FCC Part 15.247

TEST REPORT

For

Wasp Barcode Technologies

1400 10th Street, Plano, TX, 75074, United States

FCC ID: C53WWS550SBR

Report Type Original Report	**Product Type:** Barcode Scanner
Report Producer :	**Himiko Chen**
Report Number :	**RLK1805002-00B**
Report Date :	**2018/05/18**
Reviewed By:	**Jerry Chang**
Prepared By:	**Bay Area Compliance Laboratories Corp.(Taiwan)** **70, Lane 169, Sec. 2, Datong Road, Xizhi Dist.,** **New Taipei City 22183, Taiwan, R.O.C.** **Tel: +886 (2)2647 6898** **Fax: +886 (2) 2647 6895** **www.bacl.com.tw**

***Note**: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Taiwan)*

Revision History

Revision	Report Number	Issue Date	Description	Author/Revised by
1.0	RLK1805002-00B	2018/05/18	Original Report	Himiko Chen

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1 Summary of Test Results

FCC Rules	Description of Test	Result
§15.247(i), §1.1310 ,§ 2.1091	Maximum Permissible Exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Spurious 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)(3)	Maximum Peak Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance

2 General Information

2.1 Product Description for Equipment under Test (EUT)

Applicant	**Wasp Barcode Technologies** 1400 10th Street, Plano, TX, 75074, United States
Manufacturer	**Marson Technology Co., Ltd.** 9F, No. 108-3, Mincyuan Rd., Sindian Dist., New Taipei City 23141 Taiwan R.O.C
Brand(Trade) Name	
Product (Equipment)	Barcode Scanner
Model Name	WWS550SBR
EUT Function	BT: BR+EDR
Frequency Range	2402 MHz ~ 2480 MHz
Number of Channels	79 Channels
Output Power	BT BR(GFSK) Mode: 13.65 dBm (0.02317W) BT EDR(π/4-DQPSK) Mode: 11.79 dBm(0.0151W) BT EDR(8-DPSK) Mode: 13.27 dBm (0.0212W)
Received Date	Apr 24, 2018.
Date of Test	Apr 26, 2018 ~ May 11 2018
Related Submittal(s)/Grant(s)	N/A
Modulation Type	BT BR Mode: GFSK BT EDR-2M Mode: π/4-DQPSK BT EDR-3M Mode: 8-DPSK

**All measurement and test data in this report was gathered from production sample serial number: 1805002 (Assigned by BACL, Taiwan).*

2.2 Operation Condition of EUT

Power Operation (Voltage Range)	☒ AC 120V/60Hz ☒ Adapter *Brand Name: ENG* *Model: 3A-061WP05* *I/P: 100-240Vac* *O/P: 5V ⎓1.2A (4-6V ⎓6W)* ☐ By Power Core
	☐ DC Type ☐ DC Power Supply ☒ Battery : 3.7V ☐ External from USB Cable ☐ External DC Adapter
	☐ Host System

**The worst case was Adapter mode*

**Adapter not for sale*

2.3 Objective and Test Methodology

The Objective of this Test Report was to document the compliance of the Wasp Barcode Technologies Displays (Model: WWS550SBR)) to the requirements of the following Standards:

Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communication Commission's rules.

The objective is to determine compliance with FCC Part 15.247 rules and 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

2.4 Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Taiwan) to collect test data is located on

☒ 70, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

☒ 68-3, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

2.5 Measurement Uncertainty

Parameter	Expanded Measurement Uncertainty
RF output power with Power Meter	± 0.53 dB
Occupied Channel Bandwidth	± 78 kHz
RF Conducted test with Spectrum	± 1.75 dB
AC Power Line Conducted Emission	± 4.64 dB
Radiated 30 MHz – 200 MHz	± 3.76 dB
Radiated 200 MHz – 1 GHz	± 4.12 dB
Radiated 1 GHz – 6 GHz	± 4.84 dB
Radiated 6 GHz – 18 GHz	± 5.16 dB
Radiated 18 GHz – 26 GHz	± 4.84 dB
Radiated 26 GHz – 40 GHz	± 4.30 dB

3 System Test Configuration

3.1 Description of Test Configuration

The system was configured for testing in testing mode which was provided by manufacturer.

No special accessory, no modification was made to the EUT and no special equipment used during test.

For BR/EDR mode, there are totally 79 channels.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	39	2441
1	2403	-	-
2	2404	-	-
3	2405	-	-
4	2406	76	2478
-	-	77	2479
38	2440	78	2480

For BT BR/EDR modes: Channel 0, 39 and 78 were tested.

Radiated below

3.2 Description of Worst Test Configuration

Modulation Used for Conformance Test	
Configuration	**Data Rate**
BR (GFSK) mode	1 Mbps
EDR (π/4-DQPSK) mode	2 Mbps
EDR (8DPSK) mode	3 Mbps

Worst Case of Power Setting			
EUT Exercise Software	BlueSuite2_4_8		
Configuration	**Low CH**	**Mid CH**	**High CH**
BR (GFSK) mode	47	41	50
EDR (π/4-DQPSK) mode	92	95	120
EDR (8DPSK) mode	92	95	120

3.3 Support Equipment List and Details

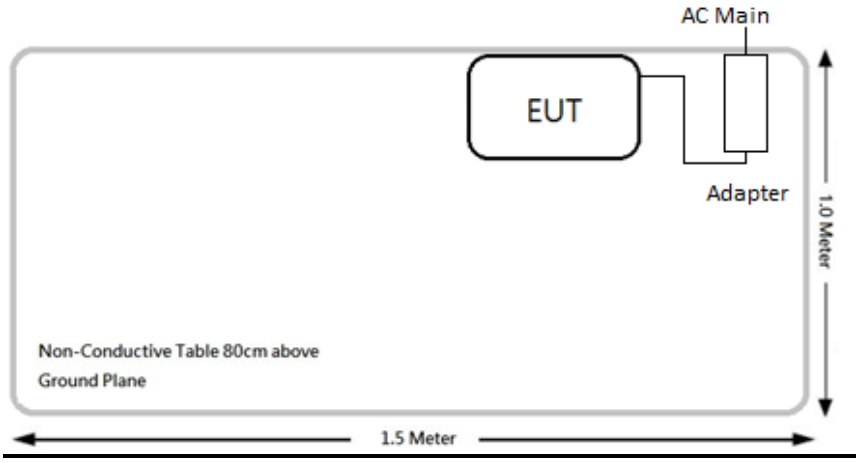
No.	Description	Manufacturer	Model Number	BSMI	FCC ID / DoC
A	NB	DELL	Latitude E5470	R33002	DoC

3.4 External Cable List and Details

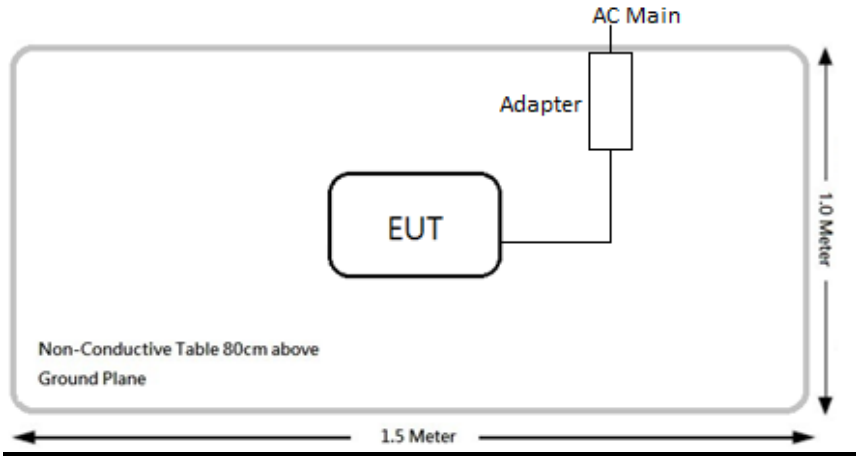
No.	Cable Description	Shielde Type	Ferrite Core	Length
1	DC Cable	Non-Shielded	NA	1.8M

3.5 Block Diagram of Test Setup

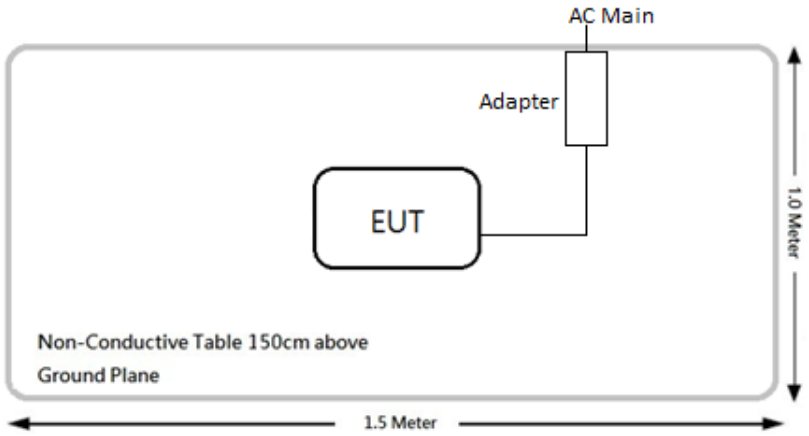
Conduction



Radiation below 1G



Radiation Above 1G



4 FCC §15.247(i), § 2.1093 - RF Exposure

4.1 Applicable Standard

According to FCC §2.1093 and §1.1307(b) (1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB 447498 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
1. f(GHz) is the RF channel transmit frequency in GHz.
2. Power and distance are rounded to the nearest mW and mm before calculation.
3. The result is rounded to one decimal place for comparison.
4. 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 4.1 f) is applied to determine SAR test exclusion.

4.2 RF Exposure Evaluation Result

For BT BR/EDR Mode Worst:

Frequency (MHz)	Tunp-up Power		Evaluation Distance (mm)	SAR Excluion Result	Extremity SAR Exclusion Limit (1g SAR)
	(dBm)	(mW)			
2402-2480	14	25.119	29	1.34	3

The Evaluation Distance as below measurement drawing, distance = 29 mm

Therefore, the stand-alone SAR evaluation for BT (BR/EDR) is not necessary.

5 FCC §15.203 – Antenna Requirements

5.1 Applicable Standard

According to § 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 user of a standard antenna jack or electrical connector is prohibited.

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 does not exceed 6 dBi.

5.2 Antenna List and Details

Manufacturer	Model	Antenna Type	Antenna Gain	Result
Walsin Technology	RFANT5220110A0T	Chip Antenna	2.66 dBi	Compliance

The EUT has an internal antenna arrangement, which was permanently attached, fulfill the requirement of this section.

6 FCC §15.207 - AC Line Conducted Emissions

6.1 Applicable Standard

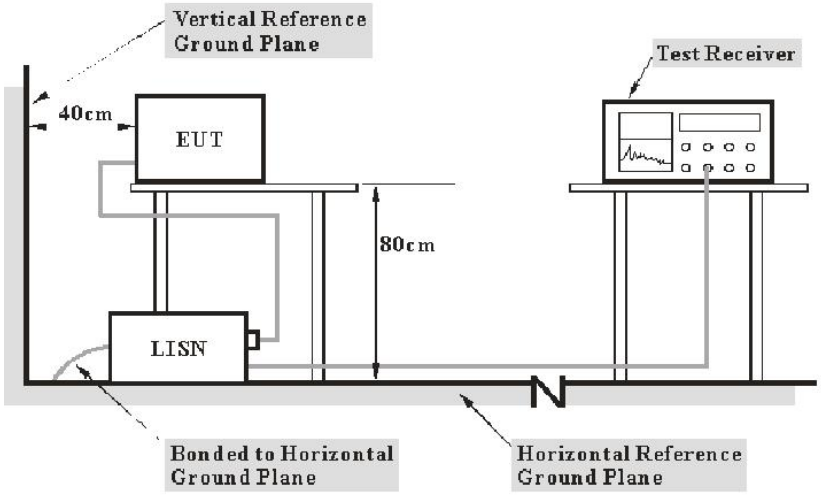
According to FCC §15.207

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 Note 1	56 to 46 Note 2
0.5-5	56	46
5-30	60	50

Note 1: Decreases with the logarithm of the frequency.
Note 2: A linear average detector is required

6.2 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.

6.3 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	Receiver RBW
150 kHz - 30 MHz	9 kHz

6.4 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.

6.5 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Date	Calibration Due Date
LISN	EMCO	3816/2	00075848	2017/08/02	2018/08/01
LISN	Rohde & Schwarz	ENV216	101248	2017/07/20	2018/07/19
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2017/11/06	2018/11/05
Pulse Limiter	Rohde & Schwarz	ESH3Z2	TXZEM104	2017/08/10	2018/08/09
RF Cable	EMEC	EM-CB5D	001	2017/07/10	2018/07/09
Software	AUDIX	E3	V9.150826k	N.C.R	N.C.R

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).*

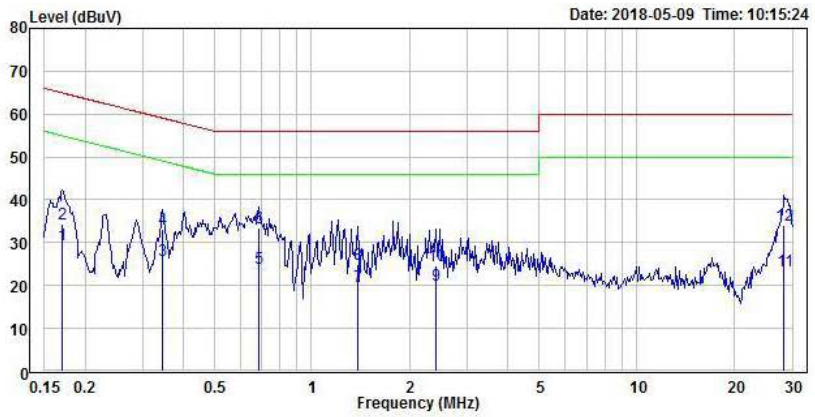
6.6 Test Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	58 %
ATM Pressure:	1010 hPa

The testing was performed by Ian Tu on 2018-05-09.

6.7 AC Line Conducted Emission Test Plot and Data

Mode 1: AC 120V/60 Hz, Line



Condition: limit\FCC\FCC Conduction Clsaa-B QP.csv Line
EUT : BT Barcode Scanner
Mode : WWS550SBR
Note : 120V/60Hz
: SCAN + ADAPTER

	Freq	Level	Limit Line	Over Limit	Factor	Read Level	Remark	Pol/Phase
	MHz	dBuV	dBuV	dB	dB	dBuV		
1	0.170	29.54	54.94	-25.40	19.50	10.04	Average	Line
2	0.170	34.31	64.94	-30.63	19.50	14.81	QP	Line
3	0.346	25.71	49.05	-23.34	19.51	6.20	Average	Line
4	0.346	33.30	59.05	-25.75	19.51	13.79	QP	Line
5	0.687	24.00	46.00	-22.00	19.52	4.48	Average	Line
6	0.687	33.44	56.00	-22.56	19.52	13.92	QP	Line
7	1.385	19.91	46.00	-26.09	19.54	0.37	Average	Line
8	1.385	24.84	56.00	-31.16	19.54	5.30	QP	Line
9	2.419	19.98	46.00	-26.02	19.59	0.39	Average	Line
10	2.419	24.59	56.00	-31.41	19.59	5.00	QP	Line
11	28.373	23.36	50.00	-26.64	19.89	3.47	Average	Line
12	28.373	33.95	60.00	-26.05	19.89	14.06	QP	Line

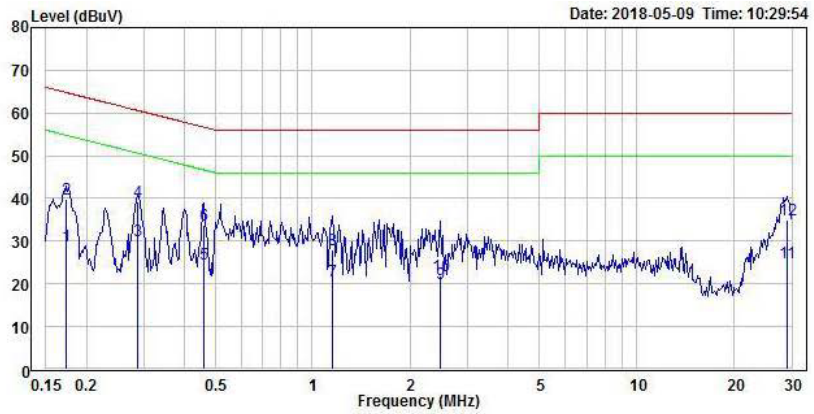
Note:

Level = Read Level + Factor

Over Limit (Margin) = Level – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

Mode 1: AC 120V/60 Hz, Neutral



Condition: limit\FCC\FCC Conduction Clsaa-B QP.csv Neutral
EUT : BT Barcode Scanner
Mode : WWS550SBR
Note : 120V/60Hz
: SCAN + ADAPTER

	Freq	Level	Limit Line	Over Limit	Factor	Read Level	Remark	Pol/Phase
	MHz	dBuV	dBuV	dB	dB	dBuV		
1	0.173	29.03	54.81	-25.78	19.63	9.40	Average	Neutral
2	0.173	39.88	64.81	-24.93	19.63	20.25	QP	Neutral
3	0.288	30.20	50.57	-20.37	19.63	10.57	Average	Neutral
4	0.288	39.24	60.57	-21.33	19.63	19.61	QP	Neutral
5	0.461	24.68	46.67	-21.99	19.64	5.04	Average	Neutral
6	0.461	33.82	56.67	-22.85	19.64	14.18	QP	Neutral
7	1.153	20.55	46.00	-25.45	19.68	0.87	Average	Neutral
8	1.153	28.11	56.00	-27.89	19.68	8.43	QP	Neutral
9	2.478	20.08	46.00	-25.92	19.73	0.35	Average	Neutral
10	2.478	21.77	56.00	-34.23	19.73	2.04	QP	Neutral
11	29.059	24.95	50.00	-25.05	20.14	4.81	Average	Neutral
12	29.059	35.03	60.00	-24.97	20.14	14.89	QP	Neutral

Note:

Level = Read Level + Factor

Over Limit (Margin) = Level – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

7 FCC §15.209, §15.205, §15.247(d) – Spurious Emissions

7.1 Applicable Standard

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As Per FCC §15.205(a) and RSS-Gen except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	4. 5 – 5. 15 5. 35 – 5. 46 7.25 – 7.75 8.025 – 8.5 9.0 – 9.2 9.3 – 9.5 10.6 – 12.7 13.25 – 13.4 14.47 – 14.5 15.35 – 16.2 17.7 – 21.4 22.01 – 23.12 23.6 – 24.0 31.2 – 31.8 36.43 – 36.5 Above 38.6

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

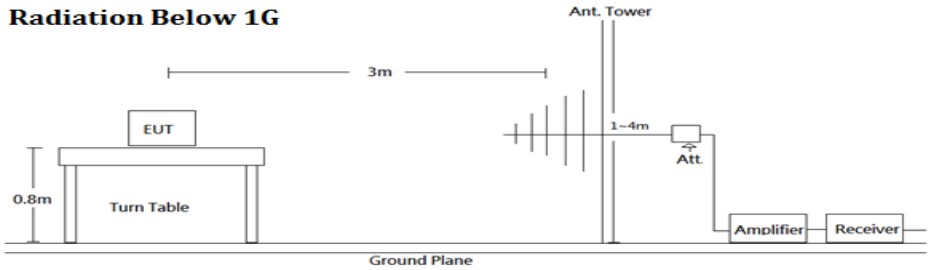
Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

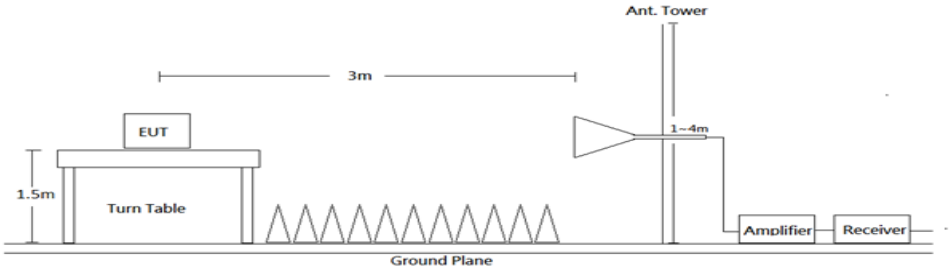
As per FCC §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c).

7.2 EUT Setup and Test Procedure

Radiation Below 1G



Radiation Above 1G



Radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC Part 15.209 and FCC 15.247 Limits.

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.

7.3 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 26.5 GHz. During the radiated emission test, the EMI test receiver was set with the following configurations measurement method 6.3 in ANSI C63.10.

Frequency Range	RBW	VBW	Measurement method
30-1000 MHz	120 kHz	/	QP
Above 1 GHz	1 MHz	3 MHz	PK
	1 MHz	10 Hz	Ave

7.4 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Date	Calibration Due Date
966A Room					
Bilog Antenna with 6 dB Attenuator	SUNOL SCIENCES & MINI-CIRCUITS	JB6/UNAT-6+	A050115/15542_01	2017/12/20	2018/12/19
Horn Antenna	EMCO	3115	9311-4158	2018/04/20	2019/04/19
Horn Antenna	ETS-Lindgren	3116	62638	2017/09/13	2018/09/12
Preamplifier	Sonoma	310N	130602	2017/07/03	2018/07/02
Preamplifier	EM Electronics Corp.	EM01G18G	060657	2017/12/14	2018/12/13
Microware Preamplifier	EM Electronics Corporatino	EM18G40G	060656	2018/01/15	2019/01/14
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2017/11/06	2018/11/05
Spectrum Analyzer	Rohde & Schwarz	FSV40	101203	2017/07/13	2018/07/12
Microflex Cable	UTIFLEX	UFB311A-Q-1440-300300	220490-006	2017/10/31	2018/10/30
Microflex Cable	UTIFLEX	UFA210A-1-3149-300300	MFR64639 226389-001	2017/11/10	2018/11/09
Microflex Cable	ROSNOL	K1K50-UP0264-K1K50-450CM	160309-1	2018/03/05	2019/03/04
Microflex Cable	ROSNOL	K1K50-UP0264-K1K50-80CM	160309-2	2018/01/17	2019/01/16
10 dB Attenuator	MTJ	MTJ6111-10	NA	Each Use	/
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
Conducted Room					
Spectrum Analyzer	Rohde & Schwarz	FSU26	200268	2018/05/08	2019/05/07
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11
10 dB Attenuator	MTJ	MTJ6111-10	NA	Each Use	/

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).*

7.5 Test Environmental Conditions

Temperature:	25.5 ℃
Relative Humidity:	58 %
ATM Pressure:	1015 hPa

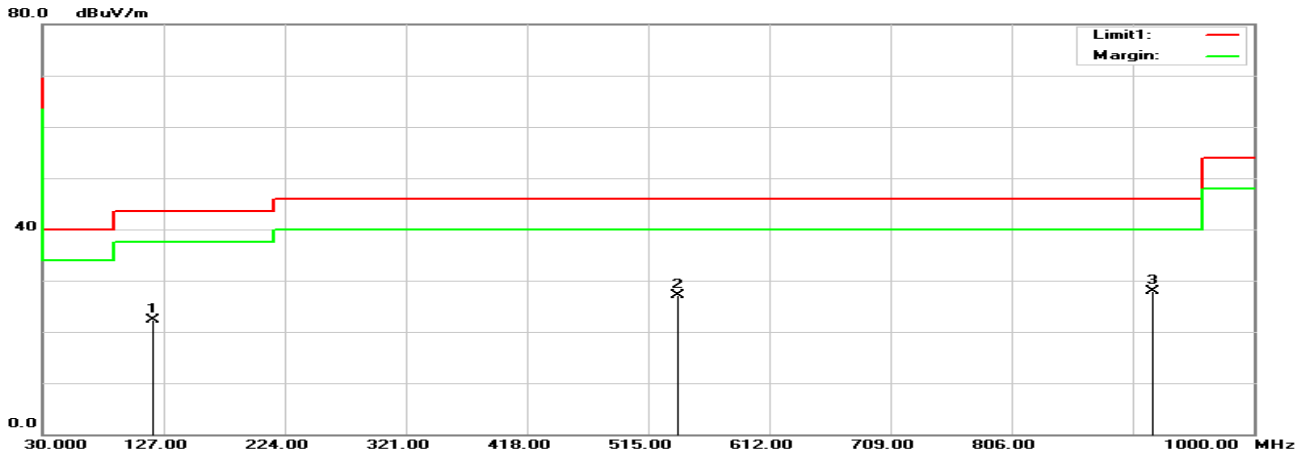
The testing was performed by Ian Tu from 2018-05-09 to 2018-05-11.

