



FCC PART 15.247

TEST REPORT

For

Nokia Shanghai Bell Co. Ltd.

No. 388, Ningqiao Rd. Pilot Free Trade Zone Shanghai China, 201206

FCC ID: 2ADZR7577WPONAPP

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	RSH180504050-00B	Original Report	2018-05-14
1	RSH180504050-00BM1	Revised Report	2018-06-30

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:	WPON
EUT Model:	WPON AP-Pole
Multiple Model:	WPON AP-Wall
FCC ID:	2ADZR7577WPONAPP
Rated Input Voltage:	AC 100-240V
External Dimension:	246mm(L)* 160 mm(W)*73mm(H)
Serial Number:	180504050
EUT Received Date:	2018.04.23

Note: The series product, models WPON AP-Pole, WPON AP-Wall are electrically identical, we selected WPON AP-Pole for full test, and please refer to the declaration letter for details.

Objective

This report is prepared on behalf of *Nokia Shanghai Bell Co. Ltd.* in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communications Commission's rules.

The tests were performed in order to determine the Bluetooth BDR and EDR mode of EUT compliance with FCC Rules Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Related Submittal(s)/Grant(s)

FCC Part 15C DXX submissions with FCC ID: 2ADZR7577WPONAPP.

Test Methodology

All measurements detailed in this Test Report were performed in accordance 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. (Dongguan).

Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.61dB
Power Spectral Density, conducted	±0.61 dB
Unwanted Emissions, radiated	30M~200MHz: 4.55 dB,200M~1GHz: 5.92 dB,1G~6GHz: 4.98 dB, 6G~18GHz: 5.89 dB,18G~26.5G:5.47 dB,26.5G~40G:5.63 dB
Unwanted Emissions, conducted	±1.5 dB
Temperature	±1 °C
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%
AC Power Lines Conducted Emission	3.12 dB (150 kHz to 30 MHz)

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 897218,the FCC Designation No. : CN1220.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062D.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in engineering mode.

EUT Exercise Software

The test software ' IPOP4.1 ' configured the maximum power level as below setting:

Test Software Version	IPOP4.1		
Test Frequency	2402MHz	2441MHz	2480MHz
GFSK	0C	0C	0C
$\pi/4$ -DQPSK	0C	0C	0C
8DPSK	0C	0C	0C

Equipment Modifications

No modification was made to the EUT.

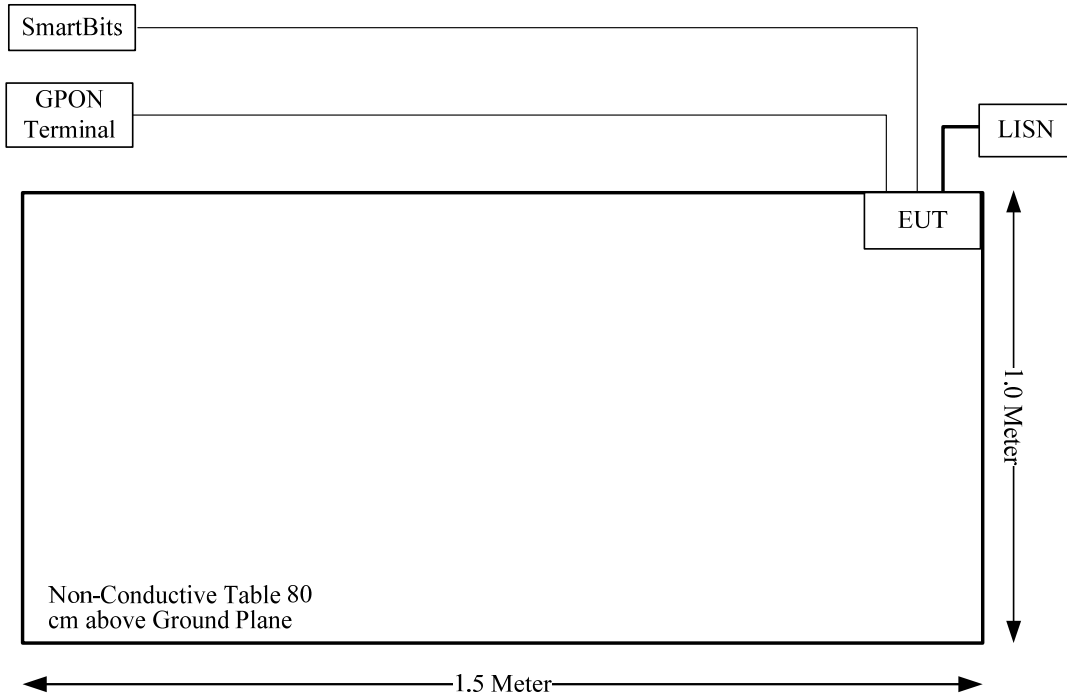
Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
HUAWEI	GPON Terminal	HG8245Q2	2102311RGB6RH1000087
Spriant	SmartBits	600B	DE7885

Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
RJ45 Cable	yes	no	10	EUT	GPON Terminal
Optical Cable	no	no	10	EUT	SmartBits

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

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)	Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(1)	20 dB 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

FCC §15.247 (i) & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

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

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm²)	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;

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculated Formulary:

Prediction of power density at the distance of the applicable MPE limit:

S = PG/4πR² = 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);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Calculated Data:

Radio	Frequency (GHz)	E.I.R.P		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBm)	(mW)			
60G Module 1	58.32-62.64	31	1258.93	25	0.16	1.0
60G Module 2	58.32-62.64	34	2511.89	25	0.32	1.0
60G Module 3	58.32-62.64	34	2511.89	25	0.32	1.0
Bluetooth	2.402-2.48	2.92	1.96	25	0.0003	1.0

Note: The output power was declared by manufacturer(Bluetooth conducted power is -2dBm, antenna gain 4.92dBi)

The three 60GHz radio and Bluetooth can transmit simultaneously:

$$\sum_i \frac{S_i}{S_{Limit,i}}$$

$$= S_{60G1}/Limit_{60G1} + S_{60G2}/Limit_{60G2} + S_{60G3}/Limit_{60G3} + S_{BT}/Limit_{BT}$$

$$= 0.16/1.0 + 0.32/1.0 + 0.32/1.0 + 0.0003/1.0$$

$$= 0.8$$

Result: The device complied with the applicable MPE Limit at the 25 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 one internal antenna arrangement for BT, and the antenna gain is 4.92 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

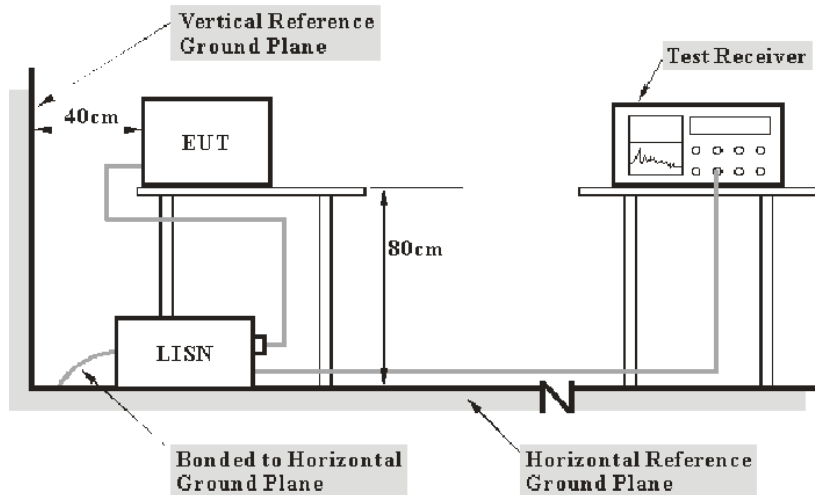
Result: Compliance.

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 setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

The EUT was connected to the main LISN with a 120 V/60 Hz AC power source.

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 first LISN.

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

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

Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$$V_C = V_R + A_C + VDF$$

Herein,

V_C : corrected voltage amplitude

V_R : reading voltage amplitude

A_C : attenuation caused by cable loss

VDF : voltage division factor of AMN or ISN

The “**Margin**” column of the following data tables indicates the degree of compliance within 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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCS 30	830245/006	2017-12-11	2018-12-11
R&S	Two-line V-network	ENV 216	101614	2017-12-08	2018-12-08
R&S	Test Software	EMC32	Version8.53.0	N/A	N/A
Unknown	Coaxial Cable	C-NJNJ-50	C-0200-01	2017-09-05	2018-09-05

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

Test Data

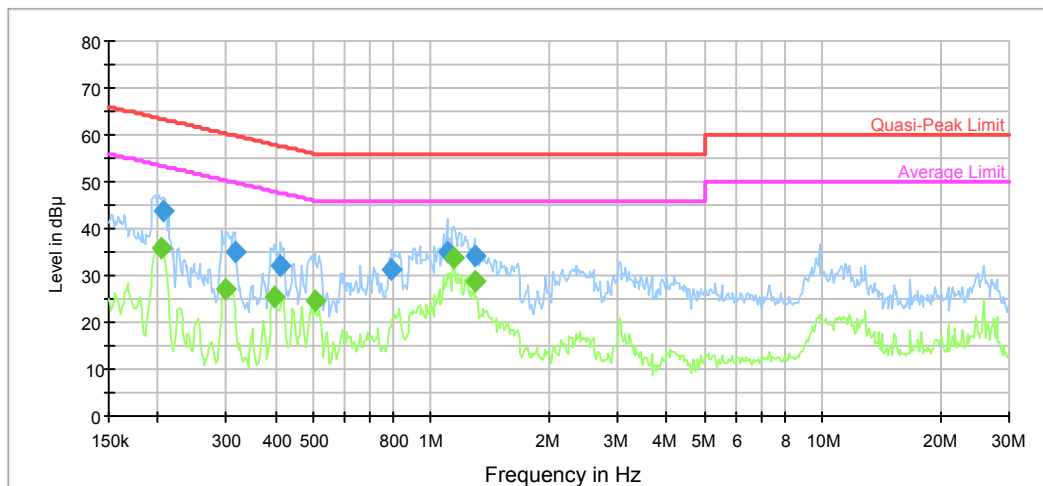
Environmental Conditions

Temperature:	25.5 °C
Relative Humidity:	57 %
ATM Pressure:	101.7 kPa

The testing was performed by Sider Huang on 2018-04-26.

Test Mode: Transmitting

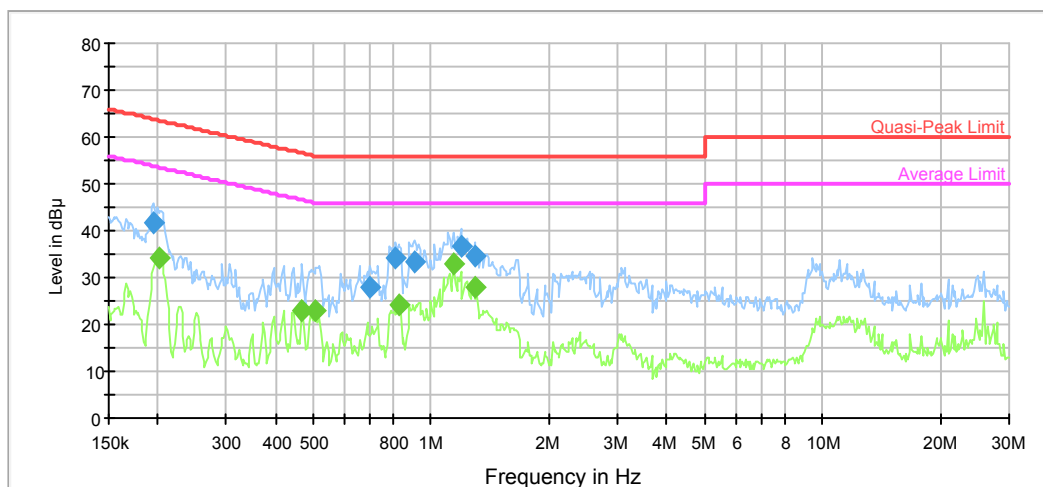
AC120 V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.206306	43.7	9.000	L1	10.6	19.7	63.4	Compliance
0.314718	35.1	9.000	L1	10.1	24.7	59.8	Compliance
0.412647	32.1	9.000	L1	10.0	25.5	57.6	Compliance
0.793127	31.3	9.000	L1	9.8	24.7	56.0	Compliance
1.099574	35.0	9.000	L1	9.8	21.0	56.0	Compliance
1.289541	34.1	9.000	L1	9.8	21.9	56.0	Compliance

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.204669	35.8	9.000	L1	10.6	17.6	53.4	Compliance
0.300025	27.1	9.000	L1	10.1	23.1	50.2	Compliance
0.396530	25.5	9.000	L1	10.0	22.4	47.9	Compliance
0.503608	24.4	9.000	L1	9.9	21.6	46.0	Compliance
1.144267	33.8	9.000	L1	9.8	12.2	46.0	Compliance
1.289541	28.6	9.000	L1	9.8	17.4	46.0	Compliance

AC120 V, 60 Hz, Neutral:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.195114	41.8	9.000	N	10.7	22.0	63.8	Compliance
0.698191	27.8	9.000	N	9.8	28.2	56.0	Compliance
0.812315	34.2	9.000	N	9.8	21.8	56.0	Compliance
0.908180	33.5	9.000	N	9.8	22.5	56.0	Compliance
1.190776	36.5	9.000	N	9.8	19.5	56.0	Compliance
1.289541	34.8	9.000	N	9.8	21.2	56.0	Compliance

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.201433	34.1	9.000	N	10.6	19.5	53.6	Compliance
0.468757	23.0	9.000	N	9.9	23.5	46.5	Compliance
0.503608	22.8	9.000	N	9.9	23.2	46.0	Compliance
0.831967	24.1	9.000	N	9.8	21.9	46.0	Compliance
1.144267	32.7	9.000	N	9.8	13.3	46.0	Compliance
1.289541	27.9	9.000	N	9.8	18.1	46.0	Compliance

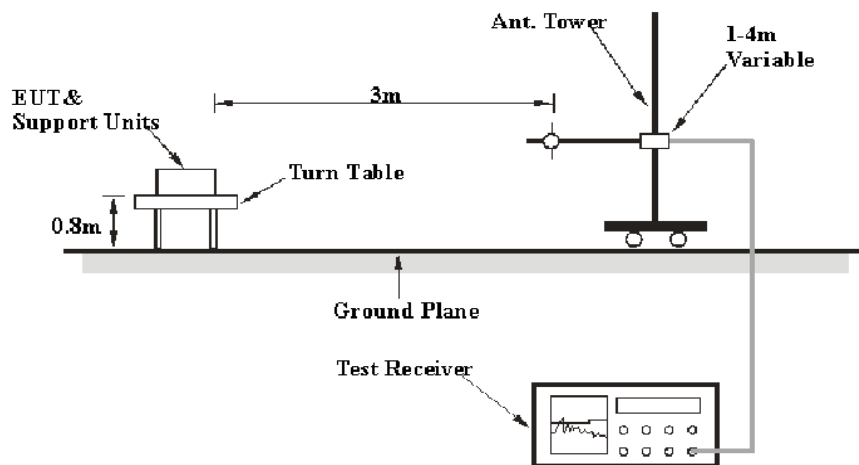
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

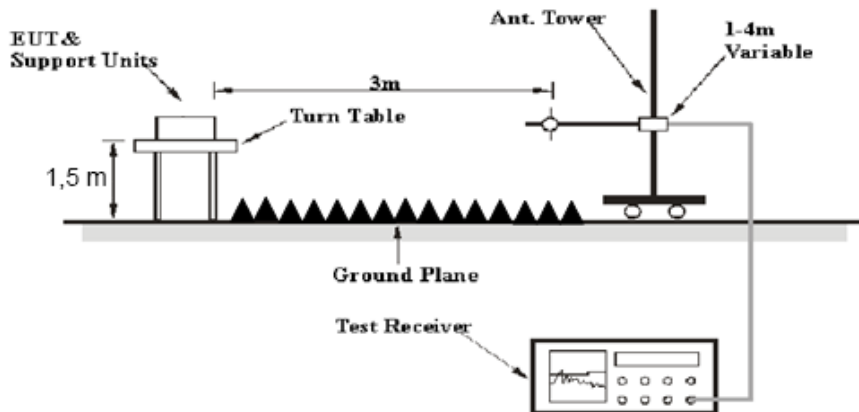
FCC §15.247 (d); §15.209; §15.205

EUT Setup

Below 1GHz:



Above 1GHz:



The radiated emission below 1GHz tests were performed in the 3 meters chamber test site A, above 1GHz tests were performed in the 3 meters chamber test site B, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

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	Measurement
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	AV

Test Procedure

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

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz - 1 GHz, peak and average detection modes for frequencies above 1 GHz.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2017-09-01	2018-09-01
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2018-11-10
HP	Amplifier	8447D	2727A05902	2017-09-05	2018-09-05
R&S	Spectrum Analyzer	E4440A	SG43360054	2017-12-08	2018-12-08
ETS-Lindgren	Horn Antenna	3115	000 527 35	2016-01-05	2019-01-04
MITEQ	Amplifier	AFS42-00101800-25-S-42	2001271	2017-09-05	2018-09-05
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-02 1304	2016-11-18	2019-11-18
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2017-06-27	2018-06-27
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1000-01	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2017-09-05	2018-09-05
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
Chengdu Ouli	Band Rejection Filter	2400-2483.5	002	2017-09-05	2018-09-05
E-Microwave	Band-stop Filters	OBSF-2400-2483.5-S	OE01601525	2017-06-16	2018-06-16
Mini Circuits	High Pass Filter	VHF-6010+	31118	2017-06-16	2018-06-16

