

TEST REPORT

Reference No..... : WTS17S0989404-1E
FCC ID : 2AN5VX029A
Applicant..... : Shenzhen Jing Xin Tai HouseWare Co., Ltd.
Address..... : 28th Building, 3th Industrial Park, Xitian, Gongming, Guangming
New District, Shenzhen, Guangdong, China
Manufacturer : Shenzhen Jing Xin Tai HouseWare Co., Ltd.
Address..... : 28th Building, 3th Industrial Park, Xitian, Gongming, Guangming
New District, Shenzhen, Guangdong, China
Product..... : Aroma diffuser
Model(s) : X029A
Standards..... : FCC CFR47 Part 15.247:2017
Date of Receipt sample : 2017-09-05
Date of Test : 2017-09-06 to 2017-11-23
Date of Issue..... : 2017-11-24
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:

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1 Laboratories Introduction

Waltek Services Test Group Ltd. is one of the largest and the most comprehensive third party testing organizations in China, our headquarter located in Shenzhen (CNAS Registration No. L3110, A2LA Certificate Number: 4243.01) and have branches in Foshan (CNAS Registration No. L6478), Dongguan (CNAS Registration No. L9950), Zhongshan, Suzhou (CNAS Registration No. L7754), Ningbo and Hong Kong, Our test capability covered four large fields: safety test. Electronic Magnetic Compatibility(EMC), reliability and energy performance, Chemical test. 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), CPSC(Consumer Product Safety Commission), CEC(California energy efficiency), IC(Industry Canada) and ELI(Efficient Lighting Initiative). It's the strategic partner and data recognition laboratory of international authoritative organizations, such as UL, Intertek(ETL-SEMKO), CSA, TÜV Rheinland, TÜV SÜD, etc. 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.

Waltek Services (Shenzhen) Co., Ltd.

A. Accreditations for Conformity Assessment (International)

Country/Region	Accreditation Body	Scope	Note
USA	CNAS (Registration No.: L3110) 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

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3 Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTS17S0989404-1E	2017-09-05	2017-09-06 to 2017-11-12	2017-11-14	original	-	Replaced
WTS17S0989404-1E	2017-09-05	2017-09-06 to 2017-11-23	2017-11-24	revision1	revised	Valid

4 General Information

4.1 General Description of E.U.T

Product	: Aroma diffuser
Model(s)	: X029A
Model Description	: N/A
Hardware Version	: V1.3
Software Version	: V1.1

4.2 Details of E.U.T

Operation Frequency	: 2402~2480MHz
Max. RF output power	: -1.08dBm
Type of Modulation	: GFSK, $\pi/4$ DQPSK, 8DPSK
Bluetooth Version	: v2.1+EDR
Antenna installation	: internal permanent wire antenna
Antenna Gain	: 0dBi
Ratings	: DC 24V, 0.65A Powered by POWER SUPPLY (POWER SUPPLY INPUT: AC100-240V~50/60Hz 0.4A Max; OUTPUT: DC 24V  0.65A, MODEL: DQS151-240065-HU DongGuan Citiland Electronics CO., LTD)

4.3 Channel List

Bluetooth Classic mode

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	101155	2017-09-12	2018-09-11
2.	LISN	SCHWARZBECK	NSLK 8128	8128-289	2017-09-12	2018-09-11
3.	Limiter	York	MTS-IMP-136	261115-001-0024	2017-09-12	2018-09-11
4.	Cable	Laplace	RF300	-	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	2017-04-29	2018-04-28
2	Broad-band Horn Antenna(1-18GHz)	SCHWARZBECK	BBHA 9120 D	667	2017-04-09	2018-04-08
3	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	2017-04-13	2018-04-12
4	Coaxial Cable (above 1GHz)	Top	1GHz-18GHz	EW02014-7	2017-04-13	2018-04-12
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	2017-04-13	2018-04-12
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	2017-04-13	2018-04-12
3	Active Loop Antenna	Beijing Dazhi	ZN30900A	-	2017-04-09	2018-04-08
4	Amplifier	ANRITSU	MH648A	M43381	2017-04-13	2018-04-12
5	Cable	HUBER+SUHNER	CBL2	525178	2017-04-13	2018-04-12
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
“*”: 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	$\pm 1 \times 10^{-6}$
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 Spurious Emissions test	± 3.64 dB (AC mains 150KHz~30MHz)

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

FCC Designation No.: N/A Test Firm Registration No.: N/A.

Test items: N/A

6 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
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
SAR Evaluation	1.1307(b)(1)	Pass
Note: Pass=Compliance; Fail=Not Compliance; 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)	Limit (dBμV)	
	Qsi-peak	Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	50	60
5 to 30	60	50

7.1 E.U.T. Operation

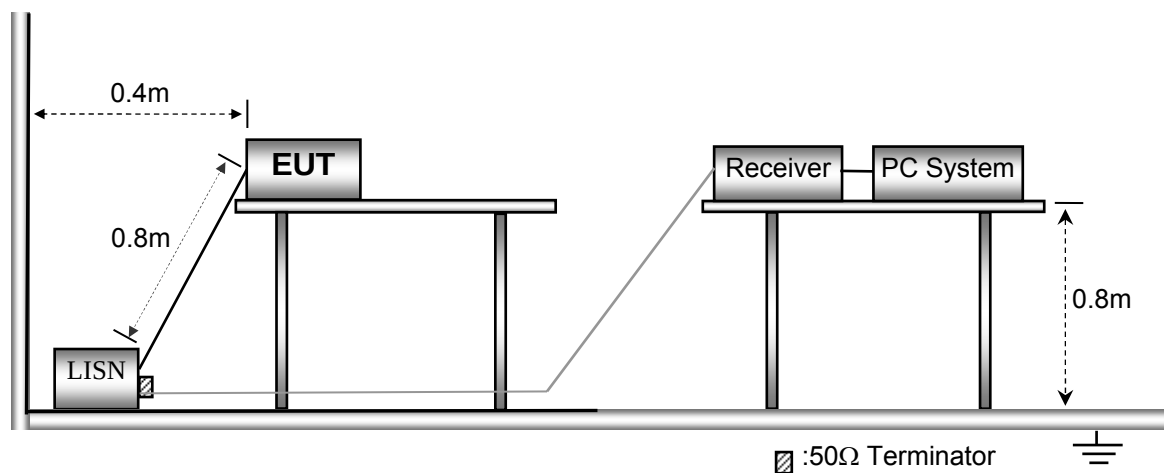
Operating Environment :	
Temperature:	22.8 °C
Humidity:	52.6 % RH
Atmospheric Pressure:	101.2kPa
Test Voltage:	AC 120V, 60Hz

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.



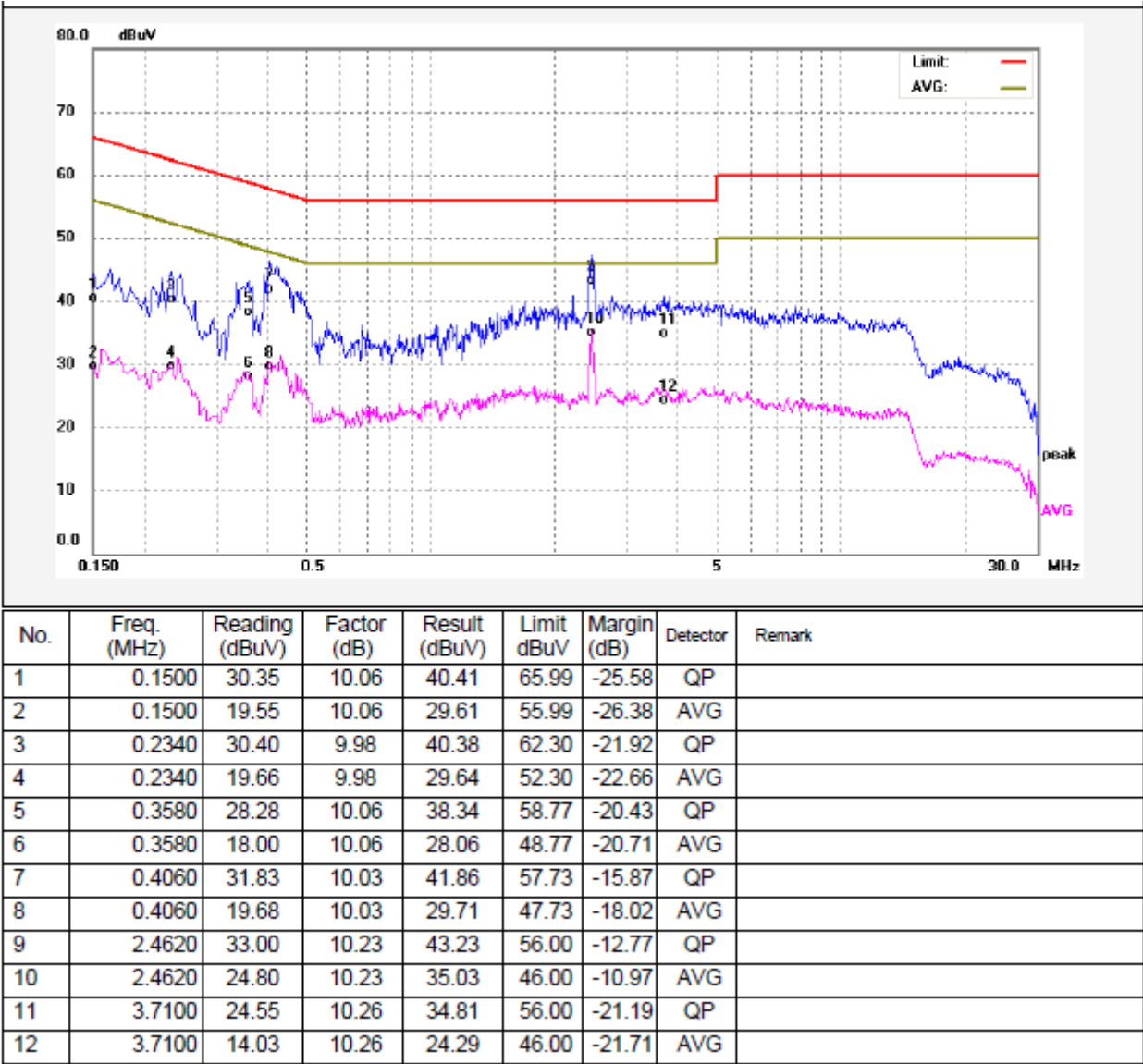
7.3 Measurement Description

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.

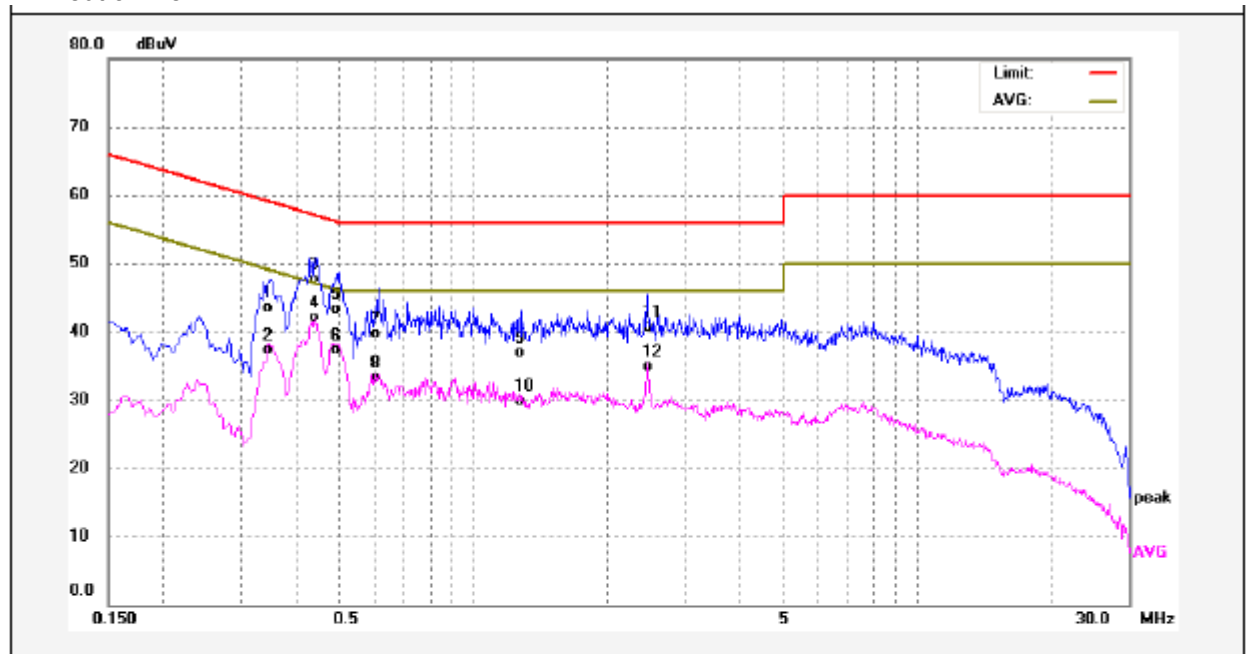
7.4 Conducted Emission Test Result

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

Live line:



Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.3500	33.49	10.06	43.55	58.96	-15.41	QP	
2	0.3500	27.28	10.06	37.34	48.96	-11.62	AVG	
3	0.4380	37.68	10.05	47.73	57.10	-9.37	QP	
4	0.4380	31.98	10.05	42.03	47.10	-5.07	AVG	
5	0.4980	33.16	10.08	43.24	56.03	-12.79	QP	
6	0.4980	27.19	10.08	37.27	46.03	-8.76	AVG	
7	0.6100	29.65	10.07	39.72	56.00	-16.28	QP	
8	0.6100	23.25	10.07	33.32	46.00	-12.68	AVG	
9	1.2780	26.53	10.34	36.87	56.00	-19.13	QP	
10	1.2780	19.60	10.34	29.94	46.00	-16.06	AVG	
11	2.4660	30.56	10.23	40.79	56.00	-15.21	QP	
12	2.4660	24.65	10.23	34.88	46.00	-11.12	AVG	

