

# TEST REPORT

Reference No..... : WTS17S0476191-1E V1  
FCC ID ..... : GAO-STAR4  
Applicant..... : Collage Investments LLC  
Address..... : 11437 NW 34 STREET, DORAL, FL 33178, United States  
Manufacturer ..... : Collage Investments LLC  
Address..... : 11437 NW 34 STREET, DORAL, FL 33178, United States  
Product Name..... : MOBILE PHONE  
Model No..... : STAR 4  
Brand..... : SMOOTH  
Standards..... : FCC CFR47 Part 15.247:2016  
Date of Receipt sample .... : Apr. 12, 2017  
Date of Test ..... : Apr. 13 ~ 28, 2017  
Date of Issue..... : May 08, 2017  
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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## 2 Laboratories Introduction

**Waltek Services Test Group Ltd** is a professional third-party testing and certification organization with multi-year product testing and certification experience, established strictly in accordance with ISO/IEC 17025 requirements, and accredited by CNAS (China National Accreditation Service for Conformity Assessment) AQS1Q, CMA and IECEE for CBTL. 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.



**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 and have branches in Foshan, Dongguan, Zhongshan, Suzhou, Ningbo and Hong Kong, Our test capability covered four large fields: safety test. ElectroMagnetic Compatibility(EMC), reliability and energy performance, Chemical test. 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.

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#### 4 Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTS17S0476191-1E	Apr. 12, 2017	Apr. 13 ~ 28, 2017	May 02, 2017	original	-	Replaced
WTS17S0476191-1E V1	Apr.12, 2017	Apr. 13 ~ 28, 2017	May 08, 2017	Version 1	Updated	Valid

## 5 General Information

### 5.1 General Description of E.U.T.

Product Name:	MOBILE PHONE
Model No.:	STAR 4
Model Description:	N/A
GSM Band(s):	GSM 850/900/1800/1900MHz
GPRS/EGPRS Class:	12
WCDMA Band(s):	FDD Band II/V
LTE Band(s):	N/A
Wi-Fi Specification:	2.4G-802.11b/g/n HT20
Bluetooth Version:	Bluetooth v3.0+EDR
GPS:	Support
NFC:	N/A
Hardware Version:	TC4_V1.2
Software Version:	TM_BASE_W17.03.5 _sc7731C_CP0_modem
Highest frequency (Exclude Radio):	1.2GHz
Storage Location:	Internal Storage
Note:	N/A

### 5.2 Details of E.U.T.

Operation Frequency:	GSM/GPRS/EDGE 850: 824~849MHz PCS/GPRS/EDGE 1900: 1850~1910MHz WCDMA Band II: 1850~1910MHz WCDMA Band V: 824~849MHz WiFi: 802.11b/g/n HT20: 2412~2462MHz Bluetooth: 2402~2480MHz
Max. RF output power:	GSM 850: 32.97dBm PCS1900: 30.00dBm WCDMA Band II: 22.60dBm WCDMA Band V: 22.95dBm WiFi(2.4G): 9.48dBm Bluetooth: 9.45dBm
Type of Modulation:	GSM,GPRS: GMSK EDGE: GMSK, 8PSK WCDMA: BPSK, 16QAM WiFi: CCK, OFDM

	Bluetooth: GFSK, Pi/4 DQPSK, 8DPSK
Antenna installation:	GSM/WCDMA: internal permanent antenna WiFi/Bluetooth: internal permanent antenna
Antenna Gain:	GSM 850: 1.7dBi PCS1900: 3.8dBi WCDMA Band II: 3.8dBi WCDMA Band V: 1.7dBi WiFi(2.4G): 3.1dBi Bluetooth: 3.1dBi
Technical Data:	Battery DC 3.7V, 1300mAh DC 5V, 500mA $\pm$ 50mA, charging from adapter (Adapter Input: 100-240V~50/60Hz)
Adapter:	Manufacture: SHENZHEN HELIANSHENG ELECTRONICS TECHNOLOGY CO.,LTD Model No.: C1

### 5.3 Channel List

Normal

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	-	-

### 5.4 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

### 5.5 Test Facility

The test facility has a test site registered with the following organizations:

- IC – Registration No.: 7760A**  
 Waltek Services(Shenzhen) Co., Ltd. Has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files. Registration number 7760A, October 15, 2016.
- FCC Test Site 1#– Registration No.: 880581**  
 Waltek Services(Shenzhen) Co., Ltd. EMC Laboratory `has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 880581, April 29, 2014.
- FCC Test Site 2#– Registration No.: 328995**  
 Waltek Services(Shenzhen) Co., Ltd. EMC Laboratory `has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 328995, December 3, 2014.

Waltek Services (Shenzhen) Co.,Ltd.

<http://www.waltek.com.cn>



## 6 Test Summary

Test Items	Test Requirement	Result
Radiated Spurious Emissions	15.205(a) 15.209 15.247(d)	PASS
Conducted Spurious emissions	15.247(d)	PASS
Band edge	15.247(d) 15.205(a)	PASS
Conduct Emission	15.207	PASS
20dB Bandwidth	15.247(a)(1)	PASS
Maximum Peak Output Power	15.247(b)(1)	PASS
Frequency Separation	15.247(a)(1)	PASS
Number of Hopping Frequency	15.247(a)(1)(iii)	PASS
Dwell time	15.247(a)(1)(iii)	PASS
Antenna Requirement	15.203	Complies
Maximum Permissible Exposure (Exposure of Humans to RF Fields)	1.1307(b)(1)	PASS

## 7 Equipment Used during Test

### 7.1 Equipments List

Conducted Emissions Test Site 1#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMI Test Receiver	R&S	ESCI	100947	Sep.12,2016	Sep.11,2017
2.	LISN	R&S	ENV216	101215	Sep.12,2016	Sep.11,2017
3.	Cable	Top	TYPE16(3.5M)	-	Sep.12,2016	Sep.11,2017
Conducted Emissions Test Site 2#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMI Test Receiver	R&S	ESCI	101155	Sep.12,2016	Sep.11,2017
2.	LISN	SCHWARZBECK	NSLK 8128	8128-289	Sep.12,2016	Sep.11,2017
3.	Limiter	York	MTS-IMP-136	261115-001-0024	Sep.12,2016	Sep.11,2017
4.	Cable	LARGE	RF300	-	Sep.12,2016	Sep.11,2017
3m Semi-anechoic Chamber for Radiation Emissions Test site 1#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	Spectrum Analyzer	R&S	FSP	100091	Apr.29, 2016	Apr.28, 2017
2	Active Loop Antenna	Beijing Dazhi	ZN30900A	-	Apr.09,2017	Apr.08,2018
3	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	Apr.09,2017	Apr.08,2018
4	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	Sep.12,2016	Sep.11,2017
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	Apr.09,2017	Apr.08,2018
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	Apr.09,2017	Apr.08,2018
7	Broadband Pre-amplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	Apr.13,2017	Apr.12,2018
8	Coaxial Cable (above 1GHz)	Top	1GHz-25GHz	EW02014-7	Apr.13,2017	Apr.12,2018
3m Semi-anechoic Chamber for Radiation Emissions Test site 2#						
Item	Equipment	Manufacturer	Model No.	Serial No	Last Calibration Date	Calibration Due Date
1	Test Receiver	R&S	ESCI	101296	Apr.13,2017	Apr.12,2018
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	Apr.09,2017	Apr.08,2018
3	Amplifier	Compliance pirection systems inc	PAP-0203	22024	Apr.13,2017	Apr.12,2018
4	Cable	HUBER+SUHNER	CBL2	525178	Apr.13,2017	Apr.12,2018

RF Conducted Testing						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMC Analyzer (9k~26.5GHz)	Agilent	E7405A	MY45114943	Sep.12,2016	Sep.11,2017
2.	Spectrum Analyzer (9k-6GHz)	R&S	FSL6	100959	Sep.12,2016	Sep.11,2017
3.	Signal Analyzer (9k~26.5GHz)	Agilent	N9010A	MY50520207	Sep.12,2016	Sep.11,2017

## 7.2 Description of Support Units

Equipment	Manufacturer	Model No.	Series No.
/	/	/	/

## 7.3 Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-6}$
RF Power	$\pm 1.0$ dB
RF Power Density	$\pm 2.2$ dB
Radiated Spurious Emissions test	$\pm 5.03$ dB (Bilog antenna 30M~1000MHz)
	$\pm 5.47$ dB (Horn antenna 1000M~25000MHz)
Conducted Emissions test	$\pm 3.64$ dB (AC mains 150KHz~30MHz)
Conducted Spurious Emissions test	$\pm 3.12$ dB (9kHz~30MHz)
	$\pm 4.21$ dB (30M~1000MHz)
	$\pm 5.14$ dB (1000M~26500MHz)
Confidence interval: 95%. Confidence factor:k=2	

## 7.4 Test Equipment Calibration

All the test equipments used are valid and calibrated by CEPREI Certification Body that address is No.110 Dongguan Zhuang RD. Guangzhou, P.R.China.

## 8 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 (dB $\mu$ V)	
	Q asi-peak	A erage
0.1 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	60
5 to 30	60	50

### 8.1 E.U.T. Operation

Operating Environment :

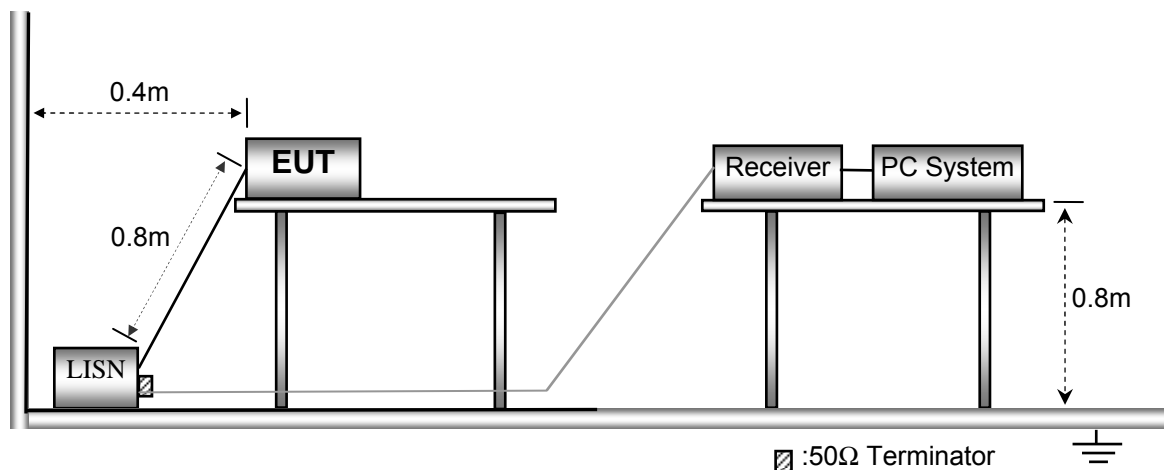
Temperature: 22.8 °C  
 Humidity: 52.6 % RH  
 Atmospheric Pressure: 101.2kPa

EUT Operation :

The test was performed in TX Transmitting mode, the test data were shown in the report.

### 8.2 EUT Setup

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



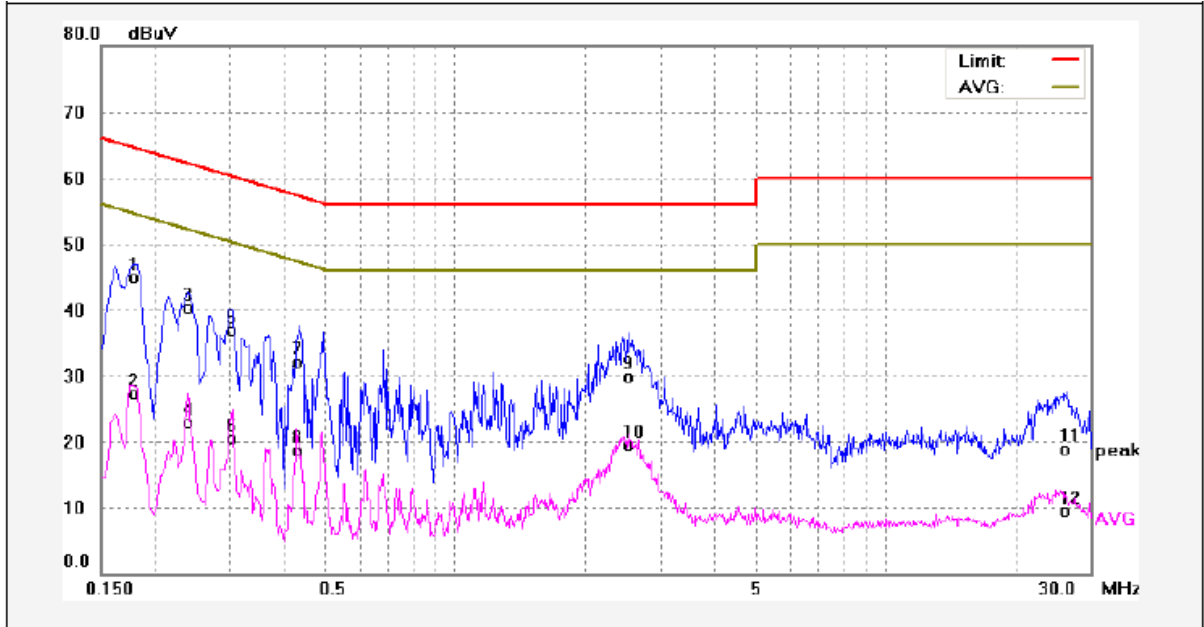
### 8.3 Measurement Description

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.

### 8.4 Conducted Emission Test Result

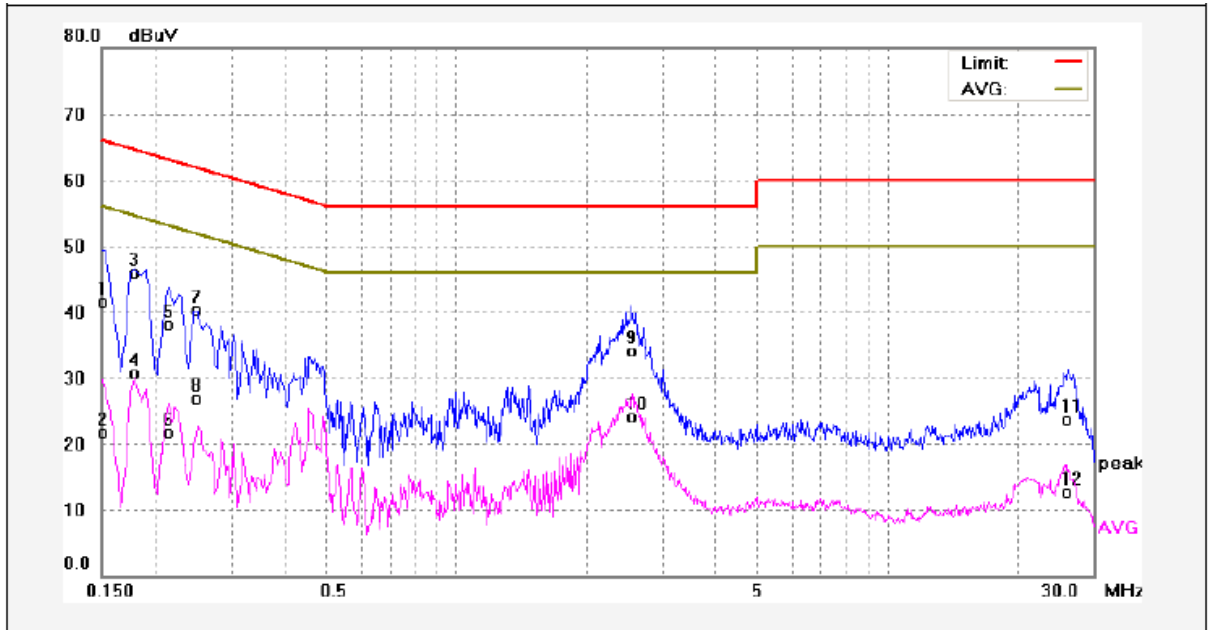
Remark: only the worst data (GFSK modulation Low channel mode) were reported

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1780	35.21	9.63	44.84	64.57	-19.73	QP	
2	0.1780	17.69	9.63	27.32	54.57	-27.25	AVG	
3	0.2380	30.76	9.64	40.40	62.16	-21.76	QP	
4	0.2380	13.32	9.64	22.96	52.16	-29.20	AVG	
5	0.2980	27.22	9.64	36.86	60.30	-23.44	QP	
6	0.2980	10.88	9.64	20.52	50.30	-29.78	AVG	
7	0.4340	22.40	9.64	32.04	57.18	-25.14	QP	
8	0.4340	8.99	9.64	18.63	47.18	-28.55	AVG	
9	2.5140	19.87	9.94	29.81	56.00	-26.19	QP	
10	2.5140	9.59	9.94	19.53	46.00	-26.47	AVG	
11	26.6620	8.50	10.41	18.91	60.00	-41.09	QP	
12	26.6620	-0.94	10.41	9.47	50.00	-40.53	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1500	31.85	9.64	41.49	65.99	-24.50	QP	
2	0.1500	12.11	9.64	21.75	55.99	-34.24	AVG	
3	0.1780	36.25	9.63	45.88	64.57	-18.69	QP	
4	0.1780	21.07	9.63	30.70	54.57	-23.87	AVG	
5	0.2140	28.51	9.63	38.14	63.04	-24.90	QP	
6	0.2140	12.03	9.63	21.66	53.04	-31.38	AVG	
7	0.2460	30.66	9.64	40.30	61.89	-21.59	QP	
8	0.2460	17.29	9.64	26.93	51.89	-24.96	AVG	
9	2.5420	24.21	9.94	34.15	56.00	-21.85	QP	
10	2.5420	14.14	9.94	24.08	46.00	-21.92	AVG	
11	26.2460	13.29	10.40	23.69	60.00	-36.31	QP	
12	26.2460	2.25	10.40	12.65	50.00	-37.35	AVG	

## 9 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(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	$20\log^{(500)}$

### 9.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

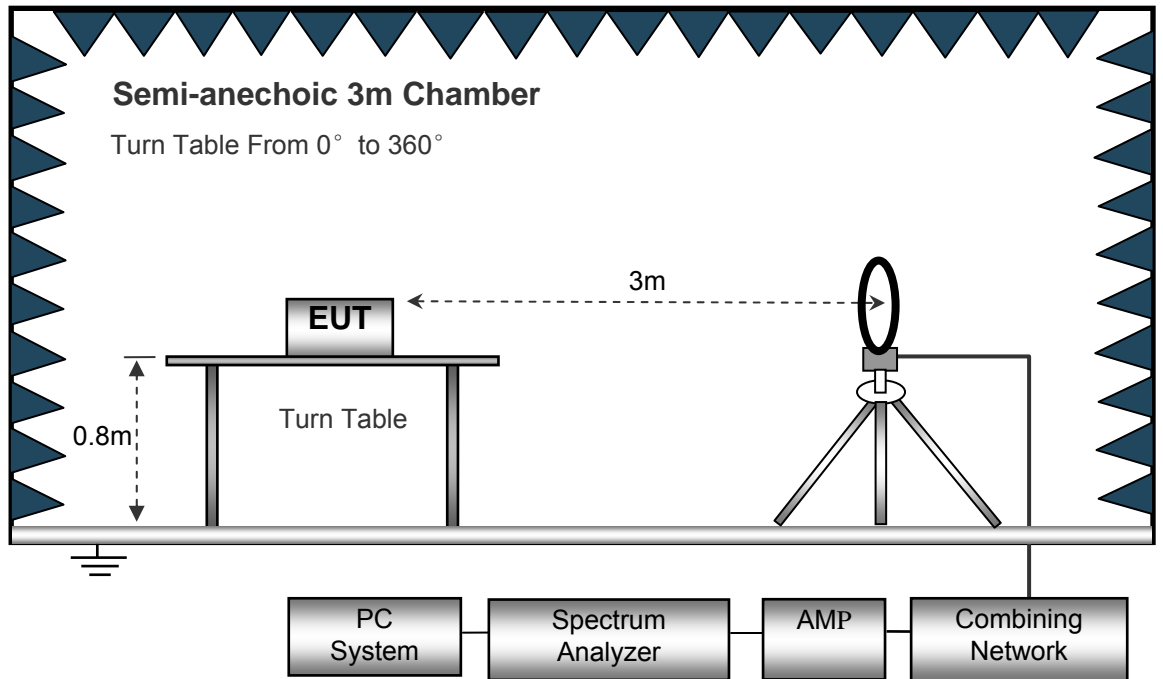
EUT Operation :

The test was performed in TX Transmitting mode, the test data were shown in the report.

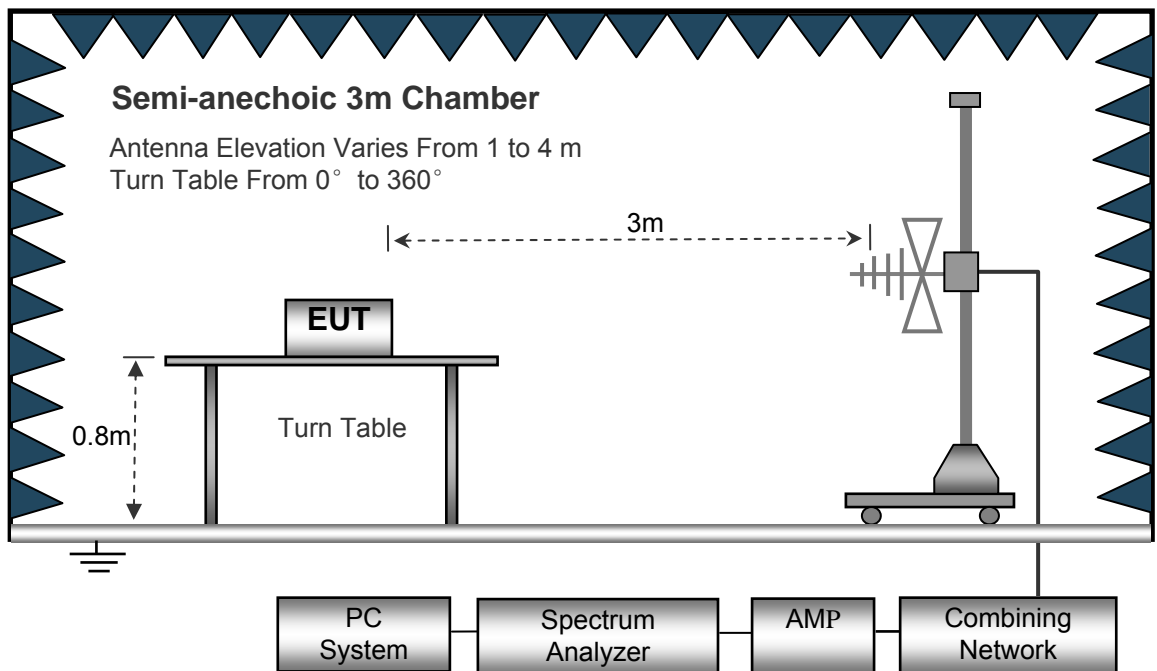
## 9.2 Test Setup

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.

