FCC TEST REPORT
FCC ID:2AVH9-BFJ-7010

Product Name	:	Massage chair
Model Name	:	BFJ-7010
Brand Name	:	N/A
Report No.	:	PTC19110603001E-FC01

Prepared for

NINGDE BOJIE ELECTRICAL MACHINERY CO., LTD

NO. 16 ANZHIDI YANHUBAN FUAN CITY FUJIAN CHINA

Prepared by

Dongguan Precise Testing & Certification Corp., Ltd.

Building D, Baoding Technology Park, Guangming Road 2, Guangming Community, Dongcheng District, Dongguan, Guangdong, China

1 TEST RESULT CERTIFICATION

Applicant's name	:	NINGDE BOJIE ELECTRICAL MACHINERY CO., LTD
Address	:	NO. 16 ANZHIDI YANHUBAN FUAN CITY FUJIAN CHINA
Manufacture's name	:	NINGDE BOJIE ELECTRICAL MACHINERY CO., LTD
Address	:	NO. 16 ANZHIDI YANHUBAN FUAN CITY FUJIAN CHINA
Product name	:	Massage chair
Model name	:	BFJ-7010
Standards	:	FCC CFR47 Part 15 Section 15.247
Test procedure	:	ANSI C63.10:2013
Test Date	:	Dec. 2, 2019 to Dec. 6, 2019
Date of Issue	:	Dec. 6, 2019
Test Result	:	Pass

This device described above has been tested by PTC, 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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Test Engineer:

Leo Yang / Engineer

Technical Manager:

Chris Du / Manager

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2 Test Summary

Test Items	Test Requirement	Result
Radiated Spurious Emissions	15.205(a) 15.209 15.247(d)	PASS
Band edge	15.247(d) 15.205(a)	PASS
Conduct Emission	15.207	PASS
20dB Bandwidth	15.247(a)(1)	PASS
Maximum Peak Output Power	15.247(b)(1)	PASS
Frequency Separation	15.247(a)(1)	PASS
Number of Hopping Frequency	15.247(a)(1)(iii)	PASS
Dwell time	15.247(a)(1)(iii)	PASS
Antenna Requirement	15.203	PASS

3 TEST FACILITY

Dongguan Precise Testing & Certification Corp., Ltd.

Address: Building D, Baoding Technology Park, Guangming Road2, Dongcheng District, Dongguan, Guangdong, China

FCC Registration Number: 790290

A2LA Certificate No.: 4408.01

IC Registration Number: 12191A-1

4 General Information

4.1 General Description of E.U.T.

Product Name	:	Massage chair
Model Name	:	BFJ-7010
Bluetooth Version	:	BT 4.2Br+Edr
Operating frequency	:	2402-2480MHz
Additional model name		N/A
Numbers of Channel	:	79 channels For DSS 40 channels For DTS
Antenna Type	:	PCB Antenna
Antenna Gain	:	0 dBi
Type of Modulation	:	GFSK, Π/4-DQPSK,8DPSK For DSS GFSK, For DTS
Power supply	:	AC 120V/60Hz
Hardware Version	:	N/A
Software Version	:	N/A

4.2 Test Mode

The EUT has been tested under its typical operating condition. Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting. Only the worst case data were reported.

The EUT has been associated with peripherals pursuant to ANSI C63.10-2013 and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation (9 KHz to the 10th harmonics of the highest fundamental frequency or to 40 GHz, whichever is lower).

The EUT has been tested under TX operating condition.

This EUT is a FHSS system, were conducted to determine the final configuration from all possible combinations. We use software control the EUT, Let EUT hopping on and transmit with highest power, all the modes GFSK, Π/4-DQPSK, 8DPSK have been tested. 79 Channels are provided by EUT. The 3 channels of lower, medium and higher were chosen for test.

Channel List:

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

Channel	Frequency(MHz)
0	2402
39	2441
78	2480

5 Equipment During Test

5.1 Equipments List

RF Conducted Test

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
MXG Signal Analyzer	Agilent	N9020A	SER MY5111038	10Hz-30GHz	Aug. 21, 2020
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	Aug. 21, 2020
Power Meter	Anritsu	ML2495A	0949003	300MHz-40GHz	Aug. 28, 2020
Power Sensor	Anritsu	MA2411B	0917017	300MHz-40GHz	Aug. 28, 2020

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

Radiated Emissions

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	9KHz-3GHz	Aug. 28, 2020
Loop Antenna	Schwarzbeck	FMZB 1519	012	9 KHz -30MHz	Aug. 28, 2020
Bilog Antenna	SCHWARZBECK	VULB9160	9160-3355	25MHz-2GHz	Aug. 22, 2020
Preamplifier (low frequency)	SCHWARZBECK	BBV 9475	9745-0013	1MHz-1GHz	Aug. 21, 2020
Cable	Schwarzbeck	PLF-100	549489	9KHz-3GHz	Aug. 21, 2020
Spectrum Analyzer	Agilent	E4407B	MY45109572	9KHz-40GHz	Aug. 28, 2020
Horn Antenna	SCHWARZBECK	9120D	9120D-1246	1GHz-18GHz	Apr. 13, 2020
Power Amplifier	LUNAR EM	LNA1G18-40	J10100000081	1GHz-26.5GHz	Aug. 21, 2020
Horn Antenna	SCHWARZBECK	BBHA 9170	9170-181	14GHz-40GHz	Apr. 13, 2020
Amplifier	SCHWARZBECK	BBV 9721	9721-205	18GHz-40GHz	Aug. 21, 2020
Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	Aug. 21, 2020

RF Cable	R&S	R204	R21X	1GHz-40GHz	Aug. 21, 2020

Conducted Emissions

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	9KHz-3GHz	Aug. 28, 2020
Artificial Mains Network	Rohde&Schwarz	ENV216	102453	9KHz-300MHz	Aug. 21, 2020
Artificial Mains Network	Rohde&Schwarz	ENV216	101342	9KHz-300MHz	Aug. 21, 2020

5.2 Measurement Uncertainty

Parameter	Uncertainty
RF output power, conducted	±1.0dB
Power Spectral Density, conducted	±2.2dB
Radio Frequency	± 1 x 10^{-6}
Bandwidth	± 1.5 x 10^{-6}
Time	±2%
Duty Cycle	±2%
Temperature	±1°C
Humidity	±5%
DC and low frequency voltages	±3%
Conducted Emissions (150kHz~30MHz)	±3.64dB
Radiated Emission(30MHz~1GHz)	±5.03dB
Radiated Emission(1GHz~25GHz)	±4.74dB

5.3 Description of Support Units

Equipment	Model No.	Series No.
Adapter	N/A	N/A

6 Conducted Emission

Test Requirement:	:	FCC CFR 47 Part 15 Section 15.207
Test Method:	:	ANSI C63.10:2013
Test Result:	:	PASS
Frequency Range:	:	150kHz to 30MHz
Class/Severity:	:	Class B
Detector:	:	Peak for pre-scan (9kHz Resolution Bandwidth)

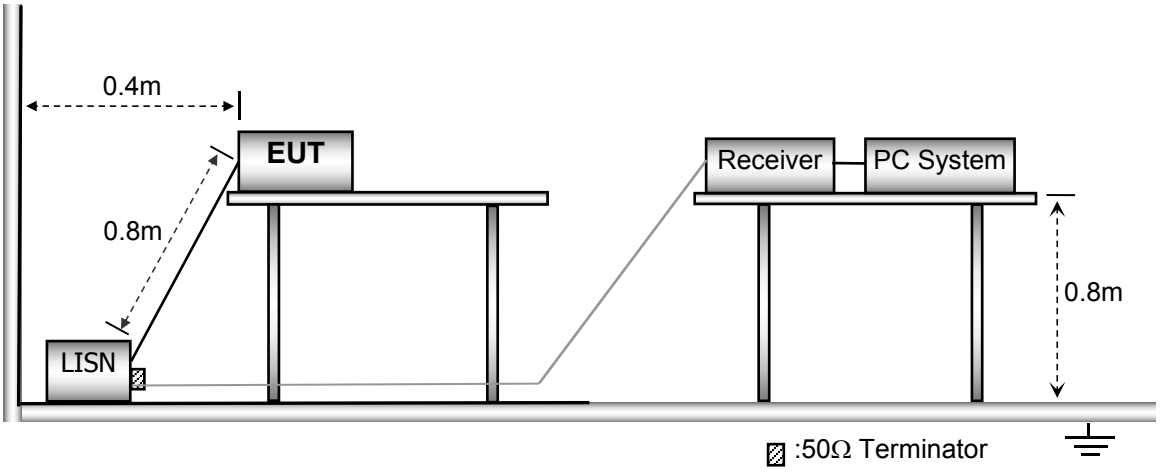
6.1 E.U.T. Operation

Operating Environment **:**

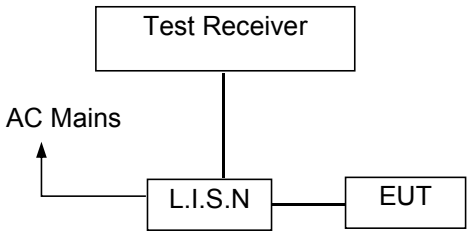
Temperature:	:	23.2°C
Humidity:	:	51 % RH
Atmospheric Pressure:	:	101.12 kPa
Test Voltage	:	AC 120V/60Hz

6.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10: 2013



6.3 Test SET-UP (Block Diagram of Configuration)



6.4 Measurement Procedure:

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured was complete.

6.5 Conducted Emission Limit

Conducted Emission

Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

Note:

1. The lower limit shall apply at the transition frequencies

2.The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

6.6 Measurement Description

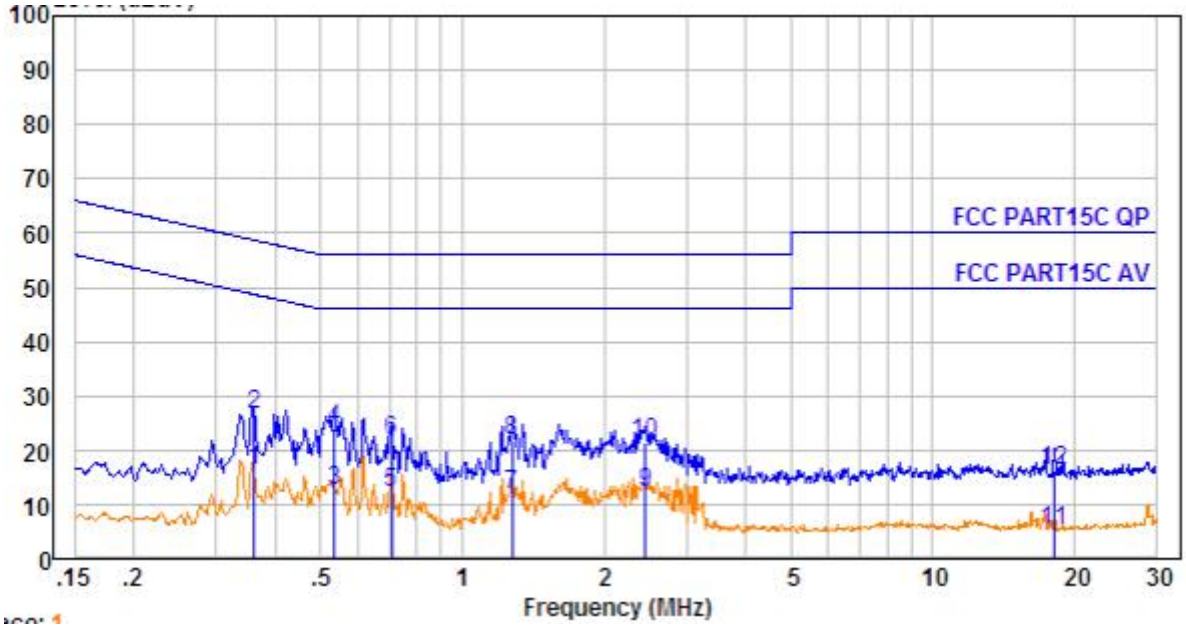
The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

6.7 Conducted Emission Test Result

Pass

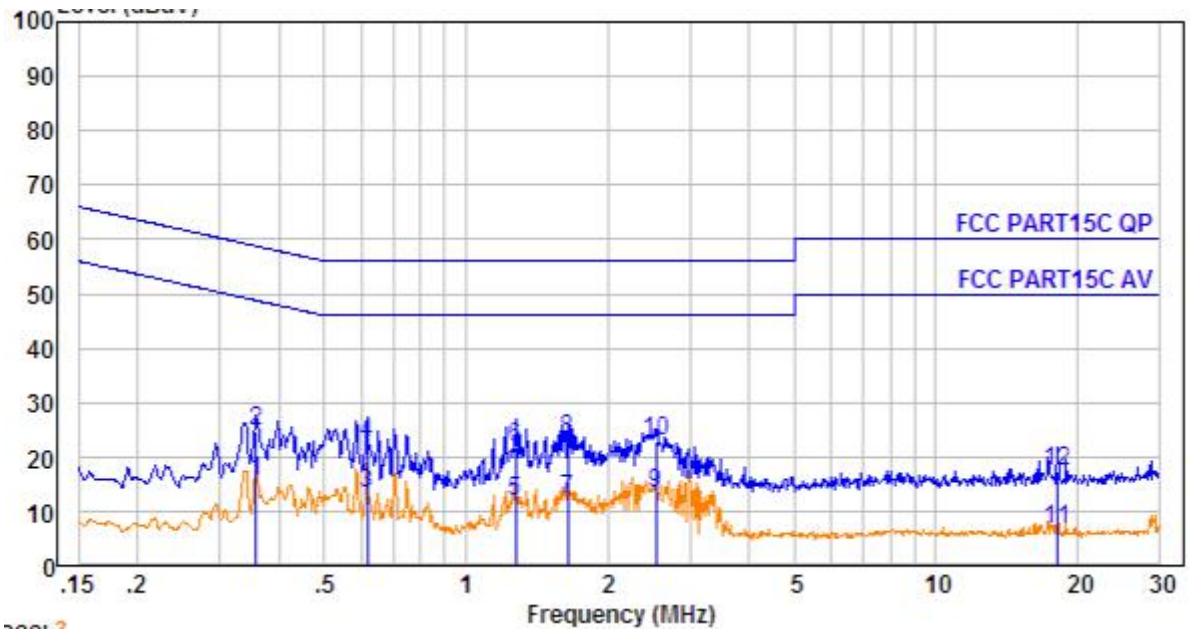
Conducted emission at both 120V & 240V is assessed, and emission at 120V represents the worst case. All the modulation modes were tested the data of the worst mode (GFSK) are recorded in the following pages and the others modulation methods do not exceed the limits.

Line -120V/60Hz:



No.	Freq MHz	Cable Loss dB	AMN Factor dB	Receiver Reading dBμV	Emission Level dBμV	Limit dBμV	Over Limit dB	Remark
1.	0.361	0.39	9.60	6.07	16.06	48.69	-32.63	Average
2.	0.361	0.39	9.60	16.42	26.41	58.69	-32.28	QP
3.	0.535	0.43	9.61	2.52	12.56	46.00	-33.44	Average
4.	0.535	0.43	9.61	13.96	24.00	56.00	-32.00	QP
5.	0.708	0.44	9.61	2.22	12.27	46.00	-33.73	Average
6.	0.708	0.44	9.61	11.73	21.78	56.00	-34.22	QP
7.	1.276	0.46	9.61	1.88	11.95	46.00	-34.05	Average
8.	1.276	0.46	9.61	11.63	21.70	56.00	-34.30	QP
9.	2.448	0.47	9.62	2.20	12.29	46.00	-33.71	Average
10.	2.448	0.47	9.62	11.27	21.36	56.00	-34.64	QP
11.	18.135	0.45	9.80	-4.92	5.33	50.00	-44.67	Average
12.	18.135	0.45	9.80	5.99	16.24	60.00	-43.76	QP

Neutral -120V/60Hz:



No.	Freq MHz	Cable Loss dB	AMN Factor dB	Receiver Reading dBμV	Emission Level dBμV	Limit dBμV	Over Limit dB	Remark
1.	0.358	0.39	9.62	5.51	15.52	48.78	-33.26	Average
2.	0.358	0.39	9.62	14.73	24.74	58.78	-34.04	QP
3.	0.617	0.44	9.64	3.26	13.34	46.00	-32.66	Average
4.	0.617	0.44	9.64	12.55	22.63	56.00	-33.37	QP
5.	1.276	0.46	9.64	1.69	11.79	46.00	-34.21	Average
6.	1.276	0.46	9.64	11.56	21.66	56.00	-34.34	QP
7.	1.645	0.47	9.64	2.01	12.12	46.00	-33.88	Average
8.	1.645	0.47	9.64	13.17	23.28	56.00	-32.72	QP
9.	2.540	0.47	9.65	2.98	13.10	46.00	-32.90	Average
10.	2.540	0.47	9.65	12.62	22.74	56.00	-33.26	QP
11.	18.135	0.45	9.88	-3.61	6.72	50.00	-43.28	Average
12.	18.135	0.45	9.88	6.89	17.22	60.00	-42.78	QP

7 Radiated Spurious Emissions

Test Requirement : FCC CFR47 Part 15 Section 15.209 & 15.247

Test Method : ANSI C63.10:2013

Test Result : PASS

Measurement Distance : 3m

Limit : See the follow table

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	2400/F(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))} + 80$
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))} + 40$
1.705 ~ 30	30	30	100 * 30	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

7.1 EUT Operation

Operating Environment :

