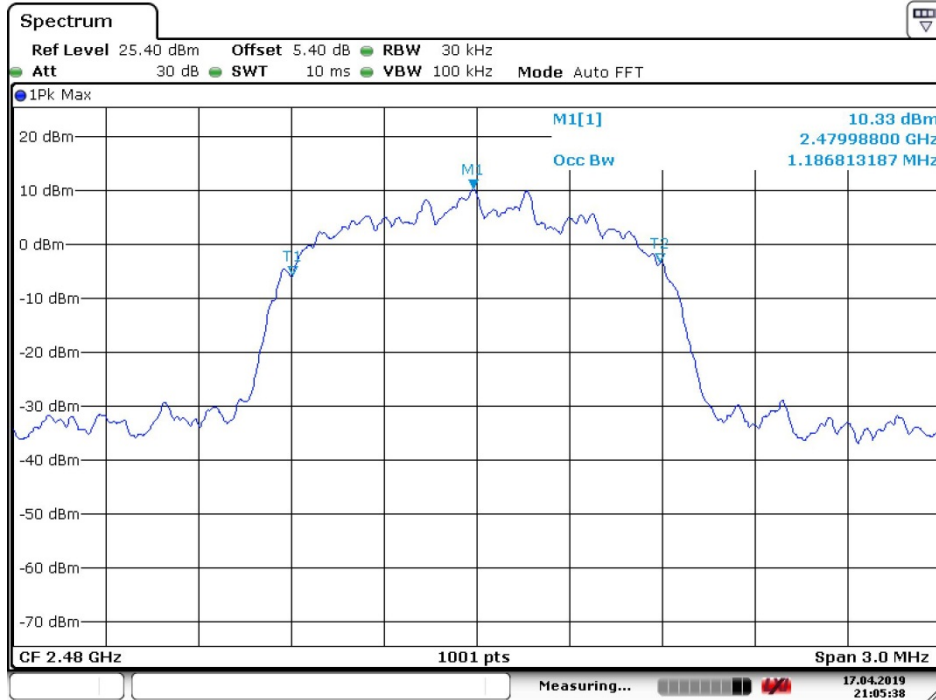
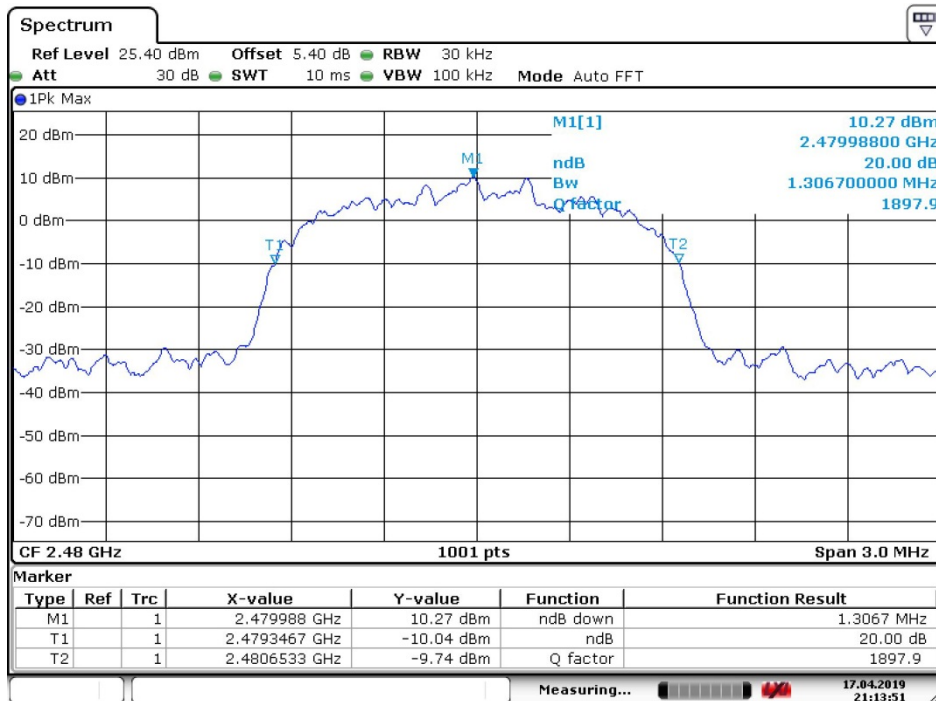


4.5.2.9 8DPSK_Highest Channel



Date: 17.APR.2019 21:05:38



Date: 17.APR.2019 21:13:52



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4.6 Carrier Frequencies Separation

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 Section 7.8.2
Test Setup:	<p>The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.</p>
Limit:	2/3 of the 20dB bandwidth Remark: the transmission power is less than 0.125W.
Exploratory Test Mode:	Hopping transmitting with all kind of modulation and all kind of data type.
Final Test Mode:	Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type, 2-DH5 of data type is the worst case of $\pi/4$ DQPSK modulation type, 3-DH5 of data type is the worst case of 8DPSK modulation type.
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass



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4.6.1 Test Results

GFSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Middle	1001	573.4	Pass
π/4DQPSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Middle	1001	793.2	Pass
8DPSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Middle	1001	799.2	Pass

Remark: According to section 6.4,

Mode	20dB bandwidth (kHz) (worse case)	Limit (kHz) (Carrier Frequencies Separation)
GFSK	875.1	583.4
π/4DQPSK	1183.8	789.2
8DPSK	11862.8	791.2

