

display. It is advantageous to have prior knowledge of the frequencies of emissions, although this may be determined from such a near-field scan. The near-field scan shall only be used to determine the frequency but not the amplitude of the emissions. Where exploratory measurements are not adequate to determine the worst-case operating modes and are used only to identify the frequencies of the highest emissions, additional preliminary tests can be required. For emissions from the EUT, the maximum level shall be determined by rotating the EUT and its antenna through 0° to 360°. For each mode of operation required to be tested, the frequency spectrum (based on findings from exploratory measurements) shall be monitored. Broadband antennas and a spectrum analyzer or a radio-noise meter with a panoramic display are often useful in this type of test. If either antenna height or EUT azimuth are not fully measured during exploratory testing, then complete testing can be required at the OATS or semi-anechoic chamber when the final full spectrum testing is performed.

Final radiated emissions measurements

The final measurements are using the orientation and equipment arrangement of the EUT based on the measurement results found during the preliminary (exploratory) measurements, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit shall be selected for the final measurement. For each mode of operation required to be tested, the frequency spectrum (based on findings from exploratory measurements) shall be monitored. The highest signal levels relative to the limit shall be determined by rotating the EUT from 0° to 360° and with varying the measurement antenna height between 1 m and 4 m in vertical and horizontal polarizations. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable), as well as the frequency and amplitude of the six highest spurious emissions relative to the limit. Emissions more than 20 dB below the limit do not need to be reported.

This maximization process was repeated with the EUT positioned in each of its three orthogonal orientations.

The receiver references:

Frequency of emission (MHz)	RBW/VBW	Sweep Time(s)
30-1000	100kHz/300kHz	5
1000-4000	1MHz/3MHz	15
4000-18000	1MHz/3MHz	40
18000-26500	1MHz/3MHz	20

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

Where:

P_{Mea} field strength recorded from the instrument

Peak Measurement results

GFSK Ch 0

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
17990.500	50.97	-25.50	46.70	29.77	74.00	23.03	H
4803.500	49.43	-37.30	33.00	53.63	74.00	24.57	V
13677.500	49.00	-29.50	40.40	38.10	74.00	25.00	H
12883.500	47.59	-30.70	39.10	39.09	74.00	26.41	H
9613.000	45.34	-33.10	38.00	40.44	74.00	28.66	V
2374.700	56.01	-20.10	28.00	48.01	74.00	17.99	V

GFSK Ch 39

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
11547.000	52.99	-32.30	38.80	46.39	74.00	21.01	V
17987.500	51.22	-25.50	46.70	30.02	74.00	22.78	V
4882.000	49.21	-37.20	33.20	53.21	74.00	24.79	V
13704.000	49.09	-29.10	40.90	37.29	74.00	24.91	V
9874.500	46.40	-33.50	38.10	41.80	74.00	27.60	V
7323.000	45.80	-35.10	36.60	44.30	74.00	28.20	V

GFSK Ch 78

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
17255.500	51.77	-25.90	44.40	33.37	74.00	22.23	V
14557.500	48.90	-27.30	41.90	34.30	74.00	25.10	H
12843.000	47.56	-30.70	39.10	39.06	74.00	26.44	H
4960.000	47.07	-37.10	33.30	50.87	74.00	26.93	V
9499.000	45.51	-33.20	37.90	40.81	74.00	28.49	V
2485.000	55.82	-20.00	28.30	47.52	74.00	18.18	V

$\pi/4$ DQPSK Ch 0

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
17973.000	50.57	-25.50	46.70	29.37	74.00	23.43	H
13619.500	49.94	-29.50	40.40	39.04	74.00	24.06	H
4803.500	49.57	-37.30	33.00	53.77	74.00	24.43	V
12824.000	47.24	-30.70	39.10	38.74	74.00	26.76	V
7205.500	46.07	-35.50	36.40	45.17	74.00	27.93	V
2377.300	55.72	-20.00	28.10	47.72	74.00	18.28	V

$\pi/4$ DQPSK Ch 39

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
17921.000	51.04	-25.50	46.70	29.84	74.00	22.96	H
4881.500	49.19	-37.20	33.20	53.19	74.00	24.81	V
14181.000	49.01	-29.00	42.00	36.01	74.00	24.99	H
12922.500	47.57	-30.50	39.20	38.87	74.00	26.43	H
9983.000	45.88	-33.60	38.10	41.38	74.00	28.12	H
7322.500	44.91	-35.10	36.60	43.41	74.00	29.09	V

$\pi/4$ DQPSK Ch 78

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
17430.500	51.42	-26.90	45.20	33.02	74.00	22.58	V
14561.000	48.65	-27.30	41.90	34.05	74.00	25.35	H
11856.000	47.09	-31.80	39.00	39.89	74.00	26.91	H
9976.000	46.33	-33.60	38.10	41.83	74.00	27.67	V
7530.500	45.08	-34.50	36.80	42.78	74.00	28.92	H
2491.400	55.71	-20.00	28.30	47.41	74.00	18.29	H

8DPSK Ch 0

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
17987.500	51.58	-25.50	46.70	30.38	74.00	22.42	V
13732.500	49.09	-29.10	40.90	37.29	74.00	24.91	V
4804.500	49.08	-37.30	33.00	53.28	74.00	24.92	V
12373.000	47.40	-31.10	38.90	39.60	74.00	26.60	V
9847.500	46.26	-33.50	38.00	41.76	74.00	27.74	V
2324.500	55.62	-20.10	27.90	47.72	74.00	18.38	V

8DPSK Ch 39

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
17927.500	51.02	-25.50	46.70	29.82	74.00	22.98	V
14108.000	48.97	-29.40	41.70	36.77	74.00	25.03	H
12836.000	47.28	-30.70	39.10	38.78	74.00	26.72	V
8732.500	46.20	-34.40	38.00	42.60	74.00	27.80	V
4882.500	45.59	-37.20	33.20	49.59	74.00	28.41	V
7215.000	45.00	-35.50	36.40	44.10	74.00	29.00	V

8DPSK Ch 78

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
17941.000	50.88	-25.50	46.70	29.68	74.00	23.12	H
13693.500	49.01	-29.50	40.40	38.11	74.00	24.99	V
12769.000	48.56	-30.50	39.10	39.96	74.00	25.44	V
4960.000	47.26	-37.10	33.30	51.06	74.00	26.74	V
9919.000	46.36	-33.50	38.10	41.76	74.00	27.64	V
2491.900	55.97	-20.00	28.30	47.67	74.00	18.03	H

Average Measurement results

GFSK Ch 0

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
4804.000	46.84	-37.30	33.00	51.04	54.00	7.16	V
17928.000	39.79	-25.50	46.70	18.59	54.00	14.21	H
7206.000	38.65	-35.50	36.40	37.75	54.00	15.35	V
14117.000	37.69	-29.00	42.00	24.69	54.00	16.31	V
12782.500	36.08	-30.70	39.10	27.58	54.00	17.92	V
2324.000	43.78	-20.10	27.90	35.88	54.00	10.22	V

GFSK Ch 39

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
4882.000	46.37	-37.20	33.20	50.37	54.00	7.63	V
14922.500	42.61	-28.60	40.80	30.41	54.00	11.39	H
17982.000	39.67	-25.50	46.70	18.47	54.00	14.33	H
11547.000	39.51	-32.30	38.80	32.91	54.00	14.49	V
7323.000	38.16	-35.10	36.60	36.66	54.00	15.84	V
8712.000	34.22	-34.40	38.00	30.62	54.00	19.78	H

GFSK Ch 78

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
4960.000	43.78	-37.10	33.30	47.58	54.00	10.22	V
17943.000	39.71	-25.50	46.70	18.51	54.00	14.29	H
13729.500	37.72	-29.10	40.90	25.92	54.00	16.28	H
12778.500	35.99	-30.70	39.10	27.49	54.00	18.01	H
8720.000	34.27	-34.40	38.00	30.67	54.00	19.73	V
2492.100	43.83	-20.00	28.30	35.53	54.00	10.17	V

$\pi/4$ DQPSK Ch 0

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
4804.000	47.04	-37.30	33.00	51.24	54.00	6.96	V
17981.000	39.45	-25.50	46.70	18.25	54.00	14.55	V
13698.500	37.71	-29.10	40.90	25.91	54.00	16.29	V
7206.000	37.62	-35.50	36.40	36.72	54.00	16.38	V
12782.000	36.11	-30.70	39.10	27.61	54.00	17.89	H
2384.700	43.86	-20.00	28.10	35.86	54.00	10.14	H

 $\pi/4$ DQPSK Ch 39

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
4882.000	46.33	-37.20	33.20	50.33	54.00	7.67	V
17978.000	39.86	-25.50	46.70	18.66	54.00	14.14	V
7323.000	38.85	-35.10	36.60	37.35	54.00	15.15	V
13682.000	37.61	-29.50	40.40	26.71	54.00	16.39	V
12777.000	35.97	-30.70	39.10	27.47	54.00	18.03	V
8723.000	34.48	-34.40	38.00	30.88	54.00	19.52	V

 $\pi/4$ DQPSK Ch 78

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
17950.000	39.64	-25.50	46.70	18.44	54.00	14.36	V
13702.500	37.57	-29.10	40.90	25.77	54.00	16.43	H
7440.000	36.84	-35.20	36.70	35.24	54.00	17.16	V
12777.000	36.02	-30.70	39.10	27.52	54.00	17.98	H
9504.500	34.26	-33.20	37.90	29.56	54.00	19.74	V
2498.000	44.04	-20.00	28.40	35.64	54.00	9.96	V

8DPSK Ch 0

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
4804.500	43.31	-37.30	33.00	47.51	54.00	10.69	V
17372.000	39.52	-25.90	44.40	21.12	54.00	14.48	V
9847.500	38.41	-33.50	38.00	33.91	54.00	15.59	V
14104.000	37.66	-29.40	41.70	25.46	54.00	16.34	H
12773.500	35.87	-30.70	39.10	27.37	54.00	18.13	V
2366.400	43.81	-20.10	28.00	35.81	54.00	10.19	V