8 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:

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	$10000 * 2400/F(\text{kHz})$	$20\log^{(2400/F(\text{kHz}))} + 80$
0.490 ~ 1.705	24000/F(kHz)	30	$100 * 24000/F(\text{kHz})$	$20\log^{(24000/F(\text{kHz}))} + 40$
1.705 ~ 30	30	30	$100 * 30$	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

8.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

Test Voltage: AC 120V, 60Hz

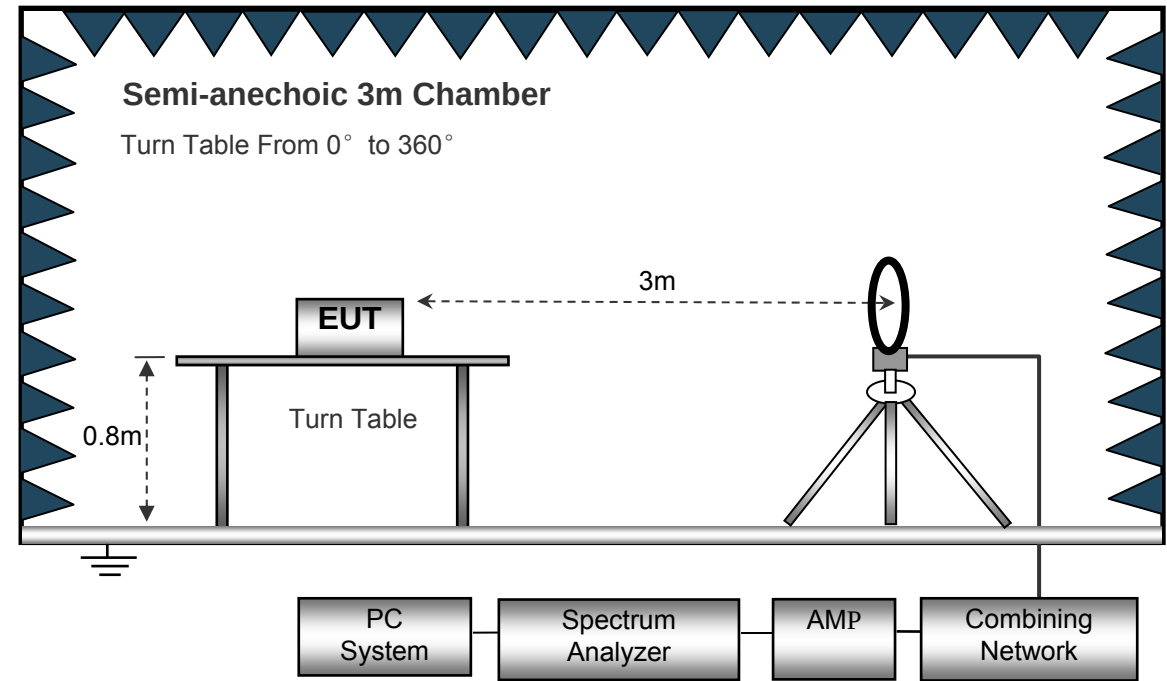
EUT Operation :

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

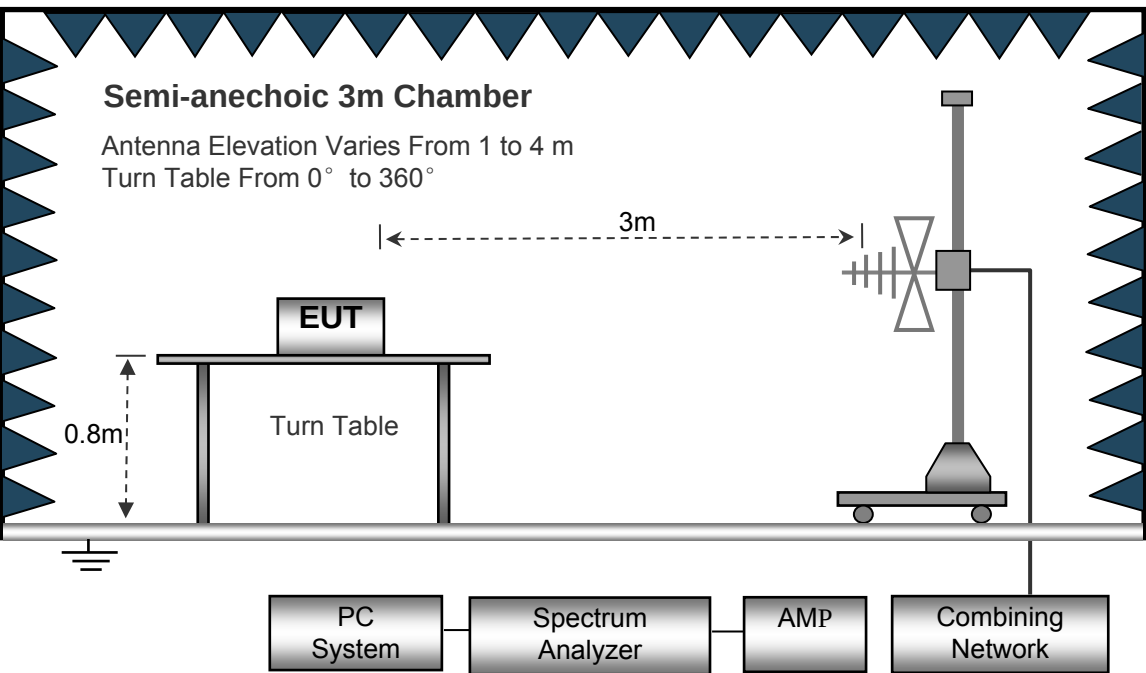
8.2 Test Setup

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

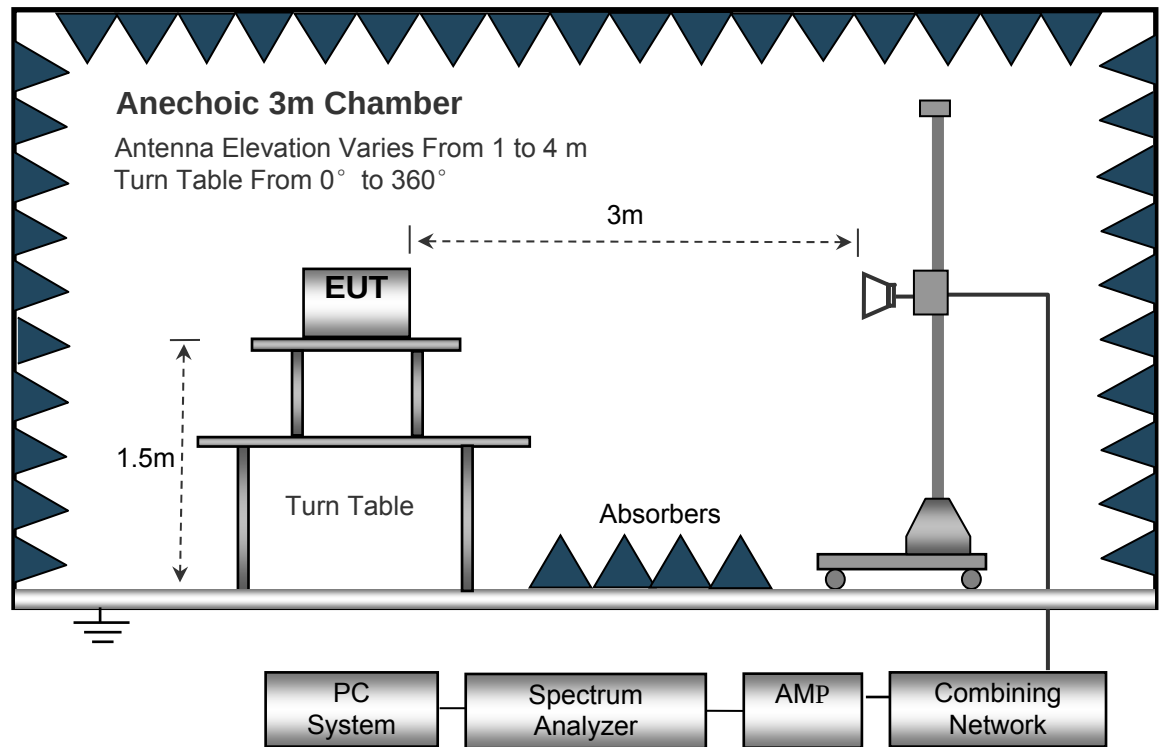
The test setup for emission measurement below 30MHz.



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
DetectorPK
Resolution Bandwidth.....100kHz
Video Bandwidth.....300kHz

Above 1GHz

Sweep Speed Auto
DetectorPK
Resolution Bandwidth.....1MHz
Video Bandwidth.....3MHz
DetectorAve.
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. 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:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

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:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Limit}$$

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: 30MHz ~ 18GHz

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

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									
232.56	35.23	QP	177	2.0	H	-13.35	21.88	46.00	-24.12
232.56	42.89	QP	325	1.9	V	-13.35	29.54	46.00	-16.46
4804.00	45.61	PK	321	1.6	V	-1.06	44.55	74.00	-29.45
4804.00	32.99	Ave	321	1.6	V	-1.06	31.93	54.00	-22.07
7206.00	49.61	PK	232	1.1	H	1.33	50.94	74.00	-23.06
7206.00	36.99	Ave	232	1.1	H	1.33	38.32	54.00	-15.68
2338.28	45.84	PK	336	1.9	V	-13.19	32.65	74.00	-41.35
2338.28	37.76	Ave	336	1.9	V	-13.19	24.57	54.00	-29.43
2356.02	43.07	PK	293	1.4	H	-13.14	29.93	74.00	-44.07
2356.02	38.11	Ave	293	1.4	H	-13.14	24.97	54.00	-29.03
2488.08	44.88	PK	253	1.8	V	-13.08	31.80	74.00	-42.20
2488.08	37.24	Ave	253	1.8	V	-13.08	24.16	54.00	-29.84

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									
232.56	36.12	QP	172	1.1	H	-13.35	22.77	46.00	-23.23
232.56	41.99	QP	345	1.6	V	-13.35	28.64	46.00	-17.36
4882.00	44.87	PK	282	1.5	V	-0.62	44.25	74.00	-29.75
4882.00	33.67	Ave	282	1.5	V	-0.62	33.05	54.00	-20.95
7323.00	48.50	PK	261	1.4	H	2.21	50.71	74.00	-23.29
7323.00	37.30	Ave	261	1.4	H	2.21	39.51	54.00	-14.49
2311.62	45.59	PK	201	1.4	V	-13.19	32.40	74.00	-41.60
2311.62	39.17	Ave	201	1.4	V	-13.19	25.98	54.00	-28.02
2361.54	43.26	PK	205	1.6	H	-13.14	30.12	74.00	-43.88
2361.54	38.46	Ave	205	1.6	H	-13.14	25.32	54.00	-28.68
2487.47	43.79	PK	173	1.1	V	-13.08	30.71	74.00	-43.29
2487.47	37.10	Ave	173	1.1	V	-13.08	24.02	54.00	-29.98

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									
232.56	37.13	QP	31	2.0	H	-13.35	23.78	46.00	-22.22
232.56	40.75	QP	330	1.5	V	-13.35	27.40	46.00	-18.60
4960.00	46.17	PK	235	1.8	V	-0.24	45.93	74.00	-28.07
4960.00	37.56	Ave	235	1.8	V	-0.24	37.32	54.00	-16.68
7440.00	47.17	PK	77	1.9	H	2.84	50.01	74.00	-23.99
7440.00	38.56	Ave	77	1.9	H	2.84	41.40	54.00	-12.60
2323.35	45.94	PK	258	1.5	V	-13.19	32.75	74.00	-41.25
2323.35	38.85	Ave	258	1.5	V	-13.19	25.66	54.00	-28.34
2377.90	43.06	PK	32	1.6	H	-13.14	29.92	74.00	-44.08
2377.90	36.68	Ave	32	1.6	H	-13.14	23.54	54.00	-30.46
2489.08	43.88	PK	286	1.5	V	-13.08	30.80	74.00	-43.20
2489.08	37.88	Ave	286	1.5	V	-13.08	24.80	54.00	-29.20

Test Frequency: 18GHz~25GHz

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

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 C63.10:2013
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