7.6 Radiated Emission Test Plot and Data

BT Mode: Transmitting Mode *(Pre-scan with three orthogonal axis, and worse case as Y axis)*

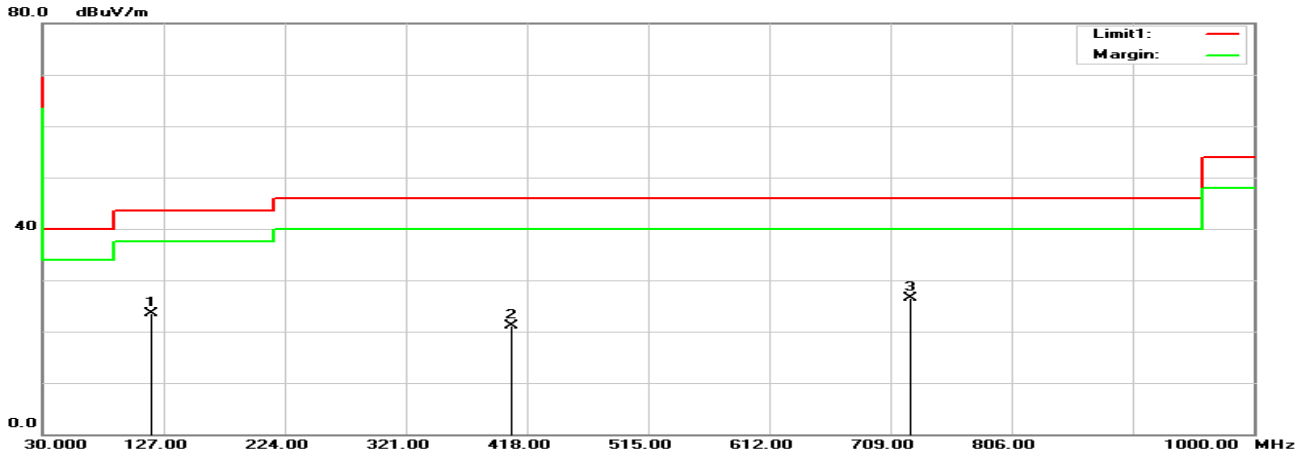
Below 1G (30 MHz-1 GHz) test the output power worst mode: Worst case is BR (GFSK) High Channel

Horizontal



Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
118.2700	33.05	-10.78	22.27	43.50	-21.23	100	82	peak
539.2500	32.19	-5.14	27.05	46.00	-18.95	100	303	peak
918.5200	26.39	1.57	27.96	46.00	-18.04	100	6	peak

Vertical

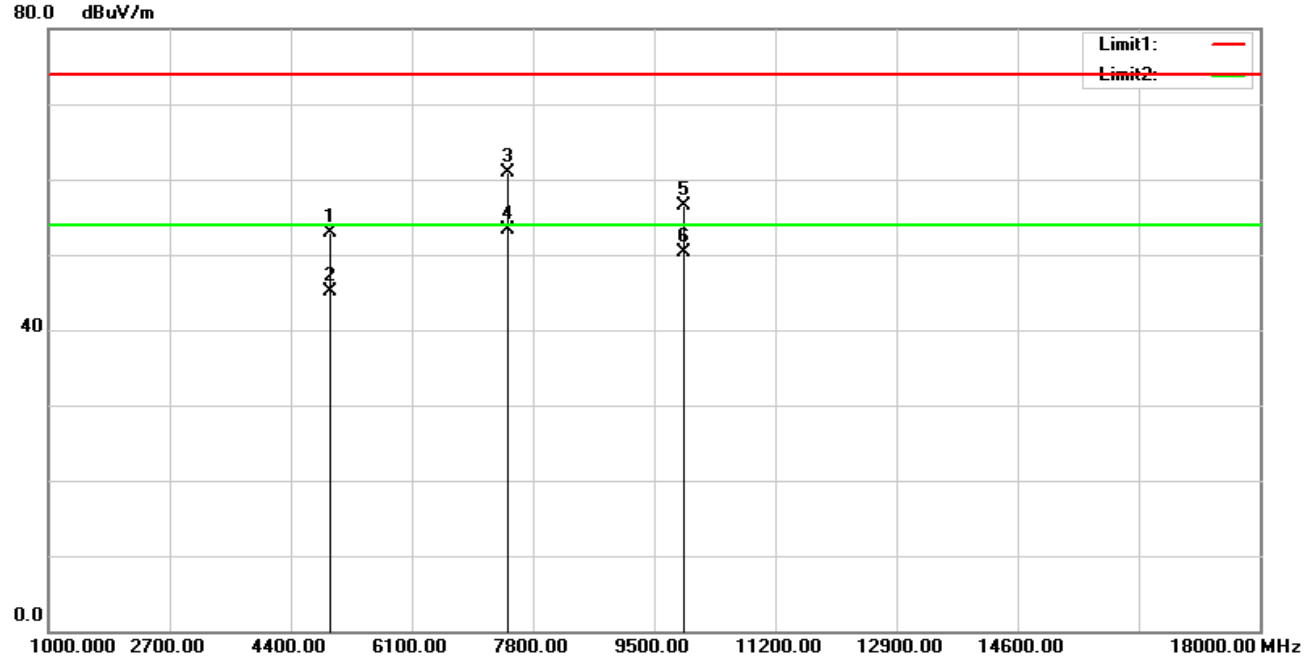


Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
117.3000	34.37	-10.89	23.48	43.50	-20.02	150	346	peak
405.3900	28.53	-7.47	21.06	46.00	-24.94	150	256	peak
725.4900	29.01	-2.42	26.59	46.00	-19.41	150	161	peak

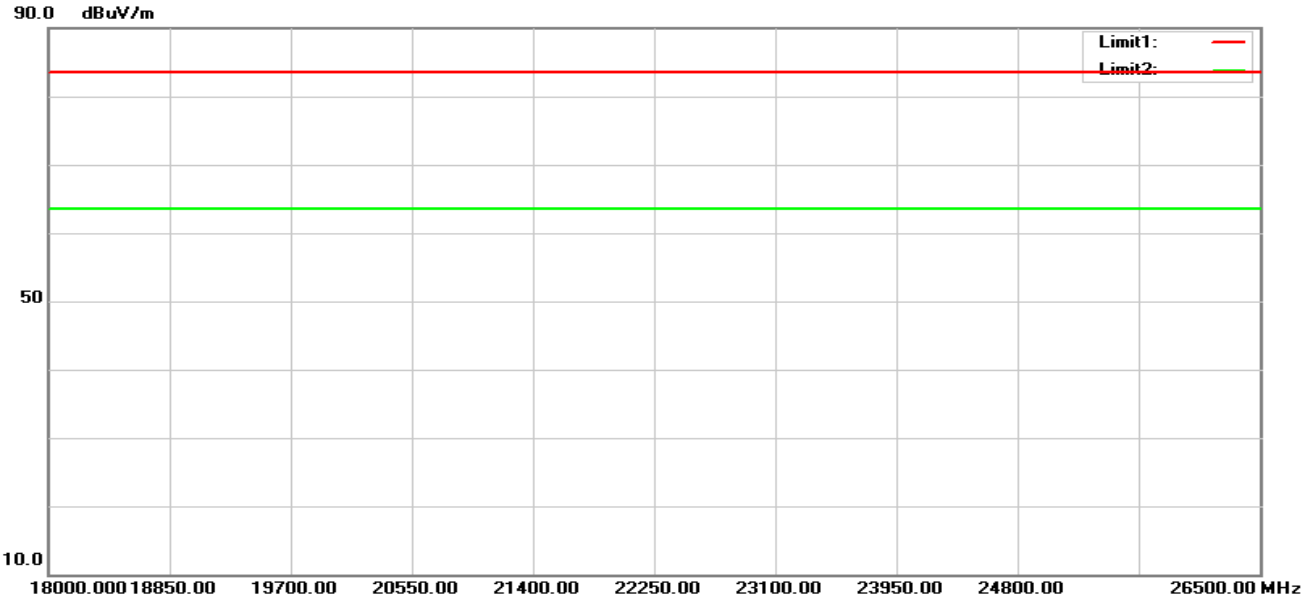
Above 1G (1 GHz-26.5 GHz) test the output power worst mode: Worst case is BR mode (GFSK) High channel)

Horizontal

1GHz-18GHz:

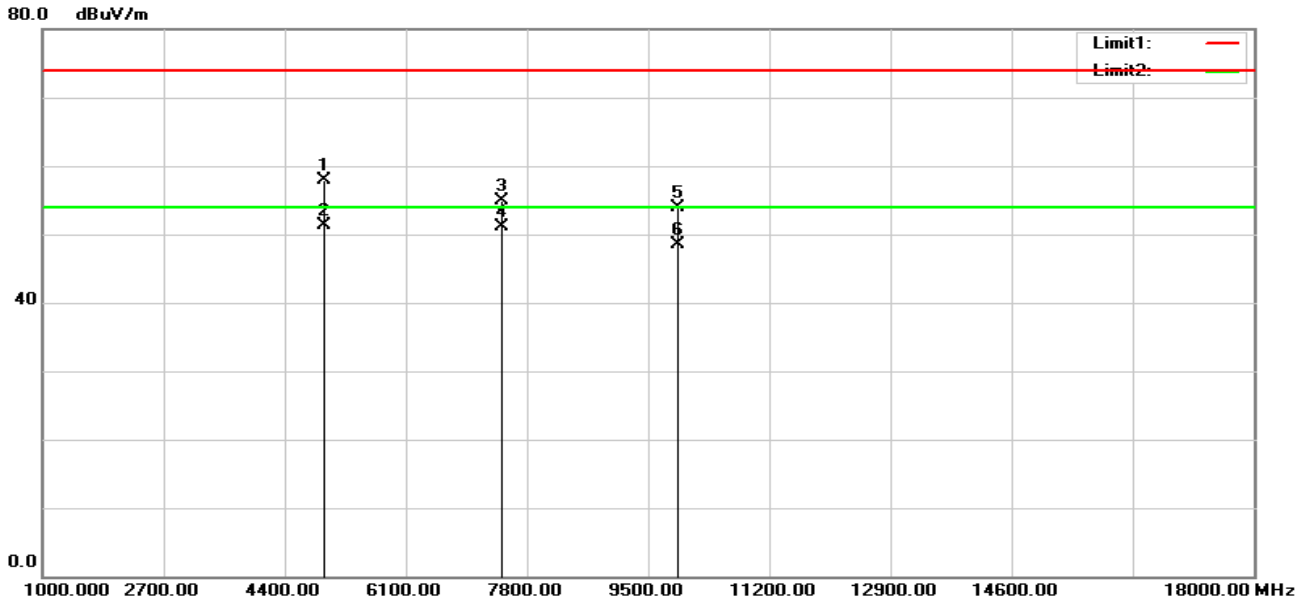


18GHz-26.5GHz:

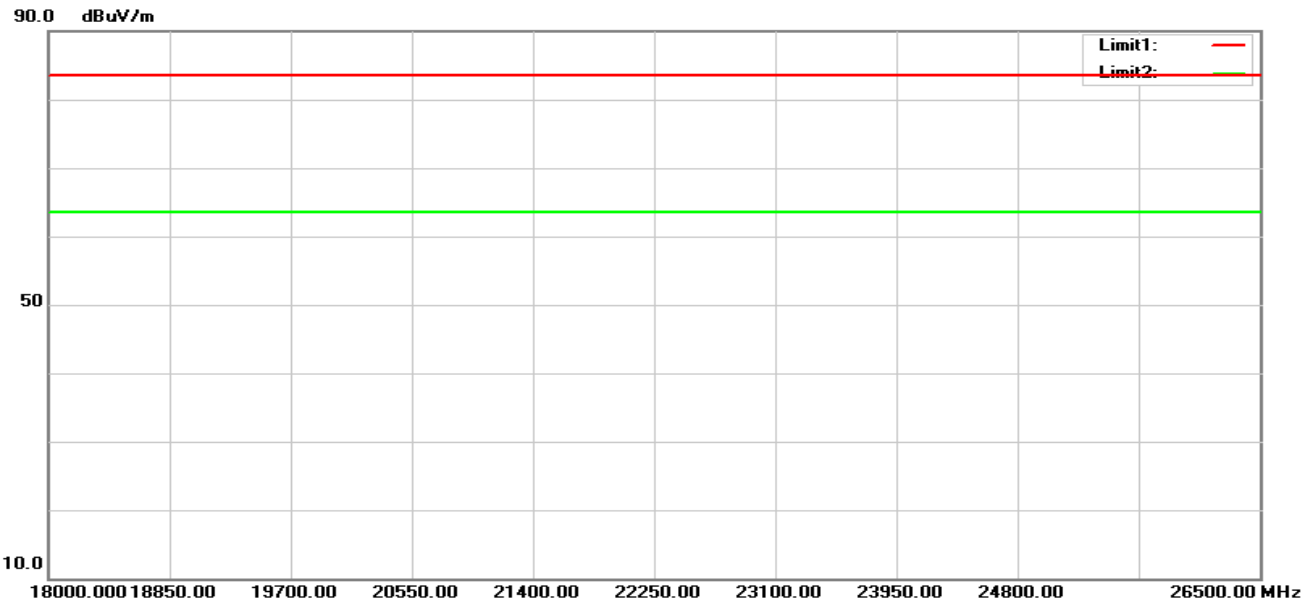


Vertical

1GHz-18GHz:



18GHz-26.5GHz:



BR mode (GFSK):

Horizontal

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
Low Channel								
2386.570	65.42	-4.89	60.53	74.00	-13.47	123	253	peak
2386.570	51.40	-4.89	46.51	54.00	-7.49	123	253	AVG
2402.150	115.69	-4.86	110.83	N/A	N/A	123	253	peak
2402.150	102.31	-4.86	97.45	N/A	N/A	123	253	AVG
4808.000	48.40	0.99	49.39	74.00	-24.61	227	91	peak
4808.000	44.15	0.99	45.14	54.00	-8.86	227	91	AVG
7205.000	52.73	6.56	59.29	74.00	-14.71	100	127	peak
7205.000	46.18	6.56	52.74	54.00	-1.26	100	127	AVG
9602.000	44.78	11.24	56.02	74.00	-17.98	204	100	peak
9602.000	37.52	11.24	48.76	54.00	-5.24	204	100	AVG
Mid Channel								
2324.820	62.70	-5.03	57.67	74.00	-16.33	150	359	peak
2324.820	49.09	-5.03	44.06	54.00	-9.94	150	359	AVG
2441.100	115.09	-4.76	110.33	N/A	N/A	150	166	peak
2441.100	101.92	-4.76	97.16	N/A	N/A	150	166	AVG
2493.350	62.70	-4.66	58.04	74.00	-15.96	150	79	peak
2493.350	50.14	-4.66	45.48	54.00	-8.52	150	79	AVG
4876.000	53.79	1.23	55.02	74.00	-18.98	107	23	peak
4876.000	46.59	1.23	47.82	54.00	-6.18	107	23	AVG
7324.000	56.45	7.03	63.48	74.00	-10.52	113	125	peak
7324.000	45.69	7.03	52.72	54.00	-1.28	113	125	AVG
9772.000	47.51	11.61	59.12	74.00	-14.88	211	110	peak
9772.000	39.17	11.61	50.78	54.00	-3.22	211	110	AVG
High Channel								
2479.840	114.11	-4.68	109.43	N/A	N/A	150	149	peak
2479.840	101.05	-4.68	96.37	N/A	N/A	150	149	AVG
2483.590	65.73	-4.69	61.04	74.00	-12.96	150	146	peak
2483.590	53.55	-4.69	48.86	54.00	-5.14	150	146	AVG
4961.000	51.33	1.52	52.85	74.00	-21.15	175	20	peak
4961.000	43.60	1.52	45.12	54.00	-8.88	175	20	AVG
7443.000	53.48	7.49	60.97	74.00	-13.03	105	139	peak
7443.000	45.86	7.49	53.35	54.00	-0.65	105	139	AVG
9925.000	44.47	11.94	56.41	74.00	-17.59	219	109	peak
9925.000	38.37	11.94	50.31	54.00	-3.69	219	109	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported

Vertical

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
Low Channel								
2386.570	65.58	-4.89	60.69	74.00	-13.31	152	251	peak
2386.570	52.57	-4.89	47.68	54.00	-6.32	152	251	AVG
2402.150	118.07	-4.86	113.21	N/A	N/A	152	251	peak
2402.150	104.35	-4.86	99.49	N/A	N/A	152	251	AVG
4791.000	52.38	0.93	53.31	74.00	-20.69	182	29	peak
4791.000	46.49	0.93	47.42	54.00	-6.58	182	29	AVG
7205.000	48.72	6.56	55.28	74.00	-18.72	100	43	peak
7205.000	42.16	6.56	48.72	54.00	-5.28	100	43	AVG
9602.000	43.74	11.24	54.98	74.00	-19.02	208	261	peak
9602.000	36.89	11.24	48.13	54.00	-5.87	208	261	AVG
Mid Channel								
2325.010	63.93	-5.03	58.90	74.00	-15.10	150	302	peak
2325.010	50.27	-5.03	45.24	54.00	-8.76	150	302	AVG
2440.910	119.60	-4.76	114.84	N/A	N/A	147	258	peak
2440.910	105.89	-4.76	101.13	N/A	N/A	147	258	AVG
2496.770	62.88	-4.65	58.23	74.00	-15.77	150	293	peak
2496.770	50.19	-4.65	45.54	54.00	-8.46	150	293	AVG
4876.000	55.28	1.23	56.51	74.00	-17.49	170	53	peak
4876.000	48.58	1.23	49.81	54.00	-4.19	170	53	AVG
7324.000	46.63	7.03	53.66	74.00	-20.34	106	242	peak
7324.000	43.15	7.03	50.18	54.00	-3.82	106	242	AVG
9772.000	41.23	11.61	52.84	74.00	-21.16	228	199	peak
9772.000	37.85	11.61	49.46	54.00	-4.54	228	199	AVG
High Channel								
2479.780	118.53	-4.68	113.85	N/A	N/A	150	264	peak
2479.780	104.89	-4.68	100.21	N/A	N/A	150	264	AVG
2483.590	69.42	-4.69	64.73	74.00	-9.27	150	262	peak
2483.590	56.37	-4.69	51.68	54.00	-2.32	150	262	AVG
4961.000	56.41	1.52	57.93	74.00	-16.07	100	70	peak
4961.000	49.87	1.52	51.39	54.00	-2.61	100	70	AVG
7443.000	47.46	7.49	54.95	74.00	-19.05	100	249	peak
7443.000	43.61	7.49	51.10	54.00	-2.90	100	249	AVG
9925.000	42.02	11.94	53.96	74.00	-20.04	216	264	peak
9925.000	36.55	11.94	48.49	54.00	-5.51	216	264	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported

EDR mode (8-DPSK):

Horizontal

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
Low Channel								
2386.190	64.11	-4.89	59.22	74.00	-14.78	150	321	peak
2386.190	52.71	-4.89	47.82	54.00	-6.18	150	321	AVG
2402.055	113.01	-4.86	108.15	N/A	N/A	150	251	peak
2402.055	98.91	-4.86	94.05	N/A	N/A	150	251	AVG
4791.000	48.06	0.93	48.99	74.00	-25.01	147	355	peak
4791.000	42.09	0.93	43.02	54.00	-10.98	147	355	AVG
7205.000	50.04	6.56	56.60	74.00	-17.40	121	126	peak
7205.000	44.53	6.56	51.09	54.00	-2.91	121	126	AVG
9602.000	43.33	11.24	54.57	74.00	-19.43	219	103	peak
9602.000	36.71	11.24	47.95	54.00	-6.05	219	103	AVG
Mid Channel								
2377.260	62.89	-4.92	57.97	74.00	-16.03	150	239	peak
2377.260	50.10	-4.92	45.18	54.00	-8.82	150	239	AVG
2440.910	114.77	-4.76	110.01	N/A	N/A	150	166	peak
2440.910	100.39	-4.76	95.63	N/A	N/A	150	166	AVG
2495.630	63.23	-4.65	58.58	74.00	-15.42	150	281	peak
2495.630	50.19	-4.65	45.54	54.00	-8.46	150	281	AVG
4876.000	55.22	1.23	56.45	74.00	-17.55	150	27	peak
4876.000	45.45	1.23	46.68	54.00	-7.32	150	27	AVG
7324.000	55.84	7.03	62.87	74.00	-11.13	150	125	peak
7324.000	46.31	7.03	53.34	54.00	-0.66	150	125	AVG
9772.000	47.78	11.61	59.39	74.00	-14.61	150	106	peak
9772.000	37.46	11.61	49.07	54.00	-4.93	150	106	AVG
High Channel								
2480.020	113.07	-4.68	108.39	N/A	N/A	150	149	peak
2480.020	98.61	-4.68	93.93	N/A	N/A	150	149	AVG
2483.530	68.33	-4.69	63.64	74.00	-10.36	150	339	peak
2483.530	54.74	-4.69	50.05	54.00	-3.95	150	339	AVG
4961.000	49.82	1.52	51.34	74.00	-22.66	150	351	peak
4961.000	40.25	1.52	41.77	54.00	-12.23	150	351	AVG
7443.000	51.11	7.49	58.60	74.00	-15.40	150	140	peak
7443.000	41.28	7.49	48.77	54.00	-5.23	150	140	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported

Vertical

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
Low Channel								
2386.000	67.82	-4.89	62.93	74.00	-11.07	150	256	peak
2386.000	56.63	-4.89	51.74	54.00	-2.26	150	256	AVG
2402.055	119.21	-4.86	114.35	N/A	N/A	150	256	peak
2402.055	103.78	-4.86	98.92	N/A	N/A	150	256	AVG
4808.000	51.44	0.99	52.43	74.00	-21.57	169	32	peak
4808.000	44.16	0.99	45.15	54.00	-8.85	169	32	AVG
7205.000	47.54	6.56	54.10	74.00	-19.90	246	45	peak
7205.000	40.45	6.56	47.01	54.00	-6.99	246	45	AVG
9602.000	42.13	11.24	53.37	74.00	-20.63	251	22	peak
9602.000	35.76	11.24	47.00	54.00	-7.00	251	22	AVG
Mid Channel								
2340.590	62.78	-5.01	57.77	74.00	-16.23	150	34	peak
2340.590	50.13	-5.01	45.12	54.00	-8.88	150	34	AVG
2440.910	119.12	-4.76	114.36	N/A	N/A	150	255	peak
2440.910	103.98	-4.76	99.22	N/A	N/A	150	255	AVG
2488.790	62.53	-4.67	57.86	74.00	-16.14	150	282	peak
2488.790	50.22	-4.67	45.55	54.00	-8.45	150	282	AVG
4876.000	55.56	1.23	56.79	74.00	-17.21	107	56	peak
4876.000	47.55	1.23	48.78	54.00	-5.22	107	56	AVG
7324.000	49.86	7.03	56.89	74.00	-17.11	100	244	peak
7324.000	43.75	7.03	50.78	54.00	-3.22	100	244	AVG
9755.000	43.36	11.57	54.93	74.00	-19.07	158	1	peak
9755.000	33.94	11.57	45.51	54.00	-8.49	158	1	AVG
High Channel								
2479.960	117.37	-4.68	112.69	N/A	N/A	150	250	peak
2479.960	102.04	-4.68	97.36	N/A	N/A	150	250	AVG
2483.500	73.52	-4.69	68.83	74.00	-5.17	150	250	peak
2483.500	57.61	-4.69	52.92	54.00	-1.08	150	250	AVG
4961.000	55.51	1.52	57.03	74.00	-16.97	150	70	peak
4961.000	47.47	1.52	48.99	54.00	-5.01	150	70	AVG
7443.000	46.17	7.49	53.66	74.00	-20.34	150	15	peak
7443.000	37.12	7.49	44.61	54.00	-9.39	150	15	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported

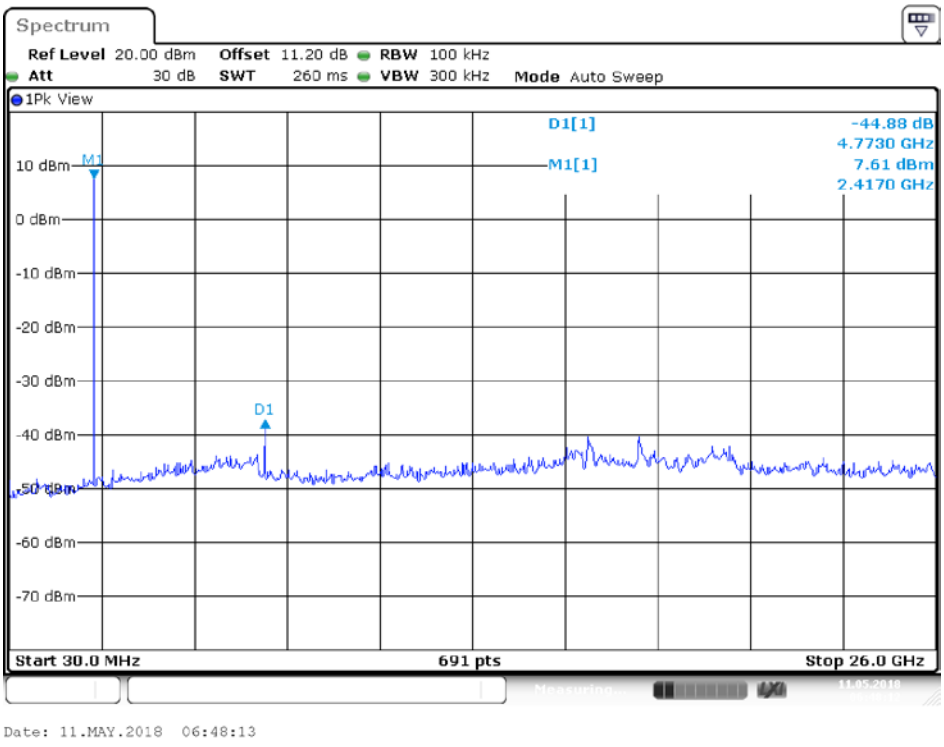
Conducted Spurious Emissions:

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BR mode (GFSK)				
Low	2402	44.88	≥ 20	Compliance
Mid	2441	48.72	≥ 20	Compliance
High	2480	52.87	≥ 20	Compliance
EDR mode (π/4-DQPSK)				
Low	2402	45.22	≥ 20	Compliance
Mid	2441	44.91	≥ 20	Compliance
High	2480	51.25	≥ 20	Compliance
EDR mode (8DPSK)				
Low	2402	48.44	≥ 20	Compliance
Mid	2441	46.76	≥ 20	Compliance
High	2480	50.78	≥ 20	Compliance

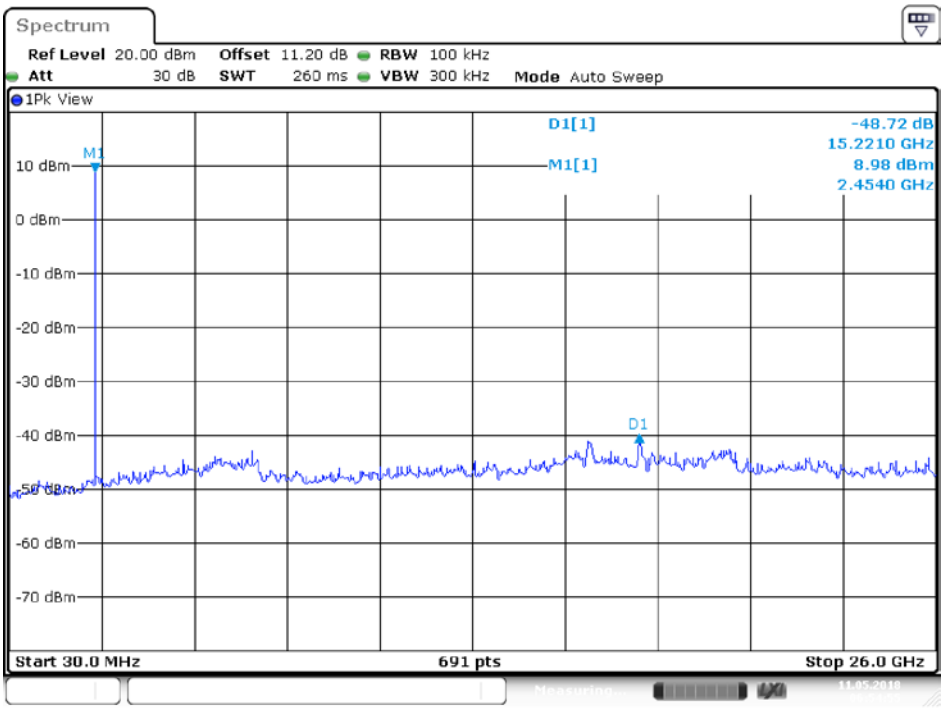
Please refer to the following plots

BR mode (GFSK):

