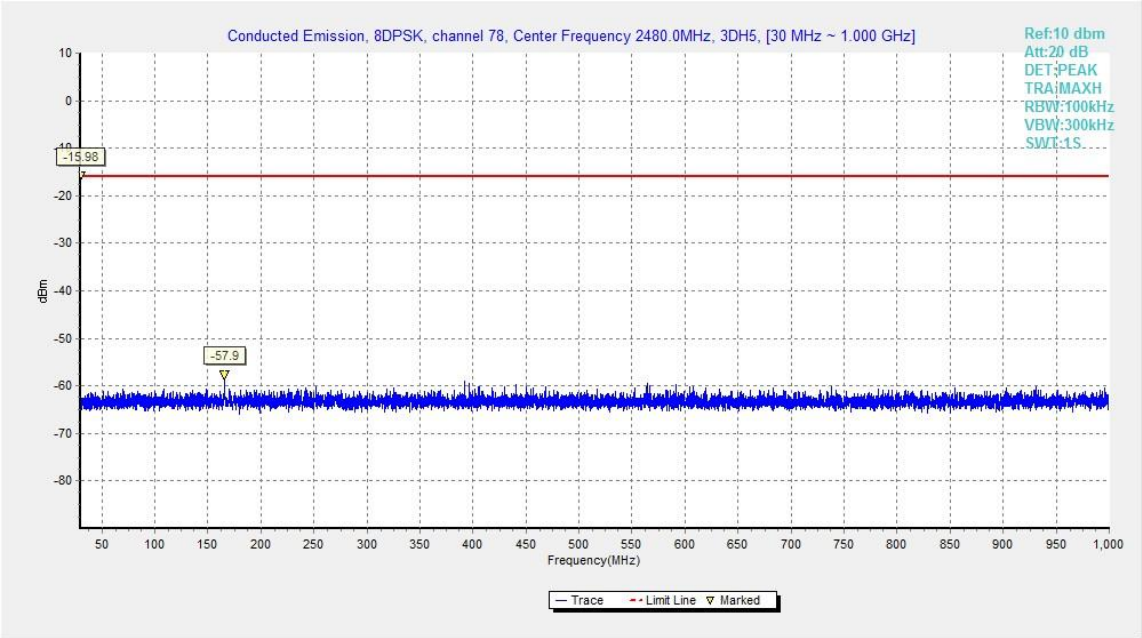

Fig.54. Conducted spurious emission: 8DPSK, Channel 78, 30MHz - 1GHz

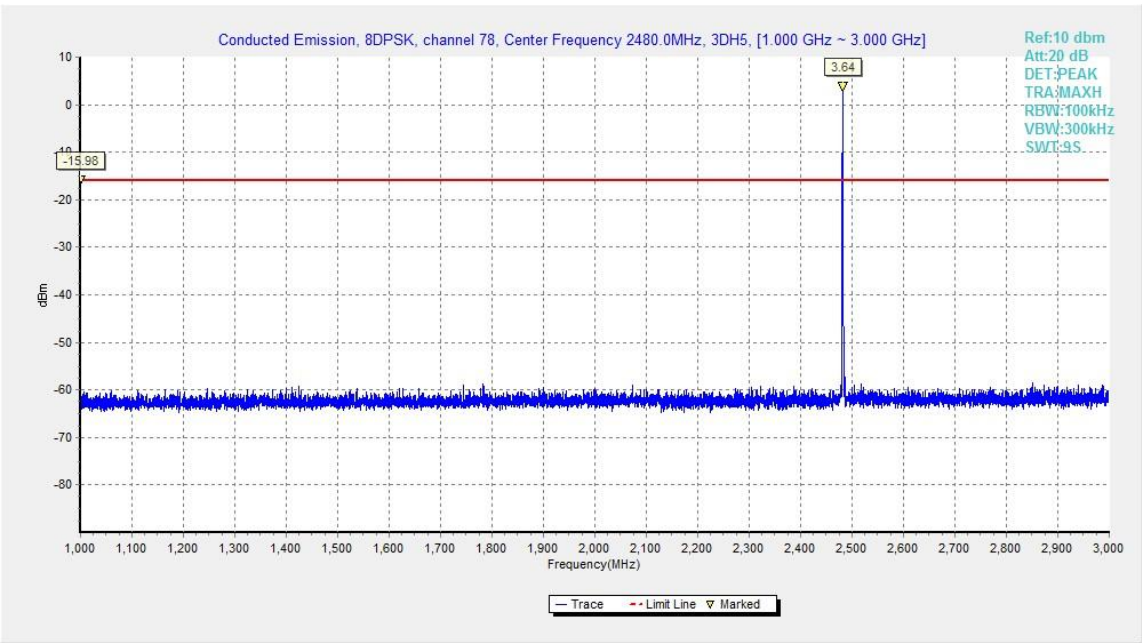

Fig.55. Conducted spurious emission: 8DPSK, Channel 78, 1GHz - 3GHz

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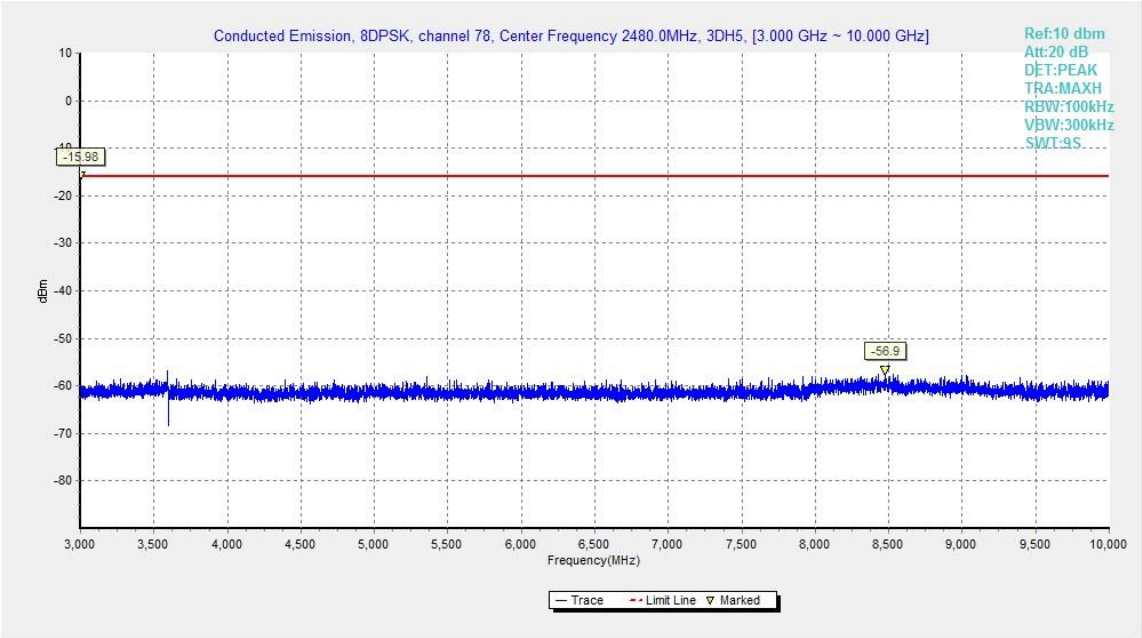

Fig.56. Conducted spurious emission: 8DPSK, Channel 78, 3GHz - 10GHz

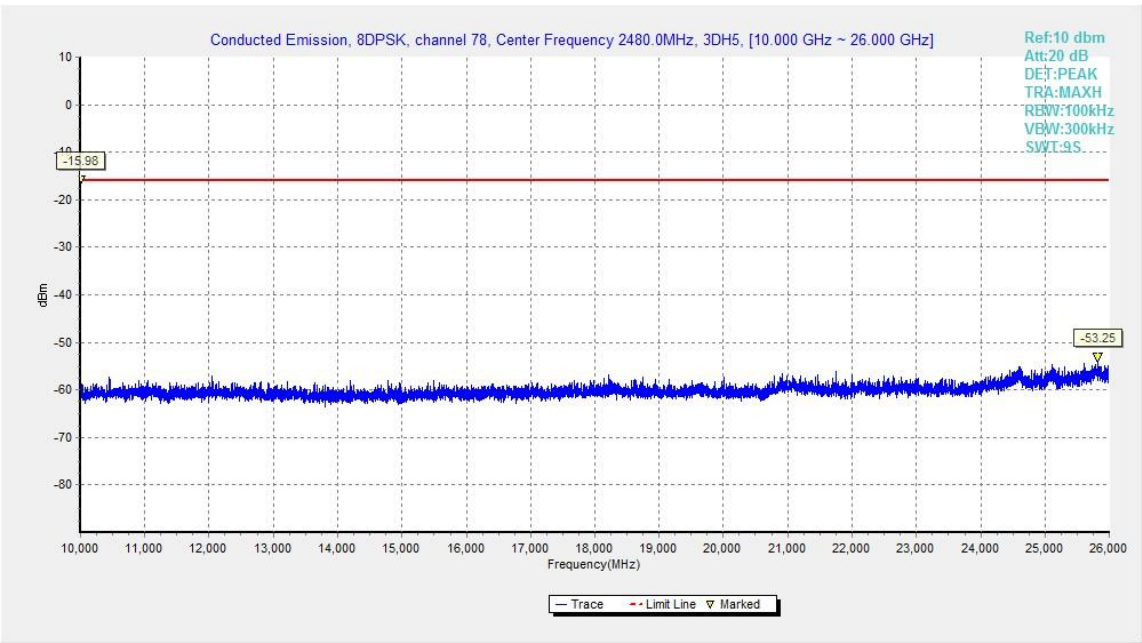

Fig.57. Conducted spurious emission: 8DPSK, Channel 78, 10GHz - 26GHz

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A.5. Transmitter Spurious Emission - Radiated

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

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For GFSK

Channel	Frequency Range	Test Results	Conclusion
Ch 0 2402 MHz	1 GHz ~ 3 GHz	--	P
	3 GHz ~ 18 GHz	--	P
Ch 39 2440 MHz	9 kHz ~ 30 MHz	--	P
	30 MHz ~ 1 GHz	--	P
	1 GHz ~ 3 GHz	--	P
	3 GHz ~ 18 GHz	--	P
Ch 78 2480 MHz	1 GHz ~ 3 GHz	--	P
	3 GHz ~ 18 GHz	--	P
Power	2.38GHz~2.4GHz---L	Fig.58	P
Power	2.45GHz~2.5GHz---H	Fig.59	P
For all channels	18 GHz ~ 26 GHz	--	P

Forπ/4 DQPSK

Channel	Frequency Range	Test Results	Conclusion
Ch 0 2402 MHz	1 GHz ~ 3 GHz	--	P
	3 GHz ~ 18 GHz	--	P
Ch 39 2440 MHz	30 MHz ~ 1 GHz	--	P
	1 GHz ~ 3 GHz	--	P
	3 GHz ~ 18 GHz	--	P
Ch 78 2480 MHz	1 GHz ~ 3 GHz	--	P
	3 GHz ~ 18 GHz	--	P
Power	2.38GHz~2.4GHz---L	Fig.60	P
Power	2.45GHz~2.5GHz---H	Fig.61	P
For all channels	18 GHz ~ 26 GHz	--	P

For 8DPSK

Channel	Frequency Range	Test Results	Conclusion
Ch 0 2402 MHz	1 GHz ~ 3 GHz	--	P
	3 GHz ~ 18 GHz	--	P
Ch 39 2440 MHz	30 MHz ~ 1 GHz	--	P
	1 GHz ~ 3 GHz	--	P
	3 GHz ~ 18 GHz	--	P
Ch 78 2480 MHz	1 GHz ~ 3 GHz	--	P
	3 GHz ~ 18 GHz	--	P
Power	2.38GHz~2.4GHz---L	Fig.62	P
Power	2.45GHz~2.5GHz---H	Fig.63	P
For all channels	18 GHz ~ 26 GHz	--	P

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GFSK Ch 0 - Average

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
2388.485	41.8	-38.8	27.2	53.449	H
17995.500	40.2	-25.5	43.4	22.302	H
17998.500	40.2	-25.5	43.4	22.302	V
18000.000	40.1	-26.5	46.4	20.205	H
17992.500	40.1	-25.5	43.4	22.202	H
17994.000	40.0	-25.5	43.4	22.102	H

GFSK Ch 39 - Average

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
17998.500	40.2	-25.5	43.4	22.302	H
18000.000	40.1	-26.5	46.4	20.205	H
17997.000	40.1	-25.5	43.4	22.202	V
17991.000	40.1	-25.5	43.4	22.202	H
17994.000	40.1	-25.5	43.4	22.202	H
17995.500	40.0	-25.5	43.4	22.102	H

GFSK Ch 78 - Average

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
2483.635	53.3	-39.0	27.2	65.114	H
17998.500	52.3	-25.5	43.4	34.402	H
18000.000	52.1	-26.5	46.4	32.205	V
17995.500	51.8	-25.5	43.4	33.902	H
17992.500	51.8	-25.5	43.4	33.902	H
17968.500	51.7	-25.5	43.4	33.802	H

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GFSK Ch 0 – Peak

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
2388.925	53.7	-38.8	27.2	65.349	H
17962.500	52.3	-25.5	43.4	34.402	H
17814.000	52.0	-25.7	43.4	34.342	V
17956.500	51.8	-25.5	43.4	33.902	H
17881.500	51.6	-25.7	43.4	33.942	H
17917.500	51.5	-25.5	43.4	33.602	H

GFSK Ch 39 - Peak

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
17865.000	52.4	-25.7	43.4	34.742	H
17961.000	52.1	-25.5	43.4	34.202	H
17946.000	51.6	-25.5	43.4	33.702	V
17997.000	51.5	-25.5	43.4	33.602	H
17962.500	51.4	-25.5	43.4	33.502	H
17986.500	51.3	-25.5	43.4	33.402	H

GFSK Ch 78 - Peak

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
2483.635	53.3	-39.0	27.2	65.114	H
17941.500	52.3	-25.5	43.4	34.402	H
17923.500	52.1	-25.5	43.4	34.202	V
17980.500	51.8	-25.5	43.4	33.902	H
17845.500	51.8	-25.7	43.4	34.142	H
17956.500	51.7	-25.5	43.4	33.802	H

