FCC PART 15.247

TEST REPORT

For

CROSBY LIMITED

Room 201B Floor 2, Lee Wai Commercial Building, 1-3 Hart Avenue, T.S.T., Kowloon, Hong Kong

FCC ID: 2AFBHSP810

Report Type:	**Product Type:**
Original Report	Bluetooth Speaker

Report Number:	RDG160627804-00
Report Date:	2016-07-19
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Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp.(Dongguan). This report may contain data or test methods that are not covered by the NVLAP accreditation scope and shall be marked with an asterisk "*" and noted.

TABLE OF CONTENTS

GENERAL INFORMATION **4**
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) 4
OBJECTIVE 4
RELATED SUBMITTAL(S)/GRANT(S) 4
TEST METHODOLOGY 4
TEST FACILITY 4
SYSTEM TEST CONFIGURATION **5**
DESCRIPTION OF TEST CONFIGURATION 5
EUT EXERCISE SOFTWARE 5
EQUIPMENT MODIFICATIONS 5
SUPPORT EQUIPMENT LIST AND DETAILS 5
EXTERNAL CABLE 5
BLOCK DIAGRAM OF TEST SETUP 6
SUMMARY OF TEST RESULTS **7**
FCC §15.247 (i) & §1.1310 & §2.1093- RF EXPOSURE **8**
APPLICABLE STANDARD 8
FCC §15.203 - ANTENNA REQUIREMENT **9**
APPLICABLE STANDARD 9
ANTENNA CONNECTOR CONSTRUCTION 9
FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS **10**
APPLICABLE STANDARD 10
MEASUREMENT UNCERTAINTY 10
EUT SETUP 10
EMI TEST RECEIVER SETUP 11
TEST PROCEDURE 11
CORRECTED AMPLITUDE & MARGIN CALCULATION 11
TEST EQUIPMENT LIST AND DETAILS 12
TEST RESULTS SUMMARY 12
TEST DATA 12
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS **15**
APPLICABLE STANDARD 15
MEASUREMENT UNCERTAINTY 15
EUT SETUP 15
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP 16
TEST PROCEDURE 16
TEST EQUIPMENT LIST AND DETAILS 17
CORRECTED AMPLITUDE & MARGIN CALCULATION 17
TEST DATA 17
FCC §15.247(a) (1) - CHANNEL SEPARATION TEST **22**
APPLICABLE STANDARD 22
TEST EQUIPMENT LIST AND DETAILS 22
TEST PROCEDURE 22
TEST DATA 22

FCC §15.247(a) (1) – 20 dB BANDWIDTH TESTING 27
APPLICABLE STANDARD 27
TEST PROCEDURE 27
TEST EQUIPMENT LIST AND DETAILS 27
TEST DATA 27
FCC §15.247(a) (1) (iii) - QUANTITY OF HOPPING CHANNEL TEST 32
APPLICABLE STANDARD 32
TEST PROCEDURE 32
TEST EQUIPMENT LIST AND DETAILS 32
TEST DATA 32
FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME) 35
APPLICABLE STANDARD 35
TEST PROCEDURE 35
TEST EQUIPMENT LIST AND DETAILS 35
TEST DATA 35
FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT 46
APPLICABLE STANDARD 46
TEST PROCEDURE 46
TEST EQUIPMENT LIST AND DETAILS 46
TEST DATA 46
FCC §15.247(d) - BAND EDGES TESTING 51
APPLICABLE STANDARD 51
TEST PROCEDURE 51
TEST EQUIPMENT LIST AND DETAILS 51
TEST DATA 52

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *CROSBY LIMITED*'s product, model number: *LI-S20149BT (FCC ID: 2AFBHSP810)* (the "EUT") in this report was a *Bluetooth Speaker,* which was measured approximately: 15.6cm (L) x 12 cm (W) x 8.6 cm (H), rated input voltage: DC3.7V from rechargeable Li-ion battery or DC5V from USB port.

All measurement and test data in this report was gathered from production sample serial number: 160627804 (Assigned by BACL, Dongguan). The EUT was received on 2016-06-29.

Objective

This report is prepared on behalf of *CROSBY LIMITED* in accordance with Part 2, Subpart J, Part 15, Subparts A, B 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 Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Related Submittal(s)/Grant(s)

N/A

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. (Dongguan).

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 Industrial Zone, Tangxia, Dongguan, Guangdong, China

Test site at Bay Area Compliance Laboratories Corp. (Dongguan) has been fully described in reports submitted to the Federal Communications Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 06, 2015.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 273710. 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

The system was configured for testing in engineering mode.
The device only support Bluetooth BDR(GFSK) and EDR(*π/4-DQPSK*) mode, EDR(8DPSK) can`t support.

EUT Exercise Software

The software 'FCC Assist-1.5' was used during testing, the software configured maxmum output power as below setting:

Test Software Version	FCC Assist-1.5		
Test Frequency	2402MHz	2441MHz	2480MHz
GFSK	10	10	10
π/4-DQPSK	10	10	10

Equipment Modifications

No modification was made to the EUT.

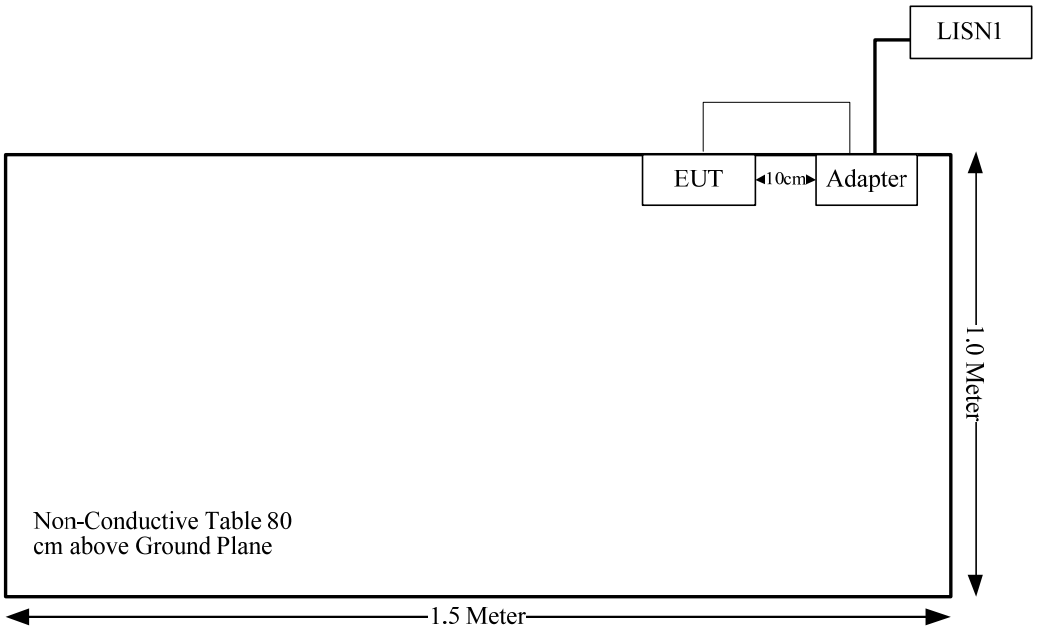
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
YESS	Adapter	YW1000US	/

External Cable

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
USB Cable	Yes	No	0.8	Adapter	EUT

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC §15.247 (i) & §1.1310 & §2.1093	RF Exposure	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

Test Time: 2016-07-01~2016-07-12.

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

Applicable Standard

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

According to KDB447498 D01 General RF Exposure Guidance v06

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

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

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

Measurement Result

The maximum tune-up power including tolerance is 0 dBm(1mW).
[(max. power of channel, mW)/(min. test separation distance, mm)][√f(GHz)]
= 1.0/5*(√2.480) = 0.3 < 3.0

So the SAR evaluation is not necessary.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Antenna Connector Construction

The EUT has one internal antenna arrangement for buletooth and the antenna gain is -3.0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

Measurement Uncertainty

Compliance or non- compliance with a disturbance limit shall be determined in the following manner：

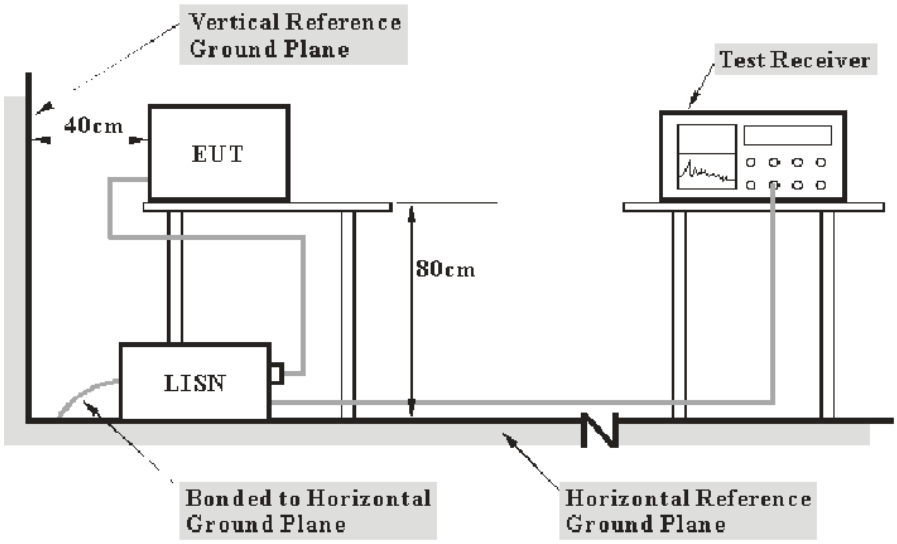
If U_{lab} is less than or equal to U_{cispr} of Table 1, then:
– compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
– non - compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.
If U_{lab} is greater than U_{cispr} of Table 1, then:
– compliance is deemed to occur if no measured disturbance level, increased by ($U_{lab} - U_{cispr}$), exceeds the disturbance limit;
– non - compliance is deemed to occur if any measured disturbance level, increased by ($U_{lab} - U_{cispr}$), exceeds the disturbance limit.

Based on CISPR 16-4-2: 2011, measurement uncertainty of conducted disturbance at mains port using AMN at Bay Area Compliance Laboratories Corp. (Dongguan) is 3.12 dB (150 kHz to 30 MHz).

Table 1 – Values of U_{cispr}

Measurement	U_{cispr}
Conducted disturbance at mains port using AMN (150 kHz to 30 MHz)	3.4 dB

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 adapter was connected to a 120 VAC/60 Hz 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 maximum limit. The equation for margin calculation is as follows:

Margin = Limit – 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	2015-12-10	2016-12-09
R&S	L.I.S.N	ESH2-Z5	892107/021	2015-07-16	2016-07-15
R&S	Two-line V-network	ENV 216	3560.6550.12	2015-11-26	2016-11-25
N/A	Coaxial Cable	1.8m	N/A	2016-05-06	2017-05-06
R&S	Test Software	EMC32	Version8.53.0	N/A	N/A

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

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207, with the worst margin reading of:

20.6 dB at **0.415949 MHz** in the **Line** conducted mode

Test Data

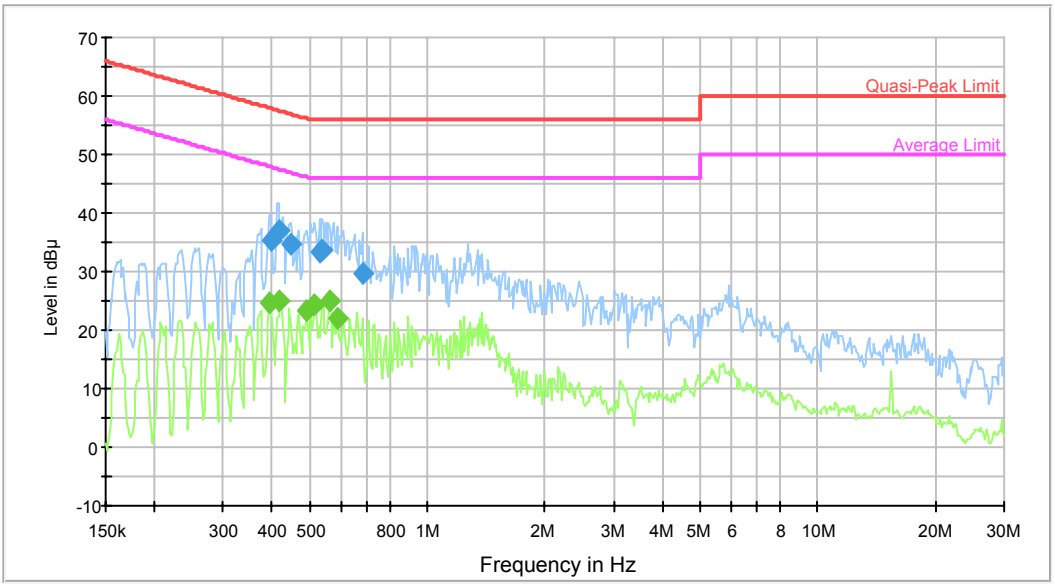
Environmental Conditions

Temperature:	21.6°C
Relative Humidity:	48%
ATM Pressure:	100.3 kPa

The testing was performed by Emily Wang on 2016-07-01.

