Appendix A: Test Results of BLE

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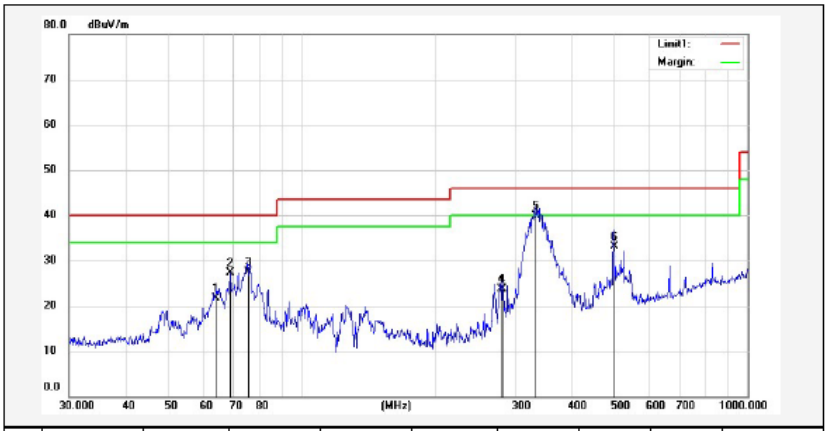
Appendix A.1 Test Results of Radiated Spurious Emission

All modes have been tested, and the report only reflects the worst mode

Below 1GHz:

Test Mode:	Mode 1(worst mode)

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correction factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (deg.)	Height (cm)	Remark
1	64.2074	35.76	-14.13	21.63	40.00	-18.37	---	---	QP
2	69.1140	42.19	-14.93	27.26	40.00	-12.74	---	---	QP
3	75.4463	43.98	-16.57	27.41	40.00	-12.59	---	---	QP
4	281.0074	36.14	-12.45	23.69	46.00	-22.31	---	---	QP
5*	333.6865	50.71	-10.86	39.85	46.00	-6.15	---	---	QP
6	499.4246	39.73	-6.53	33.20	46.00	-12.80	---	---	QP

Vertical

No.	Frequency (MHz)	Reading (dBuV)	Correction factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (deg.)	Height (cm)	Remark
1	48.3318	31.89	-13.13	18.76	40.00	-21.24	---	---	QP
2	75.4463	40.08	-16.57	23.51	40.00	-16.49	---	---	QP
3	102.7192	38.86	-17.80	21.06	43.50	-22.44	---	---	QP
4*	327.8872	44.72	-10.98	33.74	46.00	-12.26	---	---	QP
5	535.7073	34.58	-5.95	28.63	46.00	-17.37	---	---	QP
6	726.8052	31.61	-2.87	28.74	46.00	-17.26	---	---	QP

Above 1GHz：

All modes have been tested, and the report only reflects the worst mode(1Mbps)

GFSK-Low Horizontal

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4808	71.44	-21.5	49.94	74	-24.06	peak
2	4808	61.36	-21.5	39.86	54	-14.14	AVG
3	6202	67.82	-19.16	48.66	74	-25.34	peak
4	6202	53.72	-19.16	34.56	54	-19.44	AVG
5	9058	64.67	-17.79	46.88	74	-27.12	peak
6	9058	50.49	-17.79	32.7	54	-21.3	AVG
7	14090	64.72	-14.13	50.59	74	-23.41	peak
8	14090	49.15	-14.13	35.02	54	-18.98	AVG
9	15008	63.71	-12.4	51.31	74	-22.69	peak
10	15008	48.88	-12.4	36.48	54	-17.52	AVG
11	15722	64.42	-12.33	52.09	74	-21.91	peak
12	15722	49.47	-12.33	37.14	54	-16.86	AVG

GFSK-Low Vertical

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4808	71.98	-21.5	50.48	74	-23.52	peak
2	4808	60.45	-21.5	38.95	54	-15.05	AVG
3	6202	66.78	-19.16	47.62	74	-26.38	peak
4	6202	52.64	-19.16	33.48	54	-20.52	AVG
5	10588	63.93	-16.74	47.19	74	-26.81	peak
6	10588	51.3	-16.74	34.56	54	-19.44	AVG
7	13444	64.65	-15.18	49.47	74	-24.53	peak
8	13444	49.24	-15.18	34.06	54	-19.94	AVG
9	15382	64.54	-12.36	52.18	74	-21.82	peak
10	15382	48.65	-12.36	36.29	54	-17.71	AVG
11	16776	65.44	-12.07	53.37	74	-20.63	peak
12	16776	49.09	-12.07	37.02	54	-16.98	AVG

GFSK- Middle Horizontal

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4880	63.27	-13.4	49.87	74	-24.13	peak
2	4880	53.26	-13.4	39.86	54	-14.14	AVG
3	6202	58.91	-10.93	47.98	74	-26.02	peak
4	6202	43.08	-10.93	32.15	54	-21.85	AVG
5	7426	57.77	-10.79	46.98	74	-27.02	peak
6	7426	42.08	-10.79	31.29	54	-22.71	AVG
7	9058	57.29	-10.31	46.98	74	-27.02	peak
8	9058	42.16	-10.31	31.85	54	-22.15	AVG
9	12458	54.86	-6.37	48.49	74	-25.51	peak
10	12458	39.83	-6.37	33.46	54	-20.54	AVG
11	15382	51.56	-0.7	50.86	74	-23.14	peak
12	15382	36.11	-0.7	35.41	54	-18.59	AVG

GFSK-Middle Vertical

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	4880	52.4	-13.4	39	54	-15	AVG
2	4910	63.41	-13.16	50.25	74	-23.75	peak
3	6236	59.07	-11.11	47.96	74	-26.04	peak
4	6236	43.26	-11.11	32.15	54	-21.85	AVG
5	7562	57.41	-10.71	46.7	74	-27.3	peak
6	7562	42.49	-10.71	31.78	54	-22.22	AVG
7	10418	55.97	-8.71	47.26	74	-26.74	peak
8	10418	41.4	-8.71	32.69	54	-21.31	AVG
9	13886	54.11	-4.09	50.02	74	-23.98	peak
10	13886	39.51	-4.09	35.42	54	-18.58	AVG
11	15008	52.94	-1.62	51.32	74	-22.68	peak
12	15008	37.71	-1.62	36.09	54	-17.91	AVG

GFSK-High Horizontal

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	4960	52.67	-13.26	39.41	54	-14.59	AVG
2	4978	61.92	-13.31	48.61	74	-25.39	peak
3	6202	57.46	-10.93	46.53	74	-27.47	peak
4	6202	42.78	-10.93	31.85	54	-22.15	AVG
5	12458	54.53	-6.37	48.16	74	-25.84	peak
6	12458	39.83	-6.37	33.46	54	-20.54	AVG
7	13920	53.54	-4.04	49.5	74	-24.5	peak
8	13920	38.56	-4.04	34.52	54	-19.48	AVG
9	15280	51.97	-0.95	51.02	74	-22.98	peak
10	15280	37.74	-0.95	36.79	54	-17.21	AVG
11	16742	52.68	0.7	53.38	74	-20.62	peak
12	16742	36.38	0.7	37.08	54	-16.92	AVG

