

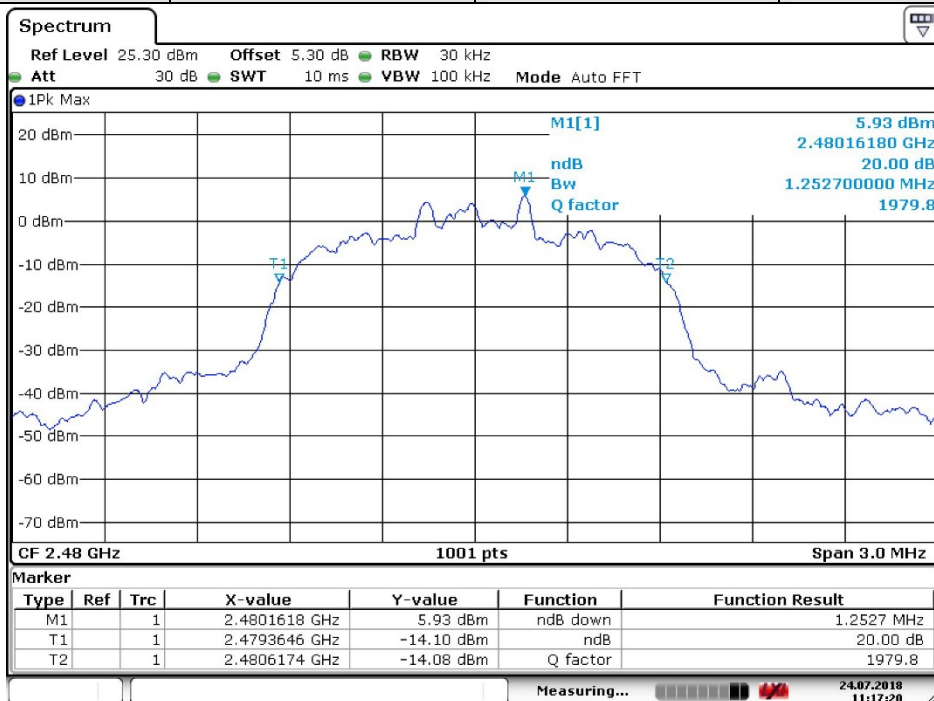


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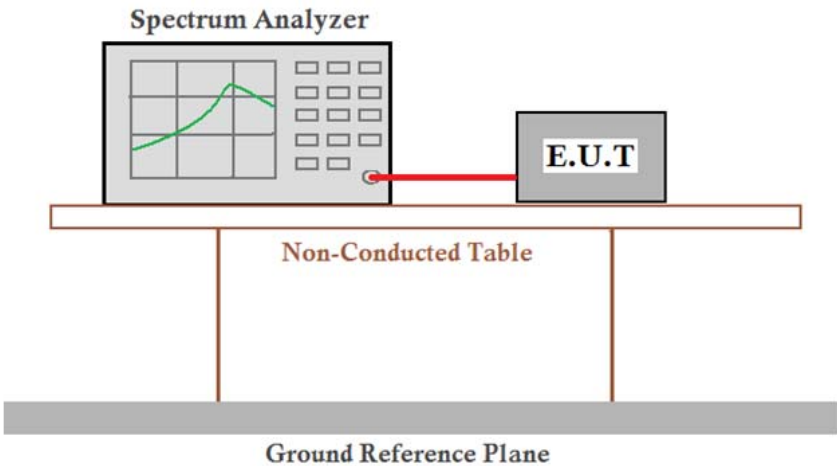
Test mode:	8DPSK	Test channel:	Highest
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## 4.5 Carrier Frequencies Separation

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 to an E.U.T. (Equipment Under Test) via a red cable. Both the Spectrum Analyzer and the E.U.T. are placed on a Non-Conducted Table. The table is supported by two vertical legs. 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 DH1 of data type is the worst case of GFSK modulation type, 2-DH1 of data type is the worst case of $\pi/4$ DQPSK modulation type, 3-DH1 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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GFSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Middle	998	571.4	Pass
$\pi/4$ DQPSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Middle	1001	845.1	Pass
8DPSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Middle	998	835.1	Pass

*Note: According to section 6.4,*

Mode	20dB bandwidth (kHz) (worse case)	Limit (kHz) (Carrier Frequencies Separation)
GFSK	857.1	571.4
$\pi/4$ DQPSK	1267.7	845.1
8DPSK	1252.7	835.1



