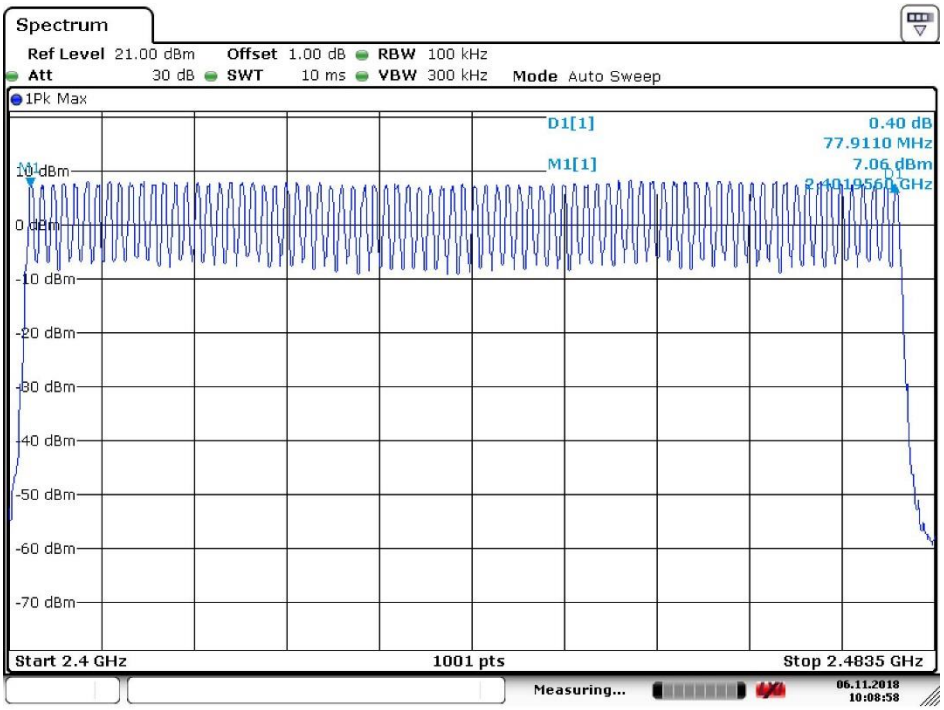
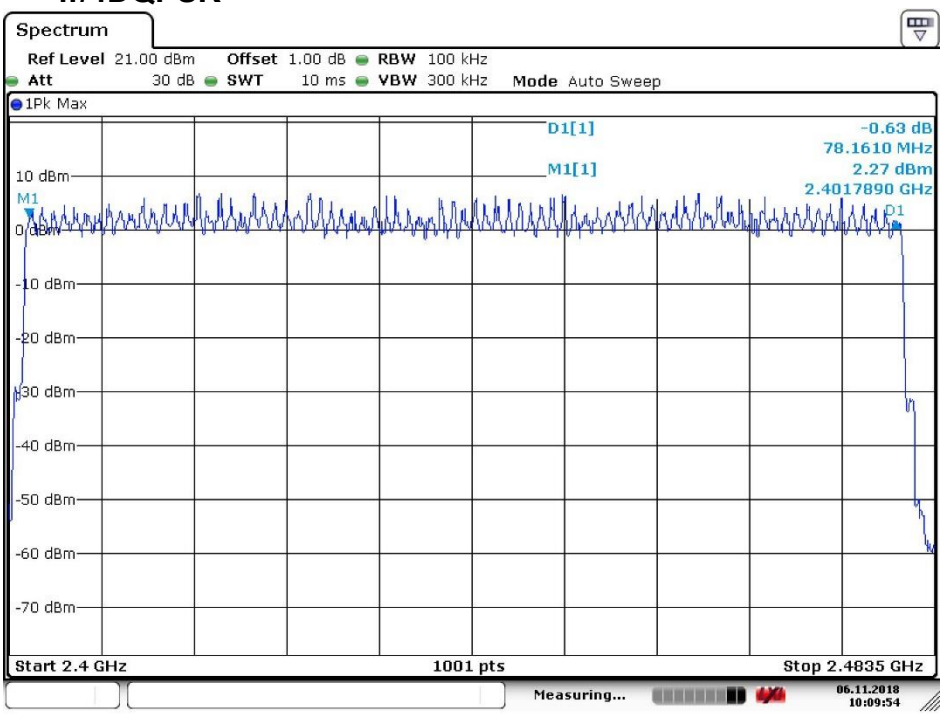
4.6.2 Test plots

4.6.2.1 GFSK



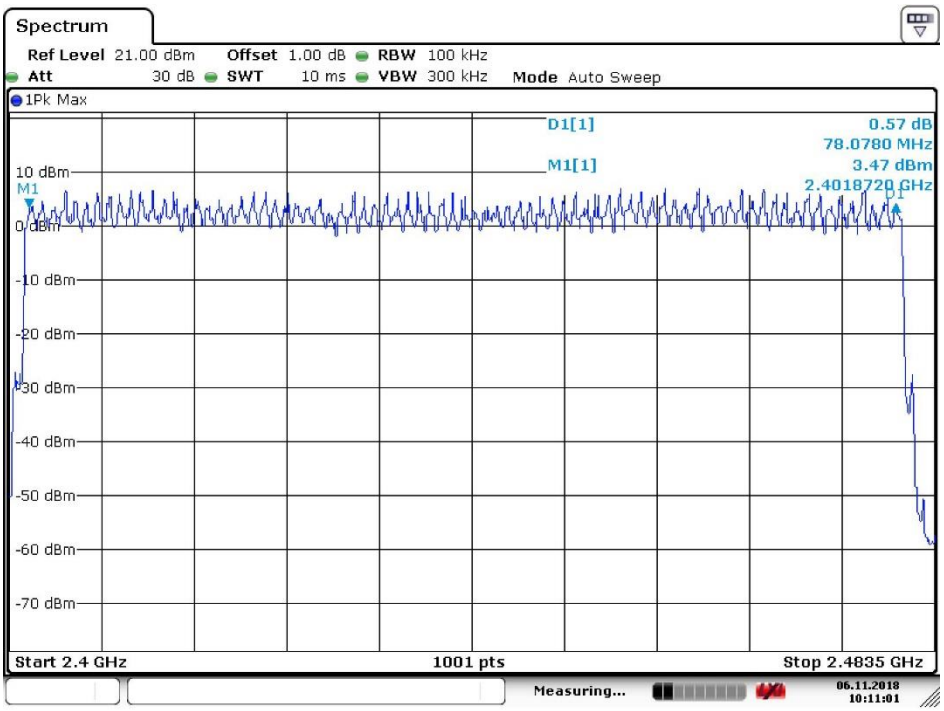
Date: 6.NOV.2018 10:08:59

4.6.2.2 π/4DQPSK



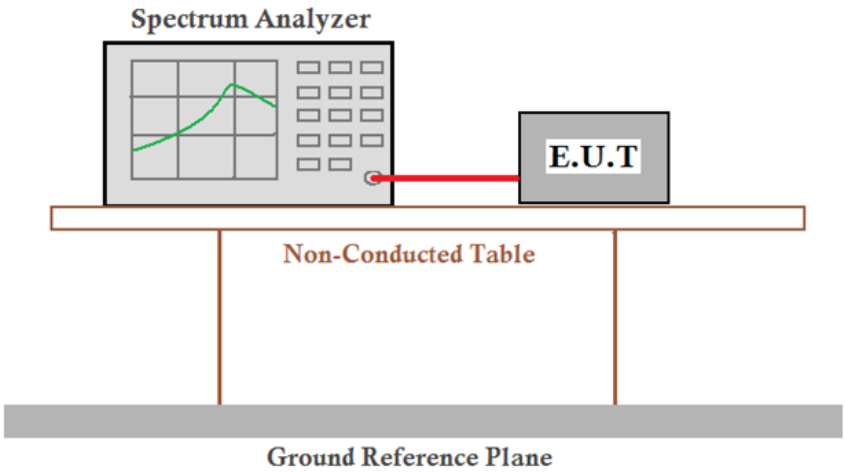
Date: 6.NOV.2018 10:09:54

4.6.2.3 8DPSK



Date: 6.NOV.2018 10:11:01

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

4.7.1 Test Results

Operation Modes	On time（ms）on one channel
DH1	0.389
DH3	1.653
DH5	2.921
2-DH1	0.396
2-DH3	1.667
2-DH5	2.910
3-DH1	0.396
3-DH3	1.656
3-DH5	2.901

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 DH5 operation）

266.67 hops/second/79 channels=3.38 hops/second (# of hops/second on one channel)

3.38 hops/second/channel*31.6seconds=106.67 hops (#hops over a 31.6 second period)

106.67 hops *2.921 ms/channel =311.58 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 DH5 operation)

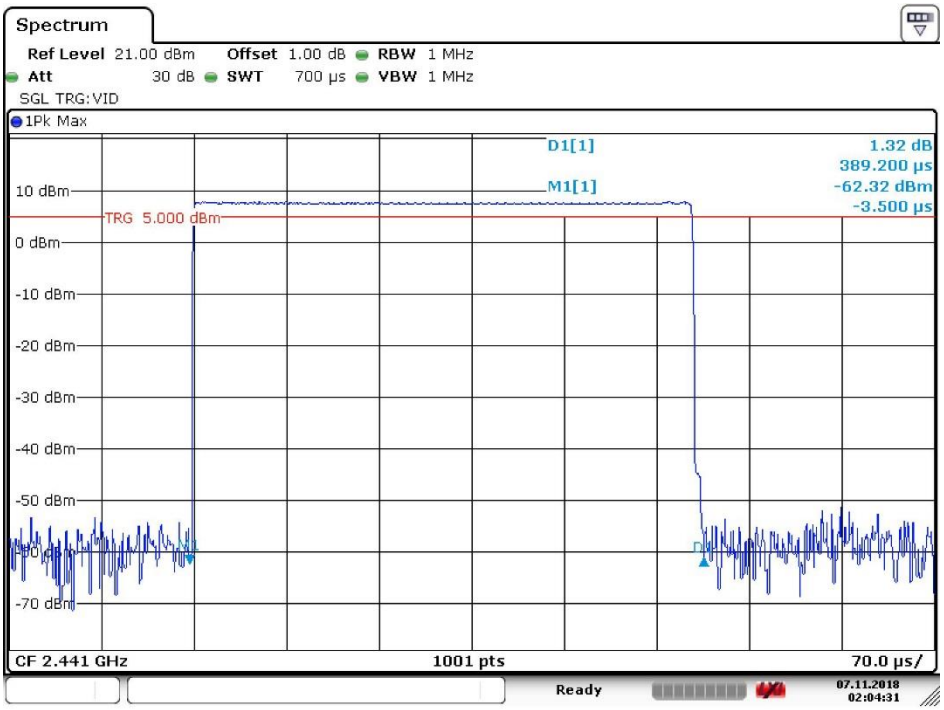
133.3 hops/second/20 channels=6.67 hops/second (#hops/second on one channel)

6.67 hops/second *8seconds=53.34 hops (#hops over a 8 seconds period)

53.34 hops x2.921 ms/channel=155.81 ms(worst case dwell time for one channel in AFH mode)

