A.4 Radiated Emission

Measurement Limit:

Standard	Limit
FCC 47 CFR Part 15.247, 15.205, 15.209	20dB below peak output power

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)).

Limit in restricted band:

Frequency of emission (MHz)	Field strength (μV/m)	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

Test Condition:

The EUT was placed on a non-conductive table. The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and the EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. This maximization process was repeated with the EUT positioned in each of its three orthogonal orientations.

Frequency of emission (MHz)	RBW/VBW	Sweep Time (s)
30-1000	120kHz/300kHz	5
1000-4000	1MHz/3MHz	15
4000-18000	1MHz/3MHz	40
18000-26500	1MHz/3MHz	20

Note: According to the performance evaluation, the radiated emission margin of EUT is over 20dB in the band from 9kHz to 30MHz. Therefore, the measurement starts from 30MHz to tenth harmonic.

The measurement results include the horizontal polarization and vertical polarization measurements.

Measurement Results:

Mode	Channel	Frequency Range	Test Results	Conclusion
GFSK	0	1 GHz ~ 18 GHz	Fig.42	**P**
	39	1 GHz ~ 18 GHz	Fig.43	**P**
	78	1 GHz ~ 18 GHz	Fig.44	**P**
	Restricted Band(CH0)	2.38 GHz ~ 2.45 GHz	Fig.45	**P**
	Restricted Band (CH78)	2.45 GHz ~ 2.5 GHz	Fig.46	**P**
π/4 DQPSK	0	1 GHz ~ 18 GHz	Fig.47	**P**
	39	1 GHz ~ 18 GHz	Fig.48	**P**
	78	1 GHz ~ 18 GHz	Fig.49	**P**
	Restricted Band (CH0)	2.38 GHz ~ 2.45 GHz	Fig.50	**P**
	Restricted Band (CH78)	2.45 GHz ~ 2.5 GHz	Fig.51	**P**
8DPSK	0	1 GHz ~ 18 GHz	Fig.52	**P**
	39	1 GHz ~ 18 GHz	Fig.53	**P**
	78	1 GHz ~ 18 GHz	Fig.54	**P**
	Restricted Band (CH0)	2.38 GHz ~ 2.45 GHz	Fig.55	**P**
	Restricted Band (CH78)	2.45 GHz ~ 2.5 GHz	Fig.56	**P**
/	All channels	9 kHz ~30 MHz	Fig.57	**P**
		30 MHz ~1 GHz	Fig.58	**P**
		18 GHz ~ 26.5 GHz	Fig.59	**P**

Worst Case Result

GFSK CH0 (1-18GHz)

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB)
5997.300000	48.38	74.00	25.62	H	5.1
8117.571429	45.53	74.00	28.47	V	6.0
11493.000000	48.79	74.00	25.21	V	10.1
14401.714286	49.26	74.00	24.74	V	11.5
16860.428571	55.07	74.00	18.93	V	18.0
17992.714286	55.10	74.00	18.90	H	19.2

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB)
5997.300000	39.52	54.00	14.48	H	5.1
8117.571429	37.22	54.00	16.78	V	6.0
11493.000000	41.37	54.00	12.63	V	10.1
14401.714286	41.16	54.00	12.84	V	11.5
16860.428571	46.27	54.00	7.73	V	18.0
17992.714286	46.03	54.00	7.97	H	19.2

π/4 DQPSK CH0 (1-18GHz)

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB)
7508.142857	46.33	74.00	27.67	V	5.7
8889.428572	46.21	74.00	27.79	V	6.5
10450.285714	48.40	74.00	25.60	V	9.0
11876.571429	47.48	74.00	26.52	V	10.1
14777.571429	51.30	74.00	22.70	V	12.7
17103.428571	55.30	74.00	18.70	V	18.4

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB)
7508.142857	33.16	54.00	20.84	V	5.7
8889.428572	33.51	54.00	20.49	V	6.5
10450.285714	35.66	54.00	18.34	V	9.0
11876.571429	35.08	54.00	18.92	V	10.1
14777.571429	38.49	54.00	15.51	V	12.7
17103.428571	42.67	54.00	11.33	V	18.4

8DPSK CH0 (1-18GHz)

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Corr. (dB)
5988.300000	48.90	74.00	25.10	H	5.0
8245.714286	45.38	74.00	28.62	V	5.9
10459.714286	47.84	74.00	26.16	V	9.0
14831.571429	50.82	74.00	23.18	V	12.9
16638.857143	54.23	74.00	19.77	H	17.1
17991.857143	55.14	74.00	18.86	V	19.2

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Corr. (dB)
5988.300000	38.47	54.00	15.53	H	5.0
8245.714286	37.45	54.00	16.55	V	5.9
10459.714286	39.40	54.00	14.60	V	9.0
14831.571429	38.71	42.71	11.29	V	12.9
16638.857143	41.71	45.71	8.29	H	17.1
17991.857143	43.02	46.02	8.98	V	19.2

Note:

A "reference path loss" is established and the A_{Rpl} is the attenuation of “reference path loss”, and Antenna Factor, the gain of the preamplifier, the cable loss. P_{Mea} is the field strength recorded from the instrument.

The measurement results are obtained as described below:

Result = P_{Mea} + Cable Loss + Antenna Factor - Gain of the preamplifier

See below for test graphs.

Conclusion: Pass

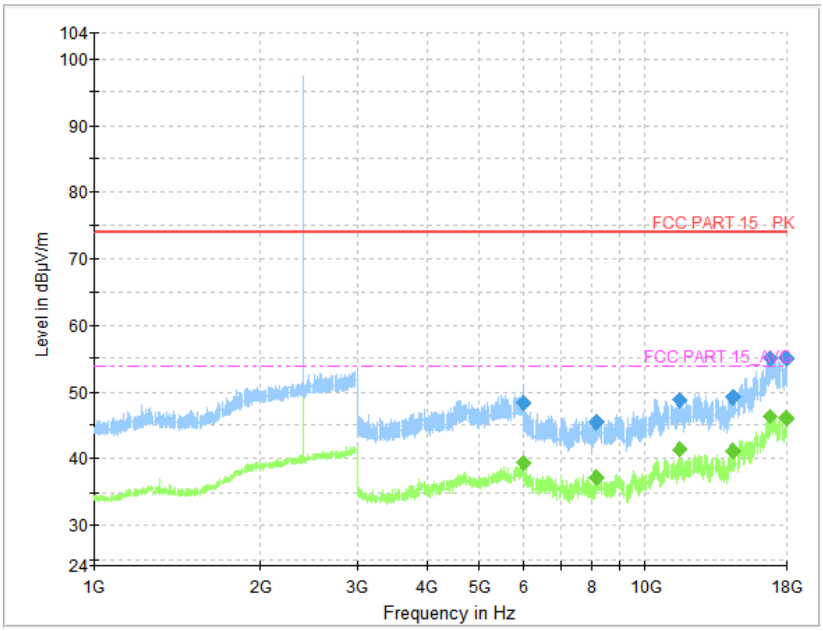

Fig. 42 Radiated Spurious Emission (GFSK, Ch0, 1GHz ~ 18GHz)

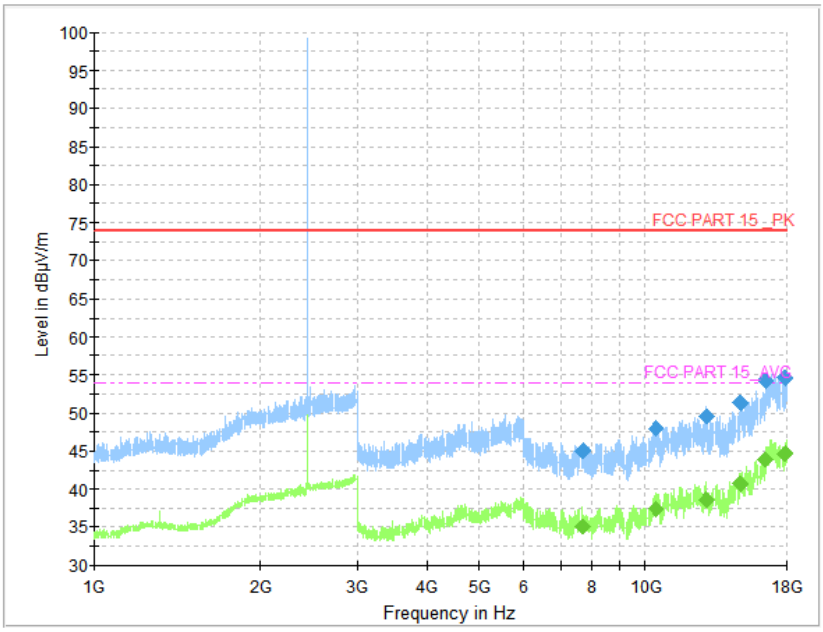

Fig. 43 Radiated Spurious Emission (GFSK, Ch39, 1GHz ~ 18GHz)

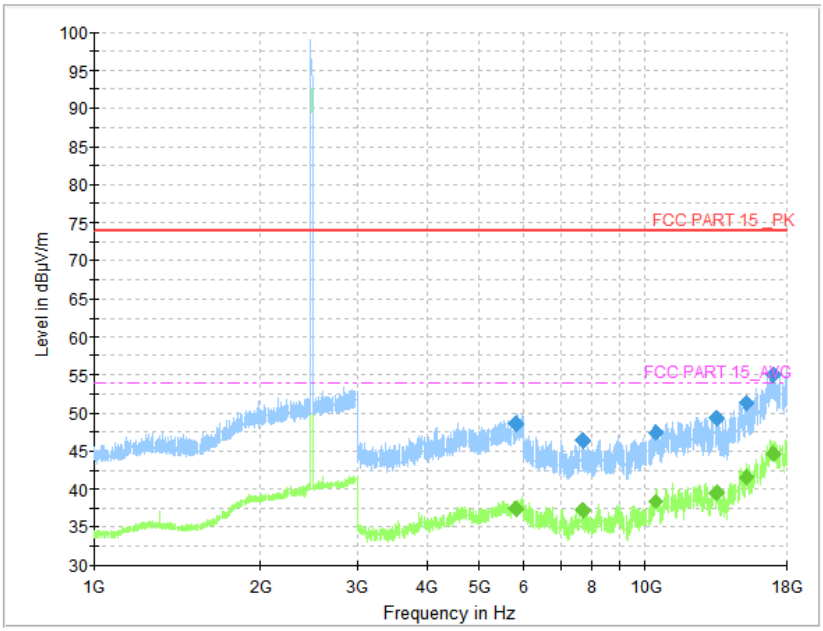

Fig. 44 Radiated Spurious Emission (GFSK, Ch78, 1GHz ~ 18GHz)

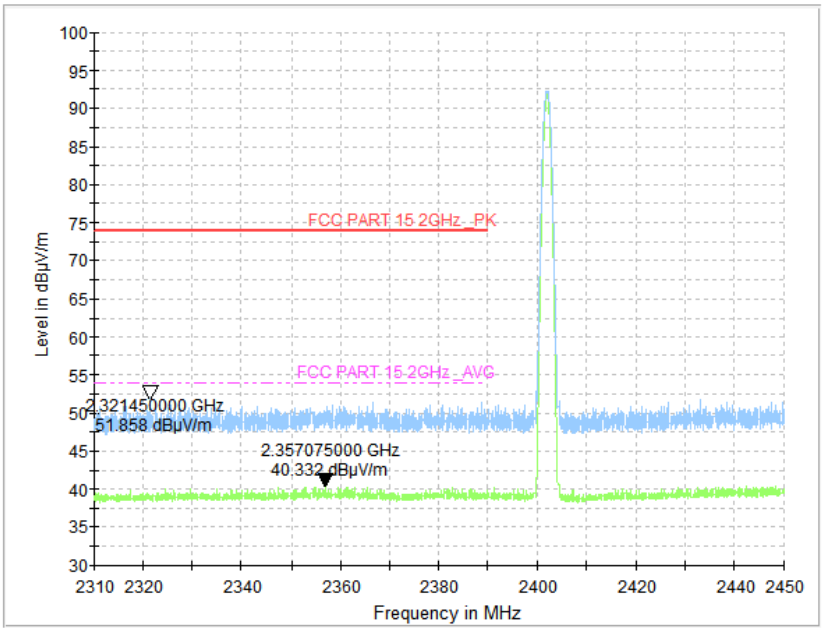

Fig. 45 Radiated Band Edges (GFSK, Ch0, 2380GHz ~ 2450GHz)

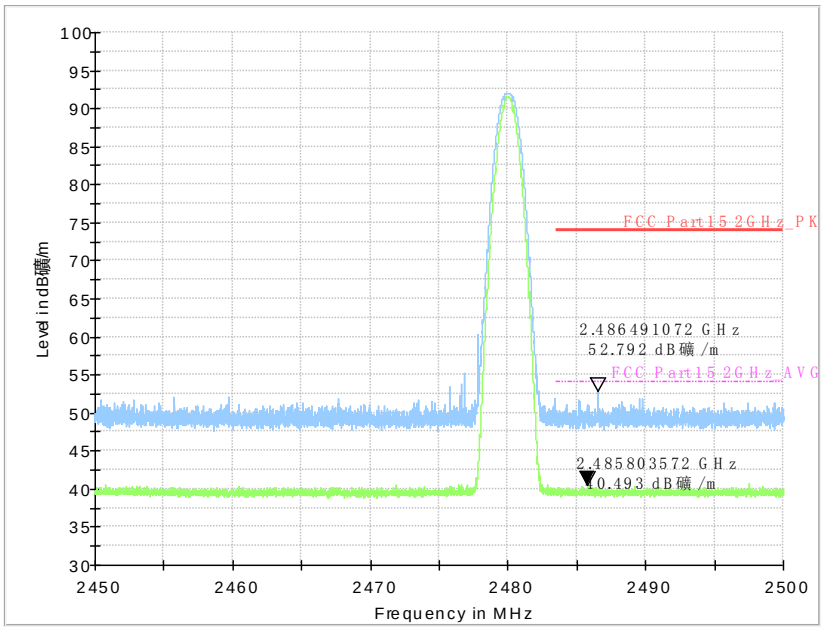

Fig. 46 Radiated Band Edges (GFSK, Ch78, 2450GHz ~ 2500GHz)