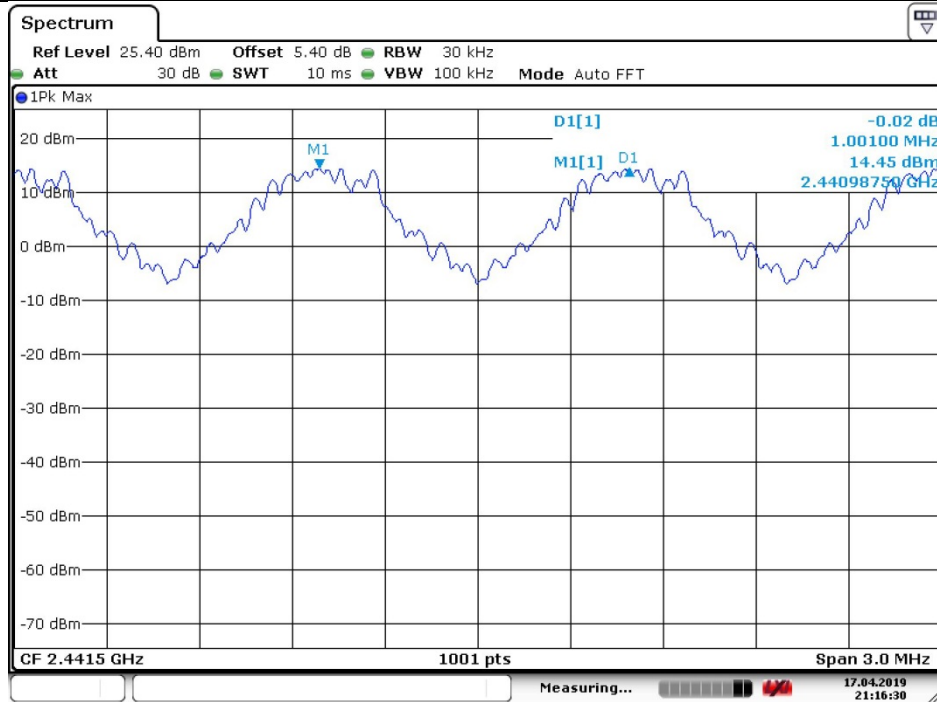


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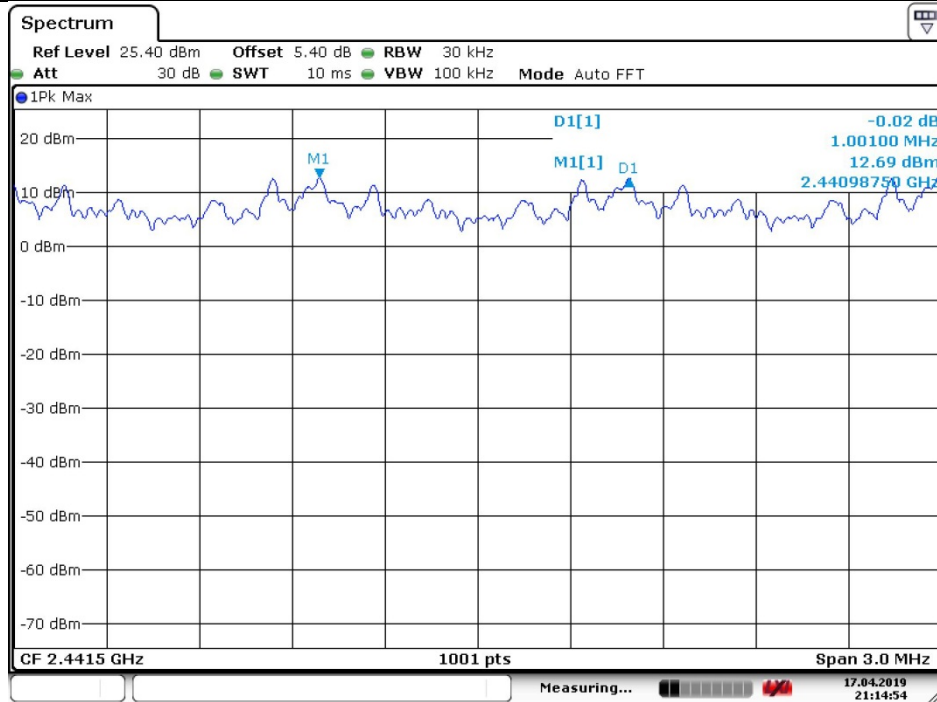
4.6.2 Test plots:

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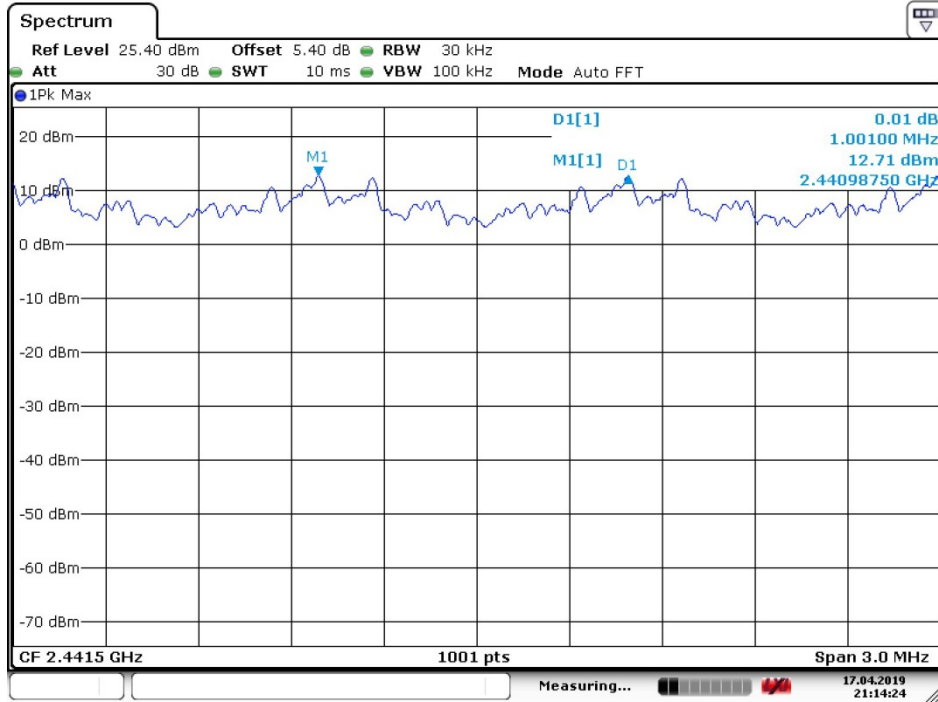


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Test mode:	8DPSK	Test channel:	Middle
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4.7 Hopping Channel Number

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 Section 7.8.3
Test Setup:	<p>The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.</p>
Limit:	At least 15 channels
Test Mode:	Hopping transmitting with all kind of modulation
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

4.7.1 Test Results

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

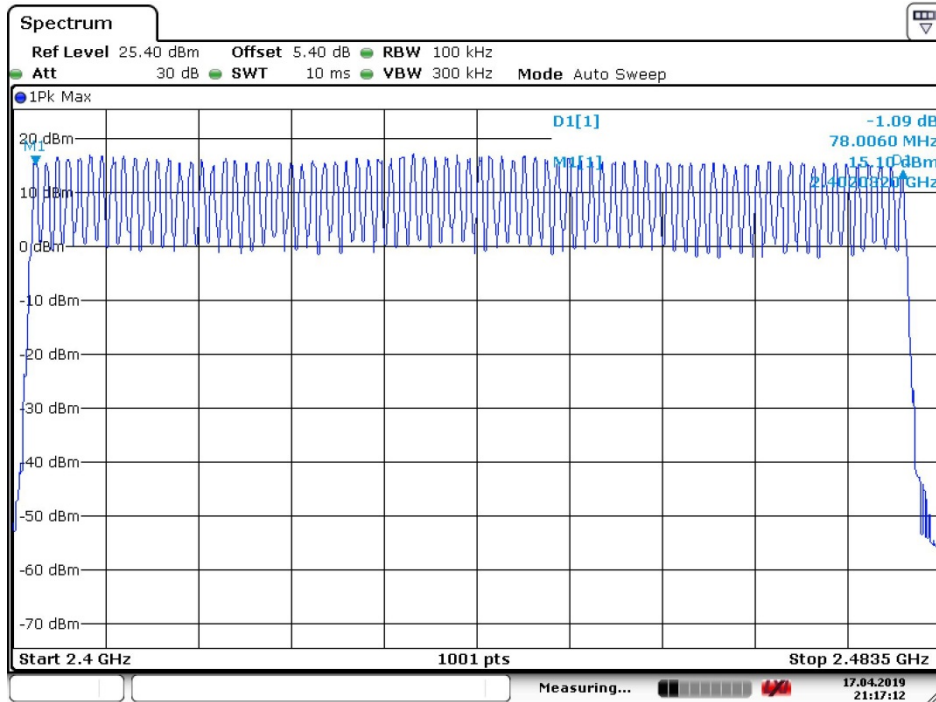


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4.7.2 Test plots

4.7.2.1 GFSK



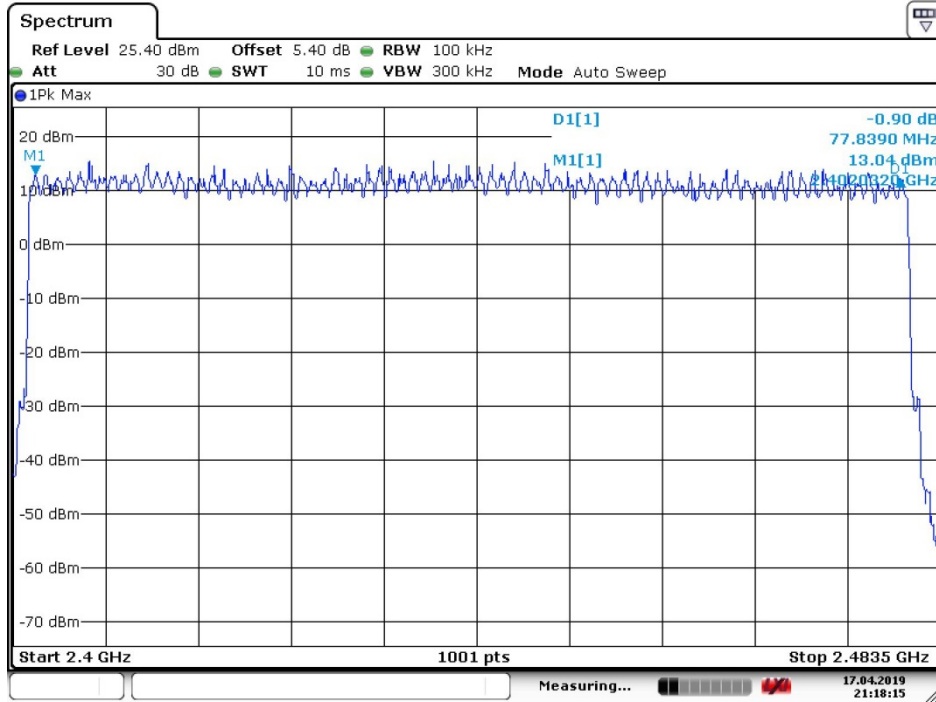
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4.7.2.2