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

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 Data

Environmental Conditions

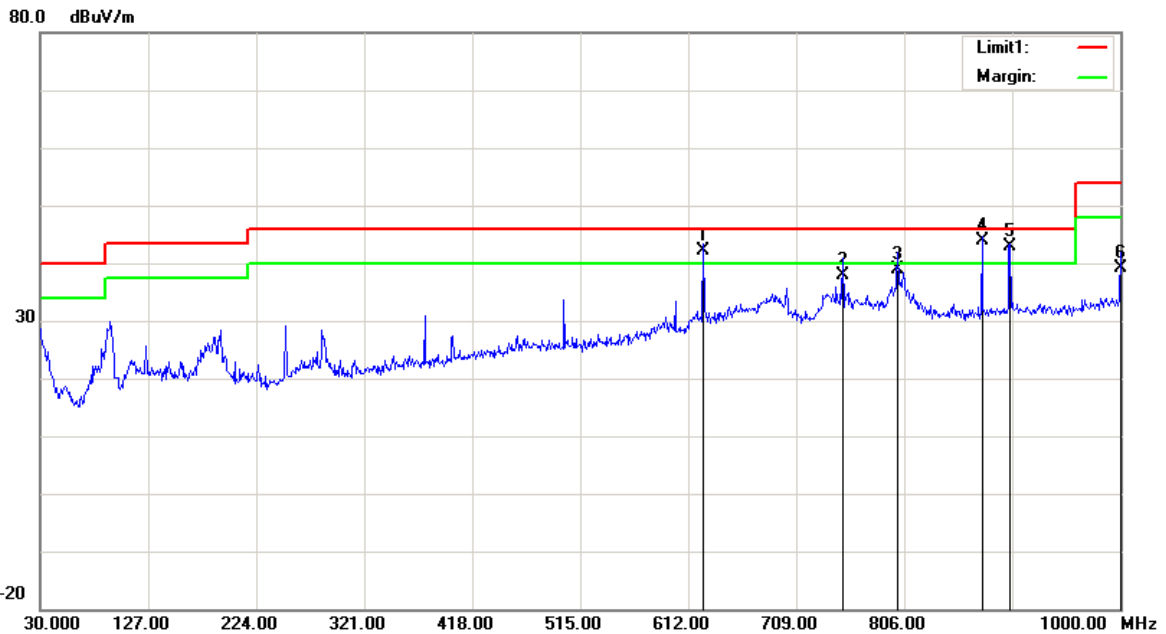
Temperature:	24.3~25.8 °C
Relative Humidity:	52~57 %
ATM Pressure:	100.3~100.8 kPa

** The testing was performed by Steven Zuo & Blake Yang on 2018-04-23 and 2018-05-01.*

Test Mode: Transmitting

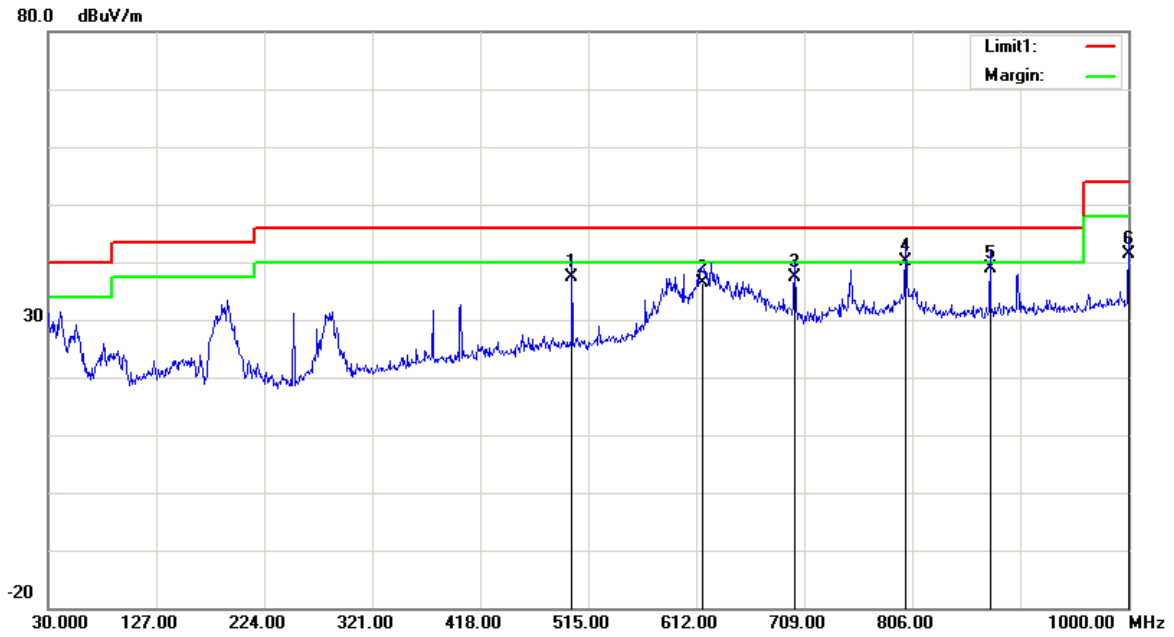
1) 30MHz-1GHz(GFSK Middle channel was the worst)

Horizontal:



Frequency (MHz)	Receiver Reading (dBμV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
625.5800	40.38	QP	1.72	42.10	46.00	3.90
750.7100	34.28	QP	3.62	37.90	46.00	8.10
800.1800	34.19	QP	4.61	38.80	46.00	7.20
875.8400	38.48	QP	5.52	44.00	46.00	2.00
901.0600	36.77	QP	6.23	43.00	46.00	3.00
1000.0000	9.60	QP	29.60	39.20	54.00	14.80

Vertical:



Frequency (MHz)	Receiver Reading (dBμV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
500.4500	37.82	QP	-0.32	37.50	46.00	8.50
617.8200	35.08	QP	1.32	36.40	46.00	9.60
700.2700	34.24	QP	3.16	37.40	46.00	8.60
800.1800	35.59	QP	4.61	40.20	46.00	5.80
875.8400	33.38	QP	5.52	38.90	46.00	7.10
1000.0000	11.90	QP	29.60	41.50	54.00	12.50

2)1GHz-25GHz:

BDR Mode (GFSK):

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	Detector	Polar (H/V)	Factor (dB/m)					
Low Channel: 2402 MHz									
2402.00	46.98	PK	H	28.10	1.80	0.00	76.88	N/A	N/A
2402.00	45.45	AV	H	28.10	1.80	0.00	75.35	N/A	N/A
2402.00	42.26	PK	V	28.10	1.80	0.00	72.16	N/A	N/A
2402.00	41.52	AV	V	28.10	1.80	0.00	71.42	N/A	N/A
2390.00	24.78	PK	H	28.08	1.80	0.00	54.66	74.00	19.34
2390.00	12.56	AV	H	28.08	1.80	0.00	42.44	54.00	11.56
4804.00	48.93	PK	H	32.91	3.17	37.20	47.81	74.00	26.19
4804.00	48.12	AV	H	32.91	3.17	37.20	47.00	54.00	7.00
7206.00	46.75	PK	H	35.74	4.82	37.23	50.08	74.00	23.92
7206.00	35.48	AV	H	35.74	4.82	37.23	38.81	54.00	15.19
Middle Channel: 2441 MHz									
2441.00	47.23	PK	H	28.18	1.82	0.00	77.23	N/A	N/A
2441.00	45.64	AV	H	28.18	1.82	0.00	75.64	N/A	N/A
2441.00	43.41	PK	V	28.18	1.82	0.00	73.41	N/A	N/A
2441.00	41.58	AV	V	28.18	1.82	0.00	71.58	N/A	N/A
4882.00	48.46	PK	H	33.06	3.27	37.21	47.58	74.00	26.42
4882.00	47.12	AV	H	33.06	3.27	37.21	46.24	54.00	7.76
7323.00	46.34	PK	H	36.04	4.62	37.38	49.62	74.00	24.38
7323.00	35.58	AV	H	36.04	4.62	37.38	38.86	54.00	15.14
High Channel: 2480 MHz									
2480.00	48.25	PK	H	28.26	1.84	0.00	78.35	N/A	N/A
2480.00	46.62	AV	H	28.26	1.84	0.00	76.72	N/A	N/A
2480.00	43.43	PK	V	28.26	1.84	0.00	73.53	N/A	N/A
2480.00	41.57	AV	V	28.26	1.84	0.00	71.67	N/A	N/A
2483.50	25.48	PK	H	28.27	1.84	0.00	55.59	74.00	18.41
2483.50	13.22	AV	H	28.27	1.84	0.00	43.33	54.00	10.67
4960.00	48.55	PK	H	33.22	3.23	37.25	47.75	74.00	26.25
4960.00	47.13	AV	H	33.22	3.23	37.25	46.33	54.00	7.67
7440.00	46.42	PK	H	36.34	4.41	37.52	49.65	74.00	24.35
7440.00	35.48	AV	H	36.34	4.41	37.52	38.71	54.00	15.29

EDR Mode ($\pi/4$ -DQPSK):

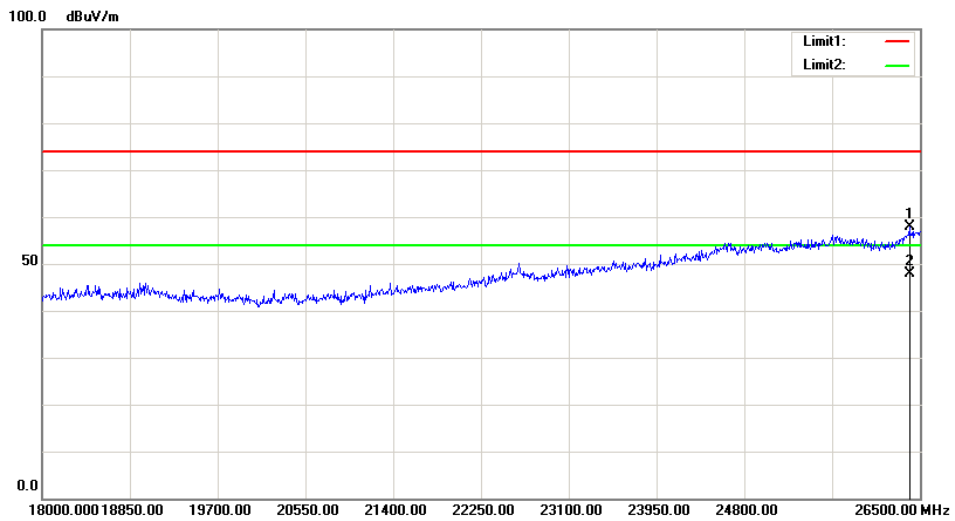
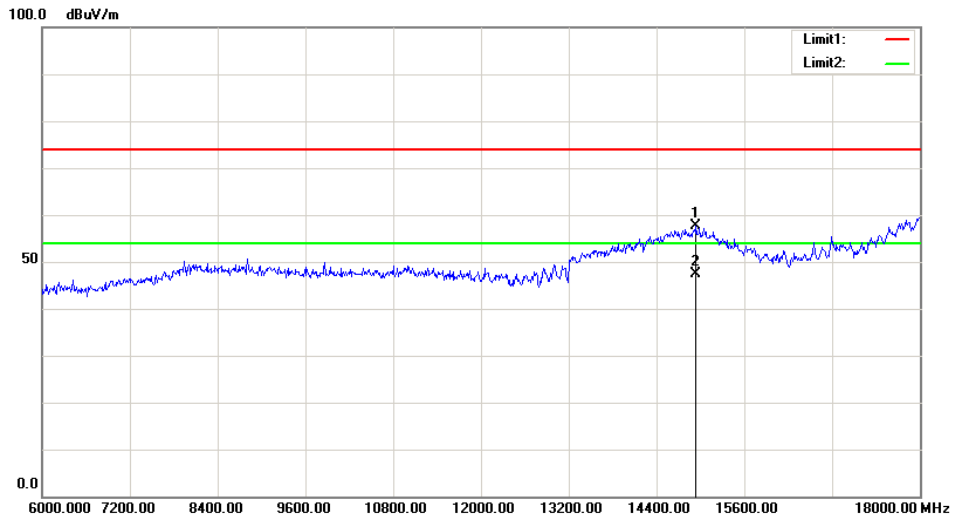
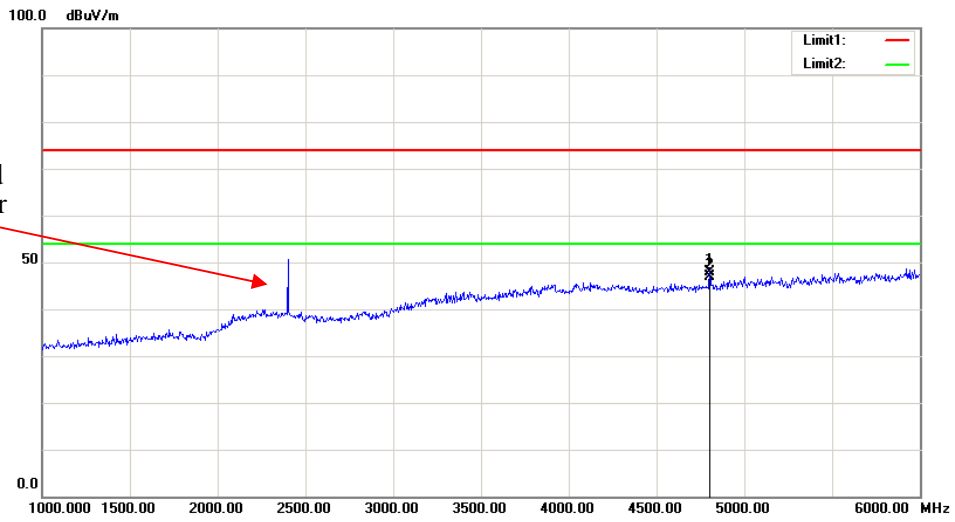
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
	Reading (dB μ V)	Detector	Polar (H/V)	Factor (dB/m)					
Low Channel: 2402 MHz									
2402.00	44.59	PK	H	28.10	1.80	0.00	74.49	N/A	N/A
2402.00	40.63	AV	H	28.10	1.80	0.00	70.53	N/A	N/A
2402.00	40.54	PK	V	28.10	1.80	0.00	70.44	N/A	N/A
2402.00	36.78	AV	V	28.10	1.80	0.00	66.68	N/A	N/A
2390.00	25.37	PK	H	28.08	1.80	0.00	55.25	74.00	18.75
2390.00	12.69	AV	H	28.08	1.80	0.00	42.57	54.00	11.43
4804.00	53.87	PK	H	32.91	3.17	37.20	52.75	74.00	21.25
4804.00	45.66	AV	H	32.91	3.17	37.20	44.54	54.00	9.46
7206.00	46.38	PK	H	35.74	4.82	37.23	49.71	74.00	24.29
7206.00	35.29	AV	H	35.74	4.82	37.23	38.62	54.00	15.38
Middle Channel: 2441 MHz									
2441.00	45.89	PK	H	28.18	1.82	0.00	75.89	N/A	N/A
2441.00	41.75	AV	H	28.18	1.82	0.00	71.75	N/A	N/A
2441.00	41.68	PK	V	28.18	1.82	0.00	71.68	N/A	N/A
2441.00	37.92	AV	V	28.18	1.82	0.00	67.92	N/A	N/A
4882.00	53.46	PK	H	33.06	3.27	37.21	52.58	74.00	21.42
4882.00	45.27	AV	H	33.06	3.27	37.21	44.39	54.00	9.61
7323.00	46.75	PK	H	36.04	4.62	37.38	50.03	74.00	23.97
7323.00	35.43	AV	H	36.04	4.62	37.38	38.71	54.00	15.29
High Channel: 2480 MHz									
2480.00	45.14	PK	H	28.26	1.84	0.00	75.24	N/A	N/A
2480.00	41.62	AV	H	28.26	1.84	0.00	71.72	N/A	N/A
2480.00	41.37	PK	V	28.26	1.84	0.00	71.47	N/A	N/A
2480.00	37.52	AV	V	28.26	1.84	0.00	67.62	N/A	N/A
2483.50	25.49	PK	H	28.27	1.84	0.00	55.60	74.00	18.40
2483.50	12.65	AV	H	28.27	1.84	0.00	42.76	54.00	11.24
4960.00	53.36	PK	H	33.22	3.23	37.25	52.56	74.00	21.44
4960.00	45.09	AV	H	33.22	3.23	37.25	44.29	54.00	9.71
7440.00	46.78	PK	H	36.34	4.41	37.52	50.01	74.00	23.99
7440.00	35.52	AV	H	36.34	4.41	37.52	38.75	54.00	15.25

EDR Mode (8-DPSK):

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
	Reading (dB μ V)	Detector	Polar (H/V)	Factor (dB/m)					
Low Channel: 2402 MHz									
2402.00	44.45	PK	H	28.10	1.80	0.00	74.35	N/A	N/A
2402.00	40.69	AV	H	28.10	1.80	0.00	70.59	N/A	N/A
2402.00	40.37	PK	V	28.10	1.80	0.00	70.27	N/A	N/A
2402.00	36.71	AV	V	28.10	1.80	0.00	66.61	N/A	N/A
2390.00	25.18	PK	H	28.08	1.80	0.00	55.06	74.00	18.94
2390.00	12.73	AV	H	28.08	1.80	0.00	42.61	54.00	11.39
4804.00	54.06	PK	H	32.91	3.17	37.20	52.94	74.00	21.06
4804.00	45.80	AV	H	32.91	3.17	37.20	44.68	54.00	9.32
7206.00	46.32	PK	H	35.74	4.82	37.23	49.65	74.00	24.35
7206.00	35.31	AV	H	35.74	4.82	37.23	38.64	54.00	15.36
Middle Channel: 2441 MHz									
2441.00	45.93	PK	H	28.18	1.82	0.00	75.93	N/A	N/A
2441.00	41.85	AV	H	28.18	1.82	0.00	71.85	N/A	N/A
2441.00	41.76	PK	V	28.18	1.82	0.00	71.76	N/A	N/A
2441.00	37.85	AV	V	28.18	1.82	0.00	67.85	N/A	N/A
4882.00	53.65	PK	H	33.06	3.27	37.21	52.77	74.00	21.23
4882.00	45.35	AV	H	33.06	3.27	37.21	44.47	54.00	9.53
7323.00	46.66	PK	H	36.04	4.62	37.38	49.94	74.00	24.06
7323.00	35.43	AV	H	36.04	4.62	37.38	38.71	54.00	15.29
High Channel: 2480 MHz									
2480.00	45.22	PK	H	28.26	1.84	0.00	75.32	N/A	N/A
2480.00	41.63	AV	H	28.26	1.84	0.00	71.73	N/A	N/A
2480.00	41.28	PK	V	28.26	1.84	0.00	71.38	N/A	N/A
2480.00	37.54	AV	V	28.26	1.84	0.00	67.64	N/A	N/A
2483.50	25.43	PK	H	28.27	1.84	0.00	55.54	74.00	18.46
2483.50	12.79	AV	H	28.27	1.84	0.00	42.90	54.00	11.10
4960.00	53.24	PK	H	33.22	3.23	37.25	52.44	74.00	21.56
4960.00	45.03	AV	H	33.22	3.23	37.25	44.23	54.00	9.77
7440.00	46.62	PK	H	36.34	4.41	37.52	49.85	74.00	24.15
7440.00	35.55	AV	H	36.34	4.41	37.52	38.78	54.00	15.22