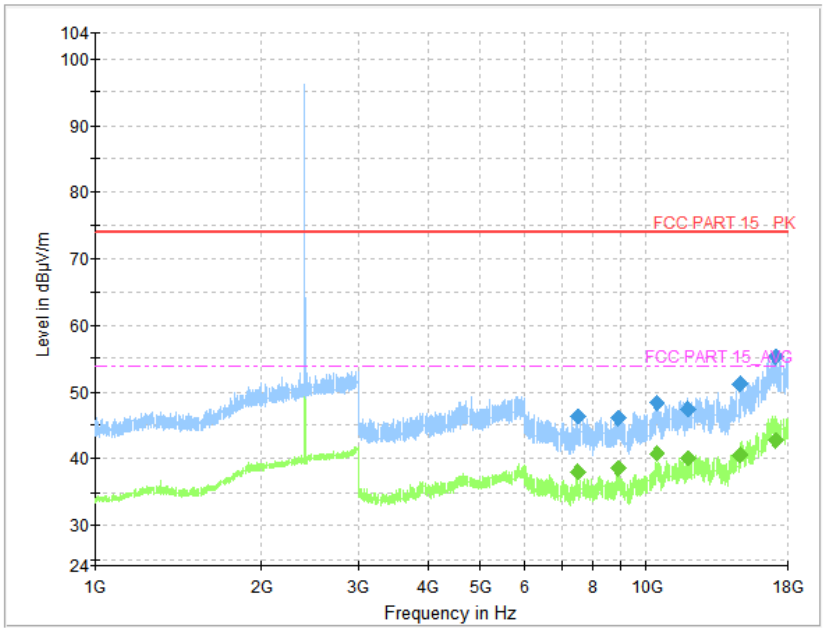

Fig. 47 Radiated Spurious Emission (π/4 DQPSK, Ch0, 1GHz ~ 18GHz)

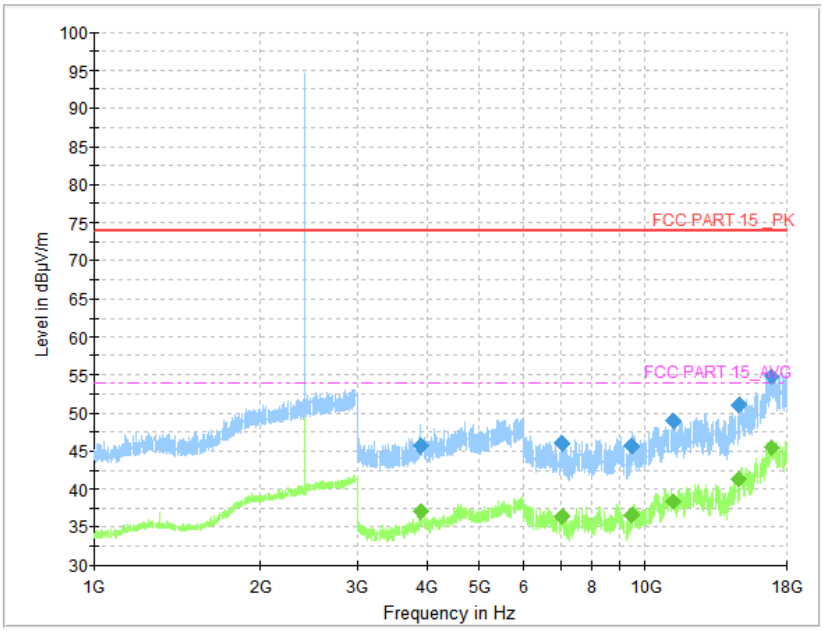

Fig. 48 Radiated Spurious Emission (π/4 DQPSK, Ch39, 1GHz ~ 18GHz)

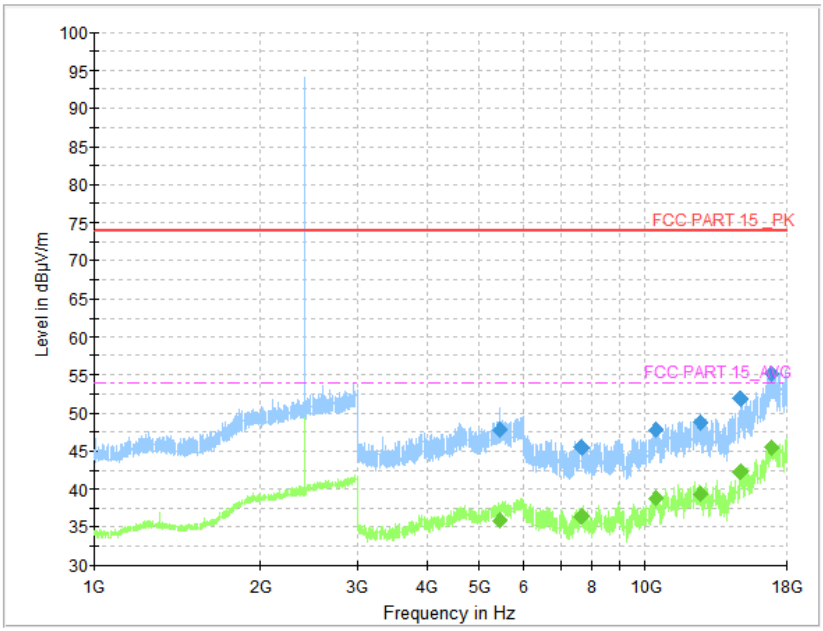

Fig. 49 Radiated Spurious Emission (π/4 DQPSK, Ch78, 1GHz ~ 18GHz)

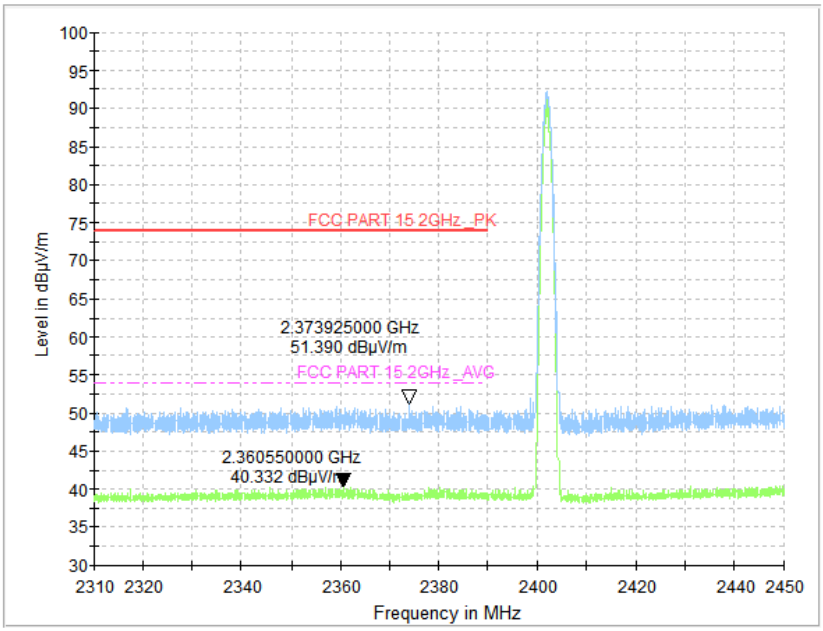

Fig. 50 Radiated Band Edges (π/4 DQPSK, Ch0, 2380GHz ~ 2450GHz)

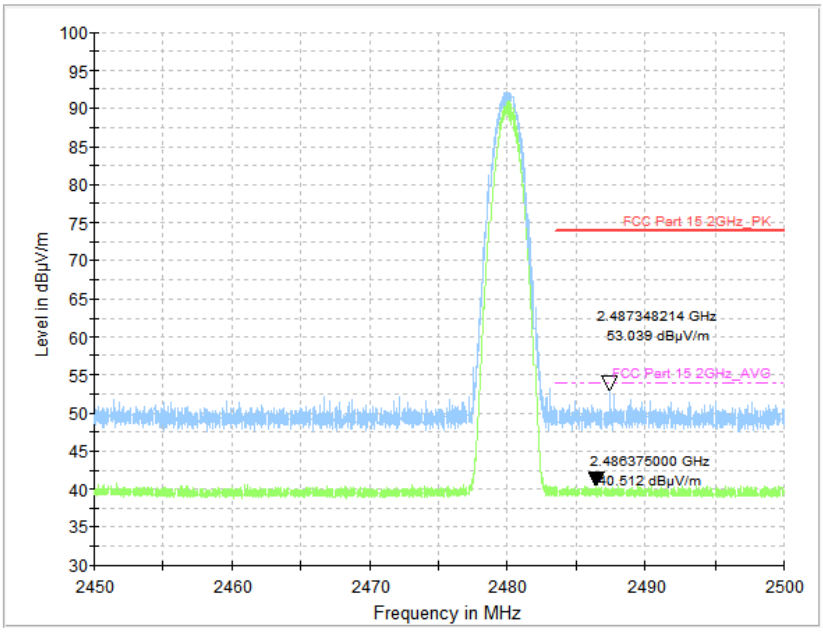

Fig. 51 Radiated Band Edges (π/4 DQPSK, Ch78, 2450GHz ~ 2500GHz)

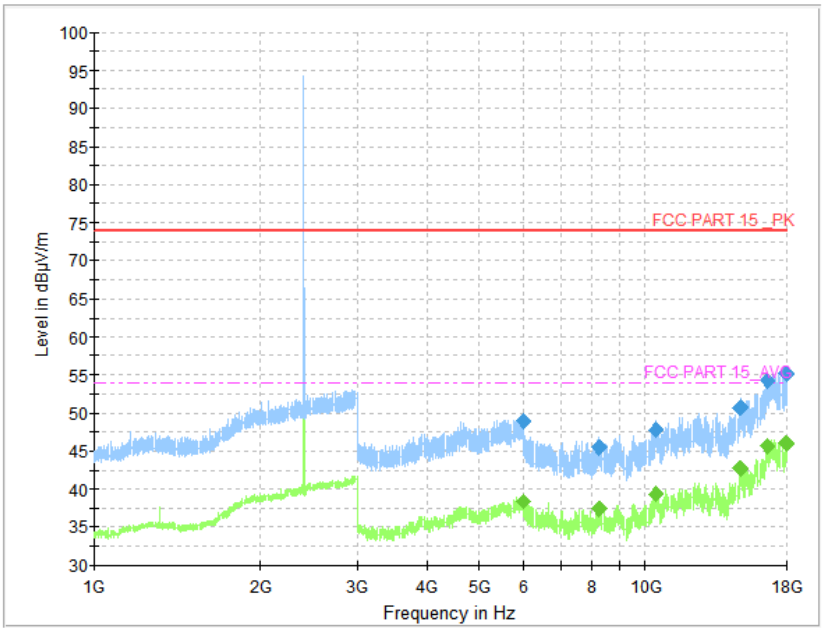

Fig. 52 Radiated Spurious Emission (8DPSK, Ch0, 1GHz ~ 18GHz)

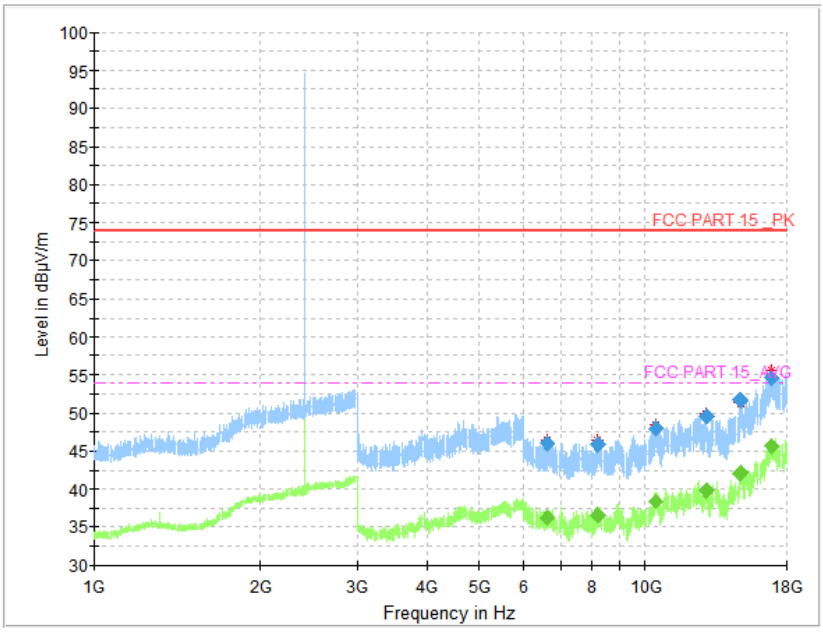

Fig. 53 Radiated Spurious Emission (8DPSK, Ch39, 1GHz ~ 18GHz)

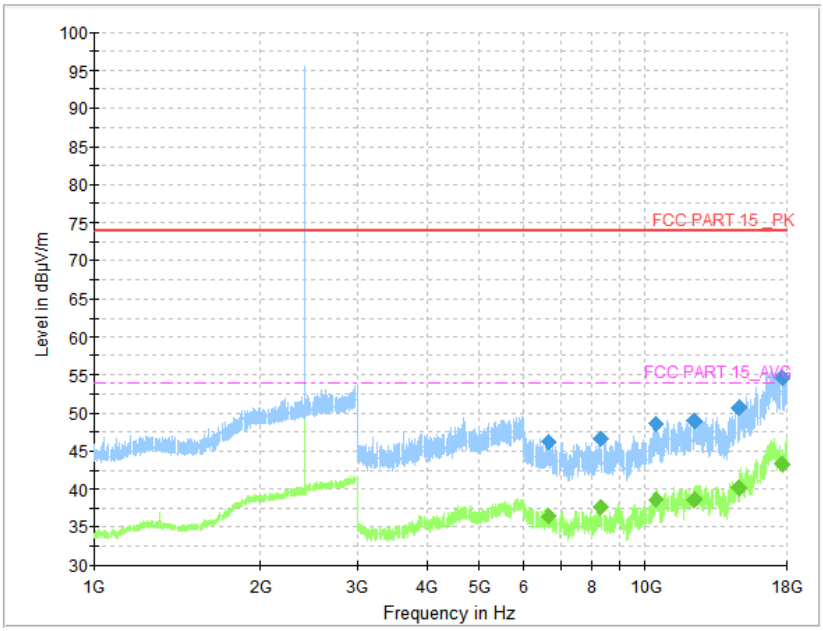

Fig. 54 Radiated Spurious Emission (8DPSK, Ch78, 1GHz ~ 18GHz)

