FCC PART 15.247
TEST REPORT

For

Dongguan Xing Yue Electronic co., Ltd

#98 LiWu Swan Industrial District, Qiao Tou Town, Dong Guan City, Guang Dong, China

FCC ID: 2ALCFXO-9296

Report Type:	**Product Type:**
Original Report	ifidelity Metal Millennium Bluetooth Speaker

Test Engineer:	Chris Wang
Report Number:	RSHA180104001-00B
Report Date:	2018-01-17
Reviewed By:	Oscar Ye RF Leader
Prepared By:	Bay Area Compliance Laboratories Corp. (Kunshan) No.248 Chenghu Road,Kunshan,Jiangsu province,China Tel: +86-0512-86175000 Fax: +86-0512-88934268 www.baclcorp.com.cn

TABLE OF CONTENTS

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Dongguan Xing Yue Electronic co., Ltd
Tested Model	XO-9296
Product Type	ifidelity Metal Millennium Bluetooth Speaker
Dimension	201 mm (L)* 65 mm (W)*60 mm(H)
Power Supply	DC 7.4V by battery and DC 5.0V charging from adapter

**All measurement and test data in this report was gathered from production sample serial number: 20180104001. (Assigned by the BACL. The EUT supplied by the applicant was received on 2018-01-04)*

Objective

This test report is prepared on behalf of Dongguan Xing Yue Electronic co., Ltd in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Related Submittal(s)/Grant(s)

FCC Part 15.247 DTS submission with FCC ID: 2ALCFXO-9296.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Item		Uncertainty
AC Power Lines Conducted Emissions		3.19dB
RF conducted test with spectrum		0.9dB
RF Output Power with Power meter		0.5dB
Radiated emission	30MHz~1GHz	6.11dB
	1GHz~6GHz	4.45dB
	6GHz~18GHz	5.23dB
	18GHz~40GHz	5.65dB
Occupied Bandwidth		0.5kHz
Temperature		1.0℃
Humidity		6%

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road,Kunshan,Jiangsu province,China.

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and the FCC designation No. CN1185 under the FCC KDB 974614 D01. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

Channel list for Bluetooth:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	40	2442
1	2403	…	…
…	…	…	…
…	…	77	2479
39	2441	78	2480

EUT was tested with Channel 0, 39 and 78.

EUT Exercise Software

RF test tool: BT FCC Tool V1.00

GFSK Power level: 3
π/4-DQPSK Power level: 3
8-DPSK Power level: 3

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

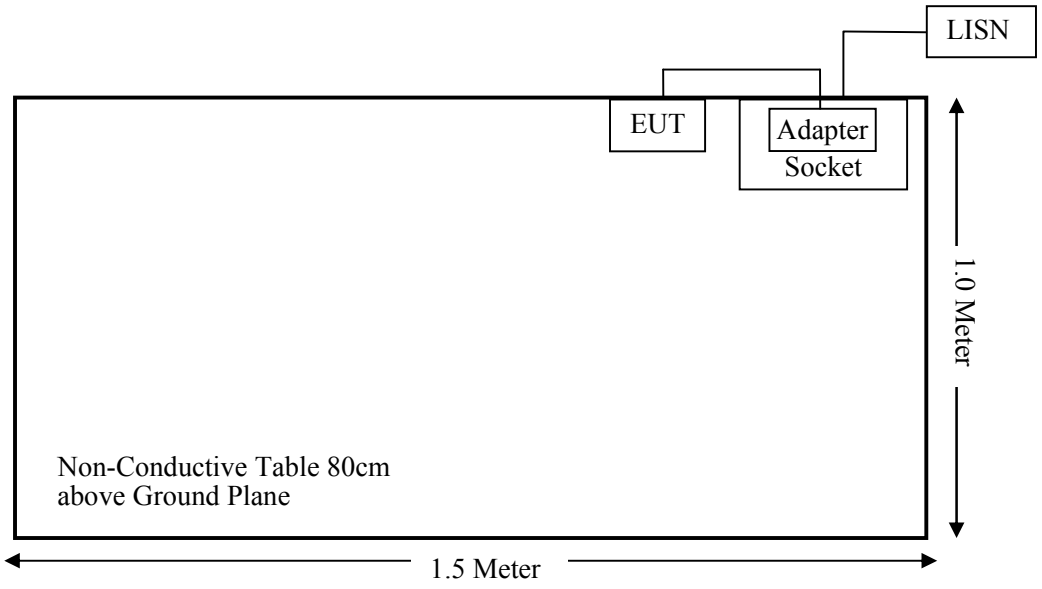
Manufacturer	Description	Model	Serial Number
Dongguan Xing Yue	Adapter Input:AC100-240V,50/60Hz,400mA Output:5.0V,2000mA	S010WU0500200	/

External I/O Cable

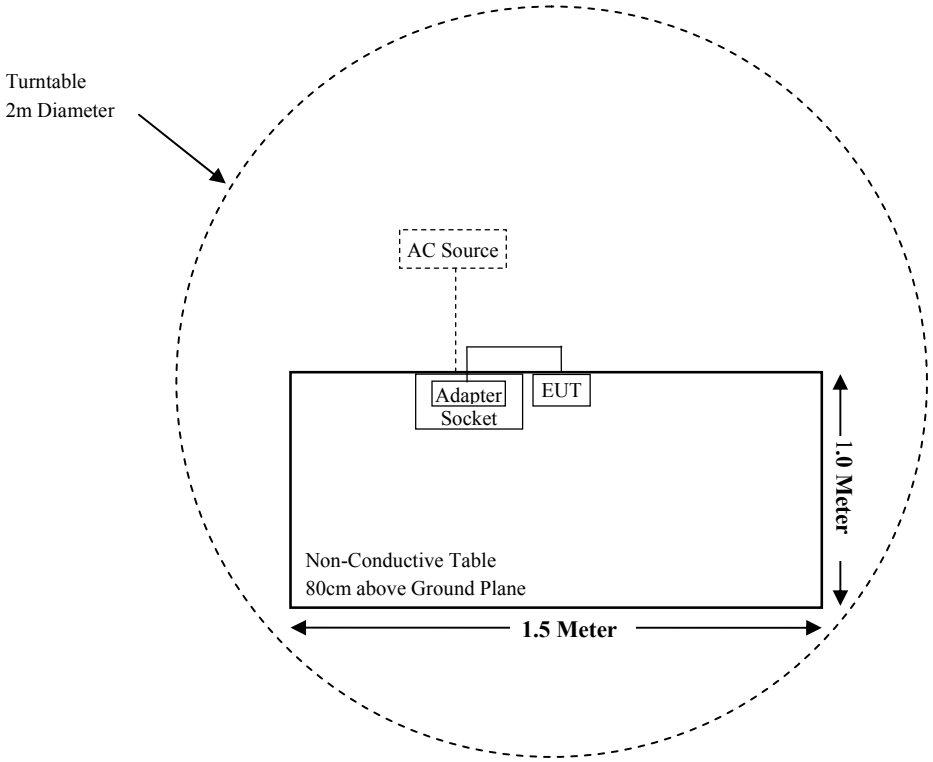
Cable Description	Shielding Type	Length (m)	From Port	To
USB Cable	Un-shielding	0.5	EUT	Adapter

Block Diagram of Test Setup

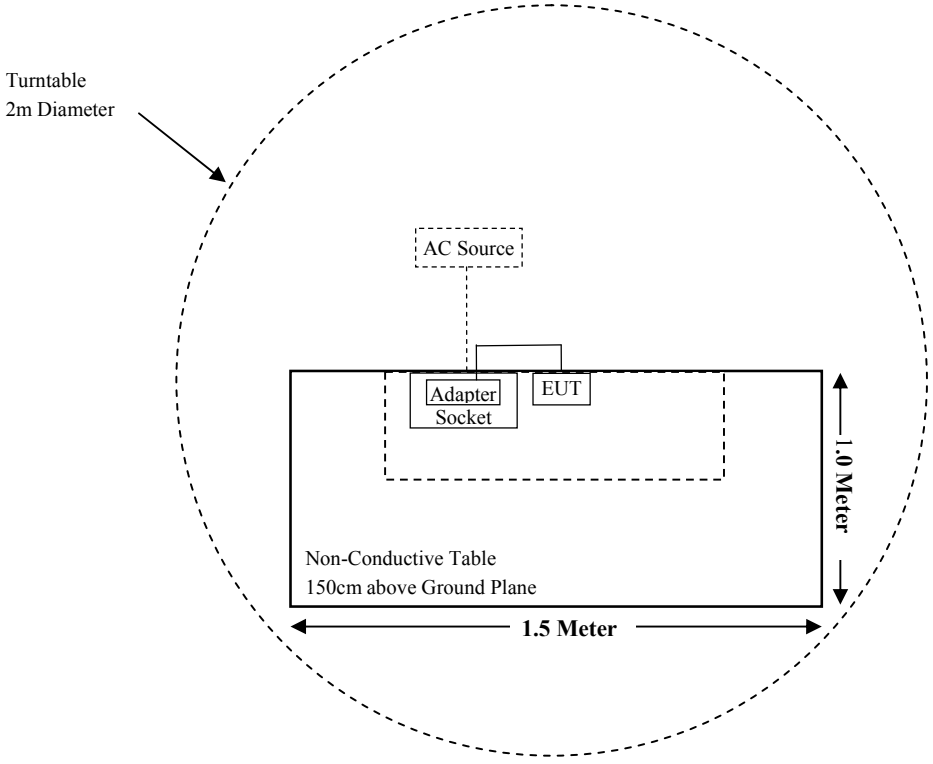
For Conducted Emissions:



For Radiated Emissions(Below 1GHz):



For Radiated Emissions(Above 1GHz):



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (I), §1.1310 & §2.1093	RF Exposure	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209 & §15.247(d)	Radiated Emissions & Restricted Bands Emissions	Compliance
§15.247(a)(1)	20 dB Emission Bandwidth	Compliance
§15.247(a)(1)	Channel Separation Test	Compliance
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliance
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliance
§15.247(b)(1)	Peak Output Power Measurement	Compliance
§15.247(d)	Band edges	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test（Chamber 1#）					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2017-11-12	2018-11-11
Sunol Sciences	Broadband Antenna	JB3	A090413-1	2016-12-26	2019-12-25
Sonoma Instrunent	Pre-amplifier	310N	171205	2017-08-15	2018-08-14
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-8	008	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2017-08-15	2018-08-14
Radiated Emission Test（Chamber 2#）					
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2017-08-27	2018-08-26
ETS-LINDGREN	Horn Antenna	3115	6229	2016-01-11	2019-01-10
ETS-LINDGREN	Horn Antenna	3116	00084159	2016-10-18	2019-10-17
Narda	Pre-amplifier	AFS42-00101800	2001270	2017-12-22	2018-12-21
QuinStar	Amplifier	QLW-18405536-J0	15964001009	2017-12-22	2018-12-21
SINOSCITE	Band Reject Filter	BSF2402-2480MN-0898	/	2017-08-05	2018-08-04
Narda	Attenuator/10dB	10dB	/	/	/
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2017-08-15	2018-08-14
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2017-09-21	2018-09-20
Narda	Attenuator/10dB	10dB	/	/	/
Dongguan Xing Yue	RF Cable	/	/	/	/
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCS30	834115/007	2017/11/12	2018/11/11
Rohde & Schwarz	LISN	ENV216	3560655016	2017-11-25	2018-11-24
BACL	Auto test Software	BACL-EMC	CE001	/	/
Narda	Attenuator/6dB	10690812-2	26850-6	2017-01-10	2018-01-09
MICRO-COAX	Coaxial Cable	Cable-15	015	2017-08-15	2018-08-14

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §15.247 (I) & §1.1310 & §2.1093 - RF EXPOSURE

Applicable Standard

According to§15.247(i) and §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB447498 D01 General RF Exposure Guidance v06:

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] • [√ f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

Measurement Result

Frequency Range (MHz)	Target Output Power		Minimum test separation distance required for the exposure conditions (mm)
	(dBm)	(mW)	
2402-2480	7.50	5.62	5.00

Note:

The target output power was declared by the manufacturer.

Result: [(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] • [√ f(GHz)]= 5.62/5* √ 2.48=1.8 <3.0.

So the stand-alone SAR evaluation is not necessary.

FCC §15.203 – ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Antenna Connector Construction

The EUT has a PCB antenna for Bluetooth, which the antenna gain is 0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

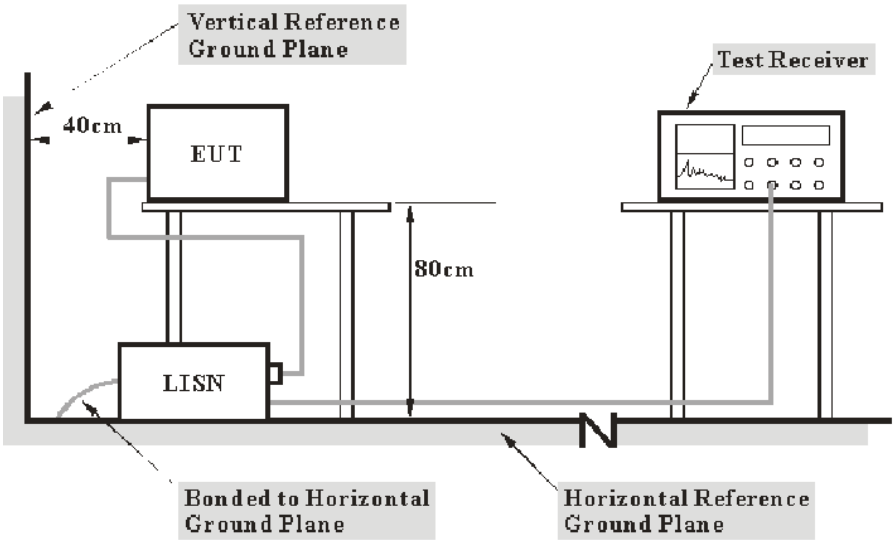
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Corrected Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

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

Margin = Limit – Reading

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207.

Test Data

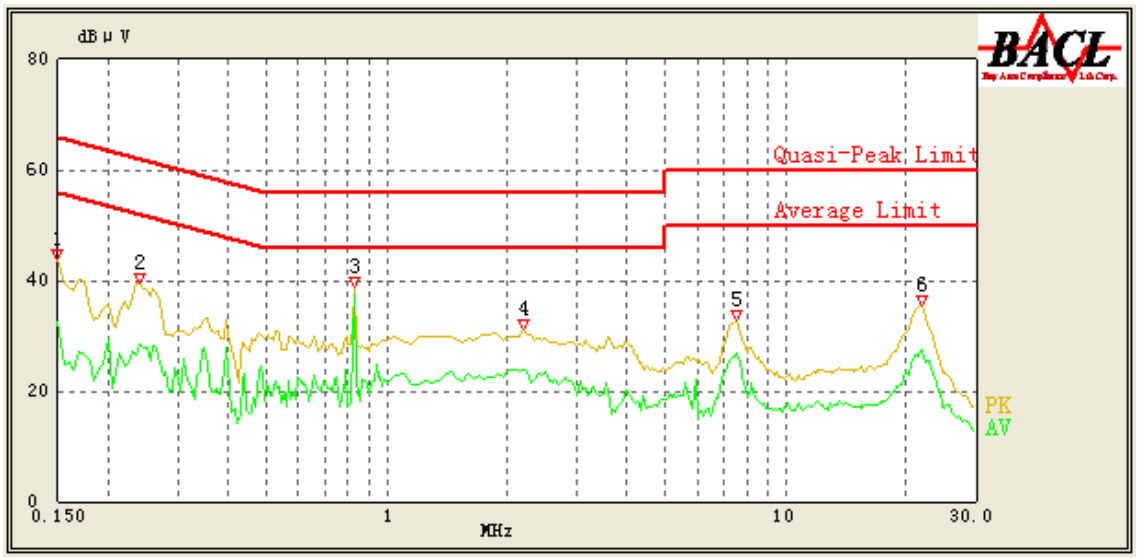
Environmental Conditions

Temperature:	23.4 ℃
Relative Humidity:	49 %
ATM Pressure:	101.1 kPa

The testing was performed by Chris Wang on 2018-01-09.

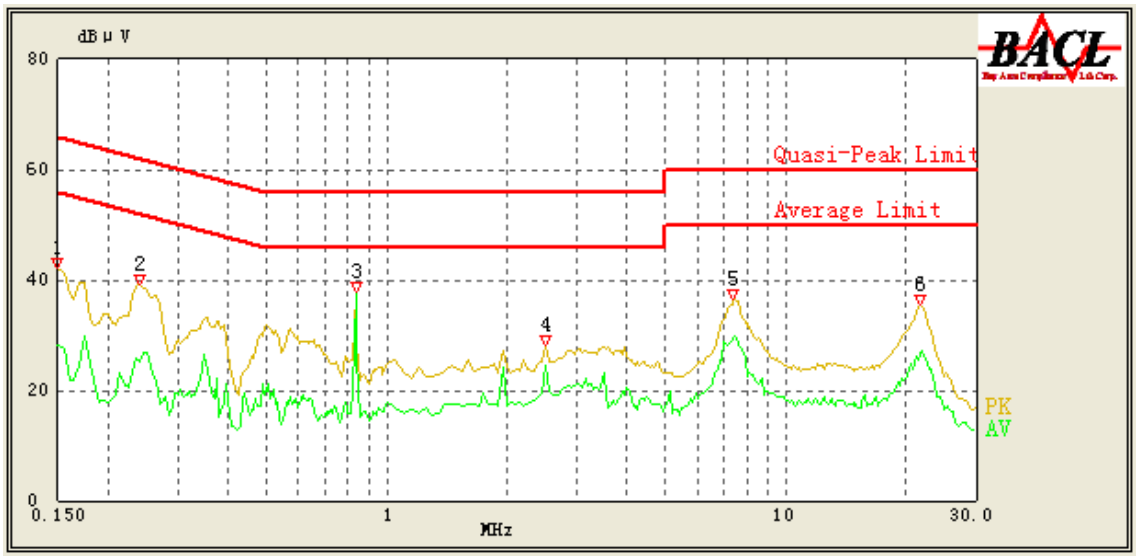
EUT operation mode: Transmitting in high channel of 8-DPSK mode (Worst case)

AC 120V/60 Hz, Line



Frequency (MHz)	Reading (dBµV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Limit (dBµV)	Margin (dB)	Comment
0.150	43.96	QP	9.000	L1	16.06	66.00	22.04	Compliance
0.150	32.52	AV	9.000	L1	16.06	56.00	23.48	Compliance
0.240	39.51	QP	9.000	L1	16.02	63.43	23.92	Compliance
0.240	28.57	AV	9.000	L1	16.02	53.43	24.86	Compliance
0.830	38.67	QP	9.000	L1	15.92	56.00	17.33	Compliance
0.830	37.52	AV	9.000	L1	15.92	46.00	8.48	Compliance
2.200	31.14	QP	9.000	L1	15.85	56.00	24.86	Compliance
2.200	23.72	AV	9.000	L1	15.85	46.00	22.28	Compliance
7.500	32.77	QP	9.000	L1	15.99	60.00	27.23	Compliance
7.550	26.87	AV	9.000	L1	15.99	50.00	23.13	Compliance
22.000	35.37	QP	9.000	L1	16.45	60.00	24.63	Compliance
22.000	27.53	AV	9.000	L1	16.45	50.00	22.47	Compliance

AC 120V/60 Hz, Neutral



Frequency (MHz)	Reading (dBµV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Limit (dBµV)	Margin (dB)	Comment
0.150	42.23	QP	9.000	N	16.06	66.00	23.77	Compliance
0.150	28.33	AV	9.000	N	16.06	56.00	27.67	Compliance
0.240	39.13	QP	9.000	N	16.06	63.43	24.30	Compliance
0.240	25.13	AV	9.000	N	16.06	53.43	28.30	Compliance
0.835	37.94	QP	9.000	N	15.97	56.00	18.06	Compliance
0.835	37.51	AV	9.000	N	15.97	46.00	8.49	Compliance
2.500	28.33	QP	9.000	N	15.90	56.00	27.67	Compliance
2.500	24.52	AV	9.000	N	15.90	46.00	21.48	Compliance
7.400	36.55	QP	9.000	N	15.93	60.00	23.45	Compliance
7.450	29.83	AV	9.000	N	15.93	50.00	20.17	Compliance
21.700	35.48	QP	9.000	N	16.19	60.00	24.52	Compliance
21.700	26.54	AV	9.000	N	16.19	50.00	23.46	Compliance

Note:
1) Corrected Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation
2) Margin = Limit – Reading

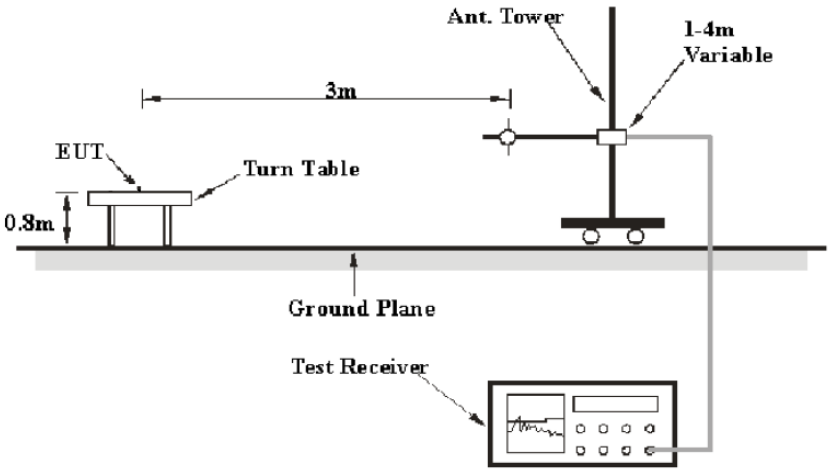
FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

Applicable Standard

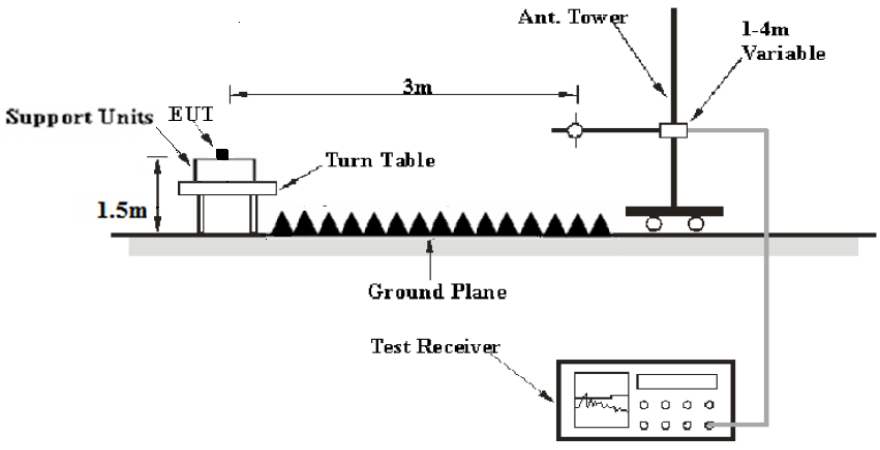
FCC §15.205; §15.209; §15.247(d)

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209 and FCC 15.247 limits.

