FCC TEST REPORT

FCC ID: 2AIO5RACR-400

Product Name	:	cassette player
Model Name	:	RACR-400
Brand Name	:	RIPTUNES
Report No.	:	PTC19061204701E-FC01

Prepared for

Luzerne Trading Company, Inc

171-47TH STREET,BROOKLYN

Prepared by

Dongguan Precise Testing & Certification Corp., Ltd.

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

1TEST RESULT CERTIFICATION		
Applicant's name	:	Luzerne Trading Company, Inc
Address	:	171-47TH STREET,BROOKLYN
Manufacture's name	:	LEOTEC ELECTRONICS CO. LTD
Address	:	**NO 106, Wentang North Road, Wenzhou Road, East District Dongguan , Guangdong Province ,China.**
Product name	:	cassette player
Model name	:	RACR-400
Standards	:	FCC CFR47 Part 15 Section 15.247
Test procedure	:	ANSI C63.10:2013
Test Date	:	June 12, 2019 to June 28, 2019
Date of Issue	:	June 28, 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. This report shall not be reproduced except in full, without the written approval of PTC, this document may be altered or revised by PTC, personal only, and shall be noted in the revision of the document.		

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	:	cassette player
Model Name	:	RACR-400
Difference of model number	:	N/A
Power supply	:	AC 120V 60Hz
Bluetooth Version	:	BT 5.0
Operating frequency	:	2402MHz-2480MHz
Numbers of Channel	:	79 channels
Operation frequency	:	2402MHz -2480MHz
Modulation	:	GFSK, π/4-DQPSK,8DPSK
Data rate	:	1Mbps, 2Mbps,3Mbps
Antenna Type	:	Integral PCB antenna, maximum PK gain: 0.91dBi
Sample Type	:	single production

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	-	-

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Worst Mode	Description	Data Rate/Modulation
Mode 1	TX CH00	1Mbps/GFSK
Mode 2	TX CH39	1Mbps/GFSK
Mode 3	TX CH78	1Mbps/GFSK
Mode 4	TX CH00	2 Mbps/π/4-DQPSK
Mode 5	TX CH39	2 Mbps/π/4-DQPSK
Mode 6	TX CH78	2 Mbps/π/4-DQPSK
Mode7	TX CH00	3 Mbps/8DPSK
Mode 8	TX CH39	3 Mbps/8DPSK
Mode 9	TX CH78	3 Mbps/8DPSK

Note:

(1) The measurements are performed at all Bit Rate of Transmitter, the worst data was reported

(2) We have be tested for all avaiable U.S. voltage and frequencies(For 120V,50/60Hz) for which the device is capable of operation.

For AC Conducted Emission

Test Case	
AC Conducted Emission	Mode 10 : Keeping BT TX

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power

selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters of FHSS.

Test software Version	Test program: Bluetooth		
Frequency	2402 MHz	2441 MHz	2480 MHz
(Power control software) Parameters(1/2/3Mbps)	Power class: 1 M rate:4:27 2 M rate:11:183 3 Mrate:15:339	Power class: 1 M rate:4:27 2 M rate:11:183 3 Mrate:15:339	Power class: 1 M rate:4:27 2 M rate:11:183 3 Mrate:15:339

4.3 Accessories of EUT

Description of Accessories	Manufacturer	Model number	Serial No.	Other

4.4 Assistant equipment used for test

Assistant equipment	Manufacturer	Model number	EMC Compliance	SN
Notebook	DELL	Latitude D610	FCC DOC	00045-534-136-300

4.5 Deviations of test standard

No Deviation.

4.6 Test environment conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature range:	21-25℃
Humidity range:	40-75%
Pressure range:	86-106kPa

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	MY56070279	10Hz-30GHz	Sep.19, 2019
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	Sep.19, 2019
Antenna Connector	Florida RF Labs	N/A	RF01#	N/A	Sep.19, 2019

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	Sep.19, 2019
Loop Antenna	Schwarzbeck	FMZB 1519	012	9 KHz -30MHz	Sep.19, 2019
Bilog Antenna	SCHWARZBECK	VULB9160	9160-3355	25MHz-2GHz	Sep.19, 2019
Preamplifier (low frequency)	SCHWARZBECK	BBV 9475	9745-0013	1MHz-1GHz	Sep.19, 2019
Cable	Schwarzbeck	PLF-100	549489	9KHz-3GHz	Sep.19, 2019
Spectrum Analyzer	Agilent	E4407B	MY45109572	9KHz-40GHz	Sep.19, 2019
Horn Antenna	SCHWARZBECK	9120D	9120D-1246	1GHz-18GHz	Sep.19, 2019
Power Amplifier	LUNAR EM	LNA1G18-40	J10100000081	1GHz-26.5GHz	Sep.19, 2019
Horn Antenna	SCHWARZBECK	BBHA 9170	9170-181	14GHz-40GHz	Sep.25, 2019
Amplifier	SCHWARZBECK	BBV 9721	9721-205	18GHz-40GHz	Sep.19, 2019
Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	Sep.19, 2019
RF Cable	R&S	R204	R21X	1GHz-40GHz	Sep.19, 2019

Conducted Emissions

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	9KHz-3GHz	Sep.19, 2019
Artificial Mains Network	Rohde&Schwarz	L2-16B	000WX31025	9KHz-300MHz	Sep.19, 2019
Artificial Mains Network	Rohde&Schwarz	ENV216	101342	9KHz-300MHz	Sep.19, 2019

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
Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95%	

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)

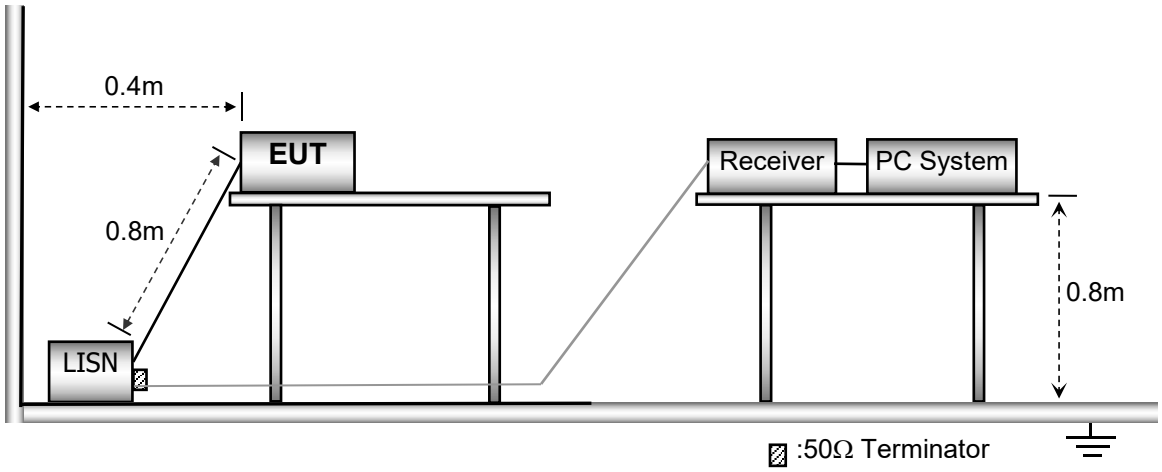
6.1 E.U.T. Operation

Operating Environment **:**

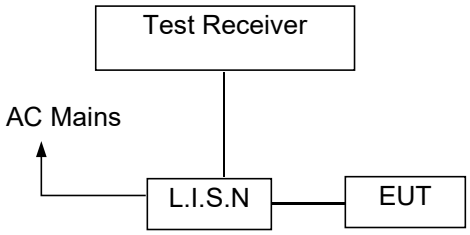
Temperature:	:	25.5 °C
Humidity:	:	51 % RH
Atmospheric Pressure:	:	101.2kPa

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.

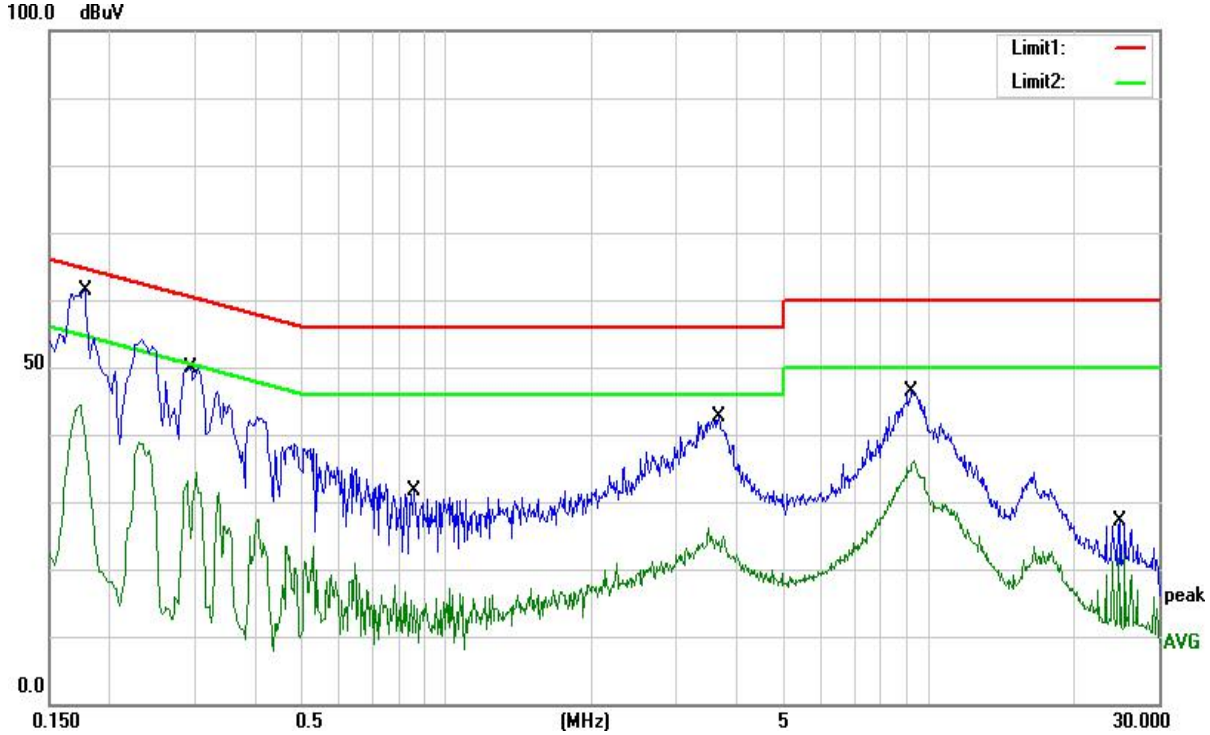
All the modulation modes were tested the data of the worst mode (AC 120V/60Hz, Model 10) are recorded in the following pages and the others modulation methods do not exceed the limits.

Neutral -120V/60Hz:

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
0.1780	51.55	9.82	61.37	64.58	-3.21	QP
0.1780	28.23	9.82	38.05	54.58	-16.53	AVG
0.2940	39.62	10.25	49.87	60.41	-10.54	QP
0.2940	19.62	10.25	29.87	50.41	-20.54	AVG
0.8540	21.79	9.83	31.62	56.00	-24.38	QP
0.8540	4.88	9.83	14.71	46.00	-31.29	AVG
3.6740	32.65	9.93	42.58	56.00	-13.42	QP
3.6740	12.81	9.93	22.74	46.00	-23.26	AVG
9.2180	36.54	9.92	46.46	60.00	-13.54	QP
9.2180	26.20	9.92	36.12	50.00	-13.88	AVG
24.9980	16.80	10.27	27.07	60.00	-32.93	QP
24.9980	7.51	10.27	17.78	50.00	-32.22	AVG

Remark:

1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit



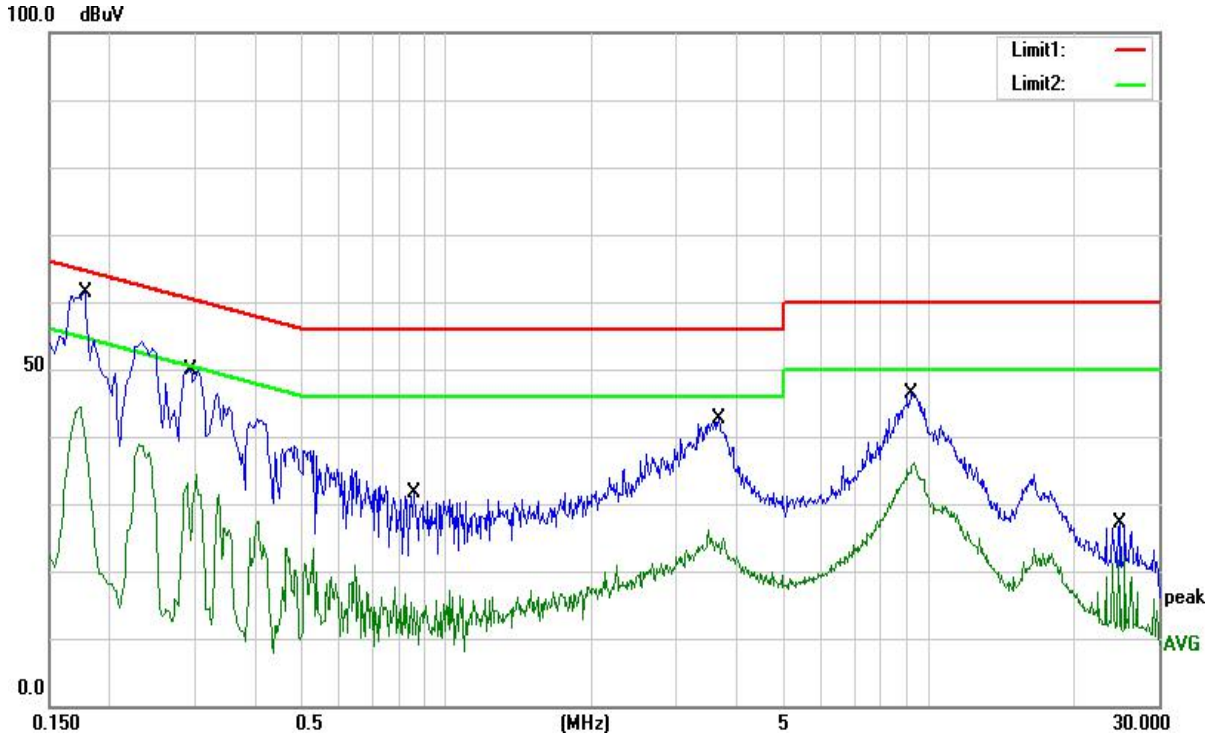
Line -120V/60Hz:

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
0.1780	51.55	9.82	61.37	64.58	-3.21	QP
0.1780	28.23	9.82	38.05	54.58	-16.53	AVG
0.2940	39.62	10.25	49.87	60.41	-10.54	QP
0.2940	19.62	10.25	29.87	50.41	-20.54	AVG
0.8540	21.79	9.83	31.62	56.00	-24.38	QP
0.8540	4.88	9.83	14.71	46.00	-31.29	AVG
3.6740	32.65	9.93	42.58	56.00	-13.42	QP
3.6740	12.81	9.93	22.74	46.00	-23.26	AVG
9.2180	36.54	9.92	46.46	60.00	-13.54	QP
9.2180	26.20	9.92	36.12	50.00	-13.88	AVG
24.9980	16.80	10.27	27.07	60.00	-32.93	QP
24.9980	7.51	10.27	17.78	50.00	-32.22	AVG

Remark:

1.All readings are Quasi-Peak and Average values.