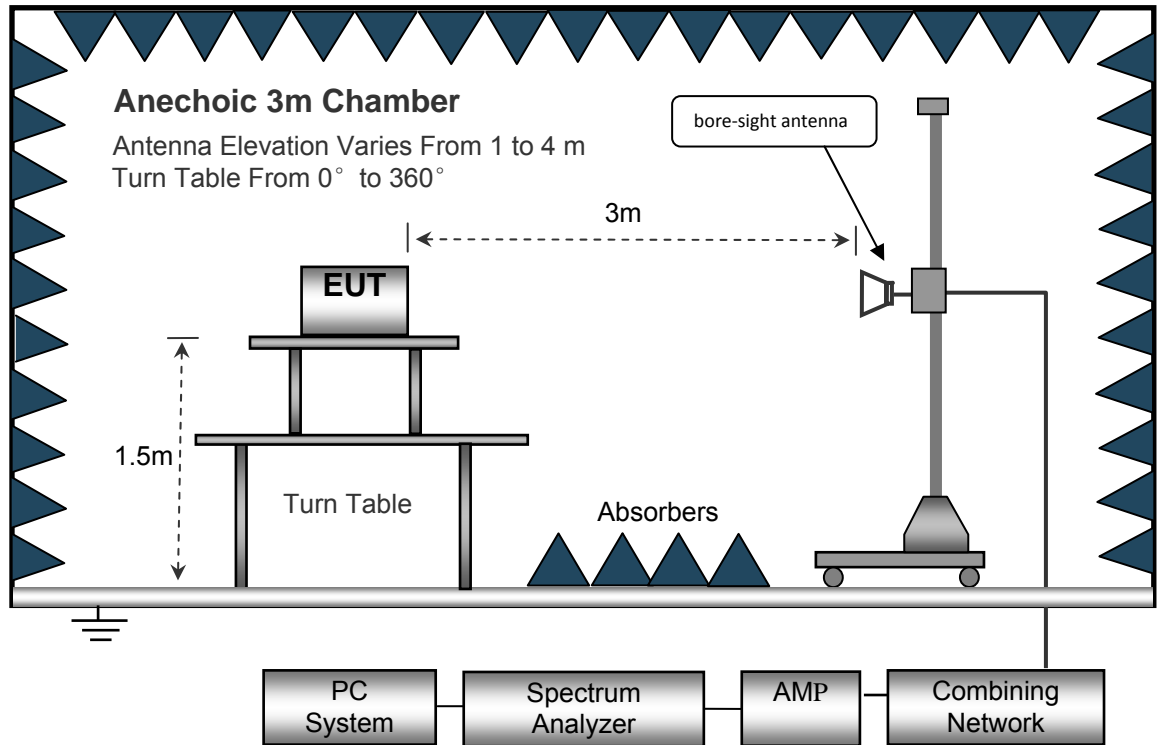


The test setup for emission measurement from 30 MHz to 1 GHz.





The test setup for emission measurement above 1 GHz.



### 9.3 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

## 9.4 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 Z position. So the data shown was the Z position only.

## 9.5 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:

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

### 9.6 Summary of Test Results

#### Test Frequency: 9KHz~30MHz

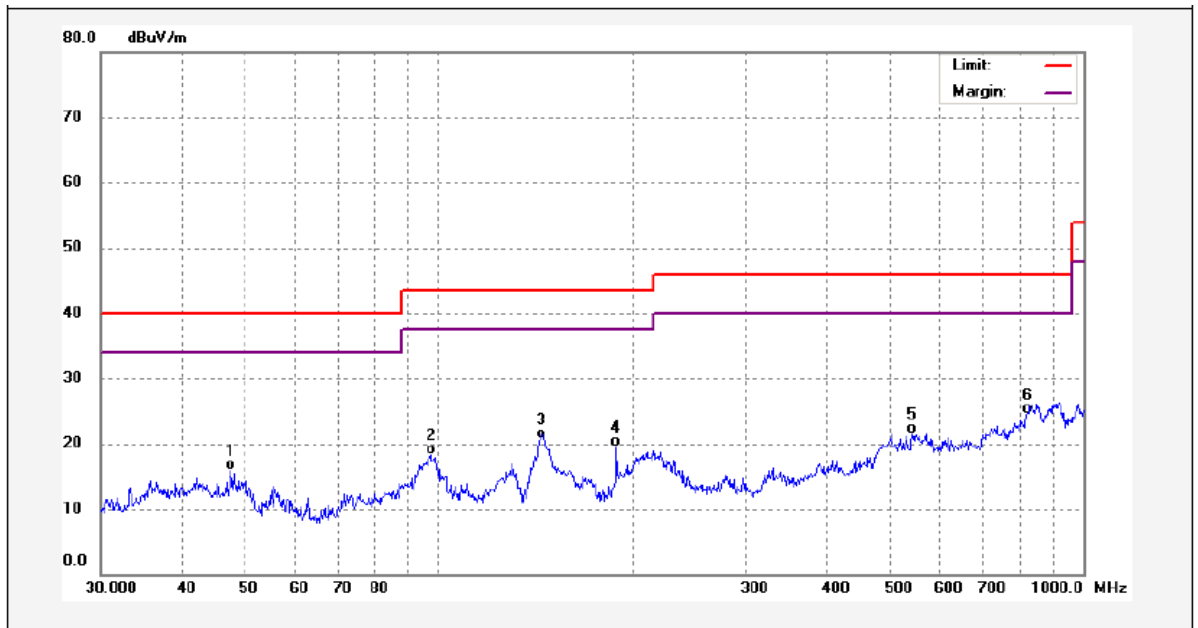
Remark: only the worst data (GFSK modulation Low channel mode) were reported

Frequency	Measurement results dB $\mu$ V @3m	Detector PK/QP	Correct factor dB/m	Extrapolation factor dB	Measurement results (calculated) dB $\mu$ V/m @30m	Limits dB $\mu$ V/m @30m	Margin dB
(MHz)	Measurement results	Detector	Correct factor	Extrapolation factor	Measurement results (calculated)	Limits	Margin
6.025	24.63	QP	21.84	40.00	6.47	29.54	-23.07
8.368	25.31	QP	21.02	40.00	6.33	29.54	-23.21
25.639	25.04	QP	20.55	40.00	5.59	29.54	-23.95

#### Test Frequency: 30MHz ~ 1GHz

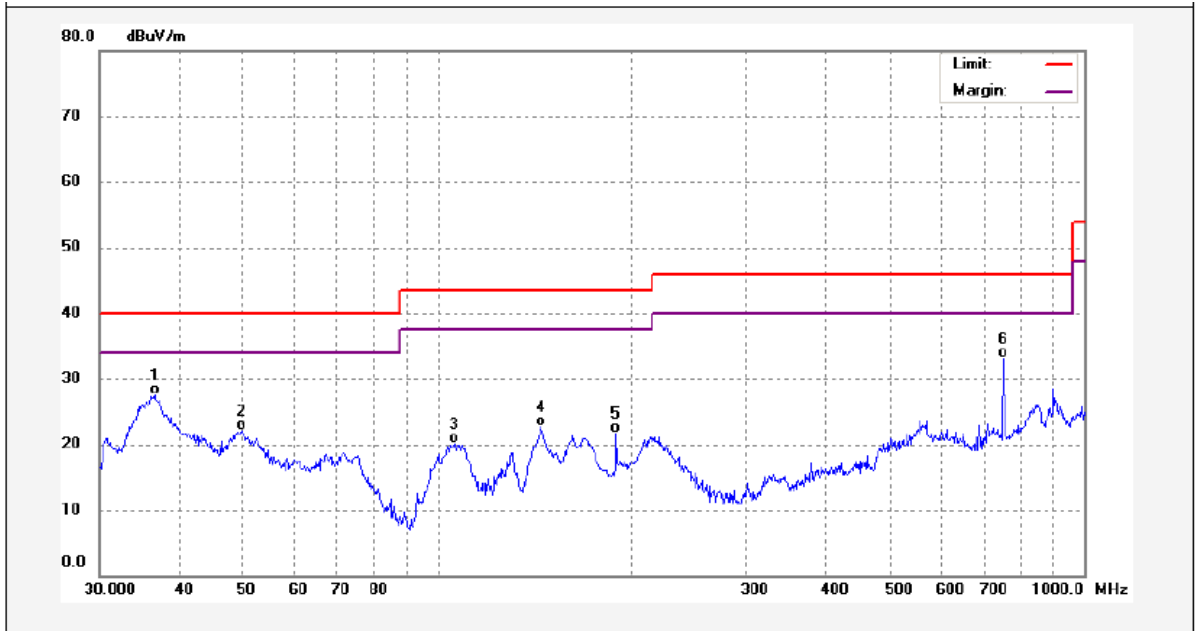
Remark: only the worst data (GFSK modulation Low Channel mode) were reported.

Low Channel - Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	47.6586	31.54	-15.58	15.96	40.00	-24.04	QP	
2	97.4560	39.19	-20.89	18.30	43.50	-25.20	QP	
3	143.8295	38.86	-18.22	20.64	43.50	-22.86	QP	
4	189.0743	36.96	-17.38	19.58	43.50	-23.92	QP	
5	543.2742	30.47	-8.91	21.56	46.00	-24.44	QP	
6	815.9678	28.62	-4.17	24.45	46.00	-21.55	QP	

Low Channel – Vertical

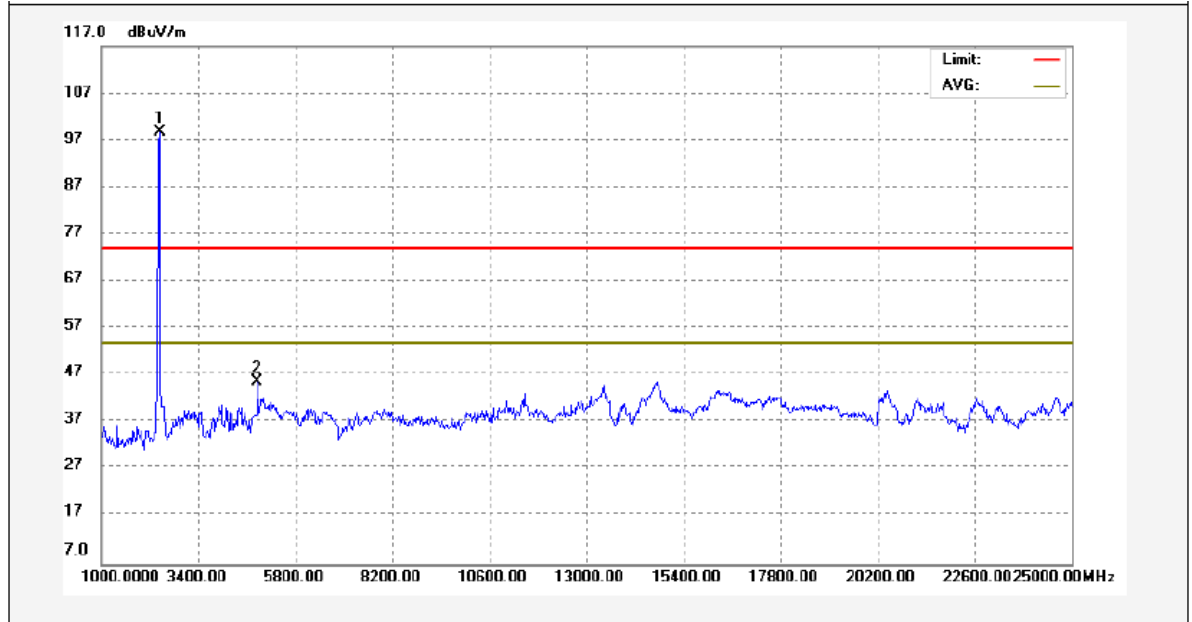


No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	36.5092	42.75	-15.29	27.46	40.00	-12.54	QP	
2	49.7068	37.65	-15.62	22.03	40.00	-17.97	QP	
3	106.0126	39.67	-19.58	20.09	43.50	-23.41	QP	
4	144.3348	40.85	-18.21	22.64	43.50	-20.86	QP	
5	189.0743	39.18	-17.38	21.80	43.50	-21.70	QP	
6	750.1083	39.84	-6.69	33.15	46.00	-12.85	QP	

**Test Frequency: Above 1GHz**

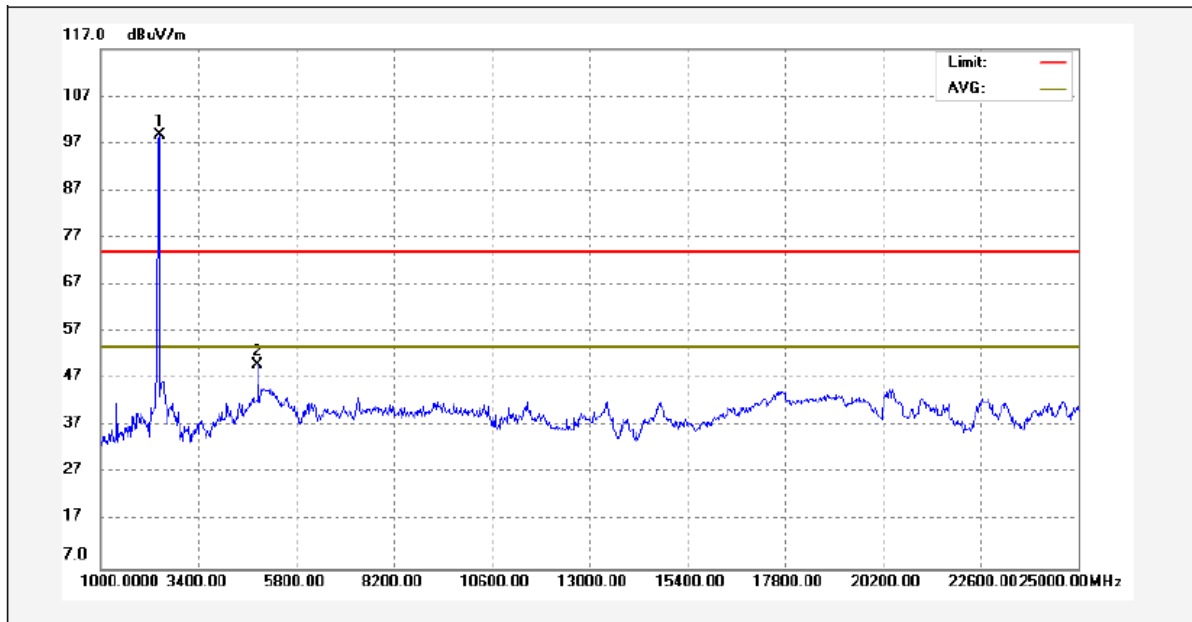
Remark: only the worst data (GFSK modulation Middle Channel mode) were reported

Middle Channel - Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2440.000	113.99	-15.31	98.68				
2	4864.000	47.48	-1.93	45.55	74.00	-28.45	peak	

Middle Channel – Vertical



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2440.000	113.99	-15.31	98.68				
2	4864.000	51.98	-1.93	50.05	74.00	-23.95	peak	

## 10 Conducted Spurious Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: ANSI C63.10: 2013

Test Result: PASS

Limit:

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 Section 15.209(a) is not required. 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)).

### 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:

Below 1GHz:

RBW = 100kHz, VBW = 300kHz, Sweep = auto

Detector function = peak, Trace = max hold

Above 1GHz:

RBW = 100kHz, VBW = 300kHz, Sweep = auto

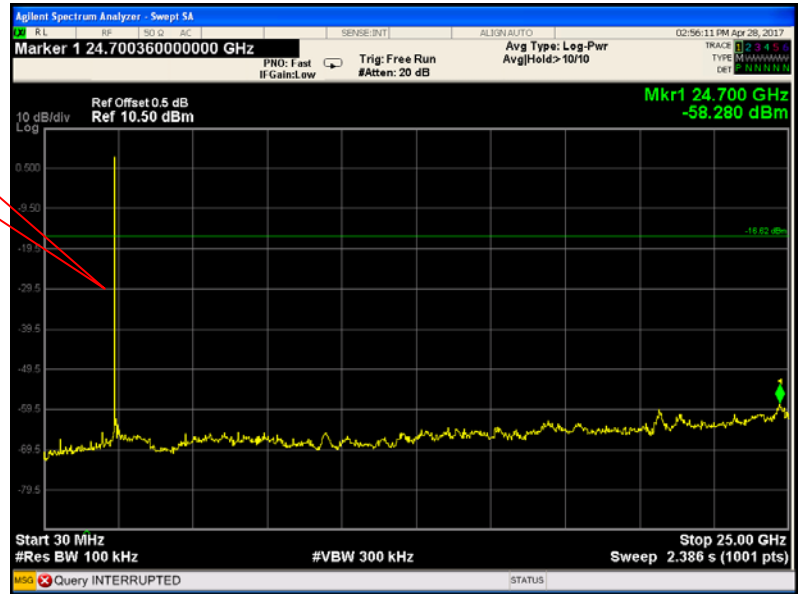
Detector function = peak, Trace = max hold

