TEST REPORT

Reference No.	:	WTD18S01100425-1E
FCC ID	:	2AA3H-ESB2118
Applicant	:	Shenzhen 3nod Digital Technology Co., Ltd.
Address	:	Bld D, No.8 Langhui Road, Tangxiayong Community, Songgang Street, Baoan District, Shenzhen, China
Manufacturer	:	Shenzhen 3nod Digital Technology Co., Ltd.
Address	:	Bld D, No.8 Langhui Road, Tangxiayong Community, Songgang Street, Baoan District, Shenzhen, China
Product	:	Element 2.1 Sound Bar With Wireless Subwoofer
Model(s)	:	ESB2118
Brand Name	:	element
Standards	:	FCC CFR47 Part 15 Section 15.247:2017
Date of Receipt sample	:	2018-01-12
Date of Test	:	2018-01-13 to 2018-04-03
Date of Issue	:	2018-04-04
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 (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. Electro Magnetic 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

3 Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTD18S01100425-1E	2018-01-12	2018-01-13 to 2018-04-03	2018-04-04	original	-	Valid

4 General Information

4.1 General Description of E.U.T.

Product:	Element 2.1 Sound Bar With Wireless Subwoofer
Model(s):	ESB2118
Operation Frequency:	2402-2480MHz, 79(EDR) Channels in total
Type of Modulation:	GFSK, π/4DQPSK, 8DPSK
Antenna Gain:	0 dBi
Antenna installation:	Internal Integral Antenna

4.2 Details of E.U.T.

Ratings:	Power Supply: 20V ⎓ 2A from SWITCHING ADAPTER (SWITCHING ADAPTER INPUT: 100-240V~50/60Hz, 1.2A, Model: ASSA79A-200200)

4.3 Channel List

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	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	-	-

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

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**

					Calibration Date	Due Date
1	Spectrum Analyzer (9k-6GHz)	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	± 1 x 10^{-6}
RF Power	± 1.0 dB
RF Power Density	± 2.2 dB
Radiated Spurious Emissions test	± 5.03 dB (Bilog antenna 30M~1000MHz)
	± 5.47 dB (Horn antenna 1000M~25000MHz)
Conducted 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
Conducted Emissions	15.207(a)	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
Antenna Requirement	15.203	PASS
RF Exposure	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: 25.5 °C

Humidity: 51 % RH

Atmospheric Pressure: 101.2kPa

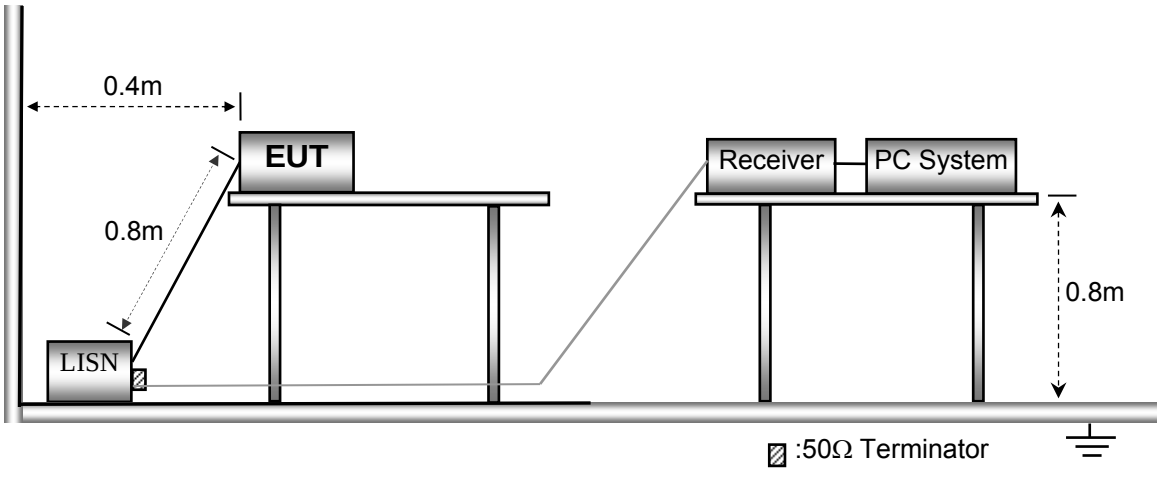
Test Voltage: AC 120V, 60Hz

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.



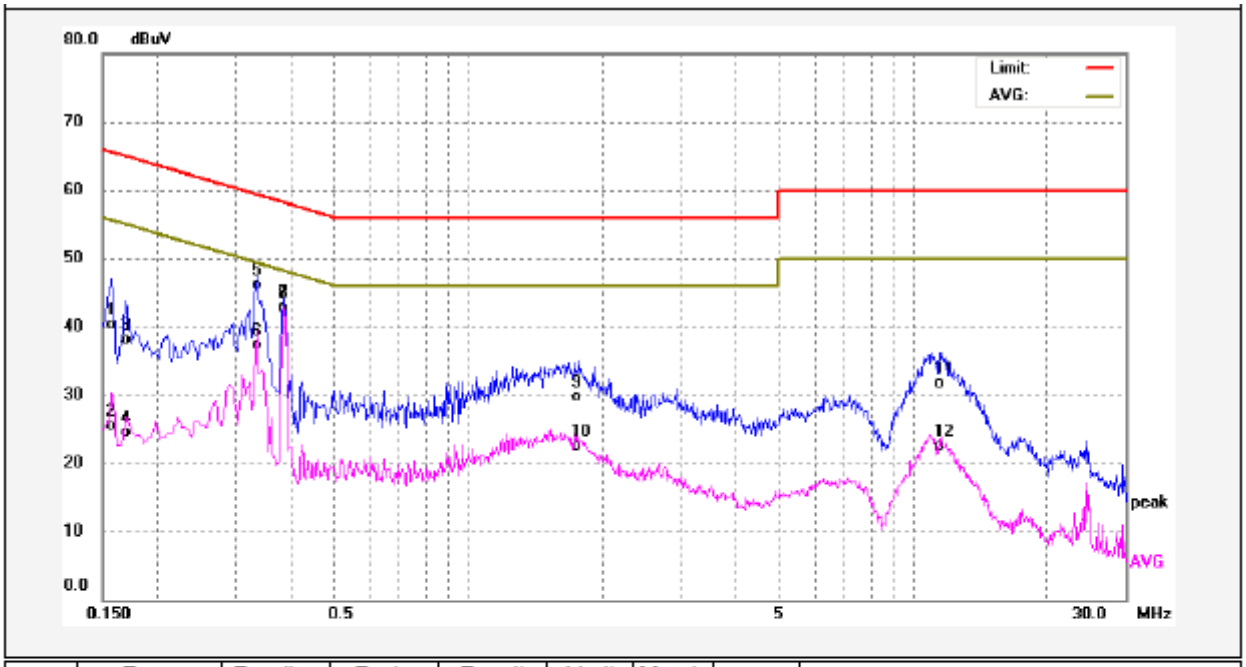
7.3 Measurement Description

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

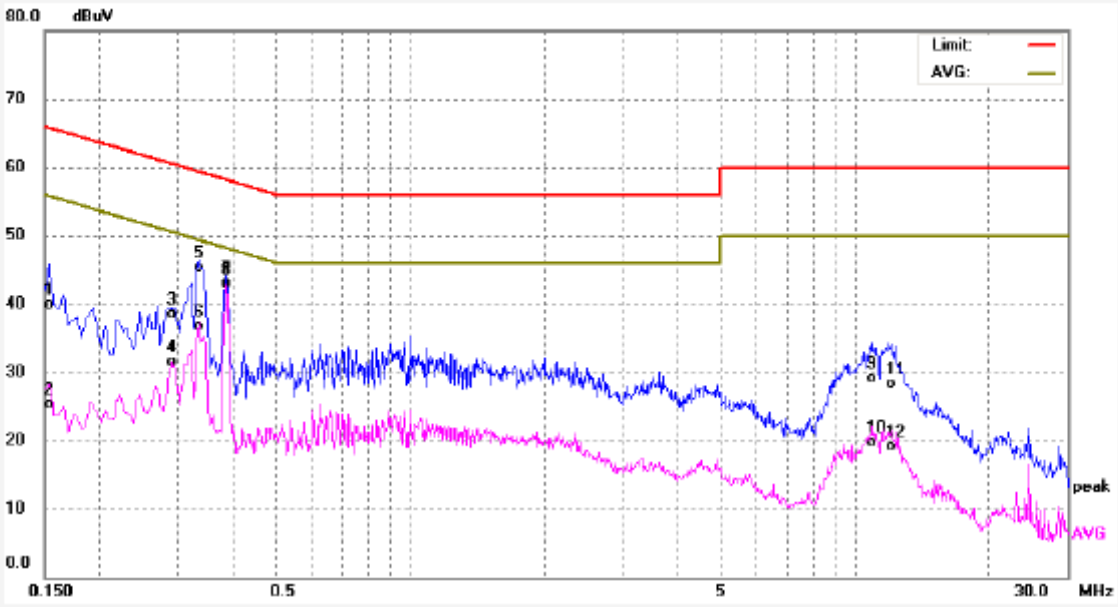
Remark: only the worst data (GFSK modulation Low channel mode) were reported

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1580	30.37	9.98	40.35	65.56	-25.21	QP	
2	0.1580	15.57	9.98	25.55	55.56	-30.01	AVG	
3	0.1700	28.22	9.86	38.08	64.96	-26.88	QP	
4	0.1700	14.68	9.86	24.54	54.96	-30.42	AVG	
5	0.3339	35.98	10.03	46.01	59.35	-13.34	QP	
6	0.3339	27.21	10.03	37.24	49.35	-12.11	AVG	
7	0.3820	32.92	10.04	42.96	58.23	-15.27	QP	
8	0.3820	32.62	10.04	42.66	48.23	-5.57	AVG	
9	1.7660	19.46	10.18	29.64	56.00	-26.36	QP	
10	1.7660	12.35	10.18	22.53	46.00	-23.47	AVG	
11	11.4900	21.31	10.37	31.68	60.00	-28.32	QP	
12	11.4900	12.15	10.37	22.52	50.00	-27.48	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1539	29.81	10.02	39.83	65.78	-25.95	QP	
2	0.1539	15.38	10.02	25.40	55.78	-30.38	AVG	
3	0.2900	28.44	9.99	38.43	60.52	-22.09	QP	
4	0.2900	21.61	9.99	31.60	50.52	-18.92	AVG	
5	0.3339	35.37	10.03	45.40	59.35	-13.95	QP	
6	0.3339	26.61	10.03	36.64	49.35	-12.71	AVG	
7	0.3860	33.14	10.04	43.18	58.15	-14.97	QP	
8	0.3860	32.80	10.04	42.84	48.15	-5.31	AVG	
9	10.9580	18.67	10.37	29.04	60.00	-30.96	QP	
10	10.9580	9.33	10.37	19.70	50.00	-30.30	AVG	
11	11.9180	17.95	10.37	28.32	60.00	-31.68	QP	
12	11.9180	8.66	10.37	19.03	50.00	-30.97	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 Distance	
	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: 51.1 % RH

