

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

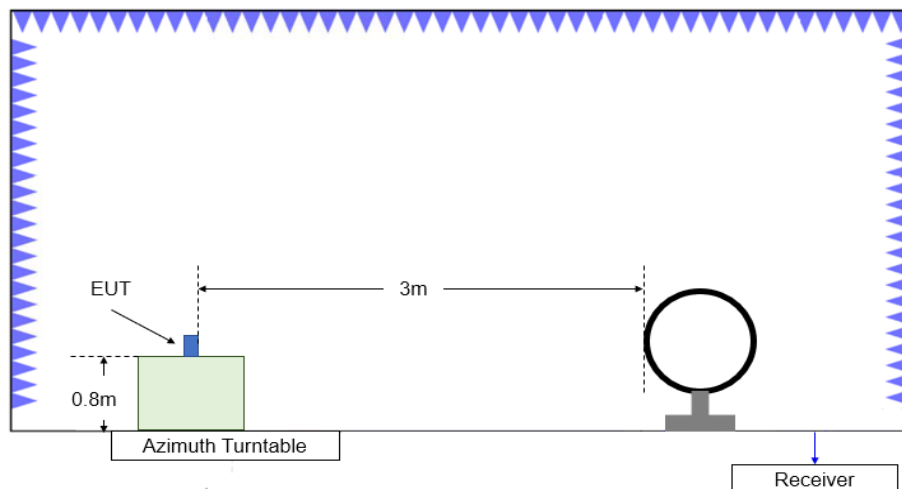
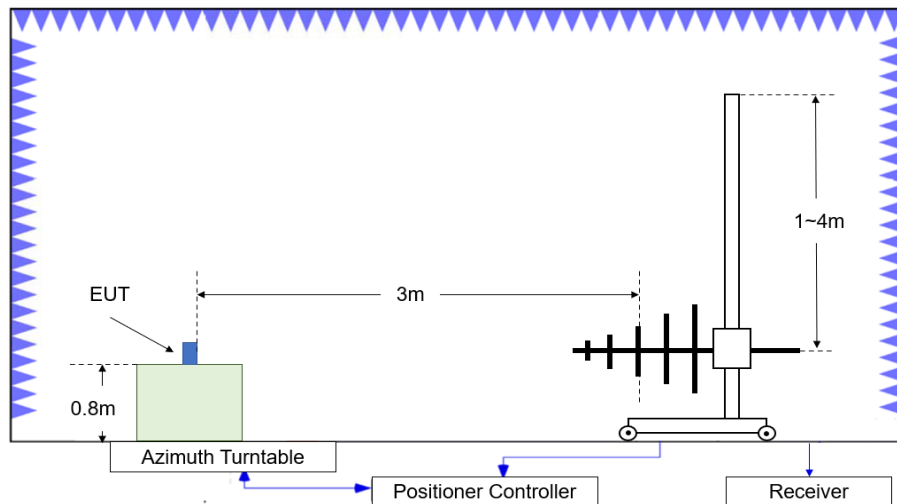
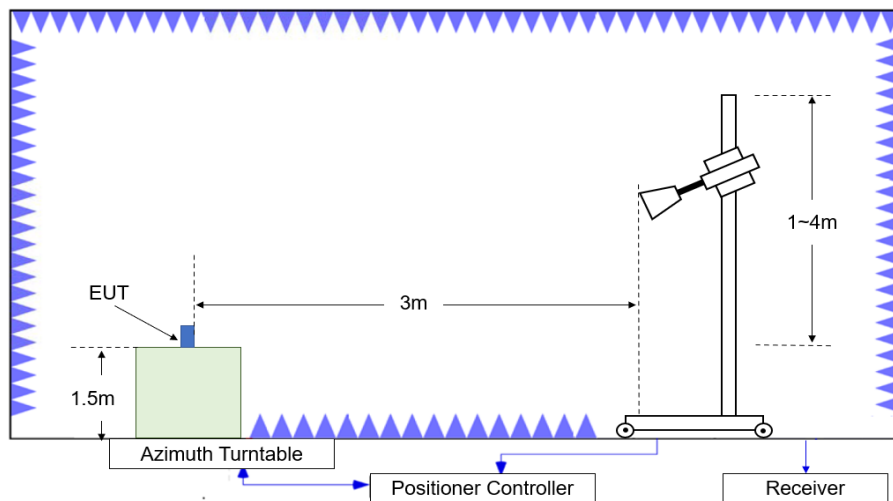


Figure B.5.1. Test Site Diagram (9kHz-30MHz)



**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:

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

### 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 10<sup>th</sup> harmonic of highest fundamental frequency or 40GHz, whichever is lower.

### Test Result

EUT ID:UT09a

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)
17954.500	54.17	-29.40	46.00	37.57	74.00	19.83	H
6005.000	52.14	-36.80	34.50	54.44	74.00	21.86	H
4803.500	50.43	-37.70	33.00	55.13	74.00	23.57	H
14173.500	50.20	-30.20	41.70	38.70	74.00	23.80	H
12997.000	46.94	-31.90	40.10	38.74	74.00	27.06	H
2341.700	53.99	-19.60	28.20	45.39	74.00	20.01	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)
17958.000	54.04	-29.40	46.00	37.44	74.00	19.96	V
6102.500	50.73	-37.00	34.50	53.23	74.00	23.27	H
4881.500	50.05	-37.50	33.40	54.15	74.00	23.95	H
14051.500	49.80	-31.10	41.60	39.30	74.00	24.20	V
12132.000	46.61	-32.30	38.90	40.01	74.00	27.39	V
9016.000	44.47	-34.30	37.80	40.97	74.00	29.53	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)
17974.500	55.02	-29.40	46.00	38.42	74.00	18.98	H
6200.000	51.59	-36.70	34.60	53.69	74.00	22.41	H
14610.500	50.40	-30.80	41.70	39.50	74.00	23.60	V
4959.500	48.85	-37.40	33.60	52.65	74.00	25.15	H



11391.500	46.47	-32.60	39.00	40.07	74.00	27.53	V
2494.700	53.05	-19.70	28.20	44.55	74.00	20.95	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)
17959.500	54.81	-29.40	46.00	38.21	74.00	19.19	H
6005.000	52.11	-36.80	34.50	54.41	74.00	21.89	H
4803.500	50.47	-37.70	33.00	55.17	74.00	23.53	H
14654.500	50.22	-30.00	41.50	38.72	74.00	23.78	H
11919.000	47.08	-32.40	39.10	40.38	74.00	26.92	V
2387.200	53.20	-19.80	28.20	44.80	74.00	20.80	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)
17961.500	53.89	-29.40	46.00	37.29	74.00	20.11	H
6102.500	50.52	-37.00	34.50	53.02	74.00	23.48	H
14169.000	50.24	-30.20	41.70	38.74	74.00	23.76	H
4881.500	49.87	-37.50	33.40	53.97	74.00	24.13	H
11899.500	46.20	-32.40	39.10	39.50	74.00	27.80	V
8891.000	45.06	-34.80	37.80	42.06	74.00	28.94	H

 **$\pi/4$  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)
17997.000	54.41	-29.40	46.00	37.81	74.00	19.59	V
6200.000	51.92	-36.70	34.60	54.02	74.00	22.08	H
14592.000	50.44	-29.00	41.90	37.54	74.00	23.56	V
4959.500	49.70	-37.40	33.60	53.50	74.00	24.30	H
11803.000	47.11	-32.00	39.20	39.91	74.00	26.89	V
2486.300	53.26	-19.70	28.20	44.76	74.00	20.74	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)
17959.500	54.09	-29.40	46.00	37.49	74.00	19.91	V
6005.000	51.81	-36.80	34.50	54.11	74.00	22.19	H
14082.500	50.11	-30.20	41.70	38.61	74.00	23.89	H
4803.500	49.64	-37.70	33.00	54.34	74.00	24.36	H
11817.500	46.52	-32.00	39.20	39.32	74.00	27.48	H
2340.900	53.11	-19.60	28.20	44.51	74.00	20.89	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)
17971.500	54.07	-29.40	46.00	37.47	74.00	19.93	V
6102.500	51.26	-37.00	34.50	53.76	74.00	22.74	H
14124.500	50.05	-30.80	41.70	39.15	74.00	23.95	H
4881.500	50.03	-37.50	33.40	54.13	74.00	23.97	H
12928.500	46.94	-31.40	40.00	38.34	74.00	27.06	H
8709.000	44.48	-34.40	37.70	41.18	74.00	29.52	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)
17946.500	54.25	-29.40	46.00	37.65	74.00	19.75	V
6199.500	51.33	-36.70	34.60	53.43	74.00	22.67	H
14064.000	49.93	-30.20	41.70	38.43	74.00	24.07	V
4959.500	49.07	-37.40	33.60	52.87	74.00	24.93	H
12989.500	46.39	-31.90	40.10	38.19	74.00	27.61	V
2492.400	52.81	-19.70	28.20	44.31	74.00	21.19	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)
6005.000	50.25	-36.80	34.50	52.55	54.00	3.75	H
4803.500	48.93	-37.70	33.00	53.63	54.00	5.07	H
17964.000	45.12	-29.40	46.00	28.52	54.00	8.88	V
14204.000	40.38	-30.20	41.70	28.88	54.00	13.62	V
12978.500	36.90	-31.90	40.10	28.70	54.00	17.10	V
2333.000	41.95	-19.60	28.20	33.35	54.00	12.05	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)
6102.500	48.79	-37.00	34.50	51.29	54.00	5.21	H
4881.500	48.63	-37.50	33.40	52.73	54.00	5.37	H
17954.500	44.76	-29.40	46.00	28.16	54.00	9.24	H
14128.000	39.95	-30.80	41.70	29.05	54.00	14.05	H
11839.000	36.68	-32.80	39.10	30.28	54.00	17.32	V
8975.500	35.14	-34.70	37.70	32.14	54.00	18.86	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)
6200.000	49.98	-36.70	34.60	52.08	54.00	4.02	H
4959.500	47.72	-37.40	33.60	51.52	54.00	6.28	H
17979.000	44.67	-29.40	46.00	28.07	54.00	9.33	H
14573.000	40.24	-29.00	41.90	27.34	54.00	13.76	V
12983.000	36.83	-31.90	40.10	28.63	54.00	17.17	H
2493.600	41.71	-19.70	28.20	33.21	54.00	12.29	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)
6005.000	50.50	-36.80	34.50	52.80	54.00	3.50	H
4804.000	49.18	-37.70	33.00	53.88	54.00	4.82	H
17964.500	44.88	-29.40	46.00	28.28	54.00	9.12	V
14168.000	40.63	-30.20	41.70	29.13	54.00	13.37	H
11785.500	37.20	-32.00	39.20	30.00	54.00	16.80	V
2366.500	41.65	-19.60	28.20	33.05	54.00	12.35	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)
6102.500	48.84	-37.00	34.50	51.34	54.00	5.16	H
4881.500	48.27	-37.50	33.40	52.37	54.00	5.73	H
17952.000	45.01	-29.40	46.00	28.41	54.00	8.99	H
14181.000	40.93	-30.20	41.70	29.43	54.00	13.07	H
11904.500	37.03	-32.40	39.10	30.33	54.00	16.97	V
9392.500	35.08	-34.10	37.90	31.28	54.00	18.92	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)
6200.000	50.19	-36.70	34.60	52.29	54.00	3.81	H
4959.500	47.75	-37.40	33.60	51.55	54.00	6.25	H
17955.000	44.73	-29.40	46.00	28.13	54.00	9.27	V
14198.000	40.59	-30.20	41.70	29.09	54.00	13.41	V
12774.000	36.95	-31.50	39.80	28.65	54.00	17.05	V
2489.300	41.58	-19.70	28.20	33.08	54.00	12.42	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)
6005.000	49.91	-36.80	34.50	52.21	54.00	4.09	H
4803.500	48.03	-37.70	33.00	52.73	54.00	5.97	H
17972.000	44.67	-29.40	46.00	28.07	54.00	9.33	V
14708.000	40.18	-30.20	41.40	29.08	54.00	13.82	V
12901.000	36.69	-31.50	40.00	28.19	54.00	17.31	V
2382.500	41.48	-19.80	28.20	33.08	54.00	12.52	H

**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)
6102.500	49.23	-37.00	34.50	51.73	54.00	4.77	H
4881.500	47.77	-37.50	33.40	51.87	54.00	6.23	H
17969.000	44.61	-29.40	46.00	28.01	54.00	9.39	H
14165.000	40.97	-30.20	41.70	29.47	54.00	13.03	V
11904.000	36.74	-32.40	39.10	30.04	54.00	17.26	V
8986.500	35.51	-34.70	37.70	32.51	54.00	18.49	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)
6200.000	49.81	-36.70	34.60	51.91	54.00	4.19	H
4959.500	47.71	-37.40	33.60	51.51	54.00	6.29	H
17958.000	44.91	-29.40	46.00	28.31	54.00	9.09	V
14516.500	40.34	-30.60	41.90	29.04	54.00	13.66	H
11905.000	37.08	-32.40	39.10	30.38	54.00	16.92	V
2496.600	41.51	-19.70	28.20	33.01	54.00	12.49	H

**Conclusion: Pass**

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

**Band edge compliance**

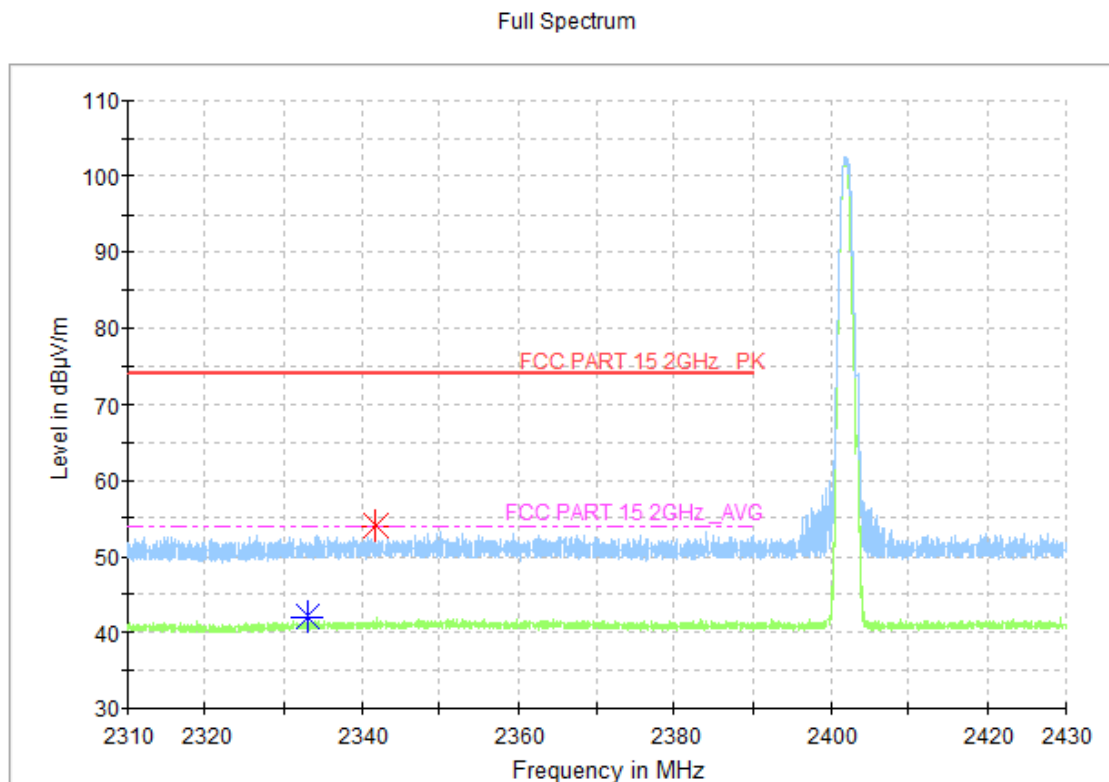
Mode	Channel	Frequency Range	Test Results	Conclusion
GFSK	0	2.31GHz ~2.43GHz	Fig.58	P
	78	2.45GHz ~2.5GHz	Fig.59	P

