TEST REPORT

Reference No.	:	WTS18S05113280-1W
FCC ID……	:	2AMNH-GRACELANDUS
Applicant	:	Berlin Brands Group Inc.
Address	:	101 Montgomery Street, Suite 2050 San Francisco, CA 94104, USA
Manufacturer	:	JIN SHUN YAN ELECTRONICS FACTORY
Address	:	Tangxia Chanjing village, Xinxu Town, Huiyang District, Huizhou City, Guangdong ,China
Product	:	BX-Graceland TT, auna Jukebox W/ TT & BT wood
Model(s).....	:	BYL-01-02PH, JSY-01-02PH, US-10030442
Standards	:	FCC CFR47 Part 15 Section 15.247:2017
Date of Receipt sample	:	2018-05-29
Date of Test	:	2018-05-30 to 2018-06-28
Date of Issue	:	2018-06-30
Test Result	:	**Pass**

Remarks:
The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

Prepared By:
Waltek Services (Shenzhen) Co., Ltd.
Address: 1/F., Fukangtai Building, West Baima Road, Songgang Street, Baoan District, Shenzhen, Guangdong, China
Test site/Test location:
Waltek Services (Shenzhen) Co., Ltd.
Address: 1/F., Fukangtai Building, West Baima Road, Songgang Street, Baoan District, Shenzhen, Guangdong, China
Tel :+86-755-83551033
Fax:+86-755-83552400

Tested by:

Frank Yin

Frank Yin / Test Engineer

Approved by:

Philo Zhong

Philo Zhong / Manager

1 Laboratories Introduction

Waltek Services (Shenzhen) Co., Ltd is a professional third-party testing and certification laboratory with multi-year product testing and certification experience, established strictly in accordance with ISO/IEC 17025 requirements, and accredited by ILAC (International Laboratory Accreditation Cooperation) member. A2LA (American Association for Laboratory Accreditation) of USA, Meanwhile, Waltek has got recognition as registration and accreditation laboratory from EMSD (Electrical and Mechanical Services Department), and American Energy star, FCC(The Federal Communications Commission), CEC(California energy efficiency), IC(Industry Canada). It's the strategic partner and data recognition laboratory of international authoritative organizations, such as Intertek(ETL-SEMKO), TÜV Rheinland, TÜV SÜD, etc.

Waltek Services (Shenzhen) Co., Ltd is one of the largest and the most comprehensive third party testing laboratory in China. Our test capability covered four large fields: safety test. ElectroMagnetic Compatibility(EMC), and energy performance, wireless radio. As a professional, comprehensive, justice international test organization, we still keep the scientific and rigorous work attitude to help each client satisfy the international standards and assist their product enter into globe market smoothly.

1.1 Test Facility

A. Accreditations for Conformity Assessment (International)

Country/Region	Accreditation Body	Scope	Note
USA	**A2LA (Certificate No.: 4243.01)**	FCC ID \ DOC \ VOC	1
Canada		IC ID \ VOC	2
Japan		MIC-T \ MIC-R	-
Europe		EMCD \ RED	-
Taiwan		NCC	-
Hong Kong		OFCA	-
Australia		RCM	-
India	**International Services**	WPC	-
Thailand		NTC	-
Singapore		IDA	-

Note:

1. FCC Designation No.: CN1201. Test Firm Registration No.: 523476.
2. IC Canada Registration No.: 7760A

B.TCBs and Notify Bodies Recognized Testing Laboratory.

Recognized Testing Laboratory of …	Notify body number
TUV Rheinland	Optional.
Intertek	
TUV SUD	
SGS	
Phoenix Testlab GmbH	0700
Element Materials Technology Warwick Ltd	0891
Timco Engineering, Inc.	1177
Eurofins Product Service GmbH	0681

2 Contents

Page

COVER PAGE 1

1 LABORATORIES INTRODUCTION 2

1.1 TEST FACILITY 3

2 CONTENTS 4

3 REVISION HISTORY 6

4 GENERAL INFORMATION 7

4.1 GENERAL DESCRIPTION OF E.U.T 7
4.2 DETAILS OF E.U.T 8
4.3 CHANNEL LIST 8
4.4 TEST MODE 8

5 EQUIPMENT USED DURING TEST 9

5.1 EQUIPMENTS LIST 9
5.2 MEASUREMENT UNCERTAINTY 10
5.3 SUBCONTRACTED 10

6 TEST SUMMARY 11

7 CONDUCTED EMISSION 12

7.1 E.U.T. OPERATION 12
7.2 EUT SETUP 12
7.3 MEASUREMENT DESCRIPTION 13
7.4 CONDUCTED EMISSION TEST RESULT 13

8 RADIATED EMISSIONS 15

8.1 EUT OPERATION 15
8.2 TEST SETUP 16
8.3 SPECTRUM ANALYZER SETUP 17
8.4 TEST PROCEDURE 18
8.5 CORRECTED AMPLITUDE & MARGIN CALCULATION 18
8.6 SUMMARY OF TEST RESULTS 19

9 BAND EDGE MEASUREMENT 22

9.1 TEST PROCEDURE 22
9.2 TEST SETUP 22
9.3 TEST RESULT: 23

10 BANDWIDTH MEASUREMENT 29

10.1 TEST PROCEDURE: 29
10.2 TEST SETUP 29
10.3 TEST RESULT: 29

11 MAXIMUM PEAK OUTPUT POWER 35

11.1 TEST PROCEDURE: 35
11.2 TEST SETUP 35
11.3 TEST RESULT: 35

12 HOPPING CHANNEL SEPARATION 41

12.1 TEST PROCEDURE: 41
12.2 TEST SETUP 41
12.3 TEST RESULT: 42

13 NUMBER OF HOPPING FREQUENCY 47
13.1 TEST PROCEDURE: 47
13.2 TEST SETUP 47
13.3 TEST RESULT: 48
14 DWELL TIME 50
14.1 TEST PROCEDURE: 50
14.2 TEST SETUP 50
14.3 TEST RESULT: 50
15 ANTENNA REQUIREMENT 56
16 FCC ID: 2AMNH-GRACELANDUS RF EXPOSURE REPORT 57
17 PHOTOGRAPHS - MODEL BYL-01-02PH TEST SETUP AND EUT 57

3 Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTS18S05113280-1W	2018-05-29	2018-05-30 to 2018-06-28	2018-06-30	original	-	Valid

4 General Information

4.1 General Description of E.U.T

Product	: BX-Graceland TT, auna Jukebox W/ TT & BT wood
Model(s)	: BYL-01-02PH, JSY-01-02PH, US-10030442
Model difference	: Only the model name are different. The model BYL-01-02PH is the tested sample.
Operation Frequency	: 2402-2480MHz, 79(EDR) Channels in total
Antenna installation	: PCB Printed Antenna
Antenna Gain	: 0dBi
Type of Modulation	: GFSK, π/4DQPSK, 8DPSK

Frequency hopping systems (FHS):

This transmitter device is frequency hopping device, and complies with FCC Part15.247 Requirements.

This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. The average time of occupancy on any channel is less than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels（79 channels）employed.

All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

This device was tested with an Bluetooth system receiver to check that the device maintained hopping synchronization, and the device complied with these requirements for FCC Part15.247.

Pseudorandom Frequency Hopping Sequence Table as below:

Channel: 18, 68, 05, 25, 37, 26, 28, 21, 62, 10, 46, 63, 55, 12, 60, 38, 30, 15, 66, 19, 67, 52, 75, 11, 44, 23, 54, 33, 76, 72, 13, 34, 00, 01, 06, 70, 40, 78, 57, 59, 56, 17, 03, 29, 41, 35, 73, 24, 31, 32, 49, 22, 48, 04, 45, 61, 51, 50, 69, 36, 42, 07, 16, 02, 71, 09, 47, 20, 43, 27, 39, 64, 14, 74, 53, 65, 58, 77, 08 etc.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

4.2 Details of E.U.T

Ratings Input: AC 100-240V, 50/60Hz by adapter

4.3 Channel List

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	2402	2	2403	3	2404	4	2405
5	2406	6	2407	7	2408	8	2409
9	2410	10	2411	11	2412	12	2413
13	2414	14	2415	15	2416	16	2417
17	2418	18	2419	19	2420	20	2421
21	2422	22	2423	23	2424	24	2425
25	2426	26	2427	27	2428	28	2429
29	2430	30	2431	31	2432	32	2433
33	2434	34	2435	35	2436	36	2437
37	2438	38	2439	39	2440	40	2441
41	2442	42	2443	43	2444	44	2445
45	2446	46	2447	47	2448	48	2449
49	2450	50	2451	51	2452	52	2453
53	2454	54	2455	55	2456	56	2457
57	2458	58	2459	59	2460	60	2461
61	2462	62	2463	63	2464	64	2465
65	2466	66	2467	67	2468	68	2469
69	2470	70	2471	71	2472	72	2473
73	2474	74	2475	75	2476	76	2477
77	2478	78	2479	79	2480	-	-

4.4 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Test mode	Low channel	Middle channel	High channel
Transmitting	2402MHz	2441MHz	2480MHz

Note: 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.

5 Equipment Used during Test

5.1 Equipments List

Conducted Emissions						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1.	EMI Test Receiver	R&S	ESCI	100947	2017-09-12	2018-09-11
2.	LISN	R&S	ENV216	100115	2017-09-12	2018-09-11
3.	Cable	Top	TYPE16(3.5M)	-	2017-09-12	2018-09-11
3m Semi-anechoic Chamber for Radiation Emissions						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	Spectrum Analyzer	R&S	FSP30	100091	2018-04-29	2019-04-28
2	Broad-band Horn Antenna(1-18GHz)	SCHWARZBECK	BBHA 9120 D	667	2018-04-29	2019-04-28
3	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	2018-04-29	2019-04-28
4	Coaxial Cable (above 1GHz)	Top	1GHz-18GHz	EW02014-7	2018-04-29	2019-04-28
5	Spectrum Analyzer	R&S	FSP40	100501	2017-10-20	2018-10-19
6	Broad-band Horn Antenna(18-40GHz)	SCHWARZBECK	BBHA 9170	BBHA9170651	2017-10-25	2018-10-24
7	Microwave Broadband Preamplifier (18-40GHz)	SCHWARZBECK	BBV 9721	100472	2017-10-25	2018-10-24
8	Cable	Top	18-40GHz	-	2017-10-25	2018-10-24
3m Semi-anechoic Chamber for Radiation Emissions						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No**	**Last Calibration Date**	**Calibration Due Date**
1	Test Receiver	R&S	ESCI	101296	2018-04-29	2019-04-28
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	2018-04-29	2019-04-28
3	Active Loop Antenna	Com-power	AL-130R	10160007	2018-04-17	2019-04-16
4	Amplifier	ANRITSU	MH648A	M43381	2018-04-29	2019-04-28
5	Cable	HUBER+SUHNER	CBL2	525178	2018-04-29	2019-04-28
6	Coaxial Cable (below 1GHz)	Top	TYPE16 (13M)	-	2017-09-12	2018-09-11

RF Conducted Testing						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1.	Spectrum Analyzer	R&S	FSL6	100959	2017-09-12	2018-09-11
2	Coaxial Cable	Top	10Hz-30GHz	-	2017-09-12	2018-09-11
3	Antenna Connector*	Realacc	45RSm	-	2017-09-12	2018-09-11
4	DC Block	Gwave	GDCB-3G-N-SMA	140307001	2017-09-12	2018-09-11
"*": 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.						

5.2 Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	± 1 x 10^{-6}
RF Power	± 1.0 dB
RF Power Density	± 2.2 dB
Radiated Spurious Emissions test	± 5.03 dB (30M~1000MHz)
	± 5.47 dB (1000M~25000MHz)
Conducted Emissions test	± 3.64 dB (AC mains 150KHz~30MHz)
Confidence interval：95%. Confidence factor:k=2	

5.3 Subcontracted

Whether parts of tests for the product have been subcontracted to other labs:

☐ Yes ☒ No

If Yes, list the related test items and lab information:

Test Lab: N/A

Lab address: N/A

Test items: N/A

6 Test Summary

Test Items	Test Requirement	Result
Conduct Emission	15.207	Pass
Radiated Spurious Emissions	15.205(a) 15.209 15.247(d)	Pass
Band edge	15.247(d) 15.205(a)	Pass
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
RF exposure	1.1307(b)(1)	Pass
Antenna Requirement	15.203	Pass
RF Exposure	1.1307(b)(1)	Pass
Note: Pass=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable.		

7 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

Limit:

Frequency (MHz)	Conducted Limit (dBμV)	
	Qsi-peak	Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5.0	56	46
5.0 to 30	60	50
*Decreases with the logarithm of the frequency.		

