FCC PART 15.247
TEST REPORT

For

Qingdao Hisense Intelligent Commercial System Co., Ltd.

Bldg 3, 151 Zhuzhou Lu, Laoshan, Qingdao, China

FCC ID: GQK-HM618

Report Type:	Product Type:
Original Report	Tablet POS

Test Engineer:	Kyle Xu
Report Number:	RSHA170823001-00A
Report Date:	2017-10-14
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

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Qingdao Hisense Intelligent Commercial System Co., Ltd.
Tested Model	HM618
Series Model	HM616
Product Type	Tablet POS
Dimension	Tablet: 282 mm(L)×198 mm(W)×18 mm(H) Dock: 151 mm(L)×121 mm(W)×92 mm(H) Multifunctional dock: 236 mm(L)×218 mm(W)×370 mm(H)
Power Supply	Tablet: DC 3.7V from battery and DC 5.0V charging by adapter Dock: DC5.0V charging by adapter Multifunctional dock: DC24.0V charging by adapter

Adapter-1 Information:
Model: ADS-25SGP-06 05020E
Input: AC100-240V, 50/60Hz, 0.7A
Output:5.0V, 4.0A

Adapter-2 Information:
Model: FSP060-DAAN2
Input: AC100-240V, 50/60Hz, 0.7A
Output:24.0V, 2.5A

** Note: The difference between tested model and series model was explained in the declaration letter.*

**All measurement and test data in this report was gathered from production sample serial number: 20170823001 (Assigned by the BACL. The EUT supplied by the applicant was received on 2017-08-23)*

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, Part15.225 DXX and Part 15.407 NII submission with FCC ID: GQK-HM618.

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		3.19 dB
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	4.88dB
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.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 815570. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For BlueTooth, 79 channels are provided for testing:

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: BLUETOOL_MI_1.9.2.0

GFSK: Power level 7
π/4-DQPSK: Power level 7
8-DPSK: Power level 7

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

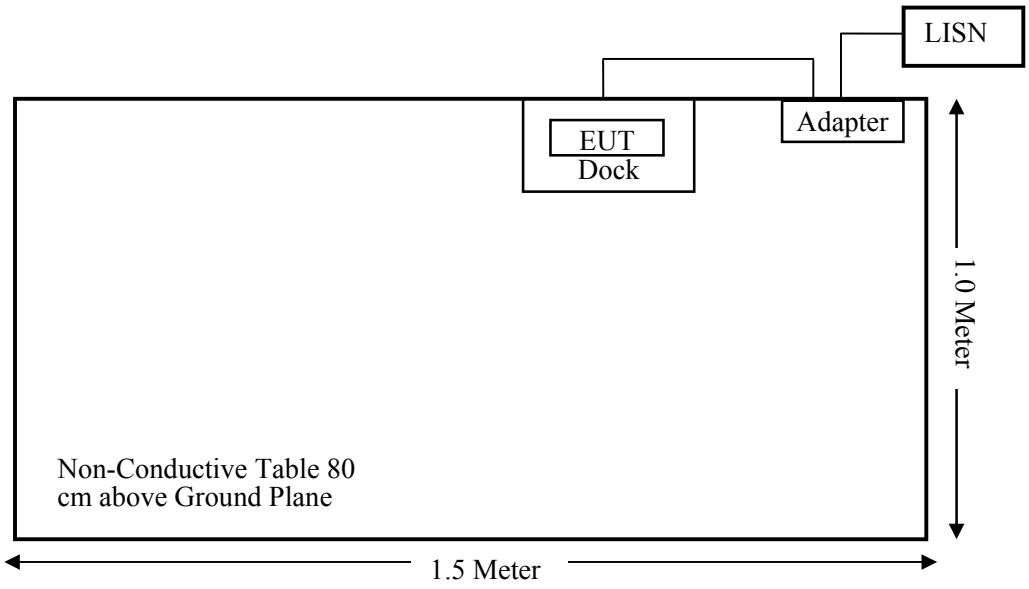
Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

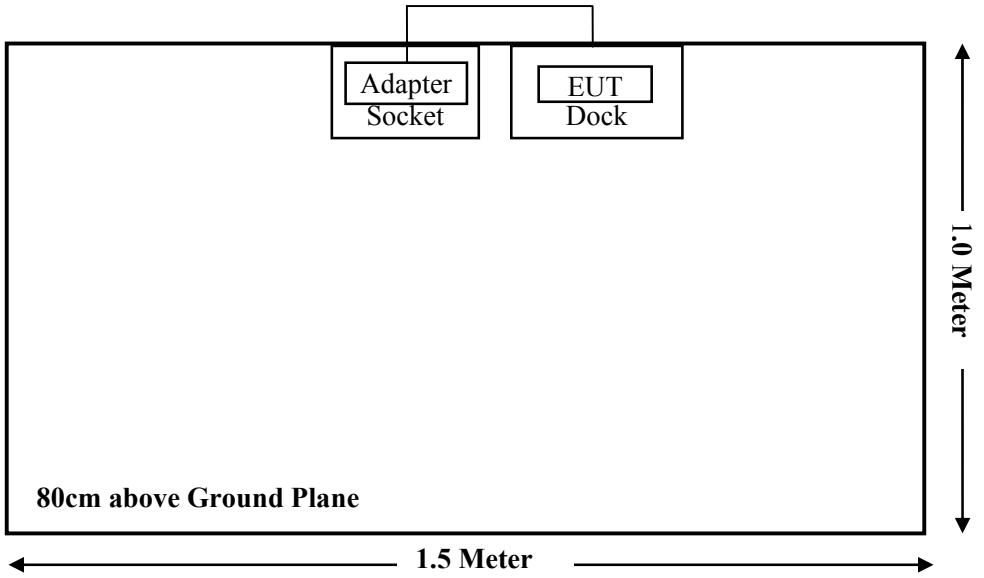
Cable Description	Shielding Type	Length (m)	From Port	To
/	/	/	/	/

Block Diagram of Test Setup

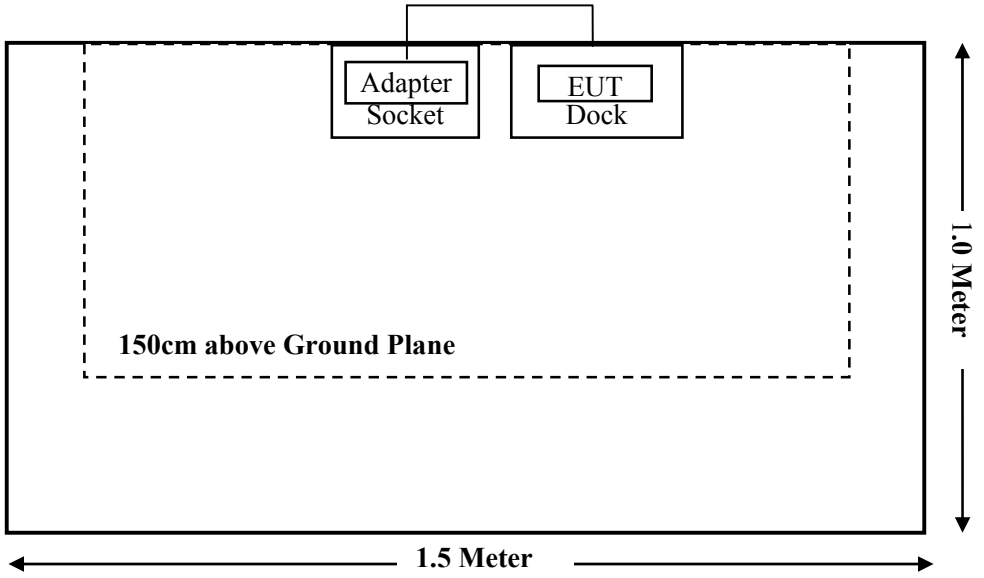
For Conducted Emissions:



For Radiated Emissions(Below 1GHz):



For Radiated Emissions(Above 1GHz):



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§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	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	2016-11-25	2017-11-24
Sunol Sciences	Broadband Antenna	JB3	A040914-2	2016-01-09	2019-01-08
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	Signal Analyzer	FSIQ26	100048	2016-11-25	2017-11-24
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	2016-12-12	2017-12-11
Heatsink Required	Amplifier	QLW-18405536-J0	15964001009	2016-12-12	2017-12-11
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
Hisense	RF Cable	N/A	N/A	2017-08-28	2018-08-37
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2016-11-25	2017-11-24
Rohde & Schwarz	LISN	ESH3-Z5	862770/011	2016-10-10	2017-10-09
Rohde & Schwarz	LISN	ENV216	3560655016	2016-11-25	2017-11-24
BACL	BACL-EMC	V1.0	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§1.1310 &§2.1093 –RF EXPOSURE

Applicable Standard

According to§2.1093and §1.1307(b)(1), 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:

For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:
[(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

·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
·When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion

Standalone SAR test exclusion

Mode	Frequency Range (MHz)	Conducted Output Power			Minimum Distance (mm)	Calculated Value	Threshold (1-g)	SAR Test Exclusion
		ANT0 (dBm)	ANT1 (dBm)	ANT0+ANT1 (dBm)				
Bluetooth	2402-2480	-1.00	/	/	5.00	0.3	3.00	Yes
BLE	2402-2480	-1.00	/	/	5.00	0.3	3.00	Yes
802.11b	2412~2462	8.50	8.00	/	5.00	2.2	3.00	Yes
802.11g	2412~2462	8.00	7.50	/	5.00	2.0	3.00	Yes
802.11n20	2412~2462	6.00	5.00	8.00	5.00	2.0	3.00	Yes
802.11n40	2422~2452	5.00	4.50	8.00	5.00	2.0	3.00	Yes
802.11a	5180~5240	7.50	7.00	/	5.00	2.6	3.00	Yes
	5745~5825	7.50	7.00	/	5.00	2.7	3.00	Yes
802.11n20	5180~5240	5.00	4.00	7.50	5.00	2.6	3.00	Yes
	5745~5825	4.50	4.00	7.00	5.00	2.4	3.00	Yes
802.11n40	5190~5230	4.50	4.00	7.00	5.00	2.3	3.00	Yes
	5755~5795	5.00	4.00	7.50	5.00	2.7	3.00	Yes
802.11ac20	5180~5240	5.00	4.00	7.50	5.00	2.6	3.00	Yes
	5745~5825	5.00	4.00	7.50	5.00	2.7	3.00	Yes
802.11ac40	5180~5240	5.00	4.00	7.50	5.00	2.6	3.00	Yes
	5755~5795	5.00	4.00	7.50	5.00	2.7	3.00	Yes
802.11ac80	5210	4.50	3.50	7.00	5.00	2.3	3.00	Yes
	5775	5.00	4.00	7.50	5.00	2.7	3.00	Yes

Standalone SAR estimation:

Mode	Frequency Range (MHz)	Max tune-up power (dBm)		Max tune-up power (mW)		Distance (mm)	Estimated $_{1-g}$ (W/kg)	
		ANT 0	ANT 1	ANT 0	ANT 1		ANT 0	ANT 1
Bluetooth	2402-2480	-1.00	/	0.79	/	5	0.03	/
BLE	2402-2480	-1.00	/	0.79	/	5	0.03	/
802.11b	2412~2462	8.50	8.00	7.08	6.31	5	0.30	0.26
802.11g	2412~2462	8.00	7.50	6.31	5.62	5	0.26	0.24
802.11n20	2412~2462	6.00	5.00	3.98	3.16	5	0.17	0.13
802.11n40	2422~2452	5.00	4.50	3.16	2.82	5	0.13	0.12
802.11a	5180~5240	7.50	7.00	5.62	5.01	5	0.34	0.31
	5745~5825	7.50	7.00	5.62	5.01	5	0.36	0.32
802.11n20	5180~5240	5.00	4.00	3.16	2.51	5	0.19	0.15
	5745~5825	4.50	4.00	2.82	2.51	5	0.18	0.16
802.11n40	5190~5230	4.50	4.00	2.82	2.51	5	0.17	0.15
	5755~5795	5.00	4.00	3.16	2.51	5	0.20	0.16
802.11ac20	5180~5240	5.00	4.00	3.16	2.51	5	0.19	0.15
	5745~5825	5.00	4.00	3.16	2.51	5	0.20	0.16
802.11ac40	5180~5240	5.00	4.00	3.16	2.51	5	0.19	0.15
	5755~5795	5.00	4.00	3.16	2.51	5	0.20	0.16
802.11ac80	5210	4.50	3.50	2.82	2.24	5	0.17	0.14
	5775	5.00	4.00	3.16	2.51	5	0.20	0.16

When standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:
[(*max. power of channel, including* ***tune-up tolerance****, mW*)/(*min. test separation distance, mm*)]·[√f(GHz)/*x*] W/kg for *test separation distances* ≤ 50 mm;
where *x* = 7.5 for 1-g SAR.
When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion

Simultaneous Transmission:

Description of Simultaneous Transmit Capabilities		
Transmitter Combination		Simultaneous?
ANT 0	ANT 1	
2.4G BT/BLE	2.4GWi-Fi	×
2.4G BT/BLE	5G Wi-Fi	√
2.4G Wi-Fi	2.4G Wi-Fi	√
2.4G Wi-Fi	5G Wi-Fi	×
5G Wi-Fi	2.4G Wi-Fi	×
5G Wi-Fi	5G Wi-Fi	√

Simultaneous SAR test exclusion considerations:

Mode (ANT 0+ ANT 1)	Reported SAR (W/kg)		ΣSAR < 1.6W/kg
	ANT 0	ANT 1	
2.4G BT +5G Wi-Fi	0.03	0.32	0.35
2.4G Wi-Fi	0.30	0.26	0.56
5G Wi-Fi	0.36	0.32	0.68

Conclusion: ΣSAR < 1.6 W/kg therefore simultaneous transmission SAR is not required.

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 FPCB antenna arrangement for Bluetooth, which the antenna gain is 1.2 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

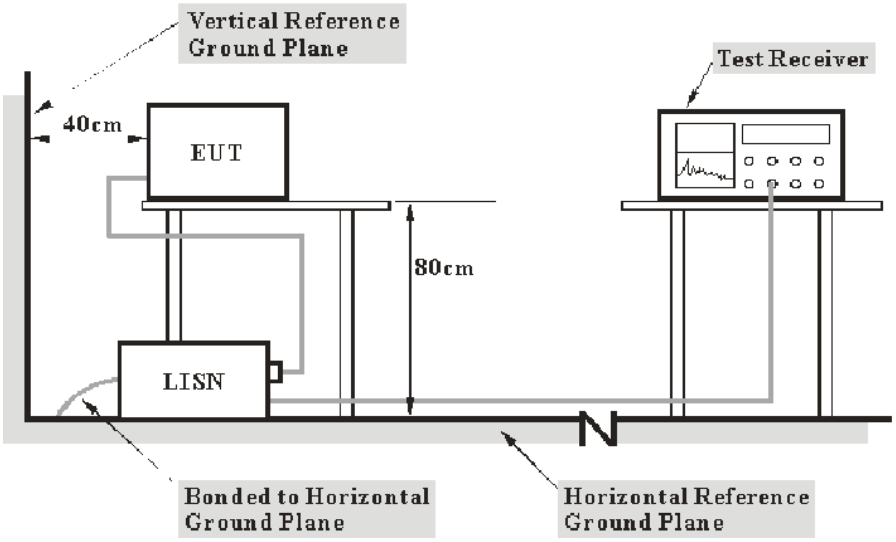
Result: Compliance.

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:

Correction 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 – Corrected Amplitude

Test Results Summary

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

Test Data

Environmental Conditions

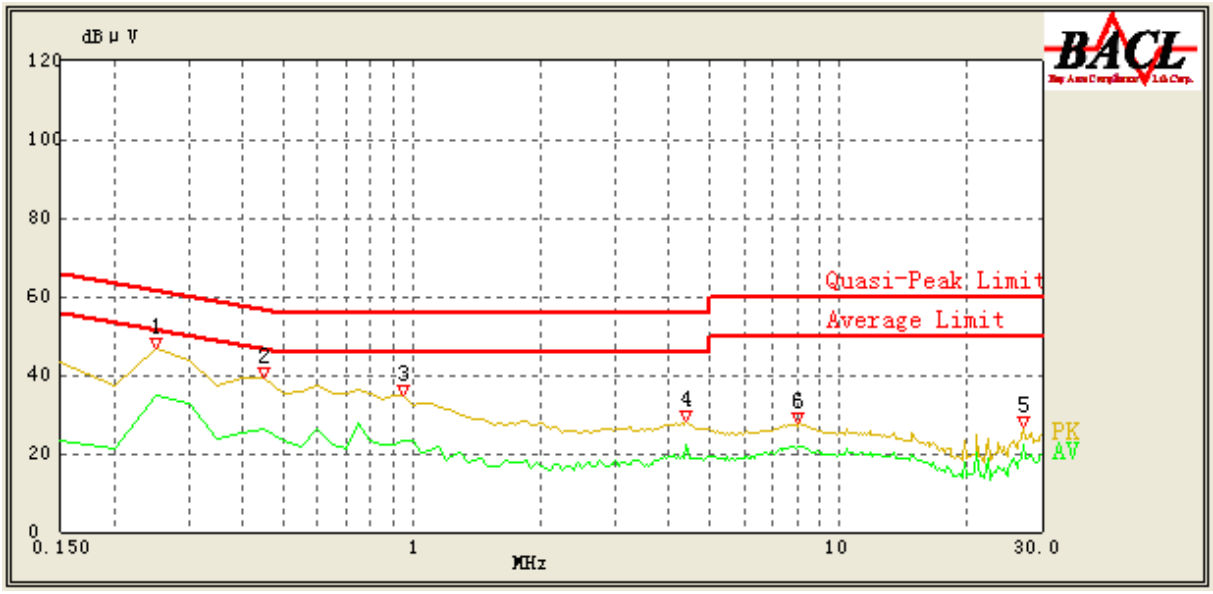
Temperature:	20.2 ℃
Relative Humidity:	51 %
ATM Pressure:	101.3 kPa

The testing was performed by Kyle Xu on 2017-08-29.

