

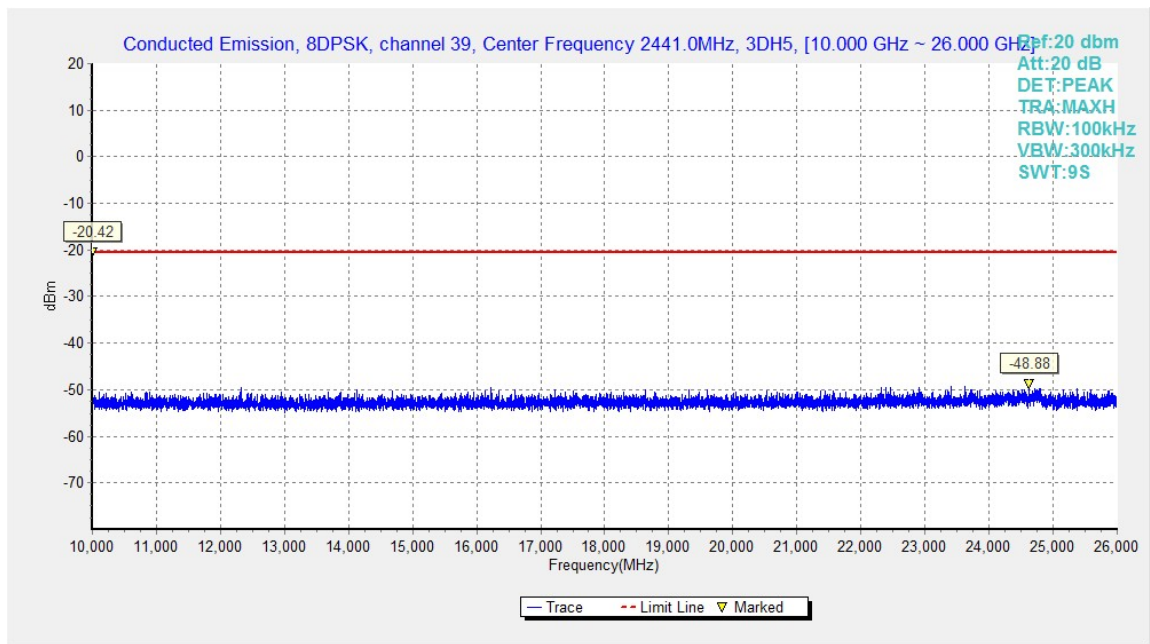


Fig.61. Conducted spurious emission: 8DPSK, Channel 39, 10GHz – 26GHz

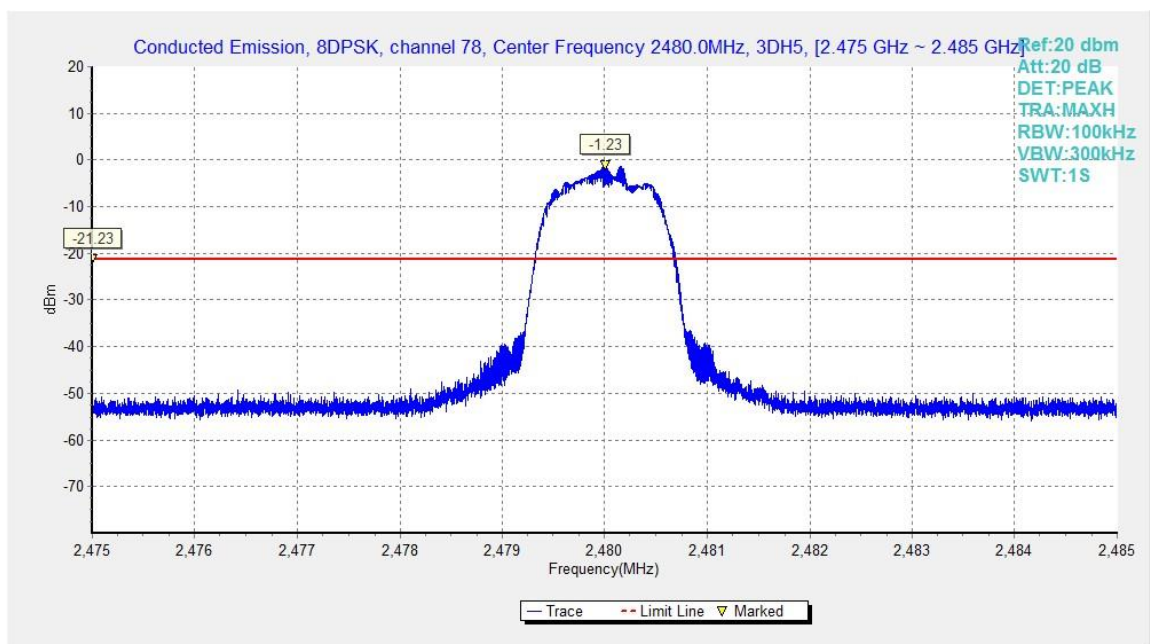


Fig.62. Conducted spurious emission: 8DPSK, Channel 78, 2480MHz

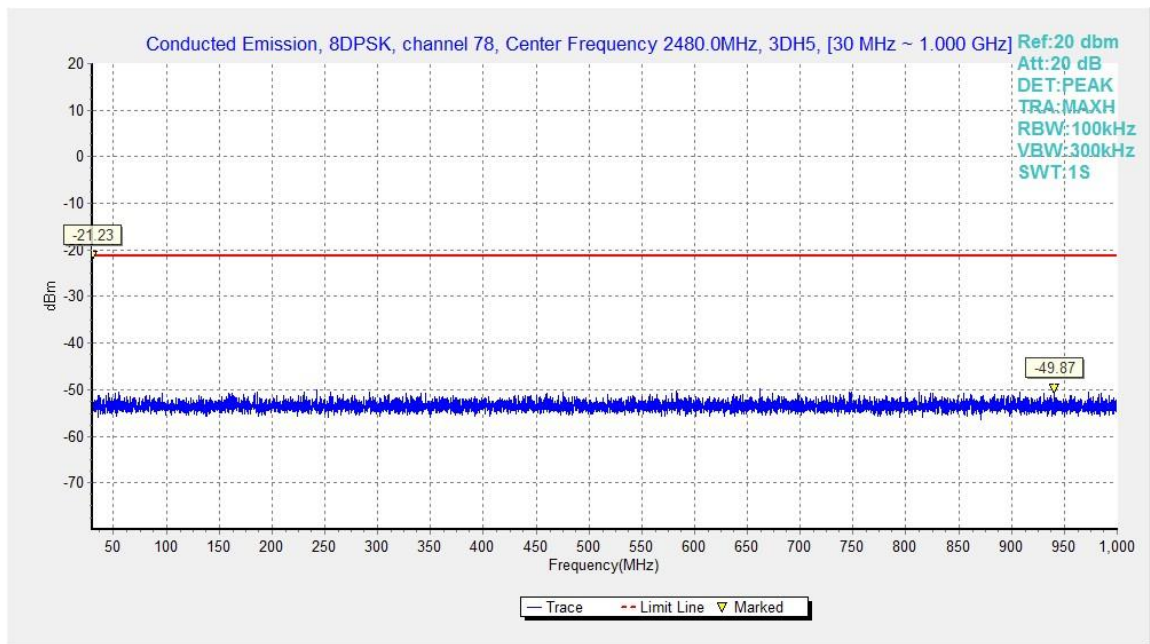


Fig.63. Conducted spurious emission: 8DPSK, Channel 78, 30MHz - 1GHz

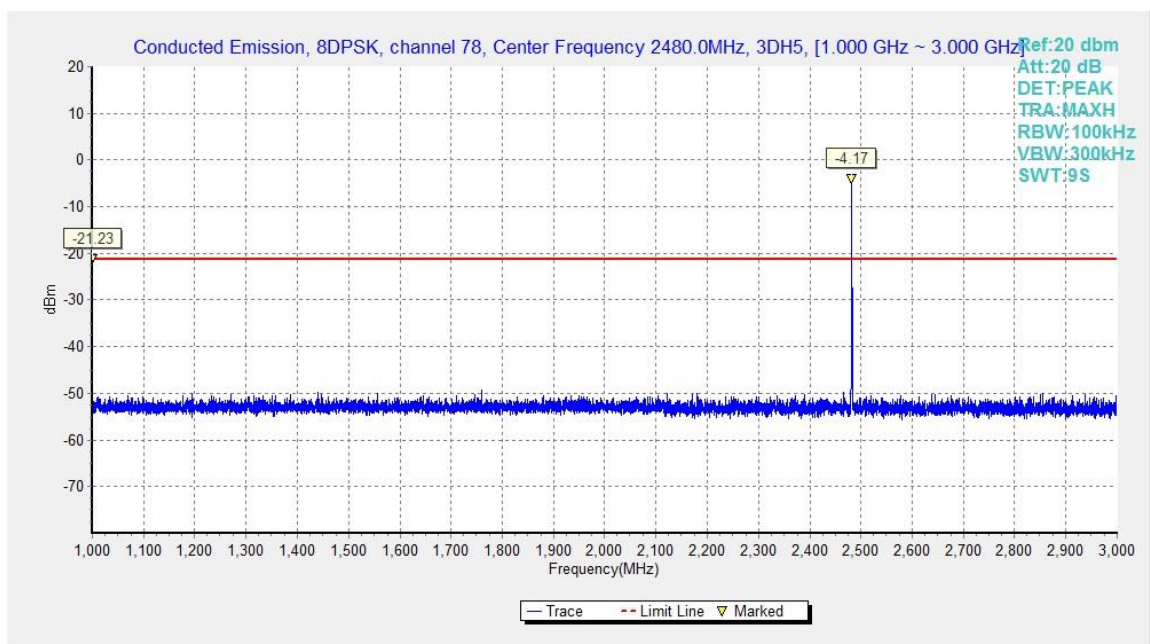


Fig.64. Conducted spurious emission: 8DPSK, Channel 78, 1GHz - 3GHz

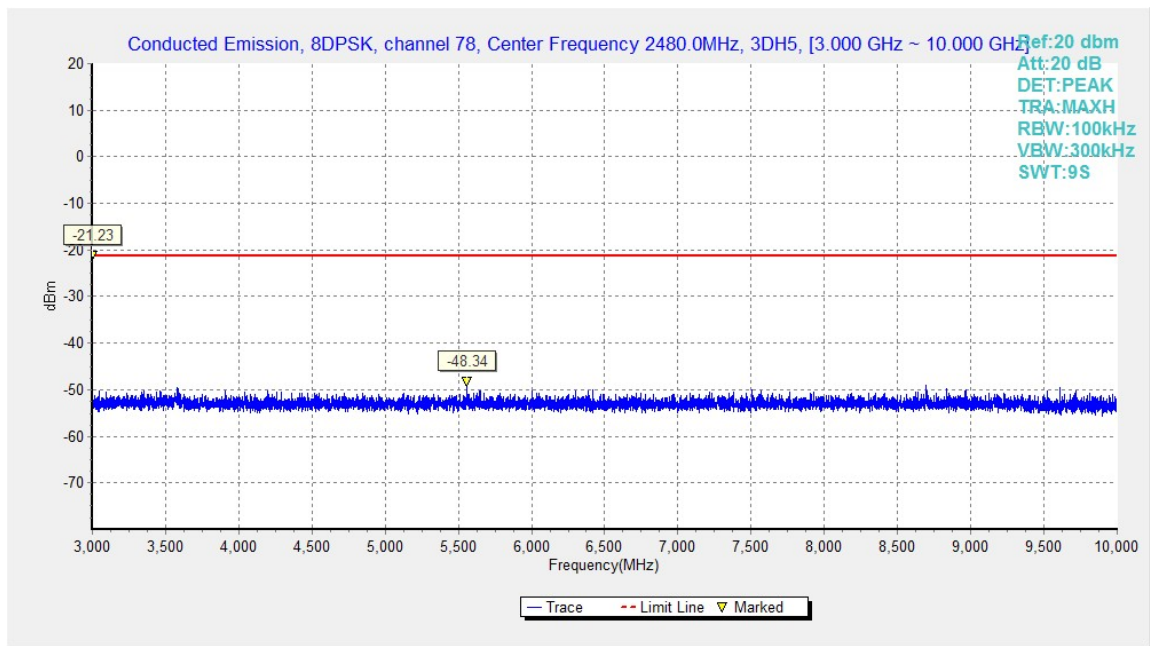


Fig.65. Conducted spurious emission: 8DPSK, Channel 78, 3GHz - 10GHz

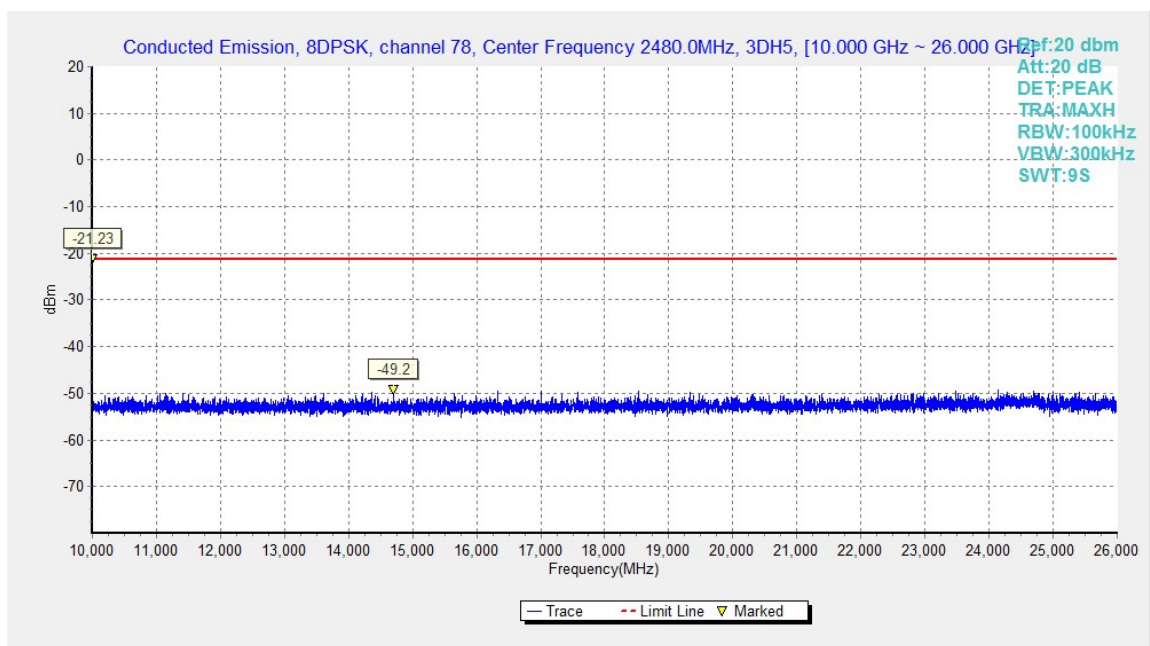


Fig.66. Conducted spurious emission: 8DPSK, Channel 78, 10GHz - 26GHz

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($\mu\text{V/m}$)	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 ($\mu\text{V/m}$)	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

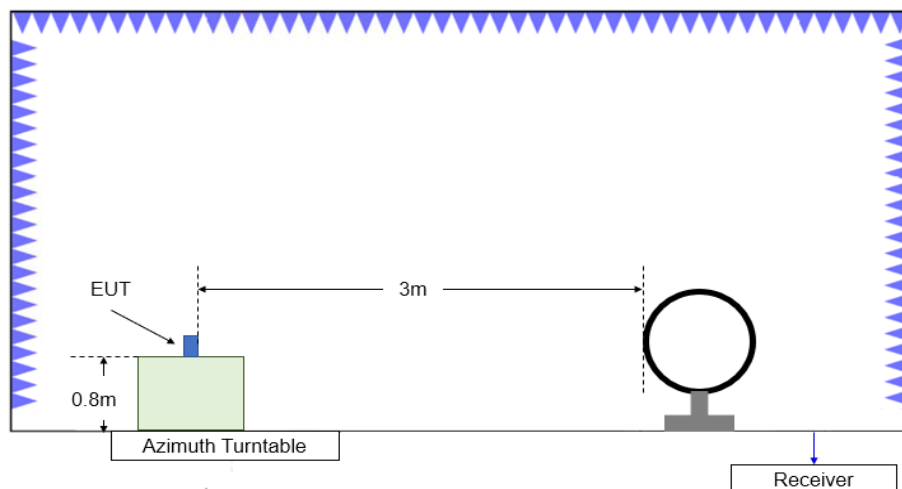


Figure B.5.1. Test Site Diagram (9kHz-30MHz)

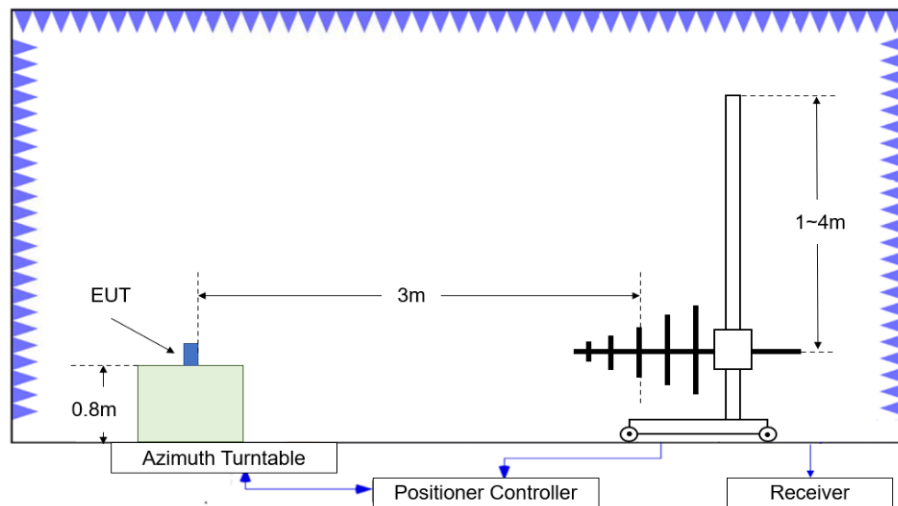


Figure B.5.2. Test Site Diagram (30MHz-1GHz)

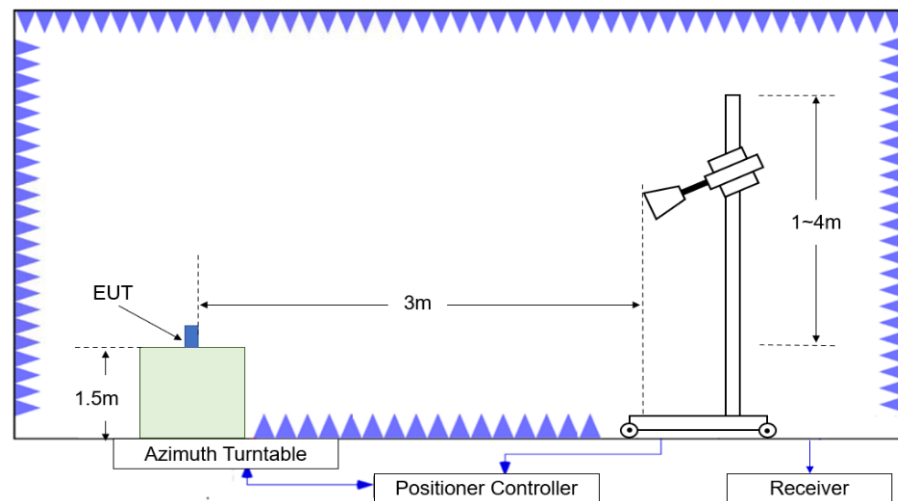


Figure B.5.3. Test Site Diagram (1GHz-40GHz)

Test Procedures

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

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:

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

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

EUT ID: EUT1

Average Measurement results

GFSK Ch 0

Frequency (MHz)	Measurement Result (dBμV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Antenna Pol. (H/V)
17950	47.18	-25.4	42.3	30.28	54	6.82	H
13796.5	42.44	-29.1	40.9	30.64	54	11.56	V
