

TEST REPORT

Reference No...... : WTS18S11130344-1W
FCC ID : 2AN97-DF-T4
Applicant..... : Shen Zhen Top-Peak Electronics Co., Ltd.
Address..... : 201-A Block A, No.2 Tengfeng 5th Road, Fenghuang, Baoan,
Shenzhen, China
Manufacturer : The same as above
Address..... : The same as above
Product..... : Agriculture Drone
Model(s) : DF-T4
Brand Name..... : SINOCHIP
Standards..... : FCC CFR47 Part 15.247:2017
Date of Receipt sample : 2018-11-27
Date of Test : 2018-11-28 to 2018-12-23
Date of Issue..... : 2018-12-24
Test Result..... : **Pass**

Remarks:

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

Prepared By:

Waltek Services (Shenzhen) Co., Ltd.

Address: 1/F., Fukangtai Building, West Baima Road, Songgang Street, Baoan District, Shenzhen, Guangdong, China

Tel :+86-755-83551033

Fax:+86-755-83552400

Compiled by:

Ford Wang

Ford Wang / Project Engineer

Approved by:



Philo Zhong

Philo Zhong / Manager

2 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, the certification number is 4243.01) of USA, CNAS (China National Accreditation Service for Conformity Assessment, the registration number is L3110) of China. 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), ISED (Innovation, Science and Economic Development 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.

Test Facility:**A. Accreditations for Conformity Assessment (International)**

Country/Region	Scope Covered By	Scope	Note
USA	ISO/IEC 17025	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		WPC	-
Thailand		NTC	-
Singapore		IDA	-
Note:			
1. FCC Designation No.: CN1201. Test Firm Registration No.: 523476.			
2. ISED 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

3 Contents

	Page
1 COVER PAGE.....	1
2 LABORATORIES INTRODUCTION	2
3 CONTENTS	4
4 REVISION HISTORY	6
5 GENERAL INFORMATION.....	7
5.1 GENERAL DESCRIPTION OF E.U.T.	7
5.2 DETAILS OF E.U.T.	7
5.3 CHANNEL LIST	8
5.4 TEST MODE	8
6 TEST SUMMARY	9
7 EQUIPMENT USED DURING TEST	10
7.1 EQUIPMENTS LIST	10
7.2 DESCRIPTION OF SUPPORT UNITS	11
7.3 MEASUREMENT UNCERTAINTY	11
7.4 TEST EQUIPMENT CALIBRATION	11
8 RADIATED SPURIOUS EMISSIONS.....	12
8.1 EUT OPERATION.....	12
8.2 TEST SETUP	13
8.3 SPECTRUM ANALYZER SETUP	14
8.4 TEST PROCEDURE	15
8.5 CORRECTED AMPLITUDE & MARGIN CALCULATION	15
8.6 SUMMARY OF TEST RESULTS	16
9 CONDUCTED SPURIOUS EMISSIONS.....	25
9.1 TEST PROCEDURE	25
9.2 TEST RESULT	26
10 BAND EDGE MEASUREMENT	33
10.1 TEST PROCEDURE.....	33
10.2 TEST RESULT	34
11 20 DB BANDWIDTH MEASUREMENT	38
11.1 TEST PROCEDURE.....	38
11.2 TEST RESULT	38
12 MAXIMUM PEAK OUTPUT POWER	42
12.1 TEST PROCEDURE.....	42
12.2 TEST RESULT	43
13 HOPPING CHANNEL SEPARATION	48
13.1 TEST PROCEDURE.....	48
13.2 TEST RESULT	49
14 NUMBER OF HOPPING FREQUENCY.....	53
14.1 TEST PROCEDURE.....	53
14.2 TEST RESULT	54
15 DWELL TIME	55
15.1 TEST PROCEDURE.....	55

15.2 TEST RESULT 55

16 ANTENNA REQUIREMENT 60

17 PHOTOGRAPHS OF TEST SETUP AND EUT..... 61

4 Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTS18S11130 344-1W	2018-11-27	2018-11-28 to 2018-12- 23	2018-12-24	original	-	Valid

5 General Information

5.1 General Description of E.U.T.

Product:	Agriculture Drone
Model(s):	DF-T4
Model Description:	N/A

5.2 Details of E.U.T.

Operation Frequency:	2402-2480MHz
Max. RF output power:	9.00dBm
Type of Modulation:	GFSK
Antenna installation:	Monopole antenna
Antenna Gain:	ANT 1: -2.0dBi ANT 2: -2.0dBi
Ratings:	Battery DC 3.7V 3000mAh

5.3 Channel List

Normal

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	2406	2	2409.5	3	2413	4	2416.5
5	2420	6	2423.5	7	2427	8	2430.5
9	2434.5	10	2438	11	2441	12	2445
13	2448.5	14	2452.5	15	2456.5	16	2460.5
17	2464.5	18	2468.5	19	2472.5	20	2476

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	2406MHz	2441MHz	2476MHz

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
Conducted Emission	15.207	N/A
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

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	2018-04-29	2019-04-28
2	Active Loop Antenna	Beijing Dazhi	ZN30900A	-	2018-04-09	2019-04-08
3	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	2018-04-09	2019-04-08
4	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	2018-09-12	2019-09-11
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	2018-04-09	2019-04-08
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	2018-04-09	2019-04-08
7	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	2018-04-13	2019-04-12
8	Coaxial Cable (above 1GHz)	Top	1GHz-25GHz	EW02014-7	2018-04-13	2019-04-12
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	2018-04-13	2019-04-12
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	2018-04-09	2019-04-08
3	Amplifier	Compliance pirection systems inc	PAP-0203	22024	2018-04-13	2019-04-12
4	Cable	HUBER+SUHNER	CBL2	525178	2018-04-13	2019-04-12
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	2018-09-12	2019-09-11
2.	Spectrum Analyzer (9k-6GHz)	R&S	FSL6	100959	2018-09-12	2019-09-11
3.	Signal Analyzer (9k~26.5GHz)	Agilent	N9010A	MY50520207	2018-09-12	2019-09-11

7.2 Description of Support Units

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

7.3 Measurement Uncertainty

Parameter	Uncertainty
Radiated Spurious Emissions	± 5.08 dB (Bilog antenna 30M~1000MHz)
	± 4.99 dB (Horn antenna 1000M~25000MHz)
Radio Frequency	± 1 x 10 ⁻⁷ Hz
RF Power	± 0.42 dB
Dwell time	1.0%
Conducted Spurious Emissions	± 2.76 dB (9kHz~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 Radiated Spurious Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.205 & 15.209 & 15.247

Test Method: ANSI C63.10: 2013

Test Result: PASS

Measurement Distance: 3m

Limit:

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	2400/F(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))} + 80$
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))} + 40$
1.705 ~ 30	30	30	100 * 30	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

8.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

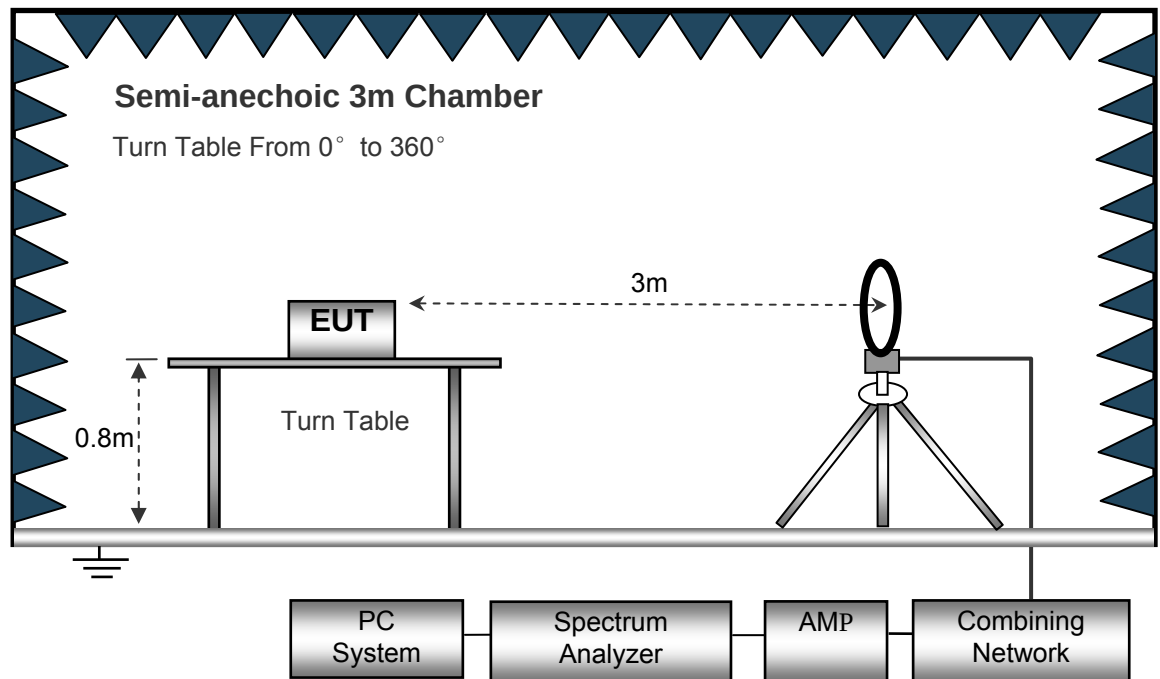
EUT Operation :

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

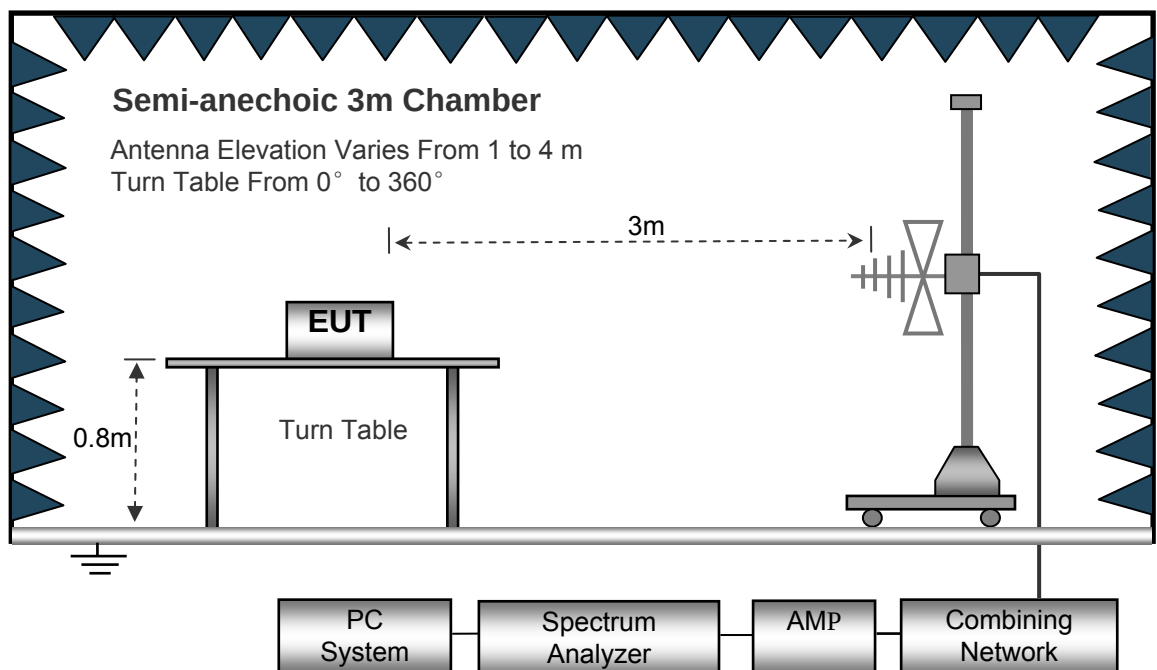
8.2 Test Setup

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

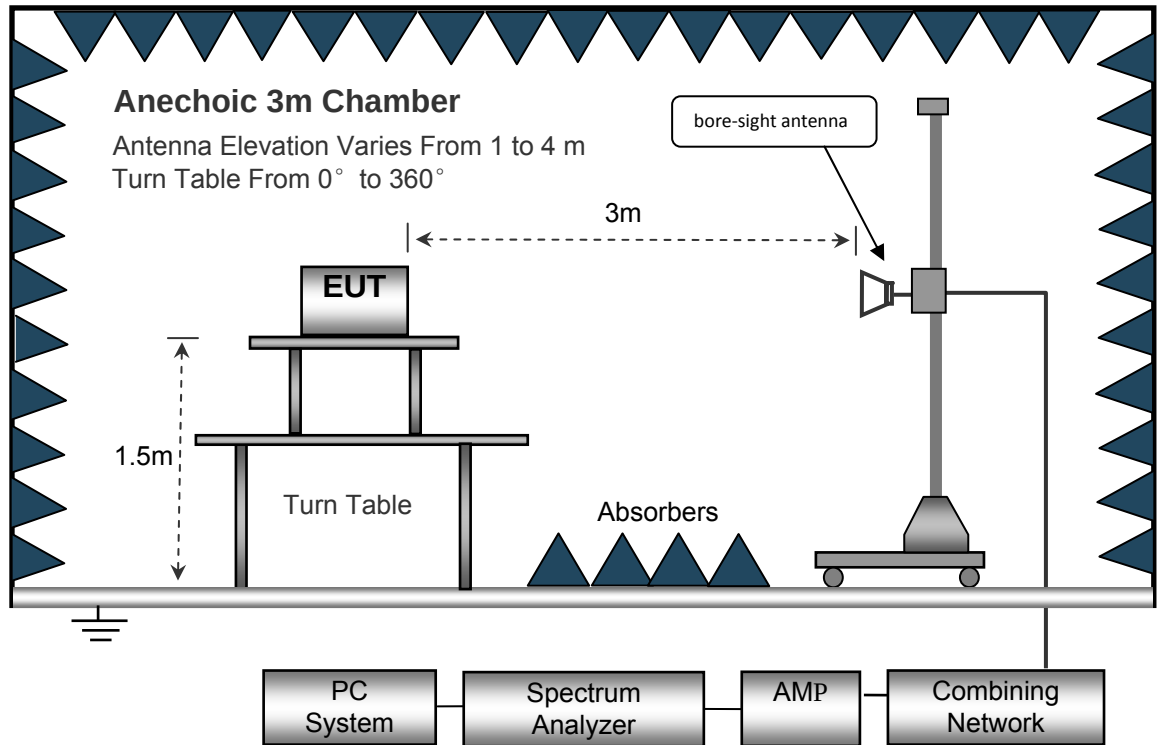
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



8.3 Spectrum Analyzer Setup

Below 30MHz

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

30MHz ~ 1GHz

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

Above 1GHz

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

8.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane for below 1GHz and 1.5m for above 1GHz.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the Z position. So the data shown was the Z position only.