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π/4 DQPSK Ch 0 - Average

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
2389.995	41.8	-38.8	27.2	53.449	H
17998.500	40.2	-25.5	43.4	22.302	H
17997.000	40.1	-25.5	43.4	22.202	V
17995.500	40.0	-25.5	43.4	22.102	H
17985.000	40.0	-25.5	43.4	22.102	H
17988.000	39.9	-25.5	43.4	22.002	H

π/4 DQPSK Ch 39 - Average

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
17998.500	40.3	-25.5	43.4	22.402	H
17994.000	40.2	-25.5	43.4	22.302	H
17992.500	40.0	-25.5	43.4	22.102	V
17995.500	40.0	-25.5	43.4	22.102	H
17997.000	39.9	-25.5	43.4	22.002	H
18000.000	39.9	-26.5	46.4	20.005	H

π/4 DQPSK Ch 78 - Average

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
2483.500	41.4	-39.0	27.2	53.214	H
18000.000	40.2	-26.5	46.4	20.305	H
17998.500	40.1	-25.5	43.4	22.202	V
17997.000	40.0	-25.5	43.4	22.102	H
17995.500	40.0	-25.5	43.4	22.102	H
17992.500	40.0	-25.5	43.4	22.102	H

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π/4 DQPSK Ch 0 – Peak

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
2388.745	54.0	-38.8	27.2	65.649	H
17896.500	52.0	-25.7	43.4	34.342	H
17986.500	51.9	-25.5	43.4	34.002	V
17836.500	51.7	-25.7	43.4	34.042	H
17926.500	51.6	-25.5	43.4	33.702	H
17955.000	51.5	-25.5	43.4	33.602	H

π/4 DQPSK Ch 39 - Peak

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
17916.000	51.8	-25.5	43.4	33.902	H
17946.000	51.7	-25.5	43.4	33.802	H
17992.500	51.3	-25.5	43.4	33.402	V
17997.000	51.3	-25.5	43.4	33.402	H
17989.500	51.3	-25.5	43.4	33.402	H
17962.500	51.2	-25.5	43.4	33.302	H

π/4 DQPSK Ch 78 - Peak

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
2483.985	54.4	-39.0	27.2	66.214	H
17898.000	51.9	-25.7	43.4	34.242	H
17992.500	51.6	-25.5	43.4	33.702	V
17968.500	51.4	-25.5	43.4	33.502	H
17796.000	51.4	-25.7	43.4	33.742	H
17961.000	51.3	-25.5	43.4	33.402	H

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8DPSK Ch 0 - Average

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
2389.110	41.8	-38.8	27.2	53.449	H
18000.000	40.3	-26.5	46.4	20.405	H
17995.500	40.1	-25.5	43.4	22.202	V
17998.500	40.1	-25.5	43.4	22.202	H
17992.500	40.0	-25.5	43.4	22.102	H
17997.000	40.0	-25.5	43.4	22.102	H

8DPSK Ch 39 - Average

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
18000.000	40.2	-26.5	46.4	20.305	H
17997.000	40.1	-25.5	43.4	22.202	H
17998.500	40.1	-25.5	43.4	22.202	V
17995.500	40.0	-25.5	43.4	22.102	H
17992.500	39.9	-25.5	43.4	22.002	H
17986.500	39.9	-25.5	43.4	22.002	H

8DPSK Ch 78 - Average

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
2484.000	41.9	-39.0	27.2	53.714	H
18000.000	40.3	-26.5	46.4	20.405	H
17998.500	40.2	-25.5	43.4	22.302	V
17995.500	40.1	-25.5	43.4	22.202	H
17994.000	40.1	-25.5	43.4	22.202	H
17982.000	40.0	-25.5	43.4	22.102	H

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8DPSK Ch 0 – Peak

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
2387.570	54.9	-38.8	27.2	66.549	H
17838.000	51.7	-25.7	43.4	34.042	H
17844.000	51.6	-25.7	43.4	33.942	V
17977.500	51.3	-25.5	43.4	33.402	H
17994.000	51.3	-25.5	43.4	33.402	H
17917.500	51.2	-25.5	43.4	33.302	H

8DPSK Ch 39 - Peak

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
17977.500	51.8	-25.5	43.4	33.902	H
17818.500	51.4	-25.7	43.4	33.742	H
18000.000	51.3	-26.5	46.4	31.405	V
17947.500	51.2	-25.5	43.4	33.302	H
17979.000	51.2	-25.5	43.4	33.302	H
17824.500	51.1	-25.7	43.4	33.442	H

8DPSK Ch 78 - Peak

Frequency (MHz)	Measurement Result (dBμV/m)	Cable loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV)	Antenna Pol. (H/V)
2485.020	54.3	-39.0	27.2	66.114	H
17983.500	52.2	-25.5	43.4	34.302	H
17965.500	52.0	-25.5	43.4	34.102	V
17884.500	51.8	-25.7	43.4	34.142	H
17973.000	51.8	-25.5	43.4	33.902	H
17979.000	51.5	-25.5	43.4	33.602	H

Conclusion: PASS

Test graphs as below:

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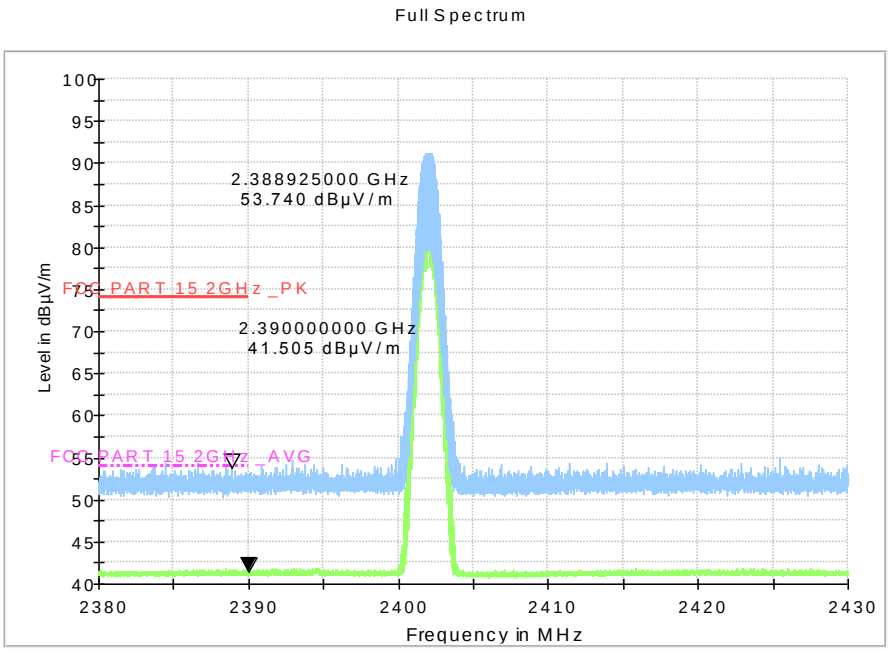

Fig.58. Radiated emission (Power): GFSK, low channel

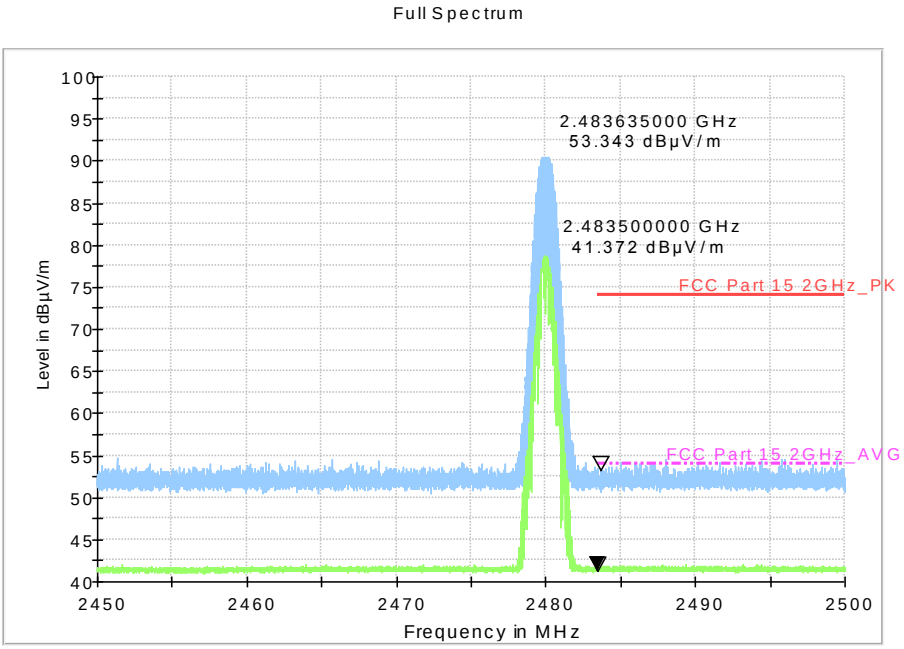

Fig.59. Radiated emission (Power) GFSK, high channel

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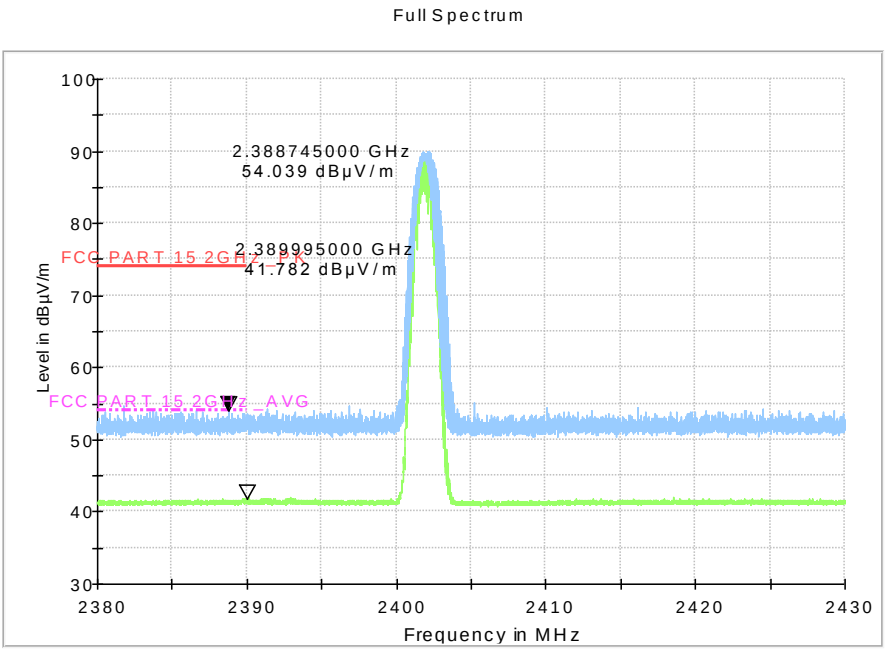

Fig.60. Radiated emission (Power): π/4 DQPSK, low channel

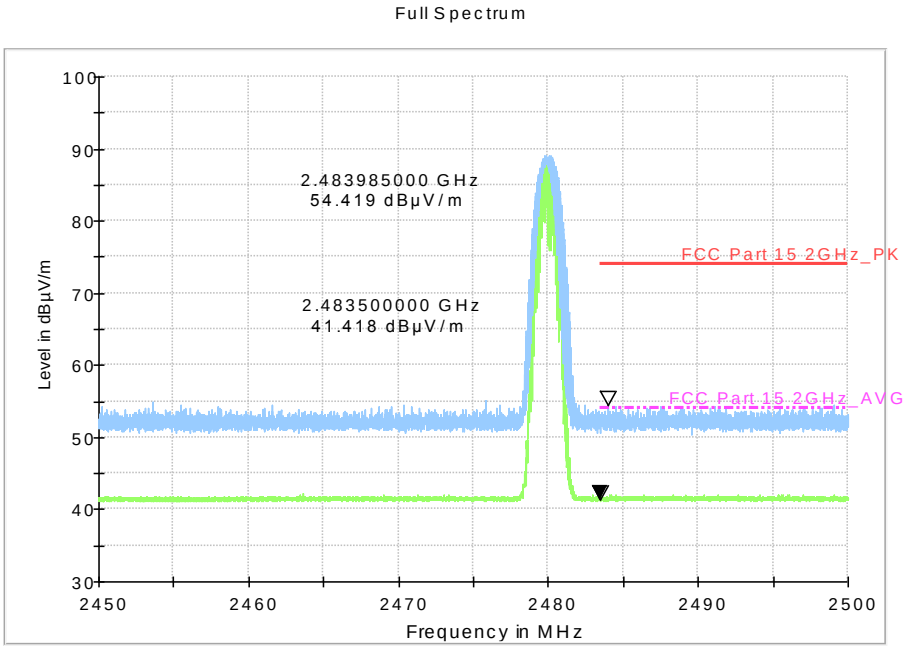

Fig.61. Radiated emission (Power): π/4 DQPSK, high channel

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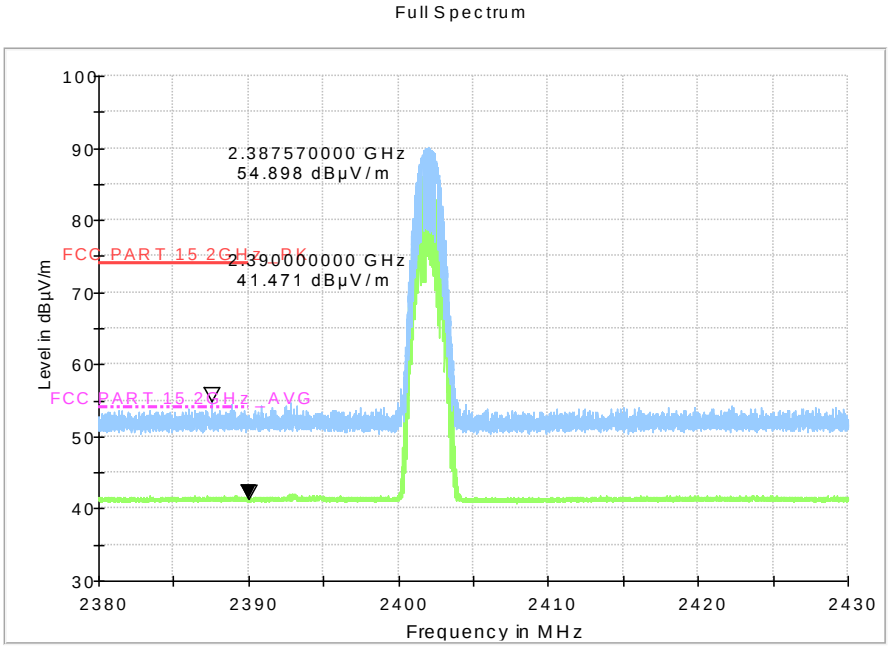