12966.5	40.11	-29.8	39.7	30.21	54	13.89	H
8877.5	37.69	-33.6	37.7	33.59	54	16.31	H
7522	36.64	-34.6	37.5	33.74	54	17.36	V
2370.2	44.34	-19.2	27.3	36.24	54	9.66	V

GFSK Ch 39

Frequency (MHz)	Measurement Result (dBμV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Antenna Pol. (H/V)
17956.5	47.39	-25.4	42.3	30.49	54	6.61	H
13739	42.45	-29.1	40.7	30.85	54	11.55	V
12780.5	40.13	-30.4	39.6	30.93	54	13.87	V
9661	37.85	-33	37.8	33.05	54	16.15	H
7420	36.58	-34.9	37.5	33.98	54	17.42	V
4933	31.54	-36.9	32.9	35.54	54	22.46	V

GFSK Ch 78

Frequency (MHz)	Measurement Result (dBμV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Antenna Pol. (H/V)
17903.5	46.97	-25.4	42.3	30.07	54	7.03	H
13748.5	42.23	-29.1	40.7	30.63	54	11.77	H
12870.5	39.99	-30.6	39.6	30.99	54	14.01	H
9643.5	37.55	-33	37.9	32.65	54	16.45	V
7514.5	36.81	-34.6	37.5	33.91	54	17.19	V
2494.1	44.92	-19	27.9	36.02	54	9.08	H

$\pi/4$ DQPSK Ch 0

Frequency (MHz)	Measurement Result (dB μ V/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Antenna Pol. (H/V)
17940	47.03	-25.4	42.3	30.13	54	6.97	H
13759.5	42.38	-29.1	40.7	30.78	54	11.62	H
12971	40.16	-29.8	39.8	30.16	54	13.84	H
9129.5	37.78	-33.7	37.8	33.68	54	16.22	V
7215.5	36.56	-34.5	37.4	33.66	54	17.44	V
2374.5	44.05	-19.2	27.3	35.95	54	9.95	V

$\pi/4$ DQPSK Ch 39

Frequency (MHz)	Measurement Result (dB μ V/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Antenna Pol. (H/V)
17924	47.18	-25.4	42.3	30.28	54	6.82	V
14114	42.62	-29.4	40.5	31.52	54	11.38	V
12967.5	40.57	-29.8	39.7	30.67	54	13.43	H
9211.5	37.68	-33.9	38	33.58	54	16.32	H
7420.5	36.88	-34.9	37.5	34.28	54	17.12	V
4944.5	31.86	-36.9	32.9	35.86	54	22.14	H

