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 ~3 GHz	Fig.51	**P**
		3 GHz ~18 GHz	Fig.52	**P**
	39	1 GHz ~3 GHz	Fig.53	**P**
		3 GHz ~18 GHz	Fig.54	**P**
	78	1 GHz ~3 GHz	Fig.55	**P**
		3 GHz ~18 GHz	Fig.56	**P**
	Restricted Band(CH0)	2.38 GHz ~ 2.45 GHz	Fig.57	**P**
	Restricted Band (CH78)	2.45 GHz ~ 2.5 GHz	Fig.58	**P**
π /4 DQPSK	0	1 GHz ~3 GHz	Fig.59	**P**
		3 GHz ~18 GHz	Fig.60	**P**
	39	1 GHz ~3 GHz	Fig.61	**P**
		3 GHz ~18 GHz	Fig.62	**P**
	78	1 GHz ~3 GHz	Fig.63	**P**
		3 GHz ~18 GHz	Fig.64	**P**
	Restricted Band (CH0)	2.38 GHz ~ 2.45 GHz	Fig.65	**P**
	Restricted Band (CH78)	2.45 GHz ~ 2.5 GHz	Fig.66	**P**
8DPSK	0	1 GHz ~3 GHz	Fig.67	**P**
		3 GHz ~18 GHz	Fig.68	**P**
	39	1 GHz ~3 GHz	Fig.69	**P**
		3 GHz ~18 GHz	Fig.70	**P**
	78	1 GHz ~3 GHz	Fig.71	**P**
		3 GHz ~18 GHz	Fig.72	**P**
	Restricted Band (CH0)	2.38 GHz ~ 2.45 GHz	Fig.73	**P**
	Restricted Band (CH78)	2.45 GHz ~ 2.5 GHz	Fig.74	**P**
/	All channels	9 kHz ~30 MHz	Fig.75	**P**
		30 MHz ~1 GHz	Fig.76	**P**
		18 GHz ~26.5 GHz	Fig.77	**P**

Worst Case Result

GFSK CH0 (1-18GHz)

Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol	Corr. (dB)
9648.50000	---	35.56	54.00	18.44	V	5.7
11420.0000	44.87	---	74.00	29.13	V	7.4
12097.5000	46.74	---	74.00	27.26	H	9.5
12174.0000	---	33.78	54.00	20.22	V	9.6
12940.5000	46.22	---	74.00	27.78	V	10.0
12960.5000	---	33.53	54.00	20.47	H	10.0
14504.0000	---	35.77	54.00	18.23	V	12.9
15180.0000	47.78	---	74.00	26.22	H	13.3
15868.0000	49.06	---	74.00	24.94	V	14.7
16472.0000	---	36.96	54.00	17.04	H	15.8
17398.5000	50.24	---	74.00	23.76	V	16.3
17573.5000	---	37.92	54.00	16.08	H	16.9

π/4 DQPSK CH0 (1-18GHz)

Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol	Corr. (dB)
9648.00000	---	40.58	54.00	13.42	H	5.7
9776.00000	44.77	---	74.00	29.23	H	6.1
10765.5000	---	31.96	54.00	22.04	H	7.3
11144.0000	44.75	---	74.00	29.25	V	7.4
12549.0000	---	33.20	54.00	20.80	V	9.7
12650.0000	46.51	---	74.00	27.49	H	9.9
14431.0000	49.57	---	74.00	24.43	V	12.8
14466.0000	---	35.61	54.00	18.39	V	12.7
15923.0000	---	36.80	54.00	17.20	V	15.0
15924.0000	48.93	---	74.00	25.07	V	15.0
16962.5000	51.36	---	74.00	22.64	V	16.3
17166.0000	---	37.58	54.00	16.42	V	16.2

8DPSK CH0 (1-18GHz)

Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol	Corr. (dB)
9648.00000	---	41.00	54.00	13.00	V	5.7
9648.50000	45.67	---	74.00	28.33	V	5.7
11707.0000	---	33.10	54.00	20.90	V	8.7
11892.0000	45.87	---	74.00	28.13	V	8.9
12716.5000	46.56	---	74.00	27.44	H	9.9
12945.0000	---	33.52	54.00	20.48	H	10.0
14095.0000	---	34.49	54.00	19.51	H	12.1
14427.0000	48.33	---	74.00	25.67	V	12.8
15936.5000	---	36.78	54.00	17.22	V	14.9
15996.5000	49.12	---	74.00	24.88	V	15.0
16993.0000	---	37.82	54.00	16.18	V	16.5
17059.0000	50.01	---	74.00	23.99	H	16.2

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

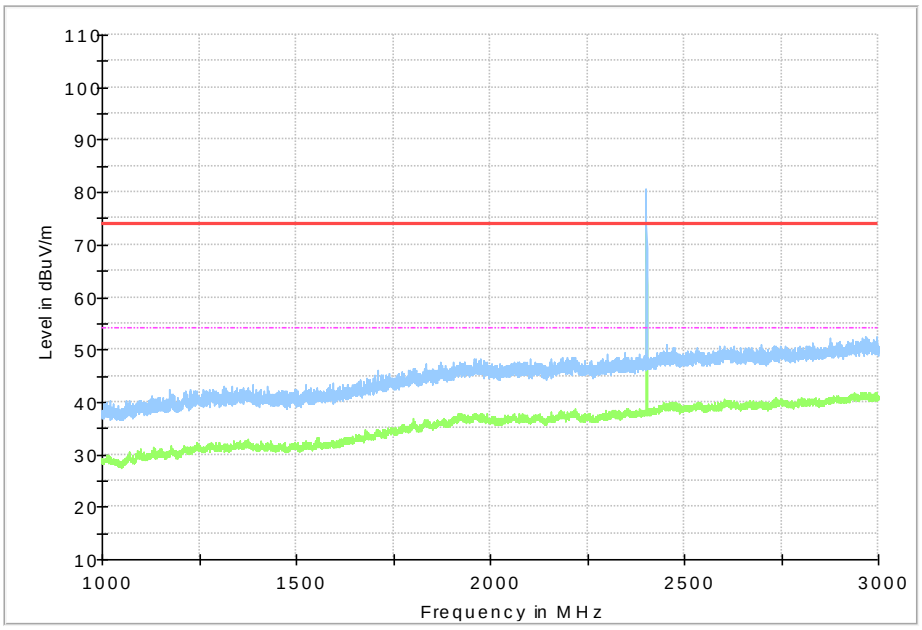

Fig. 51 Radiated Spurious Emission (GFSK, Ch0, 1 GHz ~3 GHz)

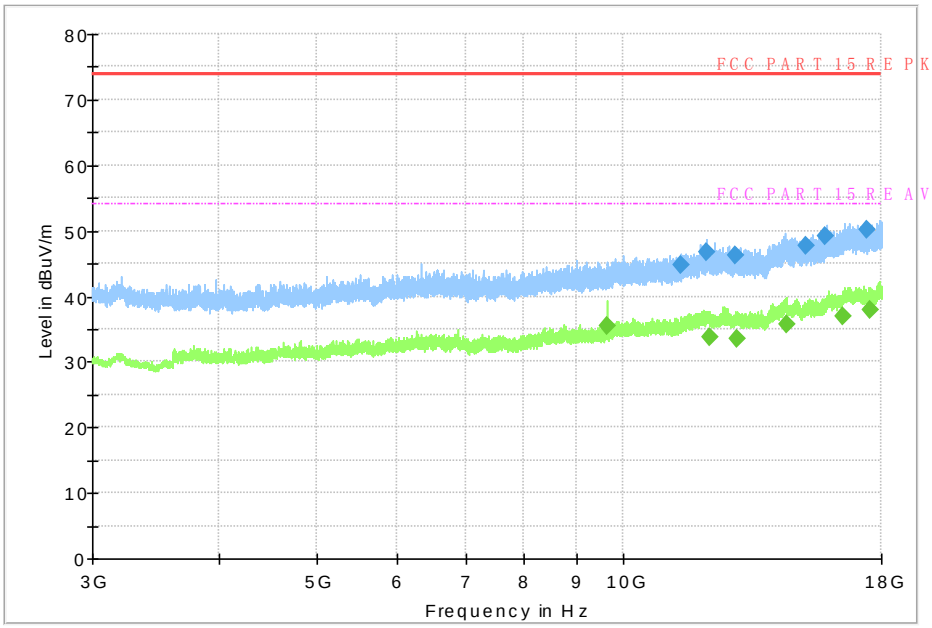

Fig. 52 Radiated Spurious Emission (GFSK, Ch0, 3 GHz ~18 GHz)

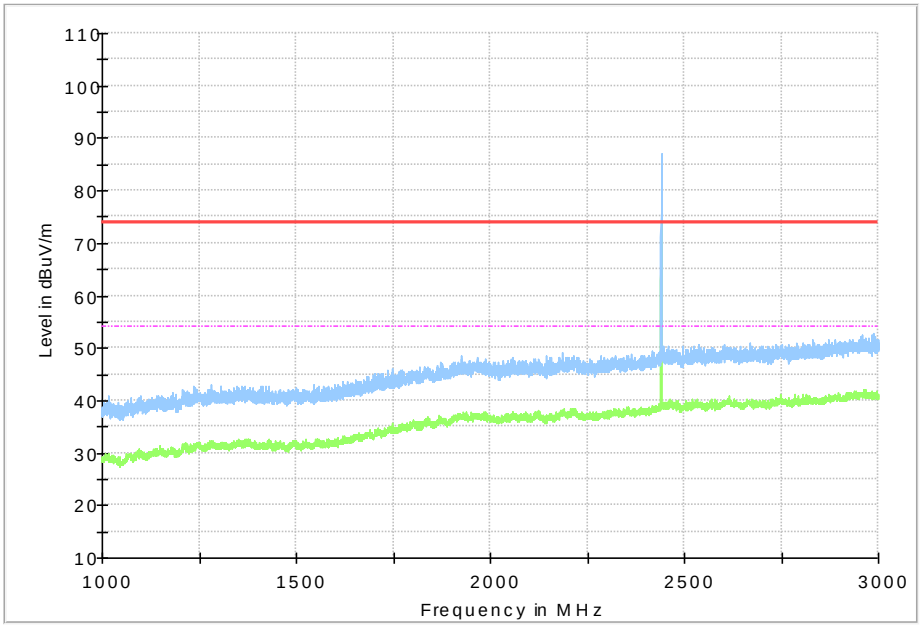

Fig. 53 Radiated Spurious Emission (GFSK, Ch39, 1 GHz ~3 GHz)

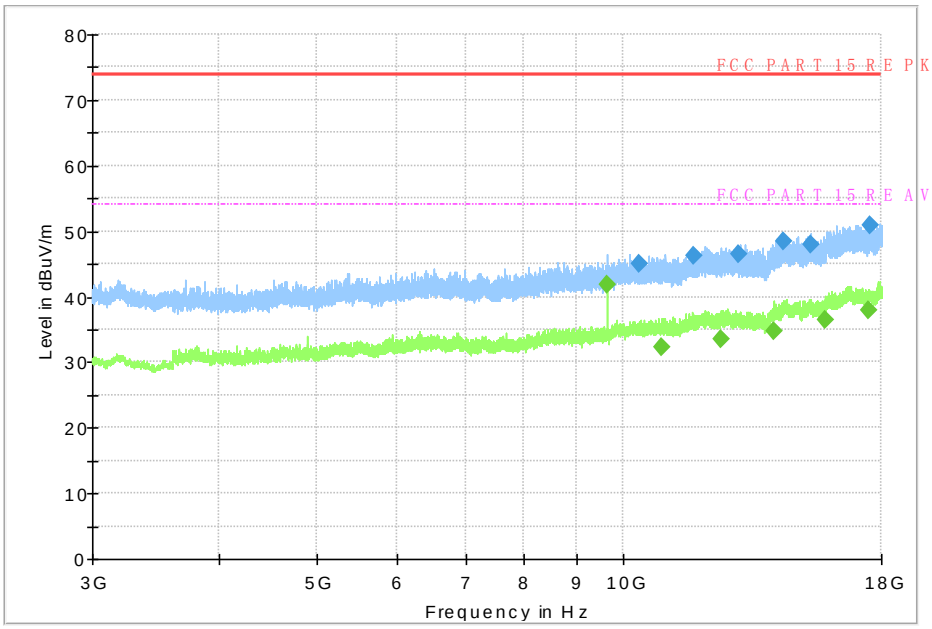

Fig. 54 Radiated Spurious Emission (GFSK, Ch39, 3 GHz ~18 GHz)

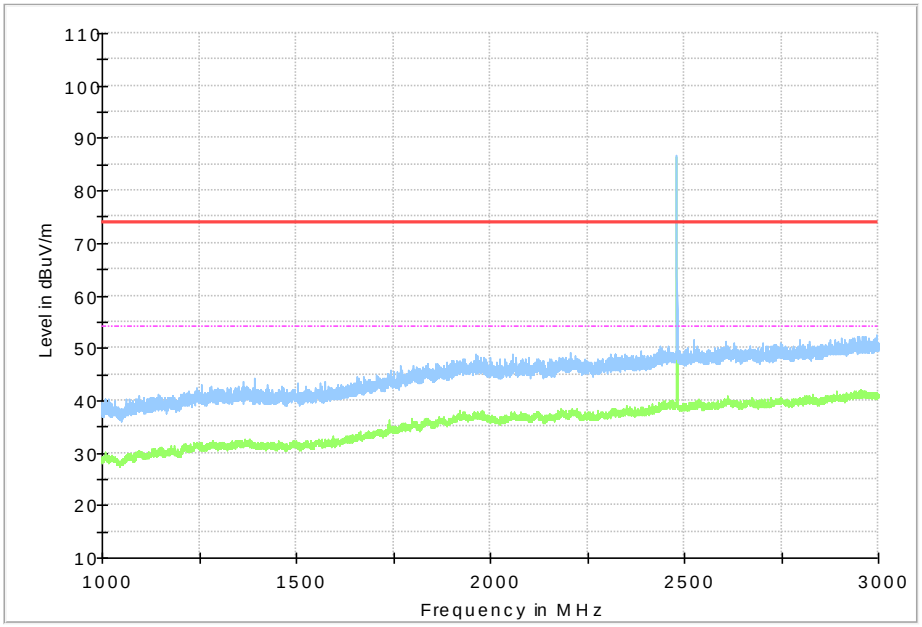

Fig. 55 Radiated Spurious Emission (GFSK, Ch78, 1 GHz ~3 GHz)

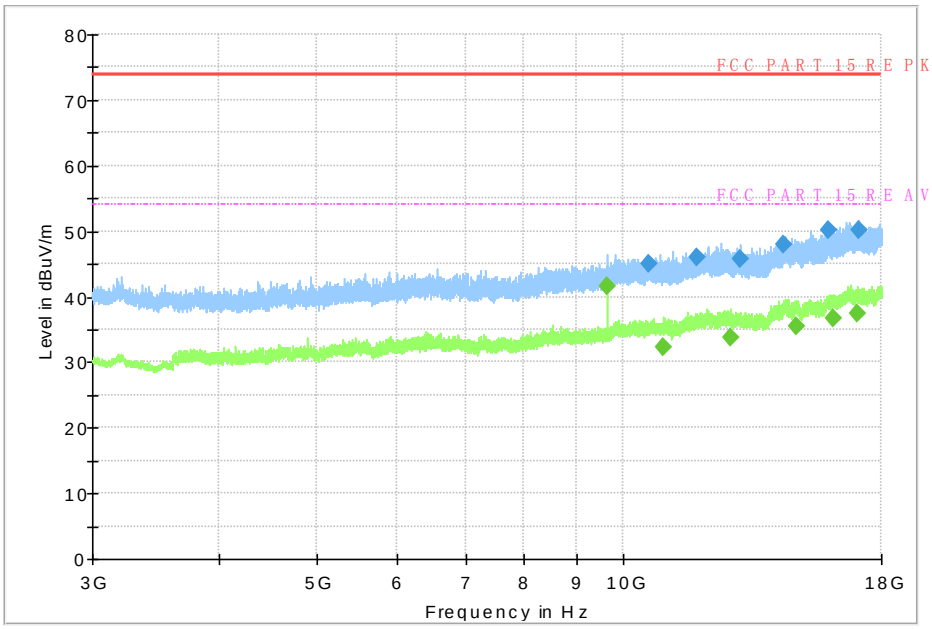

Fig. 56 Radiated Spurious Emission (GFSK, Ch78, 3 GHz ~18 GHz)