8.5 Corrected Amplitude & Margin Calculation

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

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

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

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

8.6 Summary of Test Results

ANT 1 Test Frequency: 9KHz~30MHz

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

Frequency	Measurement results dB μ V @3m	Detector PK/QP	Correct factor dB/m	Extrapolation factor dB	Measurement results (calculated) dB μ V/m @30m	Limits dB μ V/m @30m	Margin dB
(MHz)	Measurement results	Detector	Correct factor	Extrapolation factor	Measurement results (calculated)	Limits	Margin
6.021	25.34	QP	21.84	40.00	7.18	29.54	-22.36
15.730	25.30	QP	21.35	40.00	6.65	29.54	-22.89
25.680	25.32	QP	20.67	40.00	5.99	29.54	-23.55

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)	(dB μ V)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)
GFSK Low Channel									
268.32	36.97	QP	88	1.1	H	-13.35	23.62	46.00	-22.38
268.32	41.91	QP	320	1.5	V	-13.35	28.56	46.00	-17.44
4812.00	46.10	PK	236	1.4	V	-1.06	45.04	74.00	-28.96
4812.00	42.94	Ave	236	1.4	V	-1.06	41.88	54.00	-12.12
7218.00	41.38	PK	337	1.1	H	1.33	42.71	74.00	-31.29
7218.00	37.35	Ave	337	1.1	H	1.33	38.68	54.00	-15.32
2332.61	46.78	PK	113	2.0	V	-13.19	33.59	74.00	-40.41
2332.61	38.22	Ave	113	2.0	V	-13.19	25.03	54.00	-28.97
2366.18	44.83	PK	240	1.1	H	-13.14	31.69	74.00	-42.31
2366.18	36.58	Ave	240	1.1	H	-13.14	23.44	54.00	-30.56
2495.38	44.52	PK	175	1.3	V	-13.08	31.44	74.00	-42.56
2495.38	37.12	Ave	175	1.3	V	-13.08	24.04	54.00	-29.96

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									
268.32	38.01	QP	8	2.0	H	-13.35	24.66	46.00	-21.34
268.32	40.25	QP	77	1.8	V	-13.35	26.90	46.00	-19.10
4882.00	45.69	PK	353	1.4	V	-0.62	45.07	74.00	-28.93
4882.00	44.03	Ave	353	1.4	V	-0.62	43.41	54.00	-10.59
7323.00	40.78	PK	119	1.4	H	2.21	42.99	74.00	-31.01
7323.00	35.83	Ave	119	1.4	H	2.21	38.04	54.00	-15.96
2324.22	46.40	PK	175	1.2	V	-13.19	33.21	74.00	-40.79
2324.22	38.27	Ave	175	1.2	V	-13.19	25.08	54.00	-28.92
2382.42	43.19	PK	83	1.1	H	-13.14	30.05	74.00	-43.95
2382.42	37.50	Ave	83	1.1	H	-13.14	24.36	54.00	-29.64
2484.93	42.39	PK	228	1.9	V	-13.08	29.31	74.00	-44.69
2484.93	37.44	Ave	228	1.9	V	-13.08	24.36	54.00	-29.64

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dB μ V)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)
GFSK High Channel									
268.32	38.24	QP	92	1.1	H	-13.35	24.89	46.00	-21.11
268.32	41.53	QP	149	1.1	V	-13.35	28.18	46.00	-17.82
4952.00	47.24	PK	331	1.7	V	-0.24	47.00	74.00	-27.00
4952.00	43.30	Ave	331	1.7	V	-0.24	43.06	54.00	-10.94
7428.00	40.99	PK	326	2.0	H	2.84	43.83	74.00	-30.17
7428.00	36.83	Ave	326	2.0	H	2.84	39.67	54.00	-14.33
2315.37	45.77	PK	10	1.7	V	-13.19	32.58	74.00	-41.42
2315.37	38.34	Ave	10	1.7	V	-13.19	25.15	54.00	-28.85
2378.82	44.76	PK	173	1.3	H	-13.14	31.62	74.00	-42.38
2378.82	38.21	Ave	173	1.3	H	-13.14	25.07	54.00	-28.93
2498.18	44.30	PK	174	1.9	V	-13.08	31.22	74.00	-42.78
2498.18	36.56	Ave	174	1.9	V	-13.08	23.48	54.00	-30.52

Test Frequency: 18GHz~25GHz

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

ANT 2 Test Frequency: 9KHz~30MHz

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

Frequency	Measurement results dBμV @3m	Detector PK/QP	Correct factor dB/m	Extrapolation factor dB	Measurement results (calculated) dBμV/m @30m	Limits dBμV/m @30m	Margin dB
(MHz)	Measurement results	Detector	Correct factor	Extrapolation factor	Measurement results (calculated)	Limits	Margin
6.021	25.10	QP	21.84	40.00	6.94	29.54	-22.60
15.730	25.12	QP	21.35	40.00	6.47	29.54	-23.07
25.680	25.14	QP	20.67	40.00	5.81	29.54	-23.73

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									
268.32	36.59	QP	270	1.8	H	-13.35	23.24	46.00	-22.76
268.32	40.92	QP	41	1.3	V	-13.35	27.57	46.00	-18.43
4812.00	46.43	PK	292	1.6	V	-1.06	45.37	74.00	-28.63
4812.00	42.35	Ave	292	1.6	V	-1.06	41.29	54.00	-12.71
7218.00	41.67	PK	81	1.7	H	1.33	43.00	74.00	-31.00
7218.00	37.99	Ave	81	1.7	H	1.33	39.32	54.00	-14.68
2313.53	46.47	PK	267	2.0	V	-13.19	33.28	74.00	-40.72
2313.53	38.84	Ave	267	2.0	V	-13.19	25.65	54.00	-28.35
2388.93	42.52	PK	88	1.2	H	-13.14	29.38	74.00	-44.62
2388.93	36.56	Ave	88	1.2	H	-13.14	23.42	54.00	-30.58
2495.83	42.63	PK	249	1.3	V	-13.08	29.55	74.00	-44.45
2495.83	38.38	Ave	249	1.3	V	-13.08	25.30	54.00	-28.70

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									
268.32	38.01	QP	72	1.9	H	-13.35	24.66	46.00	-21.34
268.32	40.25	QP	328	1.1	V	-13.35	26.90	46.00	-19.10
4882.00	45.69	PK	104	1.9	V	-0.62	45.07	74.00	-28.93
4882.00	44.03	Ave	104	1.9	V	-0.62	43.41	54.00	-10.59
7323.00	40.78	PK	342	1.1	H	2.21	42.99	74.00	-31.01
7323.00	35.83	Ave	342	1.1	H	2.21	38.04	54.00	-15.96
2319.41	45.55	PK	257	1.7	V	-13.19	32.36	74.00	-41.64
2319.41	38.86	Ave	257	1.7	V	-13.19	25.67	54.00	-28.33
2362.77	43.80	PK	303	1.0	H	-13.14	30.66	74.00	-43.34
2362.77	36.93	Ave	303	1.0	H	-13.14	23.79	54.00	-30.21
2497.64	43.61	PK	249	1.1	V	-13.08	30.53	74.00	-43.47
2497.64	36.71	Ave	249	1.1	V	-13.08	23.63	54.00	-30.37

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									
268.32	38.24	QP	234	1.5	H	-13.35	24.89	46.00	-21.11
268.32	41.53	QP	121	1.2	V	-13.35	28.18	46.00	-17.82
4952.00	47.24	PK	287	1.9	V	-0.24	47.00	74.00	-27.00
4952.00	43.30	Ave	287	1.9	V	-0.24	43.06	54.00	-10.94
7428.00	40.99	PK	95	1.4	H	2.84	43.83	74.00	-30.17
7428.00	36.83	Ave	95	1.4	H	2.84	39.67	54.00	-14.33
2346.63	46.57	PK	150	1.3	V	-13.19	33.38	74.00	-40.62
2346.63	39.42	Ave	150	1.3	V	-13.19	26.23	54.00	-27.77
2365.17	44.53	PK	41	1.7	H	-13.14	31.39	74.00	-42.61
2365.17	38.64	Ave	41	1.7	H	-13.14	25.50	54.00	-28.50
2498.71	44.96	PK	320	1.2	V	-13.08	31.88	74.00	-42.12
2498.71	38.79	Ave	320	1.2	V	-13.08	25.71	54.00	-28.29

Test Frequency: 18GHz~25GHz

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

ANT1 +ANT2 Test Frequency: 9KHz~30MHz

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

Frequency	Measurement results dBμV @3m	Detector PK/QP	Correct factor dB/m	Extrapolation factor dB	Measurement results (calculated) dBμV/m @30m	Limits dBμV/m @30m	Margin dB
(MHz)	Measurement results	Detector	Correct factor	Extrapolation factor	Measurement results (calculated)	Limits	Margin
6.025	25.39	QP	21.84	40.00	7.23	29.54	-22.31
15.260	25.45	QP	21.35	40.00	6.80	29.54	-22.74
25.368	25.31	QP	20.67	40.00	5.98	29.54	-23.56

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									
268.34	36.89	QP	139	1.9	H	-13.35	23.54	46.00	-22.46
268.34	41.33	QP	65	1.0	V	-13.35	27.98	46.00	-18.02
4804.00	46.15	PK	356	1.1	V	-1.06	45.09	74.00	-28.91
4804.00	43.52	Ave	356	1.1	V	-1.06	42.46	54.00	-11.54
7206.00	40.62	PK	228	2.0	H	1.33	41.95	74.00	-32.05
7206.00	35.37	Ave	228	2.0	H	1.33	36.70	54.00	-17.30
2323.58	46.22	PK	137	1.1	V	-13.19	33.03	74.00	-40.97
2323.58	38.91	Ave	137	1.1	V	-13.19	25.72	54.00	-28.28
2354.48	43.35	PK	32	1.8	H	-13.14	30.21	74.00	-43.79
2354.48	36.72	Ave	32	1.8	H	-13.14	23.58	54.00	-30.42
2495.88	43.79	PK	237	1.2	V	-13.08	30.71	74.00	-43.29
2495.88	37.49	Ave	237	1.2	V	-13.08	24.41	54.00	-29.59

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									
268.34	36.50	QP	305	1.8	H	-13.35	23.15	46.00	-22.85
268.34	41.57	QP	38	1.6	V	-13.35	28.22	46.00	-17.78
4882.00	46.76	PK	60	2.0	V	-0.62	46.14	74.00	-27.86
4882.00	43.56	Ave	60	2.0	V	-0.62	42.94	54.00	-11.06
7323.00	40.89	PK	132	1.8	H	2.21	43.10	74.00	-30.90
7323.00	35.19	Ave	132	1.8	H	2.21	37.40	54.00	-16.60
2312.31	45.55	PK	330	2.0	V	-13.19	32.36	74.00	-41.64
2312.31	37.46	Ave	330	2.0	V	-13.19	24.27	54.00	-29.73
2387.03	44.62	PK	226	1.9	H	-13.14	31.48	74.00	-42.52
2387.03	38.60	Ave	226	1.9	H	-13.14	25.46	54.00	-28.54
2497.27	43.75	PK	77	1.8	V	-13.08	30.67	74.00	-43.33
2497.27	36.68	Ave	77	1.8	V	-13.08	23.60	54.00	-30.40

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									
268.34	37.62	QP	70	2.0	H	-13.35	24.27	46.00	-21.73
268.34	40.84	QP	261	1.6	V	-13.35	27.49	46.00	-18.51
4960.00	46.98	PK	202	1.4	V	-0.24	46.74	74.00	-27.26
4960.00	44.41	Ave	202	1.4	V	-0.24	44.17	54.00	-9.83
7440.00	40.21	PK	82	1.9	H	2.84	43.05	74.00	-30.95
7440.00	34.53	Ave	82	1.9	H	2.84	37.37	54.00	-16.63
2338.47	46.97	PK	267	2.0	V	-13.19	33.78	74.00	-40.22
2338.47	39.53	Ave	267	2.0	V	-13.19	26.34	54.00	-27.66
2387.77	44.37	PK	156	1.1	H	-13.14	31.23	74.00	-42.77
2387.77	37.23	Ave	156	1.1	H	-13.14	24.09	54.00	-29.91
2499.42	42.31	PK	219	1.0	V	-13.08	29.23	74.00	-44.77
2499.42	38.06	Ave	219	1.0	V	-13.08	24.98	54.00	-29.02

Test Frequency: 18GHz~25GHz

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

9 Conducted Spurious Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: KDB 558074 D01 15.247 Meas Guidance v05, August 24, 2018;
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)).