EMI Test Receiver Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1GHz	1MHz	3 MHz	/	PK
	1MHz	3 MHz	/	Ave.

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All final data was recorded in Quasi-peak detection mode for frequency range of 30 MHz -1 GHz and peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

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

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - 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 limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

Test Data

Environmental Conditions

Temperature:	23.4 ℃
Relative Humidity:	49 %
ATM Pressure:	101.1 kPa

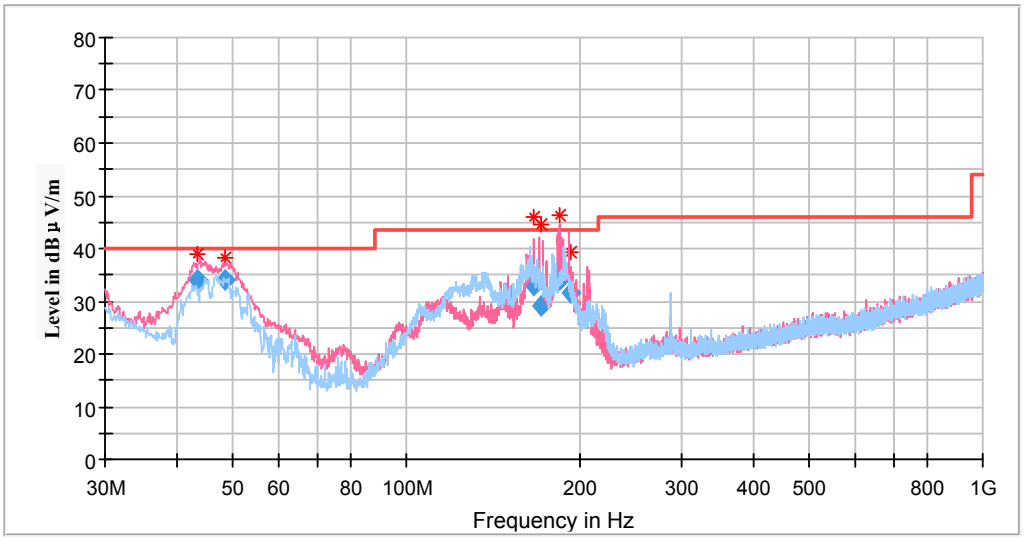
The testing was performed by Chris Wang from 2018-01-09 to 2018-01-17.

EUT operation mode: Transmitting

Spurious Emission Test:

30MHz-1GHz:

Pre-Scan with GFSK, π/4-DQPSK, 8-DPSK modes of operation in the X,Y and Z axes of orientation,, the worst case ***8-DPSK Mode in X-axis of orientation*** *was recorded*



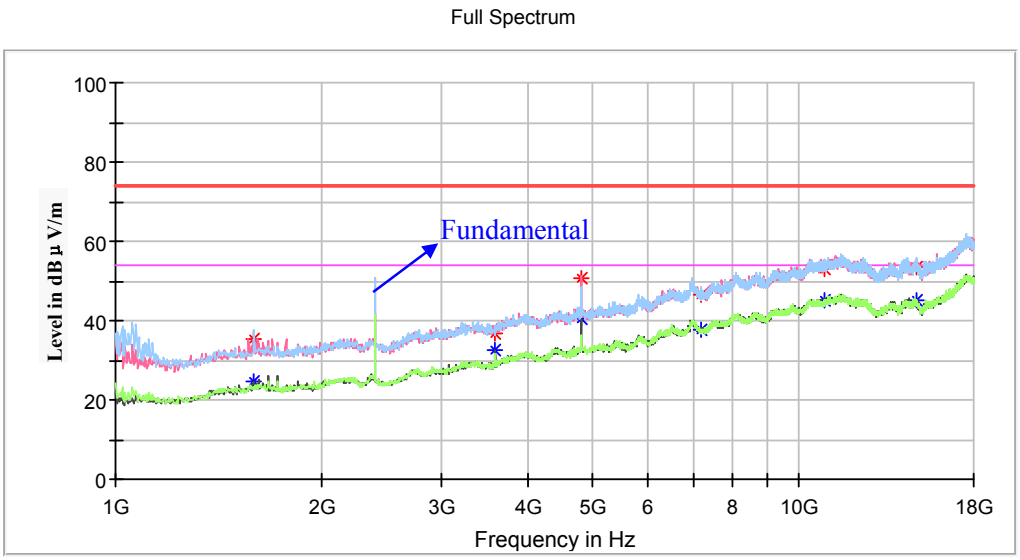
Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	QuasiPeak (dBµV/m)	Height (cm)	Polar (H/V)				
43.348290	34.06	101.0	V	159.0	-13.5	40.00	5.94
48.639830	33.98	101.0	V	171.0	-17.0	40.00	6.02
166.826810	32.86	101.0	V	16.0	-13.5	43.50	10.64
171.376380	29.22	101.0	V	346.0	-13.7	43.50	14.28
184.011020	34.04	101.0	V	0.0	-13.8	43.50	9.46
192.437250	31.44	101.0	V	309.0	-13.3	43.50	12.06

1GHz-18GHz:

Pre-Scan with GFSK, π/4-DQPSK, 8-DPSK modes of operation in the X,Y and Z axes of orientation,, the worst case ***8-DPSK Mode in X-axis of orientation*** *was recorded*

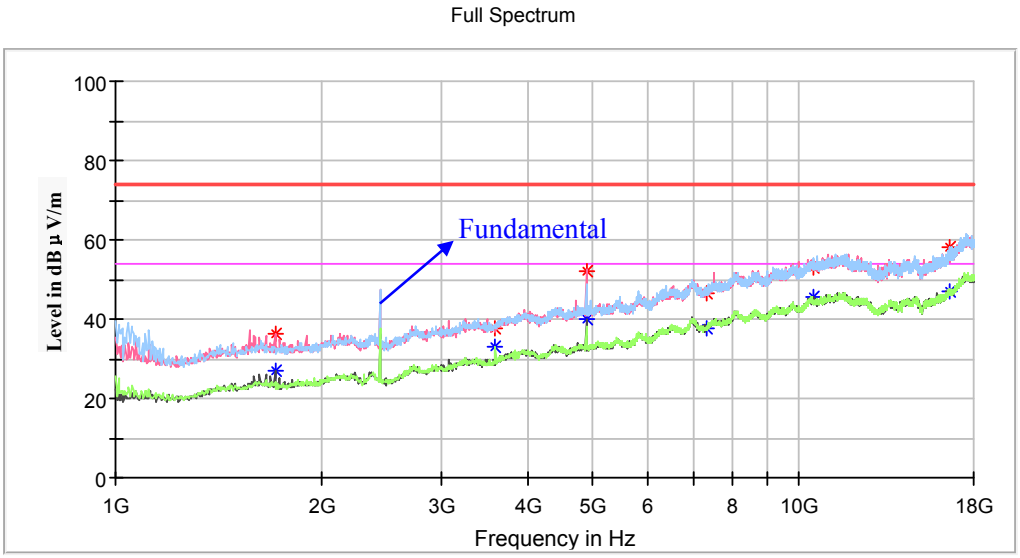
Note:
1. This test was performed with the 2.402-2.48GHz band reject filter.
2. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
   Corrected Amplitude = Corrected Factor + Reading
   Margin = Limit - Corrected. Amplitude

Low Channel: 2402MHz



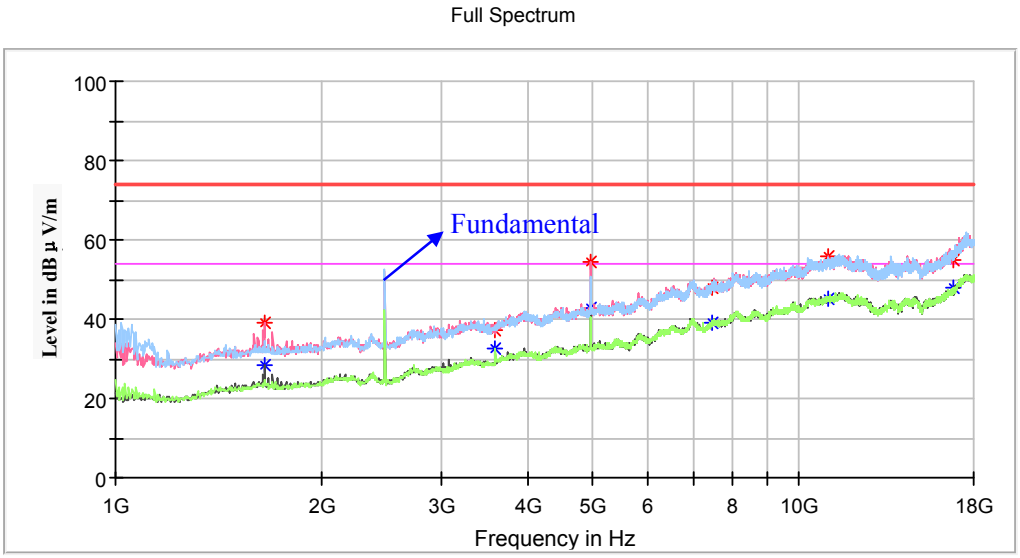
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1588.200000	35.34	---	250.0	V	224.0	-7.6	74.00	38.66
1588.200000	---	24.77	250.0	V	224.0	-7.6	54.00	29.23
3597.600000	36.95	---	150.0	V	81.0	-0.6	74.00	37.05
3597.600000	---	32.63	150.0	V	81.0	-0.6	54.00	21.37
4804.000000	---	40.48	150.0	V	3.0	2.5	54.00	13.52
4804.000000	50.67	---	150.0	V	3.0	2.5	74.00	23.33
7206.000000	---	37.59	200.0	V	296.0	9.8	54.00	16.41
7206.000000	46.50	---	200.0	V	296.0	9.8	74.00	27.50
10870.200000	53.04	---	200.0	H	211.0	17.1	74.00	20.96
10870.200000	---	44.91	200.0	H	211.0	17.1	54.00	9.09
14875.400000	53.63	---	150.0	H	312.0	15.8	74.00	20.37
14875.400000	---	44.91	150.0	H	312.0	15.8	54.00	9.09

Middle Channel: 2441MHz



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1710.600000	36.22	---	150.0	V	75.0	-7.1	74.00	37.78
1710.600000	---	26.95	150.0	V	75.0	-7.1	54.00	27.05
3597.600000	37.70	---	150.0	H	157.0	-0.6	74.00	36.30
3597.600000	---	33.00	150.0	H	157.0	-0.6	54.00	21.00
4882.000000	51.96	---	250.0	V	341.0	2.7	74.00	22.04
4882.000000	---	40.11	250.0	V	341.0	2.7	54.00	13.89
7323.000000	46.60	---	200.0	V	176.0	10.0	74.00	27.40
7323.000000	---	37.79	200.0	V	176.0	10.0	54.00	16.21
10472.400000	53.24	---	100.0	V	324.0	16.9	74.00	20.76
10472.400000	---	45.57	100.0	V	324.0	16.9	54.00	8.43
16589.000000	---	47.09	150.0	H	349.0	19.0	54.00	6.91
16589.000000	57.98	---	150.0	H	349.0	19.0	74.00	16.02

High Channel: 2480MHz

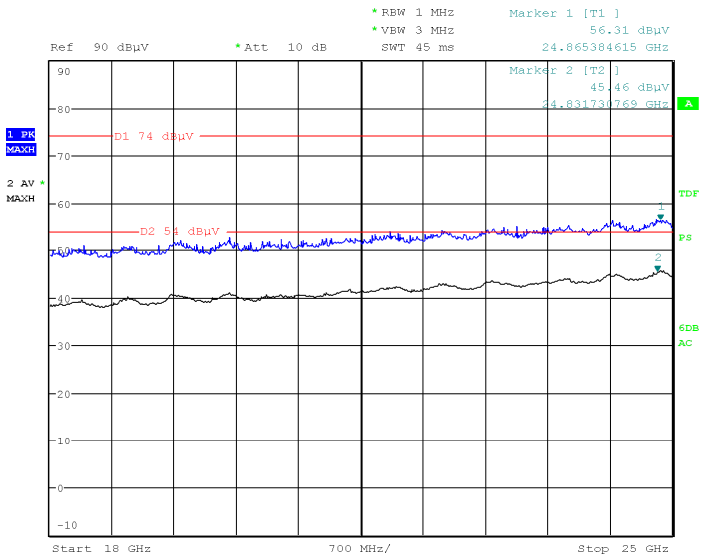


Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1652.800000	39.25	---	150.0	V	117.0	-7.4	74.00	34.75
1652.800000	---	28.32	150.0	V	117.0	-7.4	54.00	25.68
3597.600000	37.35	---	200.0	H	22.0	-0.6	74.00	36.65
3597.600000	---	32.72	200.0	H	22.0	-0.6	54.00	21.28
4960.000000	---	42.83	150.0	V	185.0	2.8	54.00	11.17
4960.000000	54.33	---	150.0	V	185.0	2.8	74.00	19.67
7440.000000	---	38.91	100.0	V	244.0	10.1	54.00	15.09
7440.000000	47.84	---	100.0	V	244.0	10.1	74.00	26.16
11016.400000	---	45.26	250.0	V	16.0	17.2	54.00	8.74
11016.400000	55.74	---	250.0	V	16.0	17.2	74.00	18.26
16789.600000	55.07	---	150.0	V	292.0	20.0	74.00	18.93
16789.600000	---	47.72	150.0	V	292.0	20.0	54.00	6.28

18GHz-25GHz:

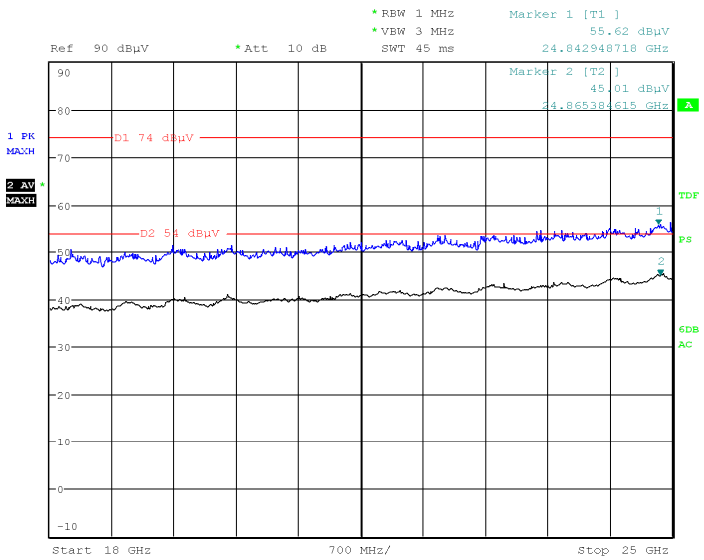
Pre-Scan with GFSK, π/4-DQPSK, 8-DPSK modes of operation in the X,Y and Z axes of orientation,, the worst case ***8-DPSK Mode in X-axis of orientation*** *was recorded*

Horizontal



Date: 17.JAN.2018 13:17:28

Vertical



Date: 17.JAN.2018 13:28:18

Fundamental Test & Restricted Bands Emissions:

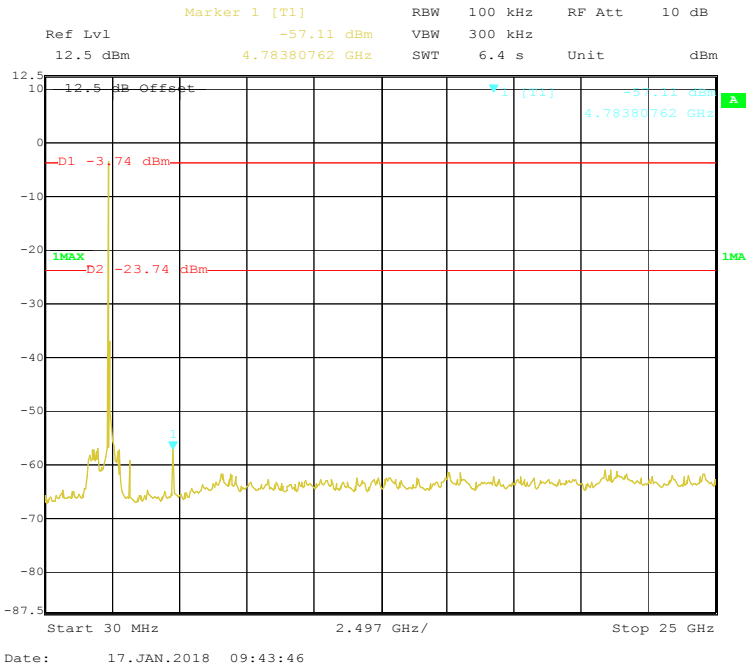
Pre-Scan with GFSK, π/4-DQPSK, 8-DPSK modes of operation in the X,Y and Z axes of orientation,, the worst case ***8-DPSK Mode in X-axis of orientation*** *was recorded*

Note:
1. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
   Corrected Amplitude = Corrected Factor + Reading
   Margin = Limit - Corrected. Amplitude

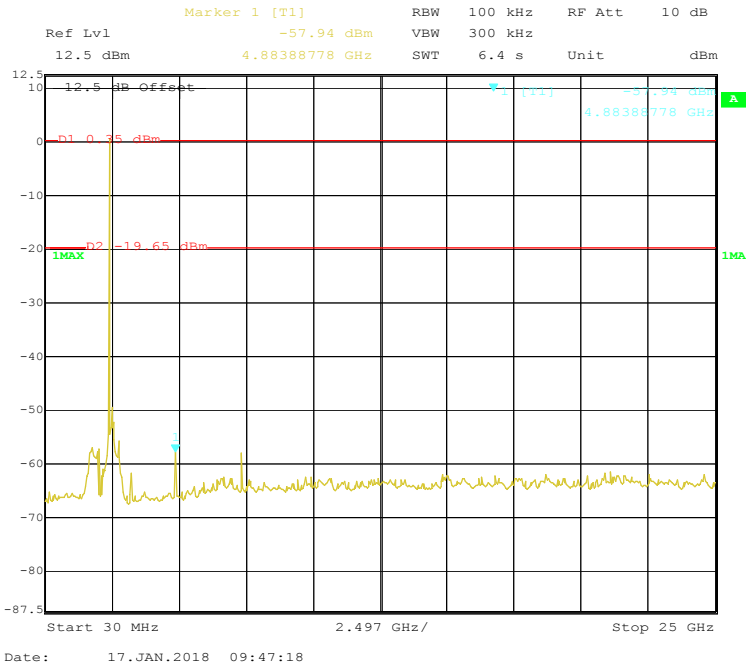
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
Low Channel: 2402MHz								
2402.000000	---	81.55	250.0	V	42.0	5.1	/	/
2402.000000	81.96	---	250.0	V	42.0	5.1	/	/
2390.000000	---	38.06	200.0	V	166.0	5.1	54.00	15.94
2390.000000	47.36	---	200.0	V	166.0	5.1	74.00	26.64
Middle Channel: 2441MHz								
2441.000000	84.04	---	250.0	V	91.0	5.2	/	/
2441.000000	---	83.57	250.0	V	91.0	5.2	/	/
High Channel: 2480MHz								
2480.000000	---	85.37	200.0	V	144.0	5.3	/	/
2480.000000	86.05	---	200.0	V	144.0	5.3	/	/
2483.500000	---	38.35	150	V	39.0	5.3	54.00	15.65
2483.500000	47.27	---	150	V	39.0	5.3	74.00	26.73

Conducted Spurious Emissions at Antenna Port:

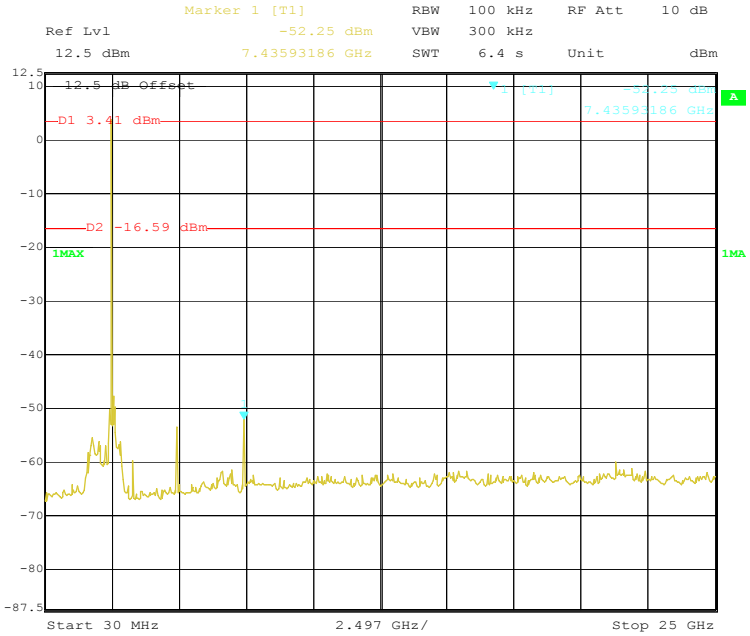
BDR (GFSK): Low Channel



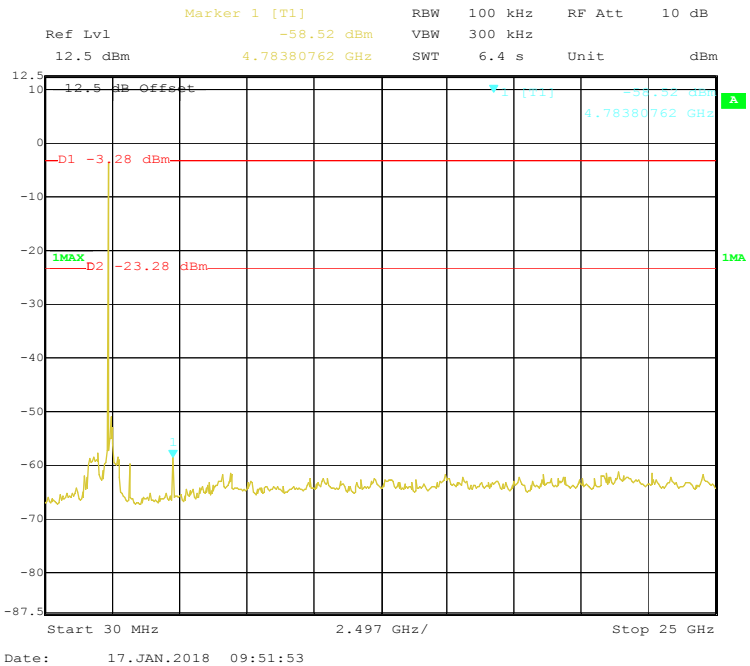
BDR (GFSK): Middle Channel



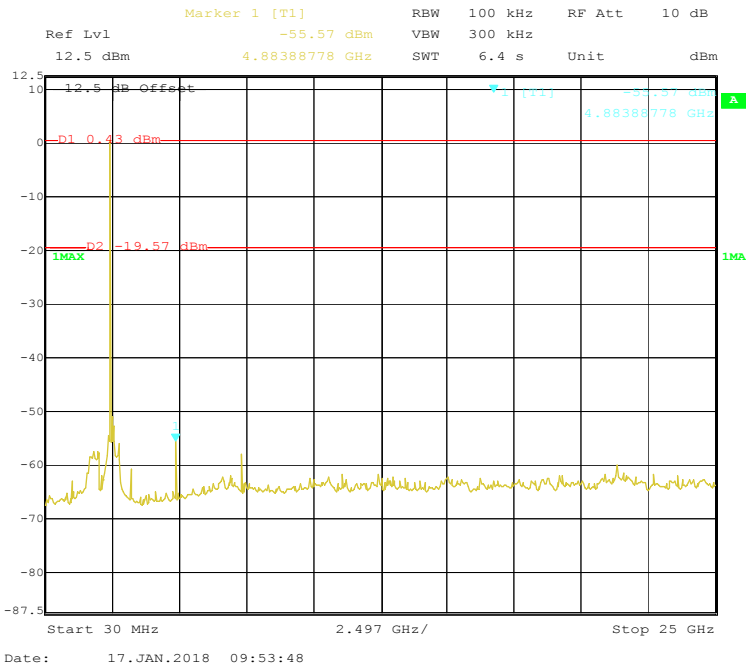
BDR (GFSK): High Channel



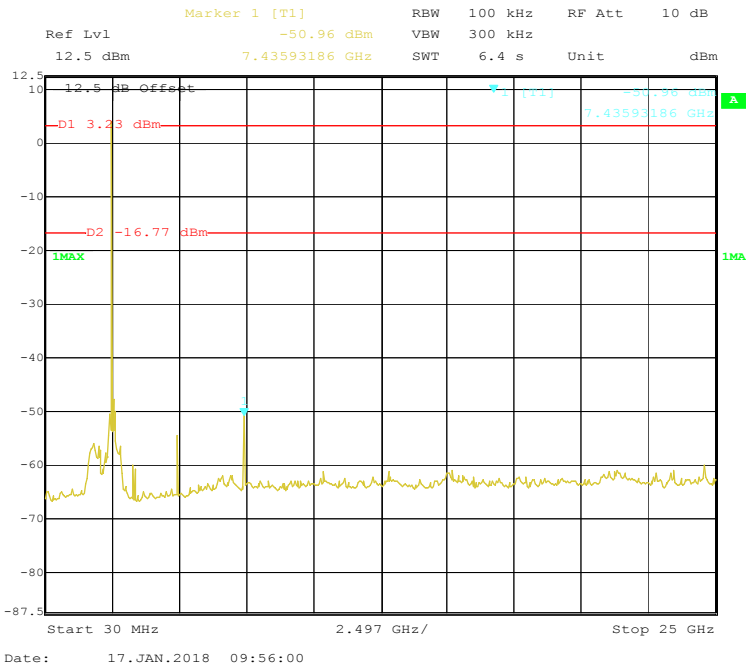
EDR (π/4-DQPSK): Low Channel



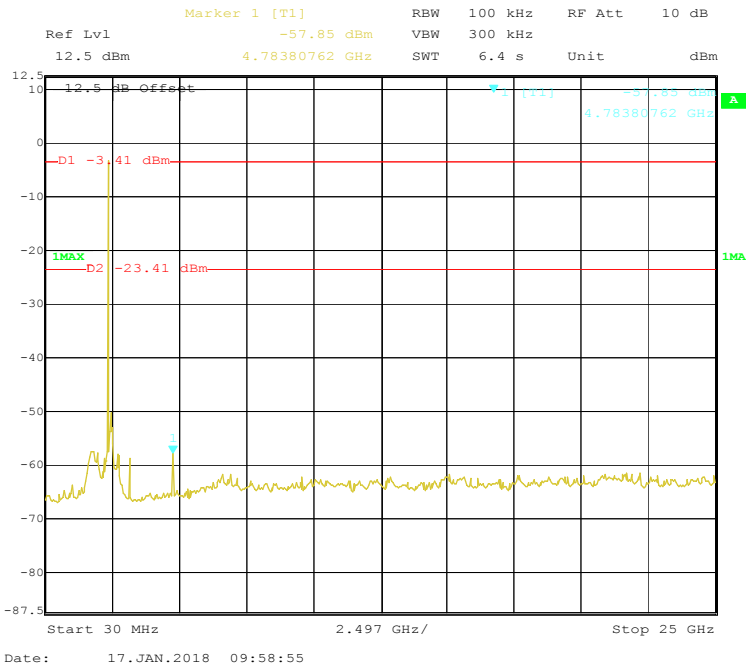
EDR (π/4-DQPSK): Middle Channel



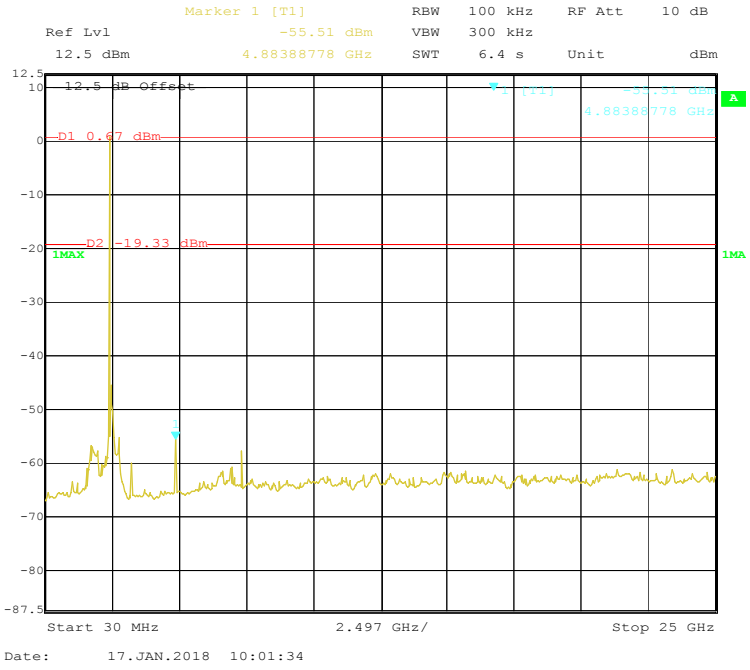
EDR (π/4-DQPSK): High Channel



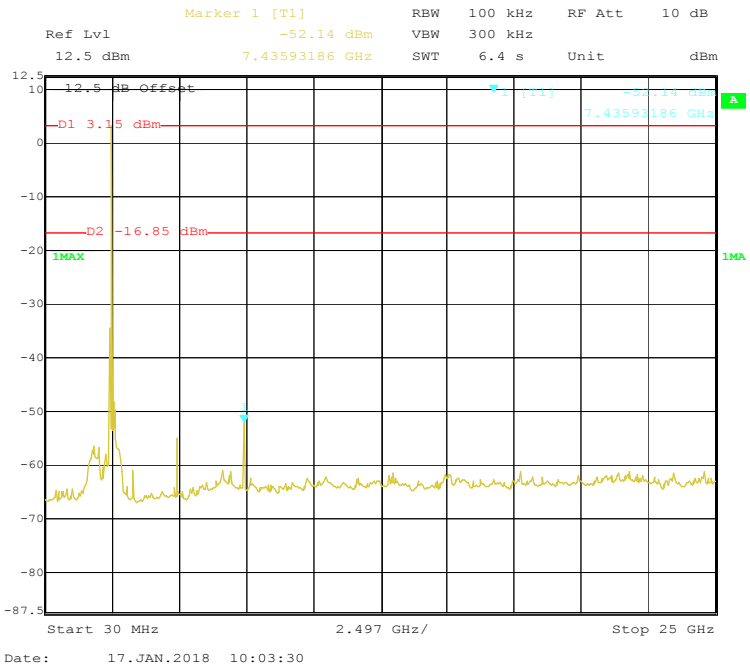
EDR (8-DPSK): Low Channel



EDR (8-DPSK): Middle Channel



EDR (8-DPSK): High Channel



FCC §15.247(a) (1)-CHANNEL SEPARATION TEST

Applicable Standard

Frequency hopping systems shall have hoping 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 125 mW.

Test Procedure

1. Set the EUT in transmitting mode, maxhold the channel.
2. Set the adjacent channel of the EUT and maxhold another trace.
3. Measure the channel separation.

Test Data

Environmental Conditions

Temperature:	23.4 ℃
Relative Humidity:	49 %
ATM Pressure:	101.1 kPa

The testing was performed by Chris Wang on 2018-01-16.

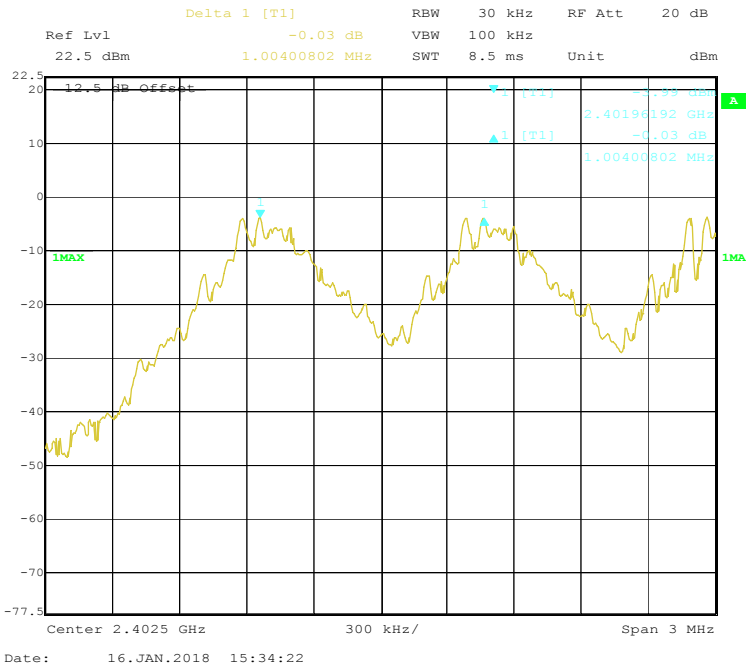
EUT operation mode: Transmitting

Test Result: Compliance.

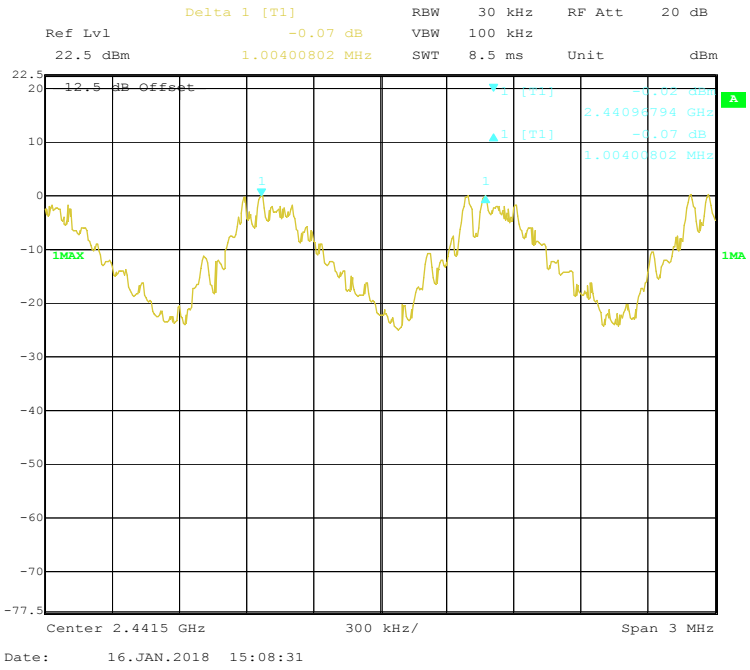
Mode	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)	Result
BDR (GFSK)	Low	2402	1.004	0.561	Pass
	Adjacent	2403			
	Middle	2441	1.004	0.561	Pass
	Adjacent	2442			
	High	2480	1.004	0.561	Pass
	Adjacent	2479			
EDR (π/4-DQPSK)	Low	2402	1.004	0.858	Pass
	Adjacent	2403			
	Middle	2441	0.998	0.858	Pass
	Adjacent	2442			
	High	2480	0.998	0.858	Pass
	Adjacent	2479			
EDR (8-DPSK)	Low	2402	1.004	0.842	Pass
	Adjacent	2403			
	Middle	2441	0.998	0.842	Pass
	Adjacent	2442			
	High	2480	0.998	0.842	Pass
	Adjacent	2479			

Note: Limit = 20 dB bandwidth*2/3

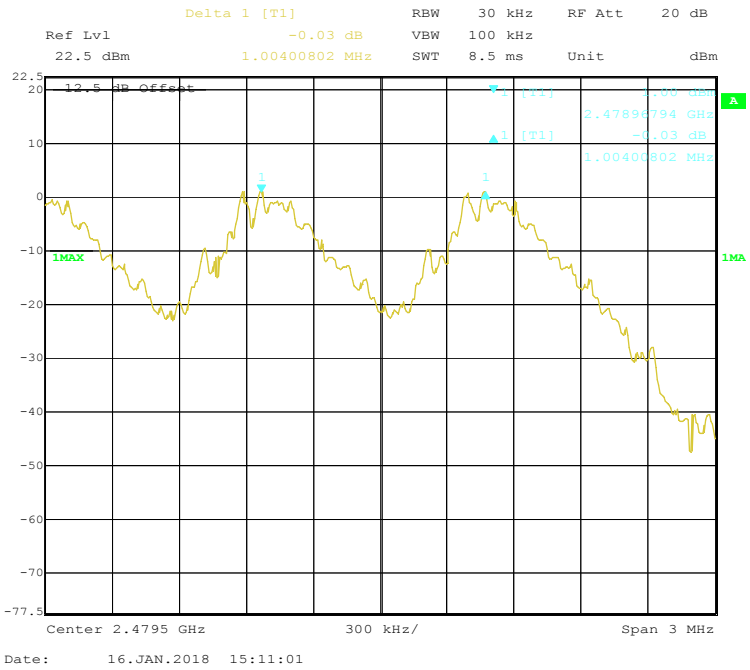
BDR (GFSK): Low Channel



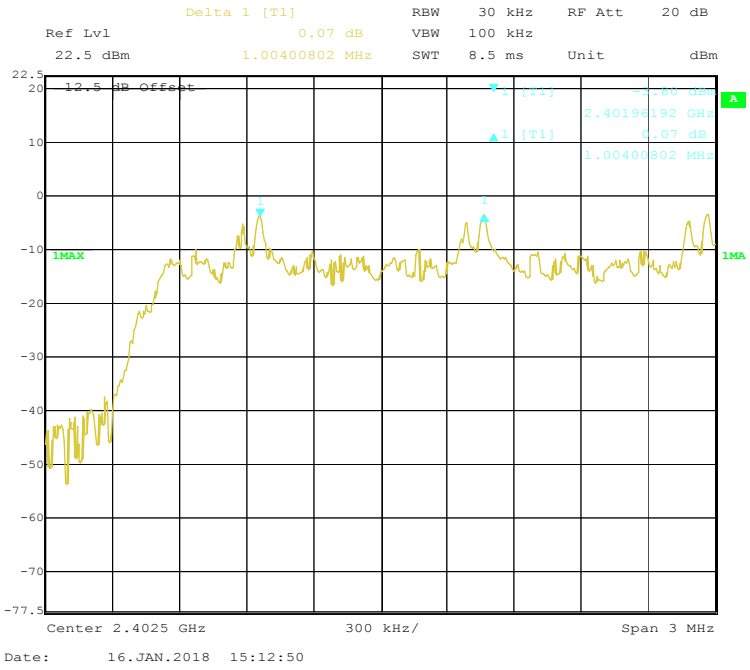
BDR (GFSK): Middle Channel



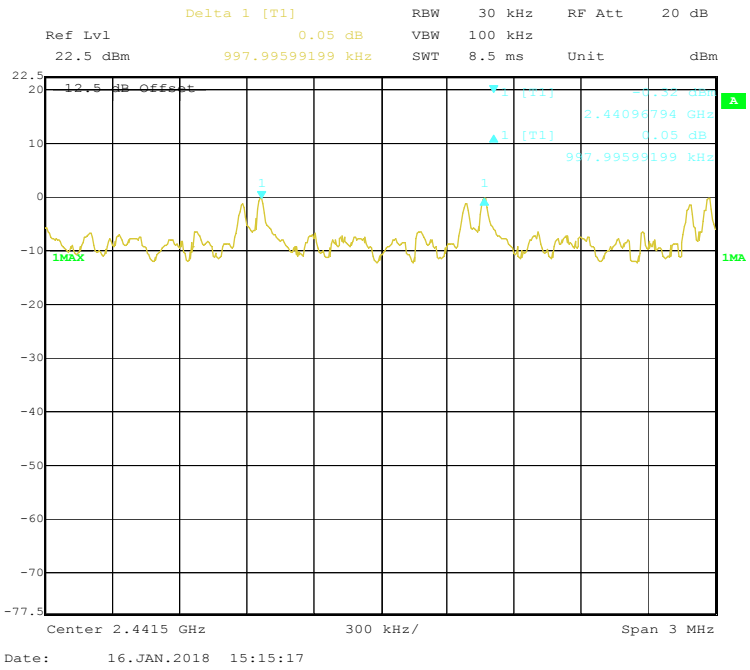
BDR (GFSK): High Channel



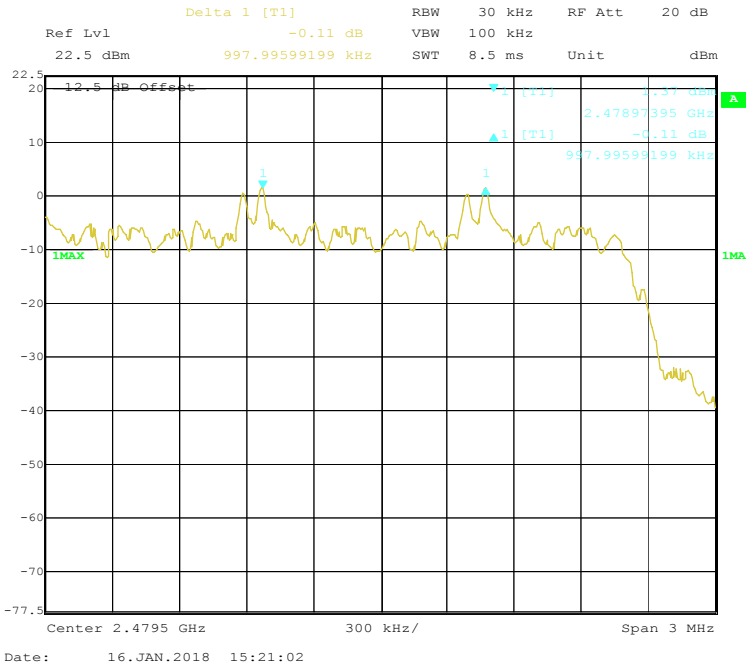
EDR (π/4-DQPSK): Low Channel



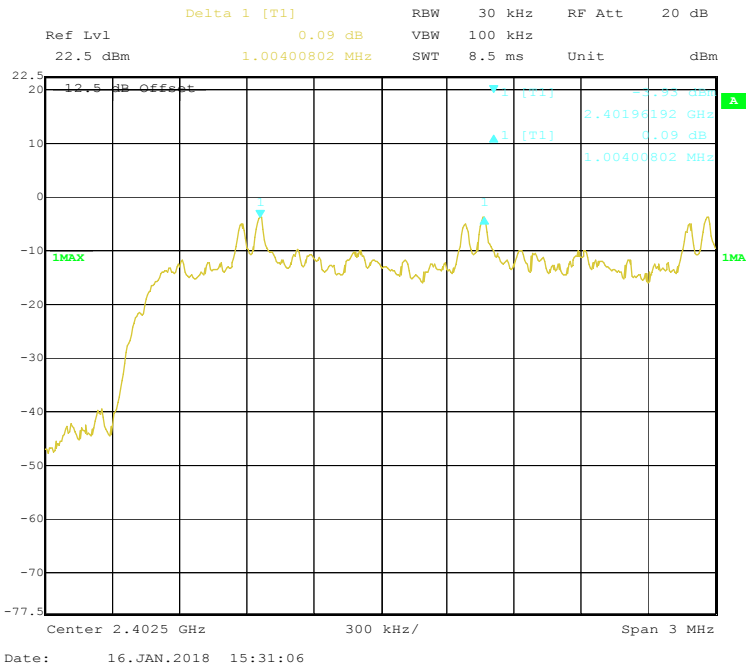
EDR (π/4-DQPSK): Middle Channel



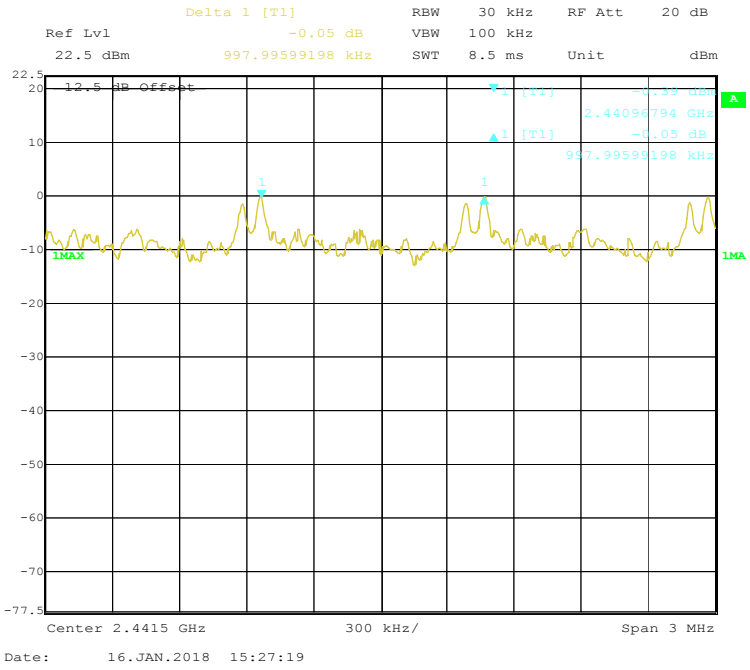
EDR (π/4-DQPSK): High Channel



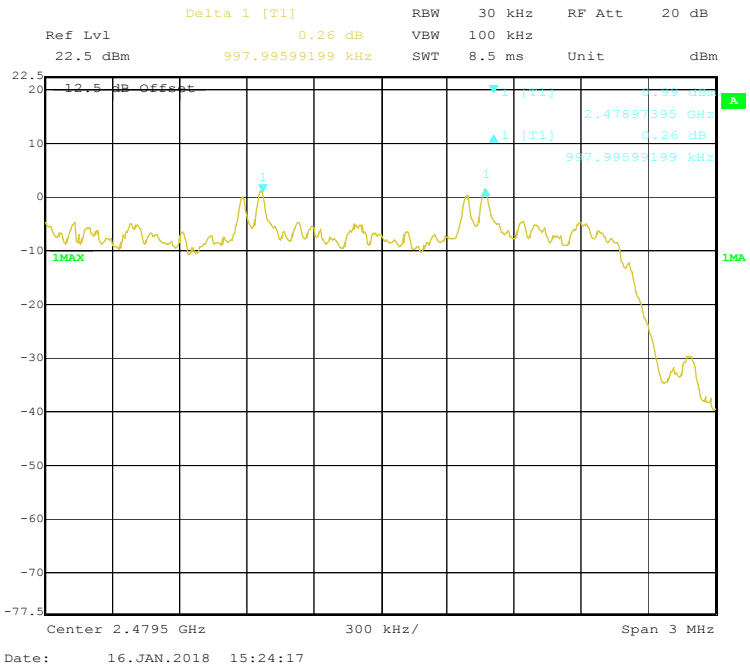
EDR (8-DPSK): Low Channel



EDR (8-DPSK): Middle Channel



EDR (8-DPSK): High Channel



FCC §15.247(a) (1) – 20 dB EMISSION BANDWIDTH

Applicable Standard

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 125 mW.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Test Data