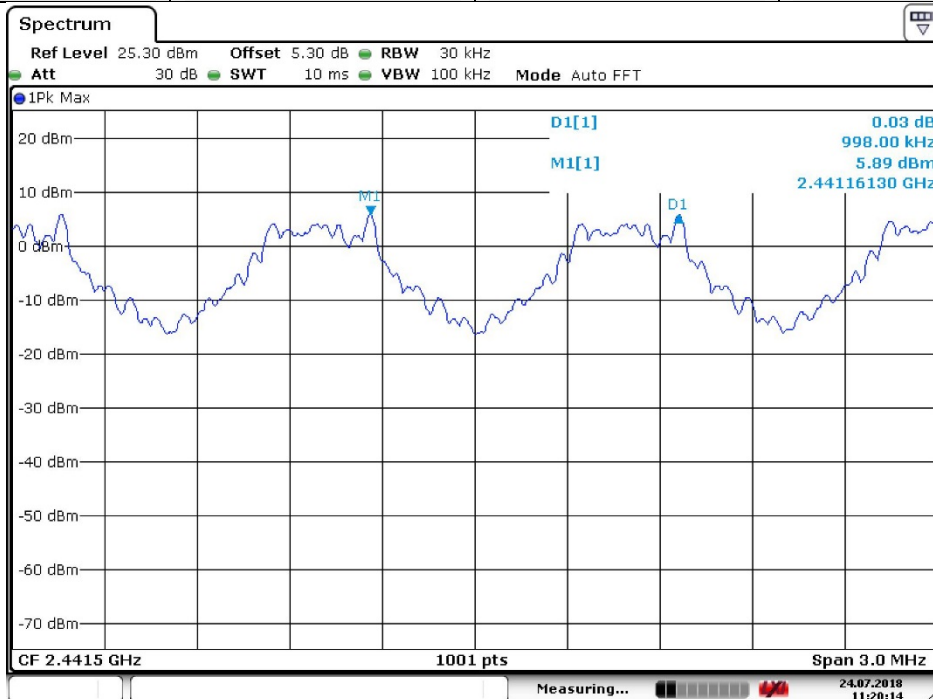
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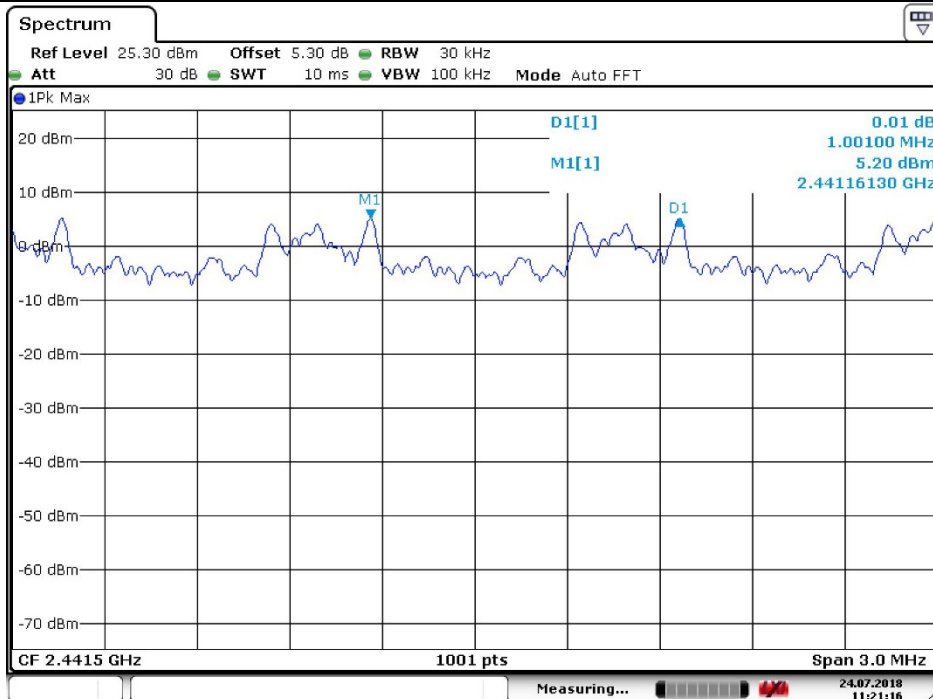
Test plot as follows:

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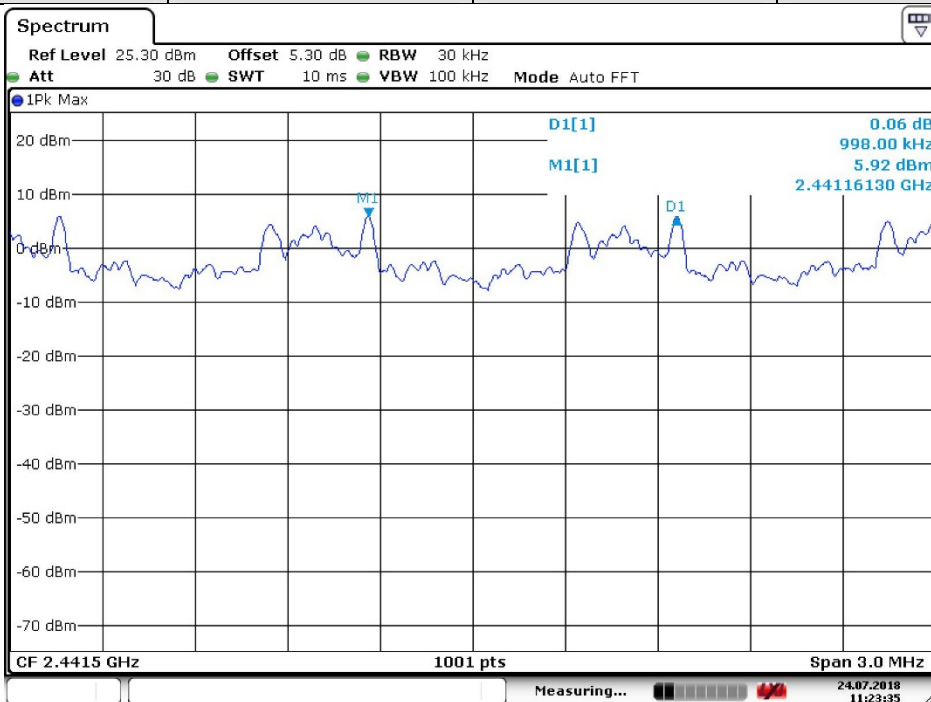


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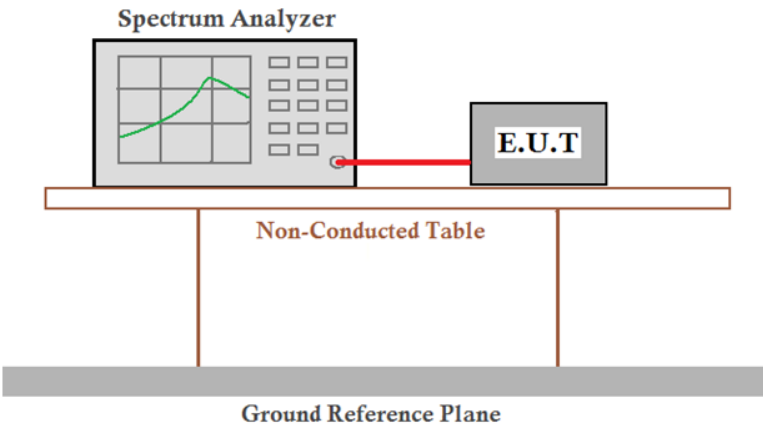
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Test mode:	8DPSK	Test channel:	Middle
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## 4.6 Hopping Channel Number

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 Section 7.8.3
Test Setup:	
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

