FCC PART 15.247
TEST REPORT

For

VIRTUAL TRUNK PTE LTD

12 Kallang Avenue The Annex #04-30 Aperia, Singapore 339511

FCC ID: 2AKDA-VT36

Report Type:	Product Type:
Original Report	IP WALKIE TALKIE

Test Engineer:	Chris Wang
Report Number:	RSHA170915005-00B
Report Date:	2017-11-22
Reviewed By:	Oscar Ye RF Leader
Prepared By:	Bay Area Compliance Laboratories Corp. (Kunshan) No.248 Chenghu Road,Kunshan,Jiangsu province,China Tel: +86-0512-86175000 Fax: +86-0512-88934268 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	VIRTUAL TRUNK PTE LTD
Tested Model	VT36
Product Type	IP WALKIE TALKIE
Dimension	26.5 mm(L)×61.5 mm(W)×119.5 mm(H)
Power Supply	IP Walkie Talkie: DC 3.8V from battery and DC 5.0V charging by adapter Desktop Charger: DC 5.0V charging by adapter

Adapter Information:
Model: K2001U-1004UL
Input: AC 100-240V, 50/60 Hz, 0.35A Max
Output: DC 5V, 2000mA

**All measurement and test data in this report was gathered from production sample serial number: 20170915005. (Assigned by the BACL. The EUT supplied by the applicant was received on 2017-09-15)*

Objective

This test report is prepared on behalf of VIRTUAL TRUNK PTE LTD in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Related Submittal(s)/Grant(s)

FCC Part 15.247 DTS and Part 22H24E27 PCB submissions with FCC ID: 2AKDA-VT36.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Item		Uncertainty
AC Power Lines Conducted Emissions		3.19dB
RF conducted test with spectrum		0.9dB
RF Output Power with Power meter		0.5dB
Radiated emission	30MHz~1GHz	6.11dB
	1GHz~6GHz	4.45dB
	6GHz~18GHz	5.23dB
Occupied Bandwidth		0.5kHz
Temperature		1.0℃
Humidity		6%

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road,Kunshan,Jiangsu province,China.

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and the FCC designation No. CN1185 under the FCC KDB 974614 D01. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

Channel list for Bluetooth:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	40	2442
1	2403	…	…
…	…	…	…
…	…	77	2479
39	2441	78	2480

EUT was tested with Channel 0, 39 and 78.

EUT Exercise Software

The EUT is tested in the engineering mode.

GFSK Power level: 0
π/4-DQPSK Power level: 0
8-DPSK Power level: 0

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

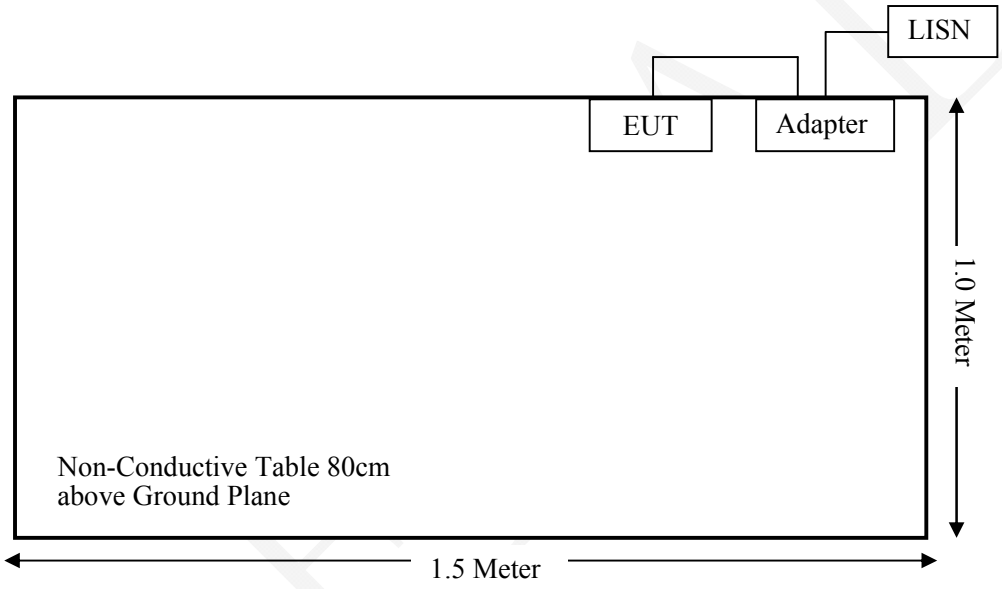
Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

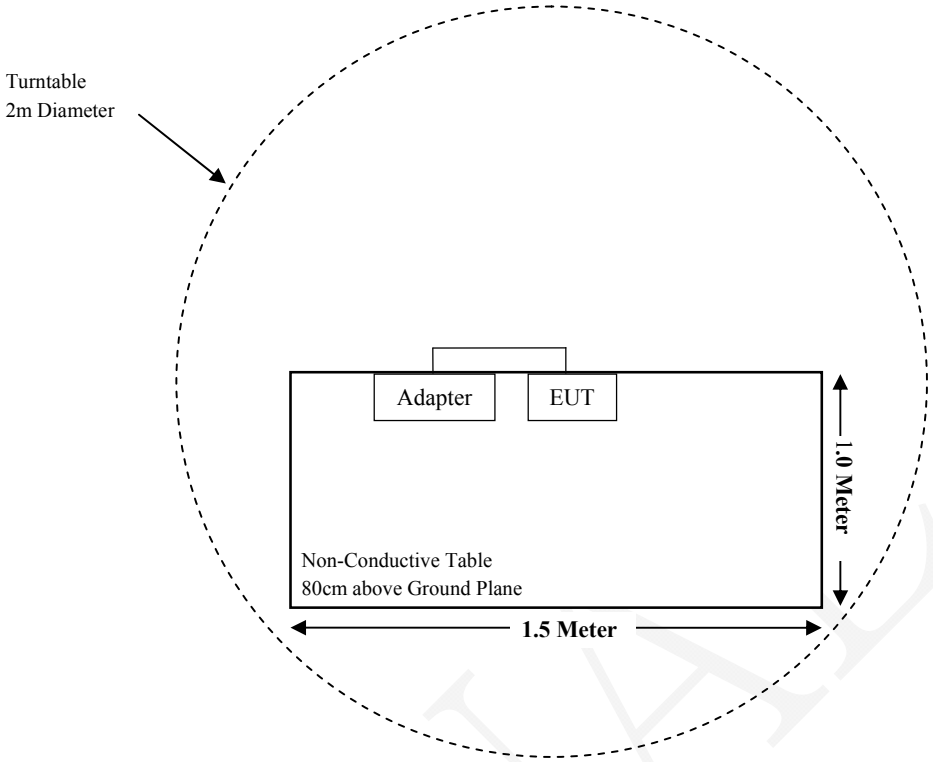
Cable Description	Shielding Type	Length (m)	From Port	To
USB Cable	Unshielding	0.8	EUT	Adapter

Block Diagram of Test Setup

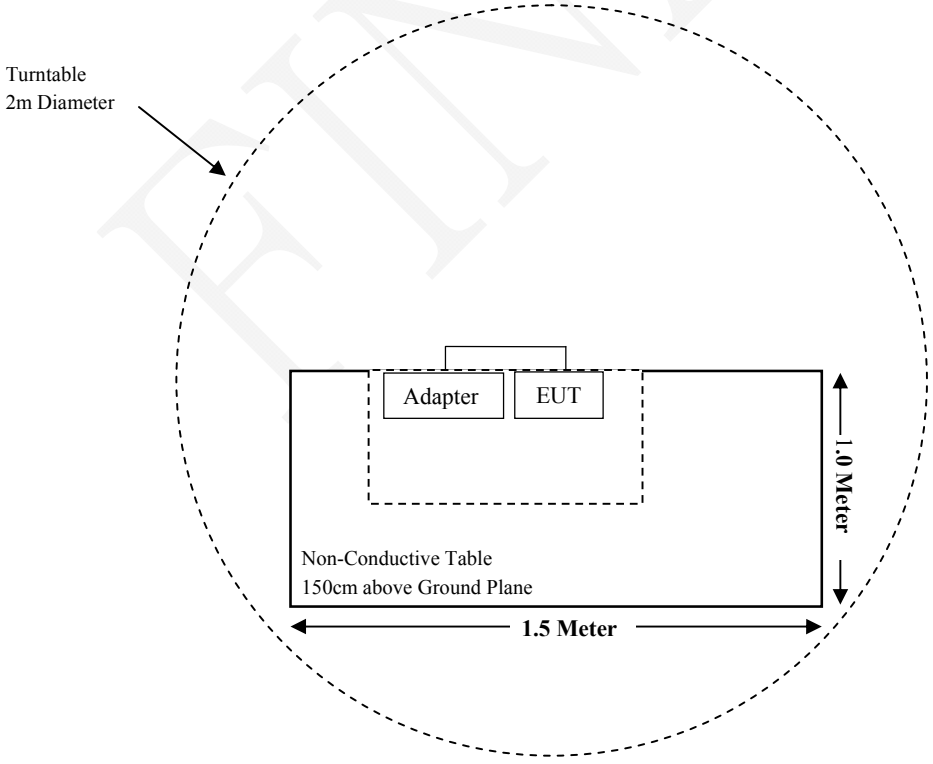
For Conducted Emissions:



For Radiated Emissions(Below 1GHz):



For Radiated Emissions(Above 1GHz):



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (I), §1.1310 & §2.1093	RF Exposure	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209 & §15.247(d)	Radiated Emissions	Compliance
§15.247(a)(1)	20 dB Emission Bandwidth	Compliance
§15.247(a)(1)	Channel Separation Test	Compliance
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliance
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliance
§15.247(b)(1)	Peak Output Power Measurement	Compliance
§15.247(d)	Band edges	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test（Chamber 1#）					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2016-11-25	2017-11-24
Sunol Sciences	Broadband Antenna	JB3	A040914-2	2016-01-09	2019-01-08
Sonoma Instrunent	Pre-amplifier	310N	171205	2017-08-15	2018-08-14
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-8	008	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2017-08-15	2018-08-14
Radiated Emission Test（Chamber 2#）					
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2017-08-27	2018-08-26
ETS-LINDGREN	Horn Antenna	3115	6229	2016-01-11	2019-01-10
ETS-LINDGREN	Horn Antenna	3116	00084159	2016-10-18	2019-10-17
Narda	Pre-amplifier	AFS42-00101800	2001270	2016-12-12	2017-12-11
Heatsink Required	Amplifier	QLW-18405536-J0	15964001009	2016-12-12	2017-12-11
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2017-08-15	2018-08-14
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	FSV40	101116	2017-07-22	2018-07-21
VIRTUAL	RF Cable	/	/	/	/
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2016-11-25	2017-11-24
Rohde & Schwarz	LISN	ESH3-Z5	862770/011	2016-10-10	2017-10-09
Rohde & Schwarz	LISN	ENV216	3560655016	2016-11-25	2017-11-24
BACL	BACL-EMC	V1.0	CE001	/	/
Narda	Attenuator/6dB	10690812-2	26850-6	2017-01-10	2018-01-09
MICRO-COAX	Coaxial Cable	Cable-15	015	2017-08-15	2018-08-14

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

FCC §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

Frequency Range (MHz)	Target Output Power		Minimum test separation distance required for the exposure conditions (mm)
	(dBm)	(mW)	
2402-2480	6.50	4.47	5.00

Note:

The target out putpower is declared by the manufacturer.

Result: [(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] • [√ f(GHz)]=4.47/5* √ 2.48=**1.4 <3**.

So the stand-alone 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 a PIFA antenna arrangement for Bluetooth, which the antenna gain is 0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

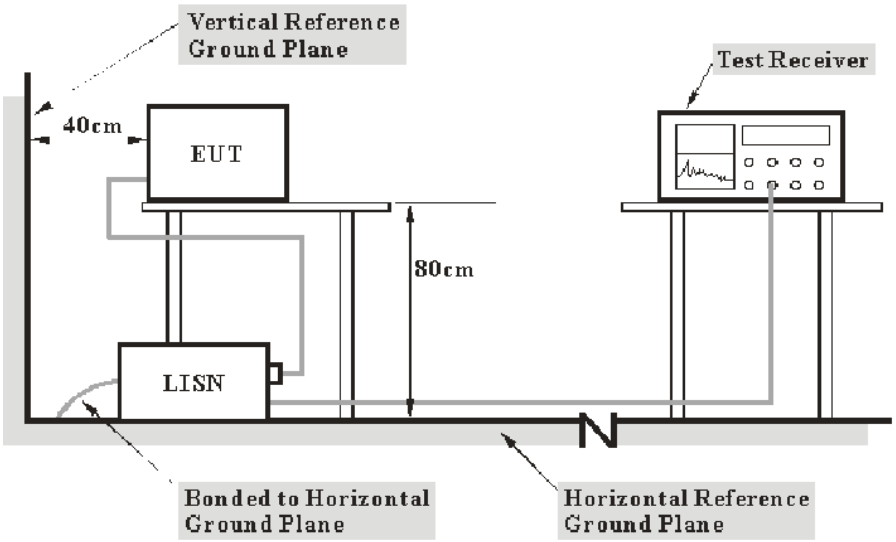
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

EMI Test Receiver Setup

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

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

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

Test Procedure

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

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

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

Corrected Factor & Margin Calculation

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

Correction Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

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

Margin = Limit – Reading

Test Results Summary

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

Test Data

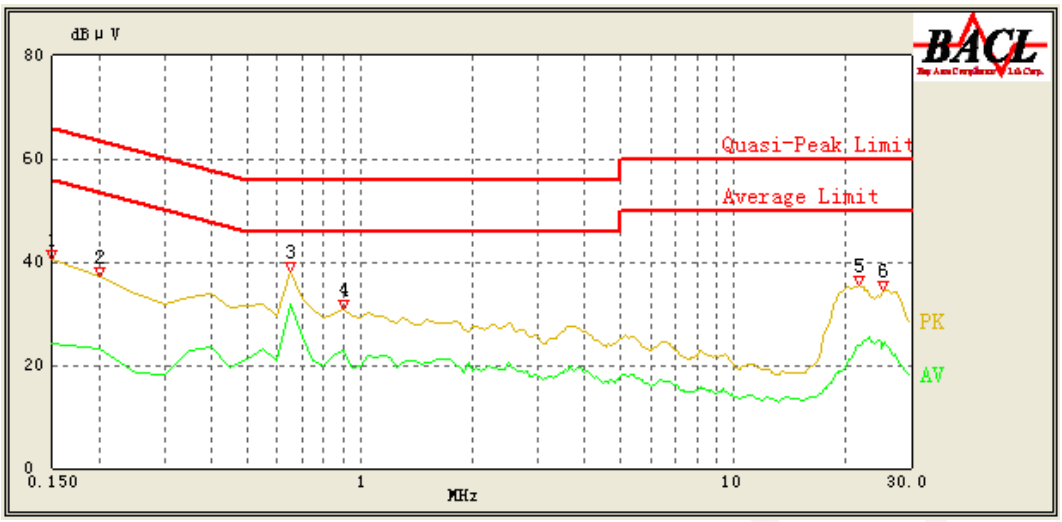
Environmental Conditions

Temperature:	23.4 ℃
Relative Humidity:	49 %
ATM Pressure:	101.1 kPa

The testing was performed by Chris Wang on 2017-09-27.

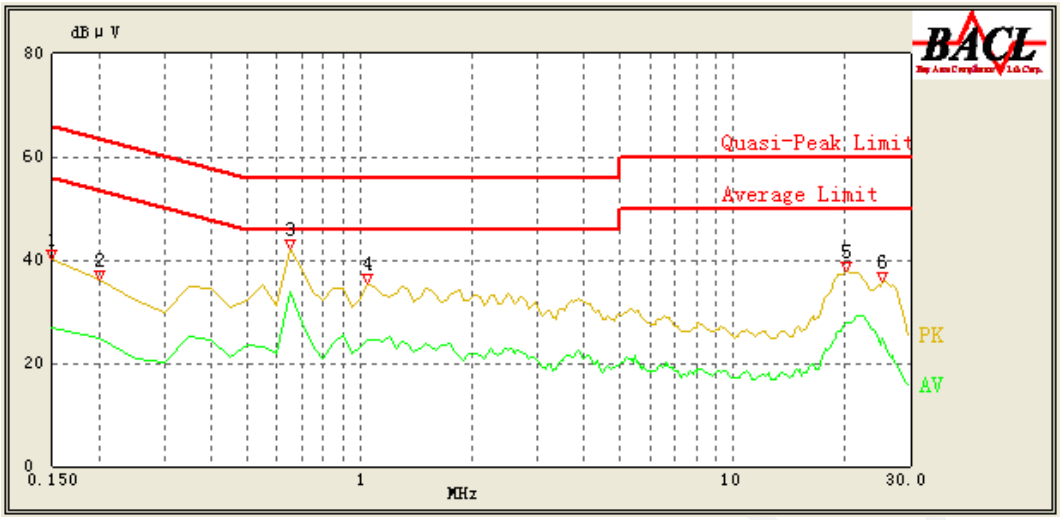
EUT operation mode: Transmitting in high channel of GFSK (Worst case)

AC 120V/60 Hz, Line



Frequency (MHz)	Reading (dBµV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Correction (dB)	Limit (dBµV)	Margin (dB)	Comment
0.150	40.46	QP	9.000	L1	16.06	66.00	25.54	Compliance
0.150	24.20	AV	9.000	L1	16.06	56.00	31.80	Compliance
0.200	37.09	QP	9.000	L1	16.01	64.57	27.48	Compliance
0.200	23.29	AV	9.000	L1	16.01	54.57	31.28	Compliance
0.650	38.09	QP	9.000	L1	15.98	56.00	17.91	Compliance
0.650	31.67	AV	9.000	L1	15.98	46.00	14.33	Compliance
0.900	30.79	QP	9.000	L1	15.90	56.00	25.21	Compliance
0.900	22.78	AV	9.000	L1	15.90	46.00	23.22	Compliance
21.700	35.49	QP	9.000	L1	16.45	60.00	24.51	Compliance
21.700	23.73	AV	9.000	L1	16.45	50.00	26.27	Compliance
25.200	34.62	QP	9.000	L1	16.47	60.00	25.38	Compliance
25.200	24.34	AV	9.000	L1	16.47	50.00	25.66	Compliance

AC 120V/60 Hz, Neutral



Frequency (MHz)	Reading (dBμV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Correction (dB)	Limit (dBμV)	Margin (dB)	Comment
0.150	40.27	QP	9.000	N	16.06	66.00	25.73	Compliance
0.150	26.88	AV	9.000	N	16.06	56.00	29.12	Compliance
0.200	36.03	QP	9.000	N	16.05	64.57	28.54	Compliance
0.200	24.81	AV	9.000	N	16.05	54.57	29.76	Compliance
0.650	42.29	QP	9.000	N	16.02	56.00	13.71	Compliance
0.650	33.73	AV	9.000	N	16.02	46.00	12.27	Compliance
1.050	35.61	QP	9.000	N	15.94	56.00	20.39	Compliance
1.050	24.50	AV	9.000	N	15.94	46.00	21.50	Compliance
20.250	37.94	QP	9.000	N	16.16	60.00	22.06	Compliance
20.250	27.96	AV	9.000	N	16.17	50.00	22.04	Compliance
25.250	35.85	QP	9.000	N	16.24	60.00	24.15	Compliance
25.250	24.93	AV	9.000	N	16.24	50.00	25.07	Compliance

Note:
1) Corr.=LISN VDF (Voltage Division Factor) + Cable Loss
2) Margin = Limit – Reading

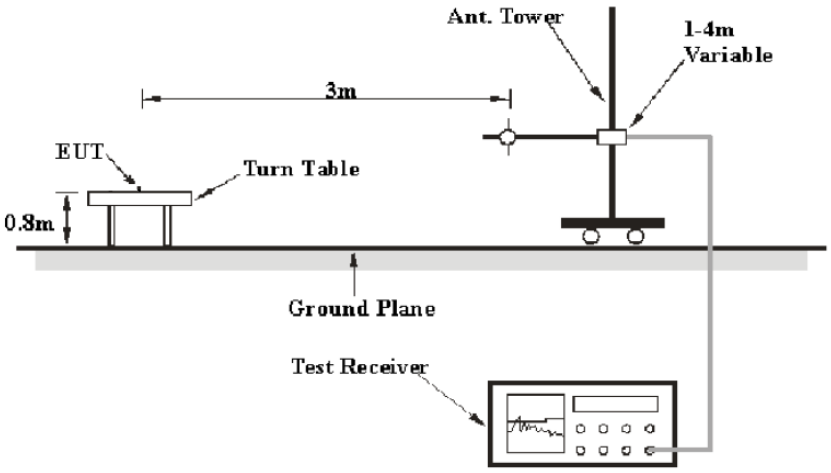
FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

Applicable Standard

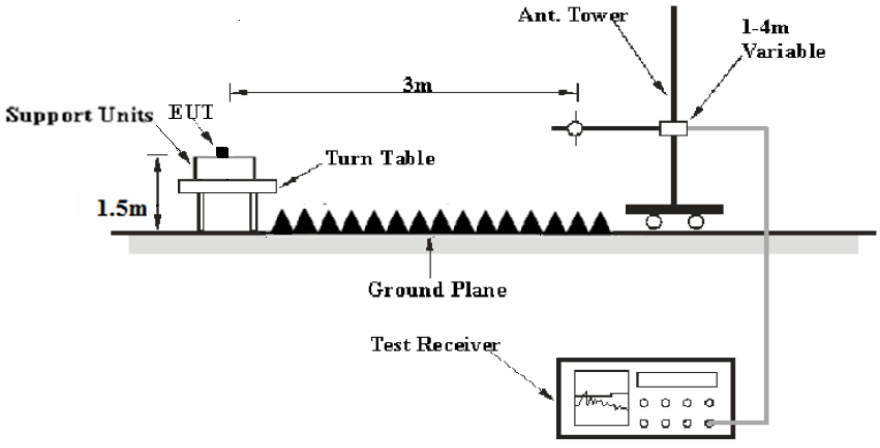
FCC §15.205; §15.209; §15.247(d)

EUT Setup

Below 1 GHz:



Above 1GHz:



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

EMI Test Receiver Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver Setup were set with the following configurations:

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

Test Procedure

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

All final data was recorded in Quasi-peak detection mode for frequency range of 30 MHz -1 GHz and peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

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

Margin = Limit – Corrected Amplitude

Test Results Summary

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

Test Data

Environmental Conditions

Temperature:	23.4 ℃
Relative Humidity:	49 %
ATM Pressure:	101.1 kPa

The testing was performed by Chris Wang on 2017-09-27.