Atmospheric Pressure: 101.2kPa

Test Voltage: AC 120V, 60Hz

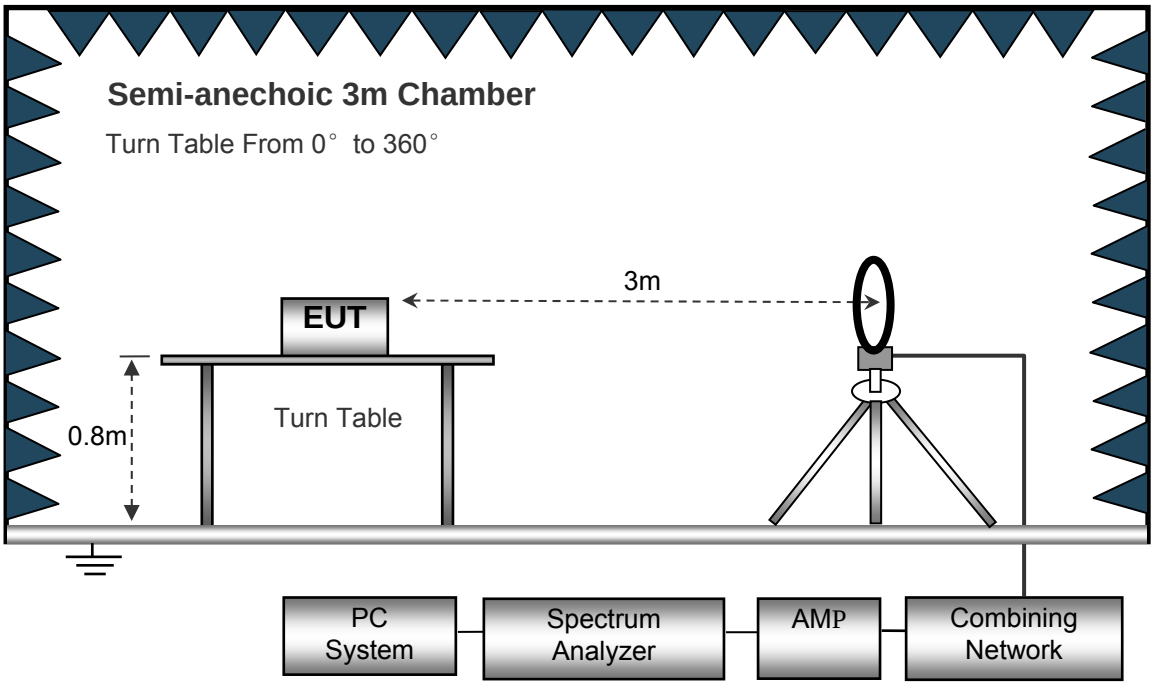
EUT Operation **:**

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

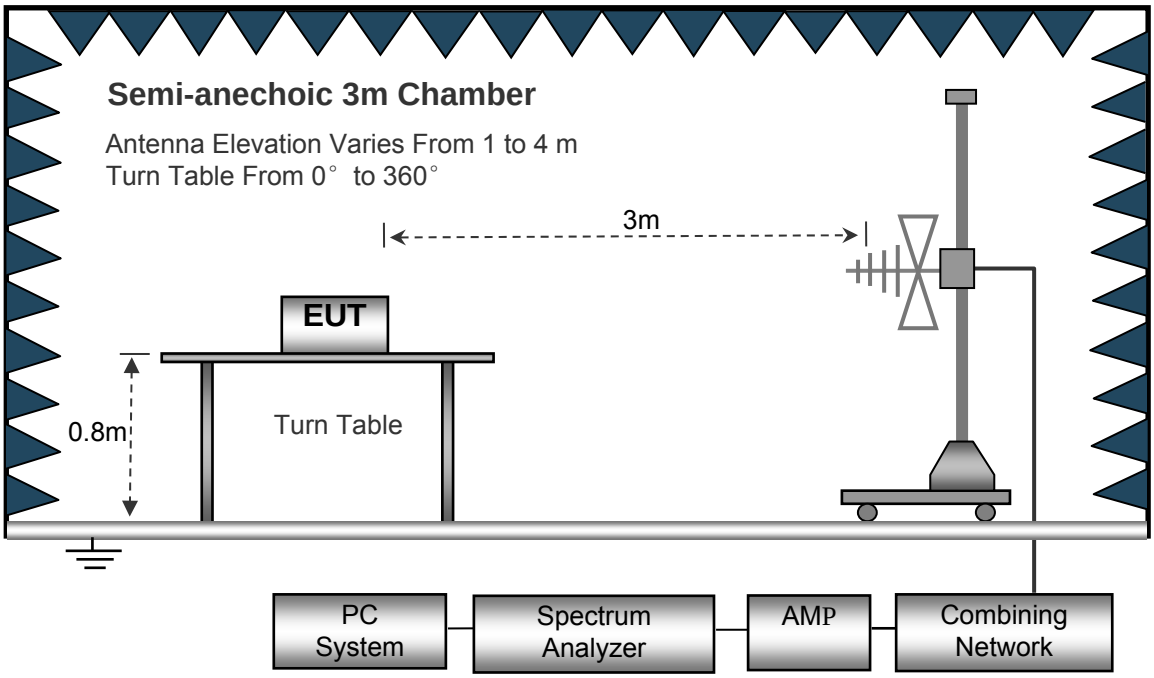
8.2 Test Setup

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

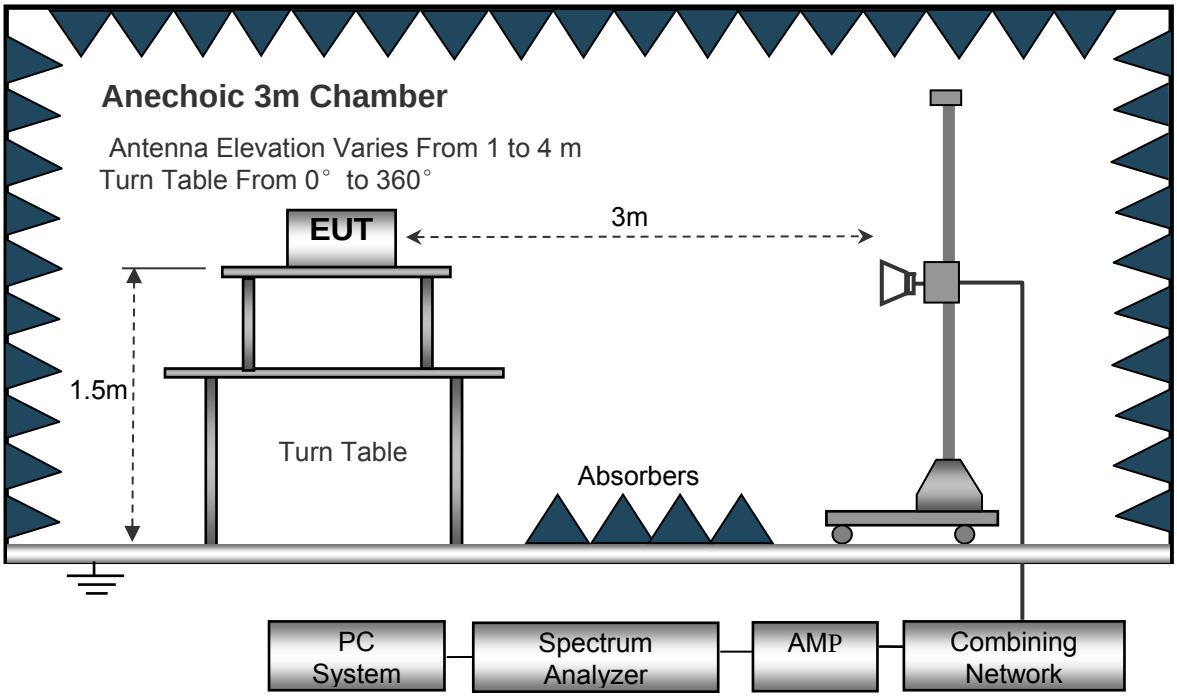
The test setup for emission measurement below 30MHz.



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
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 above ground plane.
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.

8.5 Summary of Test Results

Test Frequency: 9kHz to 30MHz

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

Test Frequency: 30MHz ~ 18GHz

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

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Low Channel									
332.58	45.26	QP	97	1.5	H	-13.35	31.91	46.00	-14.09
332.58	43.78	QP	330	1.3	V	-13.35	30.43	46.00	-15.57
4804.00	55.61	PK	55	1.1	V	-1.06	54.55	74.00	-19.45
4804.00	45.71	Ave	55	1.1	V	-1.06	44.65	54.00	-9.35
7206.00	55.66	PK	207	1.5	H	1.33	56.99	74.00	-17.01
7206.00	40.29	Ave	207	1.5	H	1.33	41.62	54.00	-12.38
2330.67	45.35	PK	200	1.8	V	-13.19	32.16	74.00	-41.84
2330.67	38.22	Ave	200	1.8	V	-13.19	25.03	54.00	-28.97
2352.85	42.90	PK	122	1.8	H	-13.14	29.76	74.00	-44.24
2352.85	36.18	Ave	122	1.8	H	-13.14	23.04	54.00	-30.96
2485.66	42.55	PK	344	1.2	V	-13.08	29.47	74.00	-44.53
2485.66	36.95	Ave	344	1.2	V	-13.08	23.87	54.00	-30.13

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Middle Channel									
332.58	46.24	QP	316	1.2	H	-13.35	32.89	46.00	-13.11
332.58	42.95	QP	262	1.5	V	-13.35	29.60	46.00	-16.40
4882.00	54.74	PK	321	1.6	V	-0.62	54.12	74.00	-19.88
4882.00	44.61	Ave	321	1.6	V	-0.62	43.99	54.00	-10.01
7323.00	55.39	PK	322	1.6	H	2.21	57.60	74.00	-16.40
7323.00	40.07	Ave	322	1.6	H	2.21	42.28	54.00	-11.72
2319.27	45.41	PK	311	1.0	V	-13.19	32.22	74.00	-41.78
2319.27	38.69	Ave	311	1.0	V	-13.19	25.50	54.00	-28.50
2354.56	44.83	PK	38	1.9	H	-13.14	31.69	74.00	-42.31
2354.56	38.24	Ave	38	1.9	H	-13.14	25.10	54.00	-28.90
2490.00	44.94	PK	262	1.0	V	-13.08	31.86	74.00	-42.14
2490.00	38.59	Ave	262	1.0	V	-13.08	25.51	54.00	-28.49

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK High Channel									
332.58	46.88	QP	171	1.0	H	-13.35	33.53	46.00	-12.47
332.58	41.55	QP	193	1.1	V	-13.35	28.20	46.00	-17.80
4960.00	55.56	PK	31	1.9	V	-0.24	55.32	74.00	-18.68
4960.00	44.37	Ave	31	1.9	V	-0.24	44.13	54.00	-9.87
7440.00	55.52	PK	323	1.7	H	2.84	58.36	74.00	-15.64
7440.00	39.36	Ave	323	1.7	H	2.84	42.20	54.00	-11.80
2330.24	45.61	PK	320	1.7	V	-13.19	32.42	74.00	-41.58
2330.24	38.39	Ave	320	1.7	V	-13.19	25.20	54.00	-28.80
2379.45	43.58	PK	30	1.5	H	-13.14	30.44	74.00	-43.56
2379.45	36.90	Ave	30	1.5	H	-13.14	23.76	54.00	-30.24
2485.03	42.79	PK	219	1.2	V	-13.08	29.71	74.00	-44.29
2485.03	36.58	Ave	219	1.2	V	-13.08	23.50	54.00	-30.50

Test Frequency: 18GHz to 25GHz

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

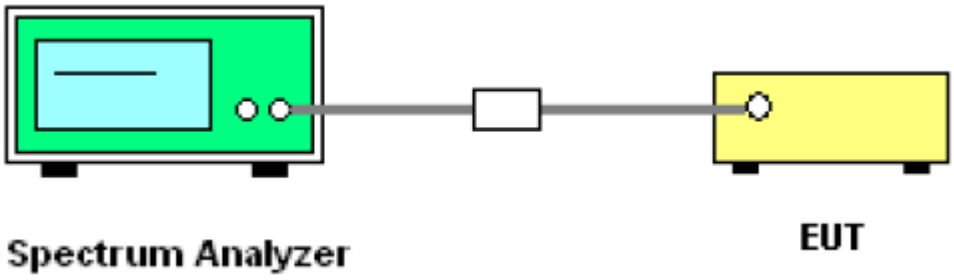
9 Band Edge Measurement

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 C63.10:2013
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 and Hopping