### Measurement Data

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



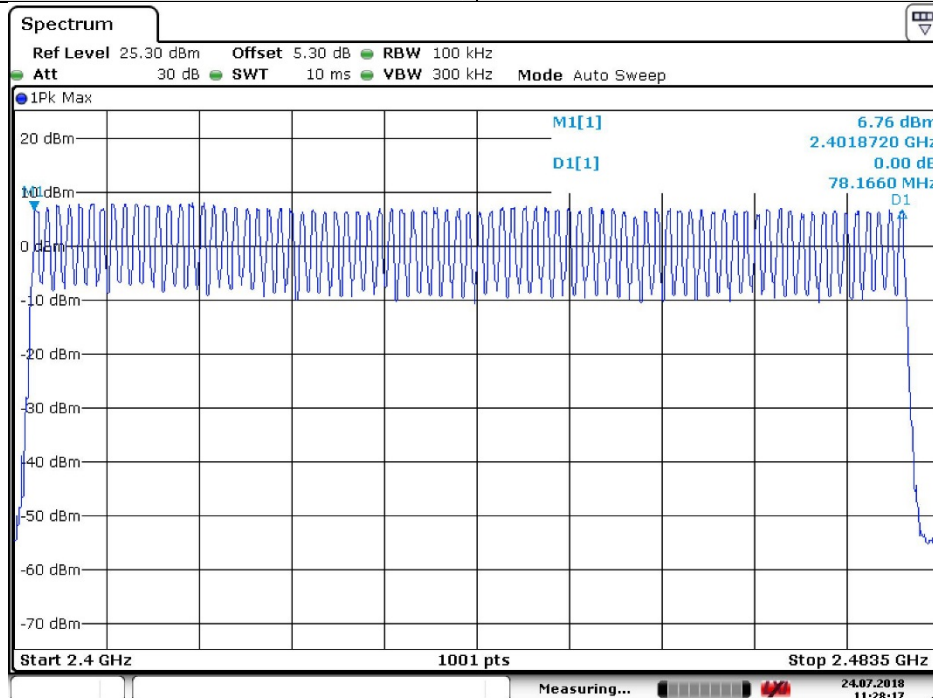
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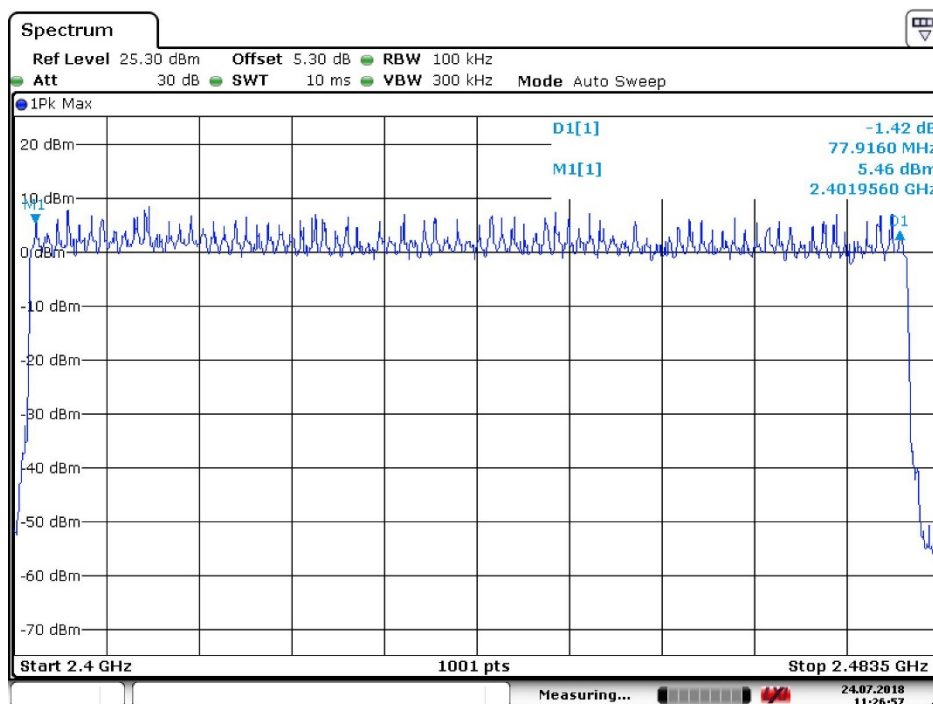
Test plot as follows

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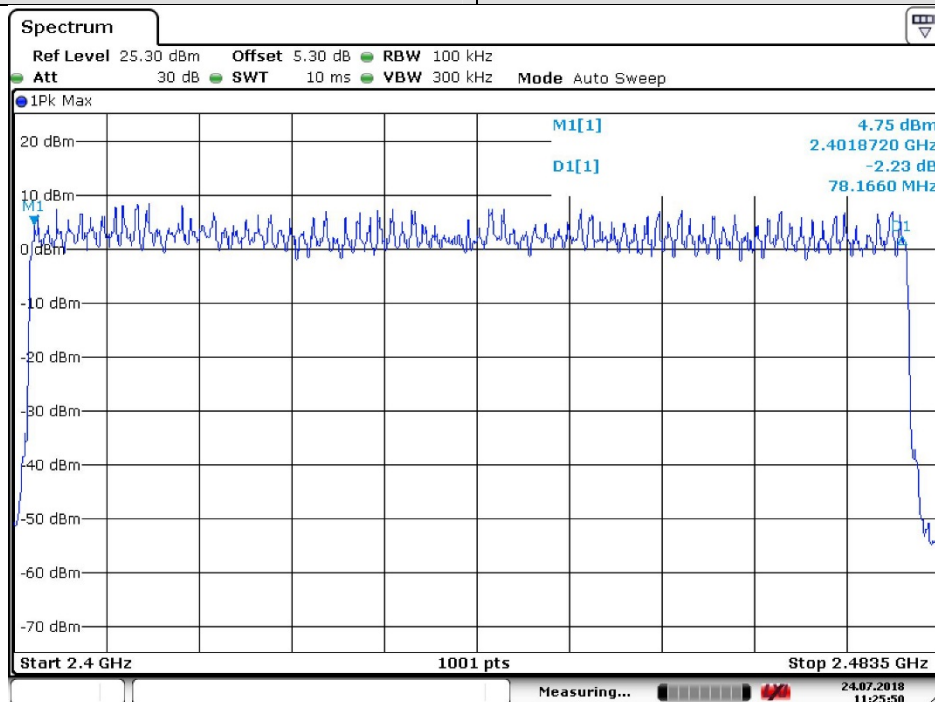