Test Mode: Transmitting

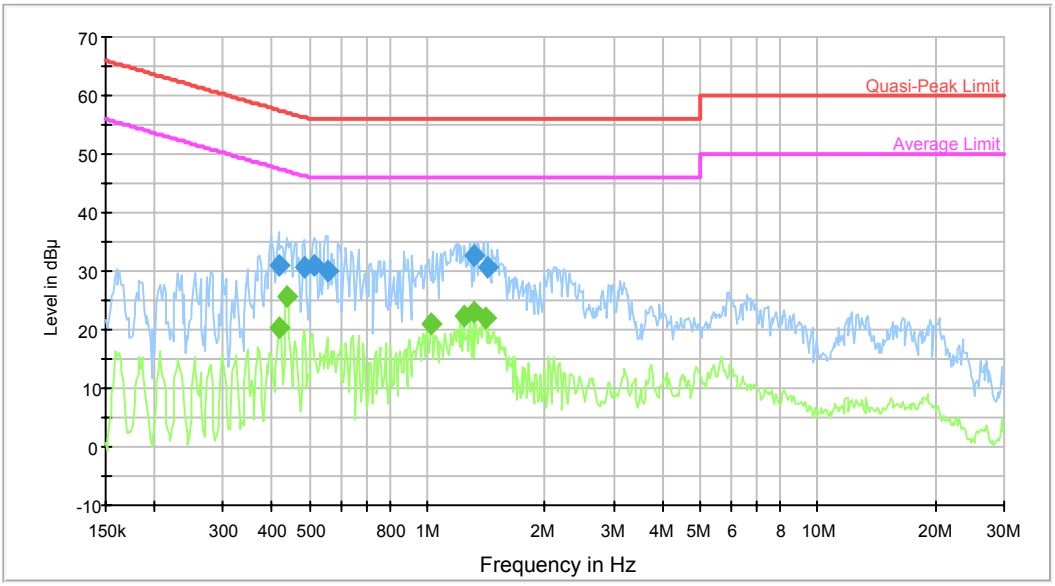
AC120 V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.396530	35.3	9.000	L1	10.2	22.6	57.9	Compliance
0.415949	36.9	9.000	L1	10.2	20.6	57.5	Compliance
0.446873	34.7	9.000	L1	10.2	22.2	56.9	Compliance
0.528270	33.3	9.000	L1	10.1	22.7	56.0	Compliance
0.536756	33.8	9.000	L1	10.1	22.2	56.0	Compliance
0.681699	29.7	9.000	L1	10.4	26.3	56.0	Compliance

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.393383	24.8	9.000	L1	10.2	23.2	48.0	Compliance
0.419276	25.1	9.000	L1	10.2	22.4	47.5	Compliance
0.491712	23.5	9.000	L1	10.1	22.6	46.1	Compliance
0.515791	24.4	9.000	L1	10.1	21.6	46.0	Compliance
0.563041	25.0	9.000	L1	10.1	21.0	46.0	Compliance
0.585926	21.9	9.000	L1	10.2	24.1	46.0	Compliance

AC120 V, 60 Hz, Neutral:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.415949	31.1	9.000	N	10.2	26.4	57.5	Compliance
0.483938	30.7	9.000	N	10.1	25.6	56.3	Compliance
0.515791	30.9	9.000	N	10.1	25.1	56.0	Compliance
0.554139	29.9	9.000	N	10.1	26.1	56.0	Compliance
1.310256	32.7	9.000	N	10.4	23.3	56.0	Compliance
1.430284	30.8	9.000	N	10.4	25.2	56.0	Compliance

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.419276	20.3	9.000	N	10.2	27.2	47.5	Compliance
0.436318	25.8	9.000	N	10.1	21.3	47.1	Compliance
1.023481	21.0	9.000	N	10.4	25.0	46.0	Compliance
1.239175	22.4	9.000	N	10.4	23.6	46.0	Compliance
1.310256	22.8	9.000	N	10.4	23.2	46.0	Compliance
1.407671	21.9	9.000	N	10.4	24.1	46.0	Compliance

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

Applicable Standard

FCC §15.247 (d); §15.209; §15.205;

Measurement Uncertainty

Compliance or non- compliance with a disturbance limit shall be determined in the following manner：

If U_{lab} is less than or equal to U_{cispr} of Table 1, then:
- compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
- non - compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.

If U_{lab} is greater than U_{cispr} of Table 1, then:
- compliance is deemed to occur if no measured disturbance level, increased by ($U_{lab} - U_{cispr}$), exceeds the disturbance limit;
- non - compliance is deemed to occur if any measured disturbance level, increased by ($U_{lab} - U_{cispr}$), exceeds the disturbance limit.

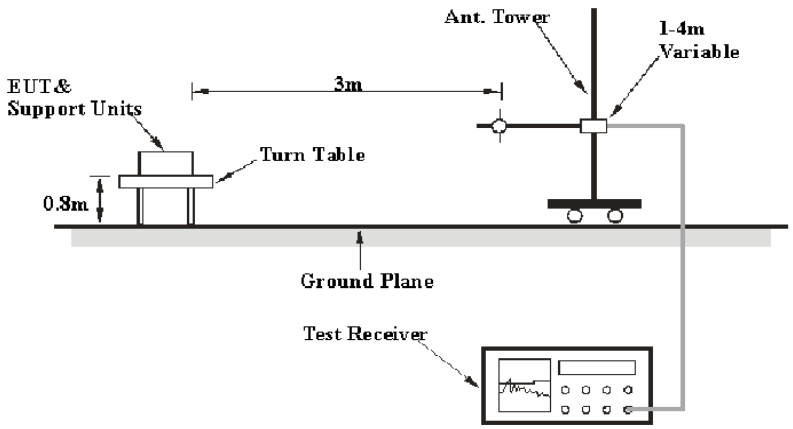
Based on CISPR 16-4-2: 2011, measurement uncertainty of radiated emission at a distance of 3m at Bay Area Compliance Laboratories Corp. (Dongguan) is: 30M~200MHz: 4.58 dB for Horizontal, 4.59 dB for Vertical; 200M~1GHz: 4.83 dB for Horizontal, 5.85 dB for Vertical; 1G~6GHz: 4.45 dB, 6G~18GHz: 5.23 dB

Table 1 – Values of U_{cispr}

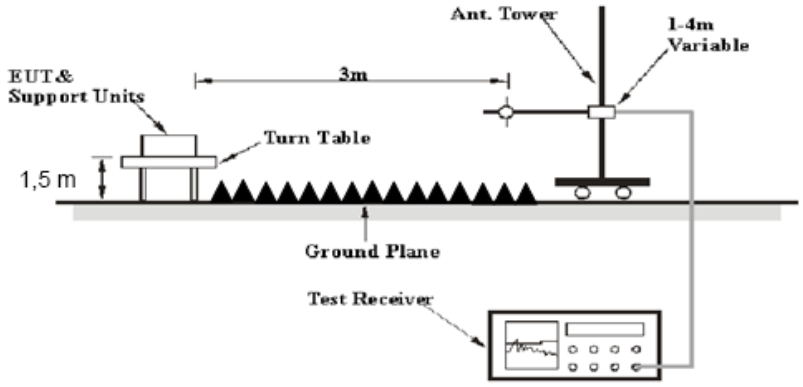
Measurement	U_{cispr}
Radiated disturbance (electric field strength at an OATS or in a SAC) (30 MHz to 1000 MHz)	6.3 dB
Radiated disturbance (electric field strength in a FAR) (1 GHz to 6 GHz)	5.2 dB
Radiated disturbance (electric field strength in a FAR) (6 GHz to 18 GHz)	5.5 dB

EUT Setup

Below 1GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters test site, 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	Detector
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	2015-08-03	2016-08-02
Sunol Sciences	Antenna	JB3	A060611-3	2014-11-06	2017-11-05
HP	Amplifier	8447E	2434A02181	2015-09-01	2016-09-01
Agilent	Spectrum Analyzer	E4440A	SG43360054	2015-11-23	2016-11-22
ETS-Lindgren	Horn Antenna	3115	9808-5557	2015-09-06	2018-09-06
Mini-Circuit	Amplifier	ZVA-213-S+	054201245	2016-02-19	2017-02-18
R&S	Spectrum Analyzer	FSP 38	100478	2015-11-23	2016-11-22
Ducommun Technolagies	Horn Antenna	ARH-4223-02	1007726-01 1304	2014-06-16	2017-06-15
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2015-09-06	2016-09-06
N/A	Coaxial Cable	14m	N/A	2016-05-06	2017-05-06
N/A	Coaxial Cable	8m	N/A	2016-05-06	2017-05-06

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, 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:

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 Data

Environmental Conditions

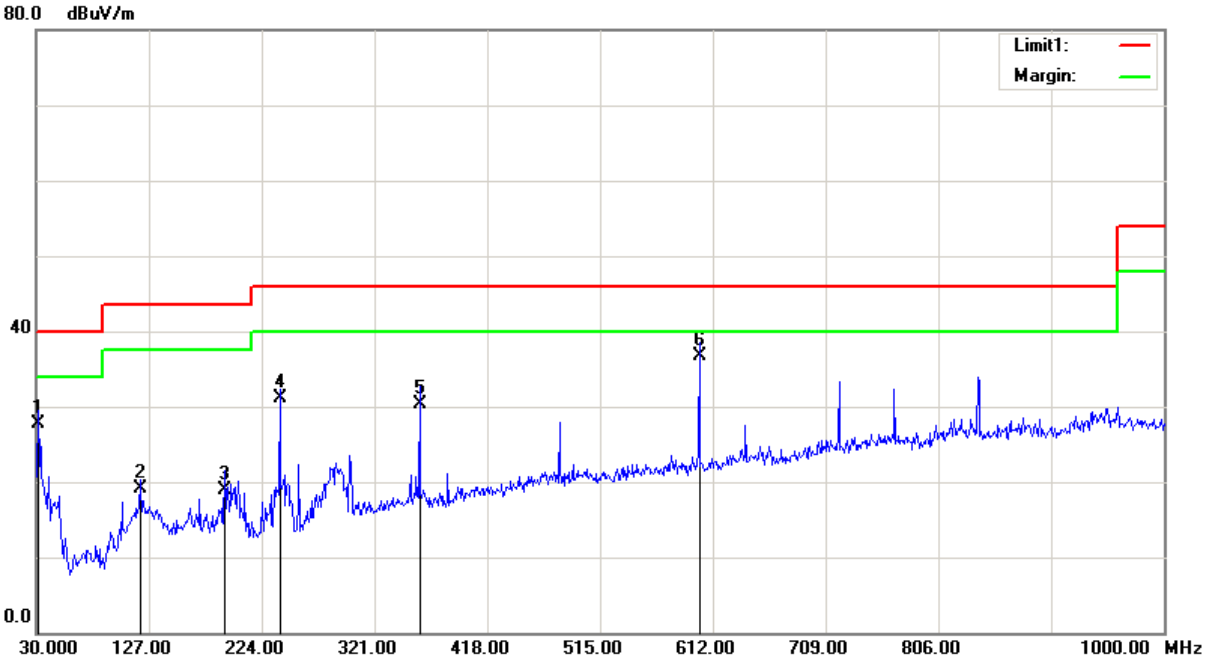
Temperature:	28.8°C
Relative Humidity:	63 %
ATM Pressure:	100.4kPa

** The testing was performed by Emily Wang from 2016-07-12.*

Test Mode: Transmitting

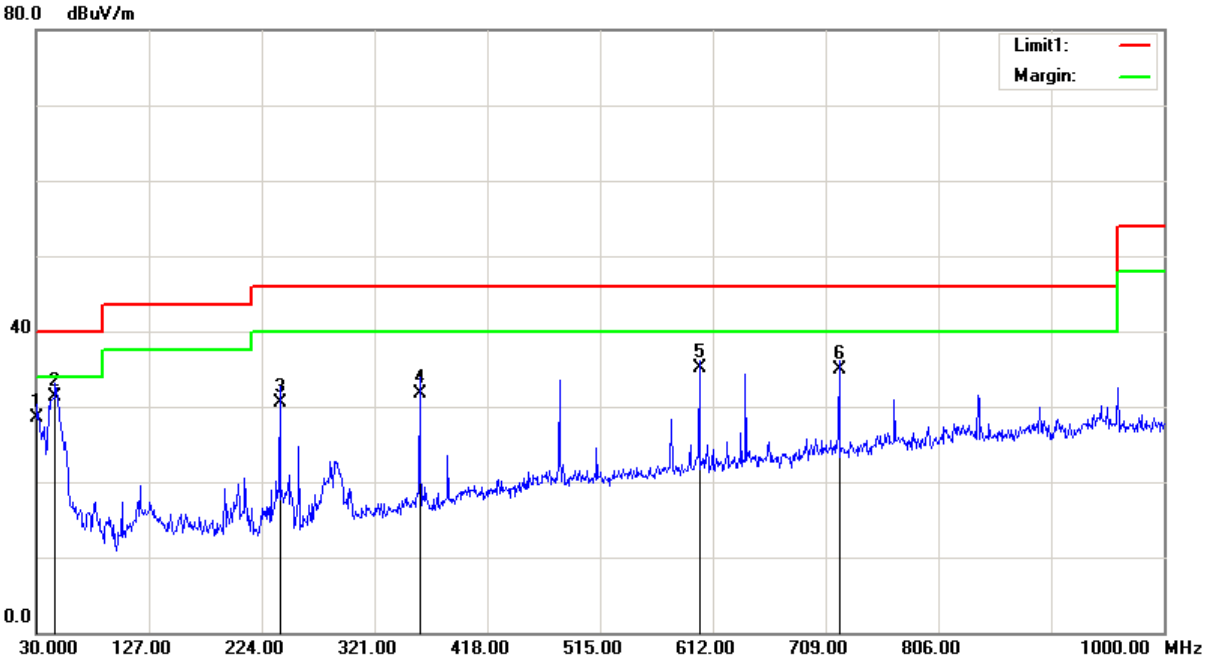
1) Below 1GHz:

Horizontal:



Frequency (MHz)	Receiver Reading (dBuV)	Detector (PK/QP/Ave)	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
31.9400	28.30	QP	-0.50	27.80	40.00	12.20
119.2400	24.85	QP	-5.75	19.10	43.50	24.40
191.9900	27.04	QP	-8.14	18.90	43.50	24.60
239.5200	38.80	QP	-7.60	31.20	46.00	14.80
359.8000	34.95	QP	-4.55	30.40	46.00	15.60
600.3600	37.37	QP	-0.67	36.70	46.00	9.30

Vertical:



Frequency (MHz)	Receiver Reading (dBuV)	Detector (PK/QP/Ave)	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.0000	27.65	QP	0.95	28.60	40.00	11.40
46.4900	42.00	QP	-10.60	31.40	40.00	8.60
239.5200	38.10	QP	-7.60	30.50	46.00	15.50
359.8000	36.25	QP	-4.55	31.70	46.00	14.30
600.3600	35.87	QP	-0.67	35.20	46.00	10.80
720.6400	33.34	QP	1.56	34.90	46.00	11.10

BDR Mode (GFSK):

Frequency	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	FCC 15.247	
(MHz)	Reading (dBμV)	Detector (PK/QP/AV)	Polar (H/V)	Factor (dB)				Limit (dBμV/m)	Margin (dB)
Low Channel: 2402 MHz									
2402	58.6	PK	H	25.65	3.66	0.00	87.91	N/A	N/A
2402	48.25	AV	H	25.65	3.66	0.00	77.56	N/A	N/A
2402	56.71	PK	V	25.65	3.66	0.00	86.02	N/A	N/A
2402	44.99	AV	V	25.65	3.66	0.00	74.30	N/A	N/A
2390	25.51	PK	H	25.61	3.63	0.00	54.75	74.00	19.25
2390	13.05	AV	H	25.61	3.63	0.00	42.29	54.00	11.71
4804	36.49	PK	H	30.59	5.06	27.41	44.73	74.00	29.27
4804	24.21	AV	H	30.59	5.06	27.41	32.45	54.00	21.55
7206	33.91	PK	H	34.09	6.61	25.91	48.70	74.00	25.30
7206	21.83	AV	H	34.09	6.61	25.91	36.62	54.00	17.38
3126	34.32	PK	H	27.60	6.91	27.43	41.40	74.00	32.60
3126	21.45	AV	H	27.60	6.91	27.43	28.53	54.00	25.47
Middle Channel: 2441 MHz									
2441	59.18	PK	H	25.75	3.76	0.00	88.69	N/A	N/A
2441	47.63	AV	H	25.75	3.76	0.00	77.14	N/A	N/A
2441	60.25	PK	V	25.75	3.76	0.00	89.76	N/A	N/A
2441	48.63	AV	V	25.75	3.76	0.00	78.14	N/A	N/A
4882	35.94	PK	H	30.79	5.19	27.42	44.50	74.00	29.50
4882	23.08	AV	H	30.79	5.19	27.42	31.64	54.00	22.36
7323	33.21	PK	H	34.38	6.75	25.88	48.46	74.00	25.54
7323	21.52	AV	H	34.38	6.75	25.88	36.77	54.00	17.23
3131	33.63	PK	H	27.62	6.93	27.43	40.75	74.00	33.25
3131	21.25	AV	H	27.62	6.93	27.43	28.37	54.00	25.63
3458	32.58	PK	H	28.67	4.87	27.22	38.90	74.00	35.10
3458	20.89	AV	H	28.67	4.87	27.22	27.21	54.00	26.79
High Channel: 2480 MHz									
2480	61.98	PK	H	25.85	3.68	0.00	91.51	N/A	N/A
2480	49.4	AV	H	25.85	3.68	0.00	78.93	N/A	N/A
2480	60.15	PK	V	25.85	3.68	0.00	89.68	N/A	N/A
2480	49.19	AV	V	25.85	3.68	0.00	78.72	N/A	N/A
2483.5	30.66	PK	H	25.86	3.67	0.00	60.19	74.00	13.81
2483.5	13.41	AV	H	25.86	3.67	0.00	42.94	54.00	11.06
4960	36.03	PK	H	31.00	5.34	27.43	44.94	74.00	29.06
4960	24.75	AV	H	31.00	5.34	27.43	33.66	54.00	20.34
7440	34.48	PK	H	34.66	6.89	25.97	50.06	74.00	23.94
7440	21.48	AV	H	34.66	6.89	25.97	37.06	54.00	16.94
3154	34.75	PK	H	27.69	6.91	27.41	41.94	74.00	32.06
3154	22.18	AV	H	27.69	6.91	27.41	29.37	54.00	24.63

EDR Mode (π/4-DQPSK):

Frequency	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	FCC 15.247	
(MHz)	Reading (dBμV)	Detector (PK/QP/AV)	Polar (H/V)	Factor (dB)				Limit (dBμV/m)	Margin (dB)
Low Channel: 2402 MHz									
2402	61.29	PK	H	25.65	3.66	0.00	90.60	N/A	N/A
2402	49.22	AV	H	25.65	3.66	0.00	78.53	N/A	N/A
2402	62.47	PK	V	25.65	3.66	0.00	91.78	N/A	N/A
2402	48.49	AV	V	25.65	3.66	0.00	77.80	N/A	N/A
2390	24.88	PK	H	25.61	3.63	0.00	54.12	74.00	19.88
2390	13.2	AV	H	25.61	3.63	0.00	42.44	54.00	11.56
4804	36.73	PK	H	30.59	5.06	27.41	44.97	74.00	29.03
4804	24.61	AV	H	30.59	5.06	27.41	32.85	54.00	21.15
7206	34.61	PK	H	34.09	6.61	25.91	49.40	74.00	24.60
7206	22.26	AV	H	34.09	6.61	25.91	37.05	54.00	16.95
3125	34.1	PK	H	27.60	6.91	27.43	41.18	74.00	32.82
3125	21.89	AV	H	27.60	6.91	27.43	28.97	54.00	25.03
Middle Channel: 2441 MHz									
2441	60.81	PK	H	25.75	3.76	0.00	90.32	N/A	N/A
2441	48.42	AV	H	25.75	3.76	0.00	77.93	N/A	N/A
2441	62.05	PK	V	25.75	3.76	0.00	91.56	N/A	N/A
2441	48.47	AV	V	25.75	3.76	0.00	77.98	N/A	N/A
4882	35.63	PK	H	30.79	5.19	27.42	44.19	74.00	29.81
4882	23.21	AV	H	30.79	5.19	27.42	31.77	54.00	22.23
7323	34.62	PK	H	34.38	6.75	25.88	49.87	74.00	24.13
7323	22.65	AV	H	34.38	6.75	25.88	37.90	54.00	16.10
3120	34.15	PK	H	27.58	6.90	27.43	41.20	74.00	32.80
3120	21.68	AV	H	27.58	6.90	27.43	28.73	54.00	25.27
3610	35.04	PK	H	29.04	4.61	27.28	41.41	74.00	32.59
3610	22.3	AV	H	29.04	4.61	27.28	28.67	54.00	25.33
High Channel: 2480 MHz									
2480	60.28	PK	H	25.85	3.68	0.00	89.81	N/A	N/A
2480	47.84	AV	H	25.85	3.68	0.00	77.37	N/A	N/A
2480	60.28	PK	V	25.85	3.68	0.00	89.81	N/A	N/A
2480	47.59	AV	V	25.85	3.68	0.00	77.12	N/A	N/A
2483.5	25.77	PK	H	25.86	3.67	0.00	55.30	74.00	18.70
2483.5	13.39	AV	H	25.86	3.67	0.00	42.92	54.00	11.08
4960	36.14	PK	H	31.00	5.34	27.43	45.05	74.00	28.95
4960	23.52	AV	H	31.00	5.34	27.43	32.43	54.00	21.57
7440	33.71	PK	H	34.66	6.89	25.97	49.29	74.00	24.71
7440	22.59	AV	H	34.66	6.89	25.97	38.17	54.00	15.83
3159	34.28	PK	H	27.71	6.82	27.40	41.41	74.00	32.59
3159	20.71	AV	H	27.71	6.82	27.40	27.84	54.00	26.16

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 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	Spectrum Analyzer	FSP 38	100478	2015-11-23	2016-11-22
N/A	Coaxial Cable	0.1m	N/A	2016-05-06	2017-05-06
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2016-05-06	2017-05-06

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, 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:	29.1°C
Relative Humidity:	57 %
ATM Pressure:	99.7kPa

** The testing was performed by Emily Wang from 2016-07-09.*

Test Result: Compliance.

Please refer to following tables and plots

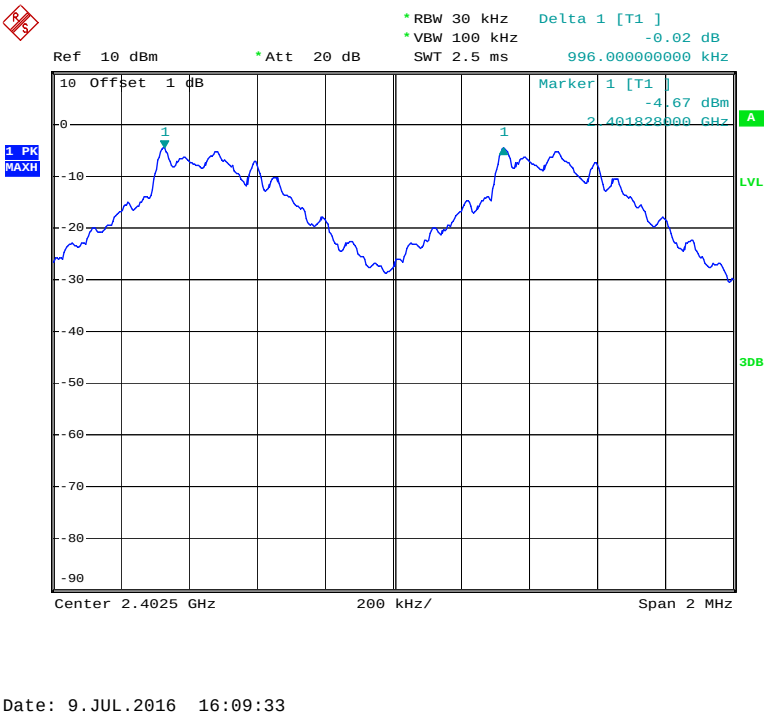
Test Mode: Transmitting

Mode	Channel	Frequency	Channel Separation	Limit
		MHz	MHz	MHz
BDR (GFSK)	Low	2402	0.996	0.57
	Middle	2441	1.000	0.57
	High	2480	1.004	0.57
EDR (π/4-DQPSK)	Low	2402	0.996	0.82
	Middle	2441	1.004	0.82
	High	2480	1.000	0.82

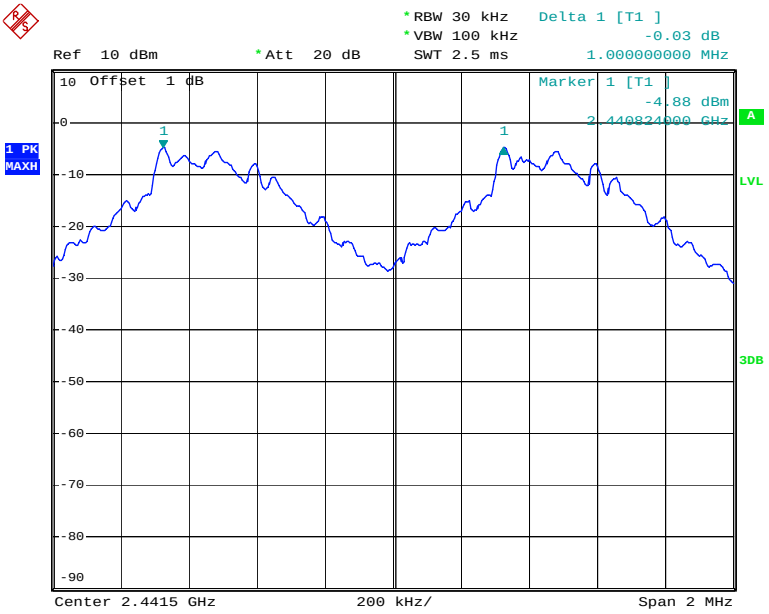
Note: Limit= (2/3) × *20dB bandwidth*

BDR Mode (GFSK):