$\pi/4$ DQPSK Ch 78

Frequency (MHz)	Measurement Result (dB μ V/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Antenna Pol. (H/V)
17943	47.41	-25.4	42.3	30.51	54	6.59	H
14109.5	42.49	-29.4	40.5	31.39	54	11.51	V
12998	39.97	-29.8	39.8	29.97	54	14.03	V
9914.5	37.74	-33.2	38.3	32.64	54	16.26	V
7515	36.73	-34.6	37.5	33.83	54	17.27	V
2498.8	44.98	-19	27.9	36.08	54	9.02	H

8DPSK Ch 0

Frequency (MHz)	Measurement Result (dBμV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Antenna Pol. (H/V)
17932	47.95	-25.4	42.3	31.05	54	6.05	H
13717.5	42.14	-29.1	40.7	30.54	54	11.86	H
12963	40.03	-29.8	39.7	30.13	54	13.97	H
8566	37.7	-33.6	37.6	33.7	54	16.3	V
7418	37.06	-34.9	37.5	34.46	54	16.94	H
2361	43.88	-19.2	27.3	35.78	54	10.12	V

8DPSK Ch 39

Frequency (MHz)	Measurement Result (dBμV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Antenna Pol. (H/V)
17921.5	47.04	-25.4	42.3	30.14	54	6.96	V
14070.5	42.88	-28.7	40.5	31.08	54	11.12	V
11874	39.98	-31	38.9	32.08	54	14.02	H
9434	37.51	-33.6	38.1	33.01	54	16.49	H
7519.5	36.45	-34.6	37.5	33.55	54	17.55	H
4918.5	31.88	-36.9	32.9	35.88	54	22.12	V

8DPSK Ch 78

Frequency (MHz)	Measurement Result (dBμV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Antenna Pol. (H/V)
17933.5	47.13	-25.4	42.3	30.23	54	6.87	H
13811.5	42.42	-29.1	40.9	30.62	54	11.58	V
12979.5	40.31	-29.8	39.8	30.31	54	13.69	V
9660	37.84	-33	37.8	33.04	54	16.16	H
7508.5	36.94	-34.6	37.5	34.04	54	17.06	H
2498.3	44.98	-19	27.9	36.08	54	9.02	V

Peak Measurement results

GFSK Ch 0

Frequency (MHz)	Measurement Result (dBμV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Antenna Pol. (H/V)
17950	56.73	-25.4	42.3	39.83	74	17.27	H
13830	51.81	-29.1	40.9	40.01	74	22.19	H
12655	49.64	-30.4	39.2	40.84	74	24.36	H
9991	47.29	-33.2	38.3	42.19	74	26.71	H
7910.5	46.4	-34.6	37	44	74	27.6	V
2312.2	56.13	-19.3	27.3	48.13	74	17.87	H

GFSK Ch 39

Frequency (MHz)	Measurement Result (dBμV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Antenna Pol. (H/V)
17990	56.06	-25.4	42.3	39.16	74	17.94	V
13833.5	52.03	-29.1	40.9	40.23	74	21.97	V
12348	50.07	-30.1	38.8	41.37	74	23.93	V
9849.5	47.62	-33.1	38	42.72	74	26.38	H
7229.5	46.7	-34.5	37.4	43.8	74	27.3	H
4784.5	41.75	-36.8	32.5	46.05	74	32.25	V

GFSK Ch 78

Frequency (MHz)	Measurement Result (dBμV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Antenna Pol. (H/V)
17929	56.25	-25.4	42.3	39.35	74	17.75	H
14113.5	51.88	-29.4	40.5	40.78	74	22.12	V
12390.5	49.56	-30.1	38.8	40.86	74	24.44	V
9644	47.32	-33	37.9	42.42	74	26.68	V
7227.5	47.05	-34.5	37.4	44.15	74	26.95	H
2496.1	57.34	-19	27.9	48.44	74	16.66	V

$\pi/4$ DQPSK Ch 0

Frequency (MHz)	Measurement Result (dB μ V/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Antenna Pol. (H/V)
17967	56.9	-25.4	42.3	40	74	17.1	H
14101.5	53.21	-28.7	40.5	41.41	74	20.79	H
12690.5	49.72	-30.4	39.4	40.72	74	24.28	V
9423	47.44	-33.6	38.1	42.94	74	26.56	V
7522	46.41	-34.6	37.5	43.51	74	27.59	V
2349.3	55.70	-19.3	27.3	47.7	74	18.30	V

$\pi/4$ DQPSK Ch 39

Frequency (MHz)	Measurement Result (dB μ V/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Antenna Pol. (H/V)
17904	56.11	-25.4	42.3	39.21	74	17.89	V
13801.5	52.42	-29.1	40.9	40.62	74	21.58	V
12432	49.8	-30.1	38.8	41.1	74	24.2	V
8810	47.33	-33.8	37.7	43.43	74	26.67	V
7312.5	46.27	-35.1	37.5	43.87	74	27.73	H
4958	41.42	-36.7	32.5	45.22	74	32.58	V

$\pi/4$ DQPSK Ch 78

Frequency (MHz)	Measurement Result (dB μ V/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Antenna Pol. (H/V)
17940	56.37	-25.4	42.3	39.47	74	17.63	H
14121.5	53.1	-29.4	40.5	42	74	20.9	H
12822.5	49.62	-30.6	39.6	40.62	74	24.38	H
9530.5	47.6	-33.2	38	42.8	74	26.4	H
7421.5	46.2	-34.9	37.5	43.6	74	27.8	H
2496	57.21	-19	27.9	48.31	74	16.79	H

8DPSK Ch 0

Frequency (MHz)	Measurement Result (dBμV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Antenna Pol. (H/V)
17845.5	56.88	-25.4	42.3	39.98	74	17.12	H
13724	52.5	-29.1	40.7	40.9	74	21.5	H
12337.5	50.37	-30.1	38.8	41.67	74	23.63	V
9125.5	47.55	-33.7	37.8	43.45	74	26.45	H
7224	46.15	-34.5	37.4	43.25	74	27.85	V
2318.9	56.22	-19.3	27.3	48.22	74	17.78	H

8DPSK Ch 39

Frequency (MHz)	Measurement Result (dBμV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Antenna Pol. (H/V)
17925	56.68	-25.4	42.3	39.78	74	17.32	H
13863	52.1	-28.9	40.9	40.1	74	21.9	H
12803	49.88	-30.4	39.6	40.68	74	24.12	H
9225.5	47.38	-33.9	38	43.28	74	26.62	H
7735	46.48	-34.6	37.1	43.98	74	27.52	V
4624.5	41.91	-37.1	32.3	46.71	74	32.09	H

8DPSK Ch 78

Frequency (MHz)	Measurement Result (dBμV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Receiver Reading (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Antenna Pol. (H/V)
17908	56.37	-25.4	42.3	39.47	74	17.63	H
13818	52.01	-29.1	40.9	40.21	74	21.99	V
12423	50.04	-30.1	38.8	41.34	74	23.96	V
9645.5	47.47	-33	37.9	42.57	74	26.53	V
6928.5	46.28	-35.2	36.7	44.78	74	27.72	V
2499.6	56.89	-19	27.9	47.99	74	17.11	H

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.67	P
	78	2.45GHz ~2.5GHz	Fig.68	P

Mode	Channel	Frequency Range	Test Results	Conclusion
$\pi/4$ DQPSK	0	2.31GHz ~2.43GHz	Fig.69	P
	78	2.45GHz ~2.5GHz	Fig.70	P

Mode	Channel	Frequency Range	Test Results	Conclusion
8DPSK	0	2.31GHz ~2.43GHz	Fig.71	P
	78	2.45GHz ~2.5GHz	Fig.72	P