Fig.62. Radiated emission (Power): 8DPSK, low channel

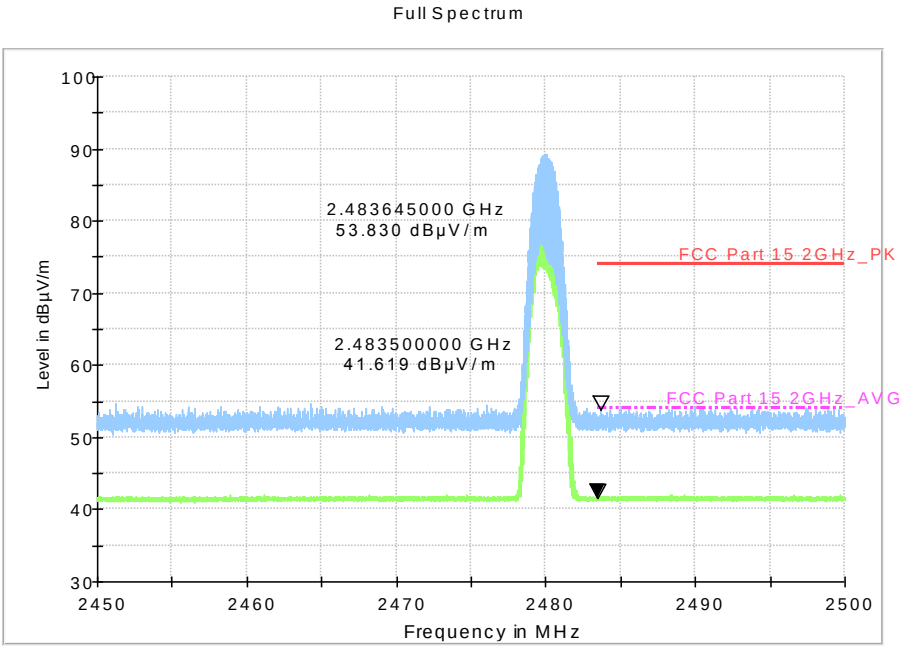

Fig.63. Radiated emission (Power): 8DPSK, high channel

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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 ≥ 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	121.21	P
		Fig.65		
	DH3	Fig.66	173.54	P
		Fig.67		
	DH5	Fig.68	187.54	P
		Fig.69		

For π/4 DQPSK

Channel	Packet	Dwell Time (ms)		Conclusion
39	DH1	Fig.70	123.87	P
		Fig.71		
	DH3	Fig.72	157.35	P
		Fig.73		
	DH5	Fig.74	184.79	P
		Fig.75		

For 8DPSK

Channel	Packet	Dwell Time (ms)		Conclusion
39	DH1	Fig.76	122.60	P
		Fig.77		
	DH3	Fig.78	153.97	P

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		Fig.79		
	DH5	Fig.80	187.78	P
		Fig.81		

Conclusion: PASS

Test graphs as below:

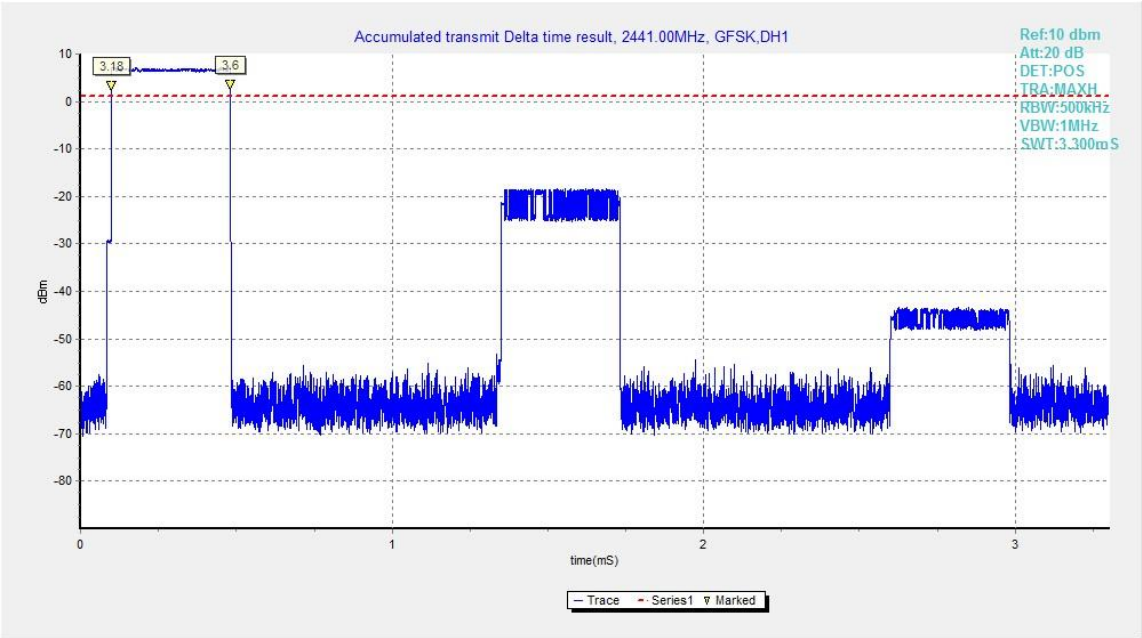

Fig.64. Time of occupancy (Dwell Time): Channel 39, Packet DH1

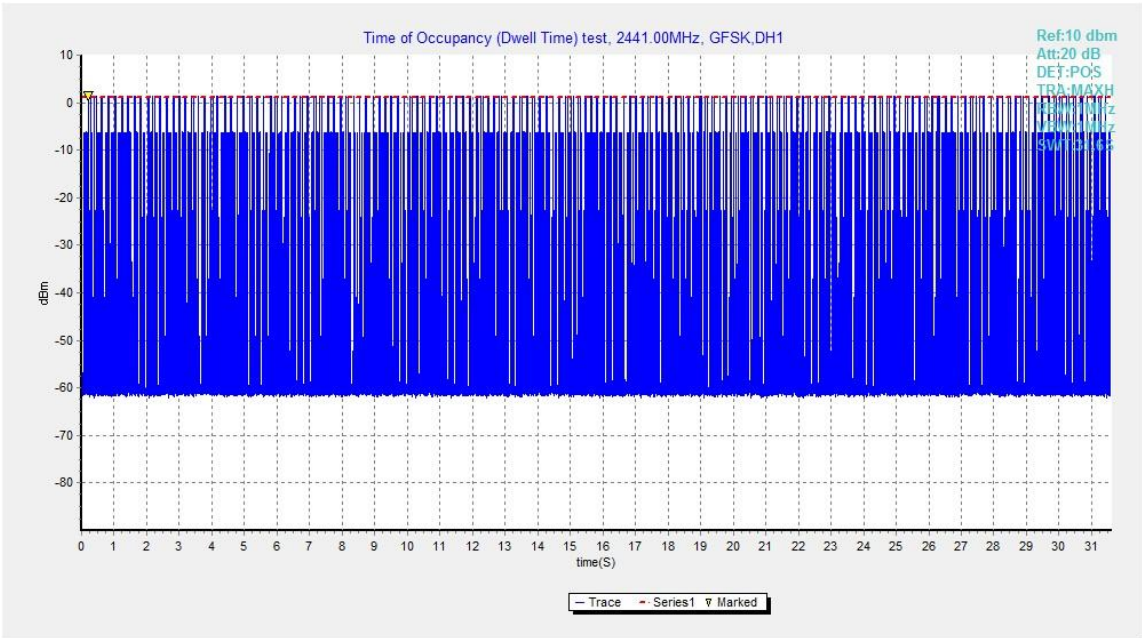

Fig.65. Number of Transmissions Measurement: Channel 39,Packet DH1

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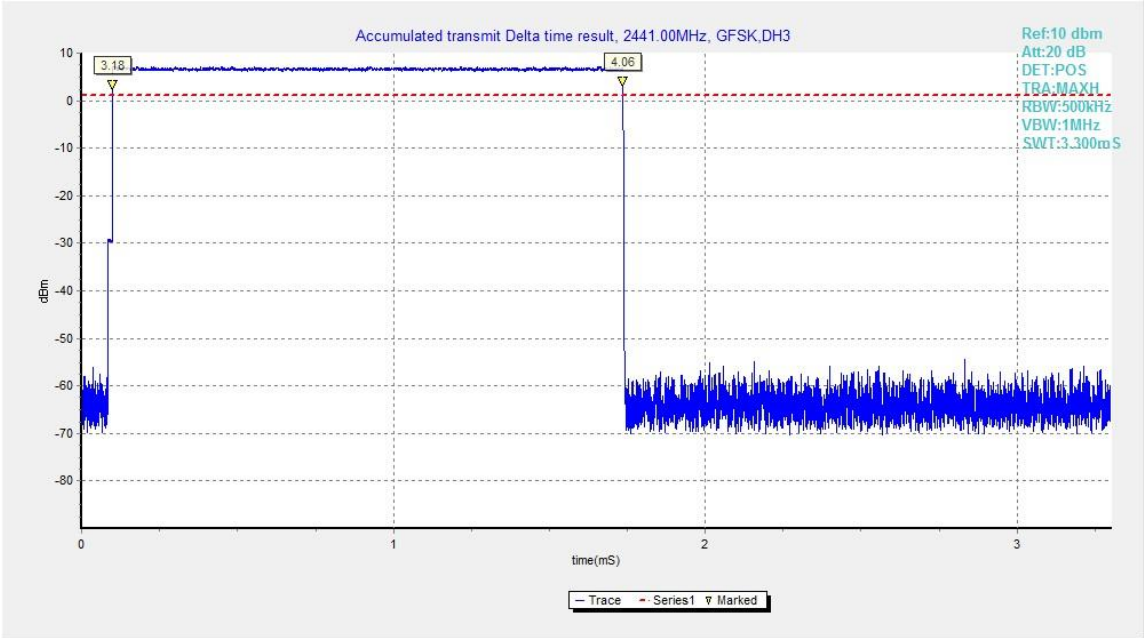

Fig.66. Time of occupancy (Dwell Time): Channel 39, Packet DH3

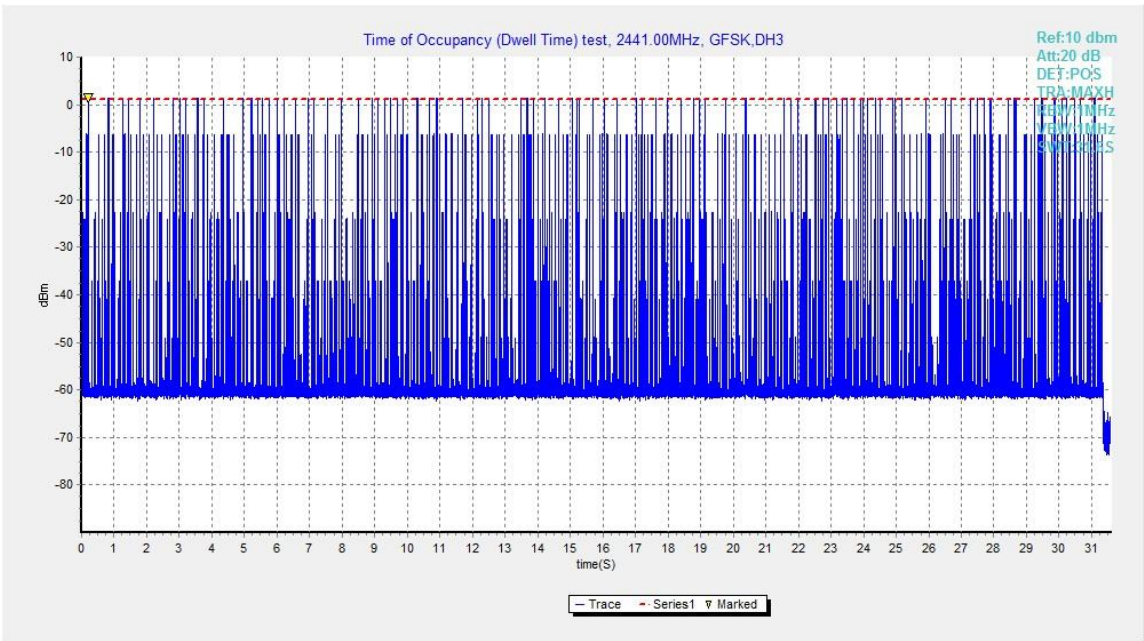

Fig.67. Number of Transmissions Measurement: Channel 39,Packet DH3

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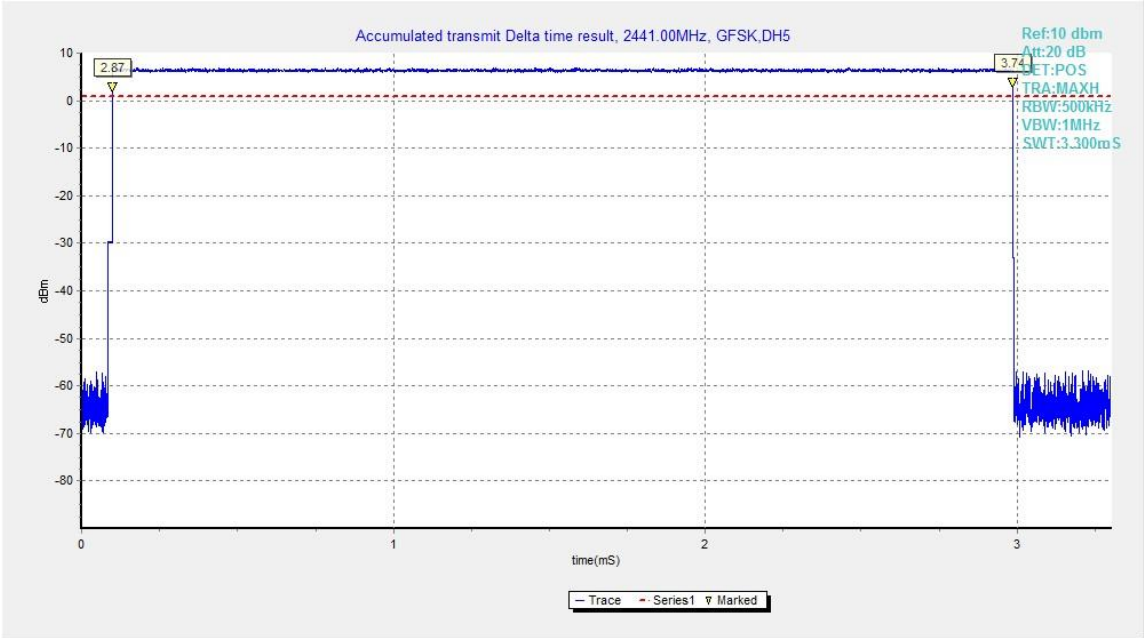

