

Appendix

Main Test Instruments

Conducted Emission					
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. date	Cal. Due date
				(yyyy-mm-dd)	(yyyy-mm-dd)
Shielding Room	ZhongYu Electron	GB-88	SEM001-06	2017/5/10	2020/5/9
LISN	Rohde & Schwarz	ENV216	SEM007-01	2018/9/2	2019/9/2
LISN	ETS-LINDGREN	Feb-16	SEM007-02	2019/4/1	2020/3/31
Measurement Software	AUDIX	e3 V5.4.1221d	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM024-01	2019/6/12	2020/6/11
2 Line ISN	Fischer Custom Communications Inc.	FCC-TLISN-T2-02	EMC0122	2019/2/11	2020/2/10
EMI Test Receiver	Rohde & Schwarz	ESCI	SEM004-02	2019/3/2	2020/3/1
RF conducted test					
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. date	Cal. Due date
				(yyyy-mm-dd)	(yyyy-mm-dd)
DC Power Supply	Agilent Technologies Inc	66311B	W009-09	2018/9/15	2019/9/15
Signal Analyzer	Rohde & Schwarz	FSV	W025-05	2019/1/13	2020/1/12
Coaxial Cable	SGS	N/A	SEM031-01	2019/6/12	2020/6/11
Attenuator	Weinschel Associates	WA41	SEM021-09	N/A	N/A
Signal Generator	KEYSIGHT	N5173B	SEM006-05	2018/9/2	2019/9/2
Temperature Chamber	GIANT FORCE	ICT-150-40-CP-AR	W027-03	2018/11/27	2019/11/27
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2018/9/2	2019/9/2

Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Total RF power, conducted	±0.75dB
2	RF power density, conducted	±2.84dB
3	Spurious emissions, conducted	±0.75dB
4	Conduct emission test	±3.12 dB(9KHz- 30MHz)
5	Temperature test	±1°C
6	Humidity test	±3%
7	DC and low frequency voltages	±0.5%

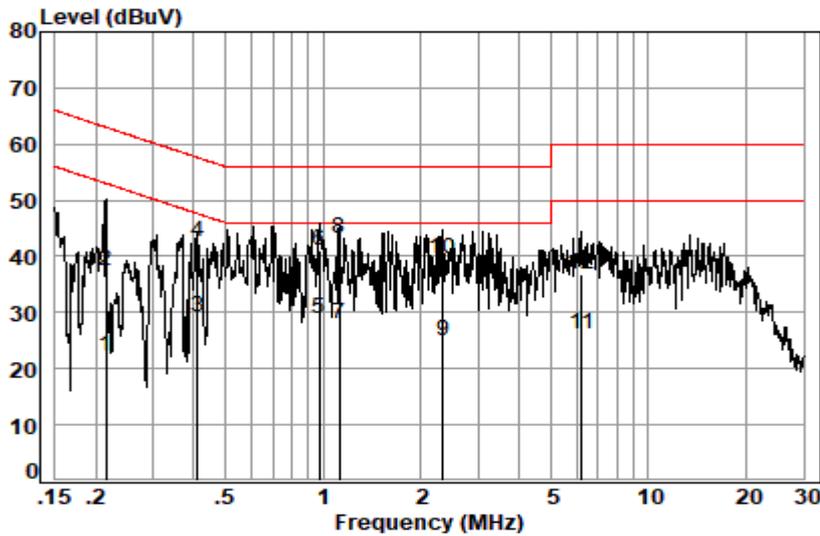
AC Power Line Conducted Emissions

Measurement Data

An initial pre-scan was performed on the live and neutral lines with peak detector.

Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

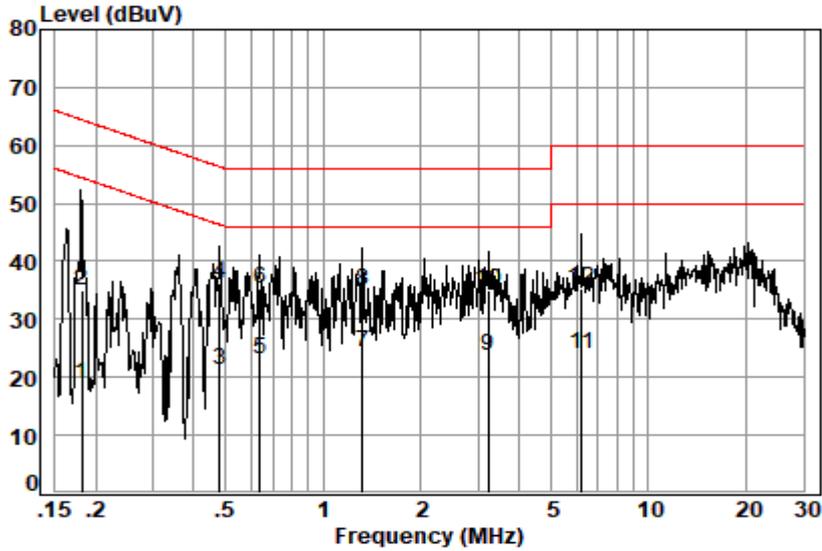
Live line:



Site : Shielding Room
 Condition: Line
 Job No. : 16976CR
 Test mode: c

	Freq	Cable Loss	LISM Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV	dBuV	dB	
1	0.2151	0.03	9.66	12.54	22.23	53.01	-30.78	Average
2	0.2151	0.03	9.66	27.68	37.37	63.01	-25.64	QP
3	0.4105	0.05	9.67	19.44	29.16	47.64	-18.48	Average
4	0.4105	0.05	9.67	32.78	42.50	57.64	-15.14	QP
5	0.9735	0.09	9.74	18.99	28.82	46.00	-17.18	Average
6	0.9735	0.09	9.74	31.11	40.94	56.00	-15.06	QP
7	1.1233	0.10	9.73	18.21	28.04	46.00	-17.96	Average
8	1.1233	0.10	9.73	33.44	43.27	56.00	-12.73	QP
9	2.3336	0.16	9.71	15.12	24.99	46.00	-21.01	Average
10	2.3336	0.16	9.71	29.60	39.47	56.00	-16.53	QP
11	6.2520	0.17	9.77	16.30	26.24	50.00	-23.76	Average
12	6.2520	0.17	9.77	26.95	36.89	60.00	-23.11	QP

Neutral line:



Site : Shielding Room
 Condition: Neutral
 Job No. : 16976CR
 Test mode: c

	Freq	Cable Loss	LISN Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV	dBuV	dB	
1	0.1815	0.02	9.64	9.14	18.80	54.42	-35.62	Average
2	0.1815	0.02	9.64	25.43	35.09	64.42	-29.33	QP
3	0.4812	0.06	9.64	11.53	21.23	46.32	-25.09	Average
4	0.4812	0.06	9.64	26.48	36.18	56.32	-20.14	QP
5	0.6372	0.07	9.64	13.29	23.00	46.00	-23.00	Average
6	0.6372	0.07	9.64	25.45	35.16	56.00	-20.84	QP
7	1.3238	0.12	9.70	14.39	24.21	46.00	-21.79	Average
8	1.3238	0.12	9.70	25.03	34.85	56.00	-21.15	QP
9	3.2239	0.16	9.68	13.99	23.83	46.00	-22.17	Average
10	3.2239	0.16	9.68	25.18	35.02	56.00	-20.98	QP
11	6.2189	0.17	9.74	13.99	23.90	50.00	-26.10	Average
12	6.2189	0.17	9.74	25.28	35.19	60.00	-24.81	QP

Remarks:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level = Receiver Reading + LISN Factor + Cable Loss.

Conducted Peak Output Power

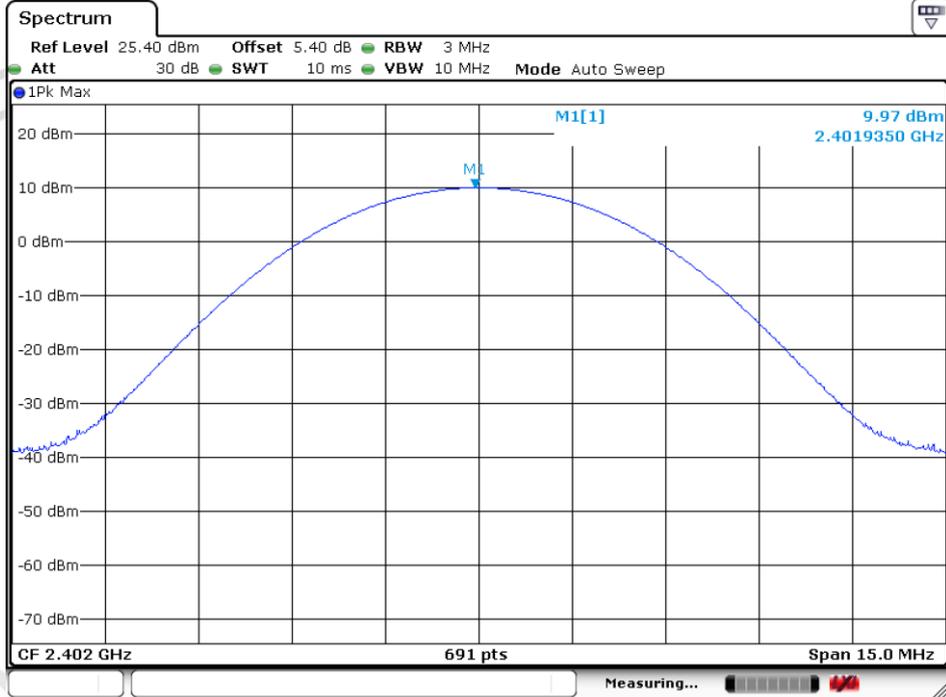
Test Results

Measurement Data of Peak power:

GFSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	9.97	20.97	Pass
Middle	9.68	20.97	Pass
Highest	8.71	20.97	Pass
$\pi/4$ DQPSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	9.36	20.97	Pass
Middle	8.93	20.97	Pass
Highest	8.52	20.97	Pass
8DPSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	9.37	20.97	Pass
Middle	8.96	20.97	Pass
Highest	8.57	20.97	Pass

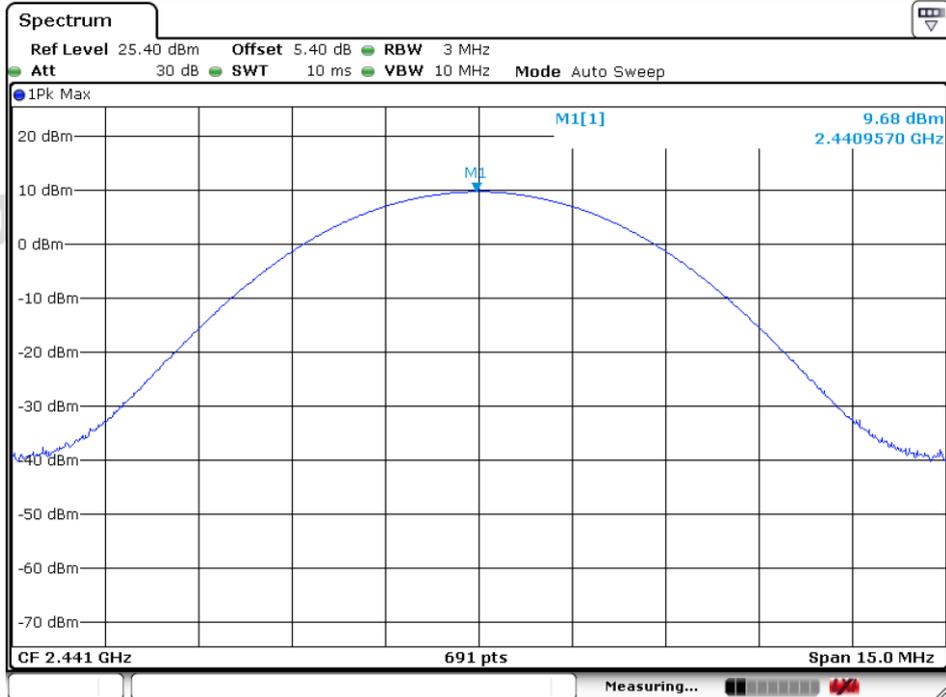
Test plots

Test mode:	GFSK	Test channel:	Lowest
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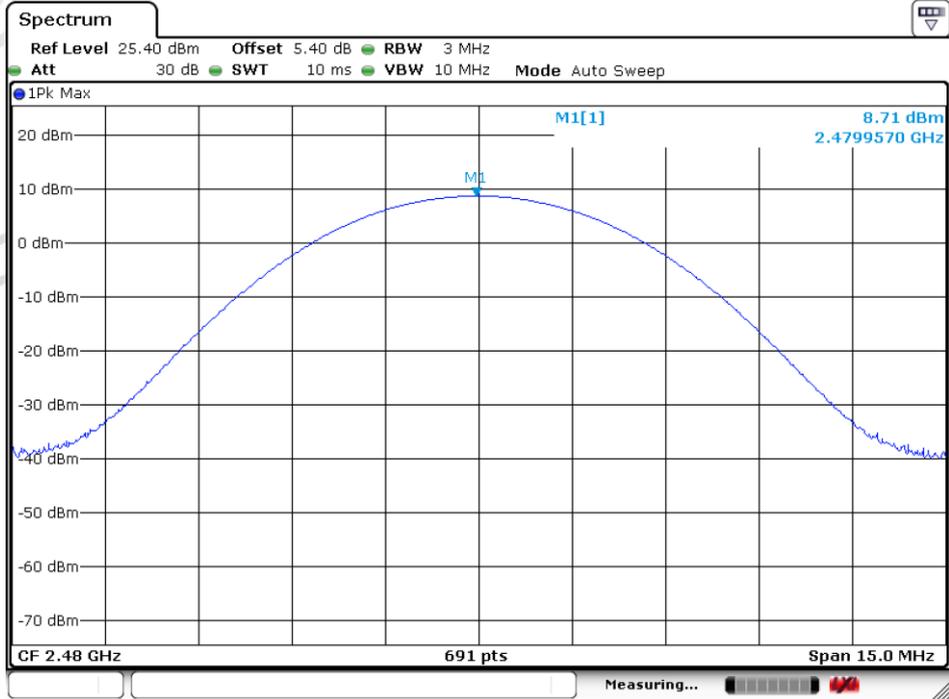
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Test mode:	GFSK	Test channel:	Middle
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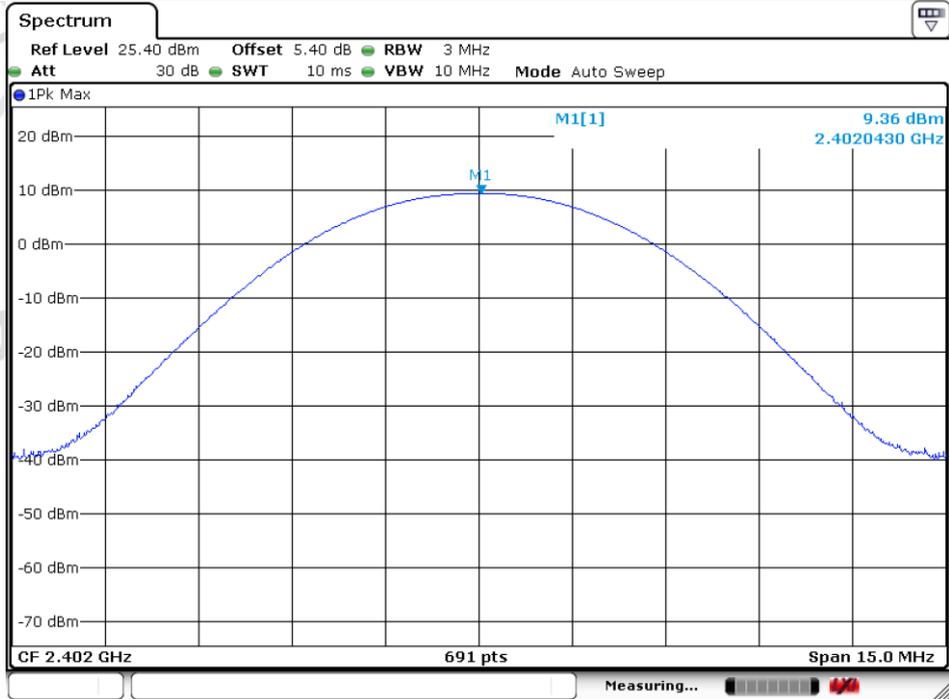
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Test mode: GFSK Test channel: Highest