Conclusion: PASS

Test graphs as below

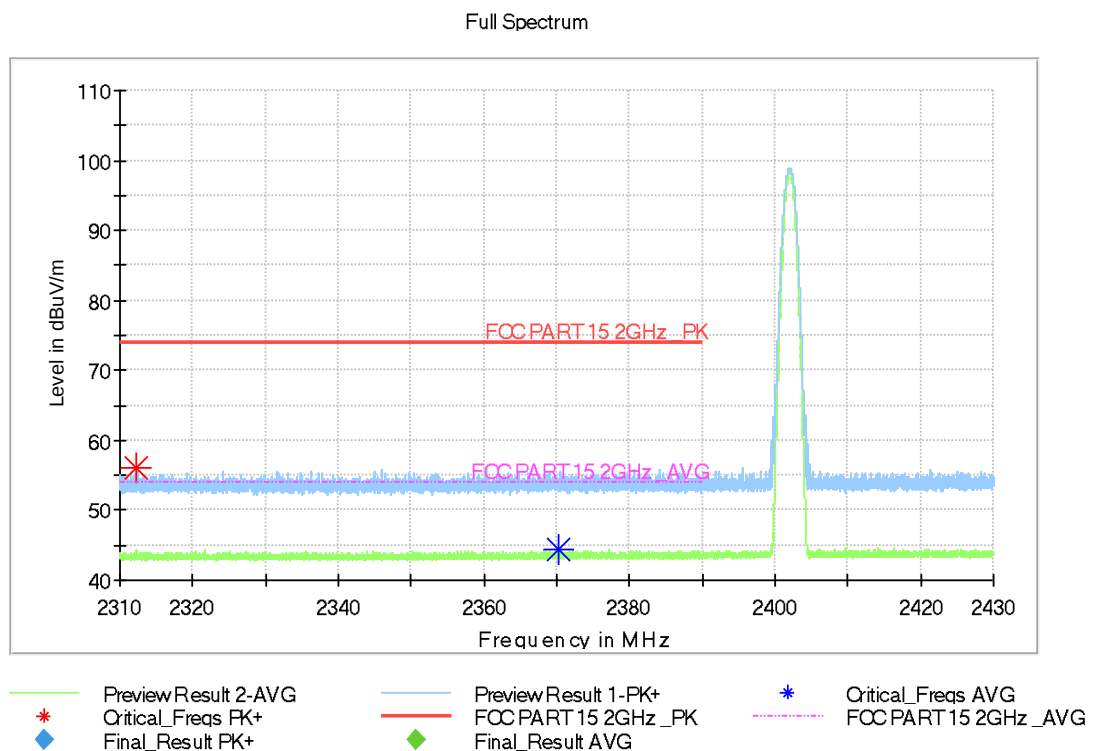


Fig.67. Frequency Band Edges: GFSK, Channel 0, Hopping Off, 2.31 GHz – 2.45GHz

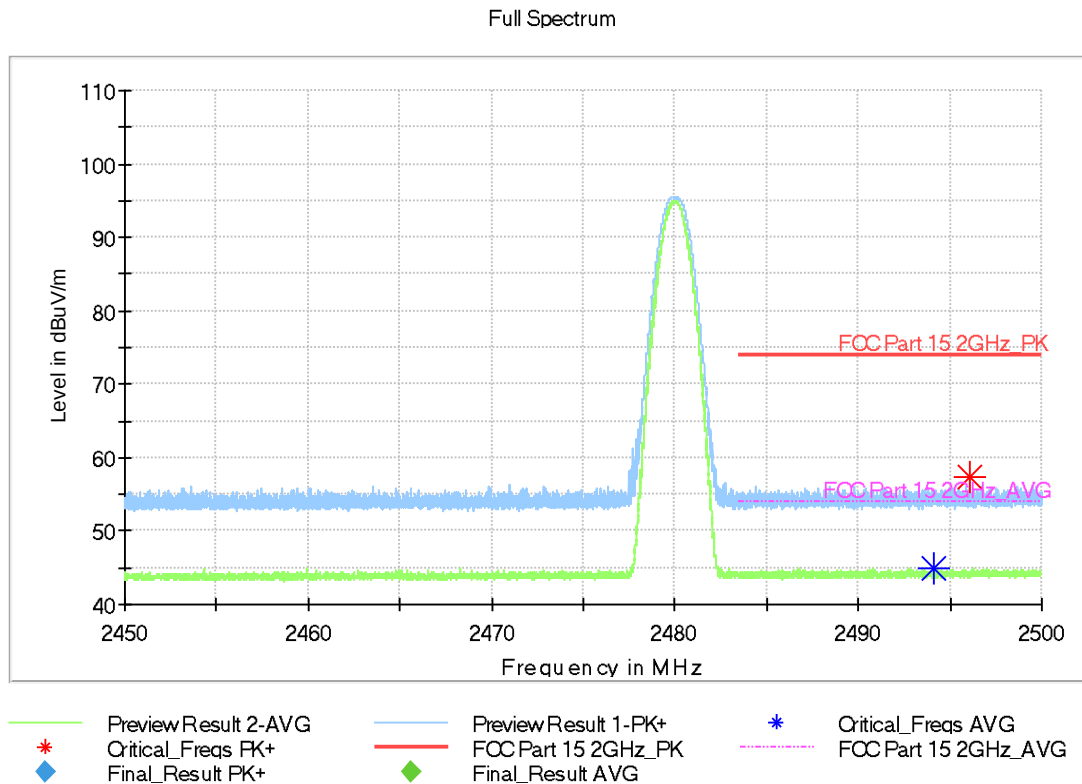


Fig.68. Frequency Band Edges: GFSK, Channel 78, Hopping Off, ch11, 2.45 GHz - 2.50GHz

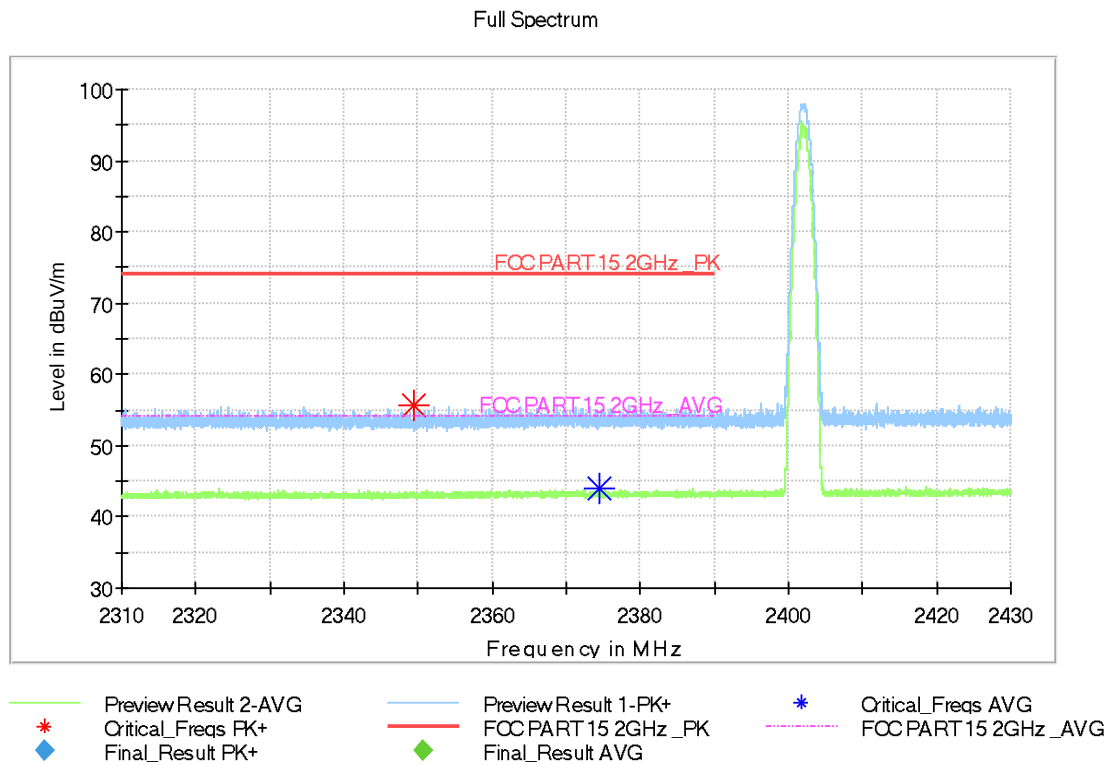


Fig.69. Frequency Band Edges: $\pi/4$ DQPSK, Channel 0, Hopping Off, 2.31 GHz - 2.45GHz

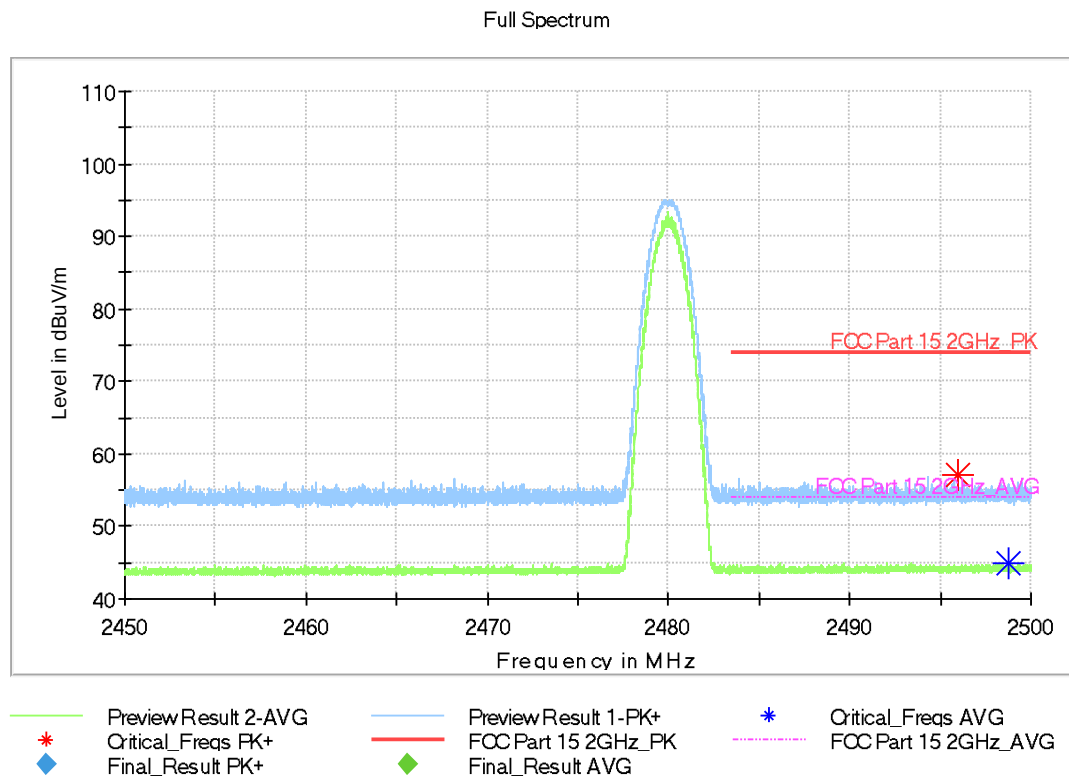


Fig.70. Frequency Band Edges: $\pi/4$ DQPSK, Channel 78, Hopping Off, 2.45 GHz - 2.50GHz