Temperature : 23.5 °C

Humidity : 51.5% RH

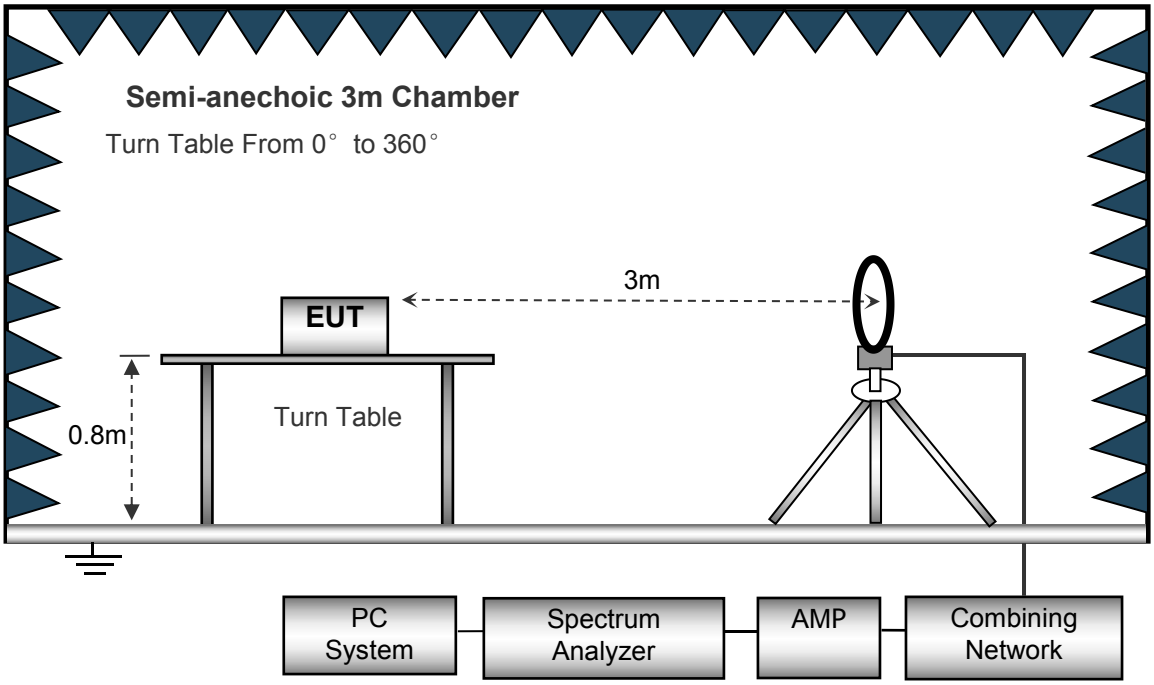
Atmospheric Pressure : 100.12kPa

Test Voltage : AC 120V/60Hz

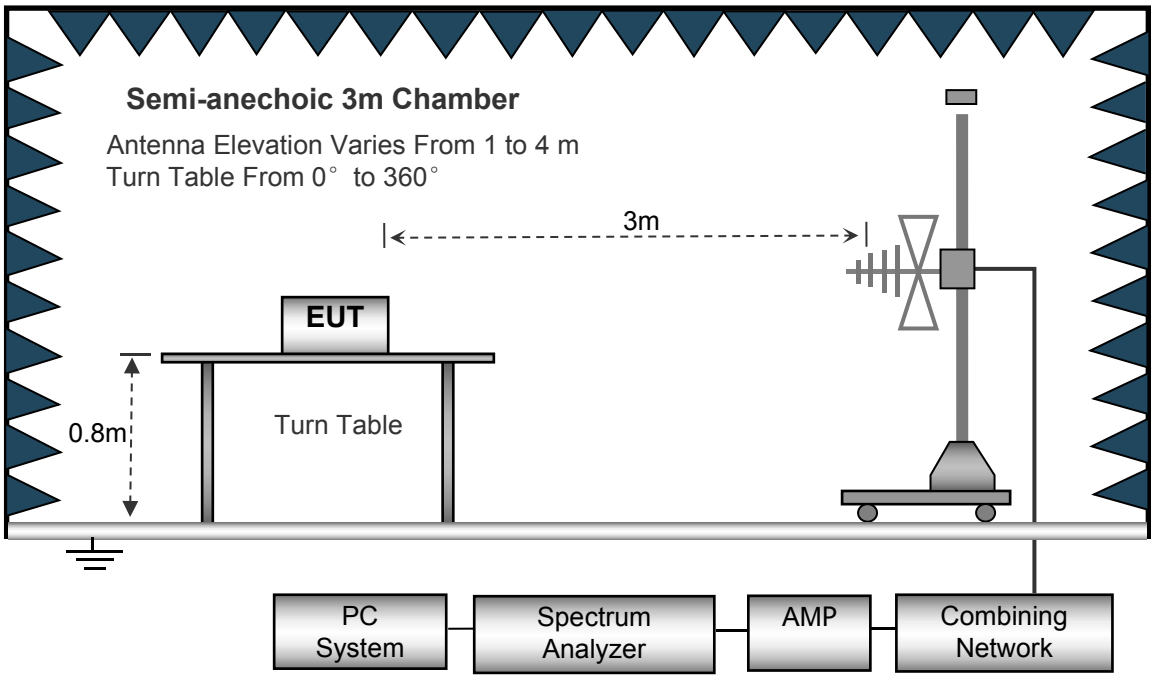
7.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site

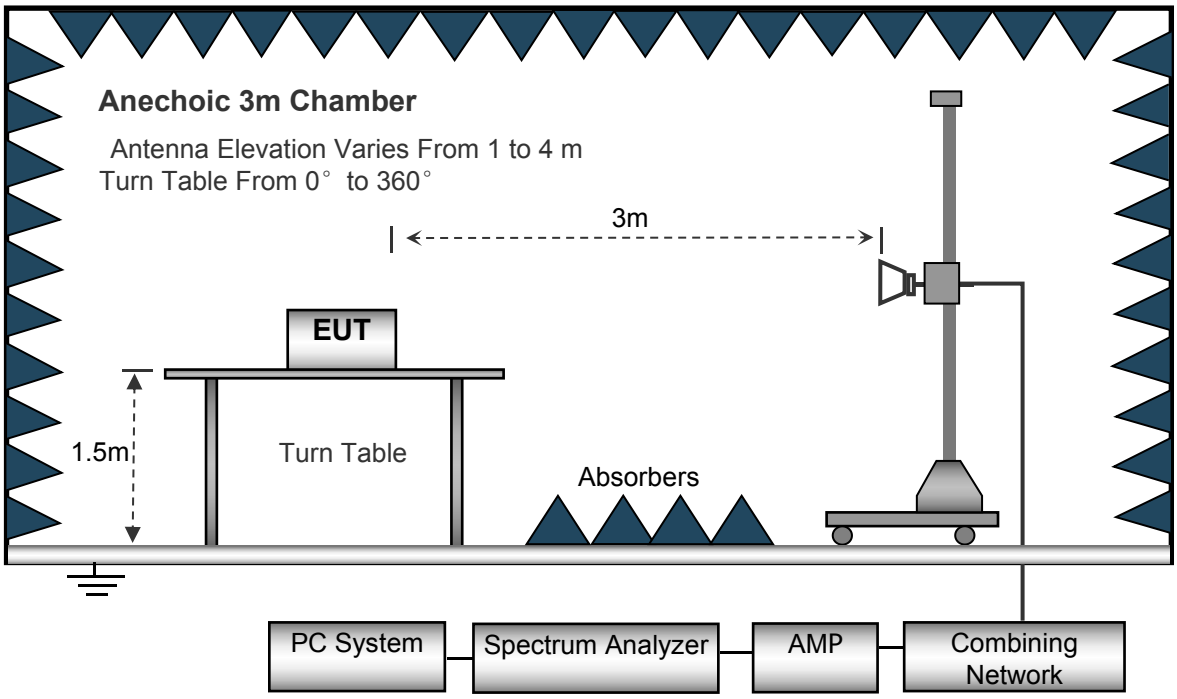
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz.



7.3 Spectrum Analyzer Setup

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / *10Hz* for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

7.4 Test Procedure

1. The testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10-2013.

2. Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane.

3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.

4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (From 1m to 4m) and turntable (from 0 degree to 360 degree) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.

5. Set to the maximum power setting and enable the EUT transmit continuously.

6. Final measurement (Above 1GHz): The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1MHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 degree to 360 degree in order to have the antenna inside the cone of radiation.

7. Test Procedure of measurement (For Above 1GHz):

1) Monitor the frequency range at horizontal polarization and move the antenna over all sides of the EUT(if necessary move the EUT to another orthogonal axis).

2) Change the antenna polarization and repeat 1) with vertical polarization.

3) Make a hardcopy of the spectrum.

4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.

5) Change the analyser mode to Clear/ Write and found the cone of emission.

6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3m and the antenna will be still inside the cone of emission.

7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarization and azimuth and the peak and average detector, which causes the maximum emission.

8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.

7. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.

7.5 Summary of Test Results

Test Frequency: 9KHz-30MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level (dBuV/m)	Limit 3m (dBuV/m)	Over (dB)
--	--	--	--	>20

Note:

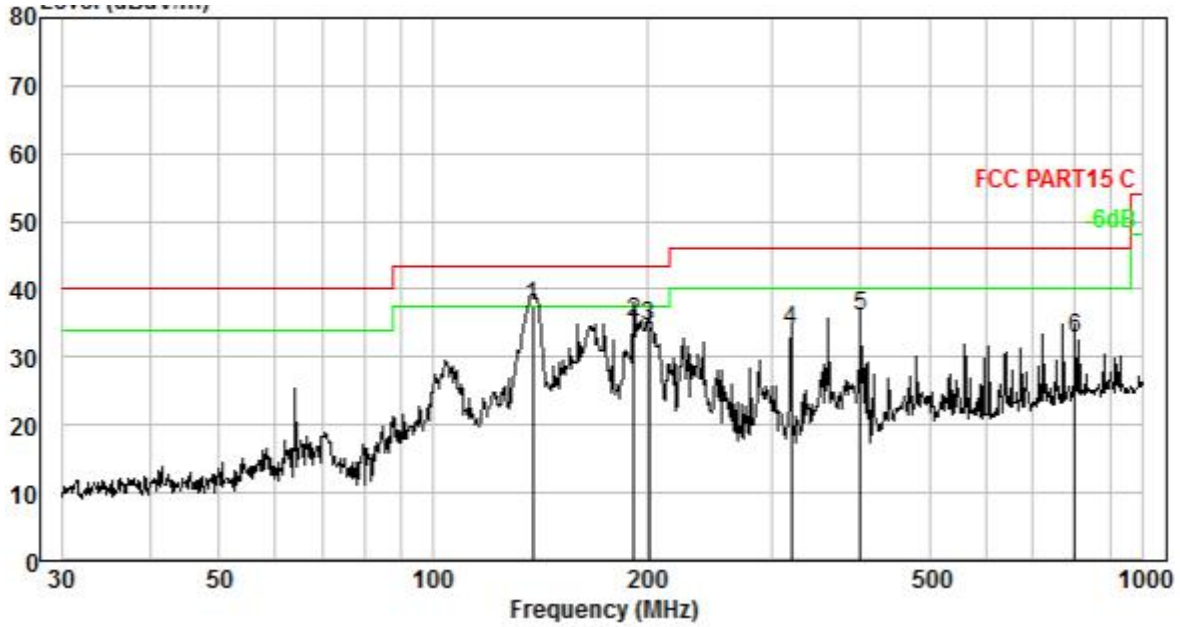
The amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

Distance extrapolation factor =40log(Specific distance/ test distance)(dB);
Limit line=Specific limits(dBuV) + distance extrapolation factor.

Test Frequency: 30MHz ~ 1GHz

Please refer to the following test plots,Low Channel (2402MHz) Worst case GFSK for record:

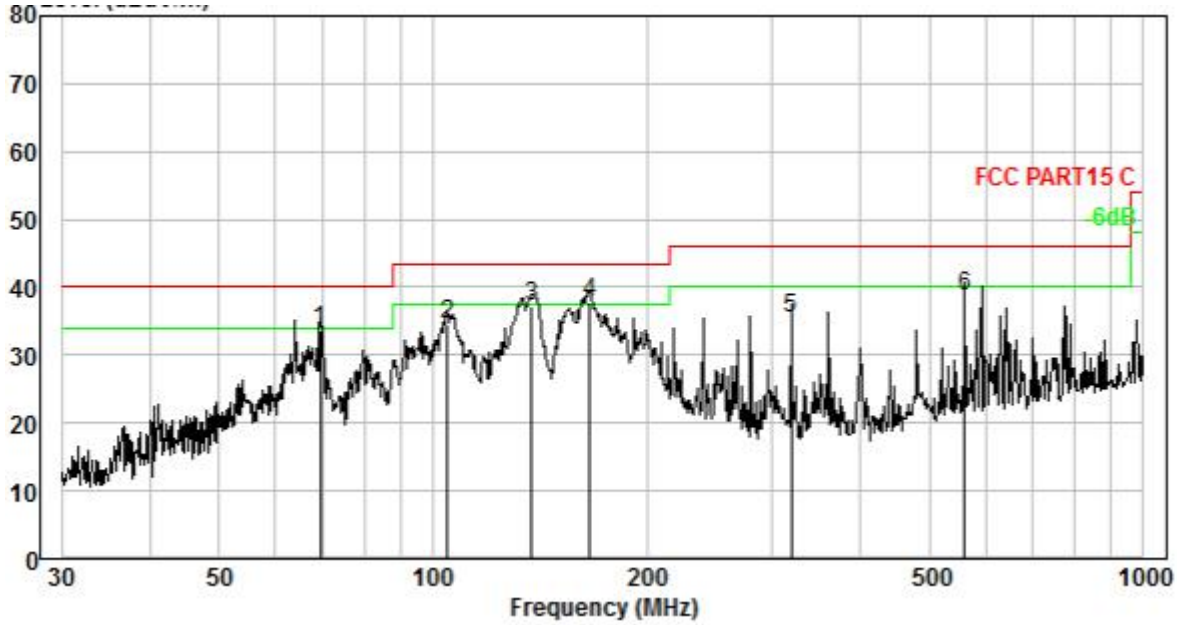
Test plot for Horizontal



No.	Freq MHz	Cable Loss dB	ANT Factor dB/m	Receiver Reading dBuV	Preamp Factor dB	Emission Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark
1.	138.387	3.83	13.20	50.33	30.01	37.35	43.50	-6.15	QP
2.	191.745	4.39	11.60	49.22	30.04	35.17	43.50	-8.33	QP
3.	201.393	4.47	11.05	49.13	30.04	34.61	43.50	-8.89	QP
4.	319.937	5.27	13.70	45.32	30.40	33.89	46.00	-12.11	QP
5.	400.432	5.66	14.81	46.33	30.70	36.10	46.00	-9.90	QP
6.	801.786	6.85	21.41	35.70	31.17	32.79	46.00	-13.21	QP

Remark:Emission Level=Reading+Cable Loss+ANT Factor-AMP Factor

Test plot for Vertical



No.	Freq MHz	Cable Loss dB	ANT Factor dB/m	Receiver Reading dBuV	Preamp Factor dB	Emission Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark
1.	69.357	2.64	10.21	50.62	29.95	33.52	40.00	-6.48	QP
2.	104.903	3.35	10.20	51.08	29.99	34.64	43.50	-8.86	QP
3.	137.903	3.82	13.17	50.09	30.01	37.07	43.50	-6.43	QP
4.	166.068	4.14	13.59	49.94	30.03	37.64	43.50	-5.86	QP
5.	319.937	5.27	13.70	46.82	30.40	35.39	46.00	-10.61	QP
6.	560.693	6.23	18.54	44.82	30.97	38.62	46.00	-7.38	QP

Remark:Emission Level=Reading+Cable Loss+ANT Factor-AMP Factor

Test Frequency 1GHz-18GHz

Low Channel (2402MHz) Worst case GFSK								
Detector: Peak Value								
Frequency (MHz)	Reading Level (dBuV)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Polarity (H/V)
4804	54.23	30.16	6.66	38.32	52.73	74	-21.27	V
4804	55.14	30.16	6.66	38.32	53.64	74	-20.36	H
7206	54.05	30.22	6.69	38.49	52.47	74	-21.53	V
7206	55.21	30.22	6.69	38.49	53.63	74	-20.37	H
9608	54.46	30.59	6.72	39.15	52.62	74	-21.38	V
9608	55.09	30.59	6.72	39.15	53.25	74	-20.75	H
Detector: Average Value								
4804	41.13	30.16	6.66	38.32	39.63	54	-14.37	V
4804	41.46	30.16	6.66	38.32	39.96	54	-14.04	H
7206	40.87	30.22	6.69	38.49	39.29	54	-14.71	V
7206	41.26	30.22	6.69	38.49	39.68	54	-14.32	H
9608	42.01	30.59	6.72	39.15	40.17	54	-13.83	V
9608	41.88	30.59	6.72	39.15	40.04	54	-13.96	H
Middle Channel (2441MHz) Worst case π/4-DQPSK								
Detector: Peak Value								
Frequency (MHz)	Reading Level (dBuV)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Polarity (H/V)
4882	55.13	30.18	6.68	38.52	53.47	74	-20.53	V
4882	57.92	30.18	6.68	38.52	56.26	74	-17.74	H
7323	56.89	30.22	6.73	39.46	54.38	74	-19.62	V
7323	56.78	30.22	6.73	39.46	54.27	74	-19.73	H
9764	56.03	30.54	6.81	40.71	52.67	74	-21.33	V
9764	57.79	30.54	6.81	40.71	54.43	74	-19.57	H
Detector: Average Value								
4882	41.76	30.18	6.68	38.52	40.1	54	-13.9	V
4882	40.54	30.18	6.68	38.52	38.88	54	-15.12	H
7323	42.34	30.22	6.73	39.46	39.83	54	-14.17	V
7323	41.88	30.22	6.73	39.46	39.37	54	-14.63	H
9764	41.94	30.54	6.81	40.71	38.58	54	-15.42	V

9764	41.76	30.54	6.81	40.71	38.4	54	-15.6	H

High Channel (2480MHz) Worst case 8DPSK								
Detector: Peak Value								
Frequency (MHz)	Reading Level (dBuV)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Polarity (H/V)
4960	56.45	30.33	6.75	40.18	53.35	74	-20.65	V
4960	58.03	30.33	6.75	40.18	54.93	74	-19.07	H
7440	57.24	30.34	6.79	41.23	53.14	74	-20.86	V
7440	57.06	30.34	6.79	41.23	52.96	74	-21.04	H
9920	57.99	30.68	6.83	42.17	53.33	74	-20.67	V
9920	58.12	30.68	6.83	42.17	53.46	74	-20.54	H
Detector: Average Value								
4960	41.57	30.33	6.75	40.18	38.47	54	-15.53	V
4960	42.12	30.33	6.75	40.18	39.02	54	-14.98	H
7440	42.68	30.34	6.79	41.23	38.58	54	-15.42	V
7440	43.98	30.34	6.79	41.23	39.88	54	-14.12	H
9920	44.27	30.68	6.83	42.17	39.61	54	-14.39	V
9920	44.18	30.68	6.83	42.17	39.52	54	-14.48	H

Note: 1. The testing has been conformed to 10*2480MHz=24800MHz.