Low Channel

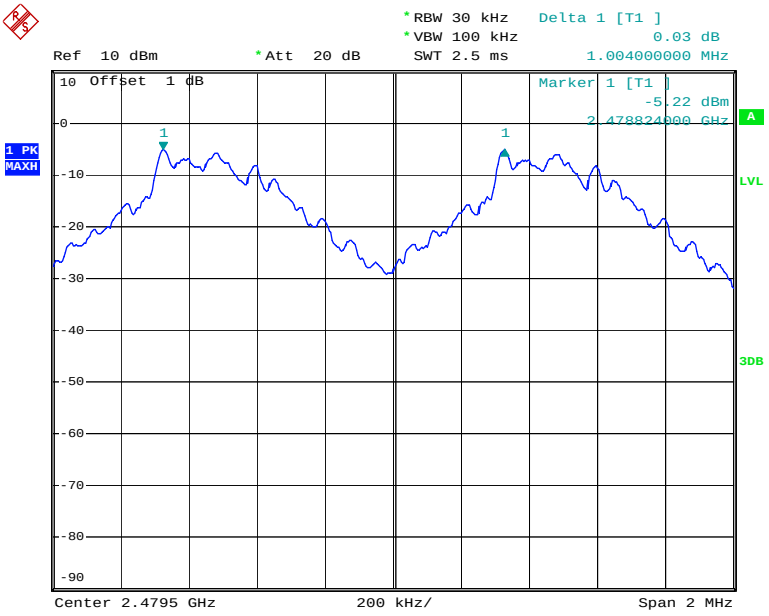


Middle Channel



Date: 9.JUL.2016 16:10:31

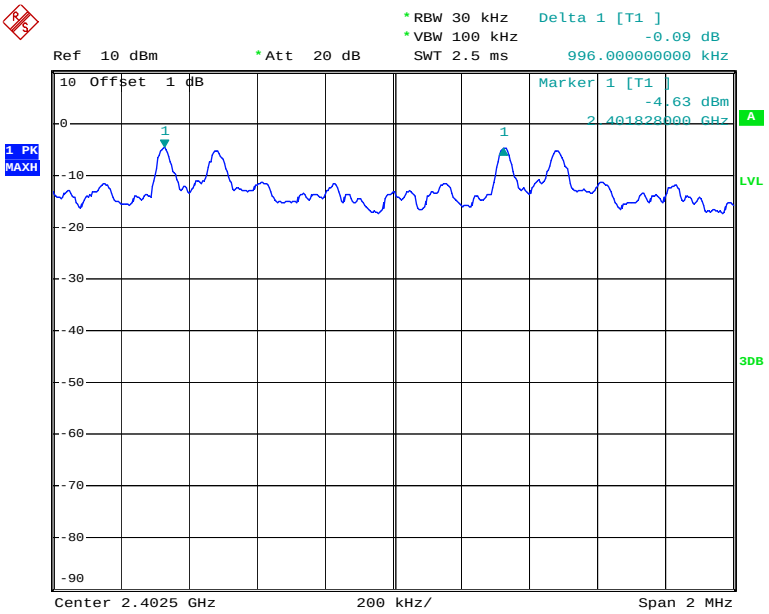
High Channel



Date: 9.JUL.2016 16:11:32

EDR Mode (π/4-DQPSK):

Low Channel



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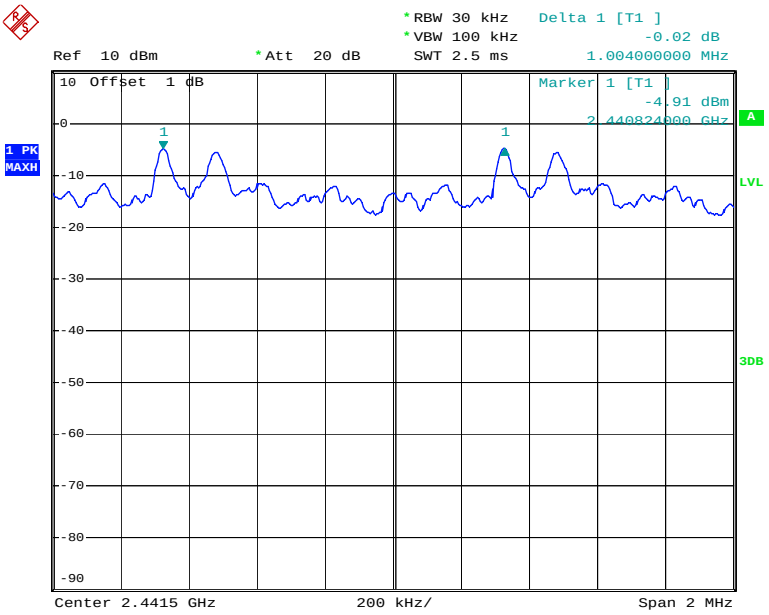
Middle Channel



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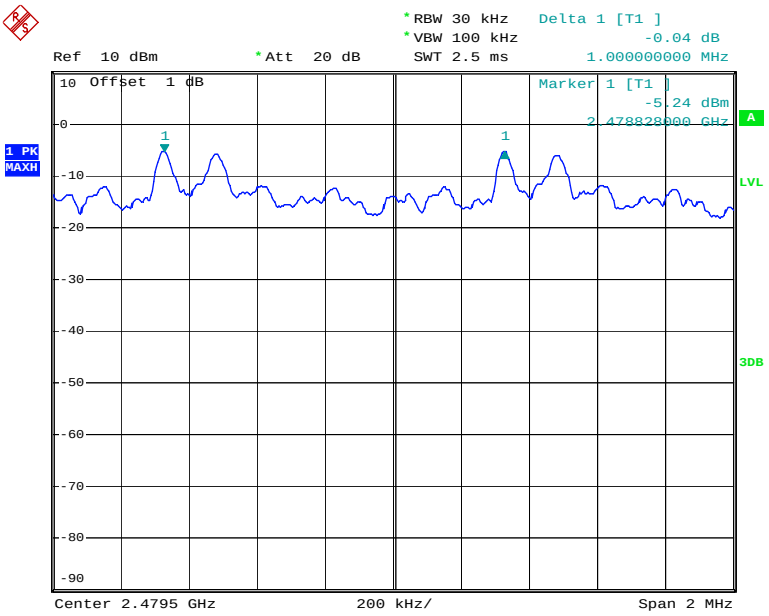
High Channel



Date: 9.JUL.2016 16:12:44

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

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 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. 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	Spectrum Analyzer	FSP 38	100478	2015-11-23	2016-11-22
N/A	Coaxial Cable	0.1m	N/A	2016-05-06	2017-05-06
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2016-05-06	2017-05-06

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

Test Data

Environmental Conditions

Temperature:	29.1°C
Relative Humidity:	57 %
ATM Pressure:	99.7kPa

** The testing was performed by Emily Wang from 2016-07-09.*

Test Result: Compliance.

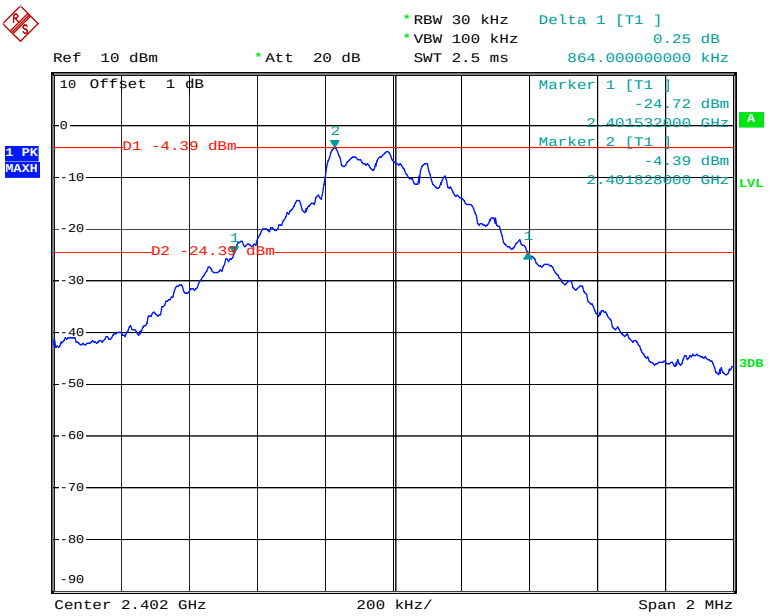
Please refer to following tables and plots

Test Mode: Transmitting

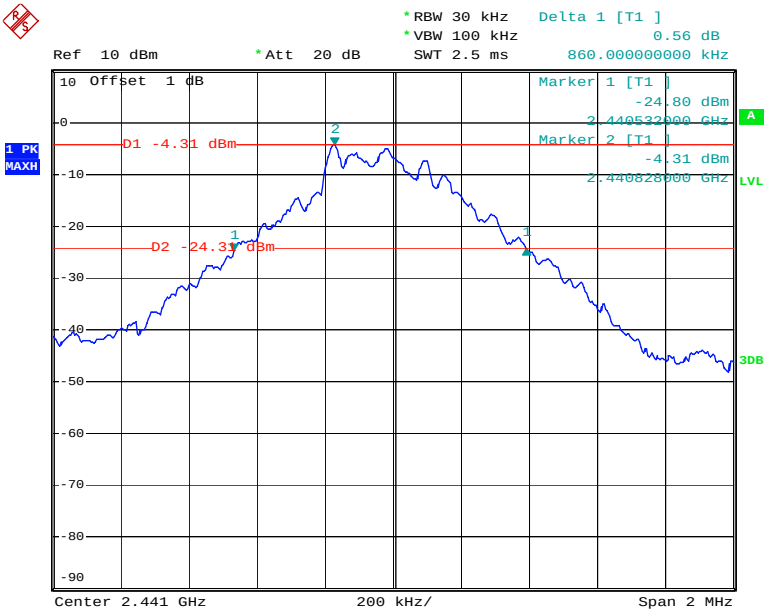
Mode	Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
BDR Mode (GFSK)	Low	2402	0.86
	Middle	2441	0.86
	High	2480	0.86
EDR Mode (π/4-DQPSK):	Low	2402	1.23
	Middle	2441	1.23
	High	2480	1.23

BDR Mode (GFSK):

Low Channel



Middle Channel



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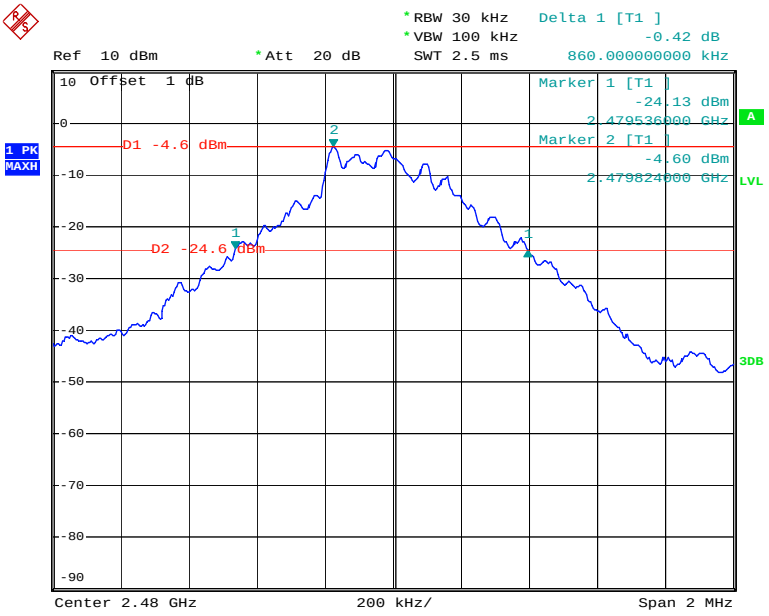
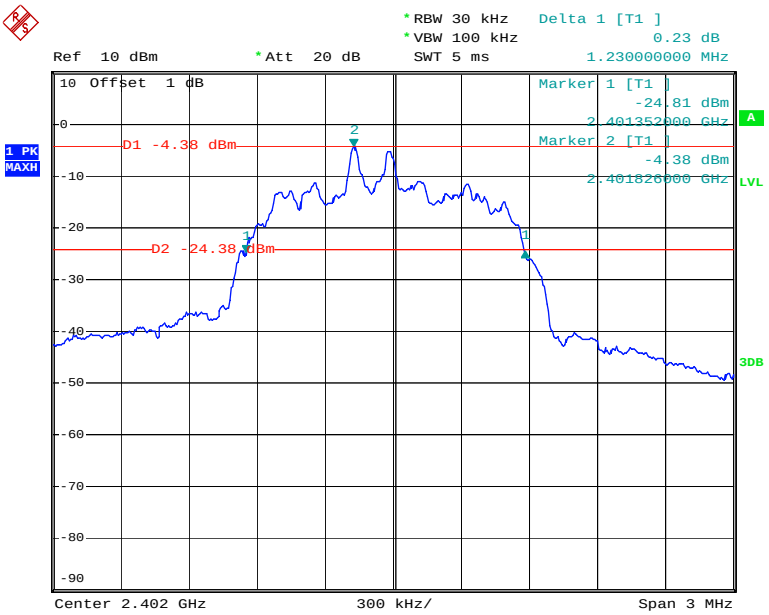
High Channel



Date: 9.JUL.2016 14:04:58

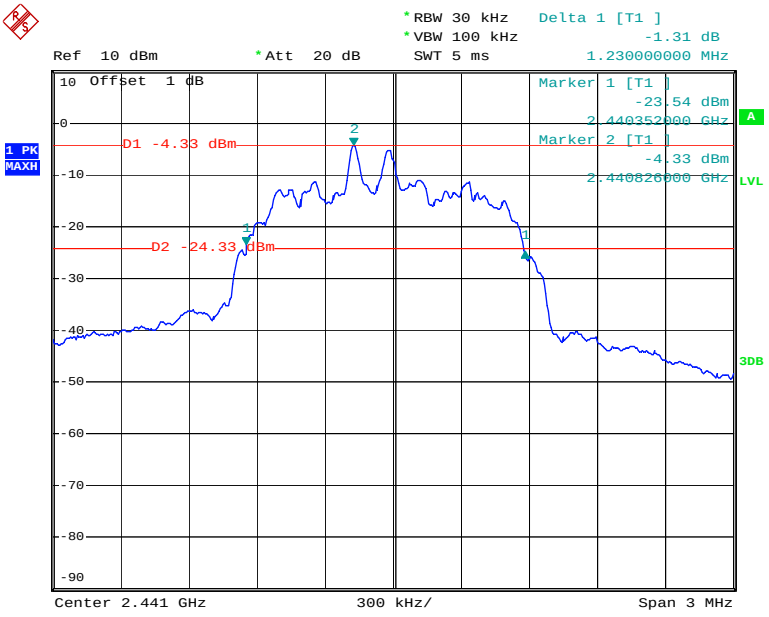
EDR Mode (π/4-DQPSK):