Environmental Conditions

Temperature:	23.2 ℃
Relative Humidity:	50 %
ATM Pressure:	101.3 kPa

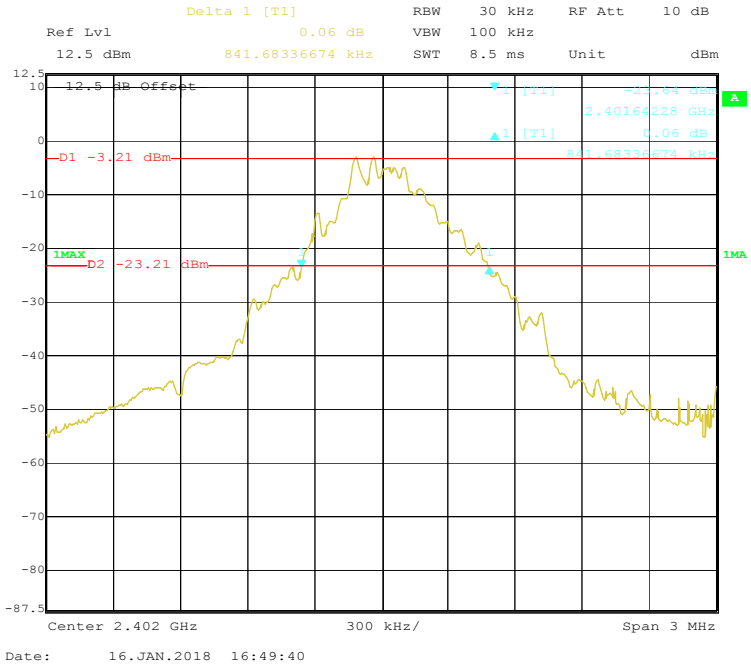
The testing was performed by Chris Wang on 2018-01-16.

EUT operation mode: Transmitting

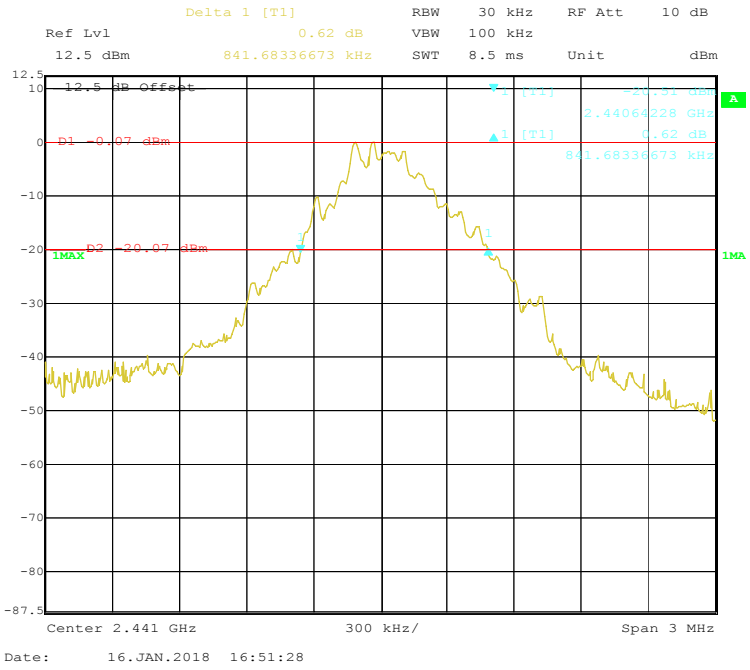
Test Result: Compliance.

Mode	Channel	Frequency (MHz)	20 dB Emission Bandwidth (MHz)
BDR (GFSK)	Low	2402	0.842
	Middle	2441	0.842
	High	2480	0.842
EDR (π/4-DQPSK)	Low	2402	1.287
	Middle	2441	1.287
	High	2480	1.287
EDR (8-DPSK)	Low	2402	1.263
	Middle	2441	1.263
	High	2480	1.263

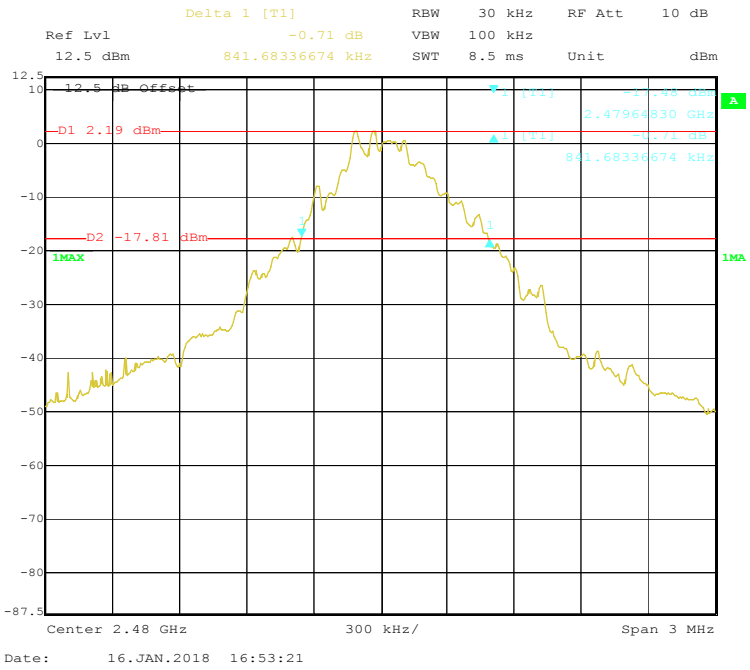
BDR (GFSK): Low Channel



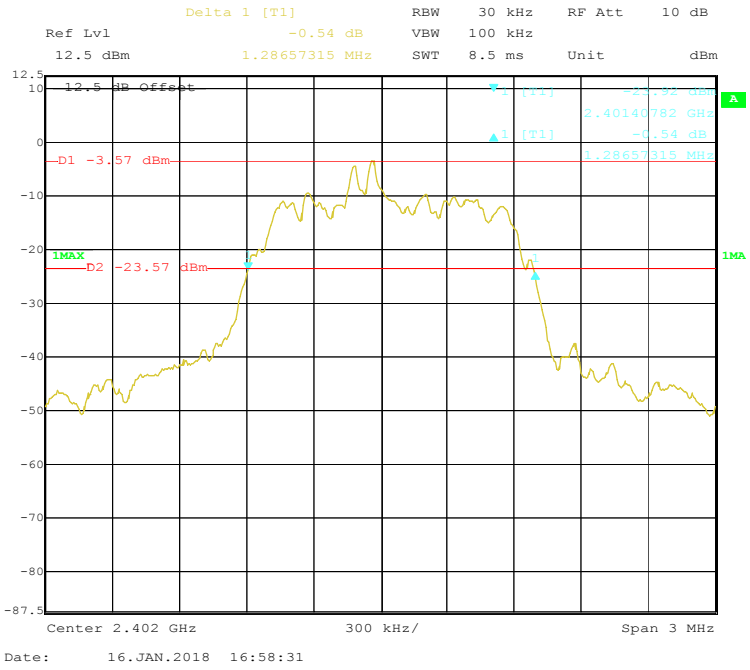
BDR (GFSK): Middle Channel



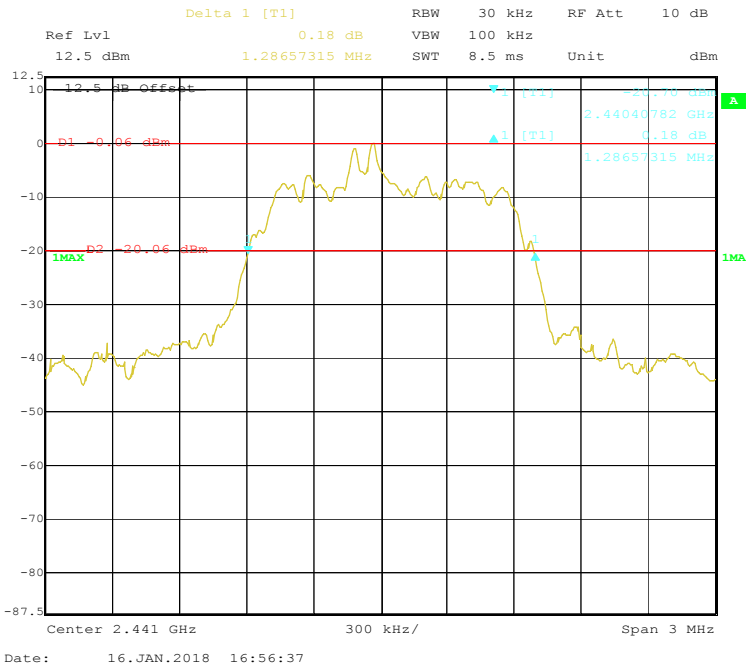
BDR (GFSK): High Channel



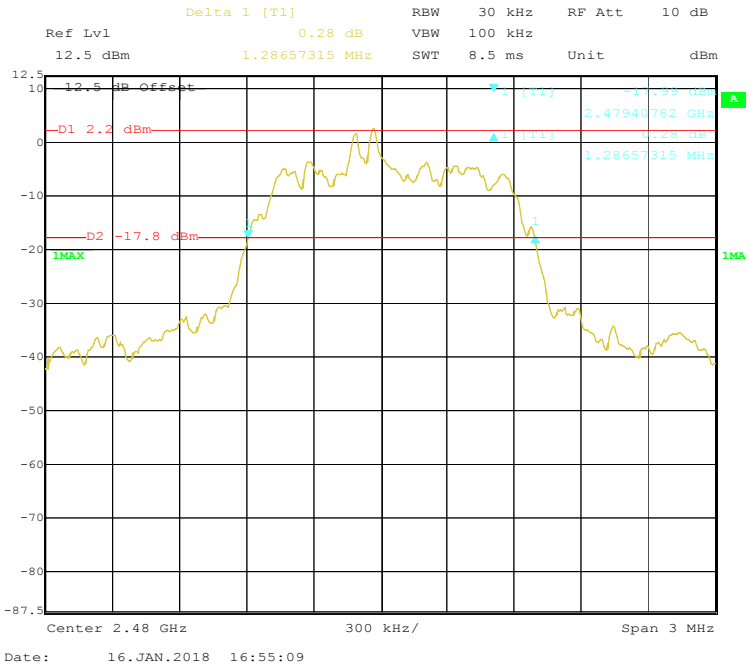
EDR (π/4-DQPSK): Low Channel



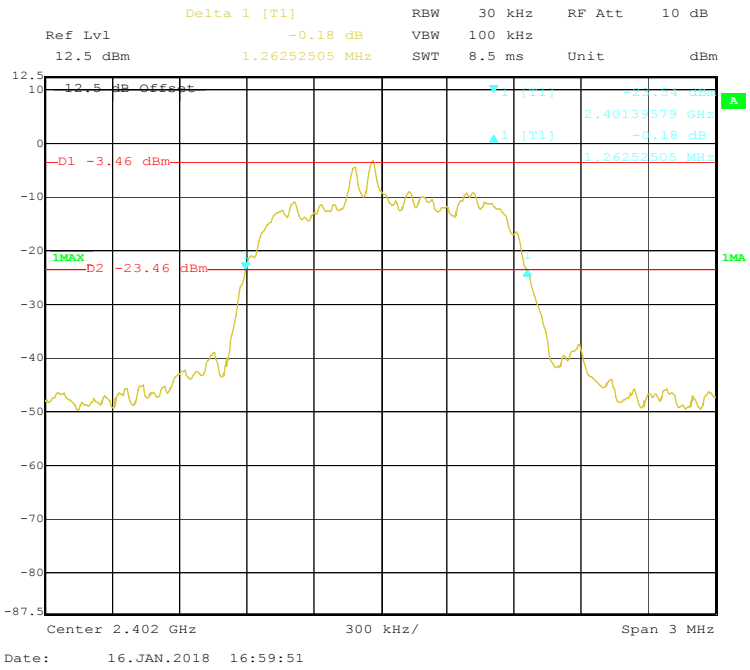
EDR(π/4-DQPSK): Middle Channel



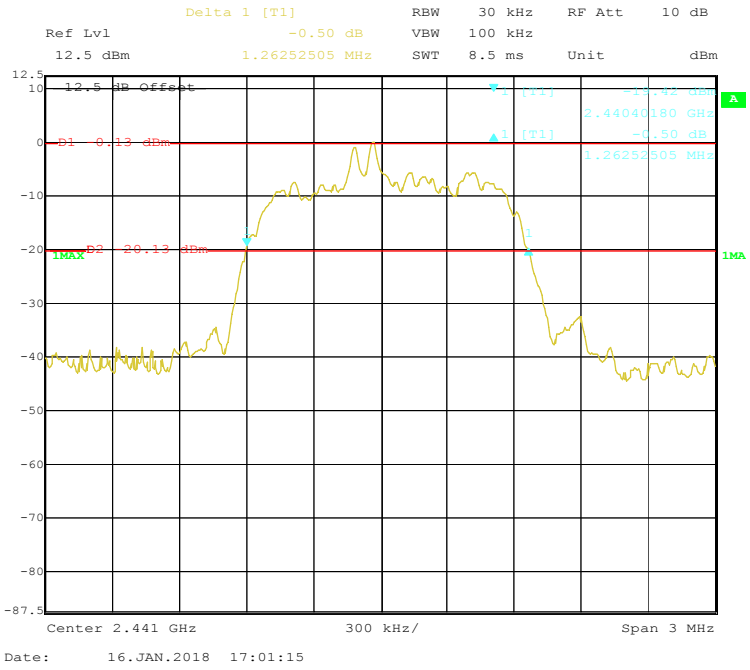
EDR (π/4-DQPSK): High Channel



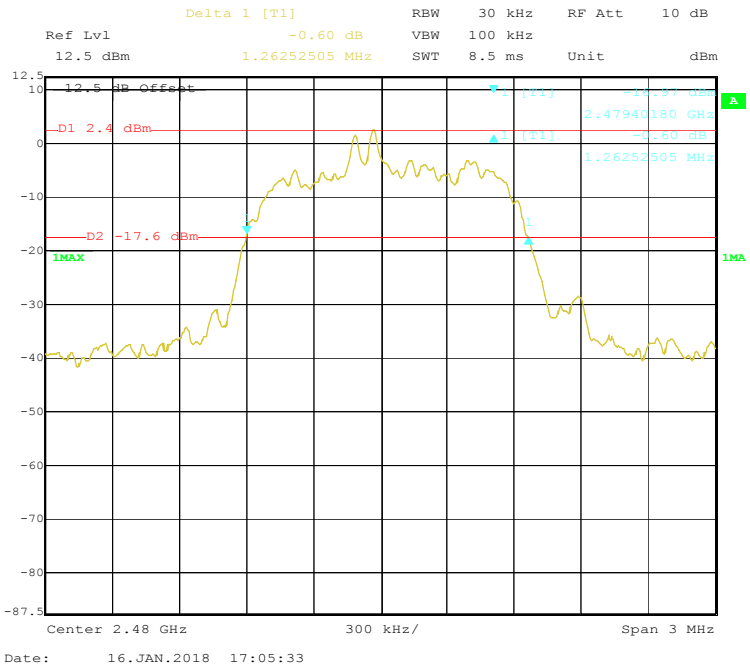
EDR (8-DPSK): Low Channel



EDR (8-DPSK): Middle Channel



EDR (8-DPSK): High Channel



FCC §15.247(a) (1) (iii)-QUANTITY OF HOPPING CHANNEL TEST

Applicable Standard

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 Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.

2. Set the EUT in hopping mode from first channel to last.

3. By using the max-hold function record the quantity of the channel.

Test Data

Environmental Conditions

Temperature:	23.2 ℃
Relative Humidity:	50 %
ATM Pressure:	101.3 kPa

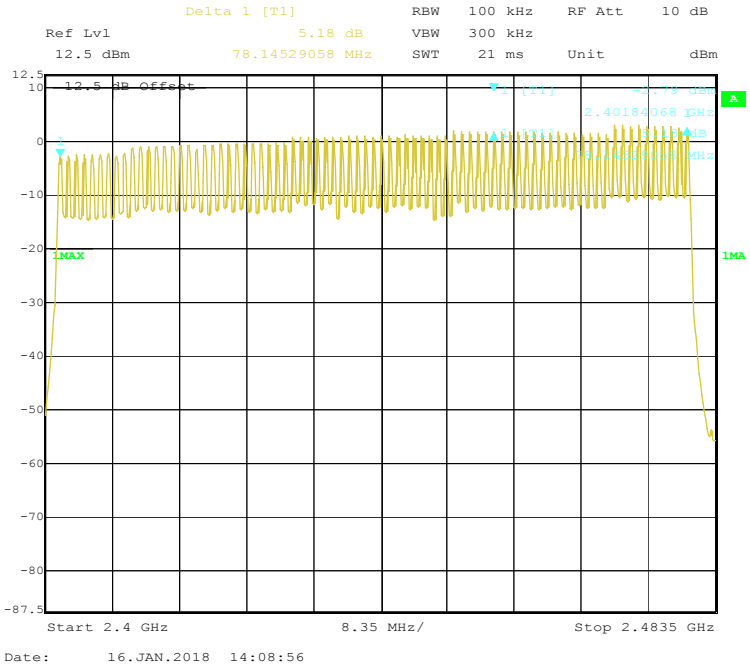
The testing was performed by Chris Wang on 2018-01-16.

EUT operation mode: Hopping

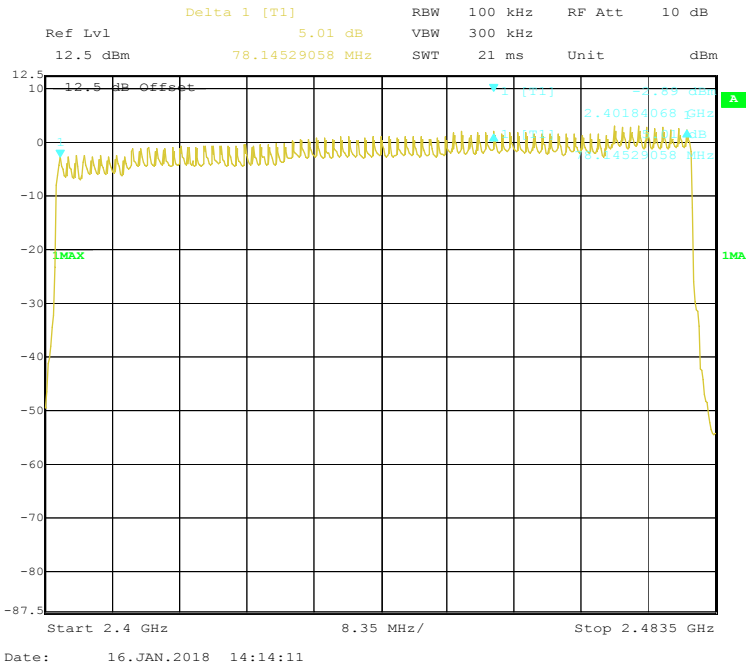
Test Result: Compliance.