7.1 E.U.T. Operation

Operating Environment **:**

Temperature: 22.8 °C

Humidity: 52.6 % RH

Atmospheric Pressure: 101.2kPa

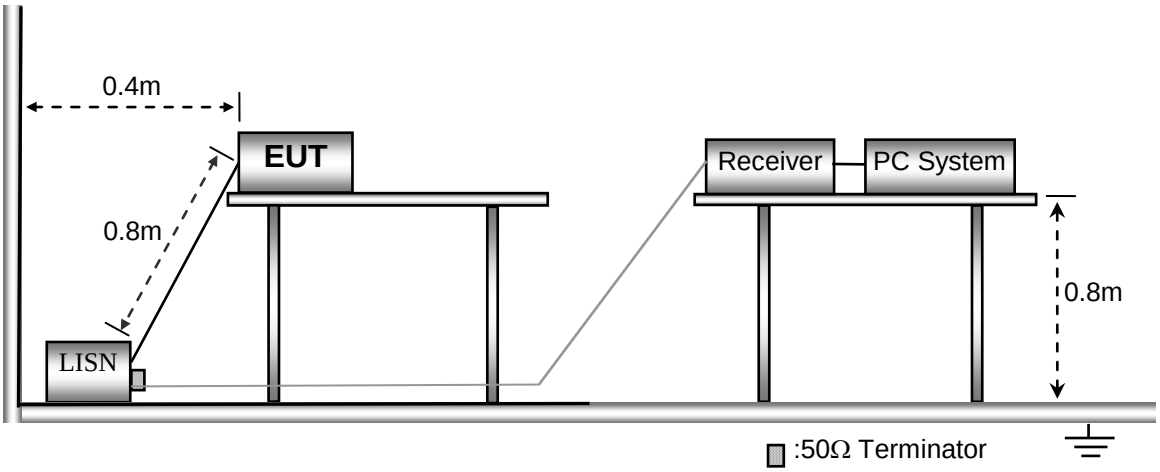
Test Voltage: AC 120V, 60Hz

EUT Operation **:**

The test was performed in Transmitting mode, the worst test data (GFSK modulation Low channel) were shown in the report.

7.2 EUT Setup

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



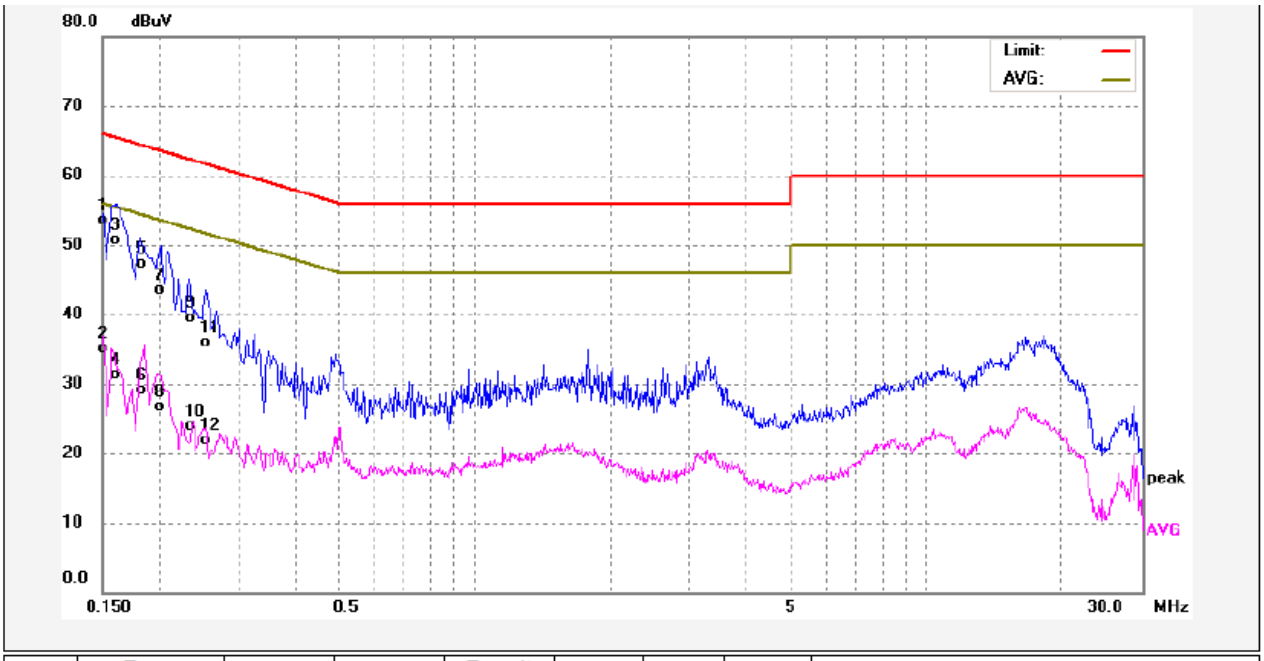
7.3 Measurement Description

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.

7.4 Conducted Emission Test Result

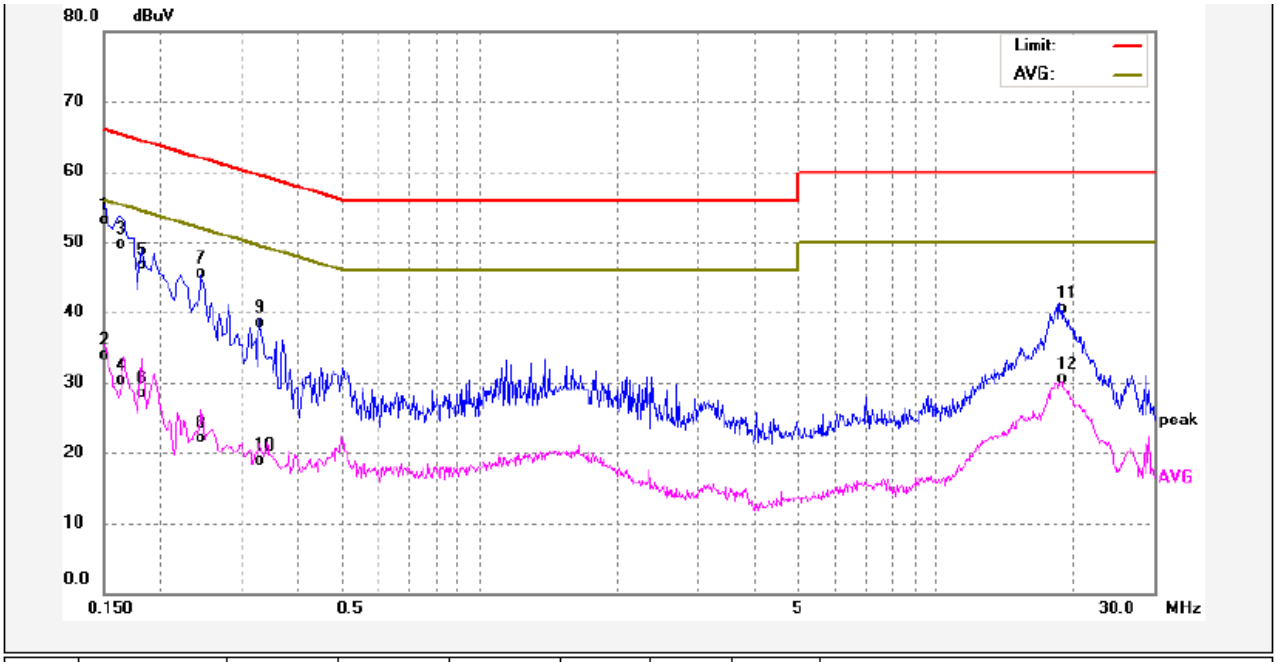
Remark: only the worst data (GFSK modulation Low channel mode) were reported

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1500	43.37	10.06	53.43	65.99	-12.56	QP	
2	0.1500	25.10	10.06	35.16	55.99	-20.83	AVG	
3	0.1620	40.77	9.94	50.71	65.36	-14.65	QP	
4	0.1620	21.45	9.94	31.39	55.36	-23.97	AVG	
5	0.1819	37.35	9.88	47.23	64.39	-17.16	QP	
6	0.1819	19.29	9.88	29.17	54.39	-25.22	AVG	
7	0.2020	33.65	9.92	43.57	63.52	-19.95	QP	
8	0.2020	16.77	9.92	26.69	53.52	-26.83	AVG	
9	0.2340	29.48	9.98	39.46	62.30	-22.84	QP	
10	0.2340	14.00	9.98	23.98	52.30	-28.32	AVG	
11	0.2540	25.94	10.01	35.95	61.62	-25.67	QP	
12	0.2540	11.99	10.01	22.00	51.62	-29.62	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1500	43.03	10.06	53.09	65.99	-12.90	QP	
2	0.1500	23.92	10.06	33.98	55.99	-22.01	AVG	
3	0.1620	39.71	9.94	49.65	65.36	-15.71	QP	
4	0.1620	20.35	9.94	30.29	55.36	-25.07	AVG	
5	0.1819	36.80	9.88	46.68	64.39	-17.71	QP	
6	0.1819	18.58	9.88	28.46	54.39	-25.93	AVG	
7	0.2460	35.54	10.00	45.54	61.89	-16.35	QP	
8	0.2460	12.04	10.00	22.04	51.89	-29.85	AVG	
9	0.3300	28.56	10.03	38.59	59.45	-20.86	QP	
10	0.3300	8.82	10.03	18.85	49.45	-30.60	AVG	
11	18.6740	30.10	10.45	40.55	60.00	-19.45	QP	
12	18.6740	19.97	10.45	30.42	50.00	-19.58	AVG	

8 Radiated 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:

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	$20\log^{(500)}$

8.1 EUT Operation

Operating Environment **:**

Temperature: 23.5 °C

Humidity: 52.1 % RH

Atmospheric Pressure: 101.2kPa

Test Voltage: AC 120V, 60Hz

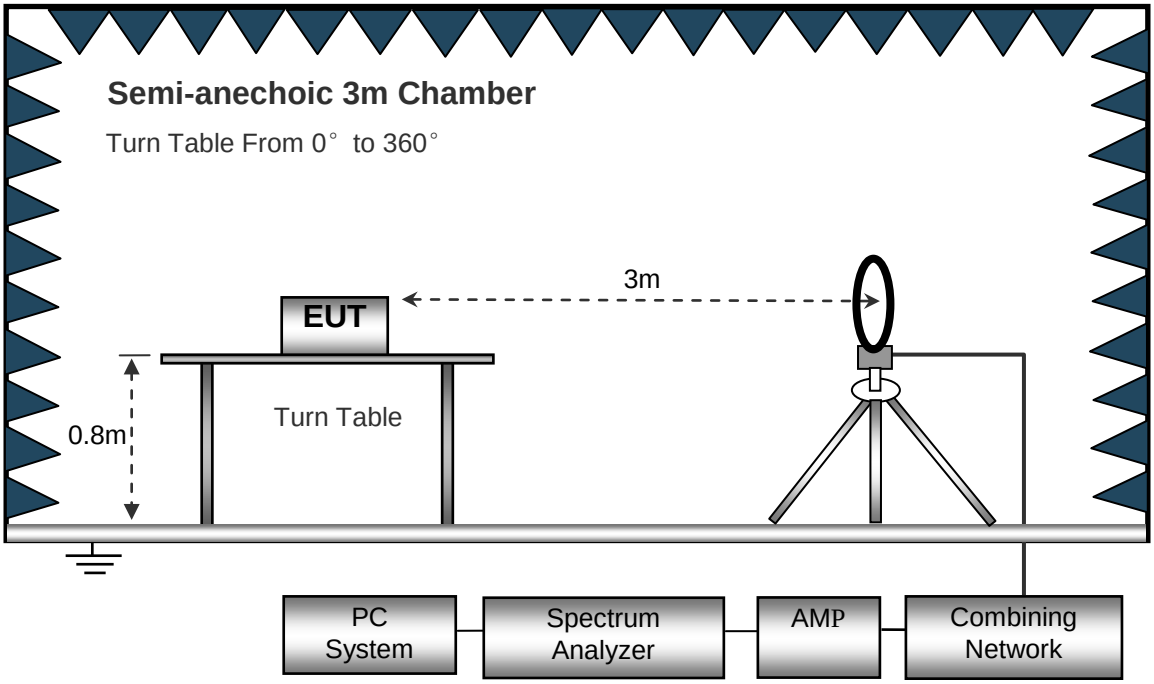
EUT Operation **:**

The test was performed in Transmitting mode, the worst test data (GFSK modulation) were shown in the report.

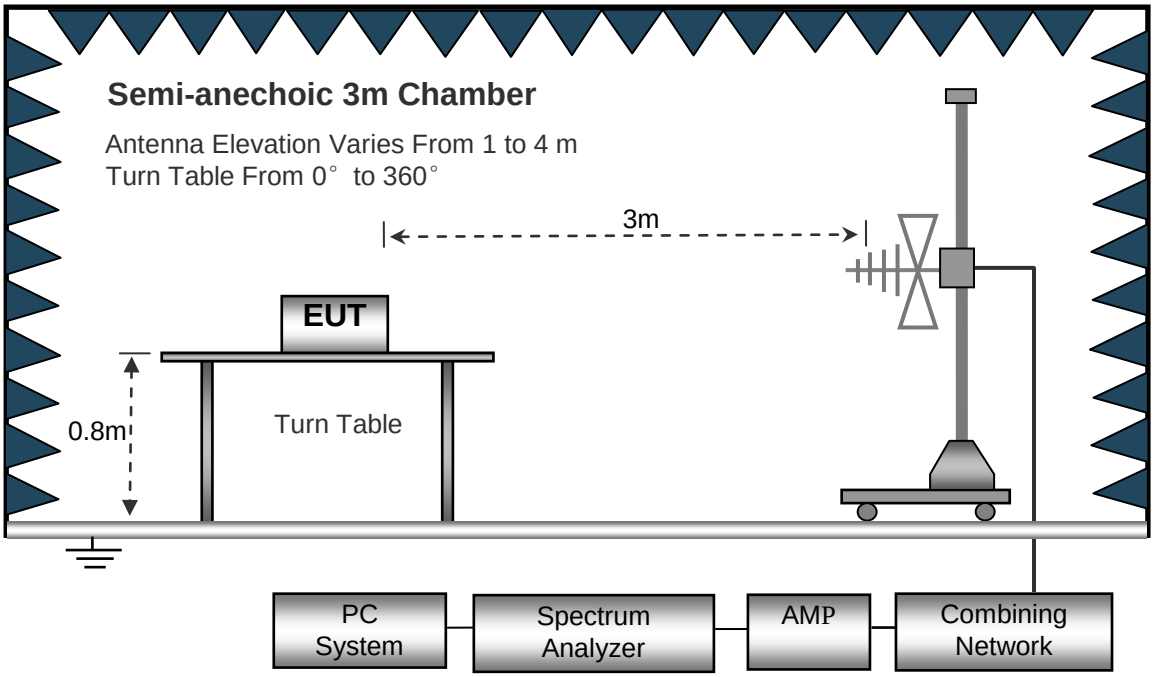
8.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10: 2013.