EUT operation mode: Transmitting in high channel of GFSK (Worst case)

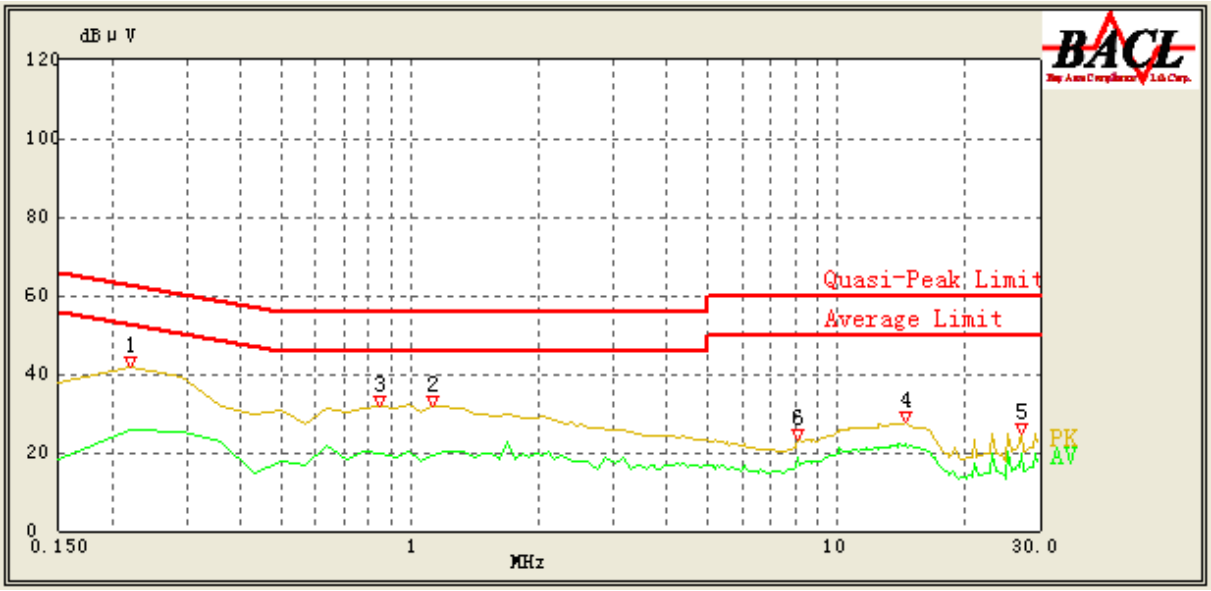
Adapter 1

AC 120V/60 Hz, Line



Frequency (MHz)	Reading (dBµV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Correction (dB)	Limit (dBµV)	Margin (dB)	Comment
0.250	46.59	PK	9.000	L1	16.02	63.14	16.55	Compliance
0.250	34.59	AV	9.000	L1	16.02	53.14	18.55	Compliance
0.450	39.17	PK	9.000	L1	16.07	57.43	18.26	Compliance
0.450	26.26	AV	9.000	L1	16.07	47.43	21.17	Compliance
0.950	34.78	PK	9.000	L1	15.89	56.00	21.22	Compliance
0.950	23.16	AV	9.000	L1	15.89	46.00	22.84	Compliance
4.400	28.09	PK	9.000	L1	15.85	56.00	27.91	Compliance
4.400	22.05	AV	9.000	L1	15.85	46.00	23.95	Compliance
27.100	26.96	PK	9.000	L1	16.51	60.00	33.04	Compliance
27.100	22.32	AV	9.000	L1	16.51	50.00	27.68	Compliance
8.050	27.84	PK	9.000	L1	16.01	60.00	32.16	Compliance
8.050	21.91	AV	9.000	L1	16.01	50.00	28.09	Compliance

AC 120V/60 Hz, Neutral



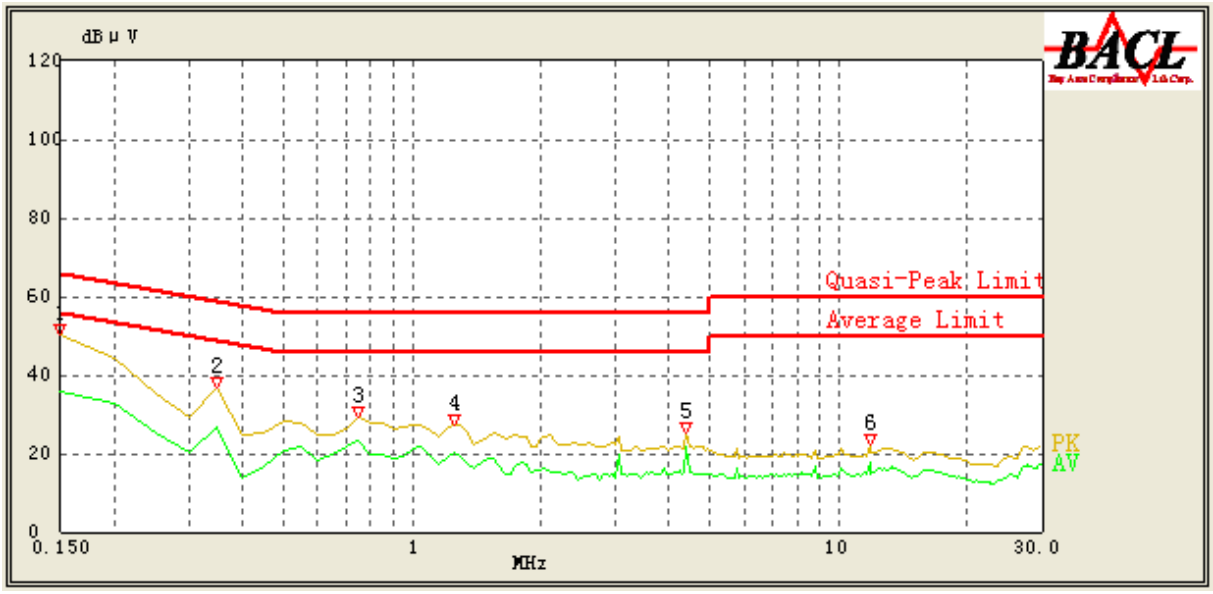
Frequency (MHz)	Reading (dBµV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Correction (dB)	Limit (dBµV)	Margin (dB)	Comment
0.220	41.89	PK	9.000	N	16.05	64.00	22.11	Compliance
0.220	25.62	AV	9.000	N	16.05	54.00	28.38	Compliance
1.130	31.55	PK	9.000	N	15.94	56.00	24.45	Compliance
1.130	19.30	AV	9.000	N	15.94	46.00	26.70	Compliance
0.850	31.94	PK	9.000	N	15.97	56.00	24.06	Compliance
0.850	19.57	AV	9.000	N	15.97	46.00	26.43	Compliance
14.570	27.64	PK	9.000	N	16.01	60.00	32.36	Compliance
14.570	22.22	AV	9.000	N	16.01	50.00	27.78	Compliance
27.100	24.87	PK	9.000	N	16.28	60.00	35.13	Compliance
27.100	19.99	AV	9.000	N	16.28	50.00	30.01	Compliance
8.130	23.48	PK	9.000	N	15.95	60.00	36.52	Compliance
8.130	18.62	AV	9.000	N	15.95	50.00	31.38	Compliance

Note:

1) Corr.=LISN VDF (Voltage Division Factor) + Cable Loss
2) Corrected Amplitude = Reading + Corr.
3) Margin = Limit –Corrected Amplitude

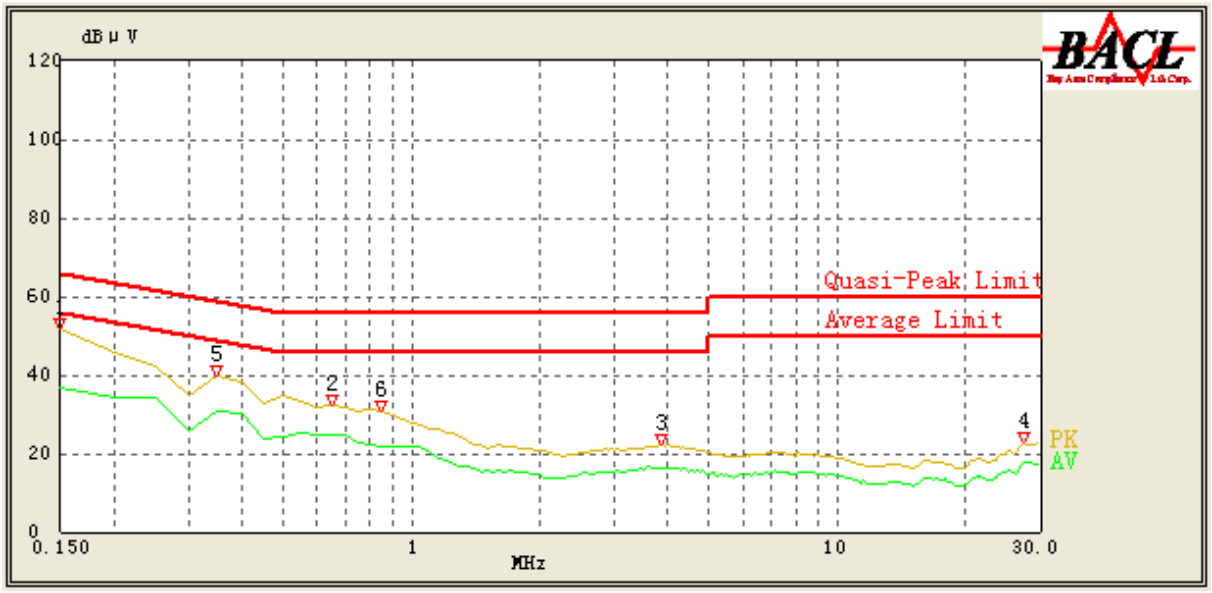
Adapter 2

AC 120V/60 Hz, Line



Frequency (MHz)	Reading (dBµV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Correction (dB)	Limit (dBµV)	Margin (dB)	Comment
0.150	50.36	PK	9.000	L1	16.06	66.00	15.64	Compliance
0.150	35.84	AV	9.000	L1	16.06	56.00	20.16	Compliance
0.350	36.51	PK	9.000	L1	16.05	60.29	23.78	Compliance
0.350	26.70	AV	9.000	L1	16.05	50.29	23.59	Compliance
0.750	29.07	PK	9.000	L1	15.94	56.00	26.93	Compliance
0.750	23.36	AV	9.000	L1	15.94	46.00	22.64	Compliance
1.250	27.16	PK	9.000	L1	15.87	56.00	28.84	Compliance
1.250	20.36	AV	9.000	L1	15.87	46.00	25.64	Compliance
4.400	25.27	PK	9.000	L1	15.85	56.00	30.73	Compliance
4.400	21.61	AV	9.000	L1	15.85	46.00	24.39	Compliance
11.850	22.34	PK	9.000	L1	16.12	60.00	37.66	Compliance
11.850	17.96	AV	9.000	L1	16.12	50.00	32.04	Compliance

AC 120V/60 Hz, Neutral



Frequency (MHz)	Reading (dBµV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Correction (dB)	Limit (dBµV)	Margin (dB)	Comment
0.150	51.87	PK	9.000	N	16.06	66.00	14.13	Compliance
0.150	36.78	AV	9.000	N	16.06	56.00	19.22	Compliance
0.650	32.05	PK	9.000	N	16.02	56.00	23.95	Compliance
0.650	24.64	AV	9.000	N	16.02	46.00	21.36	Compliance
3.850	22.09	PK	9.000	N	15.89	56.00	33.91	Compliance
3.800	16.33	AV	9.000	N	15.89	46.00	29.67	Compliance
27.450	22.62	PK	9.000	N	16.29	60.00	37.38	Compliance
27.550	17.77	AV	9.000	N	16.29	50.00	32.23	Compliance
0.350	39.71	PK	9.000	N	16.08	60.29	20.58	Compliance
0.350	30.98	AV	9.000	N	16.08	50.29	19.31	Compliance
0.850	30.76	PK	9.000	N	15.97	56.00	25.24	Compliance
0.850	21.87	AV	9.000	N	15.97	46.00	24.13	Compliance

Note:

1) Corr.=LISN VDF (Voltage Division Factor) + Cable Loss
2) Corrected Amplitude = Reading + Corr.
3) Margin = Limit –Corrected Amplitude

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

Applicable Standard

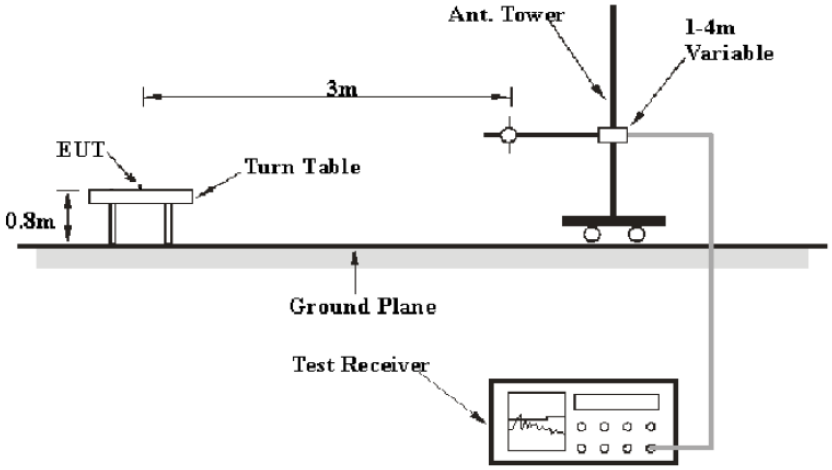
FCC §15.205; §15.209; §15.247(d)

Measurement Uncertainty

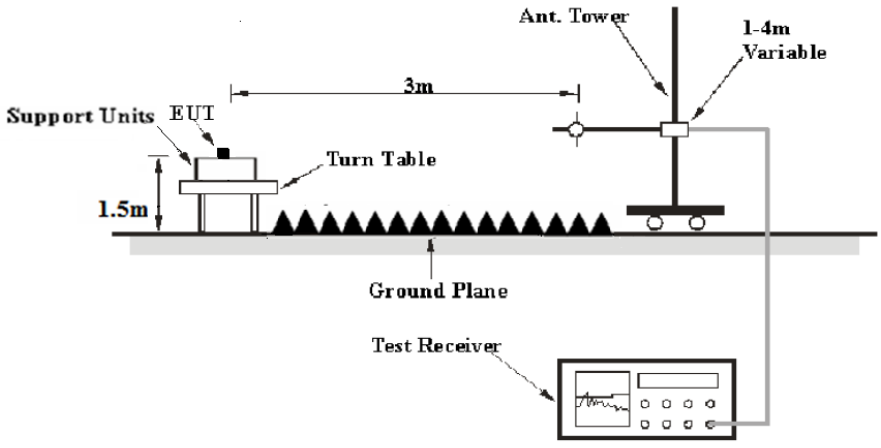
All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

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 & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer 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

Frequency Range	RBW	Video B/W	Detector
1GHz – 25GHz	1MHz	3 MHz	PK
	1MHz	10 Hz	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:	20.2 ℃
Relative Humidity:	51 %
ATM Pressure:	101.3 kPa

The testing was performed by Kyle Xu on 2017-08-29.

EUT operation mode: Transmitting

30MH -25 GHz: (*Scan with GFSK, π/4-DQPSK, 8-DPSK mode, the worst case is GFSKMode with Adapter 2*)

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
Low Channel (2402 MHz)									
242.42	53.21	QP	212	141	V	-13.40	39.81	46	6.19
2402.00	99.87	PK	130	138	V	-4.93	94.94	/	/
2402.00	93.24	Ave	130	138	V	-4.93	88.31	/	/
2402.00	99.34	PK	231	101	H	-4.93	94.41	/	/
2402.00	93.17	Ave	231	101	H	-4.93	88.24	/	/
2390.00	43.19	PK	310	219	V	-4.96	38.23	74	35.77
2390.00	29.17	Ave	310	219	V	-4.96	24.21	54	29.79
2400.00	43.68	PK	317	245	V	-8.06	35.62	74	38.38
2400.00	30.01	Ave	317	245	V	-8.06	21.95	54	32.05
1325.78	40.32	PK	315	221	V	-9.32	31.00	74	43.00
1325.78	29.35	Ave	315	221	V	-9.32	20.03	54	33.97
4804.00	41.11	PK	29	106	V	2.47	43.58	74	30.42
4804.00	29.82	Ave	29	106	V	2.47	32.29	54	21.71
7206.00	36.02	PK	274	155	V	9.79	45.81	74	28.19
7206.00	25.63	Ave	274	155	V	9.79	35.42	54	18.58

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dB μ V/m)	Margin (dB)
Middle Channel (2441 MHz)									
242.42	53.18	QP	19	117	V	-13.40	39.78	46	6.22
2441.00	98.21	PK	337	194	V	-4.82	93.39	/	/
2441.00	93.03	Ave	337	194	V	-4.82	88.21	/	/
2441.00	98.12	PK	256	192	H	-4.82	93.30	/	/
2441.00	92.94	Ave	256	192	H	-4.82	88.12	/	/
1425.35	40.03	PK	220	230	H	-8.59	31.44	74	42.56
1425.35	27.36	Ave	220	230	H	-8.59	18.77	54	35.23
3435.50	40.02	PK	156	207	H	-1.06	38.96	74	35.04
3435.50	28.36	Ave	156	207	H	-1.06	27.30	54	26.70
4882.00	40.32	PK	214	128	V	2.65	42.97	74	31.03
4882.00	28.96	Ave	214	128	V	2.65	31.61	54	22.39
6325.98	41.02	PK	179	242	H	7.38	48.40	74	25.60
6325.98	27.66	Ave	179	242	H	7.38	35.04	54	18.96
7323.00	38.35	PK	320	133	V	9.96	48.31	74	25.69
7323.00	27.36	Ave	320	133	V	9.96	37.32	54	16.68
High Channel (2480MHz)									
242.42	53.25	QP	304	223	V	-13.40	39.85	46	6.15
2480.00	99.06	PK	58	219	V	-4.72	94.34	/	/
2480.00	93.88	Ave	58	219	V	-4.72	89.16	/	/
2480.00	98.63	PK	315	112	H	-4.72	93.91	/	/
2480.00	93.45	Ave	315	112	H	-4.72	88.73	/	/
2483.50	43.21	PK	15	221	H	-6.01	37.20	74	36.80
2483.50	30.52	Ave	15	221	H	-6.01	24.51	54	29.49
2689.00	43.21	PK	354	151	H	-4.71	38.50	74	35.50
2689.00	30.95	Ave	354	151	H	-4.71	26.24	54	27.76
4960.00	40.36	PK	189	176	V	2.82	43.18	74	30.82
4960.00	28.25	Ave	189	176	V	2.82	31.07	54	22.93
6277.52	39.68	PK	229	185	H	7.13	46.81	74	27.19
6277.52	26.03	Ave	229	185	H	7.13	33.16	54	20.84
7440.00	36.24	PK	308	117	V	10.14	46.38	74	27.62
7440.00	25.35	Ave	308	117	V	10.14	35.49	54	18.51

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

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:	20.3 ℃
Relative Humidity:	51 %
ATM Pressure:	101.3 kPa

The testing was performed by Kyle Xu on 2017-10-13.

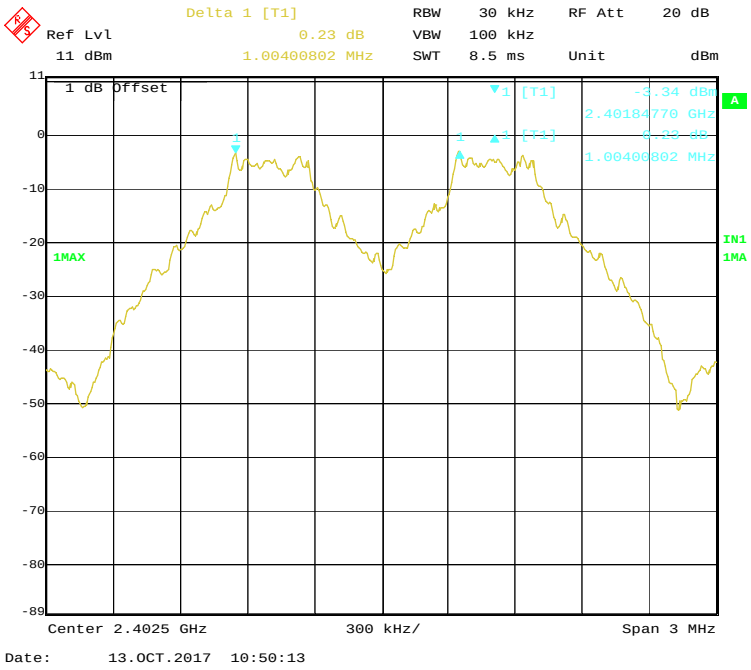
EUT operation mode: Transmitting

Test Result: Compliance.