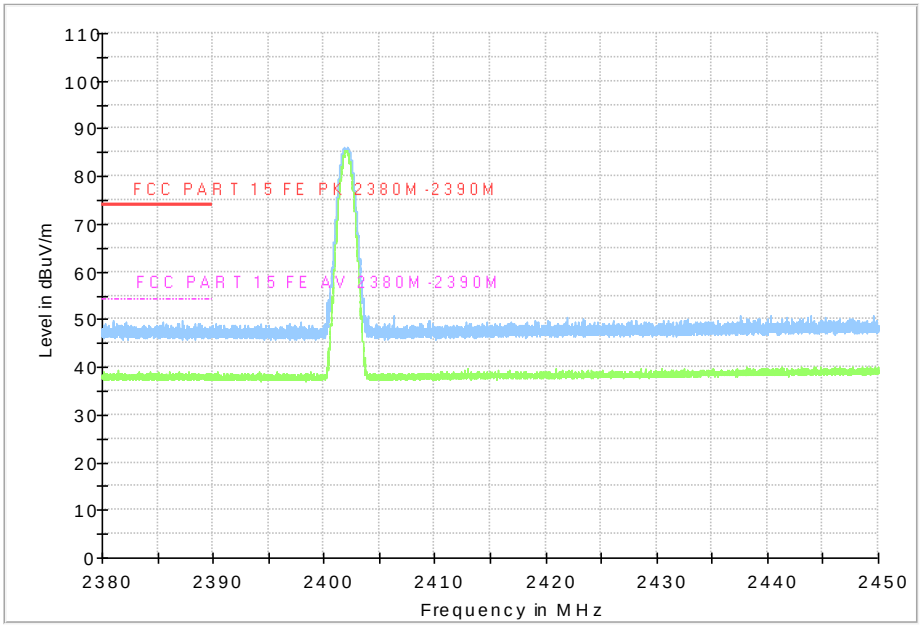

Fig. 57 Radiated Band Edges (GFSK, Ch0, 2380GHz~2450GHz)

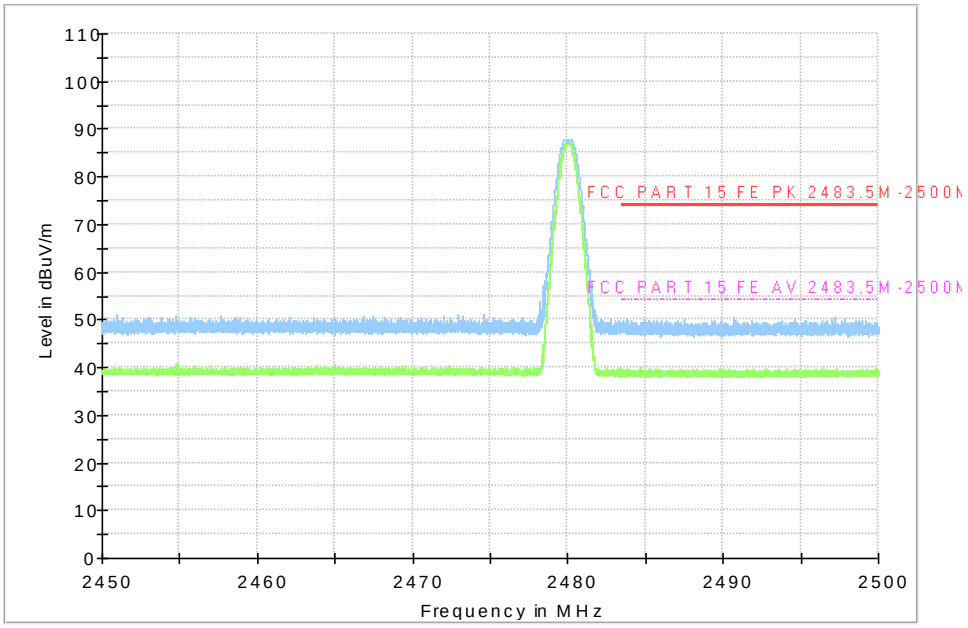

Fig. 58 Radiated Band Edges (GFSK, Ch78, 2450GHz~2500GHz)

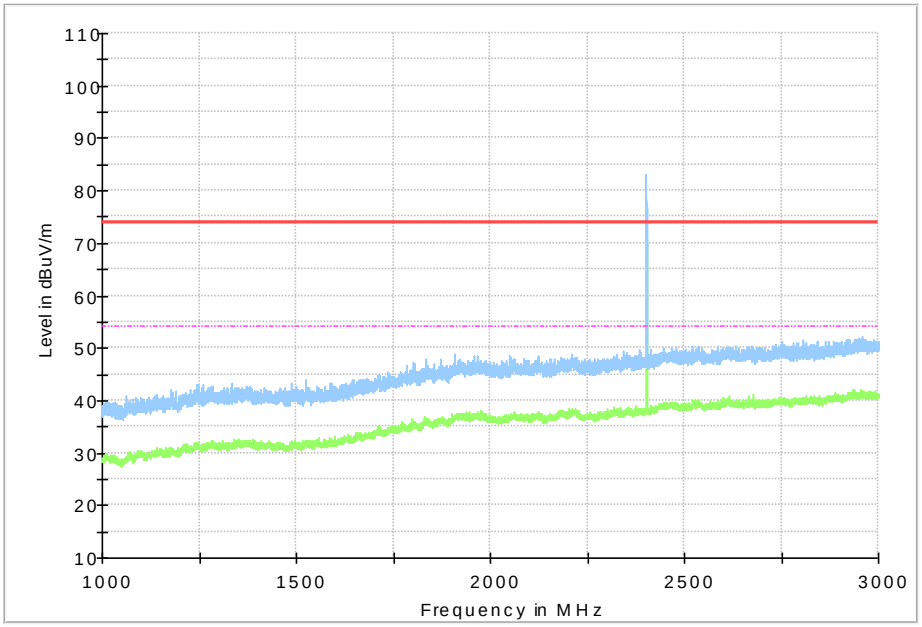

Fig. 59 Radiated Spurious Emission (π /4 DQPSK, Ch0, 1 GHz ~3 GHz)

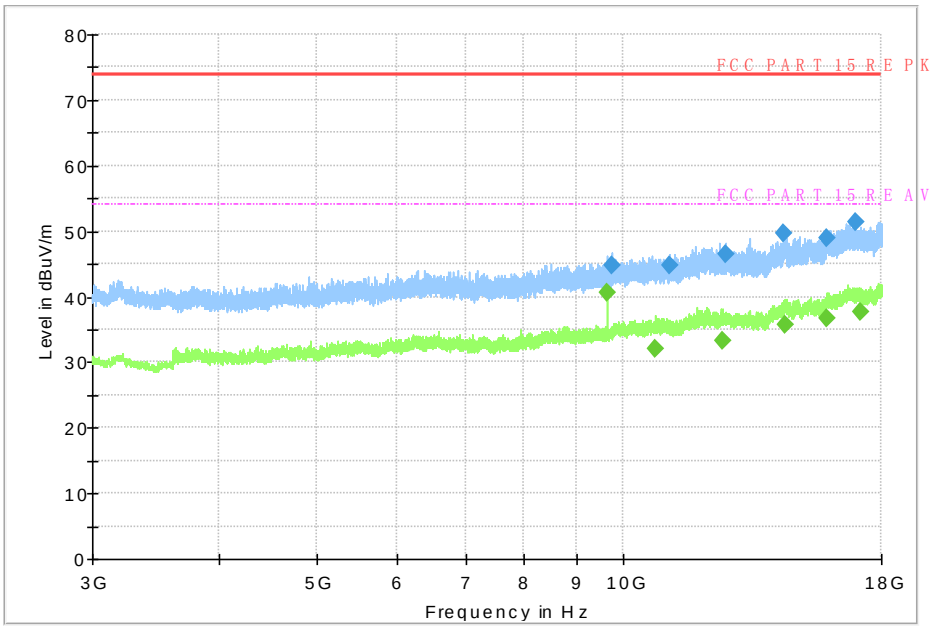

Fig. 60 Radiated Spurious Emission (π /4 DQPSK, Ch0, 3 GHz ~18 GHz)

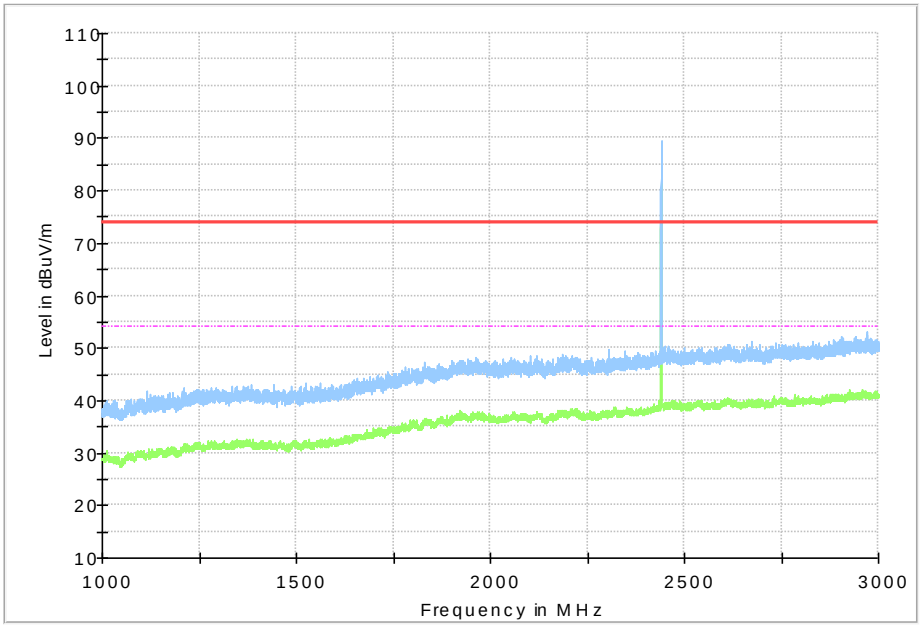

Fig. 61 Radiated Spurious Emission (π /4 DQPSK, Ch39, 1 GHz ~3 GHz)

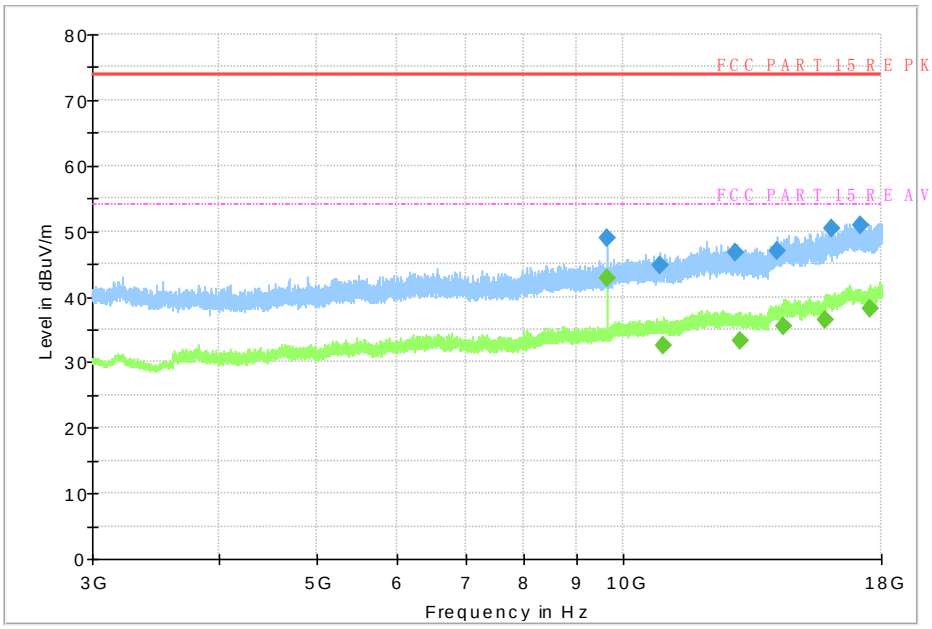

Fig. 62 Radiated Spurious Emission (π /4 DQPSK, Ch39, 3 GHz ~18 GHz)

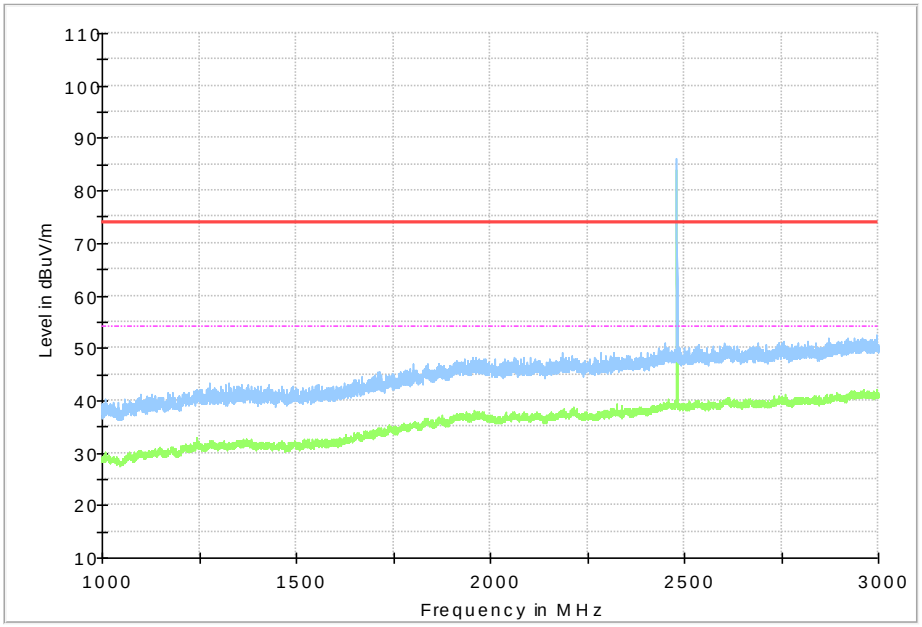

Fig. 63 Radiated Spurious Emission (π /4 DQPSK, Ch78, 1 GHz ~3 GHz)

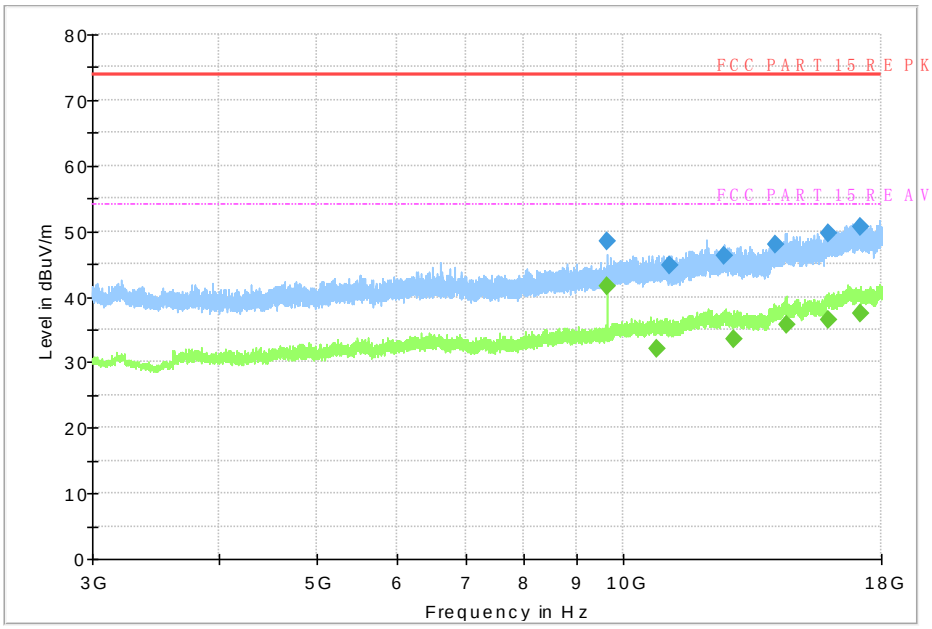

Fig. 64 Radiated Spurious Emission (π /4 DQPSK, Ch78, 3 GHz ~18 GHz)