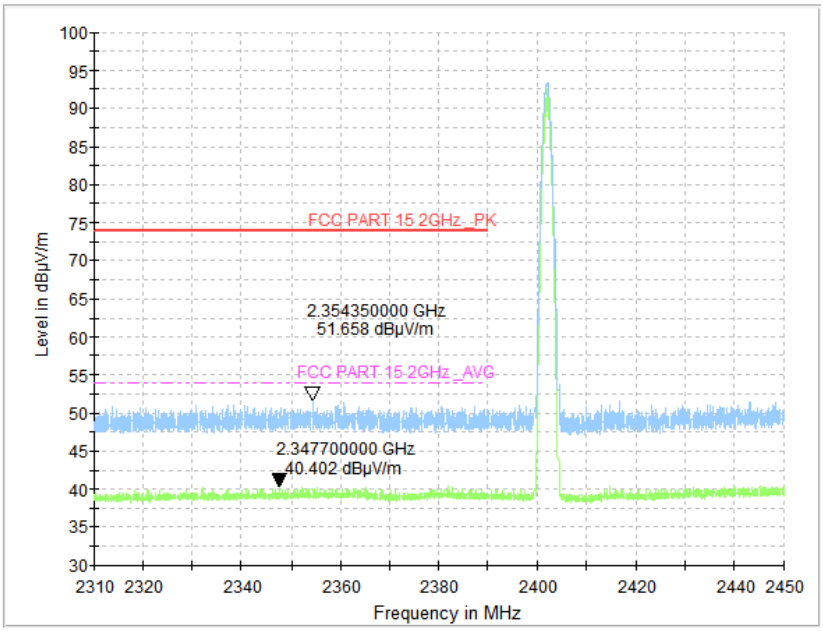

Fig. 55 Radiated Band Edges (8DPSK, Ch0, 2380GHz ~ 2450GHz)

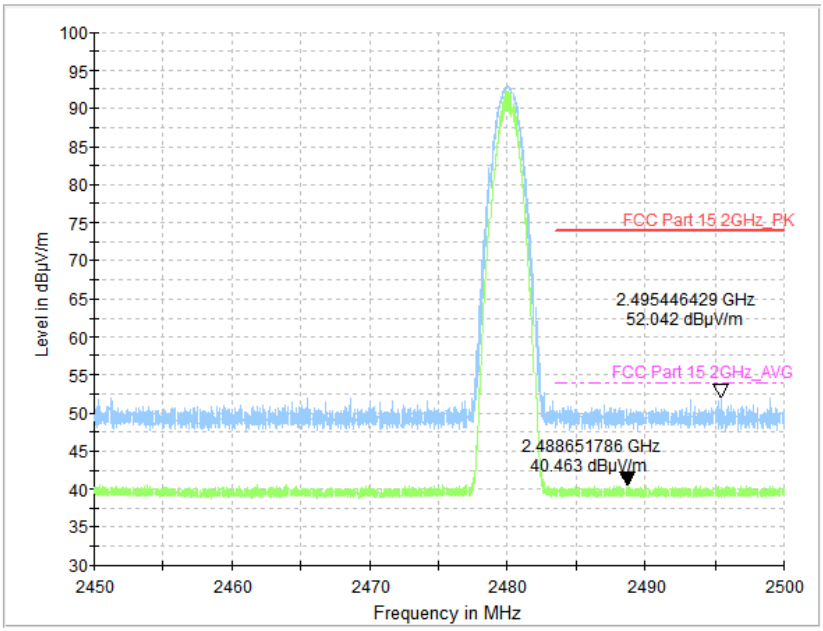

Fig. 56 Radiated Band Edges (8DPSK, Ch78, 2450GHz ~ 2500GHz)

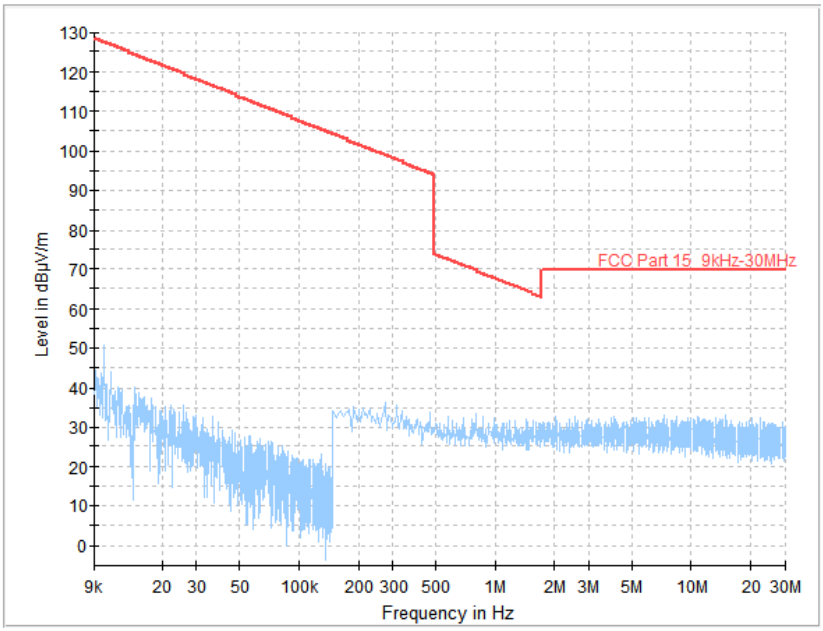

Fig. 57 Radiated Spurious Emission (All Channels, 9kHz ~ 30MHz)

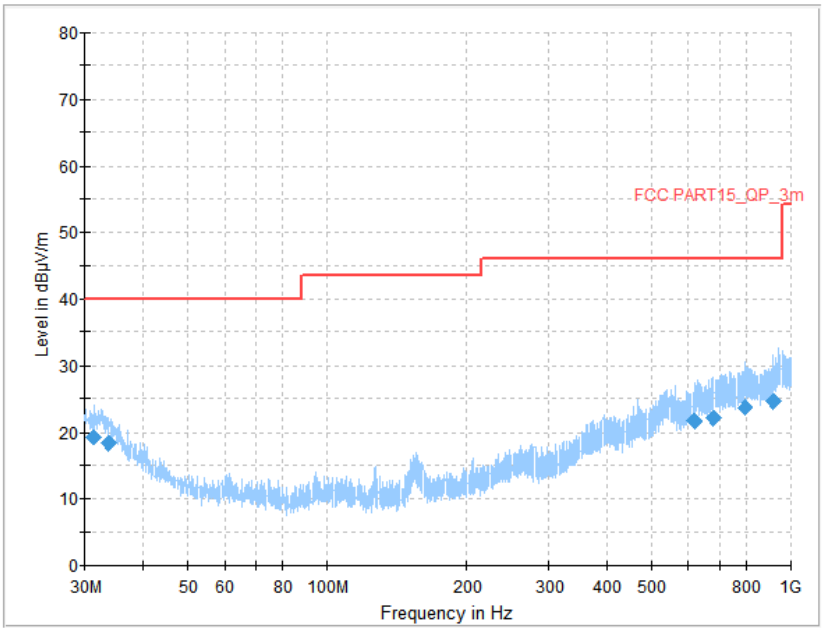

Fig. 58 Radiated Spurious Emission (All Channels, 30MHz ~ 1GHz)

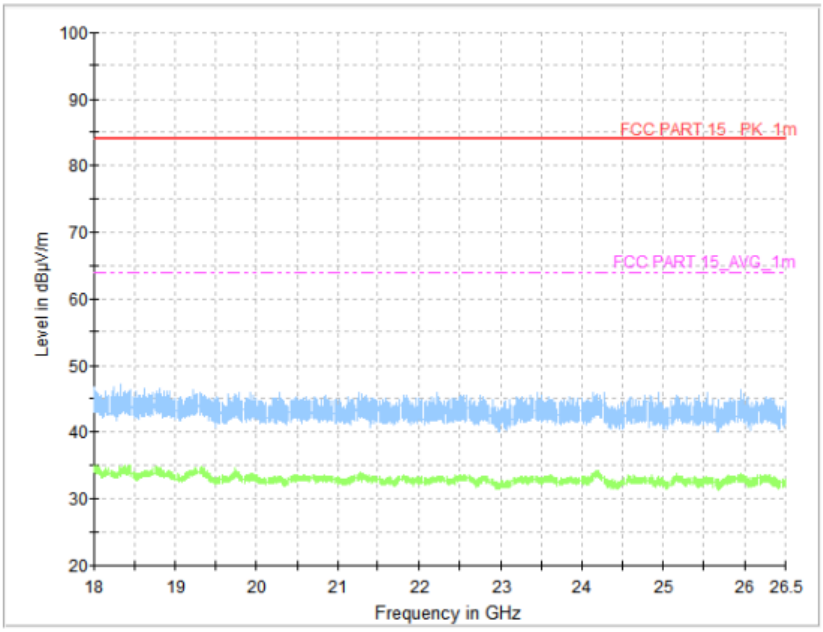

Fig. 59 Radiated Spurious Emission (All Channels, 18GHz ~ 26.5GHz)

A.5 20dB Bandwidth

Measurement Limit:

Standard	Limit (kHz)
FCC 47 CFR Part 15.247 (a)	/

Measurement Result:

Mode	Channel	20dB Bandwidth (kHz)		Conclusion
GFSK	0	Fig.60	950.25	/
	39	Fig.61	953.25	
	78	Fig.62	946.50	
π/4 DQPSK	0	Fig.63	1269.00	/
	39	Fig.64	1301.25	
	78	Fig.65	1293.00	
8DPSK	0	Fig.66	1260.75	/
	39	Fig.67	1266.75	
	78	Fig.68	1288.50	

See below for test graphs.

Conclusion: PASS

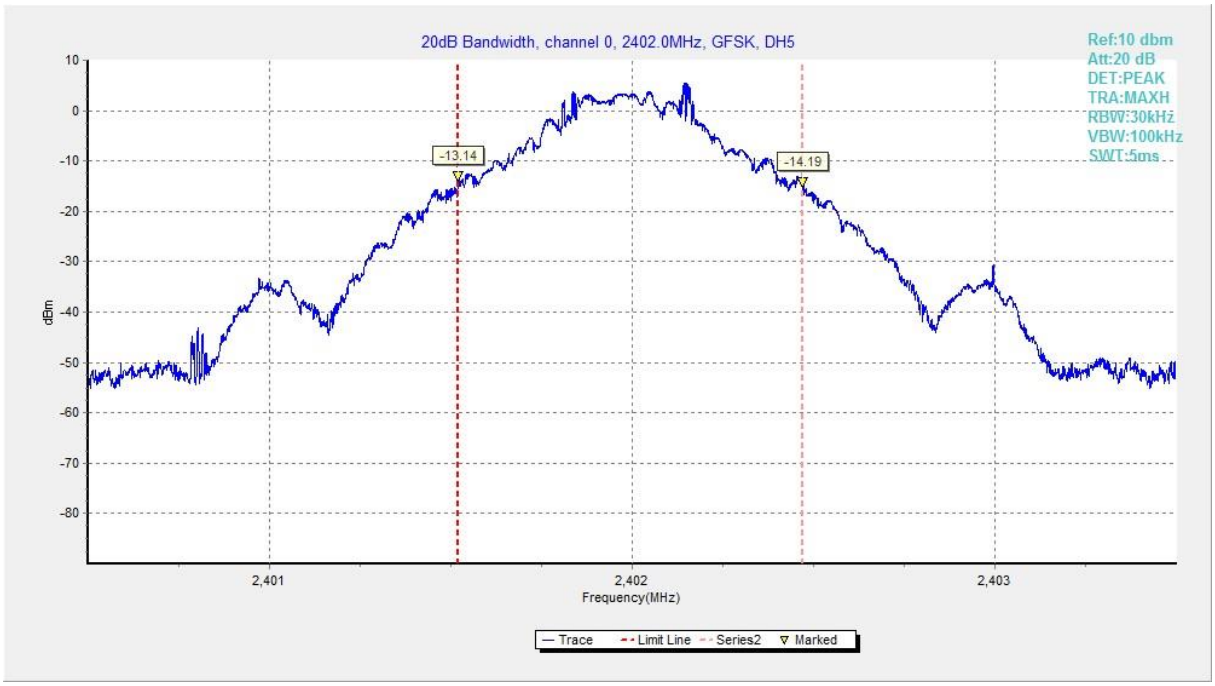

Fig. 60 20dB Bandwidth (GFSK, Ch 0)