8DPSK Ch 39

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
4882.000	40.33	-37.20	33.20	44.33	54.00	13.67	H
17996.500	39.65	-25.50	46.70	18.45	54.00	14.35	H
7323.000	37.95	-35.10	36.60	36.45	54.00	16.05	V
14099.500	37.56	-29.40	41.70	25.36	54.00	16.44	V
12770.500	36.09	-30.50	39.10	27.49	54.00	17.91	V
8733.500	34.60	-34.40	38.00	31.00	54.00	19.40	V

8DPSK Ch 78

Frequency (MHz)	Measurement Result (dBuV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Pol. (H/V)
4960.000	44.06	-37.10	33.30	47.86	54.00	9.94	V
17980.000	39.58	-25.50	46.70	18.38	54.00	14.42	V
14098.500	37.61	-29.40	41.70	25.41	54.00	16.39	H
12769.000	35.77	-30.50	39.10	27.17	54.00	18.23	V
7439.500	35.20	-35.20	36.70	33.60	54.00	18.80	V
2492.700	43.95	-20.00	28.30	35.65	54.00	10.05	V

Conclusion: Pass

B.7. 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	Packe t	Pulse time (ms)		Number of Transmissions		Dwell Time (ms)	Conclusion
39	DH1	Fig.64	0.37	Fig.65	319	118.03	P
	DH3	Fig.66	1.63	Fig.67	108	176.04	P
	DH5	Fig.68	2.88	Fig.69	59	169.92	P

For $\pi/4$ DQPSK

Channel	Packe t	Pulse time (ms)		Number of Transmissions		Dwell Time (ms)	Conclusion
39	2DH1	Fig.70	0.38	Fig.71	320	121.6	P
	2DH3	Fig.72	1.63	Fig.73	107	174.41	P
	2DH5	Fig.74	2.88	Fig.75	59	169.92	P

For 8DPSK

Channel	Packet	Pulse time (ms)		Number of Transmissions		Dwell Time (ms)	Conclusion
39	3DH1	Fig.76	0.38	Fig.77	320	121.6	P
	3DH3	Fig.78	1.63	Fig.79	108	176.04	P
	3DH5	Fig.80	2.88	Fig.81	57	164.16	P

Conclusion: PASS

Test graphs as below:

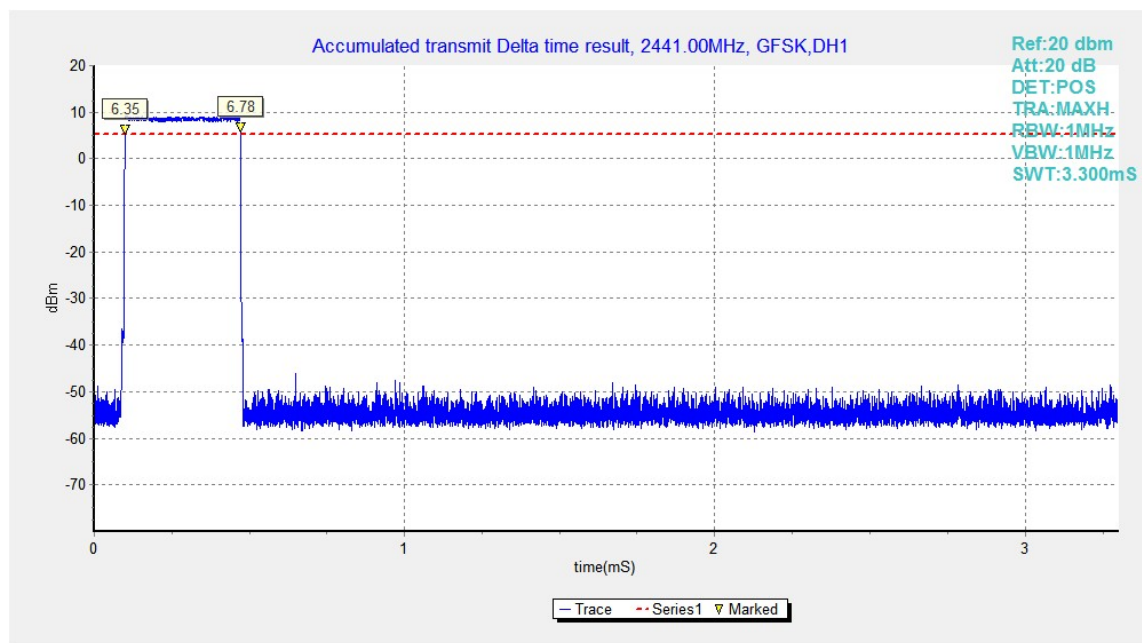


Fig.64. Time of occupancy (Dwell Time): Channel 39, Packet DH1

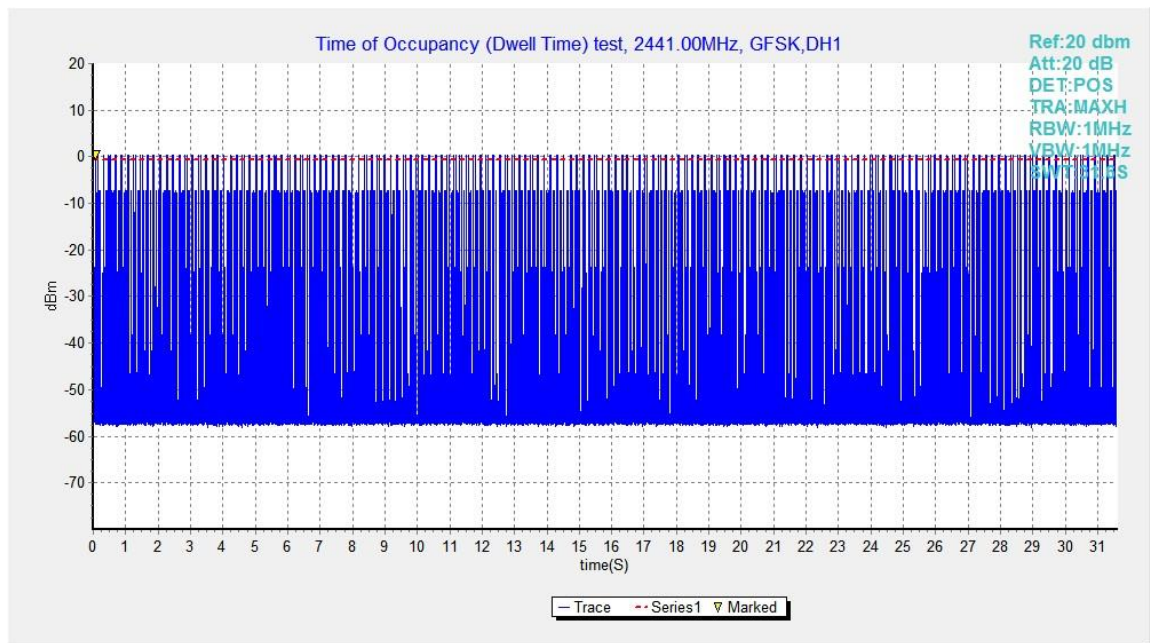


Fig.65. Number of Transmissions Measurement: Channel 39,Packet DH1

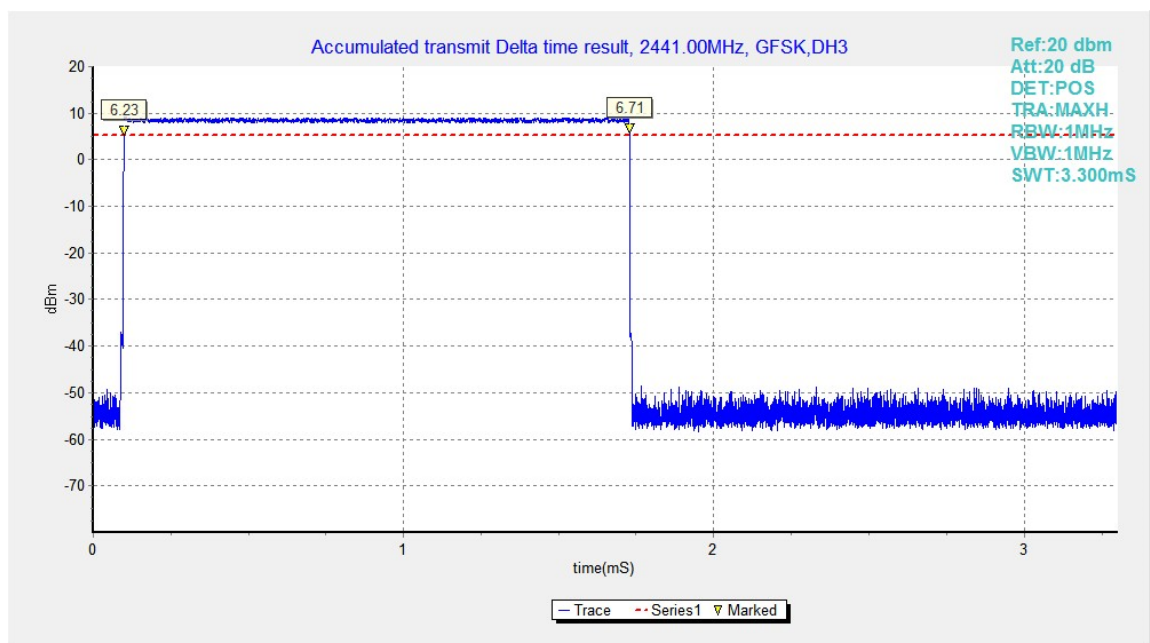


Fig.66. Time of occupancy (Dwell Time): Channel 39, Packet DH3

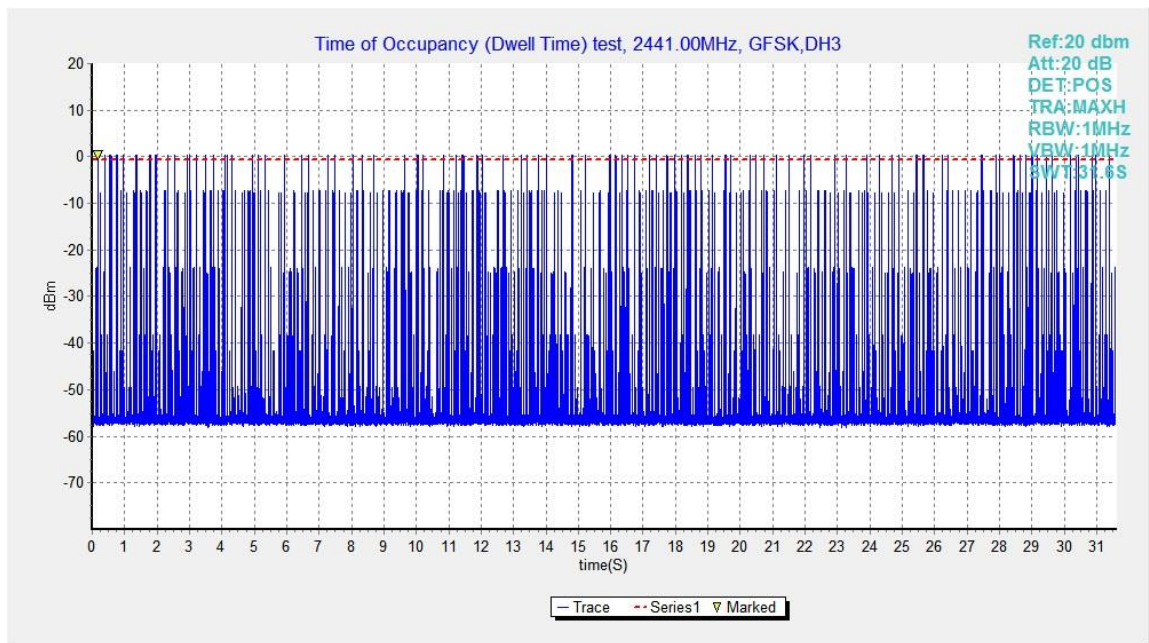


Fig.67. Number of Transmissions Measurement: Channel 39,Packet DH3

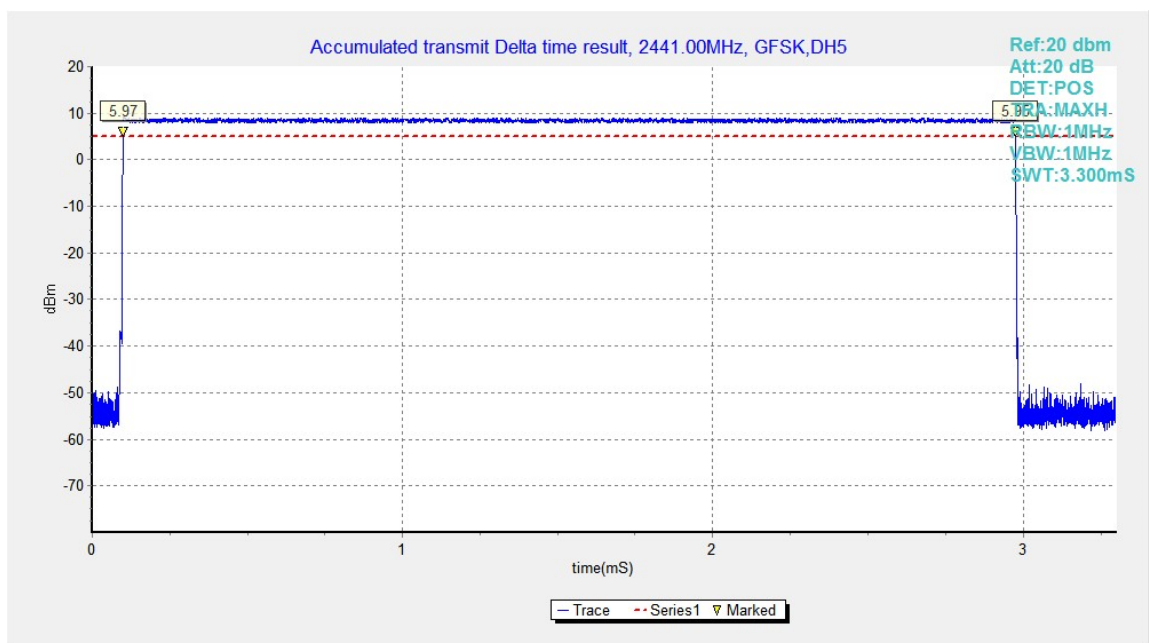


Fig.68. Time of occupancy (Dwell Time): Channel 39, Packet DH5

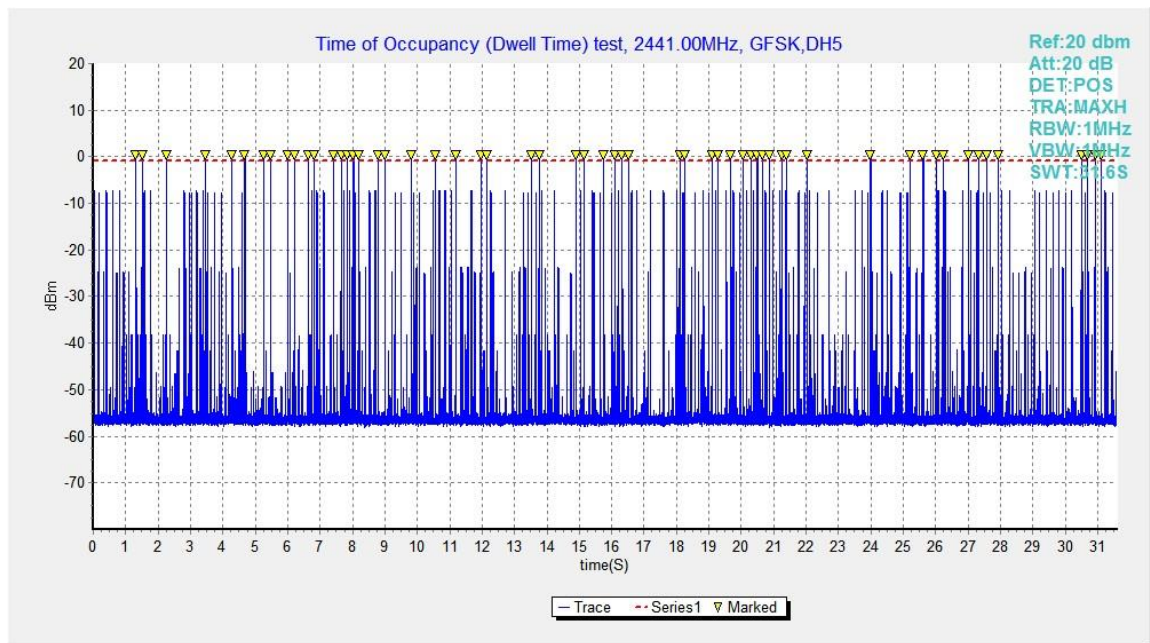