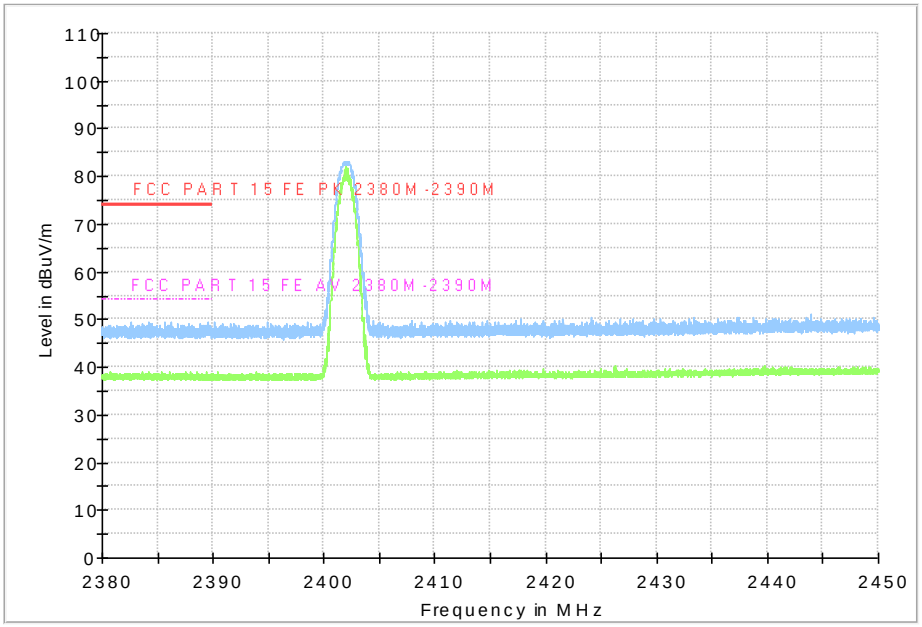

Fig. 65 Radiated Band Edges (π/4 DQPSK, Ch0, 2380GHz~2450GHz)

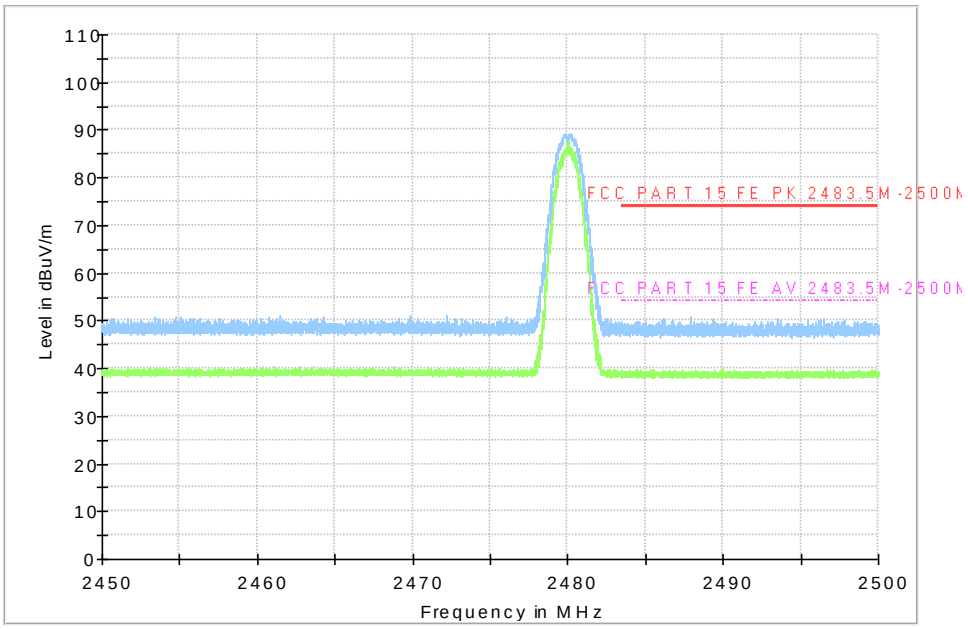

Fig. 66 Radiated Band Edges (π/4 DQPSK, Ch78, 2450GHz~2500GHz)

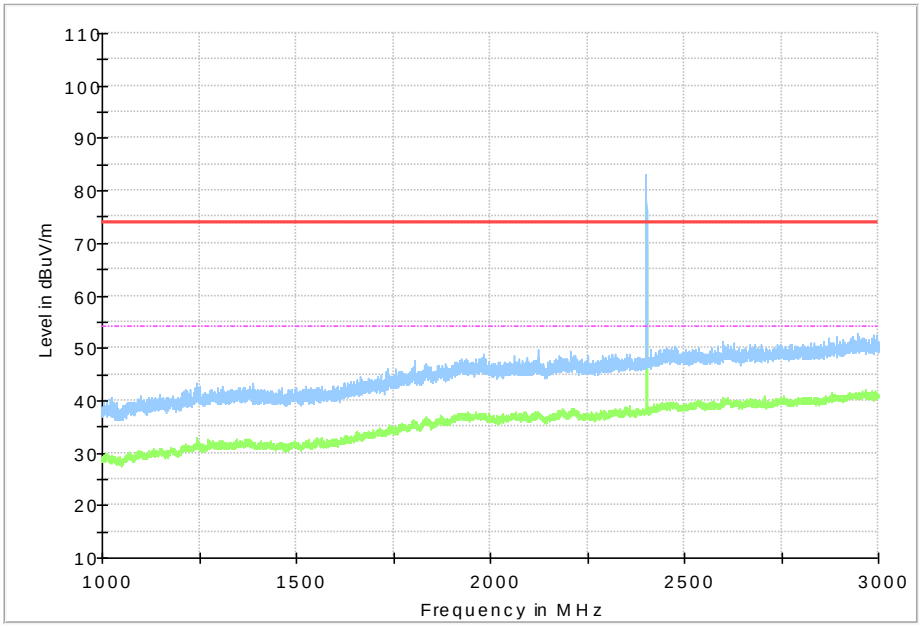

Fig. 67 Radiated Spurious Emission (8DPSK, Ch0, 1 GHz ~3 GHz)

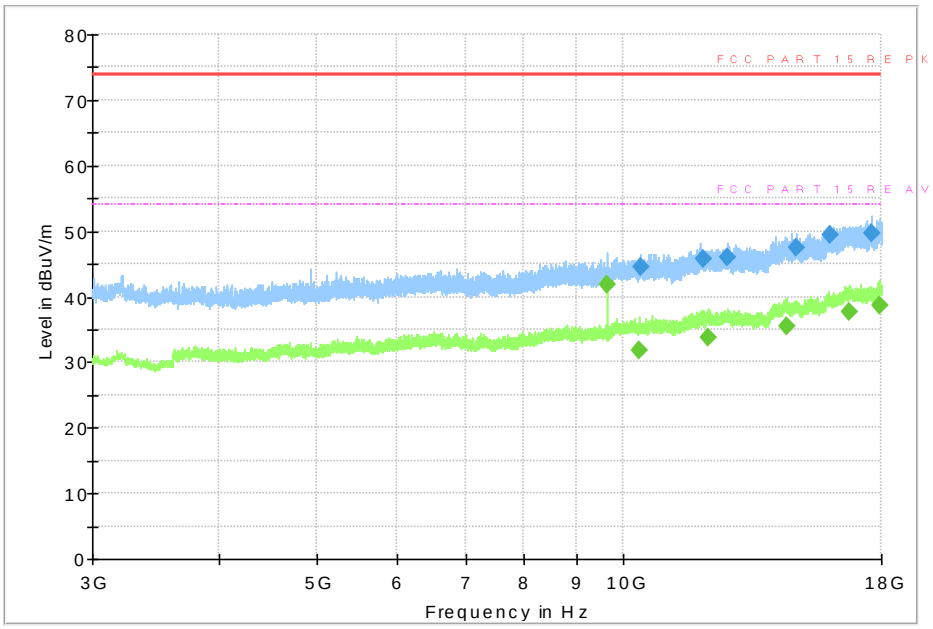

Fig. 68 Radiated Spurious Emission (8DPSK, Ch0, 3 GHz ~18 GHz)

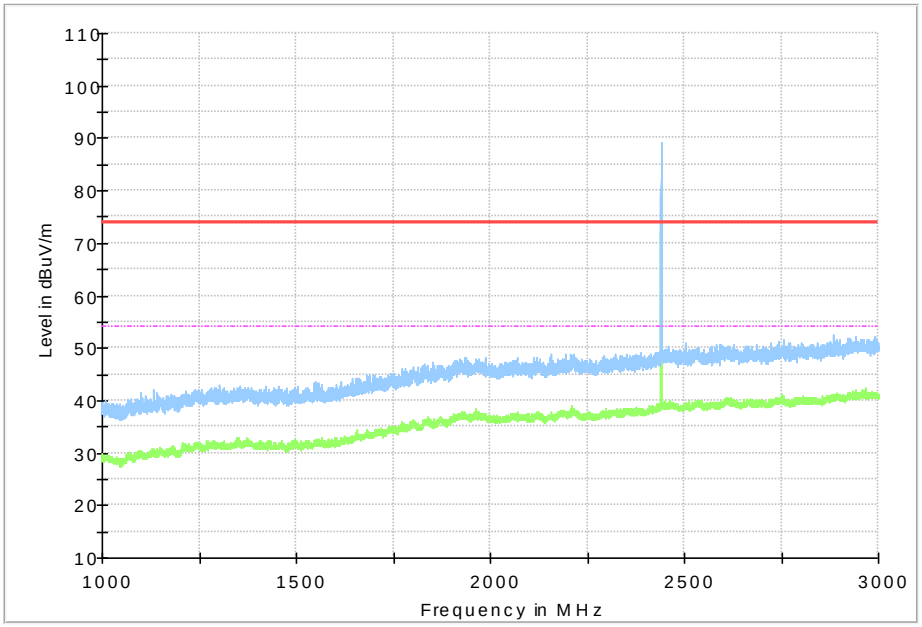

Fig. 69 Radiated Spurious Emission (8DPSK, Ch39, 1 GHz ~3 GHz)

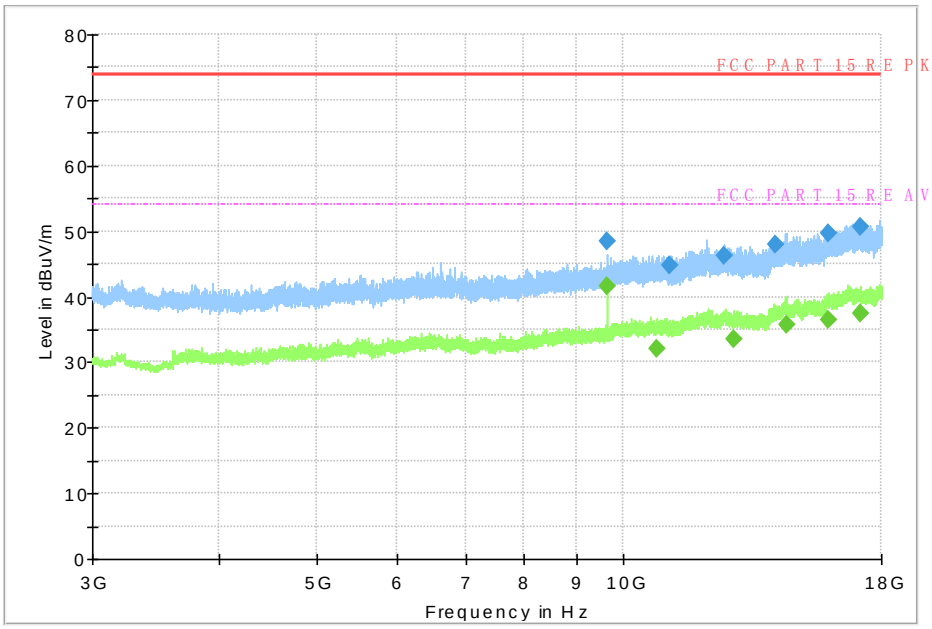

Fig. 70 Radiated Spurious Emission (8DPSK, Ch39, 3 GHz ~18 GHz)

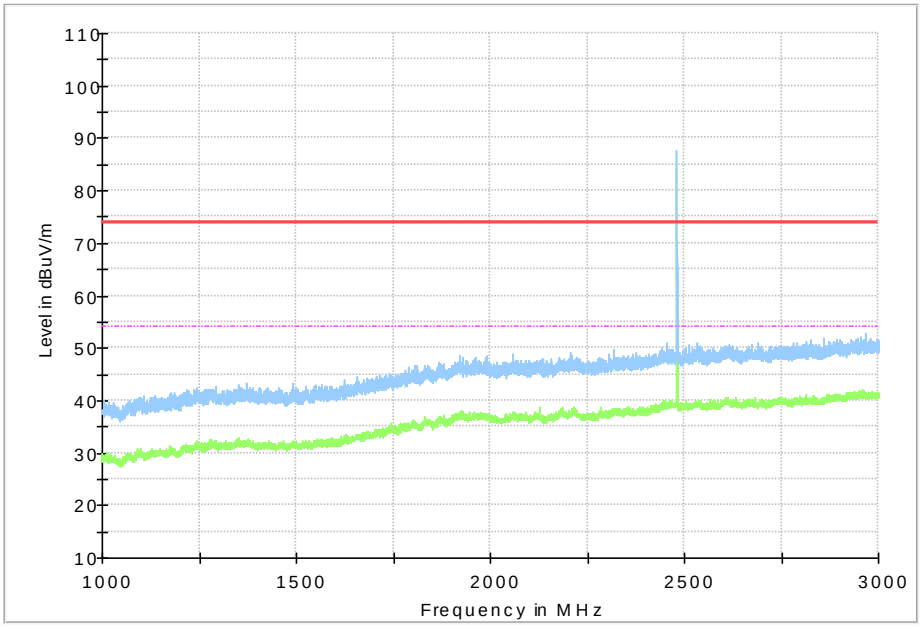

Fig. 71 Radiated Spurious Emission (8DPSK, Ch78, 1 GHz ~3 GHz)

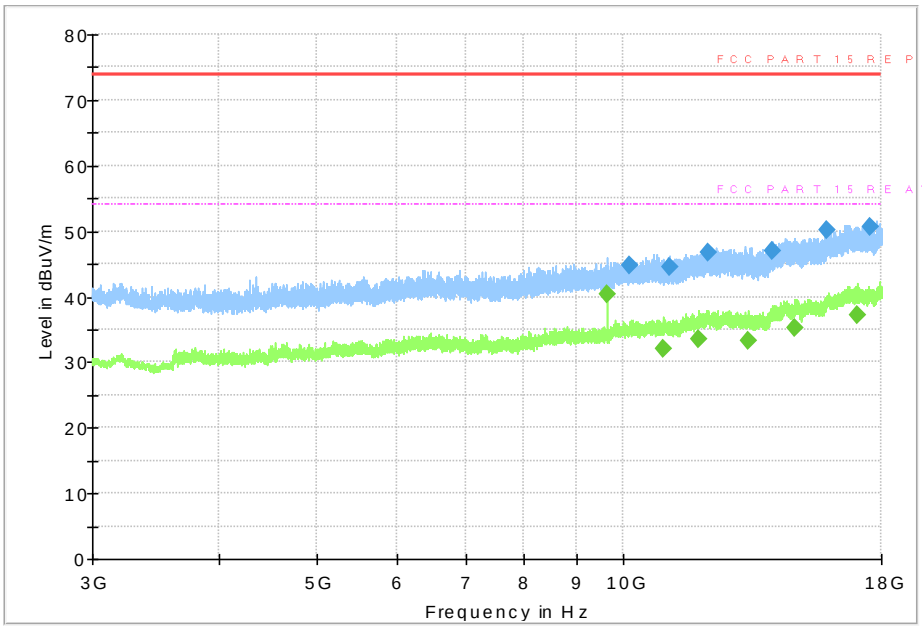

Fig. 72 Radiated Spurious Emission (8DPSK, Ch78, 3 GHz ~18 GHz)

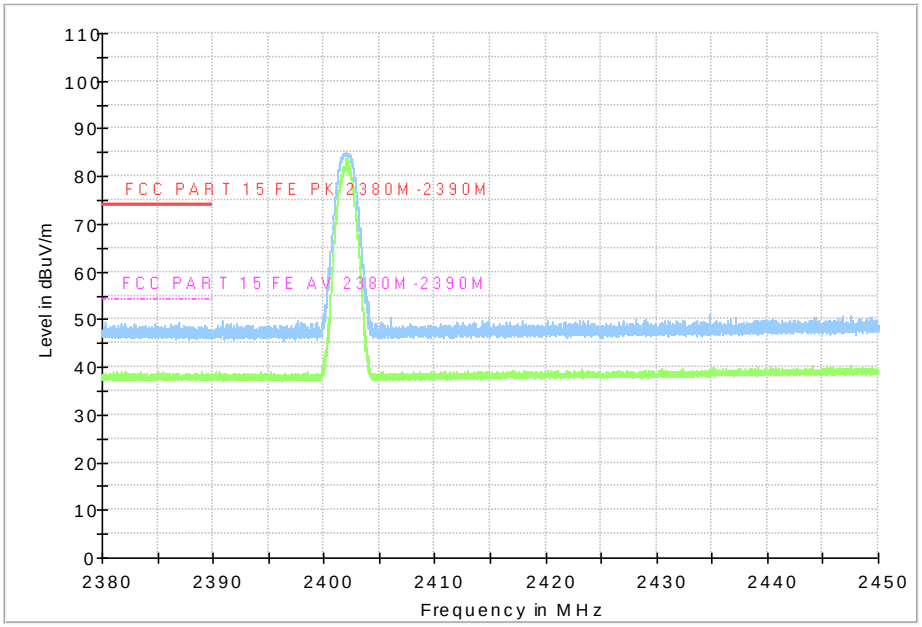

Fig. 73 Radiated Band Edges (8DPSK, Ch0, 2380GHz~2450GHz)