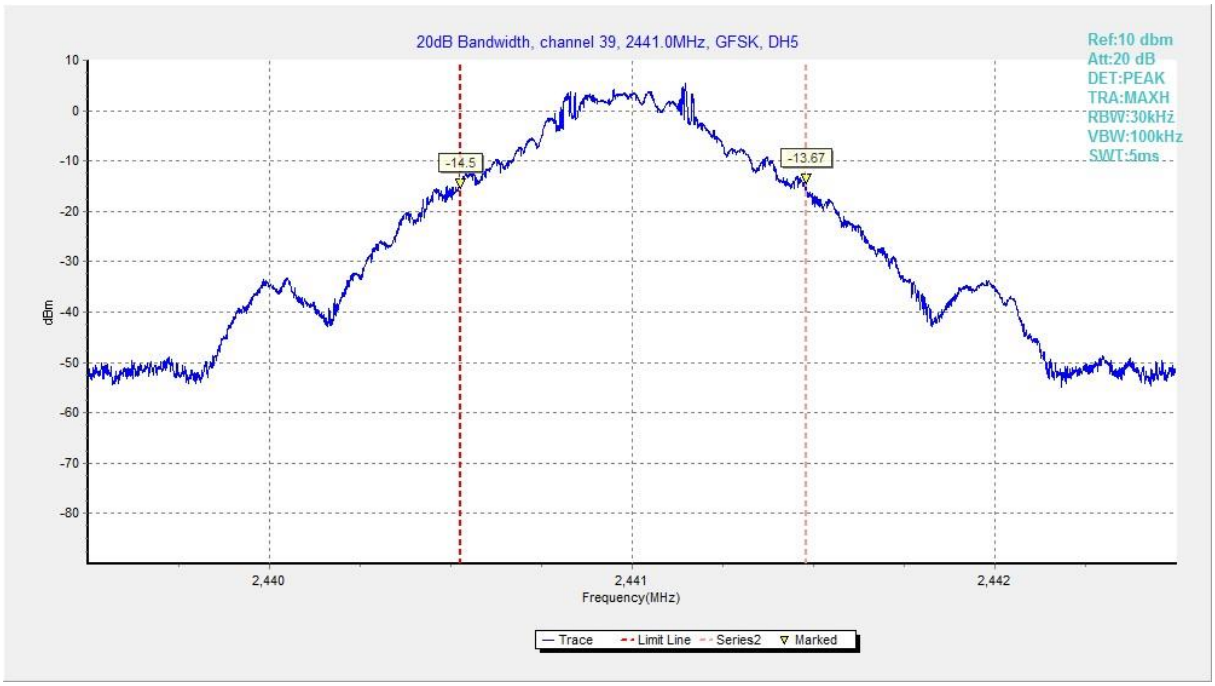

Fig. 61 20dB Bandwidth (GFSK, Ch 39)

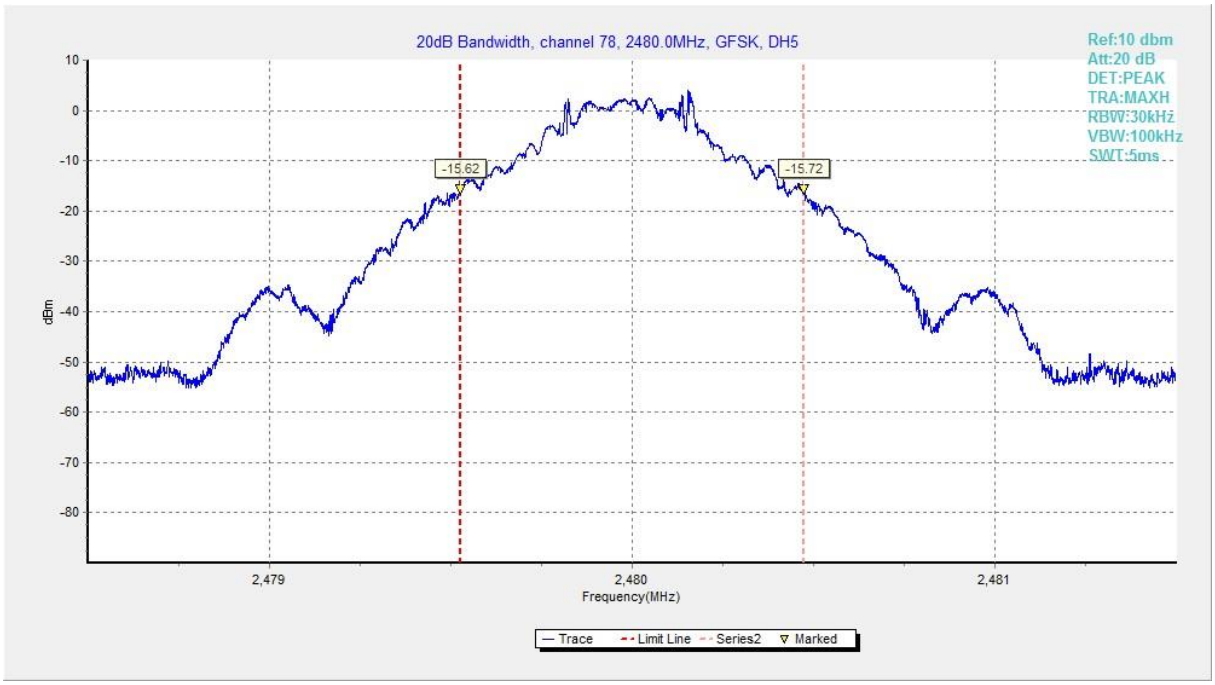

Fig. 62 20dB Bandwidth (GFSK, Ch 78)

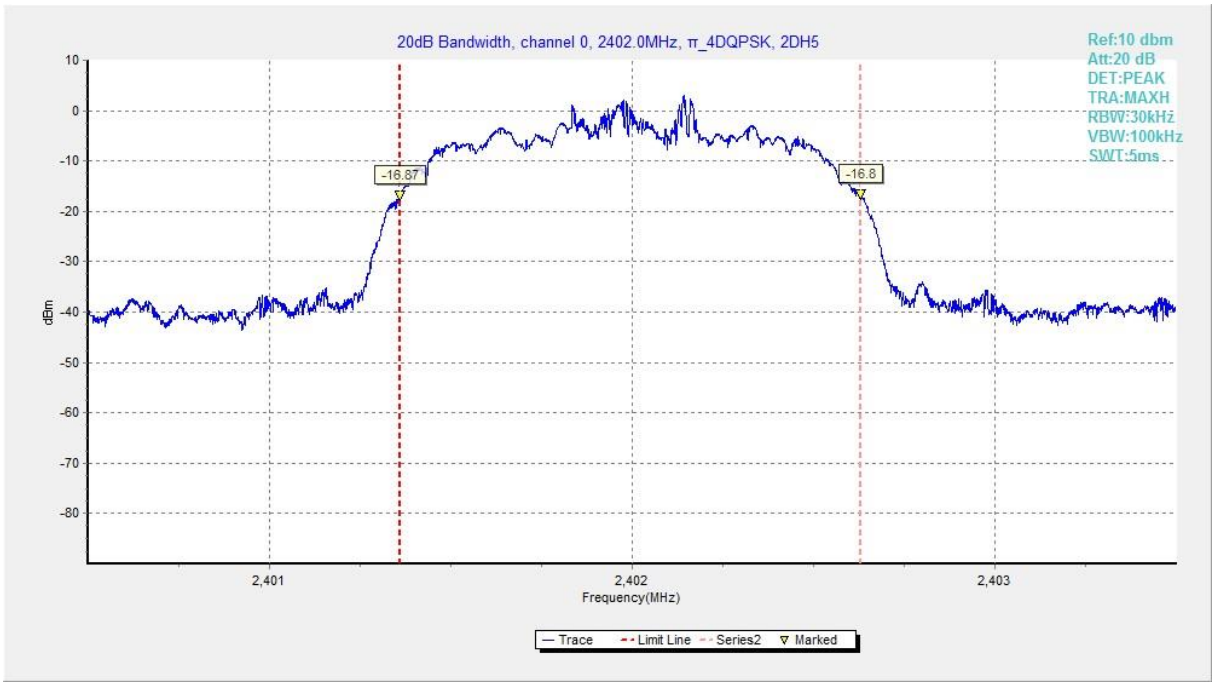

Fig. 63 20dB Bandwidth (π/4 DQPSK, Ch 0)

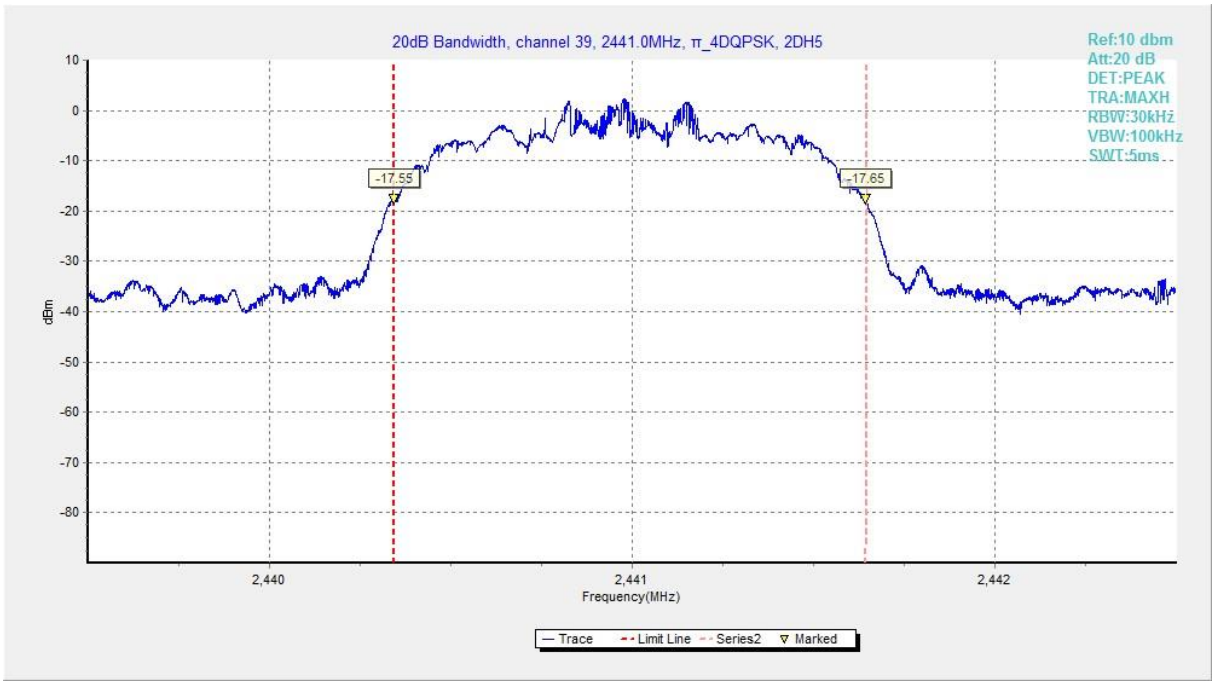

Fig. 64 20dB Bandwidth (π/4 DQPSK, Ch 39)

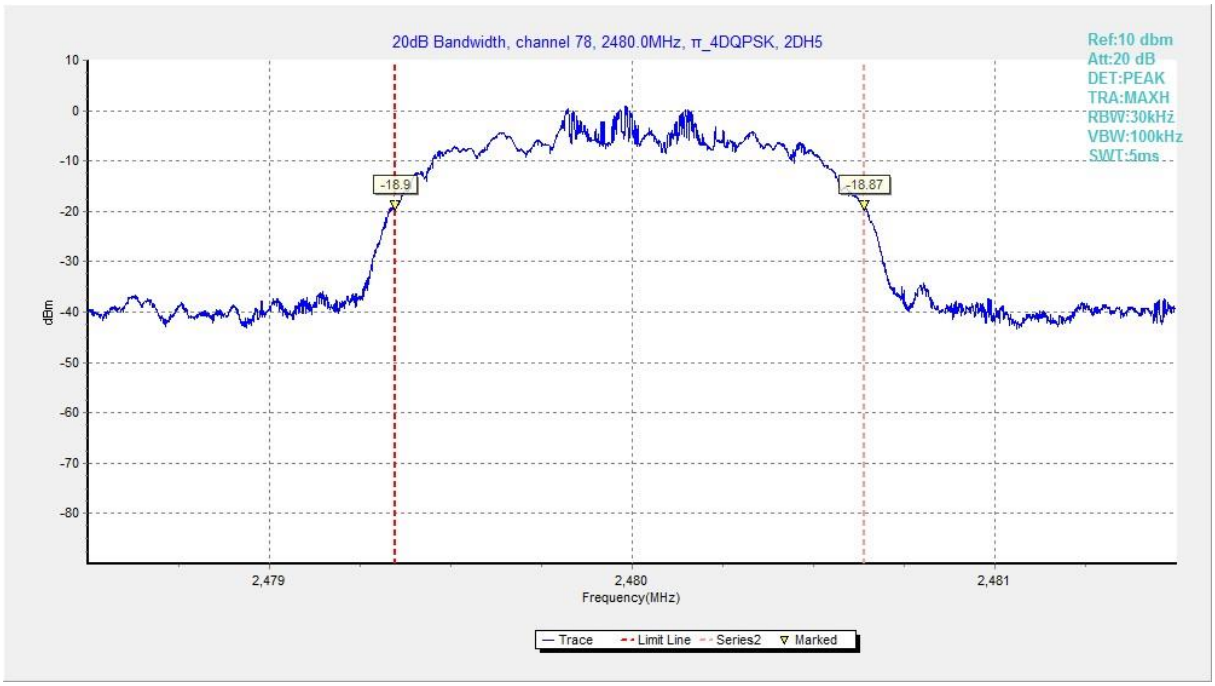

Fig. 65 20dB Bandwidth (π/4 DQPSK, Ch 78)

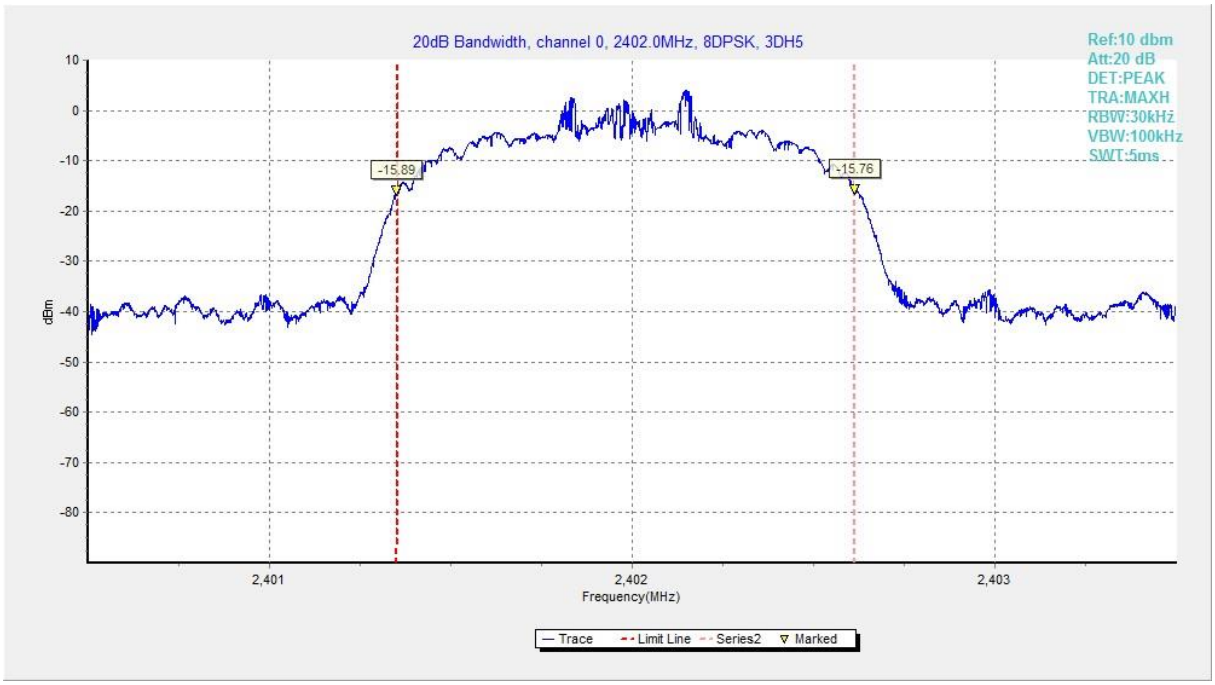

Fig. 66 20dB Bandwidth (8DPSK, Ch 0)