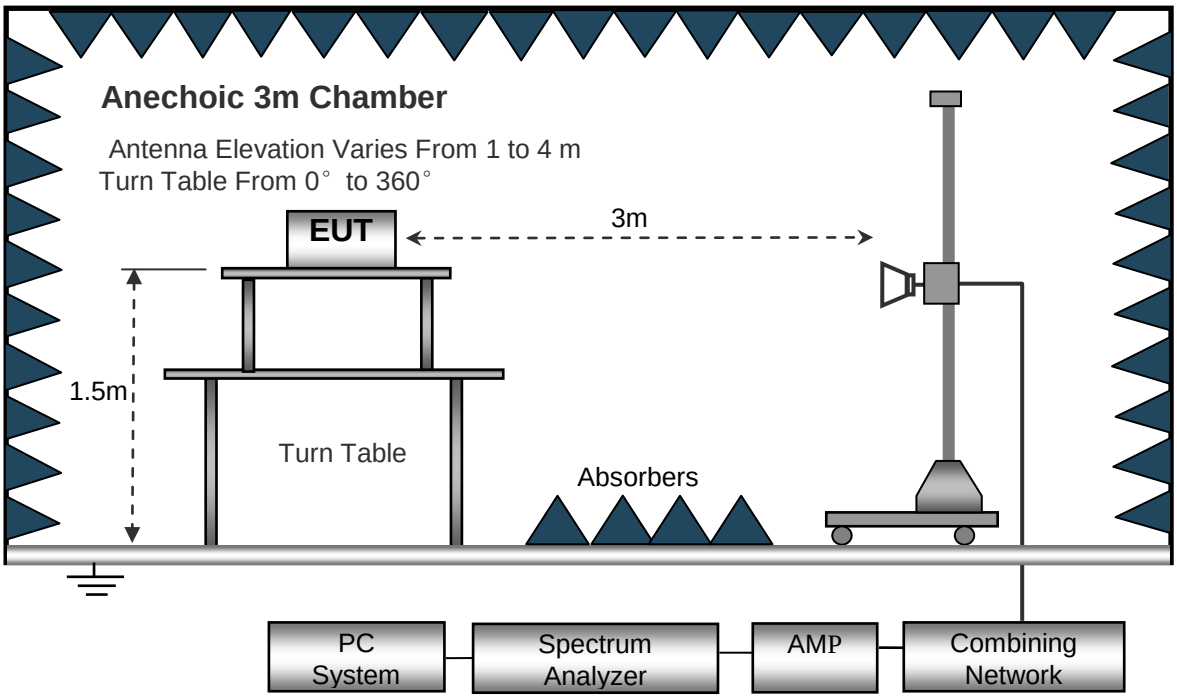
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



8.3 Spectrum Analyzer Setup

Below 30MHz

Sweep Speed ..... Auto
IF Bandwidth..... 10kHz
Video Bandwidth..... 10kHz

Resolution Bandwidth..... 10kHz

30MHz ~ 1GHz

Sweep Speed ..... Auto
Detector ..... PK
Resolution Bandwidth..... 100kHz
Video Bandwidth..... 300kHz

Above 1GHz

Sweep Speed ..... Auto
Detector ..... PK
Resolution Bandwidth..... 1MHz
Video Bandwidth..... 3MHz
Detector ..... Ave.
Resolution Bandwidth..... 1MHz
Video Bandwidth..... 10Hz

8.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane for below 1GHz and 1.5m for above 1GHz.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The 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.
8. For the radiated emission test above 1GHz:

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

8.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – Limit

8.6 Summary of Test Results

Test Frequency: 9 kHz ~ 30 MHz

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

Test Frequency: 30 MHz ~ 18 GHz

Only the worst case GFSK mode were record in the report.

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/209/205	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Low Channel 2402MHz									
36.51	51.58	QP	346	1.8	H	-17.46	14.26	40.00	-25.74
36.51	52.95	QP	236	1.8	V	-17.46	28.20	40.00	-11.80
4804.00	48.34	PK	217	1.6	V	-1.06	47.28	74.00	-26.72
4804.00	40.47	Ave	217	1.6	V	-1.06	39.41	54.00	-14.59
7206.00	49.52	PK	88	1.2	H	1.33	50.85	74.00	-23.15
7206.00	43.20	Ave	88	1.2	H	1.33	44.53	54.00	-9.47
2320.64	46.69	PK	133	1.3	V	-13.19	33.50	74.00	-40.50
2320.64	39.24	Ave	133	1.3	V	-13.19	26.05	54.00	-27.95
2363.23	42.34	PK	60	1.5	H	-13.14	29.20	74.00	-44.80
2363.23	38.78	Ave	60	1.5	H	-13.14	25.64	54.00	-28.36
2489.81	44.59	PK	318	1.2	V	-13.08	31.51	74.00	-42.49
2489.81	38.23	Ave	318	1.2	V	-13.08	25.15	54.00	-28.85

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/209/205	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Middle Channel 2441MHz									
36.51	49.79	QP	79	1.7	H	-17.46	14.32	40.00	-25.68
36.51	54.19	QP	299	1.3	V	-17.46	28.45	40.00	-11.55
4880.00	47.76	PK	24	1.6	V	-0.62	47.14	74.00	-26.86
4880.00	39.95	Ave	24	1.6	V	-0.62	39.33	54.00	-14.67
7320.00	49.75	PK	357	1.9	H	2.21	51.96	74.00	-22.04
7320.00	43.56	Ave	357	1.9	H	2.21	45.77	54.00	-8.23
2335.68	46.79	PK	334	1.3	V	-13.19	33.60	74.00	-40.40
2335.68	38.46	Ave	334	1.3	V	-13.19	25.27	54.00	-28.73
2374.72	44.25	PK	42	1.4	H	-13.14	31.11	74.00	-42.89
2374.72	36.85	Ave	42	1.4	H	-13.14	23.71	54.00	-30.29
2496.25	42.46	PK	295	1.8	V	-13.08	29.38	74.00	-44.62
2496.25	38.46	Ave	295	1.8	V	-13.08	25.38	54.00	-28.62

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/209/205	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK High Channel 2480MHz									
36.51	48.81	QP	85	1.8	H	-17.46	16.24	40.00	-23.76
36.51	52.67	QP	302	1.8	V	-17.46	29.34	40.00	-10.66
4960.00	46.76	PK	149	1.3	V	-0.24	46.52	74.00	-27.48
4960.00	39.40	Ave	149	1.3	V	-0.24	39.16	54.00	-14.84
7440.00	51.40	PK	291	2.0	H	2.84	54.24	74.00	-19.76
7440.00	41.56	Ave	291	2.0	H	2.84	44.40	54.00	-9.60
2343.47	45.19	PK	171	1.4	V	-13.19	32.00	74.00	-42.00
2343.47	39.53	Ave	171	1.4	V	-13.19	26.34	54.00	-27.66
2381.07	43.05	PK	316	1.9	H	-13.14	29.91	74.00	-44.09
2381.07	38.05	Ave	316	1.9	H	-13.14	24.91	54.00	-29.09
2490.33	44.04	PK	148	1.5	V	-13.08	30.96	74.00	-43.04
2490.33	38.11	Ave	148	1.5	V	-13.08	25.03	54.00	-28.97

Test Frequency: 18GHz~25GHz

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

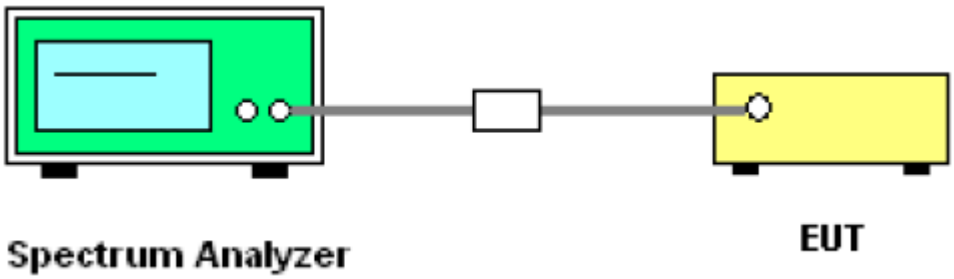
9 Band Edge Measurement

Test Requirement:	Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).
Test Method:	ANSI C63.10
Test Limit:	Regulation 15.247 (d),In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
Test Mode:	Transmitting

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 = 100kHz, VBW = 300kHz, Sweep = auto
   Detector function = peak, Trace = max hold