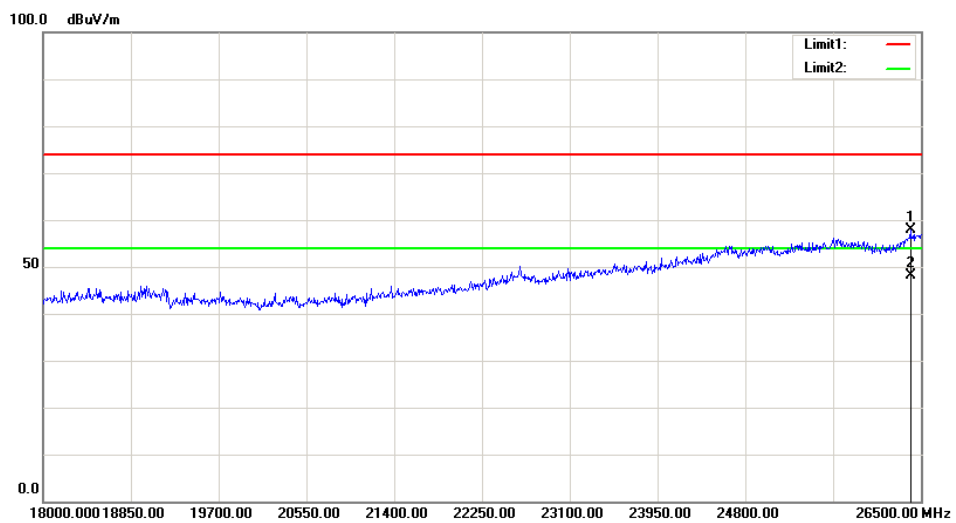
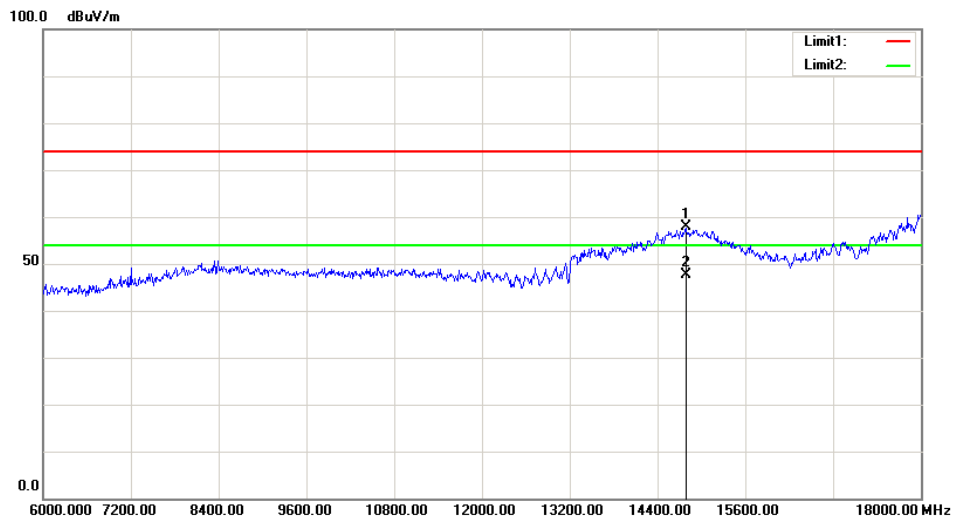
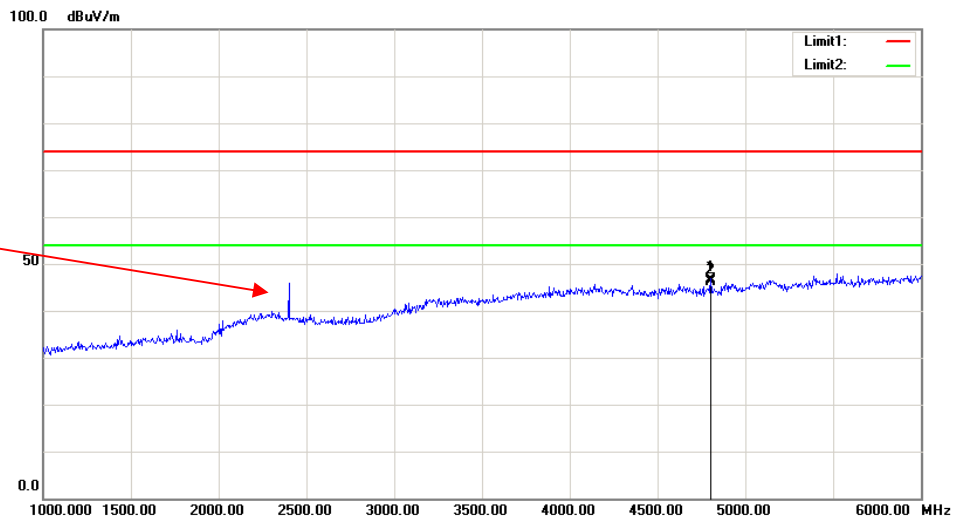
Worst plots(GFSK Low channel) Horizontal

Fundamental
Test with Band
Rejection Filter



Vertical

Fundamental
Test with Band
Rejection Filter



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

Applicable Standard

According to FCC §15.247(a) (1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.50 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	101121	2018-03-23	2019-03-23
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	/

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

Test Procedure

1. Set the EUT in transmitting mode, spectrum Bandwidth was set at 30 kHz, maxhold the channel.
2. Set the adjacent channel of the EUT maxhold another trace.
3. Measure the channel separation.

Test Data

Environmental Conditions

Temperature:	28.3 °C
Relative Humidity:	60 %
ATM Pressure:	100.8 kPa

* *The testing was performed by Tiago Huang on 2018-05-06.*

Test Result: Compliance.

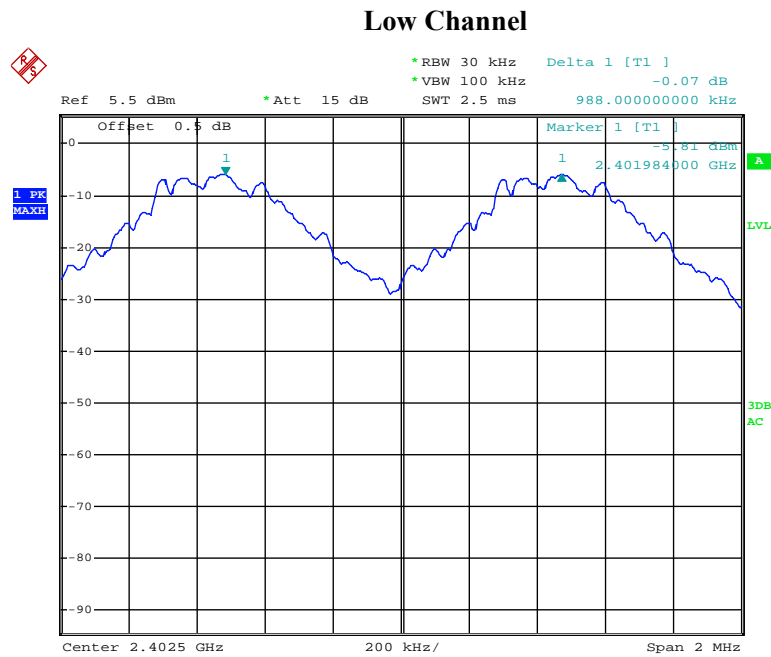
Please refer to following tables and plots

Test Mode: Transmitting

Mode	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)
BDR (GFSK)	Low	2402	0.988	0.63
	Middle	2441	0.996	0.60
	High	2480	0.996	0.60
EDR ($\pi/4$ -DQPSK)	Low	2402	0.996	0.89
	Middle	2441	1.004	0.89
	High	2480	1.004	0.89
EDR (8-DPSK)	Low	2402	1.000	0.85
	Middle	2441	1.000	0.85
	High	2480	1.000	0.85

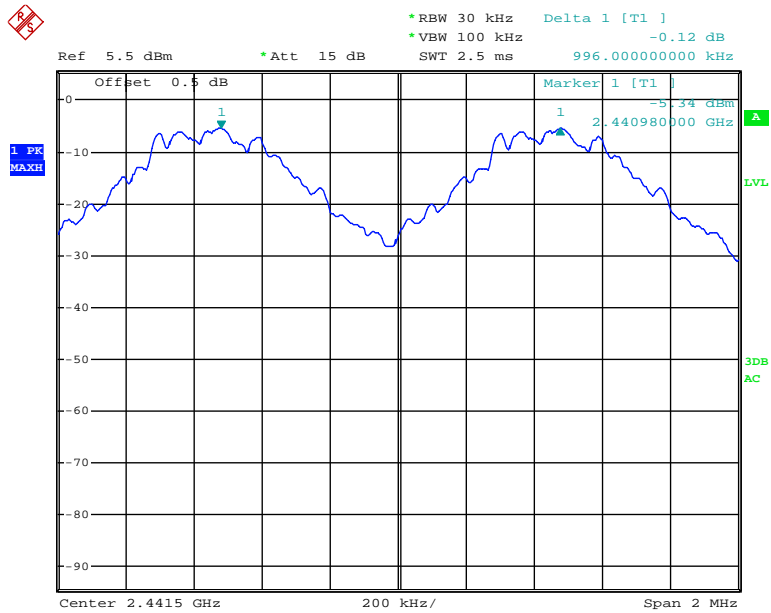
Note: Limit = $(2/3) \times 20\text{dB}$ bandwidth

BDR Mode (GFSK):



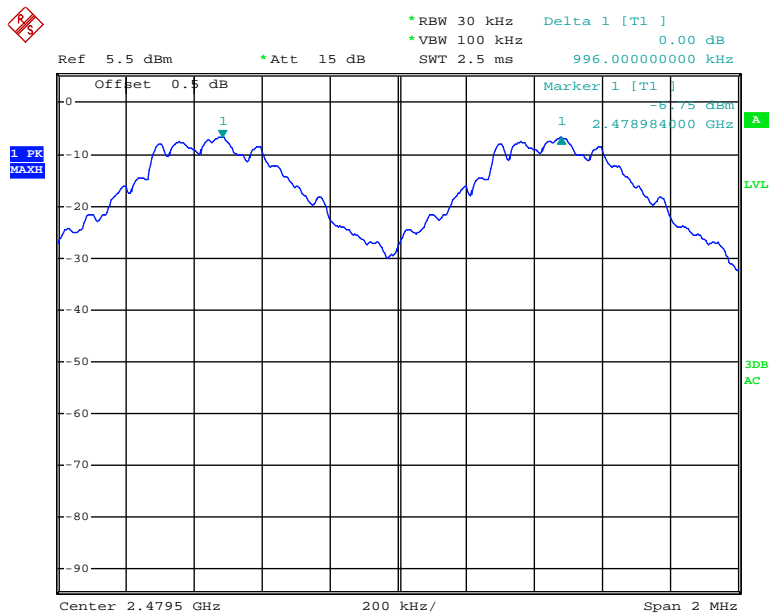
Date: 6.MAY.2018 14:21:53

Middle Channel



Date: 6.MAY.2018 14:23:16

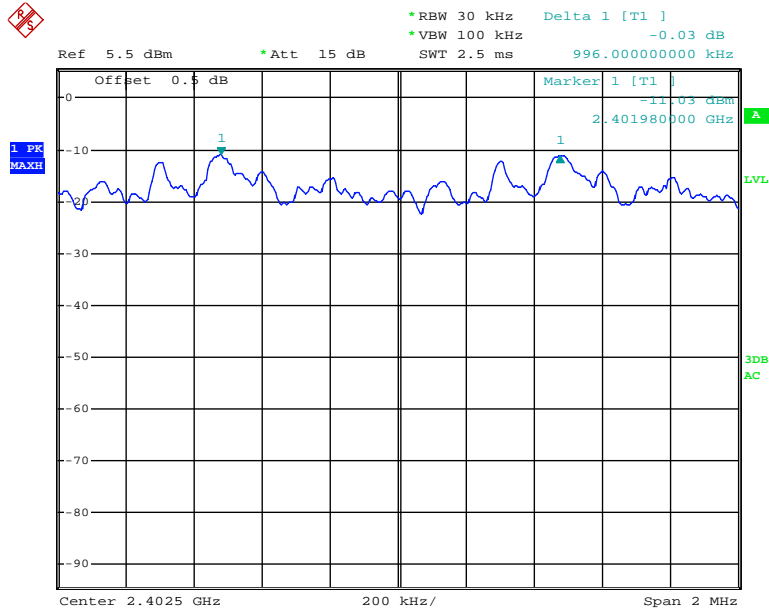
High Channel



Date: 6.MAY.2018 14:25:43

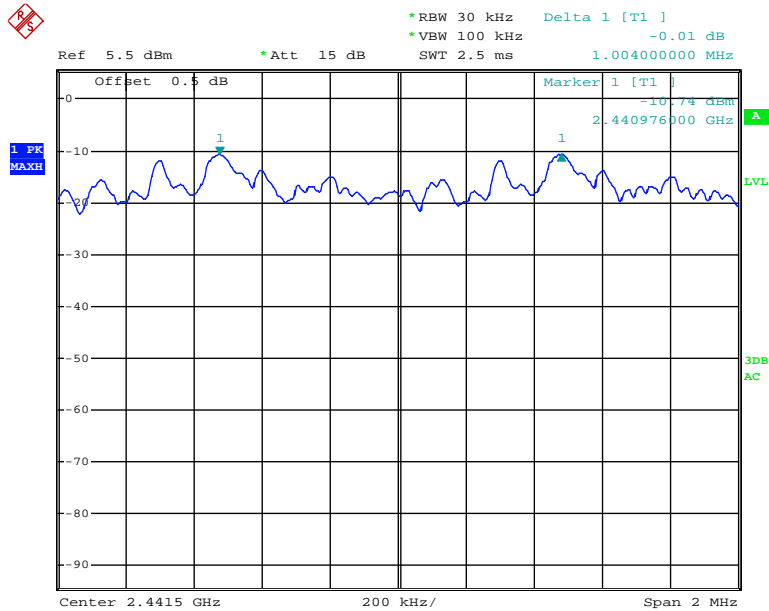
EDR Mode ($\pi/4$ -DQPSK):

Low Channel



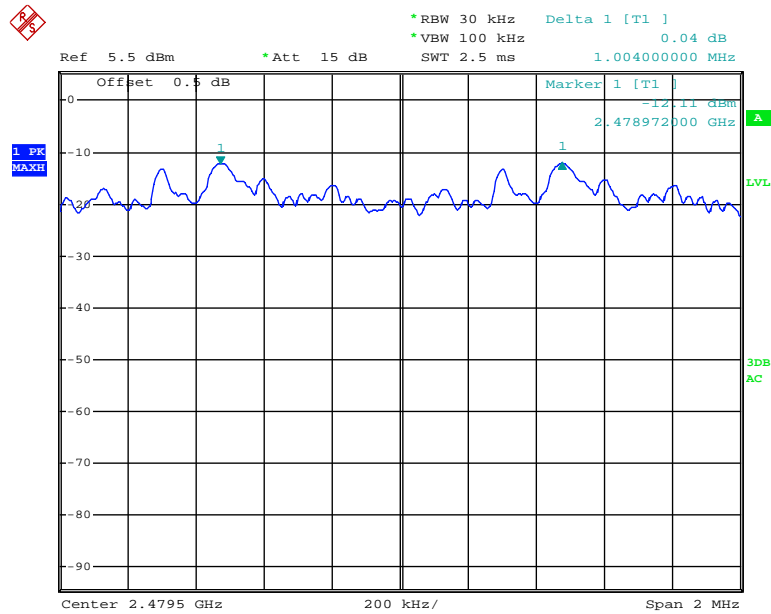
Date: 6.MAY.2018 14:19:26

Middle Channel



Date: 6.MAY.2018 14:18:25

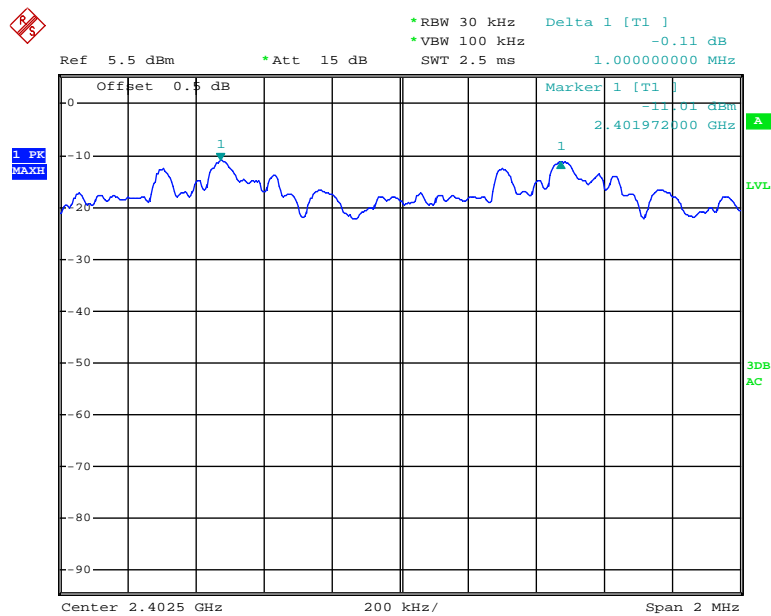
High Channel



Date: 6.MAY.2018 14:17:20

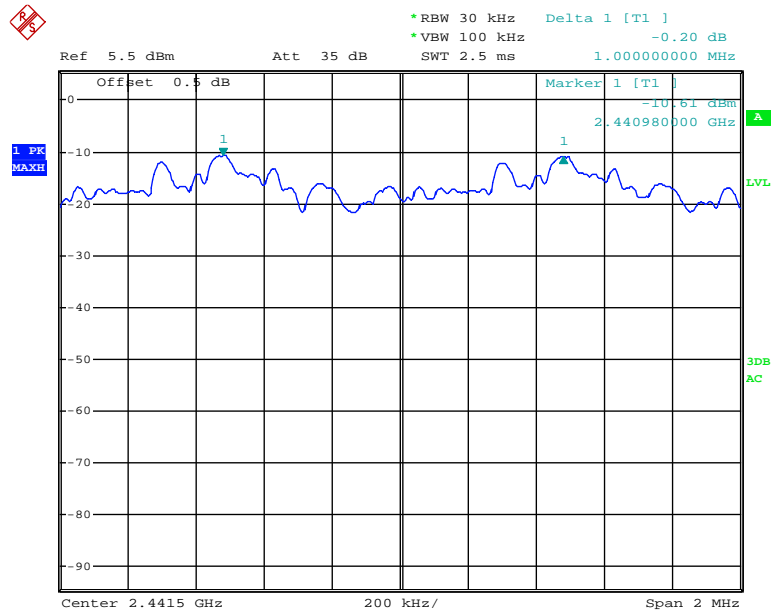
EDR Mode (8-DPSK):

