FCC PART 15.247

TEST REPORT

For

Quectel Wireless Solutions Company Limited

Room501, Building13, No.99TianZhouRoad, Xuhui District, Shanghai, China

Model: M26 FCC ID: XMR201604M26	
Report Type Original Report	Product Type: LCC GSM/GPRS Module

Test Engineer : David. Hsu

Report Number : RTW160524002-00

Report Date : 2016.05.13

Reviewed By: Jerry.Chang

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The EUT was received on 2016-04-19.

The EUT test completion date of 2016-05-13.

Revision History

Revision	Issue Date	Description
1.0	2016.05.13	Original Report

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	**:** Quectel Wireless Solutions Company Limited Room501,Building13,No.99TianZhouRoad,Xuhui District,Shanghai, China
Product	**:** LCC GSM/GPRS Module
Model	**:** M26
Trade Name	**:** N/A
Frequency Range	**:** 2402 ~ 2480 MHz
Transmit Power	**:** GFSK Mode: 8.75 dBm π /4-DQPSK Mode: 9.30 dBm 8DPSKMode: 9.62 dBm
Modulation Technique	**:** BDR(GFSK) EDR(π /4-DQPSK) EDR(8DPSK)
Transmit Data Rate	**:** GFSK Mode: 1MHz π /4-DQPSK Mode: 2MHz 8DPSKMode: 3MHz
Number of Channels	**:** 79 Channel
Antenna Specification	**:** Chip Antenna / Gain: 1.06dBi
Voltage Range	**:** DC 3.3V~4.6V
Dimension	**:** 17.7mm(L) × 15.8mm(W) × 2.3mm(H)
Date of Test	**:** May. 09, 2016~May. 12, 2016

**All measurement and test data in this report was gathered from production sample serial number: 20160419001 (Assigned by BACL, Taiwan). The EUT supplied by the applicant was received on 2016-04-19.*

Objective

This report is prepared on behalf of Quectel Wireless Solutions Company Limited in accordance with Part 2, Subpart J, Part 15, Subparts A, B and C of the Federal Communication Commission's rules.

The tests were performed in order to determine 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)

FCC Part 22H&24E PCB submission with FCC ID:XMR201604M26.

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.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Taiwan) to collect test data is located on the 70, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

Test site at Bay Area Compliance Laboratories Corp. (Taiwan) has been fully described in reports submitted to the Federal Communication 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 April 22, 2015. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.:431084. 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 an engineering mode which was controlled by software.

Equipment Modifications

No modification was made to the EUT.

EUT Exercise Software

Labtool.

GFSK :Power level 7

π /4-DQPSK :Power level 7

8DPSK :Power level 7

Support Equipment List and Details

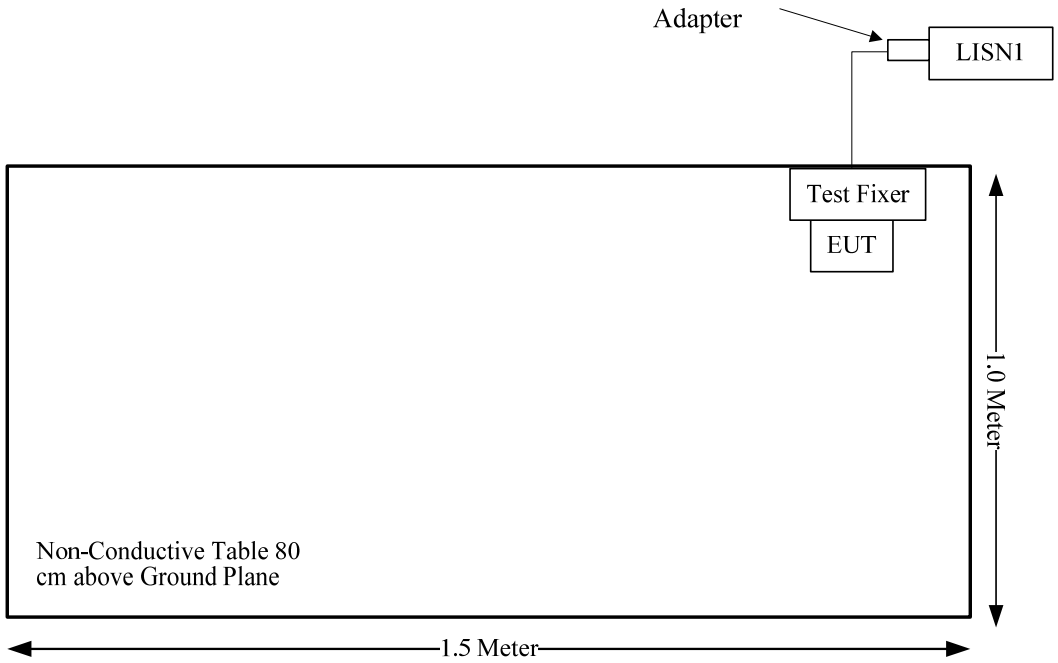
Manufacturer	Description	Model	Serial Number
Dell	Notebook	E6410	N/A
Tenda	Adapter	N/A	N/A
Quectel	Test Fixer	N/A	N/A

External Cable List and Details

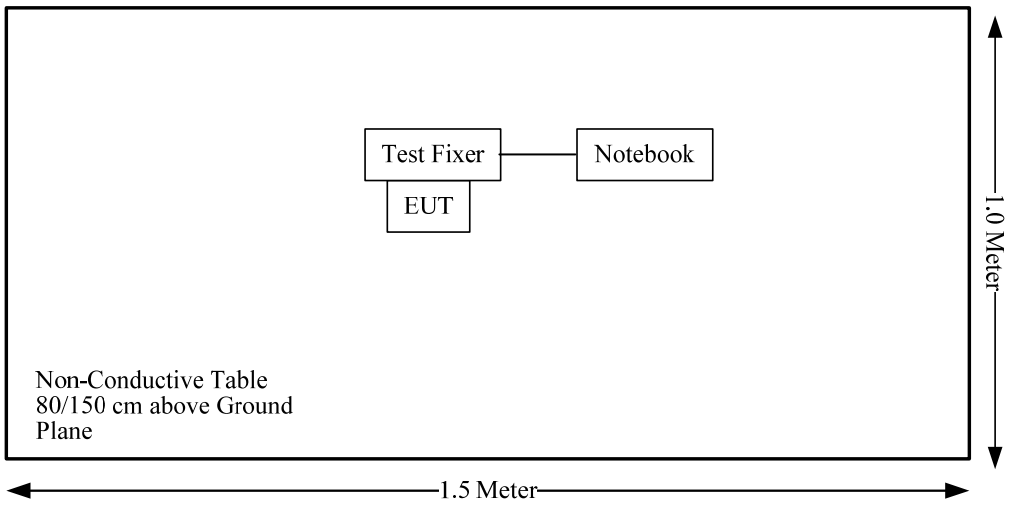
Cable Description	Length (m)	From Port	To
USB CABLE	1.0	EUT	Notebook

Block Diagram of Test Setup

Conduction Test:



Radiation Test:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
§15.247 (i), §1.1310 &§2.1091	MAXIMUM PERMISSIBLE EXPOSURE (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209 & §15.247(d)	Radiated Emissions	Compliance
§15.247(a)(1)	Channel Separation Test	Compliance
§15.247(a)(1)	20dBEmission Bandwidth	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 inexcess 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/cm^2)**	**Averaging Time (minutes)**
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/		f/1500	30
1500-100,000	/		1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;
According to §1.1310 and §2.1091 RF exposure is calculated.

Calculated Formulary:

Predication of MPE limit at a given distance
$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm2);
P = power input to the antenna (in appropriate units, e.g., mW);
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

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

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

Test Result

Calculated Data:

Mode	Frequency Range (MHz)	Antenna Gain		Target Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)	S_i/S_{limit}
		(dBi)	(numeric)	(dBm)	(mW)				
GSM850	824.2-848.8	1.0	1.26	33	1995.26	20.00	0.5000	0.55	0.9091
DCS1900	1850.2-1909.8	1.0	1.26	30	1000.00	20.00	0.2506	1.0	0.2506
Bluetooth	2402-2480	1.06	1.28	10	10.00	20.00	0.0025	1.0	0.0025

Note: Target Power =the max power including Tune-up tolerance, the tune up power declared by manufacture as:

GSM850= 32±1dBm; GSM1900=29±1dBm; BT=8.0±2dBm

GSM850 or PCS1900 can transmit simultaneously with Bluetooth, Maximum S_i/S_{limit} is GSM 850 mode,

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

$=S_{850}/S_{limit\_850}+ S_{BT}/S_{limit\_BT}$

$=0.9091 + 0.0025$

$=0.9116$

< 1.0

Result: The device meet FCC MPE at 20 cm distance

FCC §15.203–ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.

b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

Model	Type	Antenna Gain	Result
PCB Layout	Chip antenna	1.06dBi	Compliance

The EUT has one integral antenna arrangement, which was permanently attached, fulfill the requirement of this section. Please refer to the internal photos.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

According to FCC §15.207(a)

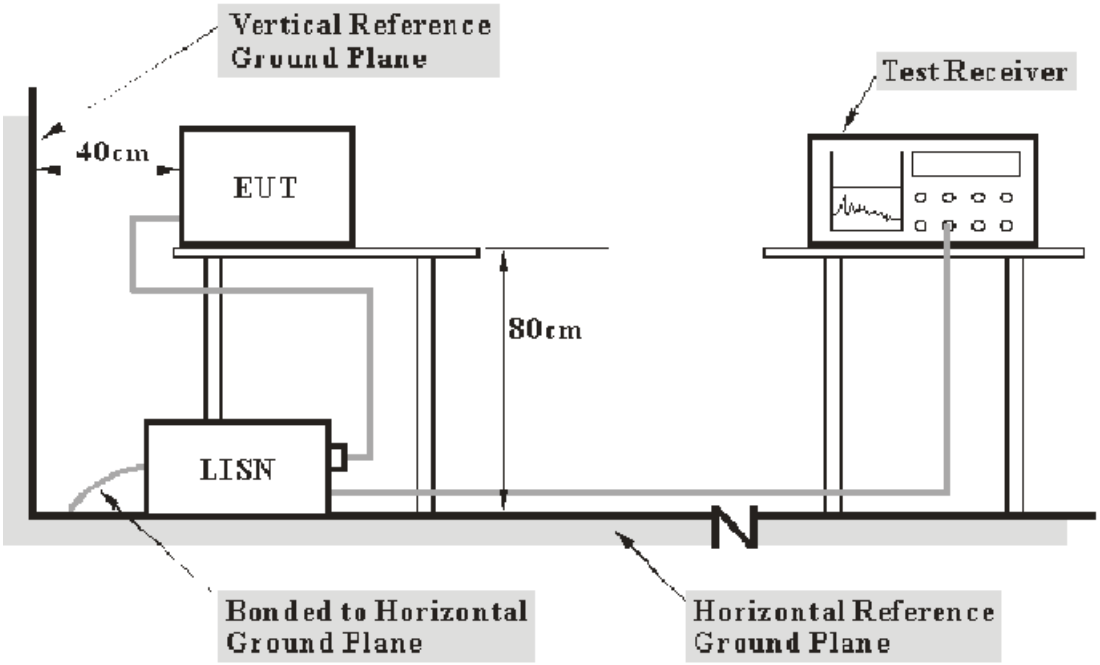
Measurement Uncertainty

Input quantities to be considered for conducted disturbance measurements maybe receiver reading, attenuation of the connection between LISN/ISN and receiver, LISN/ISN voltage division factor, LISN/ISN VDF frequency interpolation and receiver related input quantities, etc.

Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of conducted disturbance test at Bay Area Compliance Laboratories Corp. (Taiwan) is shown as below. And the uncertainty will not be taken into consideration for the test data recorded in the report

Port	Expanded Measurement uncertainty
AC Mains	2.71 dB (k=2, 95% level of confidence)
CAT 3	3.81 dB (k=2, 95% level of confidence)
CAT 5	4.24 dB (k=2, 95% level of confidence)
CAT 6	4.71 dB (k=2, 95% level of confidence)

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.

EMI Test Receiver Setup

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

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

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

Test Procedure

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

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

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

Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
LISN	Rohde & Schwarz	ENV216	101248	2015/8/3	2016/8/2
LISN	EMCO	699837	75848	2015/7/8	2016/7/7
ISN	FCC	FCC-TLISN-T 8-02-09	111154	2015/7/7	2016/7/6
Single Balanced Telecom Pair ISN	FCC	FCC-TLISN-T 4-02	20271	2015/8/25	2016/8/24
CVP	BACL	CVP	150604	2015/8/6	2016/8/5
Current Probe	hp	8710-1744	241	2015/7/17	2016/7/16
EMI Test Receiver	Rohde & Schwarz	ESCI	100540	2015/7/25	2016/7/24
Pulse Limiter	Rohde & Schwarz	ESH3Z2	TXZEM025	2015/8/28	2016/8/27
RF Cable	EMEC	EM-CB5D	001	2015/7/29	2016/7/28
Software	AUDIX	E3	V9.150826k	N.C.R	N.C.R

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

Corrected Factor & Margin Calculation

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

Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

The "Over Limit" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an over limit of -7 dB means the emission is 7 dB below the limit. The equation for Over Limit calculation is as follows:

Over Limit = Level – Limit Line

Test Results Summary

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

28.82 dB at **0.155000 MHz** in the **Neutral** conducted mode

Refer to CISPR16-4-2and CISPR 16-4-1, the measured level complies with the limit if:
$L_m + U_{(Lm)} \leq L_{lim} + U_{cispr}$

In BACL, $U_{(Lm)}$ is less than U_{cispr}, if L_m is less than L_{lim}, it implies that the EUT complies with the limit.

Test Data

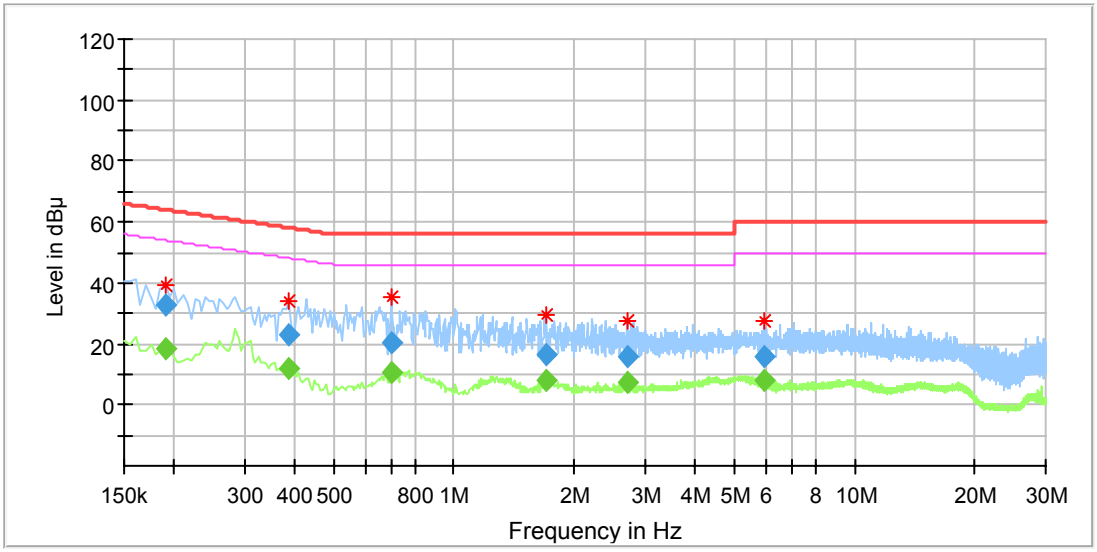
Environmental Conditions

Temperature:	24℃
Relative Humidity:	57 %

The testing was performed by David. Hsu on 2016-05-12.

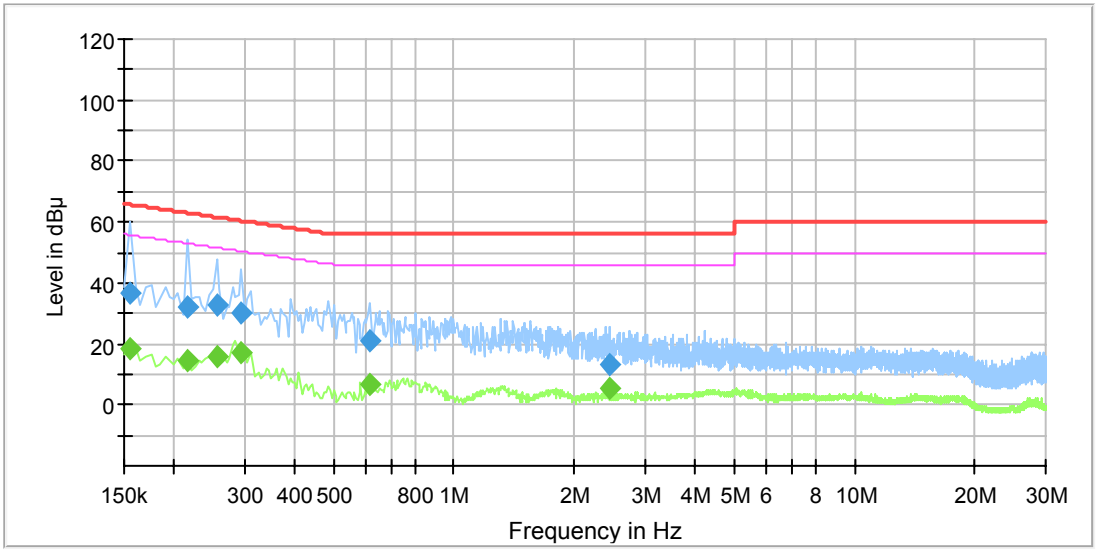
Test Result: Compliance, please refer to the below table and plots.

AC 120V/60 Hz, Line



Frequency (MHz)	QuasiPeak (dBµV)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.190000	---	18.45	9.000	L1	11.0	35.59	54.04	Compliance
0.190000	32.84	---	9.000	L1	11.0	31.20	64.04	Compliance
0.385000	---	12.20	9.000	L1	11.0	35.97	48.17	Compliance
0.385000	23.11	---	9.000	L1	11.0	35.06	58.17	Compliance
0.695000	---	10.77	9.000	L1	11.1	35.23	46.00	Compliance
0.695000	20.68	---	9.000	L1	11.1	35.32	56.00	Compliance
1.700000	---	8.16	9.000	L1	11.2	37.84	46.00	Compliance
1.700000	16.69	---	9.000	L1	11.2	39.31	56.00	Compliance
2.695000	---	7.07	9.000	L1	11.2	38.93	46.00	Compliance
2.695000	15.97	---	9.000	L1	11.2	40.03	56.00	Compliance
5.975000	---	7.88	9.000	L1	11.4	42.12	50.00	Compliance
5.975000	15.88	---	9.000	L1	11.4	44.12	60.00	Compliance

AC 120V/60 Hz, Neutral



Frequency (MHz)	QuasiPeak (dBµV)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.155000	---	18.49	9.000	N	11.0	37.24	55.73	Compliance
0.155000	36.91	---	9.000	N	11.0	28.82	65.73	Compliance
0.215000	---	14.64	9.000	N	11.0	38.37	53.01	Compliance
0.215000	32.13	---	9.000	N	11.0	30.88	63.01	Compliance
0.255000	---	15.55	9.000	N	11.0	36.04	51.59	Compliance
0.255000	32.57	---	9.000	N	11.0	29.02	61.59	Compliance
0.295000	---	17.33	9.000	N	11.0	33.05	50.38	Compliance
0.295000	30.39	---	9.000	N	11.0	29.99	60.38	Compliance
0.615000	---	6.56	9.000	N	11.1	39.44	46.00	Compliance
0.615000	21.02	---	9.000	N	11.1	34.98	56.00	Compliance
2.440000	---	5.17	9.000	N	11.3	40.83	46.00	Compliance
2.440000	13.49	---	9.000	N	11.3	42.51	56.00	Compliance

Note:

1) Corr.=LISN VDF (Voltage Division Factor) + Cable Loss

2) Corrected Amplitude = Reading + Corr.

