

FCC TEST REPORT

FCC ID: 2AIEE-DA149

Product Name	:	Wireless Portable Speaker
Model Name	:	DA149
Brand Name	:	N/A
Report No.	:	PTCHX07170921002E-FC01
Prepared for		
Shenzhen Tomtop Technology Co., Ltd		
G Zone 5/f, NO 1 Exchange Square, Huanan City, Pinghu Town, Longgang District Shenzhen, Guangdong Province 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 : Shenzhen Tomtop Technology Co., Ltd
Address : G Zone 5/f, NO 1 Exchange Square, Huanan City, Pinghu Town,
Longgang District Shenzhen, Guangdong Province China
Manufacture's name : SHENZHEN NARUI ELECTRONIC CO., LTD.
Address : No.6 Building, Ma'an shan Industrial Zone, Hao'San Area, Shajing Sub-
District, Bao'an District, Shenzhen city, China
Product name : Wireless Portable Speaker
Model name : DA149
Brand Name : N/A
Standards : FCC CFR47 Part 15 Section 15.247
Test procedure : ANSI C63.10:2013
Test Date : July 09, 2017 to July 11, 2017
Date of Issue : July 12, 2017
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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Testing Engineer

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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

Remark:

N/A: Not Applicable



PRECISE TESTING

Report No.: PTCHX07170921002E-FC01

3 TEST FACILITY

Dongguan Precise Testing & Certification Corp., Ltd.

Building D, Baoding Technology Park, Guangming Road2, Dongcheng District, Dongguan, Guangdong,
China, Dongguan, 523129

China

FCC Registration Number: 371540

IC Registration Number: 12191A-1



4 General Information

4.1 General Description of E.U.T.

Product Name	: Wireless Portable Speaker
Model Name	: DA149
Bluetooth Version	: BT4.1+EDR
Operating frequency	: 2402-2480MHz
Numbers of Channel	: 79 channels
Antenna Type:	: PCB Print Antenna
Antenna Gain:	: 2dBi
Type of Modulation	: GFSK, Pi/4DQPSK, 8DPSK
Power supply	: DC 3.7V, 2000mAh Battery
Hardware Version	: N/A
Software Version	: 4.1



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, $\pi/4$ -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)
1	2402
40	2441
79	2480



5 Equipment During Test

5.1 Equipments List

RF Conducted Test

Name of Equipment	Manufacturer	Model	Serial No.	Calibration Due
MXG Signal Analyzer	Agilent	N9020A	MY56070279	Apr 7, 18
MIMO4TX-1	/	MIMO4TX	TW5451101	Apr 7, 18
MXG Vector Signal Generator	Agilent	N5182A	MY50143410	Apr 7, 18
MXG Analog Signal Generator	KEYSIGHT	N5181B	MY53050432	Apr 7, 18

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.	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	Sep. 03, 2018
Bilog Antenna	SCHWARZBECK	VULB9160	9160-3355	Aug 31, 2018
Preamplifier (low frequency)	SCHWARZBECK	BBV 9475	9745-0013	Sep. 03, 2018
Spectrum Analyzer	Agilent	E4407B	MY45109572	Oct. 13, 2017
Horn Antenna	SCHWARZBECK	9120D	9120D-1246	Aug. 31, 2018
LOW NOISE AMPLIFIER	ZHINAN	ZN3380C	15002	Sep 03, 2018

Conducted Emissions

Name of Equipment	Manufacturer	Model	Serial No.	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	Sep. 03, 2018
Artificial Mains Network	Rohde&Schwarz	L2-16B	000WX31025	Sep. 03, 2018
Artificial Mains Network	Rohde&Schwarz	ENV216	101342	Sep. 03, 2018



5.2 Measurement Uncertainty

Parameter	Uncertainty
RF output power, conducted	$\pm 1.0\text{dB}$
Power Spectral Density, conducted	$\pm 2.2\text{dB}$
Radio Frequency	$\pm 1 \times 10^{-6}$
Bandwidth	$\pm 1.5 \times 10^{-6}$
Time	$\pm 2\%$
Duty Cycle	$\pm 2\%$
Temperature	$\pm 1^{\circ}\text{C}$
Humidity	$\pm 5\%$
DC and low frequency voltages	$\pm 3\%$
Conducted Emissions (150kHz~30MHz)	$\pm 3.64\text{dB}$
Radiated Emission(30MHz~1GHz)	$\pm 5.03\text{dB}$
Radiated Emission(1GHz~25GHz)	$\pm 4.74\text{dB}$
Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95%	



5.3 Description of Support Units

Equipment	Model No.	Series No.
Adapter	NSA12UH-050200 Input: AC 100-240V, 50/60Hz, 0.5A Output: DC 5V, 2A	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)

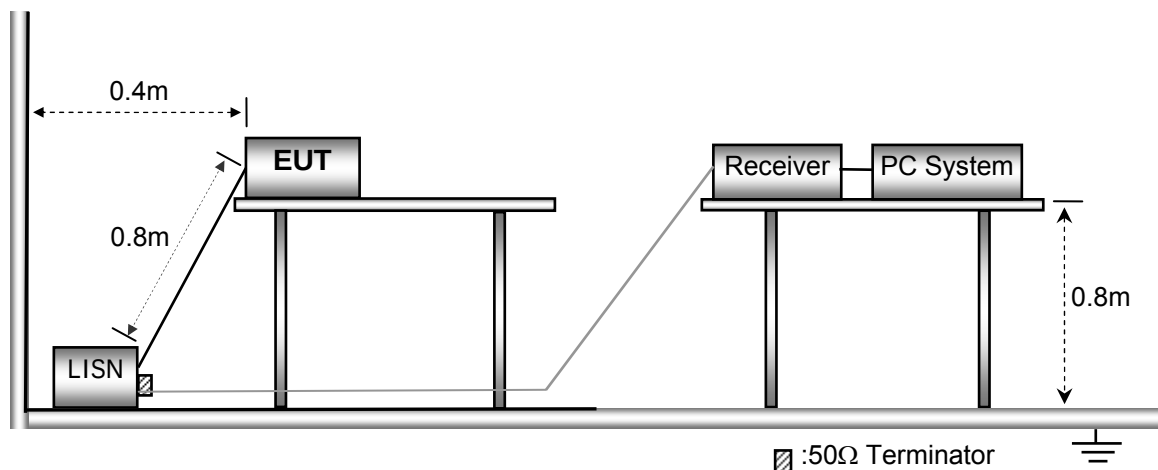
6.1 E.U.T. Operation

Operating Environment :

Temperature: : 25.5 °C
Humidity: : 51 % RH
Atmospheric Pressure: : 101.2kPa
EUT Operation : : Refer to section 3.3

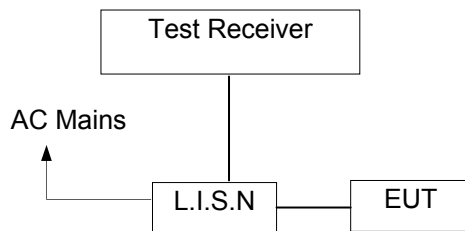
6.2 EUT Setup

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.

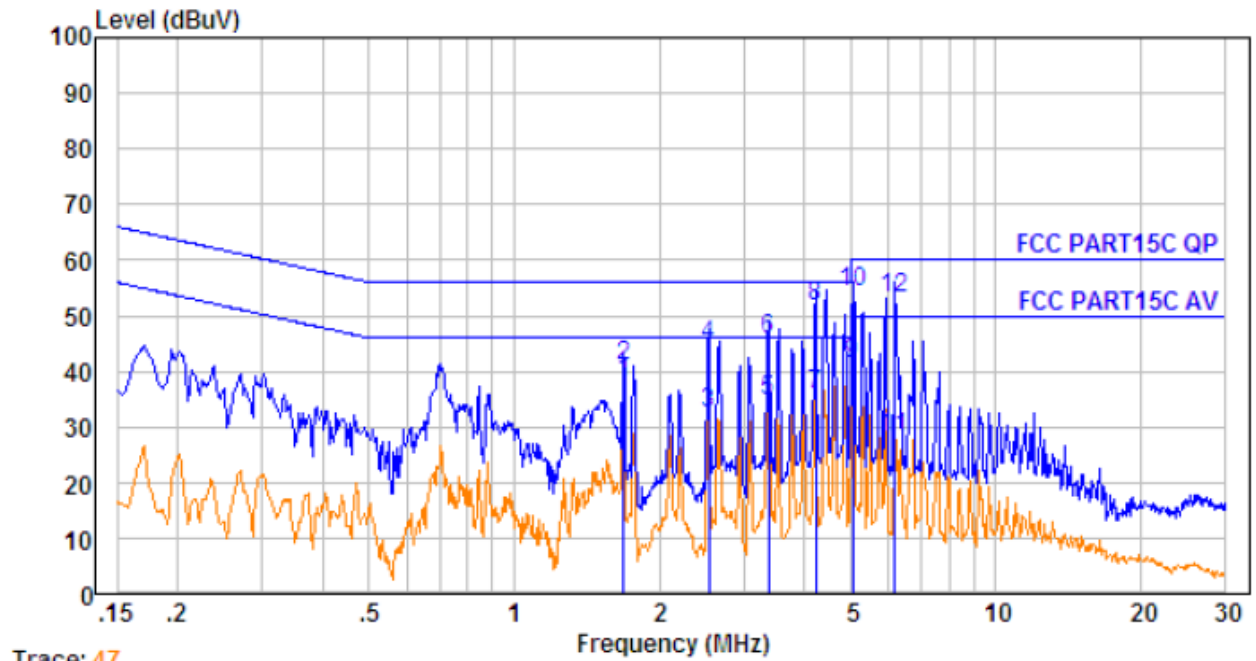
6.7 Conducted Emission Test Result

Pass

Please find the following pages.



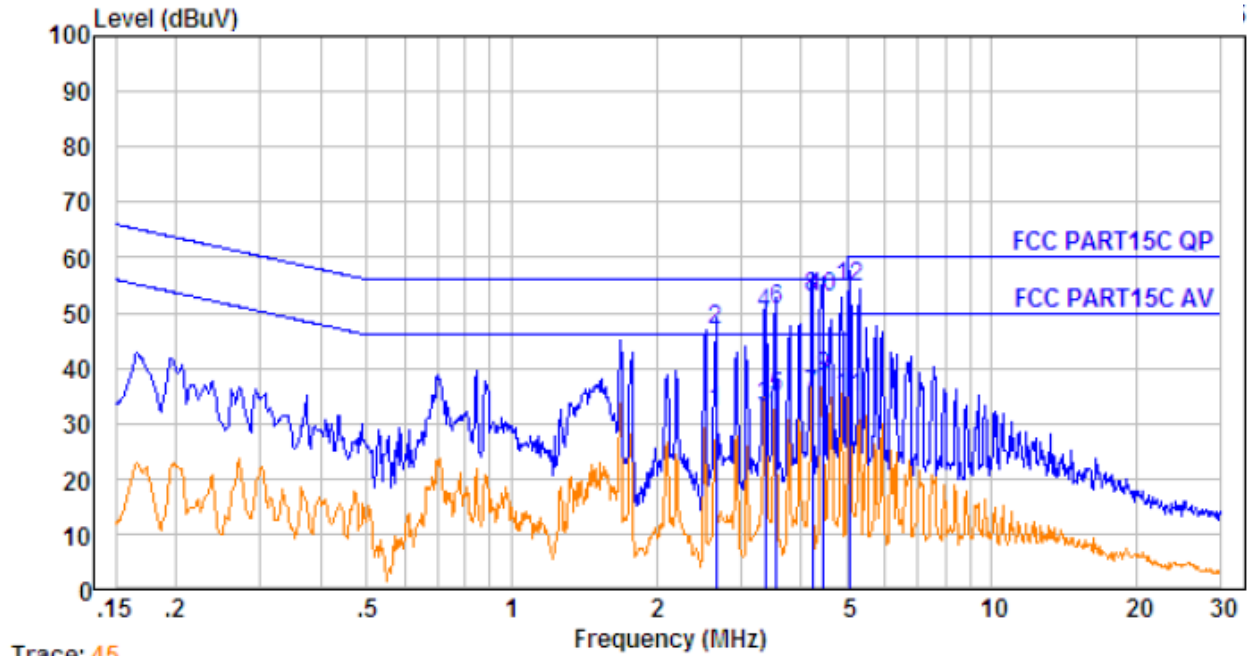
Line -120V/60Hz:



No.	Freq MHz	Cable Loss dB	AMN Factor dB	Receiver Reading dBUV	Emission Level dBUV	Limit dBUV	Over Limit dB	Remark
1.	1.689	0.47	0.15	37.40	38.02	46.00	-7.98	Average
2.	1.689	0.47	0.15	40.40	41.02	56.00	-14.98	QP
3.	2.540	0.47	0.15	32.02	32.64	46.00	-13.36	Average
4.	2.540	0.47	0.15	44.02	44.64	56.00	-11.36	QP
5.	3.381	0.47	0.15	34.23	34.85	46.00	-11.15	Average
6.	3.381	0.47	0.15	45.23	45.85	56.00	-10.15	QP
7.	4.224	0.48	0.15	35.03	35.66	46.00	-10.34	Average
8.	4.224	0.48	0.15	51.03	51.66	56.00	-4.34	QP
9.	5.058	0.50	0.15	40.52	41.17	50.00	-8.83	Average
10.	5.058	0.50	0.15	53.52	54.17	60.00	-5.83	QP
11.	6.186	0.53	0.15	27.50	28.18	50.00	-21.82	Average
12.	6.186	0.53	0.15	52.50	53.18	60.00	-6.82	QP



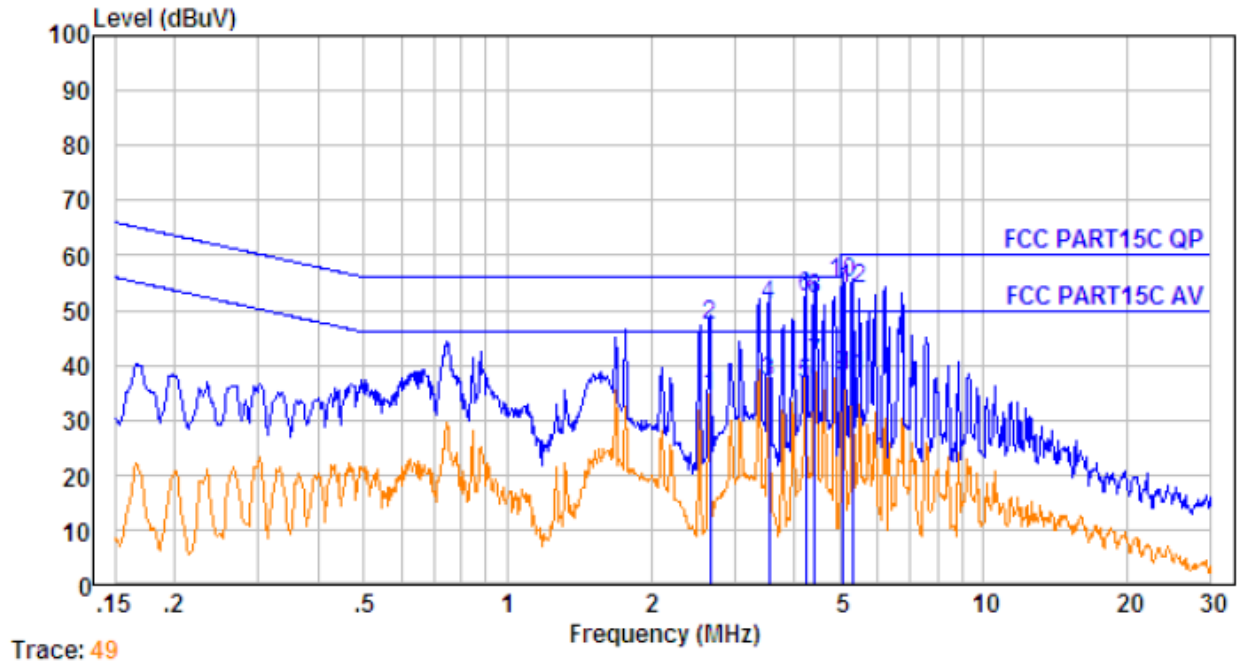
Neutral -120V/60Hz:



No.	Freq MHz	Cable Loss dB	AMN Factor dB	Receiver Reading dBuV	Emission Level dBuV	Limit dBuV	Over Limit dB	Remark
1.	2.664	0.47	0.33	31.22	32.02	46.00	-13.98	Average
2.	2.664	0.47	0.33	46.22	47.02	56.00	-8.98	QP
3.	3.381	0.47	0.32	32.20	32.99	46.00	-13.01	Average
4.	3.381	0.47	0.32	49.20	49.99	56.00	-6.01	QP
5.	3.565	0.47	0.32	33.80	34.59	46.00	-11.41	Average
6.	3.565	0.47	0.32	49.80	50.59	56.00	-5.41	QP
7.	4.224	0.48	0.31	34.22	35.01	46.00	-10.99	Average
8.	4.224	0.48	0.31	52.10	52.89	56.00	-3.11	QP
9.	4.454	0.49	0.31	37.64	38.44	46.00	-7.56	Average
10.	4.454	0.49	0.31	51.80	52.60	56.00	-3.40	QP
11.	5.058	0.50	0.31	33.81	34.62	50.00	-15.38	Average
12.	5.058	0.50	0.31	53.81	54.62	60.00	-5.38	QP