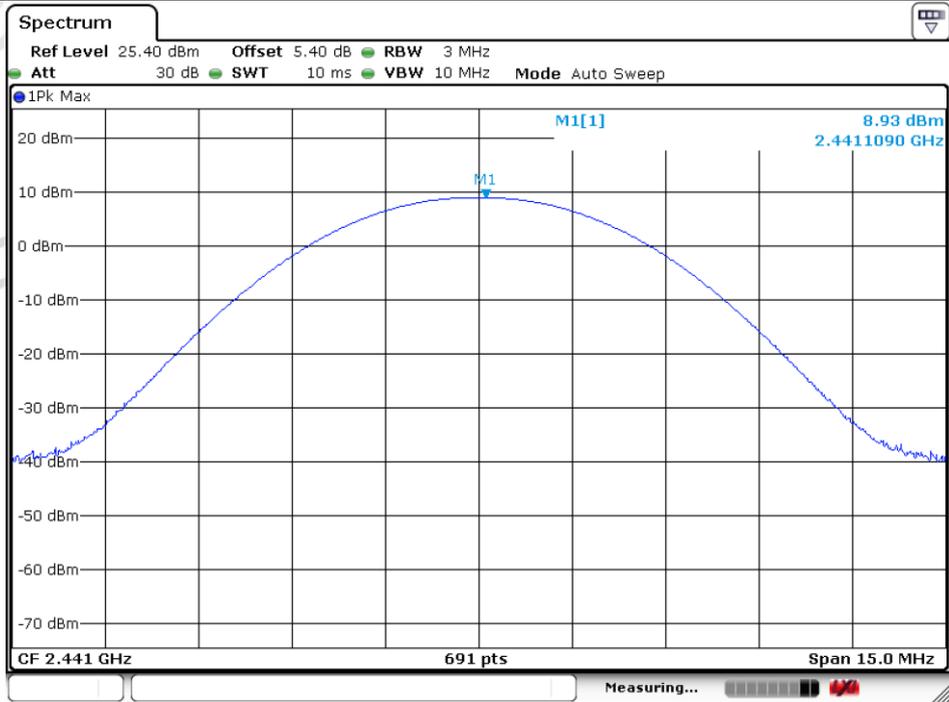
Date: 4.SEP.2019 20:38:47

Test mode: $\pi/4$ DQPSK Test channel: Lowest



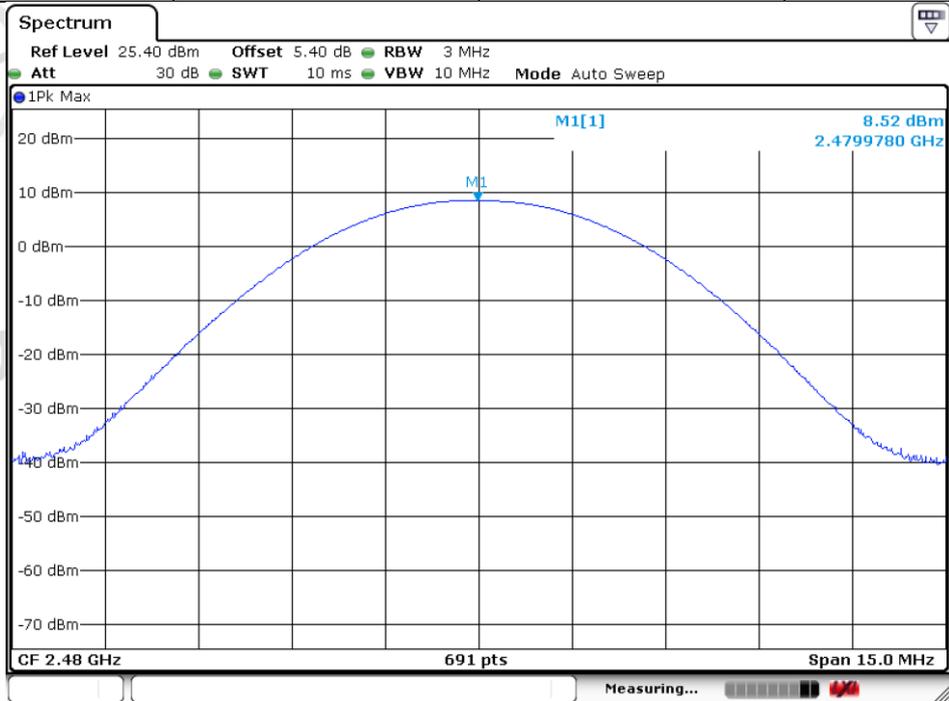
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Test mode: $\pi/4$ DQPSK Test channel: Middle



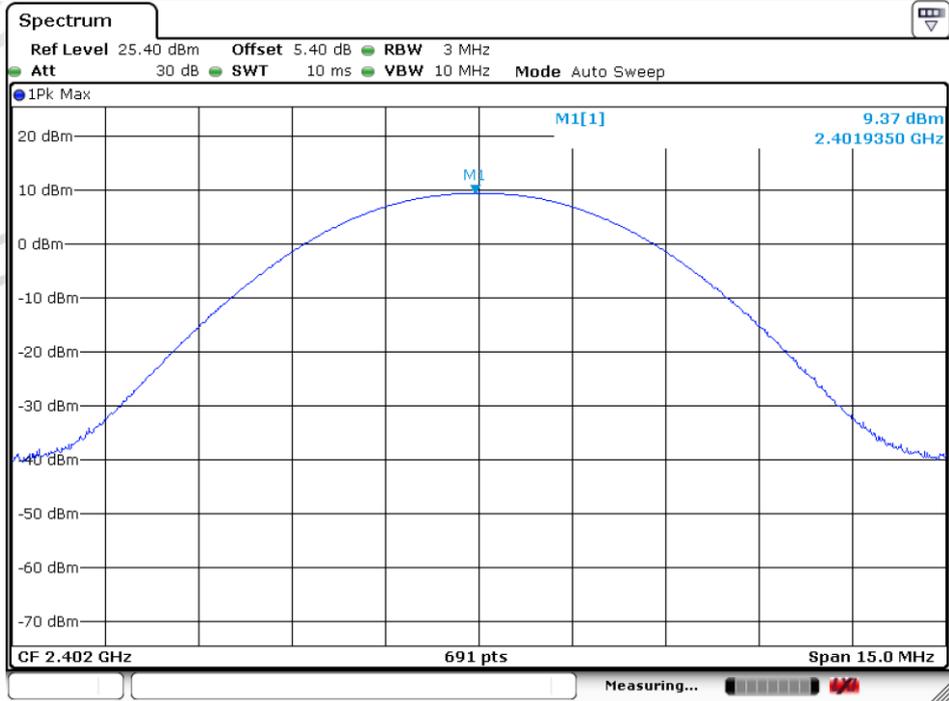
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Test mode: $\pi/4$ DQPSK Test channel: Highest



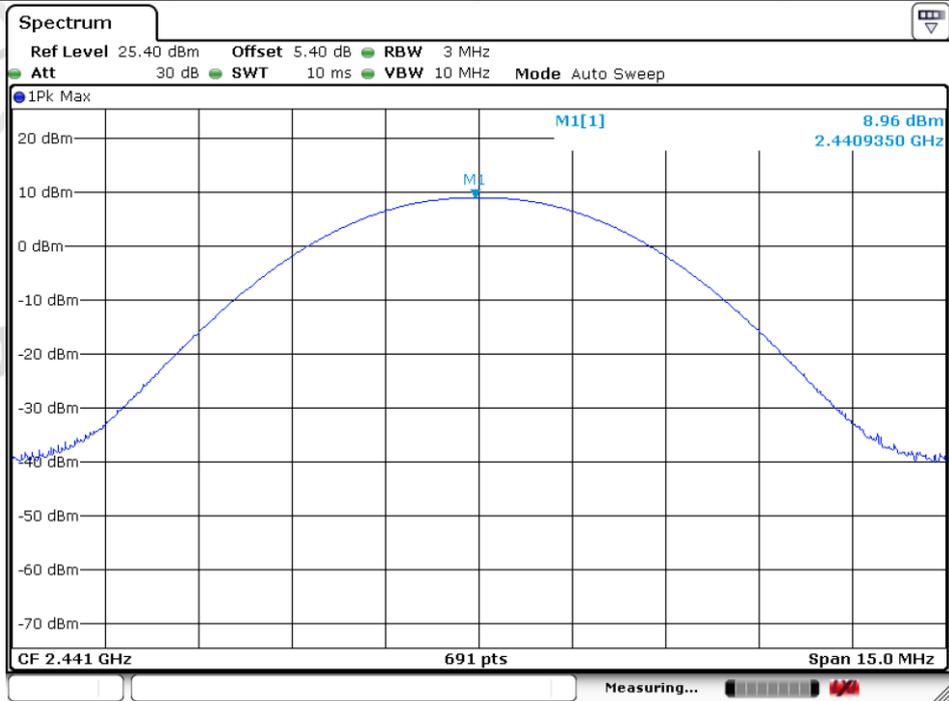
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Test mode: 8DPSK Test channel: Lowest



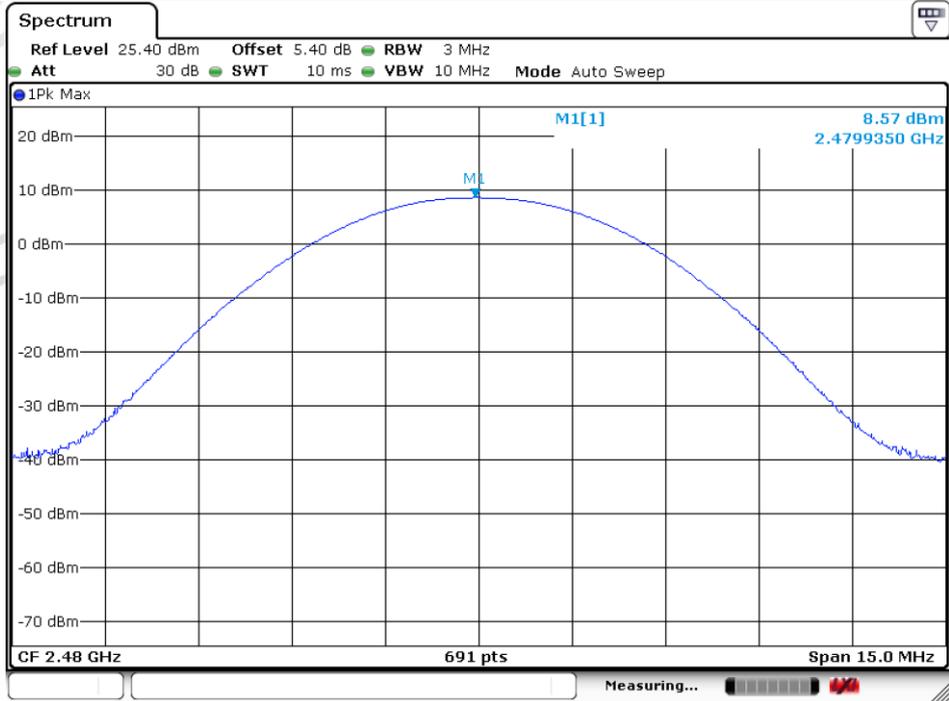
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Test mode: 8DPSK Test channel: Middle



Date: 4.SEP.2019 20:40:30

Test mode: 8DPSK Test channel: Highest



Date: 4.SEP.2019 20:40:47

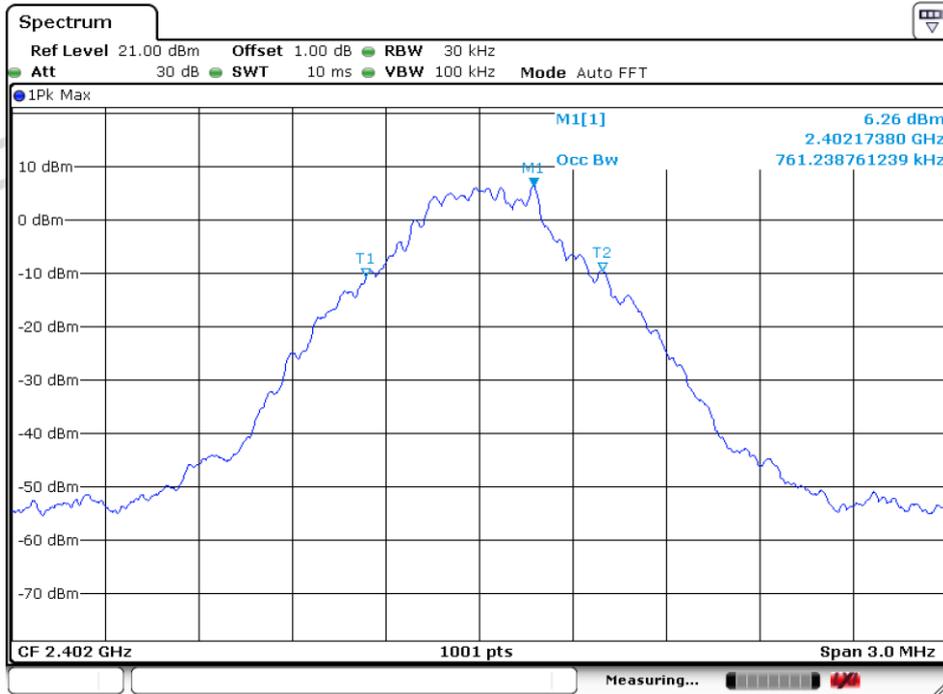
20dB Emission Bandwidth & 99% Occupied Bandwidth

Test Results

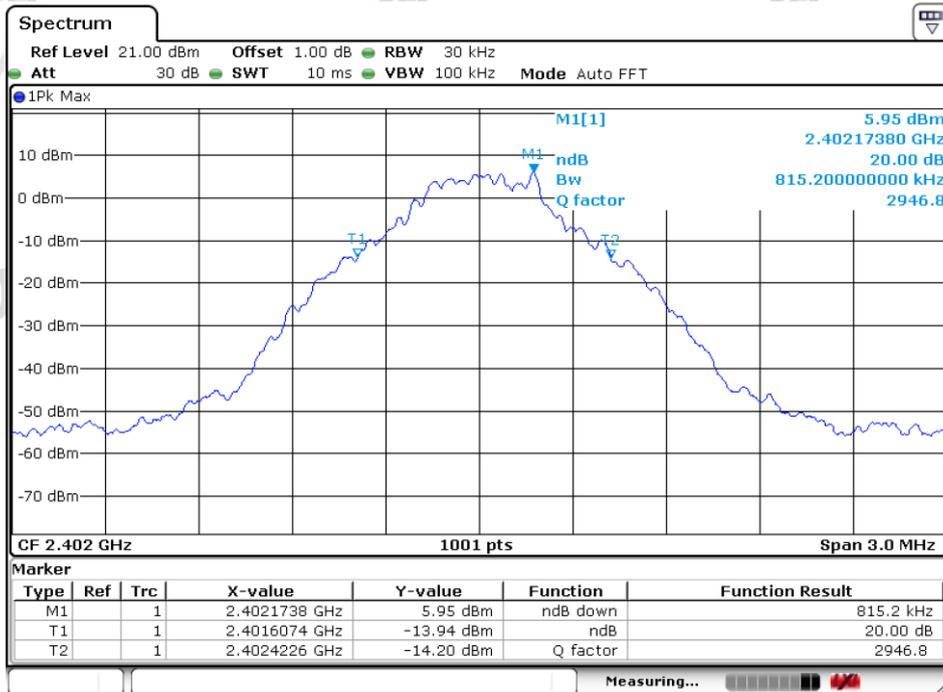
Mode	Test Channel	99% Occupied Bandwidth (KHz)	20dB Emission Bandwidth (KHz)	Result
GFSK	Lowest	761.2	815.2	Pass
	Middle	755.2	815.2	Pass
	Highest	758.2	815.2	Pass
$\pi/4$ DQPSK	Lowest	1144.9	1261.7	Pass
	Middle	1138.9	1252.7	Pass
	Highest	1141.8	1255.7	Pass
8DPSK	Lowest	1144.9	1213.8	Pass
	Middle	1144.9	1210.8	Pass
	Highest	1144.9	1213.8	Pass