Low Channel



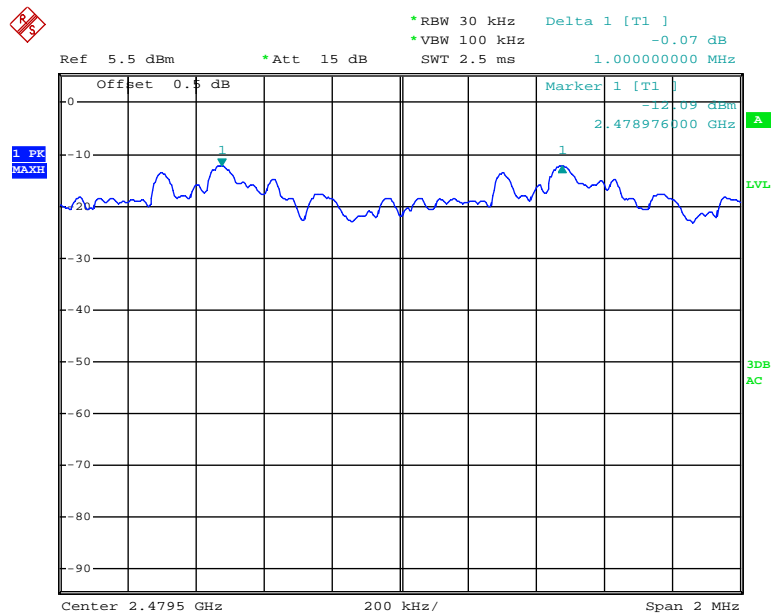
Date: 6.MAY.2018 13:57:18

Middle Channel



Date: 6.MAY.2018 14:05:14

High Channel



Date: 6.MAY.2018 14:13:16

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

Applicable Standard

According to FCC §15.247(a) (1):

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 on the test table without connection to measurement instrument. Turn on the EUT. 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. Use Occupied bandwidth test function, measure the 99% Occupied bandwidth.
5. Repeat above procedures until all frequencies measured were complete.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	101121	2018-03-23	2019-03-23
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	/

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

Test Data**Environmental Conditions**

Temperature:	28.3 °C
Relative Humidity:	60 %
ATM Pressure:	100.8 kPa

* The testing was performed by Tiago Huang on 2018-05-06.

Test Result: Compliance.

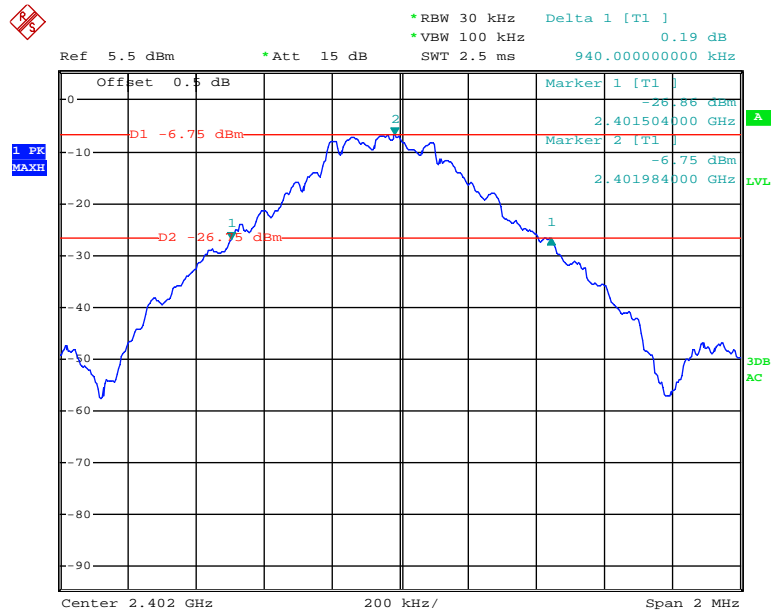
Please refer to following tables and plots

Test Mode: Transmitting

Mode	Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
BDR Mode (GFSK)	Low	2402	0.94
	Middle	2441	0.90
	High	2480	0.90
EDR Mode ($\pi/4$ -DQPSK)	Low	2402	1.33
	Middle	2441	1.33
	High	2480	1.33
EDR Mode (8-DPSK)	Low	2402	1.27
	Middle	2441	1.28
	High	2480	1.27

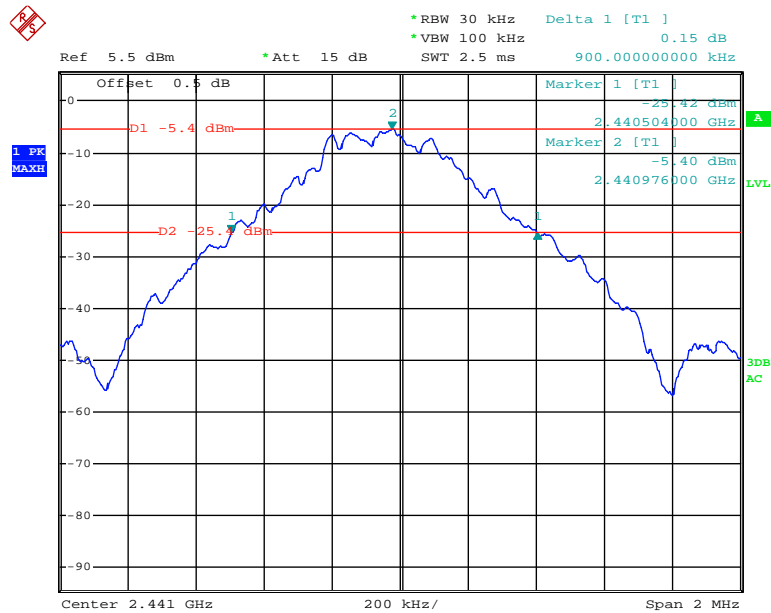
BDR Mode (GFSK):

Low Channel



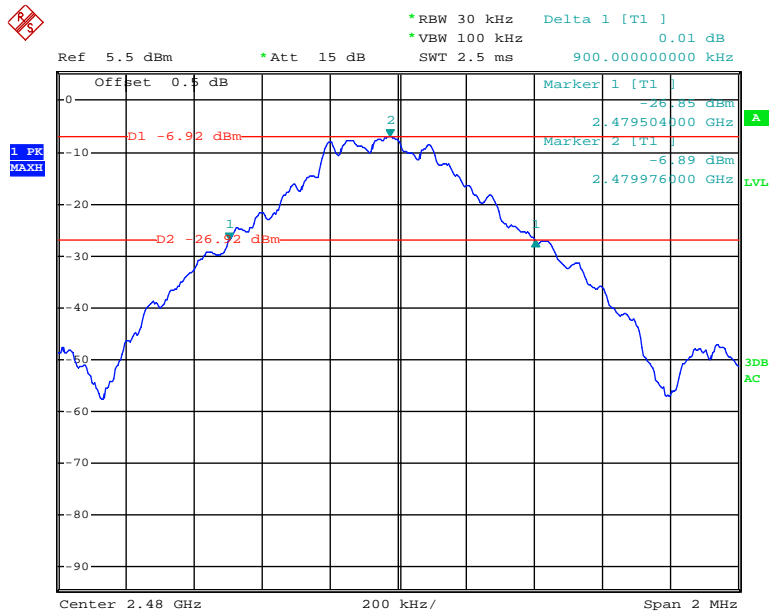
Date: 6.MAY.2018 11:58:44

Middle Channel



Date: 6.MAY.2018 13:20:15

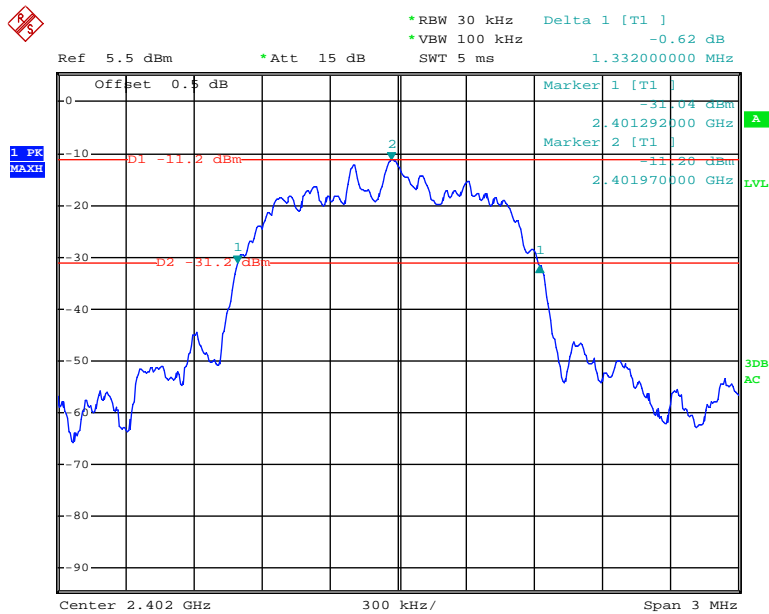
High Channel



Date: 6.MAY.2018 13:21:45

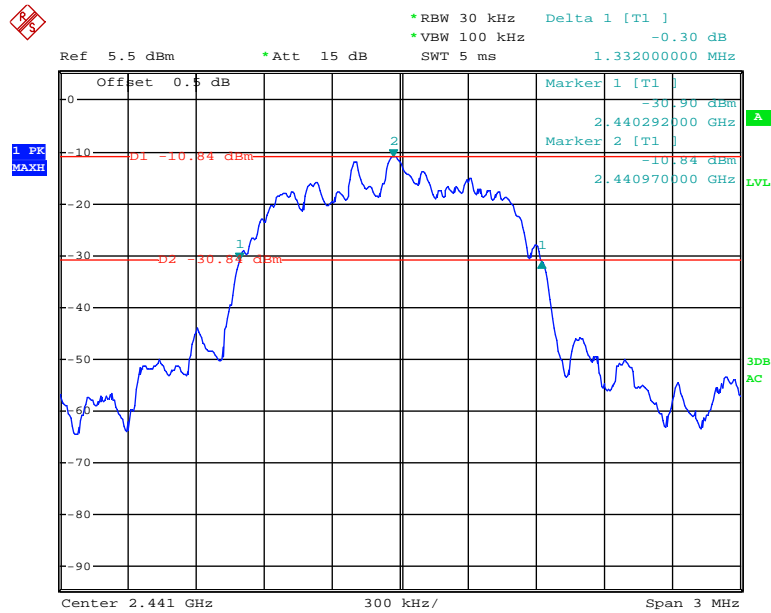
EDR Mode ($\pi/4$ -DQPSK):

Low Channel



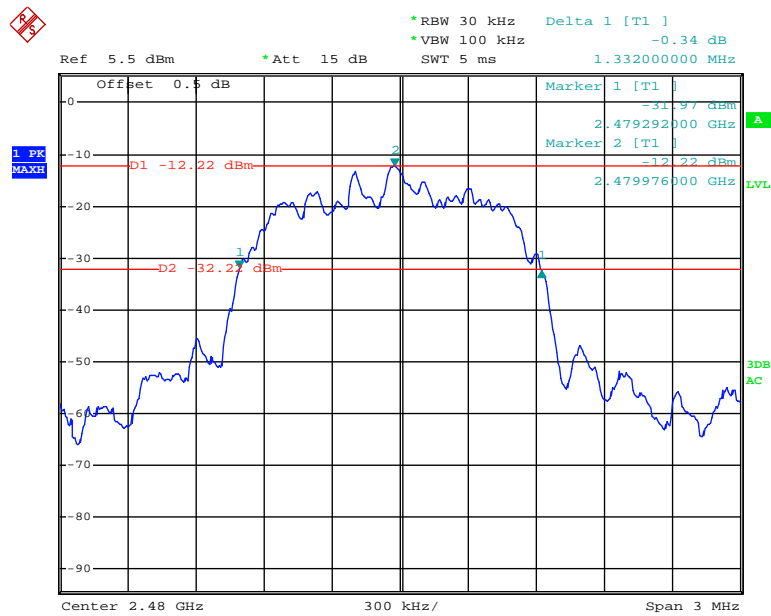
Date: 6.MAY.2018 13:36:27

Middle Channel



Date: 6.MAY.2018 13:39:45

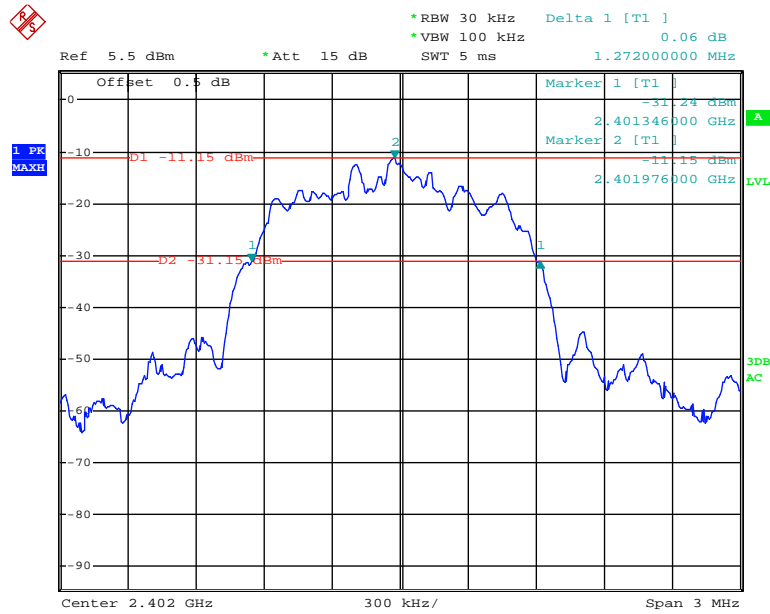
High Channel



Date: 6.MAY.2018 13:40:57

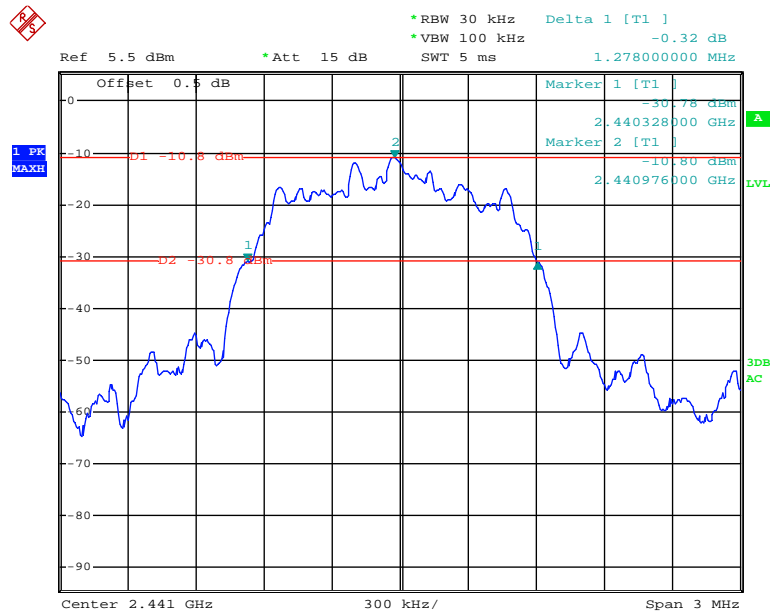
EDR Mode (8-DPSK):

Low Channel



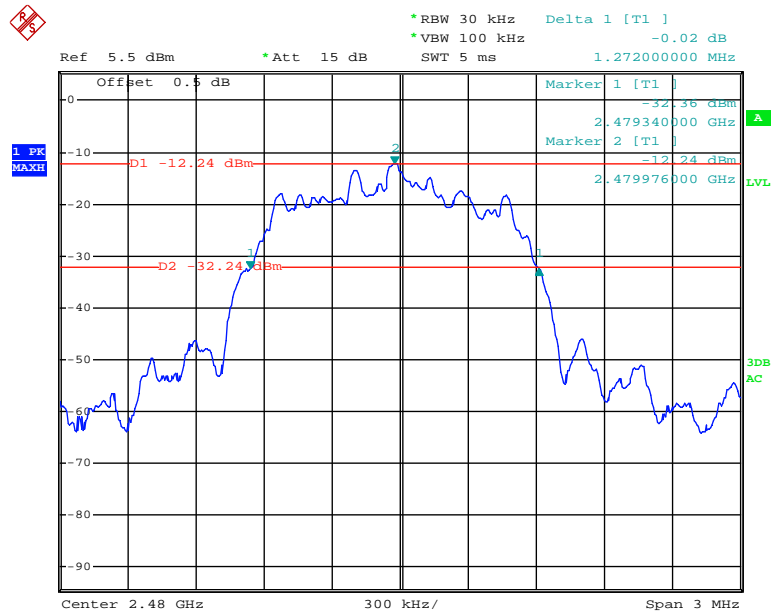
Date: 6.MAY.2018 13:51:15

Middle Channel



Date: 6.MAY.2018 13:50:03

High Channel



Date: 6.MAY.2018 13:44:19

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

Applicable Standard

According to FCC §15.247(a) (1) (iii)

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test 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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	101121	2018-03-23	2019-03-23
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	/

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

Test Data

Environmental Conditions

Temperature:	28.3 °C
Relative Humidity:	60 %
ATM Pressure:	100.8 kPa

* The testing was performed by Tiago Huang on 2018-05-06.