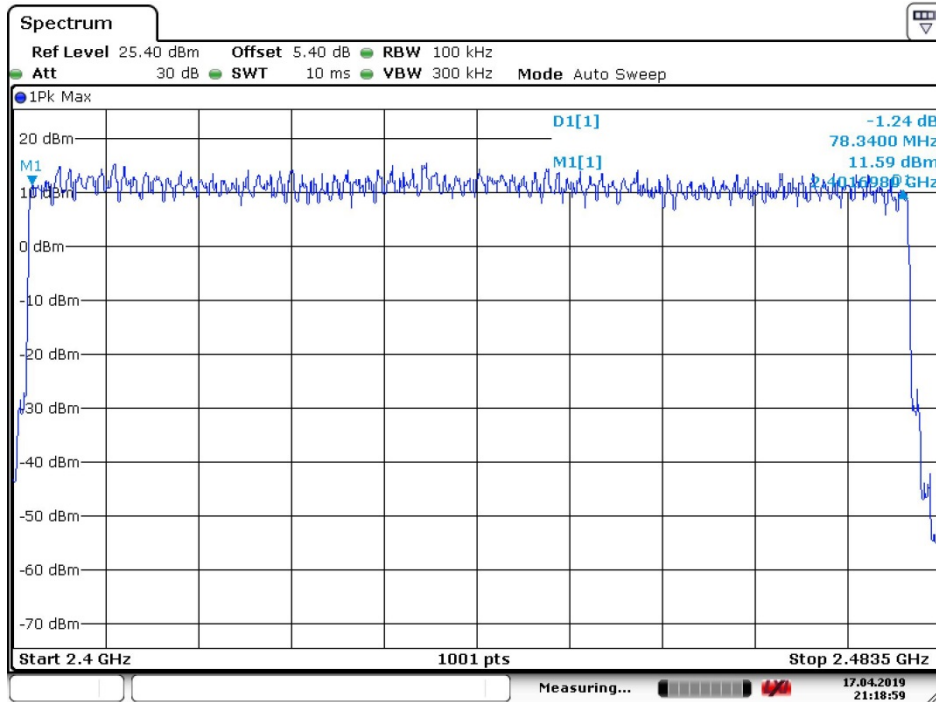
$\pi/4$ DQPSK



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4.7.2.3

8DPSK



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4.8 Dwell Time

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 Section 7.8.4
Test Setup:	<p>The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.</p>
Instruments Used:	Refer to section 5.10 for details
Test Mode:	Hopping transmitting with all kind of modulation and all kind of data type.
Limit:	0.4 Second
Test Results:	Pass



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4.8.1 Test Results

Operation Modes	On time (ms) on one channel
DH1	0.390
DH3	1.651
DH5	2.901
2-DH1	0.401
2-DH3	1.657
2-DH5	2.906
3-DH1	0.400
3-DH3	1.654
3-DH5	2.911

Bluetooth Time of Occupancy Calculation

Typically, Bluetooth 1x/EDR mode has a channel hopping rate of 1600 hops/s, since 1x/EDR modes use 5 transmit and 1 receive slot, for a total of 6 slots, the Bluetooth transmitter is actually hopping at a rate of $1600/6=266.67$ hops/slot

400ms x 79 Channel = 31.6 s (Time of Occupancy Limit)
 Worst case BT has 266.67 hops/second (for 1x/EDR modes with 3-DH5 operation)
 $266.67 \text{ hops/second} / 79 \text{ channels} = 3.38 \text{ hops/second}$ (# of hops/second on one channel)
 $3.38 \text{ hops/second/channel} * 31.6 \text{ seconds} = 106.67 \text{ hops}$ (#hops over a 31.6 second period)
 $106.67 \text{ hops} * 2.911 \text{ ms/channel} = 310.52 \text{ ms}$ (worst case dwell time for one channel in 1x/EDR

modes)

With AFH, the number of channels is reduced to a minimum of 20 channels and the channel hopping rate is reduced by 50% to 800hops/s, AFH mode also uses 6 slots so the Bluetooth transmitter hops at a rate of $800/6=133.3$ hops/s/slot

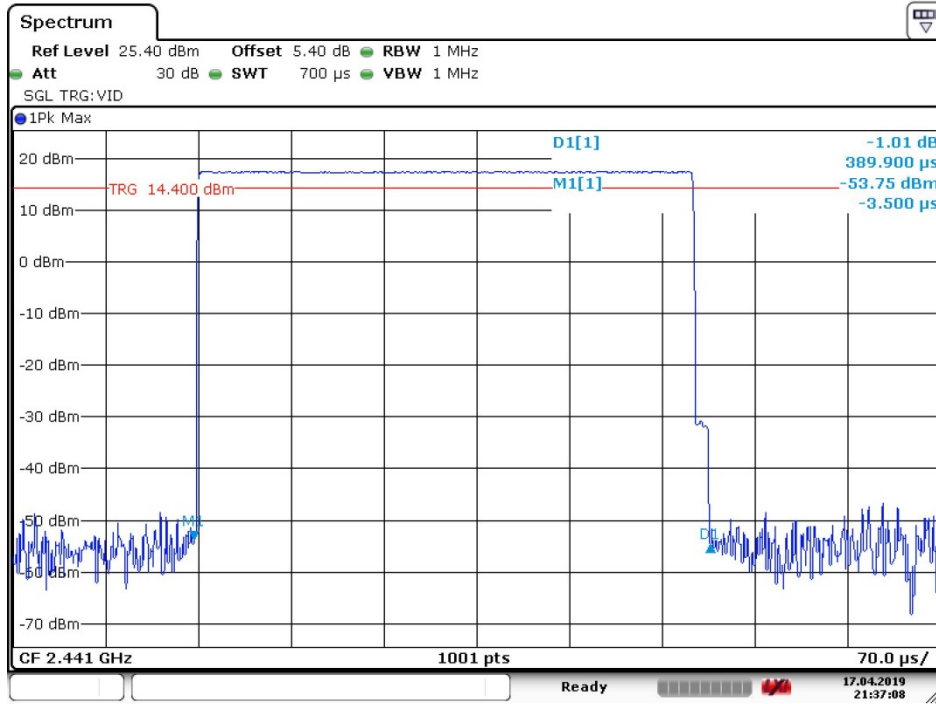
400ms x 20 Channel = 8 s (Time of Occupancy Limit)
 Worst case BT has 133.3 hops/second/slot (for AFH mode with 3-DH5 operation)
 $133.3 \text{ hops/second} / 20 \text{ channels} = 6.67 \text{ hops/second}$ (#hops/second on one channel)
 $6.67 \text{ hops/second} * 8 \text{ seconds} = 53.34 \text{ hops}$ (#hops over a 8 seconds period)
 $53.34 \text{ hops} * 2.911 \text{ ms/channel} = 155.27 \text{ ms}$ (worst case dwell time for one channel in AFH mode)