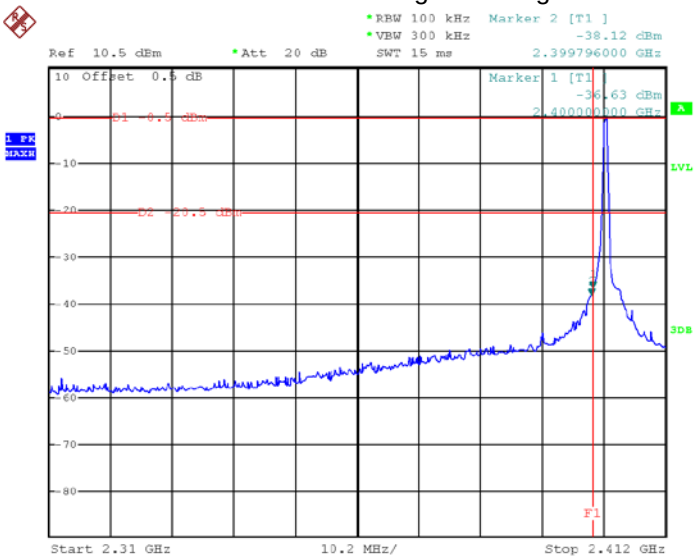
9.2 Test Setup



9.3 Test Result:

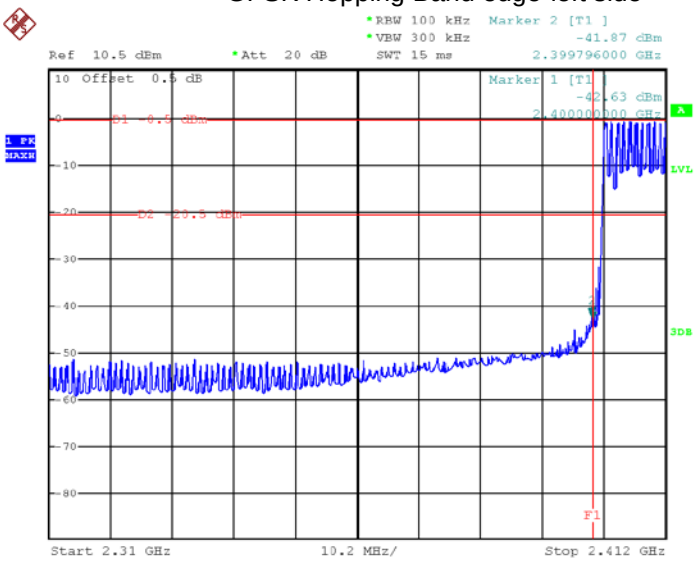
Test plots

GFSK Transmitting Band edge-left side



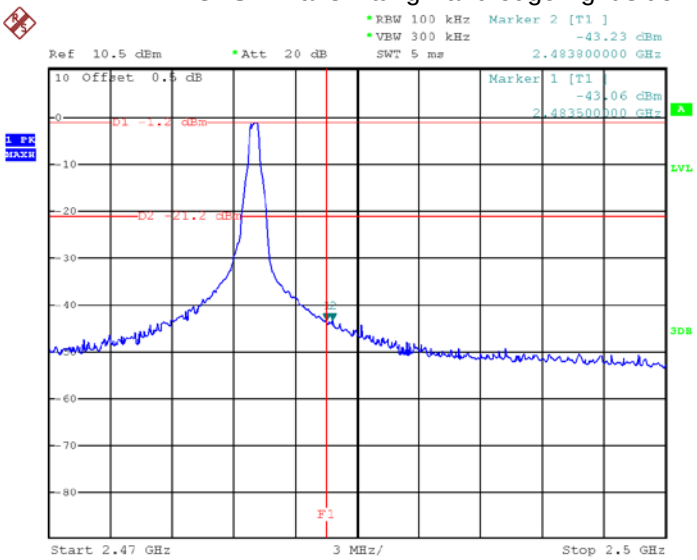
Date: 29.JUN.2018 02:05:59

GFSK Hopping Band edge-left side



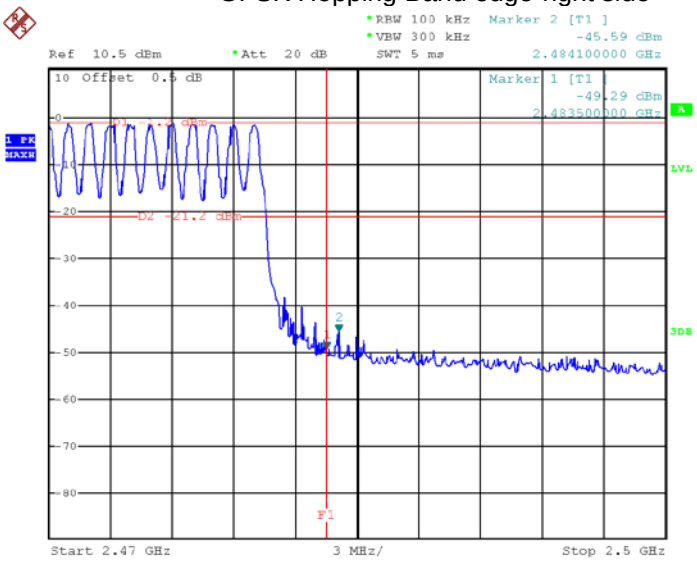
Date: 29.JUN.2018 02:53:35

GFSK Transmitting Band edge-right side



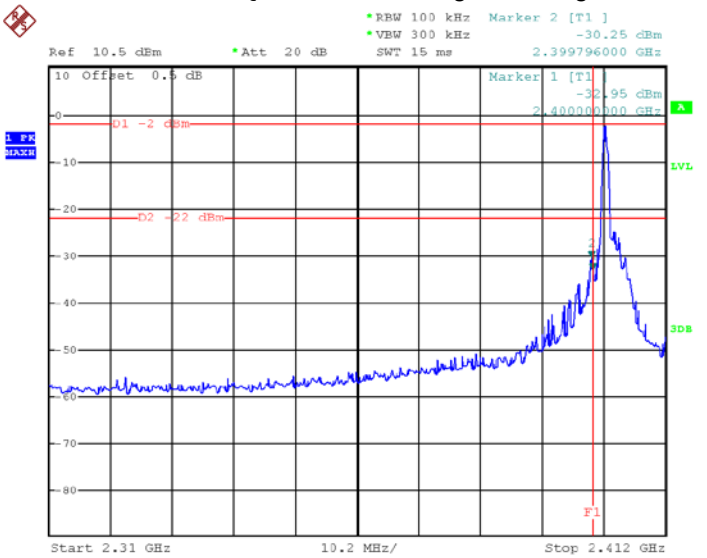
Date: 29.JUN.2018 02:13:03

GFSK Hopping Band edge-right side



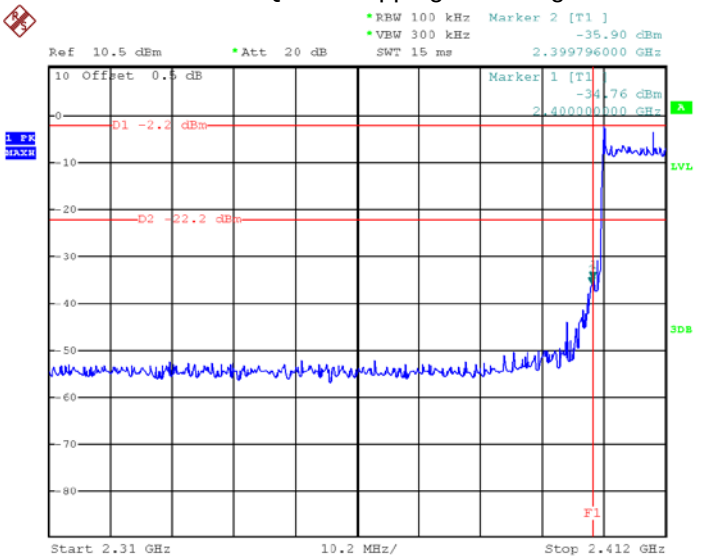
Date: 29.JUN.2018 03:06:05

π /4 DQPSK Transmitting Band edge-left side



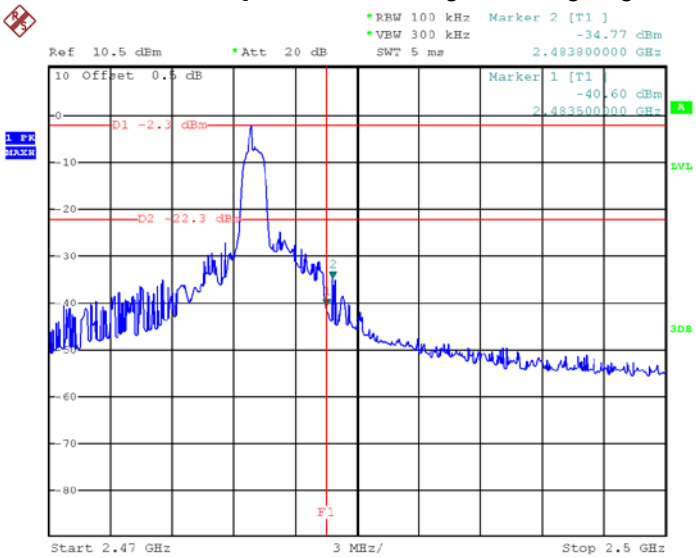
Date: 29.JUN.2018 02:10:47

π /4 DQPSK Hopping Band edge-left side



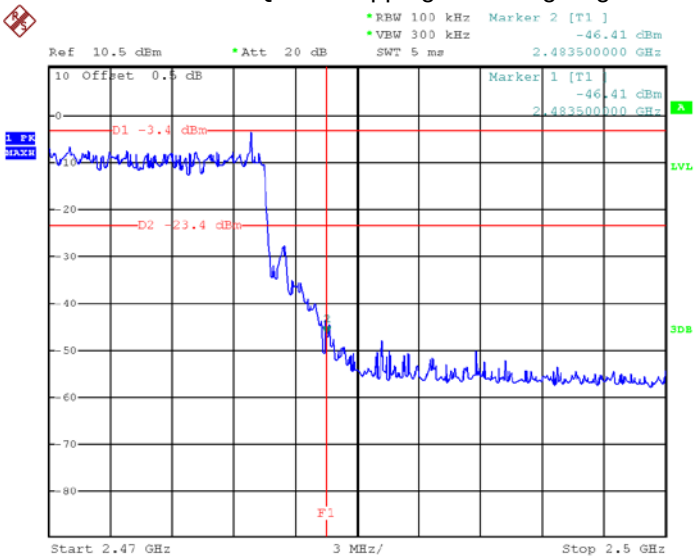
Date: 29.JUN.2018 02:56:20

π /4 DQPSK Transmitting Band edge-right side



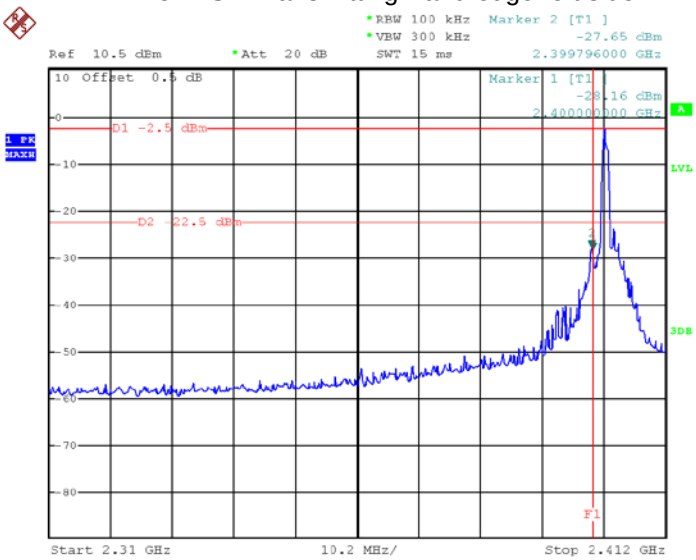
Date: 29.JUN.2018 02:15:23

π /4 DQPSK Hopping Band edge-right side



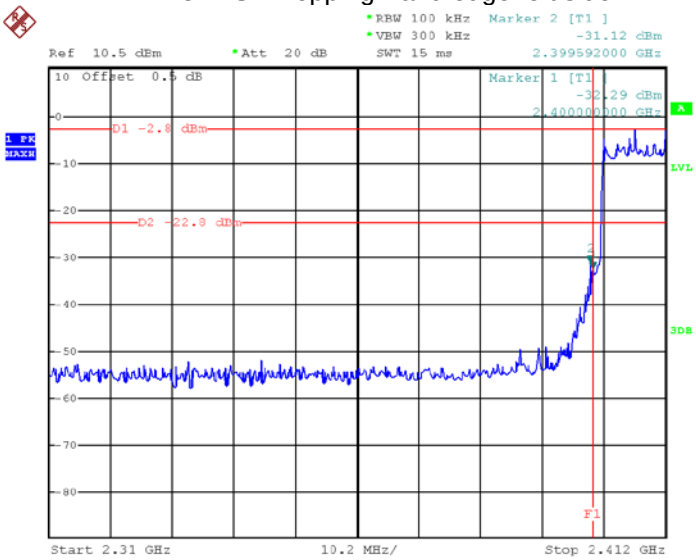
Date: 29.JUN.2018 03:04:31

8DPSK Transmitting Band edge-left side



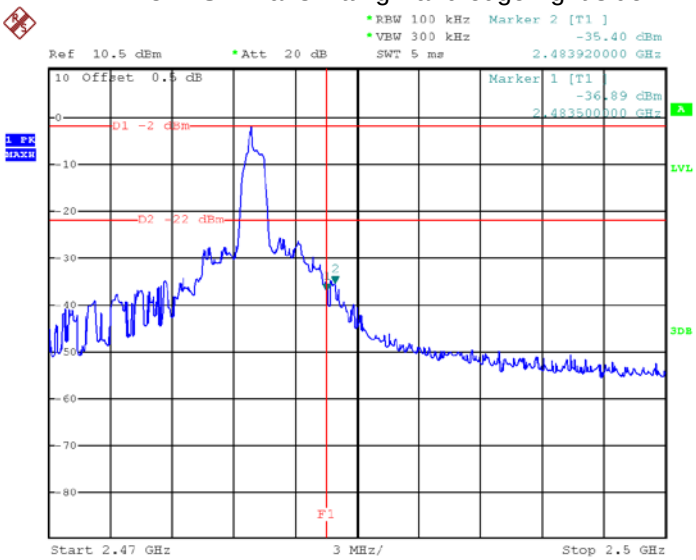
Date: 29.JUN.2018 02:09:33

8DPSK Hopping Band edge-left side



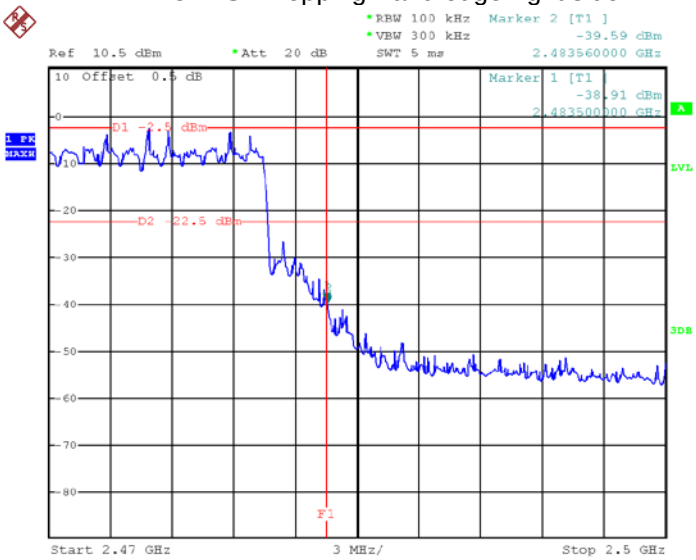
Date: 29.JUN.2018 02:57:42

8DPSK Transmitting Band edge-right side



Date: 29.JUN.2018 02:17:33

8DPSK Hopping Band edge-right side



Date: 29.JUN.2018 03:00:36

10 Bandwidth Measurement

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: C63.10: 2013

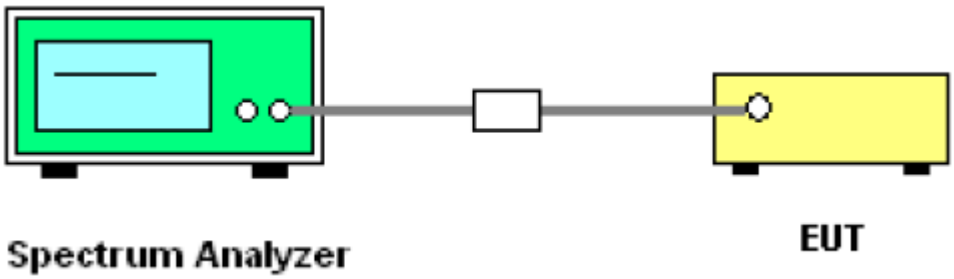
Test Mode: Test in fixing operating frequency at low, Middle, high channel.