3) Margin = Limit –Corrected Amplitude

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

Applicable Standard

FCC§15.247 (d); §15.209; §15.205

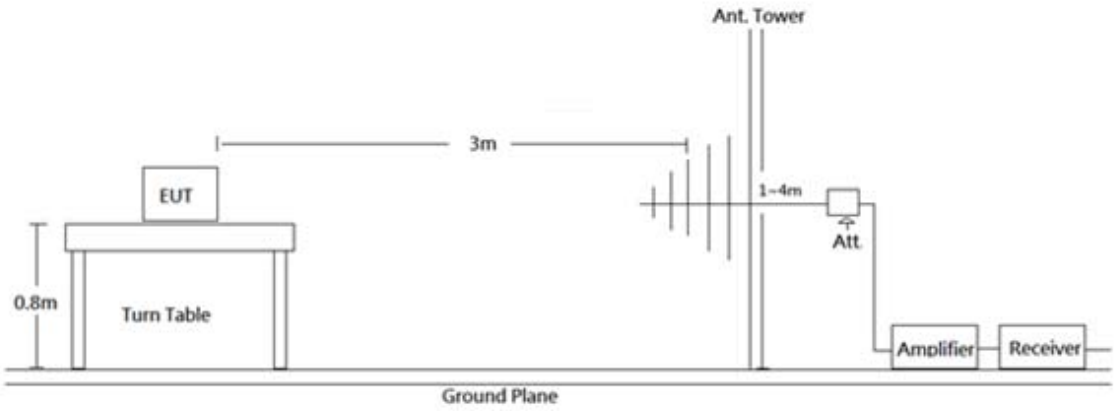
Measurement Uncertainty

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

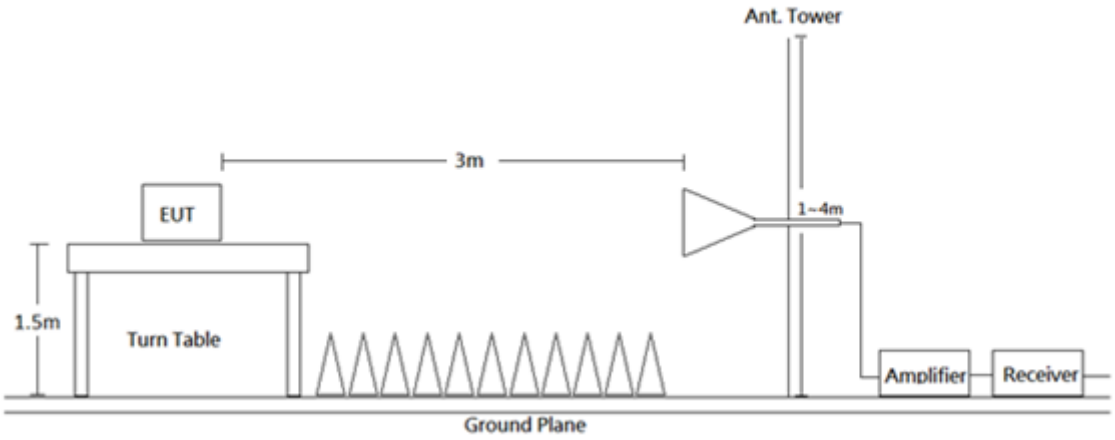
Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of radiation emissions at Bay Area Compliance Laboratories Corp. (Taiwan) is shown in below table. And the uncertainty will not be taken into consideration for the test data recorded in the report.

EUT Setup

Below 1GHz:



Above 1GHz:



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

EMI Test Receiver Setup

The system was investigated from 30 MHz to 25 GHz.

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

Frequency Range	RBW	RBW Video B/W	IF B/W	Detector
30MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3MHz	/	PK
	1MHz	10 Hz	/	Ave.

Test Procedure

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

All data was recorded in the Quasi-peak detector mode from 30 MHz to 1 GHz and PK and average detector modes for frequencies above 1 GHz.

Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Interval
Broadband Antenna	Sunol Sciences	JB6	A050115	2015/12/8	2016/12/7
EMEC Attenuator	EMEC	UNAT-6+	15542	2015/12/8	2016/12/7
Amplifier	Sonoma	310N	130601	2015/7/3	2016/7/2
Horn Antenna	EMCO	3115	9311-4158	2016/5/8	2017/5/7
Horn Antenna	ETS-Lindgren	3116	00062638	2015/9/7	2016/9/6
Preamplifier	EMEC	EM01G18G	060657	2015/12/21	2016/12/20
Preamplifier	EMEC	EM18G40G	060656	2015/12/21	2016/12/20
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2015/11/4	2016/11/3
Mircoflex Cable	UTIFLEX	UFB311A-Q-1440-300300	220490-006	2015/11/4	2016/11/3
Mircoflex Cable	UTIFLEX	UFB197C-1-2362-70U-70U	225757-001	2015/7/3	2016/7/2
Mircoflex Cable	UTIFLEX	UFA210A-1-3149-300300	MFR64639 226389-001	2015/12/2	2016/12/1
Spectrum Analyzer	Rohde & Schwarz	FSEK30	825084/006	2015/12/24	2016/12/23
Mircoflex Cable	ROSNAL	K1K50-UP0264-K1K50-80CM	160309-2	2016/3/24	2017/3/23
Mircoflex Cable	ROSNAL	K1K50-UP0264-K1K50-450CM	160309-1	2016/3/24	2017/3/23
Mini	Attenuator	ZFRSC-14-S+	SF019411452S	2016/4/30	2016/10/29
Turn Table	Champro	TT-2000	060772-T	N.C.R	N.C.R
Antenna Tower	Champro	AM-BS-4500-B	060772-A	N.C.R	N.C.R
Controller	Champro	EM1000	060772	N.C.R	N.C.R
software	Farad	EZ_EMC	BACL-03A1	N.C.R	N.C.R

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

Correct Factor& Margin Calculation

The Correct Factor 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:

Correct Factor =Antenna Factor + Cable Loss - Amplifier Gain + Attenuator

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

Margin = Limit–Result

Test Results Summary

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

7.63dB at **7323MHz** in the **Vertical** polarization

Refer to CISPR16-4-2 and CISPR 16-4-1, the measured level complies with the limit if:

L_m ++ $U_{(Lm)} \leq L_{lim}$ ++ U_{cispr}

In BACL, $U_{(Lm)}$ is less than + U_{cispr}, if L_m is less than L_{lim}, it implies that the EUT complies with the limit.

Test Data

Environmental Conditions

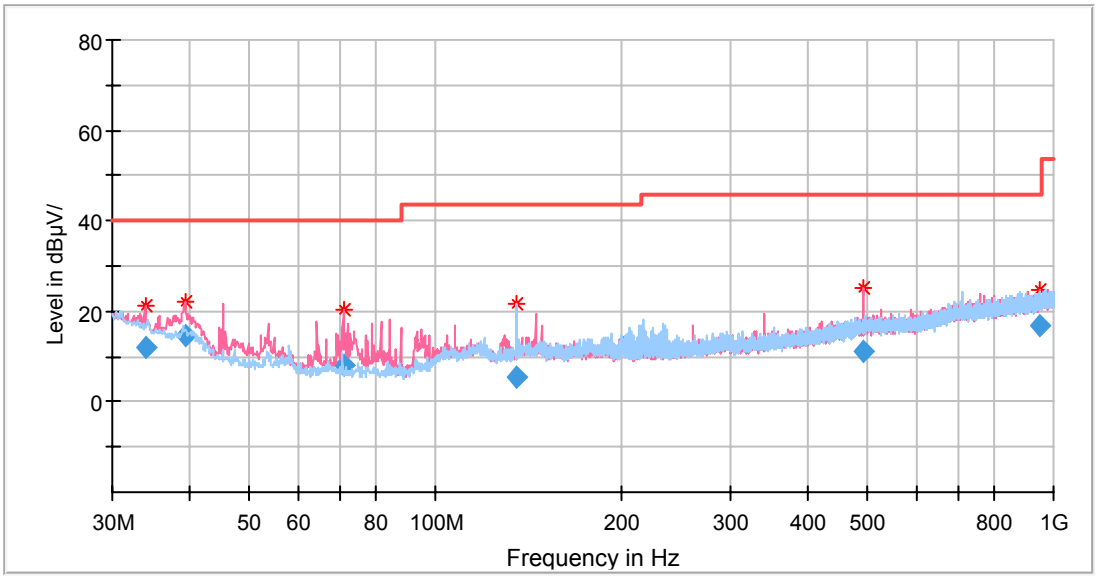
Temperature:	26℃
Relative Humidity:	60 %

The testing was performed by David. Hsu on 2016-05-12.

Test Result: Compliance, please refer to the below table and plots.

EUT operation mode: Transmitting

30MHz-1GHz:



Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBµV/m)	FCC Part 15.247/205/209	
	Reading (dBµV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dB µV/m)	Margin (dB)
34.001250	19.40	QP	269.0	100.0	V	-7.30	12.10	40.00	27.90
39.336250	24.47	QP	80.0	100.0	V	-10.00	14.47	40.00	25.53
70.982500	25.38	QP	136.0	100.0	V	-17.10	8.28	40.00	31.72
135.123750	18.17	QP	286.0	200.0	H	-12.70	5.47	43.50	38.03
491.962500	16.95	QP	236.0	100.0	V	-5.80	11.15	46.00	34.85
949.802500	17.16	QP	186.0	200.0	V	-0.30	16.86	46.00	29.14

1GHz -25 GHz: (*Scan with GFSK, π/4-DQPSK, 8-DPSK mode, the worst case is BDR Mode (GFSK)*)

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
Low Channel (2402 MHz)									
2402	92.32	PK	329	250	V	3.00	95.32	/	/
2402	83.35	Ave	329	250	V	3.00	86.35	/	/
2402	92.14	PK	221	150	H	3.00	95.14	/	/
2402	82.01	Ave	221	150	H	3.00	85.01	/	/
2350	31.16	Ave	204	250	H	4.10	35.26	54	18.74
2350	41.18	PK	204	250	H	4.10	45.28	74	28.72
2390	24.24	Ave	105	150	V	4.10	28.34	54	25.66
2390	31.68	PK	105	150	V	4.10	35.78	74	38.22
4804	31.34	Ave	164	150	H	13.70	45.04	54	8.96
4804	42.21	PK	164	150	H	13.70	55.91	74	18.09
6677	34.37	PK	203	250	V	18.80	53.17	74	20.83
6677	23.56	Ave	203	250	V	18.80	42.36	54	11.64
7206	33.68	PK	331	150	V	20.50	54.18	74	19.82
7206	24.77	Ave.	331	150	V	20.50	45.27	54	8.73
Middle Channel (2441 MHz)									
2441	91.66	PK	204	250	V	2.60	94.26	/	/
2441	81.73	Ave	204	250	V	2.60	84.33	/	/
2441	91.95	PK	66	150	H	2.60	94.55	/	/
2441	81.79	Ave	66	150	H	2.60	84.39	/	/
1530	32.41	Ave	206	250	V	0	32.41	54	21.59
1530	47.51	PK	206	250	V	0	47.51	74	26.49
2225	35.49	Ave	155	150	V	0.70	36.19	54	17.81
2225	44.57	PK	155	150	V	0.70	45.27	74	28.73
4882	41.48	PK	67	150	H	13.90	55.38	74	18.62
4882	32.44	Ave	67	150	H	13.90	46.34	54	7.66
6656	36.11	PK	94	250	H	18.80	54.91	74	19.09
6656	23.54	Ave	94	250	H	18.80	42.34	54	11.66
7323	33.41	PK	308	150	V	20.80	54.21	74	19.79
7323	25.57	Ave.	308	150	V	20.80	46.37	54	7.63

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
High Channel (2480 MHz)									
2480	92.14	PK	204	100	V	3.20	95.34	/	/
2480	82.08	Ave	204	100	V	3.20	85.28	/	/
2480	91.87	PK	58	100	H	3.20	95.07	/	/
2480	82.47	Ave	58	100	H	3.20	85.67	/	/
2483.5	41.09	PK	334	250	H	4.20	45.29	74	28.71
2483.5	39.41	Ave	334	250	H	4.20	43.61	54	10.39
2535	41.38	PK	88	150	H	4.40	45.78	74	28.22
2535	29.15	Ave	88	150	H	4.40	33.55	54	20.45
4960	31.78	Ave	152	150	H	14.10	45.88	54	8.12
4960	39.59	PK	152	150	H	14.10	53.69	74	20.31
6675	33.95	PK	166	250	V	18.80	52.75	74	21.25
6675	18.87	Ave	166	250	V	18.80	37.67	54	16.33
7440	34.51	PK	307	150	V	21.20	55.71	74	18.29
7440	23.09	Ave	307	150	V	21.20	44.29	54	9.71

Note:

Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

Margin = Limit - Corrected. Amplitude

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

Applicable Standard

Frequency hopping systems shall have hoping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW.

Test Procedure

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Spectrum Analyzer	FSU26	200268	2016/5/7	2017/5/6
WOKEN	Cable	SFL402	00100A1F6A192S	2015/12/18	2016/12/17
Mini	Attenuator	ZFRSC-14-S+	SF019411452S	2016/4/30	2016/10/29

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

Test Data

Environmental Conditions

Temperature:	26℃
Relative Humidity:	60 %

The testing was performed by David. Hsu on 2016-05-09.

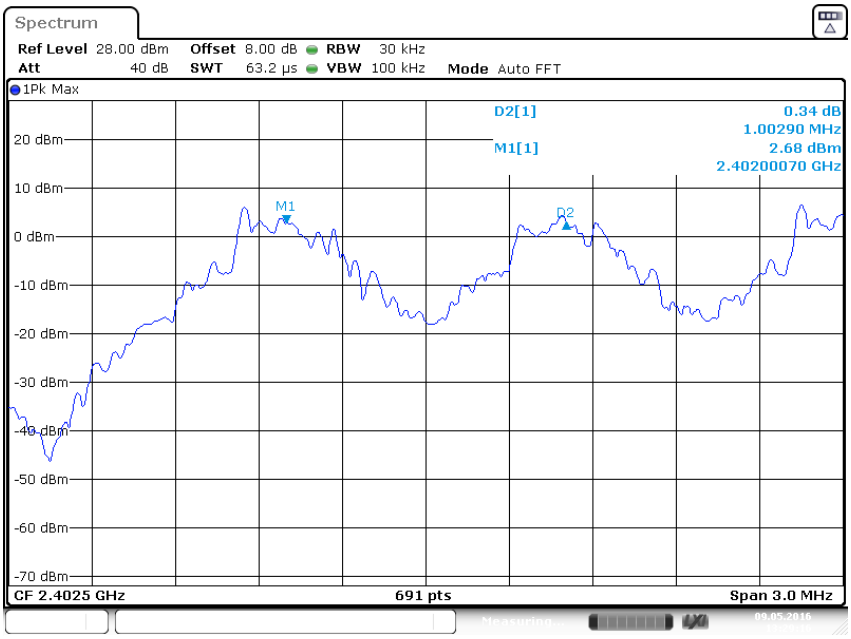
Test Result: Compliance, please refer to the below table and plots.

Mode	Channel	Frequency (MHz)	Channel Separation (MHz)	≥Limit (MHz)	Result
BDR (GFSK)	Low	2402	1.003	0.640	Pass
	Adjacent	2403			
	Middle	2441	1.003	0.640	Pass
	Adjacent	2442			
	High	2480	1.003	0.625	Pass
	Adjacent	2479			
EDR (π/4-DQPSK)	Low	2402	1.003	0.857	Pass
	Adjacent	2403			
	Middle	2441	1.003	0.859	Pass
	Adjacent	2442			
	High	2480	1.016	0.865	Pass
	Adjacent	2479			
EDR (8DPSK)	Low	2402	1.003	0.857	Pass
	Adjacent	2403			
	Middle	2441	1.003	0.863	Pass
	Adjacent	2442			
	High	2480	1.003	0.842	Pass
	Adjacent	2479			

Note: Limit = 20 dB bandwidth *2/3

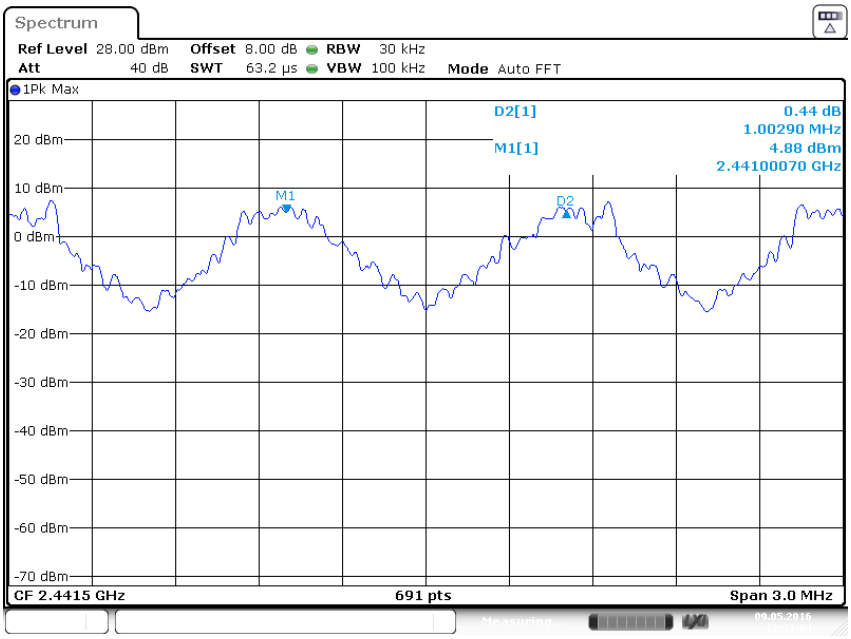
Please refer to the following tables and plots.