Test Result: Compliance.

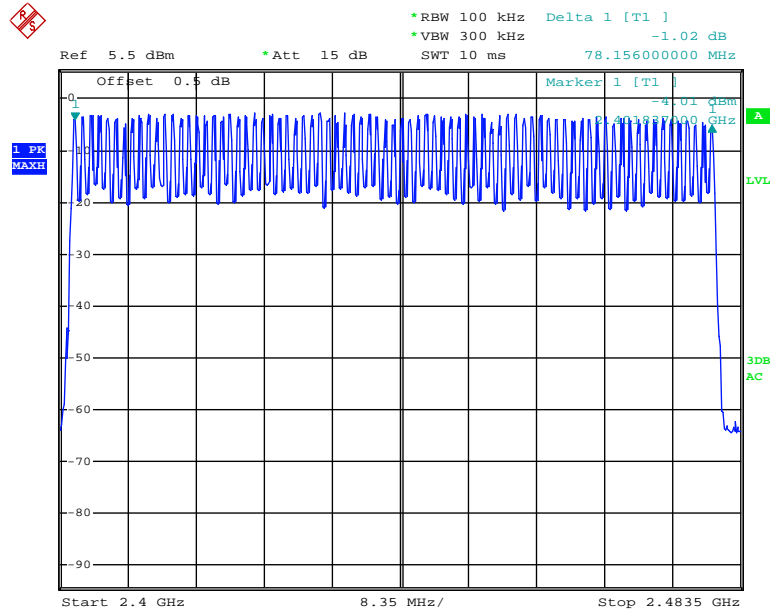
Please refer to following tables and plots

Test Mode: Transmitting

BDR Mode (GFSK):

Frequency Range (MHz)	Number of Hopping Channel	Limit
2400-2483.5	79	≥15

Number of Hopping Channels

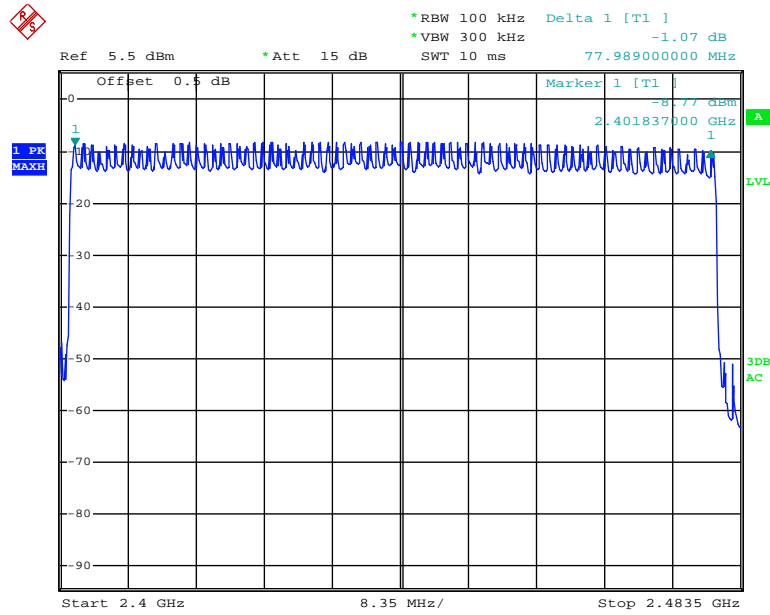


Date: 6.MAY.2018 14:28:03

EDR Mode ($\pi/4$ -DQPSK):

Frequency Range (MHz)	Number of Hopping Channel	Limit
2400-2483.5	79	≥ 15

Number of Hopping Channels

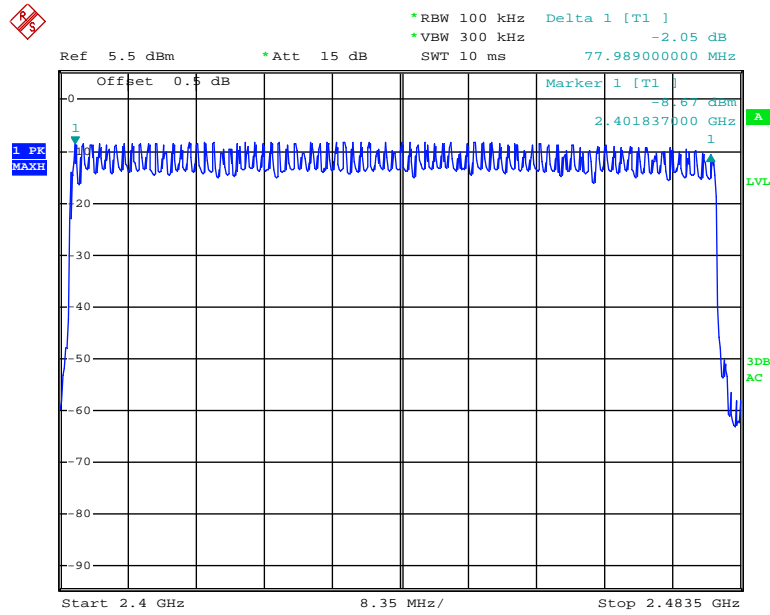


Date: 6.MAY.2018 14:37:49

EDR Mode (8-DPSK):

Frequency Range (MHz)	Number of Hopping Channel	Limit
2400-2483.5	79	≥15

Number of Hopping Channels



Date: 6.MAY.2018 14:42:32

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

Applicable Standard

According to FCC §15.247(a) (1) (iii)

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

The EUT was worked in channel hopping; the time of single pulses was tested.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	101121	2018-03-23	2019-03-23
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	/

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

Test Data

Environmental Conditions

Temperature:	28.3 °C
Relative Humidity:	60 %
ATM Pressure:	100.8 kPa

* *The testing was performed by Tiago Huang on 2018-05-06.*

Test Result: Compliance.

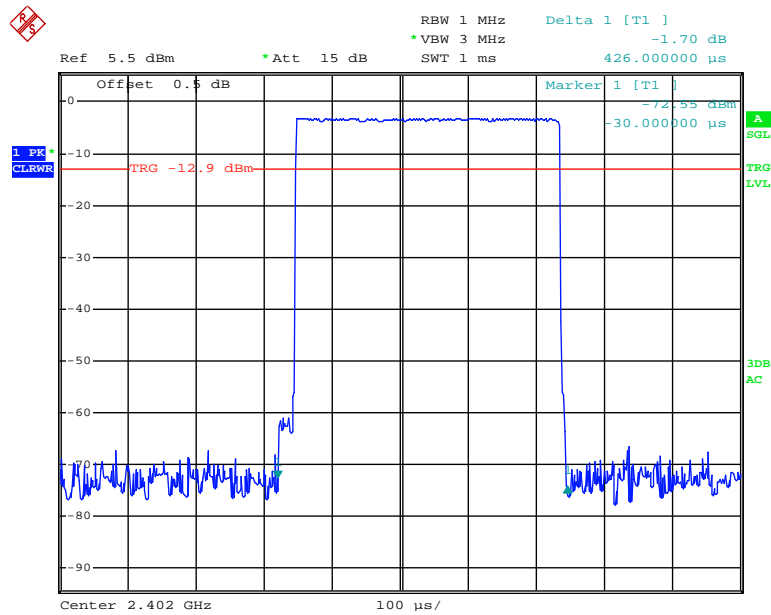
Please refer to following tables and plots

Test Mode: Transmitting

BDR Mode (GFSK):

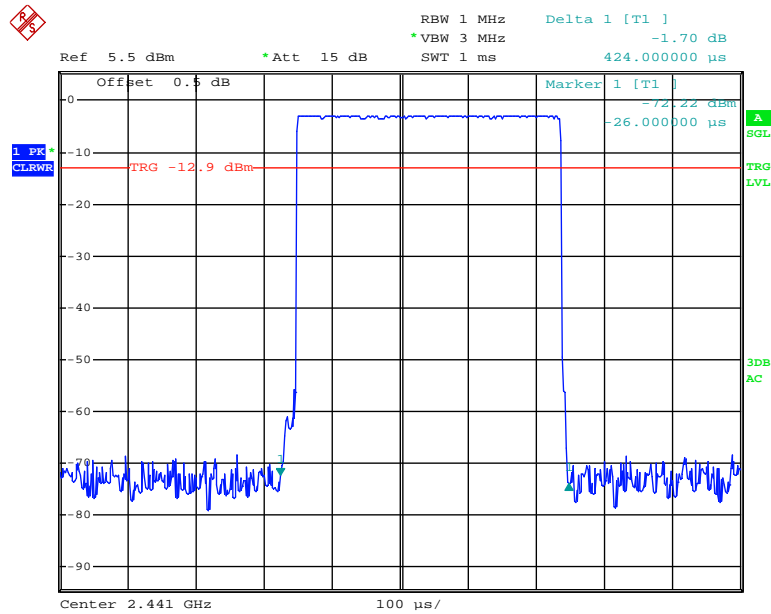
Mode	Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
DH1	Low	0.426	0.136	0.4	Compliance
	Middle	0.424	0.136	0.4	Compliance
	High	0.418	0.134	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/2/79) × 31.6 s				
DH3	Low	1.698	0.272	0.4	Compliance
	Middle	1.698	0.272	0.4	Compliance
	High	1.692	0.271	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/4/79) × 31.6 s				
DH5	Low	2.958	0.316	0.4	Compliance
	Middle	2.948	0.314	0.4	Compliance
	High	2.948	0.314	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/6/79) × 31.6 s				