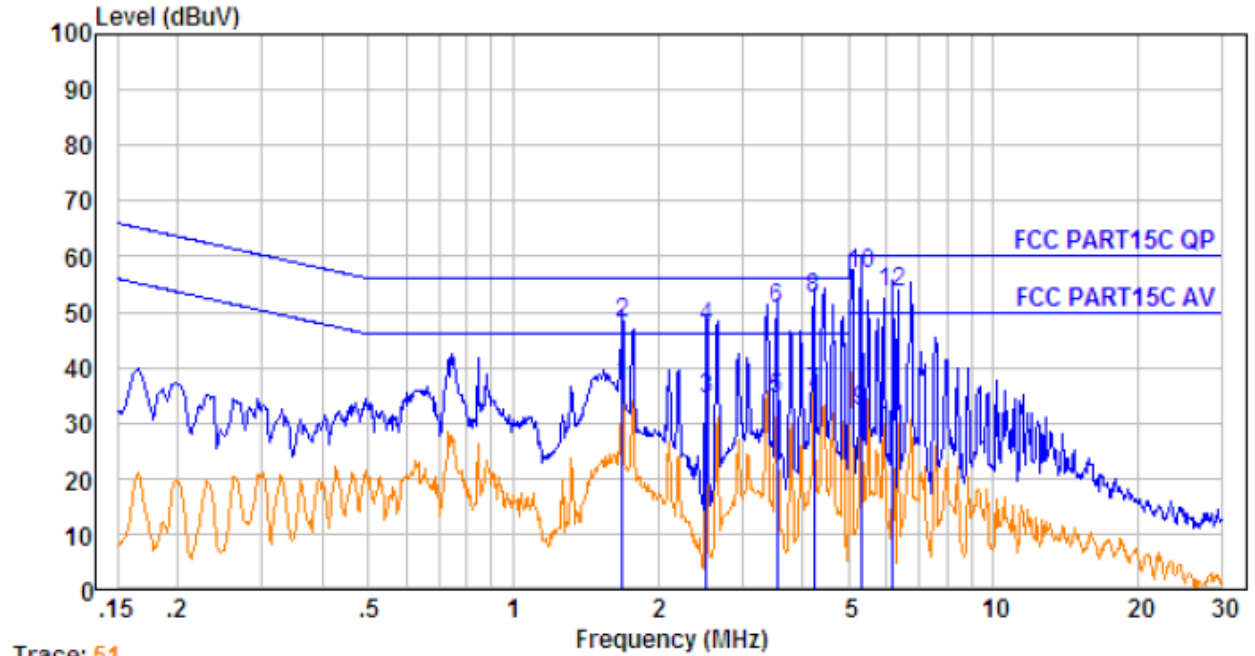
Line -240V/60Hz:



No.	Freq MHz	Cable Loss dB	AMN Factor dB	Receiver Reading dBUV	Emission Level dBUV	Limit dBUV	Over Limit dB	Remark
1.	2.664	0.47	0.15	33.58	34.20	46.00	-11.80	Average
2.	2.664	0.47	0.15	46.58	47.20	56.00	-8.80	QP
3.	3.547	0.47	0.15	36.30	36.92	46.00	-9.08	Average
4.	3.547	0.47	0.15	50.30	50.92	56.00	-5.08	QP
5.	4.224	0.48	0.15	35.79	36.42	46.00	-9.58	Average
6.	4.224	0.48	0.15	51.79	52.42	56.00	-3.58	QP
7.	4.430	0.48	0.15	39.54	40.17	46.00	-5.83	Average
8.	4.430	0.48	0.15	51.54	52.17	56.00	-3.83	QP
9.	5.058	0.50	0.15	37.35	38.00	50.00	-12.00	Average
10.	5.058	0.50	0.15	54.35	55.00	60.00	-5.00	QP
11.	5.305	0.51	0.15	37.18	37.84	50.00	-12.16	Average
12.	5.305	0.51	0.15	53.18	53.84	60.00	-6.16	QP



Neutral -240V/60Hz:



No.	Freq MHz	Cable Loss dB	AMN Factor dB	Receiver Reading dBuV	Emission Level dBuV	Limit dBuV	Over Limit dB	Remark
1.	1.689	0.47	0.36	36.17	37.00	46.00	-9.00	Average
2.	1.689	0.47	0.36	47.17	48.00	56.00	-8.00	QP
3.	2.527	0.47	0.34	33.46	34.27	46.00	-11.73	Average
4.	2.527	0.47	0.34	46.46	47.27	56.00	-8.73	QP
5.	3.547	0.47	0.32	33.63	34.42	46.00	-11.58	Average
6.	3.547	0.47	0.32	49.63	50.42	56.00	-5.58	QP
7.	4.224	0.48	0.31	34.59	35.38	46.00	-10.62	Average
8.	4.224	0.48	0.31	51.59	52.38	56.00	-3.62	QP
9.	5.305	0.51	0.31	31.23	32.05	50.00	-17.95	Average
10.	5.305	0.51	0.31	55.90	56.72	60.00	-3.28	QP
11.	6.186	0.53	0.31	27.82	28.66	50.00	-21.34	Average
12.	6.186	0.53	0.31	52.82	53.66	60.00	-6.34	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	$2400/F(\text{kHz})$	300	$10000 * 2400/F(\text{kHz})$	$20\log^{(2400/F(\text{kHz}))} + 80$
0.490 ~ 1.705	$24000/F(\text{kHz})$	30	$100 * 24000/F(\text{kHz})$	$20\log^{(24000/F(\text{kHz}))} + 40$
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

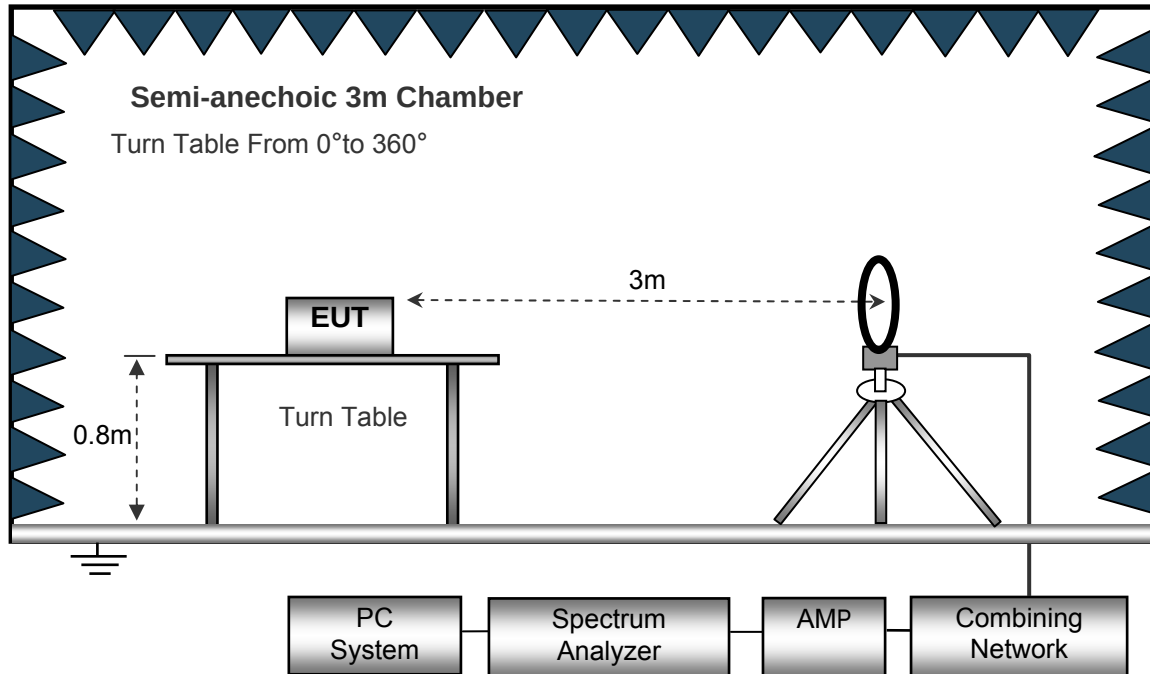
Operating Environment :

Temperature: : 23.5 °C
 Humidity: : 51.1 % RH
 Atmospheric Pressure: : 101.2kPa
 EUT Operation : : Refer to section 3.3
 Test Voltage : : AC 120V/60Hz

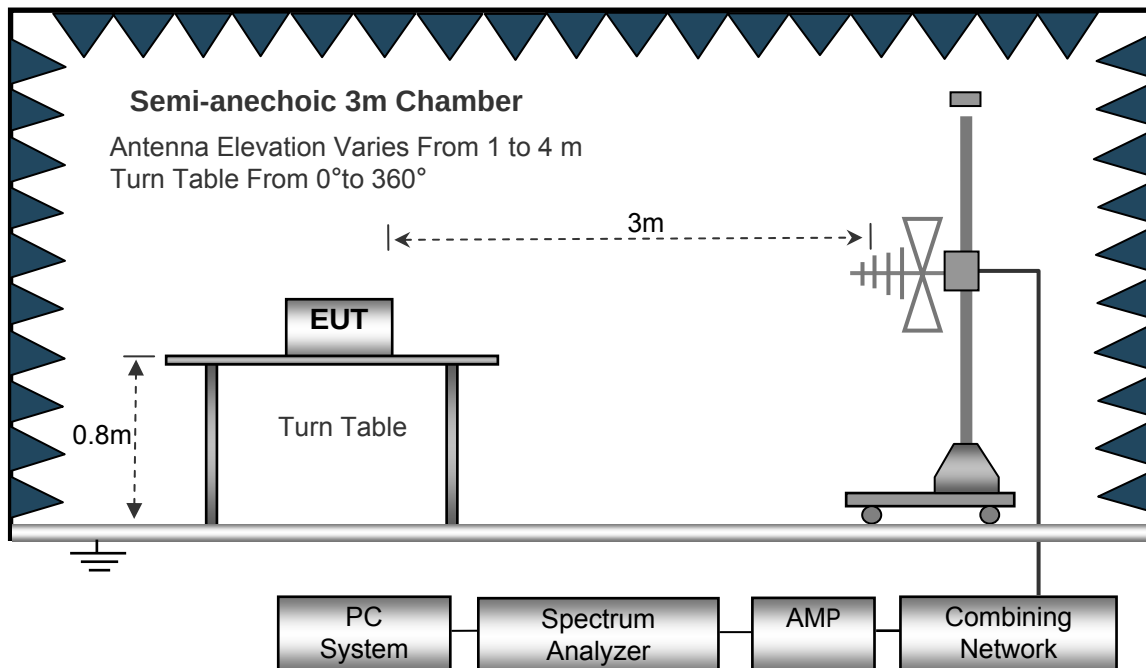
7.2 Test Setup

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

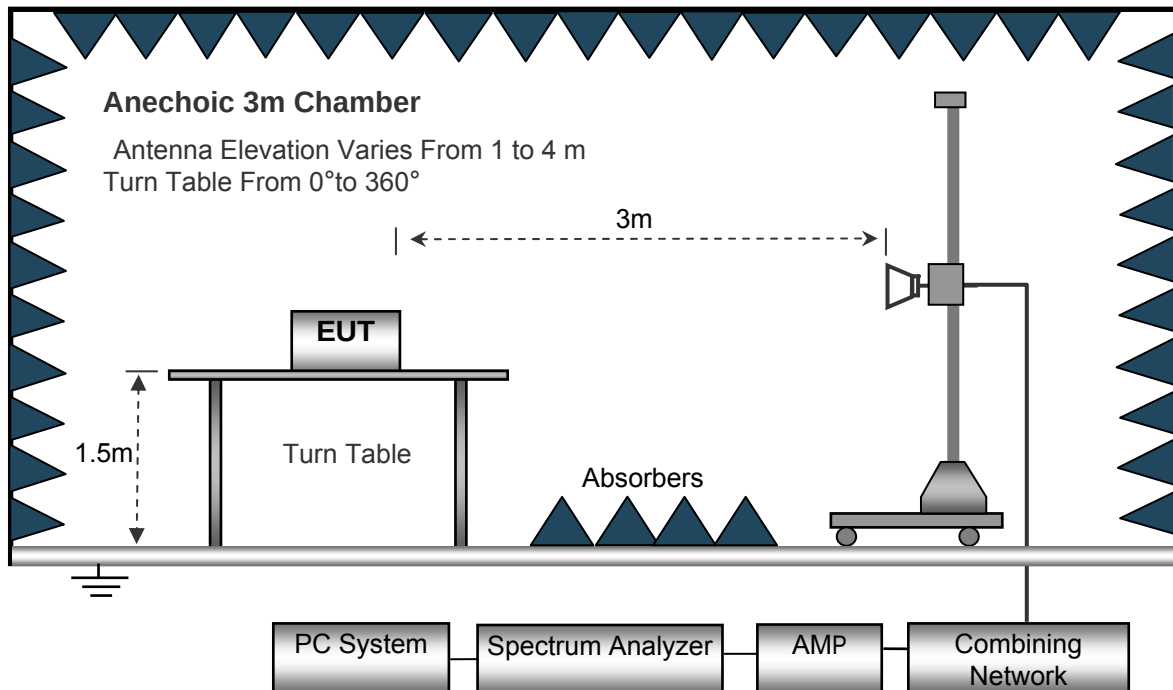
The test setup for emission measurement below 30MHz.



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: Below 30MHz

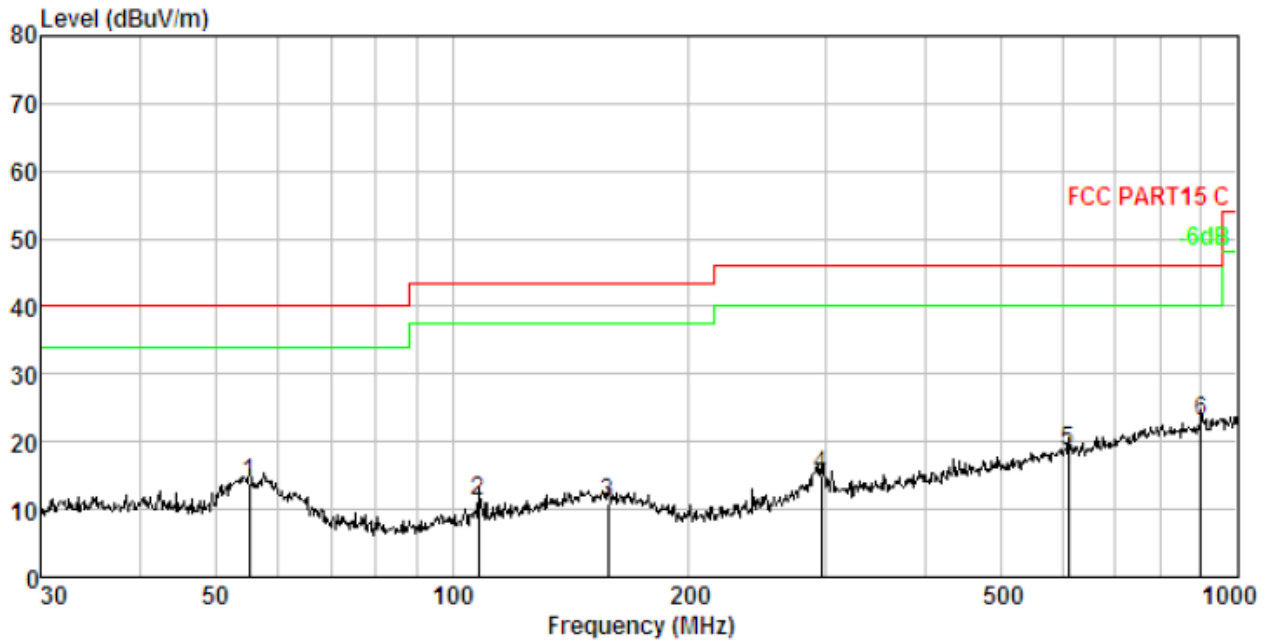
The measurements were more than 20 dB below the limit and not reported.

Test Frequency: 30MHz ~ 1GHz

Remark: only the worst data(GFSK modulation mode) were reported.