### 10.2 Test Result

#### 30MHz – 25GHz

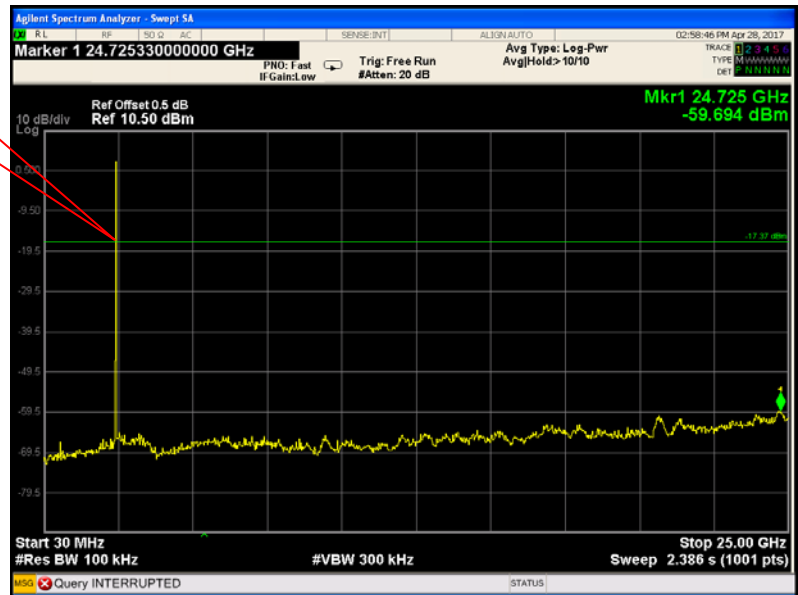
#### GFSK Low Channel

Fundamental



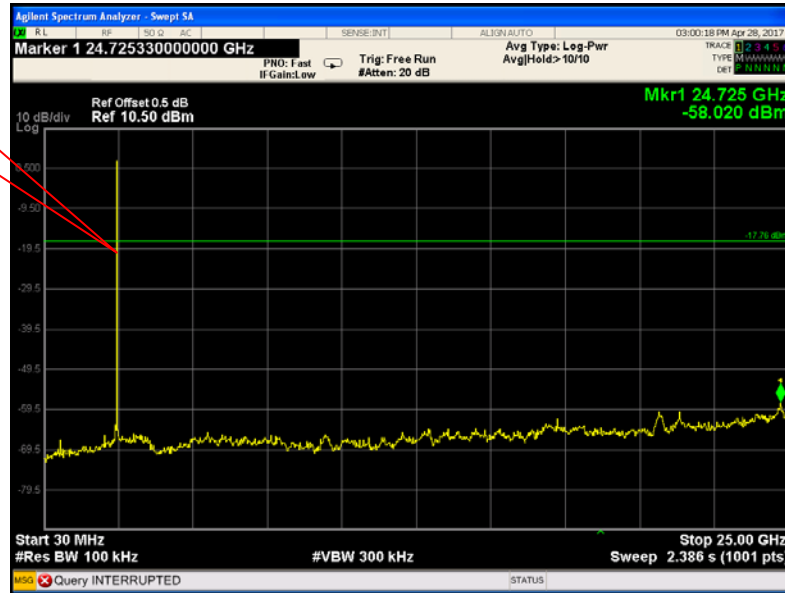
#### GFSK Middle Channel

Fundamental



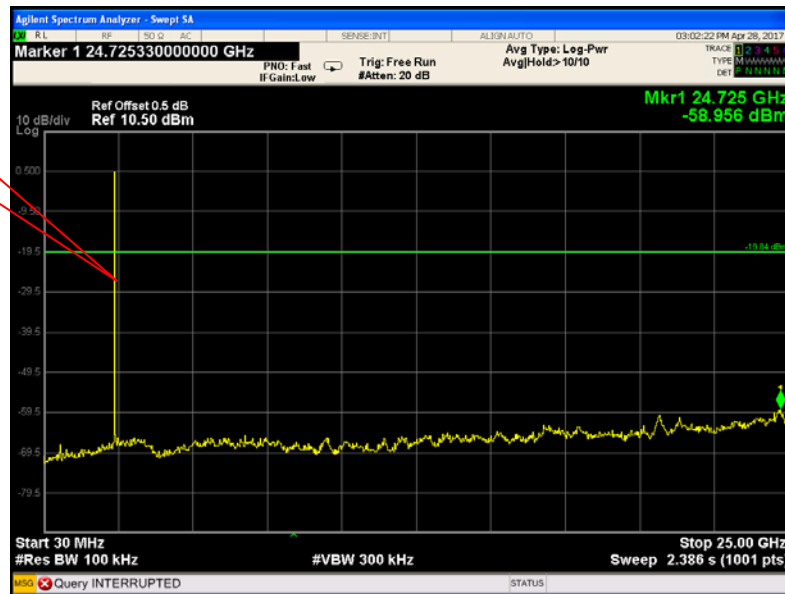
GFSK High Channel

Fundamental



Pi/4 DQPSK Low Channel

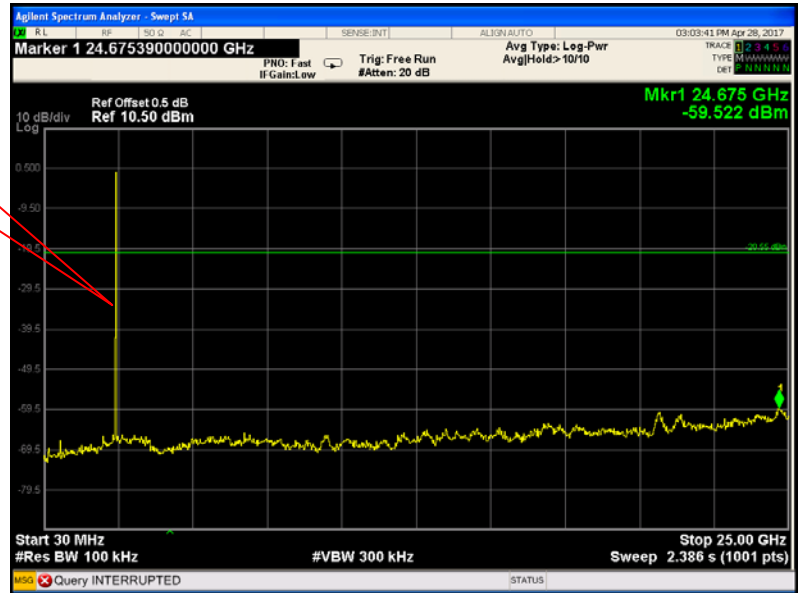
Fundamental





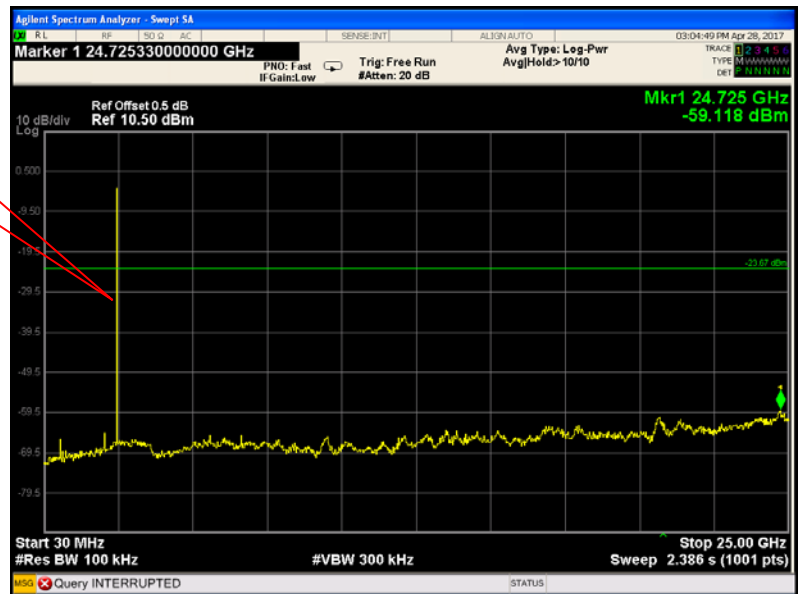
Pi/4 DQPSK Middle Channel

Fundamental



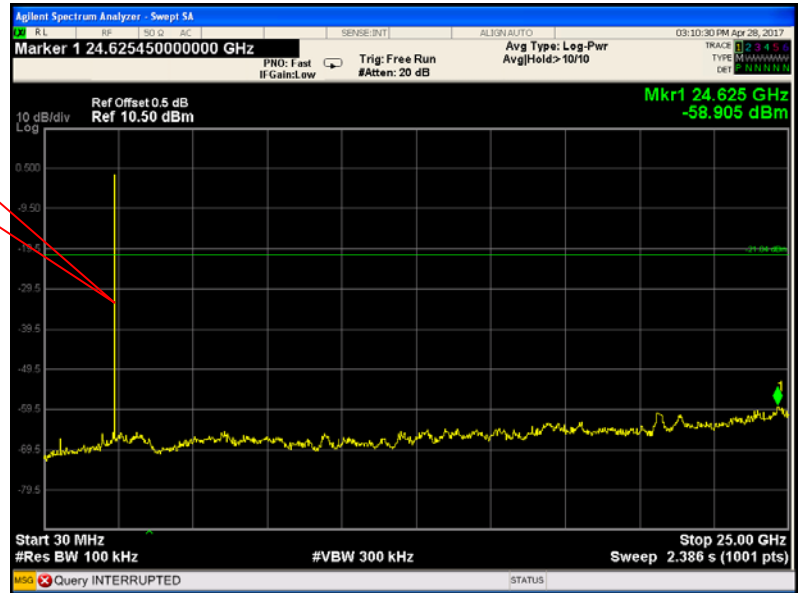
Pi/4 DQPSK High Channel

Fundamental



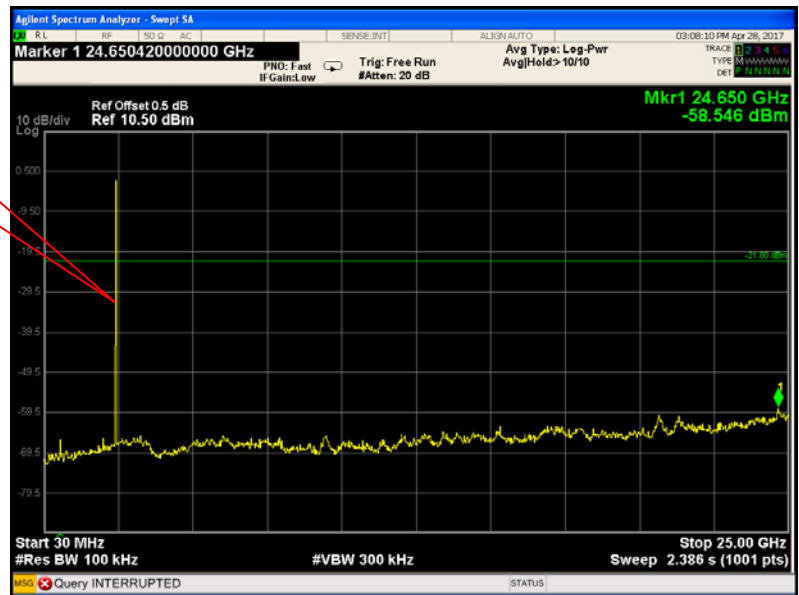
8DPSK Low Channel

Fundamental



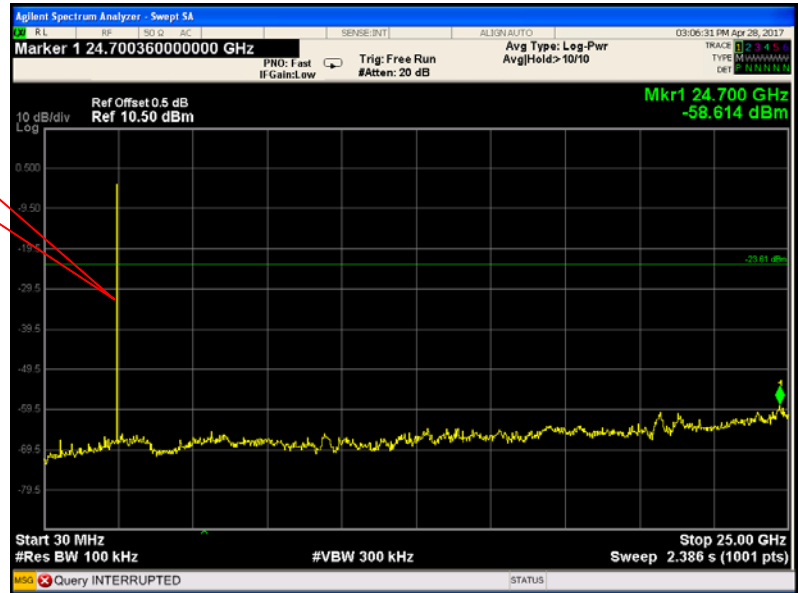
8DPSK Middle Channel

Fundamental



8DPSK High Channel

Fundamental



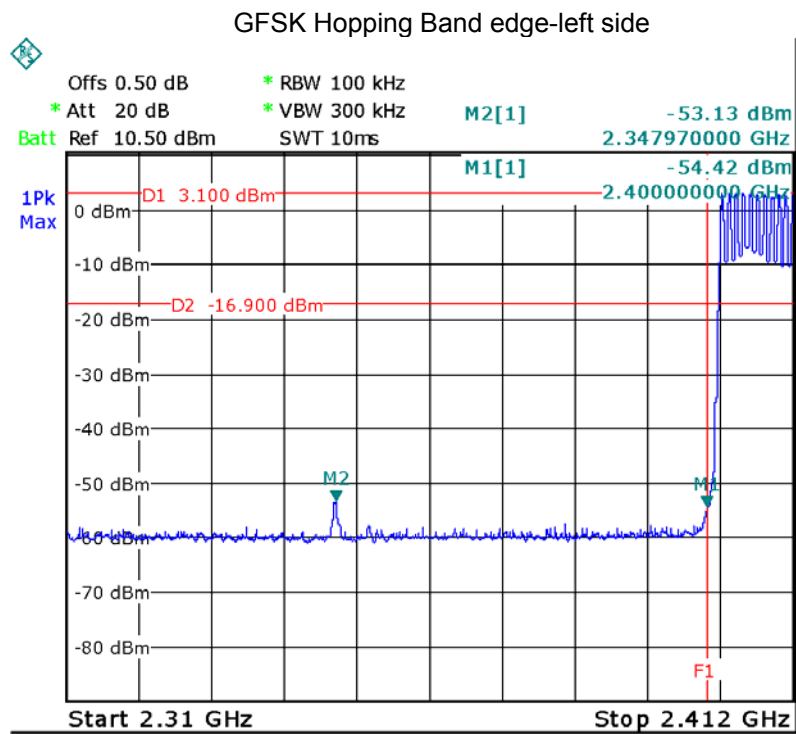
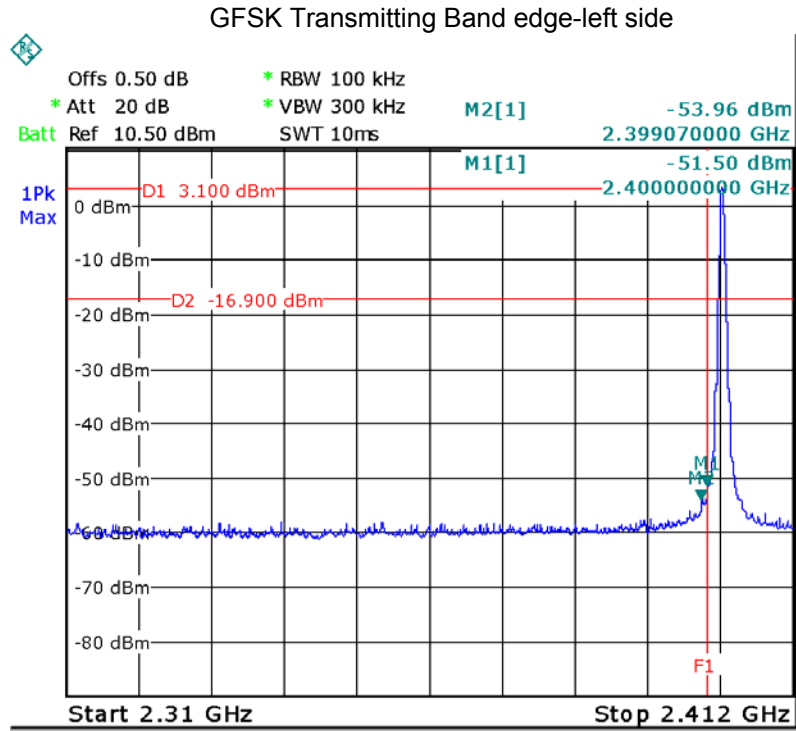
## 11 Band Edge Measurement

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

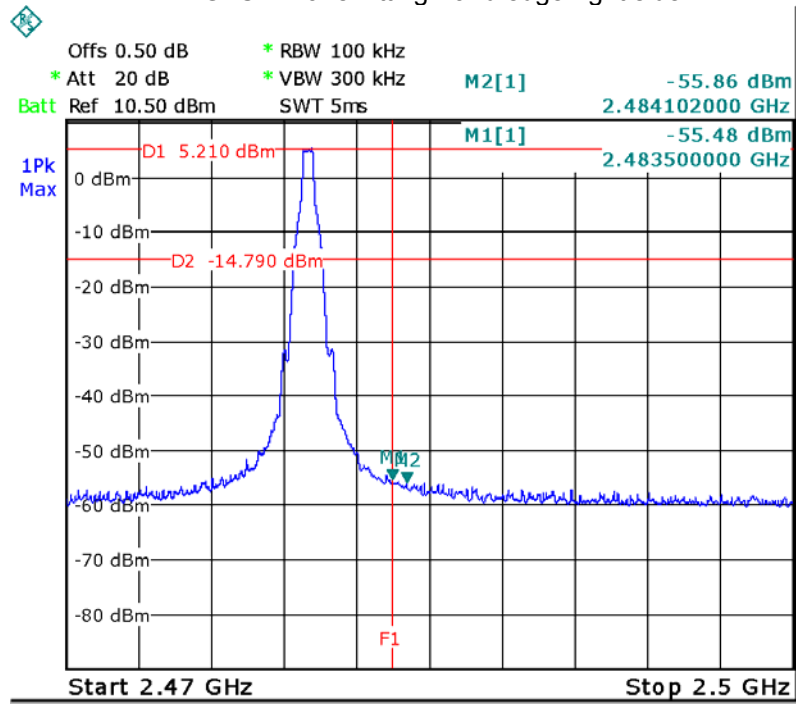
### 11.1 Test Procedure

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

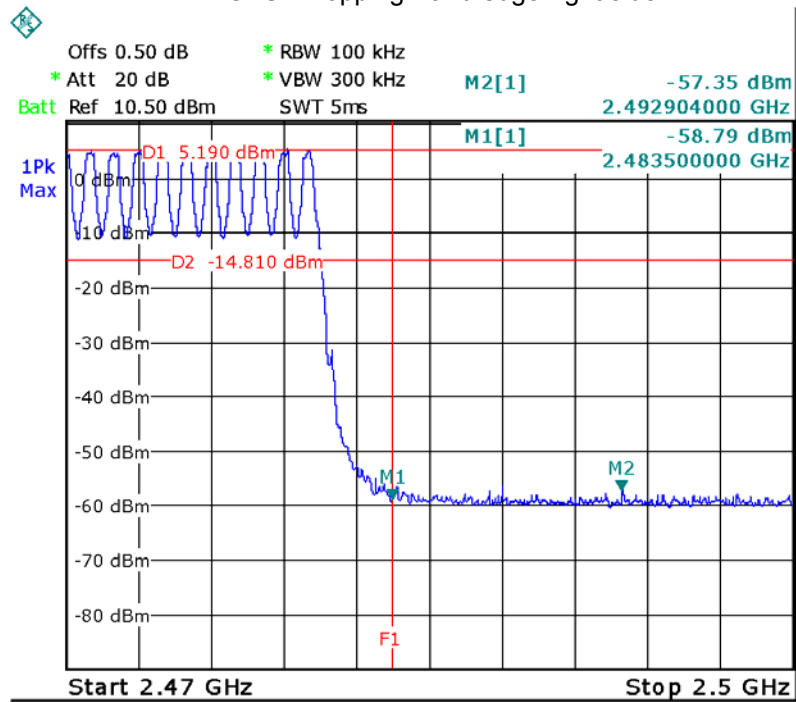
### 11.2 Test Result



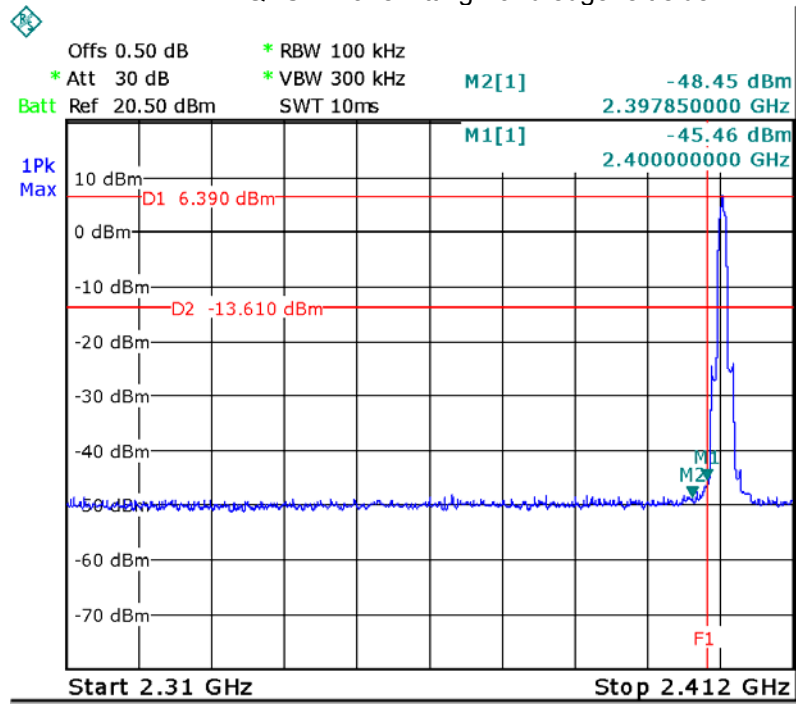
GFSK Transmitting Band edge-right side



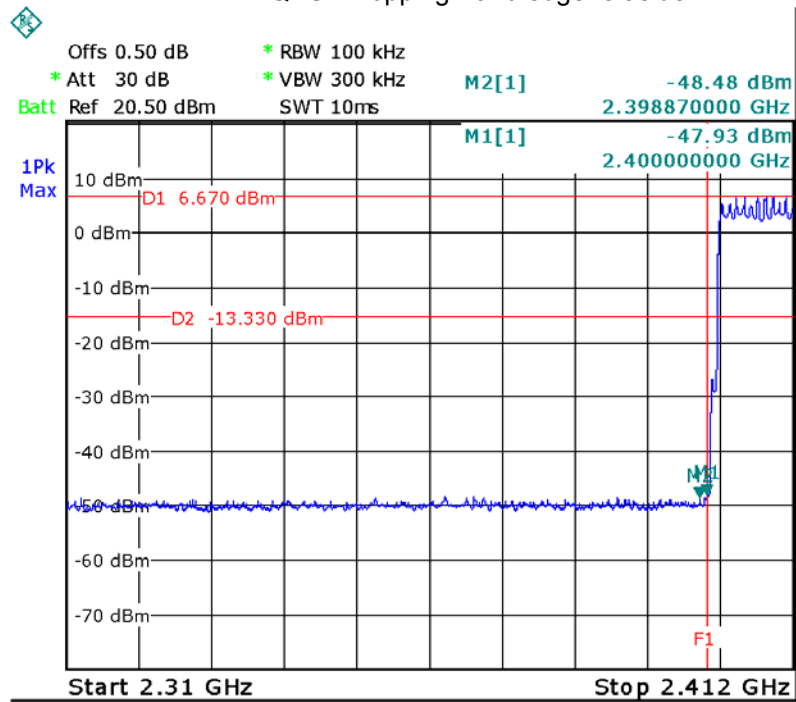
GFSK Hopping Band edge-right side



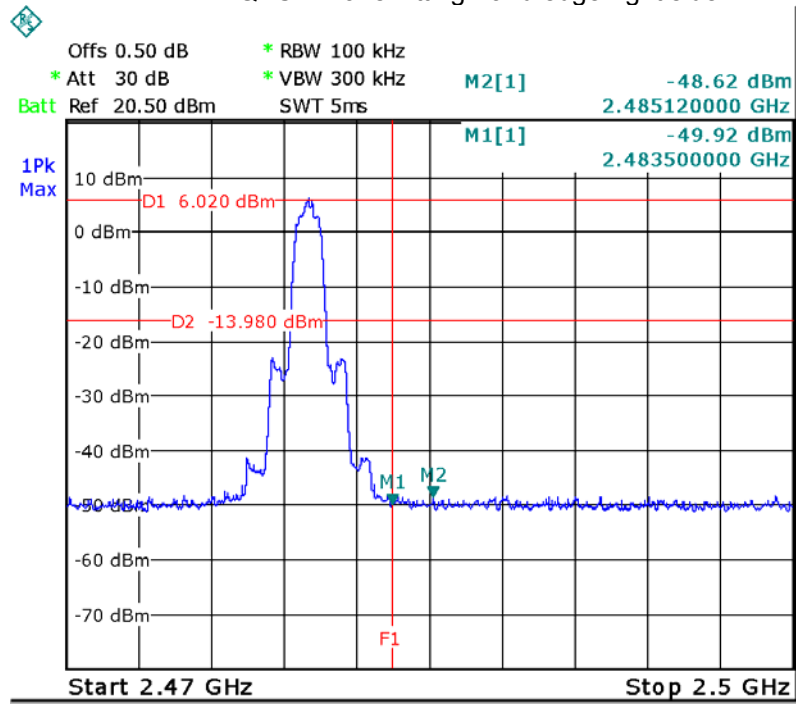
Pi/4 DQPSK Transmitting Band edge-left side