DH1: Low Channel



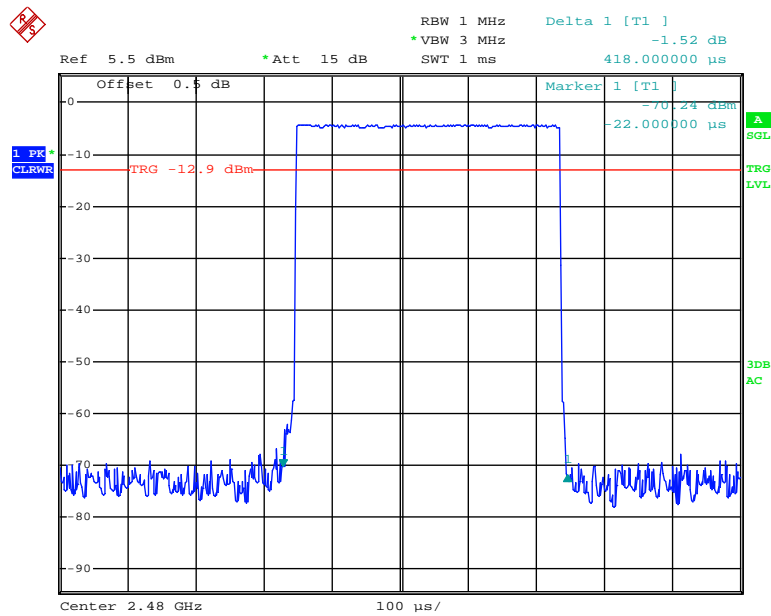
Date: 6.MAY.2018 15:11:30

DH1: Middle Channel



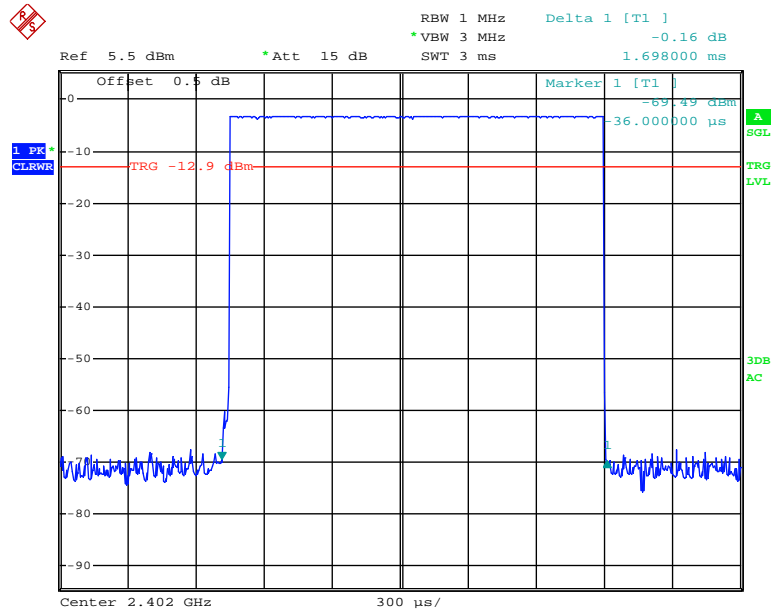
Date: 6.MAY.2018 15:12:02

DH1: High Channel



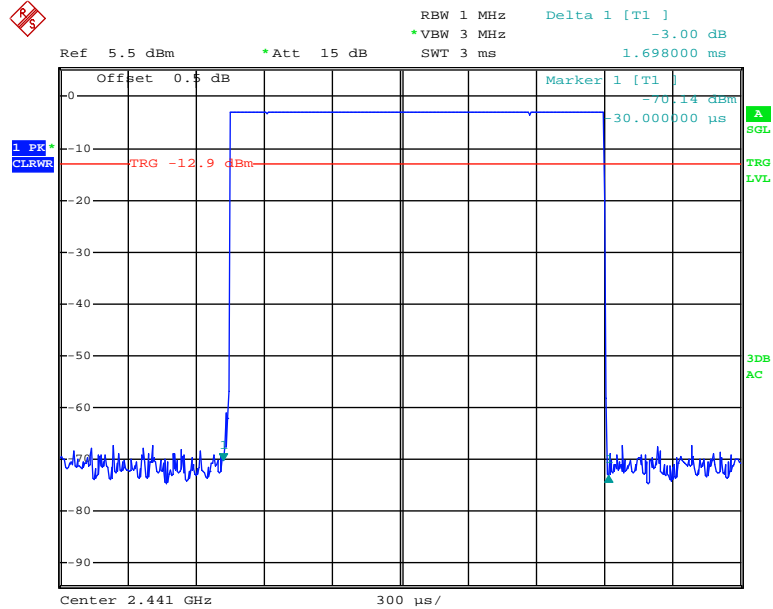
Date: 6.MAY.2018 15:12:29

DH3: Low Channel



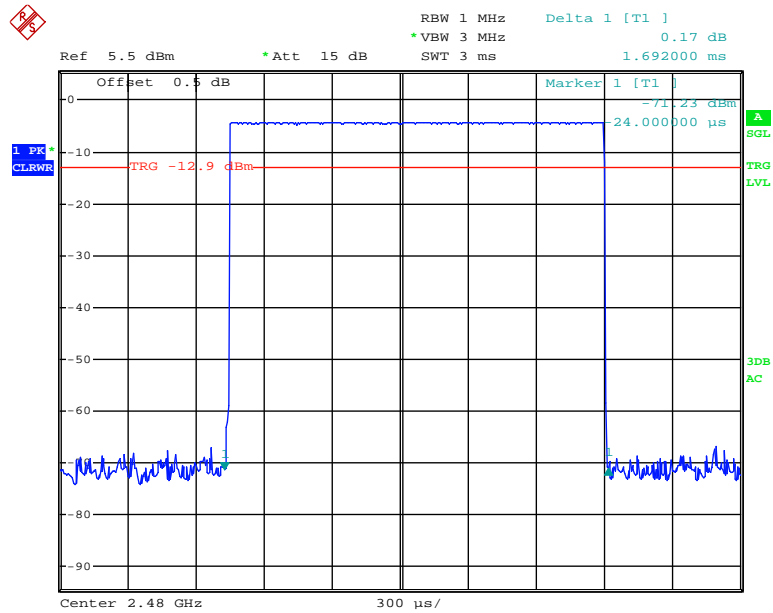
Date: 6.MAY.2018 15:08:18

DH3: Middle Channel



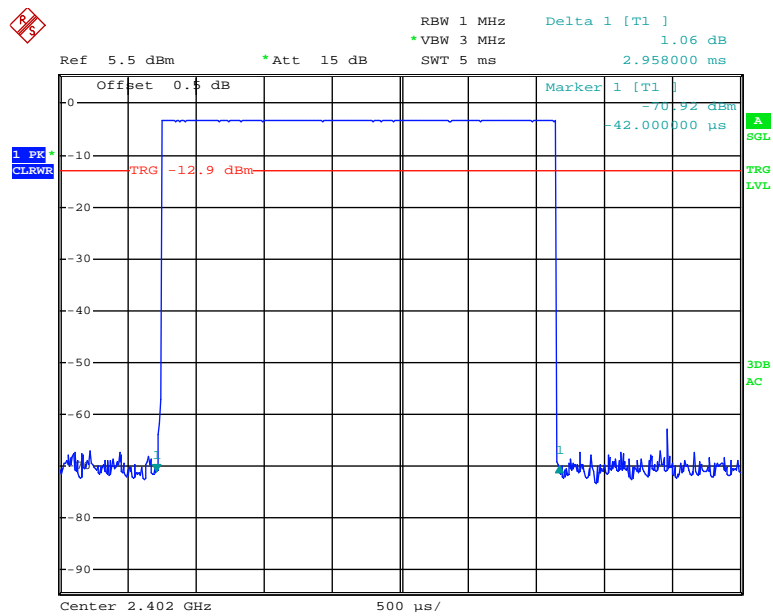
Date: 6.MAY.2018 15:07:47

DH3: High Channel



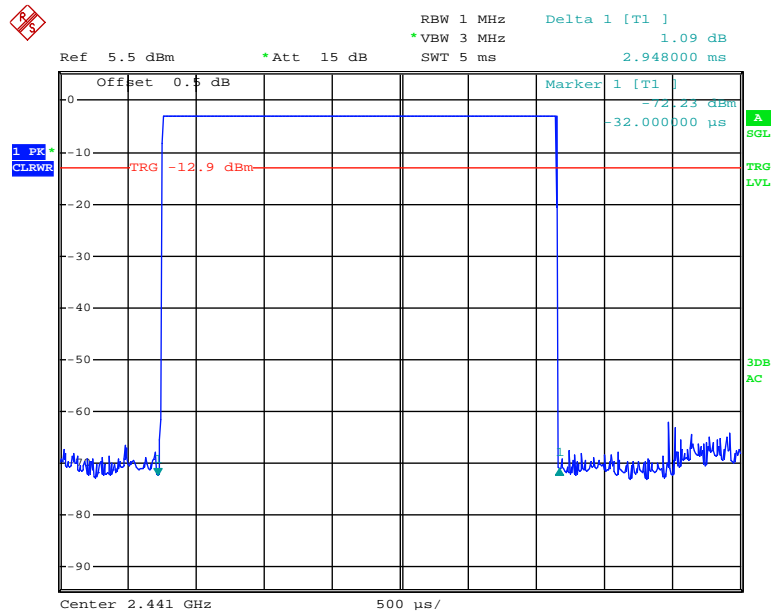
Date: 6.MAY.2018 15:07:19

DH5: Low Channel



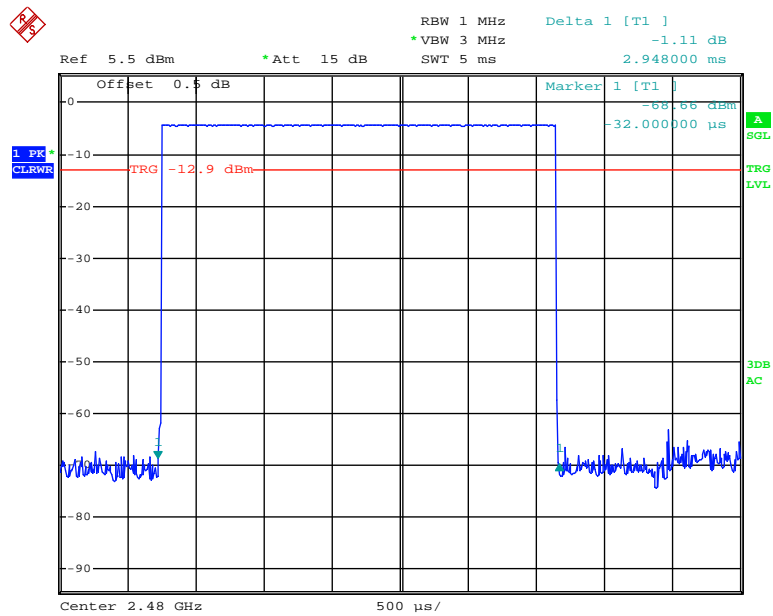
Date: 6.MAY.2018 15:17:33

DH5: Middle Channel



Date: 6.MAY.2018 15:17:10

DH5: High Channel

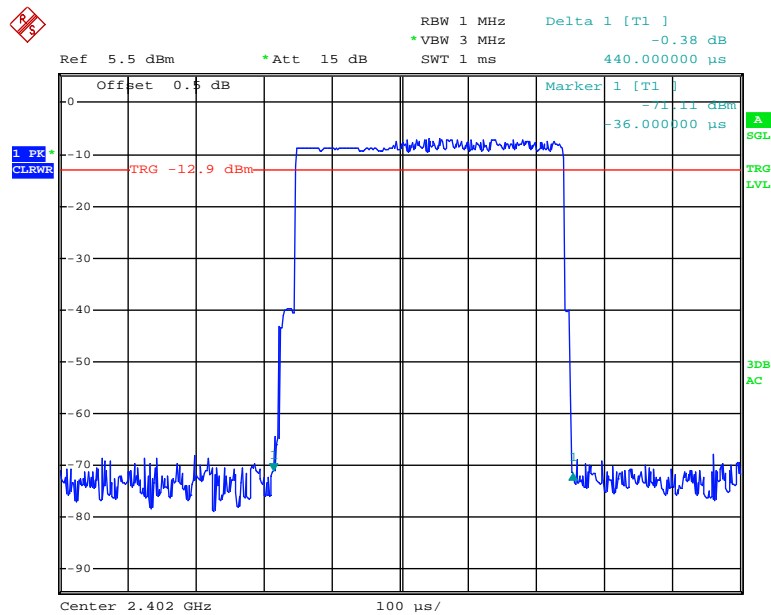


Date: 6.MAY.2018 15:16:43

EDR Mode ($\pi/4$ -DQPSK):

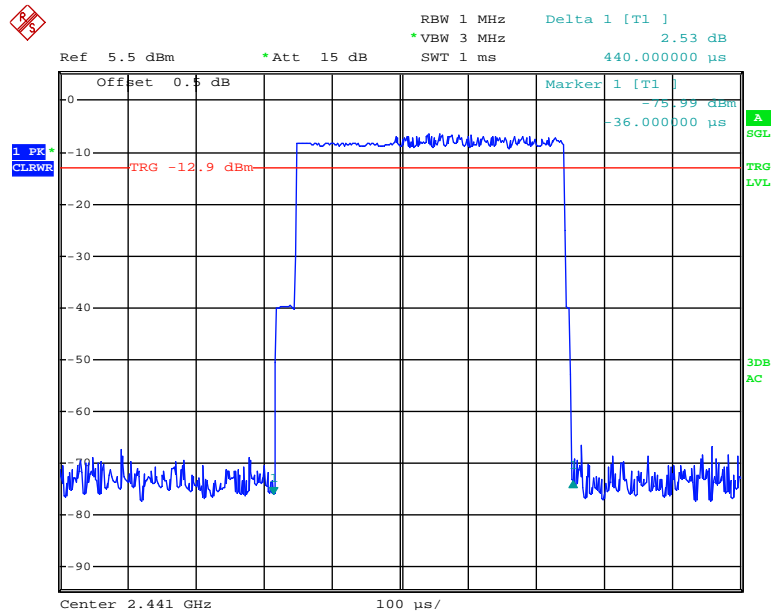
Mode	Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
2DH1	Low	0.440	0.141	0.4	Compliance
	Middle	0.440	0.141	0.4	Compliance
	High	0.438	0.140	0.4	Compliance
	Note: Dwell time=Pulse time (ms) \times (1600/2/79) \times 31.6 s				
2DH3	Low	1.716	0.275	0.4	Compliance
	Middle	1.716	0.275	0.4	Compliance
	High	1.716	0.275	0.4	Compliance
	Note: Dwell time=Pulse time (ms) \times (1600/4/79) \times 31.6 s				
2DH5	Low	2.966	0.316	0.4	Compliance
	Middle	2.966	0.316	0.4	Compliance
	High	2.956	0.315	0.4	Compliance
	Note: Dwell time=Pulse time (ms) \times (1600/6/79) \times 31.6 s				

2DH1: Low Channel



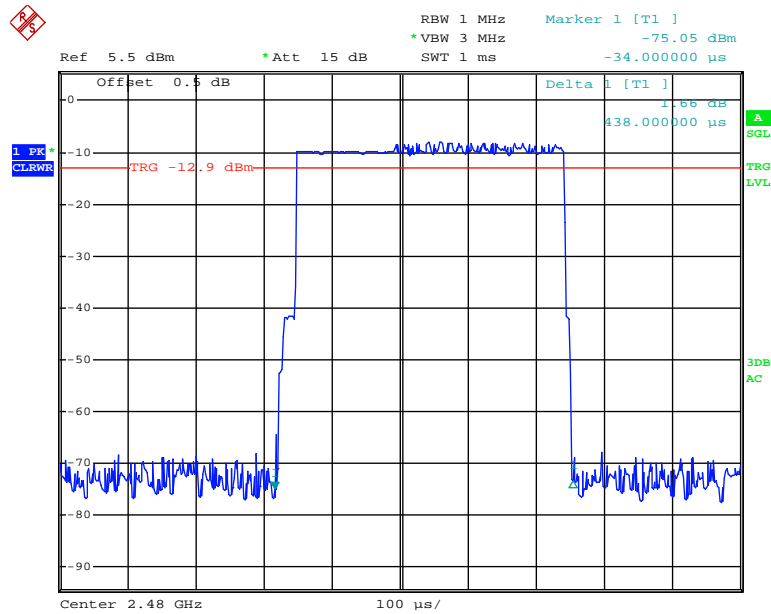
Date: 6.MAY.2018 15:21:59

2DH1: Middle Channel



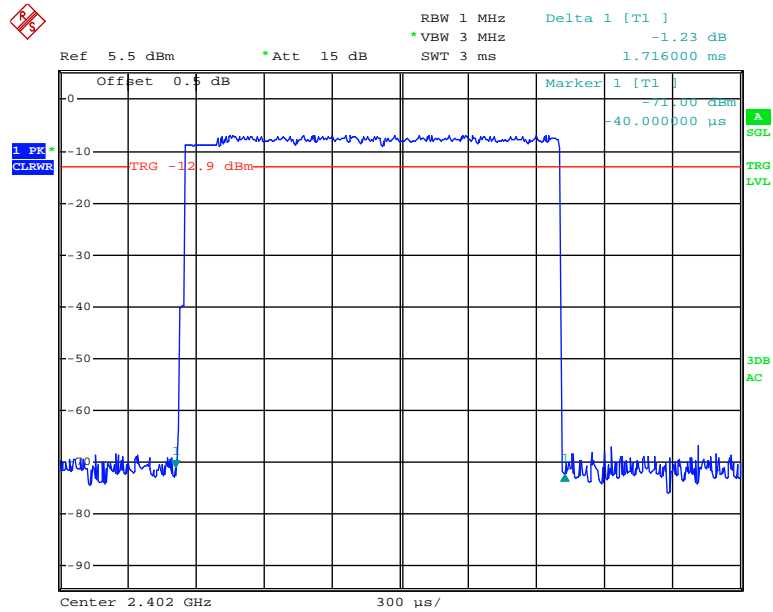
Date: 6.MAY.2018 15:22:25

2DH1: High Channel



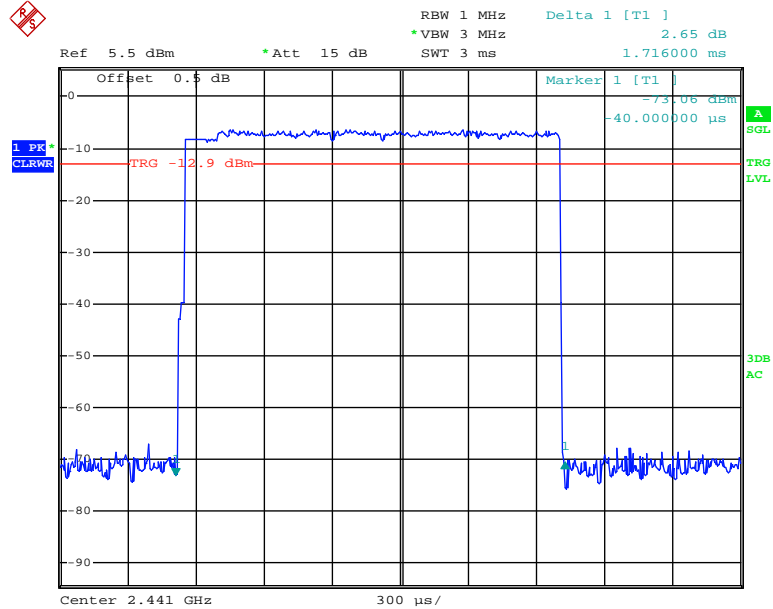
Date: 6.MAY.2018 15:22:54

2DH3: Low Channel



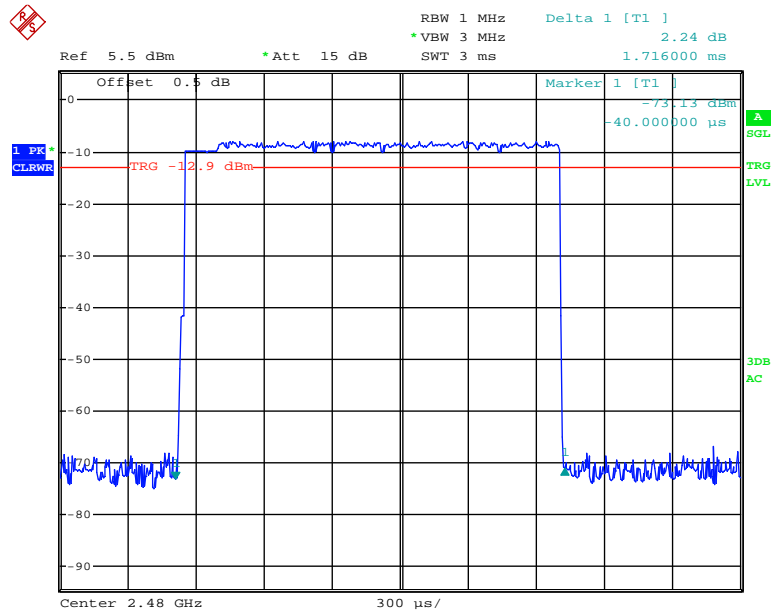
Date: 6.MAY.2018 15:27:14

2DH3: Middle Channel



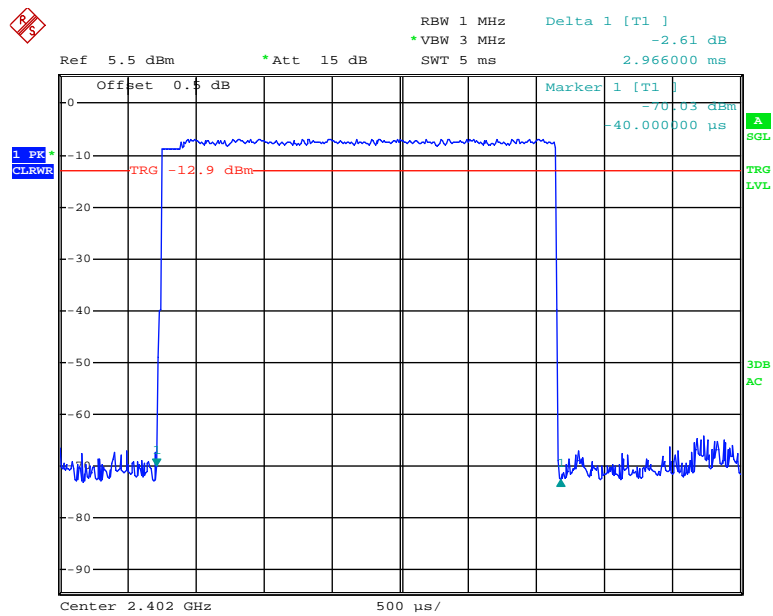
Date: 6.MAY.2018 15:25:56

2DH3: High Channel



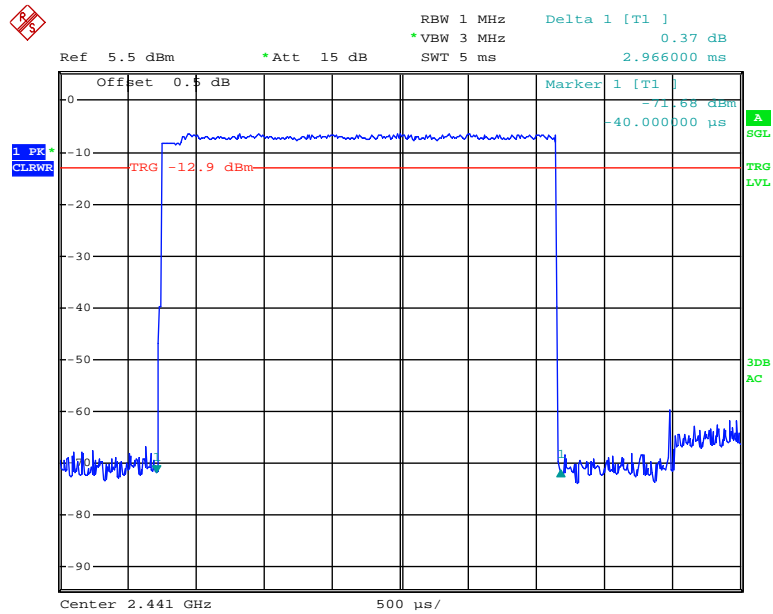
Date: 6.MAY.2018 15:25:27

2DH5: Low Channel



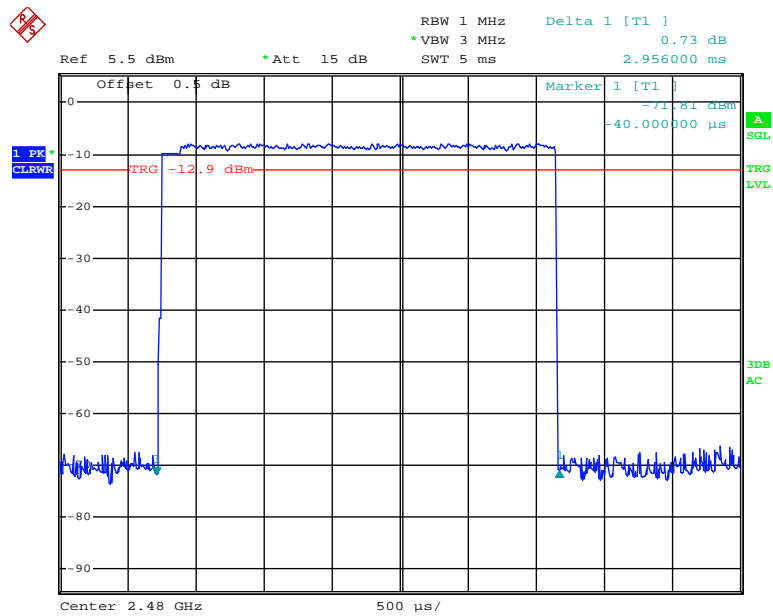
Date: 6.MAY.2018 15:29:14

2DH5: Middle Channel



Date: 6.MAY.2018 15:29:32

2DH5: High Channel

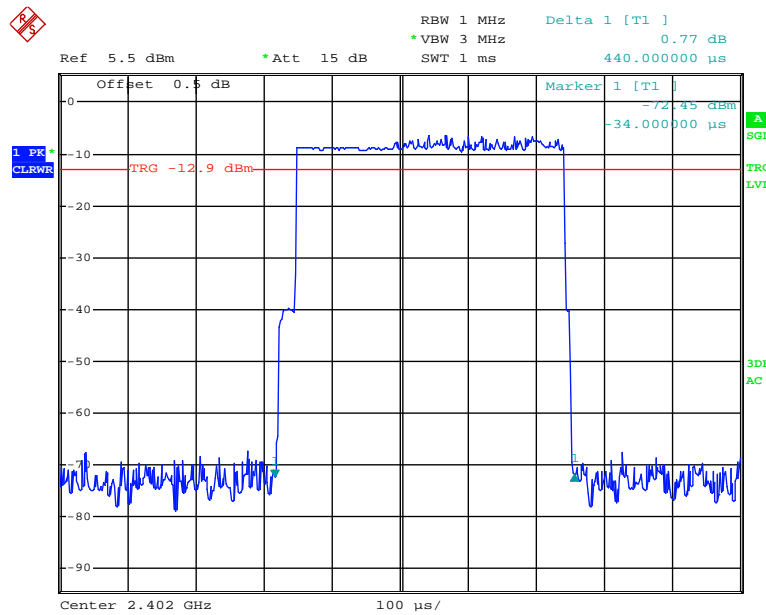


Date: 6.MAY.2018 15:30:00

EDR Mode (8-DPSK):