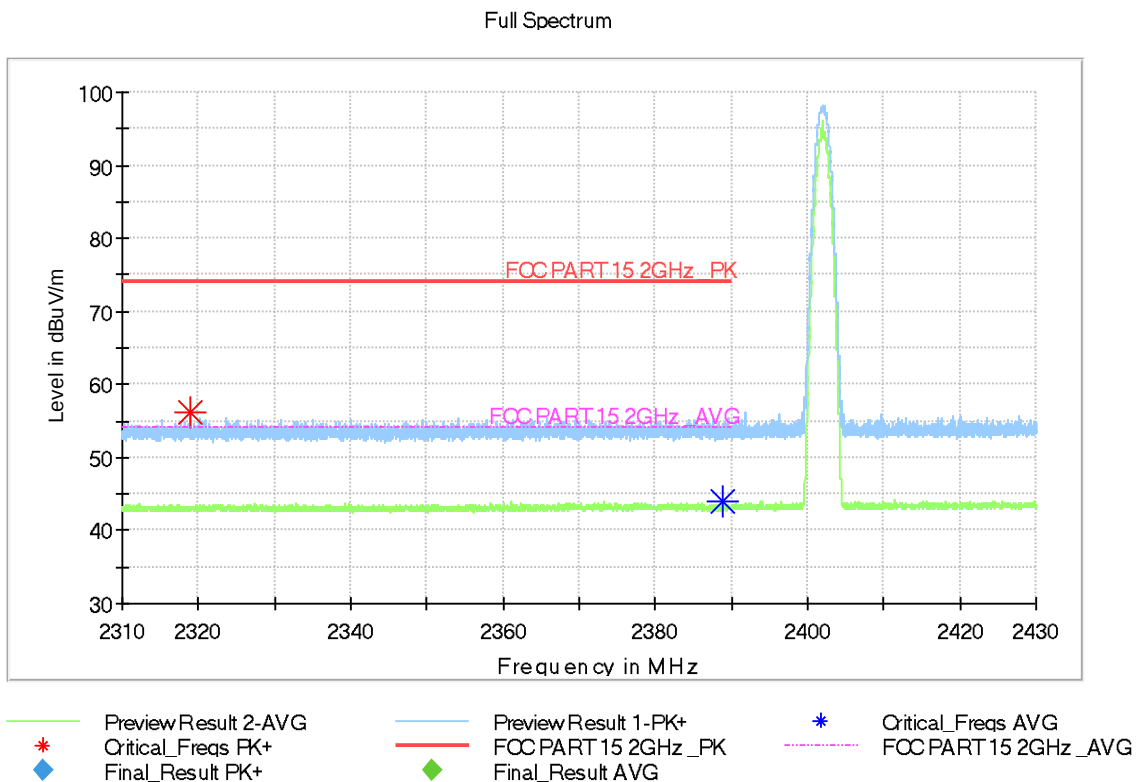


Fig.71. Frequency Band Edges: 8DPSK, Channel 0, 2.31 GHz - 2.45GHz

Full Spectrum

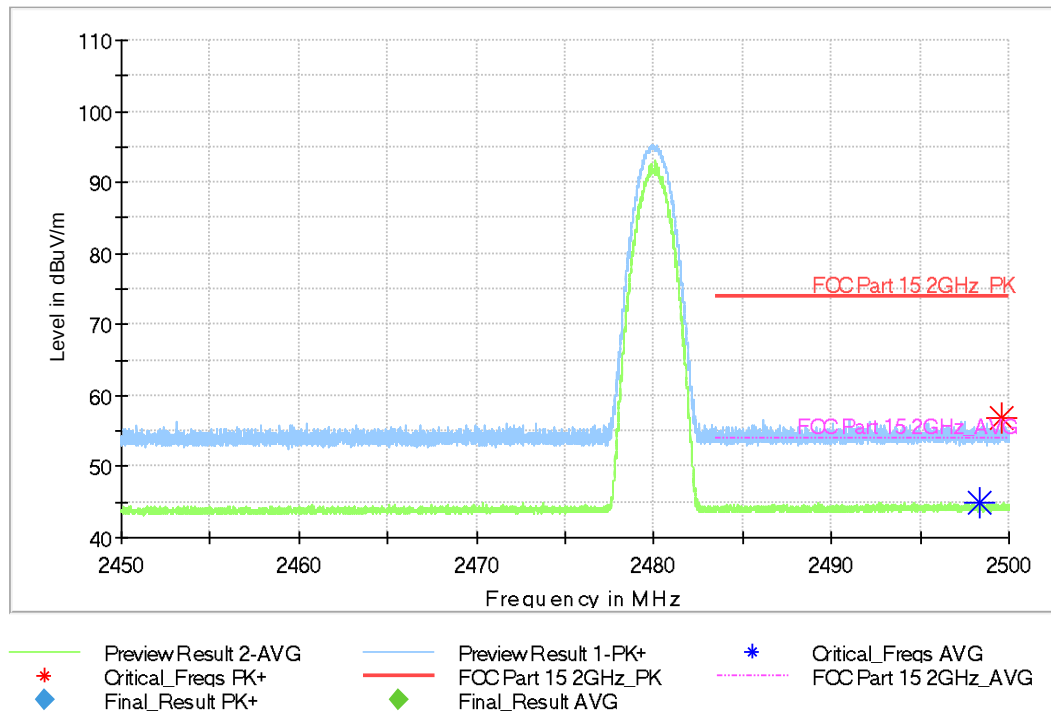


Fig.72. Frequency Band Edges: 8DPSK, Channel 78, 2.45 GHz - 2.50GHz

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
39	DH1	Fig.73	0.38	Fig.74	318	120.84	P
	DH3	Fig.75	1.64	Fig.76	117	191.88	P
	DH5	Fig.77	2.88	Fig.78	61	175.68	P

For $\pi/4$ DQPSK

Channel	Packet	Pulse time (ms)		Number of Transmissions		Dwell Time (ms)	Conclusion
39	2DH1	Fig.79	0.39	Fig.80	320	124.8	P
	2DH3	Fig.81	1.64	Fig.82	98	160.72	P
	2DH5	Fig.83	2.89	Fig.84	67	193.63	P

For 8DPSK

Channel	Packet	Pulse time (ms)		Number of Transmissions		Dwell Time (ms)	Conclusion
39	3DH1	Fig.85	0.39	Fig.86	318	124.02	P
	3DH3	Fig.87	1.64	Fig.88	109	178.76	P
	3DH5	Fig.89	2.89	Fig.90	57	164.73	P

Conclusion: PASS

Test graphs as below:

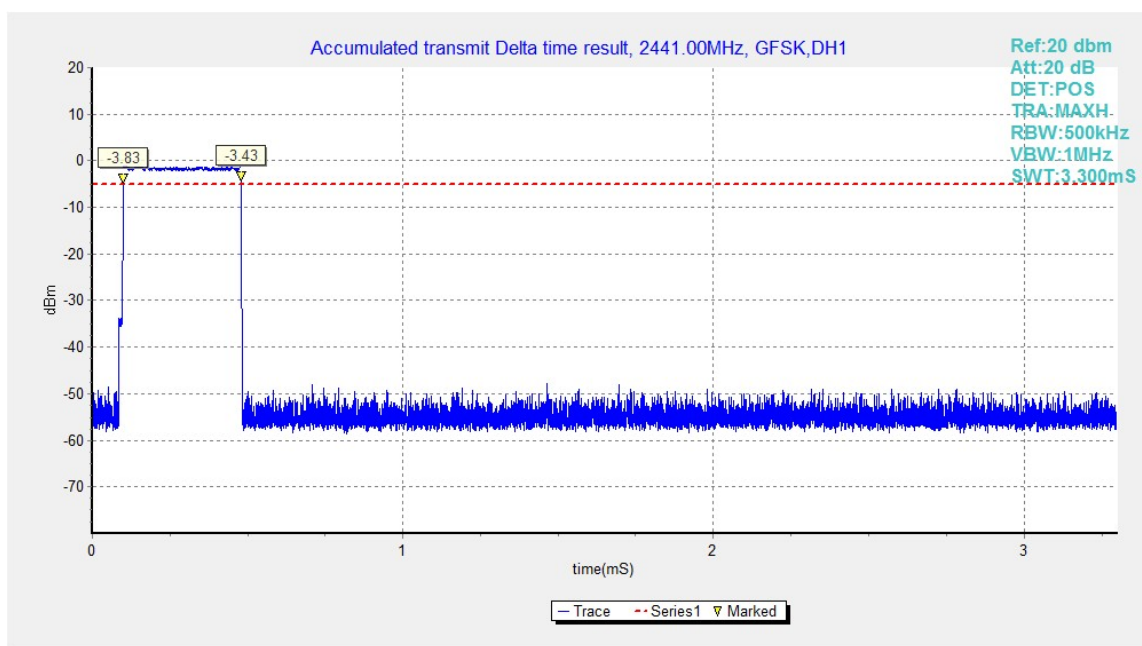


Fig.73. Time of occupancy (Dwell Time): Channel 39, Packet DH1

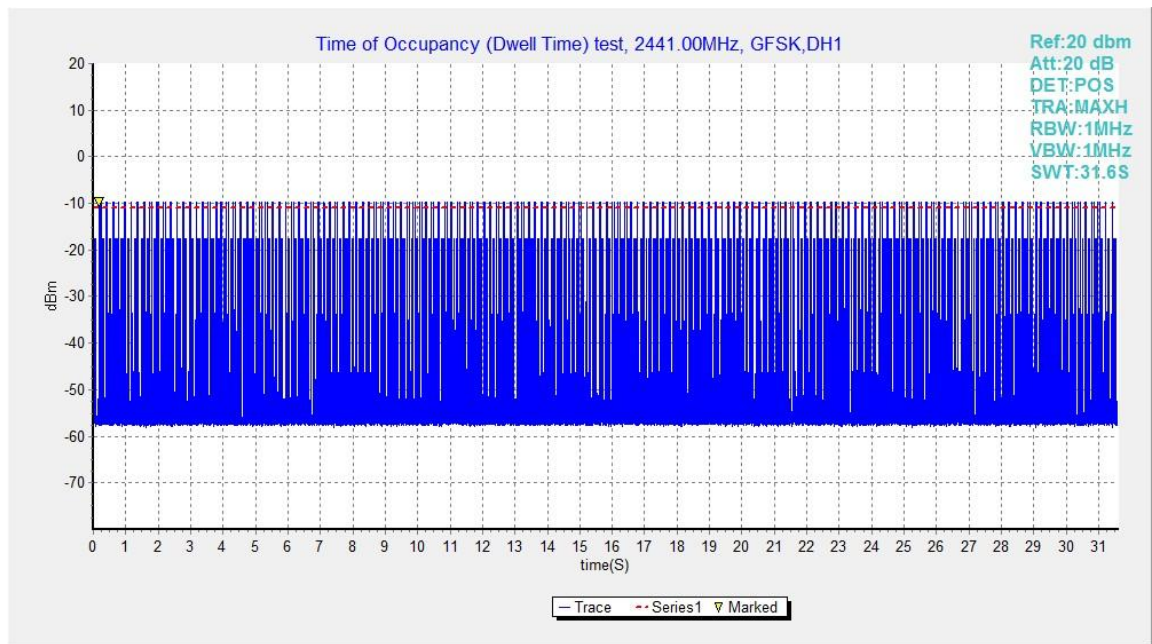


Fig.74. Number of Transmissions Measurement: Channel 39,Packet DH1

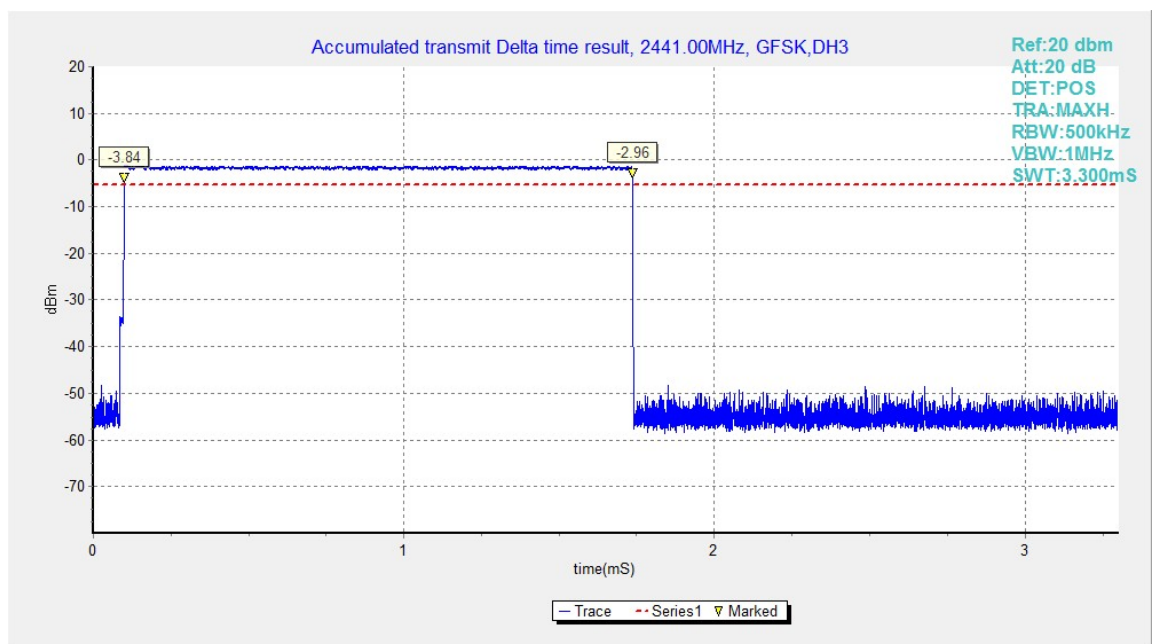


Fig.75. Time of occupancy (Dwell Time): Channel 39, Packet DH3

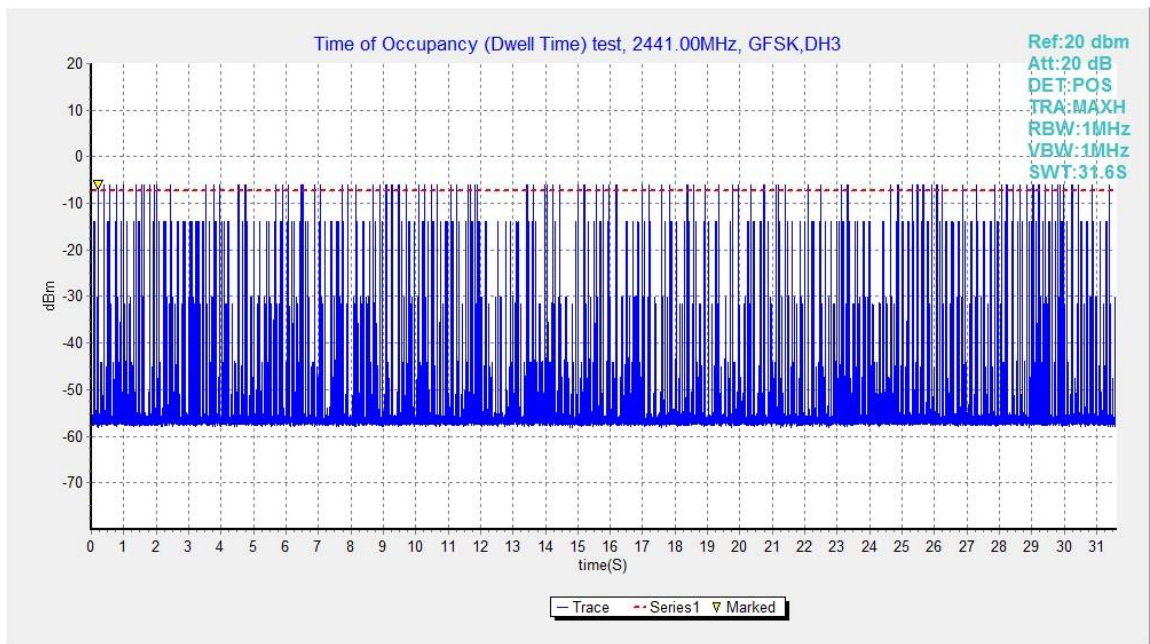


Fig.76. Number of Transmissions Measurement: Channel 39,Packet DH3

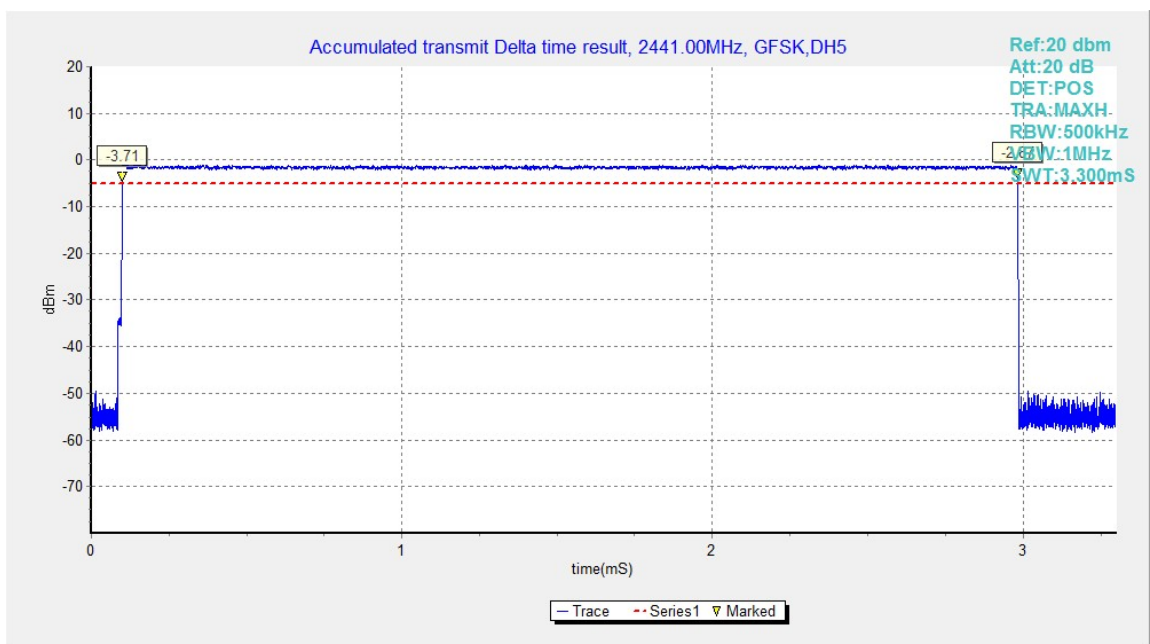


Fig.77. Time of occupancy (Dwell Time): Channel 39, Packet DH5

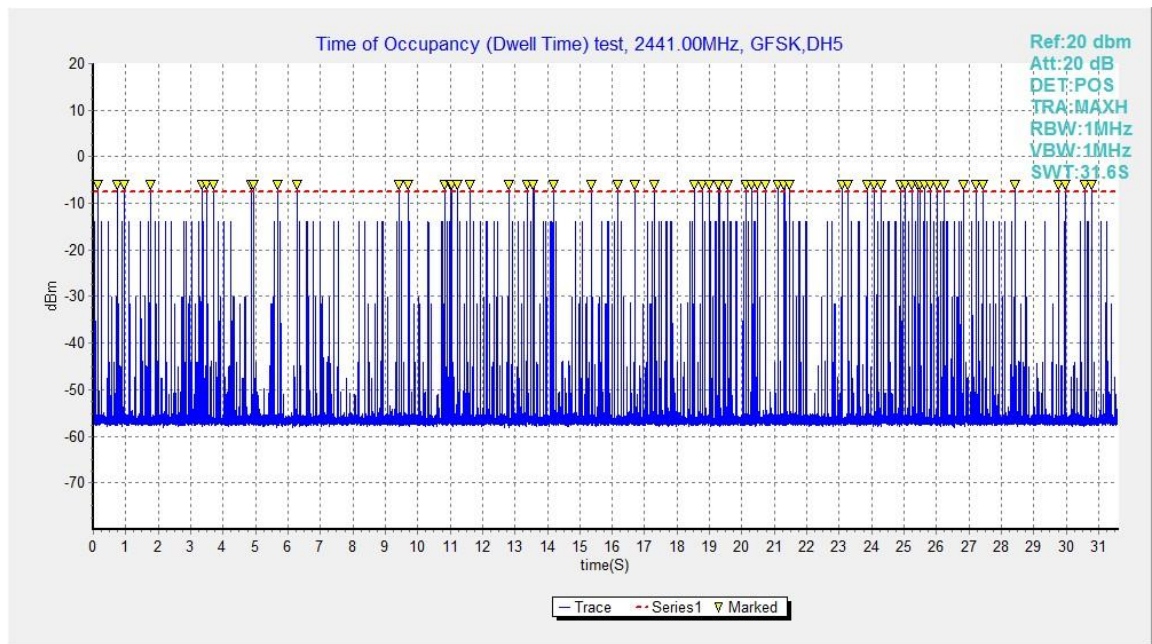


Fig.78. Number of Transmissions Measurement: Channel 39,Packet DH5