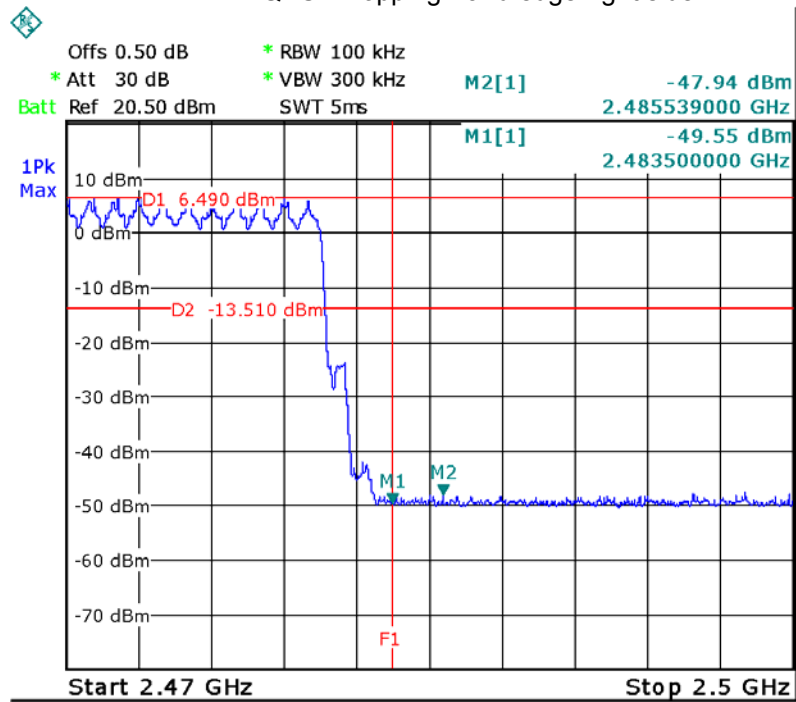
Pi/4 DQPSK Hopping Band edge-left side



Pi/4 DQPSK Transmitting Band edge-right side

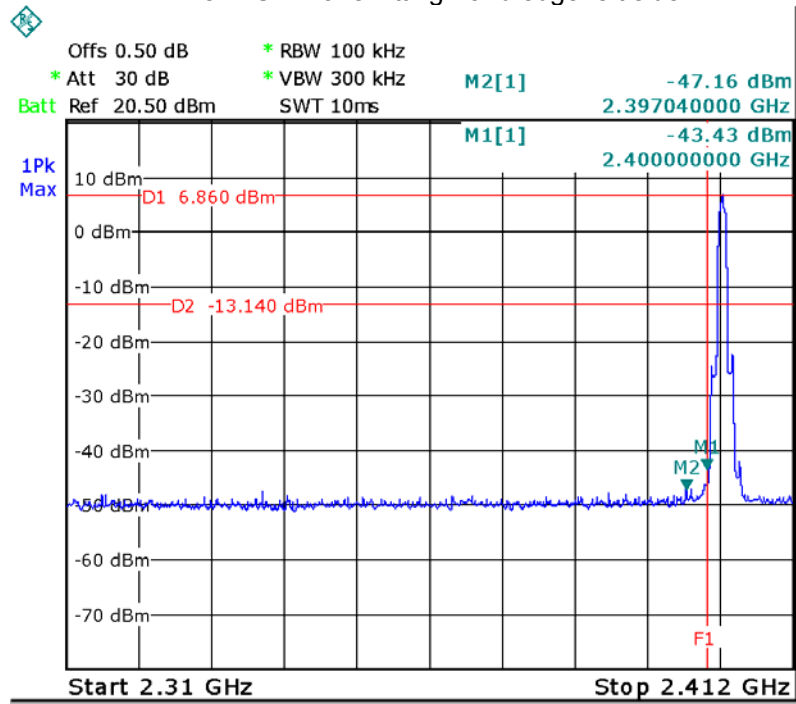


Pi/4 DQPSK Hopping Band edge-right side

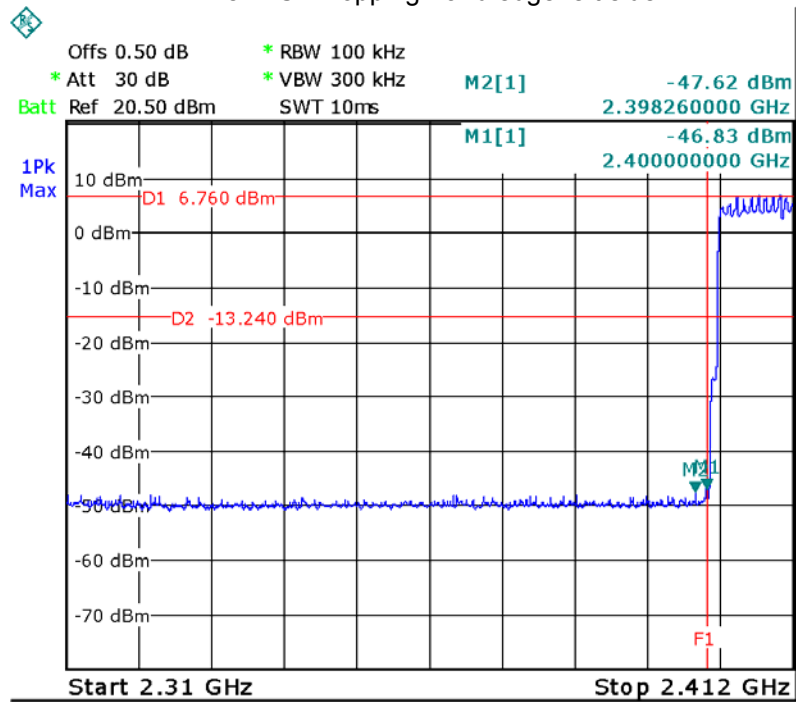


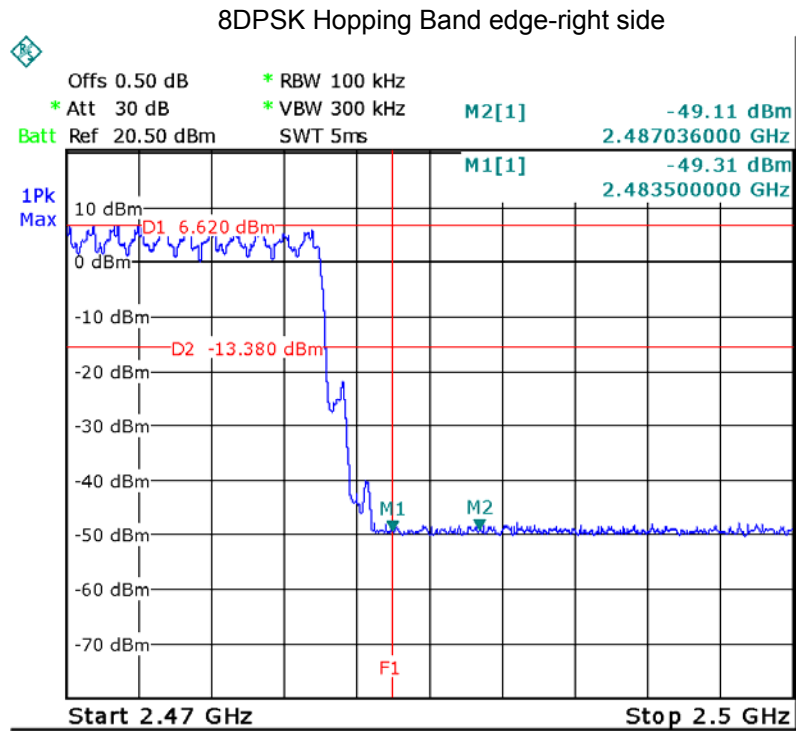
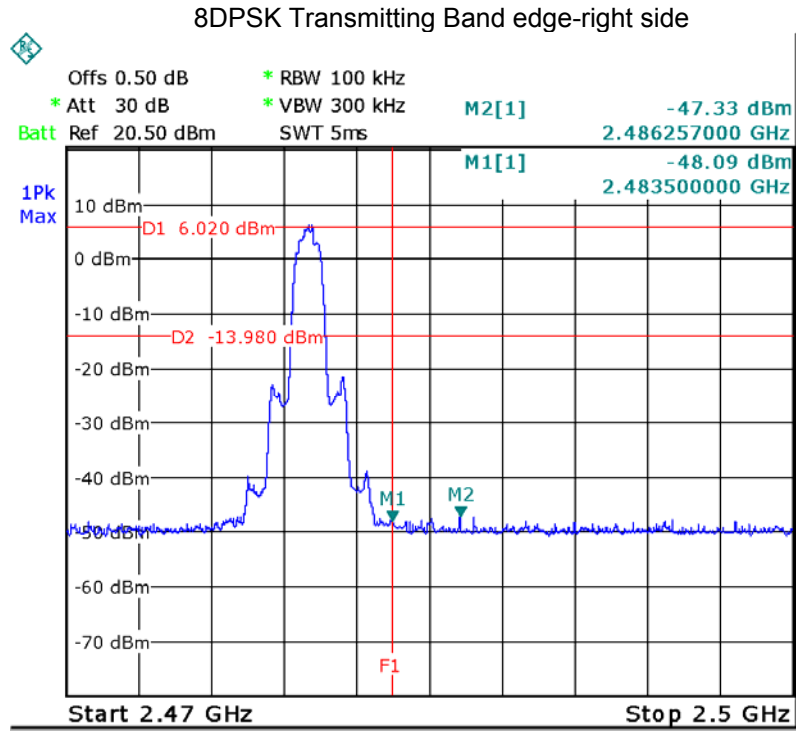


8DPSK Transmitting Band edge-left side

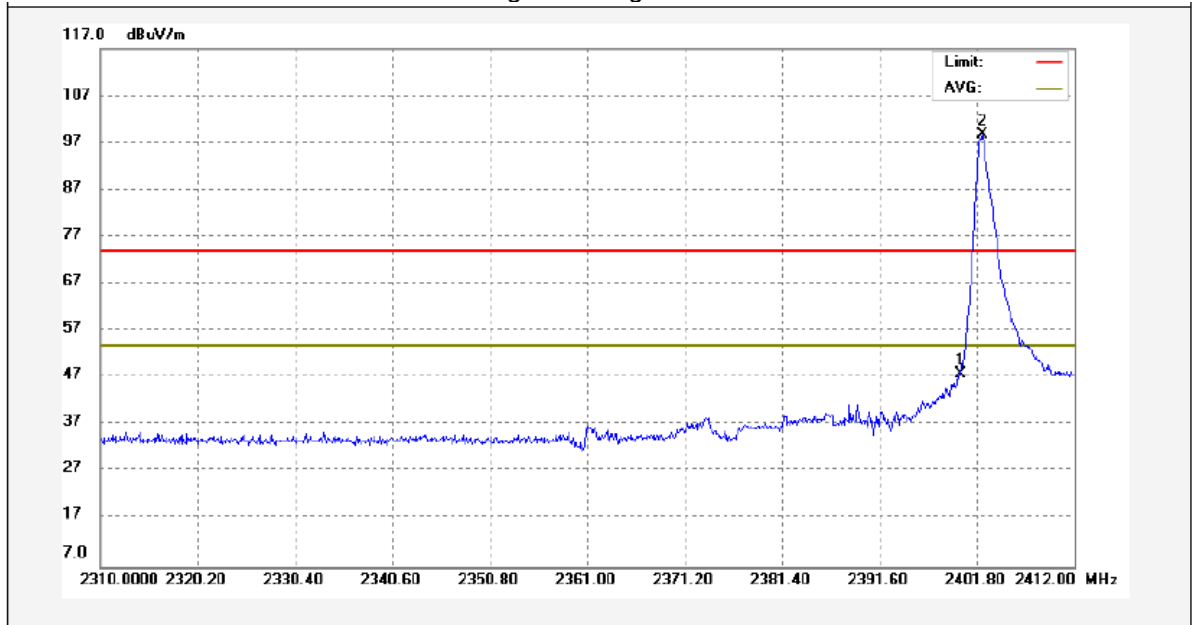


8DPSK Hopping Band edge-left side



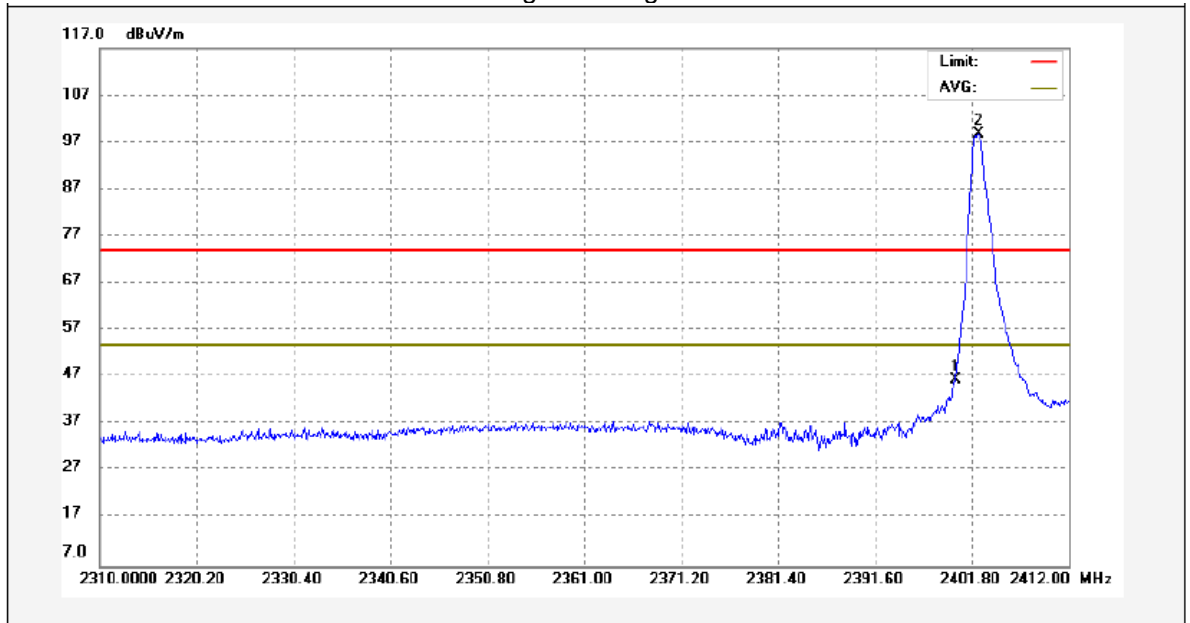


GFSK Transmitting Band edge-left side Horizontal



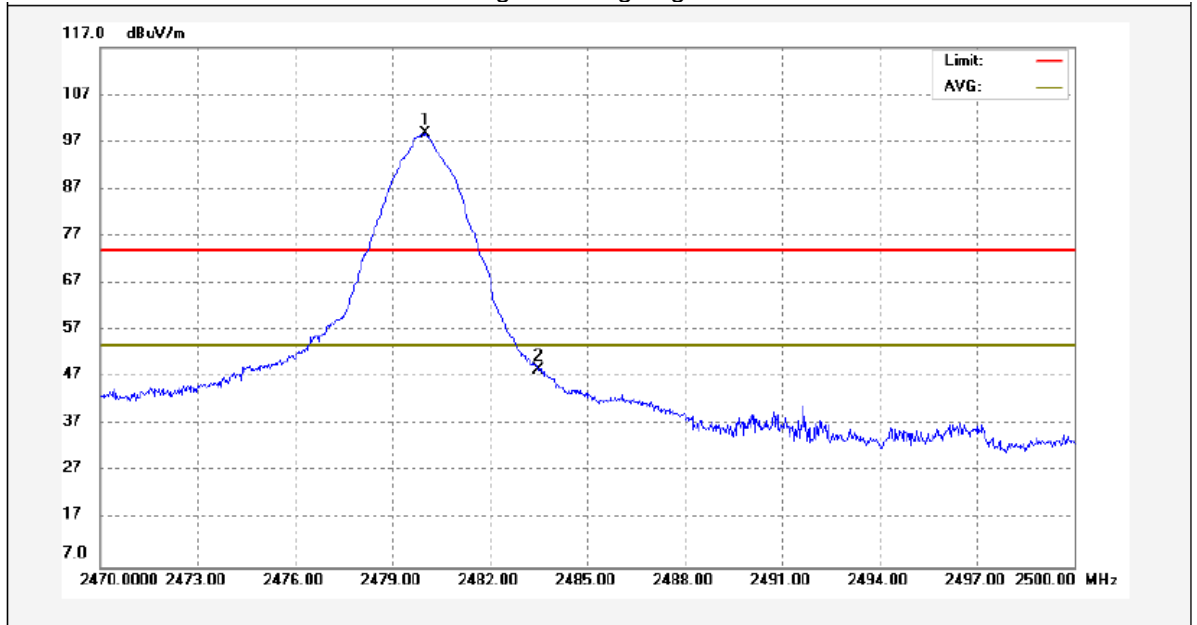
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2400.000	63.07	-15.24	47.83	74.00	-26.17	peak	
2	2402.412	113.87	-15.24	98.63				

GFSK Transmitting Band edge-left side Vertical



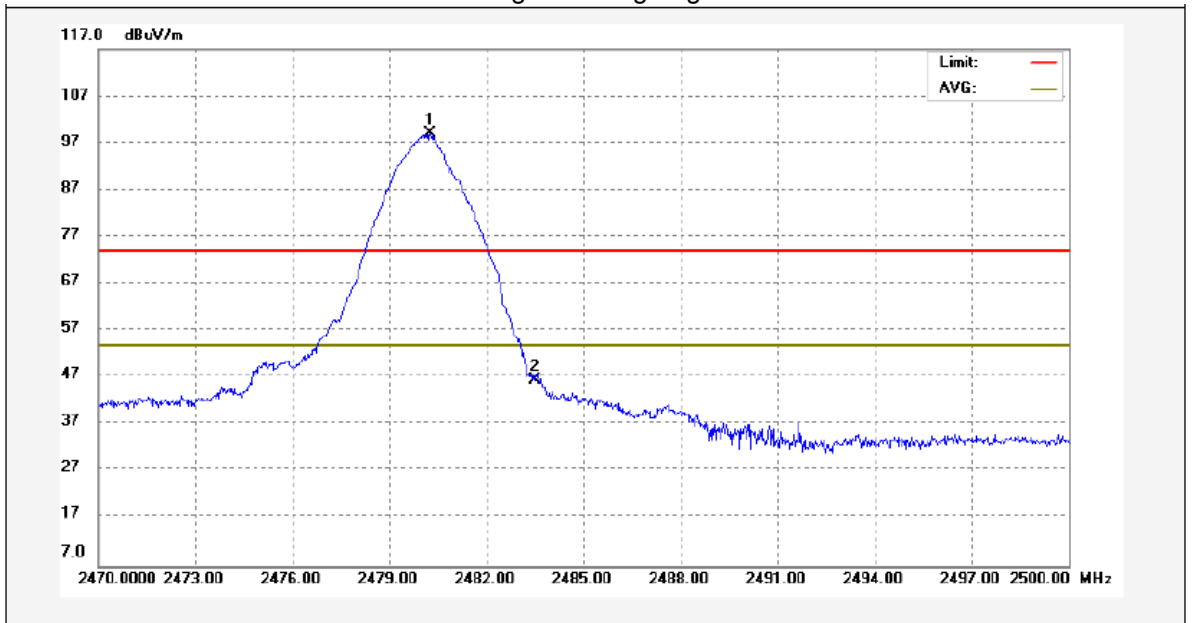
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2400.000	61.57	-15.24	46.33	74.00	-27.67	peak	
2	2402.514	113.92	-15.24	98.68				

GFSK Transmitting Band edge-right side Horizontal



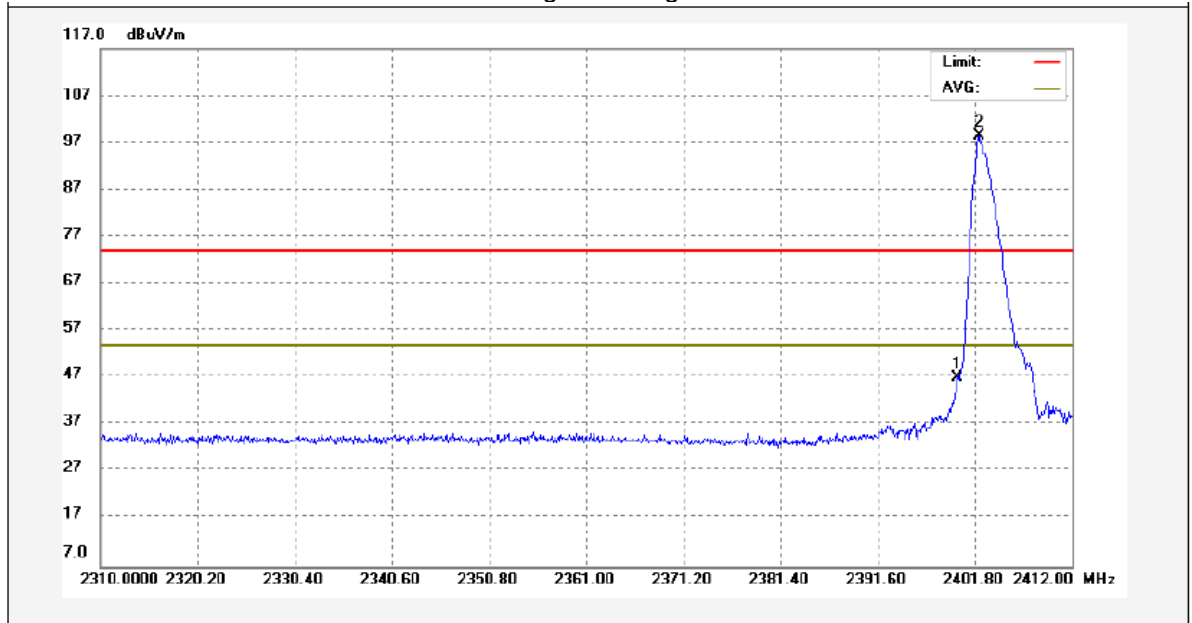
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2480.020	114.11	-15.38	98.73				
2	2483.500	63.93	-15.39	48.54	74.00	-25.46	peak	

GFSK Transmitting Band edge-right side Vertical



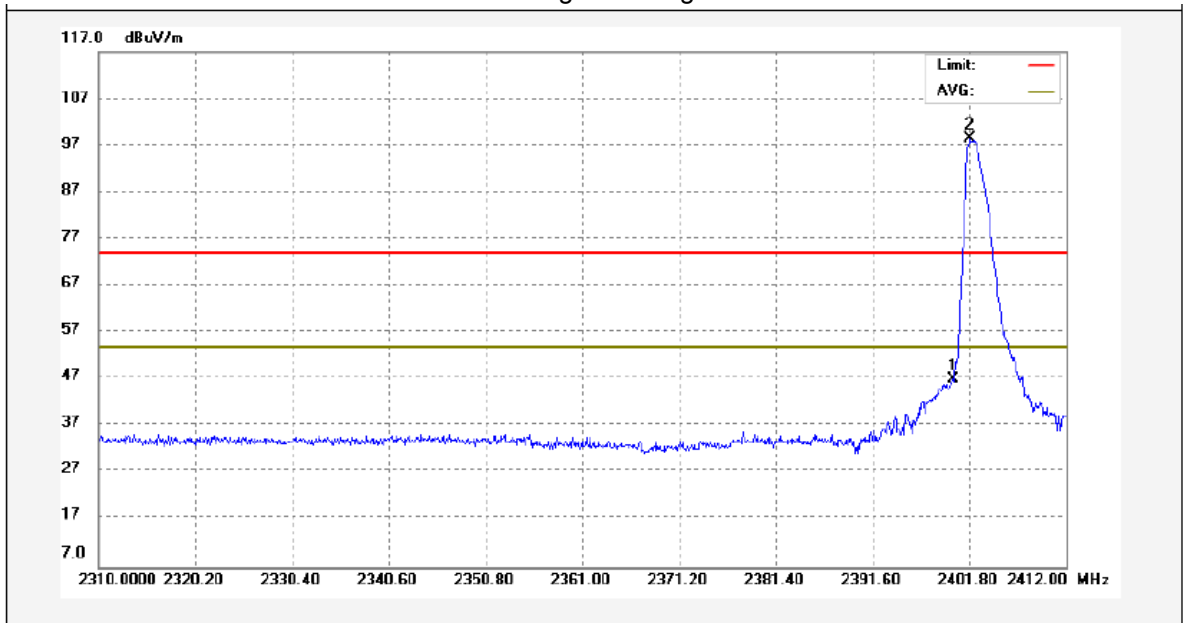
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2480.260	114.35	-15.38	98.97				
2	2483.500	61.93	-15.39	46.54	74.00	-27.46	peak	