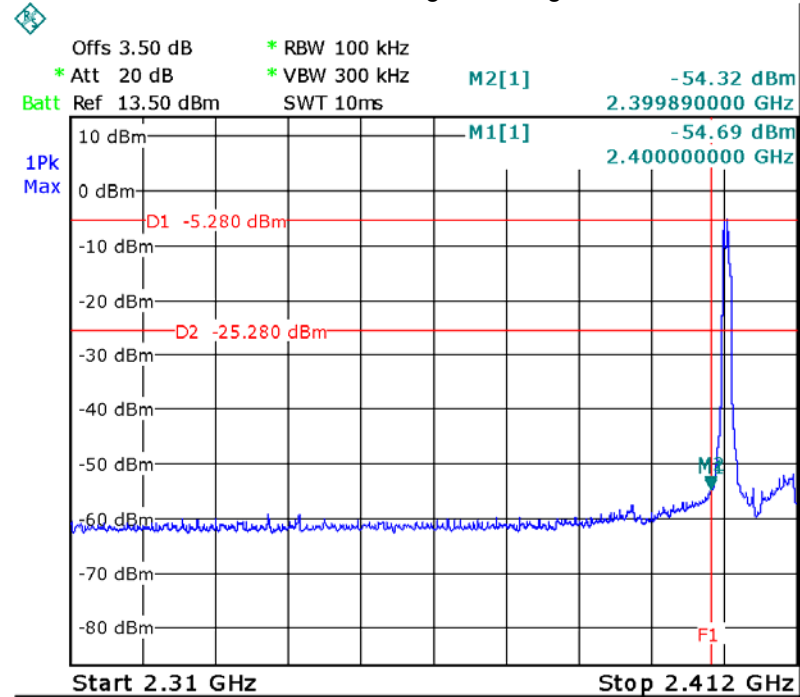
9.1 Test Procedure

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

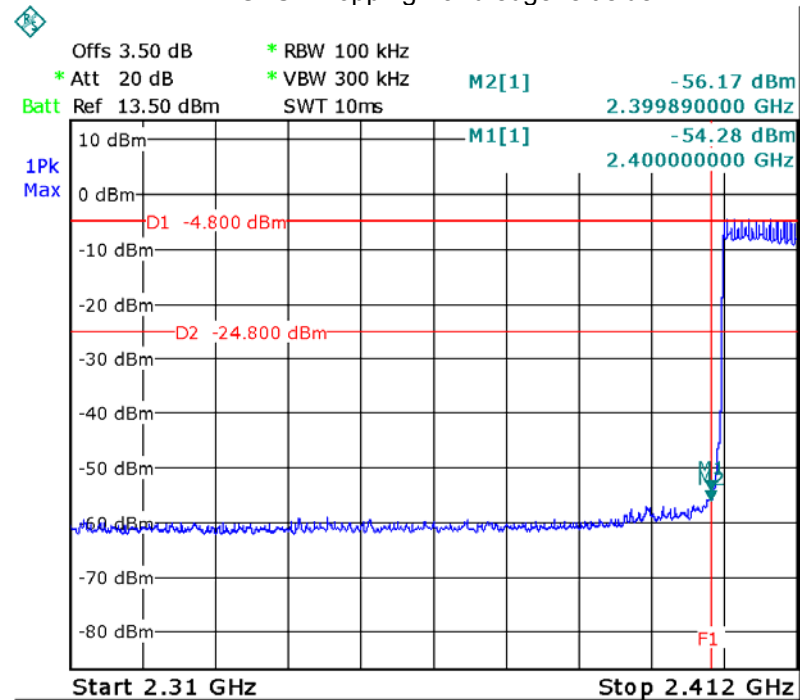
9.2 Test Result

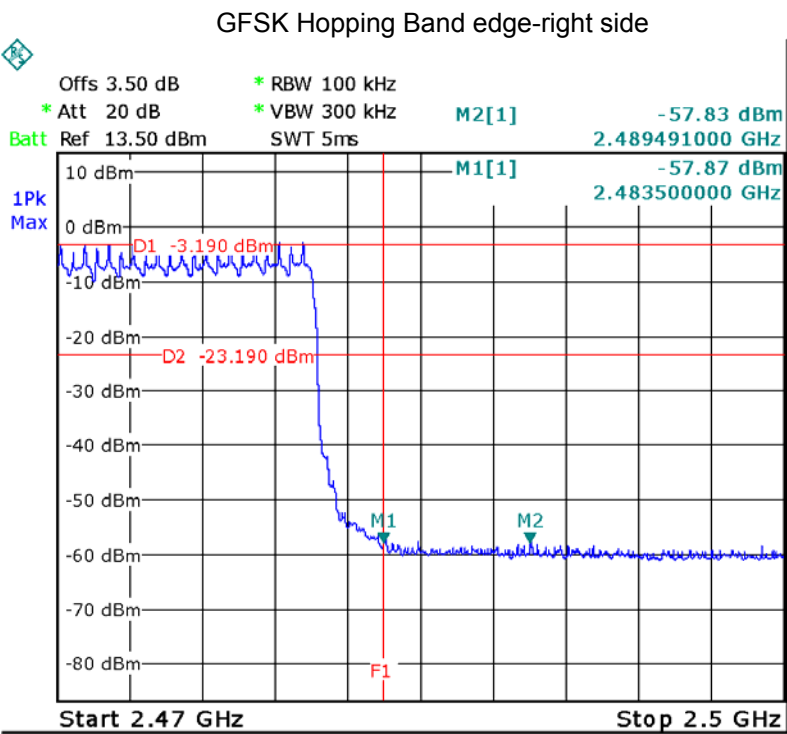
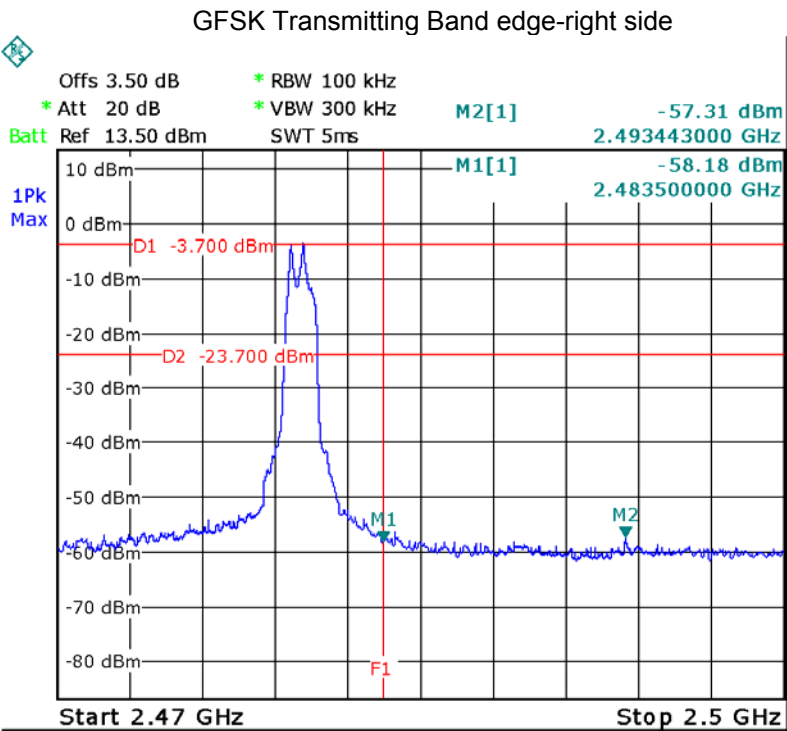
Test plots

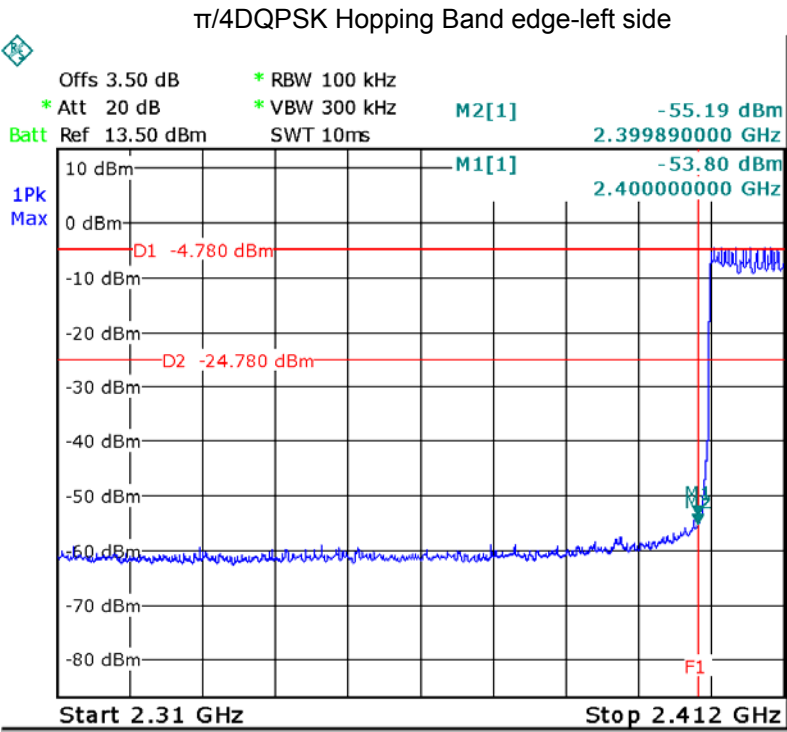
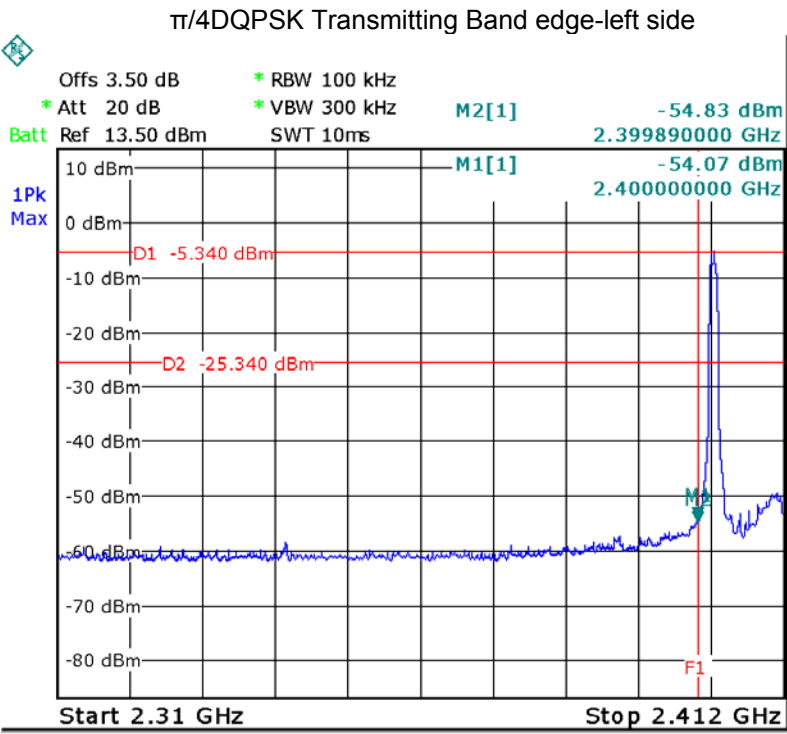
GFSK Transmitting Band edge-left side

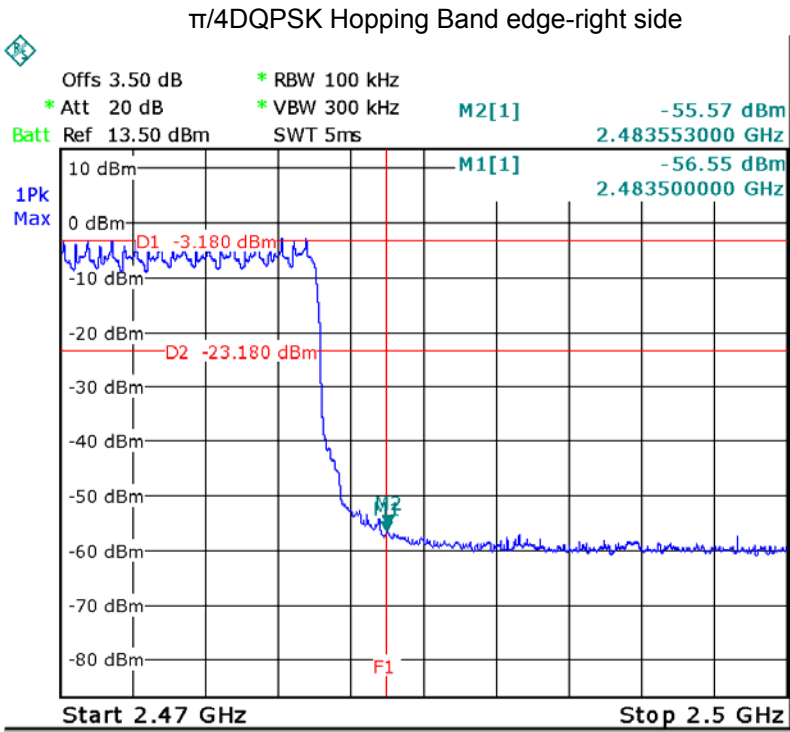
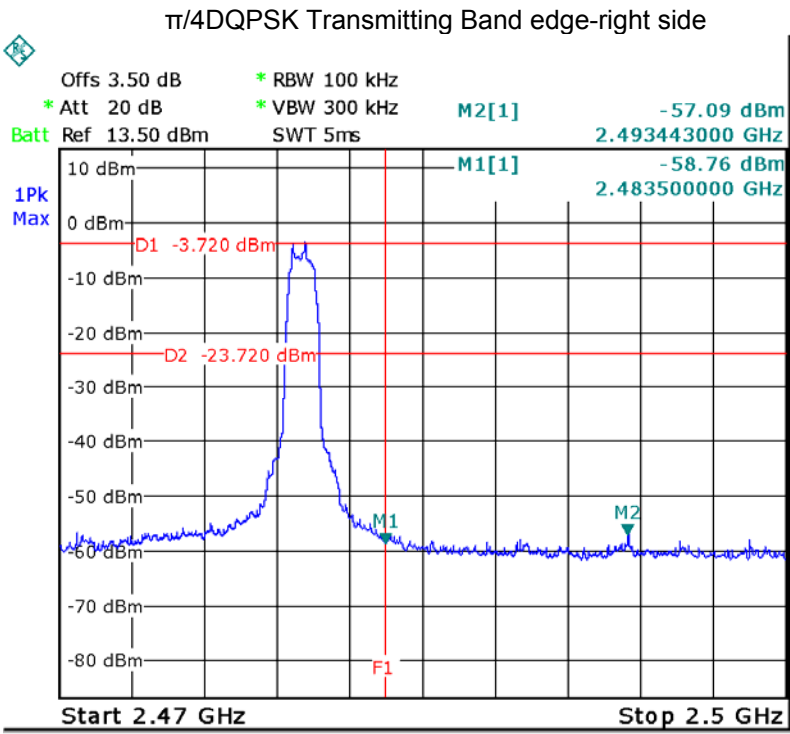