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

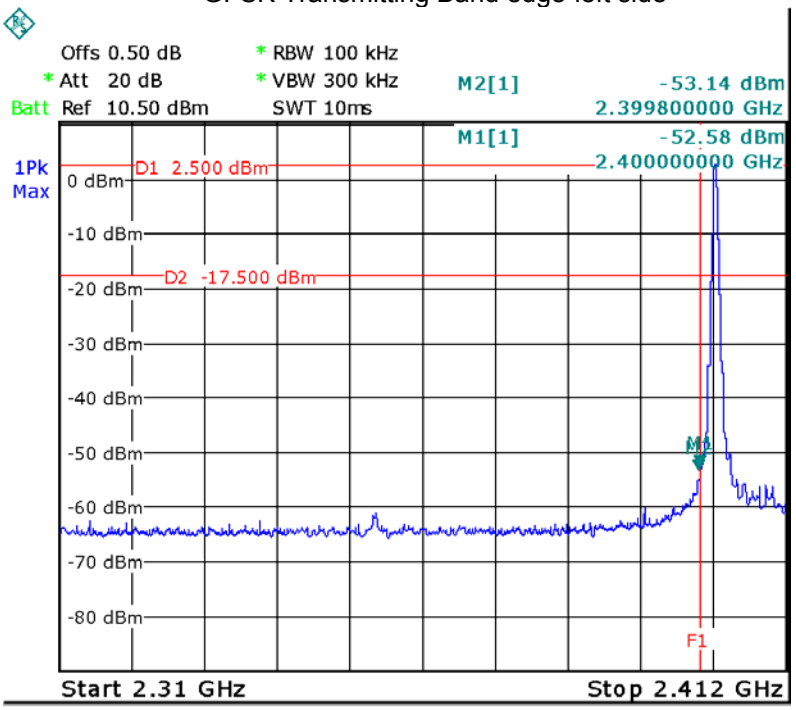
9.2 Test Setup



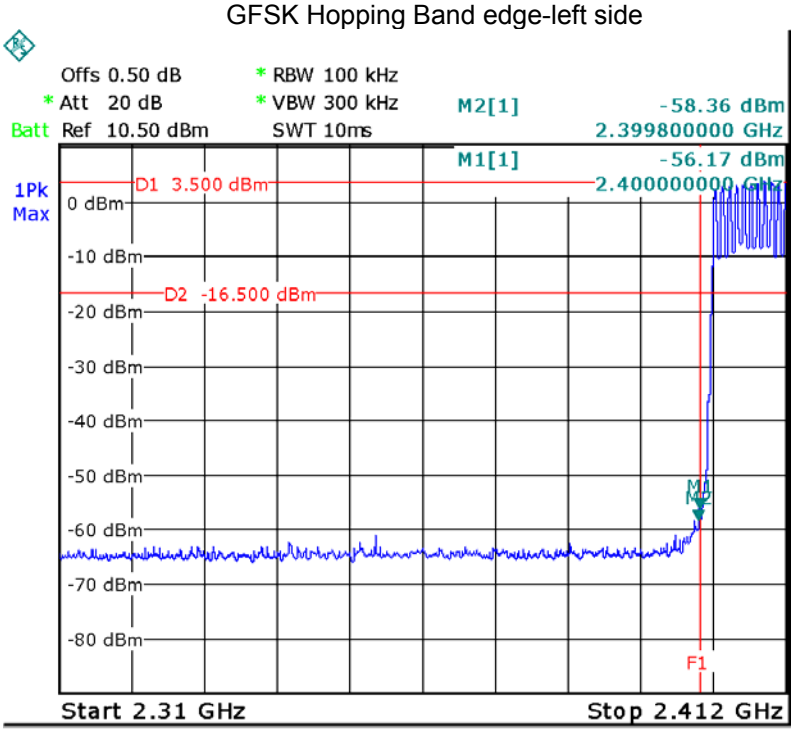
9.3 Test Result

Test plots

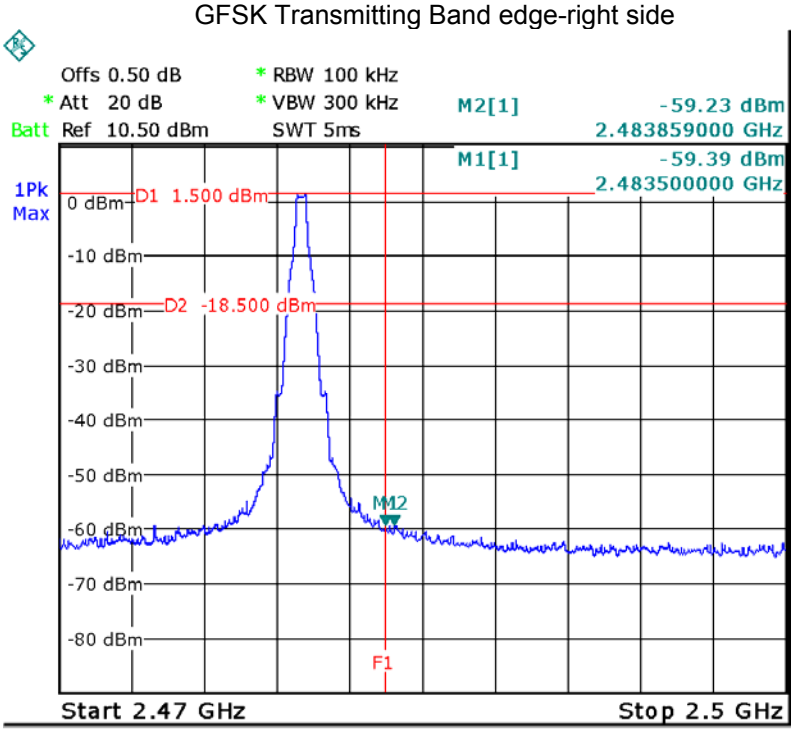
GFSK Transmitting Band edge-left side



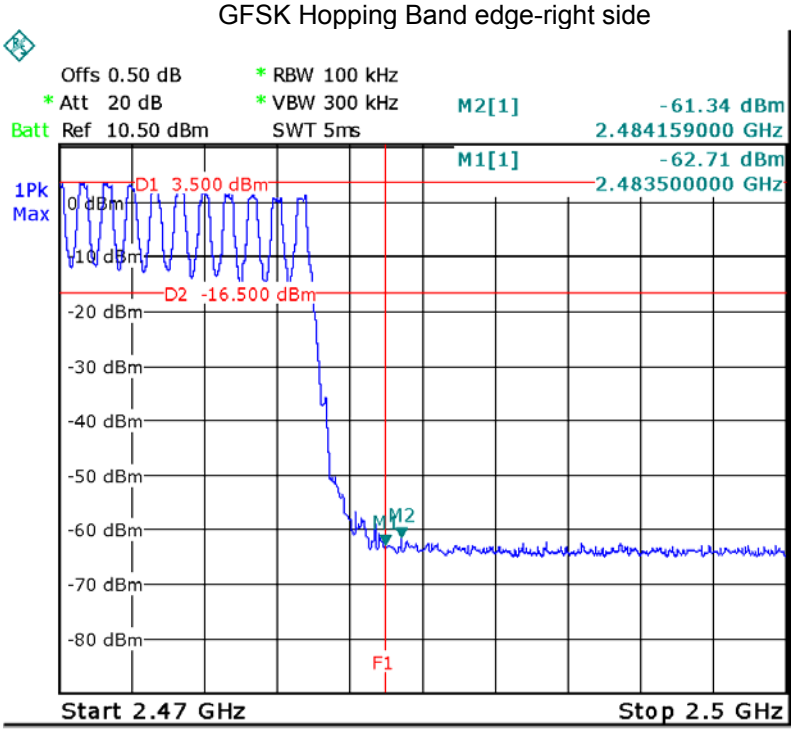
GFSK Hopping Band edge-left side



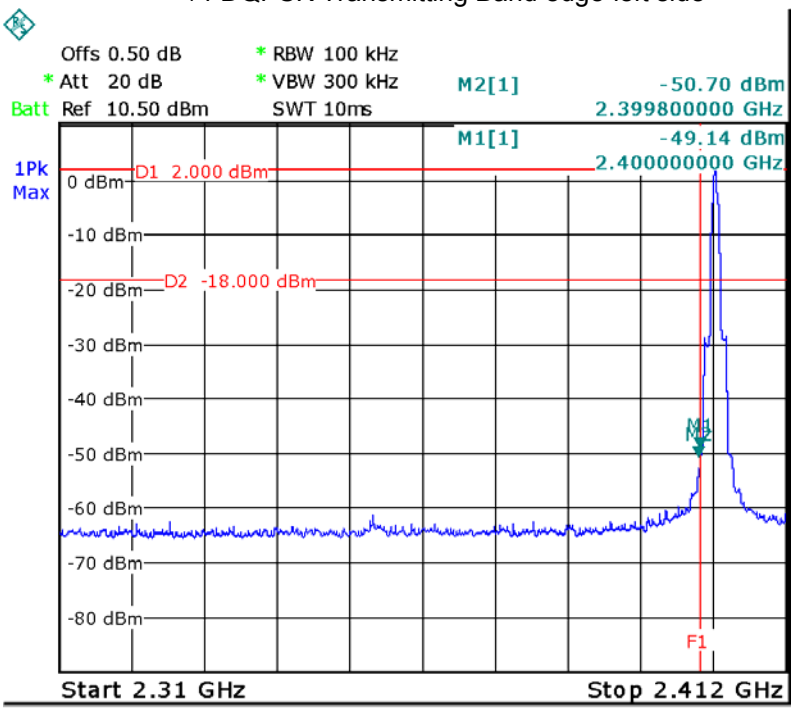
GFSK Transmitting Band edge-right side



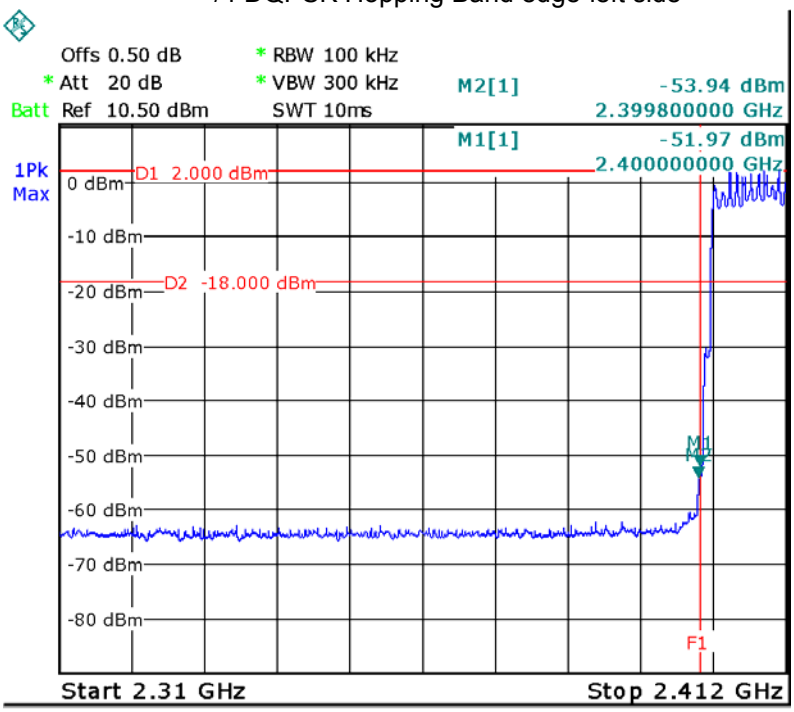
GFSK Hopping Band edge-right side



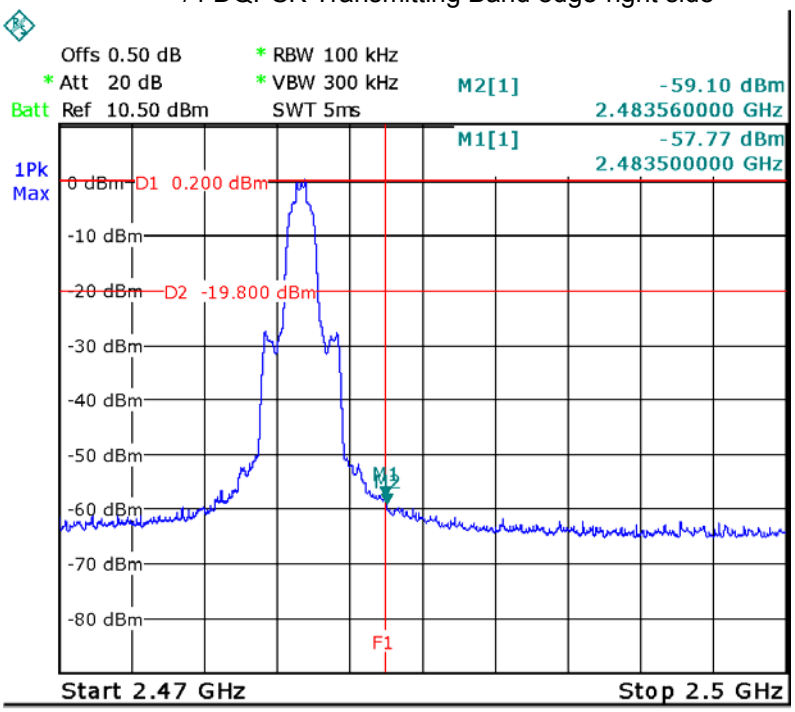
π /4 DQPSK Transmitting Band edge-left side



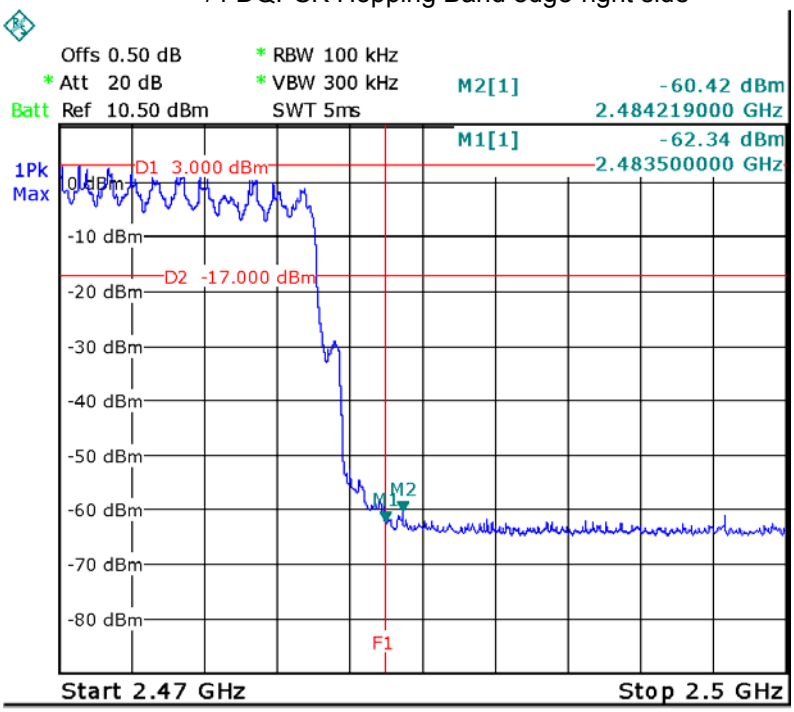
π /4 DQPSK Hopping Band edge-left side



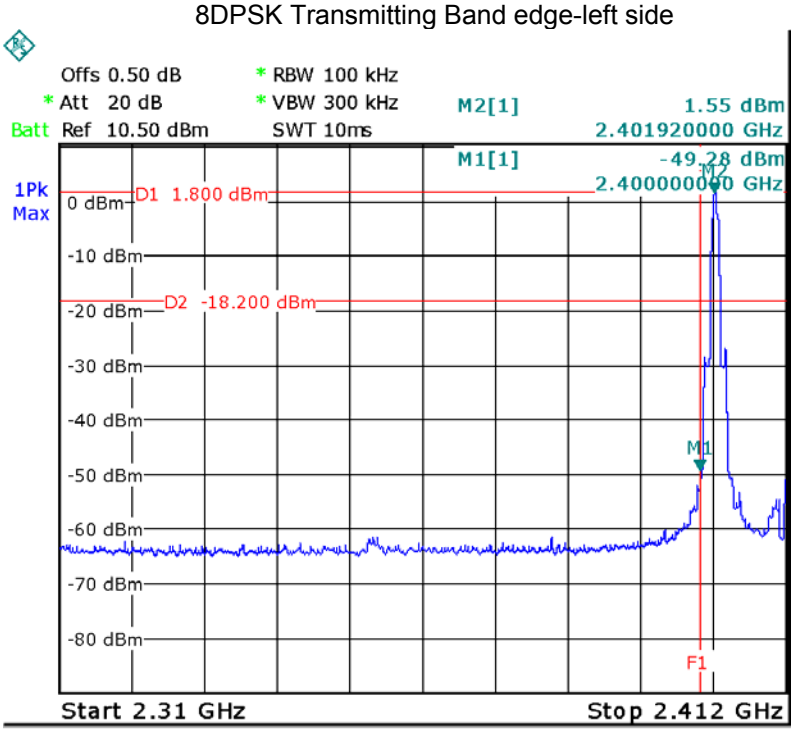
π /4 DQPSK Transmitting Band edge-right side