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 = 30kHz, VBW = 100kHz

10.2 Test Setup

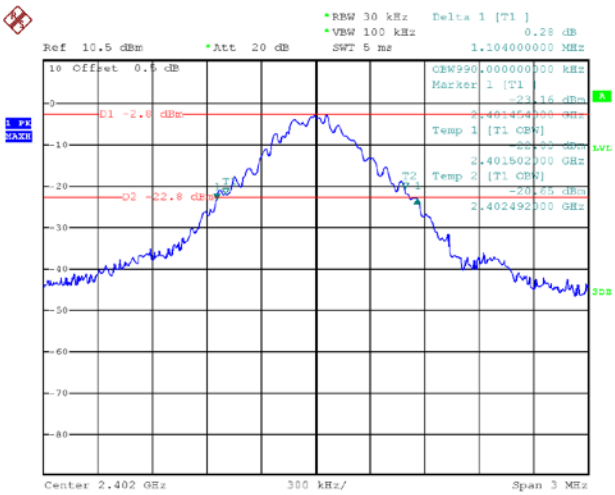


10.3 Test Result:

Modulation	Test Channel	20 dB Bandwidth	99% Bandwidth
GFSK	Low	1.104MHz	0.990MHz
GFSK	Middle	1.110MHz	0.996MHz
GFSK	High	1.110MHz	1.002MHz
π /4 DQPSK	Low	1.362MHz	1.410MHz
π 4 DQPSK	Middle	1.362MHz	1.344MHz
π /4 DQPSK	High	1.338MHz	1.320MHz
8DPSK	Low	1.368MHz	1.416MHz
8DPSK	Middle	1.356MHz	1.314MHz
8DPSK	High	1.356MHz	1.332MHz

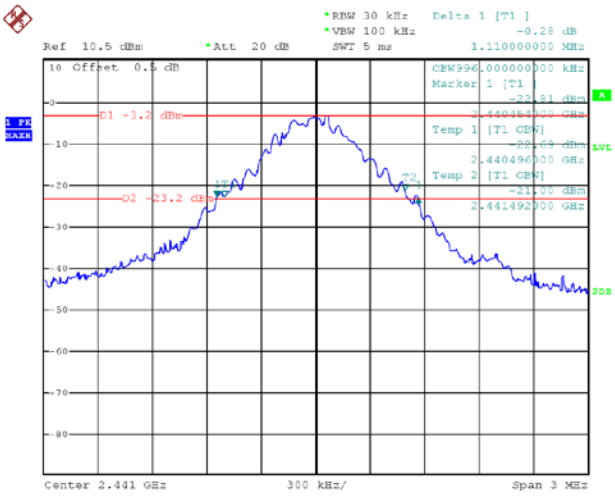
Test result plot as follows:

Modulation: GFSK Low Channel



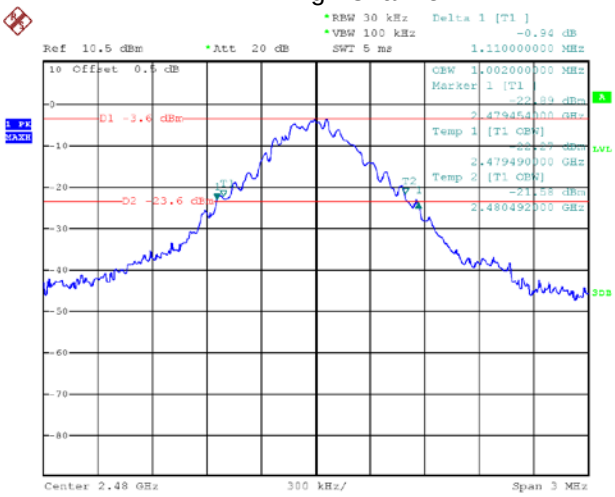
Date: 29.JUN.2018 02:00:20

Middle Channel



Date: 29.JUN.2018 02:01:46

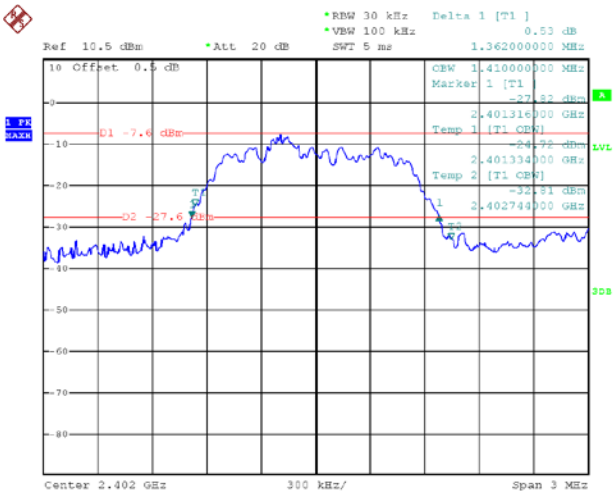
High Channel



Date: 29.JUN.2018 02:02:55

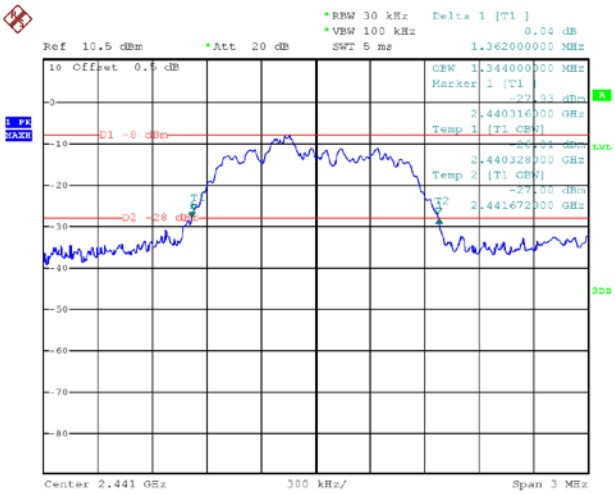
Modulation: π /4 DQPSK

Low Channel



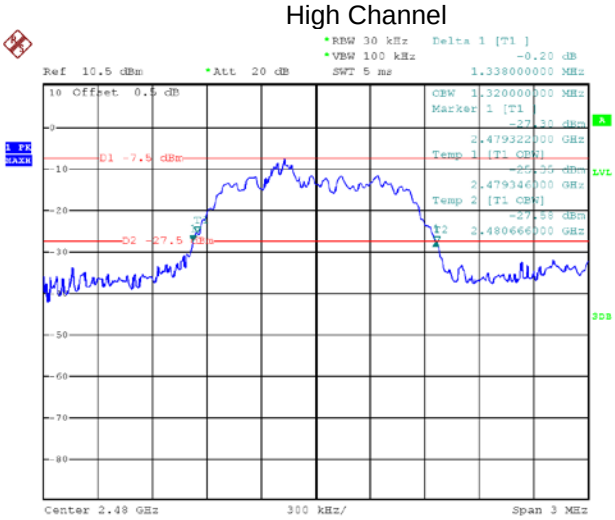
Date: 29.JUN.2018 01:59:11

Middle Channel



Date: 29.JUN.2018 01:56:33

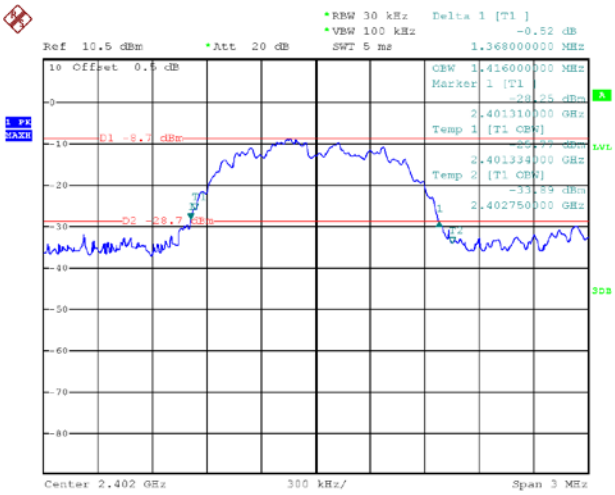
High Channel



Date: 29.JUN.2018 01:54:32

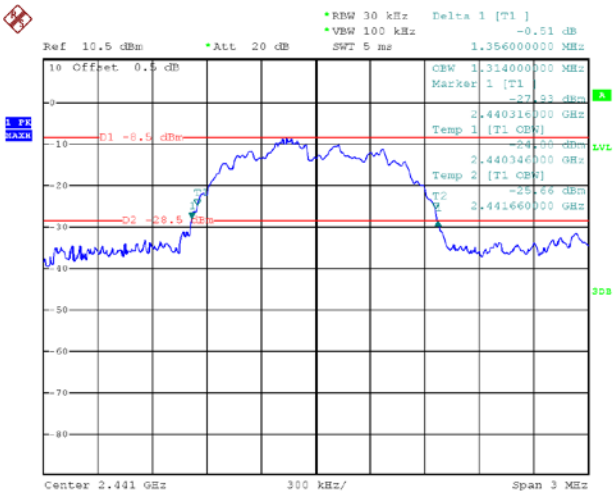
Modulation: 8DPSK

Low Channel



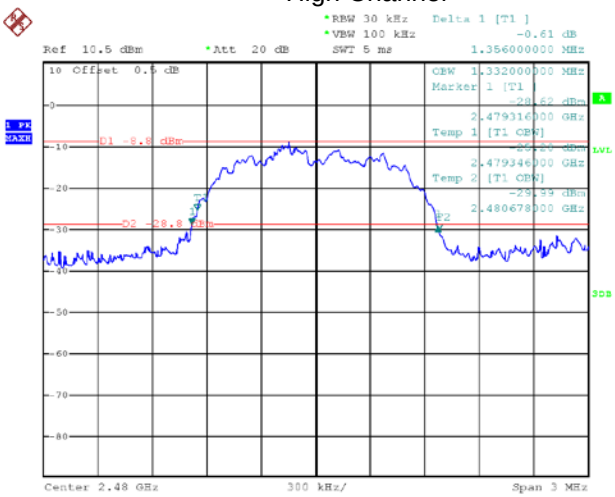
Date: 29.JUN.2018 04:48:31

Middle Channel



Date: 29.JUN.2018 04:51:01

High Channel



Date: 29.JUN.2018 04:52:54

11 Maximum Peak Output Power

Test Requirement: FCC CFR47 Part 15 Section 15.247

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

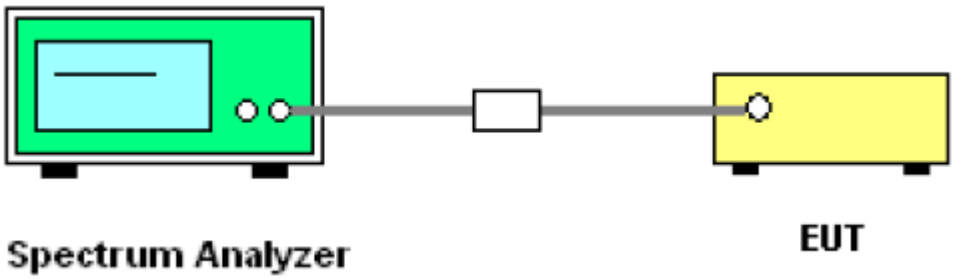
Refer to the result "Number of Hopping Frequency" of this document. The 1watts (30 dBm) limit applies.

Test mode: Test in fixing frequency transmitting mode.

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

11.2 Test Setup



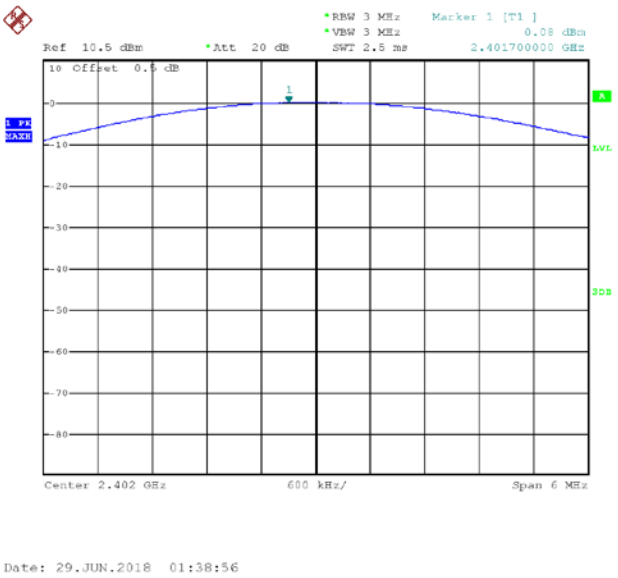
11.3 Test Result:

Test Mode	Data Rate	Peak Power(dBm)			Limit (dBm)
		Low Channel	Middle Channel	High Channel	
GFSK	1Mbps	**0.08**	-0.29	-0.79	20.97
π/4 DQPSK	2Mbps	-1.46	-1.88	**-0.70**	20.97
8DPSK	3Mbps	-1.44	**-1.32**	-1.79	20.97

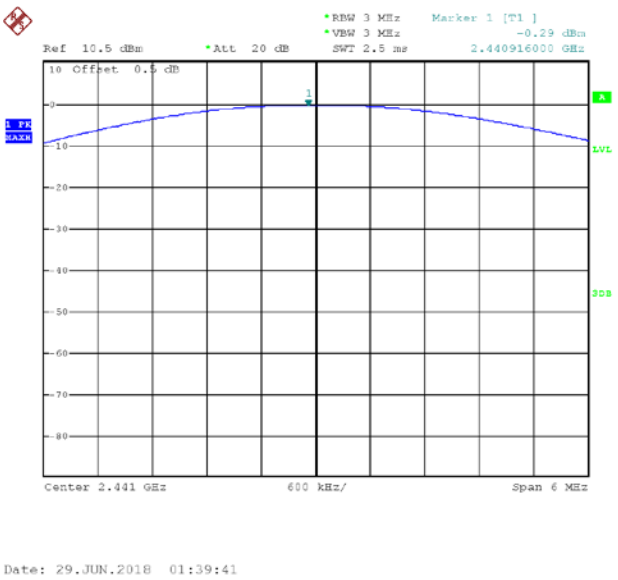
Test result plot as follows:

Modulation: GFSK

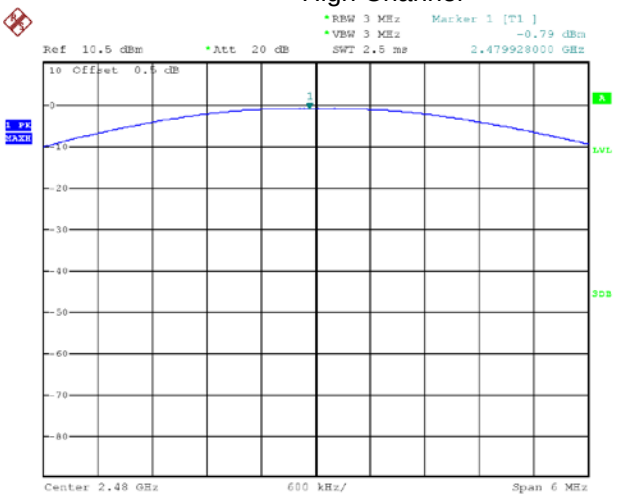
Low Channel



Middle Channel



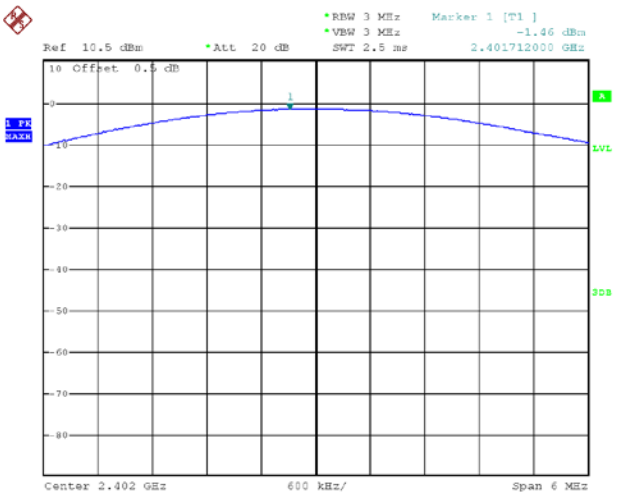
High Channel



Date: 29.JUN.2018 01:42:49

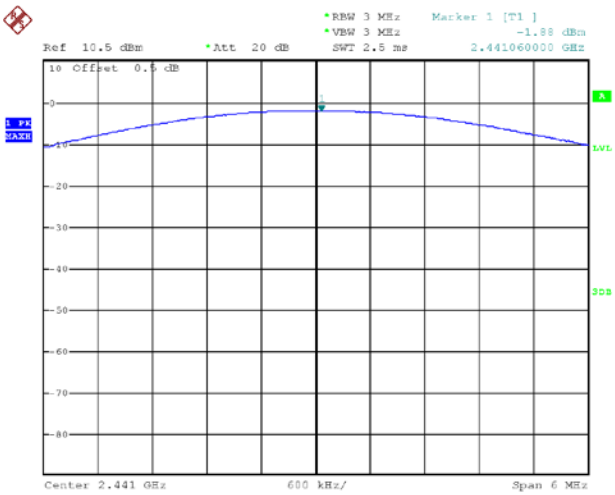
Modulation: π /4 DQPSK Low Channel

Low Channel



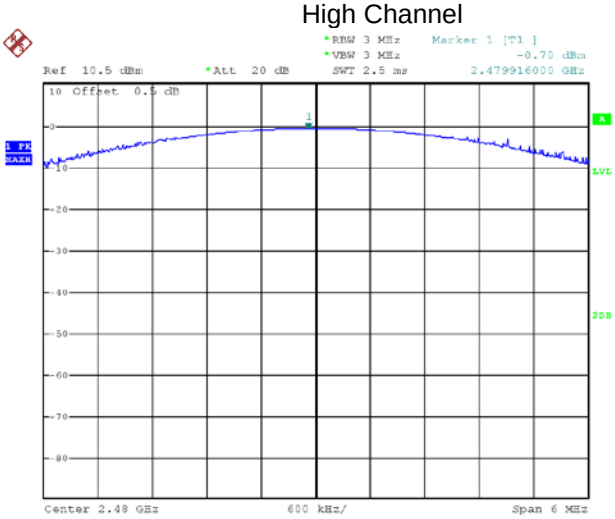
Date: 29.JUN.2018 01:45:33

Middle Channel



Date: 29.JUN.2018 01:44:34

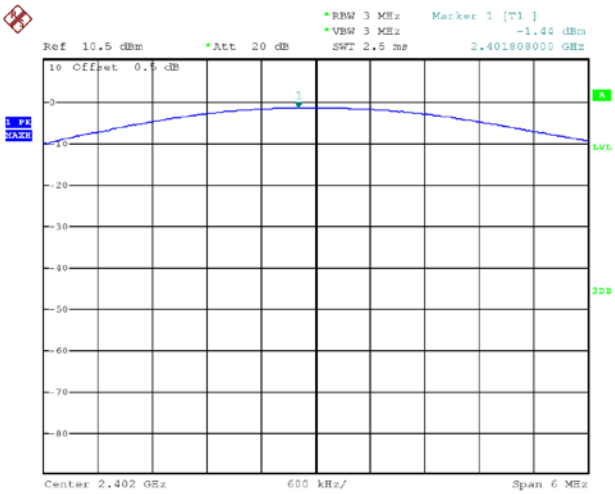
High Channel



Date: 29.JUN.2018 01:43:34

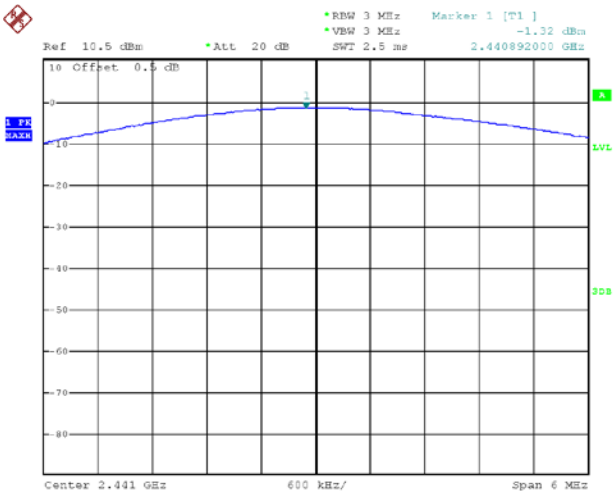
Modulation: 8DPSK Low Channel

Low Channel



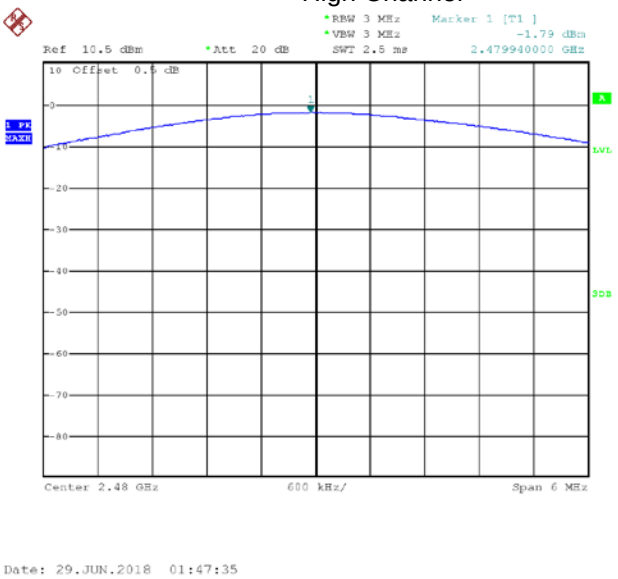
Date: 29.JUN.2018 01:45:59

Middle Channel



Date: 29.JUN.2018 01:46:52

High Channel



12 Hopping Channel Separation

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	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 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 1W.
Test Mode:	Test in hopping transmitting operating mode.

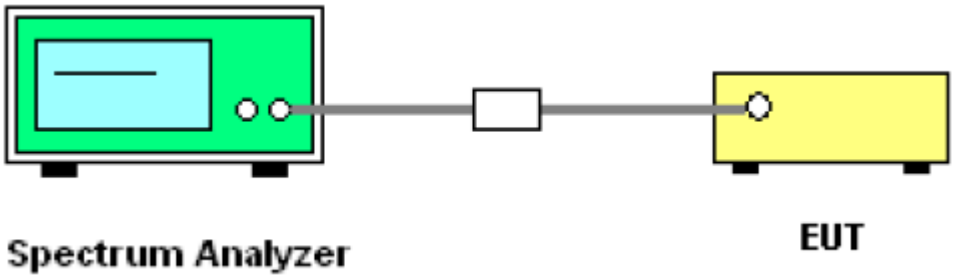
12.1 Test Procedure:

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 = 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.

12.2 Test Setup



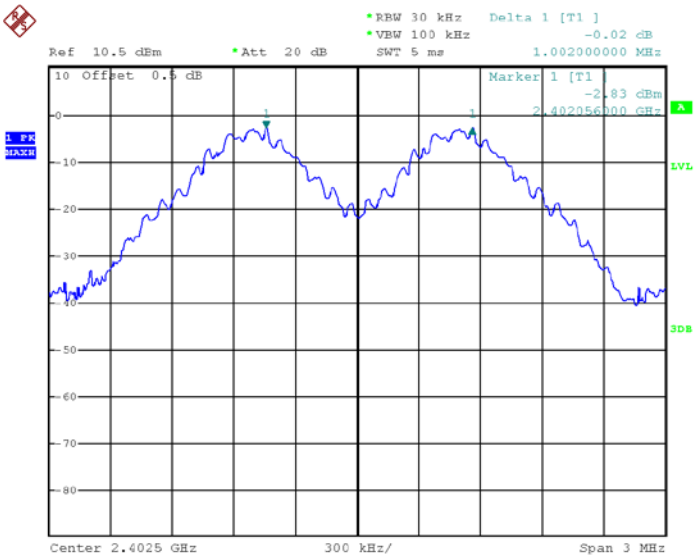
12.3 Test Result:

Test result plot as follows:

Modulation	Test Channel	Separation (MHz)	Result
GFSK	Low	1 MHz	PASS
GFSK	Middle	1 MHz	PASS
GFSK	High	1 MHz	PASS
π /4 DQPSK	Low	1 MHz	PASS
π /4 DQPSK	Middle	1 MHz	PASS
π /4 DQPSK	High	1 MHz	PASS
8DPSK	Low	1 MHz	PASS
8DPSK	Middle	1 MHz	PASS
8DPSK	High	1 MHz	PASS