Mode	Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
BDR (GFSK)	2400-2483.5	79	⩾15
EDR (π/4-DQPSK)	2400-2483.5	79	⩾15
EDR (8-DPSK)	2400-2483.5	79	⩾15

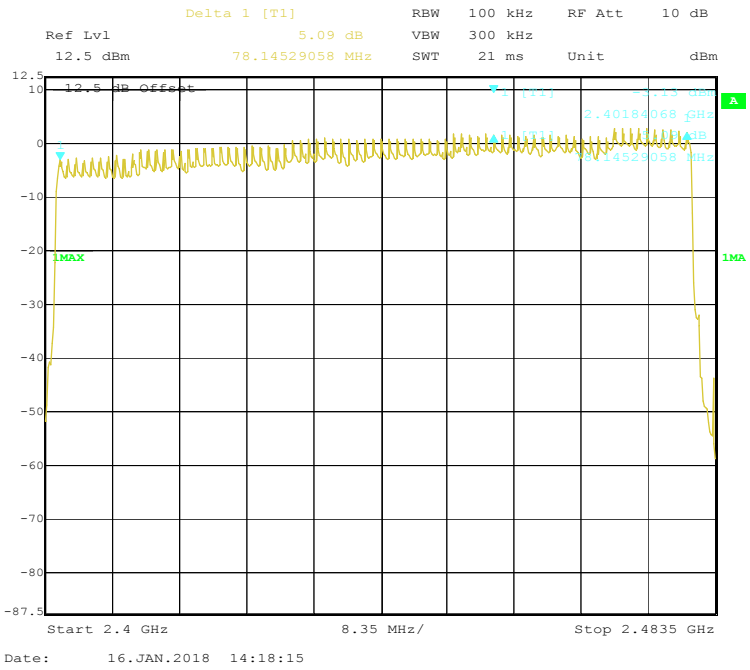
BDR (GFSK): Number of Hopping Channels



EDR (π/4-DQPSK): Number of Hopping Channels



EDR (8-DPSK): Number of Hopping Channels



FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME)

Applicable Standard

Frequency hopping systems in the 2400-2483.5 MHz 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 Procedure

1 Span: Zero span, centered on a hopping channel.
2 RBW shall be ⩽ channel spacing and where possible RBW should be set ⩾ 1 / T, where T is the expected dwell time per channel.
3 Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
4 Detector function: Peak.
5 Trace: Max hold.

Test Data

Environmental Conditions

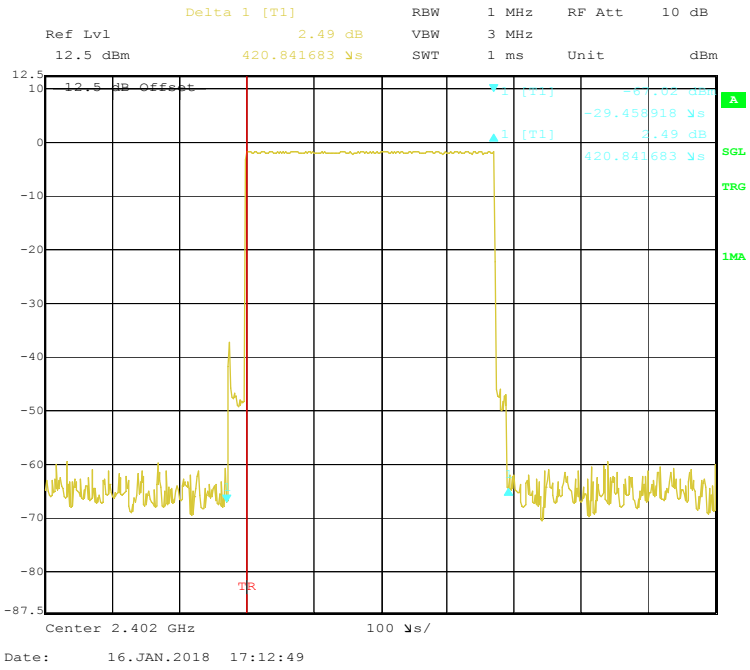
Temperature:	23.4 ℃
Relative Humidity:	51 %
ATM Pressure:	101.2 kPa

The testing was performed by Chris Wang on 2018-01-16.

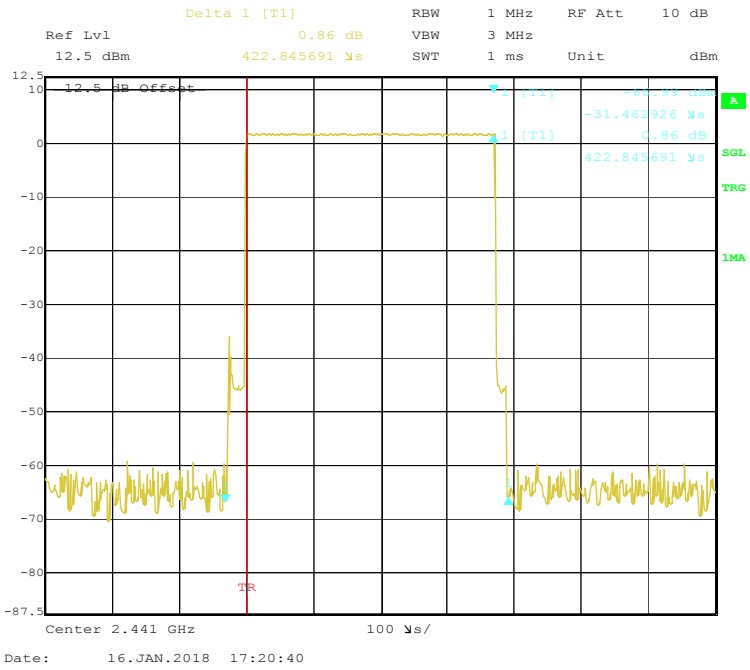
EUT operation mode: Hopping

Mode		Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
BDR (GFSK)	DH1	Low	0.421	0.135	0.4	Pass
		Middle	0.423	0.135	0.4	Pass
		High	0.423	0.135	0.4	Pass
		Note: DH1:Dwell time = Pulse time*(1600/2/79)*31.6S				
	DH3	Low	1.689	0.270	0.4	Pass
		Middle	1.701	0.272	0.4	Pass
		High	1.701	0.272	0.4	Pass
		Note: DH3:Dwell time = Pulse time*(1600/4/79)*31.6S				
	DH5	Low	2.950	0.315	0.4	Pass
		Middle	2.958	0.316	0.4	Pass
		High	2.958	0.316	0.4	Pass
		Note: DH5:Dwell time = Pulse time*(1600/6/79)*31.6S				
EDR (π/4-DQPSK)	2DH1	Low	0.435	0.139	0.4	Pass
		Middle	0.433	0.139	0.4	Pass
		High	0.429	0.137	0.4	Pass
		Note: 2DH1:Dwell time = Pulse time*(1600/2/79)*31.6S				
	2DH3	Low	1.701	0.272	0.4	Pass
		Middle	1.701	0.272	0.4	Pass
		High	1.701	0.272	0.4	Pass
		Note: 2DH3:Dwell time = Pulse time*(1600/4/79)*31.6S				
	2DH5	Low	2.950	0.315	0.4	Pass
		Middle	2.966	0.316	0.4	Pass
		High	2.942	0.314	0.4	Pass
		Note: 2DH5:Dwell time = Pulse time*(1600/6/79)*31.6S				
EDR (8-DPSK)	3DH1	Low	0.431	0.138	0.4	Pass
		Middle	0.433	0.139	0.4	Pass
		High	0.433	0.139	0.4	Pass
		Note:3 DH1:Dwell time = Pulse time*(1600/2/79)*31.6S				
	3DH3	Low	1.701	0.272	0.4	Pass
		Middle	1.689	0.270	0.4	Pass
		High	1.695	0.271	0.4	Pass
		Note: 3DH3:Dwell time = Pulse time*(1600/4/79)*31.6S				
	3DH5	Low	2.950	0.315	0.4	Pass
		Middle	2.958	0.316	0.4	Pass
		High	2.942	0.314	0.4	Pass
		Note: 3DH5:Dwell time = Pulse time*(1600/6/79)*31.6S				

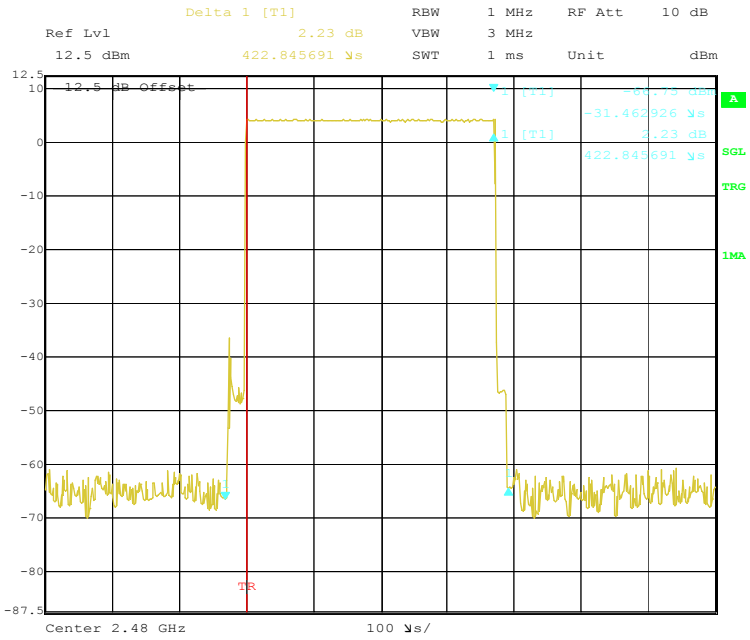
BDR (GFSK): Pulse time, Low Channel, DH1



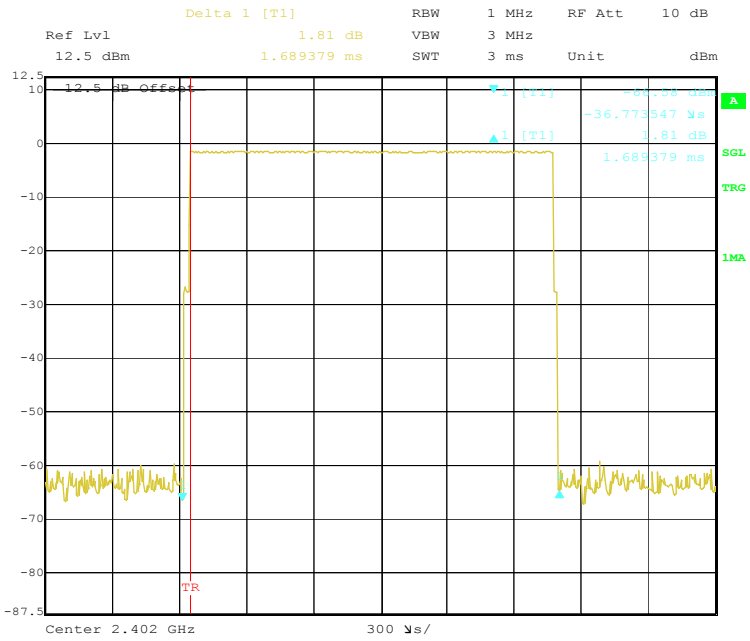
BDR (GFSK): Pulse time, Middle Channel, DH1



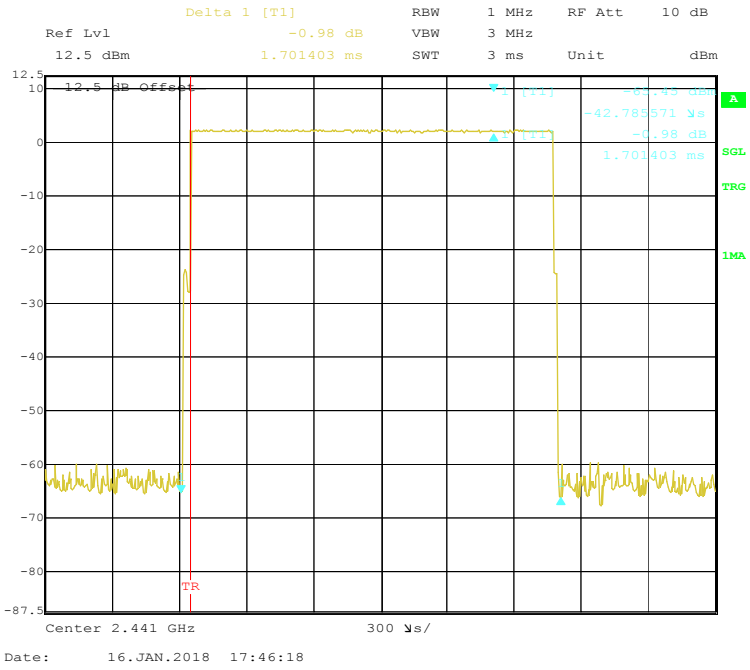
BDR (GFSK): Pulse time, High Channel, DH1



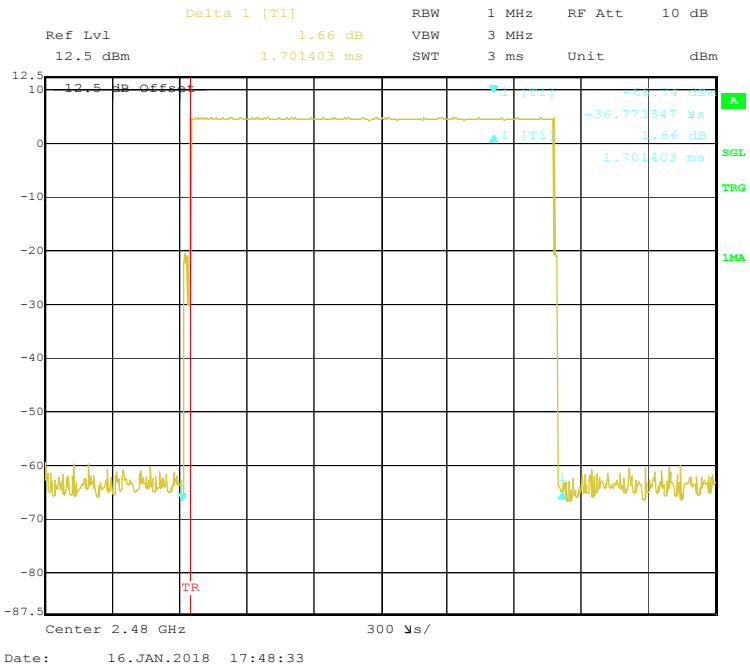
BDR (GFSK): Pulse time, Low Channel, DH3



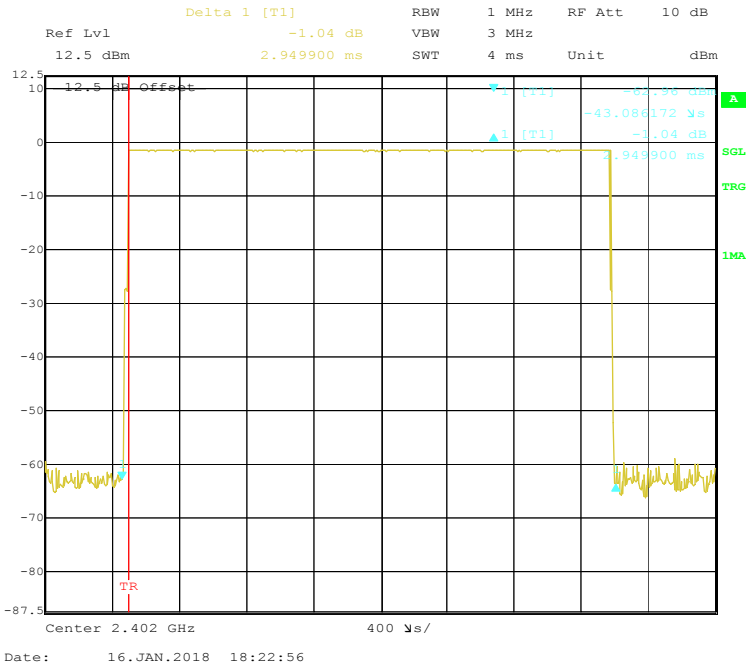
BDR (GFSK): Pulse time, Middle Channel, DH3



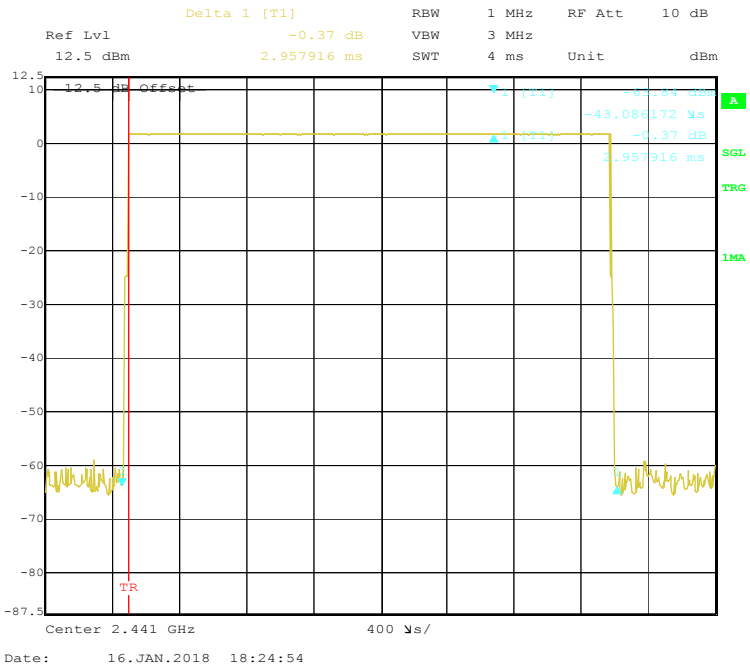
BDR (GFSK): Pulse time, High Channel, DH3



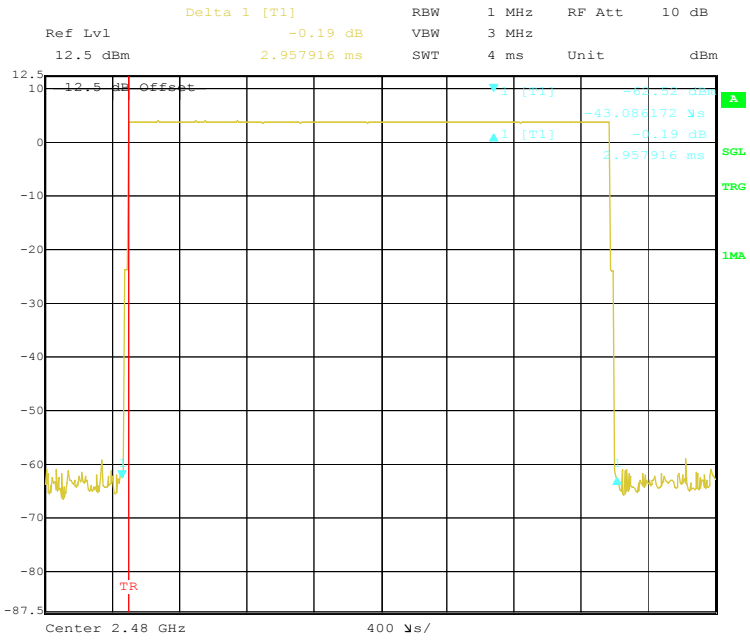
BDR (GFSK): Pulse time, Low Channel, DH5



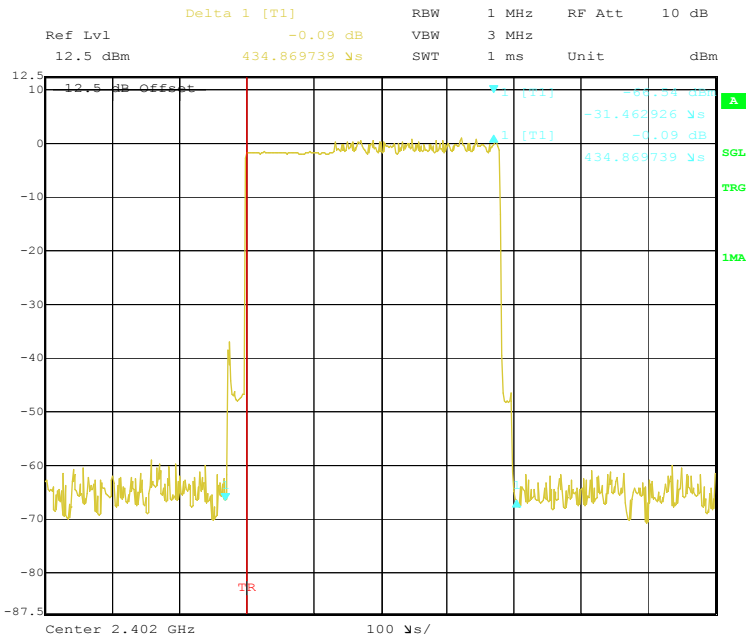
BDR (GFSK): Pulse time, Middle Channel, DH5



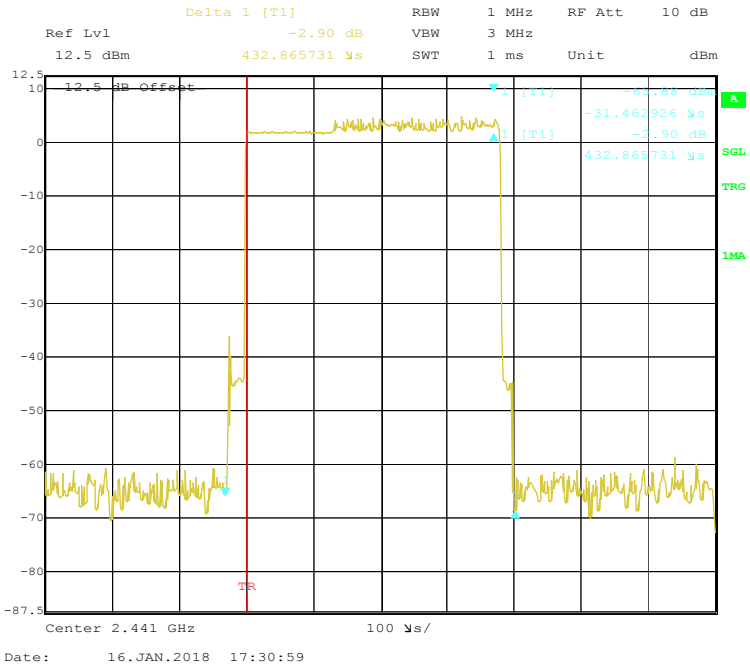
BDR (GFSK): Pulse time, High Channel, DH5