Low Channel

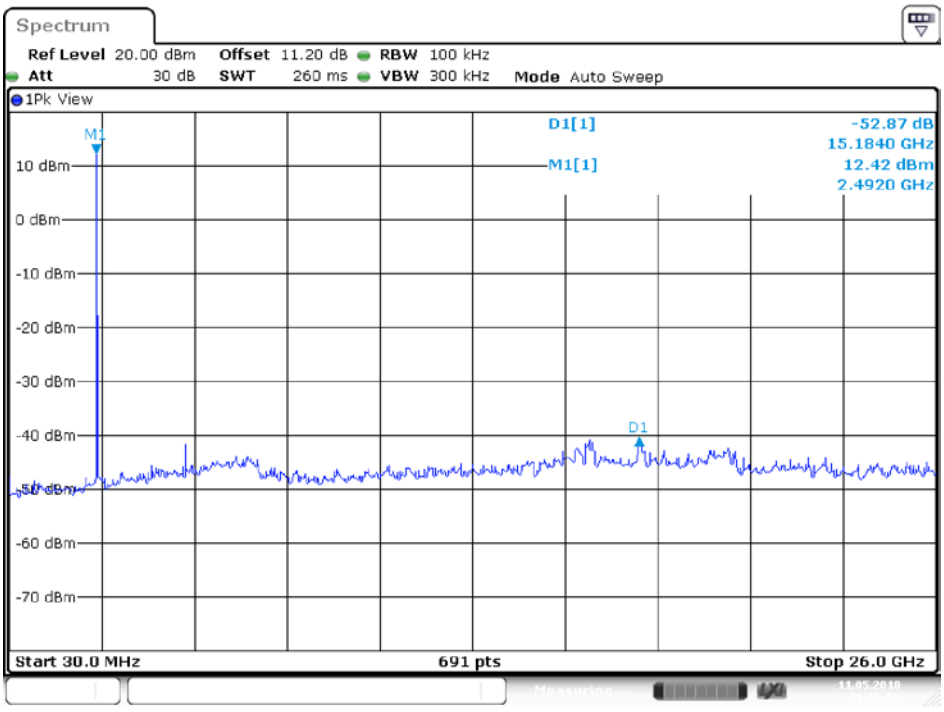


Middle Channel



Date: 11.MAY.2018 06:54:55

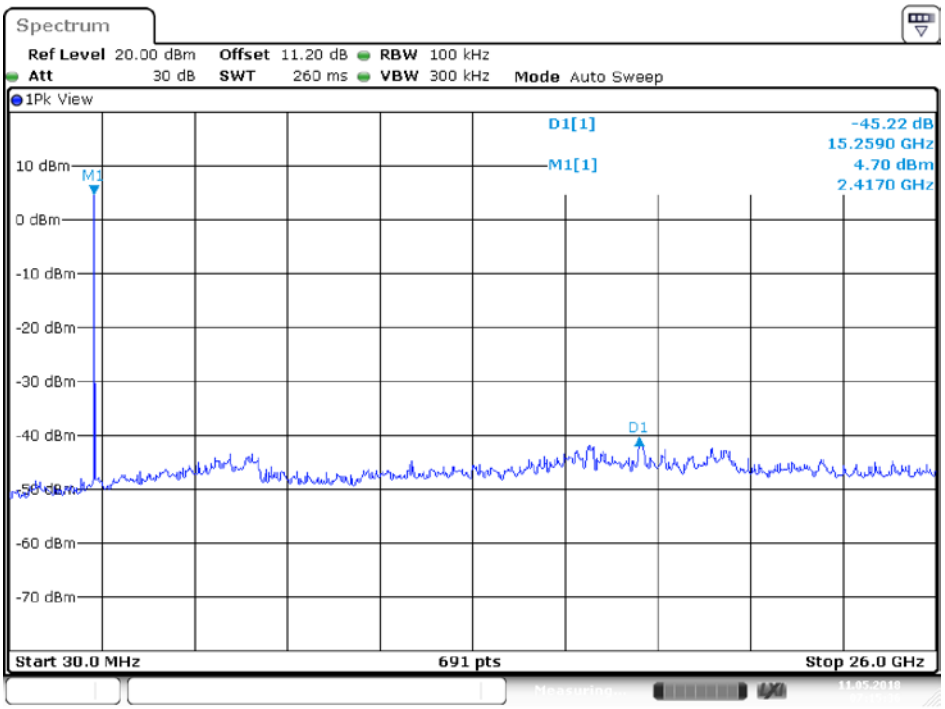
High Channel



Date: 11.MAY.2018 06:55:55

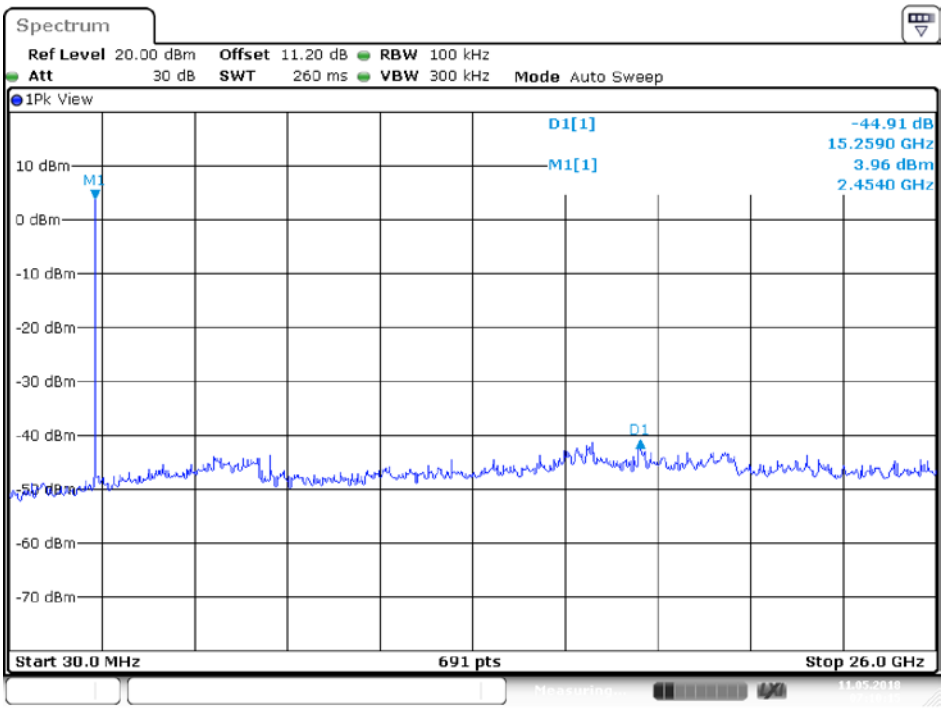
EDR mode (π/4-DQPSK):

Low Channel



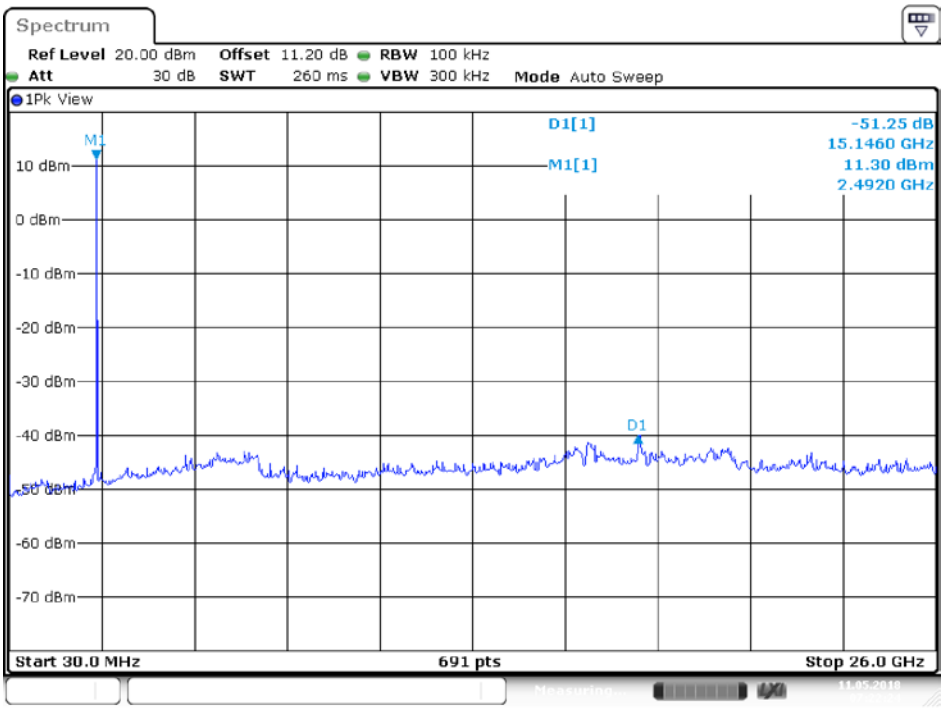
Date: 11.MAY.2018 07:15:36

Middle Channel



Date: 11.MAY.2018 07:10:16

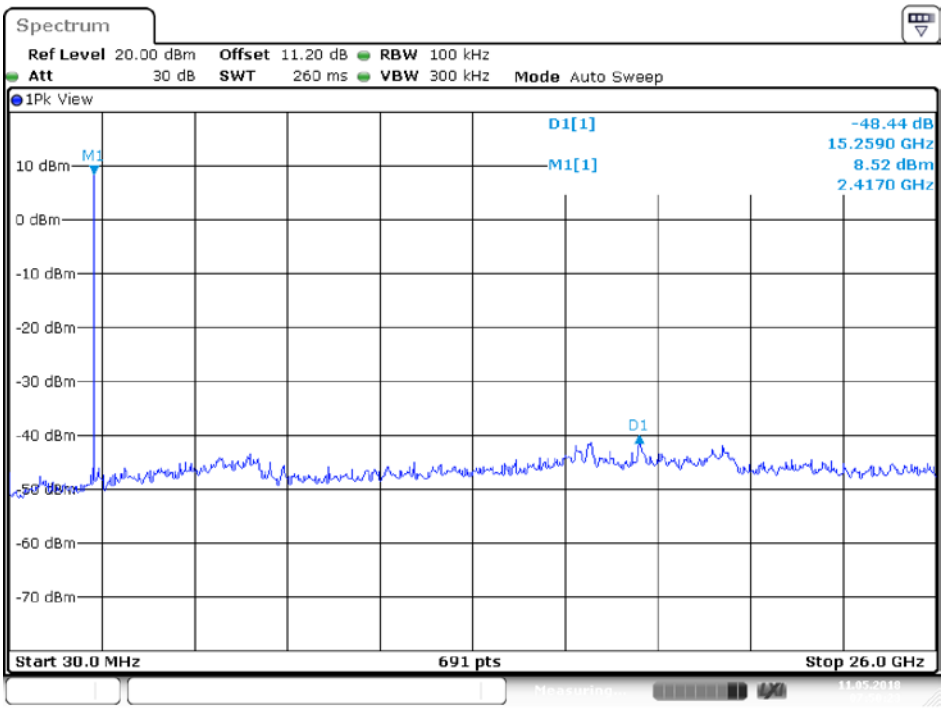
High Channel



Date: 11.MAY.2018 07:22:24

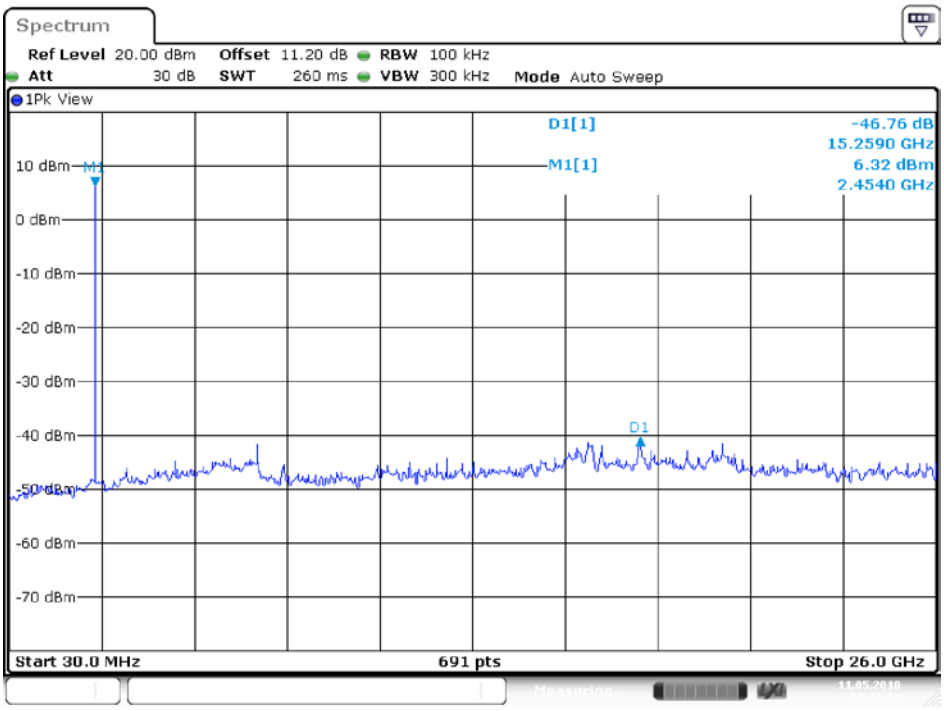
EDR mode (8DPSK):

Low Channel



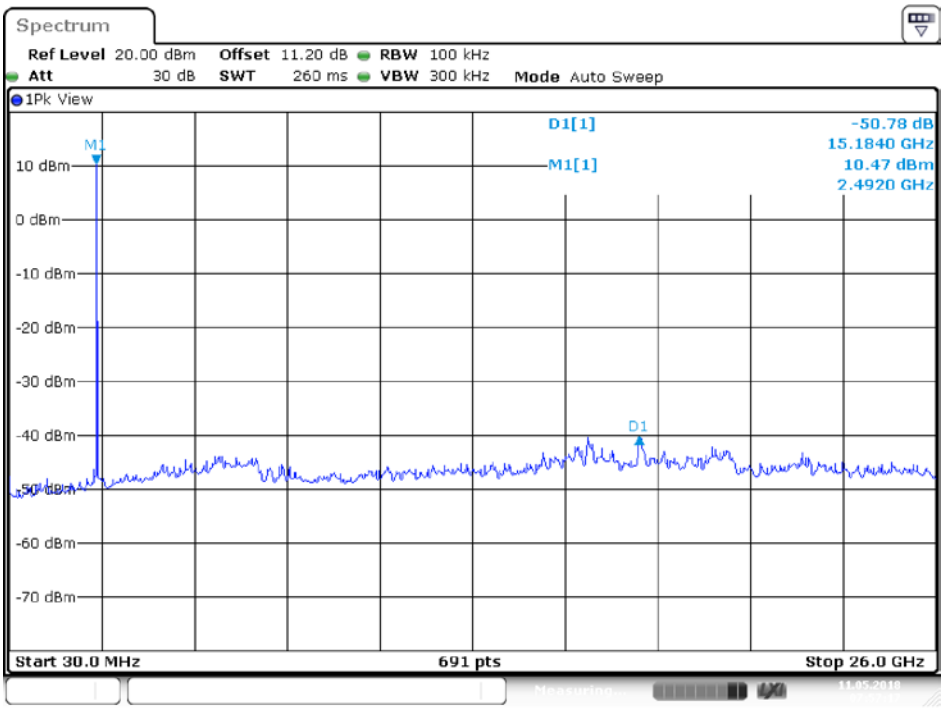
Date: 11.MAY.2018 07:50:23

Middle Channel



Date: 11.MAY.2018 07:45:38

High Channel



Date: 11.MAY.2018 07:57:17

8 FCC §15.247(a)(1) – 20 dB Emission Bandwidth

8.1 Applicable Standard

According to FCC §15.247(a) (1) the maximum 20 dB bandwidth of the hopping channel shall be presented.

8.2 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.

8.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Date	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSV40	101140	2017/11/15	2018/11/14
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).*

8.4 Test Environmental Conditions

Temperature:	23.5 ℃
Relative Humidity:	55.4 %
ATM Pressure:	1015 hPa

The testing was performed by Ian Tu on 2018-05-11.

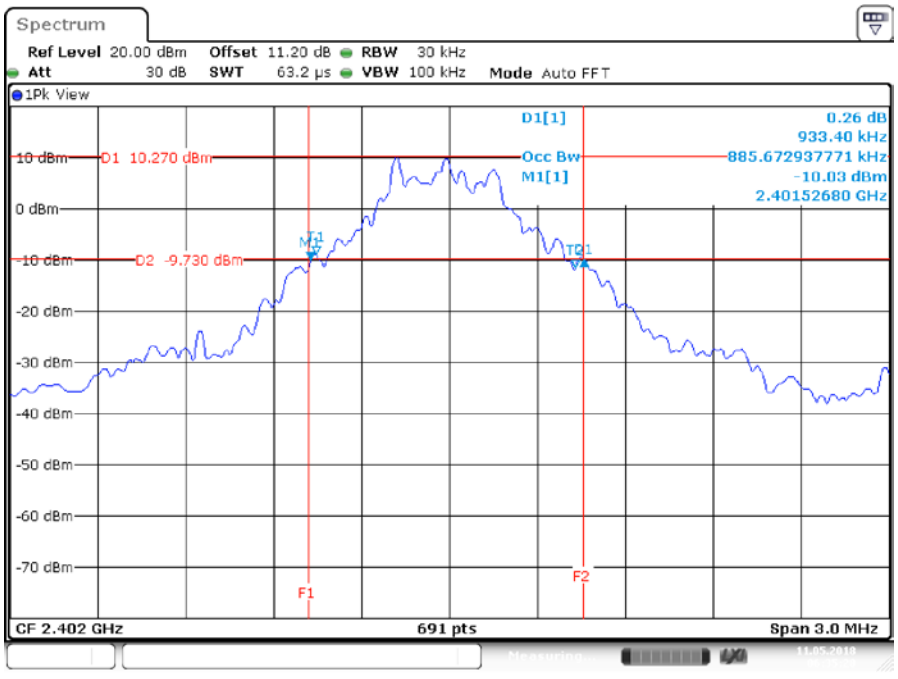
8.5 Test Results

Channel	Frequency (MHz)	OBW (99% Bandwidth) (MHz)	20 dB Bandwidth (MHz)
BR Mode (GFSK)			
Low	2402	0.8857	0.9334
Middle	2441	0.8509	0.8292
High	2480	0.8466	0.8292
EDR Mode (π/4-DQPSK)			
Low	2402	1.2069	1.2417
Middle	2441	1.2200	1.2634
High	2480	1.2851	1.2677
EDR Mode (8DPSK)			
Low	2402	1.2069	1.2287
Middle	2441	1.2113	1.2764
High	2480	1.2764	1.2894

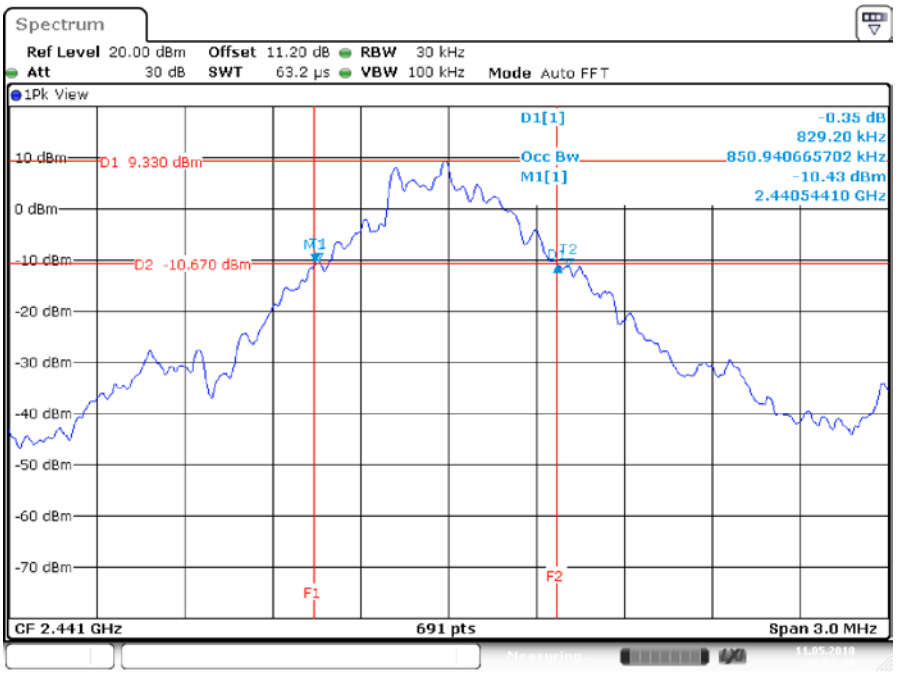
**Please refer to the following plots*

BR Mode (GFSK):

Low Channel

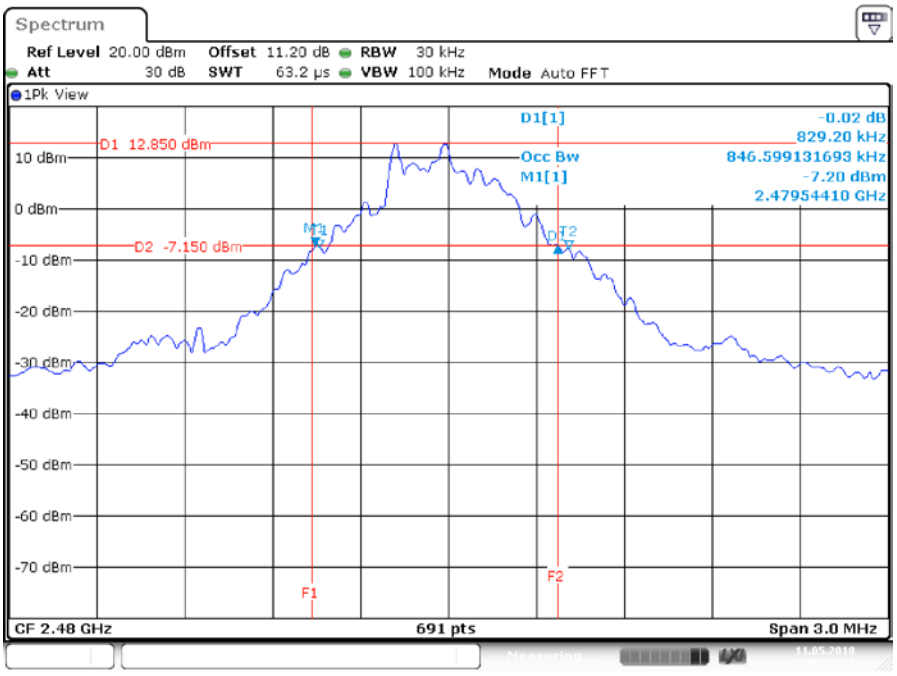


Middle Channel



Date: 11.MAY.2018 06:53:48

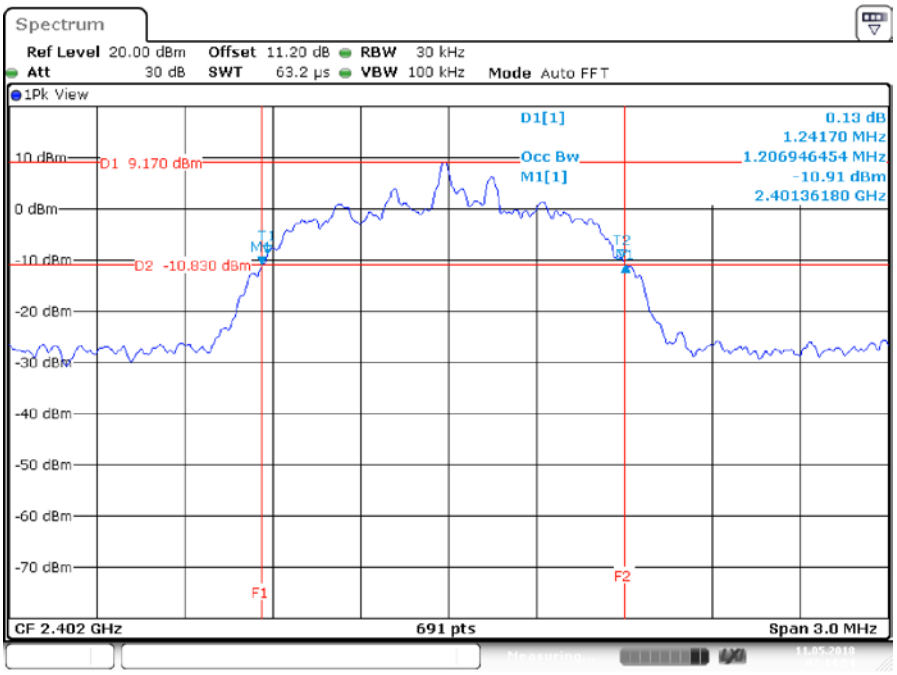
High Channel



Date: 11.MAY.2018 06:57:22

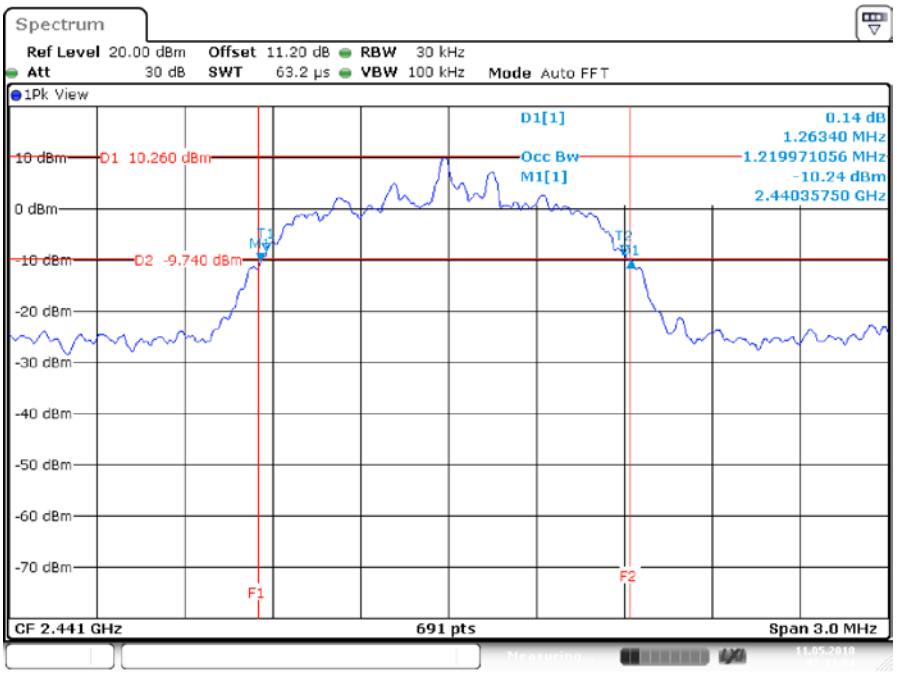
EDR Mode (π/4-DQPSK):