BDR (GFSK): Low Channel



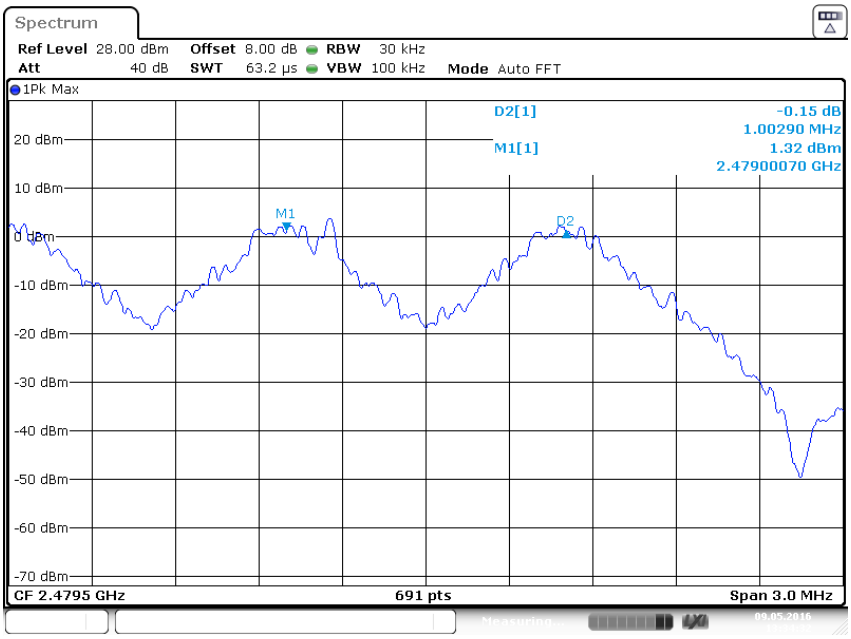
Date: 9.MAY.2016 13:29:16

BDR (GFSK): Middle Channel



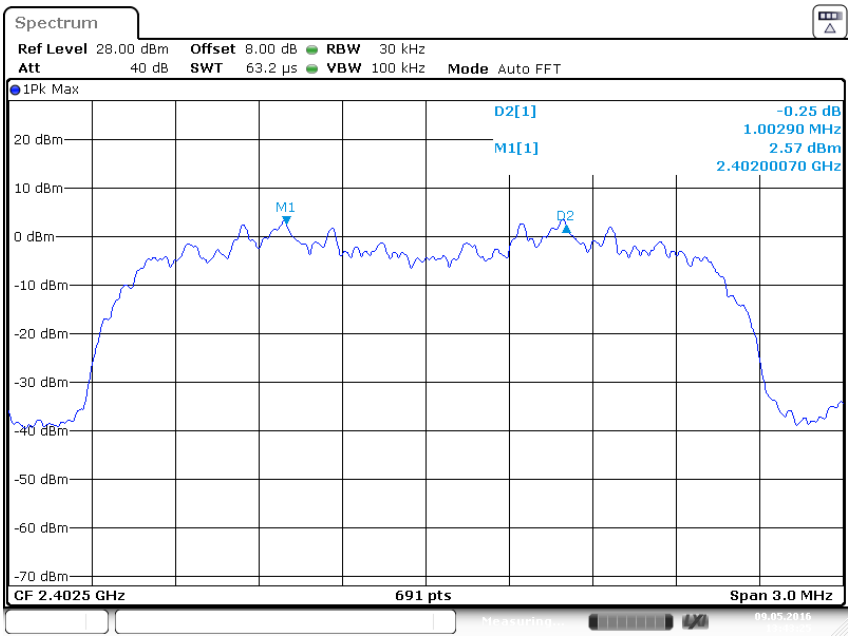
Date: 9.MAY.2016 13:33:04

BDR (GFSK): High Channel



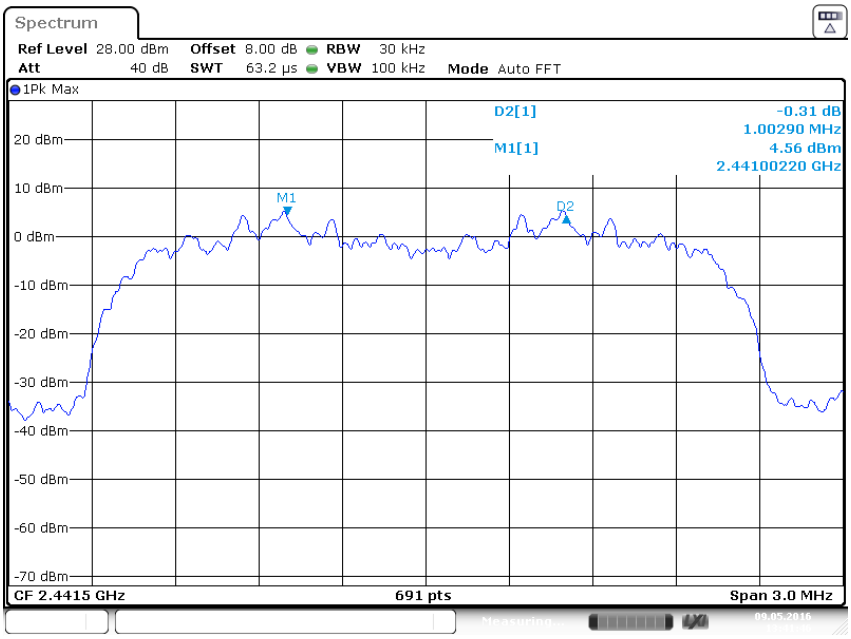
Date: 9.MAY.2016 13:34:33

EDR (π/4-DQPSK): Low Channel



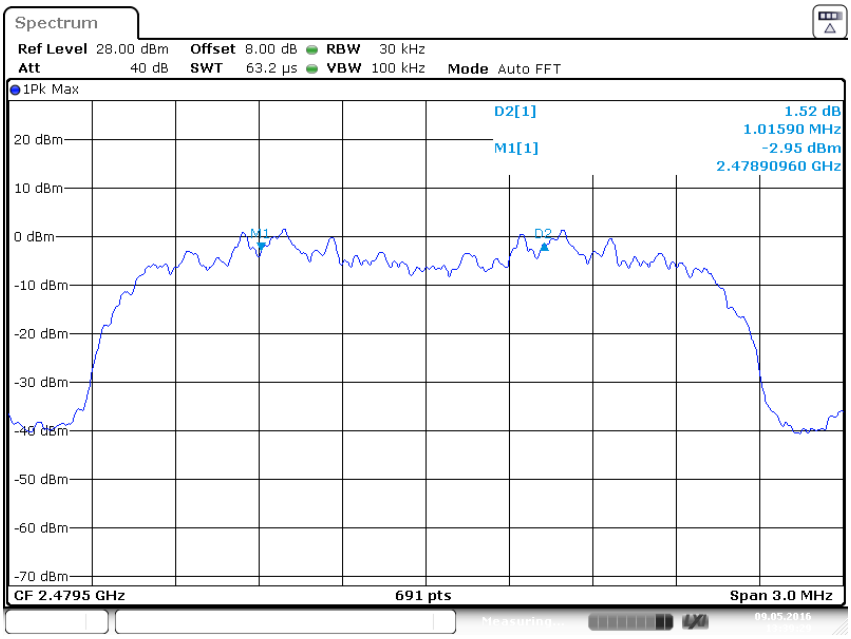
Date: 9.MAY.2016 13:43:25

EDR (π/4-DQPSK): Middle Channel



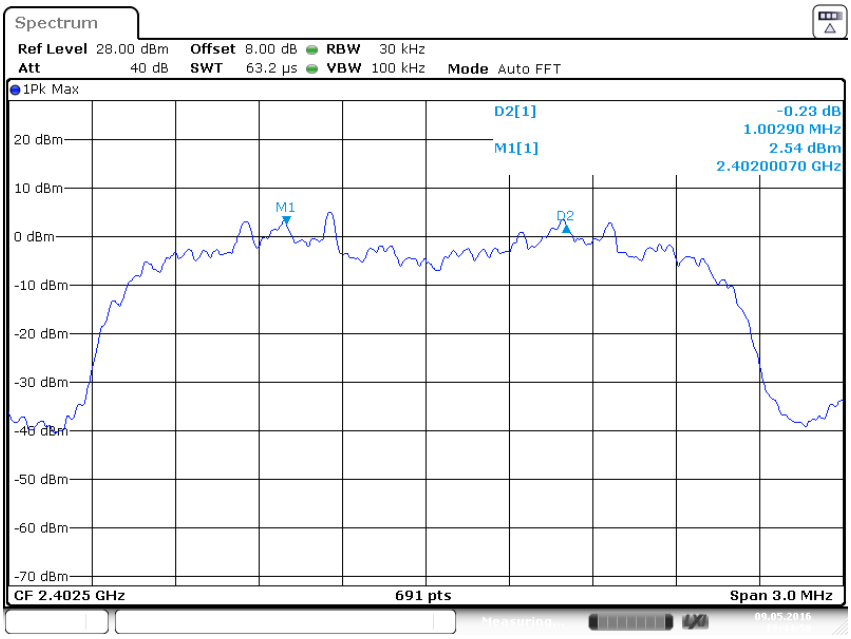
Date: 9.MAY.2016 13:41:46

EDR (π/4-DQPSK): High Channel



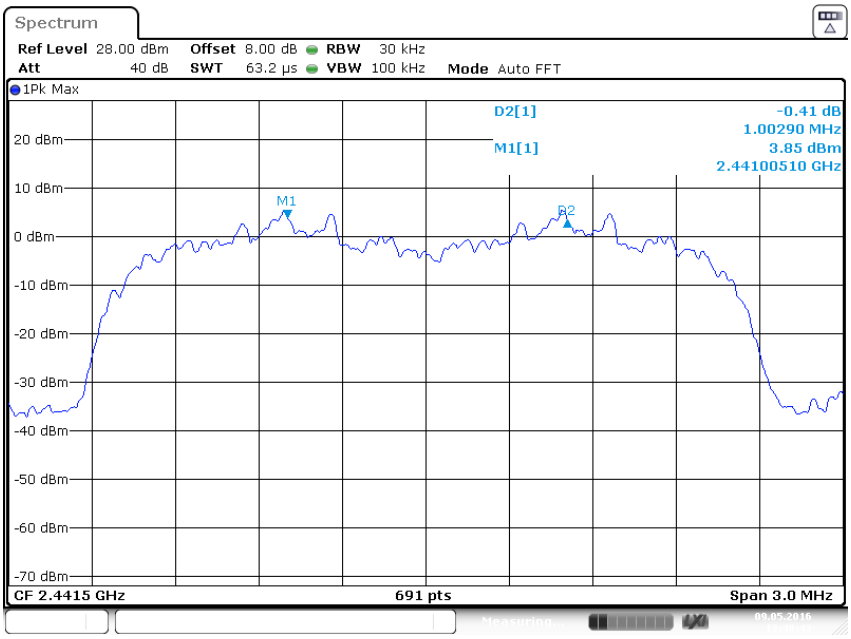
Date: 9.MAY.2016 13:39:29

EDR (8DPSK): Low Channel



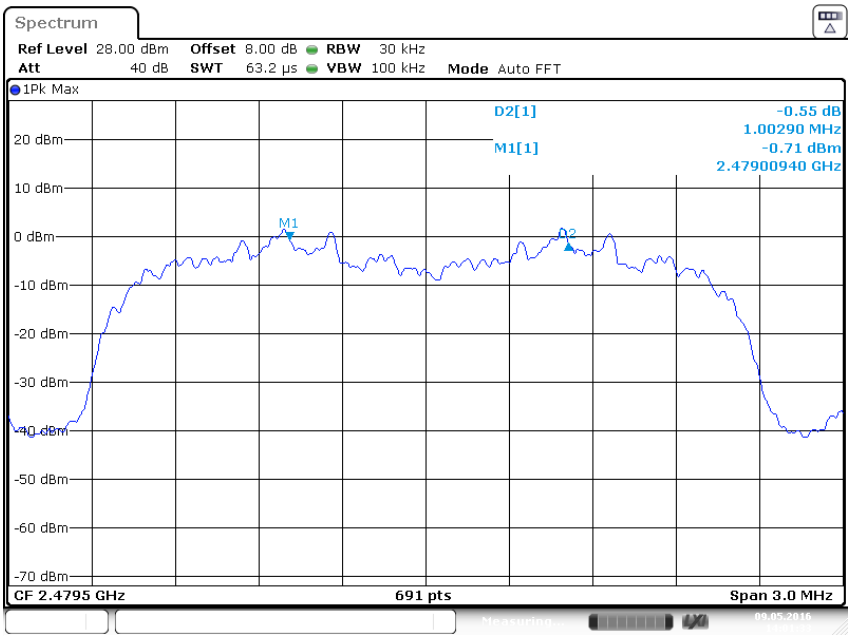
Date: 9.MAY.2016 13:44:58

EDR (8DPSK): Middle Channel



Date: 9.MAY.2016 13:48:43

EDR (8DPSK): High Channel



Date: 9.MAY.2016 14:01:32

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

Applicable Standard

Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Test Procedure

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Spectrum Analyzer	FSU26	200268	2016/5/7	2017/5/6
WOKEN	Cable	SFL402	00100A1F6A192S	2015/12/18	2016/12/17
Mini	Attenuator	ZFRSC-14-S+	SF019411452S	2016/4/30	2016/10/29

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

Test Data

Environmental Conditions

Temperature:	26℃
Relative Humidity:	60 %

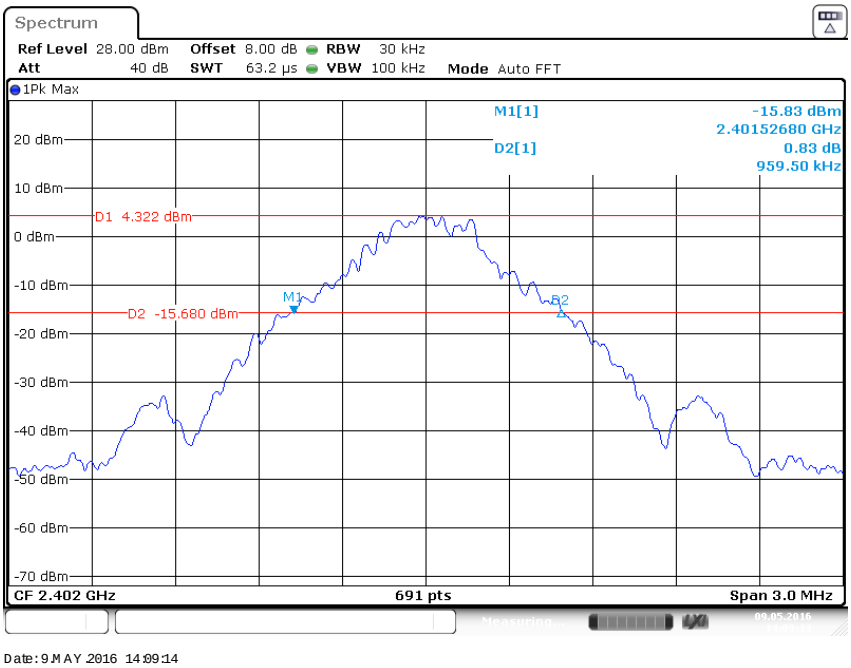
The testing was performed by David. Hsu on 2016-05-09.

Test Result: Compliance, please refer to the below table and plots.

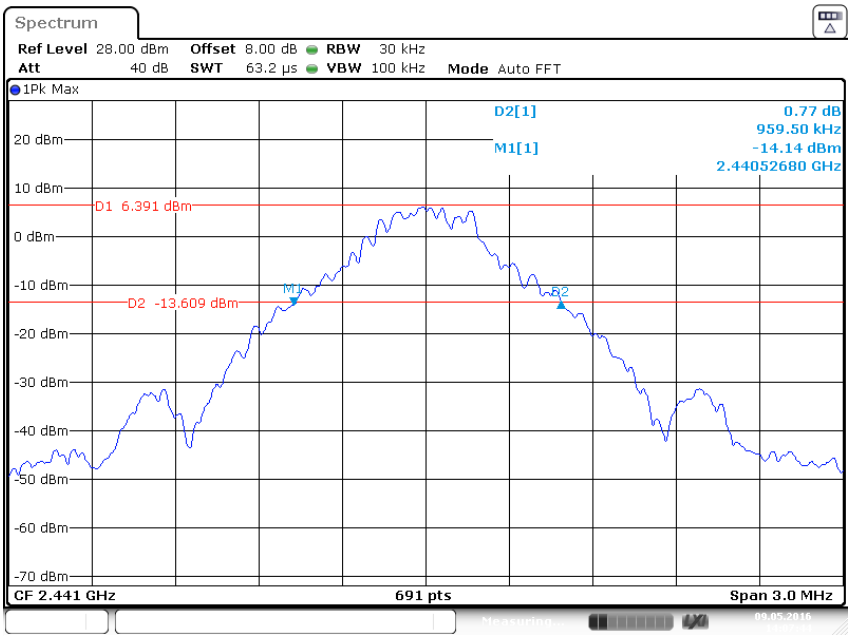
Mode	Channel	Frequency (MHz)	20 dB Emission Bandwidth (MHz)
BDR (GFSK)	Low	2402	0.960
	Middle	2441	0.960
	High	2480	0.937
EDR (π/4-DQPSK)	Low	2402	1.285
	Middle	2441	1.289
	High	2480	1.298
EDR (8DPSK)	Low	2402	1.285
	Middle	2441	1.294
	High	2480	1.263

Please refer to the following tables and plots.