EUT operation mode: Transmitting

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

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)									
128.70	30.25	QP	62	142	V	-11.95	18.30	43.50	25.20
2402.00	100.47	PK	225	151	V	-4.93	95.54	/	/
2402.00	96.60	Ave	225	151	V	-4.93	91.67	/	/
2402.00	100.56	PK	29	101	H	-4.93	95.63	/	/
2402.00	96.82	Ave	29	101	H	-4.93	91.89	/	/
2390.00	40.61	PK	26	132	H	-4.96	35.65	74.00	38.35
2390.00	30.17	Ave	26	132	H	-4.96	25.21	54.00	28.79
1926.80	42.73	PK	108	167	V	-6.33	36.40	74.00	37.60
1926.80	30.07	Ave	108	167	V	-6.33	23.74	54.00	30.26
3672.60	42.50	PK	53	157	V	-0.33	42.17	74.00	31.83
3672.60	30.57	Ave	53	157	V	-0.33	30.24	54.00	23.76
4804.00	43.52	PK	194	204	H	2.47	45.99	74.00	28.01
4804.00	35.16	Ave	194	204	H	2.47	37.63	54.00	16.37
7206.00	38.83	PK	57	182	H	9.79	48.62	74.00	25.38
7206.00	28.16	Ave	57	182	H	9.79	37.95	54.00	16.05

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dB μ V/m)	Margin (dB)
Middle Channel (2441 MHz)									
128.70	30.31	QP	125	138	V	-11.95	18.36	43.50	25.14
2441.00	100.86	PK	190	234	V	-4.82	96.04	/	/
2441.00	97.17	Ave	190	234	V	-4.82	92.35	/	/
2441.00	101.12	PK	112	220	H	-4.82	96.30	/	/
2441.00	97.43	Ave	112	220	H	-4.82	92.61	/	/
1926.80	42.78	PK	100	230	V	-6.33	36.45	74.00	37.55
1926.80	30.11	Ave	100	230	V	-6.33	23.78	54.00	30.22
3672.60	42.48	PK	117	224	V	-0.33	42.15	74.00	31.85
3672.60	30.53	Ave	117	224	V	-0.33	30.20	54.00	23.80
4882.00	43.29	PK	240	221	H	2.65	45.94	74.00	28.06
4882.00	34.90	Ave	240	221	H	2.65	37.55	54.00	16.45
6458.60	42.67	PK	283	123	V	8.06	50.73	74.00	23.27
6458.60	29.72	Ave	283	123	V	8.06	37.78	54.00	16.22
7323.00	38.52	PK	157	196	H	9.96	48.48	74.00	25.52
7323.00	27.94	Ave	157	196	H	9.96	37.90	54.00	16.10
High Channel (2480MHz)									
128.70	30.44	QP	76	111	V	-11.95	18.49	43.50	25.01
2480.00	100.83	PK	91	116	V	-4.72	96.11	/	/
2480.00	97.19	Ave	91	116	V	-4.72	92.47	/	/
2480.00	101.15	PK	234	108	H	-4.72	96.43	/	/
2480.00	97.46	Ave	234	108	H	-4.72	92.74	/	/
2483.50	41.23	PK	116	225	H	-4.71	36.52	74.00	37.48
2483.50	32.25	Ave	116	225	H	-4.71	27.54	54.00	26.46
3672.60	42.51	PK	143	248	V	-0.33	42.18	74.00	31.82
3672.60	30.55	Ave	143	248	V	-0.33	30.22	54.00	23.78
4960.00	43.10	PK	206	207	H	2.82	45.92	74.00	28.08
4960.00	34.82	Ave	206	207	H	2.82	37.64	54.00	16.36
6458.60	42.68	PK	210	106	V	8.06	50.74	74.00	23.26
6458.60	29.69	Ave	210	106	V	8.06	37.75	54.00	16.25
7440.00	38.38	PK	82	185	H	10.14	48.52	74.00	25.48
7440.00	27.78	Ave	82	185	H	10.14	37.92	54.00	16.08

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

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

Applicable Standard

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

Test Procedure

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

Test Data

Environmental Conditions

Temperature:	23.4 ℃
Relative Humidity:	49 %
ATM Pressure:	101.1 kPa

The testing was performed by Chris Wang on 2017-09-27.

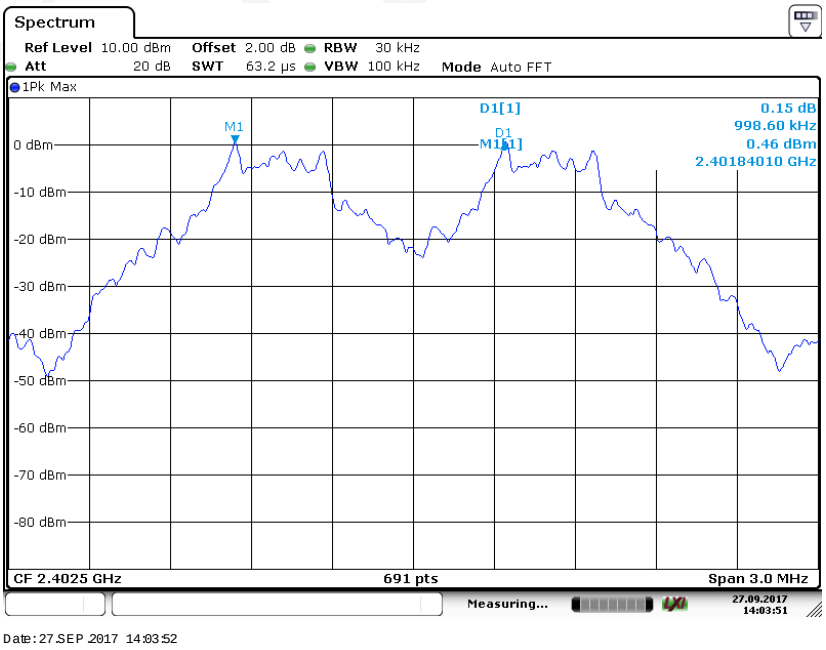
EUT operation mode: Transmitting

Test Result: Compliance.

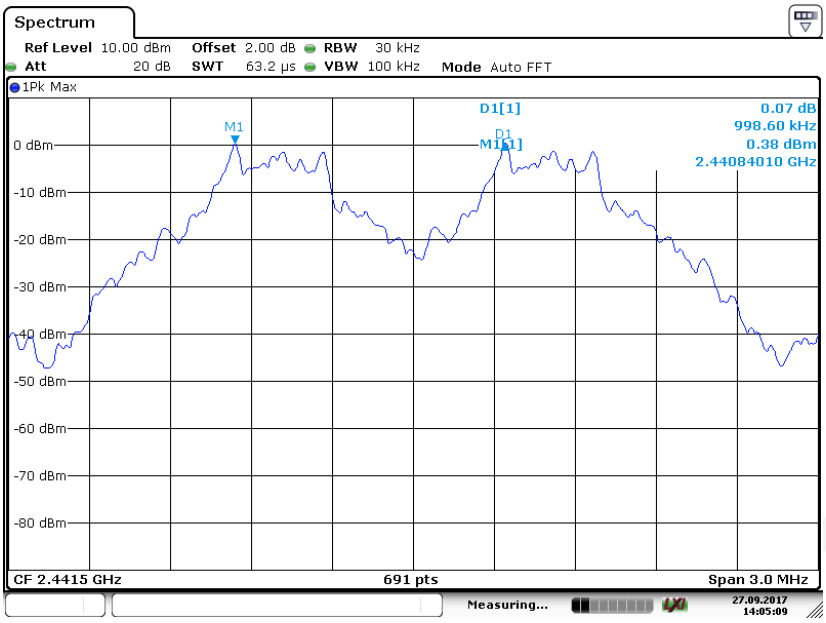
Mode	Channel	Frequency (MHz)	Channel Separation (kHz)	Limit (kHz)	Result
BDR (GFSK)	Low	2402	998.60	564.40	Pass
	Adjacent	2403			
	Middle	2441	998.60	564.40	Pass
	Adjacent	2442			
	High	2480	998.60	564.40	Pass
	Adjacent	2479			
EDR (π/4-DQPSK)	Low	2402	1002.90	749.67	Pass
	Adjacent	2403			
	Middle	2441	1002.90	752.53	Pass
	Adjacent	2442			
	High	2480	1002.90	746.73	Pass
	Adjacent	2479			
EDR (8-DPSK)	Low	2402	1002.90	772.80	Pass
	Adjacent	2403			
	Middle	2441	1002.90	769.87	Pass
	Adjacent	2442			
	High	2480	1002.90	769.87	Pass
	Adjacent	2479			