Low Channel



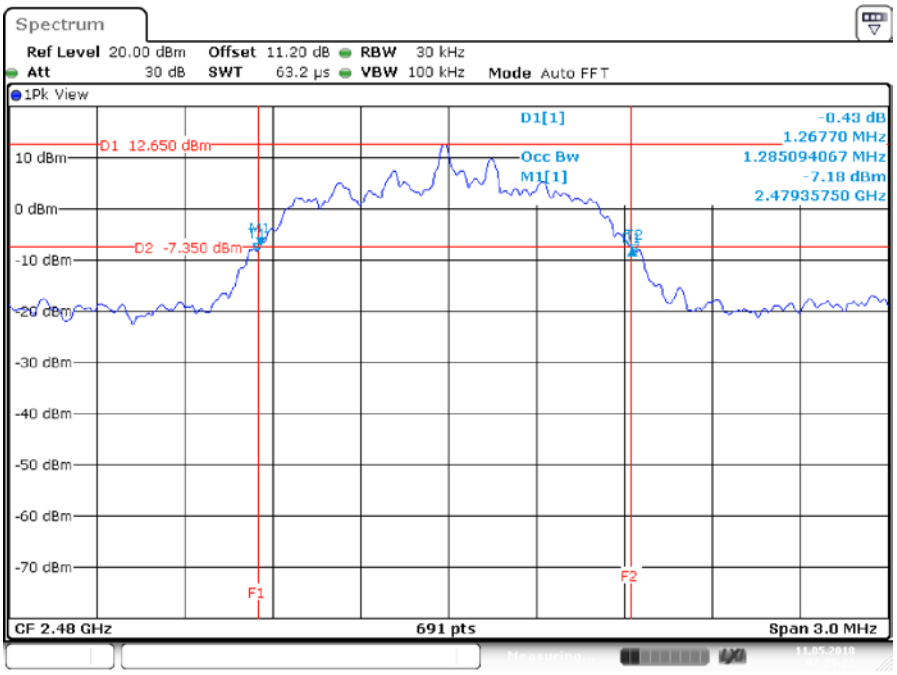
Date: 11.MAY.2018 07:14:55

Middle Channel



Date: 11.MAY.2018 07:13:04

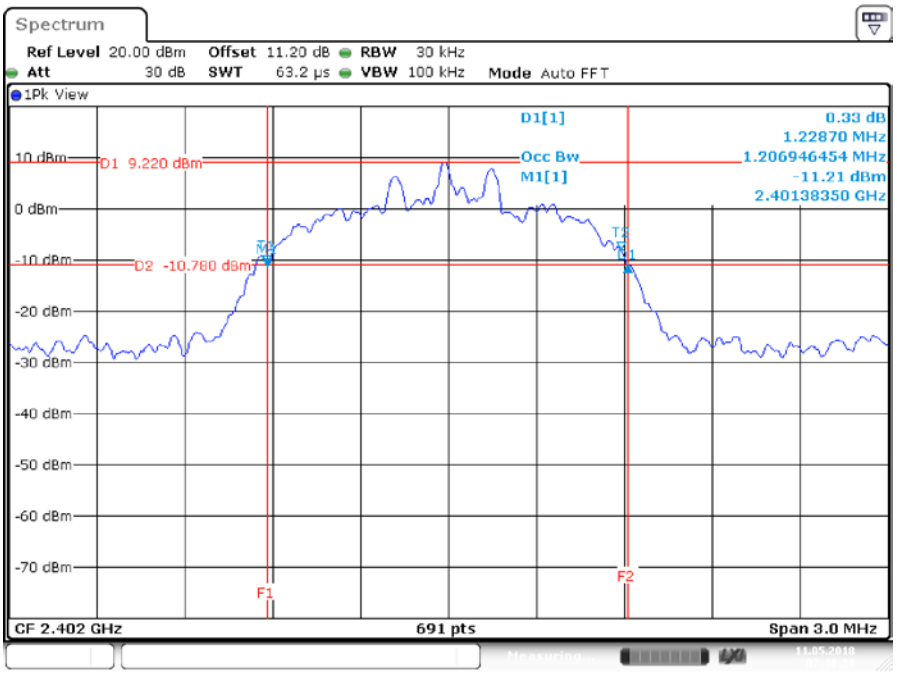
High Channel



Date: 11.MAY.2018 07:25:22

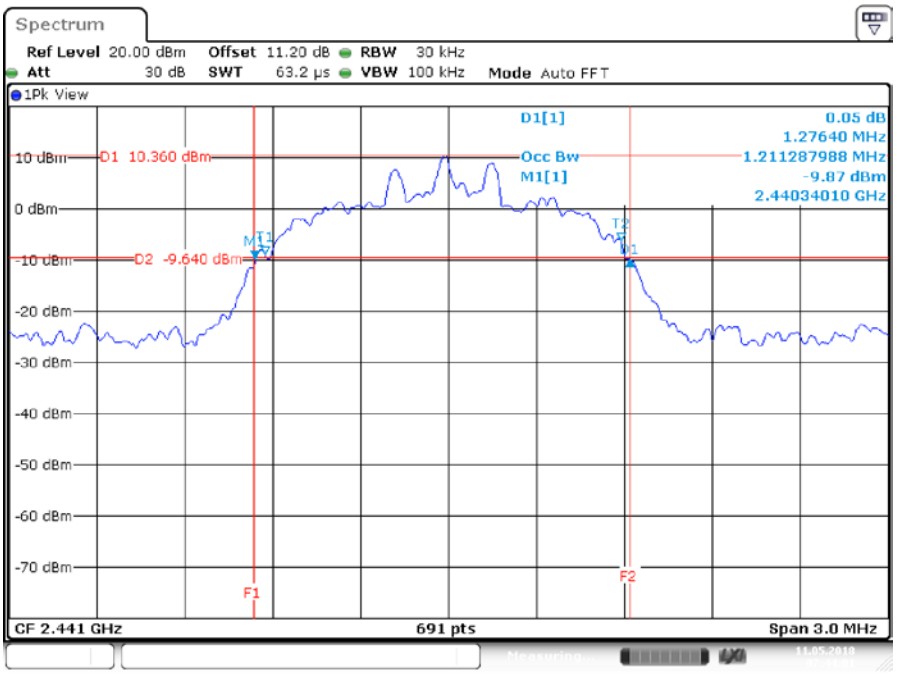
EDR Mode (8DPSK):

Low Channel



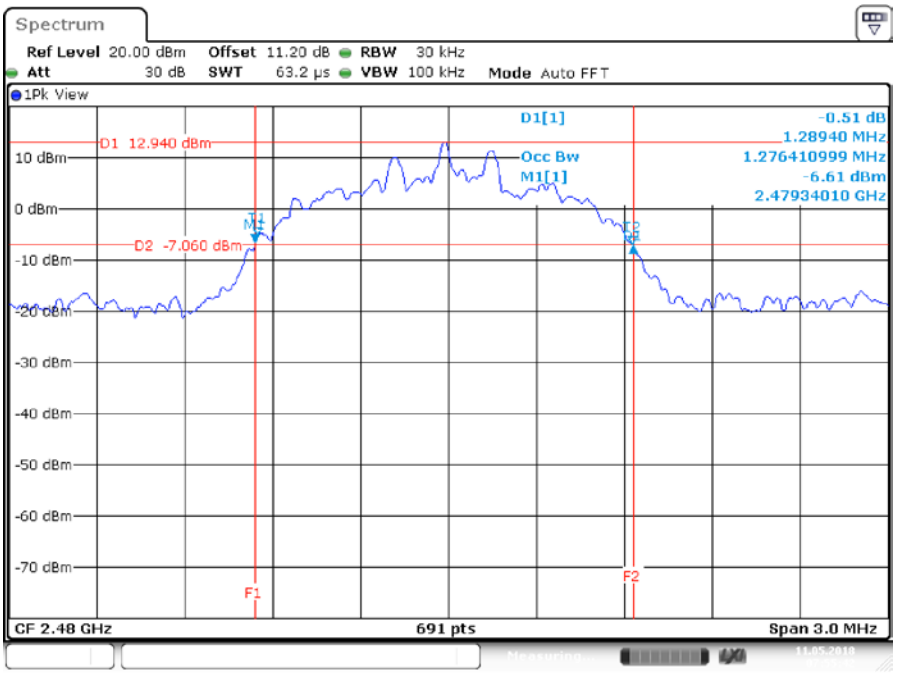
Date: 11.MAY.2018 07:48:40

Middle Channel



Date: 11.MAY.2018 07:44:02

High Channel



Date: 11.MAY.2018 07:55:43

9 FCC §15.247(a)(1) – Channel Separation Test

9.1 Applicable Standard

According to FCC §15.247(a) (1): Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

9.2 Test Procedure

Set the EUT in transmitting mode, maxhold the channel.

Set the adjacent channel of the EUT and maxhold another trace.

Measure the channel separation.

9.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Date	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSV40	101140	2017/11/15	2018/11/14
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).*

9.4 Test Environmental Conditions

Temperature:	23.5 ℃
Relative Humidity:	55.4 %
ATM Pressure:	1015 hPa

The testing was performed by Ian Tu on 2018-05-11.

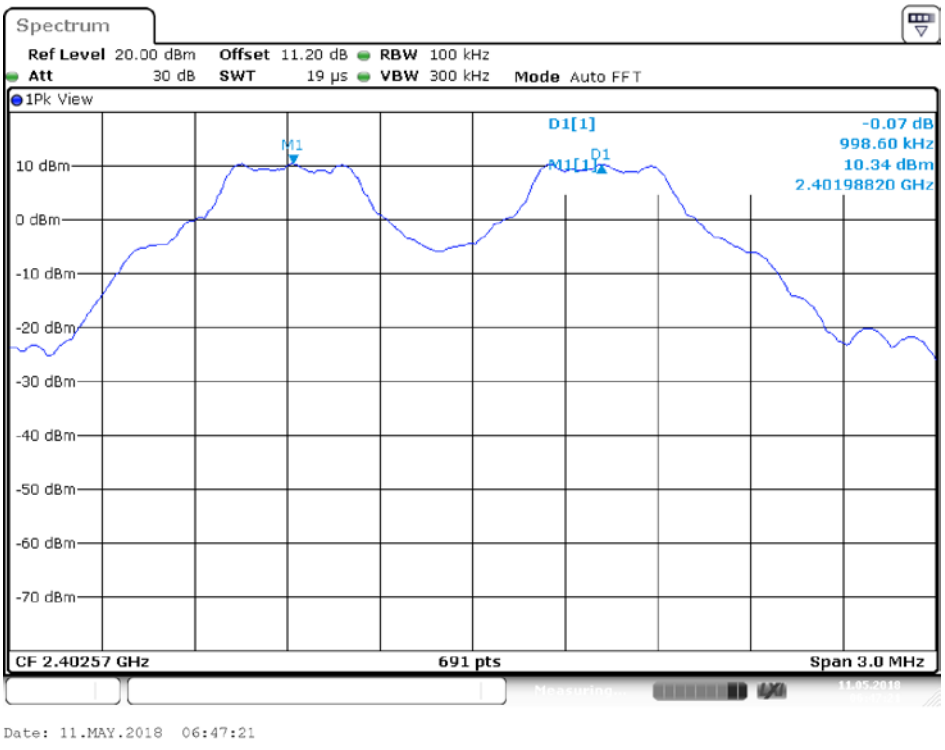
9.5 Test Results

Channel	Channel Separation (MHz)	20 dBc BW (MHz)	Two-thirds of the 20 dB bandwidth (MHz)	Limit (MHz)	Result
BR mode (GFSK)					
Low	0.9986	0.9334	0.622	>two-thirds of the 20 dB bandwidth	Compliance
Middle	0.9986	0.8292	0.553	>two-thirds of the 20 dB bandwidth	Compliance
High	1.0029	0.8292	0.553	>two-thirds of the 20 dB bandwidth	Compliance
EDR mode (π/4-DQPSK)					
Low	1.0029	1.2417	0.828	>two-thirds of the 20 dB bandwidth	Compliance
Middle	0.9942	1.2634	0.842	>two-thirds of the 20 dB bandwidth	Compliance
High	1.0029	1.2677	0.845	>two-thirds of the 20 dB bandwidth	Compliance
EDR mode (8DPSK)					
Low	1.0029	1.2287	0.819	>two-thirds of the 20 dB bandwidth	Compliance
Middle	1.0029	1.2764	0.851	>two-thirds of the 20 dB bandwidth	Compliance
High	1.0029	1.2894	0.860	>two-thirds of the 20 dB bandwidth	Compliance

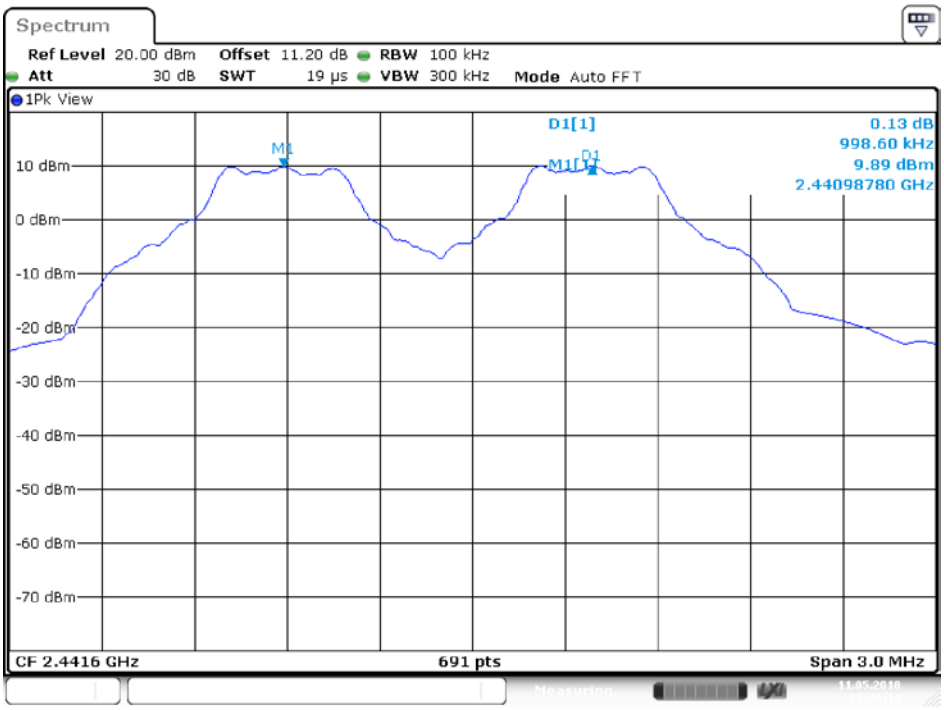
Please refer to the following plots

BR mode (GFSK):

Low Channel

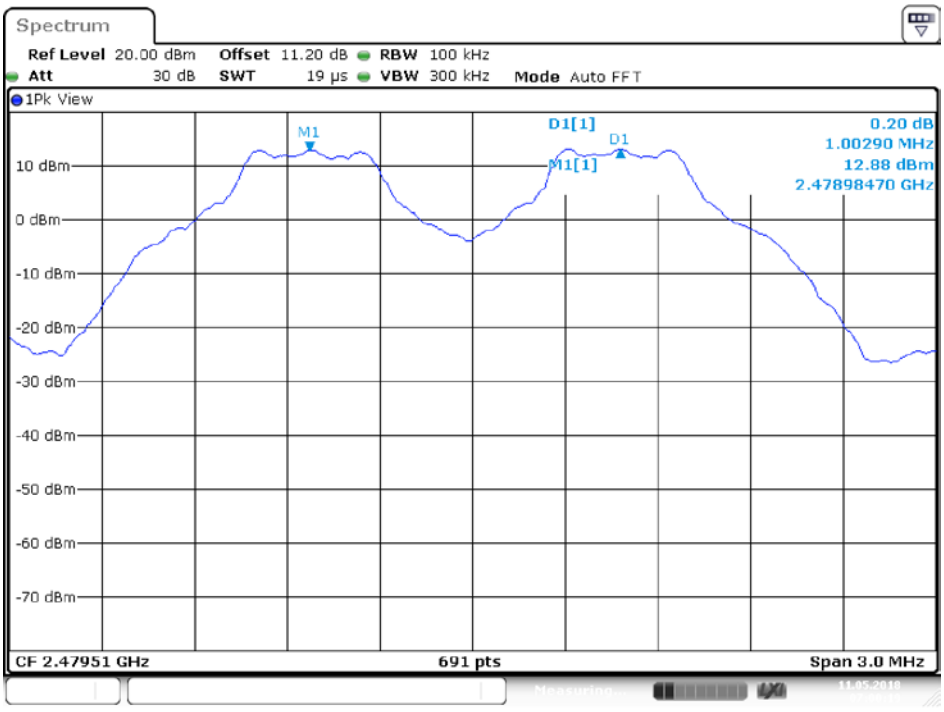


Middle Channel



Date: 11.MAY.2018 06:46:15

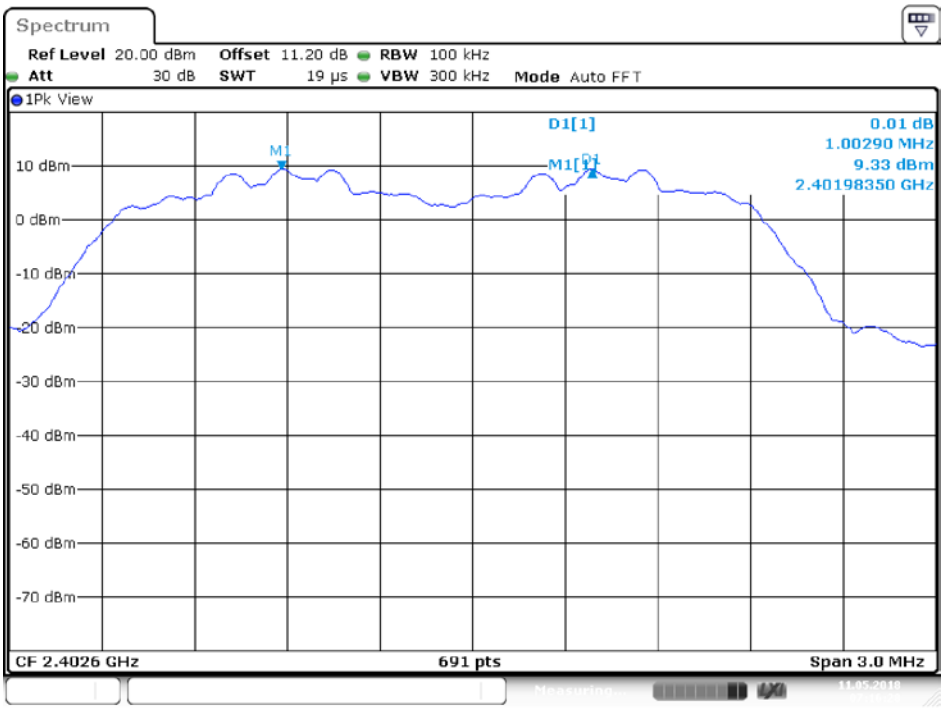
High Channel



Date: 11.MAY.2018 07:00:19

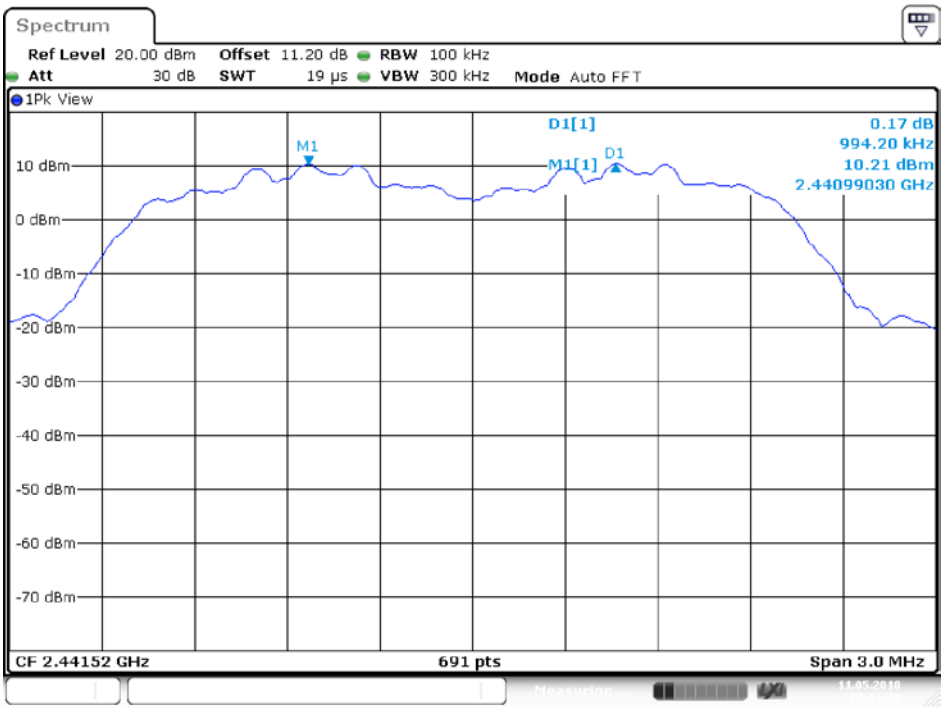
EDR mode (π/4-DQPSK):

Low Channel



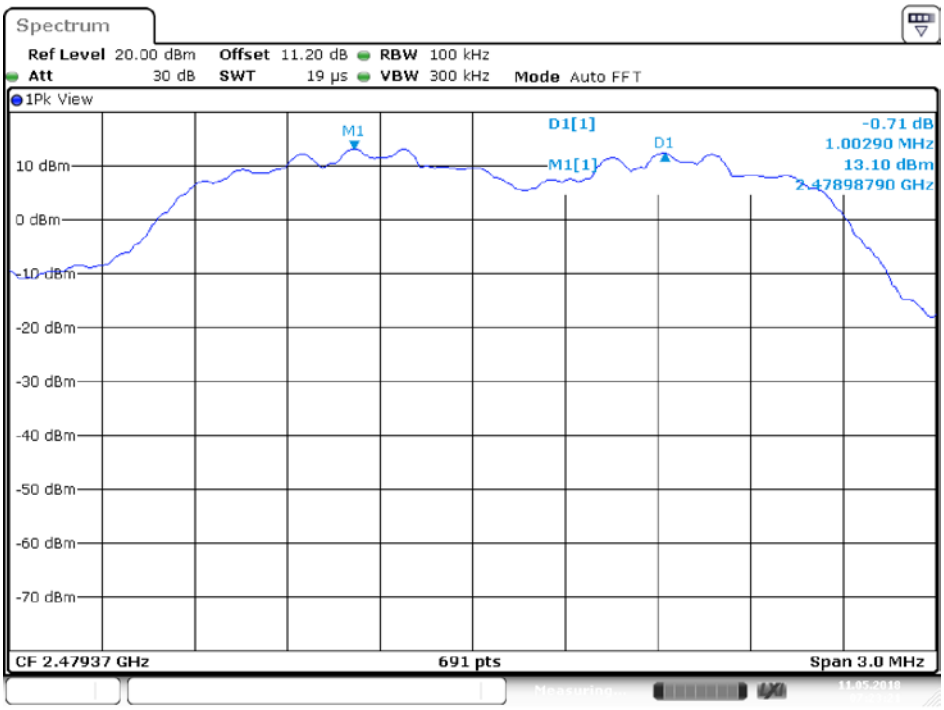
Date: 11.MAY.2018 07:16:29

Middle Channel



Date: 11.MAY.2018 07:11:29

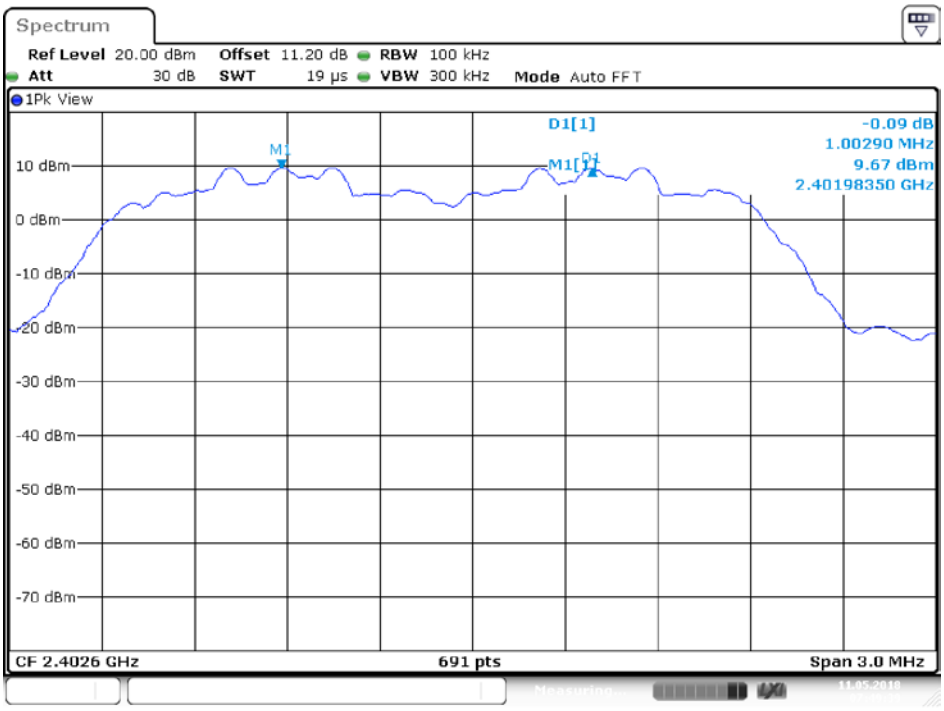
High Channel



Date: 11.MAY.2018 07:23:21

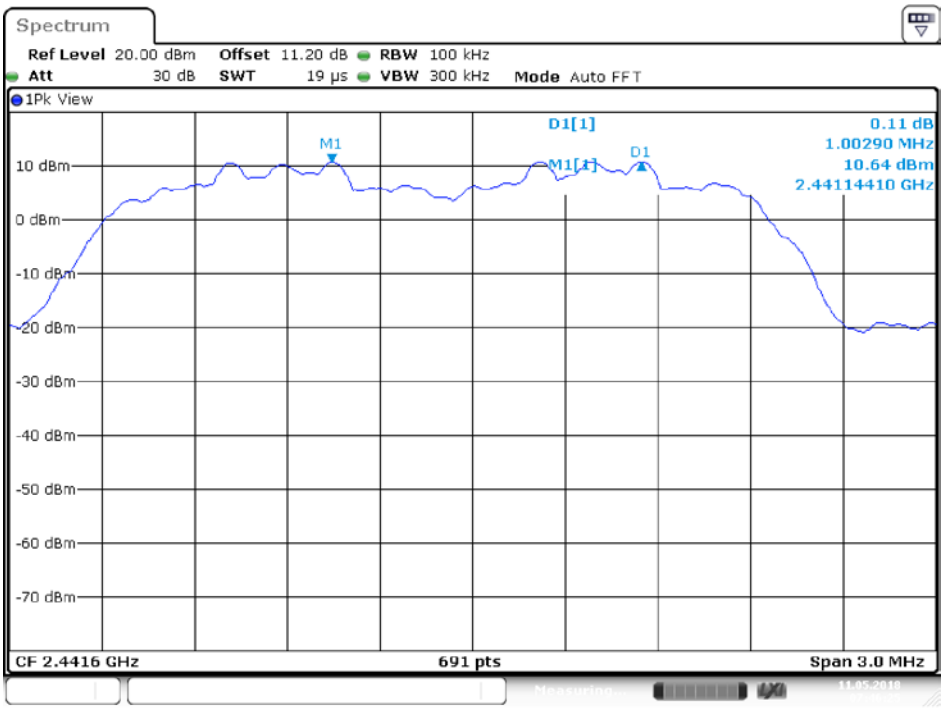
EDR mode (8-DPSK):