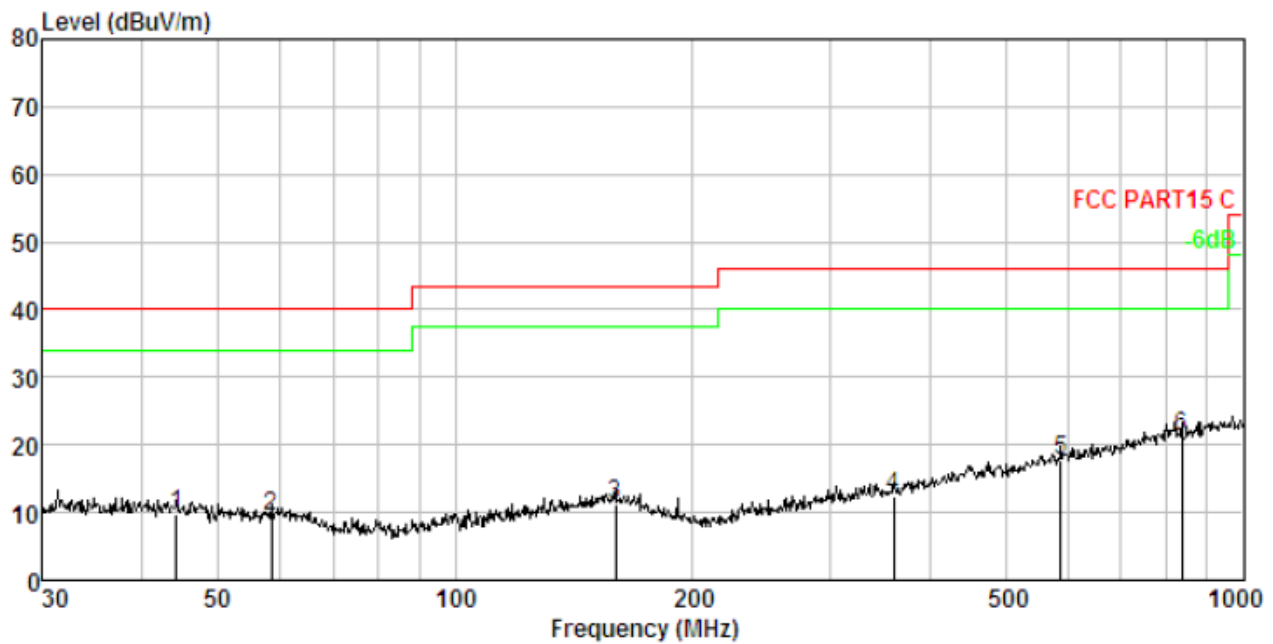
Test plot for Horizontal: GFSK(2402MHz)



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.	55.221	1.61	11.91	30.53	30.18	13.87	40.00	-26.13	QP
2.	107.888	2.21	10.90	28.48	30.42	11.17	43.50	-32.33	QP
3.	158.112	2.56	13.88	25.14	30.55	11.03	43.50	-32.47	QP
4.	295.147	3.13	13.10	29.49	30.77	14.95	46.00	-31.05	QP
5.	609.922	3.78	19.18	26.68	31.02	18.62	46.00	-27.38	QP
6.	900.147	4.13	22.58	27.38	31.15	22.94	46.00	-23.06	QP



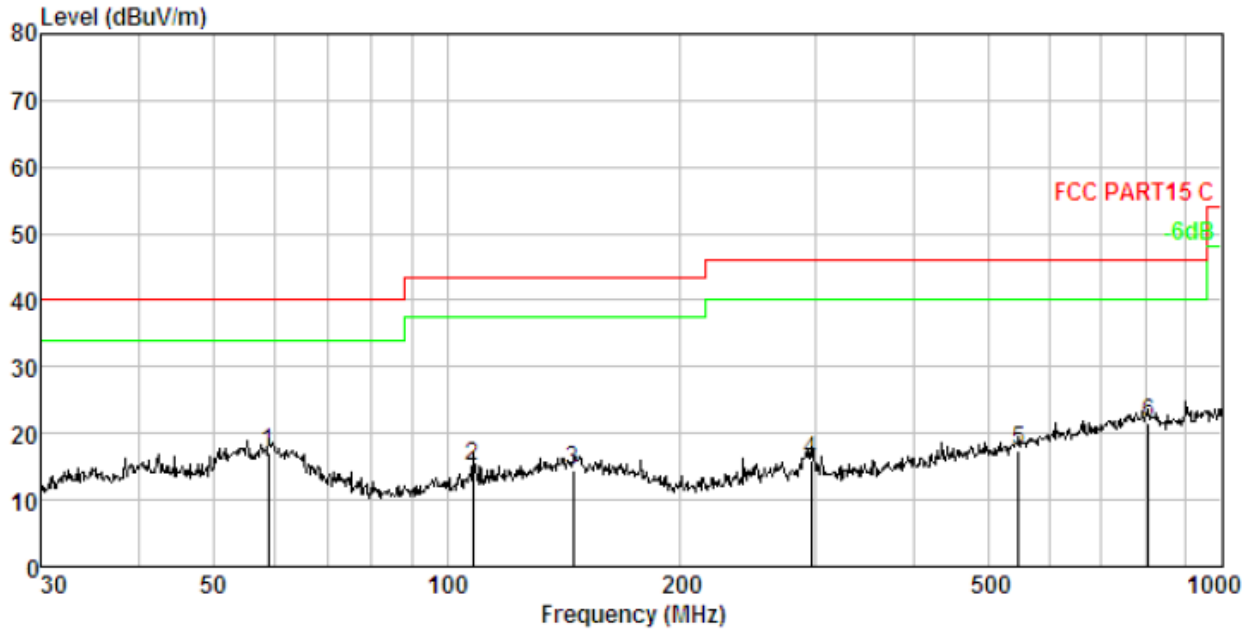
Test plot for Vertical: GFSK(2402MHz)



No.	Freq MHz	Cable Loss dB	ANT Factor dB/m	Receiver Reading dBuV	Preamplifier Factor dB	Emission Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark
1.	44.275	1.41	13.31	25.26	30.11	9.87	40.00	-30.13	QP
2.	58.407	1.66	12.09	25.77	30.20	9.32	40.00	-30.68	QP
3.	159.784	2.57	13.88	25.30	30.55	11.20	43.50	-32.30	QP
4.	360.448	3.31	14.40	25.51	30.83	12.39	46.00	-33.61	QP
5.	586.844	3.75	18.81	26.28	31.00	17.84	46.00	-28.16	QP
6.	836.244	4.07	21.99	26.32	31.13	21.25	46.00	-24.75	QP



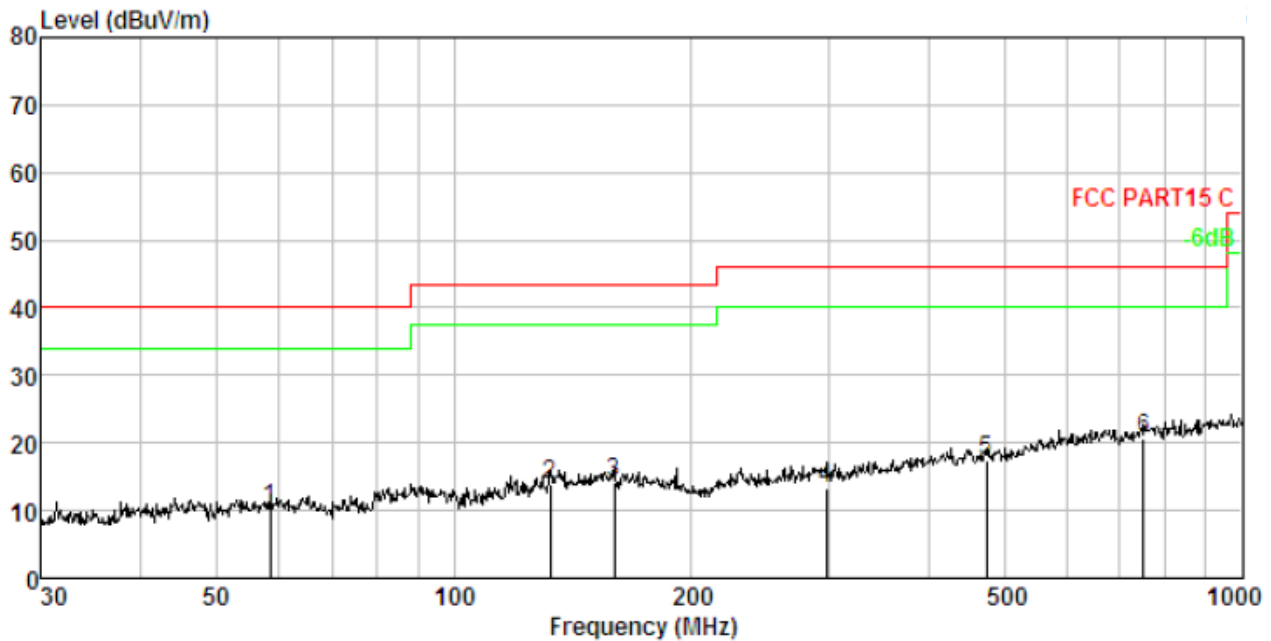
Test plot for Horizontal: GFSK(2441MHz)



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.	58.819	1.66	12.11	33.68	30.20	17.25	40.00	-22.75	QP
2.	107.888	2.21	10.90	32.48	30.42	15.17	43.50	-28.33	QP
3.	145.351	2.48	13.65	28.98	30.52	14.59	43.50	-28.91	QP
4.	295.147	3.13	13.10	30.49	30.77	15.95	46.00	-30.05	QP
5.	547.098	3.68	17.86	26.86	30.98	17.42	46.00	-28.58	QP
6.	804.603	4.03	21.79	26.78	31.11	21.49	46.00	-24.51	QP



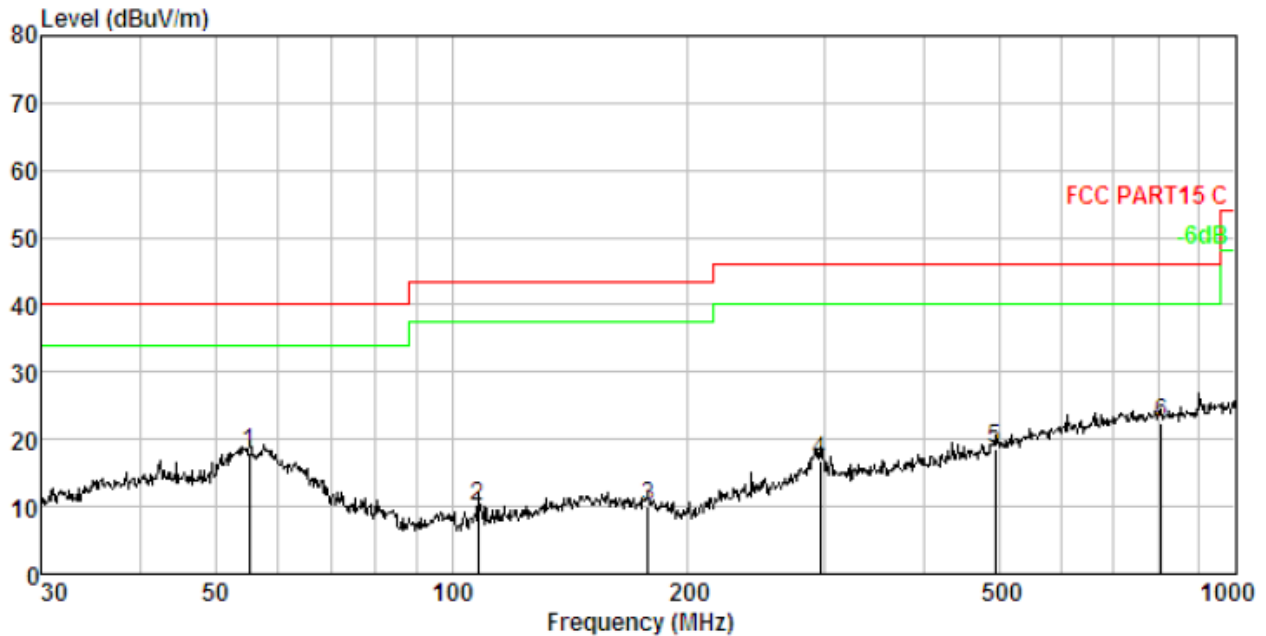
Test plot for Vertical: GFSK(2441MHz)



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.	58.407	1.66	12.09	26.77	30.20	10.32	40.00	-29.68	QP
2.	132.685	2.40	12.83	29.08	30.49	13.82	43.50	-29.68	QP
3.	159.784	2.57	13.88	28.30	30.55	14.20	43.50	-29.30	QP
4.	297.224	3.13	13.14	27.72	30.77	13.22	46.00	-32.78	QP
5.	473.835	3.55	16.77	27.93	30.93	17.32	46.00	-28.68	QP
6.	750.108	3.97	21.35	26.50	31.09	20.73	46.00	-25.27	QP



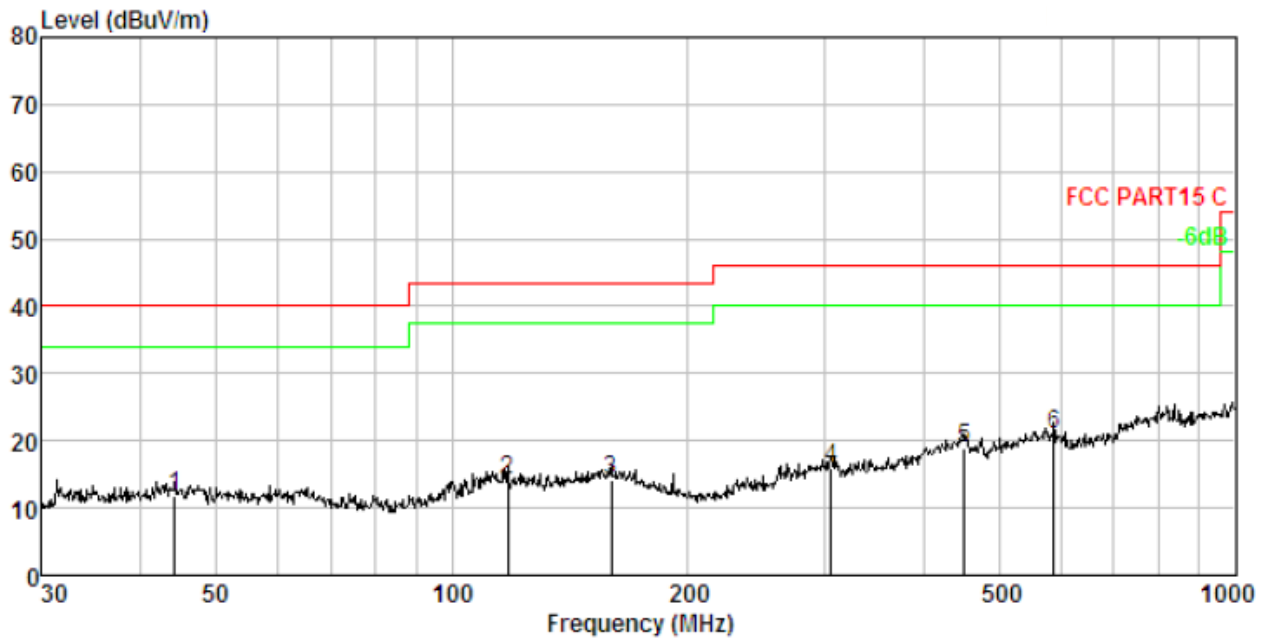
Test plot for Horizontal: GFSK(2480MHz)



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.	55.221	1.61	11.91	34.53	30.18	17.87	40.00	-22.13	QP
2.	107.888	2.21	10.90	27.48	30.42	10.17	43.50	-33.33	QP
3.	178.133	2.67	12.60	25.35	30.59	10.03	43.50	-33.47	QP
4.	295.147	3.13	13.10	31.49	30.77	16.95	46.00	-29.05	QP
5.	494.199	3.59	17.01	28.99	30.94	18.65	46.00	-27.35	QP
6.	804.603	4.03	21.79	27.78	31.11	22.49	46.00	-23.51	QP



Test plot for Vertical: GFSK(2480MHz)



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.	44.275	1.41	13.31	27.26	30.11	11.87	40.00	-28.13	QP
2.	117.773	2.29	11.82	30.44	30.45	14.10	43.50	-29.40	QP
3.	159.784	2.57	13.88	28.30	30.55	14.20	43.50	-29.30	QP
4.	304.610	3.15	13.30	30.18	30.78	15.85	46.00	-30.15	QP
5.	451.135	3.51	16.38	29.97	30.91	18.95	46.00	-27.05	QP
6.	586.844	3.75	18.81	29.28	31.00	20.84	46.00	-25.16	QP

**Test Frequency: Above 1000MHz~10th Harmonics:****GFSK Low Channel (2402MHz)**

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4804	34.69	AV	V	30.33	6.18	29.35	41.85	54	-12.15
4804	35.06	AV	H	30.33	6.18	29.35	42.22	54	-11.78
4804	41.24	PK	V	30.33	6.18	29.35	48.4	74	-25.6
4804	42.07	PK	H	30.33	6.18	29.35	49.23	74	-24.77
17800	24.66	AV	V	41.33	9.73	30.35	45.37	54	-8.63
17800	23.15	AV	H	41.33	9.73	30.35	43.86	54	-10.14
17800	38.04	PK	V	41.33	9.73	30.35	58.75	74	-15.25
17800	37.96	PK	H	41.33	9.73	30.35	58.67	74	-15.33

GFSK Low Channel (2441MHz)

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4882	35.26	AV	V	31.36	6.59	28.06	45.15	54	-8.85
4882	34.01	AV	H	31.36	6.59	28.06	43.9	54	-10.1
4882	43.15	PK	V	31.36	6.59	28.06	53.04	74	-20.96
4882	42.69	PK	H	31.36	6.59	28.06	52.58	74	-21.42
17811	25.72	AV	V	40.55	9.73	30.58	45.42	54	-8.58
17811	24.05	AV	H	40.55	9.73	30.58	43.75	54	-10.25
17811	39.65	PK	V	40.55	9.73	30.58	59.35	74	-14.65
17811	37.45	PK	H	40.55	9.73	30.58	57.15	74	-16.85

GFSK High Channel (2480MHz)

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4960	33.22	AV	V	31	6.03	28.43	41.82	54	-12.18
4960	34.04	AV	H	31	6.03	28.43	42.64	54	-11.36
4960	45.27	PK	V	31	6.03	28.43	53.87	74	-20.13
4960	44.15	PK	H	31	6.03	28.43	52.75	74	-21.25
17809	24.69	AV	V	41.35	7.35	30.69	42.7	54	-11.3
17809	25.37	AV	H	41.35	7.35	30.69	43.38	54	-10.62
17809	38.15	PK	V	41.35	7.35	30.69	56.16	74	-17.84
17809	36.69	PK	H	41.35	7.35	30.69	54.7	74	-19.3

 π /4-DQPSK Low Channel (2402MHz)

