TEST REPORT

Reference No.	:	WTS18S08121909-2W
FCC ID	:	2ANY6-TE390
Applicant.....	:	Telo Systems Ltd.
Address.....	:	Room 408, Chuangye Building, Seven-Star Park, Chuangye 2nd Road, Bao'an 28th District, Xin'an Bao'an District, Shenzhen, China
Manufacturer	:	The same as above
Address.....	:	The same as above
Product.....	:	Smart Phone
Model(s).	:	TE390
Brand Name.....	:	Telo Systems
Standards.....	:	FCC CFR47 Part 15.247:2017
Date of Receipt sample	:	2018-08-23
Date of Test	:	2018-08-24 to 2018-09-04
Date of Issue.....	:	2018-09-05
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.

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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) of USA, Meanwhile, Waltek has got recognition as registration and accreditation laboratory from EMSD (Electrical and Mechanical Services Department), and American Energy star, FCC(The Federal Communications Commission), CEC(California energy efficiency), IC(Industry Canada). It's the strategic partner and data recognition laboratory of international authoritative organizations, such as Intertek(ETL-SEMKO), TÜV Rheinland, TÜV SÜD, etc.

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

Test Facility:

A. Accreditations for Conformity Assessment (International)

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

Note:

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

B. TCBs and Notify Bodies Recognized Testing Laboratory.

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

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4 Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTS18S08121909-2W	2018-08-23	2018-08-24 to 2018-09-04	2018-09-05	original	-	Valid

5 General Information

5.1 General Description of E.U.T.

Product:	Smart Phone
Model(s):	TE390
Model Description:	N/A
GSM Band(s):	GSM 850/900/1800/1900MHz
GPRS/EGPRS Class:	12
WCDMA Band(s):	FDD Band II/IV/V
LTE Band(s):	FDD Band 2/4/5/7/12/17
Wi-Fi Specification:	2.4G-802.11b/g/n HT20/n HT40 5G-802.11a/n HT20/n HT40
Bluetooth Version:	Bluetooth v4.0 with BLE
GPS:	Support
NFC:	N/A
Hardware Version:	R886_MB_V2.0_20180112
Software Version:	TE390_US_V4_20180818
Highest frequency (Exclude Radio):	1.25GHz
Storage Location:	Internal Storage
Note:	N/A

5.2 Details of E.U.T.

Operation Frequency:	2402~2480MHz
Max. RF output power:	-0.69dBm
Type of Modulation:	GFSK, Pi/4 DQPSK, 8DPSK
Antenna installation:	internal permanent antenna
Antenna Gain:	0dBi
Ratings:	Battery DC 3.8V, 3600mAh
Adapter:	DC 5V, 2.0A, charging from adapter (Adapter Input: 100-240V~50/60Hz 0.3A) Manufacturer: Shen zhen Mao Two Power Co.,Ltd. Model No.: MR-0502000US

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

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	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	2017-09-12	2018-09-11
2.	LISN	R&S	ENV216	101215	2017-09-12	2018-09-11
3.	Cable	Top	TYPE16(3.5M)	-	2017-09-12	2018-09-11
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	2017-09-12	2018-09-11
2.	LISN	SCHWARZBECK	NSLK 8128	8128-289	2017-09-12	2018-09-11
3.	Limiter	York	MTS-IMP-136	261115-001-0024	2017-09-12	2018-09-11
4.	Cable	LARGE	RF300	-	2017-09-12	2018-09-11
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)	-	2017-09-12	2018-09-11
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	2017-09-12	2018-09-11
2.	Spectrum Analyzer (9k-6GHz)	R&S	FSL6	100959	2017-09-12	2018-09-11
3.	Signal Analyzer (9k~26.5GHz)	Agilent	N9010A	MY50520207	2017-09-12	2018-09-11

7.2 Description of Support Units

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

7.3 Measurement Uncertainty

Parameter	Uncertainty
Conducted Emission	± 3.64 dB(AC mains 150KHz~30MHz)
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 Conducted Emission

Test Requirement: FCC CFR 47 Part 15 Section 15.207

Test Method: ANSI C63.10:2013

Test Result: PASS

Frequency Range: 150kHz to 30MHz

Class/Severity: Class B

Limit:

Frequency (MHz)	Limit (dBμV)	
	Quasi-peak	Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

8.1 E.U.T. Operation

Operating Environment :

Temperature: 22.8 °C

Humidity: 52.6 % RH

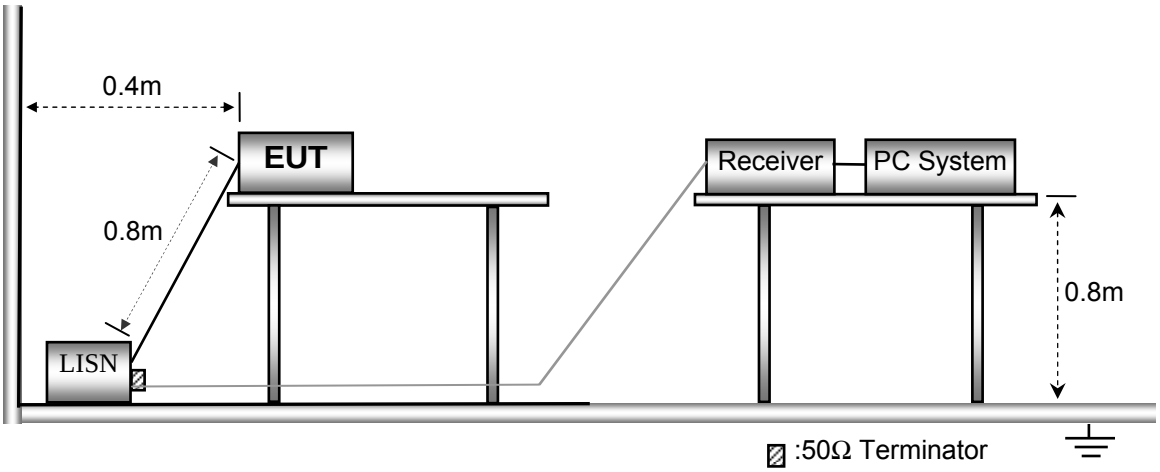
Atmospheric Pressure: 101.2kPa

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.



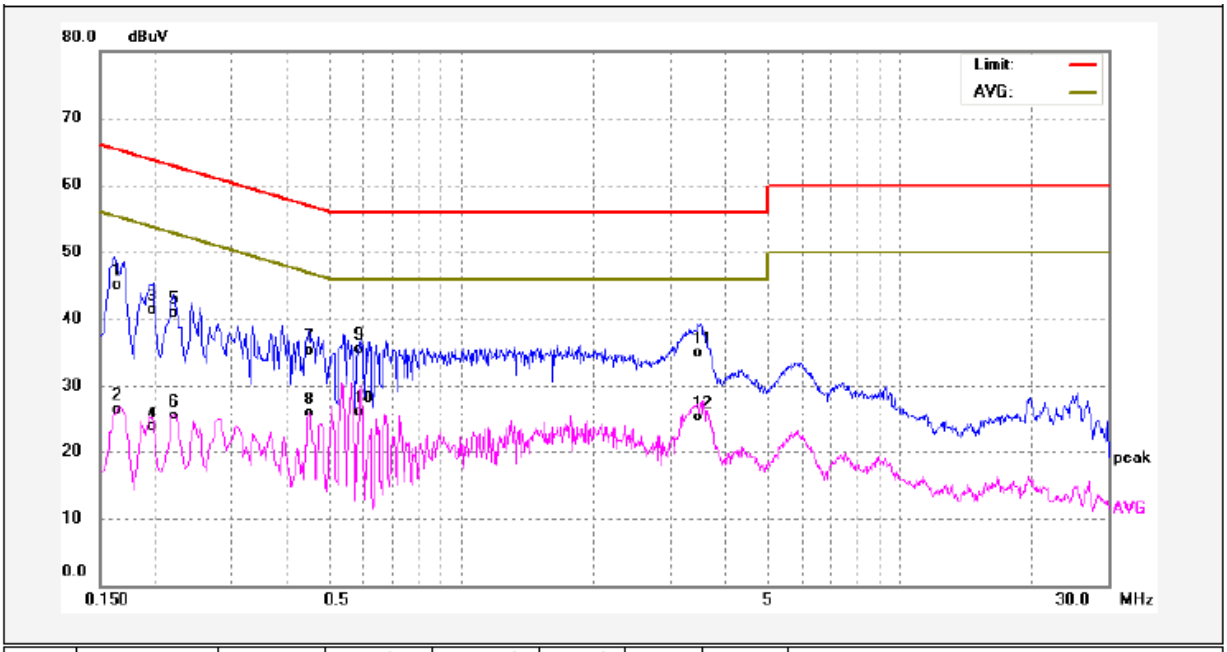
8.3 Measurement Description

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

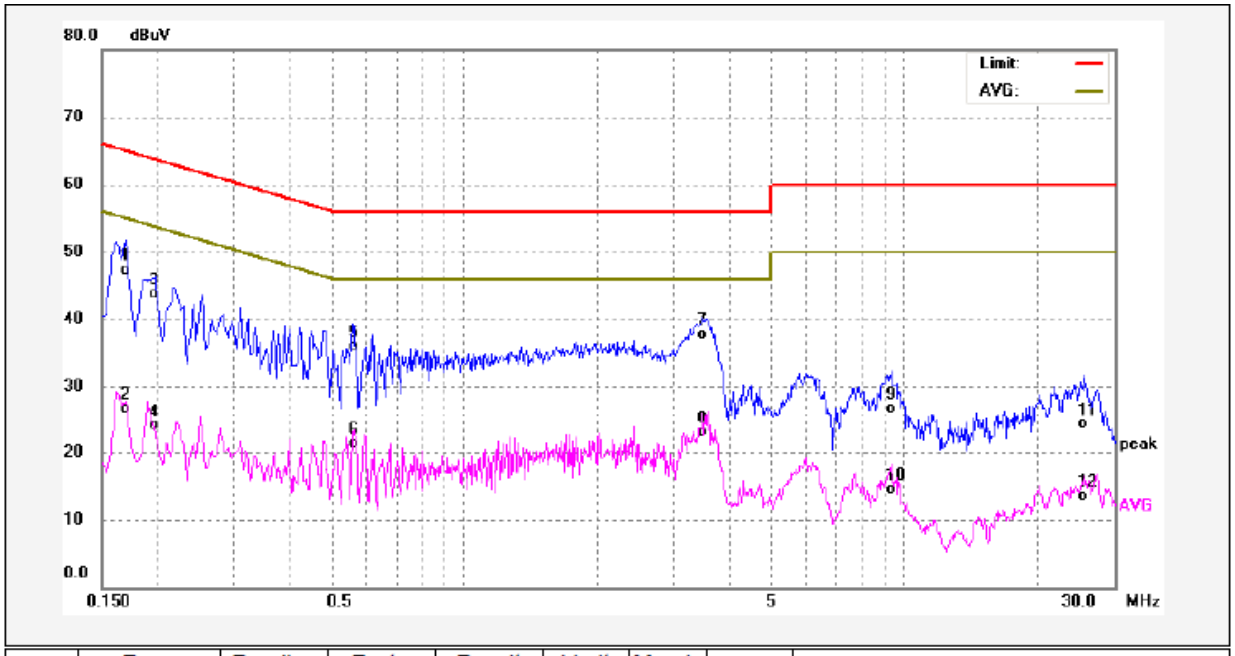
Remark: only the worst data (GFSK modulation Low channel mode) were reported

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1620	34.87	10.28	45.15	65.36	-20.21	QP	
2	0.1620	16.18	10.28	26.46	55.36	-28.90	AVG	
3	0.1980	31.04	10.32	41.36	63.69	-22.33	QP	
4	0.1980	13.43	10.32	23.75	53.69	-29.94	AVG	
5	0.2220	30.51	10.35	40.86	62.74	-21.88	QP	
6	0.2220	15.10	10.35	25.45	52.74	-27.29	AVG	
7	0.4500	24.82	10.42	35.24	56.87	-21.63	QP	
8	0.4500	15.46	10.42	25.88	46.87	-20.99	AVG	
9	0.5940	24.93	10.49	35.42	56.00	-20.58	QP	
10	0.5940	15.69	10.49	26.18	46.00	-19.82	AVG	
11	3.4580	24.12	10.73	34.85	56.00	-21.15	QP	
12	3.4580	14.58	10.73	25.31	46.00	-20.69	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1700	37.07	10.29	47.36	64.96	-17.60	QP	
2	0.1700	16.49	10.29	26.78	54.96	-28.18	AVG	
3	0.1980	33.39	10.32	43.71	63.69	-19.98	QP	
4	0.1980	13.77	10.32	24.09	53.69	-29.60	AVG	
5	0.5580	25.44	10.46	35.90	56.00	-20.10	QP	
6	0.5580	10.82	10.46	21.28	46.00	-24.72	AVG	
7	3.4900	26.88	10.73	37.61	56.00	-18.39	QP	
8	3.4900	12.35	10.73	23.08	46.00	-22.92	AVG	
9	9.3300	15.58	11.18	26.76	60.00	-33.24	QP	
10	9.3300	3.25	11.18	14.43	50.00	-35.57	AVG	
11	25.5459	13.80	10.48	24.28	60.00	-35.72	QP	
12	25.5459	3.09	10.48	13.57	50.00	-36.43	AVG	

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

9.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

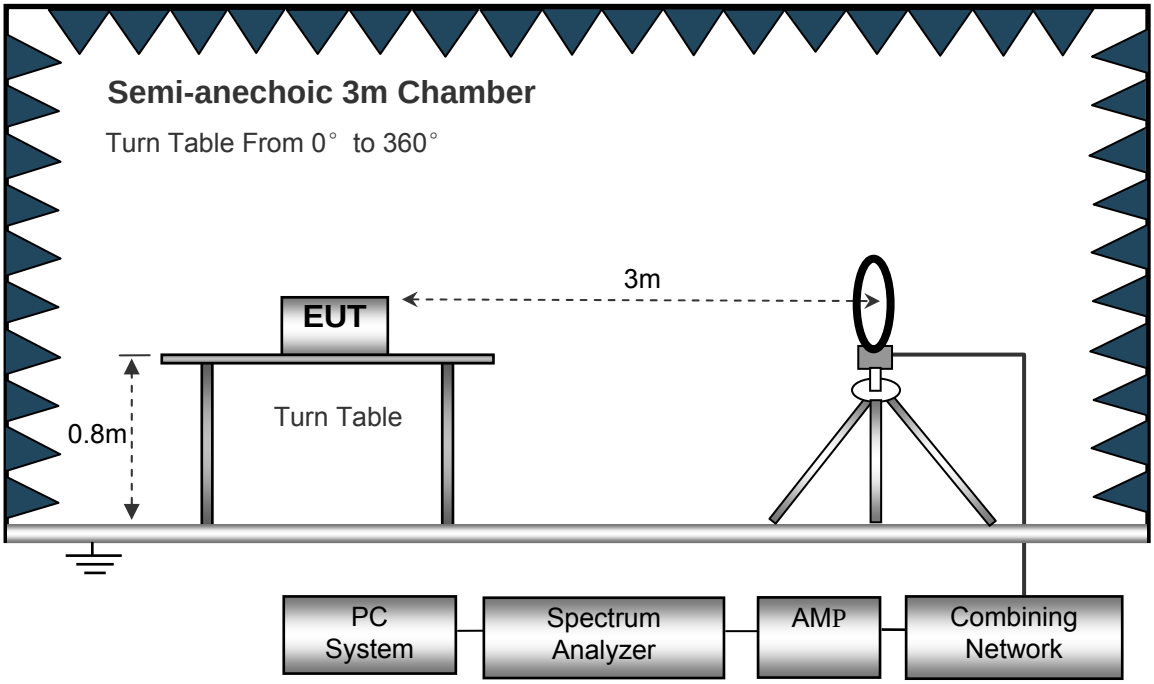
EUT Operation :