Test plots

GFSK_Lowest Channel

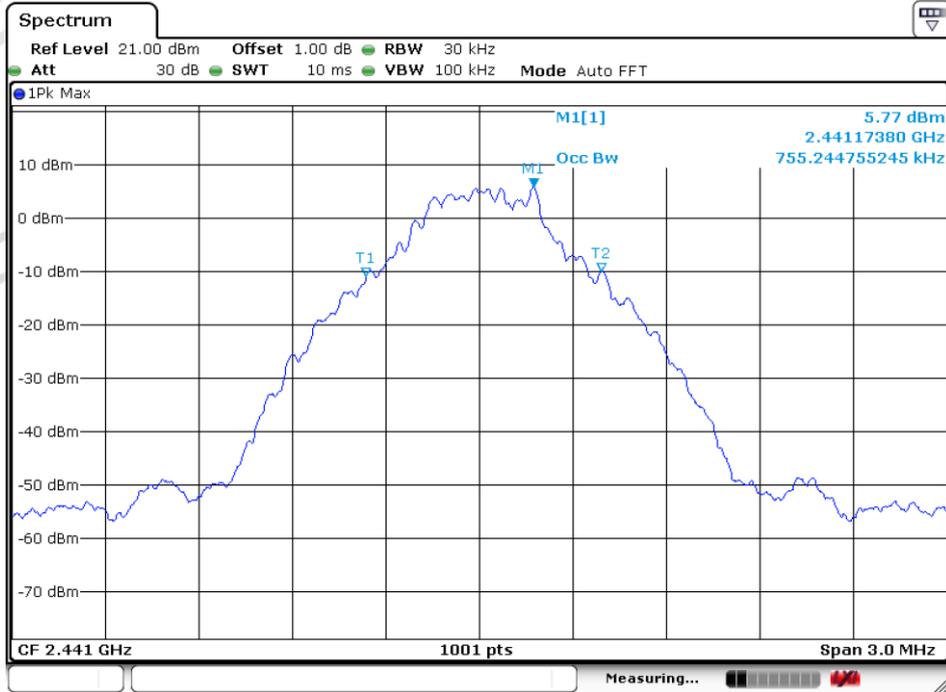


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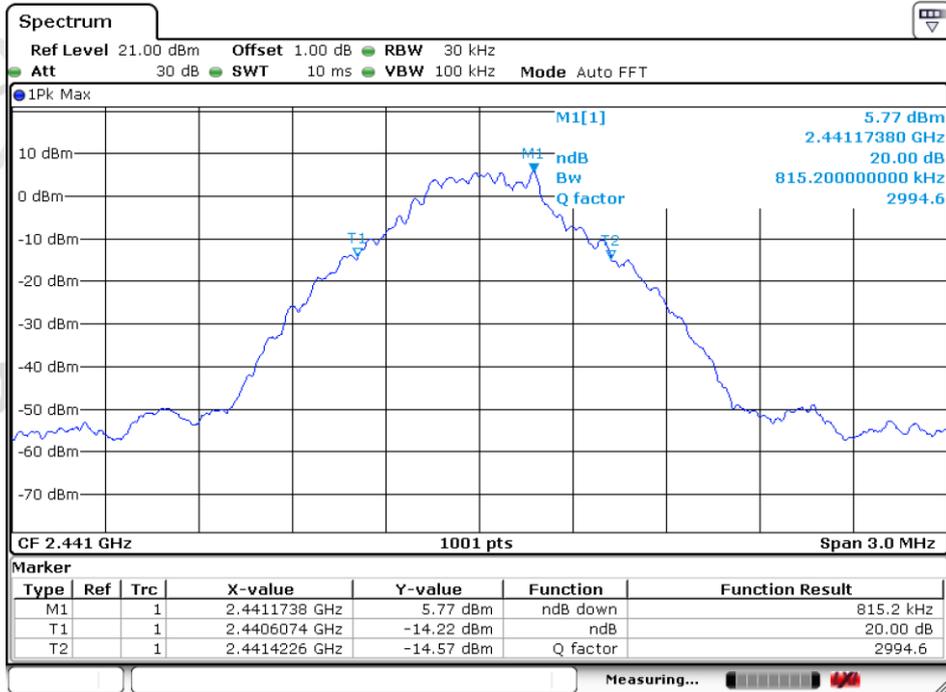


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GFSK_Middle Channel

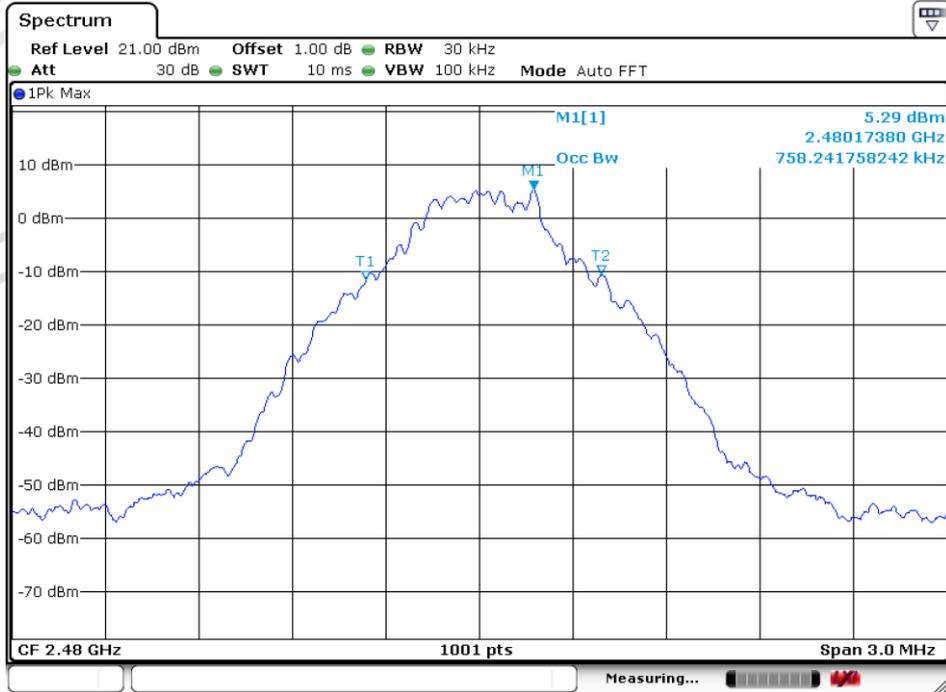


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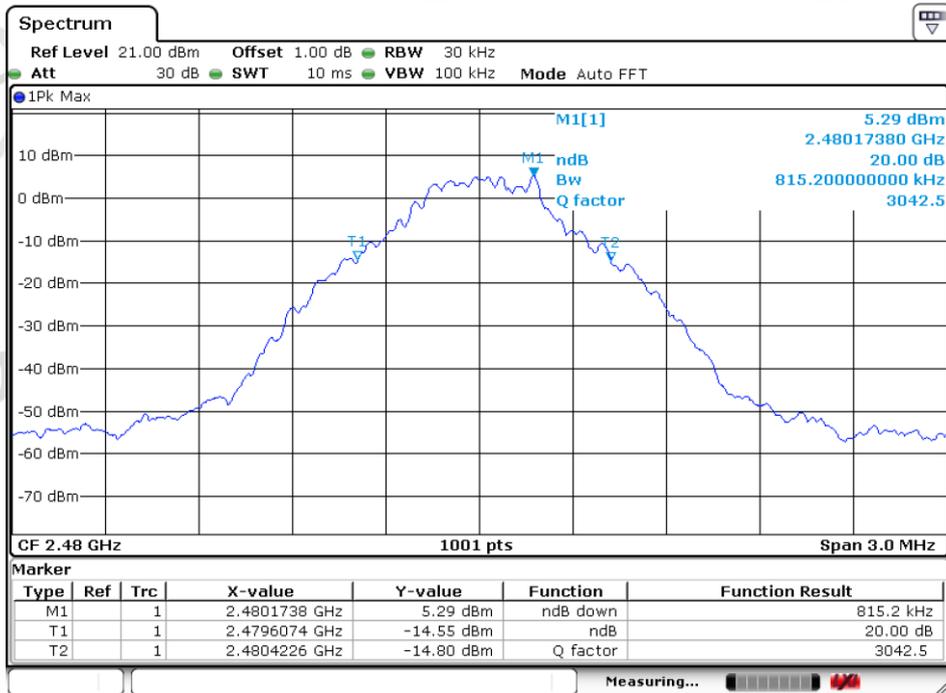


Date: 31.JUL.2019 20:59:56

GFSK_Highest Channel

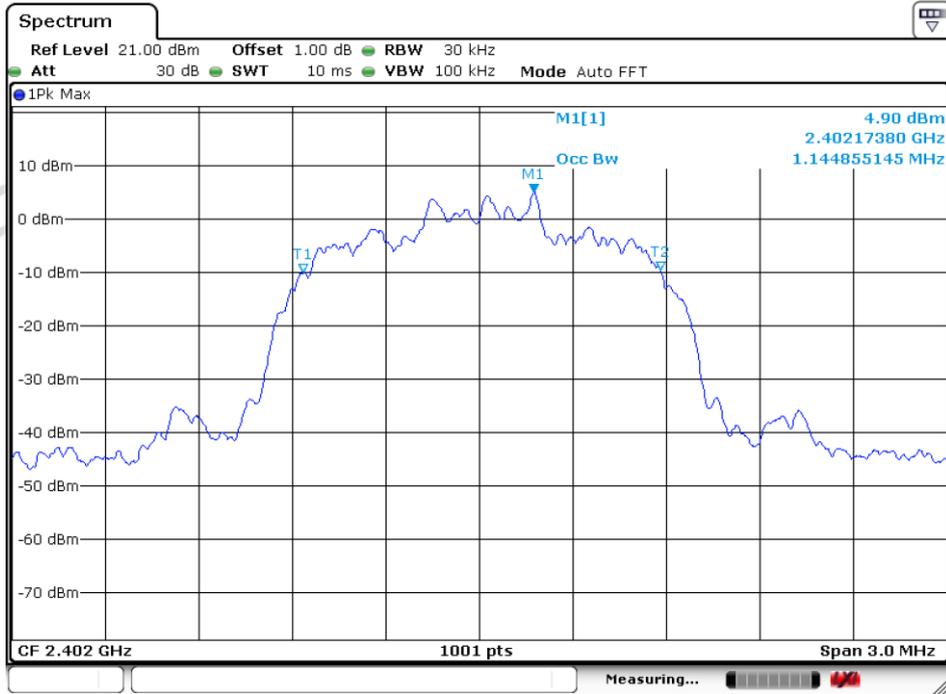


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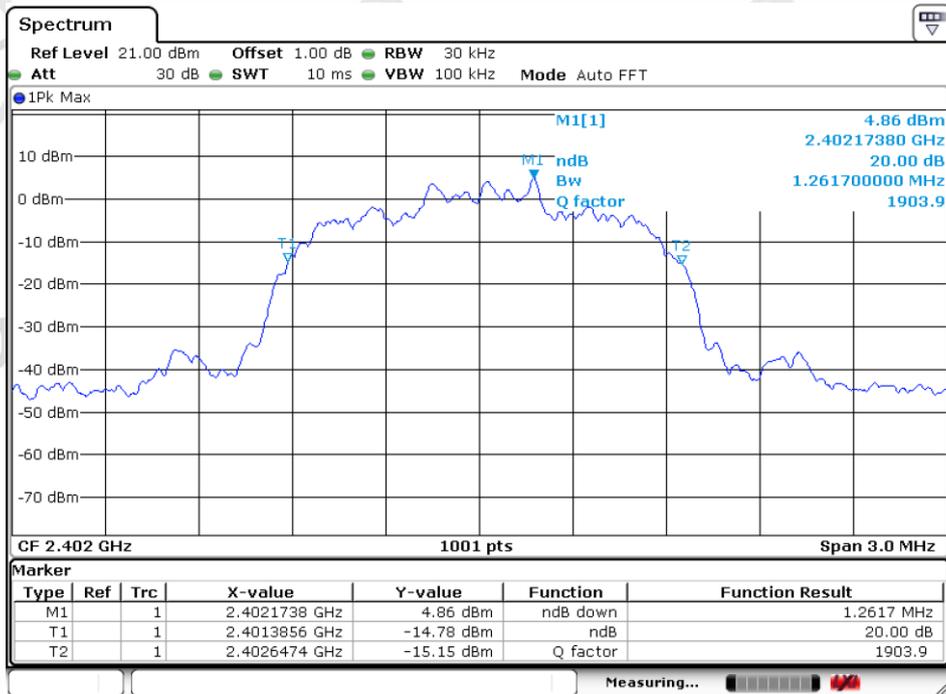


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$\pi/4$ DQPSK_Lowest Channel

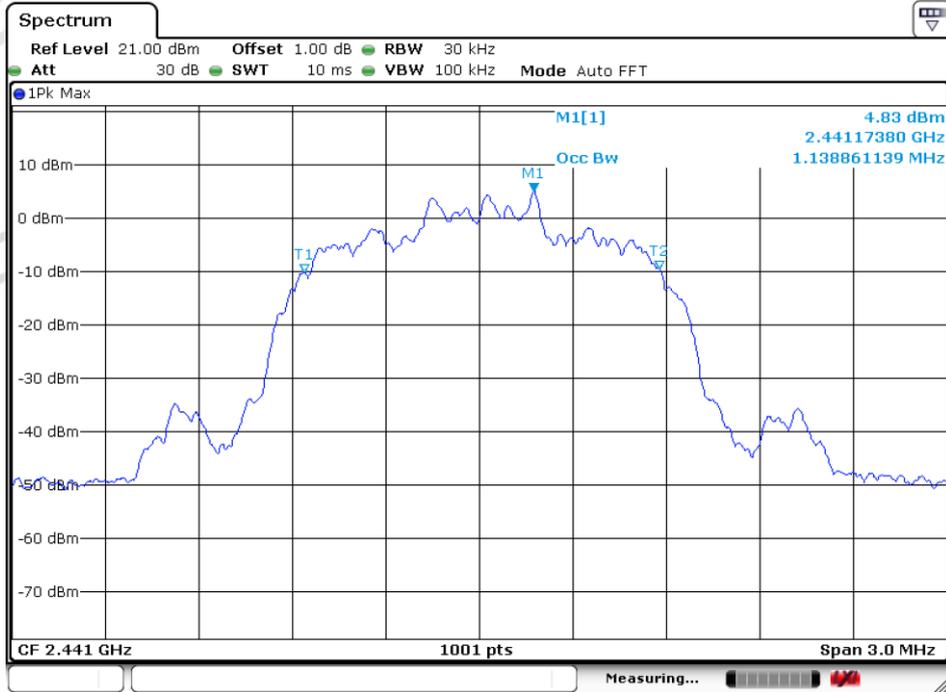


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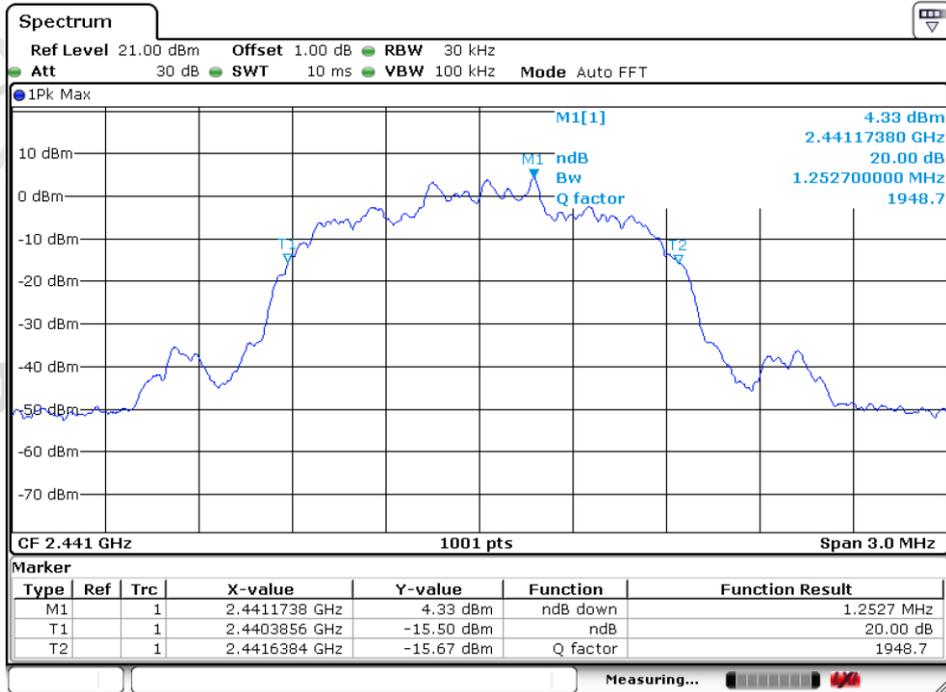