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:

Below 30MHz:

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

Detector function = peak, Trace = max hold

Above 30MHz:

RBW = 1MHz, VBW = 3MHz, Sweep = auto

Detector function = peak, Trace = max hold

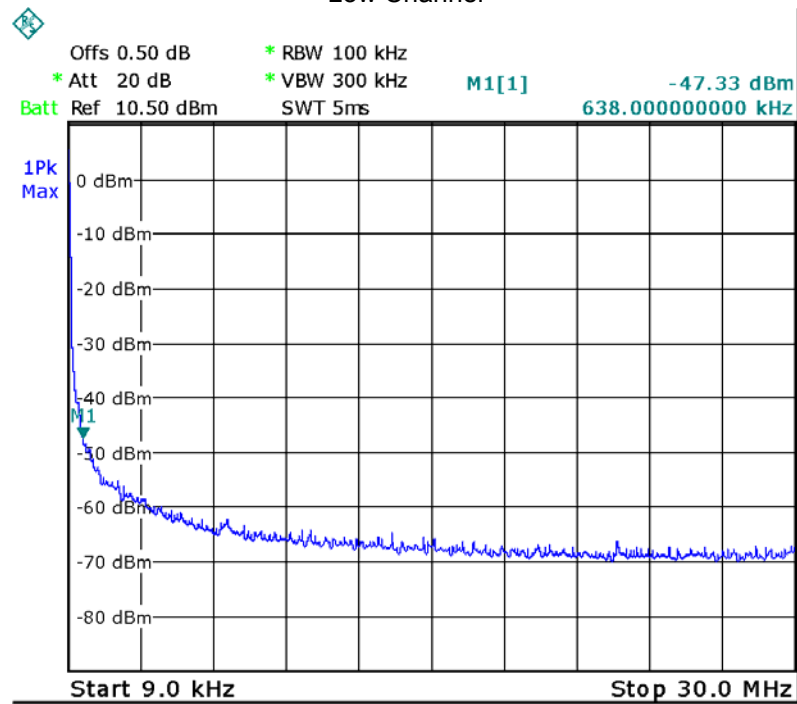
9.2 Test Result

9KHz - 30MHz

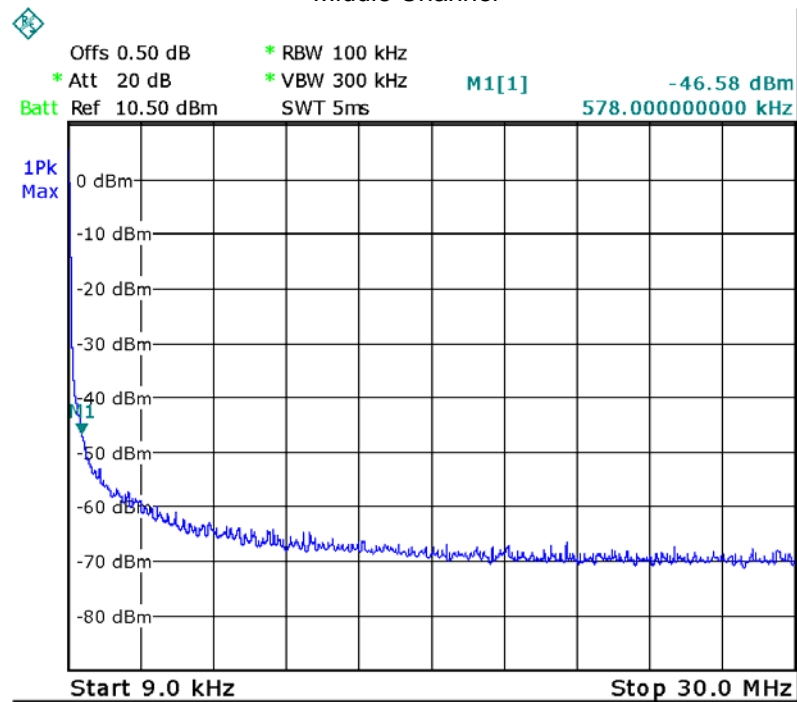
ANT 1

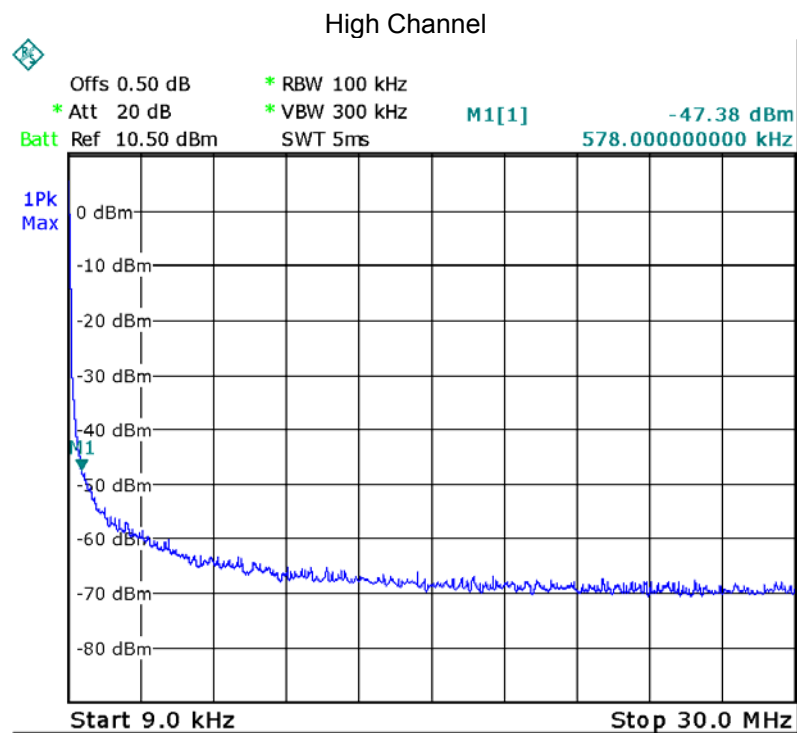
GFSK

Low Channel



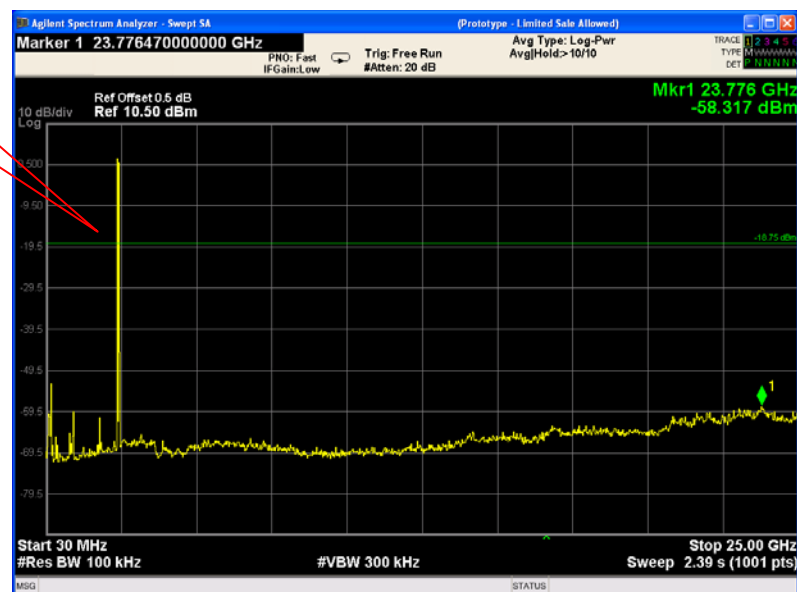
Middle Channel





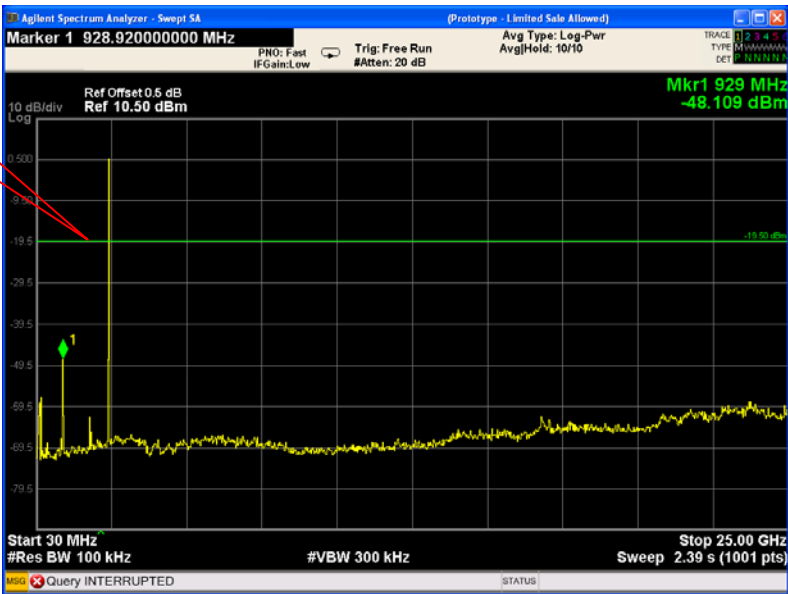
30MHz – 25GHz
GFSK Low Channel

Fundamental



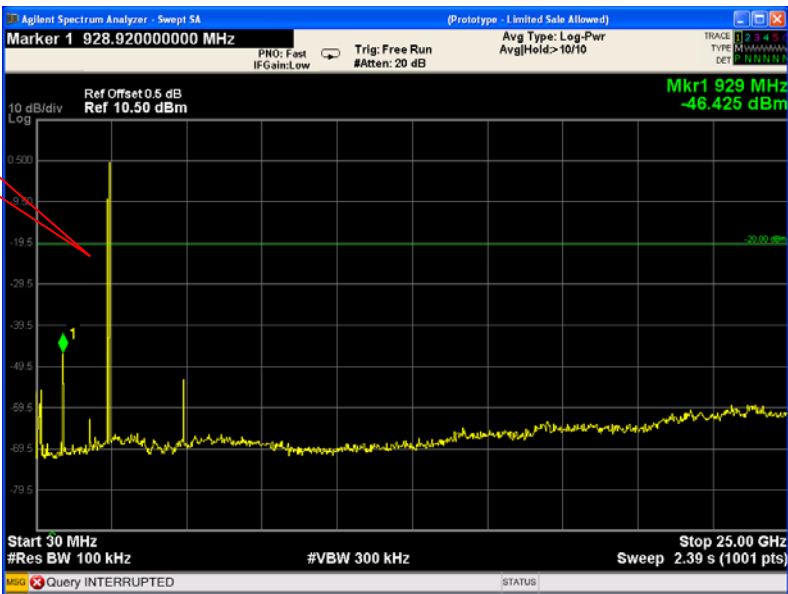
GFSK Middle Channel

Fundamental



GFSK High Channel

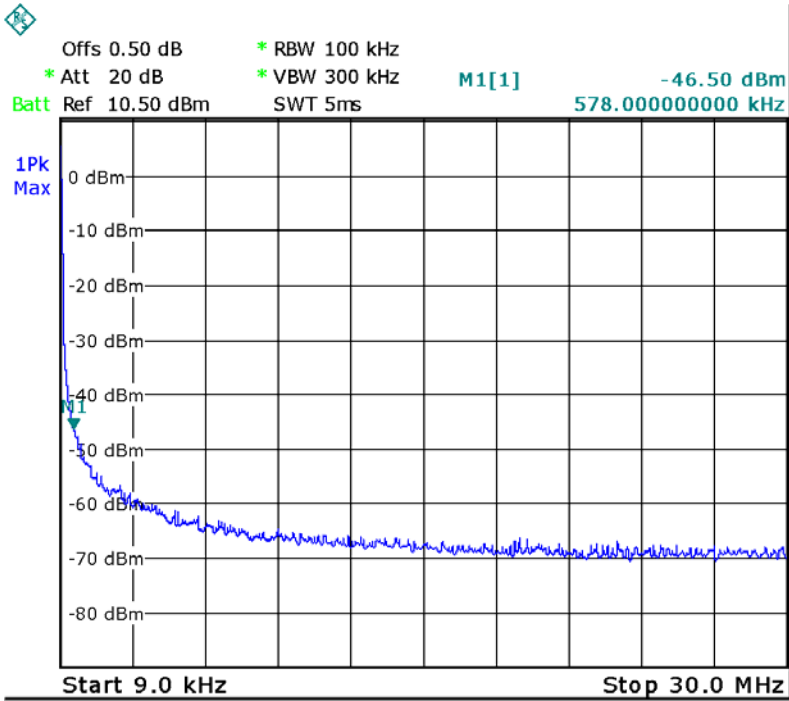
Fundamental



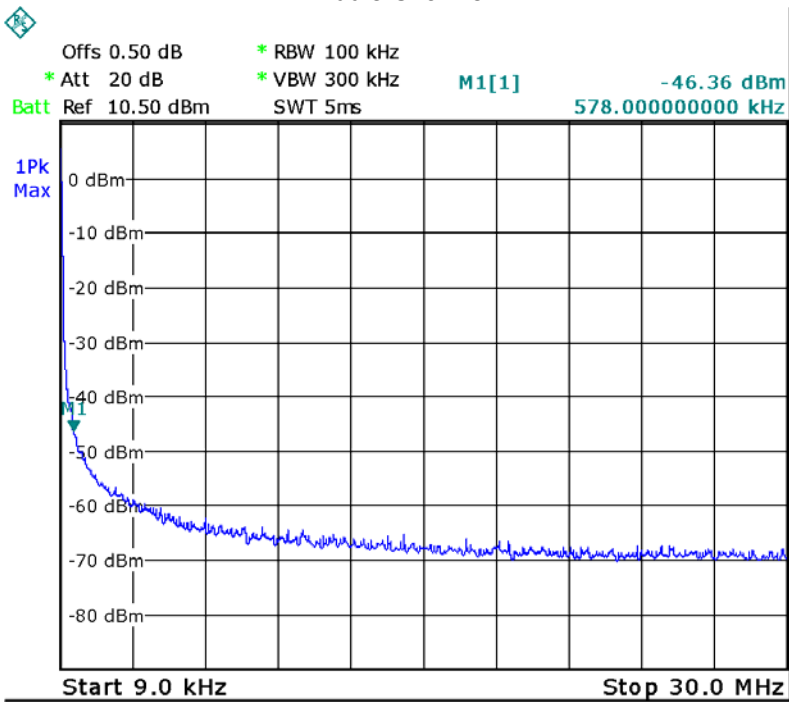