Low Channel



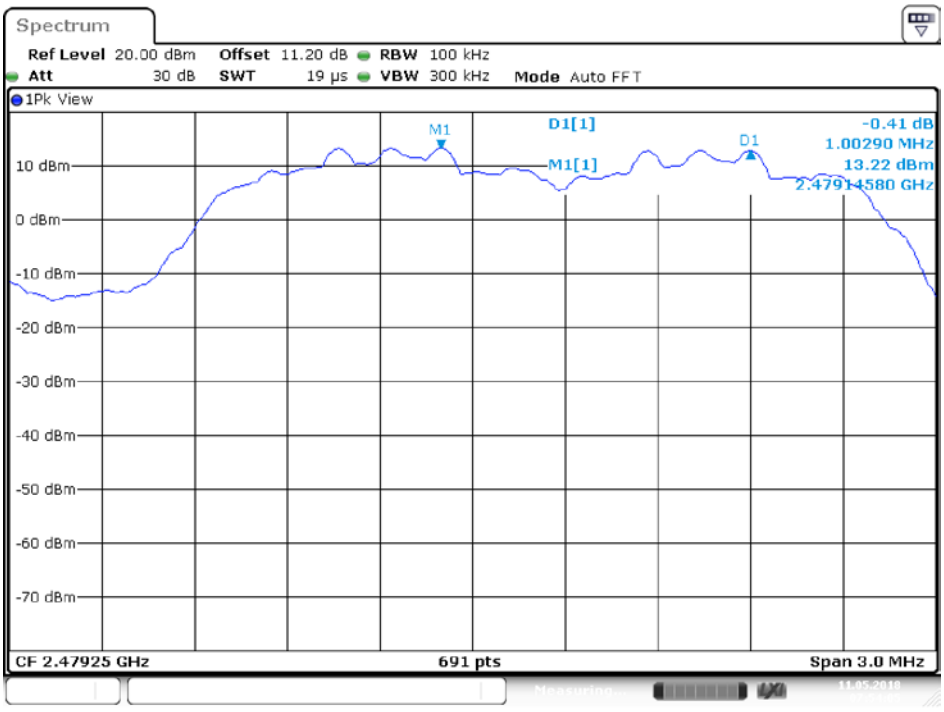
Date: 11.MAY.2018 07:49:39

Middle Channel



Date: 11.MAY.2018 07:46:26

High Channel



Date: 11.MAY.2018 07:54:05

10 FCC §15.247(a)(1)(iii) – Time of Occupancy (Dwell Time)

10.1 Applicable Standard

According to FCC §15.247(a) (1)(iii).

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

10.2 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel
RBW ≤ channel spacing and where possible RBW should be set >> 1/T, where T is the expected dwell time per channel
Sweep = as necessary to capture the entire dwell time per hopping channel Detector function = peak
Trace = max hold
Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.
Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements.
Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:
(Number of hops in the period specified in the requirements) = (number of hops on spectrum analyzer) x (period specified in the requirements / analyzer sweep time)
The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.

10.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Date	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSV40	101140	2017/11/15	2018/11/14
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).*

10.4 Test Environmental Conditions

Temperature:	23.5 ℃
Relative Humidity:	55.4 %
ATM Pressure:	1015 hPa

The testing was performed by Ian Tu from 2018-04-26 to 2018-05-11.

10.5 Test Results

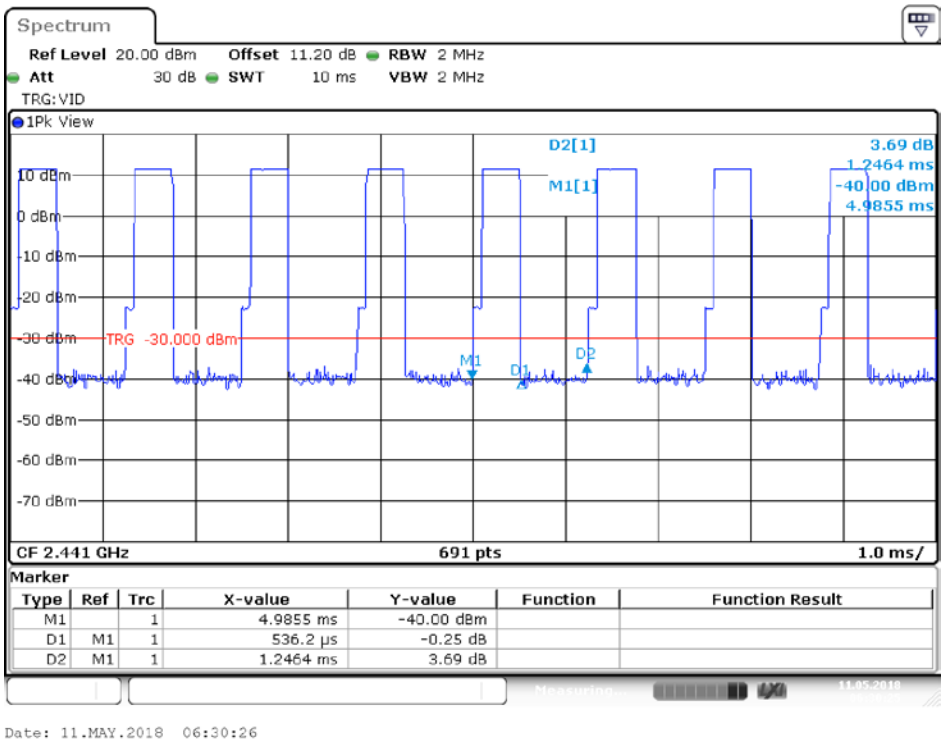
Mode	Pulse Time (ms)	Hopping Number	Period Time (s)	Total of Dwell (ms)	Limit (ms)	Result
BR mode (GFSK) : 2402-2480 MHz						
DH1	0.536	310	31.6	166.2	<400	Compliance
DH3	1.797	160	31.6	287.5	<400	Compliance
DH5	3.058	110	31.6	336.4	<400	Compliance
EDR mode (π/4-DQPSK) : 2402-2480 MHz						
2DH1	0.551	320	31.6	176.3	<400	Compliance
2DH3	1.812	160	31.6	289.9	<400	Compliance
2DH5	3.058	110	31.6	336.4	<400	Compliance
EDR mode (8DPSK) : 2402-2480 MHz						
3DH1	0.551	320	31.6	176.3	<400	Compliance
3DH3	1.797	160	31.6	287.5	<400	Compliance
3DH5	3.058	100	31.6	305.8	<400	Compliance

*Note 1: A period time = 0.4 * 79 = 31.6 (s), Total of Dwell= Pulse Time
*Note 2: Hopping Number = Hopping Number/10 * 10
*Note 3: Hopping Number/10 = Total of highest signals in 3.16s. (Second High signals were other channel)

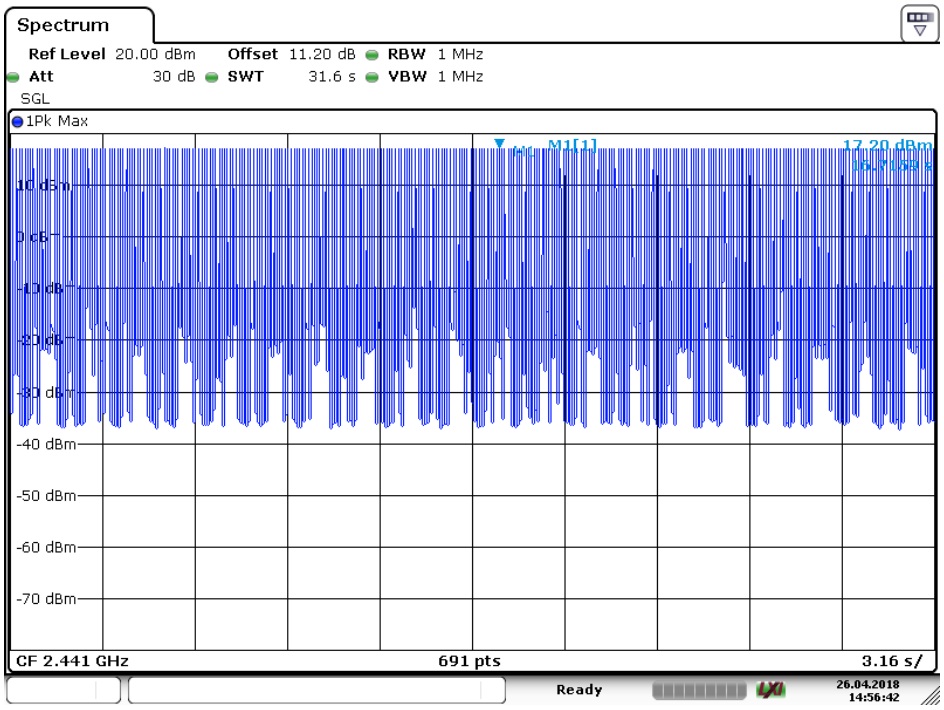
Please refer to the following plots

BR mode (GFSK):

DH1: Pulse Width

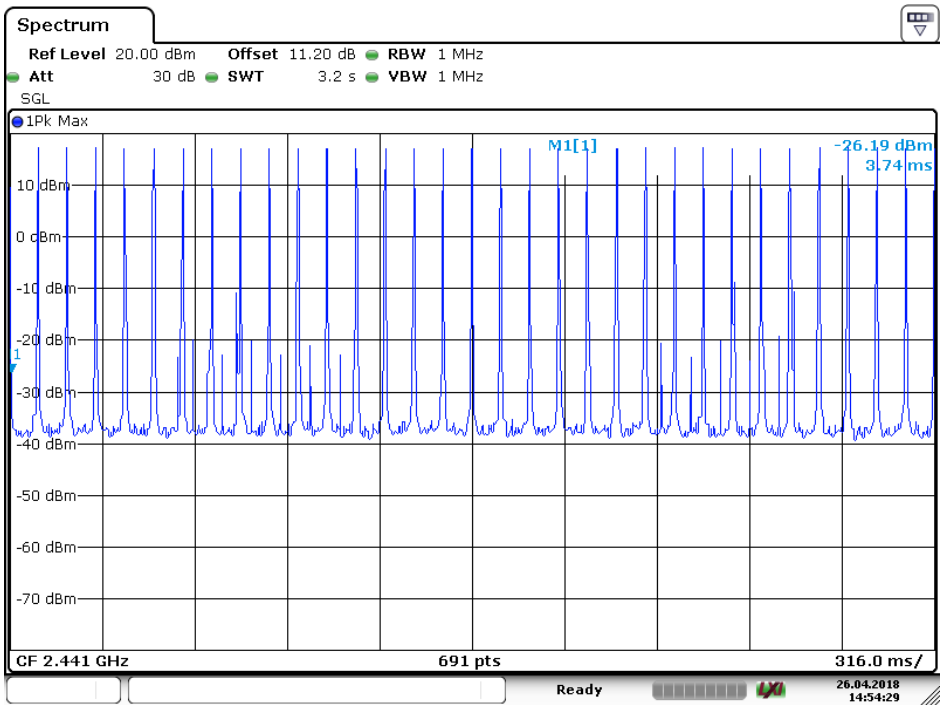


DH1: Hopping Number



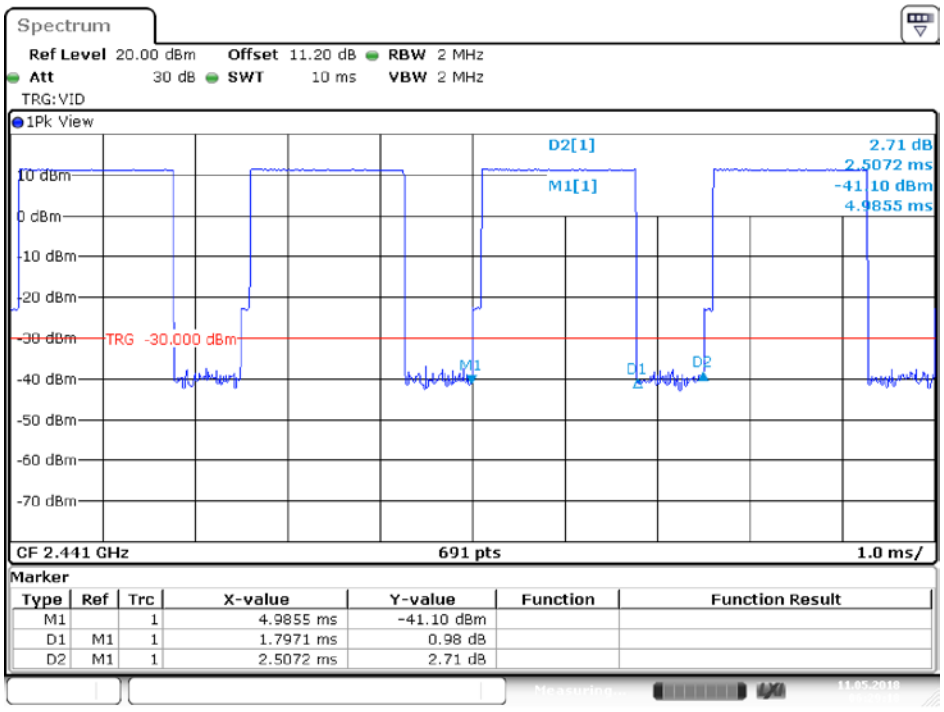
Date: 26.APR.2018 14:56:43

DH1: Hopping Number/10
(Hopping Number = 31 in 1/10 period of highest signals, Second High signals were other channel)



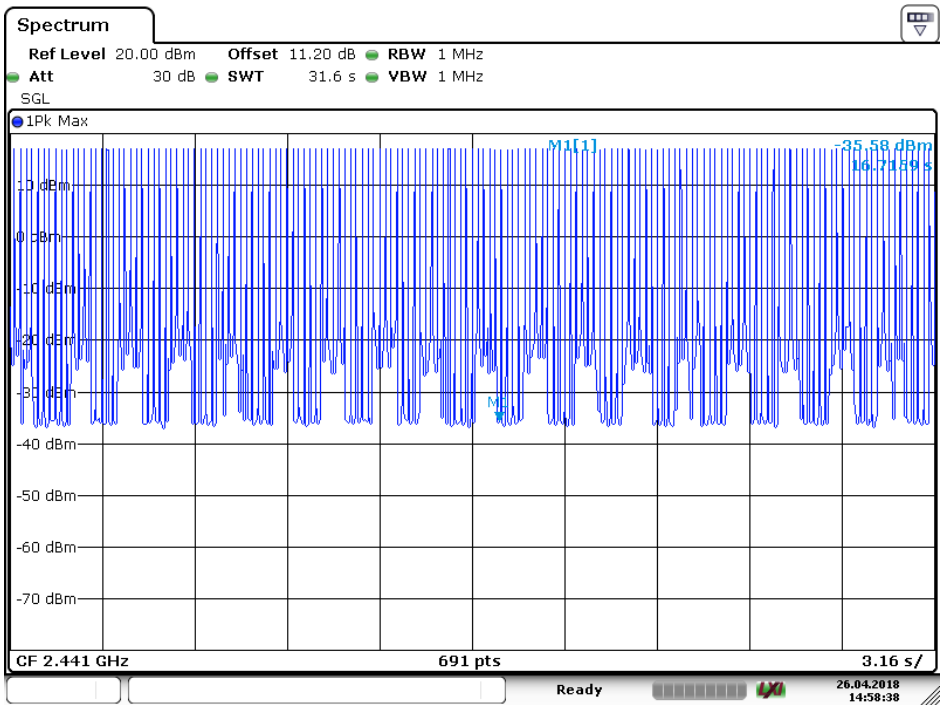
Date: 26.APR.2018 14:54:29

DH3: Pulse Width



Date: 11.MAY.2018 06:29:19

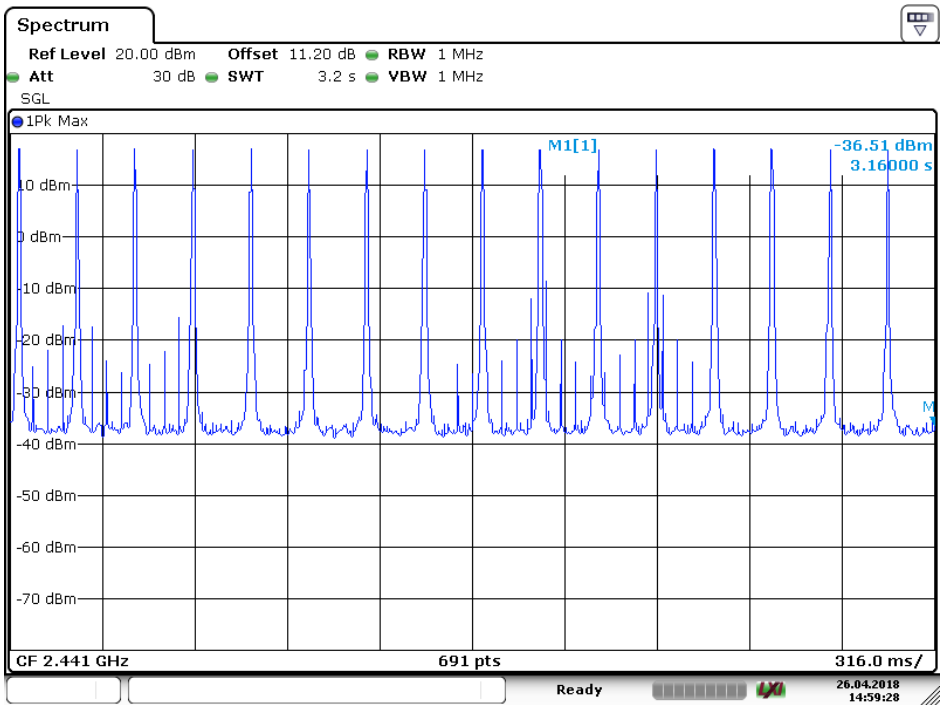
DH3: Hopping Number



Date: 26.APR.2018 14:58:38

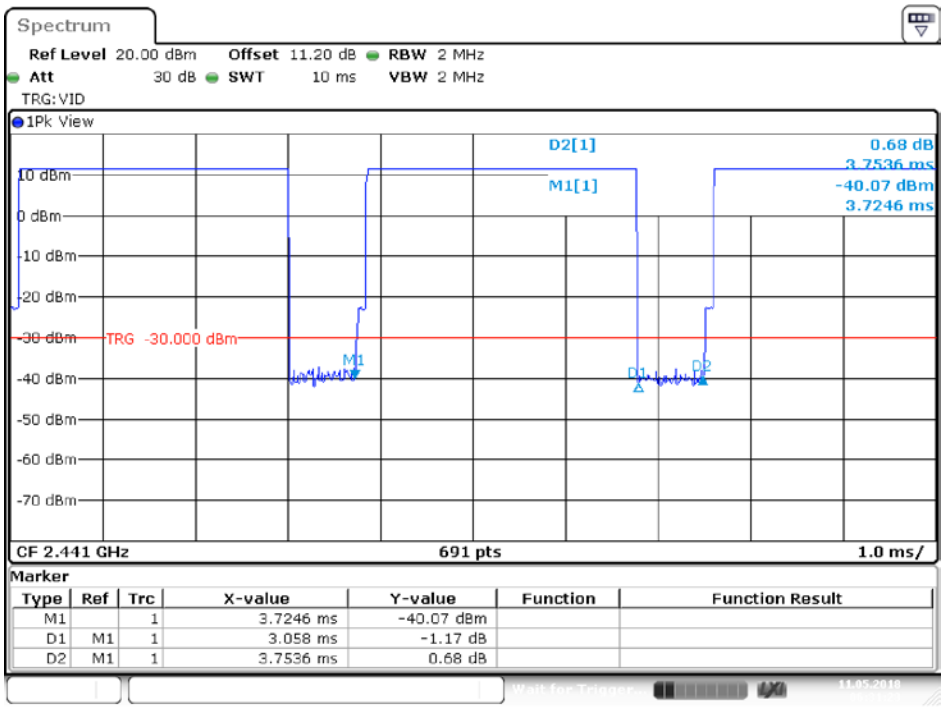
DH3: Hopping Number/10

(Hopping Number = 16 in 1/10 period of highest signals, Second High signals were other channel)