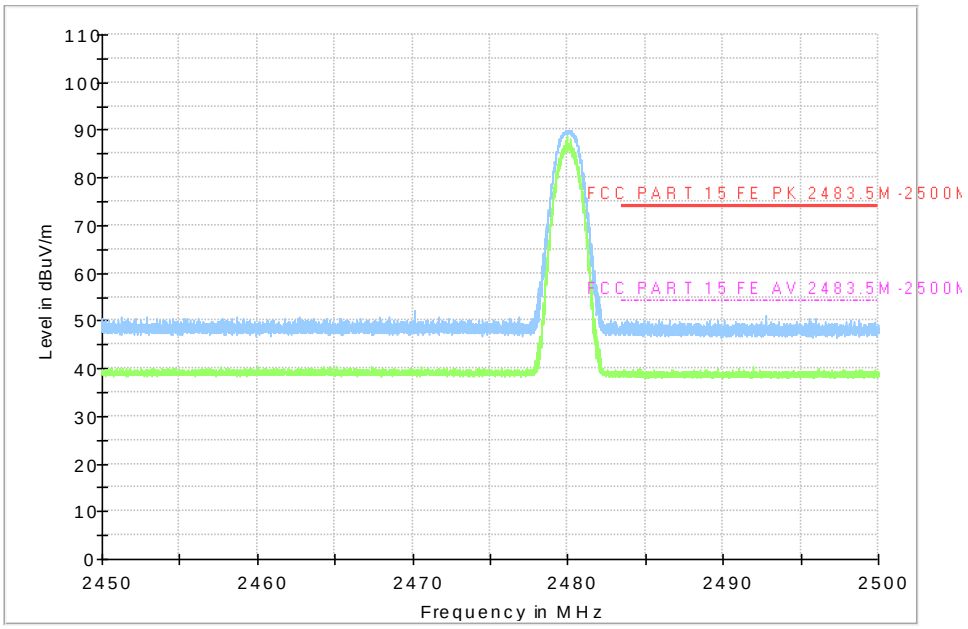

Fig. 74 Radiated Band Edges (8DPSK, Ch78, 2450GHz~2500GHz)

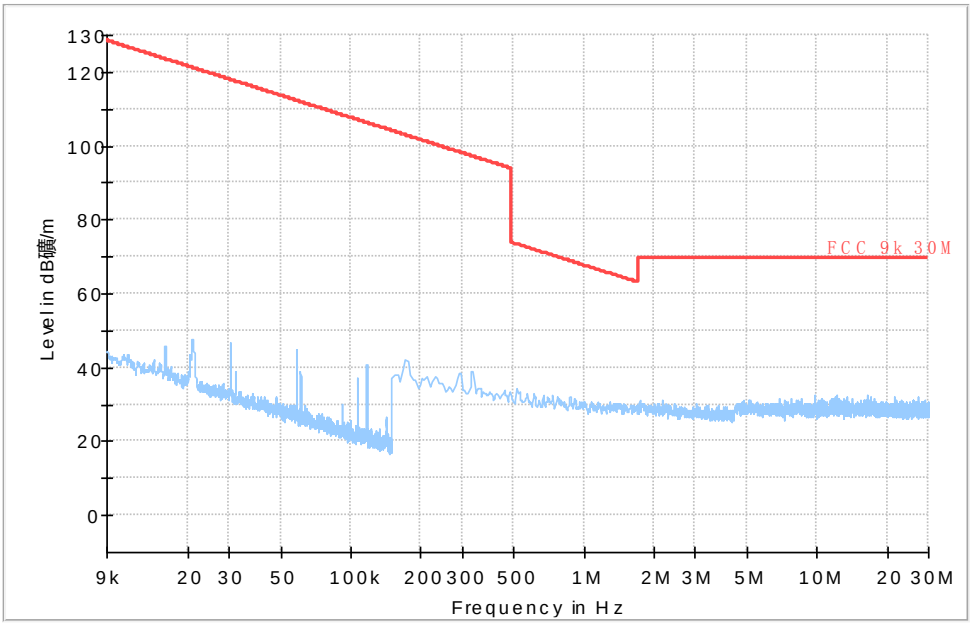

Fig. 75 Radiated Spurious Emission (All Channels, 9 kHz ~30 MHz)

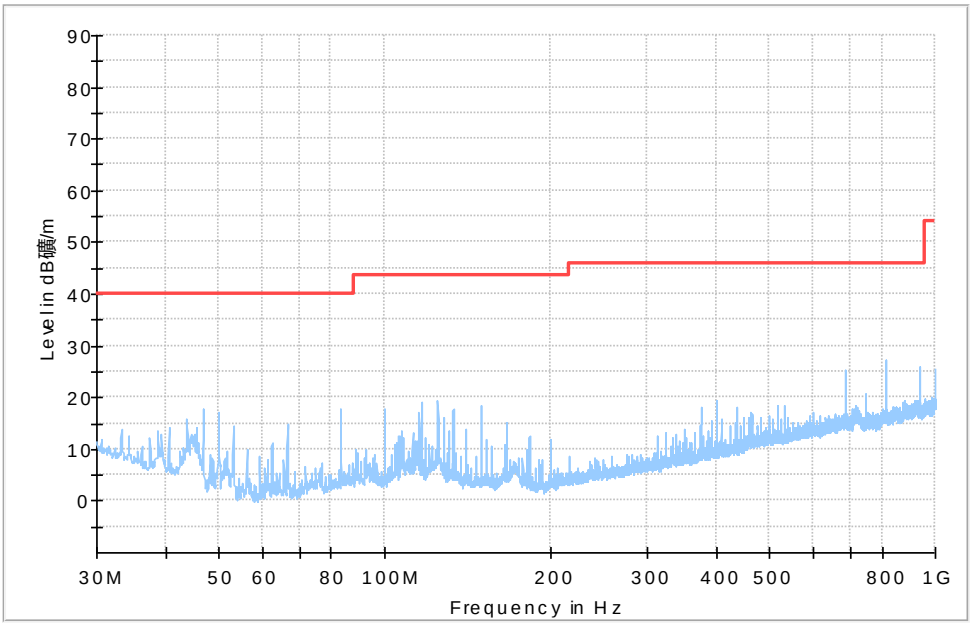

Fig. 76 Radiated Spurious Emission (All Channels, 30 MHz ~1 GHz)

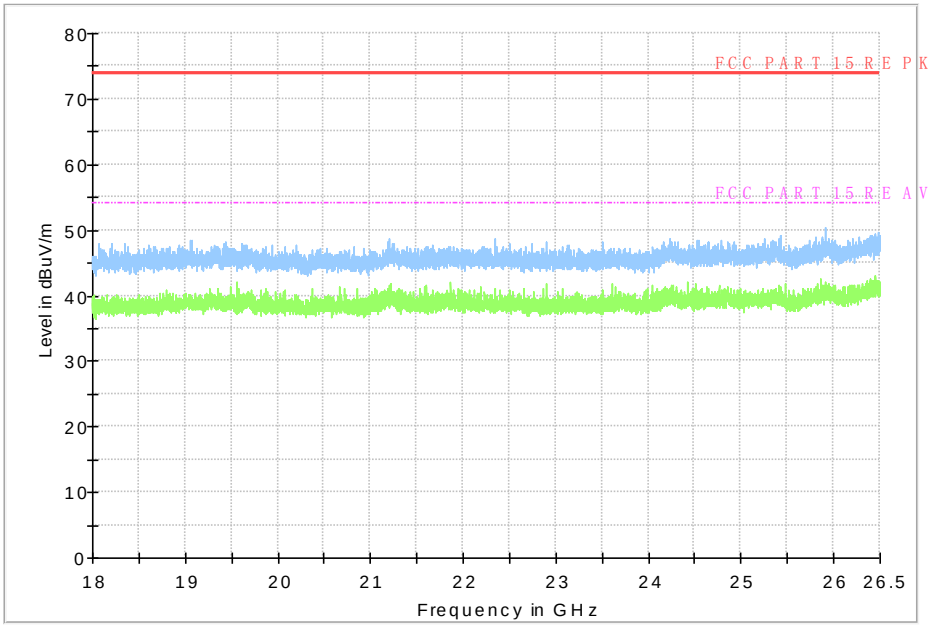

Fig. 77 Radiated Spurious Emission (All Channels, 18 GHz ~26.5 GHz)

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.78	936.00	/
	39	Fig.79	936.75	
	78	Fig.80	936.75	
π /4 DQPSK	0	Fig.81	1284.75	/
	39	Fig.82	1277.25	
	78	Fig.83	1277.25	
8DPSK	0	Fig.84	1292.25	/
	39	Fig.85	1265.25	
	78	Fig.86	1265.25	

See below for test graphs.

Conclusion: PASS

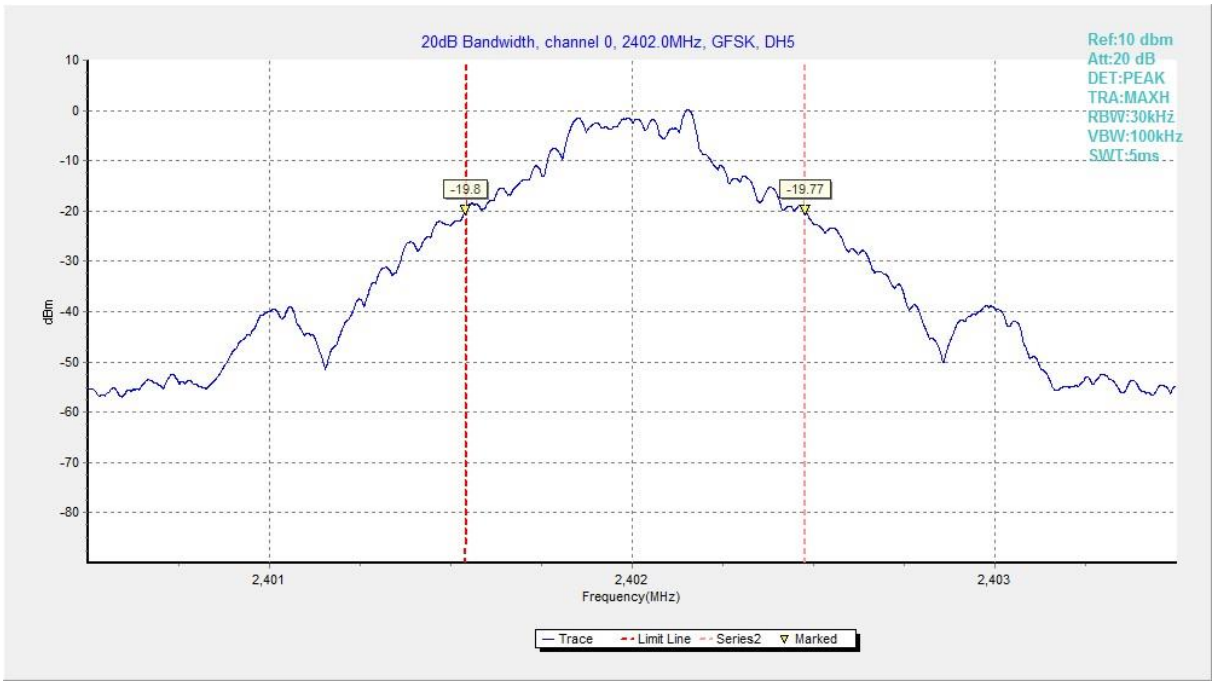

Fig. 78 20dB Bandwidth (GFSK, Ch 0)

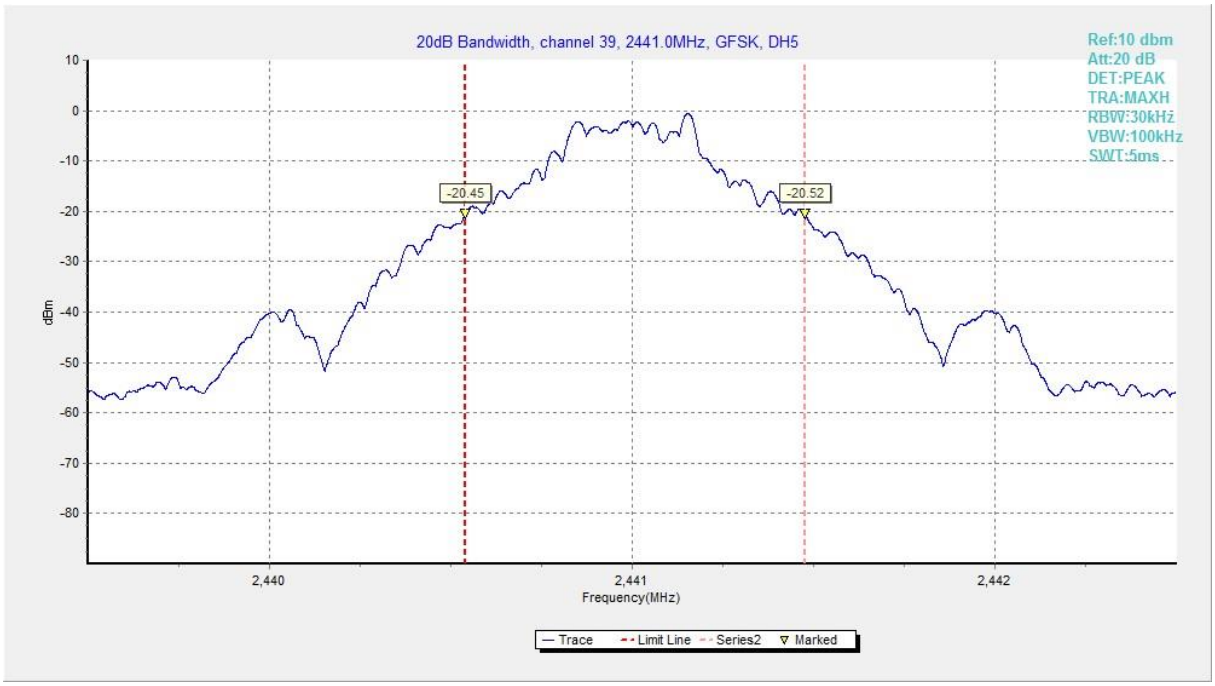

Fig. 79 20dB Bandwidth (GFSK, Ch 39)

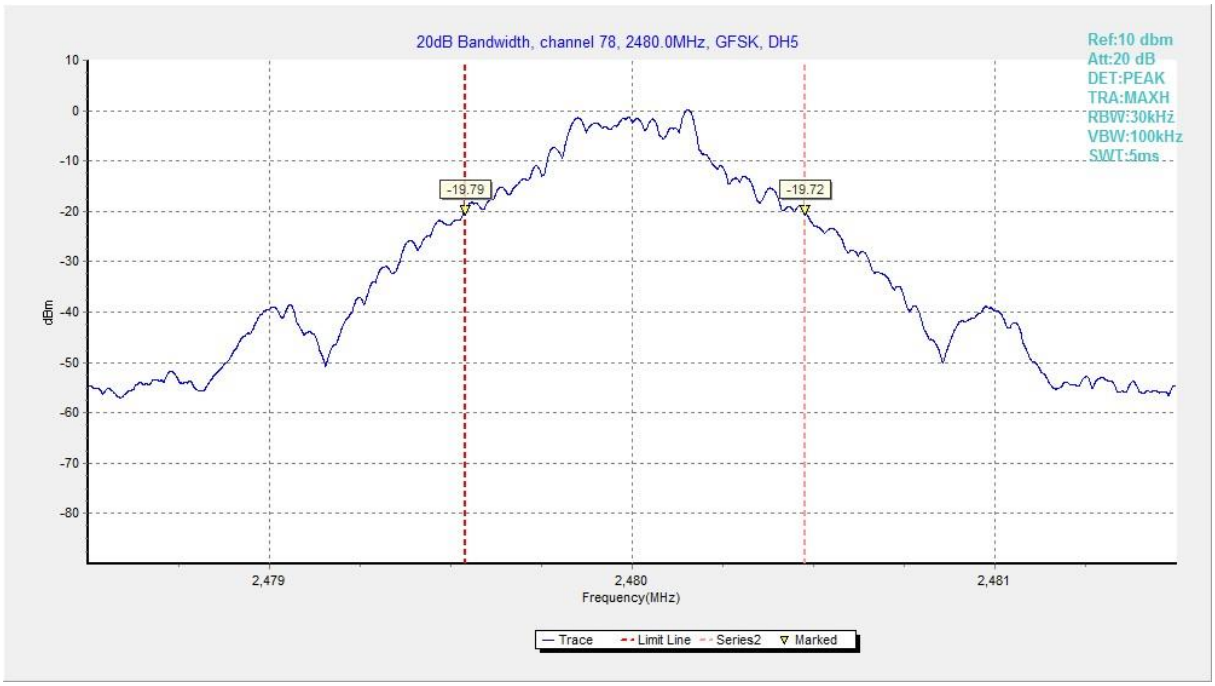

Fig. 80 20dB Bandwidth (GFSK, Ch 78)