2.Margin = Result (Result =Reading + Factor)–Limit



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 :

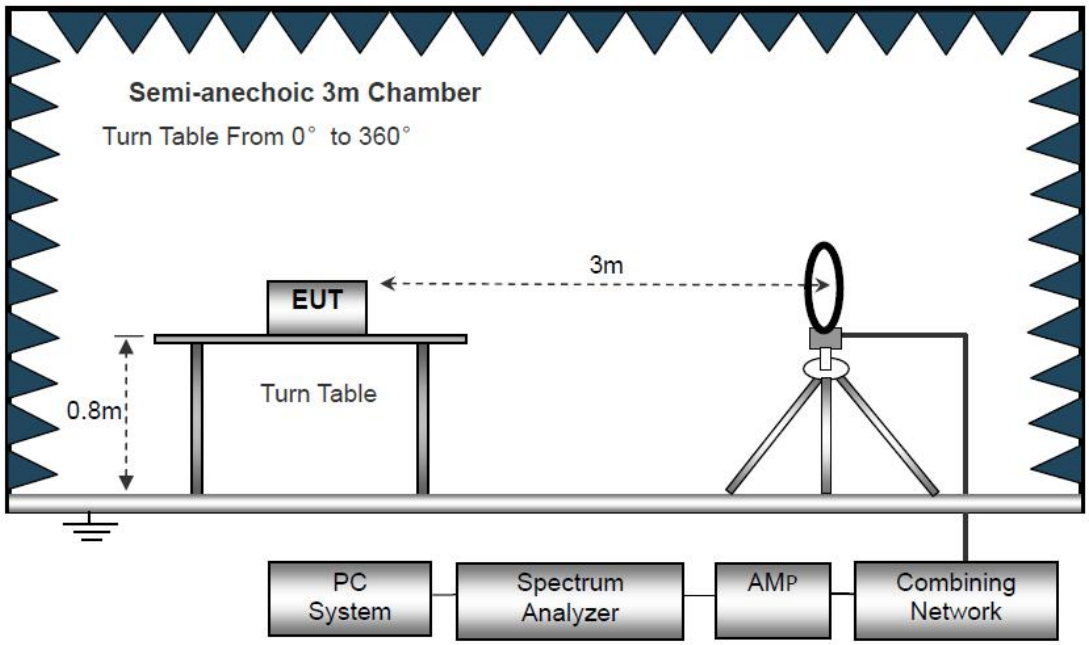
Temperature : 23.5 °C

Humidity : 51.1 % RH

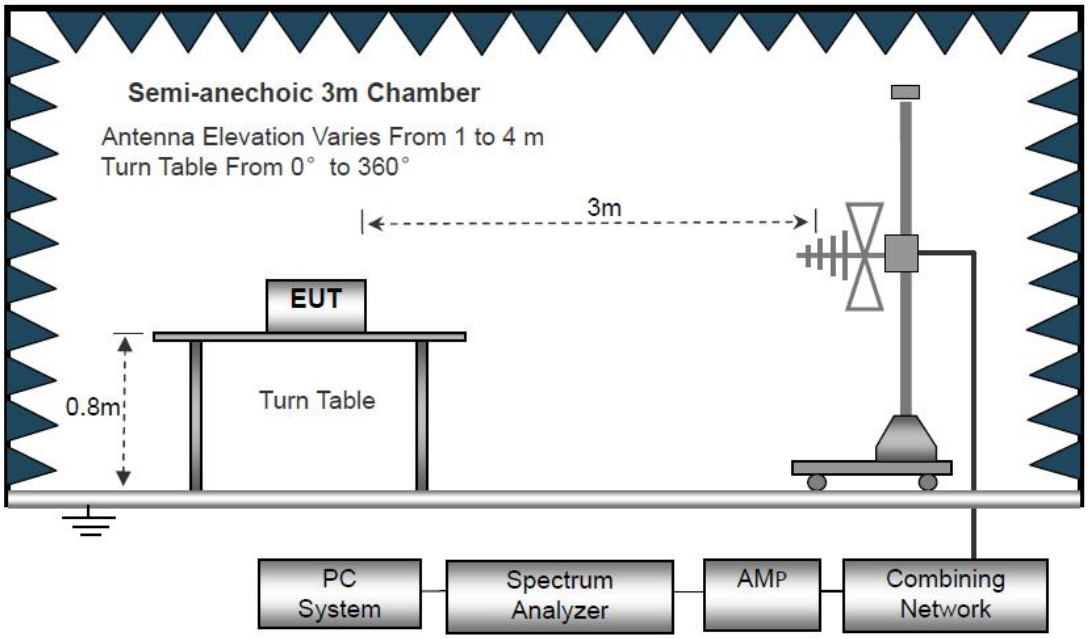
Atmospheric Pressure : 101.2kPa

7.2 Test Setup

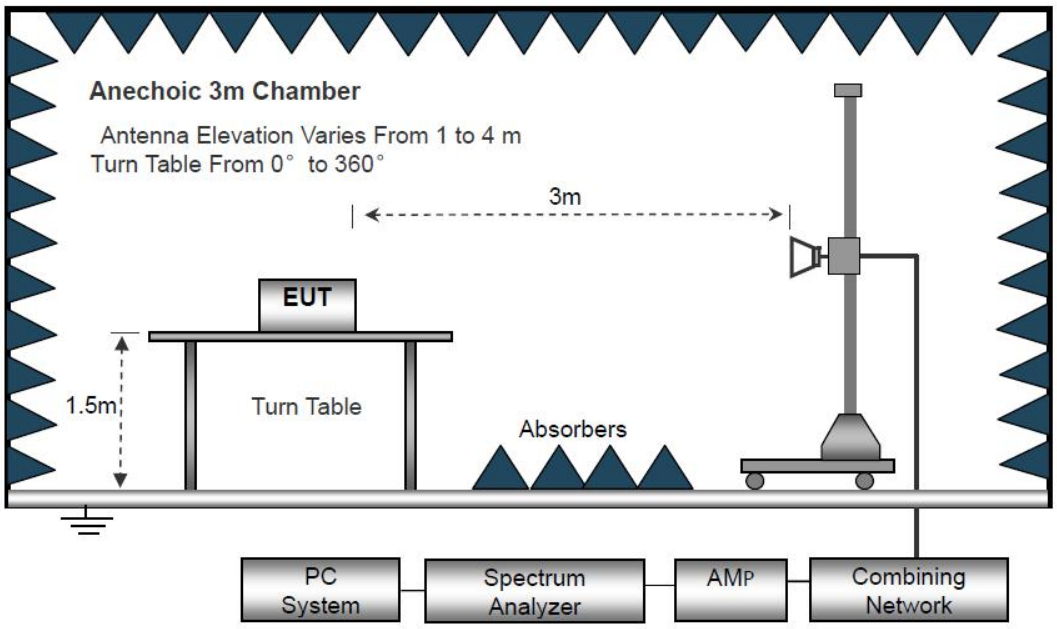
The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site
The test setup for emission measurement below 30MHz.



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

PASS. (See below detailed test result)

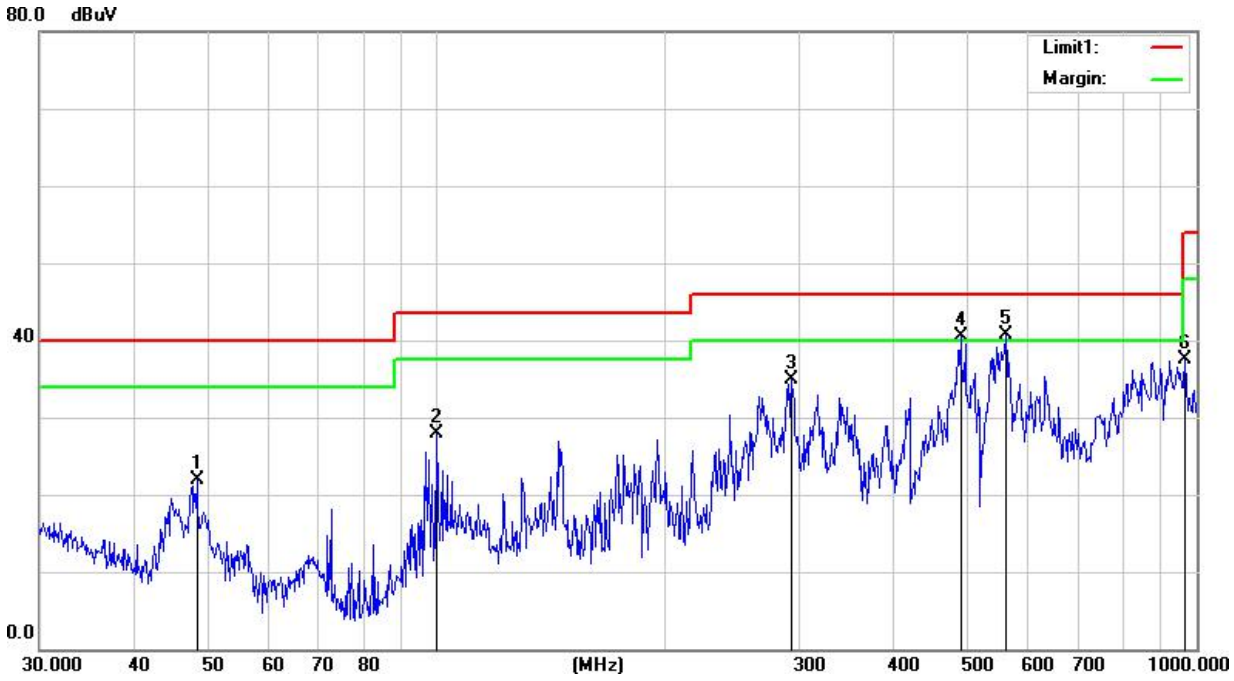
All the emissions except fundamental emission from 9 kHz to 25GHz were comply with 15.209 limits.

Note1: According exploratory test no any obvious emission was detected from 9kHz to 30MHz and 18GHz to 25GHz.

Note2: For emissions below 1GHz, according exploratory explorer test, when change Tx mode and channel, have no distinct influence on emissions level, so for emissions below 1GHz, the final test was only performed with EUT working in GFSK, Tx 2402MHz mode is worst mode.

Note3: For emissions above 1GHz. If peak results comply with AV limit, AV Result is deemed to comply with AV limit.

