

Fig.54. Conducted spurious emission: 8DPSK, Channel 78, 30MHz - 1GHz

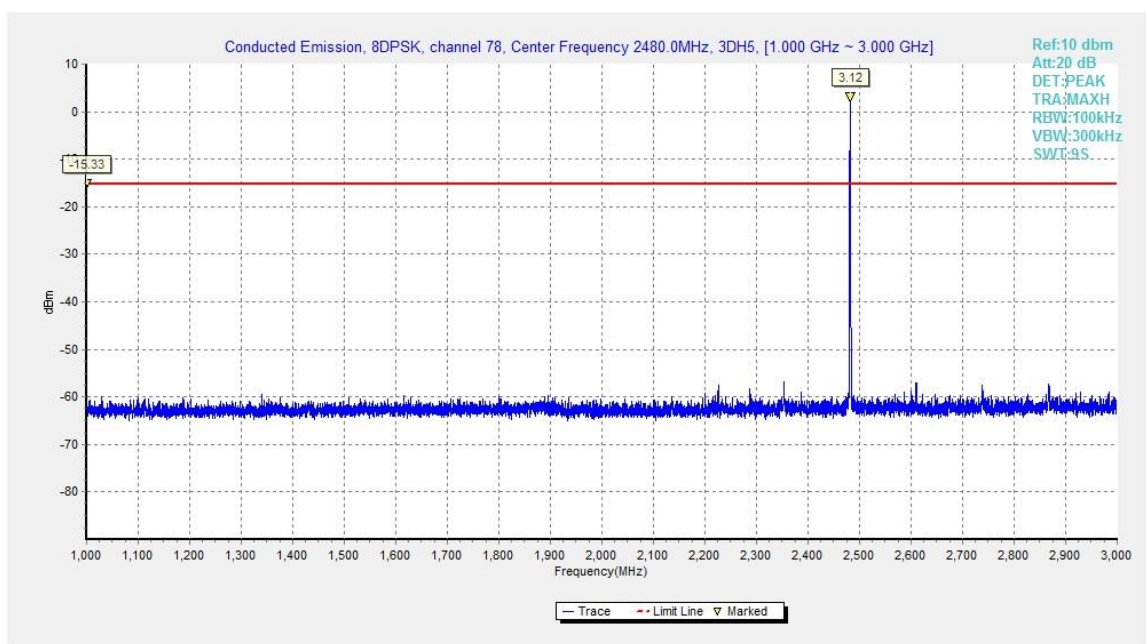


Fig.55. Conducted spurious emission: 8DPSK, Channel 78, 1GHz - 3GHz

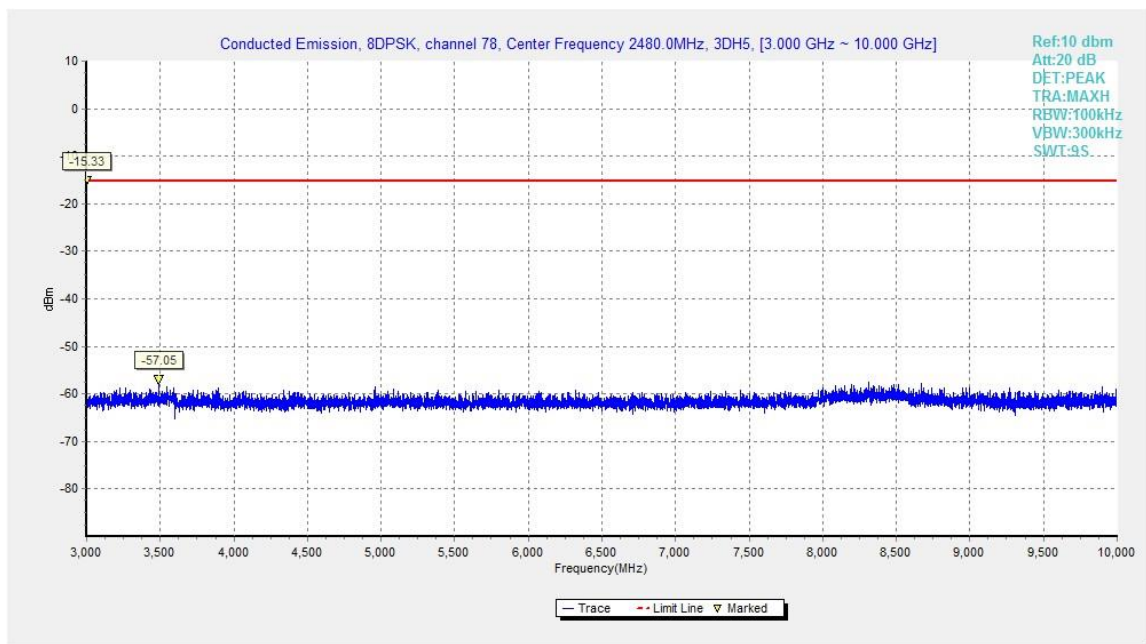


Fig.56. Conducted spurious emission: 8DPSK, Channel 78, 3GHz - 10GHz

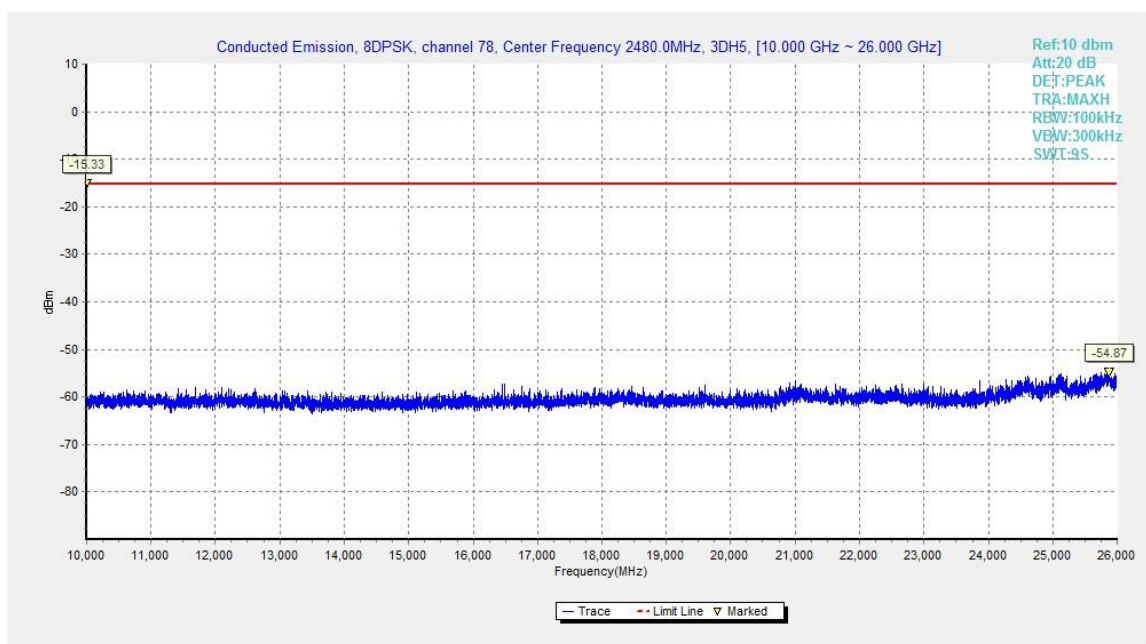


Fig.57. Conducted spurious emission: 8DPSK, Channel 78, 10GHz - 26GHz

A.5. 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)).

The measurement is made according to ANSI C63.10

Limit in restricted band:

Frequency of emission (MHz)	Field strength(uV/m)	Field strength(dBuV/m)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

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	100KHz/300KHz	5
1000-4000	1MHz/1MHz	15
4000-18000	1MHz/1MHz	40
18000-26500	1MHz/1MHz	20

Measurement Results:

Result= $P_{Mea} + ARPL$

For GFSK

Channel	Frequency Range	Test Results	Conclusion
Power	2.38GHz~2.4GHz---L	Fig.58	P
Power	2.45GHz~2.5GHz---H	Fig.59	P

For $\pi/4$ DQPSK

Channel	Frequency Range	Test Results	Conclusion
Power	2.38GHz~2.4GHz---L	Fig.60	P
Power	2.45GHz~2.5GHz---H	Fig.61	P

For 8DPSK

Channel	Frequency Range	Test Results	Conclusion
Power	2.38GHz~2.4GHz---L	Fig.62	P
Power	2.45GHz~2.5GHz---H	Fig.63	P

GFSK Ch 0 - Average

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	PMea(dBuv/m)	Polarization
2386.940	41.5	-38.8	52.600	V
17913.000	44.7	-18.5	17.600	H
17919.000	44.7	-17.7	16.800	V
17926.500	44.7	-17.7	16.800	H
17920.000	44.7	-17.7	16.800	V
17916.000	44.7	-17.7	16.800	H

GFSK Ch 39 - Average

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	Pmea(dBuv/m)	Polarization
17911.000	45.7	-18.5	18.600	H
17915.000	45.3	-17.7	17.400	H
17928.000	45.2	-17.7	17.300	V
17918.000	45.2	-17.7	17.300	H
17926.000	45.2	-17.7	17.300	H
17911.500	45.2	-18.5	18.100	H

GFSK Ch 78 - Average

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	Pmea(dBuv/m)	Polarization
2483.790	42.2	-38.9	53.4	H
17919.000	45.2	-17.7	17.3	H
17928.000	45.2	-17.7	17.3	H
17935.000	45.1	-17.7	17.2	H
17906.000	45.1	-18.5	18.0	V
17908.500	45.1	-18.5	18.0	V

$\pi/4$ DQPSK Ch 0 - Average

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	Pmea(dBuv/m)	Polarization
2386.200	42.2	-38.8	53.3	H
17915.000	45.2	-17.7	17.3	H
17928.000	45.2	-17.7	17.3	V
17913.500	45.1	-18.5	18.0	V
17910.500	45.1	-18.5	18.0	V
17901.000	45.1	-18.5	18.0	H

$\pi/4$ DQPSK Ch 39 - Average

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	Pmea(dBuv/m)	Polarization
17913.000	45.4	-18.5	18.3	H
17915.000	45.2	-17.7	17.3	H
17914.500	45.1	-17.7	17.2	V
17903.000	45.1	-18.5	18.0	H
17933.500	45.0	-17.7	17.1	V
17906.000	45.0	-18.5	17.9	H

$\pi/4$ DQPSK Ch 78 - Average

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	Pmea(dBuv/m)	Polarization
2484.505	42.0	-38.9	53.2	H
17911.000	45.2	-18.5	18.1	H
17924.000	45.2	-17.7	17.3	H
17915.000	45.1	-17.7	17.2	H
17925.000	45.1	-17.7	17.2	V
17896.000	45.1	-18.5	18.0	H

8DPSK Ch 0 - Average

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	Pmea(dBuv/m)	Polarization
2383.785	41.9	-38.8	53.0	H
17905.000	45.3	-18.5	18.2	H
17909.000	45.2	-18.5	18.1	V
17915.000	45.2	-17.7	17.3	H
17927.000	45.2	-17.7	17.3	H
17921.000	45.1	-17.7	17.2	V

8DPSK Ch 39 - Average

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	Pmea(dBuv/m)	Polarization
17914.000	45.3	-18.5	18.2	H
17921.500	45.3	-17.7	17.4	H
17906.500	45.2	-18.5	18.1	V
17907.500	45.2	-18.5	18.1	H
17913.000	45.2	-18.5	18.1	H
17916.500	45.2	-17.7	17.3	H

8DPSK Ch 78 - Average

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	Pmea(dBuv/m)	Polarization
2489.555	42.1	-38.9	53.3	H
17929.500	45.3	-17.7	17.4	H
17923.000	45.2	-17.7	17.3	V
17922.000	45.2	-17.7	17.3	H
17921.500	45.2	-17.7	17.3	H
17919.500	45.2	-17.7	17.3	V

GFSK Ch 0 – Peak

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	PMea(dBuv/m)	Polarization
2387.020	54.6	-38.8	65.7	H
17901.000	56.2	-18.5	29.1	H
17956.000	56.2	-17.7	28.3	H
17916.000	56.1	-17.7	28.2	H
17906.500	56.1	-18.5	29.0	H
17928.000	56.0	-17.7	28.1	H

GFSK Ch 39 - Peak

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	Pmea(dBuv/m)	Polarization
17936.500	56.6	-17.7	28.7	H
17935.500	56.6	-17.7	28.7	V
17941.500	56.6	-17.7	28.7	V
17925.500	56.3	-17.7	28.4	H
17841.000	56.3	-18.5	29.2	H
17880.000	56.3	-18.5	29.2	H

GFSK Ch 78 - Peak

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	Pmea(dBuv/m)	Polarization
2484.035	54.6	-38.9	65.8	H
17920.500	57.7	-17.7	29.8	H
17908.000	57.4	-18.5	30.3	V
17891.500	56.8	-18.5	29.7	H
17818.000	56.8	-18.5	29.7	H
17917.000	56.5	-17.7	28.6	V

$\pi/4$ DQPSK Ch 0 - Peak

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	Pmea(dBuv/m)	Polarization
2385.965	54.5	-38.8	65.600	H
17908.500	55.8	-18.5	28.700	H
17925.500	55.8	-17.7	27.900	V
17954.500	55.7	-17.7	27.800	V
17885.500	55.7	-18.5	28.600	H
17941.000	55.6	-17.7	27.700	H

$\pi/4$ DQPSK Ch 39 - Peak

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	Pmea(dBuv/m)	Polarization
17923.500	56.7	-17.7	28.8	H
17880.000	56.5	-18.5	29.4	V
17916.500	56.5	-17.7	28.6	H
17925.500	56.5	-17.7	28.6	H
17930.500	56.2	-17.7	28.3	H
17997.500	56.1	-17.7	28.2	H

$\pi/4$ DQPSK Ch 78 - Peak

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	Pmea(dBuv/m)	Polarization
2484.550	55.1	-38.9	66.3	V
17927.000	56.4	-17.7	28.5	H
17937.000	56.3	-17.7	28.4	H
17938.500	56.3	-17.7	28.4	H
17823.000	56.2	-18.5	29.1	V
17835.000	56.1	-18.5	29.0	H

8DPSK Ch 0 - Peak

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	Pmea(dBuv/m)	Polarization
2383.655	54.7	-38.8	65.8	H
17898.500	56.3	-18.5	29.2	H
17890.500	56.0	-18.5	28.9	V
17862.000	56.0	-18.5	28.9	H
17904.000	56.0	-18.5	28.9	V
17974.000	56.0	-17.7	28.1	H

8DPSK Ch 39 - Peak

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	Pmea(dBuv/m)	Polarization
17931.000	56.7	-17.7	28.8	H
17918.000	56.5	-17.7	28.6	H
17987.500	56.3	-17.7	28.4	V
17941.000	56.3	-17.7	28.4	H
17961.500	56.2	-17.7	28.3	H
17907.500	56.0	-18.5	28.9	V

8DPSK Ch 78 - Peak

Frequency(MHz)	Result(dBuv/m)	ARPL (dB)	Pmea(dBuv/m)	Polarization
2489.765	54.8	-38.9	66.0	H
17909.500	56.9	-18.5	29.8	H
17858.000	56.5	-18.5	29.4	V
17898.500	56.2	-18.5	29.1	H
17862.500	56.2	-18.5	29.1	H
17895.500	56.1	-18.5	29.0	H

Conclusion: PASS

Test graphs as below:

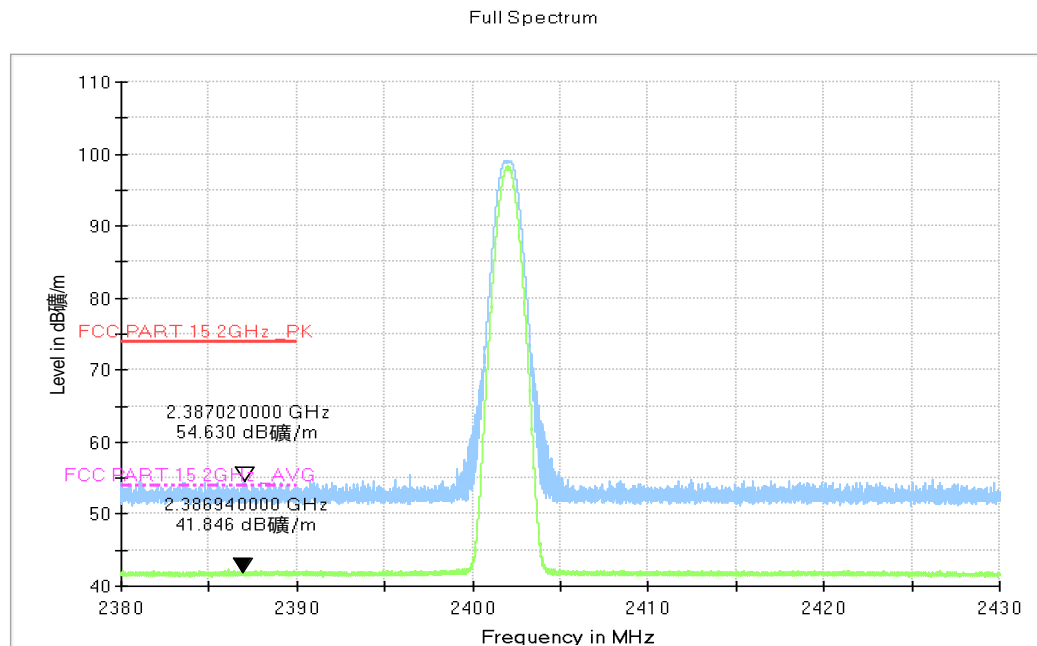


Fig.58. Radiated emission (Power): GFSK, low channel

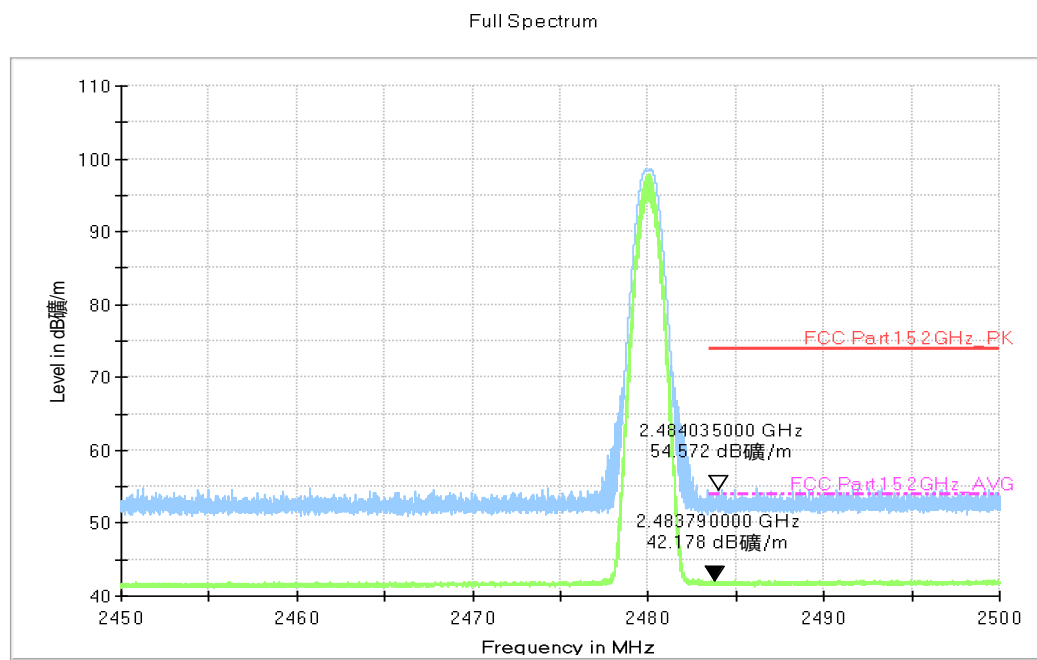


Fig.59. Radiated emission (Power) GFSK, high channel

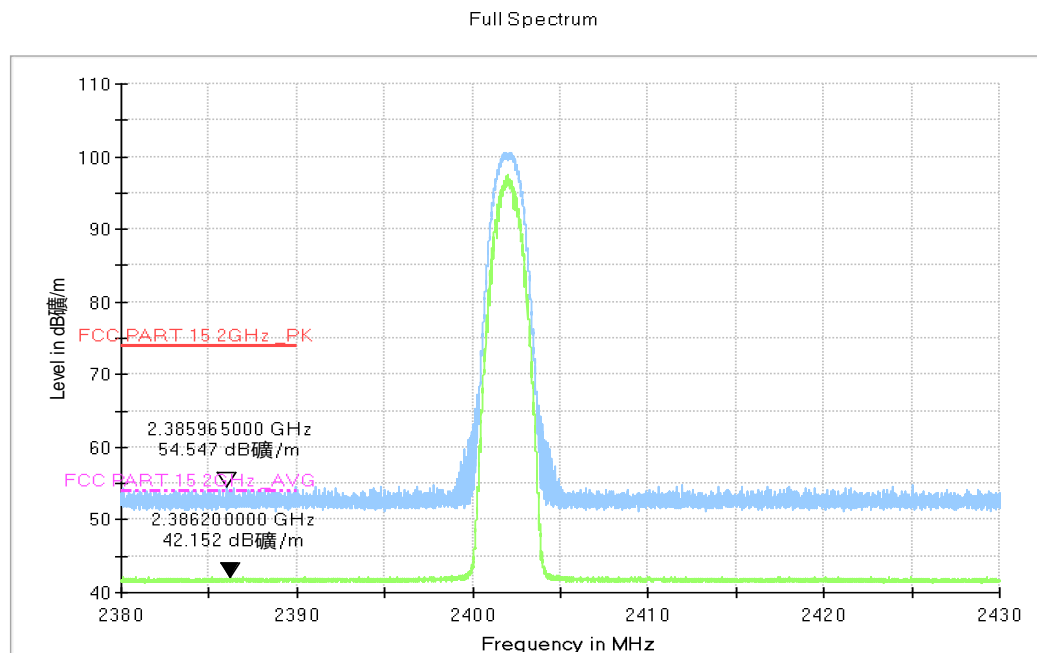


Fig.60. Radiated emission (Power): $\pi/4$ DQPSK, low channel

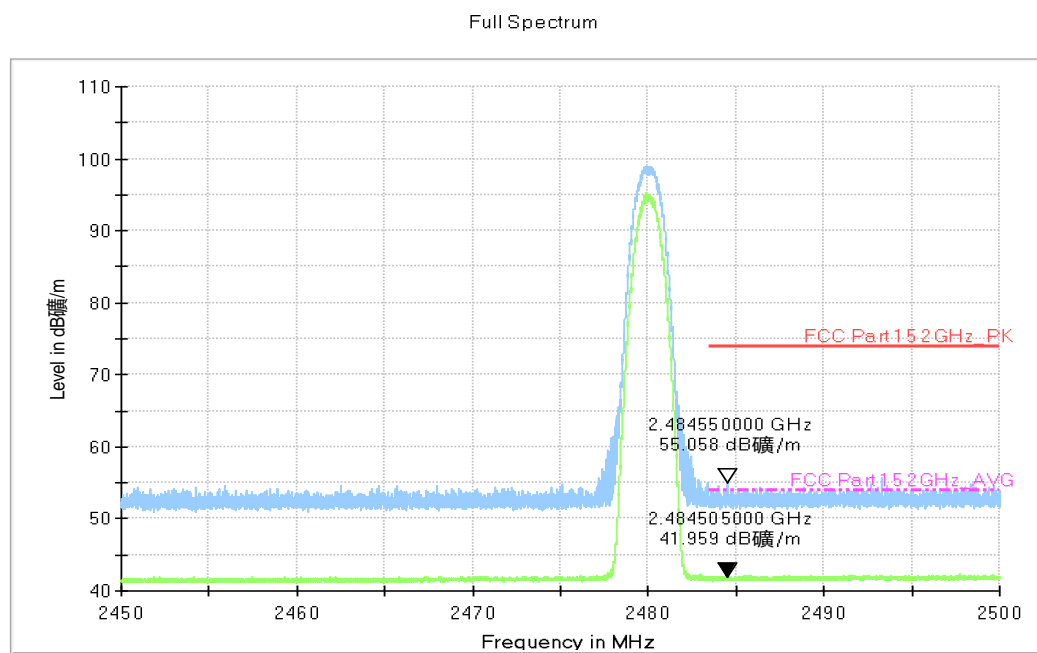


Fig.61. Radiated emission (Power): $\pi/4$ DQPSK, high channel

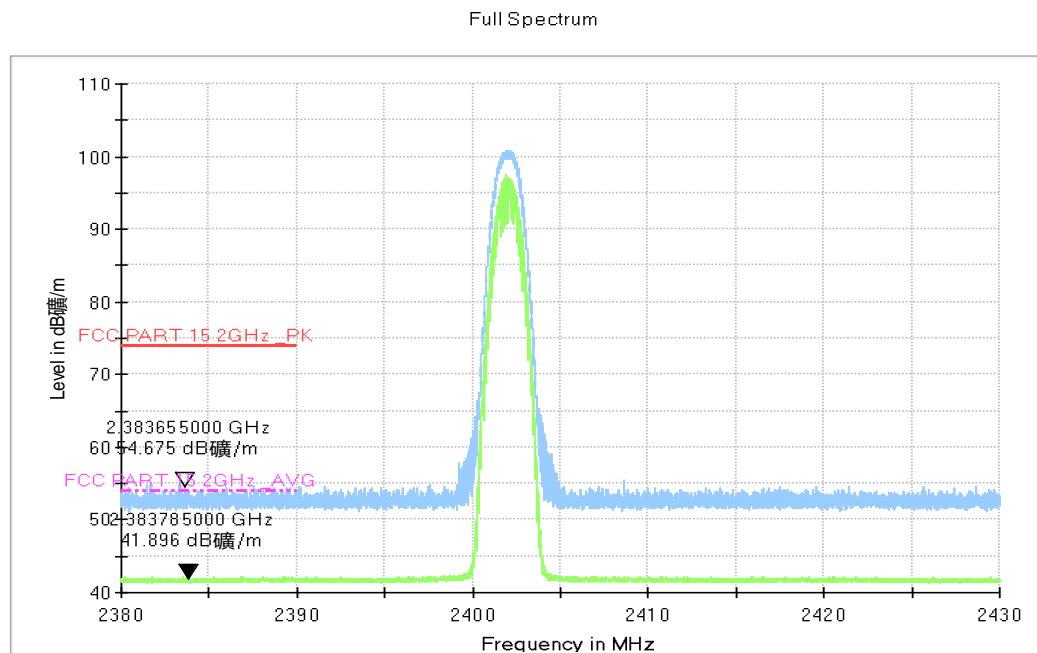


Fig.62. Radiated emission (Power): 8DPSK, low channel

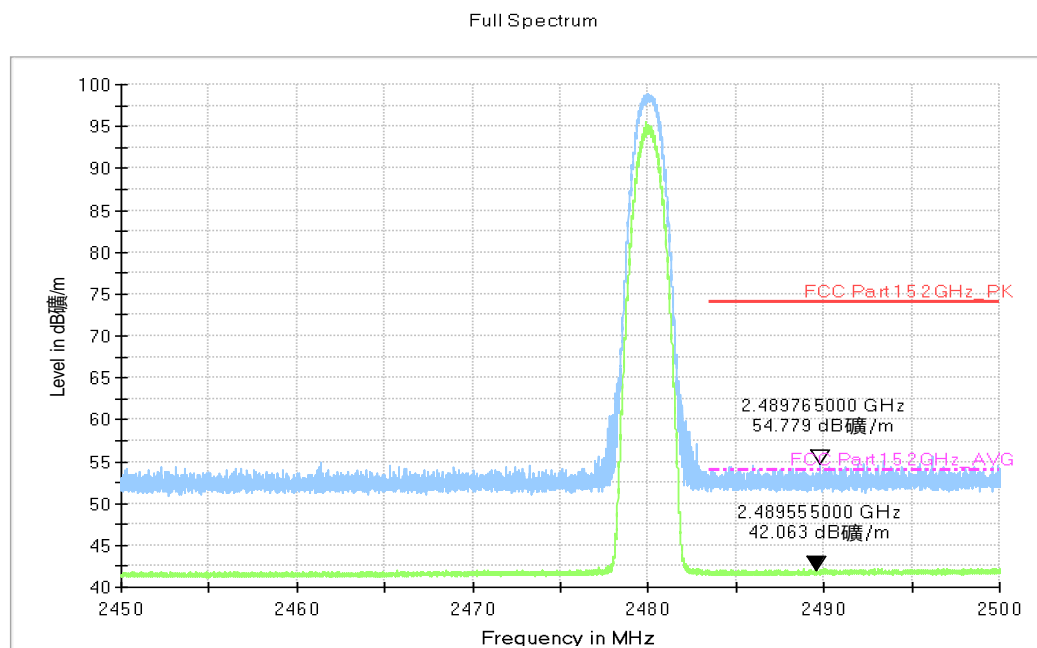


Fig.63. Radiated emission (Power): 8DPSK, high channel

A.6. Time of Occupancy (Dwell Time)

Method of Measurement: See ANSI C63.10-clause 7.8.4

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

- Span = zero span, centered on a hopping channel
- RBW = 1 MHz
- VBW \geq RBW
- Sweep = as necessary to capture the entire dwell time per hopping channel
- Detector function = peak
- Trace = max hold

Measure a pulse time in time domain at middle frequency and then count the hopping number in 31.6s(which equals with 0.4 multiply 79) of middle frequency ,then multiply the pulse time and hopping number and record them.