Fig.69. Number of Transmissions Measurement: Channel 39,Packet DH5

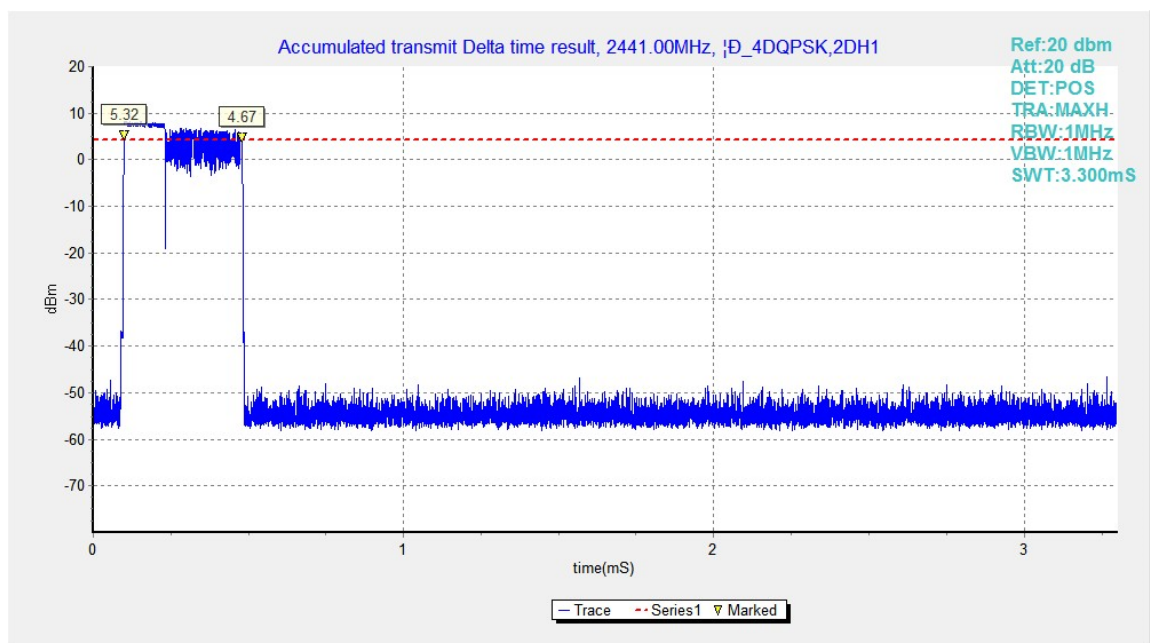


Fig.70. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH1

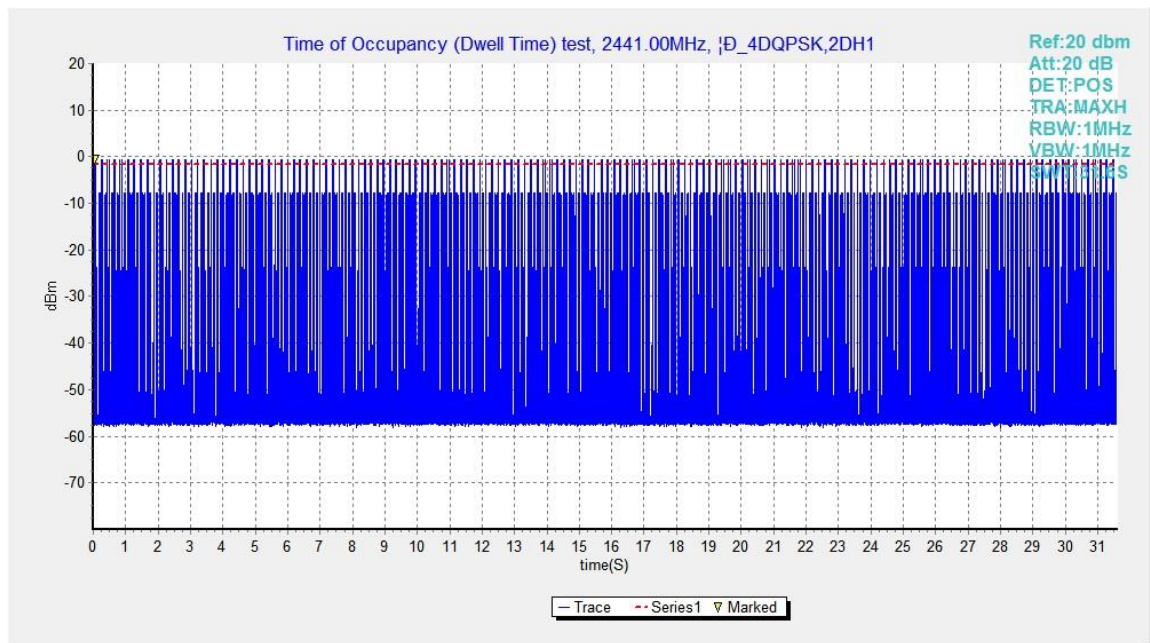


Fig.71. Number of Transmissions Measurement: Channel 39,Packet 2-DH1

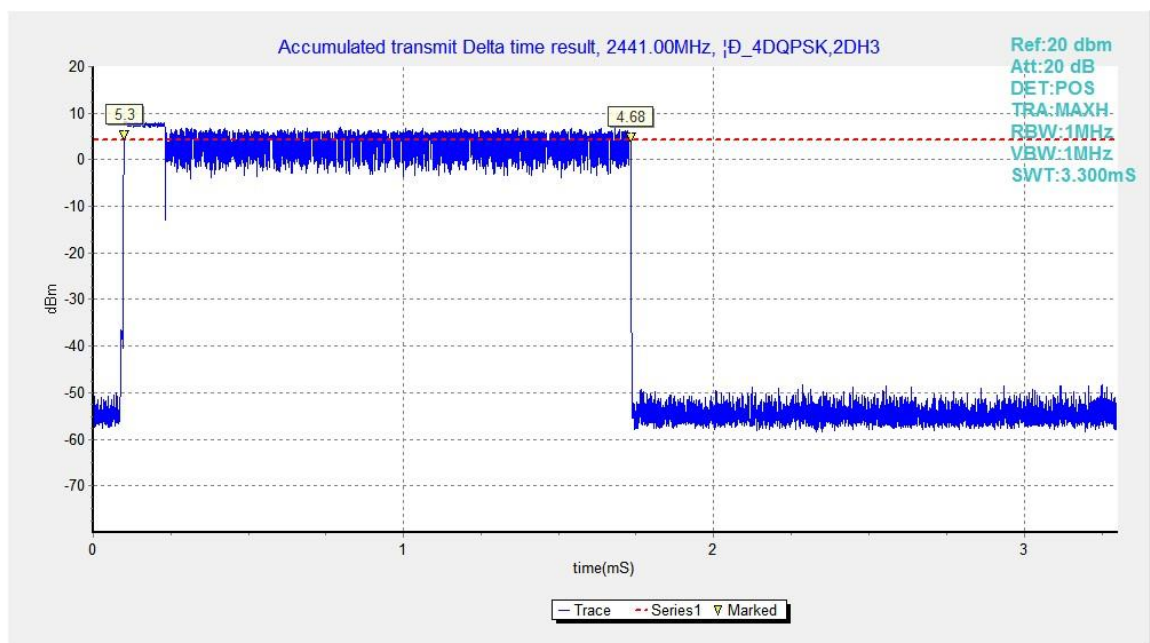


Fig.72. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH3

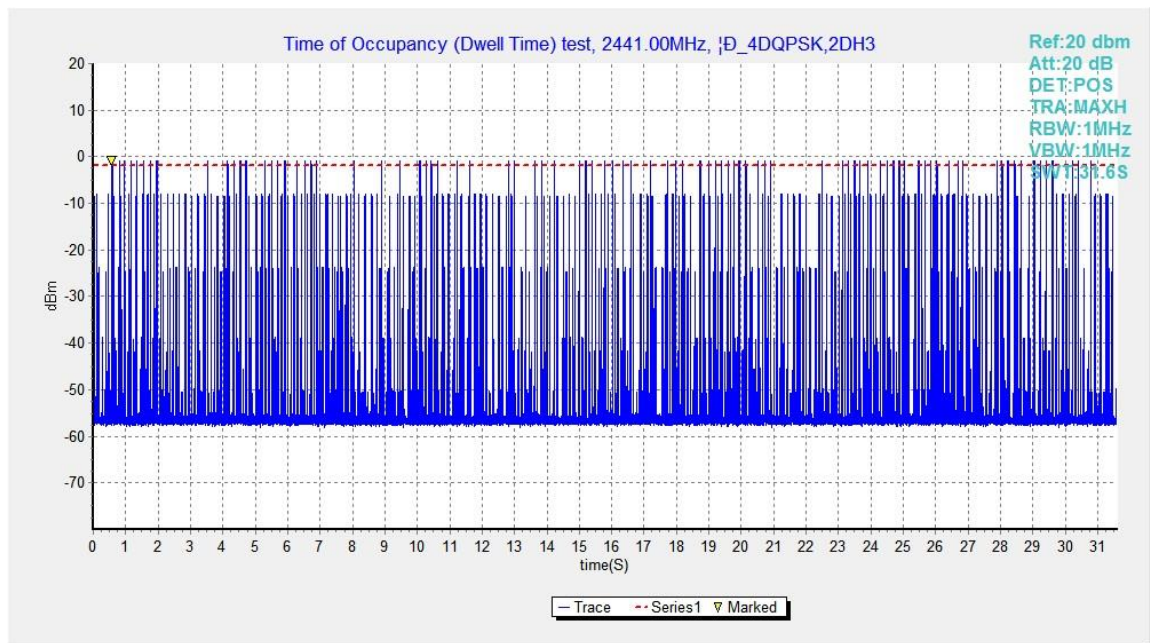


Fig.73. Number of Transmissions Measurement: Channel 39,Packet 2-DH3

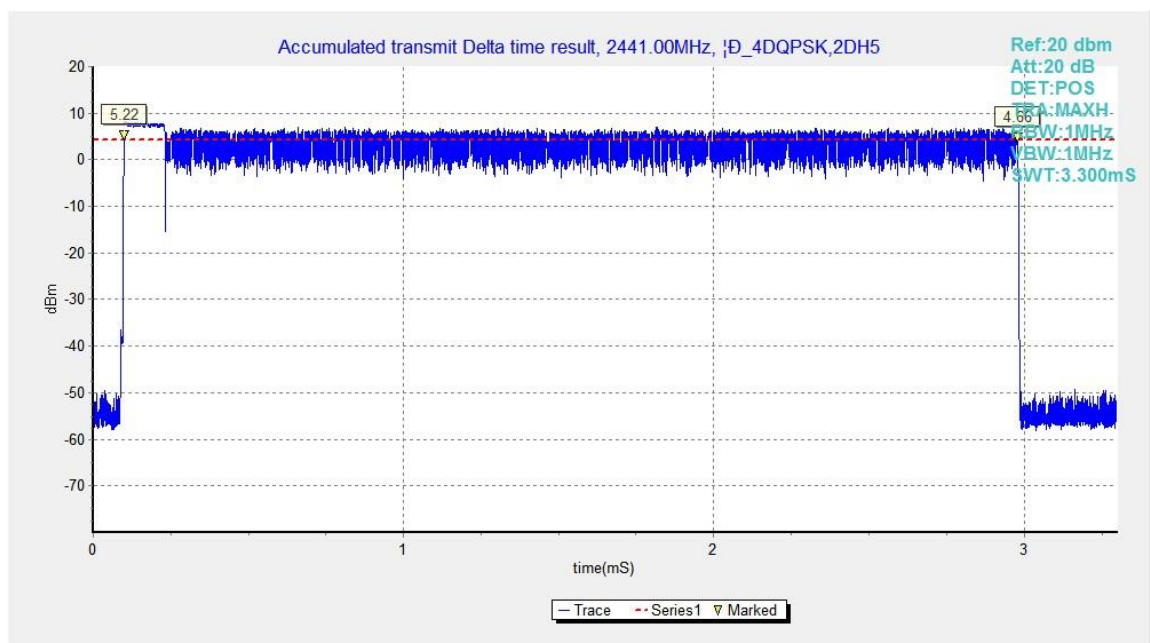


Fig.74. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH5