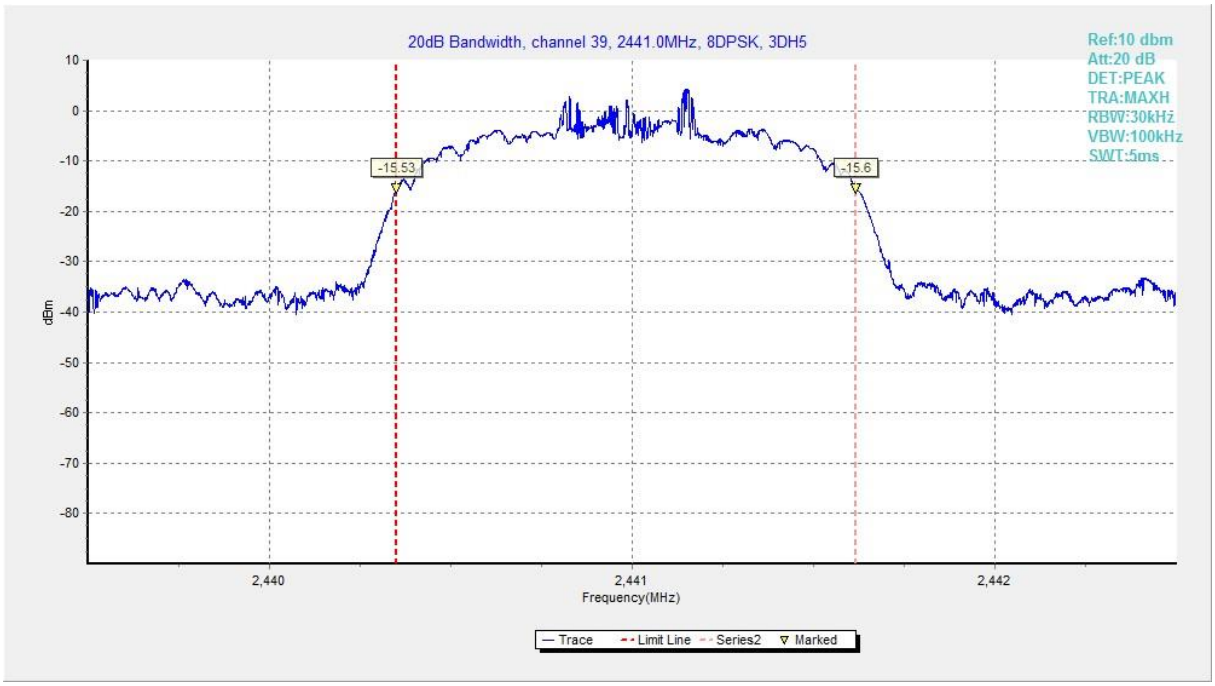

Fig. 67 20dB Bandwidth (8DPSK, Ch 39)

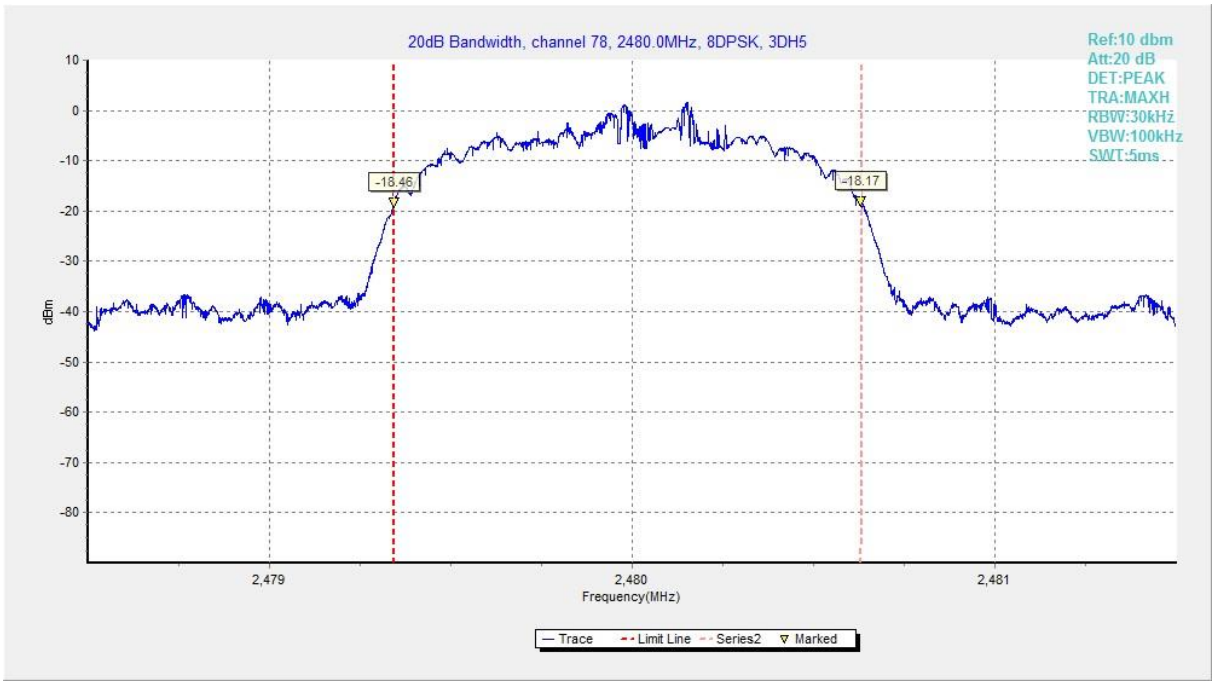

Fig. 68 20dB Bandwidth (8DPSK, Ch 78)

A.6 Time of Occupancy (Dwell Time)

Measurement Limit:

Standard	Limit
FCC 47 CFR Part 15.247 (a)	< 400 ms

Measurement Results:

Mode	Channel	Packet	Dwell Time(ms)		Conclusion
GFSK	39	DH5	Fig.69	170.03	**P**
			Fig.70		
π/4 DQPSK	39	2-DH5	Fig.71	161.39	**P**
			Fig.72		
8DPSK	39	3-DH5	Fig.73	207.44	**P**
			Fig.74		

See below for test graphs.

Conclusion: Pass

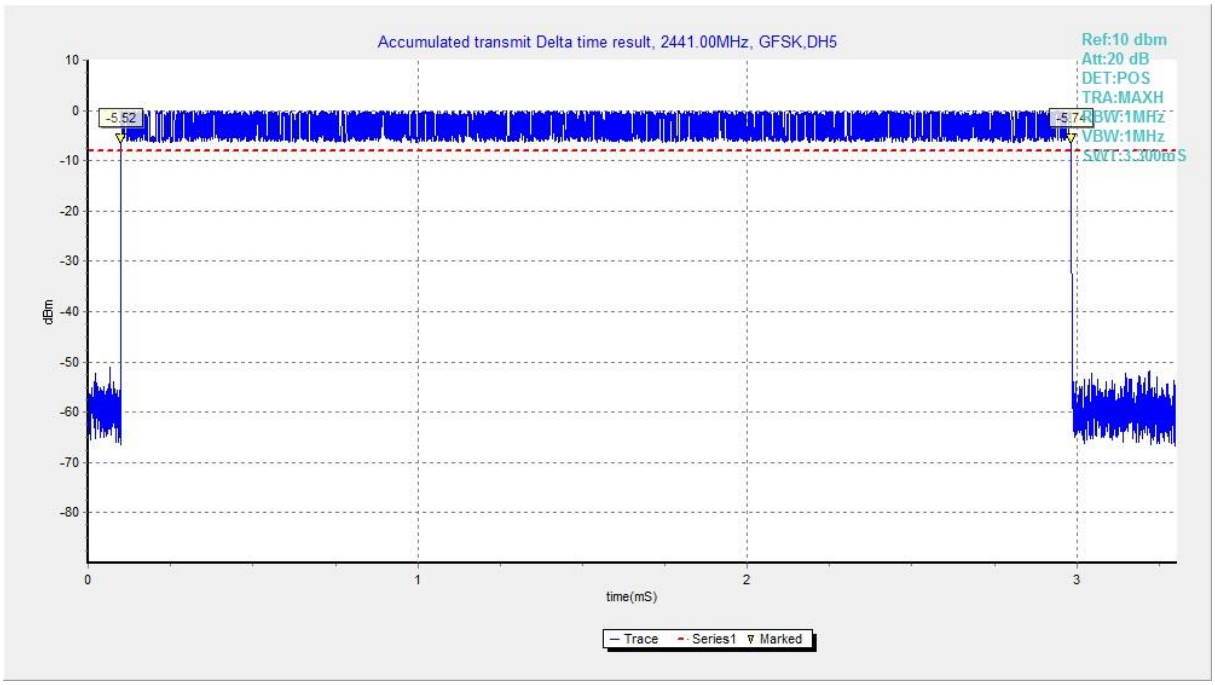

Fig. 69 Time of Occupancy (Dwell Time) (GFSK, Ch39)

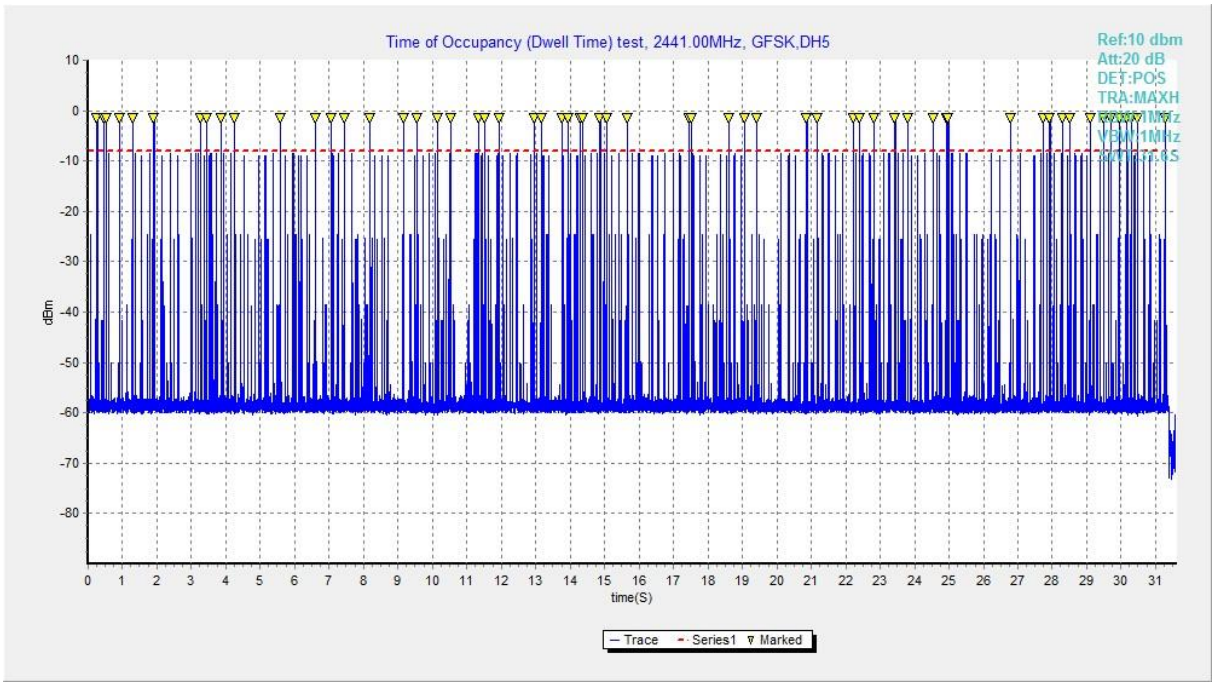

Fig. 70 Time of Occupancy (Dwell Time) (GFSK, Ch39)