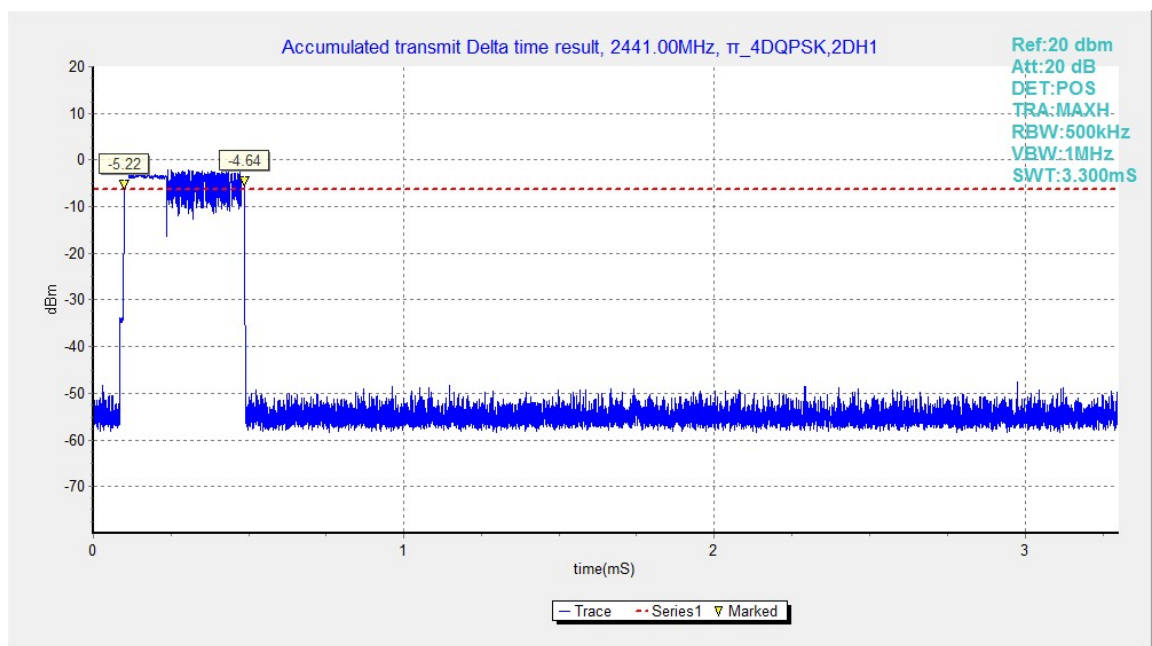


Fig.79. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH1

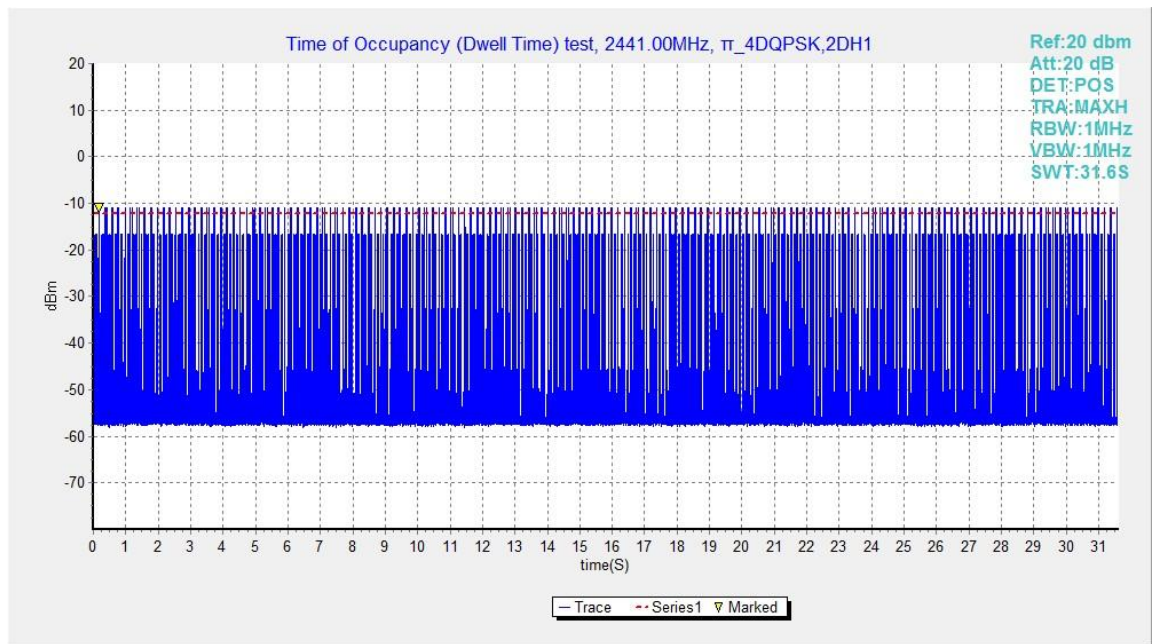


Fig.80. Number of Transmissions Measurement: Channel 39,Packet 2-DH1

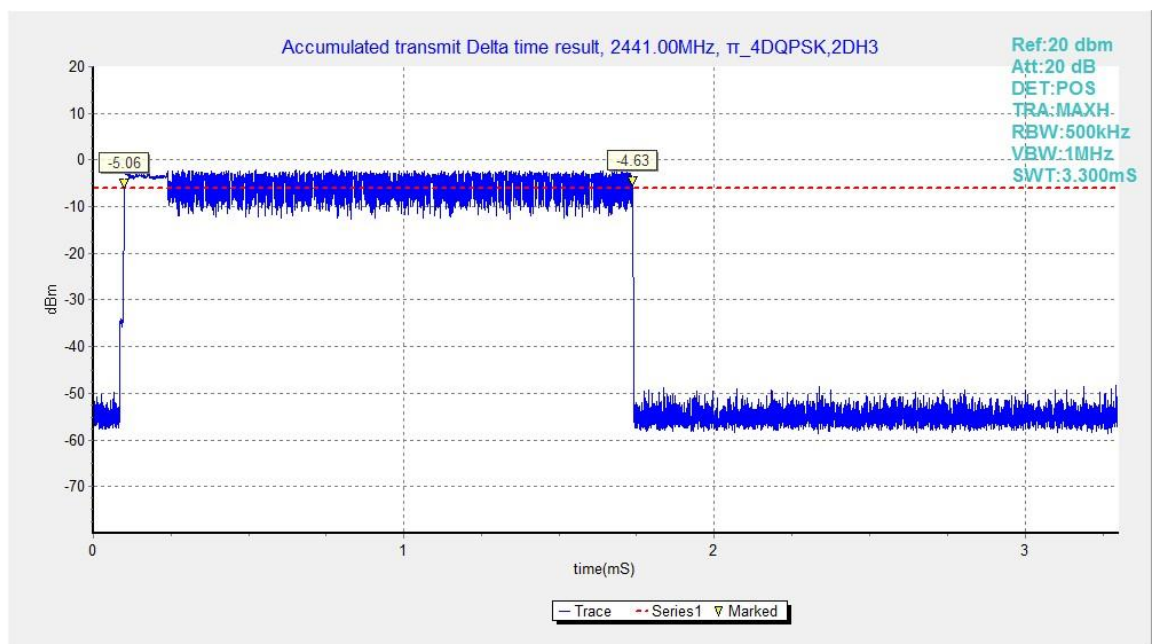


Fig.81. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH3

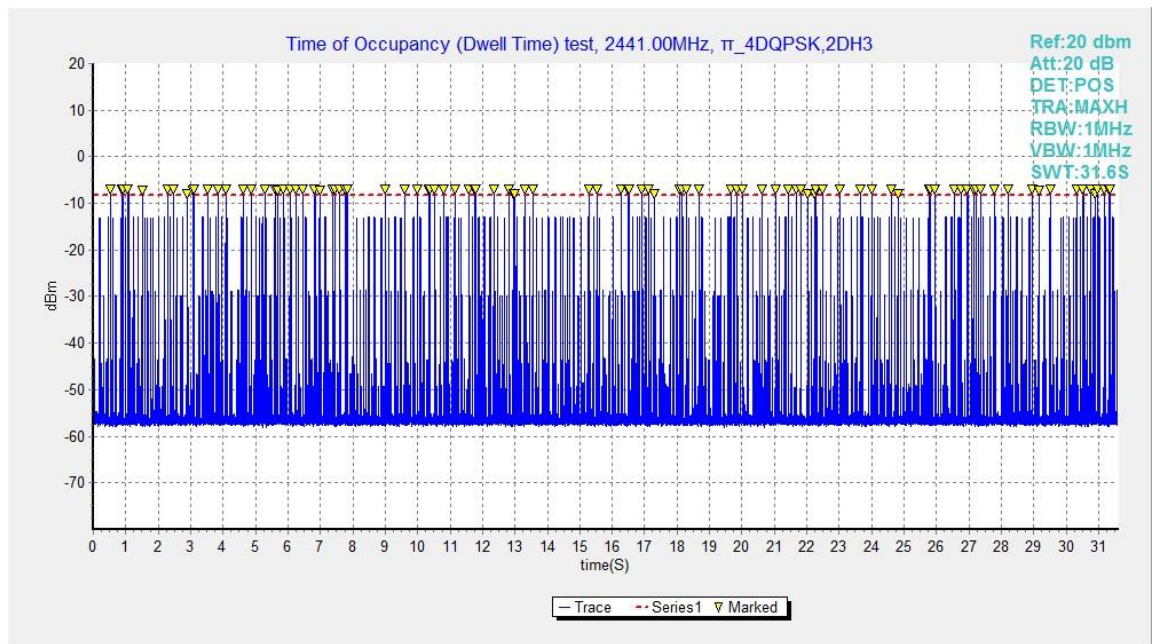


Fig.82. Number of Transmissions Measurement: Channel 39,Packet 2-DH3

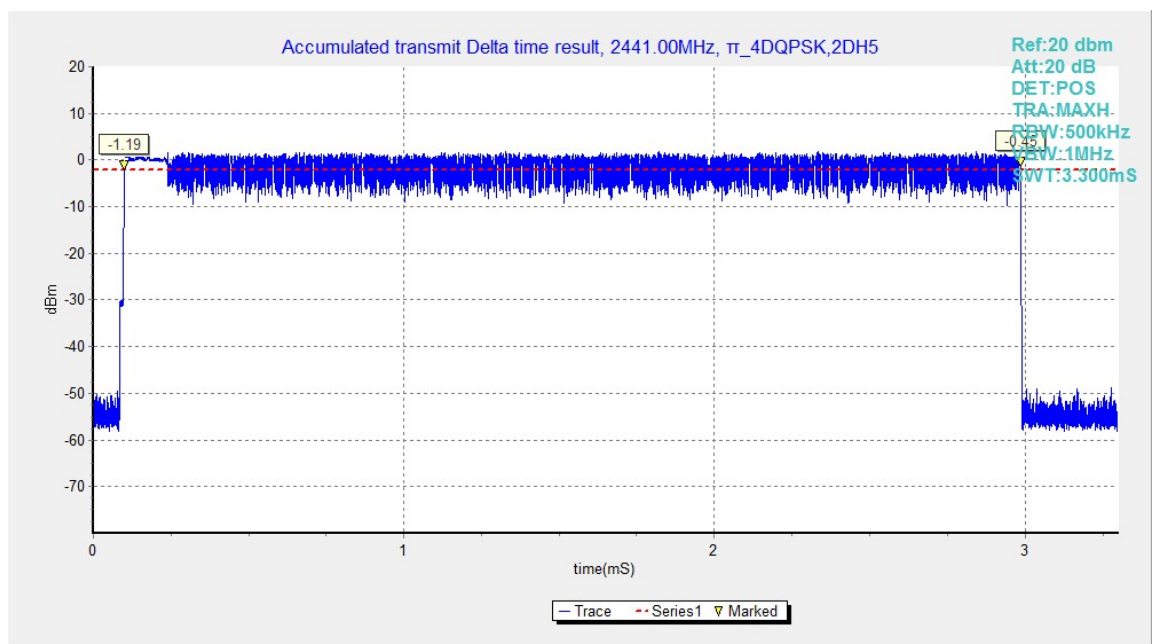


Fig.83. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH5

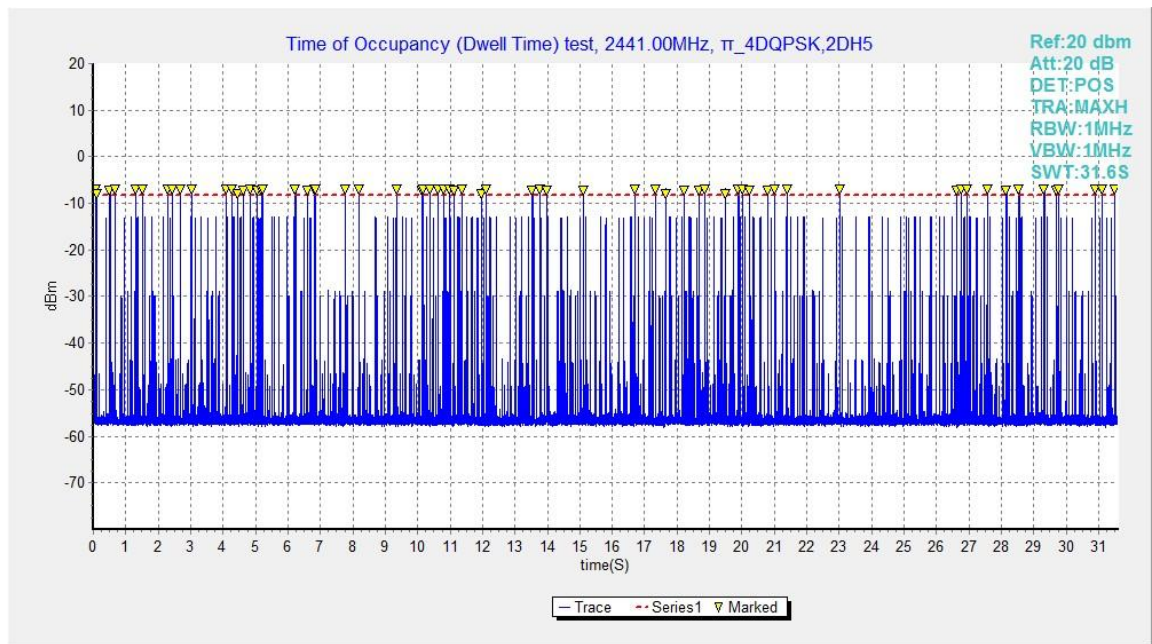