Fig.68. Time of occupancy (Dwell Time): Channel 39, Packet DH5

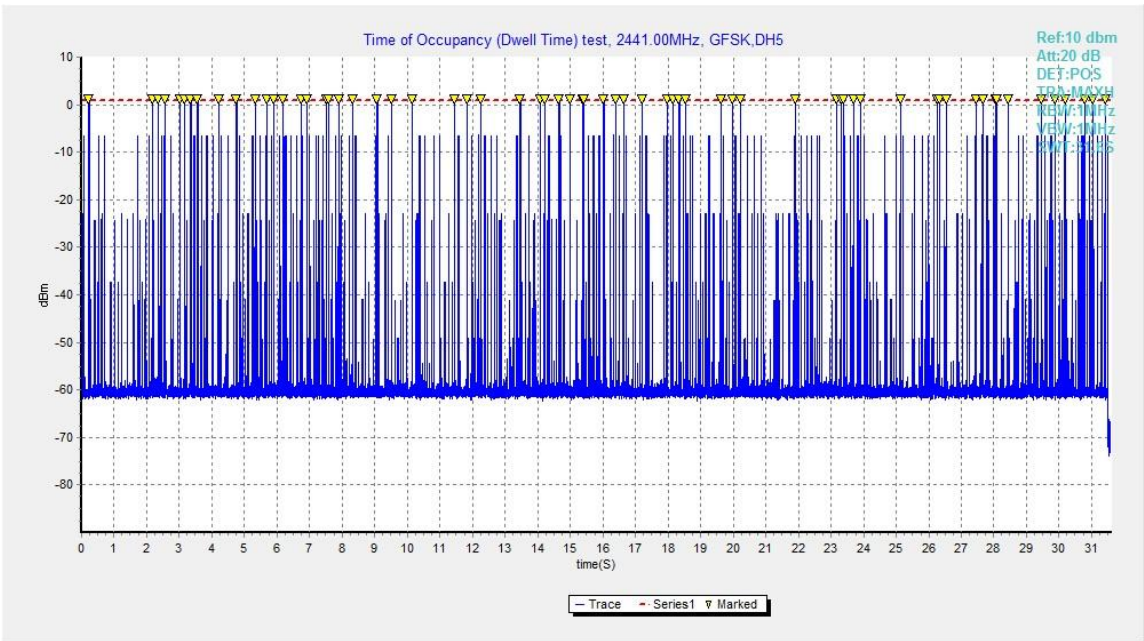

Fig.69. Number of Transmissions Measurement: Channel 39,Packet DH5

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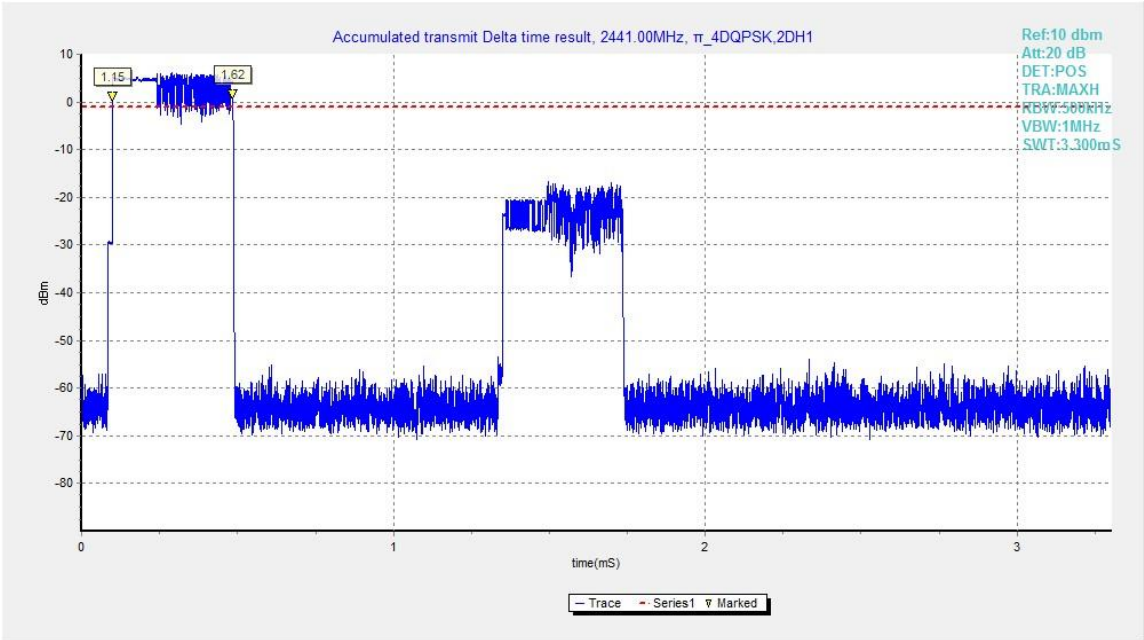

Fig.70. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH1

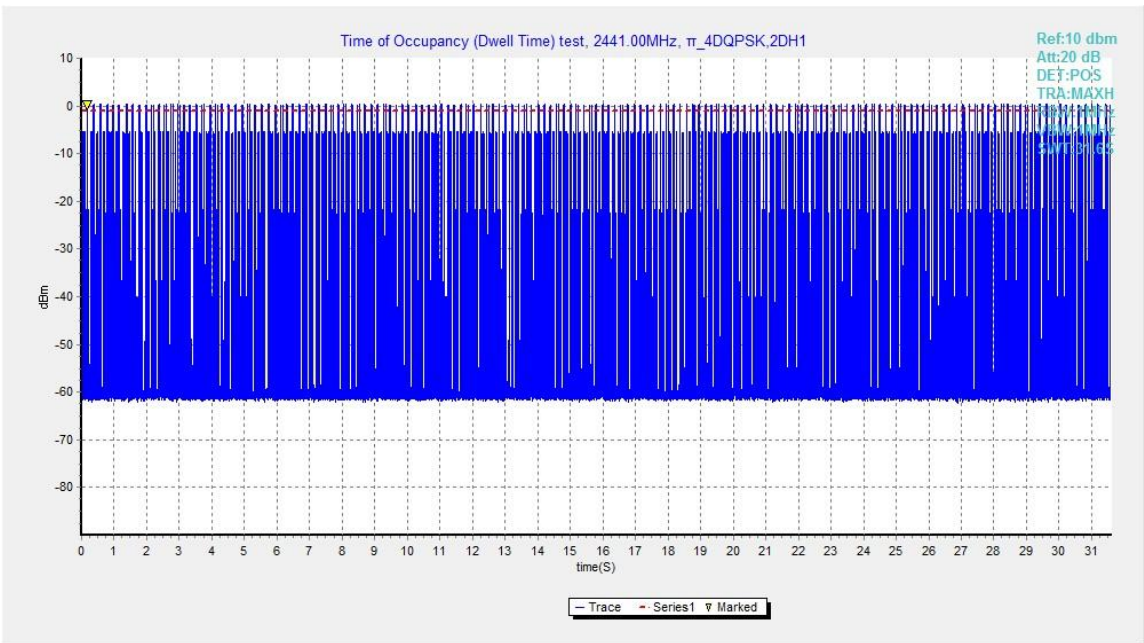

Fig.71. Number of Transmissions Measurement: Channel 39,Packet 2-DH1

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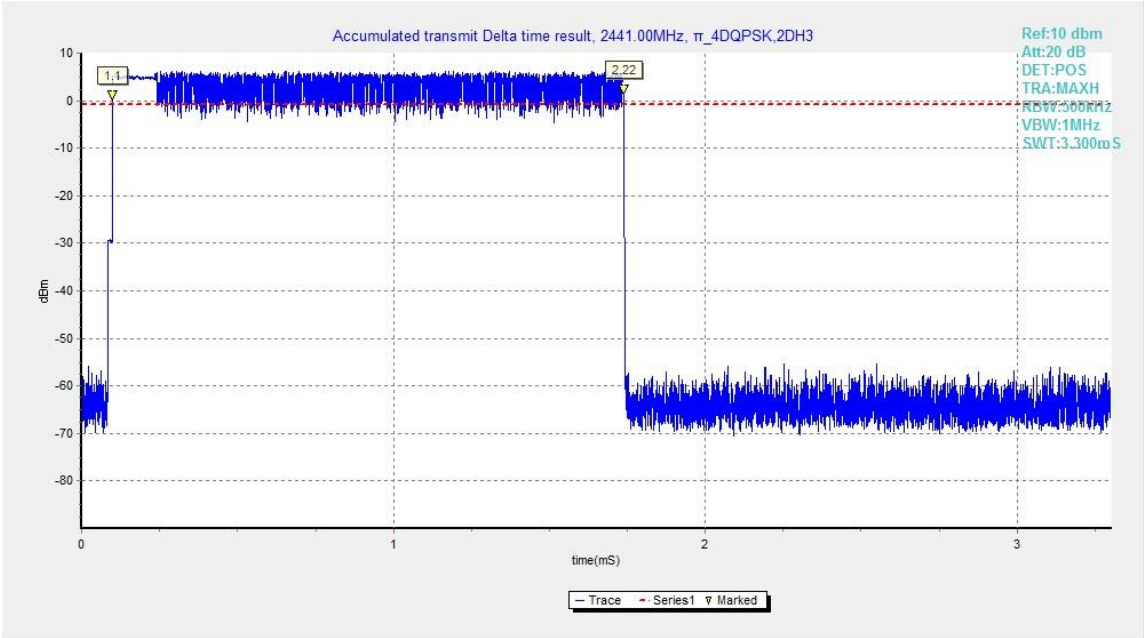

Fig.72. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH3

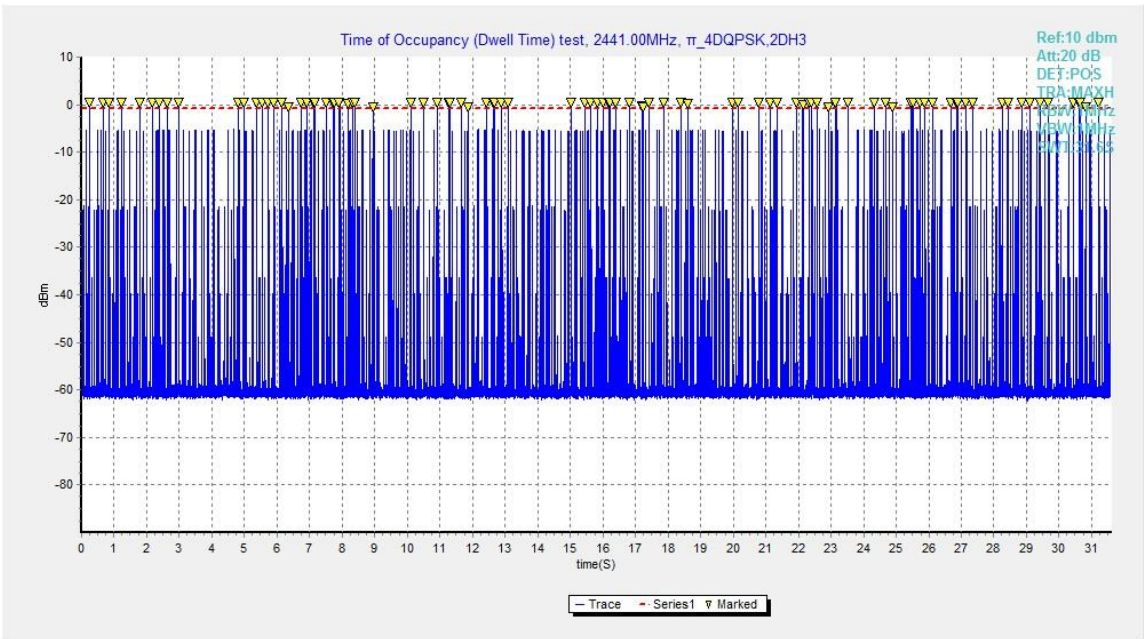

Fig.73. Number of Transmissions Measurement: Channel 39,Packet 2-DH3

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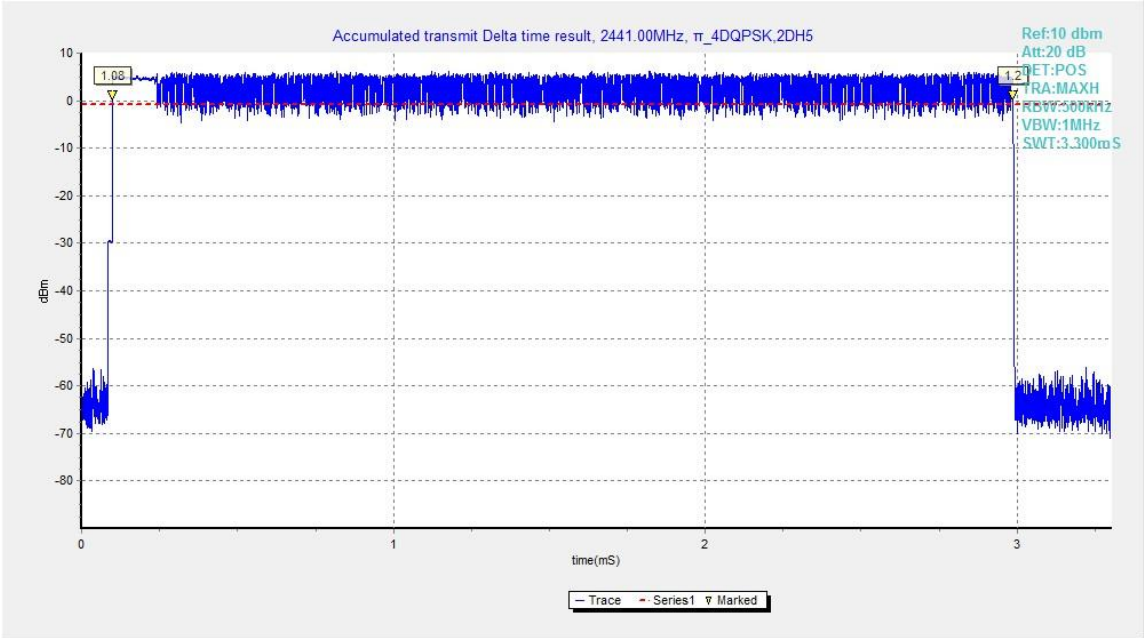