BDR (GFSK): Low Channel

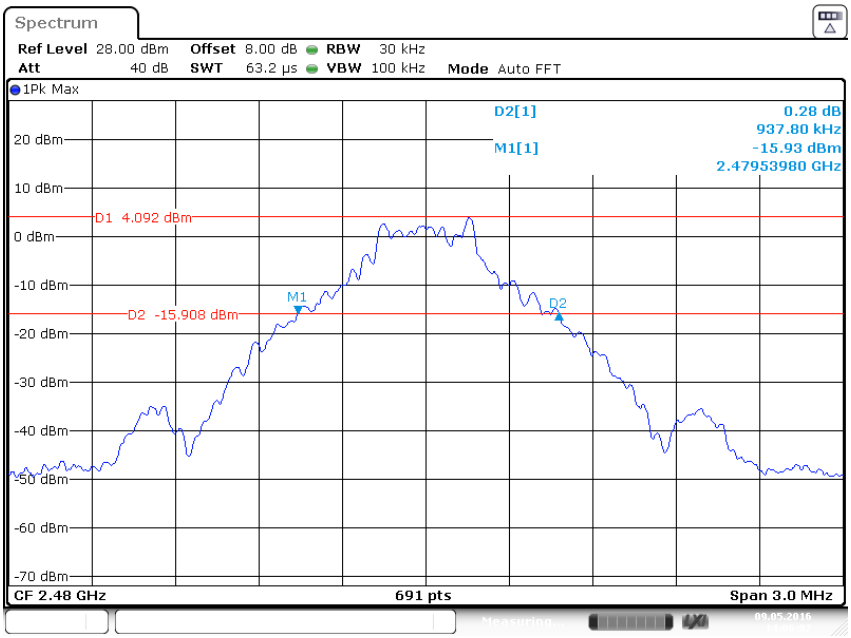


BDR (GFSK): Middle Channel



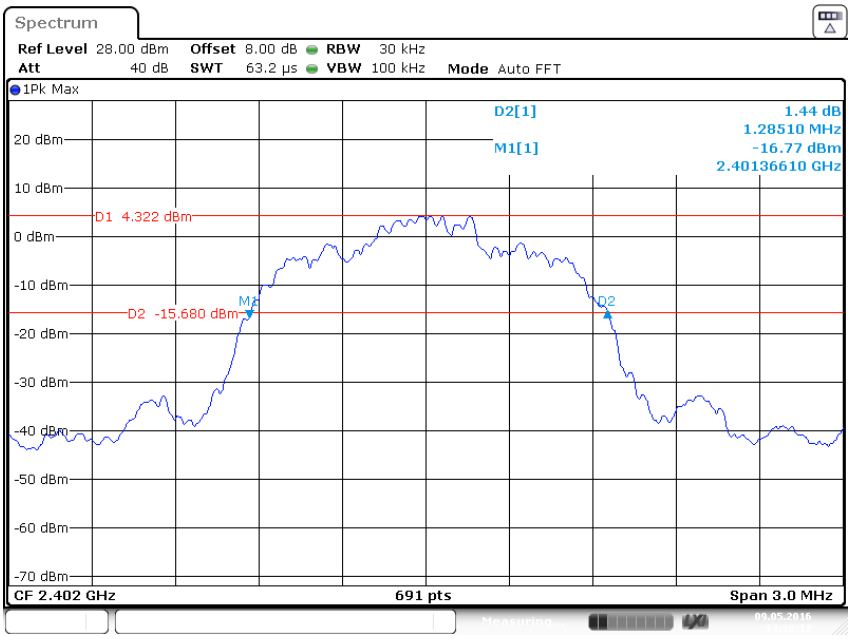
Date: 9.MAY.2016 14:07:44

BDR (GFSK): High Channel



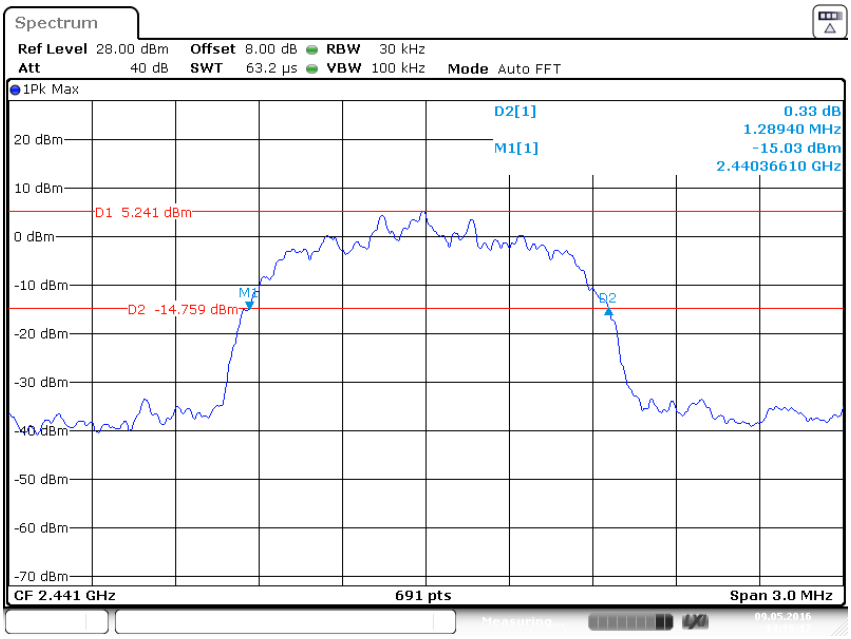
Date: 9.MAY.2016 14:06:08

EDR (π/4-DQPSK): Low Channel



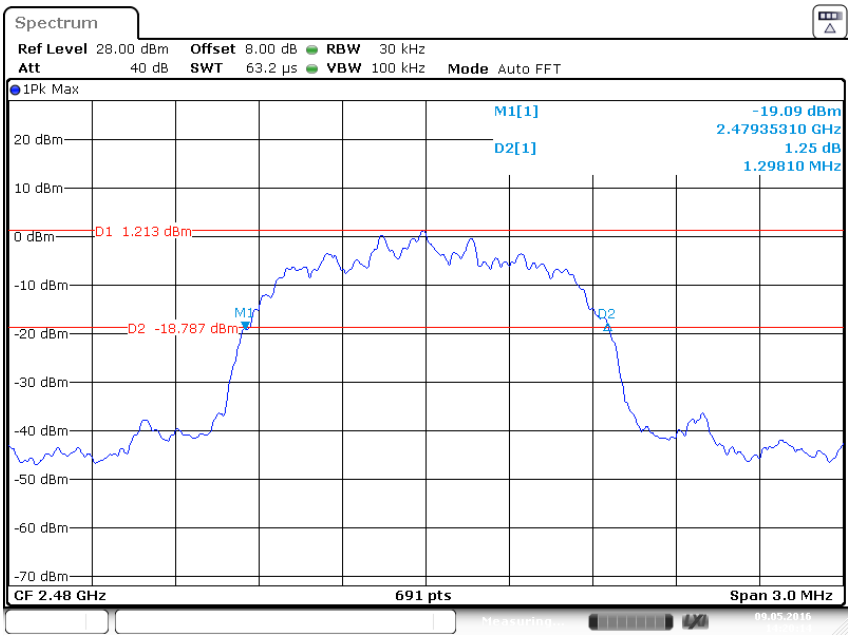
Date:9.MAY.2016 14:10:12

EDR (π/4-DQPSK): Middle Channel



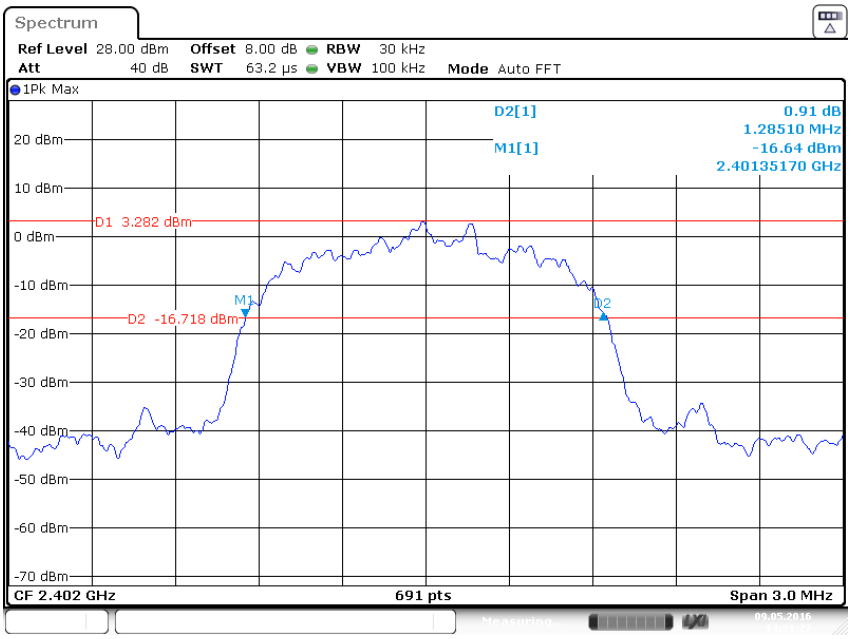
Date:9.MAY.2016 14:16:17

EDR (π/4-DQPSK): High Channel



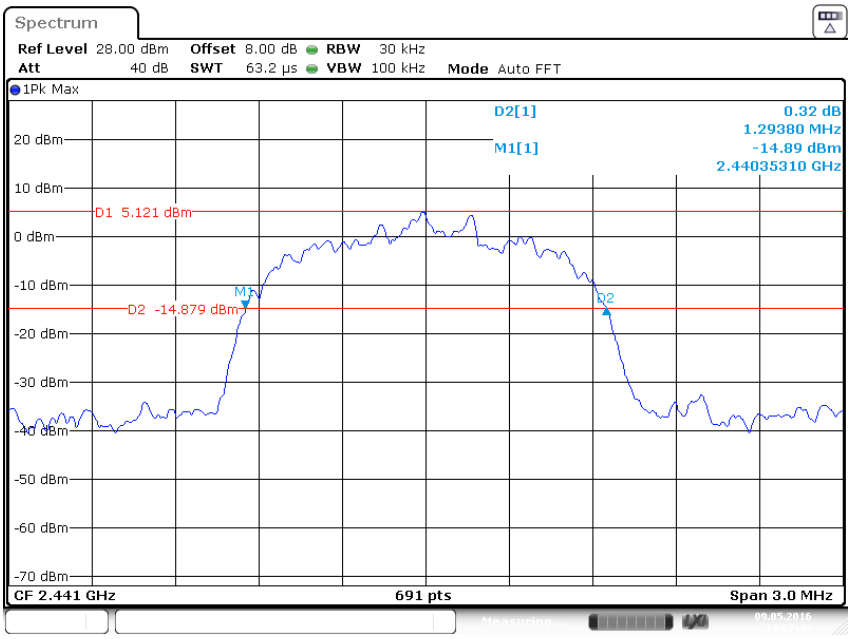
Date: 9.MAY.2016 14:20:14

EDR (8DPSK): Low Channel



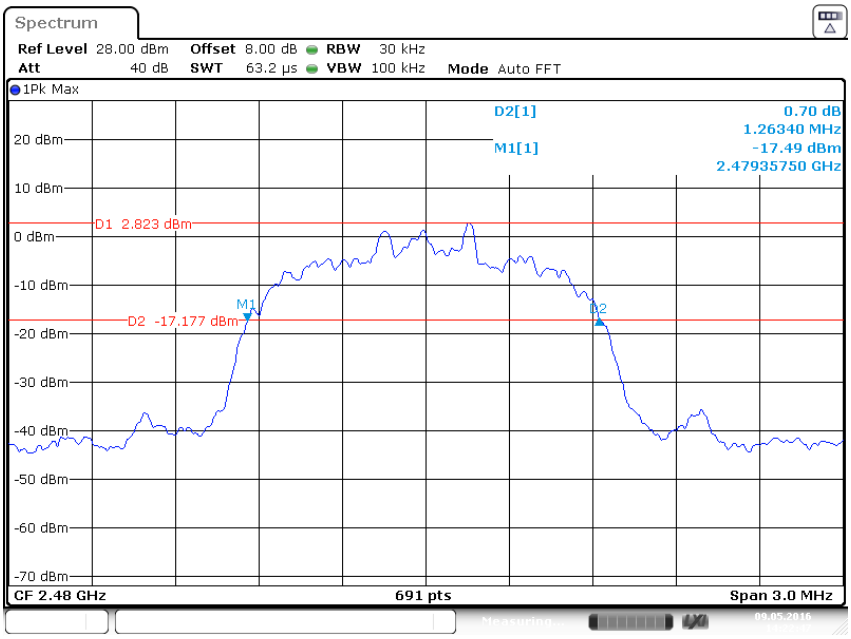
Date: 9.MAY.2016 14:31:27

EDR (8DPSK): Middle Channel



Date: 9.MAY.2016 14:27:44

EDR (8DPSK): High Channel



Date: 9.MAY.2016 14:22:47

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	2016-05-09	2017-05-08
WOKEN	Cable	SFL402	00100A1F6A192S	2015/12/18	2016/12/17
Mini	Attenuator	ZFRSC-14-S+	SF019411452S	2016/4/30	2016/10/29

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

Test Data

Environmental Conditions

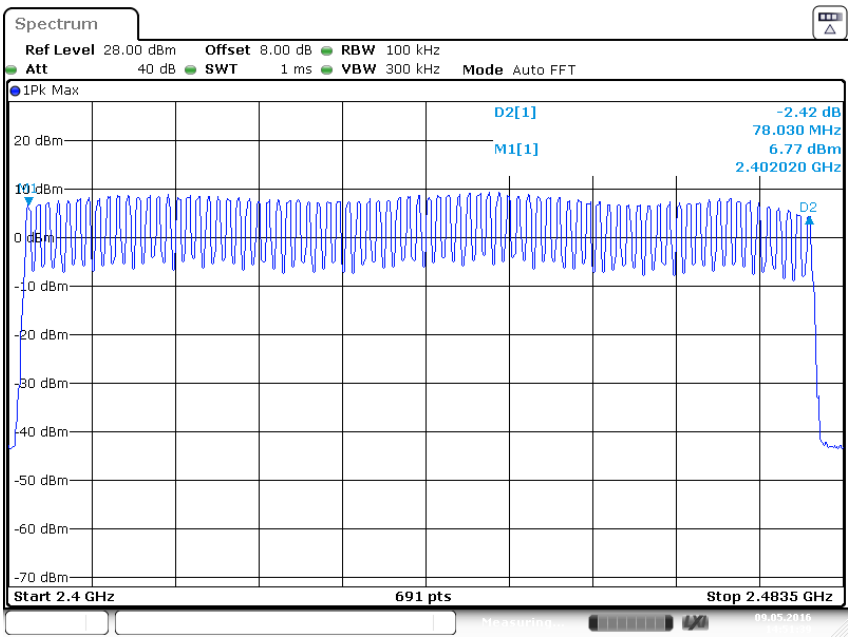
Temperature:	26℃
Relative Humidity:	60 %

The testing was performed by David. Hsu on 2016-05-09.

Test Result: Compliance, please refer to the below table and plots.

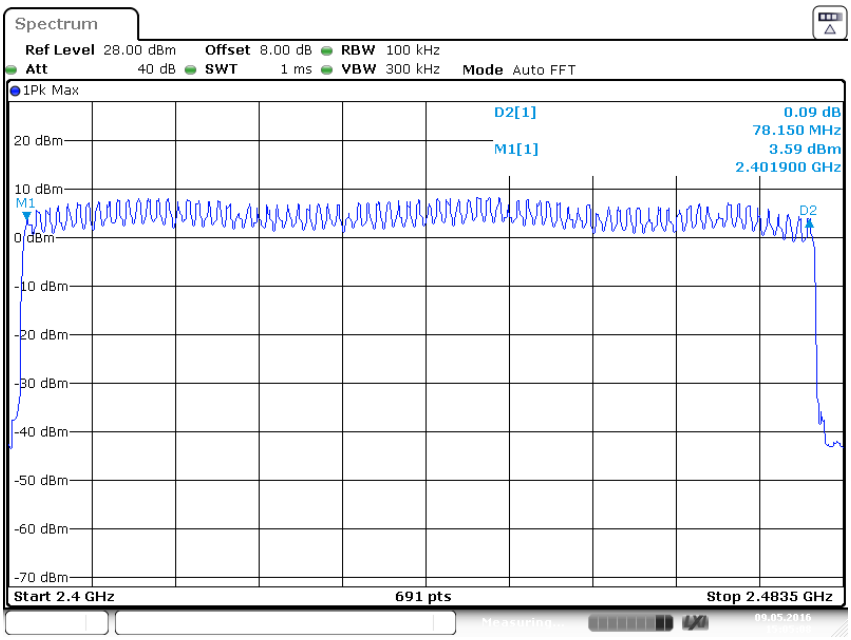
Mode	Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
BDR(GFSK)	2400-2483.5	79	≥15
EDR(π/4-DQPSK)	2400-2483.5	79	≥15
EDR(8DPSK)	2400-2483.5	79	≥15

BDR (GFSK): Number of Hopping Channels



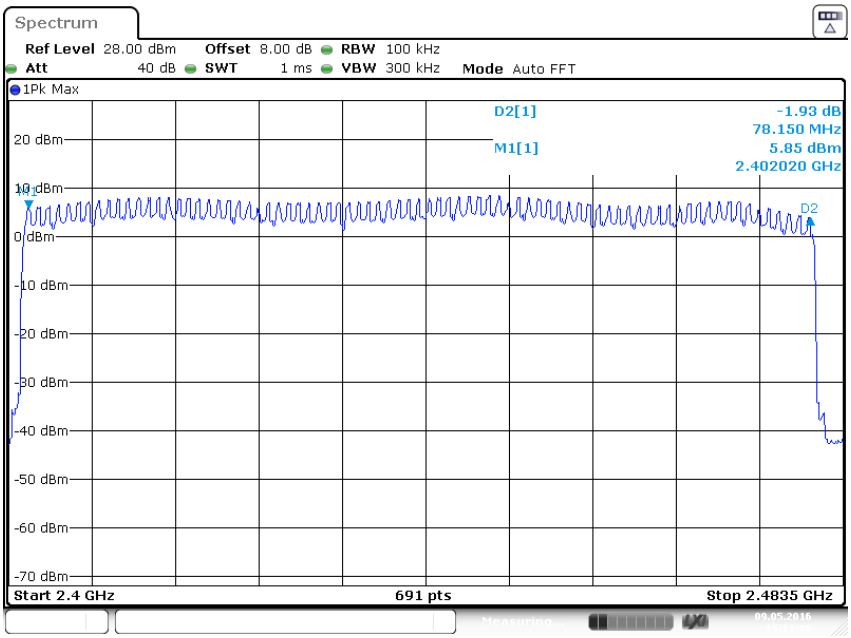
Date: 9.MAY.2016 14:51:40

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



Date: 9.MAY.2016 15:05:09

EDR (8DPSK): Number of Hopping Channels



Date: 9.MAY.2016 15:11:05

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 X channel no. (s), the quantity of pulse was get from single sweep. In addition, the time of single pulses was tested.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2015-05-09	2016-05-08
WOKEN	Cable	SFL402	00100A1F6A192S	2015/12/18	2016/12/17
Mini	Attenuator	ZFRSC-14-S+	SF019411452S	2016/4/30	2016/10/29

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

Test Data

Environmental Conditions

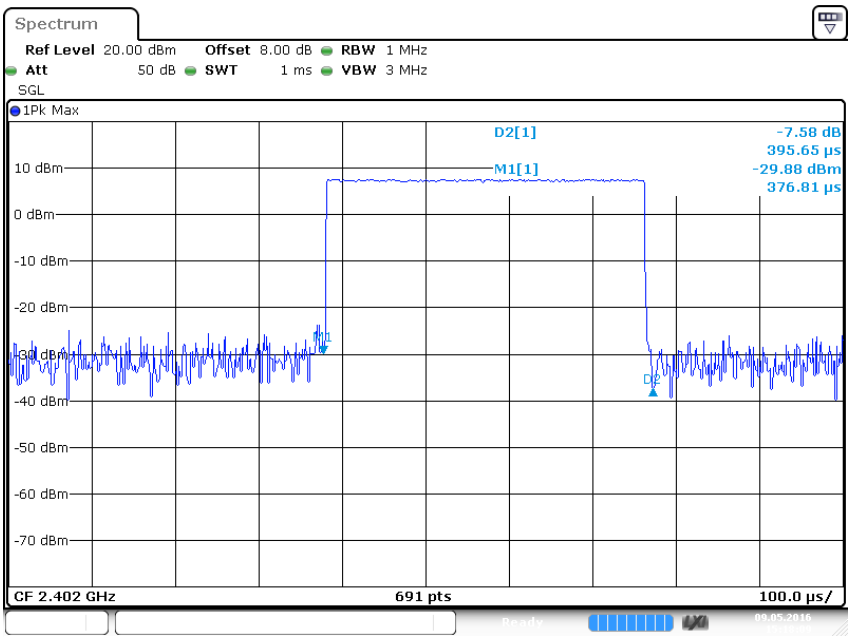
Temperature:	25℃
Relative Humidity:	58 %

The testing was performed by David. Hsu on 2016-05-09.

Test Result: Compliance, please refer to the below table and plots.