2. All other emissions more than 30dB below the limit.

3. Factor = Antenna Factor + Cable Loss – Pre-amplifier.
Emission Level = Reading + Factor
Margin=Emission Level-Limit

Spurious Emission in Restricted Band 2310-2390MHz and 2483.5-2500MHz

Bluetooth (GFSK, Pi/4-DQPSK, 8DPSK, Hopping)mode have been tested, and the worst result(GFSK, Hopping) was report as below

Test Mode: Low Channel 2402MHz									
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over (dB)	Polarity H/V	Test Value
2390	54.08	27.38	6.15	36.29	51.32	74	-22.68	H	Peak
2390	38.12	27.38	6.15	36.29	35.36	54	-18.64	H	Average
2390	53.15	27.43	6.68	36.79	50.47	74	-23.53	V	Peak
2390	37.26	27.43	6.68	36.79	34.58	54	-19.42	V	Average

Test Mode: High Channel 2480MHz									
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over (dB)	Polarity H/V	Test Value
2483.5	55.29	27.38	6.15	36.29	52.53	74	-21.47	H	Peak
2483.5	42.58	27.38	6.15	36.29	39.82	54	-14.18	H	Average
2483.5	56.14	27.43	6.68	36.79	53.46	74	-20.54	V	Peak
2483.5	42.37	27.43	6.68	36.79	39.69	54	-14.31	V	Average

8 CONDUCTED BAND EDGE EMISSION

8.1 REQUIREMENT

According to FCC section 15.247(d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

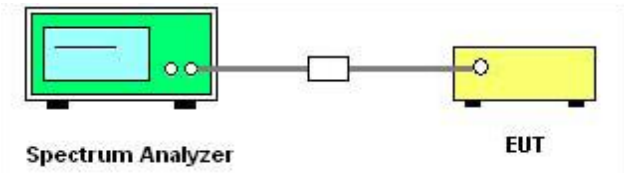
8.2 TEST PROCEDURE

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	30 MHz to 10th carrier harmonic
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

. For Band edge

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	Lower Band Edge: 2300 – 2403 MHz Upper Band Edge: 2479 – 2500 MHz
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

8.3 TEST SETUP



1. The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100KHz. The video bandwidth is set to 300KHz.

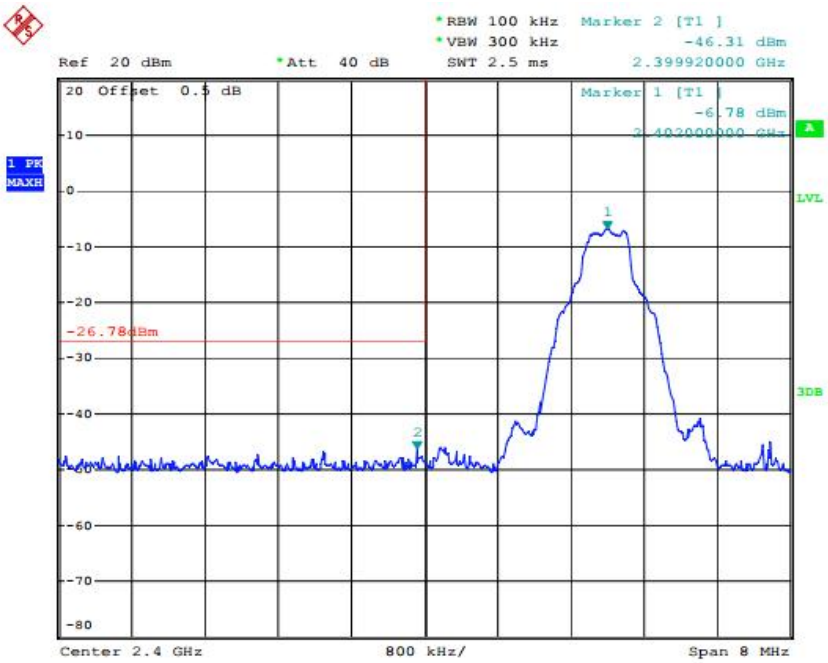
2. The spectrum from 30MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

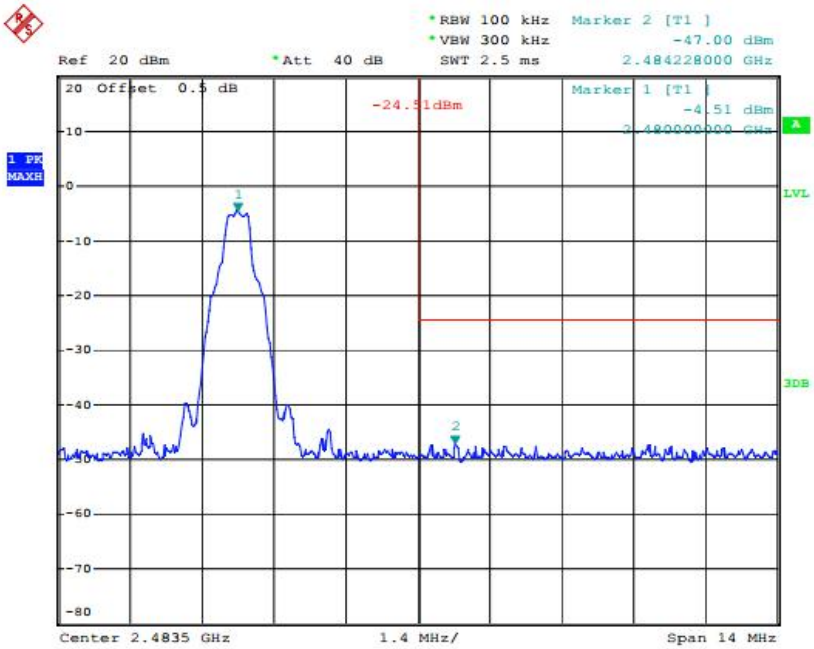
8.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

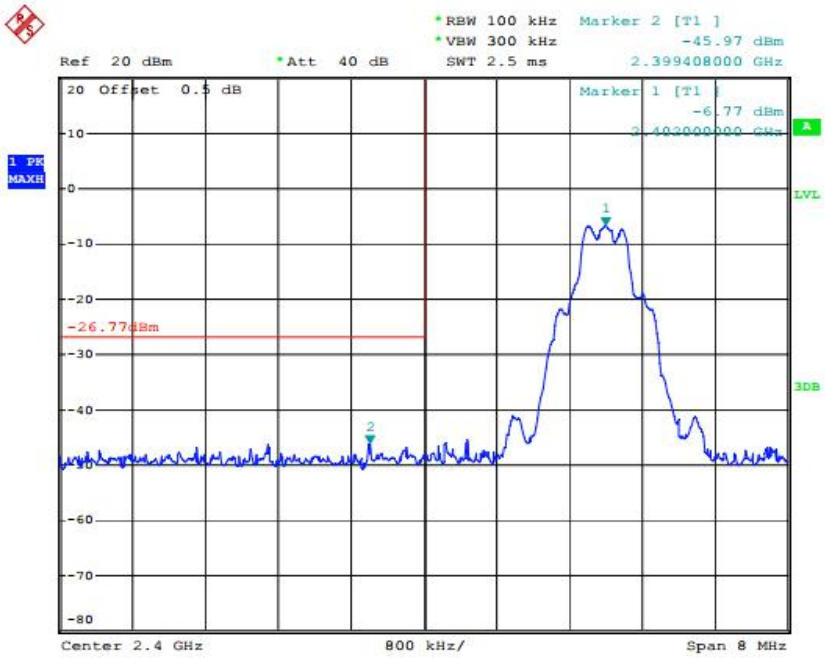
8.5 TEST RESULTS

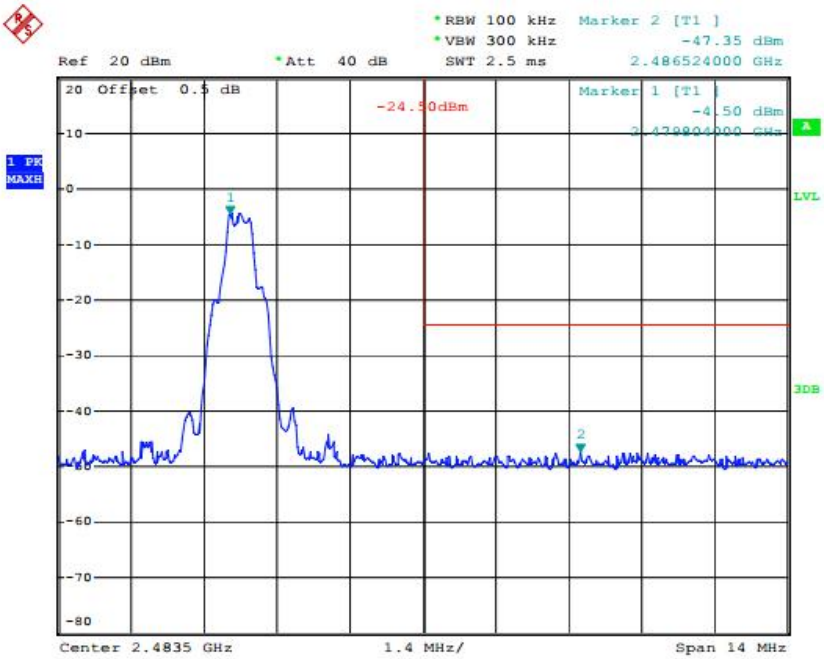
For Non-Hopping Mode: GFSK


RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Marker 2 [T1]
-46.31 dBm
2.399920000 GHz
Ref 20 dBm
Att 40 dB
20 Offset 0.5 dB
Marker 1 [T1]
-6.78 dBm
2.402000000 GHz
1 PK
MAXH
LVL
3DB
-26.78dBm
Center 2.4 GHz
800 kHz/
Span 8 MHz

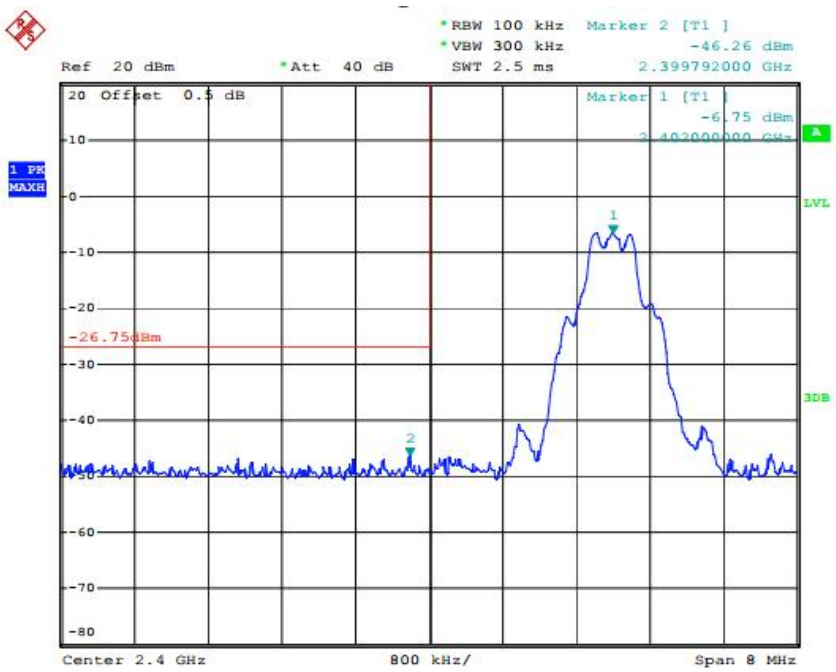

RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Marker 2 [T1]
-47.00 dBm
2.484228000 GHz
Ref 20 dBm
Att 40 dB
20 Offset 0.5 dB
-24.51dBm
Marker 1 [T1]
-4.51 dBm
2.480000000 GHz
1 PK
MAXH
LVL
3DB
Center 2.4835 GHz
1.4 MHz/
Span 14 MHz

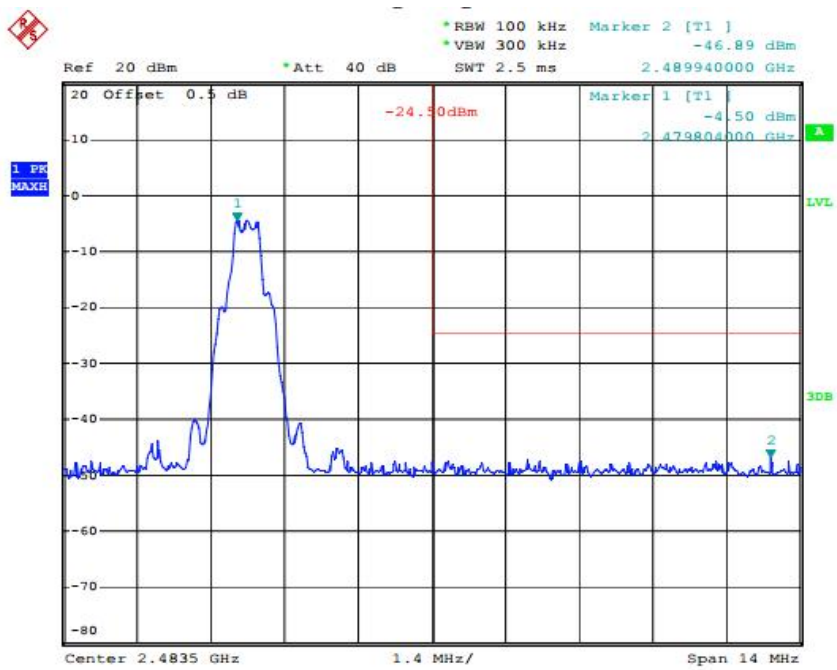
π/4-DQPSK


RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Marker 2 [T1]
-45.97 dBm
2.399408000 GHz
Ref 20 dBm
Att 40 dB
20 Offset 0.5 dB
Marker 1 [T1]
-6.77 dBm
2.402000000 GHz
1 PK MAXH
A
LVL
3DB
-26.77dBm
Center 2.4 GHz
800 kHz/
Span 8 MHz

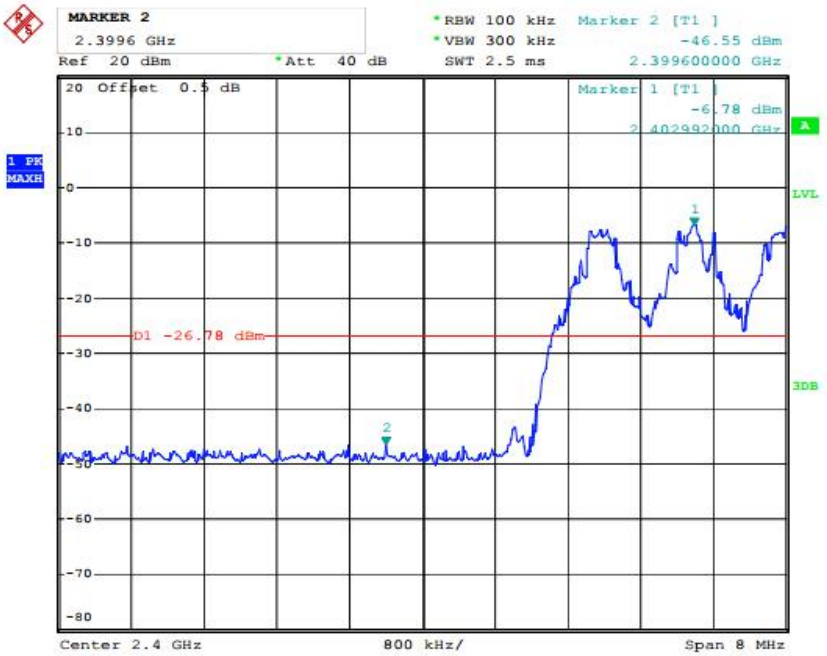

RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Marker 2 [T1]
-47.35 dBm
2.486524000 GHz
Ref 20 dBm
Att 40 dB
20 Offset 0.5 dB
-24.50dBm
Marker 1 [T1]
-4.50 dBm
2.479804000 GHz
1 PK MAXH
A
LVL
3DB
Center 2.4835 GHz
1.4 MHz/
Span 14 MHz

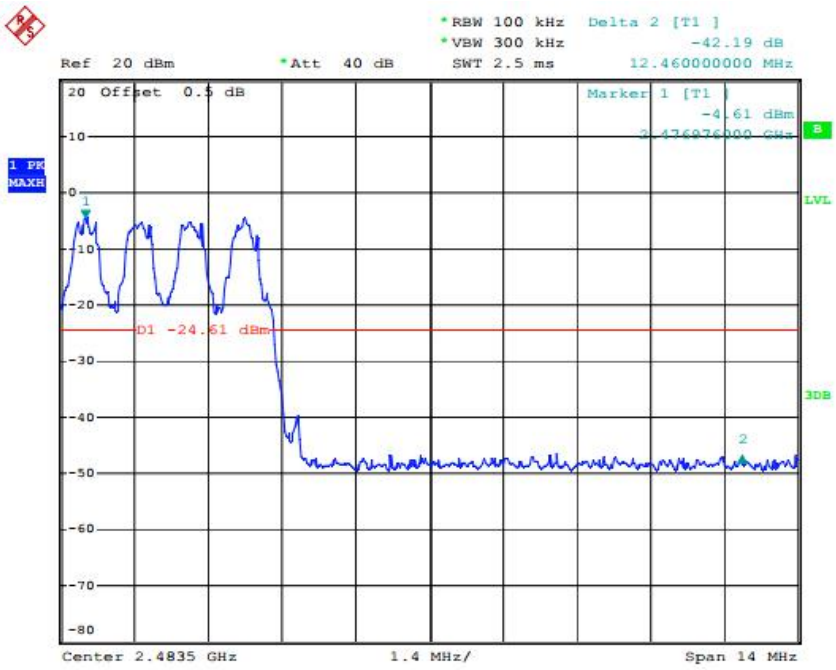
8DPSK


RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Marker 2 [T1]
-46.26 dBm
2.399792000 GHz
Ref 20 dBm
Att 40 dB
20 Offset 0.5 dB
Marker 1 [T1]
-6.75 dBm
2.403000000 GHz
1 PK
MAXH
A
LVL
3DB
-26.75dBm
Center 2.4 GHz
800 kHz/
Span 8 MHz