Date: 31.JUL.2019 21:00:37

$\pi/4$ DQPSK Middle Channel

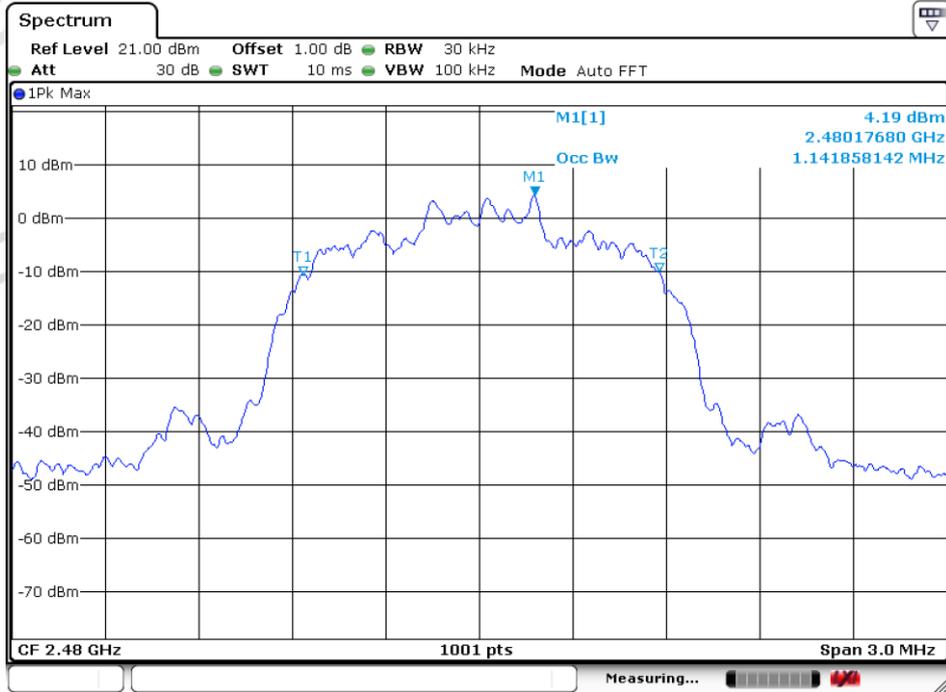


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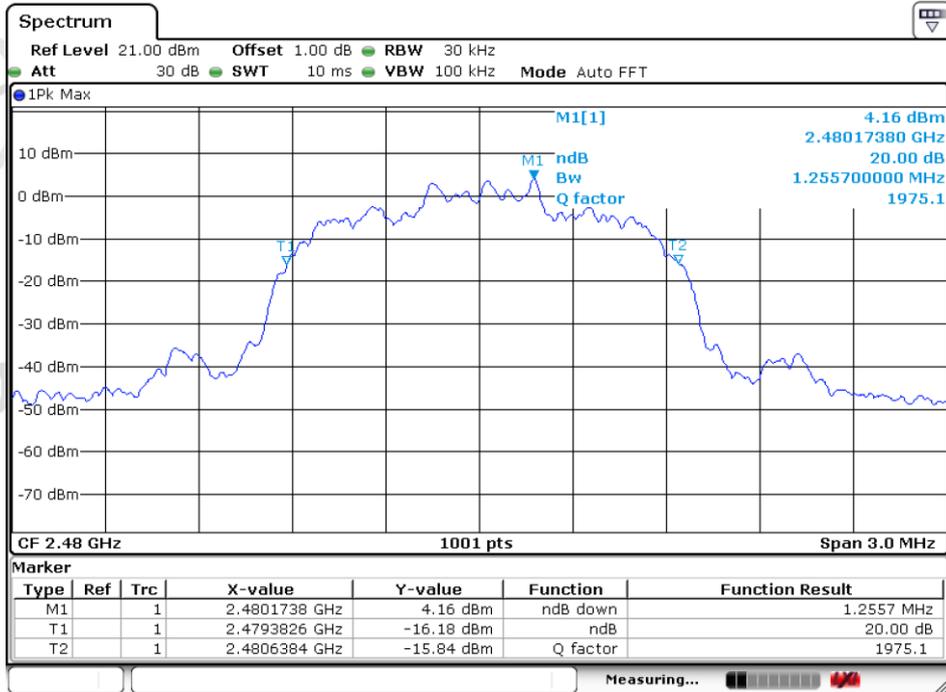


Date: 31.JUL.2019 21:00:54

$\pi/4$ DQPSK_Highest Channel

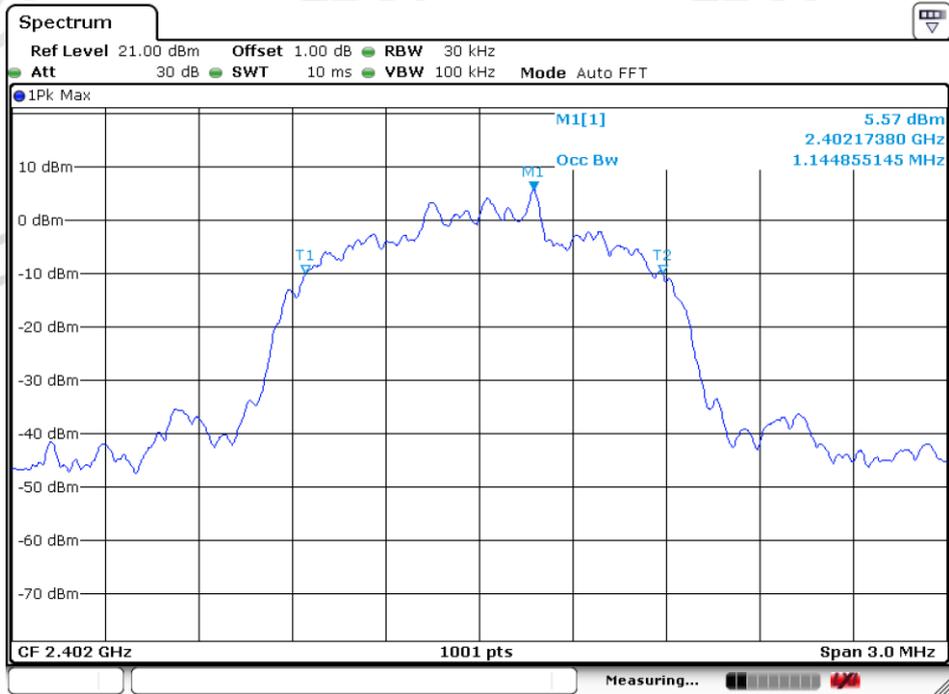


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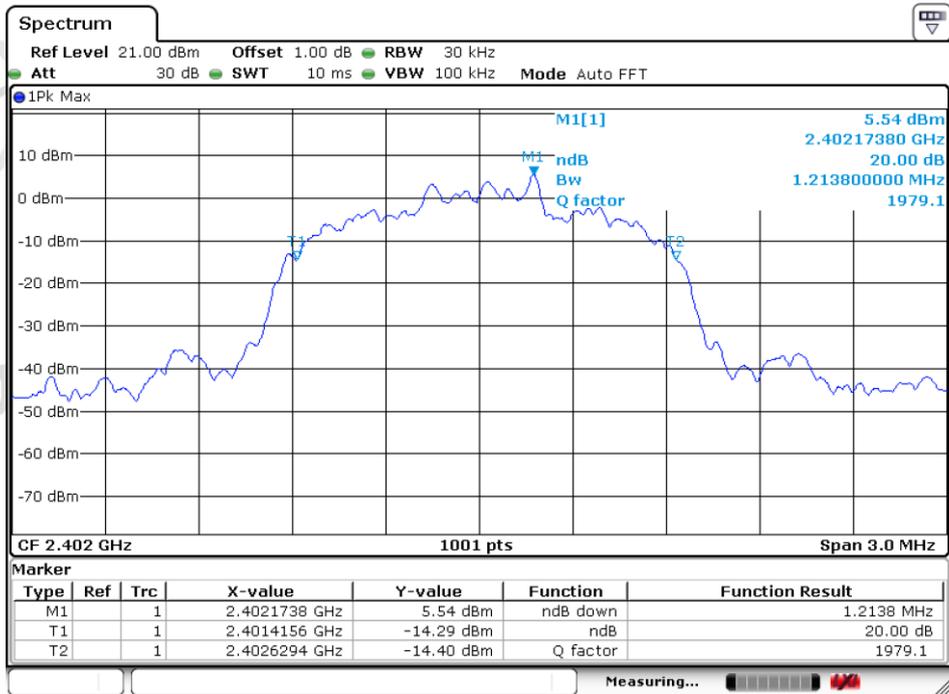


Date: 31.JUL.2019 21:01:28

8DPSK_Lowest Channel

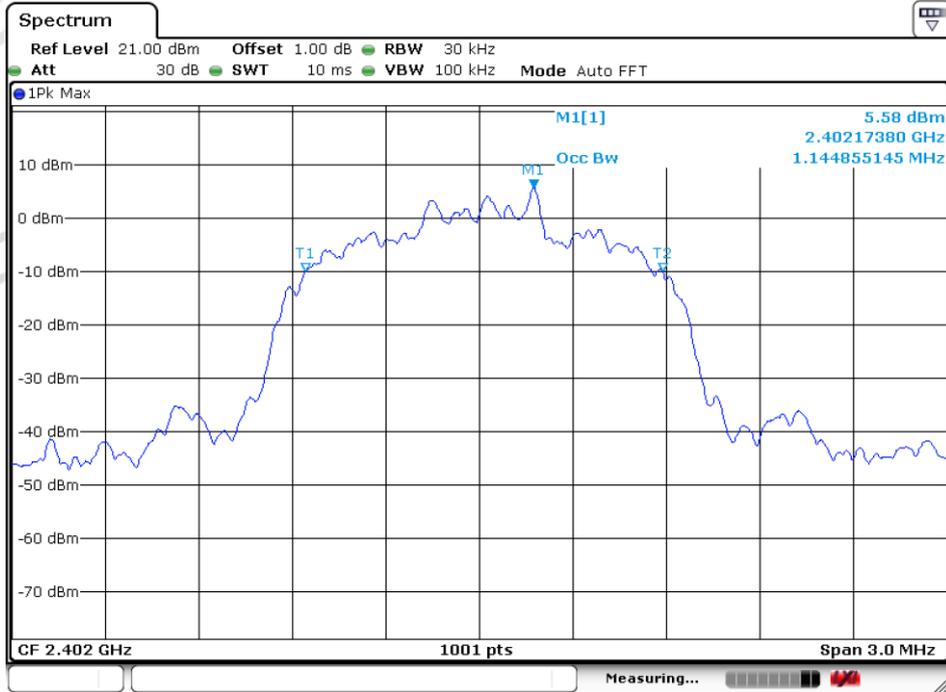


Date: 31.JUL.2019 20:36:24

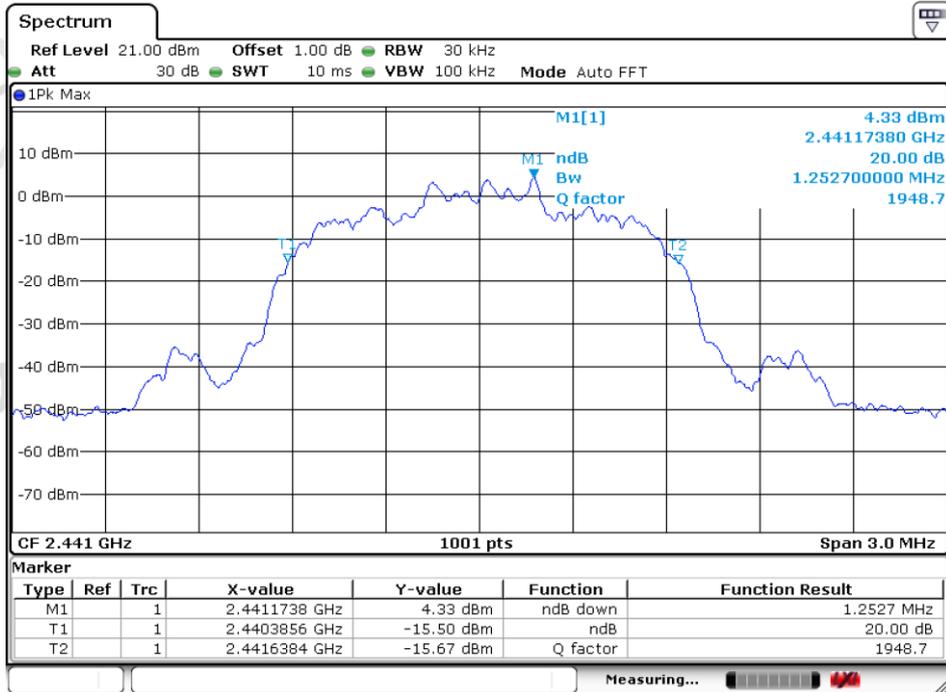


Date: 31.JUL.2019 21:06:17

8DPSK_Middle Channel

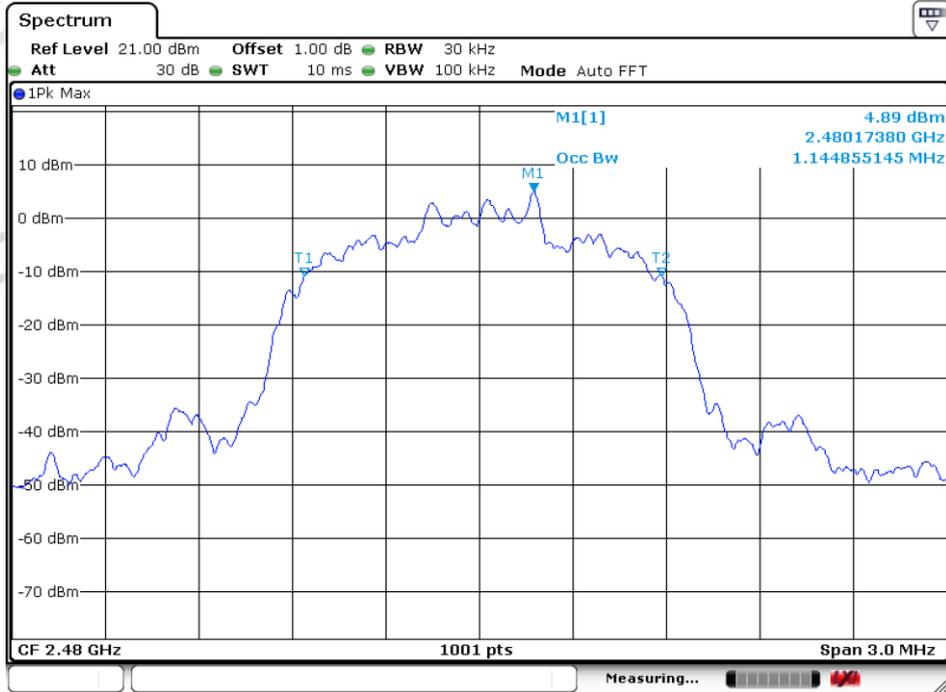


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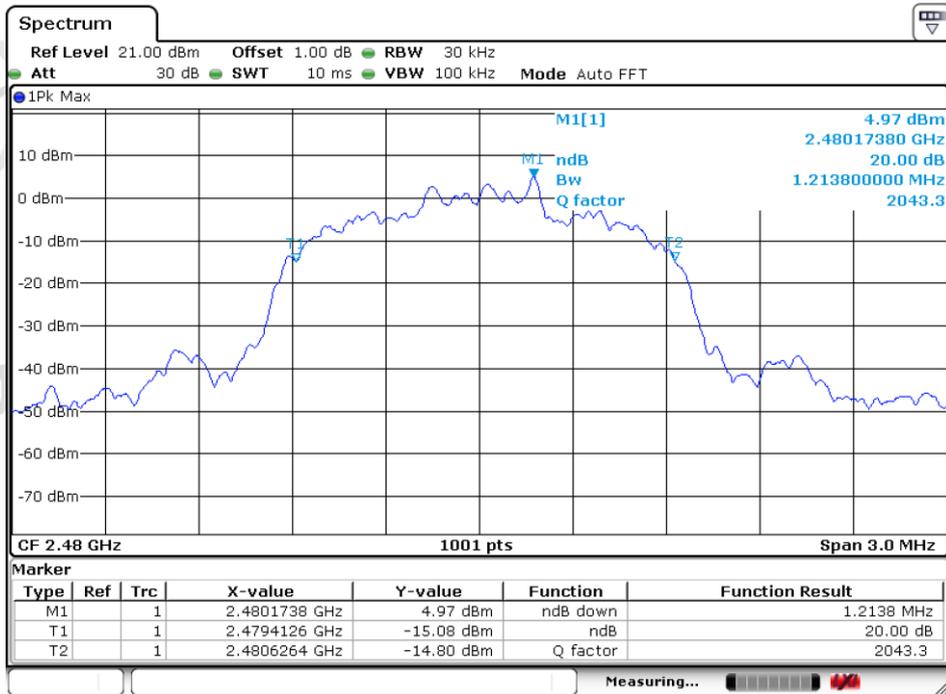


Date: 31.JUL.2019 21:00:54

8DPSK_Highest Channel



Date: 31.JUL.2019 20:39:20



Date: 31.JUL.2019 21:05:22

Carrier Frequencies Separation

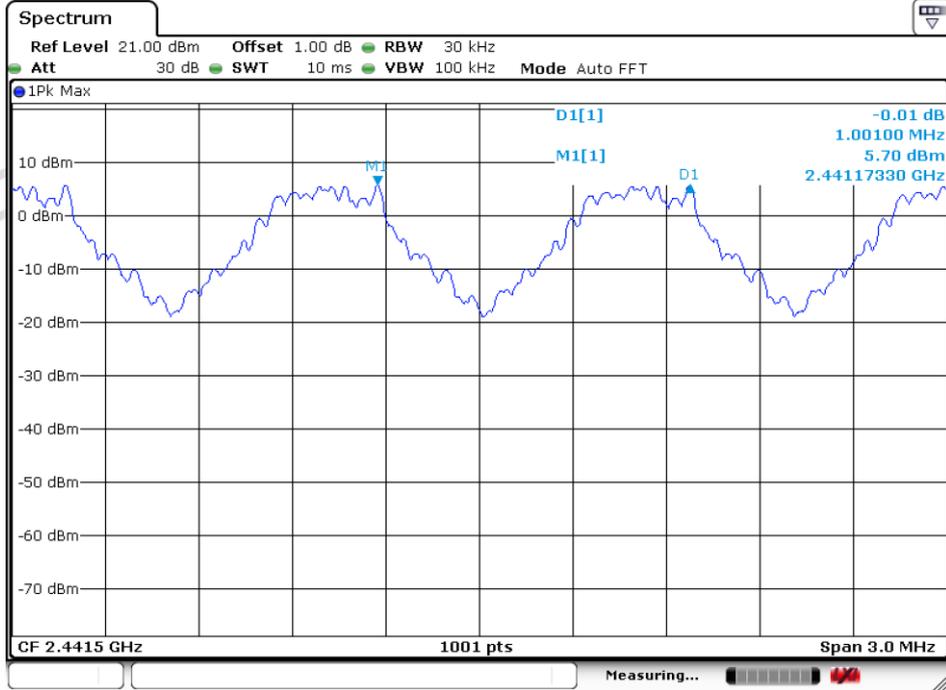
Test Results

GFSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Middle	1001	543.5	Pass
$\pi/4$ DQPSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Middle	998	841.2	Pass
8DPSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Middle	1001	809.2	Pass