Note: Limit = 20 dB bandwidth*2/3

BDR (GFSK): Low Channel

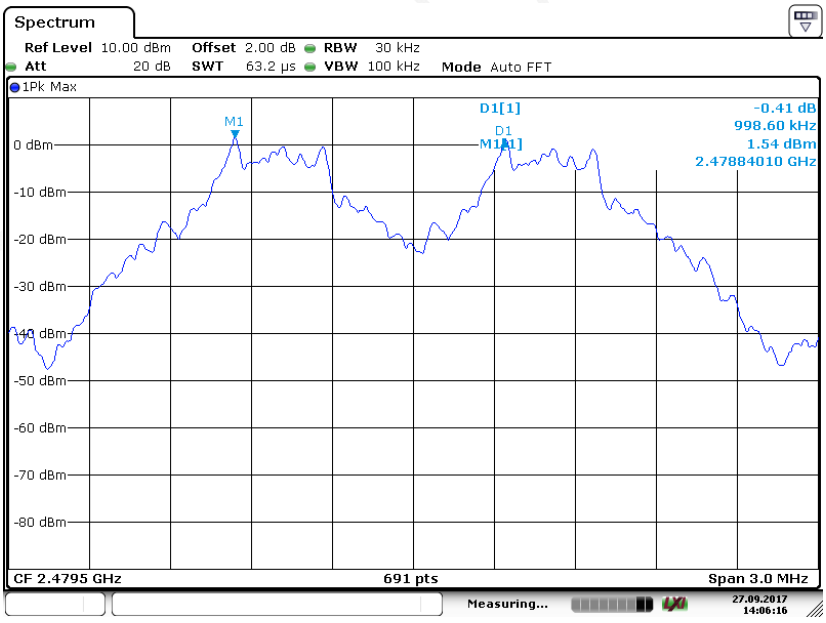


BDR (GFSK): Middle Channel



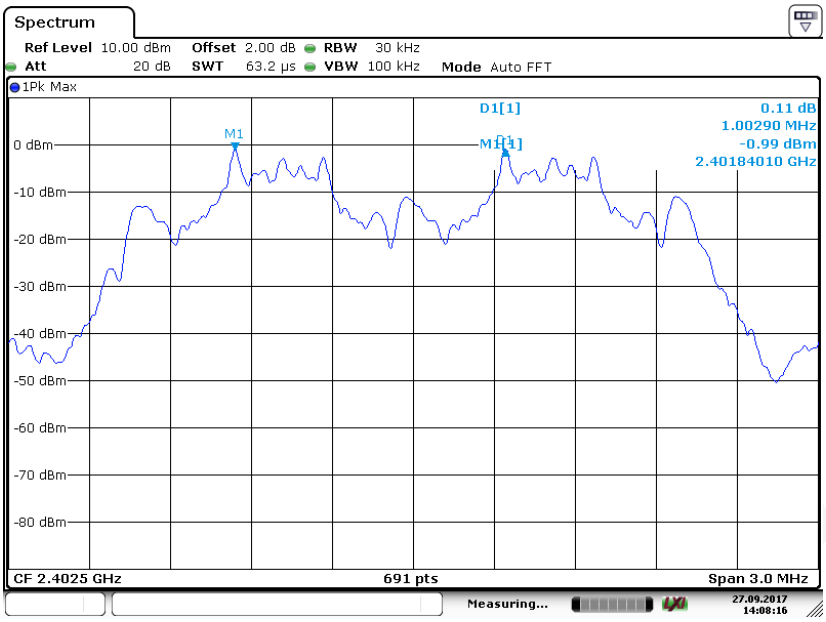
Date: 27.SEP.2017 14:05:09

BDR (GFSK): High Channel



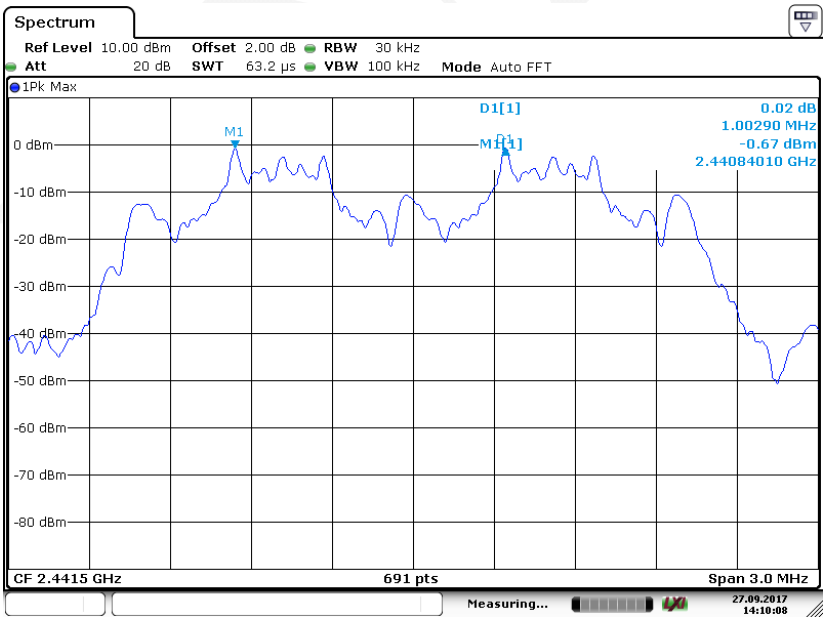
Date: 27.SEP.2017 14:06:16

EDR (π/4-DQPSK): Low Channel



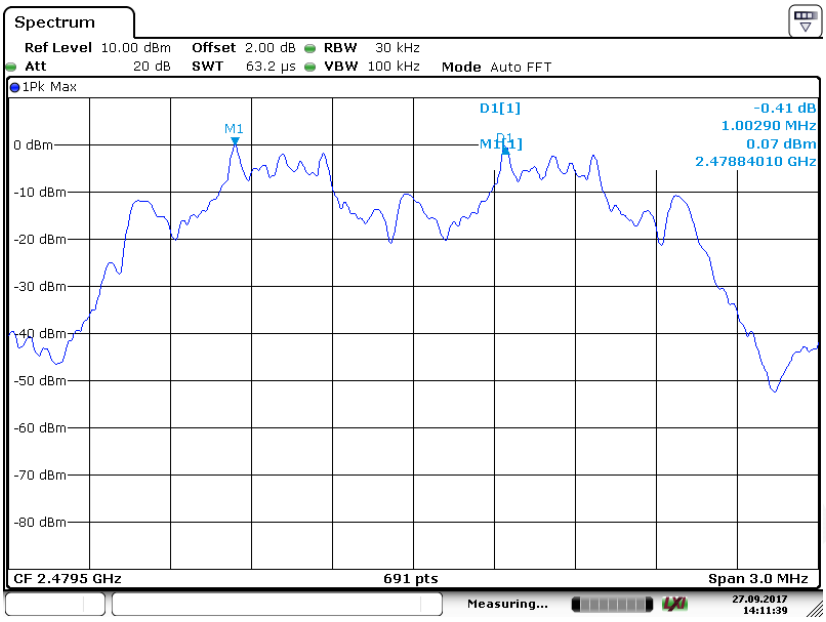
Date: 27.SEP.2017 14:08:16

EDR (π/4-DQPSK): Middle Channel



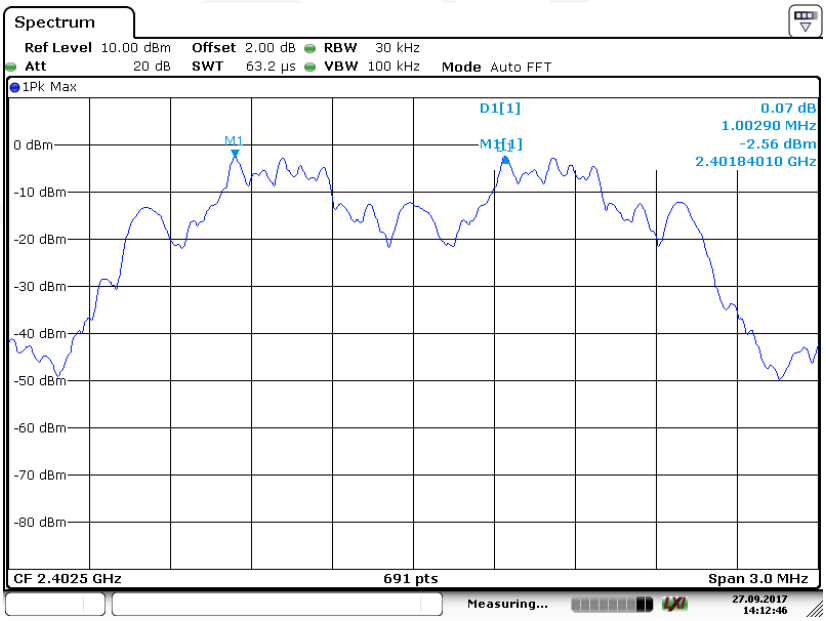
Date: 27.SEP.2017 14:10:08

EDR (π/4-DQPSK): High Channel



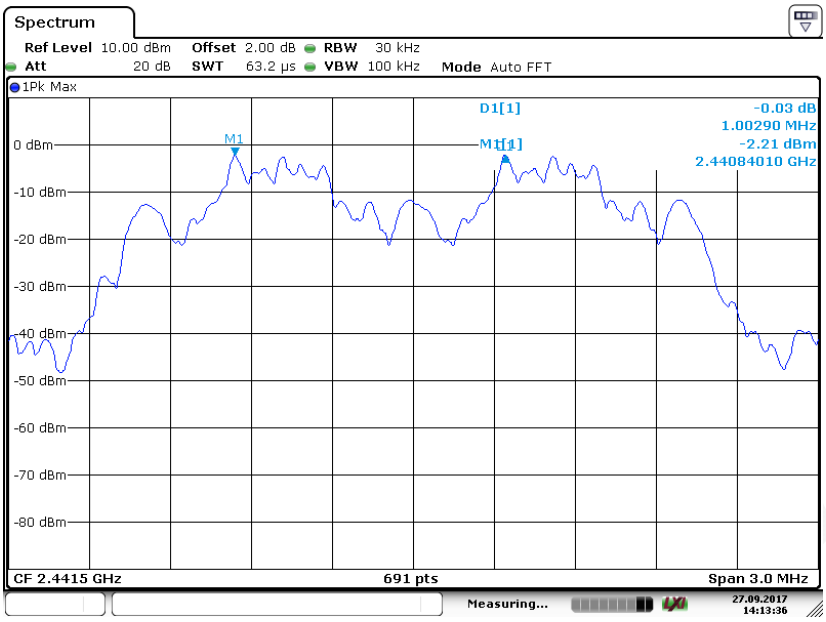
Date: 27.SEP.2017 14:11:39

EDR (8-DPSK): Low Channel



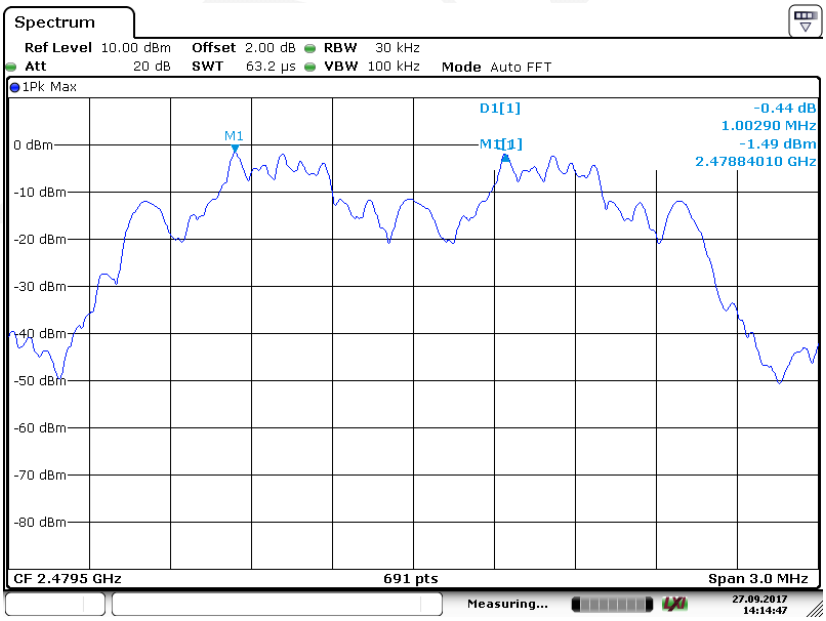
Date: 27.SEP.2017 14:12:46

EDR (8-DPSK): Middle Channel



Date: 27.SEP.2017 14:13:35

EDR (8-DPSK): High Channel



Date: 27.SEP.2017 14:14:47

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

Applicable Standard

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

Test Procedure

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

Test Data

Environmental Conditions

Temperature:	23.2 ℃
Relative Humidity:	50 %
ATM Pressure:	101.3 kPa

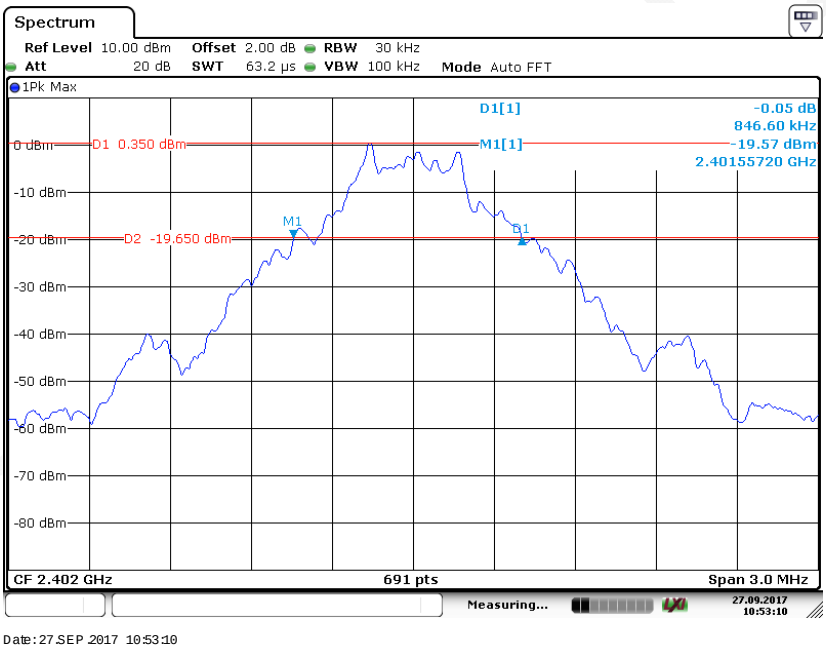
The testing was performed by Chris Wang on 2017-09-27.

EUT operation mode: Transmitting

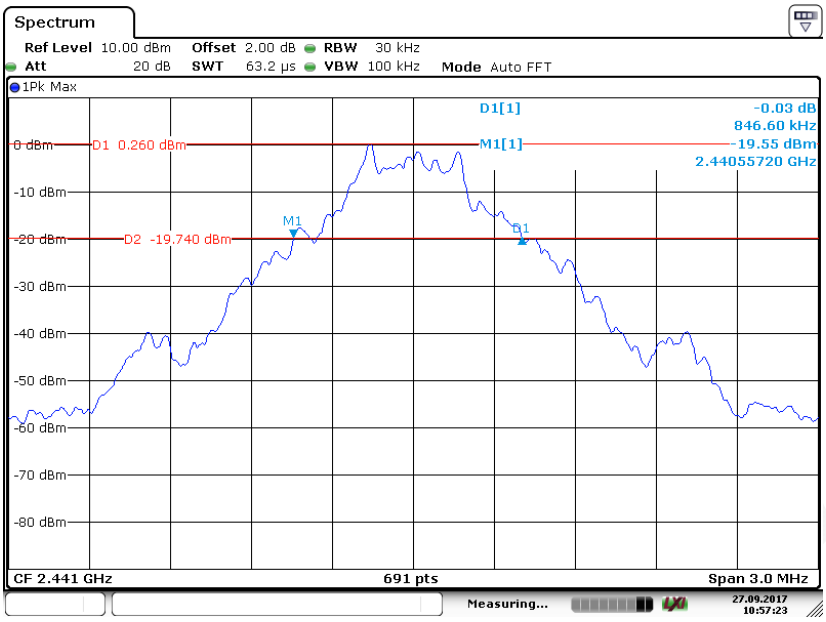
Test Result: Compliance.

Mode	Channel	Frequency (MHz)	20 dB Emission Bandwidth (kHz)
BDR (GFSK)	Low	2402	846.60
	Middle	2441	846.60
	High	2480	846.60
EDR (π/4-DQPSK)	Low	2402	1124.50
	Middle	2441	1128.80
	High	2480	1120.10
EDR (8-DPSK)	Low	2402	1159.20
	Middle	2441	1154.80
	High	2480	1154.80

BDR (GFSK): Low Channel

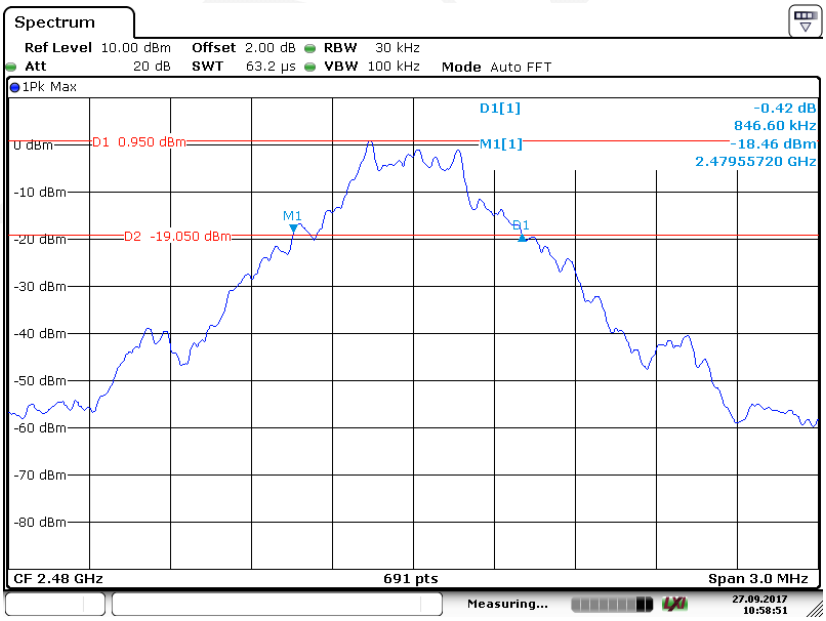


BDR (GFSK): Middle Channel



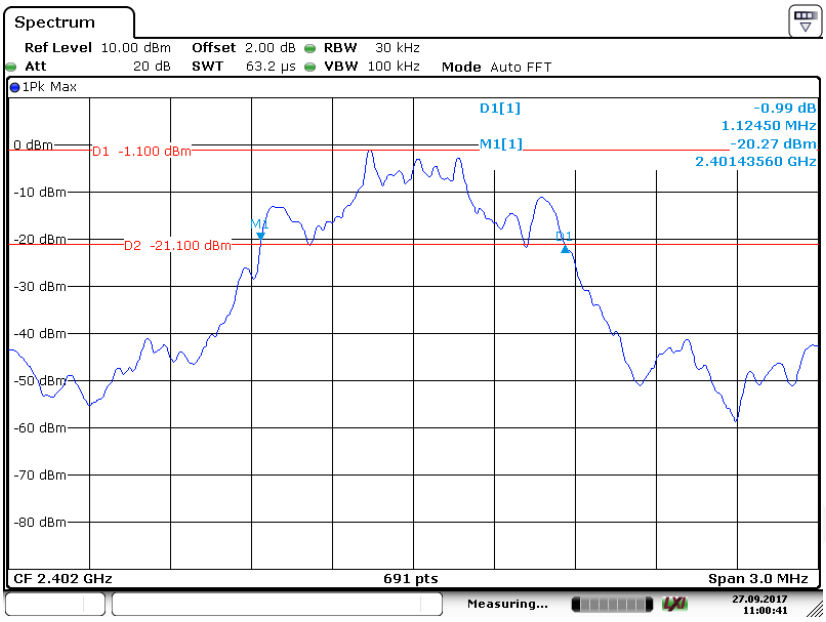
Date: 27.SEP.2017 10:57:23

BDR (GFSK): High Channel



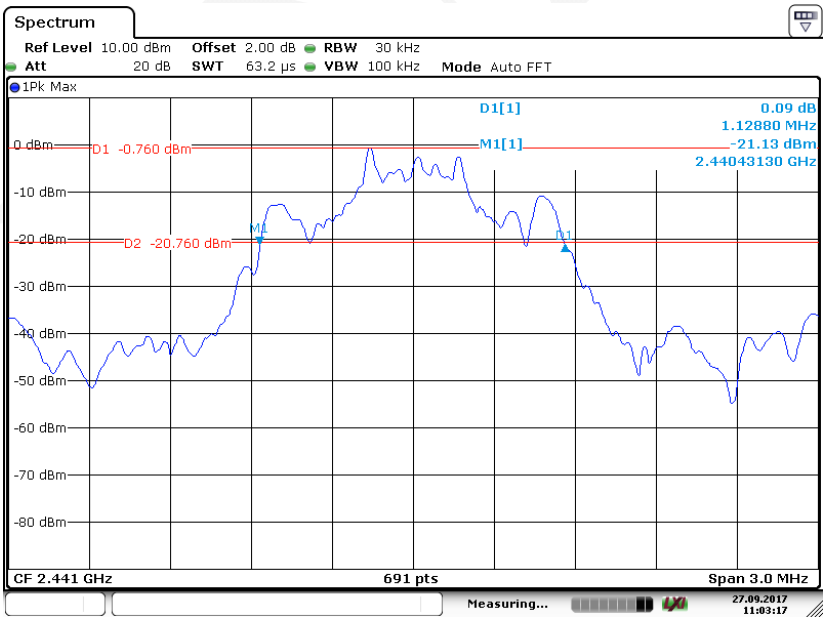
Date: 27.SEP.2017 10:58:52

EDR (π/4-DQPSK): Low Channel



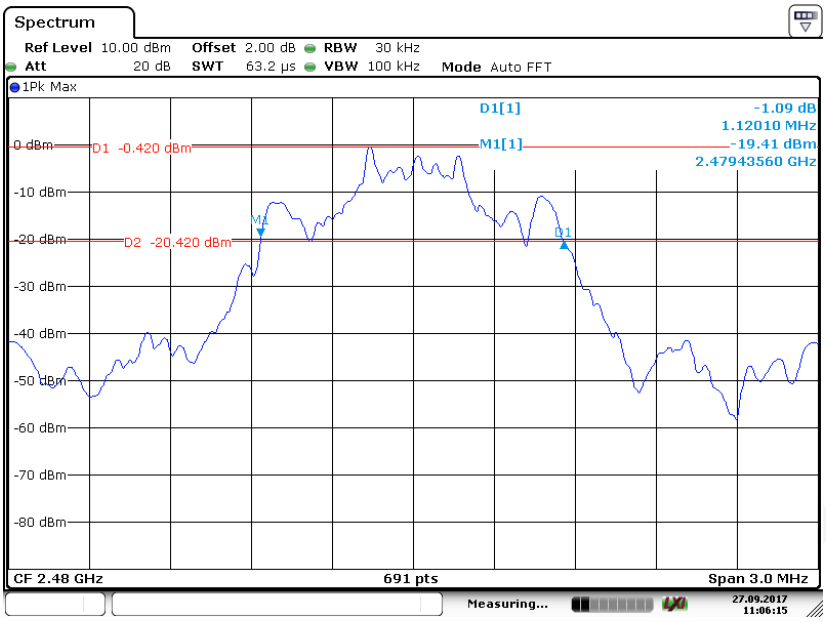
Date: 27.SEP.2017 11:00:41

EDR(π/4-DQPSK): Middle Channel



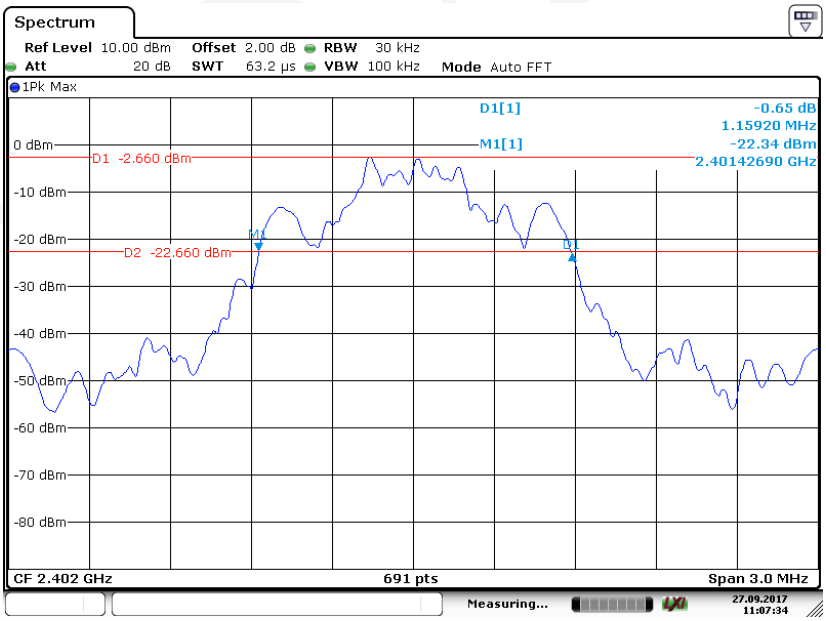
Date: 27.SEP.2017 11:03:17

EDR (π/4-DQPSK): High Channel



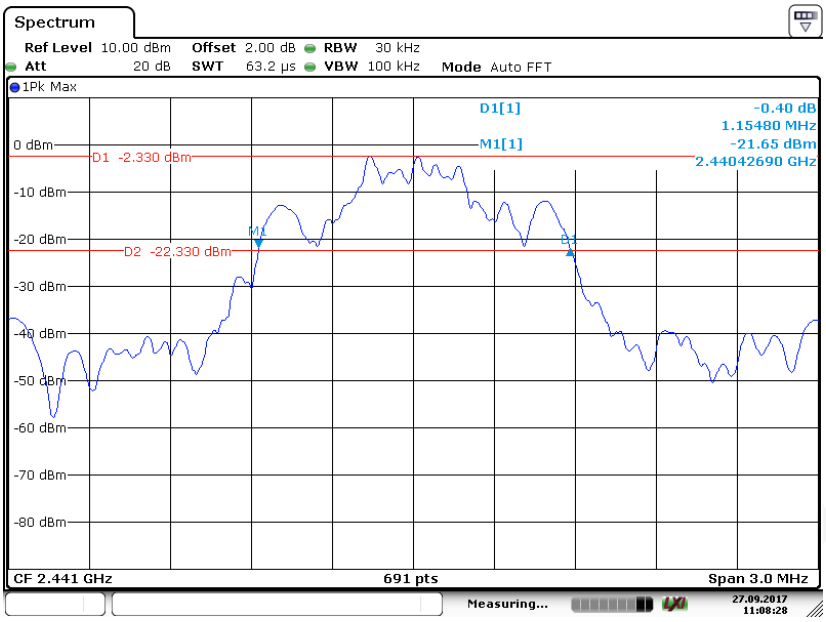
Date: 27.SEP.2017 11:06:15

EDR (8-DPSK): Low Channel



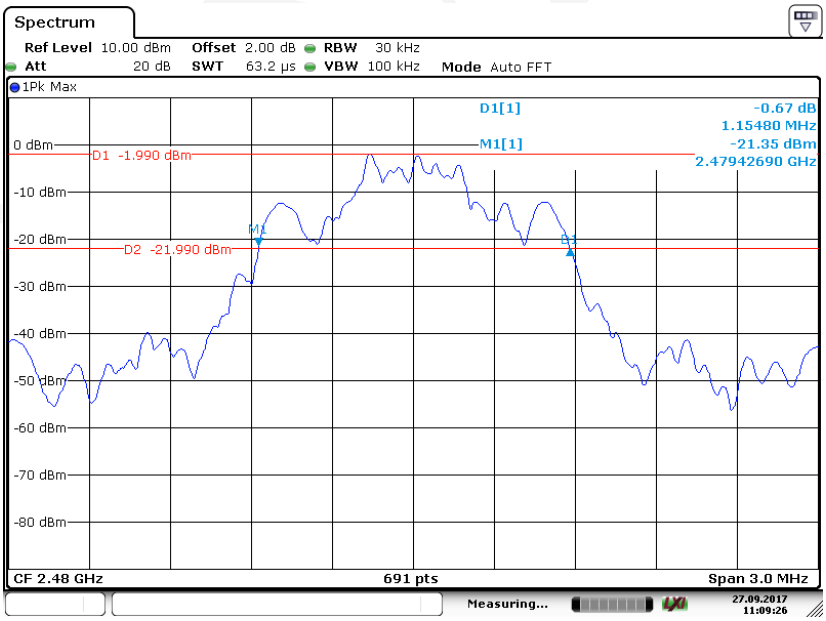
Date: 27.SEP.2017 11:07:35

EDR (8-DPSK): Middle Channel



Date: 27.SEP.2017 11:08:29

EDR (8-DPSK): High Channel



Date: 27.SEP.2017 11:09:26

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

Applicable Standard

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

Test Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.