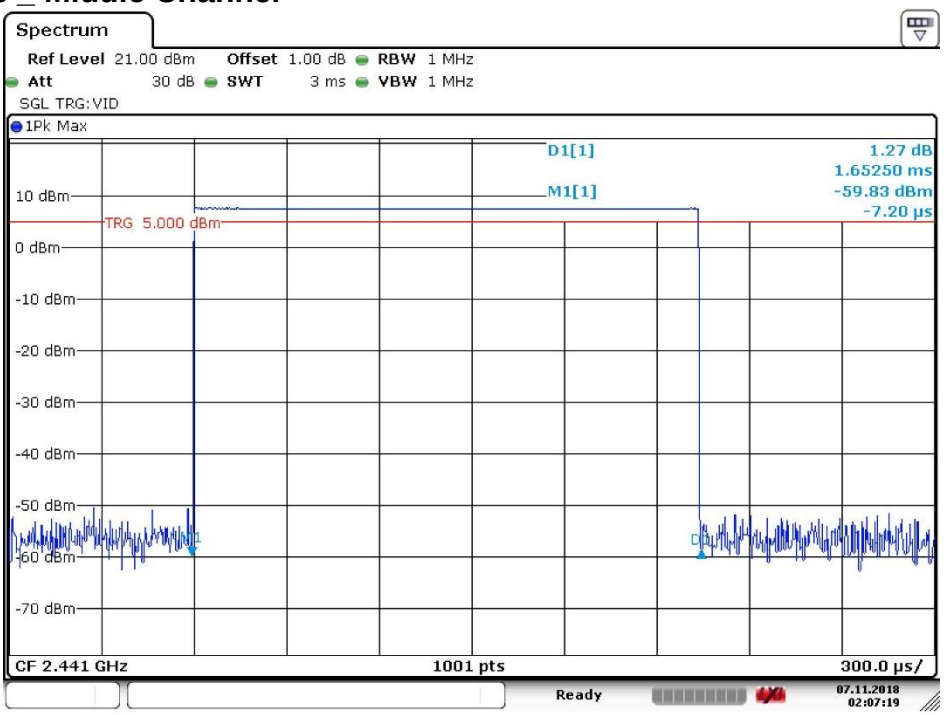
4.7.2 Test plots

4.7.2.1 DH1 _Middle Channel



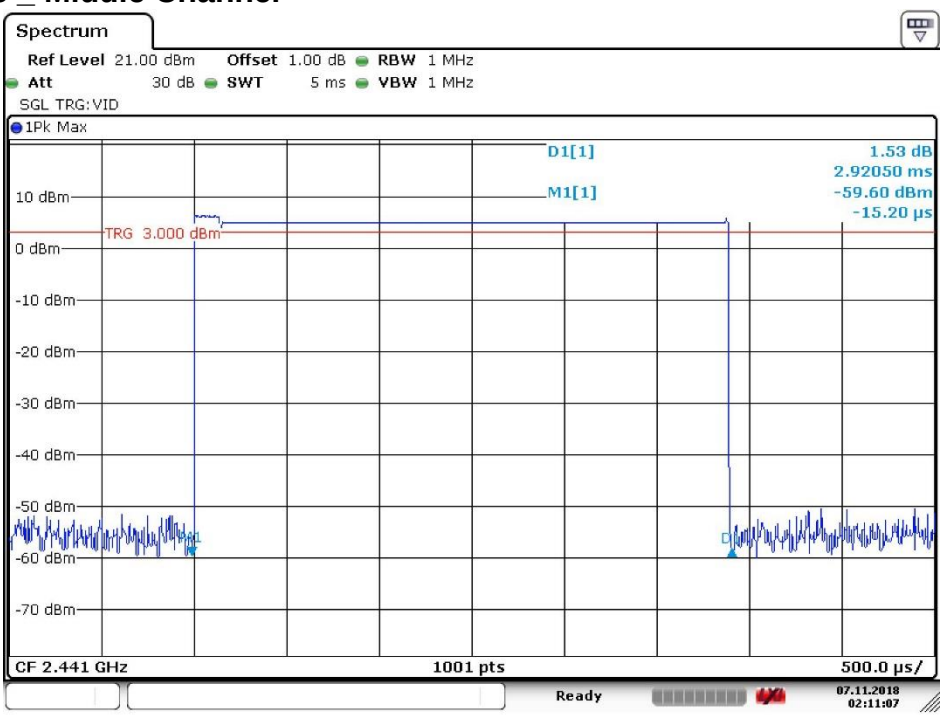
Date: 7.NOV.2018 02:04:32

4.7.2.2 DH3 _ Middle Channel



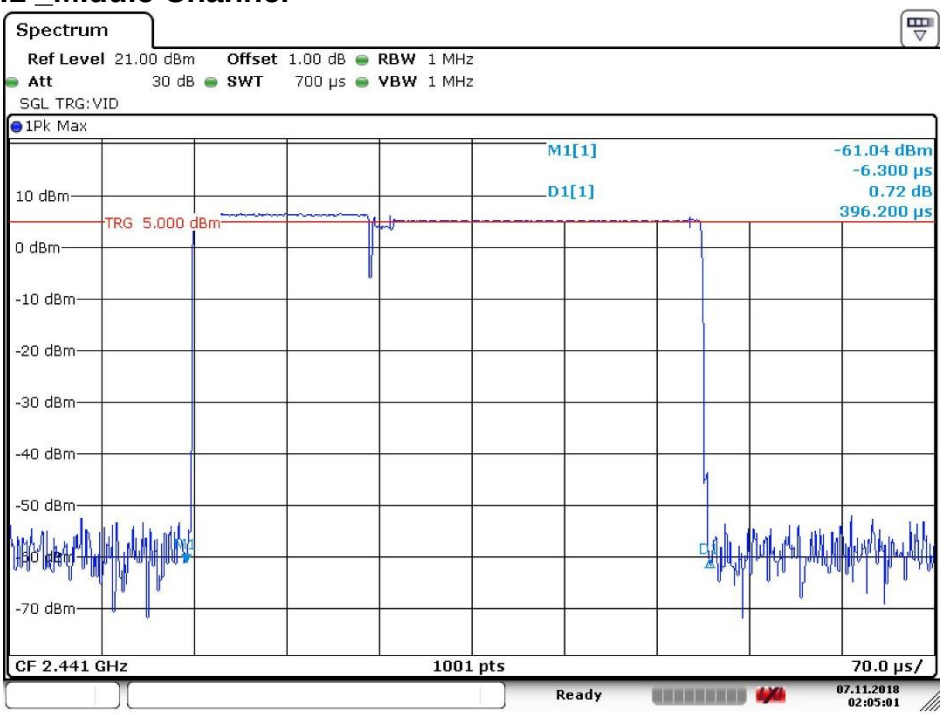
Date: 7.NOV.2018 02:07:20

4.7.2.3 DH5 _ Middle Channel



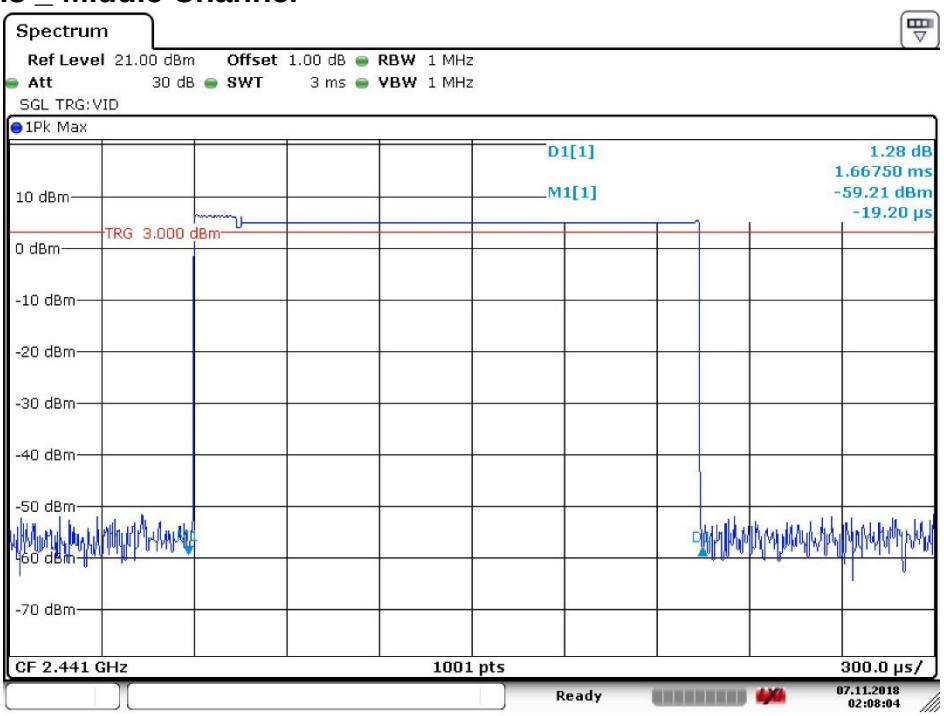
Date: 7.NOV.2018 02:11:07

4.7.2.4 2DH1 _Middle Channel



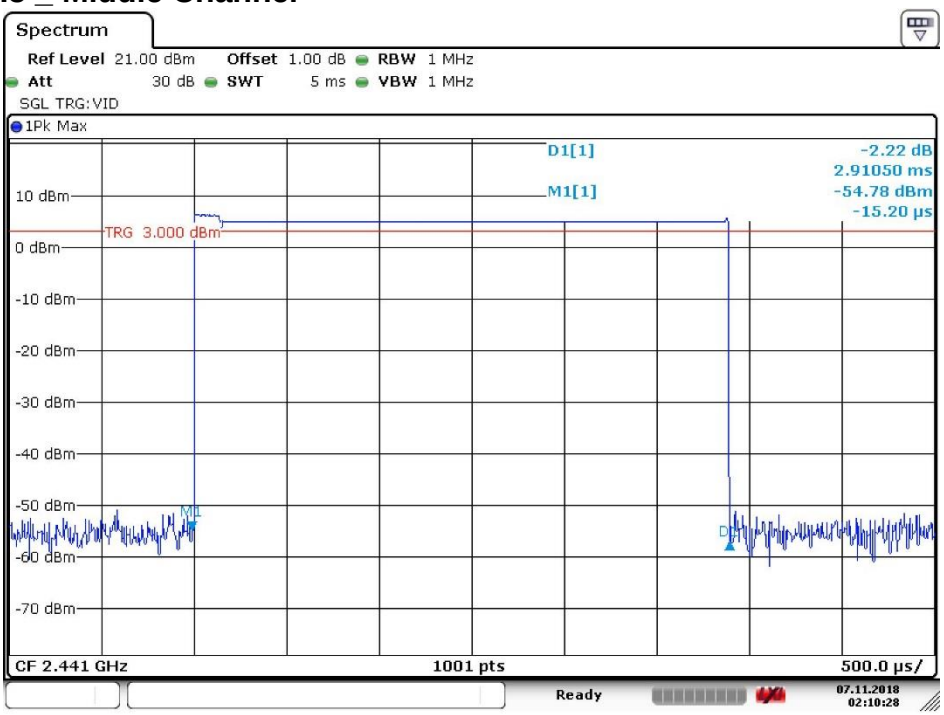
Date: 7.NOV.2018 02:05:02

4.7.2.5 2DH3 _ Middle Channel



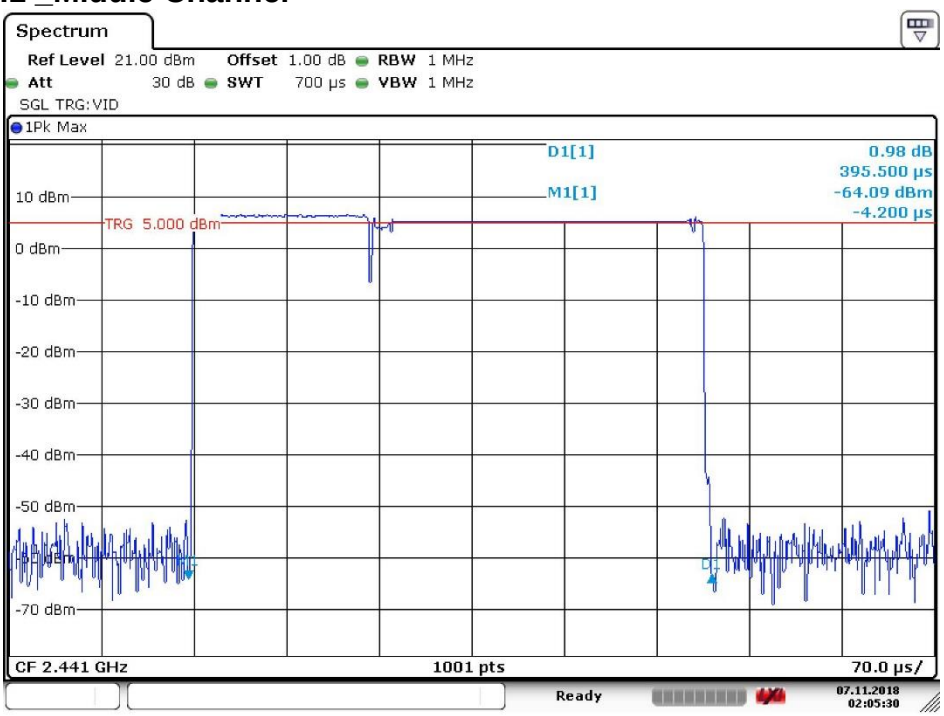
Date: 7.NOV.2018 02:08:05