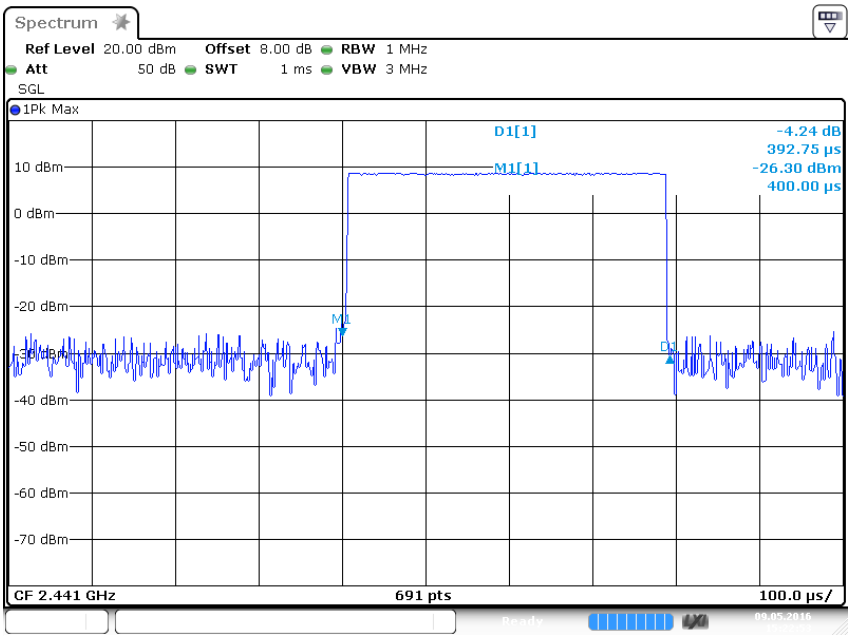
Mode		Channel	Pulse Width(ms)	Dwell Time(s)	Limit(s)	Result
BDR (GFSK)	DH 1	Low	0.396	0.127	0.4	Pass
		Middle	0.393	0.126	0.4	Pass
		High	0.391	0.125	0.4	Pass
		Note: DH1:Dwell time = Pulse time*(1600/2/79)*31.6S				
	DH 3	Low	1.665	0.266	0.4	Pass
		Middle	1.661	0.266	0.4	Pass
		High	1.670	0.267	0.4	Pass
		Note: DH3:Dwell time = Pulse time*(1600/4/79)*31.6S				
	DH 5	Low	2.926	0.312	0.4	Pass
		Middle	2.948	0.314	0.4	Pass
		High	2.926	0.312	0.4	Pass
		Note: DH5:Dwell time = Pulse time*(1600/6/79)*31.6S				
EDR (π/4-DQPSK)	DH 1	Low	0.397	0.127	0.4	Pass
		Middle	0.397	0.127	0.4	Pass
		High	0.396	0.127	0.4	Pass
		Note: DH1:Dwell time = Pulse time*(1600/2/79)*31.6S				
	DH 3	Low	1.657	0.265	0.4	Pass
		Middle	1.661	0.266	0.4	Pass
		High	1.657	0.265	0.4	Pass
		Note: DH3:Dwell time = Pulse time*(1600/4/79)*31.6S				
	DH 5	Low	2.917	0.311	0.4	Pass
		Middle	2.919	0.311	0.4	Pass
		High	2.926	0.312	0.4	Pass
		Note: DH5:Dwell time = Pulse time*(1600/6/79)*31.6S				
EDR (8DPSK)	DH 1	Low	0.399	0.128	0.4	Pass
		Middle	0.397	0.127	0.4	Pass
		High	0.394	0.126	0.4	Pass
		Note: DH1:Dwell time = Pulse time*(1600/2/79)*31.6S				
	DH 3	Low	1.664	0.266	0.4	Pass
		Middle	1.668	0.267	0.4	Pass
		High	1.668	0.267	0.4	Pass
		Note: DH3:Dwell time = Pulse time*(1600/4/79)*31.6S				
	DH 5	Low	2.929	0.312	0.4	Pass
		Middle	2.929	0.312	0.4	Pass
		High	2.929	0.312	0.4	Pass
		Note: DH5:Dwell time = Pulse time*(1600/6/79)*31.6S				