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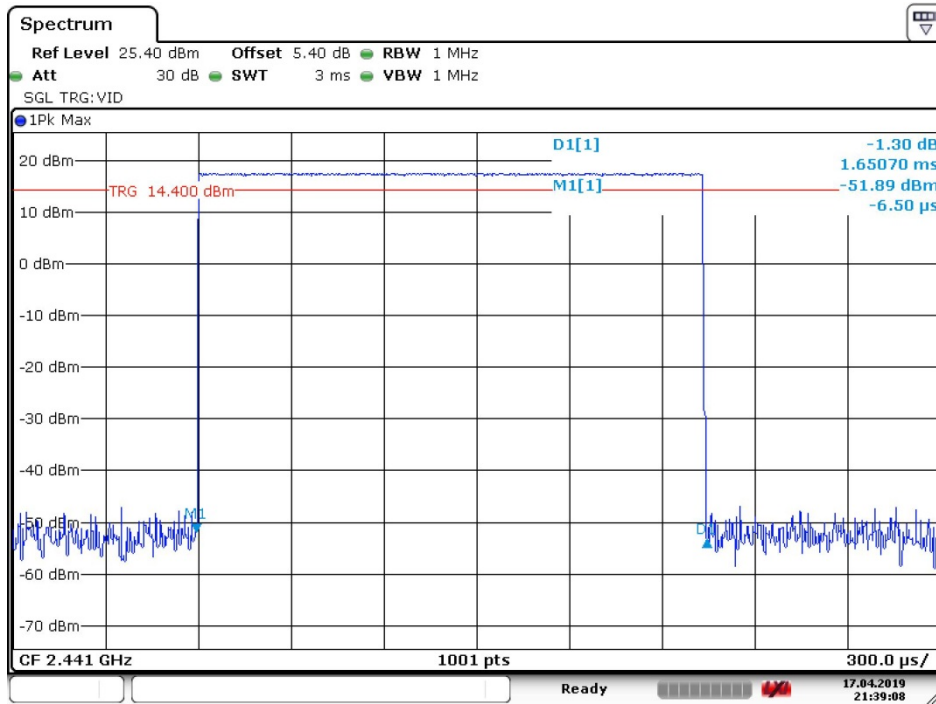
4.8.2 Test plots

4.8.2.1 DH1_Middle Channel



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4.8.2.2 DH3_Middle Channel

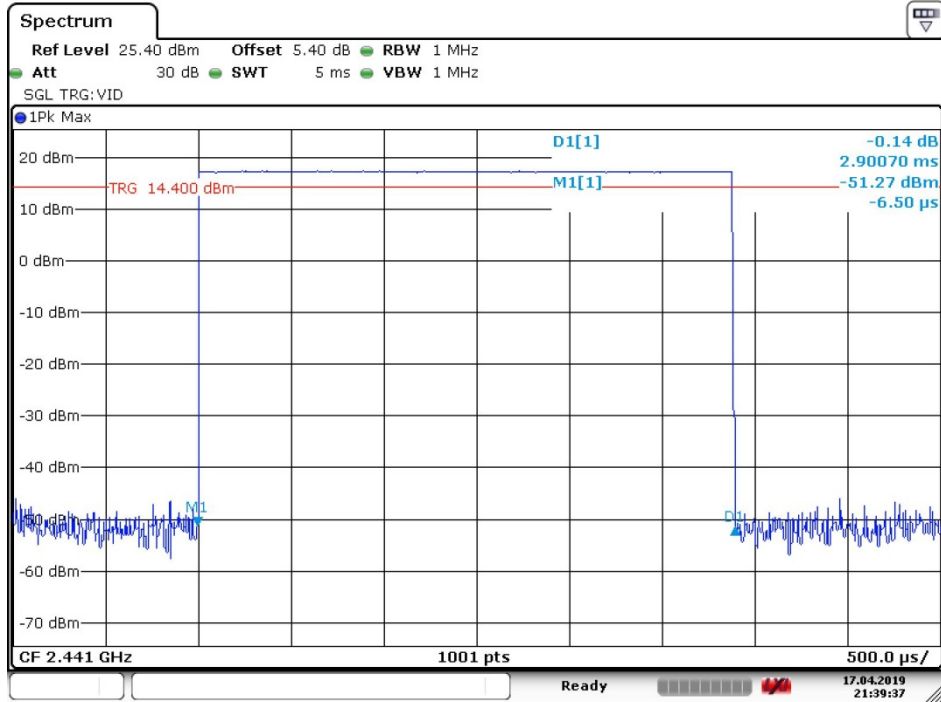


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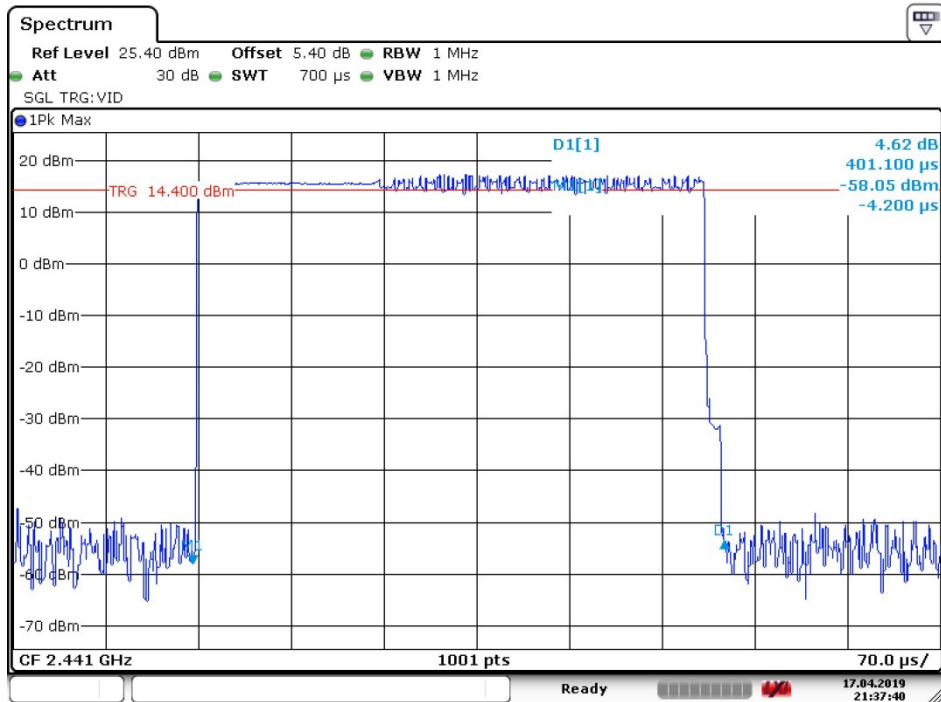
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4.8.2.3 DH5 _ Middle Channel



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4.8.2.4 2DH1 _ Middle Channel