4.7.2.6 2DH5 _ Middle Channel



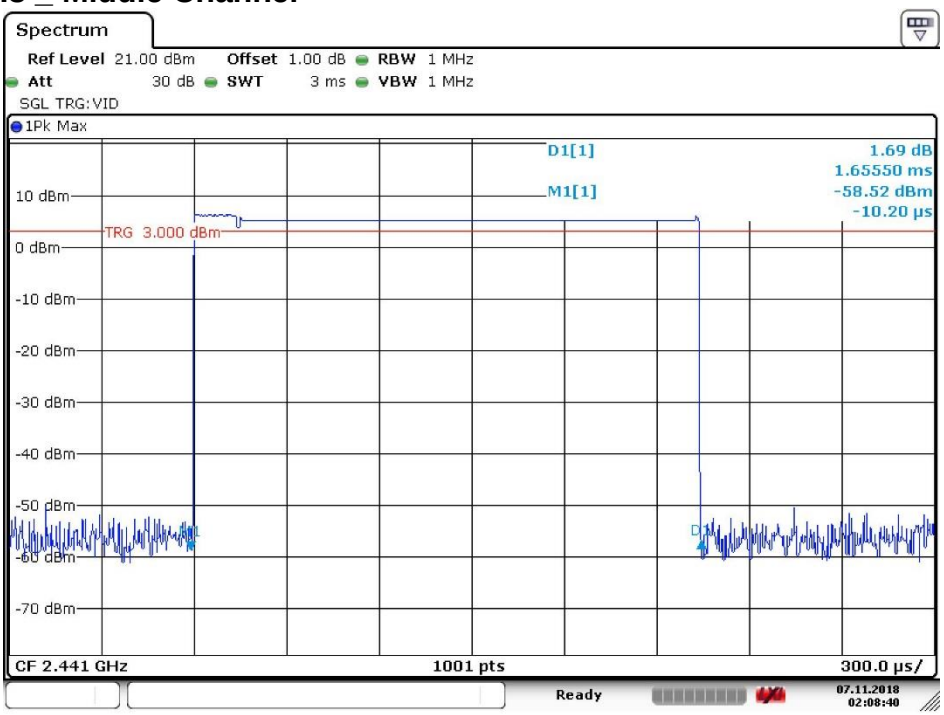
Date: 7.NOV.2018 02:10:29

4.7.2.7 3DH1 _Middle Channel



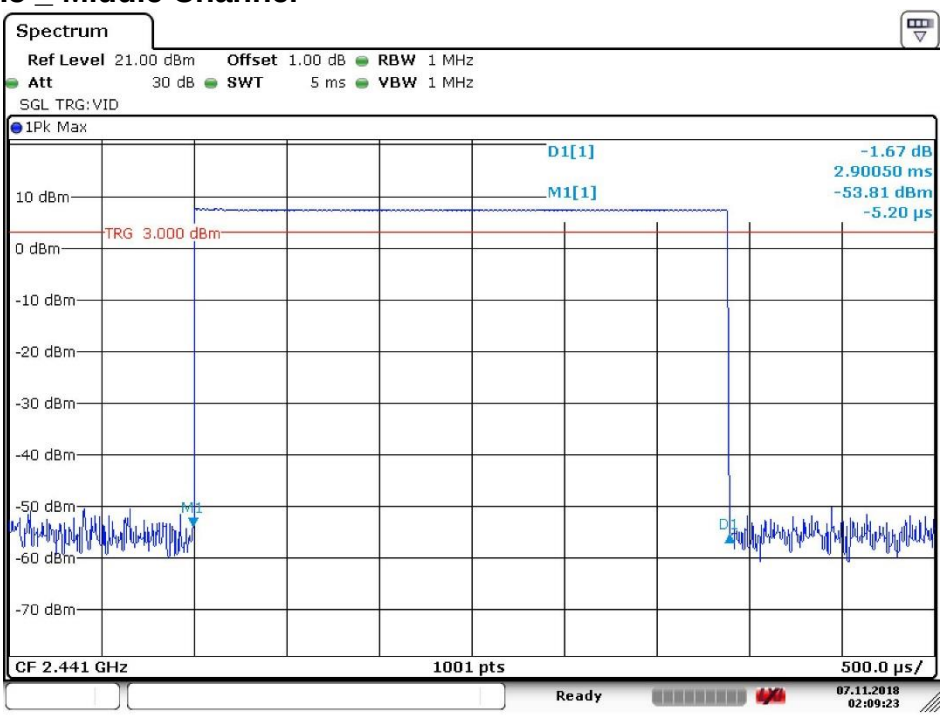
Date: 7.NOV.2018 02:05:31

4.7.2.8 3DH3 _ Middle Channel



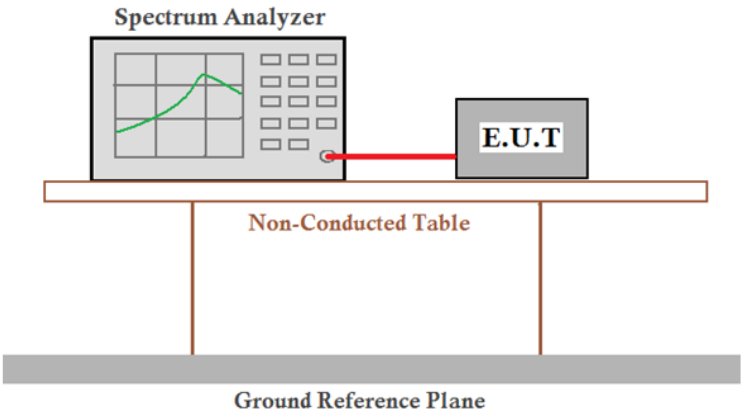
Date: 7.NOV.2018 02:08:39

4.7.2.9 3DH5 _ Middle Channel



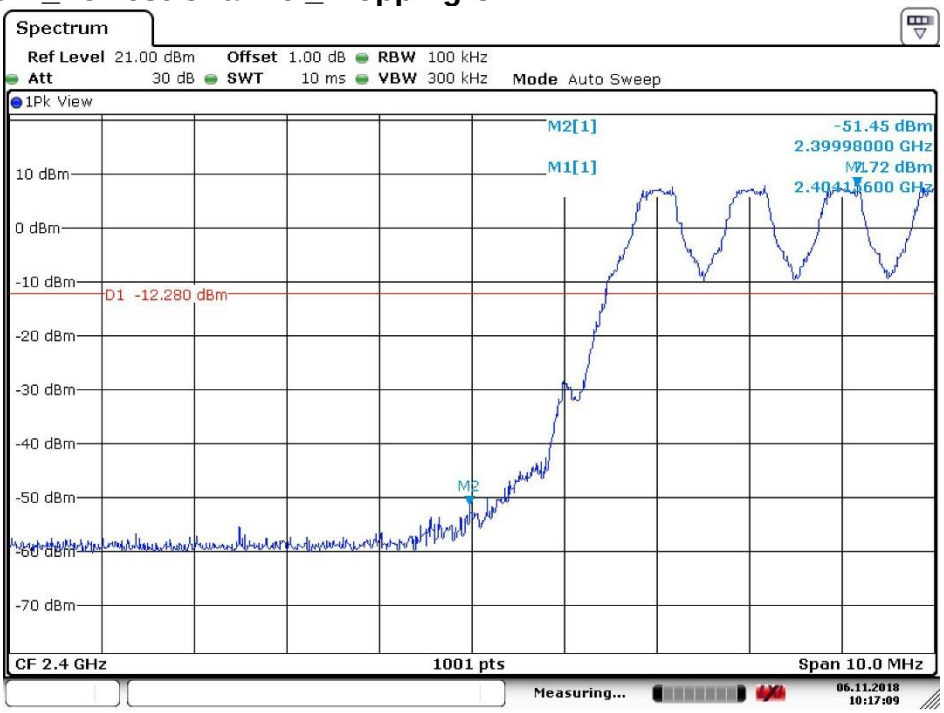
Date: 7.NOV.2018 02:09:24

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:	
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 π/4DQPSK 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