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

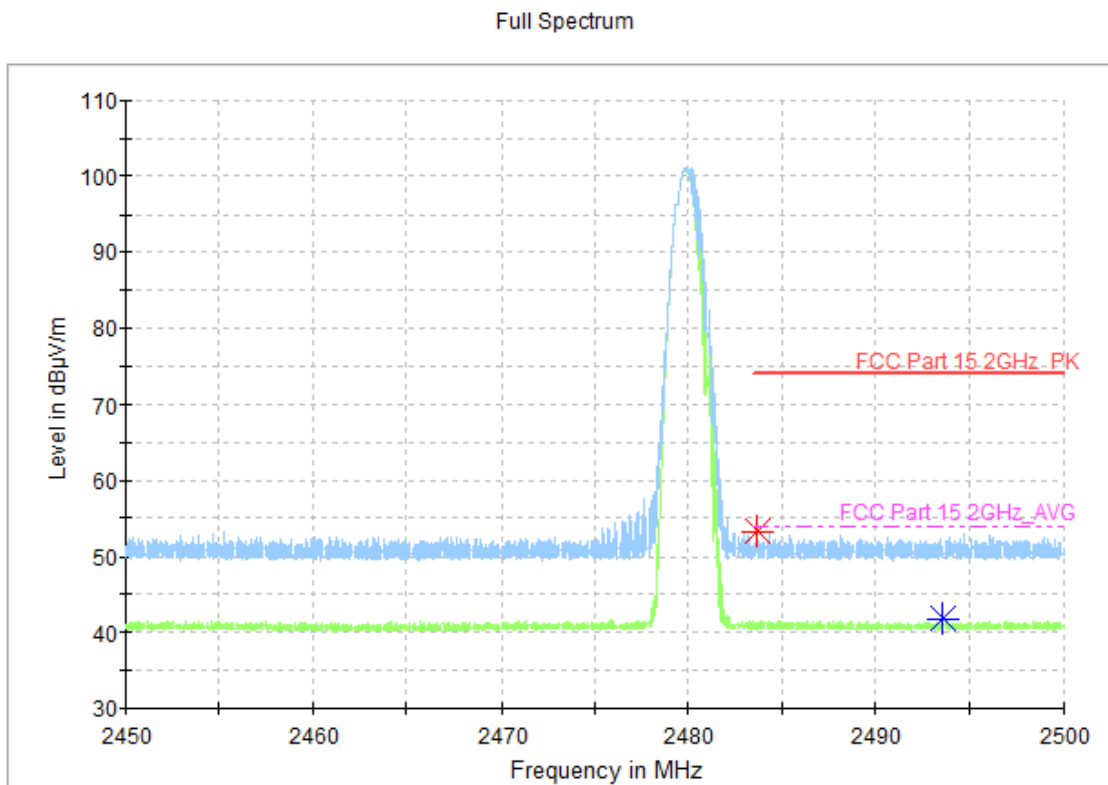
Mode	Channel	Frequency Range	Test Results	Conclusion
8DPSK	0	2.31GHz ~2.43GHz	Fig.62	P
	78	2.45GHz ~2.5GHz	Fig.63	P

**Conclusion: PASS**

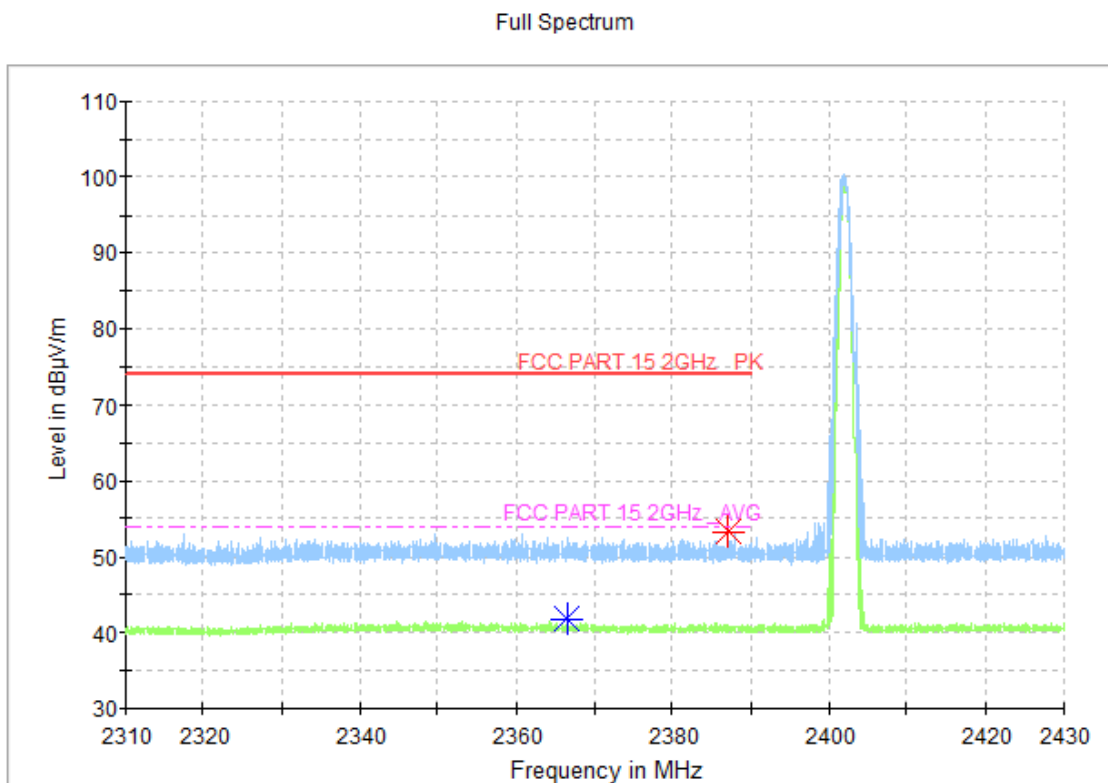
Test graphs as below



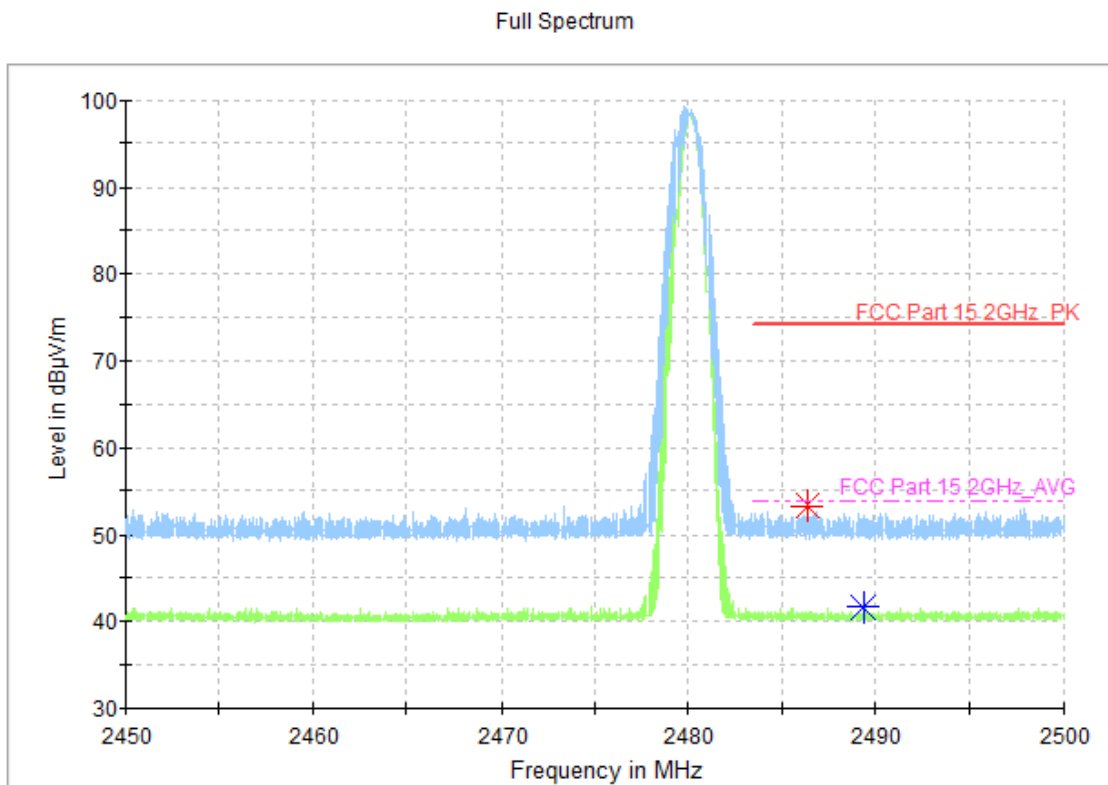
**Fig.58. Frequency Band Edges: GFSK, Channel 0, Hopping Off, 2.31 GHz – 2.45GHz**



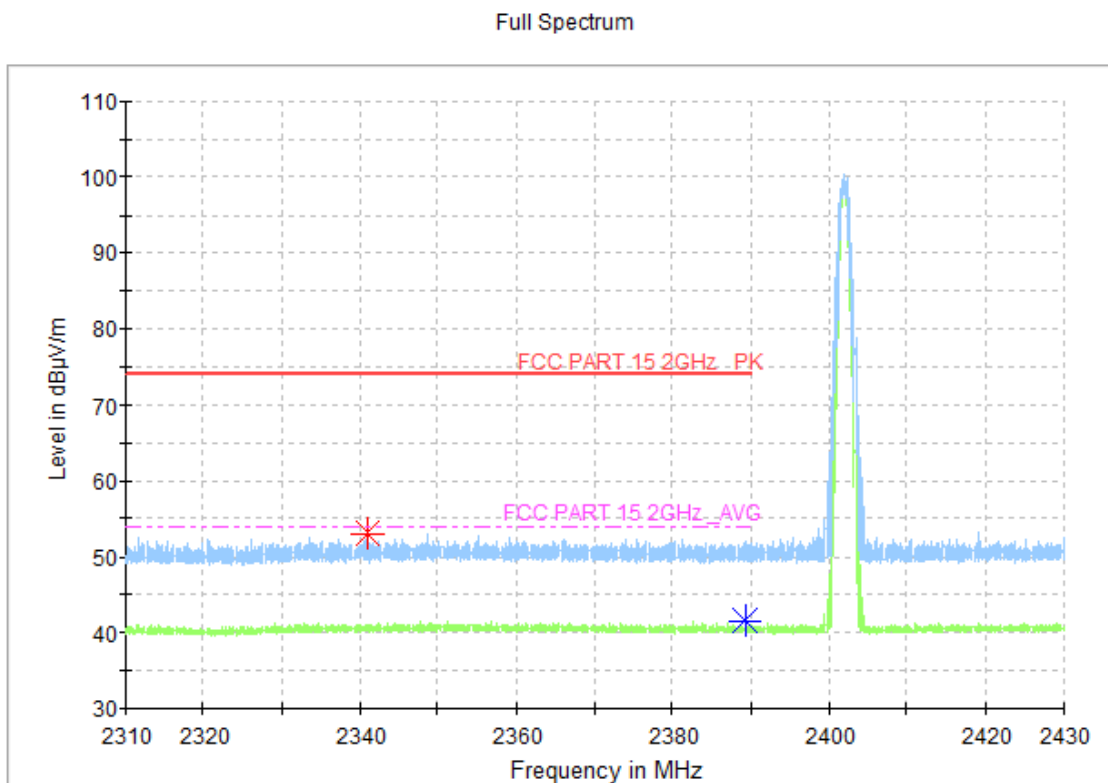
**Fig.59. Frequency Band Edges: GFSK, Channel 78, Hopping Off, ch11, 2.45 GHz - 2.50GHz**



**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

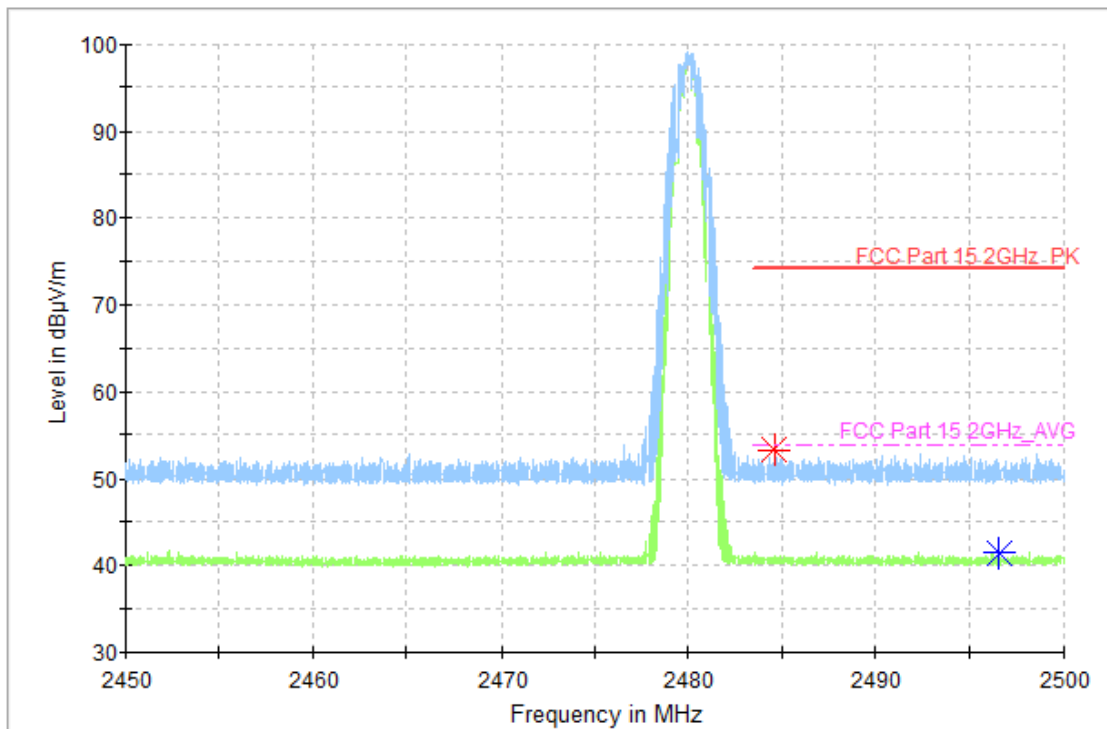


Fig.63. Frequency Band Edges: 8DPSK, Channel 78, 2.45 GHz - 2.50GHz

## 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	0.37	Fig.65	319	118.03	P
	DH3	Fig.66	1.63	Fig.67	102	166.26	P
	DH5	Fig.68	2.88	Fig.69	76	218.88	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	321	121.98	P
	2DH3	Fig.72	1.63	Fig.73	111	180.93	P
	2DH5	Fig.74	2.88	Fig.75	62	178.56	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	115	187.45	P
	3DH5	Fig.80	2.88	Fig.81	59	169.92	P