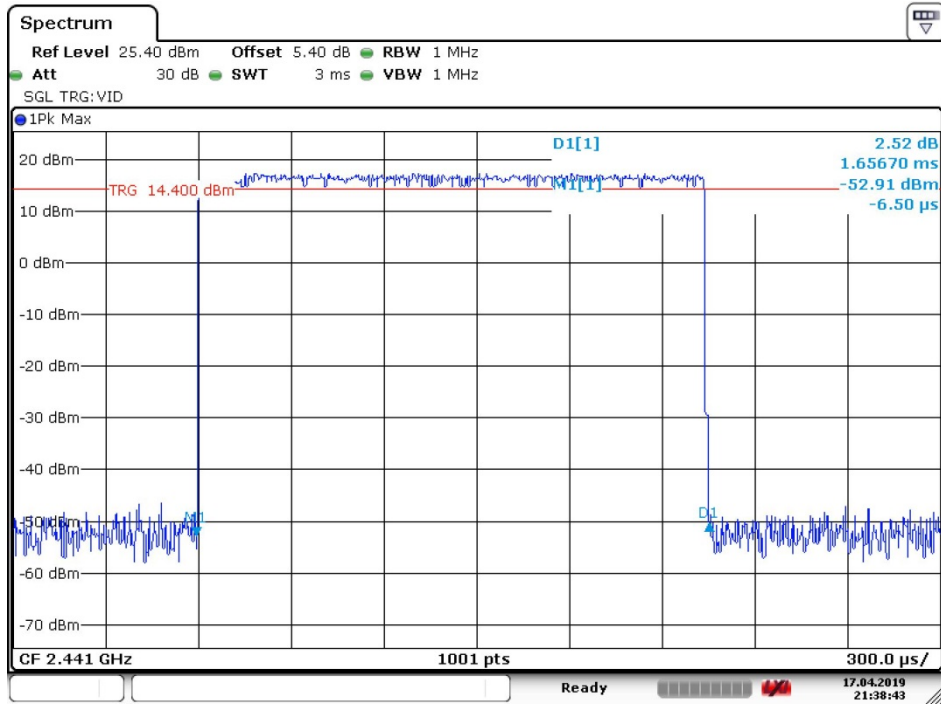


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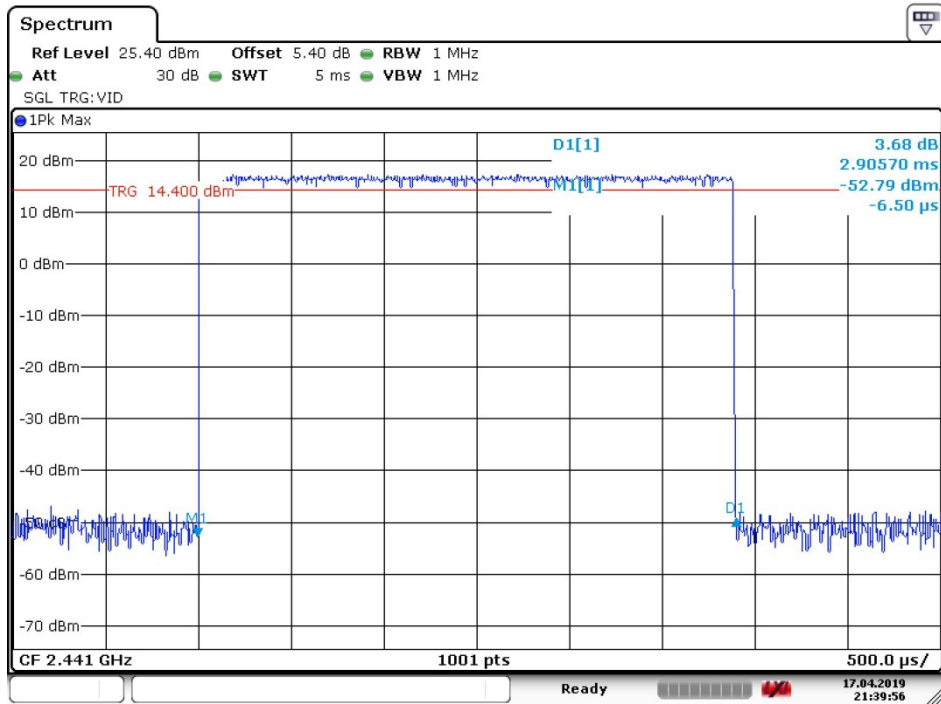
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4.8.2.5 2DH3 _ Middle Channel



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4.8.2.6 2DH5 _ Middle Channel

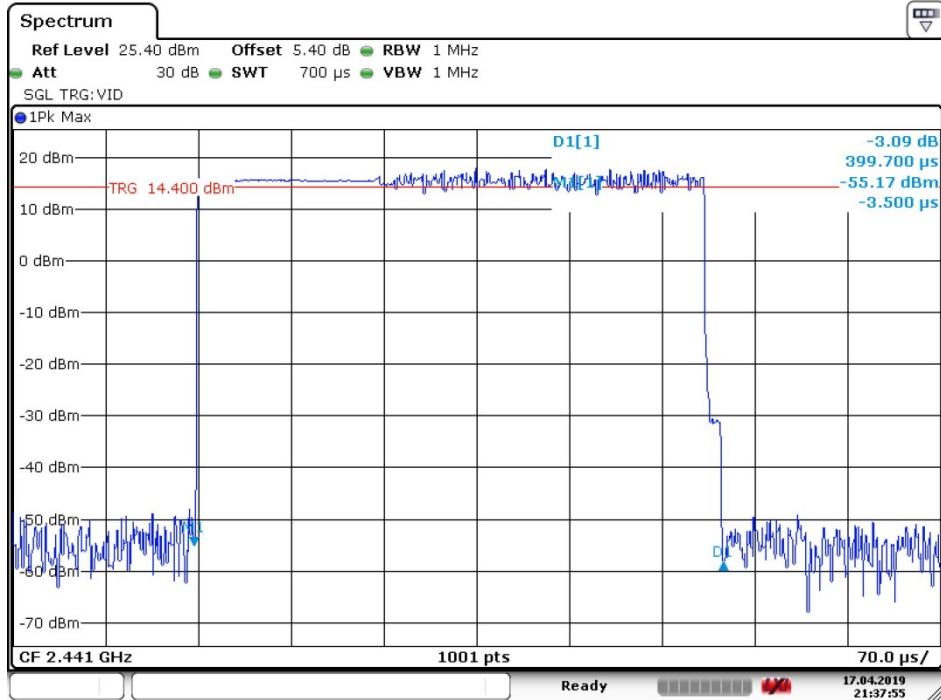


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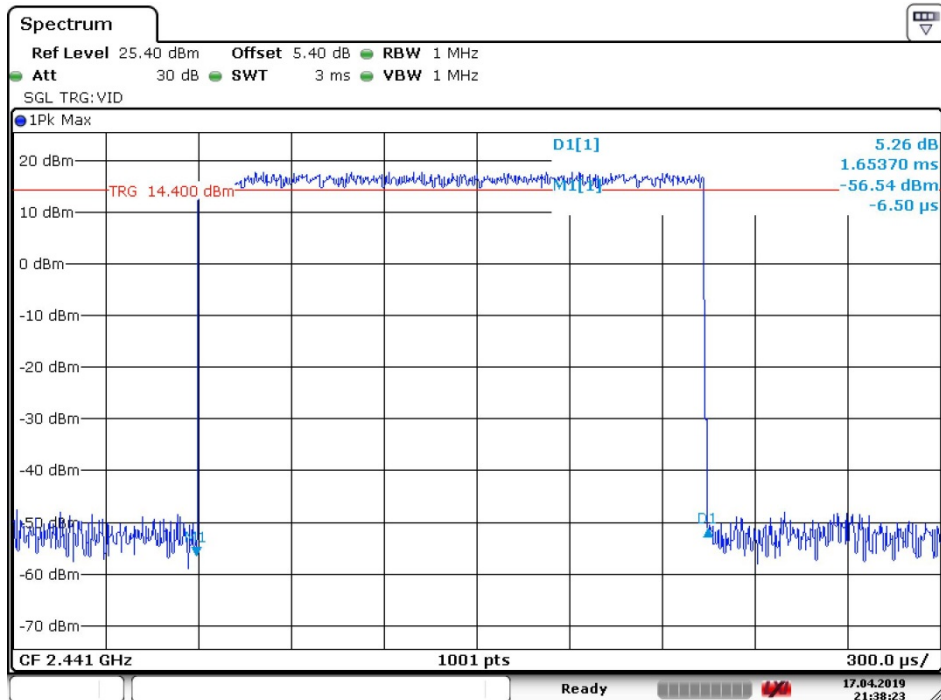
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4.8.2.7 3DH1_Middle Channel