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

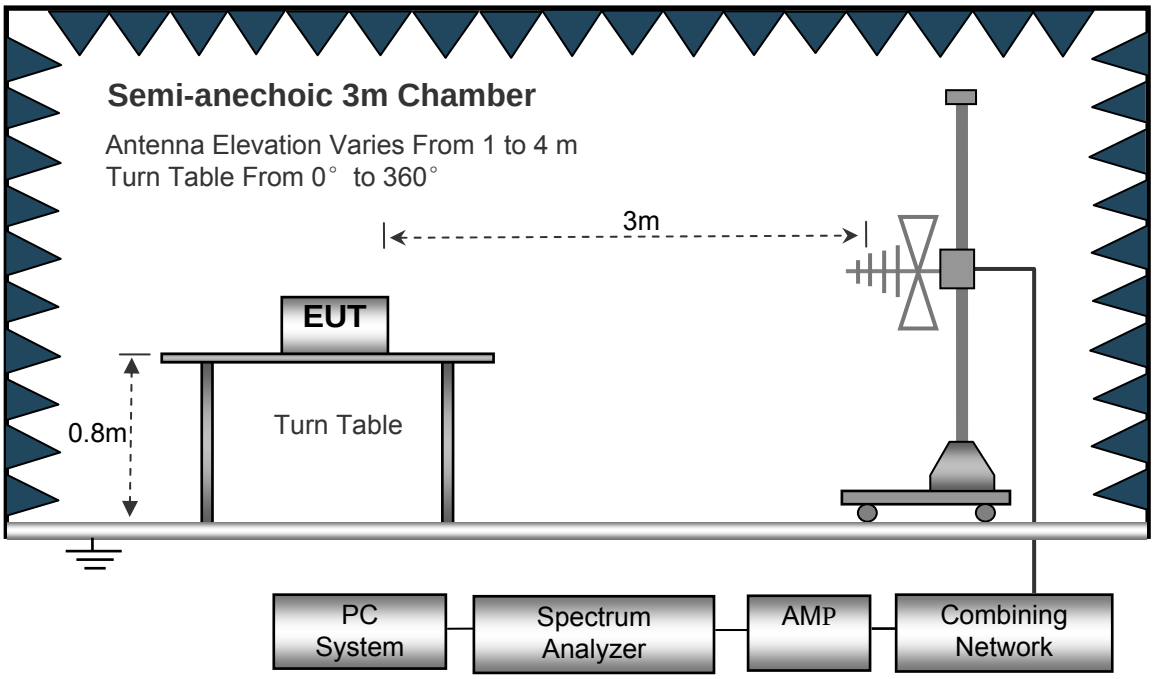
9.2 Test Setup

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

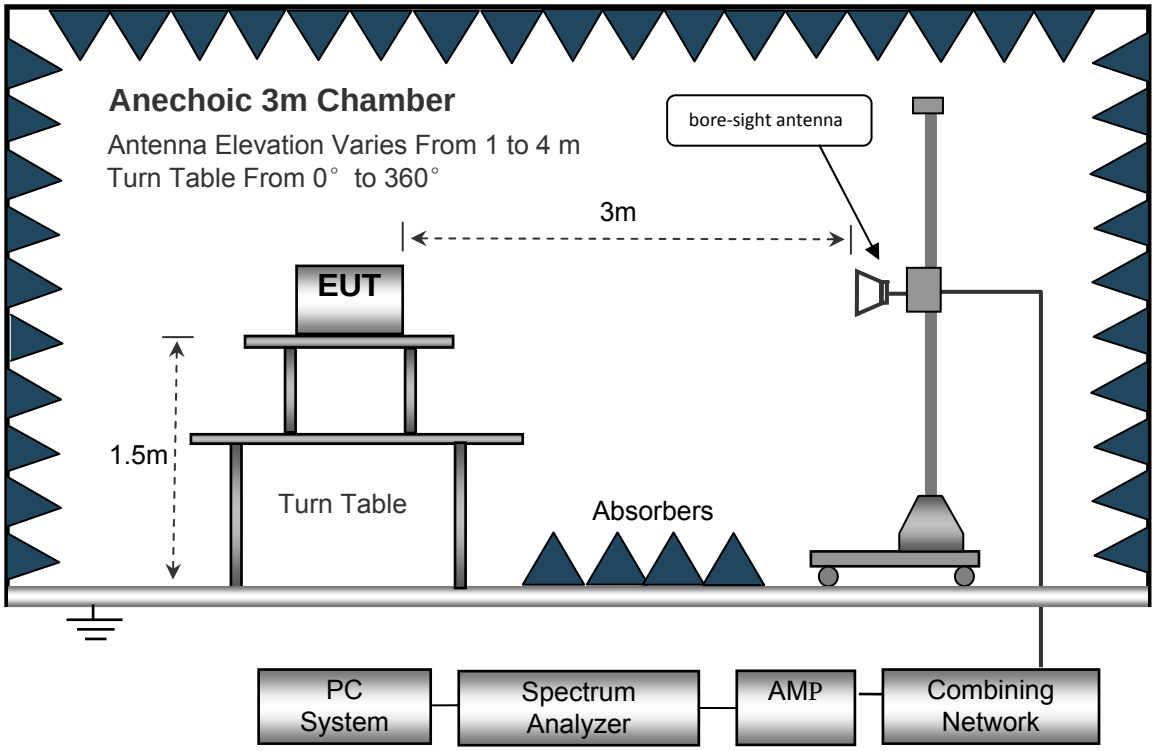
The test setup for emission measurement below 30MHz.



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:

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

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

Margin = Corr. Ampl. – Limit

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 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	25.30	QP	21.84	40.00	7.14	29.54	-22.40
15.730	24.85	QP	21.35	40.00	6.20	29.54	-23.34
25.680	25.13	QP	20.67	40.00	5.80	29.54	-23.74

.

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	36.53	QP	204	1.3	H	-13.35	23.18	46.00	-22.82
268.32	42.17	QP	173	1.1	V	-13.35	28.82	46.00	-17.18
4804.00	46.03	PK	139	1.2	V	-1.06	44.97	74.00	-29.03
4804.00	42.77	Ave	139	1.2	V	-1.06	41.71	54.00	-12.29
7206.00	41.26	PK	26	1.0	H	1.33	42.59	74.00	-31.41
7206.00	34.79	Ave	26	1.0	H	1.33	36.12	54.00	-17.88
2322.85	45.95	PK	30	1.4	V	-13.19	32.76	74.00	-41.24
2322.85	39.61	Ave	30	1.4	V	-13.19	26.42	54.00	-27.58
2369.92	44.23	PK	107	1.0	H	-13.14	31.09	74.00	-42.91
2369.92	37.54	Ave	107	1.0	H	-13.14	24.40	54.00	-29.60
2499.59	44.85	PK	179	1.0	V	-13.08	31.77	74.00	-42.23
2499.59	36.41	Ave	179	1.0	V	-13.08	23.33	54.00	-30.67

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	36.30	QP	346	1.3	H	-13.35	22.95	46.00	-23.05
268.32	41.54	QP	96	1.3	V	-13.35	28.19	46.00	-17.81
4882.00	47.03	PK	321	1.8	V	-0.62	46.41	74.00	-27.59
4882.00	42.03	Ave	321	1.8	V	-0.62	41.41	54.00	-12.59
7323.00	40.81	PK	2	1.1	H	2.21	43.02	74.00	-30.98
7323.00	35.17	Ave	2	1.1	H	2.21	37.38	54.00	-16.62
2311.77	45.05	PK	21	1.0	V	-13.19	31.86	74.00	-42.14
2311.77	37.24	Ave	21	1.0	V	-13.19	24.05	54.00	-29.95
2356.88	43.44	PK	297	1.6	H	-13.14	30.30	74.00	-43.70
2356.88	36.75	Ave	297	1.6	H	-13.14	23.61	54.00	-30.39
2494.34	42.95	PK	94	1.2	V	-13.08	29.87	74.00	-44.13
2494.34	36.88	Ave	94	1.2	V	-13.08	23.80	54.00	-30.20

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	37.25	QP	136	1.7	H	-13.35	23.90	46.00	-22.10
268.32	43.08	QP	207	1.5	V	-13.35	29.73	46.00	-16.27
4960.00	45.30	PK	277	1.2	V	-0.24	45.06	74.00	-28.94
4960.00	42.54	Ave	277	1.2	V	-0.24	42.30	54.00	-11.70
7440.00	41.44	PK	272	1.6	H	2.84	44.28	74.00	-29.72
7440.00	33.84	Ave	272	1.6	H	2.84	36.68	54.00	-17.32
2311.59	46.04	PK	88	1.6	V	-13.19	32.85	74.00	-41.15
2311.59	38.86	Ave	88	1.6	V	-13.19	25.67	54.00	-28.33
2366.51	43.33	PK	349	1.1	H	-13.14	30.19	74.00	-43.81
2366.51	37.38	Ave	349	1.1	H	-13.14	24.24	54.00	-29.76
2488.93	44.82	PK	202	1.3	V	-13.08	31.74	74.00	-42.26
2488.93	37.11	Ave	202	1.3	V	-13.08	24.03	54.00	-29.97

Test Frequency: 18GHz~25GHz

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

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:

Blow 30MHz:

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

Detector function = peak, Trace = max hold

Above 30MHz:

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

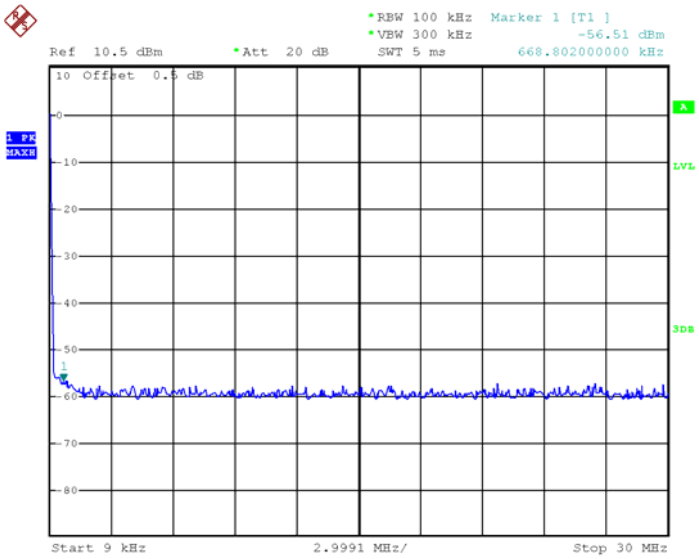
Detector function = peak, Trace = max hold