GFSK-High Vertical

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	4960	52.31	-13.26	39.05	54	-14.95	AVG
2	4978	62.25	-13.31	48.94	74	-25.06	peak
3	6202	59.45	-10.93	48.52	74	-25.48	peak
4	6202	44.34	-10.93	33.41	54	-20.59	AVG
5	7018	58.65	-11.57	47.08	74	-26.92	peak
6	7018	44.32	-11.57	32.75	54	-21.25	AVG
7	12458	54.43	-6.37	48.06	74	-25.94	peak
8	12458	39.66	-6.37	33.29	54	-20.71	AVG
9	13920	53.49	-4.04	49.45	74	-24.55	peak
10	13920	38.9	-4.04	34.86	54	-19.14	AVG
11	15756	52.64	-0.15	52.49	74	-21.51	peak
12	15756	37.04	-0.15	36.89	54	-17.11	AVG

Node:

1、Testing was carried out within frequency range 9kHz to the tenth harmonics. The measurement results below 30MHz and 18GHz - 26.5GHz were greater than 20dB below the limit, so only the radiated spurious emissions from 30MHz to 18GHz were reported..

2、Radiated emissions measured in frequency above 1GHz were made with an instrument using peak/average detector mode.

3、Average test would be performed if the peak result were greater than the average limit or as required by the applicant.

4、Margin (dB), result in dBuV/m – limit in dBuV/m.

Restricted band Requirements

GFSK Low

All modes have been tested, and the report only reflects the worst mode(1Mbps)

Horizontal

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2379.8	53.72	-3.93	49.79	74	-24.21	peak
2	2379.8	39.34	-3.93	35.41	54	-18.59	AVG
3	2390	51.32	-3.9	47.42	74	-26.58	peak
4	2390	37.86	-3.9	33.96	54	-20.04	AVG

Vertical

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2357.8	47.76	1.52	49.28	74	-24.72	peak
2	2357.8	32.63	1.52	34.15	54	-19.85	AVG
3	2390	45.56	1.61	47.17	74	-26.83	peak
4	2390	32.35	1.61	33.96	54	-20.04	AVG

GFSK-High

Horizontal

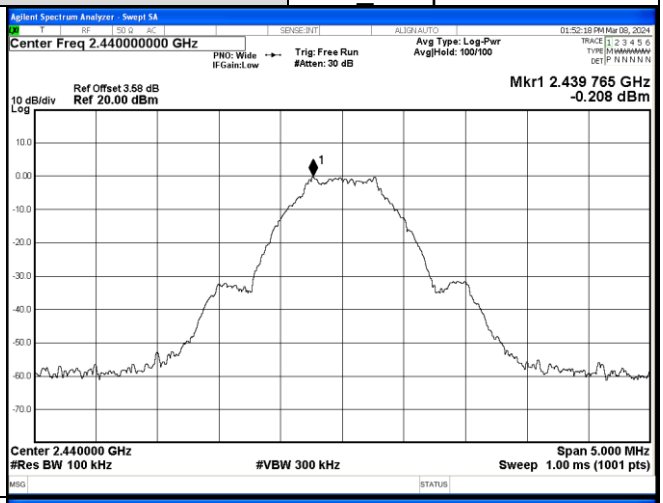
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.5	52.2	-3.23	48.97	74	-25.03	peak
2	2483.5	39.19	-3.23	35.96	54	-18.04	AVG
3	2492.02	54.24	-3.16	51.08	74	-22.92	peak
4	2492.02	39.31	-3.16	36.15	54	-17.85	AVG

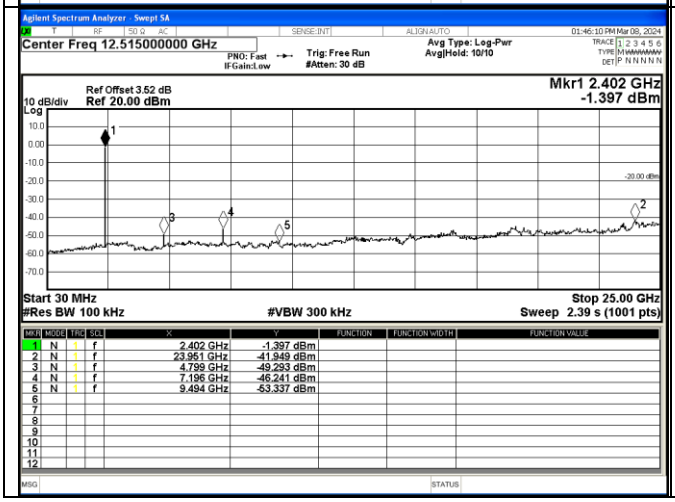
Vertical

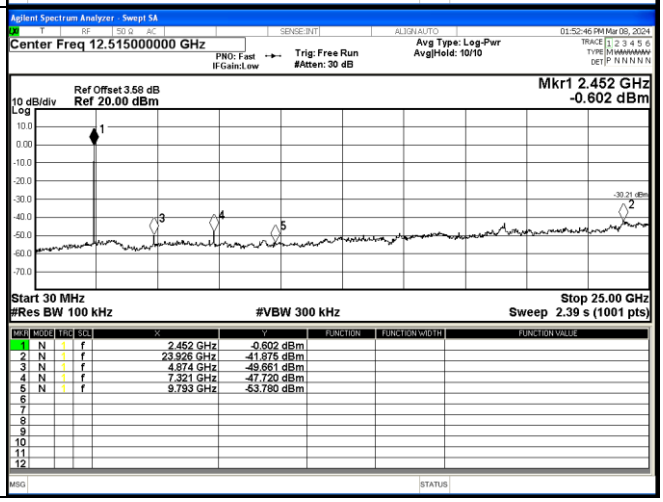
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.5	51.36	-3.23	48.13	74	-25.87	peak
2	2483.5	38.44	-3.23	35.21	54	-18.79	AVG
3	2489.92	54.65	-3.18	51.47	74	-22.53	peak
4	2489.92	36.87	-3.18	33.69	54	-20.31	AVG

Appendix A.2 Test Results of Conducted Spurious Emissions Measured in 100 kHz Bandwidth