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4.8.2.8 3DH3_Middle Channel

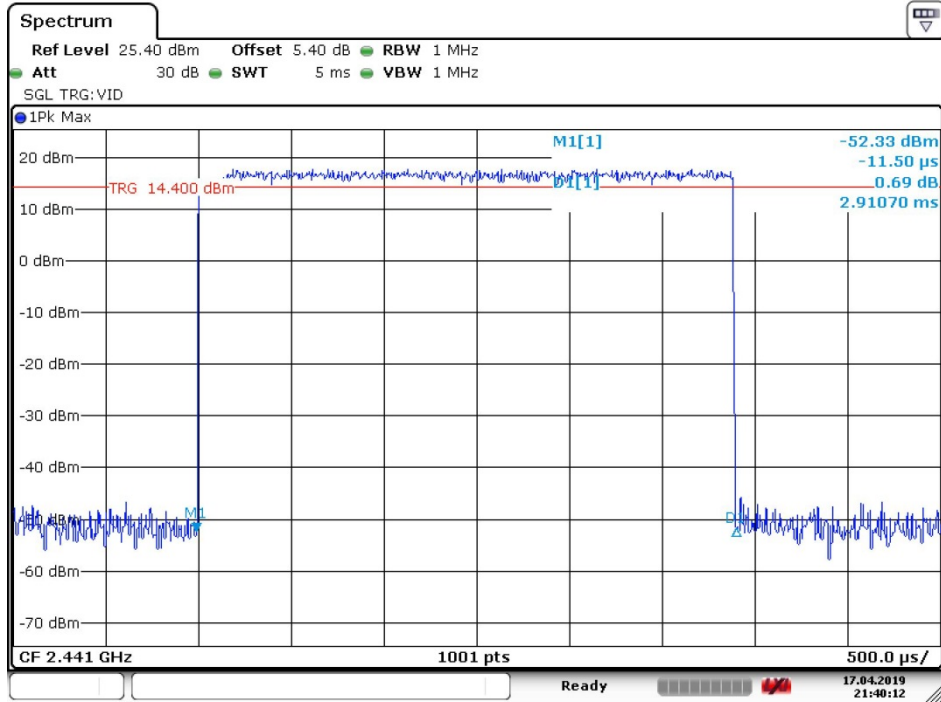


Date: 17.APR.2019 21:38:24



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4.8.2.9 3DH5 _ Middle Channel



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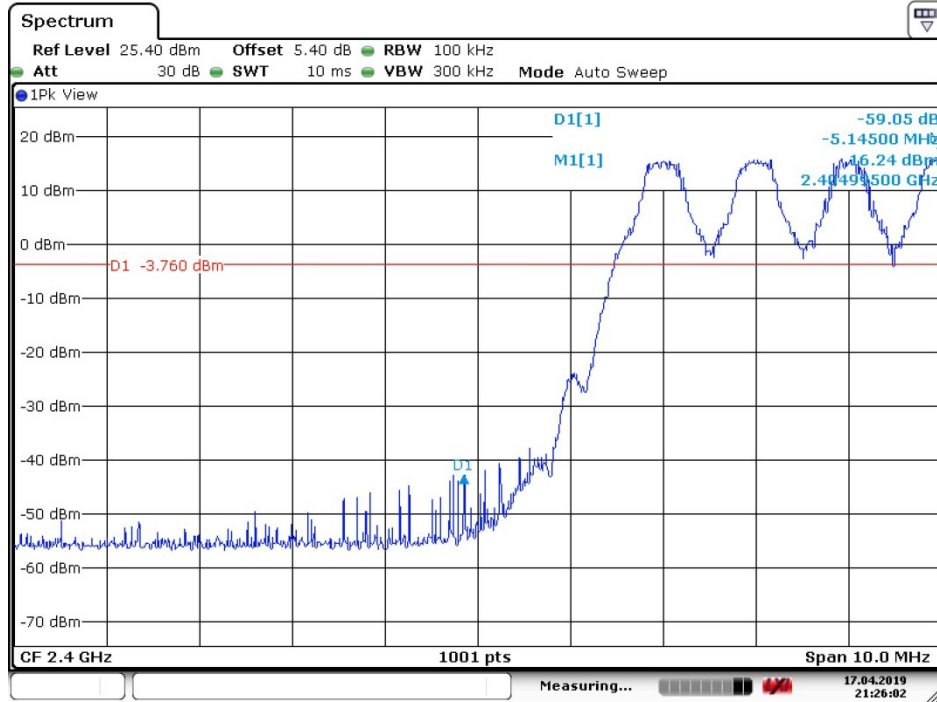
4.9 Band-edge for RF Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10:2013 Section 7.8.6
Test Setup:	
Limit:	In any 100 kHz bandwidth outside the frequency band 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.
Exploratory Test Mode:	Hopping and Non-hopping transmitting with all kind of modulation and all kind of data type
Final Test Mode:	Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type, 2-DH5 of data type is the worst case of $\pi/4$ DQPSK modulation type, 3-DH5 of data type is the worst case of 8DPSK modulation type.
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass



4.9.1 Test plots

4.9.1.1 GFSK _Lowest Channel_ Hopping ON



Date: 17.APR.2019 21:26:02

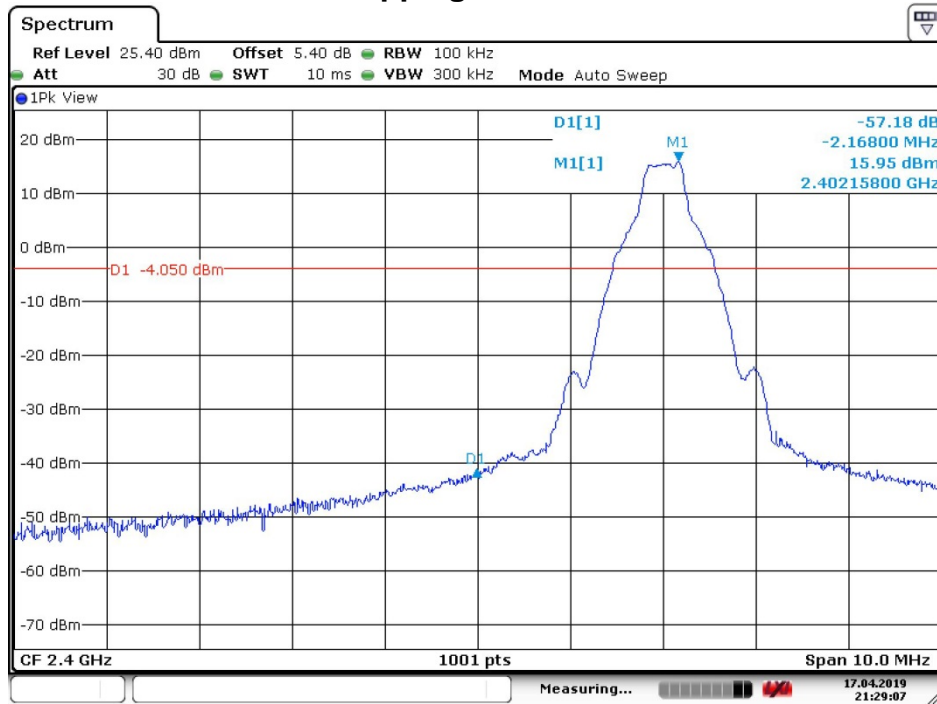


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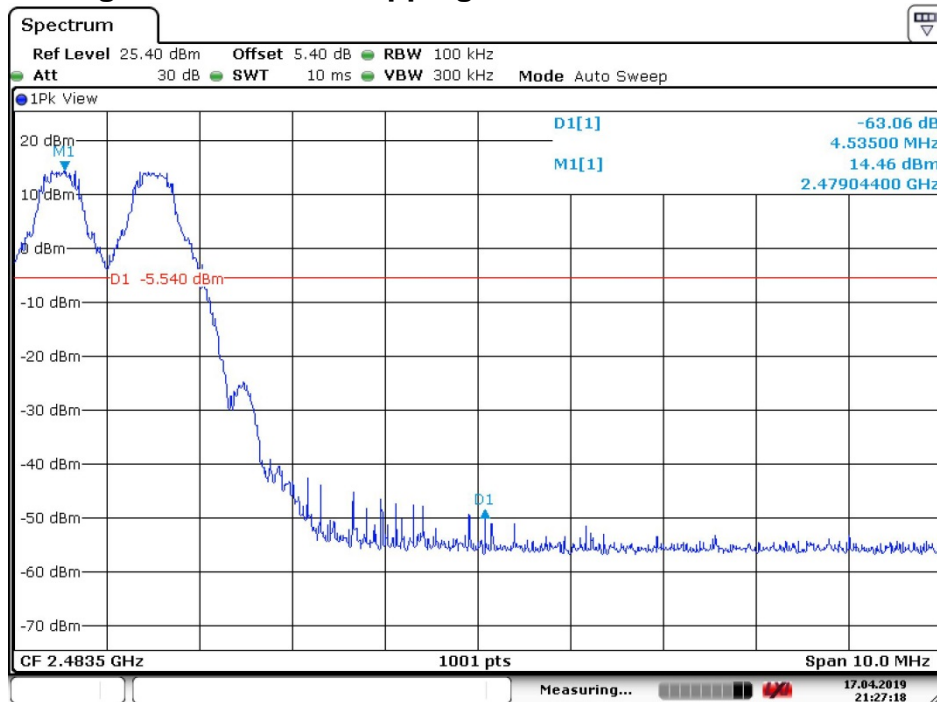
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4.9.1.2 GFSK _Lowest Channel_ Hopping OFF



Date: 17.APR.2019 21:29:07

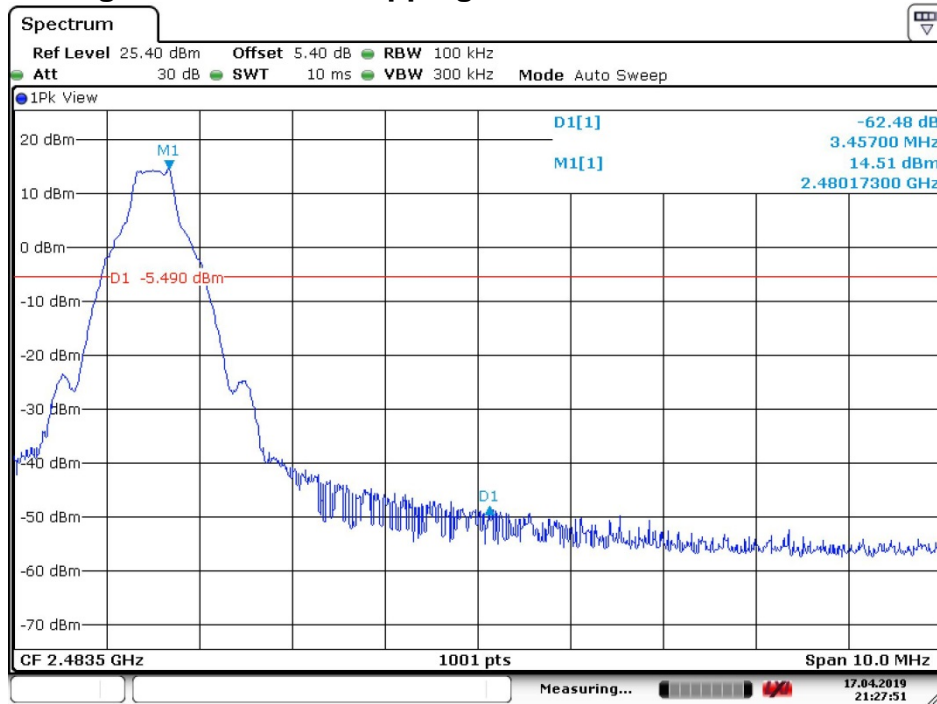
4.9.1.3 GFSK _Highest Channel_ Hopping ON



Date: 17.APR.2019 21:27:18

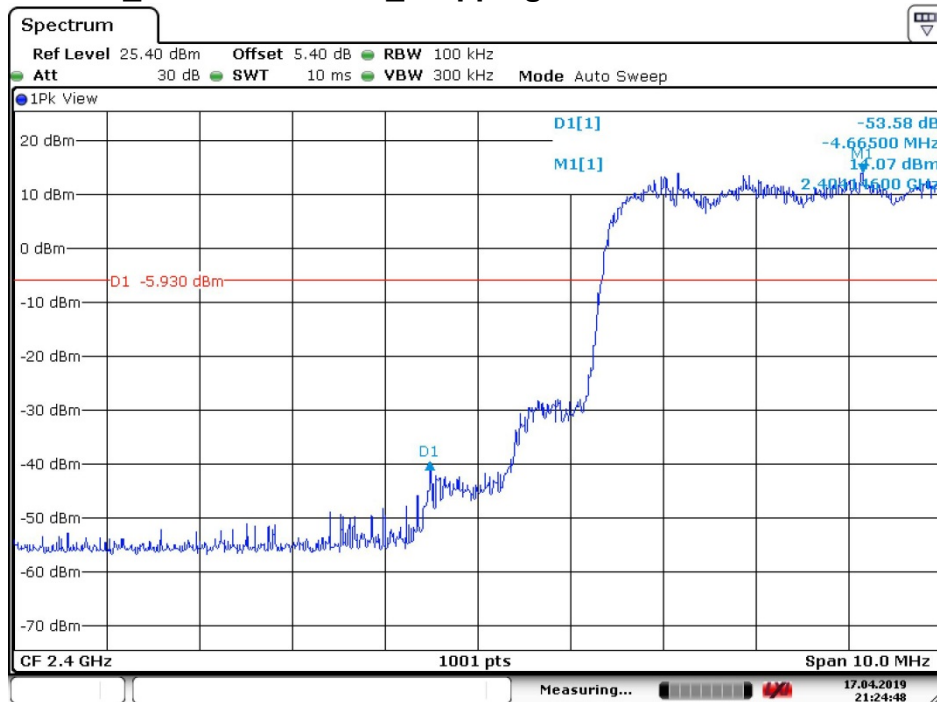


4.9.1.4 GFSK _Highest Channel_ Hopping OFF



Date: 17.APR.2019 21:27:51

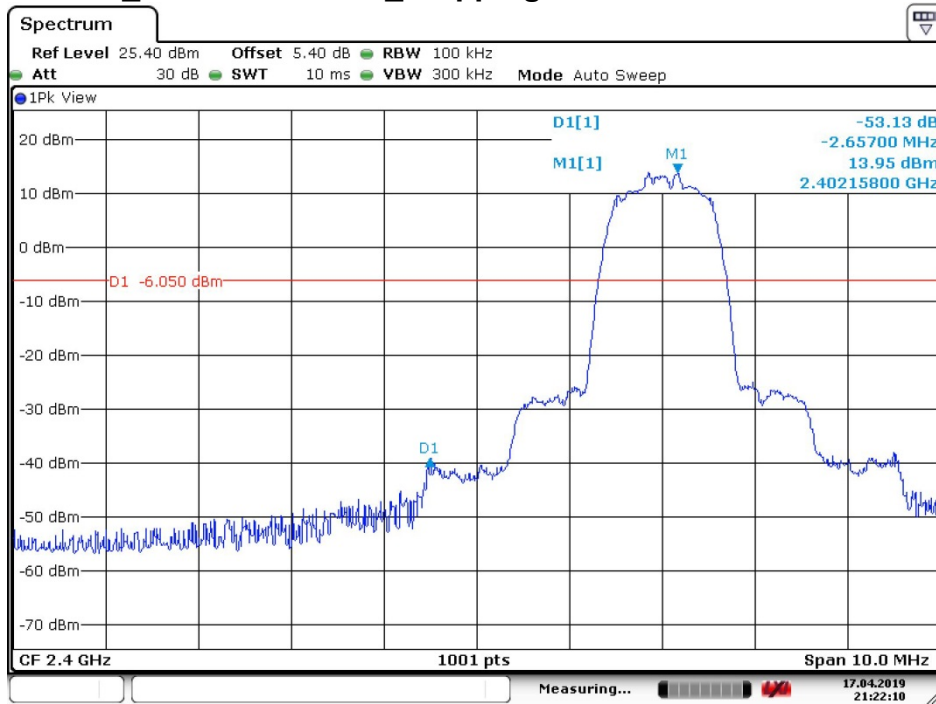
4.9.1.5 $\pi/4$ DQPSK _Lowest Channel_ Hopping ON