Low Channel



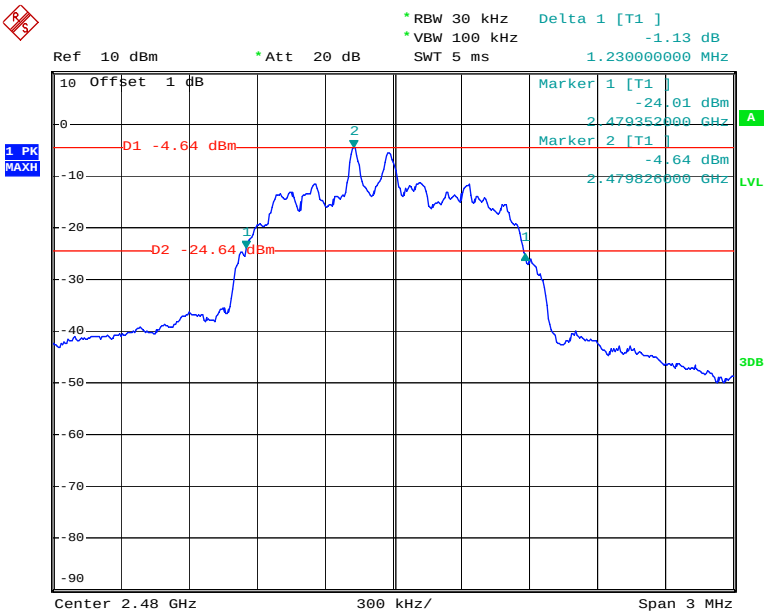
Date: 9.JUL.2016 14:08:58

Middle Channel



Date: 9.JUL.2016 14:07:52

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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2015-11-23	2016-11-22
N/A	Coaxial Cable	0.1m	N/A	2016-05-06	2017-05-06
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2016-05-06	2017-05-06

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

Test Data

Environmental Conditions

Temperature:	29.1°C
Relative Humidity:	57 %
ATM Pressure:	99.7 kPa

** The testing was performed by Emily Wang from 2016-07-09.*

Test Result: Compliance.

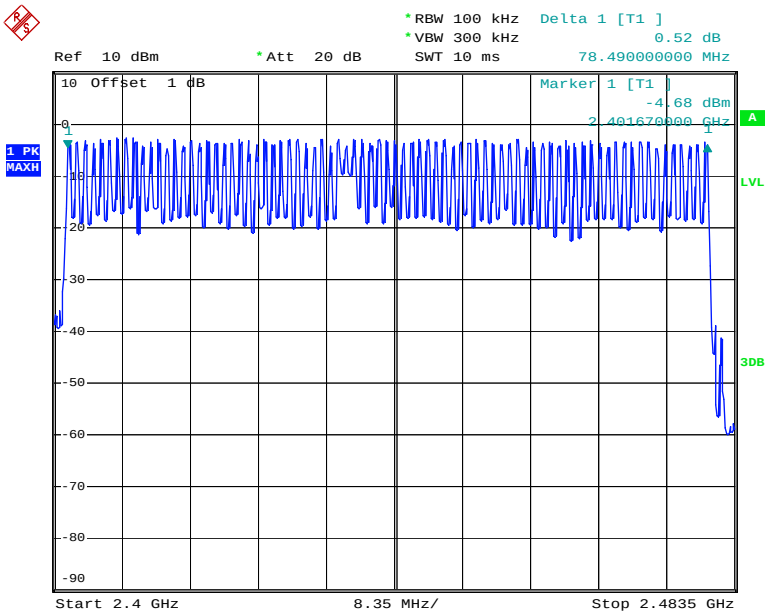
Please refer to following tables and plots

Test Mode: Transmitting

BDR Mode (GFSK):

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

Number of Hopping Channels

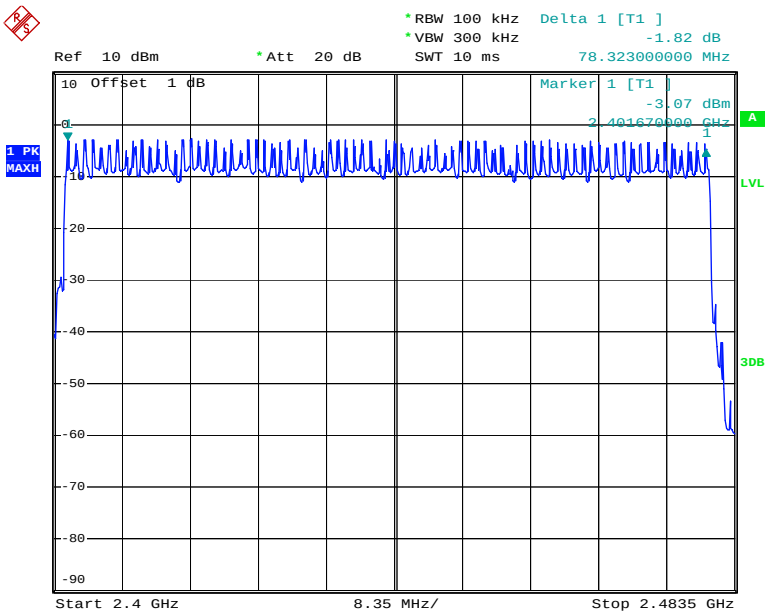


Date: 9.JUL.2016 17:25:16

EDR Mode (π/4-DQPSK):

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

Number of Hopping Channels



Date: 9.JUL.2016 17:27:32

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

The EUT was worked in channel hopping; Spectrum SPAN was set as 0. Sweep was set as 0.4 * channel no. (s), the quantity of pulse was get from single sweep. In addition, the time of single pulses was tested.

Dwell Time= time slot length * hope rate/ number of hopping channels * 31.6s
Hop rate=1600/s

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2015-11-23	2016-11-22
N/A	Coaxial Cable	0.1m	N/A	2016-05-06	2017-05-06
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2016-05-06	2017-05-06

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

Test Data

Environmental Conditions

Temperature:	29.1°C
Relative Humidity:	57 %
ATM Pressure:	99.7kPa

** The testing was performed by Emily Wang from 2016-07-09.*

Test Result: Compliance.

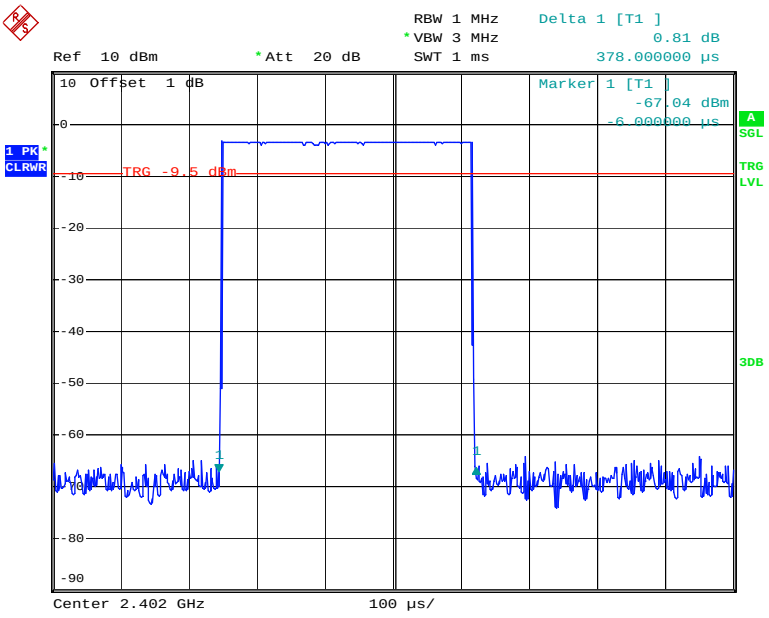
Please refer to following tables and plots

Test Mode: Transmitting

BDR Mode (GFSK):

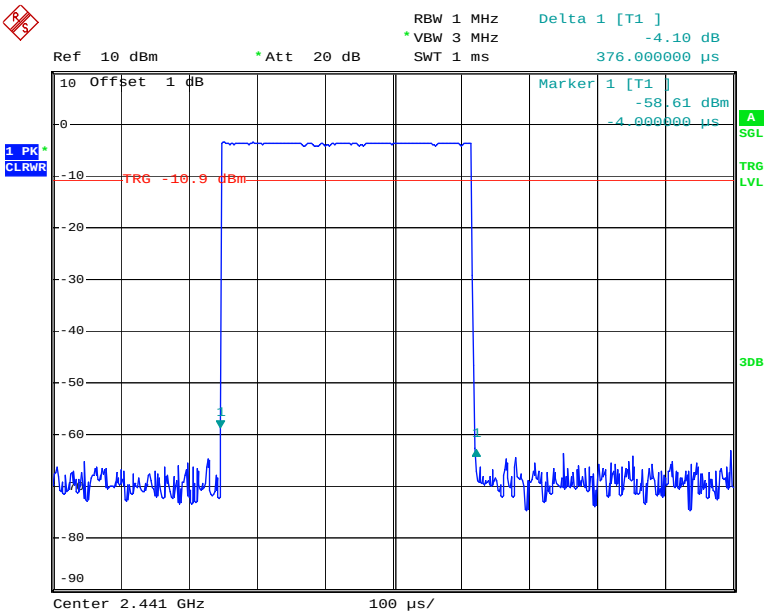
Mode	Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
DH1	Low	0.378	0.121	0.4	Compliance
	Middle	0.376	0.120	0.4	Compliance
	High	0.378	0.121	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/2/79) ×31.6 s				
DH3	Low	1.650	0.264	0.4	Compliance
	Middle	1.650	0.264	0.4	Compliance
	High	1.650	0.264	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/4/79) ×31.6 s				
DH5	Low	2.900	0.309	0.4	Compliance
	Middle	2.900	0.309	0.4	Compliance
	High	2.900	0.309	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/6/79) ×31.6 s				