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Test mode:	8DPSK
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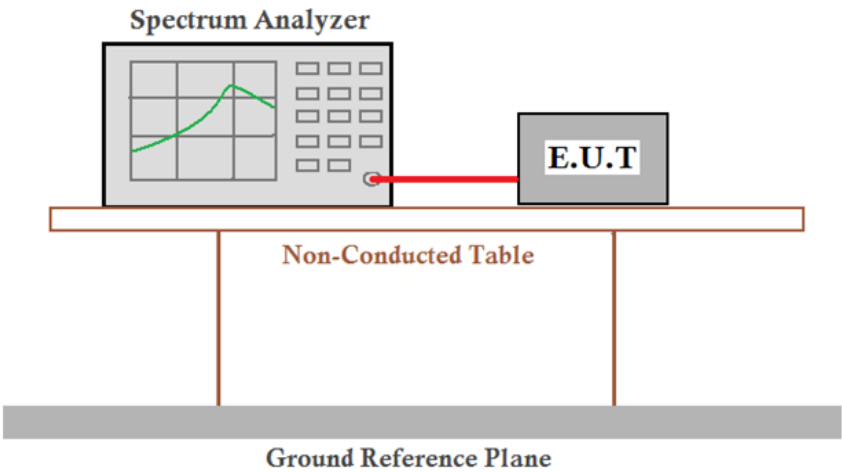


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## 4.7 Dwell Time

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 Section 7.8.4
Test Setup:	
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

### Measurement Data

Operation Modes	On time (ms) on one channel
DH1	0.380
DH3	1.643
DH5	2.902
2DH1	0.392
2DH3	1.652
2DH5	2.897
3DH1	0.392
3DH3	1.652
3DH5	2.892



**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

$400\text{ms} \times 79 \text{ Channel} = 31.6 \text{ s}$  (Time of Occupancy Limit)

Worst case BT has 266.67 hops/second (for 1x/EDR modes with DH5 operation)

$266.67 \text{ hops/second} / 79 \text{ channels} = 3.38 \text{ hops/second}$  (# of hops/second on one channel)

$3.38 \text{ hops/second/channel} \times 31.6 \text{ seconds} = 106.67 \text{ hops}$  (#hops over a 31.6 second period)

$106.67 \text{ hops} \times 2.902 \text{ ms/channel} = 309.56 \text{ ms}$  (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

$400\text{ms} \times 20 \text{ Channel} = 8 \text{ s}$  (Time of Occupancy Limit)

Worst case BT has 133.3 hops/second/slot (for AFH mode with DH5 operation)

$133.3 \text{ hops/second} / 20 \text{ channels} = 6.67 \text{ hops/second}$  (#hops/second on one channel)

$6.67 \text{ hops/second} \times 8 \text{ seconds} = 53.34 \text{ hops}$  (#hops over a 8 seconds period)

$53.34 \text{ hops} \times 2.902 \text{ ms/channel} = 154.79 \text{ ms}$  (worst case dwell time for one channel in AFH mode)



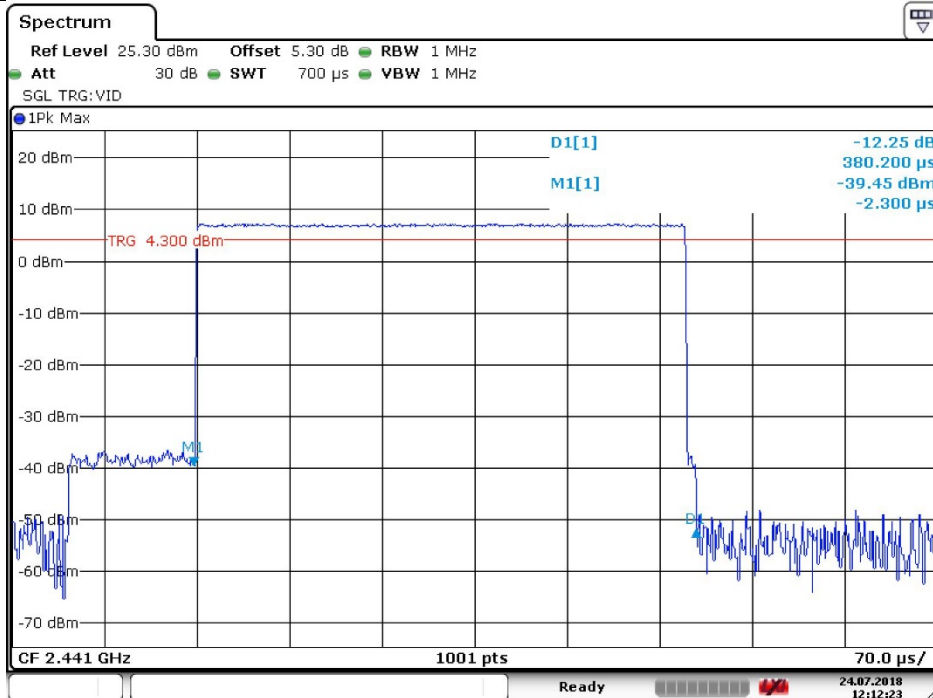
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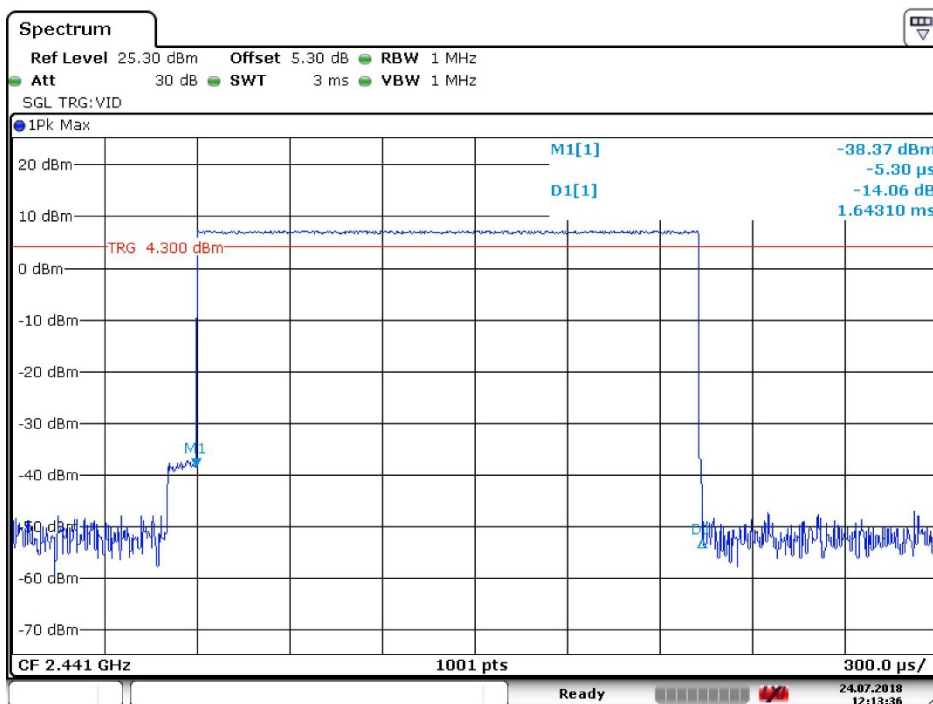
Test plot as follows:

Test Packet:	DH1
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Test Packet:	DH3
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Date: 24.JUL.2018 12:13:37

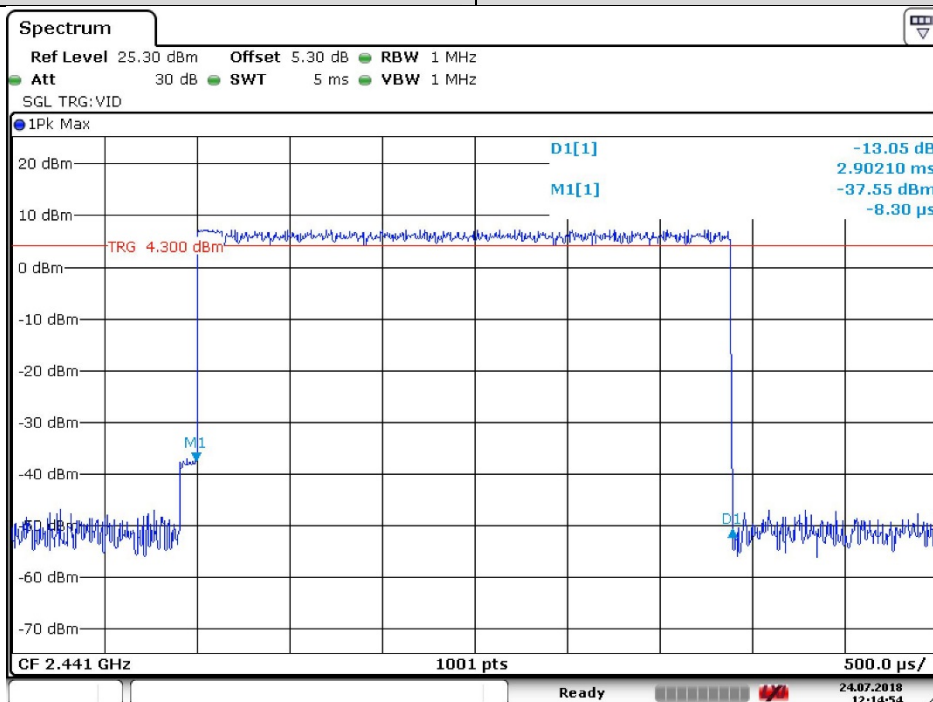


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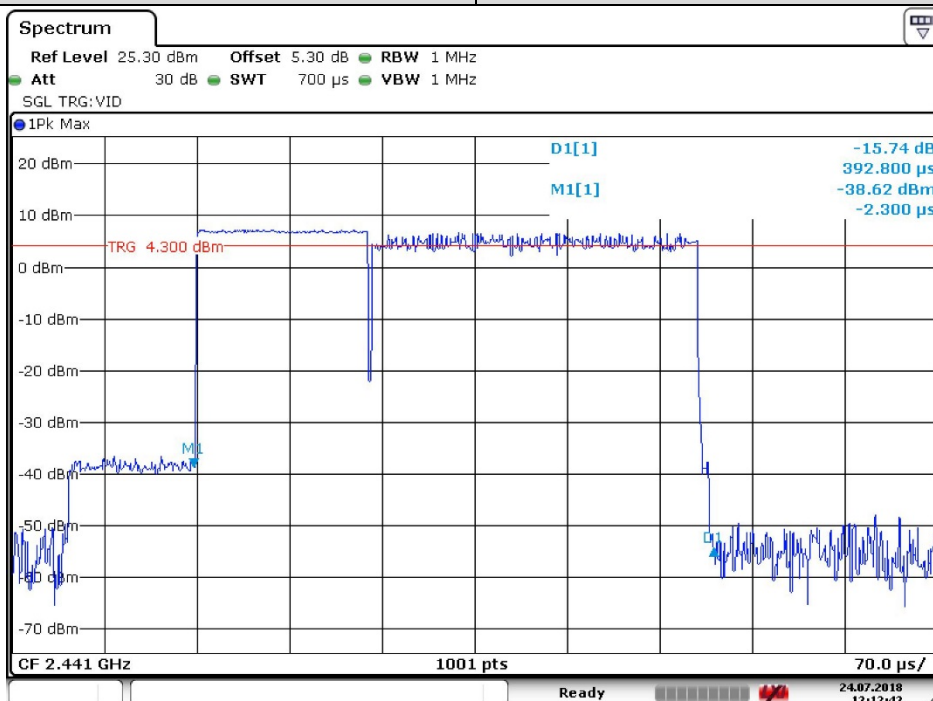
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Test Packet:	DH5
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Date: 24 JUL 2018 12:14:54