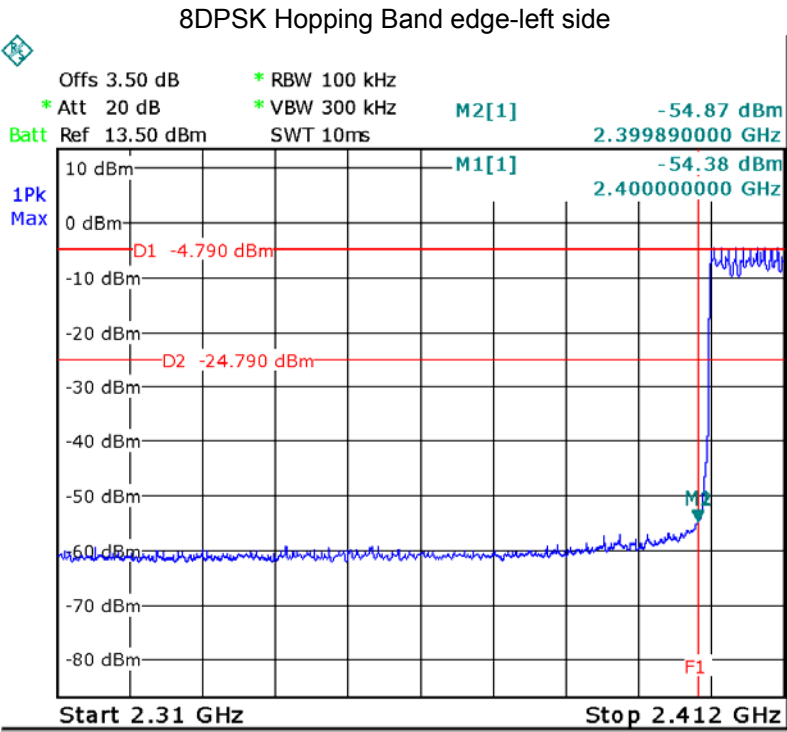
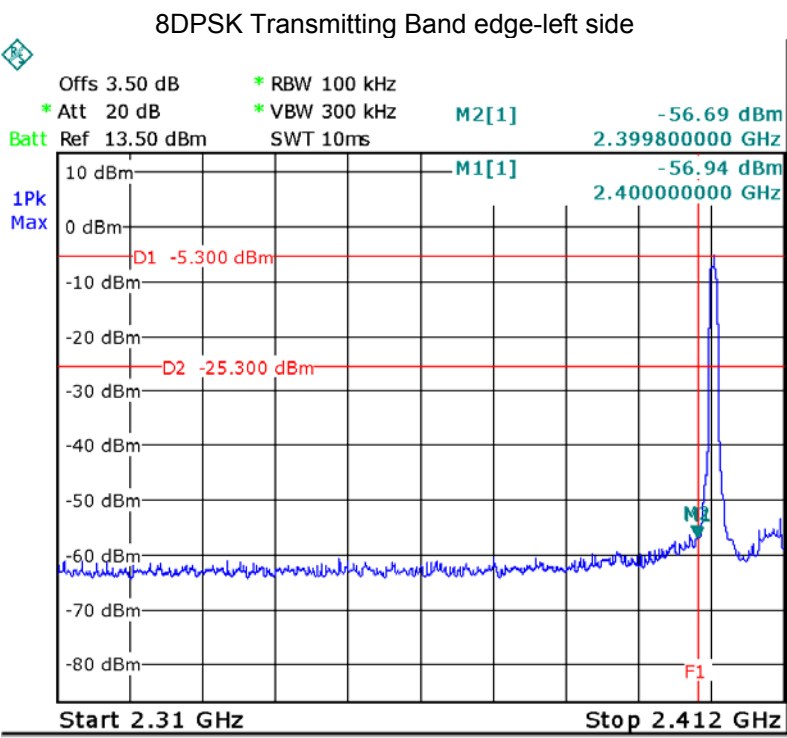
GFSK Hopping Band edge-left side

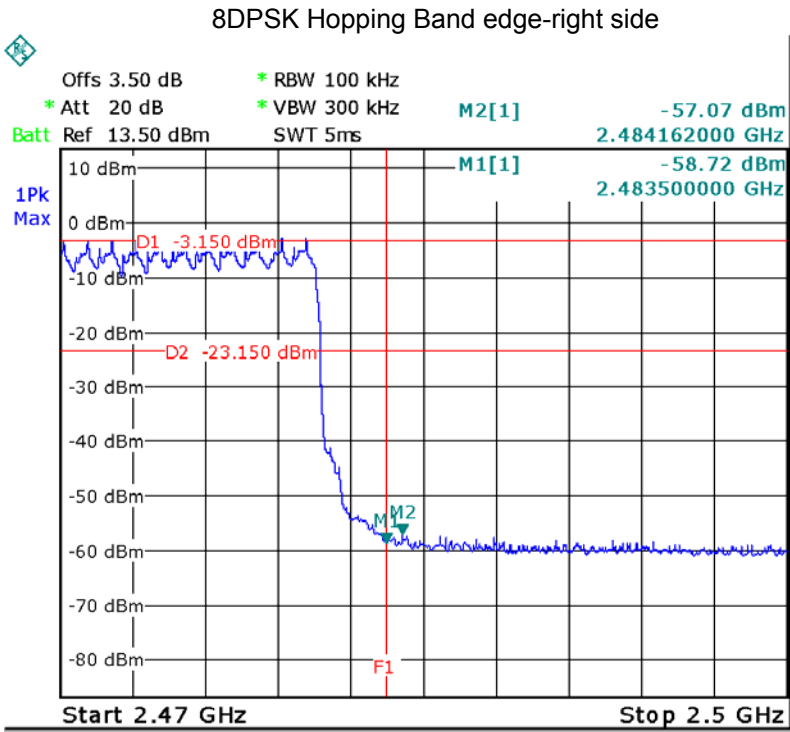
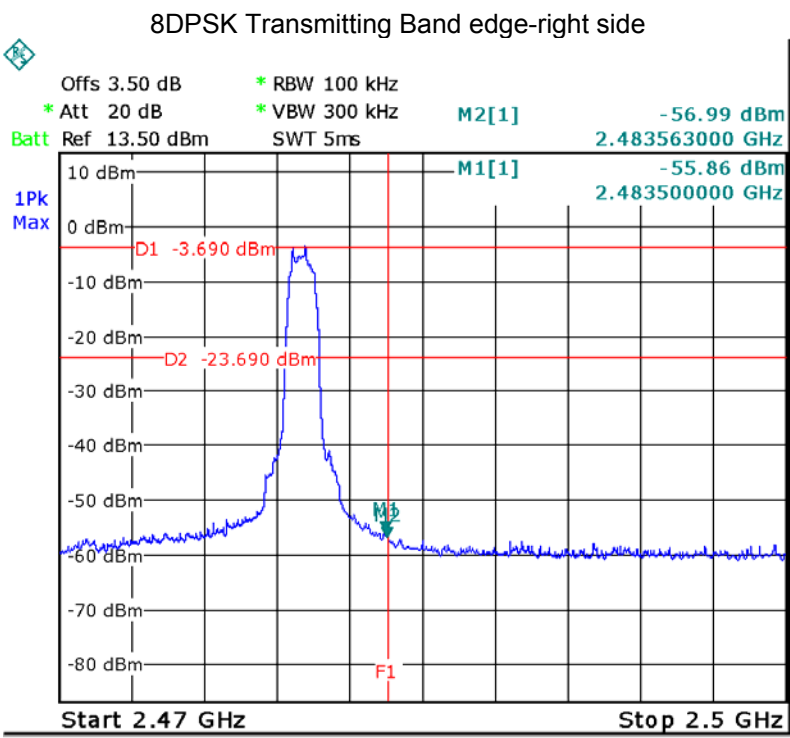












10 Bandwidth Measurement

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: ANSI C63.10:2013

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

10.1 Test Procedure

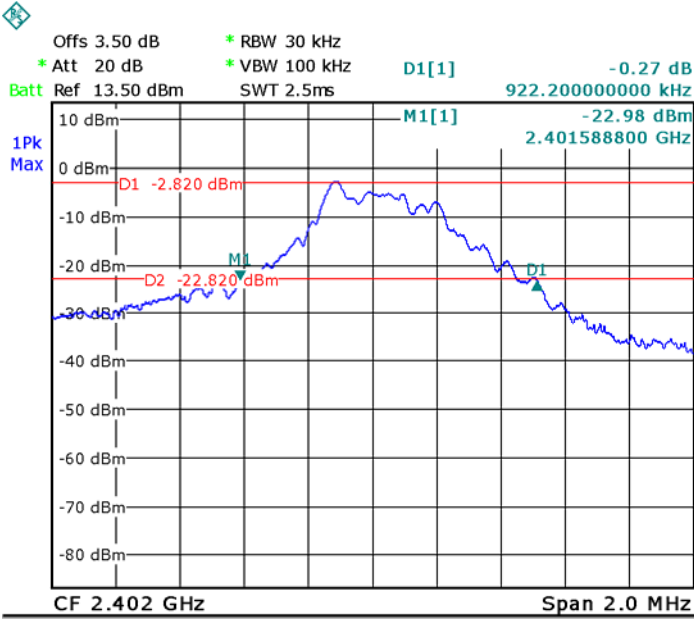
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 30kHz, VBW = 100kHz

10.2 Test Result

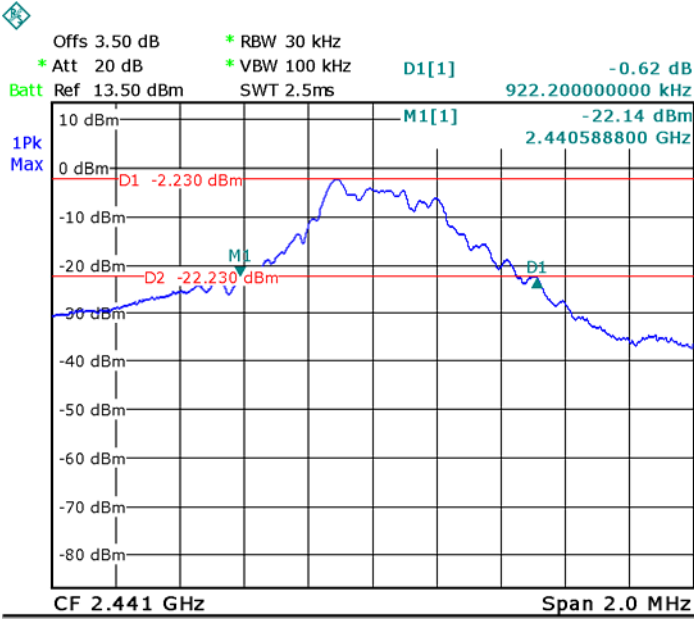
Modulation	Test Channel	20dB Bandwidth(MHz)
GFSK	Low	0.922
GFSK	Middle	0.922
GFSK	High	0.922
$\pi/4$ DQPSK	Low	1.190
$\pi/4$ DQPSK	Middle	1.190
$\pi/4$ DQPSK	High	1.190
8DPSK	Low	1.198
8DPSK	Middle	1.198
8DPSK	High	1.198