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



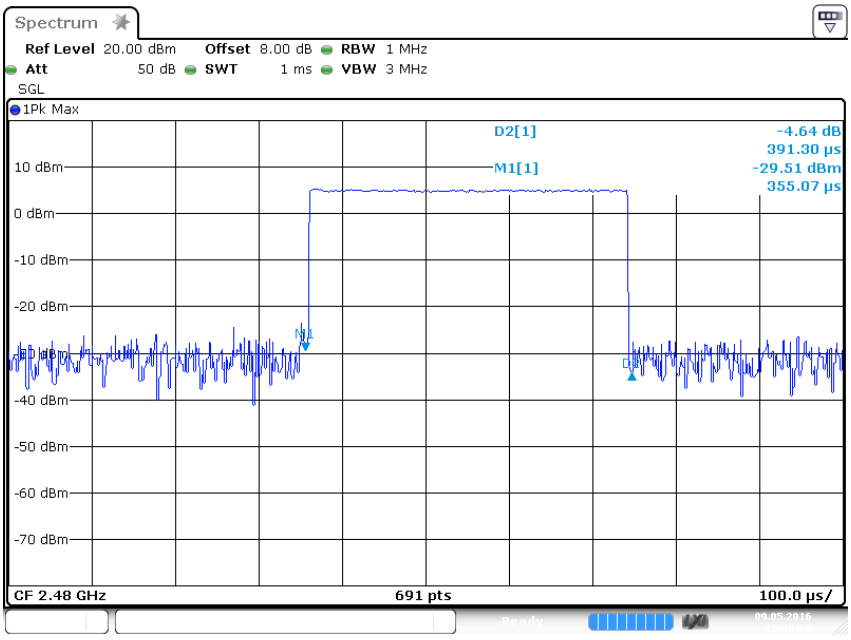
Date:9.MAY.2016 15:18:10

Pulse time, Middle Channel, DH1



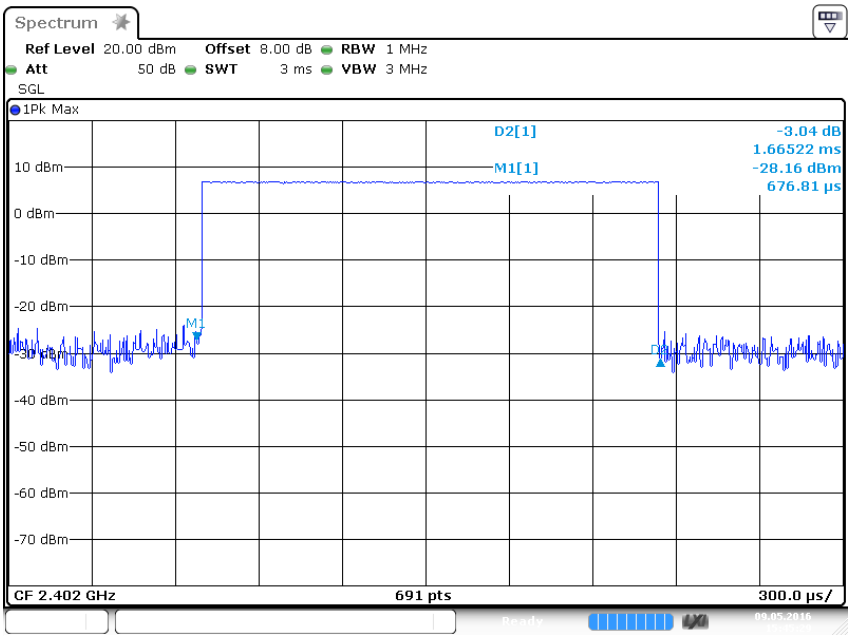
Date:9.MAY.2016 15:22:53

Pulse time, High Channel, DH1



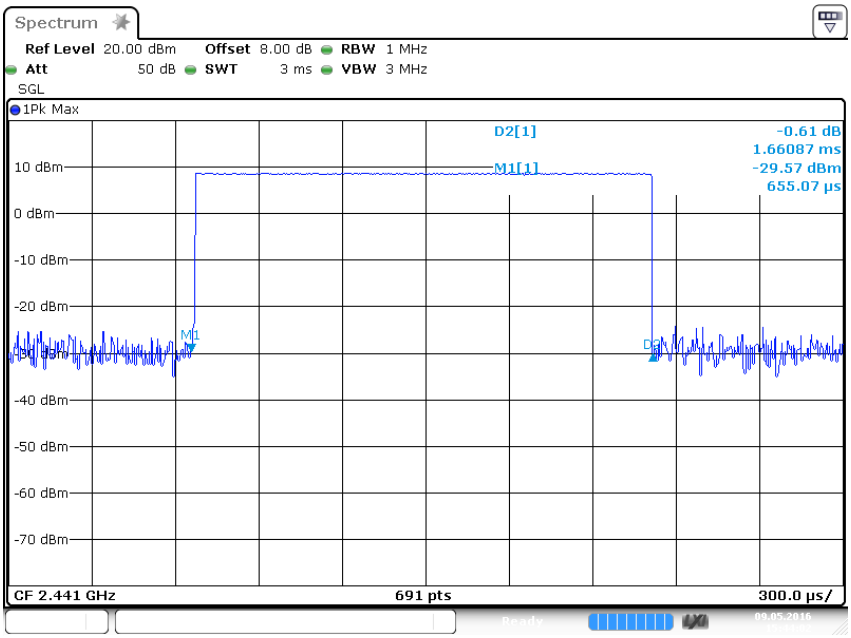
Date: 9.MAY.2016 15:40:00

Pulse time, Low Channel, DH3



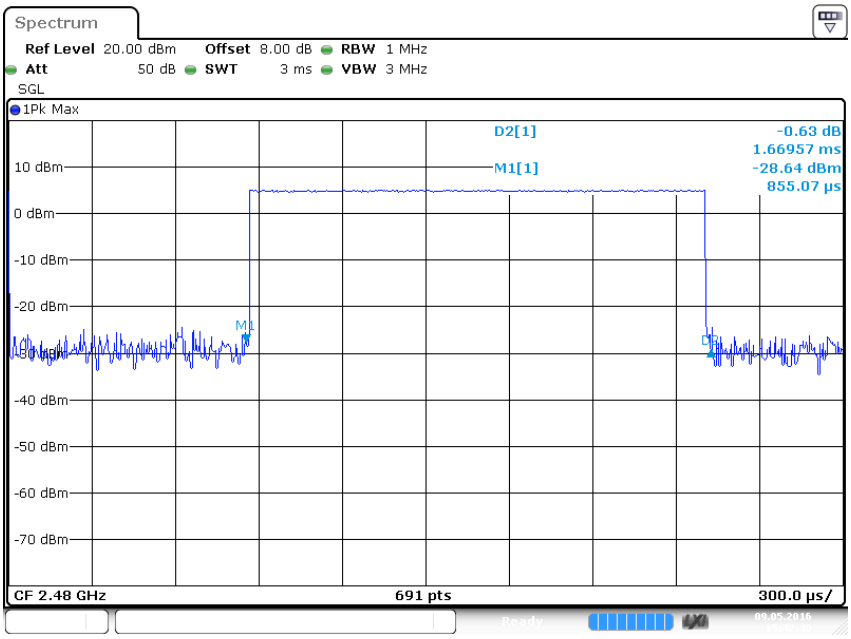
Date: 9.MAY.2016 15:45:29

Pulse time, Middle Channel, DH3



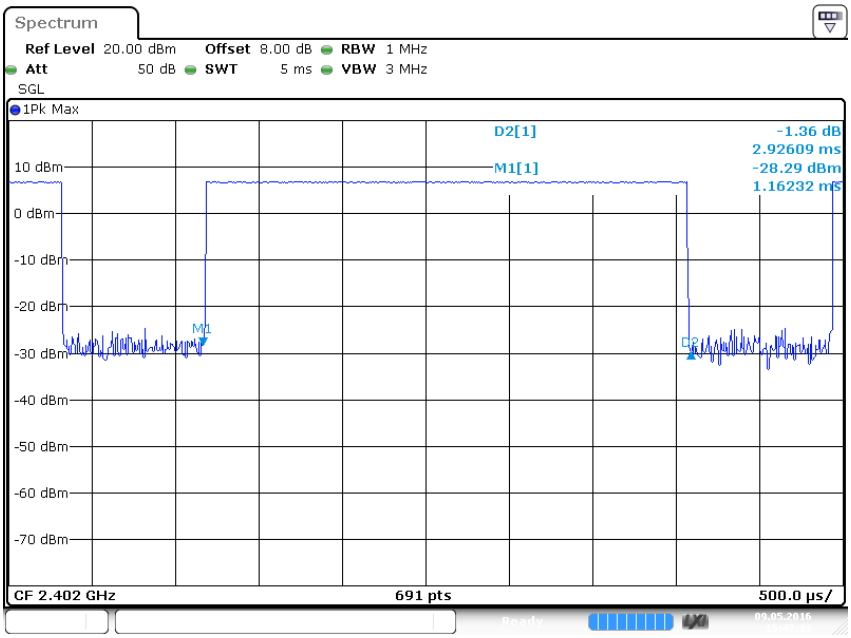
Date: 9.MAY.2016 15:44:03

Pulse time, High Channel, DH3



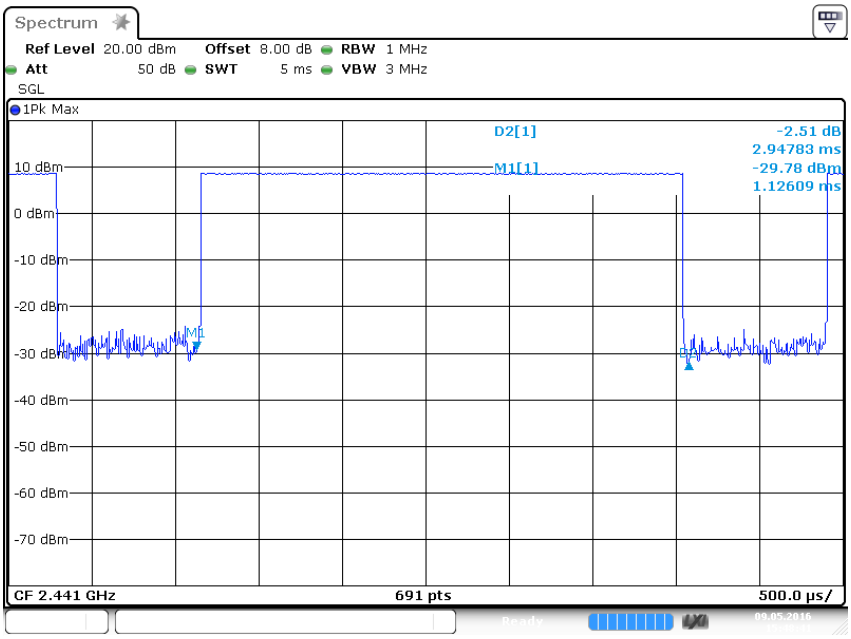
Date: 9.MAY.2016 15:42:41

Pulse time, Low Channel, DH5



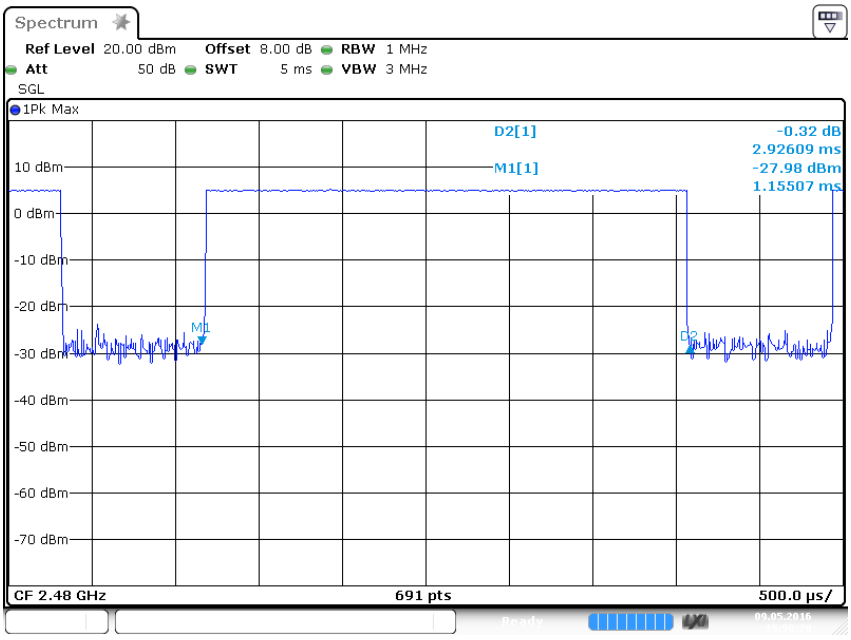
Date: 9.MAY.2016 15:47:33

Pulse time, Middle Channel, DH5



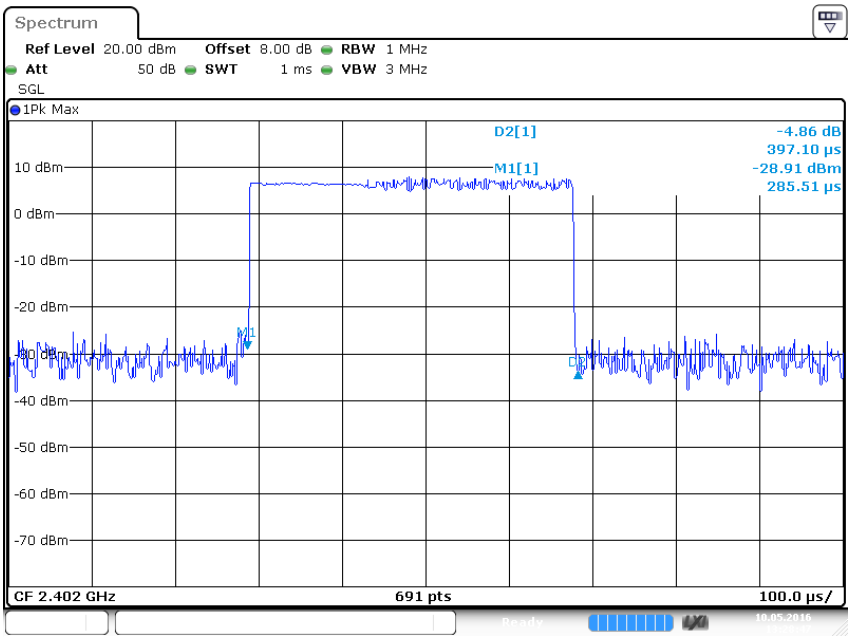
Date: 9.MAY.2016 15:48:42

Pulse time, High Channel, DH5



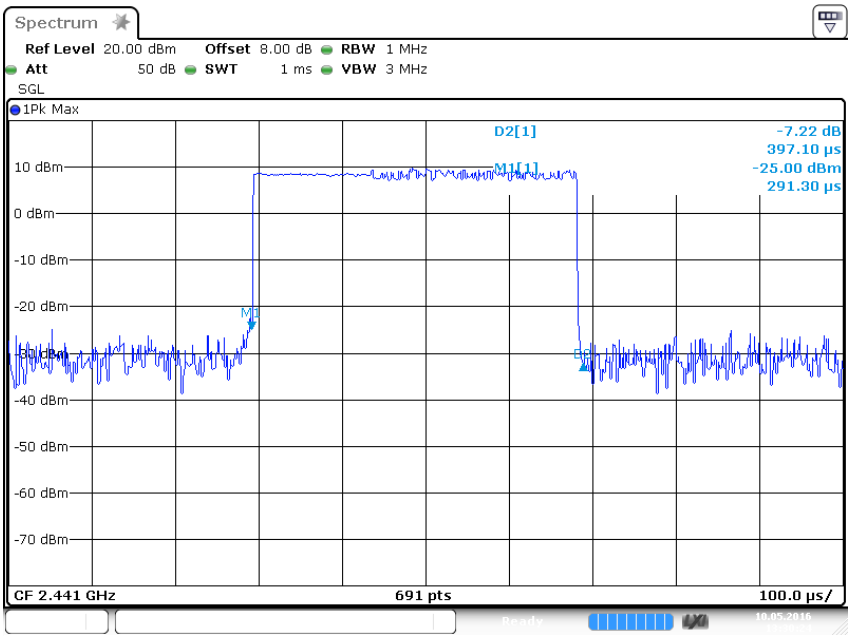
Date: 9.MAY.2016 15:50:20

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



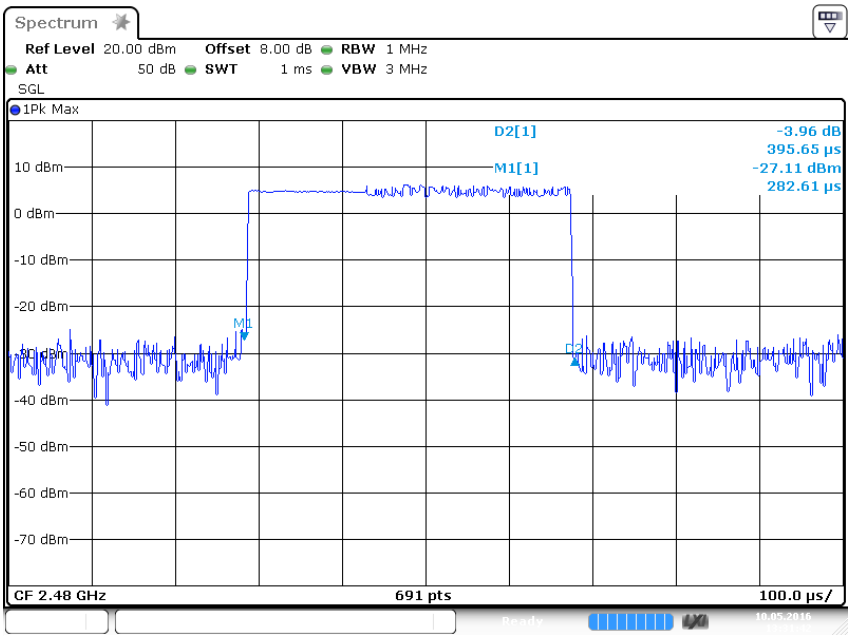
Date: 10.MAY.2016 13:28:48

Pulse time, Middle Channel, DH1



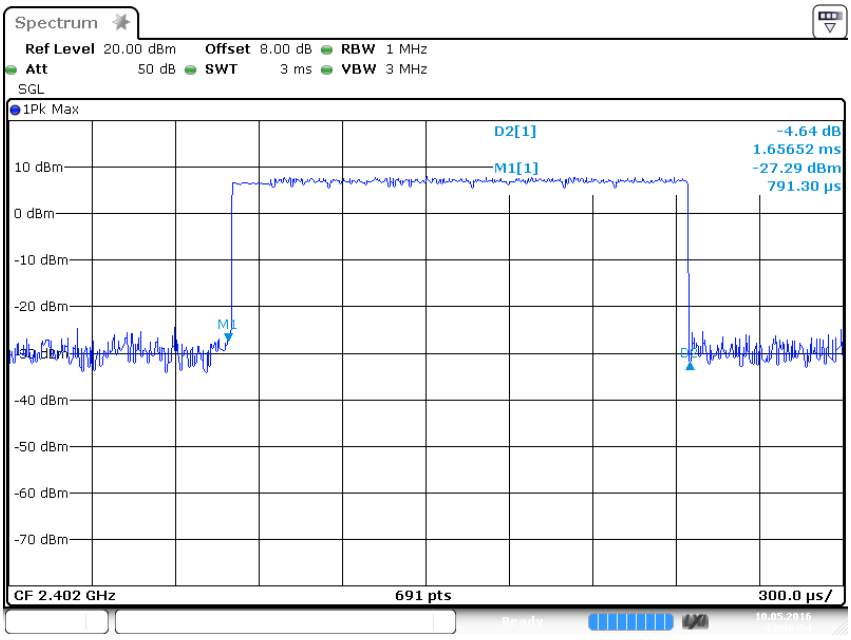
Date: 10.MAY.2016 13:30:25

Pulse time, High Channel, DH1



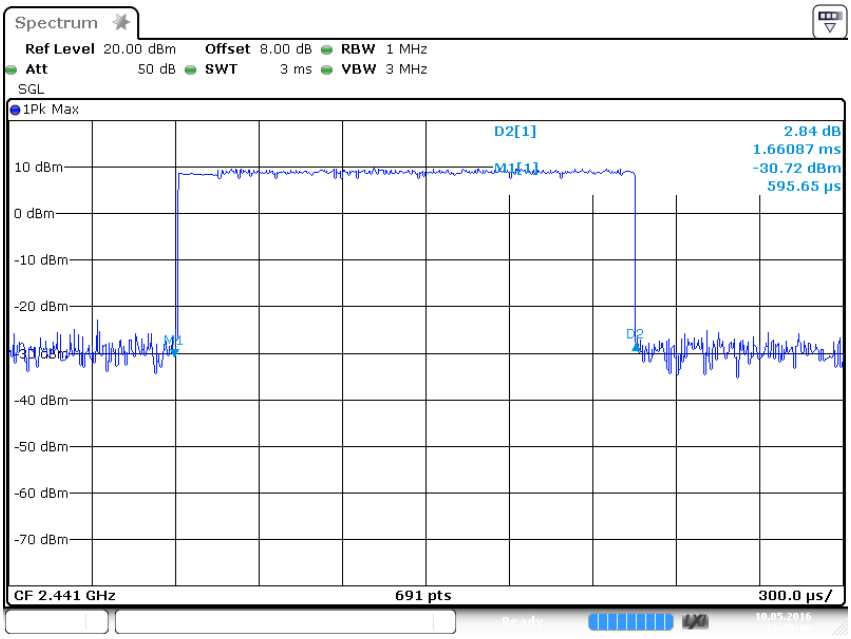
Date: 10.MAY.2016 13:31:42

Pulse time, Low Channel, DH3



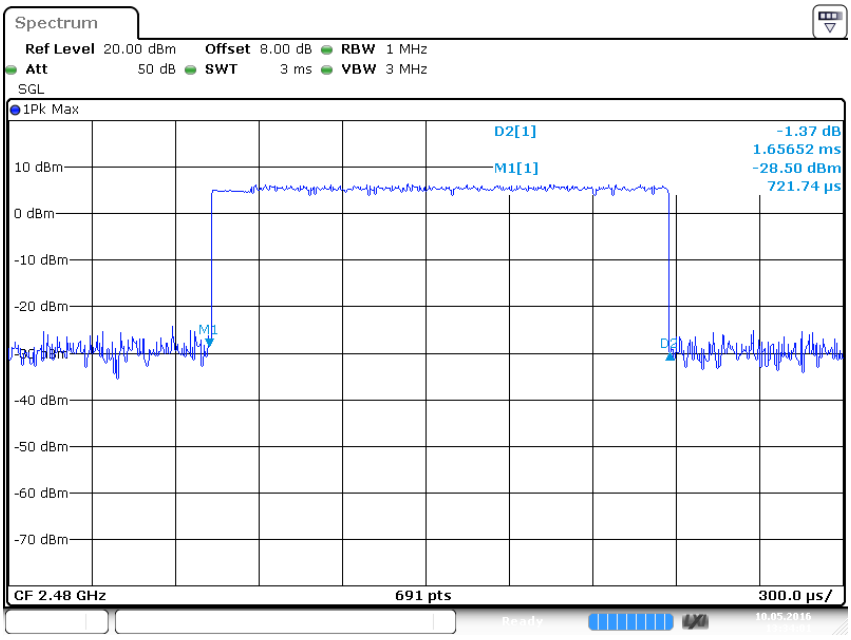
Date: 10.MAY.2016 13:36:54

Pulse time, Middle Channel, DH3



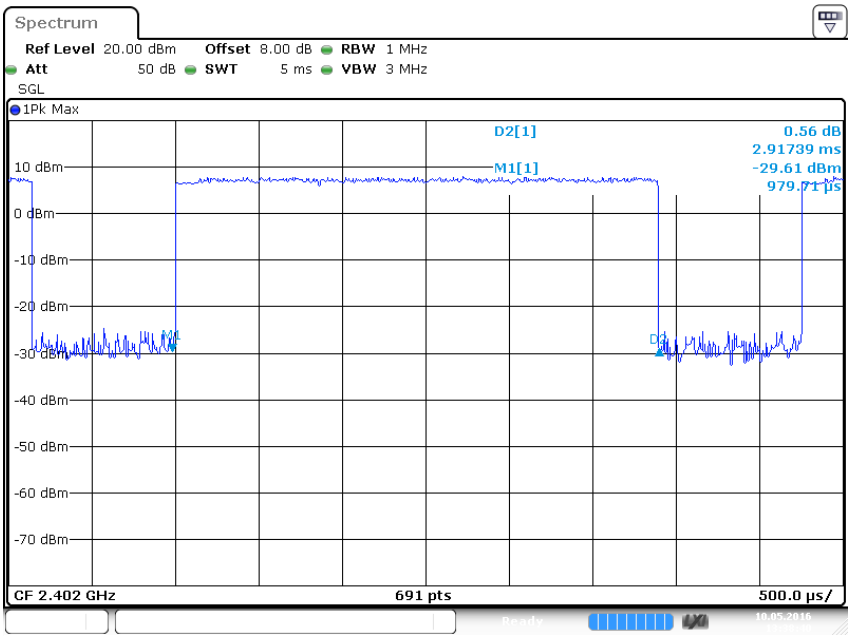
Date: 10.MAY.2016 13:35:49

Pulse time, High Channel, DH3



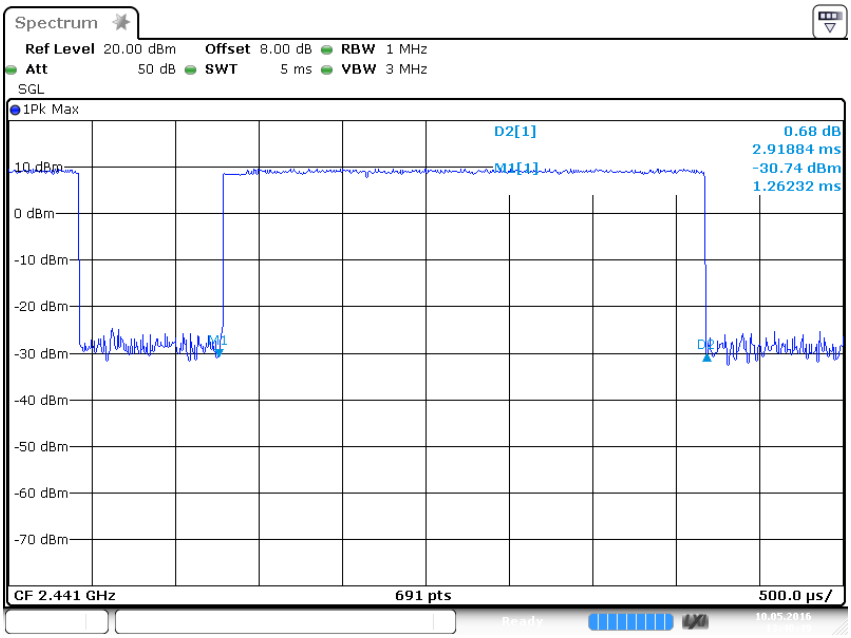
Date: 10.MAY.2016 13:34:02

Pulse time, Low Channel, DH5

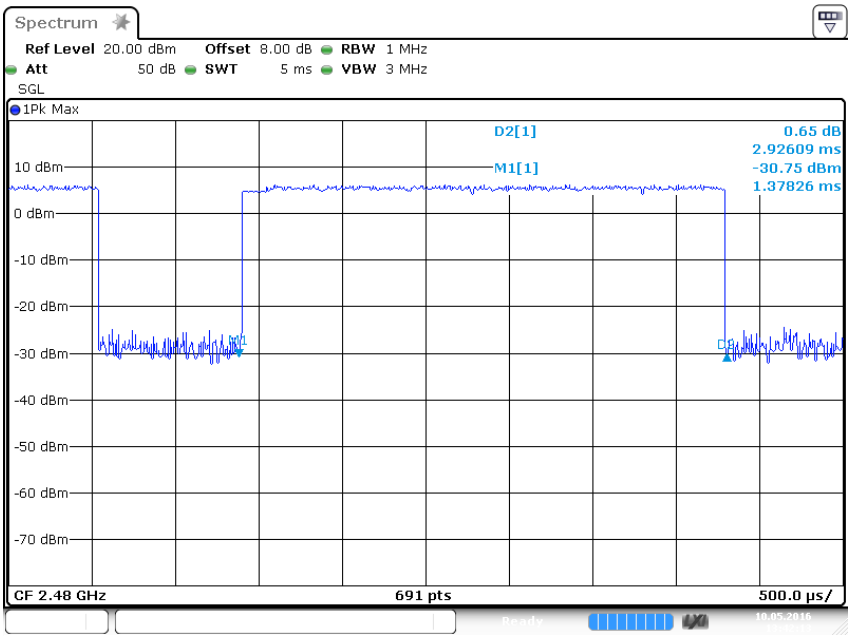


Date: 10.MAY.2016 13:38:41

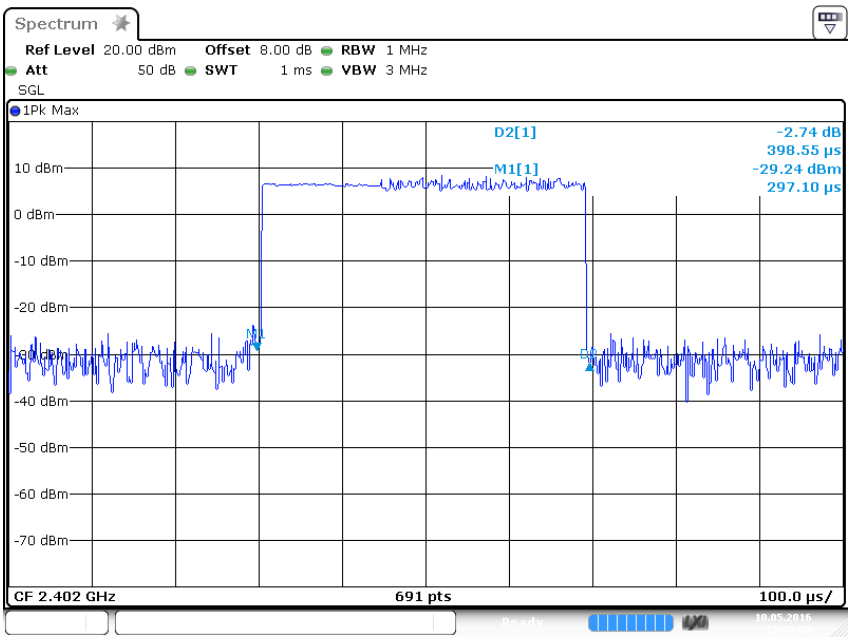
Pulse time, Middle Channel, DH5



Pulse time, High Channel, DH5

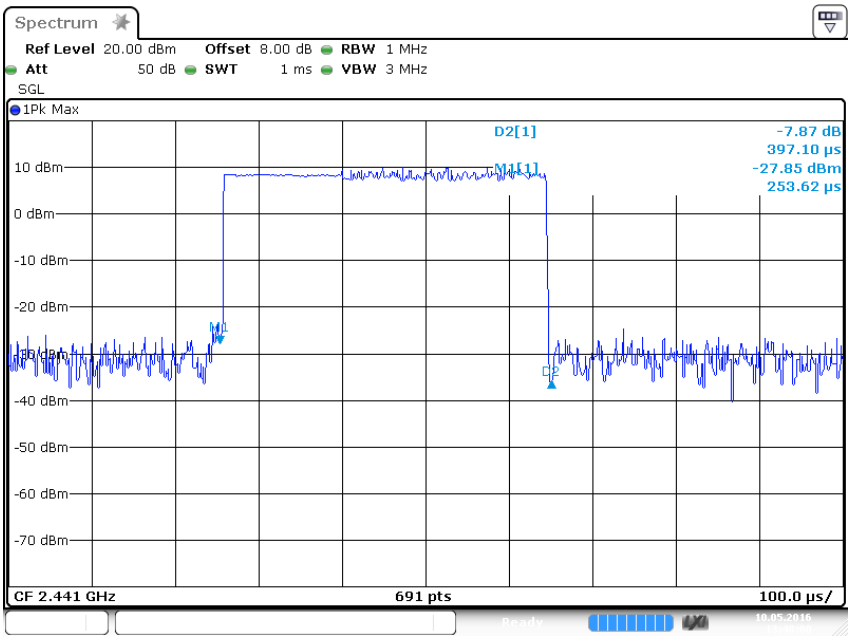


EDR(8DPSK):
Pulse time, Low Channel, DH1



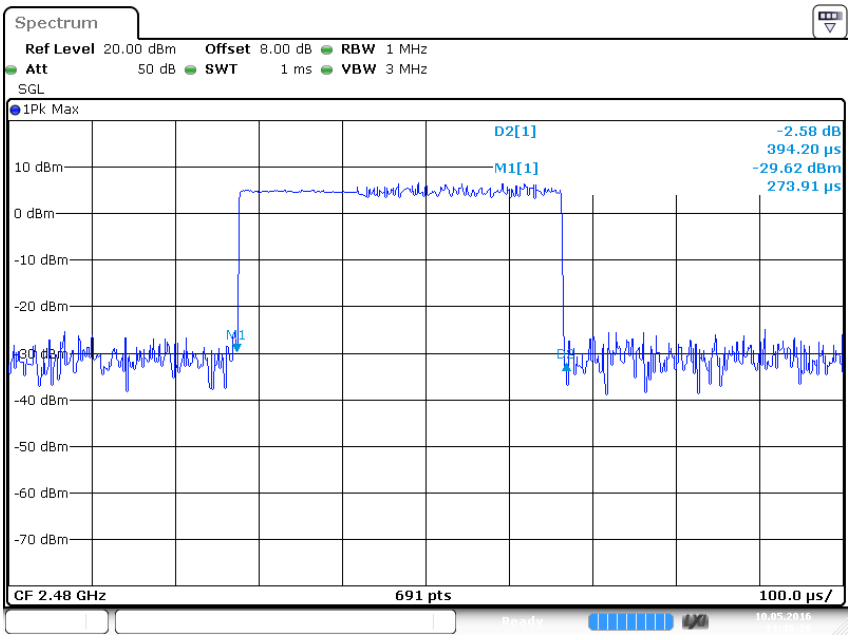