Mode	20dB bandwidth (kHz) (worse case)	Limit (kHz) (Carrier Frequencies Separation)
GFSK	815.2	543.5
$\pi/4$ DQPSK	1261.7	841.1
8DPSK	1213.8	809.2

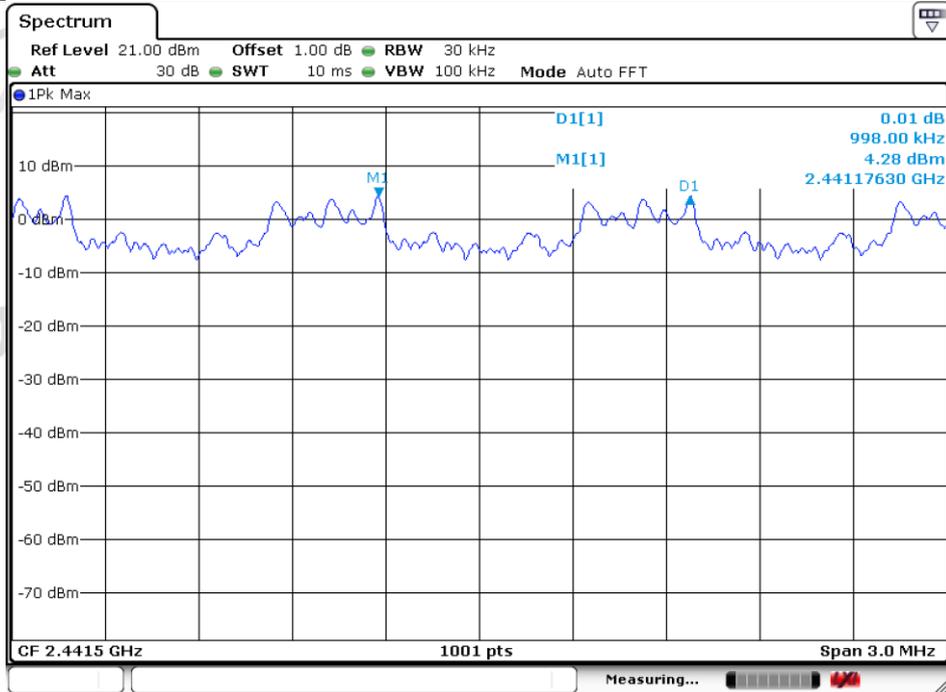
Test plots:

Test mode:	GFSK	Test channel:	Middle
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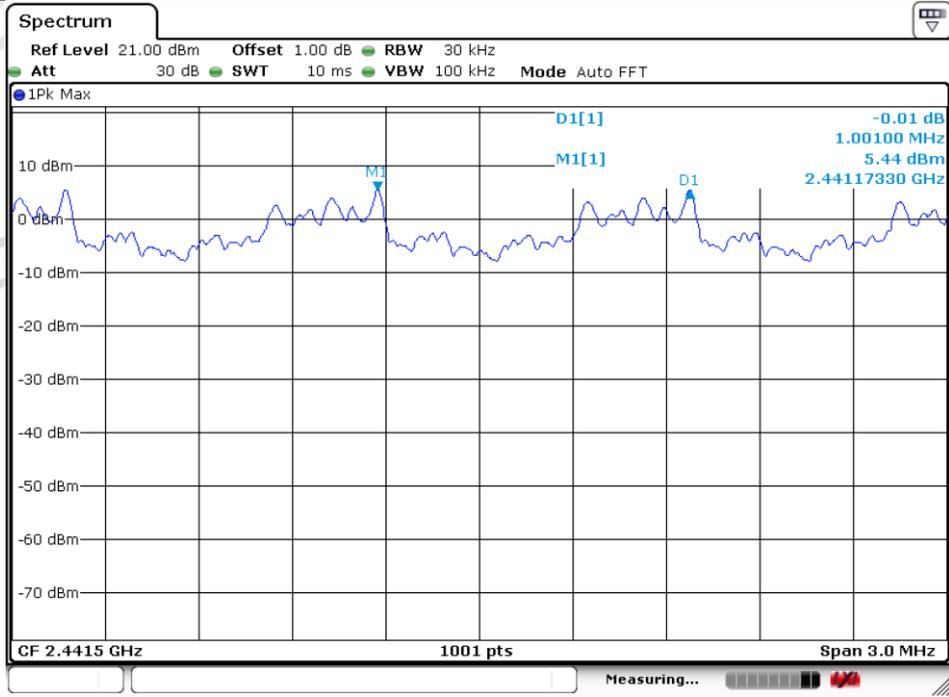
Date: 31.JUL.2019 21:09:41

Test mode:	$\pi/4$ DQPSK	Test channel:	Middle
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Date: 31.JUL.2019 21:08:58

Test mode: 8DPSK Test channel: Middle



Date: 31.JUL.2019 21:06:47

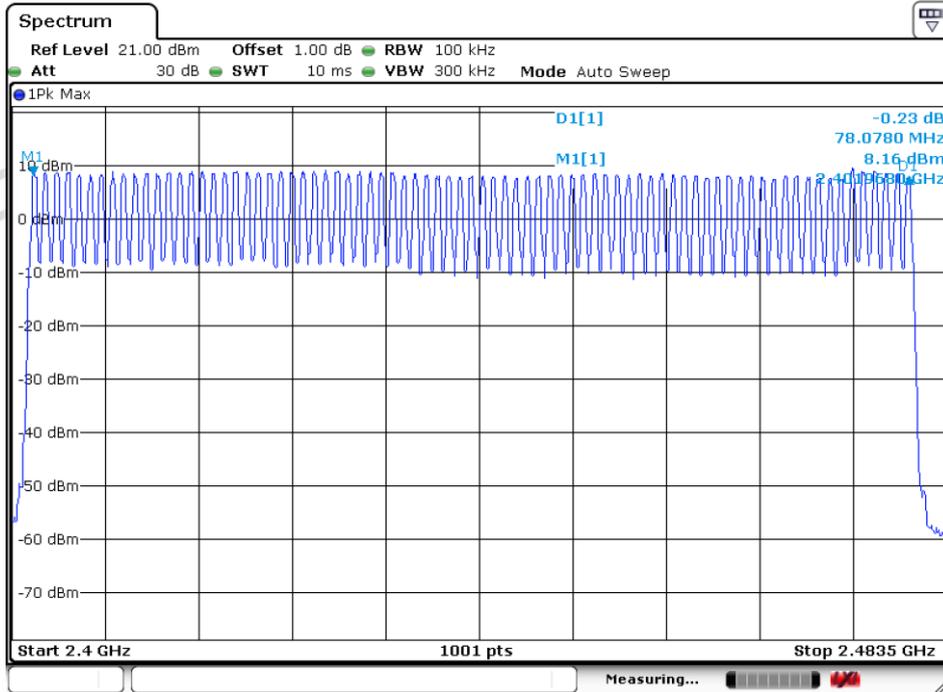
Hopping Channel Number

Test Results

Mode	Hopping channel numbers	Limit
GFSK	79	≥15
$\pi/4$ DQPSK	79	≥15
8DPSK	79	≥15

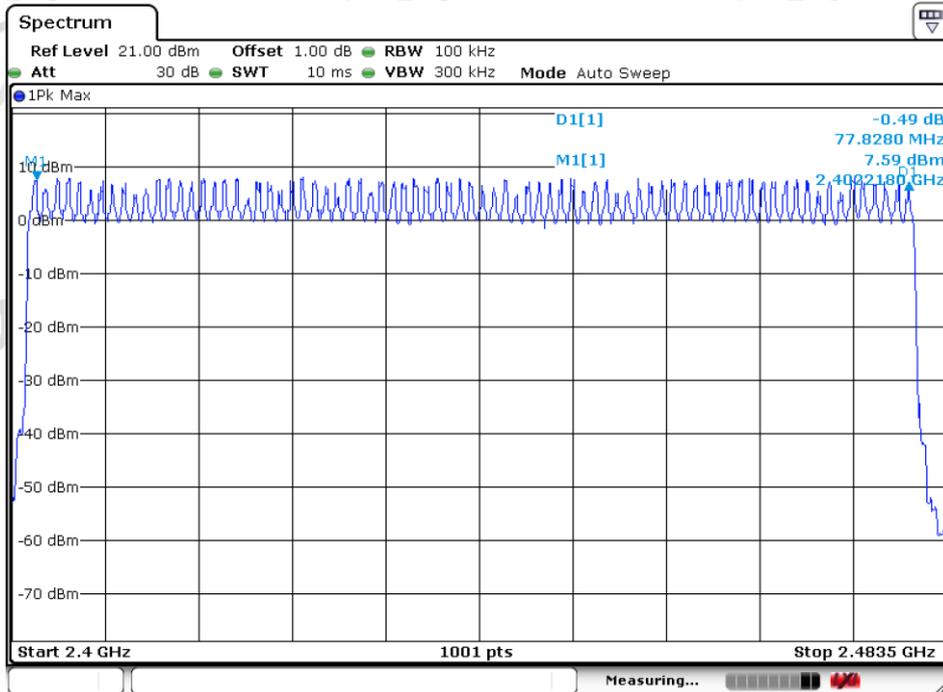
Test plots

GFSK



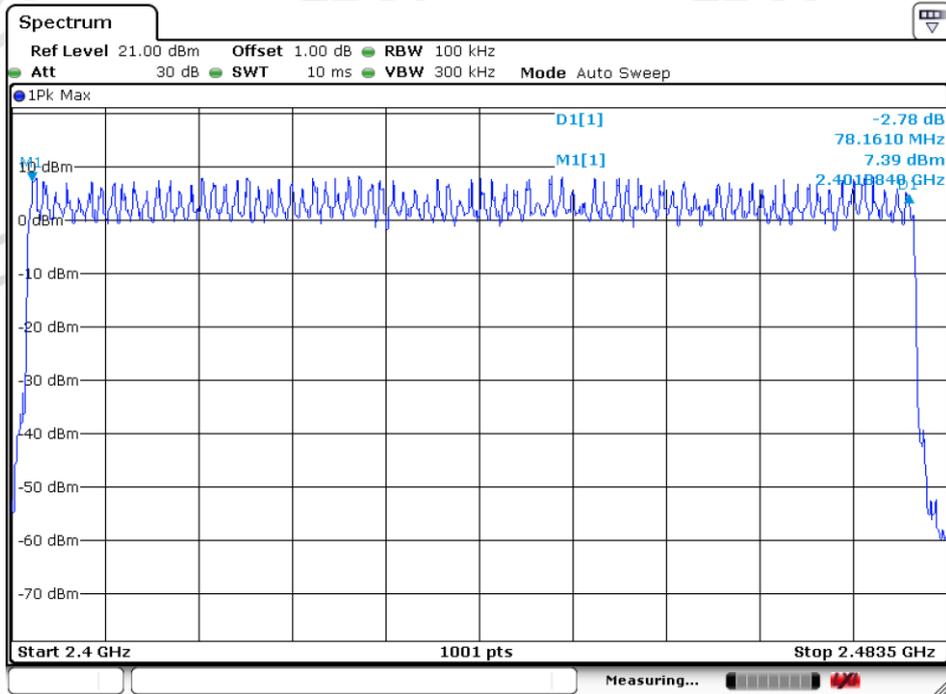
Date: 31.JUL.2019 21:11:51

$\pi/4$ DQPSK



Date: 31.JUL.2019 21:14:31

8DPSK



Date: 31.JUL.2019 21:15:57

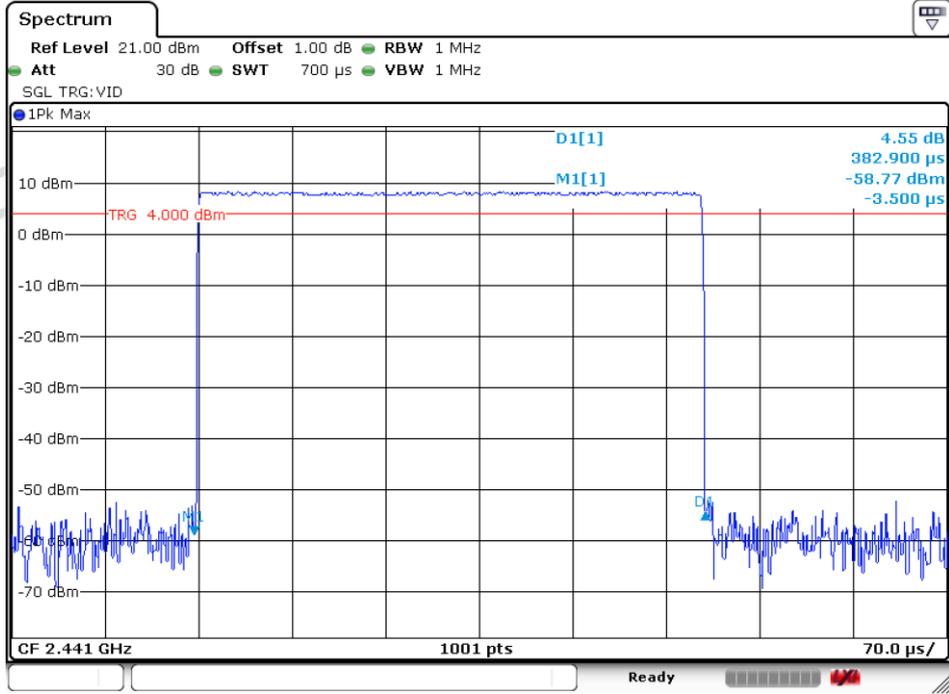
Dwell Time

Test Results

Operation Modes	On time (ms) on one channel
DH1	0.383
DH3	1.648
DH5	2.905
2-DH1	0.392
2-DH3	1.654
2-DH5	2.895
3-DH1	0.391
3-DH3	1.660
3-DH5	2.910

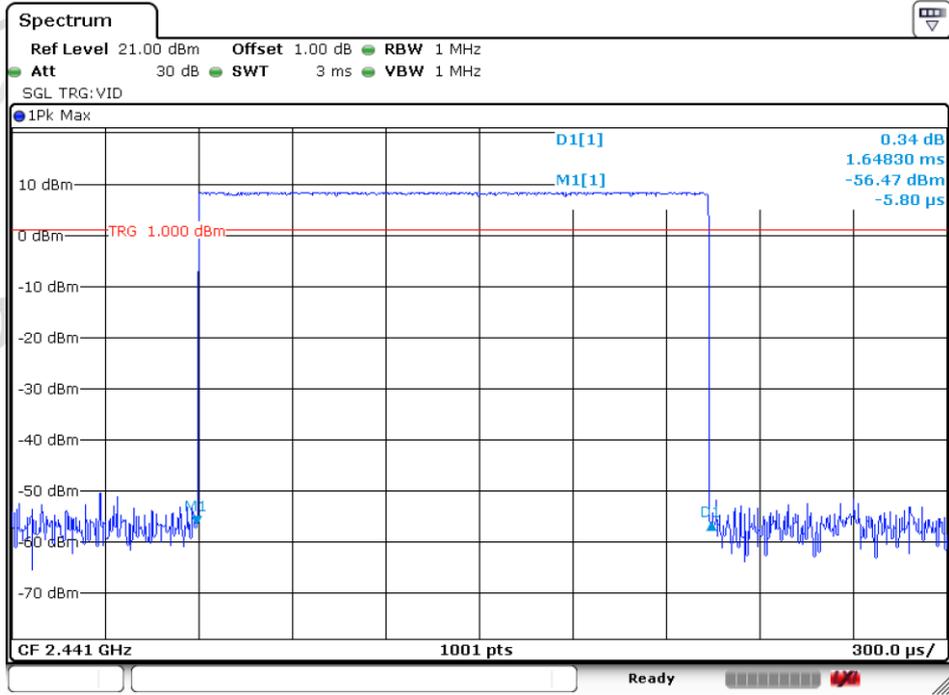
Test plots

DH1 _ Middle Channel



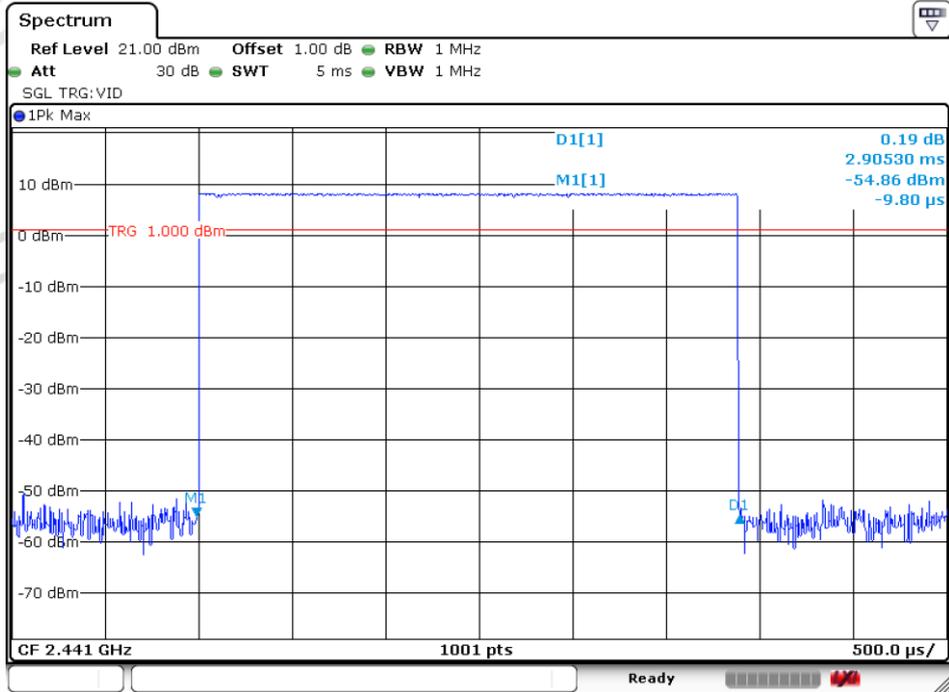
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DH3 _ Middle Channel