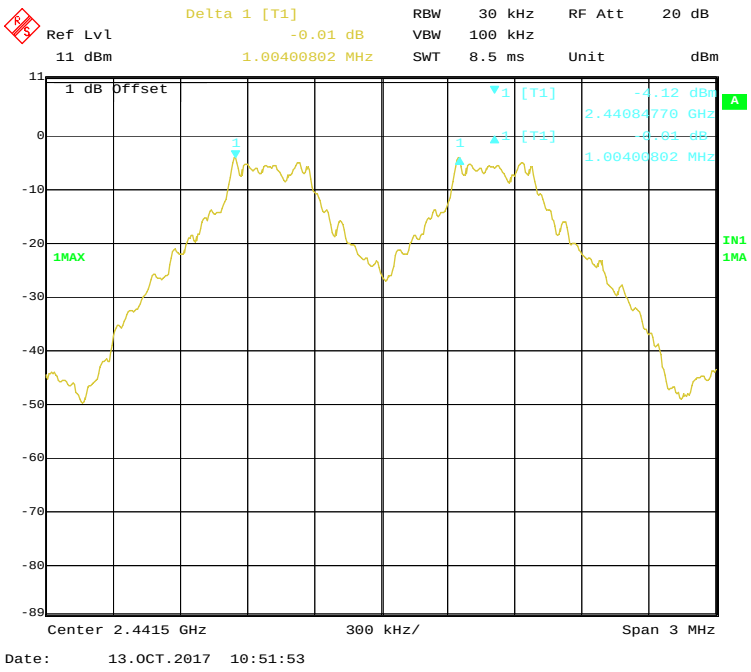
Mode	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit	Result
BDR (GFSK)	Low	2402	1.004	0.627	Pass
	Adjacent	2403			
	Middle	2441	1.004	0.627	Pass
	Adjacent	2442			
	High	2480	1.004	0.627	Pass
	Adjacent	2479			
EDR (π/4-DQPSK)	Low	2402	1.004	0.840	Pass
	Adjacent	2403			
	Middle	2441	1.004	0.847	Pass
	Adjacent	2442			
	High	2480	1.004	0.840	Pass
	Adjacent	2479			
EDR (8-DPSK)	Low	2402	1.004	0.847	Pass
	Adjacent	2403			
	Middle	2441	1.004	0.847	Pass
	Adjacent	2442			
	High	2480	1.004	0.847	Pass
	Adjacent	2479			

Note: Limit = 20 dB bandwidth*2/3

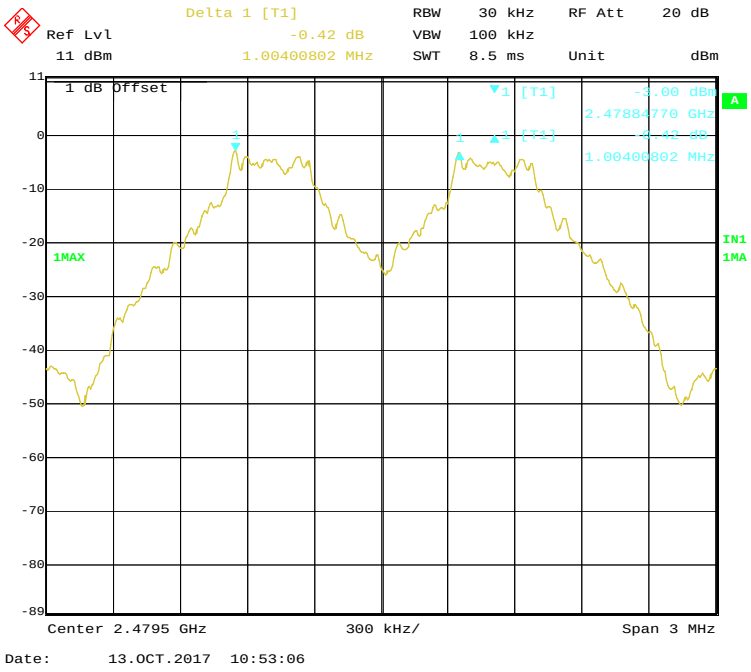
BDR (GFSK): Low Channel



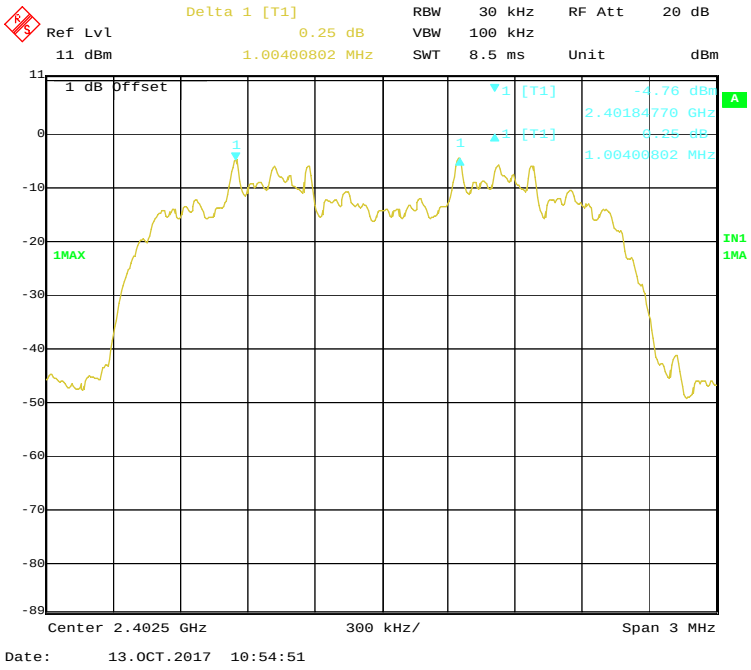
BDR (GFSK): Middle Channel



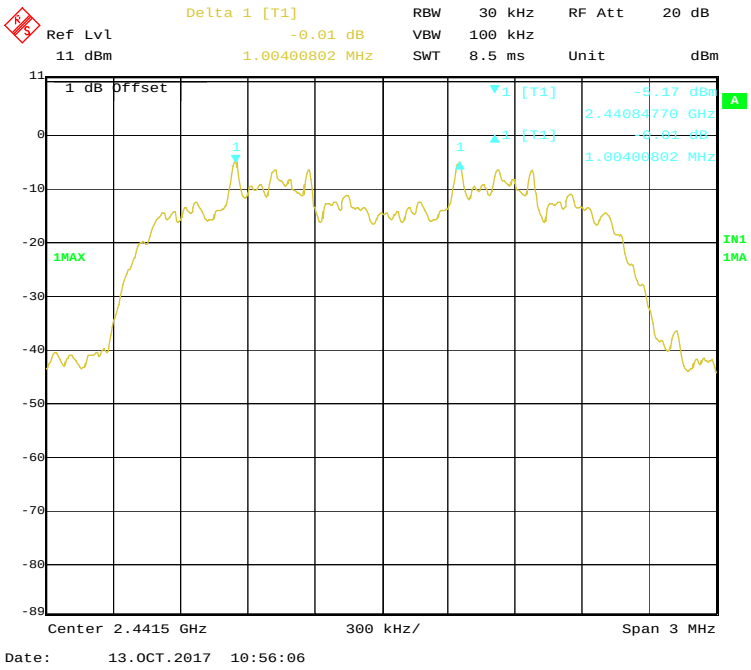
BDR (GFSK): High Channel



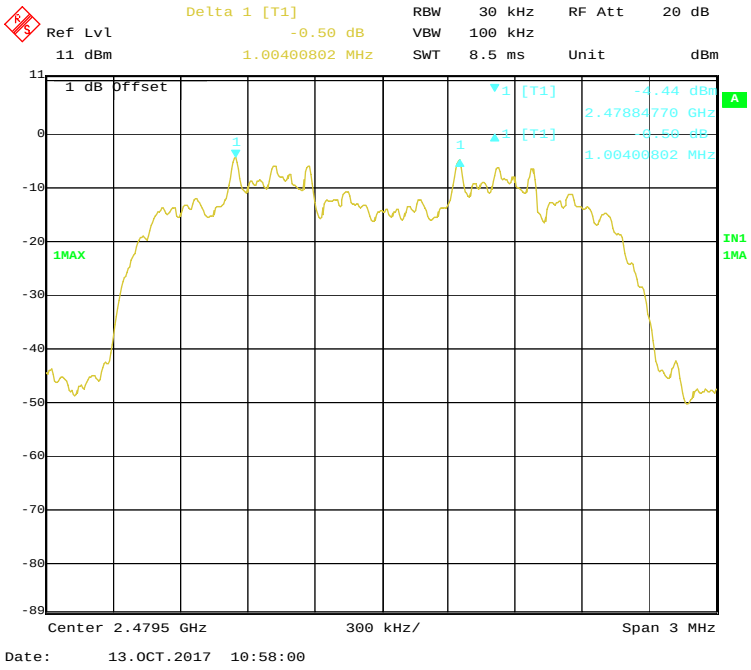
EDR (π/4-DQPSK): Low Channel



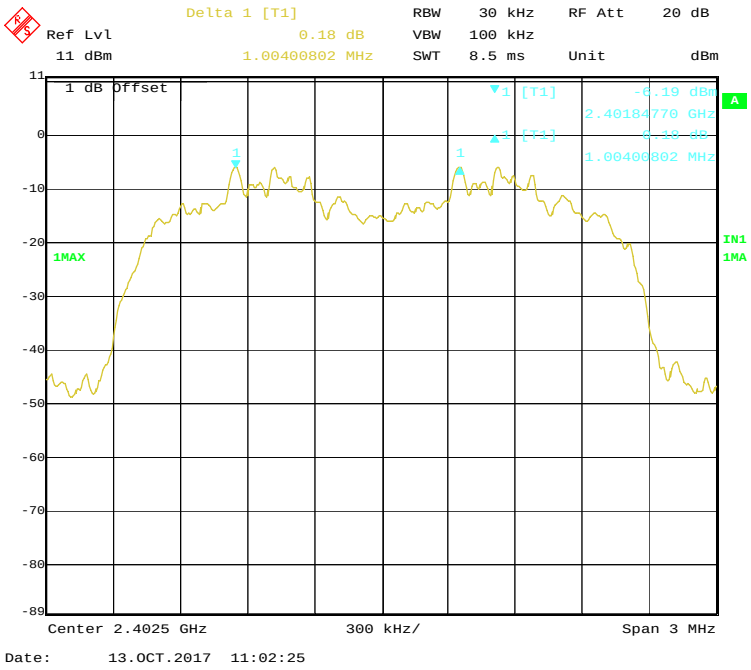
EDR (π/4-DQPSK): Middle Channel



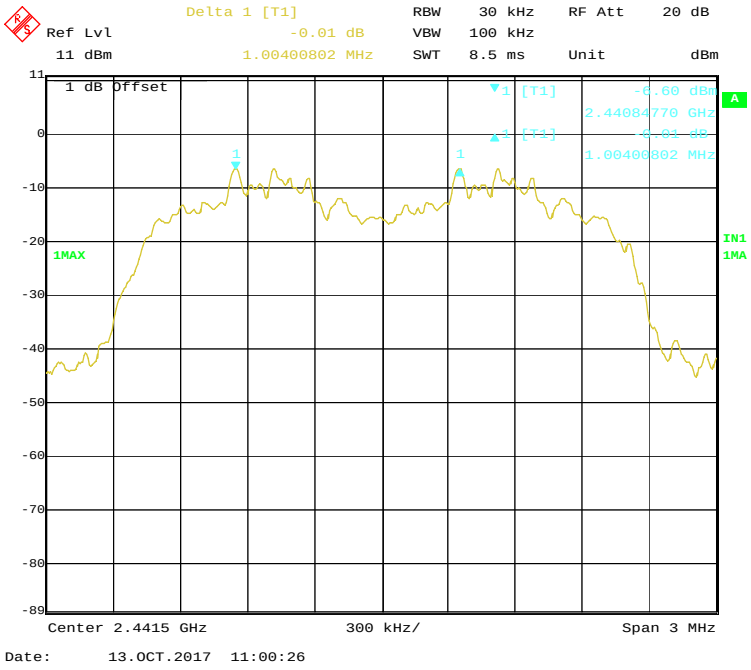
EDR (π/4-DQPSK): High Channel



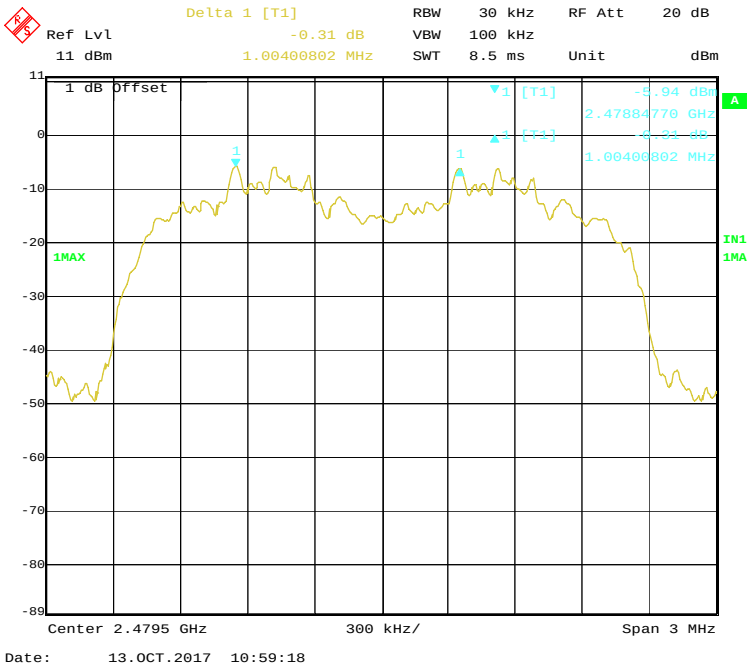
EDR (8-DPSK): Low Channel



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:	20.3 ℃
Relative Humidity:	55 %
ATM Pressure:	101.3 kPa

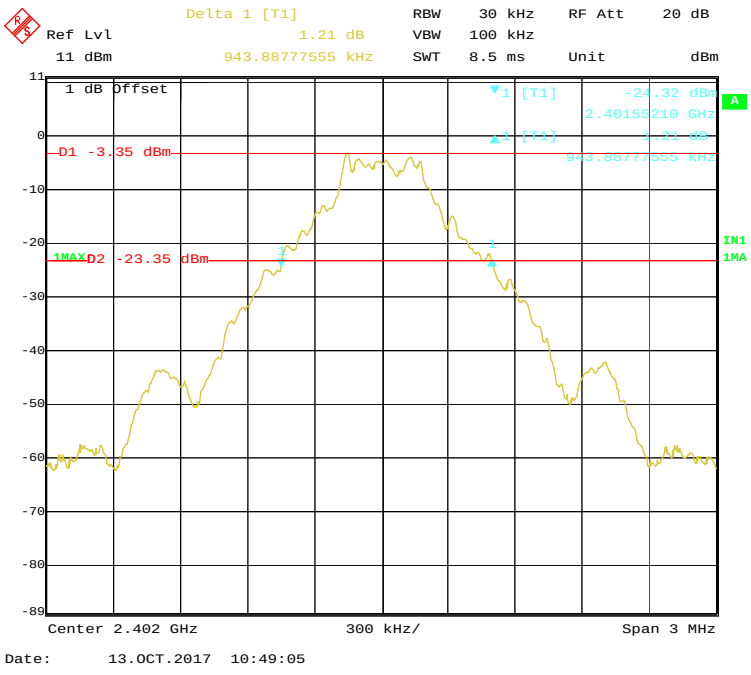
The testing was performed by Kyle Xu on 2017-10-13.

EUT operation mode: Transmitting

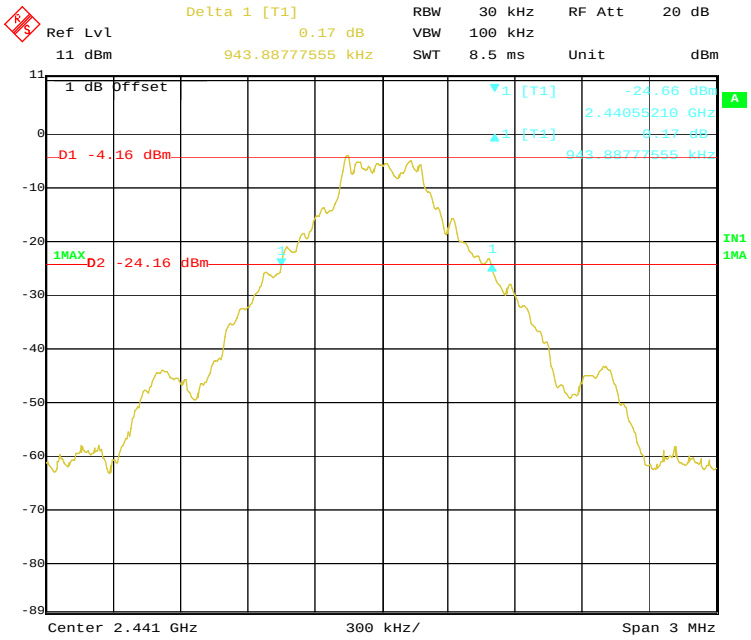
Test Result: Compliance.