Date: 10.MAY.2016 13:48:56

Pulse time, Middle Channel, DH1



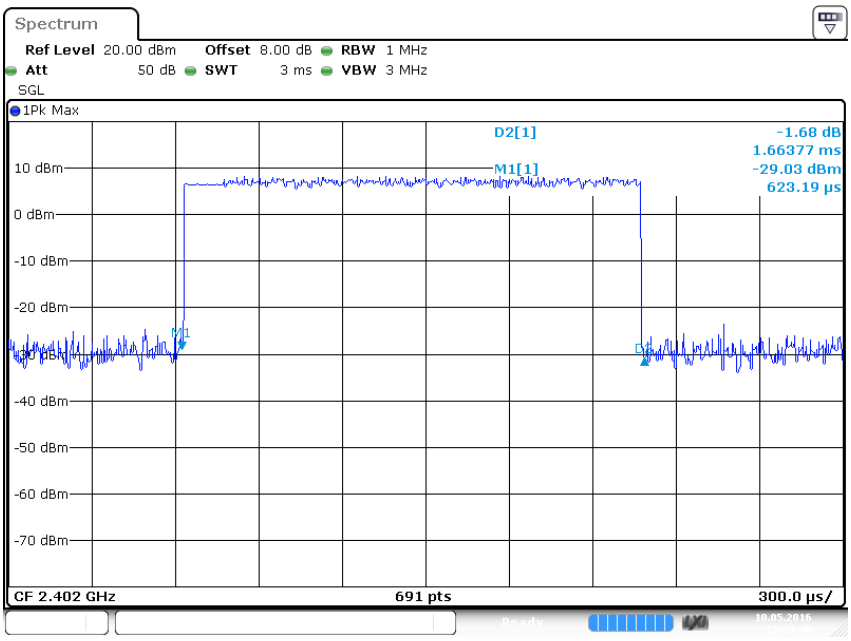
Date: 10.MAY.2016 13:48:00

Pulse time, High Channel, DH1



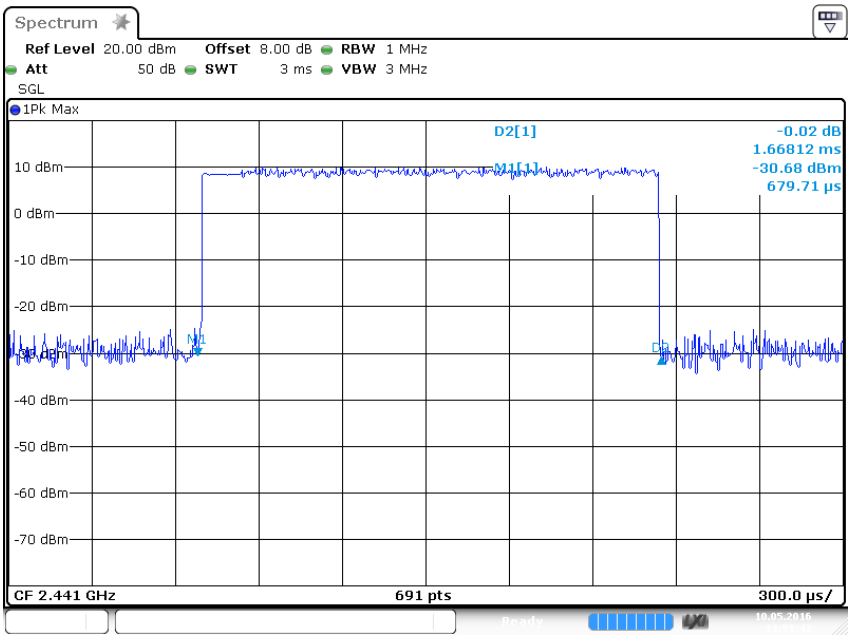
Date: 10 MAY 2016 13:46:28

Pulse time, Low Channel, DH3



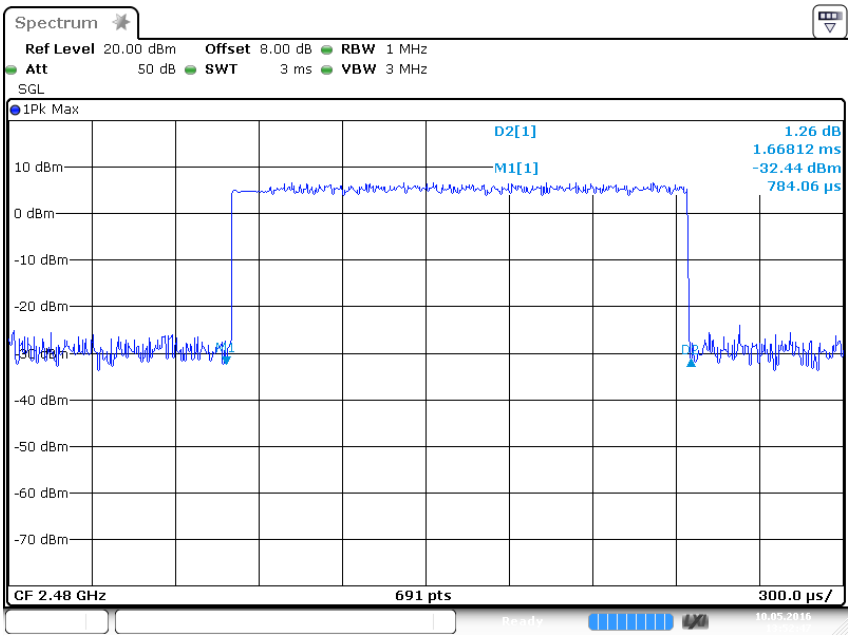
Date: 10 MAY 2016 13:50:47

Pulse time, Middle Channel, DH3



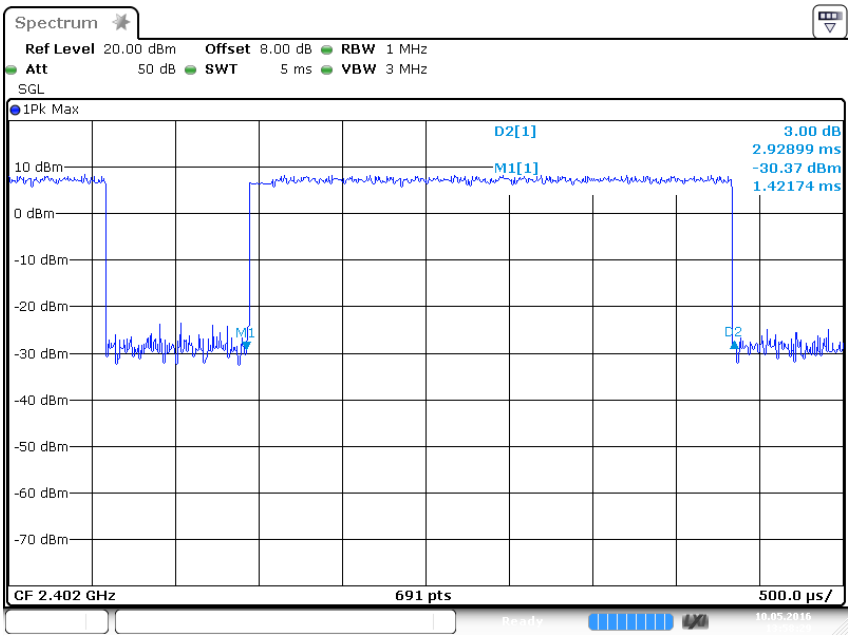
Date: 10.MAY.2016 13:51:44

Pulse time, High Channel, DH3



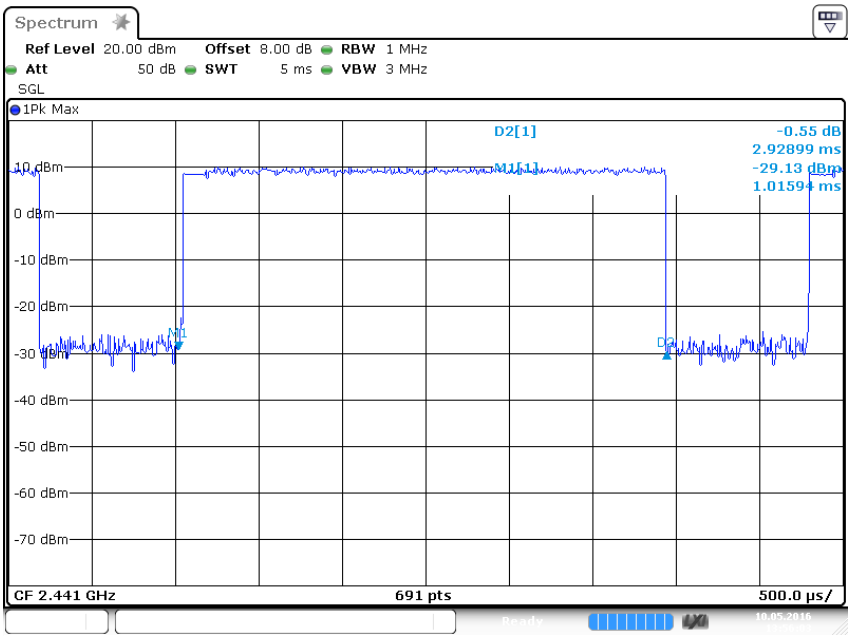
Date: 10.MAY.2016 13:52:47

Pulse time, Low Channel, DH5



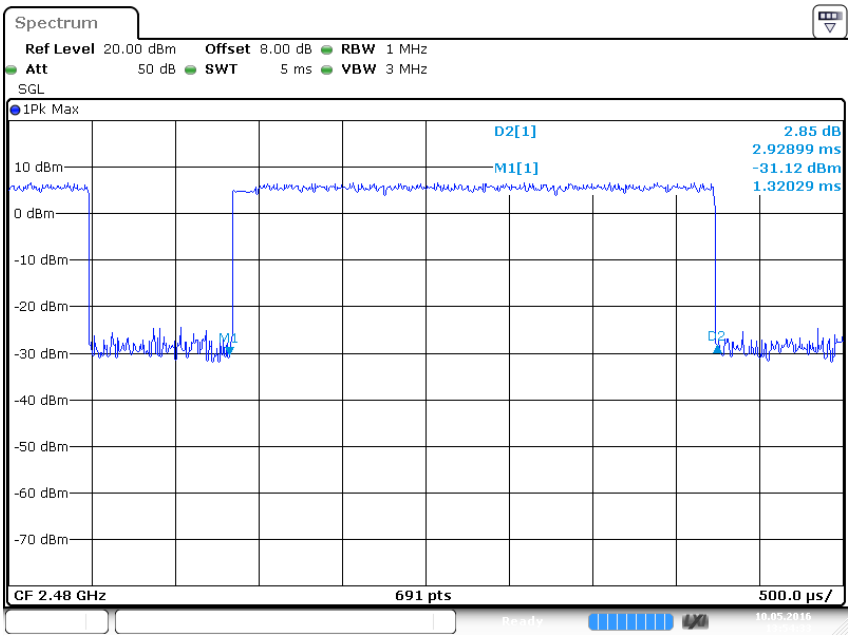
Date: 10.MAY.2016 13:58:29

Pulse time, Middle Channel, DH5



Date: 10.MAY.2016 13:56:03

Pulse time, High Channel, DH5



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

Applicable Standard

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

Test Procedure

1. Place the EUT on a bench and set in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to onetest 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	2016-05-09	2017-05-08
WOKEN	Cable	SFL402	00100A1F6A192S	2015/12/18	2016/12/17
Mini	Attenuator	ZFRSC-14-S+	SF019411452S	2016/4/30	2016/10/29

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

Test Data

Environmental Conditions

Temperature:	25℃
Relative Humidity:	60 %

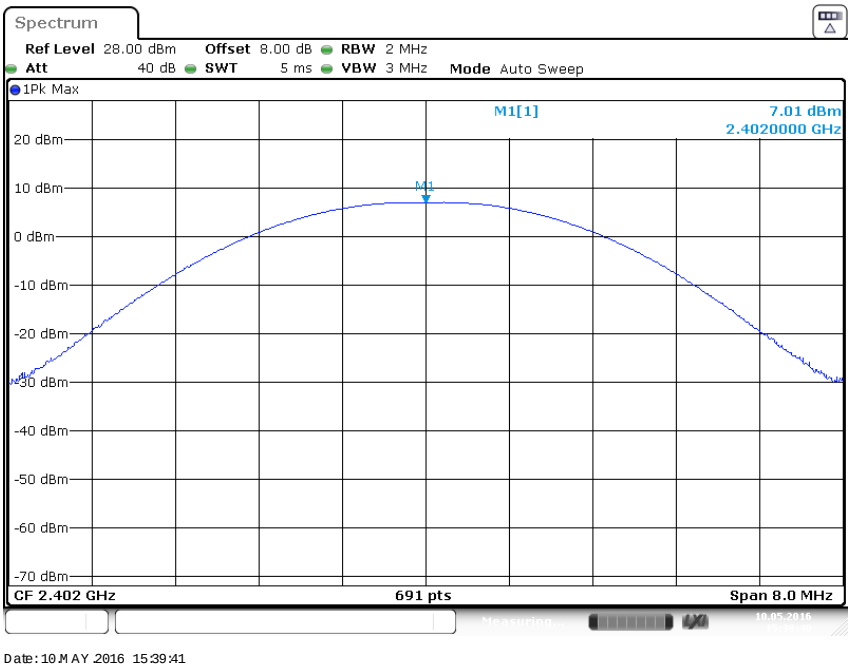
The testing was performed by David. Hsu on 2016-05-10.

Test Result: Compliance, please refer to the below table and plots.

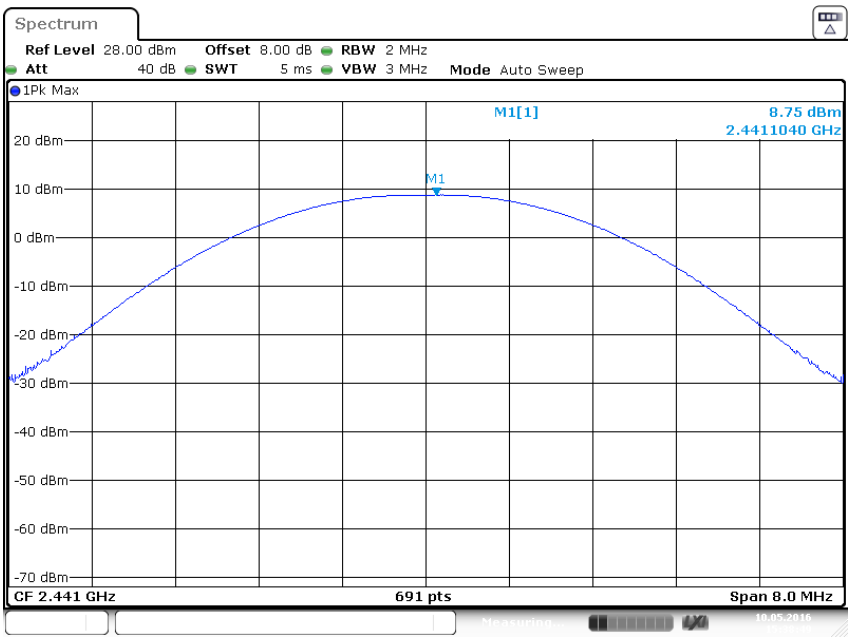
Mode	Channel	Frequency (MHz)	Peak Output Power		Limit (mW)
			(dBm)	(mW)	
BDR (GFSK)	Low	2402	7.01	5.023	1000
	Middle	2441	8.75	7.499	1000
	High	2480	6.13	4.102	1000
EDR (π/4-DQPSK)	Low	2402	7.92	6.194	1000
	Middle	2441	9.30	8.511	1000
	High	2480	6.52	4.487	1000
EDR (8DPSK)	Low	2402	8.22	6.637	1000
	Middle	2441	9.62	9.162	1000
	High	2480	5.33	3.412	1000

Please refer to the following tables and plots.