**Conclusion: PASS**

**Test graphs as below:**

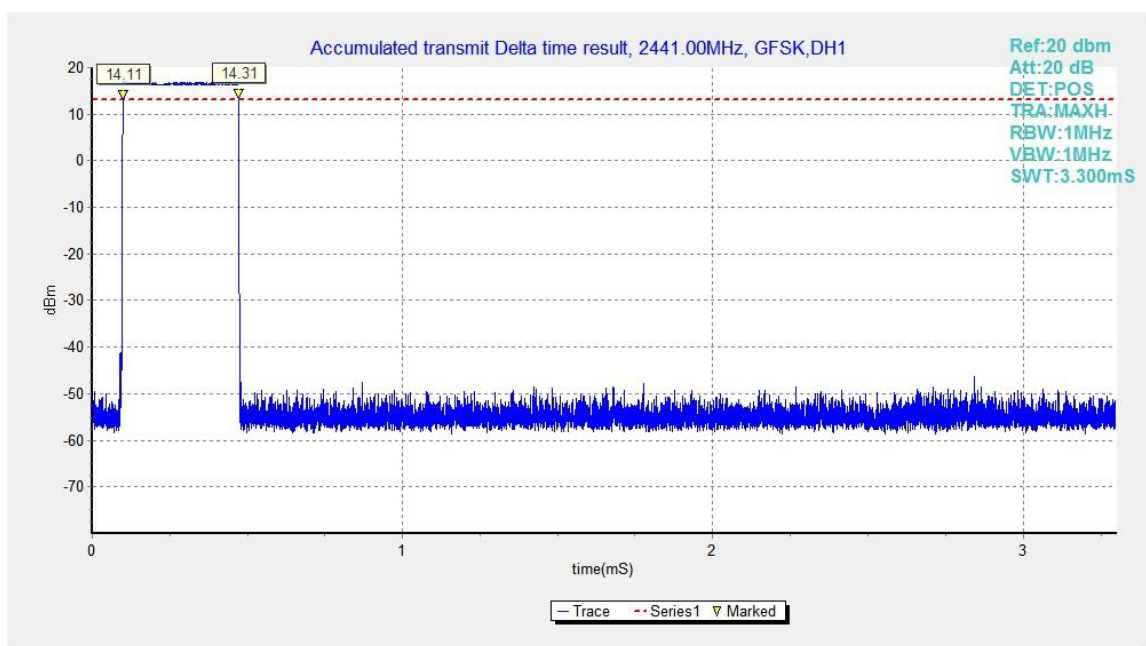


Fig.64. Time of occupancy (Dwell Time): Channel 39, Packet DH1

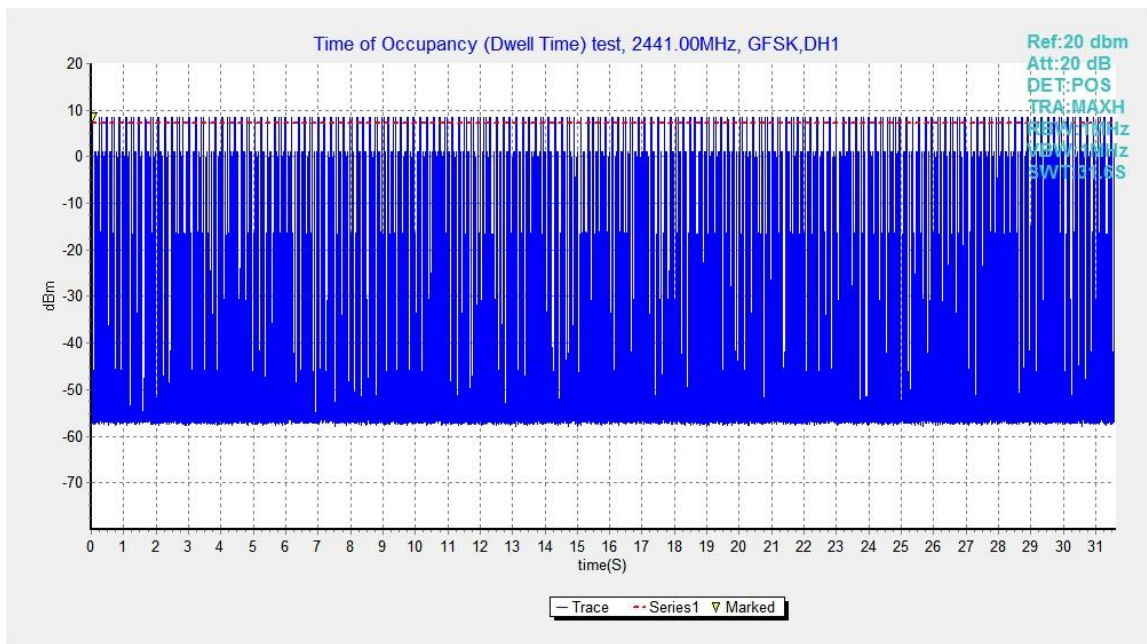


Fig.65. Number of Transmissions Measurement:Channel 39,Packet DH1

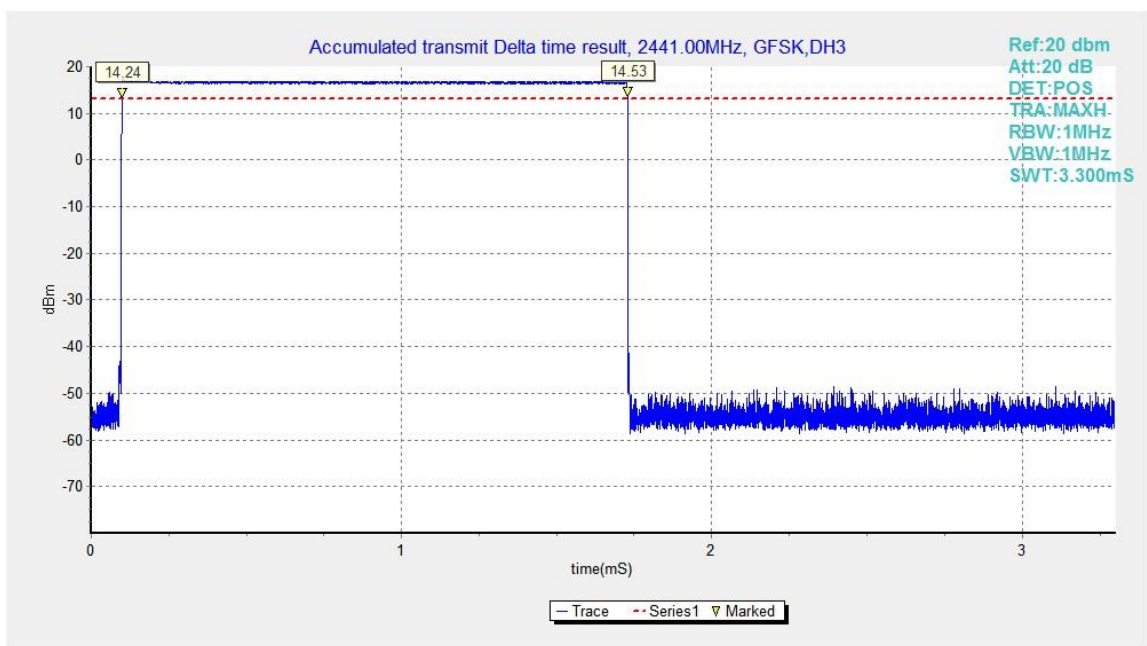


Fig.66. Time of occupancy (Dwell Time): Channel 39, Packet DH3



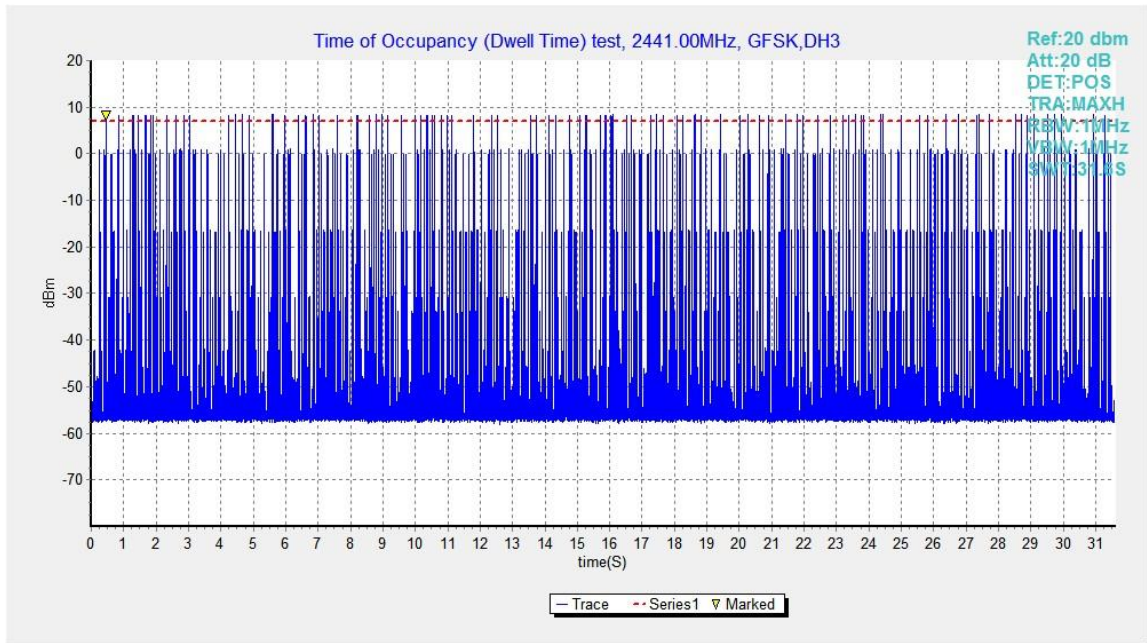


Fig.67. Number of Transmissions Measurement:Channel 39,Packet DH3

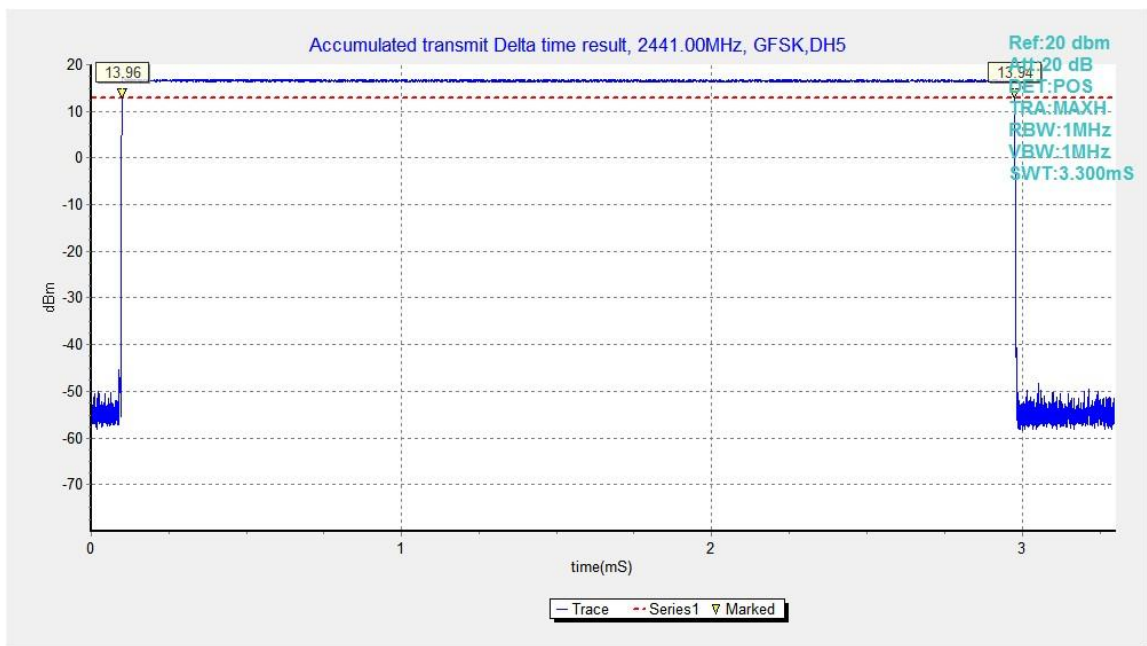


Fig.68. Time of occupancy (Dwell Time): Channel 39, Packet DH5

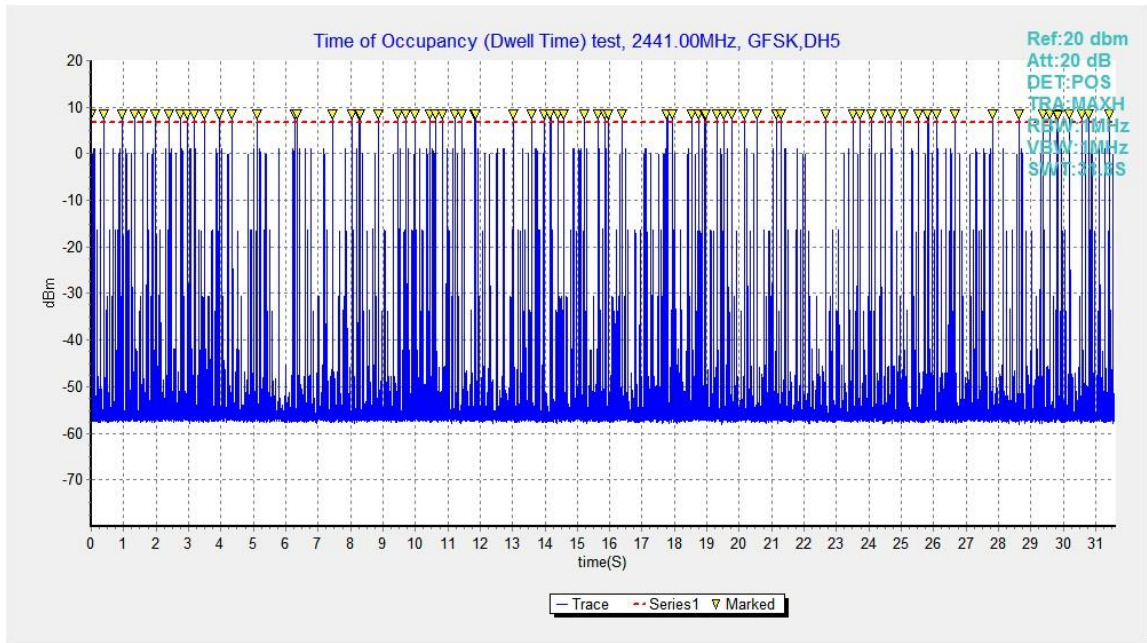


Fig.69. Number of Transmissions Measurement: Channel 39, Packet DH5

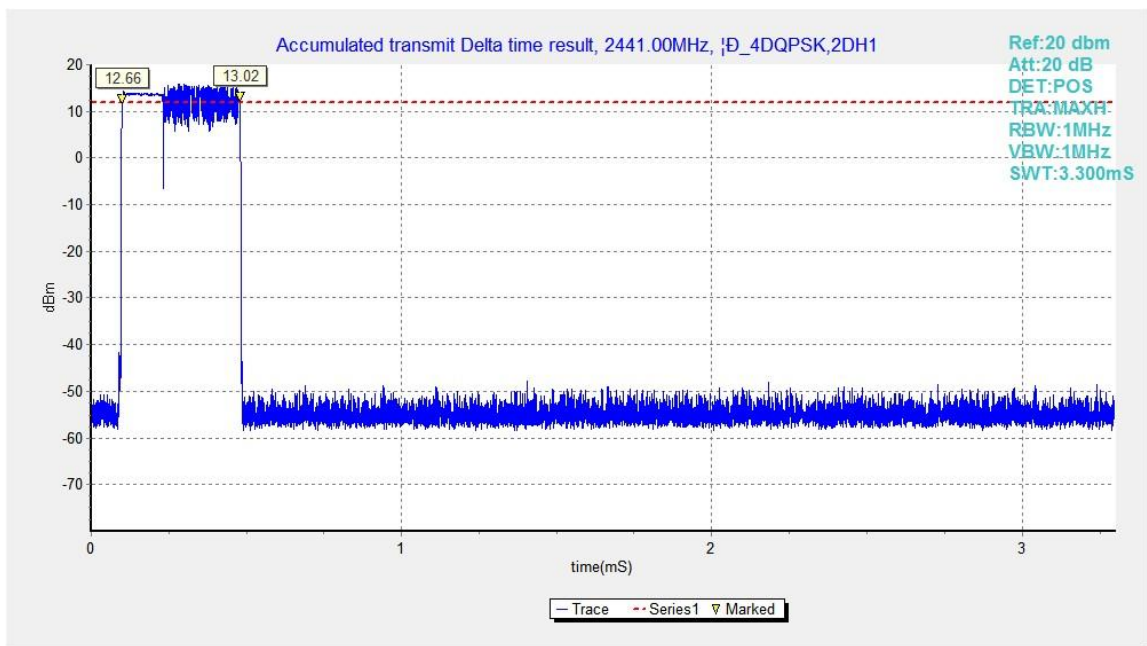


Fig.70. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH1