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4804	35.15	AV	V	29.38	5.36	30.33	39.56	54	-14.44
4804	34.06	AV	H	29.38	5.36	30.33	38.47	54	-15.53
4804	40.27	PK	V	29.38	5.36	30.33	44.68	74	-29.32
4804	41.66	PK	H	29.38	5.36	30.33	46.07	74	-27.93
17803	25.34	AV	V	40.72	8.76	29.75	45.07	54	-8.93
17803	24.17	AV	H	40.72	8.76	29.75	43.9	54	-10.1
17803	37.92	PK	V	40.72	8.76	29.75	57.65	74	-16.35
17803	36.26	PK	H	40.72	8.76	29.75	55.99	74	-18.01

 π /4-DQPSK Low Channel (2441MHz)

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4882	34.66	AV	V	30.75	5.93	27.63	43.71	54	-10.29
4882	33.26	AV	H	30.75	5.93	27.63	42.31	54	-11.69
4882	42.15	PK	V	30.75	5.93	27.63	51.2	74	-22.8
4882	40.28	PK	H	30.75	5.93	27.63	49.33	74	-24.67
17804	24.59	AV	V	39.76	8.72	39.73	33.34	54	-20.66
17804	23.68	AV	H	39.76	8.72	39.73	32.43	54	-21.57
17804	38.15	PK	V	39.76	8.72	39.73	46.9	74	-27.1
17804	37.56	PK	H	39.76	8.72	39.73	46.31	74	-27.69

 π /4-DQPSK High Channel (2480MHz)

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4960	32.66	AV	V	29.67	7.15	27.45	42.03	54	-11.97
4960	33.04	AV	H	29.67	7.15	27.45	42.41	54	-11.59
4960	44.15	PK	V	29.67	7.15	27.45	53.52	74	-20.48
4960	43.25	PK	H	29.67	7.15	27.45	52.62	74	-21.38
17816	26.72	AV	V	40.33	6.39	31.69	41.75	54	-12.25
17816	24.15	AV	H	40.33	6.39	31.69	39.18	54	-14.82
17816	37.05	PK	V	40.33	6.39	31.69	52.08	74	-21.92
17816	35.69	PK	H	40.33	6.39	31.69	50.72	74	-23.28



8DPSK Low Channel (2402MHz)

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4804	34.66	AV	V	30.35	5.69	29.75	40.95	54	-13.05
4804	33.15	AV	H	30.35	5.69	29.75	39.44	54	-14.56
4804	39.2	PK	V	30.35	5.69	29.75	45.49	74	-28.51
4804	40.35	PK	H	30.35	5.69	29.75	46.64	74	-27.36
17809	24.59	AV	V	38.72	7.36	30.11	40.56	54	-13.44
17809	25.36	AV	H	38.72	7.36	30.11	41.33	54	-12.67
17809	38.04	PK	V	38.72	7.36	30.11	54.01	74	-19.99
17809	37.46	PK	H	38.72	7.36	30.11	53.43	74	-20.57

8DPSK Low Channel (2441MHz)

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4882	34.21	AV	V	29.66	6.69	26.49	44.07	54	-9.93
4882	31.05	AV	H	29.66	6.69	26.49	40.91	54	-13.09
4882	40.15	PK	V	29.66	6.69	26.49	50.01	74	-23.99
4882	38.06	PK	H	29.66	6.69	26.49	47.92	74	-26.08
17806	25.74	AV	V	38.25	9.43	37.69	35.73	54	-18.27
17806	23.69	AV	H	38.25	9.43	37.69	33.68	54	-20.32
17806	36.25	PK	V	38.25	9.43	37.69	46.24	74	-27.76
17806	35.75	PK	H	38.25	9.43	37.69	45.74	74	-28.26

8DPSK High Channel (2480MHz)

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4960	31.36	AV	V	28.75	6.99	26.72	40.38	54	-13.62
4960	32.05	AV	H	28.75	6.99	26.72	41.07	54	-12.93
4960	41.25	PK	V	28.75	6.99	26.72	50.27	74	-23.73
4960	42.69	PK	H	28.75	6.99	26.72	51.71	74	-22.29
17811	25.14	AV	V	39.67	7.14	30.33	41.62	54	-12.38
17811	23.68	AV	H	39.67	7.14	30.33	40.16	54	-13.84
17811	38.42	PK	V	39.67	7.14	30.33	54.9	74	-19.1
17811	34.69	PK	H	39.67	7.14	30.33	51.17	74	-22.83

Note: 1. The testing has been conformed to $10 \times 2480\text{MHz} = 24800\text{MHz}$.

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



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.

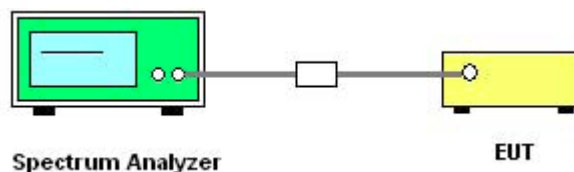
8.2 TEST PROCEDURE

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:

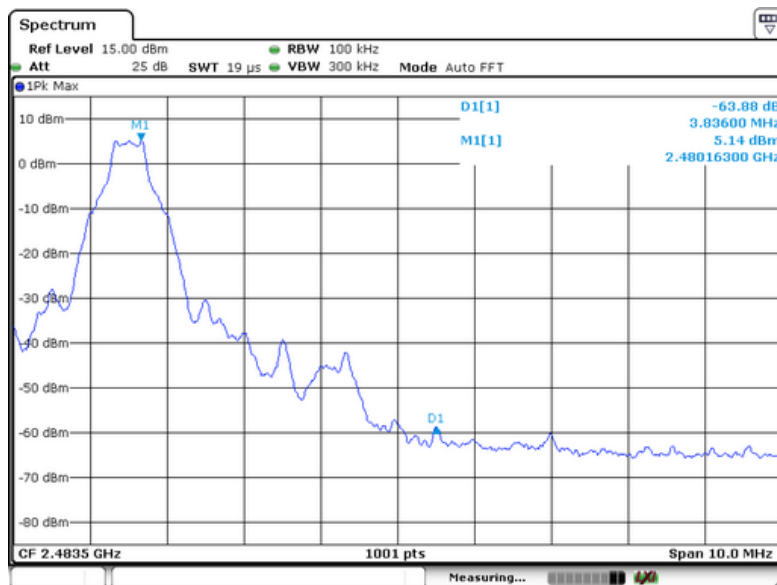
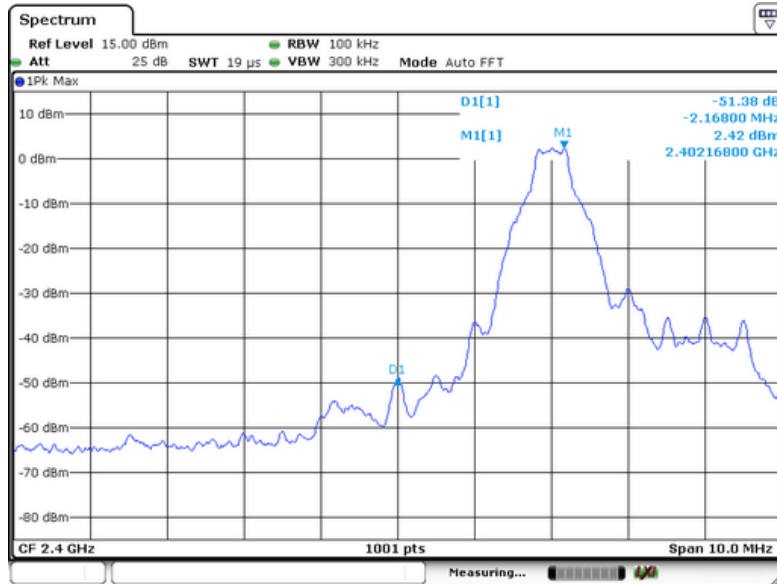
Frequency(MHz)	Modulation	Peak Power Output (dBm)	Emission Read Value (dBm)	Result of Band edge (dBc)	Band Edge Limit (dBc)
2399.99	GFSK	2.42	-48.96	51.38	>20dBc
2399.99	$\pi/4$ -DQPSK	-0.92	-49.81	48.89	>20dBc
2399.99	8DPSK	-0.84	-50.42	49.58	>20dBc
2483.99	GFSK	5.14	-58.74	63.88	>20dBc
2483.53	$\pi/4$ -DQPSK	3.21	-58.84	62.05	>20dBc
2483.73	8DPSK	3.25	-58.45	61.70	>20dBc

Test Plot:

Please refer to the following pages.

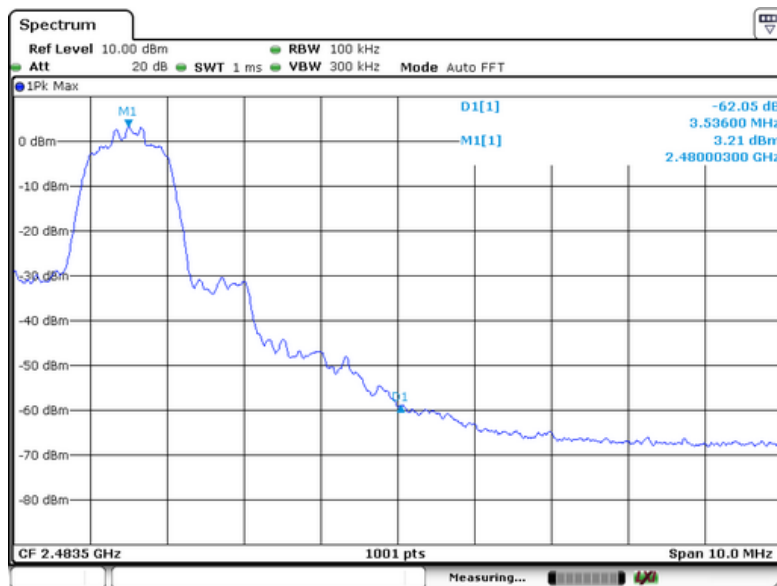
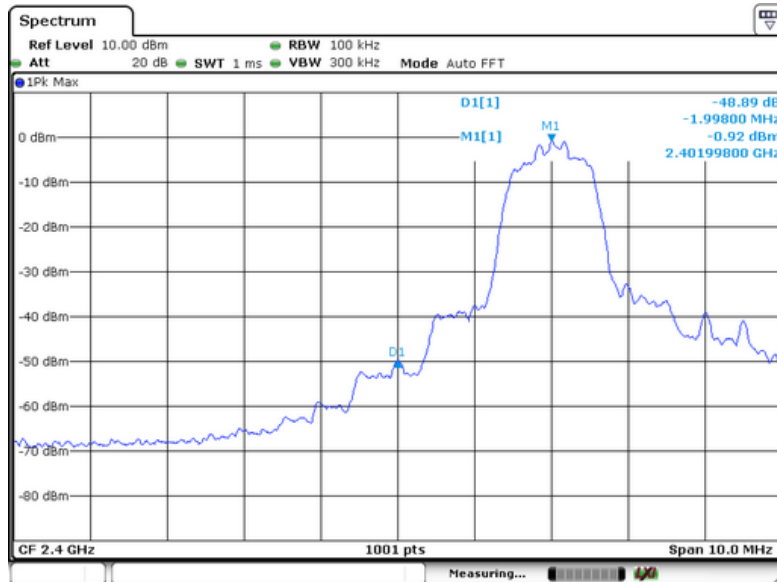


GFSK





$\pi/4$ -DQPSK

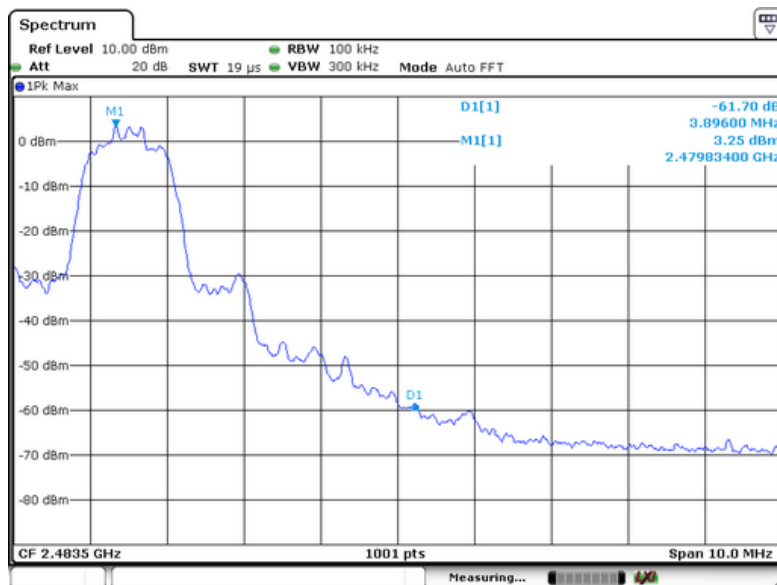
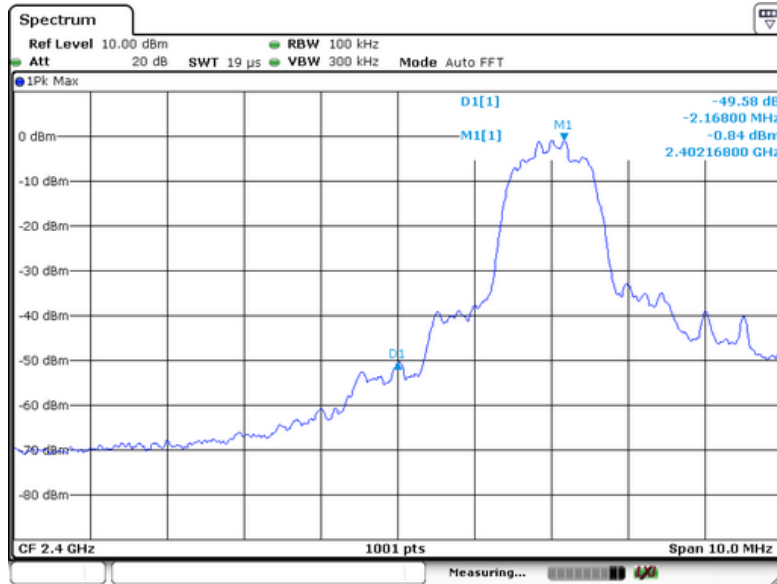




PRECISE TESTING

Report No.: PTCHX07170921002E-FC01

8DPSK





For Hopping Mode:

Frequency(MHz)	Modulation	Peak Power Output (dBm)	Emission Read Value (dBm)	Result of Band edge (dBc)	Band Edge Limit (dBc)
2399.99	GFSK	3.38	-50.08	53.46	>20dBc
2399.99	$\pi/4$ -DQPSK	8.47	-42.26	50.73	>20dBc
2399.99	8DPSK	4.52	-49.72	54.24	>20dBc
2484.97	GFSK	5.11	-52.48	57.59	>20dBc
2484.99	$\pi/4$ -DQPSK	3.21	-53.42	56.63	>20dBc
2485.14	8DPSK	3.16	-53.72	56.88	>20dBc

Test Plot:

Please refer to the following pages.

Spectrum

Ref Level 10.00 dBm
 Att 20 dB
 RBW 100 kHz
 VBW 300 kHz
 Mode Auto FFT
 SWT 1 ms

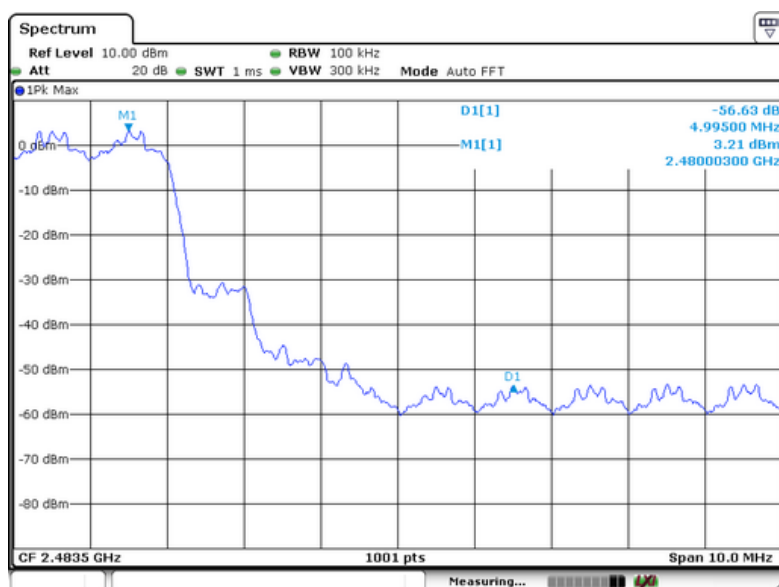
1Pk Max

0 dBm
 -10 dBm
 -20 dBm
 -30 dBm
 -40 dBm
 -50 dBm
 -60 dBm
 -70 dBm
 -80 dBm

D1[1] -50.73 dBm
 M1[1] -4.98500 MHz
 2.40499500 GHz

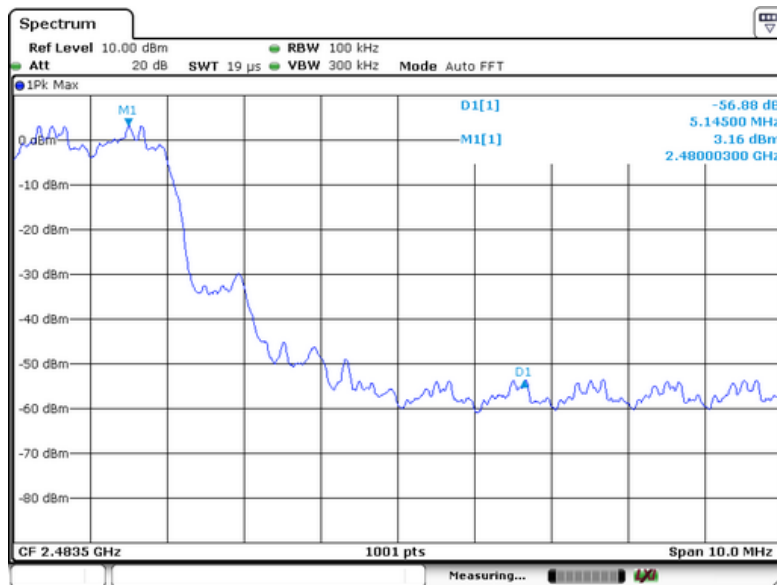
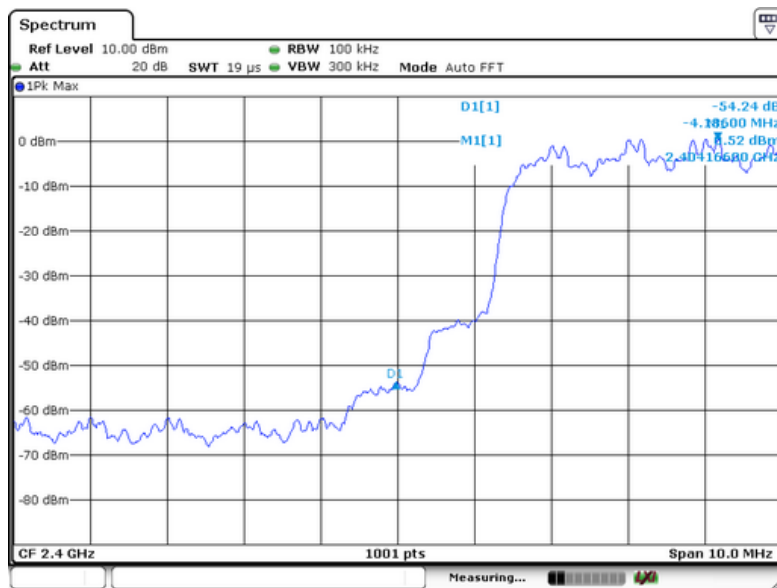
CF 2.4 GHz 1001 pts Span 10.0 MHz

Measuring...