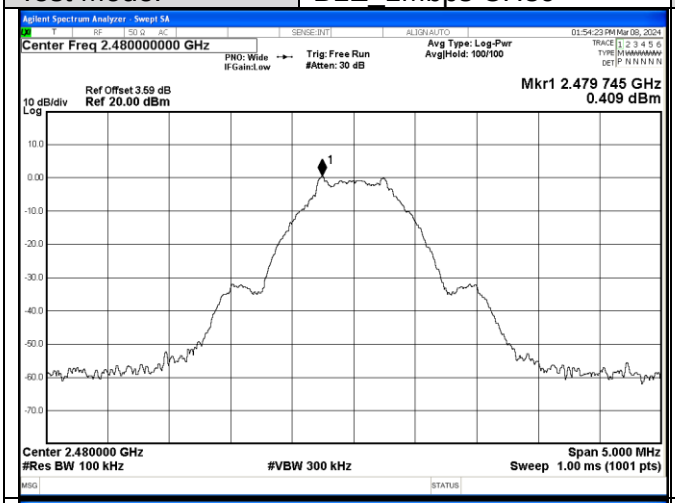
Conducted spurious emission			
Test Mode:	BLE_1Mbps CH00	Test Mode:	BLE_1Mbps CH19

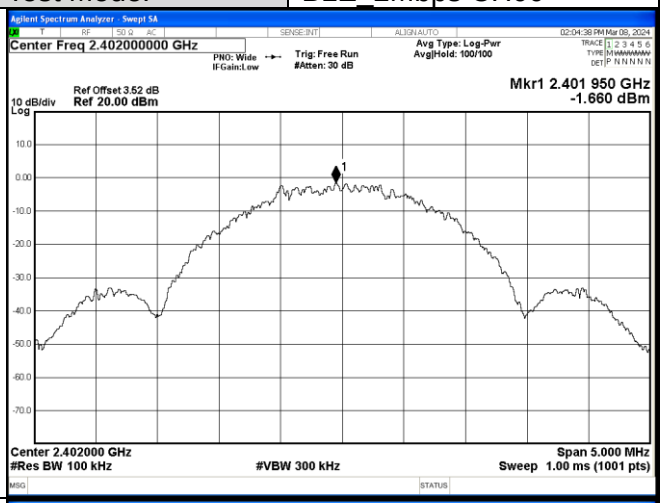


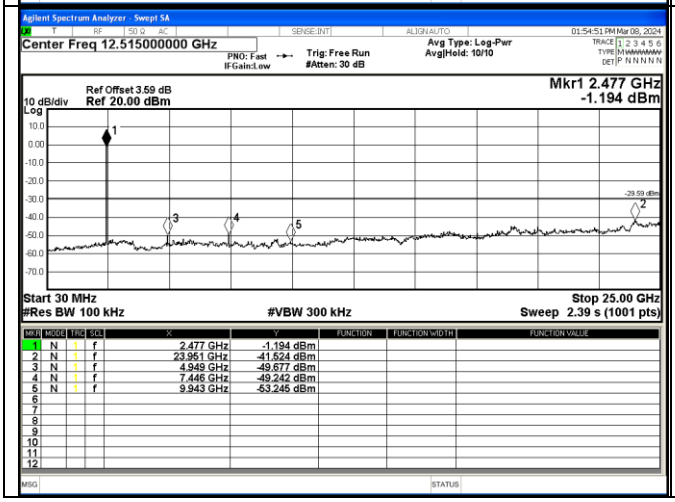


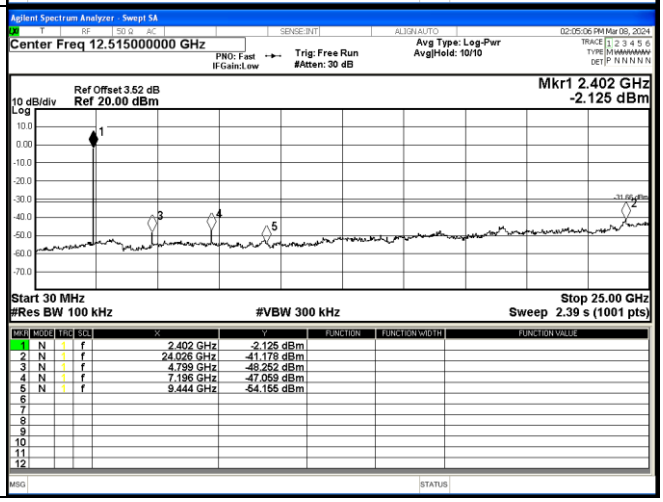


Test Mode:	BLE_1Mbps CH39	Test Mode:	BLE_2Mbps CH00

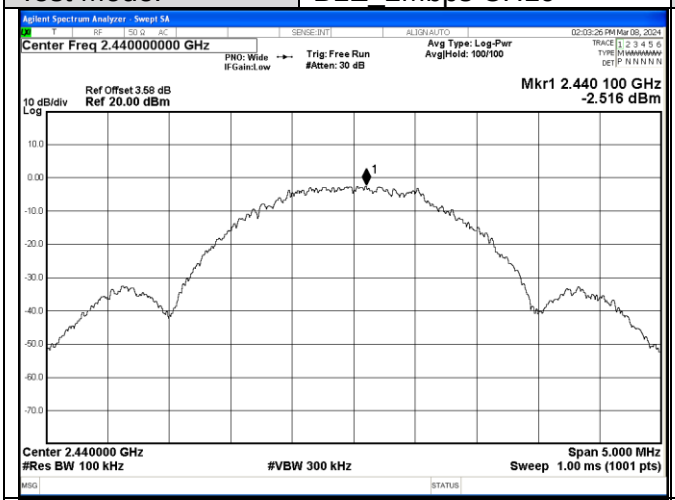


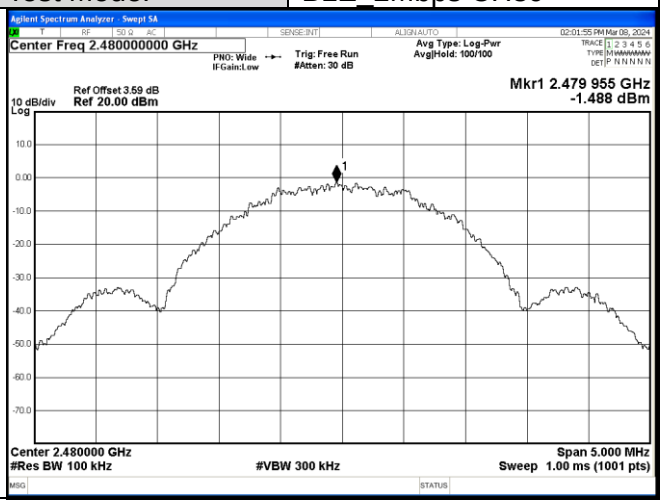


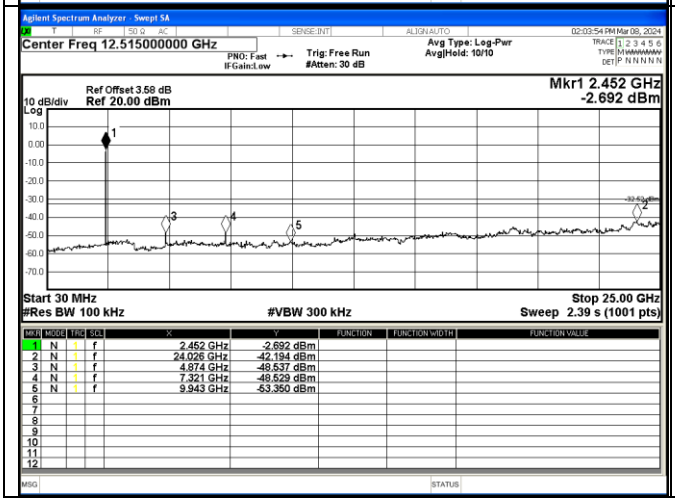