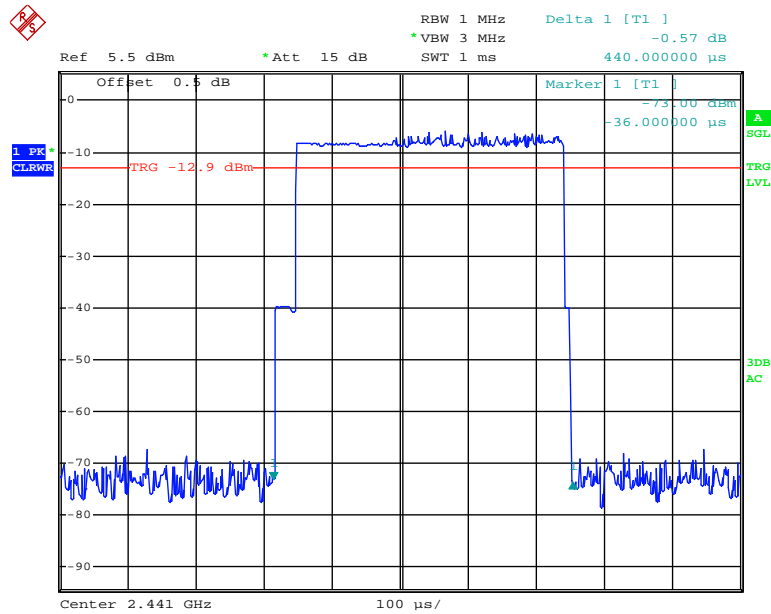
Mode	Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
3DH1	Low	0.440	0.141	0.4	Compliance
	Middle	0.440	0.141	0.4	Compliance
	High	0.434	0.139	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/2/79) × 31.6 s				
3DH3	Low	1.712	0.274	0.4	Compliance
	Middle	1.706	0.273	0.4	Compliance
	High	1.712	0.274	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/4/79) × 31.6 s				
3DH5	Low	2.962	0.316	0.4	Compliance
	Middle	2.962	0.316	0.4	Compliance
	High	2.962	0.316	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/6/79) × 31.6 s				

3DH1: Low Channel



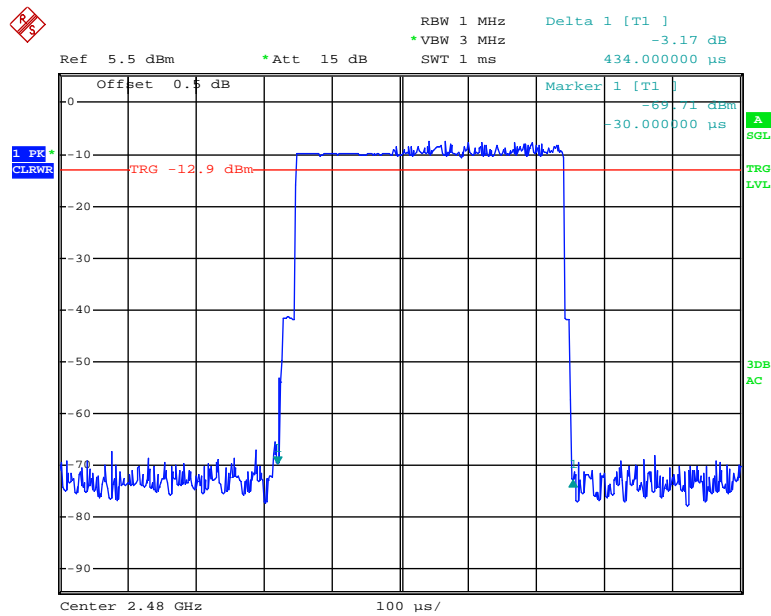
Date: 6.MAY.2018 15:32:41

3DH1: Middle Channel



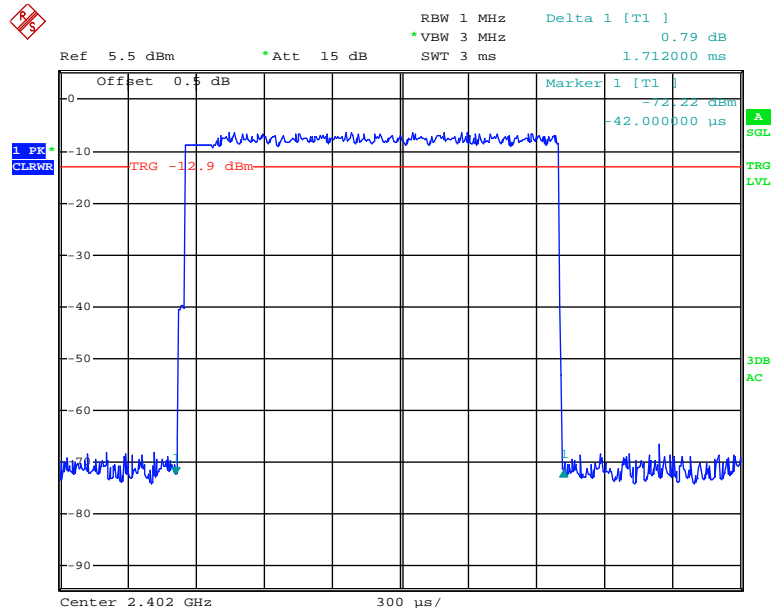
Date: 6.MAY.2018 15:33:02

3DH1: High Channel



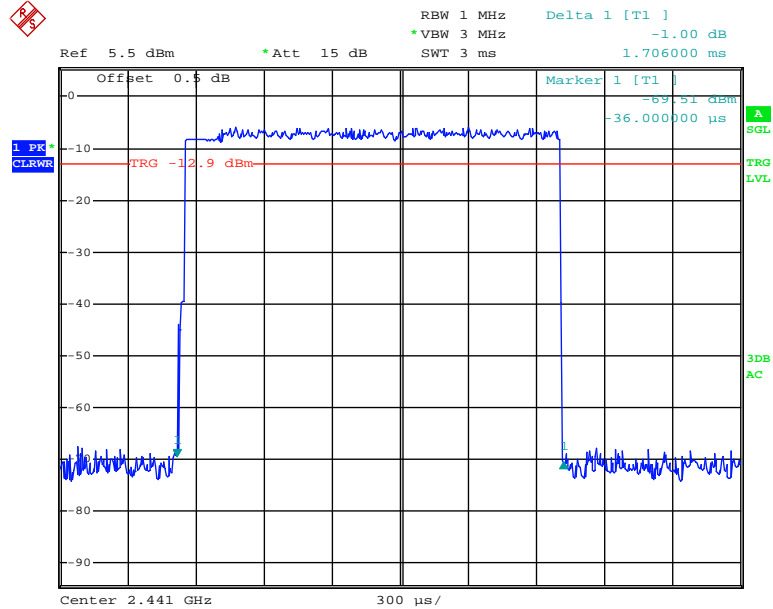
Date: 6.MAY.2018 15:32:12

3DH3: Low Channel



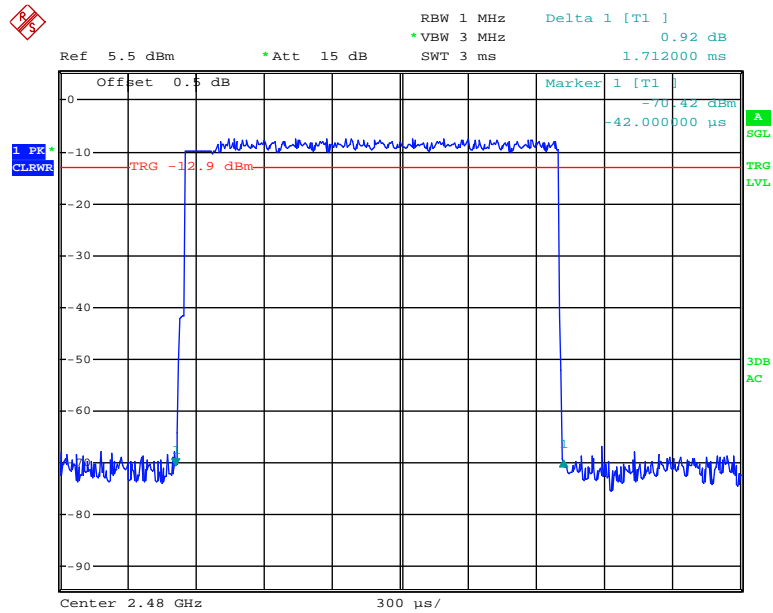
Date: 6.MAY.2018 15:35:56

3DH3: Middle Channel



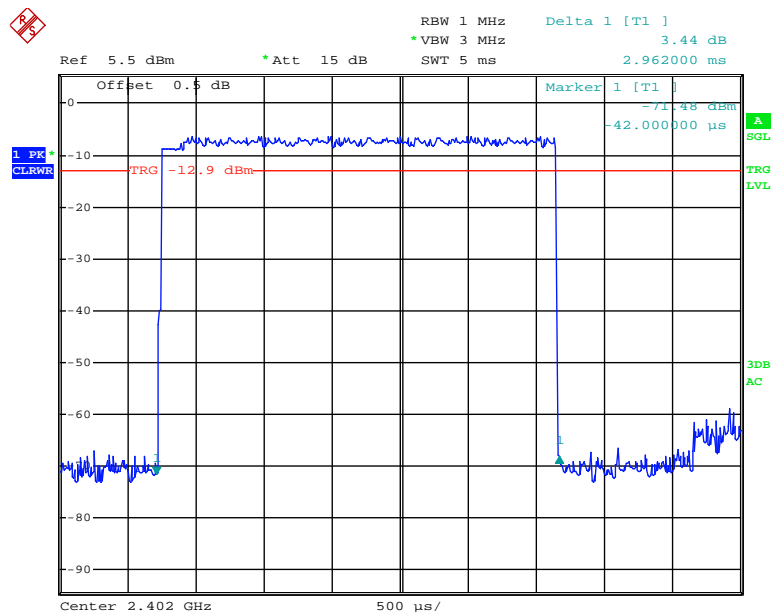
Date: 6.MAY.2018 15:35:22

3DH3: High Channel



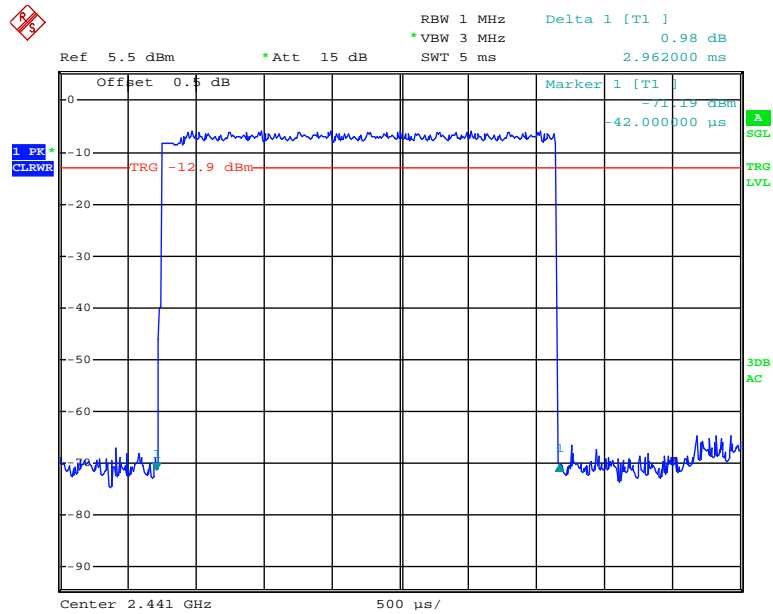
Date: 6.MAY.2018 15:36:39

3DH5: Low Channel



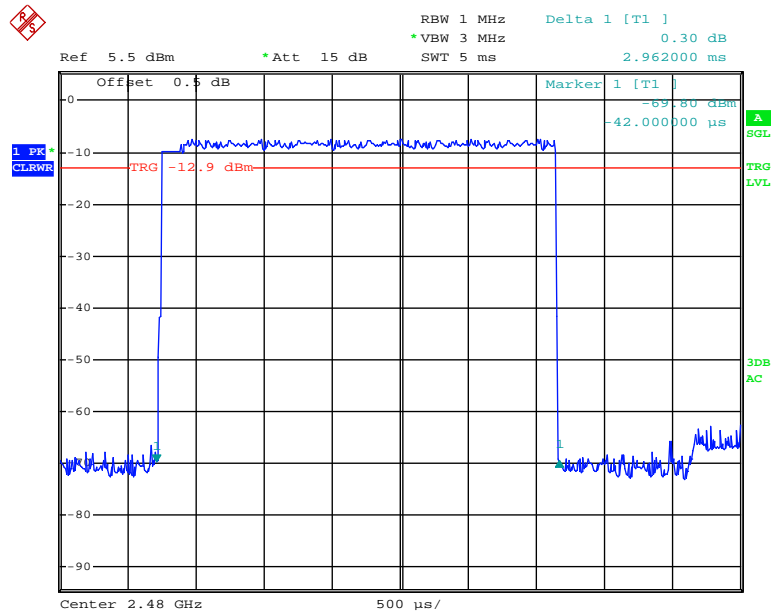
Date: 6.MAY.2018 15:39:12

3DH5: Middle Channel



Date: 6.MAY.2018 15:38:54

3DH5: High Channel



Date: 6.MAY.2018 15:38:30

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

Applicable Standard

According to FCC §15.247(b) (1)

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. 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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Agilent	USB Wideband Power Sensor	U2022XA	MY5417006	2017-12-11	2018-12-11
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	/

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

Test Data

Environmental Conditions

Temperature:	28.3 °C
Relative Humidity:	60 %
ATM Pressure:	100.8 kPa

* The testing was performed by Tiago Huang on 2018-05-06.

Test Result: Compliance.

Test Mode: Transmitting

Mode	Frequency (MHz)	Peak Conducted Output power (dBm)	Limit (dBm)
BDR Mode (GFSK)	2402	-3.84	21
	2441	-2.80	21
	2480	-4.27	21
EDR Mode ($\pi/4$ -DQPSK)	2402	-6.25	21
	2441	-5.85	21
	2480	-7.29	21
EDR Mode (8-DPSK)	2402	-5.58	21
	2441	-5.21	21
	2480	-6.68	21

Note: The data above was tested in conducted mode.