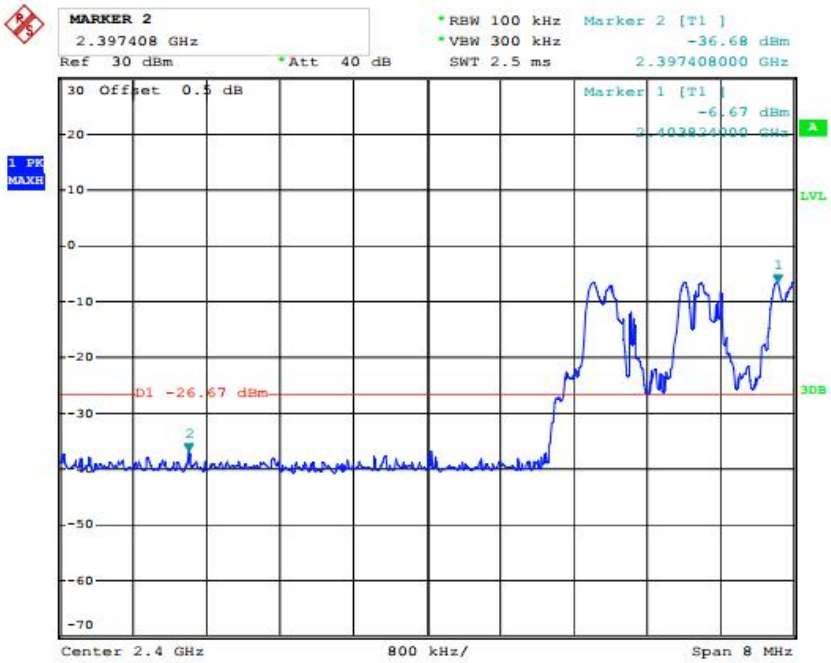

RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Marker 2 [T1]
-46.89 dBm
2.489940000 GHz
Ref 20 dBm
Att 40 dB
20 Offset 0.5 dB
-24.50dBm
Marker 1 [T1]
-4.50 dBm
2.479804000 GHz
1 PK
MAXH
A
LVL
3DB
Center 2.4835 GHz
1.4 MHz/
Span 14 MHz

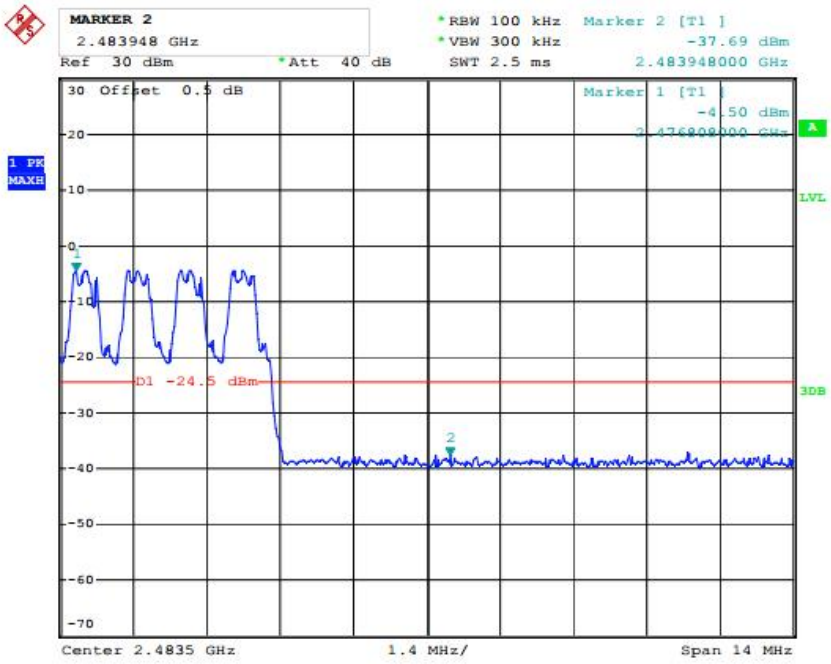
For Hopping Mode: GFSK



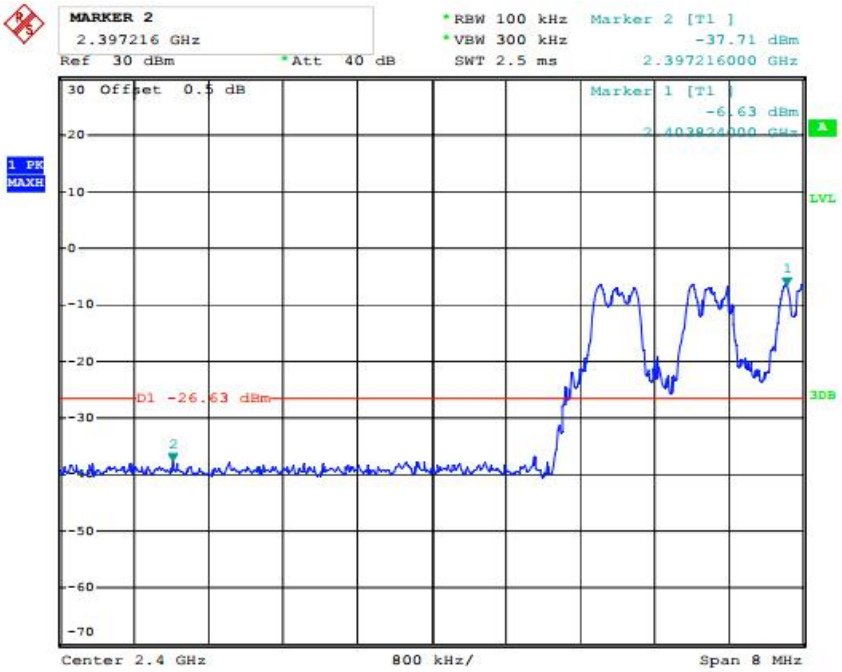


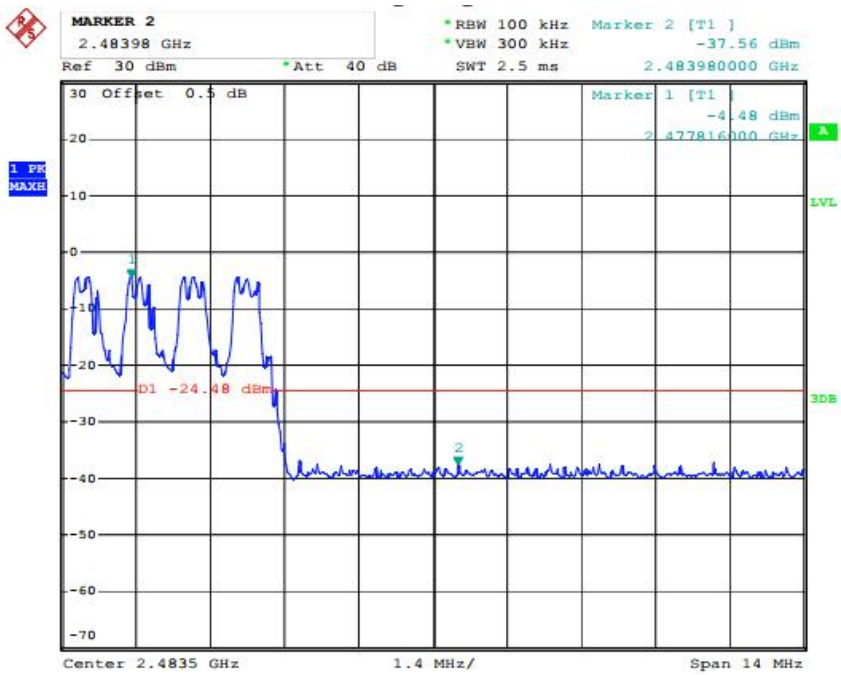
π /4-DQPSK


MARKER 2
2.397408 GHz
Ref 30 dBm
Att 40 dB
RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Marker 2 [T1]
-36.68 dBm
2.397408000 GHz
30 Offset 0.5 dB
Marker 1 [T1]
-6.67 dBm
2.403824000 GHz
1 PK MAXH
A
LVL
3DB
D1 -26.67 dBm
Center 2.4 GHz
800 kHz/
Span 8 MHz

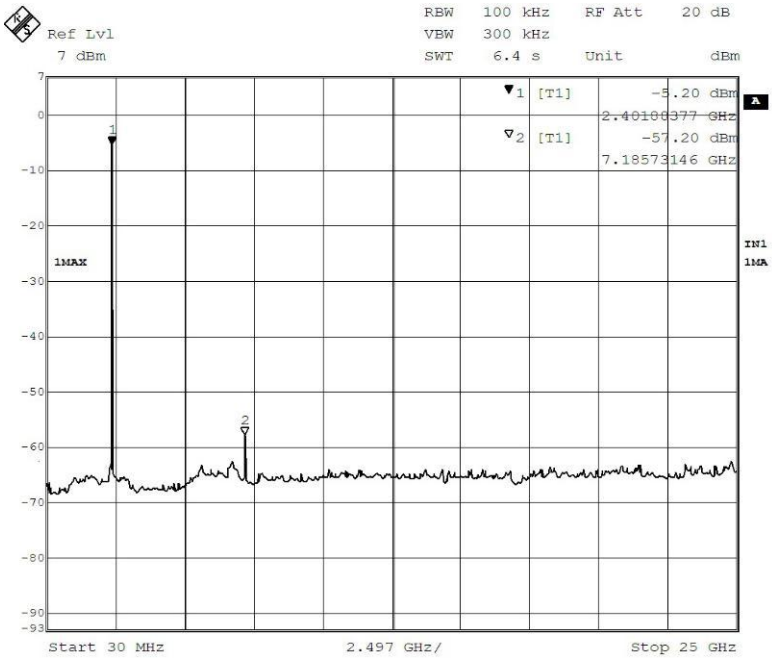

MARKER 2
2.483948 GHz
Ref 30 dBm
Att 40 dB
RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Marker 2 [T1]
-37.69 dBm
2.483948000 GHz
30 Offset 0.5 dB
Marker 1 [T1]
-4.50 dBm
2.476808000 GHz
1 PK MAXH
A
LVL
3DB
D1 -24.5 dBm
Center 2.4835 GHz
1.4 MHz/
Span 14 MHz

8DPSK

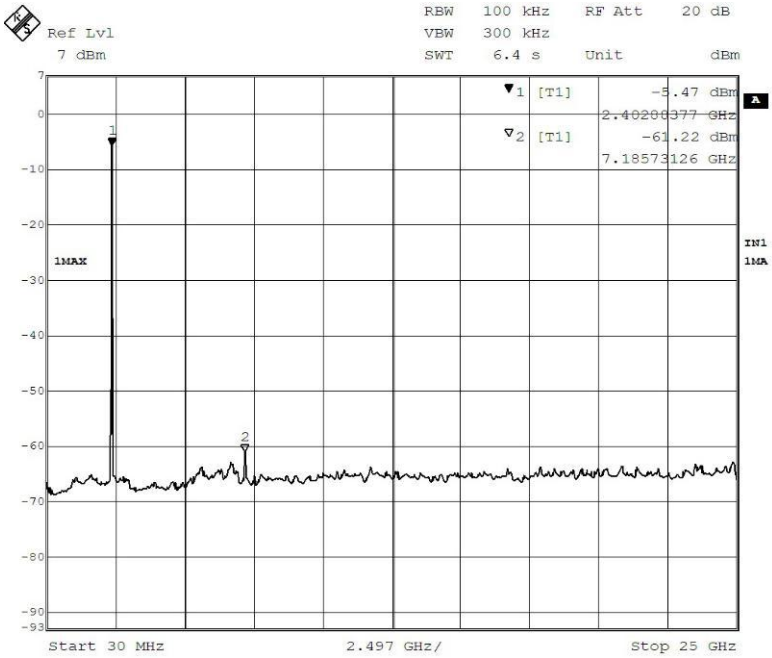

MARKER 2
2.397216 GHz
Ref 30 dBm
*Att 40 dB
*RBW 100 kHz
*VBW 300 kHz
SWT 2.5 ms
Marker 2 [T1]
-37.71 dBm
2.397216000 GHz
30 Offset 0.5 dB
Marker 1 [T1]
-6.63 dBm
2.403824000 GHz
D1 -26.63 dBm
1 PK
MAXH
LVL
3DB
Center 2.4 GHz
800 kHz/
Span 8 MHz


MARKER 2
2.48398 GHz
Ref 30 dBm
*Att 40 dB
*RBW 100 kHz
*VBW 300 kHz
SWT 2.5 ms
Marker 2 [T1]
-37.56 dBm
2.483980000 GHz
30 Offset 0.5 dB
Marker 1 [T1]
-4.48 dBm
2.477816000 GHz
D1 -24.48 dBm
1 PK
MAXH
LVL
3DB
Center 2.4835 GHz
1.4 MHz/
Span 14 MHz

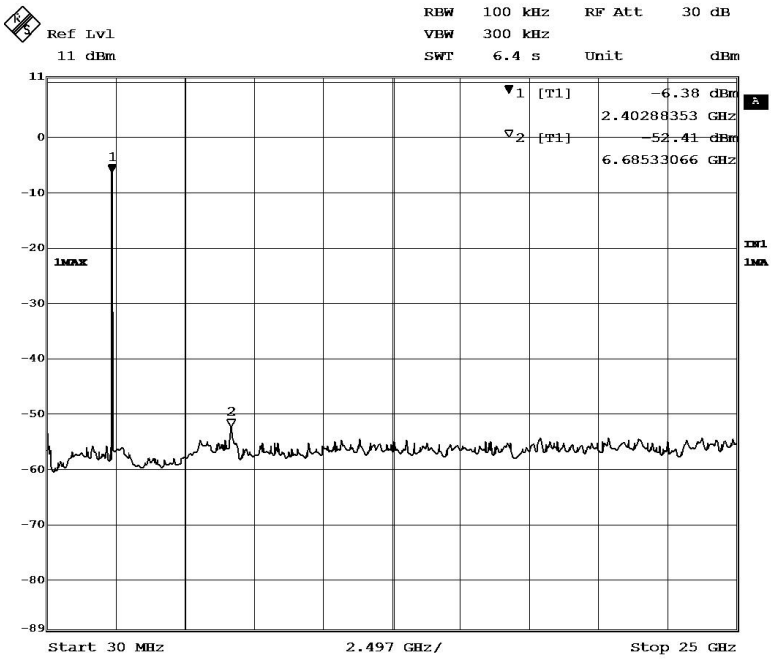
For Conduct spurious emissions: GFSK Low Channel Worstcase mode



π/4-DQPSK Low Channel Worstcase mode



8DPSK Low Channel Worstcase mode



9 20 dB Bandwidth Measurement

Test Requirement : FCC CFR47 Part 15 Section 15.247

Test Method : ANSI C63.10:2013

9.1 Test Procedure

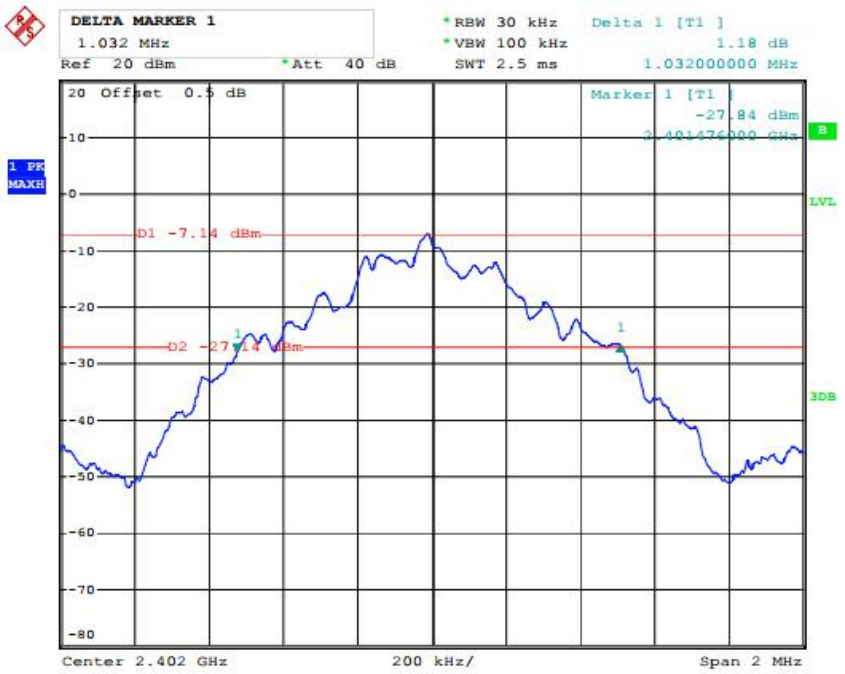
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;

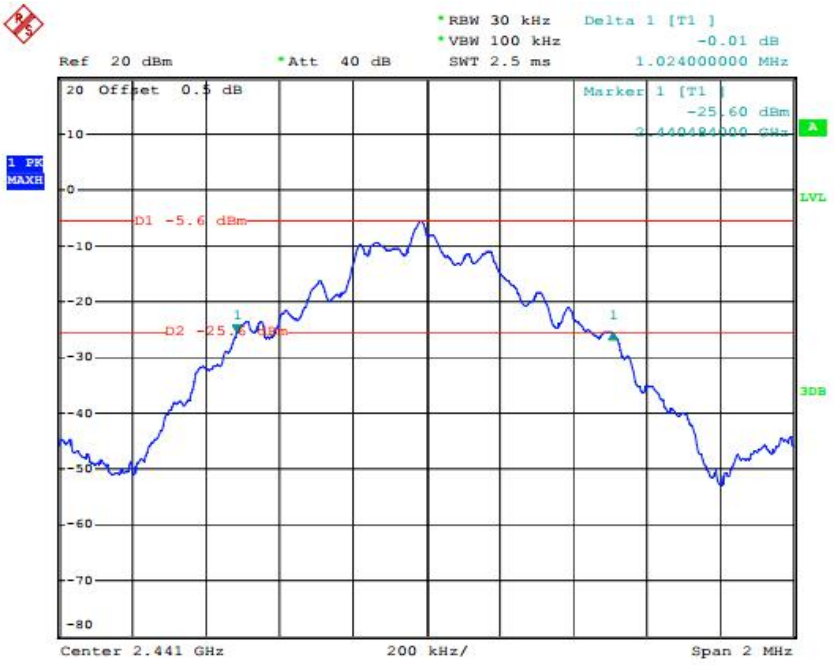
2. Set the spectrum analyzer: RBW =30kHz, VBW = 100kHz

