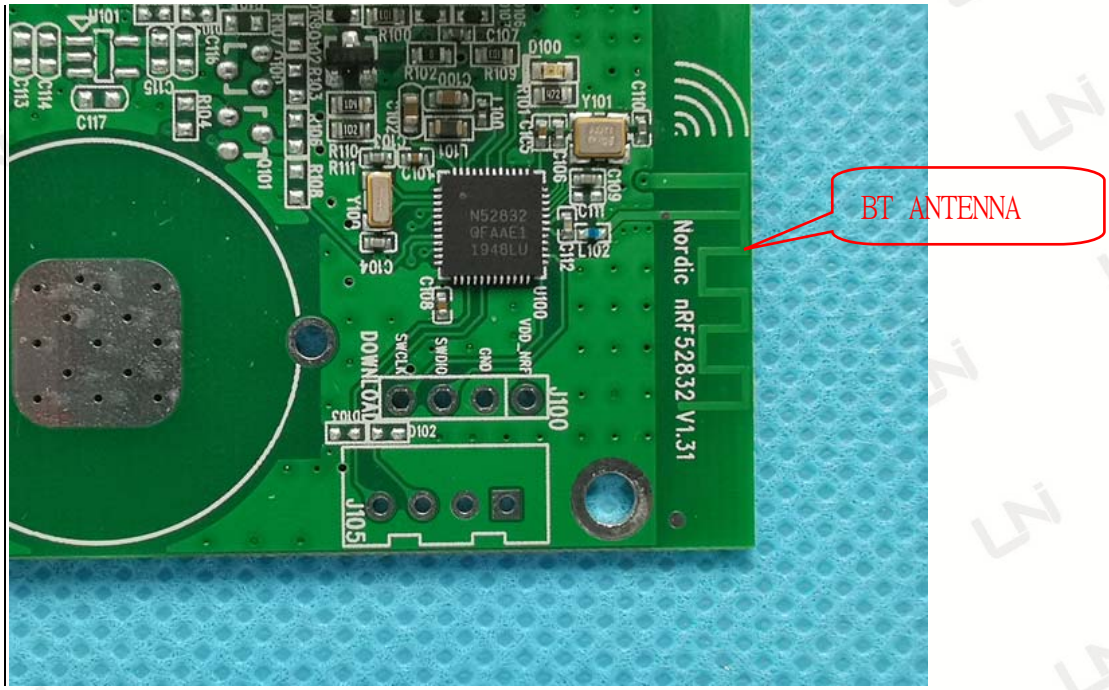


12 ANTENNA REQUIREMENT

Standard Applicable:
For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

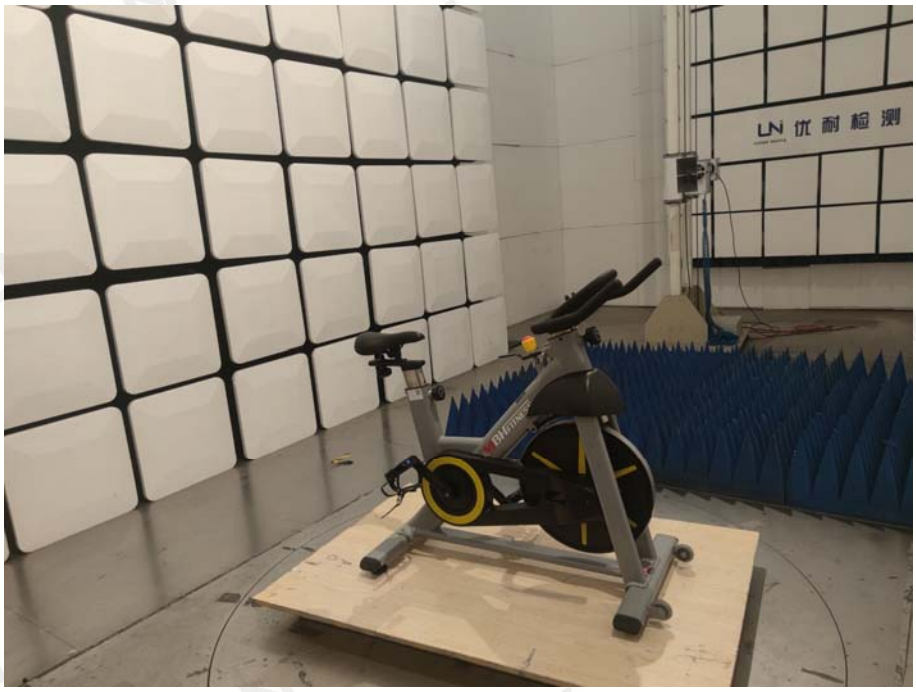
Antenna Connected Construction
The antenna used in this product is a PCB Antenna, The directional gains of antenna used for transmitting is 1.0dBi.

ANTENNA:



13 PHOTO OF TEST

13.1 RADIATED EMISSION



13.2 CONDUCTED EMISSION

N/A

End of Report