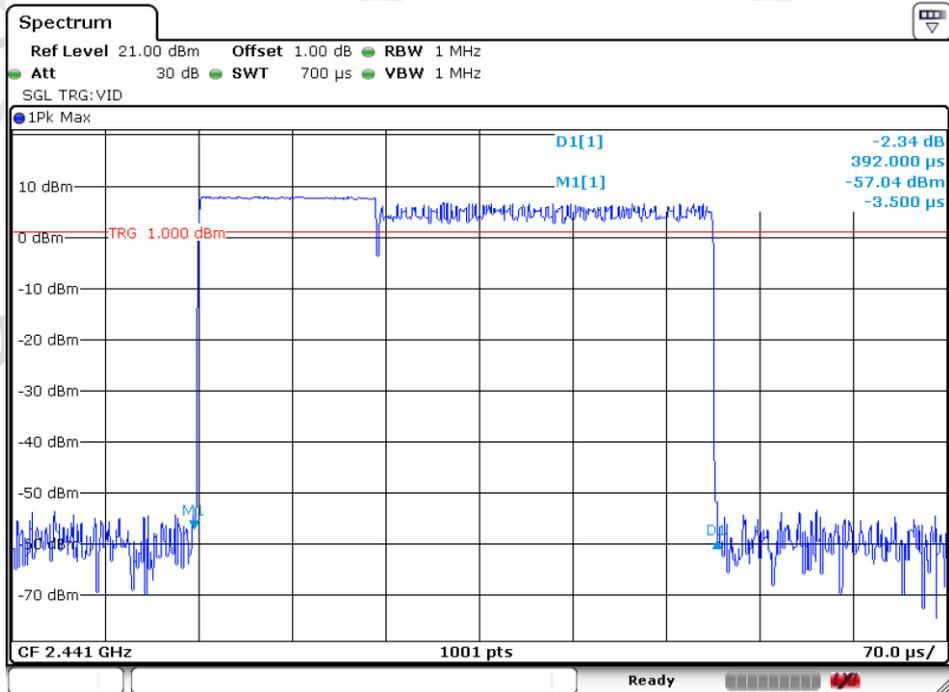
Date: 31.JUL.2019 22:11:25

DH5 _ Middle Channel



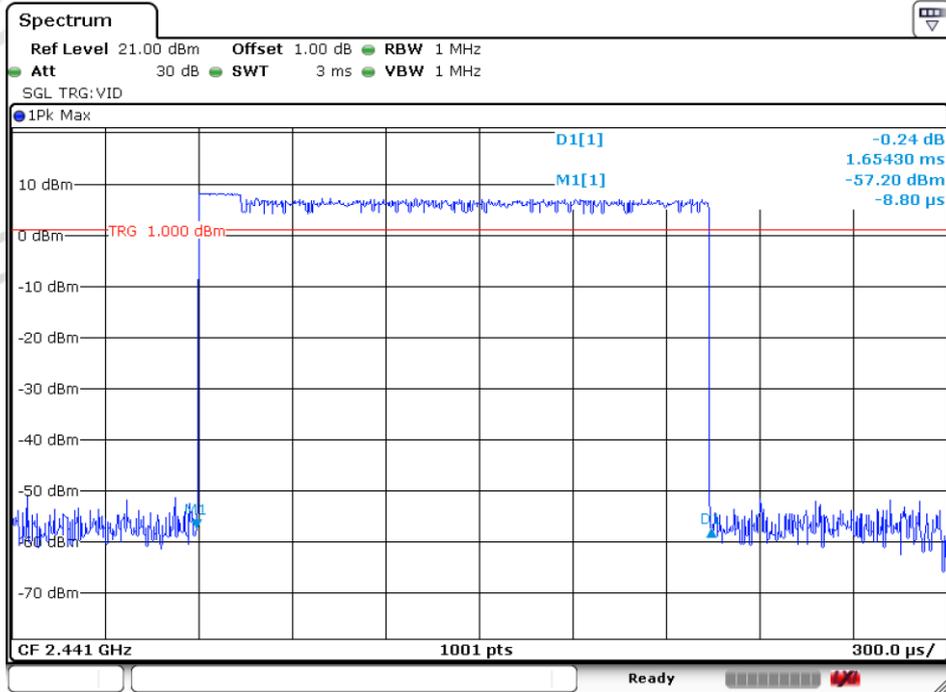
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2DH1 _ Middle Channel



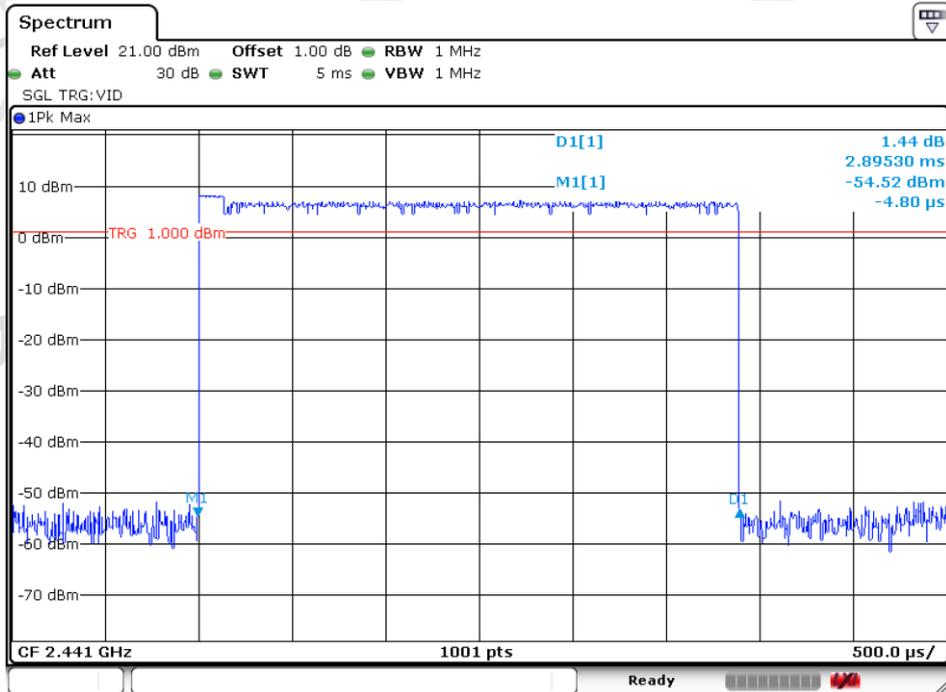
Date: 31.JUL.2019 22:10:11

2DH3 Middle Channel



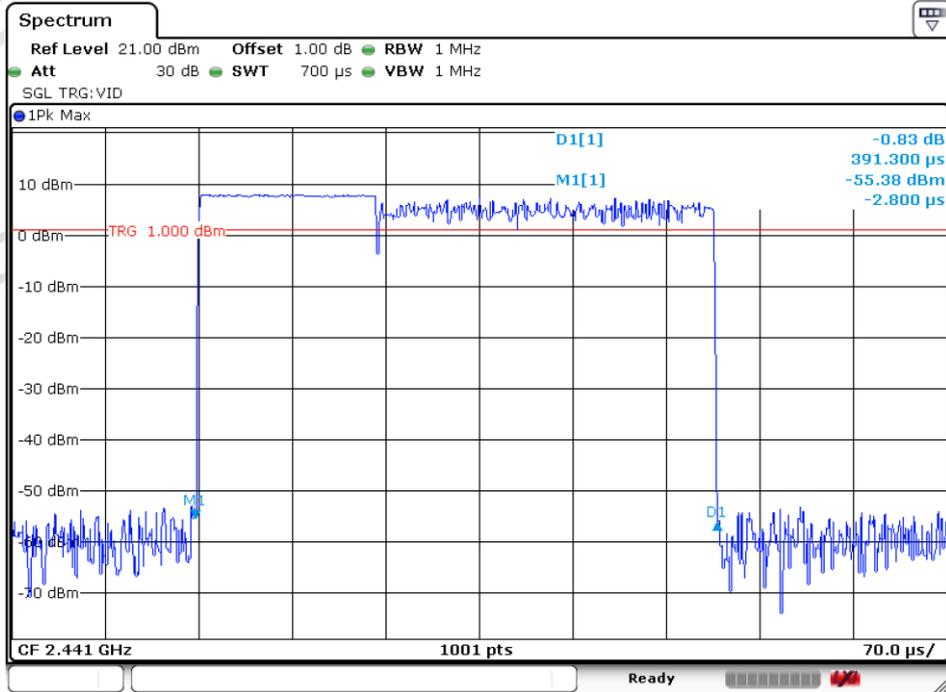
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2DH5 Middle Channel



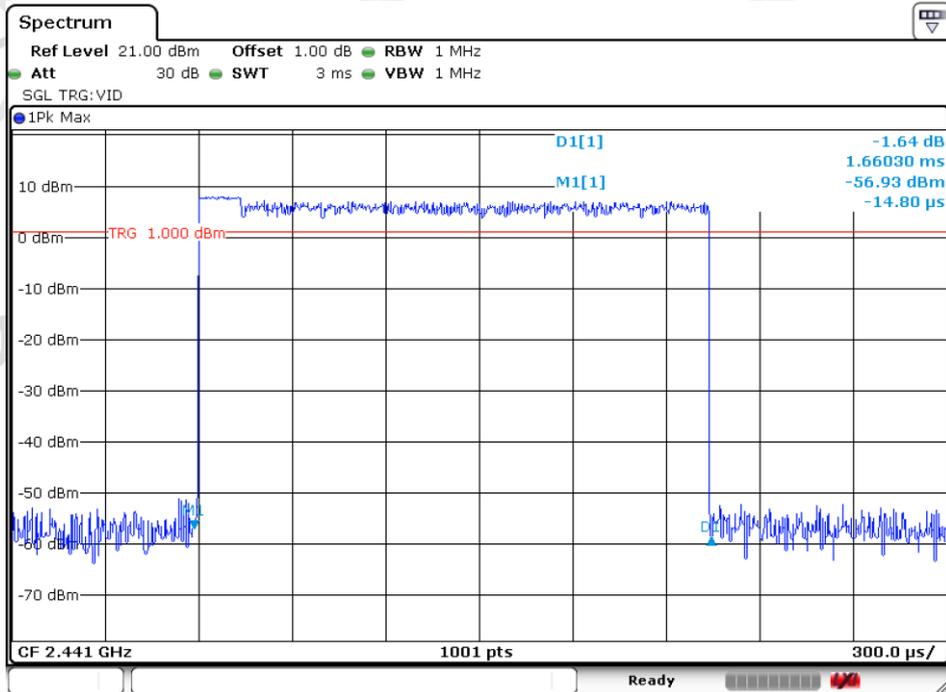
Date: 31.JUL.2019 22:13:51

3DH1 Middle Channel



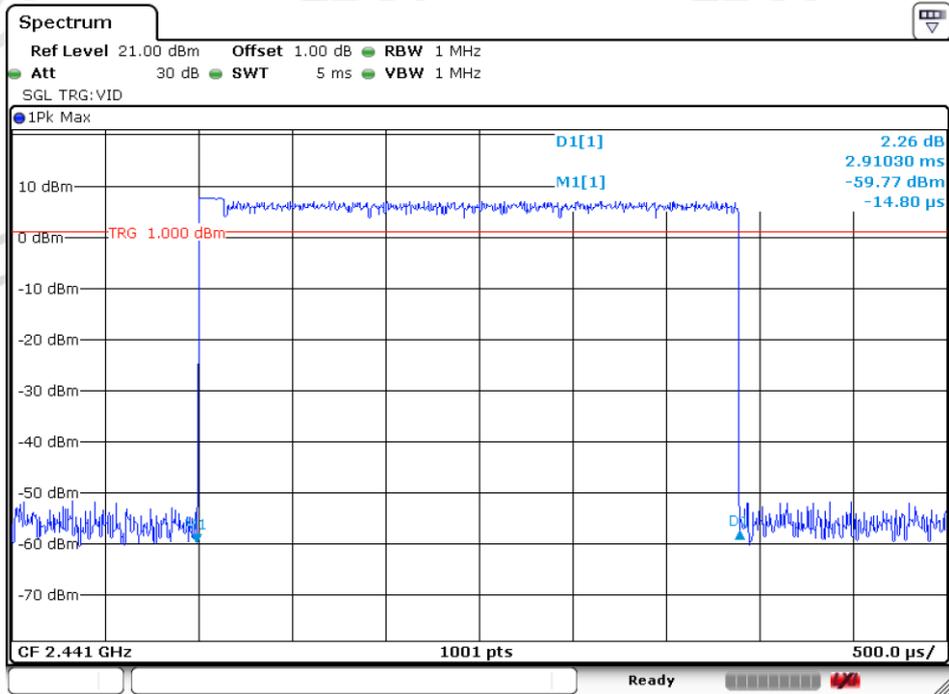
Date: 31.JUL.2019 22:10:37

3DH3 Middle Channel



Date: 31.JUL.2019 22:12:35

3DH5 Middle Channel

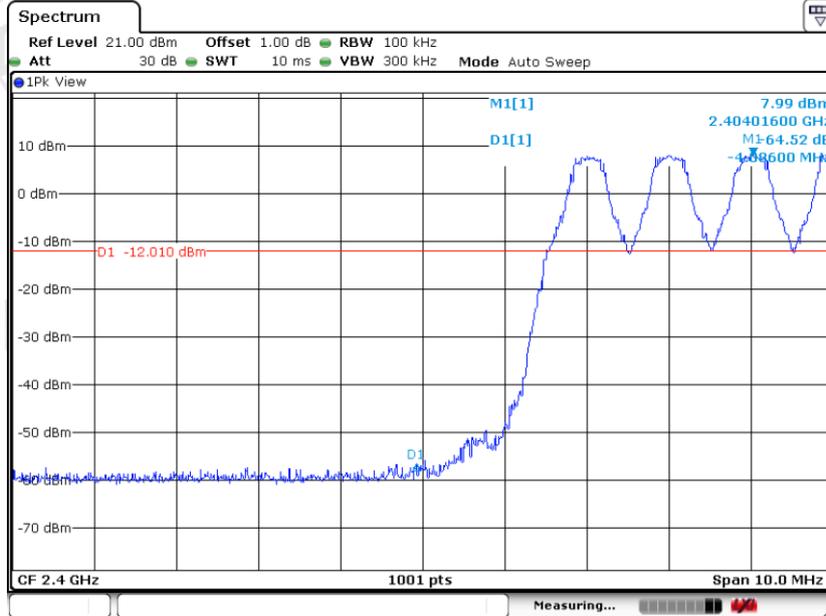


Date: 31.JUL.2019 22:14:24

Band-edge for RF Conducted Emissions

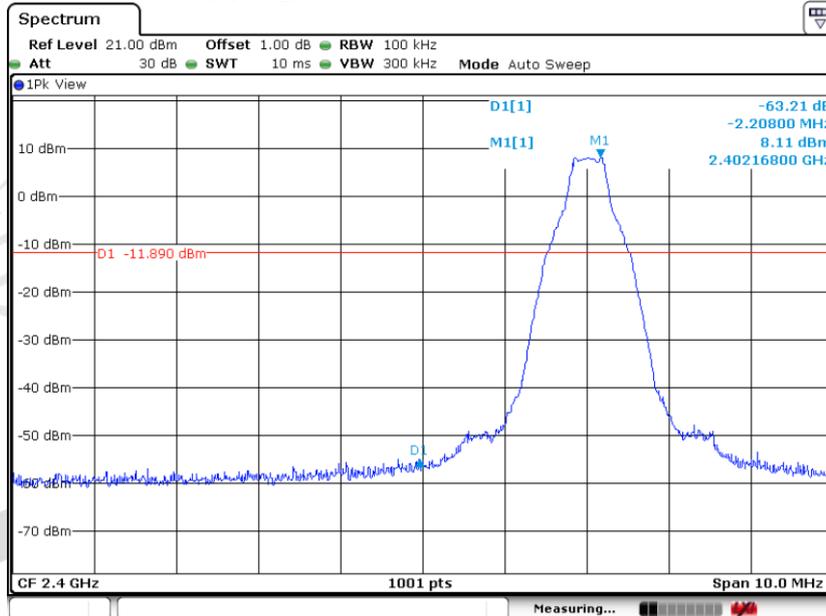
Test plots

GFSK _Lowest Channel_ Hopping ON



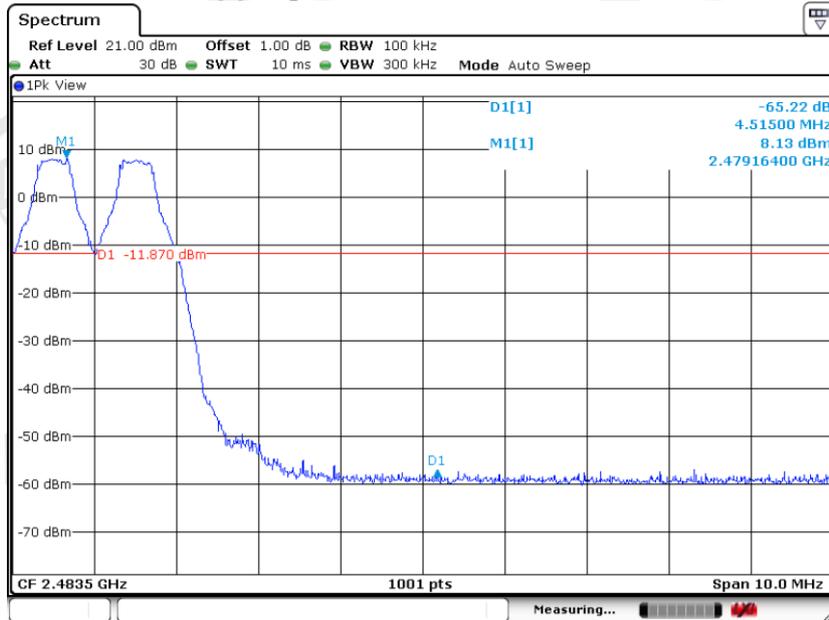
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GFSK _Lowest Channel_ Hopping OFF