Mode	Channel	Frequency (MHz)	20 dB Emission Bandwidth (MHz)
BDR (GFSK)	Low	2402	0.94
	Middle	2441	0.94
	High	2480	0.94
EDR (π/4-DQPSK)	Low	2402	1.26
	Middle	2441	1.27
	High	2480	1.26
EDR (8-DPSK)	Low	2402	1.27
	Middle	2441	1.27
	High	2480	1.27

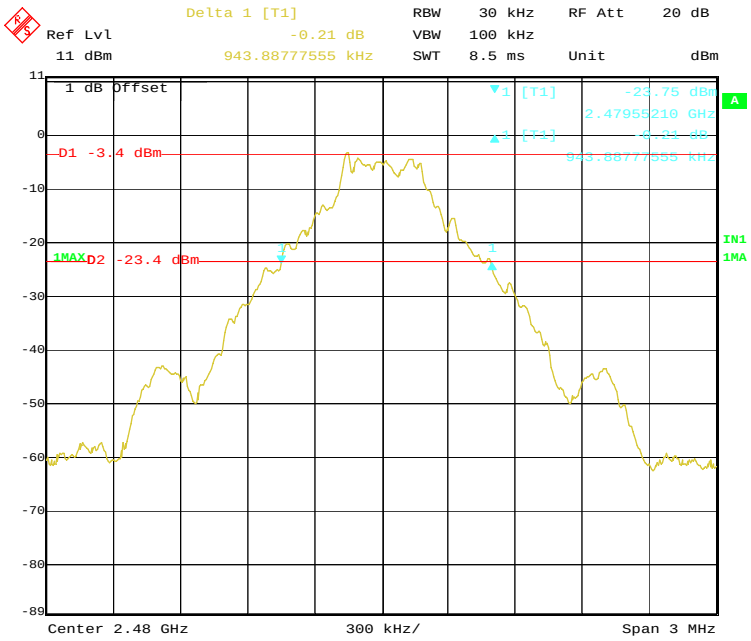
BDR (GFSK): Low Channel



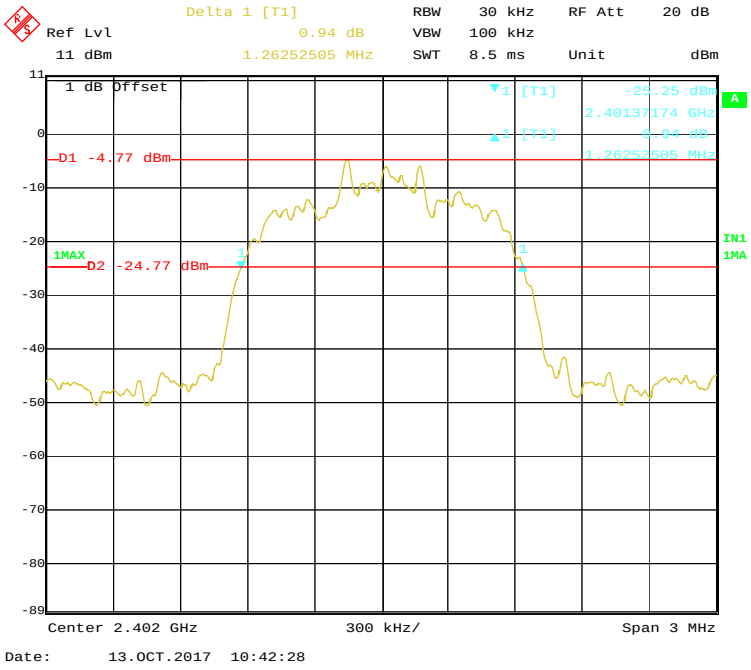
BDR (GFSK): Middle Channel



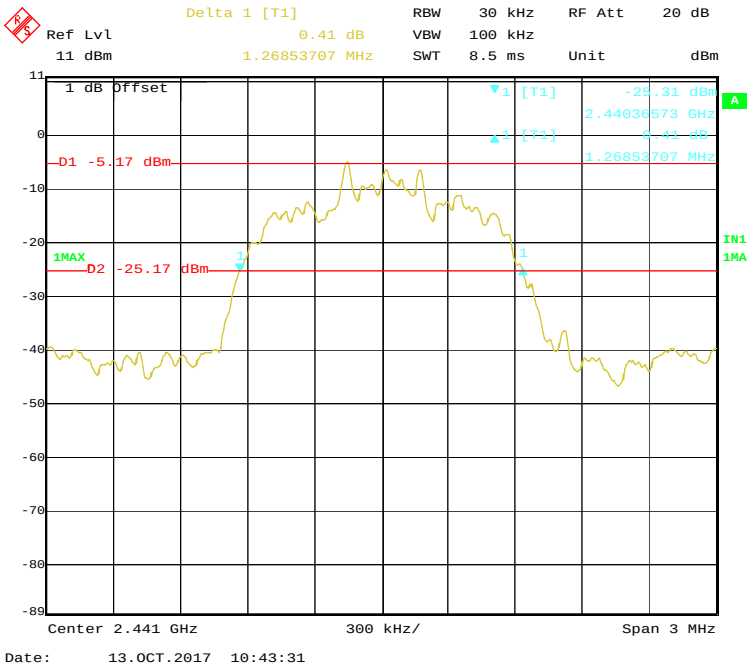
BDR (GFSK): High Channel



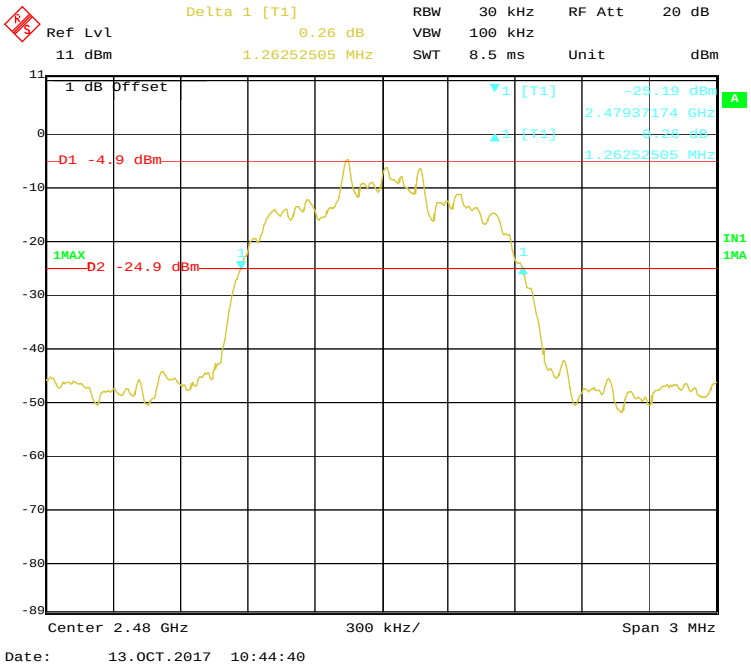
EDR (π/4-DQPSK): Low Channel



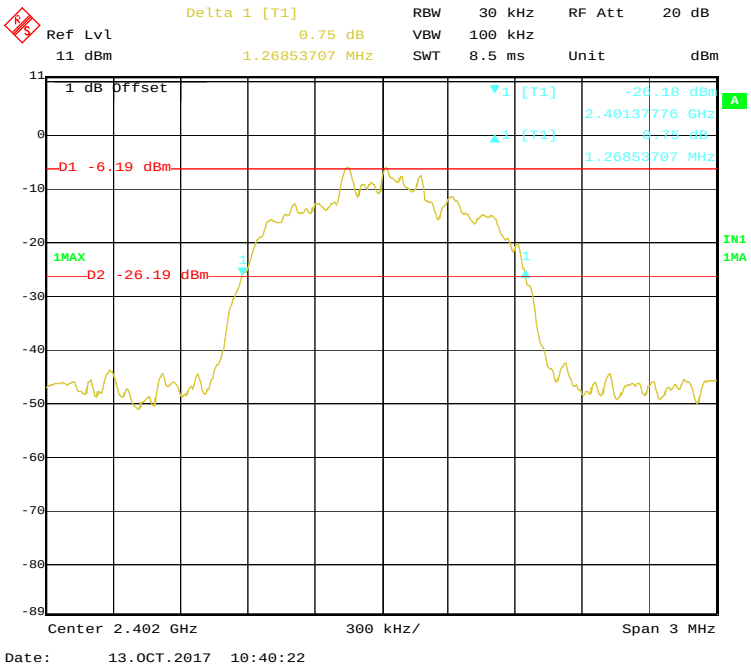
EDR(π/4-DQPSK): Middle Channel



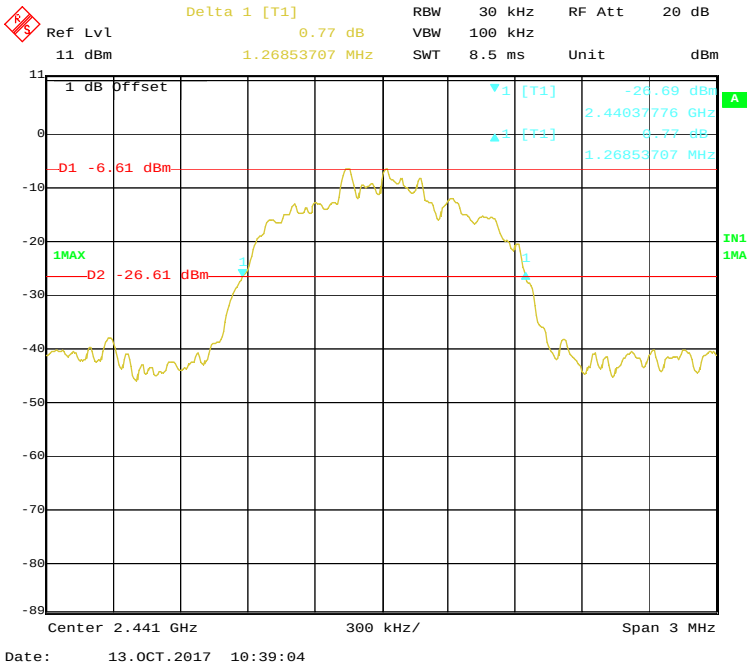
EDR (π/4-DQPSK): High Channel



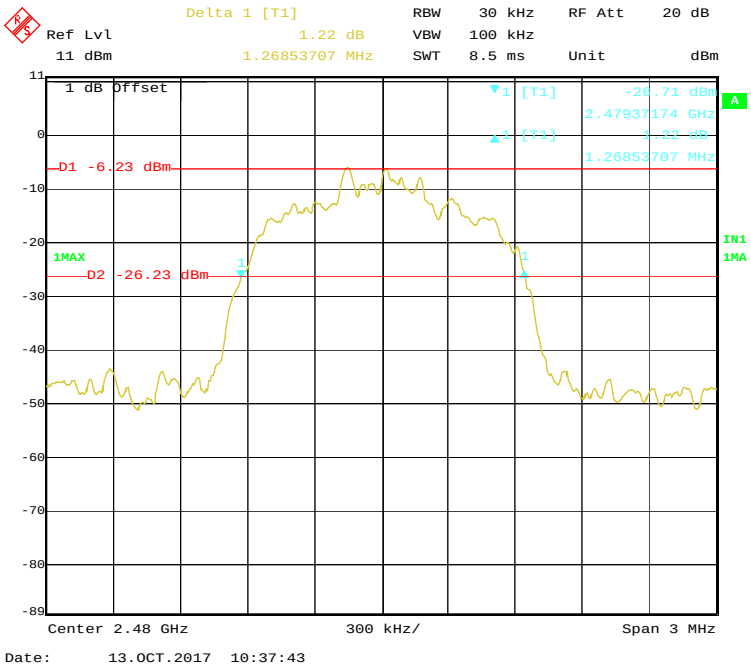
EDR (8-DPSK): Low Channel



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:	20.1 ℃
Relative Humidity:	51 %
ATM Pressure:	101.3 kPa

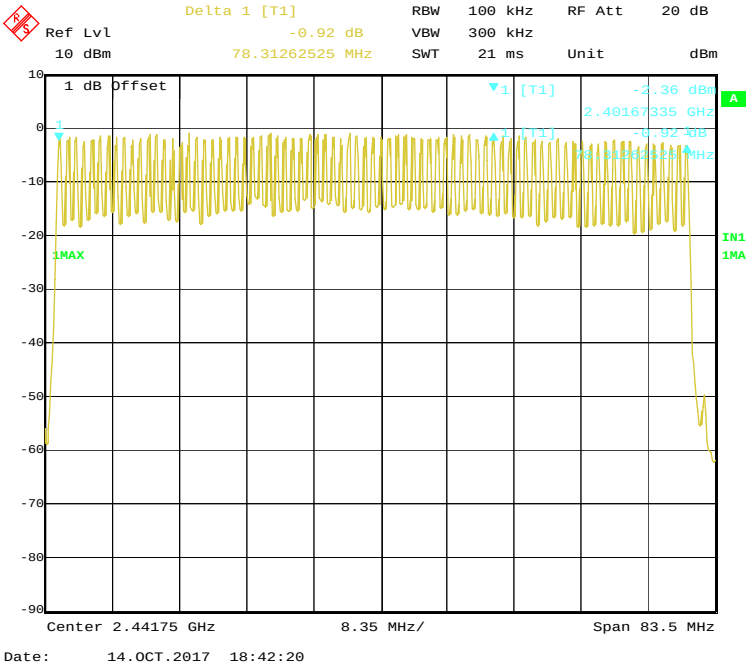
The testing was performed by Kyle Xu on 2017-10-14.

EUT operation mode: Transmitting

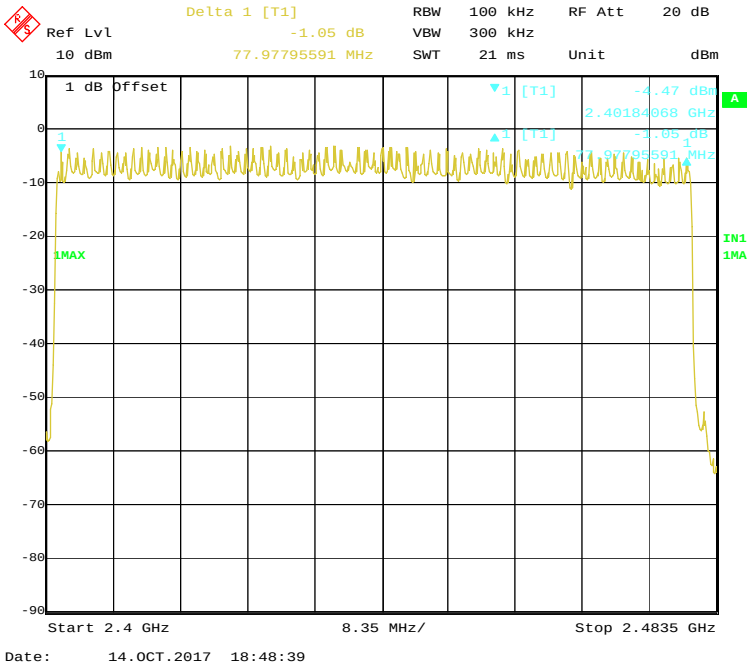
Test Result: Compliance.

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

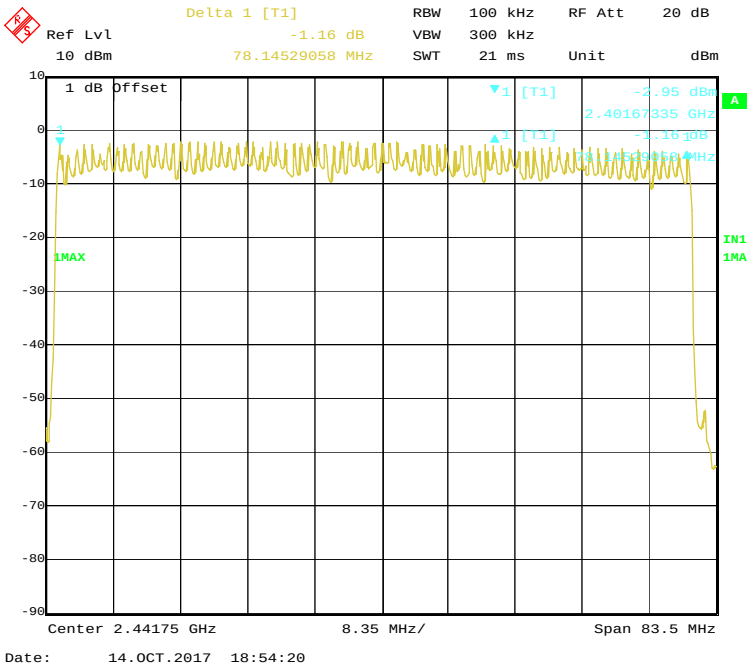
BDR (GFSK): Number of Hopping Channels



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:	20.1 ℃
Relative Humidity:	51 %
ATM Pressure:	101.3 kPa

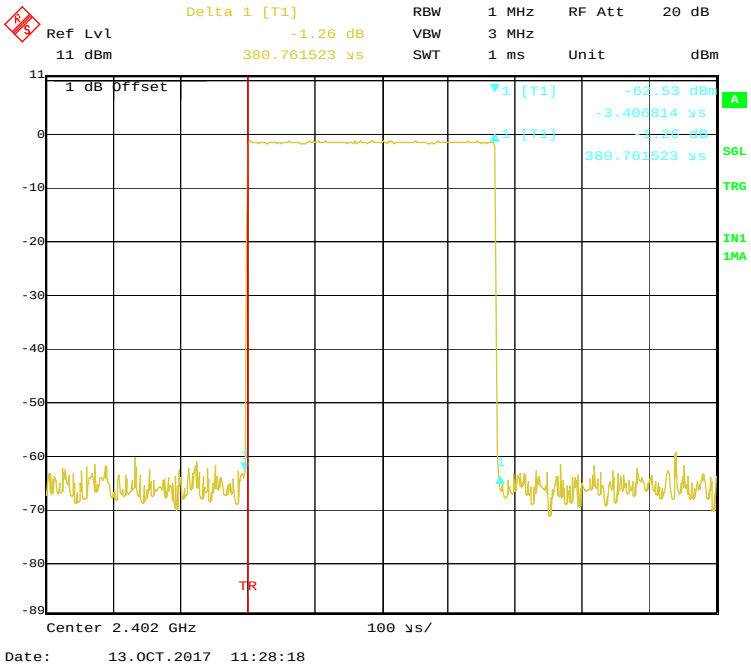
The testing was performed by Kyle Xu on 2017-10-13.

EUT operation mode: Transmitting

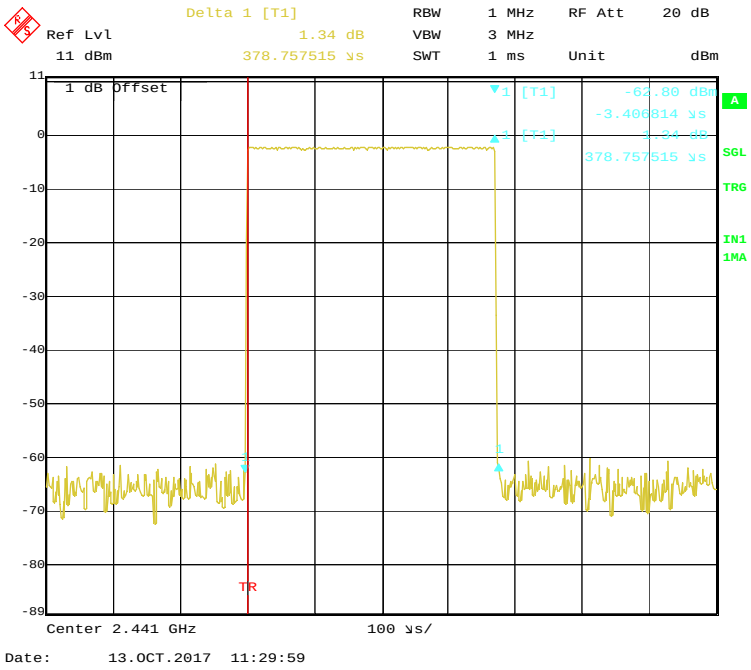
Test Result: Compliance.