10.2 Test Result

9KHz - 30MHz

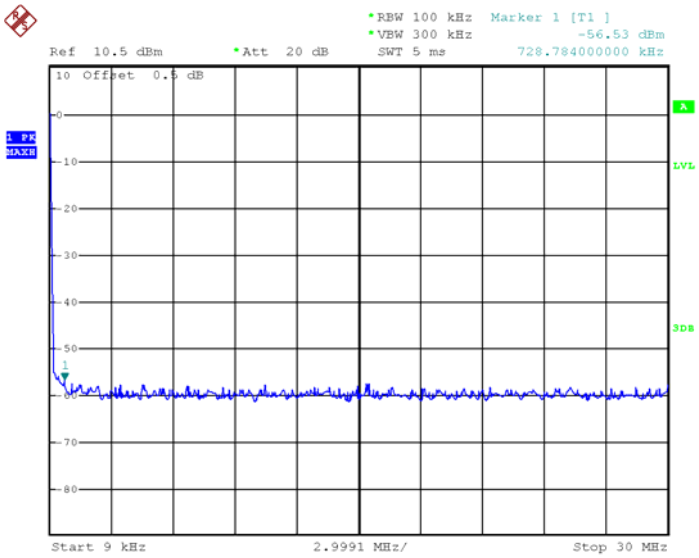
GFSK

Low Channel



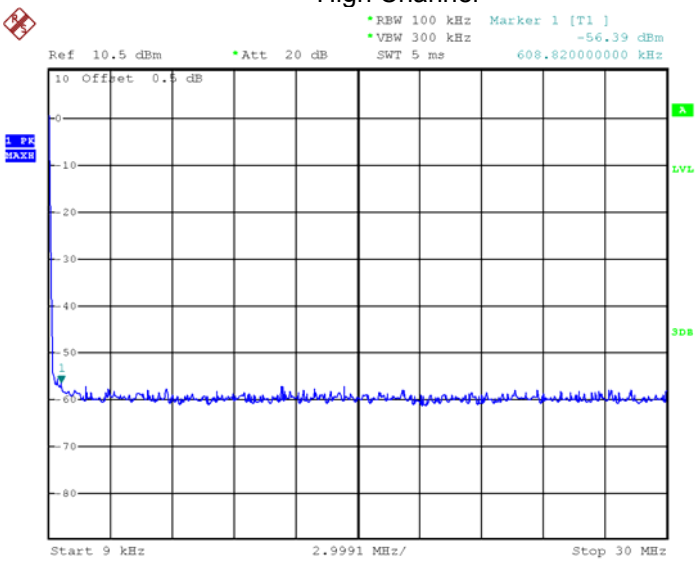
Date: 26.AUG.2018 20:16:01

Middle Channel



Date: 26.AUG.2018 20:15:35

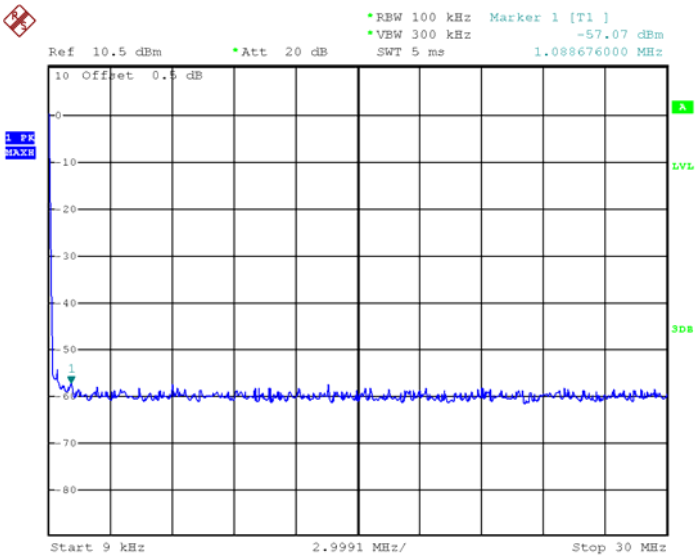
High Channel



Date: 26.AUG.2018 20:13:49

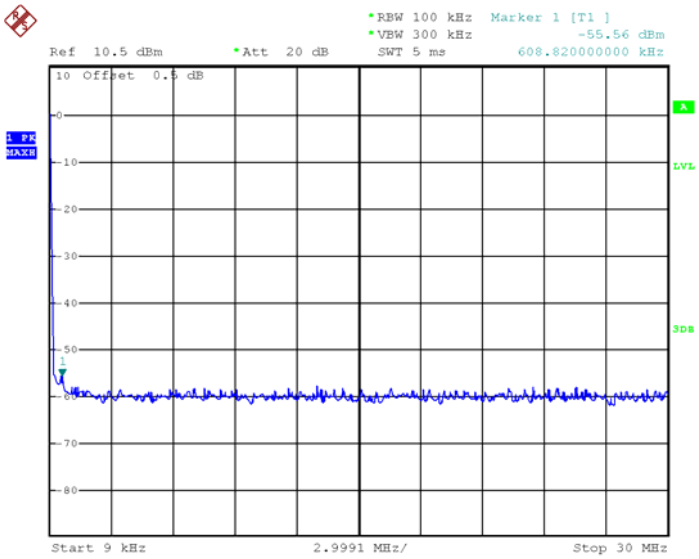
Pi/4DQPSK

Low Channel



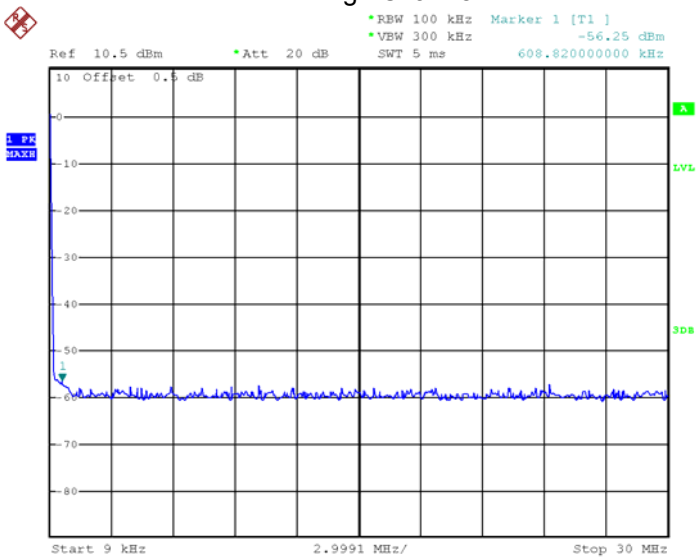
Date: 26.AUG.2018 20:14:24

Middle Channel



Date: 26.AUG.2018 20:15:19

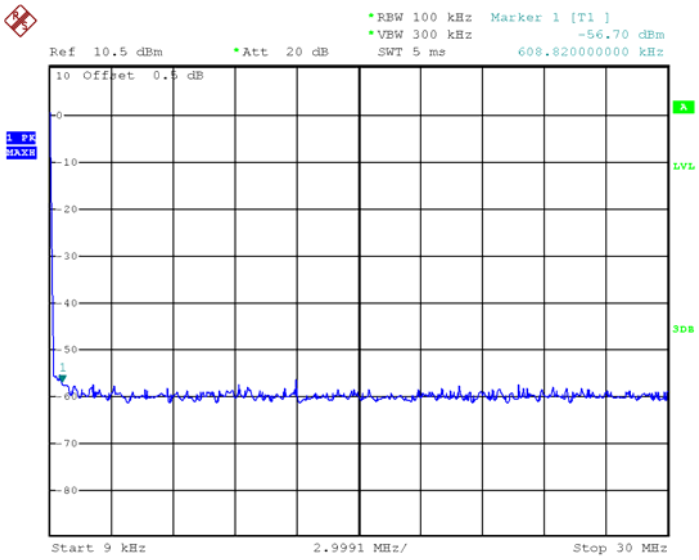
High Channel



Date: 26.AUG.2018 20:12:26

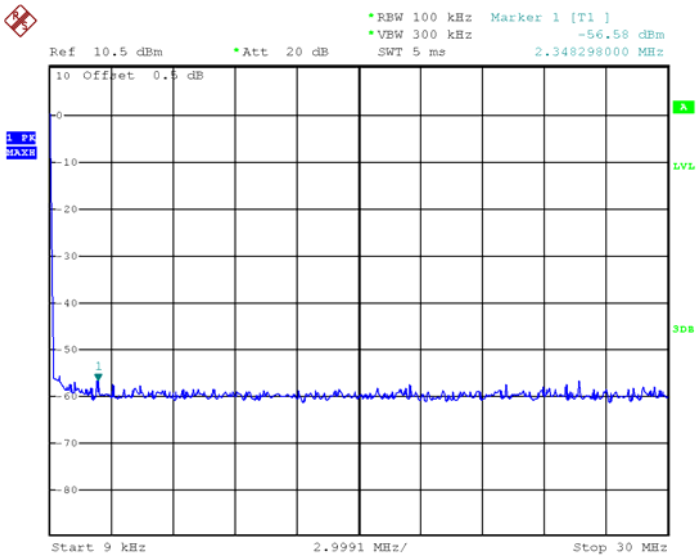
8DPSK

Low Channel



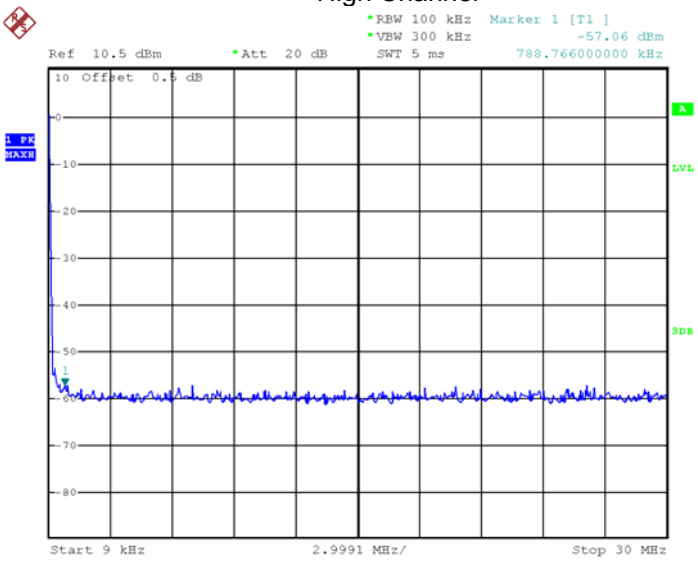
Date: 26.AUG.2018 20:13:31

Middle Channel



Date: 26.AUG.2018 20:15:06

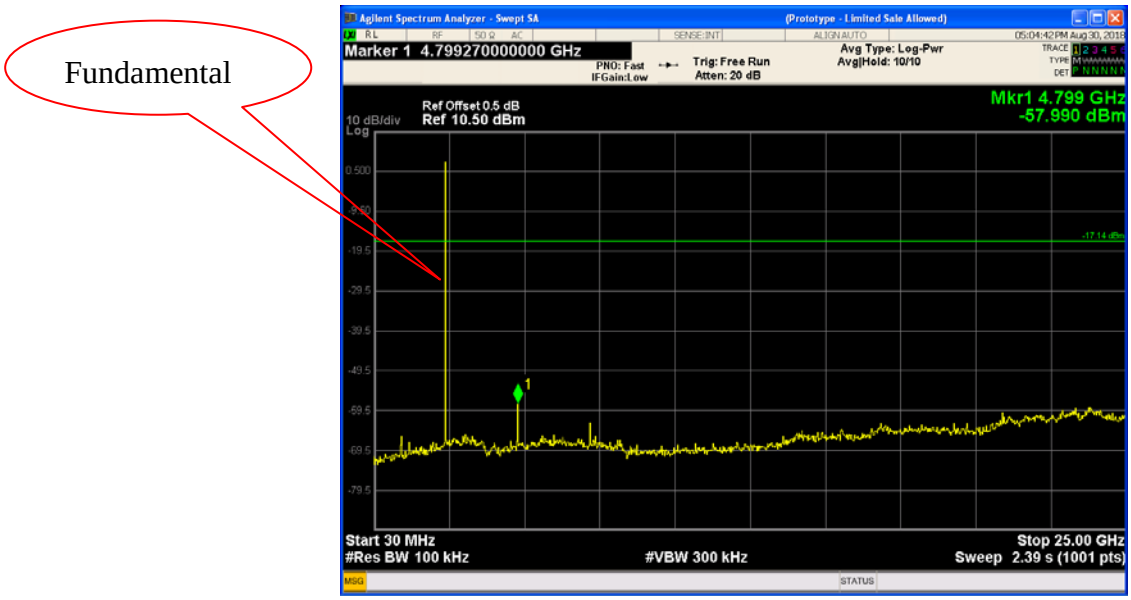
High Channel



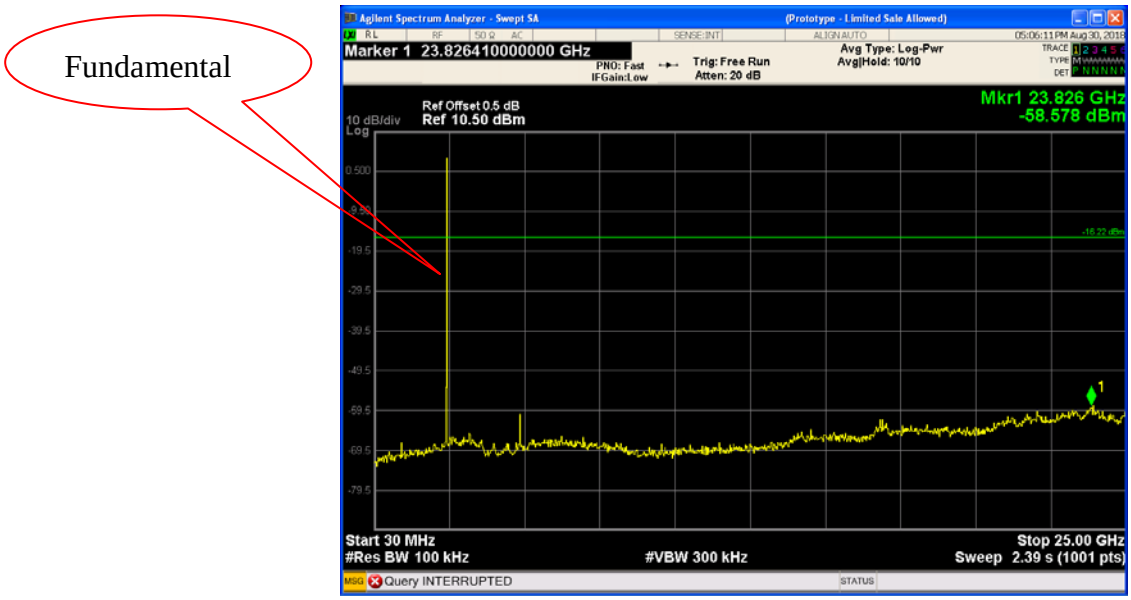
