

FCC PART 15.247 TEST REPORT

For

**Qingdao Hisense Intelligent Commercial System Co.,
Ltd.**

399 Songling Road, Laoshan, Qingdao, China

FCC ID: GQK-HK716

Report Type: Original Report	Product Type: All-in-one POS
Test Engineer: Ada Yu <i>Ada Yu</i>	
Report Number: RSHA171211001-00A	
Report Date: 2018-02-11	
Reviewed By:	Oscar Ye <i>Oscar Ye</i> 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	

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Qingdao Hisense Intelligent Commercial System Co., Ltd.
Tested Model	HK716
Product Type	All-in-one POS
Dimension	345 mm (L)* 210 mm (W)*435 mm(H)
Power Supply	DC 24V from adapter

Adapter Information:

Model: FSP090-AAAN2

Input: AC100-240 V 50/60Hz 1.2A

Output: 24V, 3.75A

**All measurement and test data in this report was gathered from production sample serial number: 20171211001.
(Assigned by the BACL. The EUT supplied by the applicant was received on 2017-12-11)*

Objective

This test report is prepared on behalf of Qingdao Hisense Intelligent Commercial System 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 and Part 15.225 DXX submissions with FCC ID: GQK-HK716.

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: RtkWiFiTest-v2.0.4

GFSK Power level: 5

π /4-DQPSK Power level: 5

8DPSK Power level: 5

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

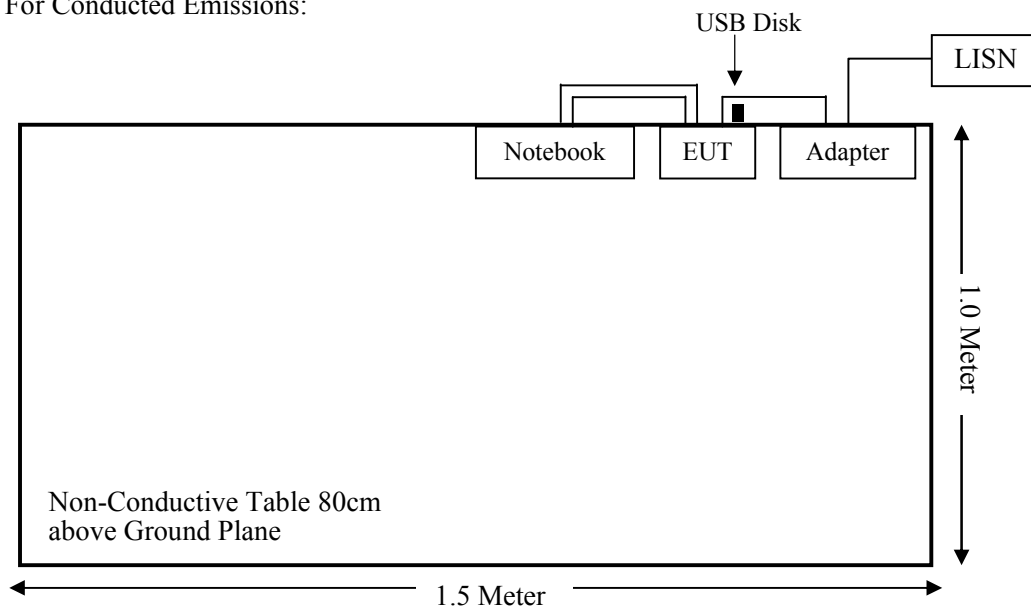
Manufacturer	Description	Model	Serial Number
San Disk	USB Disk	SDCZ36	/

External I/O Cable

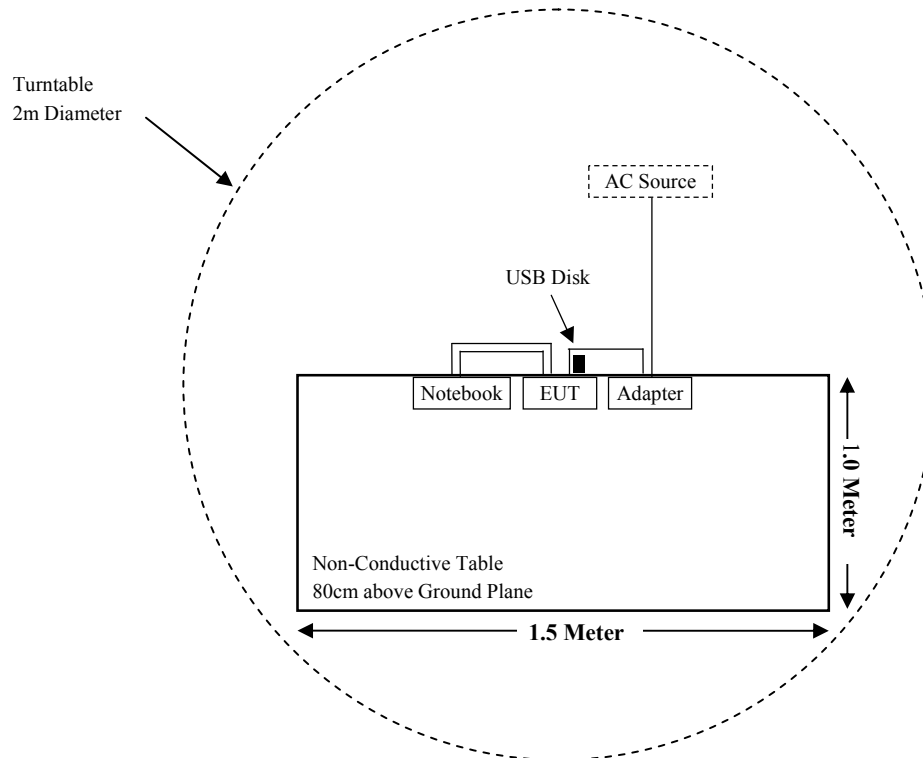
Cable Description	Shielding Type	Length (m)	From Port	To
RJ45 Cable	Un-shielding	1.0	EUT	Notebook
RS232 to USB Cable	Un-shielding	1.2	EUT	Notebook

Block Diagram of Test Setup

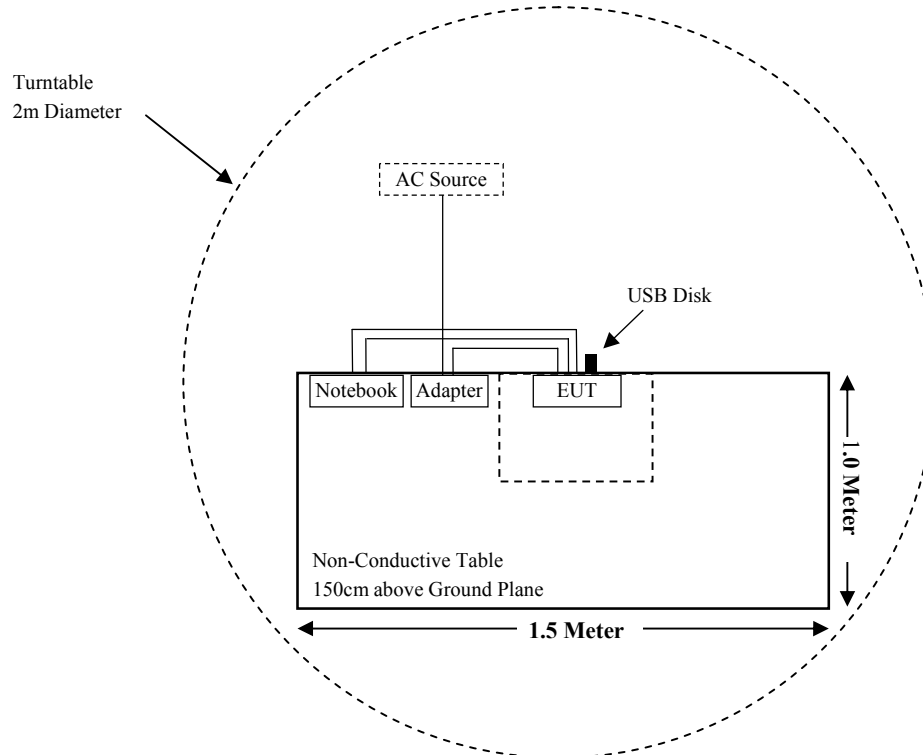
For Conducted Emissions:



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 & §2.1091	MAXIMUM PERMISSIBLE EXPOSURE (MPE)	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 Instrument	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	/	2017-08-15	2018-08-14
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/6dB	10690812-2	26850-6	2018-01-10	2019-01-09
Qingdao Hisense	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	2018-01-10	2019-01-09
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 §1.1307 (b) (1) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)**Applicable Standard**

According to subpart 15.247 (i) and subpart 1.1307 (b)(1), 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500	/		f/1500	30
1500-100,000	/		1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density

Calculated Formulary:

Predication of MPE limit at a given distance

$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm²);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

Calculated Data:

Mode	Frequency Range (MHz)	Antenna Gain		Target Output Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
BT3.0	2402-2480	5.00	3.16	5.50	3.55	20	0.0022	1

Note:

(1) The target output power was declared by the manufacturer.

(2) Wi-Fi and BT cannot transmit simultaneously

Result: The device meet FCC MPE at 20 cm distance.

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 PIFA antenna for Bluetooth, which the antenna gain is 5dBi, fulfill the requirement of this section. Please refer to the EUT photos.

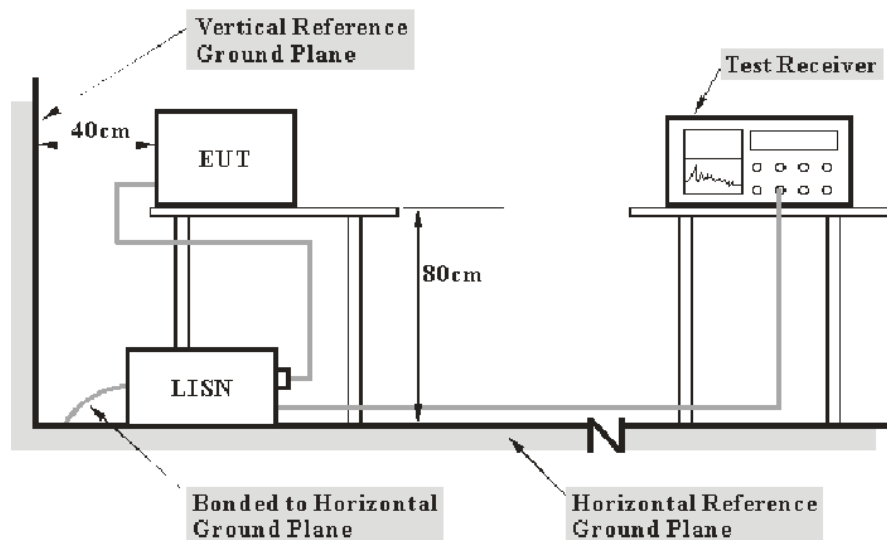
Result: Compliance.

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:

$$\text{Corrected Factor} = \text{LISN VDF} + \text{Cable Loss} + \text{Transient Limiter Attenuation}$$

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:

$$\text{Margin} = \text{Limit} - \text{Reading}$$

Test Results Summary

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

Test Data

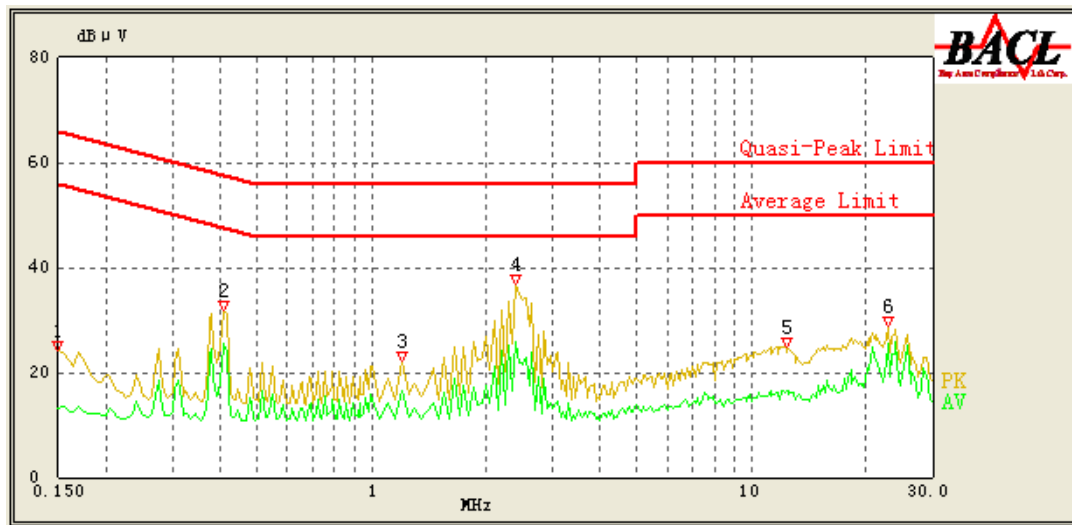
Environmental Conditions

Temperature:	23.4 °C
Relative Humidity:	49 %
ATM Pressure:	101.1 kPa

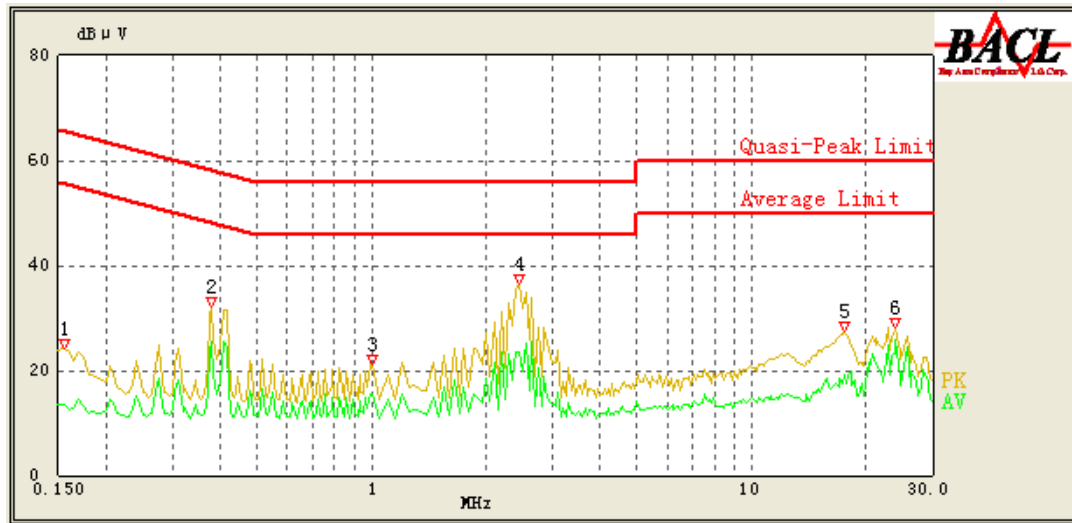
The testing was performed by Ada Yu on 2018-01-16.

EUT operation mode: Transmitting in low channel of 8DPSK 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	24.19	QP	9.000	L1	16.06	66.00	41.81	Compliance
0.150	13.15	AV	9.000	L1	16.06	56.00	42.85	Compliance
0.410	31.92	QP	9.000	L1	16.06	58.57	26.65	Compliance
0.410	25.66	AV	9.000	L1	16.06	48.57	22.91	Compliance
1.200	22.15	QP	9.000	L1	15.87	56.00	33.85	Compliance
1.200	16.63	AV	9.000	L1	15.87	46.00	29.37	Compliance
2.400	36.96	QP	9.000	L1	15.85	56.00	19.04	Compliance
2.400	25.97	AV	9.000	L1	15.85	46.00	20.03	Compliance
12.350	24.89	QP	9.000	L1	16.13	60.00	35.11	Compliance
12.300	16.09	AV	9.000	L1	16.13	50.00	33.91	Compliance
22.900	28.67	QP	9.000	L1	16.45	60.00	31.33	Compliance
22.900	25.61	AV	9.000	L1	16.45	50.00	24.39	Compliance

AC 120V/60 Hz, Neutral

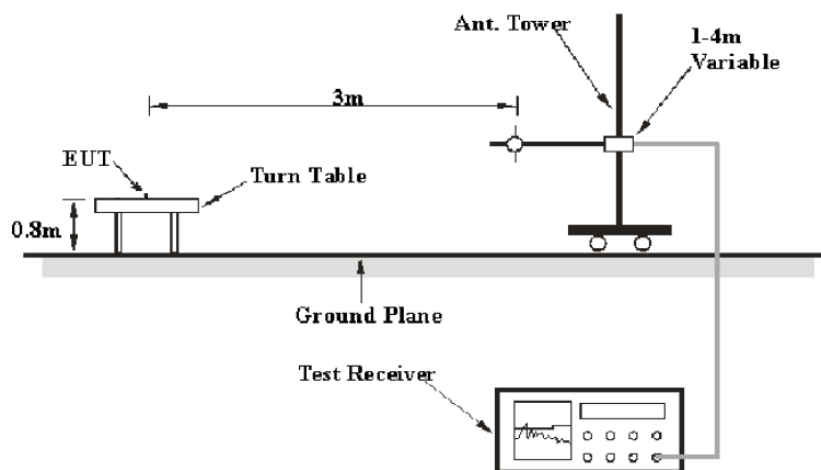
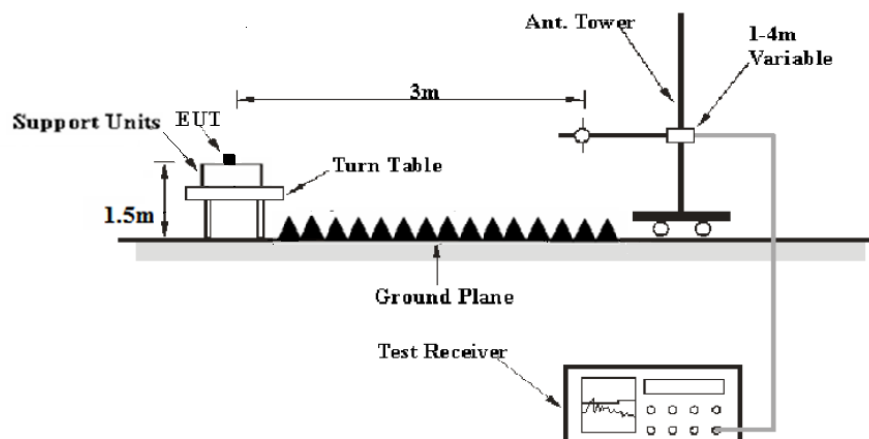
Frequency (MHz)	Reading (dBμV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Limit (dBμV)	Margin (dB)	Comment
0.155	24.10	QP	9.000	N	16.06	65.86	41.76	Compliance
0.155	13.49	AV	9.000	N	16.06	55.86	42.37	Compliance
0.380	32.02	QP	9.000	N	16.09	59.43	27.41	Compliance
0.380	25.44	AV	9.000	N	16.09	49.43	23.99	Compliance
1.000	21.19	QP	9.000	N	15.94	56.00	34.81	Compliance
1.000	15.40	AV	9.000	N	15.94	46.00	30.60	Compliance
2.450	36.38	QP	9.000	N	15.90	56.00	19.62	Compliance
2.450	23.38	AV	9.000	N	15.90	46.00	22.62	Compliance
17.500	27.39	QP	9.000	N	16.08	60.00	32.61	Compliance
17.500	19.26	AV	9.000	N	16.08	50.00	30.74	Compliance
24.000	28.15	QP	9.000	N	16.22	60.00	31.85	Compliance
24.000	25.85	AV	9.000	N	16.22	50.00	24.15	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:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

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**

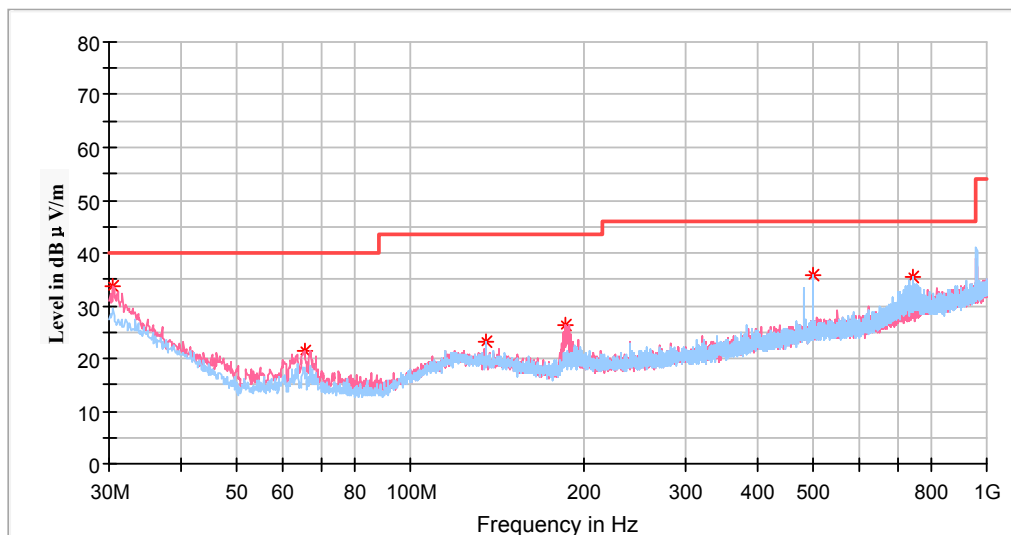
Temperature:	23.4 °C
Relative Humidity:	49 %
ATM Pressure:	101.1 kPa

The testing was performed by Ada Yu on 2018-01-16 & 2018-02-01.

