

Fig.52. Conducted spurious emission: 8DPSK, Channel 39, 10GHz – 26GHz

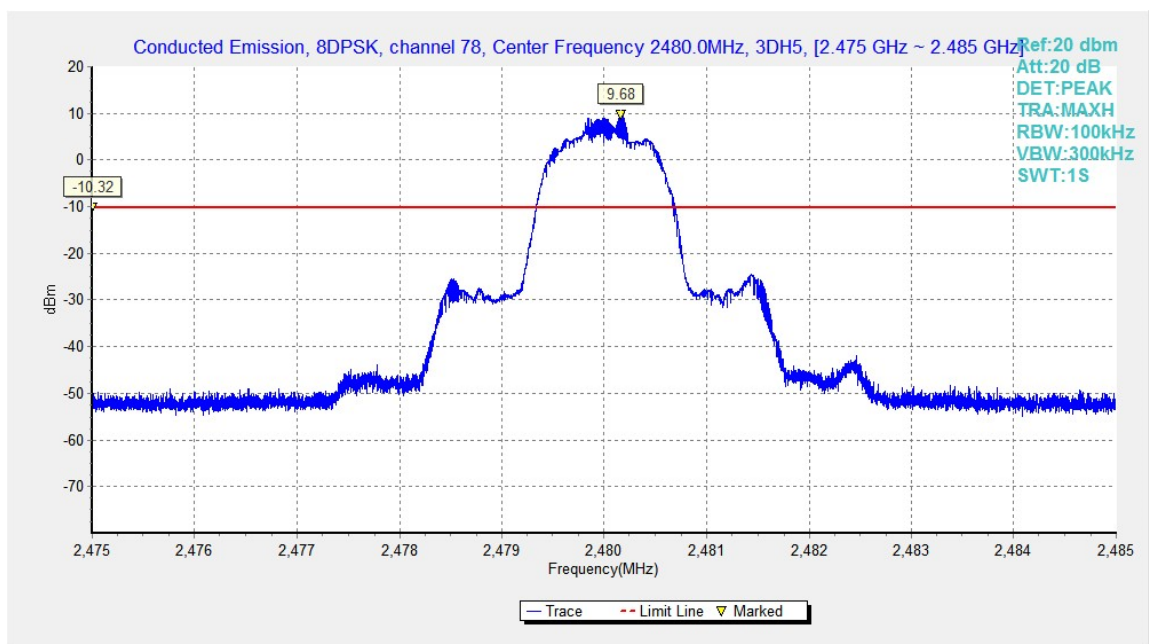


Fig.53. Conducted spurious emission: 8DPSK, Channel 78, 2480MHz

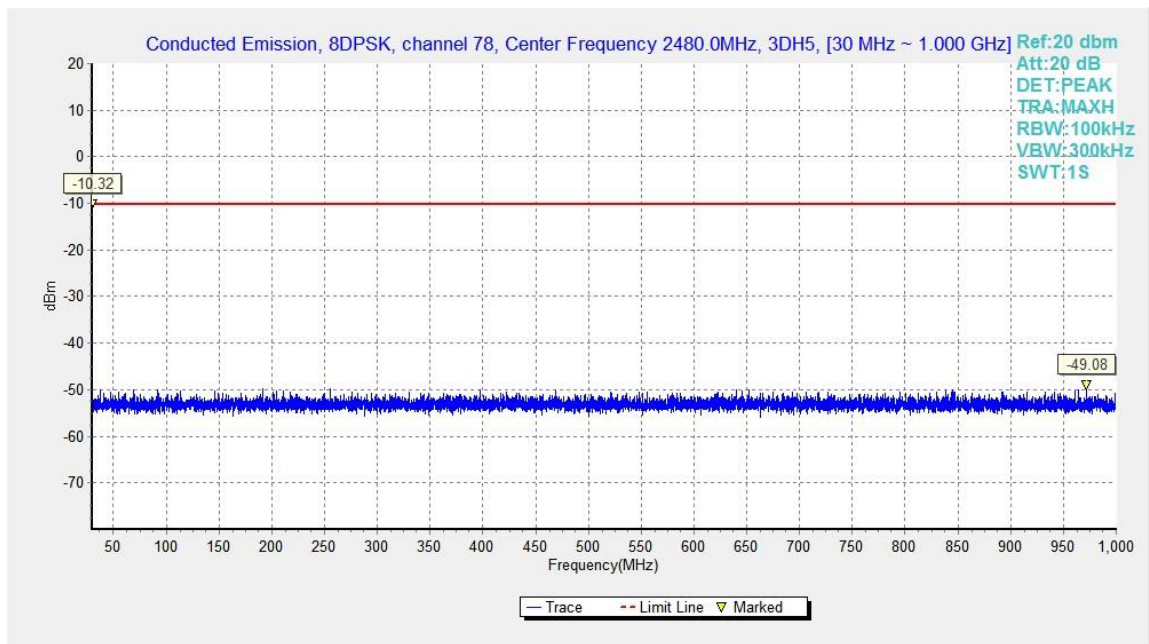


Fig.54. Conducted spurious emission: 8DPSK, Channel 78, 30MHz - 1GHz

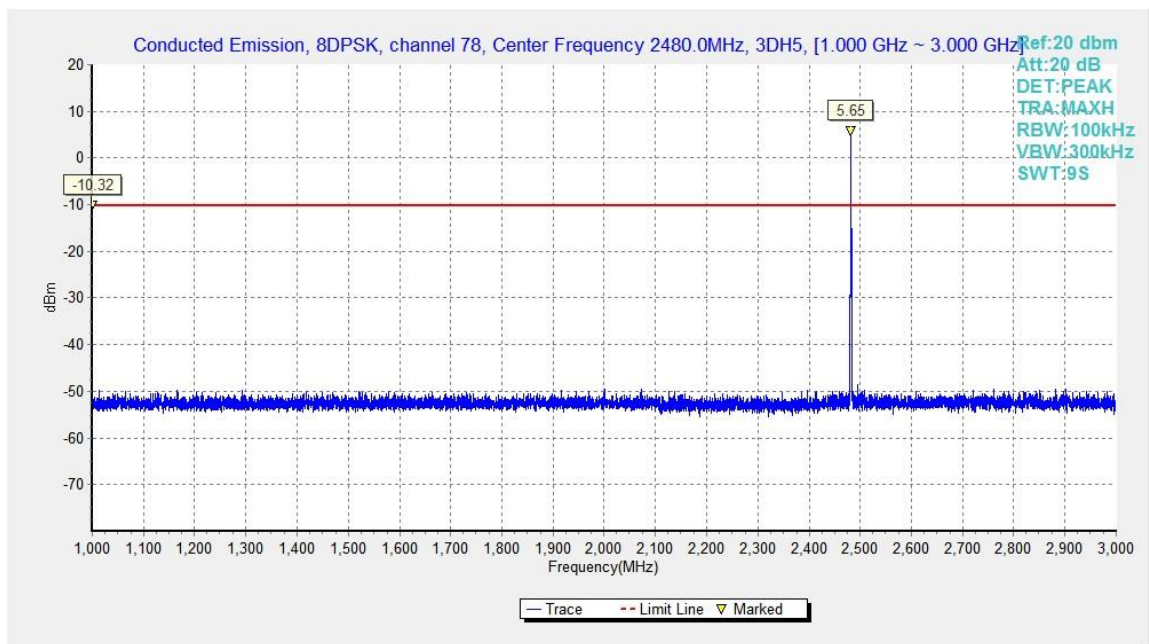


Fig.55. Conducted spurious emission: 8DPSK, Channel 78, 1GHz - 3GHz

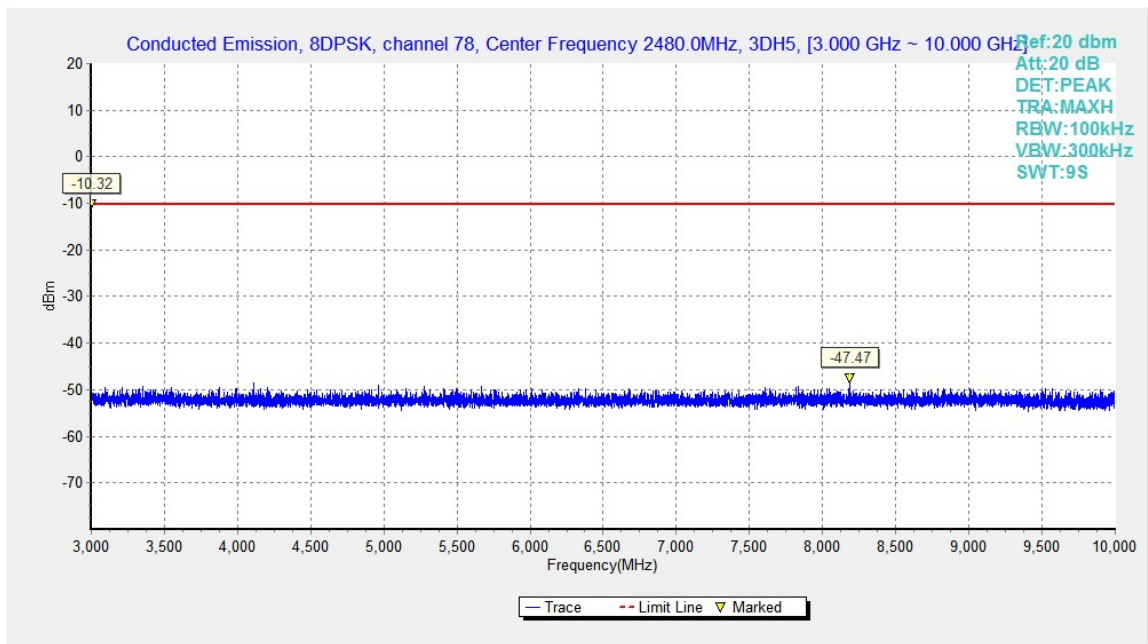


Fig.56. Conducted spurious emission: 8DPSK, Channel 78, 3GHz - 10GHz

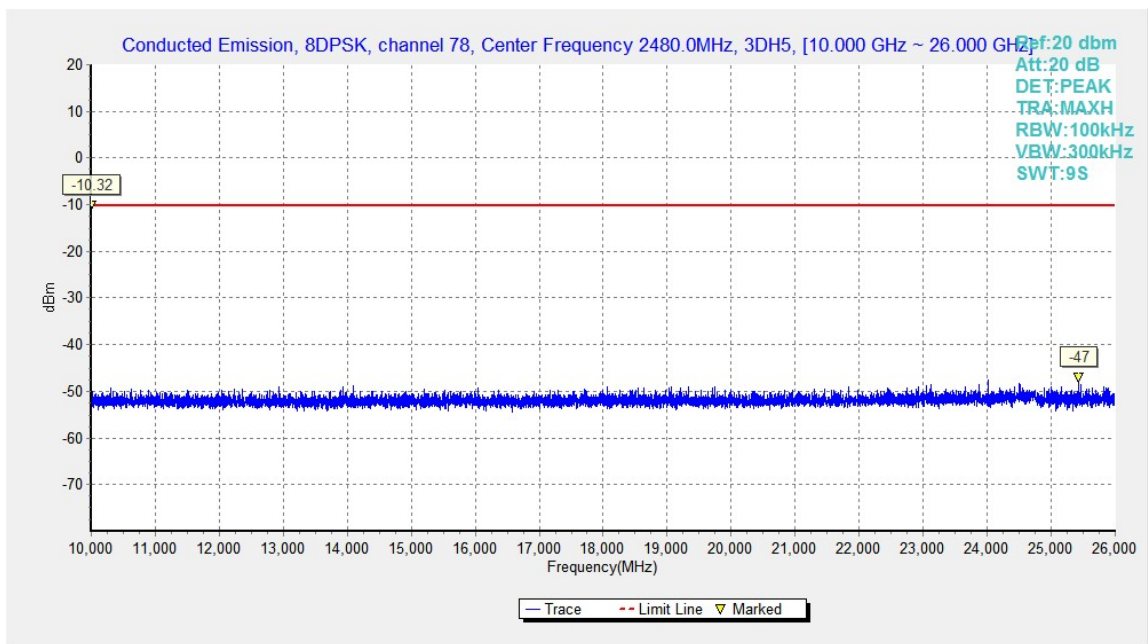


Fig.57. Conducted spurious emission: 8DPSK, Channel 78, 10GHz - 26GHz

B.5. Radiated Unwanted Emission

Limits

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 (MHz)	Field strength($\mu\text{V}/\text{m}$)	Measurement distance (m)
0.009 - 0.490	$2400/F(\text{kHz})$	300
0.490 - 1.705	$24000/F(\text{kHz})$	30
1.705 – 30.0	30	30

Frequency of emission (MHz)	Field strength ($\mu\text{V}/\text{m}$)	Field strength (dBuV/m)	Measurement distance (m)
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

Note: When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor.

Test setup

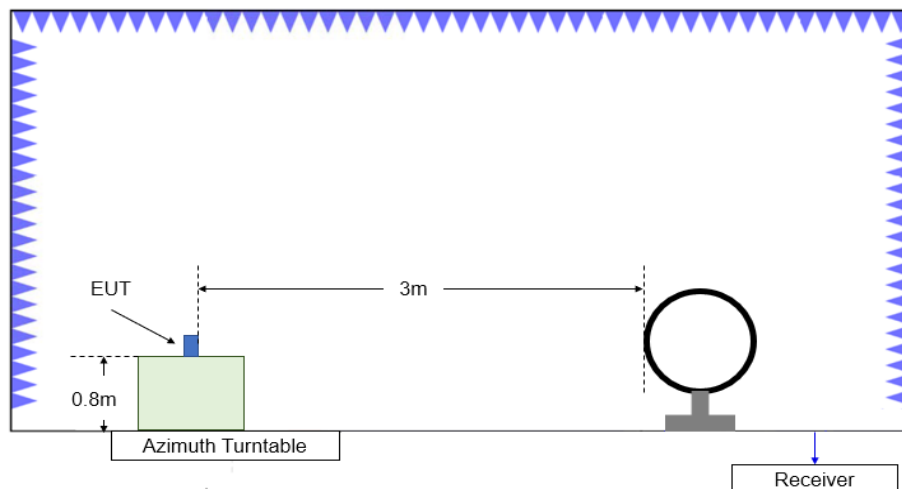


Figure B.5.1. Test Site Diagram (9kHz-30MHz)