Date: 26.AUG.2018 20:12:57

30MHz – 25GHz

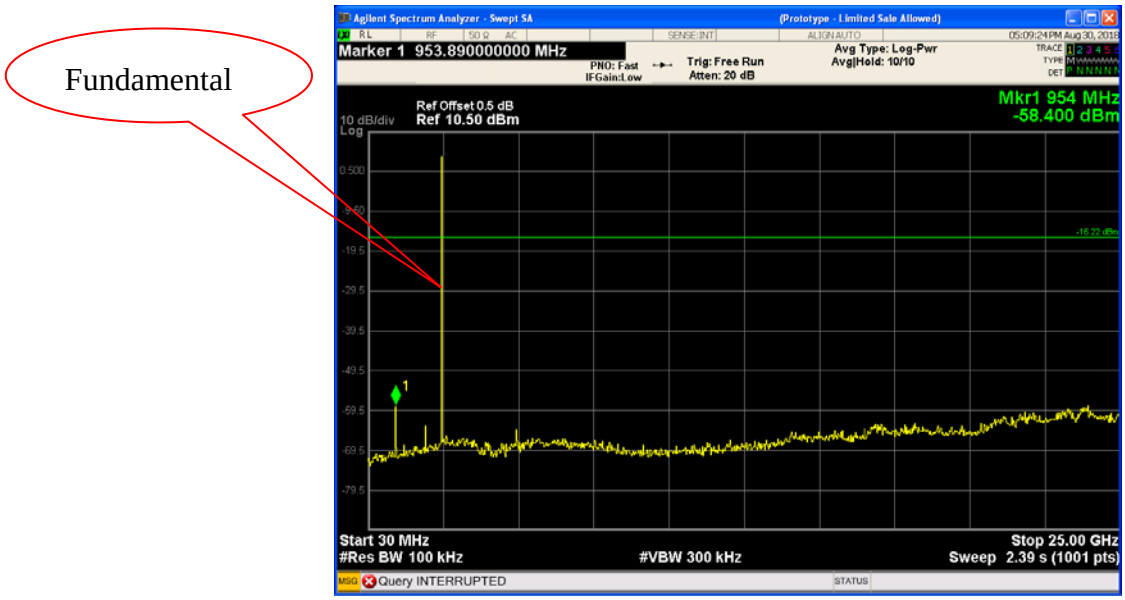
GFSK Low Channel



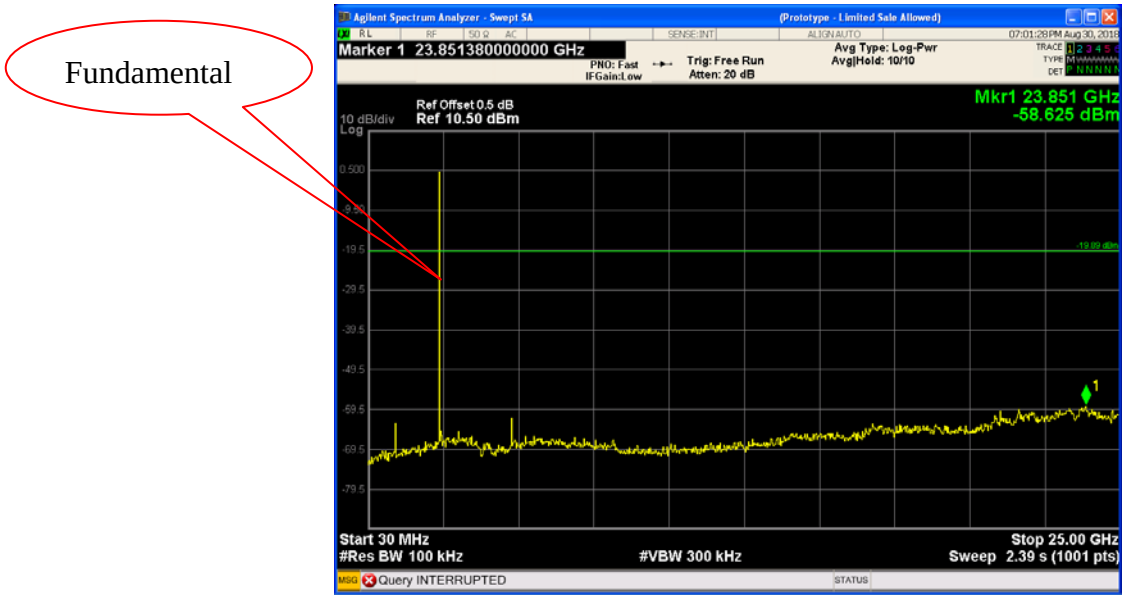
GFSK Middle Channel



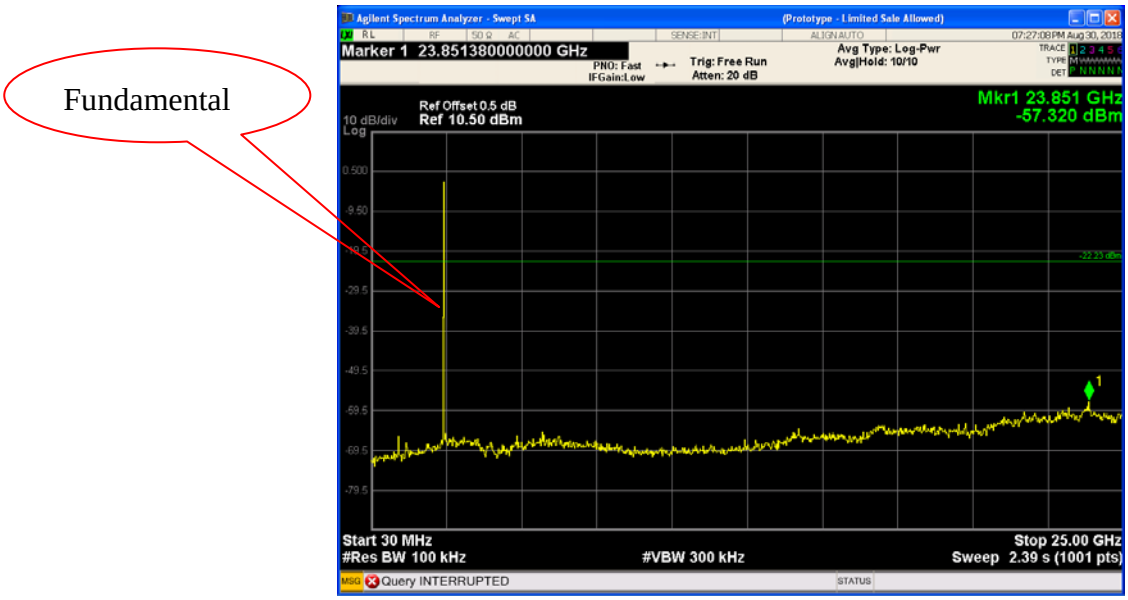
GFSK High Channel



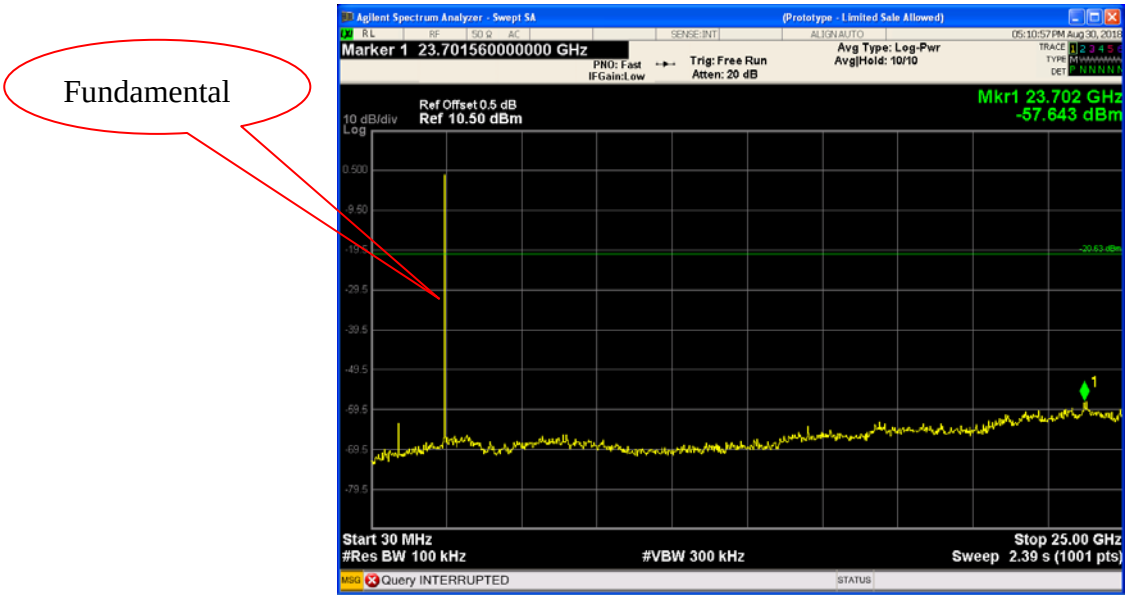
Pi/4 DQPSK Low Channel



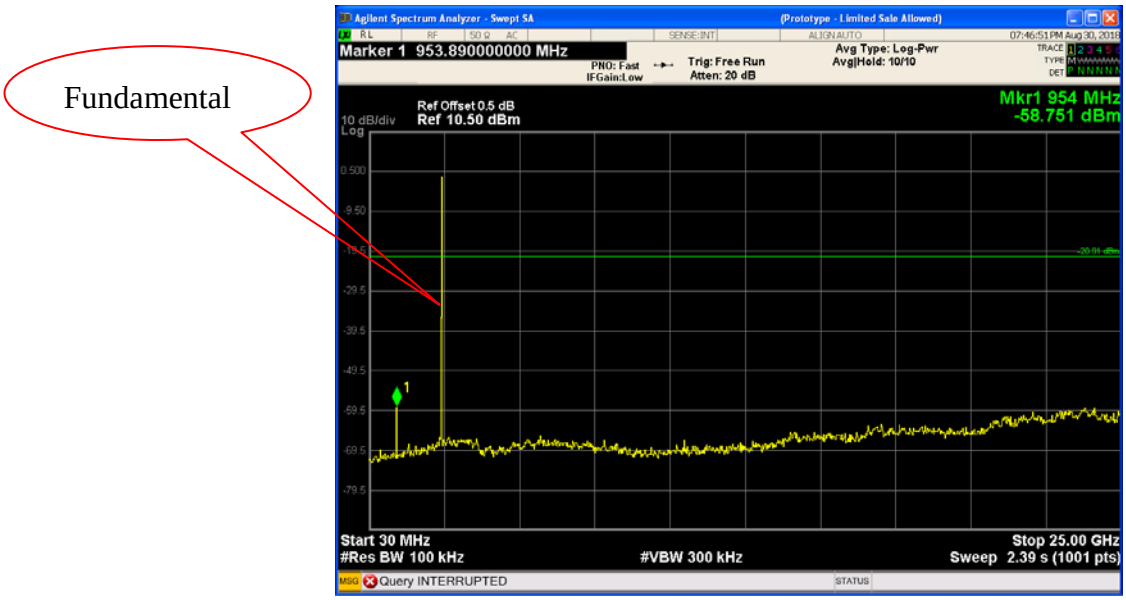
Pi/4 DQPSK Middle Channel



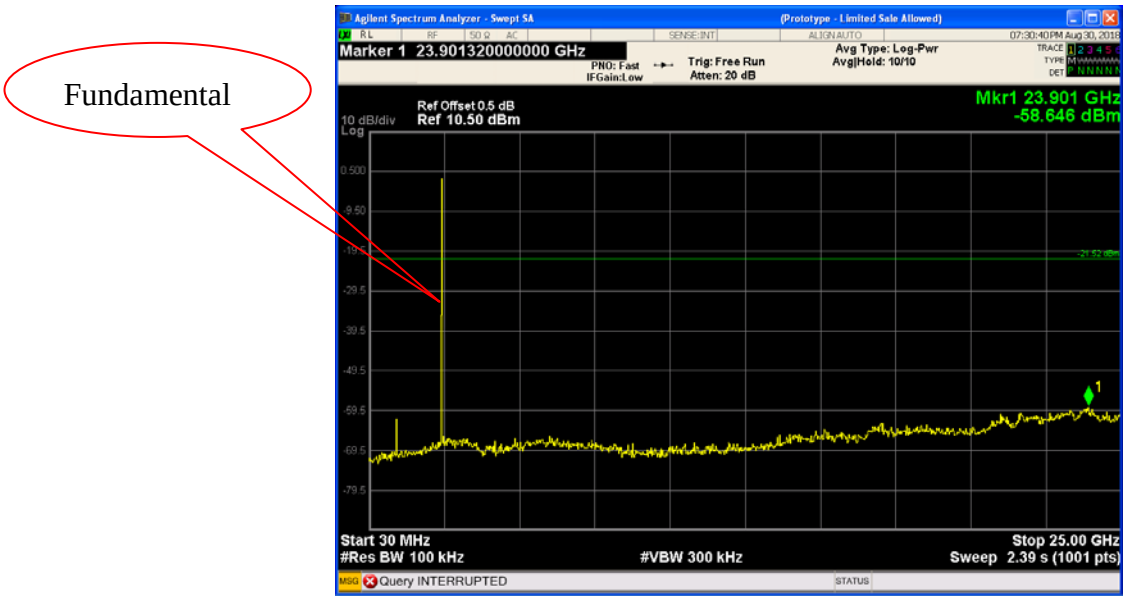
Pi/4 DQPSK High Channel



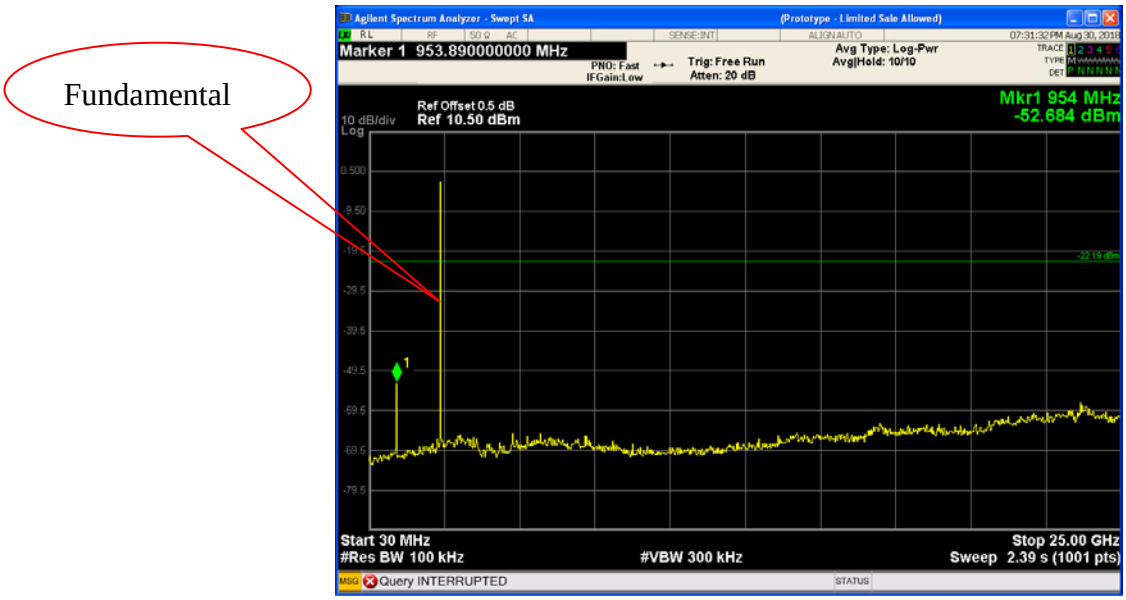
8DPSK Low Channel



8DPSK Middle Channel



8DPSK High Channel



11 Band Edge Measurement

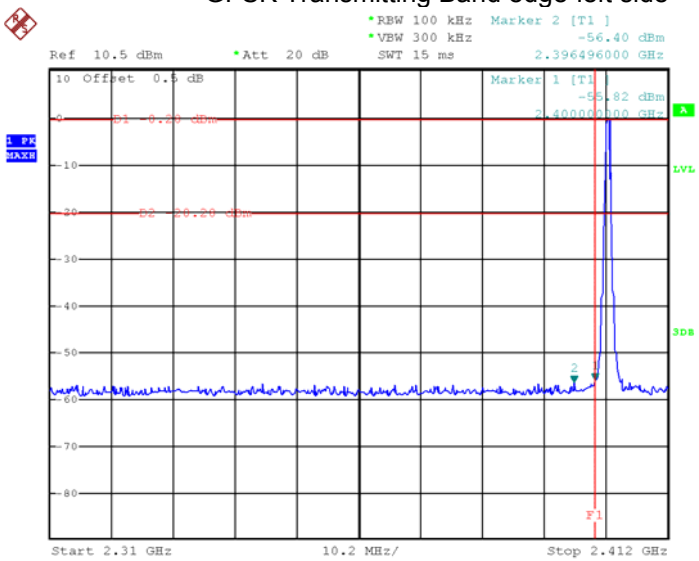
Test Requirement:	Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).
Test Method:	ANSI C63.10: 2013
Test Limit:	Regulation 15.247 (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