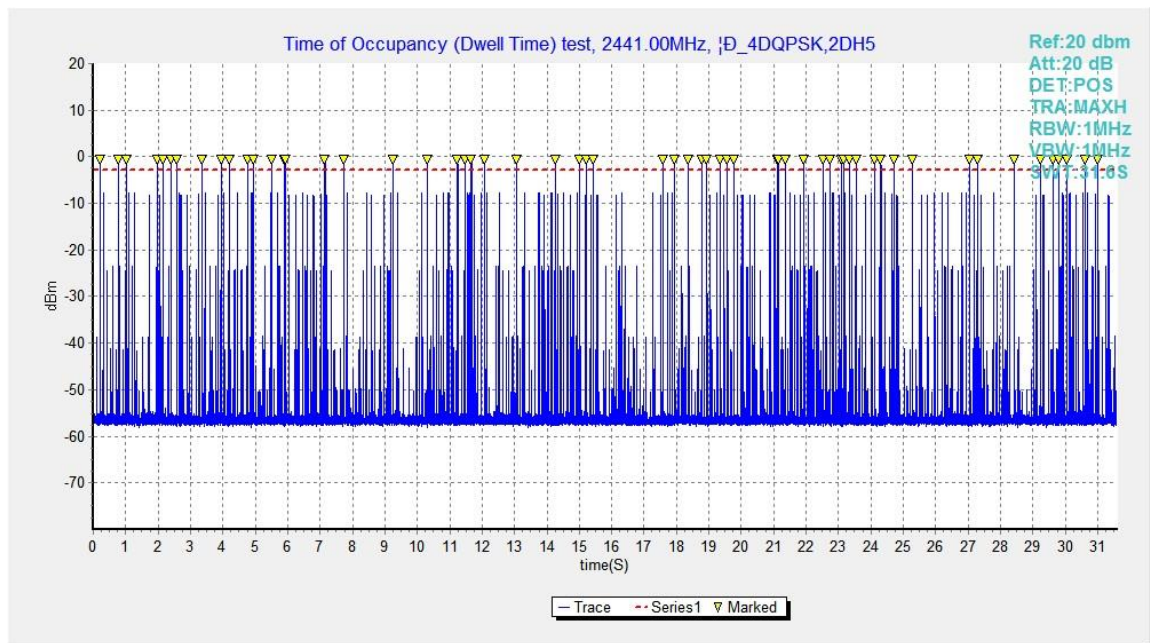


Fig.75. Number of Transmissions Measurement: Channel 39,Packet 2-DH5

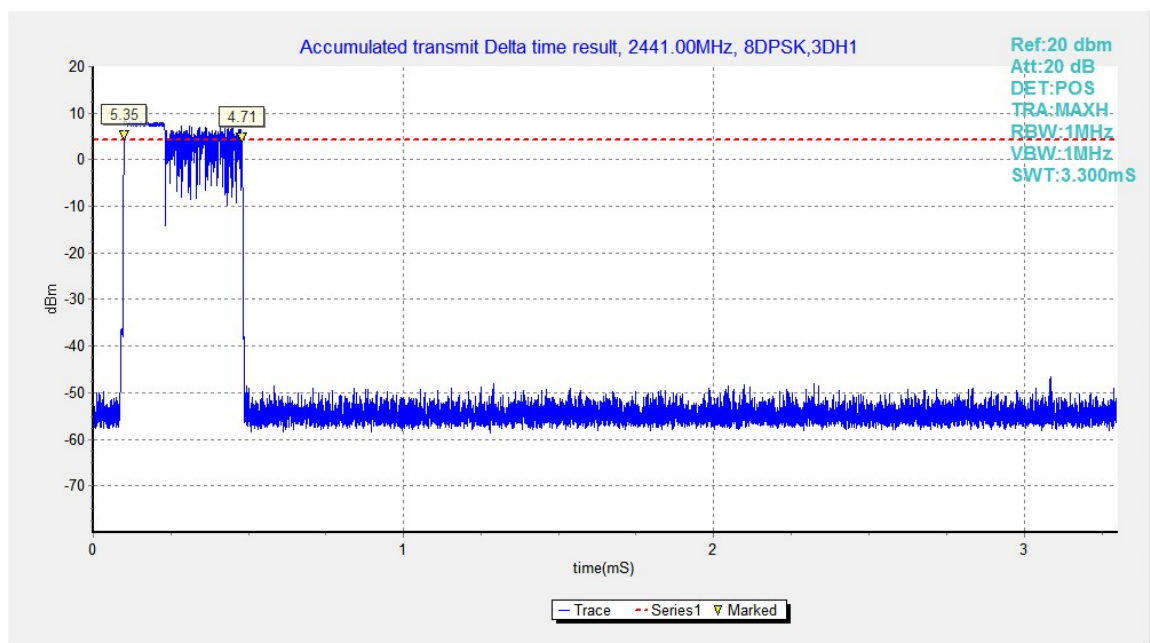


Fig.76. Time of occupancy (Dwell Time): Channel 39, Packet 3-DH1

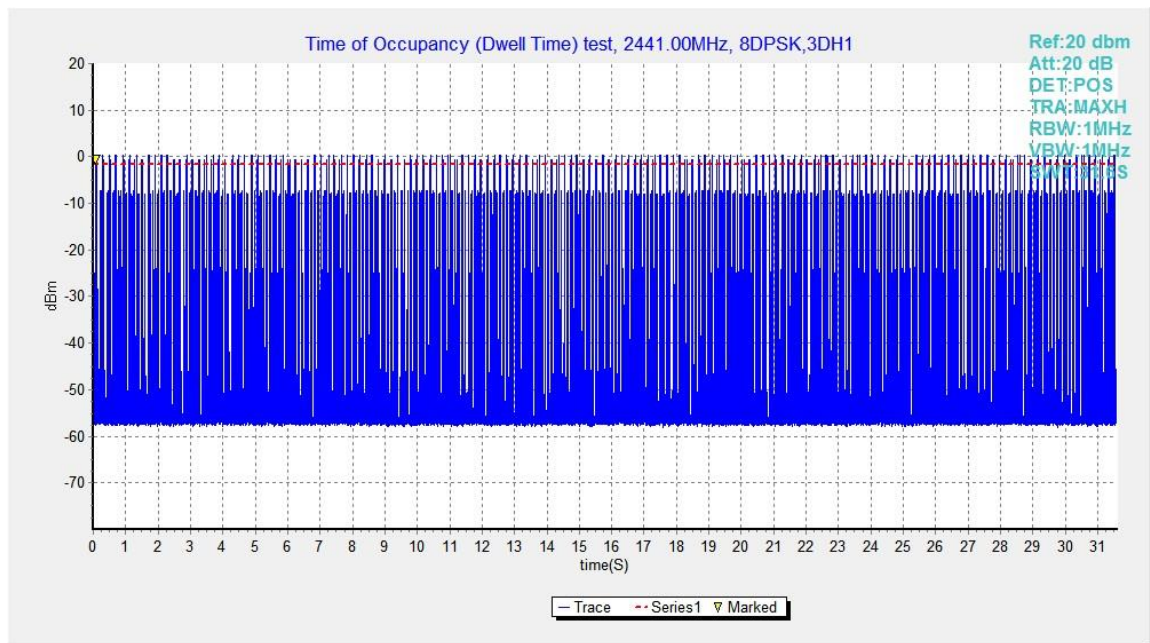


Fig.77. Number of Transmissions Measurement: Channel 39,Packet 3-DH1

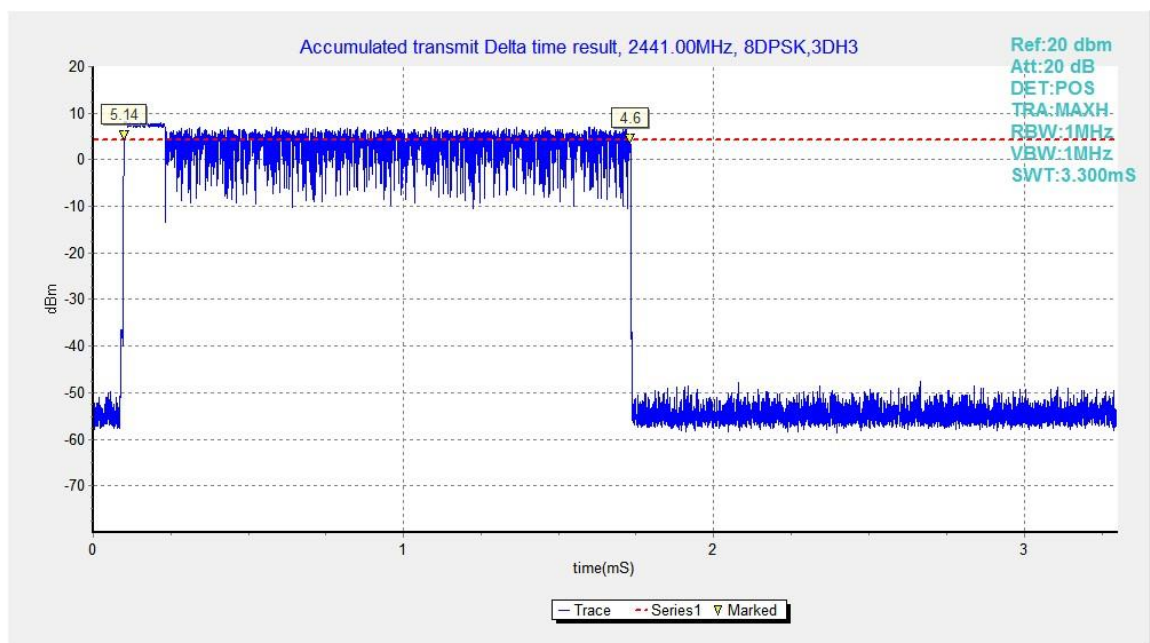


Fig.78. Time of occupancy (Dwell Time): Channel 39, Packet 3-DH3

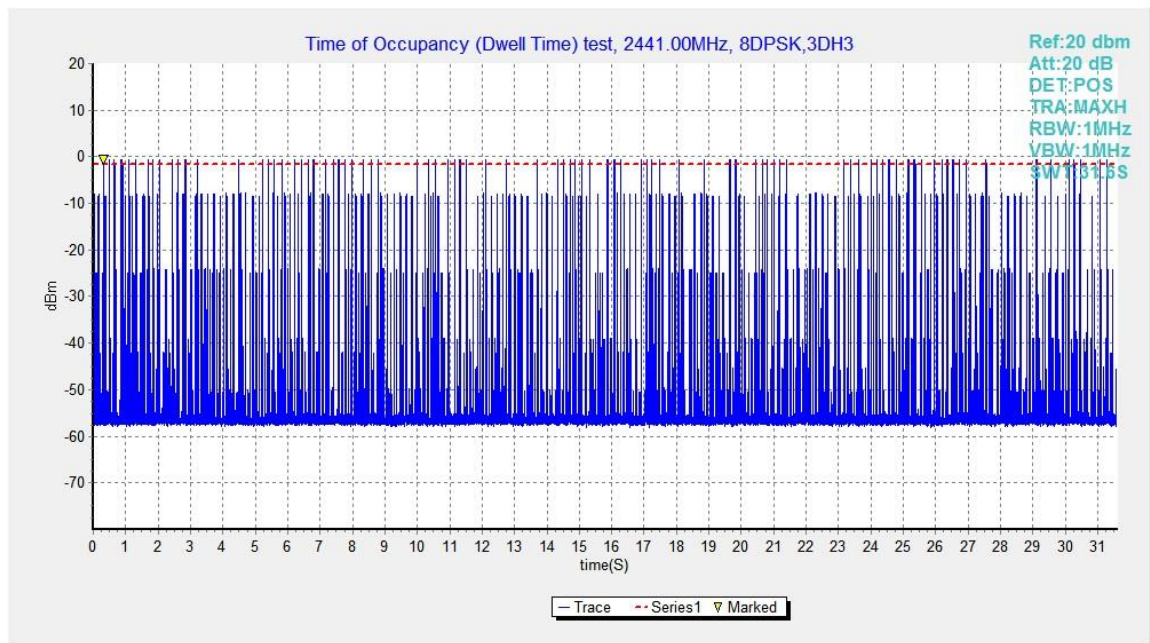


Fig.79. Number of Transmissions Measurement: Channel 39,Packet 3-DH3