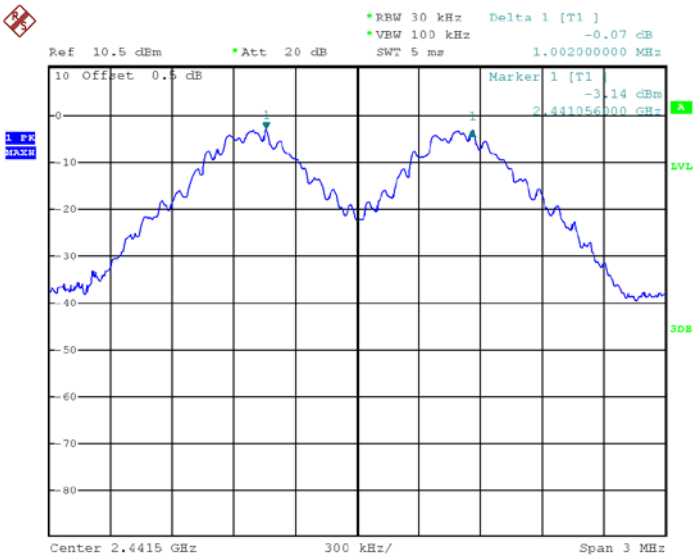
Test plots

GFSK Low Channel



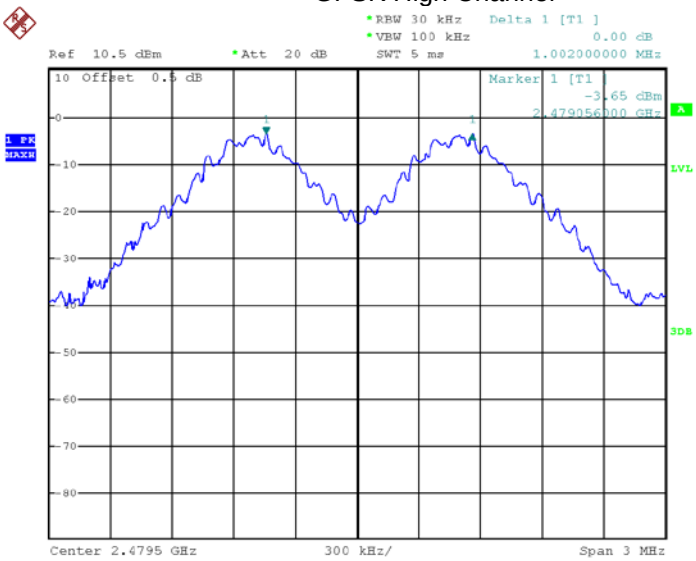
Date: 29.JUN.2018 02:21:26

GFSK Middle Channel



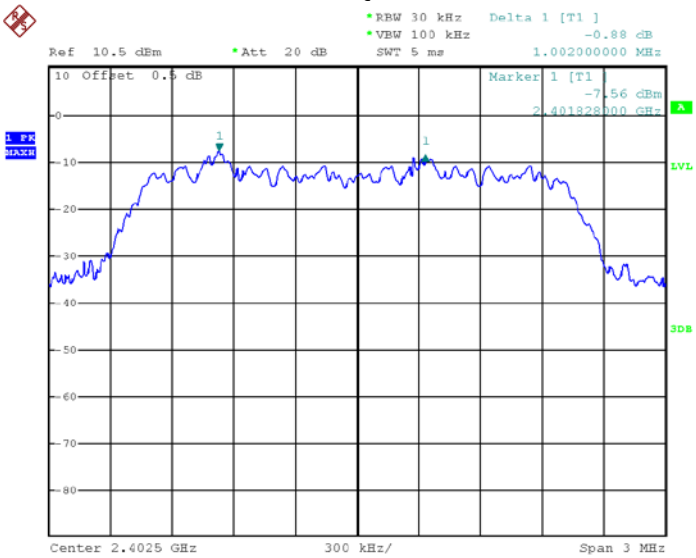
Date: 29.JUN.2018 02:24:58

GFSK High Channel



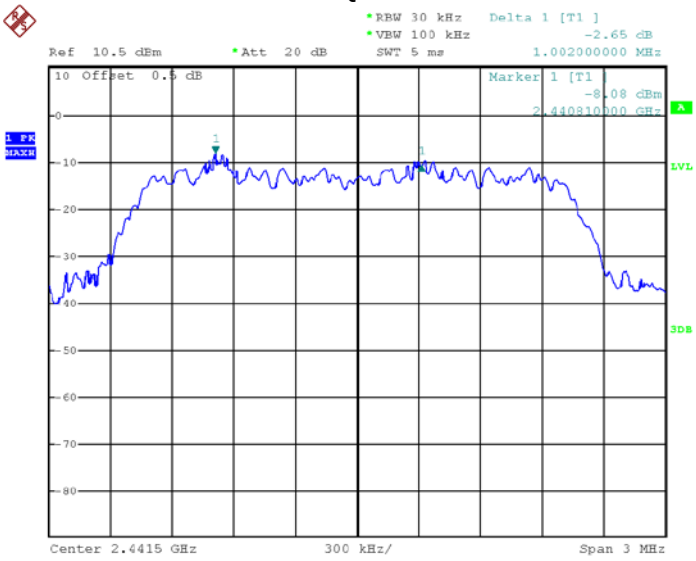
Date: 29.JUN.2018 02:26:19

π /4 DQPSK Low Channel



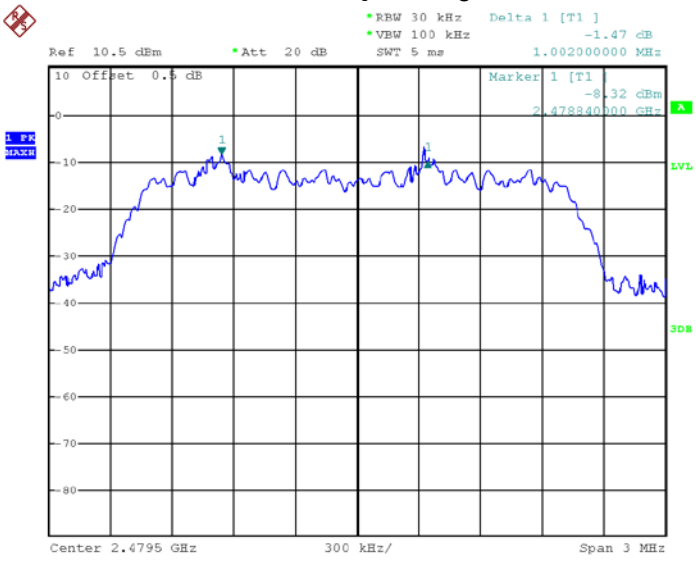
Date: 29.JUN.2018 02:29:43

π /4 DQPSK Middle Channel



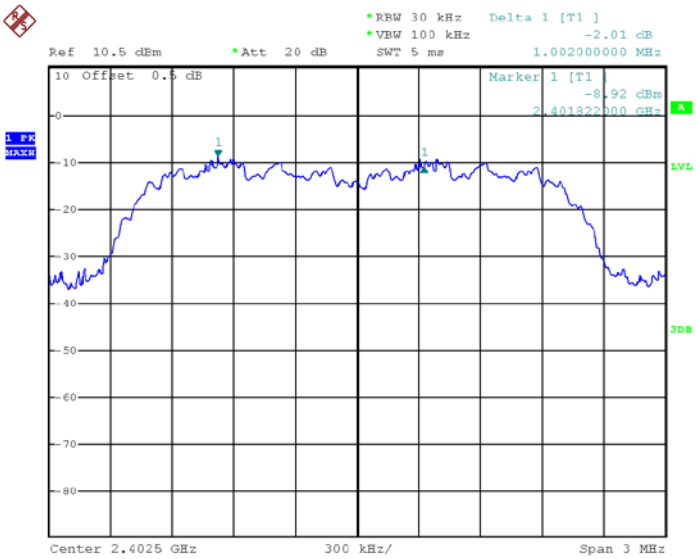
Date: 29.JUN.2018 02:30:59

π /4 DQPSK High Channel



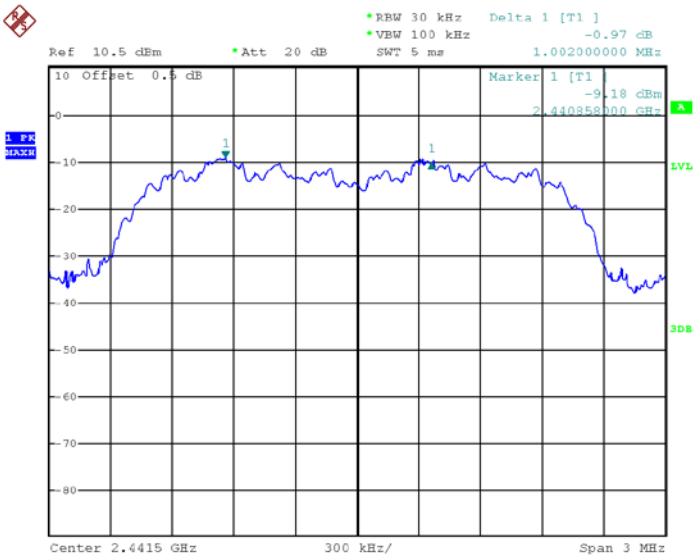
Date: 29.JUN.2018 02:32:53

8DPSK Low Channel



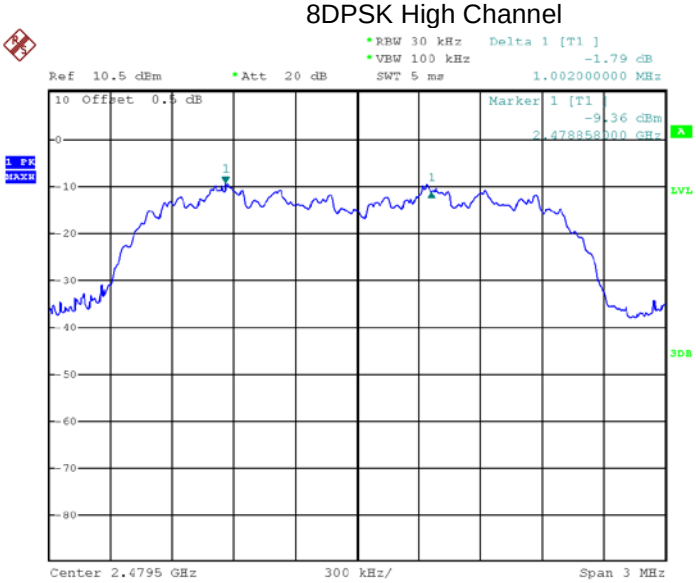
Date: 29.JUN.2018 02:34:40

8DPSK Middle Channel



Date: 29.JUN.2018 02:37:43

8DPSK High Channel



Date: 29.JUN.2018 02:39:20

13 Number of Hopping Frequency

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	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:	Test in hopping transmitting operating mode.

13.1 Test Procedure:

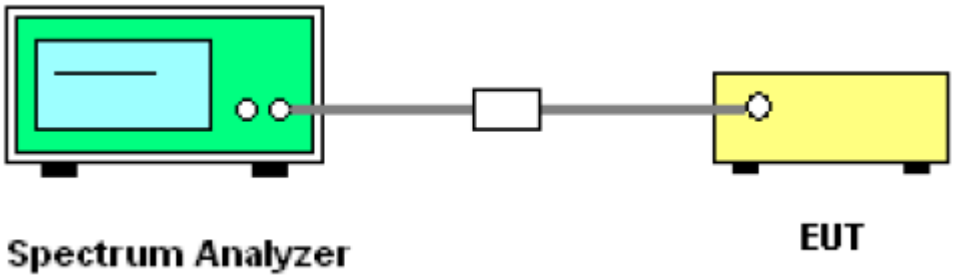
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 300 kHz. VBW = 300 kHz. 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 = 2.4835GHz. Sweep=auto;

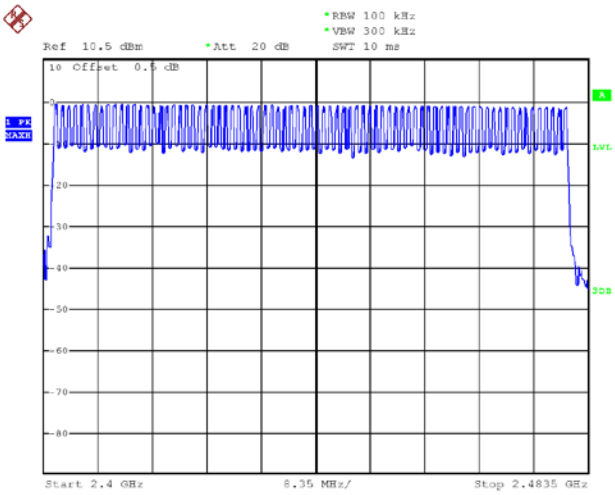
13.2 Test Setup



13.3 Test Result:

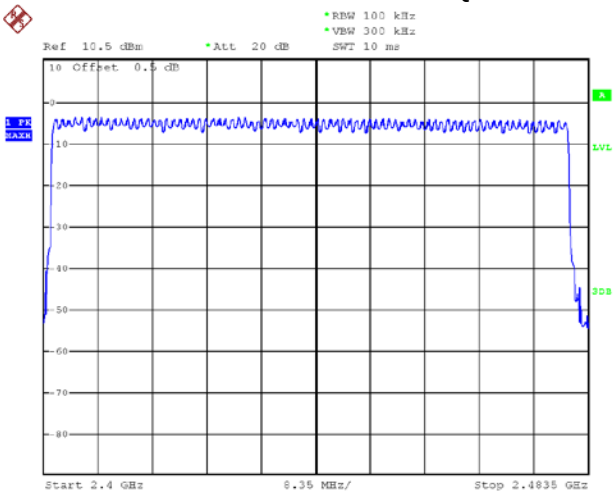
Total Channels are 79 Channels.

Modulation: GFSK



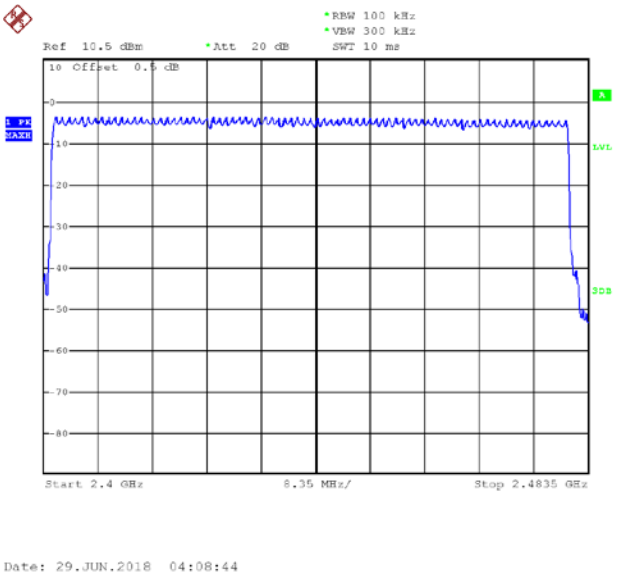
Date: 29.JUN.2018 03:11:32

Modulation: π /4 DQPSK



Date: 29.JUN.2018 03:59:00

Modulation: 8DPSK



14 Dwell Time

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
Test Mode:	Test in hopping transmitting operating mode.

14.1 Test Procedure:

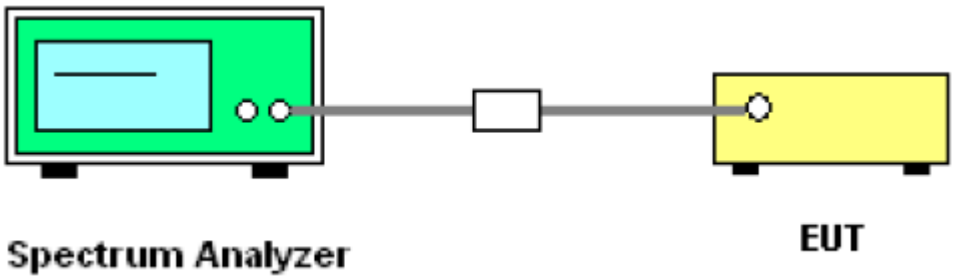
1.Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

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.

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).

14.2 Test Setup



14.3 Test Result:

Dwell time = Pulse wide x (Hopping rate / Number of channels) x Period
The test period: T= 0.4(s) * 79 = 31.6 (s)
DH5 Packet permit maximum 1600 / 79 / 6 hops per second in each channel (5 time slots RX, 1 time slot TX).
DH3 Packet permit maximum 1600 / 79 / 4 hops per second in each channel (3 time slots RX, 1 time slot TX).