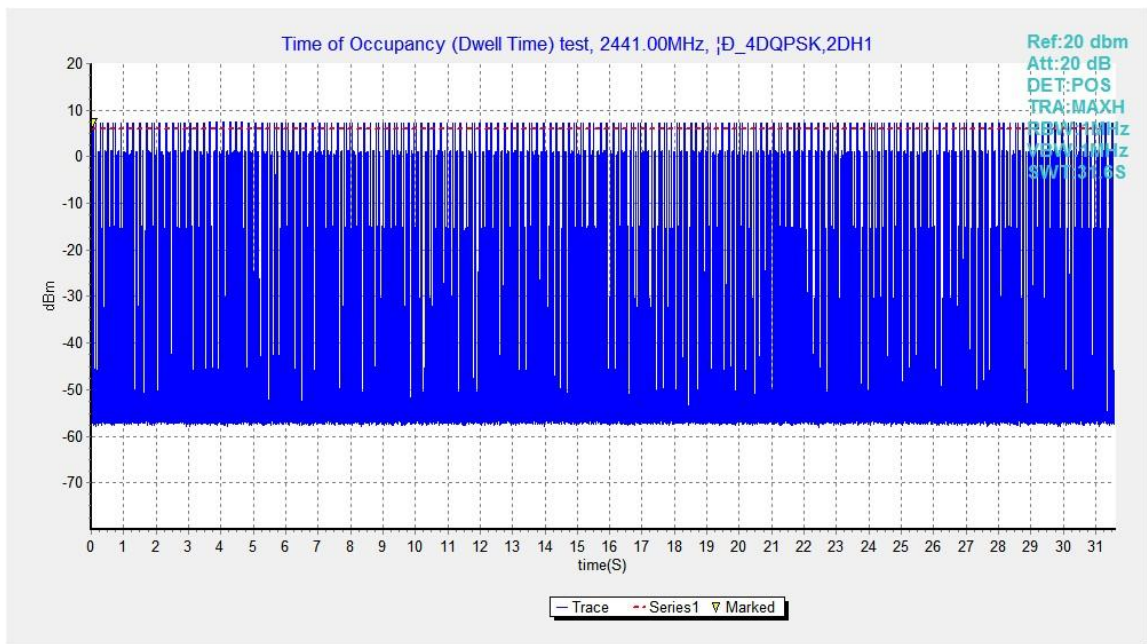


Fig.71. Number of Transmissions Measurement:Channel 39,Packet 2-DH1

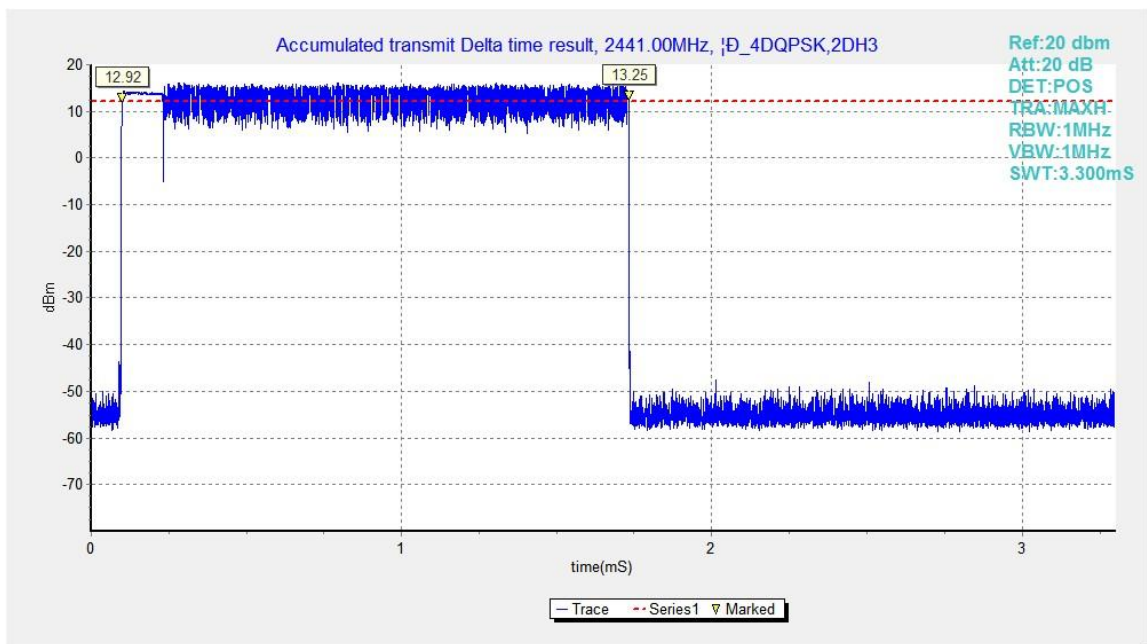


Fig.72. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH3

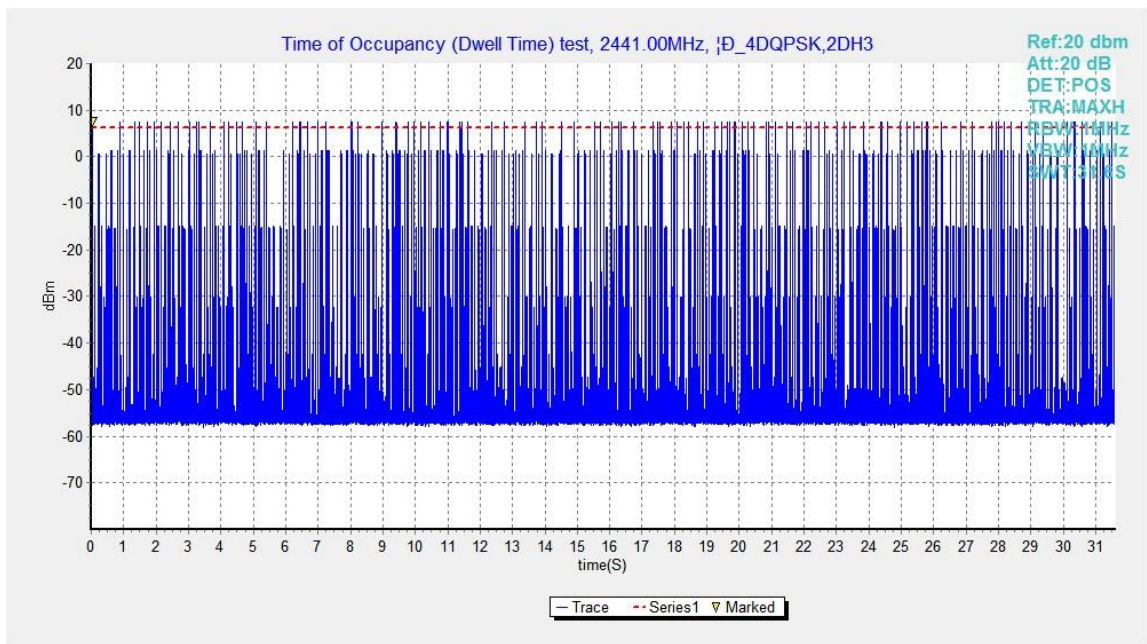


Fig.73. Number of Transmissions Measurement:Channel 39,Packet 2-DH3

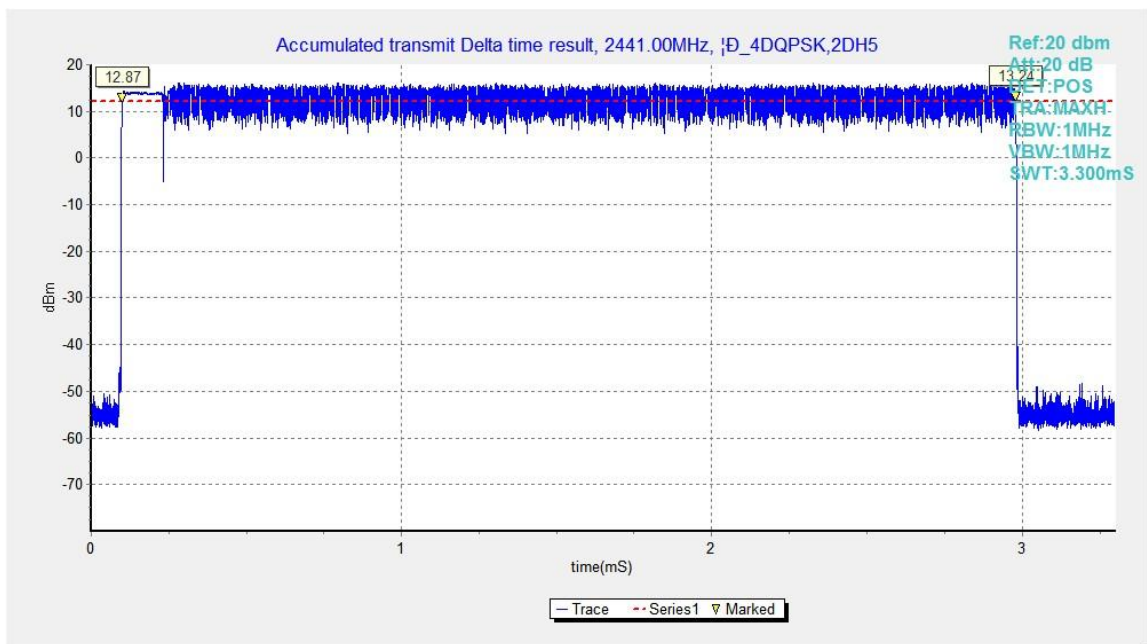


Fig.74. Time of occupancy (Dwell Time): Channel 39, Packet 2-DH5



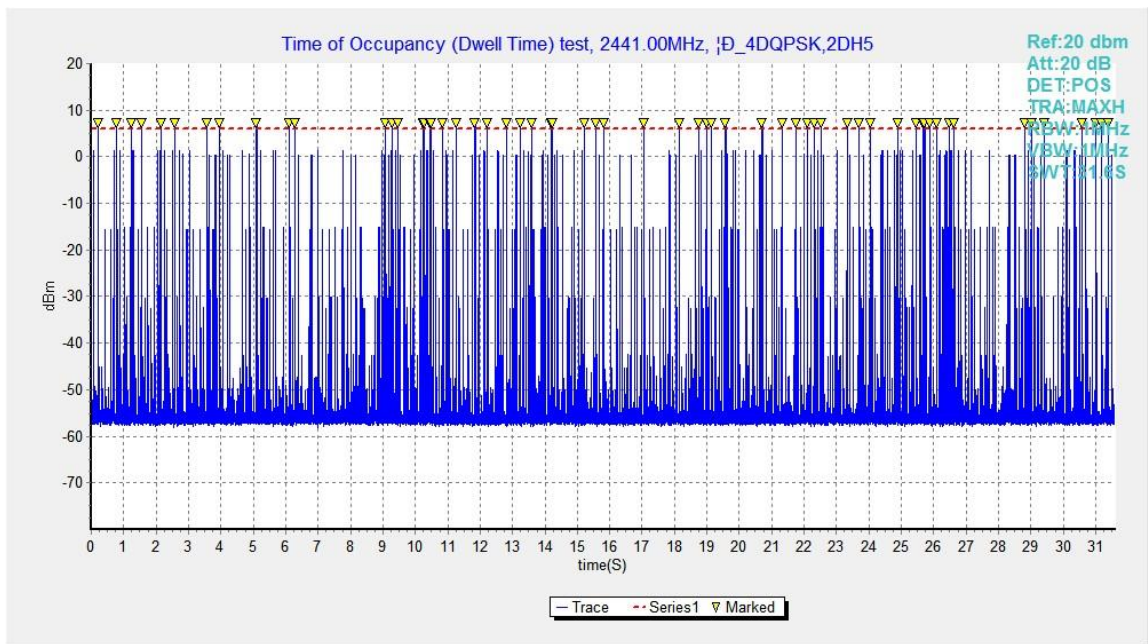


Fig.75. Number of Transmissions Measurement:Channel 39,Packet 2-DH5

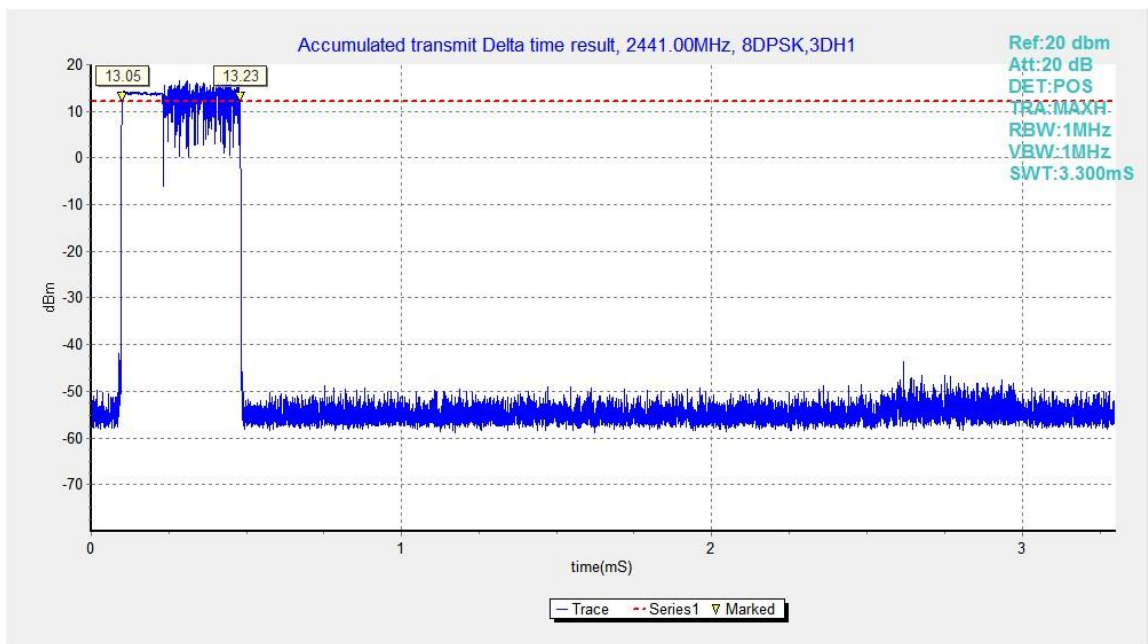


Fig.76. Time of occupancy (Dwell Time): Channel 39, Packet 3-DH1

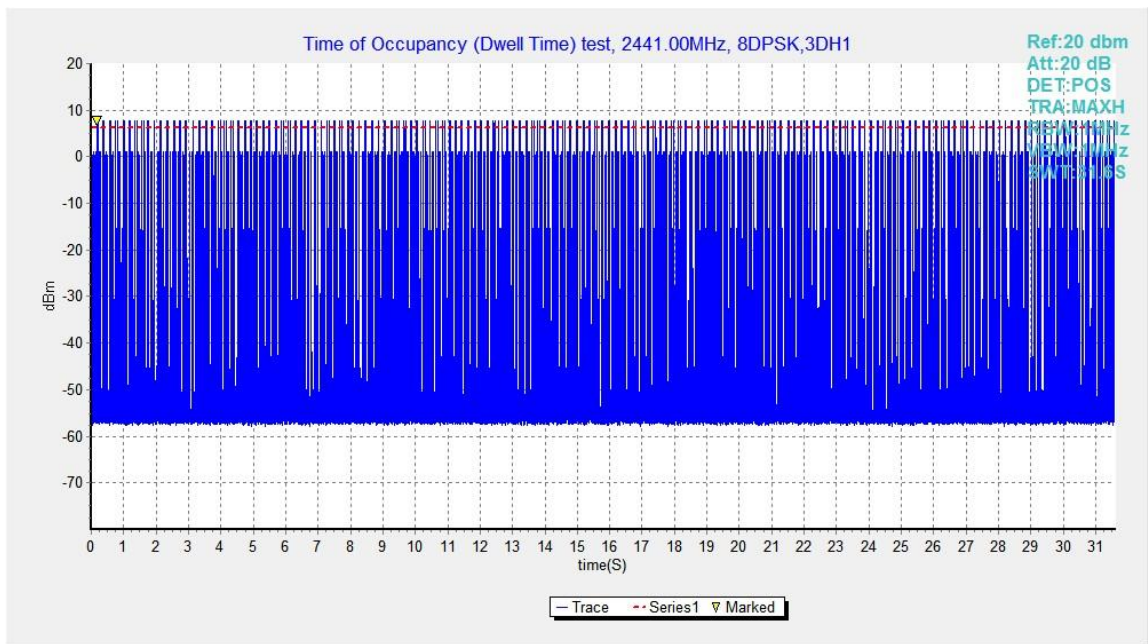


Fig.77. Number of Transmissions Measurement:Channel 39,Packet 3-DH1