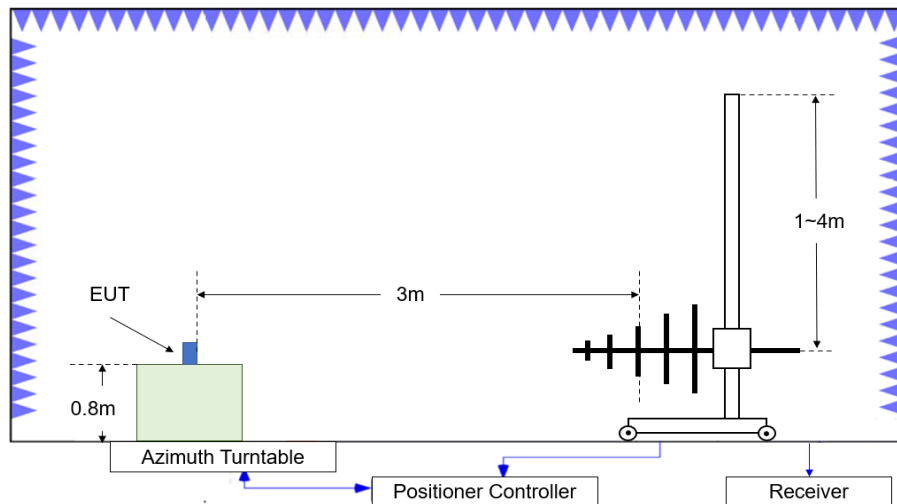


Figure B.5.2. Test Site Diagram (30MHz-1GHz)

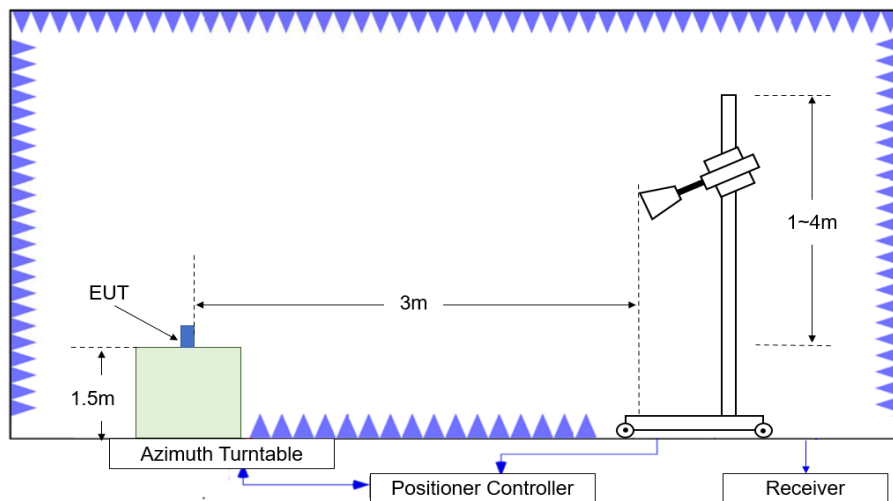


Figure B.5.3. Test Site Diagram (1GHz-40GHz)

Test Procedures

Radiated unwanted emissions from the EUT were measured according to ANSI C63.10-2013 (ANSI C63.10-2020).

Test setting

Frequency of emission (MHz)	RBW/VBW	Sweep Time(s)
30-1000	100kHz/300kHz	5
1000-3000	1MHz/3MHz	15
3000-18000	1MHz/3MHz	40
18000-26500	1MHz/3MHz	20

Sample Calculation

A "reference path loss" is established and the A_{Rpl} is the attenuation of "reference path loss", and including the gain of receive antenna, 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:

$$\text{Result} = P_{\text{Mea}} + A_{\text{Rpl}} = P_{\text{Mea}} + \text{Cable Loss} + \text{Antenna Factor}$$

Test note

1. Investigation has been done on all modes and modulations/data rates. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.
2. Spurious emissions for all channels were investigated and almost the same below 1GHz. According to FCC 47 CFR §15.31, emission levels are not report much lower than the limit by over 20dB
3. Measurement frequencies were performed from 9 kHz to the 10th harmonic of highest fundamental frequency or 40GHz, whichever is lower.