Test Packet:	2-DH1
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Date: 24 JUL 2018 12:12:43

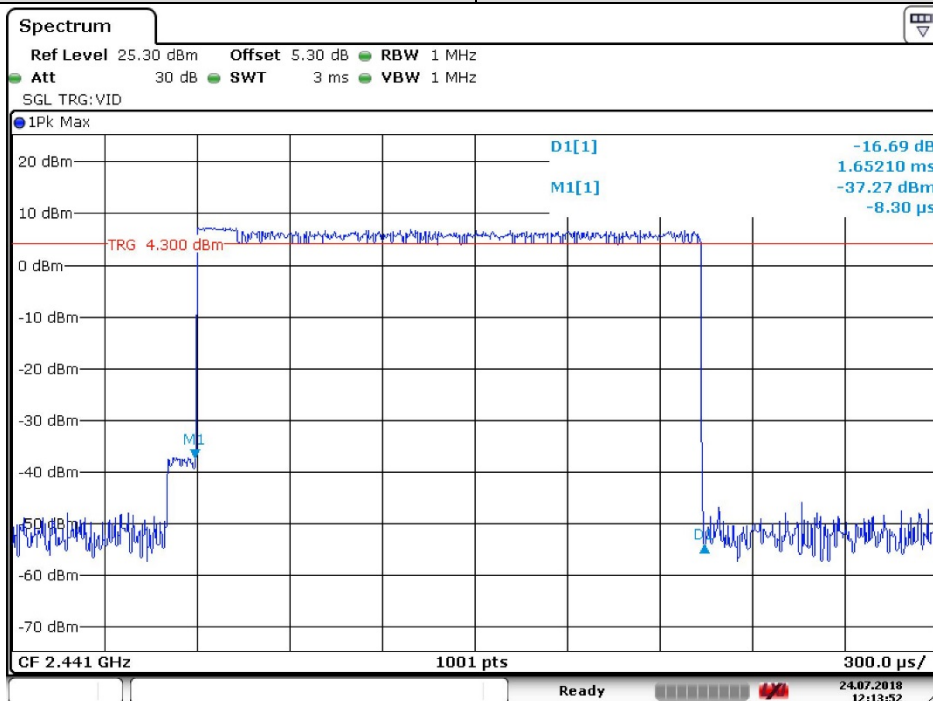


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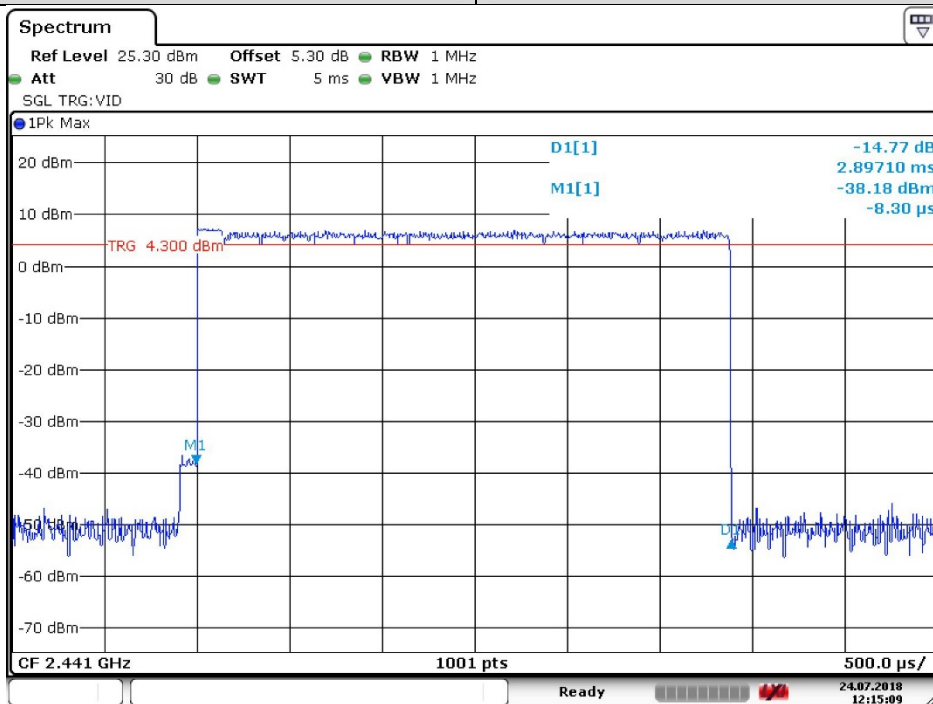
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Test Packet:	2-DH3
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Date: 24 JUL 2018 12:13:53

Test Packet:	2-DH5
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Date: 24 JUL 2018 12:15:09