BDR (GFSK): Low Channel

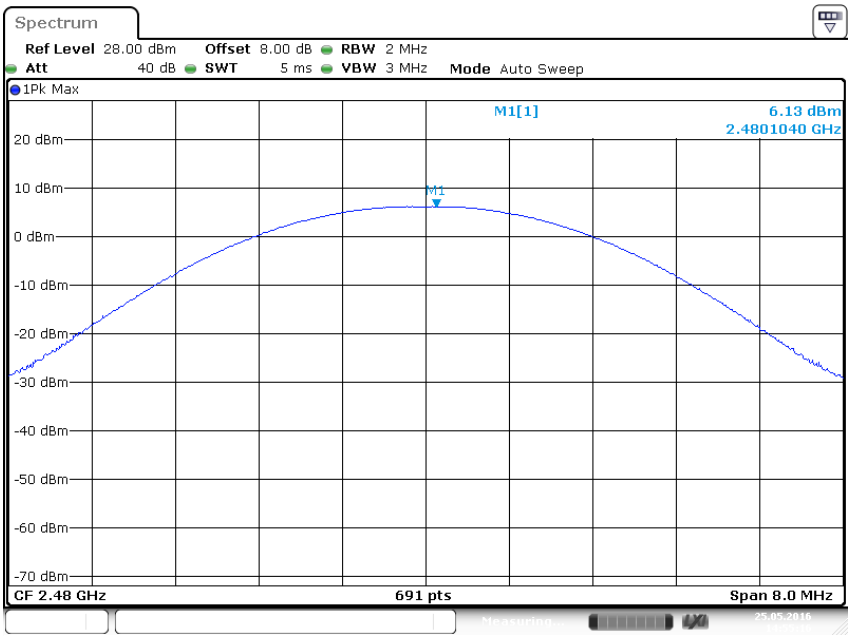


BDR (GFSK): Middle Channel



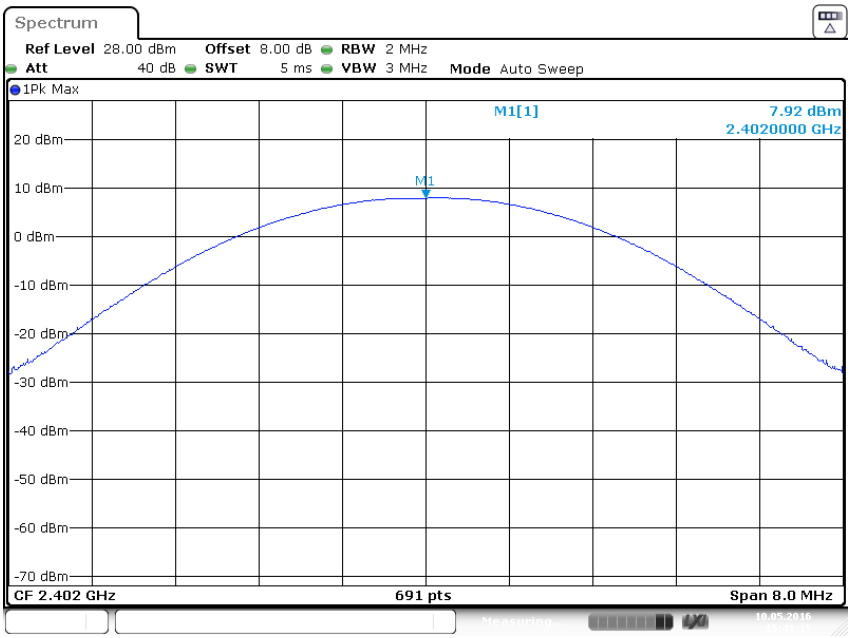
Date: 10.MAY.2016 15:38:49

BDR (GFSK): High Channel



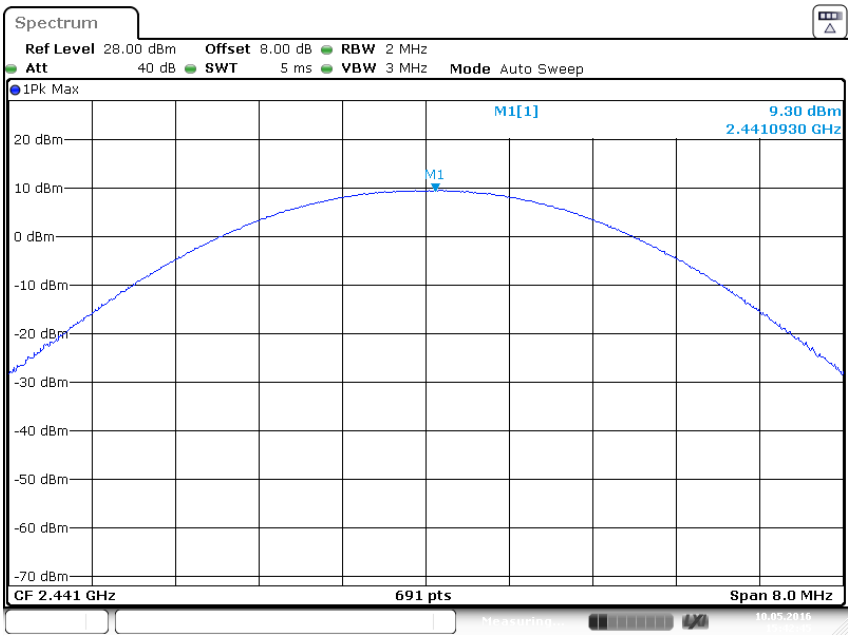
Date: 25.MAY.2016 14:55:16

EDR(π/4-DQPSK): Low Channel



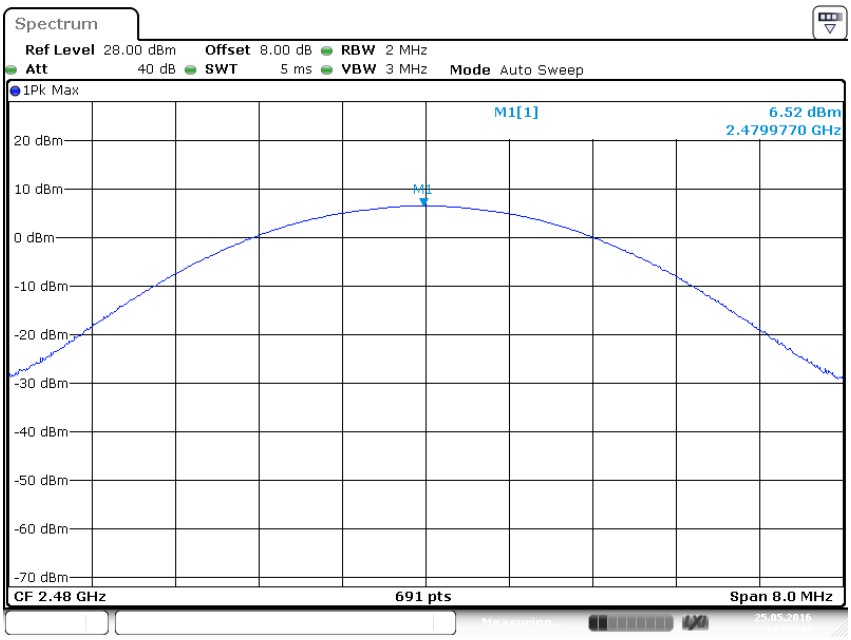
Date: 10 MAY 2016 15:41:15

EDR(π/4-DQPSK): Middle Channel



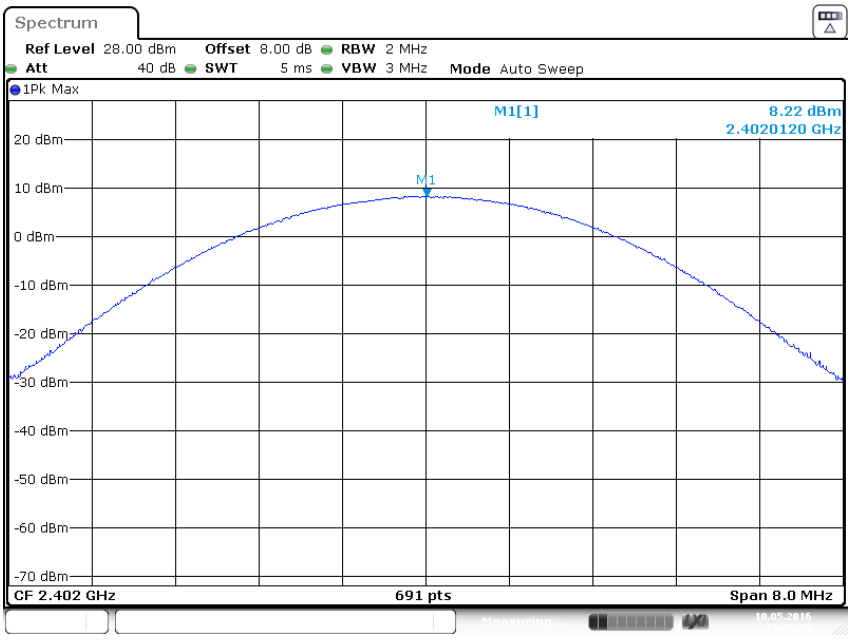
Date: 10 MAY 2016 15:42:45

EDR(π/4-DQPSK): High Channel



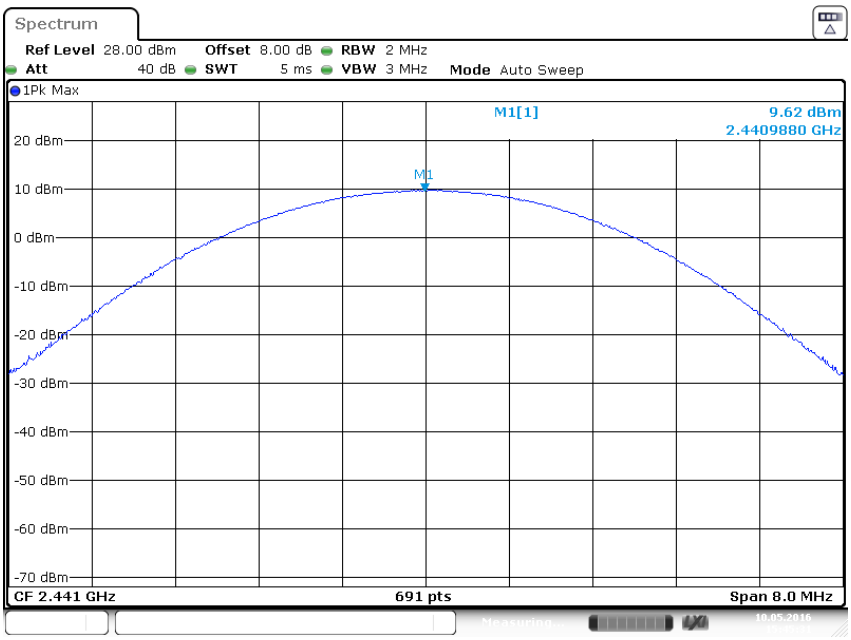
Date: 25.MAY.2016 14:57:44

EDR(8DPSK): Low Channel



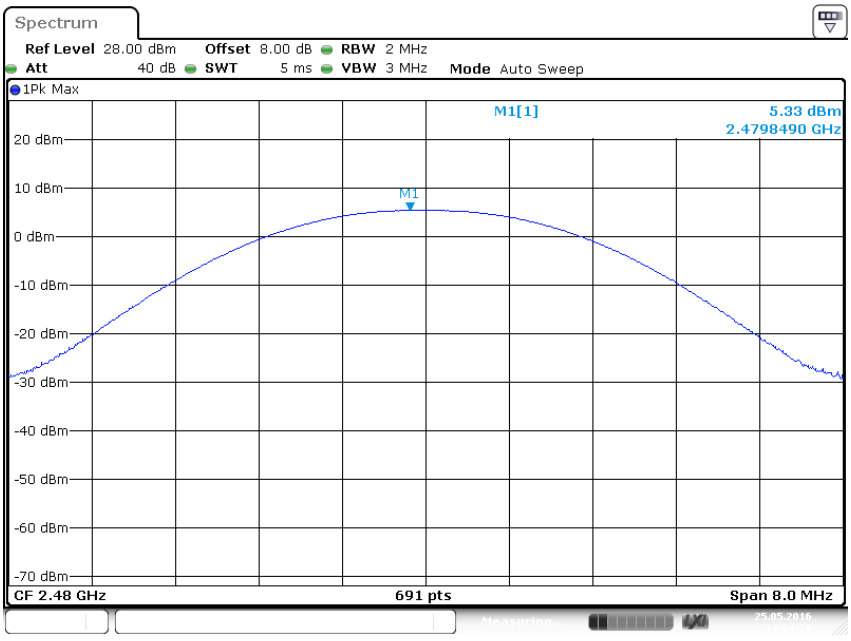
Date: 10.MAY.2016 15:46:25

EDR(8DPSK): Middle Channel



Date: 10.MAY.2016 15:45:31

EDR(8DPSK): High Channel



Date: 25.MAY.2016 14:54:28

FCC §15.247(d) - BAND EDGES TESTING

Applicable Standard

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

Test Procedure

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	200268	2016-05-07	2017-05-06
WOKEN	Cable	SFL402	00100A1F6A192S	2015/12/18	2016/12/17
Mini	Attenuator	ZFRSC-14-S+	SF019411452S	2016/4/30	2016/10/29

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

Test Data

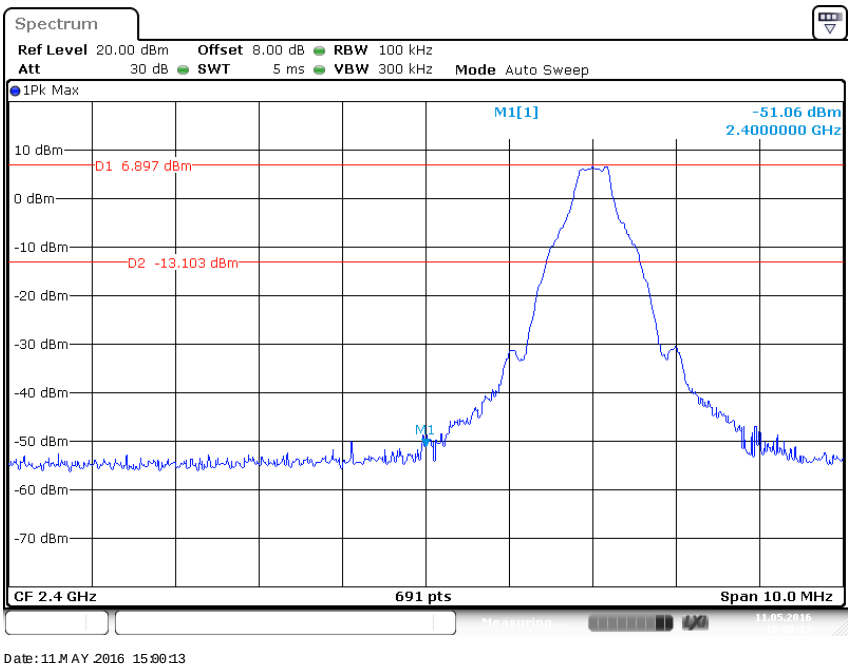
Environmental Conditions

Temperature:	25℃
Relative Humidity:	60 %

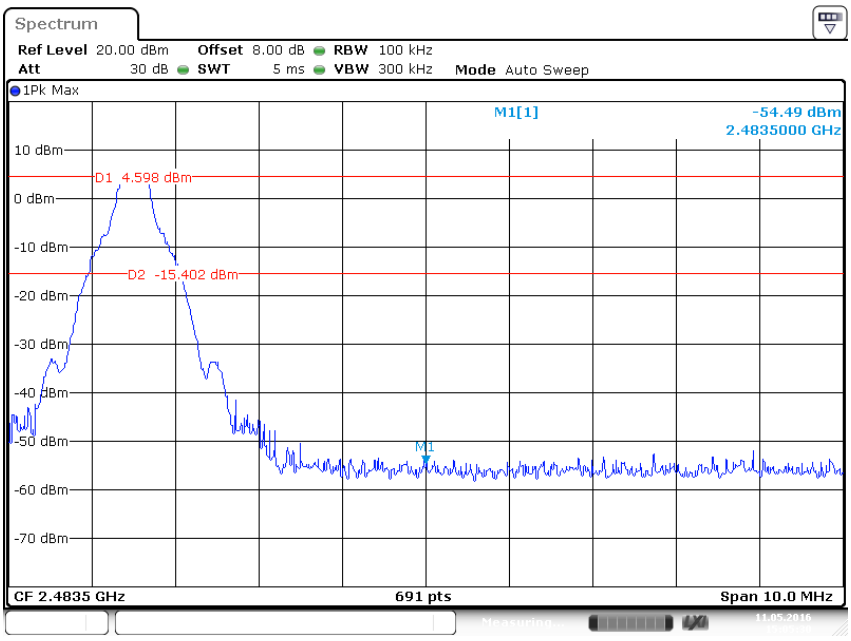
The testing was performed by David. Hsu on 2016-05-11.

Test Result: Compliance, please refer to the below plots.

BDR (GFSK): Band Edge-Left Side

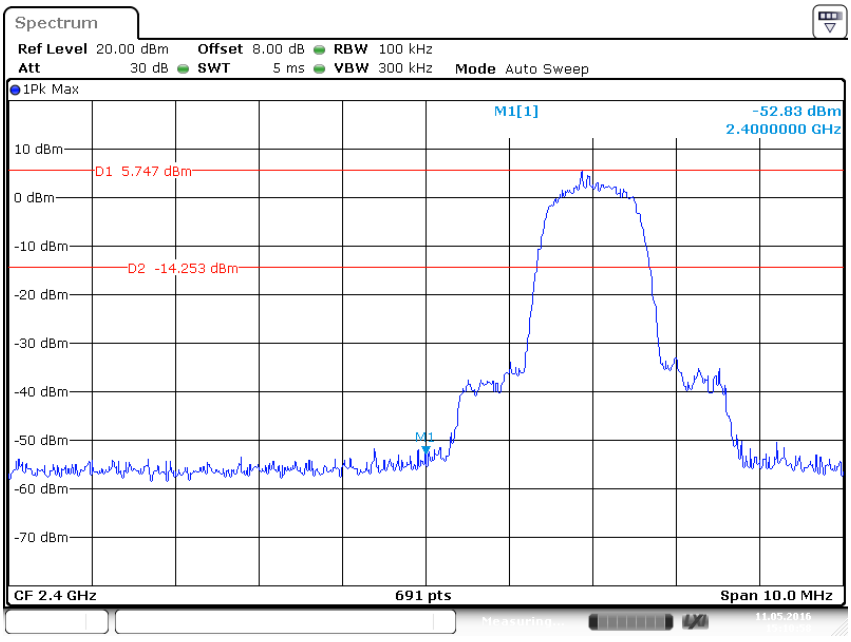


BDR (GFSK): Band Edge-Right Side



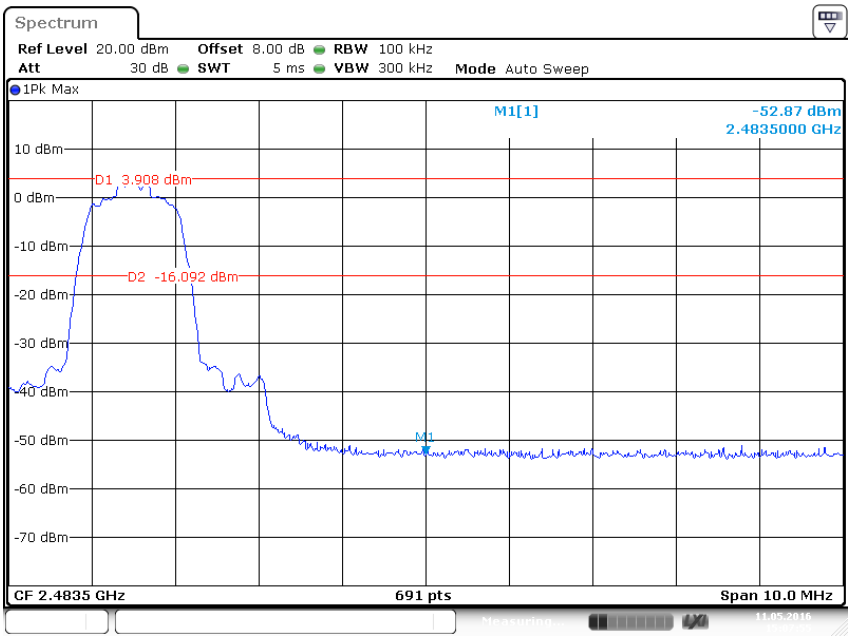
Date: 11.MAY.2016 15:05:30

EDR (π/4-DQPSK): Band Edge-Left Side



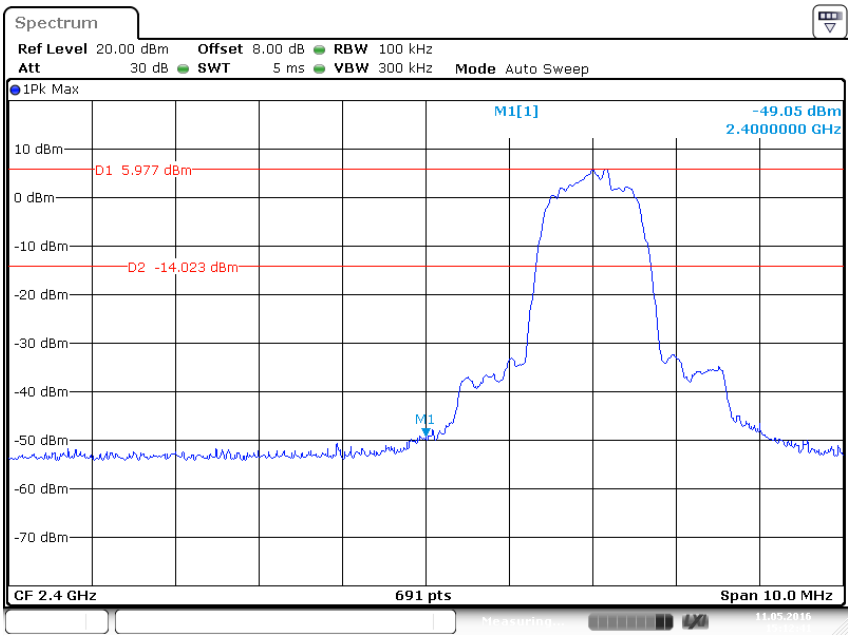
Date: 11.MAY.2016 15:10:58

EDR (π/4-DQPSK): Band Edge-Right Side



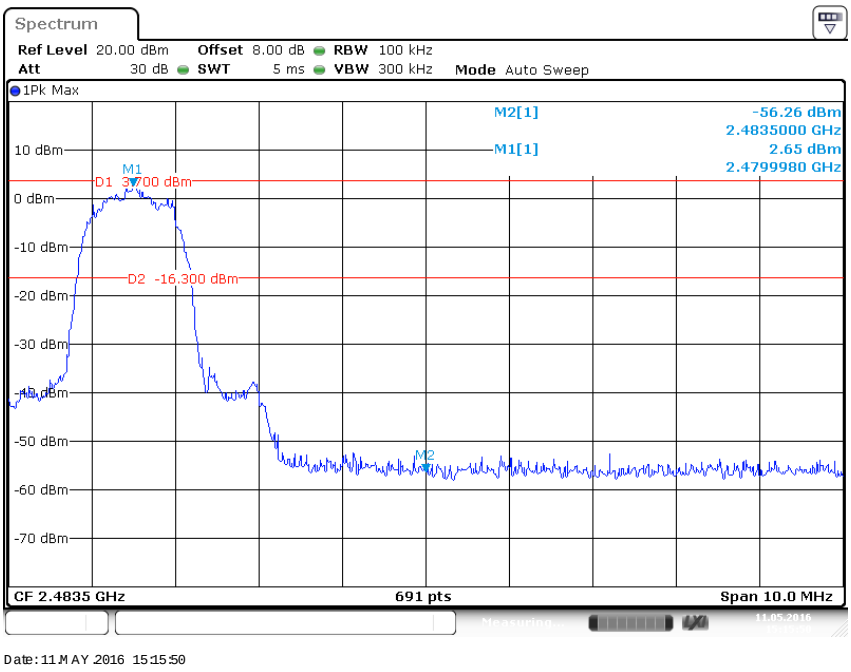
Date: 11.MAY.2016 15:07:54

EDR (8DPSK): Band Edge-Left Side



Date: 11.MAY.2016 15:12:40

BDR (8DPSK): Band Edge-Right Side



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