Mode		Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
BDR (GFSK)	DH 1	Low	0.381	0.122	0.4	Pass
		Middle	0.379	0.121	0.4	Pass
		High	0.381	0.122	0.4	Pass
		Note: DH1:Dwell time = Pulse time*(1600/2/79)*31.6S				
	DH 3	Low	1.643	0.263	0.4	Pass
		Middle	1.643	0.263	0.4	Pass
		High	1.643	0.263	0.4	Pass
		Note: DH3:Dwell time = Pulse time*(1600/4/79)*31.6S				
	DH 5	Low	2.906	0.310	0.4	Pass
		Middle	2.896	0.309	0.4	Pass
		High	2.906	0.310	0.4	Pass
		Note: DH5:Dwell time = Pulse time*(1600/6/79)*31.6S				
EDR (π/4-DQPSK)	2DH 1	Low	0.385	0.123	0.4	Pass
		Middle	0.389	0.124	0.4	Pass
		High	0.385	0.123	0.4	Pass
		Note: 2DH1:Dwell time = Pulse time*(1600/2/79)*31.6S				
	2DH 3	Low	1.653	0.264	0.4	Pass
		Middle	1.653	0.264	0.4	Pass
		High	1.653	0.264	0.4	Pass
		Note: 2DH3:Dwell time = Pulse time*(1600/4/79)*31.6S				
	2DH 5	Low	2.906	0.310	0.4	Pass
		Middle	2.906	0.310	0.4	Pass
		High	2.906	0.310	0.4	Pass
		Note: 2DH5:Dwell time = Pulse time*(1600/6/79)*31.6S				
EDR (8-DPSK)	3DH 1	Low	0.381	0.122	0.4	Pass
		Middle	0.379	0.121	0.4	Pass
		High	0.381	0.122	0.4	Pass
		Note:3 DH1:Dwell time = Pulse time*(1600/2/79)*31.6S				
	3DH 3	Low	1.643	0.263	0.4	Pass
		Middle	1.643	0.263	0.4	Pass
		High	1.643	0.263	0.4	Pass
		Note: 3DH3:Dwell time = Pulse time*(1600/4/79)*31.6S				
	3DH 5	Low	2.906	0.310	0.4	Pass
		Middle	2.896	0.309	0.4	Pass
		High	2.906	0.310	0.4	Pass
		Note: 3DH5:Dwell time = Pulse time*(1600/6/79)*31.6S				

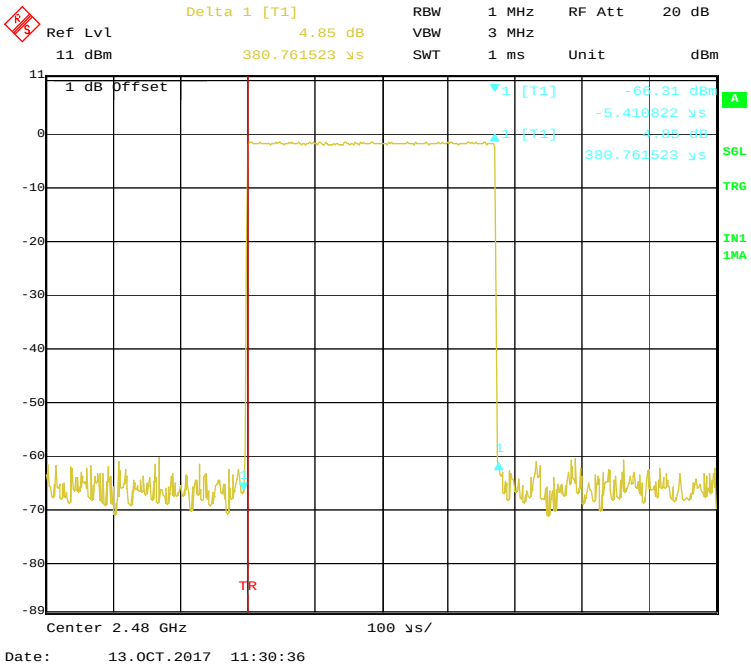
BDR (GFSK): Pulse time, Low Channel, DH1



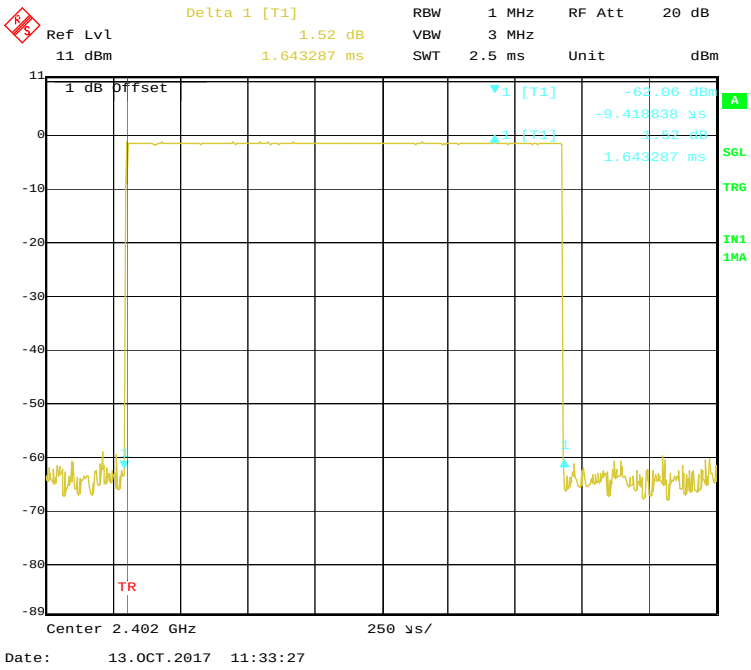
BDR (GFSK): Pulse time, Middle Channel, DH1



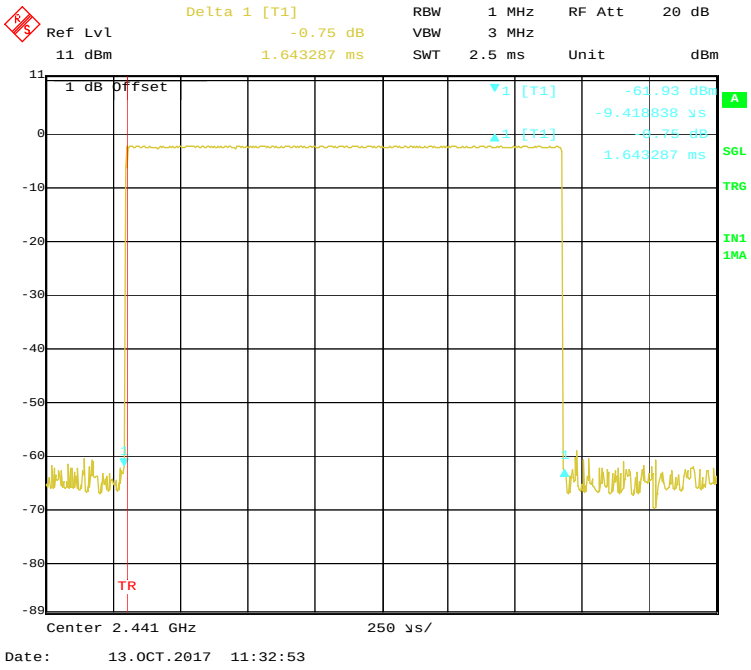
BDR (GFSK): Pulse time, High Channel, DH1



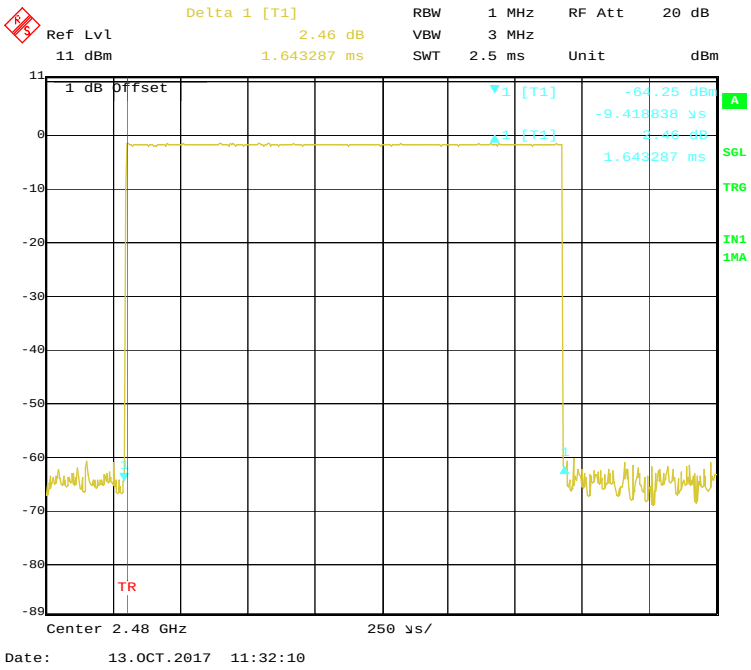
BDR (GFSK): Pulse time, Low Channel, DH3



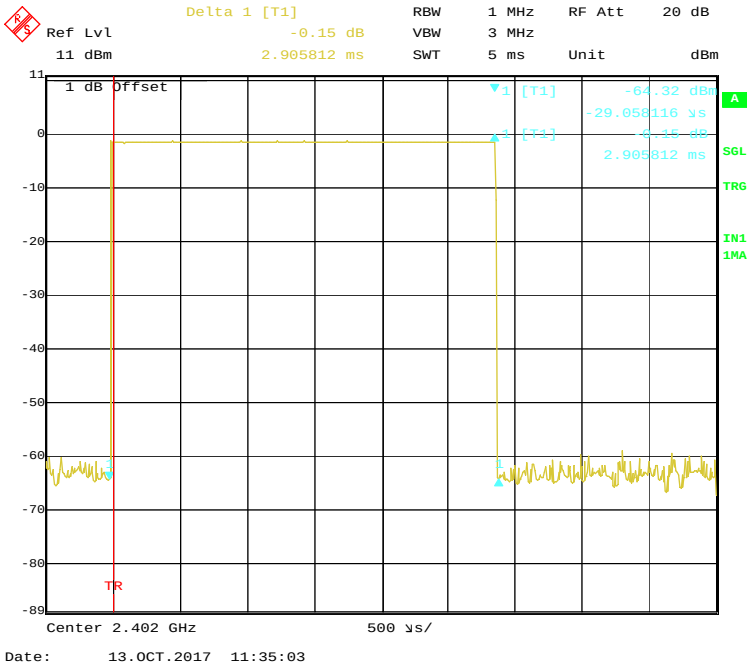
BDR (GFSK): Pulse time, Middle Channel, DH3



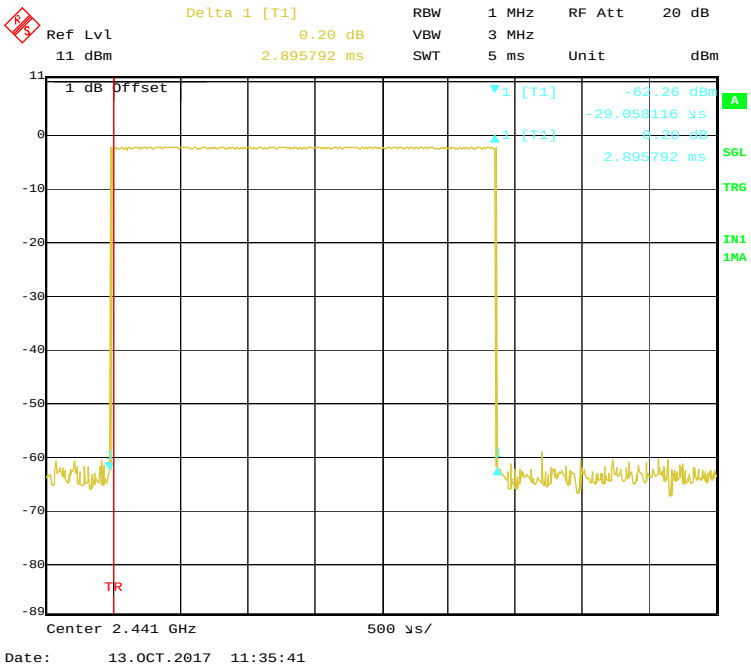
BDR (GFSK): Pulse time, High Channel, DH3



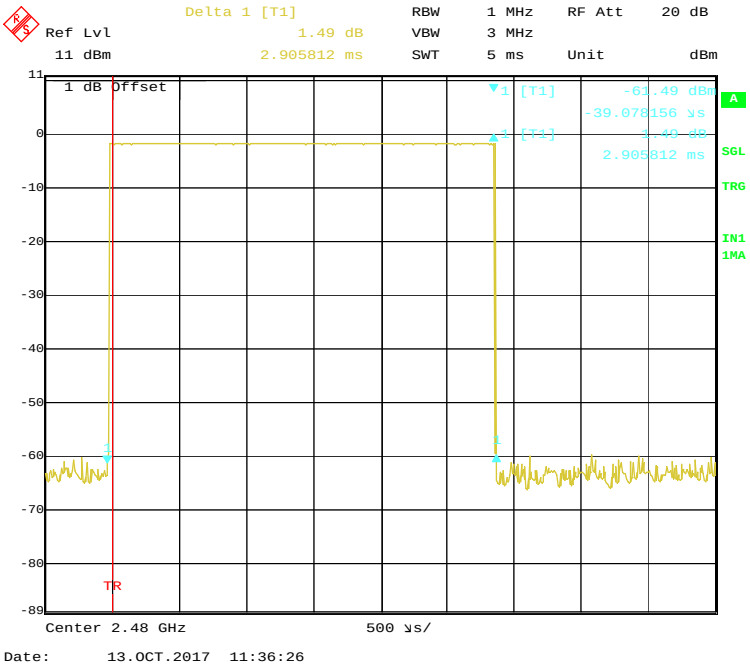
BDR (GFSK): Pulse time, Low Channel, DH5



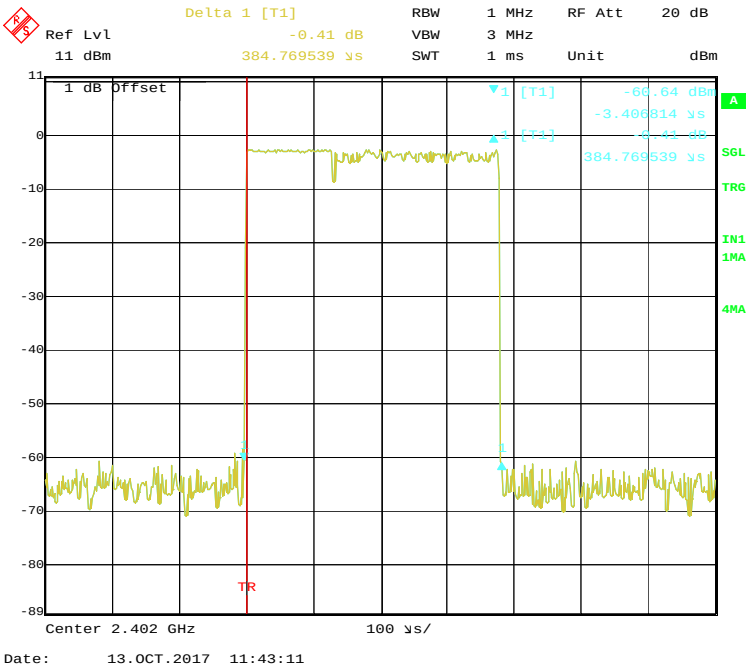
BDR (GFSK): Pulse time, Middle Channel, DH5



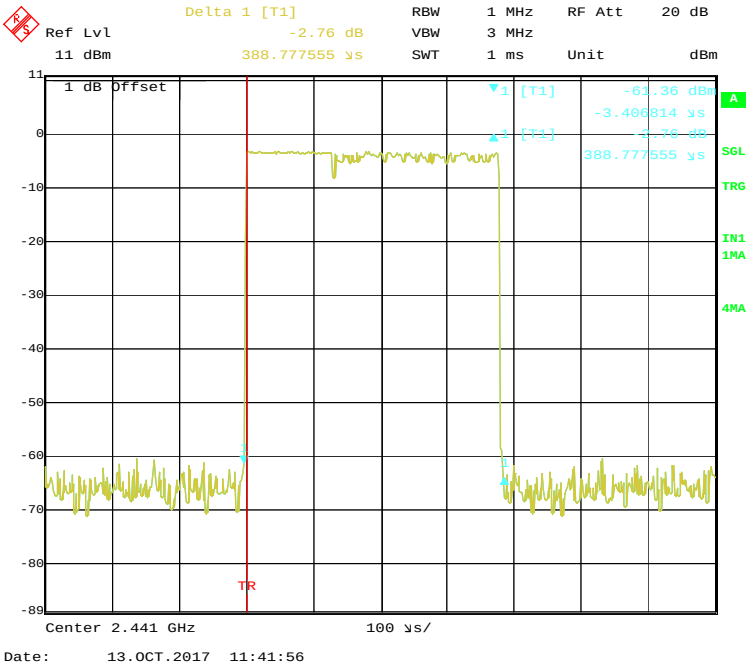
BDR (GFSK): Pulse time, High Channel, DH5



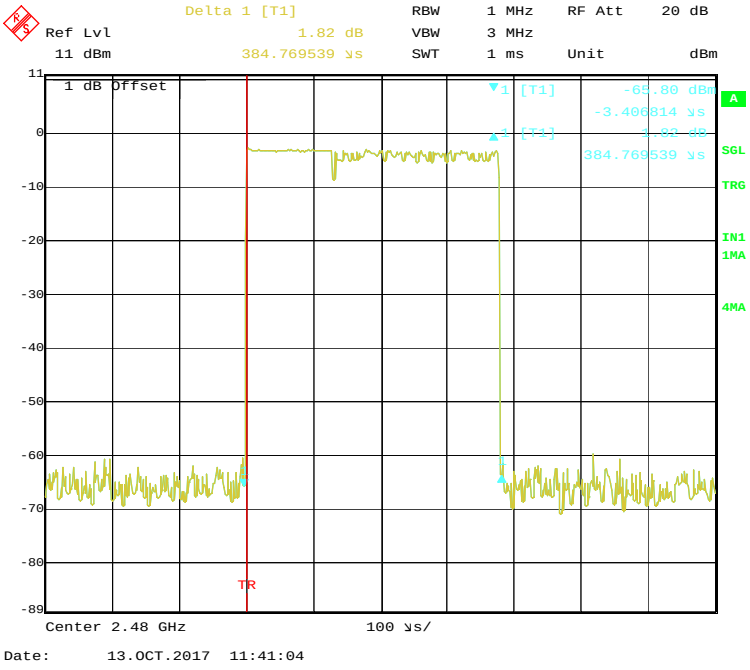
EDR (π/4-DQPSK): Pulse time, Low Channel, 2DH1



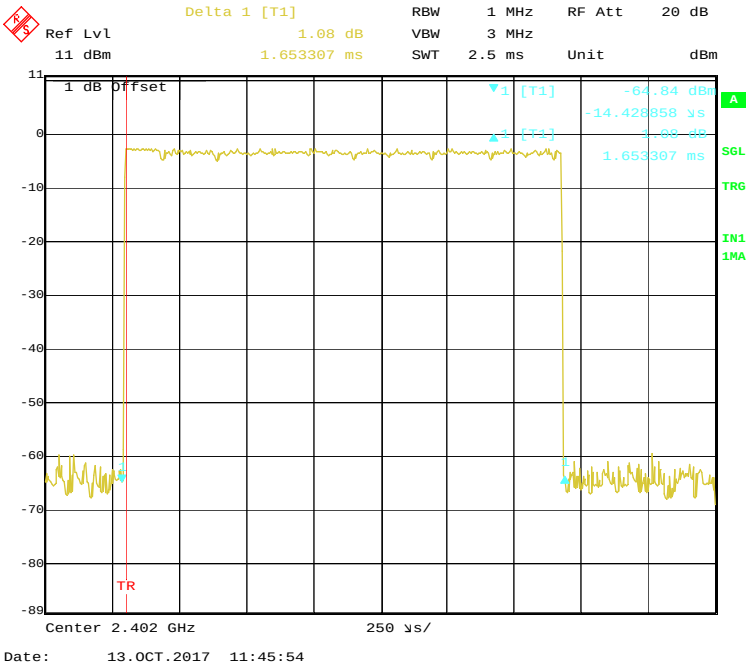
EDR (π/4-DQPSK):Pulse time, Middle Channel, 2DH1