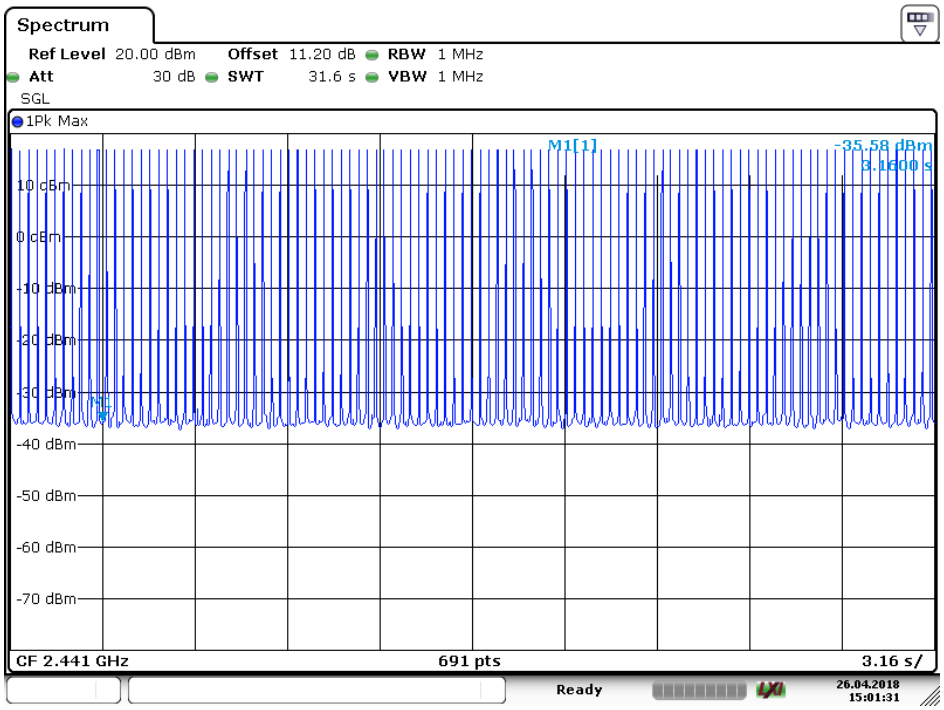
Date: 26.APR.2018 14:59:29

DH5: Pulse Width



Date: 11.MAY.2018 06:31:23

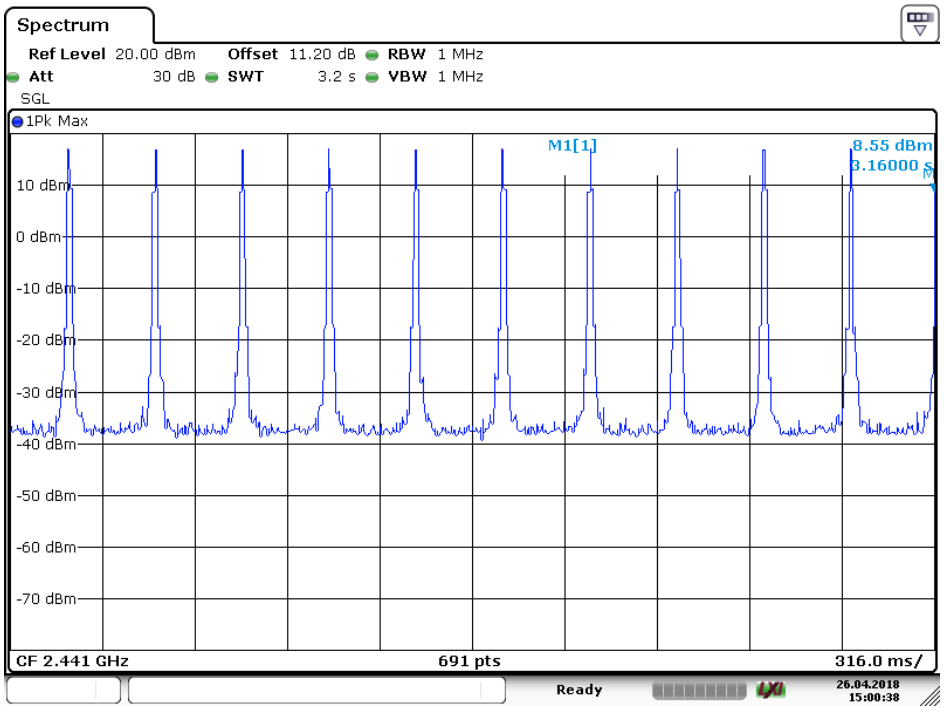
DH5: Hopping Number



Date: 26.APR.2018 15:01:31

DH5: Hopping Number/10

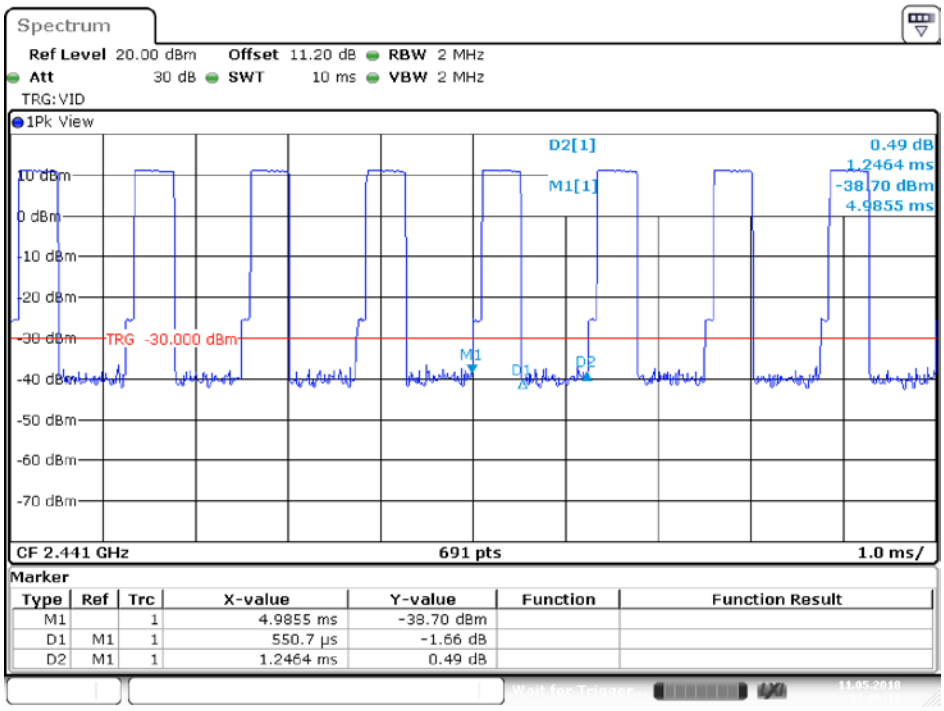
(Hopping Number = 11 in 1/10 period of highest signals, Second High signals were other channel)



Date: 26.APR.2018 15:00:38

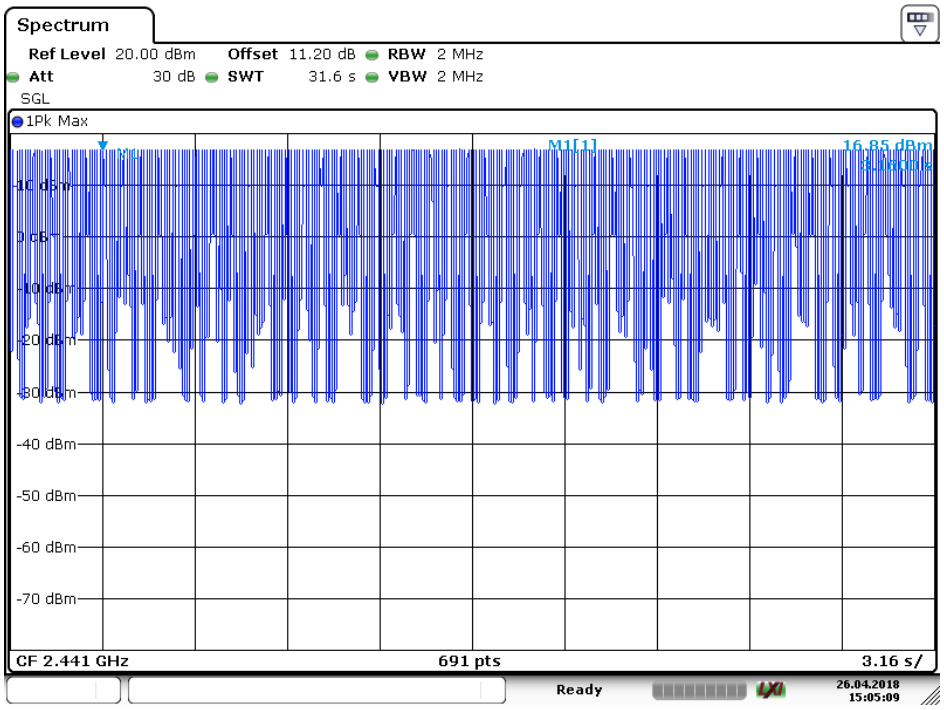
EDR mode (π/4-DQPSK):

DH1: Pulse Width



Date: 11.MAY.2018 07:06:19

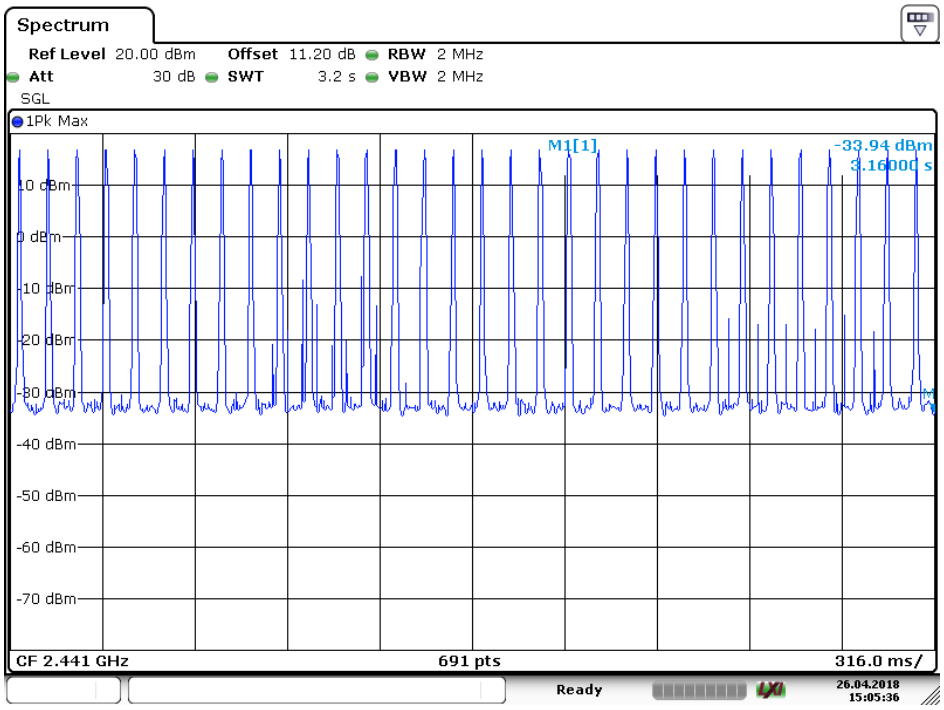
DH1: Hopping Number



Date: 26.APR.2018 15:05:10

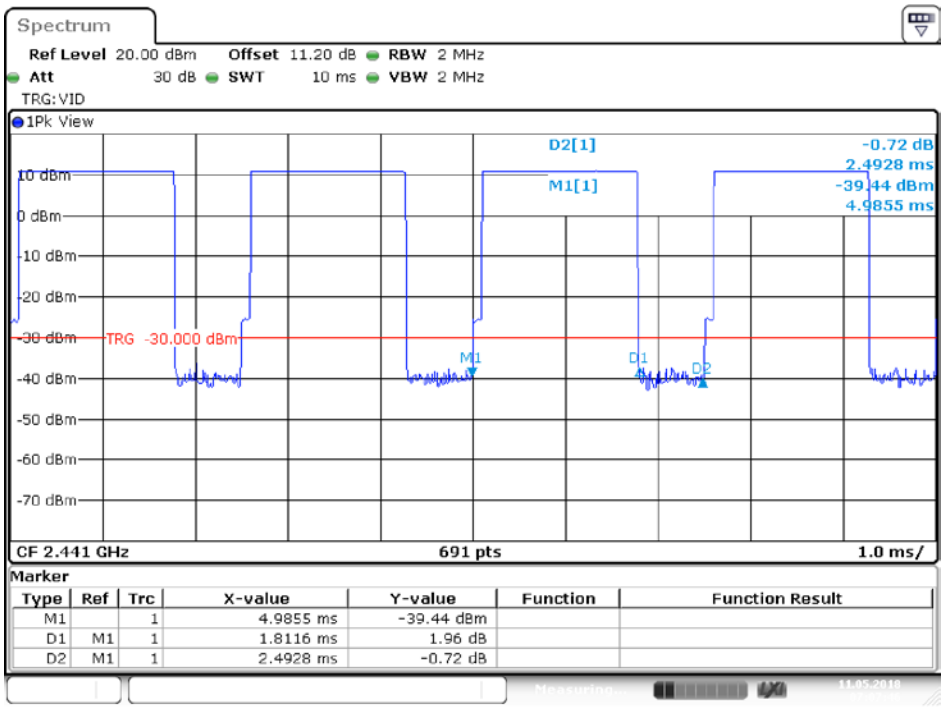
DH1: Hopping Number/10

(Hopping Number = 32 in 1/10 period of highest signals, Second High signals were other channel)



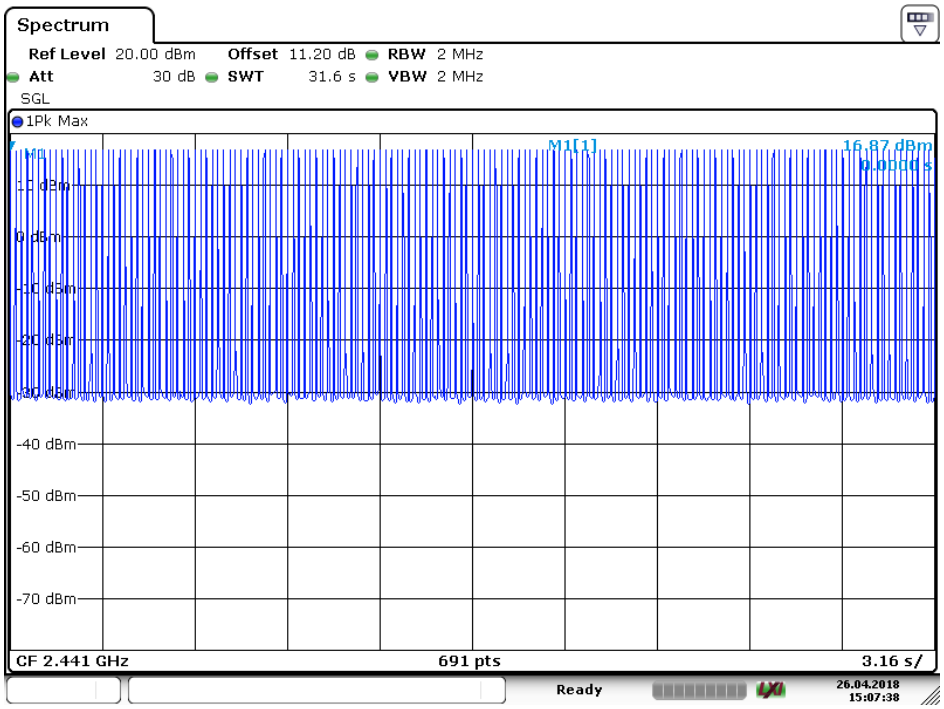
Date: 26.APR.2018 15:05:36

DH3: Pulse Width



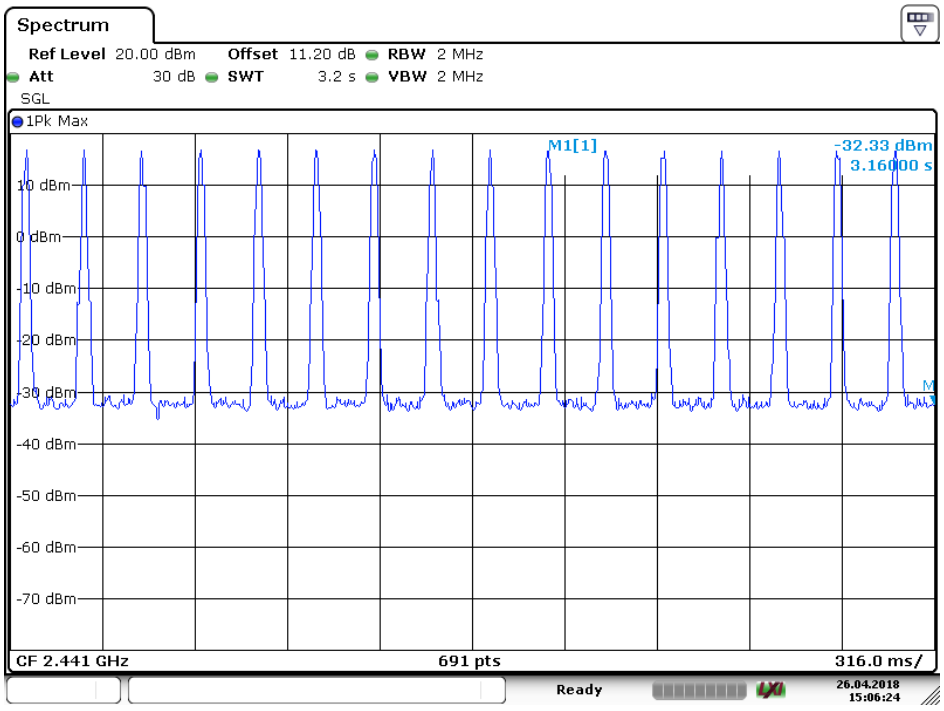
Date: 11.MAY.2018 07:07:47

DH3: Hopping Number



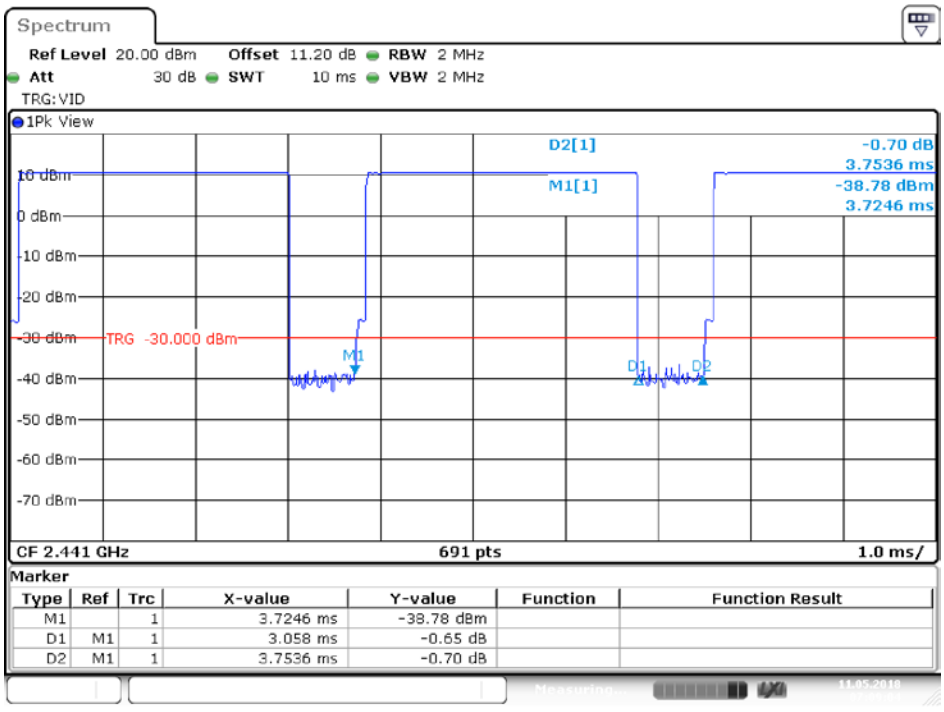
Date: 26.APR.2018 15:07:39

DH3: Hopping Number/10
(Hopping Number = 16 in 1/10 period of highest signals, Second High signals were other channel)



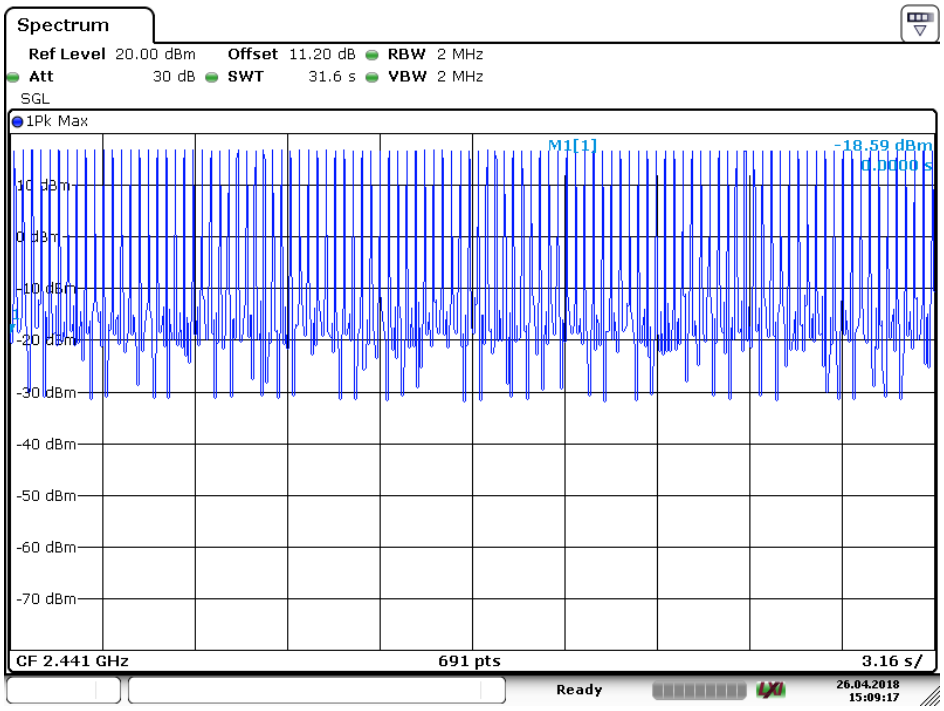
Date: 26.APR.2018 15:06:24

DH5: Pulse Width



Date: 11.MAY.2018 07:09:04

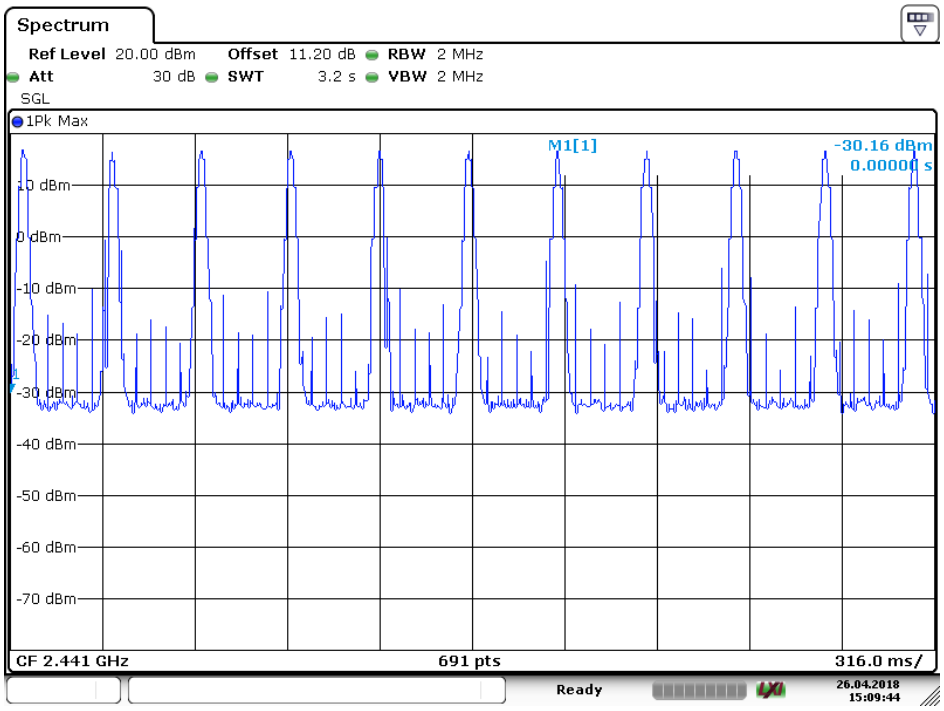
DH5: Hopping Number



Date: 26.APR.2018 15:09:18

DH5: Hopping Number/10

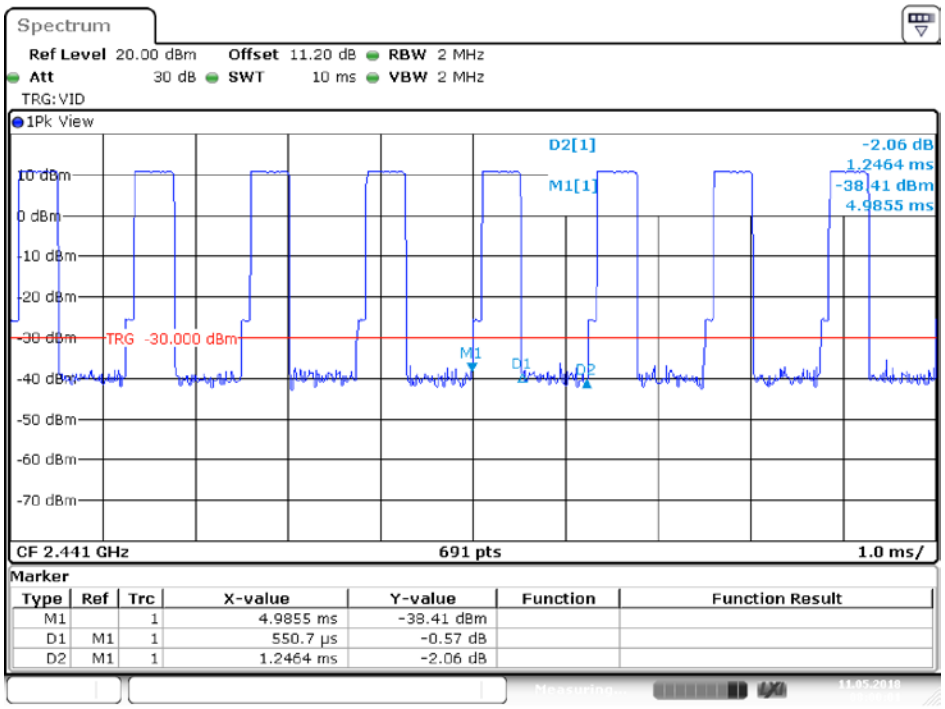
(Hopping Number = 11 in 1/10 period of highest signals, Second High signals were other channel)



Date: 26.APR.2018 15:09:44

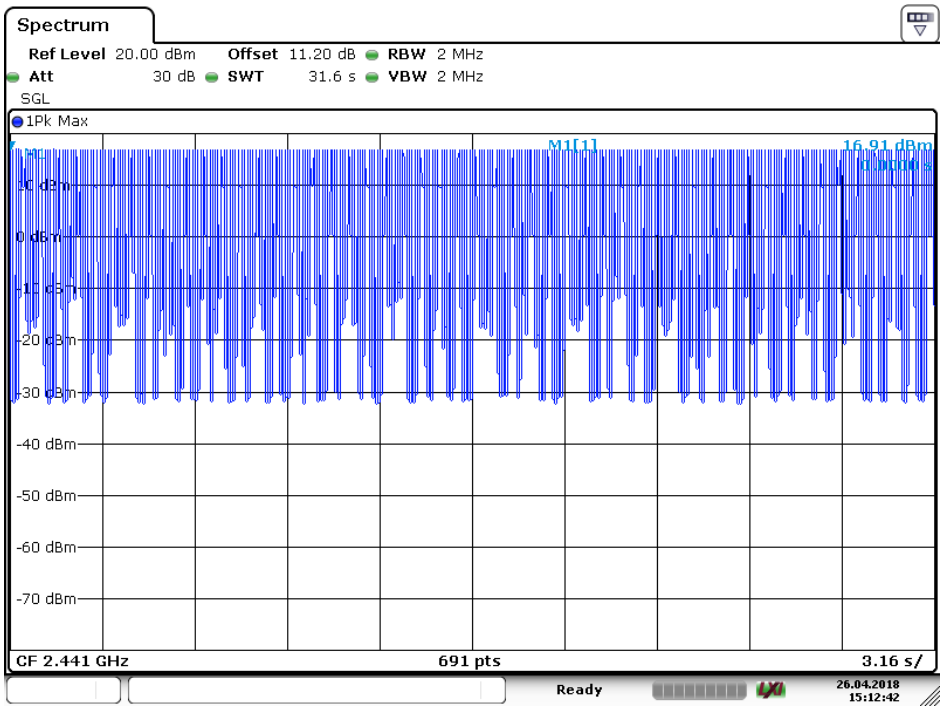
EDR mode (8-DPSK):