Test Result

Radiated Spurious Emission

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)
16935.500	47.91	-29.70	40.60	37.01	74.00	26.09	V
14098.000	45.85	-30.20	41.70	34.35	74.00	28.15	V
4803.500	44.31	-37.70	33.00	49.01	74.00	29.69	V
12532.000	42.84	-31.20	39.20	34.84	74.00	31.16	V
8701.500	41.75	-34.40	37.70	38.45	74.00	32.25	V
2373.900	53.49	-19.70	28.20	44.99	74.00	20.51	H

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)
16949.000	47.78	-29.70	40.60	36.88	74.00	26.22	H
14058.000	45.07	-31.10	41.60	34.57	74.00	28.93	H
12857.000	43.64	-31.90	39.90	35.64	74.00	30.36	H
4881.500	43.35	-37.50	33.40	47.45	74.00	30.65	V
9490.000	43.10	-34.60	37.70	40.00	74.00	30.90	V
7911.000	41.11	-35.20	36.70	39.61	74.00	32.89	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)
17377.000	47.58	-29.50	43.80	33.28	74.00	26.42	H
13016.000	45.45	-31.90	40.10	37.25	74.00	28.55	H
12345.000	44.17	-32.30	39.00	37.57	74.00	29.83	H
8698.000	42.88	-34.40	37.70	39.58	74.00	31.12	H
7232.500	42.35	-35.60	36.40	41.55	74.00	31.65	H
2483.800	53.59	-19.70	28.20	45.09	74.00	20.41	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)
17137.000	48.15	-29.30	41.70	35.75	74.00	25.85	H
13934.000	45.21	-30.60	41.40	34.41	74.00	28.79	H
4803.500	43.41	-37.70	33.00	48.11	74.00	30.59	V
12993.000	43.19	-31.90	40.10	34.99	74.00	30.81	V
9297.000	42.24	-34.50	37.60	39.14	74.00	31.76	H
2336.300	52.64	-19.60	28.20	44.04	74.00	21.36	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)
17328.000	47.43	-28.60	43.40	32.63	74.00	26.57	V
14081.500	45.07	-30.20	41.70	33.57	74.00	28.93	V
10607.500	43.82	-33.50	38.30	39.02	74.00	30.18	H
4882.000	43.39	-37.50	33.40	47.49	74.00	30.61	H
9513.500	42.86	-33.80	37.60	39.06	74.00	31.14	V
7299.000	41.78	-35.40	36.60	40.58	74.00	32.22	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)
16940.500	47.61	-29.70	40.60	36.71	74.00	26.39	H
13888.500	45.60	-31.10	41.30	35.40	74.00	28.40	H
11871.500	44.32	-32.80	39.10	37.92	74.00	29.68	H
9395.000	42.80	-34.10	37.90	39.00	74.00	31.20	H
4959.500	42.37	-37.40	33.60	46.17	74.00	31.63	V
2485.500	53.11	-19.70	28.20	44.61	74.00	20.89	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)
17039.500	47.80	-29.40	41.10	36.10	74.00	26.20	H
13942.000	44.96	-30.60	41.40	34.16	74.00	29.04	V
4803.500	44.32	-37.70	33.00	49.02	74.00	29.68	H
10727.000	44.12	-33.70	38.40	39.42	74.00	29.88	H
8367.000	42.09	-34.40	37.30	39.19	74.00	31.91	H
2338.800	52.81	-19.60	28.20	44.21	74.00	21.19	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)
16906.000	48.15	-29.30	40.30	37.15	74.00	25.85	H
13268.000	44.91	-31.40	40.60	35.71	74.00	29.09	V
12409.500	43.48	-31.90	38.90	36.48	74.00	30.52	H
9312.500	42.70	-34.10	37.80	39.00	74.00	31.30	H
7306.500	42.13	-35.40	36.60	40.93	74.00	31.87	H
4882.000	42.09	-37.50	33.40	46.19	74.00	31.91	H

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)
16945.500	47.82	-29.70	40.60	36.92	74.00	26.18	V
13529.000	45.11	-31.50	40.80	35.81	74.00	28.89	H
11418.000	44.82	-32.60	39.00	38.42	74.00	29.18	V
7421.000	43.04	-35.10	36.60	41.54	74.00	30.96	V
8991.500	42.84	-34.70	37.70	39.84	74.00	31.16	V
2497.900	54.05	-19.70	28.20	45.55	74.00	19.95	V

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)
4803.500	42.07	-37.70	33.00	46.77	54.00	11.93	V
16954.000	38.67	-29.70	40.60	27.77	54.00	15.33	V
13925.000	36.46	-30.60	41.40	25.66	54.00	17.54	H
6005.000	35.96	-36.80	34.50	38.26	54.00	18.04	H
12543.000	34.71	-31.20	39.20	26.71	54.00	19.29	V
2368.900	41.27	-19.70	28.20	32.77	54.00	12.73	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	39.29	-37.50	33.40	43.39	54.00	14.71	V
17050.000	38.95	-29.40	41.10	27.25	54.00	15.05	V
14333.000	36.17	-30.40	41.90	24.67	54.00	17.83	H
6102.500	34.67	-37.00	34.50	37.17	54.00	19.33	V
11509.000	34.42	-32.80	39.10	28.12	54.00	19.58	V
9507.000	33.63	-33.80	37.60	29.83	54.00	20.37	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	40.12	-37.40	33.60	43.92	54.00	13.88	H
17346.500	38.73	-28.60	43.40	23.93	54.00	15.27	H
13844.000	36.00	-30.00	41.20	24.70	54.00	18.00	H
11916.000	35.00	-32.40	39.10	28.30	54.00	19.00	H
6002.500	34.48	-36.80	34.50	36.78	54.00	19.52	V
2486.400	41.46	-19.70	28.20	32.96	54.00	12.54	H

$\pi/4$ 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)
4803.500	41.45	-37.70	33.00	46.15	54.00	12.55	V
17136.000	38.81	-29.30	41.70	26.41	54.00	15.19	V
13949.500	36.02	-30.60	41.40	25.22	54.00	17.98	V
6005.000	35.12	-36.80	34.50	37.42	54.00	18.88	H
11382.500	34.18	-33.40	38.90	28.78	54.00	19.82	H
2345.900	41.16	-19.60	28.20	32.56	54.00	12.84	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)
4882.000	40.95	-37.50	33.40	45.05	54.00	13.05	H
17042.500	38.69	-29.40	41.10	26.99	54.00	15.31	H
13948.000	36.08	-30.60	41.40	25.28	54.00	17.92	V
12925.500	34.98	-31.40	40.00	26.38	54.00	19.02	H
6102.500	33.86	-37.00	34.50	36.36	54.00	20.14	V
8459.500	33.72	-35.10	37.40	31.42	54.00	20.28	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)
16966.500	38.56	-29.70	40.60	27.66	54.00	15.44	V
4960.000	38.54	-37.40	33.60	42.34	54.00	15.46	H
13970.500	36.70	-30.60	41.50	25.80	54.00	17.30	H
11371.500	34.75	-33.40	38.90	29.35	54.00	19.25	V
9399.500	34.11	-34.10	37.90	30.31	54.00	19.89	H
2490.500	41.40	-19.70	28.20	32.90	54.00	12.60	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)
4803.500	42.45	-37.70	33.00	47.15	54.00	11.55	H
17025.000	38.55	-29.30	40.90	27.05	54.00	15.45	V
13920.000	36.62	-30.60	41.40	25.82	54.00	17.38	V
6005.000	35.10	-36.80	34.50	37.40	54.00	18.90	H
11394.000	34.70	-32.60	39.00	28.30	54.00	19.30	V
2352.300	41.10	-19.60	28.20	32.50	54.00	12.90	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	38.83	-37.50	33.40	42.93	54.00	15.17	H
17039.500	38.75	-29.40	41.10	27.05	54.00	15.25	H
13906.000	36.39	-31.10	41.30	26.19	54.00	17.61	V
12770.500	34.83	-31.80	39.60	26.93	54.00	19.17	V
6102.500	34.58	-37.00	34.50	37.08	54.00	19.42	H
8695.500	34.42	-34.40	37.70	31.12	54.00	19.58	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)
16930.500	39.11	-29.30	40.30	28.11	54.00	14.89	H
4960.000	38.52	-37.40	33.60	42.32	54.00	15.48	H
13950.000	36.89	-30.60	41.40	26.09	54.00	17.11	V
12843.500	35.16	-31.90	39.90	27.16	54.00	18.84	H
9447.500	34.33	-33.60	37.90	30.03	54.00	19.67	V
2489.900	41.70	-19.70	28.20	33.20	54.00	12.30	V

Conclusion: Pass

Note: the spurious emission above 18G is noise only and did not show on the report.

Band edge compliance

Mode	Channel	Frequency Range	Test Results	Conclusion
GFSK	0	2.31GHz ~2.43GHz	Fig.58	P
	78	2.45GHz ~2.5GHz	Fig.59	P

Mode	Channel	Frequency Range	Test Results	Conclusion
$\pi/4$ DQPSK	0	2.31GHz ~2.43GHz	Fig.60	P
	78	2.45GHz ~2.5GHz	Fig.61	P

Mode	Channel	Frequency Range	Test Results	Conclusion
8DPSK	0	2.31GHz ~2.43GHz	Fig.62	P
	78	2.45GHz ~2.5GHz	Fig.63	P