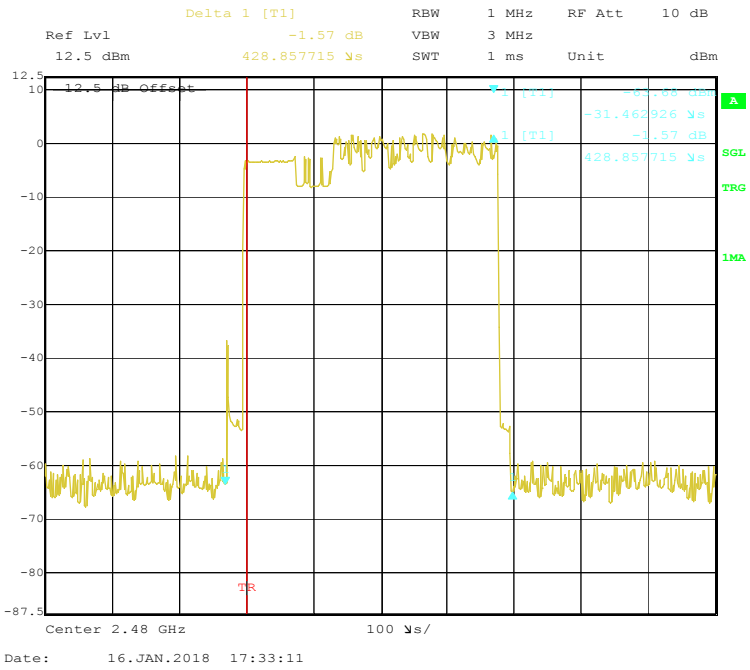
EDR (π/4-DQPSK): Pulse time, Low Channel, 2DH1



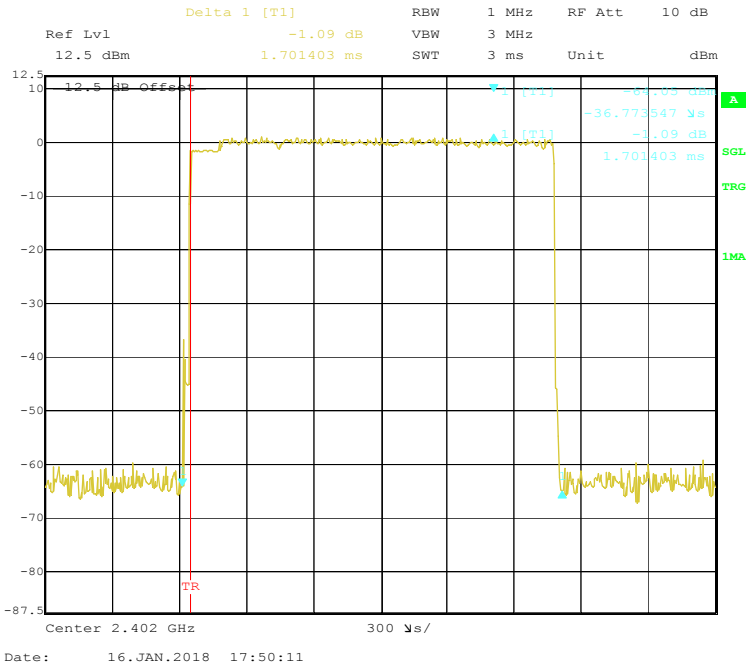
EDR (π/4-DQPSK):Pulse time, Middle Channel, 2DH1



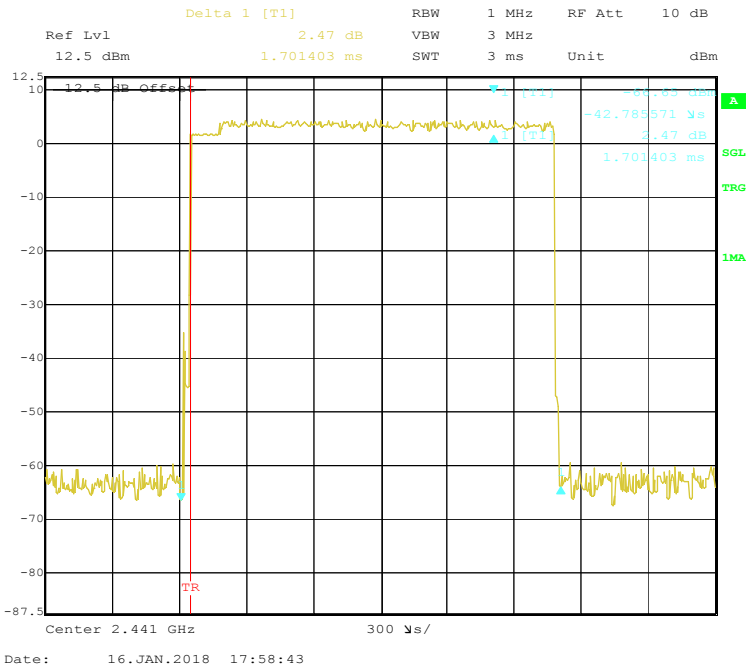
EDR (π/4-DQPSK):Pulse time, High Channel, 2DH1



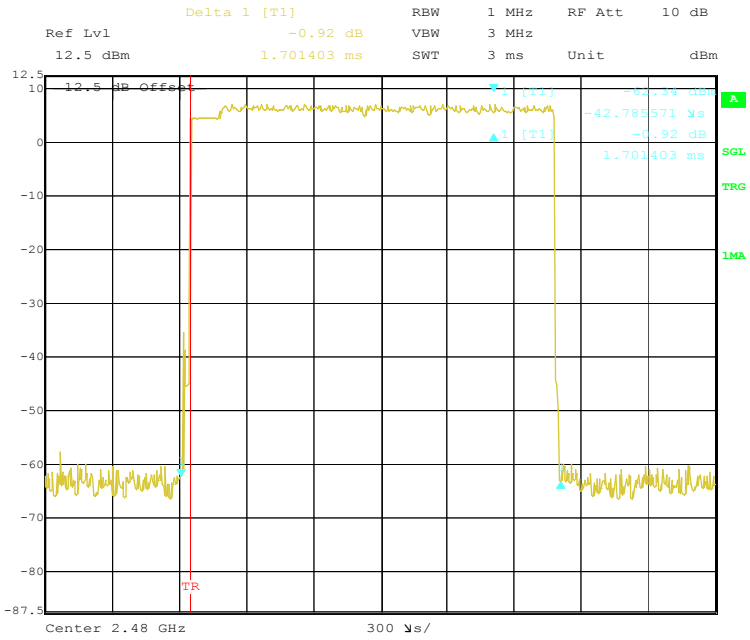
EDR (π/4-DQPSK):Pulse time, Low Channel, 2DH3



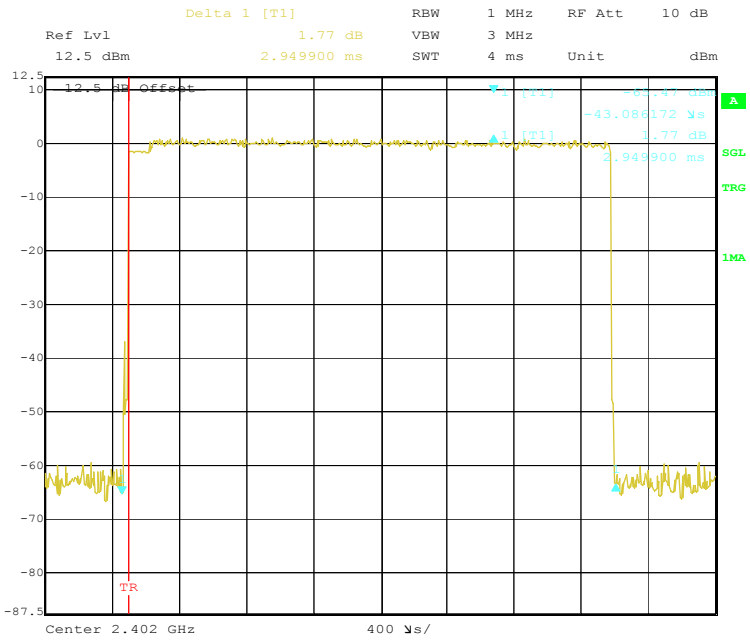
EDR (π/4-DQPSK):Pulse time, Middle Channel, 2DH3



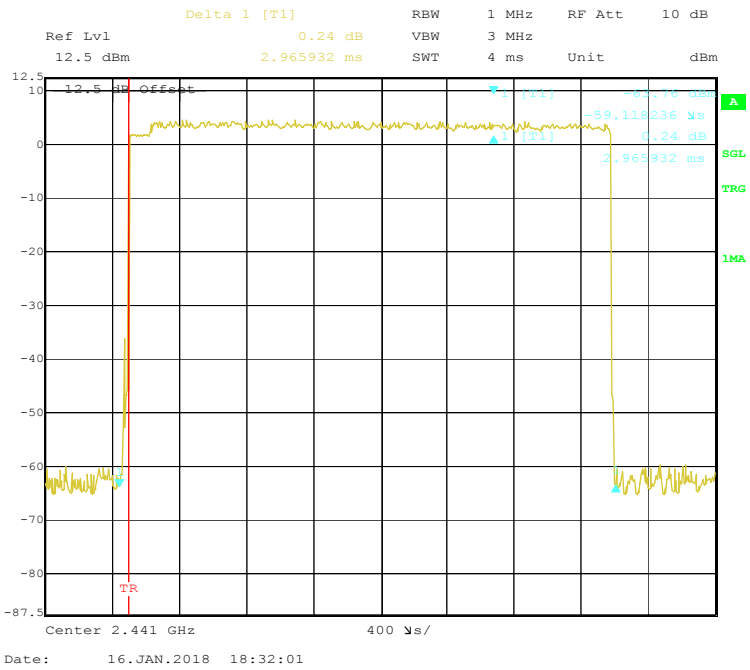
EDR (π/4-DQPSK):Pulse time, High Channel, 2DH3



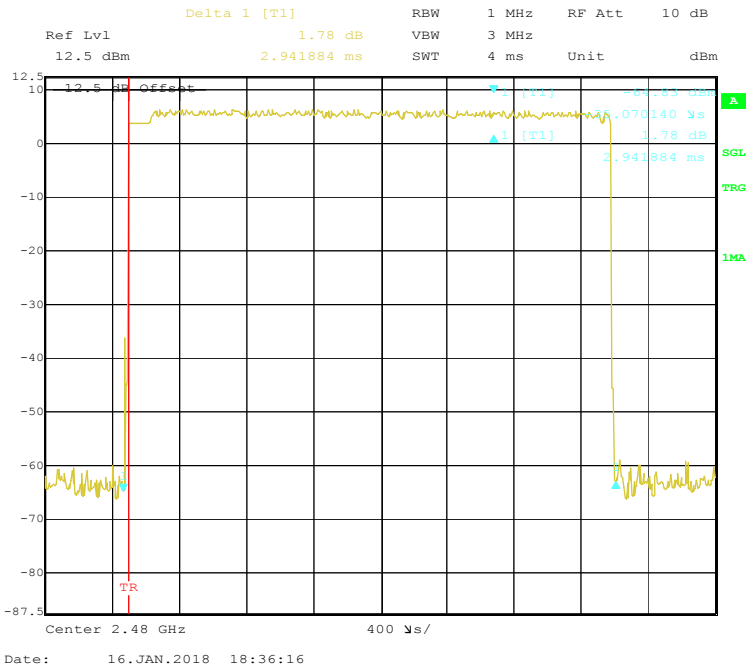
EDR (π/4-DQPSK):Pulse time, Low Channel, 2DH5



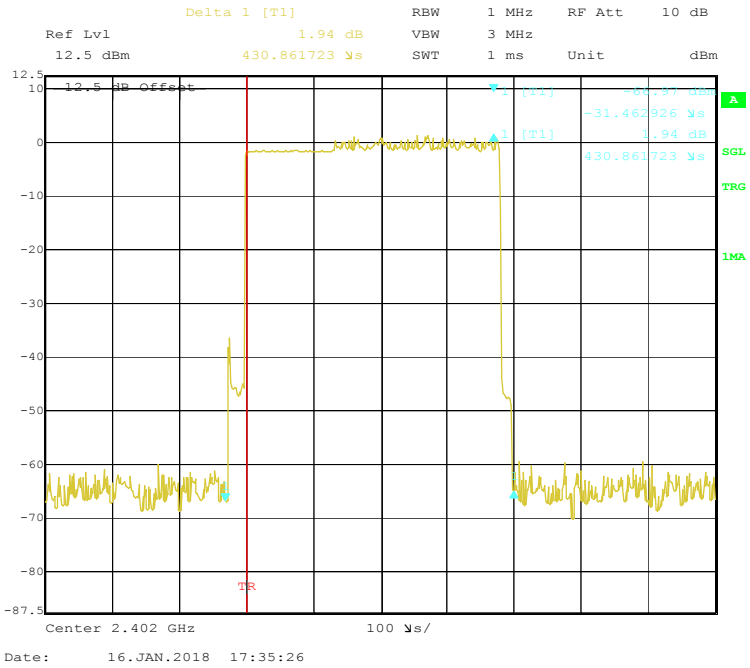
EDR (π/4-DQPSK):Pulse time, Middle Channel, 2DH5



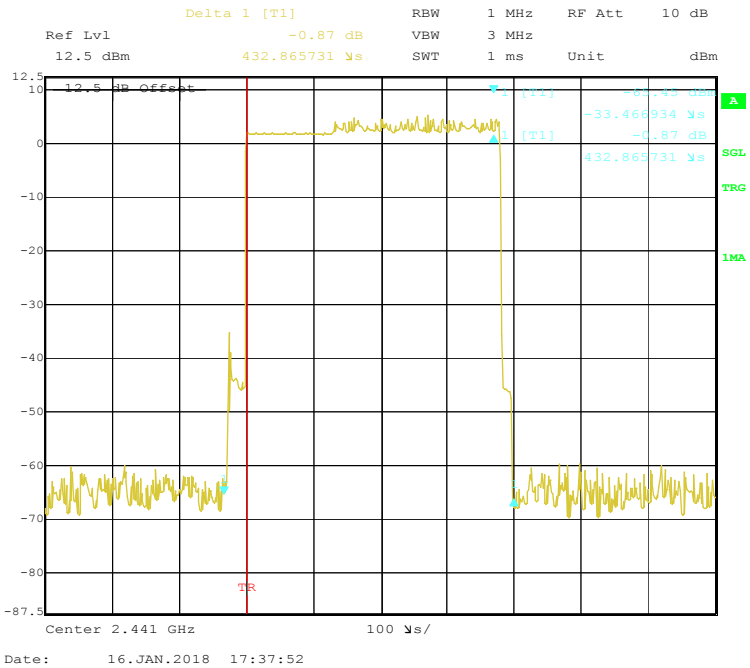
EDR (π/4-DQPSK):Pulse time, High Channel, 2DH5



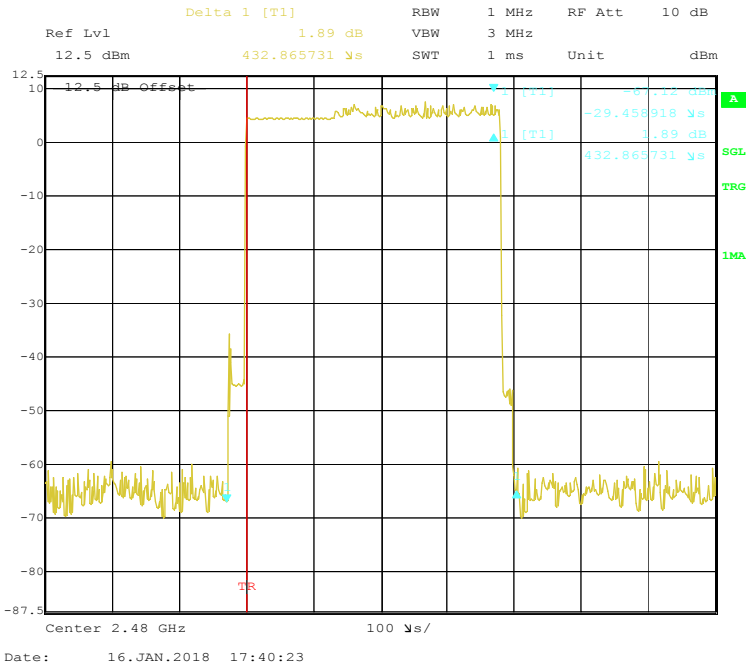
EDR (8-DPSK): Pulse time, Low Channel, 3DH1



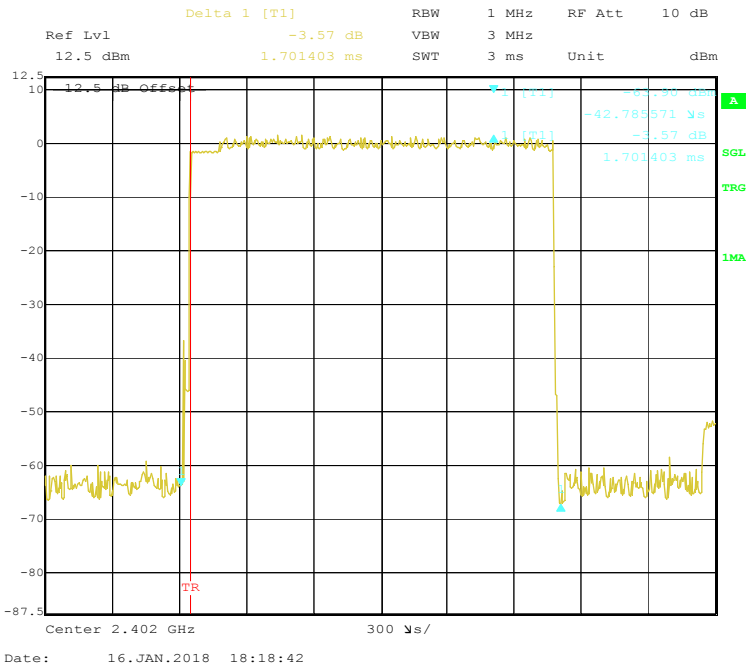
EDR (8-DPSK): Pulse time, Middle Channel, 3DH1



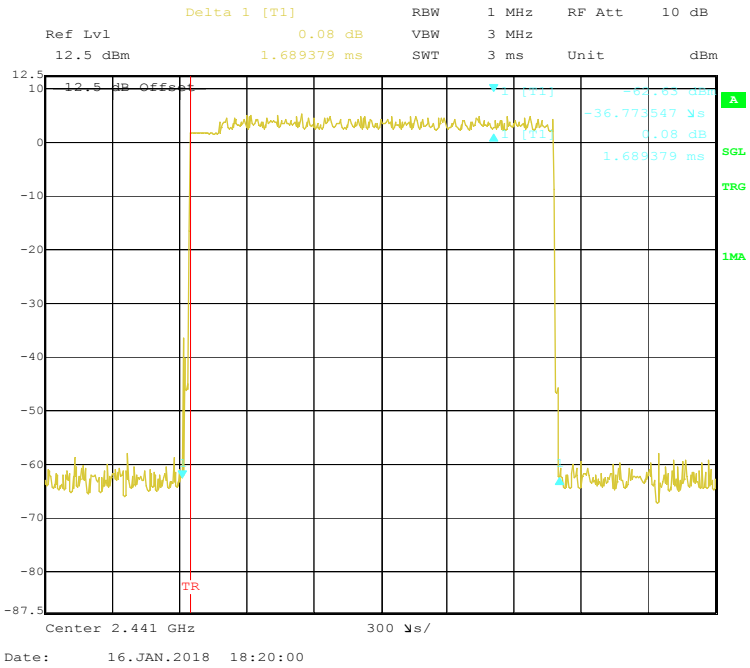
EDR (8-DPSK): Pulse time, High Channel, 3DH1



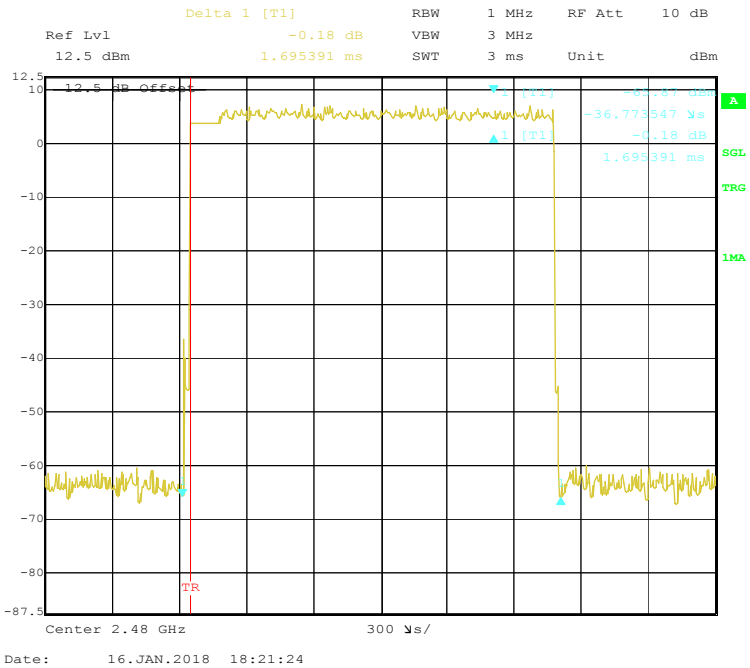
EDR (8-DPSK): Pulse time, Low Channel, 3DH3