EUT operation mode: Transmitting

Spurious Emission Test:**30MHz-1GHz:**

Pre-Scan with GFSK, $\pi/4$ -DQPSK, 8DPSK modes of operation in the X,Y and Z axes of orientation, the worst case **8DPSK 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)
	Quasi-peak (dBμV/m)	Height (cm)	Polar (H/V)				
30.485000	33.63	200.0	V	0.0	-4.7	40.00	6.37
65.405000	21.42	100.0	V	35.0	-18.0	40.00	18.58
135.002500	23.18	100.0	H	0.0	-12.2	43.50	20.32
185.685000	26.44	100.0	V	161.0	-13.7	43.50	17.06
499.965000	35.64	200.0	H	157.0	-6.1	46.00	10.36
746.466250	35.56	100.0	H	218.0	-2.3	46.00	10.44

1GHz-18GHz:

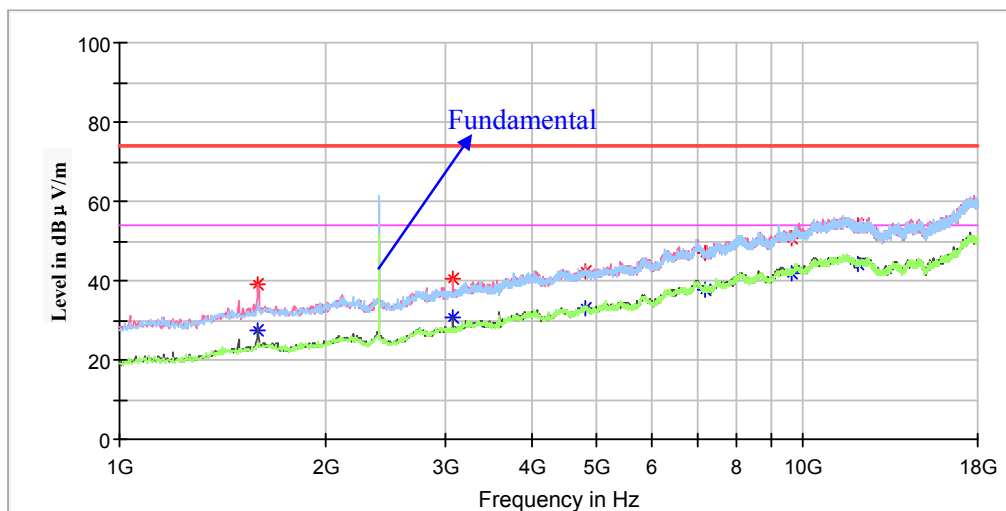
Pre-Scan with GFSK, $\pi/4$ -DQPSK, 8DPSK modes of operation in the X,Y and Z axes of orientation, the worst case 8DPSK Mode in X-axis of orientation was recorded

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

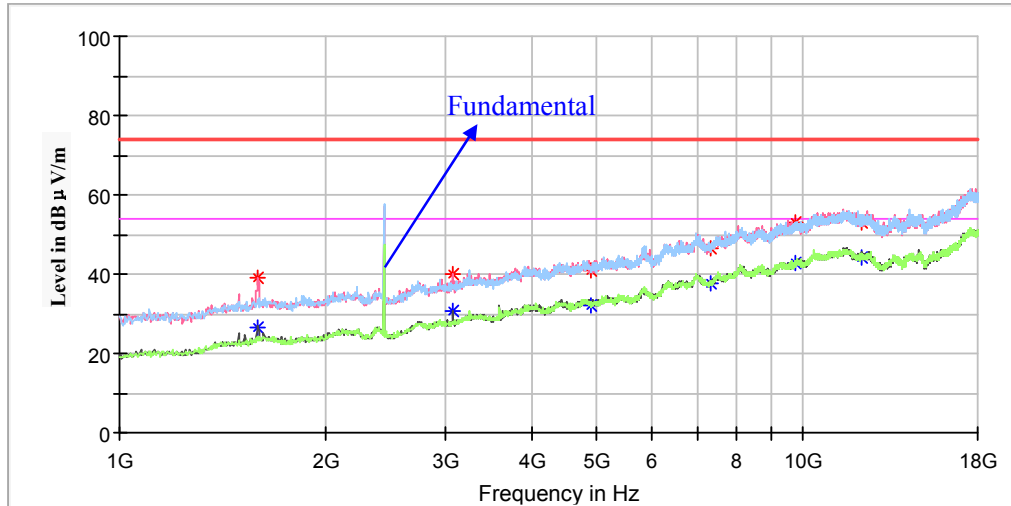
Full Spectrum



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)				
1595.000000	39.01	---	200.0	V	351.0	-7.6	74.00	34.99
1595.000000	---	27.58	200.0	V	351.0	-7.6	54.00	26.42
3070.600000	40.50	---	200.0	V	35.0	-1.9	74.00	33.50
3070.600000	---	30.48	200.0	V	35.0	-1.9	54.00	23.52
4804.000000	---	32.98	250.0	V	223.0	2.5	54.00	21.02
4804.000000	42.45	---	250.0	V	223.0	2.5	74.00	31.55
7206.000000	---	37.88	250.0	V	145.0	9.8	54.00	16.12
7206.000000	47.07	---	250.0	V	145.0	9.8	74.00	26.93
9608.800000	---	41.93	150.0	V	347.0	14.9	54.00	12.07
9608.800000	50.72	---	150.0	V	347.0	14.9	74.00	23.28
12012.600000	---	44.32	100.0	H	47.0	16.5	54.00	9.68
12012.600000	53.84	---	100.0	H	47.0	16.5	74.00	20.16

Middle Channel: 2441MHz

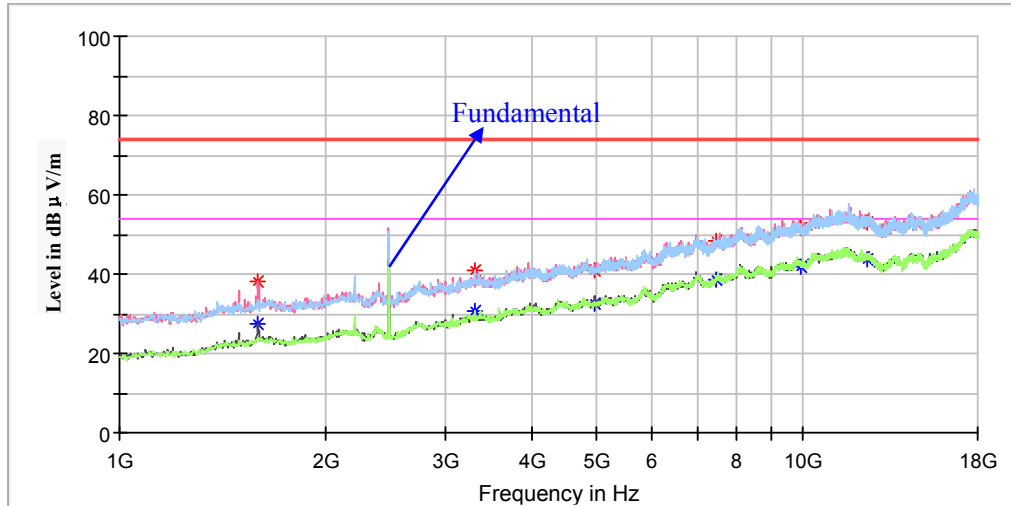
Full Spectrum



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)				
1595.000000	39.12	---	150.0	V	42.0	-7.6	74.00	34.88
1595.000000	---	26.65	150.0	V	42.0	-7.6	54.00	27.35
3070.600000	39.92	---	150.0	V	158.0	-1.9	74.00	34.08
3070.600000	---	30.55	150.0	V	158.0	-1.9	54.00	23.45
4882.000000	40.95	---	250.0	V	357.0	2.7	74.00	33.05
4882.000000	---	32.29	250.0	V	357.0	2.7	54.00	21.71
7323.000000	---	37.74	100.0	V	91.0	10.0	54.00	16.26
7323.000000	46.52	---	100.0	V	91.0	10.0	74.00	27.48
9765.200000	---	42.95	200.0	H	309.0	14.9	54.00	11.05
9765.200000	52.95	---	200.0	H	309.0	14.9	74.00	21.05
12206.400000	52.99	---	150.0	V	249.0	16.8	74.00	21.01
12206.400000	---	44.34	150.0	V	249.0	16.8	54.00	9.66

High Channel: 2480MHz

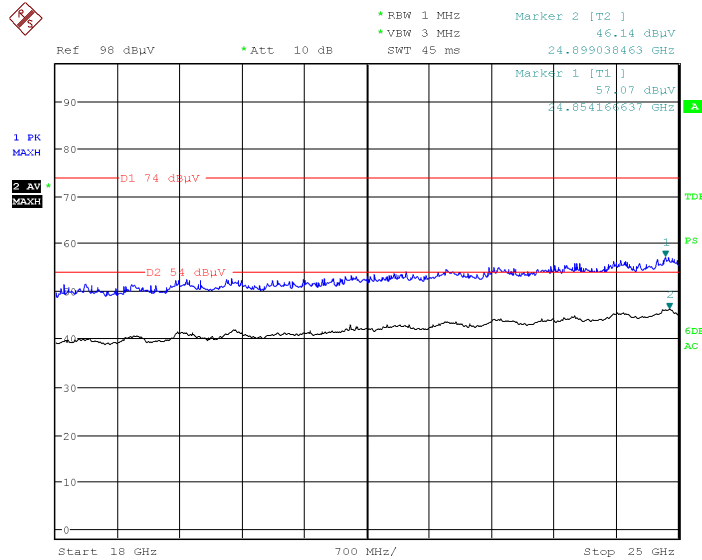
Full Spectrum



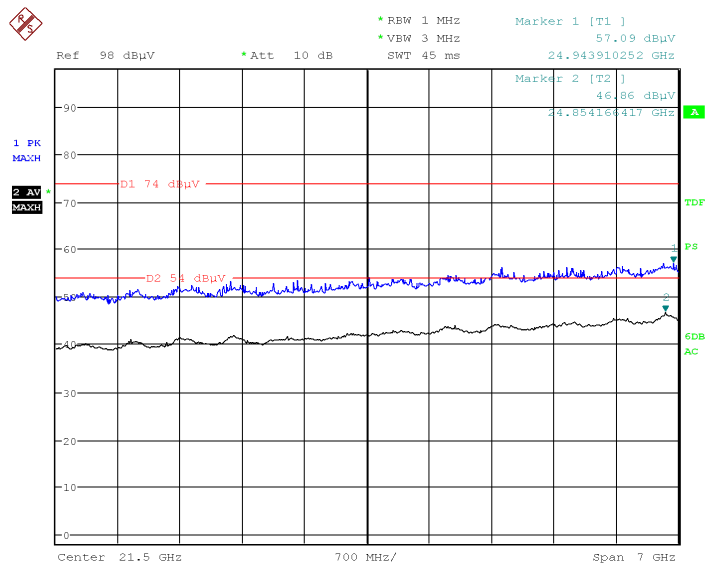
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dB μ V/m)	Margin (dB)
	MaxPeak (dB μ V /m)	Average (dB μ V /m)	Height (cm)	Polar (H/V)				
1591.600000	38.18	---	200.0	V	349.0	-7.6	74.00	35.82
1591.600000	---	27.27	200.0	V	349.0	-7.6	54.00	26.73
3305.200000	40.70	---	100.0	H	45.0	-1.3	74.00	33.30
3305.200000	---	30.76	100.0	H	45.0	-1.3	54.00	23.24
4960.000000	40.77	---	150.0	V	221.0	2.8	74.00	33.23
4960.000000	---	32.64	150.0	V	221.0	2.8	54.00	21.36
7440.000000	48.31	---	250.0	V	309.0	10.1	74.00	25.69
7440.000000	---	38.38	250.0	V	309.0	10.1	54.00	15.62
9921.600000	51.60	---	100.0	V	58.0	14.9	74.00	22.40
9921.600000	---	41.92	100.0	V	58.0	14.9	54.00	12.08
12400.200000	53.14	---	200.0	V	15.0	17.0	74.00	20.86
12400.200000	---	43.89	200.0	V	15.0	17.0	54.00	10.11

18GHz-25GHz:

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

Horizontal

Date: 1.FEB.2018 09:32:19

Vertical

Date: 1.FEB.2018 09:45:04

Fundamental Test & Restricted Bands Emissions:

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

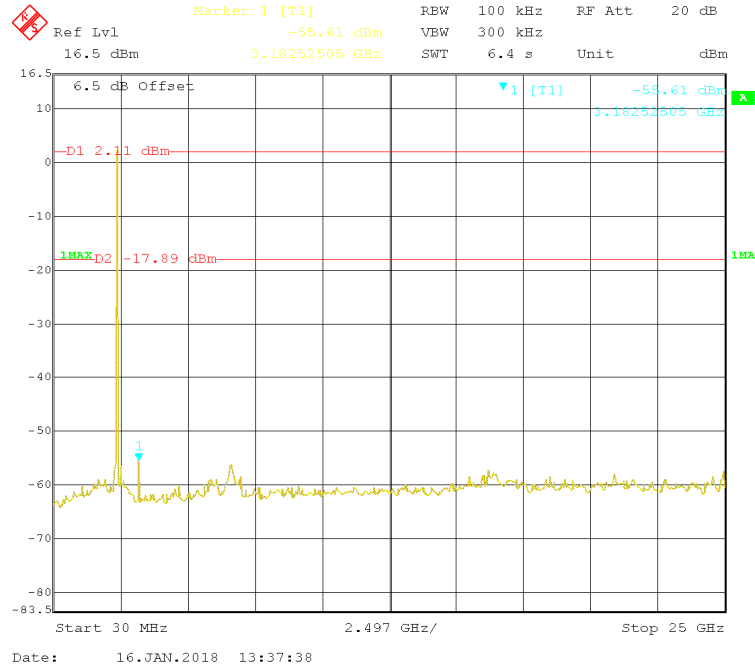
Note:

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

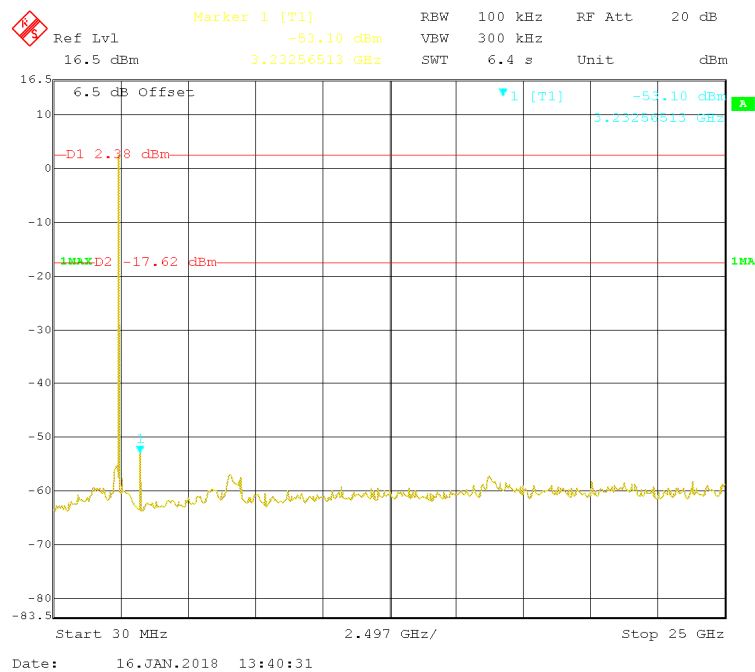
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
Low Channel: 2402MHz								
2402.000000	---	104.27	250.0	V	42.0	5.1	/	/
2402.000000	105.30	---	250.0	V	42.0	5.1	/	/
2390.000000	---	37.80	200.0	V	166.0	5.1	54.00	16.20
2390.000000	55.56	---	200.0	V	166.0	5.1	74.00	18.44
Middle Channel: 2441MHz								
2441.000000	104.57	---	250.0	V	91.0	5.2	/	/
2441.000000	---	104.31	250.0	V	91.0	5.2	/	/
High Channel: 2480MHz								
2480.000000	---	104.04	200.0	V	144.0	5.3	/	/
2480.000000	104.76	---	200.0	V	144.0	5.3	/	/
2483.500000	---	41.46	150.0	V	39.0	5.3	54.00	12.54
2483.500000	60.68	---	150.0	V	39.0	5.3	74.00	13.32