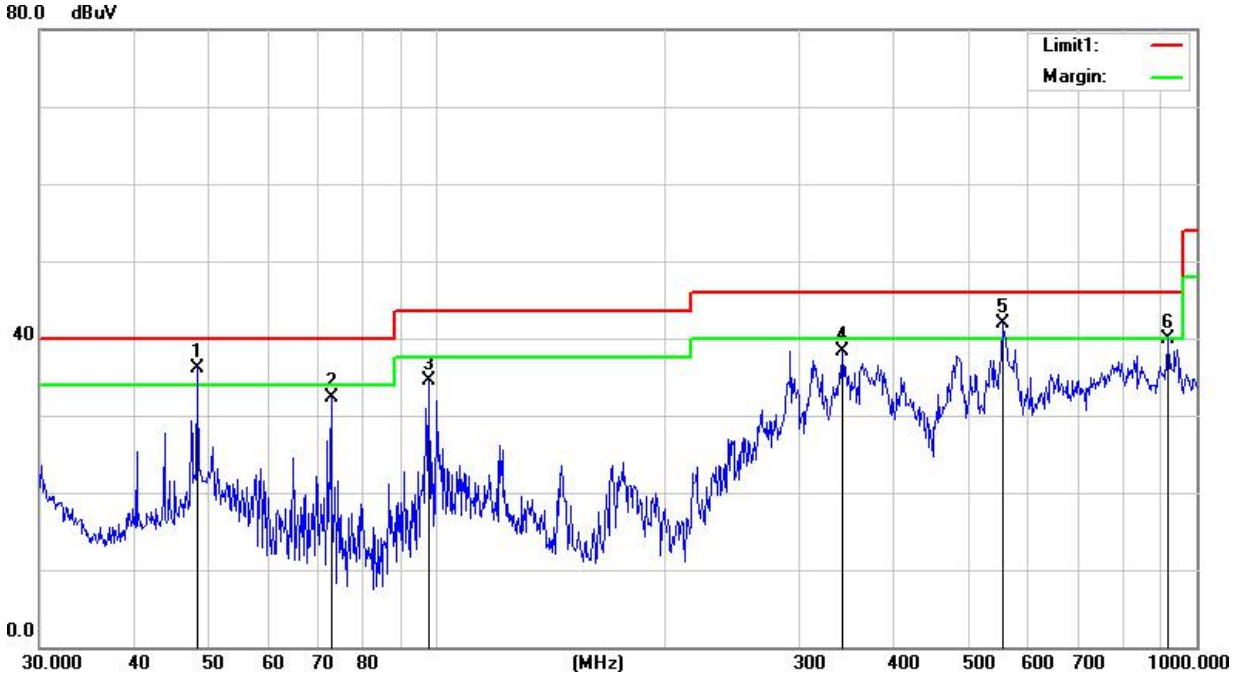
Test plot for Horizontal: GFSK(2402MHz)



Frequency	Reading	Correct	Result	Limit	Margin	Remark
(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
48.3318	56.72	-20.62	36.10	40.00	-3.90	QP
72.5916	56.01	-23.74	32.27	40.00	-7.73	QP
97.4560	54.00	-19.44	34.56	43.50	-8.94	QP
341.9786	52.23	-13.93	38.30	46.00	-7.70	QP
556.7744	48.58	-6.63	41.95	46.00	-4.05	QP
916.0687	41.67	-1.71	39.96	46.00	-6.04	QP

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit

Test plot for Vertical: GFSK(2402MHz)



Frequency	Reading	Correct	Result	Limit	Margin	Remark
(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
48.3318	56.72	-20.62	36.10	40.00	-3.90	QP
72.5916	56.01	-23.74	32.27	40.00	-7.73	QP
97.4560	54.00	-19.44	34.56	43.50	-8.94	QP
341.9786	52.23	-13.93	38.30	46.00	-7.70	QP
556.7744	48.58	-6.63	41.95	46.00	-4.05	QP
916.0687	41.67	-1.71	39.96	46.00	-6.04	QP

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit

(1GHz~25GHz) Restricted band and Spurious emission Requirements

GFSK Low Channel

Frequency (MHz)	Reading (dBμV)	Amplifier （dB）	Loss （dB）	Antenna Factor （dB/m）	Corrected Factor （dB）	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type	Comment
Low Channel (2402 MHz)										
3264.69	48.62	44.70	6.70	28.20	-9.80	38.82	74.00	-35.18	PK	Vertical
3264.69	39.60	44.70	6.70	28.20	-9.80	29.80	54.00	-24.20	AV	Vertical
3264.61	48.92	44.70	6.70	28.20	-9.80	39.12	74.00	-34.88	PK	Horizontal
3264.61	38.22	44.70	6.70	28.20	-9.80	28.42	54.00	-25.58	AV	Horizontal
4804.49	58.12	44.20	9.04	31.60	-3.56	54.56	74.00	-19.44	PK	Vertical
4804.49	39.25	44.20	9.04	31.60	-3.56	35.69	54.00	-18.31	AV	Vertical
4804.53	58.48	44.20	9.04	31.60	-3.56	54.92	74.00	-19.08	PK	Horizontal
4804.53	38.87	44.20	9.04	31.60	-3.56	35.31	54.00	-18.69	AV	Horizontal
5359.65	45.10	44.20	9.86	32.00	-2.34	42.76	74.00	-31.24	PK	Vertical
5359.65	38.28	44.20	9.86	32.00	-2.34	35.94	54.00	-18.06	AV	Vertical
5359.73	45.51	44.20	9.86	32.00	-2.34	43.17	74.00	-30.83	PK	Horizontal
5359.73	38.47	44.20	9.86	32.00	-2.34	36.13	54.00	-17.87	AV	Horizontal
7205.74	51.53	43.50	11.40	35.50	3.40	54.93	74.00	-19.07	PK	Vertical
7205.74	33.04	43.50	11.40	35.50	3.40	36.44	54.00	-17.56	AV	Vertical
7205.83	50.76	43.50	11.40	35.50	3.40	54.16	74.00	-19.84	PK	Horizontal
7205.83	34.00	43.50	11.40	35.50	3.40	37.40	54.00	-16.60	AV	Horizontal
11035.76	40.00	43.60	14.30	39.50	10.20	50.20	74.00	-23.80	PK	Vertical
11035.76	31.01	43.60	14.30	39.50	10.20	41.21	54.00	-12.79	AV	Vertical
11036.09	40.80	43.60	14.30	39.50	10.20	51.00	74.00	-23.00	PK	Horizontal
11036.09	30.45	43.60	14.30	39.50	10.20	40.65	54.00	-13.35	AV	Horizontal
13299.31	40.17	42.60	15.90	38.90	12.20	52.37	74.00	-21.63	PK	Vertical
13299.31	28.54	42.60	15.90	38.90	12.20	40.74	54.00	-13.26	AV	Vertical
13299.32	40.12	42.60	15.90	38.90	12.20	52.32	74.00	-21.68	PK	Horizontal
13299.32	28.62	42.60	15.90	38.90	12.20	40.82	54.00	-13.18	AV	Horizontal
15999.91	39.95	42.70	18.00	37.10	12.40	52.35	74.00	-21.65	PK	Vertical
15999.91	28.64	42.70	18.00	37.10	12.40	41.04	54.00	-12.96	AV	Vertical

15999.78	40.17	42.70	18.00	37.10	12.40	52.57	74.00	-21.43	PK	Horizontal
15999.78	29.60	42.70	18.00	37.10	12.40	42.00	54.00	-12.00	AV	Horizontal
17997.92	30.80	42.70	19.40	46.50	23.20	54.00	74.00	-20.00	PK	Vertical
17997.92	20.04	42.70	19.40	46.50	23.20	43.24	54.00	-10.76	AV	Vertical
17997.65	30.32	42.70	19.40	46.50	23.20	53.52	74.00	-20.48	PK	Horizontal
17997.65	18.54	42.70	19.40	46.50	23.20	41.74	54.00	-12.26	AV	Horizontal

GFSK Mid Channel

Frequency (MHz)	Reading (dBμV)	Amplifier （dB）	Loss （dB）	Antenna Factor （dB/m）	Corrected Factor （dB）	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type	Comment
Mid Channel (2441 MHz)										
3264.86	48.91	44.70	6.70	28.20	-9.80	39.11	74.00	-34.89	PK	Vertical
3264.86	39.82	44.70	6.70	28.20	-9.80	30.02	54.00	-23.98	AV	Vertical
3264.63	47.85	44.70	6.70	28.20	-9.80	38.05	74.00	-35.95	PK	Horizontal
3264.63	37.88	44.70	6.70	28.20	-9.80	28.08	54.00	-25.92	AV	Horizontal
4882.57	59.59	44.20	9.04	31.60	-3.56	56.03	74.00	-17.97	PK	Vertical
4882.57	38.16	44.20	9.04	31.60	-3.56	34.60	54.00	-19.40	AV	Vertical
4882.56	59.15	44.20	9.04	31.60	-3.56	55.59	74.00	-18.41	PK	Horizontal
4882.56	38.24	44.20	9.04	31.60	-3.56	34.68	54.00	-19.32	AV	Horizontal
5359.68	45.56	44.20	9.86	32.00	-2.34	43.22	74.00	-30.78	PK	Vertical
5359.68	37.04	44.20	9.86	32.00	-2.34	34.70	54.00	-19.30	AV	Vertical
5359.82	45.99	44.20	9.86	32.00	-2.34	43.65	74.00	-30.35	PK	Horizontal
5359.82	38.51	44.20	9.86	32.00	-2.34	36.17	54.00	-17.83	AV	Horizontal
7313.76	50.91	43.50	11.40	35.50	3.40	54.31	74.00	-19.69	PK	Vertical
7313.76	33.57	43.50	11.40	35.50	3.40	36.97	54.00	-17.03	AV	Vertical
7313.78	50.50	43.50	11.40	35.50	3.40	53.90	74.00	-20.10	PK	Horizontal
7313.78	32.87	43.50	11.40	35.50	3.40	36.27	54.00	-17.73	AV	Horizontal
9608.01	39.92	43.60	14.30	39.50	10.20	50.12	74.00	-23.88	PK	Vertical
9608.01	30.11	43.60	14.30	39.50	10.20	40.31	54.00	-13.69	AV	Vertical
9608.12	40.49	43.60	14.30	39.50	10.20	50.69	74.00	-23.31	PK	Horizontal
9608.12	30.30	43.60	14.30	39.50	10.20	40.50	54.00	-13.50	AV	Horizontal
13299.38	40.59	42.60	15.90	38.90	12.20	52.79	74.00	-21.21	PK	Vertical
13299.38	28.54	42.60	15.90	38.90	12.20	40.74	54.00	-13.26	AV	Vertical
13299.50	40.61	42.60	15.90	38.90	12.20	52.81	74.00	-21.19	PK	Horizontal
13299.50	29.41	42.60	15.90	38.90	12.20	41.61	54.00	-12.39	AV	Horizontal
15999.81	40.52	42.70	18.00	37.10	12.40	52.92	74.00	-21.08	PK	Vertical
15999.81	28.64	42.70	18.00	37.10	12.40	41.04	54.00	-12.96	AV	Vertical
15999.56	40.10	42.70	18.00	37.10	12.40	52.50	74.00	-21.50	PK	Horizontal
15999.56	29.12	42.70	18.00	37.10	12.40	41.52	54.00	-12.48	AV	Horizontal

17997.74	30.88	42.70	19.40	46.50	23.20	54.08	74.00	-19.92	PK	Vertical
17997.74	19.03	42.70	19.40	46.50	23.20	42.23	54.00	-11.77	AV	Vertical
17997.75	30.62	42.70	19.40	46.50	23.20	53.82	74.00	-20.18	PK	Horizontal
17997.75	19.27	42.70	19.40	46.50	23.20	42.47	54.00	-11.53	AV	Horizontal

GFSK High Channel

Frequency (MHz)	Reading (dBμV)	Amplifier （dB）	Loss （dB）	Antenna Factor （dB/m）	Corrected Factor （dB）	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type	Comment
High Channel (2480 MHz)										
3264.90	48.40	44.70	6.70	28.20	-9.80	38.60	74.00	-35.40	PK	Vertical
3264.90	38.71	44.70	6.70	28.20	-9.80	28.91	54.00	-25.09	AV	Vertical
3264.56	49.21	44.70	6.70	28.20	-9.80	39.41	74.00	-34.59	PK	Horizontal
3264.56	38.31	44.70	6.70	28.20	-9.80	28.51	54.00	-25.49	AV	Horizontal
4960.51	58.53	44.20	9.04	31.60	-3.56	54.97	74.00	-19.03	PK	Vertical
4960.51	39.15	44.20	9.04	31.60	-3.56	35.59	54.00	-18.41	AV	Vertical
4960.43	59.50	44.20	9.04	31.60	-3.56	55.94	74.00	-18.06	PK	Horizontal
4960.43	38.16	44.20	9.04	31.60	-3.56	34.60	54.00	-19.40	AV	Horizontal
5359.86	46.22	44.20	9.86	32.00	-2.34	43.88	74.00	-30.12	PK	Vertical
5359.86	37.53	44.20	9.86	32.00	-2.34	35.19	54.00	-18.81	AV	Vertical
5359.85	45.10	44.20	9.86	32.00	-2.34	42.76	74.00	-31.24	PK	Horizontal
5359.85	37.47	44.20	9.86	32.00	-2.34	35.13	54.00	-18.87	AV	Horizontal
7439.72	51.23	43.50	11.40	35.50	3.40	54.63	74.00	-19.37	PK	Vertical
7439.72	32.56	43.50	11.40	35.50	3.40	35.96	54.00	-18.04	AV	Vertical
7439.74	51.86	43.50	11.40	35.50	3.40	55.26	74.00	-18.74	PK	Horizontal
7439.74	33.34	43.50	11.40	35.50	3.40	36.74	54.00	-17.26	AV	Horizontal
9919.82	40.63	43.60	14.30	39.50	10.20	50.83	74.00	-23.17	PK	Vertical
9919.82	30.18	43.60	14.30	39.50	10.20	40.38	54.00	-13.62	AV	Vertical
9920.27	39.88	43.60	14.30	39.50	10.20	50.08	74.00	-23.92	PK	Horizontal
9920.27	29.87	43.60	14.30	39.50	10.20	40.07	54.00	-13.93	AV	Horizontal
13299.25	39.98	42.70	18.00	37.10	12.40	52.38	74.00	-21.62	PK	Vertical
13299.25	28.54	42.70	18.00	37.10	12.40	40.94	54.00	-13.06	AV	Vertical
13299.50	39.94	42.70	18.00	37.10	12.40	52.34	74.00	-21.66	PK	Horizontal
13299.50	29.12	42.70	18.00	37.10	12.40	41.52	54.00	-12.48	AV	Horizontal
17997.69	30.59	42.70	19.40	46.50	23.20	53.79	74.00	-20.21	PK	Vertical
17997.69	19.18	42.70	19.40	46.50	23.20	42.38	54.00	-11.62	AV	Vertical
17997.62	31.10	42.70	19.40	46.50	23.20	54.30	74.00	-19.70	PK	Horizontal
17997.62	18.84	42.70	19.40	46.50	23.20	42.04	54.00	-11.96	AV	Horizontal