Fig.74. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH5

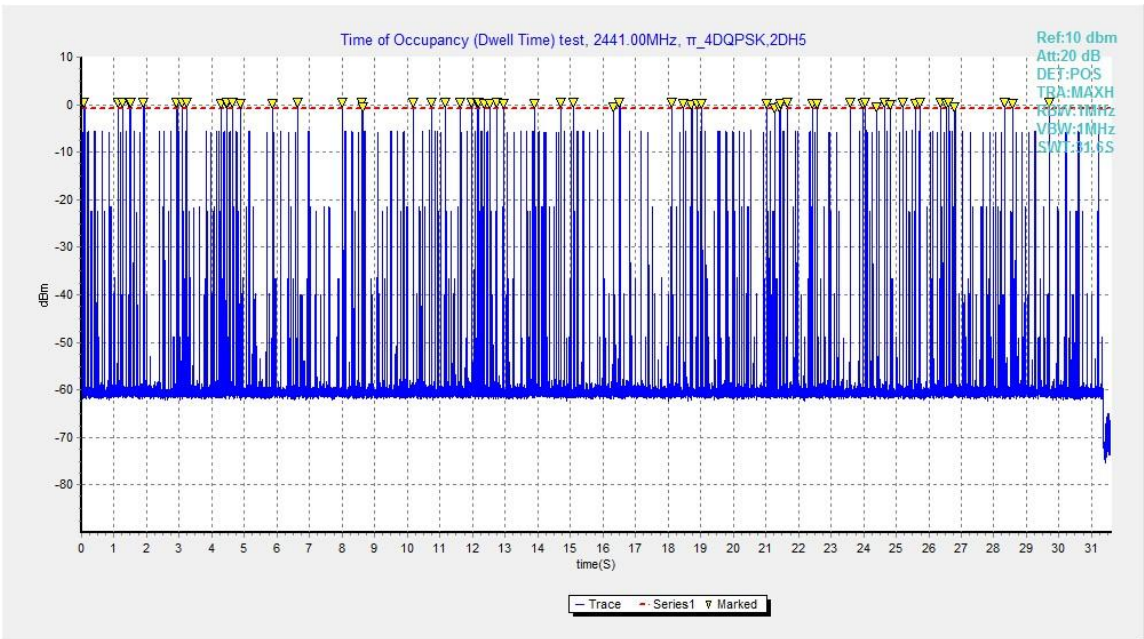

Fig.75. Number of Transmissions Measurement: Channel 39,Packet 2-DH5

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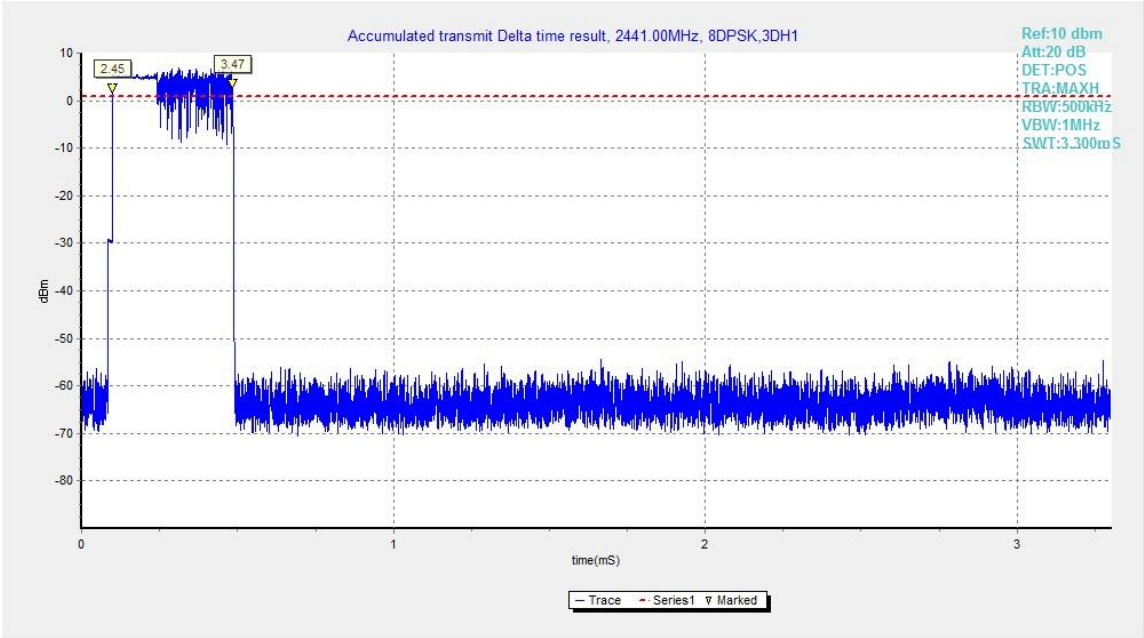

Fig.76. Time of occupancy (Dwell Time): Channel 39, Packet 3-DH1

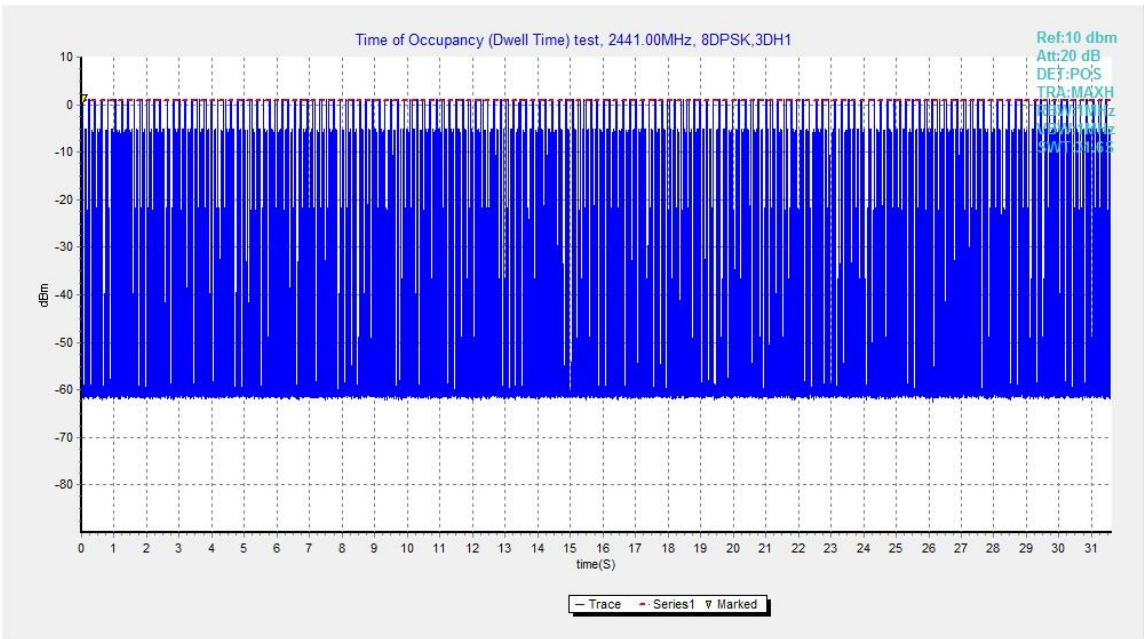

Fig.77. Number of Transmissions Measurement: Channel 39,Packet 3-DH1

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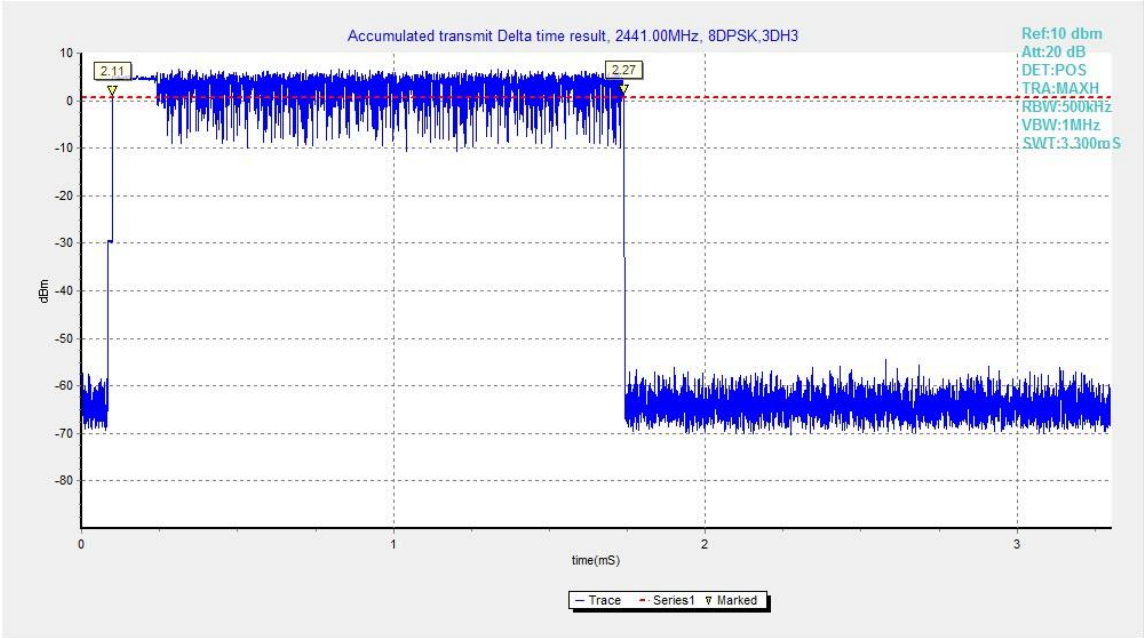

Fig.78. Time of occupancy (Dwell Time): Channel 39, Packet 3-DH3

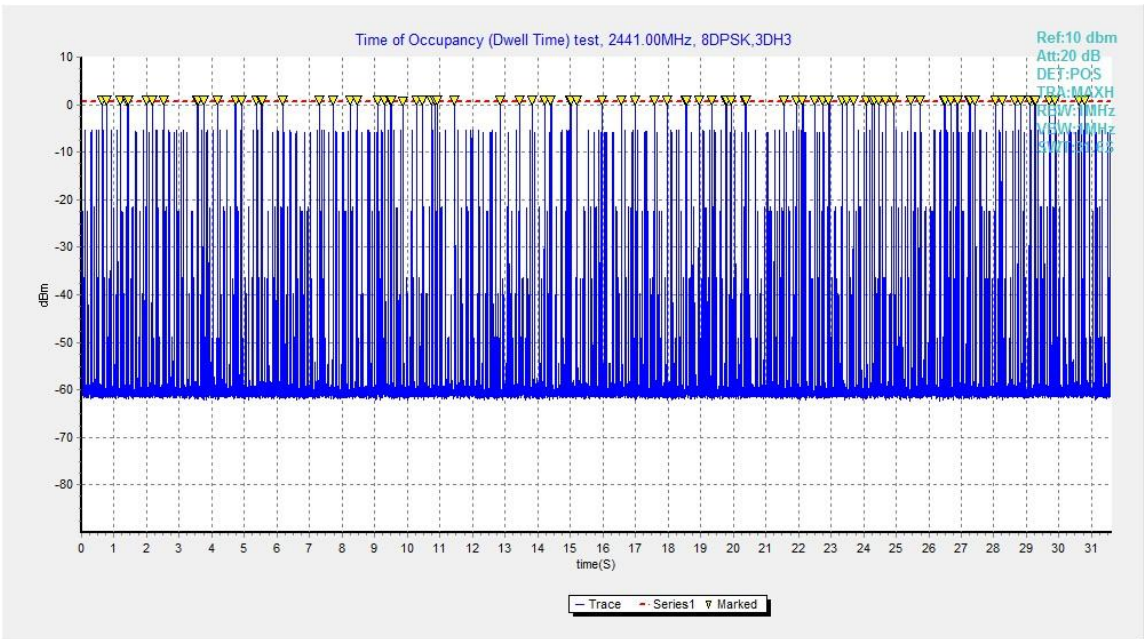

Fig.79. Number of Transmissions Measurement: Channel 39,Packet 3-DH3

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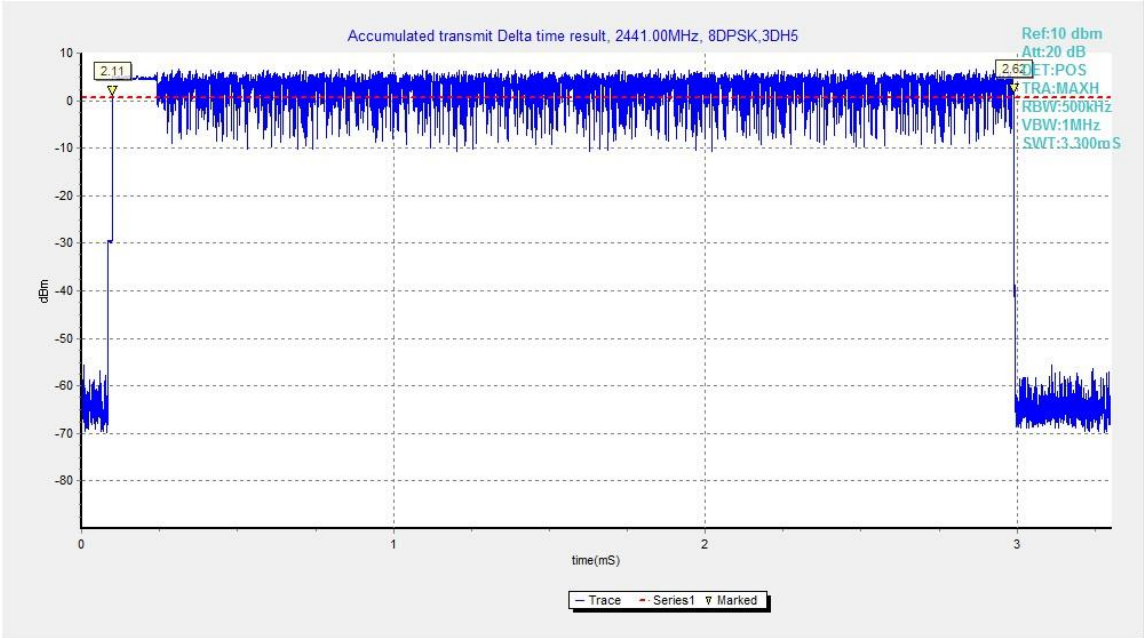