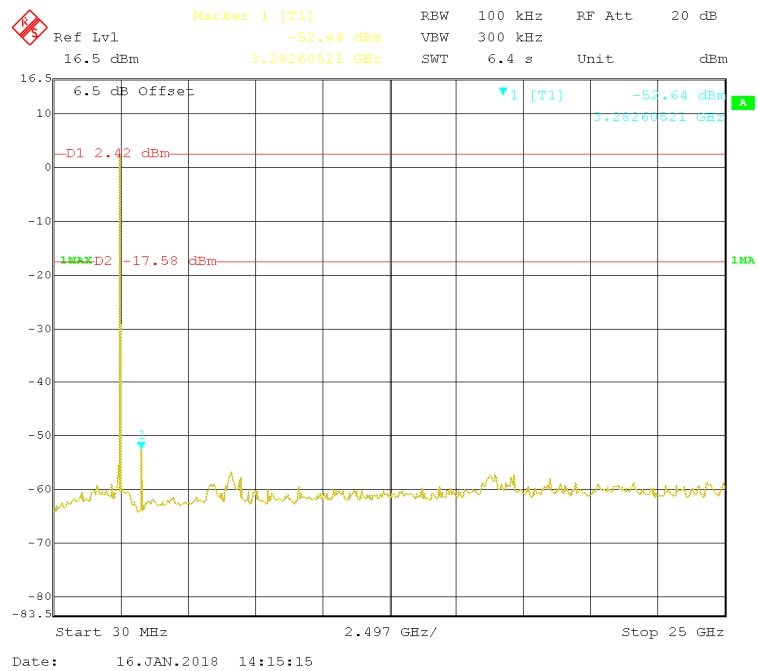
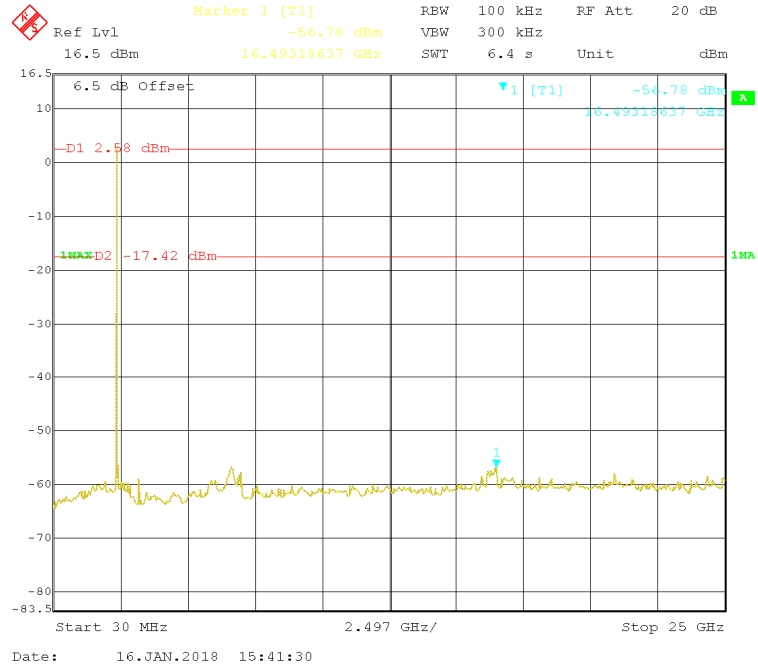
Conducted Spurious Emissions at Antenna Port

BDR (GFSK): Low Channel

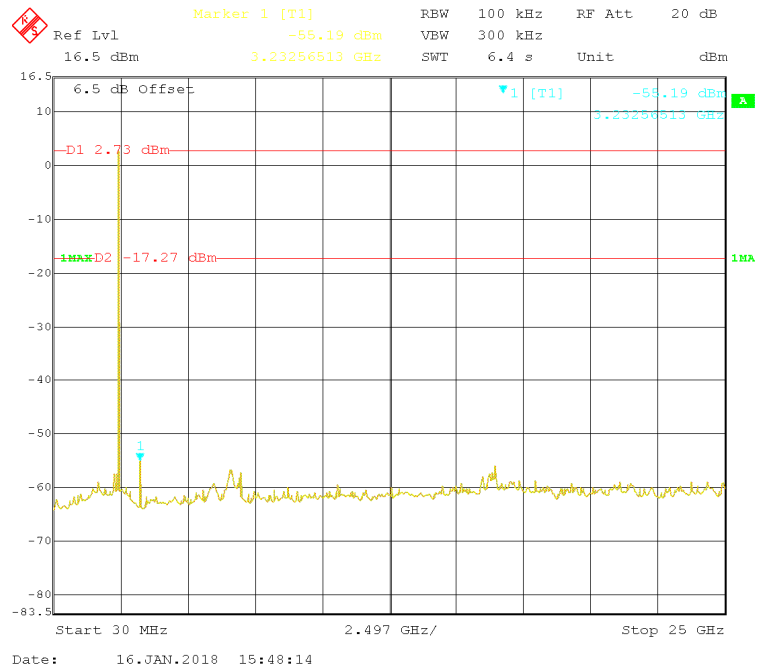


BDR (GFSK): Middle Channel

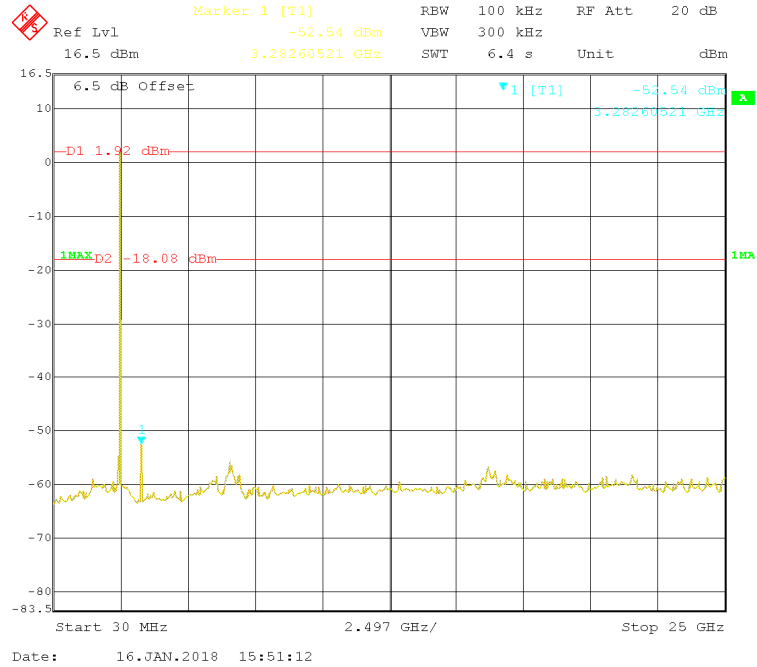


BDR (GFSK): High Channel**EDR ($\pi/4$ -DQPSK): Low Channel**

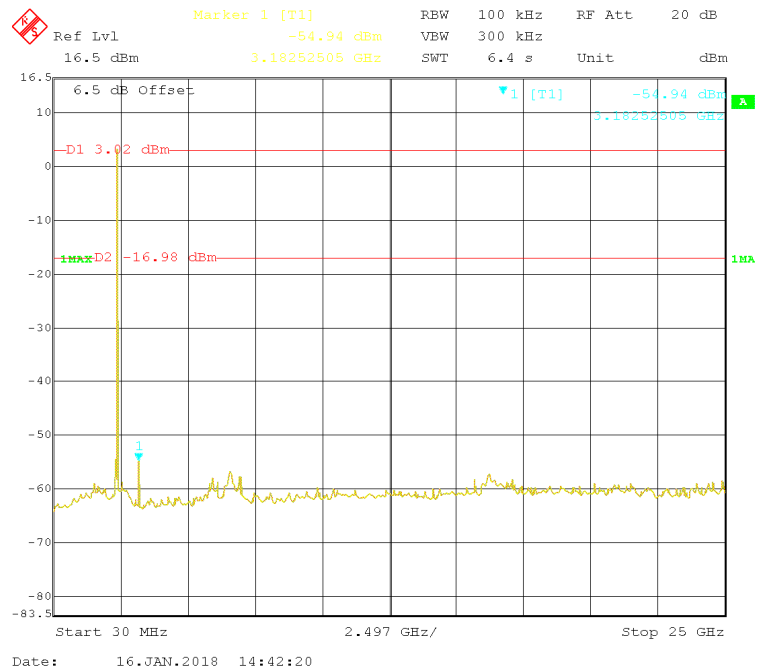
EDR ($\pi/4$ -DQPSK): Middle Channel



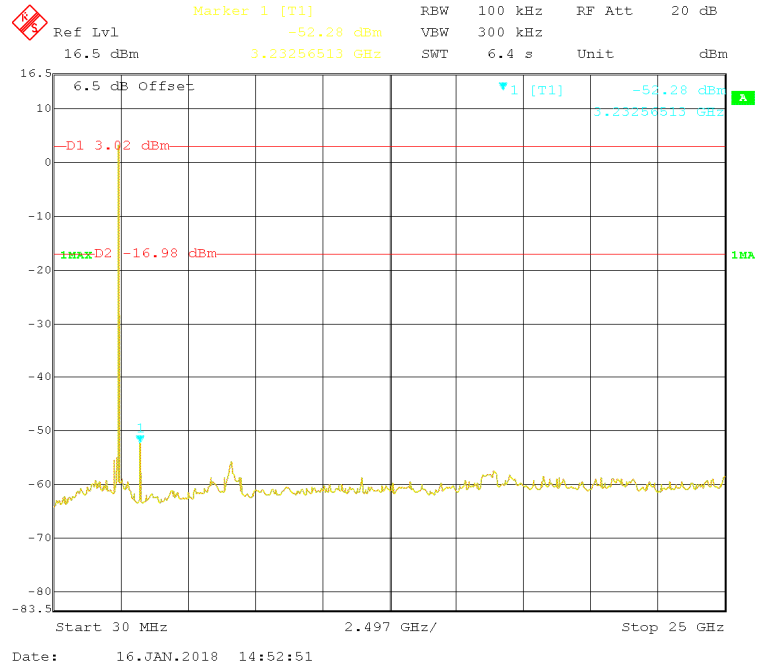
EDR ($\pi/4$ -DQPSK): High Channel



EDR (8DPSK): Low Channel



EDR (8DPSK): Middle Channel



The screenshot displays a spectrum analyzer interface. At the top, various parameters are listed: Ref Lvl (16.5 dBm), Marker 1 [T1] (-51.82 dBm), REW (100 kHz), RF Att (20 dB), VBW (300 kHz), Unit (dBm), and SWT (6.4 s). The main plot area shows a frequency range from -83.5 MHz to 25 GHz. A prominent signal peak is visible at approximately 3.28260521 GHz, reaching a level of -17.15 dBm. Other markers include D1 at 2.85 dBm and D2 at -17.15 dBm. The x-axis is labeled 'Start 30 MHz' and 'Stop 25 GHz'. The y-axis represents power in dBm, ranging from -83.5 to 16.5.

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

Applicable Standard

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 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 °C
Relative Humidity:	49 %
ATM Pressure:	101.1 kPa

The testing was performed by Ada Yu on 2018-01-16.

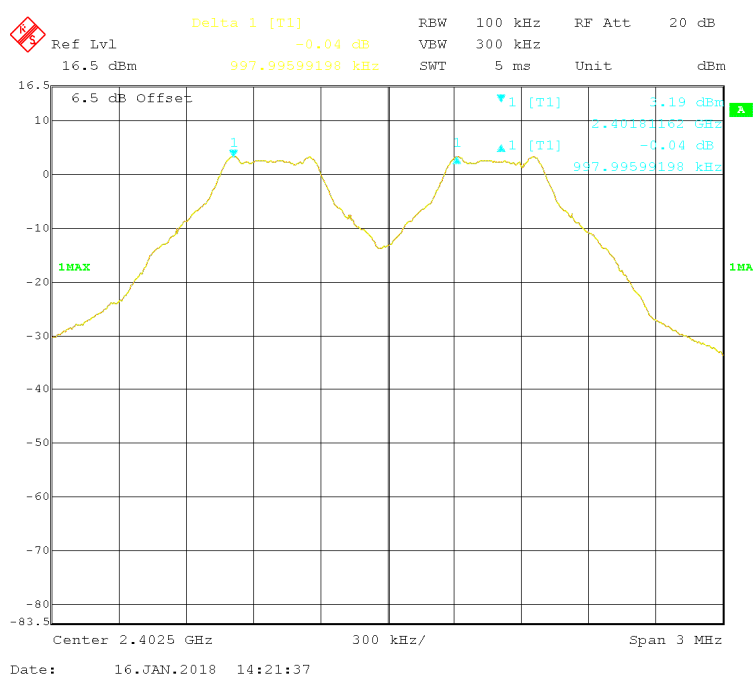
EUT operation mode: Transmitting

Test Result: Compliance.

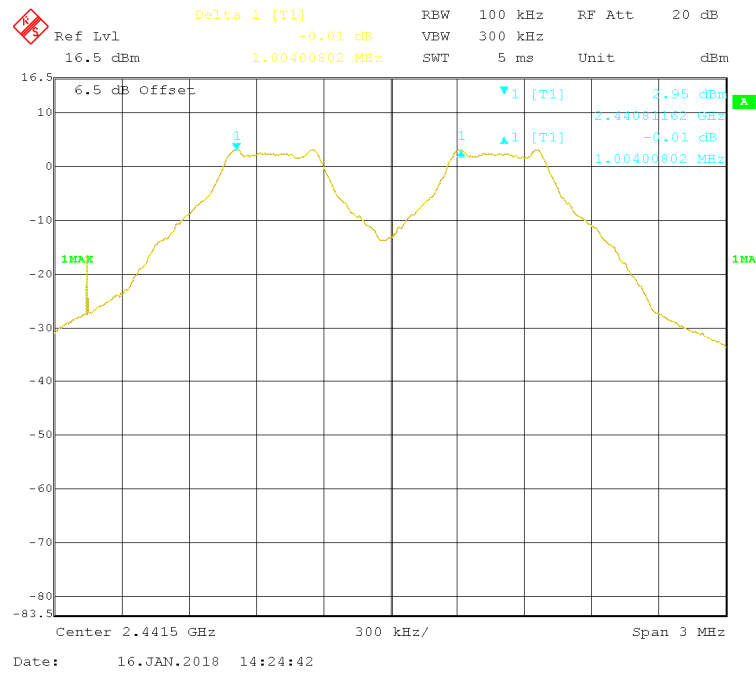
Mode	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)	Result
BDR (GFSK)	Low	2402	0.998	0.932	Pass
	Adjacent	2403			
	Middle	2441	1.004	0.944	Pass
	Adjacent	2442			
	High	2480	0.998	0.926	Pass
	Adjacent	2479			
EDR ($\pi/4$-DQPSK)	Low	2402	1.004	0.821	Pass
	Adjacent	2403			
	Middle	2441	1.004	0.813	Pass
	Adjacent	2442			
	High	2480	1.010	0.825	Pass
	Adjacent	2479			
EDR (8DPSK)	Low	2402	0.998	0.842	Pass
	Adjacent	2403			
	Middle	2441	1.004	0.842	Pass
	Adjacent	2442			
	High	2480	0.998	0.846	Pass
	Adjacent	2479			

Note: For BDR mode, Limit = 20 dB bandwidth; For EDR mode, Limit = 20 dB bandwidth*2/3.