Conclusion: PASS

Test graphs as below

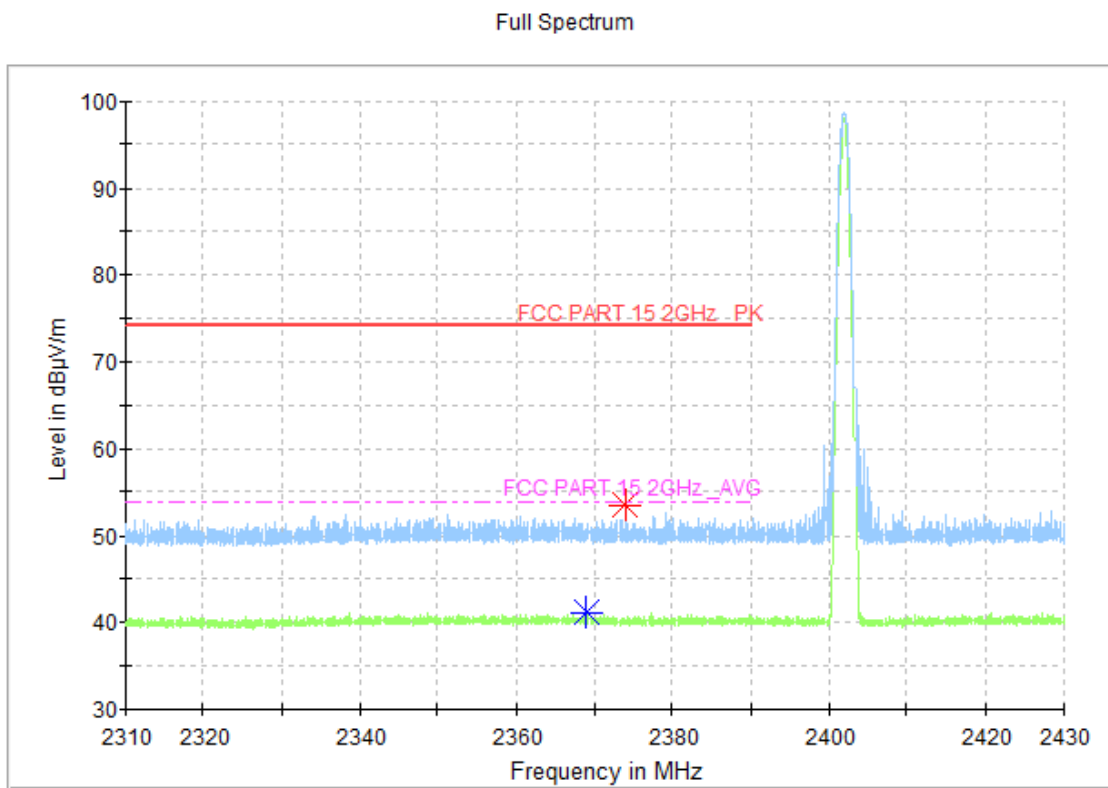


Fig.58. Frequency Band Edges: GFSK, Channel 0, Hopping Off, 2.31 GHz – 2.45GHz

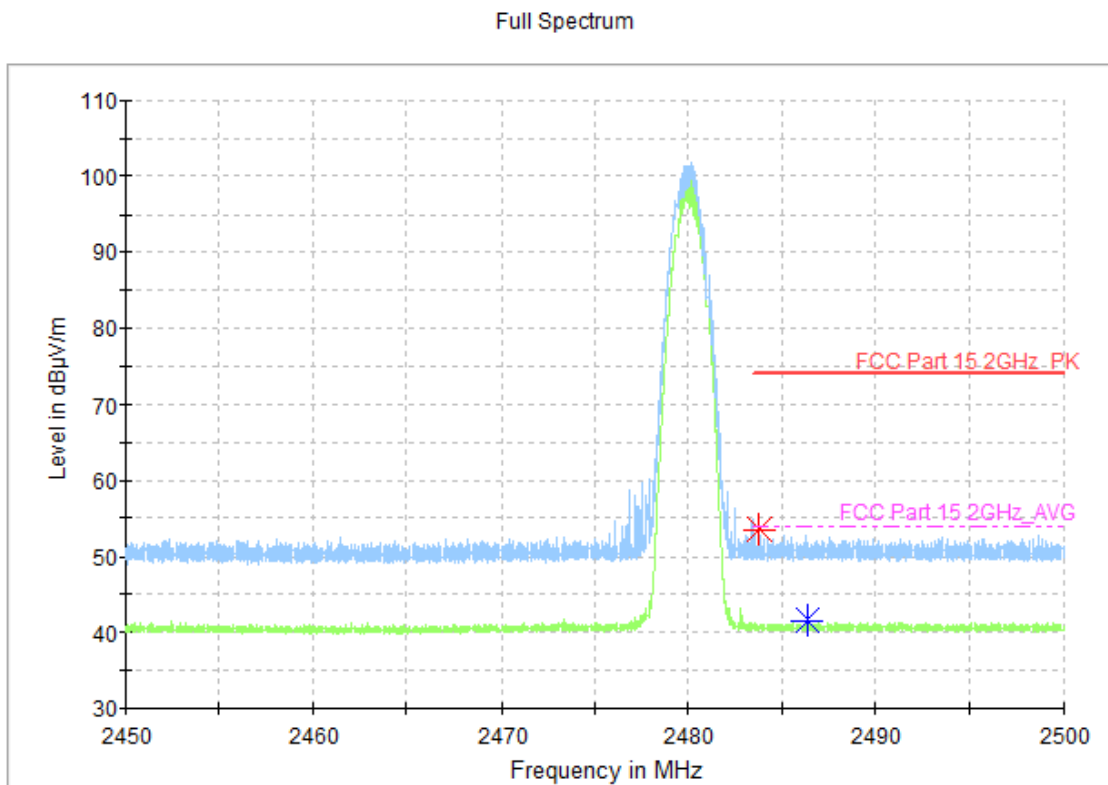


Fig.59. Frequency Band Edges: GFSK, Channel 78, Hopping Off, ch11, 2.45 GHz - 2.50GHz

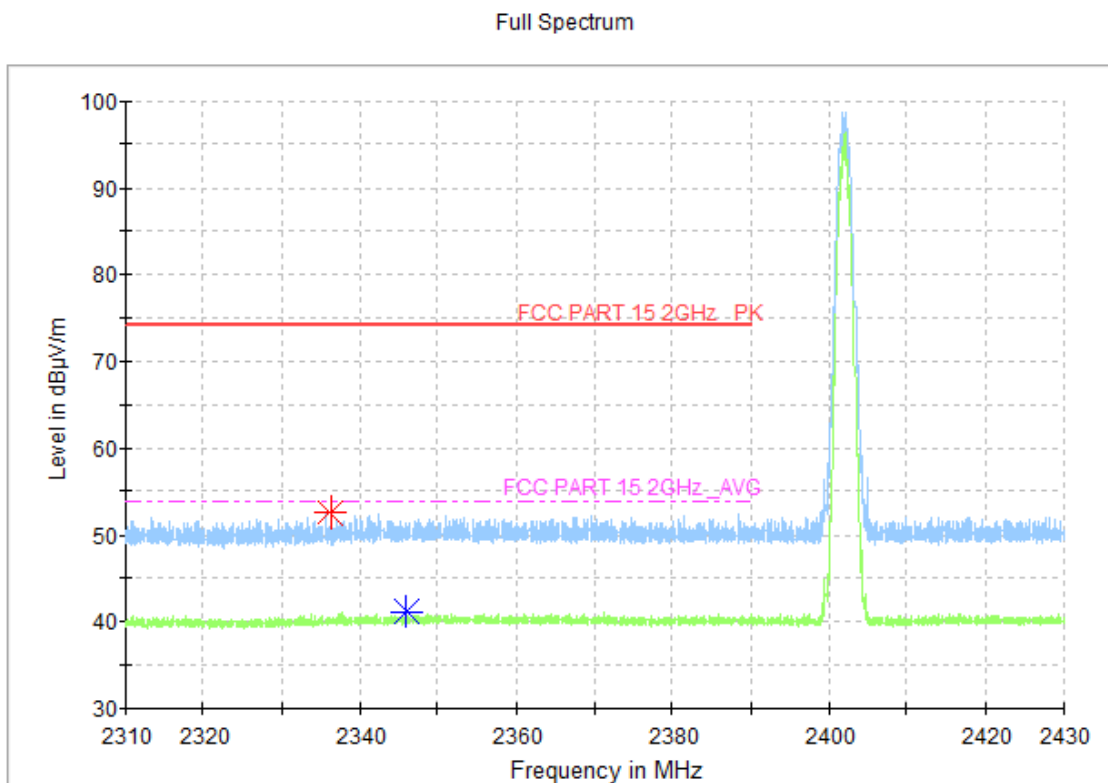


Fig.60. Frequency Band Edges: $\pi/4$ DQPSK, Channel 0, Hopping Off, 2.31 GHz - 2.45GHz

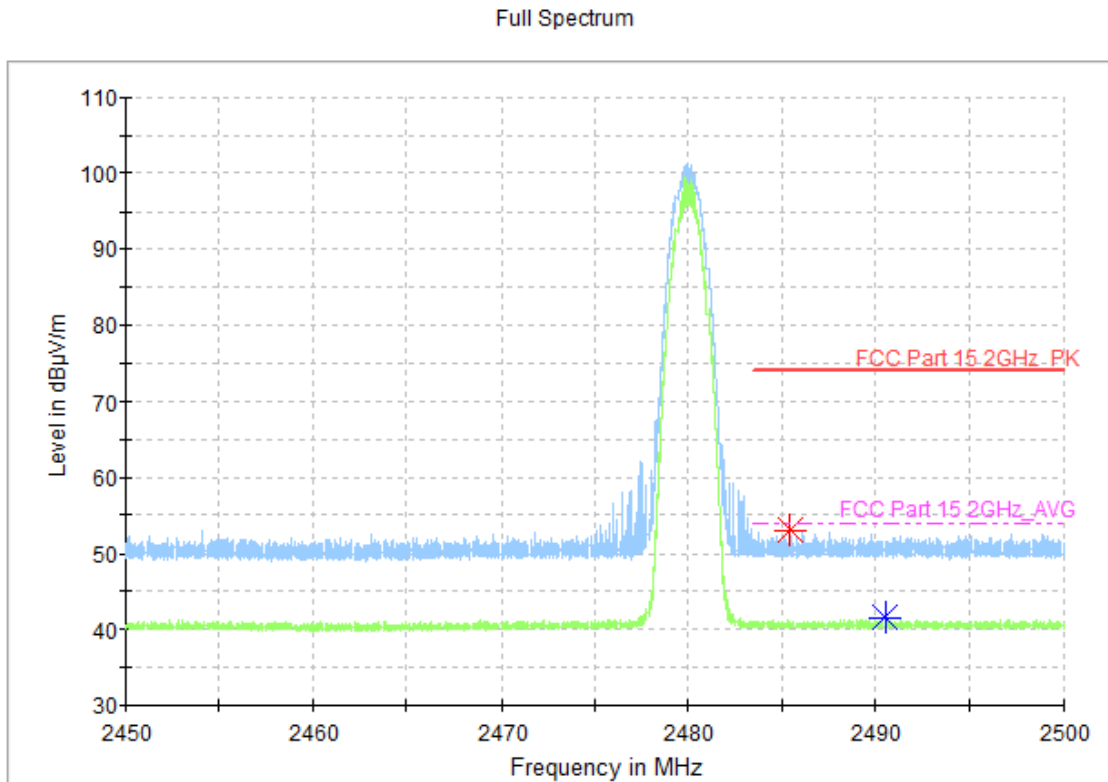


Fig.61. Frequency Band Edges: $\pi/4$ DQPSK, Channel 78, Hopping Off, 2.45 GHz - 2.50GHz