2. Set the EUT in hopping mode from first channel to last.

3. By using the max-hold function record the quantity of the channel.

Test Data

Environmental Conditions

Temperature:	23.2 ℃
Relative Humidity:	50 %
ATM Pressure:	101.3 kPa

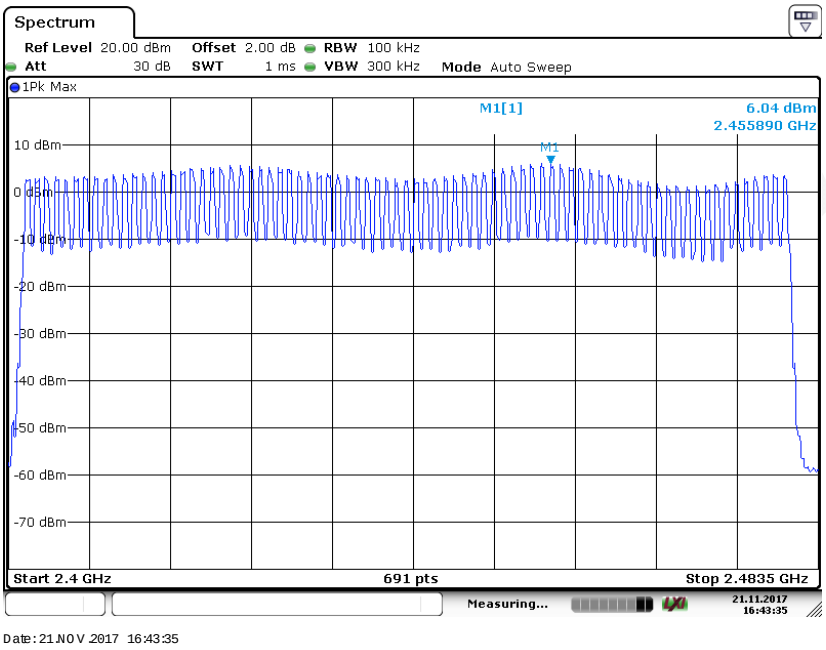
The testing was performed by Chris Wang on 2017-11-21.

EUT operation mode: Hopping

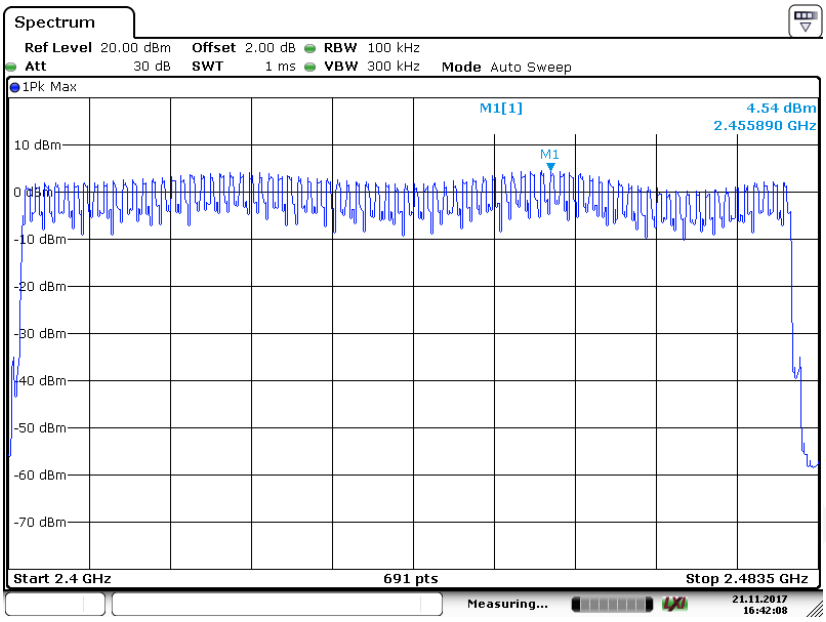
Test Result: Compliance.

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

BDR (GFSK): Number of Hopping Channels

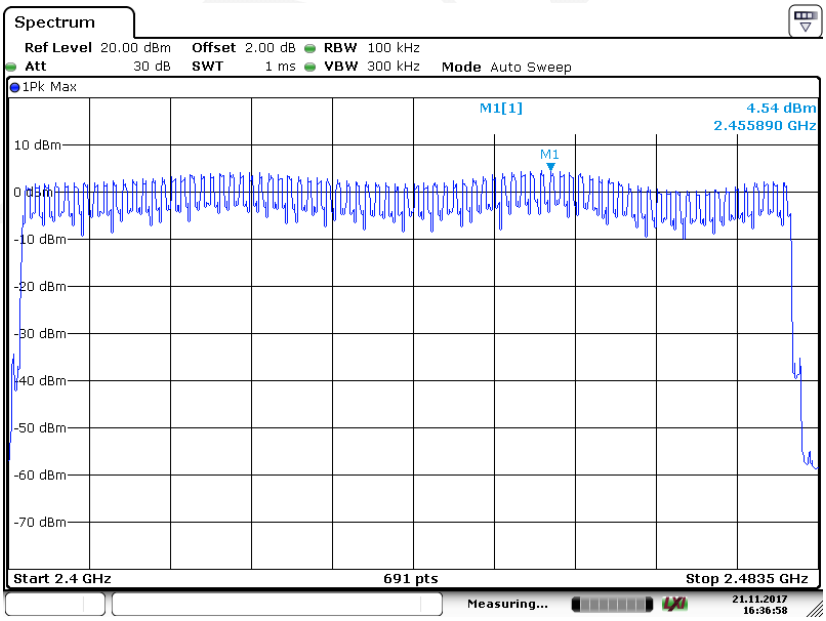


EDR (π/4-DQPSK): Number of Hopping Channels



Date: 21.NOV.2017 16:42:08

EDR (8-DPSK): Number of Hopping Channels



Date: 21.NOV.2017 16:36:59

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

Applicable Standard

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

Test Procedure

1 Span: Zero span, centered on a hopping channel.
2 RBW shall be ⩽ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
3 Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
4 Detector function: Peak.
5 Trace: Max hold.

Test Data

Environmental Conditions

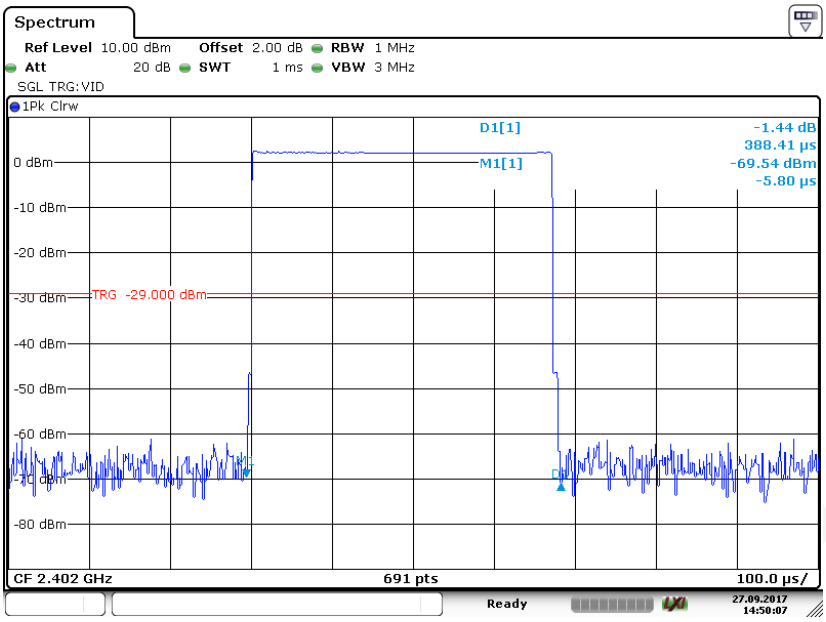
Temperature:	23.4 ℃
Relative Humidity:	51 %
ATM Pressure:	101.2 kPa

The testing was performed by Chris Wang on 2017-09-27.

EUT operation mode: Hopping

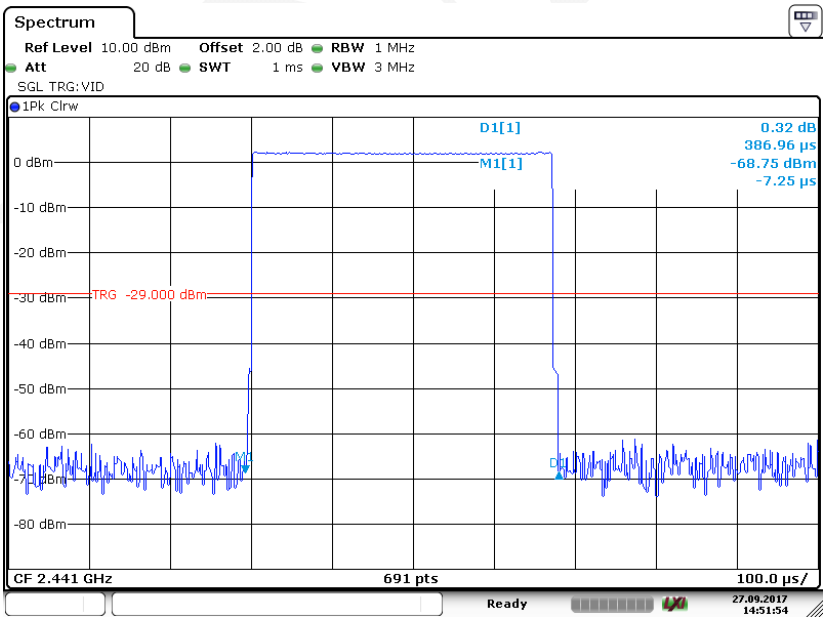
Mode		Channel	Pulse Width (ms)	Dwell Time (s)	Limit (s)	Result
BDR (GFSK)	DH1	Low	0.388	0.124	0.4	Pass
		Middle	0.387	0.124	0.4	Pass
		High	0.390	0.125	0.4	Pass
		Note: DH1:Dwell time = Pulse time*(1600/2/79)*31.6S				
	DH3	Low	1.657	0.265	0.4	Pass
		Middle	1.670	0.267	0.4	Pass
		High	1.665	0.266	0.4	Pass
		Note: DH3:Dwell time = Pulse time*(1600/4/79)*31.6S				
	DH5	Low	2.917	0.311	0.4	Pass
		Middle	2.935	0.313	0.4	Pass
		High	2.935	0.313	0.4	Pass
		Note: DH5:Dwell time = Pulse time*(1600/6/79)*31.6S				
EDR (π/4-DQPSK)	2DH1	Low	0.394	0.126	0.4	Pass
		Middle	0.394	0.126	0.4	Pass
		High	0.394	0.126	0.4	Pass
		Note: 2DH1:Dwell time = Pulse time*(1600/2/79)*31.6S				
	2DH3	Low	1.657	0.265	0.4	Pass
		Middle	1.661	0.266	0.4	Pass
		High	1.674	0.268	0.4	Pass
		Note: 2DH3:Dwell time = Pulse time*(1600/4/79)*31.6S				
	2DH5	Low	2.906	0.310	0.4	Pass
		Middle	2.912	0.311	0.4	Pass
		High	2.906	0.310	0.4	Pass
		Note: 2DH5:Dwell time = Pulse time*(1600/6/79)*31.6S				
EDR (8-DPSK)	3DH1	Low	0.397	0.127	0.4	Pass
		Middle	0.400	0.128	0.4	Pass
		High	0.400	0.128	0.4	Pass
		Note:3 DH1:Dwell time = Pulse time*(1600/2/79)*31.6S				
	3DH3	Low	1.665	0.266	0.4	Pass
		Middle	1.657	0.265	0.4	Pass
		High	1.665	0.266	0.4	Pass
		Note: 3DH3:Dwell time = Pulse time*(1600/4/79)*31.6S				
	3DH5	Low	2.912	0.311	0.4	Pass
		Middle	2.912	0.311	0.4	Pass
		High	2.912	0.311	0.4	Pass
		Note: 3DH5:Dwell time = Pulse time*(1600/6/79)*31.6S				