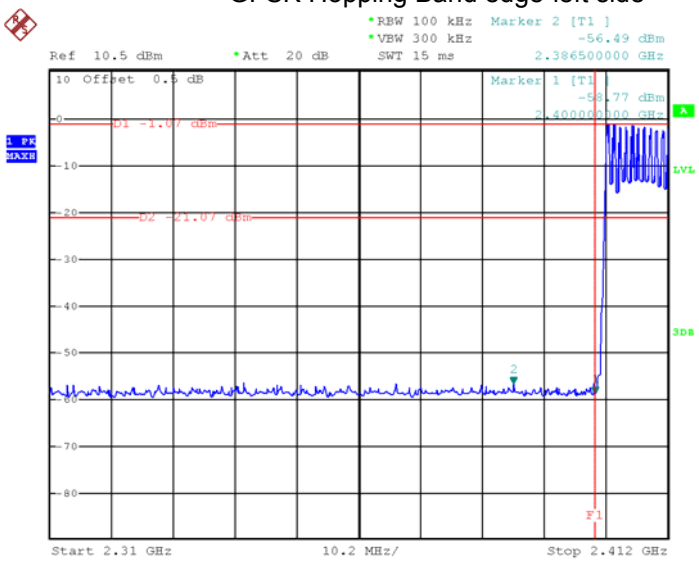
11.2 Test Result

GFSK Transmitting Band edge-left side



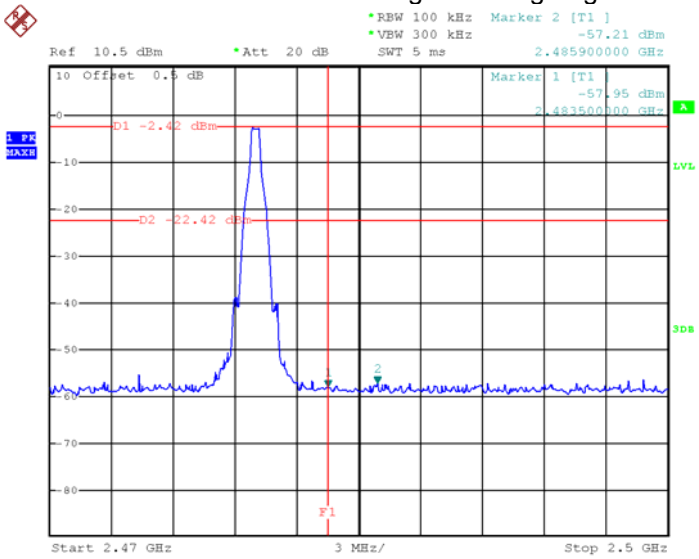
Date: 29.AUG.2018 21:41:55

GFSK Hopping Band edge-left side



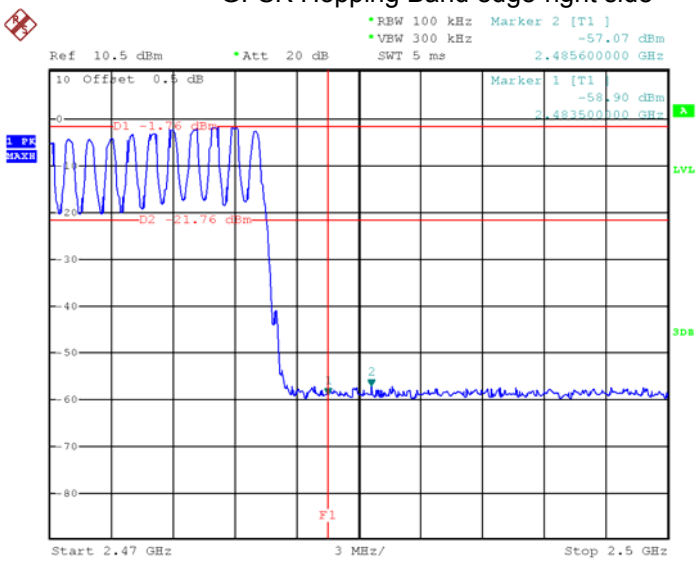
Date: 29.AUG.2018 22:10:31

GFSK Transmitting Band edge-right side



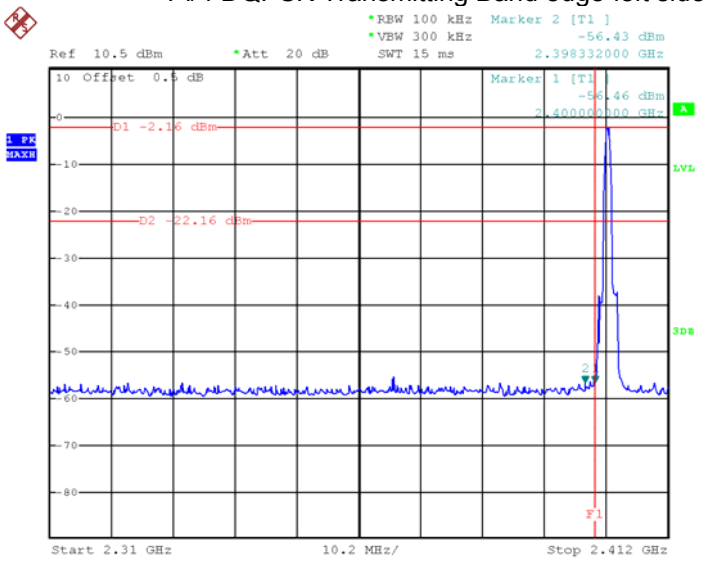
Date: 29.AUG.2018 21:43:29

GFSK Hopping Band edge-right side



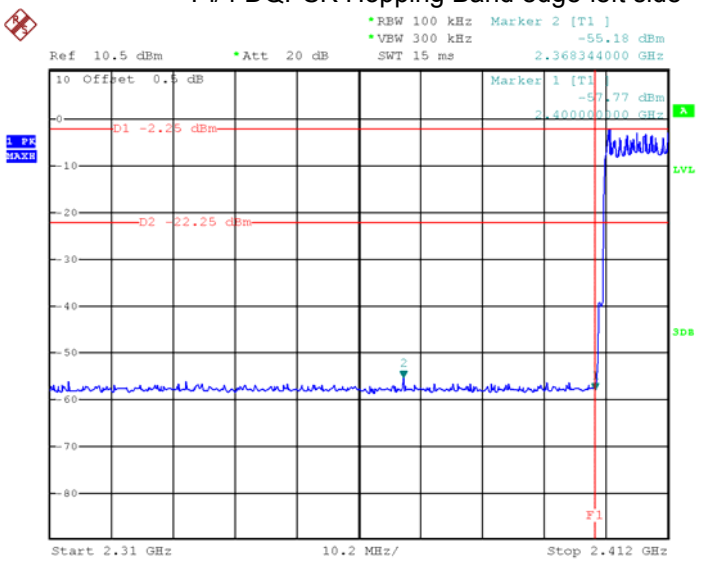
Date: 31.AUG.2018 01:37:10

Pi/4 DQPSK Transmitting Band edge-left side



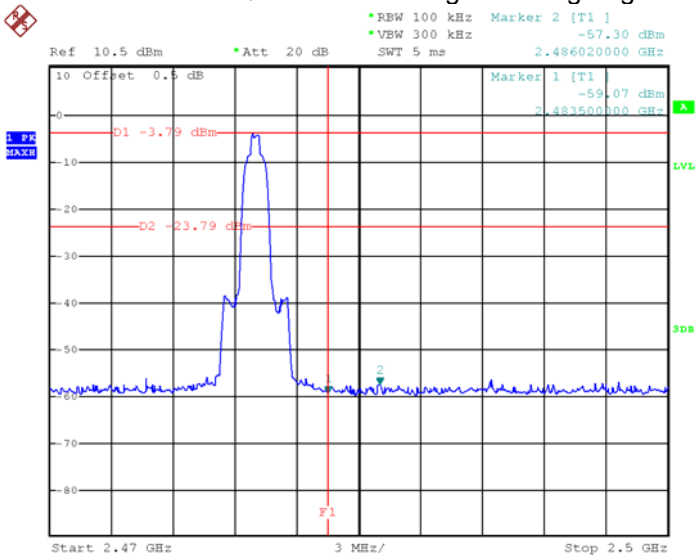
Date: 29.AUG.2018 21:40:04

Pi/4 DQPSK Hopping Band edge-left side



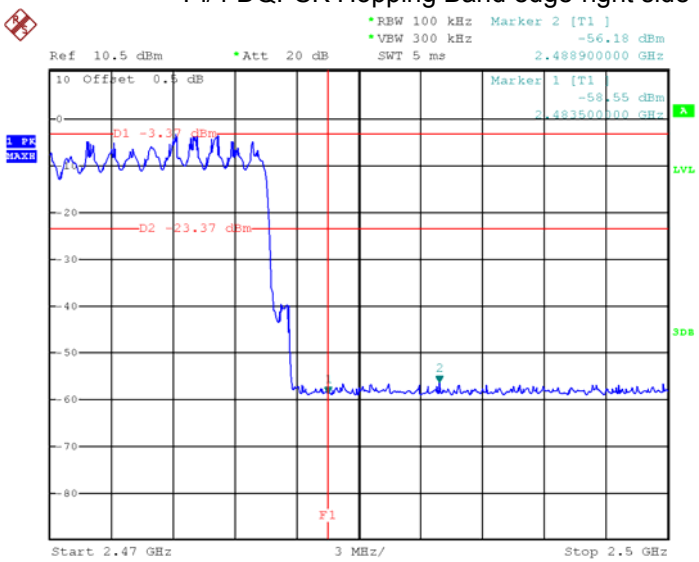
Date: 29.AUG.2018 22:09:19

Pi/4 DQPSK Transmitting Band edge-right side



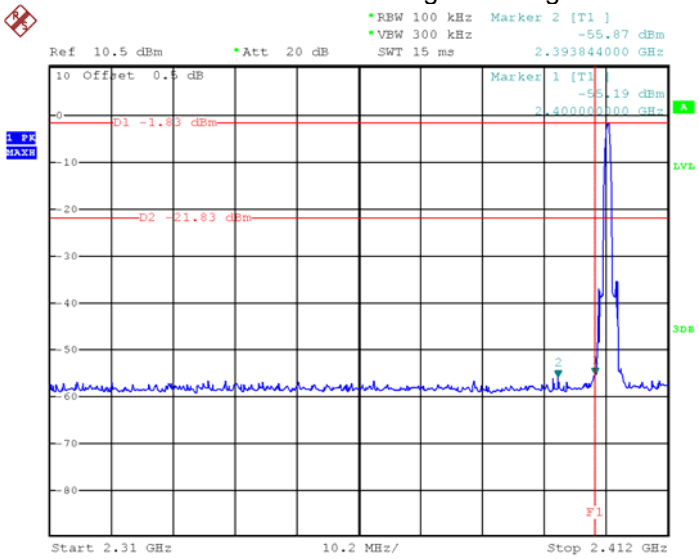
Date: 29.AUG.2018 21:44:43

Pi/4 DQPSK Hopping Band edge-right side



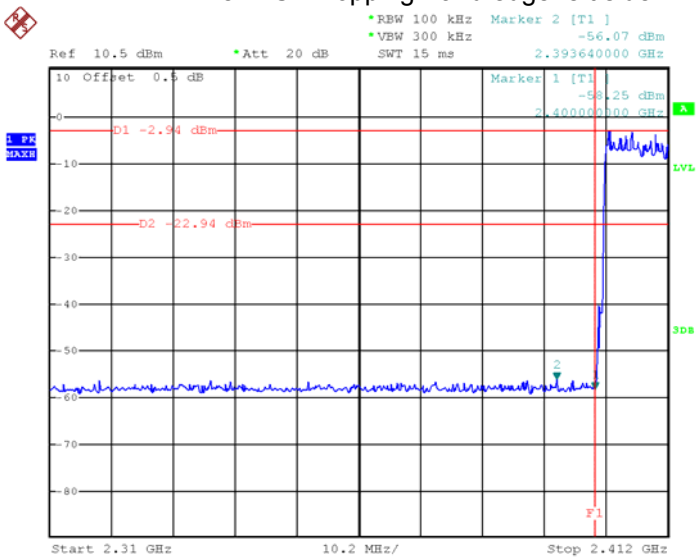
Date: 29.AUG.2018 22:00:56

8DPSK Transmitting Band edge-left side



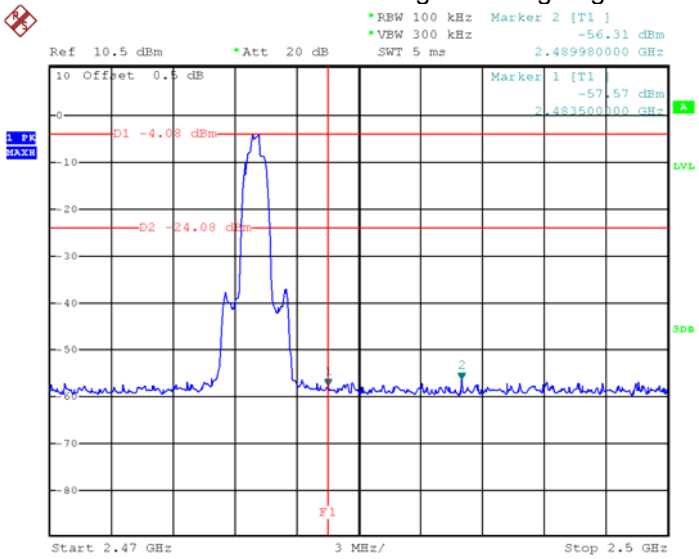
Date: 29.AUG.2018 21:38:03

8DPSK Hopping Band edge-left side



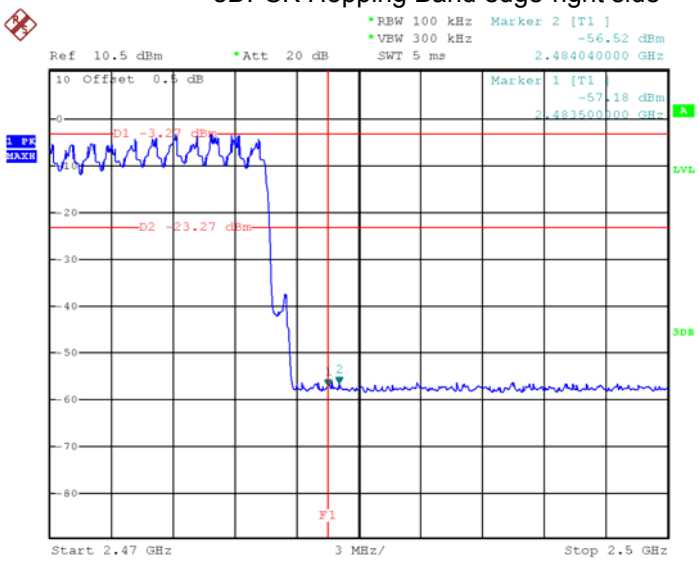
Date: 29.AUG.2018 22:13:06

8DPSK Transmitting Band edge-right side



Date: 29.AUG.2018 21:45:52

8DPSK Hopping Band edge-right side



Date: 29.AUG.2018 21:57:23

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

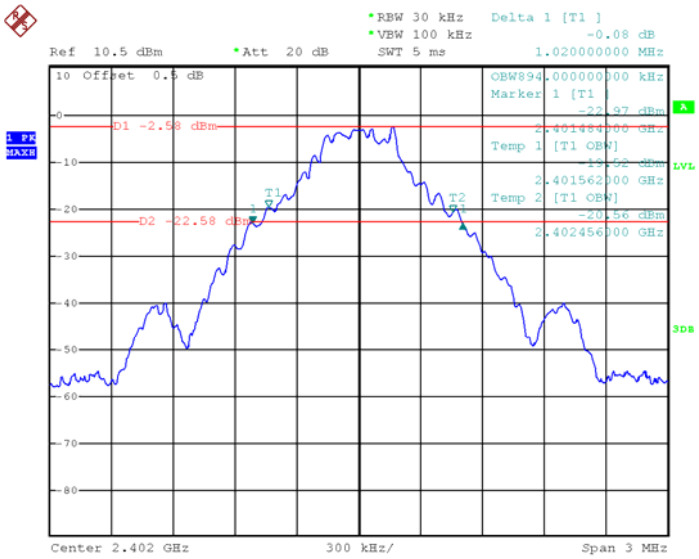
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 30kHz, VBW = 100kHz

12.2 Test Result

Modulation	Test Channel	Bandwidth(MHz)
GFSK	Low	1.020
GFSK	Middle	1.020
GFSK	High	1.020
Pi/4 DQPSK	Low	1.296
Pi/4 DQPSK	Middle	1.314
Pi/4 DQPSK	High	1.296
8DPSK	Low	1.302
8DPSK	Middle	1.302
8DPSK	High	1.296