DH1: Low Channel



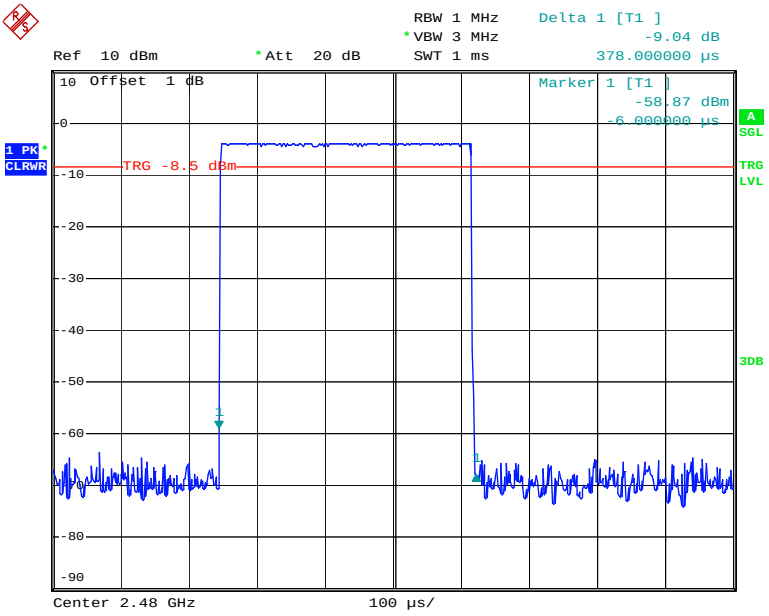
Date: 9.JUL.2016 16:15:46

DH1: Middle Channel



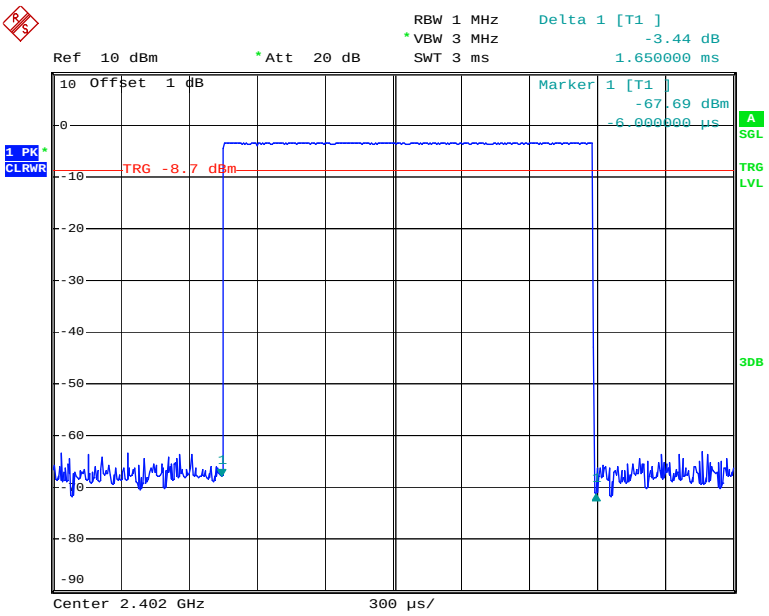
Date: 9.JUL.2016 16:15:55

DH1: High Channel



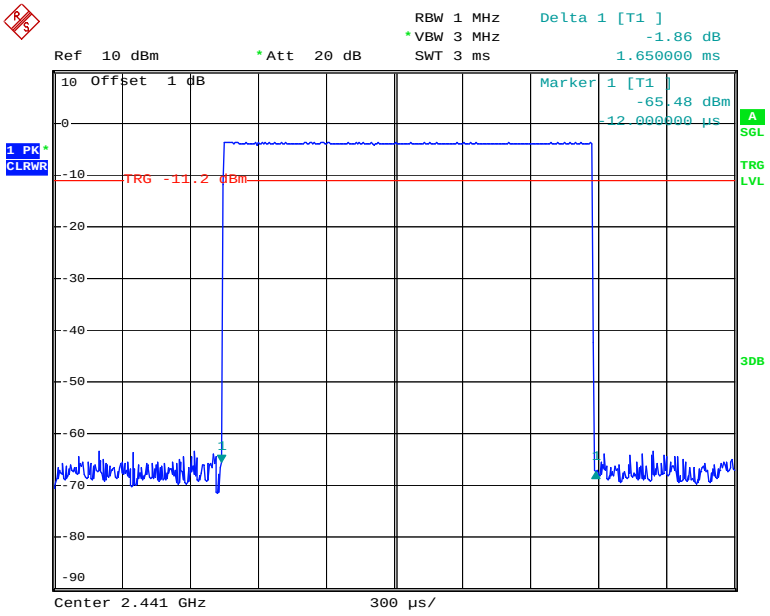
Date: 9.JUL.2016 16:16:04

DH3: Low Channel



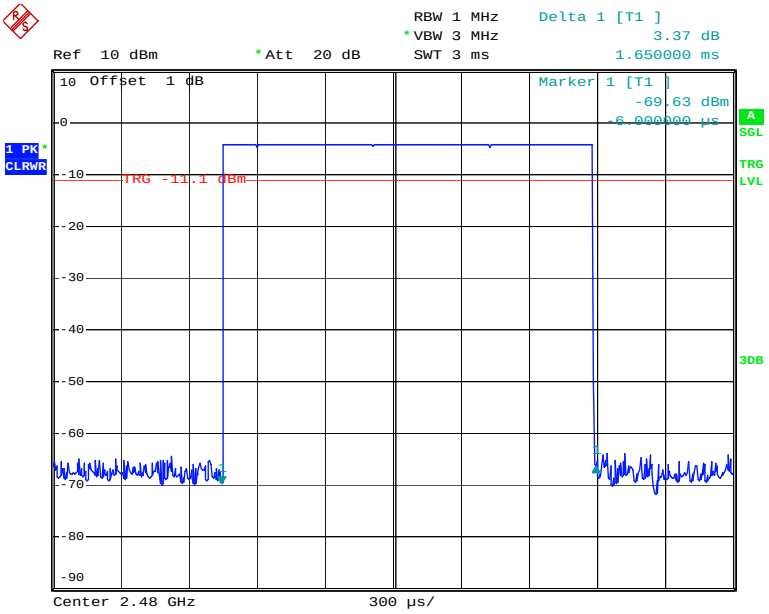
Date: 9.JUL.2016 16:16:30

DH3: Middle Channel



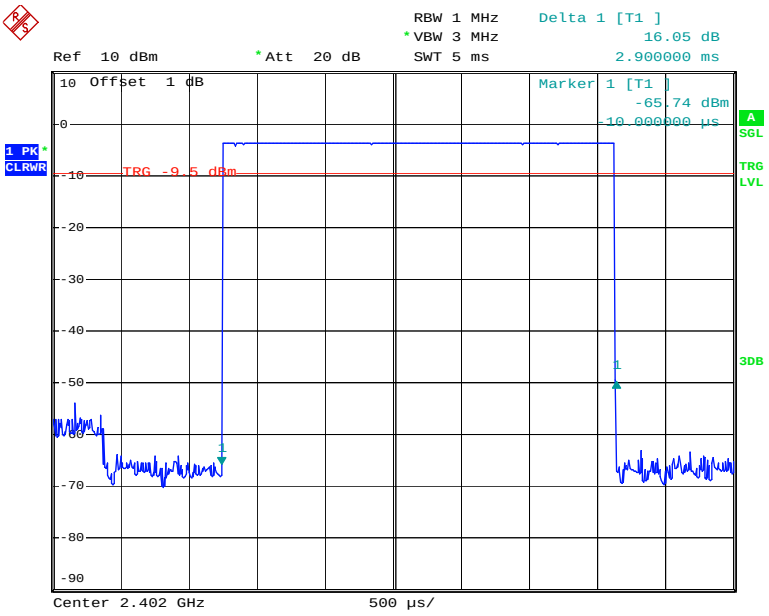
Date: 9.JUL.2016 16:16:39

DH3: High Channel



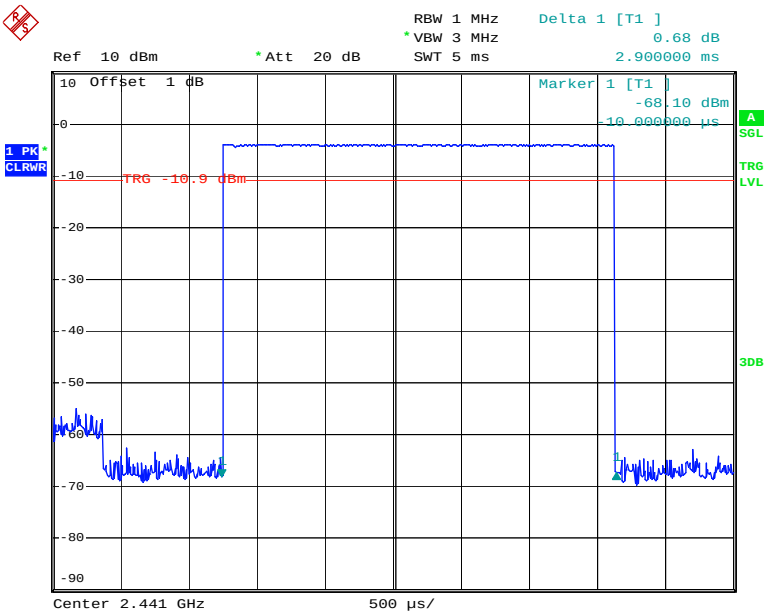
Date: 9.JUL.2016 16:16:48

DH5: Low Channel



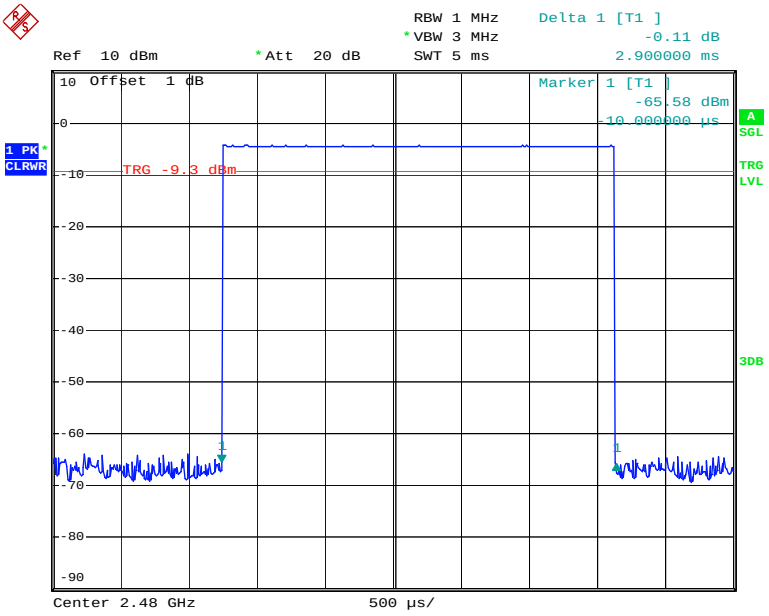
Date: 9.JUL.2016 16:17:20

DH5: Middle Channel



Date: 9.JUL.2016 16:17:29

DH5: High Channel

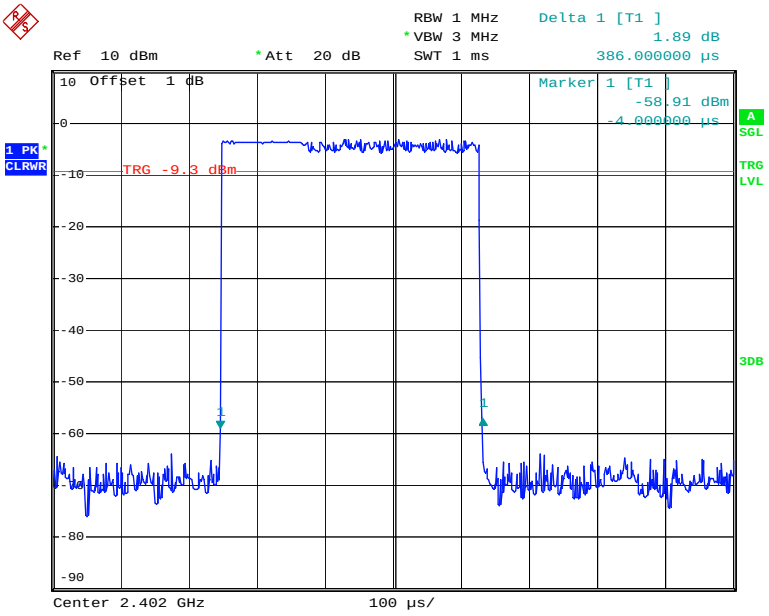


Date: 9.JUL.2016 16:17:39

EDR Mode (π/4-DQPSK):

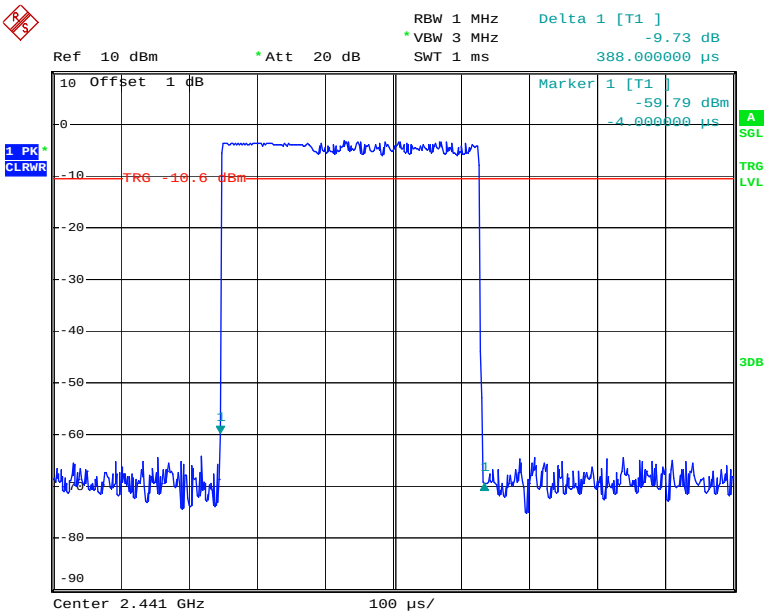
Mode	Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
2DH1	Low	0.386	0.124	0.4	Compliance
	Middle	0.388	0.124	0.4	Compliance
	High	0.386	0.124	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/2/79) ×31.6 s				
2DH3	Low	1.656	0.265	0.4	Compliance
	Middle	1.650	0.264	0.4	Compliance
	High	1.650	0.264	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/4/79) ×31.6 s				
2DH5	Low	2.910	0.310	0.4	Compliance
	Middle	2.910	0.310	0.4	Compliance
	High	2.910	0.310	0.4	Compliance
	Note: Dwell time=Pulse time (ms) × (1600/6/79) ×31.6 s				