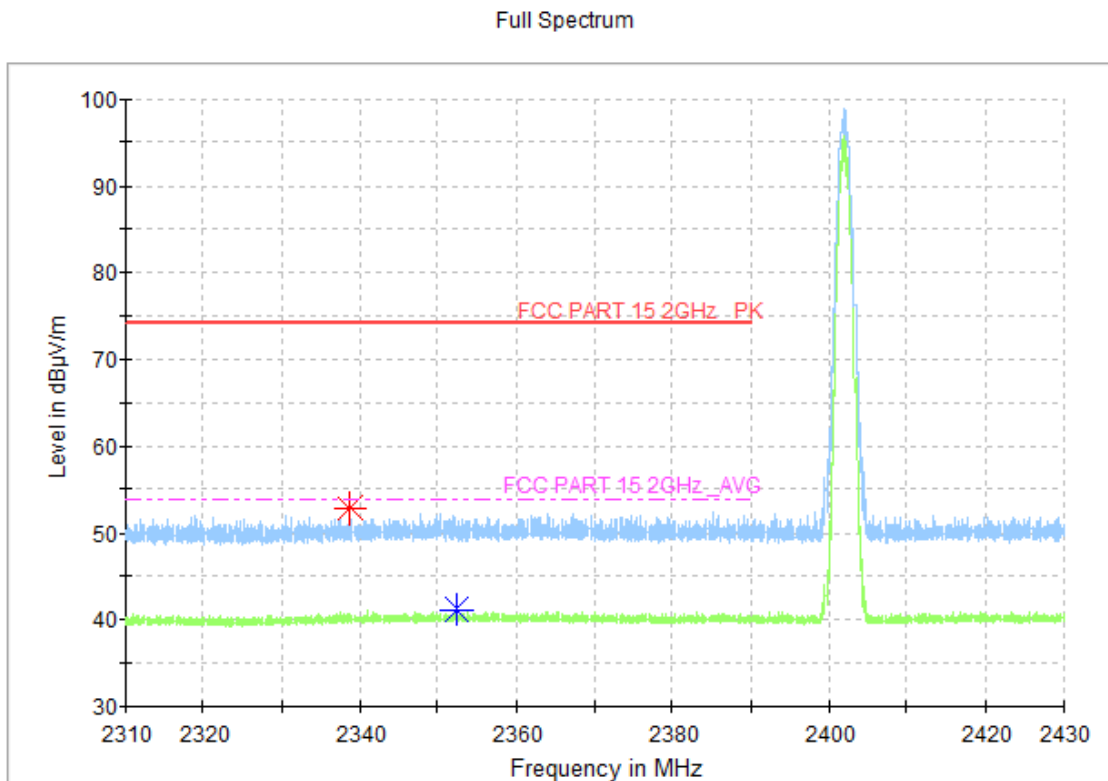


Fig.62. Frequency Band Edges: 8DPSK, Channel 0, 2.31 GHz - 2.45GHz

Full Spectrum

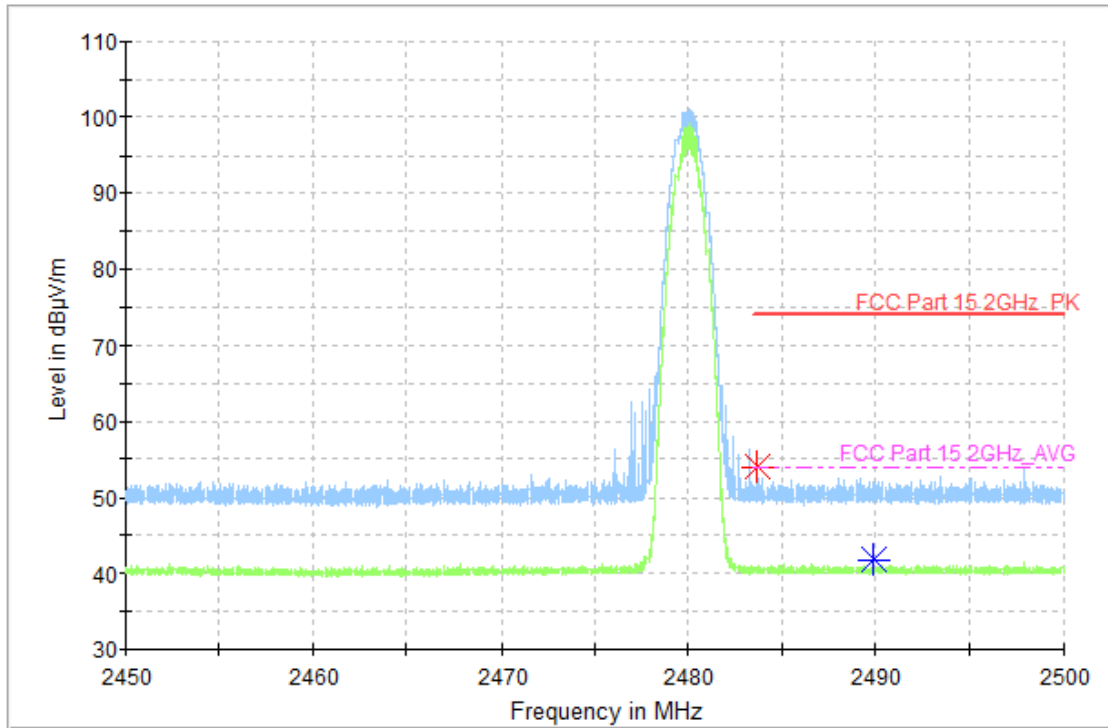


Fig.63. Frequency Band Edges: 8DPSK, Channel 78, 2.45 GHz - 2.50GHz

B.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	Pulse time (ms)		Number of Transmissions		Dwell Time (ms)	Conclusion
		Fig.	Value	Fig.	Value		
39	DH1	Fig.64	0.38	Fig.65	320	121.6	P
	DH3	Fig.66	1.63	Fig.67	105	171.15	P
	DH5	Fig.68	2.88	Fig.69	71	204.48	P

For $\pi/4$ DQPSK

Channel	Packet	Pulse time (ms)		Number of Transmissions		Dwell Time (ms)	Conclusion
		Fig.	Value	Fig.	Value		
39	2DH1	Fig.70	0.38	Fig.71	317	120.46	P
	2DH3	Fig.72	1.64	Fig.73	110	180.4	P
	2DH5	Fig.74	2.89	Fig.75	72	208.08	P

For 8DPSK

Channel	Packet	Pulse time (ms)		Number of Transmissions		Dwell Time (ms)	Conclusion
		Fig.	ms	Fig.	Count		
39	3DH1	Fig.76	0.38	Fig.77	319	121.22	P
	3DH3	Fig.78	1.63	Fig.79	103	167.89	P
	3DH5	Fig.80	2.89	Fig.81	55	158.95	P

Conclusion: PASS

Test graphs as below:

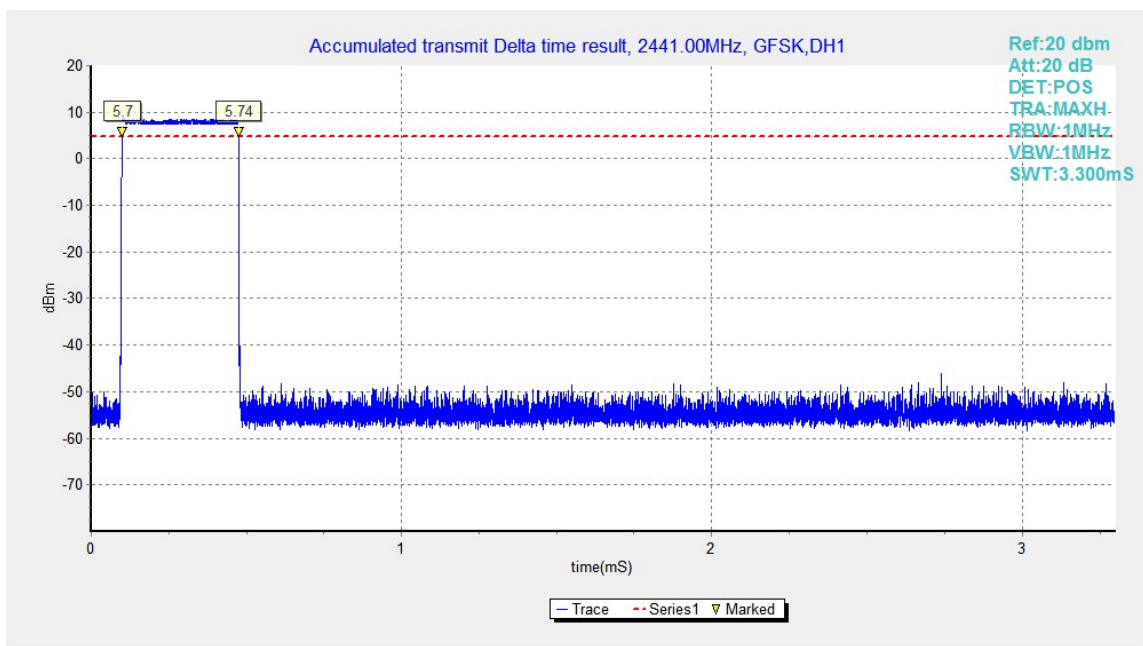


Fig.64. Time of occupancy (Dwell Time): Channel 39, Packet DH1

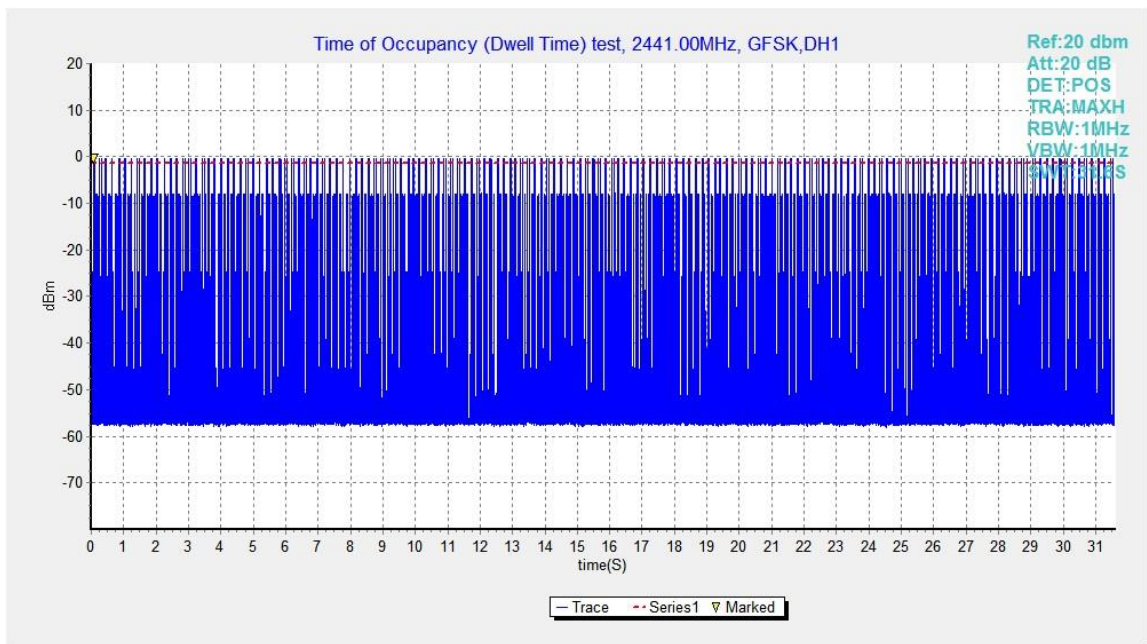


Fig.65. Number of Transmissions Measurement: Channel 39,Packet DH1

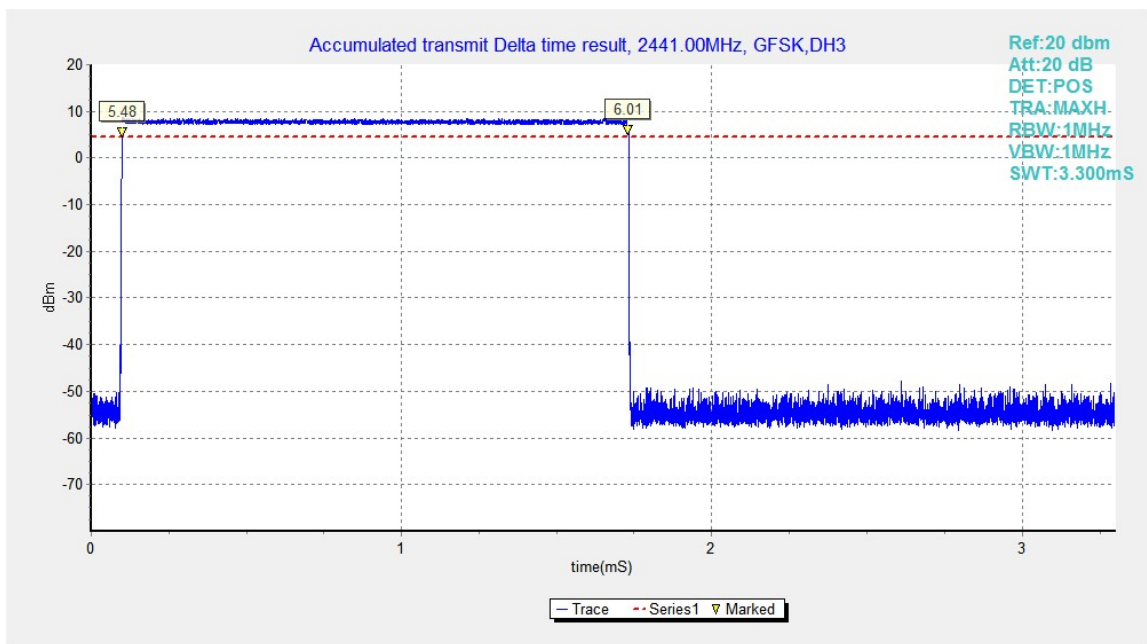


Fig.66. Time of occupancy (Dwell Time): Channel 39, Packet DH3

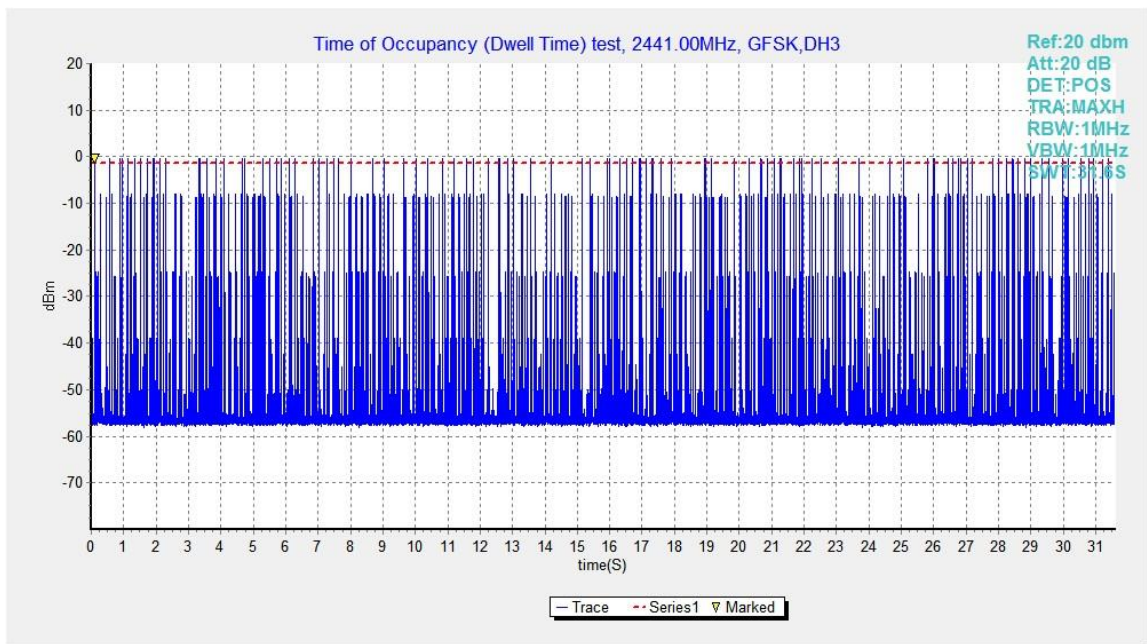


Fig.67. Number of Transmissions Measurement: Channel 39,Packet DH3

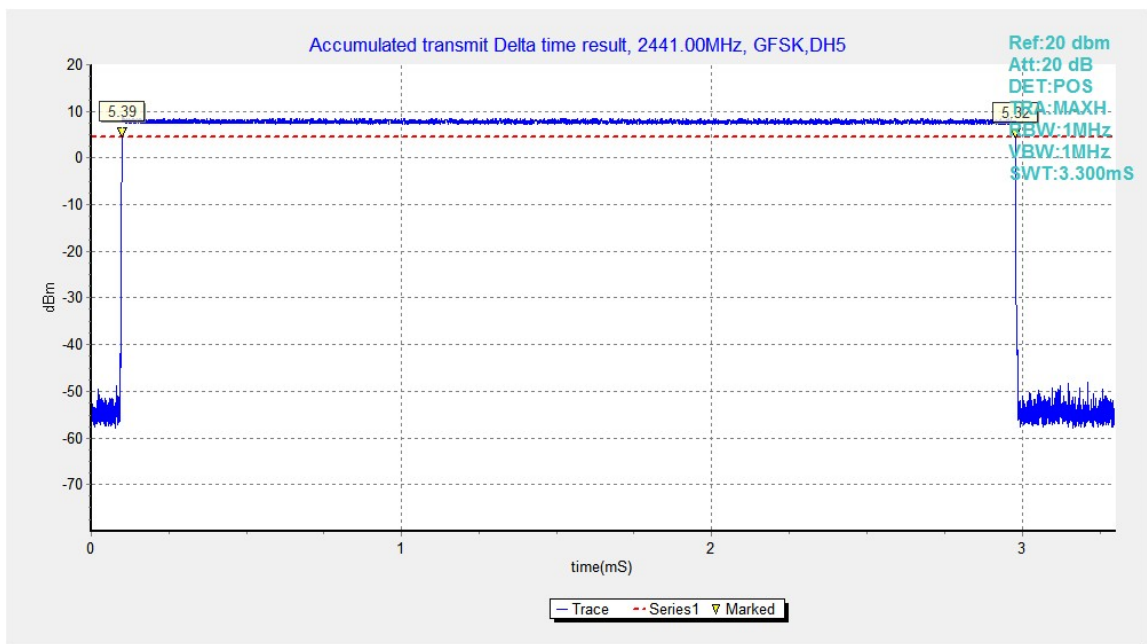