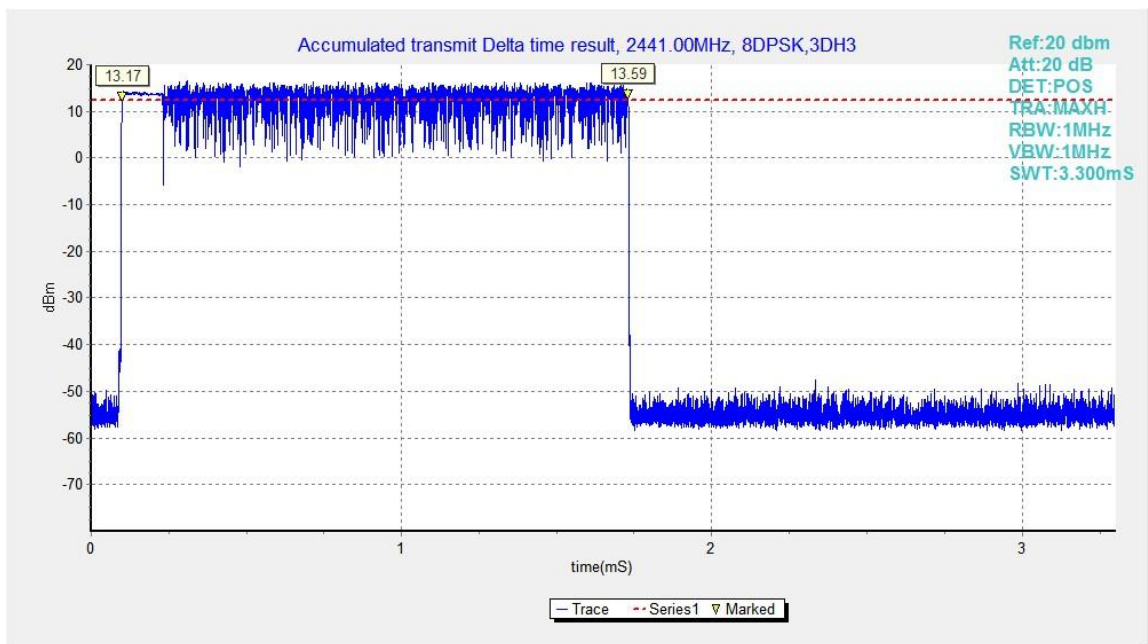


Fig.78. Time of occupancy (Dwell Time): Channel 39, Packet 3-DH3

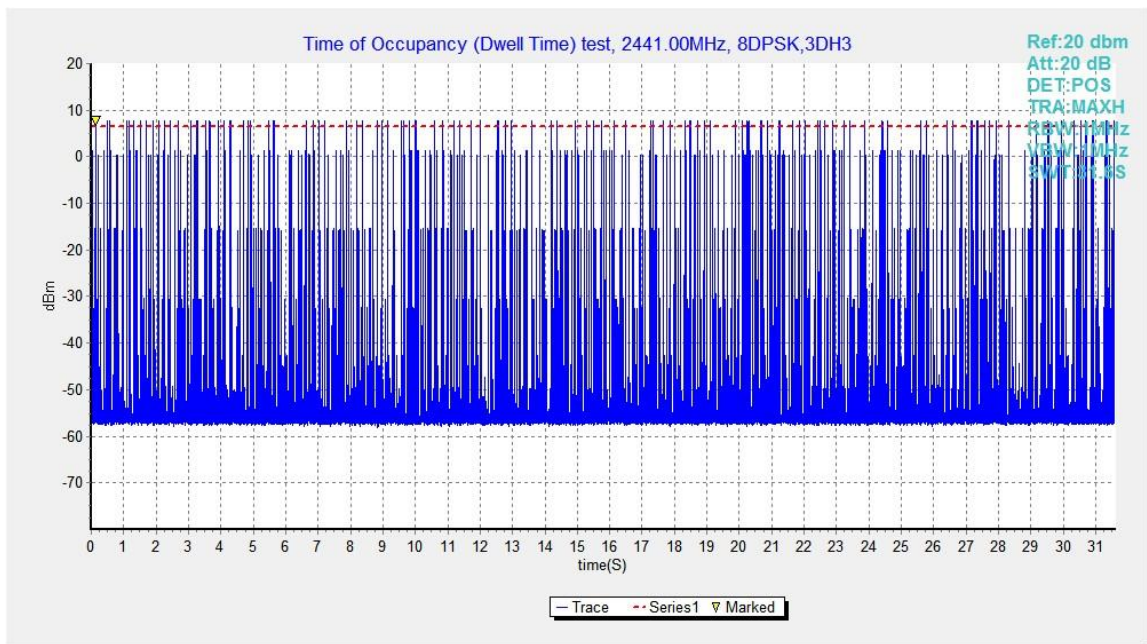


Fig.79. Number of Transmissions Measurement:Channel 39,Packet 3-DH3

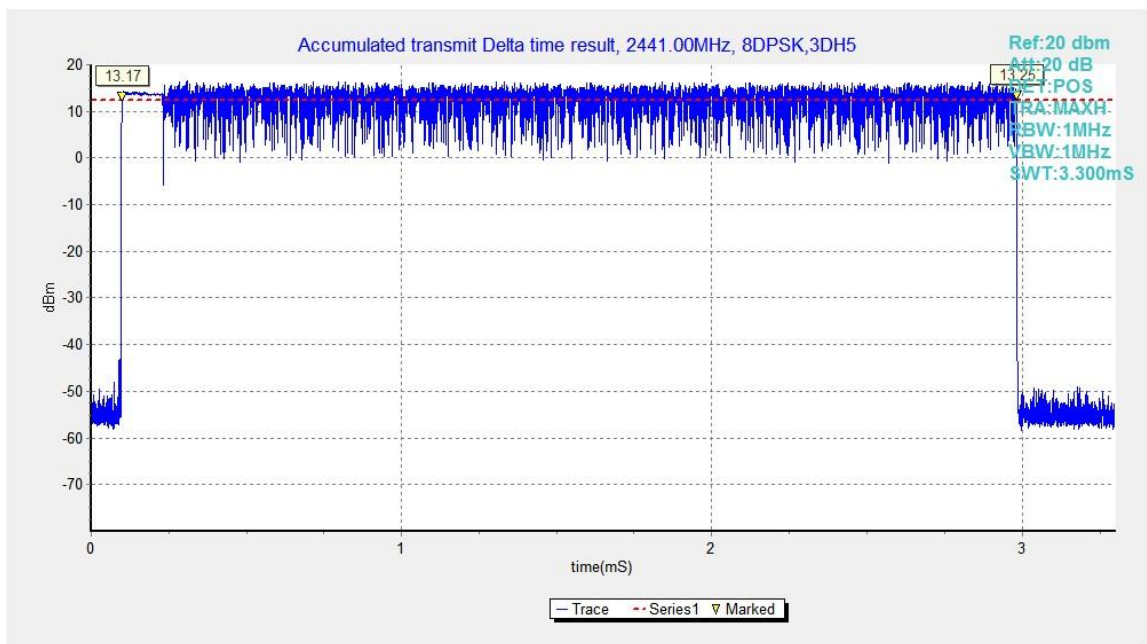


Fig.80. Time of occupancy (Dwell Time): Channel 39, Packet 3-DH5

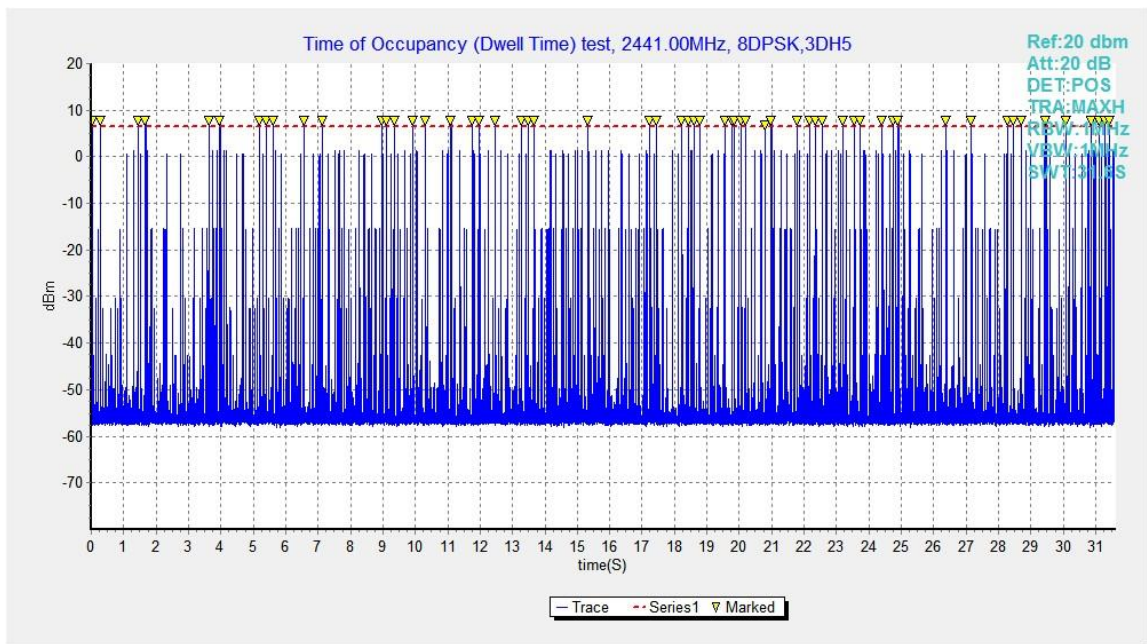


Fig.81. Number of Transmissions Measurement:Channel 39,Packet 3-DH5



## B.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	939.00	NA
39	Fig.83	938.25	NA
78	Fig.84	947.25	NA

#### For $\pi/4$ DQPSK

Channel	20dB Bandwidth (kHz)		Conclusion
0	Fig.85	1297.50	NA
39	Fig.86	1282.50	NA
78	Fig.87	1284.00	NA

#### For 8DPSK

Channel	20dB Bandwidth (kHz)		Conclusion
0	Fig.88	1298.25	NA
39	Fig.89	1283.25	NA
78	Fig.90	1283.25	NA