Measurement Limit:

Standard	Limit (ms)
FCC 47 CFR Part 15.247(a) (1)(iii)	< 400

Measurement Result:

For GFSK

Channel	Packet	Dwell Time (ms)		Conclusion
39	DH1	Fig.64	121.53	P
		Fig.65		
	DH3	Fig.66	162.08	P
		Fig.67		
	DH5	Fig.68	187.54	P
		Fig.69		

For $\pi/4$ DQPSK

Channel	Packet	Dwell Time (ms)		Conclusion
39	DH1	Fig.70	122.99	P
		Fig.71		
	DH3	Fig.72	191.74	P
		Fig.73		
	DH5	Fig.74	184.76	P
		Fig.75		

For 8DPSK

Channel	Packet	Dwell Time (ms)		Conclusion
39	DH1	Fig.76	122.94	P
		Fig.77		
	DH3	Fig.78	152.31	P

	DH5	Fig.79	176.22	P
		Fig.80		
		Fig.81		

Conclusion: PASS

Test graphs as below:

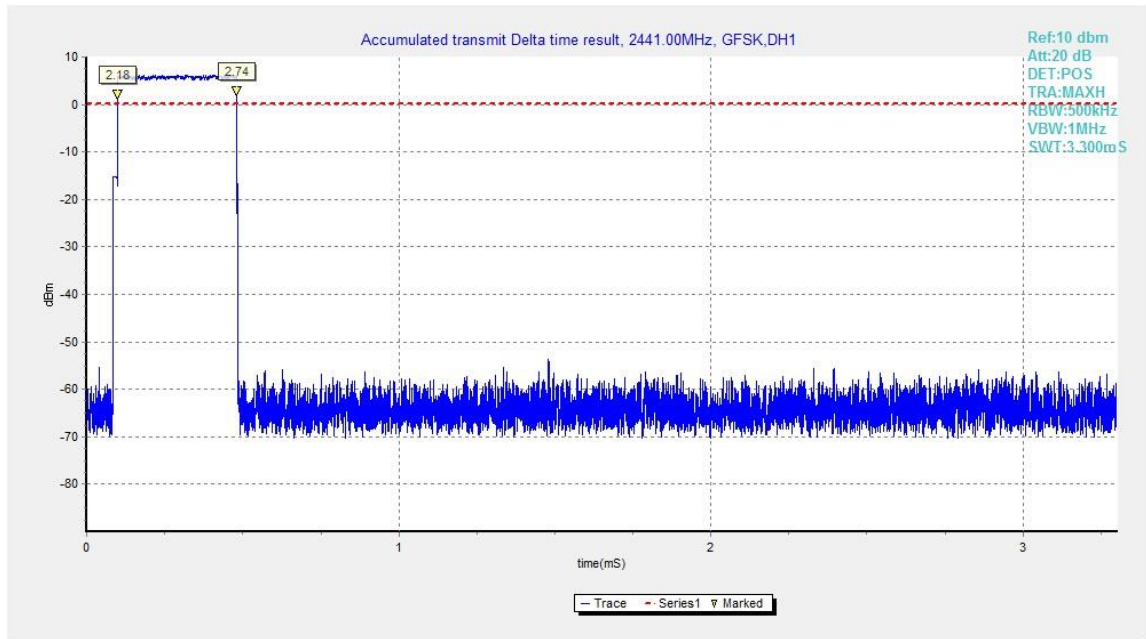


Fig.64. Time of occupancy (Dwell Time): Channel 39, Packet DH1

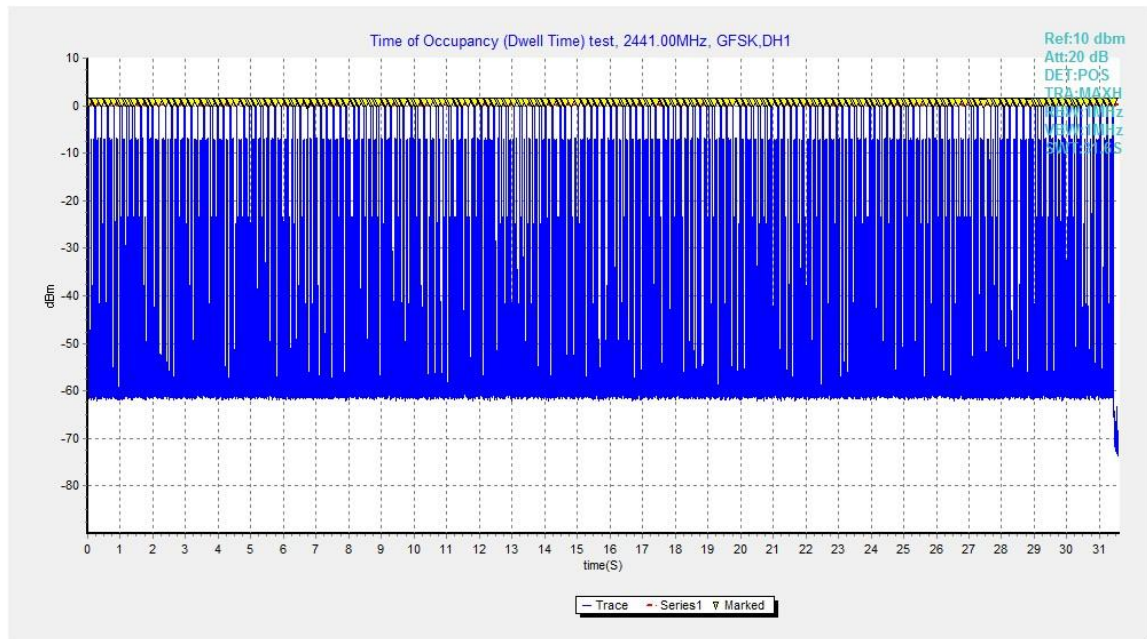


Fig.65. Number of Transmissions Measurement:Channel 39,Packet DH1

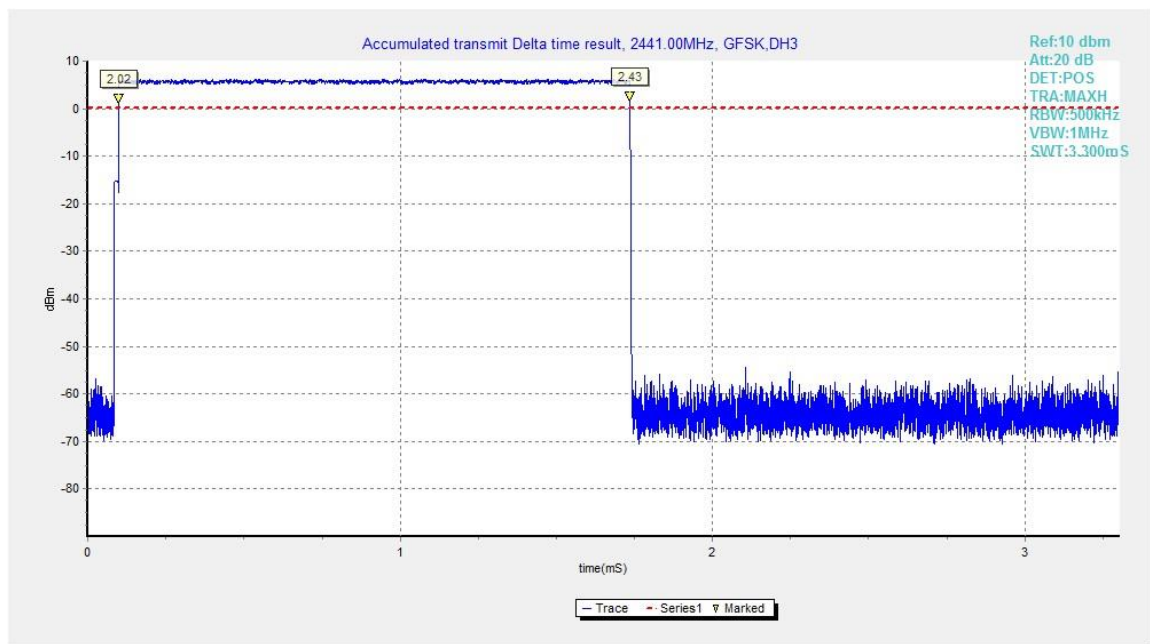


Fig.66. Time of occupancy (Dwell Time): Channel 39, Packet DH3

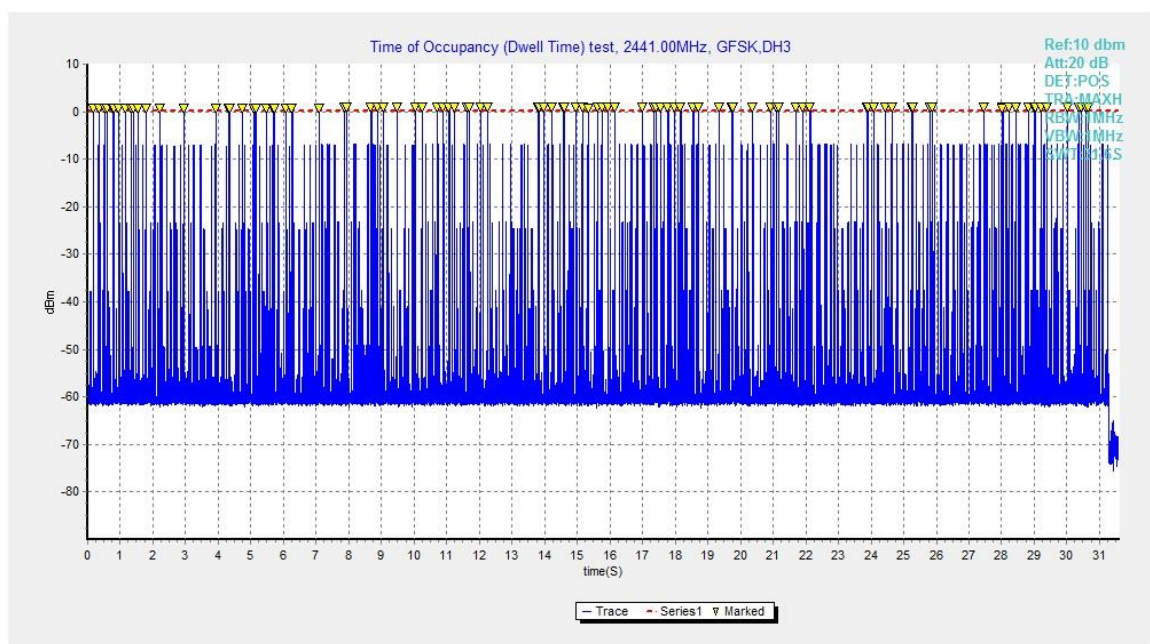


Fig.67. Number of Transmissions Measurement:Channel 39,Packet DH3



Fig.68. Time of occupancy (Dwell Time): Channel 39, Packet DH5

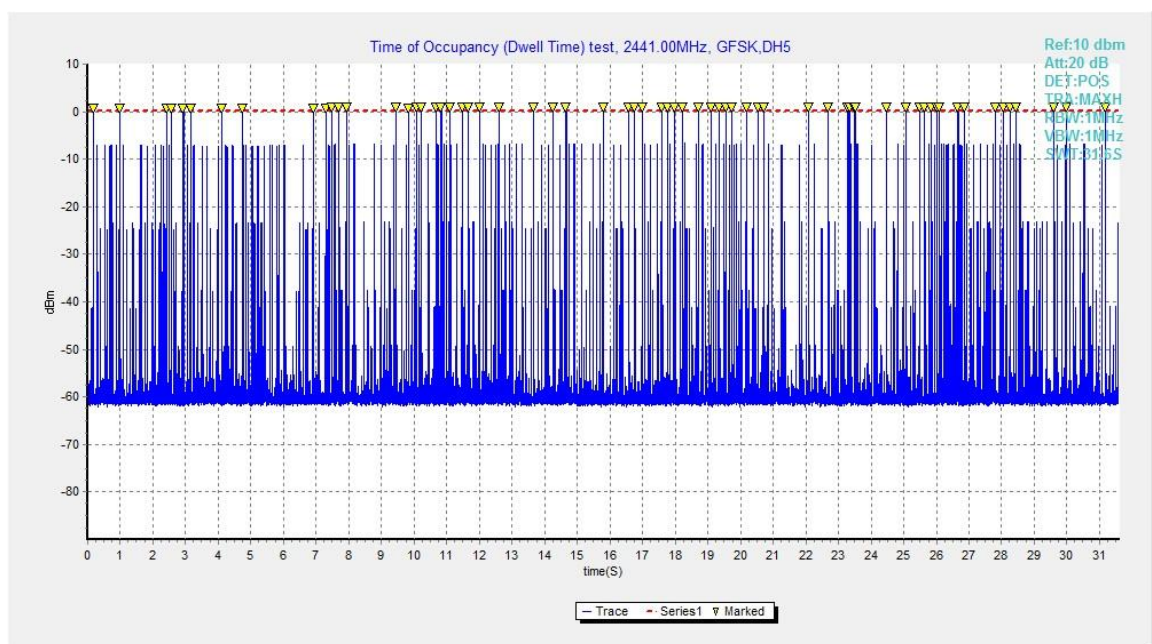


Fig.69. Number of Transmissions Measurement:Channel 39,Packet DH5