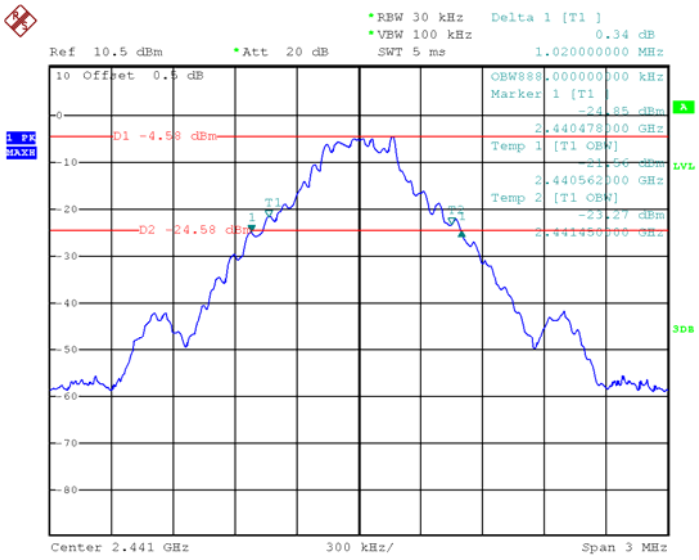
Test plots

GFSK Low Channel



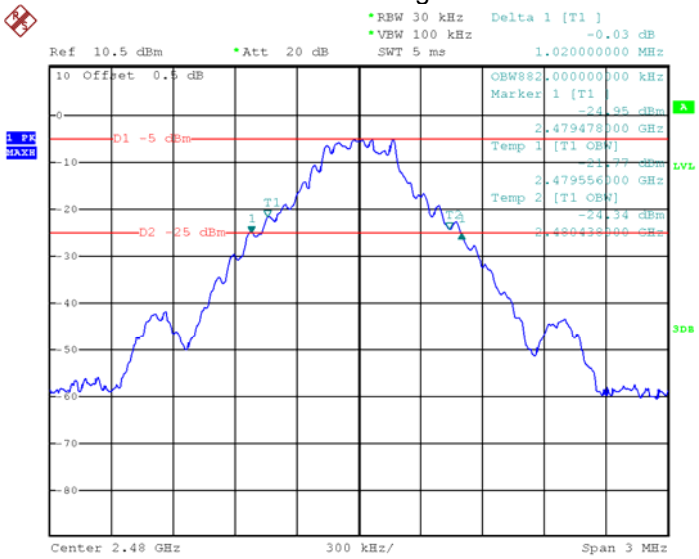
Date: 29.AUG.2018 21:16:17

GFSK Middle Channel



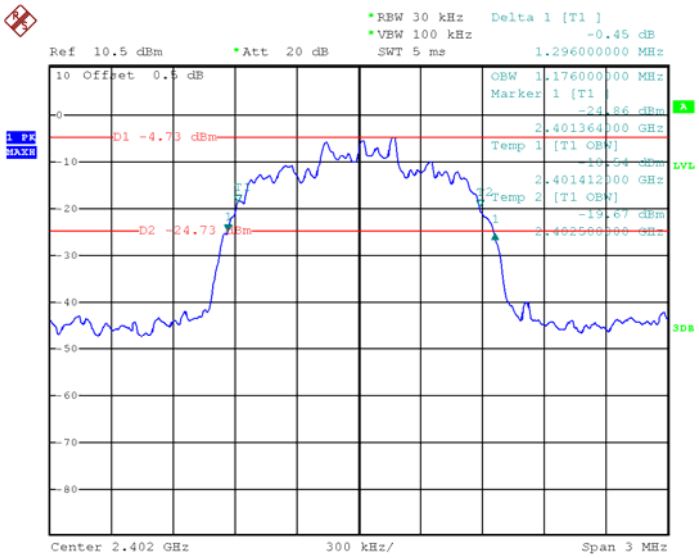
Date: 29.AUG.2018 21:17:52

GFSK High Channel



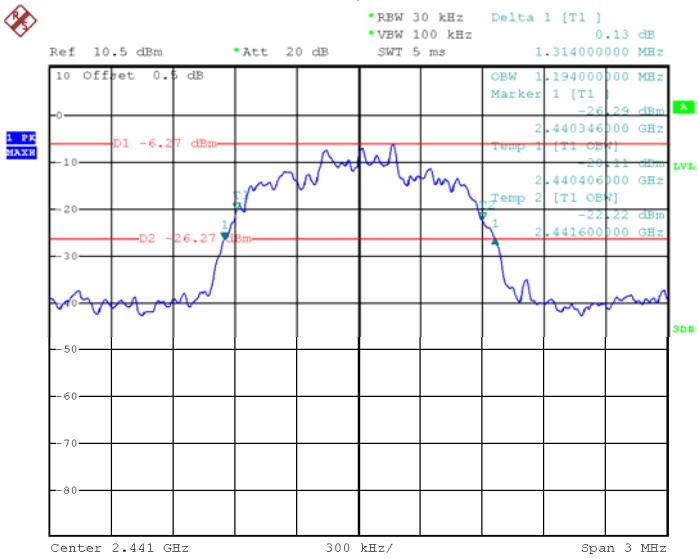
Date: 29.AUG.2018 21:19:04

Pi/4 DQPSK Low Channel



Date: 29.AUG.2018 21:30:39

Pi/4 DQPSK Middle Channel



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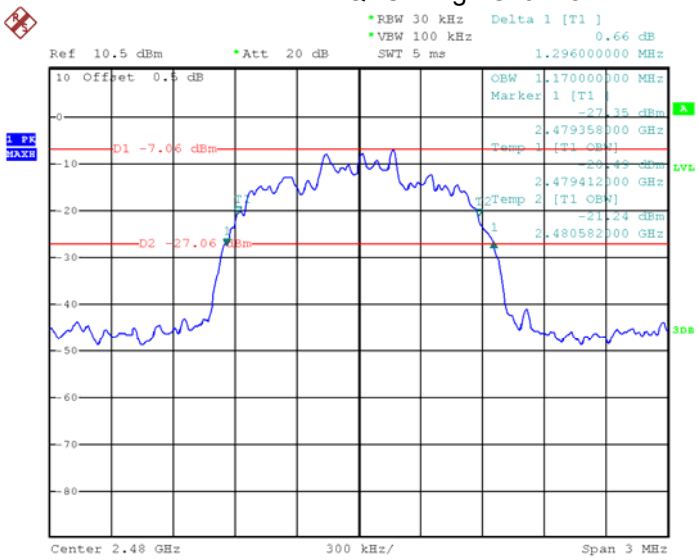
Pi/4 DQPSK High Channel



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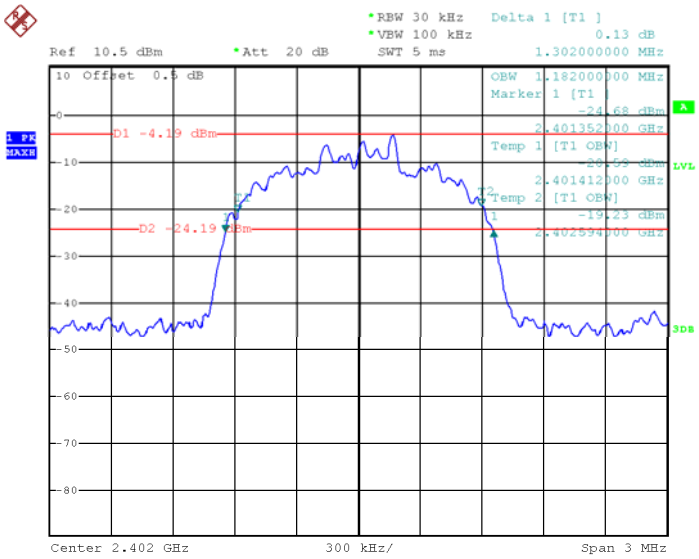
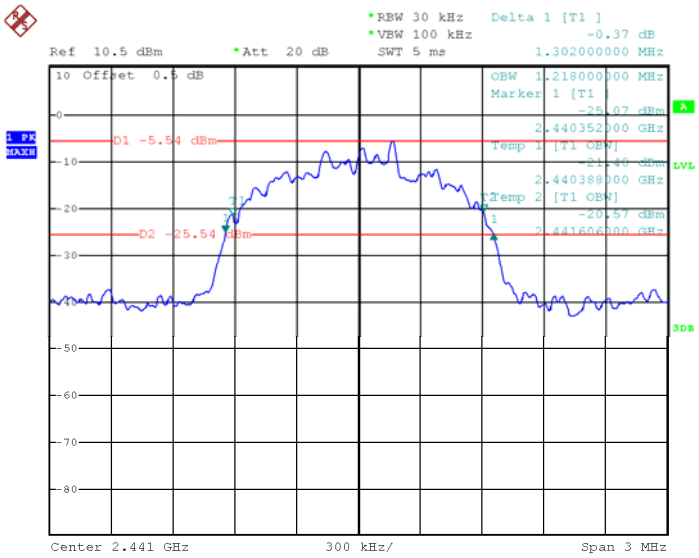
8DPSK Low Channel



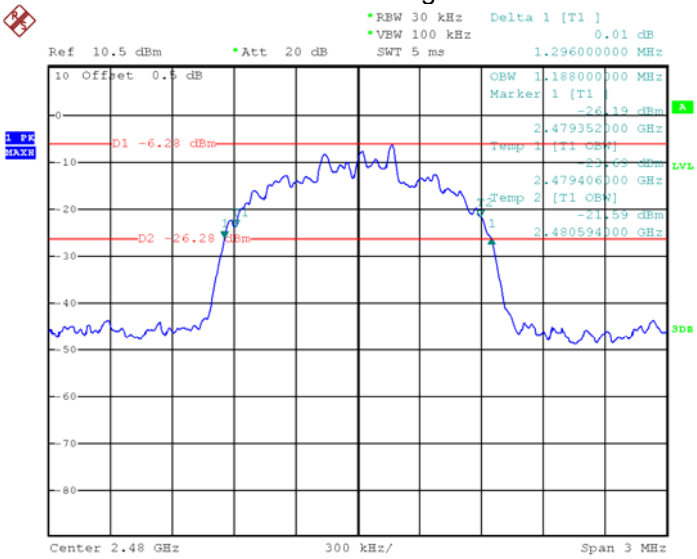
Date: 29.AUG.2018 21:32:31

8DPSK Middle Channel



Date: 29.AUG.2018 21:34:08

8DPSK High Channel



Date: 29.AUG.2018 21:35:25

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

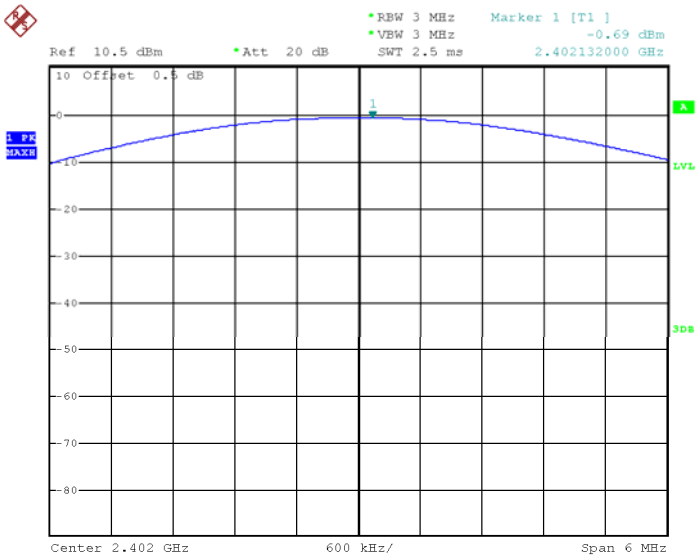
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3MHz. VBW = 3MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.///

13.2 Test Result

Modulation	Test Channel	Output Power (dBm)	Limit (dBm)
GFSK	Low	-0.69	21
GFSK	Middle	-2.21	21
GFSK	High	-2.13	21
Pi/4 DQPSK	Low	-1.17	21
Pi/4 DQPSK	Middle	-2.92	21
Pi/4 DQPSK	High	-3.03	21
8DPSK	Low	-0.91	21
8DPSK	Middle	-2.75	21
8DPSK	High	-3.00	21