ANT 2

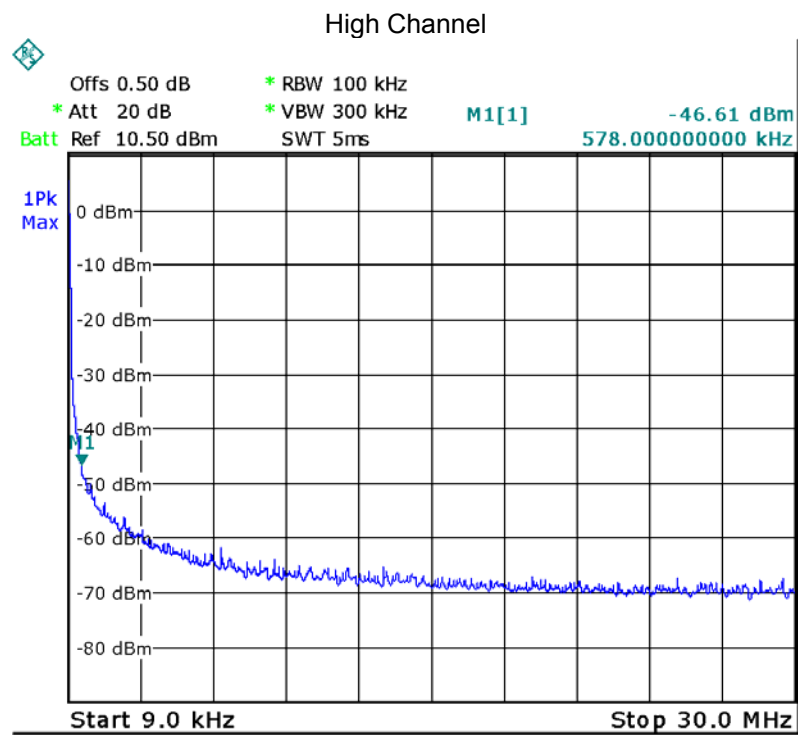
GFSK

Low Channel



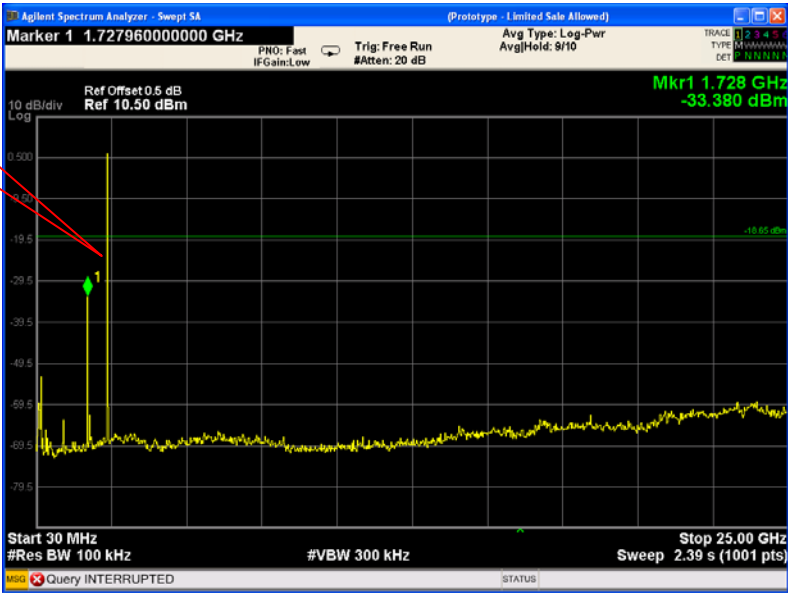
Middle Channel





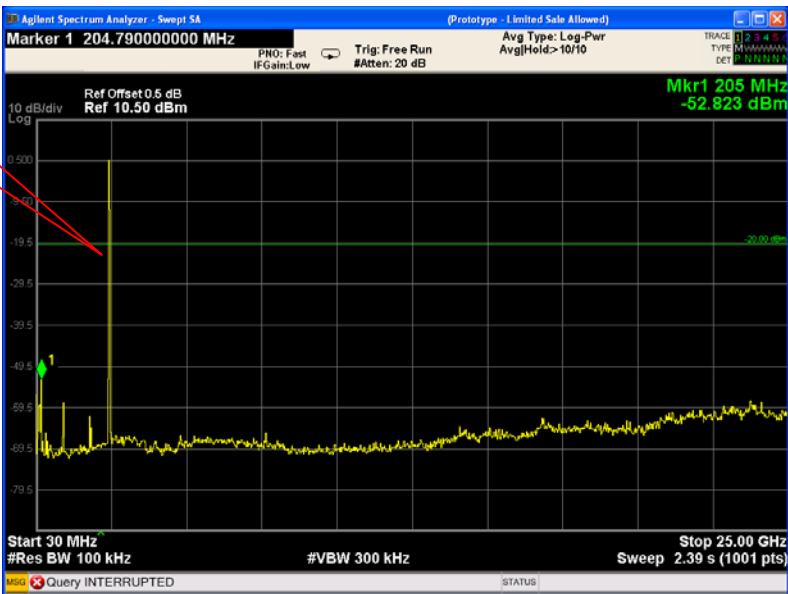
30MHz – 25GHz
GFSK Low Channel

Fundamental



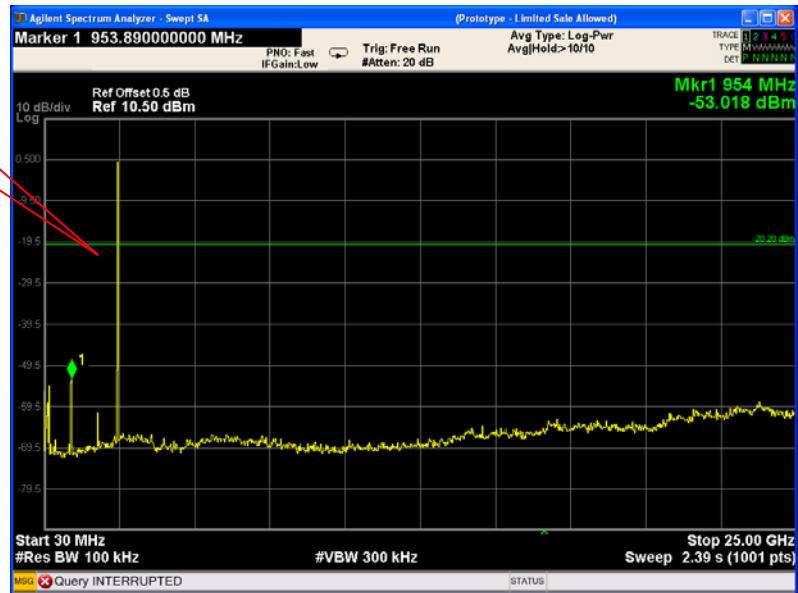
GFSK Middle Channel

Fundamental



GFSK High Channel

Fundamental



10 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:	KDB 558074 D01 15.247 Meas Guidance v05, August 24, 2018; 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

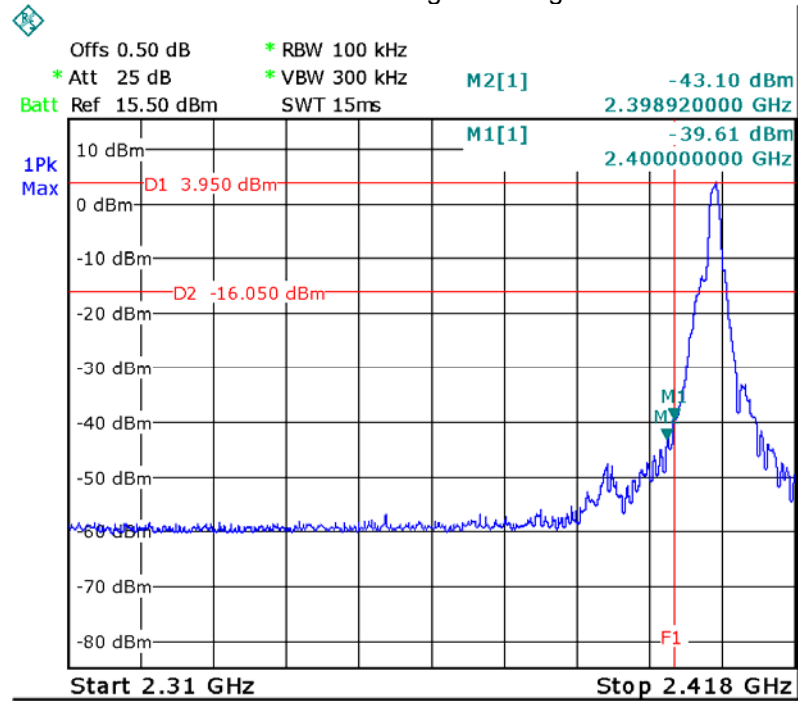
10.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto
Detector function = peak, Trace = max hold

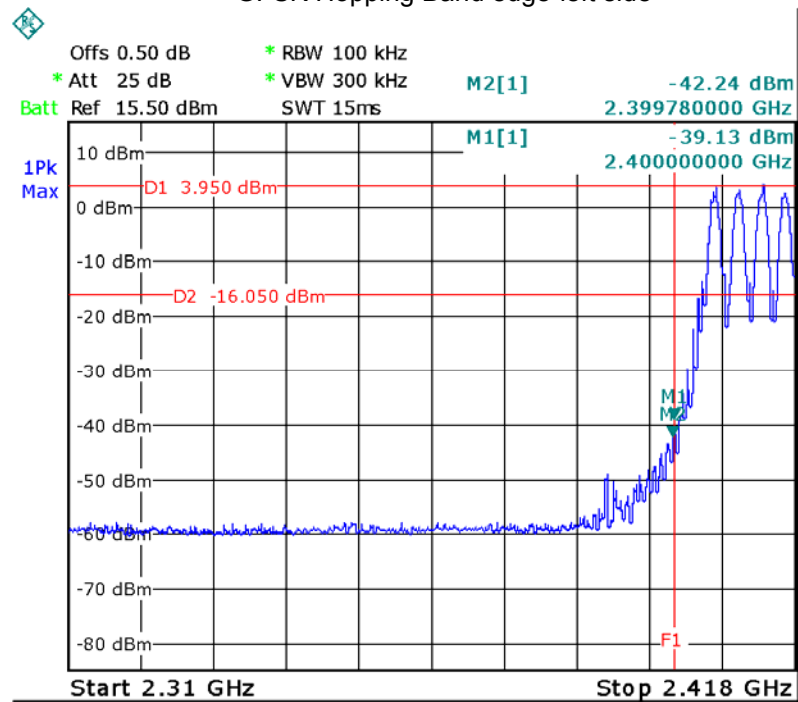
10.2 Test Result

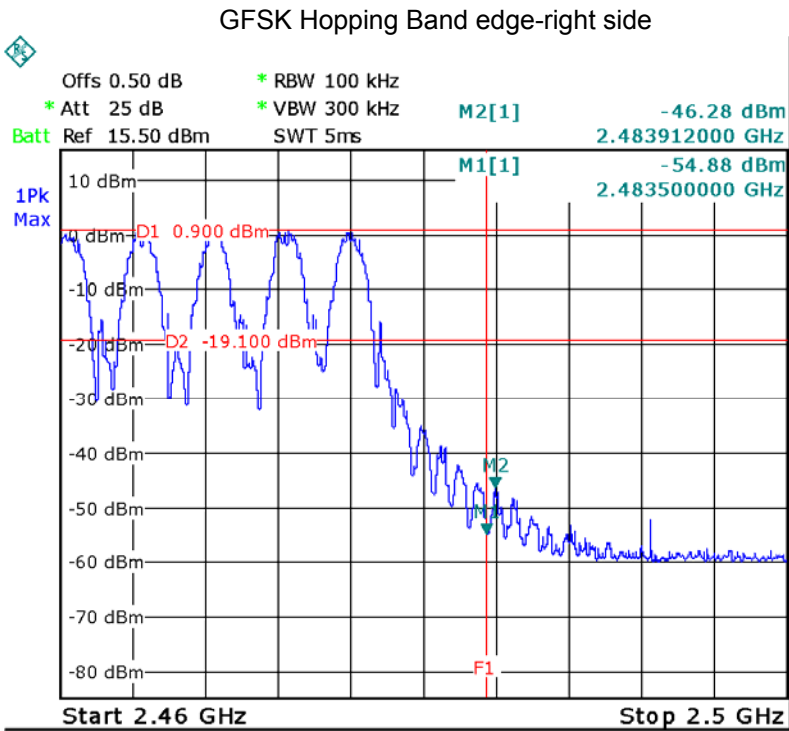
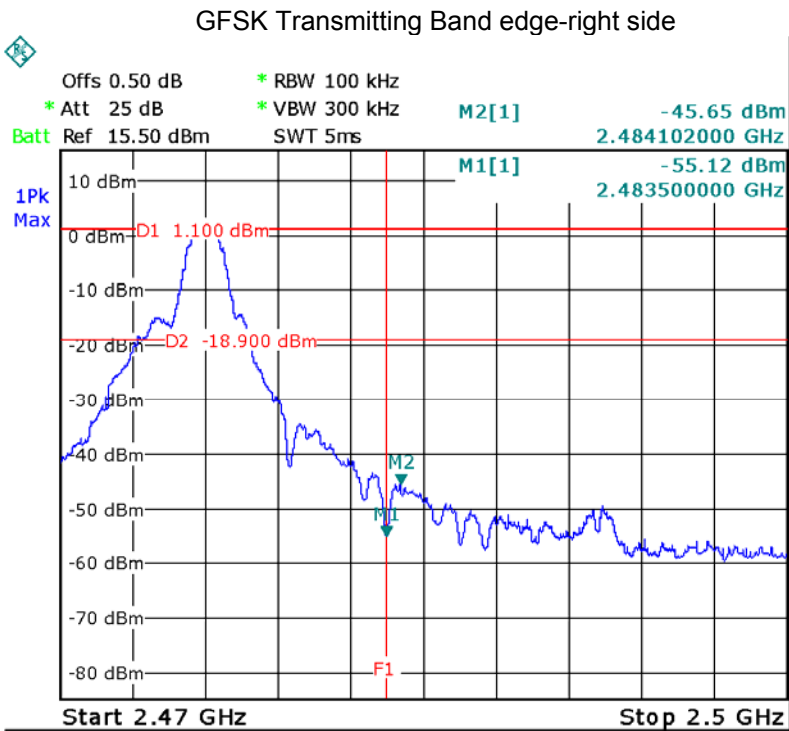
ANT 1