DH1: Pulse Width



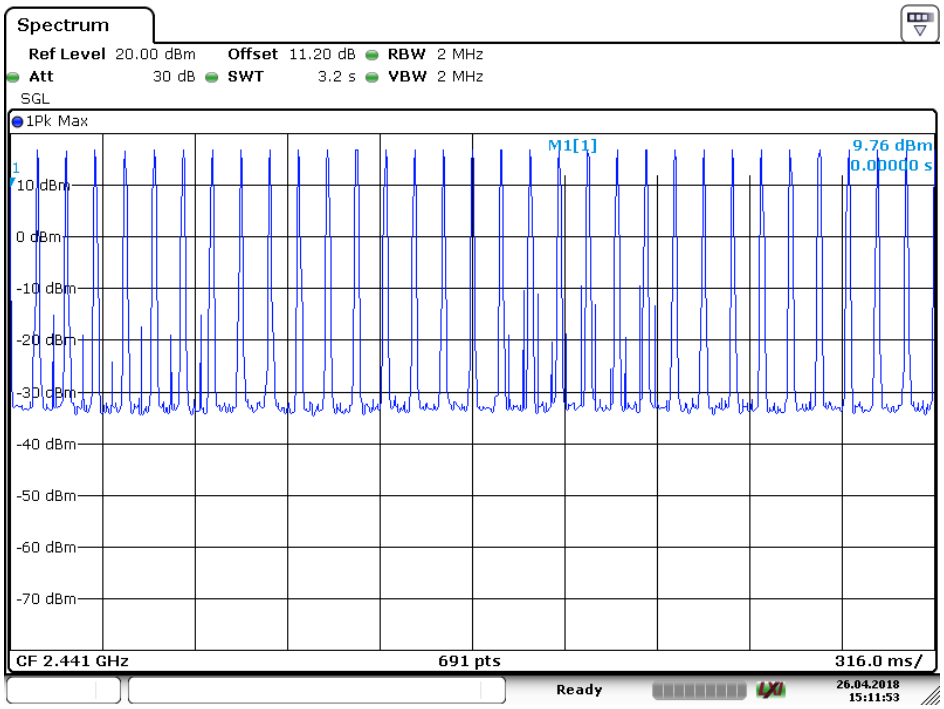
Date: 11.MAY.2018 08:00:01

DH1: Hopping Number



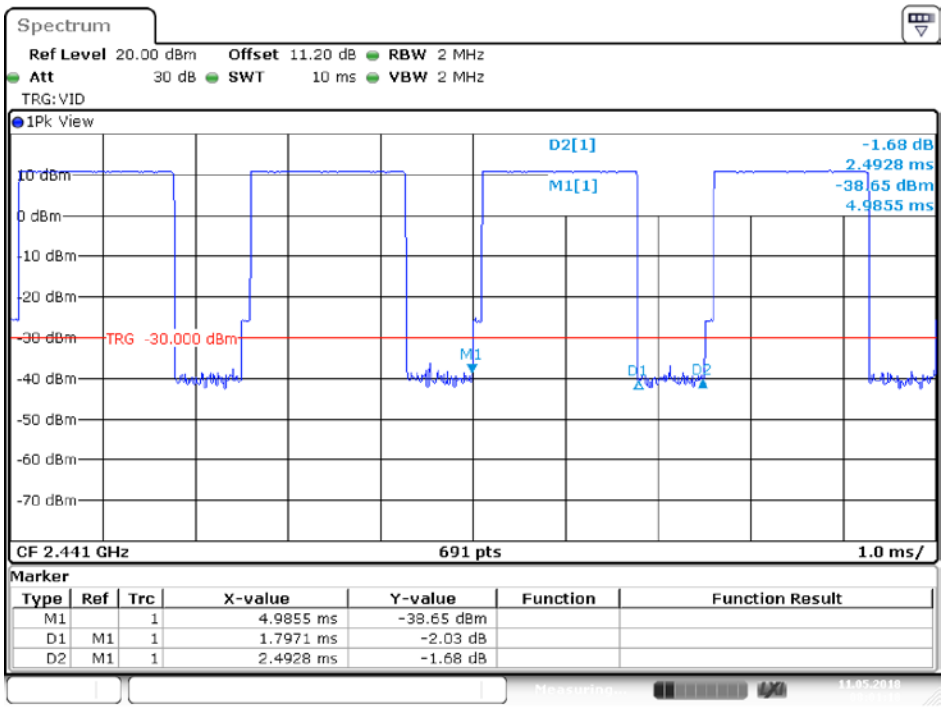
Date: 26.APR.2018 15:12:42

DH1: Hopping Number/10
(Hopping Number = 32 in 1/10 period of highest signals, Second High signals were other channel)



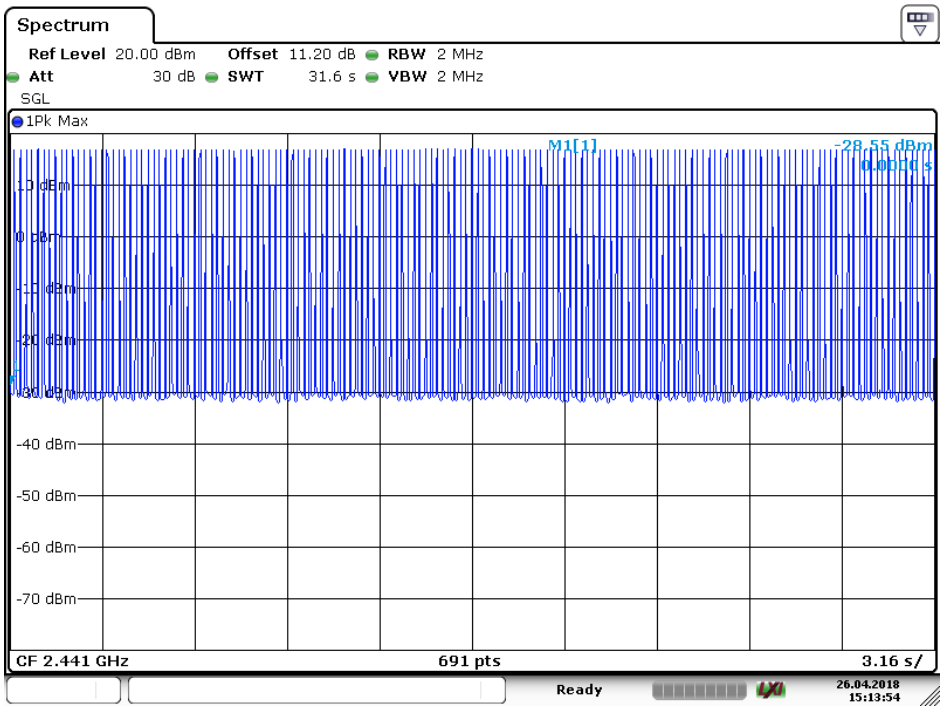
Date: 26.APR.2018 15:11:53

DH3: Pulse Width



Date: 11.MAY.2018 08:01:18

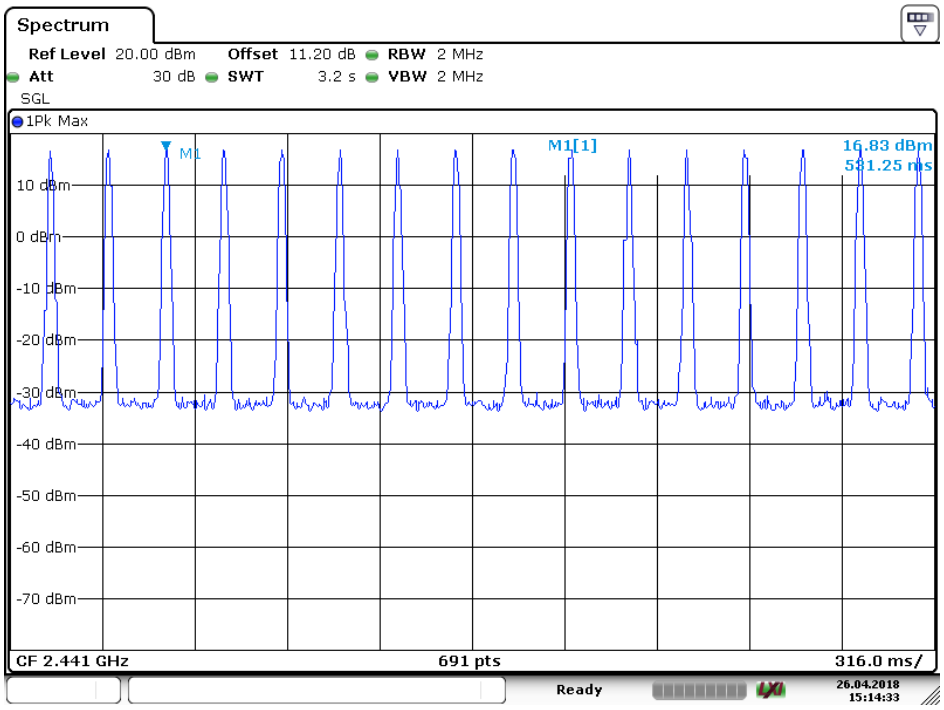
DH3: Hopping Number



Date: 26.APR.2018 15:13:54

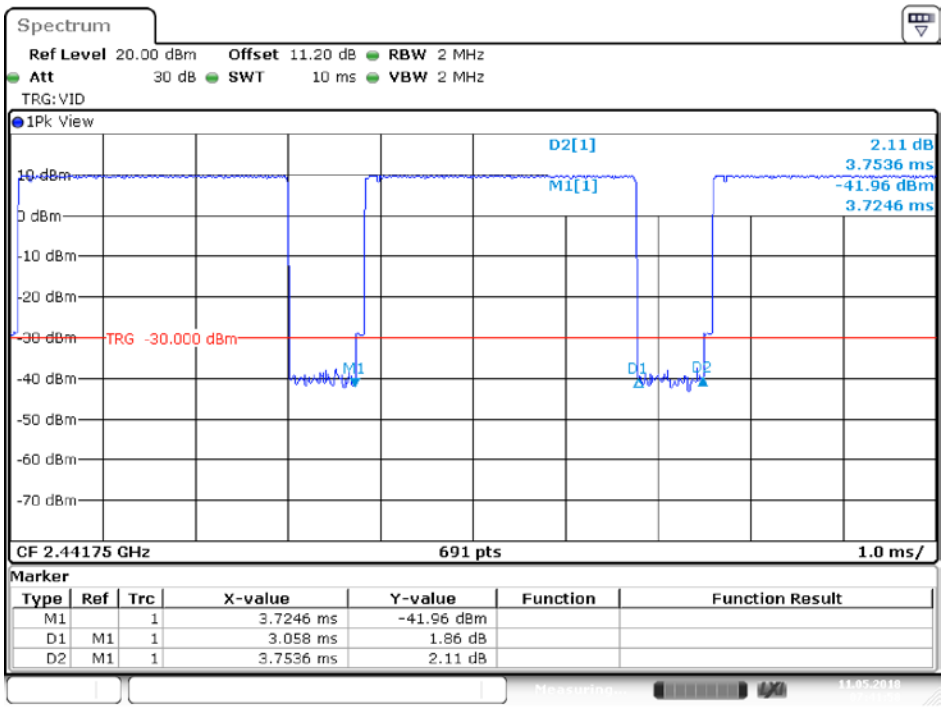
DH3: Hopping Number/10

(Hopping Number = 16 in 1/10 period of highest signals, Second High signals were other channel)



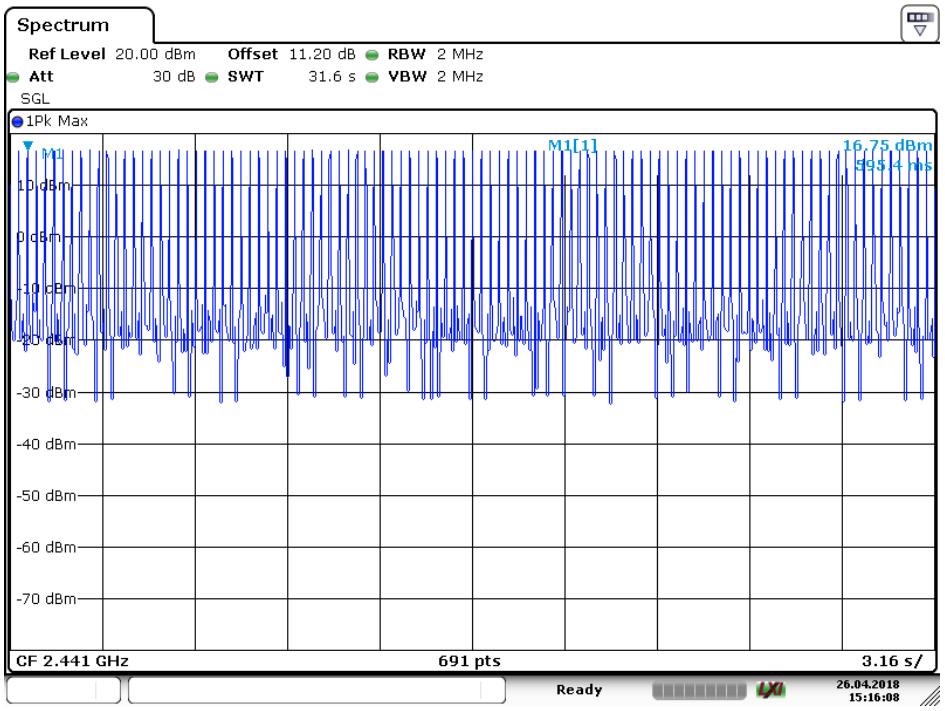
Date: 26.APR.2018 15:14:33

DH5: Pulse Width



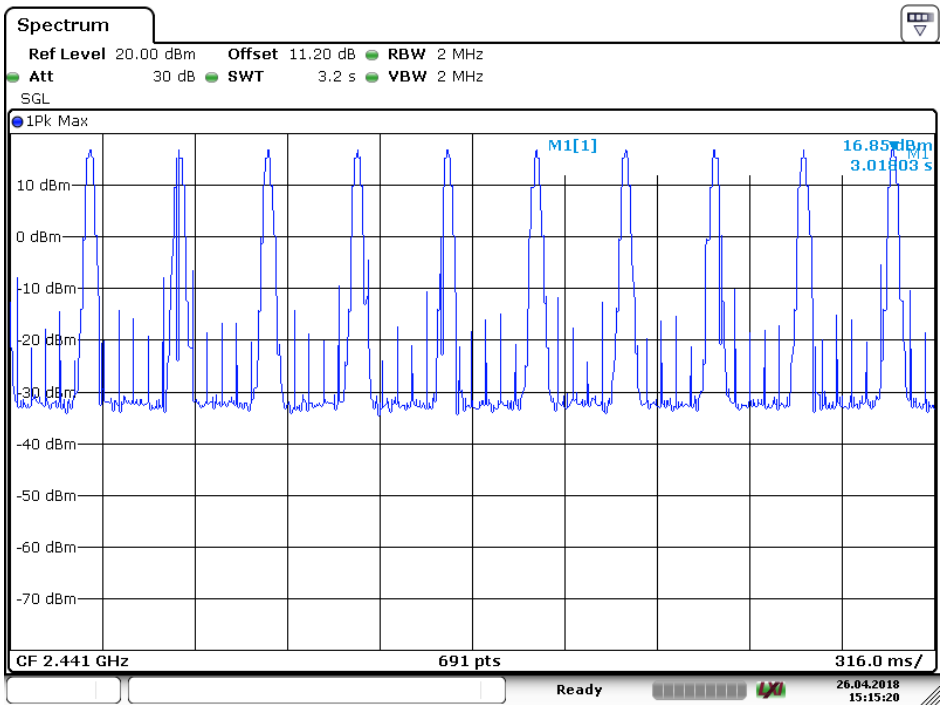
Date: 11.MAY.2018 07:41:58

DH5: Hopping Number



Date: 26.APR.2018 15:16:08

DH5: Hopping Number/10
(Hopping Number = 10 in 1/10 period of highest signals, Second High signals were other channel)



Date: 26.APR.2018 15:15:21

11 FCC §15.247(a)(1)(iii) –Quantity of hopping channel Test

11.1 Applicable Standard

According to FCC §15.247(a) (1) (iii).

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

11.2 Test Procedure

Span = the frequency band of operation
RBW < 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller VBW ≥ RBW
Sweep = auto
Detector function = peak Trace = max hold

11.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Date	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSV40	101140	2017/11/15	2018/11/14
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).*

11.4 Test Environmental Conditions

Temperature:	23.5 ℃
Relative Humidity:	55.4 %
ATM Pressure:	1015 hPa

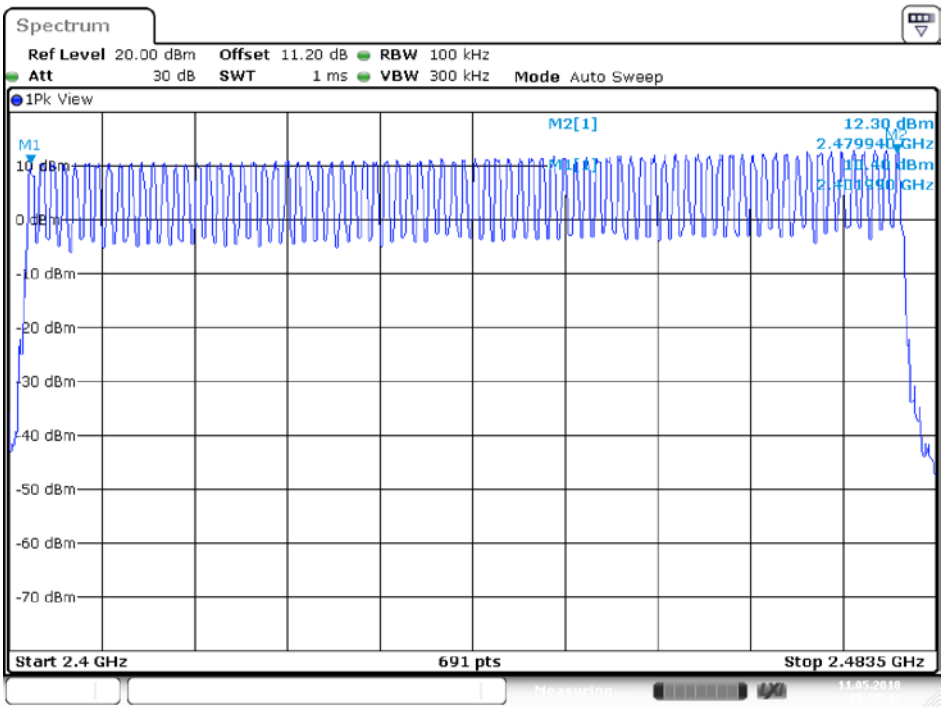
The testing was performed by Ian Tu on 2018-05-11.

11.5 Test Results

Mode	Frequency Range (MHz)	Number of Hopping Channel	Limit (CH)	Result
GFSK	*2402-2480*	*79*	*>15*	*Compliance*
π/4-DQPSK	*2402-2480*	79	*>15*	Compliance
8DPSK	*2402-2480*	79	*>15*	Compliance

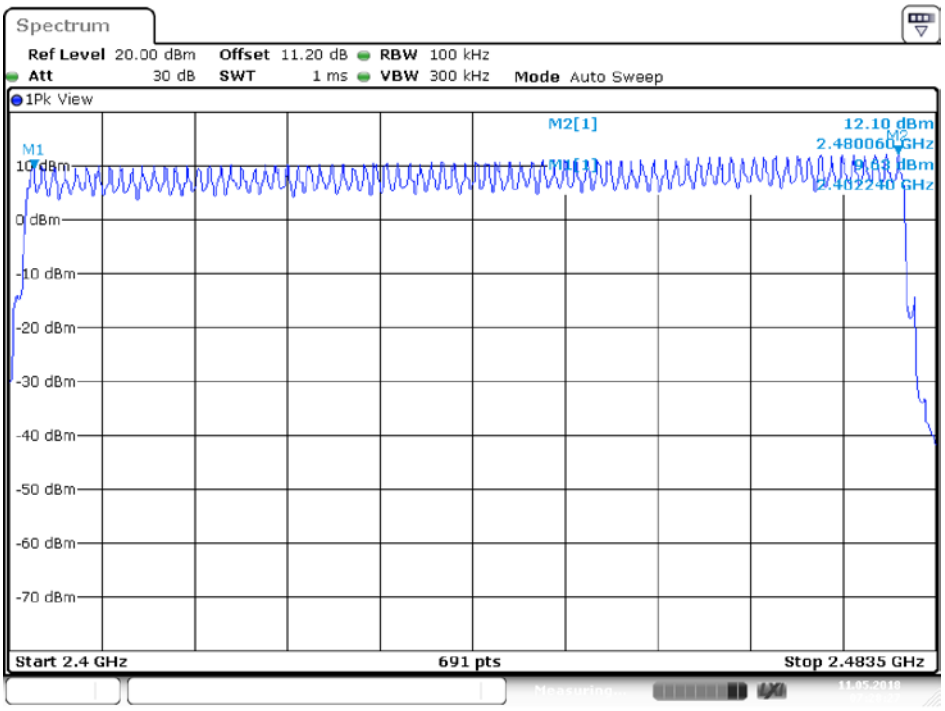
Please refer to the following plots

BR mode (GFSK):



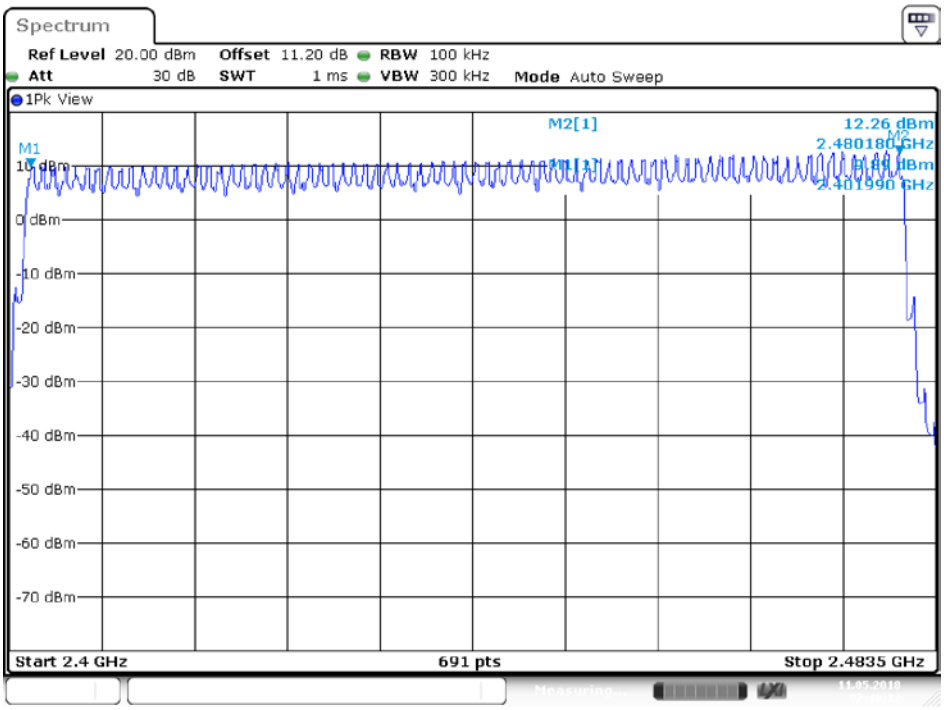
Date: 11.MAY.2018 05:55:44

EDR mode (π/4-DQPSK):



Date: 11.MAY.2018 07:28:27

EDR mode (8DPSK):



Date: 11.MAY.2018 07:40:12

12 FCC §15.247(b)(1) – Maximum Output Power

12.1 Applicable Standard

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

12.2 Test Procedure

Place the EUT on a bench and set it in transmitting mode.
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to an Power sensor.

12.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Date	Calibration Due Date
Power Sensor	KEYSIGHT	U2021XA	MY54080018	2018/03/07	2019/03/06
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).*

12.4 Test Environmental Conditions

Temperature:	23.5 ℃
Relative Humidity:	55.4 %
ATM Pressure:	1015 hPa

The testing was performed by Ian Tu on 2018-05-11.

12.5 Test Results

Channel	Frequency (MHz)	Maximum peak Conducted Output Power (dBm)	Limit (dBm)	Result
BR mode (GFSK)				
Low	2402	11.68	21	Compliance
Middle	2441	10.76	21	Compliance
High	2480	13.65	21	Compliance
EDR mode (π/4-DQPSK)				
Low	2402	11.52	21	Compliance
Middle	2441	11.24	21	Compliance
High	2480	11.79	21	Compliance
EDR mode (8DPSK)				
Low	2402	11.05	21	Compliance
Middle	2441	11.72	21	Compliance
High	2480	13.27	21	Compliance

13 FCC §15.247(d) – 100 kHz Bandwidth of Frequency Band Edge

13.1 Applicable Standard

According to FCC §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum 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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emissions limits specified in §15.209(a) see §15.205(c)
.

13.2 Test Procedure

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
RBW = 100 kHz VBW = 300 kHz
Sweep = coupled
Detector function = peak Trace = max hold

13.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Date	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSV40	101140	2017/11/15	2018/11/14
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).*

13.4 Test Environmental Conditions

Temperature:	23.5 ℃
Relative Humidity:	55.4 %
ATM Pressure:	1015 hPa

The testing was performed by Ian Tu on 2018-05-11.