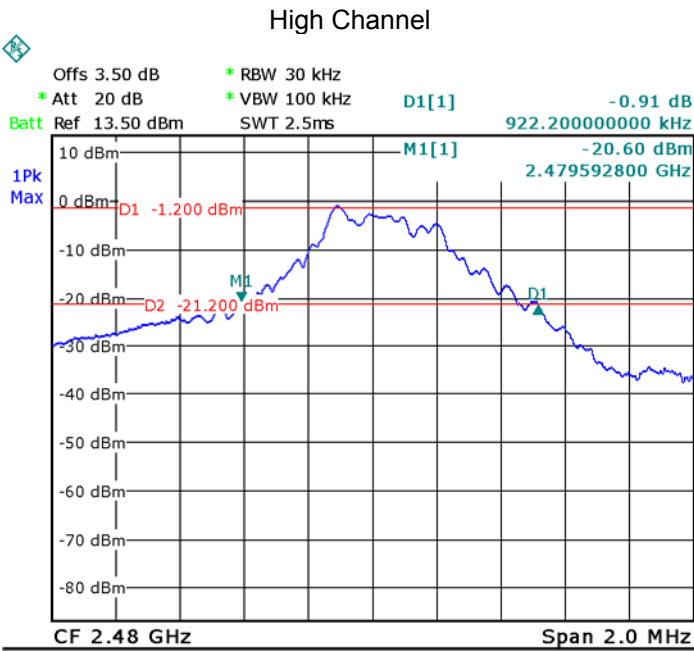
Test plots

GFSK Low Channel

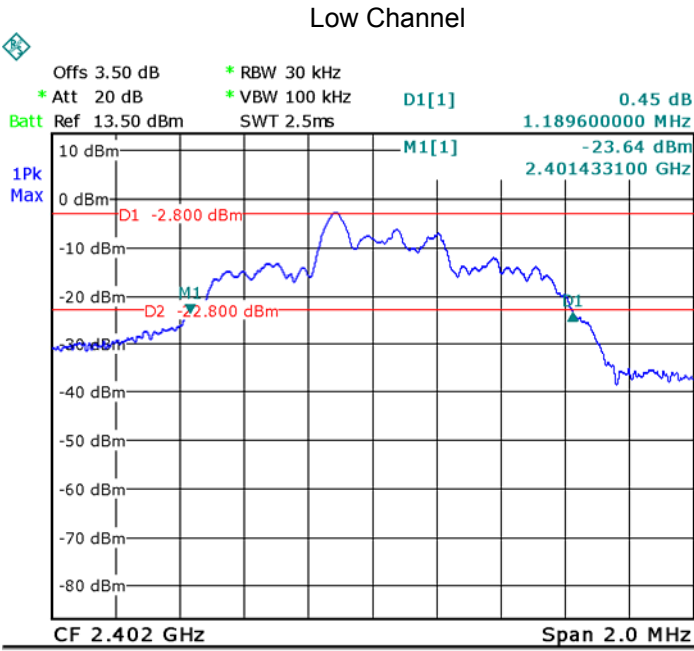


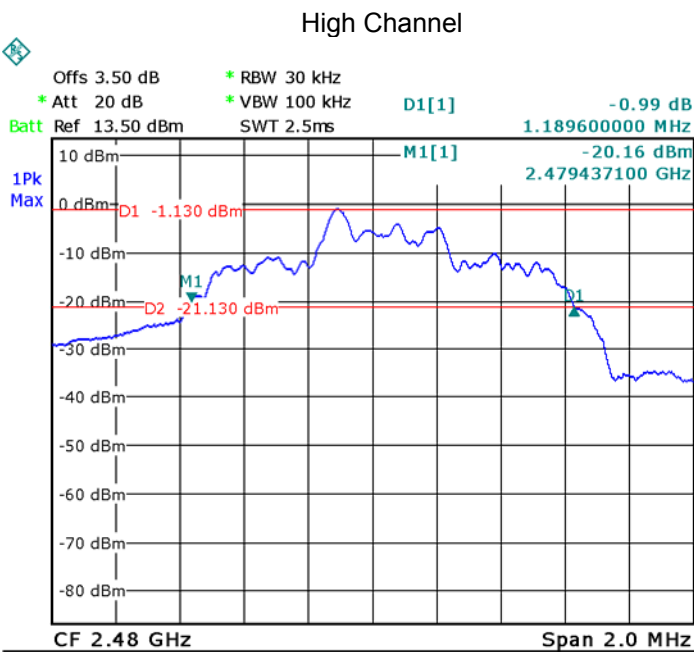
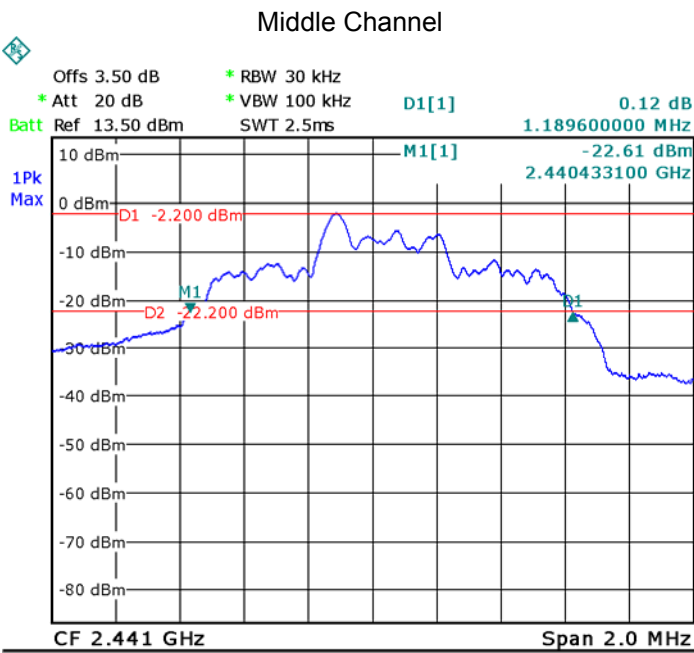
Middle Channel





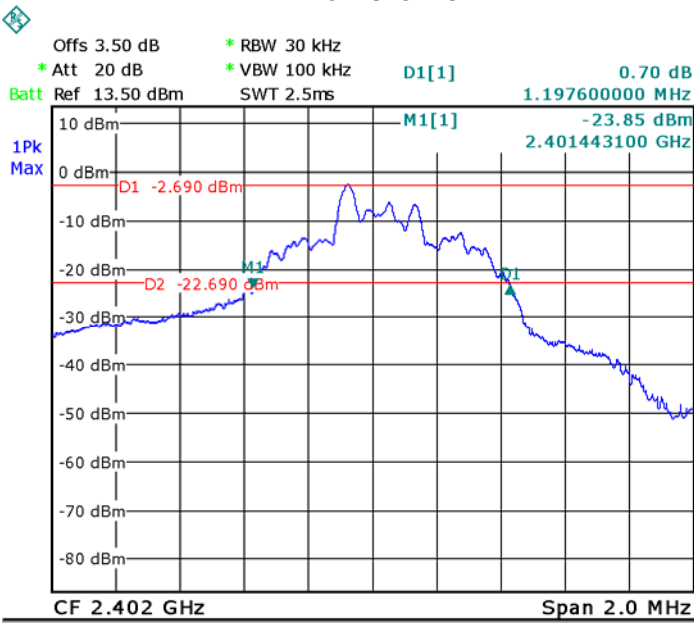
Modulation: $\pi/4$ DQPSK



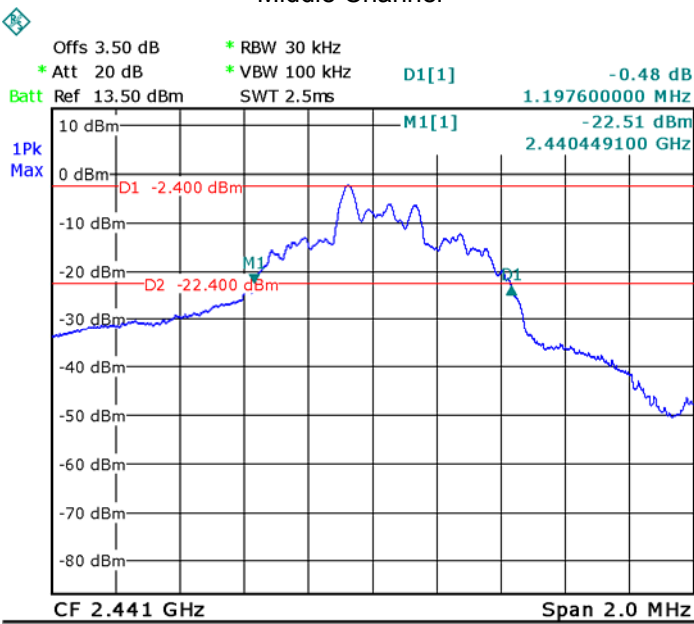


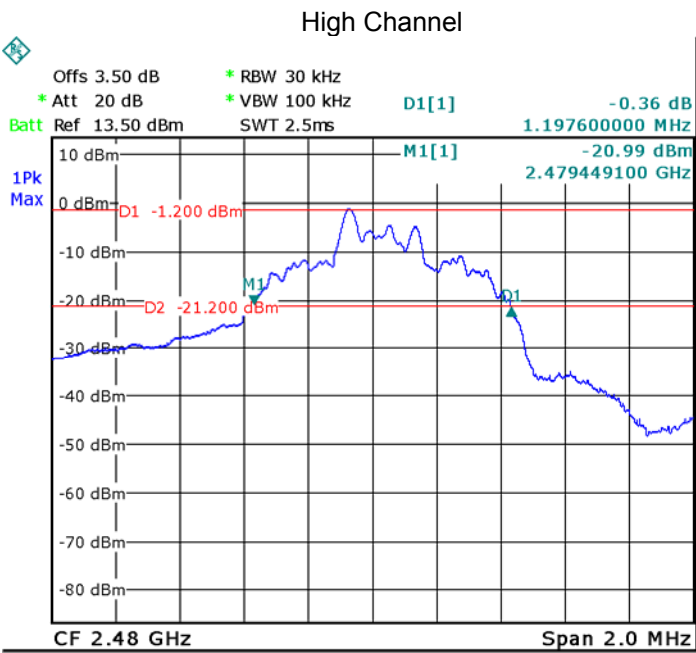
Modulation: 8DPSK

Low Channel



Middle Channel





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 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.
Test mode:	Test in fixing frequency transmitting mode.

11.1 Test Procedure

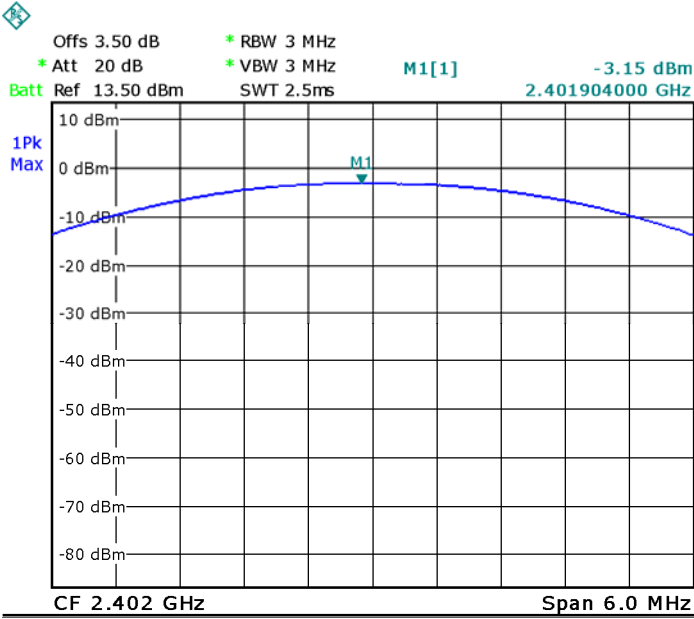
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3MHz. VBW = 3MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

11.2 Test Result

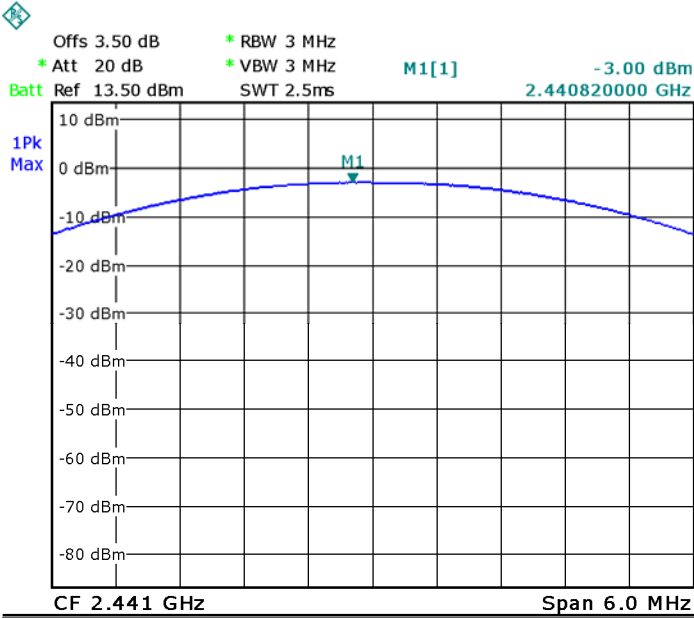
Modulation	Test Channel	Output Power (dBm)	Limit (dBm)
GFSK	Low	-3.15	30
GFSK	Middle	-3.00	30
GFSK	High	-1.50	30
$\pi/4$ DQPSK	Low	-2.75	21
$\pi/4$ DQPSK	Middle	-2.59	21
$\pi/4$ DQPSK	High	-1.08	21
8DPSK	Low	-2.74	21
8DPSK	Middle	-2.61	21
8DPSK	High	-1.09	21

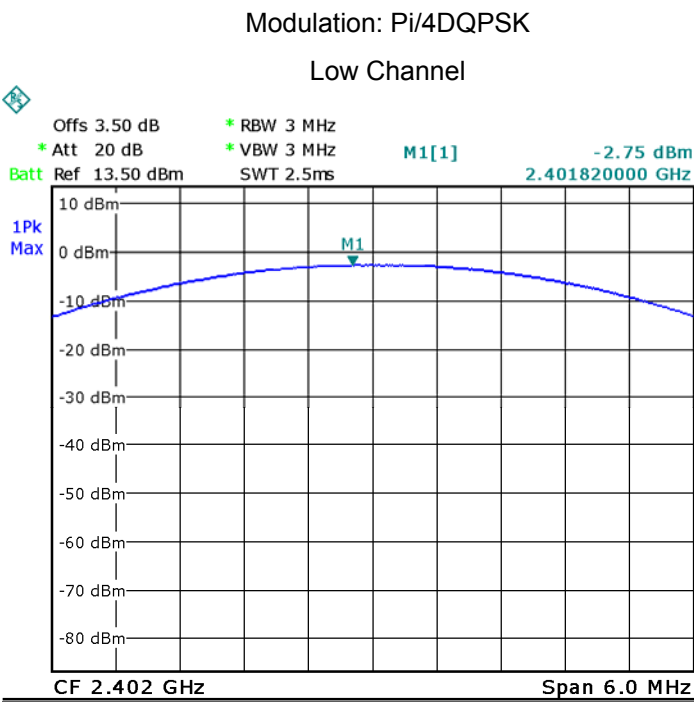
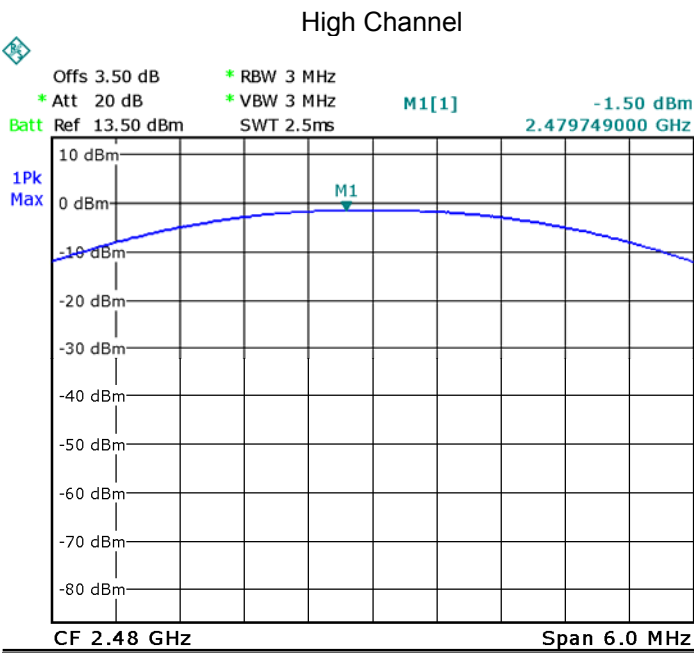
Test plots