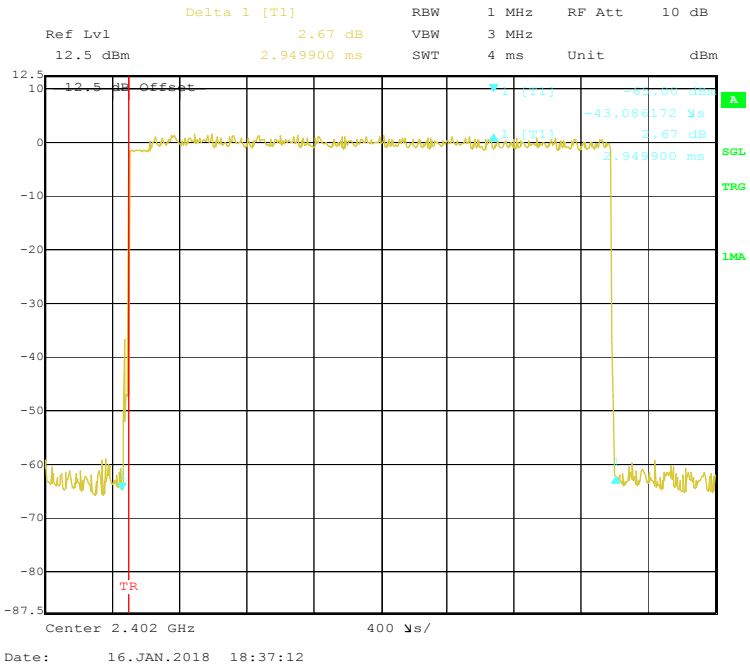
EDR (8-DPSK): Pulse time, Middle Channel, 3DH3



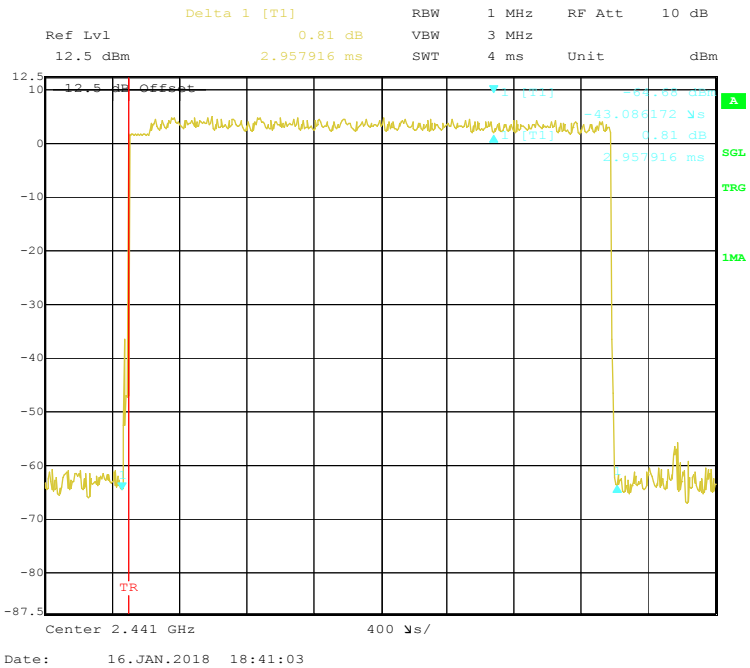
EDR (8-DPSK): Pulse time, High Channel, 3DH3



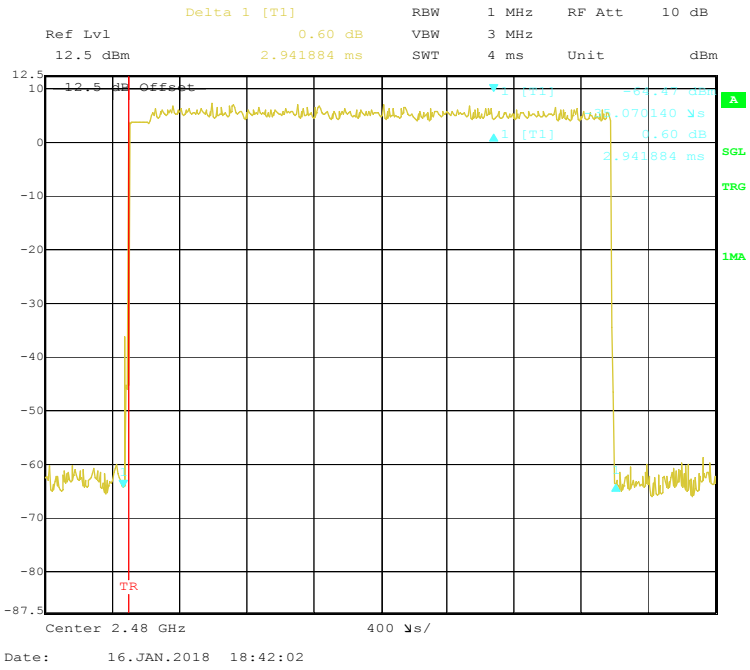
EDR (8-DPSK): Pulse time, Low Channel, 3DH5



EDR (8-DPSK): Pulse time, Middle Channel, 3DH5



EDR (8-DPSK): Pulse time, High Channel, 3DH5



FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT

Applicable Standard

According to §15.247(b) (1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. And for all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

Test Procedure

1. Place the EUT on a bench and set in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.

Test Data

Environmental Conditions

Temperature:	23.2 ℃
Relative Humidity:	50 %
ATM Pressure:	101.2 kPa

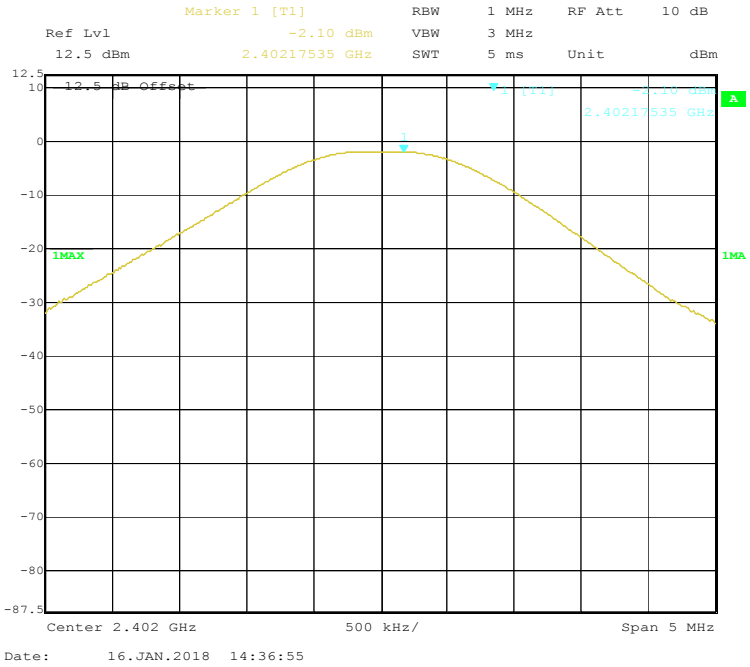
The testing was performed by Chris Wang on 2018-01-16.

EUT operation mode: Transmitting

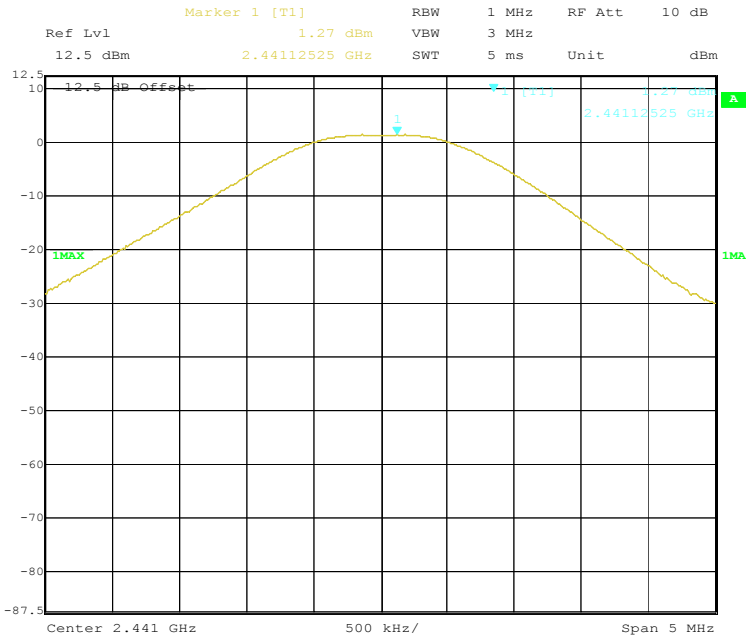
Test Result: Compliance.

Mode	Frequency (MHz)	Output Power		Limit (mW)
		(dBm)	(mW)	
BDR (GFSK)	2402	-2.1	0.62	1000
	2441	1.27	1.34	1000
	2471	3.24	2.11	1000
	2480	2.27	1.69	1000
EDR (π/4-DQPSK)	2402	0.93	1.24	1000
	2441	4.65	2.92	1000
	2475	6.15	4.12	1000
	2480	6.02	4.00	1000
EDR (8-DPSK)	2402	1.43	1.39	1000
	2441	5.15	3.27	1000
	2471	7.06	5.08	1000
	2480	6.27	4.24	1000

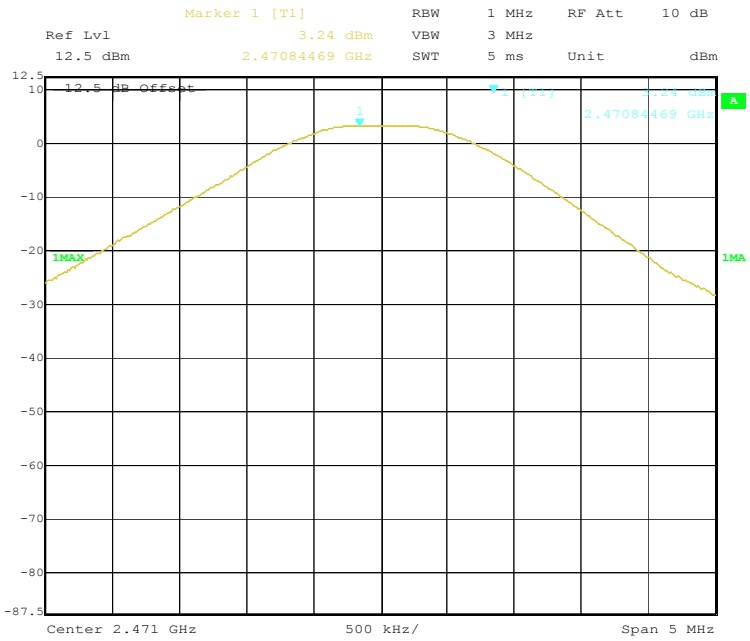
BDR (GFSK): 2402MHz



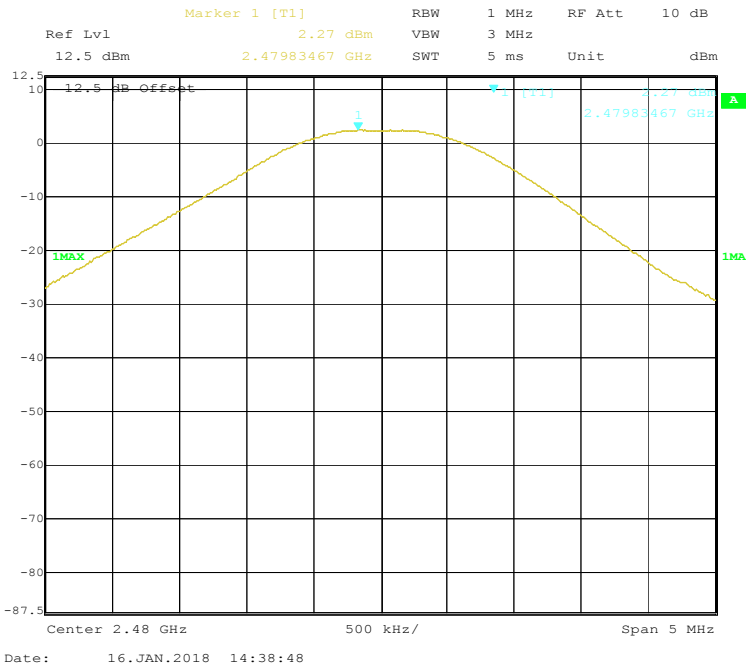
BDR (GFSK): 2441MHz



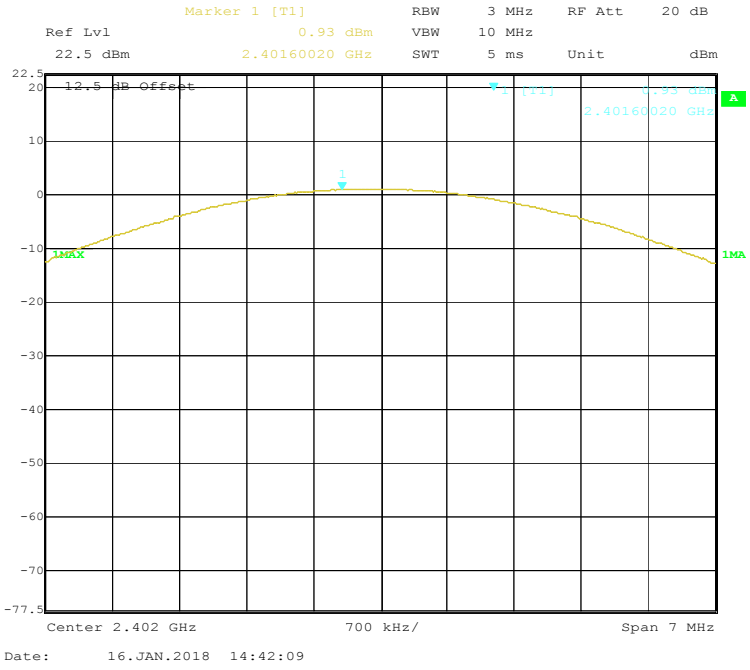
BDR (GFSK): 2471MHz



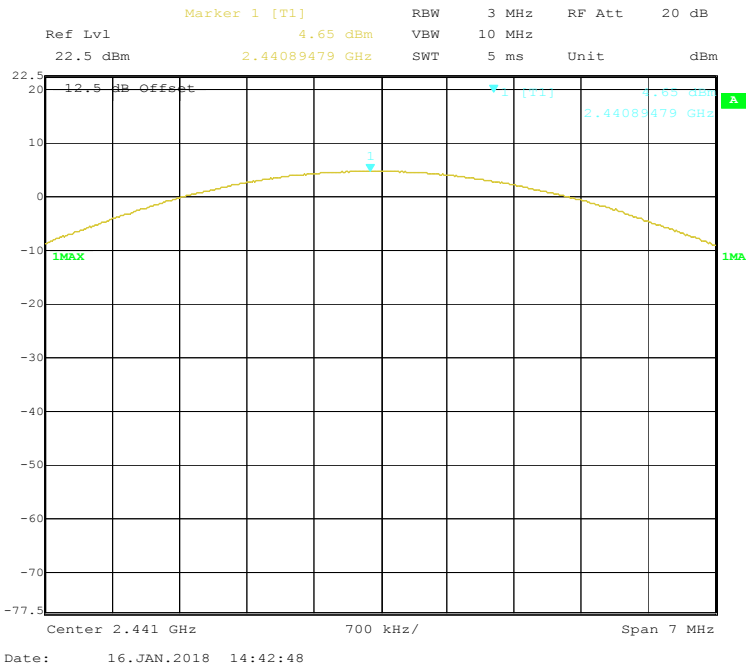
BDR (GFSK): 2480MHz



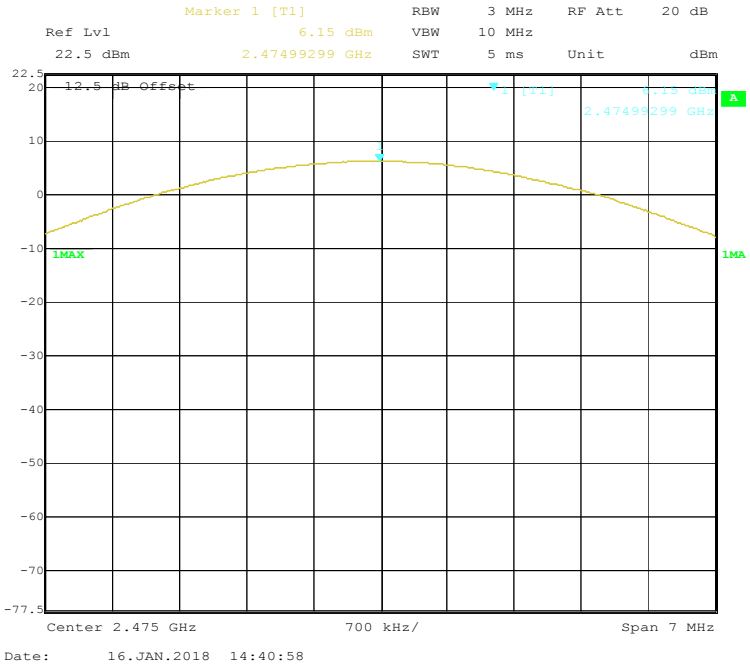
EDR(π/4-DQPSK): 2402MHz



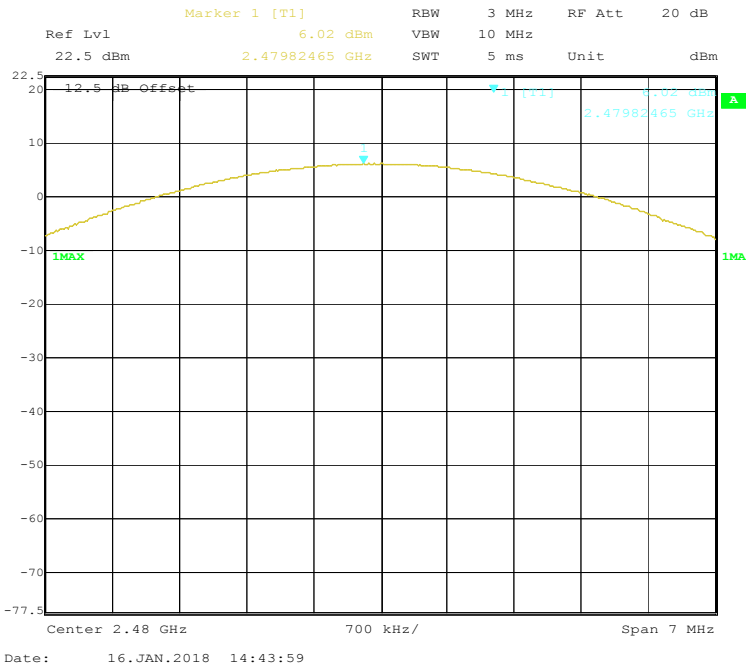
EDR(π/4-DQPSK): 2441MHz



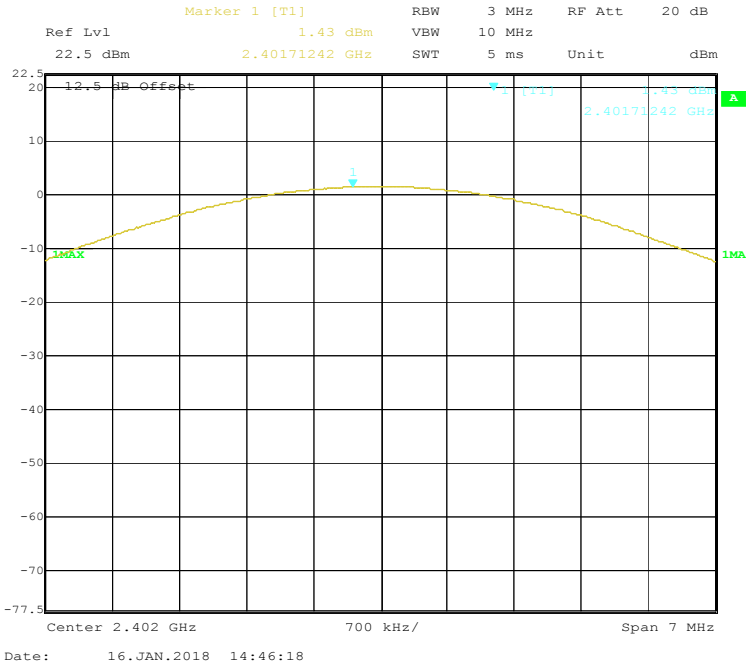
EDR(π/4-DQPSK): 2475MHz



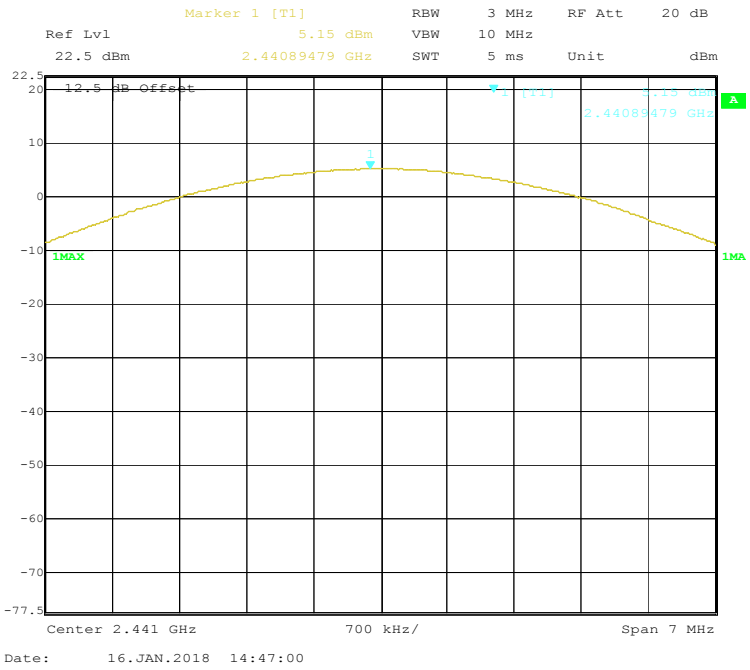
EDR(π/4-DQPSK): 2480MHz



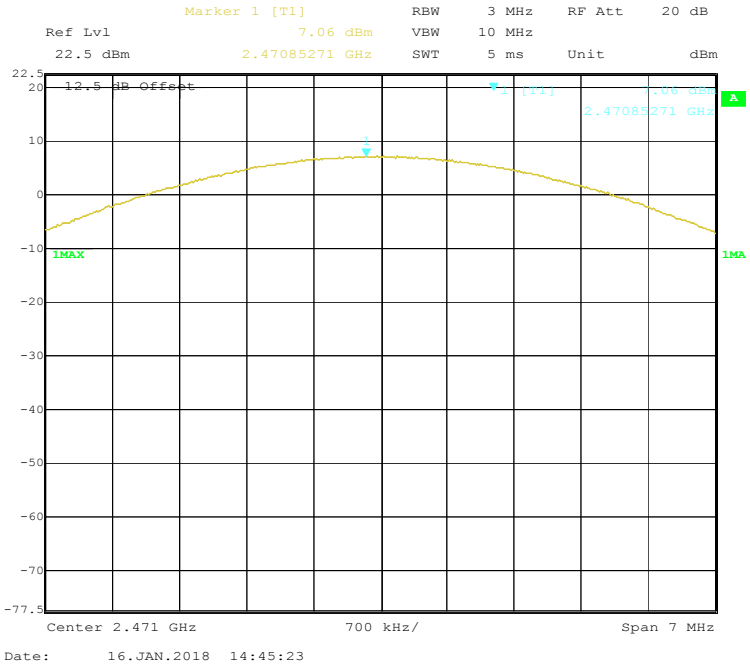
EDR(8-DPSK): 2402MHz



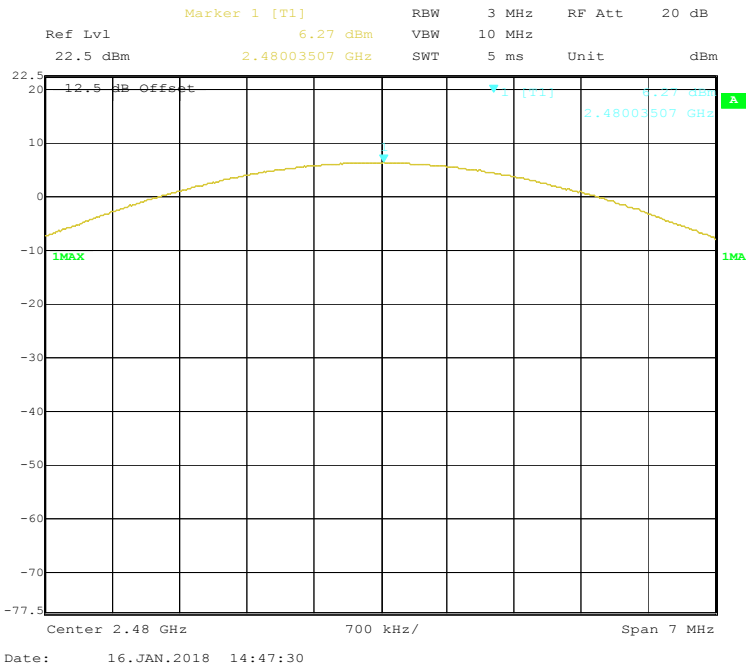
EDR(8-DPSK): 2441MHz



EDR(8-DPSK):2471MHz



EDR(8-DPSK):2480MHz



FCC §15.247(d) - BAND EDGES TESTING

Applicable Standard

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 Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