8DPSK





9 20 dB Bandwidth Measurement

Test Requirement : FCC CFR47 Part 15 Section 15.247
Test Method : ANSI C63.10:2013
Test Mode : Refer to section 3.3

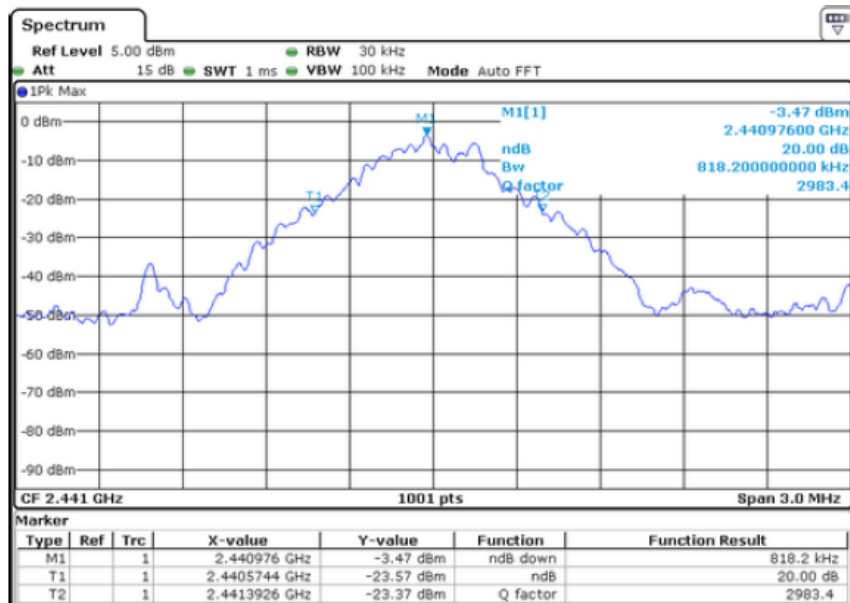
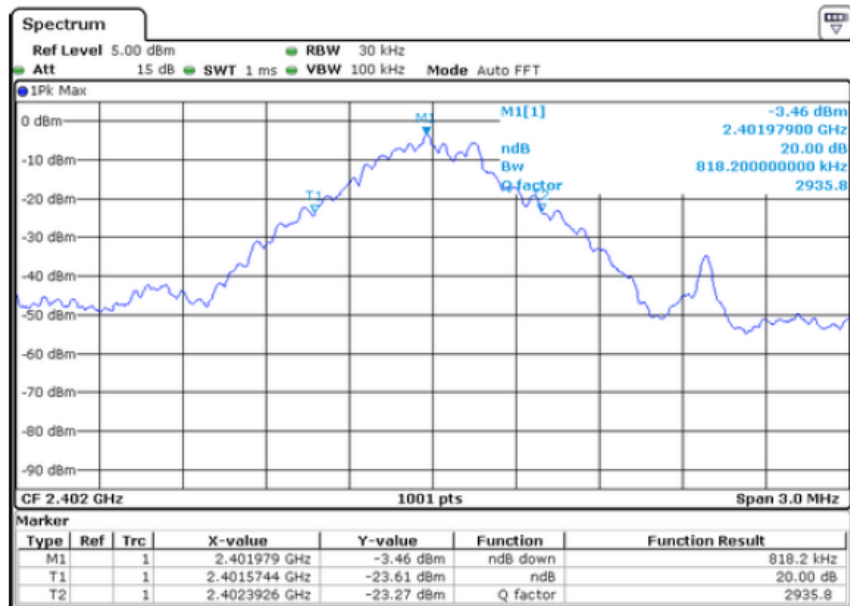
9.1 Test Procedure

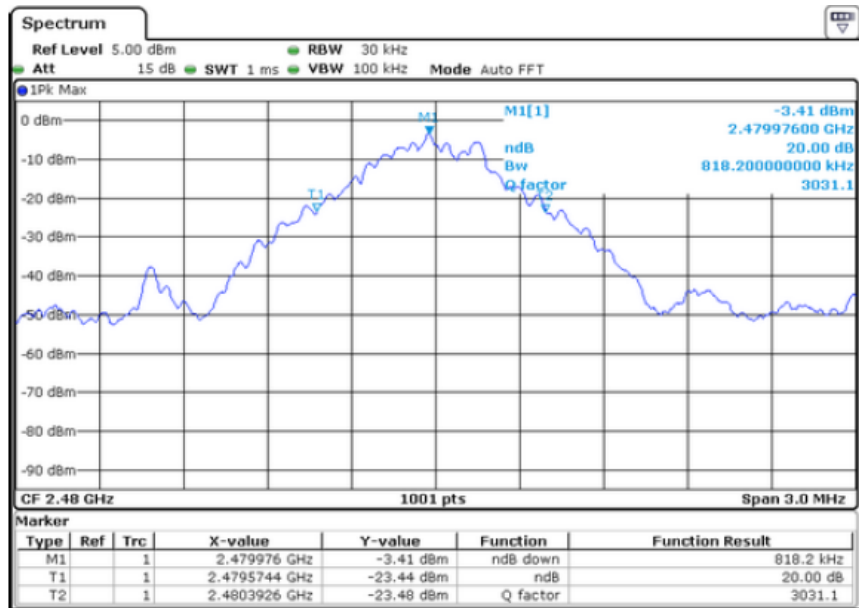
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 30kHz, VBW = 100kHz

9.2 Test Result

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

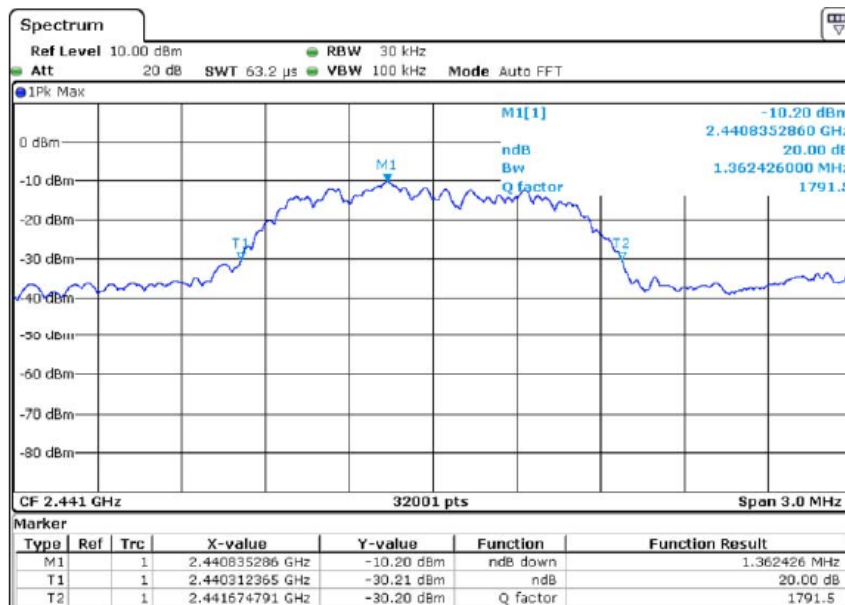
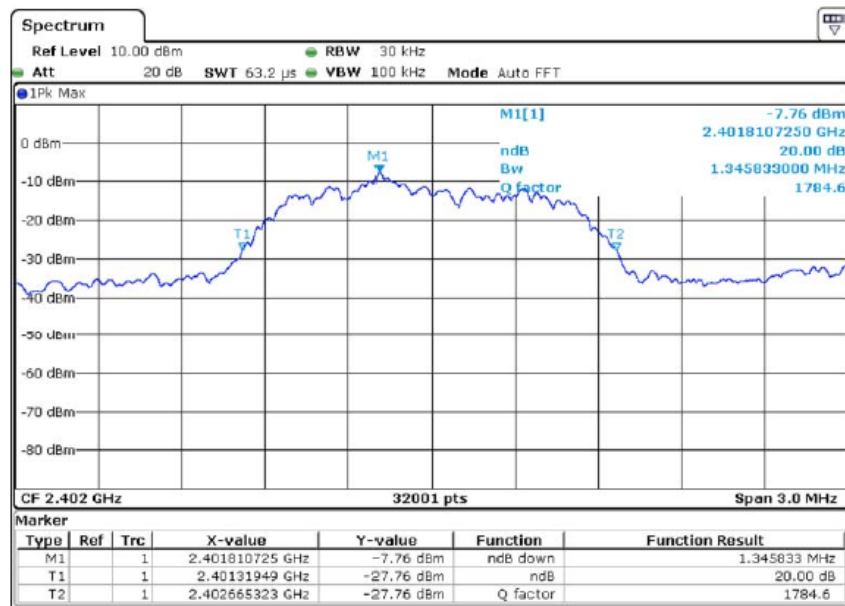
Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
00	2402	818
39	2441	818
78	2480	818

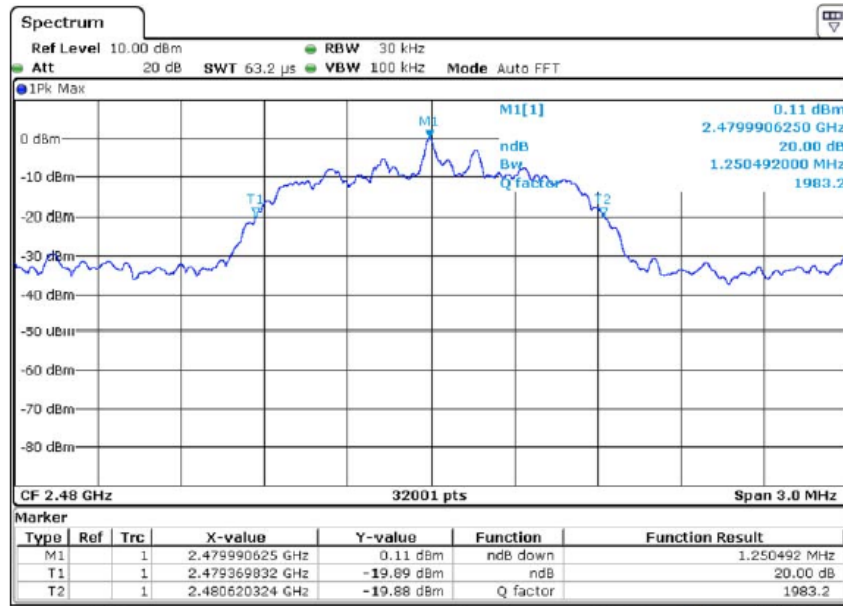




Test Mode: CH00 / CH39 / CH78 (Π/4-DQPSK /(2Mbps)Mode)

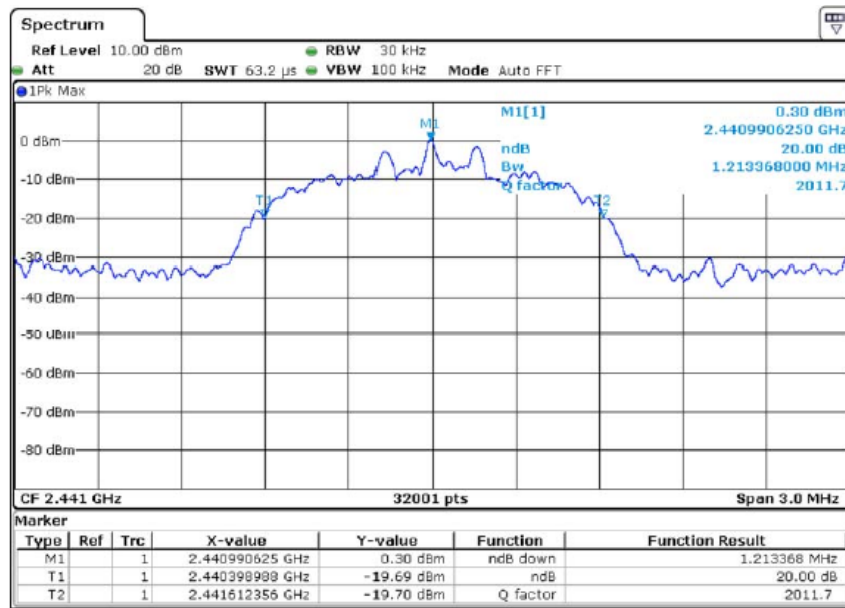
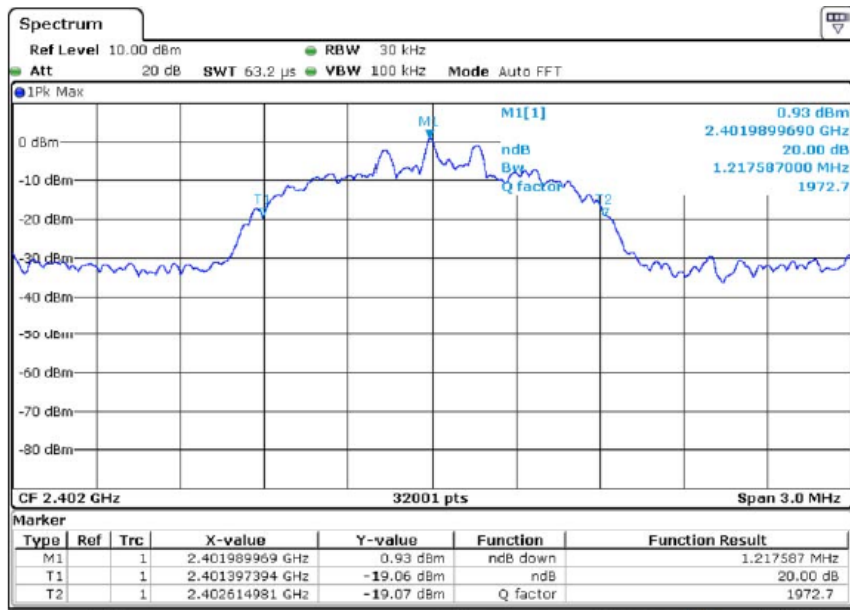
Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
00	2402	1346
39	2441	1362
78	2480	1250

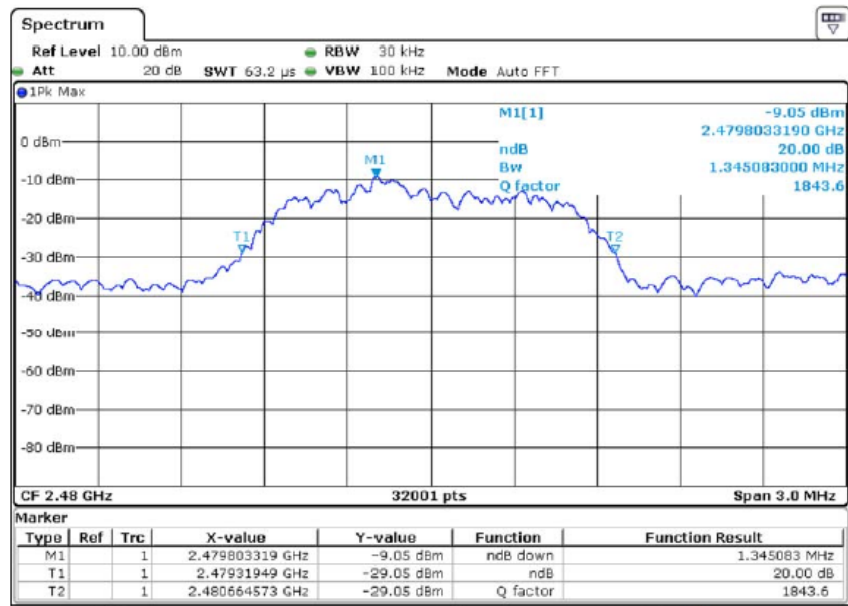




Test Mode: CH00 / CH39 / CH78 (8DPSK(3Mbps)Mode)

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
00	2402	1218
39	2441	1213
78	2480	1345







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 employing 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.