Fig.80. Time of occupancy (Dwell Time): Channel 39, Packet 3-DH5

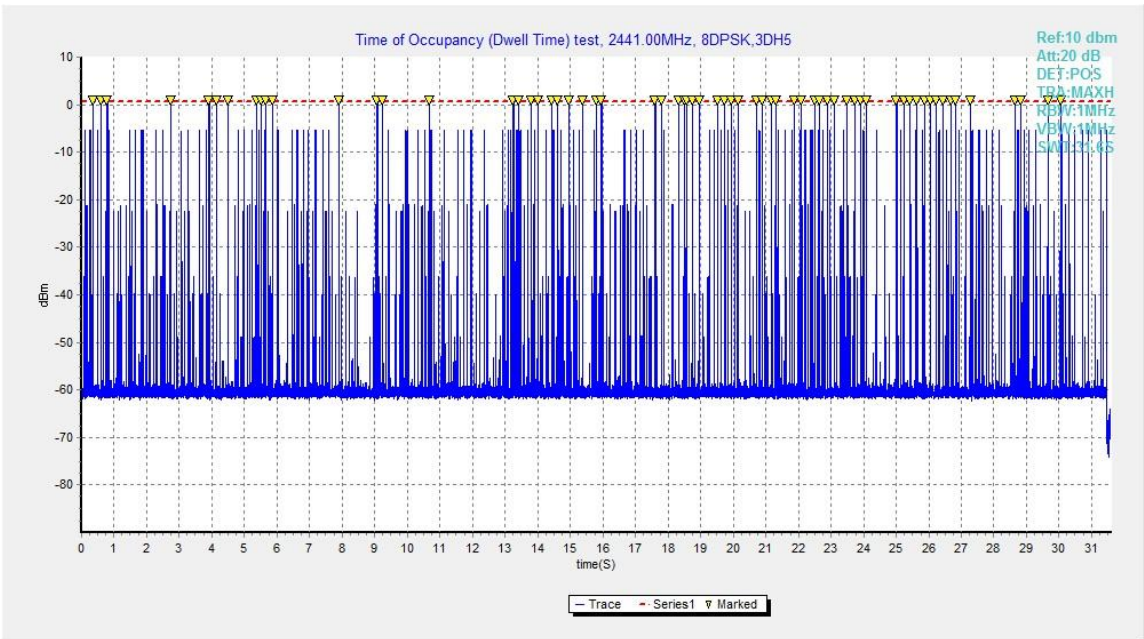

Fig.81. Number of Transmissions Measurement: Channel 39,Packet 3-DH5

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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	945.00	NA
39	Fig.83	940.50	NA
78	Fig.84	939.00	NA

For π/4 DQPSK

Channel	20dB Bandwidth (kHz)		Conclusion
0	Fig.85	1288.50	NA
39	Fig.86	1291.50	NA
78	Fig.87	1290.75	NA

For 8DPSK

Channel	20dB Bandwidth (kHz)		Conclusion
0	Fig.88	1295.25	NA
39	Fig.89	1272.75	NA
78	Fig.90	1270.50	NA

Conclusion: NA

Test graphs as below:

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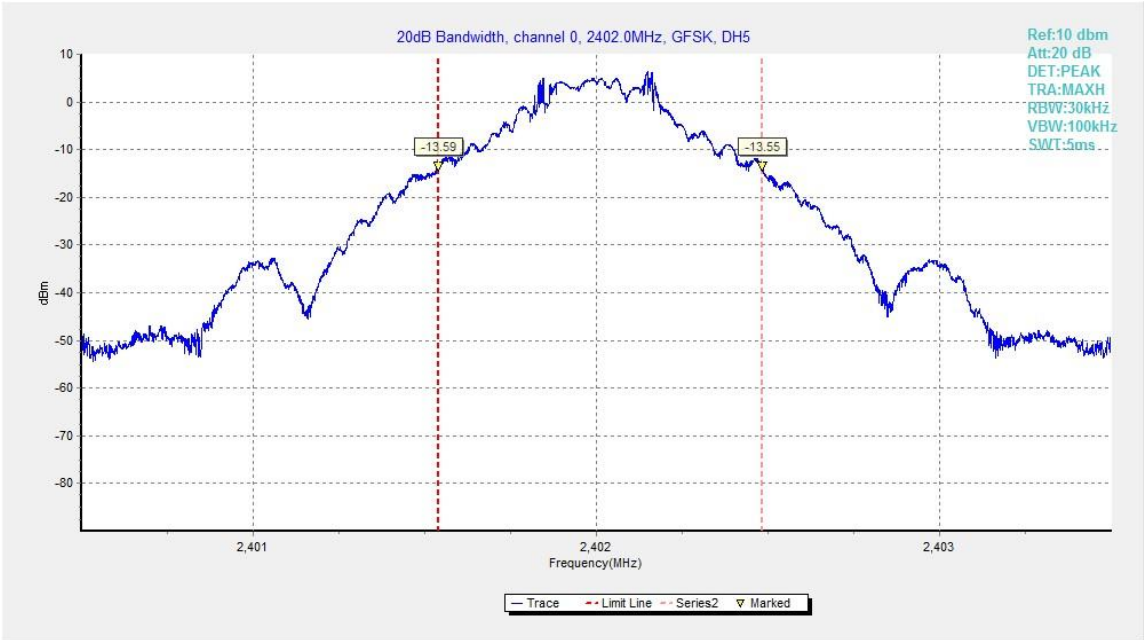

Fig.82. 20dB Bandwidth: GFSK, Channel 0

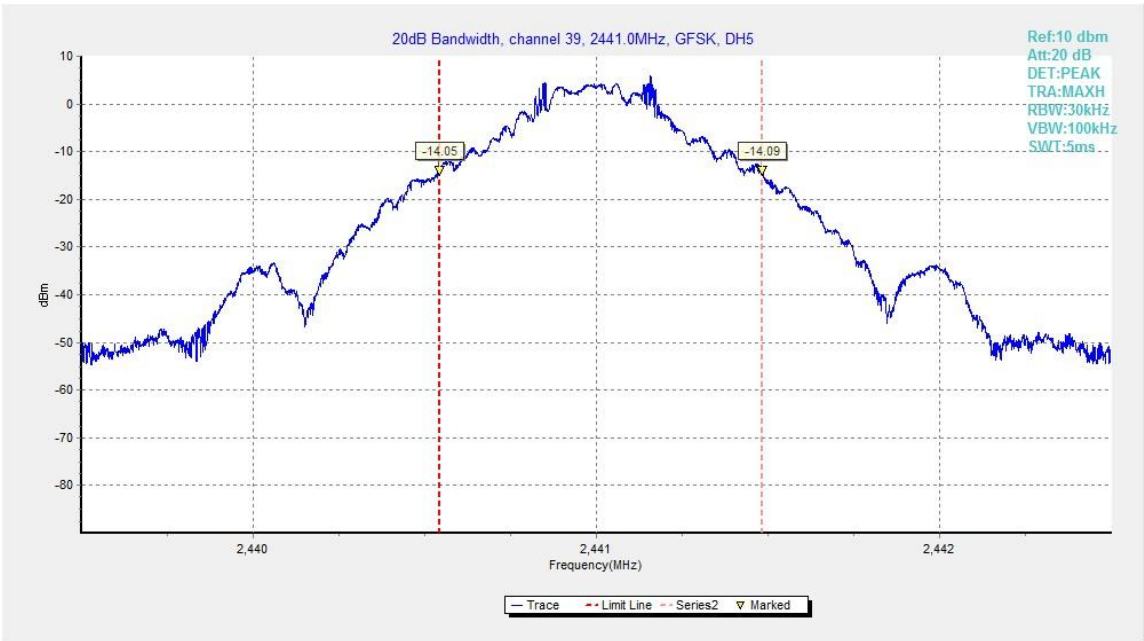

Fig.83. 20dB Bandwidth: GFSK, Channel 39

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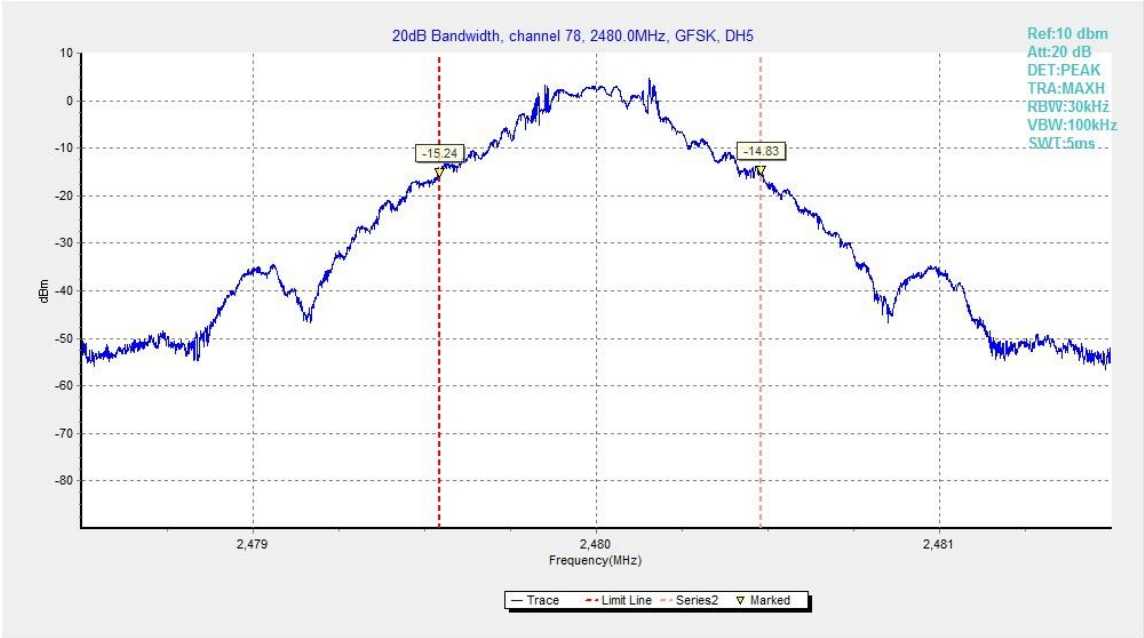