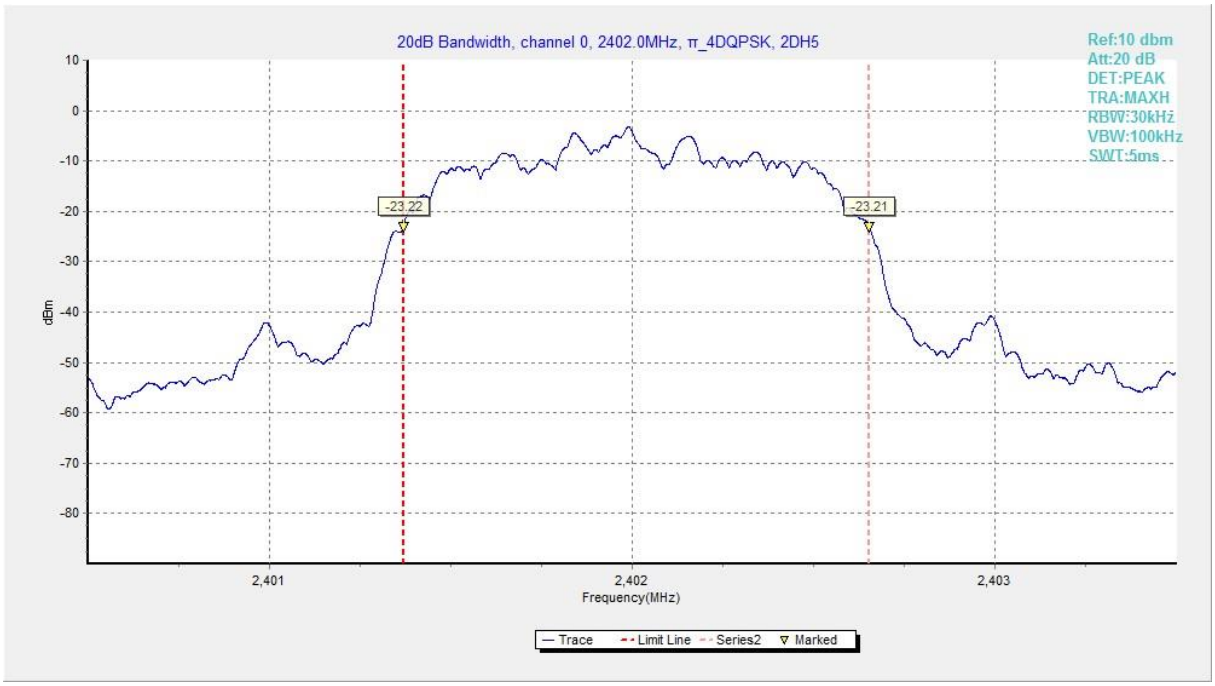

Fig. 81 20dB Bandwidth (π /4 DQPSK, Ch 0)

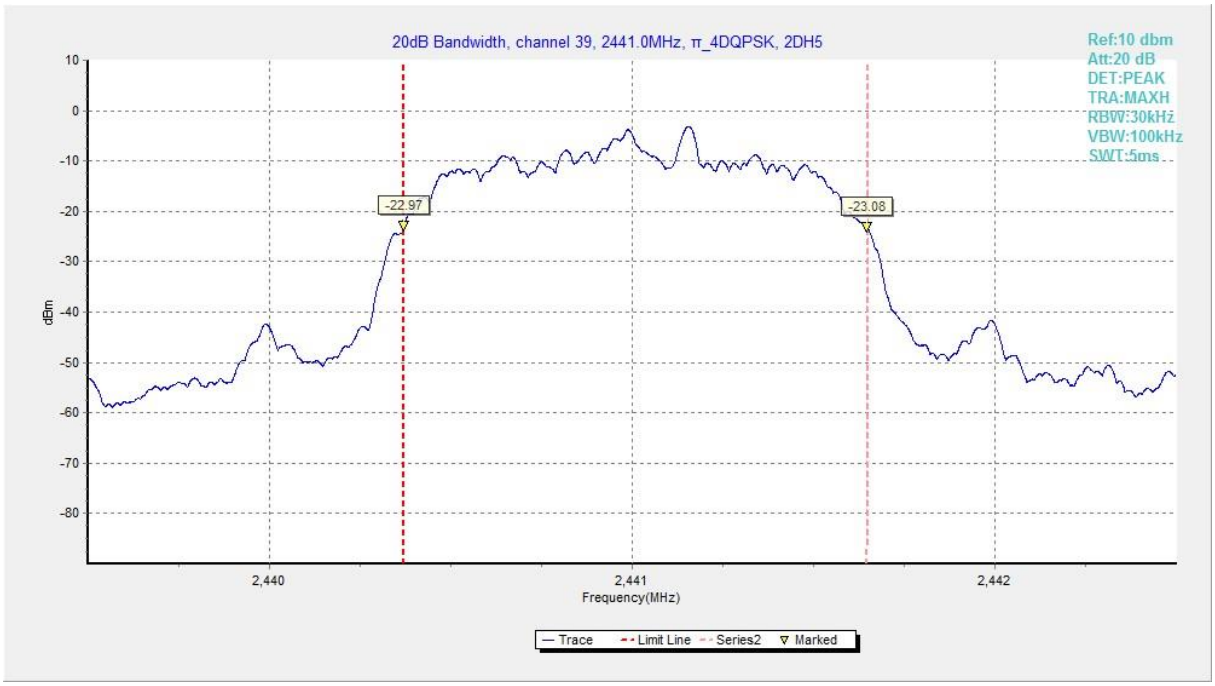

Fig. 82 20dB Bandwidth (π /4 DQPSK, Ch 39)

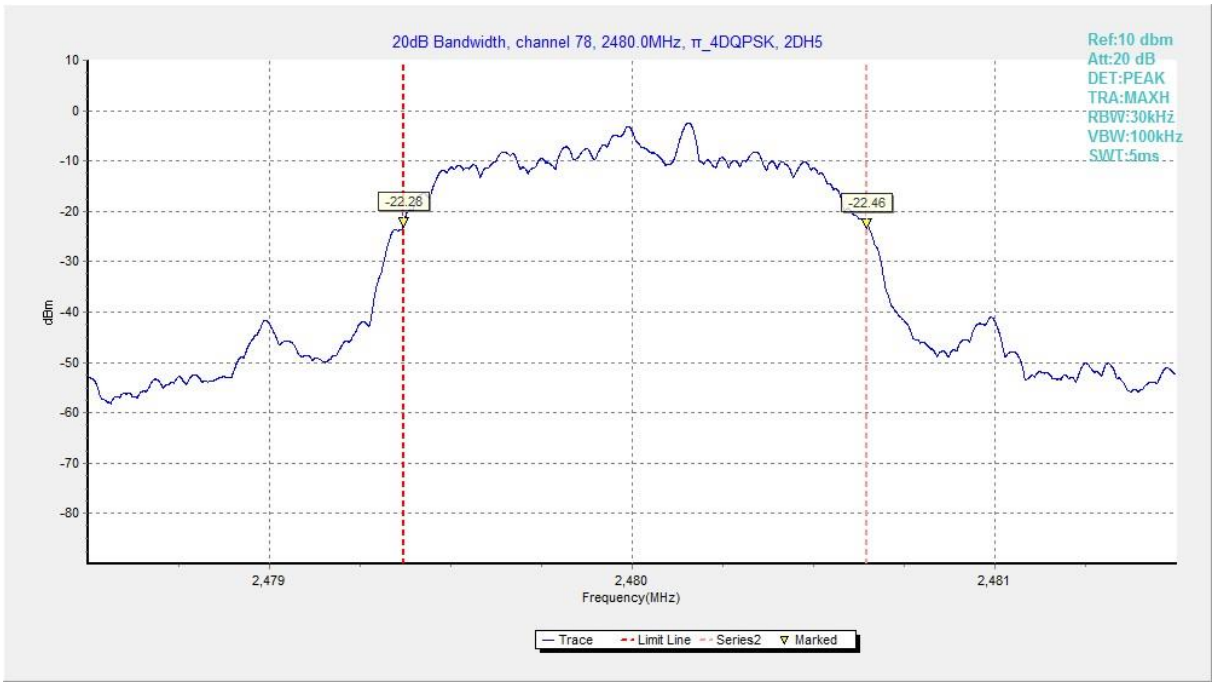

Fig. 83 20dB Bandwidth (π /4 DQPSK, Ch 78)

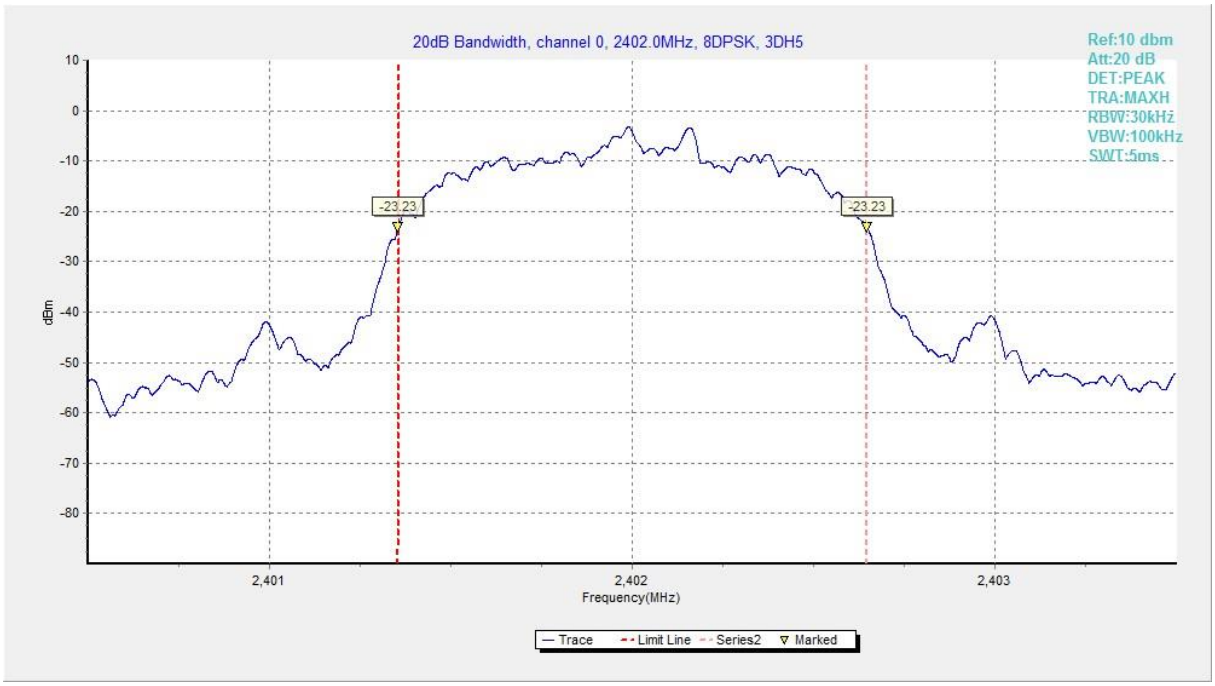

Fig. 84 20dB Bandwidth (8DPSK, Ch 0)

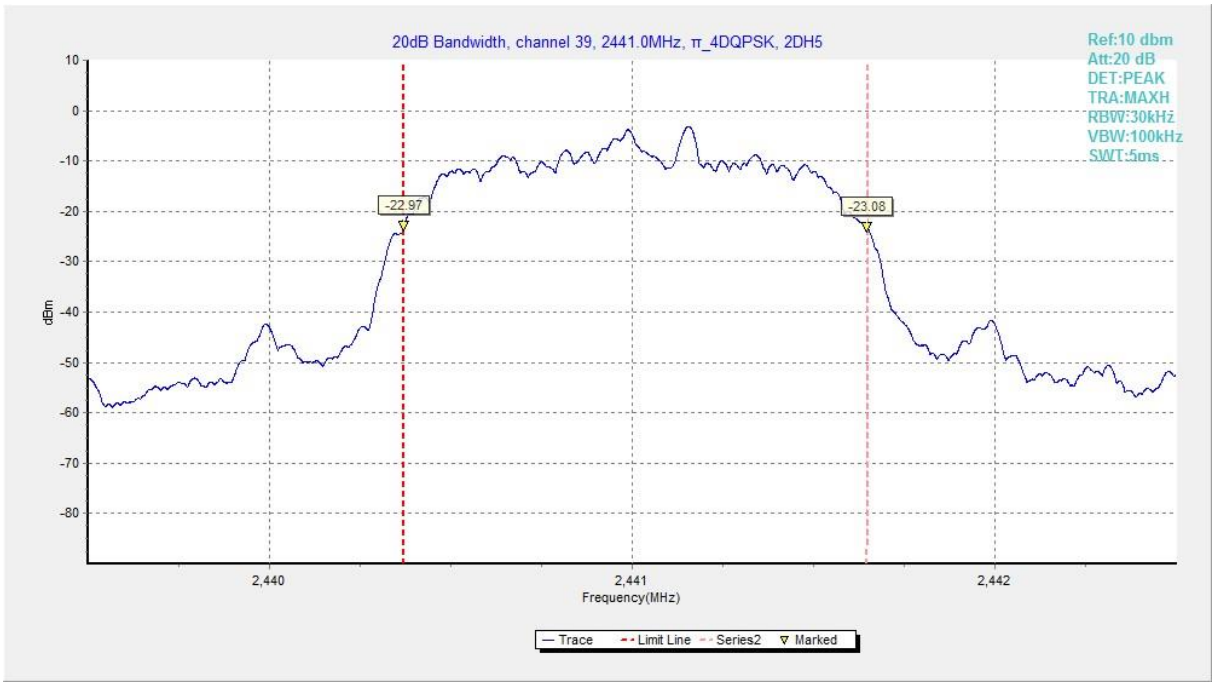

Fig. 85 20dB Bandwidth (8DPSK, Ch 39)

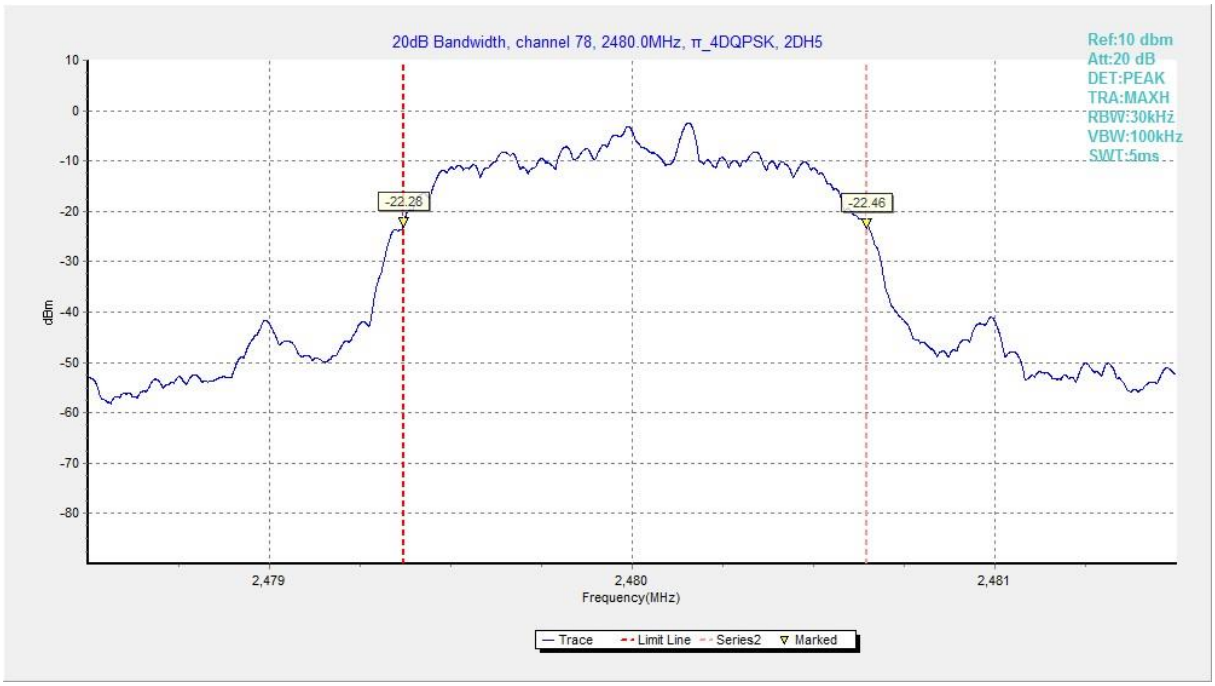

Fig. 86 20dB Bandwidth (8DPSK, Ch 78)

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.87	209.74	**P**
			Fig.88		
π/4 DQPSK	39	2-DH5	Fig.89	213.68	**P**
			Fig.90		
8DPSK	39	3-DH5	Fig.91	209.79	**P**
			Fig.92		

See below for test graphs.