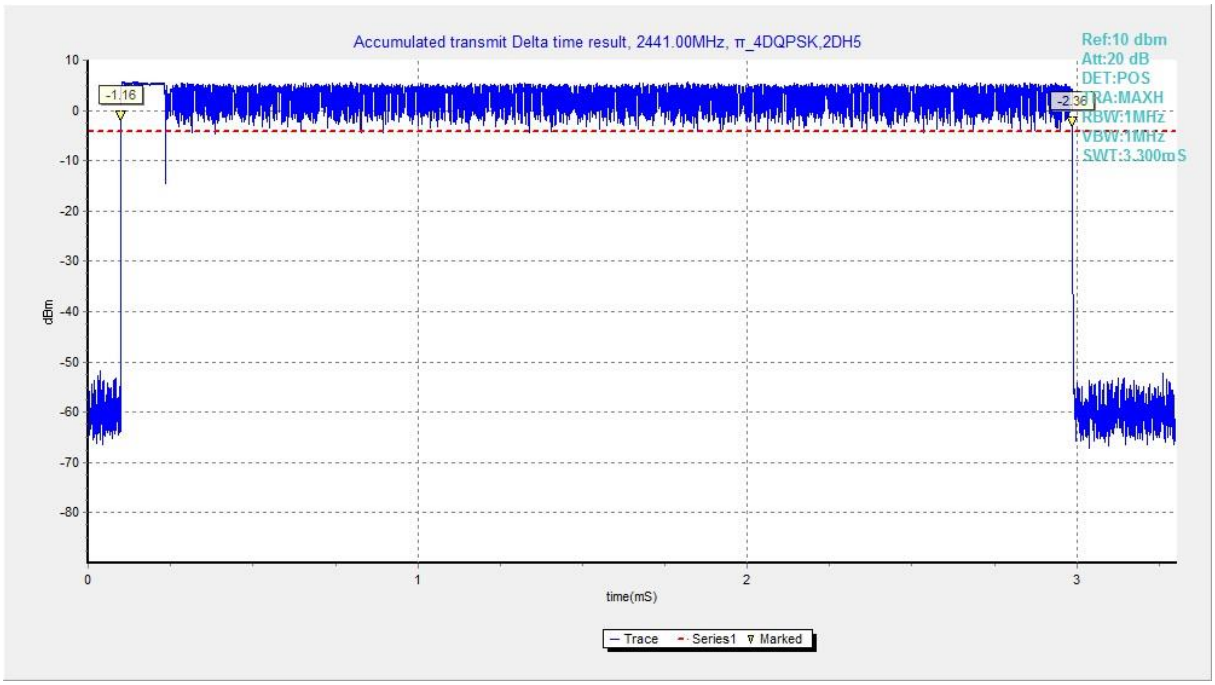

Fig. 71 Time of Occupancy (Dwell Time) (π/4 DQPSK, Ch39)

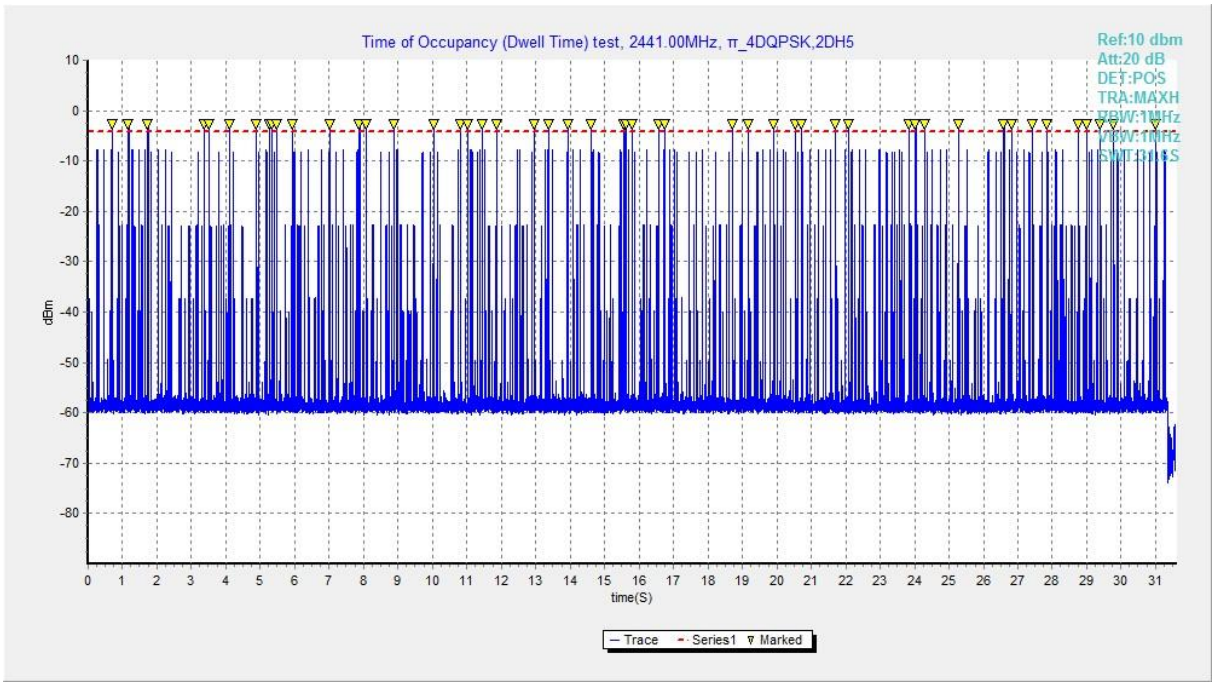

Fig. 72 Time of Occupancy (Dwell Time) (π/4 DQPSK, Ch39)

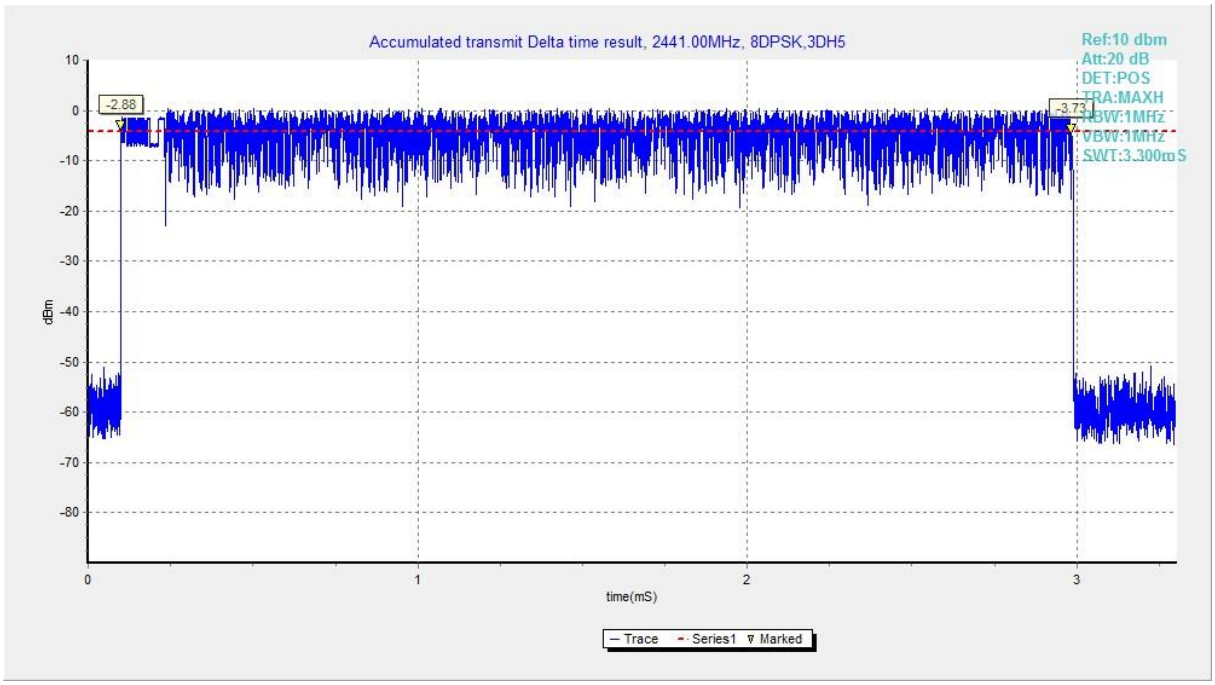

Fig. 73 Time of Occupancy (Dwell Time) (8DPSK, Ch39)

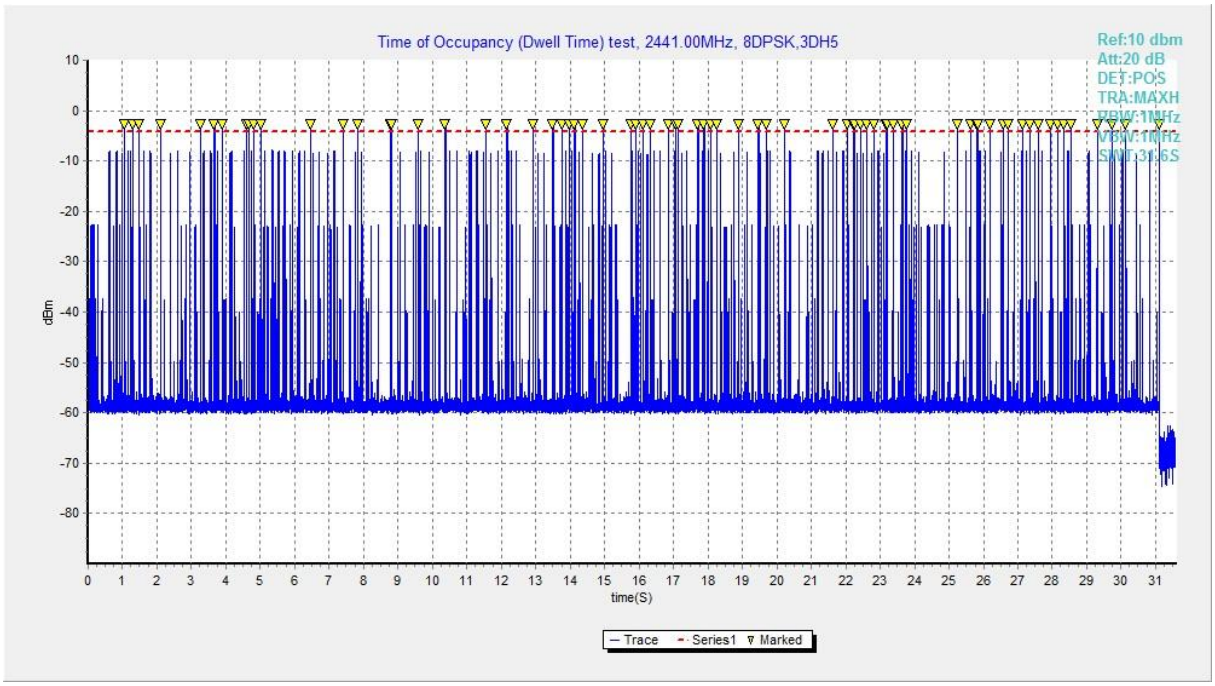

Fig. 74 Time of Occupancy (Dwell Time) (8DPSK, Ch39)

A.7 Number of Hopping Channels

Measurement Limit:

Standard	Limit
FCC 47 CFR Part 15.247(a)	At least 15 non-overlapping channels

Measurement Results:

Mode	Packet	Number of hopping channels		Test result	Conclusion
GFSK	DH5	Fig.75	Fig.76	79	**P**
π/4 DQPSK	2-DH5	Fig.77	Fig.78	79	**P**
8DPSK	3-DH5	Fig.79	Fig.80	79	**P**

See below for test graphs.

Conclusion: Pass

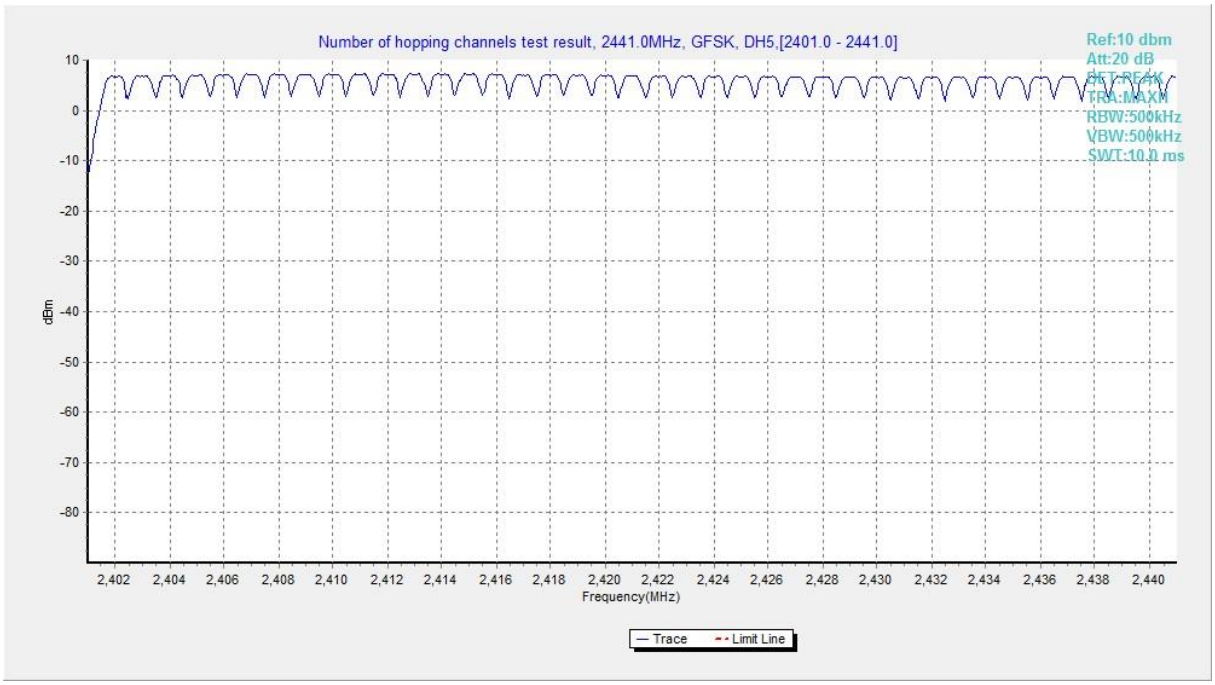

Fig. 75 Hopping channel ch0~39 (GFSK, Ch39)