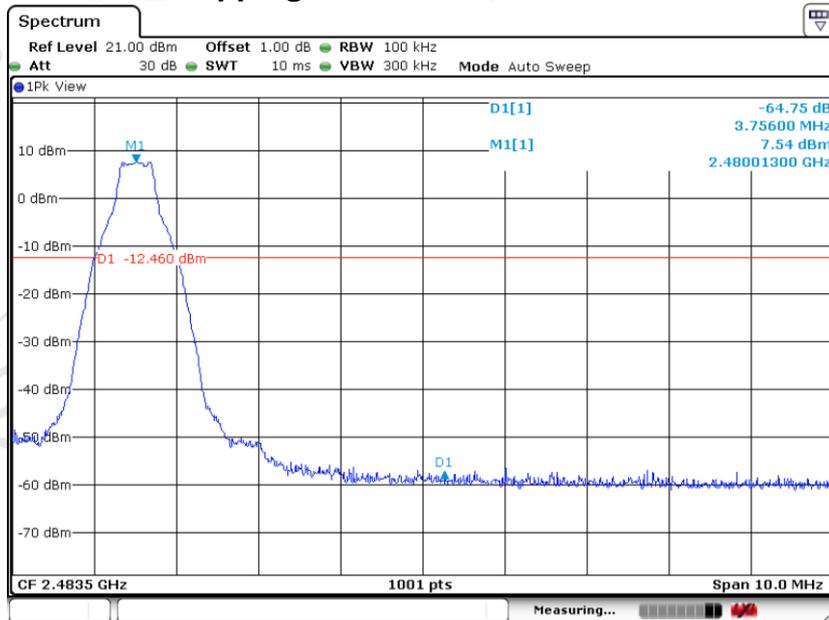


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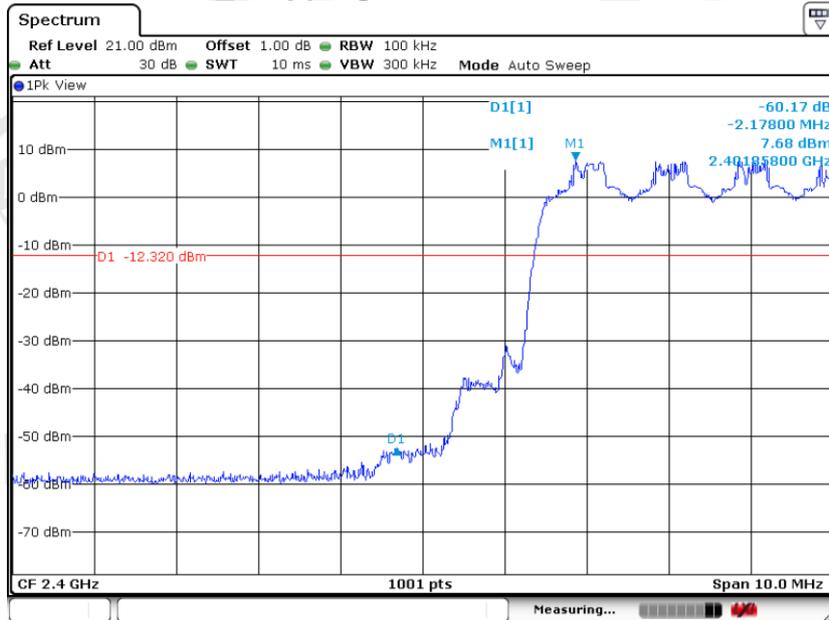
GFSK_Highest Channel_Hopping ON



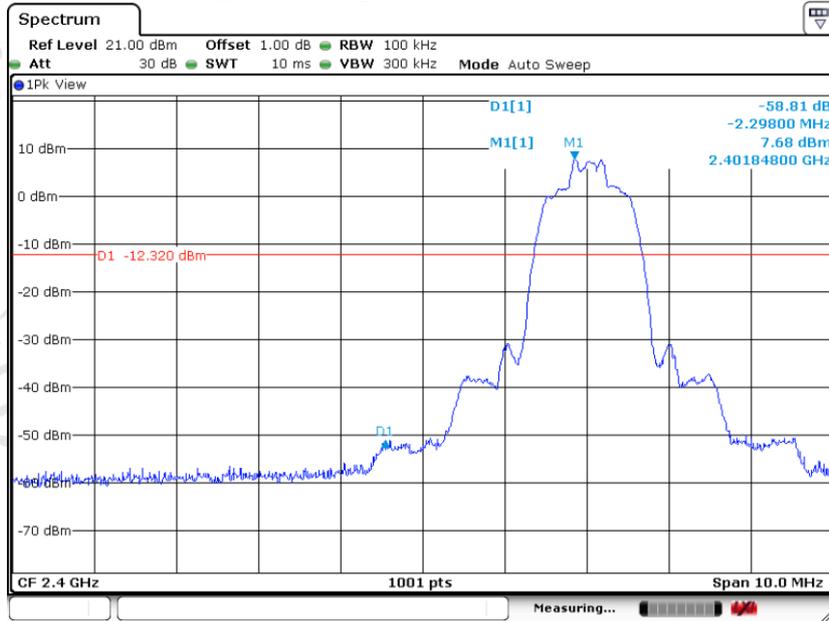
GFSK_Highest Channel_Hopping OFF



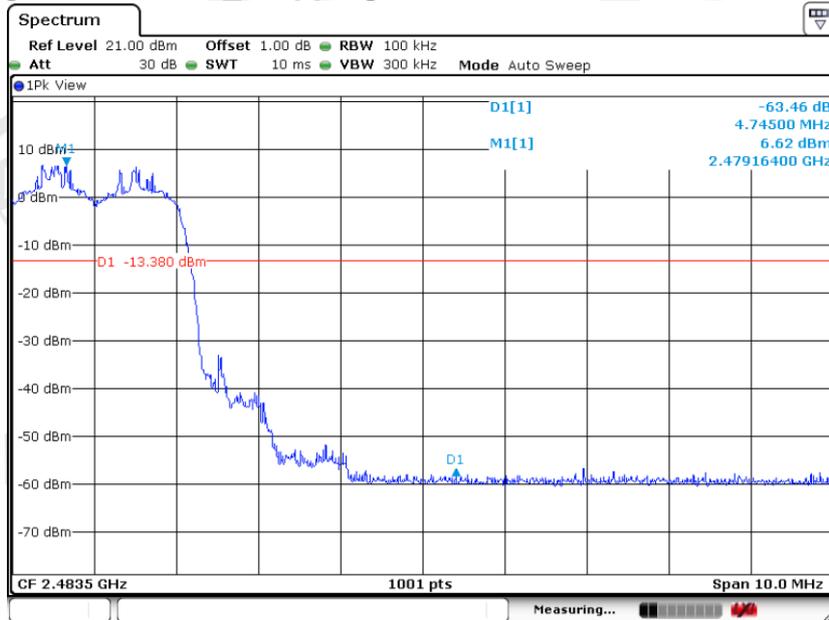
$\pi/4$ DQPSK _Lowest Channel_ Hopping ON



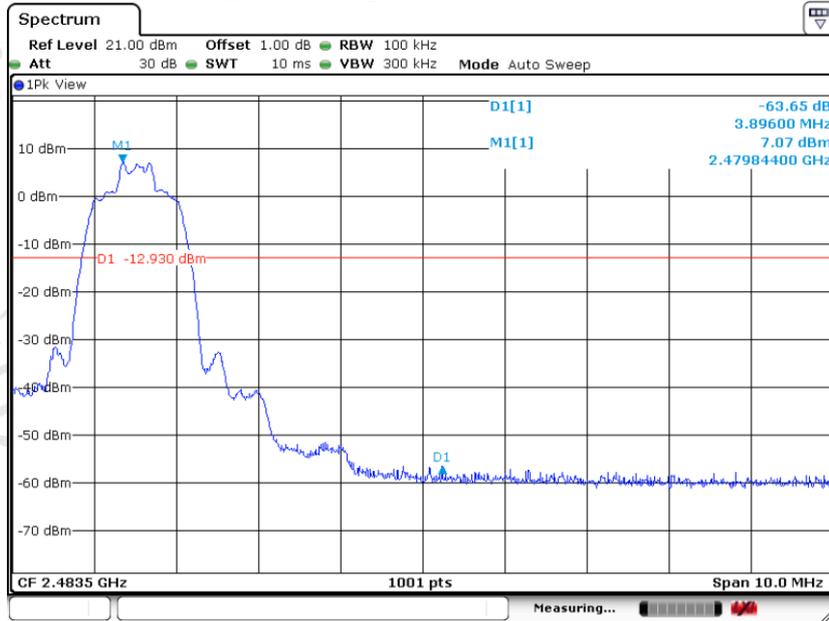
$\pi/4$ DQPSK _Lowest Channel_ Hopping OFF



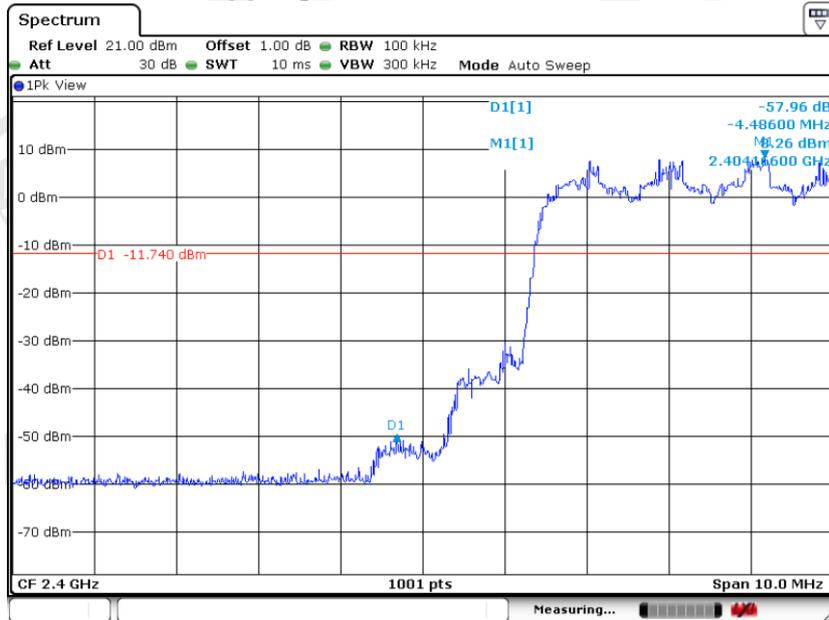
$\pi/4$ DQPSK_Highest Channel_Hopping ON



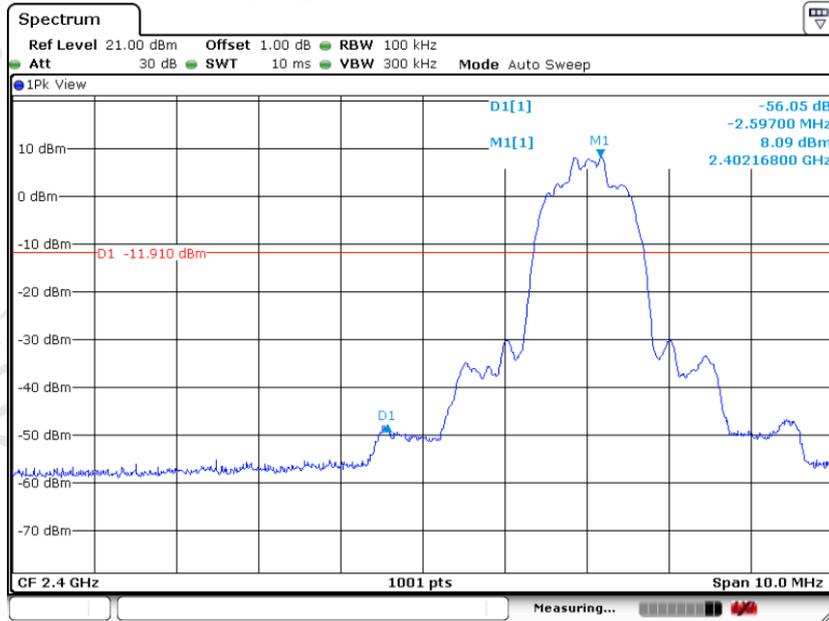
$\pi/4$ DQPSK_Highest Channel_Hopping OFF