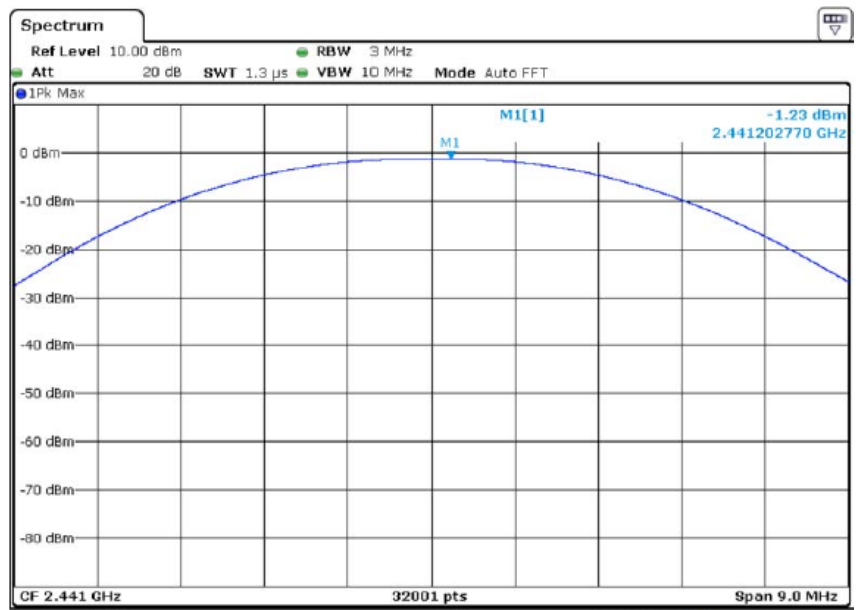
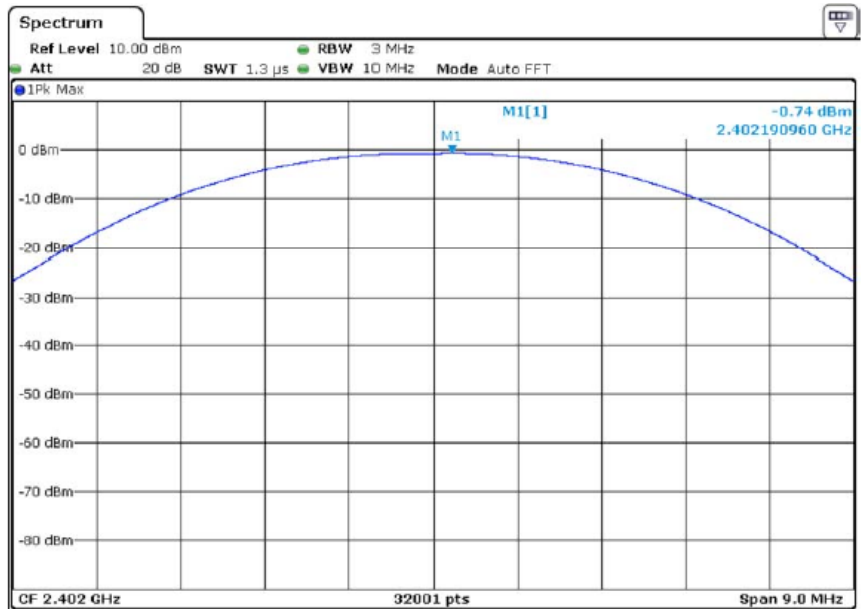
Test Mode : Refer to section 3.3

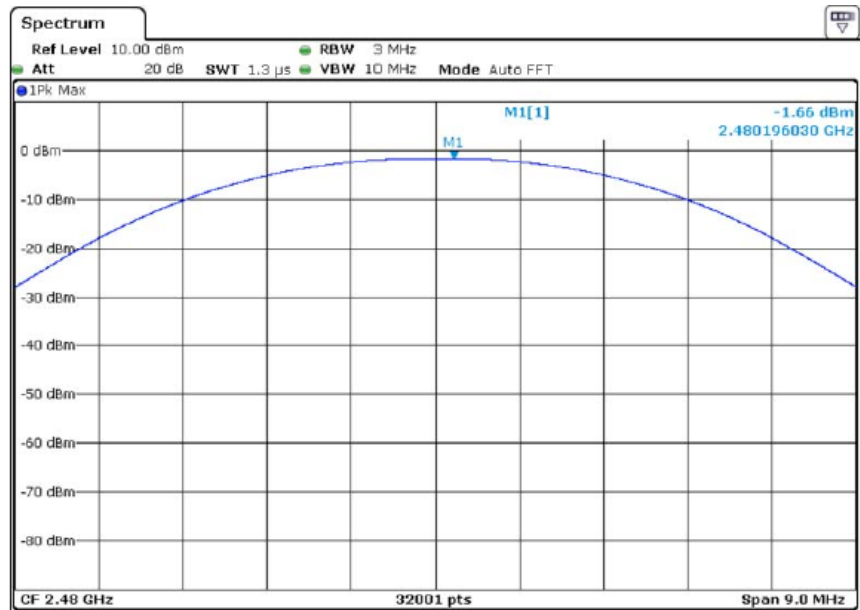
10.1 Test Procedure

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 = 10MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

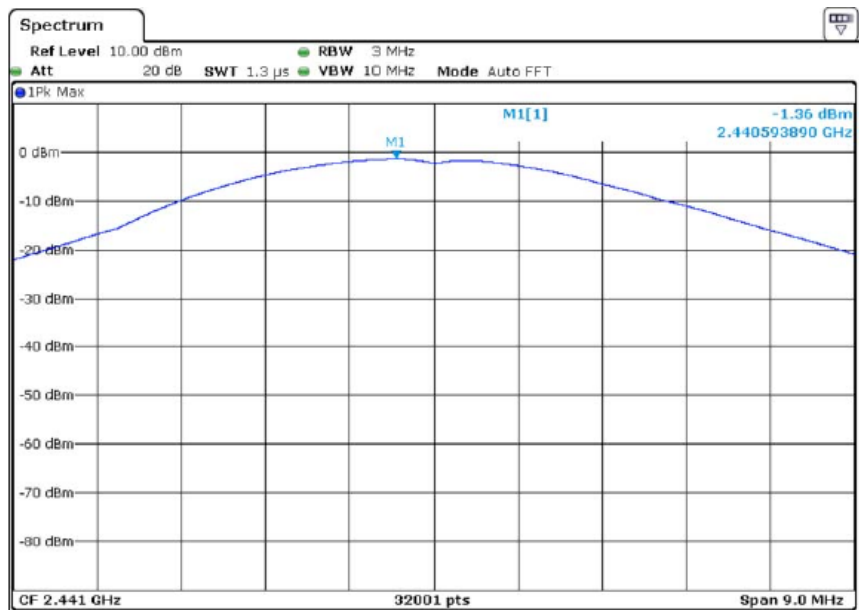
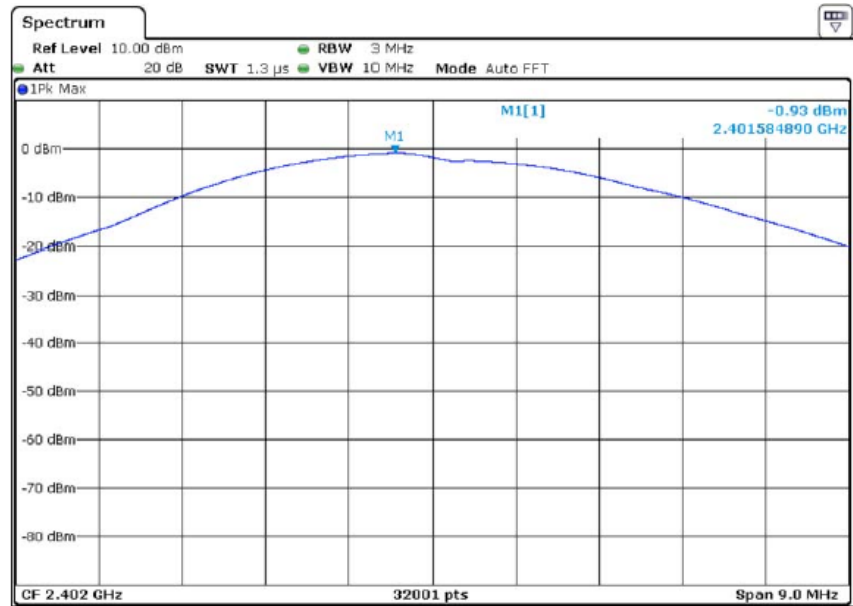
10.2 Test Result

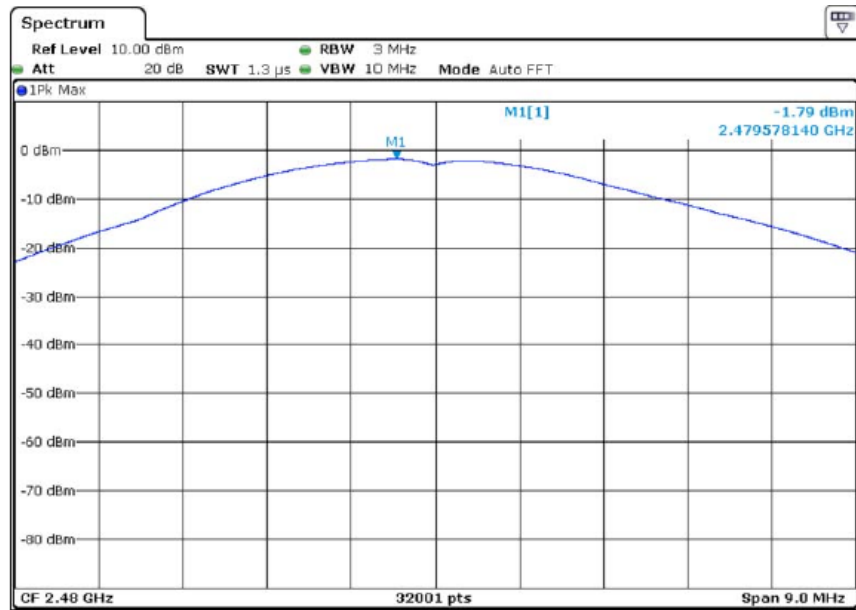
GFSK(1Mbps)					
Test Channel	Frequency	Conducted Output Peak Power	Conducted Output Peak Power	LIMIT	Pass/Fail
	(MHz)	(dBm)	(mW)	(mW)	
CH00	2402	-0.74	0.843	1000	Pass
CH39	2441	-1.23	0.753	1000	Pass
CH78	2480	-1.66	0.682	1000	Pass



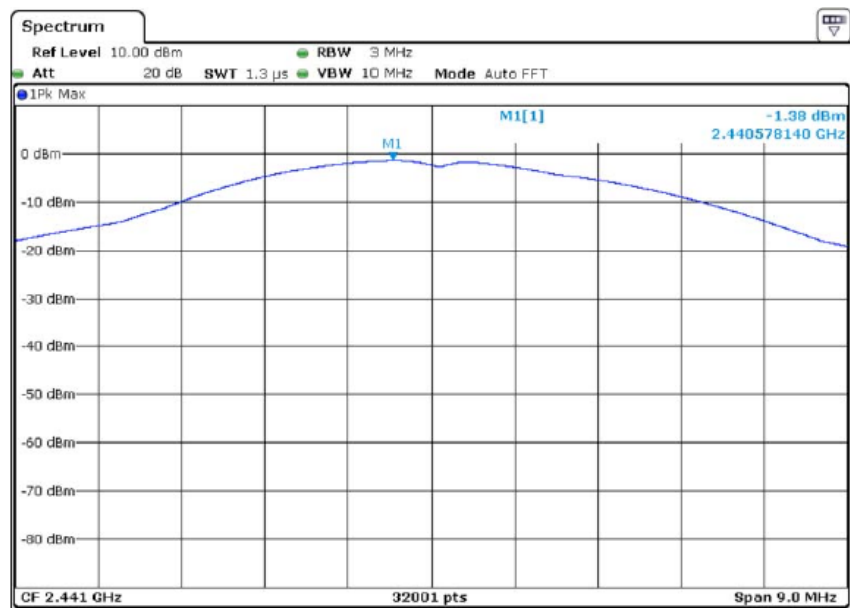
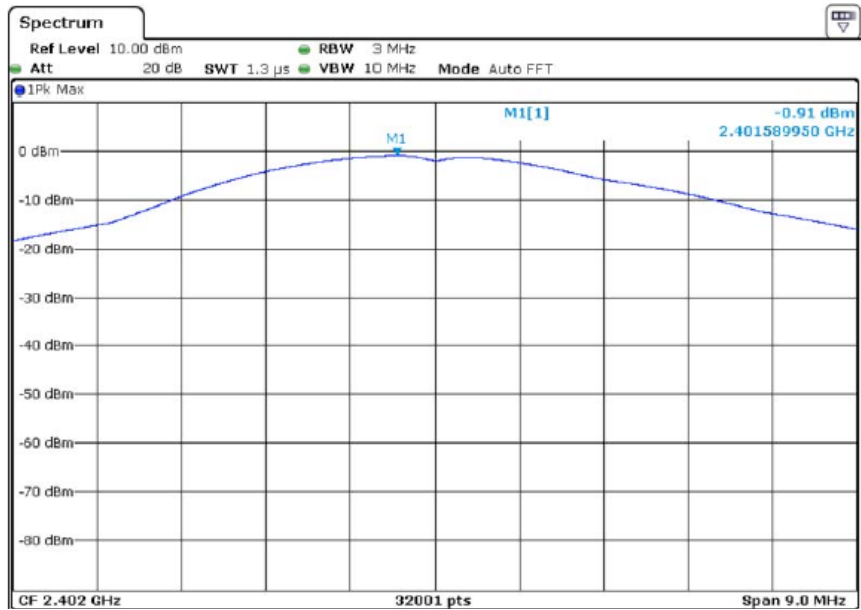


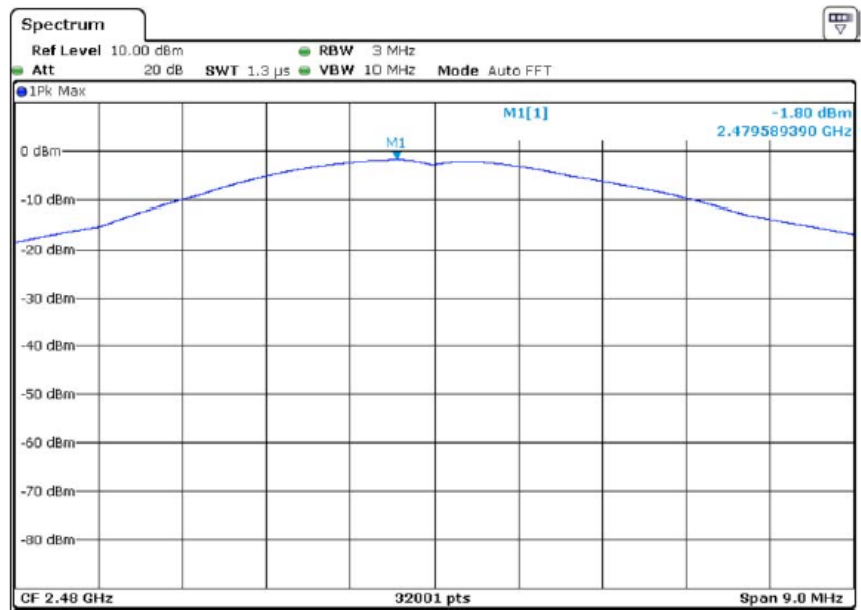
$\pi/4$ QPSK(2Mbps)					
Test Channel	Frequency	Conducted Output Peak Power	Conducted Output Peak Power	LIMIT	Pass/Fail
	(MHz)	(dBm)	(mW)	(mW)	
CH00	2402	-0.93	0.807	125	Pass
CH39	2441	-1.36	0.731	125	Pass
CH78	2480	-1.79	0.662	125	Pass





8DPSK(3Mbps)					
Test Channel	Frequency	Conducted Output Peak Power	Conducted Output Peak Power	LIMIT	Pass/Fail
	(MHz)	(dBm)	(mW)	(mW)	
CH00	2402	-0.91	0.811	125	Pass
CH39	2441	-1.38	0.728	125	Pass
CH78	2480	-1.80	0.661	125	Pass







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

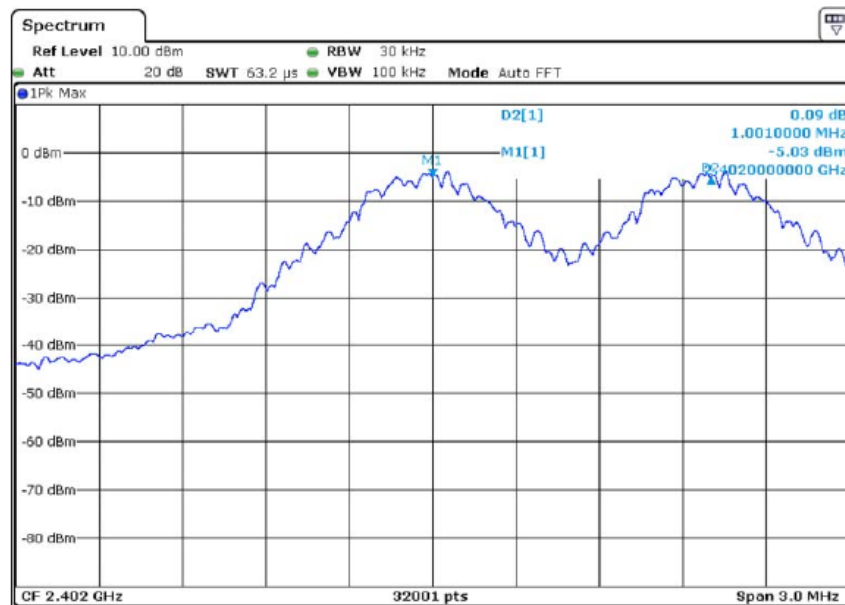
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 30KHz. VBW = 100KHz , Span = 3MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to 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.