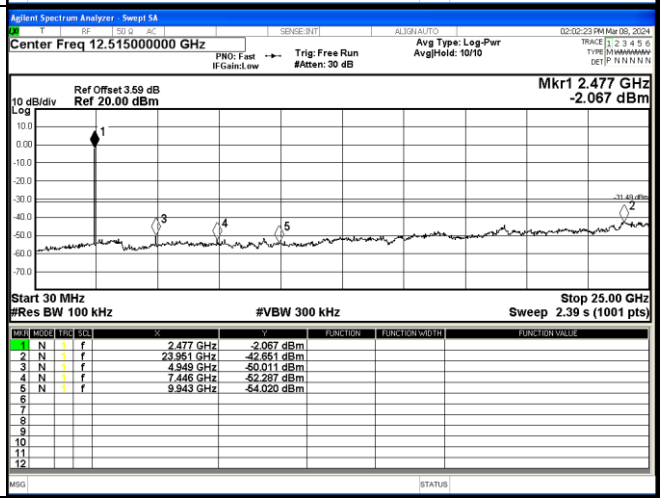


Test Mode:	BLE_2Mbps CH19	Test Mode:	BLE_2Mbps CH39

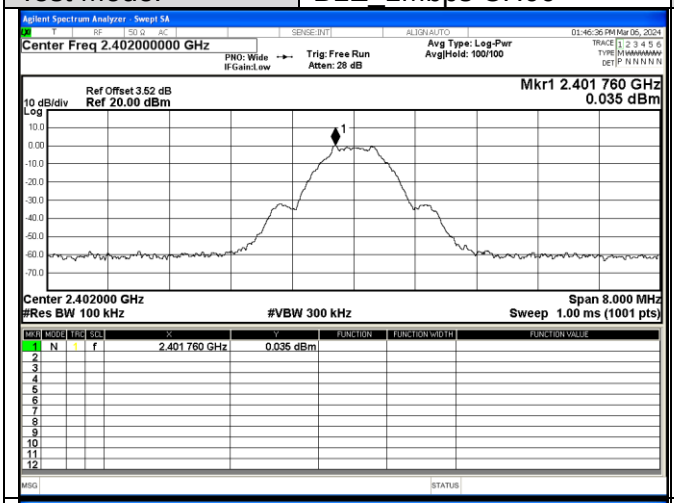


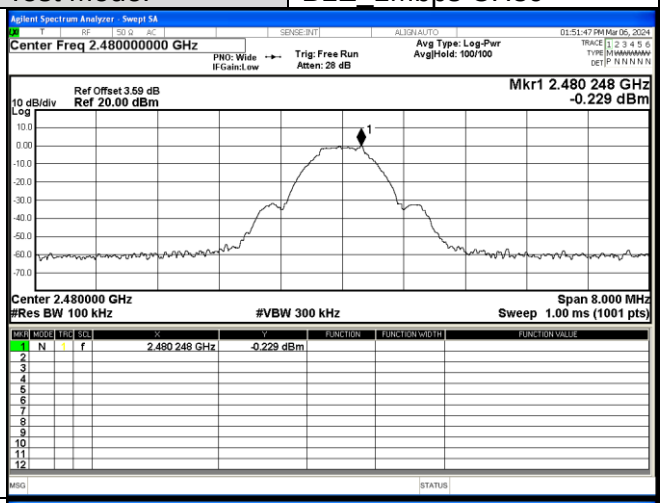


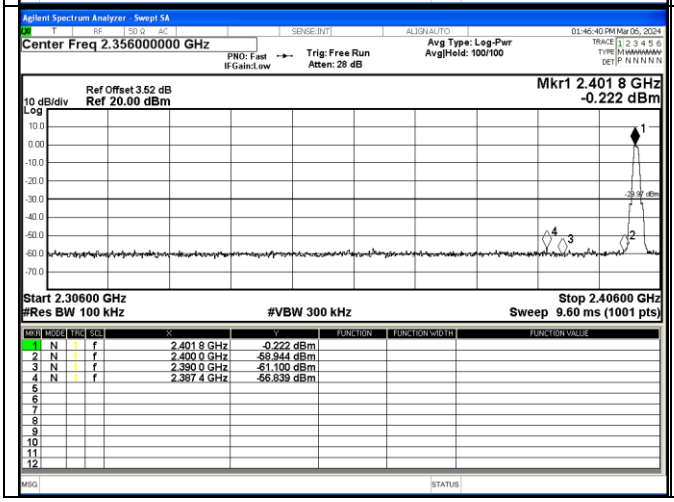


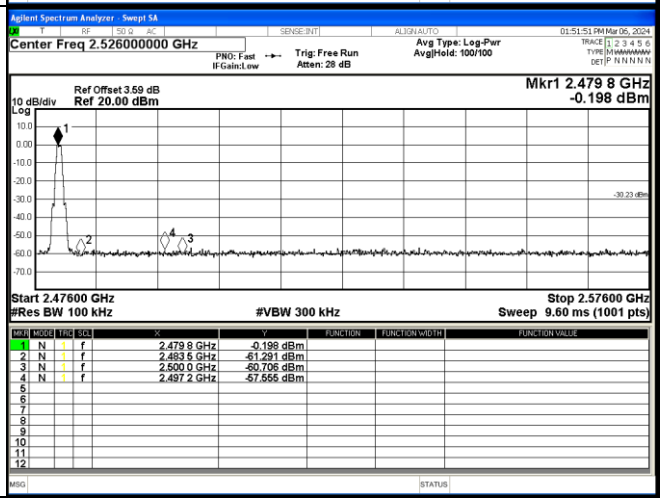


For Band edge(it's also the reference level for conducted spurious emission)			
Test Mode:	BLE_1Mbps CH00	Test Mode:	BLE_1Mbps CH39