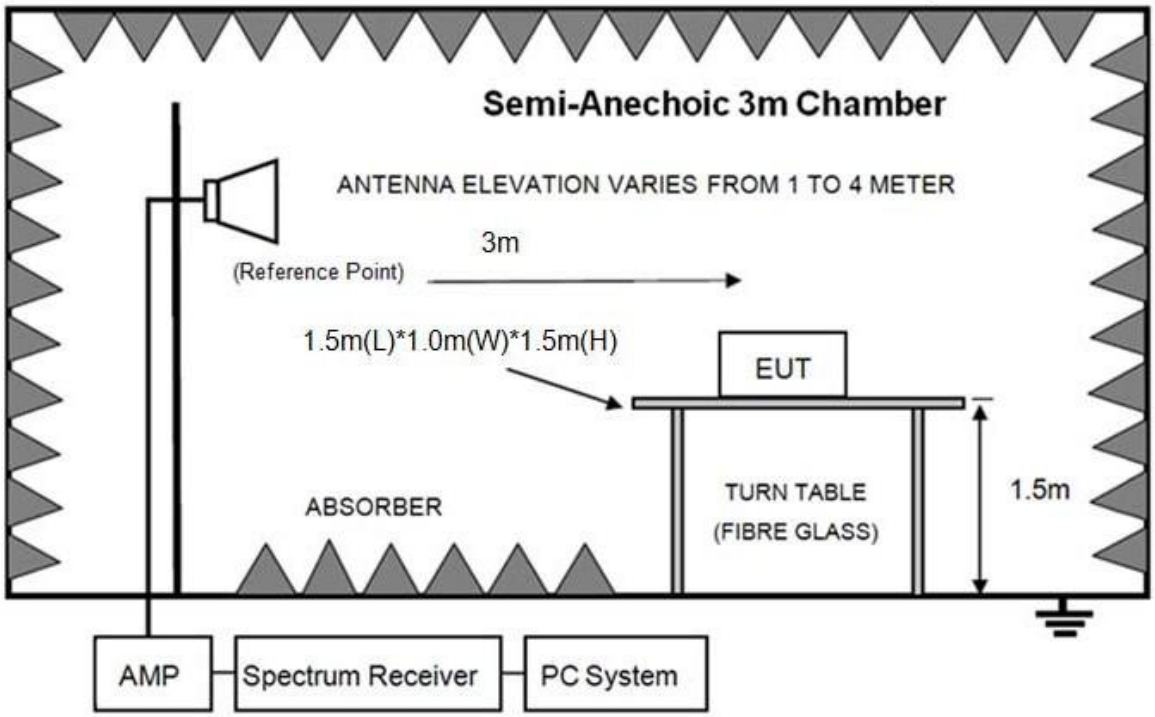
Note:

1) Scan with GFSK, π/4-DQPSK,8DPSK,the worst case is GFSK Mode

2) Corrected Factor = Amplifier.-Antenna Factor - Cable Loss

Emission Level = Reading + Corrected Factor

8 Band Edge Compliance (radiated method)Block diagram of test setup



8.1 Limit

All restriction band should comply with 15.209, other emission should be at least 20dB blow the fundamental.

8.2 Test Procedure

Same with clause 10.3 except change investigated frequency range from 2310MHz to 2415MHz and 2475MHz to 2500MHz.

Remark: All restriction band have been tested, and only the worst case is shown in report.

8.3 Test result

PASS. (See below detailed test result)

Remark: hopping on and hopping off mode all have been test, hopping off mode is worst and reported only.

Band edge Requirements

Frequency (MHz)	Reading (dBμV)	Amplifier （dB）	Loss （dB）	Antenna Factor （dB/m）	Corrected Factor （dB）	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type	Comment
GFSK										
2390.00	68.04	43.80	4.91	25.90	-12.99	55.05	74.00	-18.95	PK	Vertical
2390.00	53.07	43.80	4.91	25.90	-12.99	40.08	54.00	-13.92	AV	Vertical
2390.00	68.32	43.80	4.91	25.90	-12.99	55.33	74.00	-18.67	PK	Horizontal
2390.00	52.46	43.80	4.91	25.90	-12.99	39.47	54.00	-14.53	AV	Horizontal
2483.50	69.16	43.80	5.12	25.90	-12.78	56.38	74.00	-17.62	PK	Vertical
2483.50	53.36	43.80	5.12	25.90	-12.78	40.58	54.00	-13.42	AV	Vertical
2483.50	69.81	43.80	5.12	25.90	-12.78	57.03	74.00	-16.97	PK	Horizontal
2483.50	52.25	43.80	5.12	25.90	-12.78	39.47	54.00	-14.53	AV	Horizontal
π/4-DQPSK										
2390.00	68.35	43.80	4.91	25.90	-12.99	55.36	74.00	-18.64	PK	Vertical
2390.00	54.10	43.80	4.91	25.90	-12.99	41.11	54.00	-12.89	AV	Vertical
2390.00	68.77	43.80	4.91	25.90	-12.99	55.78	74.00	-18.22	PK	Horizontal
2390.00	53.25	43.80	4.91	25.90	-12.99	40.26	54.00	-13.74	AV	Horizontal
2483.50	70.30	43.80	5.12	25.90	-12.78	57.52	74.00	-16.48	PK	Vertical
2483.50	52.32	43.80	5.12	25.90	-12.78	39.54	54.00	-14.46	AV	Vertical
2483.50	69.72	43.80	5.12	25.90	-12.78	56.94	74.00	-17.06	PK	Horizontal
2483.50	52.64	43.80	5.12	25.90	-12.78	39.86	54.00	-14.14	AV	Horizontal
8DPSK										
2390.00	67.72	43.80	4.91	25.90	-12.99	54.73	74.00	-19.27	PK	Vertical
2390.00	53.60	43.80	4.91	25.90	-12.99	40.61	54.00	-13.39	AV	Vertical
2390.00	68.84	43.80	4.91	25.90	-12.99	55.85	74.00	-18.15	PK	Horizontal
2390.00	52.44	43.80	4.91	25.90	-12.99	39.45	54.00	-14.55	AV	Horizontal
2483.50	70.09	43.80	5.12	25.90	-12.78	57.31	74.00	-16.69	PK	Vertical
2483.50	53.07	43.80	5.12	25.90	-12.78	40.29	54.00	-13.71	AV	Vertical

2483.50	69.33	43.80	5.12	25.90	-12.78	56.55	74.00	-17.45	PK	Horizontal
2483.50	52.06	43.80	5.12	25.90	-12.78	39.28	54.00	-14.72	AV	Horizontal
Low measurement frequencies is range from 2300 to 2403 MHz, high measurement frequencies is range from 2479 to 2500 MHz. Only showthe worst point data of the emissions in the frequency 2300-2403 MHz and 2479-2500 MHz.										

Note:

Corrected Factor = Amplifier.-Antenna Factor - Cable Loss

Emission Level = Reading + Corrected Factor

Hopping Band edge

Frequency (MHz)	Reading (dBμV)	Amplifier （dB）	Loss （dB）	Antenna Factor （dB/m）	Corrected Factor （dB）	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type	Comment
GFSK										
2390.00	67.93	43.80	4.91	25.90	-12.99	54.94	74.00	-19.06	PK	Vertical
2390.00	54.06	43.80	4.91	25.90	-12.99	41.07	54.00	-12.93	AV	Vertical
2390.00	68.39	43.80	4.91	25.90	-12.99	55.40	74.00	-18.60	PK	Horizontal
2390.00	53.26	43.80	4.91	25.90	-12.99	40.27	54.00	-13.73	AV	Horizontal
2483.50	69.54	43.80	5.12	25.90	-12.78	56.76	74.00	-17.24	PK	Vertical
2483.50	53.44	43.80	5.12	25.90	-12.78	40.66	54.00	-13.34	AV	Vertical
2483.50	70.37	43.80	5.12	25.90	-12.78	57.59	74.00	-16.41	PK	Horizontal
2483.50	53.01	43.80	5.12	25.90	-12.78	40.23	54.00	-13.77	AV	Horizontal
π/4-DQPSK										
2390.00	67.23	43.80	4.91	25.90	-12.99	54.24	74.00	-19.76	PK	Vertical
2390.00	53.89	43.80	4.91	25.90	-12.99	40.90	54.00	-13.10	AV	Vertical
2390.00	68.81	43.80	4.91	25.90	-12.99	55.82	74.00	-18.18	PK	Horizontal
2390.00	52.59	43.80	4.91	25.90	-12.99	39.60	54.00	-14.40	AV	Horizontal
2483.50	70.13	43.80	5.12	25.90	-12.78	57.35	74.00	-16.65	PK	Vertical
2483.50	53.14	43.80	5.12	25.90	-12.78	40.36	54.00	-13.64	AV	Vertical
2483.50	70.22	43.80	5.12	25.90	-12.78	57.44	74.00	-16.56	PK	Horizontal
2483.50	52.83	43.80	5.12	25.90	-12.78	40.05	54.00	-13.95	AV	Horizontal
8DPSK										
2390.00	68.16	43.80	4.91	25.90	-12.99	55.17	74.00	-18.83	PK	Vertical
2390.00	54.37	43.80	4.91	25.90	-12.99	41.38	54.00	-12.62	AV	Vertical
2390.00	68.50	43.80	4.91	25.90	-12.99	55.51	74.00	-18.49	PK	Horizontal
2390.00	53.25	43.80	4.91	25.90	-12.99	40.26	54.00	-13.74	AV	Horizontal

2483.50	69.56	43.80	5.12	25.90	-12.78	56.78	74.00	-17.22	PK	Vertical
2483.50	52.59	43.80	5.12	25.90	-12.78	39.81	54.00	-14.19	AV	Vertical
2483.50	70.31	43.80	5.12	25.90	-12.78	57.53	74.00	-16.47	PK	Horizontal
2483.50	52.60	43.80	5.12	25.90	-12.78	39.82	54.00	-14.18	AV	Horizontal
Low measurement frequencies is range from 2300 to 2403 MHz, high measurement frequencies is range from 2479 to 2500 MHz. Only showthe worst point data of the emissions in the frequency 2300-2403 MHz and 2479-2500 MHz.										

Note:

Corrected Factor = Amplifier.-Antenna Factor - Cable Loss

Emission Level = Reading + Corrected Factor

9 CONDUCTED BAND EDGE EMISSION

9.1 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.

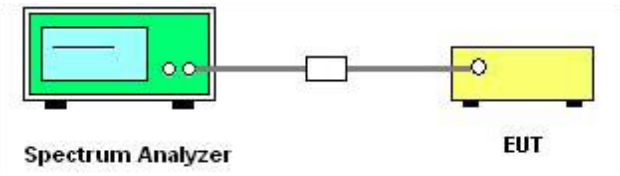
9.2 TEST PROCEDURE

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

9.3 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.

9.4 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.

9.5 TEST RESULTS

Mode	Freq (MHz)	Conclusion
GFSK	Hopping off 2402	PASS
	Hopping off 2480	PASS
	Hopping on	PASS
π/4-DQPSK	Hopping off 2402	PASS
	Hopping off 2480	PASS
	Hopping on	PASS
8DPSK	Hopping off 2402	PASS
	Hopping off 2480	PASS
	Hopping on	PASS

For Non-Hopping Mode:

GFSK

For Hopping Mode:

GFSK

For Non-Hopping Mode:

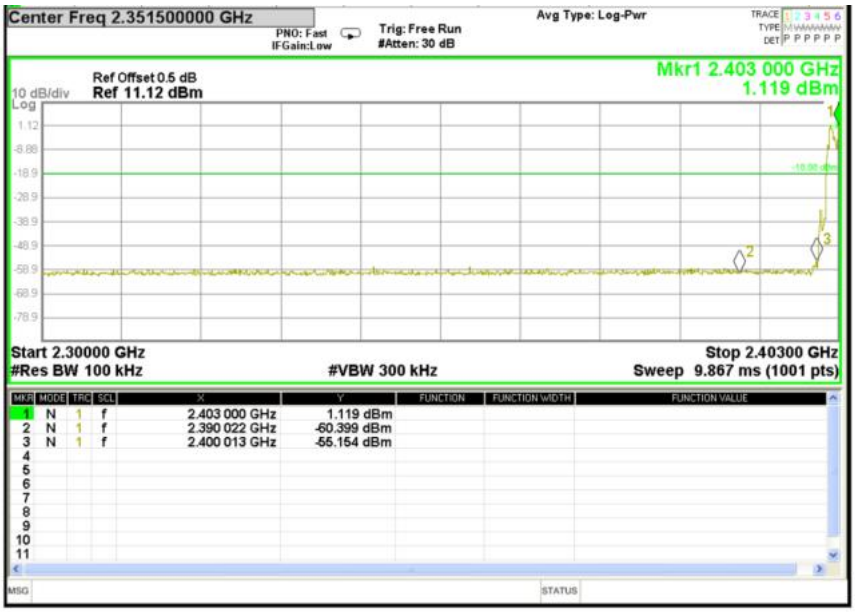
π/4-DQPSK

For Hopping Mode:

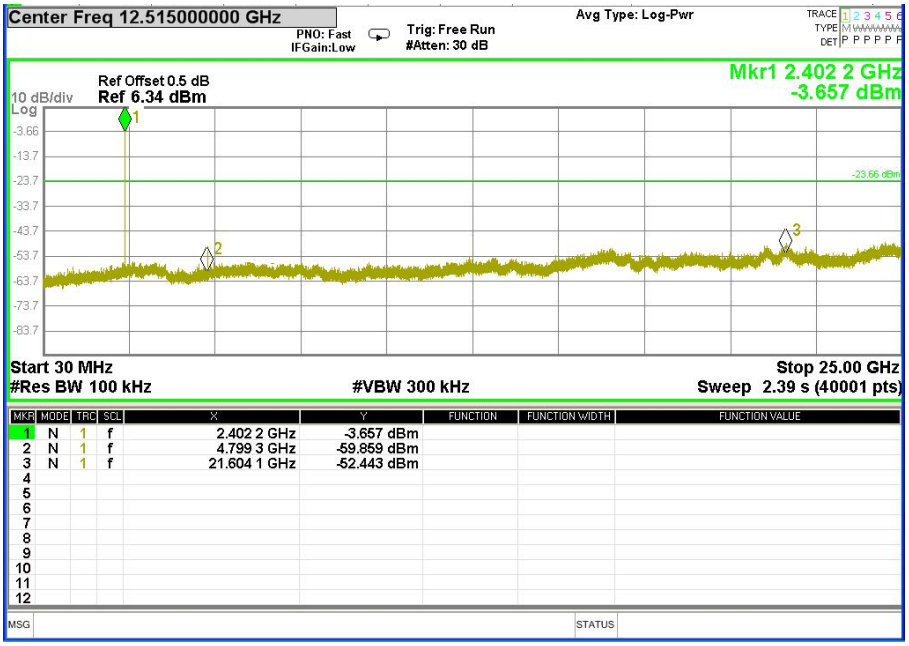
For Non-Hopping Mode:

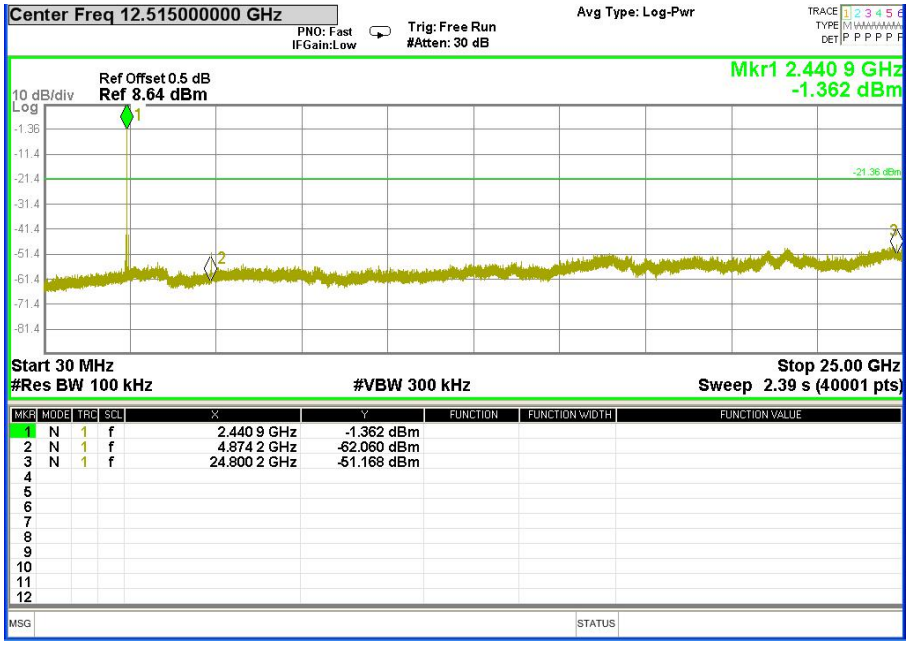
8DQPSK

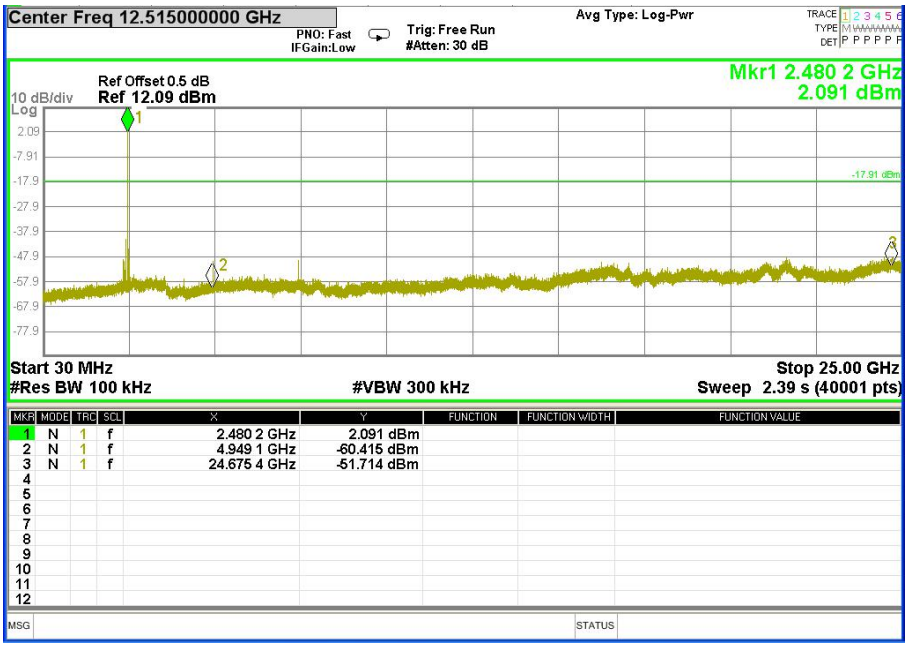
For Hopping Mode:



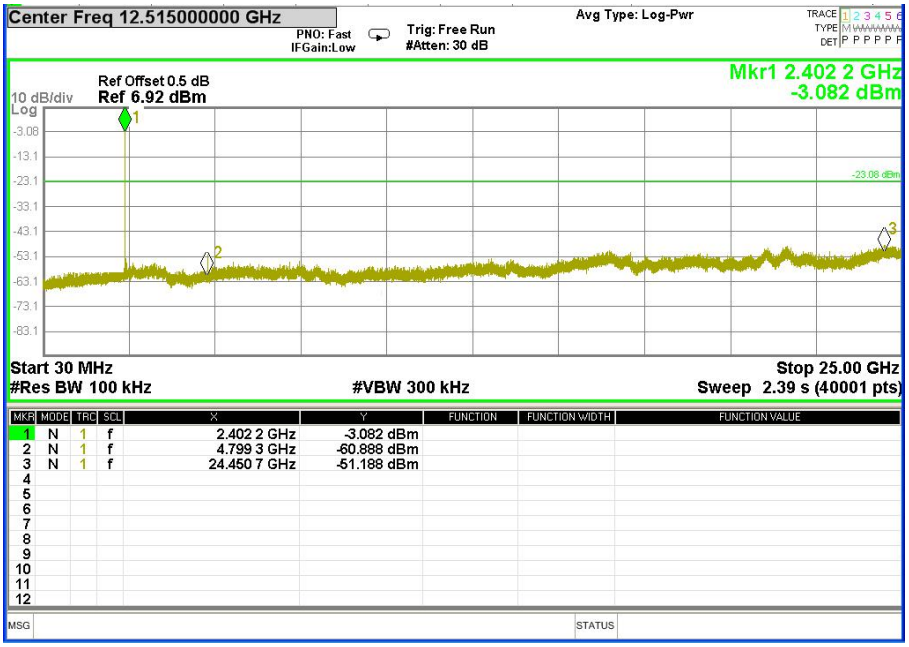
GFSK(1Mbps)-00/39/78 CH

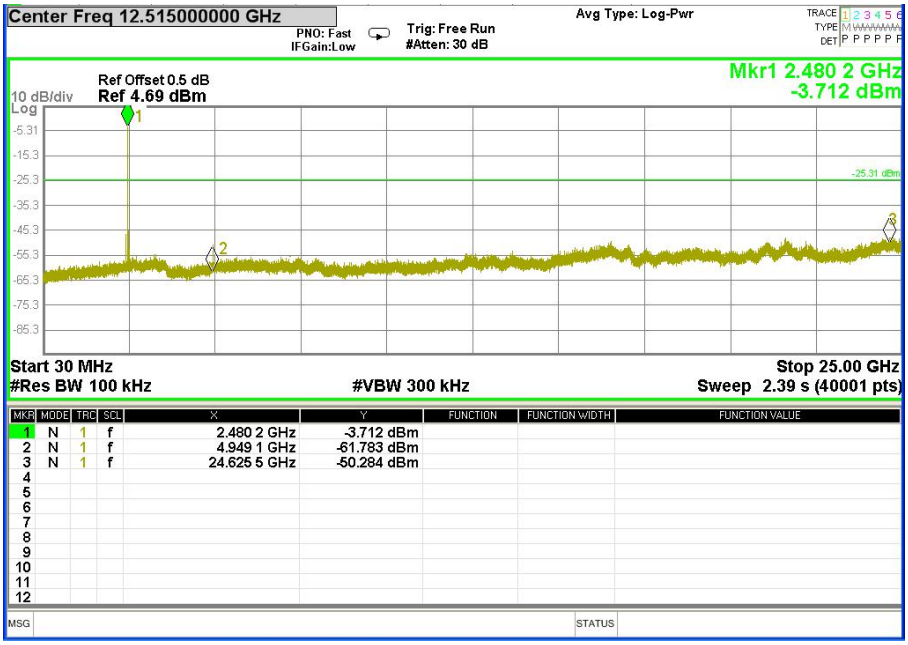


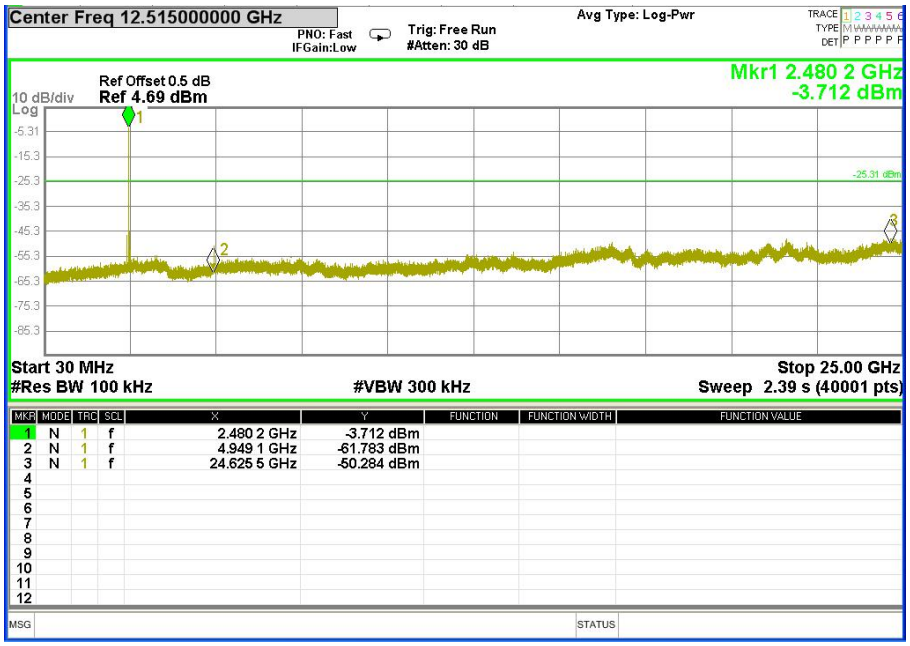

Center Freq 12.515000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE M
DET P P P P P
Mkr1 2.440 9 GHz
-1.362 dBm
Ref Offset 0.5 dB
10 dB/div
Ref 8.64 dBm
Log
-1.36
-11.4
-21.4
-31.4
-41.4
-51.4
-61.4
-71.4
-81.4
-21.36 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.39 s (40001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.440 9 GHz -1.362 dBm
2 N 1 f 4.874 2 GHz -62.060 dBm
3 N 1 f 24.800 2 GHz -51.168 dBm
4
5
6
7
8
9
10
11
12
MSG
STATUS


Center Freq 12.515000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE M
DET P P P P P
Mkr1 2.480 2 GHz
2.091 dBm
Ref Offset 0.5 dB
10 dB/div
Ref 12.09 dBm
Log
2.09
-7.91
-17.9
-27.9
-37.9
-47.9
-57.9
-67.9
-77.9
-17.91 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.39 s (40001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.480 2 GHz 2.091 dBm
2 N 1 f 4.949 1 GHz -60.415 dBm
3 N 1 f 24.675 4 GHz -51.714 dBm
4
5
6
7
8
9
10
11
12
MSG
STATUS