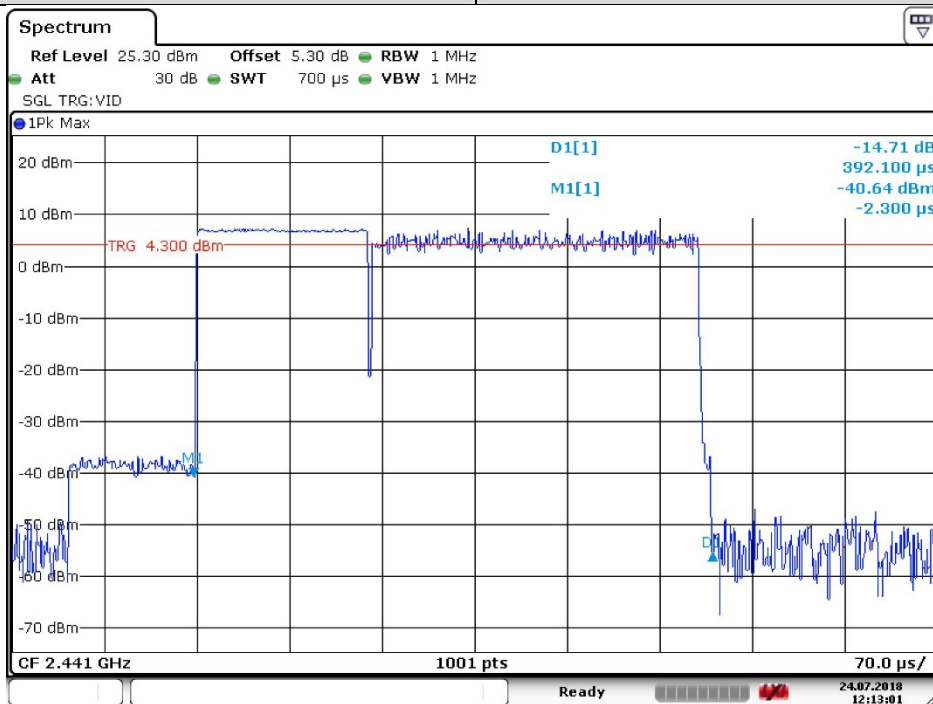


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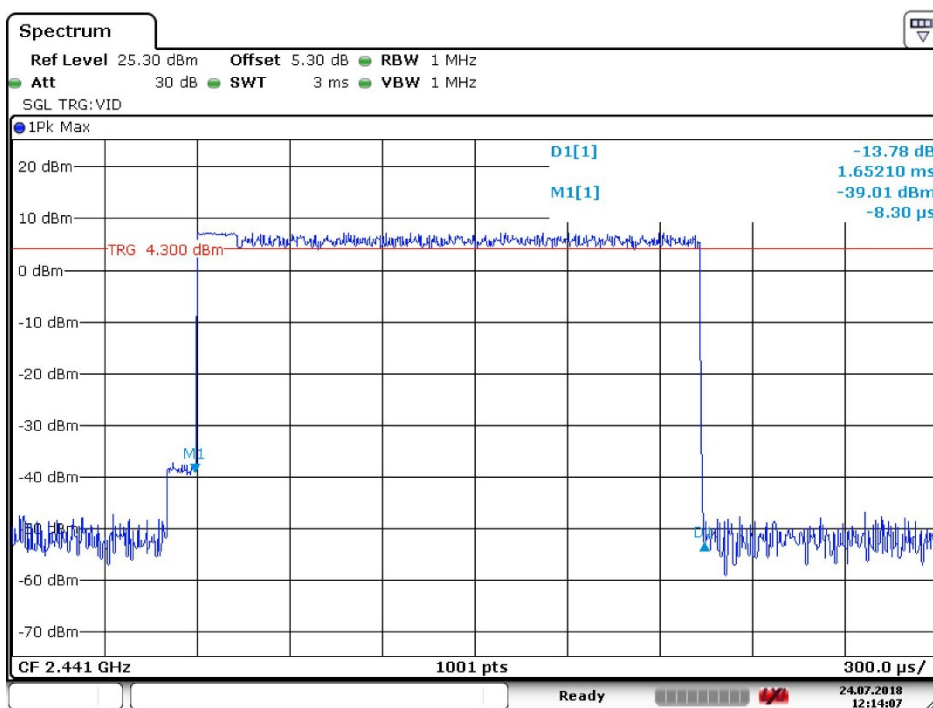
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Test Packet:	3-DH1
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Date: 24.JUL.2018 12:13:01

Test Packet:	3-DH3
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Date: 24.JUL.2018 12:14:07

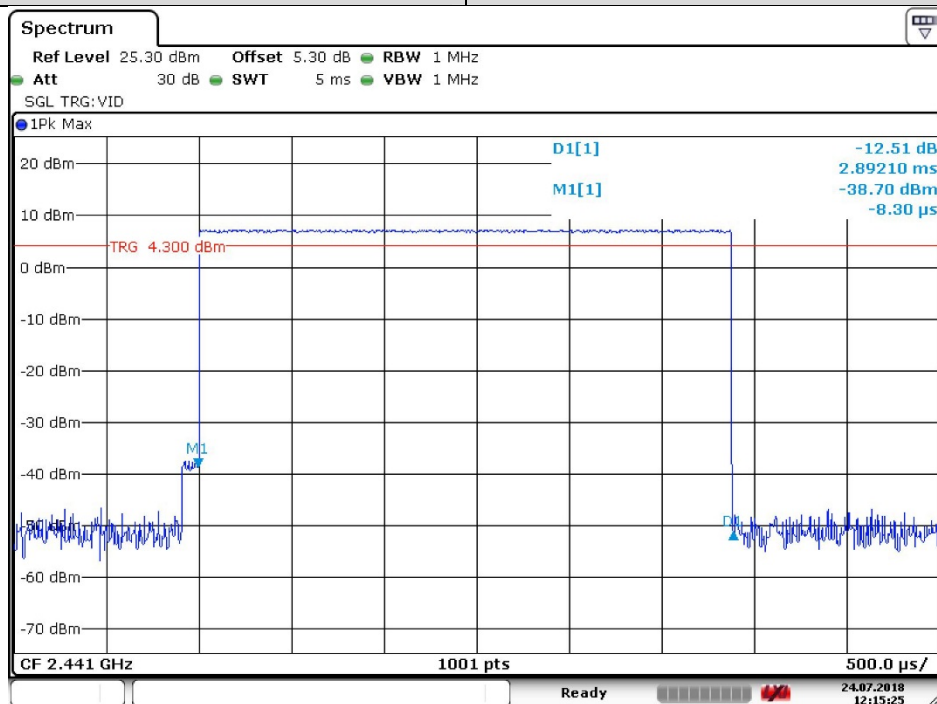


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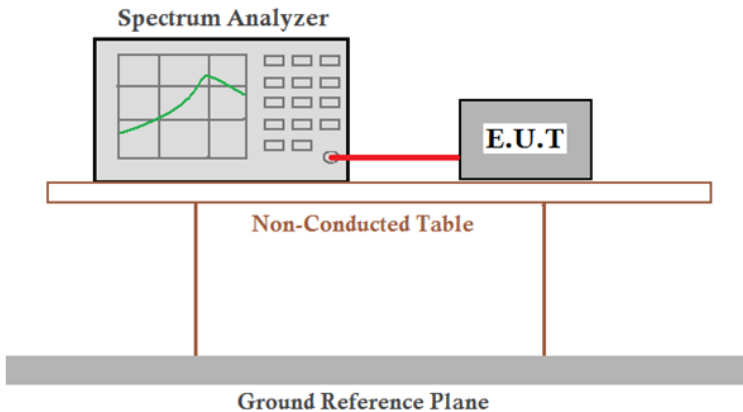
Test Packet:	3-DH5
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Date: 24.JUL.2018 12:15:25