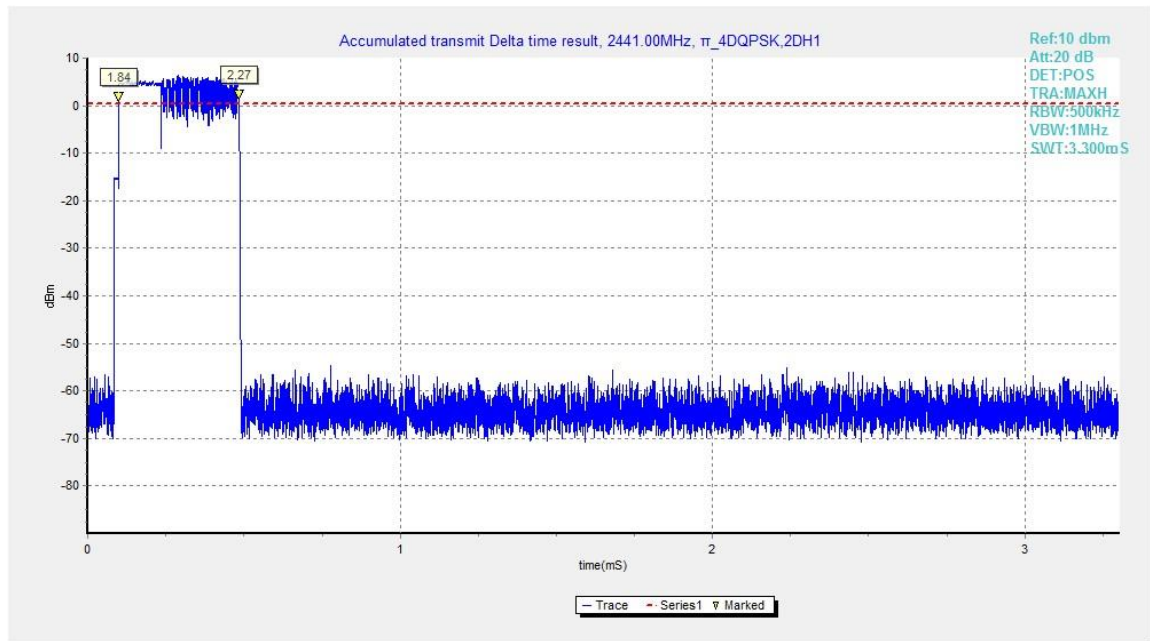


Fig.70. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH1

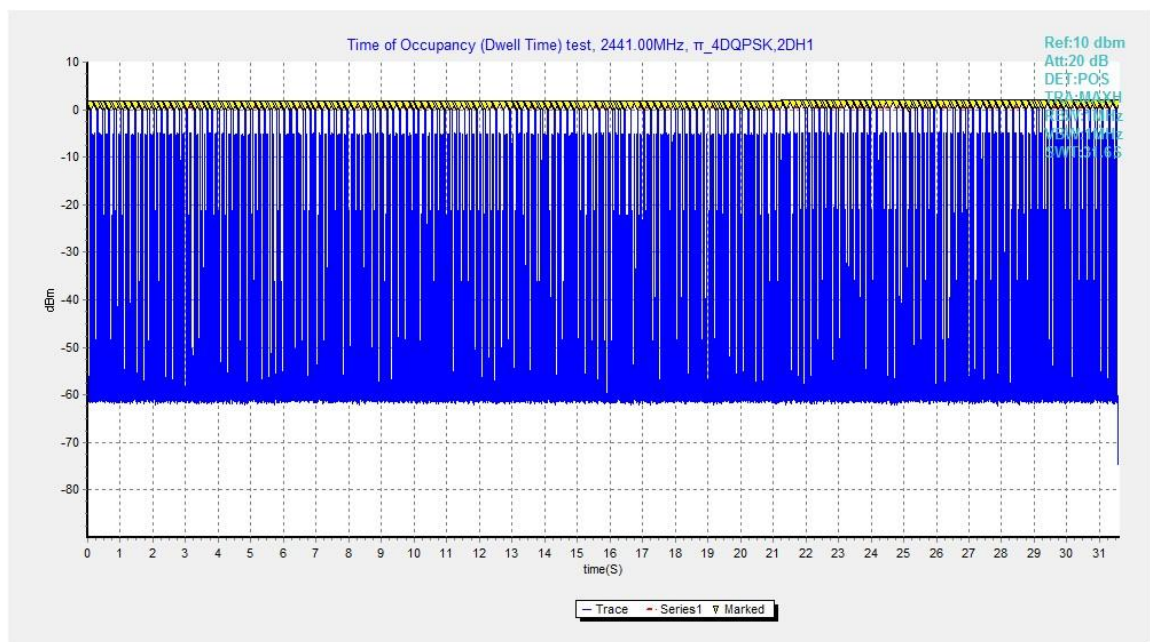


Fig.71. Number of Transmissions Measurement:Channel 39,Packet 2-DH1

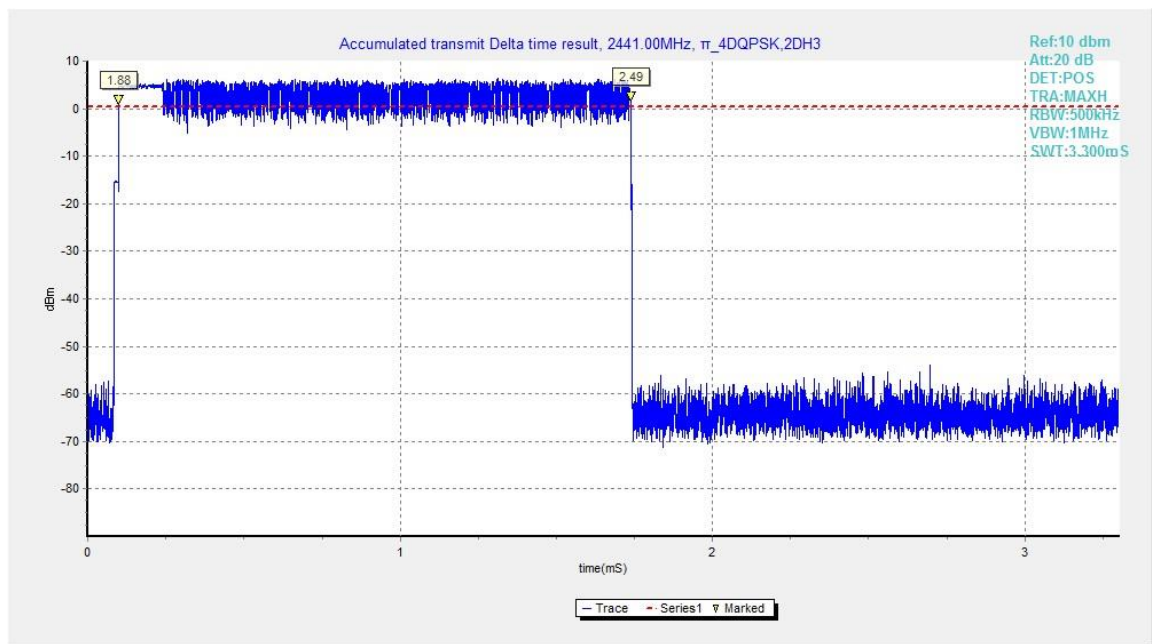


Fig.72. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH3

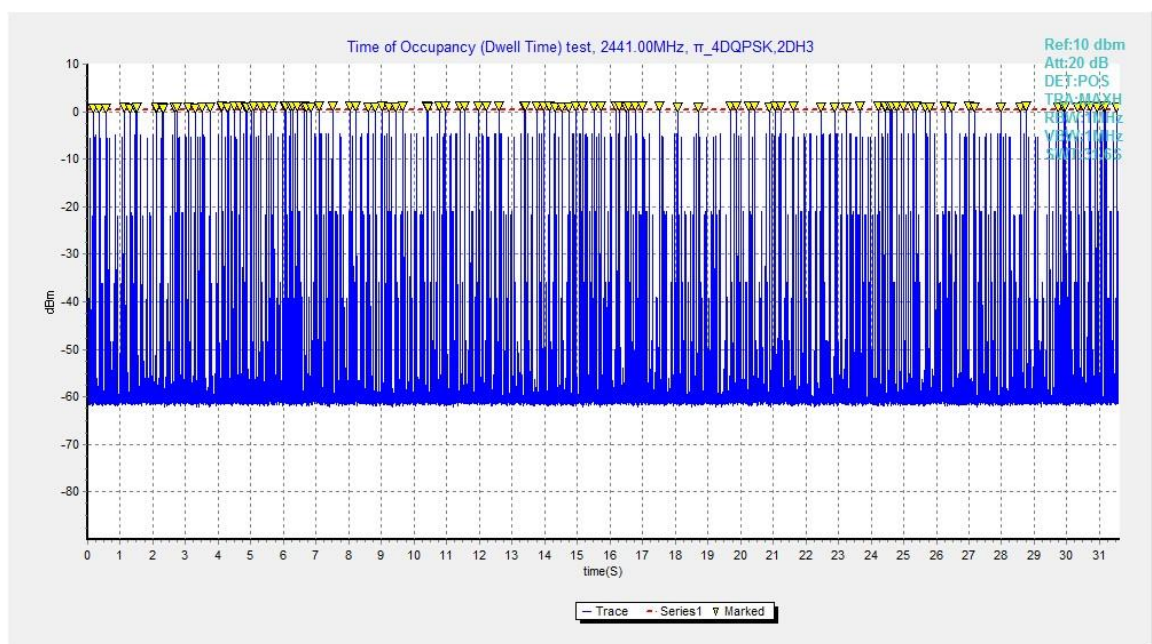


Fig.73. Number of Transmissions Measurement:Channel 39,Packet 2-DH3

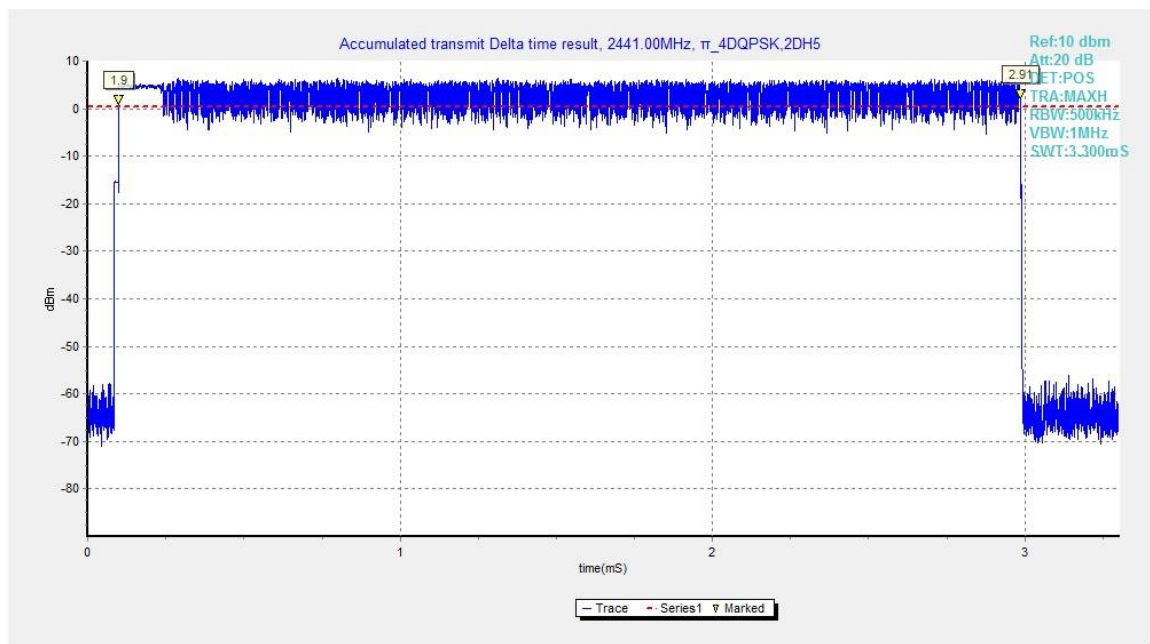


Fig.74. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH5

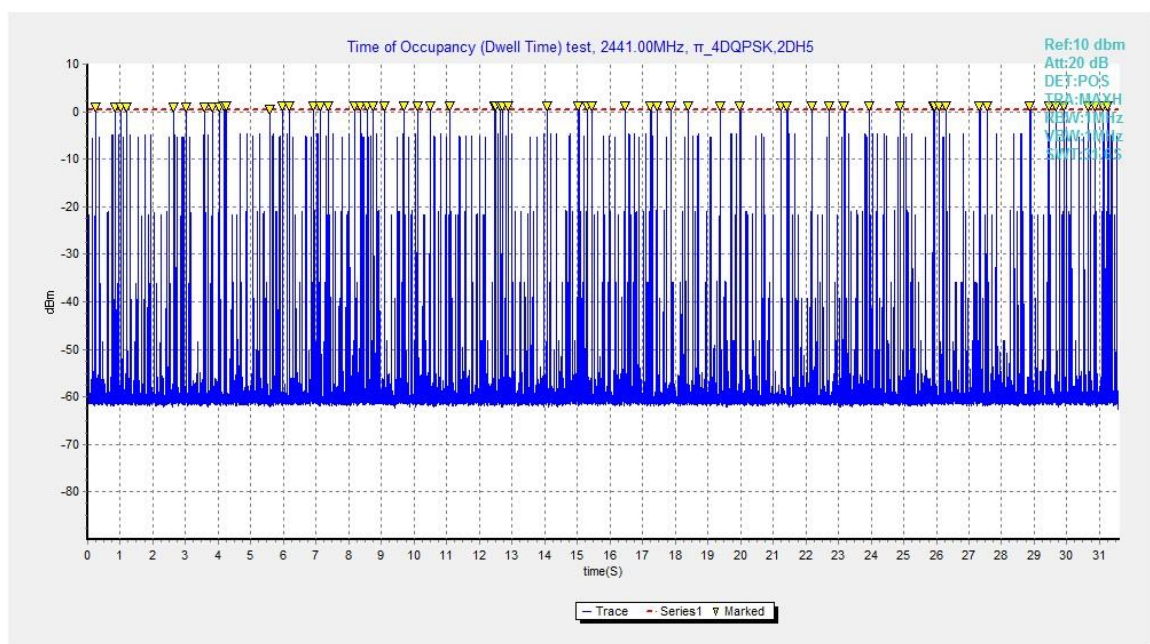


Fig.75. Number of Transmissions Measurement:Channel 39,Packet 2-DH5

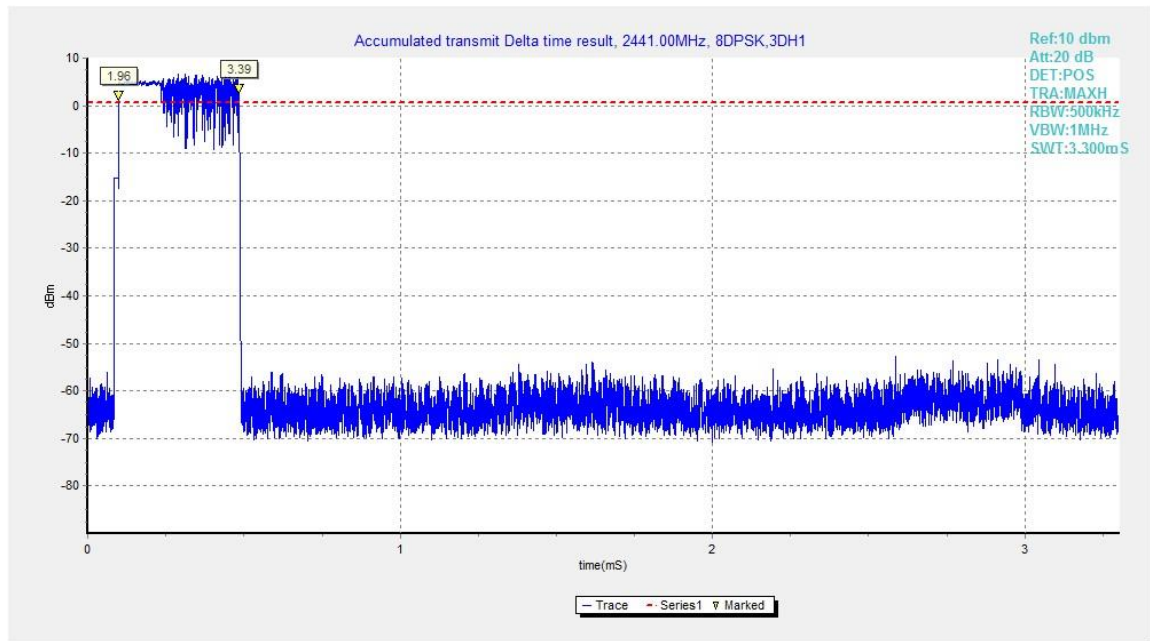


Fig.76. Time of occupancy (Dwell Time): Channel 39, Packet 3-DH1

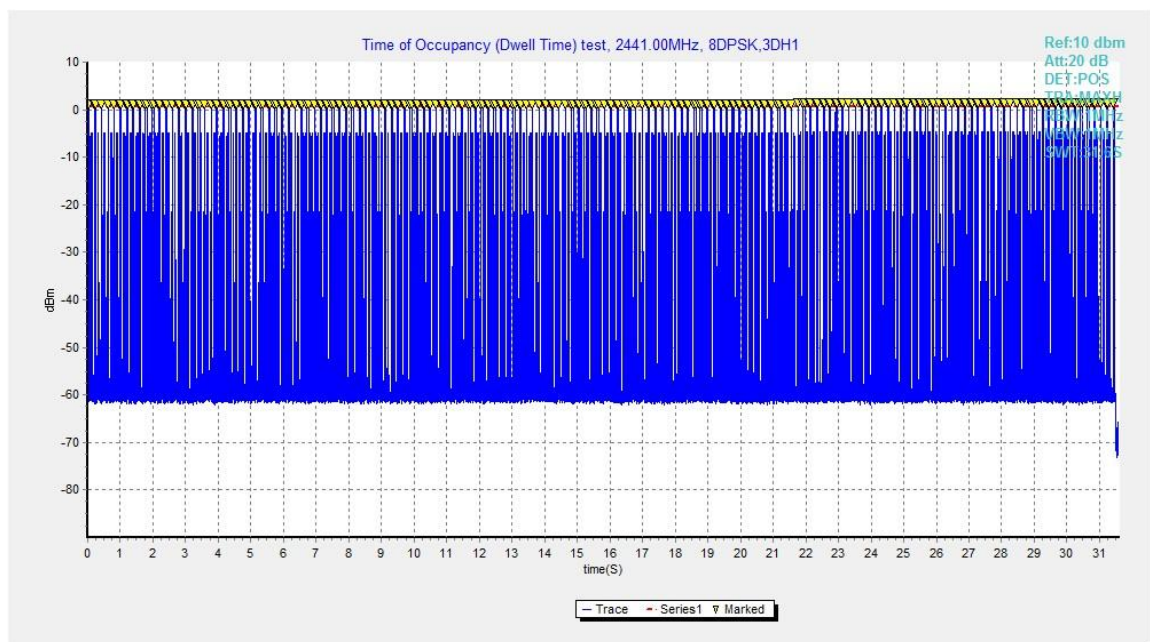


Fig.77. Number of Transmissions Measurement:Channel 39,Packet 3-DH1

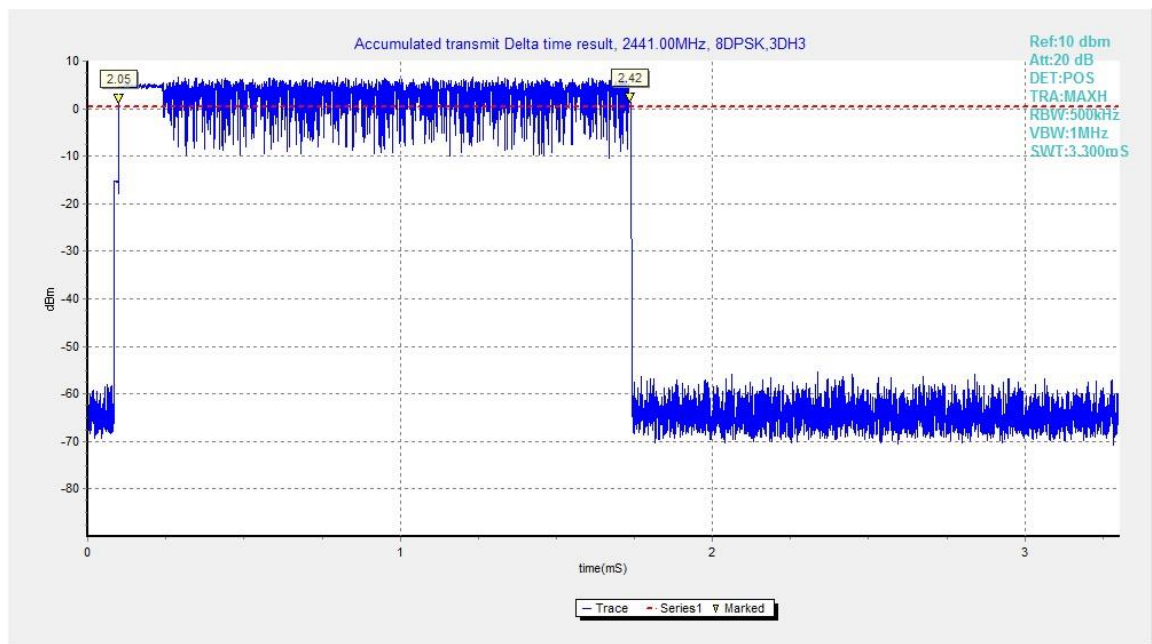


Fig.78. Time of occupancy (Dwell Time): Channel 39, Packet 3-DH3

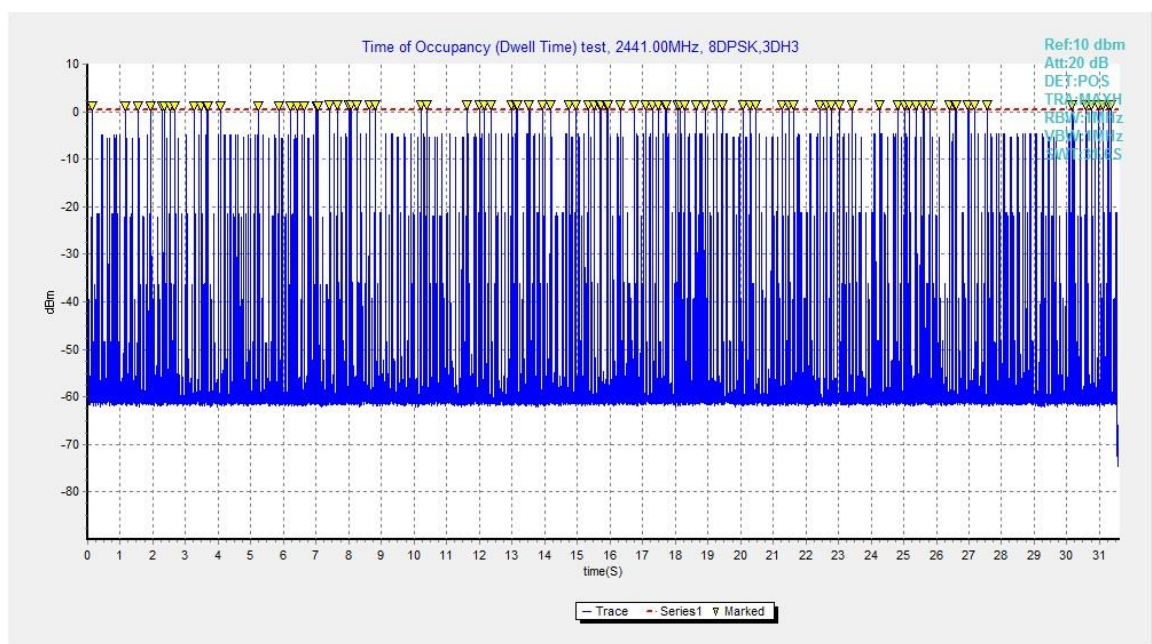


Fig.79. Number of Transmissions Measurement:Channel 39,Packet 3-DH3

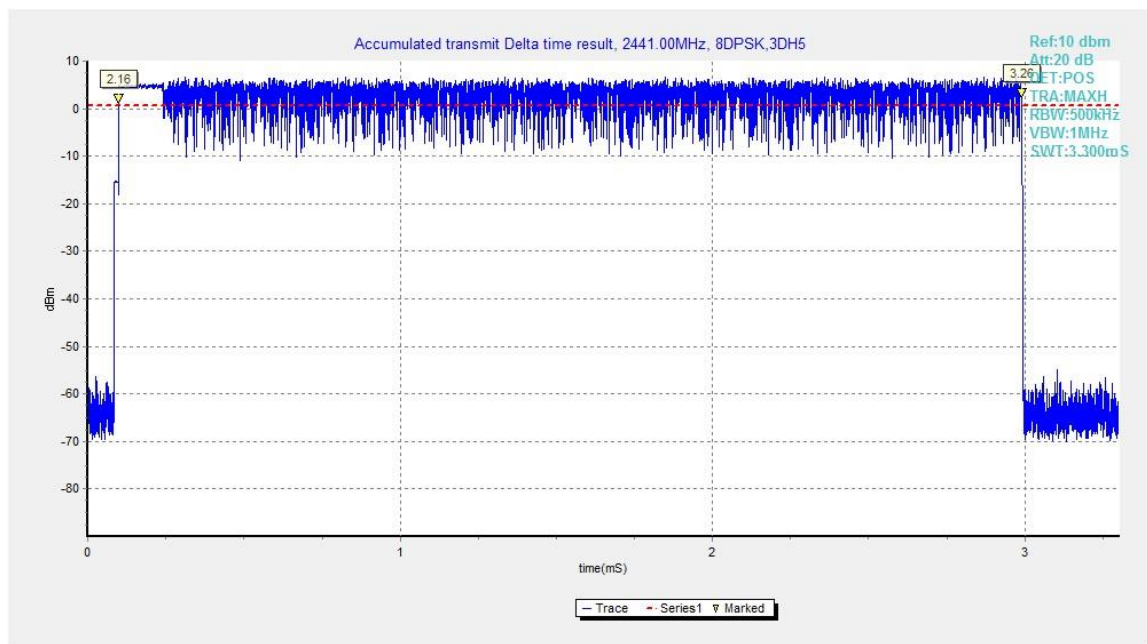


Fig.80. Time of occupancy (Dwell Time): Channel 39, Packet 3-DH5