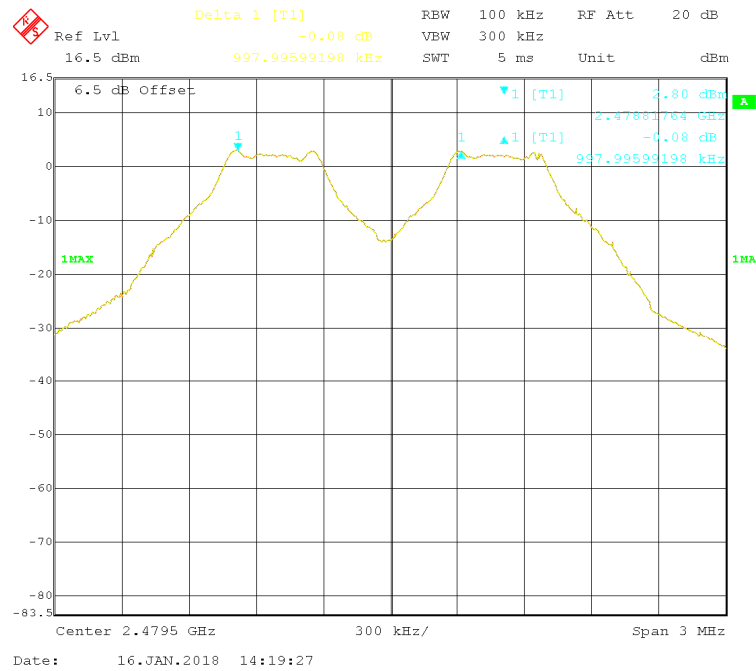
BDR (GFSK): Low Channel



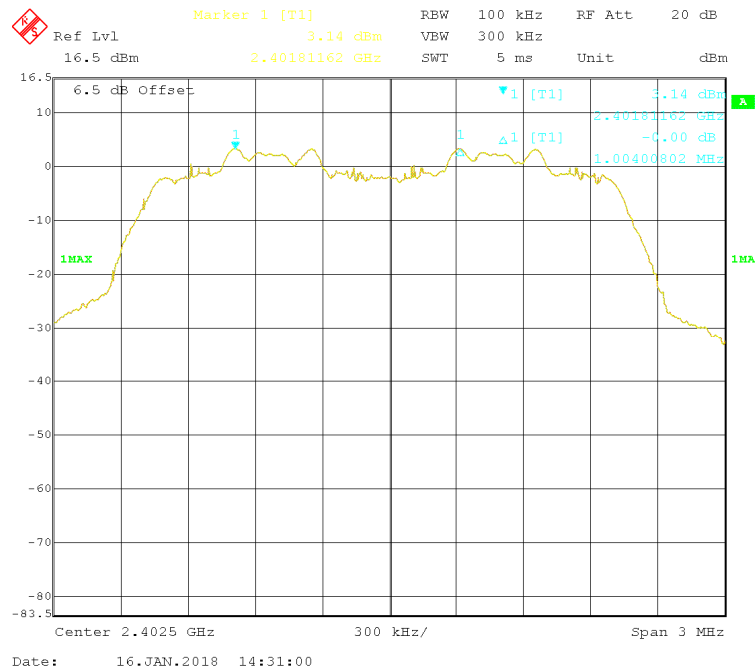
BDR (GFSK): Middle Channel



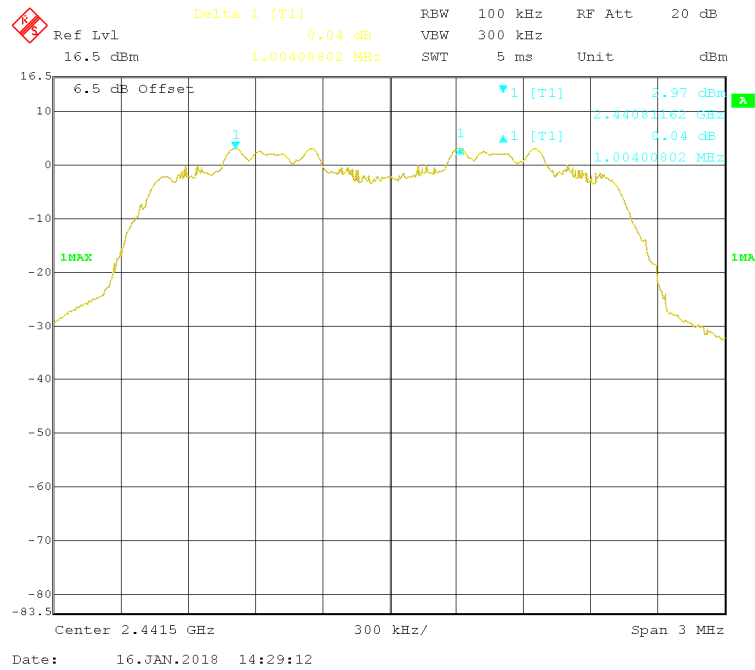
BDR (GFSK): High Channel



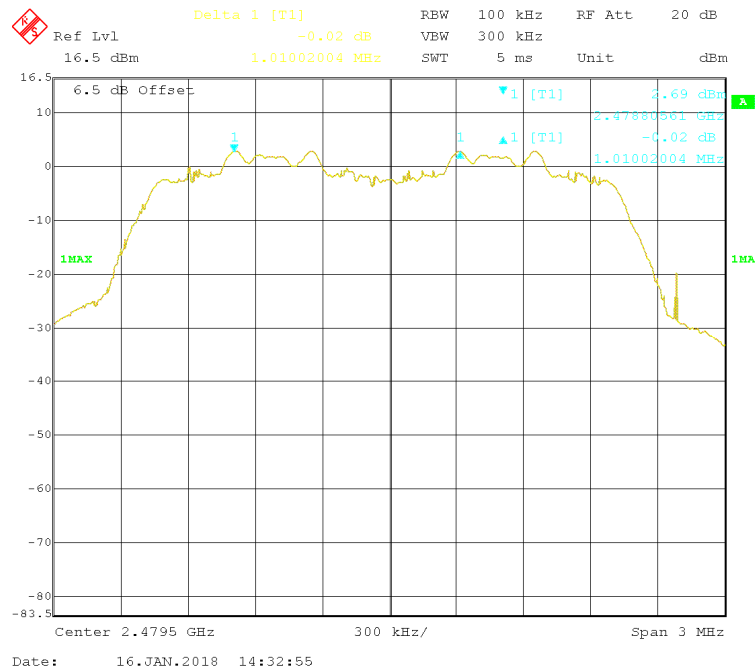
EDR ($\pi/4$ -DQPSK): Low Channel



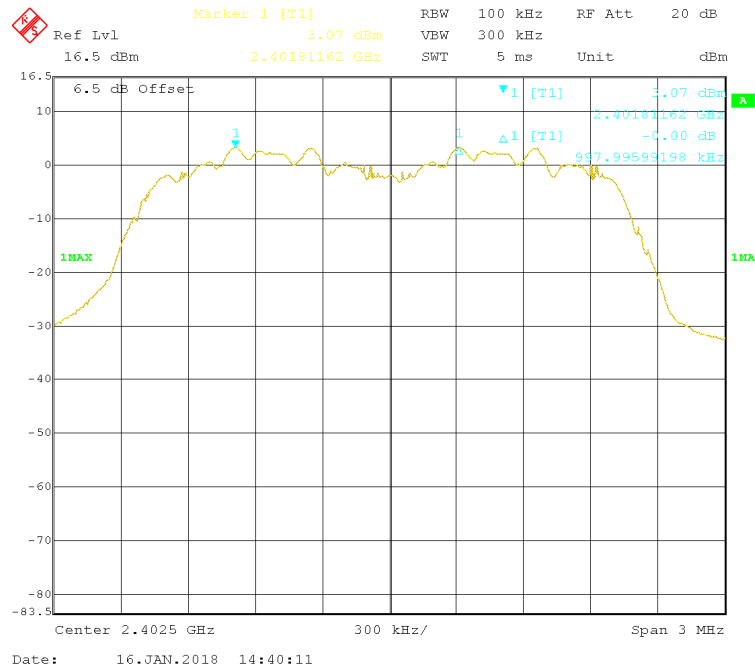
EDR ($\pi/4$ -DQPSK): Middle Channel



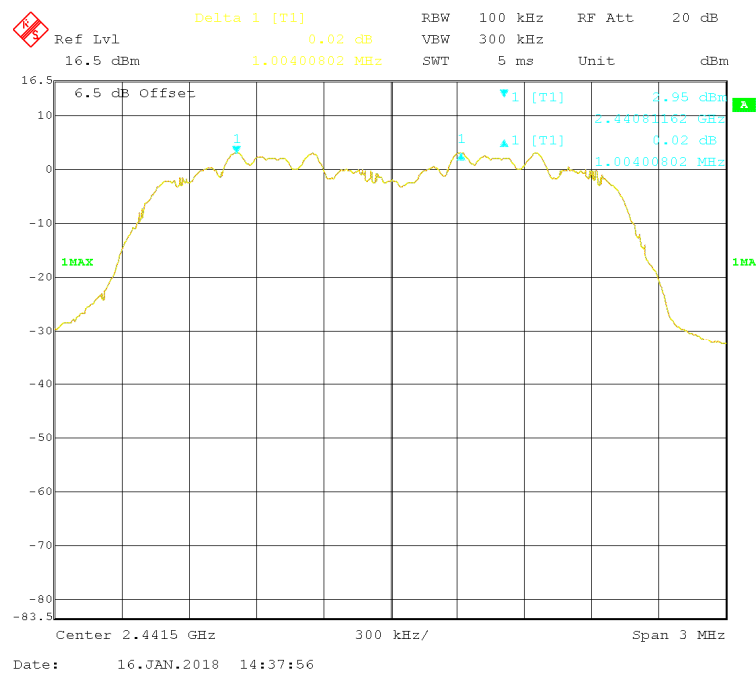
EDR ($\pi/4$ -DQPSK): High Channel



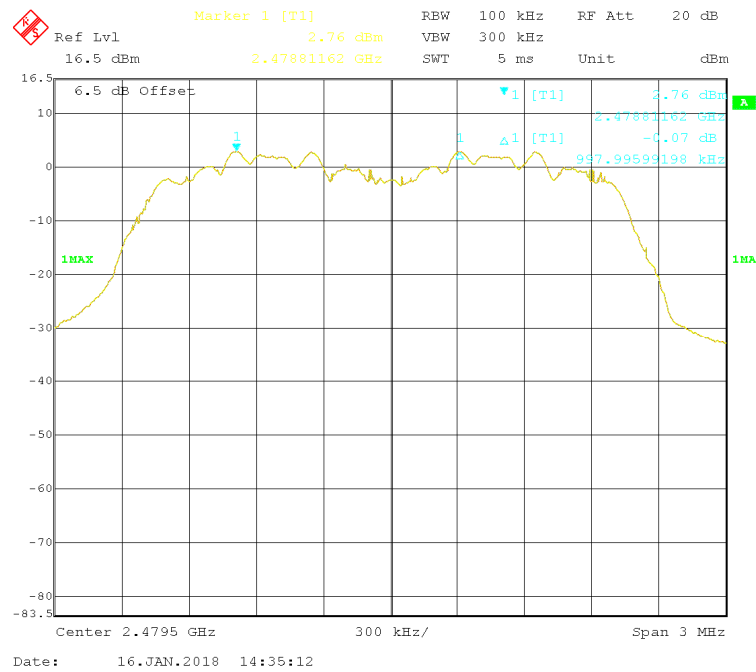
EDR (8DPSK): Low Channel



EDR (8DPSK): Middle Channel



EDR (8DPSK): 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**

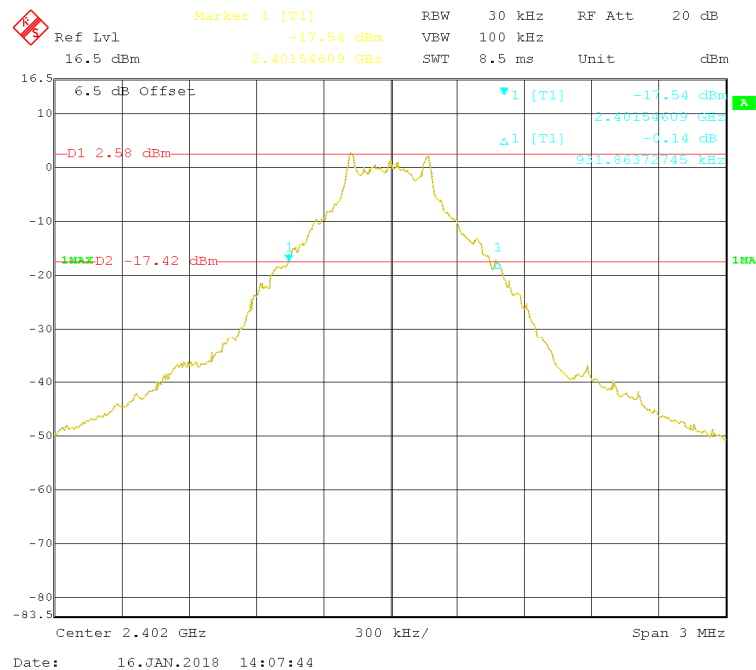
Temperature:	23.2 °C
Relative Humidity:	50 %
ATM Pressure:	101.3 kPa

The testing was performed by Ada Yu on 2018-01-16.

EUT operation mode: Transmitting

Test Result: Compliance.

Mode	Channel	Frequency (MHz)	20 dB Emission Bandwidth (MHz)
BDR (GFSK)	Low	2402	0.932
	Middle	2441	0.944
	High	2480	0.926
EDR ($\pi/4$-DQPSK)	Low	2402	1.232
	Middle	2441	1.220
	High	2480	1.238
EDR (8DPSK)	Low	2402	1.263
	Middle	2441	1.263
	High	2480	1.269

BDR (GFSK): Low Channel

Delta 1 [T1] 0.07 dB
 Ref Lvl 16.5 dBm 943.88777555 kHz
 RBW 30 kHz RF Att 20 dB
 VBW 100 kHz
 SWT 8.5 ms Unit dBm

6.5 dB Offset
 D1 2.81 dBm
 D2 -17.19 dBm
 1 [T1] 2.44052806 GHz
 2 [T1] 943.88777555 kHz
 1 [T1] -17.58 dBm
 2 [T1] 0.07 dB

Center 2.441 GHz 300 kHz/
 Span 3 MHz

Date: 16.JAN.2018 13:44:21

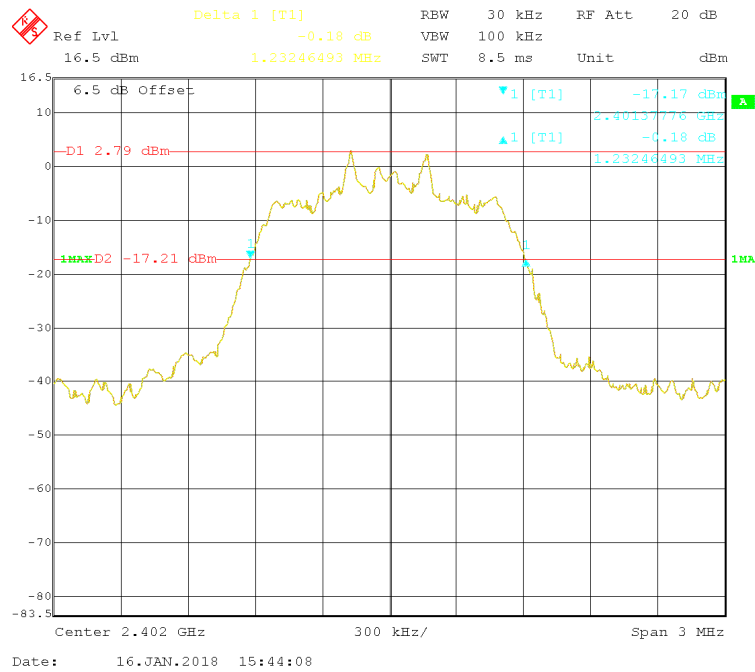
Delta 1 [T1] -0.80 dB
 Ref Lvl 16.5 dBm
 RBW 30 kHz
 RF Att 20 dB
 925.85170341 kHz
 SWT 8.5 ms
 Unit dBm

6.5 dB Offset
 -D1 2.38 dBm
 -17.62 dBm
 -17.34 dBm
 2.47958210 GHz
 -0.80 dB
 925.85170341 kHz

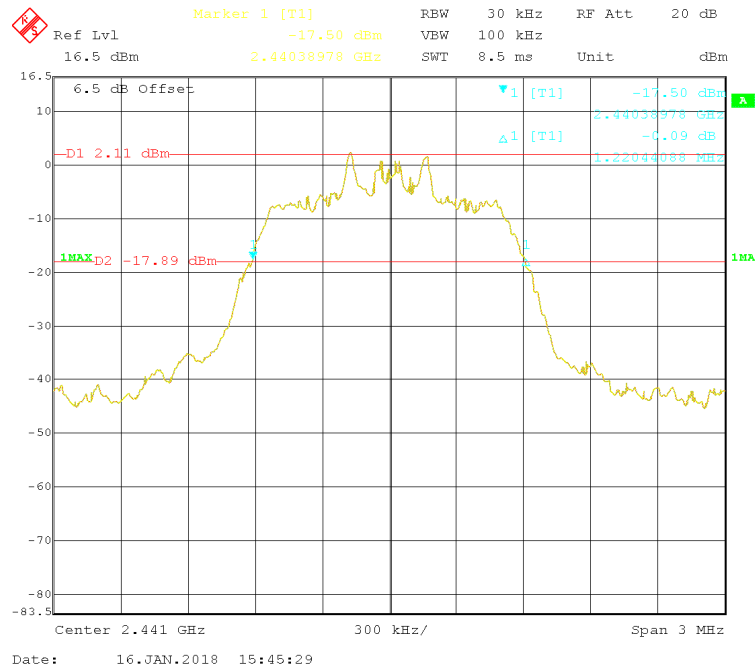
Center 2.48 GHz
 300 kHz/
 Span 3 MHz

Date: 16.JAN.2018 14:02:54

EDR ($\pi/4$ -DQPSK): Low Channel



EDR($\pi/4$ -DQPSK): Middle Channel



Delta 1 [T1] 0.43 dB RBW 30 kHz RF Att 20 dB
 Ref Lvl 16.5 dBm 1.23847695 MHz SWT 8.5 ms Unit dBm

6.5 dB Offset
 -D1 2.07 dBm
 1MAX D2 -17.93 dBm
 1 [T1] -16.32 dBm
 1 [T1] 2.47937174 GHz
 1.23847695 MHz
 1MA

Center 2.48 GHz 300 kHz/
 Span 3 MHz

Date: 16.JAN.2018 15:53:08

[illegible]

Marker 1 [T1]

Ref Lvl -17.32 dBm RBW 30 kHz RF Att 20 dB

16.5 dBm 2.44034168 GHz SWT 8.5 ms Unit dBm

6.5 dB Offset

-D1 2.21 dBm

17.32 dBm [T1]

2.44034168 GHz

-C.34 dB

1.26252505 MHz

17.79 dBm D2

17.32 dBm [T1]

Center 2.441 GHz 300 kHz/ Span 3 MHz

Date: 16.JAN.2018 14:50:59

Delta 1 [T1] 0.29 dB
 Ref Lvl 16.5 dBm
 RBW 30 kHz
 RF Att 20 dB
 1.26853707 MHz
 SWT 8.5 ms
 Unit dBm
 6.5 dB Offset
 -18.39 dBm
 2.47933507 GHz
 1.26853707 MHz
 D1 1.62 dBm
 D2 -18.38 dBm
 1MAX
 1MAX
 Center 2.48 GHz
 300 kHz/
 Span 3 MHz
 Date: 16.JAN.2018 15:07:32

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 °C
Relative Humidity:	50 %
ATM Pressure:	101.3 kPa

The testing was performed by Ada Yu on 2018-01-16.

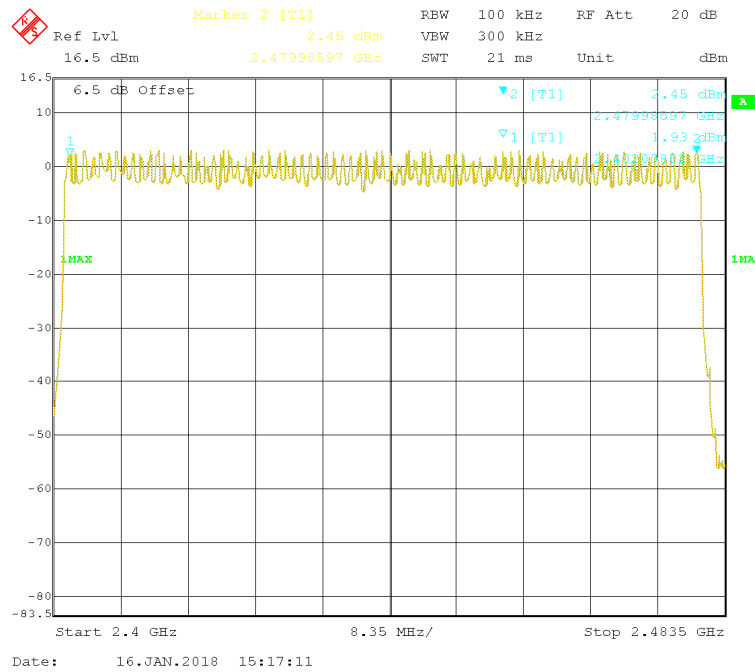
EUT operation mode: Hopping

Test Result: Compliance.

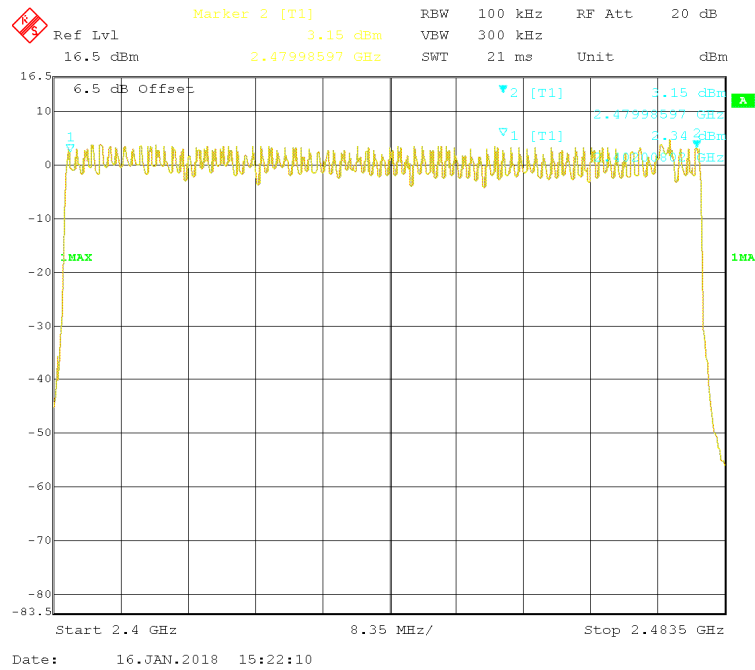
Mode	Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
BDR (GFSK)	2400-2483.5	79	≥ 15
EDR ($\pi/4$ -DQPSK)	2400-2483.5	79	≥ 15
EDR (8DPSK)	2400-2483.5	79	≥ 15

[illegible]

EDR ($\pi/4$ -DQPSK): Number of Hopping Channels



EDR (8DPSK): 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 $\leq$ channel spacing and where possible RBW should be set $\geq 1 / T$, 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**

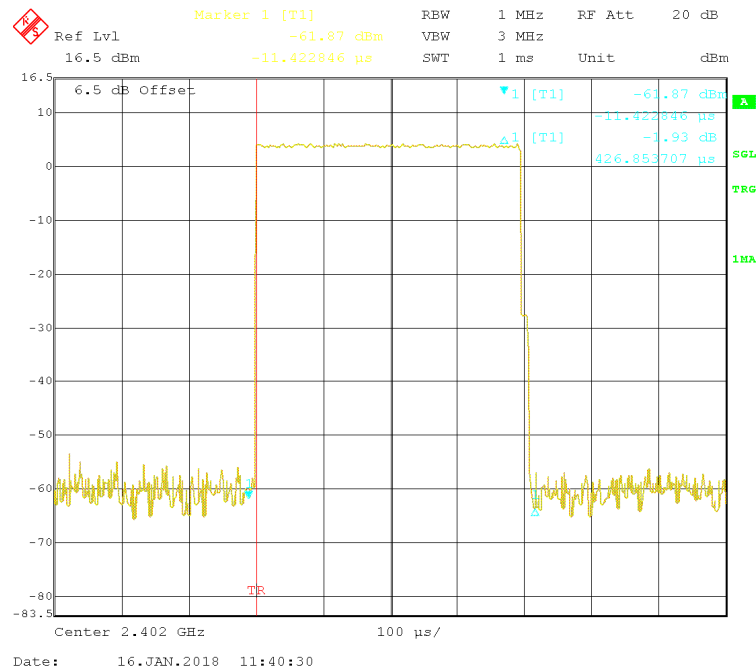
Temperature:	23.4 °C
Relative Humidity:	51 %
ATM Pressure:	101.2 kPa

The testing was performed by Ada Yu on 2018-01-16.