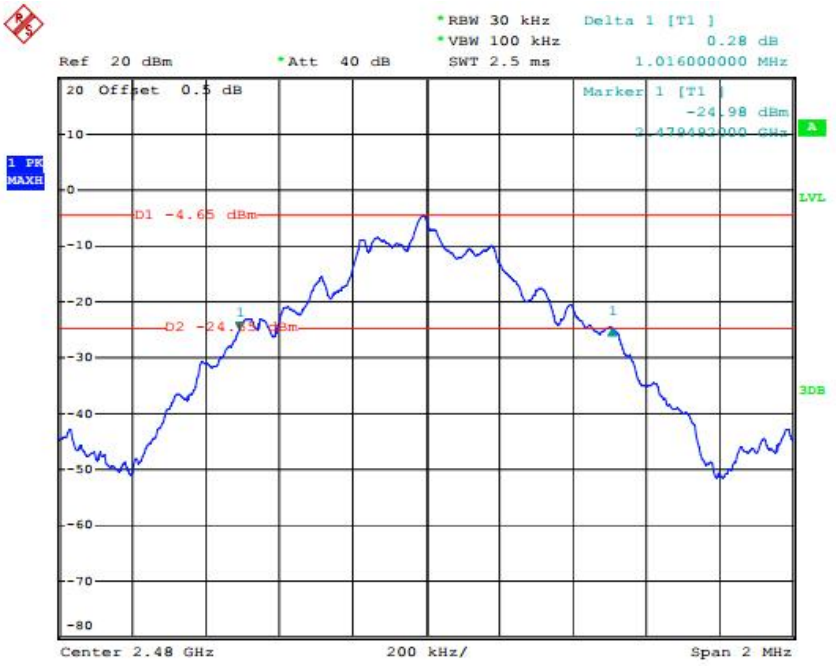
9.2 Test Result

Test Mode: CH00 / CH39 / CH78 (GFSK/(1Mbps)Mode)

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
00	2402	1032
39	2441	1024
78	2480	1016

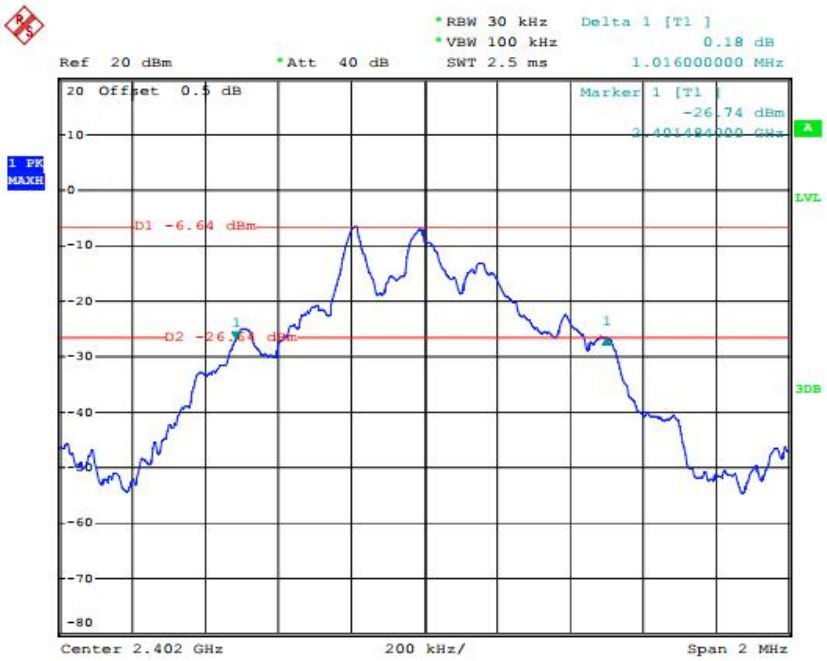


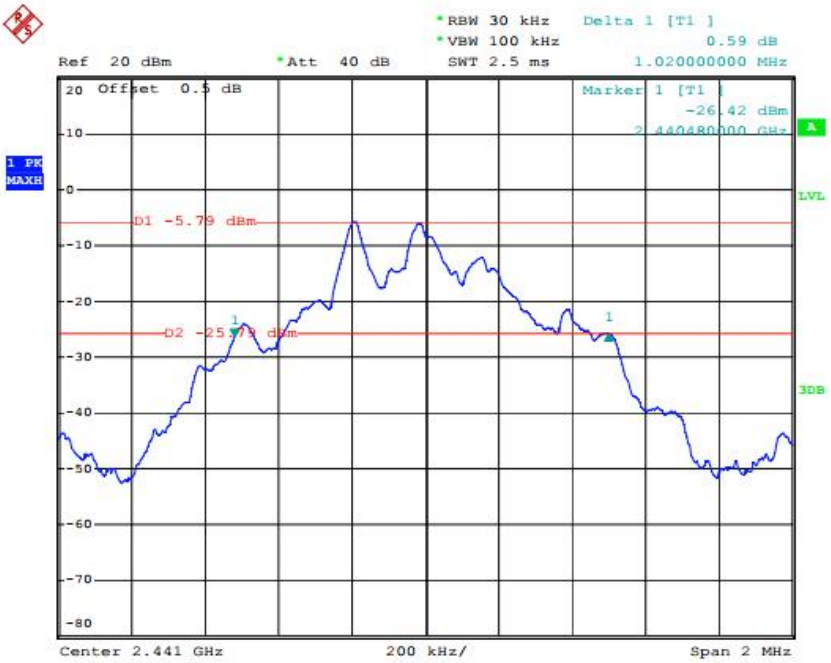

RBW 30 kHz
VBW 100 kHz
SWT 2.5 ms
Delta 1 [T1]
-0.01 dB
1.024000000 MHz
Ref 20 dBm
Att 40 dB
20 Offset 0.5 dB
Marker 1 [T1]
-25.60 dBm
2.440484000 GHz
1 PK MAXH
LVL
D1 -5.6 dBm
D2 -25.60 dBm
3DB
Center 2.441 GHz
200 kHz/
Span 2 MHz

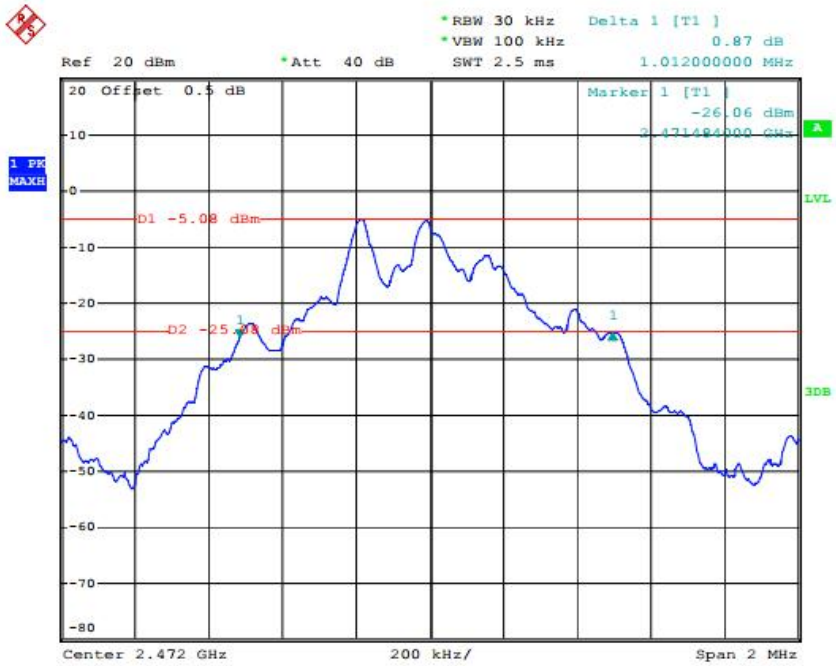

RBW 30 kHz
VBW 100 kHz
SWT 2.5 ms
Delta 1 [T1]
0.28 dB
1.016000000 MHz
Ref 20 dBm
Att 40 dB
20 Offset 0.5 dB
Marker 1 [T1]
-24.98 dBm
2.479492000 GHz
1 PK MAXH
LVL
D1 -4.65 dBm
D2 -24.98 dBm
3DB
Center 2.48 GHz
200 kHz/
Span 2 MHz

Test Mode: CH00 / CH39 / CH78 (Π/4-DQPSK /(2Mbps)Mode)

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
00	2402	1016
39	2441	1020
78	2480	1012

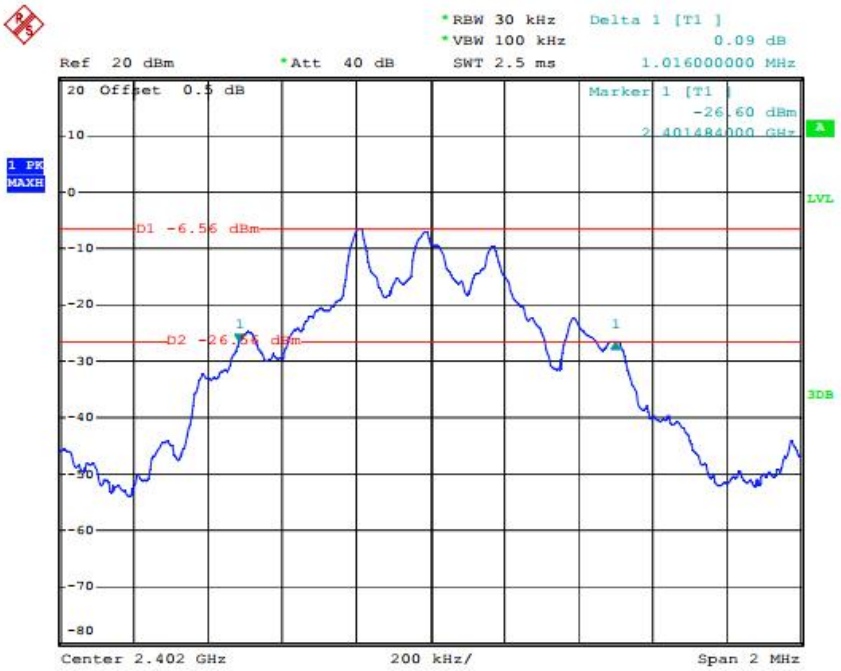


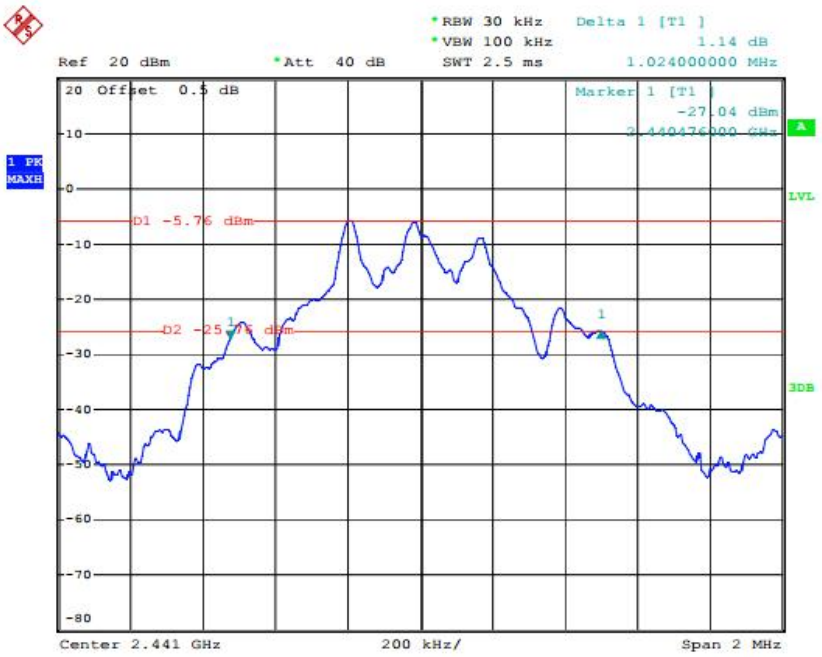

RBW 30 kHz
VBW 100 kHz
SWT 2.5 ms
Delta 1 [T1]
0.59 dB
1.020000000 MHz
Ref 20 dBm
Att 40 dB
Offset 0.5 dB
Marker 1 [T1]
-26.42 dBm
1 PK MAXH
D1 -5.79 dBm
D2 -25.79 dBm
LVL
3DB
Center 2.441 GHz
200 kHz/
Span 2 MHz

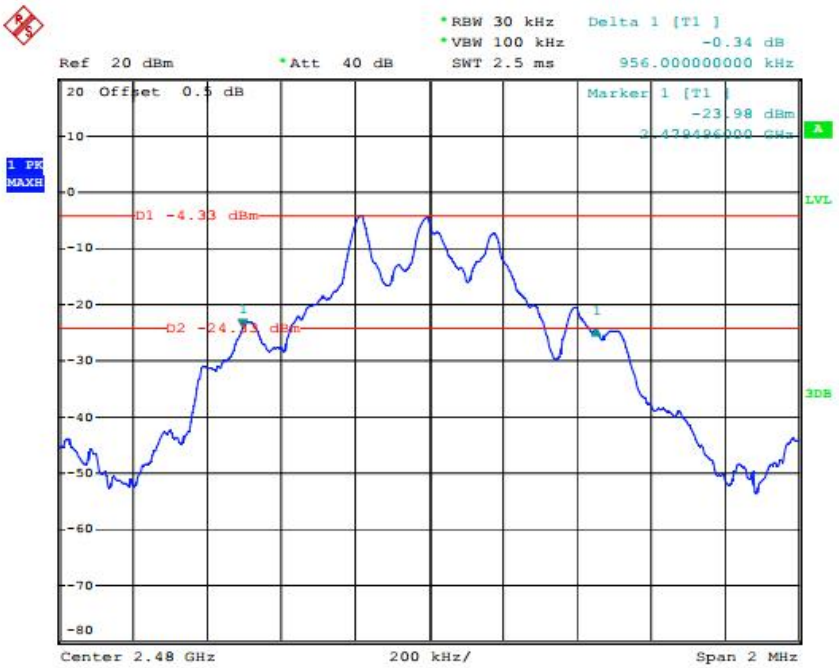

RBW 30 kHz
VBW 100 kHz
SWT 2.5 ms
Delta 1 [T1]
0.87 dB
1.012000000 MHz
Ref 20 dBm
Att 40 dB
Offset 0.5 dB
Marker 1 [T1]
-26.06 dBm
1 PK MAXH
D1 -5.08 dBm
D2 -25.08 dBm
LVL
3DB
Center 2.472 GHz
200 kHz/
Span 2 MHz

Test Mode: CH00 / CH39 / CH78 (8DPSK(3Mbps)Mode)

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
00	2402	1016
39	2441	1024
78	2480	956




RBW 30 kHz
VBW 100 kHz
SWT 2.5 ms
Delta 1 [T1]
1.14 dB
1.024000000 MHz
Ref 20 dBm
Att 40 dB
20 Offset 0.5 dB
Marker 1 [T1]
-27.04 dBm
2.440476000 GHz
1 PK MAXH
D1 -5.76 dBm
D2 -25.76 dBm
LVL
3DB
Center 2.441 GHz
200 kHz/
Span 2 MHz


RBW 30 kHz
VBW 100 kHz
SWT 2.5 ms
Delta 1 [T1]
-0.34 dB
956.000000000 kHz
Ref 20 dBm
Att 40 dB
20 Offset 0.5 dB
Marker 1 [T1]
-23.98 dBm
2.479496000 GHz
1 PK MAXH
D1 -4.33 dBm
D2 -24.33 dBm
LVL
3DB
Center 2.48 GHz
200 kHz/
Span 2 MHz

10 Maximum Peak Output Power

Test Requirement : FCC CFR47 Part 15 Section 15.247

Test Method : ANSI C63.10:2013

Test Limit : Regulation 15.247 (b)(1), For frequency hopping systems operating in the 2400-2483.5 MHz band eploying at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt (30dBm). For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

Refer to the result "Number of Hopping Frequency" of this document. The 0.125watts (20.97 dBm) limit applies.

10.1 Test Procedure

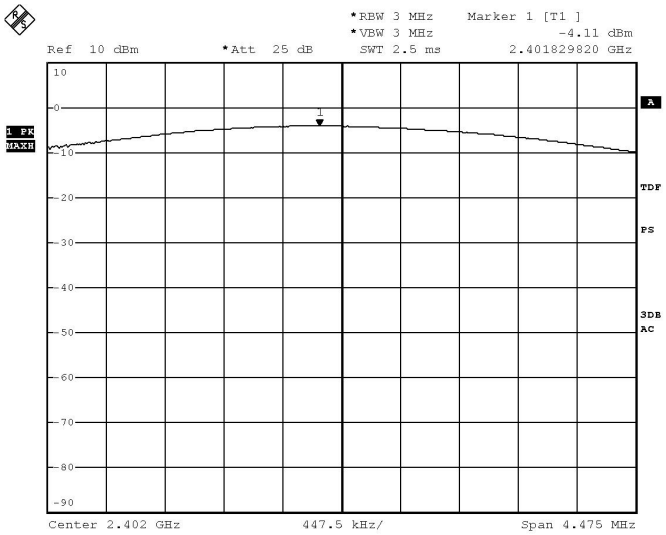
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

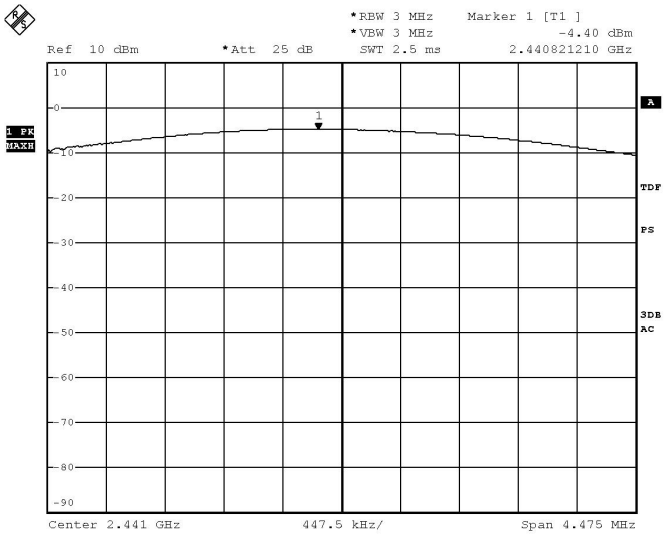
2. Set the spectrum analyser: RBW = 3 MHz. VBW =3MHz. Sweep = auto; Detector Function = Peak.