Conclusion: Pass

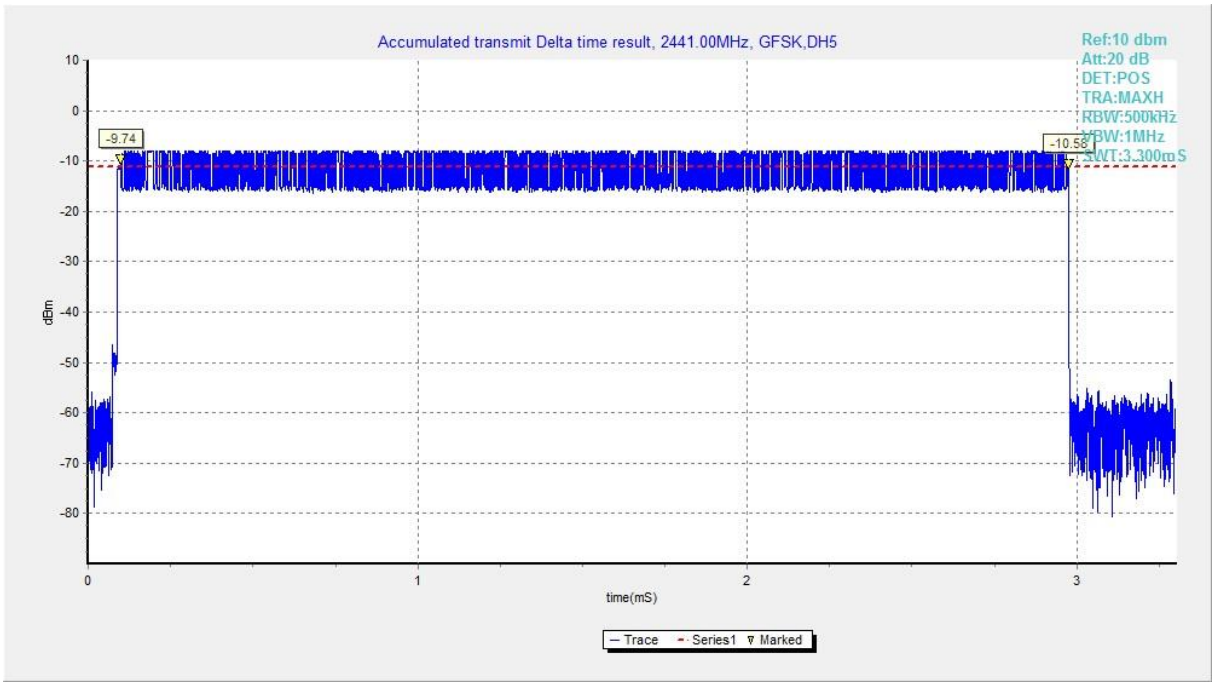

Fig. 87 Time of Occupancy(Dwell Time) (GFSK, Ch39)

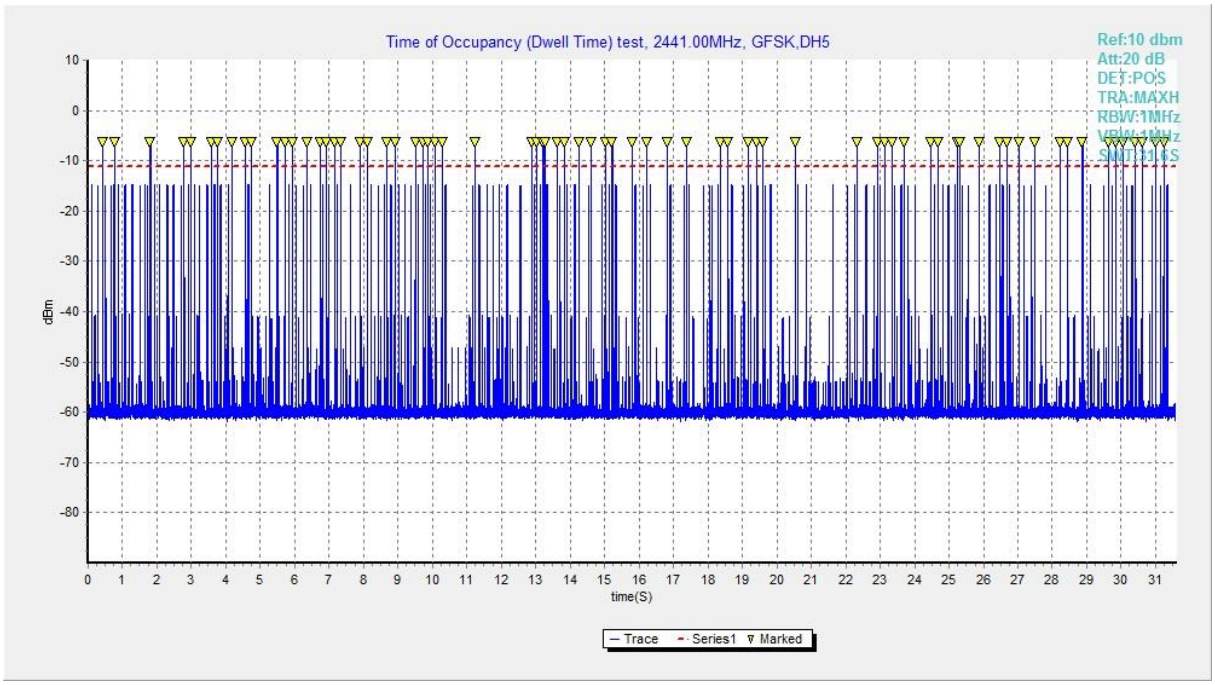

Fig. 88 Time of Occupancy(Dwell Time) (GFSK, Ch39)

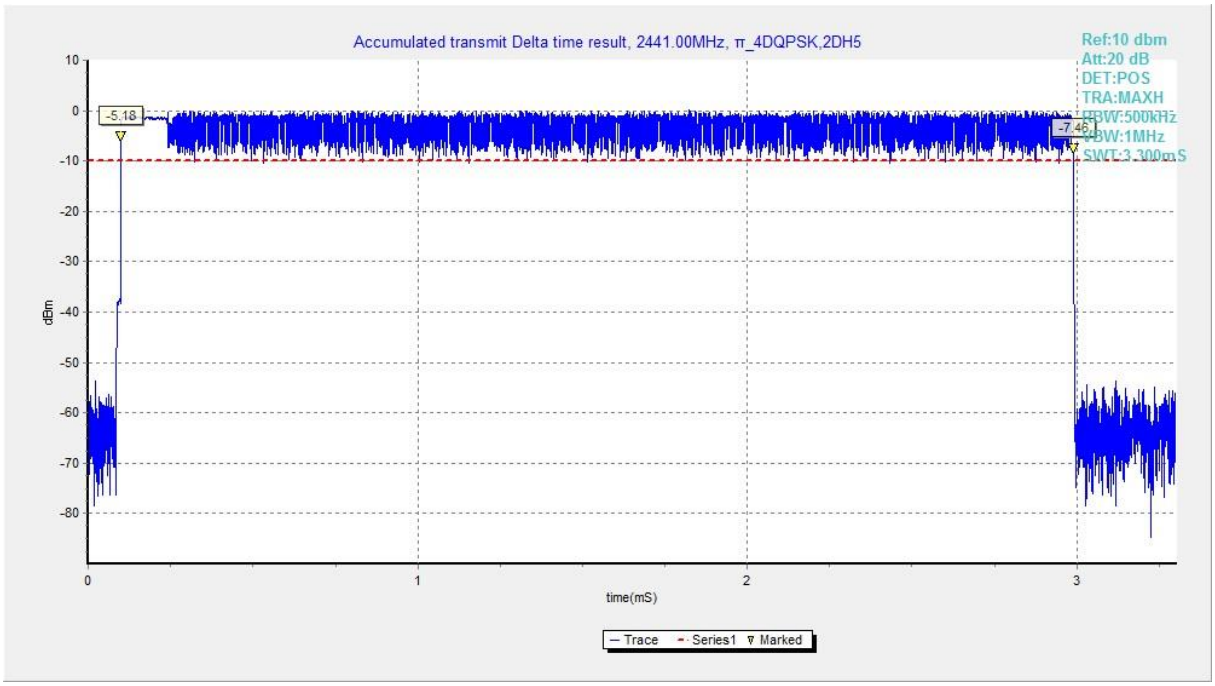

Fig. 89 Time of Occupancy(Dwell Time) (π /4 DQPSK, Ch39)

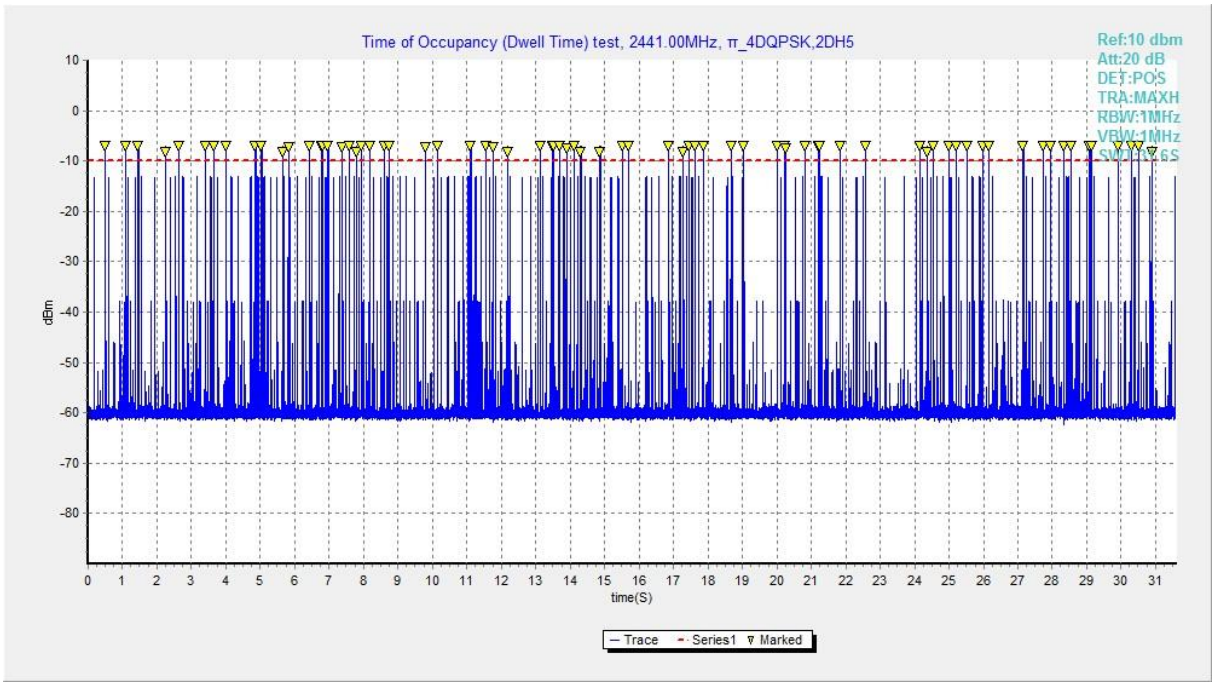

Fig. 90 Time of Occupancy(Dwell Time) (π /4 DQPSK, Ch39)

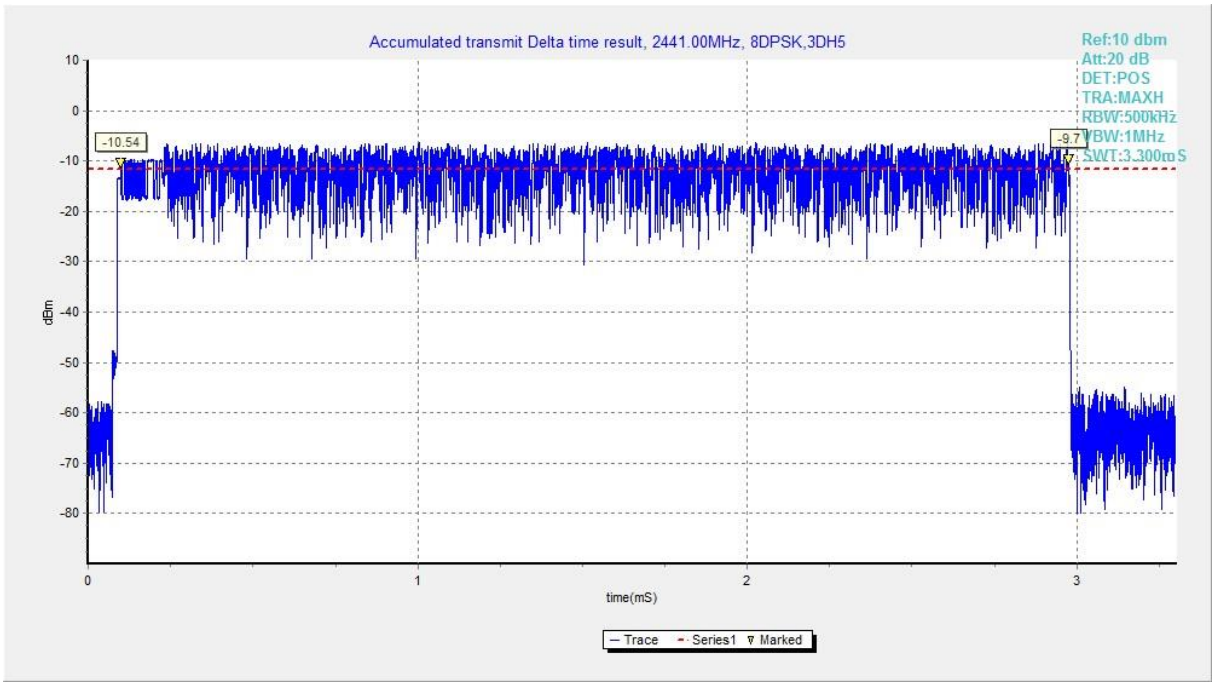

Fig. 91 Time of Occupancy(Dwell Time) (8DPSK, Ch39)

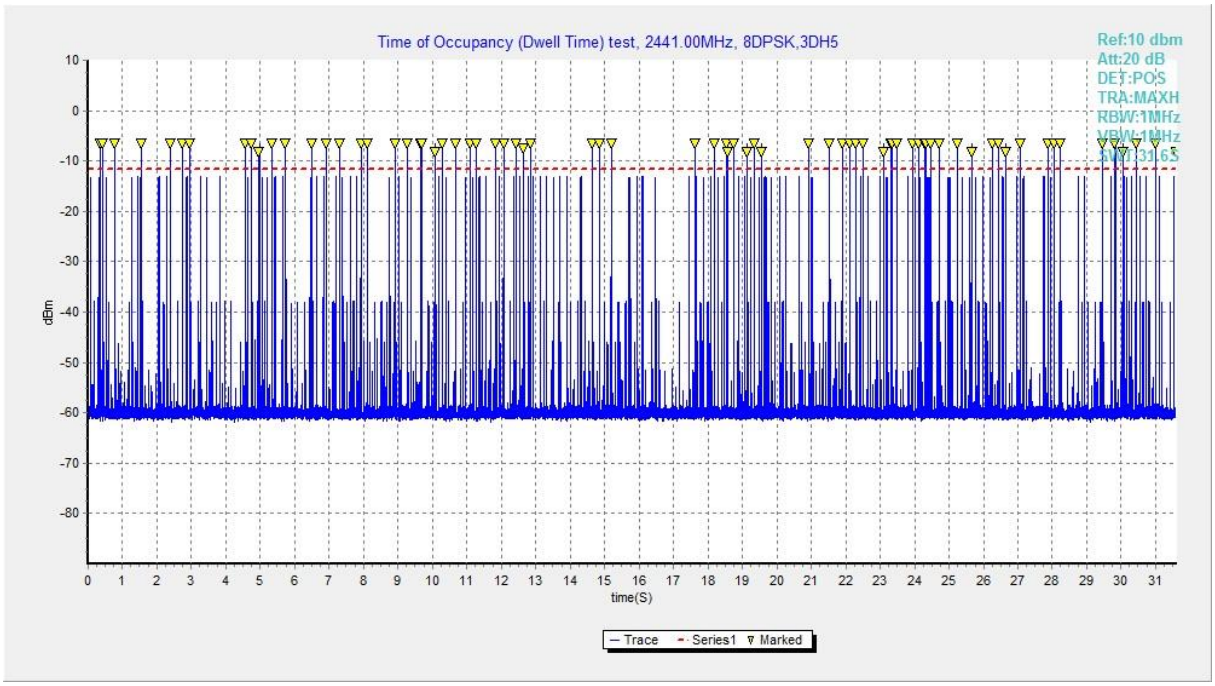

Fig. 92 Time of Occupancy(Dwell Time) (8DPSK, Ch39)

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		Test result	Conclusion
GFSK	DH5	Fig.93	Fig.94	79	**P**
π/4 DQPSK	2-DH5	Fig.95	Fig.96	79	**P**
8DPSK	3-DH5	Fig.97	Fig.98	79	**P**

See below for test graphs.