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



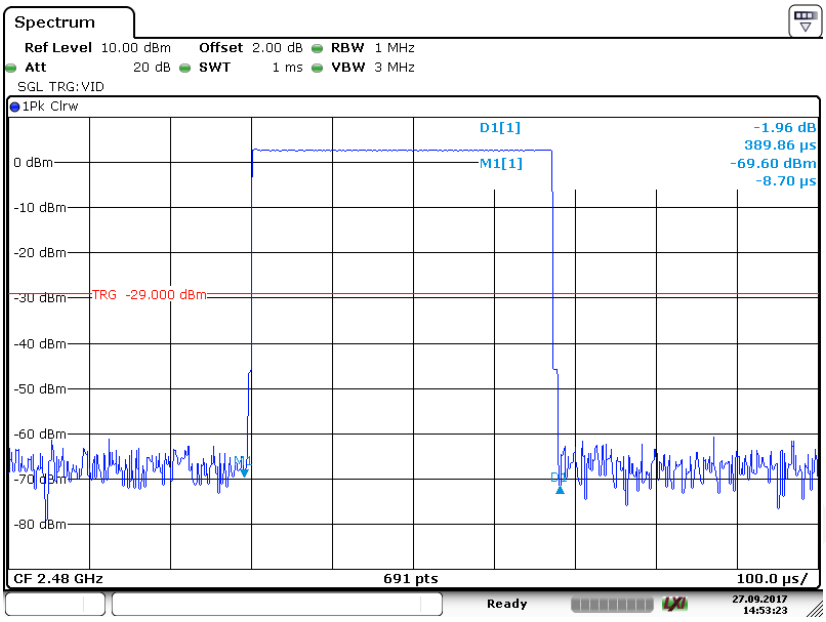
Date: 27.SEP.2017 14:50:07

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



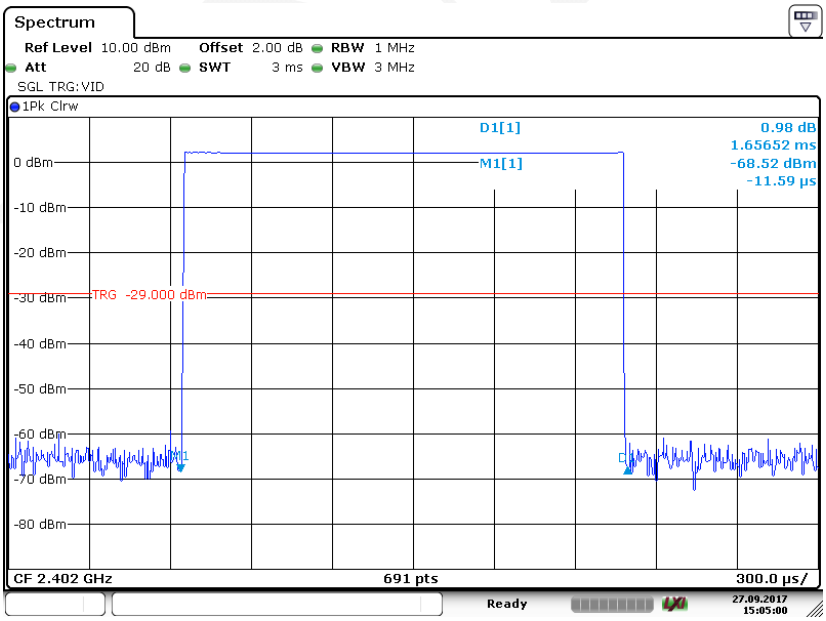
Date: 27.SEP.2017 14:51:55

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



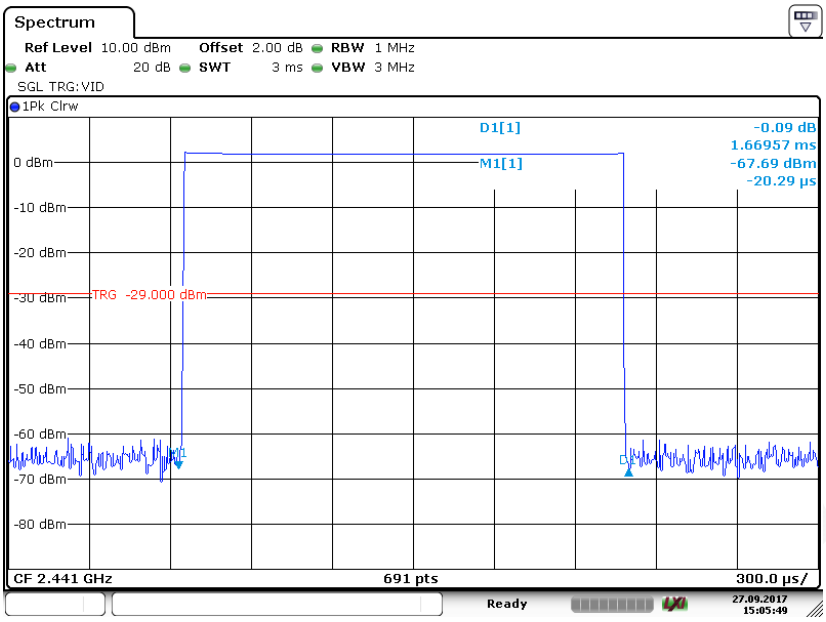
Date: 27.SEP.2017 14:53:22

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



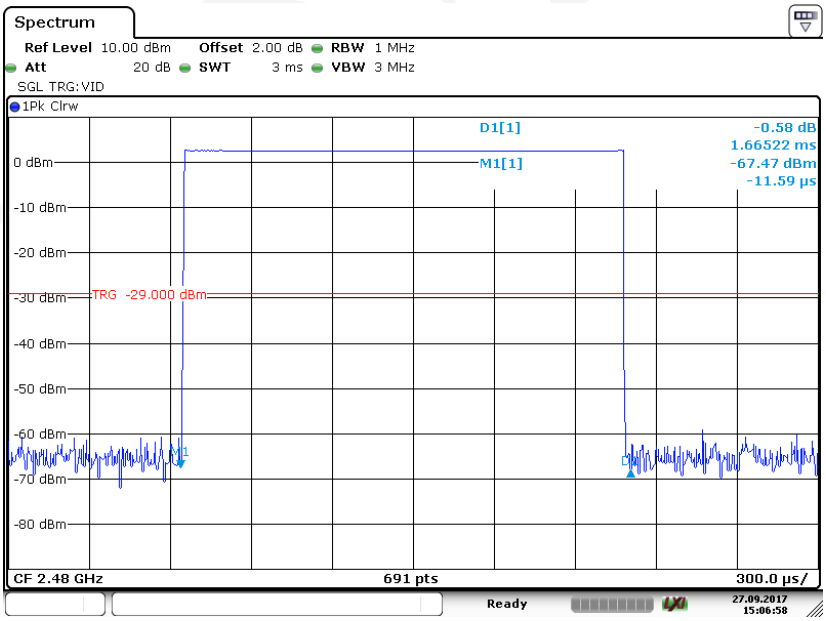
Date: 27.SEP.2017 15:05:00

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



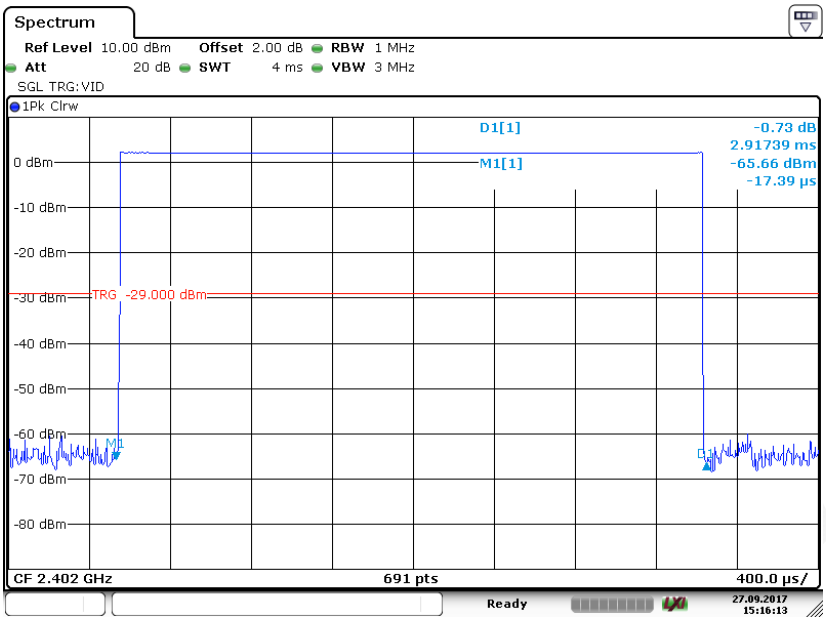
Date: 27.SEP.2017 15:05:49

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



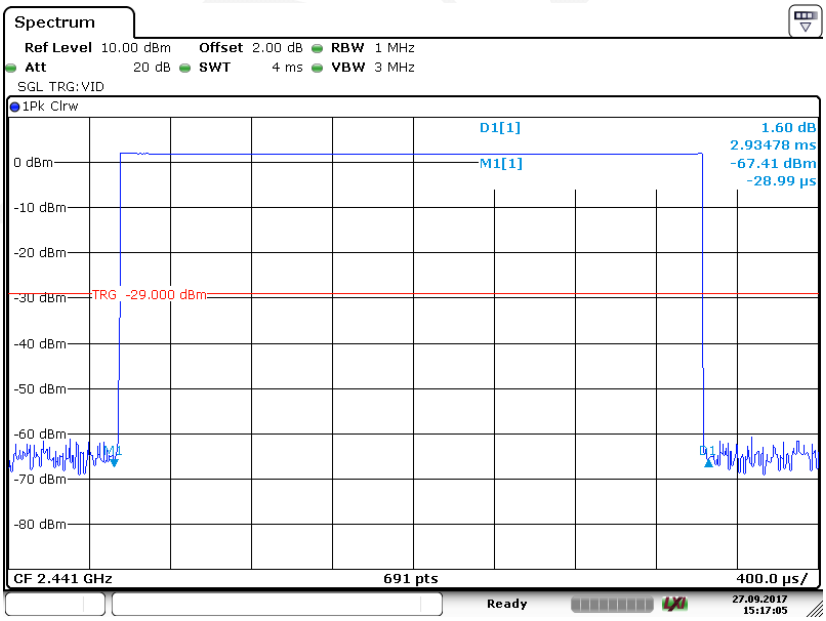
Date: 27.SEP.2017 15:06:58

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



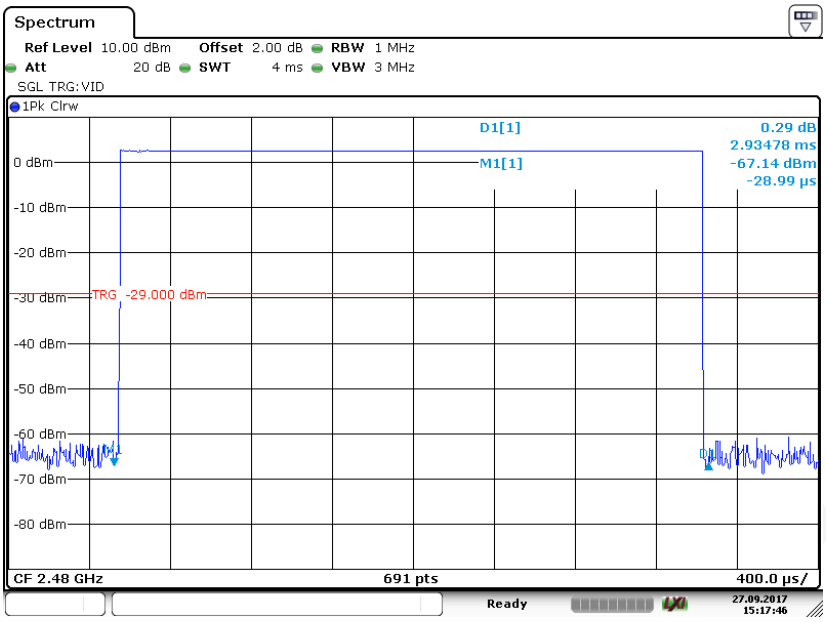
Date: 27.SEP.2017 15:16:14

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



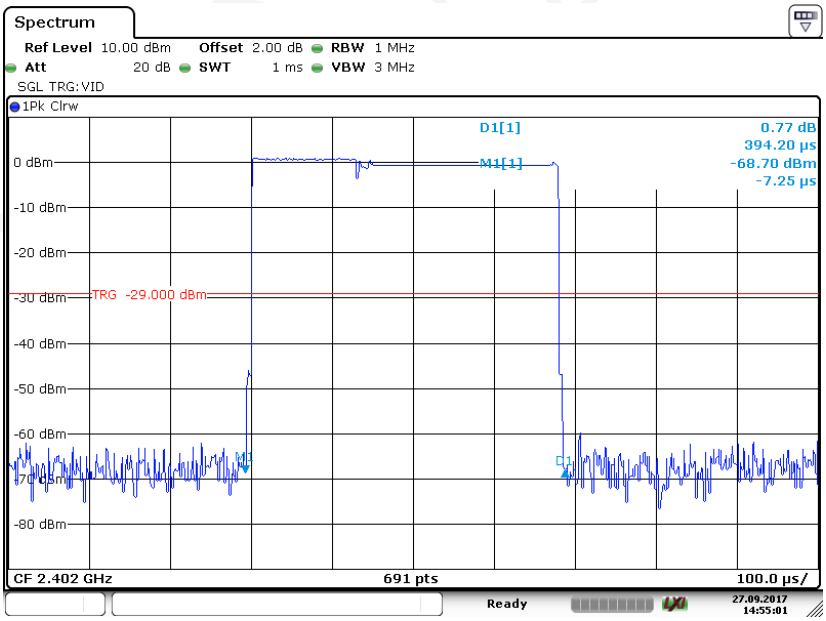
Date: 27.SEP.2017 15:17:05

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



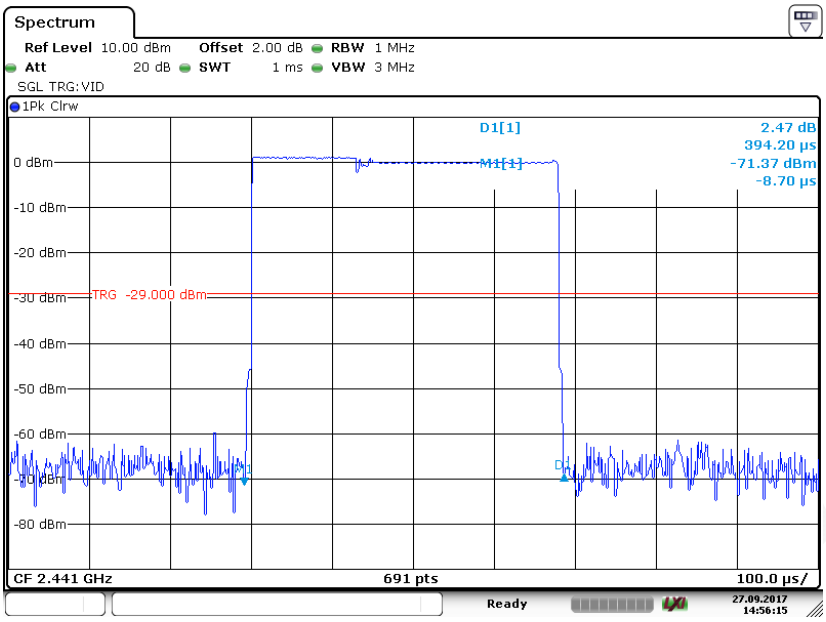
Date: 27.SEP.2017 15:17:46

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



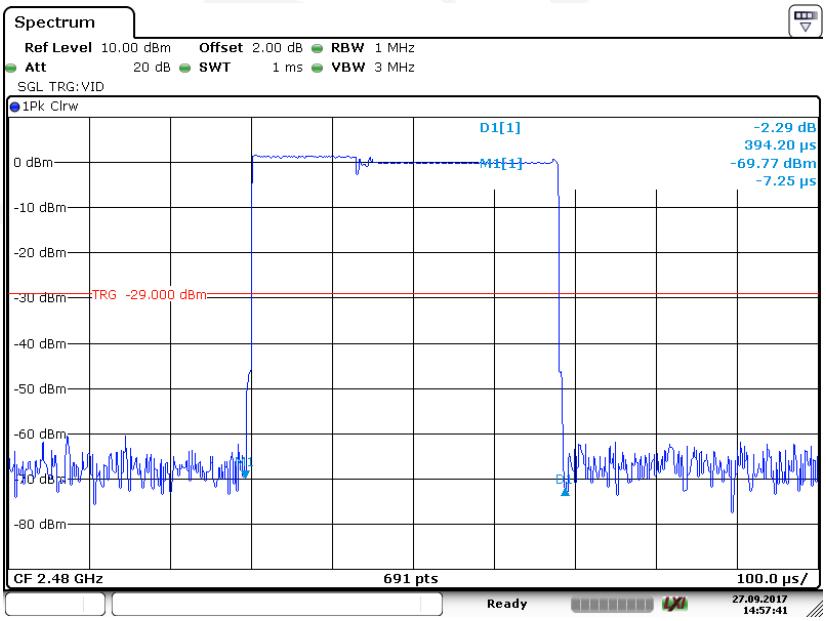
Date: 27.SEP.2017 14:55:02

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



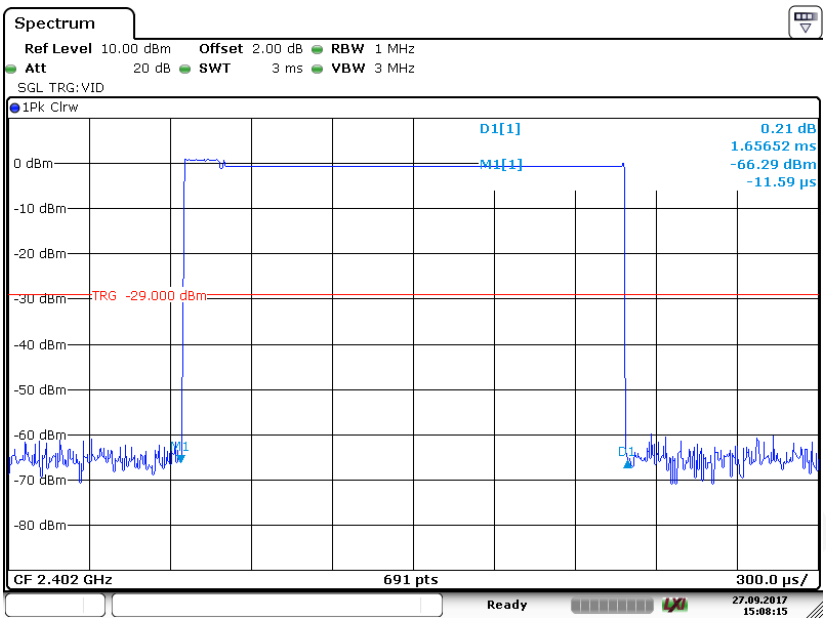
Date: 27.SEP.2017 14:56:15

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



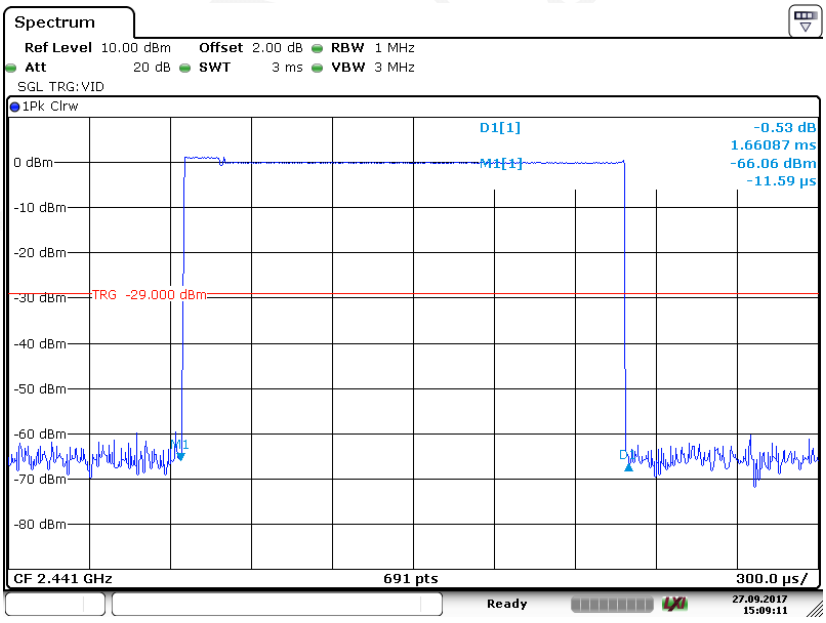
Date: 27.SEP.2017 14:57:41

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



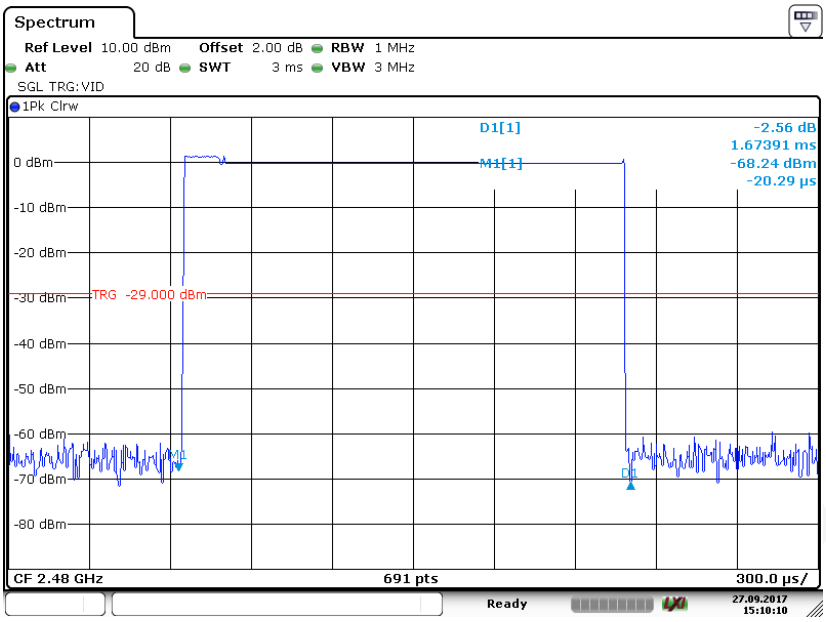
Date: 27.SEP.2017 15:08:15

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



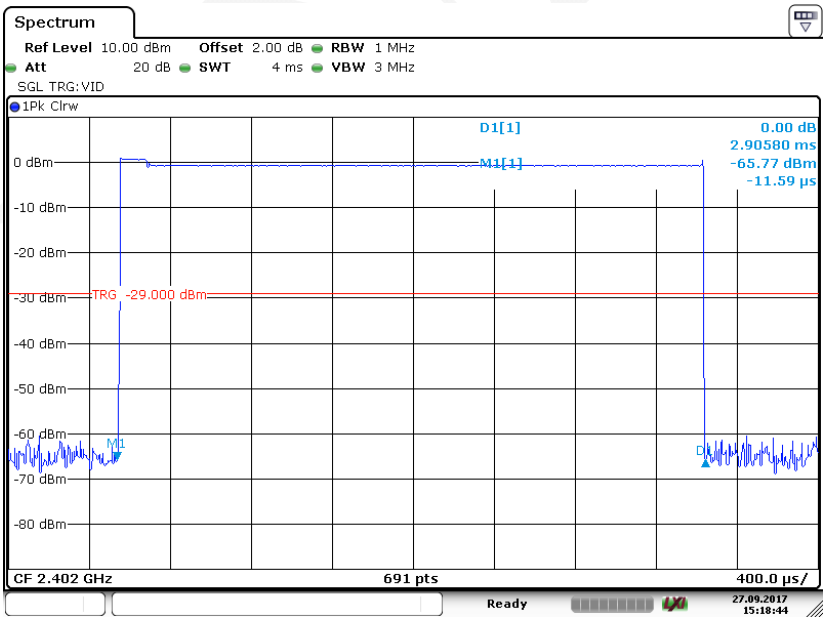
Date: 27.SEP.2017 15:09:11

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



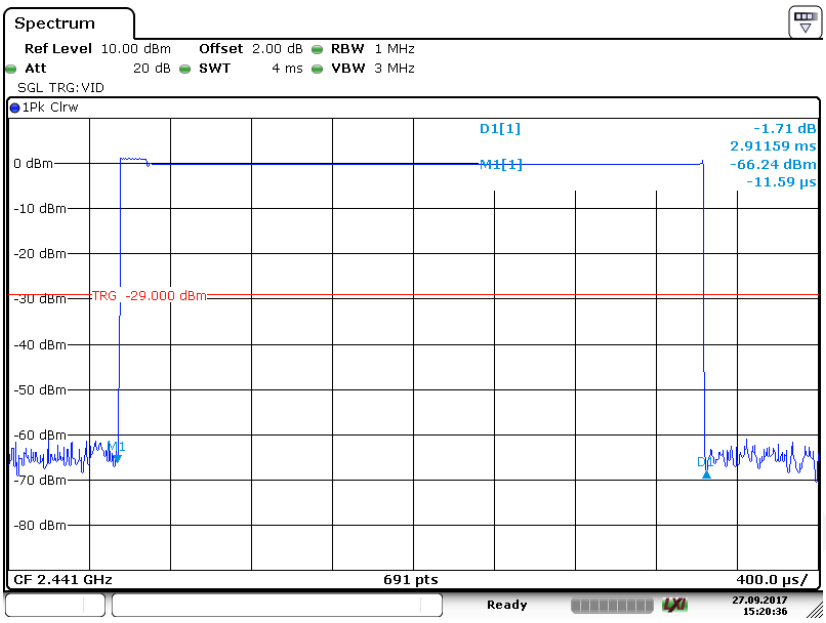
Date: 27.SEP.2017 15:10:10

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