## 4.8 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:	 <p>The diagram illustrates the test setup for RF conducted emissions. A Spectrum Analyzer is connected to an E.U.T. (Equipment Under Test) via a red cable. Both the Spectrum Analyzer and the E.U.T. are placed on a Non-Conducted Table, which is supported by two vertical legs. Below the table is a Ground Reference Plane.</p>
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 DH1 of data type is the worst case of GFSK modulation type, 2-DH1 of data type is the worst case of $\pi/4$ DQPSK modulation type, 3-DH1 of data type is the worst case of 8DPSK modulation type.
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass





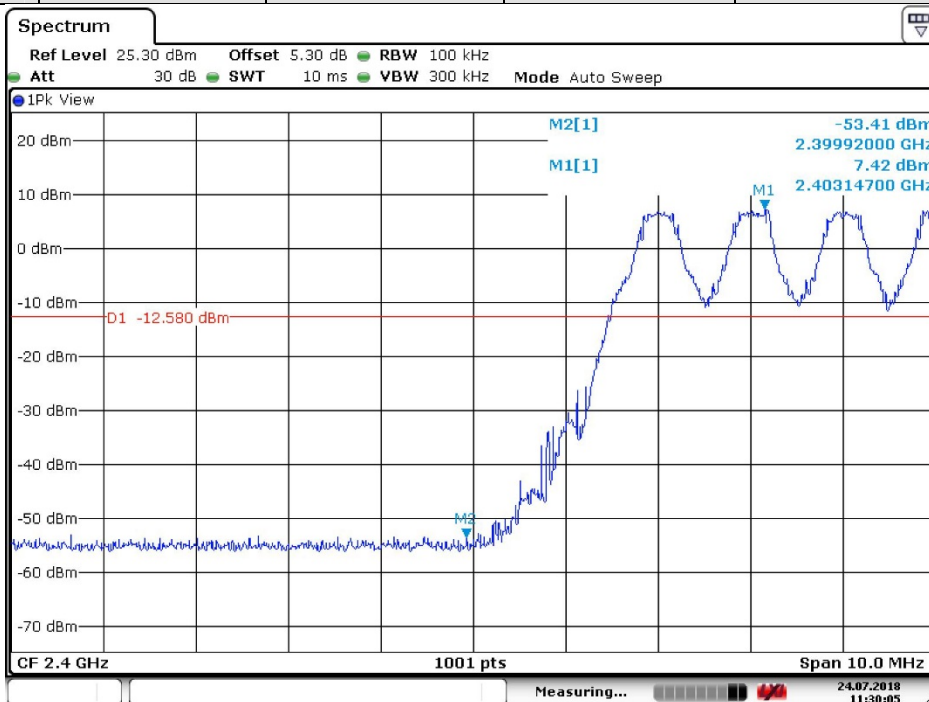
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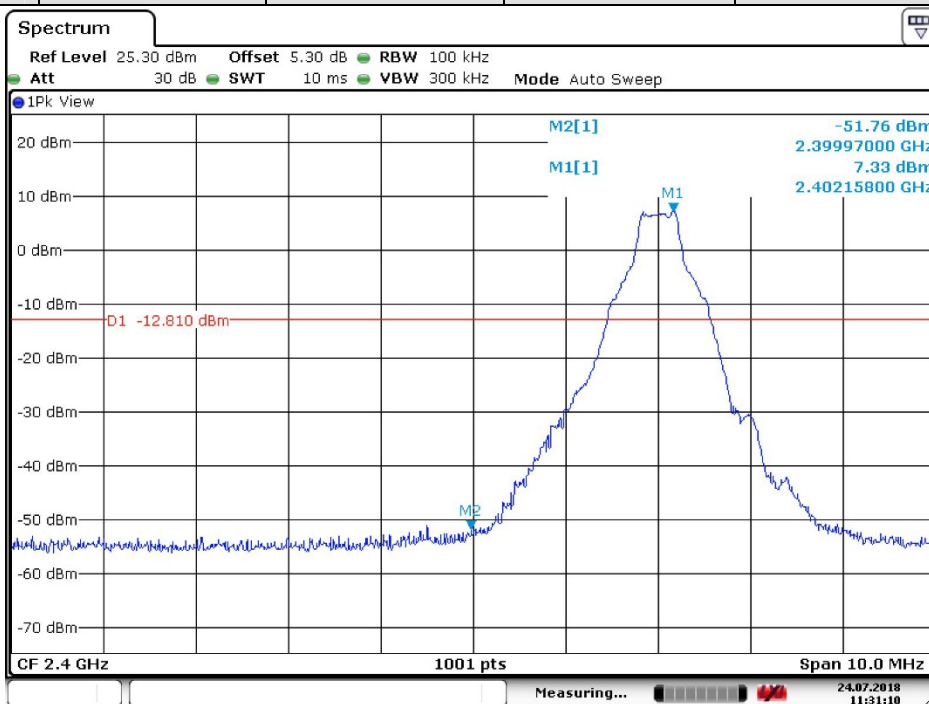
Test plot as follows:

Test mode:	GFSK	Test channel:	Lowest	Hopping	ON
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Date: 24.JUL.2018 11:30:06

Test mode:	GFSK	Test channel:	Lowest	Hopping	OFF
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Date: 24.JUL.2018 11:31:11