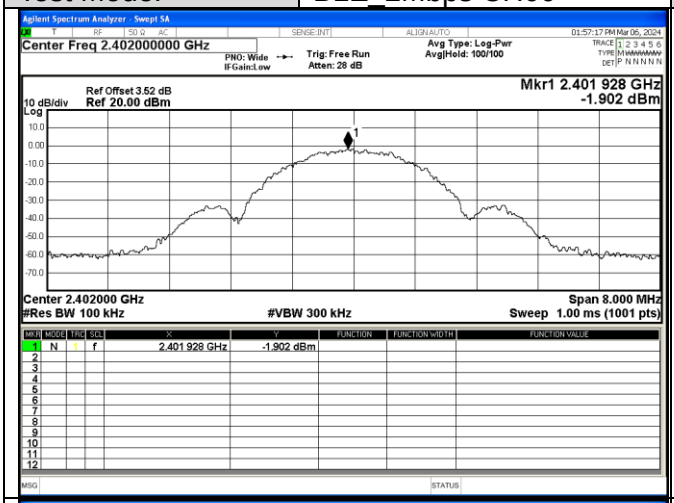


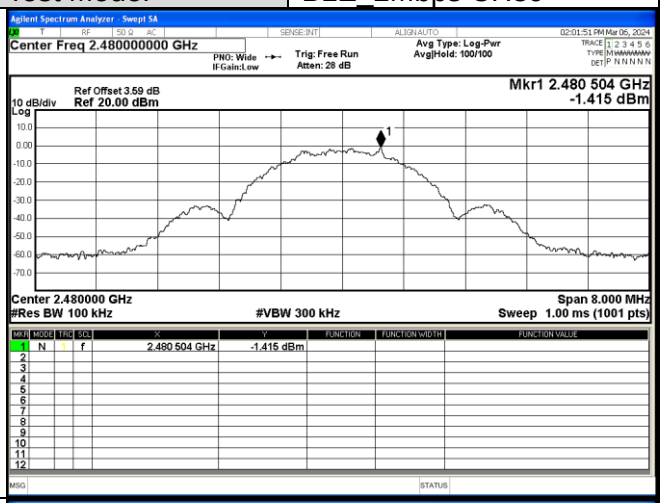


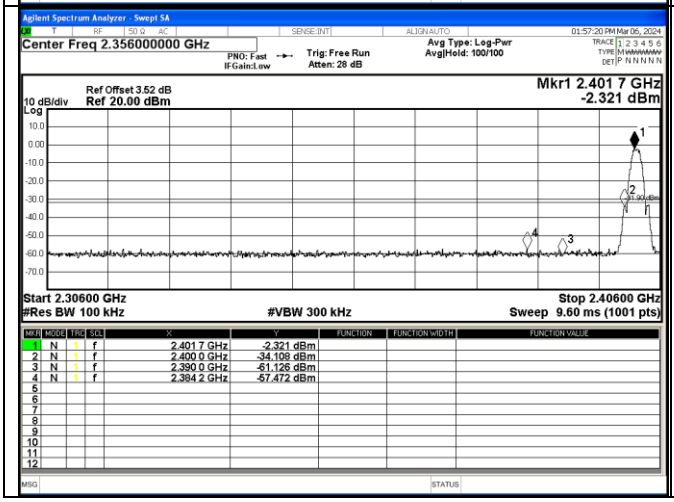


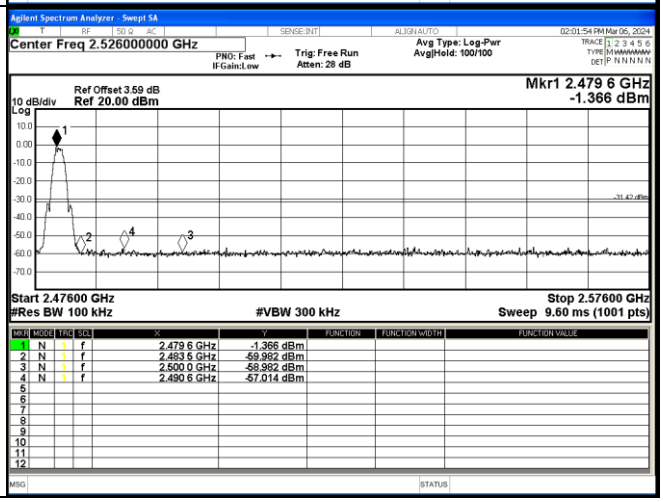


Test Mode:	BLE_2Mbps CH00	Test Mode:	BLE_2Mbps CH39







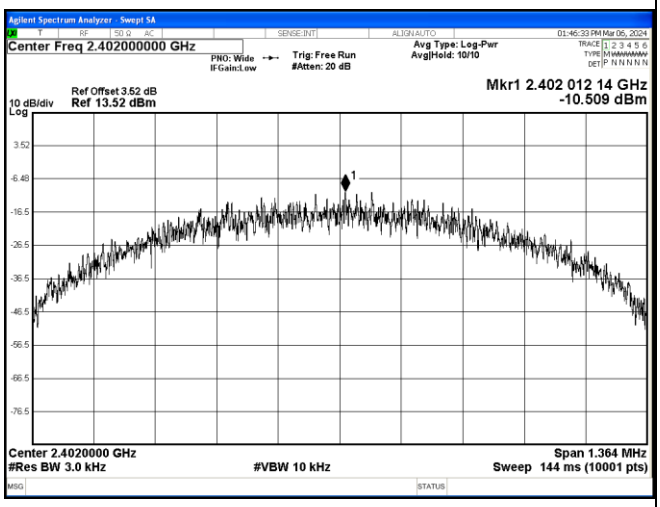


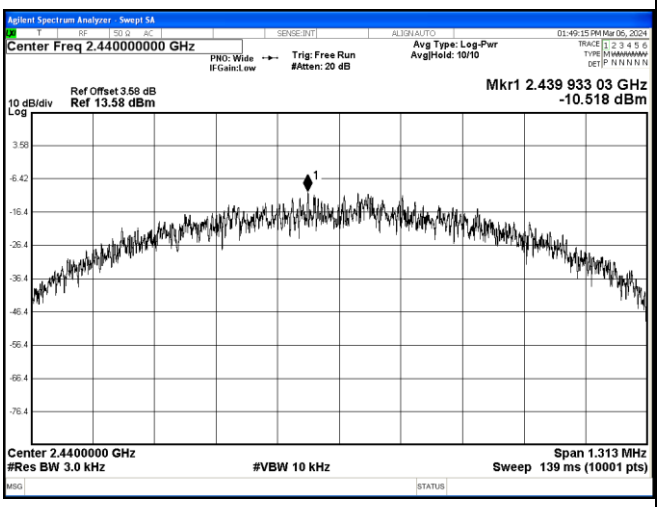
Appendix A.3 Test Results of Conducted Power Spectral Density

GFSK_1Mbps			
Frequency	Power Density (dBm/3kHz)	Limit (dBm/3KHz)	Result
CH00	-10.509	8	Pass
CH19	-10.518	8	Pass
CH39	-9.784	8	Pass