Fig.84. 20dB Bandwidth: GFSK, Channel 78

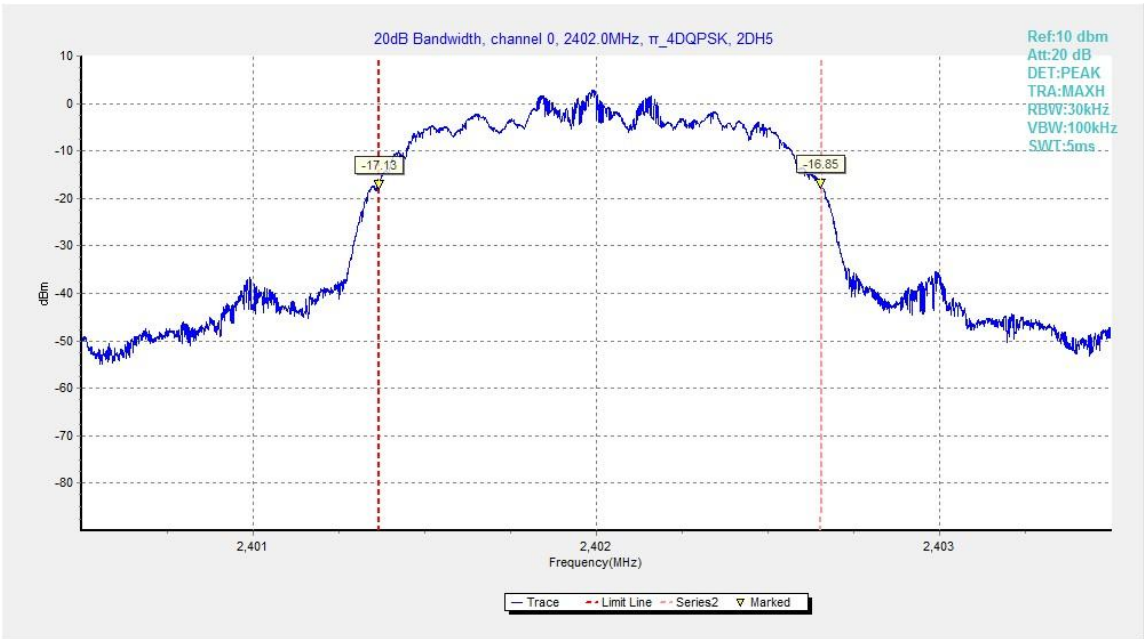

Fig.85. 20dB Bandwidth: π/4 DQPSK, Channel 0

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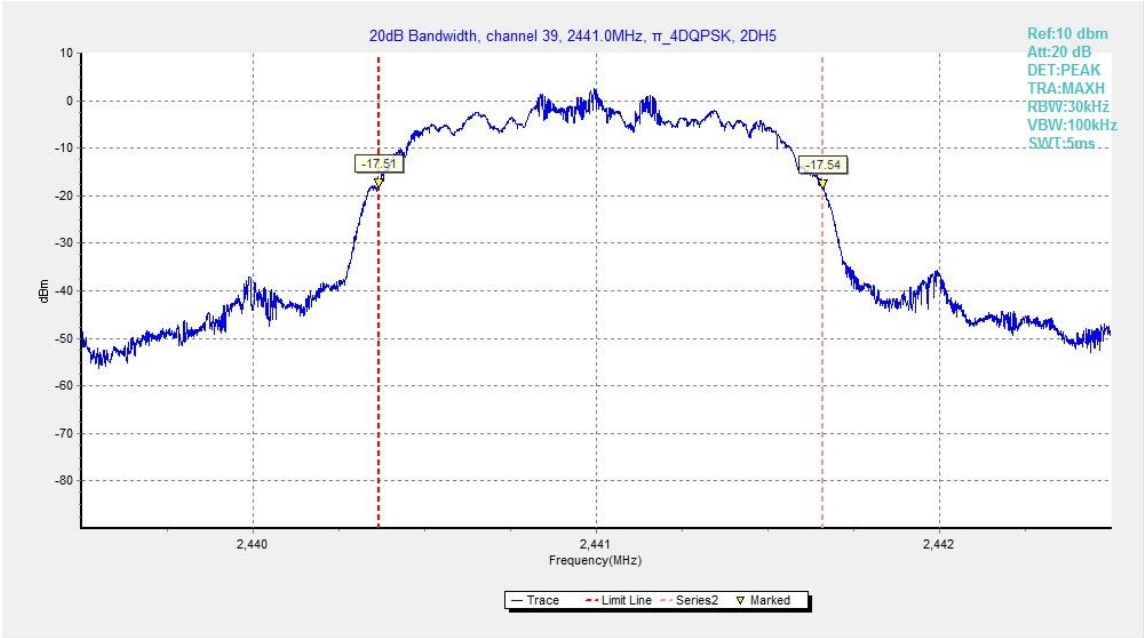

Fig.86. 20dB Bandwidth: π/4 DQPSK, Channel 39

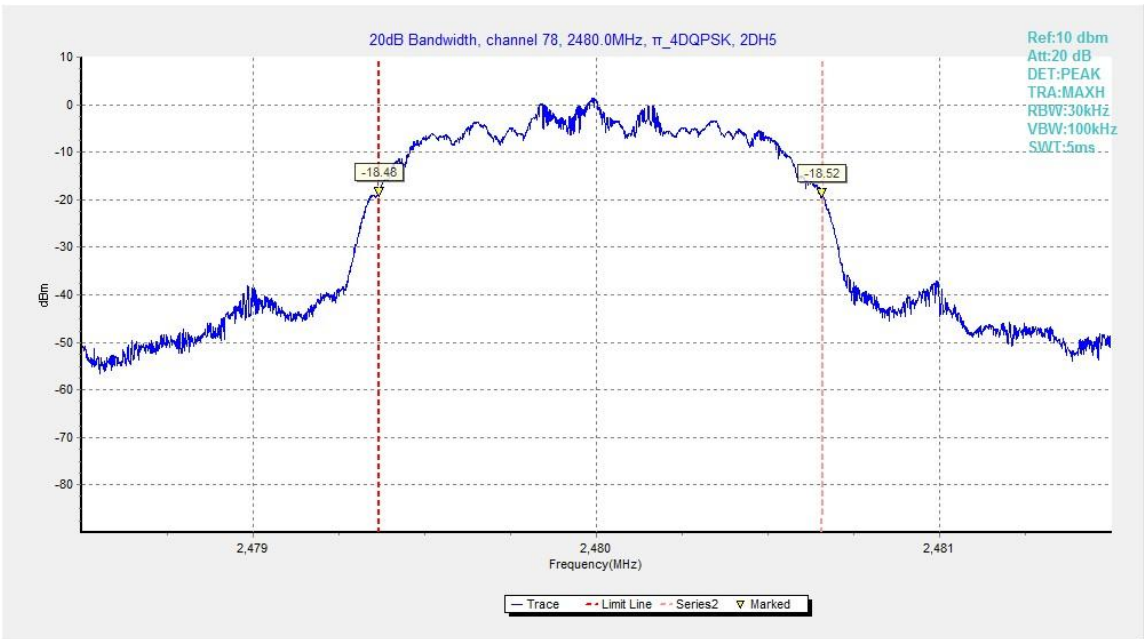

Fig.87. 20dB Bandwidth: π/4 DQPSK, Channel 78

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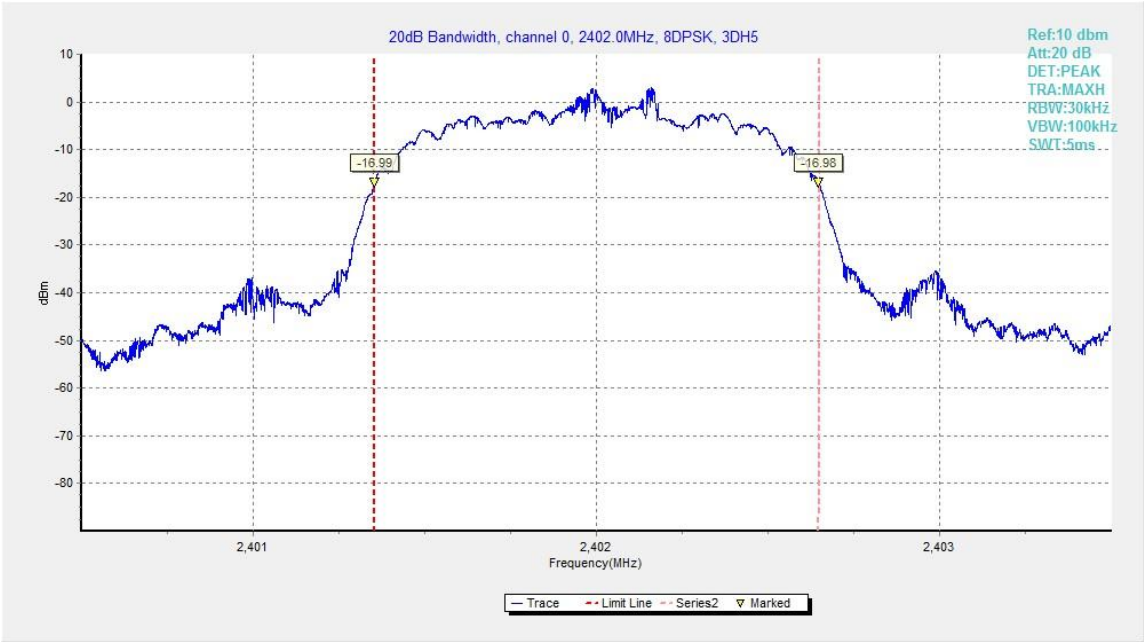

Fig.88. 20dB Bandwidth: 8DPSK, Channel 0

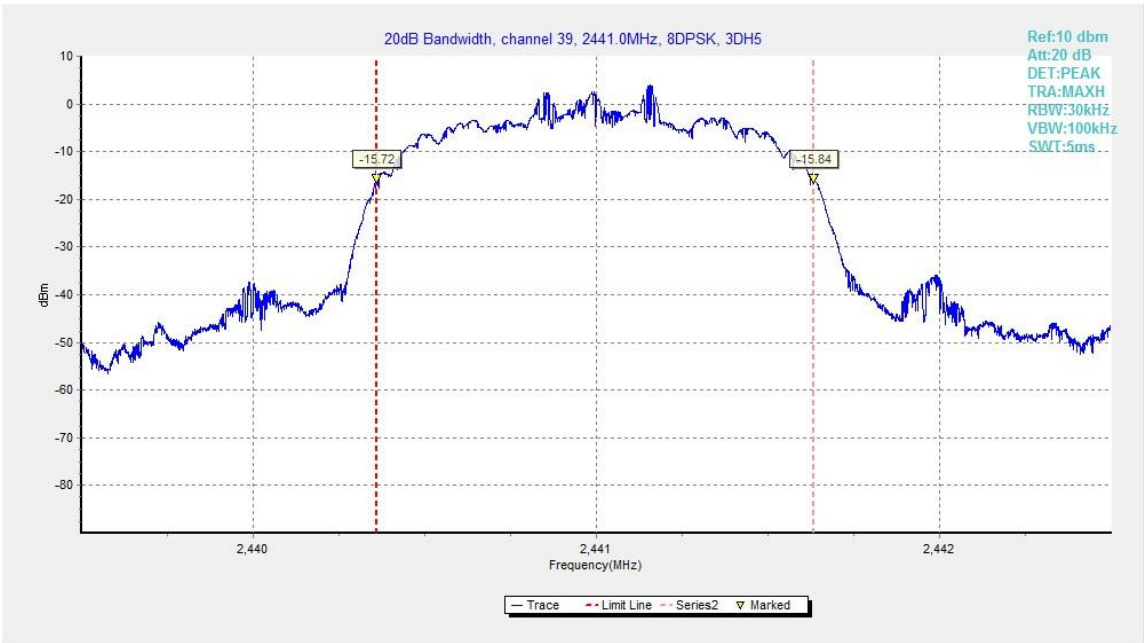

Fig.89. 20dB Bandwidth: 8DPSK, Channel 39

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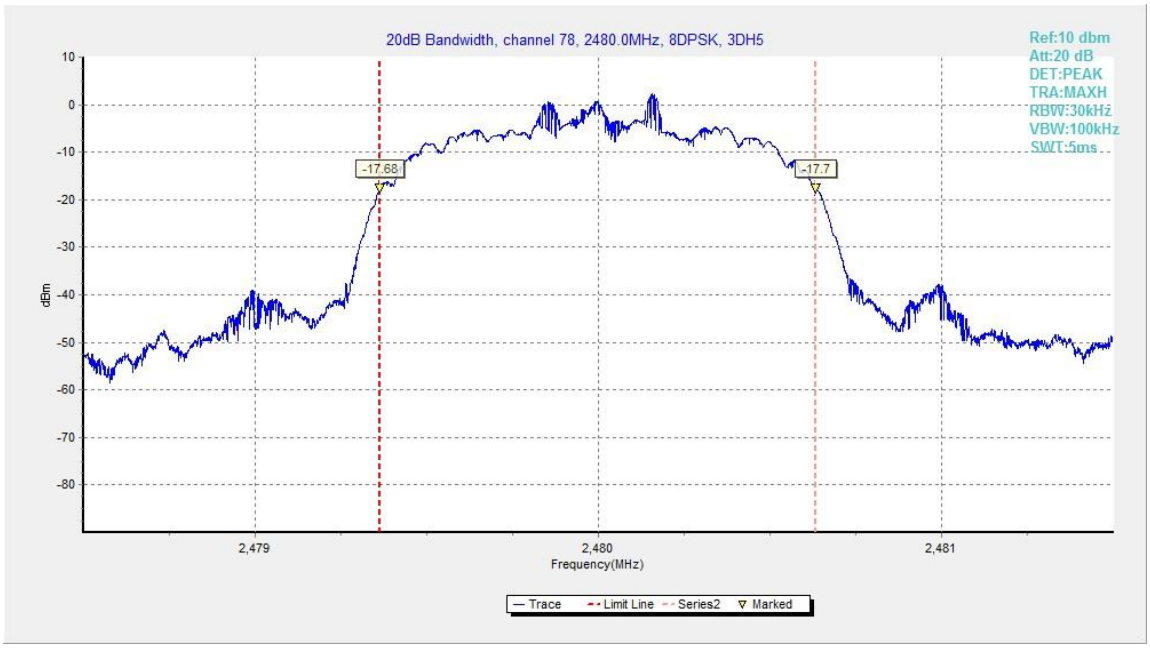

Fig.90. 20dB Bandwidth: 8DPSK, Channel 78

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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) * 20dB bandwidth, whichever is greater.