Pi/4 DQPSK Transmitting Band edge-left side Horizontal



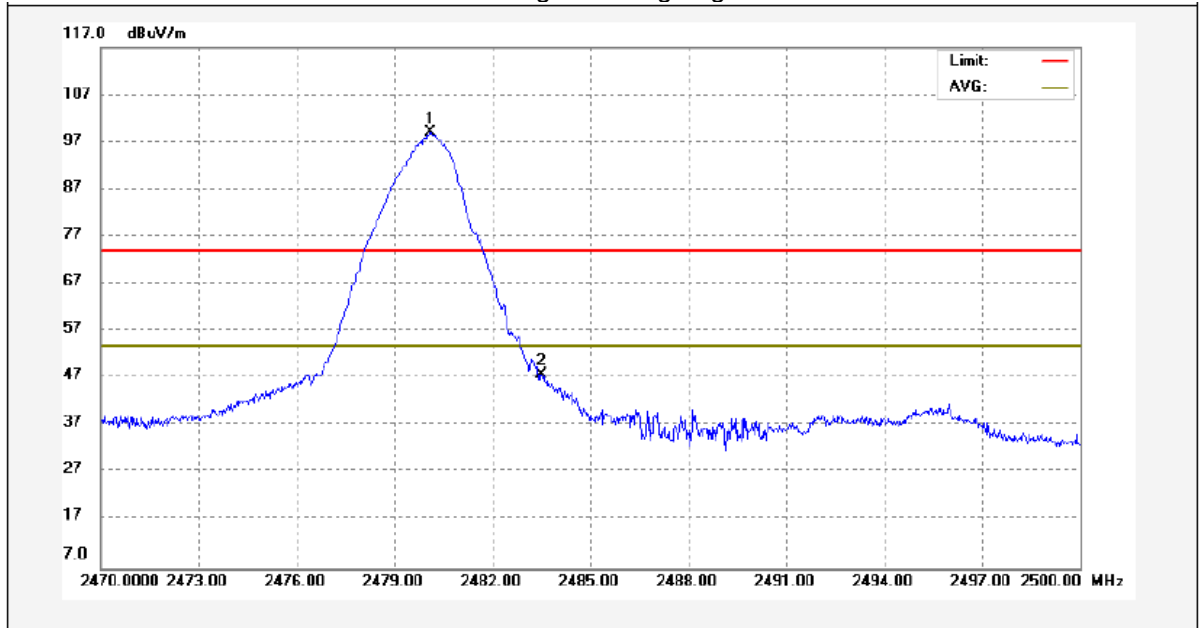
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2400.000	62.23	-15.24	46.99	74.00	-27.01	peak	
2	2402.208	113.80	-15.24	98.56				

Pi/4 DQPSK Transmitting Band edge-left side Vertical



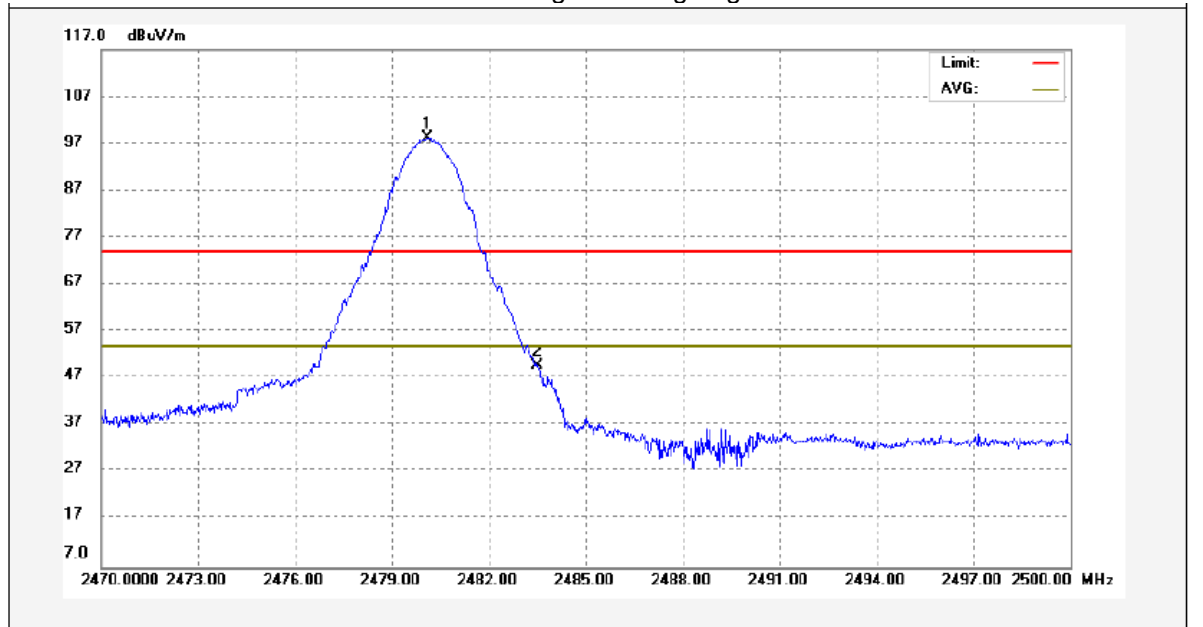
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2400.000	62.23	-15.24	46.99	74.00	-27.01	peak	
2	2401.902	113.70	-15.23	98.47				

Pi/4 DQPSK Transmitting Band edge-right side Horizontal



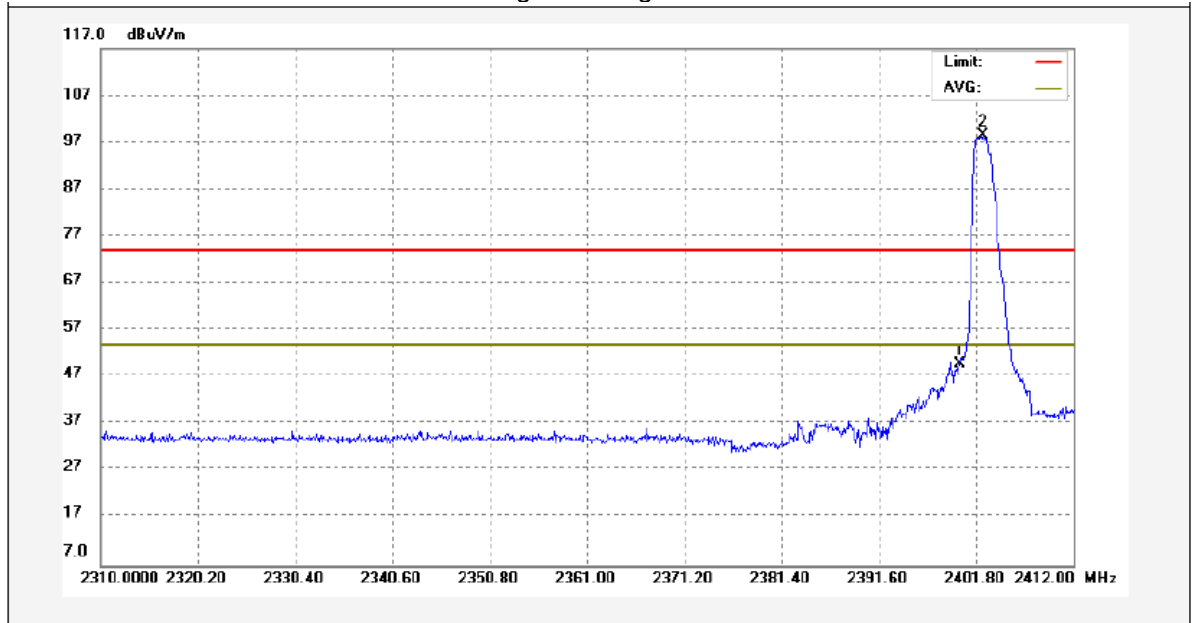
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2480.110	114.46	-15.38	99.08				
2	2483.500	63.15	-15.39	47.76	74.00	-26.24	peak	

Pi/4 DQPSK Transmitting Band edge-right side Vertical



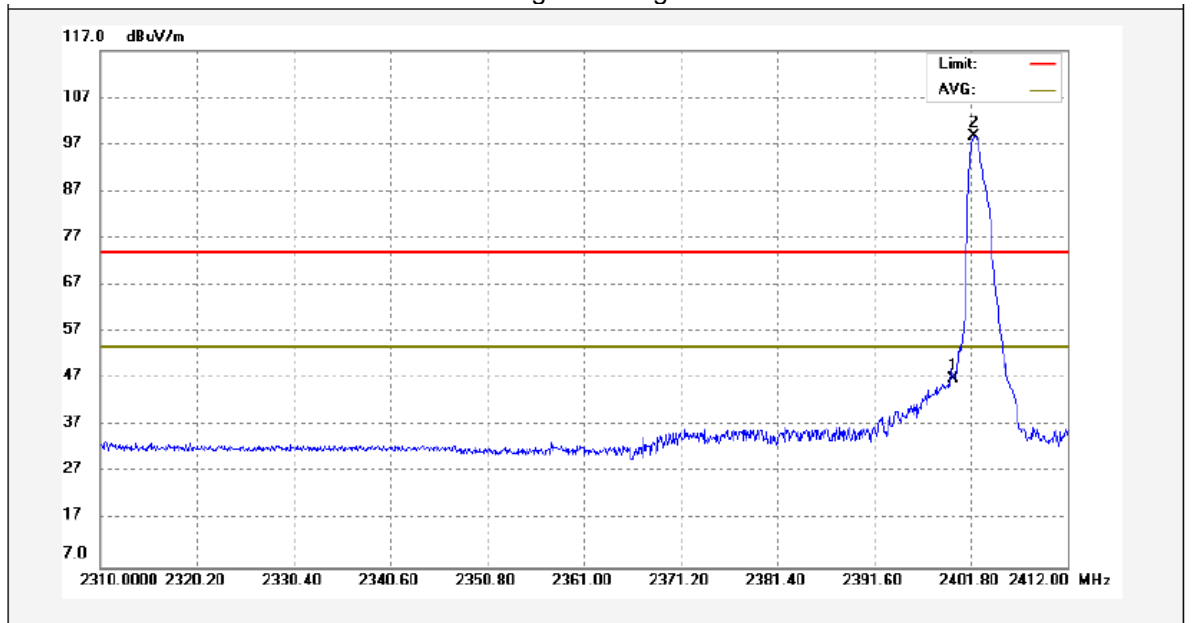
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2480.080	113.47	-15.38	98.09				
2	2483.500	65.15	-15.39	49.76	74.00	-24.24	peak	

8DPSK Transmitting Band edge-left side Horizontal



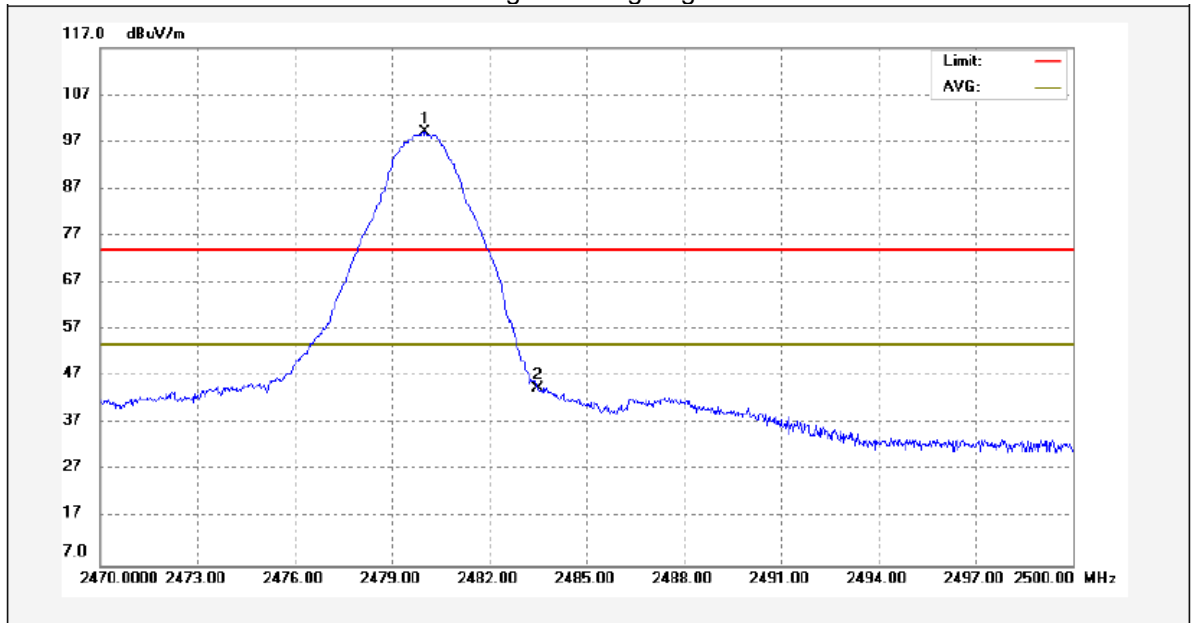
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2400.000	64.88	-15.24	49.64	74.00	-24.36	peak	
2	2402.514	113.62	-15.24	98.38				

8DPSK Transmitting Band edge-left side Vertical



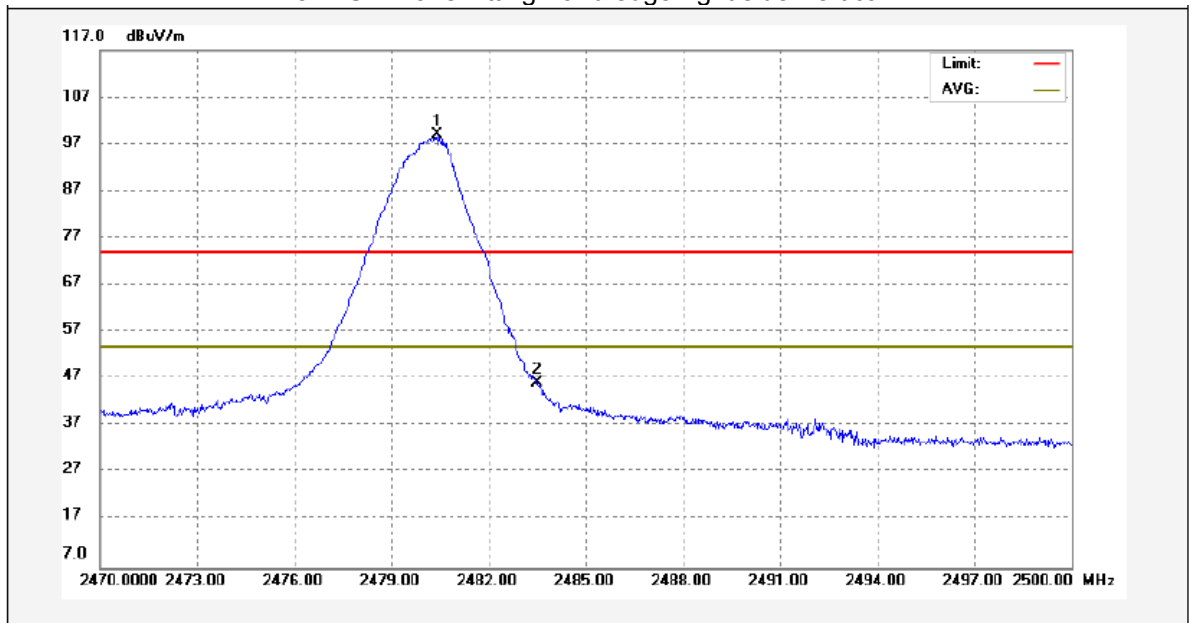
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2400.000	62.38	-15.24	47.14	74.00	-26.86	peak	
2	2402.106	113.93	-15.24	98.69				

8DPSK Transmitting Band edge-right side Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2480.020	114.47	-15.38	99.09				
2	2483.500	60.03	-15.39	44.64	74.00	-29.36	peak	

8DPSK Transmitting Band edge-right side Vertical



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2480.410	114.32	-15.38	98.94				
2	2483.500	61.53	-15.39	46.14	74.00	-27.86	peak	



## 12 20 dB 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.

### 12.1 Test Procedure

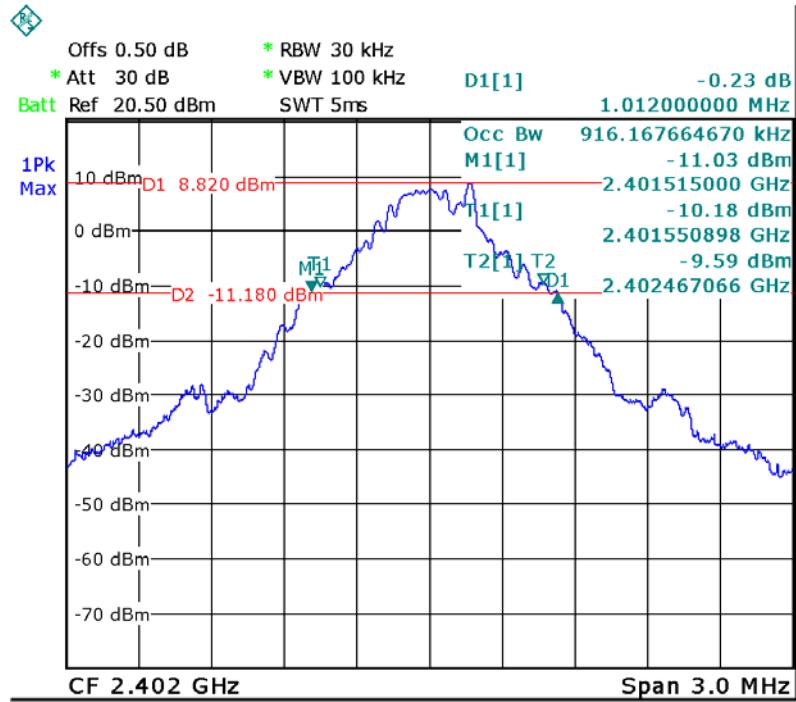
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 30kHz, VBW = 100kHz

### 12.2 Test Result

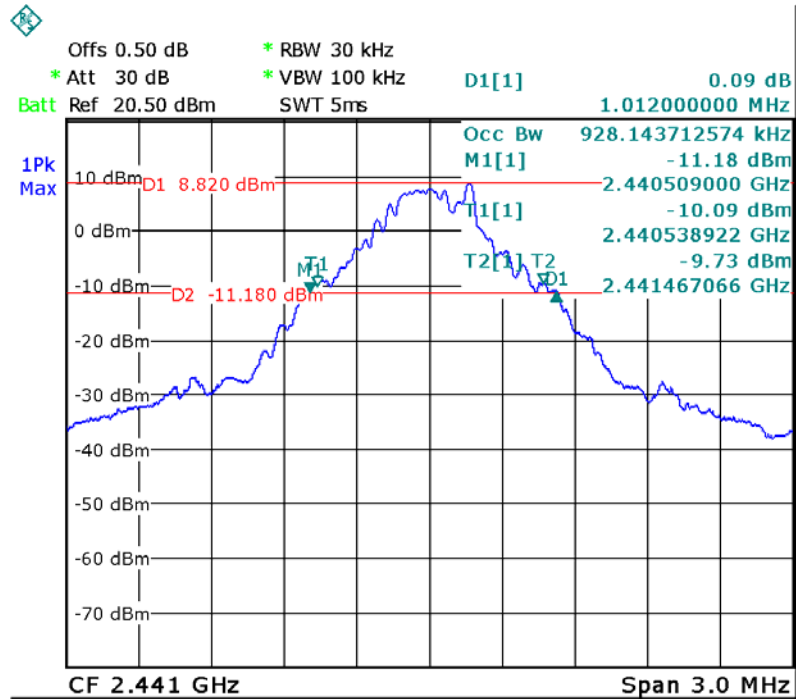
Modulation	Test Channel	Bandwidth(MHz)
GFSK	Low	1.012
GFSK	Middle	1.012
GFSK	High	1.012
Pi/4 DQPSK	Low	1.359
Pi/4 DQPSK	Middle	1.383
Pi/4 DQPSK	High	1.359
8DPSK	Low	1.323
8DPSK	Middle	1.323
8DPSK	High	1.323