Date: 17.APR.2019 21:24:48

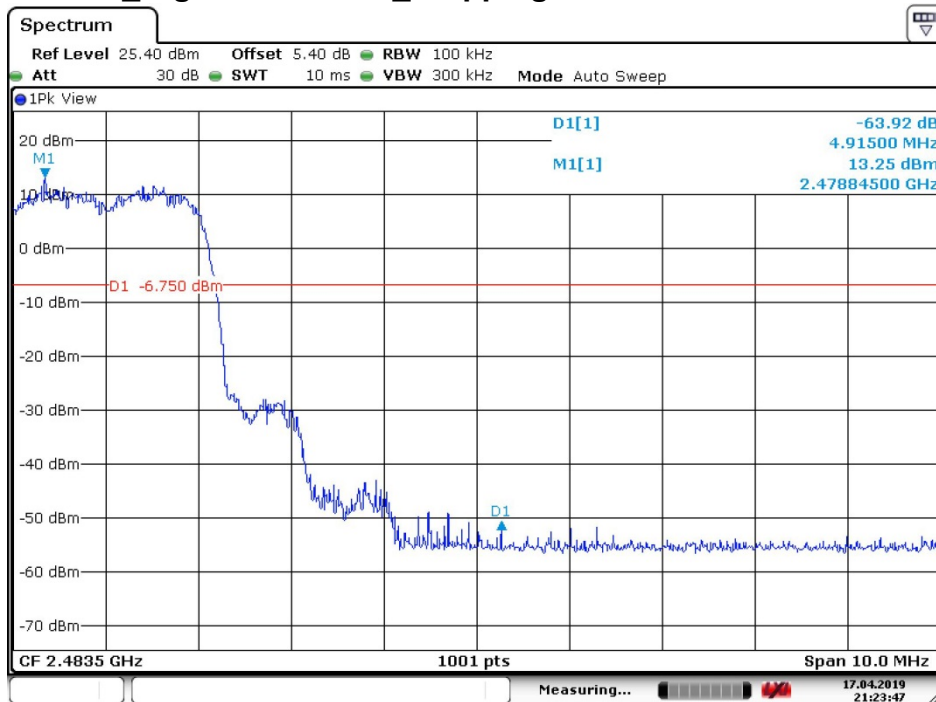


4.9.1.6 $\pi/4$ DQPSK _Lowest Channel_ Hopping OFF



Date: 17.APR.2019 21:22:11

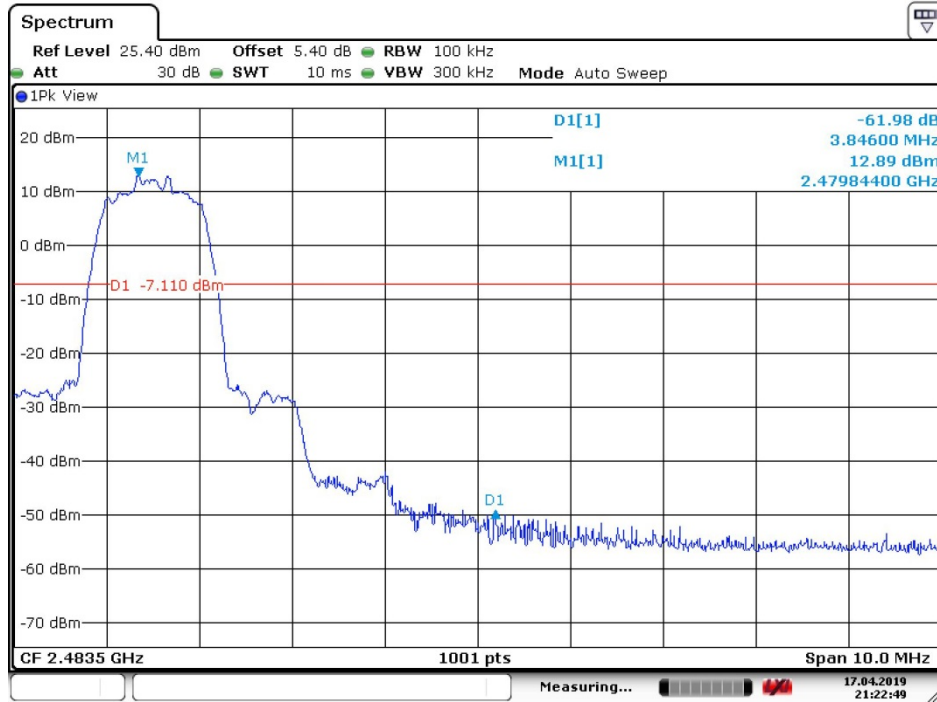
4.9.1.7 $\pi/4$ DQPSK _Highest Channel_ Hopping ON



Date: 17.APR.2019 21:23:47

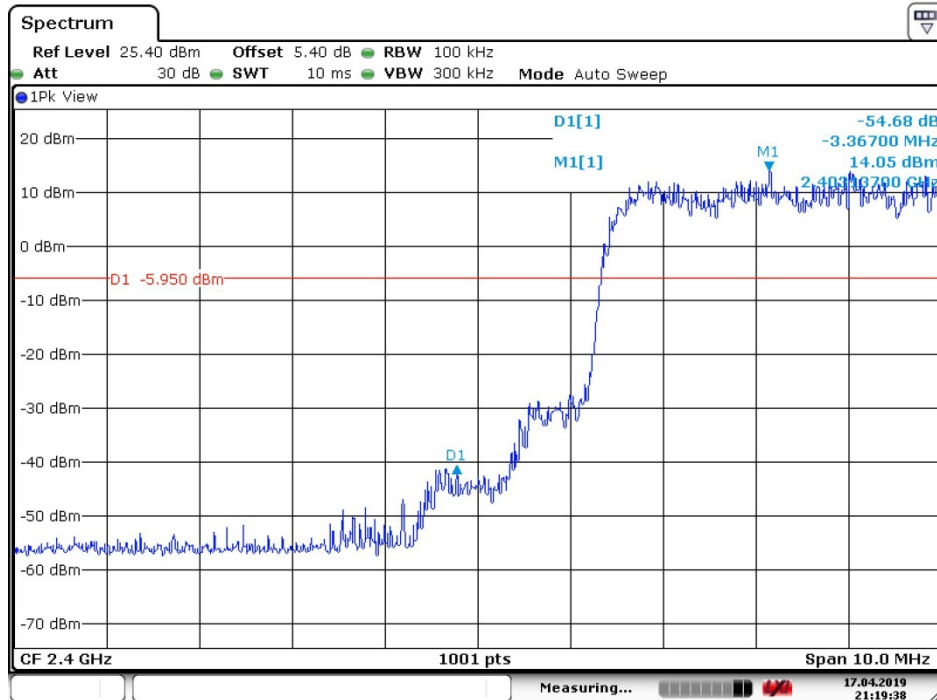


4.9.1.8 $\pi/4$ DQPSK _Highest Channel_ Hopping OFF



Date: 17.APR.2019 21:22:50

4.9.1.9 8DPSK _Lowest Channel_ Hopping ON



Date: 17.APR.2019 21:19:38