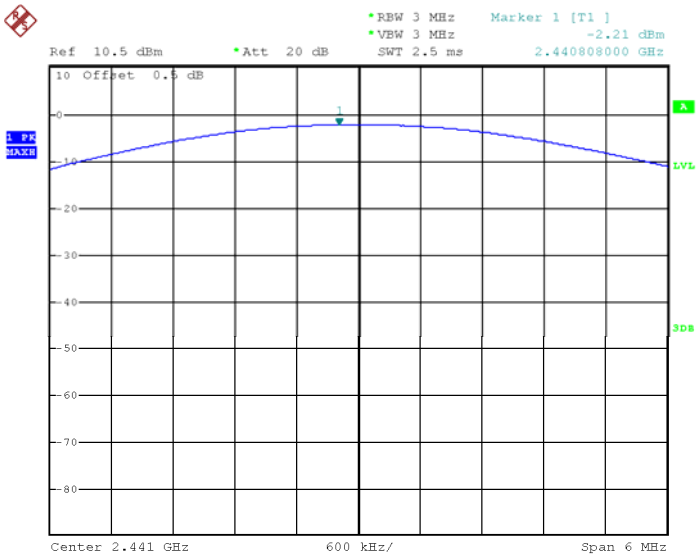
Test plots

GFSK Low Channel



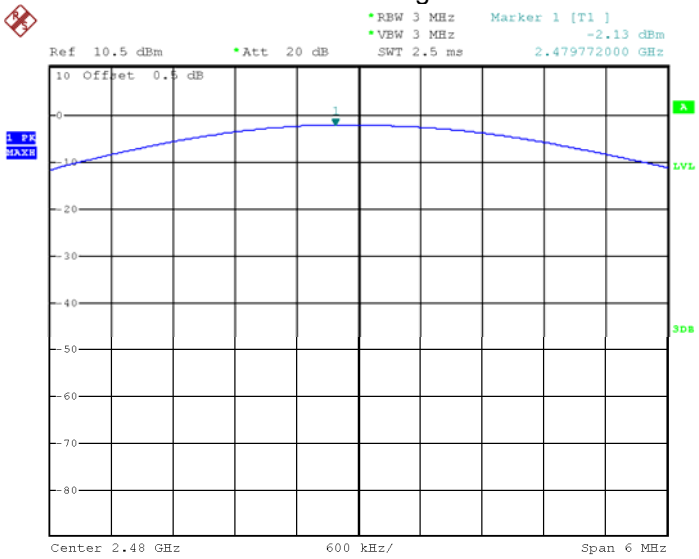
Date: 29.AUG.2018 20:24:06

GFSK Middle Channel



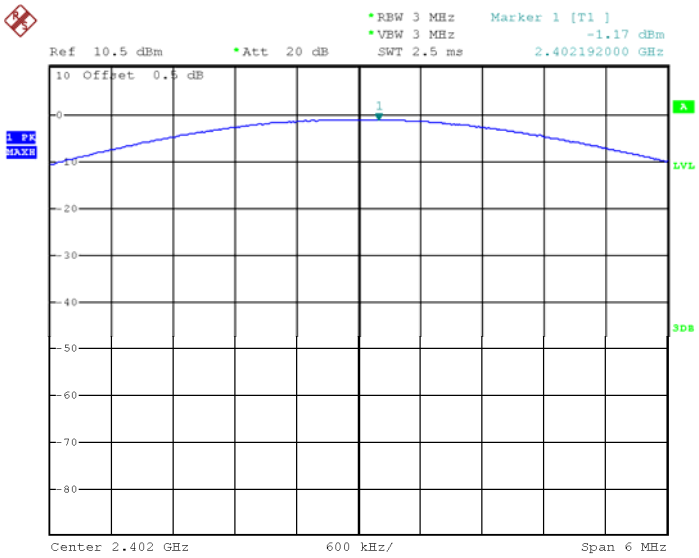
Date: 29.AUG.2018 20:25:07

GFSK High Channel



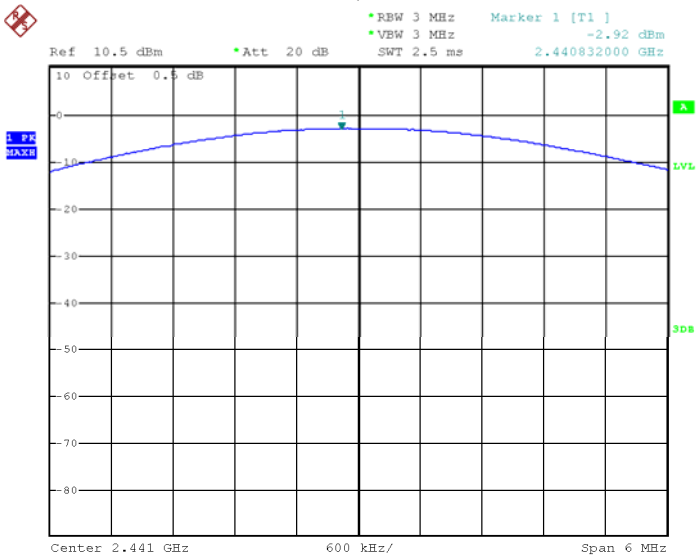
Date: 29.AUG.2018 20:25:40

Pi/4 DQPSK Low Channel



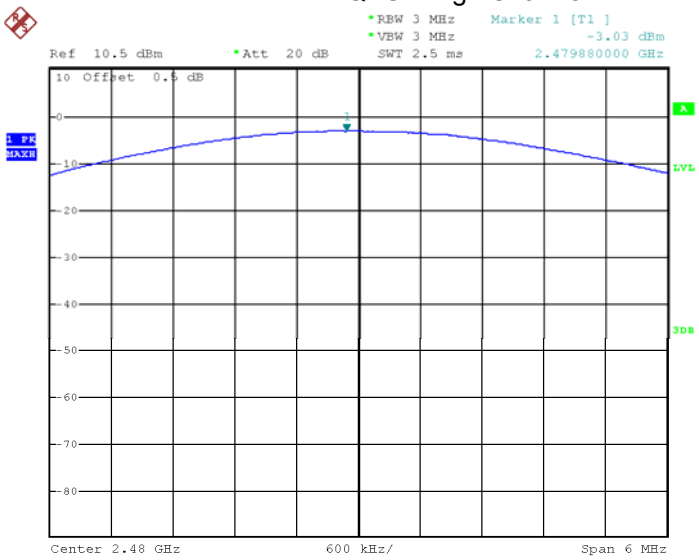
Date: 29.AUG.2018 20:27:43

Pi/4 DQPSK Middle Channel



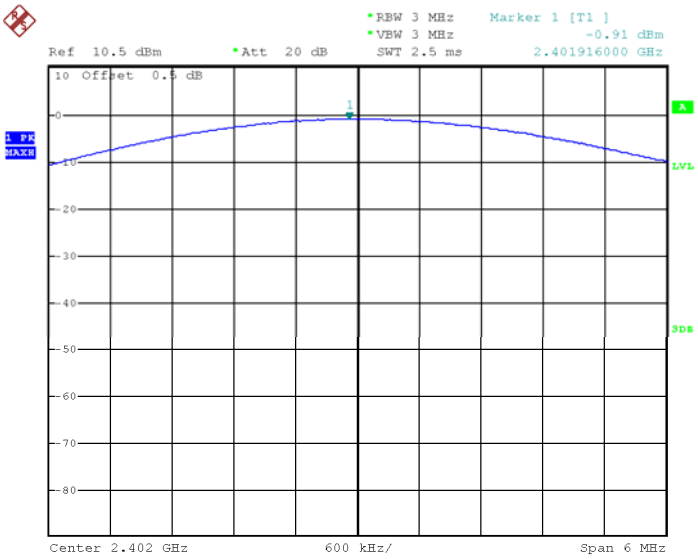
Date: 29.AUG.2018 20:27:17

Pi/4 DQPSK High Channel



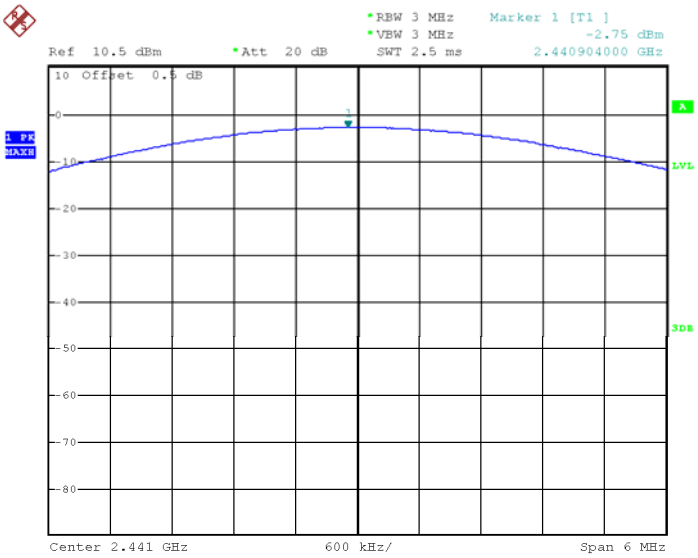
Date: 29.AUG.2018 20:26:45

8DPSK Low Channel



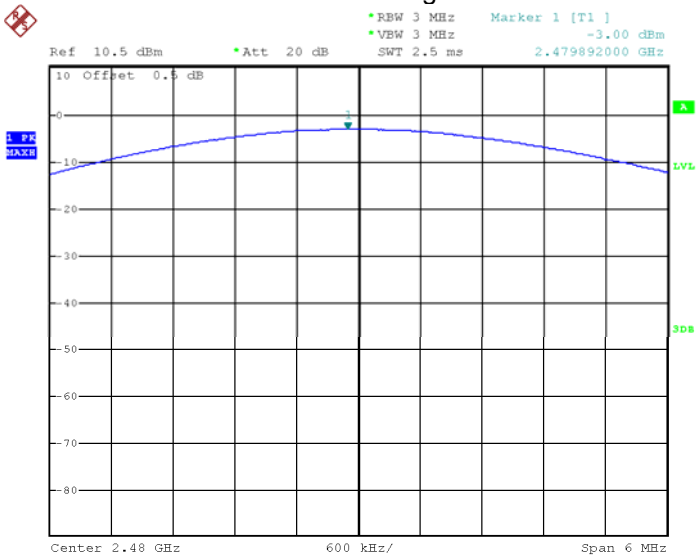
Date: 29.AUG.2018 20:28:26

8DPSK Middle Channel



Date: 29.AUG.2018 20:28:53

8DPSK High Channel



Date: 29.AUG.2018 20:29:28

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

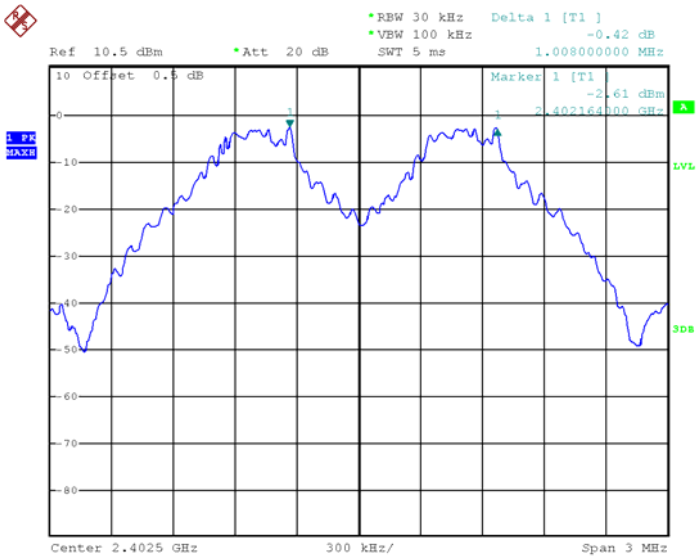
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 30kHz. VBW = 100kHz , Span = 3.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to 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	1.008	0.680	PASS
GFSK	Middle	1.002	0.680	PASS
GFSK	High	0.996	0.680	PASS
Pi/4 DQPSK	Low	0.996	0.864	PASS
Pi/4 DQPSK	Middle	1.002	0.876	PASS
Pi/4 DQPSK	High	1.002	0.864	PASS
8DPSK	Low	1.002	0.868	PASS
8DPSK	Middle	1.008	0.868	PASS
8DPSK	High	1.002	0.864	PASS

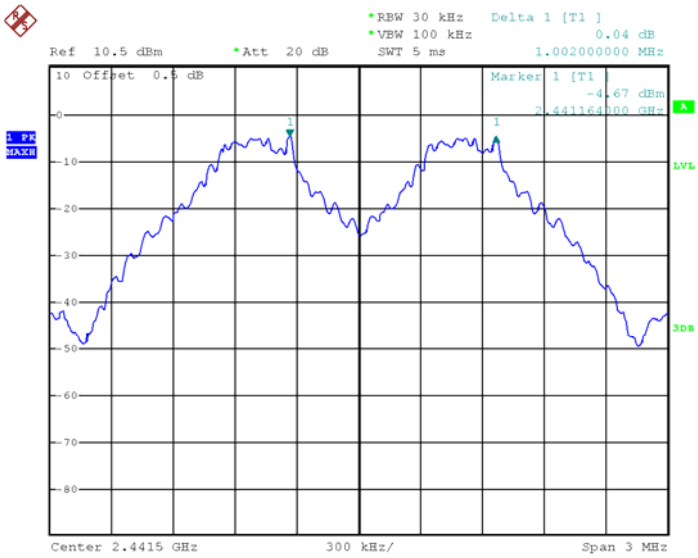
Test plots

GFSK Low Channel



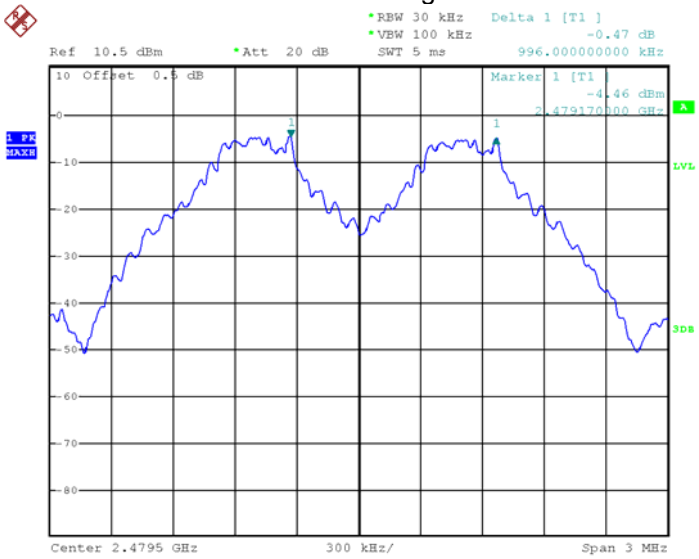
Date: 29.AUG.2018 21:12:11

GFSK Middle Channel



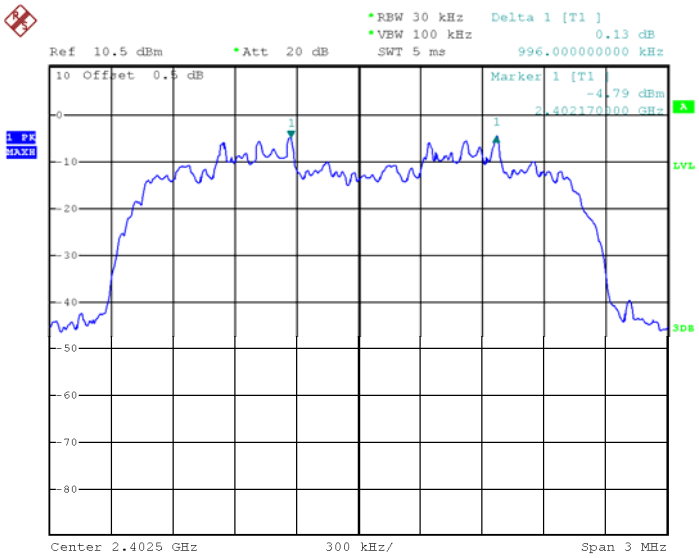
Date: 29.AUG.2018 21:11:13

GFSK High Channel



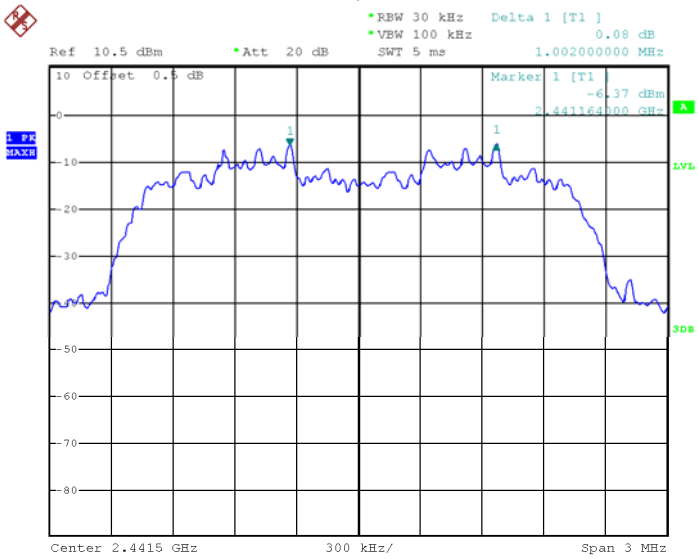
Date: 29.AUG.2018 21:09:05

Pi/4 DQPSK Low Channel



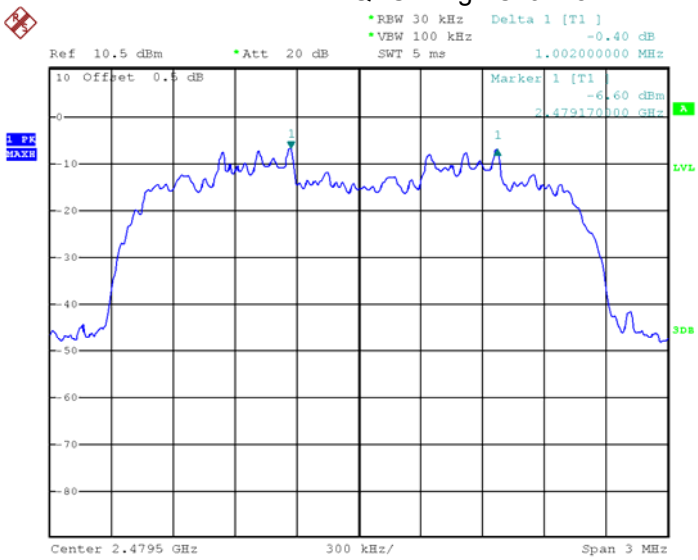
Date: 29.AUG.2018 20:54:14

Pi/4 DQPSK Middle Channel



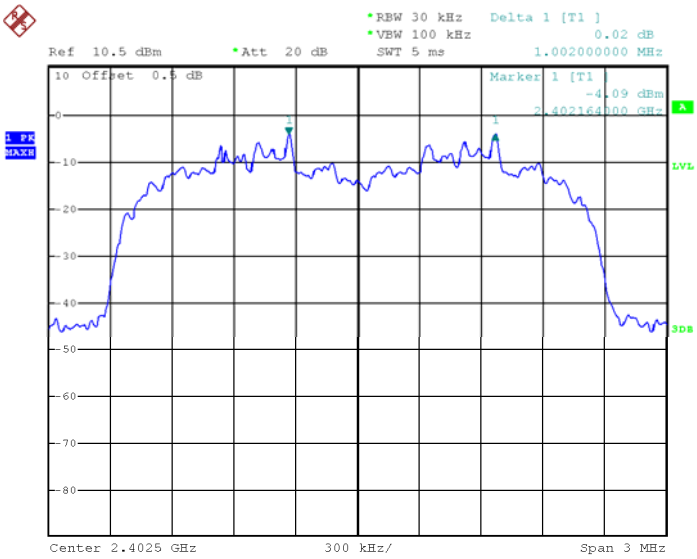
Date: 29.AUG.2018 21:04:16

Pi/4 DQPSK High Channel



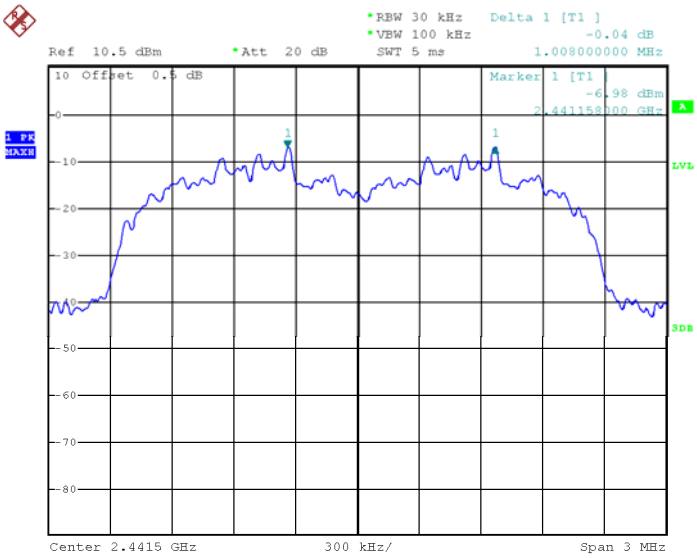
Date: 29.AUG.2018 21:06:02

8DPSK Low Channel



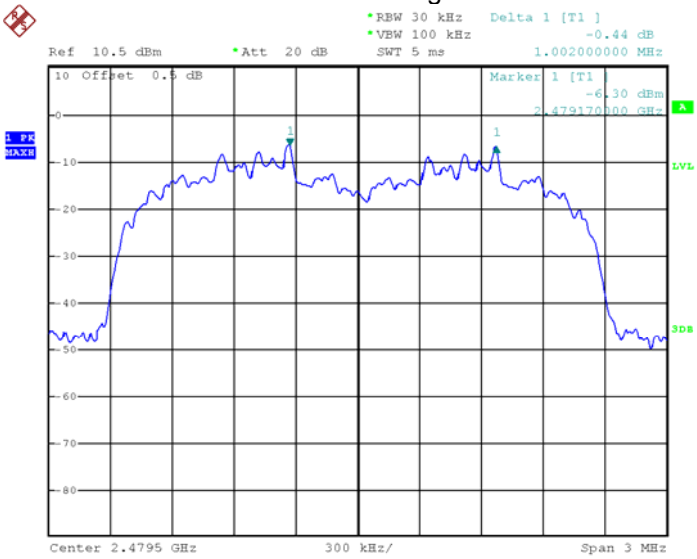
Date: 29.AUG.2018 20:52:19

8DPSK Middle Channel



Date: 29.AUG.2018 20:47:12

8DPSK High Channel



Date: 29.AUG.2018 20:32:16

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

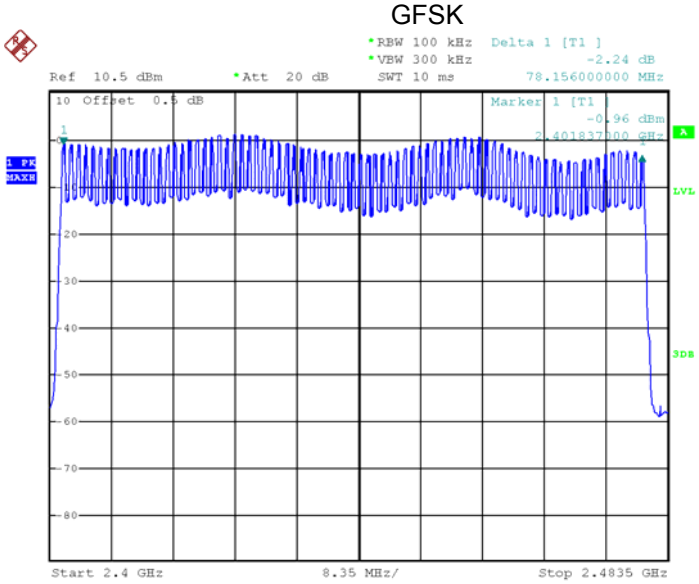
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100kHz. VBW = 300kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to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