**Conclusion: NA**

**Test graphs as below:**

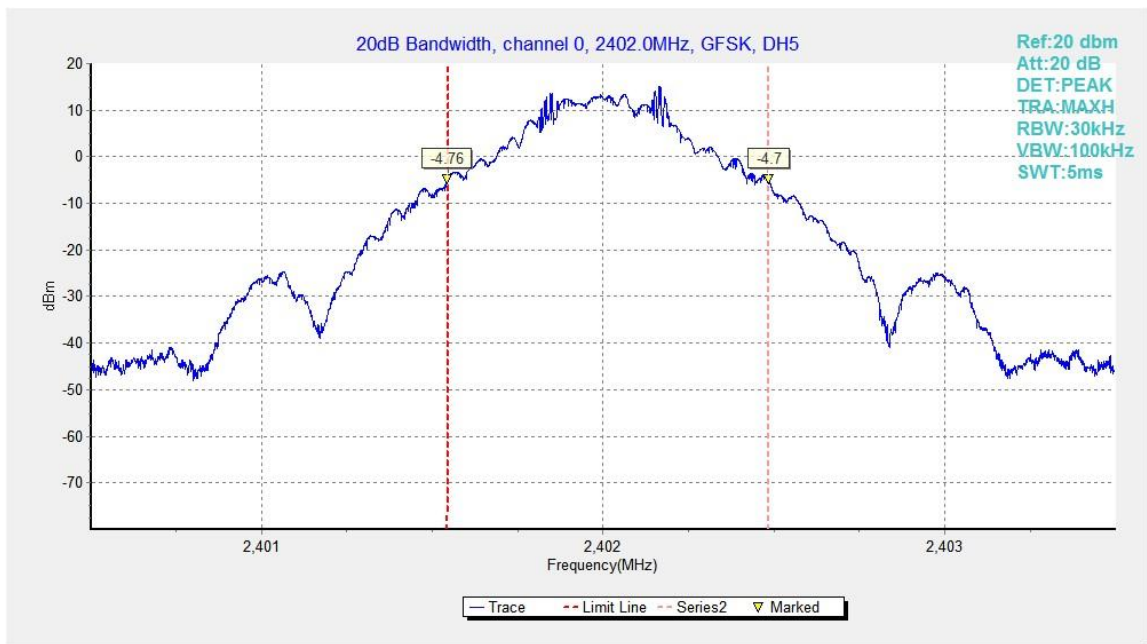


Fig.82. 20dB Bandwidth: GFSK, Channel 0

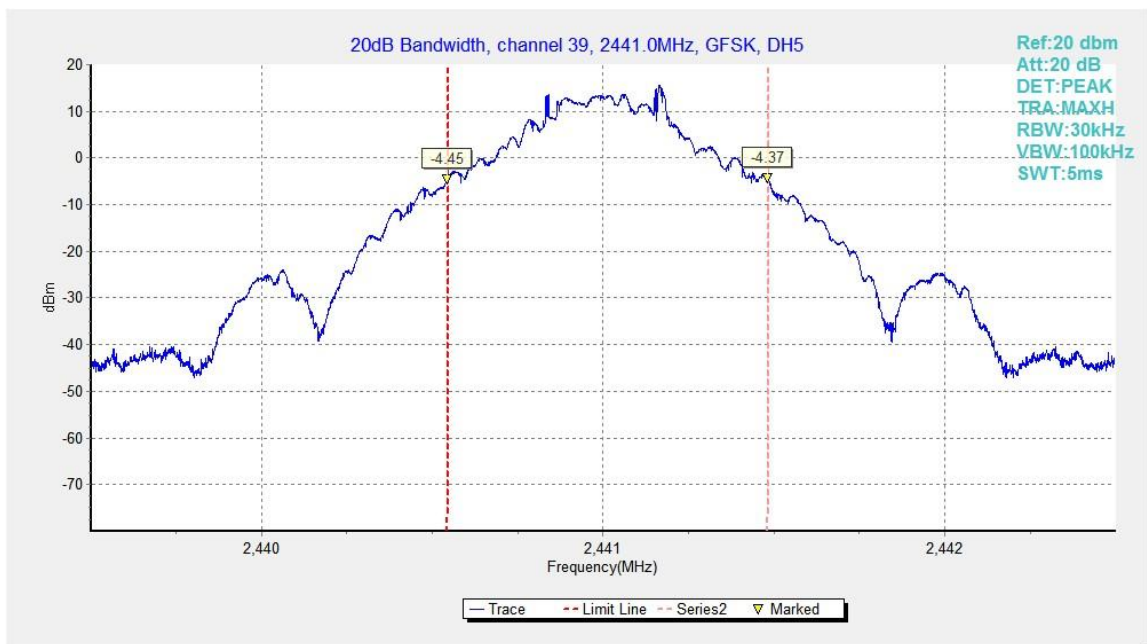


Fig.83. 20dB Bandwidth: GFSK, Channel 39

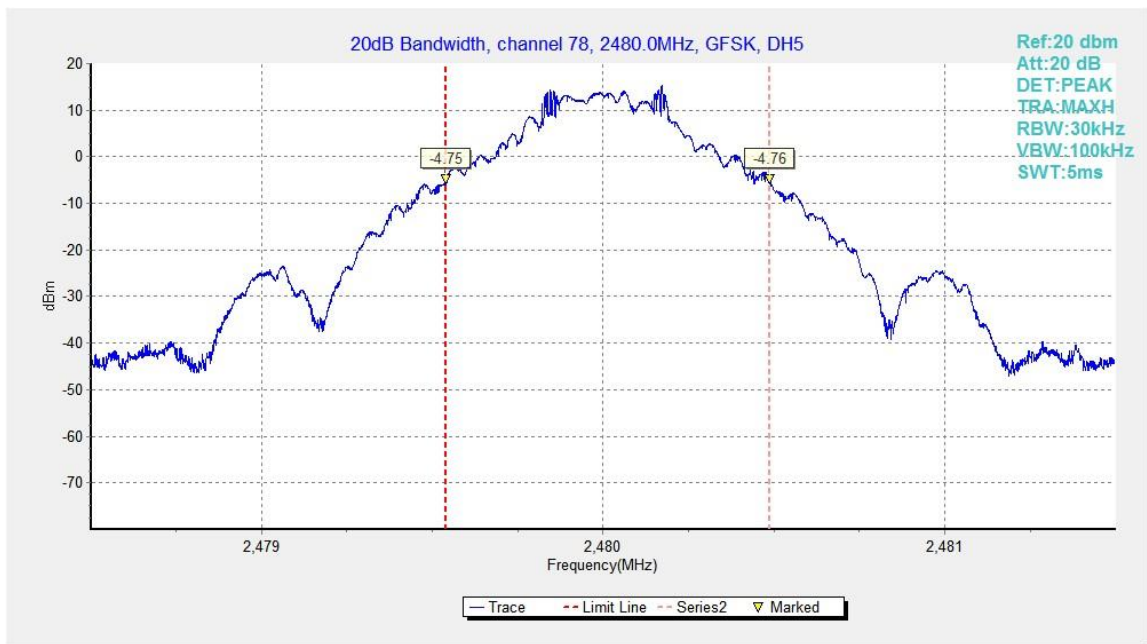


Fig.84. 20dB Bandwidth: GFSK, Channel 78

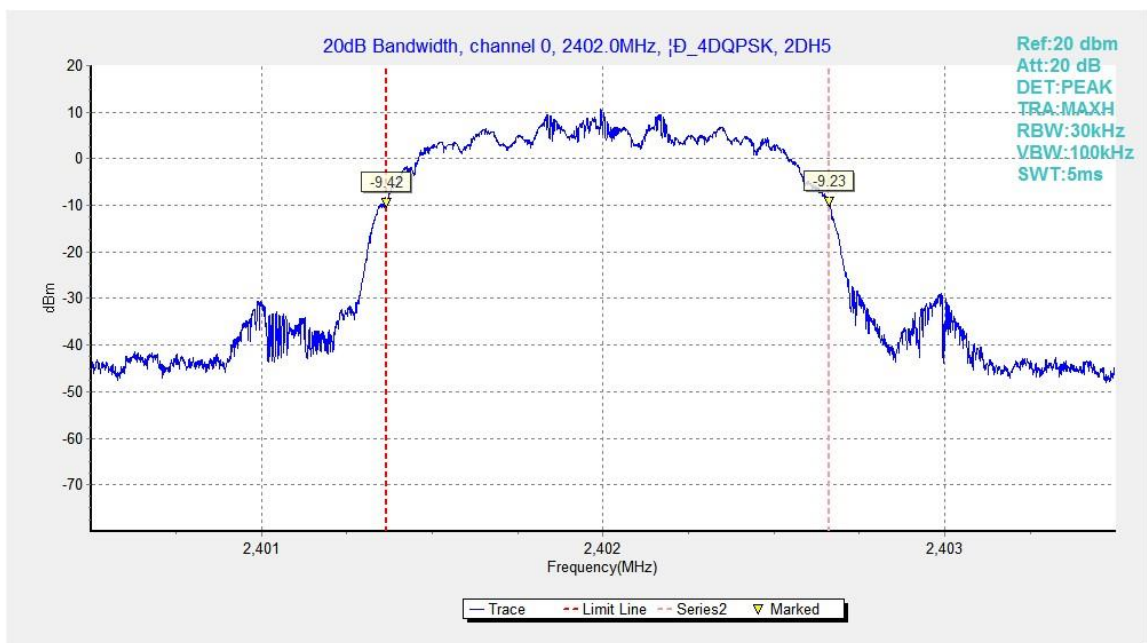


Fig.85. 20dB Bandwidth:  $\pi/4$  DQPSK, Channel 0

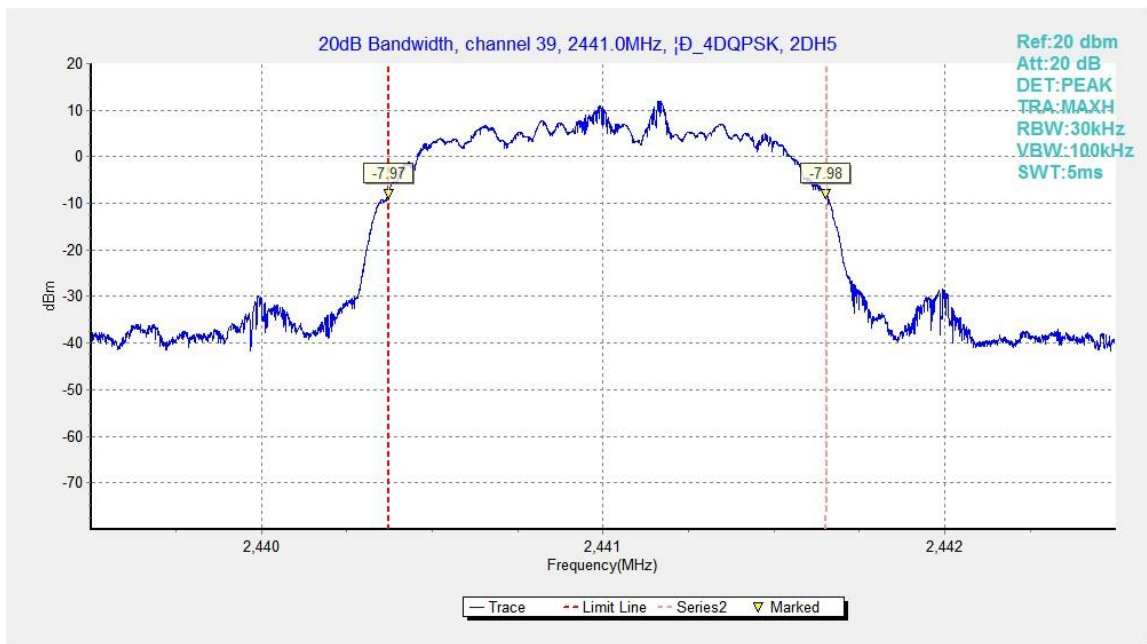


Fig.86. 20dB Bandwidth:  $\pi/4$  DQPSK, Channel 39

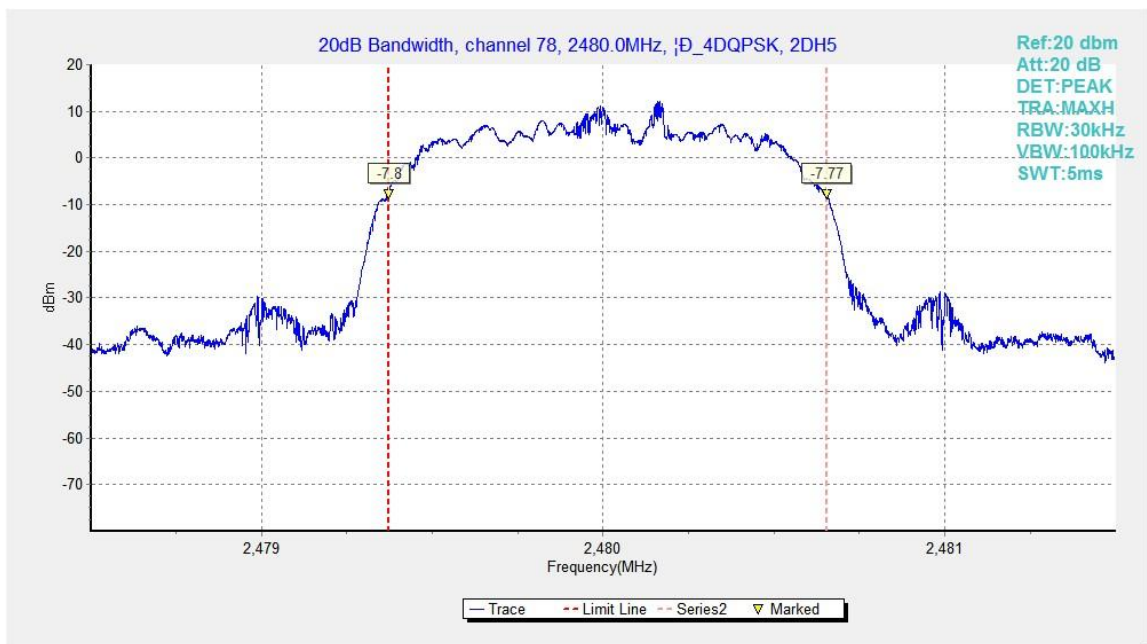


Fig.87. 20dB Bandwidth:  $\pi/4$  DQPSK, Channel 78

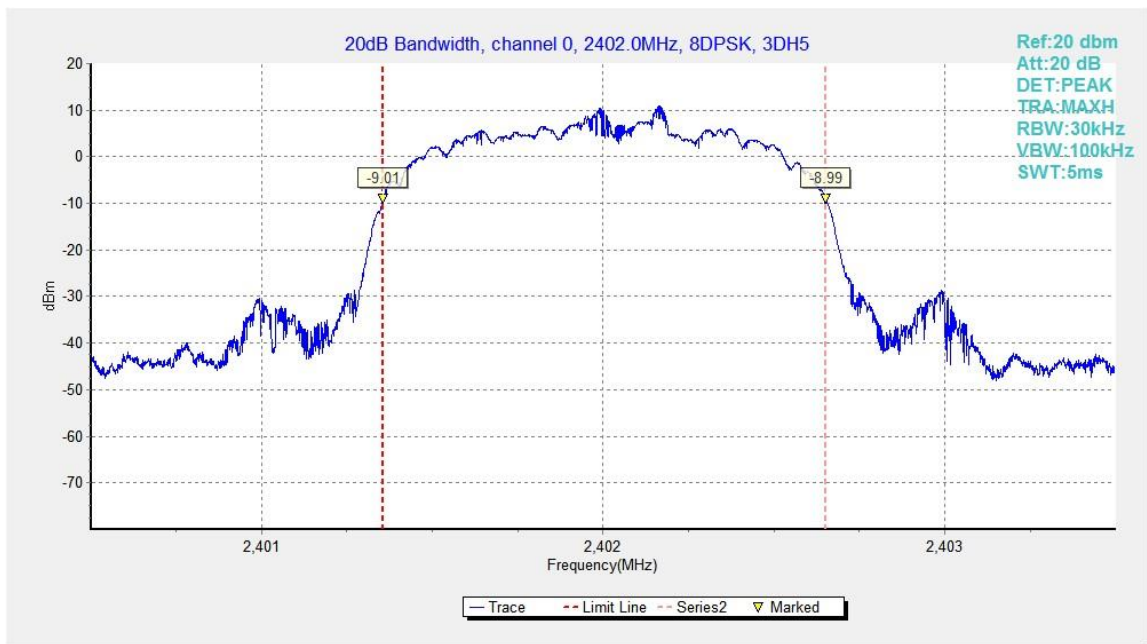


Fig.88. 20dB Bandwidth: 8DPSK, Channel 0

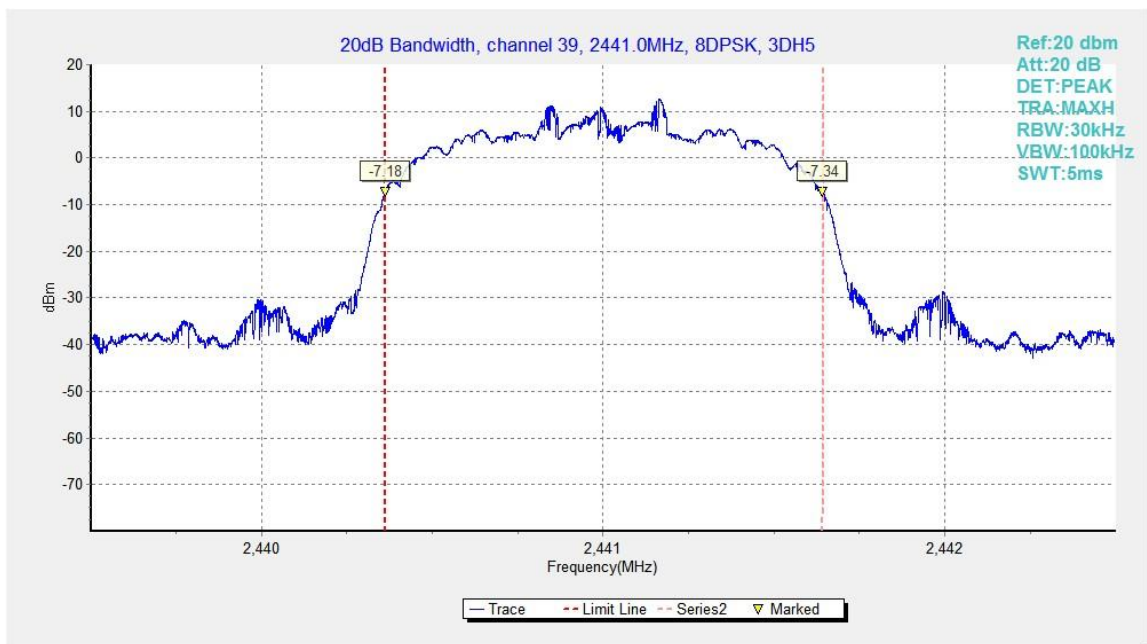


Fig.89. 20dB Bandwidth: 8DPSK, Channel 39

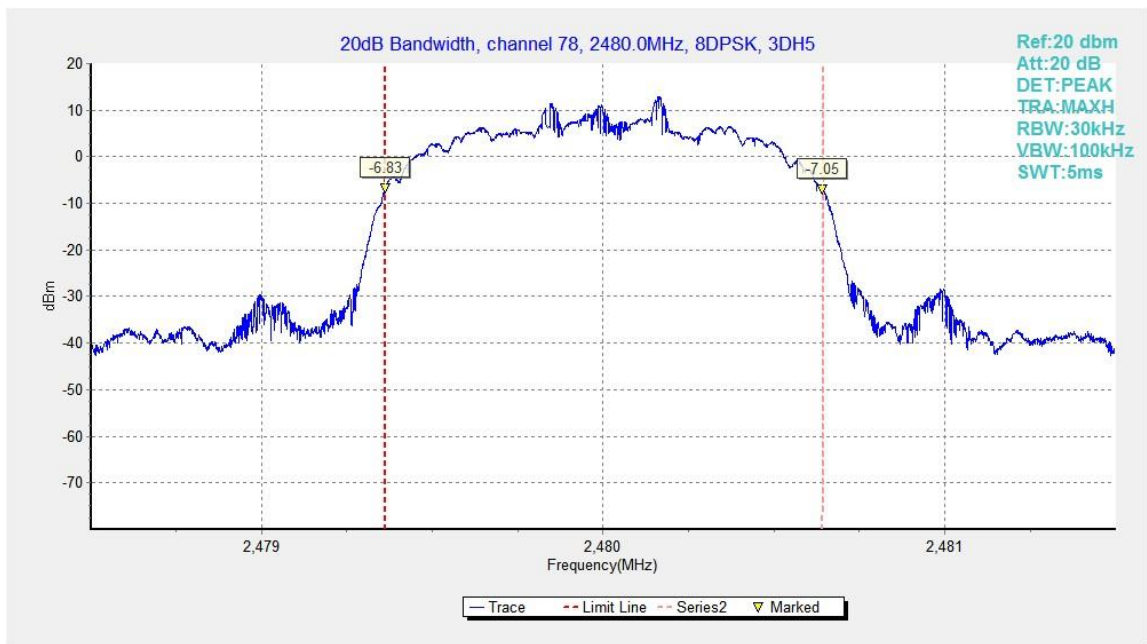


Fig.90. 20dB Bandwidth: 8DPSK, Channel 78



## B.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	849.00	P

#### For $\pi/4$ DQPSK

Channel	Carrier frequency separation (kHz)		Conclusion