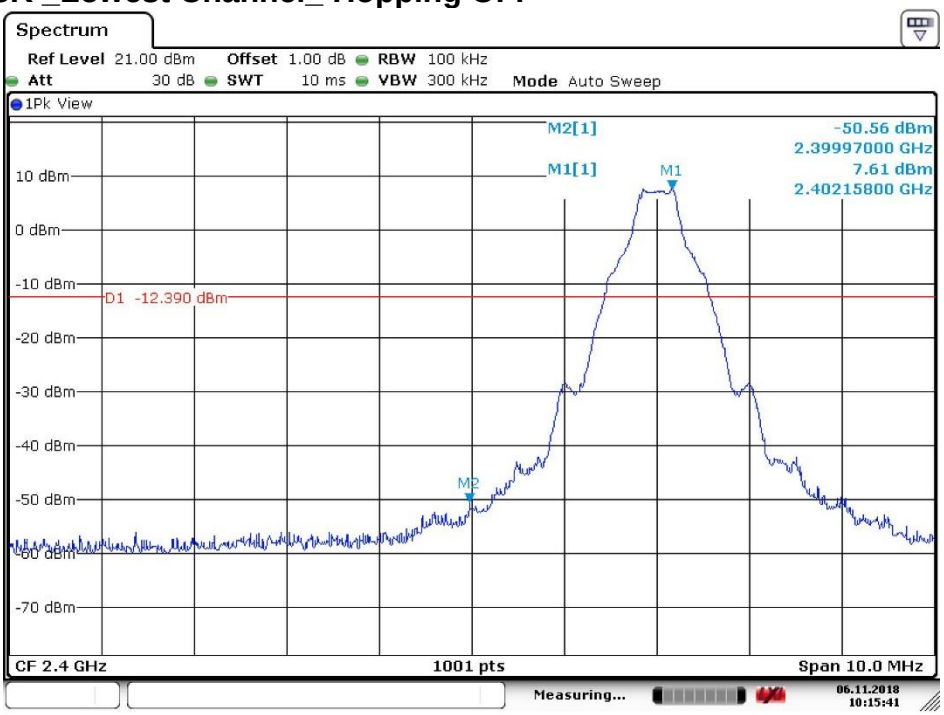
4.8.1 Test plots

4.8.1.1 GFSK _Lowest Channel_ Hopping ON



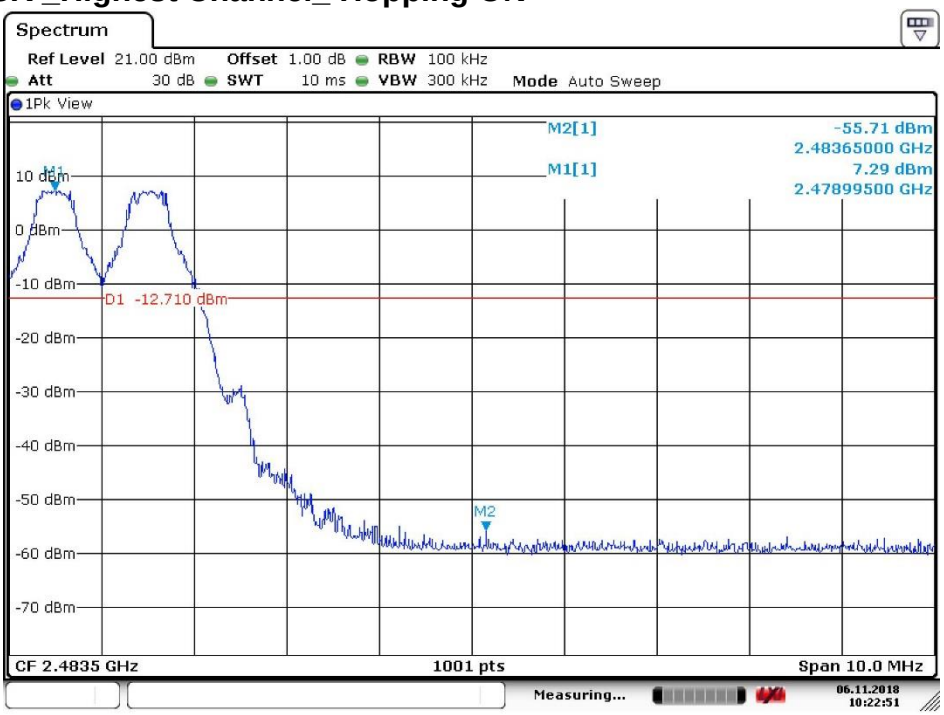
Date: 6.NOV.2018 10:17:10

4.8.1.2 GFSK _Lowest Channel_ Hopping OFF



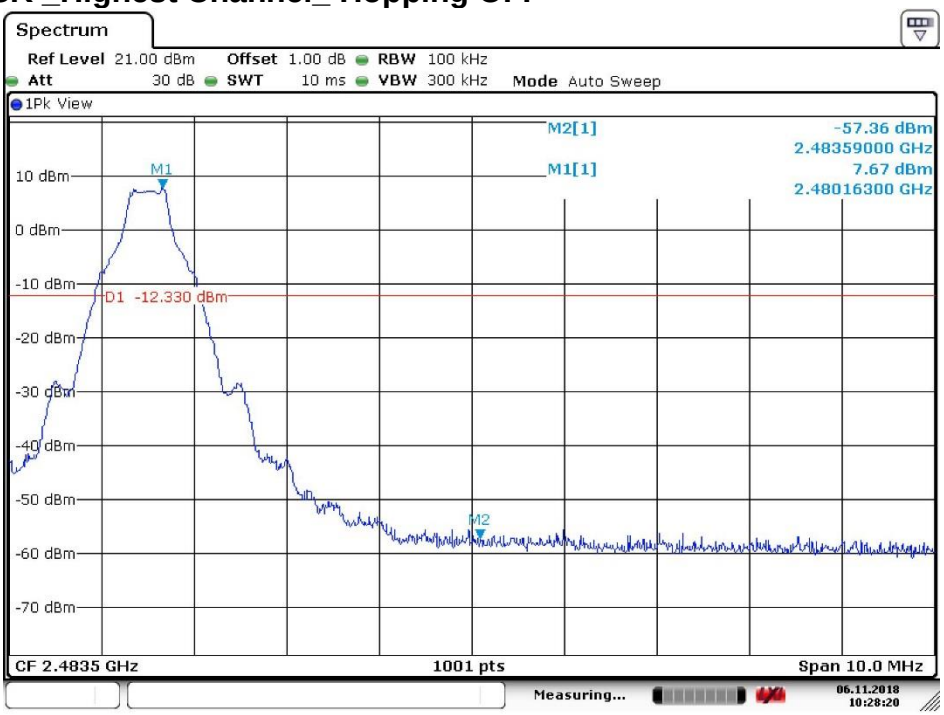
Date: 6.NOV.2018 10:15:41

4.8.1.3 GFSK _Highest Channel_ Hopping ON



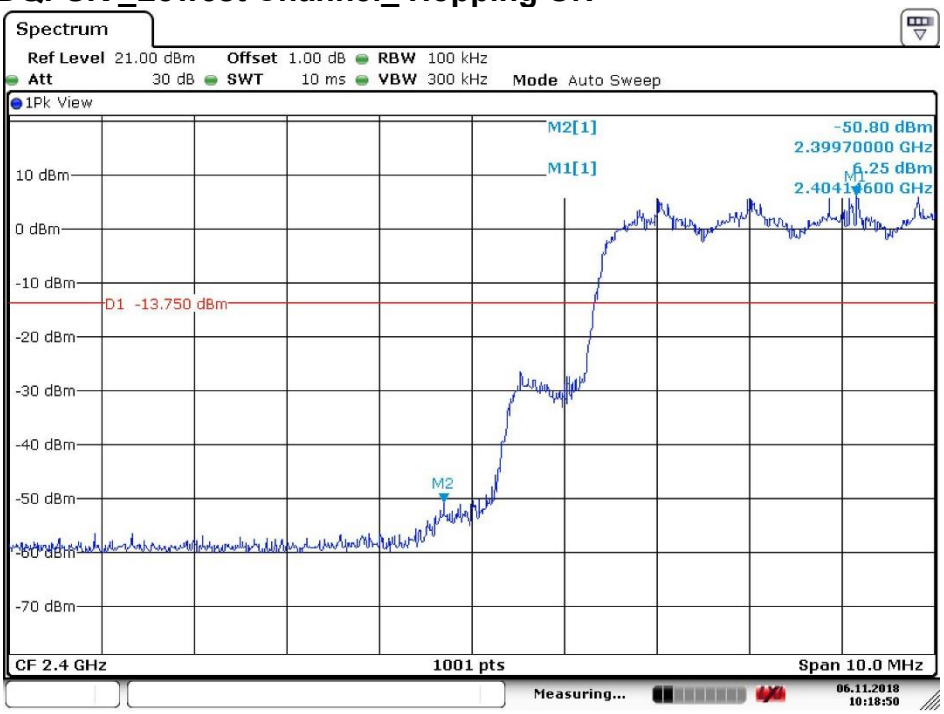
Date: 6.NOV.2018 10:22:51

4.8.1.4 GFSK _Highest Channel_ Hopping OFF



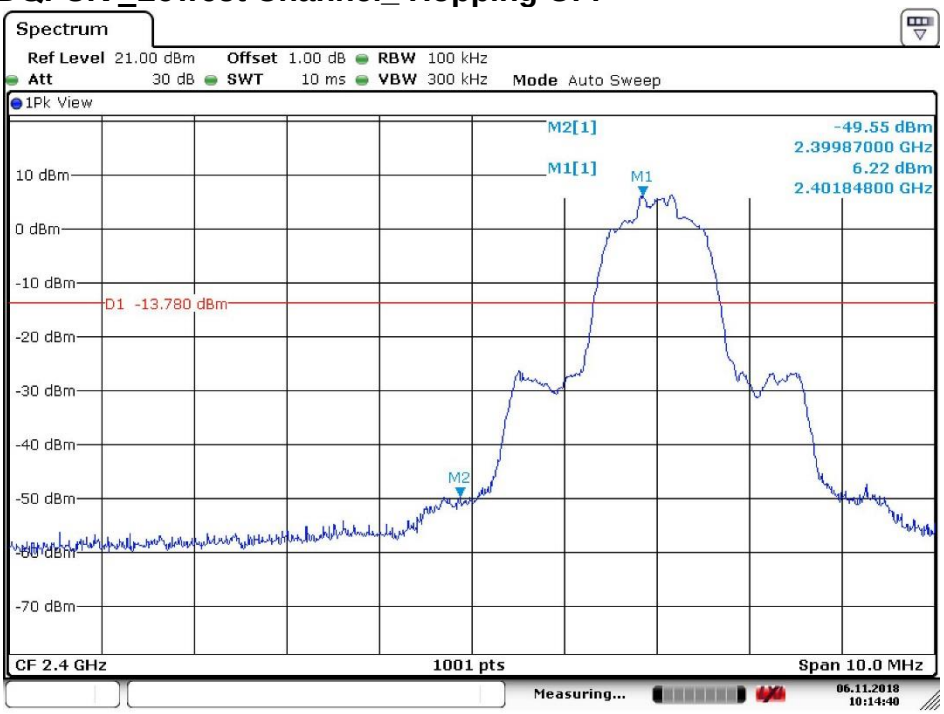
Date: 6.NOV.2018 10:28:21

4.8.1.5 π/4DQPSK _Lowest Channel_ Hopping ON



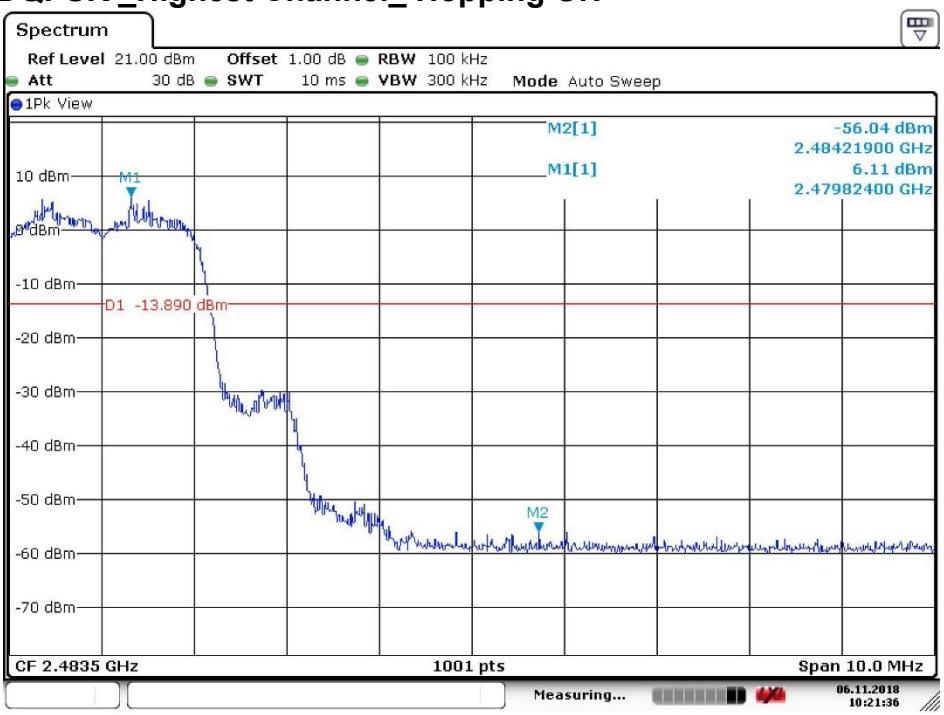
Date: 6.NOV.2018 10:18:50

4.8.1.6 π/4DQPSK _Lowest Channel_ Hopping OFF



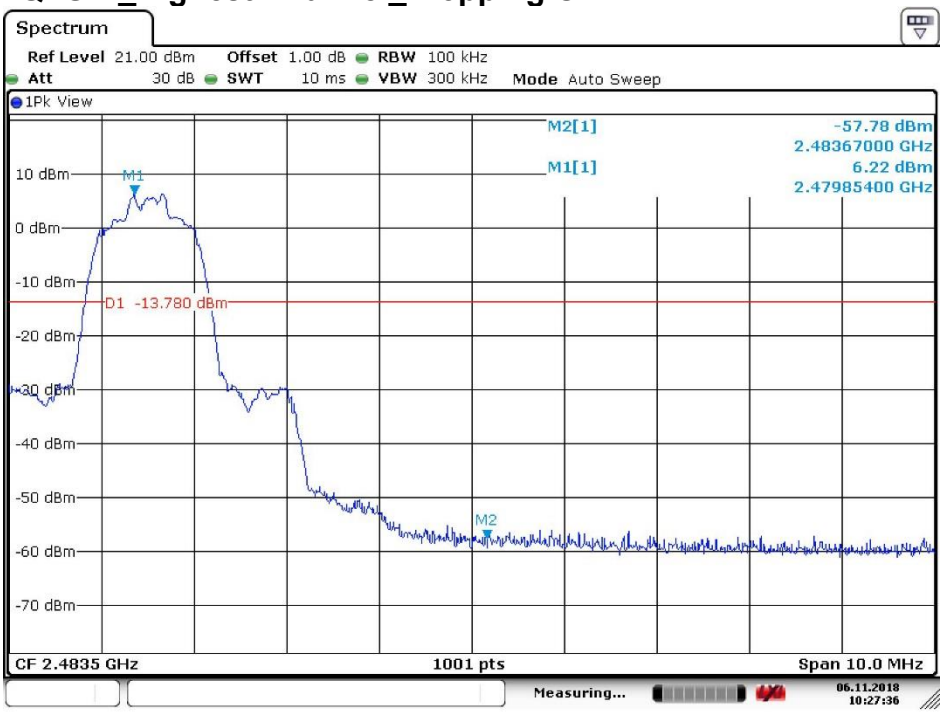
Date: 6.NOV.2018 10:14:40

4.8.1.7 π/4DQPSK _Highest Channel_ Hopping ON



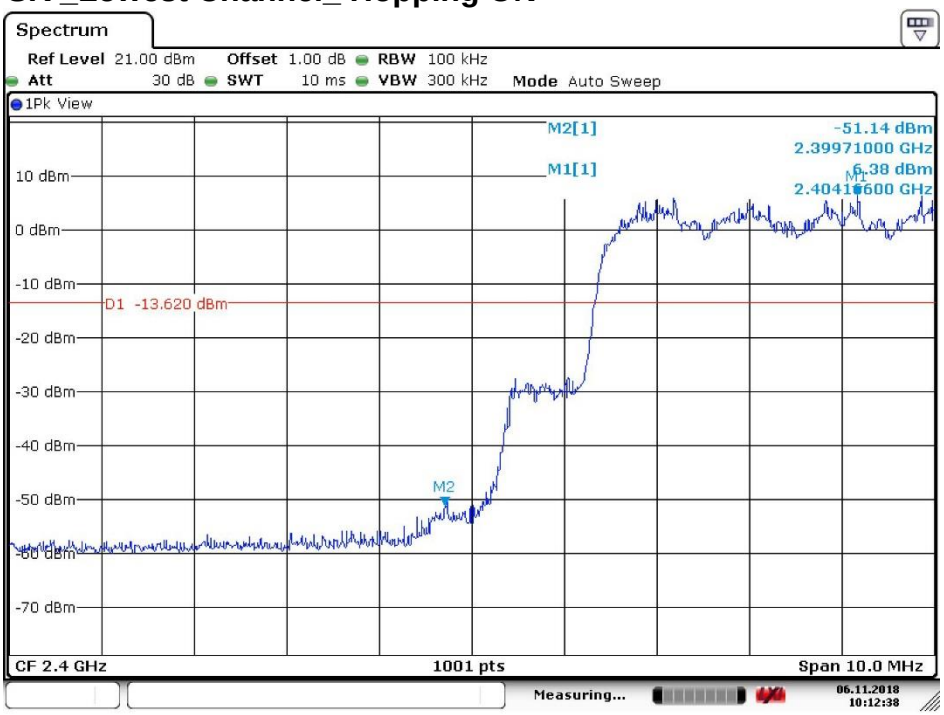
Date: 6.NOV.2018 10:21:36