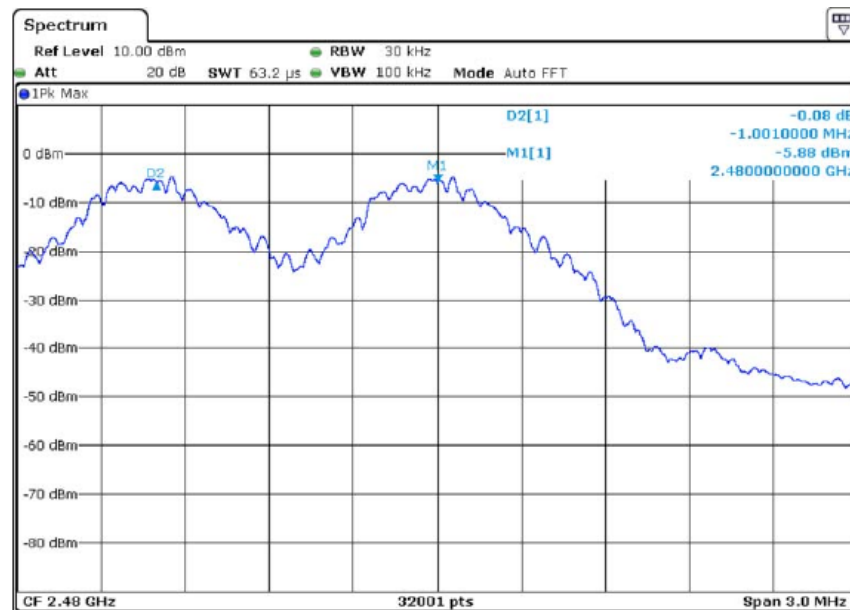
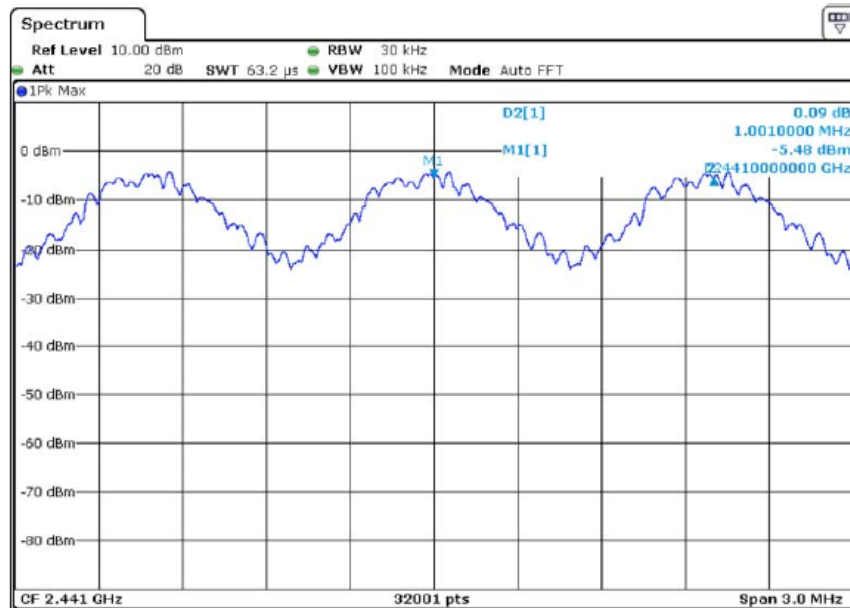


11.2 Test Result

Test Mode:	CH00 / CH39 / CH78 (GFSK(1Mbps) Mode)
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Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
00	2402	1001	>818
39	2441	1001	>818
78	2480	1001	>818

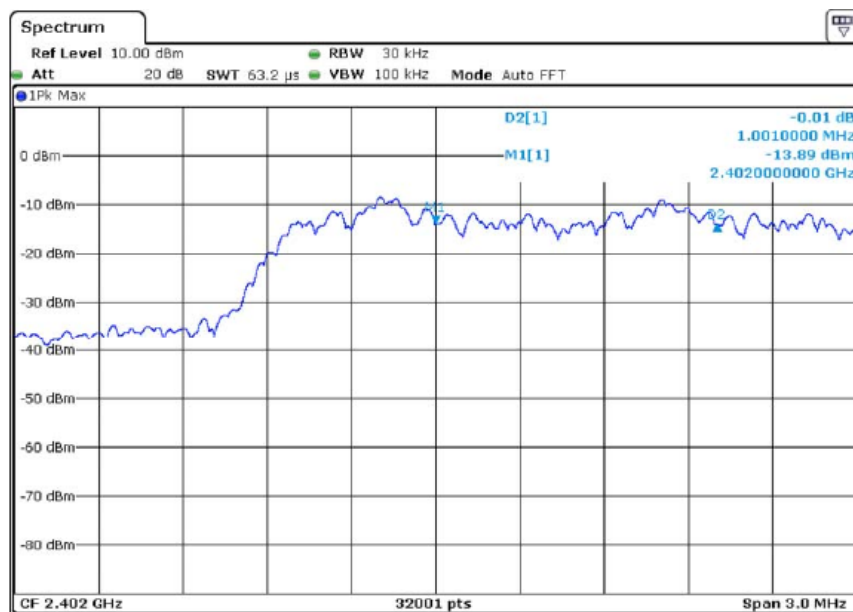


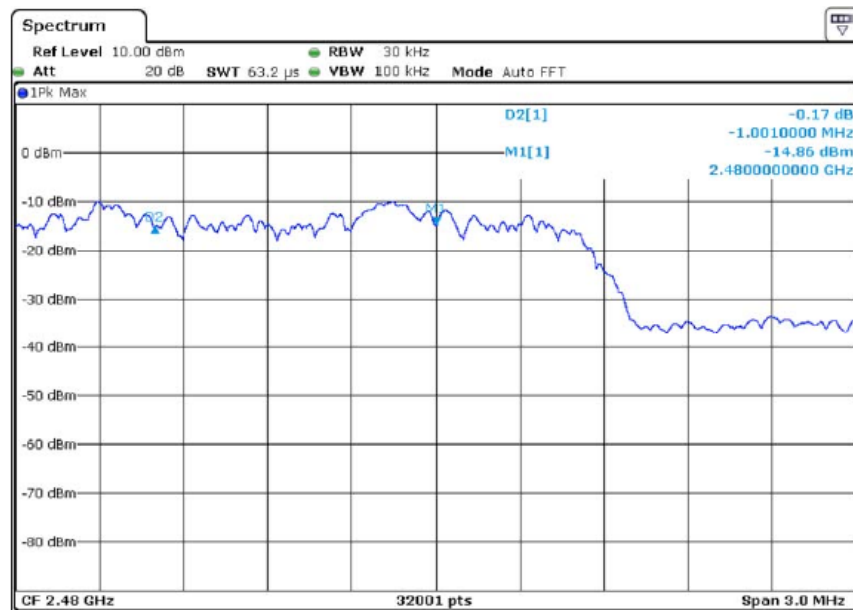
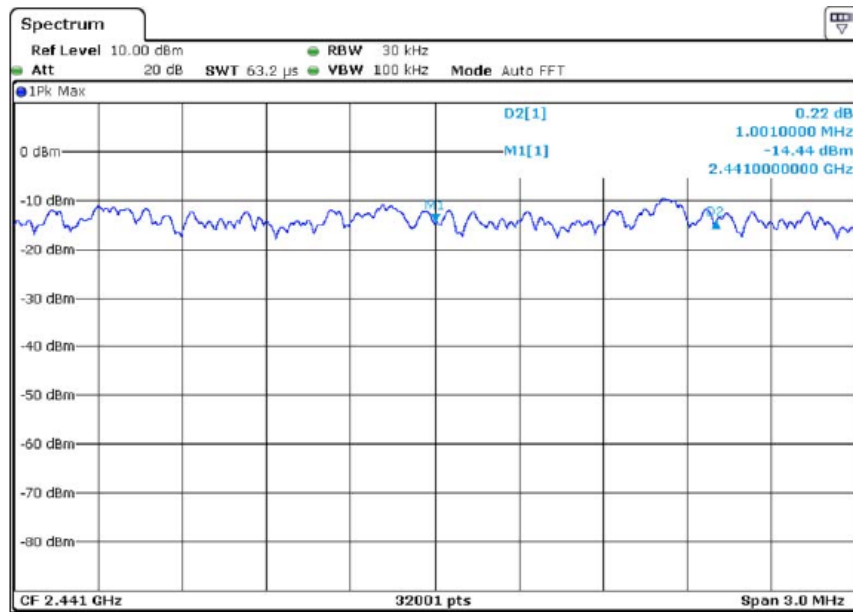




Test Mode:	CH00 / CH39 / CH78 ($\pi/4$ -DQPSK(2Mbps) Mode)
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Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
00	2402	1001	>897
39	2441	1001	>908
78	2480	1001	>833

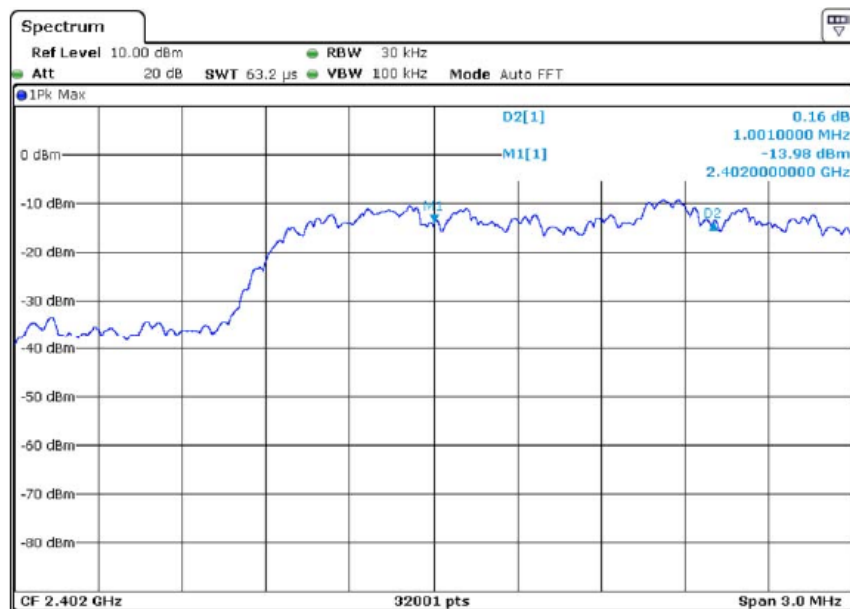


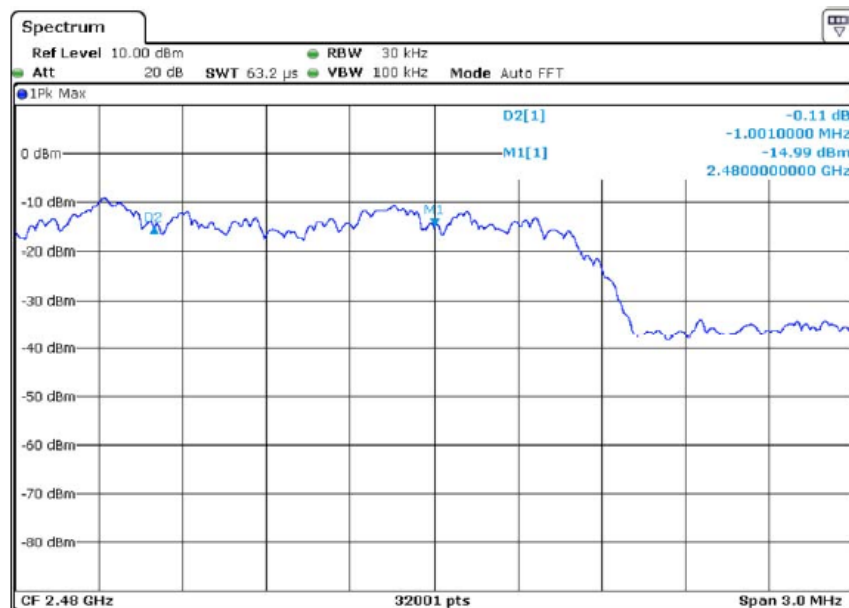
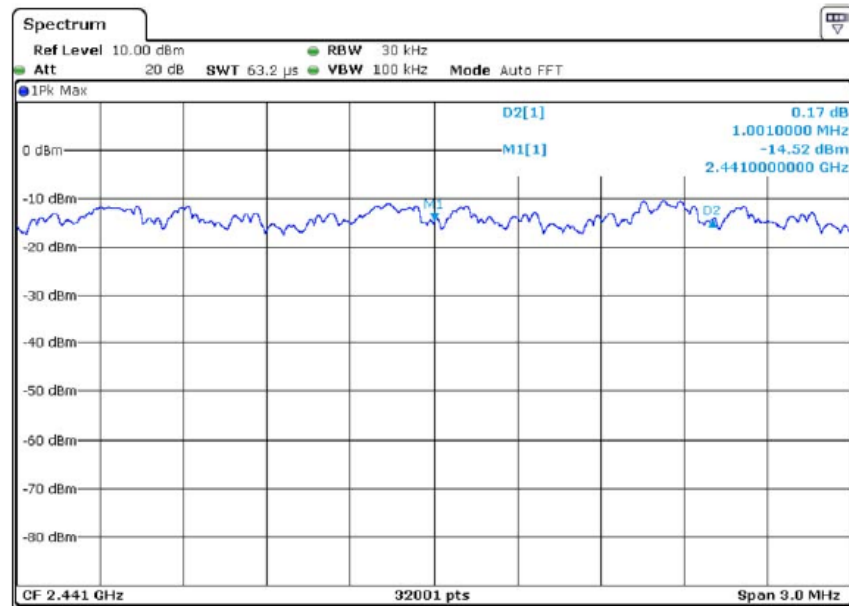




Test Mode:	CH00 / CH39 / CH78 (8DPSK(3Mbps)Mode)
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Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
00	2402	1001	>812
39	2441	1001	>809
78	2480	1001	>897







12 Number of Hopping Frequency

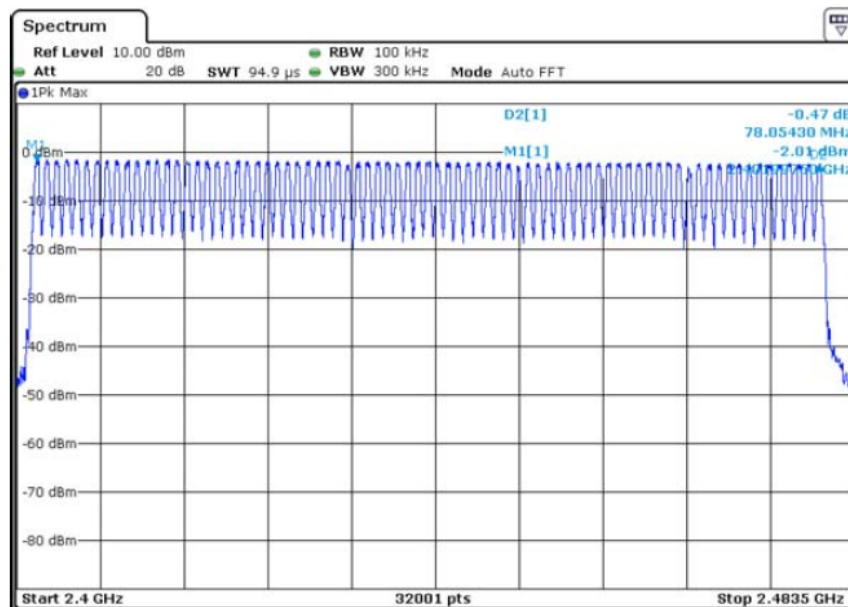
Test Requirement	: FCC CFR47 Part 15 Section 15.247
Test Method	: ANSI C63.10:2013
Test Limit	: Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
Test Mode	: Hopping(GFSK)