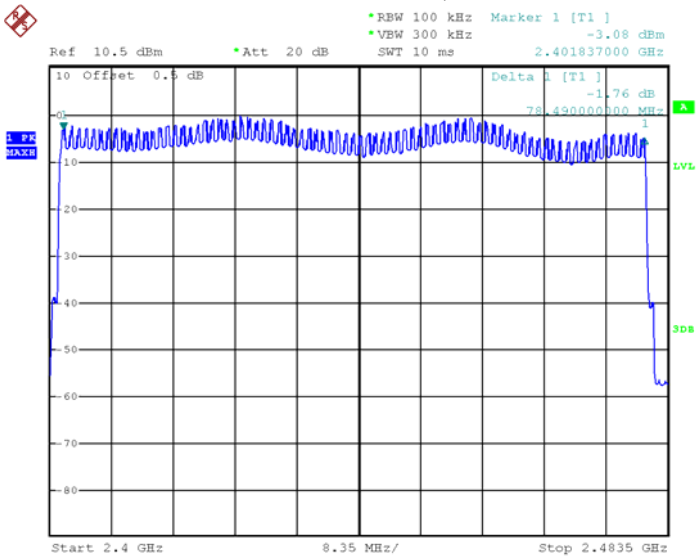
79 Channels in total

GFSK



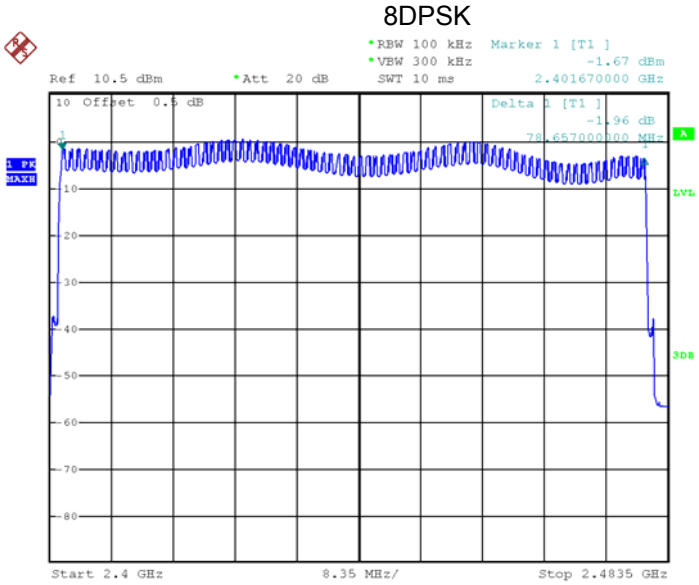
Date: 29.AUG.2018 22:28:48

Pi/4 DQPSK



Date: 29.AUG.2018 22:55:28

8DPSK



Date: 30.AUG.2018 00:47:56

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).

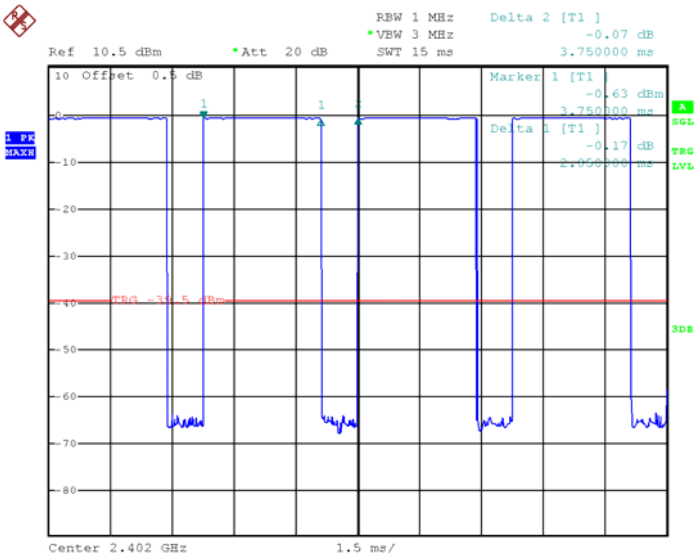
DH1 Packet permit maximum 1600 / 79 /2 hops per second in each channel (1 time slot RX, 1 time slot TX). So, the Dwell Time can be calculated as follows:

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	2.850	0.304	0.4
		middle	2.850	0.304	0.4
		High	2.850	0.304	0.4
Pi/4DQPSK	DH5	Low	2.850	0.304	0.4
		middle	2.850	0.304	0.4
		High	2.850	0.304	0.4
8DPSK	DH5	Low	2.850	0.304	0.4
		middle	2.850	0.304	0.4
		High	2.850	0.304	0.4

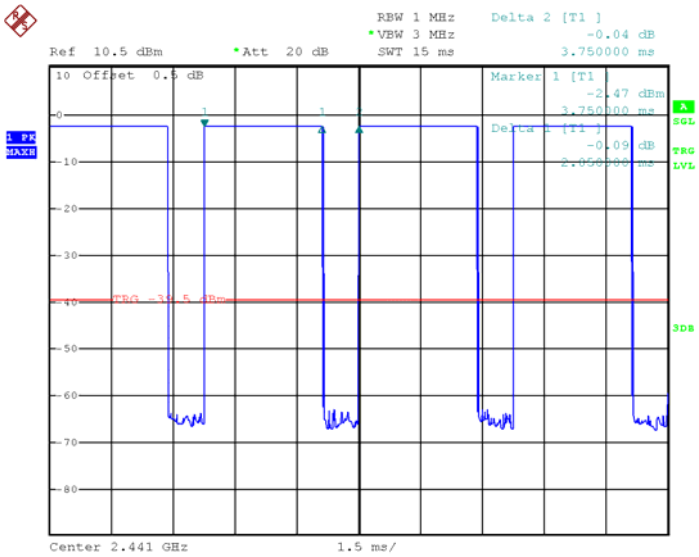
Remark: Only the worst-case mode DH5 is recorded.

Test Plots
GFSK DH5 Low Channel



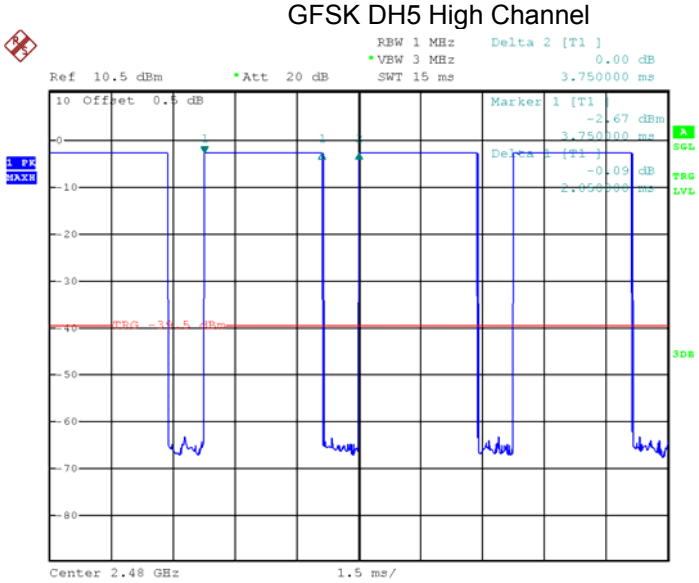
Date: 29.AUG.2018 22:23:40

GFSK DH5 Middle Channel



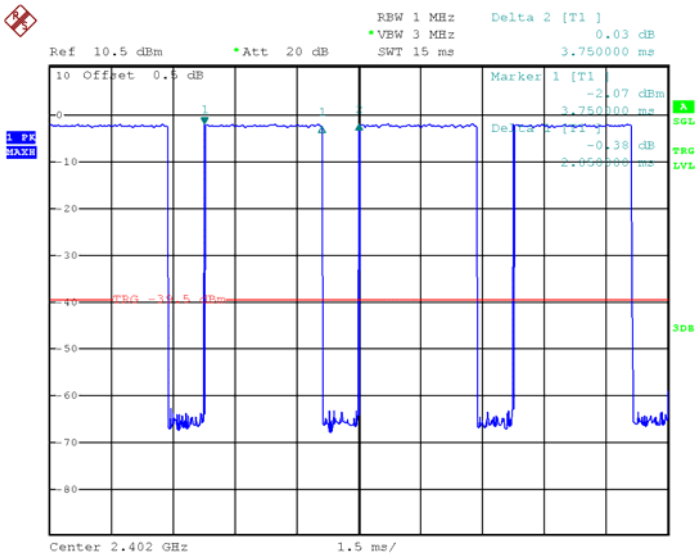
Date: 29.AUG.2018 22:24:06

GFSK DH5 High Channel



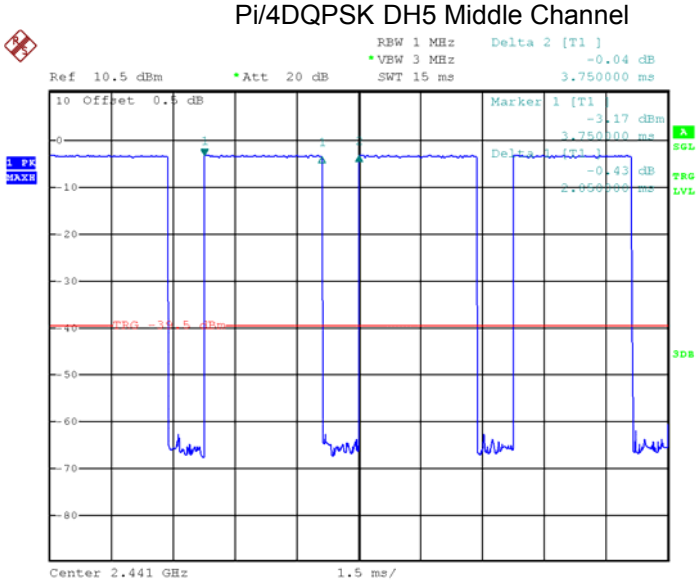
Date: 29.AUG.2018 22:24:40

Pi/4DQPSK DH5 Low Channel



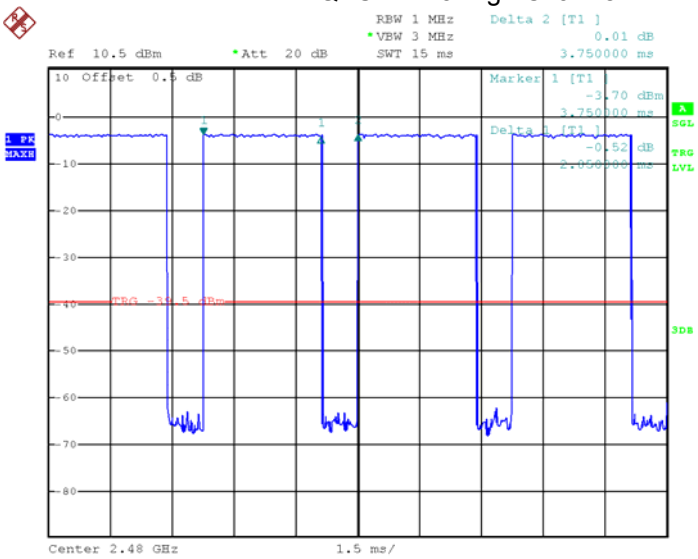
Date: 29.AUG.2018 22:23:09

Pi/4DQPSK DH5 Middle Channel



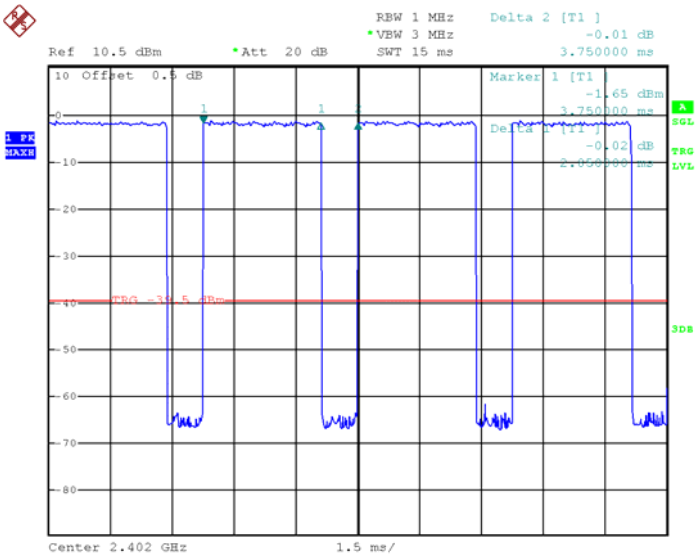
Date: 29.AUG.2018 22:22:41

Pi/4DQPSK DH5 High Channel



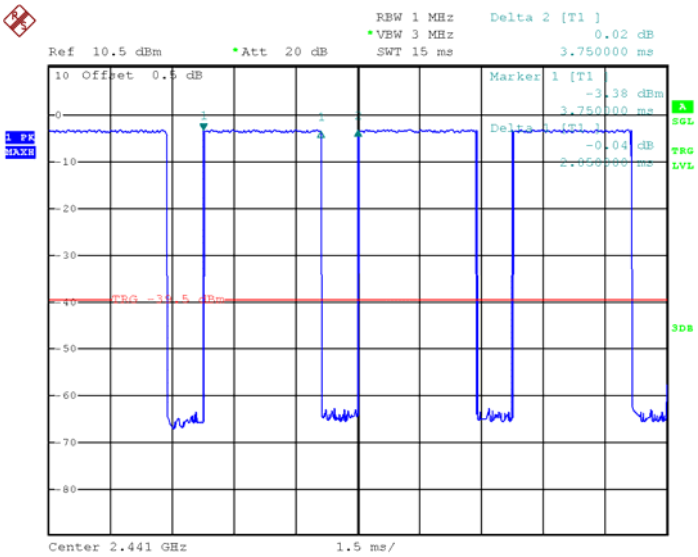
Date: 29.AUG.2018 22:22:10

8DPSK DH5 Low Channel



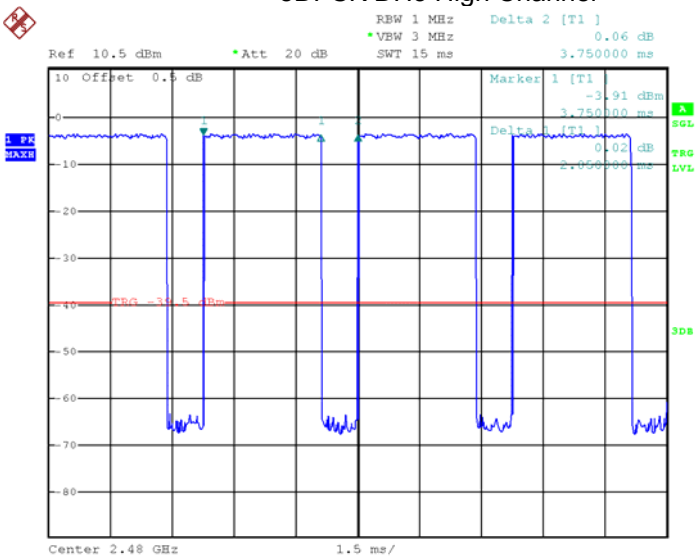
Date: 29.AUG.2018 22:20:37

8DPSK DH5 Middle Channel



Date: 29.AUG.2018 22:21:15

8DPSK DH5 High Channel



Date: 29.AUG.2018 22:21:40

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: WTS18S08121909-1W.

19 Photographs of test setup and EUT.

Note: Please refer to appendix: WTS18S08121909W_Photo.

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