4.8.1.8 π/4DQPSK _Highest Channel_ Hopping OFF



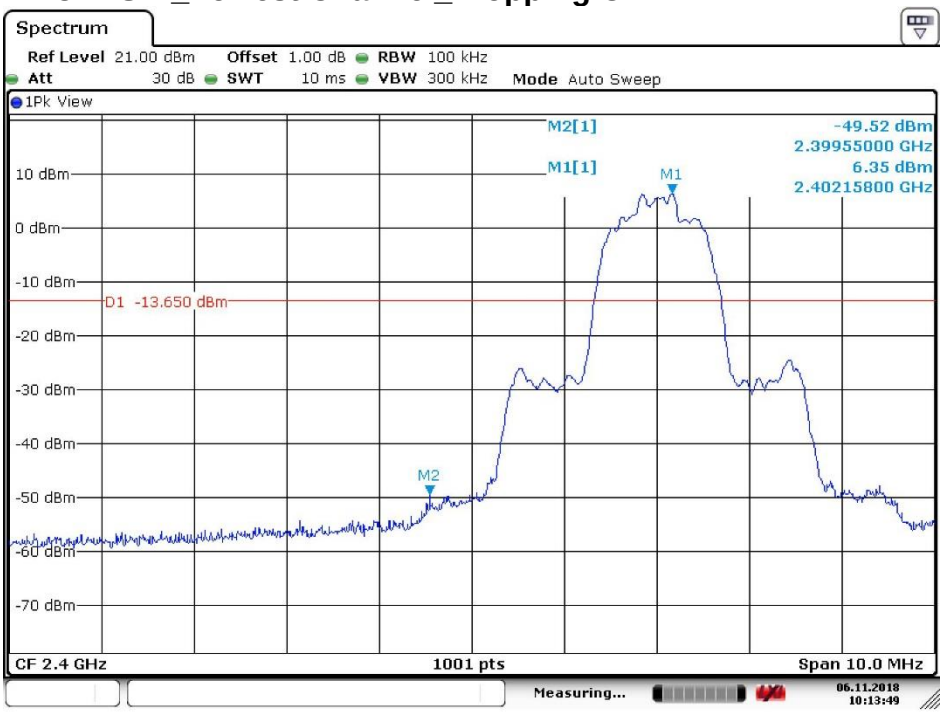
Date: 6.NOV.2018 10:27:36

4.8.1.9 8DPSK _Lowest Channel_ Hopping ON



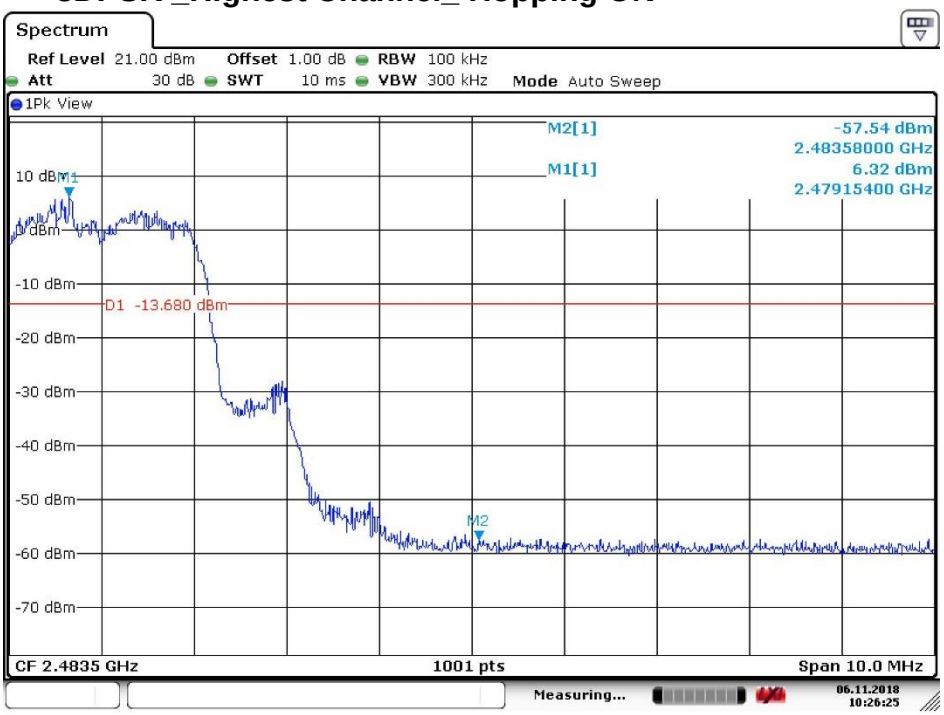
Date: 6.NOV.2018 10:12:39

4.8.1.10 8DPSK _Lowest Channel_ Hopping OFF



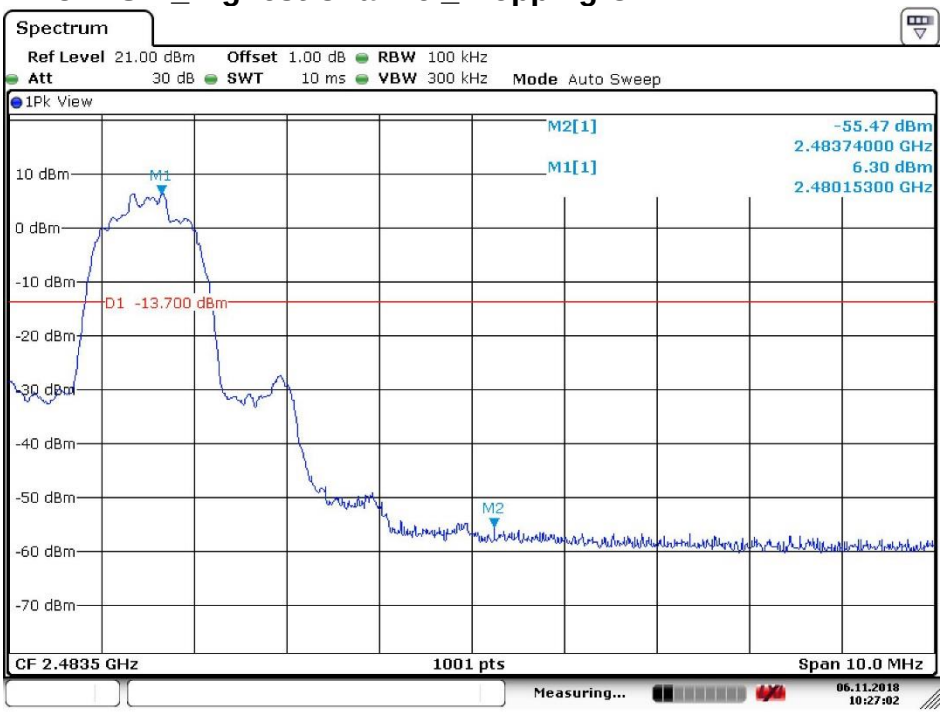
Date: 6.NOV.2018 10:13:49

4.8.1.11 8DPSK _Highest Channel_ Hopping ON



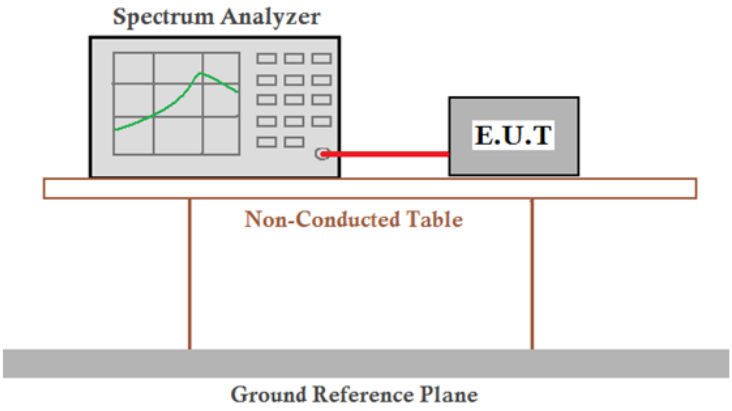
Date: 6.NOV.2018 10:26:25

4.8.1.12 8DPSK _Highest Channel_ Hopping OFF



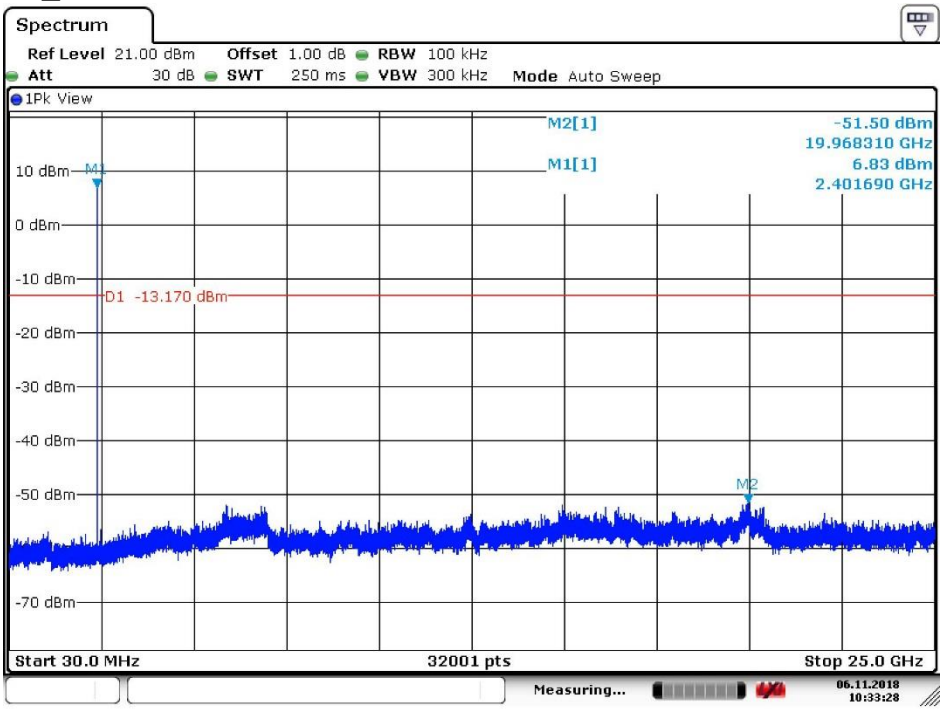
Date: 6.NOV.2018 10:27:02

4.9 Spurious RF Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10:2013 Section 7.8.8
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:	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 π/4DQPSK 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