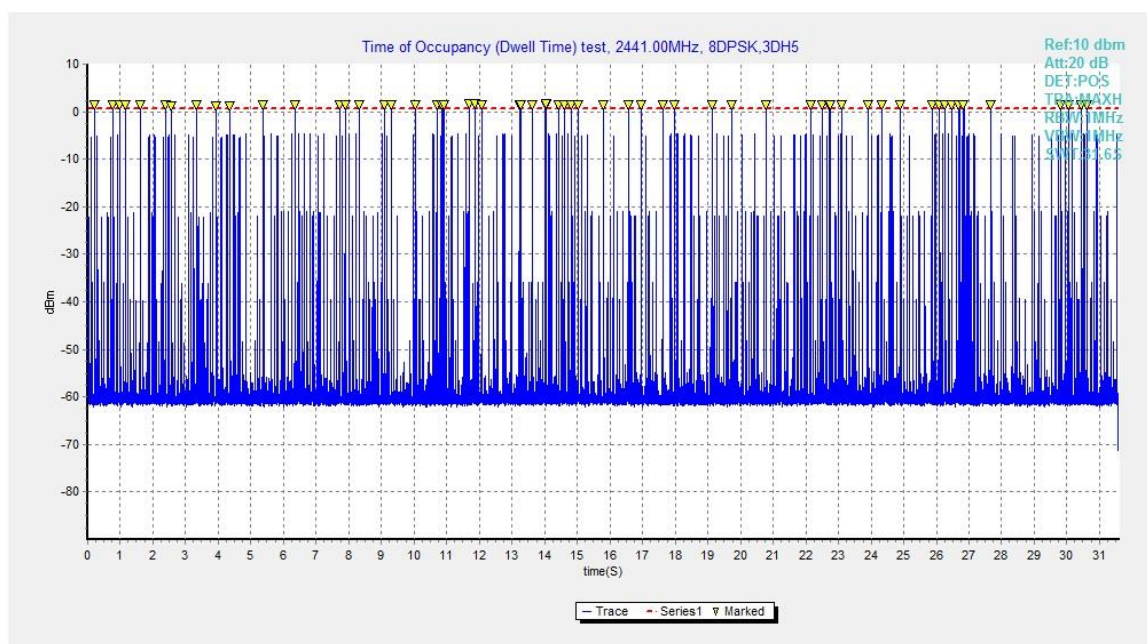


Fig.81. Number of Transmissions Measurement:Channel 39,Packet 3-DH5

A.7. 20dB Bandwidth

Method of Measurement: See ANSI C63.10-clause 6.9.2

Measurement Procedure - Unwanted Emissions

1. Set RBW = 30kHz.
2. Set VBW = 100 kHz.
3. Set span to 3MHz
4. Detector = peak.
5. Trace Mode = max hold.
6. Sweep = auto couple.
7. Allow the trace to stabilize (this may take some time, depending on the extent of the span).

Measurement Limit:

Standard	Limit
FCC 47 CFR Part 15.247(a)(1)	NA *

Use NdB Down function of the SA to measure the 20dB Bandwidth

* Comment: This test case is not required according to the latest FCC 47 CFR Part 15.247. But the test results are necessary for “carrier frequency separation” test case, in Annex A.8.

Measurement Results:

For GFSK

Channel	20dB Bandwidth (kHz)		Conclusion
0	Fig.82	936.00	NA
39	Fig.83	936.00	NA
78	Fig.84	939.75	NA

For $\pi/4$ DQPSK

Channel	20dB Bandwidth (kHz)		Conclusion
0	Fig.85	1296.75	NA
39	Fig.86	1281.75	NA
78	Fig.87	1310.25	NA

For 8DPSK

Channel	20dB Bandwidth (kHz)		Conclusion
0	Fig.88	1279.50	NA
39	Fig.89	1293.75	NA
78	Fig.90	1276.50	NA

Conclusion: NA

Test graphs as below:

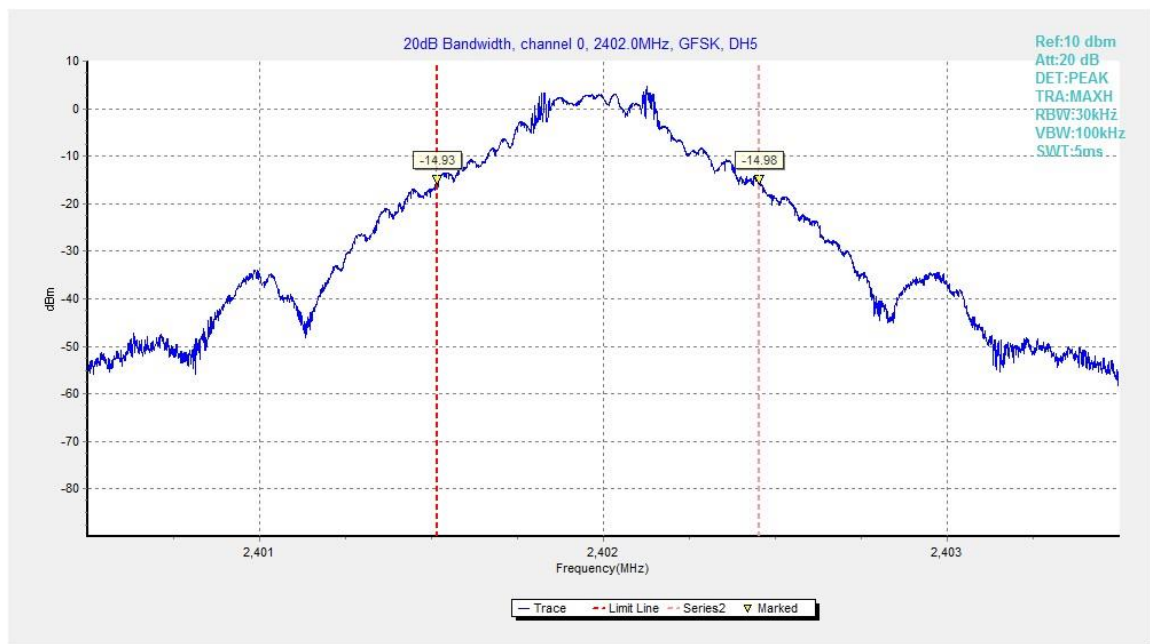


Fig.82. 20dB Bandwidth: GFSK, Channel 0

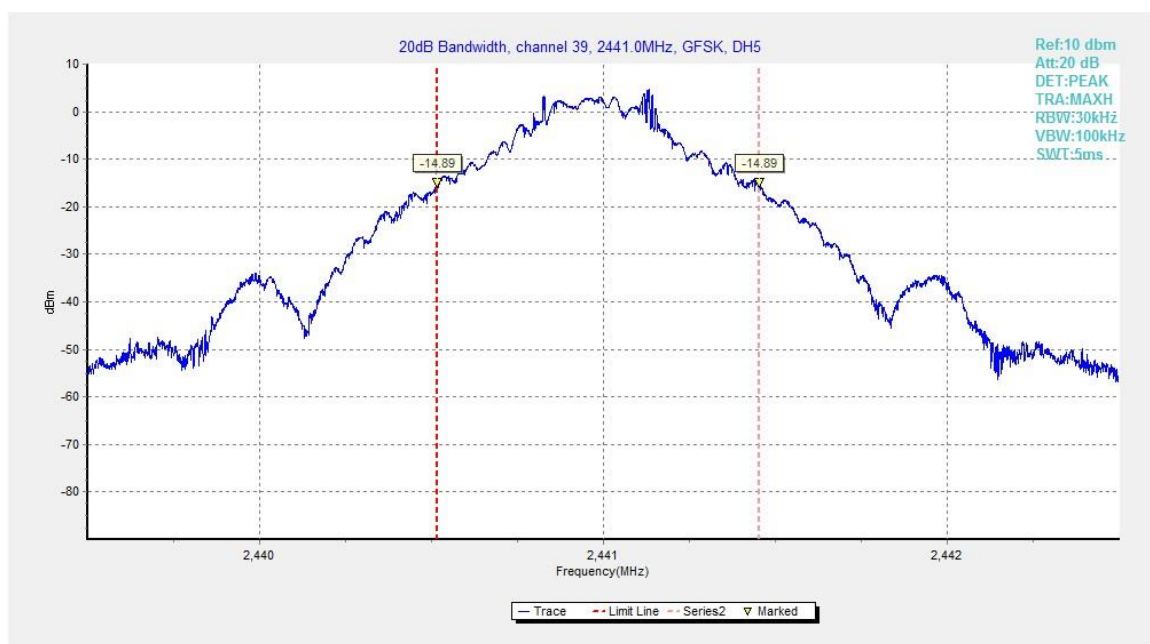


Fig.83. 20dB Bandwidth: GFSK, Channel 39

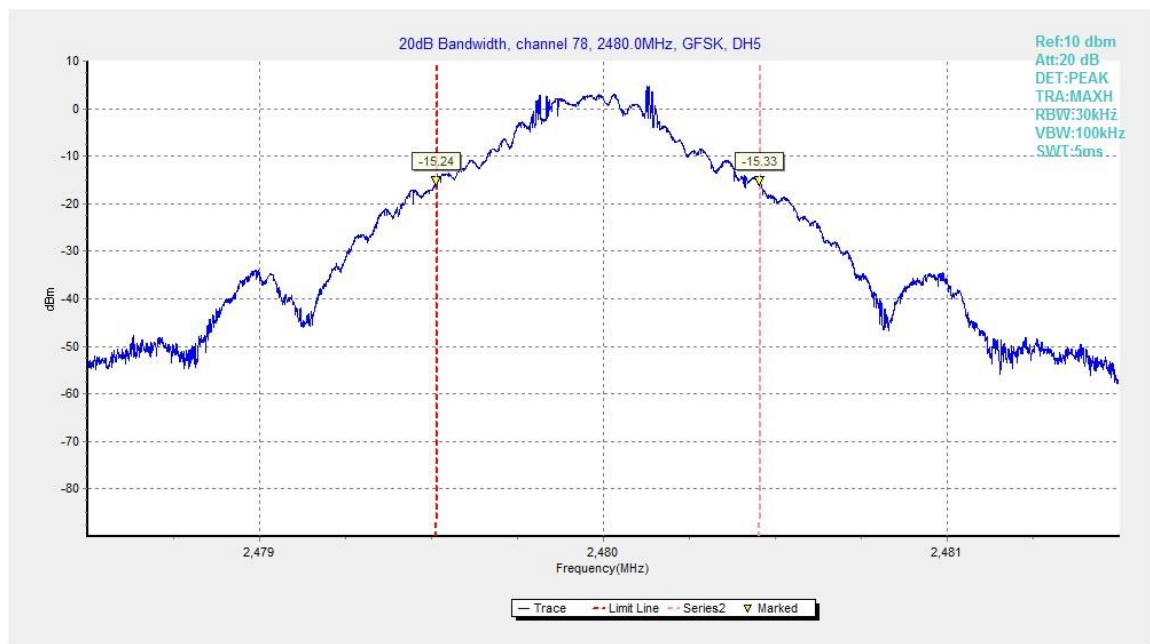


Fig.84. 20dB Bandwidth: GFSK, Channel 78

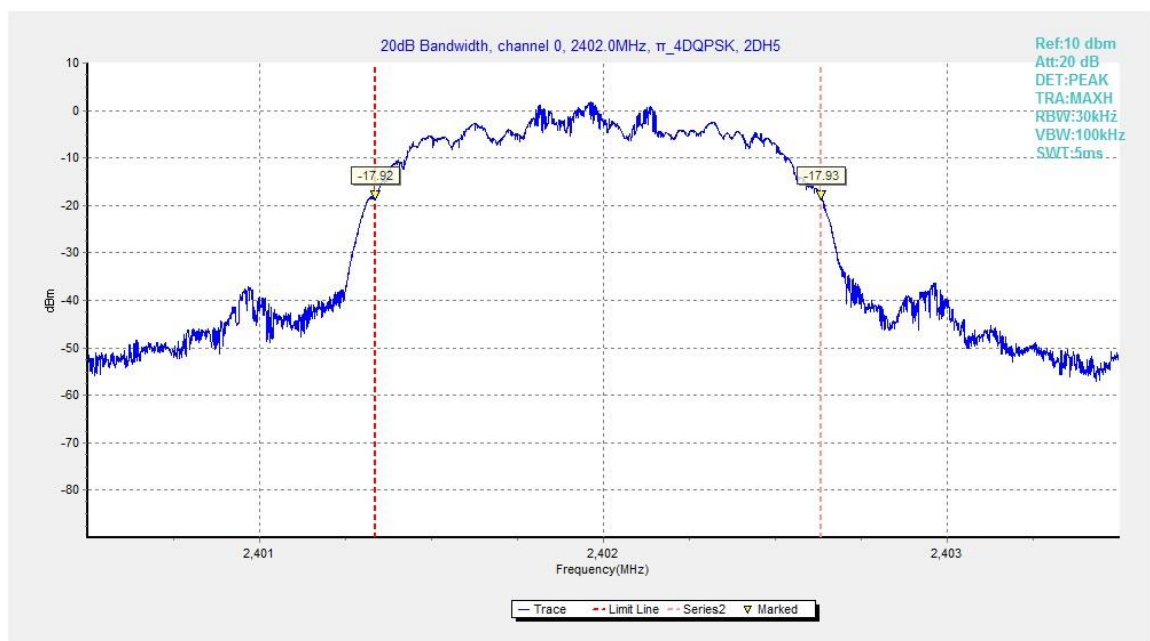


Fig.85. 20dB Bandwidth: $\pi/4$ DQPSK, Channel 0

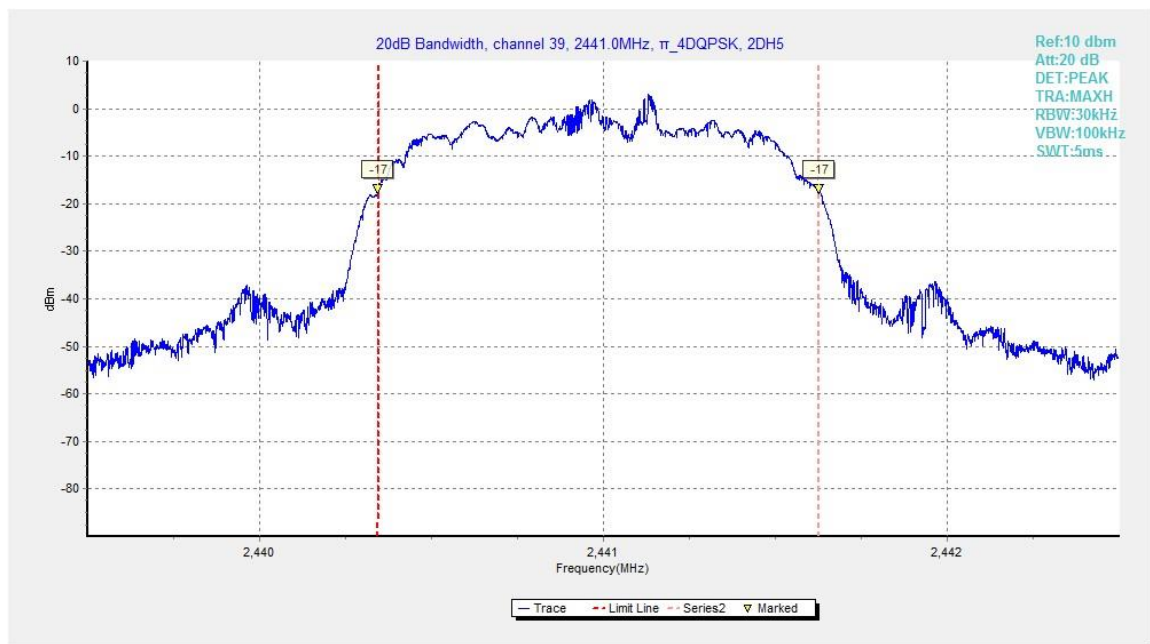


Fig.86. 20dB Bandwidth: $\pi/4$ DQPSK, Channel 39

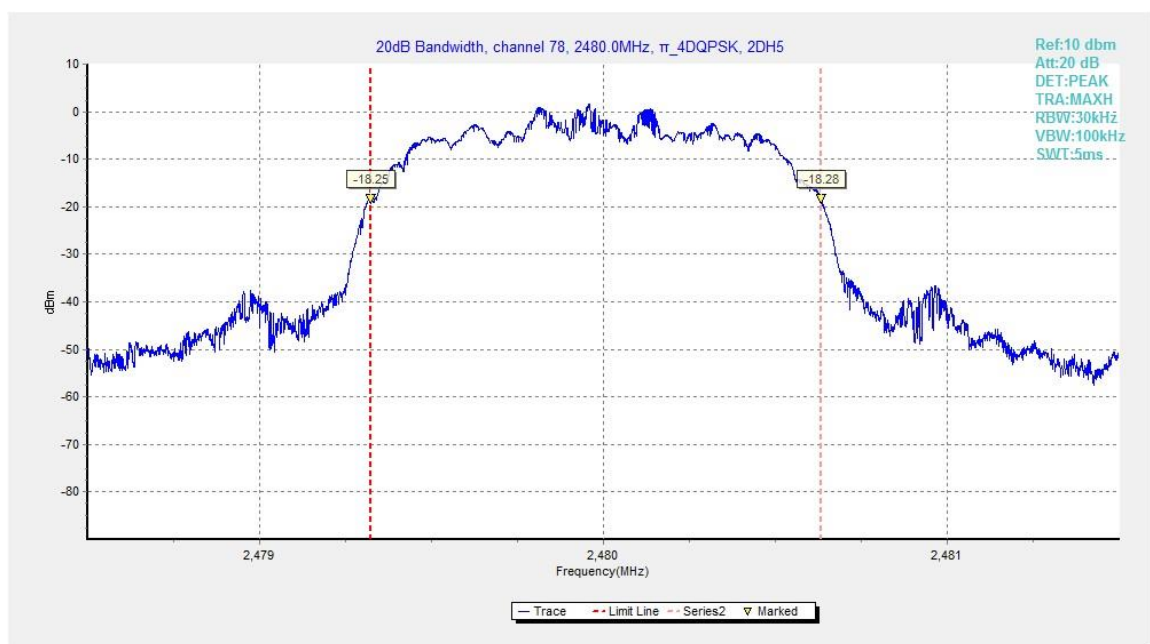


Fig.87. 20dB Bandwidth: $\pi/4$ DQPSK, Channel 78

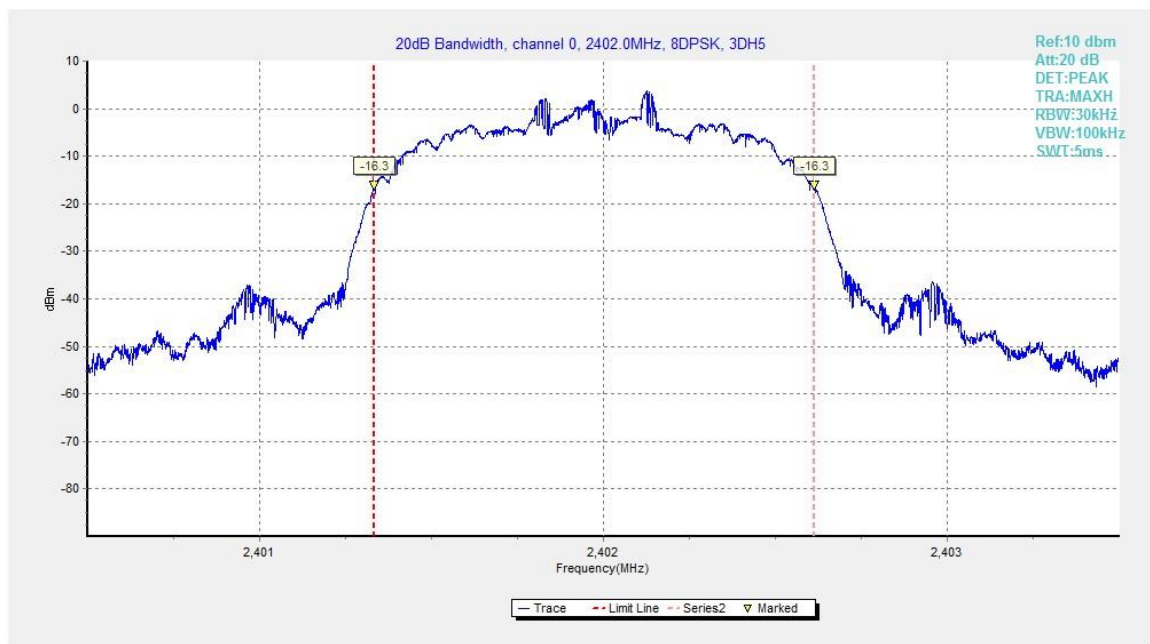


Fig.88. 20dB Bandwidth: 8DPSK, Channel 0

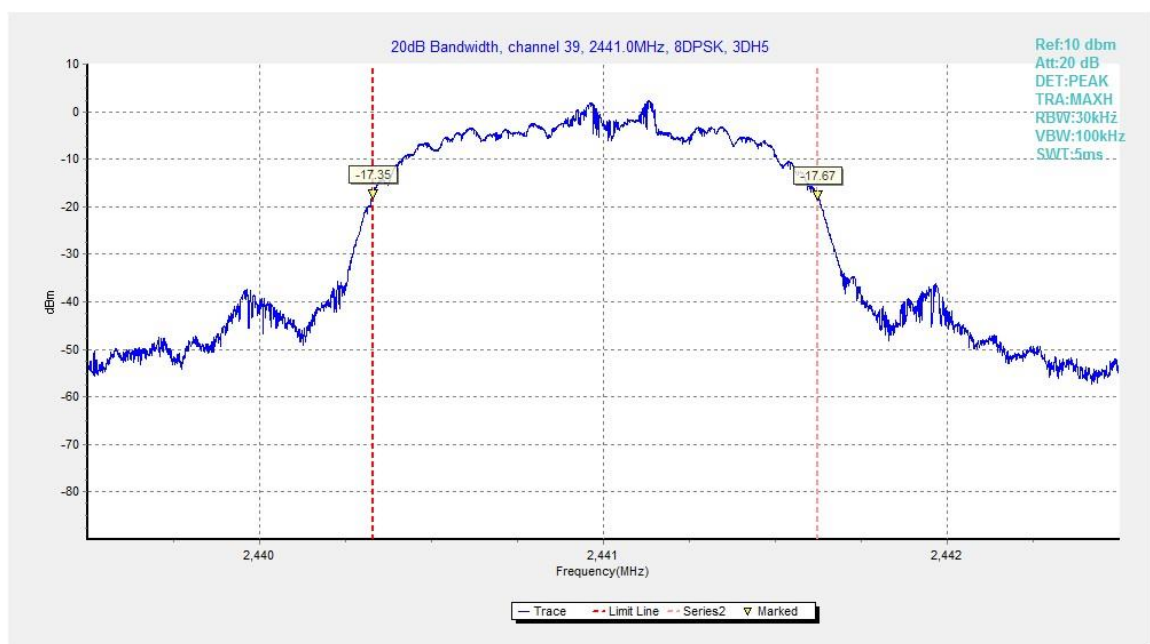


Fig.89. 20dB Bandwidth: 8DPSK, Channel 39

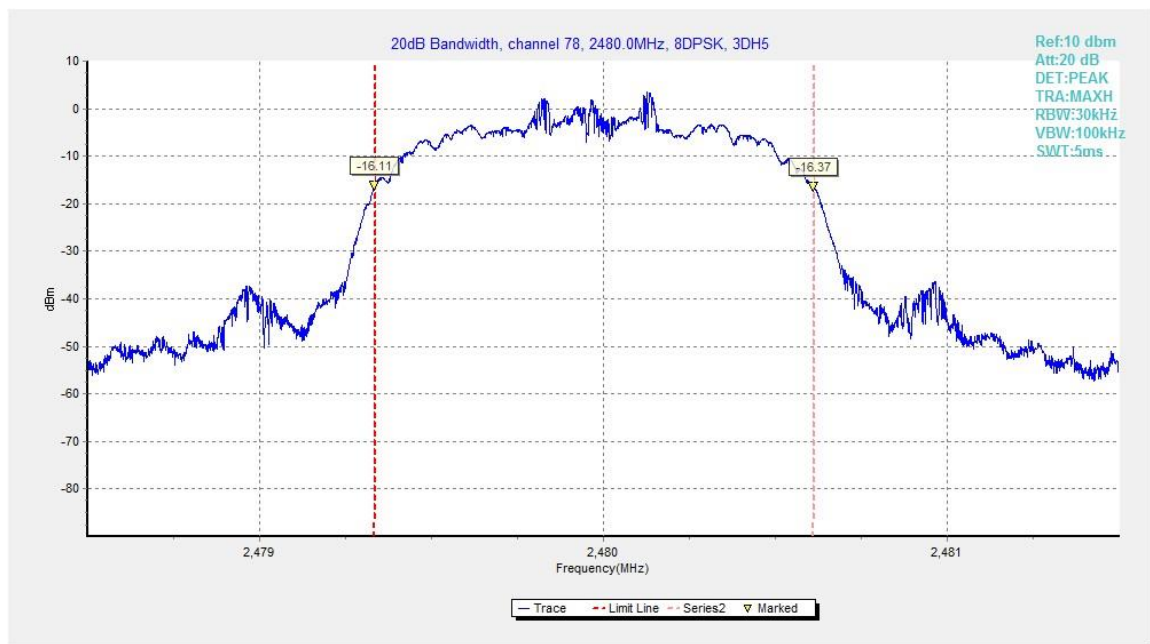


Fig.90. 20dB Bandwidth: 8DPSK, Channel 78

A.8. Carrier Frequency Separation

Method of Measurement: See ANSI C63.10-clause 7.8.2

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

- Span = 3MHz
- RBW=300kHz
- VBW=300kHz
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize

Search the peak marks of the middle frequency and adjacent channel, then record the separation between them.