39	Fig.92	1249.50	P

#### For 8DPSK

Channel	Carrier frequency separation (kHz)		Conclusion
39	Fig.93	1002.75	P

**Conclusion: PASS**

**Test graphs as below:**

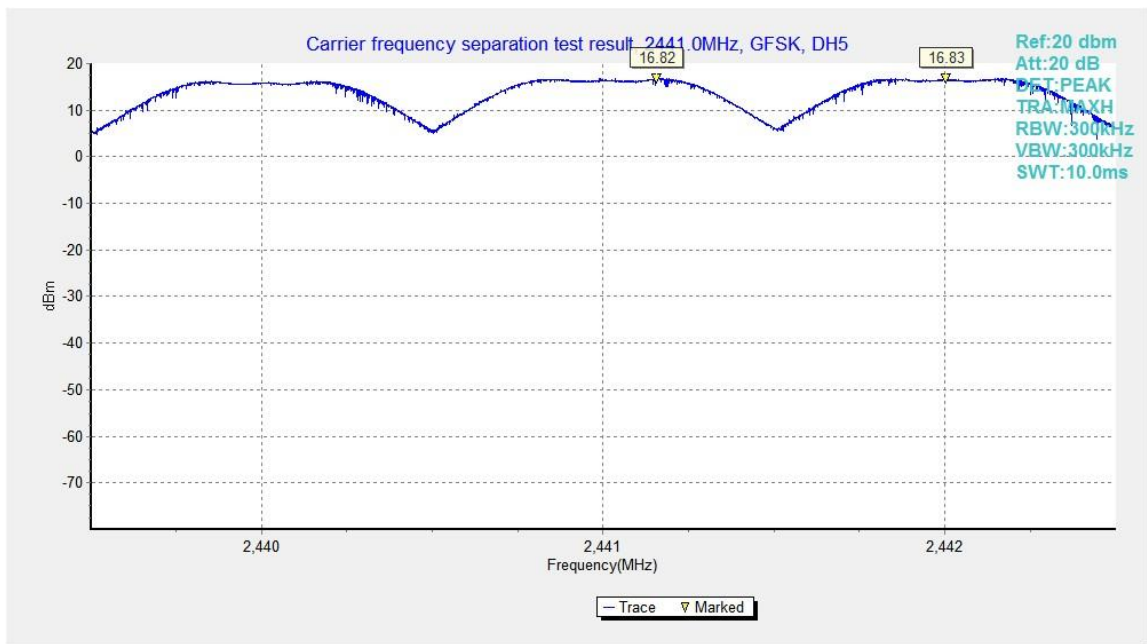


Fig.91. Carrier frequency separation measurement: GFSK, Channel 39

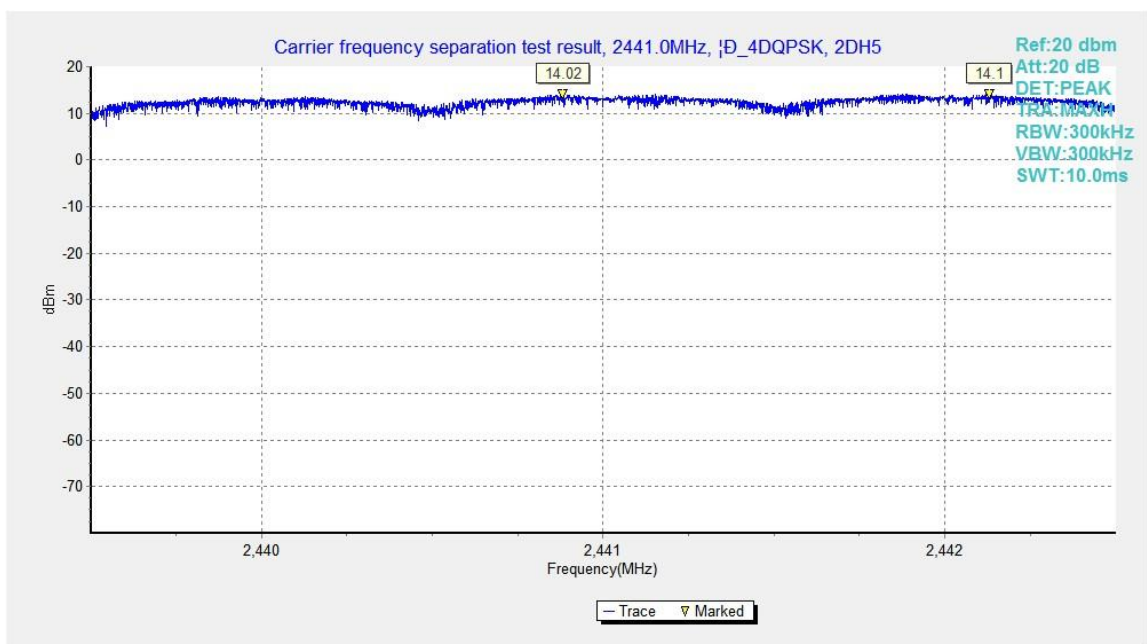


Fig.92. Carrier frequency separation measurement:  $\pi/4$  DQPSK, Channel 39



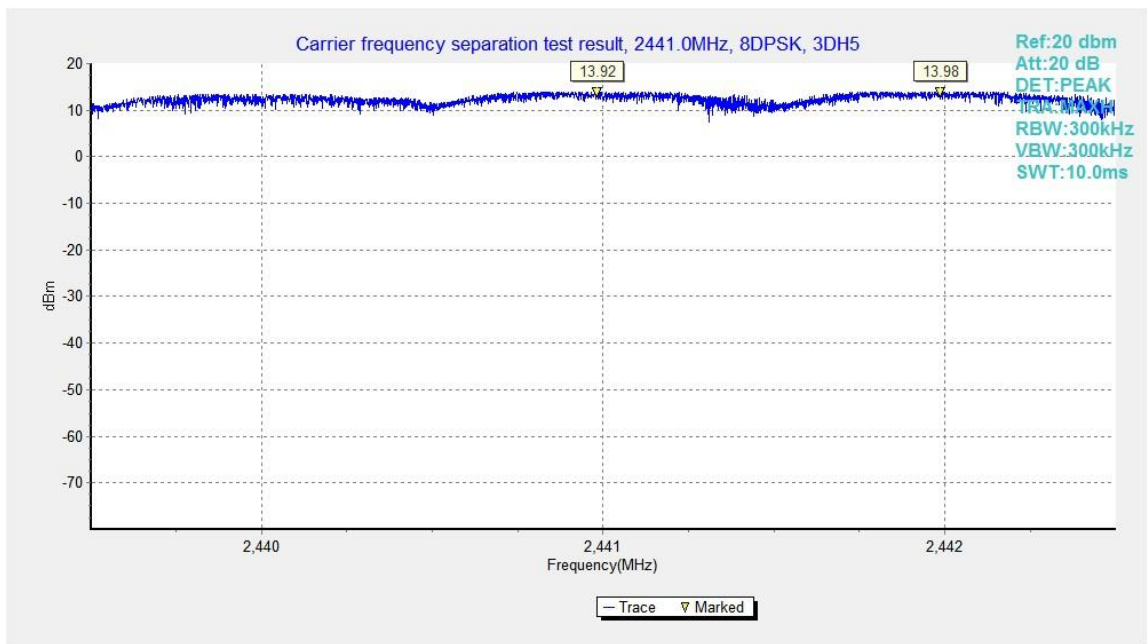


Fig.93. Carrier frequency separation measurement: 8DPSK, Channel 39

## B.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:**

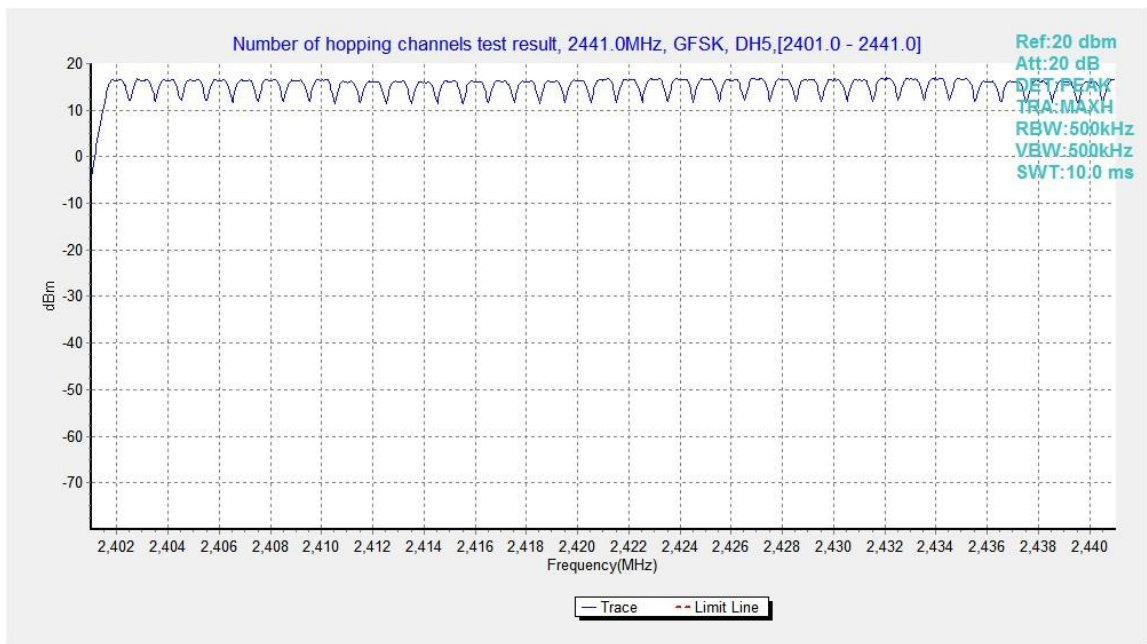


Fig.94. Number of hopping frequencies: GFSK, Channel 0 - 39

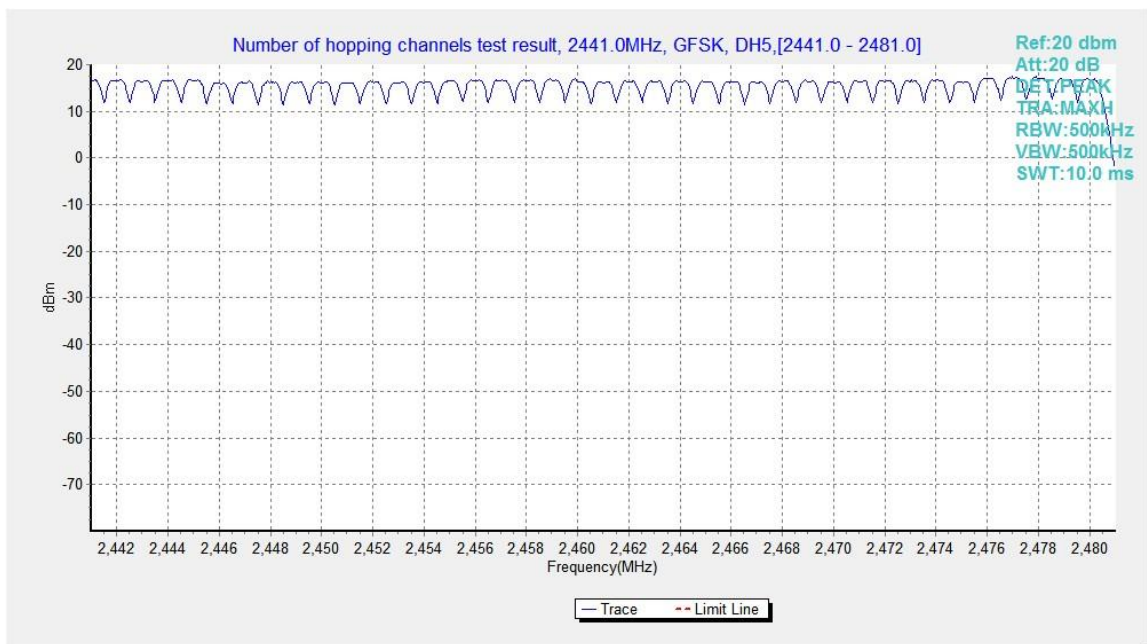
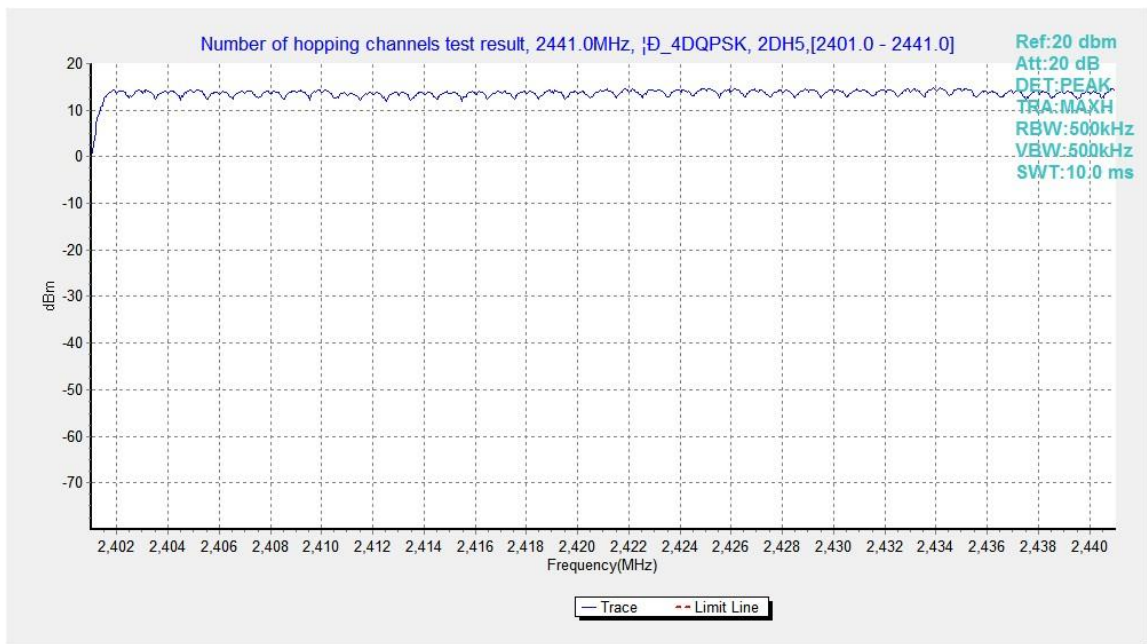
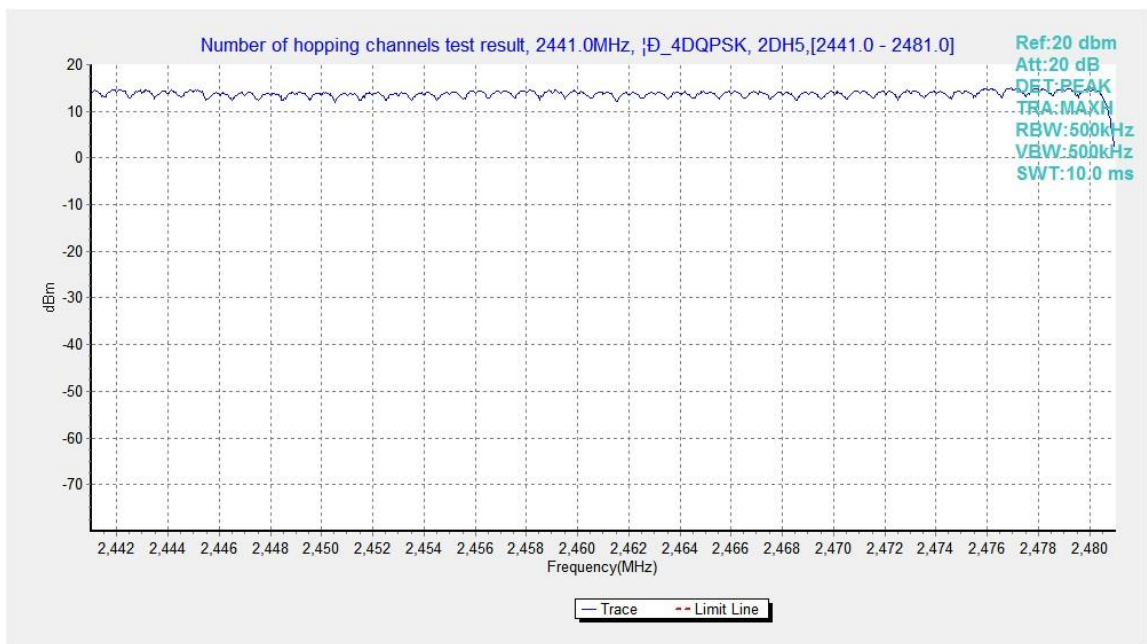


Fig.95. Number of hopping frequencies: GFSK, Channel 40 - 78

Fig.96. Number of hopping frequencies:  $\pi/4$  DQPSK, Channel 0 - 39Fig.97. Number of hopping frequencies:  $\pi/4$  DQPSK, Channel 40 - 78