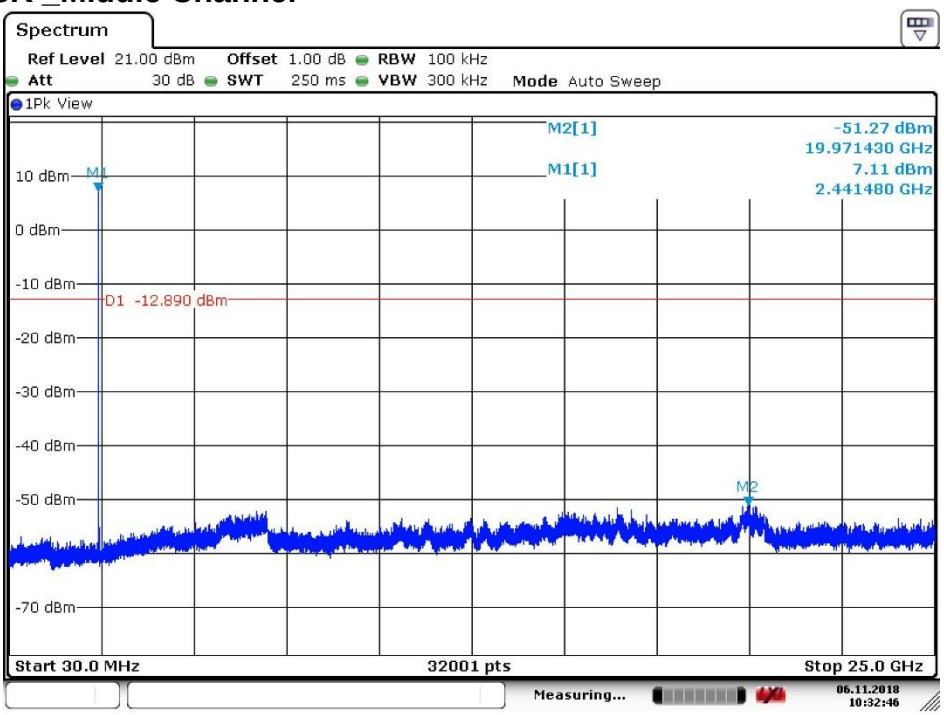
4.9.1 Test plots

4.9.1.1 GFSK _Lowest Channel



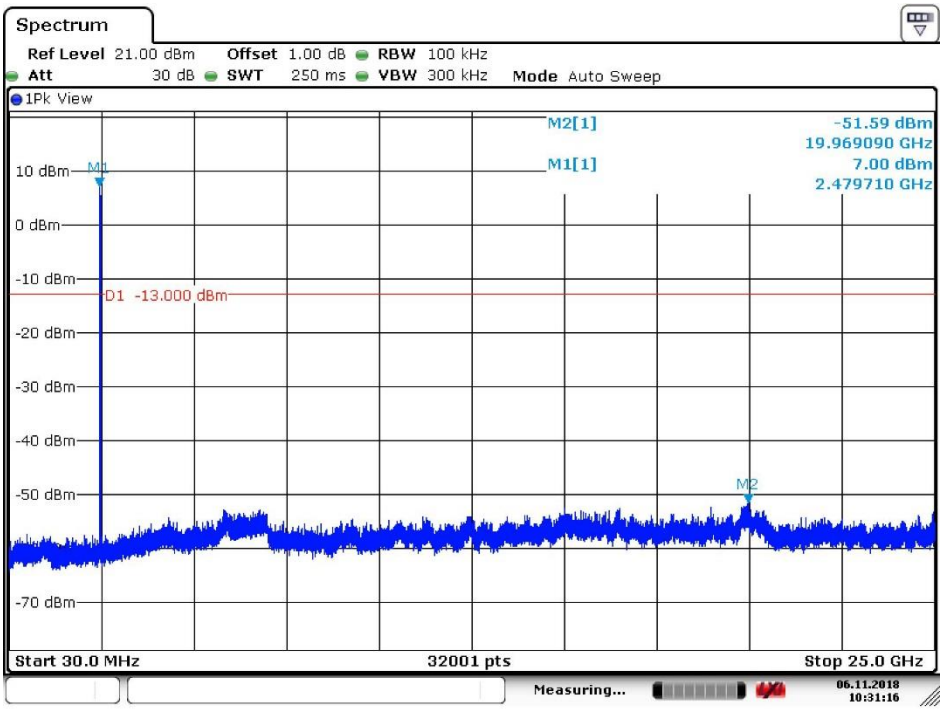
Date: 6.NOV.2018 10:33:28

4.9.1.2 GFSK _Middle Channel



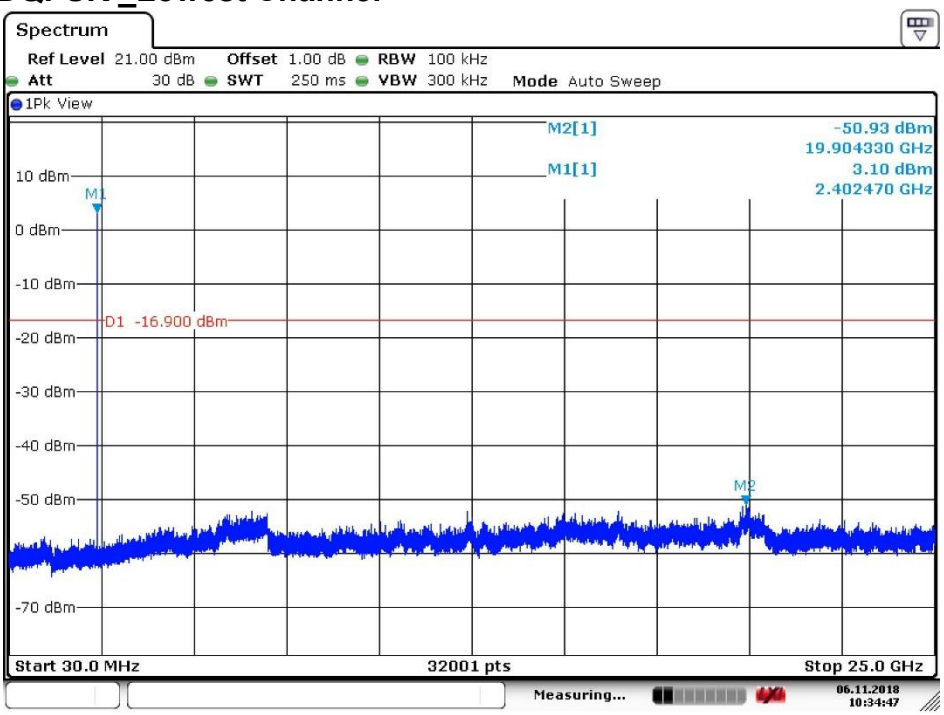
Date: 6.NOV.2018 10:32:47

4.9.1.3 GFSK _Highest Channel



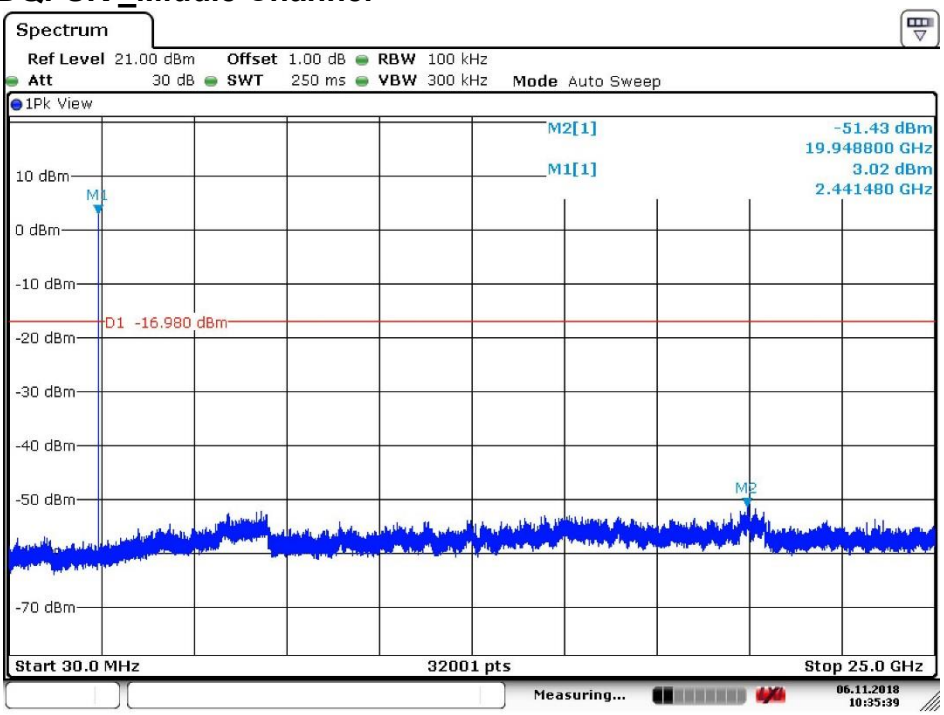
Date: 6.NOV.2018 10:31:16

4.9.1.4 π/4DQPSK _Lowest Channel



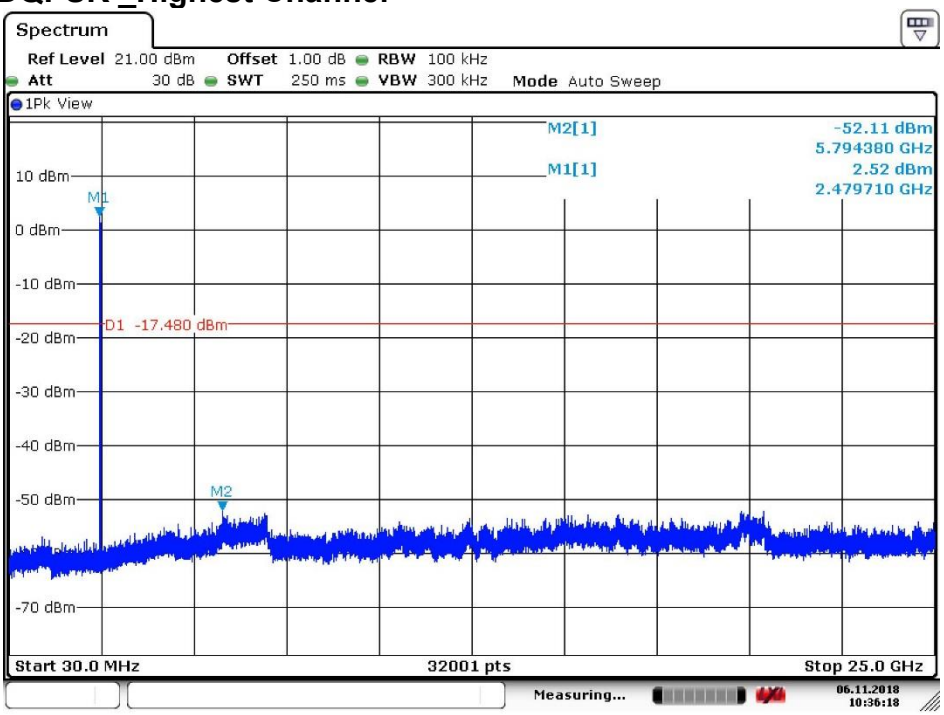
Date: 6.NOV.2018 10:34:47

4.9.1.5 π/4DQPSK _Middle Channel



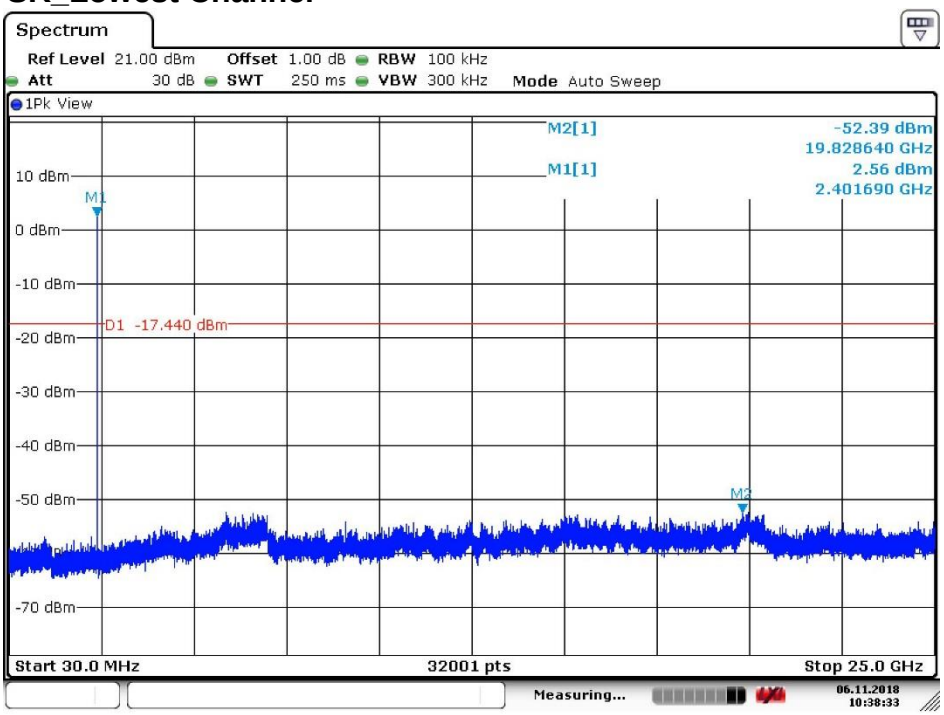
Date: 6.NOV.2018 10:35:40

4.9.1.6 π/4DQPSK _Highest Channel



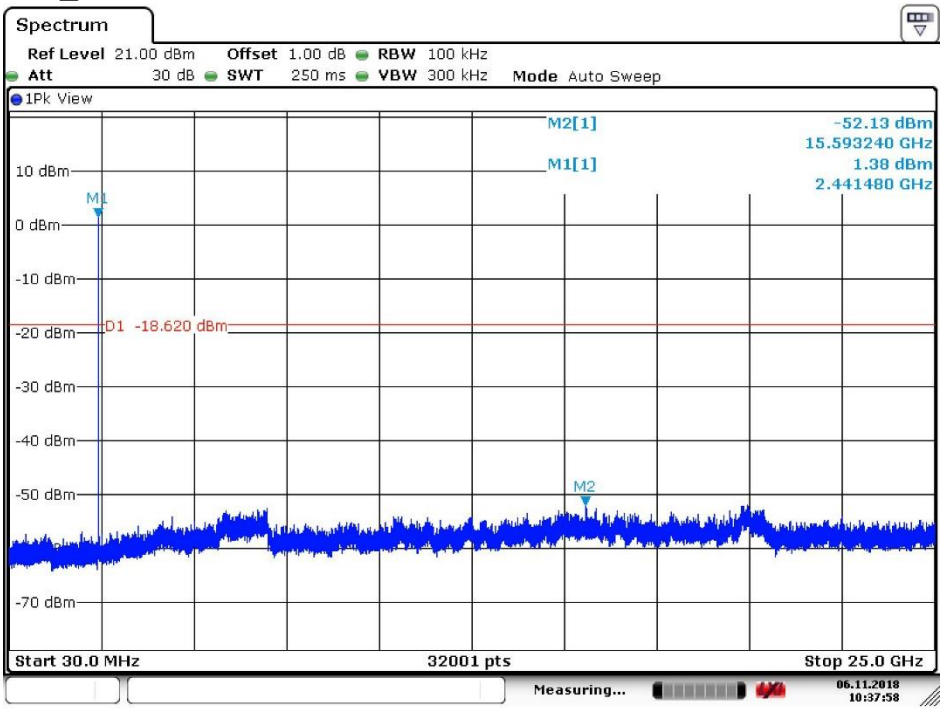
Date: 6.NOV.2018 10:36:19

4.9.1.7 8DPSK_Lowest Channel



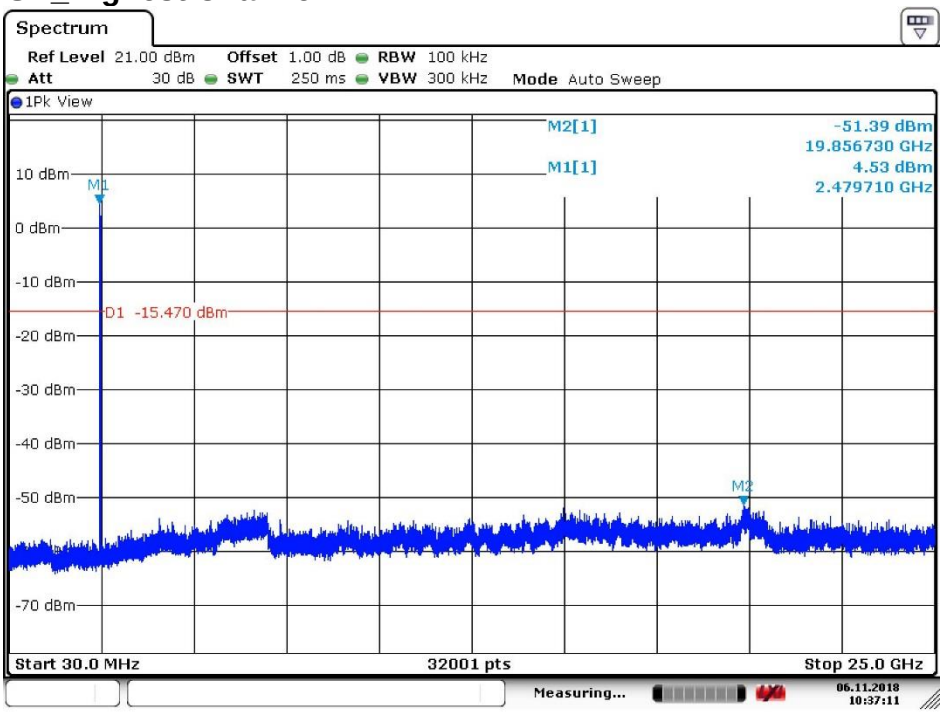
Date: 6.NOV.2018 10:38:34

4.9.1.8 8DPSK _Middle Channel



Date: 6.NOV.2018 10:37:58

4.9.1.9 8DPSK_Highest Channel



Date: 6.NOV.2018 10:37:12

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.

4.10 Radiated Spurious Emission

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205				
Test Method:	ANSI C63.10: 2013				
Test Site:	Measurement Distance: 3m or 10m (Semi-Anechoic Chamber)				
Receiver Setup:	Frequency	Detector	RBW	VBW	Remark
	0.009MHz-0.090MHz	Peak	10kHz	30kHz	Peak
	0.009MHz-0.090MHz	Average	10kHz	30kHz	Average
	0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
	0.110MHz-0.490MHz	Peak	10kHz	30kHz	Peak
	0.110MHz-0.490MHz	Average	10kHz	30kHz	Average
	0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
	30MHz-1GHz	Quasi-peak	100 kHz	300kHz	Quasi-peak
	Above 1GHz	Peak	1MHz	3MHz	Peak
		Peak	1MHz	10Hz	Average
Limit:	Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
	0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
	0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
	1.705MHz-30MHz	30	-	-	30
	30MHz-88MHz	100	40.0	Quasi-peak	3
	88MHz-216MHz	150	43.5	Quasi-peak	3
	216MHz-960MHz	200	46.0	Quasi-peak	3
	960MHz-1GHz	500	54.0	Quasi-peak	3
	Above 1GHz	500	54.0	Average	3
	Remark: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.				