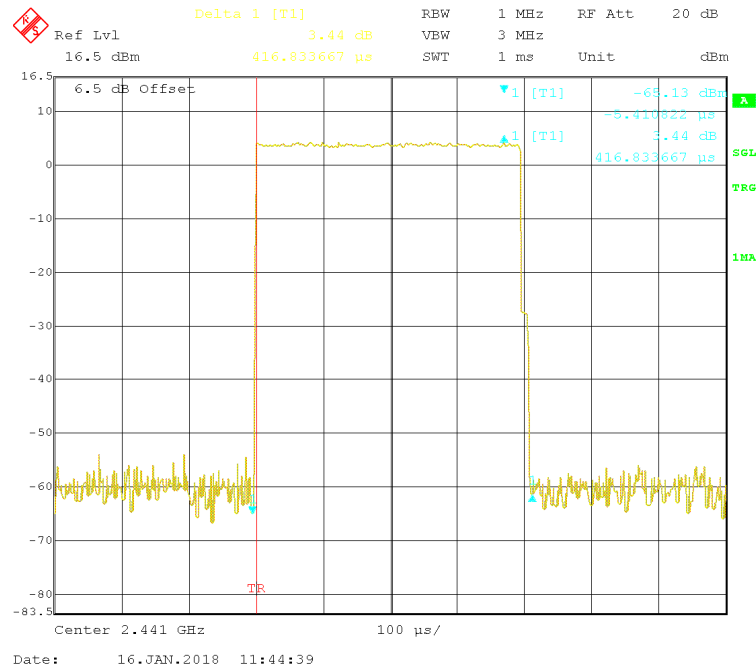
EUT operation mode: Hopping

Mode		Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
BDR (GFSK)	DH1	Low	0.427	0.137	0.4	Pass
		Middle	0.417	0.133	0.4	Pass
		High	0.421	0.135	0.4	Pass
		Note: DH1:Dwell time = Pulse time*(1600/2/79)*31.6S				
	DH3	Low	1.739	0.278	0.4	Pass
		Middle	1.684	0.269	0.4	Pass
		High	1.684	0.269	0.4	Pass
		Note: DH3:Dwell time = Pulse time*(1600/4/79)*31.6S				
	DH5	Low	2.940	0.314	0.4	Pass
		Middle	2.980	0.318	0.4	Pass
		High	2.948	0.314	0.4	Pass
		Note: DH5:Dwell time = Pulse time*(1600/6/79)*31.6S				
EDR ($\pi/4$ -DQPSK)	2DH1	Low	0.429	0.137	0.4	Pass
		Middle	0.423	0.135	0.4	Pass
		High	0.431	0.138	0.4	Pass
		Note: 2DH1:Dwell time = Pulse time*(1600/2/79)*31.6S				
	2DH3	Low	1.709	0.273	0.4	Pass
		Middle	1.689	0.270	0.4	Pass
		High	1.694	0.271	0.4	Pass
		Note: 2DH3:Dwell time = Pulse time*(1600/4/79)*31.6S				
	2DH5	Low	2.964	0.316	0.4	Pass
		Middle	2.940	0.314	0.4	Pass
		High	2.932	0.313	0.4	Pass
		Note: 2DH5:Dwell time = Pulse time*(1600/6/79)*31.6S				
EDR (8DPSK)	3DH1	Low	0.425	0.136	0.4	Pass
		Middle	0.433	0.139	0.4	Pass
		High	0.425	0.136	0.4	Pass
		Note: 3 DH1:Dwell time = Pulse time*(1600/2/79)*31.6S				
	3DH3	Low	1.699	0.272	0.4	Pass
		Middle	1.689	0.270	0.4	Pass
		High	1.689	0.270	0.4	Pass
		Note: 3DH3:Dwell time = Pulse time*(1600/4/79)*31.6S				
	3DH5	Low	2.964	0.316	0.4	Pass
		Middle	2.980	0.318	0.4	Pass
		High	2.980	0.318	0.4	Pass
		Note: 3DH5:Dwell time = Pulse time*(1600/6/79)*31.6S				

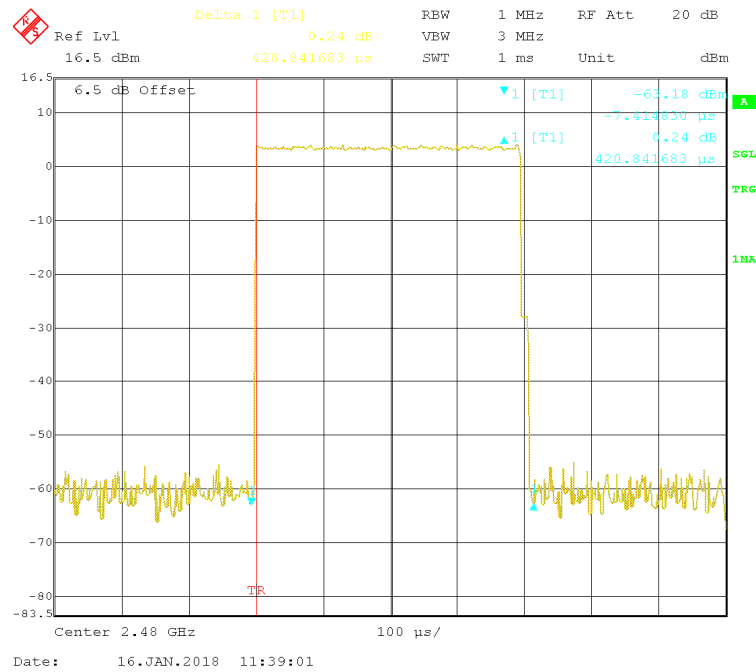
BDR (GFSK): Pulse time, Low Channel, DH1



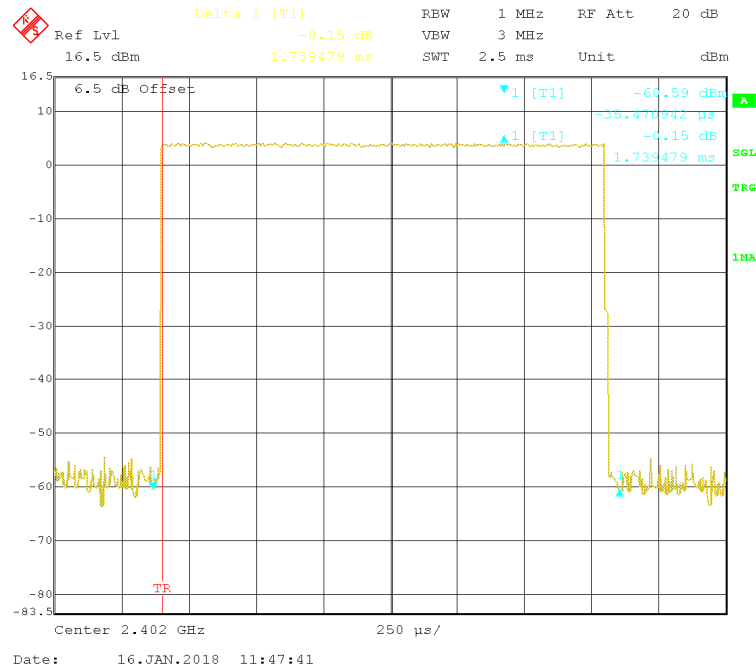
BDR (GFSK): Pulse time, Middle Channel, DH1

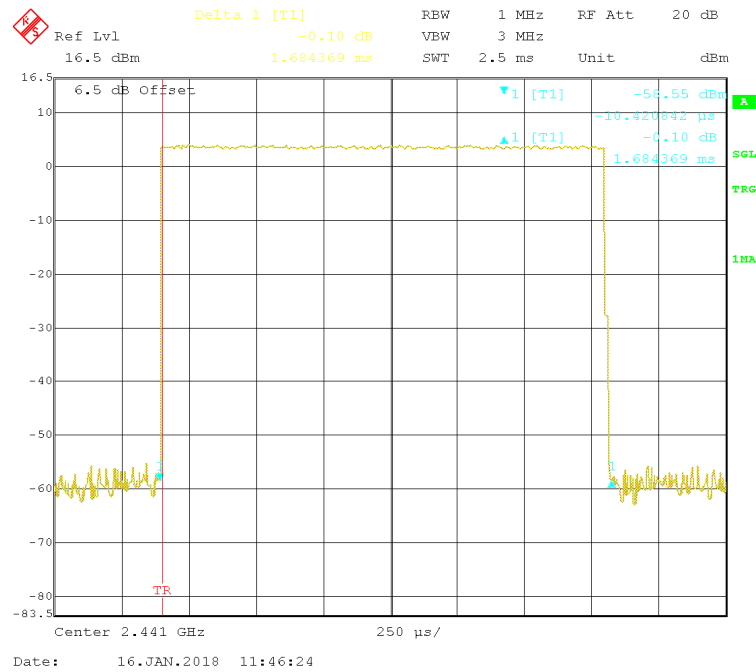
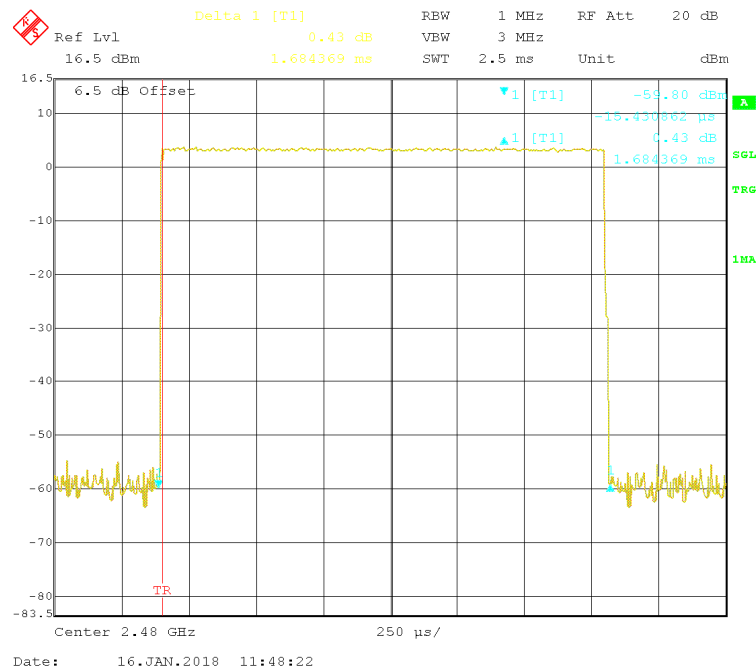


BDR (GFSK): Pulse time, High Channel, DH1

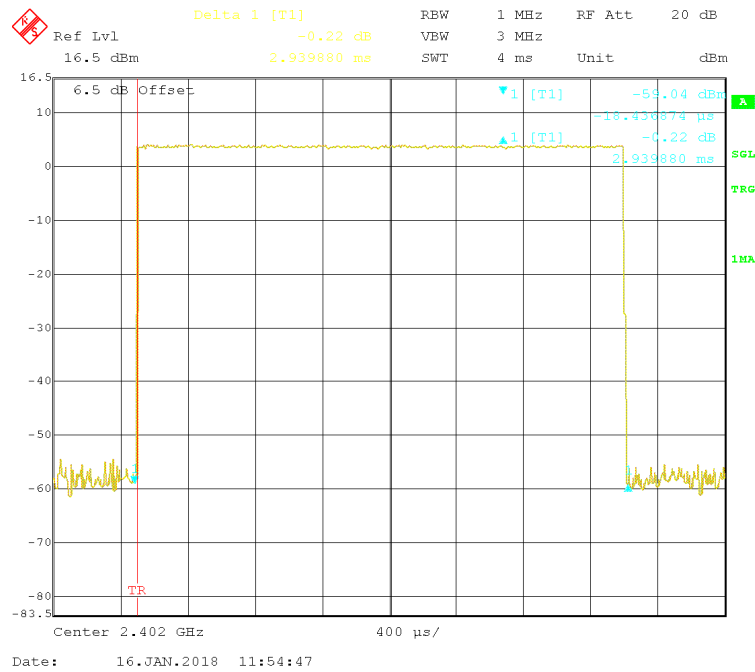


BDR (GFSK): Pulse time, Low Channel, DH3

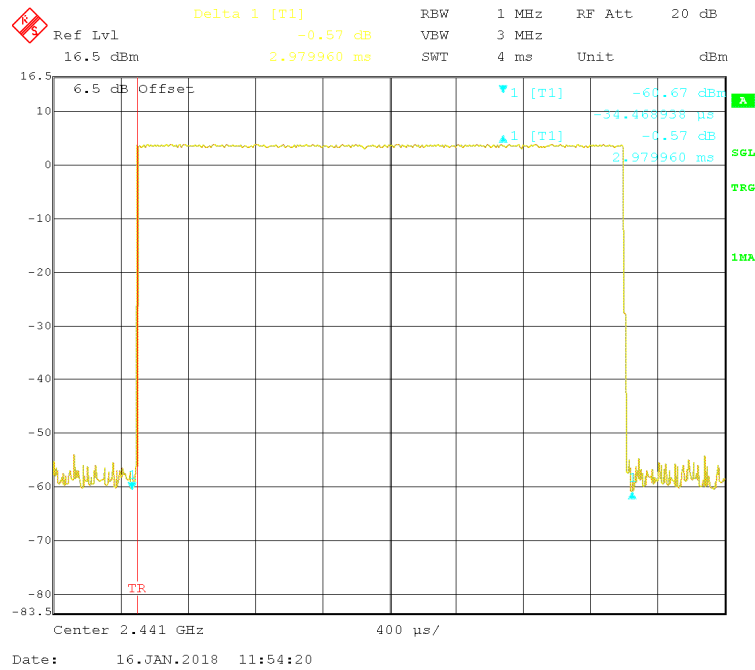


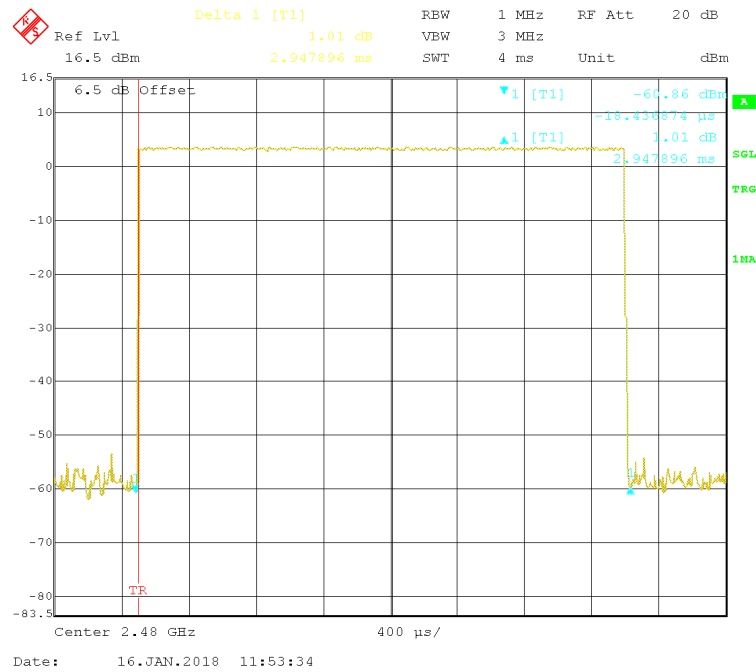
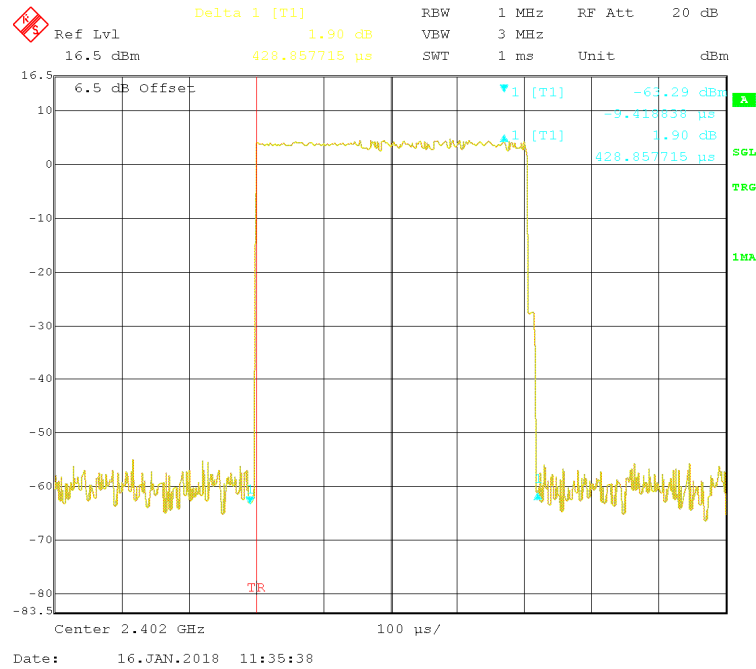
BDR (GFSK): Pulse time, Middle Channel, DH3**BDR (GFSK): Pulse time, High Channel, DH3**