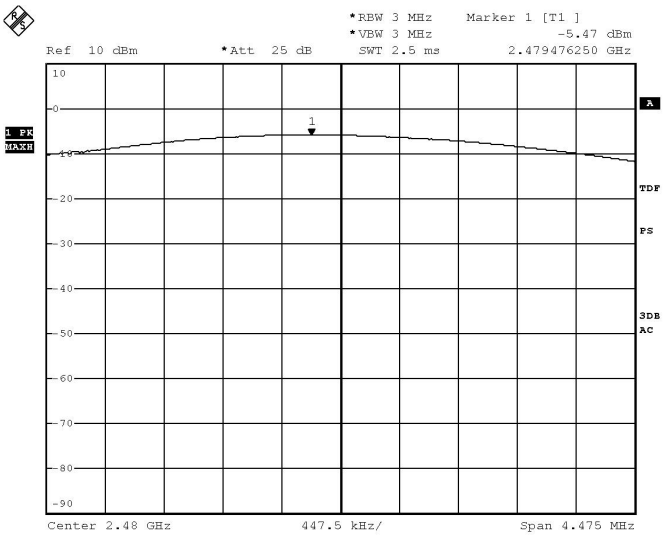
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

10.2 Test Result

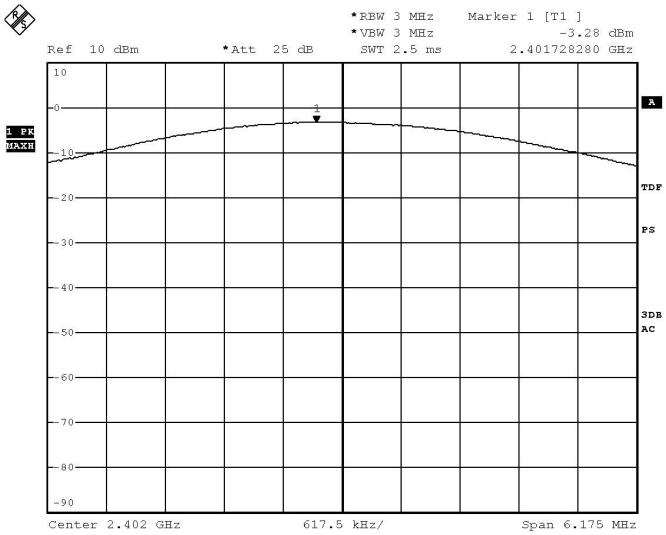
GFSK(1Mbps)					
Test Channel	Frequency	Conducted Output Peak Power	Conducted Output Peak Power	LIMIT	Pass/Fail
	(MHz)	(dBm)	(W)	(W)	
CH00	2402	-4.11	0.000388	0.125	Pass
CH39	2441	-4.40	0.000363	0.125	Pass
CH78	2480	-5.47	0.000284	0.125	Pass

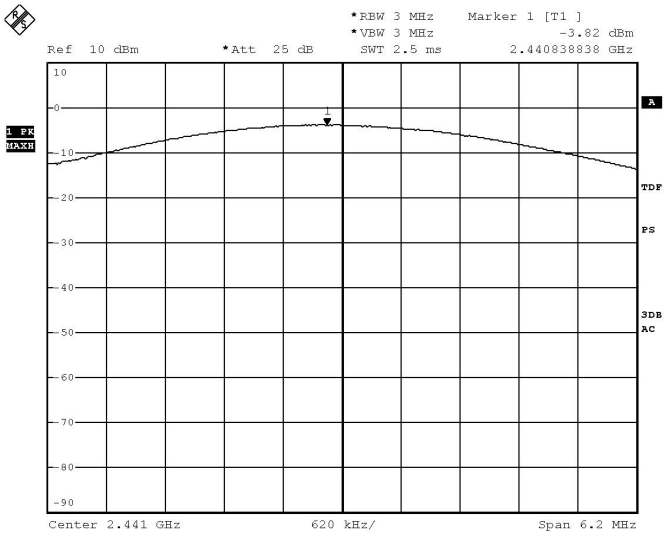

*RBW 3 MHz
Marker 1 [T1]
*VBW 3 MHz
-4.11 dBm
Ref 10 dBm
*Att 25 dB
SWT 2.5 ms
2.401829820 GHz
1 PK
MAXH
A
TDF
PS
3DB
AC
Center 2.402 GHz
447.5 kHz/
Span 4.475 MHz

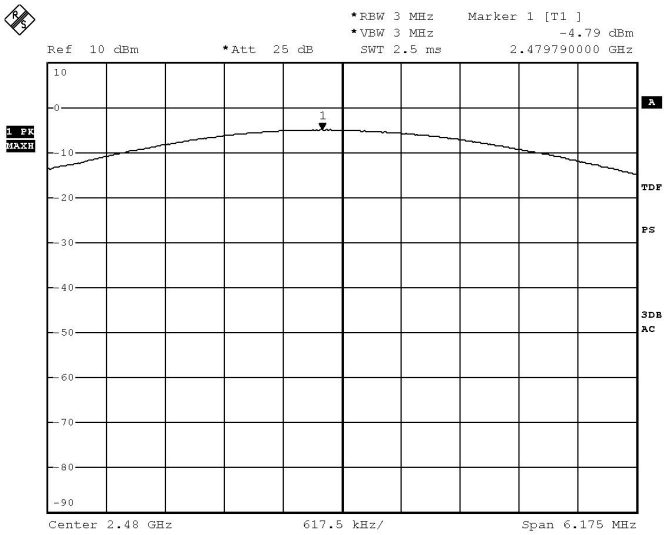

*RBW 3 MHz
Marker 1 [T1]
*VBW 3 MHz
-4.40 dBm
Ref 10 dBm
*Att 25 dB
SWT 2.5 ms
2.440821210 GHz
1 PK
MAXH
A
TDF
PS
3DB
AC
Center 2.441 GHz
447.5 kHz/
Span 4.475 MHz



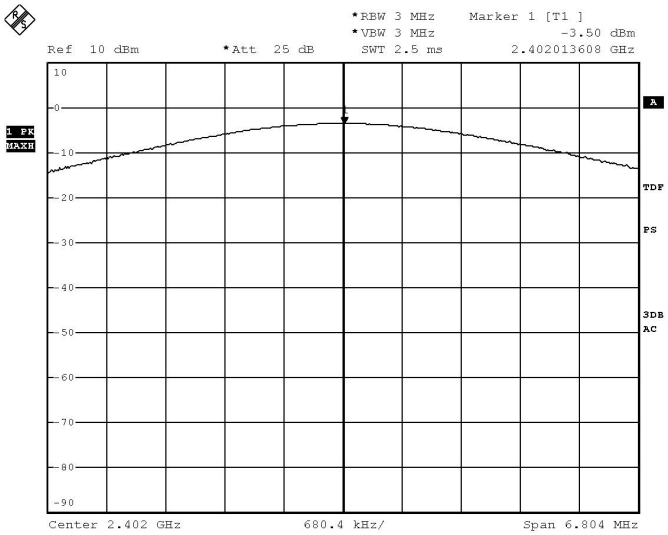
π/4QPSK(2Mbps)					
Test Channel	Frequency	Conducted Output Peak Power	Conducted Output Peak Power	LIMIT	Pass/Fail
	(MHz)	(dBm)	(W)	(W)	
CH00	2402	-3.28	0.000470	0.125	Pass
CH39	2441	-3.82	0.000415	0.125	Pass
CH78	2480	-4.79	0.000332	0.125	Pass

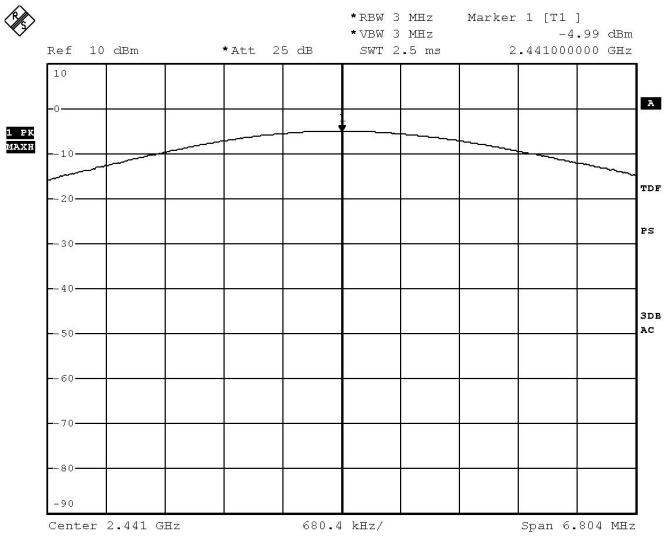

*RBW 3 MHz
*VBW 3 MHz
Marker 1 [T1]
-3.28 dBm
2.401728280 GHz
Ref 10 dBm
*Att 25 dB
SWT 2.5 ms
1 PK
MAXH
A
TDF
PS
3DB
AC
Center 2.402 GHz
617.5 kHz/
Span 6.175 MHz

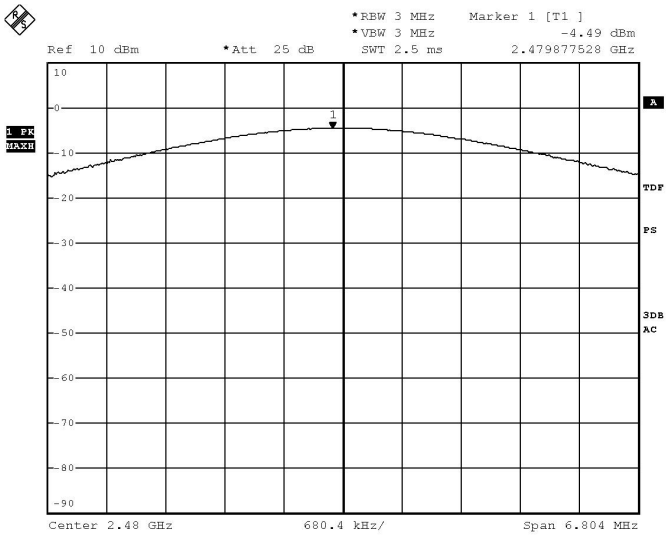

*RBW 3 MHz
*VBW 3 MHz
Marker 1 [T1]
-3.82 dBm
2.440838838 GHz
Ref 10 dBm
*Att 25 dB
SWT 2.5 ms
1 PK
MAXH
A
TDF
PS
3DB
AC
Center 2.441 GHz
620 kHz/
Span 6.2 MHz



8DPSK(3Mbps)					
Test Channel	Frequency	Conducted Output Peak Power	Conducted Output Peak Power	LIMIT	Pass/Fail
	(MHz)	(dBm)	(W)	(W)	
CH00	2402	-3.50	0.000447	0.125	Pass
CH39	2441	-4.99	0.000317	0.125	Pass
CH78	2480	-4.49	0.000356	0.125	Pass


*RBW 3 MHz
Marker 1 [T1]
*VBW 3 MHz
-3.50 dBm
Ref 10 dBm
*Att 25 dB
SWT 2.5 ms
2.402013608 GHz
1 PK
MAXH
A
TDF
PS
3DB
AC
Center 2.402 GHz
680.4 kHz/
Span 6.804 MHz


*RBW 3 MHz
Marker 1 [T1]
*VBW 3 MHz
-4.99 dBm
Ref 10 dBm
*Att 25 dB
SWT 2.5 ms
2.441000000 GHz
1 PK
MAXH
A
TDF
PS
3DB
AC
Center 2.441 GHz
680.4 kHz/
Span 6.804 MHz


*RBW 3 MHz
Marker 1 [T1]
*VBW 3 MHz
-4.49 dBm
Ref 10 dBm
*Att 25 dB
SWT 2.5 ms
2.479877528 GHz
1 PK
MAXH
A
TDF
PS
3DB
AC
Center 2.48 GHz
680.4 kHz/
Span 6.804 MHz

11 Hopping Channel Separation

Test Requirement	:	FCC CFR47 Part 15 Section 15.247
Test Method	:	ANSI C63.10:2013
Test Limit	:	Regulation 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 2400-2483.5MHz 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 1W.
Test Mode	:	Hopping

11.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

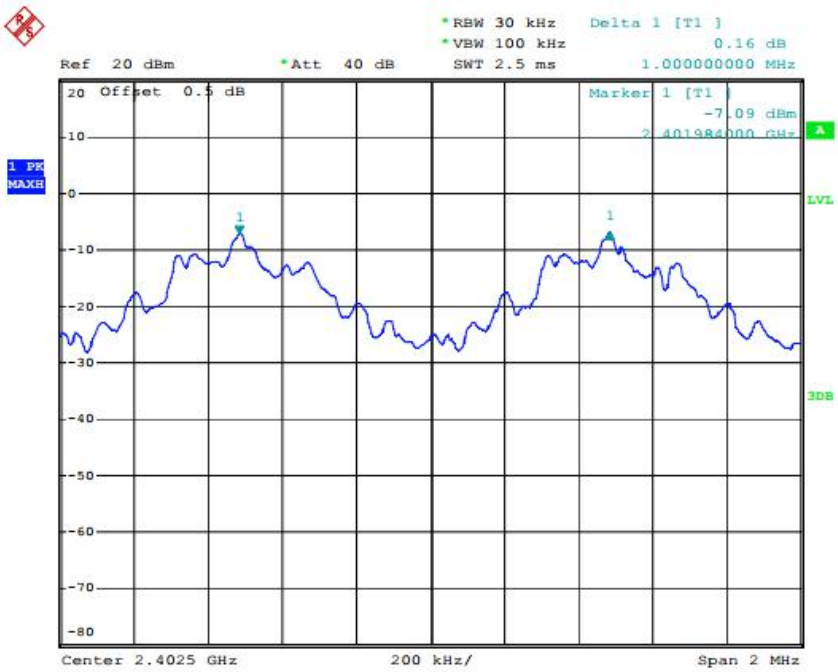
2. Set the spectrum analyzer: RBW = 30KHz. VBW = 100KHz, Span = 4.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

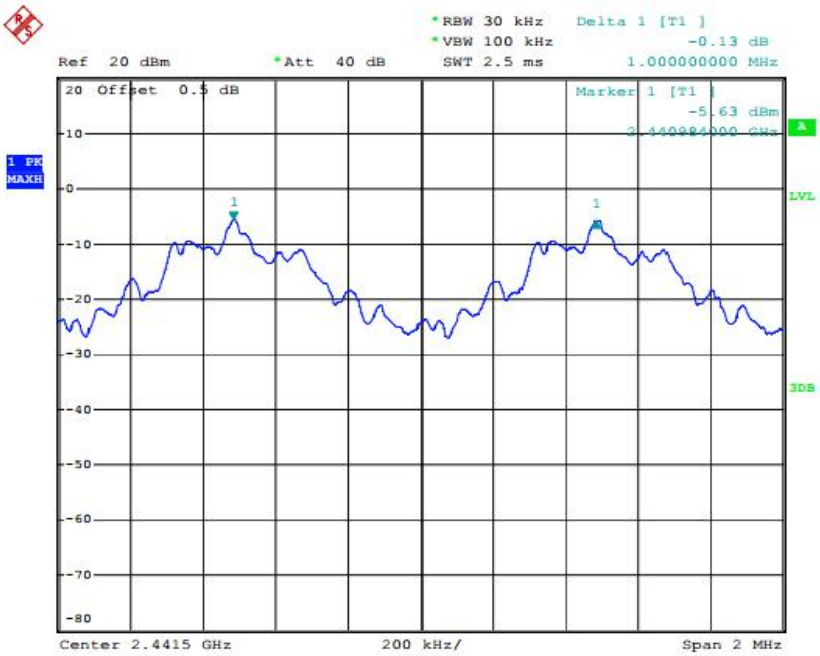
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

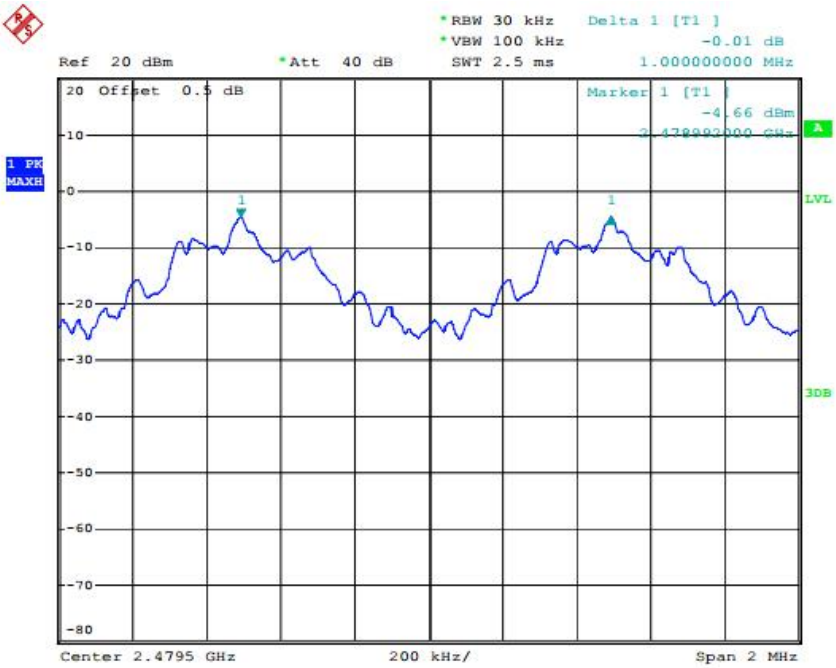
11.2 Test Result

Test Mode:	CH00 / CH39 / CH78 (GFSK(1Mbps) Mode)