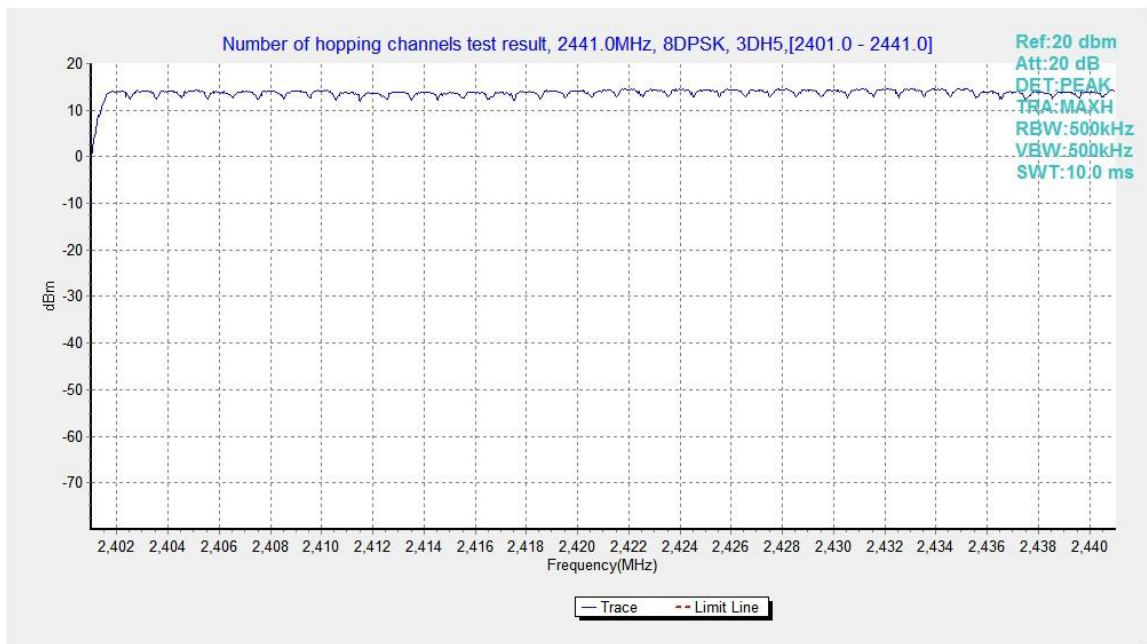


Fig.98. Number of hopping frequencies: 8DPSK, Channel 0 - 39

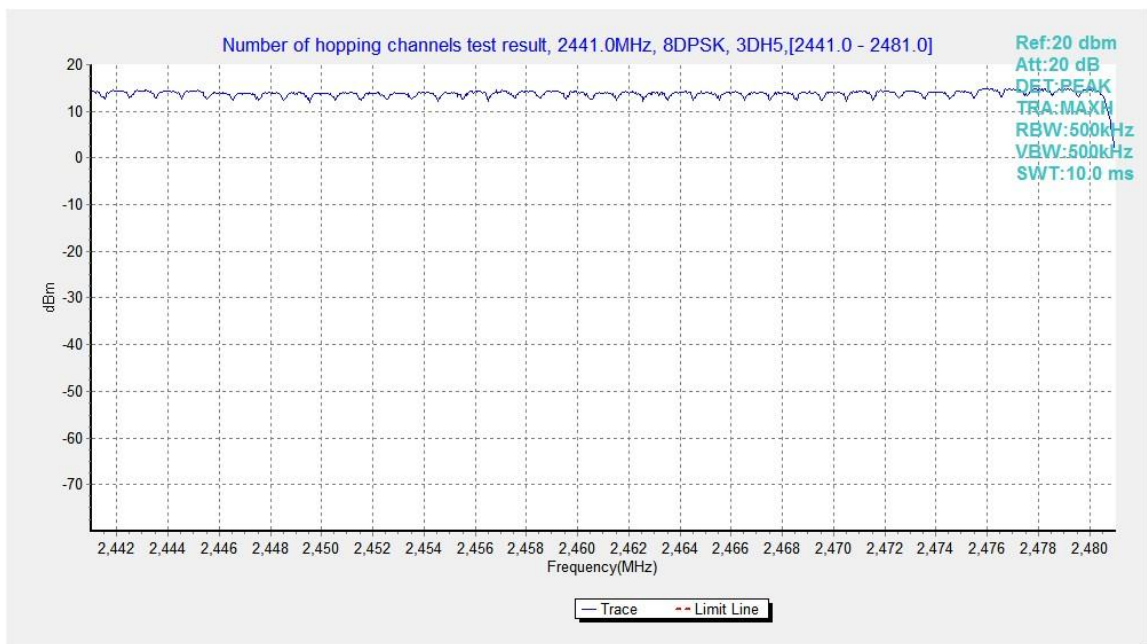


Fig.99. Number of hopping frequencies: 8DPSK, Channel 40 - 78

## B.10. AC Powerline Conducted Emission

### Summary

All AC line conducted spurious emissions are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section

### Method of Measurement:

See Clause 6.2 of ANSI C63.10 specifically.

See Clause 4 and Clause 5 of ANSI C63.10 generally.

The conducted emissions from the AC port of the EUT are measured in a shielding room. The EUT is connected to a Line Impedance Stabilization Network (LISN). An overview sweep with peak detection was performed. The measurements were performed with a quasi-peak detector and if required, an average detector.

The conducted emission measurements were made with the following detector of the test receiver: Quasi-Peak / Average Detector.

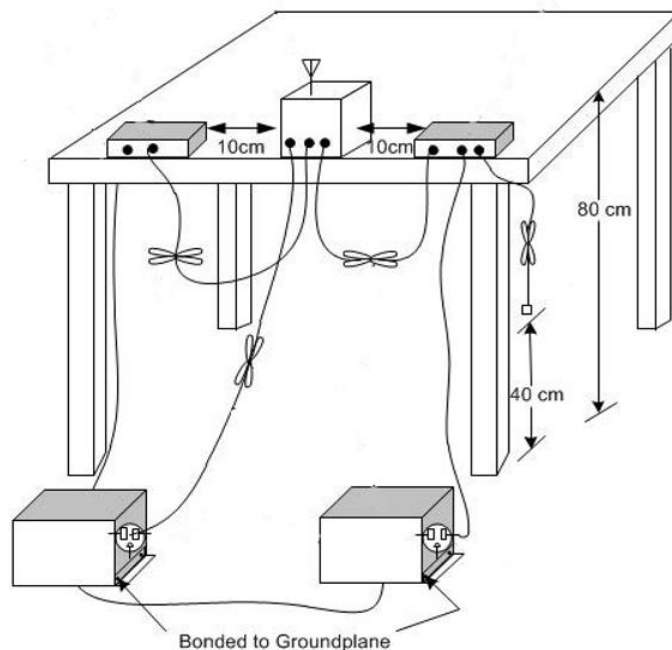
The measurement bandwidth is:

Frequency of Emission (MHz)	RBW/IF bandwidth
0.15-30	9kHz

### Test Condition:

Voltage (V)	Frequency (Hz)
120	60

### Test setup



### Measurement Result and limit:



**Bluetooth (Quasi-peak Limit)**

Frequency range (MHz)	Quasi-peak Limit (dB $\mu$ V)	Result (dB $\mu$ V)		Conclusion
		With charger AE2-1		
		bluetooth	Idle	
0.15 to 0.5	66 to 56	Fig.B.10.1	Fig.B.10.2	<b>P</b>
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 $\mu$ V)	Result (dB $\mu$ V)		Conclusion
		With charger AE2-1		
		bluetooth	Idle	
0.15 to 0.5	56 to 46	Fig.B.10.1	Fig.B.10.2	<b>P</b>
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.

**Bluetooth (Quasi-peak Limit)**

Frequency range (MHz)	Quasi-peak Limit (dB $\mu$ V)	Result (dB $\mu$ V)		Conclusion
		With charger AE2-2		
		bluetooth	Idle	
0.15 to 0.5	67 to 56	Fig.B.10.3	/	<b>P</b>
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.

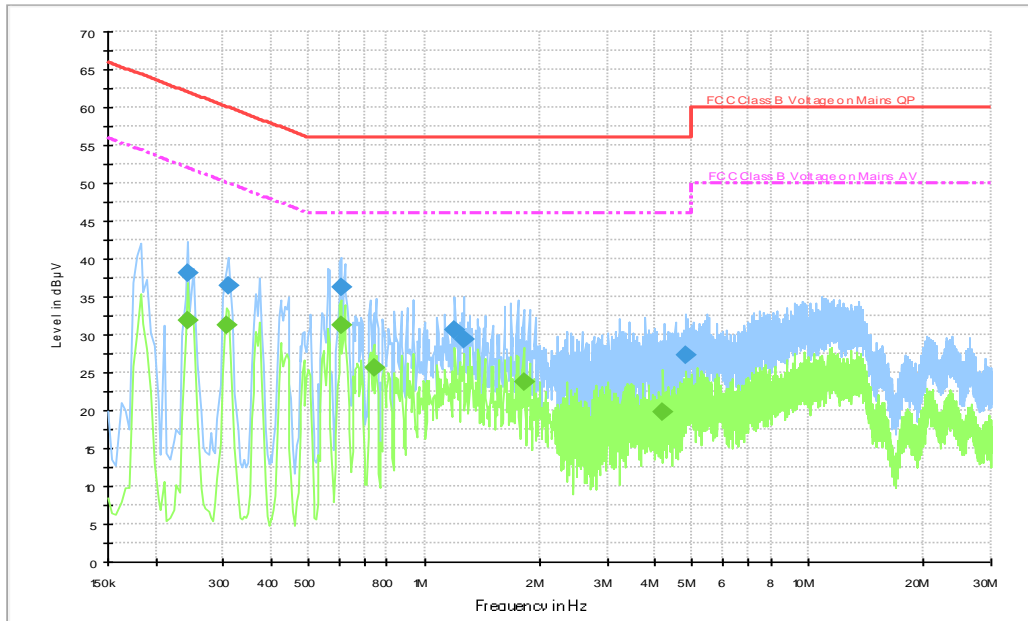
**Bluetooth (Average Limit)**

Frequency range (MHz)	Average Limit (dB $\mu$ V)	Result (dB $\mu$ V)		Conclusion
		With charger AE2-2		
		bluetooth	Idle	
0.15 to 0.5	56 to 46	Fig.B.10.3	/	<b>P</b>
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.

**Conclusion: Pass**

**Test graphs as below:**



**Fig.B.10.1 AC Powerline Conducted Emission-Bluetooth(AE2-1)**

Note: The graphic result above is the maximum of the measurements for both phase line and neutral line.

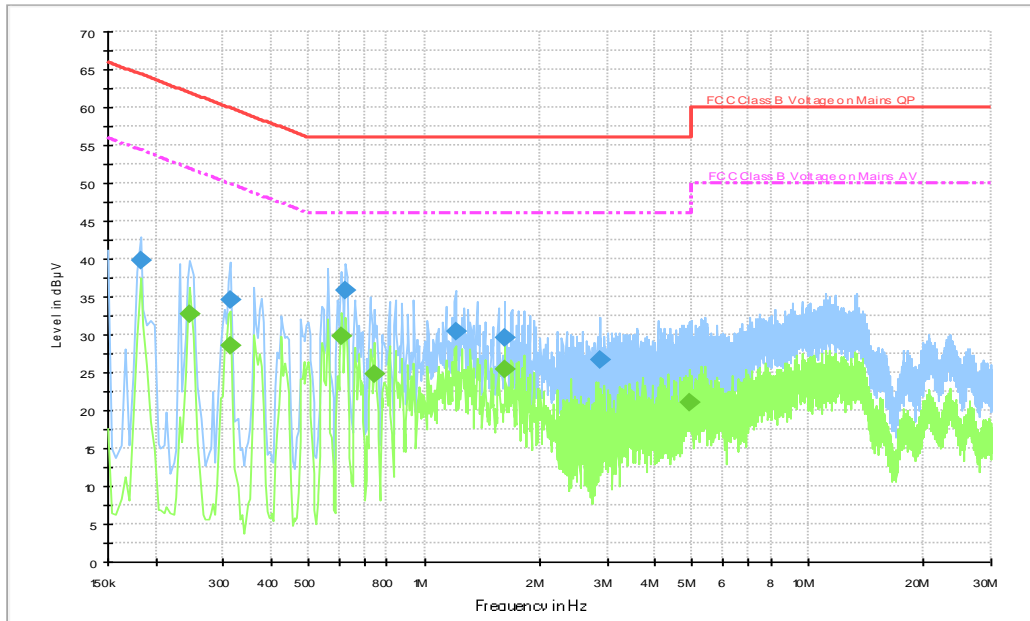
**Final Result 1**

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.242000	38.1	2000.	9.000	On	N	19.7	23.9	62.0
0.310000	36.5	2000.	9.000	On	N	19.7	23.5	60.0
0.606000	36.2	2000.	9.000	On	N	19.7	19.8	56.0
1.202000	30.6	2000.	9.000	On	N	19.6	25.4	56.0
1.270000	29.4	2000.	9.000	On	N	19.6	26.6	56.0
4.786000	27.2	2000.	9.000	On	N	19.6	28.8	56.0

**Final Result 2**

Frequency (MHz)	CAverage (dBµV)	Meas. Time	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.242000	32.0	2000.	9.000	On	N	19.7	20.1	52.0
0.306000	31.2	2000.	9.000	On	N	19.7	18.8	50.1
0.606000	31.2	2000.	9.000	On	N	19.7	14.8	46.0
0.738000	25.5	2000.	9.000	On	N	19.7	20.5	46.0
1.814000	23.7	2000.	9.000	On	N	19.6	22.3	46.0
4.198000	19.8	2000.	9.000	On	N	19.6	26.2	46.0





**Fig.B.10.2 AC Powerline Conducted Emission-Idle(AE2-1)**

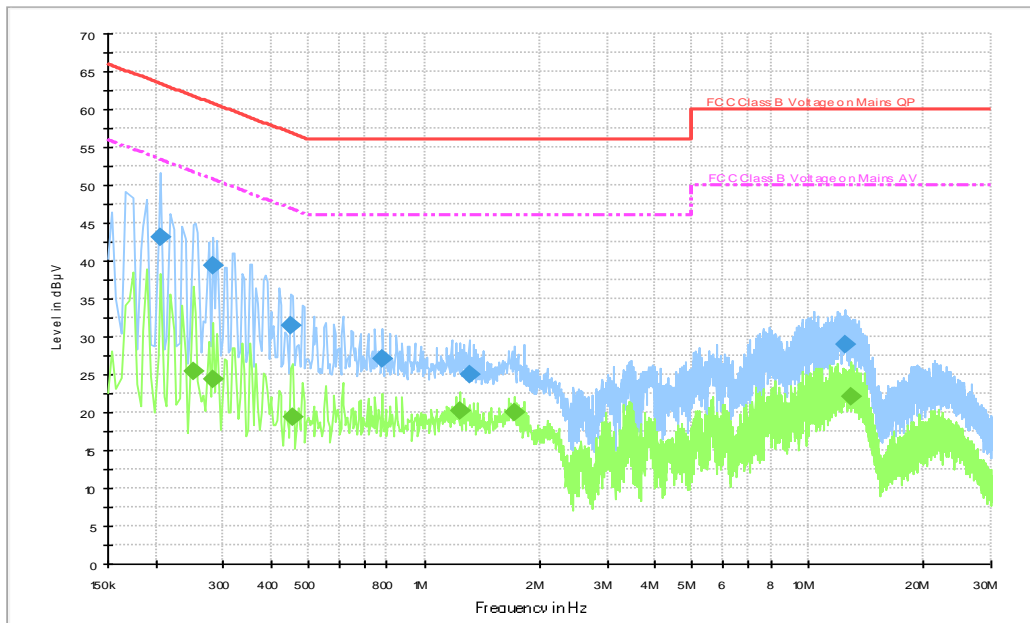
Note: The graphic result above is the maximum of the measurements for both phase line and neutral line.

**Final Result 1**

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.182000	39.7	2000.	9.000	On	N	19.7	24.7	64.4
0.314000	34.5	2000.	9.000	On	N	19.7	25.4	59.9
0.626000	35.9	2000.	9.000	On	N	19.7	20.1	56.0
1.206000	30.3	2000.	9.000	On	N	19.6	25.7	56.0
1.622000	29.5	2000.	9.000	On	N	19.6	26.5	56.0
2.886000	26.6	2000.	9.000	On	N	19.6	29.4	56.0

**Final Result 2**

Frequency (MHz)	CAverage (dBµV)	Meas. Time	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.246000	32.7	2000.	9.000	On	N	19.7	19.2	51.9
0.314000	28.4	2000.	9.000	On	N	19.7	21.4	49.9
0.610000	29.8	2000.	9.000	On	N	19.7	16.2	46.0
0.742000	24.8	2000.	9.000	On	N	19.7	21.2	46.0
1.622000	25.4	2000.	9.000	On	N	19.6	20.6	46.0
4.934000	20.9	2000.	9.000	On	N	19.6	25.1	46.0



**Fig.B.10.3 AC Powerline Conducted Emission-Bluetooth(AE2-2)**

Note: The graphic result above is the maximum of the measurements for both phase line and neutral line.

**Final Result 1**

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.206000	43.2	2000.	9.000	On	L1	19.7	20.2	63.4
0.282000	39.4	2000.	9.000	On	N	19.7	21.3	60.8
0.450000	31.5	2000.	9.000	On	N	19.7	25.4	56.9
0.778000	27.2	2000.	9.000	On	N	19.7	28.8	56.0
1.310000	24.9	2000.	9.000	On	N	19.6	31.1	56.0
12.458000	29.0	2000.	9.000	On	L1	19.8	31.0	60.0

**Final Result 2**

Frequency (MHz)	CAverage (dBµV)	Meas. Time	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.250000	25.4	2000.	9.000	On	N	19.7	26.4	51.8
0.282000	24.4	2000.	9.000	On	N	19.7	26.4	50.8
0.454000	19.3	2000.	9.000	On	L1	19.7	27.5	46.8
1.242000	20.2	2000.	9.000	On	N	19.6	25.8	46.0
1.722000	20.0	2000.	9.000	On	N	19.6	26.0	46.0
12.910000	22.1	2000.	9.000	On	L1	19.7	27.9	50.0



## **B.11.Antenna Requirement**

The antenna of the device is permanently attached. There are no provisions for connection to an external antenna.

The unit complies with the requirement of FCC Part 15.203.

## ANNEX C: Accreditation Certificate



### Accredited Laboratory

A2LA has accredited

### TELECOMMUNICATION TECHNOLOGY LABS, CAICT

Beijing, People's Republic of China

for technical competence in the field of

### Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 26<sup>th</sup> day of June 2023.

Mr. Trace McInturff, Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 7049.01  
Valid to July 31, 2024

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

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