Measurement Limit:

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

Measurement Result:

For GFSK

Channel	Carrier frequency separation (kHz)		Conclusion
39	Fig.91	985.50	P

For π/4 DQPSK

Channel	Carrier frequency separation (kHz)		Conclusion
39	Fig.92	983.25	P

For 8DPSK

Channel	Carrier frequency separation (kHz)		Conclusion
39	Fig.93	984.75	P

Conclusion: PASS

Test graphs as below:

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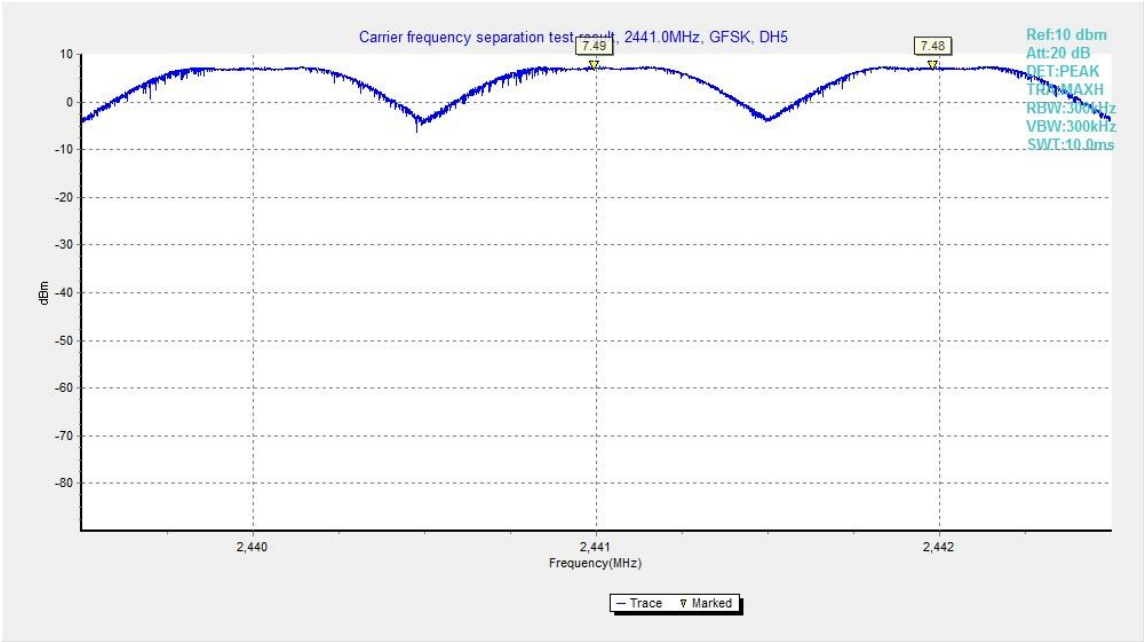

Fig.91. Carrier frequency separation measurement: GFSK, Channel 39

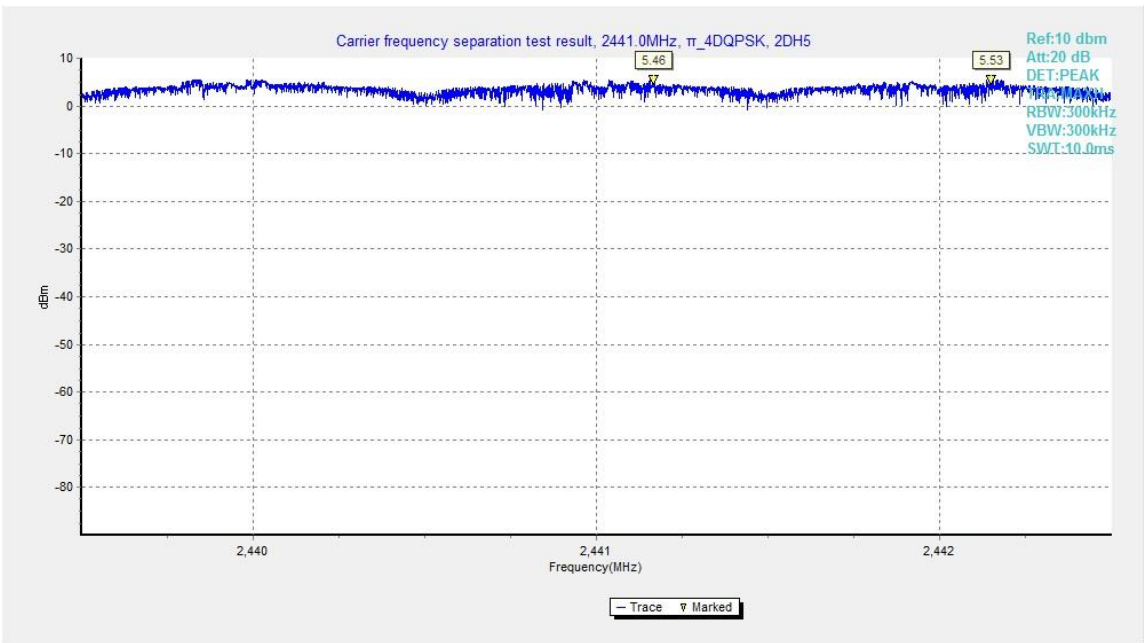

Fig.92. Carrier frequency separation measurement: π/4 DQPSK, Channel 39

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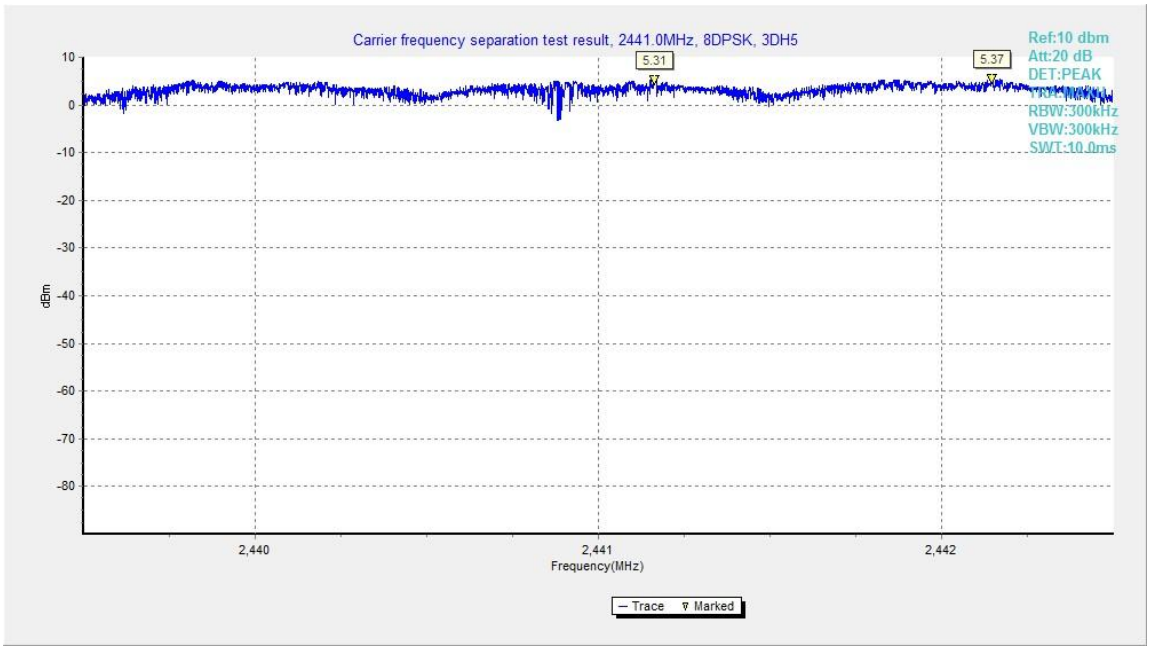

Fig.93. Carrier frequency separation measurement: 8DPSK, Channel 39

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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		

Forπ/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:

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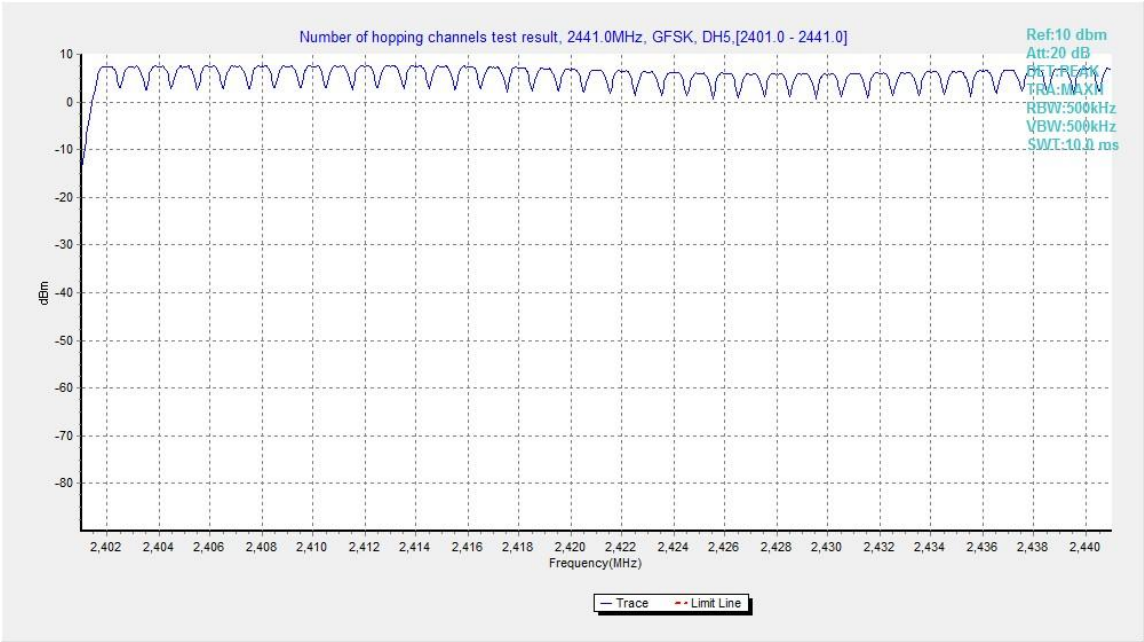

Fig.94. Number of hopping frequencies: GFSK, Channel 0 - 39

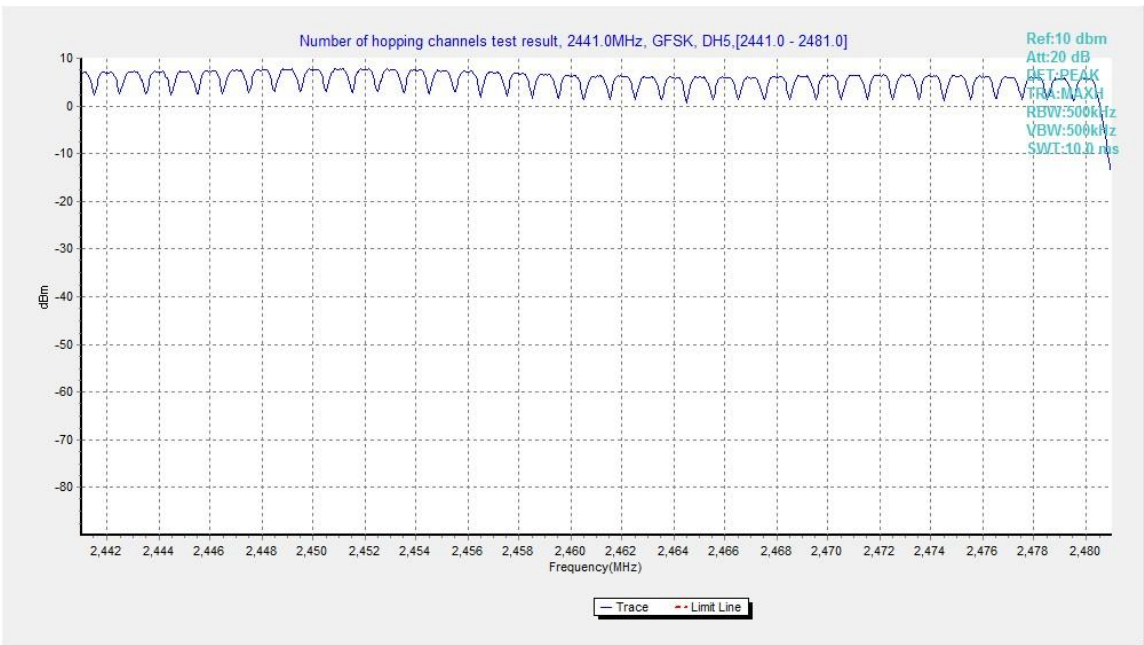

Fig.95. Number of hopping frequencies: GFSK, Channel 40 - 78

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

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

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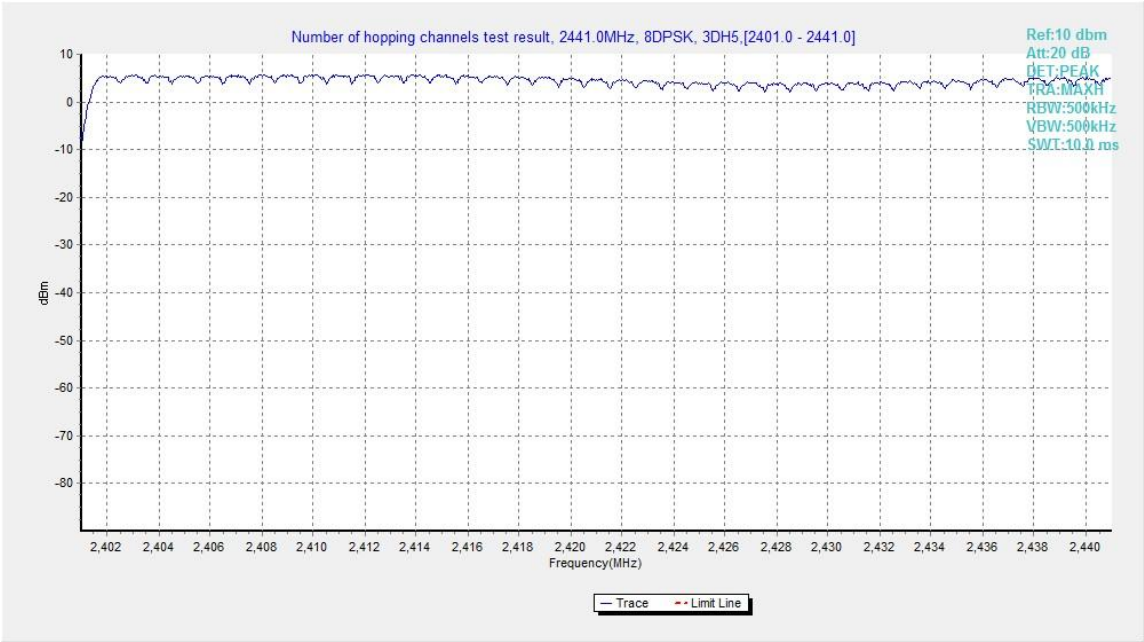

Fig.98. Number of hopping frequencies: 8DPSK, Channel 0 - 39

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

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ANNEX E: Accreditation Certificate

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 600118-0

Telecommunication Technology Labs, CAICT
Beijing
China

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Electromagnetic Compatibility & Telecommunications

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2017-08-22 through 2018-09-30
Effective Dates

For the National Voluntary Laboratory Accreditation Program

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

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