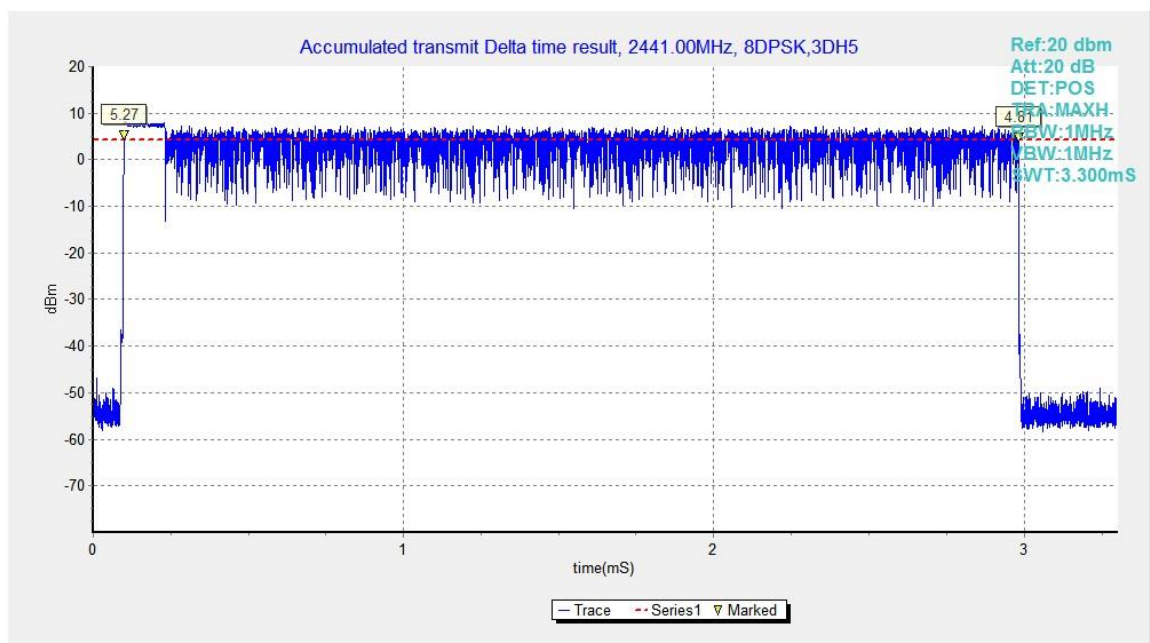


Fig.80. Time of occupancy (Dwell Time): Channel 39, Packet 3-DH5

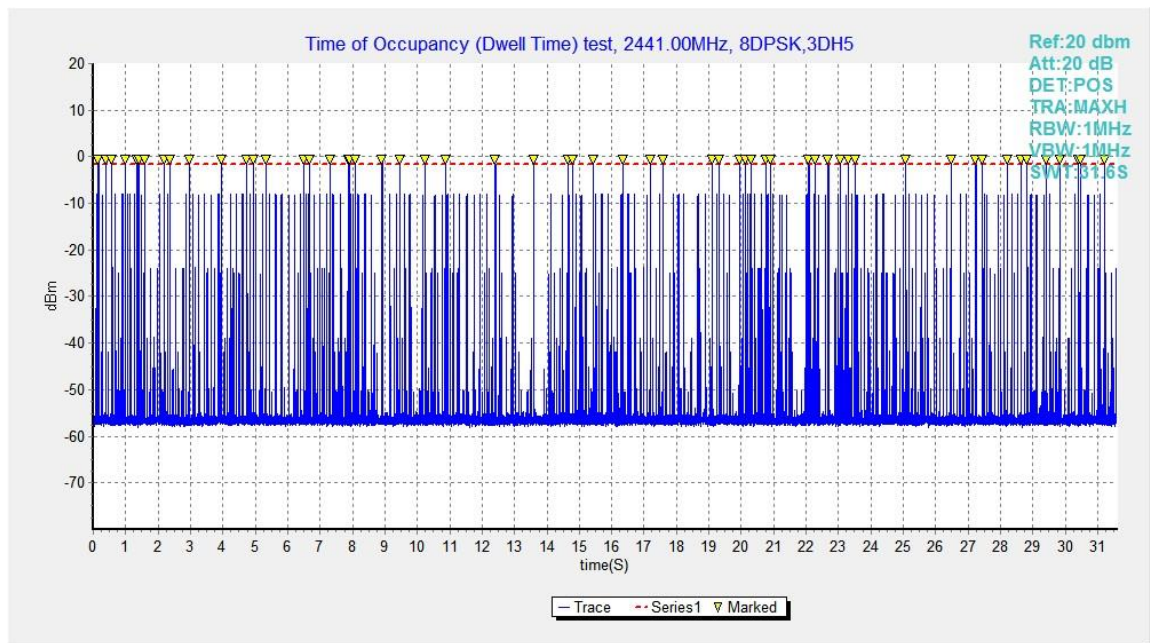


Fig.81. Number of Transmissions Measurement: Channel 39,Packet 3-DH5

B.8. 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	939.00	NA
39	Fig.83	940.50	NA
78	Fig.84	943.50	NA

For $\pi/4$ DQPSK

Channel	20dB Bandwidth (kHz)		Conclusion
0	Fig.85	1257.75	NA
39	Fig.86	1257.75	NA
78	Fig.87	1260.00	NA

For 8DPSK

Channel	20dB Bandwidth (kHz)		Conclusion
0	Fig.88	1204.50	NA
39	Fig.89	1260.75	NA
78	Fig.90	1263.75	NA

Conclusion: NA

Test graphs as below:

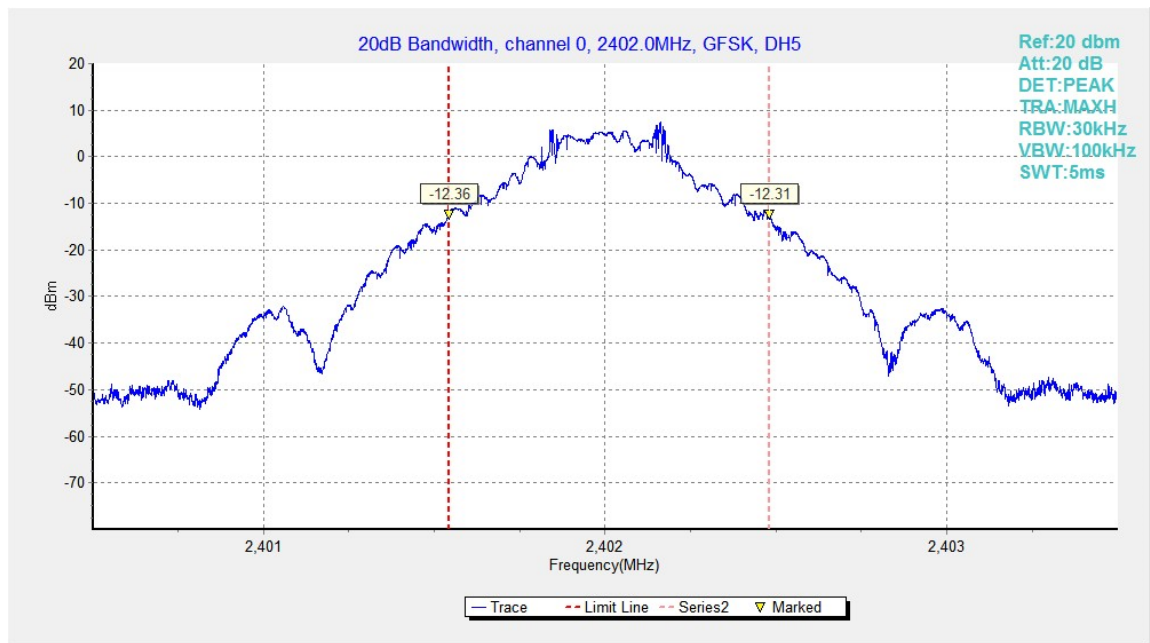


Fig.82. 20dB Bandwidth: GFSK, Channel 0

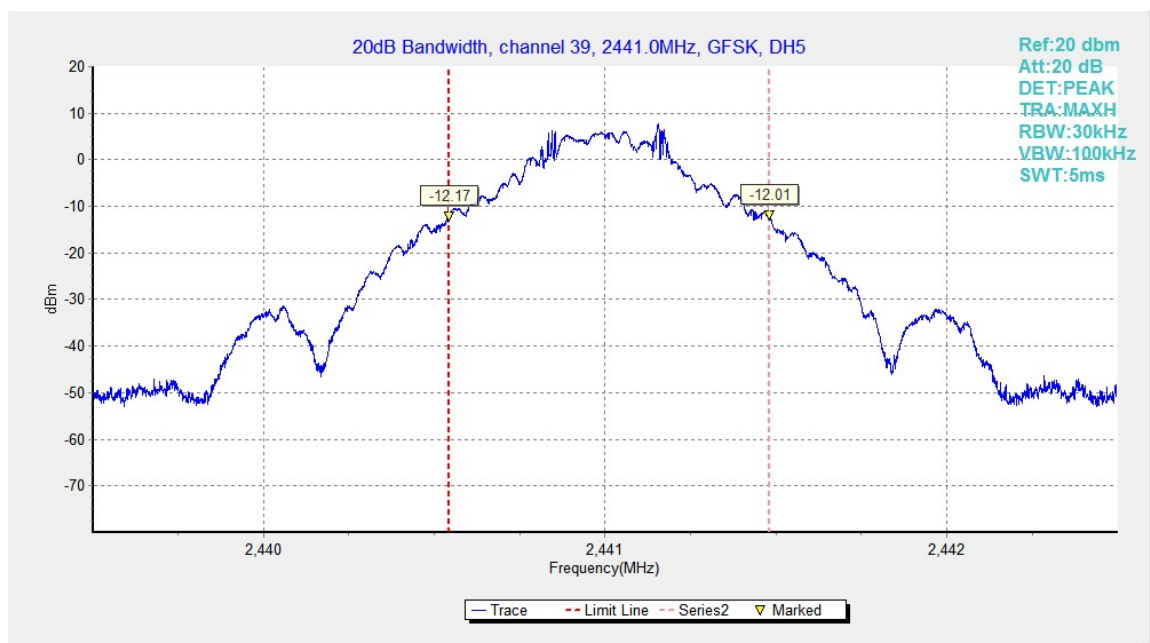


Fig.83. 20dB Bandwidth: GFSK, Channel 39

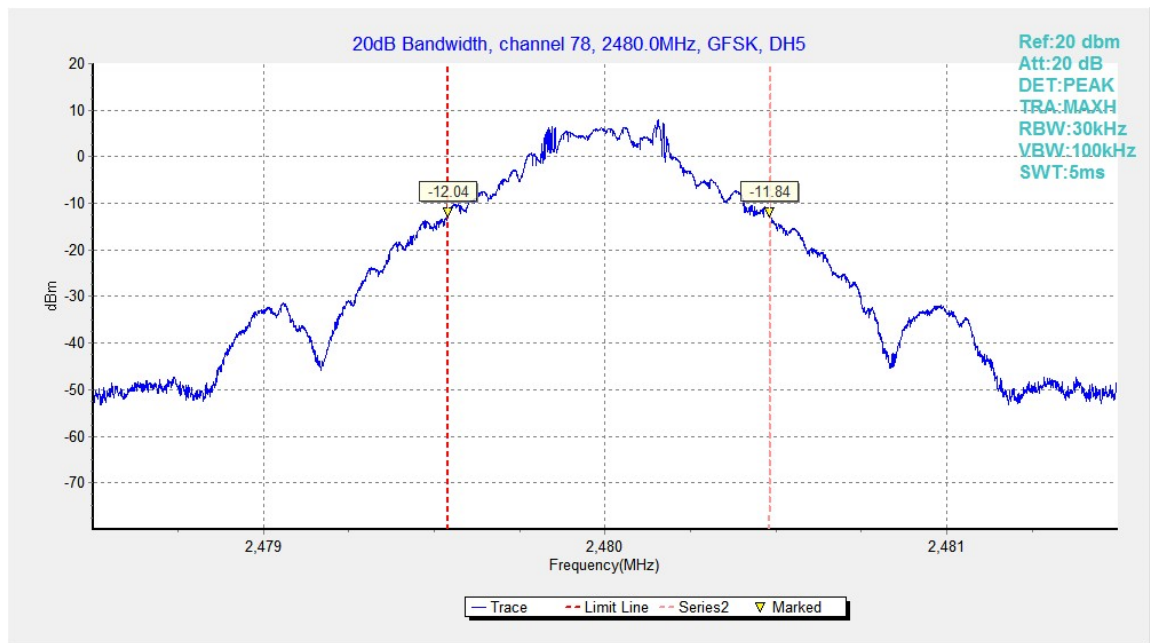


Fig.84. 20dB Bandwidth: GFSK, Channel 78

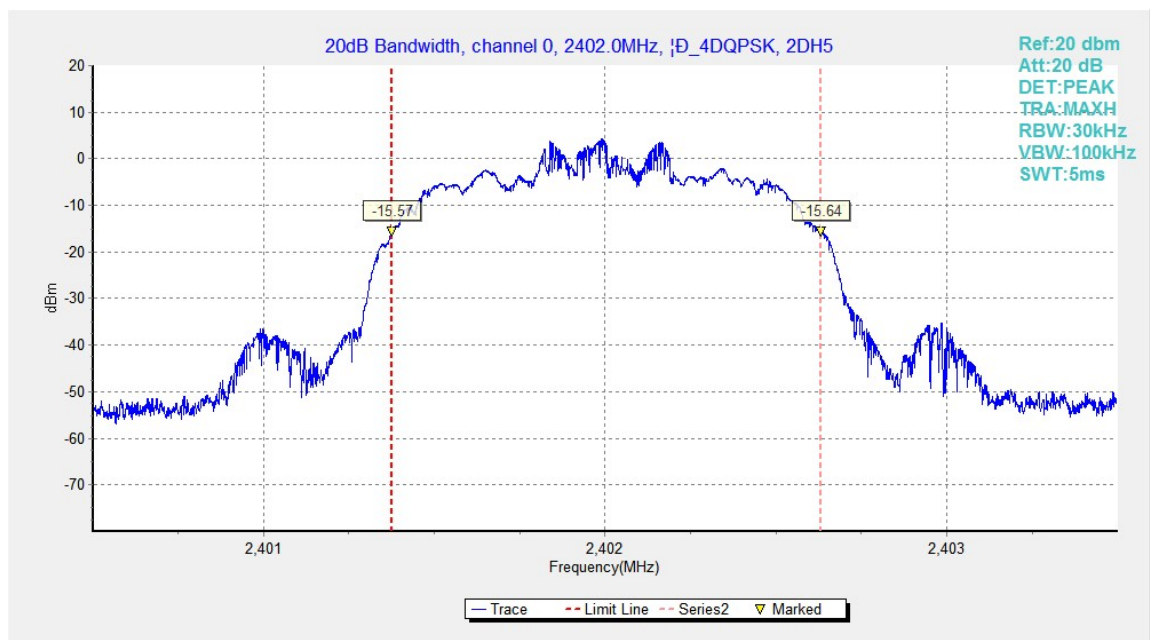


Fig.85. 20dB Bandwidth: $\pi/4$ DQPSK, Channel 0

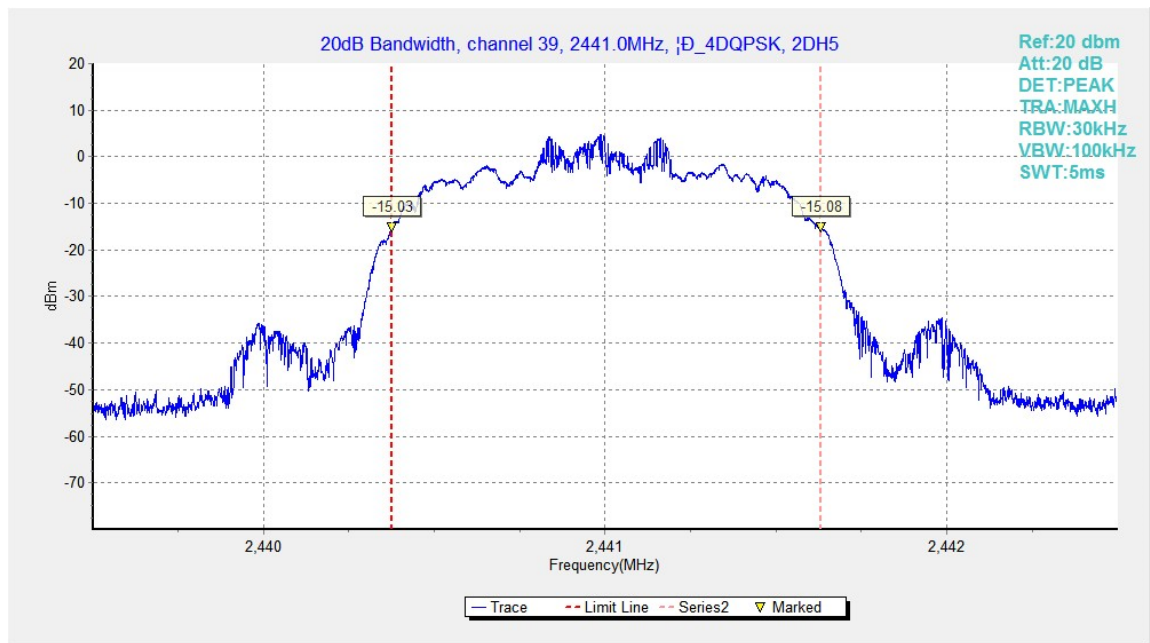