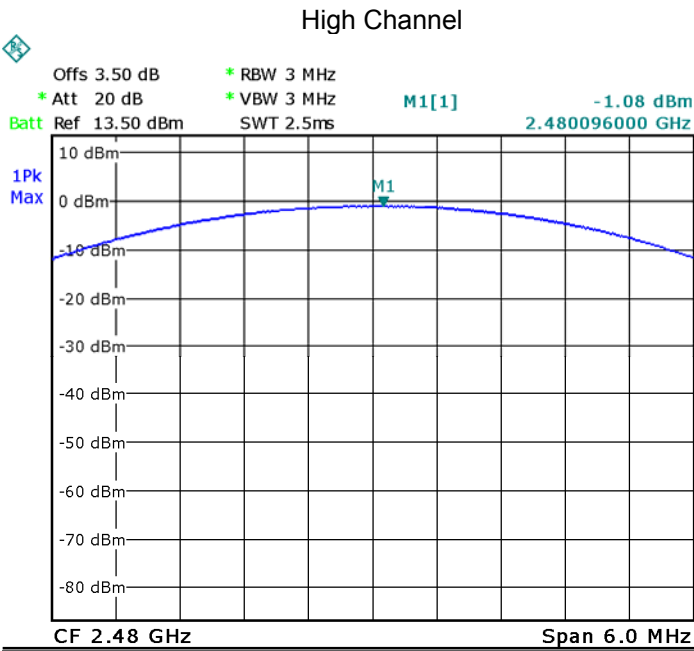
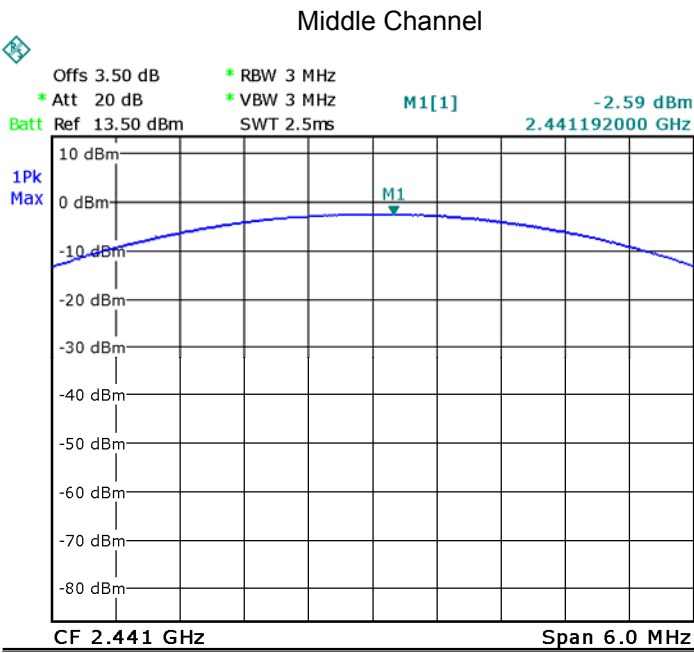
GFSK Low Channel



Middle Channel

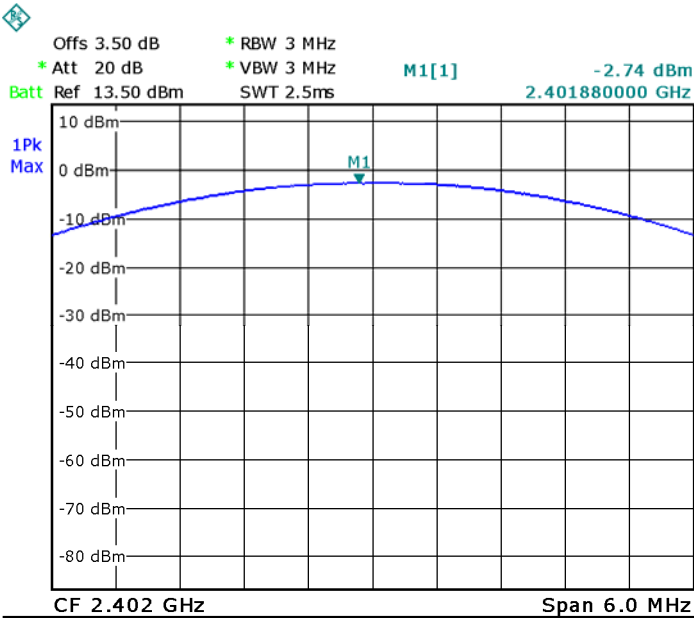




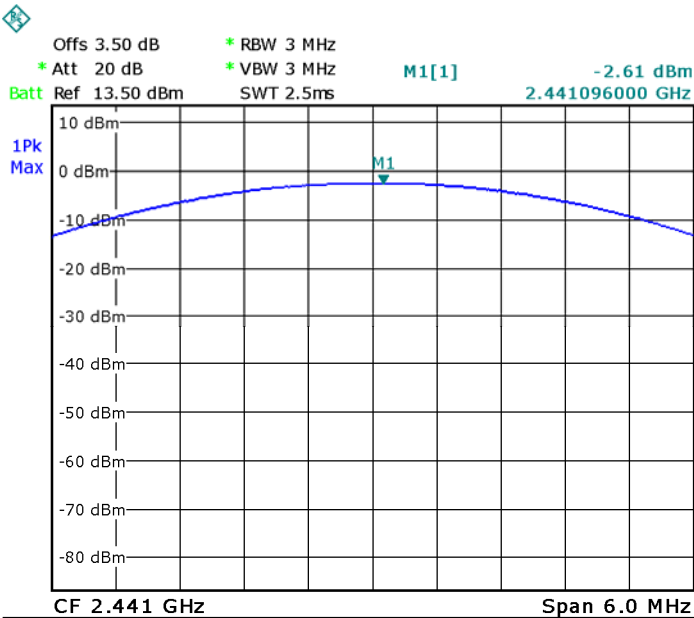


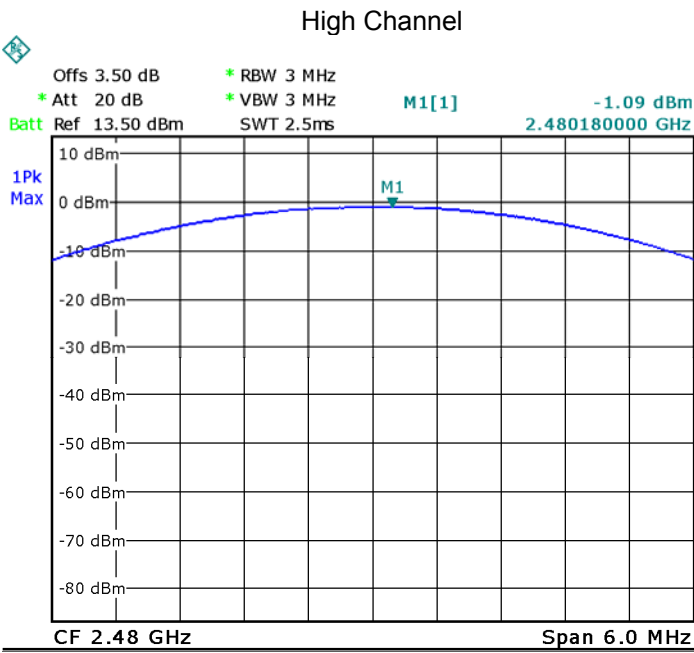
Modulation: 8DPSK

Low Channel



Middle Channel





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 2400-2483.5 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 0.125W.
Test Mode:	Test in hopping transmitting operating mode.

12.1 Test Procedure

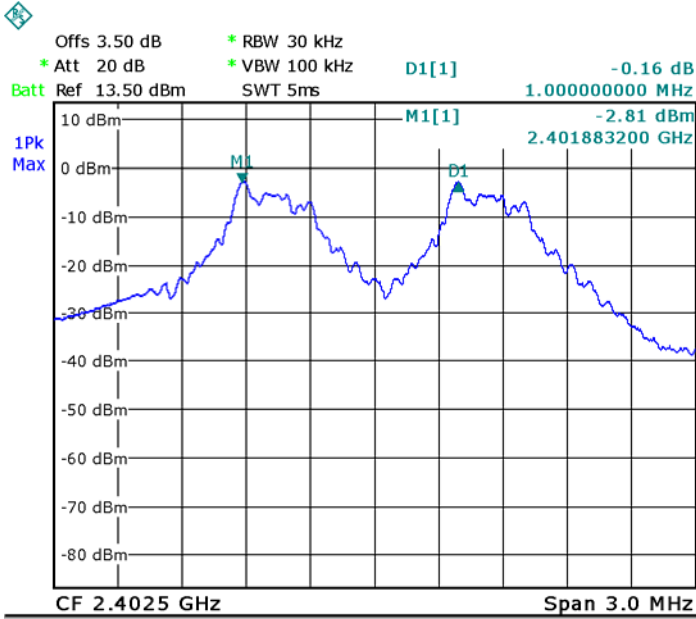
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 30kHz. VBW = 100kHz , Span = 3.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

12.2 Test Result

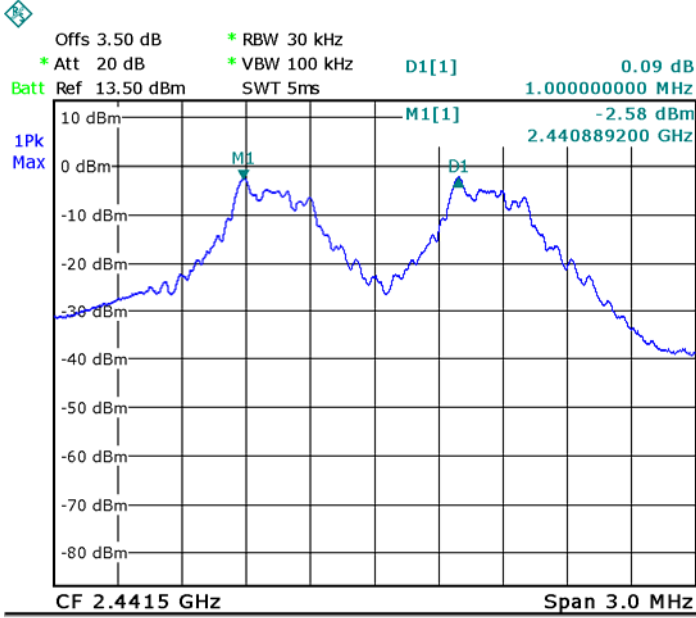
Modulation	Test Channel	Separation (MHz)	Result
GFSK	Low	1.000	PASS
GFSK	Middle	1.000	PASS
GFSK	High	1.000	PASS
$\pi/4$ DQPSK	Low	1.000	PASS
$\pi/4$ DQPSK	Middle	1.000	PASS
$\pi/4$ DQPSK	High	1.000	PASS
8DPSK	Low	1.000	PASS
8DPSK	Middle	1.000	PASS
8DPSK	High	1.000	PASS