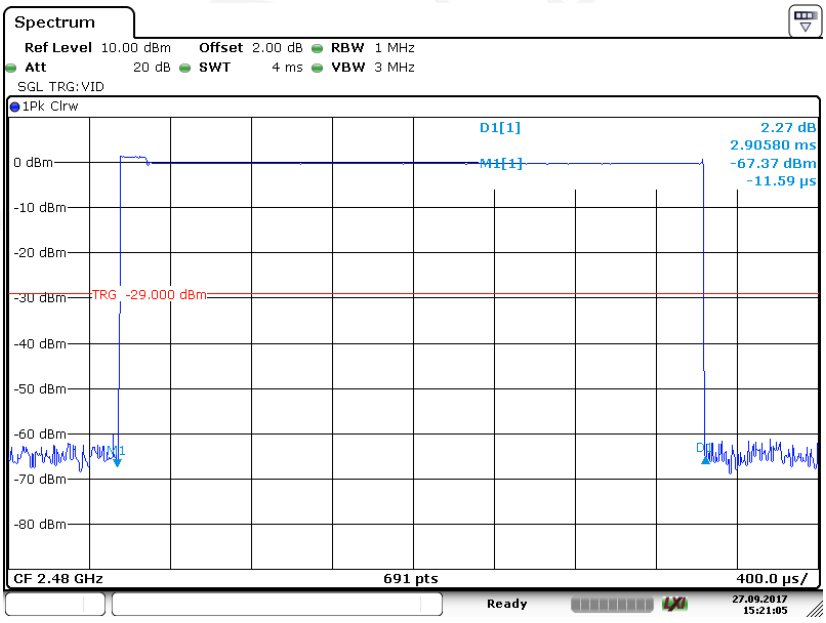
Date: 27.SEP.2017 15:18:43

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



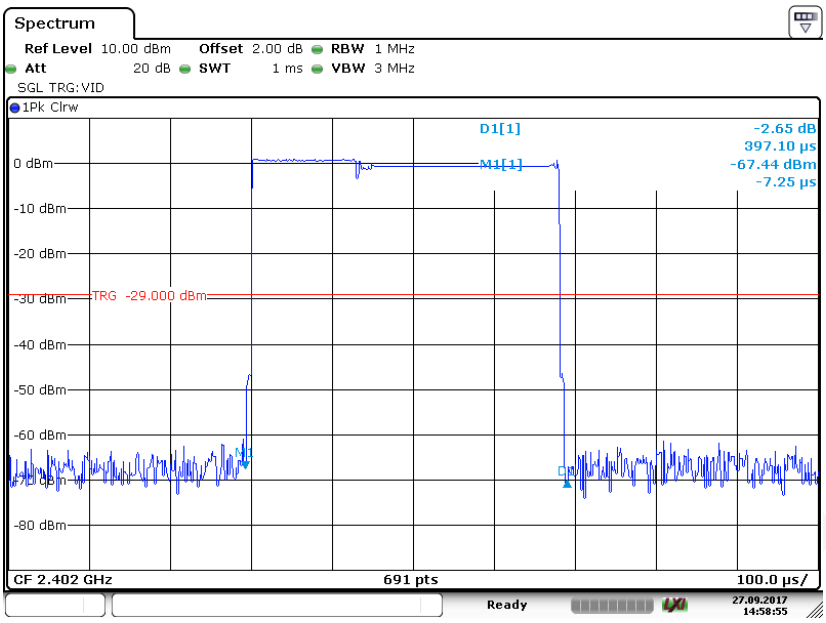
Date: 27.SEP.2017 15:20:36

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



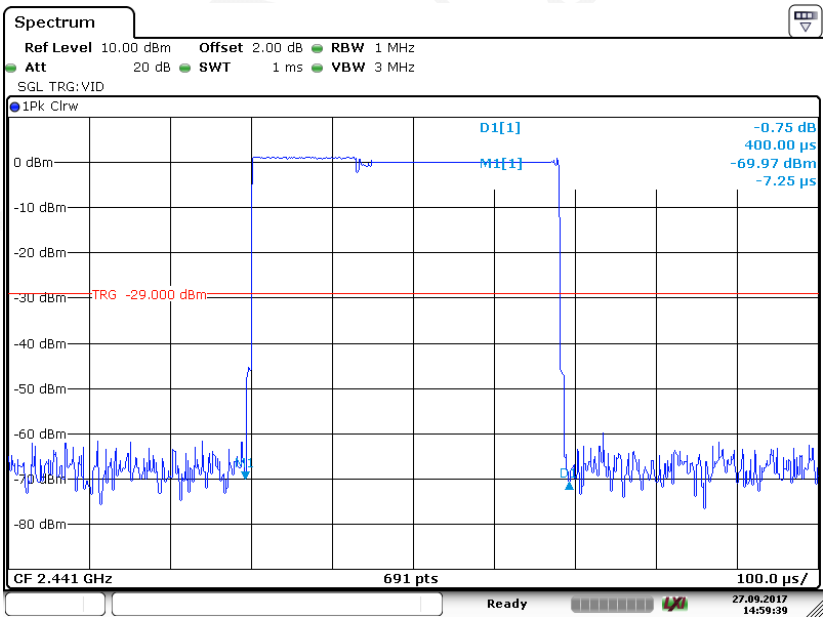
Date: 27.SEP.2017 15:21:06

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



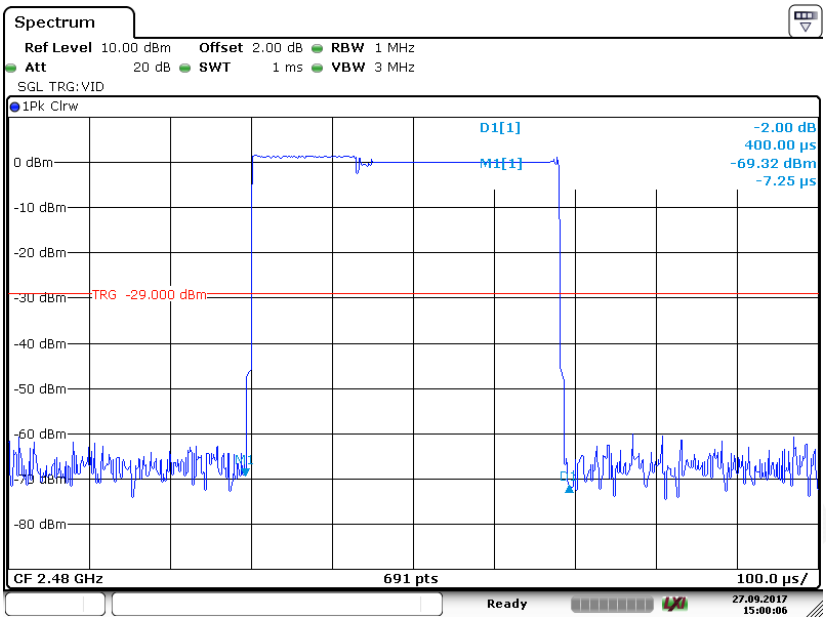
Date: 27.SEP.2017 14:58:55

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



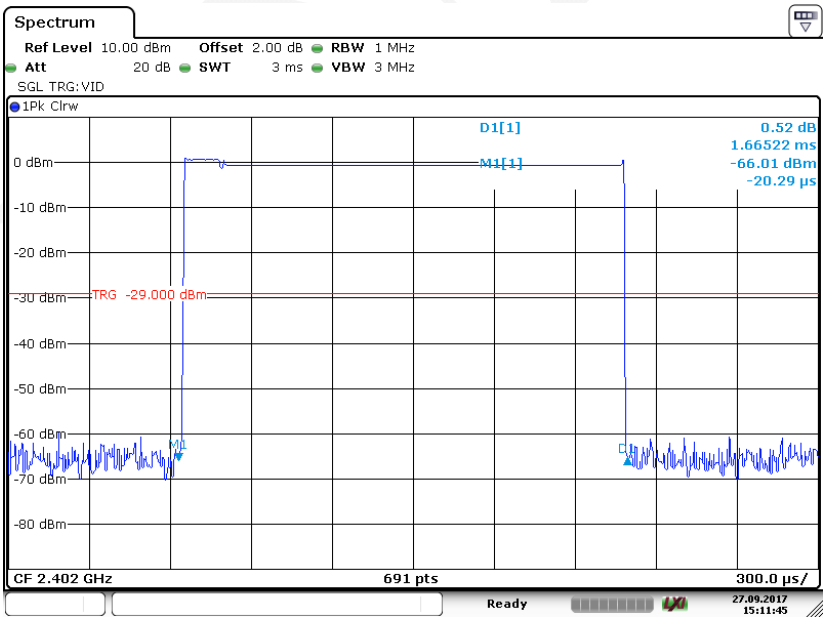
Date: 27.SEP.2017 14:59:39

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



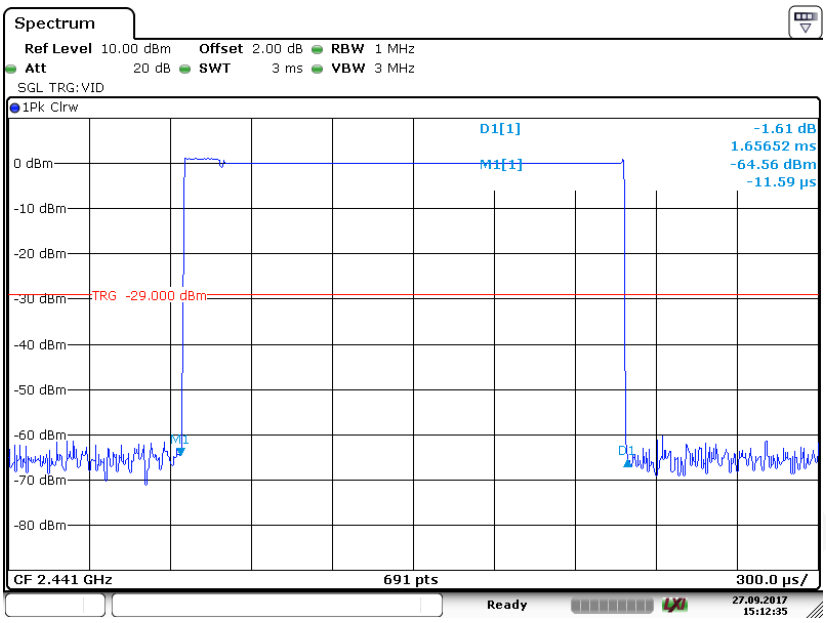
Date: 27.SEP.2017 15:00:07

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



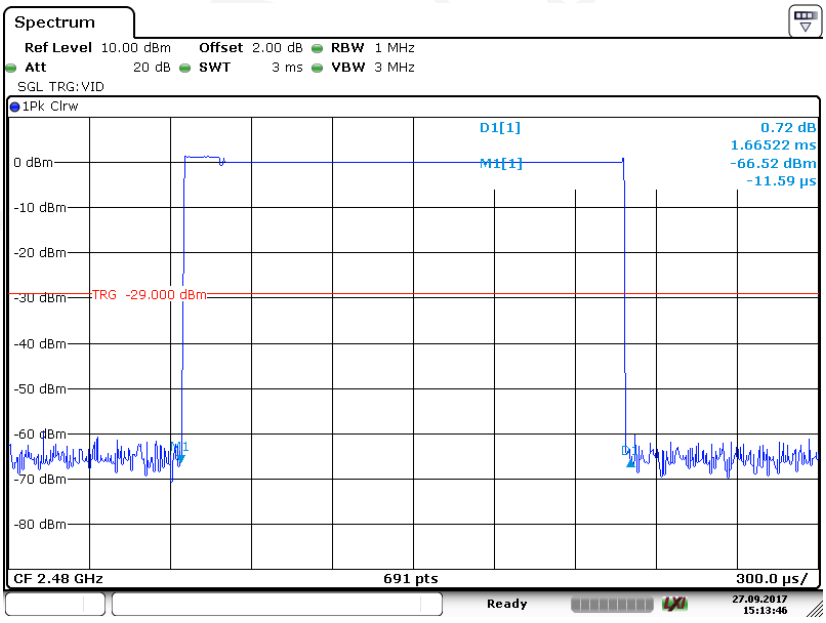
Date: 27.SEP.2017 15:11:45

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



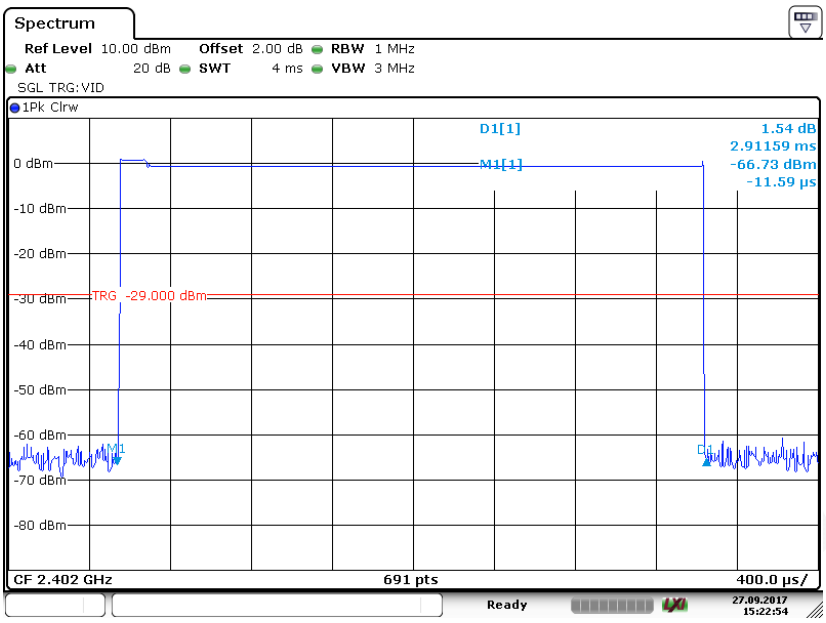
Date: 27.SEP.2017 15:12:36

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



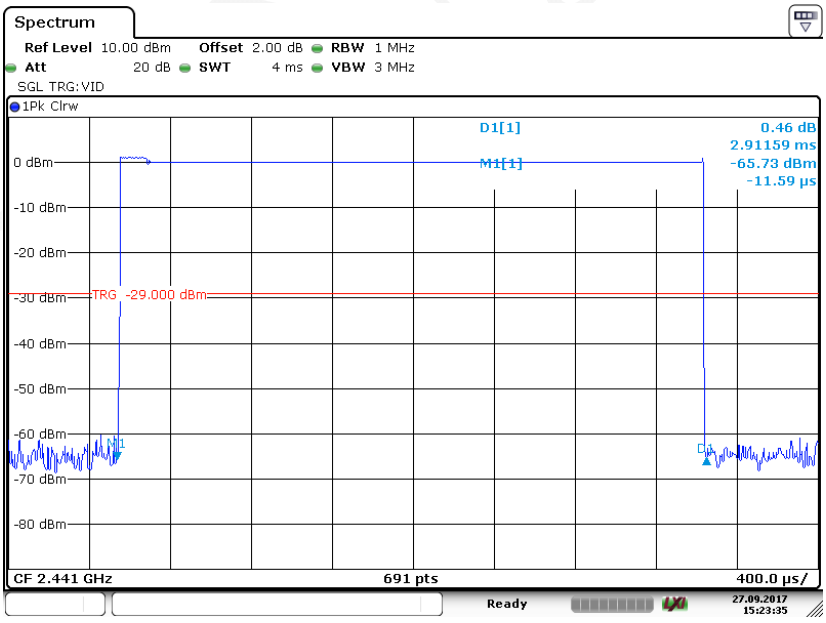
Date: 27.SEP.2017 15:13:47

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



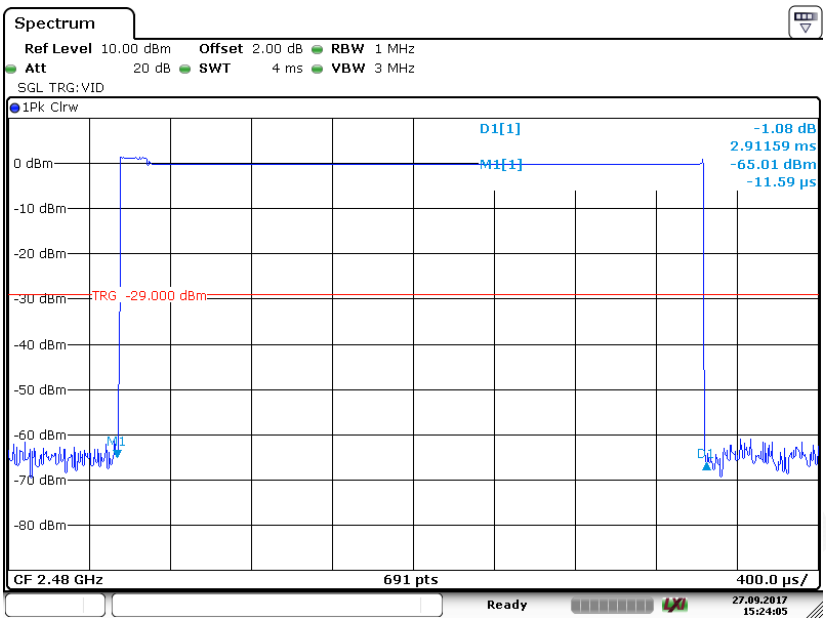
Date: 27.SEP.2017 15:22:55

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



Date: 27.SEP.2017 15:23:34

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



Date: 27.SEP.2017 15:24:06

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

Applicable Standard

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

Test Procedure

1. Place the EUT on a bench and set in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.

Test Data

Environmental Conditions

Temperature:	23.2 ℃
Relative Humidity:	50 %
ATM Pressure:	101.2 kPa

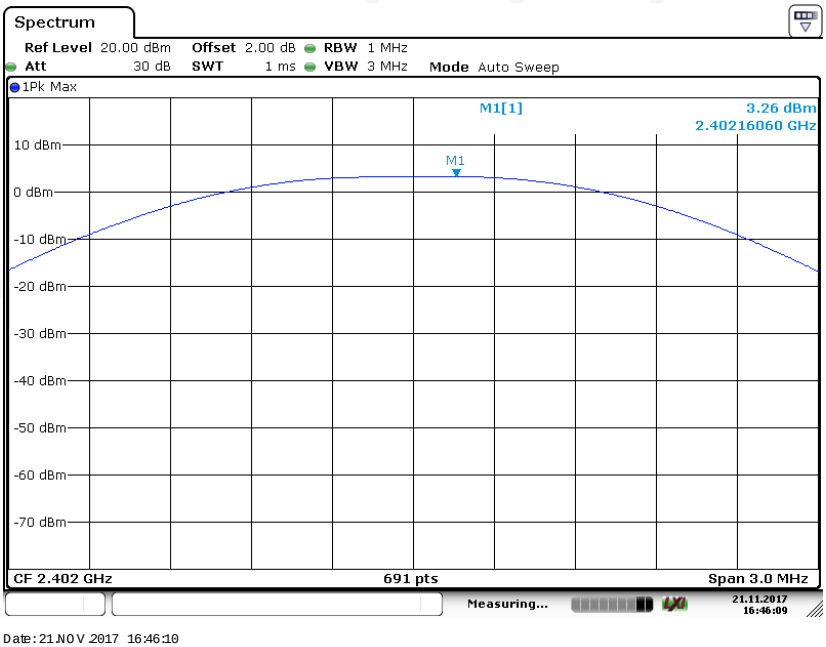
The testing was performed by Chris Wang on 2017-11-21.

EUT operation mode: Transmitting

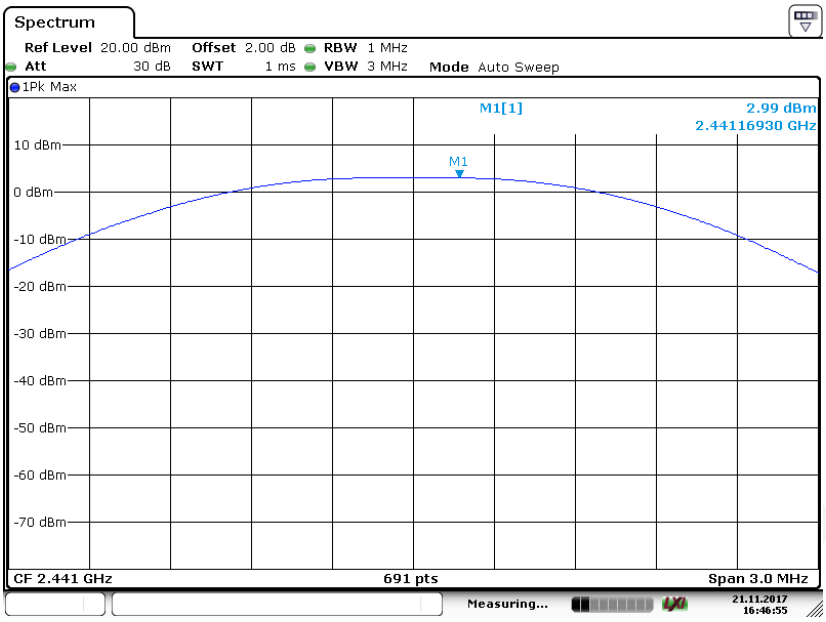
Test Result: Compliance.