Fig.86. 20dB Bandwidth: $\pi/4$ DQPSK, Channel 39

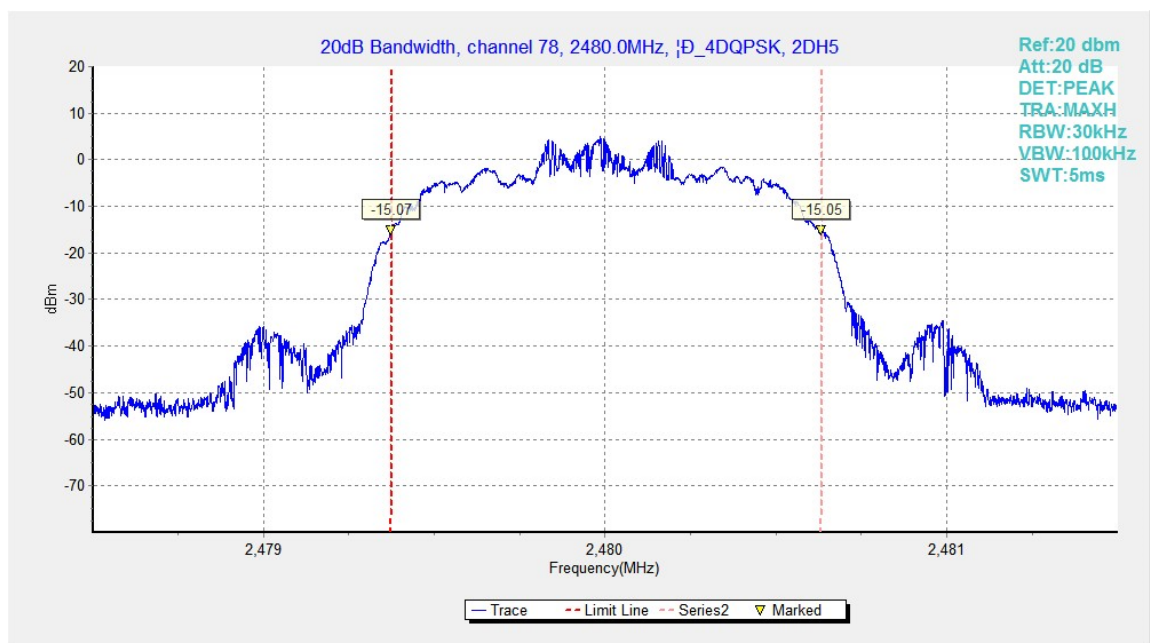


Fig.87. 20dB Bandwidth: $\pi/4$ DQPSK, Channel 78

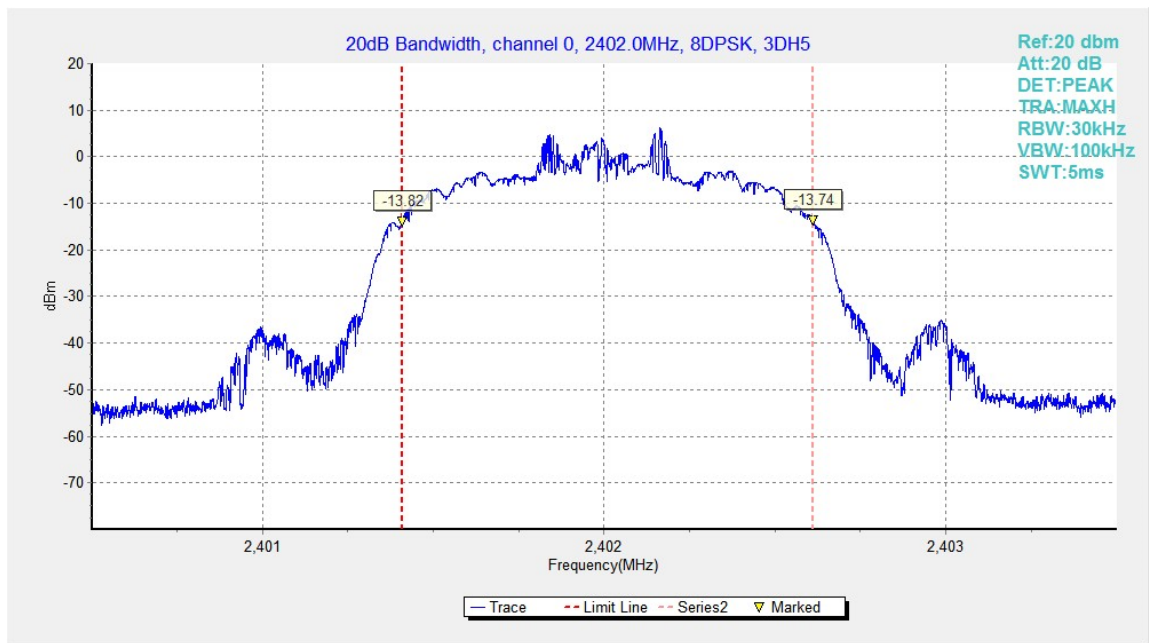


Fig.88. 20dB Bandwidth: 8DPSK, Channel 0

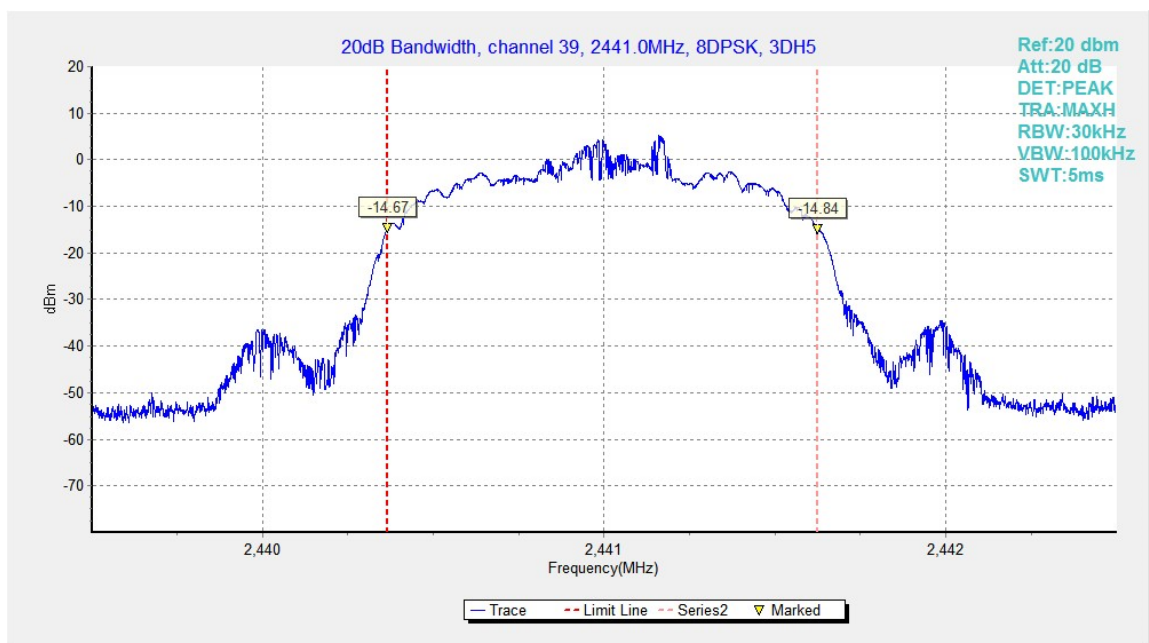


Fig.89. 20dB Bandwidth: 8DPSK, Channel 39

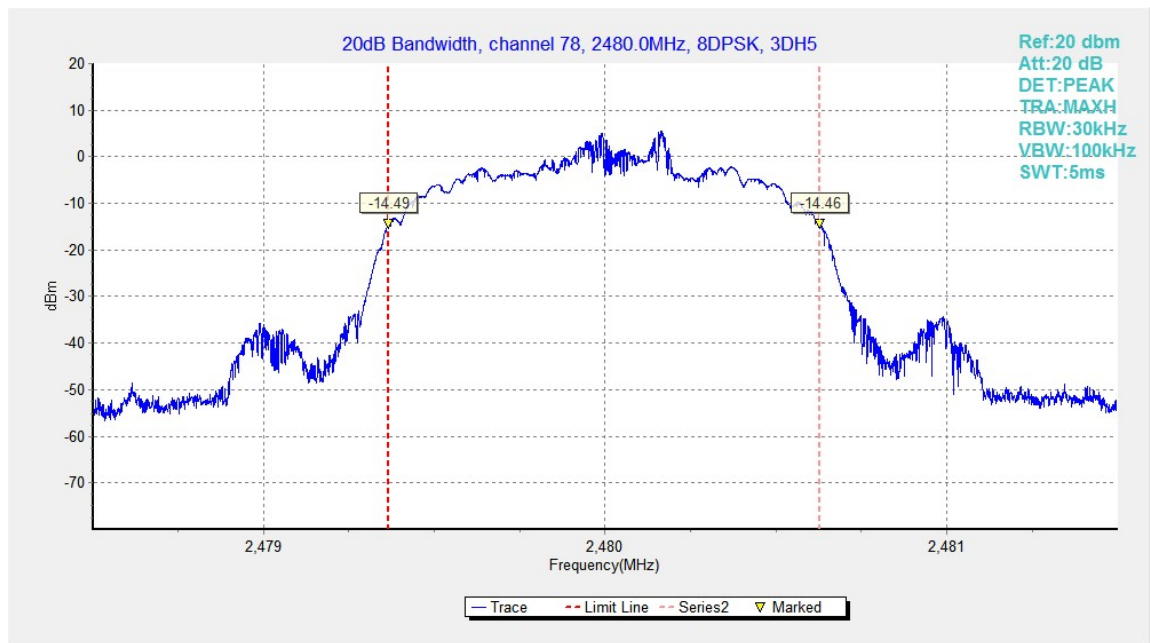


Fig.90. 20dB Bandwidth: 8DPSK, Channel 78