Conclusion: Pass

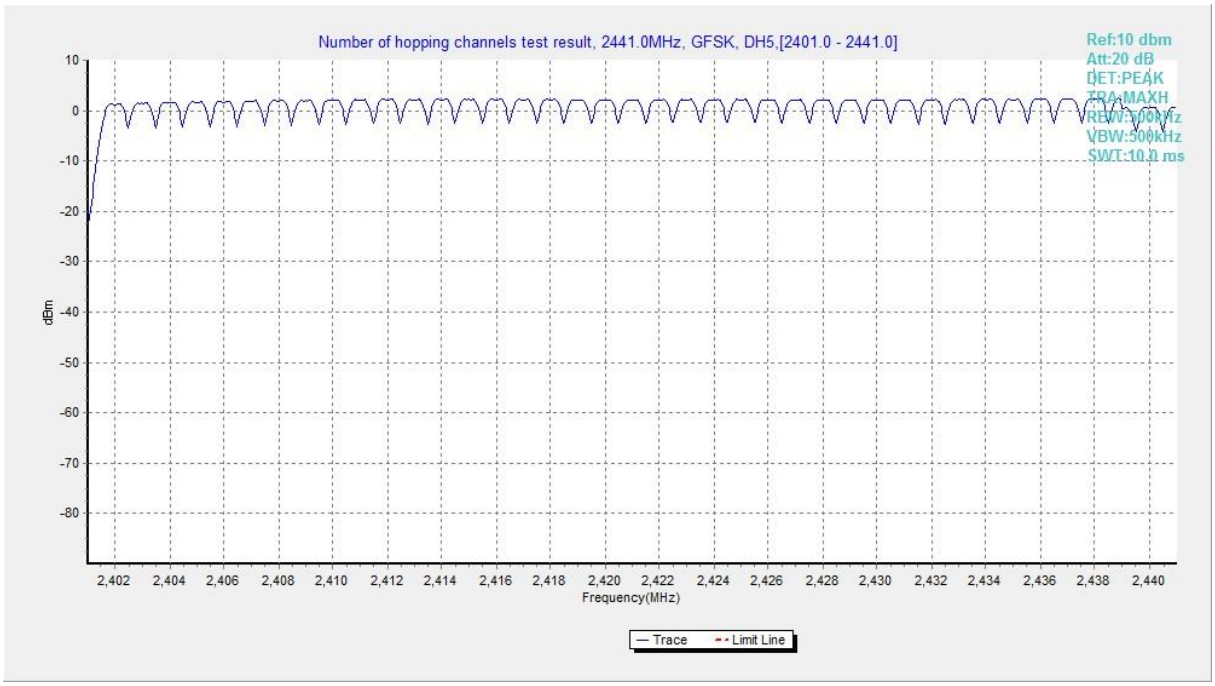

Fig. 93 Hopping channel ch0~39 (GFSK, Ch39)

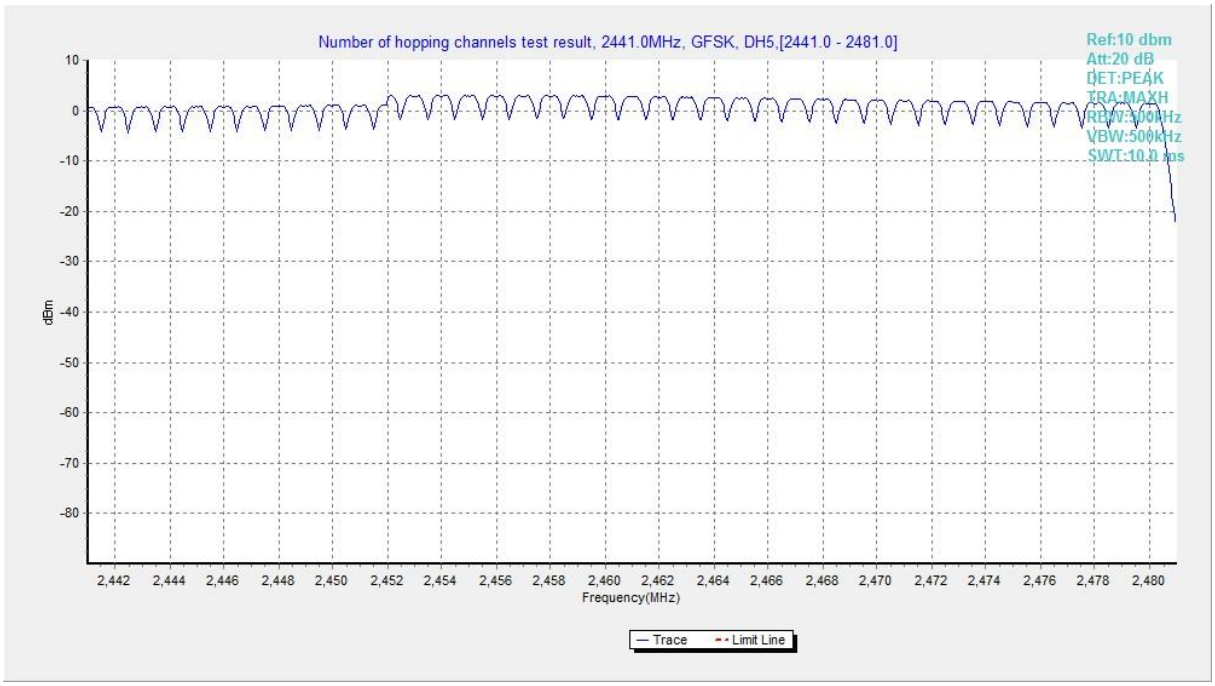

Fig. 94 Hopping channel ch39~78 (GFSK, Ch39)

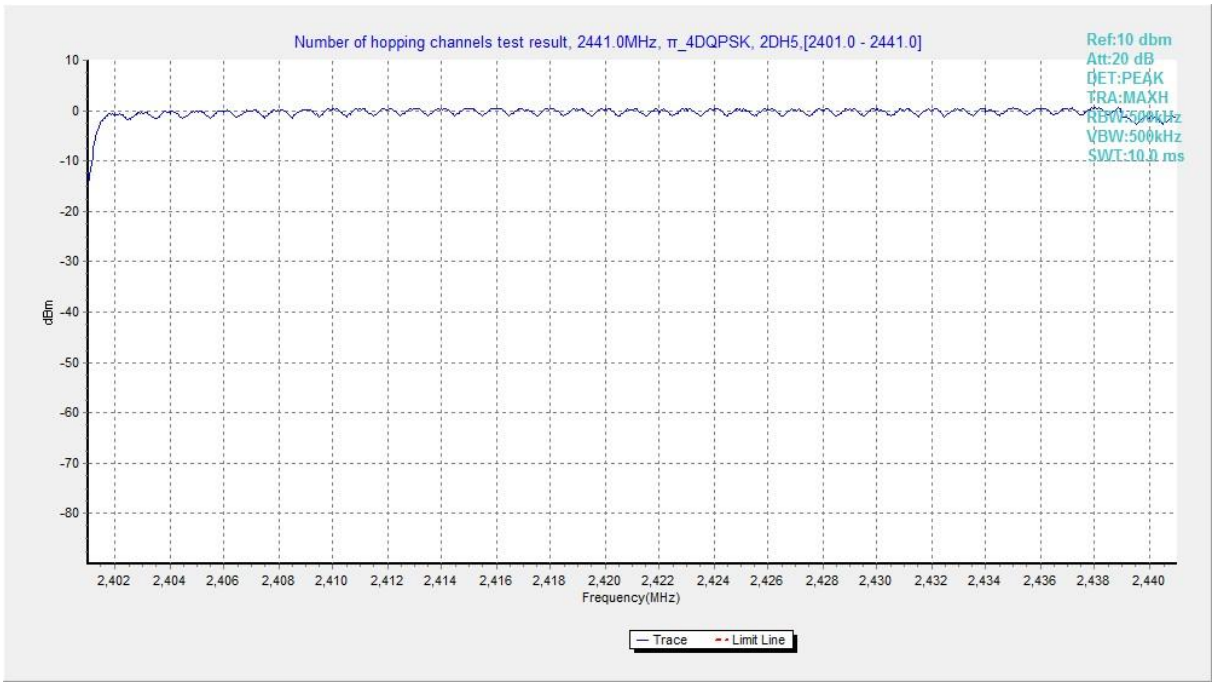

Fig. 95 Hopping channel ch0~39 (π /4 DQPSK, Ch39)

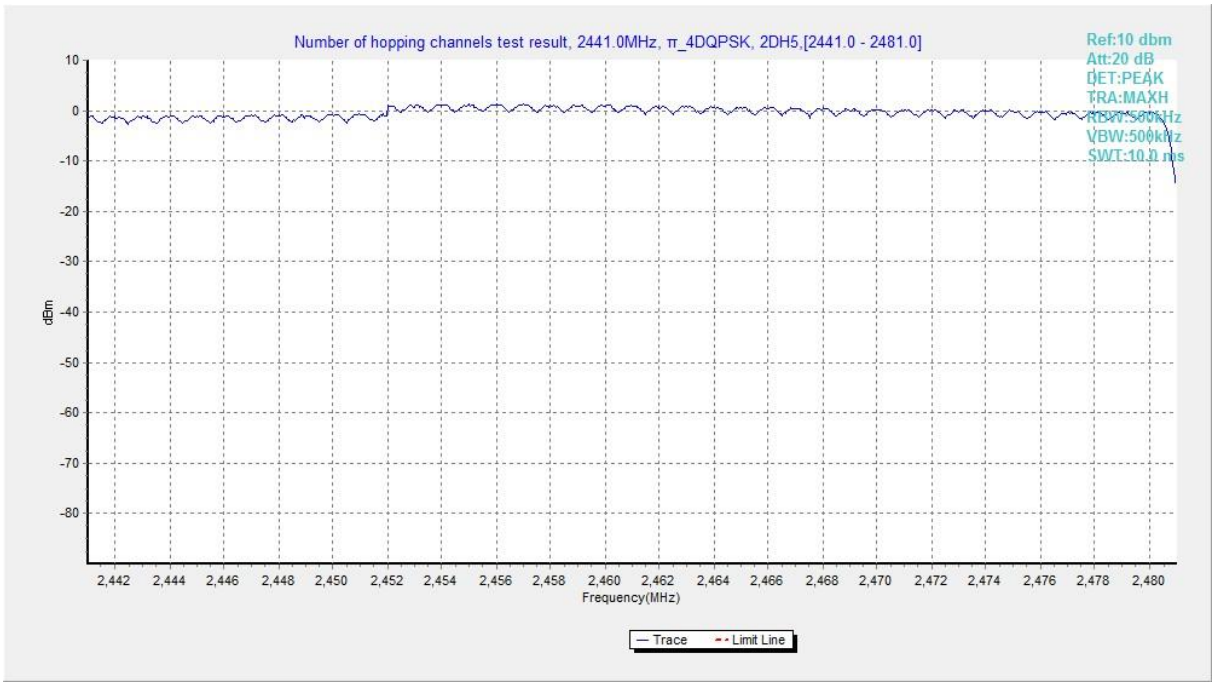

Fig. 96 Hopping channel ch39~78 (π /4 DQPSK, Ch39)

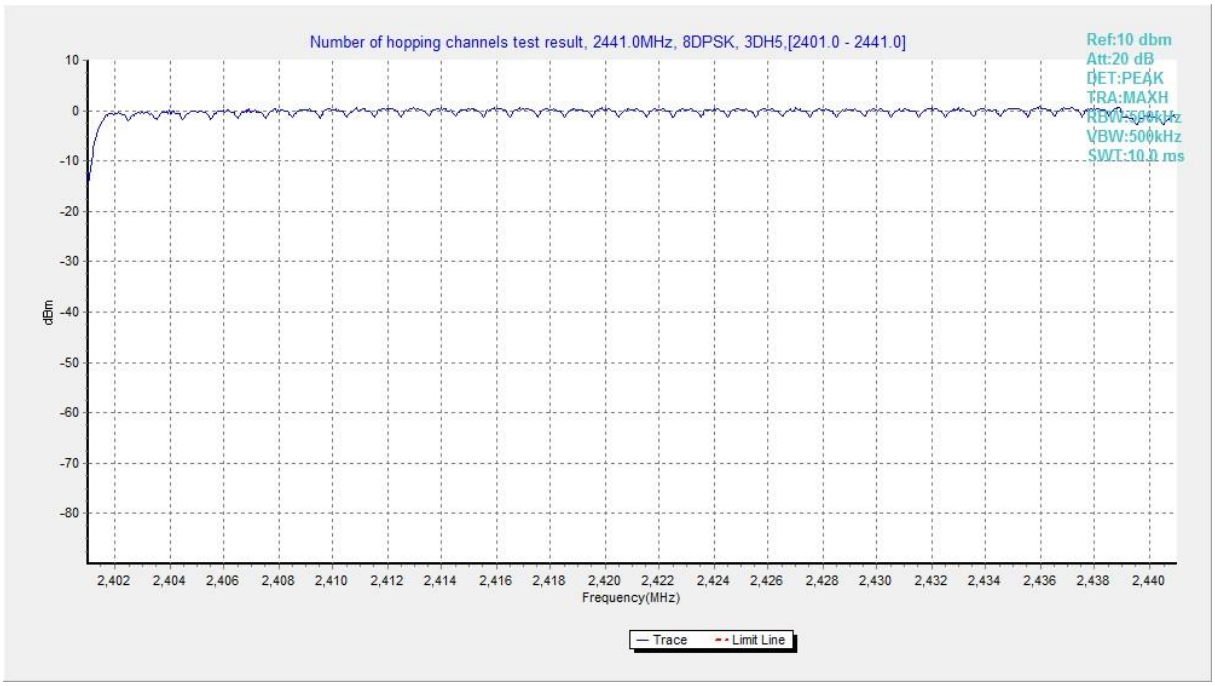

Fig. 97 Hopping channel ch0~39 (8DPSK, Ch39)

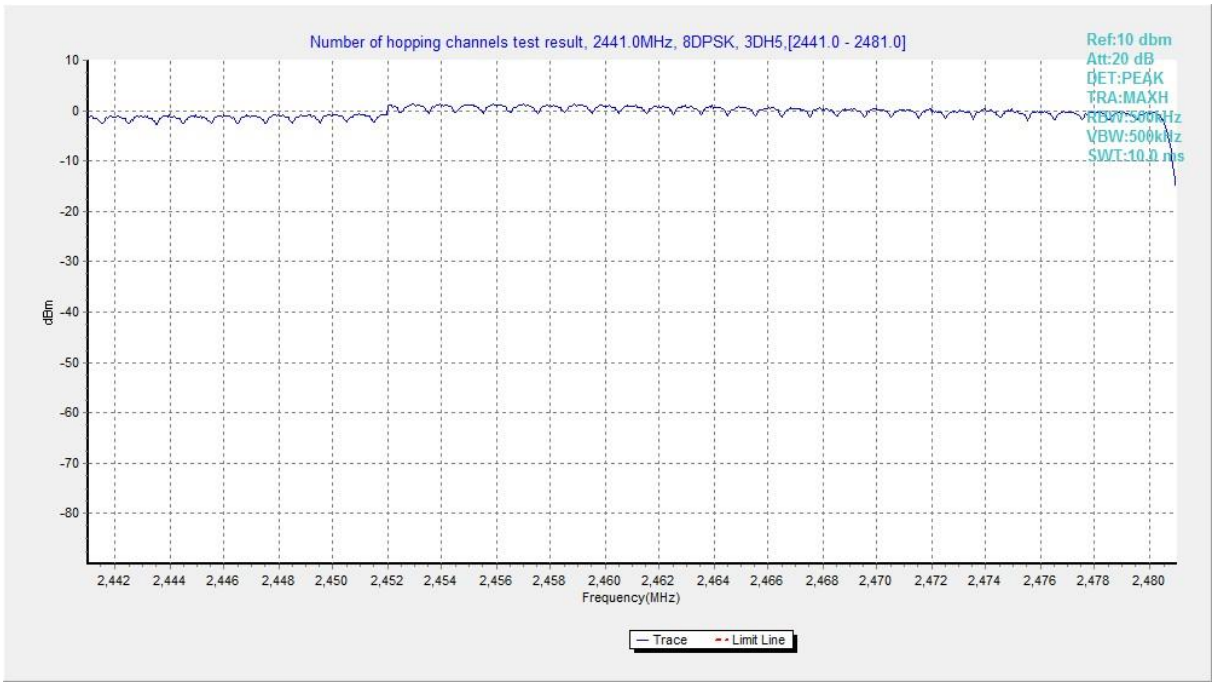

Fig. 98 Hopping channel ch39~78 (8DPSK, Ch39)

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.99	997.50	**P**
π /4 DQPSK	39	2-DH5	Fig.100	1007.25	**P**
8DPSK	39	3-DH5	Fig.101	1005.00	**P**

See below for test graphs.