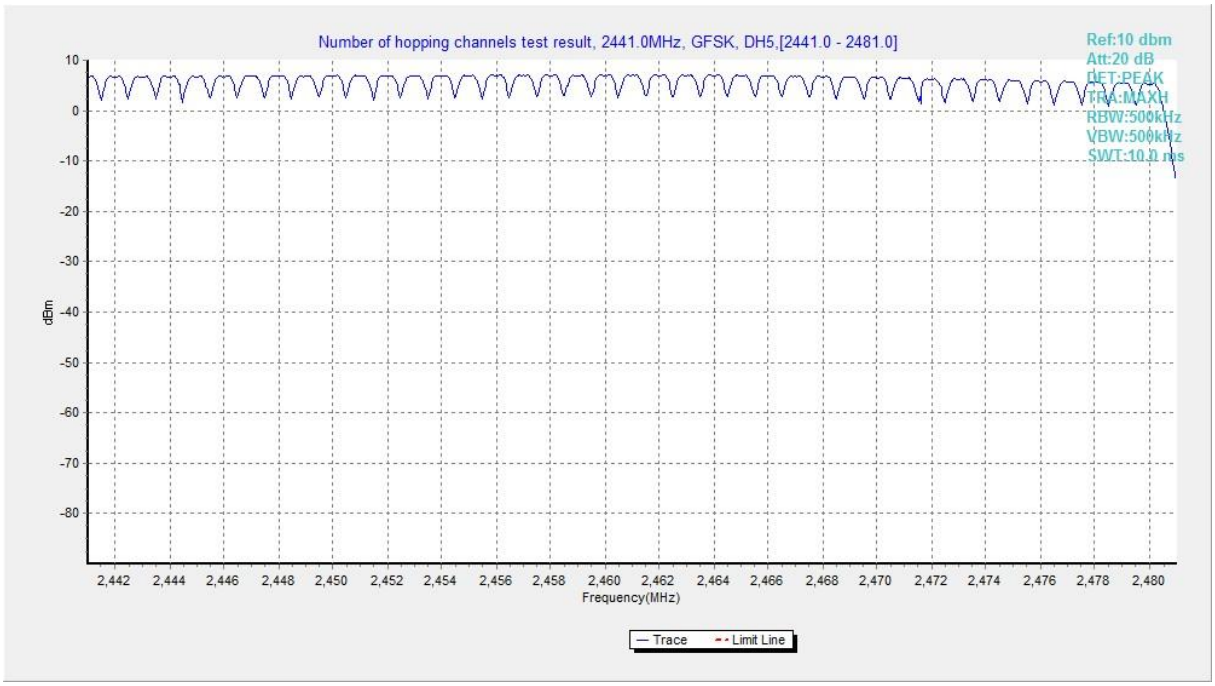

Fig. 76 Hopping channel ch40~78 (GFSK, Ch39)

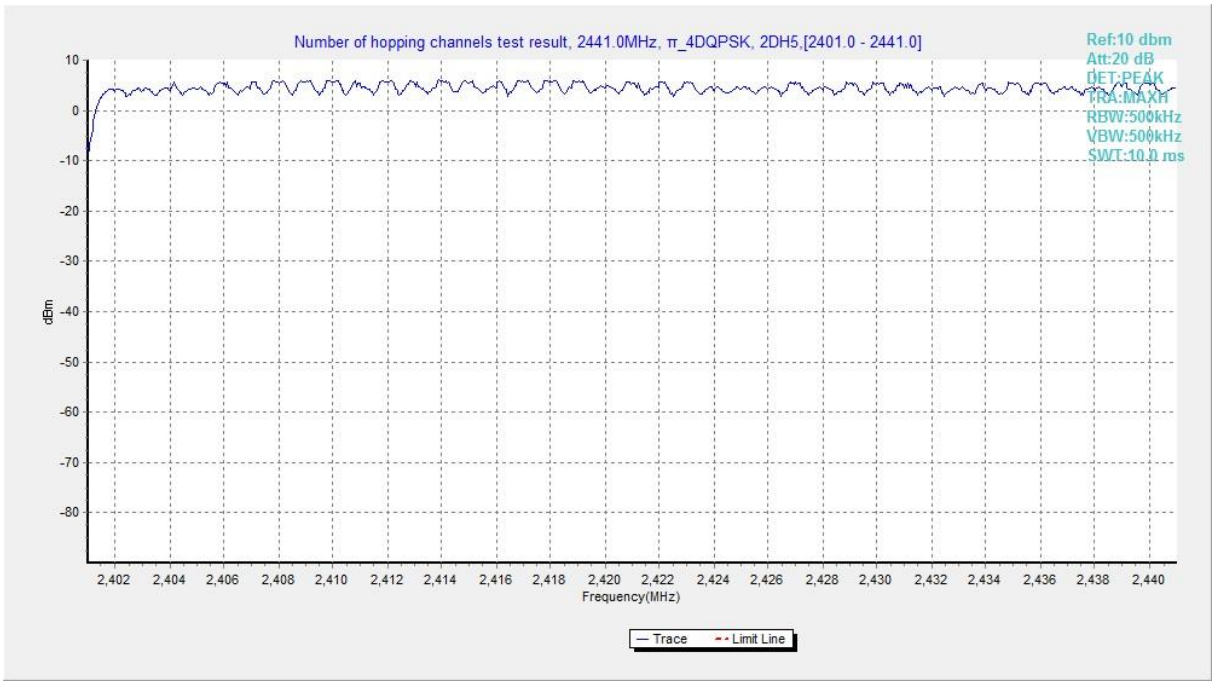

Fig. 77 Hopping channel ch0~39 (π/4 DQPSK, Ch39)

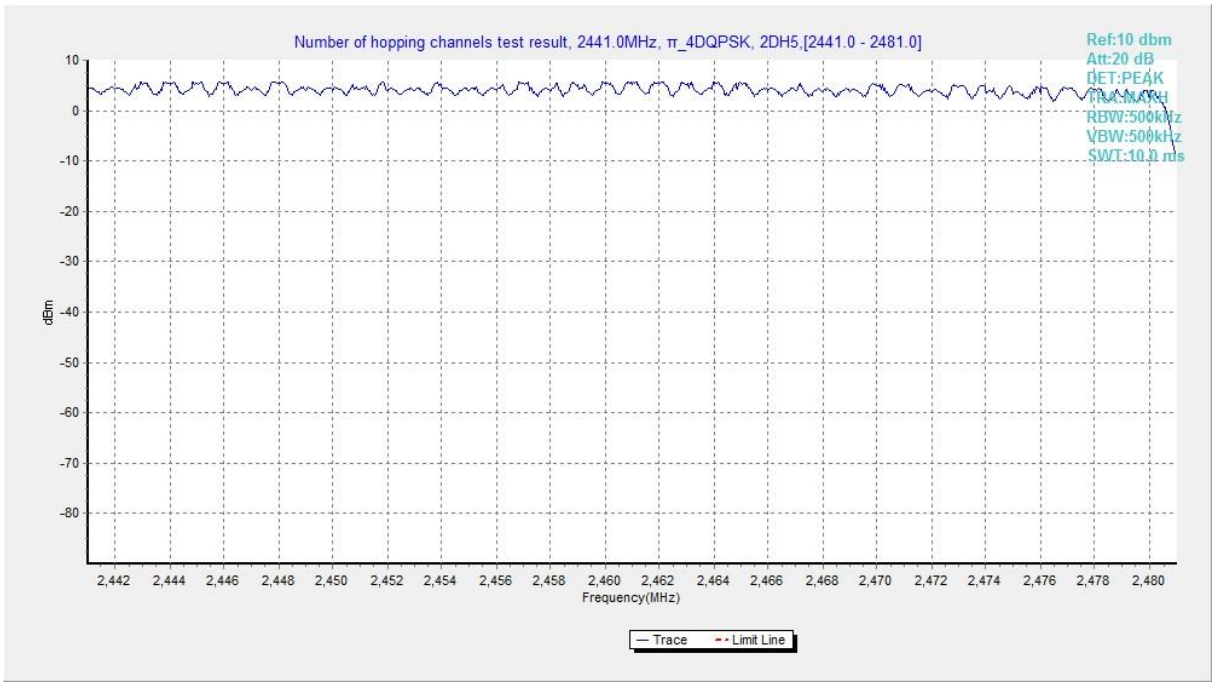

Fig. 78 Hopping channel ch40~78 (π/4 DQPSK, Ch39)

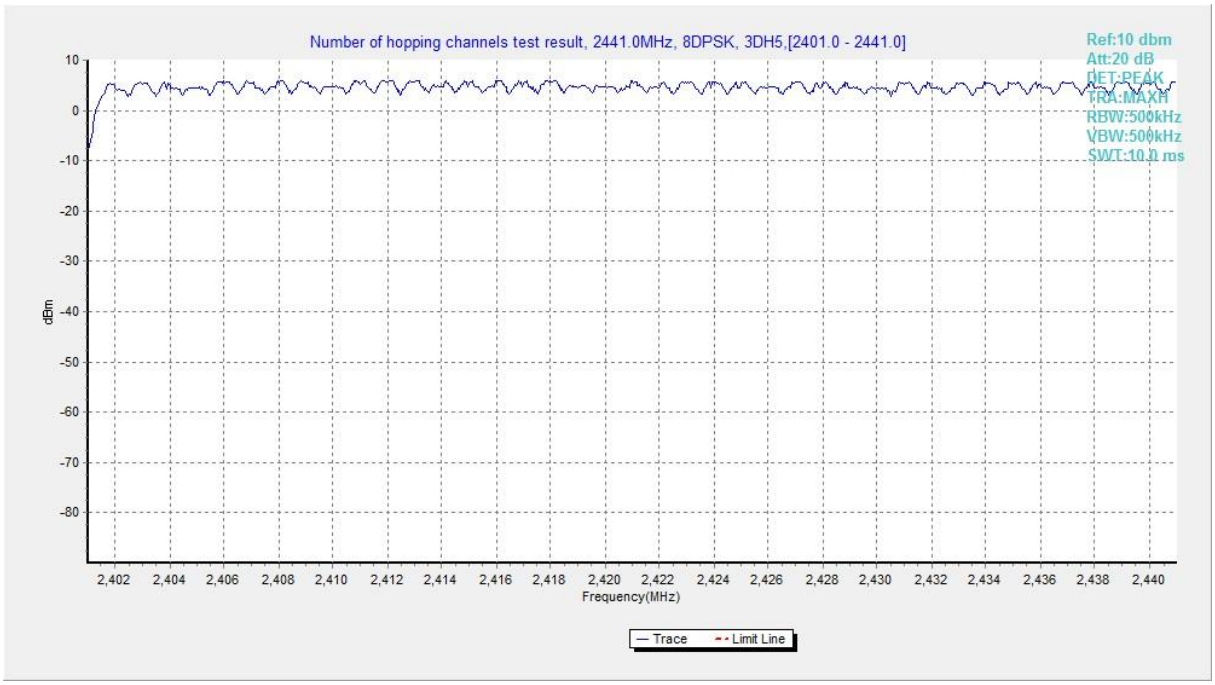

Fig. 79 Hopping channel ch0~39 (8DPSK, Ch39)

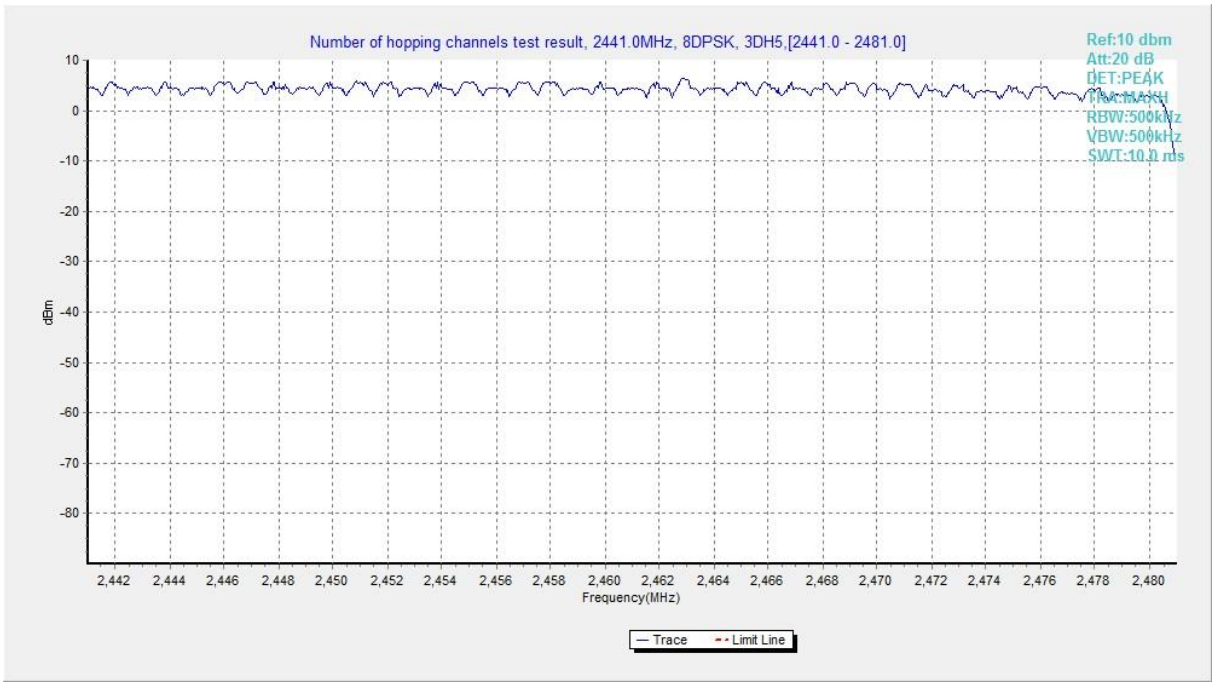

Fig. 80 Hopping channel ch40~78 (8DPSK, Ch39)

A.8 Carrier Frequency Separation

Measurement Limit:

Standard	Limit
FCC 47 CFR Part 15.247(a)	By a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater

Measurement Results:

Mode	Channel	Packet	Separation of hopping channels	Test result (kHz)	Conclusion
GFSK	39	DH5	Fig.81	1050.75	**P**
π/4 DQPSK	39	2-DH5	Fig.82	974.25	**P**
8DPSK	39	3-DH5	Fig.83	1008.75	**P**

See below for test graphs.