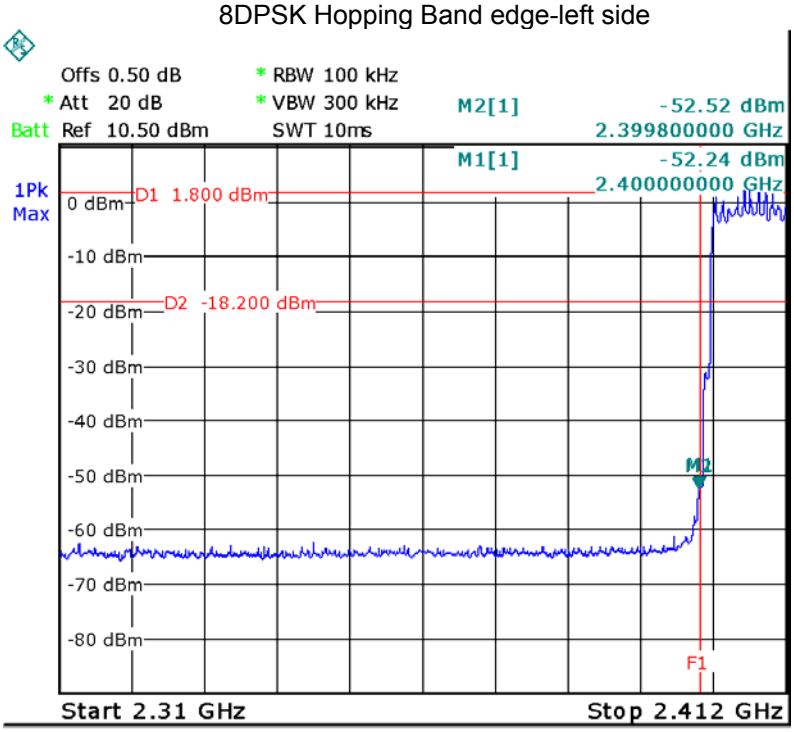
π /4 DQPSK Hopping Band edge-right side



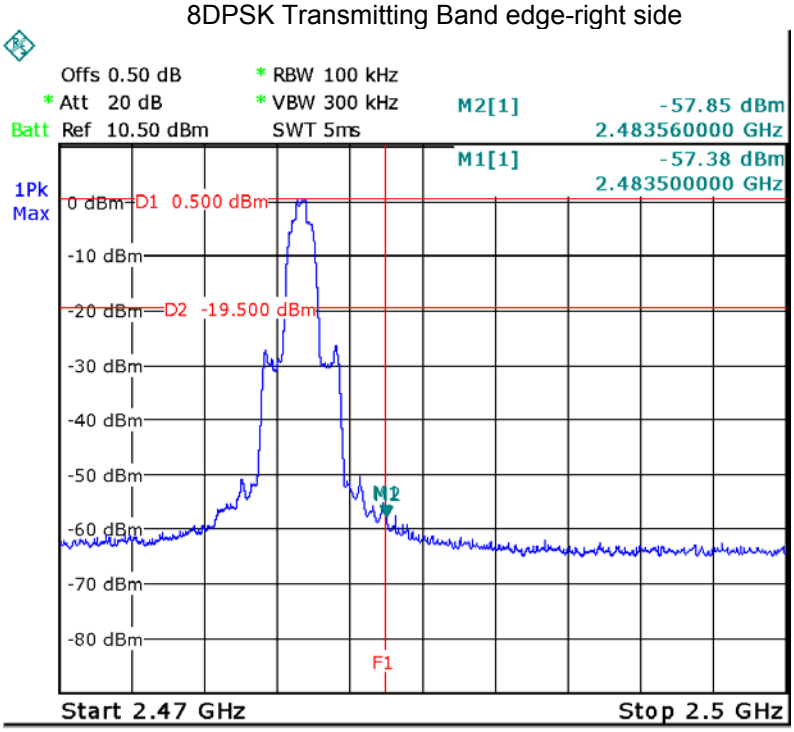
8DPSK Transmitting Band edge-left side



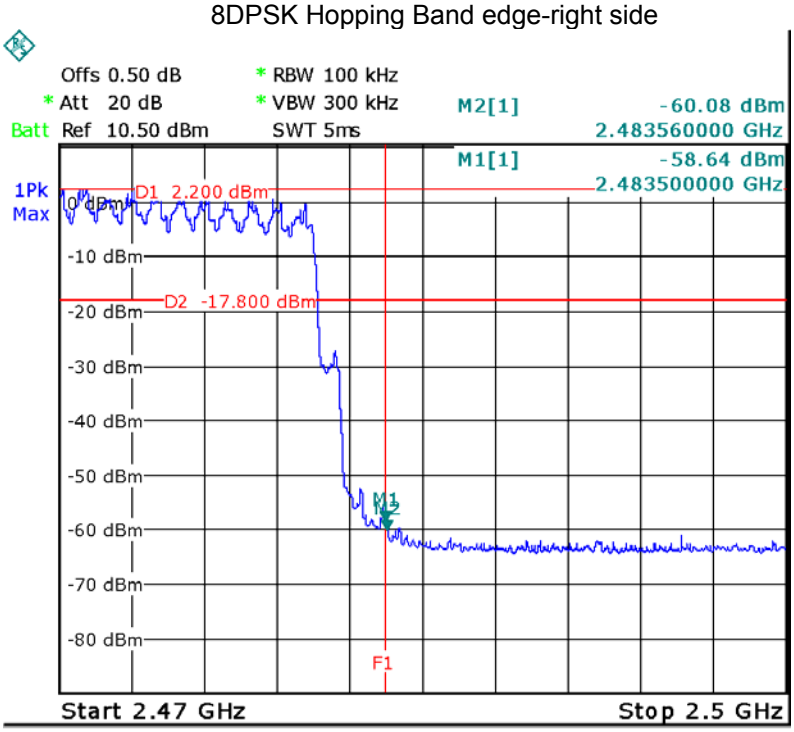
8DPSK Hopping Band edge-left side



8DPSK Transmitting Band edge-right side



8DPSK Hopping Band edge-right side



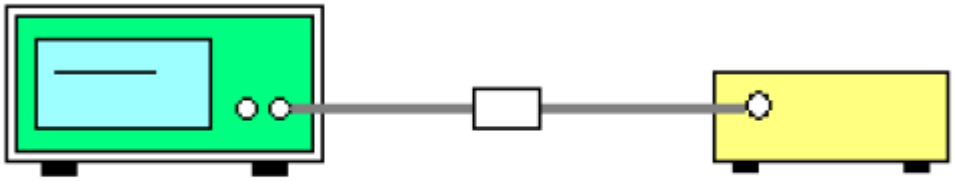
10 Bandwidth Measurement

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 Setup

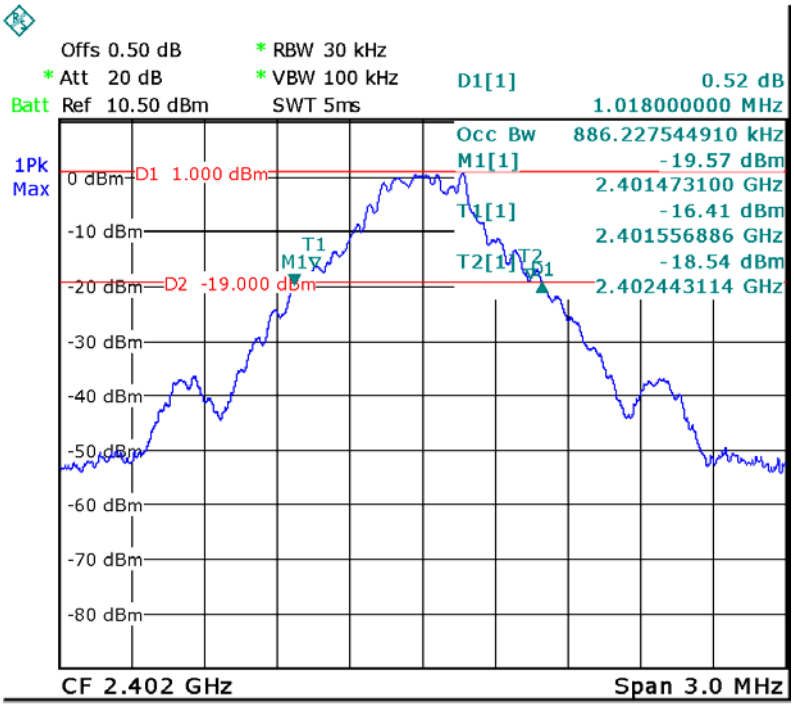


10.3 Test Result

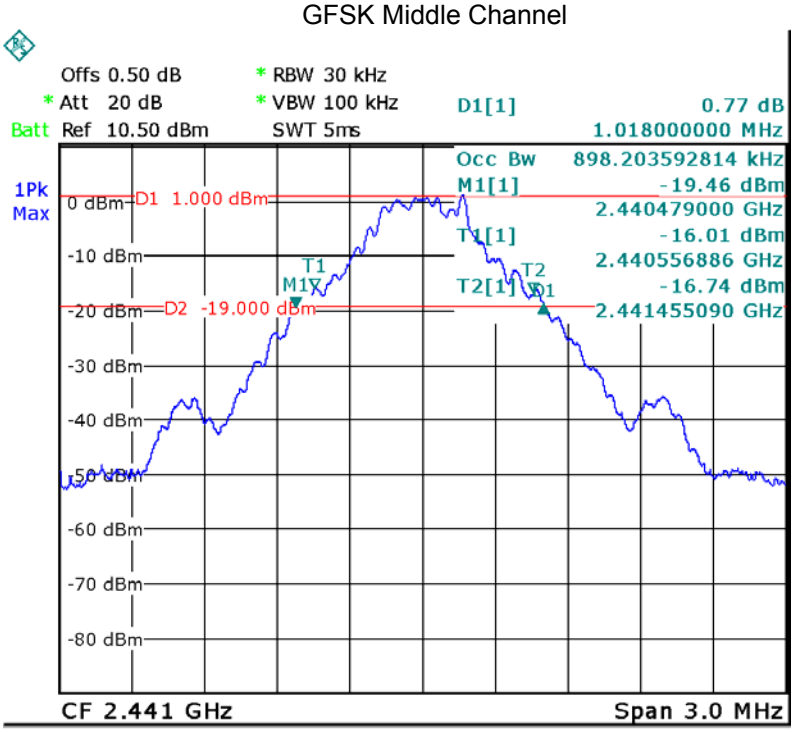
Modulation	Test Channel	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)
GFSK	Low	1.018	0.886
	Middle	1.018	0.898
	High	1.018	0.904
π/4DQPSK	Low	1.311	1.192
	Middle	1.311	1.198
	High	1.311	1.204
8DPSK	Low	1.293	1.204
	Middle	1.293	1.210
	High	1.293	1.222