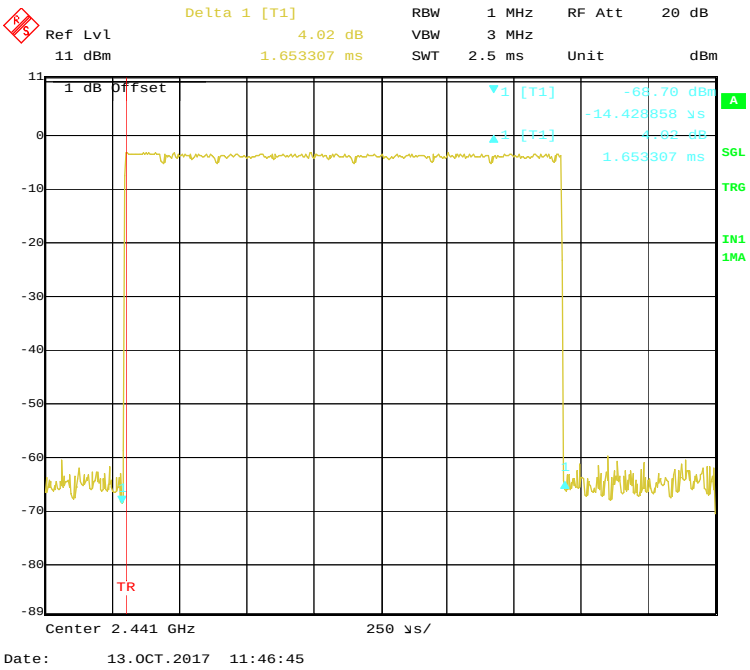
EDR (π/4-DQPSK):Pulse time, High Channel, 2DH1



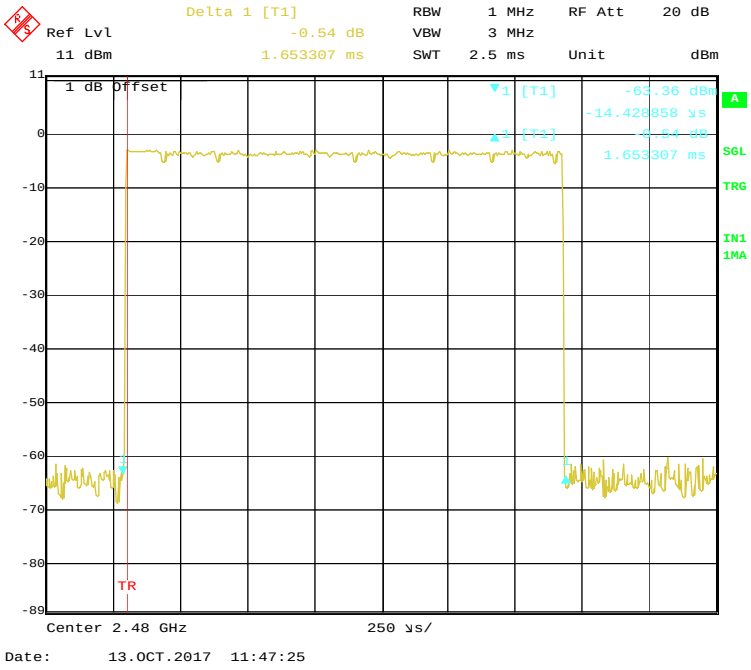
EDR (π/4-DQPSK):Pulse time, Low Channel, 2DH3



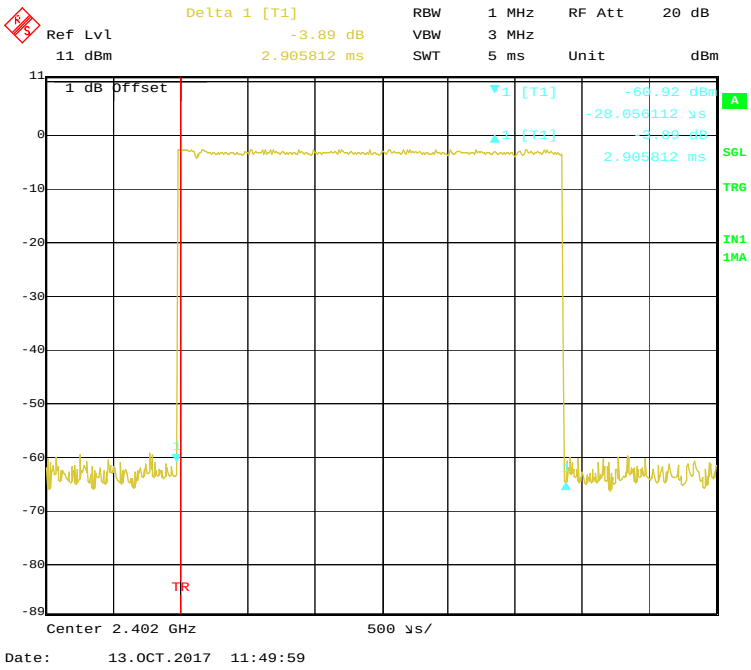
EDR (π/4-DQPSK):Pulse time, Middle Channel, 2DH3



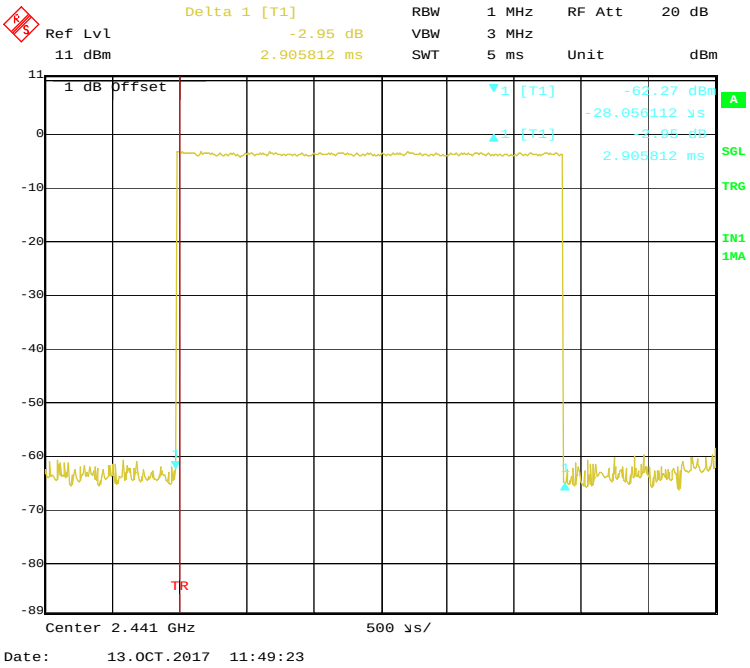
EDR (π/4-DQPSK):Pulse time, High Channel, 2DH3



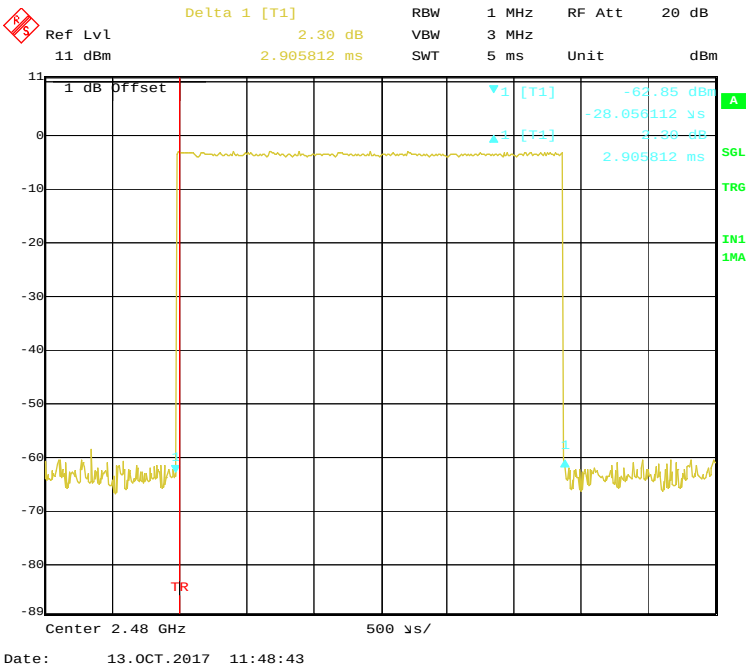
EDR (π/4-DQPSK):Pulse time, Low Channel, 2DH5



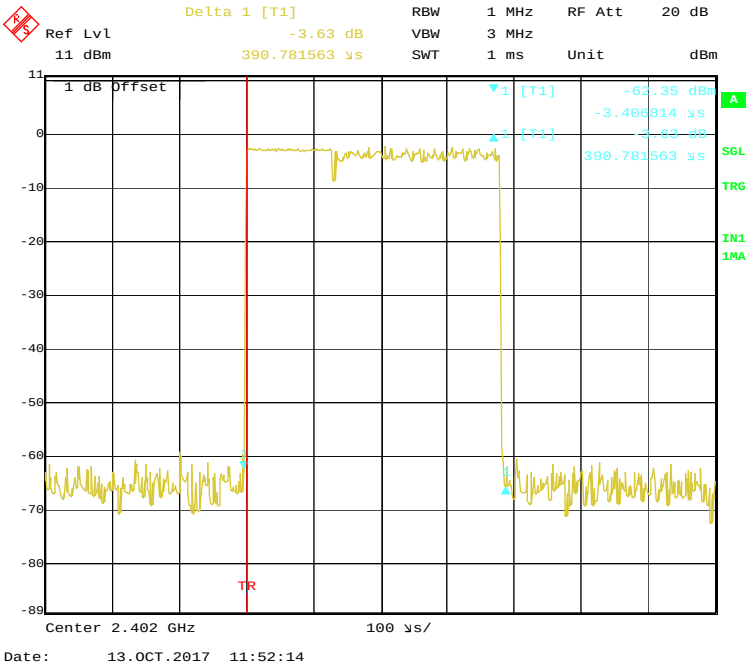
EDR (π/4-DQPSK):Pulse time, Middle Channel, 2DH5



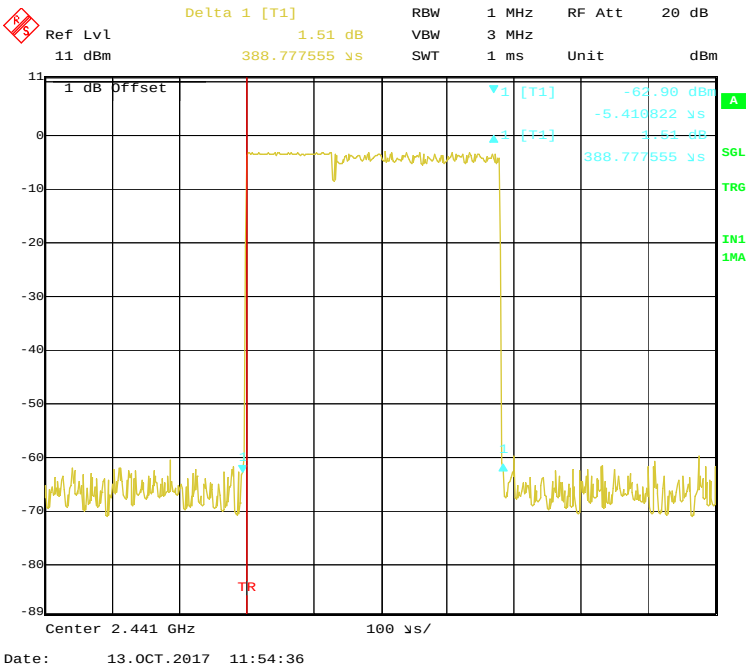
EDR (π/4-DQPSK):Pulse time, High Channel, 2DH5



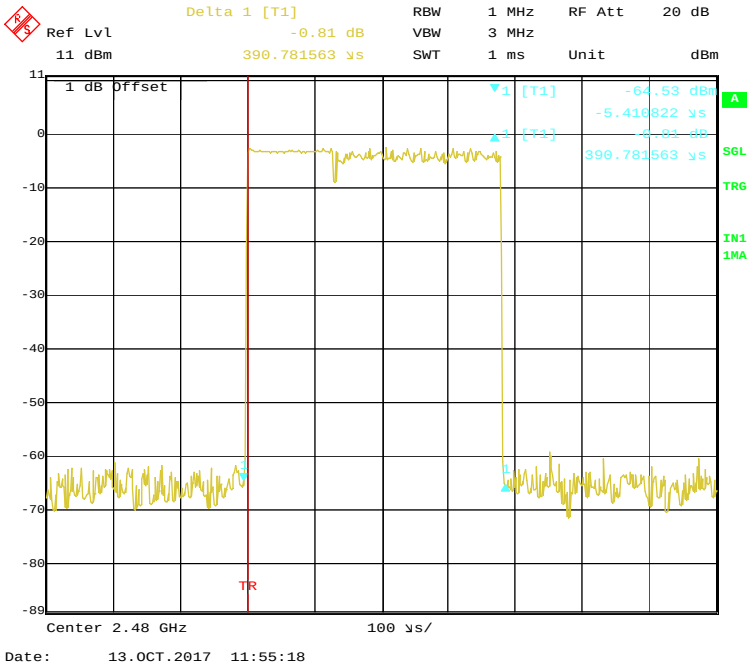
EDR (8-DPSK): Pulse time, Low Channel, 3DH1



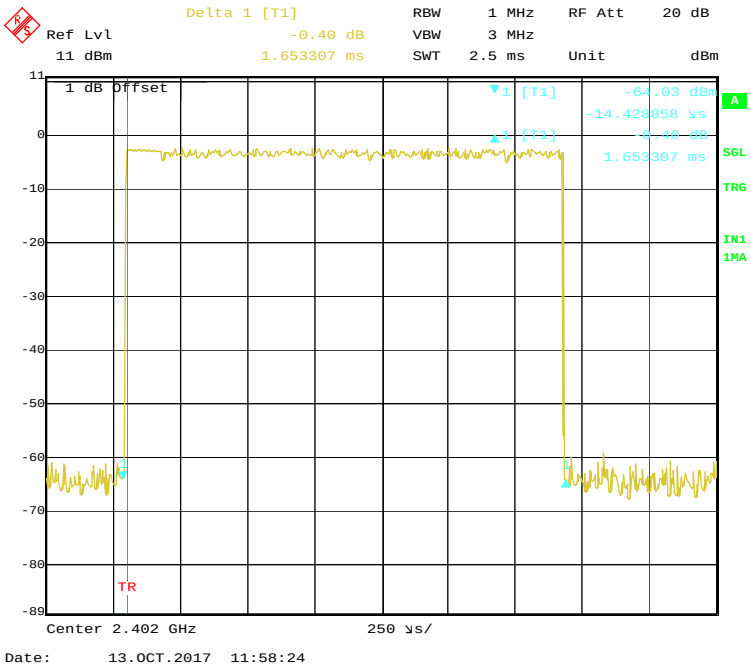
EDR (8-DPSK): Pulse time, Middle Channel, 3DH1



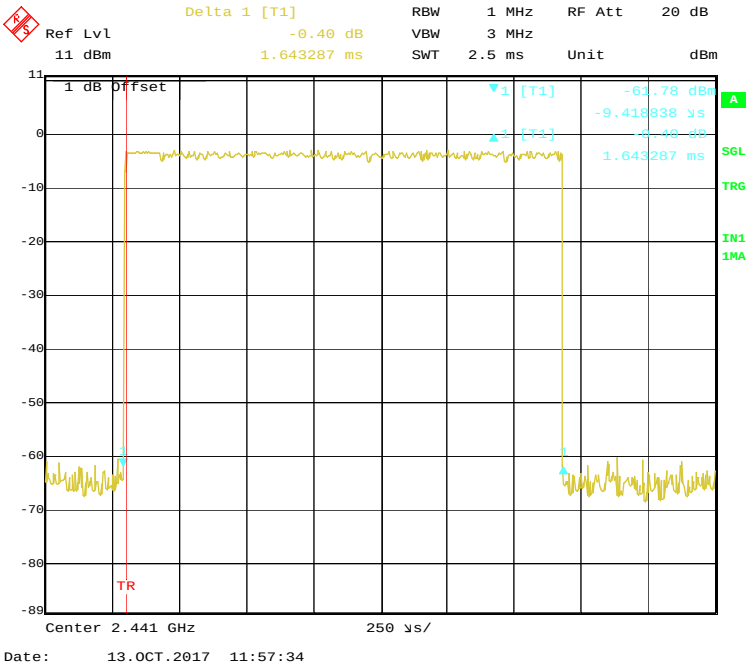
EDR (8-DPSK): Pulse time, High Channel, 3DH1



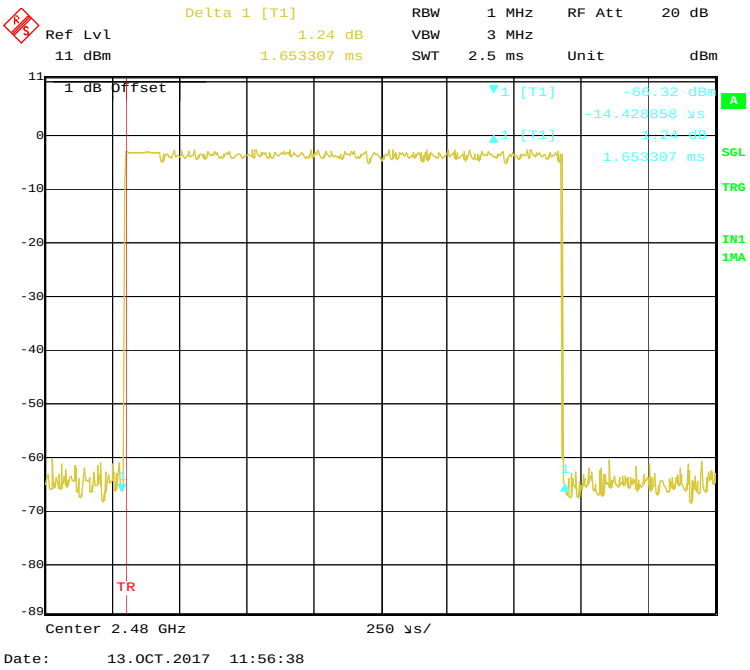
EDR (8-DPSK): Pulse time, Low Channel, 3DH3



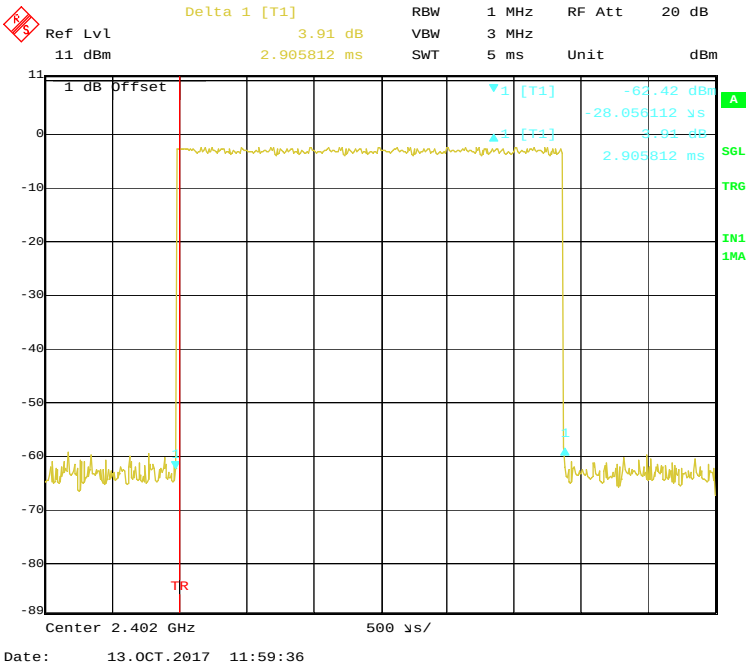
EDR (8-DPSK): Pulse time, Middle Channel, 3DH3