**Test plots**

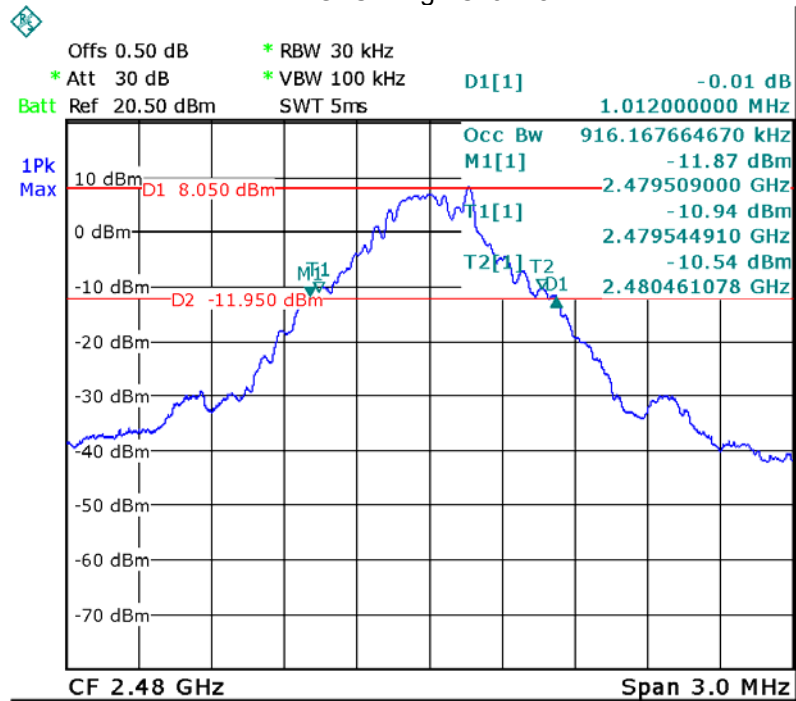
GFSK Low Channel



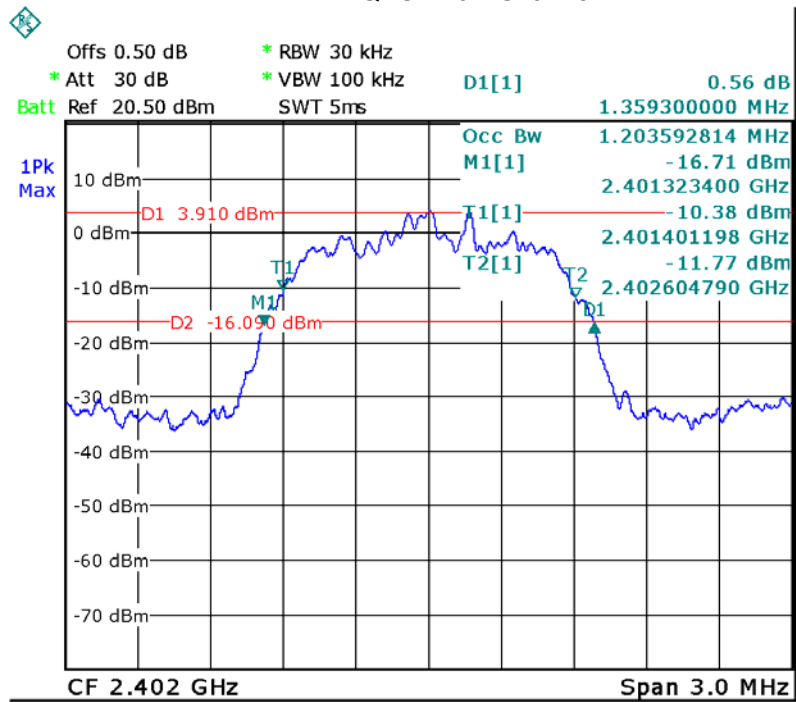
GFSK Middle Channel



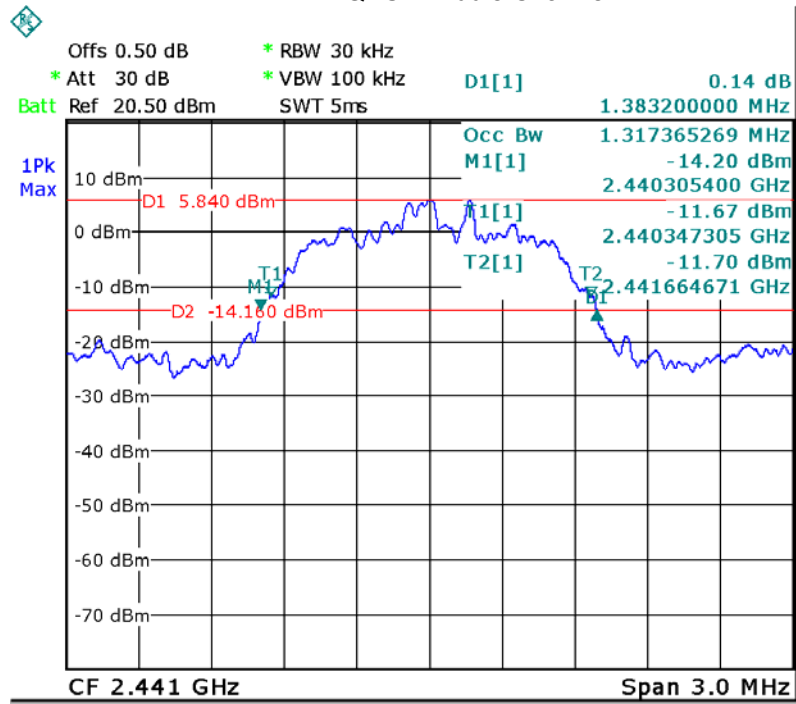
### GFSK High Channel



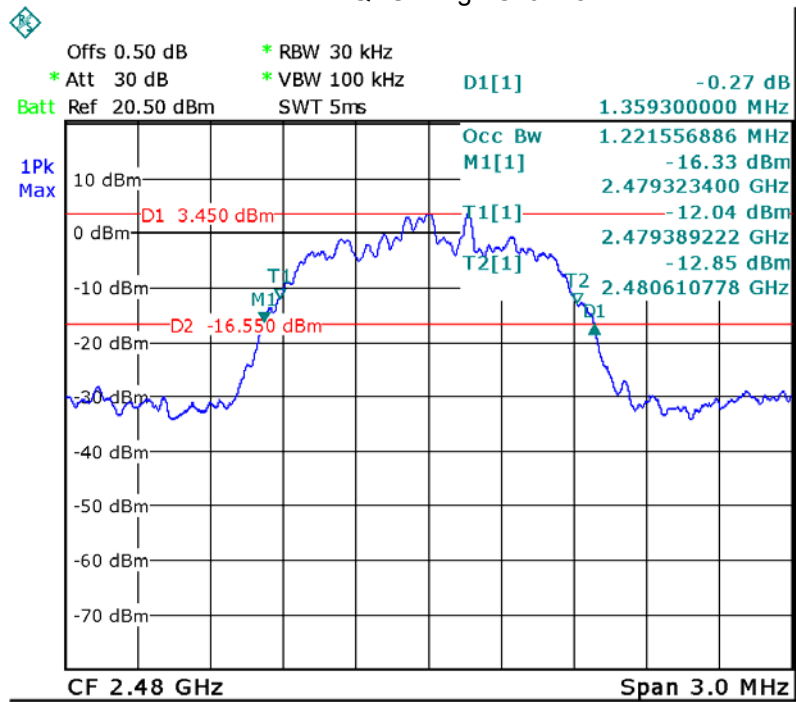
### Pi/4 DQPSK Low Channel



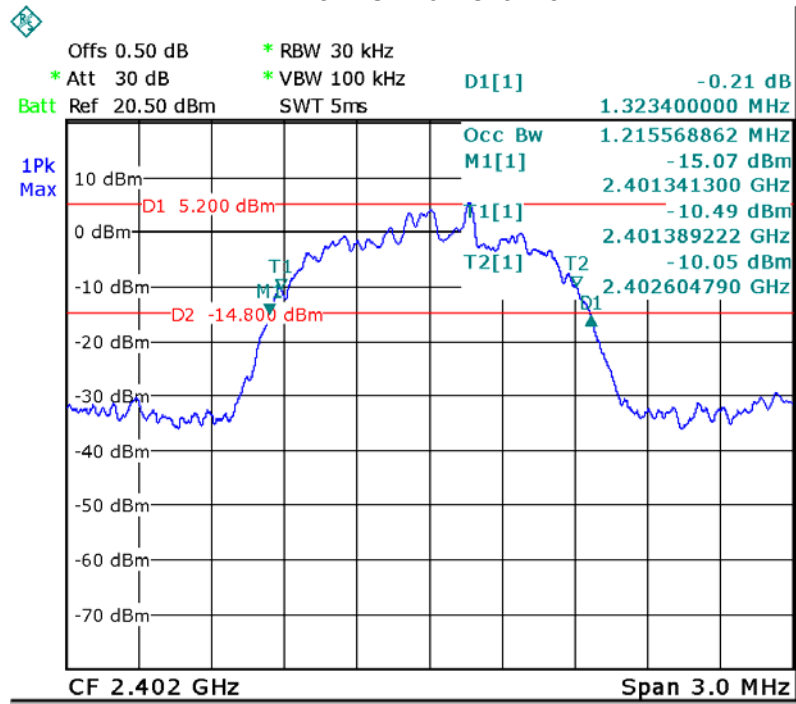
Pi/4 DQPSK Middle Channel



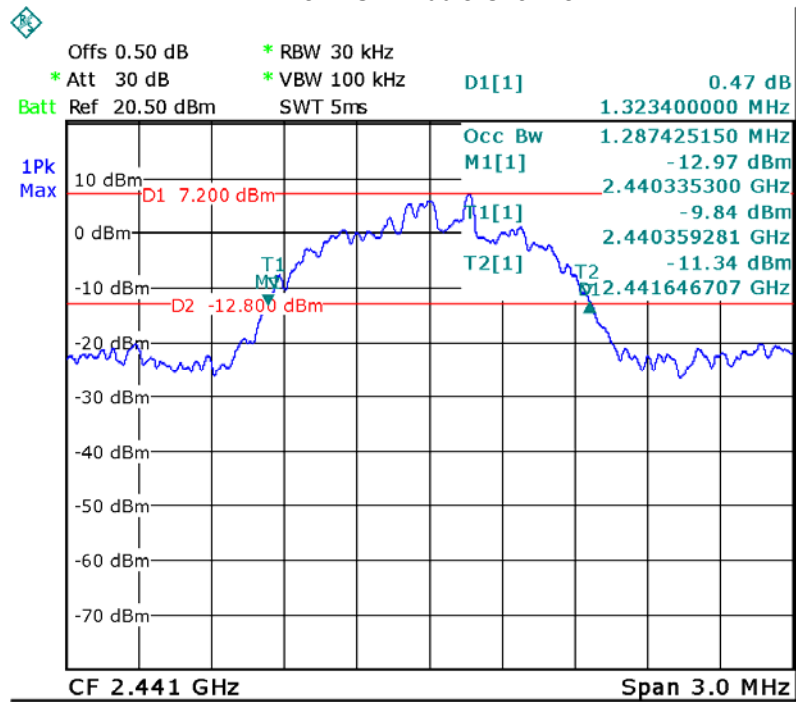
Pi/4 DQPSK High Channel

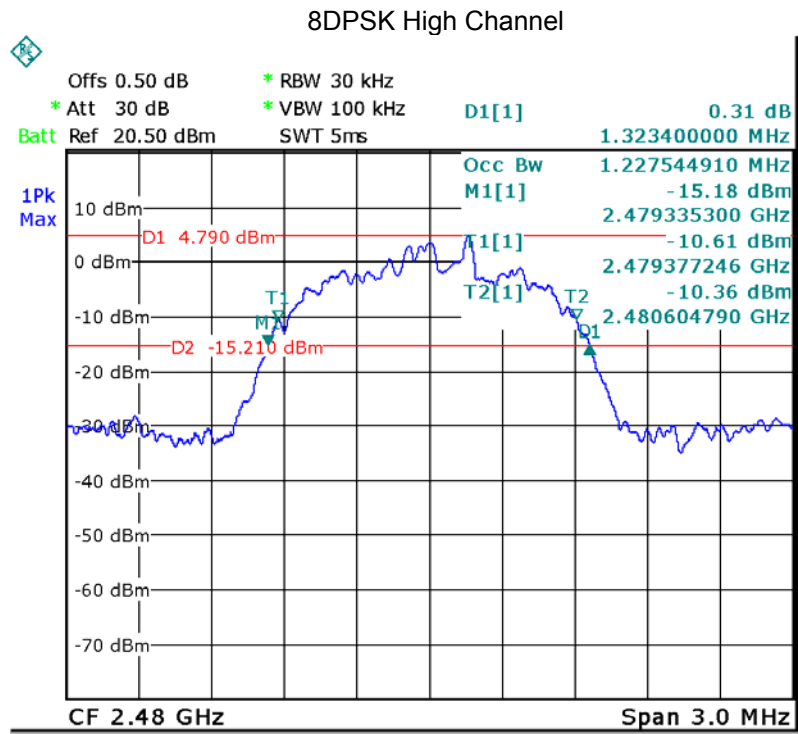


### 8DPSK Low Channel



### 8DPSK Middle Channel





## 13 Maximum Peak Output Power

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	ANSI C63.10: 2013
Test Limit:	Regulation 15.247 (a)(1), For frequency hopping systems operating in the 2400-2483.5 MHz band by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater: 0.125 watts..
Test mode:	Test in fixing frequency transmitting mode.

### 13.1 Test Procedure

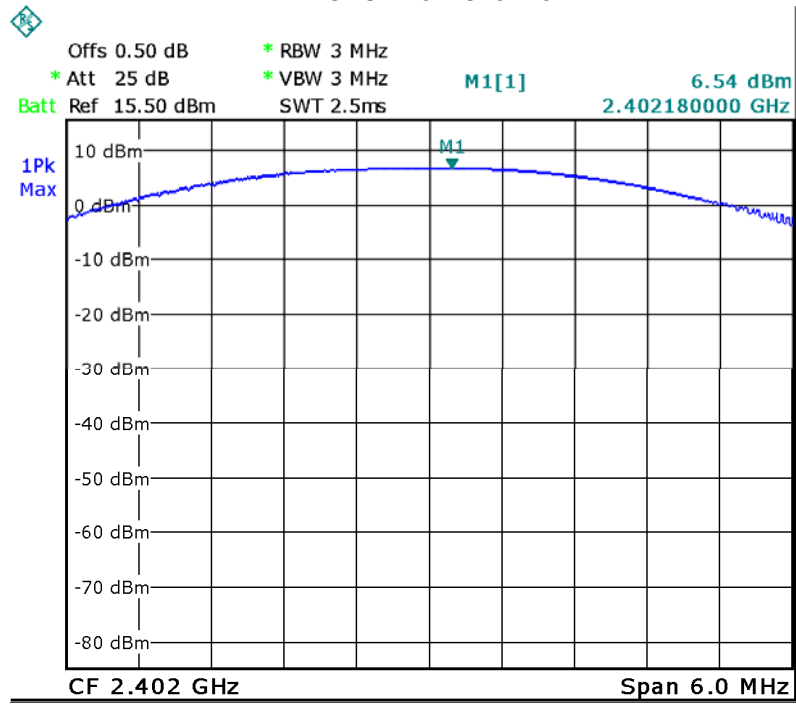
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3MHz. VBW = 3MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.///

### 13.2 Test Result

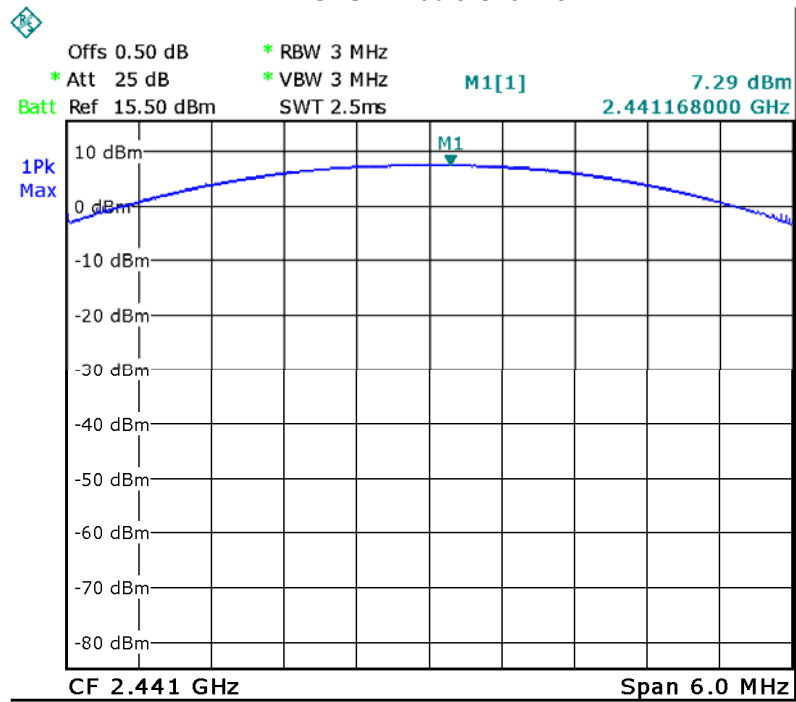
Modulation	Test Channel	Output Power (dBm)	Limit (dBm)
GFSK	Low	6.54	21
GFSK	Middle	7.29	21
GFSK	High	8.24	21
Pi/4 DQPSK	Low	8.62	21
Pi/4 DQPSK	Middle	9.45	21
Pi/4 DQPSK	High	9.11	21
8DPSK	Low	9.14	21
8DPSK	Middle	8.72	21
8DPSK	High	9.38	21

### Test plots

#### GFSK Low Channel

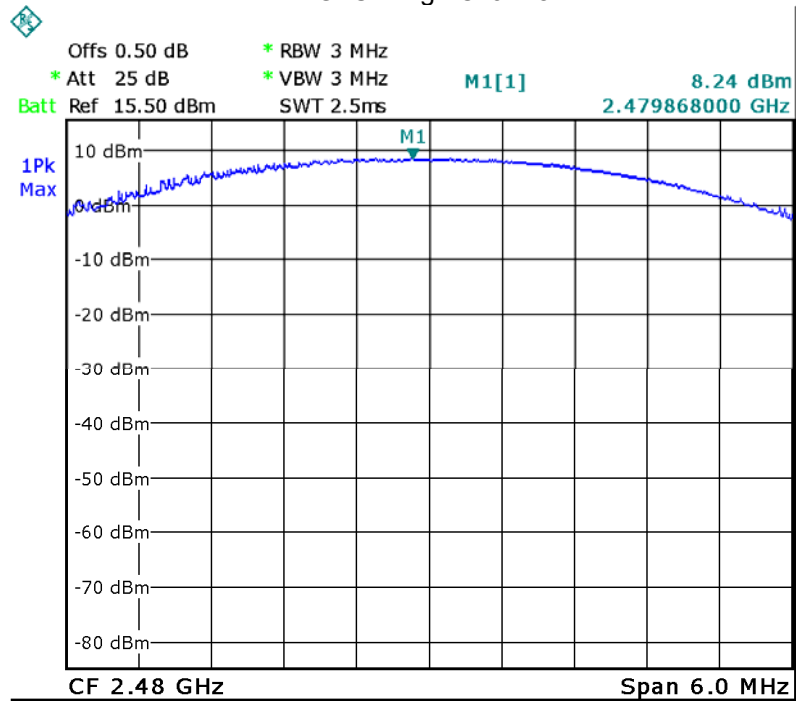


#### GFSK Middle Channel

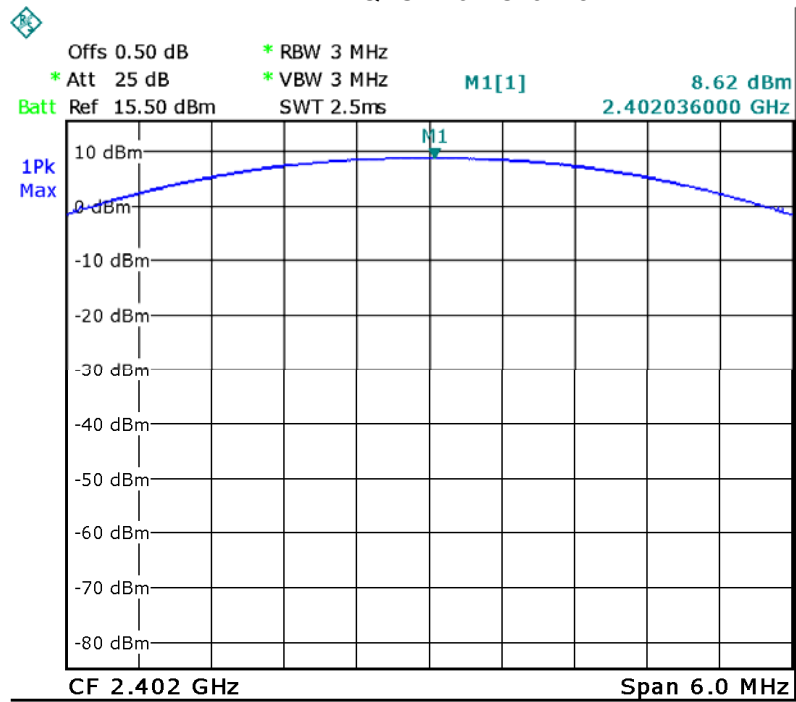


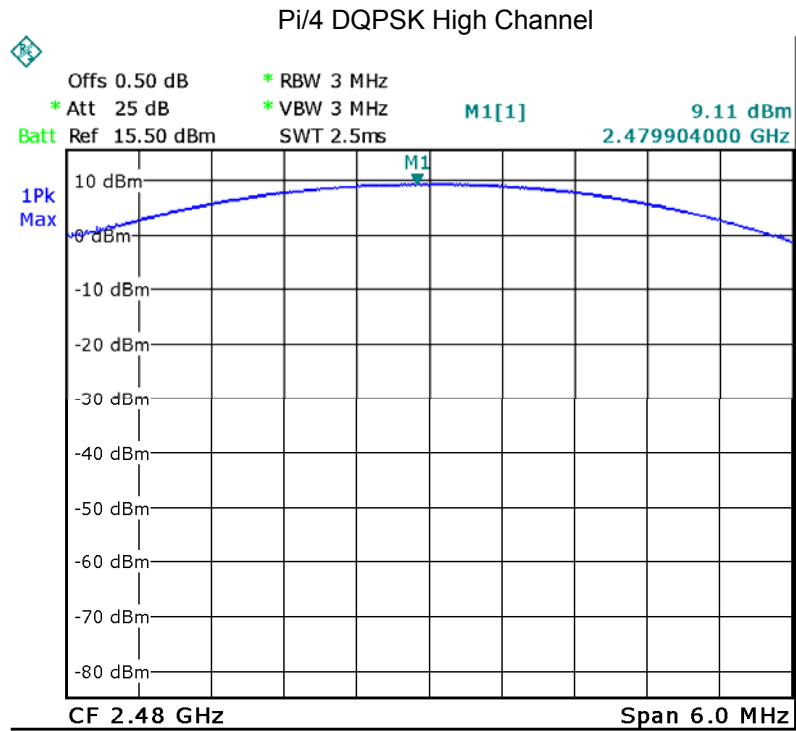
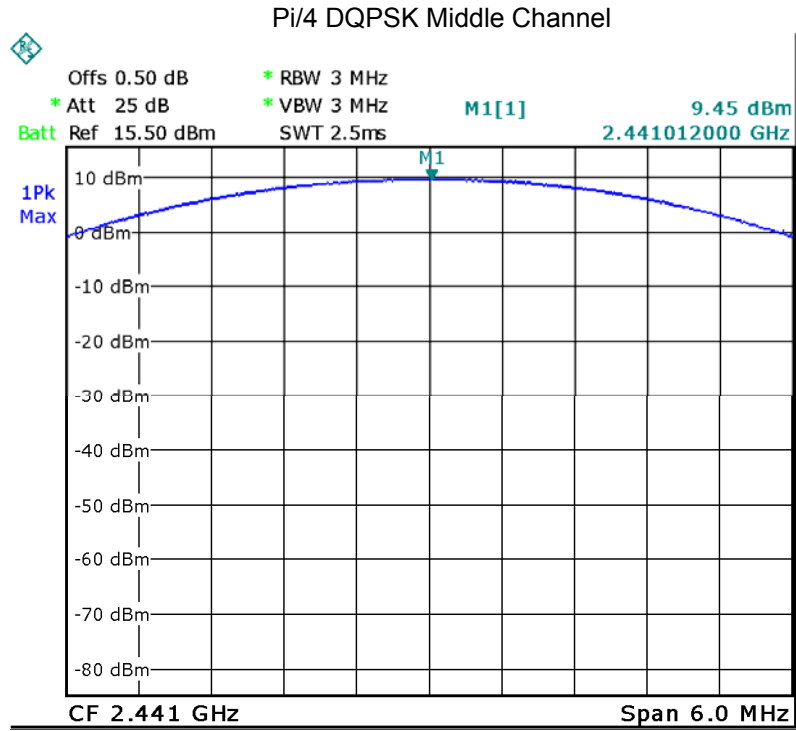