Mode	Frequency (MHz)	Output Power		Limit (mW)
		(dBm)	(mW)	
BDR (GFSK)	2402	3.26	2.12	1000
	2441	2.99	1.99	1000
	2456	6.14	4.11	1000
	2480	3.70	2.34	1000
EDR (π/4-DQPSK)	2402	2.25	1.68	125
	2441	2.35	1.72	125
	2456	5.13	3.26	125
	2480	2.69	1.86	125
EDR (8-DPSK)	2402	2.21	1.66	125
	2441	2.36	1.72	125
	2456	5.12	3.25	125
	2480	2.67	1.85	125

BDR (GFSK): 2402MHz

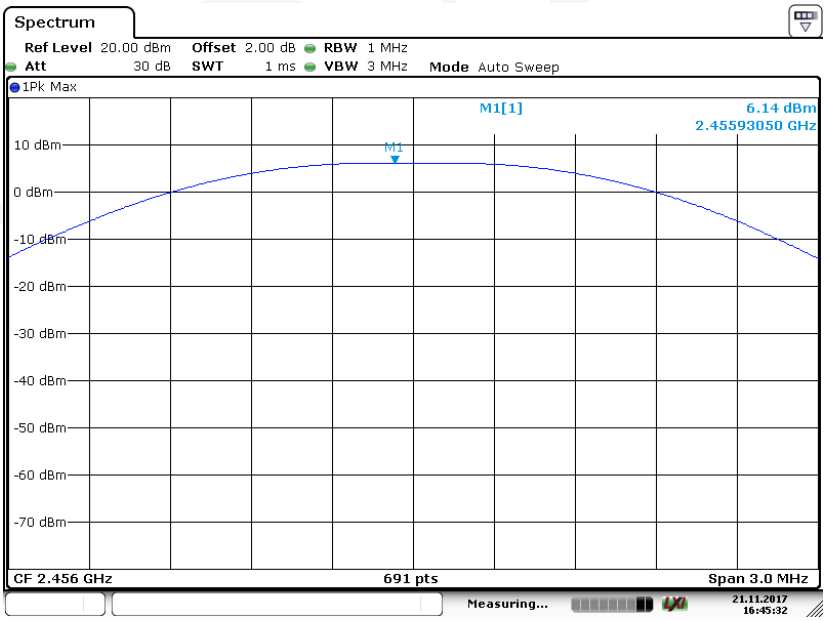


BDR (GFSK): 2441MHz



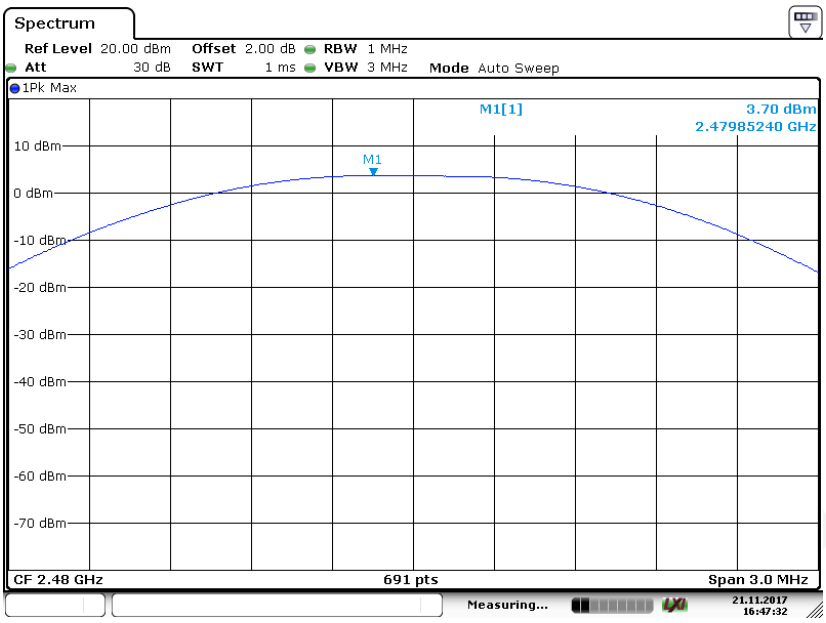
Date: 21.NOV.2017 16:46:55

BDR (GFSK): 2456MHz



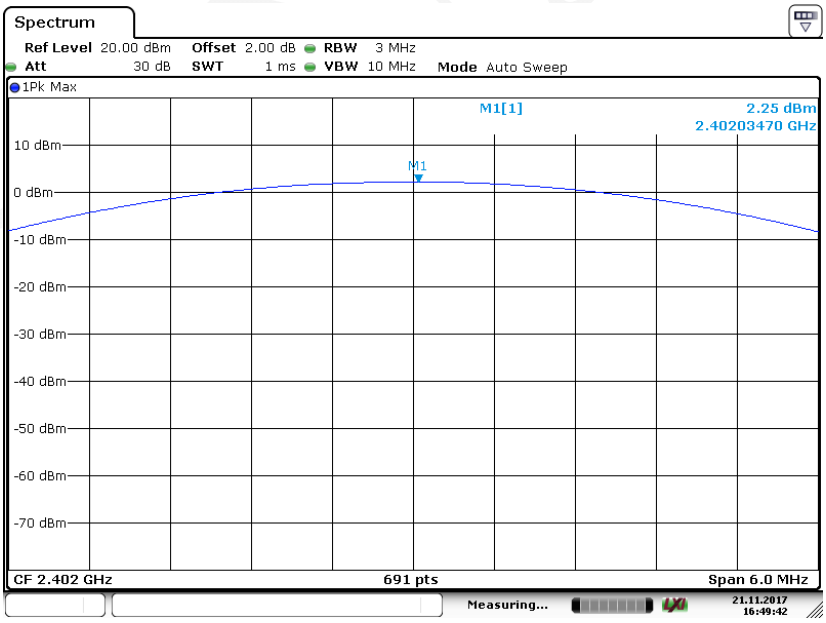
Date: 21.NOV.2017 16:45:33

BDR (GFSK): 2480MHz



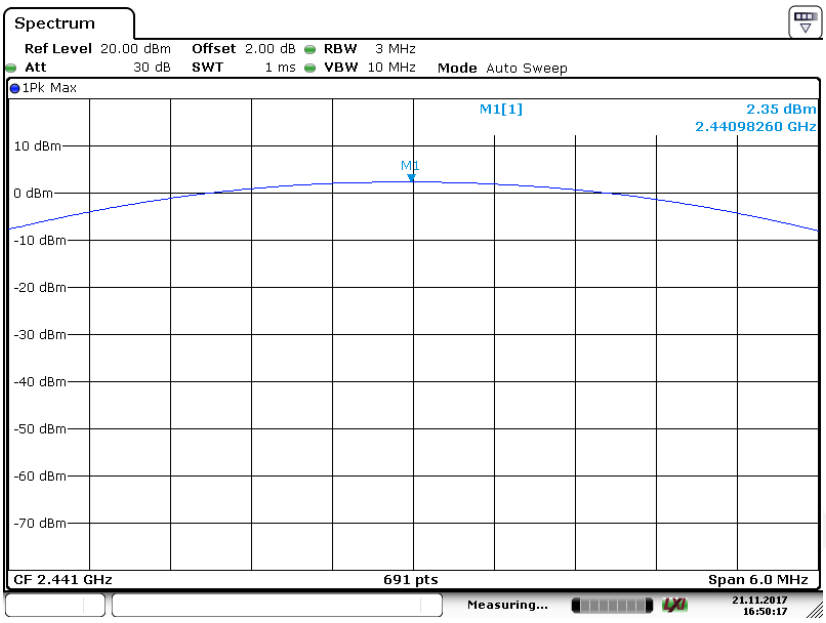
Date: 21.NOV.2017 16:47:32

EDR(π/4-DQPSK): 2402MHz



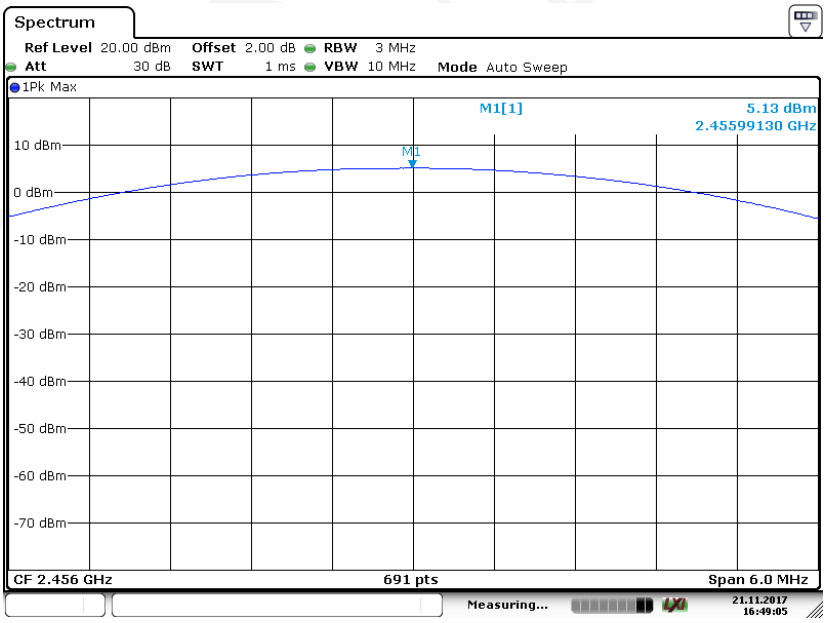
Date: 21.NOV.2017 16:49:42

EDR(π/4-DQPSK): 2441MHz



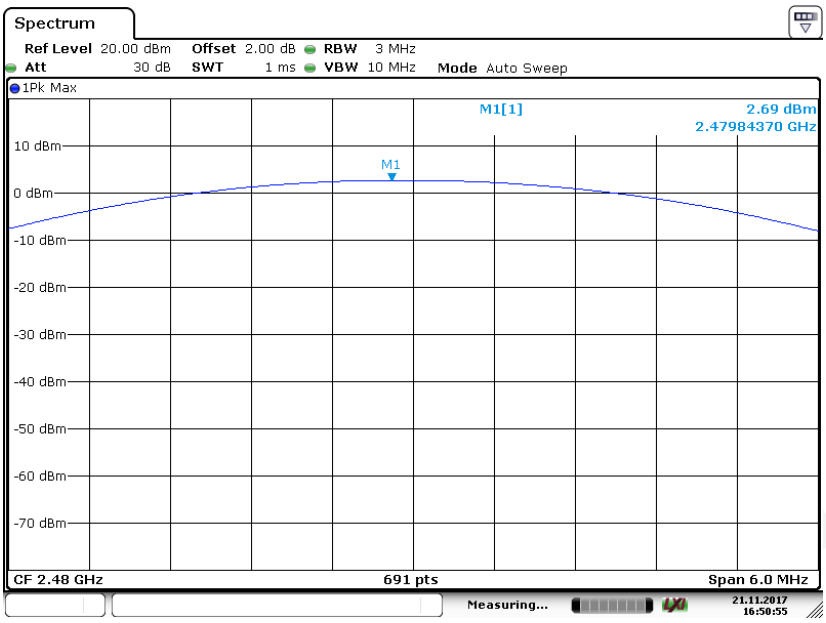
Date: 21.NOV.2017 16:50:17

EDR(π/4-DQPSK): 2456MHz



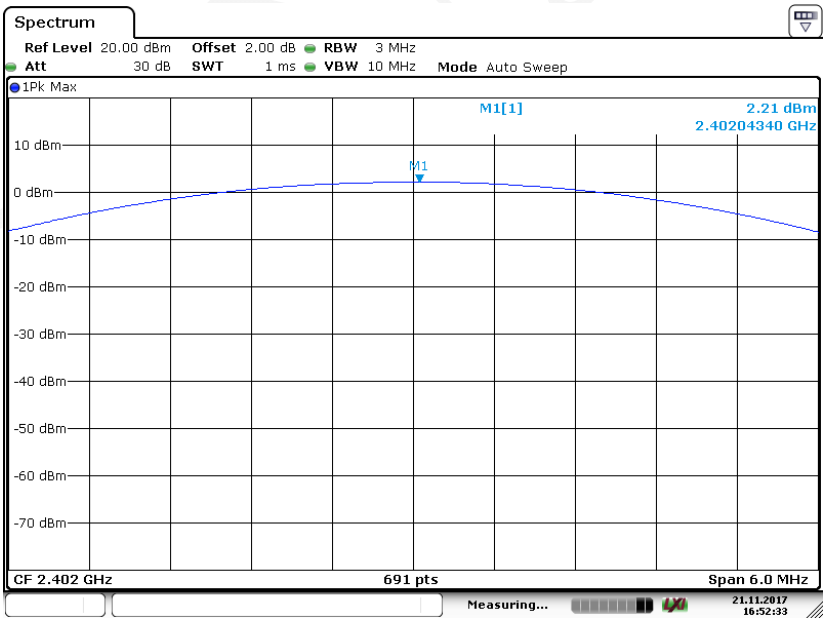
Date: 21.NOV.2017 16:49:05

EDR(π/4-DQPSK): 2480MHz



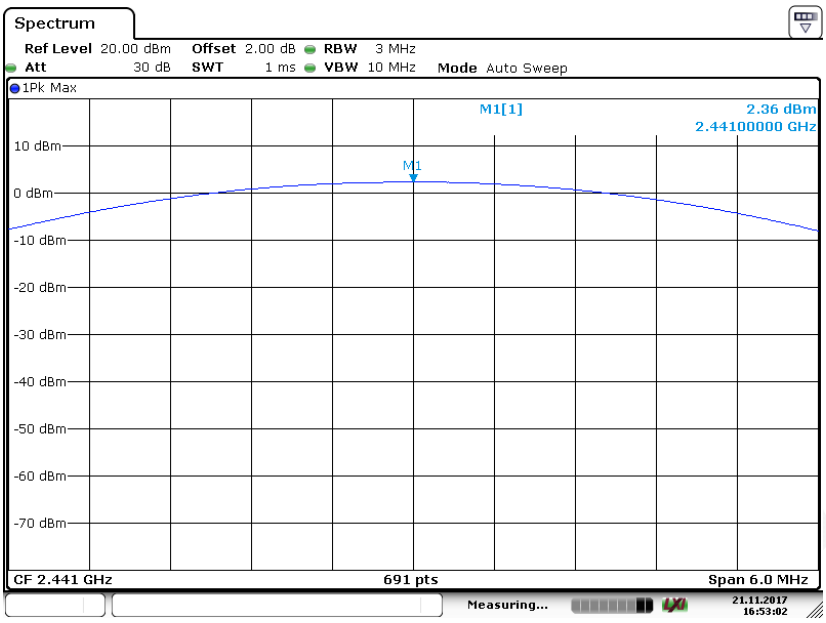
Date: 21.NOV.2017 16:50:55

EDR(8-DPSK): 2402MHz



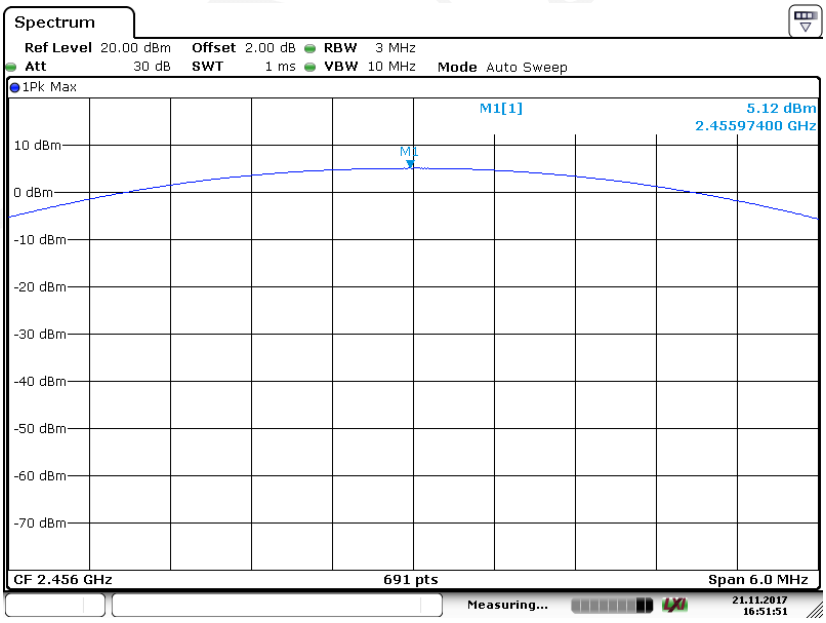
Date: 21.NOV.2017 16:52:34

EDR(8-DPSK): 2441MHz



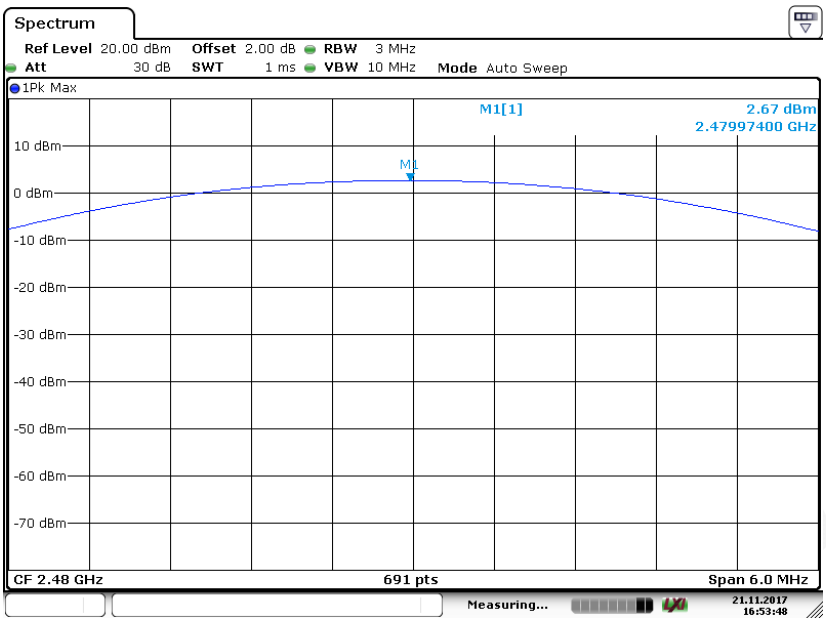
Date: 21.NOV.2017 16:53:02

EDR(8-DPSK): 2456MHz



Date: 21.NOV.2017 16:51:51

EDR(8-DPSK):2480MHz



Date: 21.NOV.2017 16:53:48

FCC §15.247(d) - BAND EDGES TESTING

Applicable Standard

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

Test Procedure

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

Test Data

Environmental Conditions

Temperature:	23.2 ℃
Relative Humidity:	50 %
ATM Pressure:	101.3 kPa

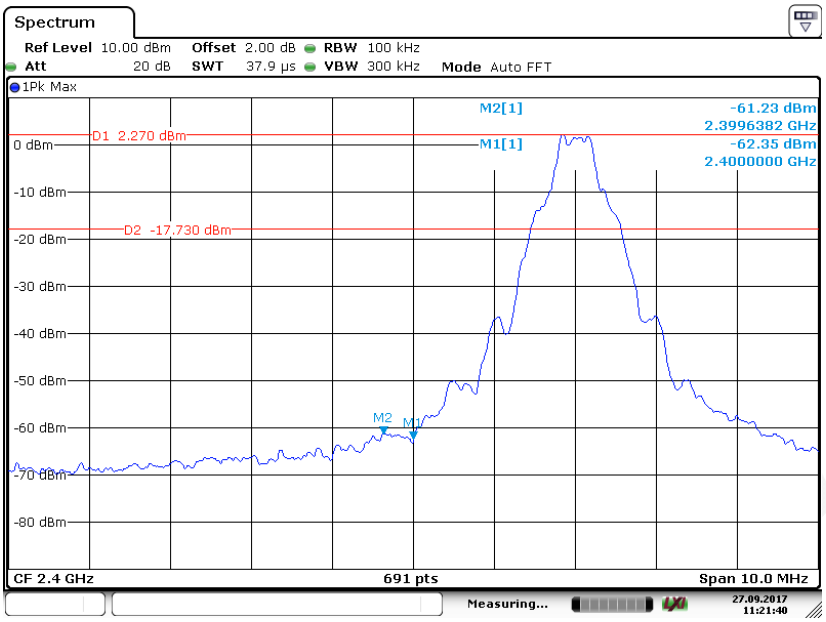
The testing was performed by Chris Wang on 2017-09-27 to 2017-11-21.