Test Setup:	

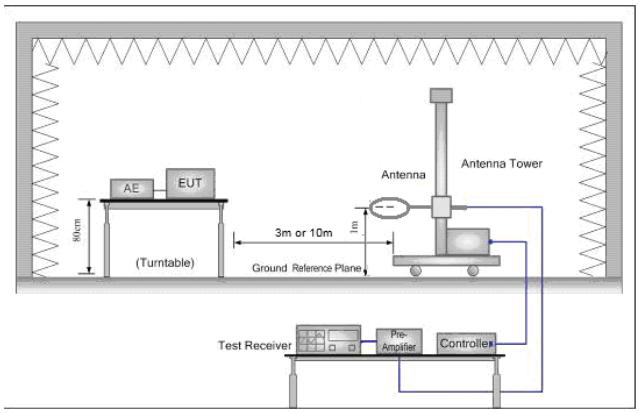


Figure 1. Below 30MHz

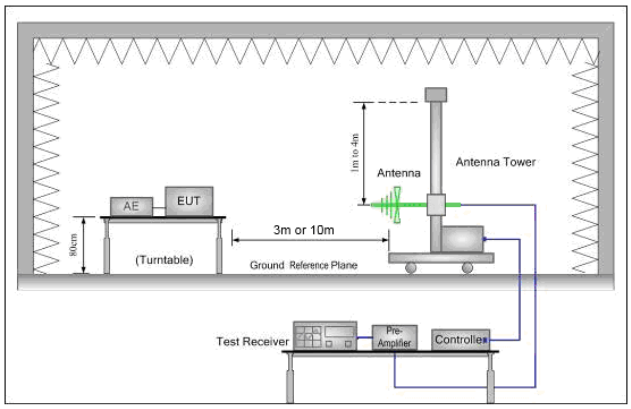


Figure 2. 30MHz to 1GHz

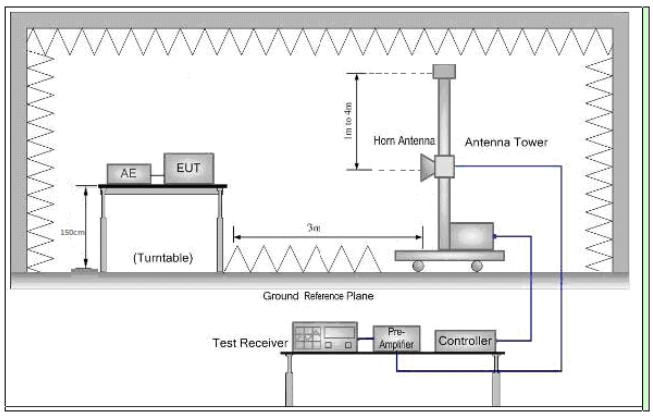
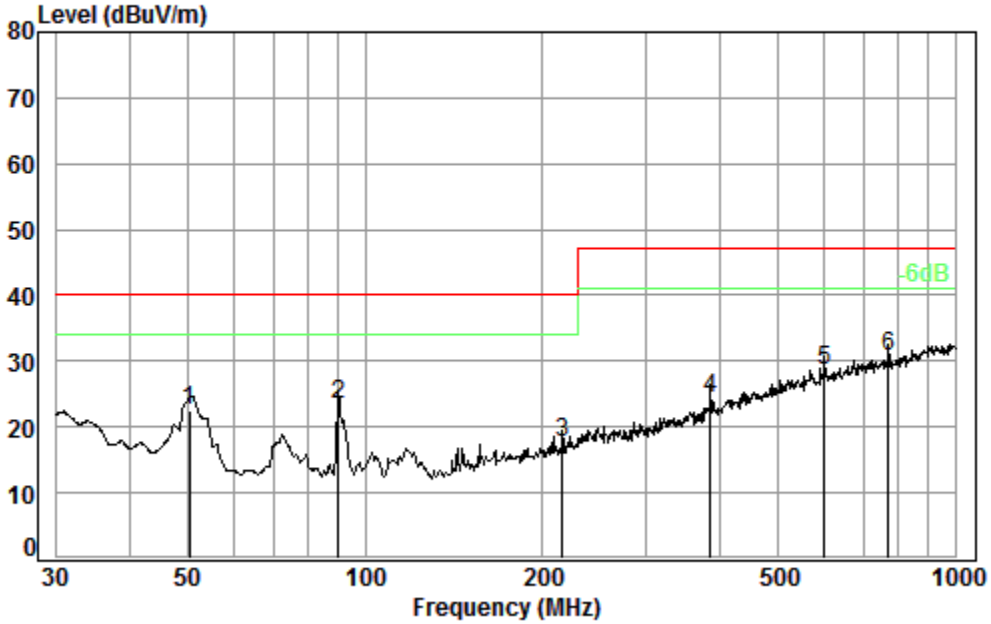


Figure 3. Above 1 GHz

Test Procedure:	a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation. b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation. c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. h. Test the EUT in the lowest channel (2402MHz),the middle channel (2441MHz),the Highest channel (2480MHz) i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case. j. Repeat above procedures until all frequencies measured was complete.
Exploratory Test Mode:	Non-hopping transmitting mode with all kind of modulation and all kind of data type Charge + Transmitting mode.
Final Test Mode:	Through Pre-scan, find the DH5 of data type and GFSK modulation is the worst case. Pretest the EUT at Charge + Transmitting mode For below 1GHz part, through pre-scan, the worst case is the lowest channel. Only the worst case is recorded in the report.
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

4.10.1 Radiated Emission below 1GHz

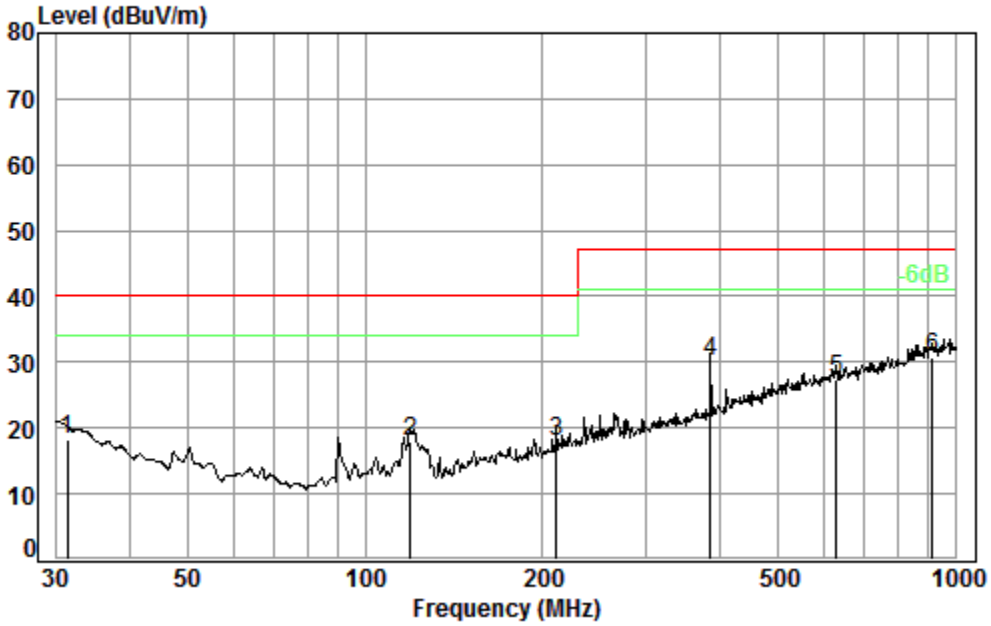
4.10.1.1 Charge + Transmitting, Vertical



Condition: 3m VERTICAL
Job No. : 90032
Test mode: b

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	50.41	0.80	14.16	27.41	35.00	22.55	40.00	-17.45
2	90.22	1.10	13.12	27.36	36.63	23.49	40.00	-16.51
3	216.02	1.49	17.07	26.85	25.82	17.53	40.00	-22.47
4	383.93	2.16	22.00	27.11	27.28	24.33	47.00	-22.67
5	599.32	2.70	26.59	27.95	27.31	28.65	47.00	-18.35
6 pp	768.75	3.11	28.32	27.68	26.86	30.61	47.00	-16.39

4.10.1.2 Charge + Transmitting, Horizontal

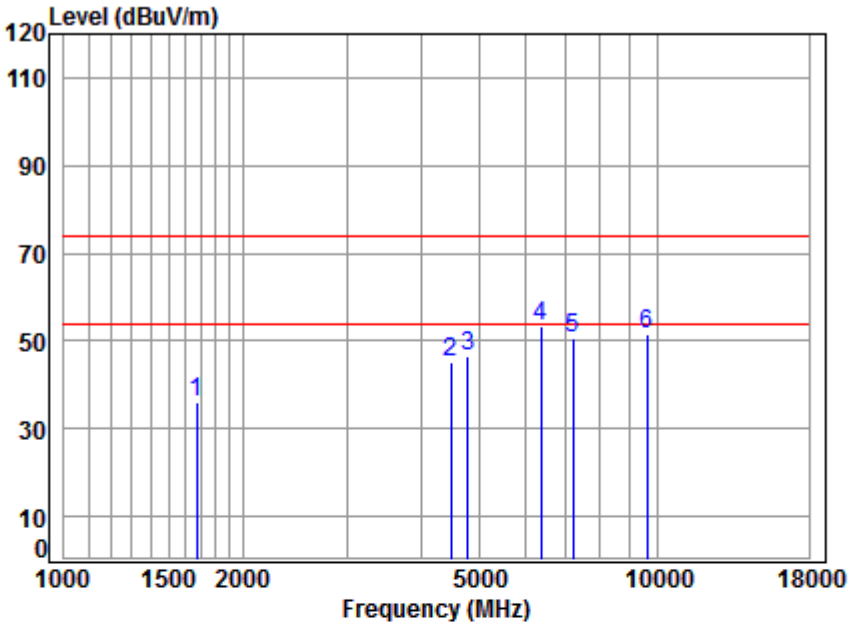


Condition: 3m HORIZONTAL
Job No. : 90032
Test mode: b

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	31.40	0.60	21.71	27.45	23.33	18.19	40.00	-21.81
2	119.44	1.25	13.12	27.24	30.88	18.01	40.00	-21.99
3	210.79	1.46	16.89	26.87	26.51	17.99	40.00	-22.01
4	383.93	2.16	22.00	27.11	33.15	30.20	47.00	-16.80
5	627.27	2.76	26.97	27.90	25.56	27.39	47.00	-19.61
6 pp	912.86	3.61	29.87	26.98	24.21	30.71	47.00	-16.29

4.10.2 Transmitter Emission above 1GHz

4.10.2.1 GFSK(DH5) _Lowest Channel_ Peak _Vertical



Site : chamber
Condition: 3m VERTICAL
Job No : 90032
Mode : 2402 TX RSE
Note : BT

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1672.779	5.26	26.56	41.52	45.52	35.82	74.00	-38.18	peak
2	4495.125	7.55	33.59	42.42	46.46	45.18	74.00	-28.82	peak
3	4804.000	7.89	33.97	42.47	47.08	46.47	74.00	-27.53	peak
4	6377.195	11.31	35.48	41.31	47.95	53.43	74.00	-20.57	peak
5	7206.000	10.08	36.07	40.71	45.33	50.77	74.00	-23.23	peak
6	9608.000	10.75	37.67	37.74	40.93	51.61	74.00	-22.39	peak