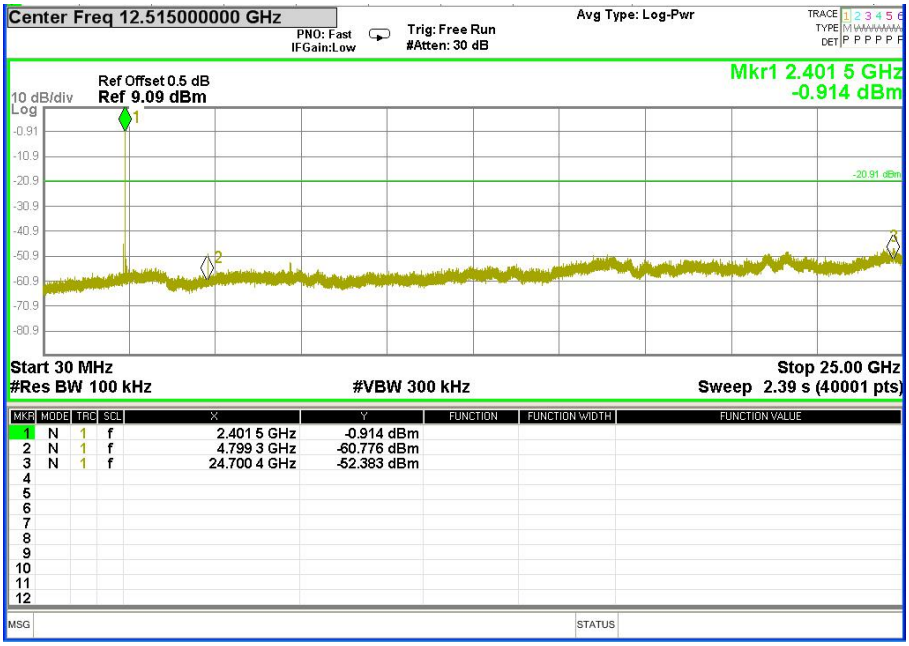
π/4-DQPSK(2Mbps) –00/39/78 CH

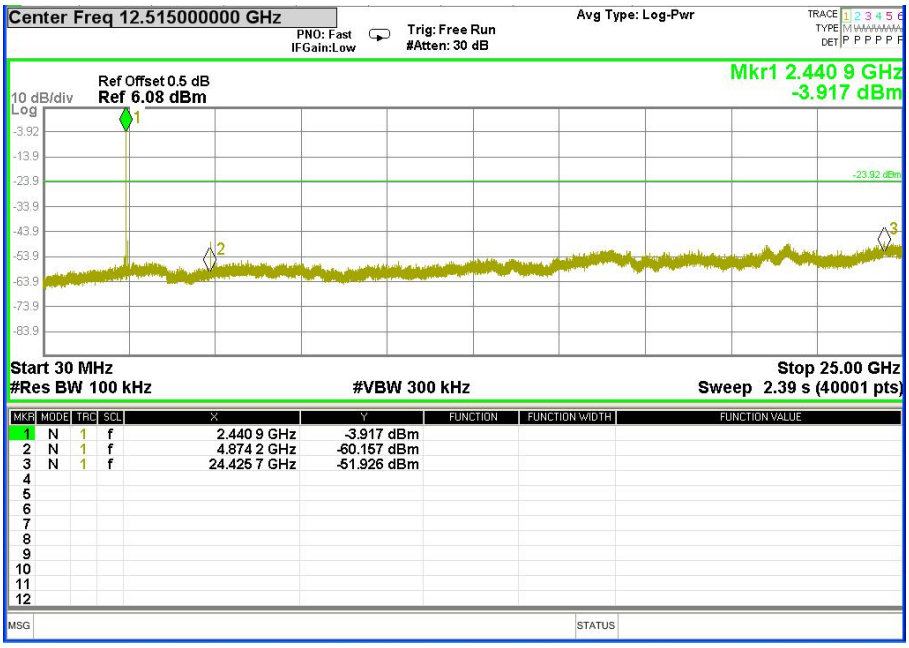






8DPSK(3Mbps) -00/39/78 CH




Center Freq 12.515000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Ref Offset 0.5 dB
10 dB/div
Ref 6.08 dBm
Mkr1 2.440 9 GHz
-3.917 dBm
-23.92 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.39 s (40001 pts)
1 N 1 f 2.440 9 GHz -3.917 dBm
2 N 1 f 4.874 2 GHz -60.157 dBm
3 N 1 f 24.425 7 GHz -51.926 dBm


Center Freq 12.515000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Ref Offset 0.5 dB
10 dB/div
Ref 6.43 dBm
Mkr1 2.479 6 GHz
-3.574 dBm
-23.57 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.39 s (40001 pts)
1 N 1 f 2.479 6 GHz -3.574 dBm
2 N 1 f 4.949 1 GHz -62.584 dBm
3 N 1 f 24.425 7 GHz -51.864 dBm

10 20 dB Bandwidth Measurement

Test Requirement	:	FCC CFR47 Part 15 Section 15.247
Test Method	:	ANSI C63.10:2013
Limits	:	Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

10.1 Test Procedure

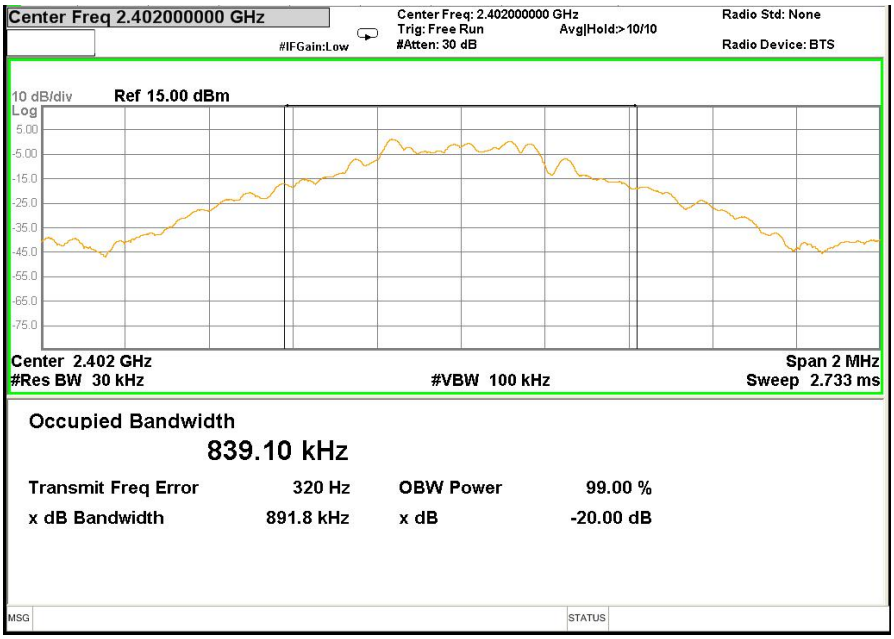
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;

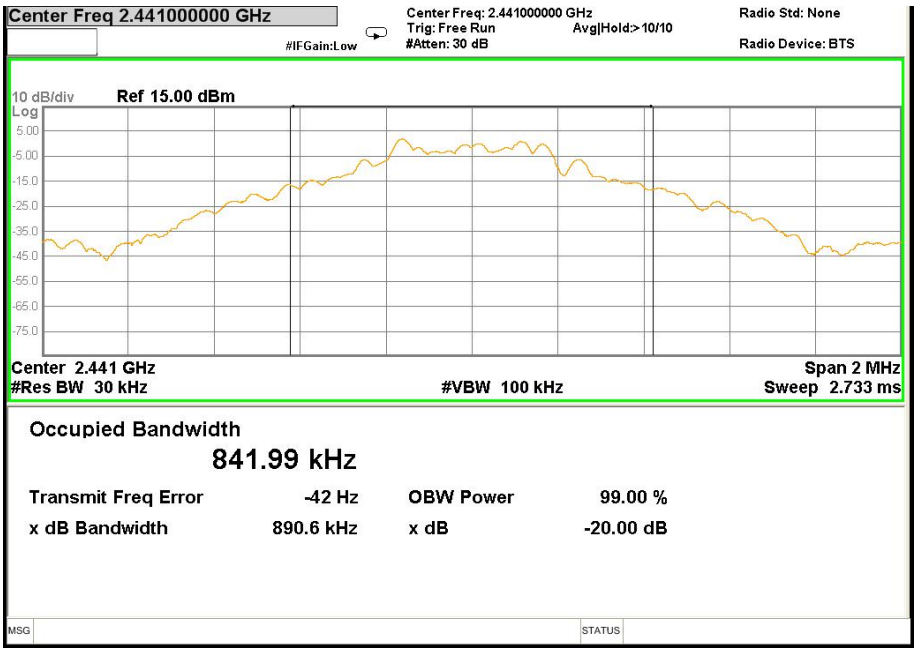
2. Set the spectrum analyzer: RBW =100kHz, VBW = 100kHz

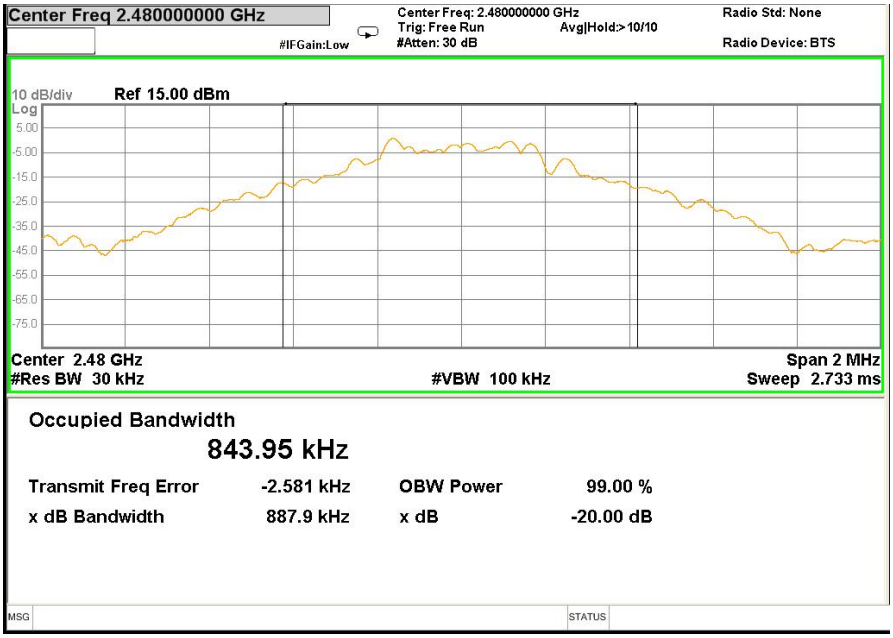
10.2 Test Result

Mode	Freq. (MHz)	20dB bandwidth Result (MHz)	Conclusion
GFSK	2402	0.892	PASS
	2441	0.891	PASS
	2480	0.888	PASS
π/4-DQPSK	2402	1.283	PASS
	2441	1.282	PASS
	2480	1.282	PASS
8DQPSK	2402	1.181	PASS
	2441	1.181	PASS
	2480	1.180	PASS

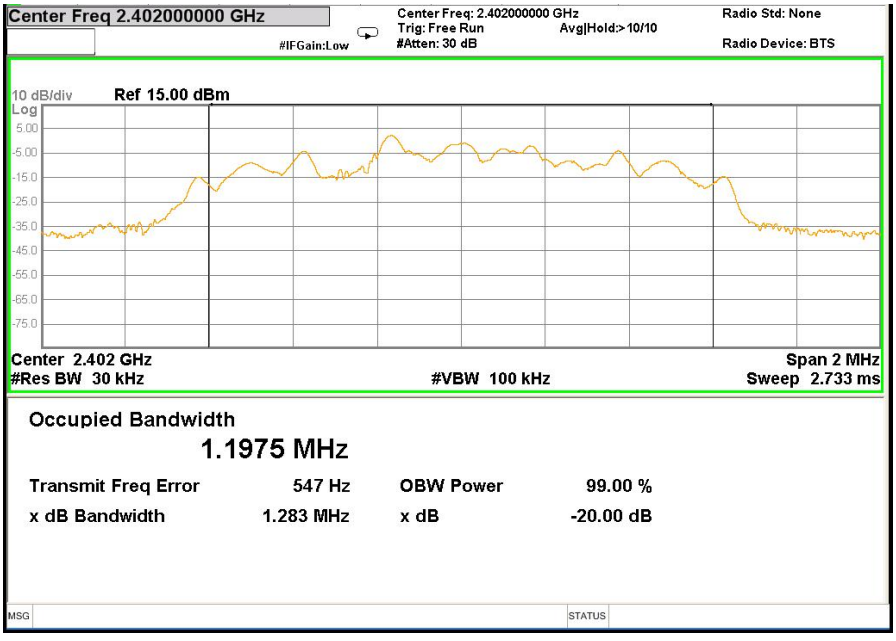
Test Mode: CH00 / CH39 / CH78 (GFSK Mode)