### GFSK High Channel

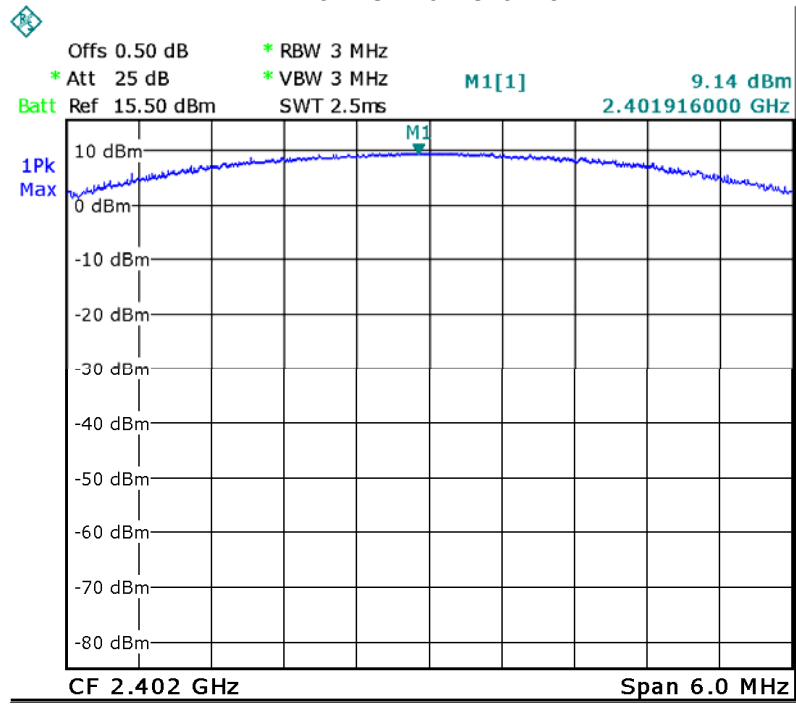


### Pi/4 DQPSK Low Channel

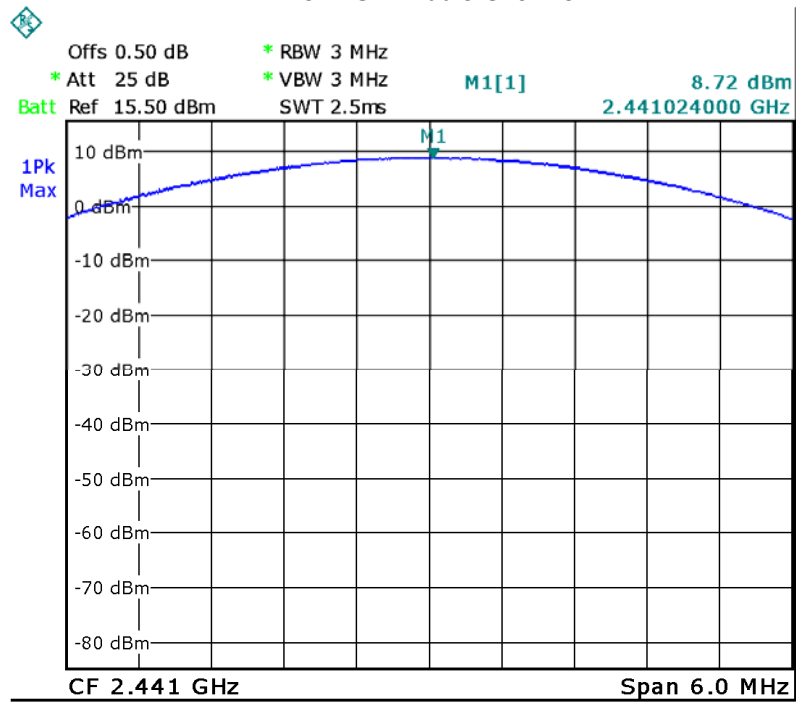


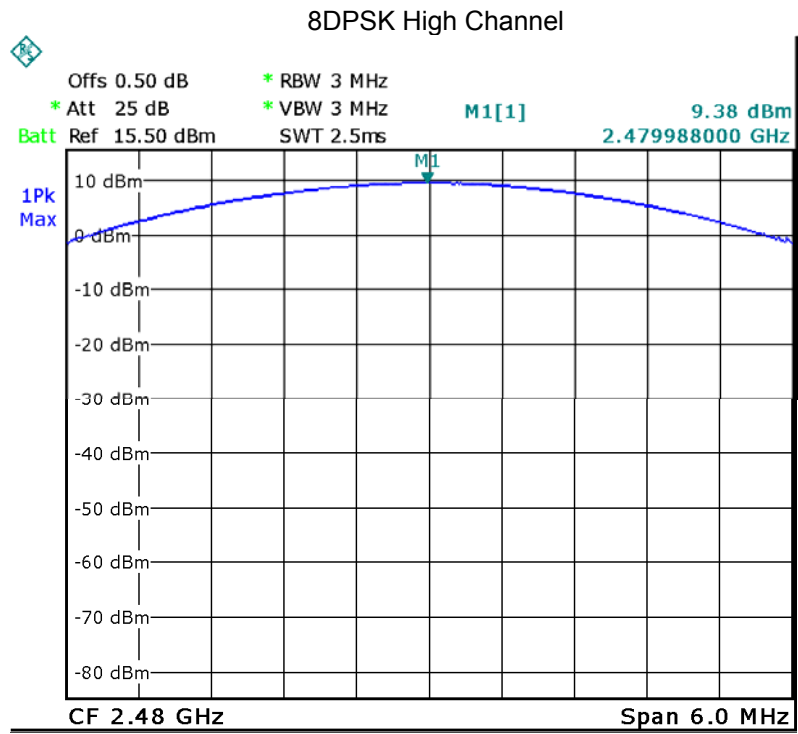


### 8DPSK Low Channel



### 8DPSK Middle Channel





## 14 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.

### 14.1 Test Procedure

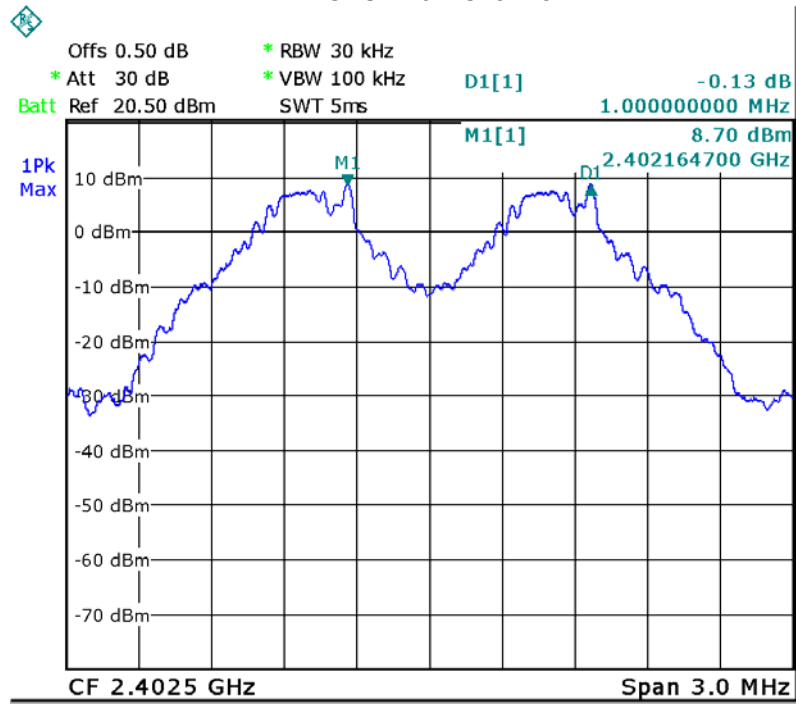
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 30kHz. VBW = 100kHz , Span = 3.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to 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.

### 14.2 Test Result

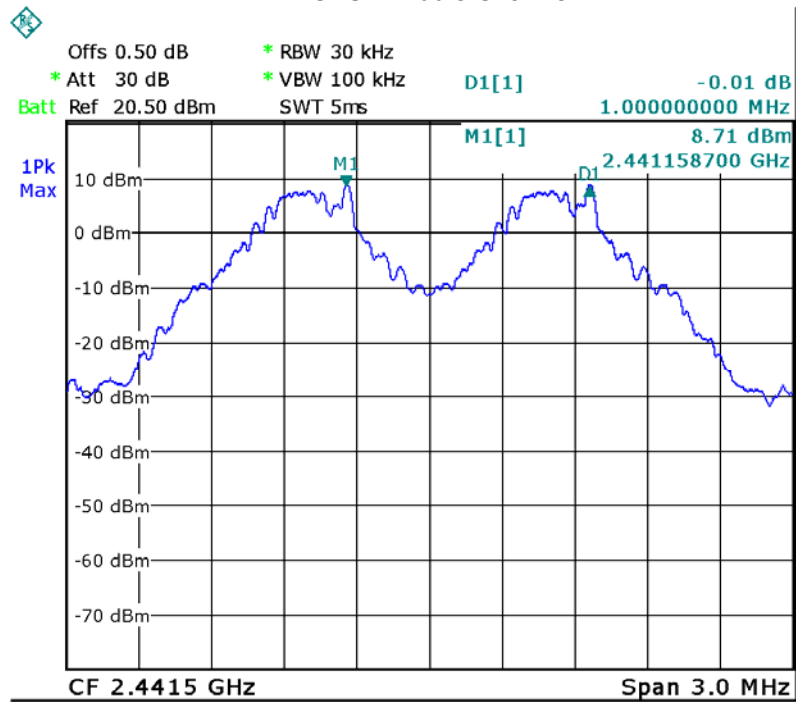
Modulation	Test Channel	Separation (MHz)	Limit(MHz)	Result
GFSK	Low	1.000	0.675	PASS
GFSK	Middle	1.000	0.675	PASS
GFSK	High	1.000	0.675	PASS
Pi/4 DQPSK	Low	1.000	0.906	PASS
Pi/4 DQPSK	Middle	1.000	0.922	PASS
Pi/4 DQPSK	High	1.000	0.906	PASS
8DPSK	Low	1.000	0.882	PASS
8DPSK	Middle	1.000	0.882	PASS
8DPSK	High	1.000	0.882	PASS

### Test plots

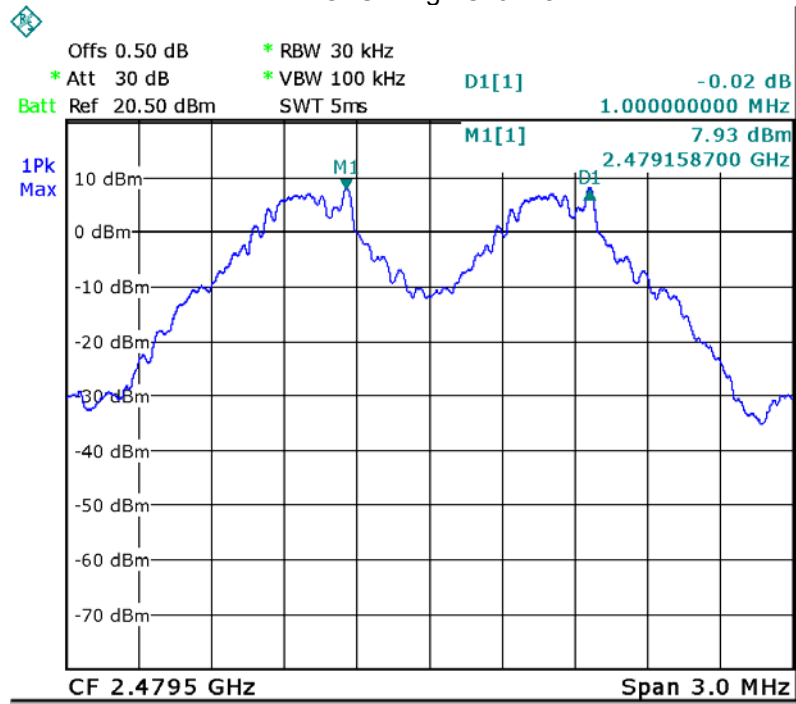
GFSK Low Channel



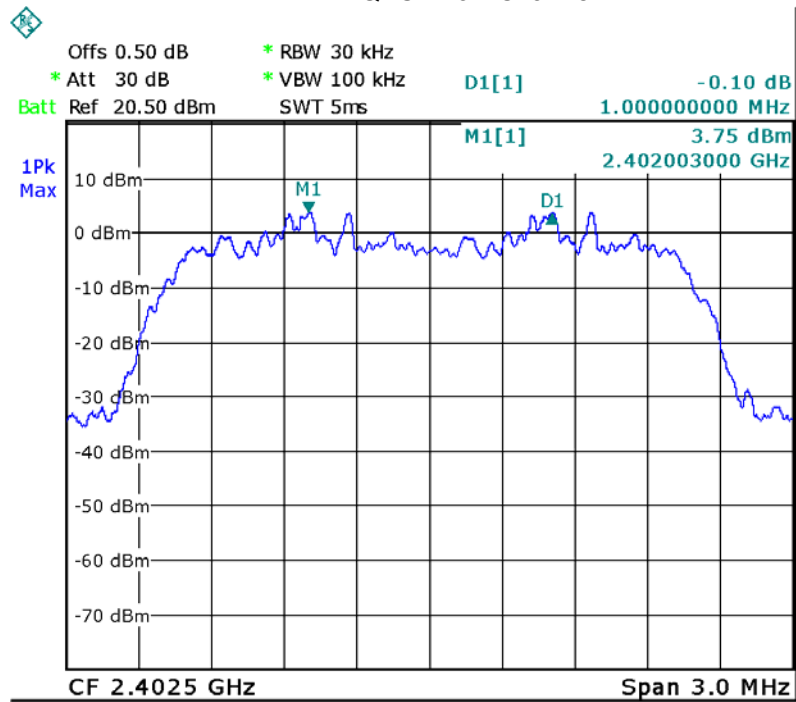
GFSK Middle Channel

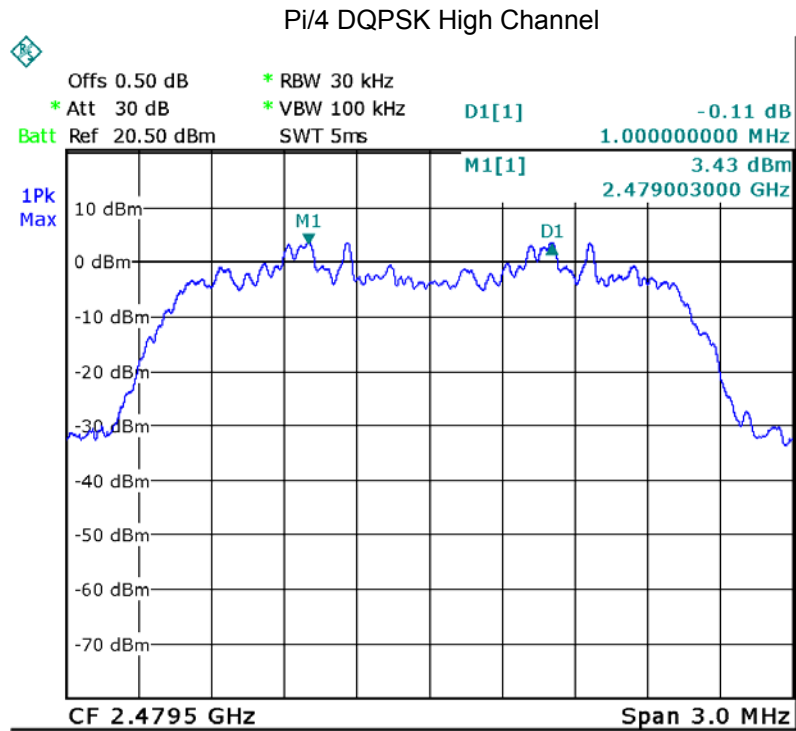
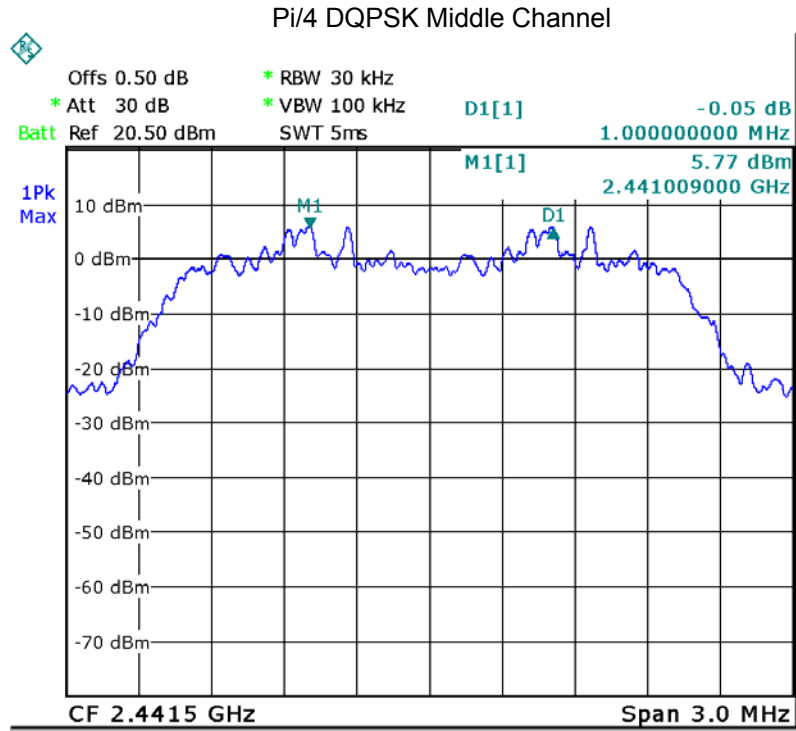


### GFSK High Channel



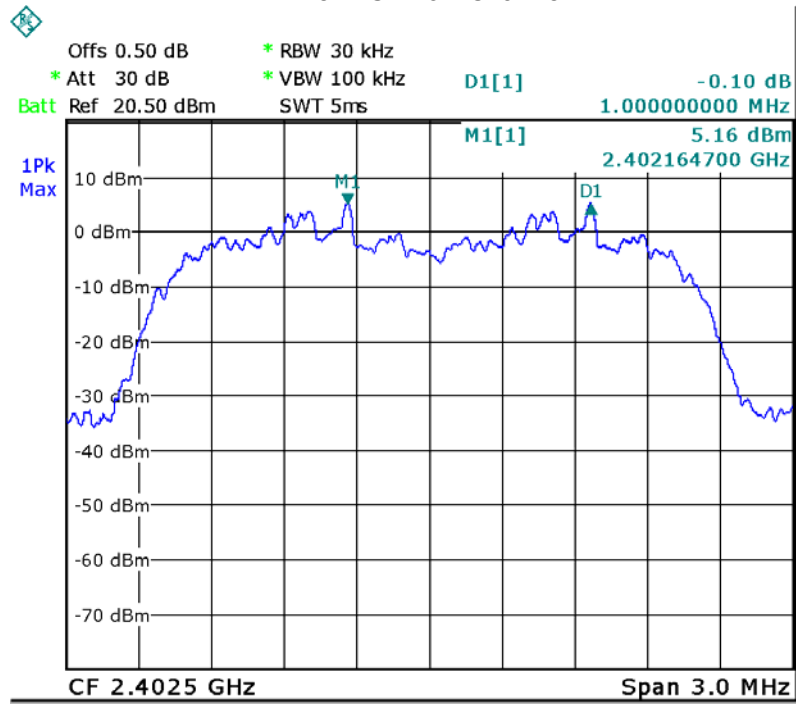
### Pi/4 DQPSK Low Channel



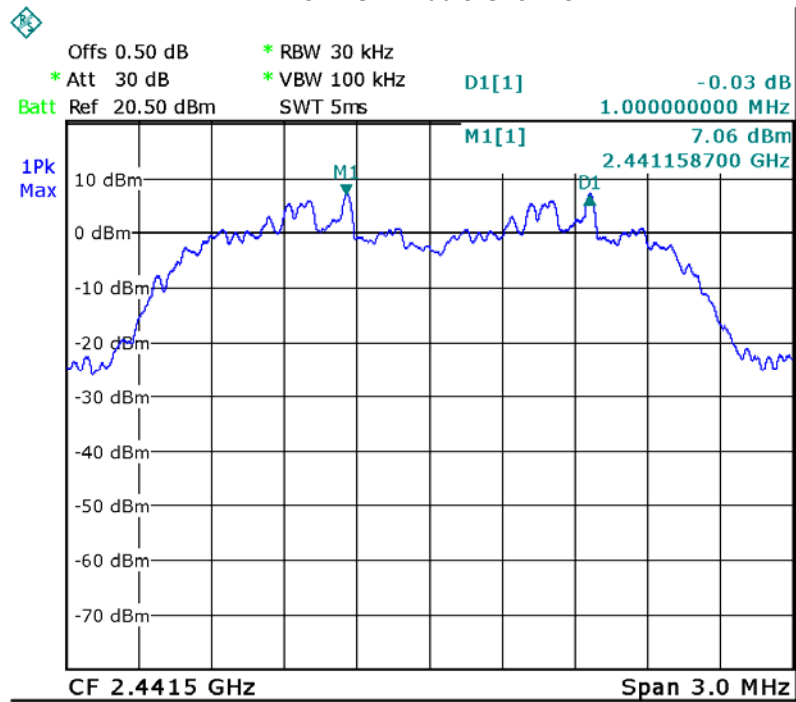


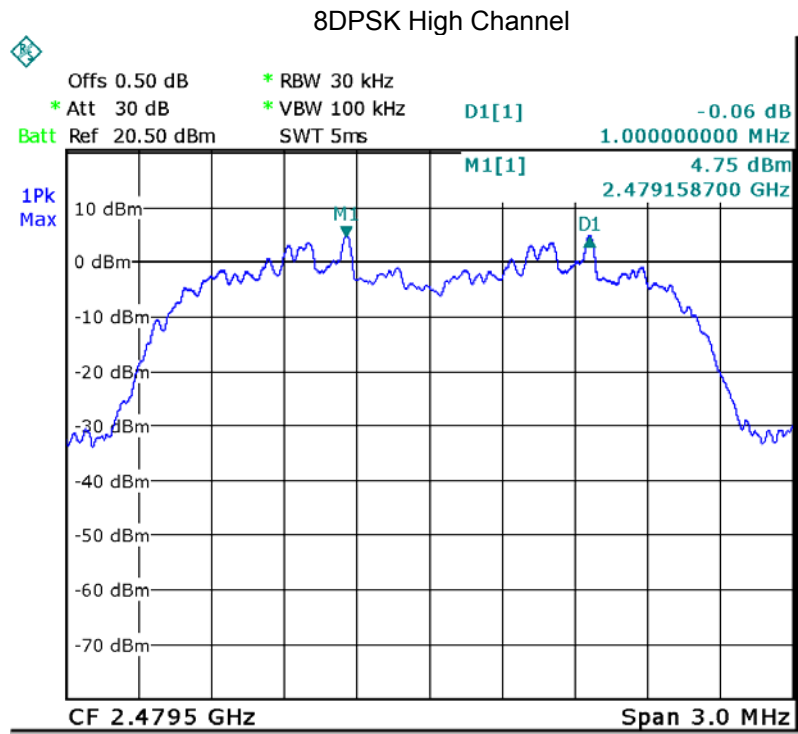


### 8DPSK Low Channel



### 8DPSK Middle Channel





## 15 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.

### 15.1 Test Procedure

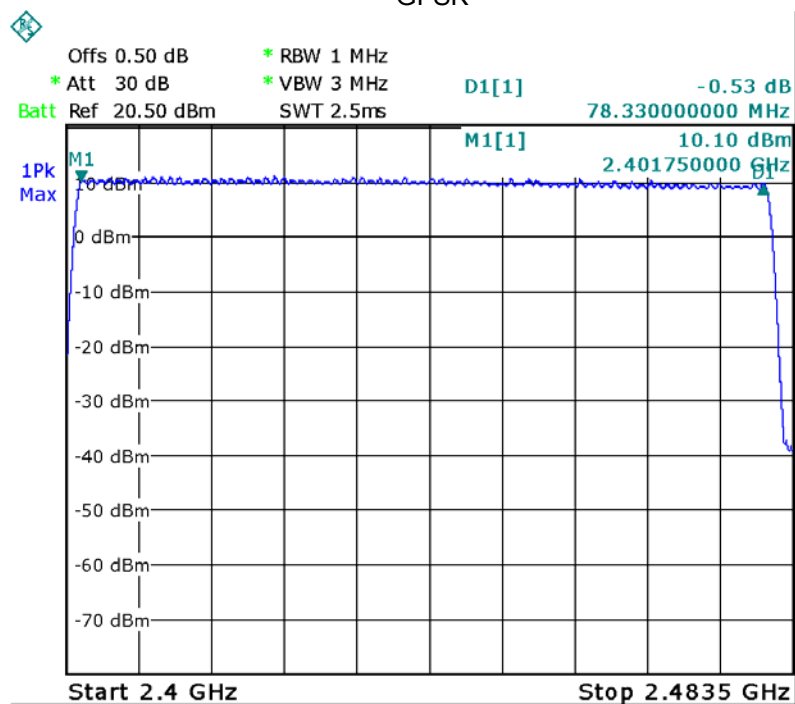
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 1MHz. VBW = 3MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections.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