Test plots

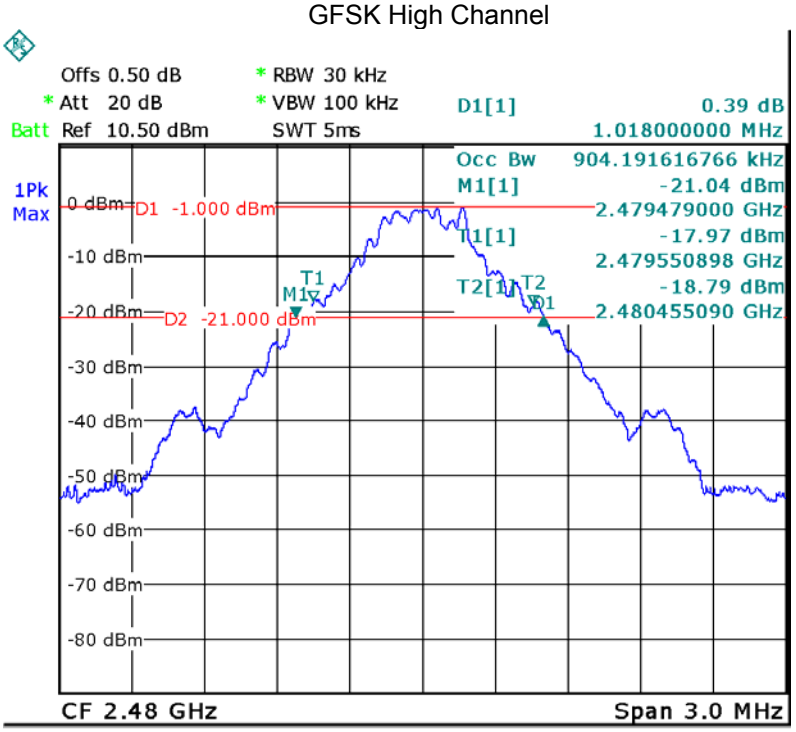
GFSK Low Channel



GFSK Middle Channel

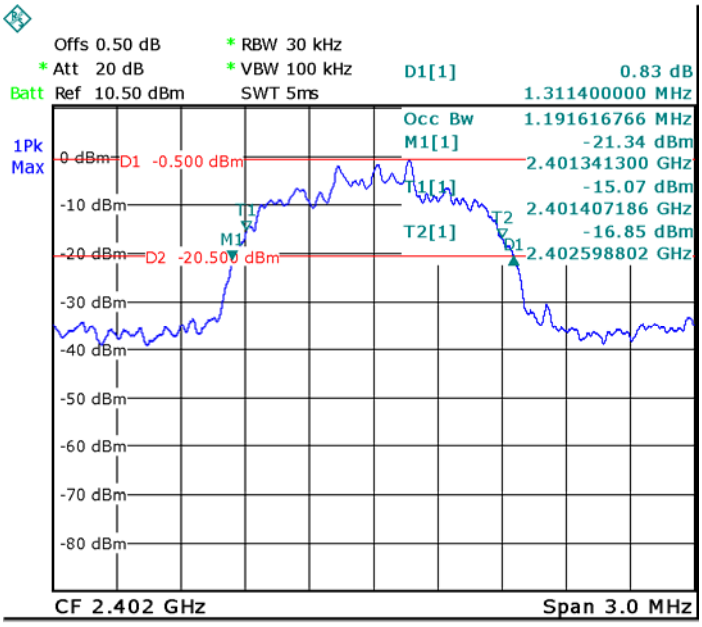


GFSK High Channel

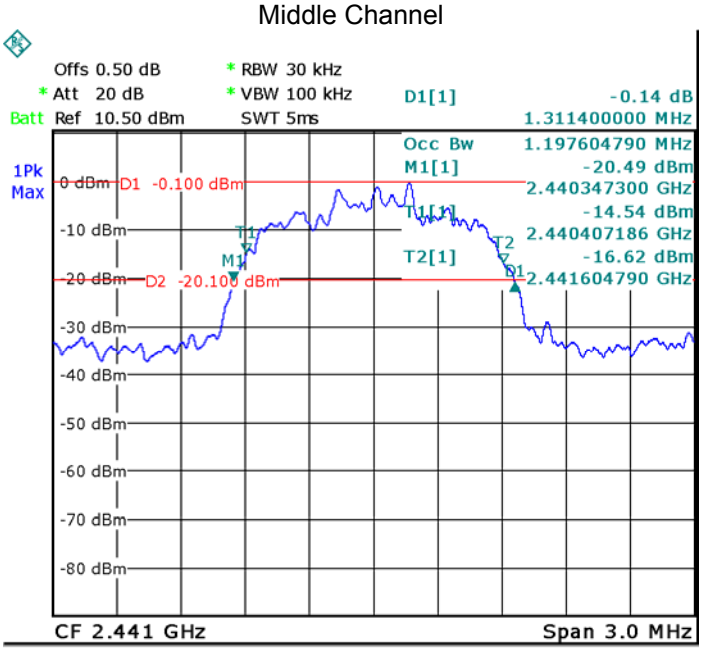


Modulation: π/4DQPSK

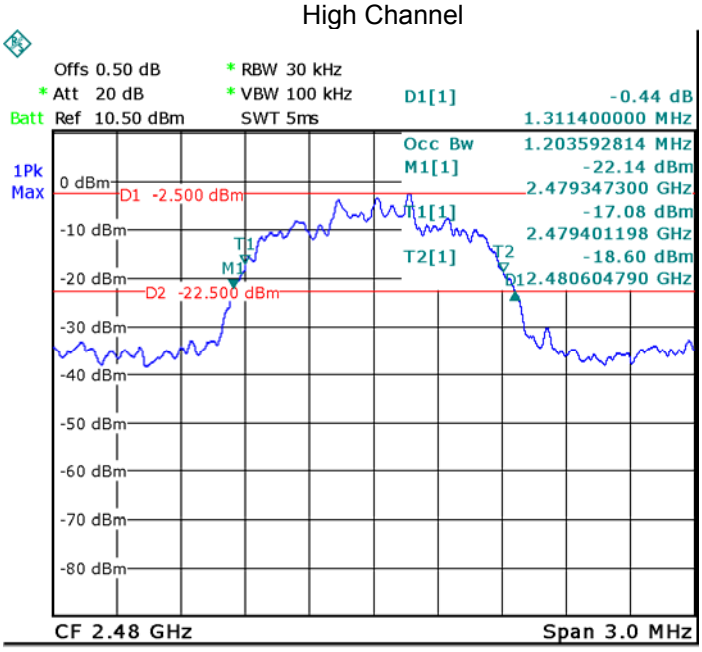
Lower Channel



Middle Channel

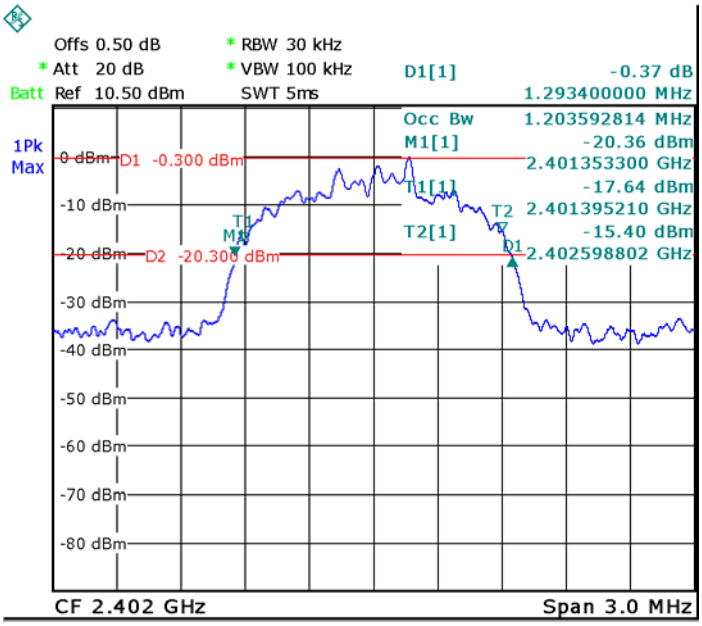


High Channel

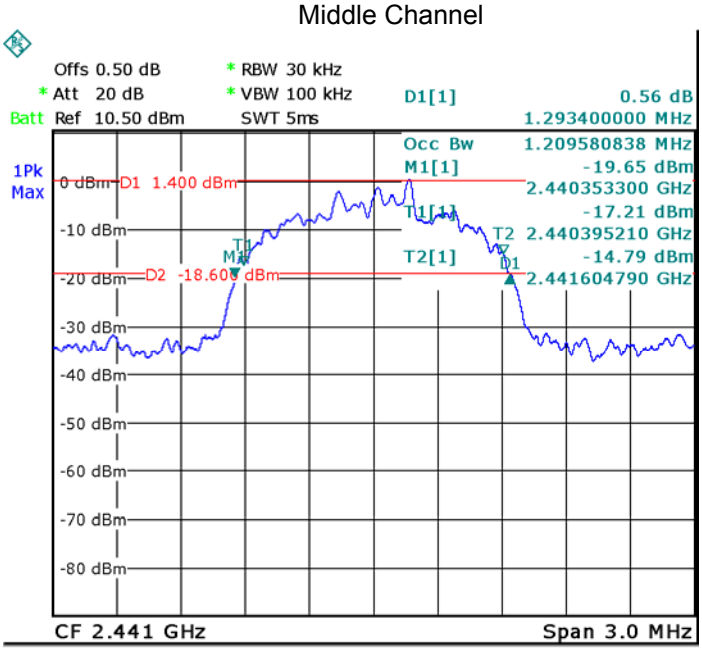


Modulation: 8DPSK

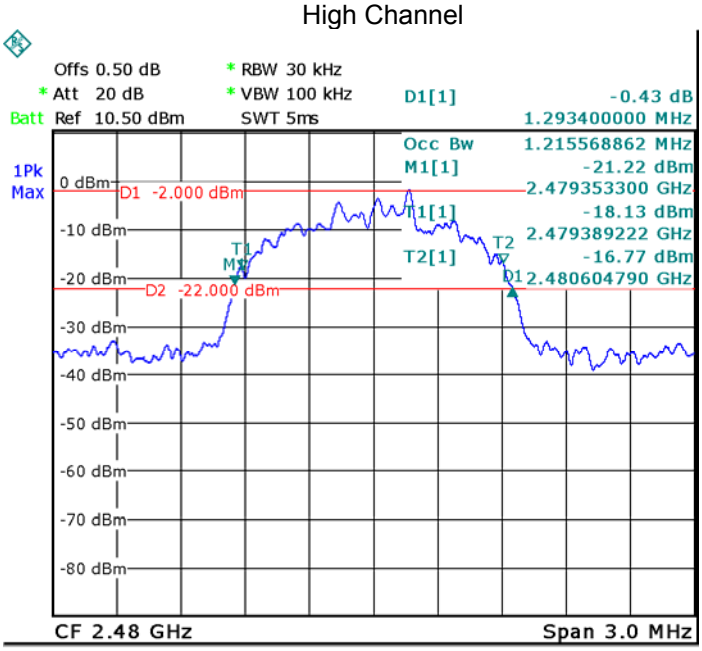
Lower Channel



Middle Channel



High Channel



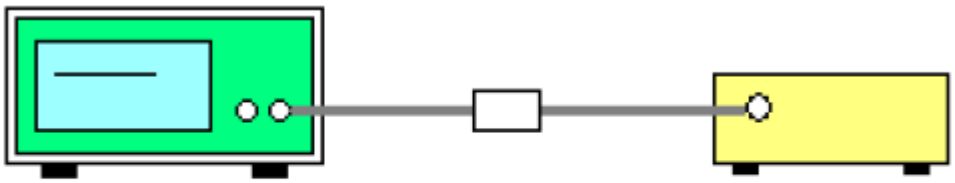
11 Maximum Peak Output Power

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. Refer to the result “Number of Hopping Frequency” of this document. The 0.125watts (20.97 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



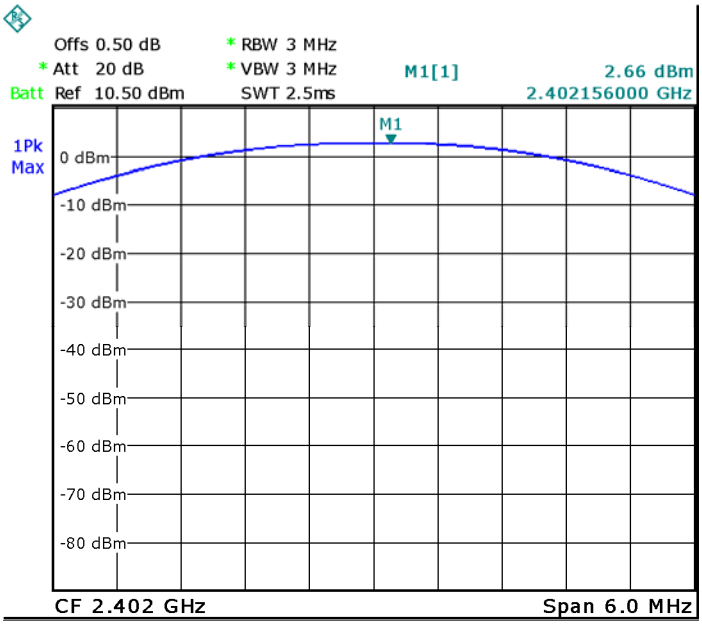
11.3 Test Result

Test Mode	Data Rate	Peak Power(dBm)			Limit (dBm)
		CH00	CH39	CH78	
GFSK	1Mbps	2.66	**3.36**	1.38	20.97
π/4DQPSK	2Mbps	2.26	2.97	0.87	20.97
8DPSK	3Mbps	2.33	3.11	0.96	20.97