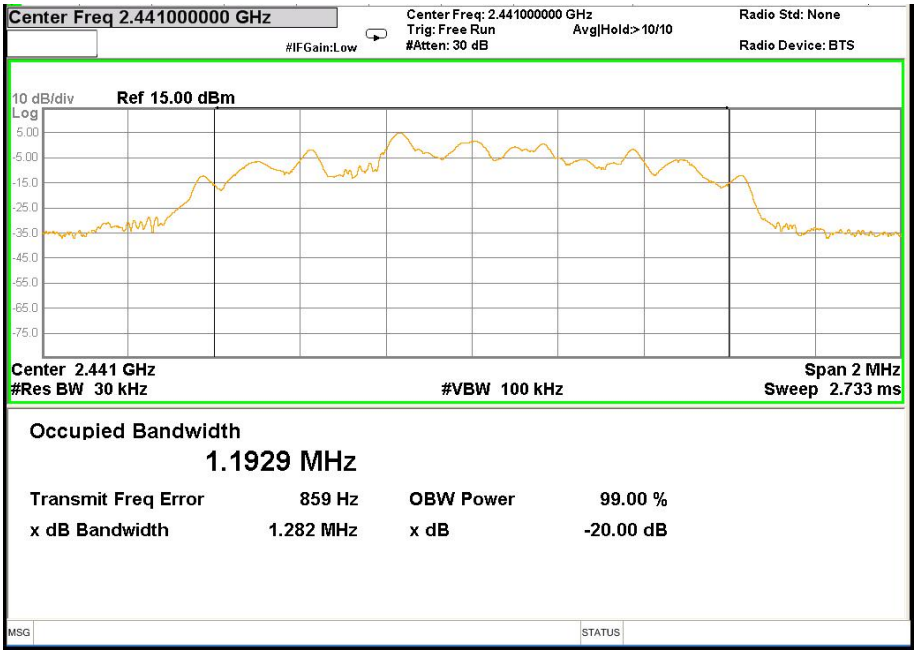


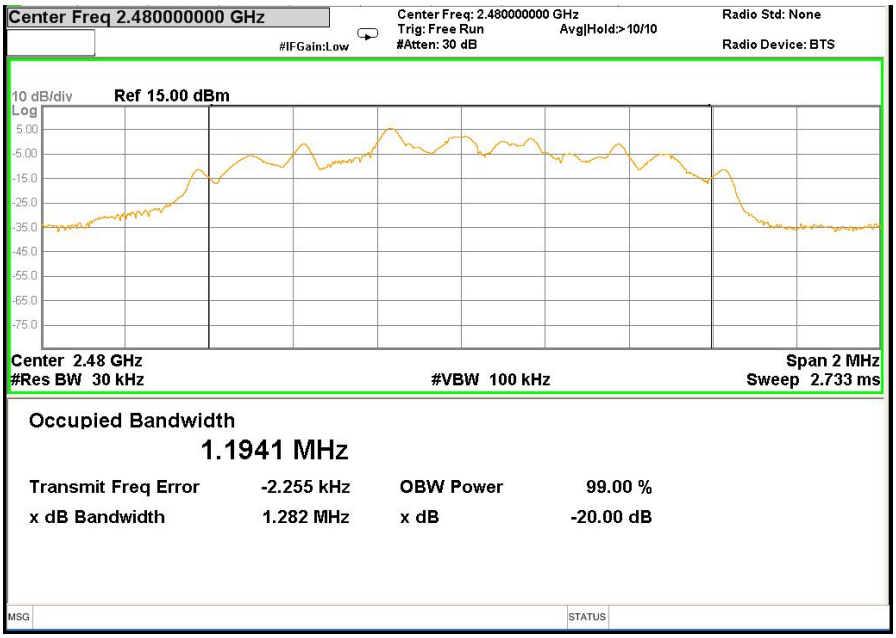




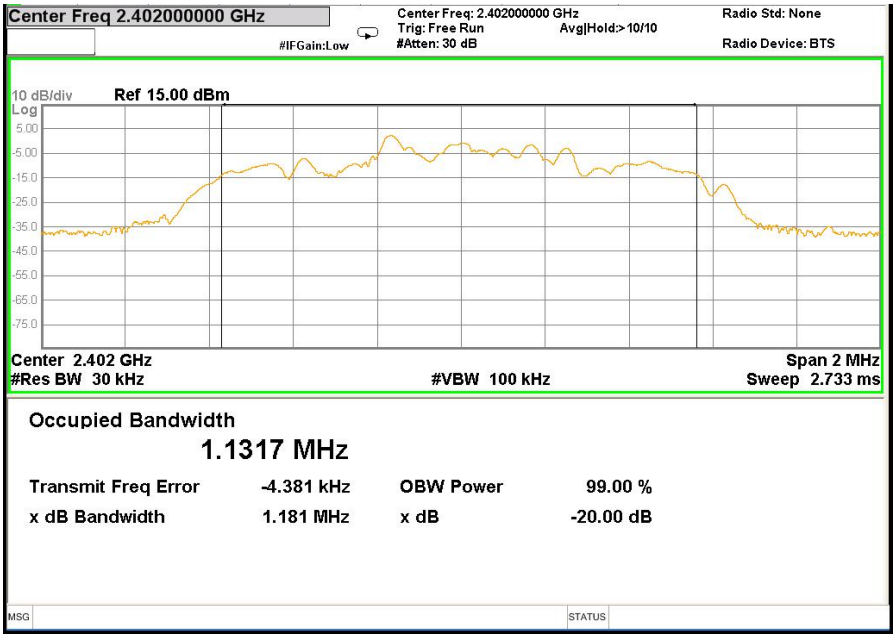
Test Mode: CH00 / CH39 / CH78 (Π/4-DQPSK Mode)

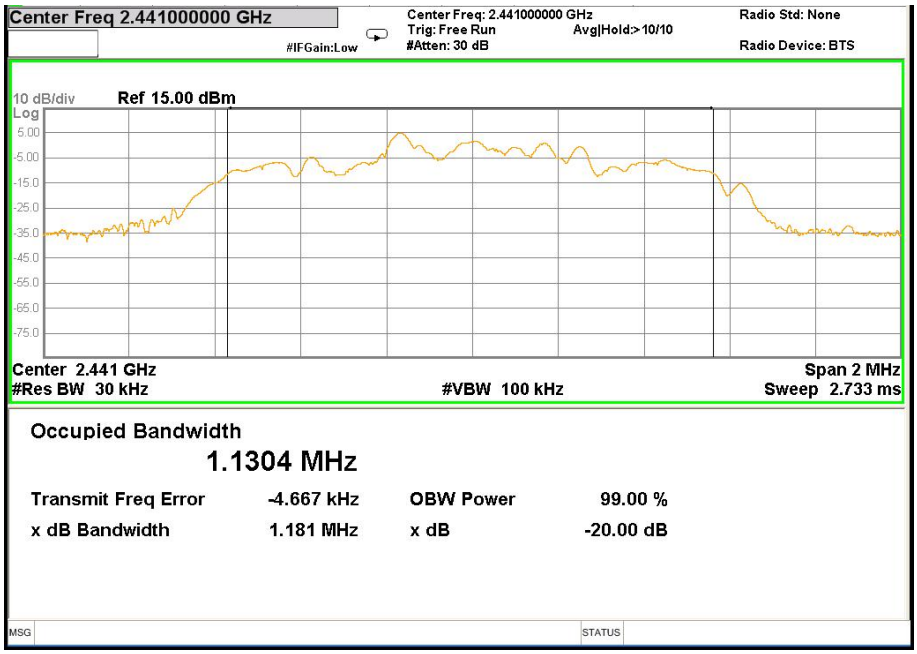


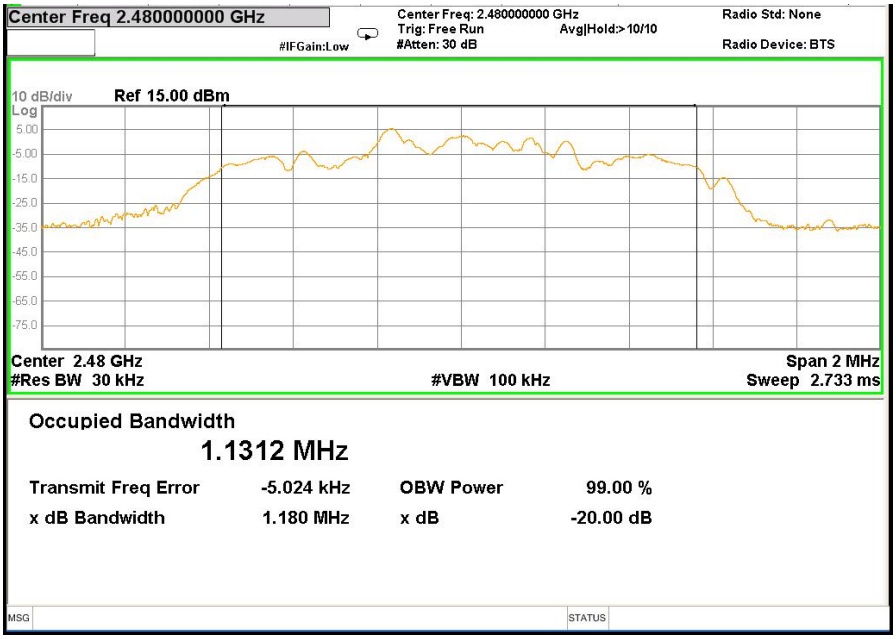

Center Freq 2.441000000 GHz
Center Freq: 2.441000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
10 dB/div
Log
Ref 15.00 dBm
5.00
-5.00
-15.0
-25.0
-35.0
-45.0
-55.0
-65.0
-75.0
Center 2.441 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 2 MHz
Sweep 2.733 ms
Occupied Bandwidth
1.1929 MHz
Transmit Freq Error 859 Hz
OBW Power 99.00 %
x dB Bandwidth 1.282 MHz
x dB -20.00 dB
MSG
STATUS


Center Freq 2.480000000 GHz
Center Freq: 2.480000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
10 dB/div
Log
Ref 15.00 dBm
5.00
-5.00
-15.0
-25.0
-35.0
-45.0
-55.0
-65.0
-75.0
Center 2.48 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 2 MHz
Sweep 2.733 ms
Occupied Bandwidth
1.1941 MHz
Transmit Freq Error -2.255 kHz
OBW Power 99.00 %
x dB Bandwidth 1.282 MHz
x dB -20.00 dB
MSG
STATUS

Test Mode: CH00 / CH39 / CH78 (8DQPSK Mode)






Center Freq 2.480000000 GHz
Center Freq: 2.480000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
10 dB/div
Log
Ref 15.00 dBm
5.00
-5.00
-15.0
-25.0
-35.0
-45.0
-55.0
-65.0
-75.0
Center 2.48 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 2 MHz
Sweep 2.733 ms
Occupied Bandwidth
1.1312 MHz
Transmit Freq Error
-5.024 kHz
OBW Power
99.00 %
x dB Bandwidth
1.180 MHz
x dB
-20.00 dB
MSG
STATUS

11 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.

11.1Test 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 = 3.0 MHz. VBW =3.0 MHz. Sweep = auto; Detector Function = Peak.

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

11.2Test Result

Mode	Freq (MHz)	Result (dBm)	Limit (dBm)	Conclusion
GFSK	2402	5.96	21	PASS
	2441	5.39	21	PASS
	2480	5.11	21	PASS
π/4-DQPSK	2402	5.68	21	PASS
	2441	5.31	21	PASS
	2480	5.05	21	PASS
8DQPSK	2402	5.51	21	PASS
	2441	5.36	21	PASS
	2480	5.02	21	PASS
Note:the channel separation >2/3 bandwidth				

12 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 125 mW.
Test Mode	:	Hopping

12.1 Test Procedure

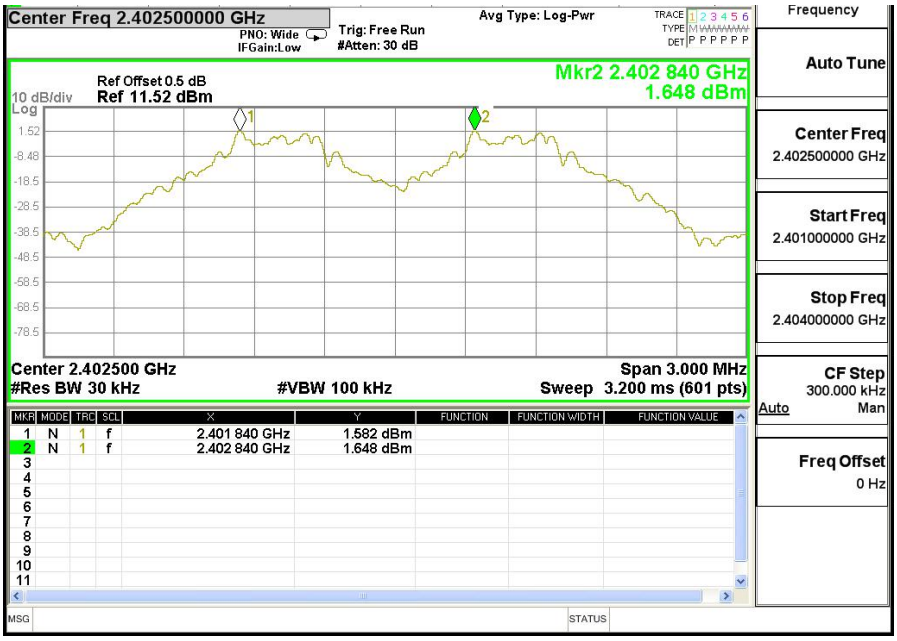
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 100KHz. VBW =300KHz, Sweep = auto; Detector Function = Peak. Trace = Max hold.

3. Allow the trace to stabilize. 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.

12.2 Test Result

Mode	Channel separation (MHz)	20dB bandwidth (MHz) (worse case)	Limit (MHz) 2/3 of 20dB bandwidth	Conclusion
GFSK	1.005	0.888	≥0.592	PASS
π/4-DQPSK	0.995	0.855	≥0.570	PASS
8DQPSK	0.995	0.787	≥0.525	PASS


Center Freq 2.402500000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Frequency
Auto Tune
Ref Offset 0.5 dB
10 dB/div
Ref 11.52 dBm
Mkr2 2.402 840 GHz
1.648 dBm
Center Freq
2.402500000 GHz
Start Freq
2.401000000 GHz
Stop Freq
2.404000000 GHz
Center 2.402500 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 3.000 MHz
Sweep 3.200 ms (601 pts)
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz
1 N 1 f 2.401 840 GHz 1.582 dBm
2 N 1 f 2.402 840 GHz 1.648 dBm
MSG
STATUS


Center Freq 2.441500000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Frequency
Auto Tune
Ref Offset 0.5 dB
10 dB/div
Ref 10.79 dBm
Mkr2 2.441 835 GHz
0.771 dBm
Center Freq
2.441500000 GHz
Start Freq
2.440000000 GHz
Stop Freq
2.443000000 GHz
Center 2.441500 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 3.000 MHz
Sweep 3.200 ms (601 pts)
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz
1 N 1 f 2.440 840 GHz 0.826 dBm
2 N 1 f 2.441 835 GHz 0.771 dBm
MSG
STATUS


Center Freq 2.441500000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P P P P P P
Ref Offset 0.5 dB
10 dB/div
Log
Ref 10.79 dBm
Mkr2 2.441 835 GHz
0.771 dBm
0.790
-9.21
-19.2
-29.2
-39.2
-49.2
-59.2
-69.2
-79.2
Center 2.441500 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 3.000 MHz
Sweep 3.200 ms (601 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.440 840 GHz 0.826 dBm
2 N 1 f 2.441 835 GHz 0.771 dBm
3
4
5
6
7
8
9
10
11
MSG
STATUS
Frequency
Auto Tune
Center Freq
2.441500000 GHz
Start Freq
2.440000000 GHz
Stop Freq
2.443000000 GHz
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz

13 Number of Hopping Frequency

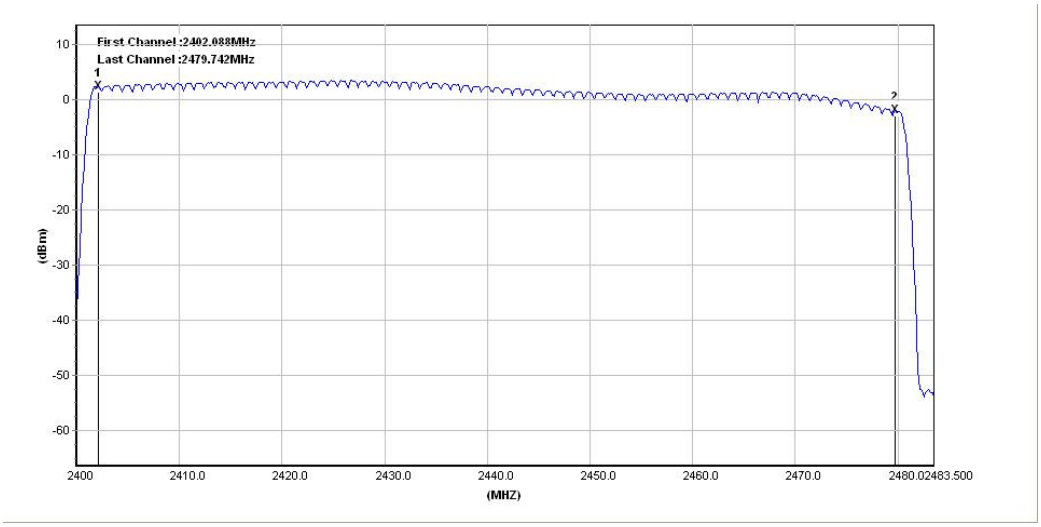
Test Requirement	:	FCC CFR47 Part 15 Section 15.247
Test Method	:	ANSI C63.10:2013
Test Limit	:	Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
Test Mode	:	Hopping(GFSK)

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 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;

13.2 Test Result

Mode	Number of hopping channel	Limit	Conclusion
Hopping mode	79	>15	PASS



14 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

14.1 Test Procedure

a. The transmitter output (antenna port) was connected to the spectrum analyzer

b. Set RBW =1MHz/VBW =3MHz.

c. Use a video trigger with the trigger level set to enable triggering only on full pulses.

d. Sweep Time is more than once pulse time.

e. Set the center frequency on any frequency would be measure and set the frequency span to zero span.

f. Measure the maximum time duration of one single pulse.

g. Set the EUT for DH5, DH3 and DH1 packet transmitting.

h. Measure the maximum time duration of one single pulse.

i. DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slots RX, 1 time slot TX). Sothe dwell time is the time duration of the pulse times 3.37 x 31.6 = 106.6 within 31.6 seconds.

j. DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots RX, 1 time slot TX). Sothe dwell time is the time duration of the pulse times 5.06 x 31.6 = 160 within 31.6 seconds.