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

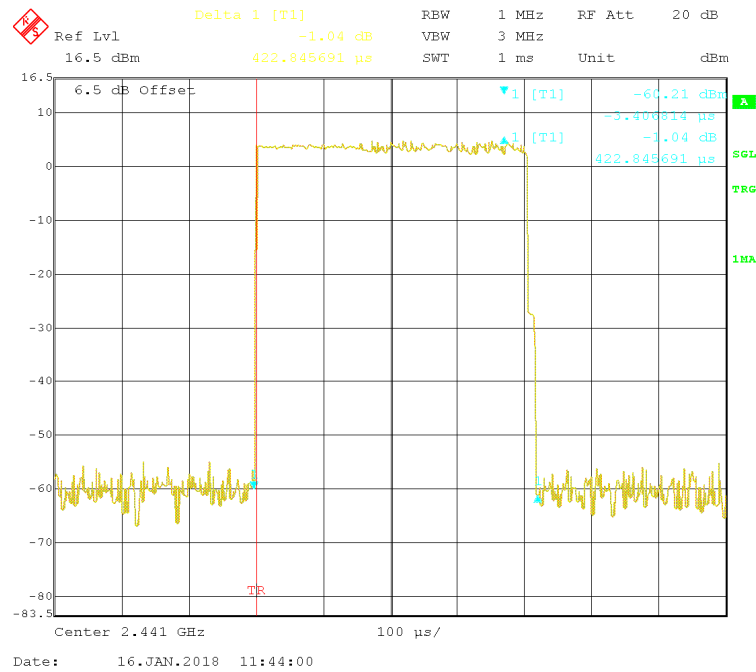


BDR (GFSK): Pulse time, Middle Channel, DH5

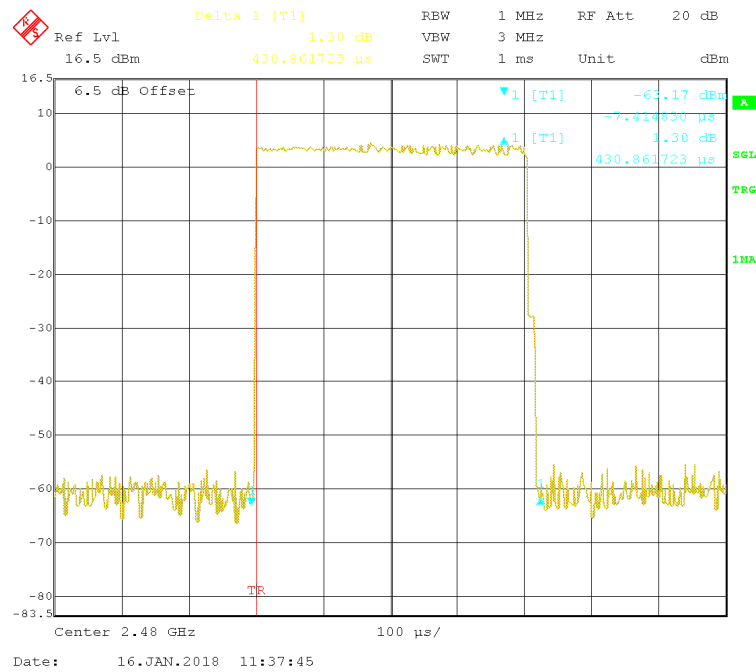


BDR (GFSK): Pulse time, High Channel, DH5**EDR ($\pi/4$ -DQPSK): Pulse time, Low Channel, 2DH1**

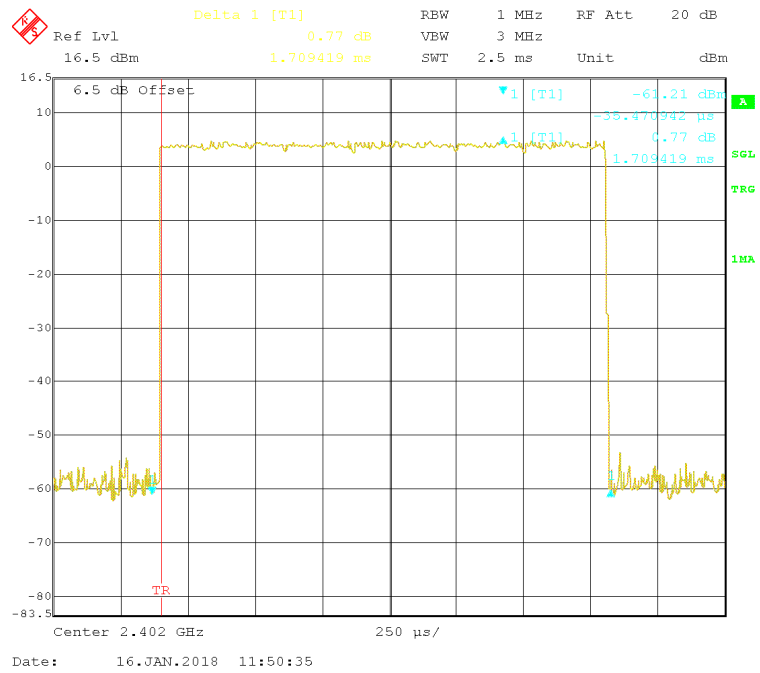
EDR ($\pi/4$ -DQPSK):Pulse time, Middle Channel, 2DH1



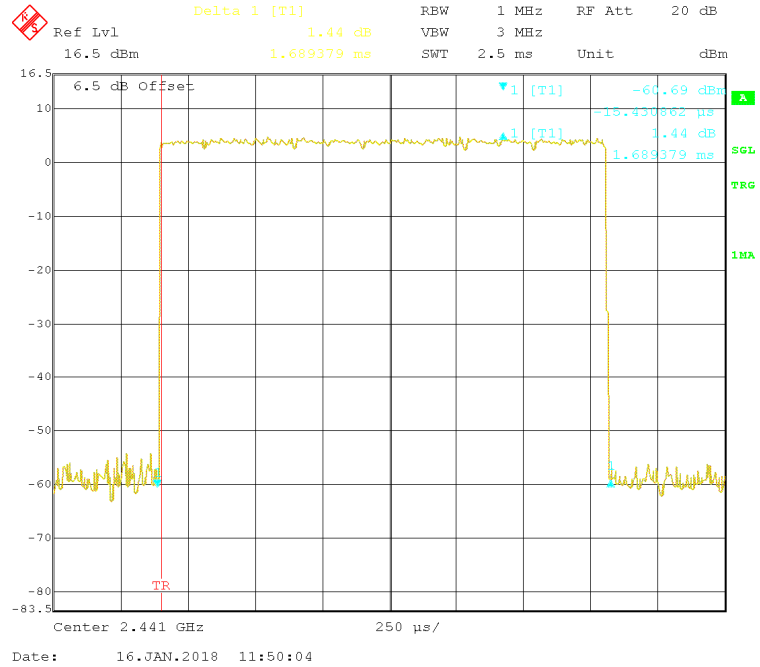
EDR ($\pi/4$ -DQPSK):Pulse time, High Channel, 2DH1



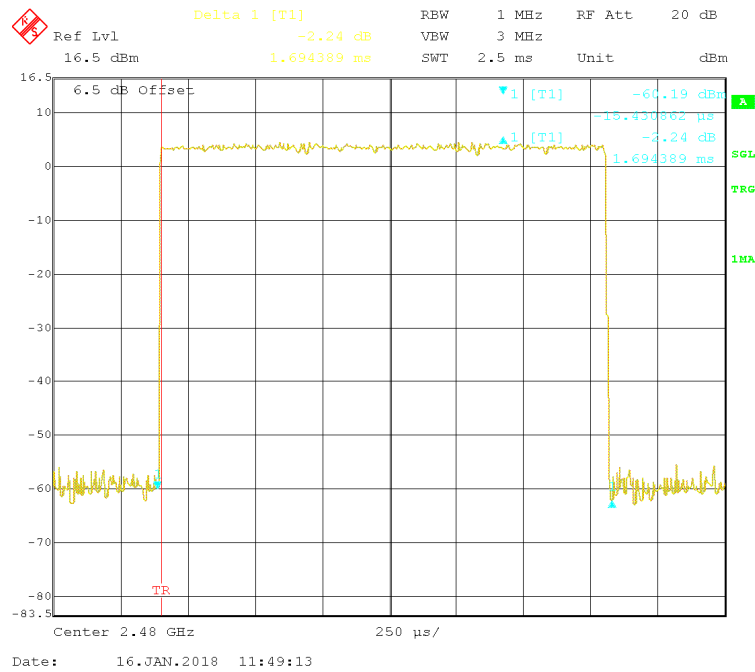
EDR ($\pi/4$ -DQPSK):Pulse time, Low Channel, 2DH3



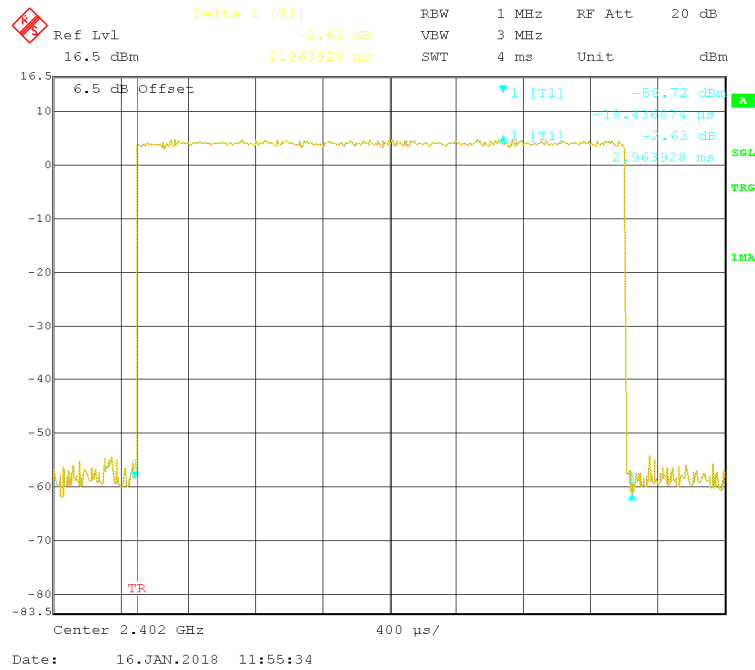
EDR ($\pi/4$ -DQPSK):Pulse time, Middle Channel, 2DH3



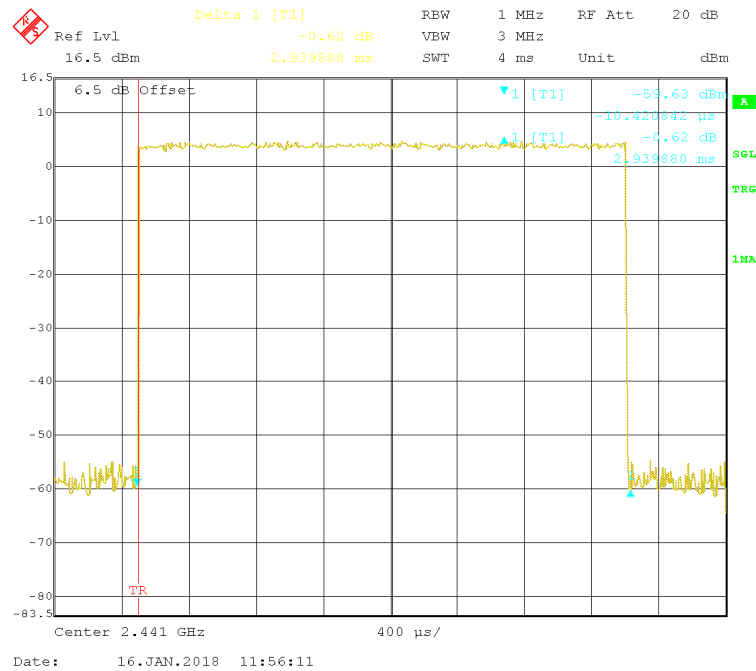
EDR ($\pi/4$ -DQPSK):Pulse time, High Channel, 2DH3



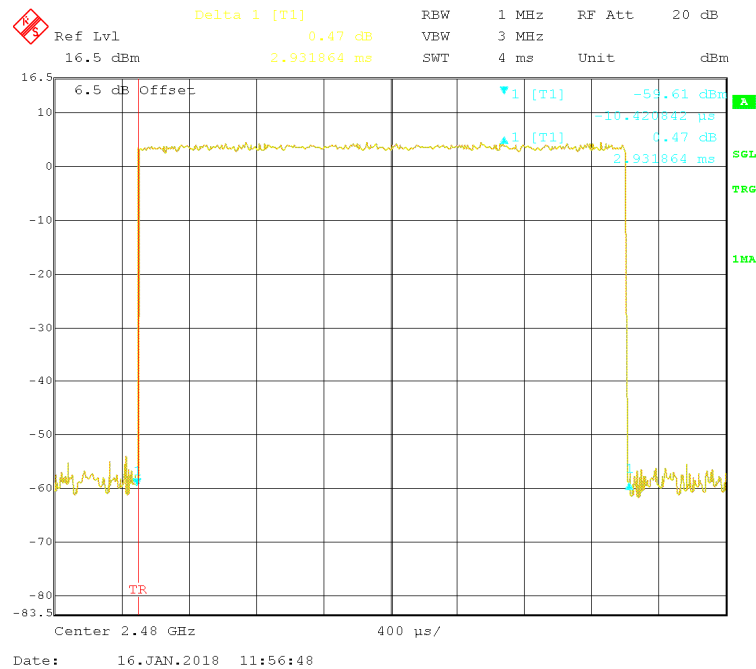
EDR ($\pi/4$ -DQPSK):Pulse time, Low Channel, 2DH5



EDR ($\pi/4$ -DQPSK):Pulse time, Middle Channel, 2DH5



EDR ($\pi/4$ -DQPSK):Pulse time, High Channel, 2DH5



Delta 1 [T1] RBW 1 MHz RF Att 20 dB
 Ref Lvl 2.39 dB VBW 3 MHz
 16.5 dBm 424.849699 μs SWT 1 ms Unit dBm

6.5 dB Offset
 16.5
 10
 0
 -10
 -20
 -30
 -40
 -50
 -60
 -70
 -80
 -83.5

Center 2.402 GHz 100 μs/

Date: 16.JAN.2018 11:41:12

Delta 1 [T1]

Ref Lvl 3.14 dB

16.5 dBm 432.865731 μs

RBW 1 MHz RF Att 20 dB

VBW 3 MHz

SWT 1 ms Unit dBm

6.5 dB Offset

▼1 [T1] -65.85 dBm

▲1 [T1] 3.14 dB

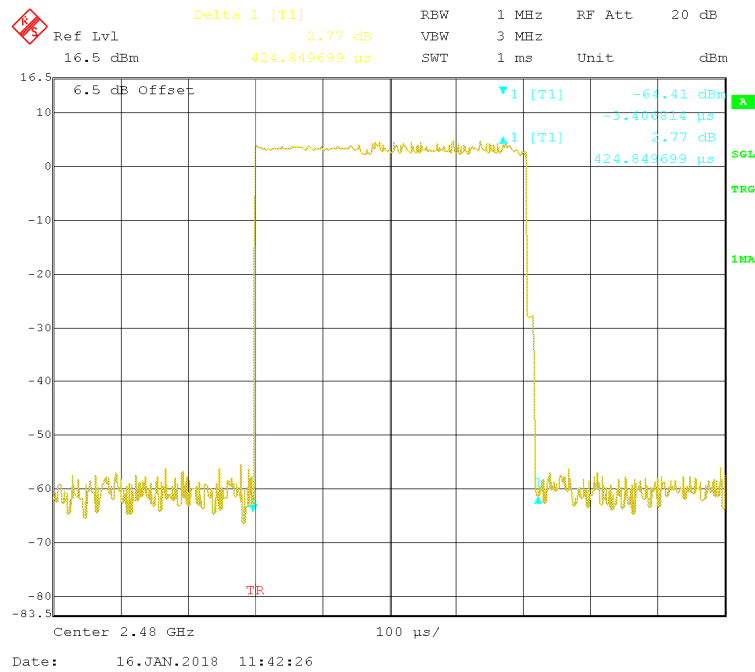
432.865731 μs

TR

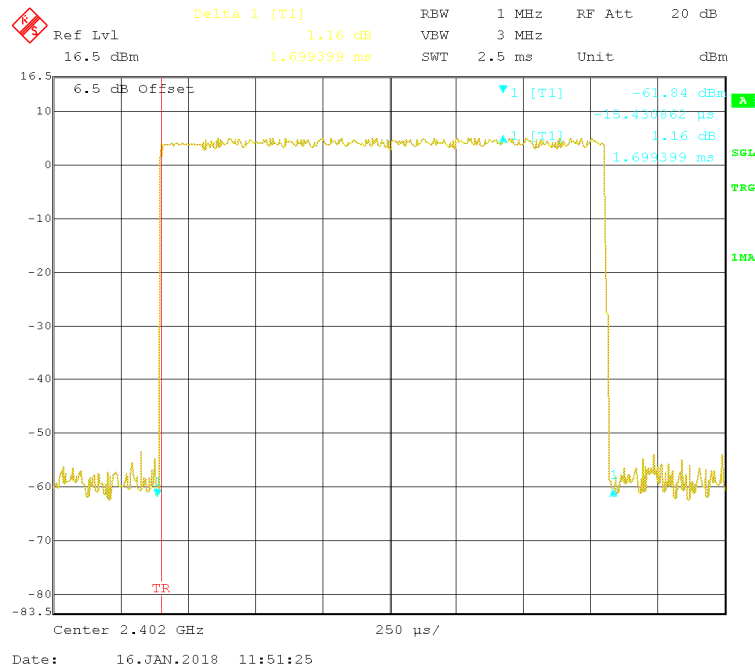
Center 2.441 GHz 100 μs/

Date: 16.JAN.2018 11:41:58

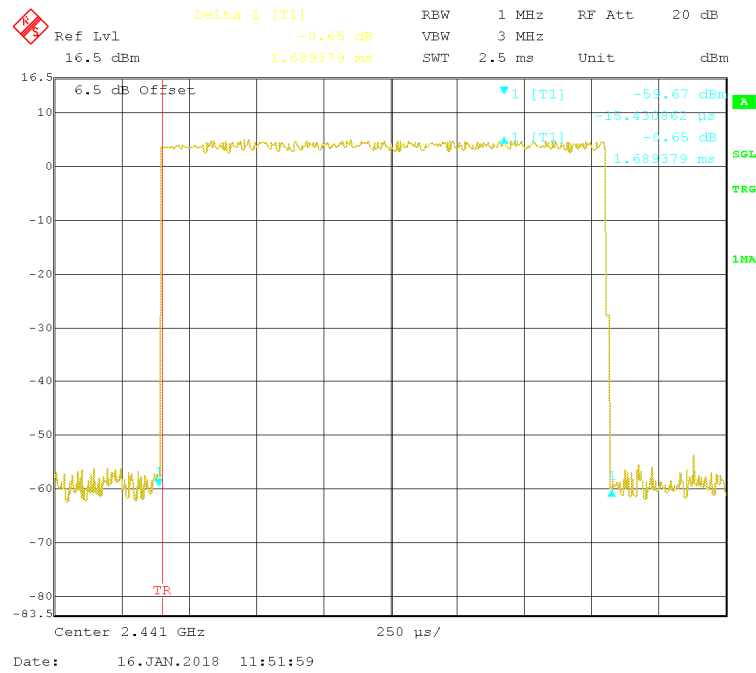
EDR (8DPSK): Pulse time, High Channel, 3DH1



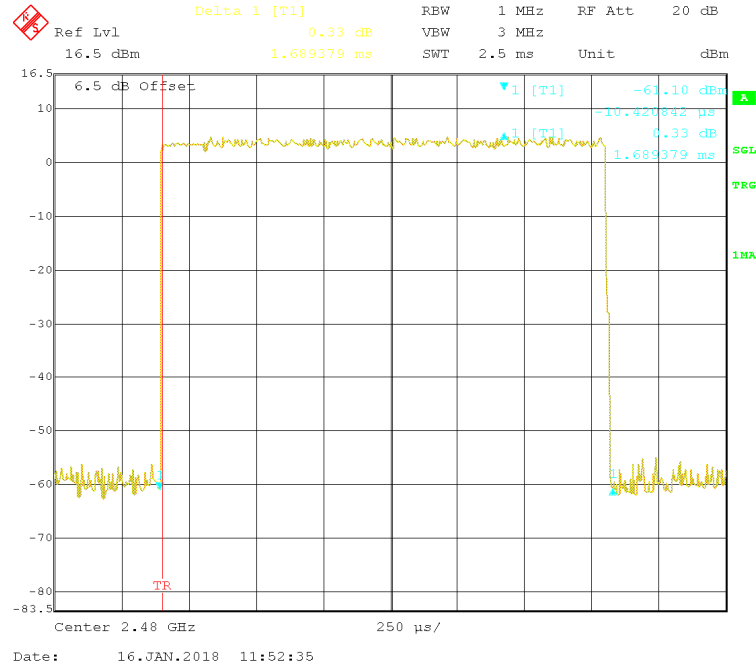
EDR (8DPSK): Pulse time, Low Channel, 3DH3