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3*20dB Down BW(kHz)
00	2402	1000	>688.0
39	2441	1000	>682.7
78	2480	1000	>677.3

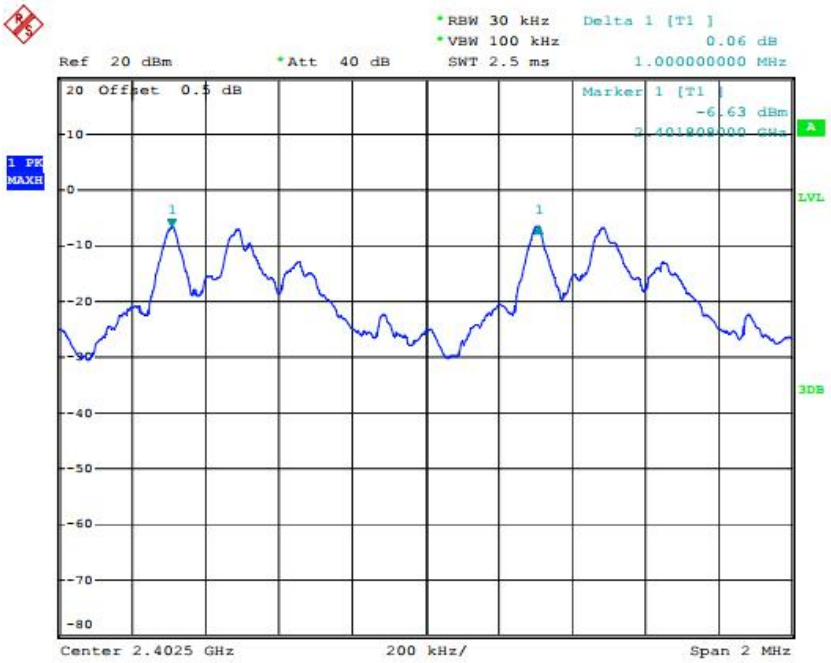


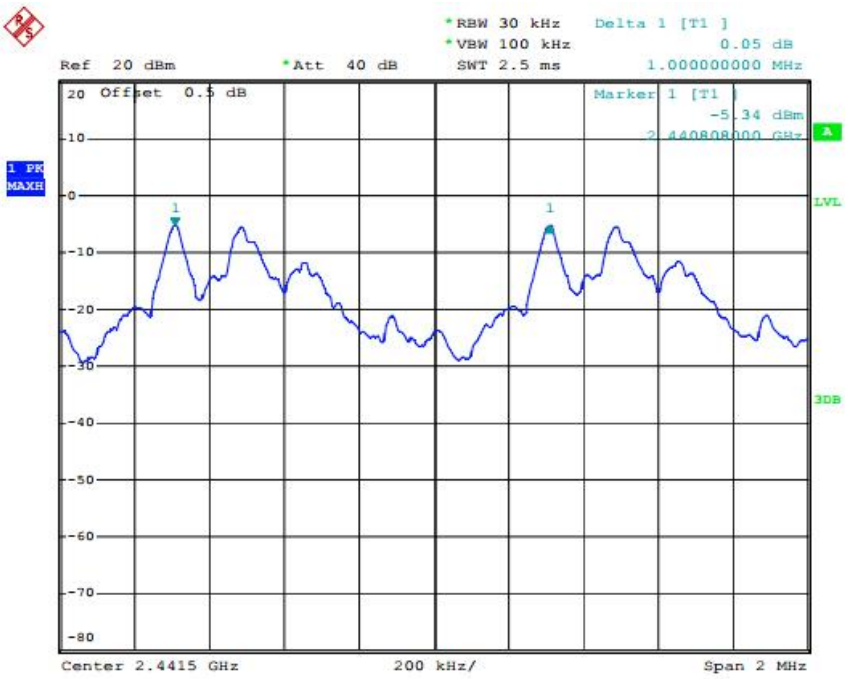

RBW 30 kHz
VBW 100 kHz
SWT 2.5 ms
Delta 1 [T1]
-0.13 dB
1.000000000 MHz
Ref 20 dBm
Att 40 dB
20 Offset 0.5 dB
Marker 1 [T1]
-5.63 dBm
1 PK MAXH
LVL
3DB
Center 2.4415 GHz
200 kHz/
Span 2 MHz

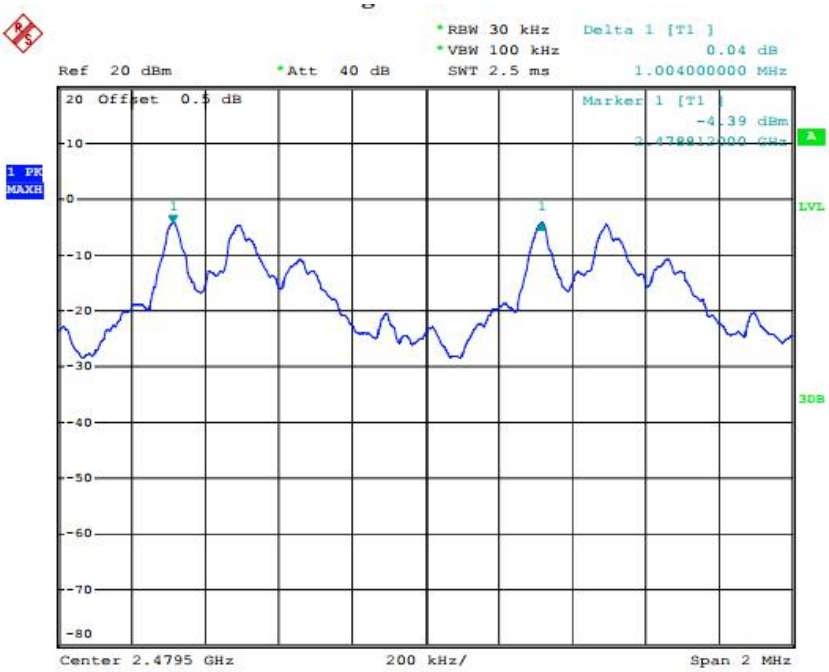

RBW 30 kHz
VBW 100 kHz
SWT 2.5 ms
Delta 1 [T1]
-0.01 dB
1.000000000 MHz
Ref 20 dBm
Att 40 dB
20 Offset 0.5 dB
Marker 1 [T1]
-4.66 dBm
1 PK MAXH
LVL
3DB
Center 2.4795 GHz
200 kHz/
Span 2 MHz

Test Mode:	CH00 / CH39 / CH78 (π/4-DQPSK(2Mbps) Mode)

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
00	2402	1000	>677.3
39	2441	1000	>674.7
78	2480	1000	>674.7

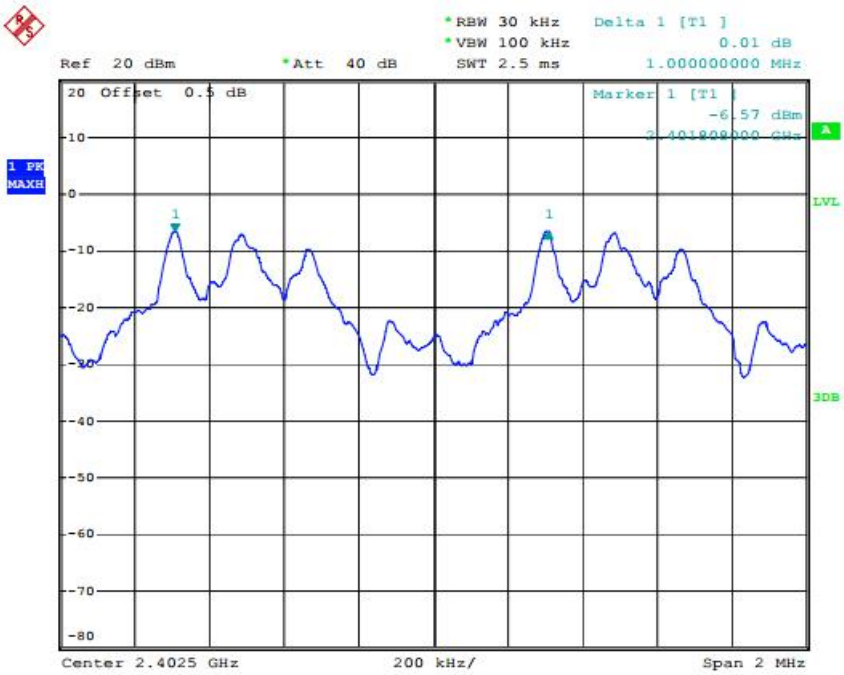


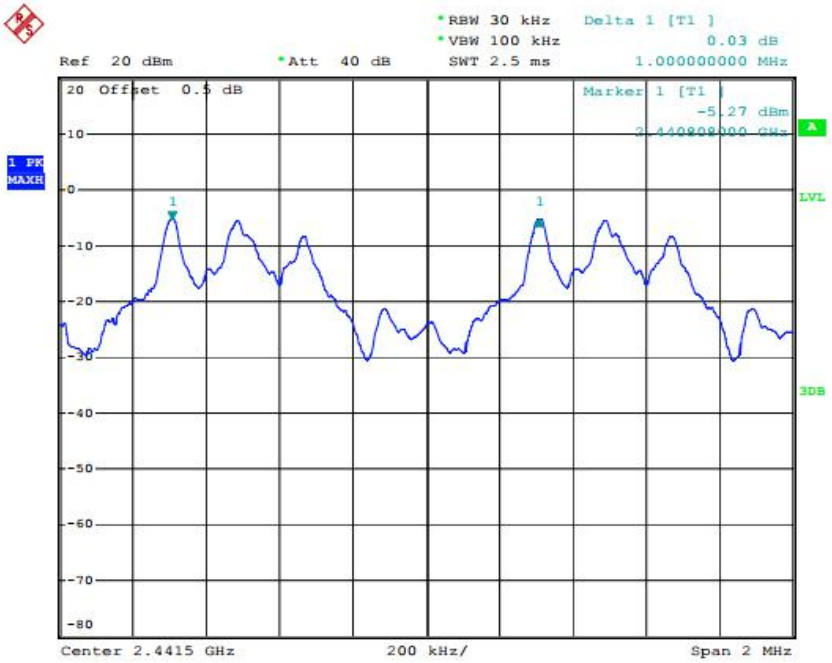

RBW 30 kHz
VBW 100 kHz
SWT 2.5 ms
Delta 1 [T1]
0.05 dB
1.000000000 MHz
Ref 20 dBm
Att 40 dB
Offset 0.5 dB
Marker 1 [T1]
-5.34 dBm
2.440808000 GHz
1 PK MAXH
LVL
3DB
Center 2.4415 GHz
200 kHz/
Span 2 MHz

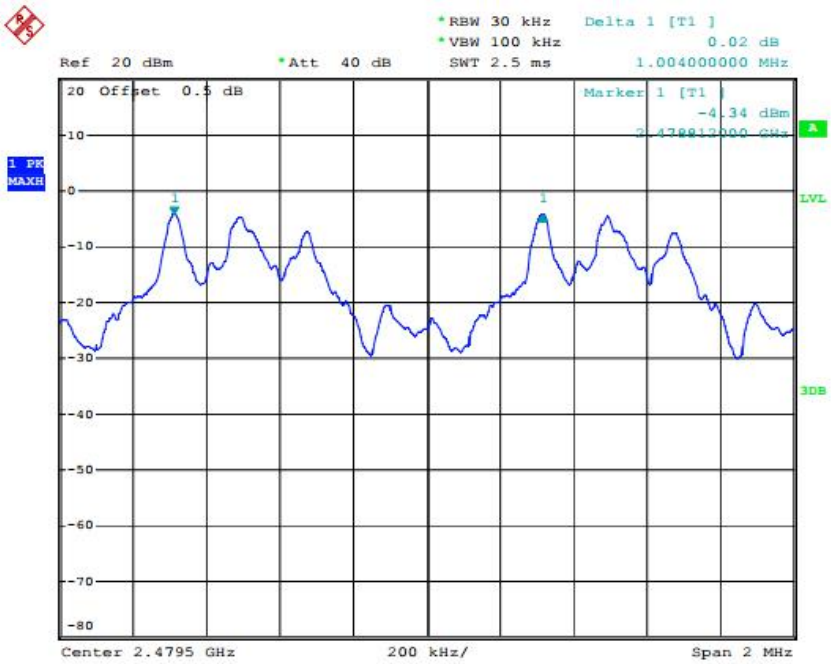

RBW 30 kHz
VBW 100 kHz
SWT 2.5 ms
Delta 1 [T1]
0.04 dB
1.004000000 MHz
Ref 20 dBm
Att 40 dB
Offset 0.5 dB
Marker 1 [T1]
-4.39 dBm
1 PK MAXH
LVL
3DB
Center 2.4795 GHz
200 kHz/
Span 2 MHz

Test Mode:	CH00 / CH39 / CH78 (8DPSK(3Mbps)Mode)

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
00	2402	1000	>677.3
39	2441	1000	>682.7
78	2480	1004	>637.3




RBW 30 kHz
VBW 100 kHz
SWT 2.5 ms
Delta 1 [T1]
0.03 dB
1.000000000 MHz
Ref 20 dBm
Att 40 dB
20 Offset 0.5 dB
Marker 1 [T1]
-5.27 dBm
1 PK MAXH
LVL
3DB
Center 2.4415 GHz
200 kHz/
Span 2 MHz


RBW 30 kHz
VBW 100 kHz
SWT 2.5 ms
Delta 1 [T1]
0.02 dB
1.004000000 MHz
Ref 20 dBm
Att 40 dB
20 Offset 0.5 dB
Marker 1 [T1]
-4.34 dBm
1 PK MAXH
LVL
3DB
Center 2.4795 GHz
200 kHz/
Span 2 MHz

12 Number of Hopping Frequency

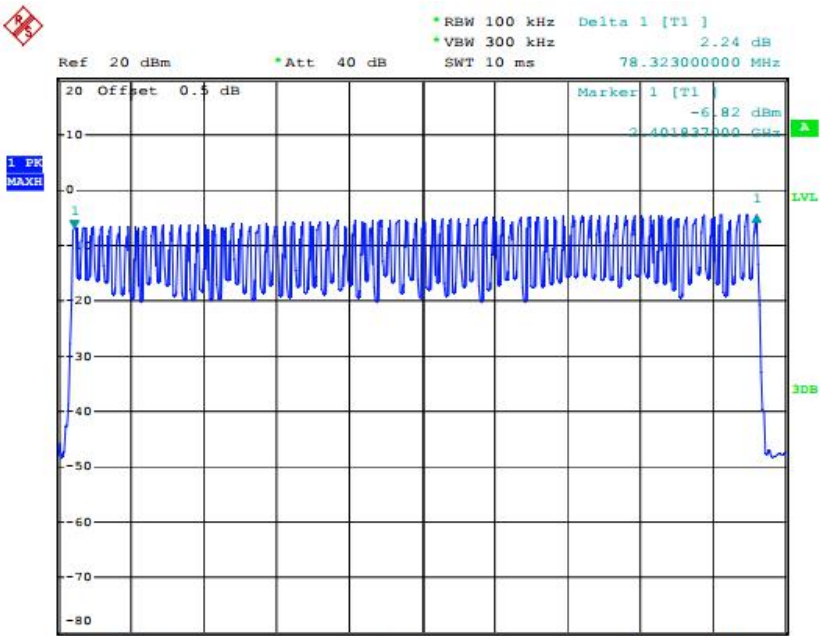
Test Requirement	:	FCC CFR47 Part 15 Section 15.247
Test Method	:	ANSI C63.10:2013
Test Limit	:	Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
Test Mode	:	Hopping(GFSK)

12.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100KHz. VBW = 300KHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.483GHz. Sweep=auto;

12.2 Test Result

Channel Number	Limit
79	≥15



13 Dwell Time

Test Requirement	:	FCC CFR47 Part 15 Section 15.247
Test Method	:	ANSI C63.10:2013
Test Limit	:	Regulation 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.
Test Mode	:	The worst case(GFSK) was recorded

13.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set spectrum analyzer span = 0. Centred on a hopping channel;

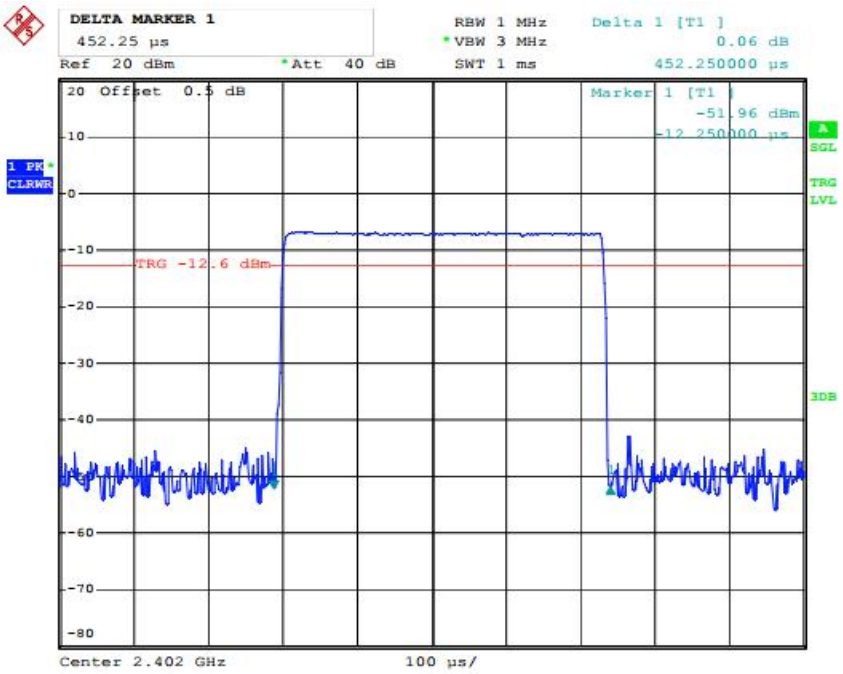
3. Set RBW = 1MHz and VBW = 3MHz.Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.