GFSK Transmitting Band edge-left side



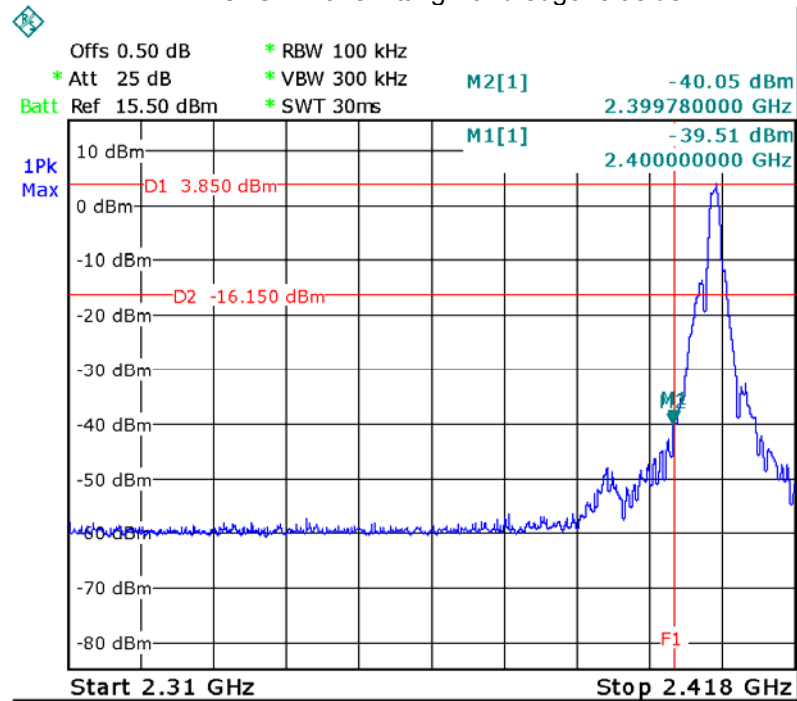
GFSK Hopping Band edge-left side



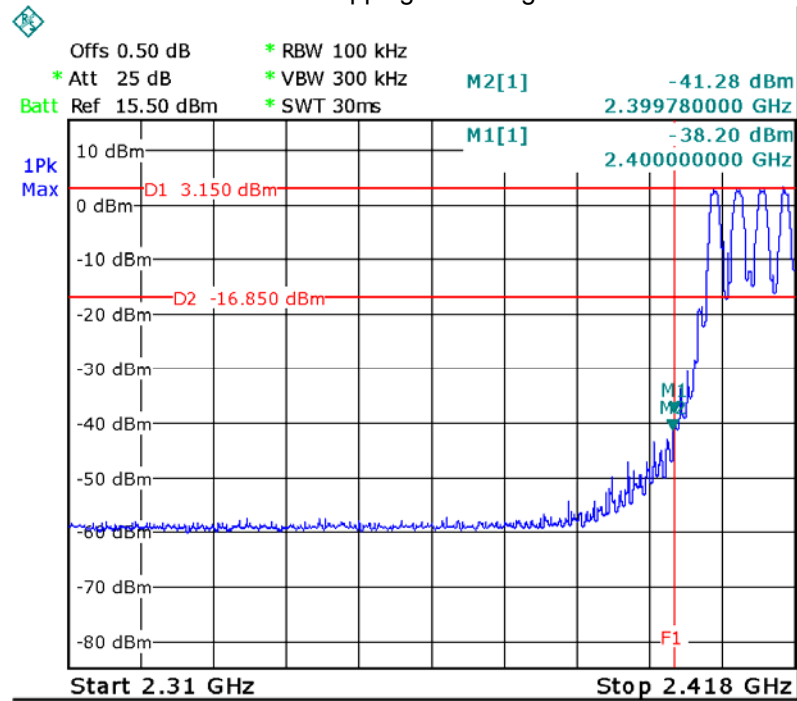


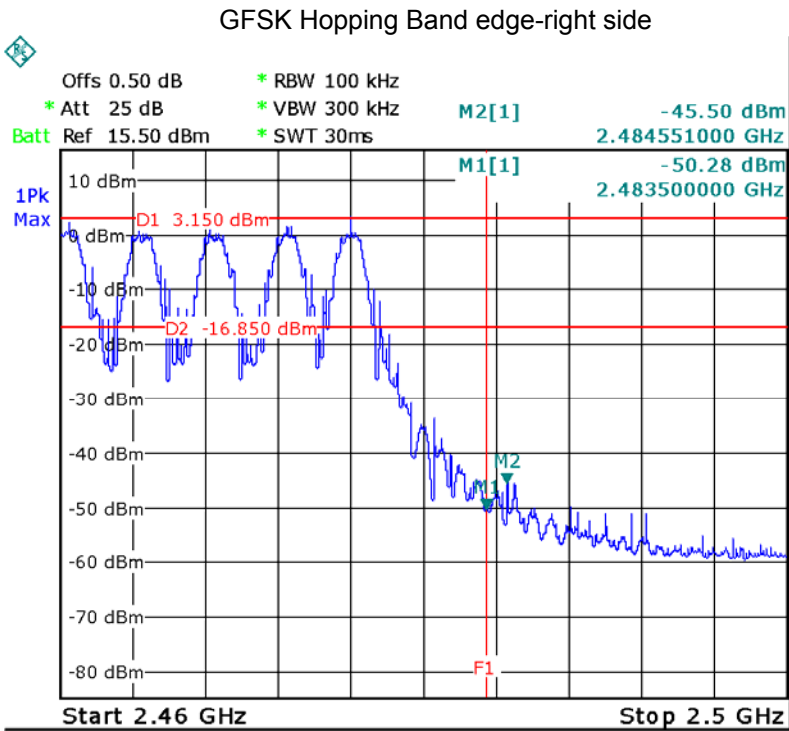
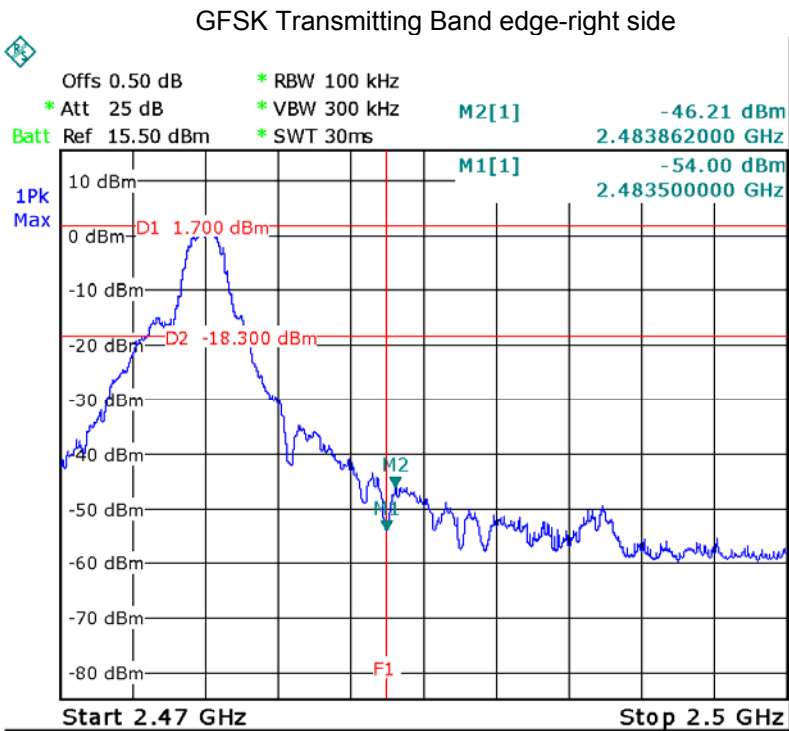
ANT 2

GFSK Transmitting Band edge-left side



GFSK Hopping Band edge-left side





11 20 dB Bandwidth Measurement

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: KDB 558074 D01 15.247 Meas Guidance v05, August 24, 2018;
ANSI C63.10: 2013

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

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 = 30kHz, VBW = 100kHz

11.2 Test Result

ANT 1

Modulation	Test Channel	Bandwidth(MHz)
GFSK	Low	2.499
GFSK	Middle	2.499
GFSK	High	2.555

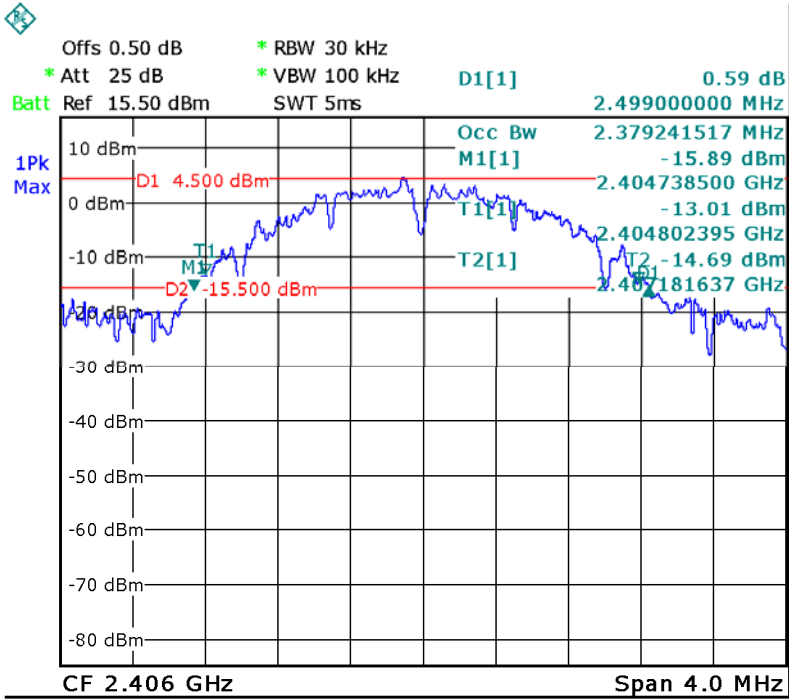
ANT 2

Modulation	Test Channel	Bandwidth(MHz)
GFSK	Low	2.507
GFSK	Middle	2.499
GFSK	High	2.563

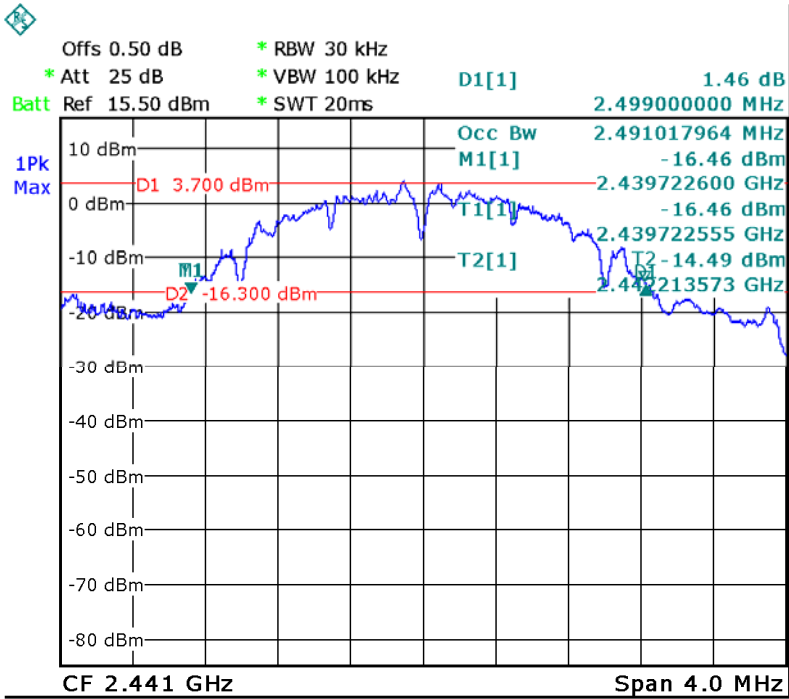
Test plots

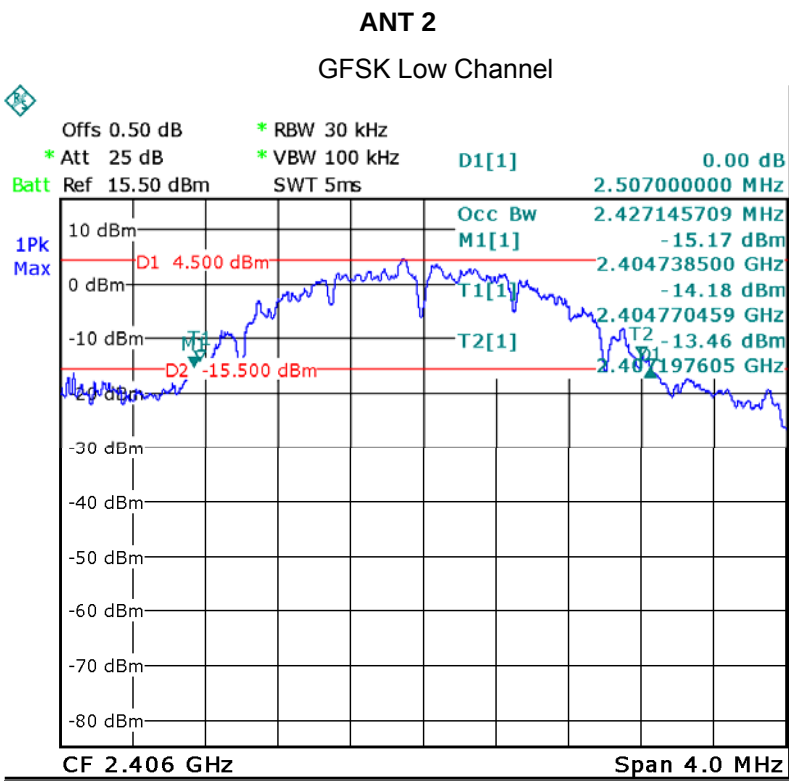
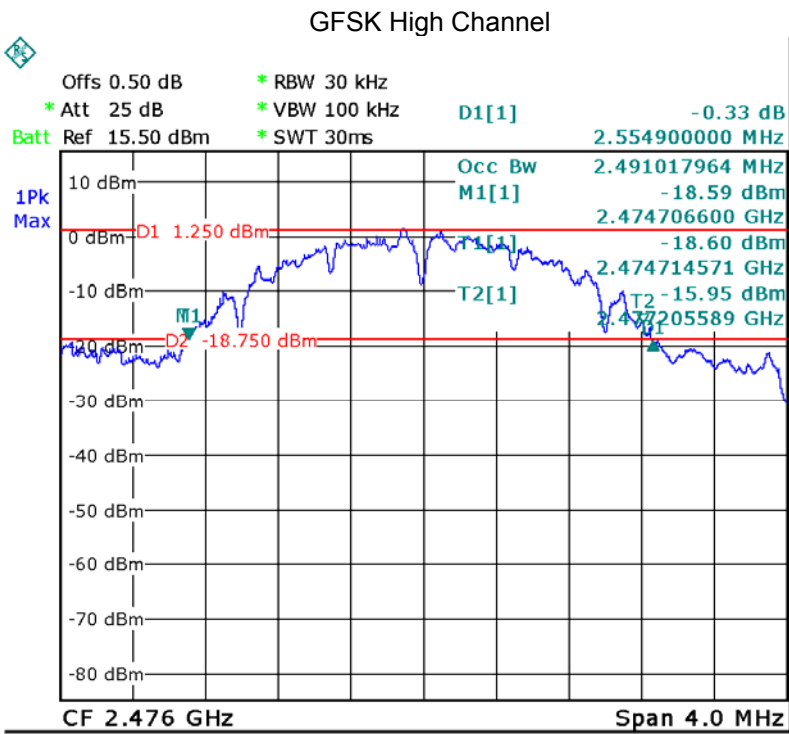
ANT 1