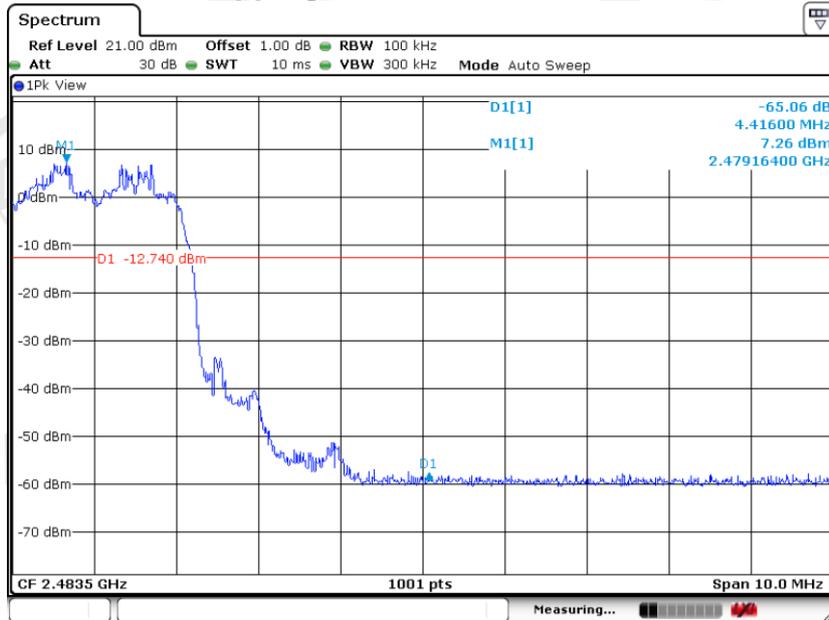
8DPSK _Lowest Channel_ Hopping ON



8DPSK _Lowest Channel_ Hopping OFF

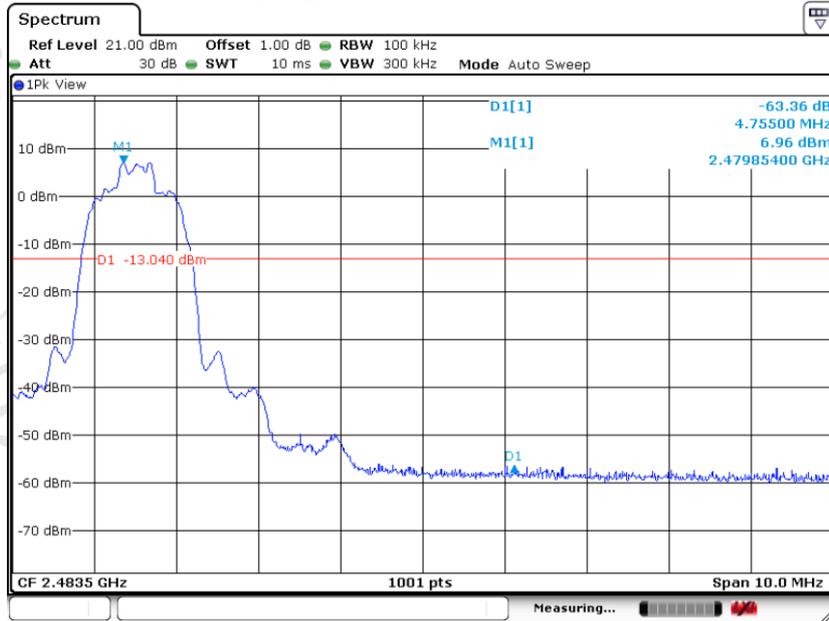


8DPSK_Highest Channel_Hopping ON



Date: 31.JUL.2019 21:58:00

8DPSK_Highest Channel_Hopping OFF

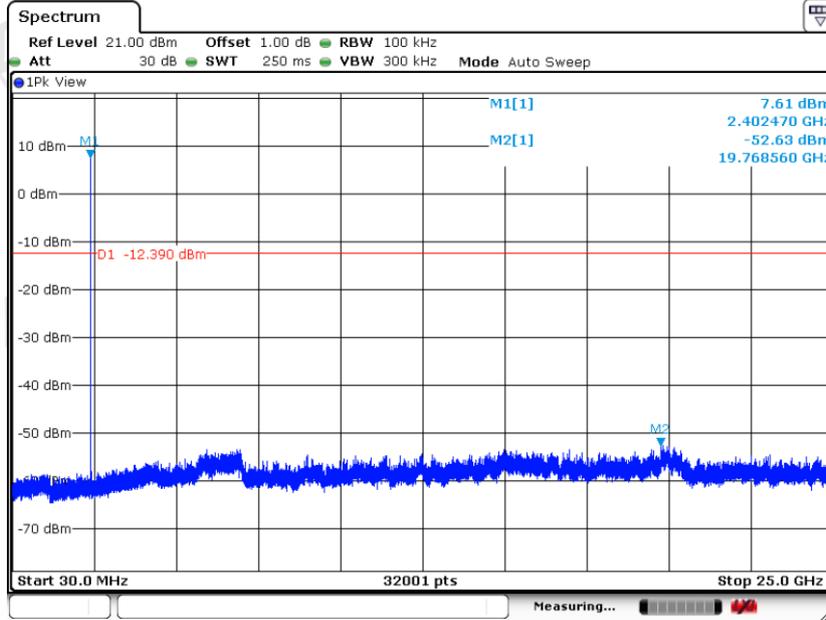


Date: 31.JUL.2019 21:56:34

Spurious RF Conducted Emissions

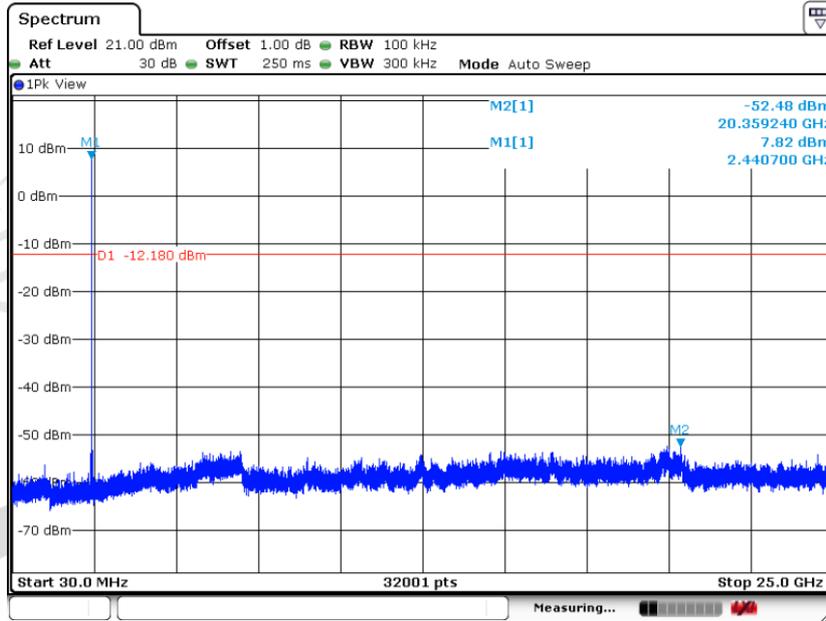
Test plots

GFSK _Lowest Channel



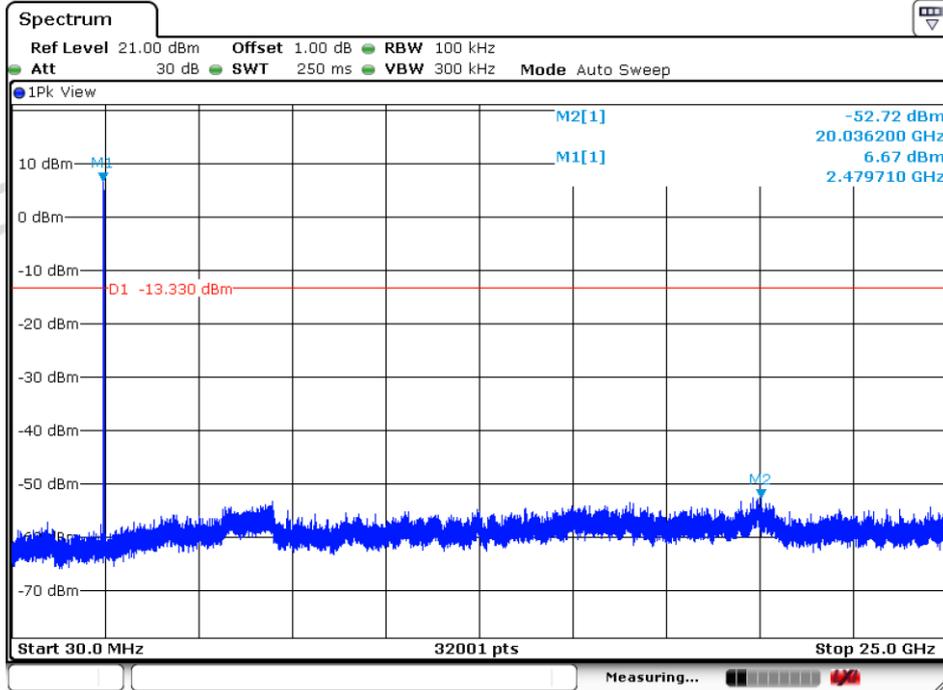
Date: 31 JUL 2019 22:07:11

GFSK _Middle Channel



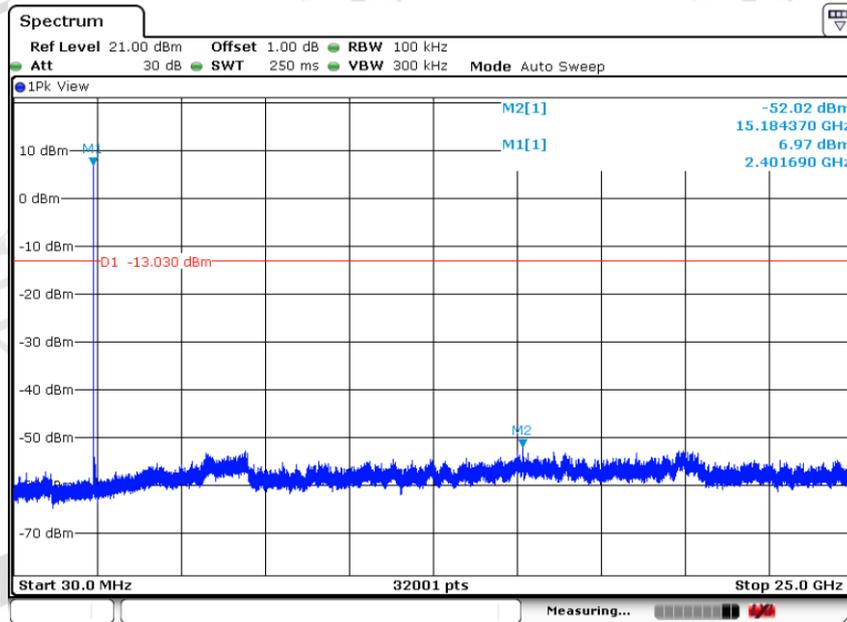
Date: 31 JUL 2019 22:06:29

GFSK_Highest Channel



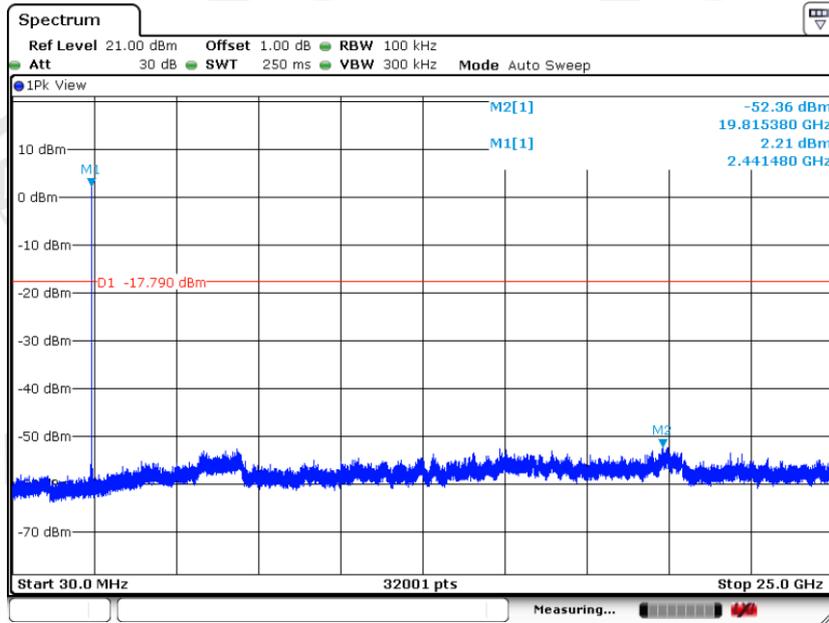
Date: 31.JUL.2019 22:05:49

$\pi/4$ DQPSK_Lowest Channel

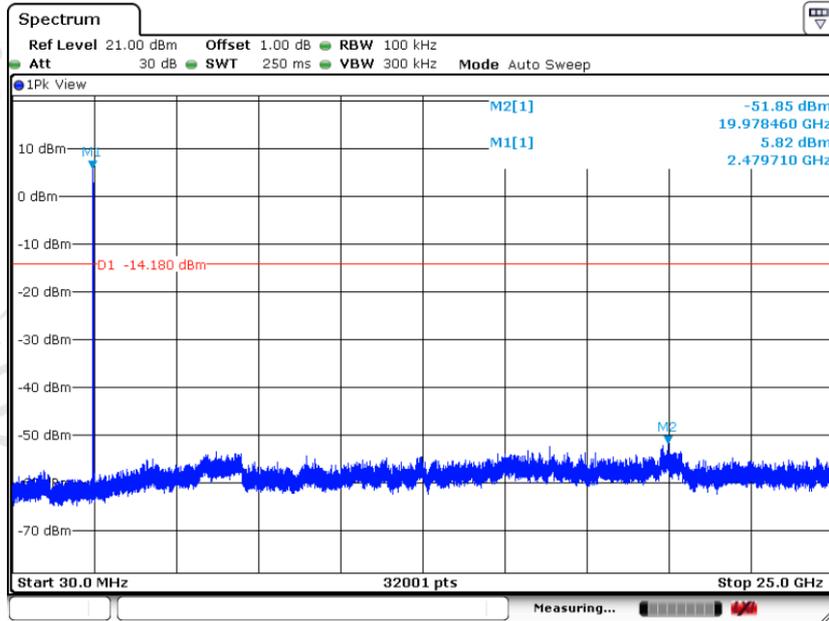


Date: 31.JUL.2019 22:03:00

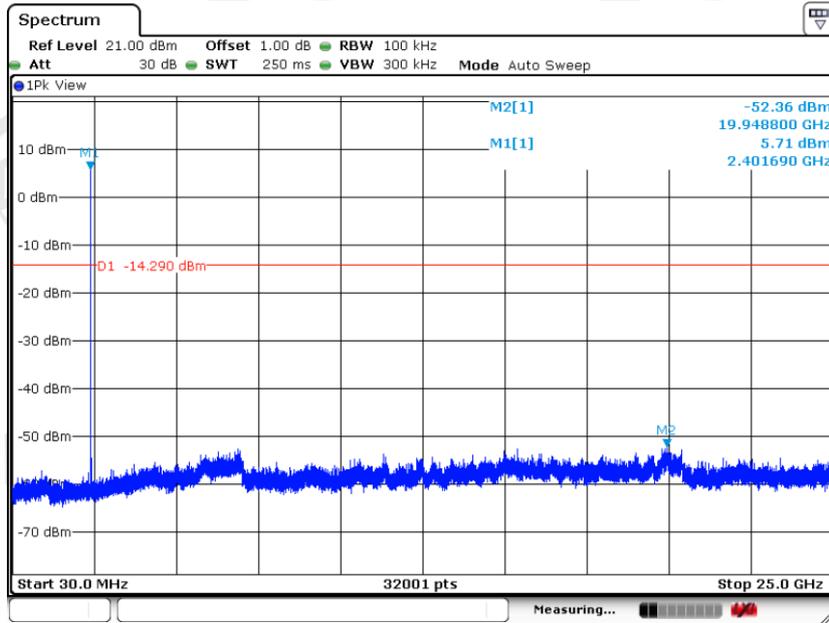
$\pi/4$ DQPSK_Middle Channel



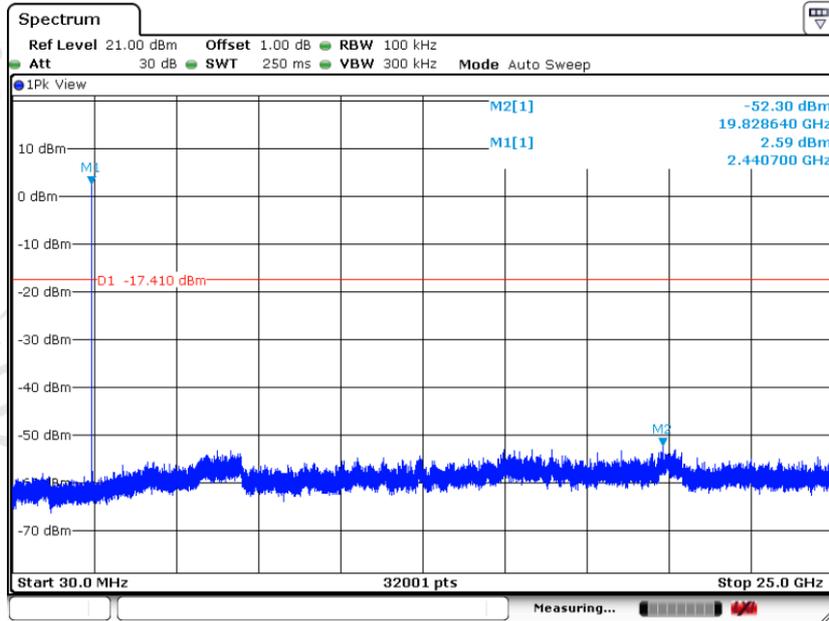
$\pi/4$ DQPSK_Highest Channel



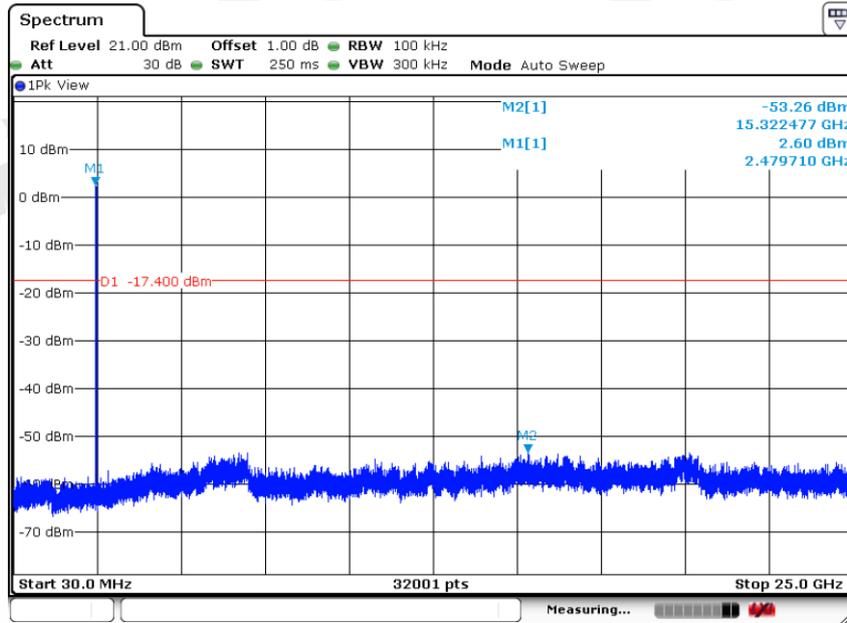
8DPSK_Lowest Channel



8DPSK_Middle Channel



8DPSK_Highest Channel



Remark:

Scan from 9kHz to 25GHz, the disturbance between 9KHz to 30MHz was very low, and the above harmonics were the highest point could be found when testing, The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

The End