Fig.68. Time of occupancy (Dwell Time): Channel 39, Packet DH5

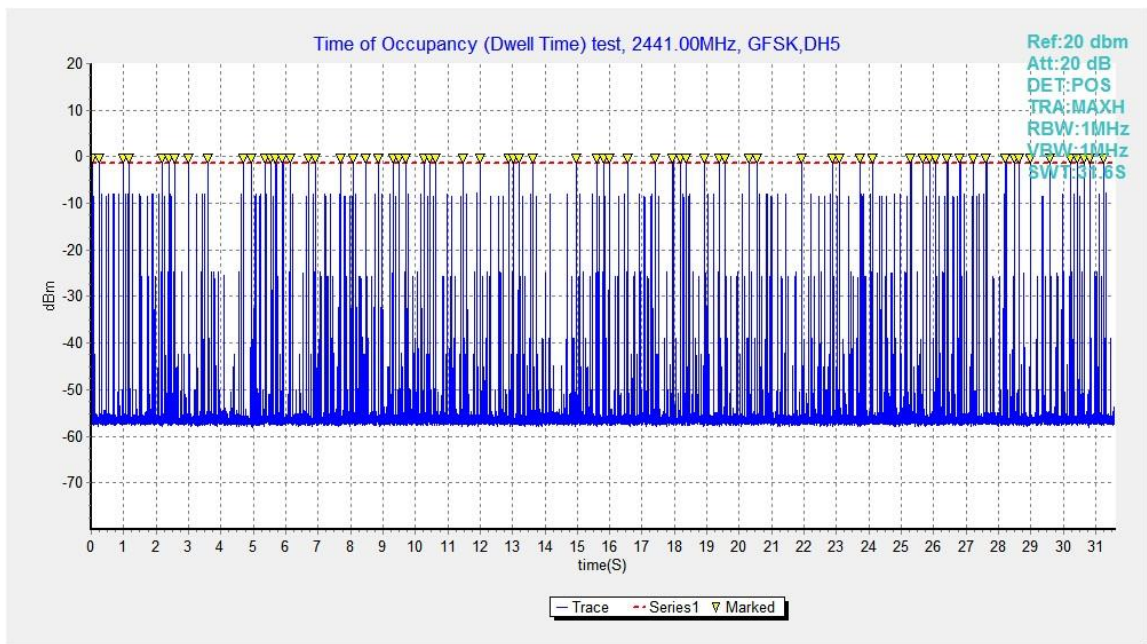


Fig.69. Number of Transmissions Measurement: Channel 39,Packet DH5

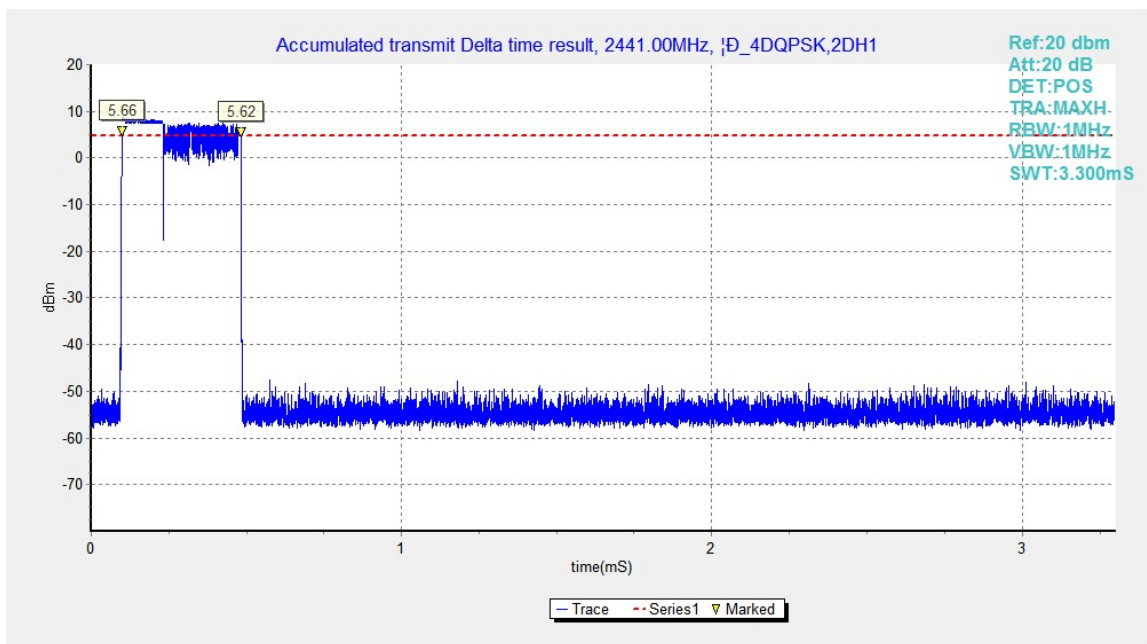


Fig.70. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH1

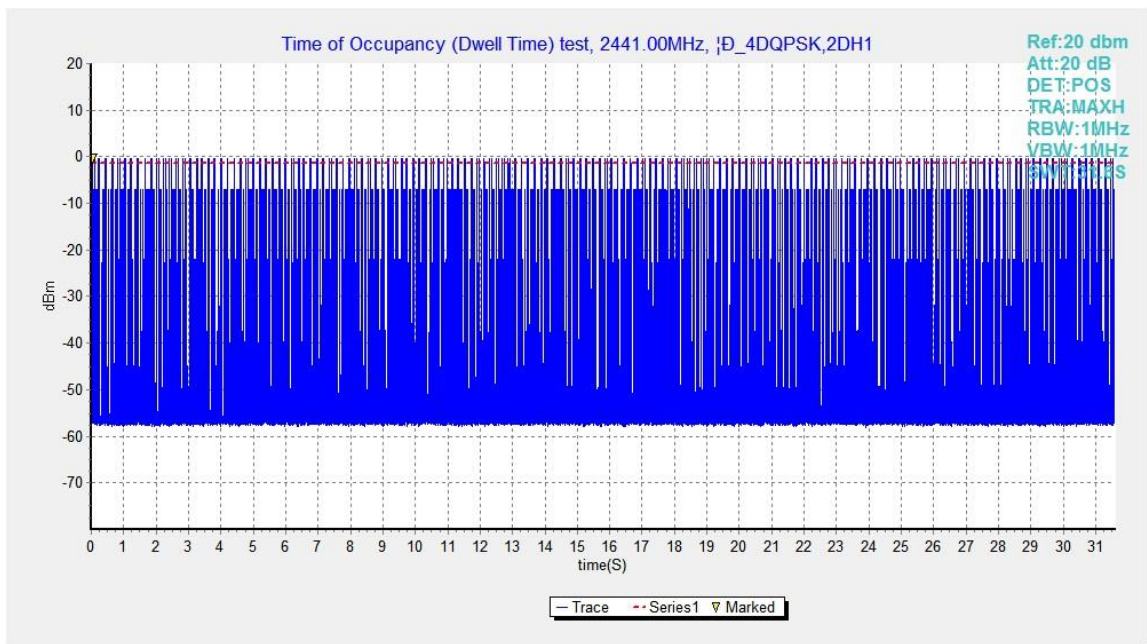


Fig.71. Number of Transmissions Measurement: Channel 39,Packet 2-DH1

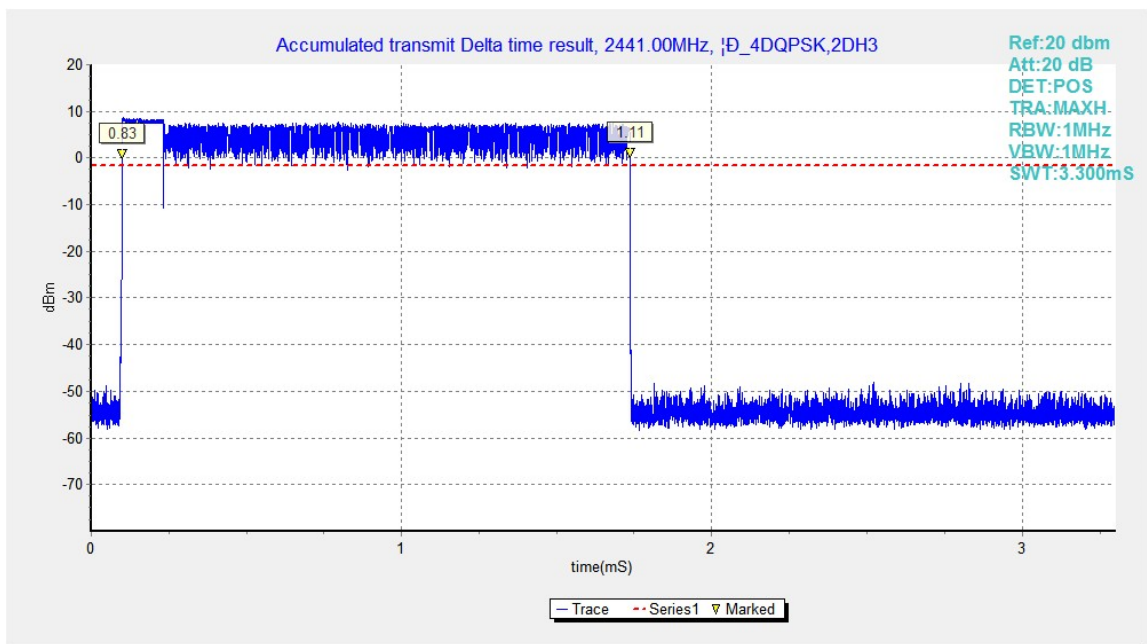