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

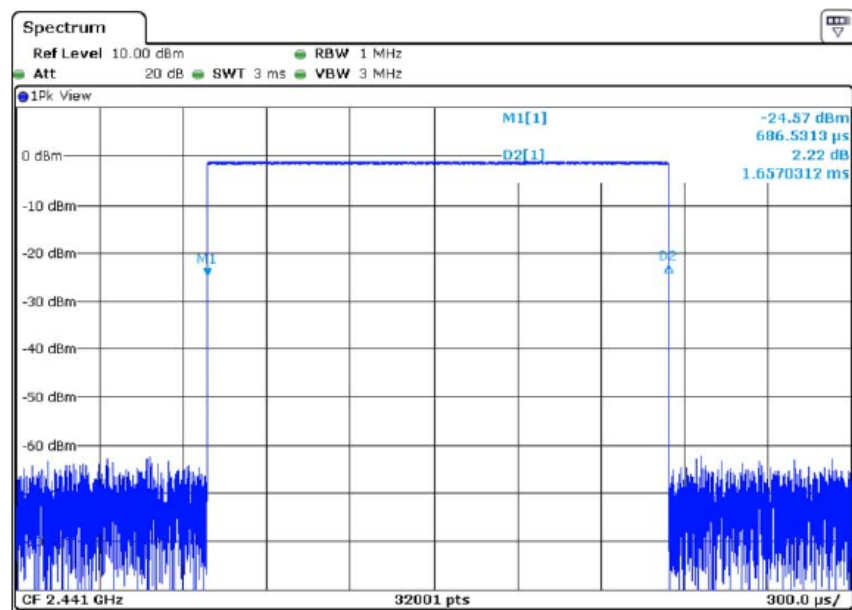
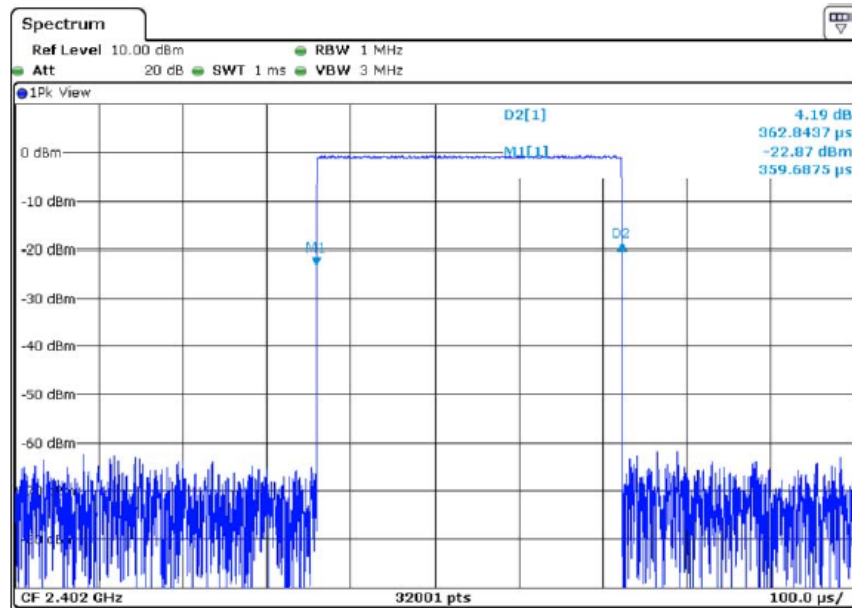
13.1 Test Procedure

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) –DH1/DH3/DH5
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Mode	Number of transmission in a 31.6(79 Hopping*0.4)	Length of transmissions time(msec)	Result (msec)	Limit (msec)
DH1	$1600/(2*79) \times 31.6 = 320$	0.359	114.88	400
DH3	$1600/(4*79) \times 31.6 = 160$	1.657	265.12	400
DH5	$1600/(6*79) \times 31.6 = 106.67$	2.778	296.32	400





Spectrum

Ref Level 10.00 dBm RBW 1 MHz

Att 20 dB SWT 5 ms VBW 3 MHz

1Pk View

M1[1] -23.46 dBm
533.906 μ s
-0.53 dB

D2[1] 2.778125 ms

CF 2.48 GHz 32001 pts 500.0 μ s/



14 Antenna Requirement

According to the FCC part15.203, a transmitter can only be sold or operated with antennas with which it was approved. This product has an internal PCB Antenna, it meet the requirement of this section.



15 TEST PHOTOS



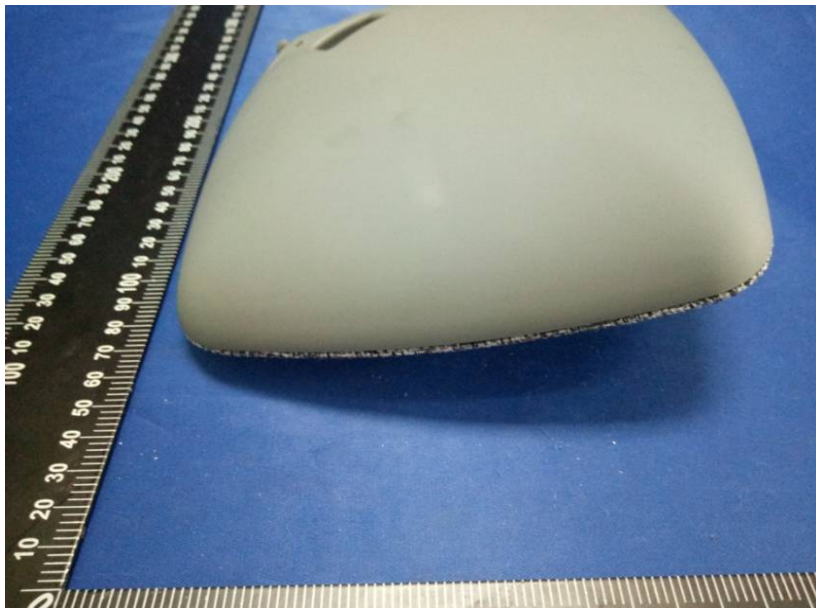




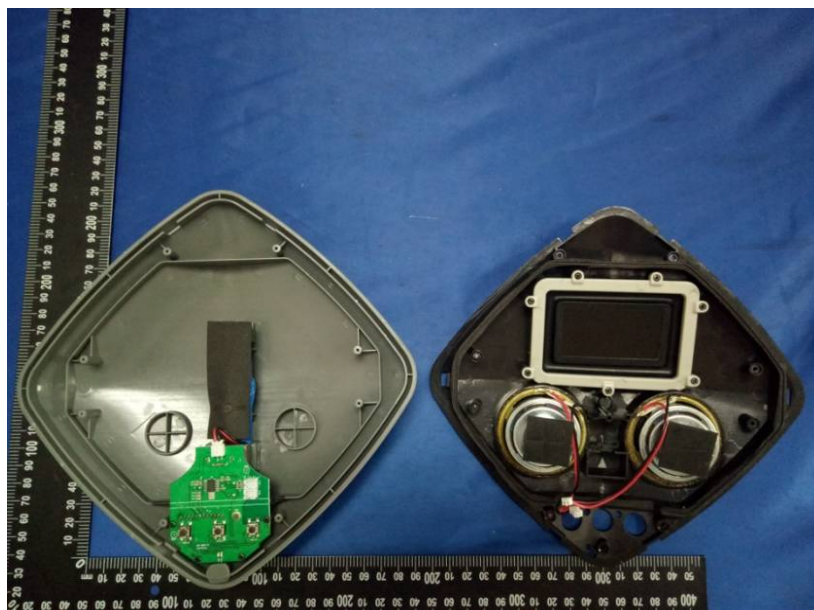
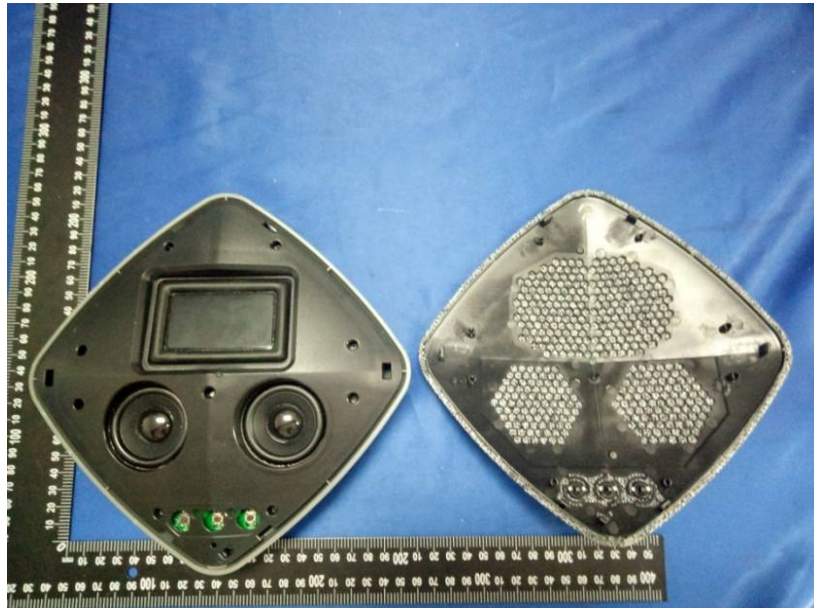
16 EUT PHOTOS

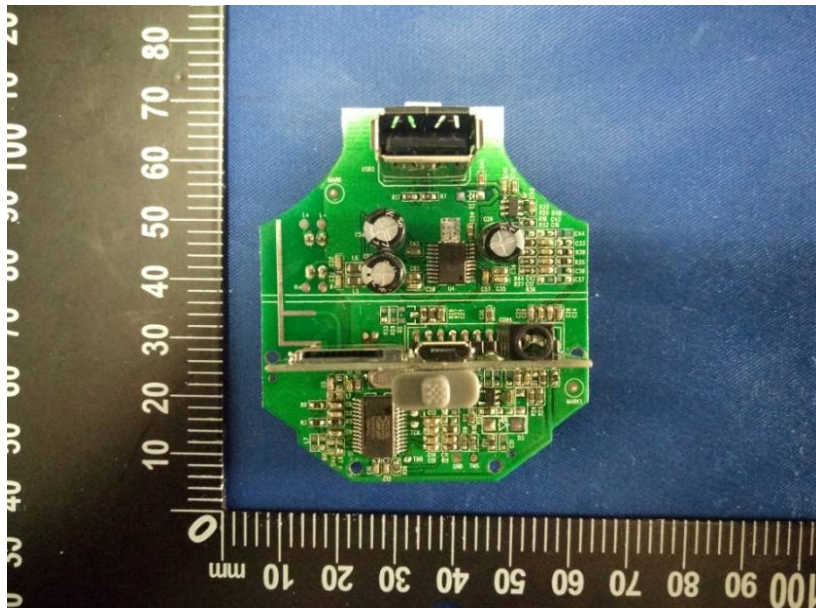
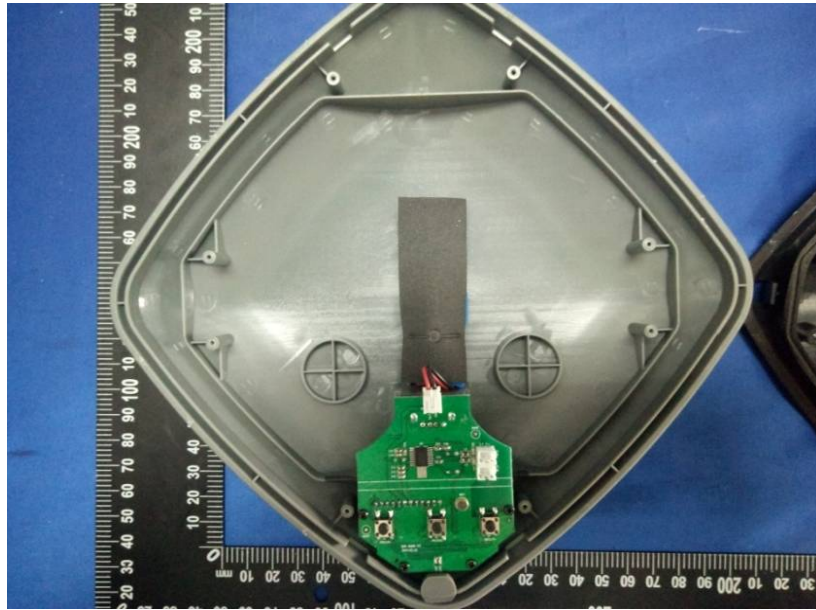


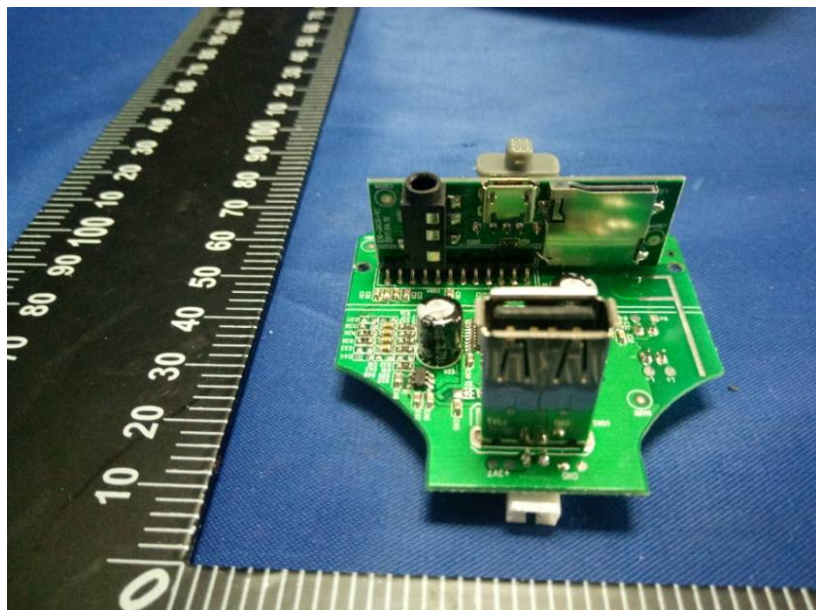
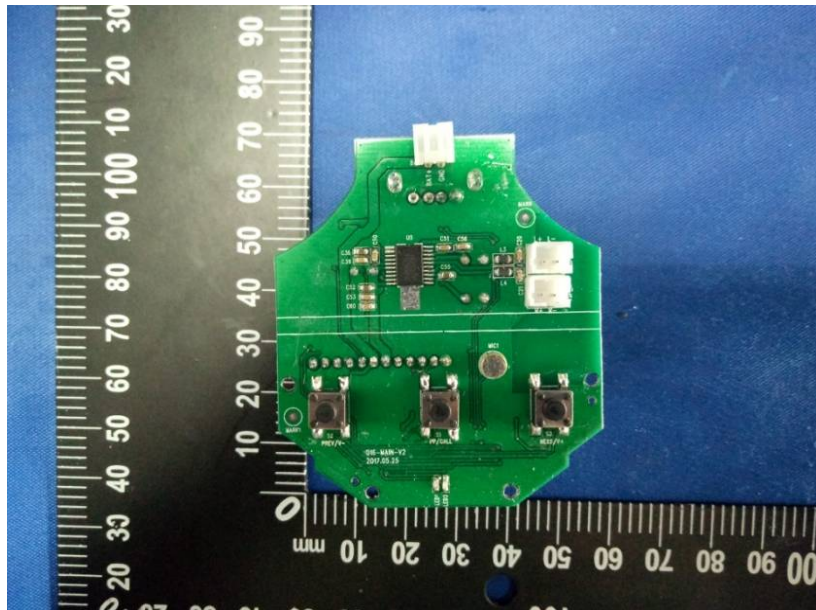


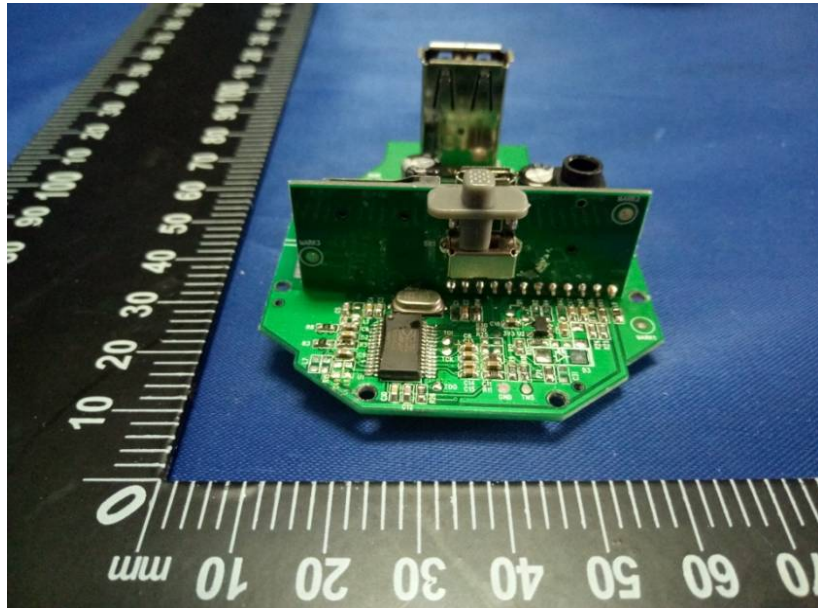


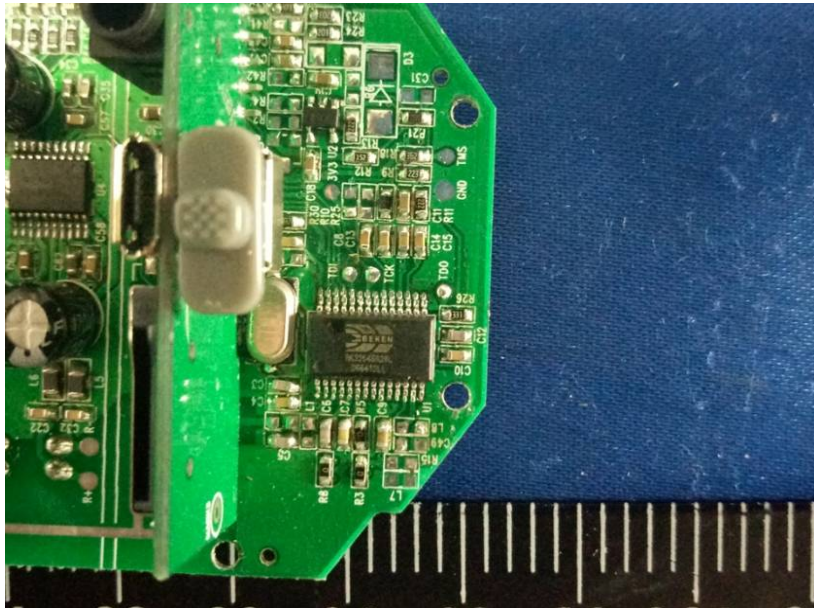












*****THE END REPORT*****