* Comment: This limit should be over 25 kHz or $(2/3) * 20\text{dB}$ bandwidth, whichever is greater.

Measurement Limit:

Standard	Limit(kHz)
FCC 47 CFR Part 15.247(a)(1)	over 25 kHz or $(2/3) * 20\text{dB}$ bandwidth

Measurement Result:

For GFSK

Channel	Carrier frequency separation (kHz)		Conclusion
39	Fig.91	1316.25	P

For $\pi/4$ DQPSK

Channel	Carrier frequency separation (kHz)		Conclusion
39	Fig.92	936.00	P

For 8DPSK

Channel	Carrier frequency separation (kHz)		Conclusion
39	Fig.93	964.50	P

Conclusion: PASS

Test graphs as below:

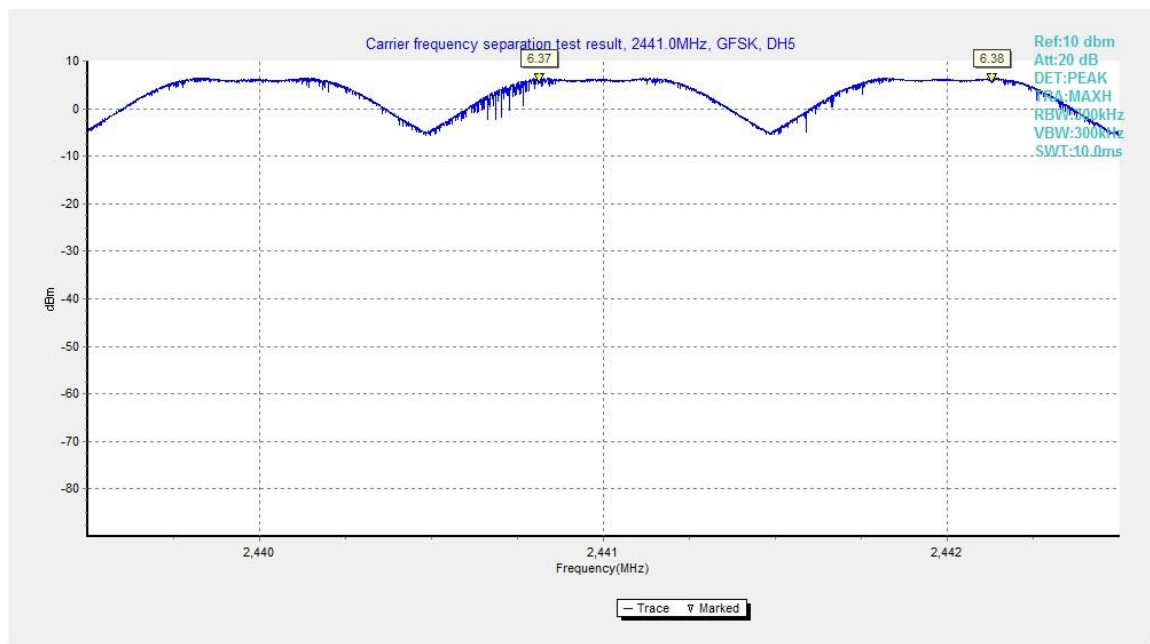


Fig.91. Carrier frequency separation measurement: GFSK, Channel 39

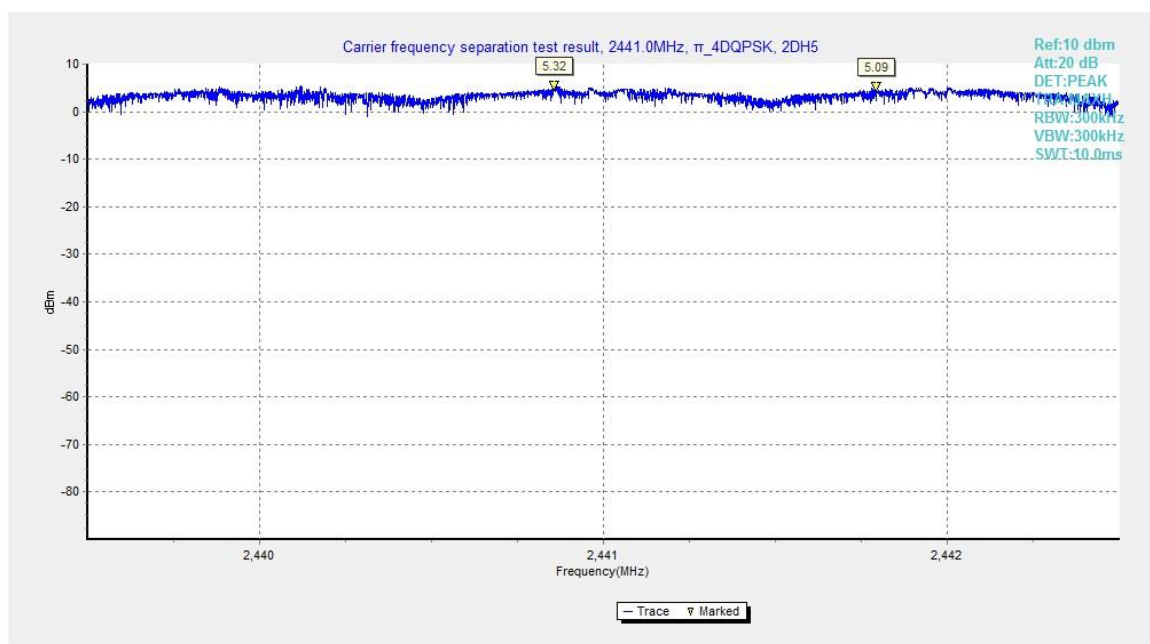


Fig.92. Carrier frequency separation measurement: $\pi/4$ DQPSK, Channel 39

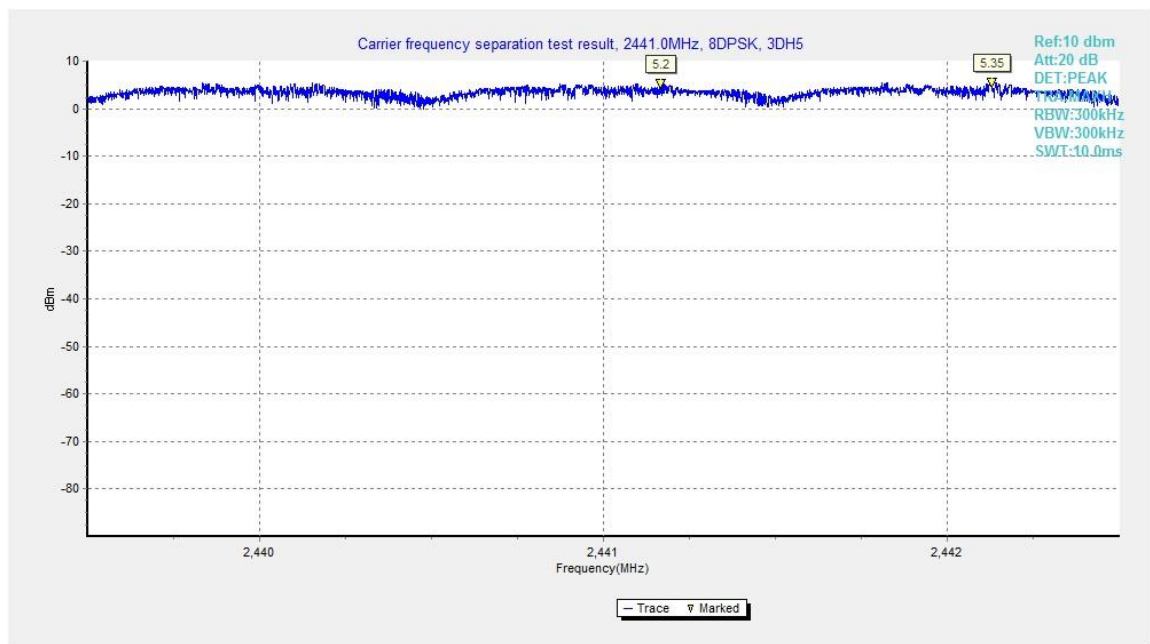


Fig.93. Carrier frequency separation measurement: 8DPSK, Channel 39

A.9. Number of Hopping Channels

Method of Measurement: See ANSI C63.10-clause 7.8.3

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

- Span = the frequency band of operation
- RBW = 500kHz
- VBW = 500kHz
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize

It might prove necessary to break the span up into subranges to show clearly all of the hopping frequencies. Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of hopping channels. A plot of the data shall be included in the test report.

Measurement Limit:

Standard	Limit
FCC 47 CFR Part 15.247(a) (1)(iii)	At least 15 non-overlapping channels

Measurement Result:

For GFSK

Channel	Number of hopping channels		Conclusion
0~39	Fig.94	79	P
40~78	Fig.95		

For $\pi/4$ DQPSK

Channel	Number of hopping channels		Conclusion
0~39	Fig.96	79	P
40~78	Fig.97		

For 8DPSK

Channel	Number of hopping channels		Conclusion
0~39	Fig.98	79	P
40~78	Fig.99		

Conclusion: PASS

Test graphs as below:

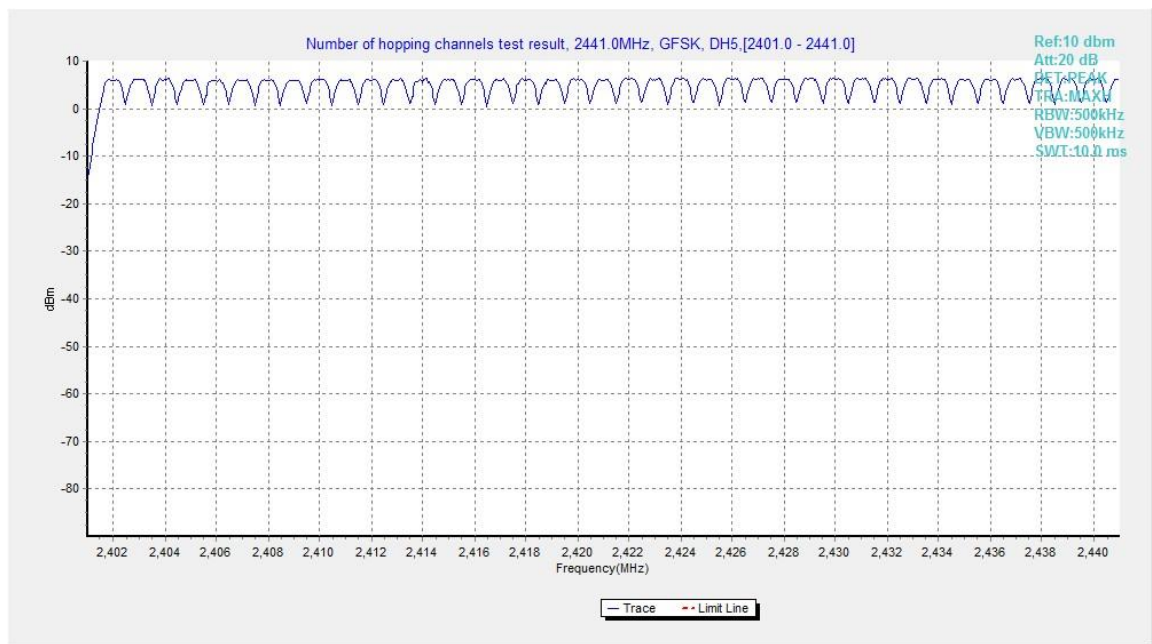


Fig.94. Number of hopping frequencies: GFSK, Channel 0 - 39

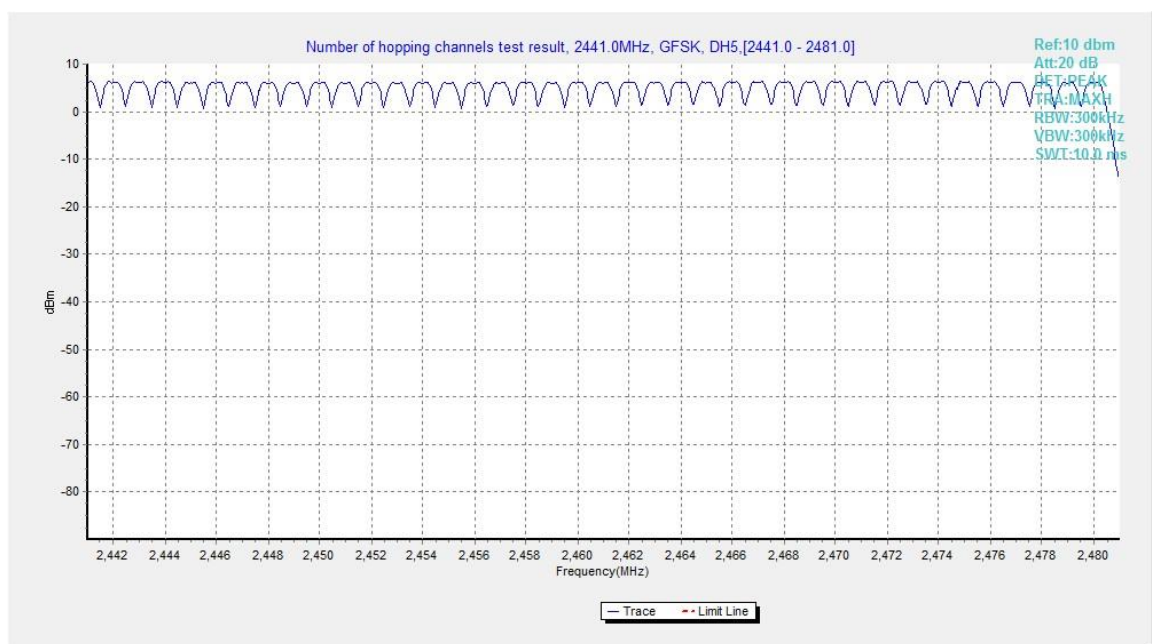


Fig.95. Number of hopping frequencies: GFSK, Channel 40 - 78

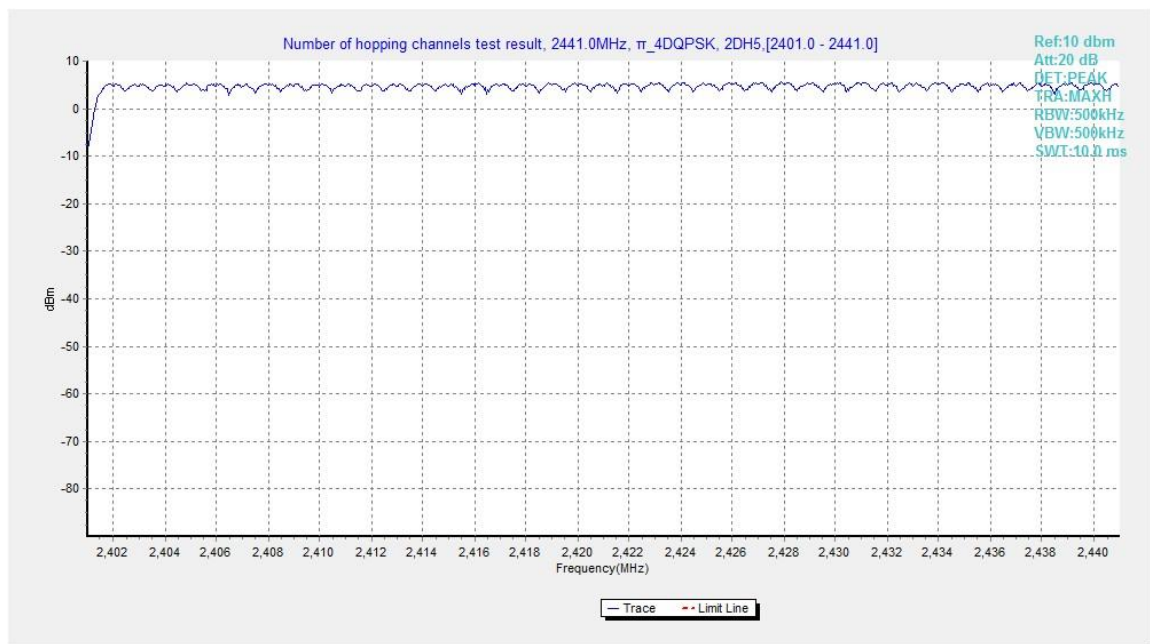


Fig.96. Number of hopping frequencies: $\pi/4$ DQPSK, Channel 0 - 39

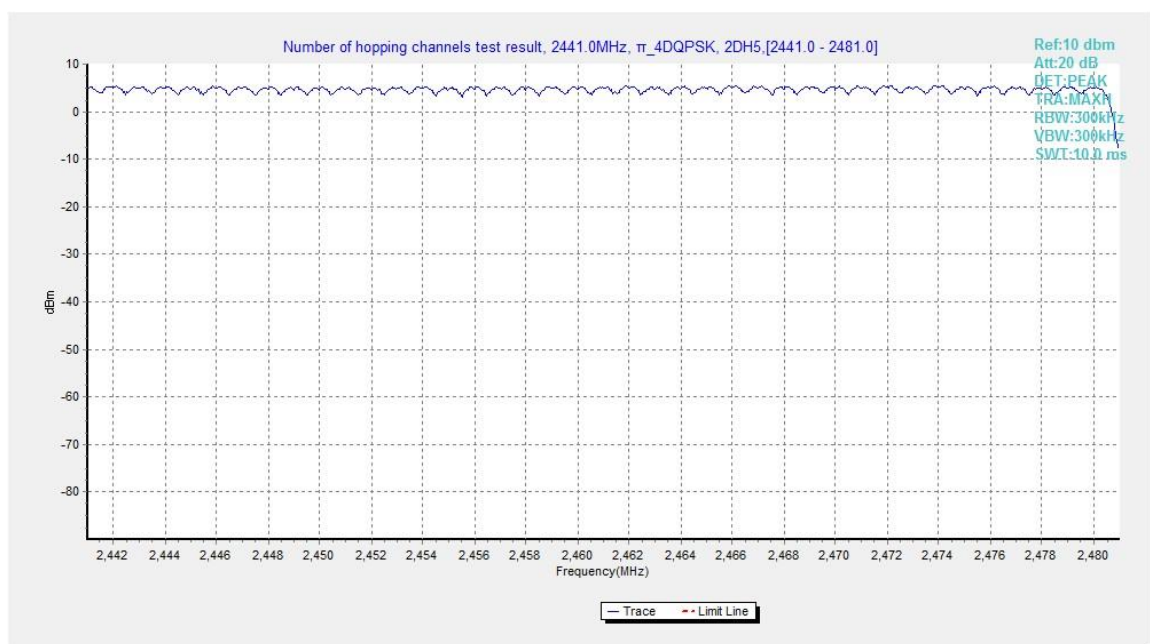


Fig.97. Number of hopping frequencies: $\pi/4$ DQPSK, Channel 40 - 78

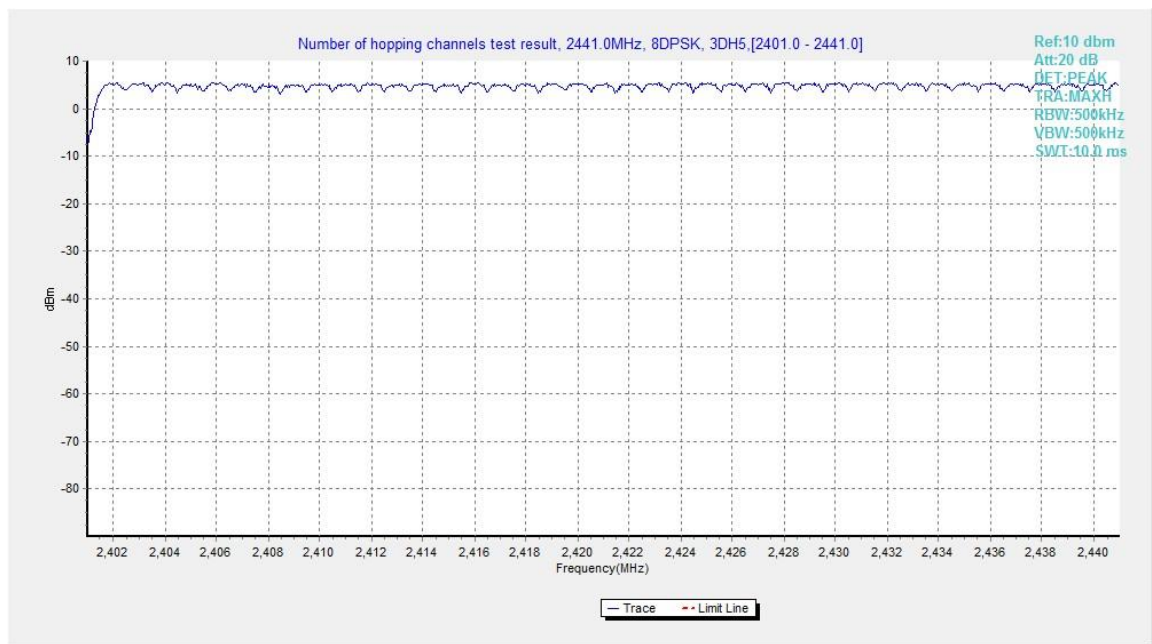


Fig.98. Number of hopping frequencies: 8DPSK, Channel 0 - 39

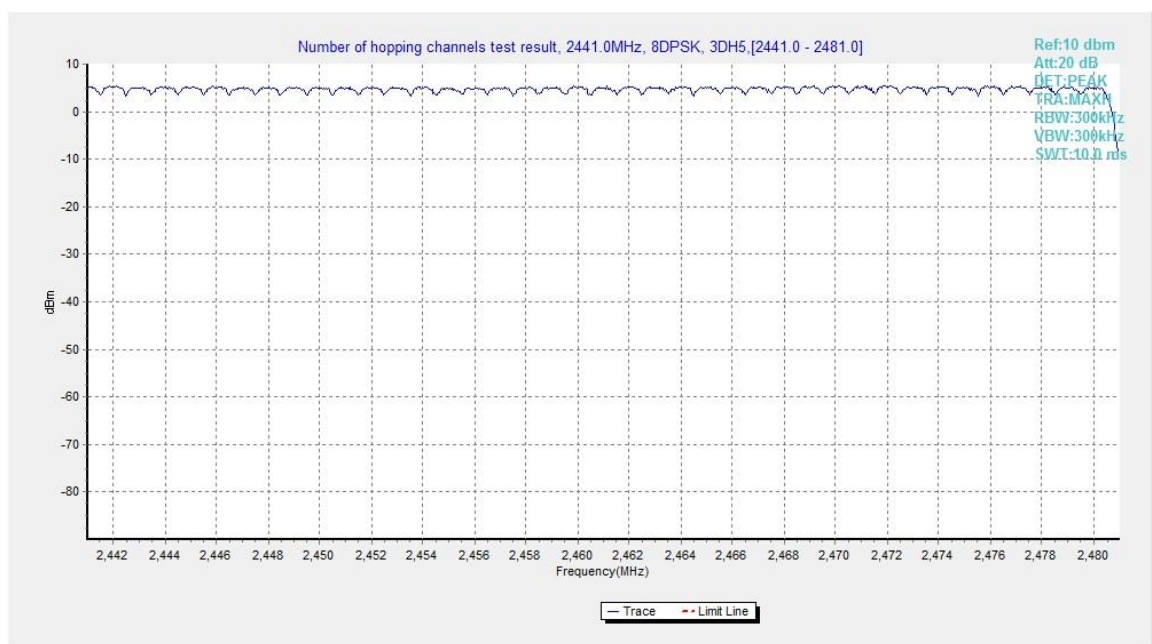


Fig.99. Number of hopping frequencies: 8DPSK, Channel 40 - 78

A.10. AC Powerline Conducted Emission

Test Condition

Voltage (V)	Frequency (Hz)
120	60

Measurement Result and limit:

Bluetooth (Quasi-peak Limit)

Frequency range (MHz)	Quasi-peak Limit (dB μ V)	Conclusion
0.15 to 0.5	66 to 56	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.

Bluetooth (Average Limit)

Frequency range (MHz)	Average Limit (dB μ V)	Conclusion
0.15 to 0.5	56 to 46	P
0.5 to 5	46	
5 to 30	50	

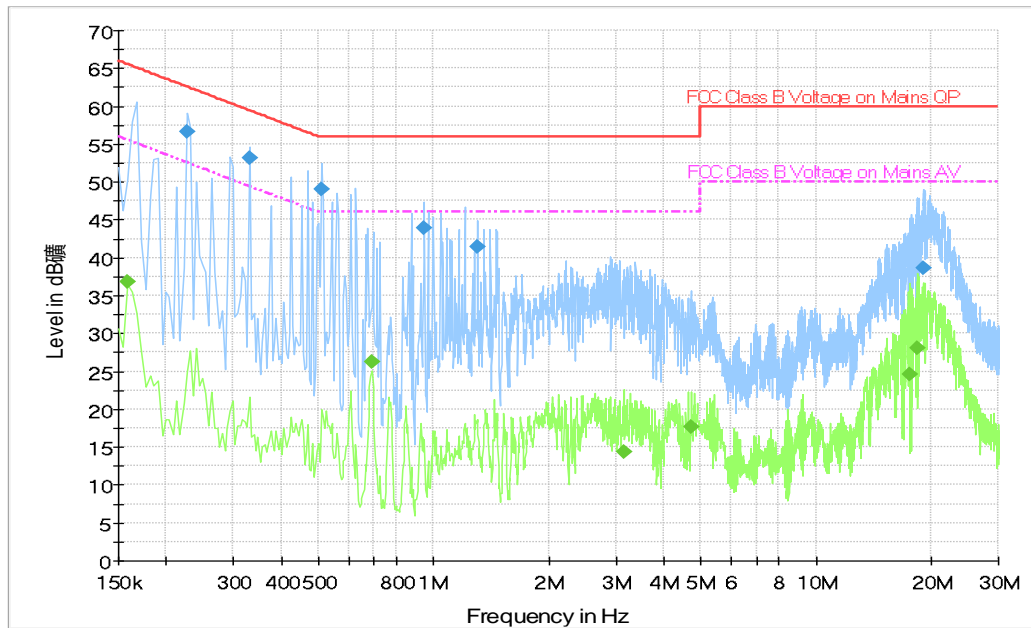
NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.

The measurement is made according to ANSI C63.10

Conclusion: PASS

Test graphs as below:

Traffic:



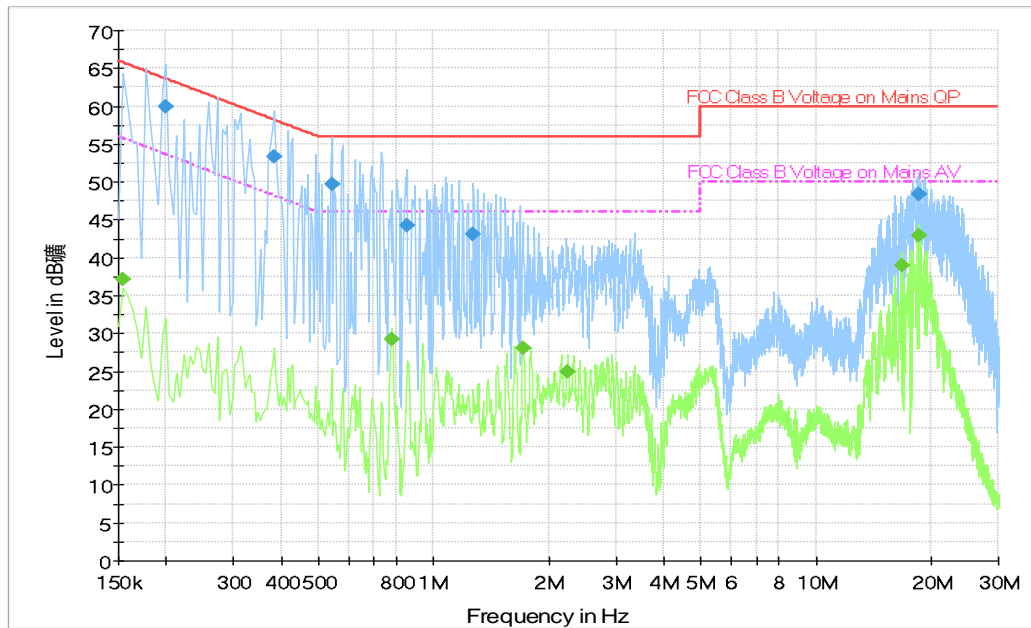
Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.226500	56.6	2000.0	9.000	On	L1	19.8	6.0	62.6
0.330000	53.2	2000.0	9.000	On	L1	19.8	6.3	59.5
0.510000	49.1	2000.0	9.000	On	L1	19.9	6.9	56.0
0.946500	44.0	2000.0	9.000	On	L1	19.8	12.0	56.0
1.302000	41.4	2000.0	9.000	On	L1	19.7	14.6	56.0
19.126500	38.6	2000.0	9.000	On	L1	19.9	21.4	60.0

Final Result 2

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.159000	36.8	2000.0	9.000	On	L1	19.9	18.7	55.5
0.690000	26.3	2000.0	9.000	On	L1	19.8	19.7	46.0
3.138000	14.4	2000.0	9.000	On	L1	19.3	31.6	46.0
4.726500	17.7	2000.0	9.000	On	N	19.6	28.3	46.0
17.659500	24.6	2000.0	9.000	On	N	19.9	25.4	50.0
18.505500	28.0	2000.0	9.000	On	N	19.9	22.0	50.0

Idle:



Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.199500	59.9	2000.0	9.000	On	N	19.8	3.8	63.6
0.384000	53.4	2000.0	9.000	On	N	19.9	4.8	58.2
0.541500	49.7	2000.0	9.000	On	N	19.9	6.3	56.0
0.852000	44.3	2000.0	9.000	On	N	19.8	11.7	56.0
1.270500	43.0	2000.0	9.000	On	N	19.7	13.0	56.0
18.640500	48.4	2000.0	9.000	On	N	19.9	11.6	60.0

Final Result 2

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.154500	37.1	2000.0	9.000	On	N	20.0	18.7	55.8
0.780000	29.2	2000.0	9.000	On	N	19.8	16.8	46.0
1.716000	28.1	2000.0	9.000	On	N	19.7	17.9	46.0
2.247000	24.9	2000.0	9.000	On	N	19.3	21.1	46.0
16.768500	38.9	2000.0	9.000	On	L1	19.8	11.1	50.0
18.564000	43.0	2000.0	9.000	On	N	19.9	7.0	50.0

END OF REPORT