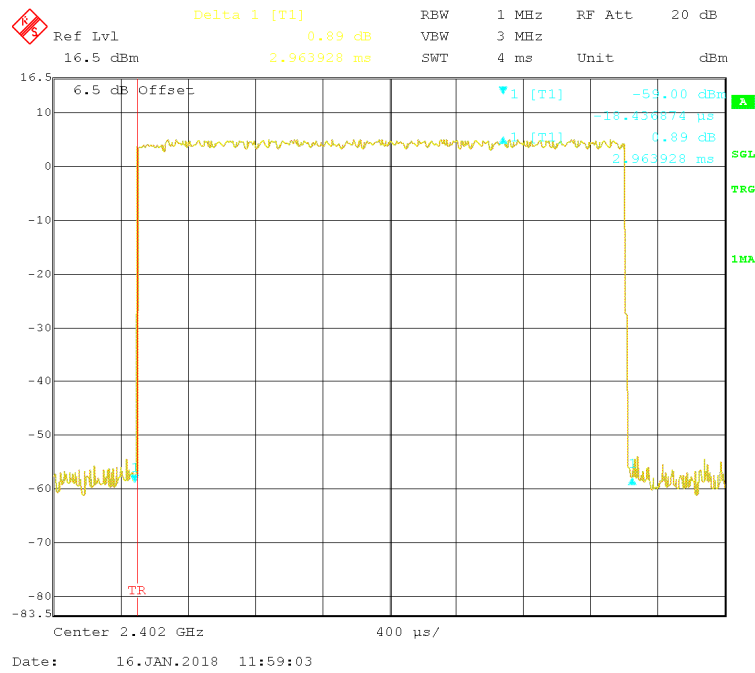
EDR (8DPSK): Pulse time, Middle Channel, 3DH3



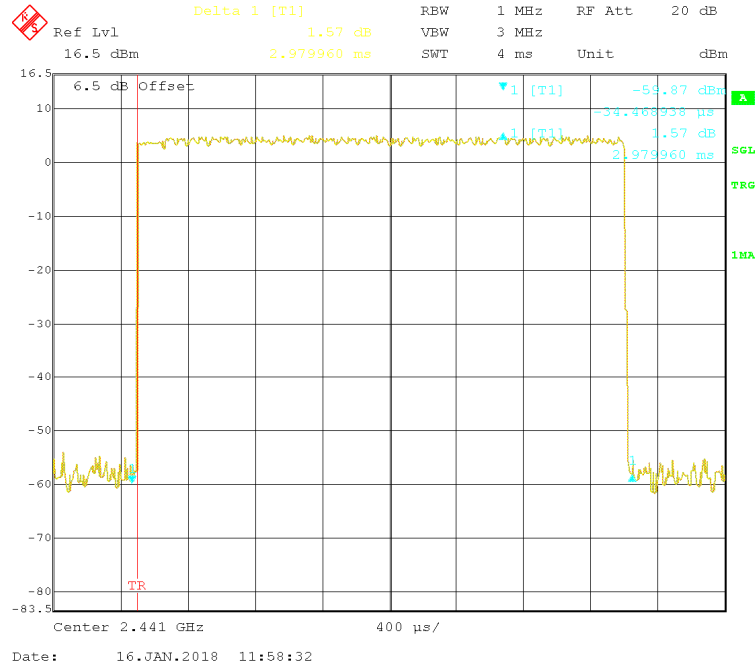
EDR (8DPSK): Pulse time, High Channel, 3DH3



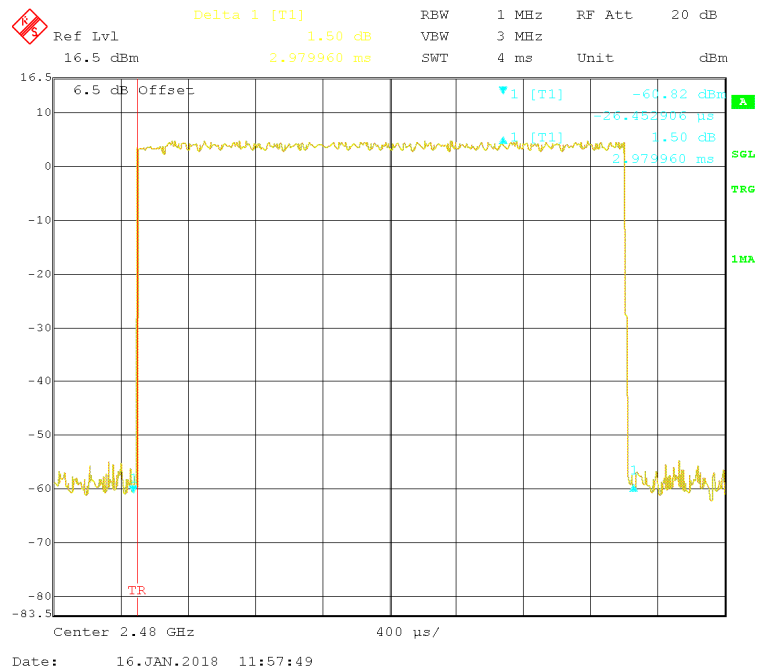
EDR (8DPSK): Pulse time, Low Channel, 3DH5



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



EDR (8DPSK): 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**

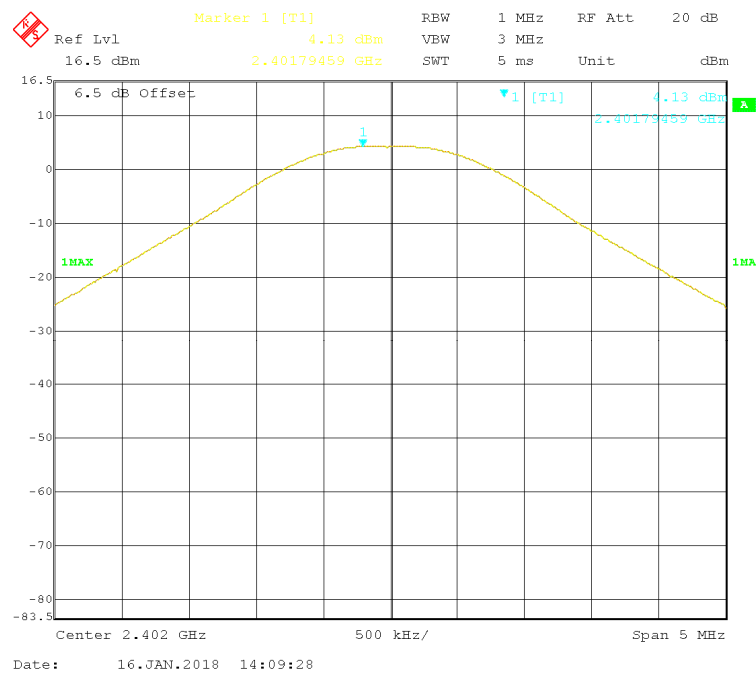
Temperature:	23.2 °C
Relative Humidity:	50 %
ATM Pressure:	101.2 kPa

The testing was performed by Ada Yu on 2018-01-16.

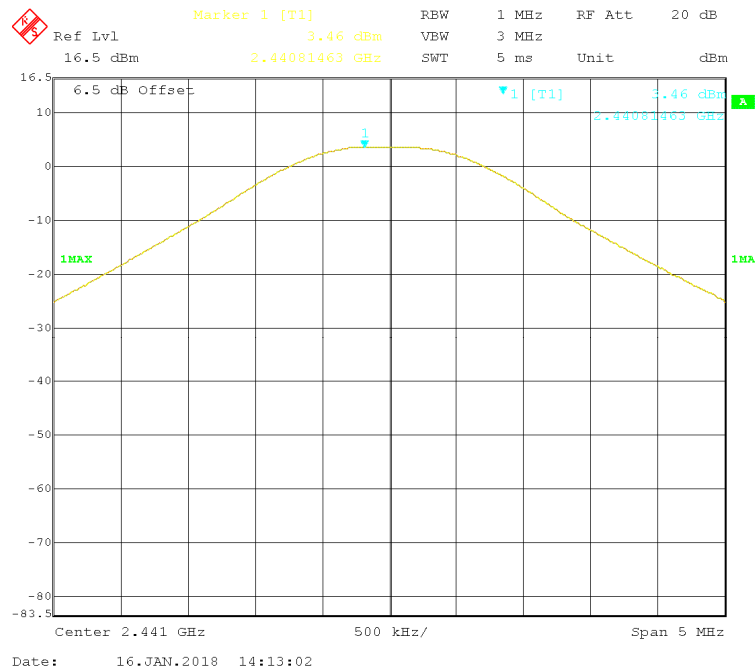
EUT operation mode: Transmitting

Test Result: Compliance.

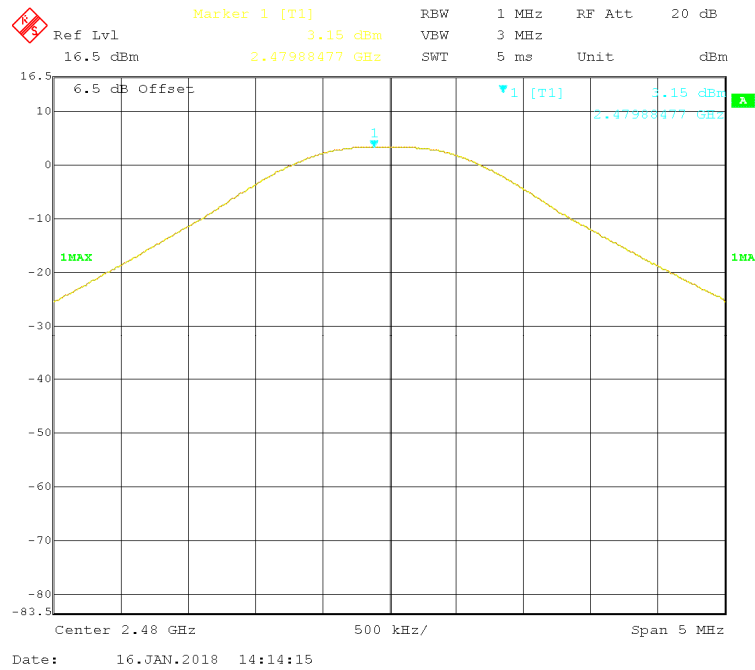
Mode	Frequency (MHz)	Output Power		Limit (mW)
		(dBm)	(mW)	
BDR (GFSK)	2402	4.13	2.59	1000
	2441	3.46	2.22	1000
	2480	3.15	2.07	1000
EDR ($\pi/4$-DQPSK)	2402	5.17	3.29	125
	2441	4.70	2.95	125
	2480	4.70	2.95	125
EDR (8DPSK)	2402	5.42	3.48	125
	2441	5.29	3.38	125
	2480	5.17	3.29	125

BDR (GFSK): 2402MHz

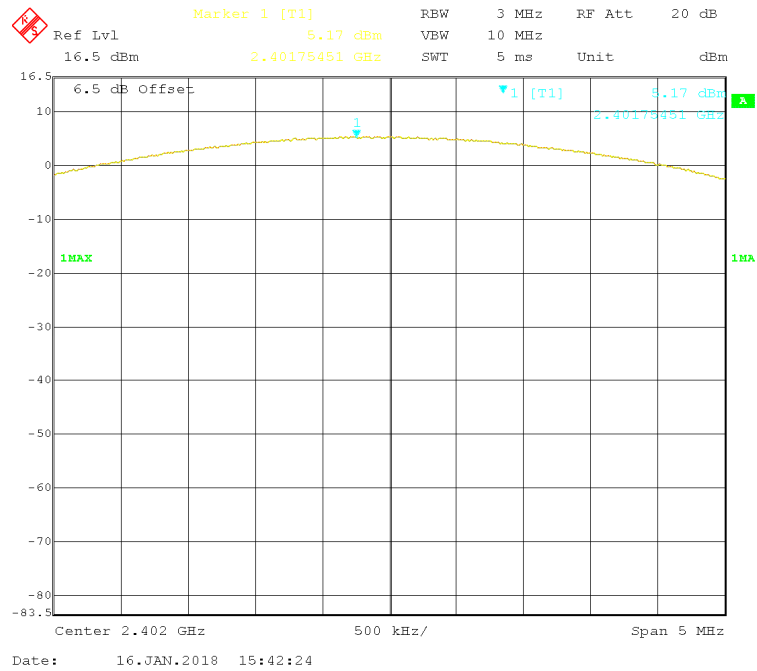
BDR (GFSK): 2441MHz



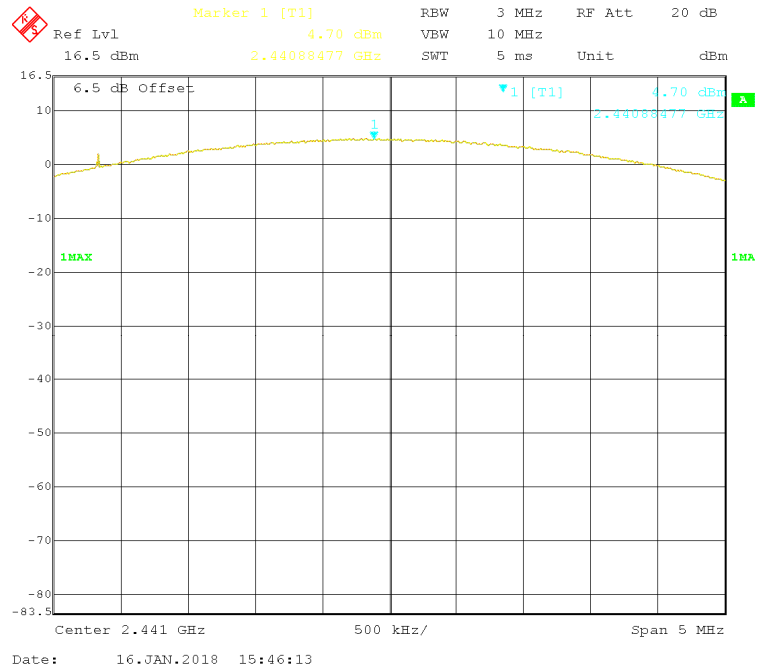
BDR (GFSK): 2480MHz



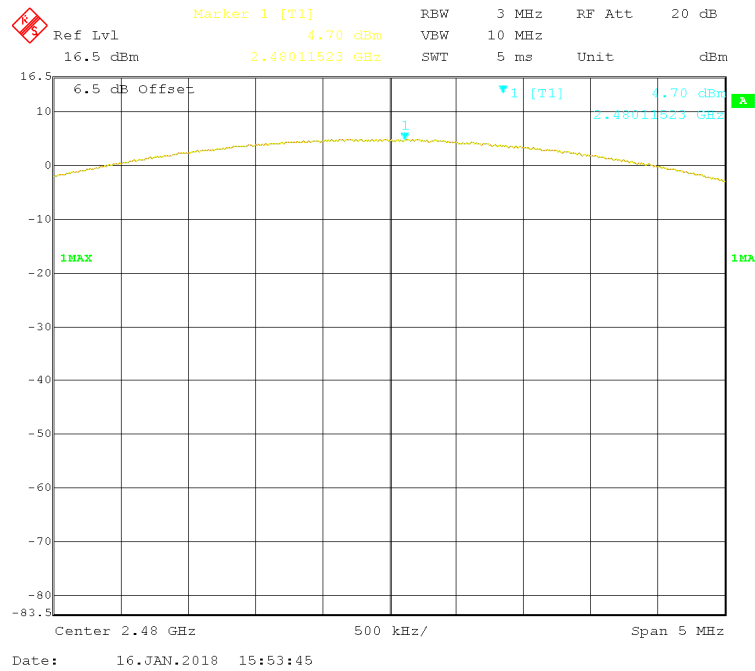
EDR($\pi/4$ -DQPSK): 2402MHz



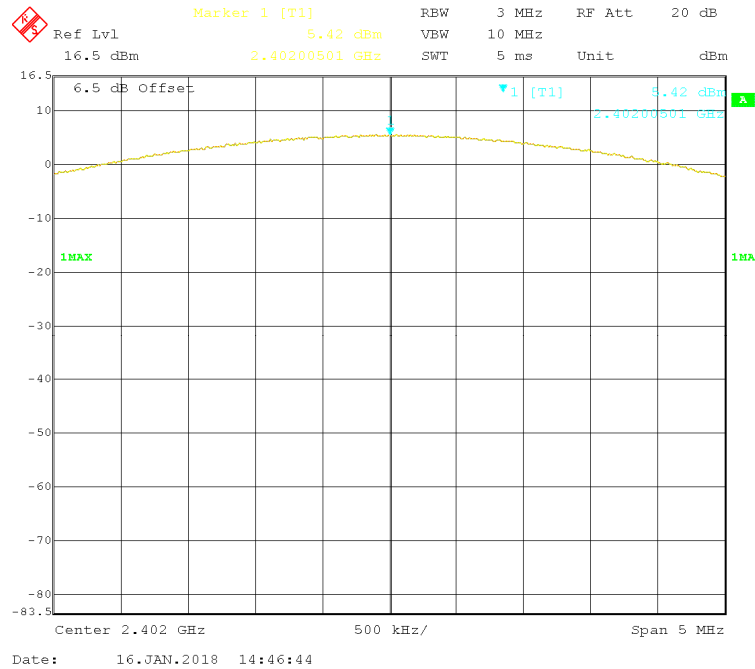
EDR($\pi/4$ -DQPSK): 2441MHz



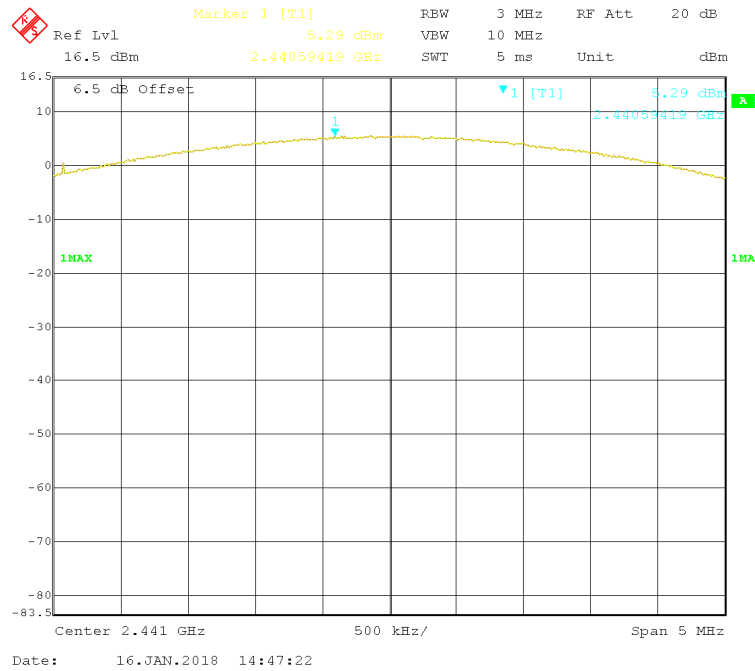
EDR(π /4-DQPSK): 2480MHz



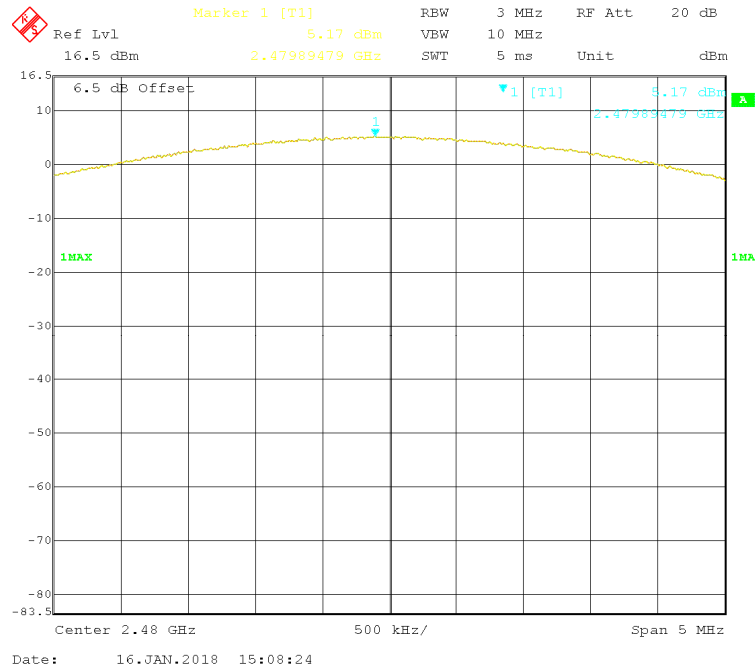
EDR(8DPSK): 2402MHz



EDR(8DPSK): 2441MHz



EDR(8DPSK): 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

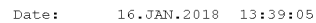
Temperature:	23.2 °C
Relative Humidity:	50 %
ATM Pressure:	101.3 kPa

The testing was performed by Ada Yu on 2018-01-16.