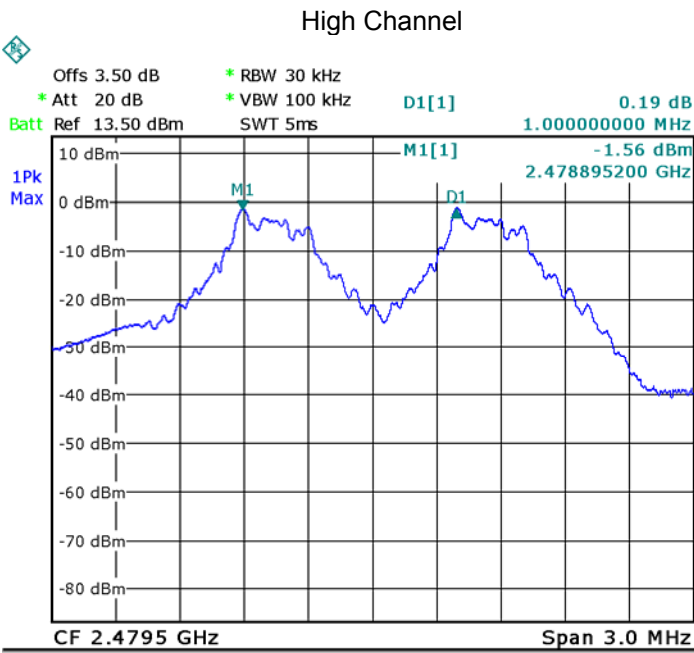
Test plots

GFSK Low Channel

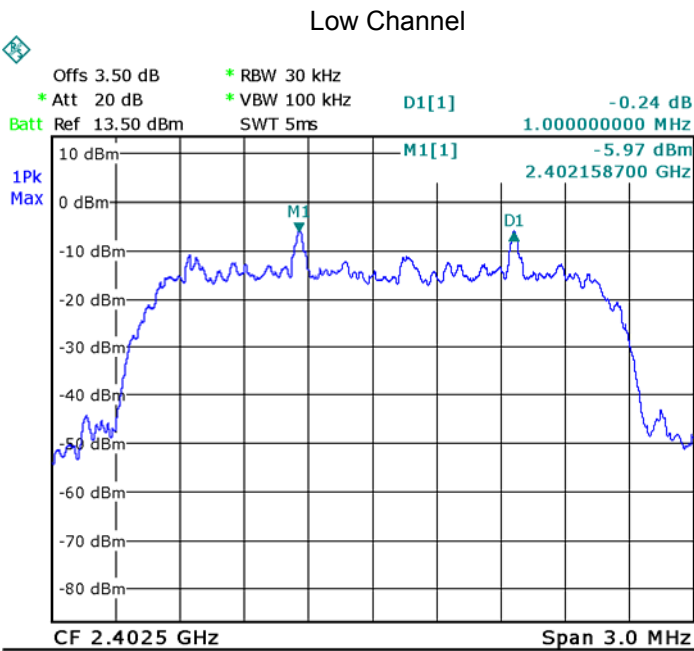


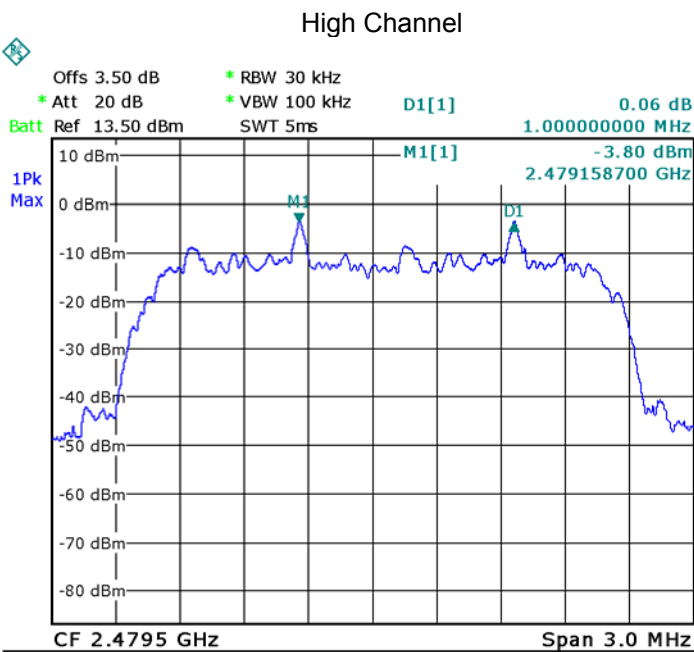
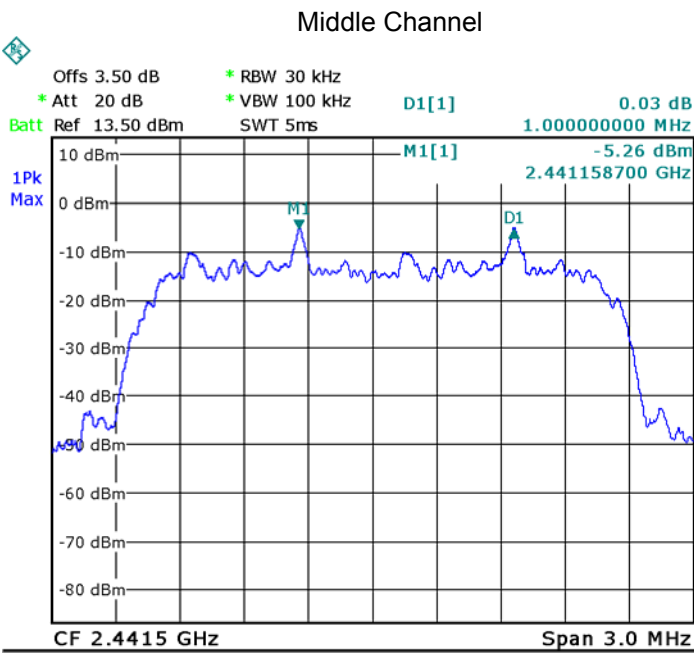
Middle Channel





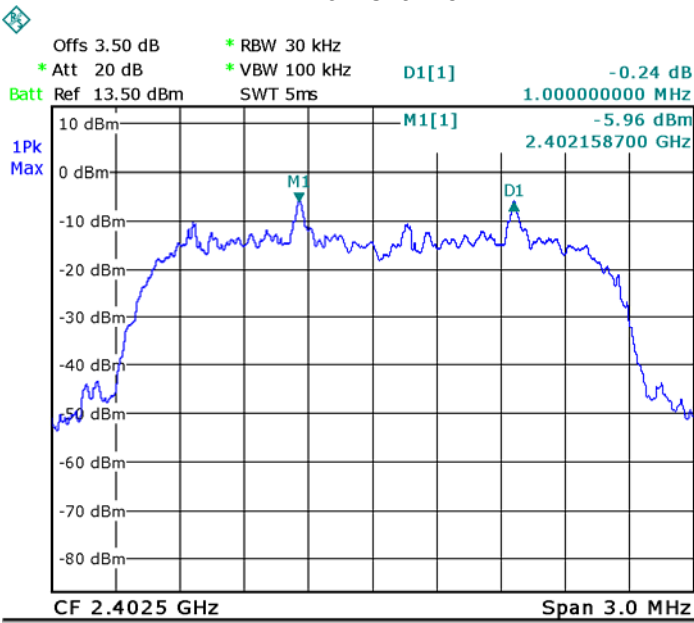
Modulation: $\pi/4$ DQPSK



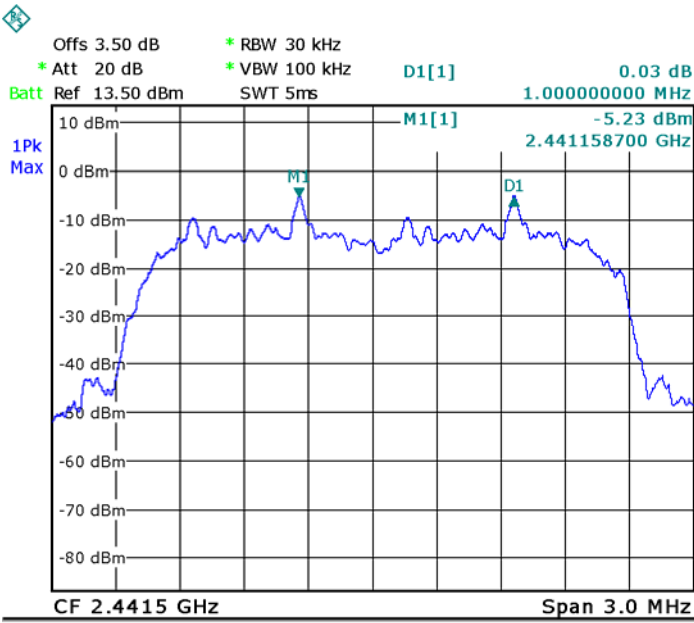


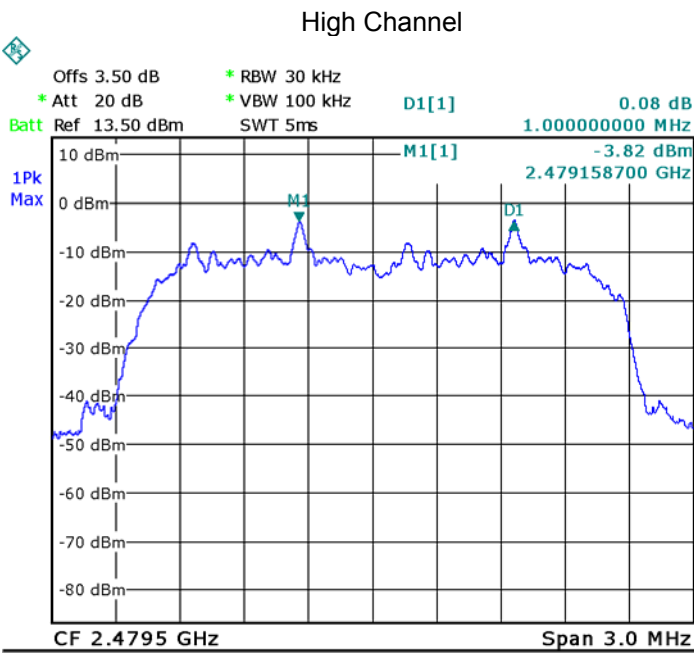
Modulation: 8DPSK

Low Channel



Middle Channel





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:	Test in hopping transmitting operating mode.

13.1 Test Procedure

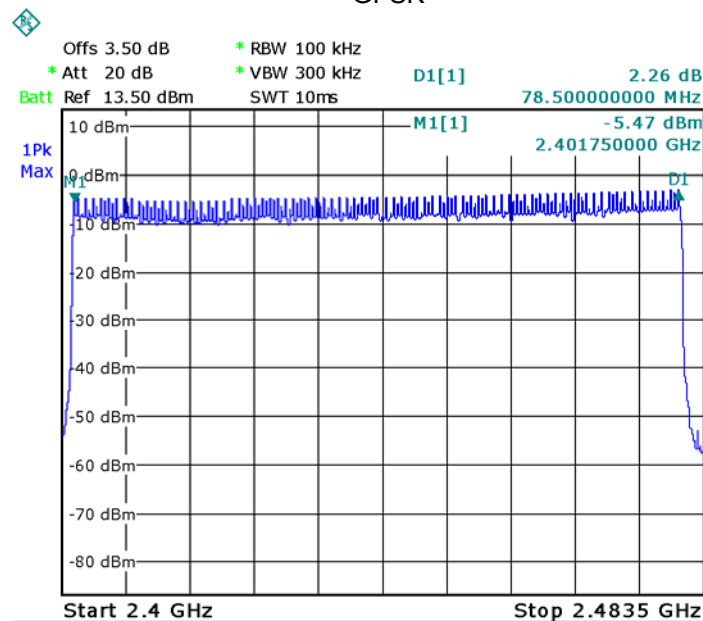
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100 KHz. VBW = 300 KHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up 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 = 2.483GHz. Sweep=auto;

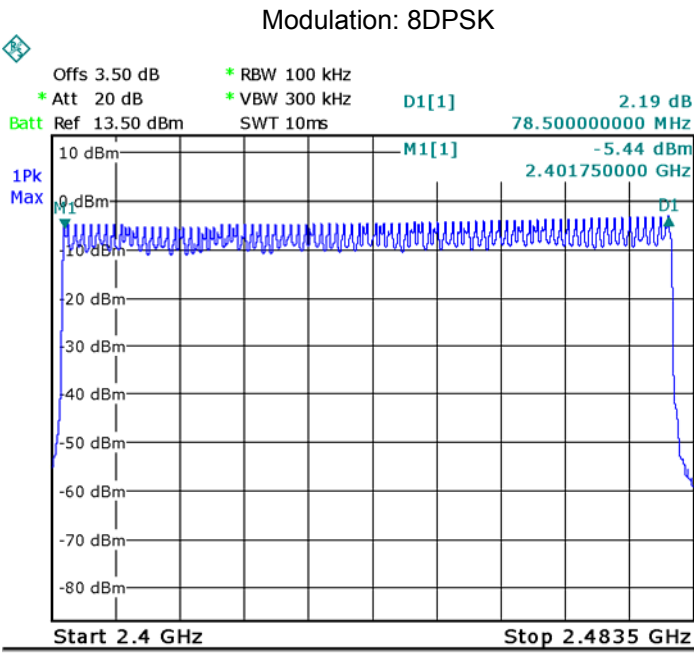
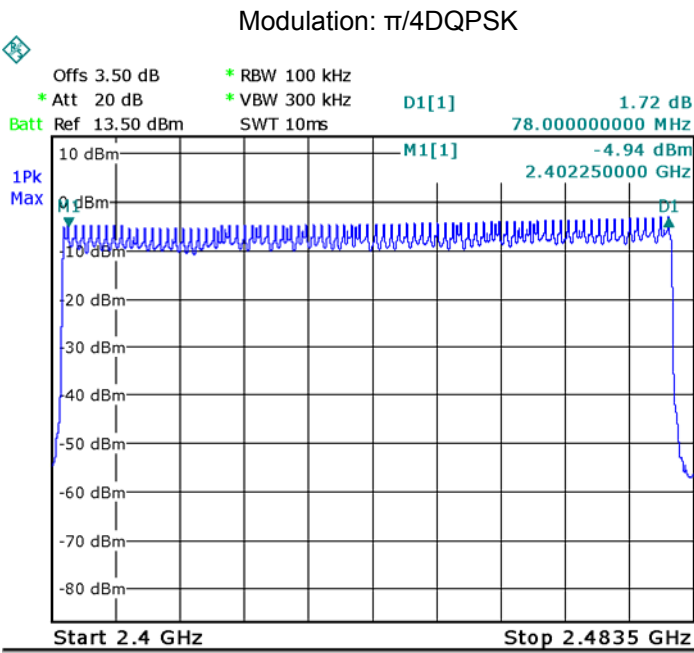
13.2 Test Result

Test Plots:

79 Channels in total

GFSK





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. 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. Set the EUT for DH5, DH3 and DH1 packet transmitting.
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

14.2 Test Result

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).

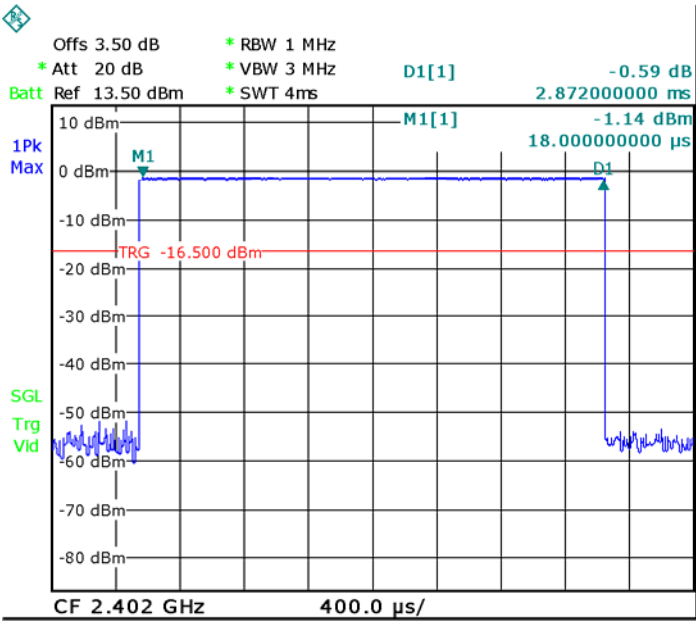
DH1 Packet permit maximum $1600 / 79 / 2$ hops per second in each channel (1 time slot RX, 1 time slot TX). So, the Dwell Time can be calculated as follows:

Data Packet	Dwell Time(s)
DH5	$1600/79/6*0.4*79*(MkrDelta)/1000$
DH3	$1600/79/4*0.4*79*(MkrDelta)/1000$
DH1	$1600/79/2*0.4*79*(MkrDelta)/1000$
Remark: Mkr Delta is once pulse time.	