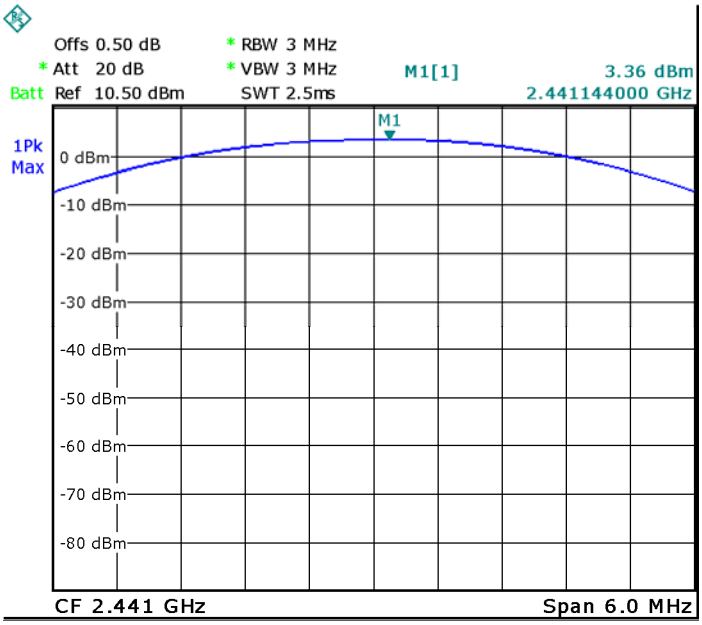
Test plots

Modulation: GFSK

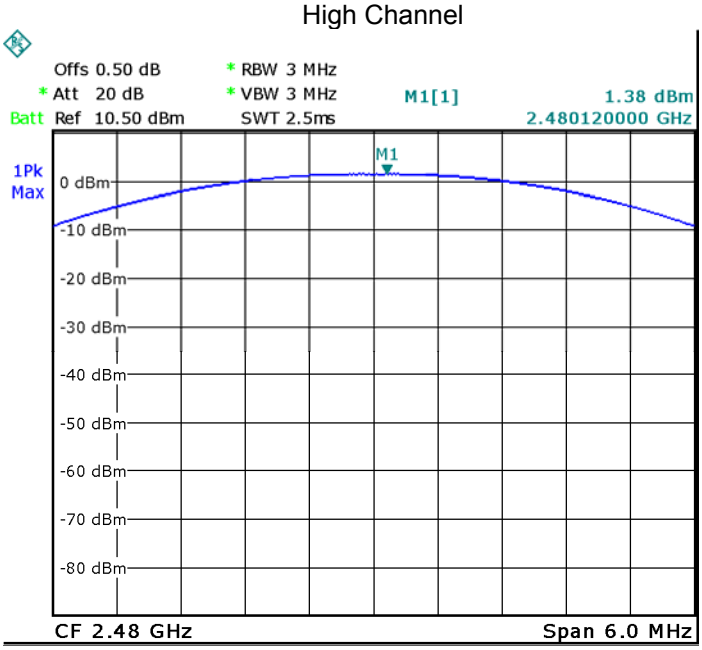
Lower Channel



Middle Channel

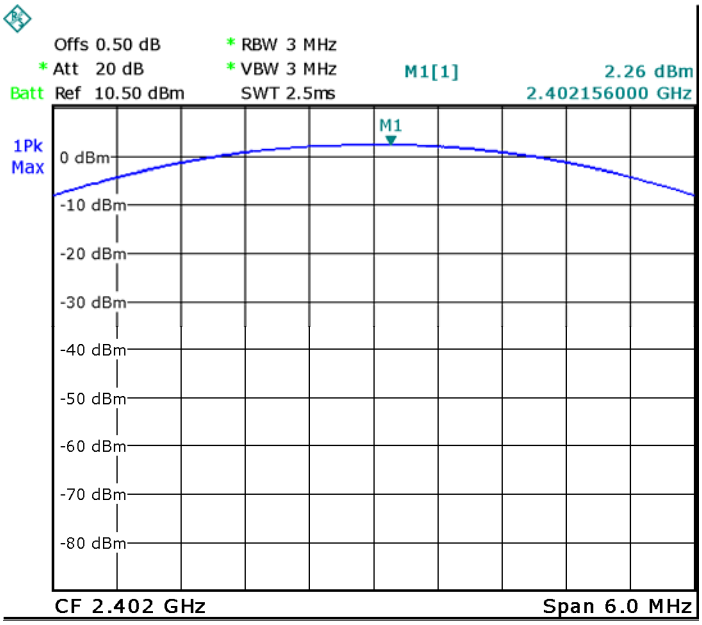


High Channel

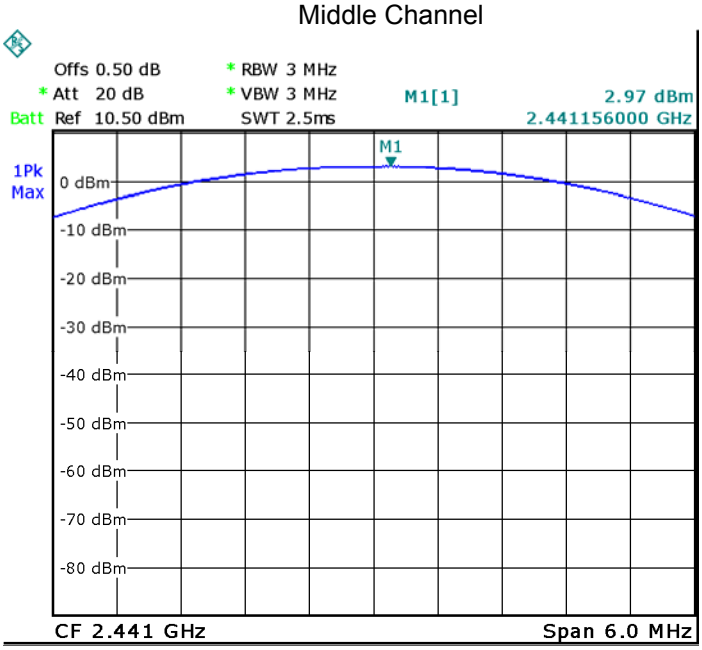


Modulation: π/4DQPSK

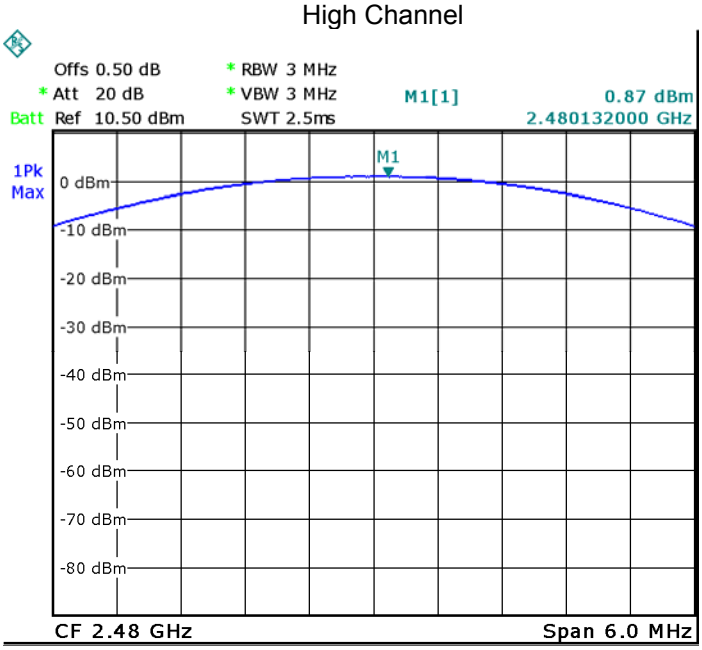
Lower Channel



Middle Channel

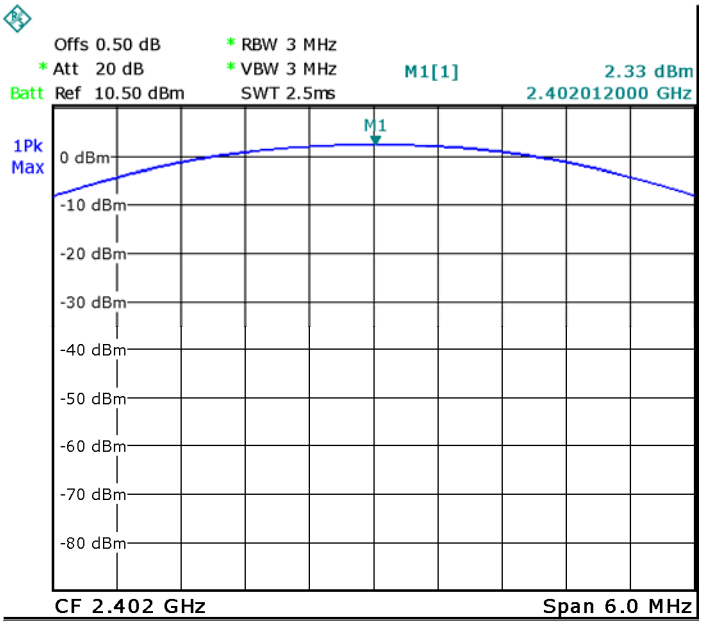


High Channel

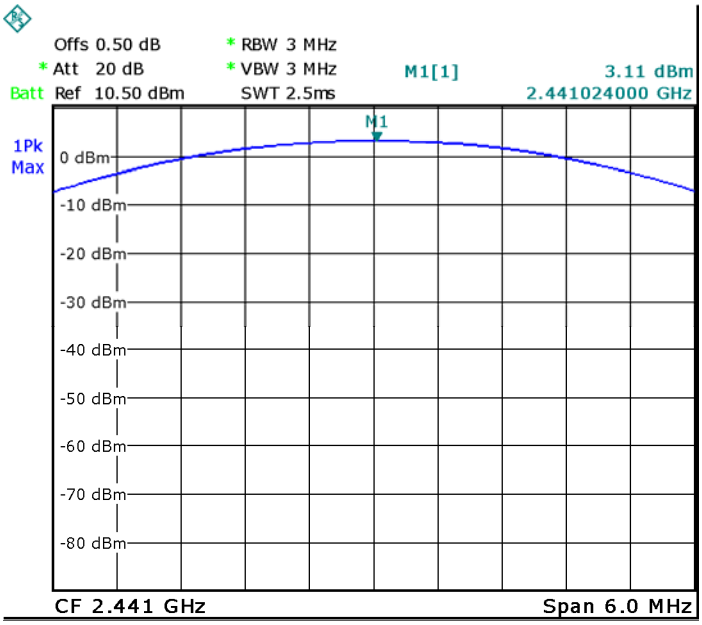


Modulation: 8DPSK

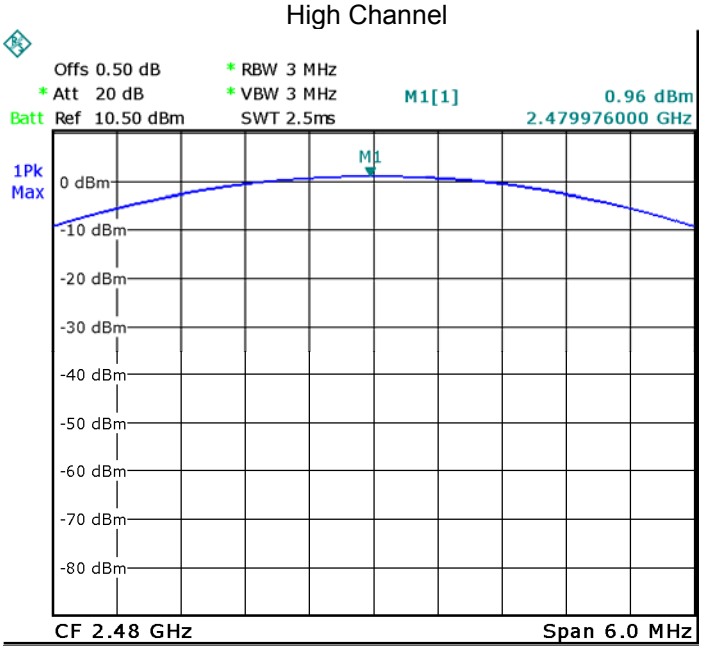
Lower Channel



Middle Channel



High Channel



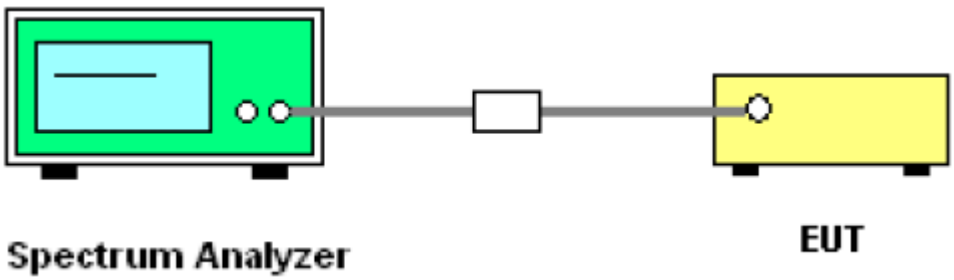
12 Hopping Channel Separation

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 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 1W.
Test Mode:	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