FCC §15.247(d) - BAND EDGES TESTING

Applicable Standard

According to FCC §15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Test 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/ VBW of spectrum analyzer to 100/300 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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	101121	2018-03-23	2019-03-23
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	/

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

Test Data**Environmental Conditions**

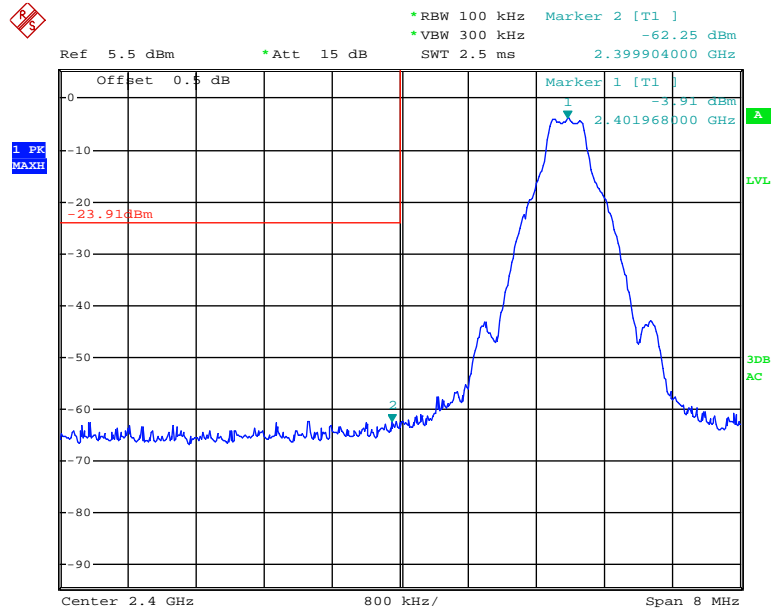
Temperature:	28.3 °C
Relative Humidity:	60 %
ATM Pressure:	100.8 kPa

* *The testing was performed by Tiago Huang on 2018-05-06.*

Test Result: Compliance

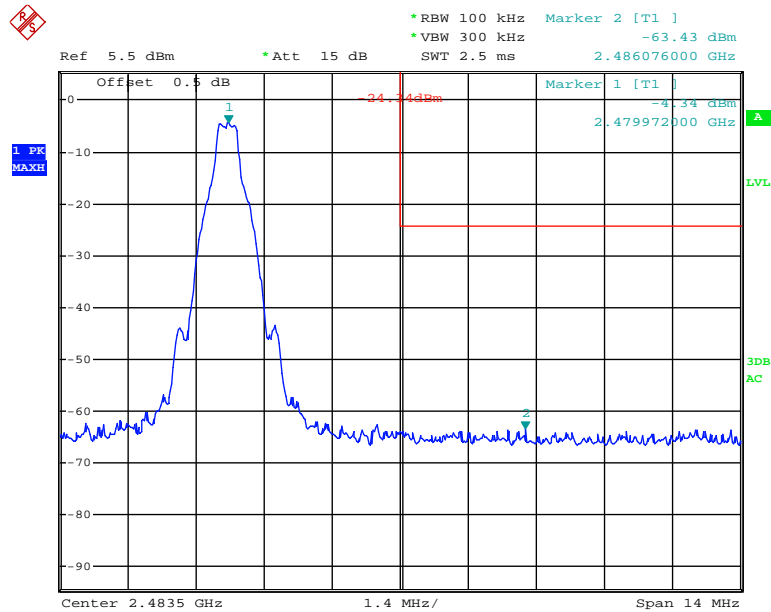
Single Channel:
BDR Mode (GFSK):

Band Edge, Left Side



Date: 6.MAY.2018 11:59:35

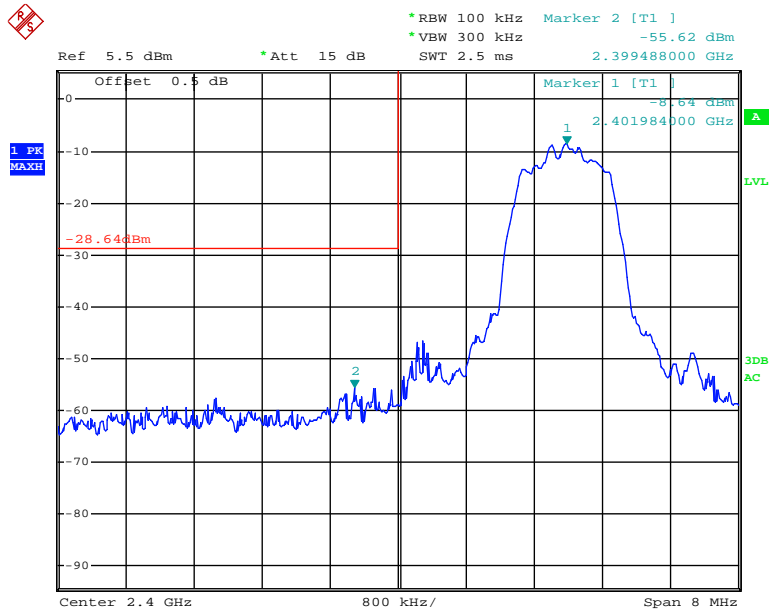
Band Edge, Right Side



Date: 6.MAY.2018 13:22:36

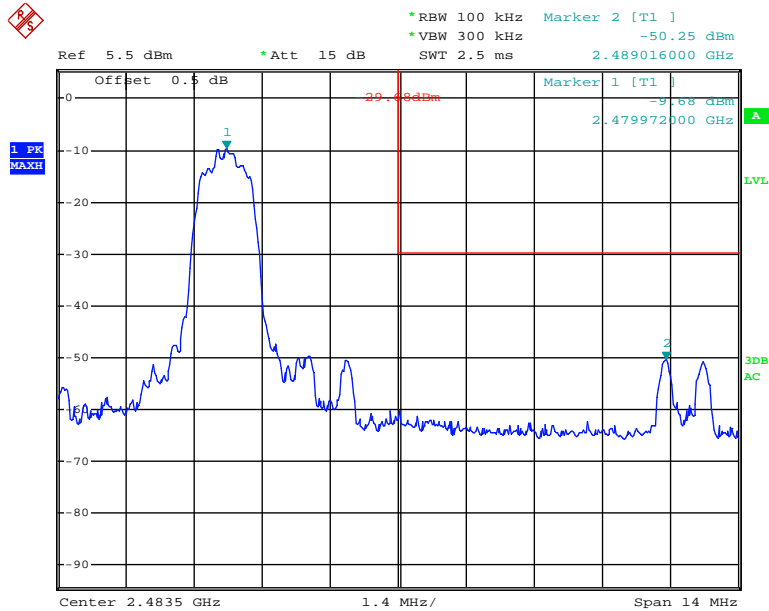
EDR Mode ($\pi/4$ -DQPSK):

Band Edge, Left Side



Date: 6.MAY.2018 13:37:30

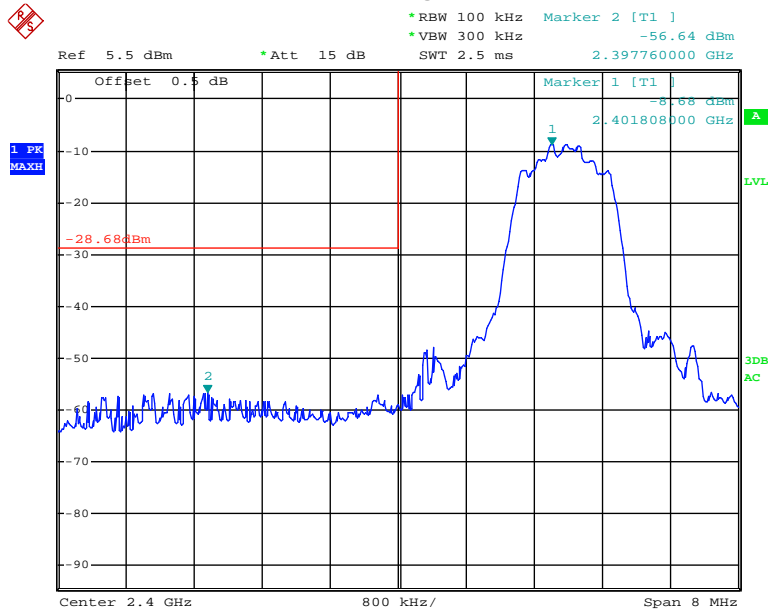
Band Edge, Right Side



Date: 6.MAY.2018 13:42:13

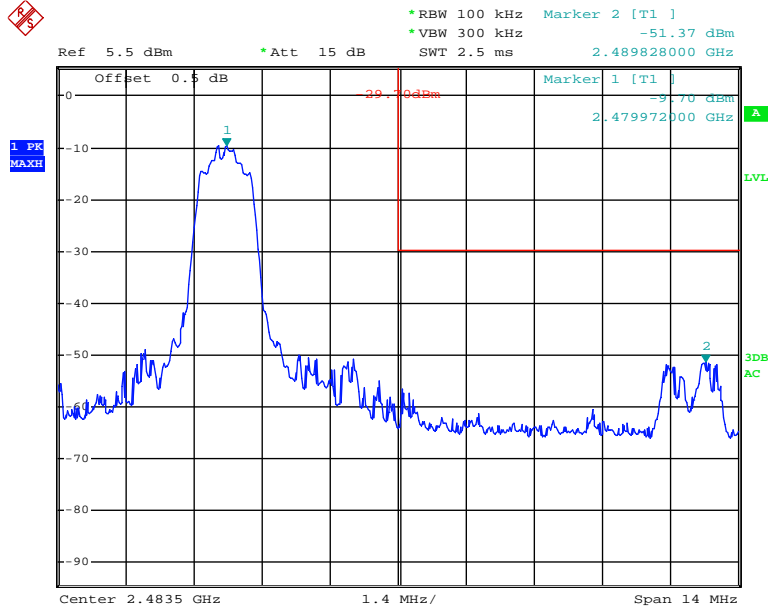
EDR Mode (8-DPSK):

Band Edge, Left Side



Date: 6.MAY.2018 13:52:11

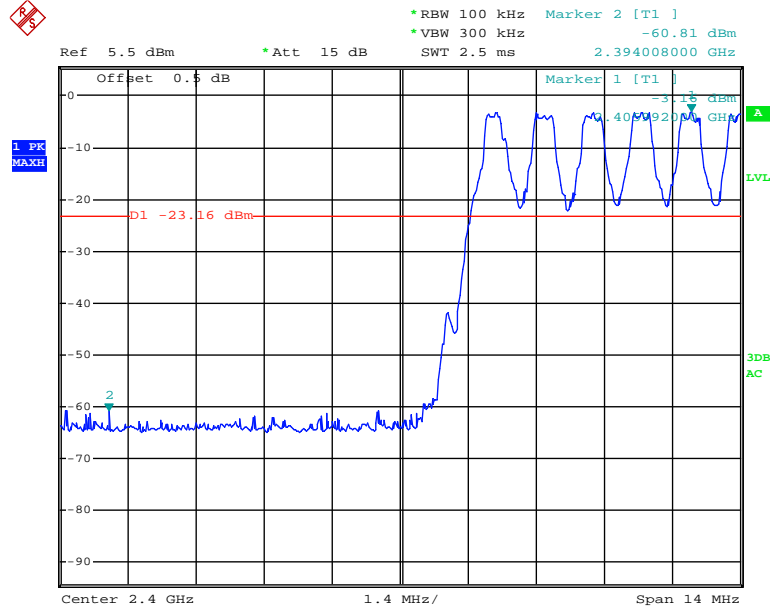
Band Edge, Right Side



Date: 6.MAY.2018 13:45:15

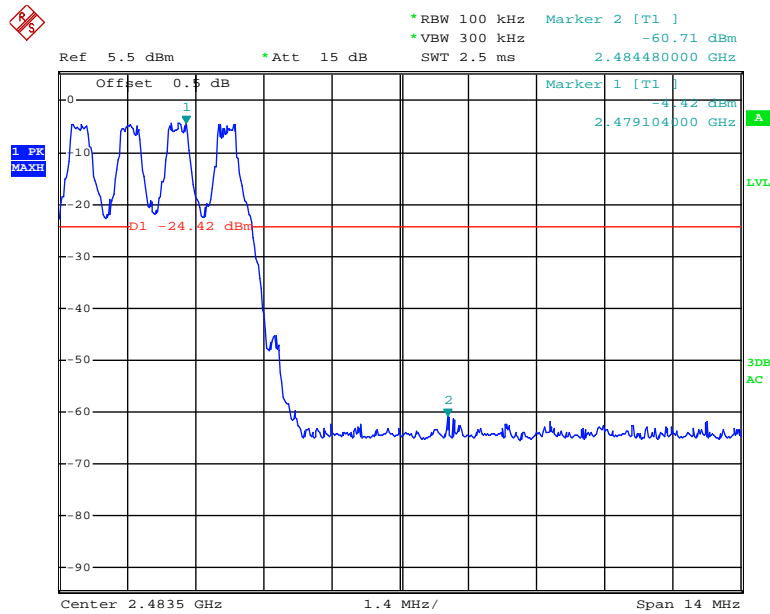
Frequency Hopping:
BDR Mode (GFSK):

Band Edge, Left Side



Date: 6.MAY.2018 15:44:59

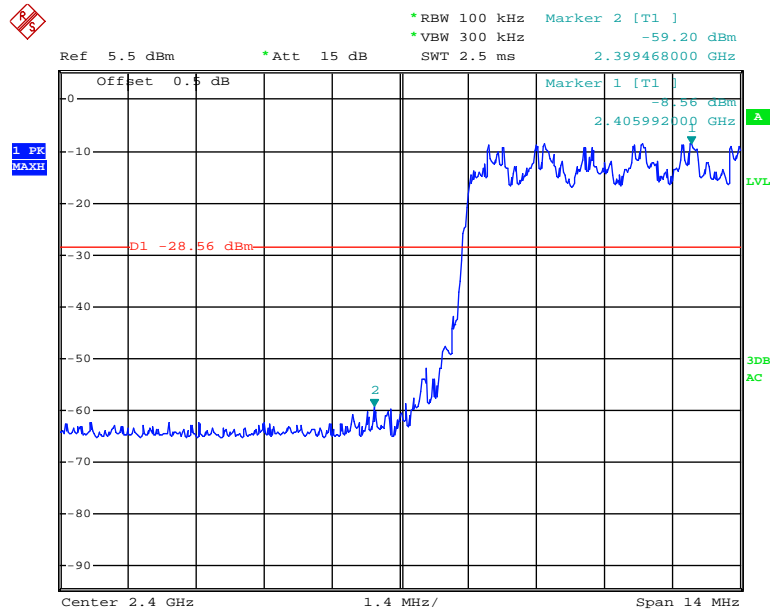
Band Edge, Right Side



Date: 6.MAY.2018 15:47:02

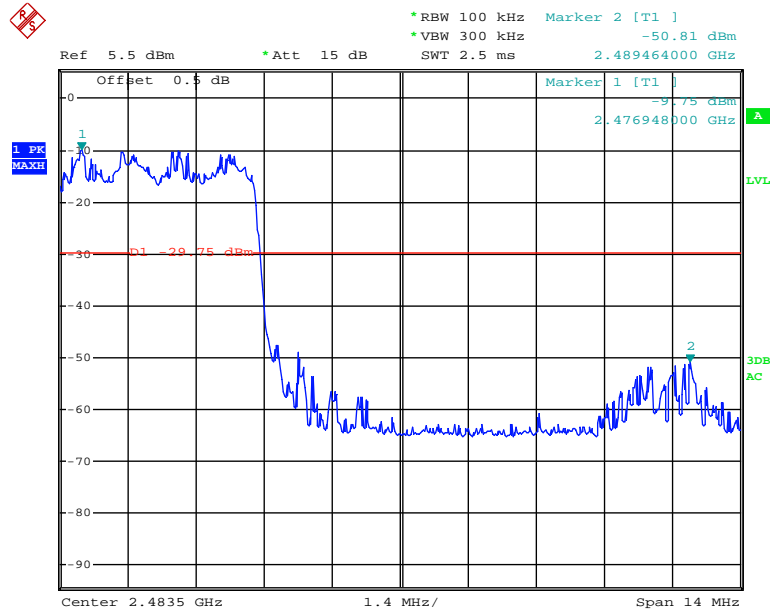
EDR Mode ($\pi/4$ -DQPSK):

Band Edge, Left Side



Date: 6.MAY.2018 15:52:28

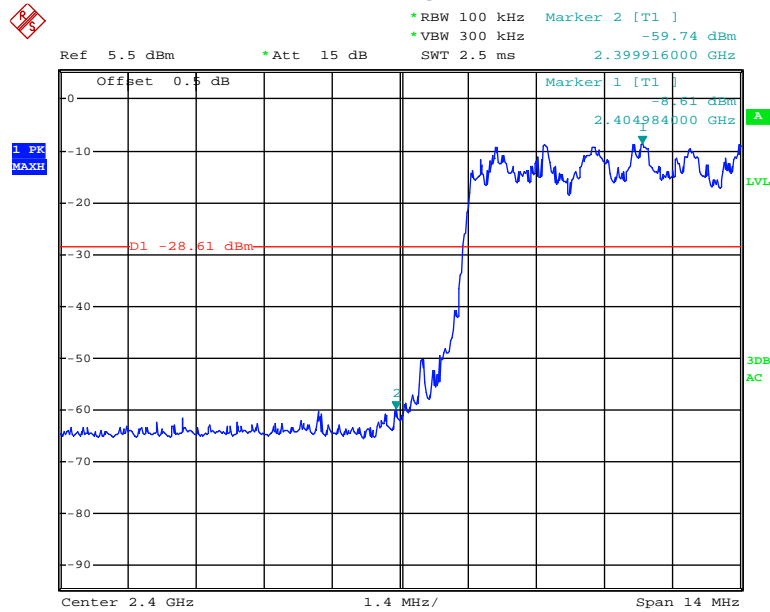
Band Edge, Right Side



Date: 6.MAY.2018 15:49:48

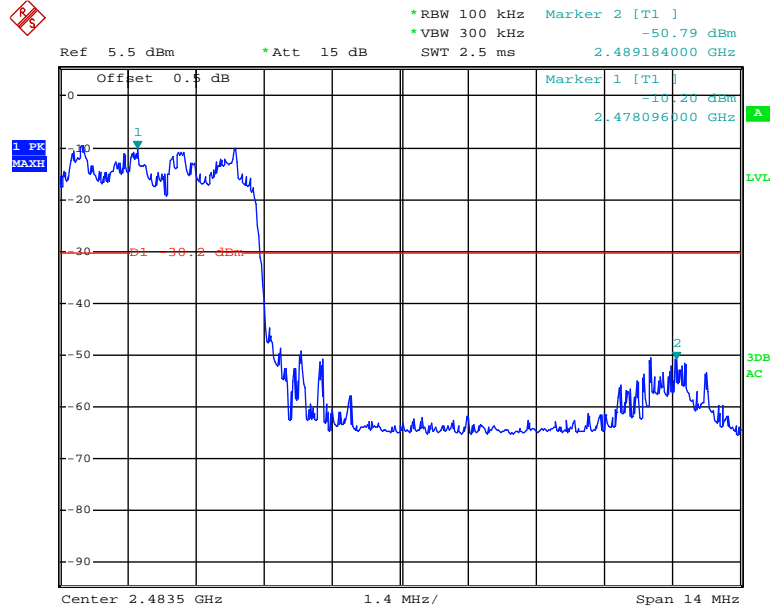
EDR Mode (8-DPSK):

Band Edge, Left Side



Date: 6.MAY.2018 15:54:27

Band Edge, Right Side



Date: 6.MAY.2018 15:56:05

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