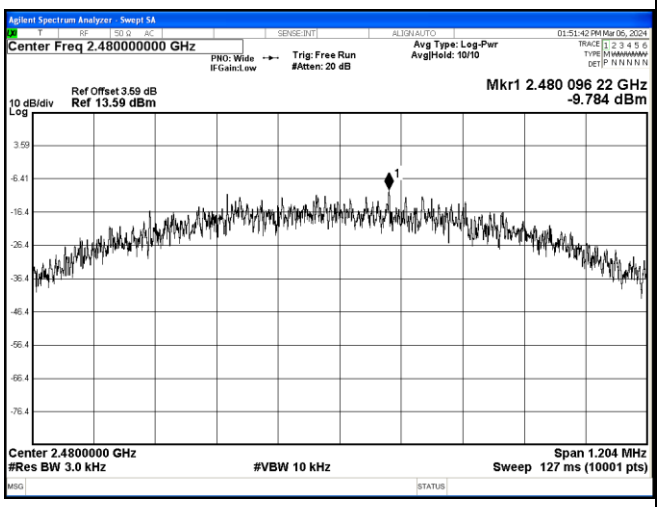
GFSK_2Mbps			
Frequency	Power Density (dBm/3kHz)	Limit (dBm/3KHz)	Result
CH00	-14.051	8	Pass
CH19	-12.368	8	Pass
CH39	-14.181	8	Pass

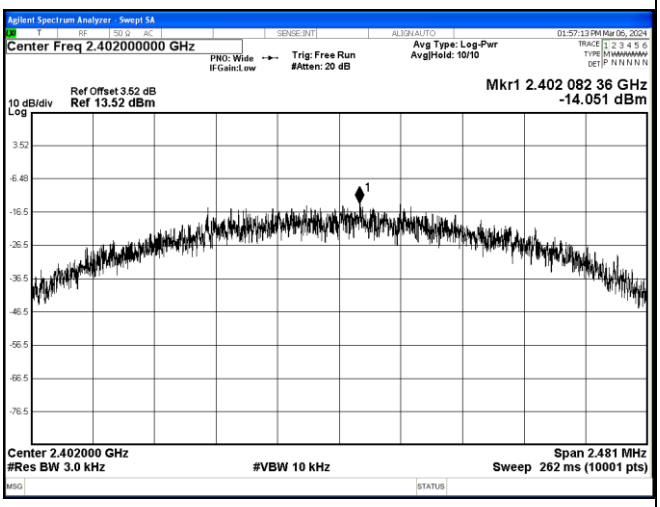
Test Mode:	GFSK_1Mbps CH00	Test Mode:	GFSK_1Mbps CH19



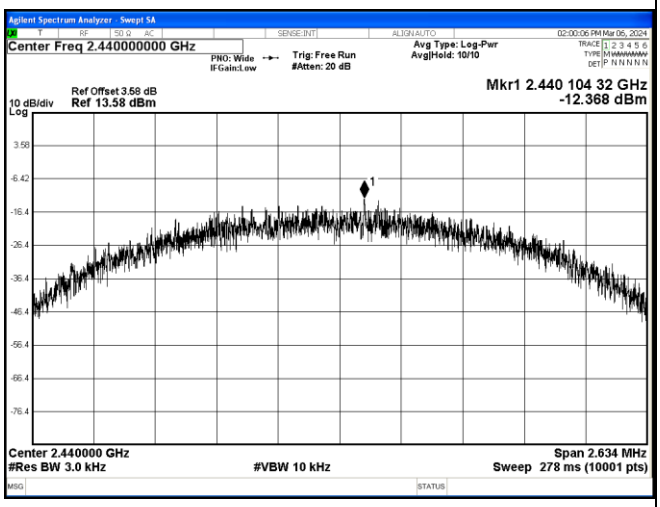


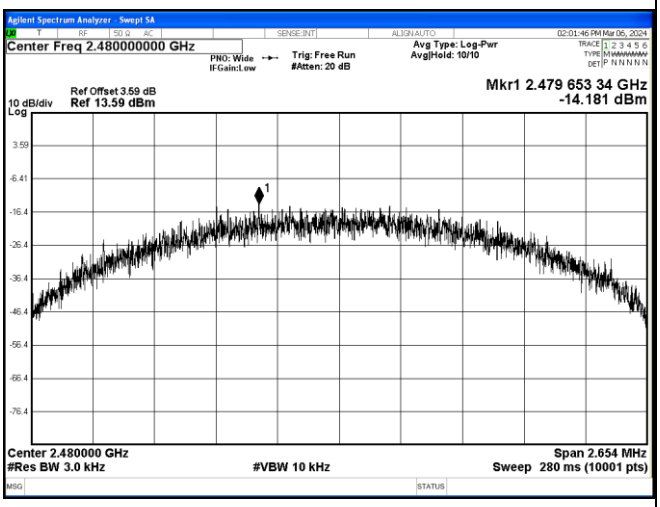
Test Mode:	GFSK_1Mbps CH39	Test Mode:	GFSK_2Mbps CH00





Test Mode:	GFSK_2Mbps CH19	Test Mode:	GFSK_2Mbps CH39



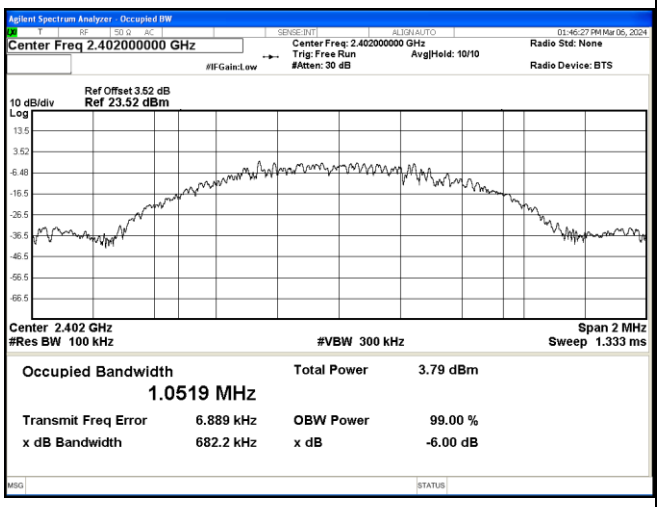


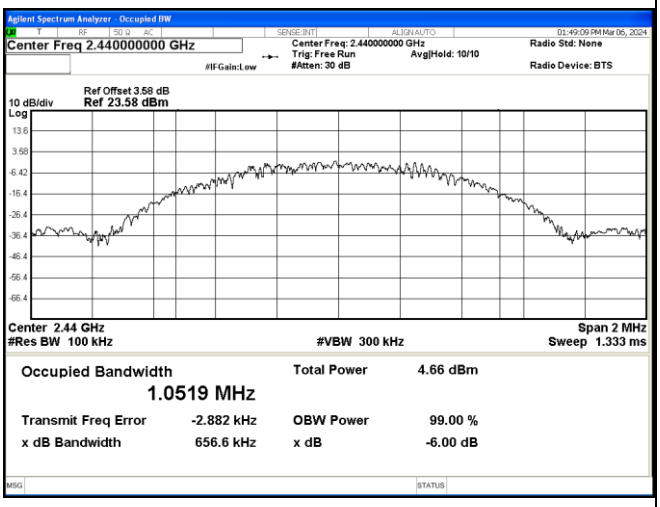
Appendix A.4 Test Results of 6dB and 99% BANDWIDTH