EUT operation mode: Transmitting

Test Result: Compliance.

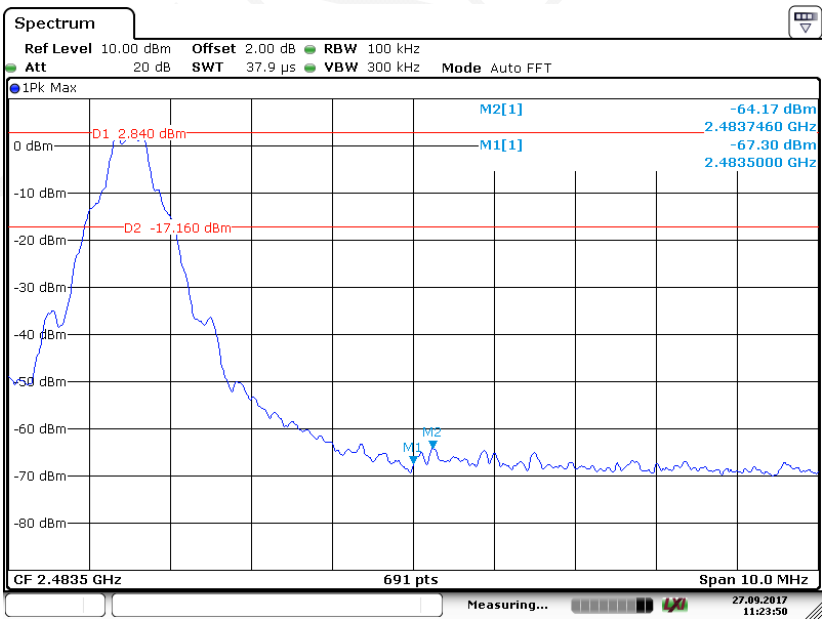
Band Edge

BDR (GFSK): Left Side



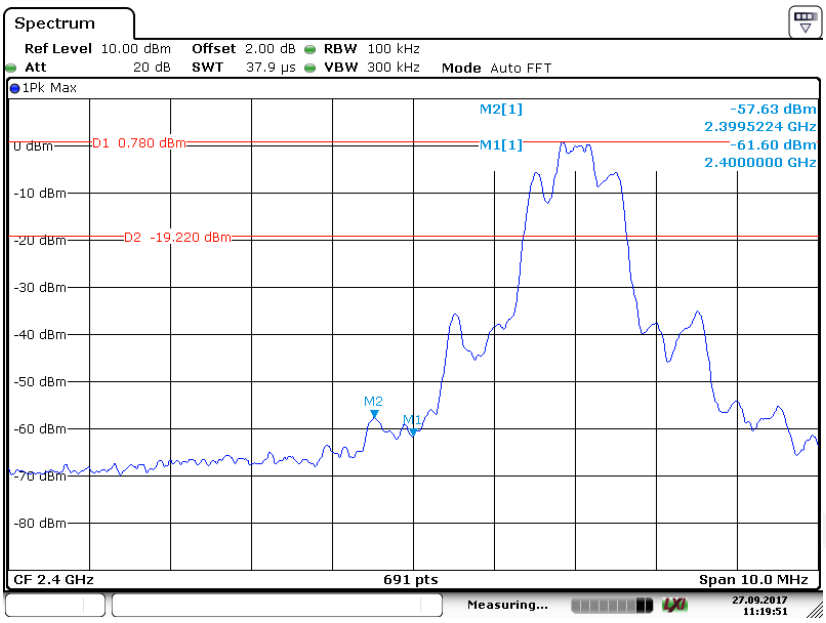
Date: 27.SEP.2017 11:21:40

BDR (GFSK): Right Side



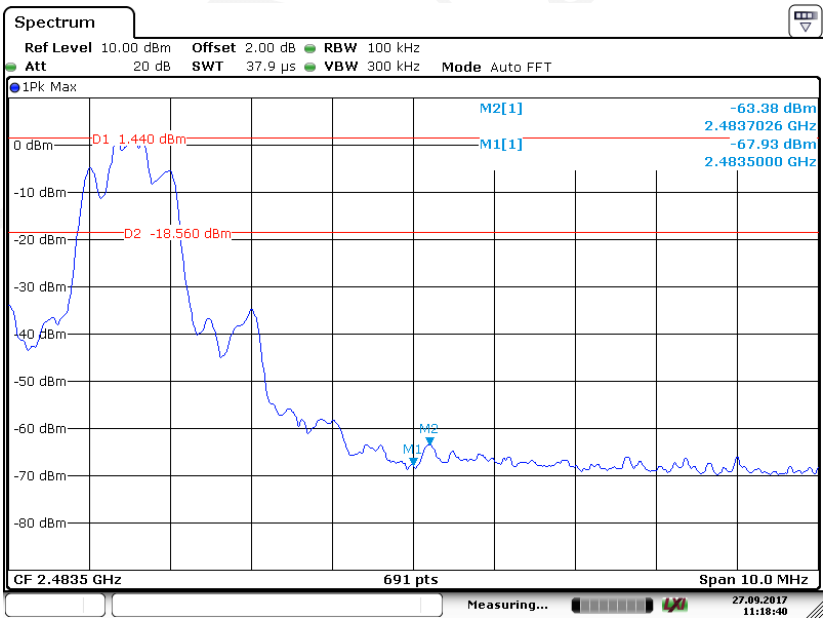
Date: 27.SEP.2017 11:23:51

EDR (π/4-DQPSK): Left Side



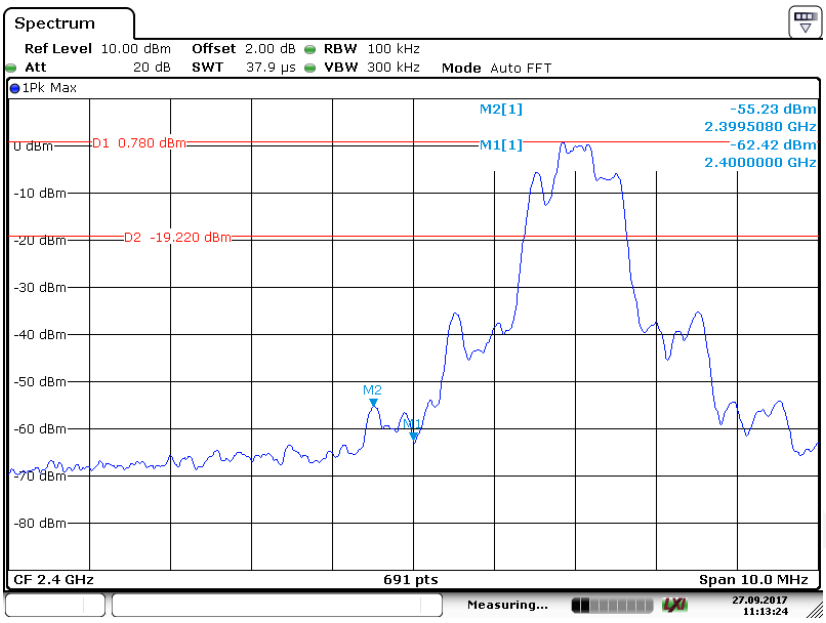
Date: 27.SEP.2017 11:19:51

EDR (π/4-DQPSK): Right Side



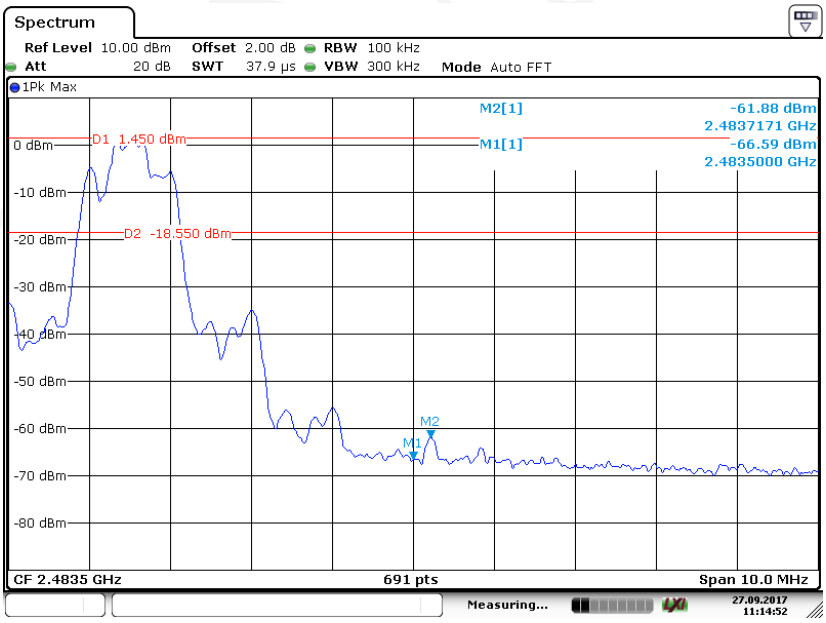
Date: 27.SEP.2017 11:18:40

EDR (8-DPSK): Left Side



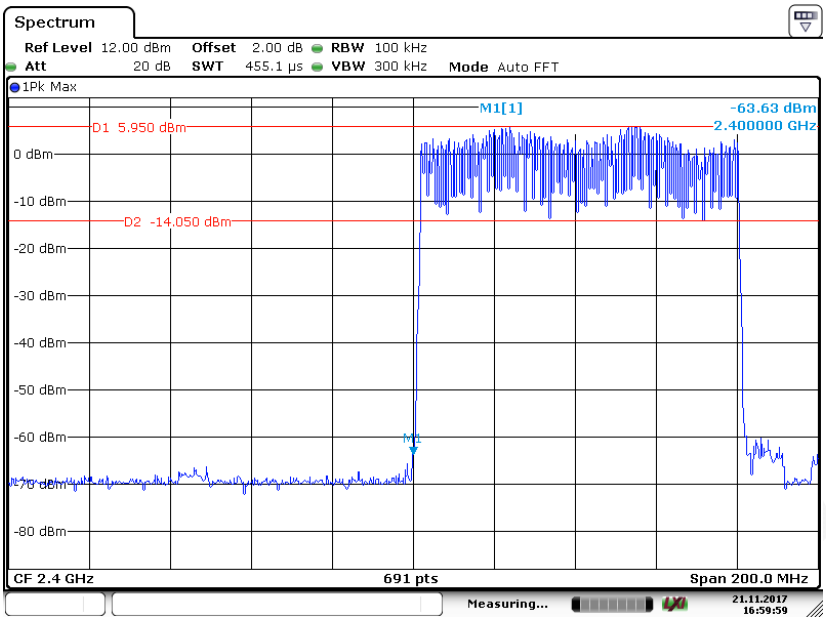
Date: 27.SEP.2017 11:13:24

EDR (8-DPSK): Right Side



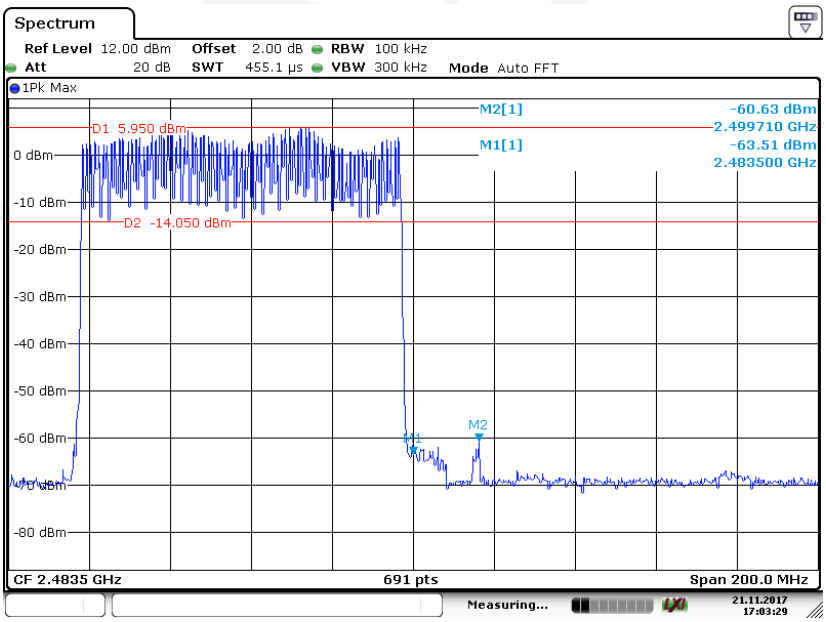
Date: 27.SEP.2017 11:14:53

BDR (GFSK): Left Side - Hopping



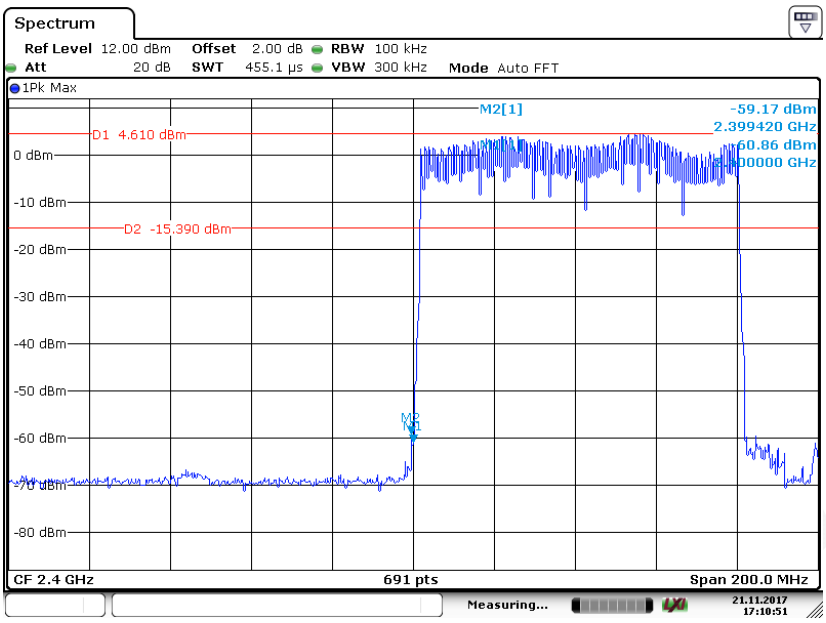
Date: 21.NOV.2017 17:00:00

BDR (GFSK): Right Side- Hopping



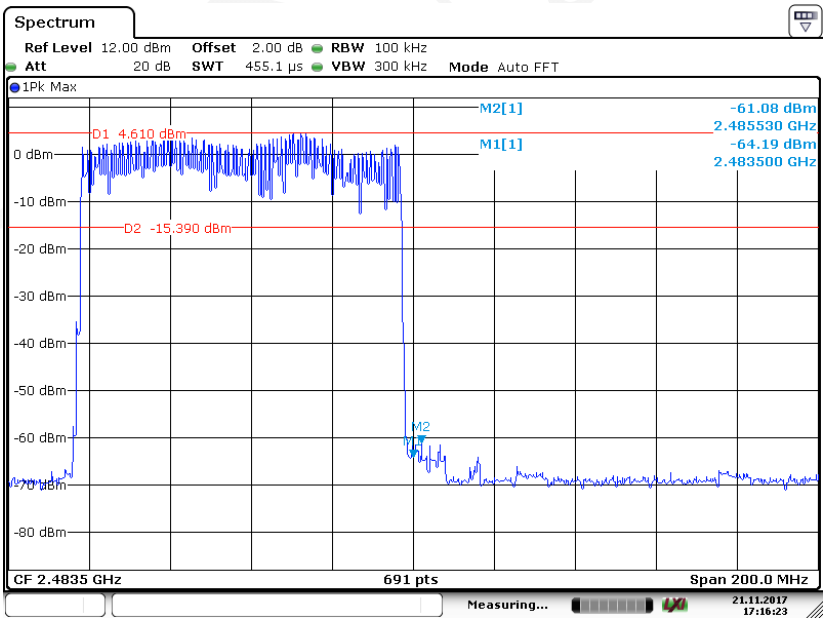
Date: 21.NOV.2017 17:03:29

EDR (π/4-DQPSK): Left Side- Hopping



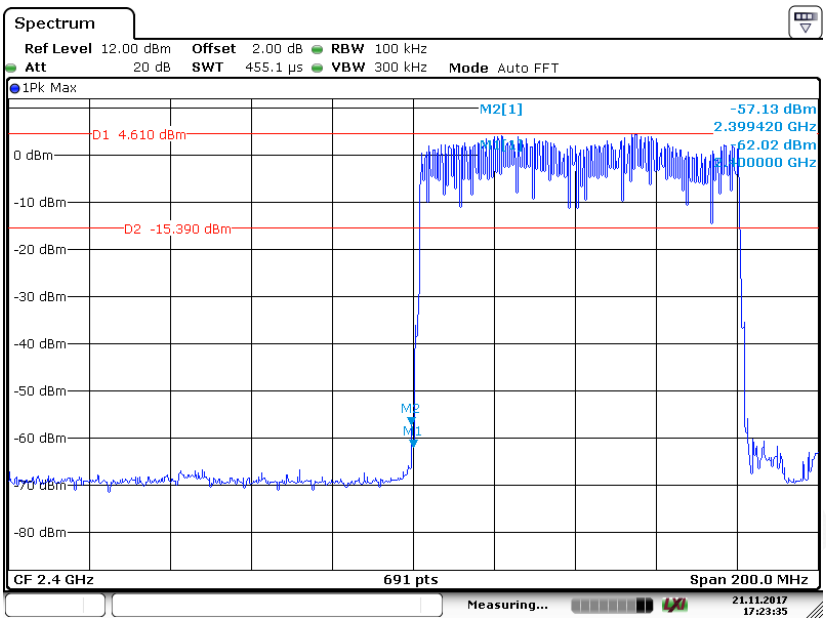
Date: 21.NOV.2017 17:10:52

EDR (π/4-DQPSK): Right Side- Hopping



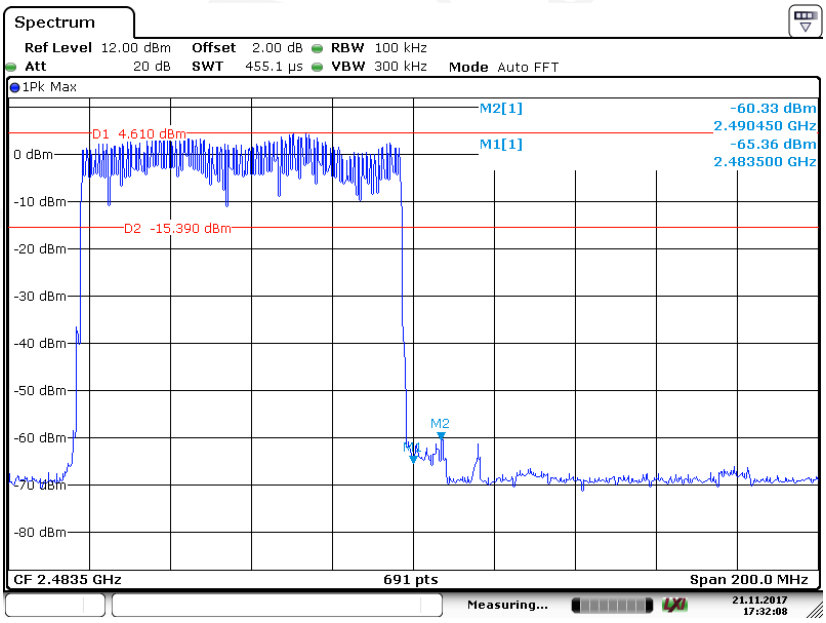
Date: 21.NOV.2017 17:16:24

EDR (8-DPSK): Left Side- Hopping



Date: 21.NOV.2017 17:23:36

EDR (8-DPSK): Right Side- Hopping



Date: 21.NOV.2017 17:32:08

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