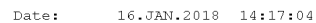
EUT operation mode: Transmitting&Hopping

Test Result: Compliance.

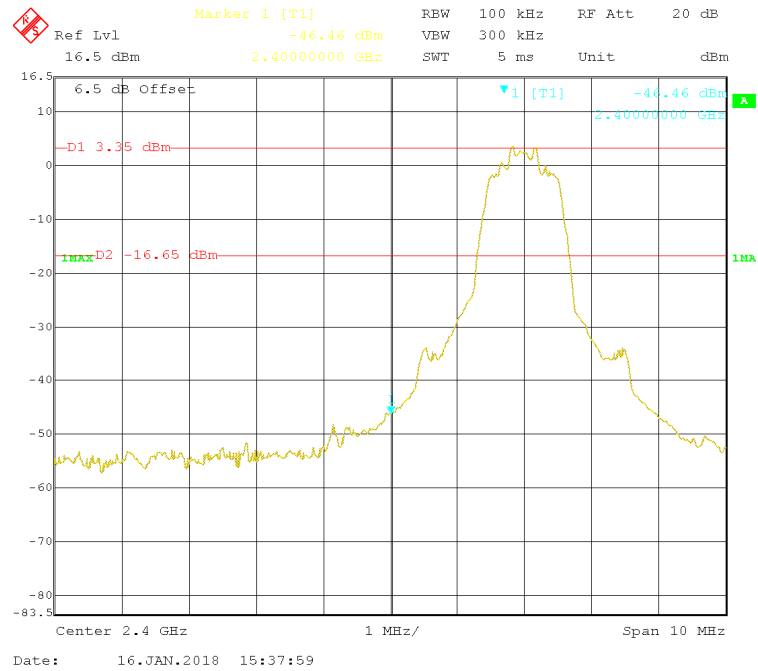
BDR (GFSK): Left Side



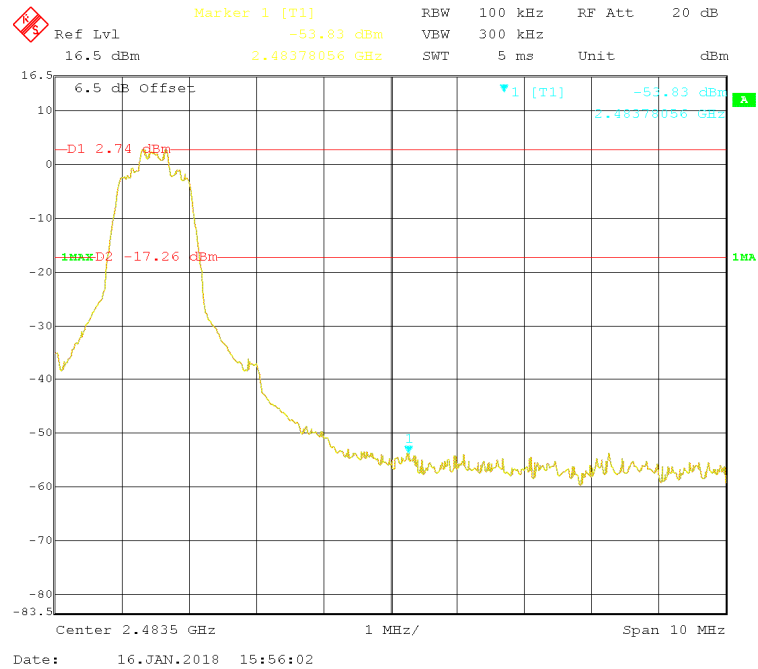
BDR (GFSK): Right Side



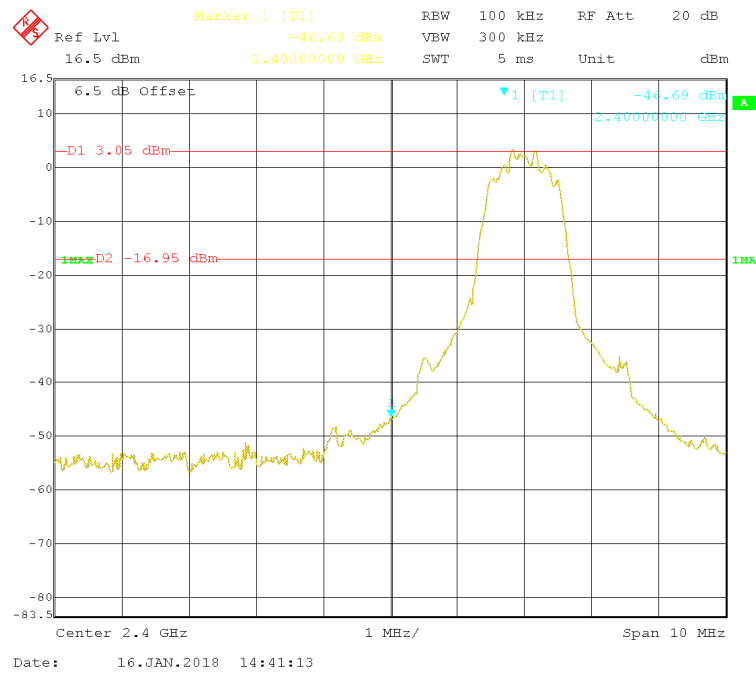
EDR ($\pi/4$ -DQPSK): Left Side



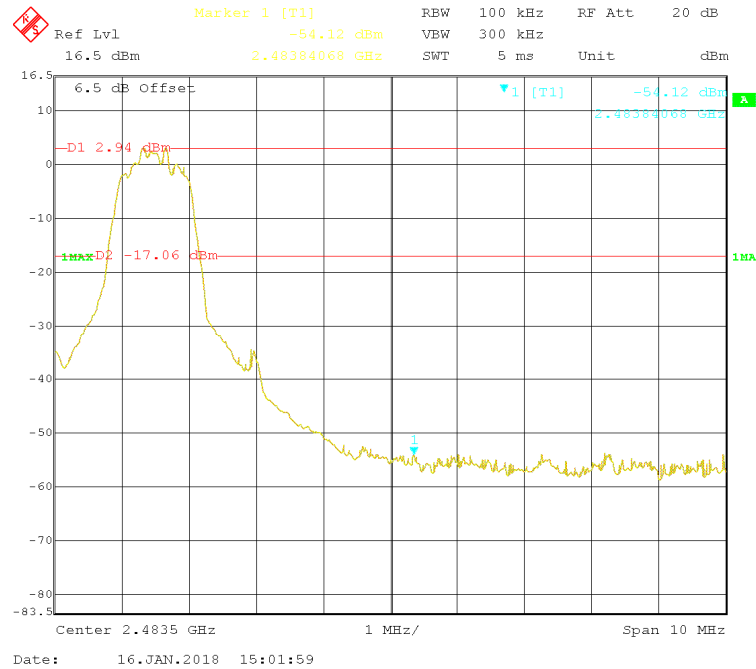
EDR ($\pi/4$ -DQPSK): Right Side

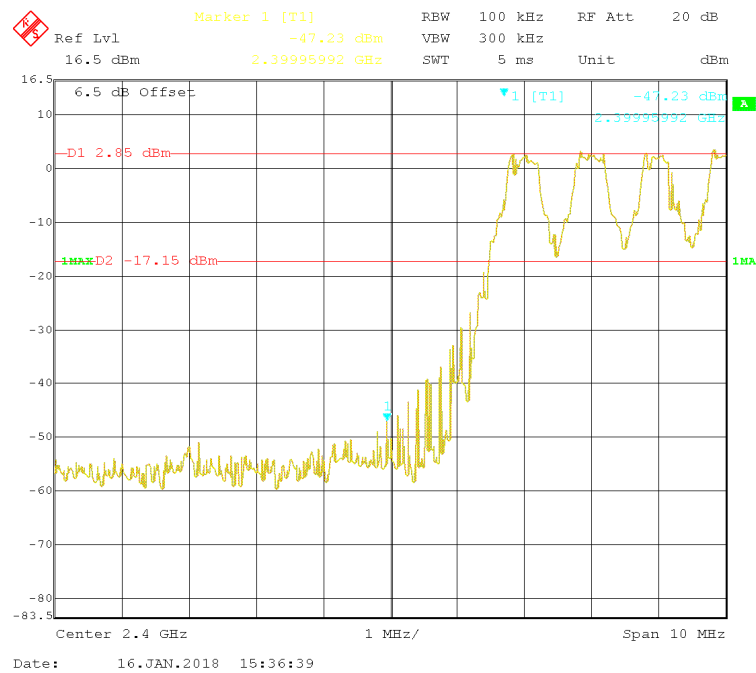
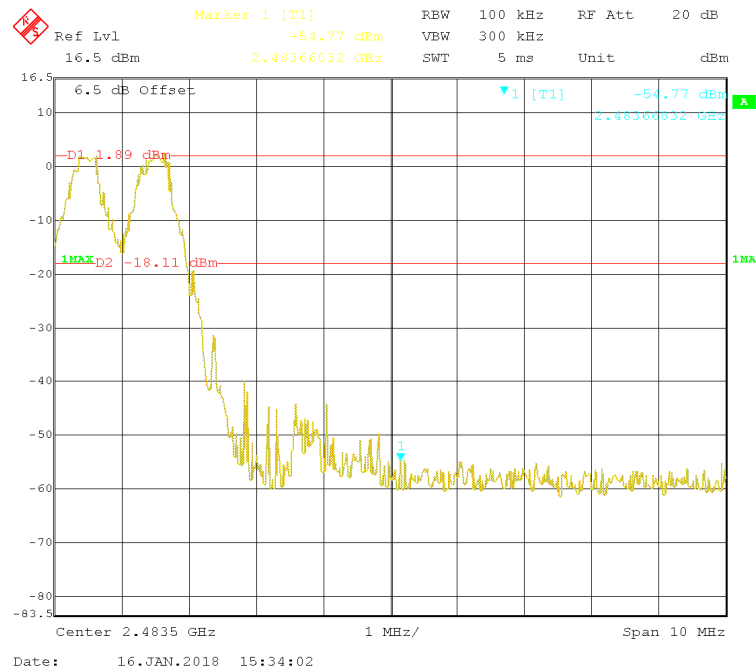


EDR (8DPSK): Left Side

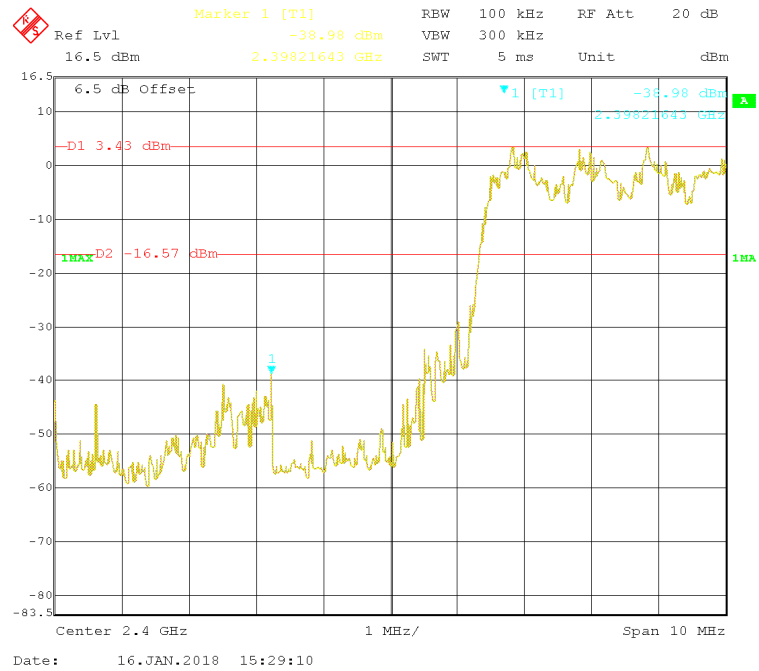


EDR (8DPSK): Right Side

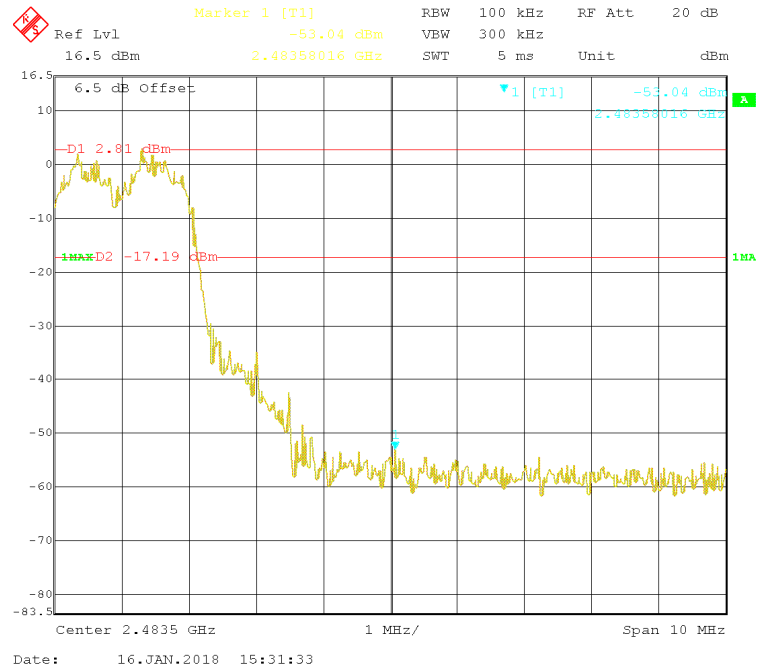


BDR (GFSK): Left Side - Hopping**BDR (GFSK): Right Side- Hopping**

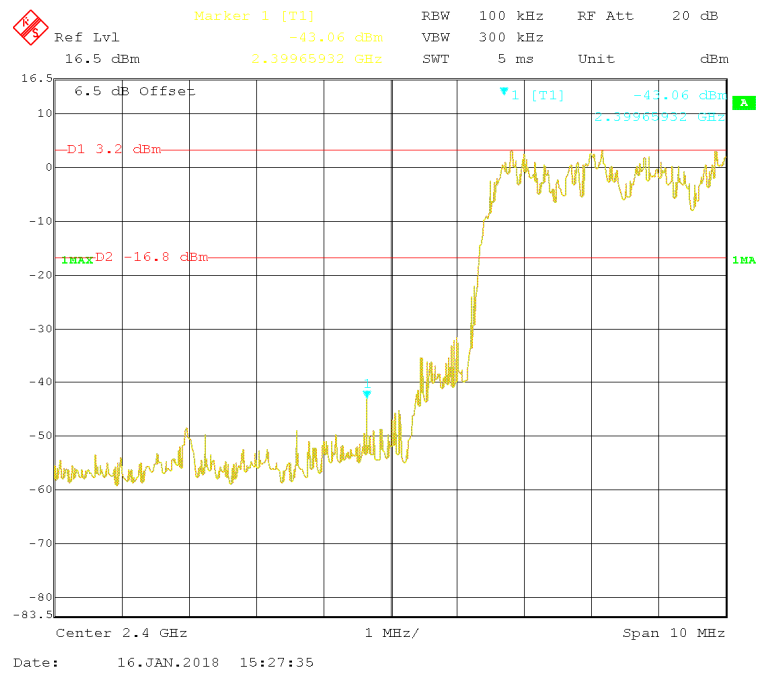
EDR ($\pi/4$ -DQPSK): Left Side- Hopping



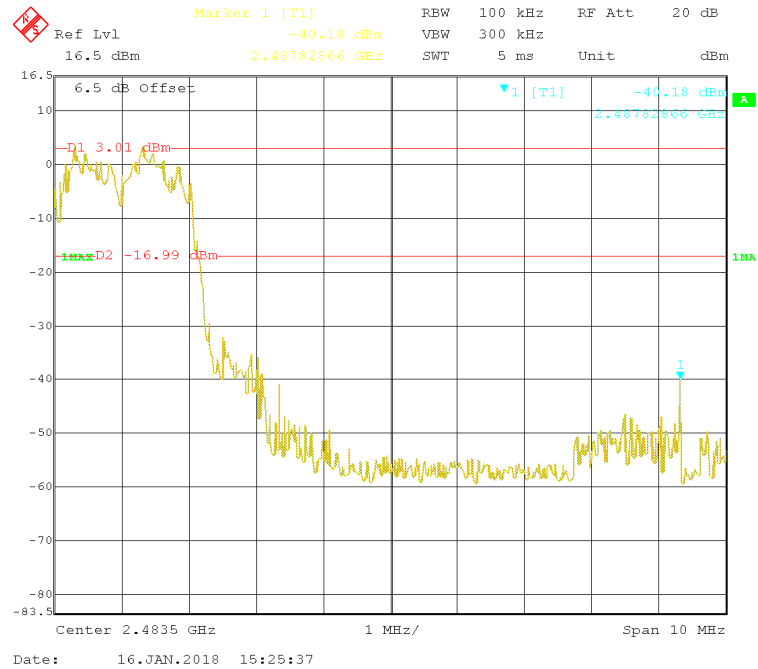
EDR ($\pi/4$ -DQPSK): Right Side- Hopping



EDR (8DPSK): Left Side- Hopping



EDR (8DPSK): Right Side- Hopping



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