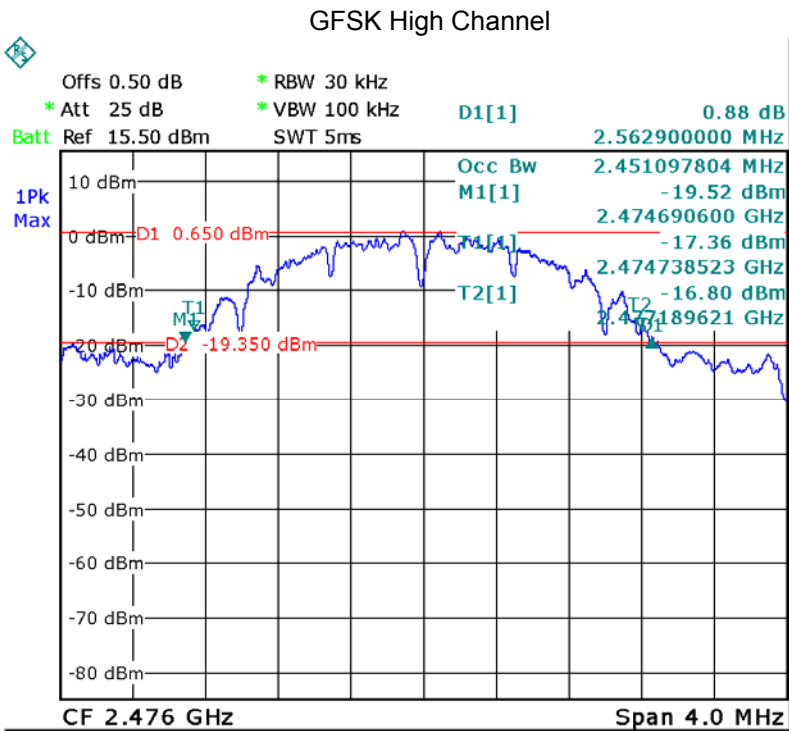
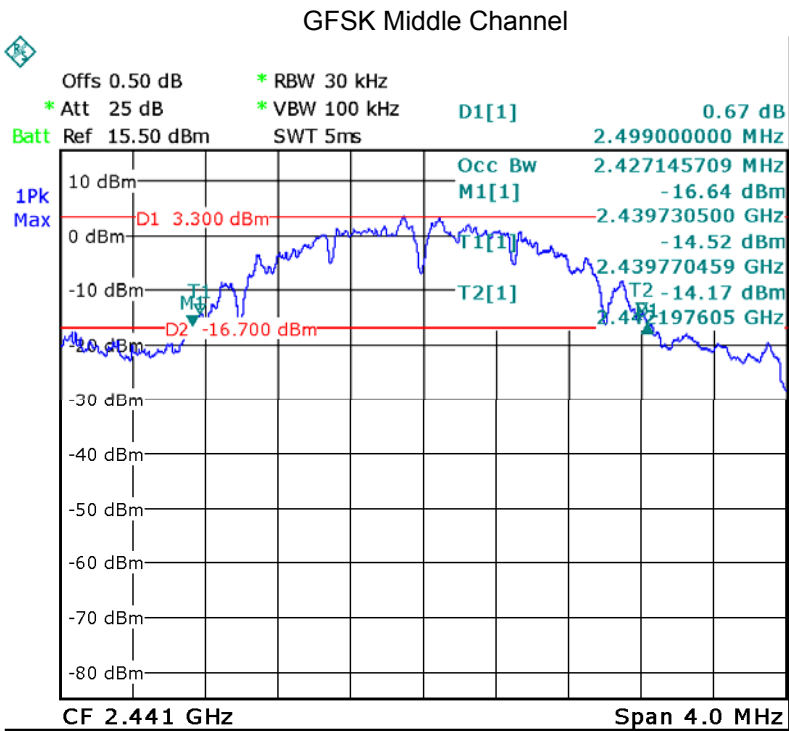
GFSK Low Channel



GFSK Middle Channel







12 Maximum Peak Output Power

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: KDB 558074 D01 15.247 Meas Guidance v05, August 24, 2018;
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.

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:
 - a) Use the following spectrum analyzer settings:
 - 1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
 - 2) RBW $\geq$ 20 dB bandwidth of the emission being measured.
 - 3) VBW $\geq$ RBW.
 - 4) Sweep: Auto.
 - 5) Detector function: Peak.
 - 6) Trace: Max hold.
 - b) Allow trace to stabilize.
 - c) Use the marker-to-peak function to set the marker to the peak of the emission.
 - d) The indicated level is the peak output power, after any corrections for external attenuators and cables.
 - e) A plot of the test results and setup description shall be included in the test report.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

12.2 Test Result

ANT 1

Modulation	Test Channel	Output Power (dBm)	Limit (dBm)
GFSK	Low	6.70	21
GFSK	Middle	5.98	21
GFSK	High	4.86	21

ANT 2

Modulation	Test Channel	Output Power (dBm)	Limit (dBm)
GFSK	Low	5.15	21
GFSK	Middle	5.38	21
GFSK	High	3.70	21

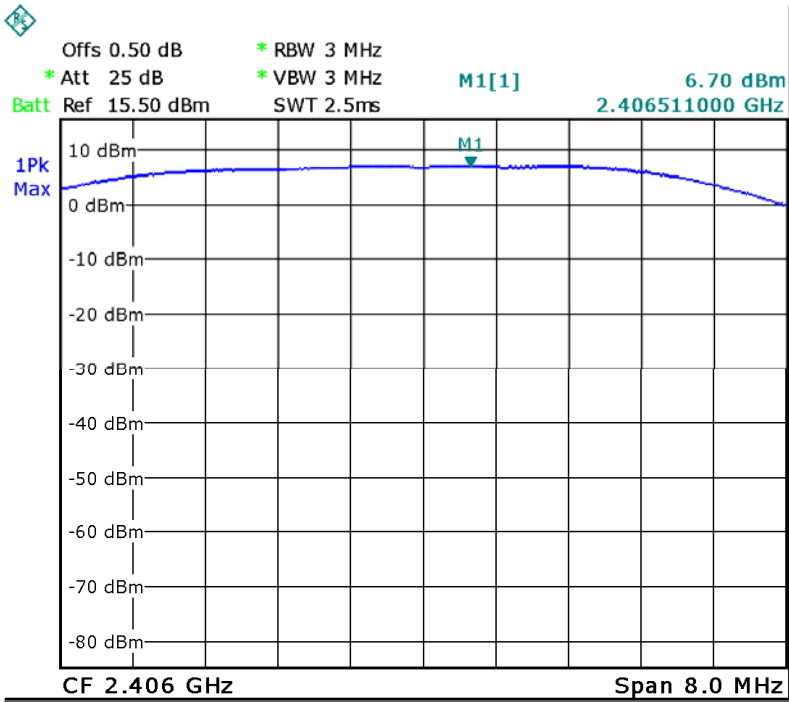
Total

Modulation	Test Channel	Output Power (dBm)	Limit (dBm)
GFSK	Low	9.00	21
GFSK	Middle	8.70	21
GFSK	High	7.33	21

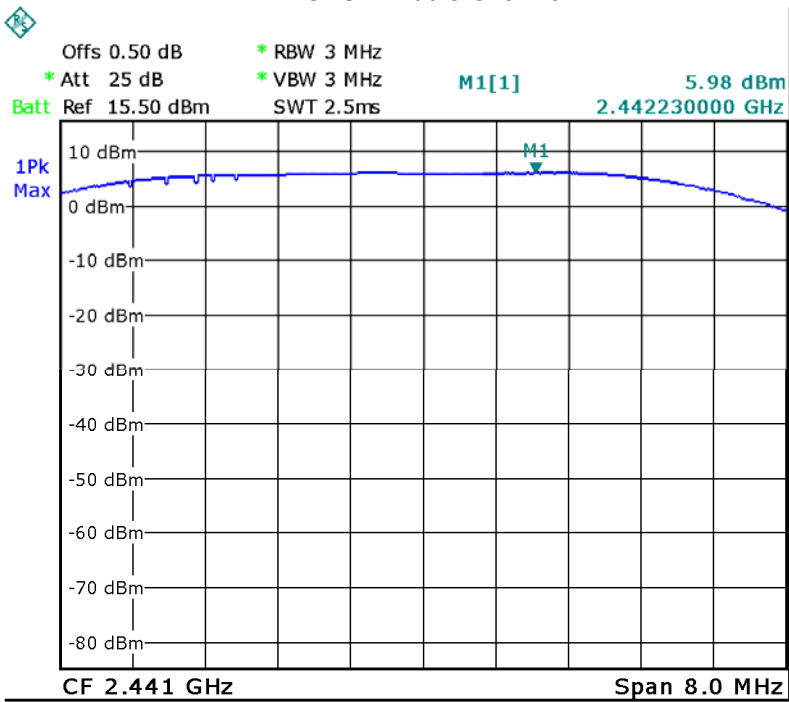
Test plots

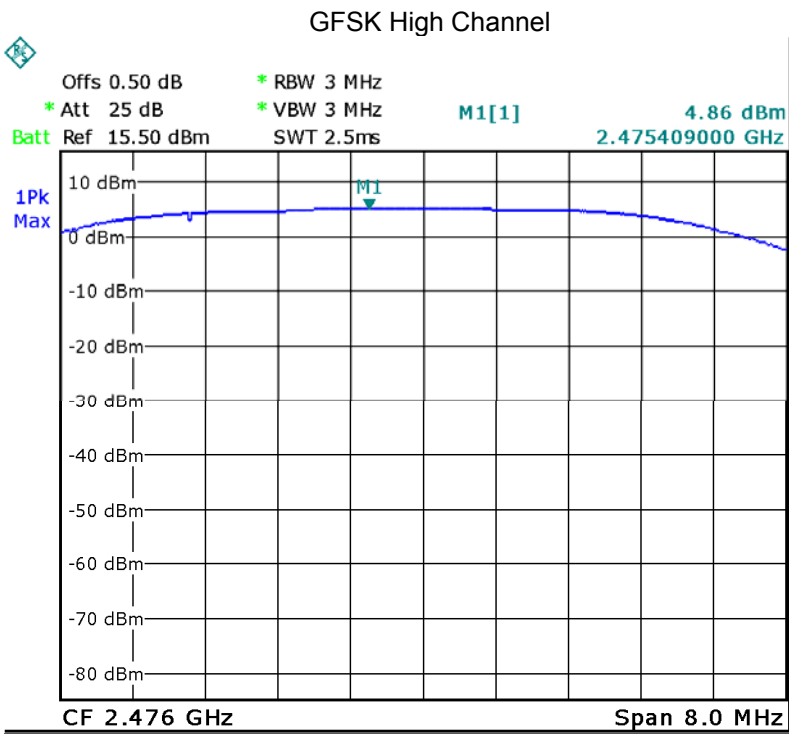
ANT 1

GFSK Low Channel



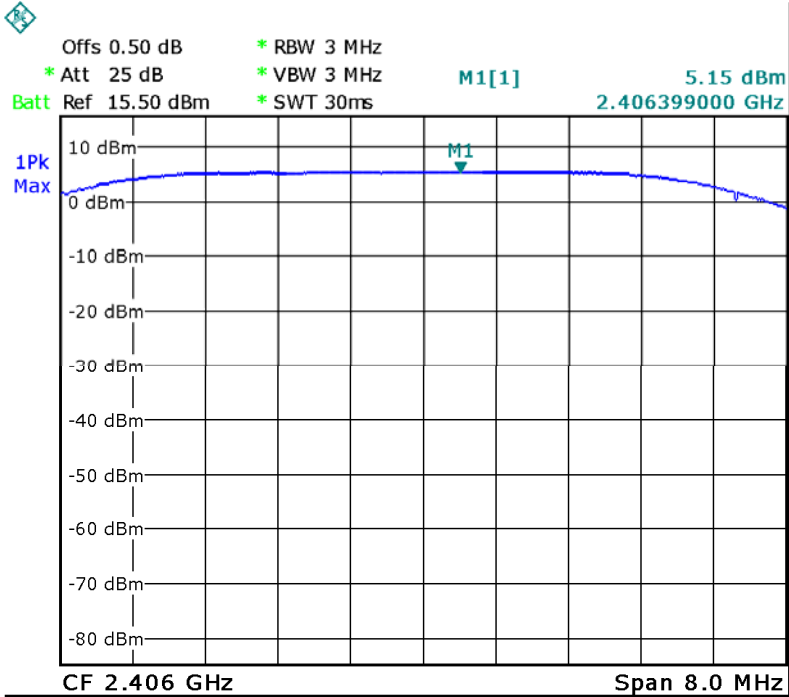
GFSK Middle Channel



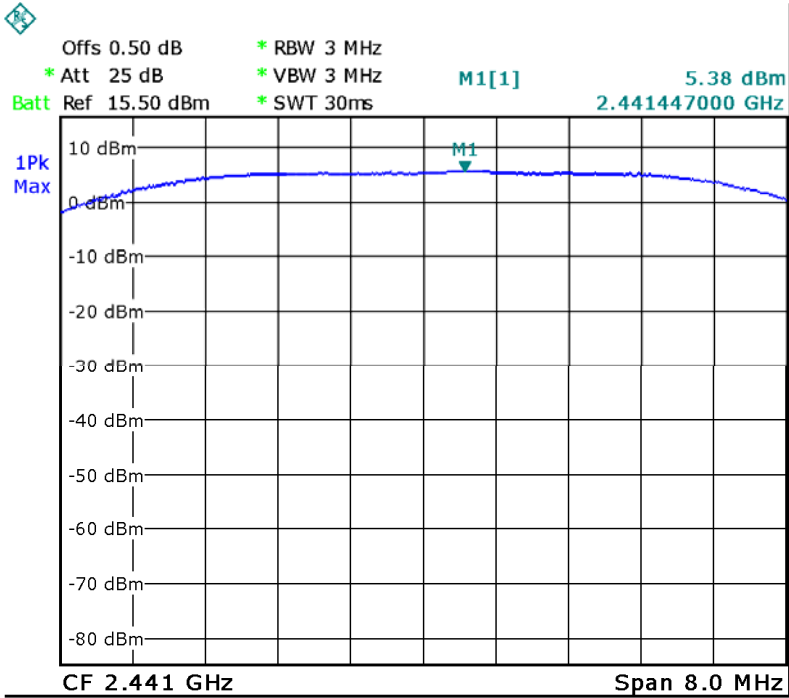


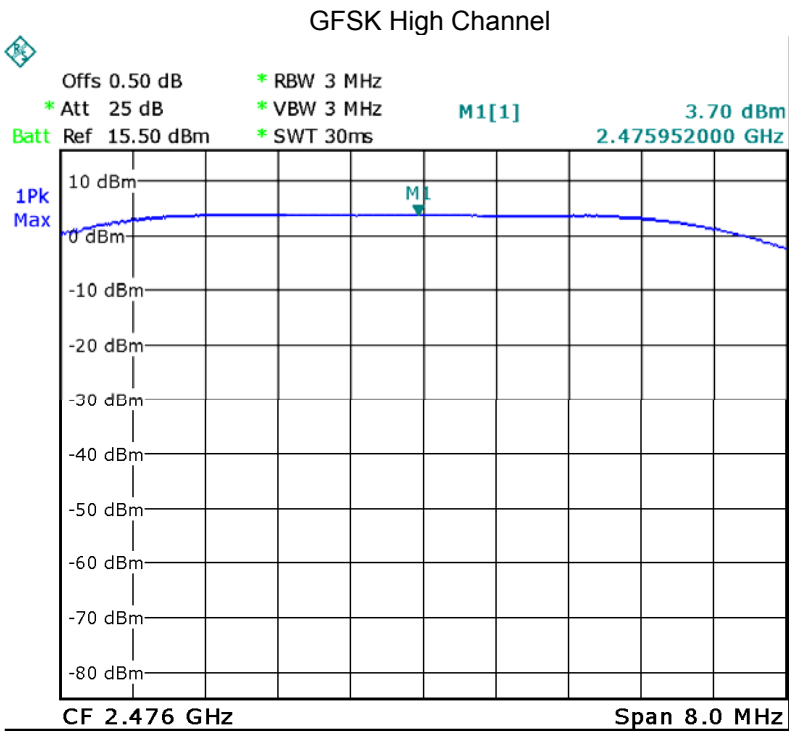
ANT 2

GFSK Low Channel



GFSK Middle Channel





13 Hopping Channel Separation

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: KDB 558074 D01 15.247 Meas Guidance v05, August 24, 2018;
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 power no greater than 0.125W.