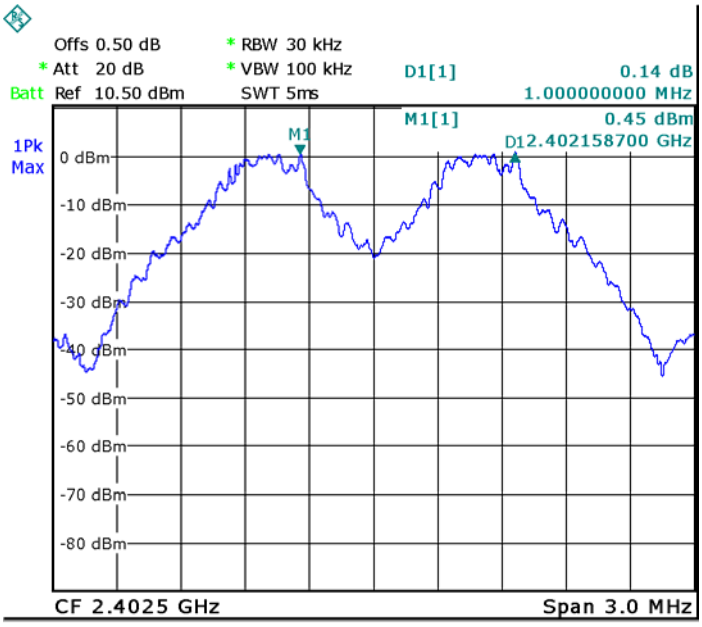
12.3 Test Result

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

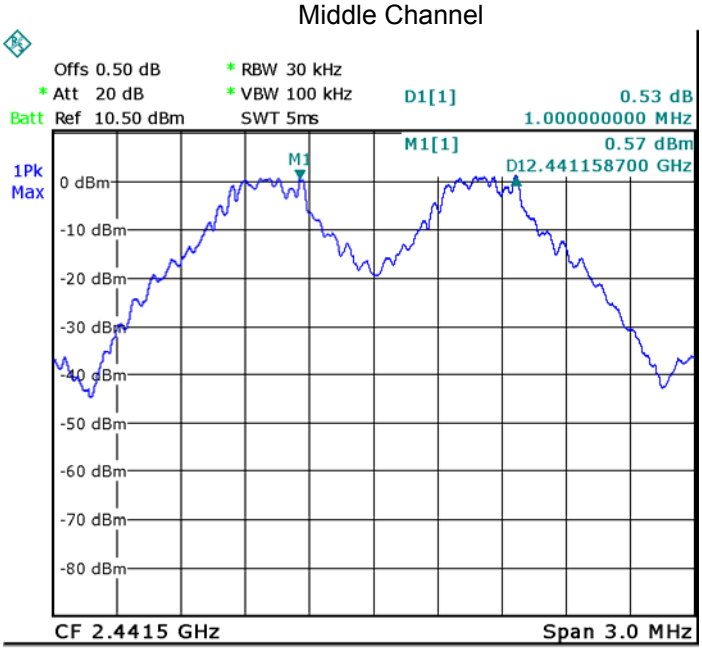
Test plots

Modulation: GFSK

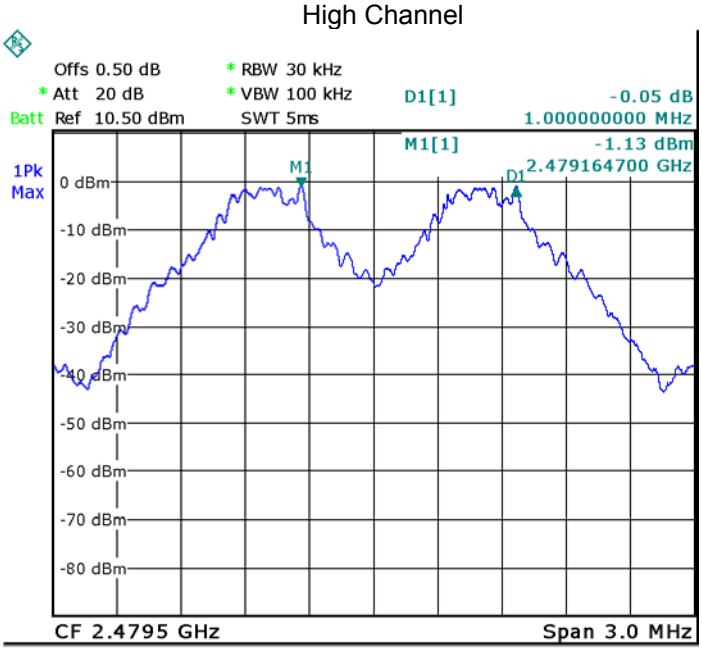
Lower Channel



Middle Channel

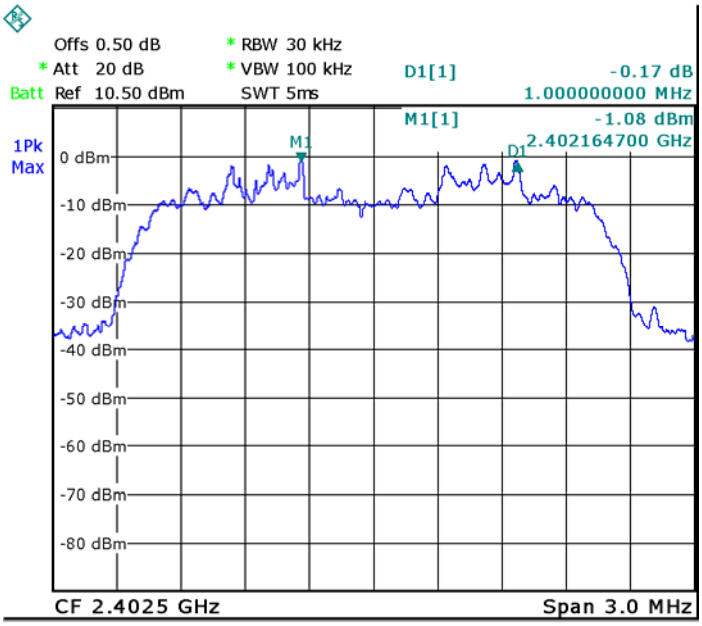


High Channel

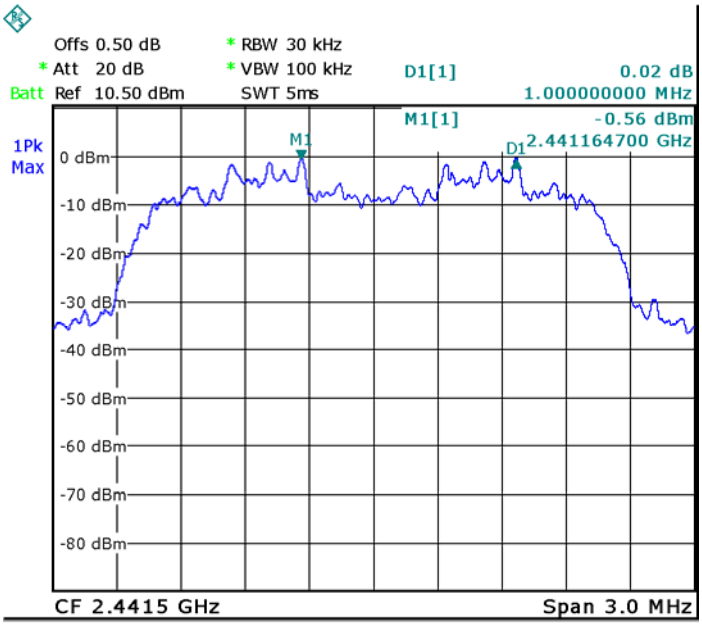


Modulation: π/4DQPSK

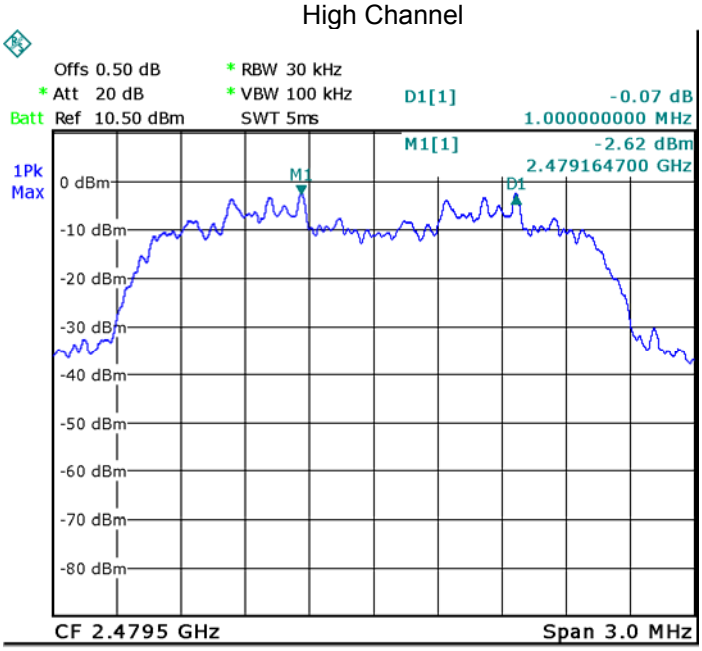
Lower Channel



Middle Channel

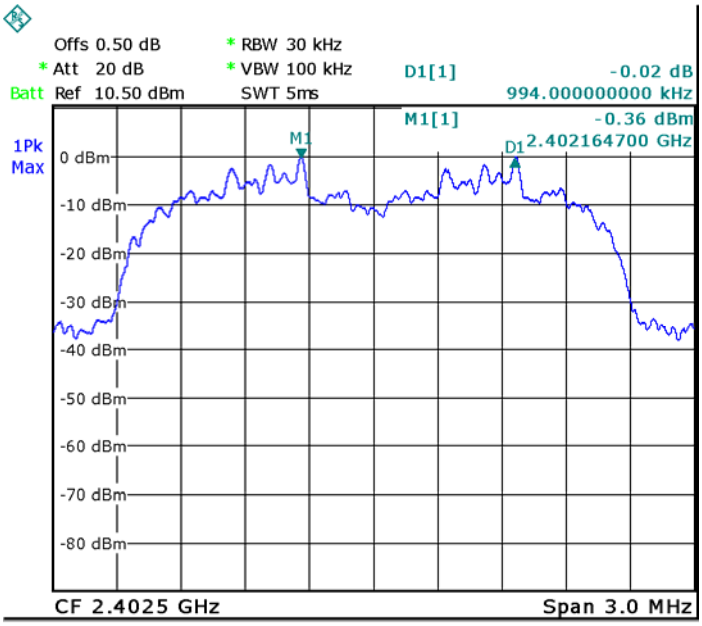


High Channel

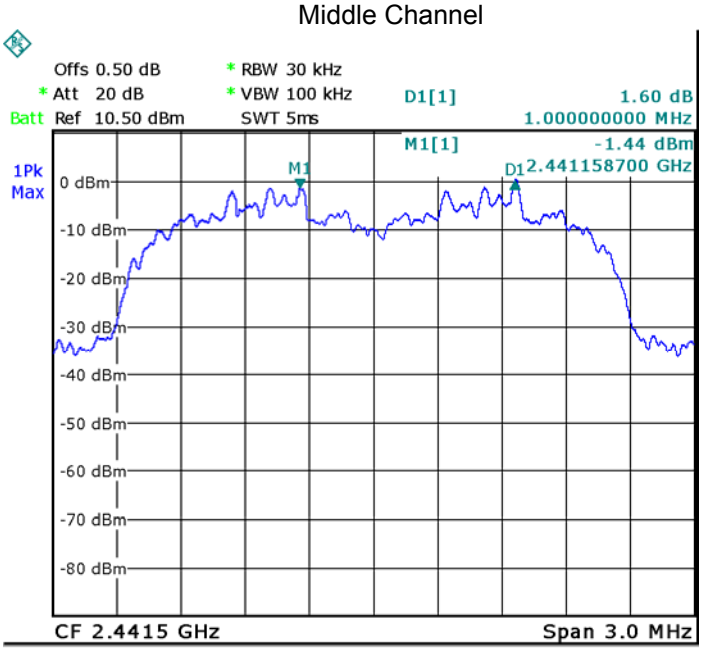


Modulation: 8DPSK

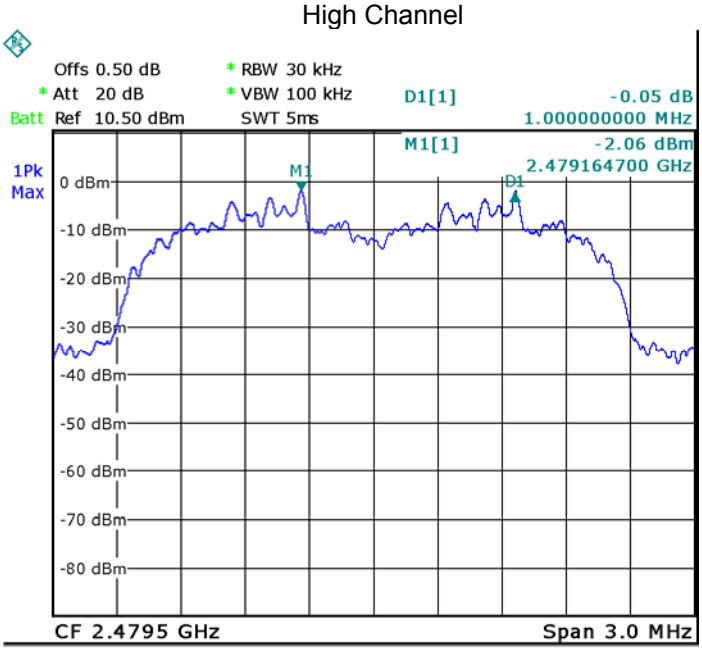
Lower Channel



Middle Channel



High Channel



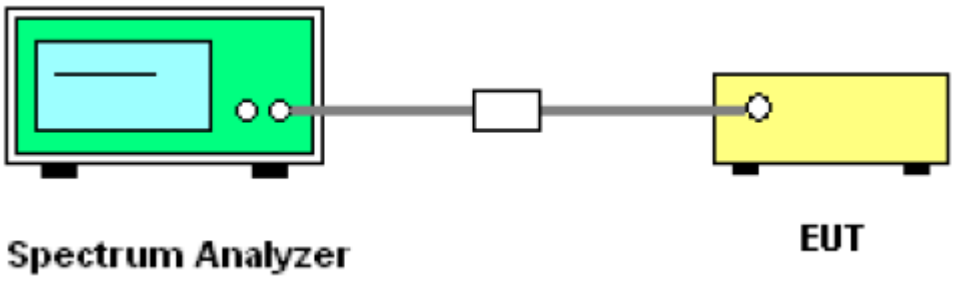
13 Number of Hopping Frequency

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 = 2.4835GHz. Sweep=auto;

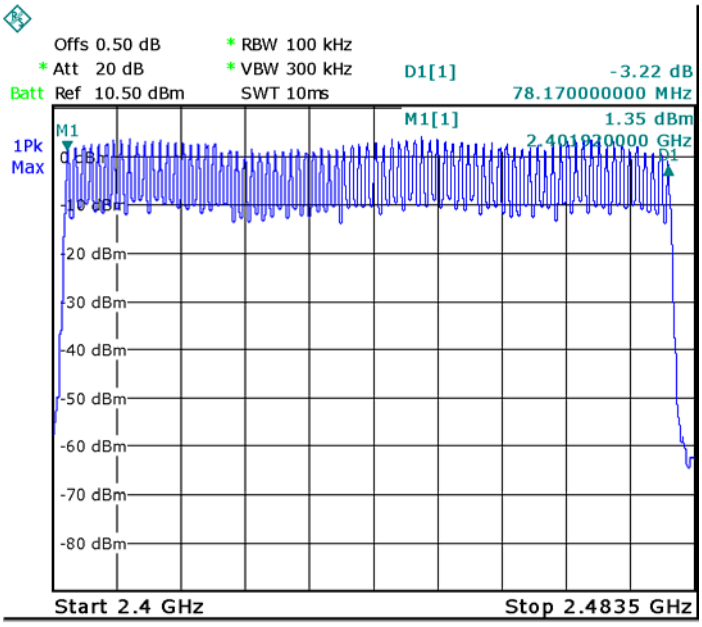
13.2 Test Setup



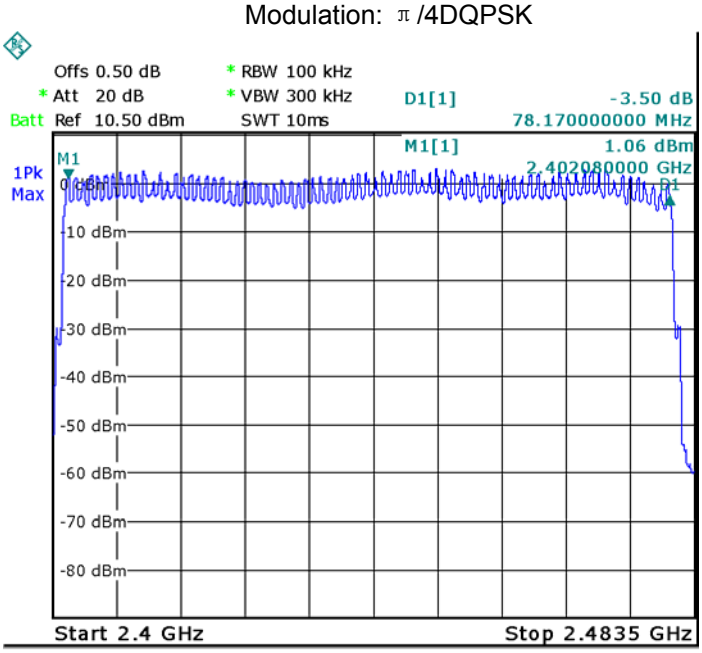
13.3 Test Result

Test Plots: 79 Channels in total

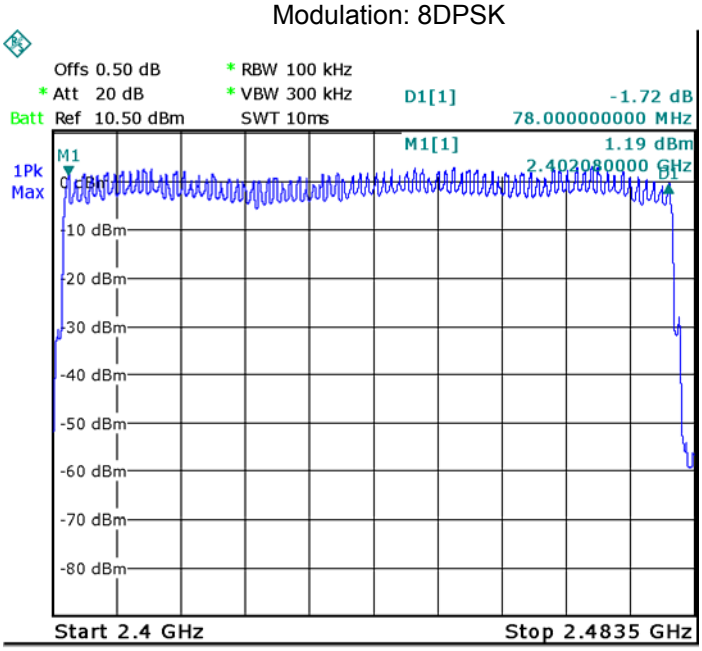
Modulation: GFSK



Modulation: π/4DQPSK



Modulation: 8DPSK



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

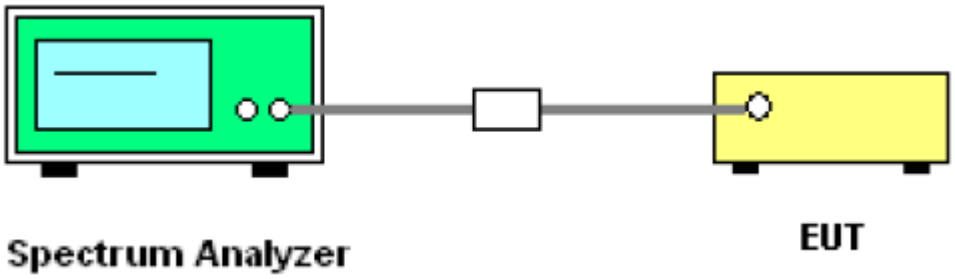
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

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 Setup



14.3 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:

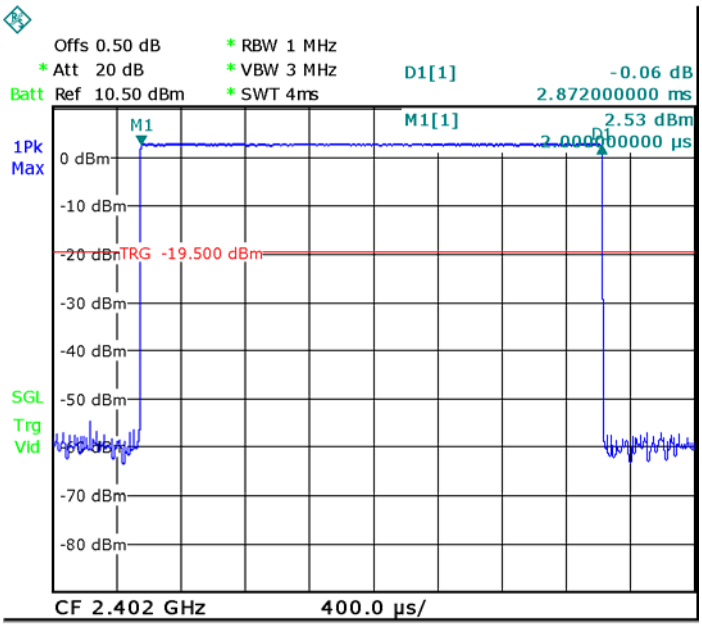
Data Packet	Dwell Time(s)
DH5	1600/79/6*0.4*79*(MkrDelta)/1000
DH3	1600/79/4*0.4*79*(MkrDelta)/1000
DH1	1600/79/2*0.4*79*(MkrDelta)/1000
Remark: Mkr Delta is once pulse time. Only the worst data(DH5) were show as follow.	