2DH1: Low Channel



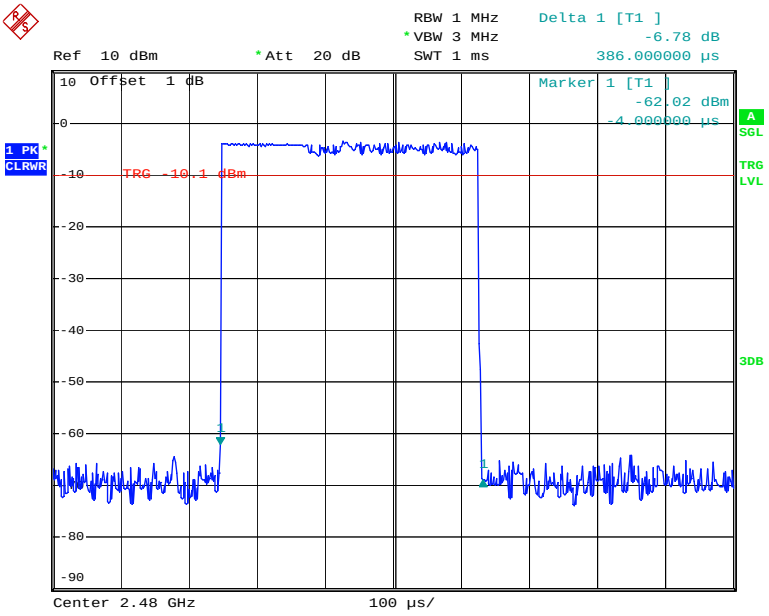
Date: 9.JUL.2016 16:18:08

2DH1: Middle Channel



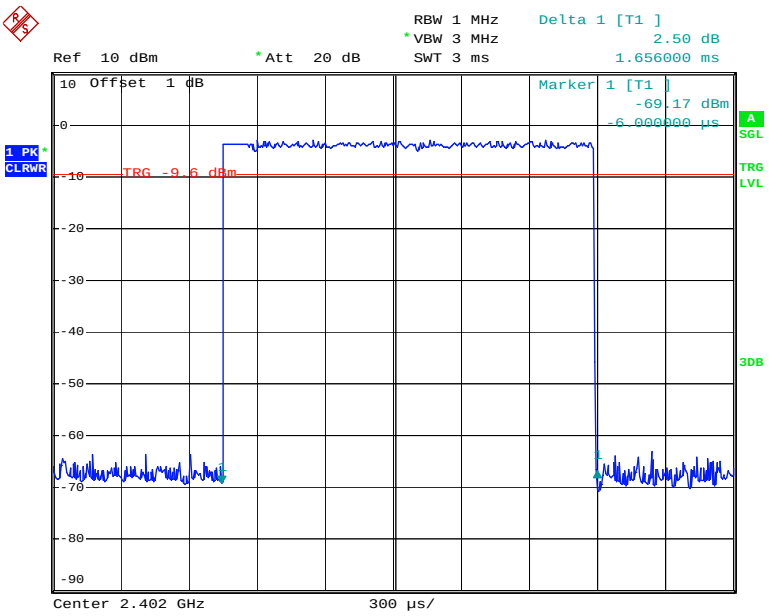
Date: 9.JUL.2016 16:18:23

2DH1: High Channel



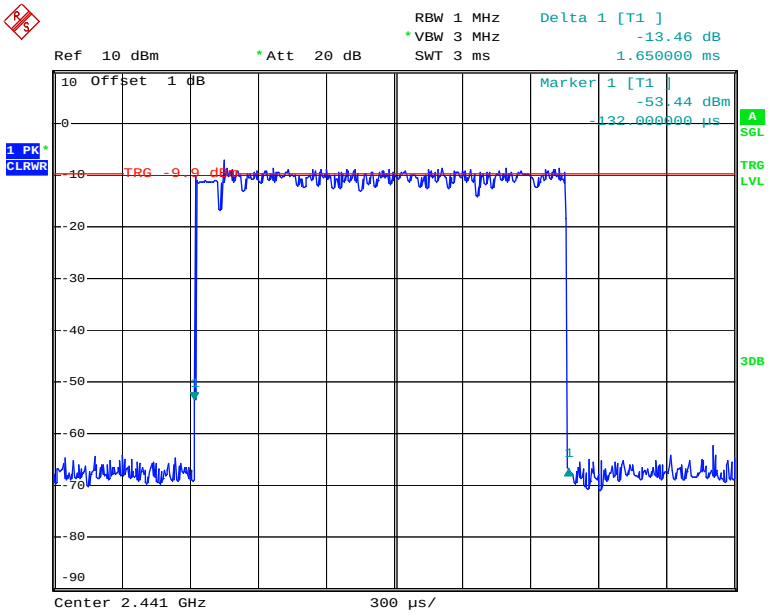
Date: 9.JUL.2016 16:18:35

2DH3: Low Channel



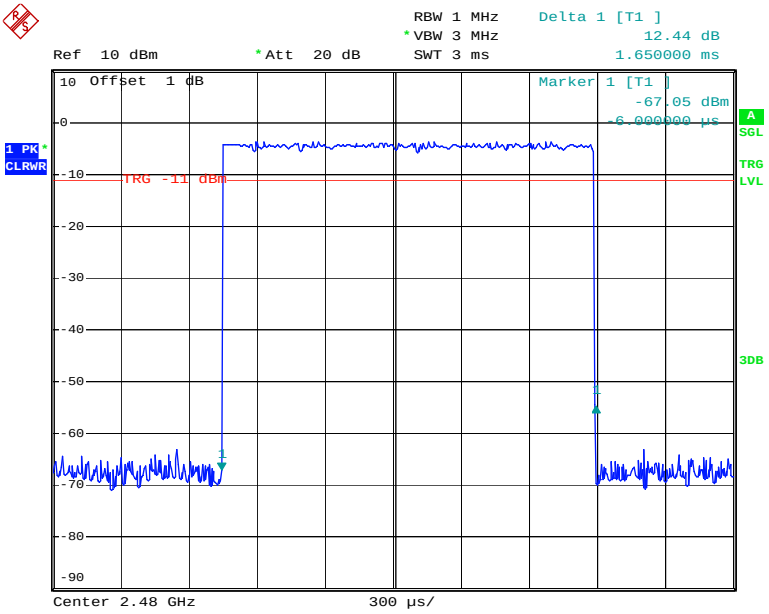
Date: 9.JUL.2016 16:18:58

2DH3: Middle Channel



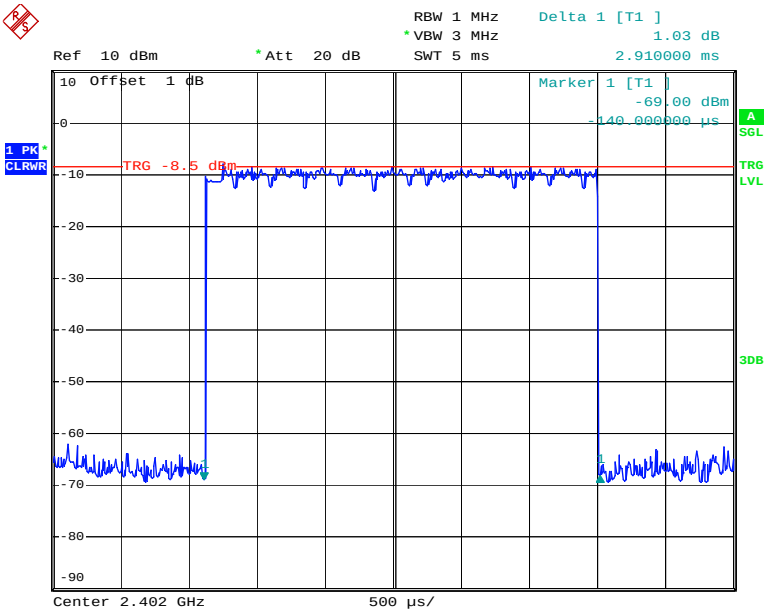
Date: 9.JUL.2016 16:19:07

2DH3: High Channel



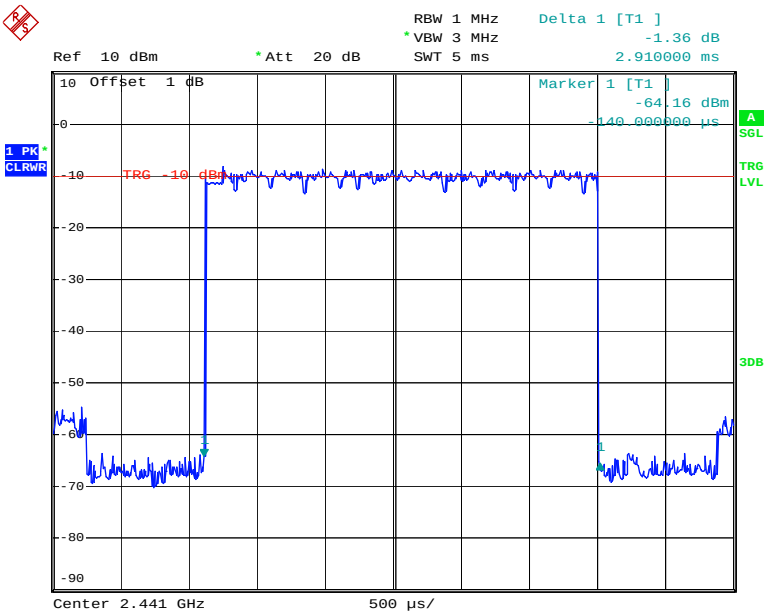
Date: 9.JUL.2016 16:19:16

2DH5: Low Channel



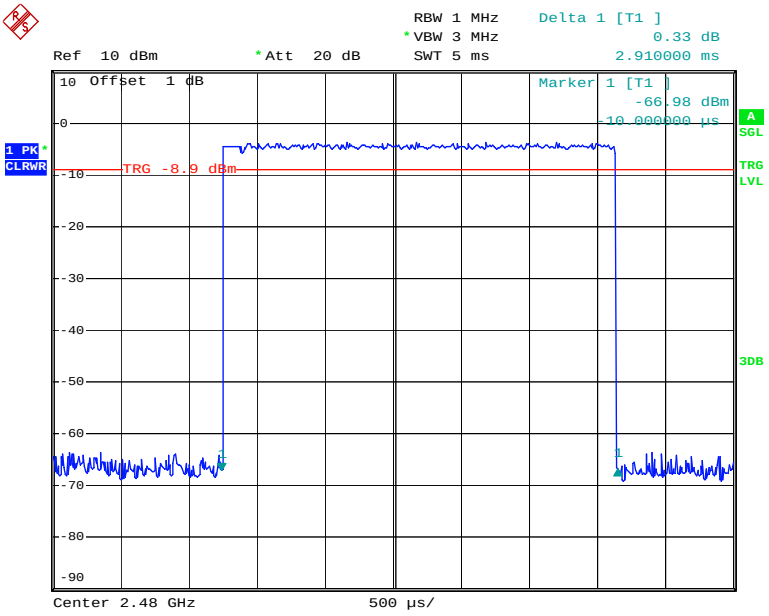
Date: 9.JUL.2016 16:19:45

2DH5: Middle Channel



Date: 9.JUL.2016 16:19:53

2DH5: High Channel



Date: 9.JUL.2016 16:20:02

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. 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
R&S	Spectrum Analyzer	FSP 38	100478	2015-11-23	2016-11-22
N/A	Coaxial Cable	0.1m	N/A	2016-05-06	2017-05-06
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2016-05-06	2017-05-06

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

Test Data

Environmental Conditions

Temperature:	29.1°C
Relative Humidity:	57 %
ATM Pressure:	99.7 kPa

** The testing was performed by Emily Wang on 2016-07-09.*

Test Result: Compliance.

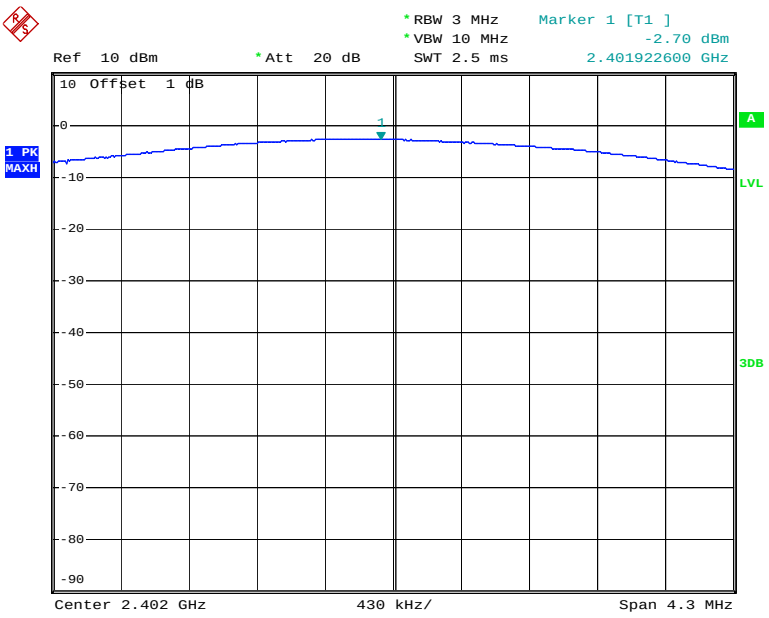
Test Mode: Transmitting

Mode	Channel	Frequency (MHz)	Conducted Peak Output power (dBm)	Limit (dBm)
BDR Mode (GFSK)	Low	2402	-2.70	30
	Middle	2441	-2.67	30
	High	2480	-3.00	30
EDR Mode (π/4-DQPSK)	Low	2402	-1.84	30
	Middle	2441	-1.81	30
	High	2480	-2.02	30

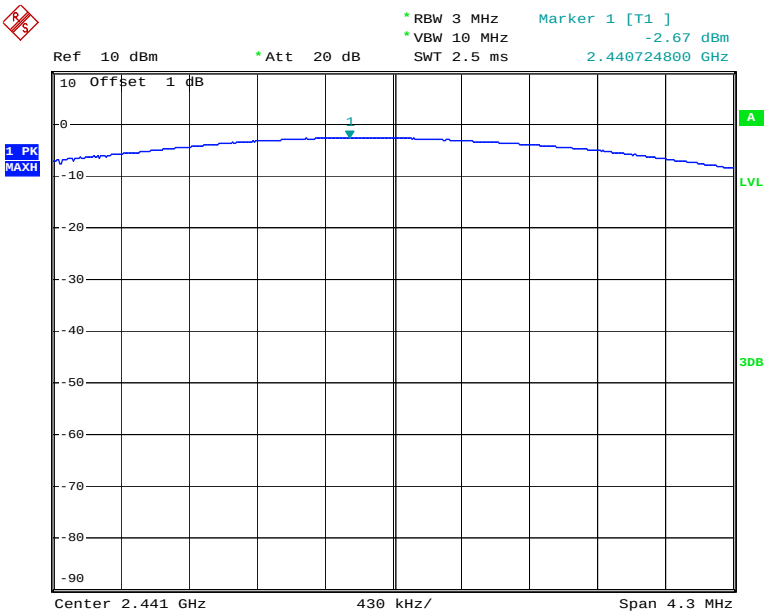
Note: The data above was tested in conducted mode.