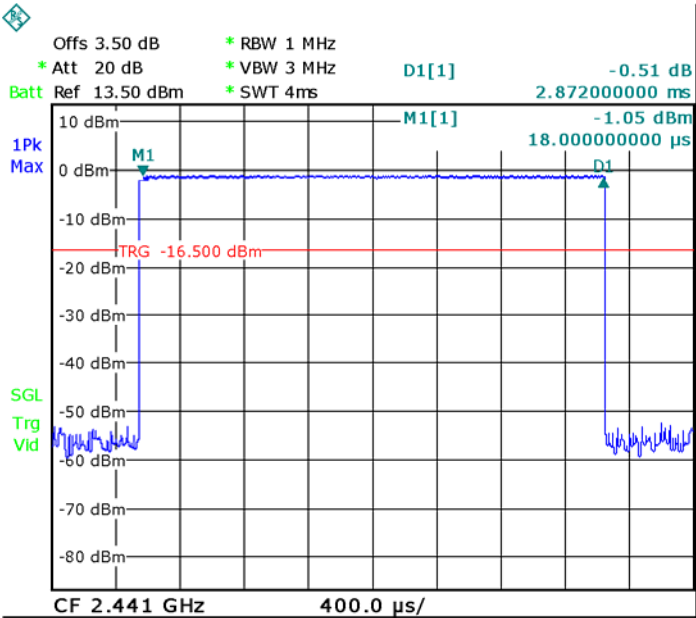
Modulation	Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
GFSK	DH5	Low	2.872	0.306	0.4
		middle	2.872	0.306	0.4
		High	2.872	0.306	0.4
$\pi/4$ DQPSK	DH5	Low	2.872	0.306	0.4
		middle	2.872	0.306	0.4
		High	2.872	0.306	0.4
8DPSK	DH5	Low	2.872	0.306	0.4
		middle	2.872	0.306	0.4
		High	2.872	0.306	0.4

Remark: Only the worst-case is recorded.

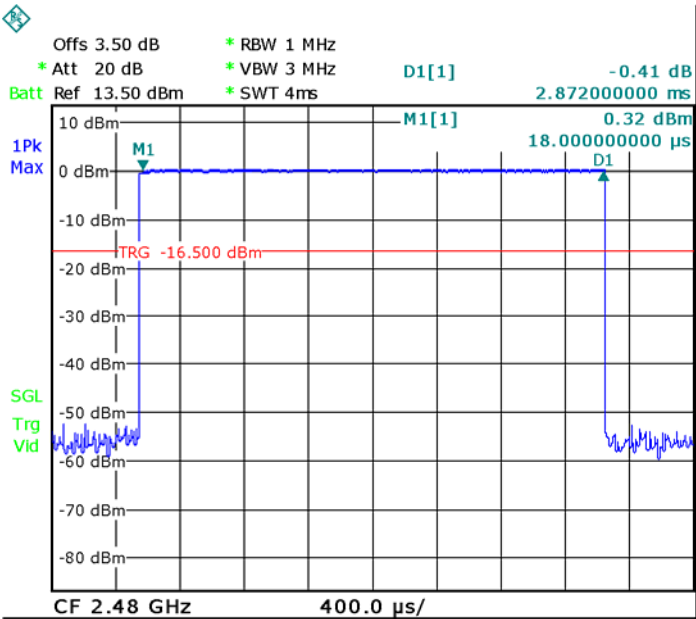
Test Plots
GFSK DH5 Low Channel



Data Packet:
DH5.Middle channel



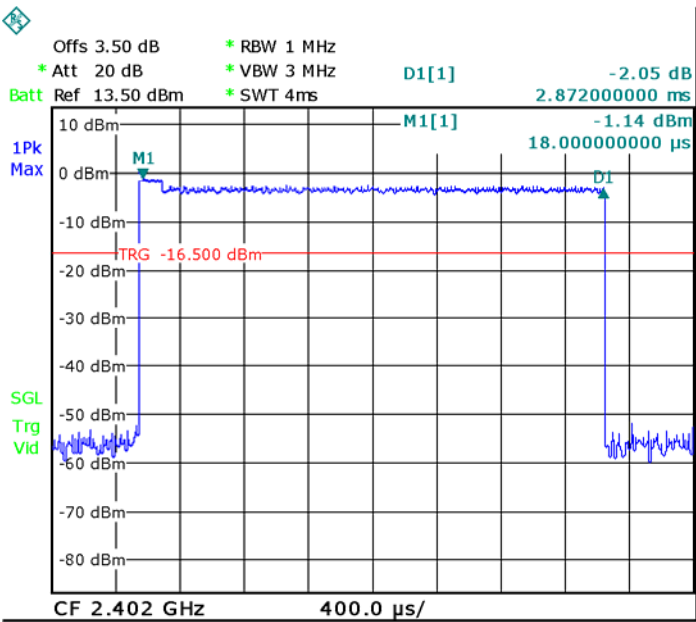
Data Packet:
DH5, High channel



$\pi/4$ DQPSK

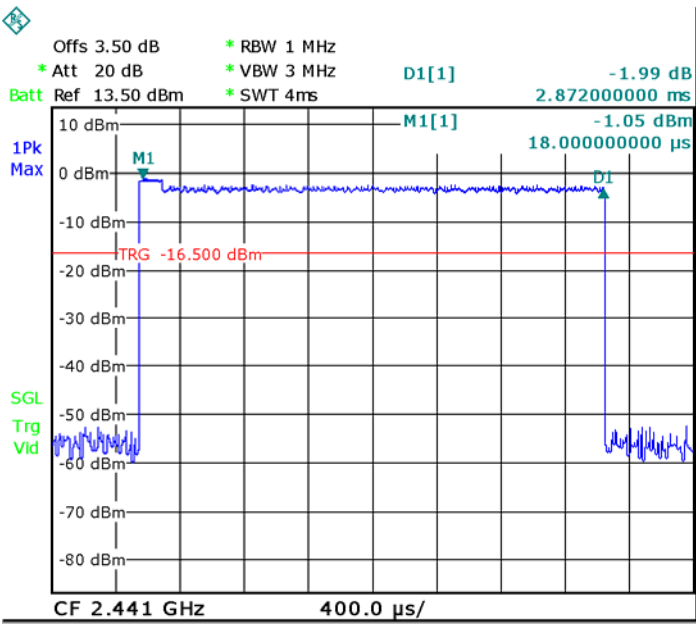
Data Packet:

DH5, Low channel

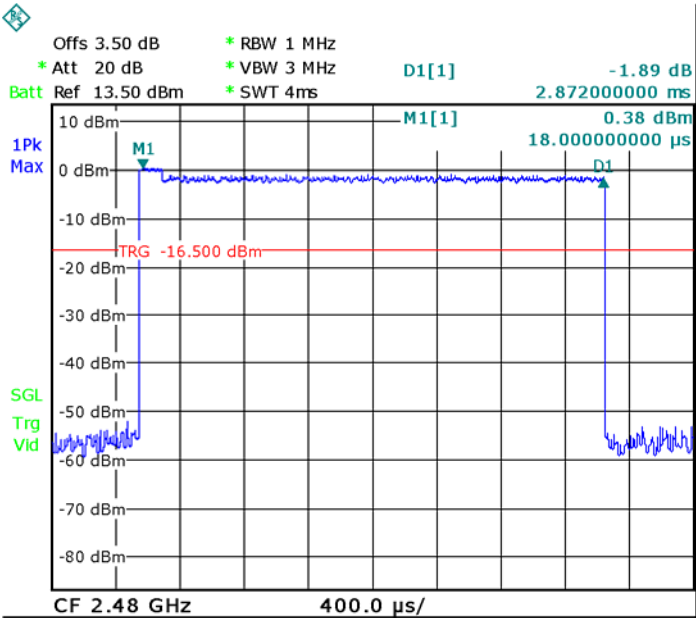


Data Packet:

DH5, Middle channel

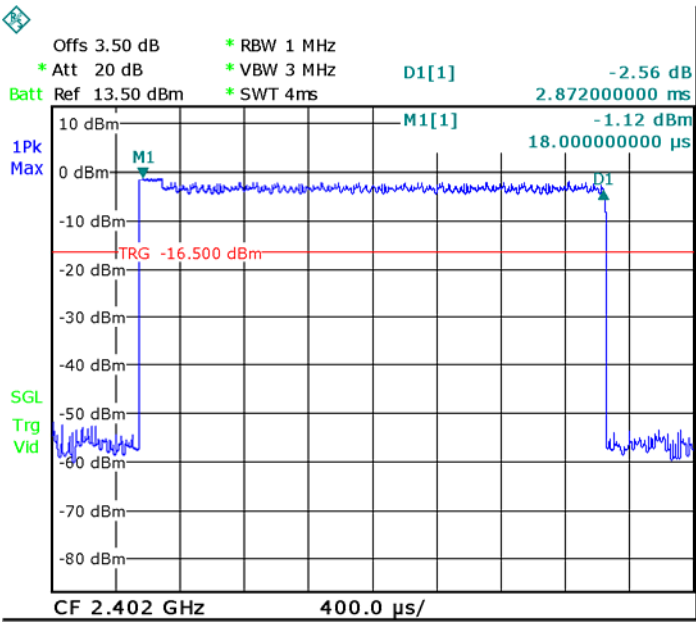


Data Packet:
DH5, High channel

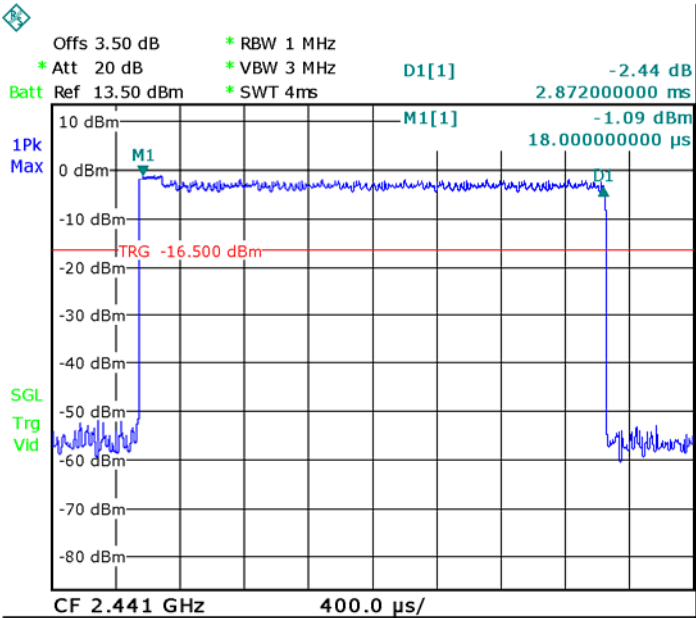


8DPSK

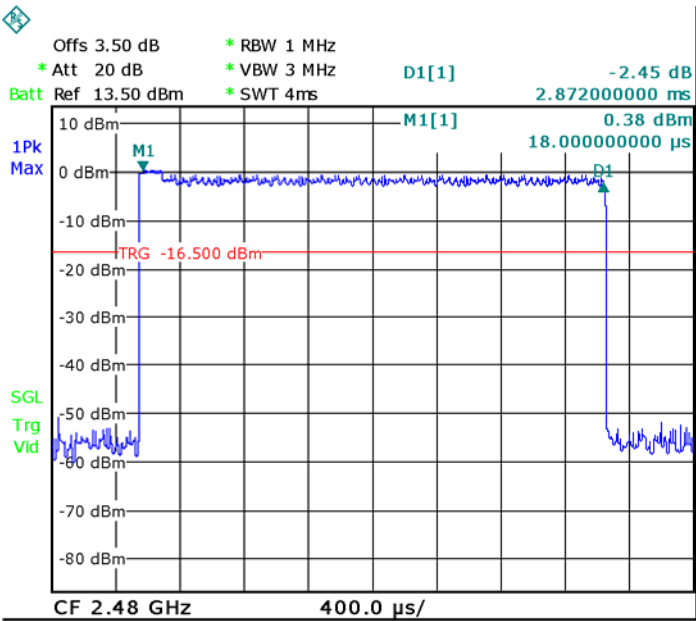
Data Packet:
DH5, Low channel



Data Packet:
DH5, Middle channel



Data Packet:
DH5, High channel



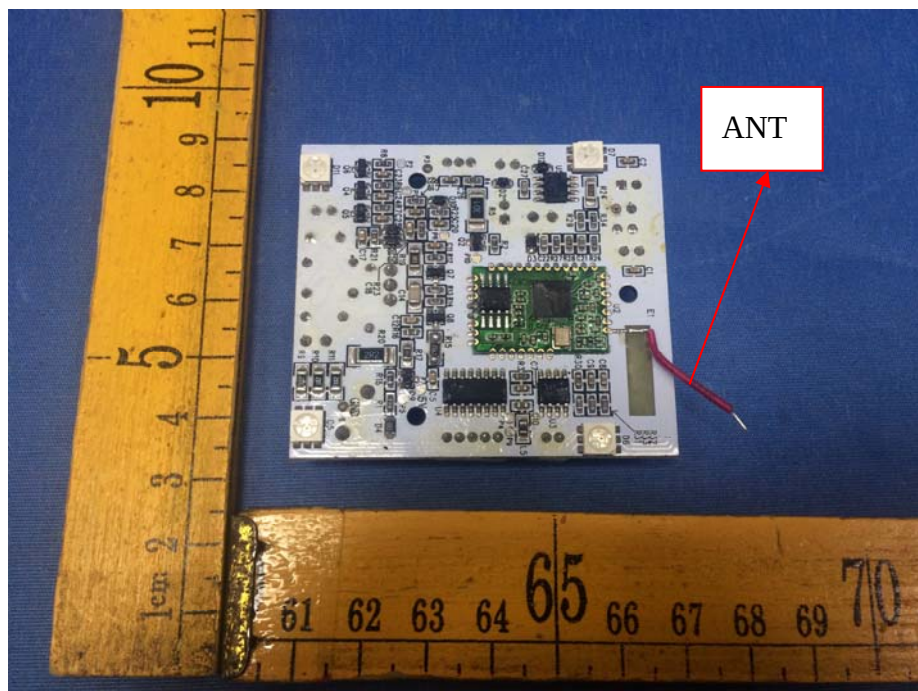
15 Antenna Requirement

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 internal permanent wire antenna, the gain is 0dBi. meets the requirements of FCC 15.203.



16 Photographs-Model X029A Test Setup Photos

Note: Please refer to Photos: WTS17S0989404-2E.

17 Photographs - Constructional Details

17.1 Model X029A – External Photos

Note: Please refer to Photos: WTS17S0989404-2E.

17.2 Model X029A – Internal Photos

Note: Please refer to Photos: WTS17S0989404-2E.

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