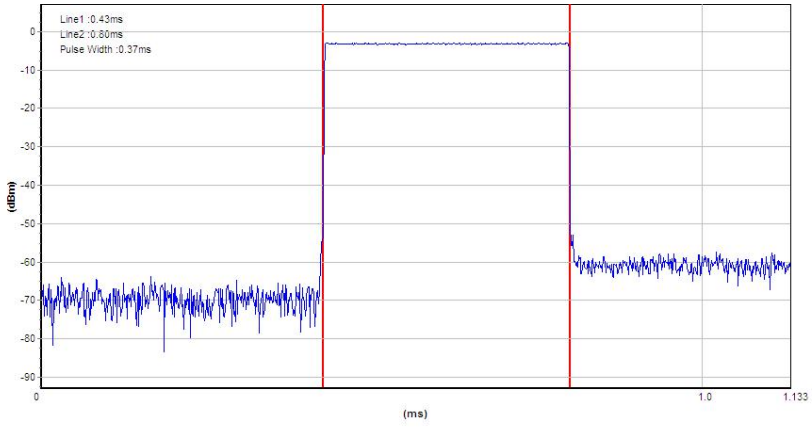
k. DH1 Packet permit maximum 1600 / 79 /2 = 10.12 hops per second in each channel (1 time slot RX, 1 time slot TX). So the dwell time is the time duration of the pulse times 10.12 x 31.6 = 320 within 31.6 seconds.

14.2 Test Result

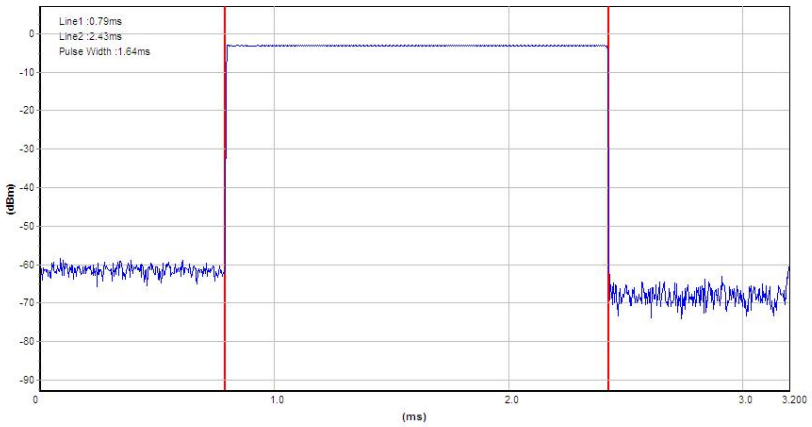
Mode	Dwell time (s)	Pulse's on time (ms)	Limit	Conclusion
DH1	0.118	0.370	<400ms	PASS
DH3	0.262	1.640	<400ms	PASS
DH5	0.307	2.880	<400ms	PASS
2-DH1	0.122	0.380	<400ms	PASS
2-DH3	0.262	1.640	<400ms	PASS
2-DH5	0.308	2.890	<400ms	PASS
3DH1	0.122	0.380	<400ms	PASS
3DH3	0.262	1.640	<400ms	PASS
3DH5	0.308	2.890	<400ms	PASS

GFSK

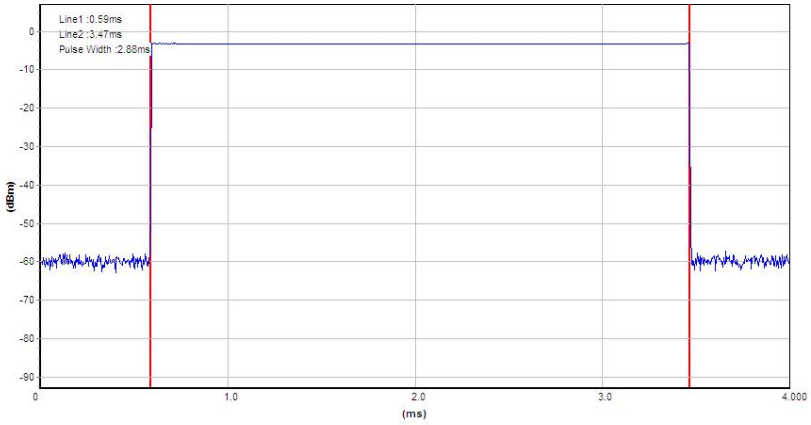
DH1



DH3

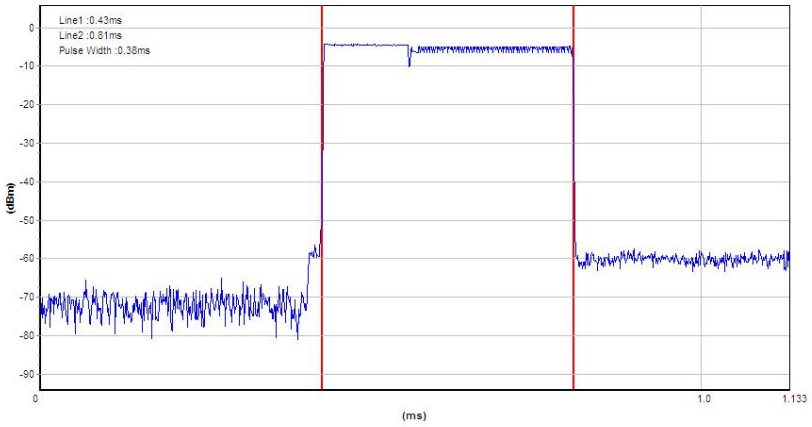

Line1 :0.79ms
Line2 :2.43ms
Pulse Width :1.64ms
(dBm)
(ms)

DH5

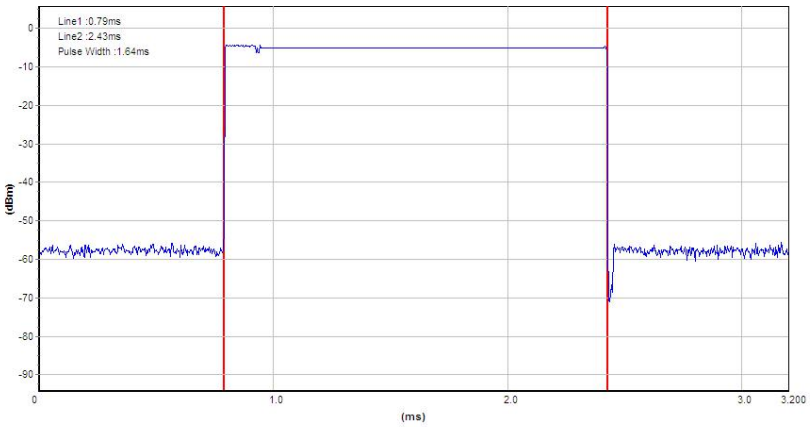

Line1 :0.59ms
Line2 :3.47ms
Pulse Width :2.88ms
(dBm)
(ms)

π/4-DQPSK

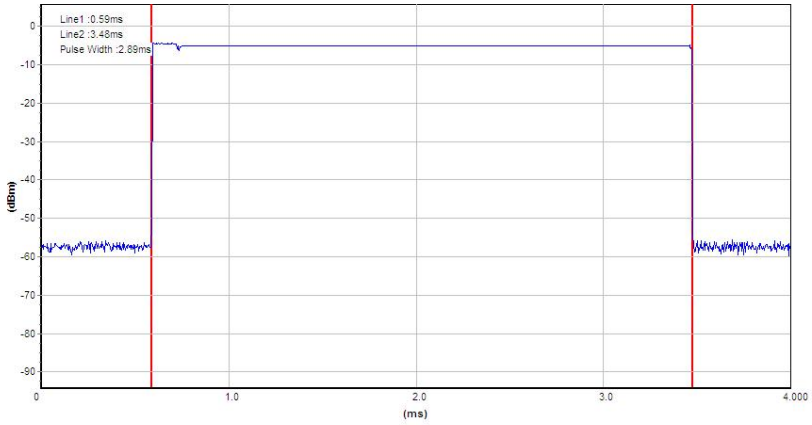
DH1



DH3

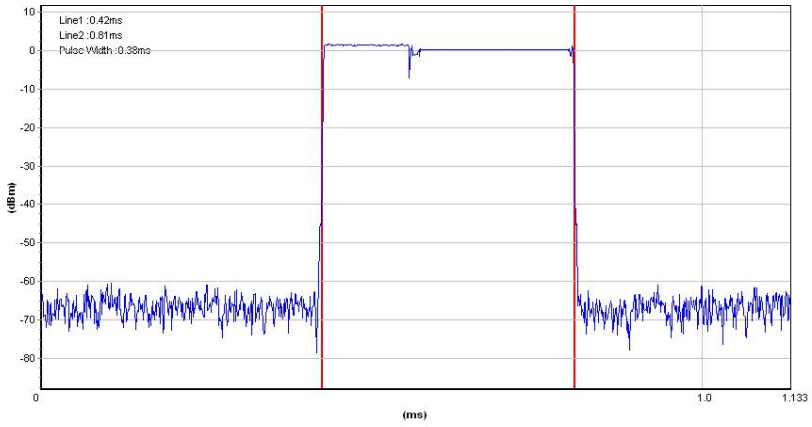


DH5

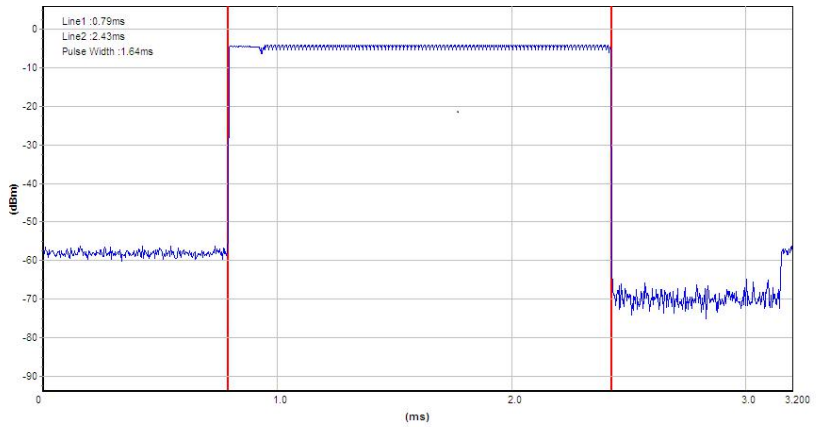


8DQPSK

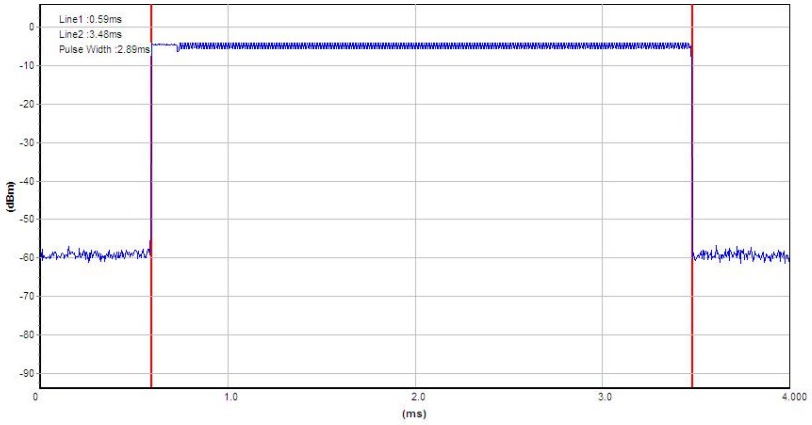
DH1



DH3


Line1 :0.79ms
Line2 :2.43ms
Pulse Width :1.64ms
(dBm)
(ms)

DH5


Line1 :0.59ms
Line2 :3.48ms
Pulse Width :2.89ms
(dBm)
(ms)

15 Antenna Requirement

15.1 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.

15.2 Result

The EUT'S antenna, permanent attached antenna, is Internal PCB Antenna. The antenna's gain is 0.91dBi and meets the requirement.

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