BDR Mode (GFSK):

Output Power, Low Channel

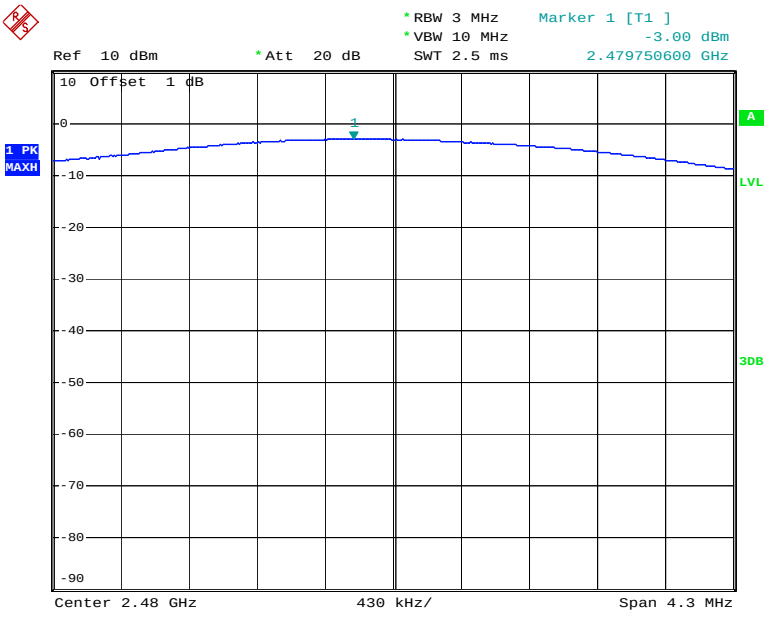


Output Power, Middle Channel



Date: 9.JUL.2016 14:04:20

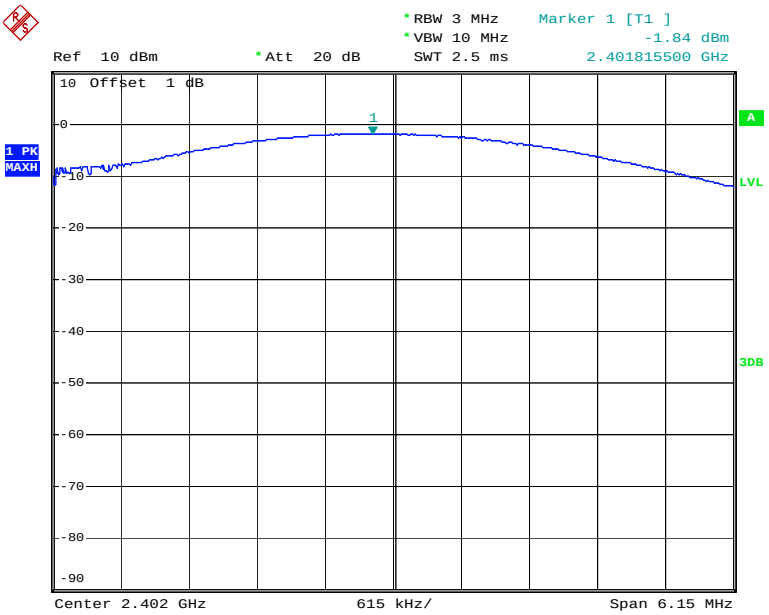
Output Power, High Channel



Date: 9.JUL.2016 14:05:25

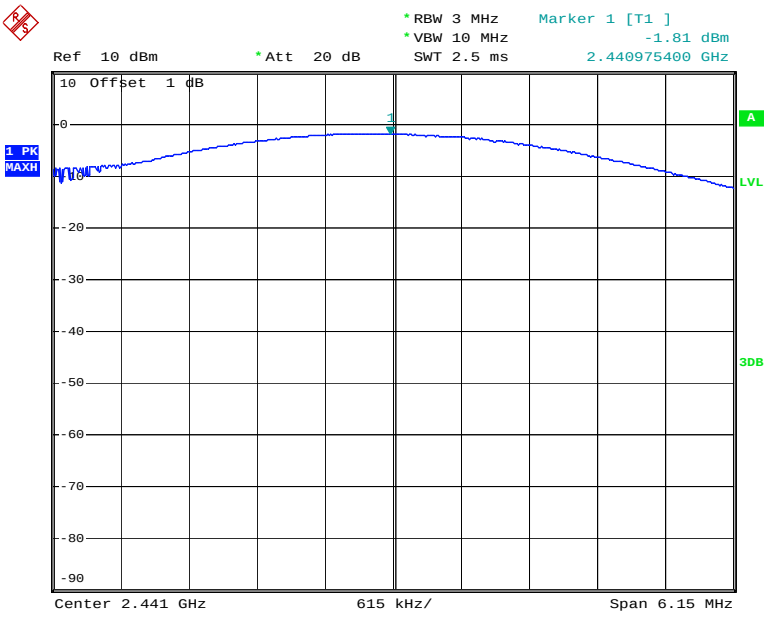
EDR Mode (π/4-DQPSK):

Output Power, Low Channel



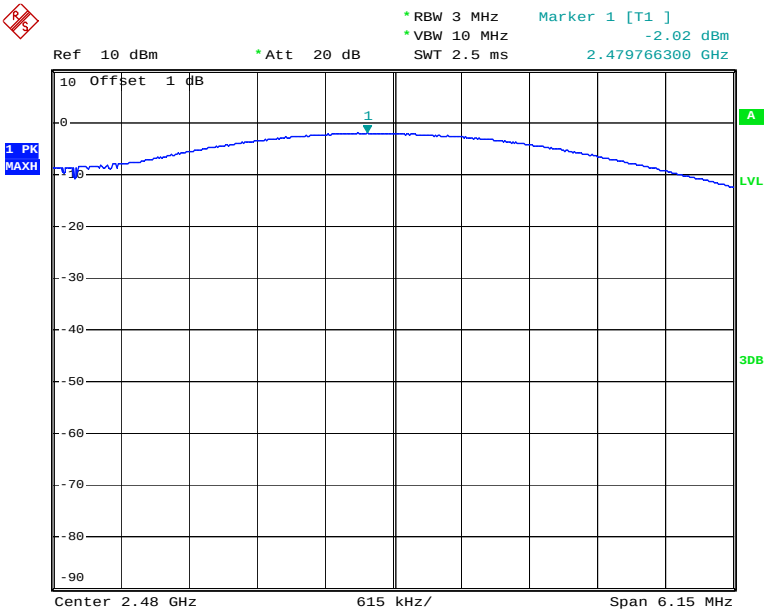
Date: 9.JUL.2016 14:09:25

Output Power, Middle Channel



Date: 9.JUL.2016 14:08:18

Output Power, High Channel



Date: 9.JUL.2016 14:06:50

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 both RBW and VBW 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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2015-11-23	2016-11-22
N/A	Coaxial Cable	0.1m	N/A	2016-05-06	2017-05-06
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2016-05-06	2017-05-06

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

Test Data

Environmental Conditions

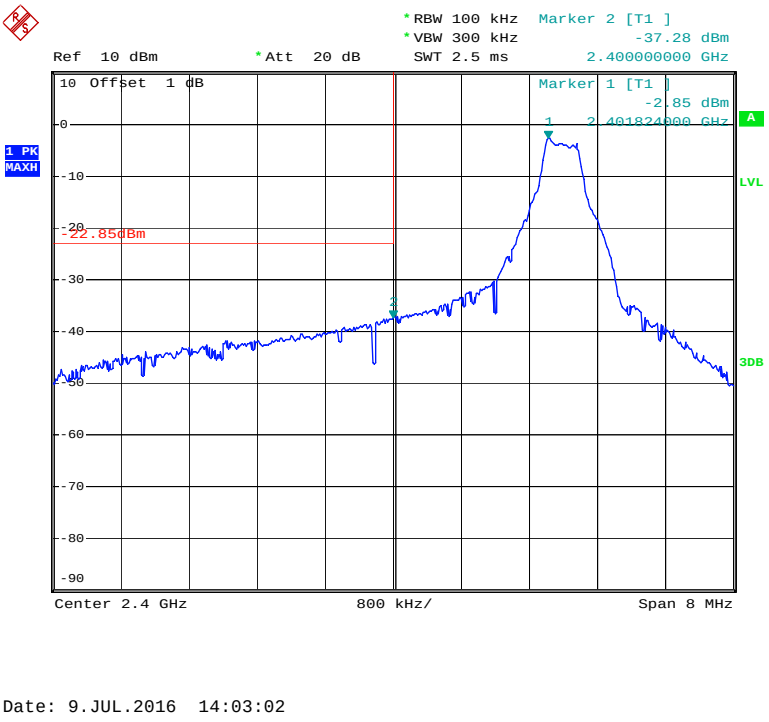
Temperature:	29.1 °C
Relative Humidity:	57 %
ATM Pressure:	99.7 kPa

** The testing was performed by Emily Wang on 2016-07-09.*

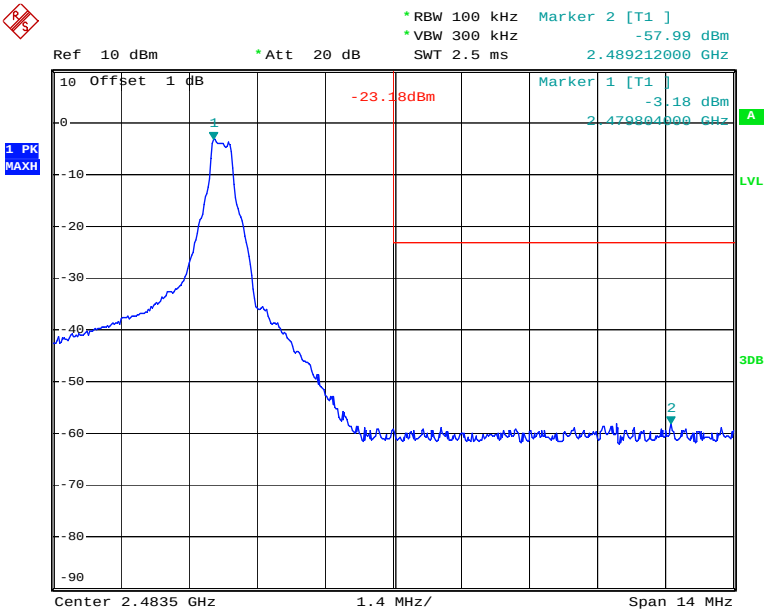
Test Result: Compliance

BDR Mode (GFSK):

Band Edge, Left Side



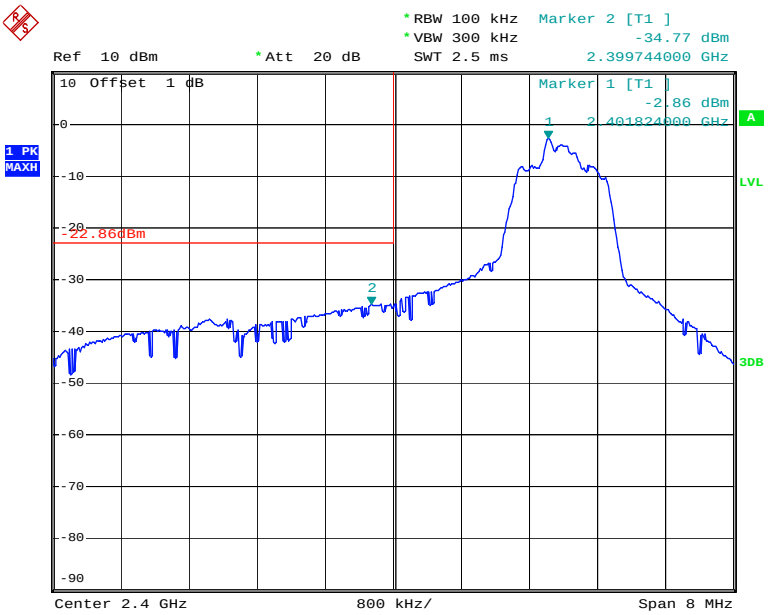
Band Edge, Right Side



Date: 9.JUL.2016 14:05:48

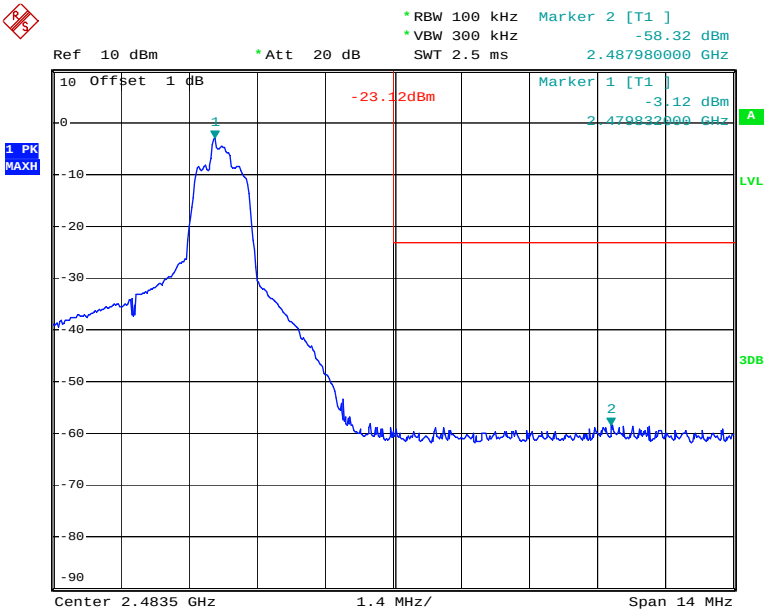
EDR Mode (π/4-DQPSK):

Band Edge, Left Side



Date: 9.JUL.2016 14:09:49

Band Edge, Right Side



Date: 9.JUL.2016 14:07:13

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