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:
 - a) Span: Wide enough to capture the peaks of two adjacent channels.
 - b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
 - c) Video (or average) bandwidth (VBW) $\geq$ RBW.
 - d) Sweep: Auto.
 - e) Detector function: Peak.
 - f) Trace: Max hold.
 - g) Allow the trace to stabilize.
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.

13.2 Test Result

ANT 1

Modulation	Test Channel	Separation (MHz)	Limit(MHz)	Result
GFSK	Low	3.529	2.499	PASS
GFSK	Middle	3.784	2.499	PASS
GFSK	High	3.481	2.555	PASS

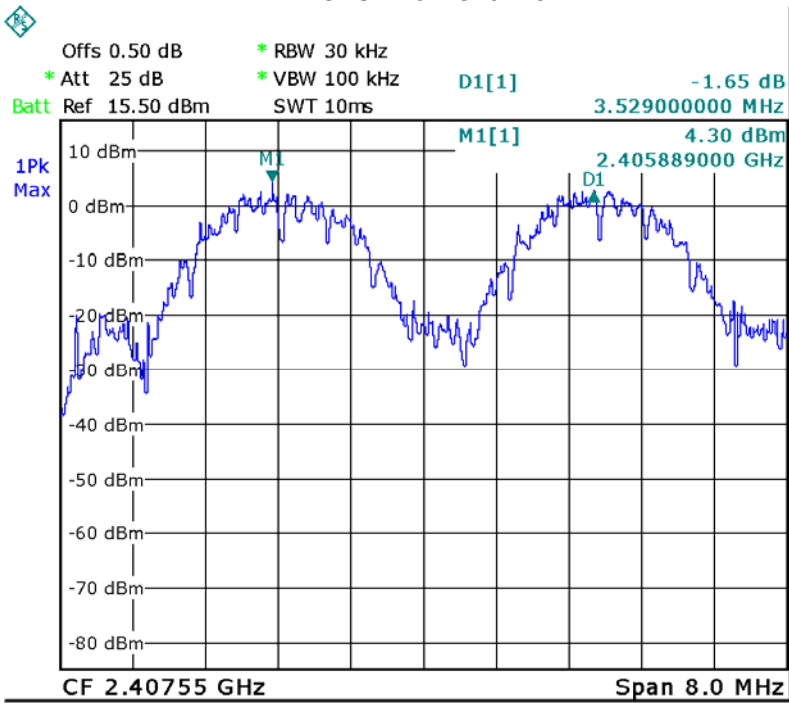
ANT 2

Modulation	Test Channel	Separation (MHz)	Limit(MHz)	Result
GFSK	Low	3.337	2.507	PASS
GFSK	Middle	3.848	2.499	PASS
GFSK	High	3.497	2.563	PASS

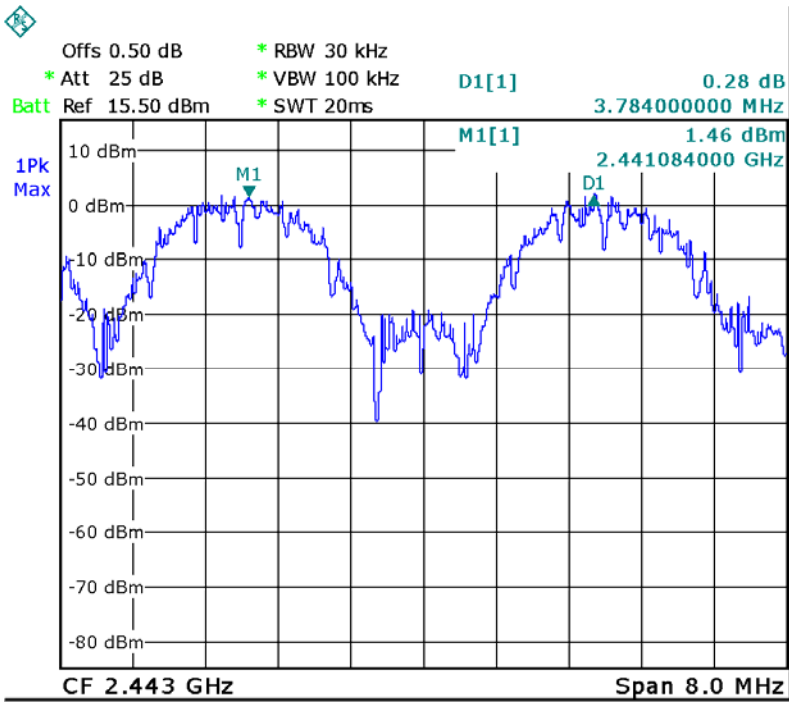
Test plots

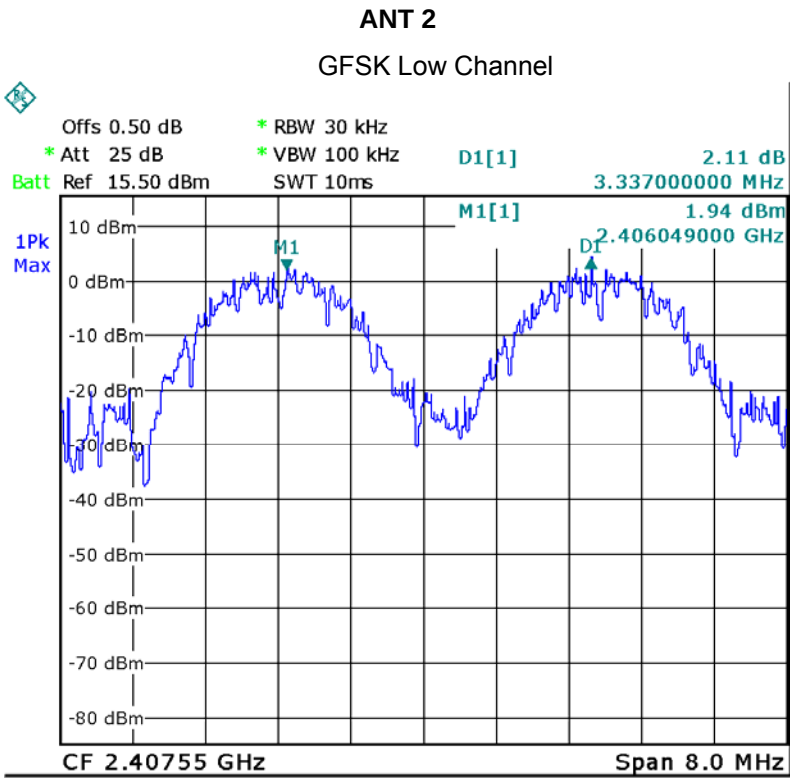
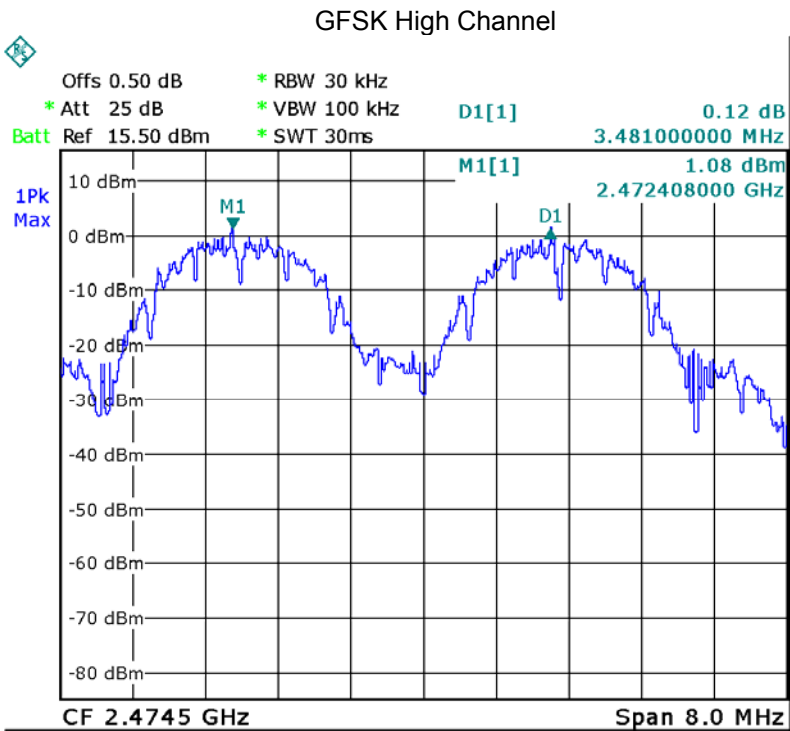
ANT 1

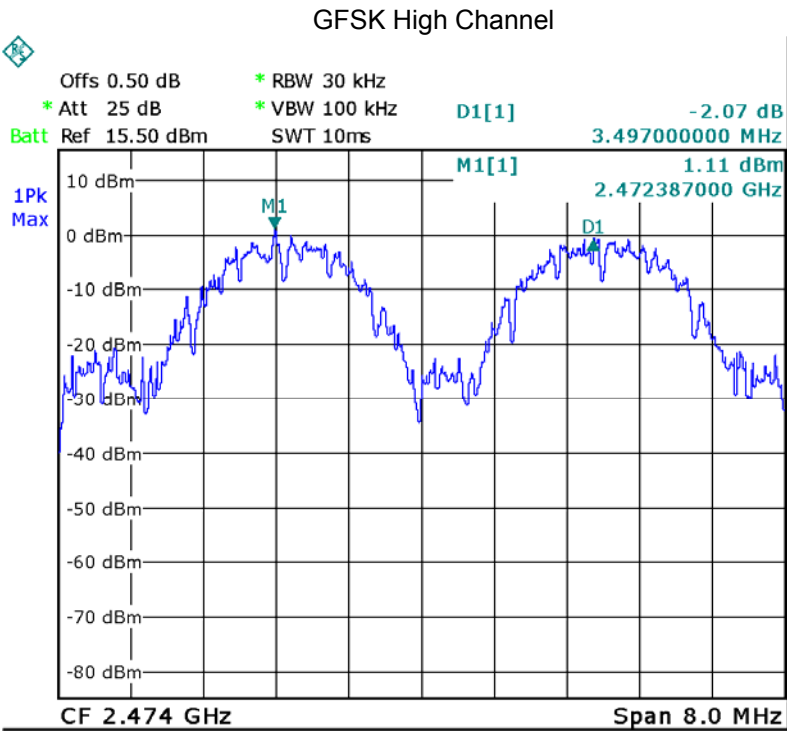
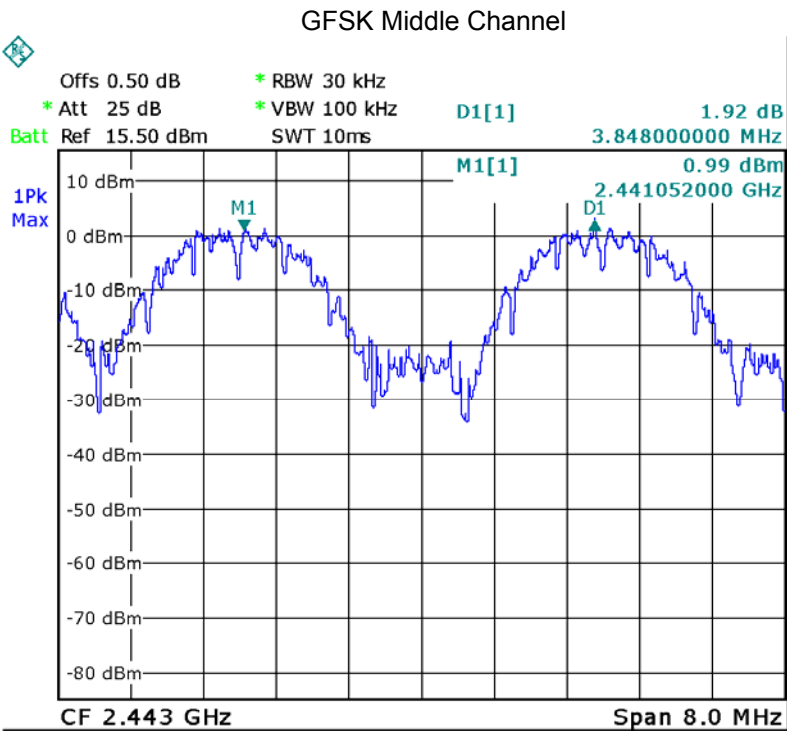
GFSK Low Channel



GFSK Middle Channel







14 Number of Hopping Frequency

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: KDB 558074 D01 15.247 Meas Guidance v05, August 24, 2018;
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.