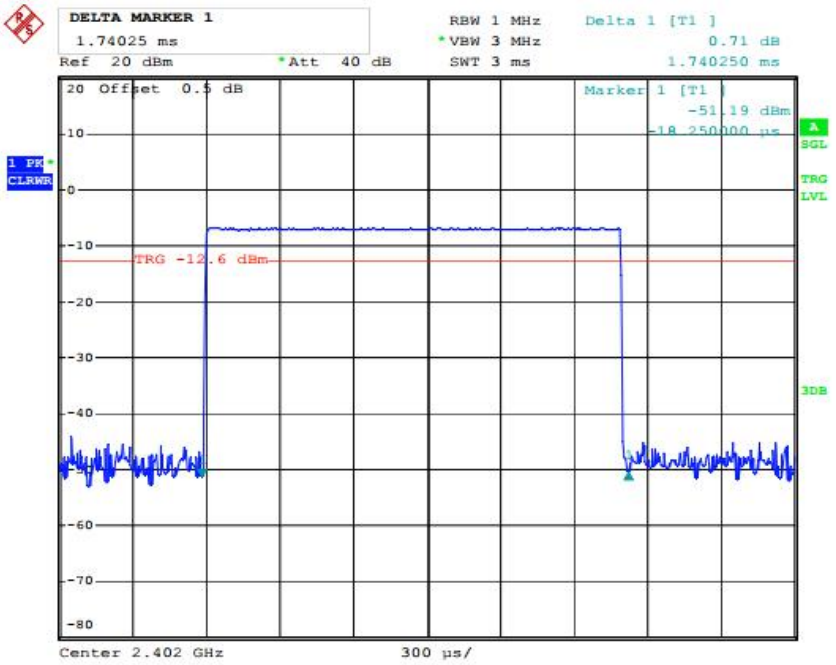
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

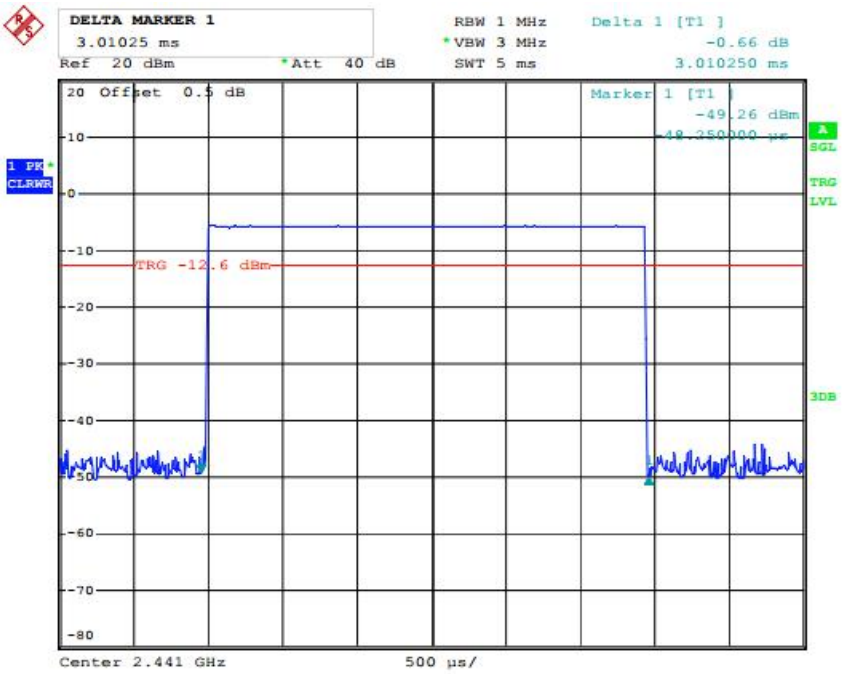
13.2 Test Result

Test Mode:	GFSK(1Mbps)

Mode	Packet	Length of transmissions time(sec)	Result (sec)	Limit (sec)
GFSK	DH1	0.452	0.145	0.4
	DH3	1.740	0.278	0.4
	DH5	3.010	0.321	0.4
	Note: The test period= 0.4 Second/channel * 79 channel = 31.6s Calculation Formula: Dwell time=Ton time per hop*Hopping numbers*Period For Example: DH1 time slot=0.452*(1600/(2*79))*31.6=145ms DH3 time slot=1.740*(1600/(4*79))*31.6=278ms DH5 time slot=3.010*(1600/(6*79))*31.6=321ms			


DELTA MARKER 1
452.25 µs
RBW 1 MHz
VBW 3 MHz
SWT 1 ms
Delta 1 [T1]
0.06 dB
452.250000 µs
Ref 20 dBm
Att 40 dB
20 Offset 0.5 dB
Marker 1 [T1]
-51.96 dBm
-12.250000 µs
1 PK
CLRWR
A
SGL
TRG
LVL
TRG -12.6 dBm
3DB
Center 2.402 GHz
100 µs/


DELTA MARKER 1
1.74025 ms
RBW 1 MHz
VBW 3 MHz
SWT 3 ms
Delta 1 [T1]
0.71 dB
1.740250 ms
Ref 20 dBm
Att 40 dB
20 Offset 0.5 dB
Marker 1 [T1]
-51.19 dBm
-18.250000 µs
1 PK
CLRWR
A
SGL
TRG
LVL
TRG -12.6 dBm
3DB
Center 2.402 GHz
300 µs/


DELTA MARKER 1
3.01025 ms
Ref 20 dBm
*Att 40 dB
RBW 1 MHz
*VBW 3 MHz
SWT 5 ms
Delta 1 [T1]
-0.66 dB
3.010250 ms
20 Offset 0.5 dB
Marker 1 [T1]
-49.26 dBm
-48.250000 µs
1 PK
CLRWR
A
SGL
TRG
LVL
TRG -12.6 dBm
3DB
10
0
-10
-20
-30
-40
-50
-60
-70
-80
Center 2.441 GHz
500 µs/

14 Antenna Requirement

14.1 Antenna Requirement

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. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

14.2 Result

The EUT'S antenna, permanent attached antenna, is PCB Antenna. The antenna's gain is 0dBi and meets the requirement.

15 TEST PHOTOS

Conducted Emissions

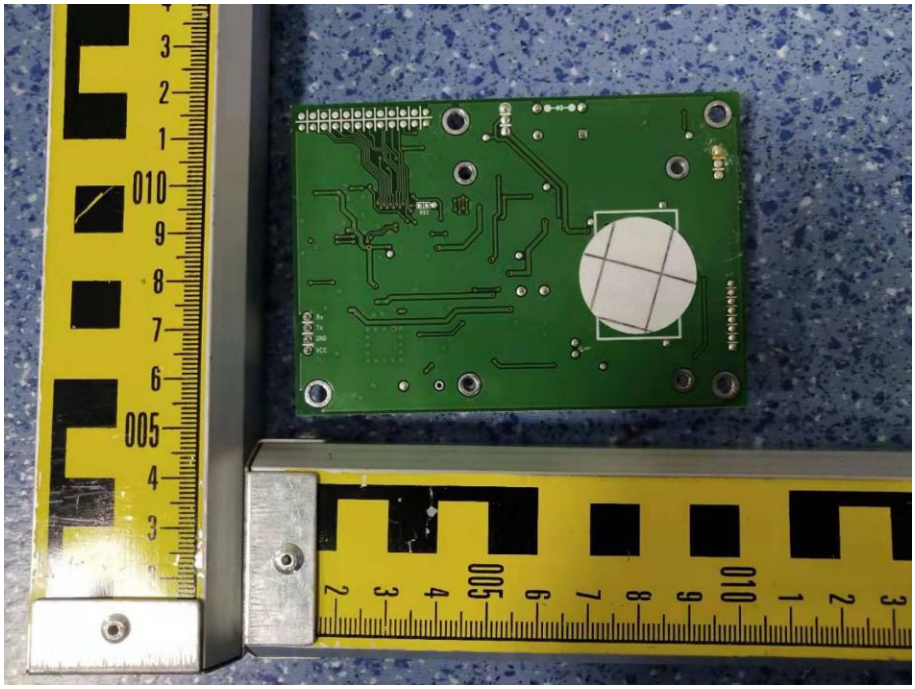
Radiated Spurious Emissions

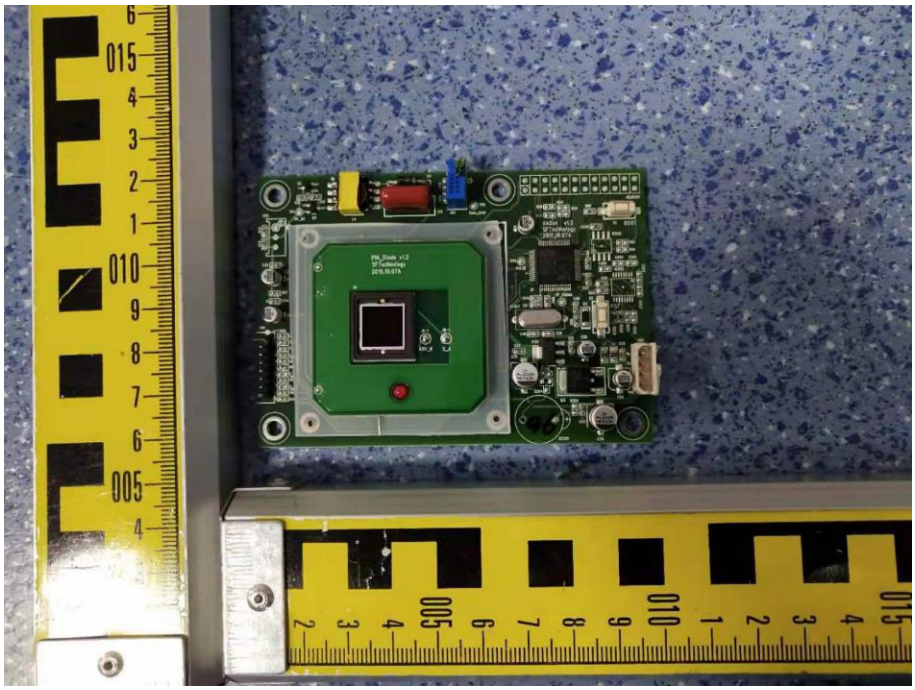
Test Frequency From Below 1000MHz

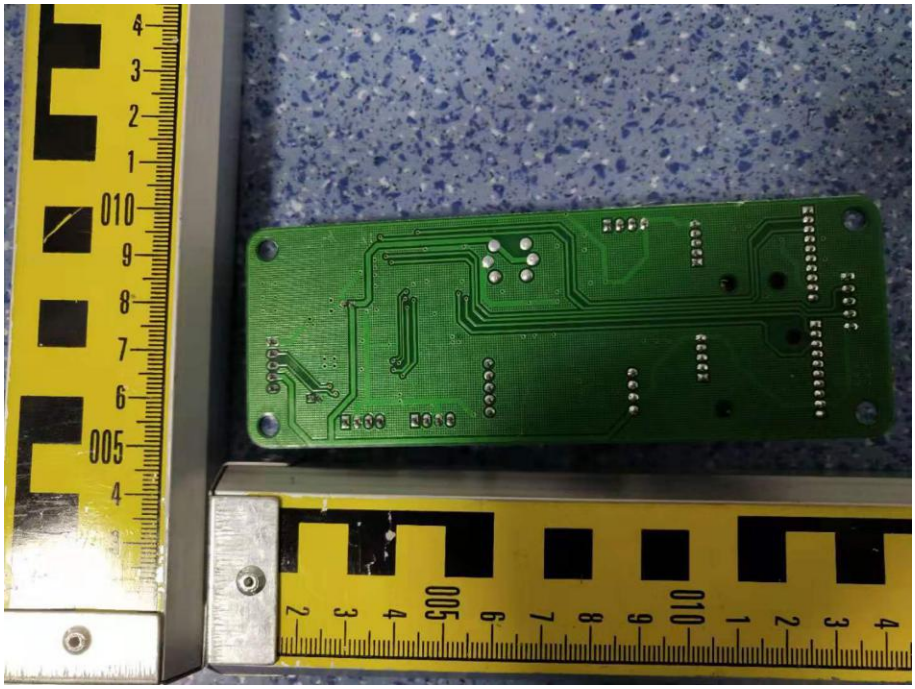
Test frequency from Above 1GHz

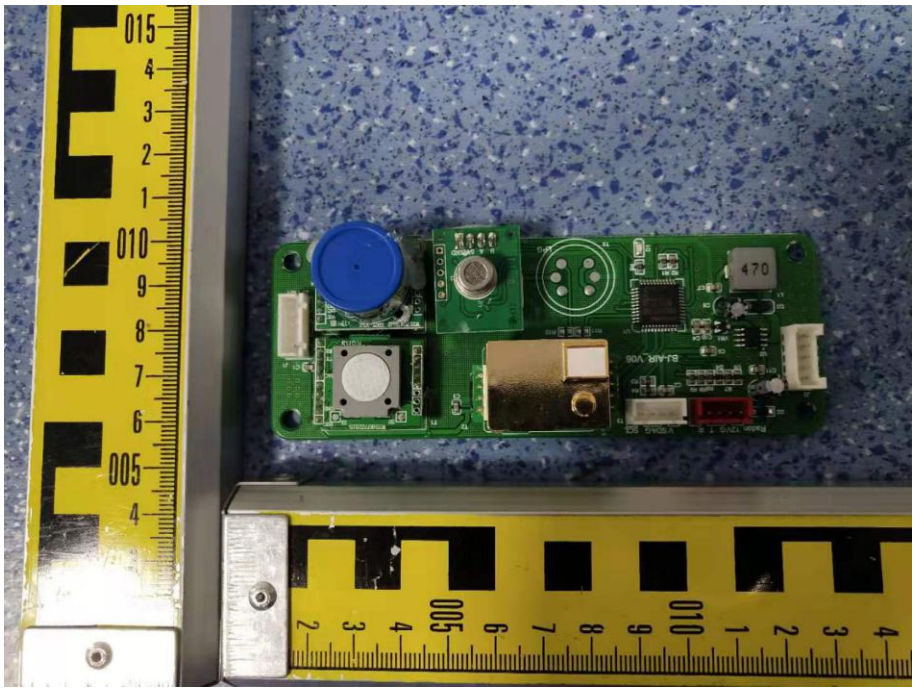
16 EUT PHOTOS

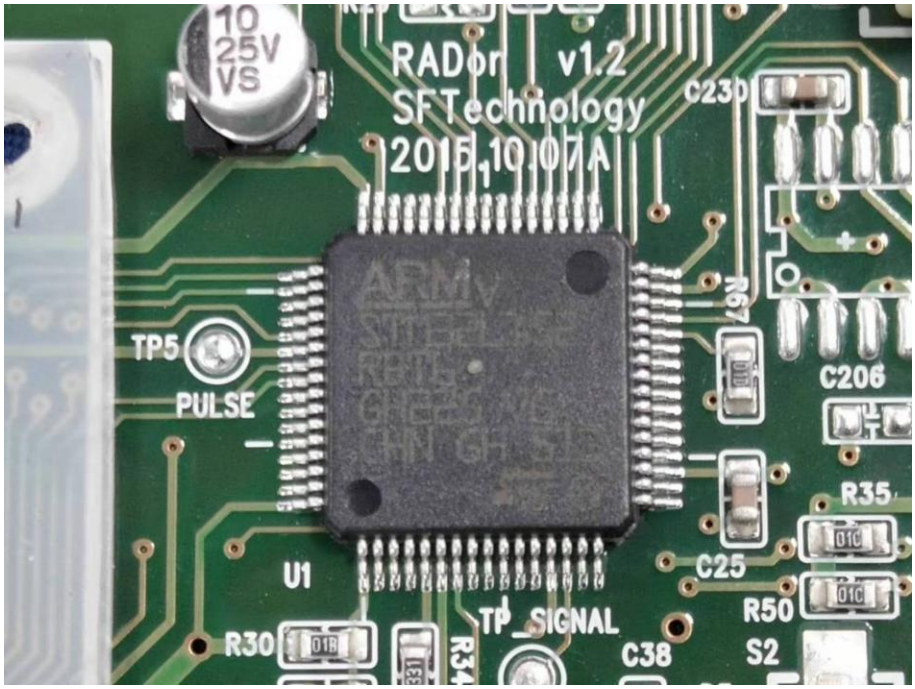
AGERA

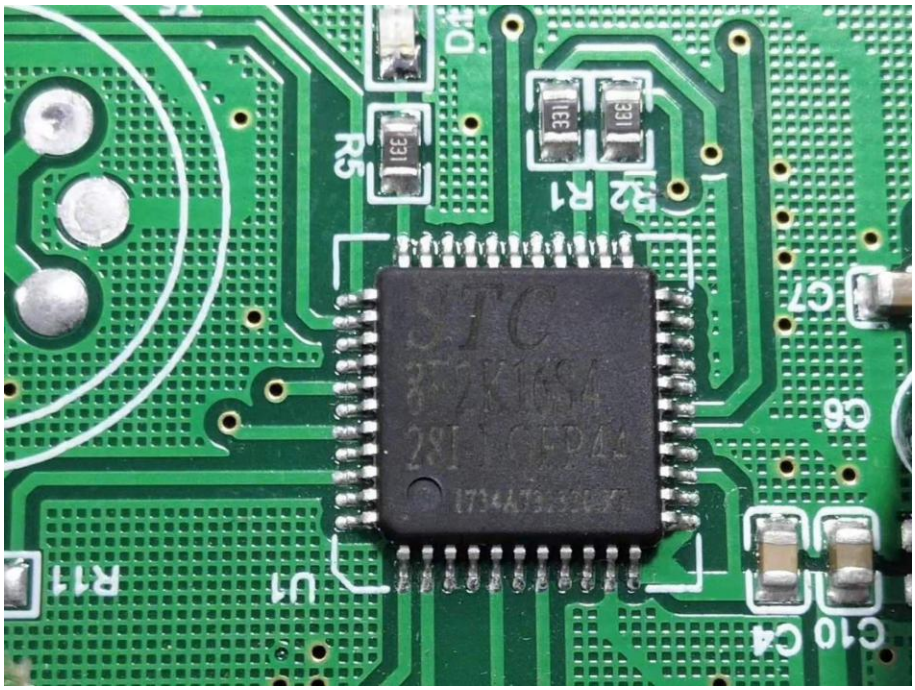







470





********THE END REPORT********