GFSK_1Mbps				
Frequency	Bandwidth (MHz)		6dB limit (kHz)	Result
	99%	6dB		
CH00	1.0271	0.6822	0.5	Pass
CH19	1.0345	0.6566	0.5	Pass
CH39	1.0081	0.6021	0.5	Pass

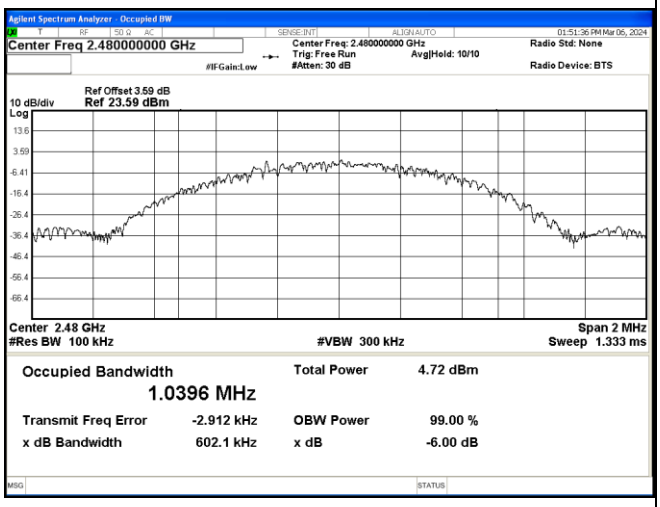
GFSK_2Mbps				
Frequency	Bandwidth (MHz)		6dB limit (kHz)	Result
	99%	6dB		
CH00	2.0281	1.240	0.5	Pass
CH19	2.0906	1.317	0.5	Pass
CH39	2.0822	1.327	0.5	Pass

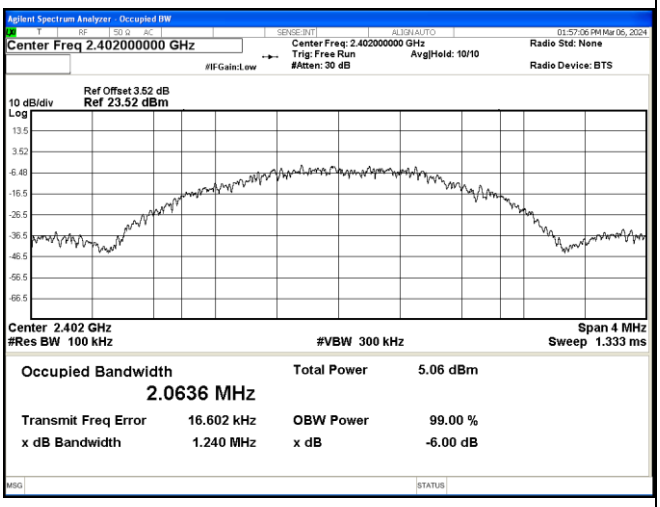
6dB Bandwidth			
Test Mode:	GFSK_1Mbps CH00	Test Mode:	GFSK_1Mbps CH19



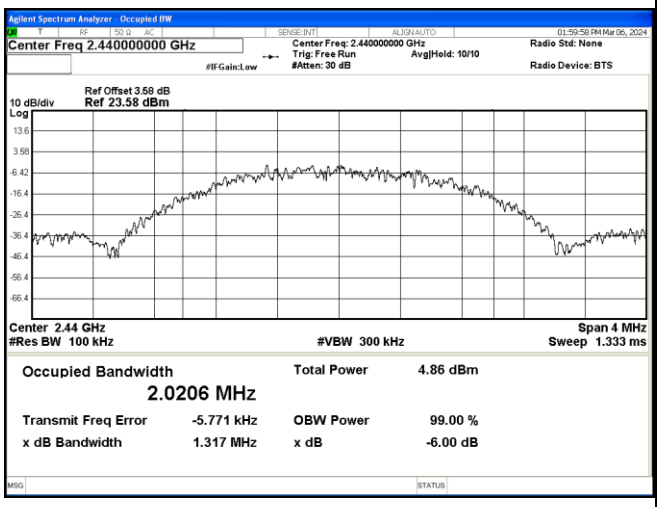


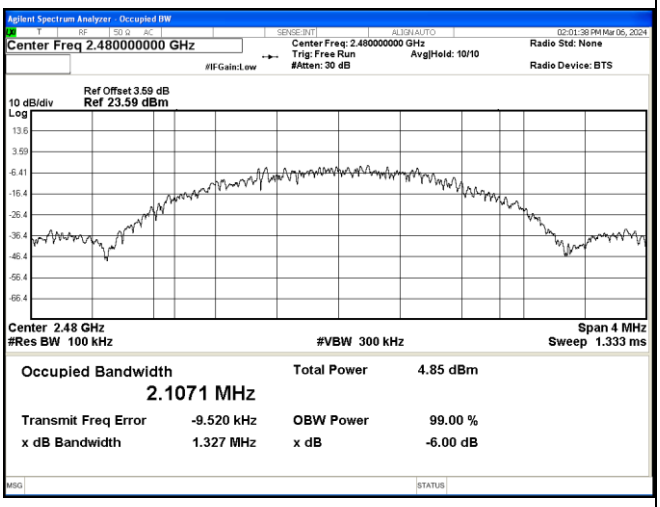
Test Mode:	GFSK_1Mbps CH39	Test Mode:	GFSK_2Mbps CH00



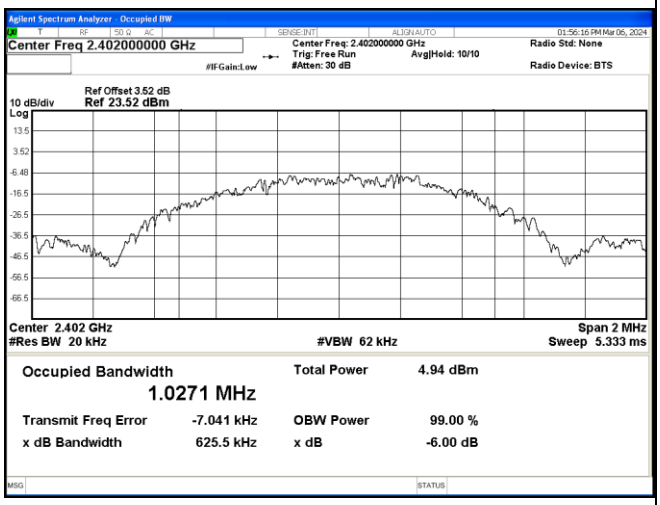


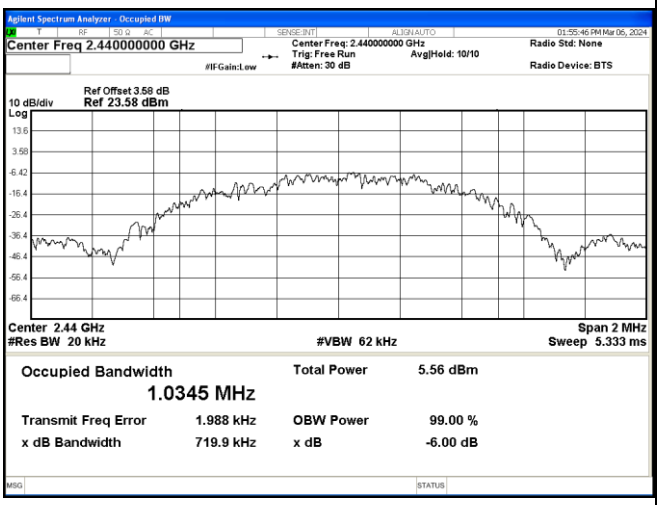
Test Mode:	GFSK_2Mbps CH19	Test Mode:	GFSK_2Mbps CH39