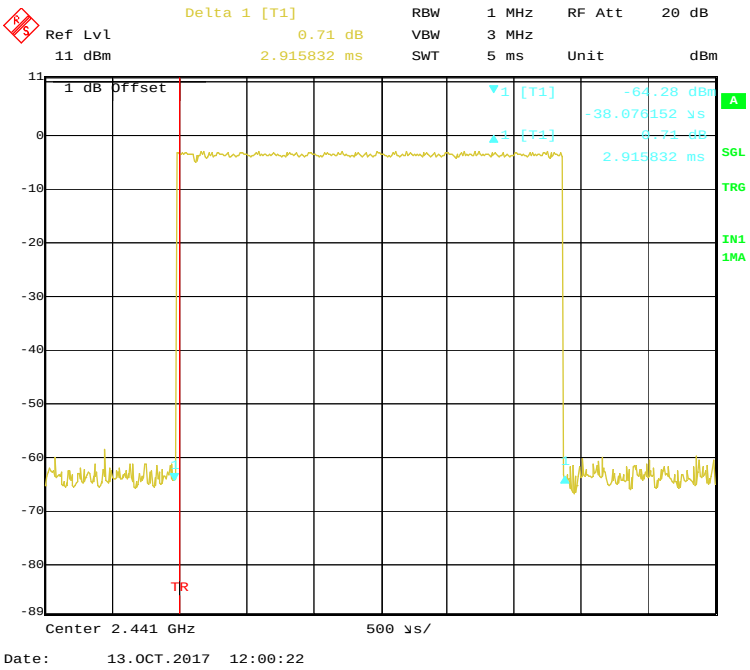
EDR (8-DPSK): Pulse time, High Channel, 3DH3



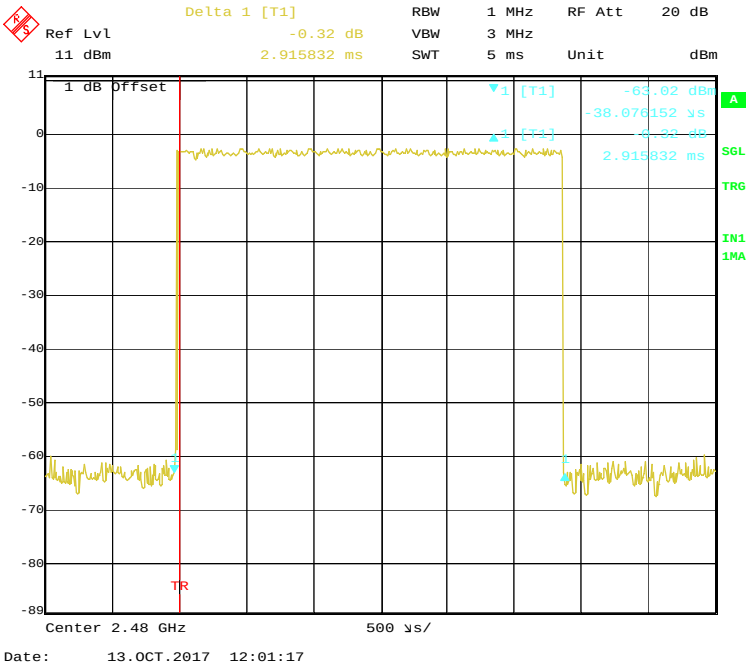
EDR (8-DPSK): Pulse time, Low Channel, 3DH5



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:	20.2 ℃
Relative Humidity:	51 %
ATM Pressure:	101.3 kPa

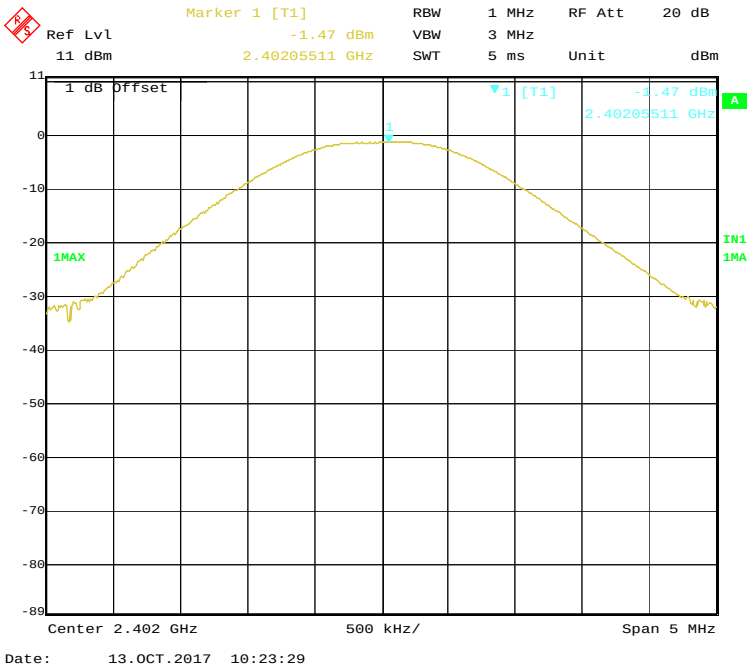
The testing was performed by Kyle Xu on 2017-10-13.

EUT operation mode: Transmitting

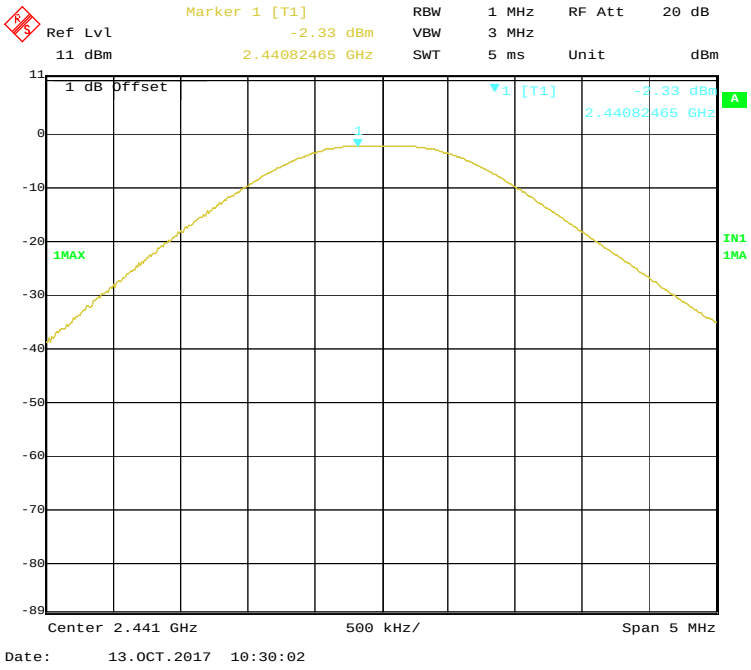
Test Result: Compliance.

Mode	Frequency (MHz)	Output Power		Limit (mW)
		(dBm)	(mW)	
BDR (GFSK)	2402	-1.47	0.71	1000
	2441	-2.33	0.58	1000
	2480	-1.56	0.70	1000
EDR (π/4-DQPSK)	2402	-2.45	0.57	125
	2441	-2.99	0.50	125
	2480	-2.57	0.55	125
EDR (8-DPSK)	2402	-2.08	0.62	125
	2441	-2.80	0.52	125
	2480	-2.33	0.58	125

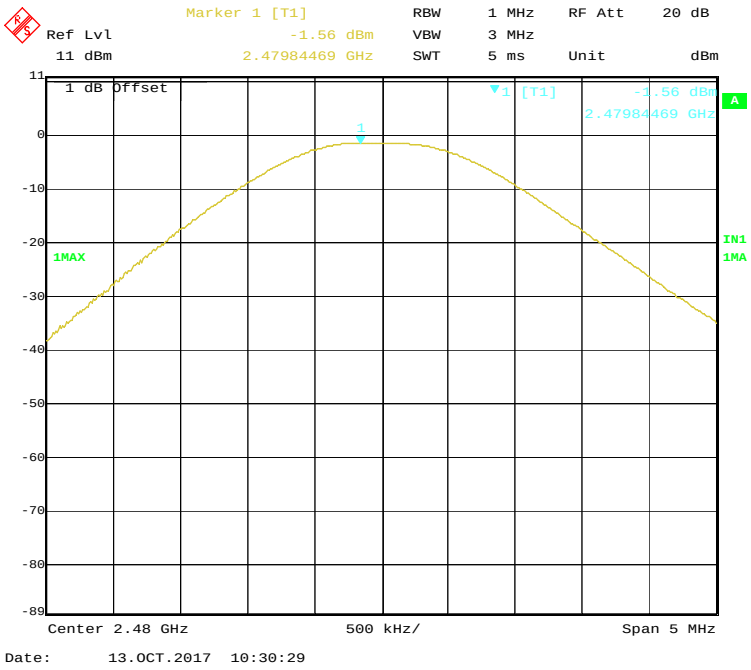
BDR (GFSK): Low Channel



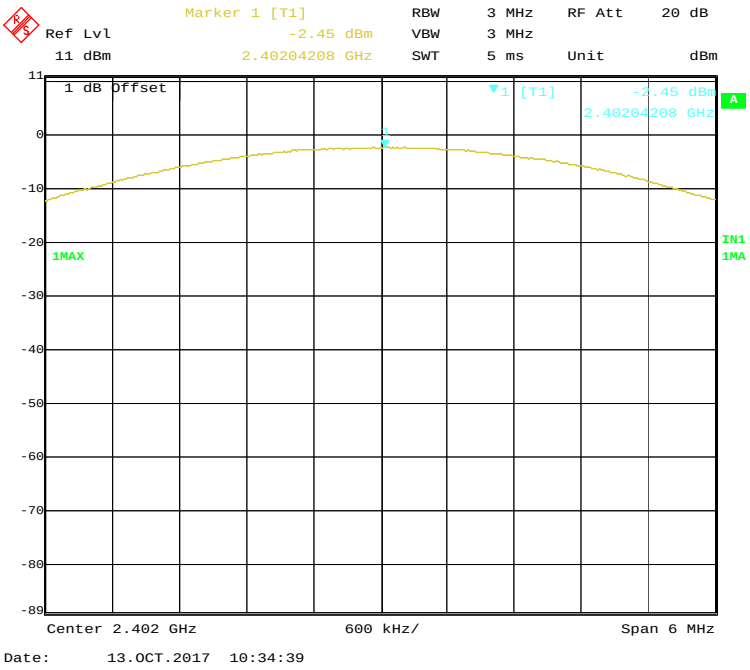
BDR (GFSK): Middle Channel



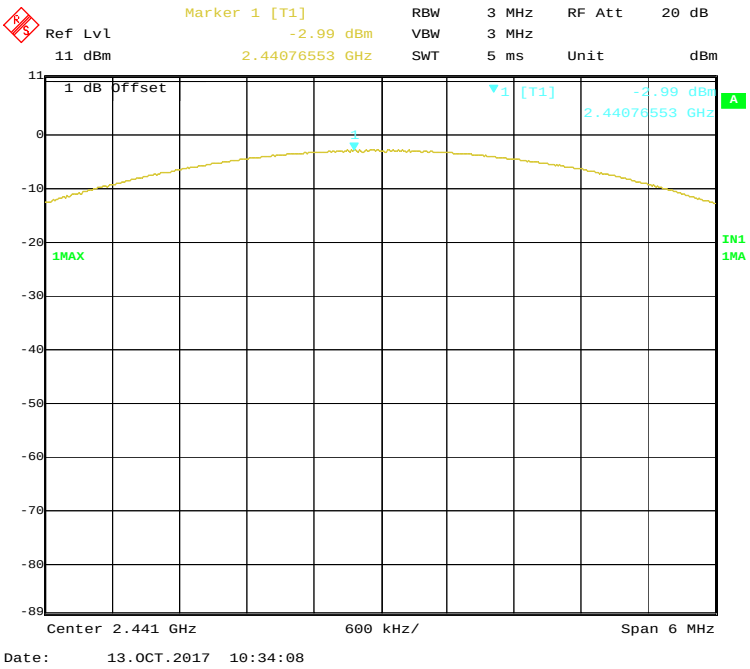
BDR (GFSK): High Channel



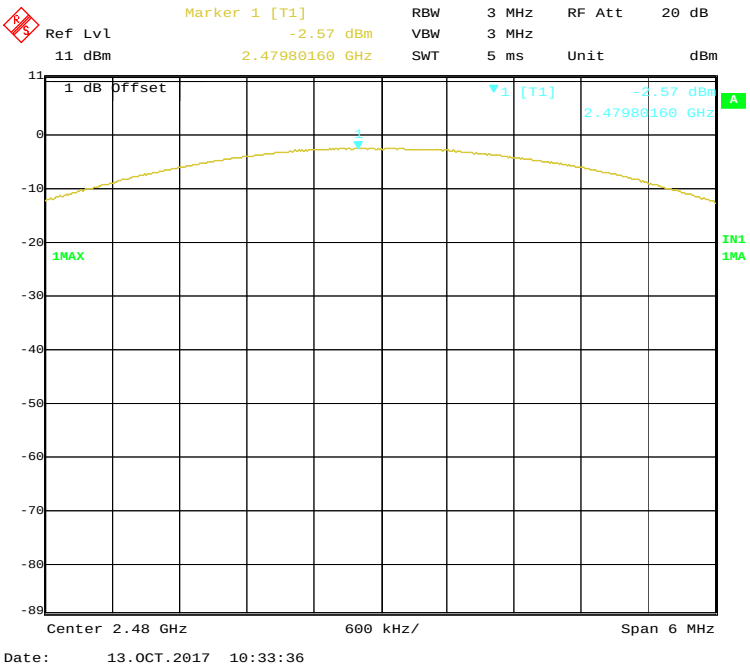
EDR(π/4-DQPSK): Low Channel



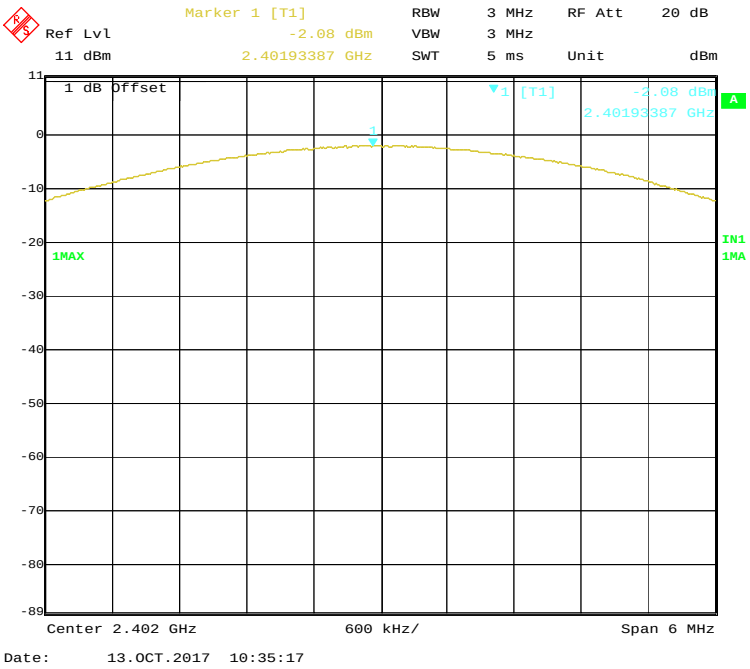
EDR(π/4-DQPSK): Middle Channel



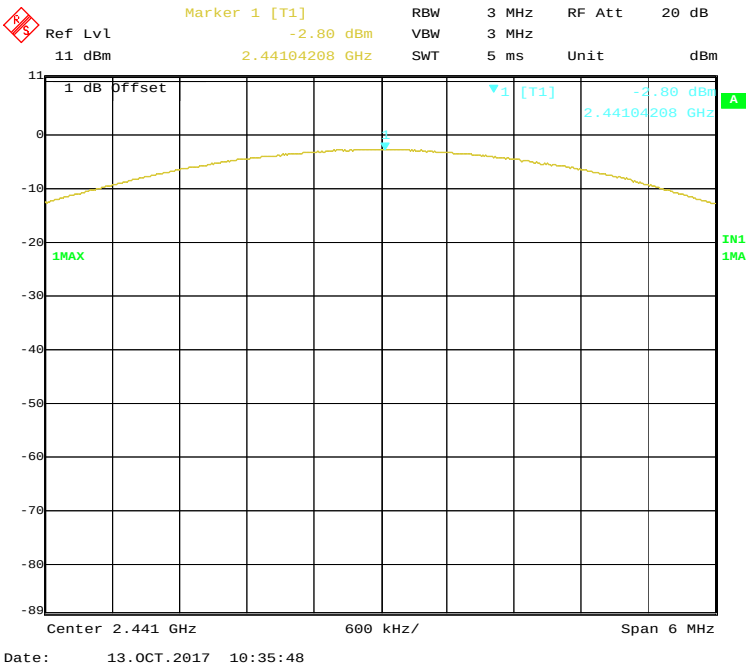
EDR(π/4-DQPSK): High Channel



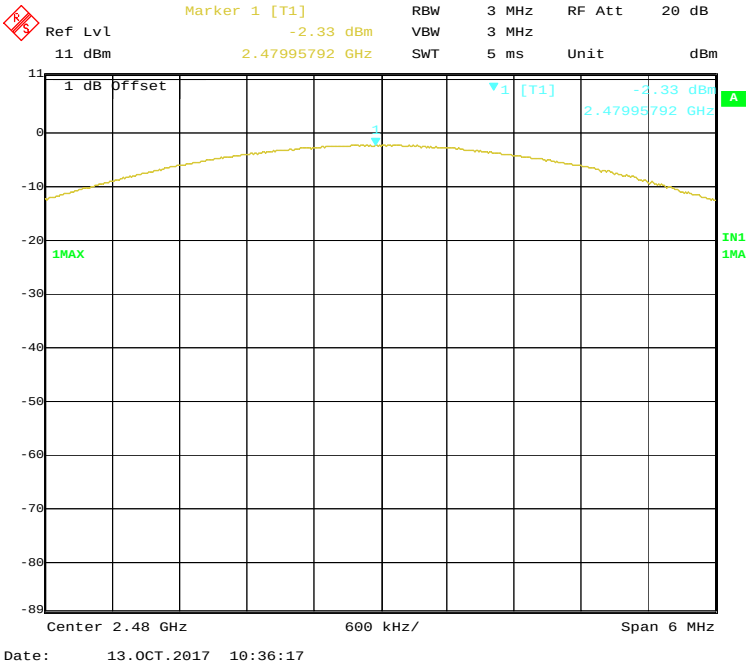
EDR(8-DPSK): Low Channel



EDR(8-DPSK): Middle Channel



EDR(8-DPSK): High Channel



FCC §15.247(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:	20.2 ℃
Relative Humidity:	51 %
ATM Pressure:	101.3 kPa

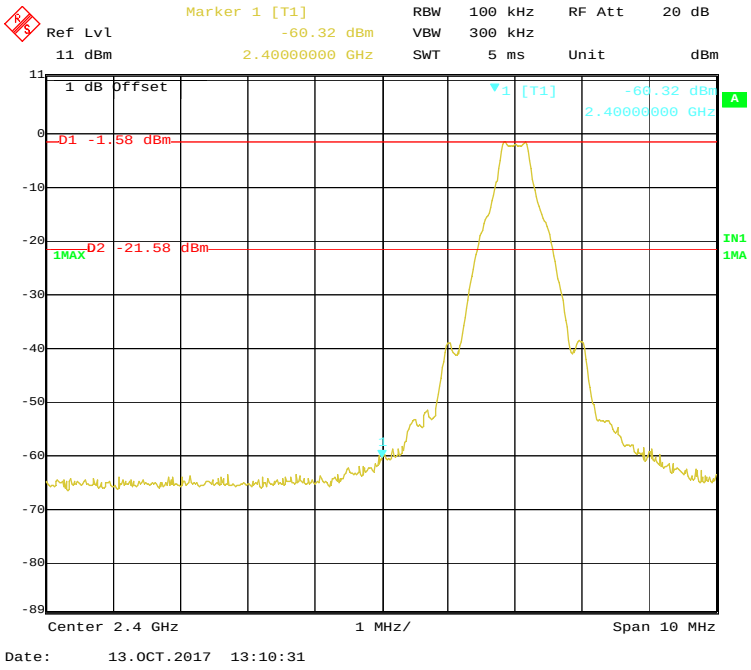
The testing was performed by Kyle Xu on 2017-10-13.