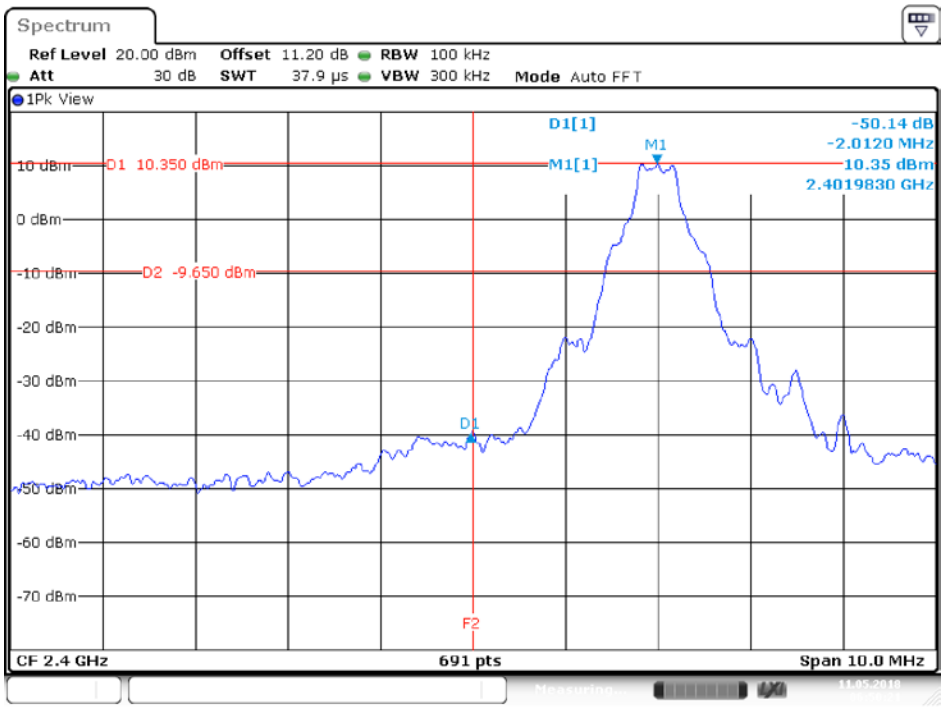
13.5 Test Results

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BR mode (GFSK)				
Low	2402	50.14	≥ 20	Compliance
High	2480	57.96	≥ 20	Compliance
BR Hopping mode (GFSK)				
Low	2402	57.58	≥ 20	Compliance
High	2480	58.74	≥ 20	Compliance
EDR mode (π/4-DQPSK)				
Low	2402	39.10	≥ 20	Compliance
High	2480	56.78	≥ 20	Compliance
EDR Hopping mode (π/4-DQPSK)				
Low	2402	40.17	≥ 20	Compliance
High	2480	57.16	≥ 20	Compliance
EDR mode (8DPSK)				
Low	2402	37.70	≥ 20	Compliance
High	2480	52.19	≥ 20	Compliance
EDR Hopping mode (8DPSK)				
Low	2402	38.93	≥ 20	Compliance
High	2480	58.05	≥ 20	Compliance

Please refer to the following plots

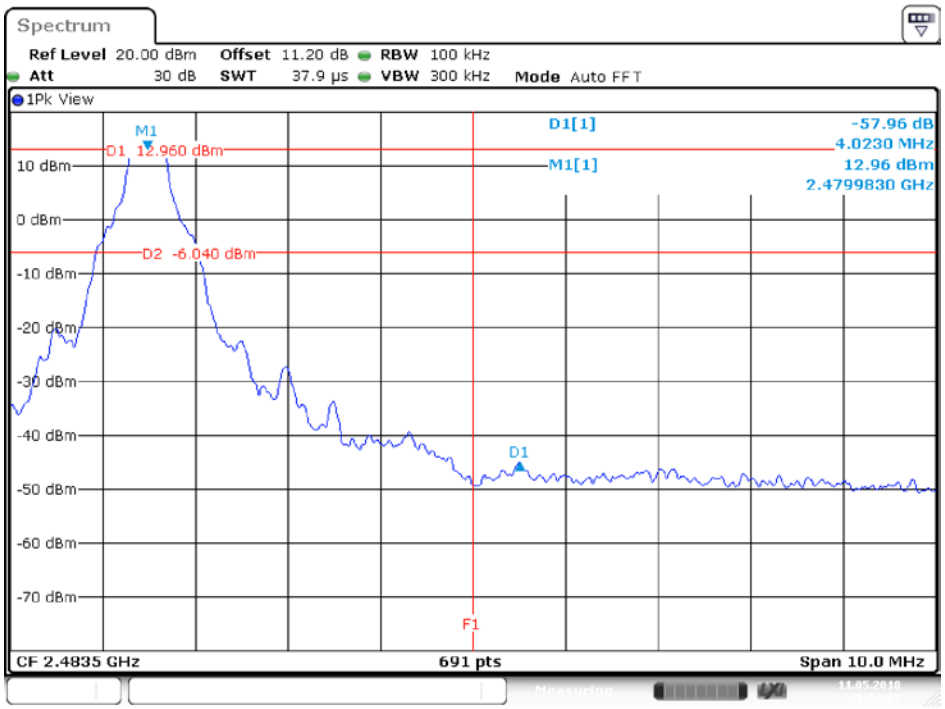
BR mode (GFSK):

Band Edge, Left Side



Date: 11.MAY.2018 06:50:22

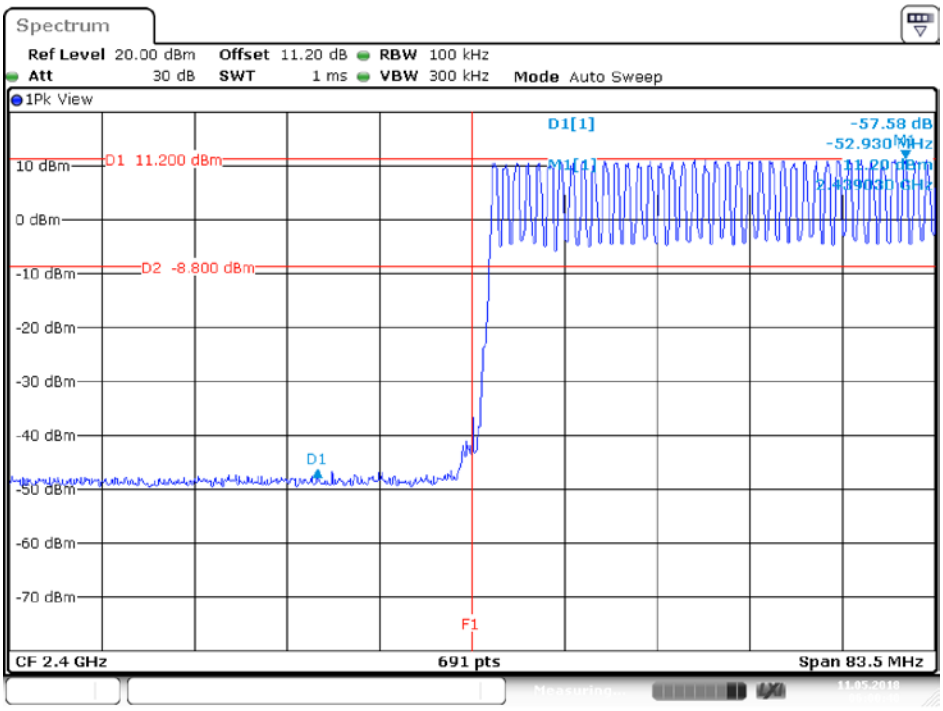
Band Edge, Right Side



Date: 11.MAY.2018 06:59:05

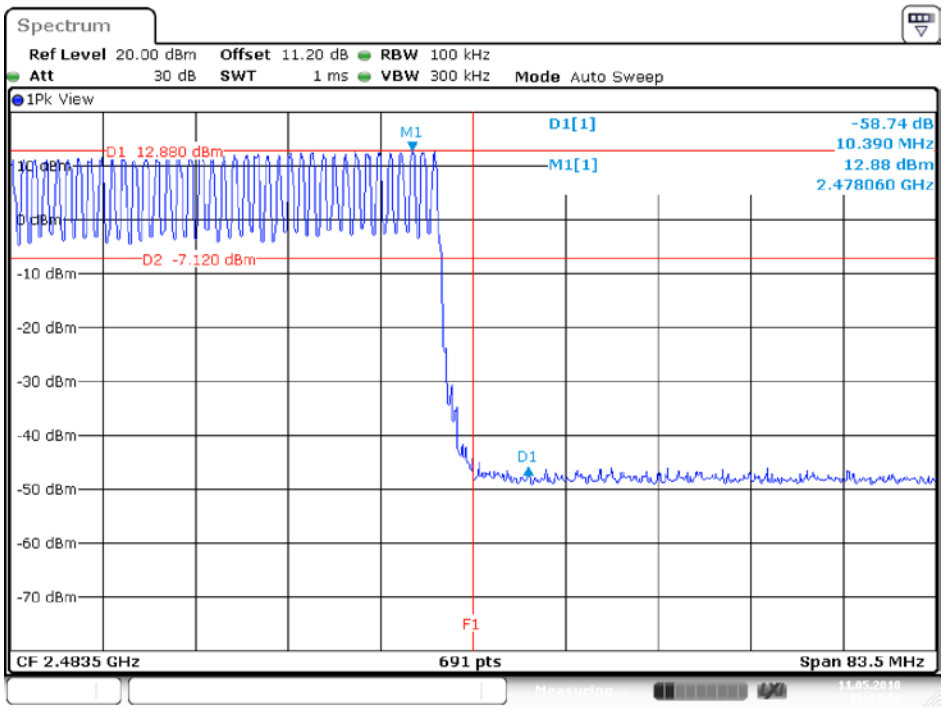
BR Hopping mode (GFSK):

Band Edge, Left Side



Date: 11.MAY.2018 06:00:40

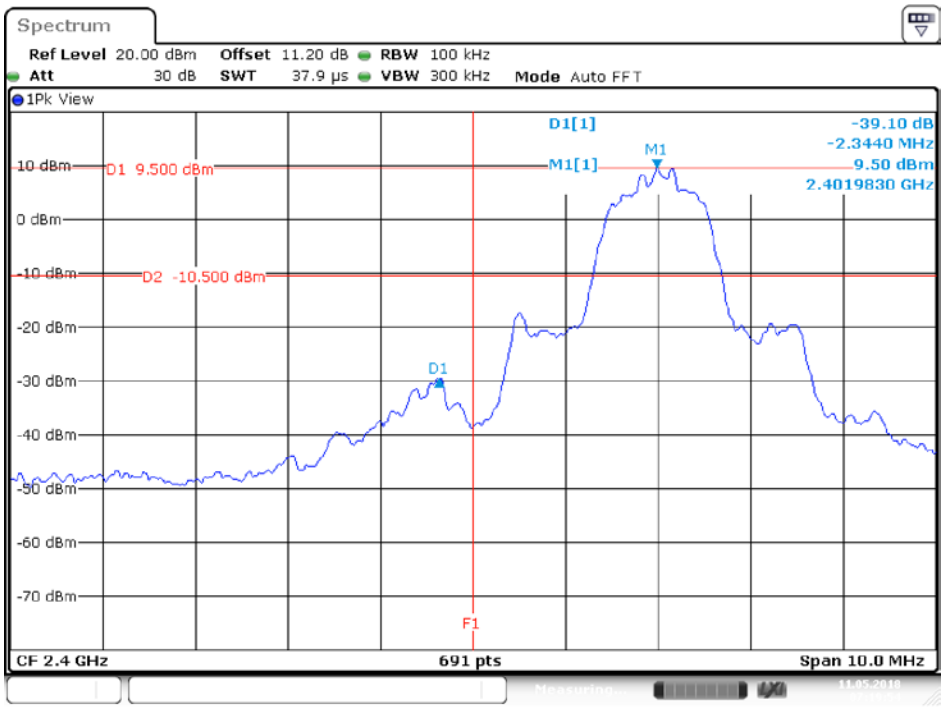
Band Edge, Right Side



Date: 11.MAY.2018 06:19:00

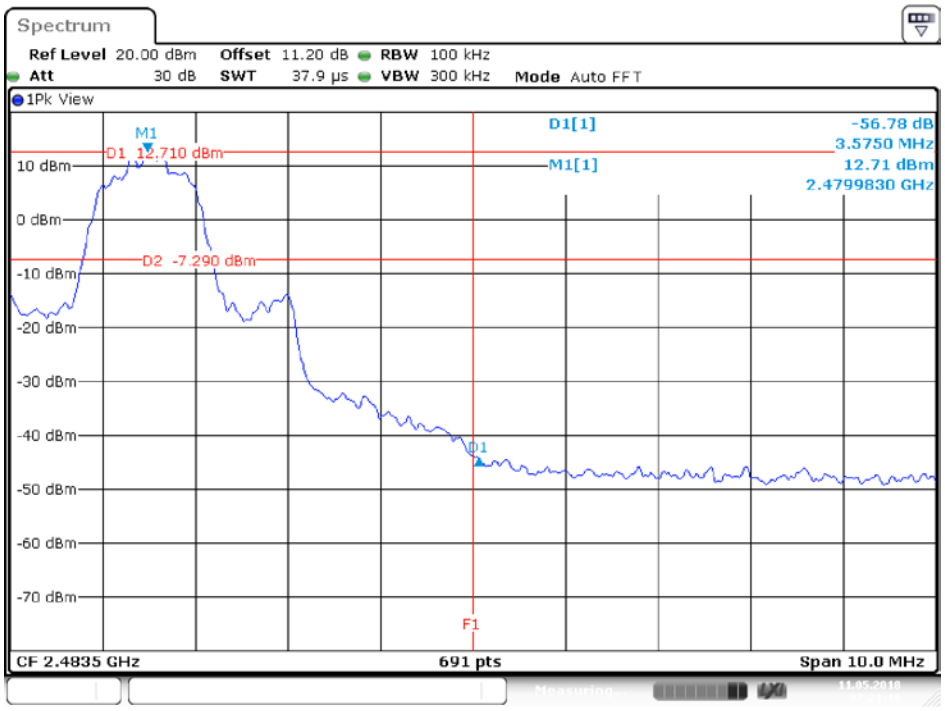
EDR mode (π /4-DQPSK):

Band Edge, Left Side



Date: 11.MAY.2018 07:19:54

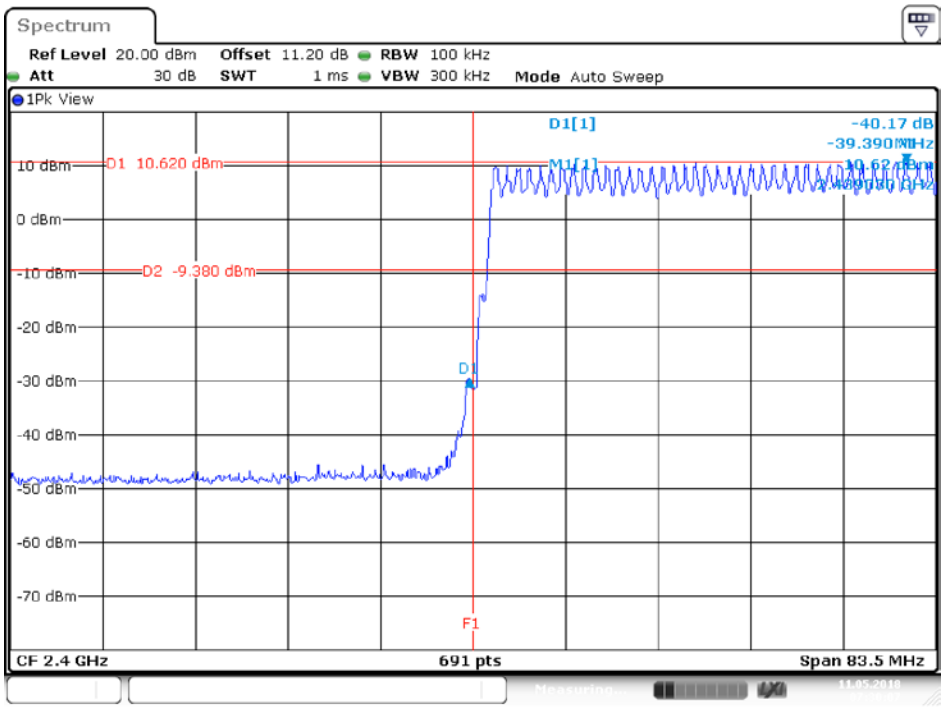
Band Edge, Right Side



Date: 11.MAY.2018 07:21:19

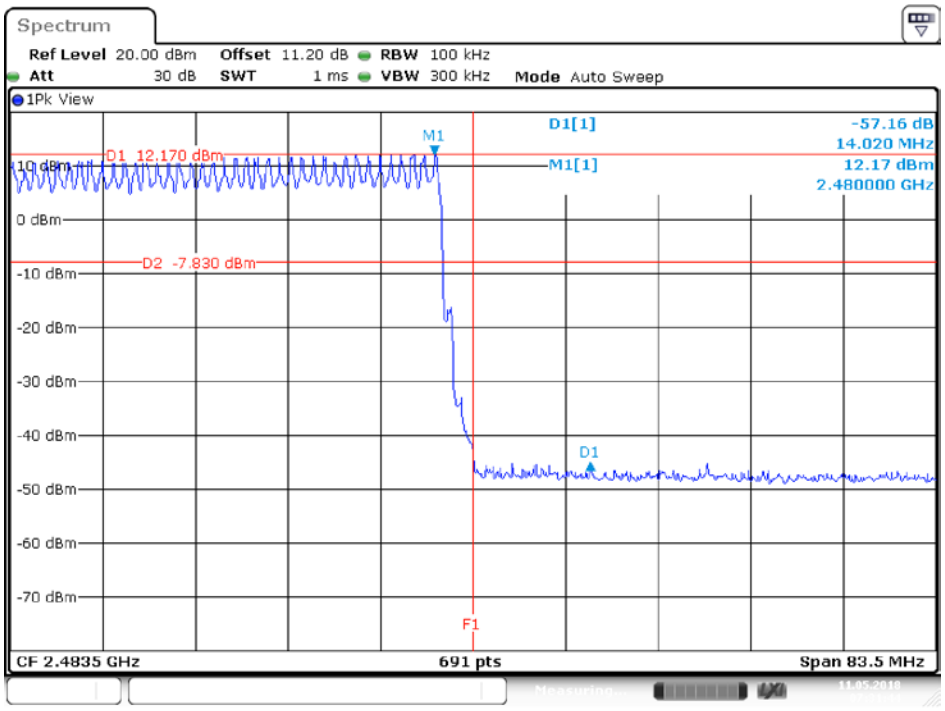
EDR Hopping mode (π /4-DQPSK):

Band Edge, Left Side



Date: 11.MAY.2018 07:30:08

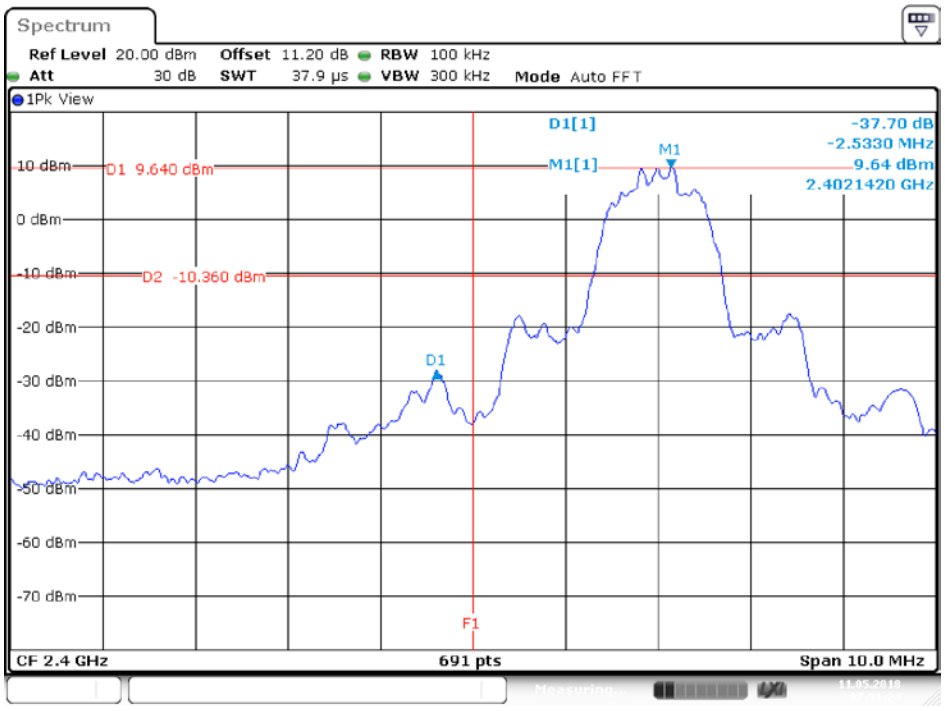
Band Edge, Right Side



Date: 11.MAY.2018 07:31:45

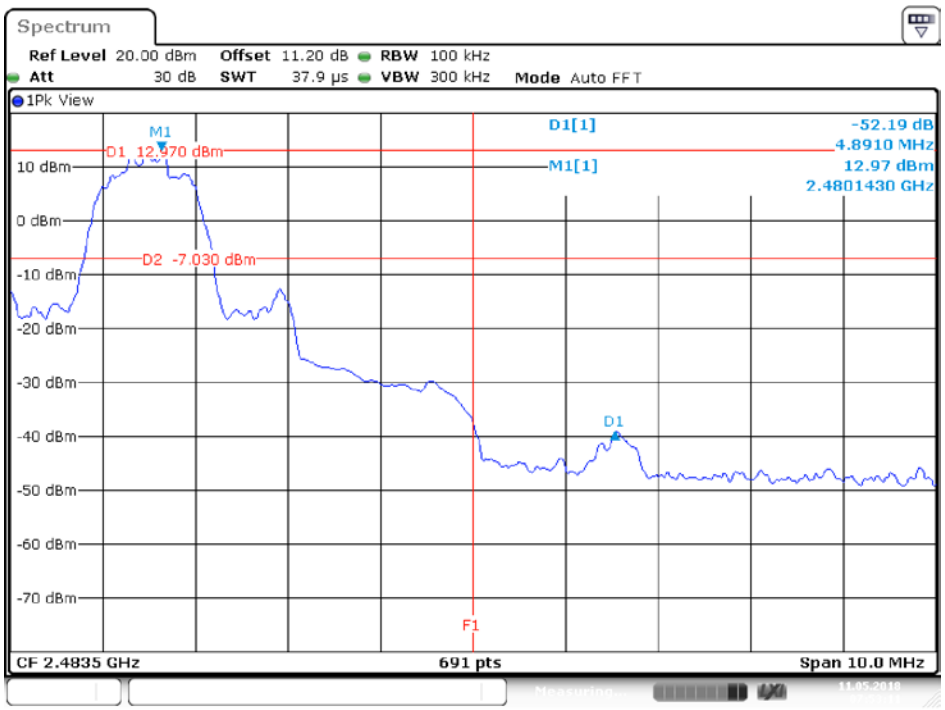
EDR mode (8DPSK):

Band Edge, Left Side



Date: 11.MAY.2018 07:51:24

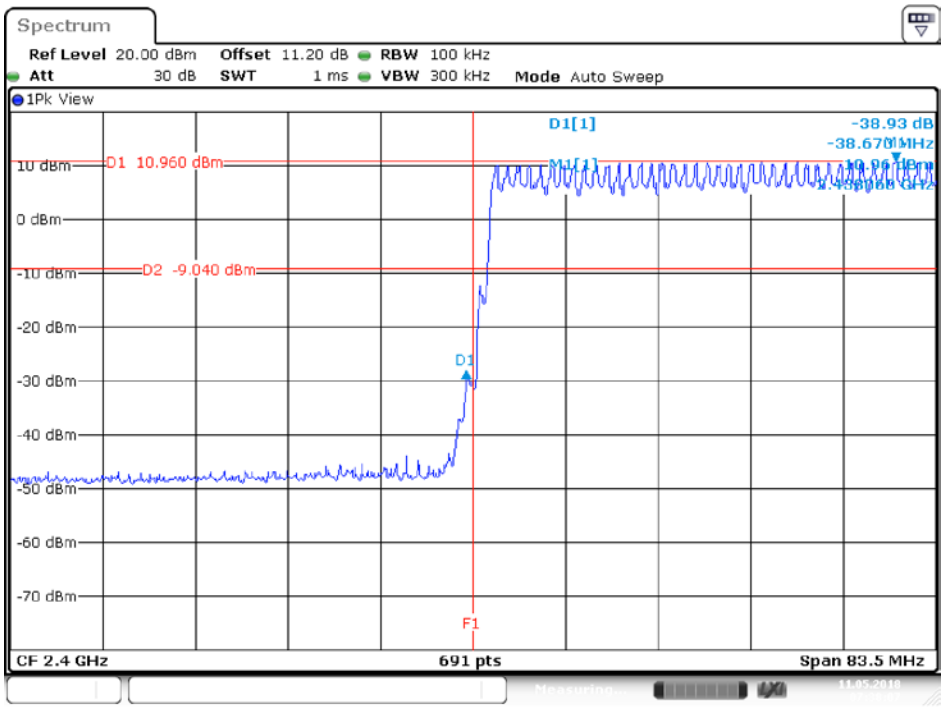
Band Edge, Right Side



Date: 11.MAY.2018 07:53:11

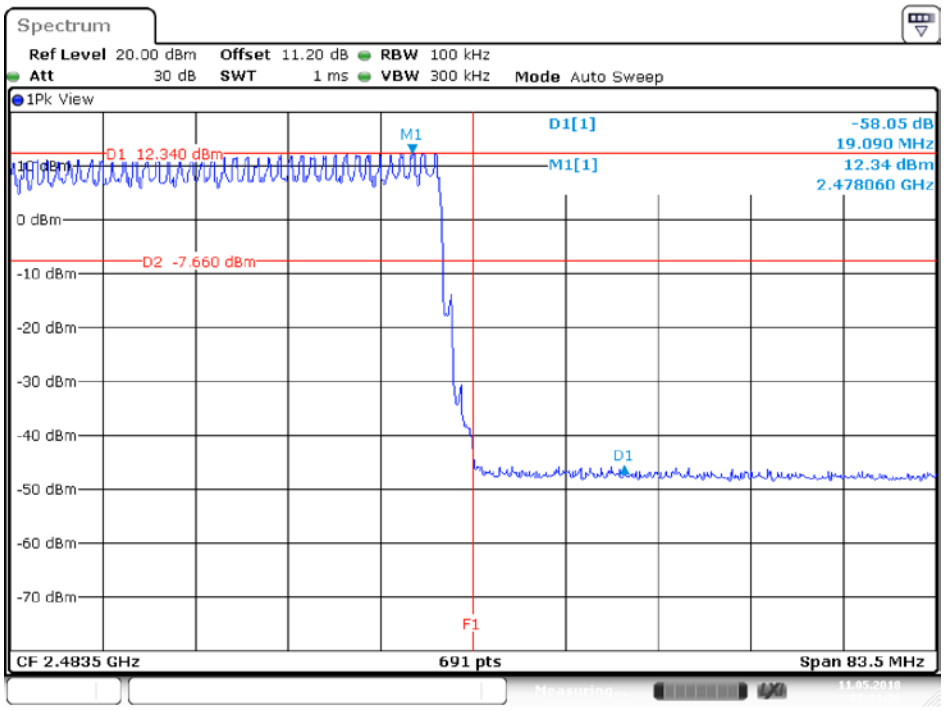
EDR Hopping mode (8DQSK):

Band Edge, Left Side



Date: 11.MAY.2018 07:38:07

Band Edge, Right Side



Date: 11.MAY.2018 07:34:21

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