### 15.2 Test Result

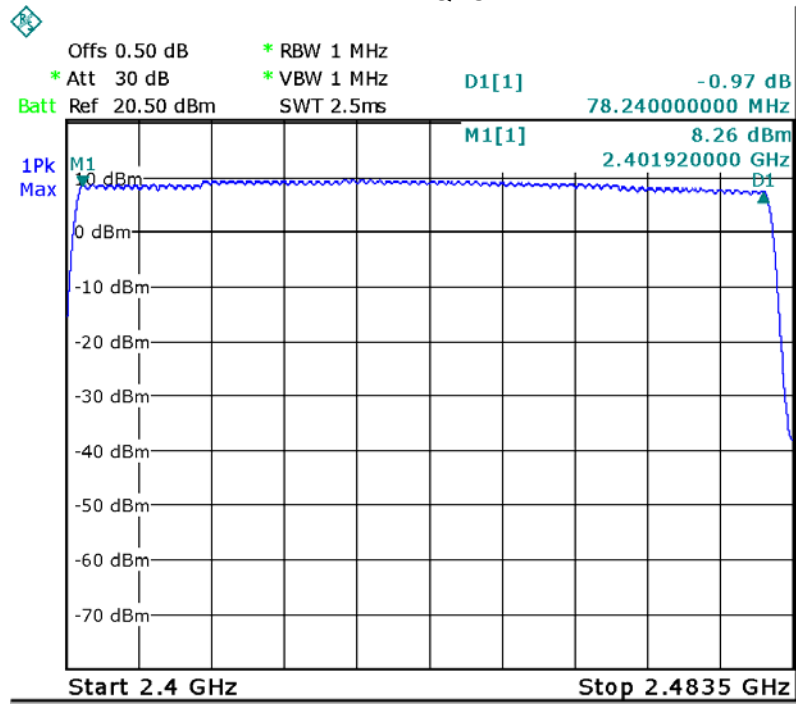
#### Test Plots:

79 Channels in total

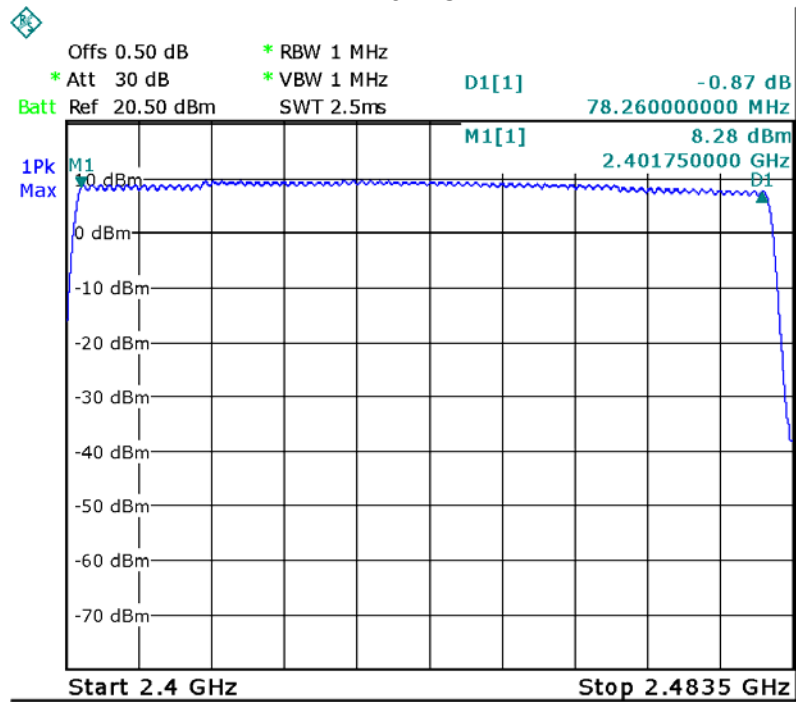
GFSK



### Pi/4 DQPSK



### 8DPSK



## 16 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.

### 16.1 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).

### 16.2 Test Result

DH5 Packet permit maximum  $1600 / 79 / 6$  hops per second in each channel (5 time slots RX, 1 time slot TX).

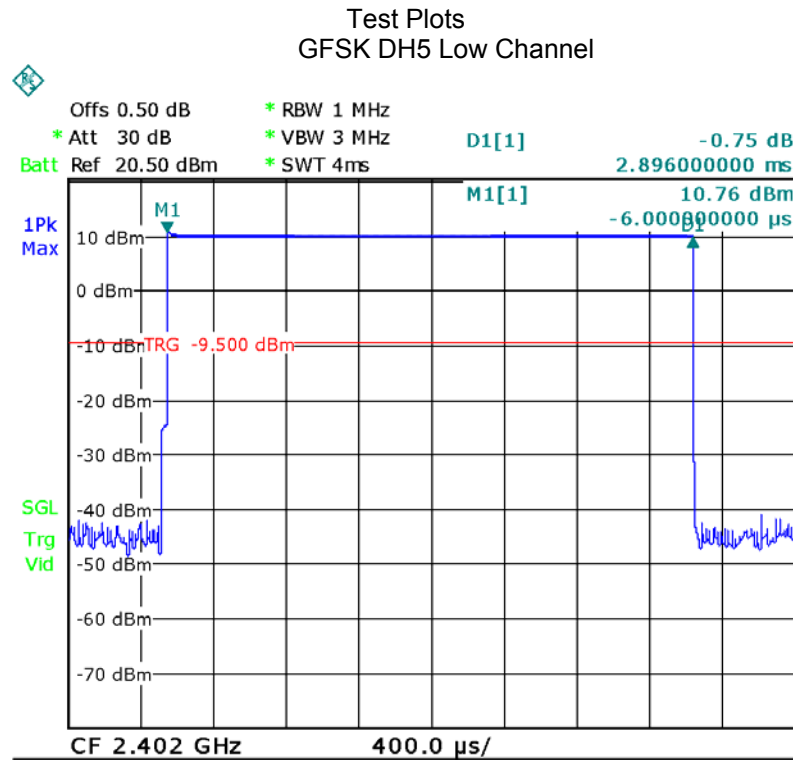
DH3 Packet permit maximum  $1600 / 79 / 4$  hops per second in each channel (3 time slots RX, 1 time slot TX).

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:

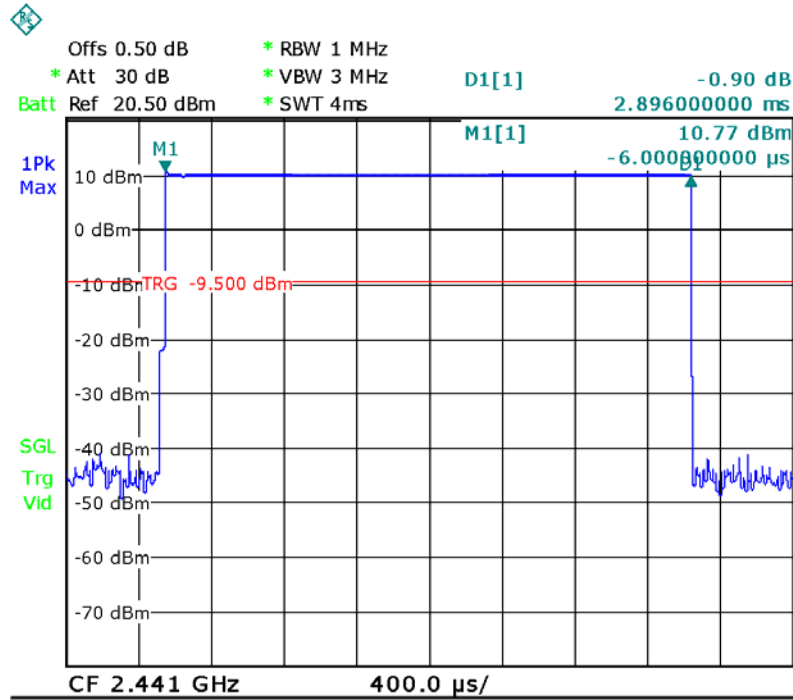
Data Packet	Dwell Time(s)
DH5	$1600/79/6*0.4*79*(MkrDelta)/1000$
DH3	$1600/79/4*0.4*79*(MkrDelta)/1000$
DH1	$1600/79/2*0.4*79*(MkrDelta)/1000$
Remark: Mkr Delta is once pulse time.	

Modulation	Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
GFSK	DH5	Low	2.896	0.309	0.4
		middle	2.896	0.309	0.4
		High	2.896	0.309	0.4
Pi/4DQPSK	DH5	Low	2.896	0.309	0.4
		middle	2.896	0.309	0.4
		High	2.896	0.309	0.4
8DPSK	DH5	Low	2.896	0.309	0.4
		middle	2.896	0.309	0.4
		High	2.896	0.309	0.4

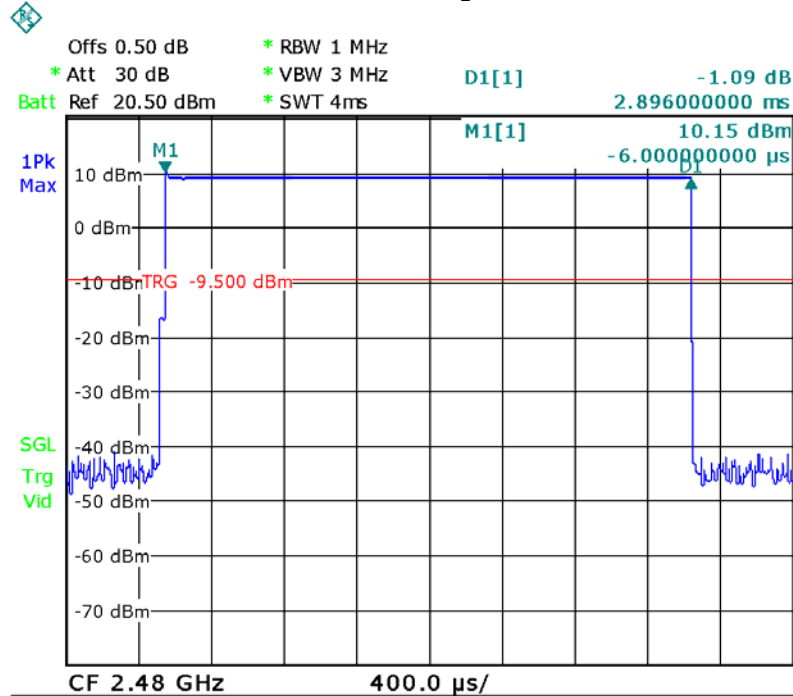
Remark: Only the worst-case mode DH5 is recorded.



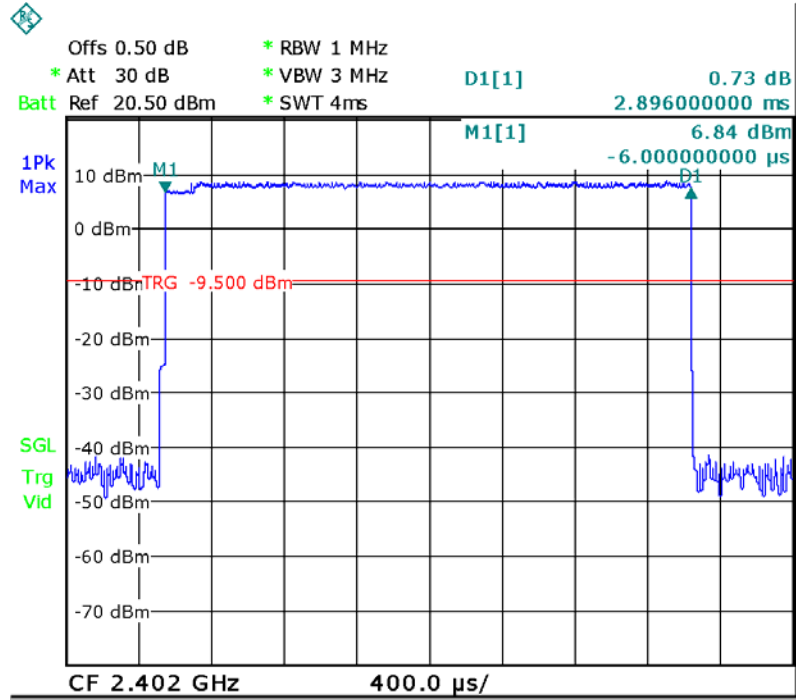
GFSK DH5 Middle Channel



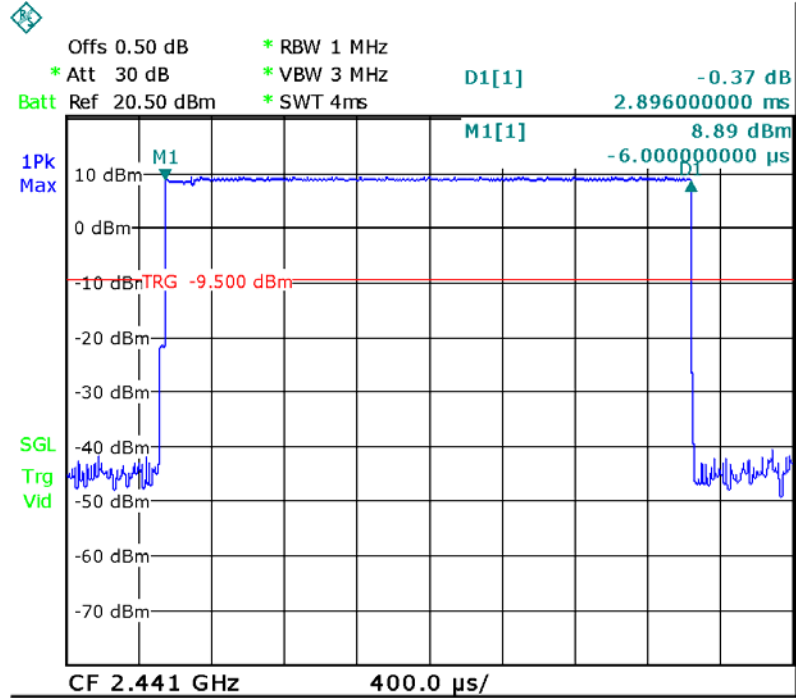
GFSK DH5 High Channel



Pi/4DQPSK DH5 Low Channel

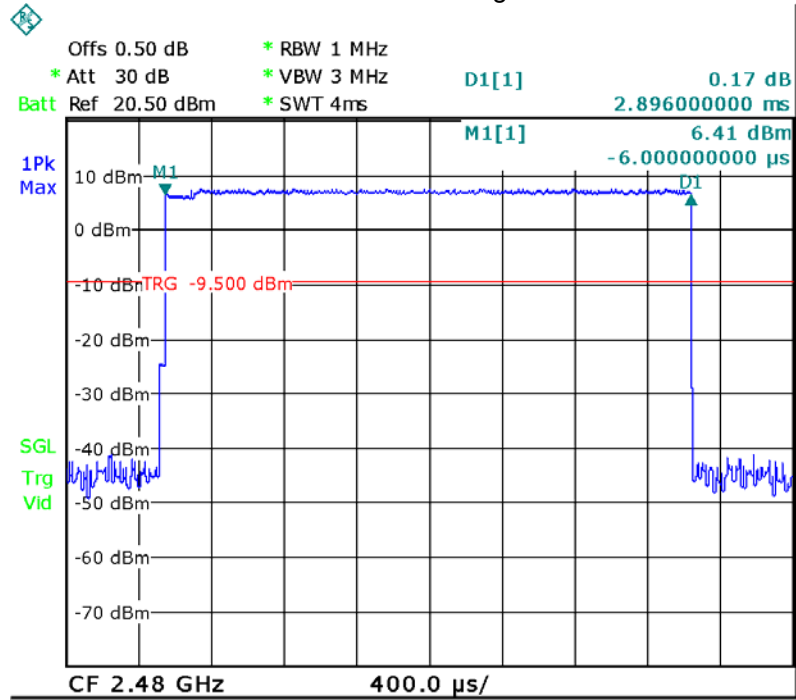


Pi/4DQPSK DH5 Middle Channel

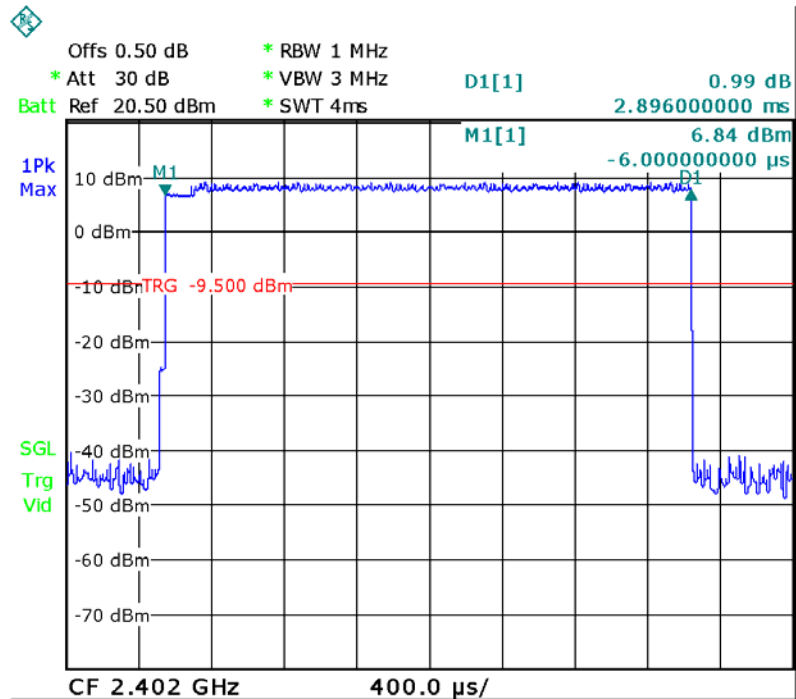




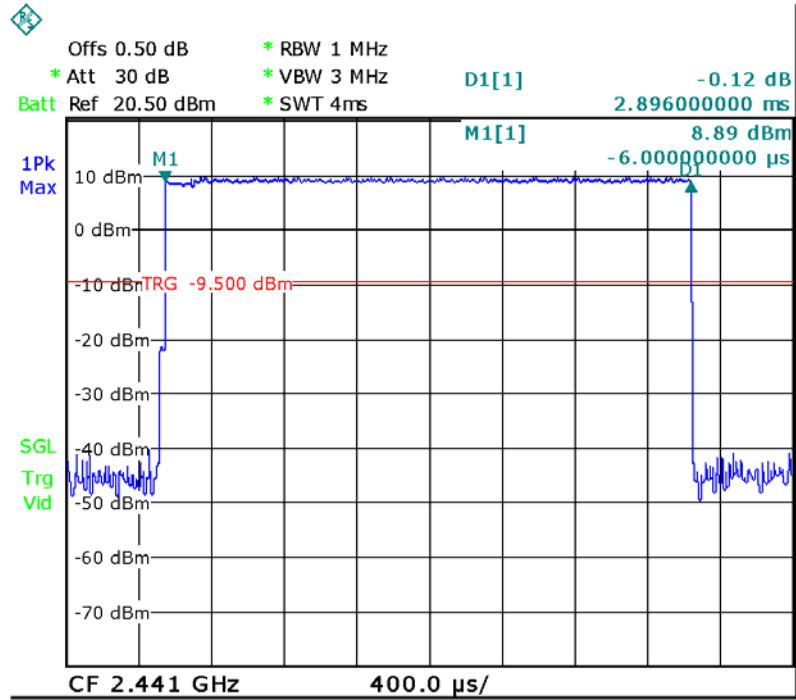
### Pi/4DQPSK DH5 High Channel



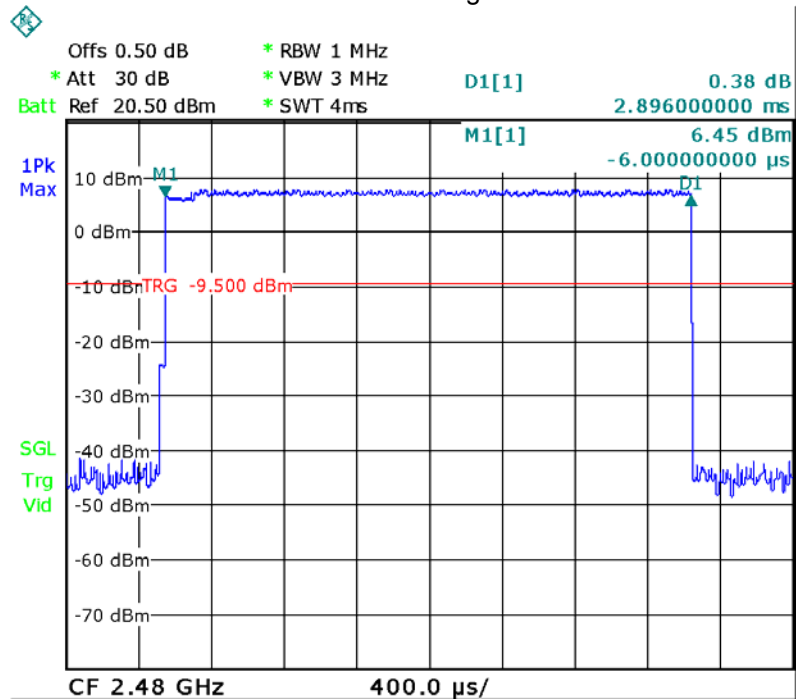
### 8DPSK DH5 Low Channel



### 8DPSK DH5 Middle Channel



### 8DPSK DH5 High Channel



## **17 Antenna Requirement**

According to the FCC Part 15 Paragraph 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. This product has an integrated antenna, fulfil the requirement of this section.

## **18 RF Exposure**

Remark: refer to SAR test report: WTS17S0476190E.

## **19 Photographs of test setup and EUT.**

Note: Please refer to appendix: WTS17S0476191E\_Photo.

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