Test Data

Environmental Conditions

Temperature:	23.2 ℃
Relative Humidity:	50 %
ATM Pressure:	101.3 kPa

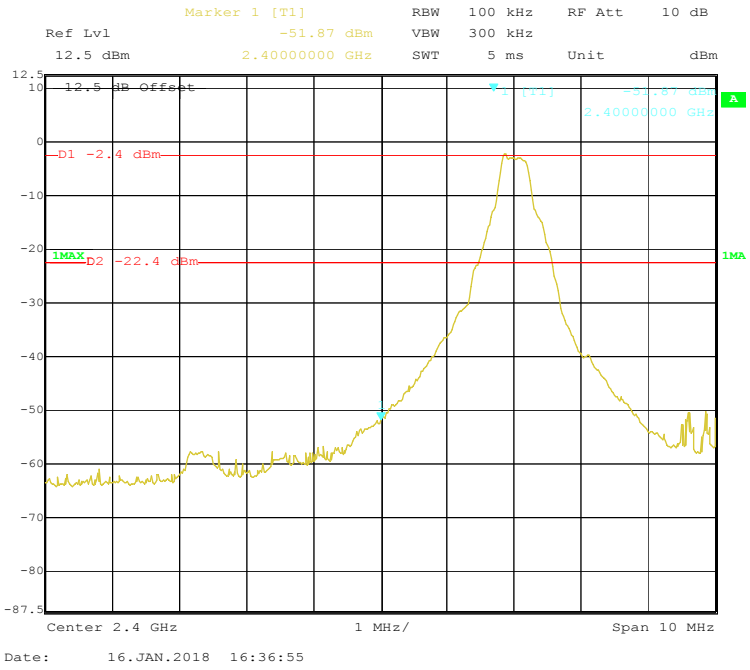
The testing was performed by Chris Wang on 2018-01-16.

EUT operation mode: Transmitting&Hopping

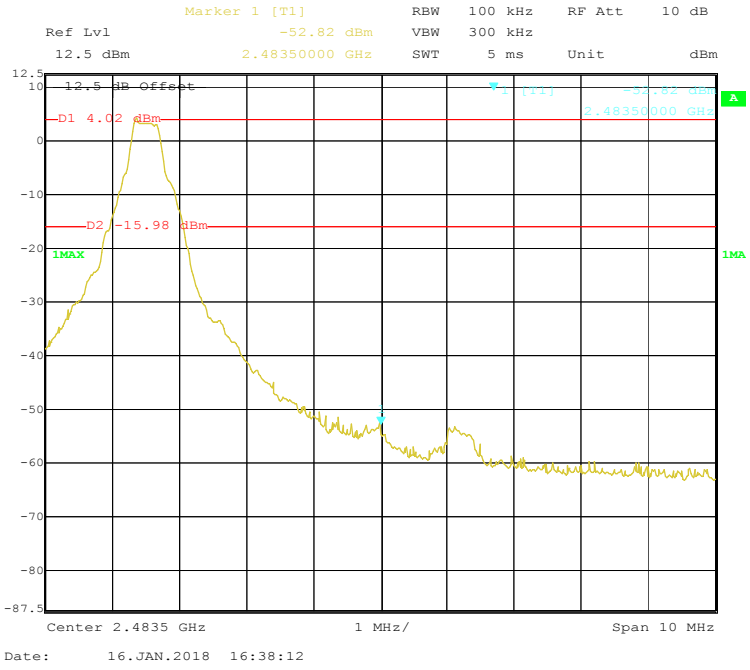
Test Result: Compliance.

Band Edge

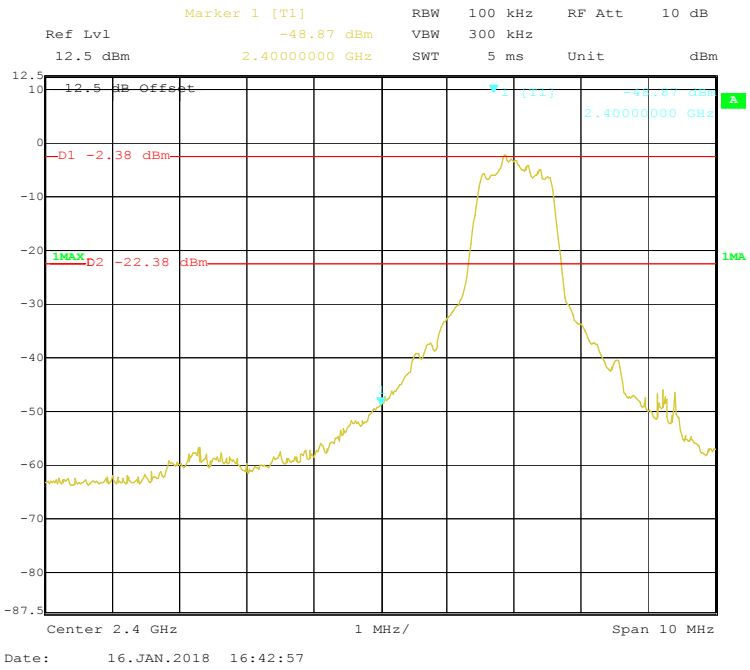
BDR (GFSK): Left Side



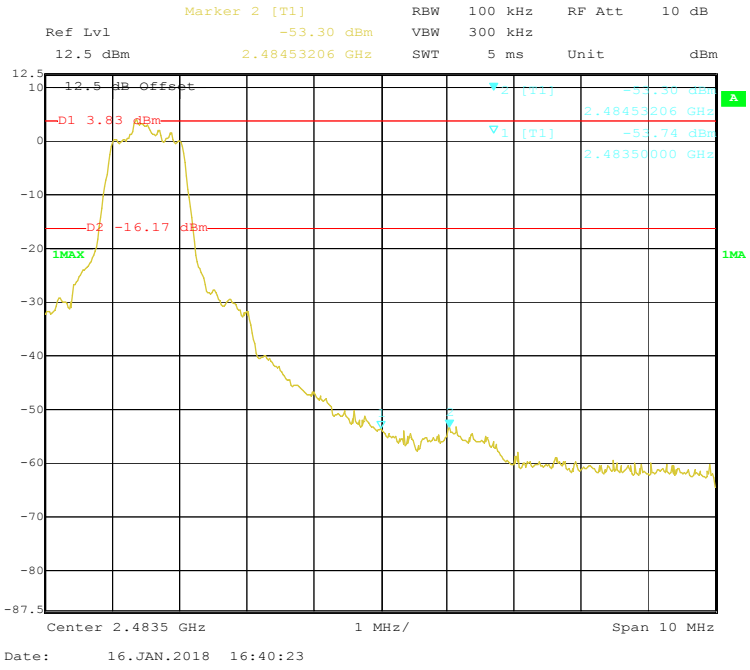
BDR (GFSK): Right Side



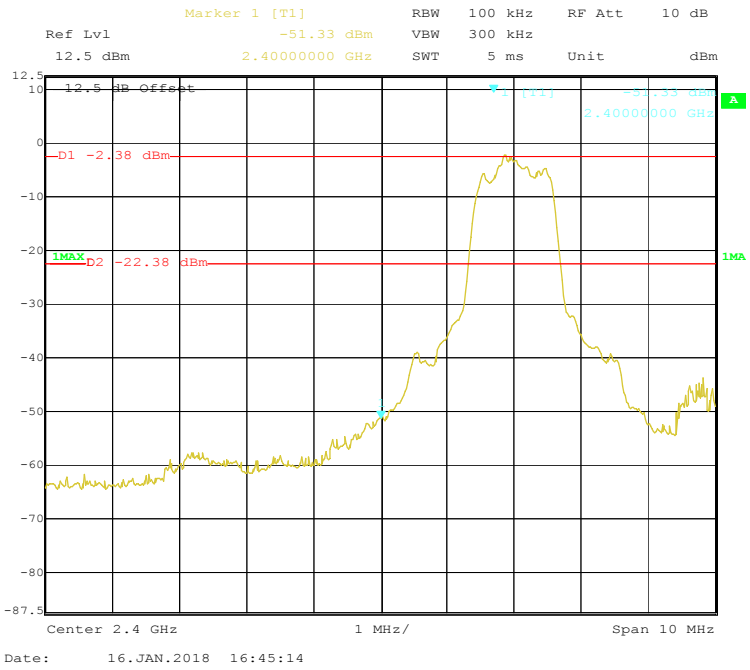
EDR (π/4-DQPSK): Left Side



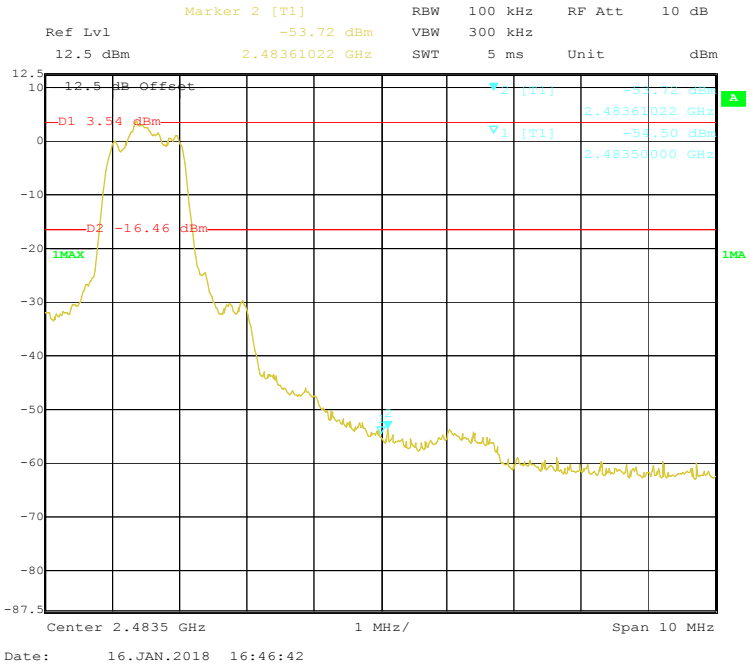
EDR (π/4-DQPSK): Right Side



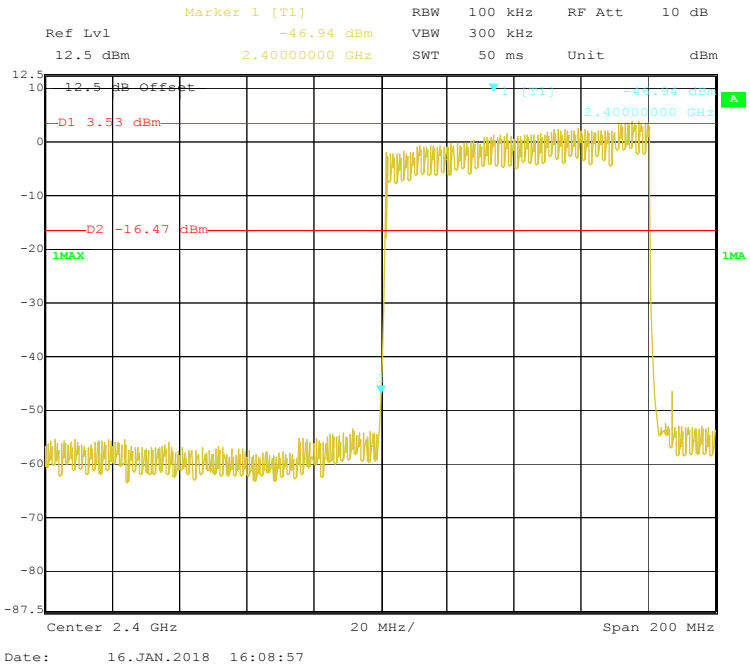
EDR (8-DPSK): Left Side



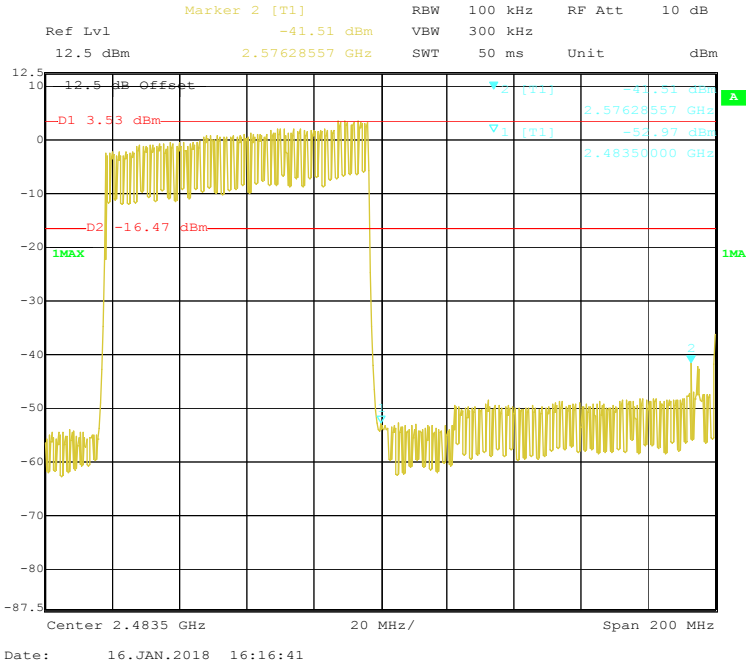
EDR (8-DPSK): Right Side



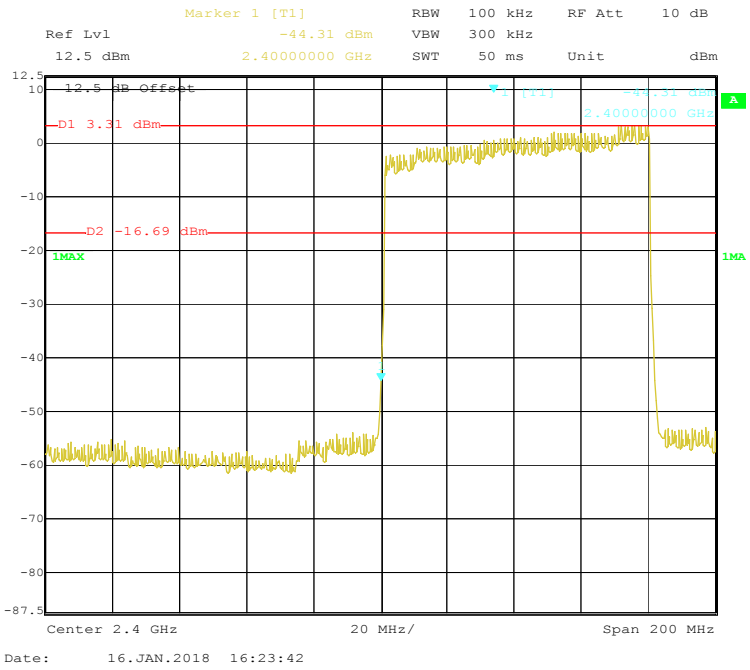
BDR (GFSK): Left Side - Hopping



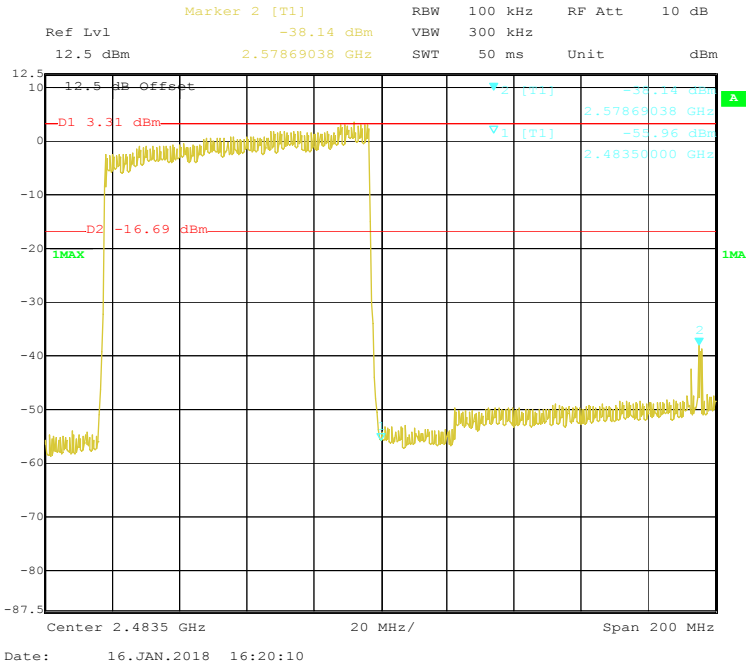
BDR (GFSK): Right Side- Hopping



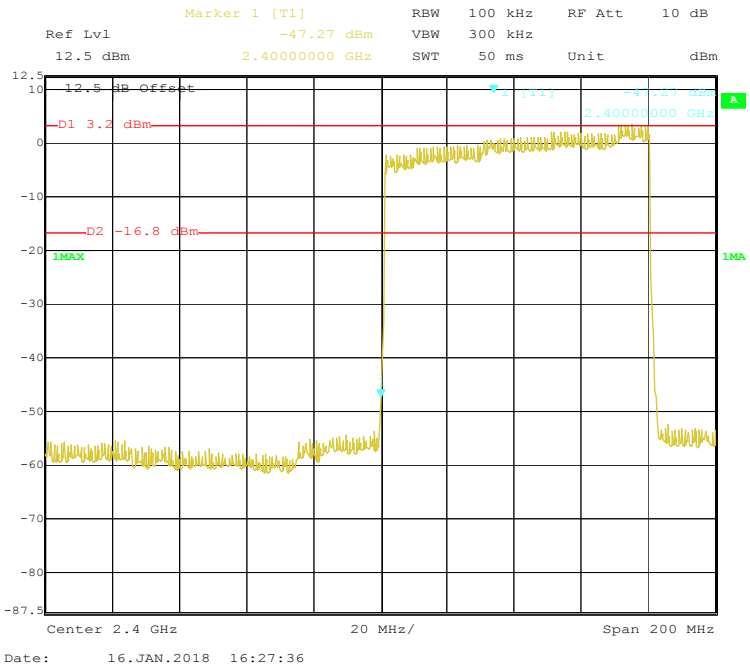
EDR (π/4-DQPSK): Left Side- Hopping



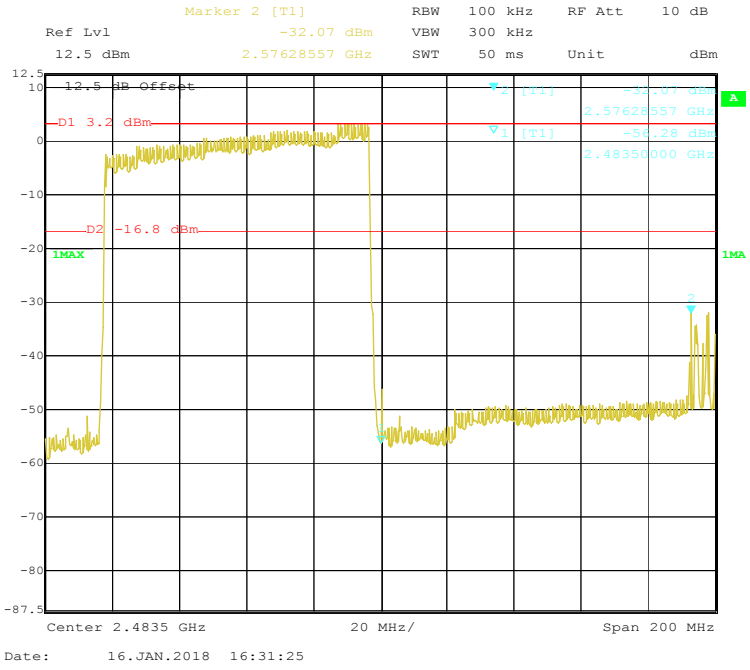
EDR (π/4-DQPSK): Right Side- Hopping



EDR (8-DPSK): Left Side- Hopping



EDR (8-DPSK): Right Side- Hopping



******* END OF REPORT *******