EUT operation mode: Transmitting

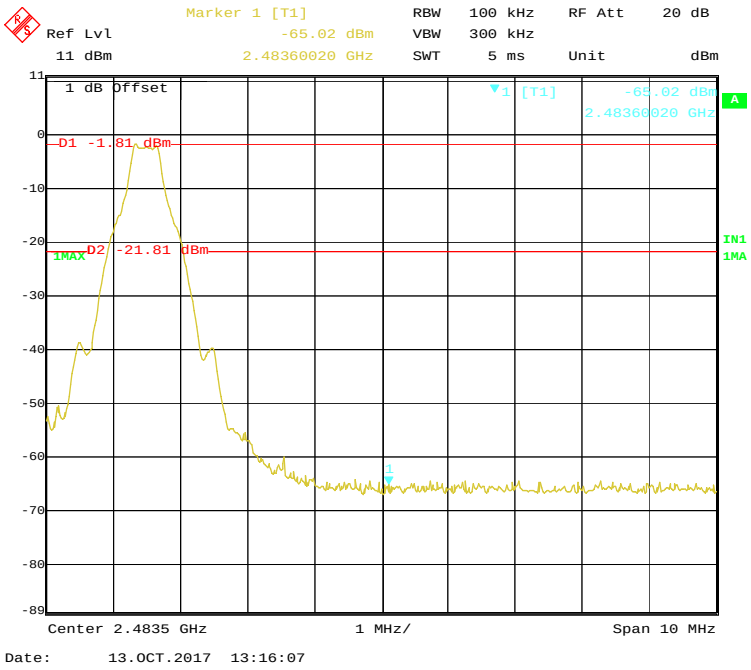
Test Result: Compliance.

Band Edge

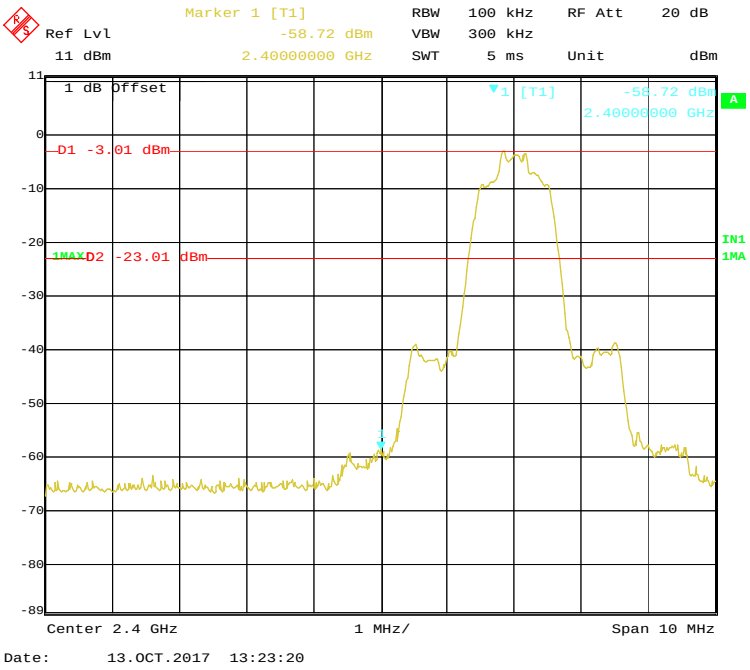
BDR (GFSK): Left Side



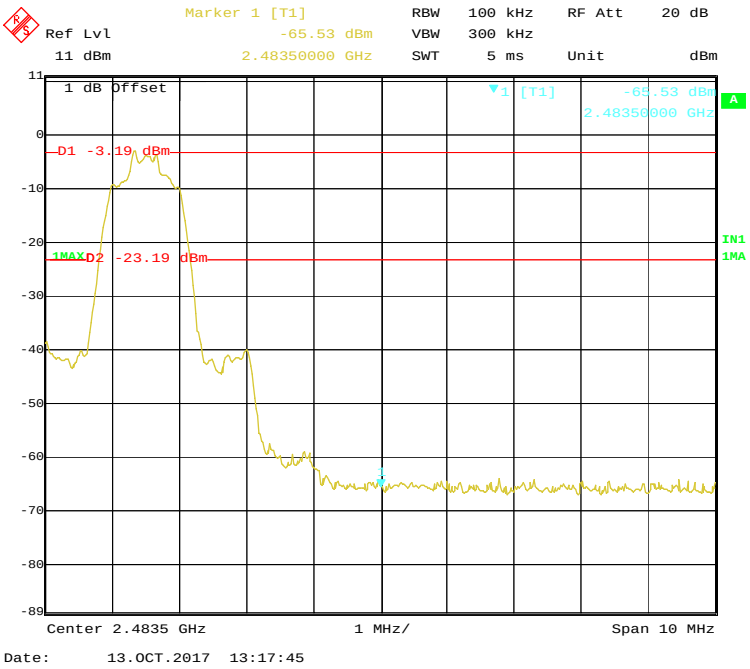
BDR (GFSK): Right Side



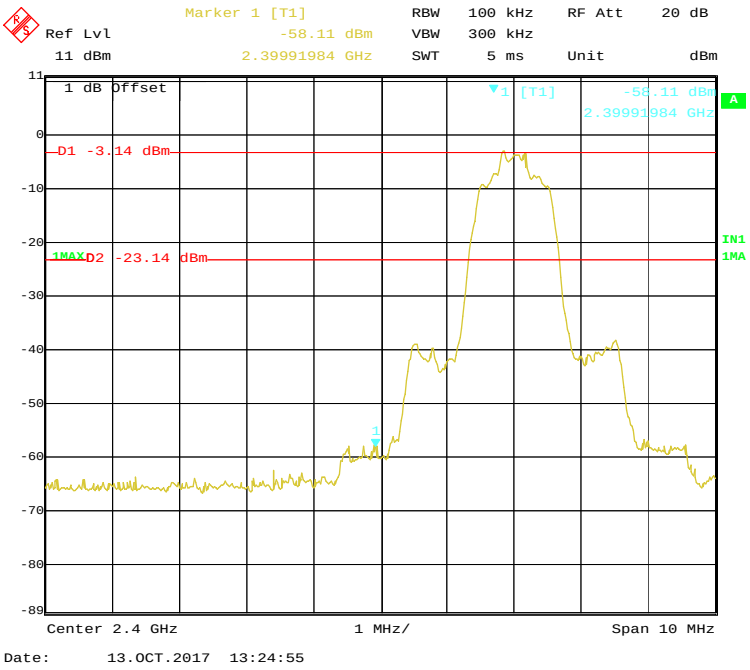
EDR (π/4-DQPSK): Left Side



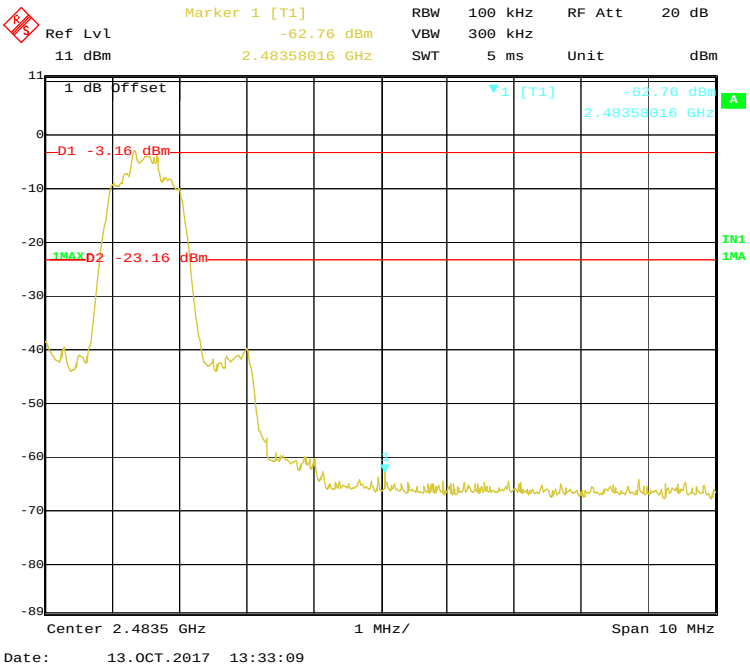
EDR (π/4-DQPSK): Right Side



EDR (8-DPSK): Left Side

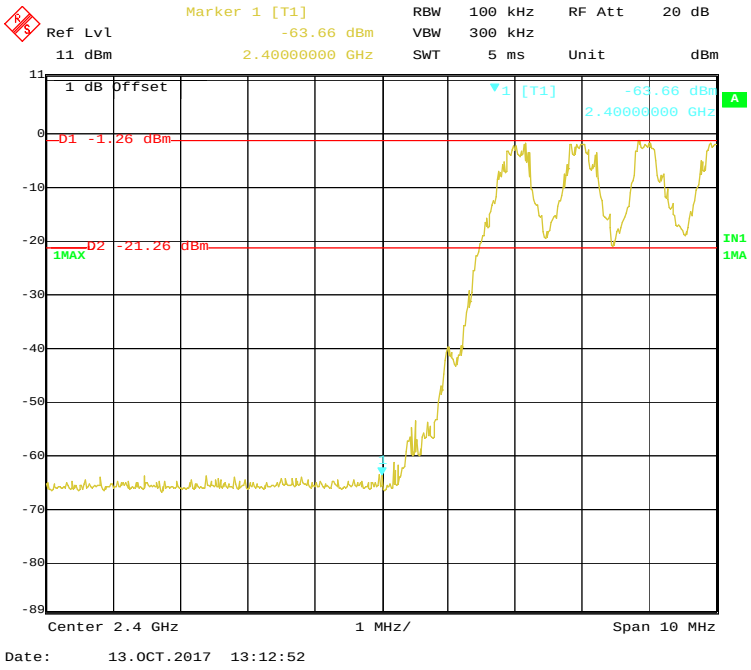


BDR (8-DPSK): Right Side

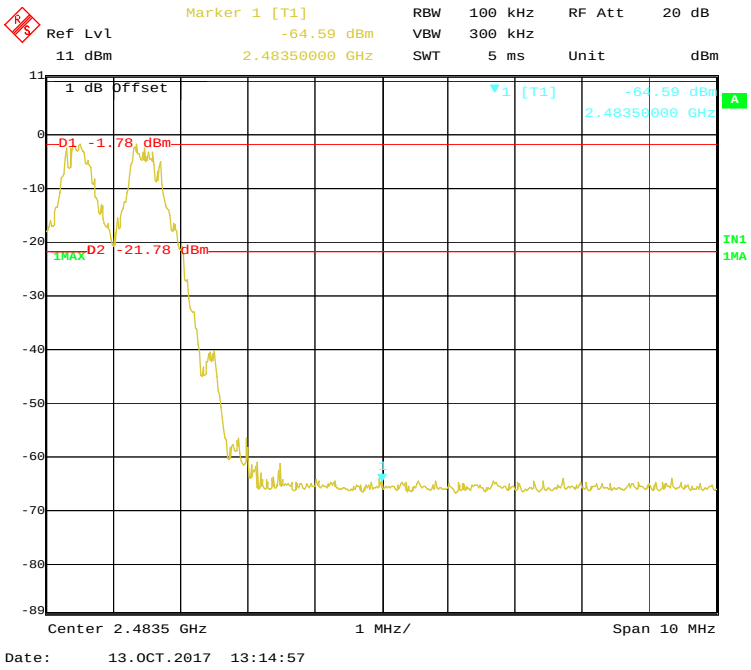


Band Edge-Hopping

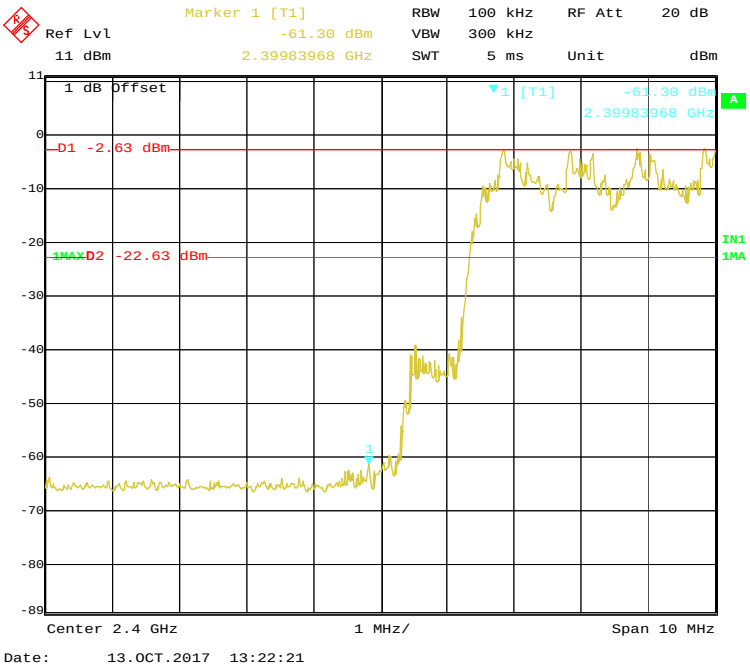
BDR (GFSK): Left Side



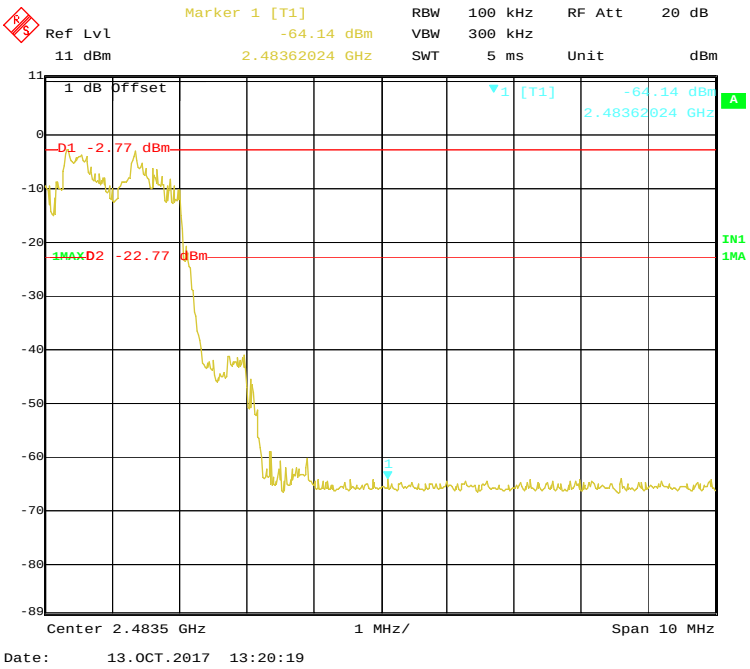
BDR (GFSK): Right Side



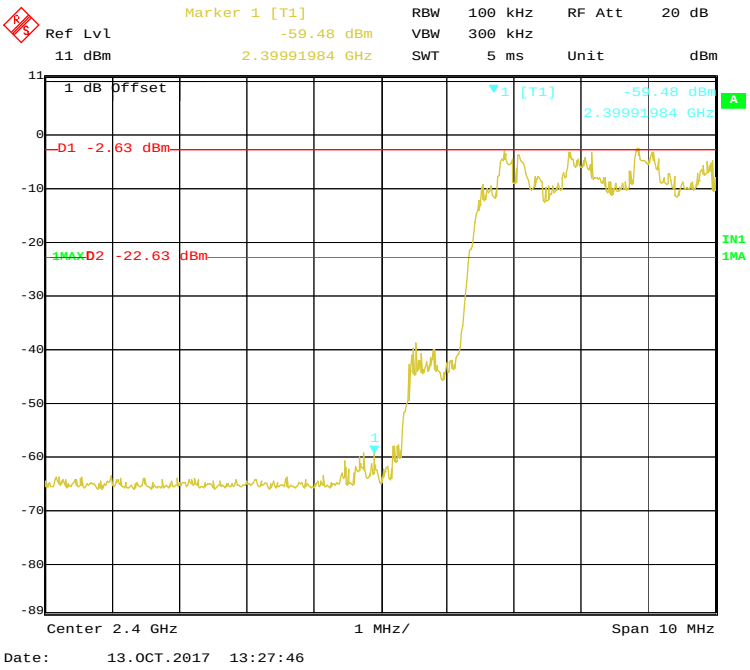
EDR (π/4-DQPSK): Left Side



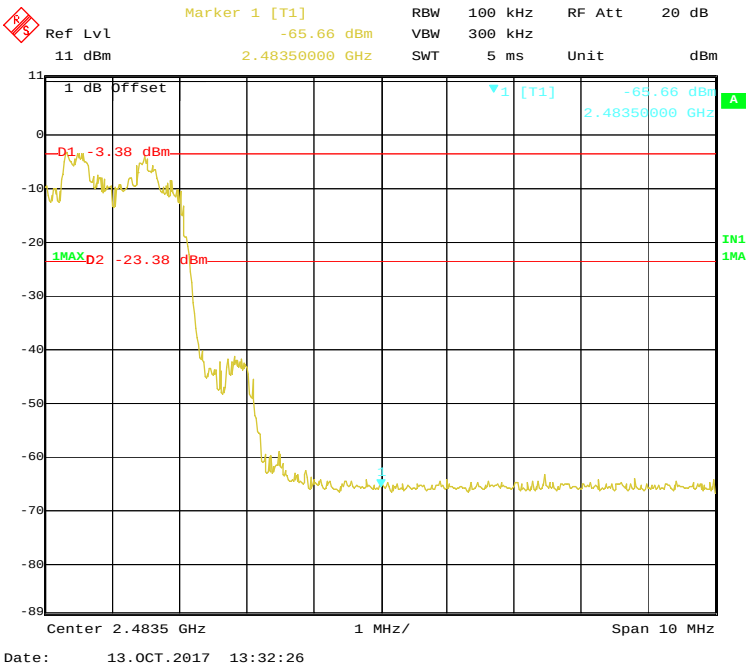
EDR (π/4-DQPSK): Right Side



EDR (8-DPSK): Left Side



BDR (8-DPSK): Right Side



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