DH1 Packet permit maximum 1600 / 79 / 2 hops per second in each channel (1 time slot RX, 1 time slot TX).

So, the Dwell Time can be calculated as follows:

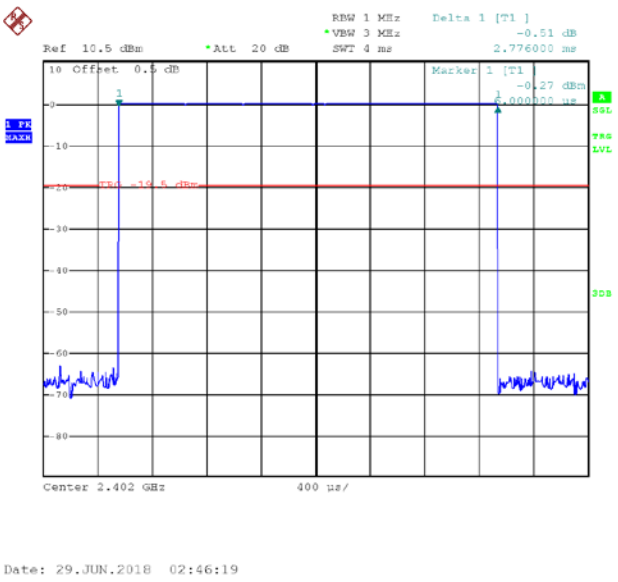
Data Packet	Dwell Time(s)
DH5	1600/79/6*31.6*(MkrDelta)/1000
DH3	1600/79/4*31.6*(MkrDelta)/1000
DH1	1600/79/2*31.6*(MkrDelta)/1000
Remark	Mkr Delta is single pulse time.

Modulation	Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
GFSK	DH5	Low	2.776	0.296	0.4
		middle	2.768	0.295	0.4
		High	2.792	0.298	0.4
π /4 DQPSK	DH5	Low	2.800	0.299	0.4
		middle	2.776	0.296	0.4
		High	2.792	0.298	0.4
8DPSK	DH5	Low	2.800	0.299	0.4
		middle	2.792	0.298	0.4
		High	2.800	0.299	0.4

Modulation: GFSK

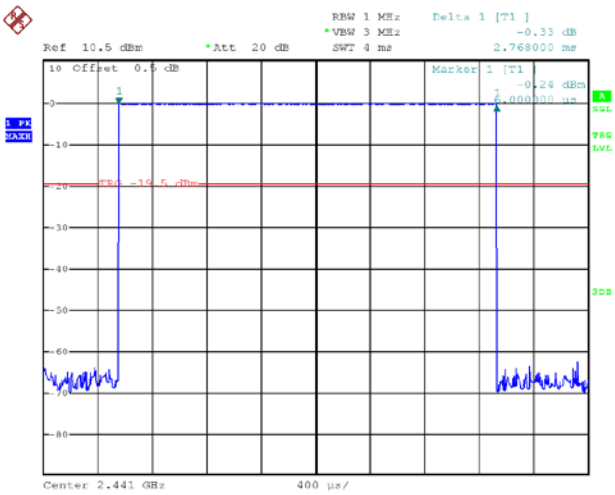
Data Packet:

DH5.Low channel



Data Packet:

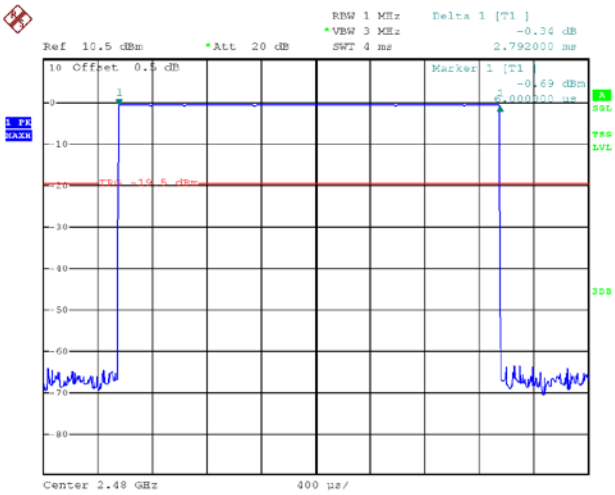
DH5.Middle channel



Date: 29.JUN.2018 02:45:38

Data Packet:

DH5, High channel

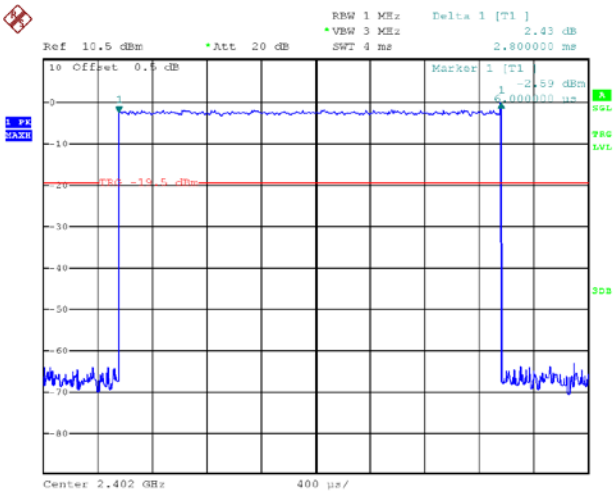


Date: 29.JUN.2018 02:47:12

Modulation: π /4 DQPSK

Data Packet:

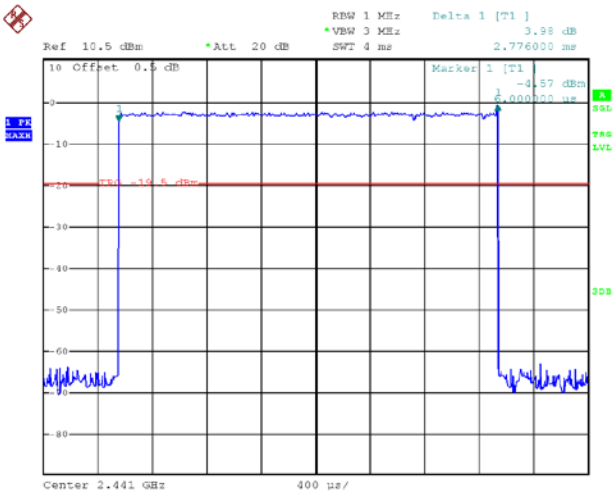
2DH5 Low channel



Date: 29.JUN.2018 02:48:17

Data Packet:

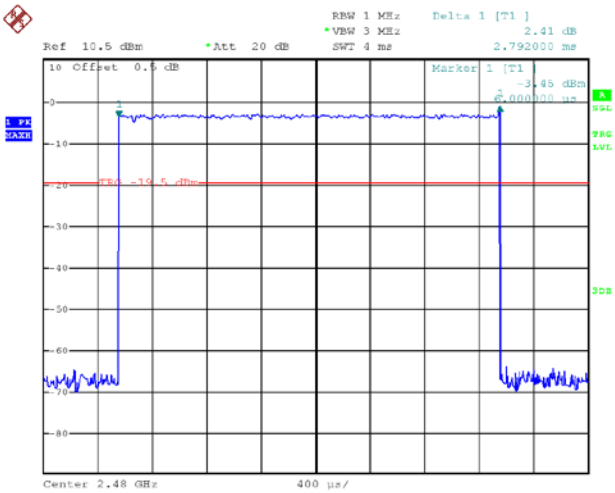
2DH5.Middle channel



Date: 29.JUN.2018 02:48:57

Data Packet:

2DH5, High channel

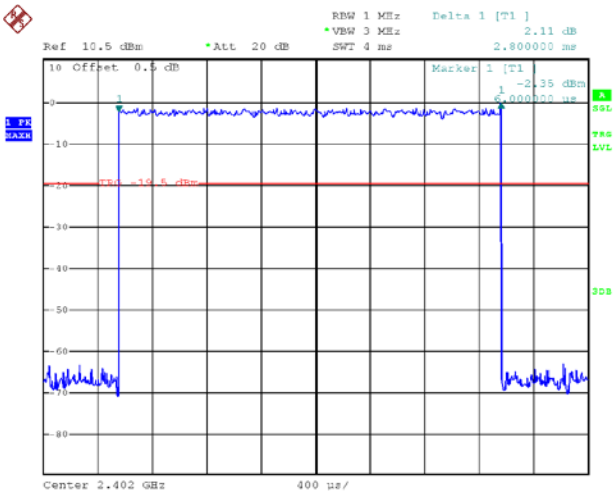


Date: 29.JUN.2018 02:49:26

Modulation: 8DPSK

Data Packet:

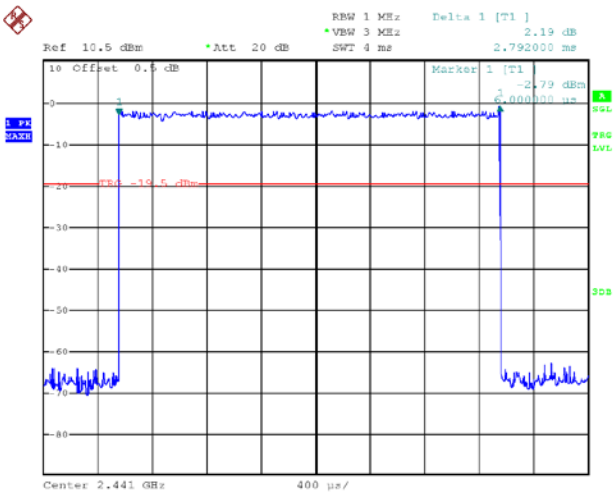
3DH5.Low channel



Date: 29.JUN.2018 02:50:06

Data Packet:

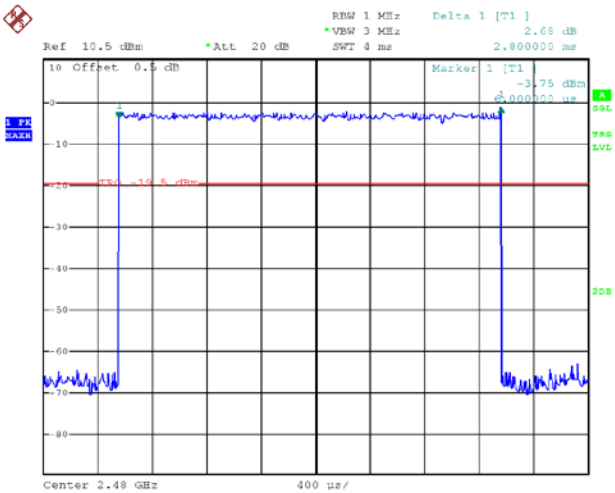
3DH5.Middle channel



Date: 29.JUN.2018 02:50:34

Data Packet:

3DH5, High channel



Date: 29.JUN.2018 02:51:03

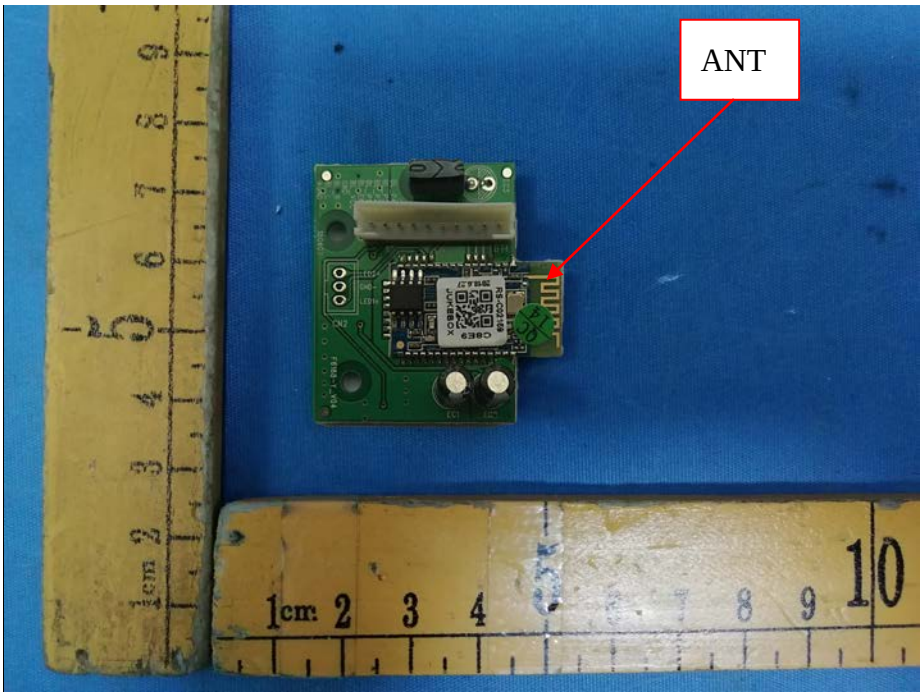
15 Antenna Requirement

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

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.

Result:

The EUT has one PCB Printed Antenna for Bluetooth Antenna, meets the requirements of FCC 15.203.



16 FCC ID: 2AMNH-GRACELANDUS RF Exposure Report

Note: Please refer to RF Exposure Report: WTS18S05113280-2W.

17 Photographs - Model BYL-01-02PH Test Setup and EUT

Refer to the file CS-WRLS-VNTMT-10W_Ext Photos, CS-WRLS-VNTMT-10W_Int Photos and CS-WRLS-VNTMT-10W_Tsup Photos.

======End of Report======