Fig.72. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH3

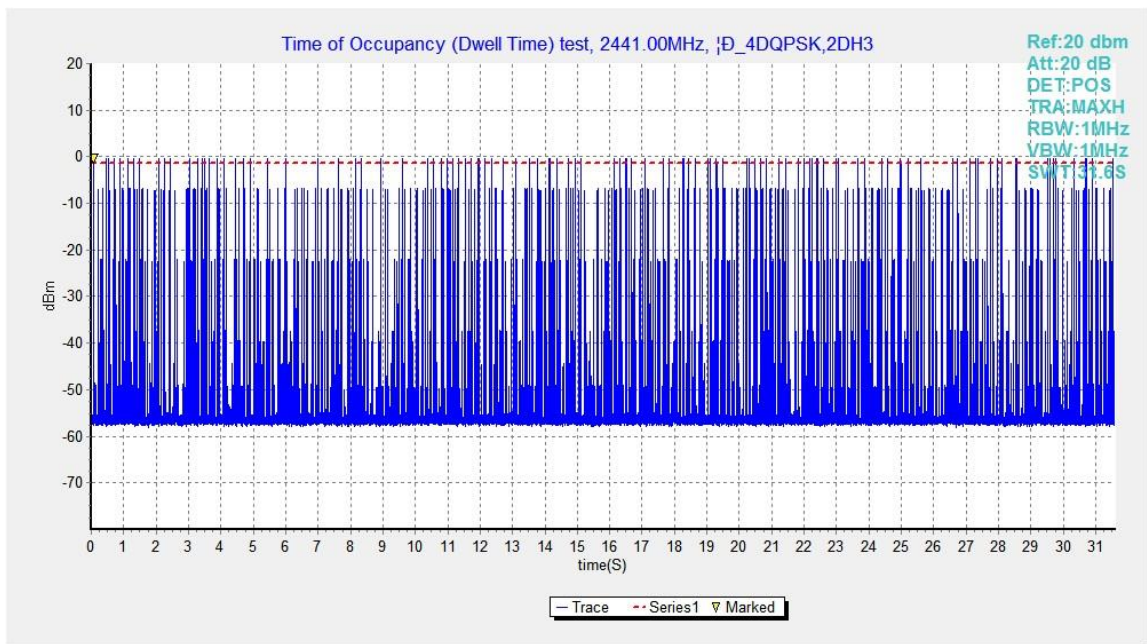


Fig.73. Number of Transmissions Measurement: Channel 39,Packet 2-DH3

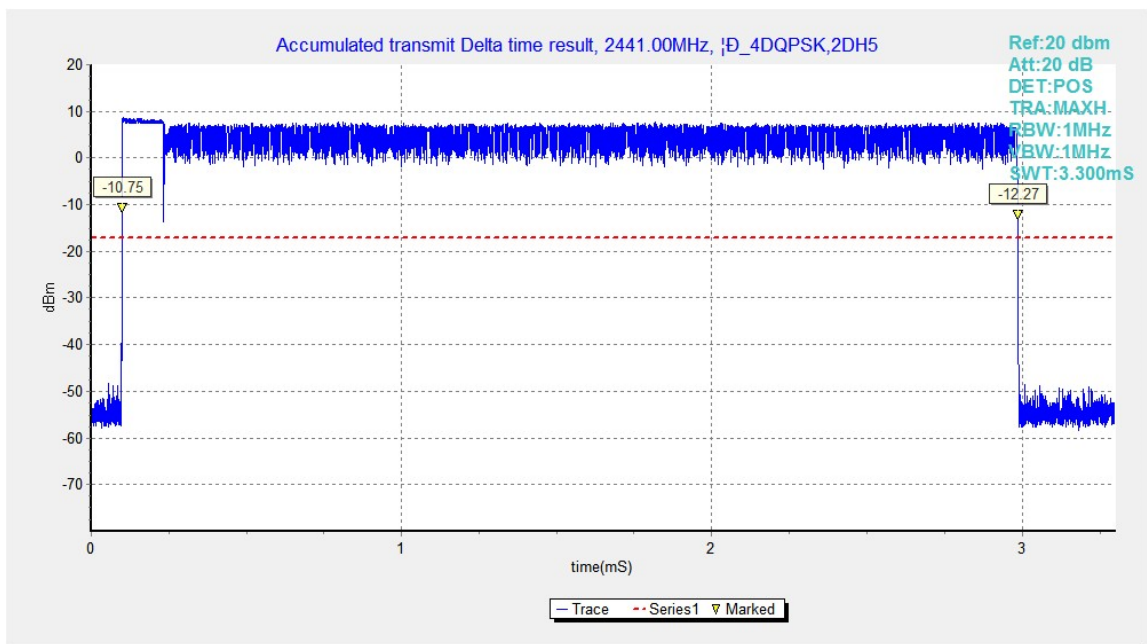


Fig.74. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH5

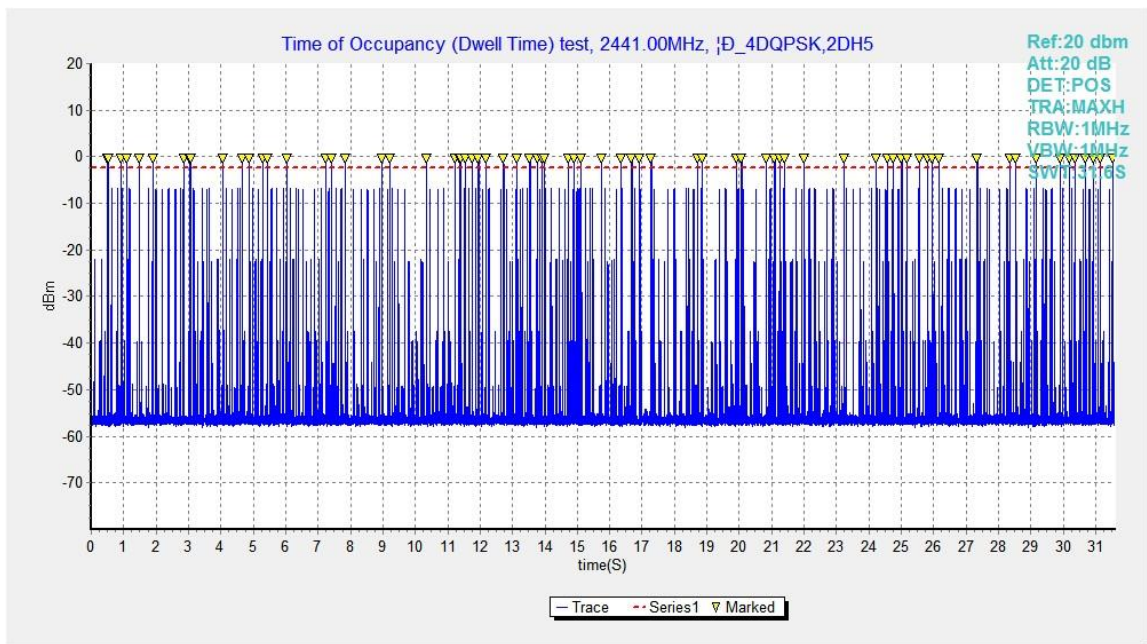


Fig.75. Number of Transmissions Measurement: Channel 39,Packet 2-DH5

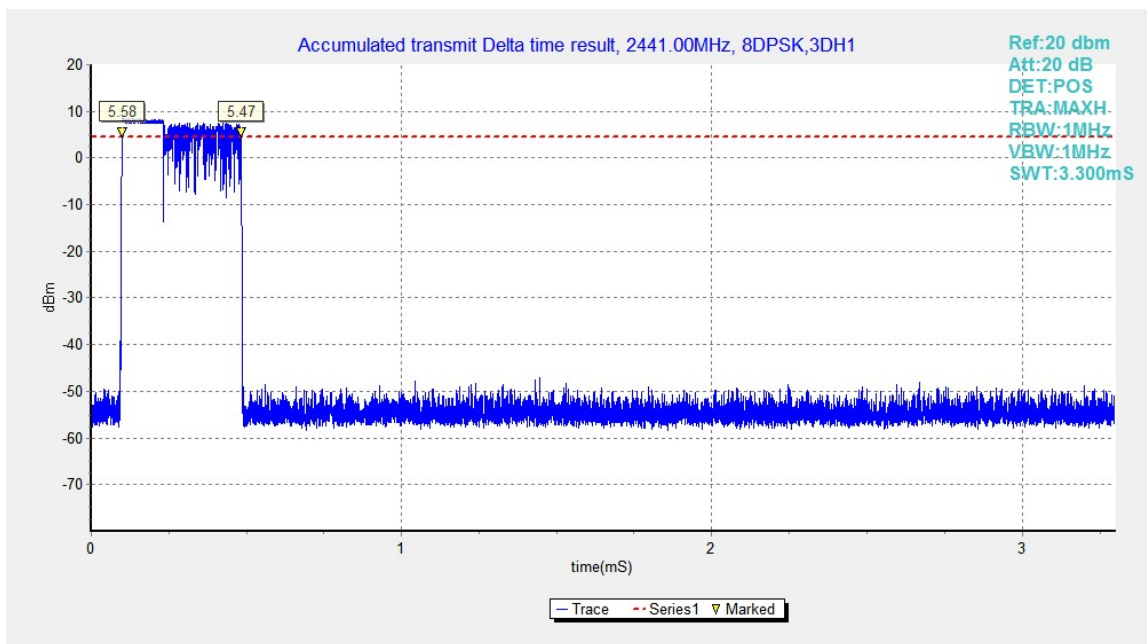


Fig.76. Time of occupancy (Dwell Time): Channel 39, Packet 3-DH1