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:
 - a) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
 - b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
 - c) VBW $\geq$ RBW.
 - d) Sweep: Auto.
 - e) Detector function: Peak.
 - f) Trace: Max hold.
 - g) Allow the trace to stabilize..
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;

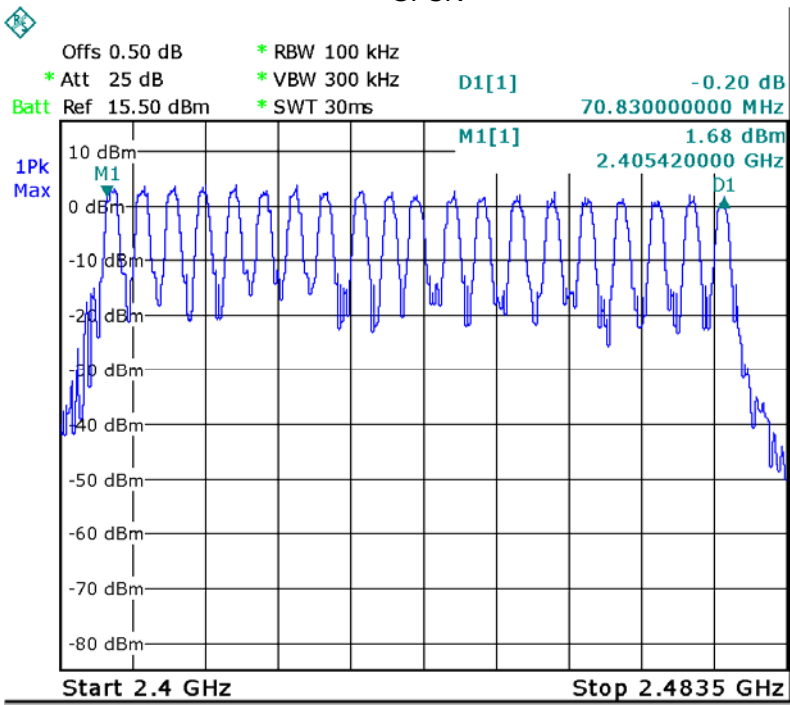
14.2 Test Result

Test Plots:

ANT 1

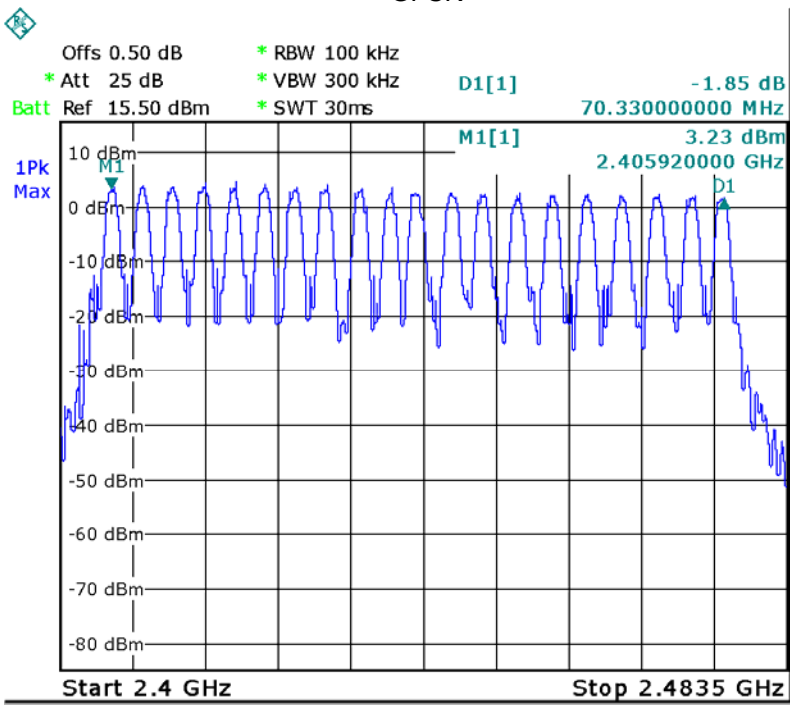
20 Channels in total

GFSK



ANT 2

GFSK



15 Dwell Time

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: KDB 558074 D01 15.247 Meas Guidance v05, August 24, 2018;
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.

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 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 continue 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).

15.2 Test Result

DH5 Packet permit maximum 1600 / 20 / 6 hops per second in each channel (5 time slots RX, 1 time slot TX).

Data Packet	Dwell Time(s)
DH5	$1600/20/6*0.4*20*(MkrDelta)/1000$
Remark: Mkr Delta is once pulse time.	

ANT 1

Modulation	Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
GFSK	DH5	Low	1.560	0.166	0.4
		middle	1.560	0.166	0.4
		High	1.560	0.166	0.4

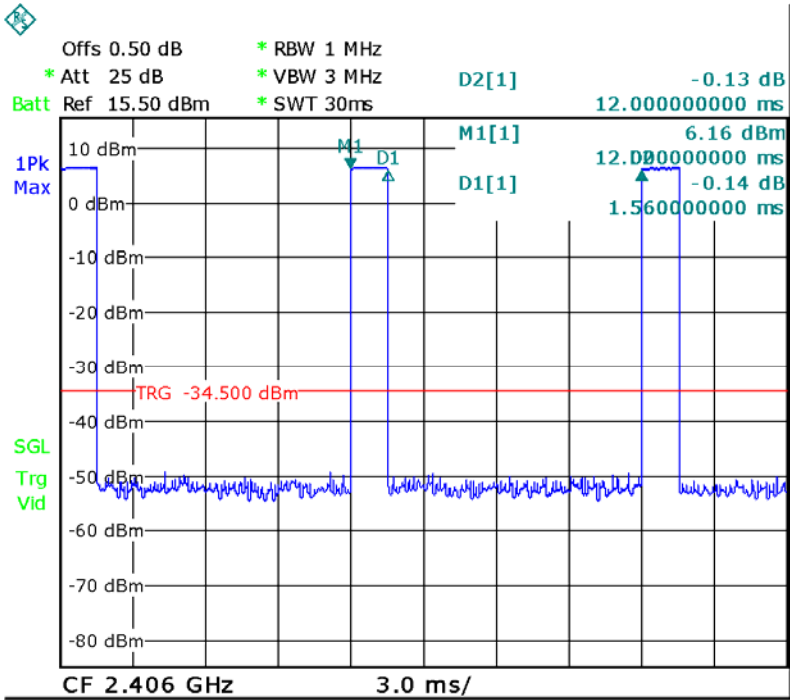
ANT 2

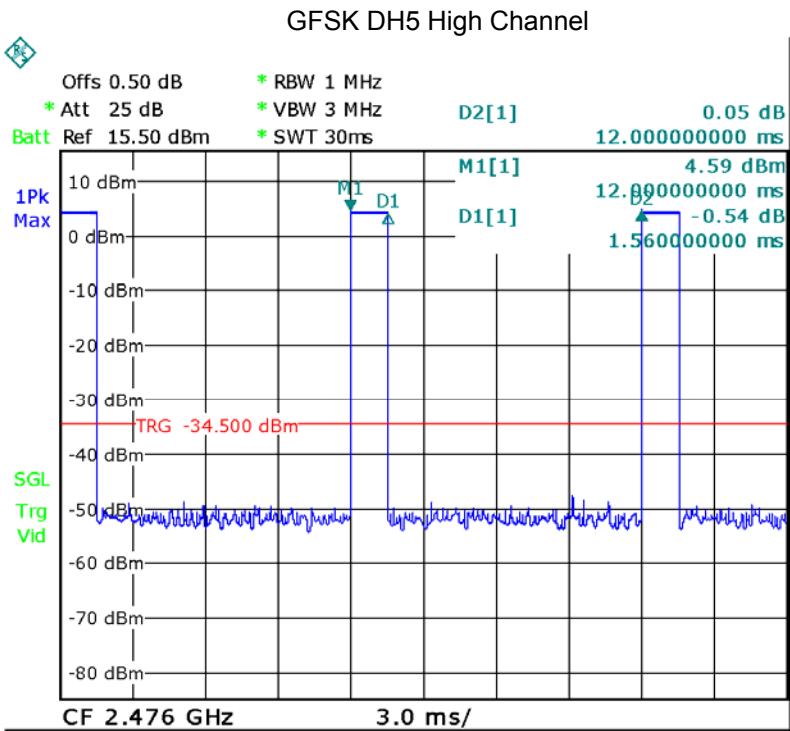
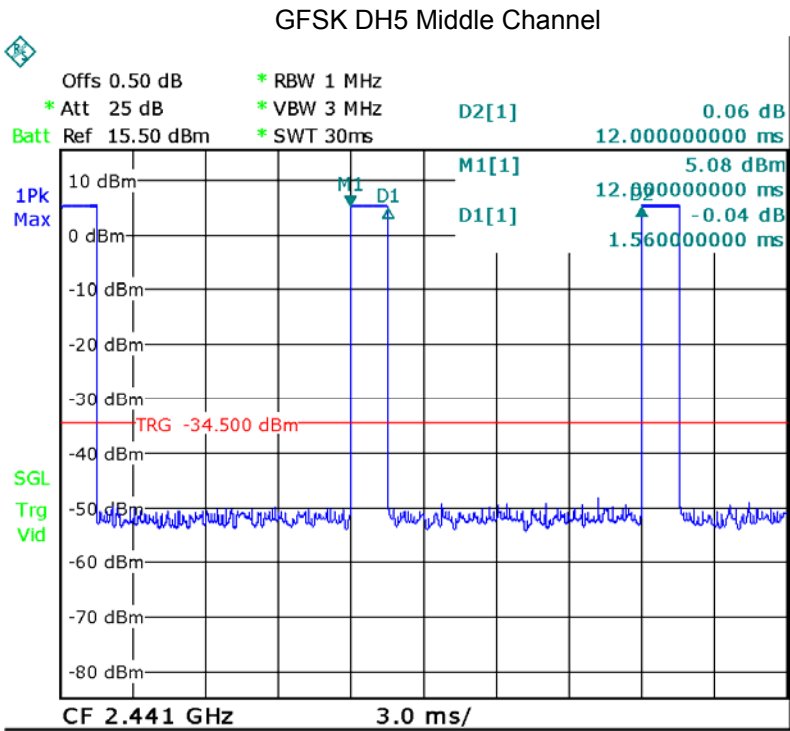
Modulation	Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
GFSK	DH5	Low	1.560	0.166	0.4
		middle	1.560	0.166	0.4
		High	1.560	0.166	0.4

Test Plots

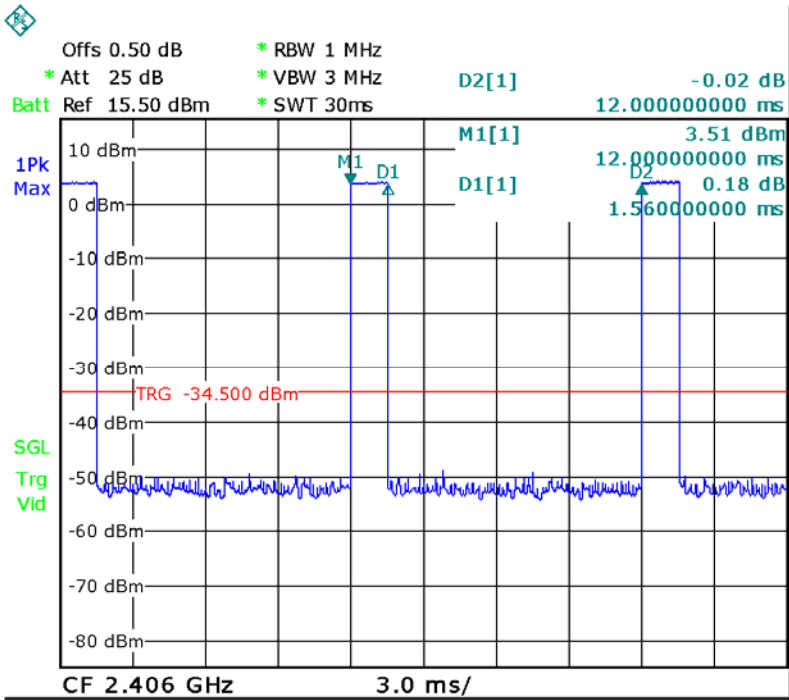
ANT 1

GFSK DH5 Low Channel

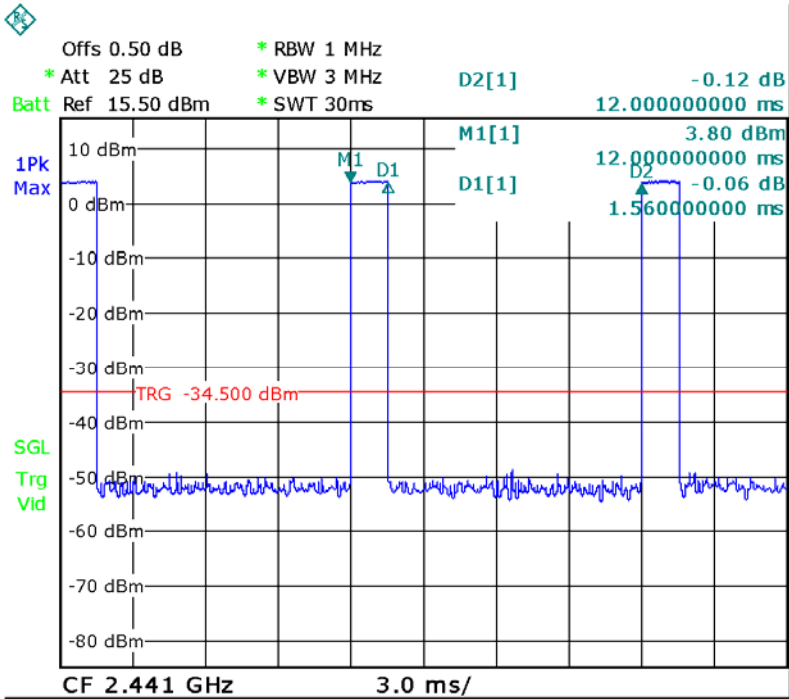


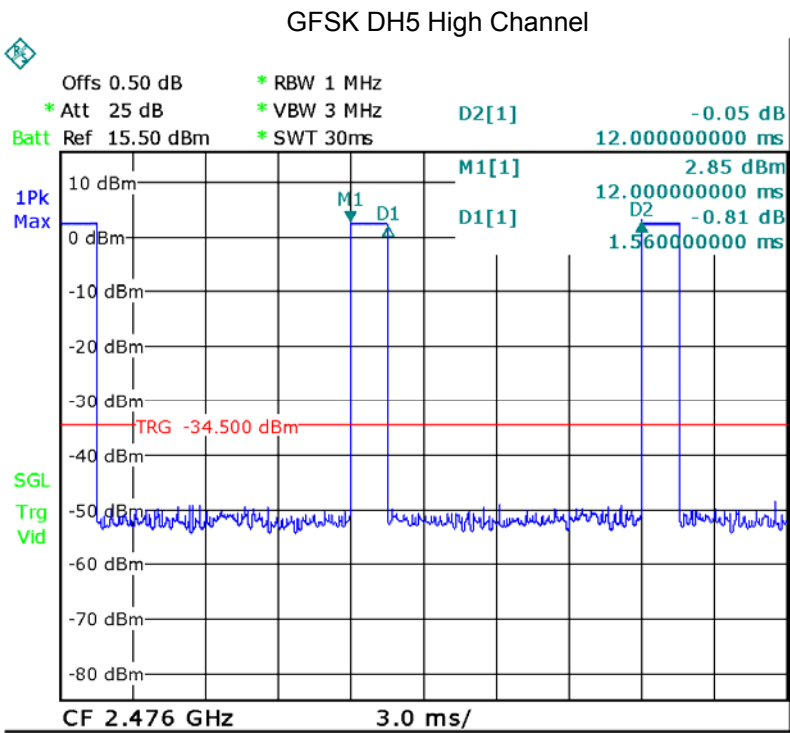


ANT 2
GFSK DH5 Low Channel



GFSK DH5 Middle Channel





16 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.

17 Photographs of test setup and EUT.

Note: Please refer to appendix: WTS18S11130344W_Photo.

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