Fig.84. Number of Transmissions Measurement: Channel 39,Packet 2-DH5

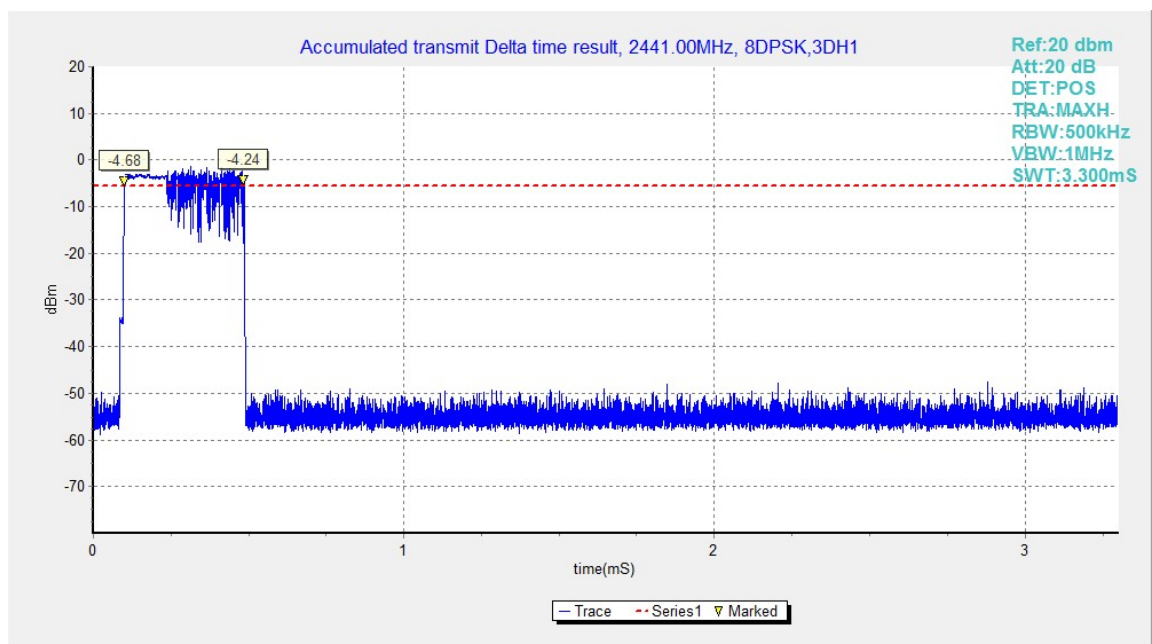


Fig.85. Time of occupancy (Dwell Time): Channel 39, Packet 3-DH1

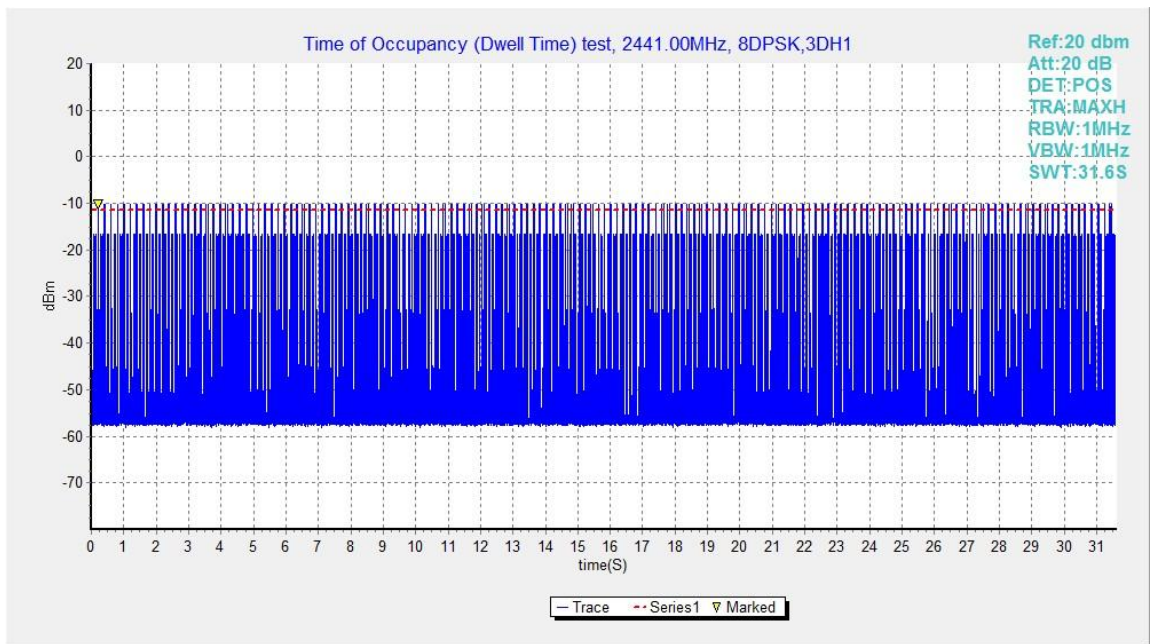


Fig.86. Number of Transmissions Measurement: Channel 39,Packet 3-DH1

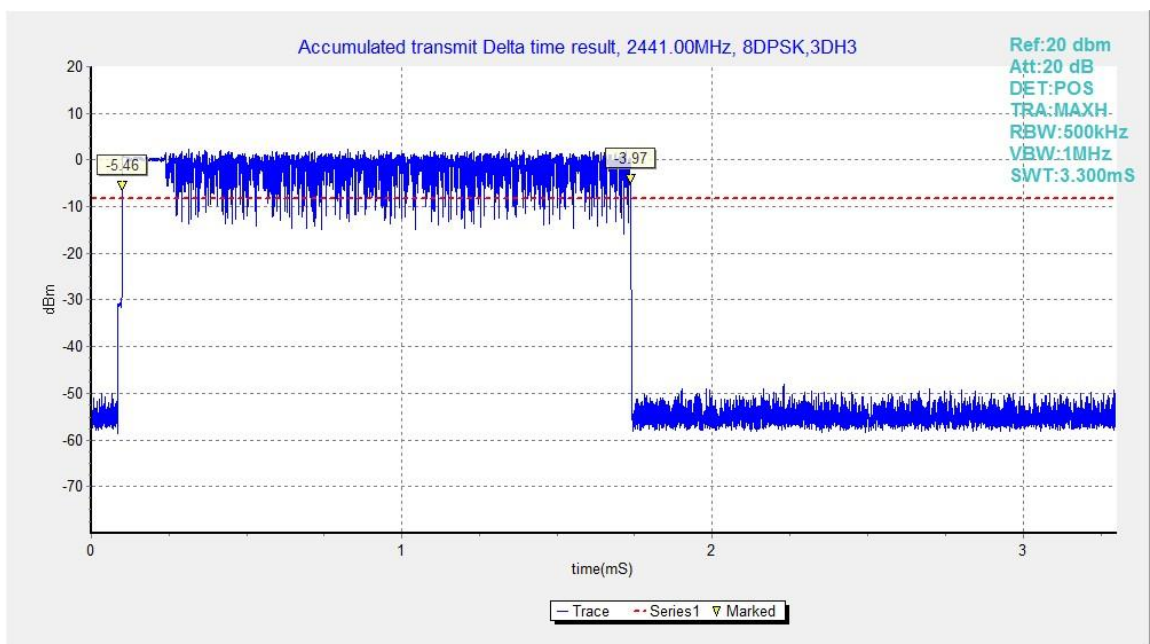


Fig.87. Time of occupancy (Dwell Time): Channel 39, Packet 3-DH3

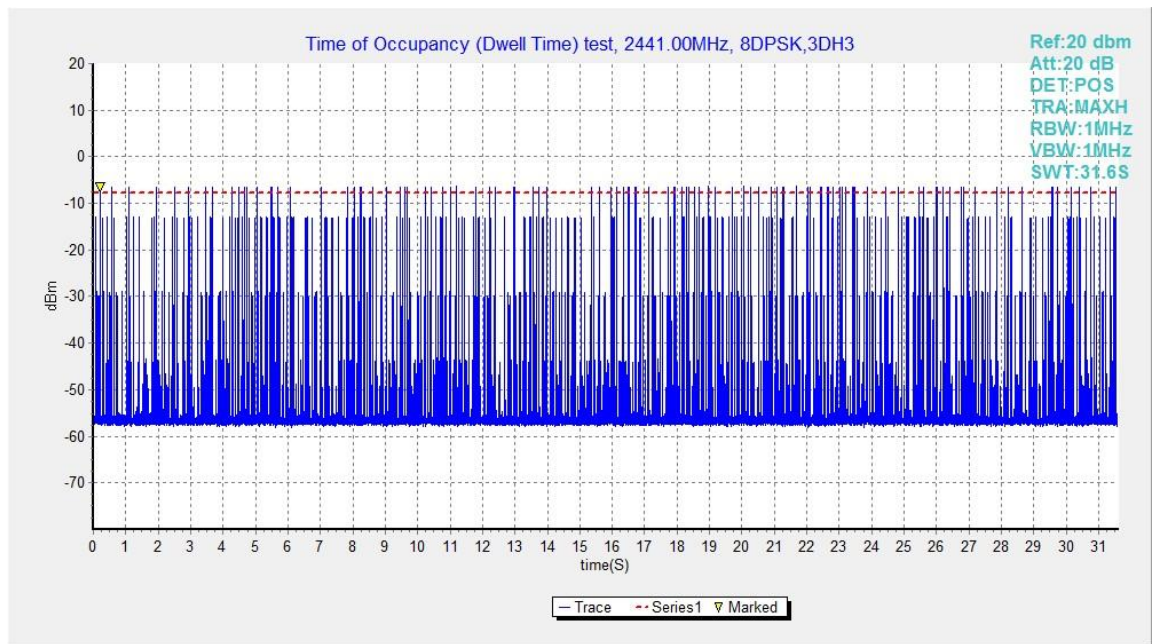


Fig.88. Number of Transmissions Measurement: Channel 39,Packet 3-DH3

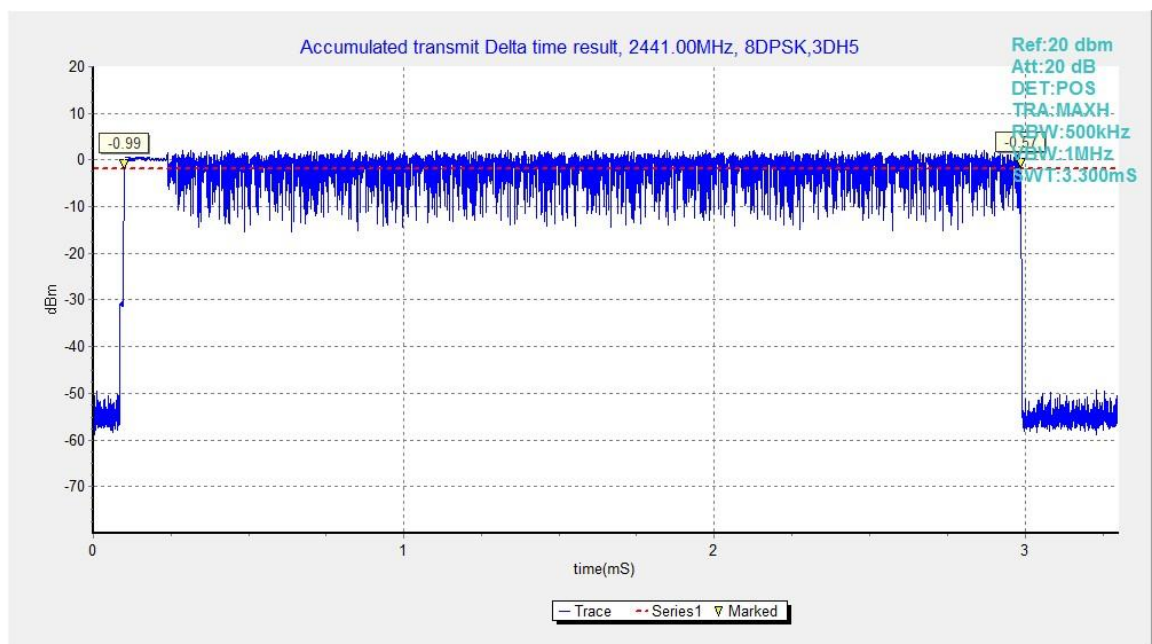


Fig.89. Time of occupancy (Dwell Time): Channel 39, Packet 3-DH5