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
π/4DQPSK	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

Modulation: GFSK

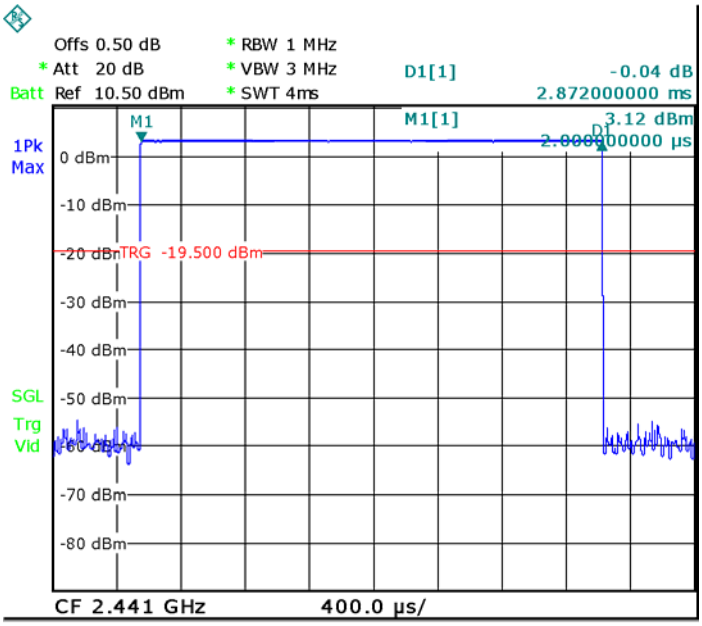
Data Packet:

DH5.Lower channel



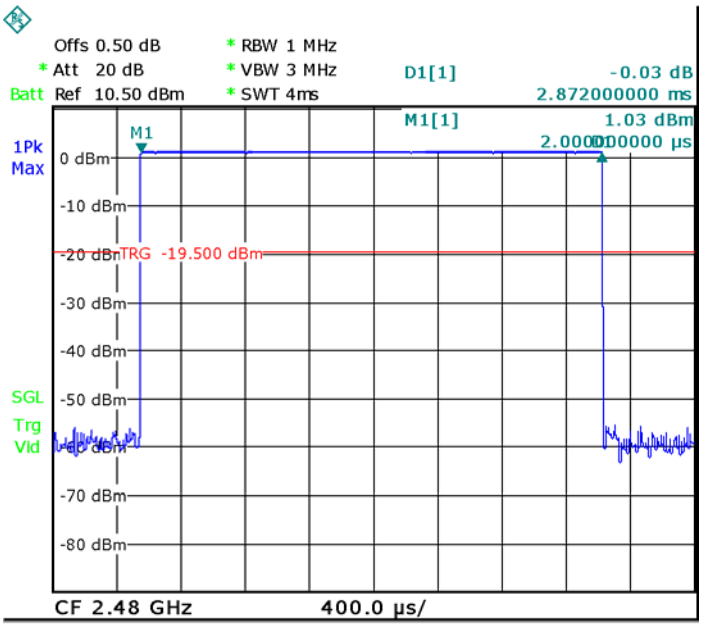
Data Packet:

DH5.Middle channel



Data Packet:

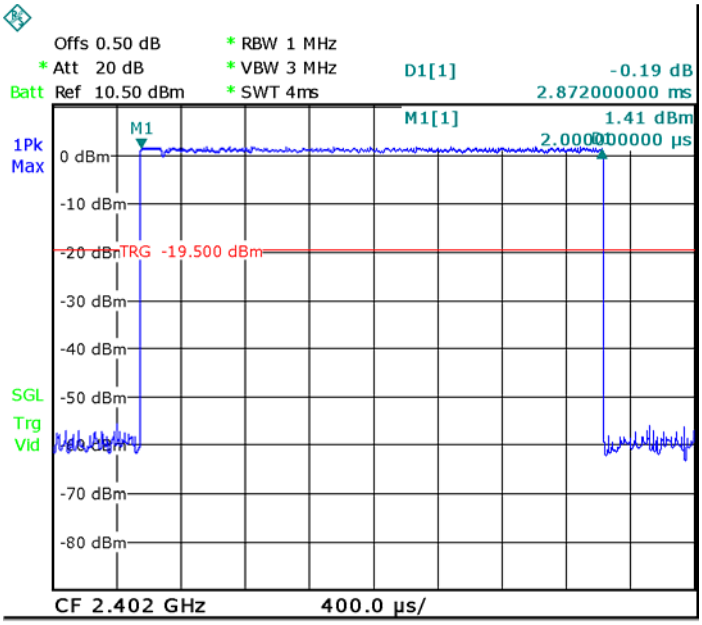
DH5, High channel



π /4DQPSK

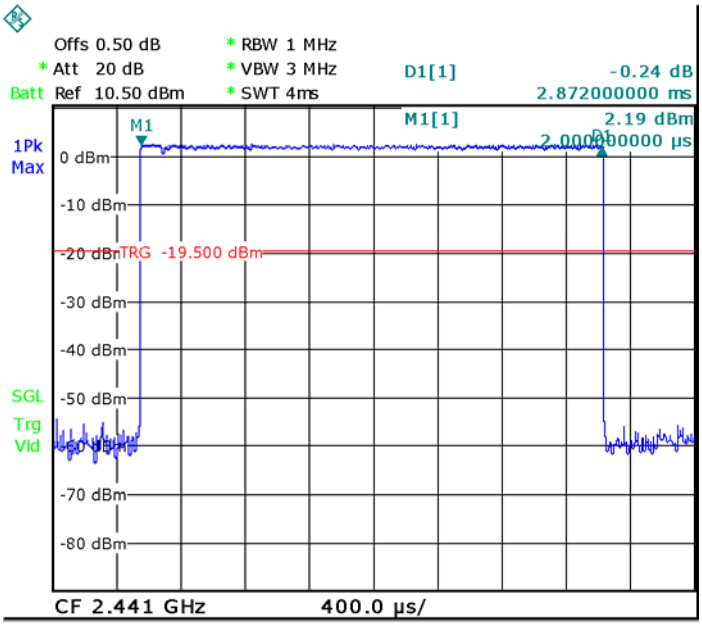
Data Packet:

DH5, Lower channel



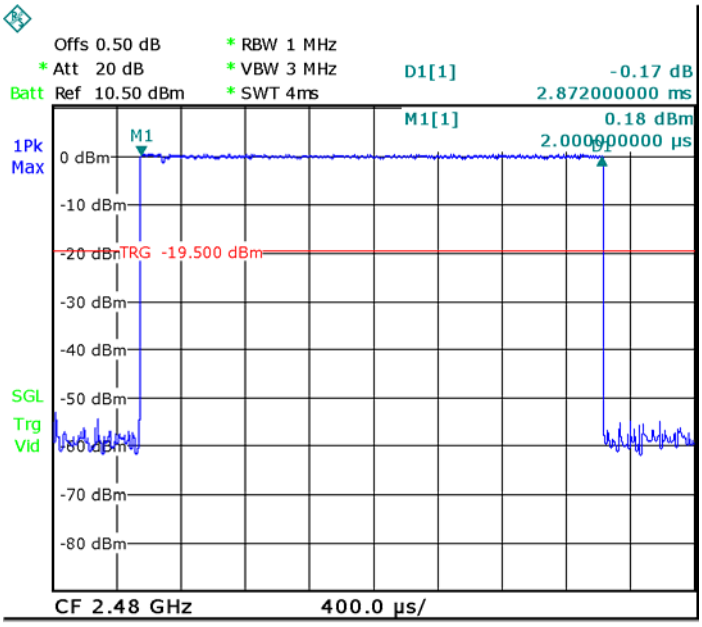
Data Packet:

DH5, Middle channel



Data Packet:

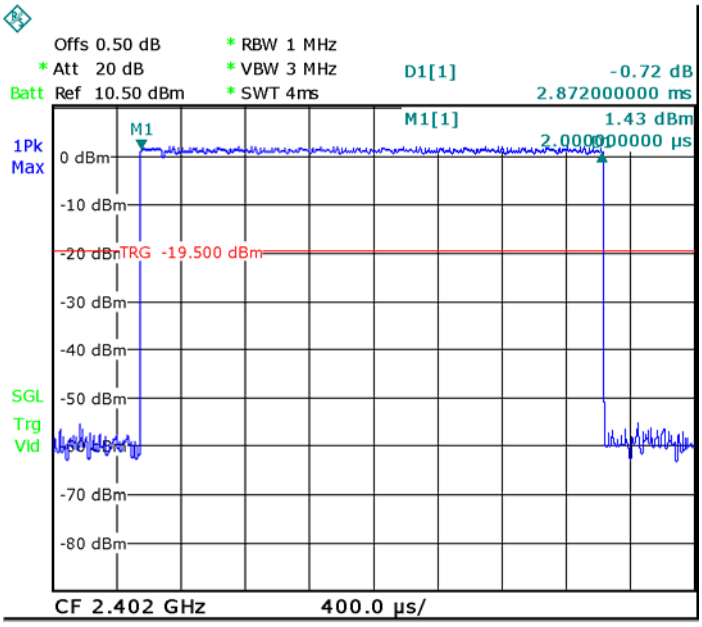
DH5, High channel



8DPSK

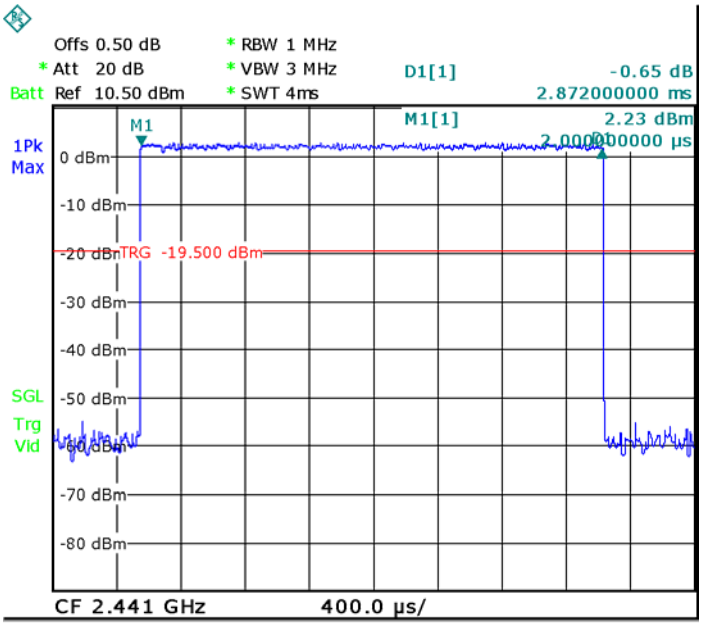
Data Packet:

DH5, Lower channel



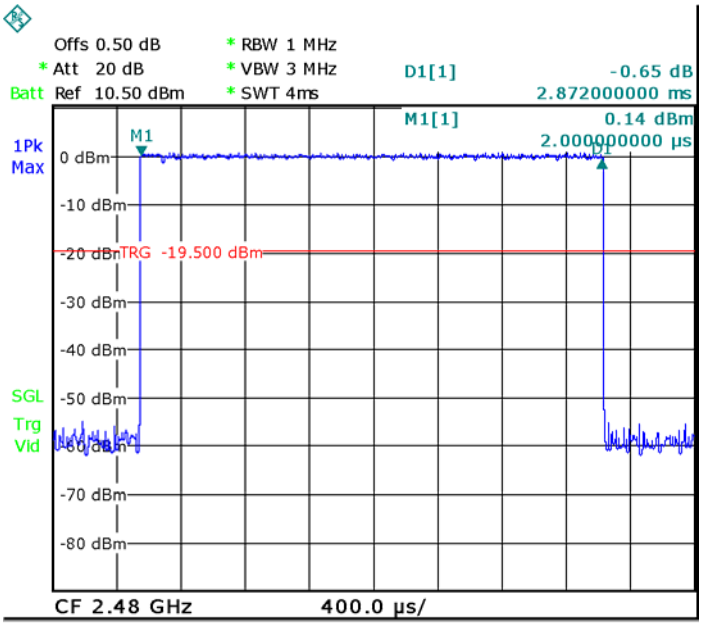
Data Packet:

DH5, Middle channel



Data Packet:

DH5, High channel



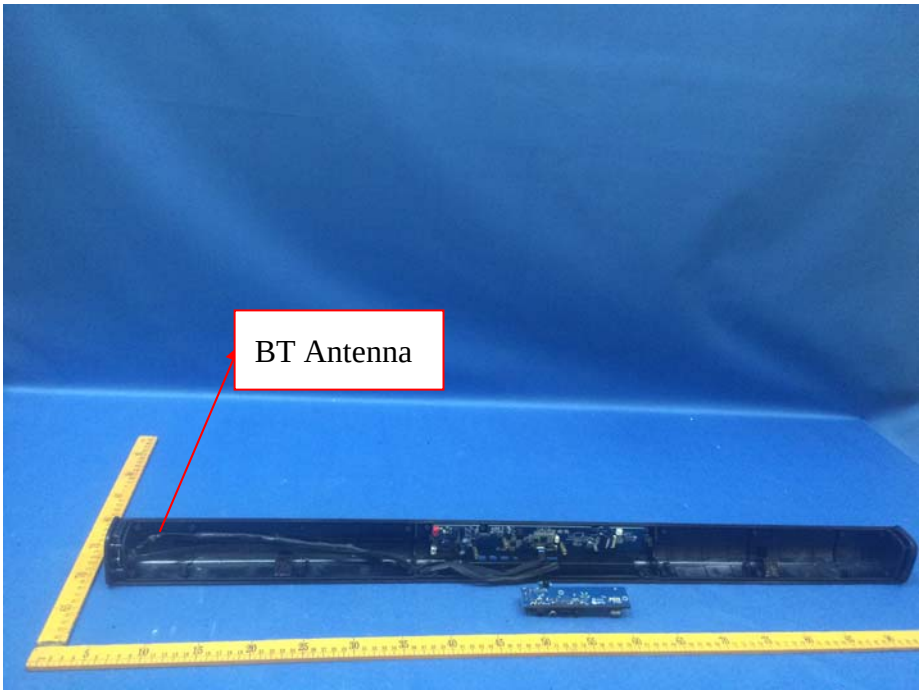
15 Antenna Requirement

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 Integral Antenna, the gain is 0dBi. meets the requirements of FCC 15.203.



16 FCC ID: 2AA3H-ESB2118 RF Exposure Report

Note: Please refer to RF Exposure report: WTD18S01100425-2E.

17 Photographs-Model ESB2118 Test Setup

Note: Please refer to Photos: WTD18S01100425-3E

18 Photographs - Constructional Details

18.1 Model ESB2118–External Photos

Note: Please refer to Photos: WTD18S01100425-3E.

18.2 Model ESB2118–Internal Photos

Note: Please refer to Photos: WTD18S01100425-3E.

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