Conclusion: Pass

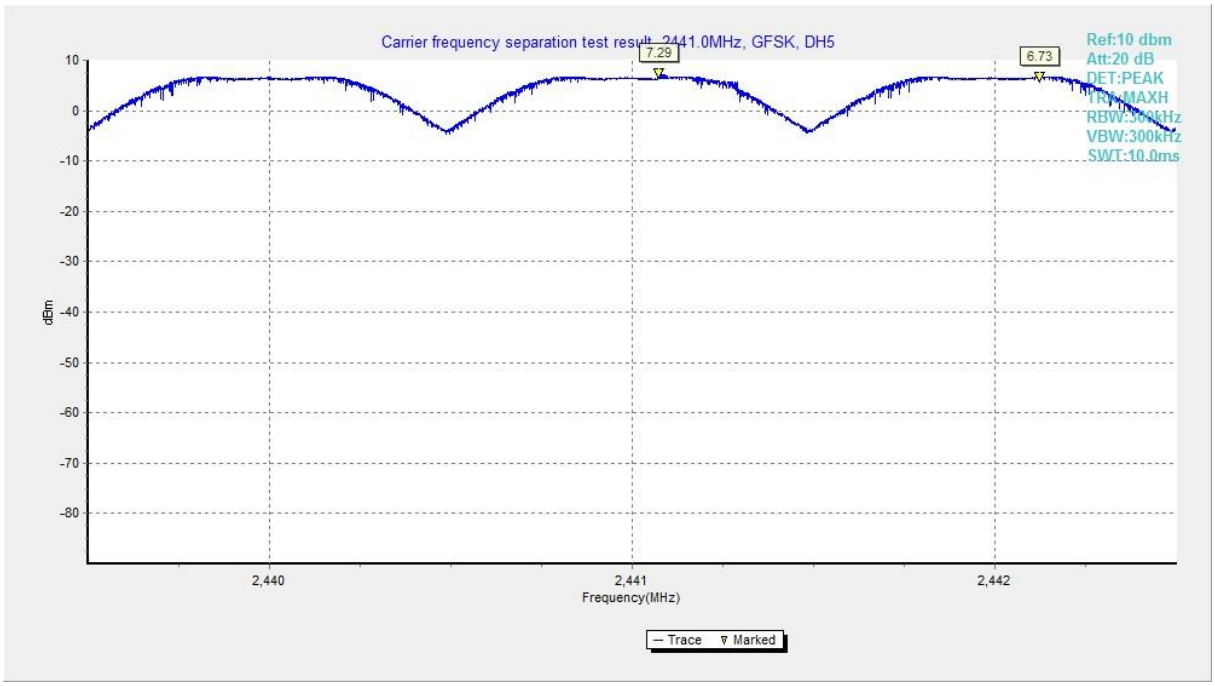

Fig. 81 Carrier Frequency Separation (GFSK, Ch39)

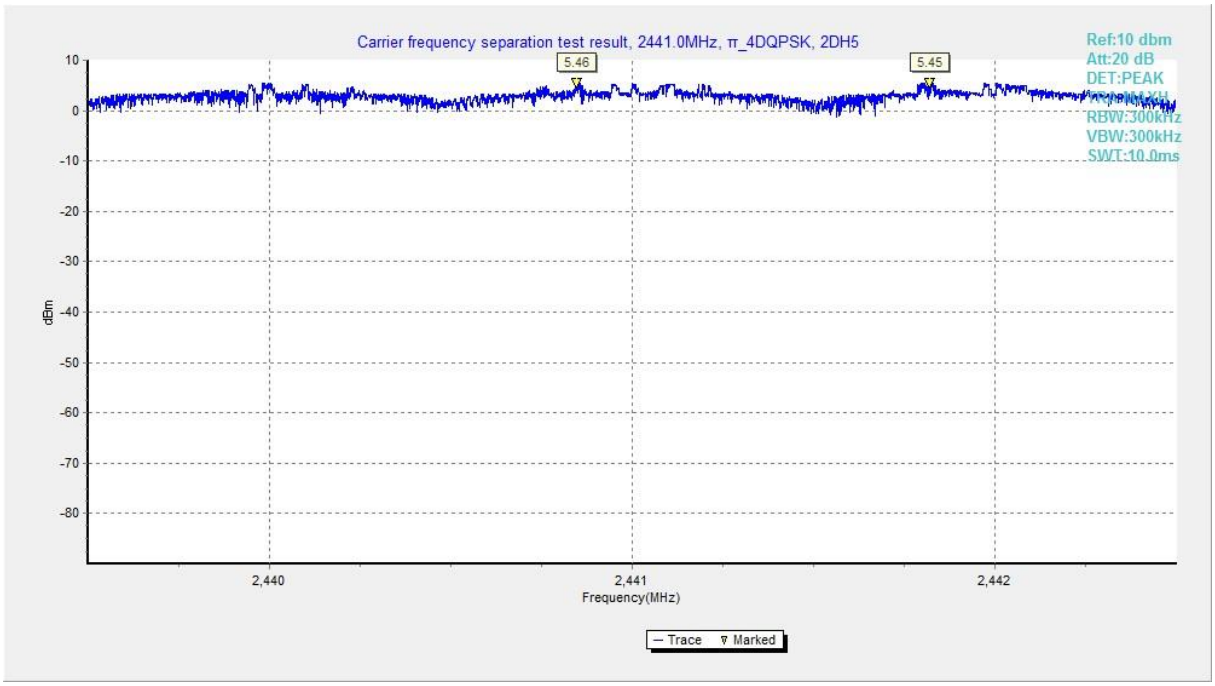

Fig. 82 Carrier Frequency Separation (π/4 DQPSK, Ch39)

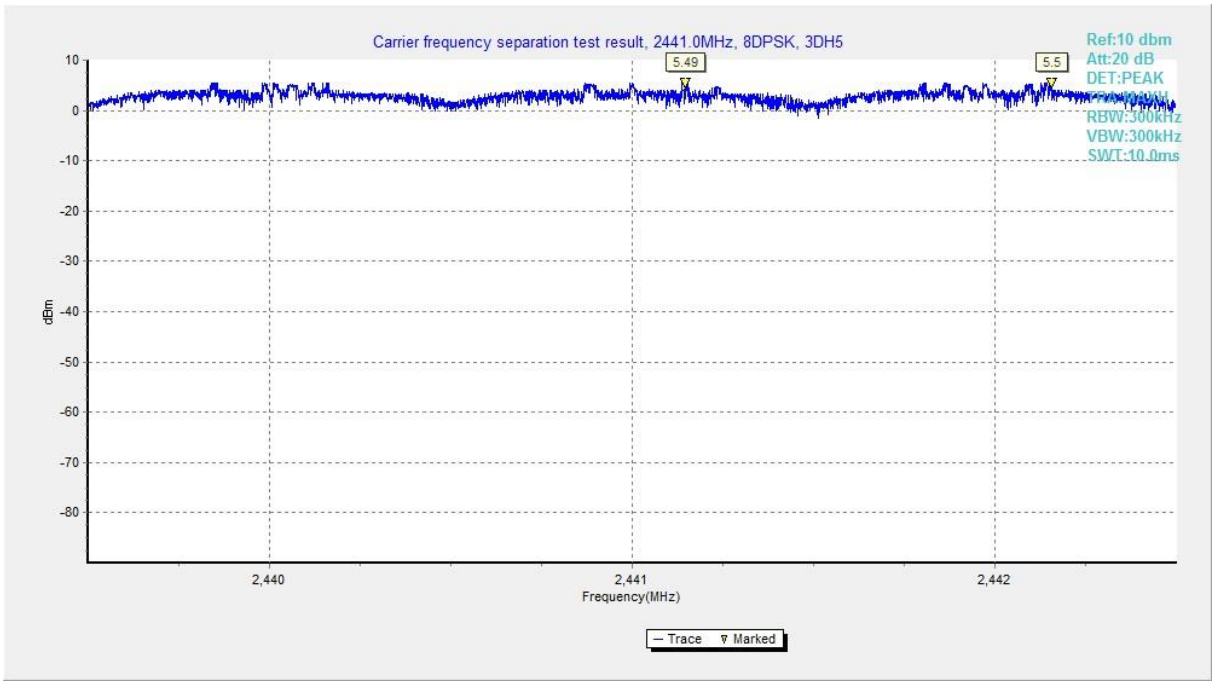

Fig. 83 Carrier Frequency Separation (8DPSK, Ch39)

A.9 AC Power line Conducted Emission

Test Condition:

Voltage (V)	Frequency (Hz)
120	60

Measurement Result and limit:

BT- AE2, AE3, AE4

Frequency range (MHz)	Quasi-peak Limit (dBμV)	Average-peak Limit (dBμV)	Result (dBμV)		Conclusion
			Traffic	Idle	
0.15 to 0.5	66 to 56	56 to 46	Fig.84	Fig.85	**P**
0.5 to 5	56	46			
5 to 30	60	50			
NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.					

Note: The measurement results include the L1 and N measurements.

See below for test graphs.

Conclusion: Pass

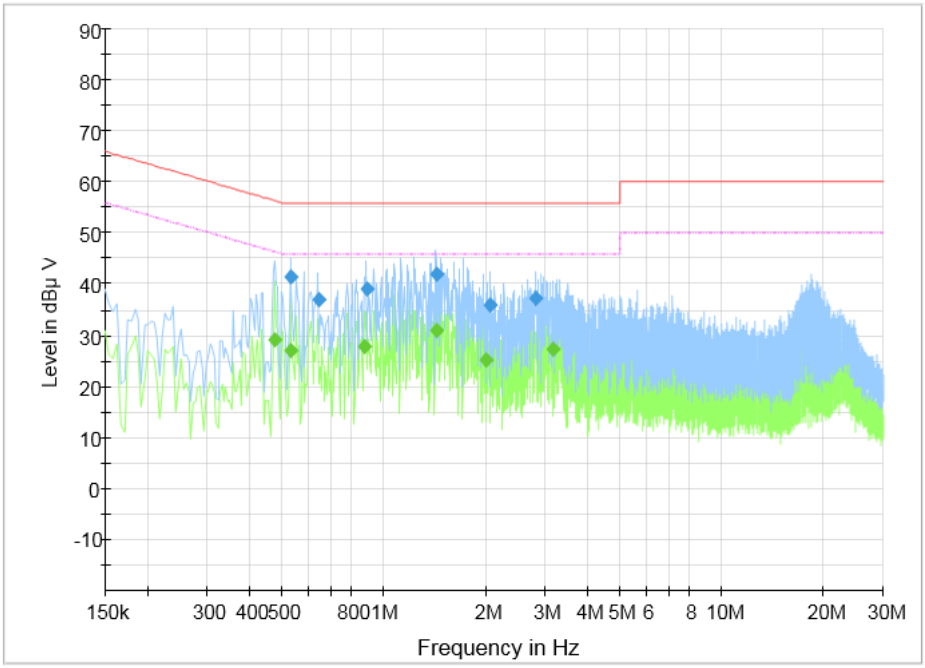

Fig. 84 AC Power line Conducted Emission (Traffic)

Measurement Results: Quasi Peak

Frequency (MHz)	Quasi Peak (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.534021	41.53	56.00	14.47	L1	ON	9.5
0.644893	37.07	56.00	18.93	L1	ON	9.5
0.892221	39.07	56.00	16.93	L1	ON	9.5
1.429521	41.94	56.00	14.06	L1	ON	9.6
2.064429	35.97	56.00	20.03	L1	ON	9.6
2.819443	37.22	56.00	18.78	L1	ON	9.6

Measurement Results: Average

Frequency (MHz)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.478350	29.2	46.37	17.17	L1	ON	9.5
0.534021	26.96	46.00	19.04	L1	ON	9.5
0.879429	27.80	46.00	18.20	L1	ON	9.5
1.429521	31.03	46.00	14.97	L1	ON	9.6
2.017521	25.28	46.00	20.72	L1	ON	9.6
3.160350	27.25	46.00	18.75	L1	ON	9.6

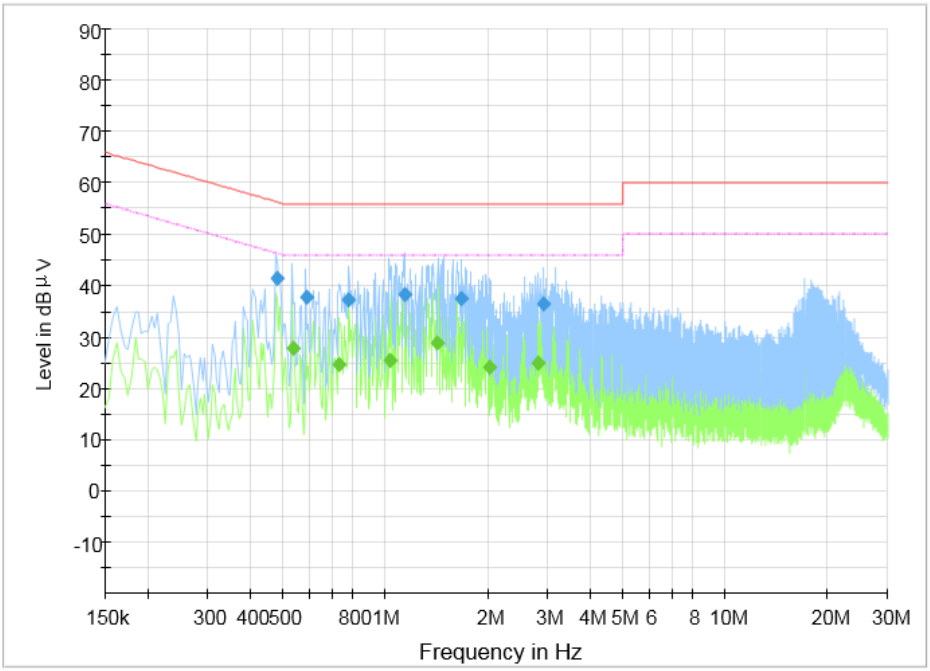

Fig. 85 AC Power line Conducted Emission (Idle)

Measurement Results: Quasi Peak

Frequency (MHz)	Quasi Peak (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.482850	41.31	56.29	14.98	L1	ON	9.5
0.589457	37.64	56.00	18.36	L1	ON	9.5
0.781114	37.26	56.00	18.74	L1	ON	9.5
1.139314	38.18	56.00	17.82	L1	ON	9.6
1.672114	37.51	56.00	18.49	L1	ON	9.6
2.926286	36.42	56.00	19.58	L1	ON	9.6

Measurement Results: Average

Frequency (MHz)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.538286	27.73	46.00	18.27	L1	ON	9.5
0.734443	24.60	46.00	21.40	L1	ON	9.5
1.032943	25.41	46.00	20.59	L1	ON	9.6
1.424786	28.75	46.00	17.25	L1	ON	9.6
2.021786	23.99	46.00	22.01	L1	ON	9.6
2.814943	24.96	46.00	21.04	L1	ON	9.6

*****END OF REPORT*****