Conclusion: Pass

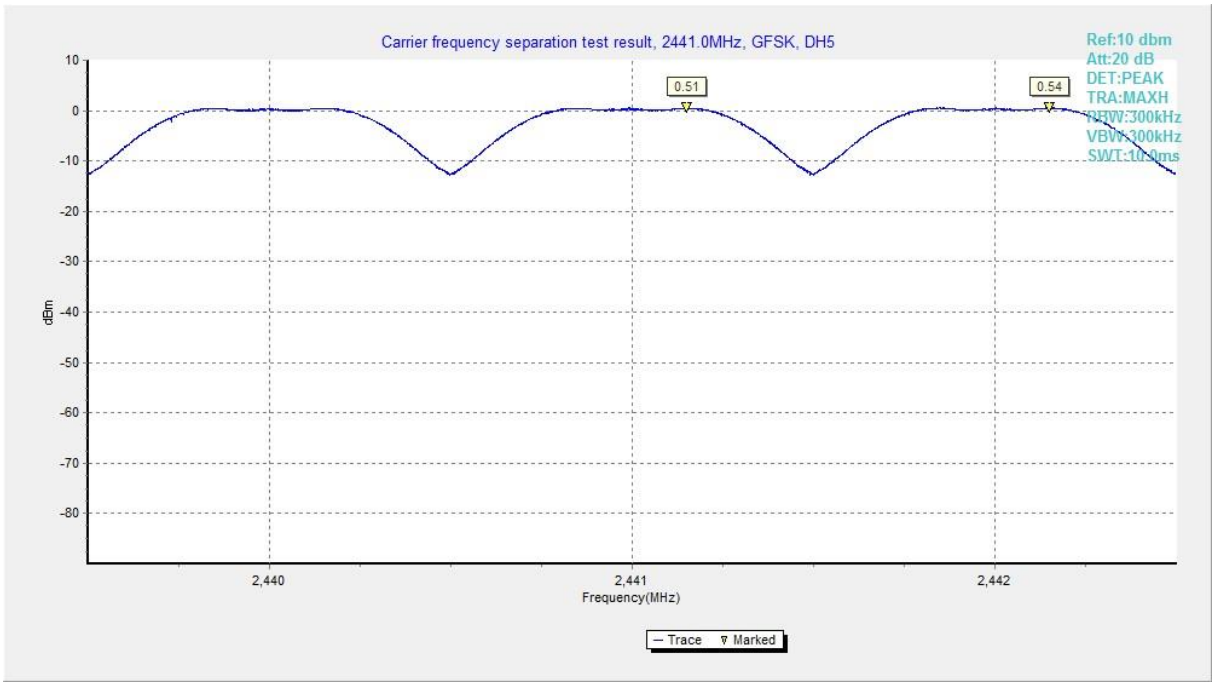

Fig. 99 Carrier Frequency Separation (GFSK, Ch39)

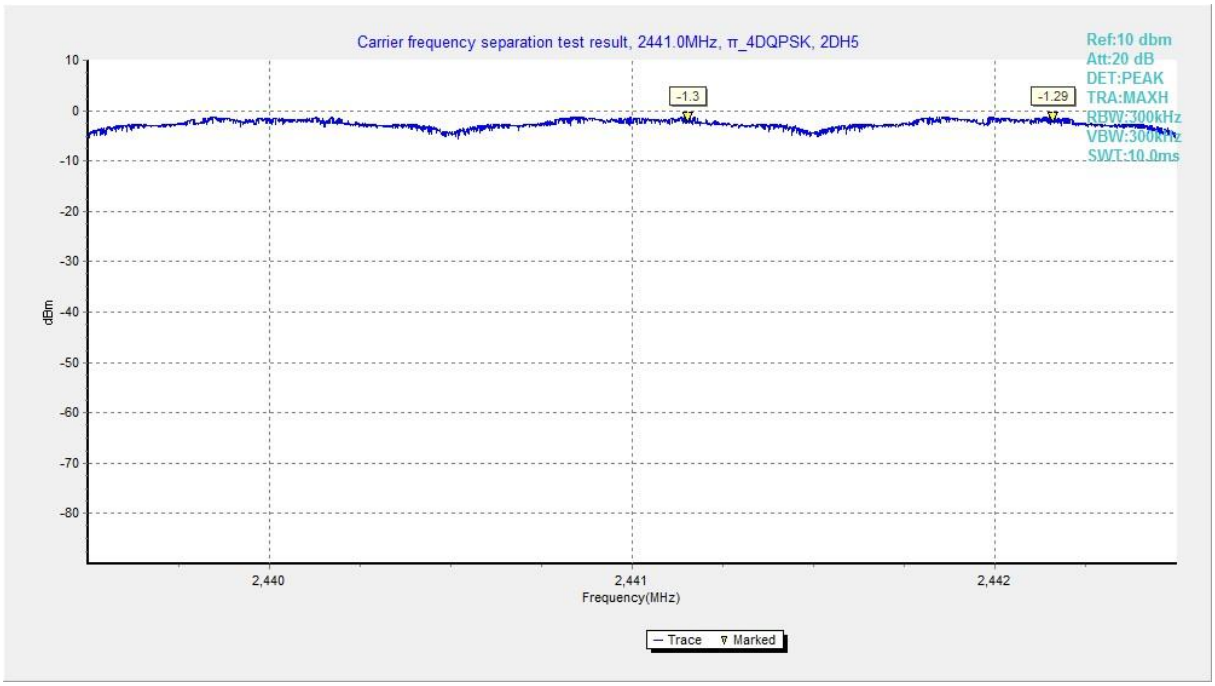

Fig. 100 Carrier Frequency Separation (π /4 DQPSK, Ch39)

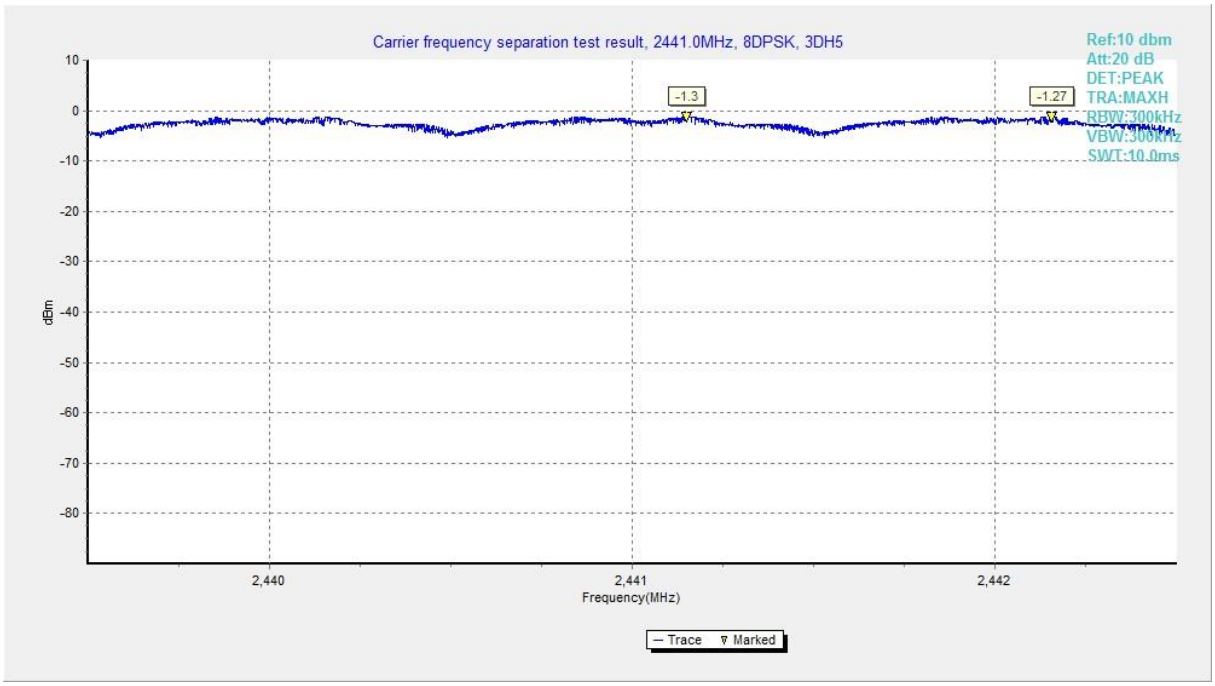

Fig. 101 Carrier Frequency Separation (8DPSK, Ch39)

A.9 AC Power line Conducted Emission

Test Condition:

Voltage（V）	Frequency（Hz）
120	60

Measurement Result and limit:

BT (Quasi-peak Limit)

Frequency range (MHz)	Quasi-peak Limit (dBμV)	Result (dBμV)		Conclusion
		Traffic	Idle	
0.15 to 0.5	66 to 56	Fig.102	Fig.103	**P**
0.5 to 5	56			
5 to 30	60			
NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.				

BT (Average Limit)

Frequency range (MHz)	Average-peak Limit (dBμV)	Result (dBμV)		Conclusion
		Traffic	Idle	
0.15 to 0.5	56 to 46	Fig 102	Fig 103	**P**
0.5 to 5	46			
5 to 30	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

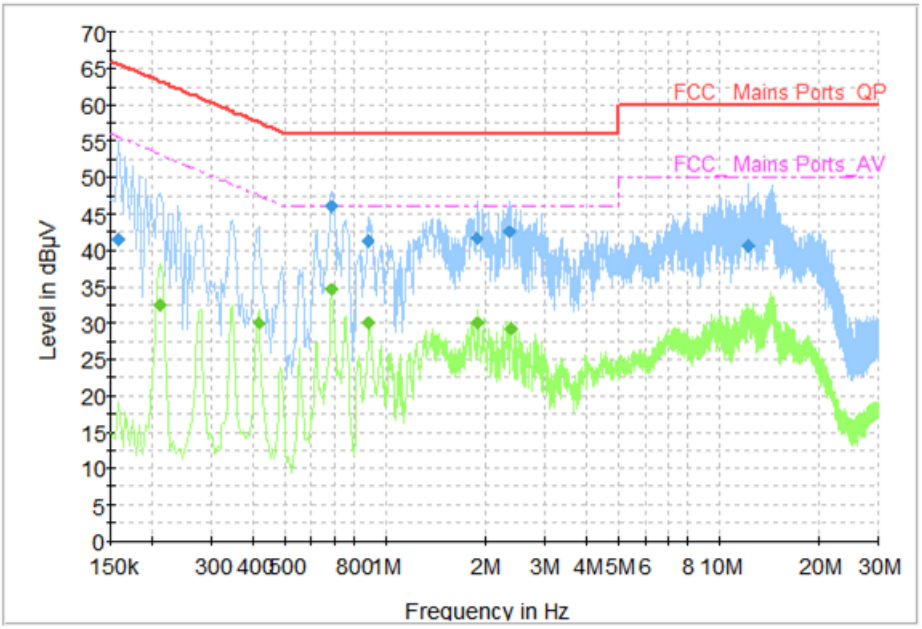

Fig. 102 AC Powerline Conducted Emission (Traffic)

Measurement Results: Quasi Peak

Frequency (MHz)	Quasi Peak (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.158000	41.48	65.57	24.08	L1	ON	9.7
0.686000	45.95	56.00	10.05	N	ON	9.7
0.886000	41.31	56.00	14.69	N	ON	9.7
1.882000	41.60	56.00	14.40	N	ON	9.7
2.362000	42.52	56.00	13.48	N	ON	9.7
12.242000	40.62	60.00	19.38	N	ON	9.9

Measurement Results : Average

Frequency (MHz)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.210000	32.43	53.21	20.77	N	ON	9.6
0.414000	30.06	47.57	17.51	N	ON	9.7
0.686000	34.57	46.00	11.43	N	ON	9.7
0.894000	29.89	46.00	16.11	N	ON	9.7
1.890000	30.00	46.00	16.00	N	ON	9.7
2.370000	29.33	46.00	16.67	N	ON	9.7

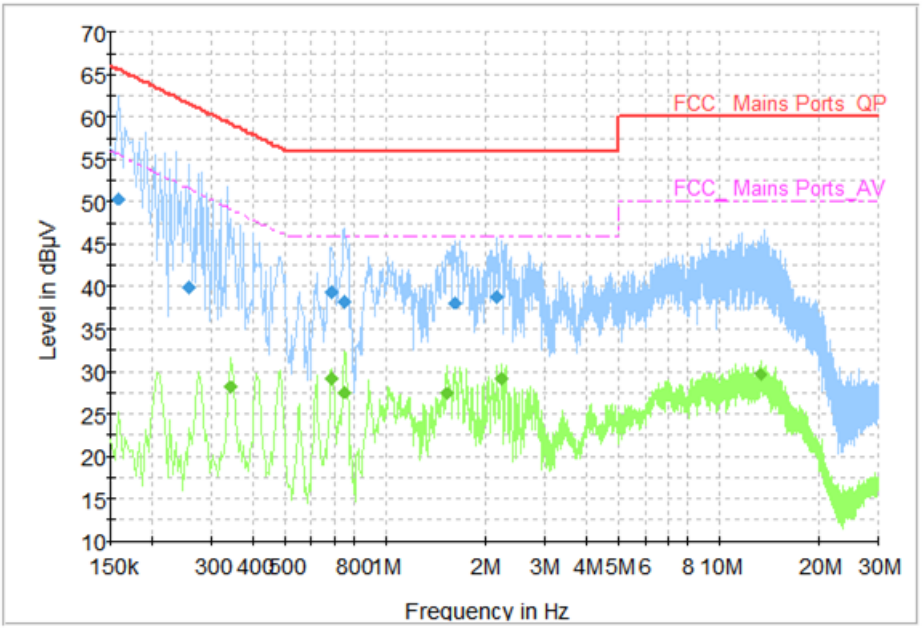

Fig. 103 AC Power line Conducted Emission (Idle)

Measurement Results: Quasi Peak

Frequency (MHz)	Quasi Peak (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.158000	50.30	65.57	15.27	N	ON	9.6
0.258000	39.96	61.50	21.53	N	ON	9.6
0.690000	39.31	56.00	16.69	N	ON	9.7
0.750000	38.32	56.00	17.68	N	ON	9.7
1.606000	38.17	56.00	17.83	N	ON	9.7
2.166000	38.77	56.00	17.23	N	ON	9.7

Measurement Results : Average

Frequency (MHz)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.342000	28.16	49.16	21.00	N	ON	9.6
0.686000	29.15	46.00	16.85	N	ON	9.7
0.754000	27.55	46.00	18.45	N	ON	9.7
1.522000	27.31	46.00	18.69	N	ON	9.7
2.218000	29.19	46.00	16.81	N	ON	9.7
13.318000	25.68	50.00	24.32	N	ON	9.9

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