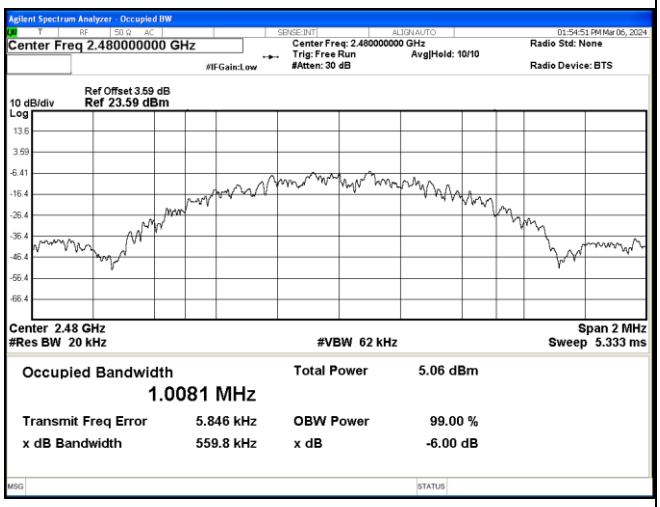


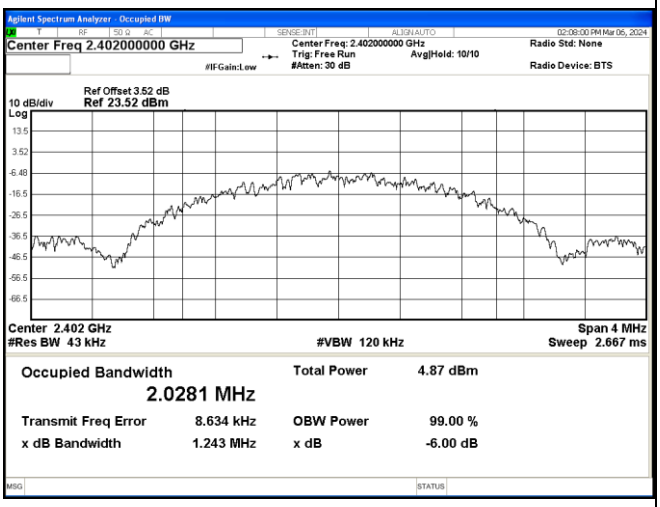
99% Bandwidth			
Test Mode:	GFSK_1Mbps CH00	Test Mode:	GFSK_1Mbps CH19



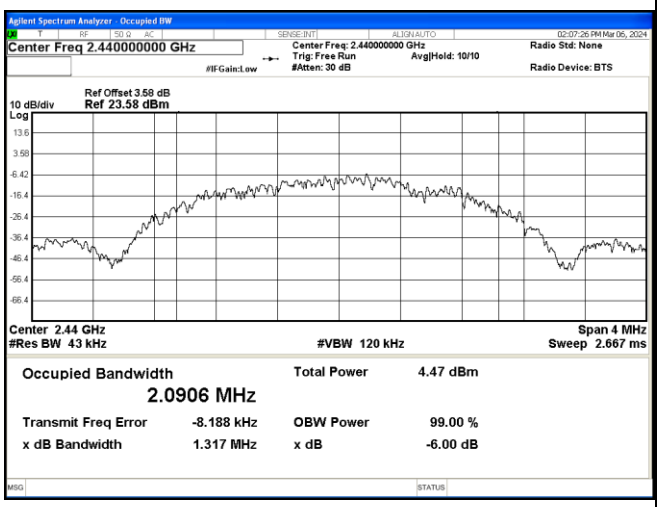


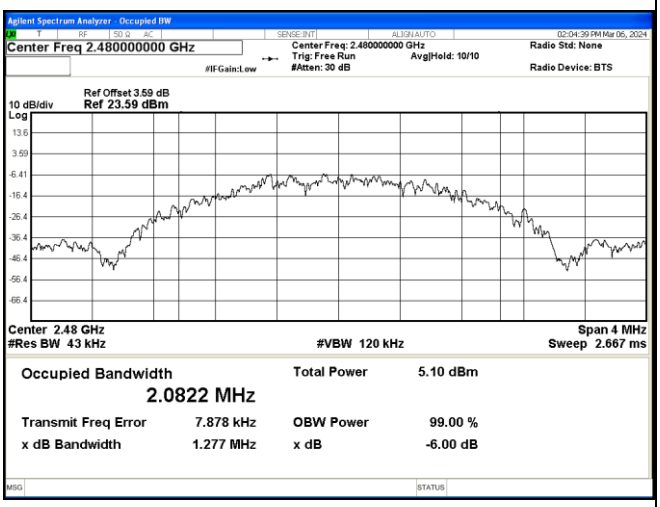
Test Mode:	GFSK_1Mbps CH39	Test Mode:	GFSK_2Mbps CH00





Test Mode:	GFSK_2Mbps CH19	Test Mode:	GFSK_2Mbps CH39





Appendix A.5 Test Results of Maximum Conducted Power

For FCC:

Mode	Frequency [MHz]	Measured of Average Power		Limit [W]
		Conducted [dBm]	W	
BLE_1Mbps	2402	1.86	0.0015	≤ 1.0
	2440	2.09	0.0016	≤ 1.0
	2480	2.14	0.0016	≤ 1.0
BLE_2Mbps	2402	1.90	0.0015	≤ 1.0
	2440	1.94	0.0016	≤ 1.0
	2480	2.03	0.0016	≤ 1.0

Note:
1) The cable loss is taken into account in results.
2) Antenna gain(G) BLE: 1.5 dBi
e.i.r.p.=P(AVG power)+ G, which is far below the 4 W

For IC:

Mode	Frequency [MHz]	Measured of Average Power		Limit [dBm]
		Conducted [dBm]	EIRP [dBm]	
BLE_1Mbps	2402	1.86	3.36	≤ 36
	2440	2.09	3.59	≤ 36
	2480	2.14	3.64	≤ 36
BLE_2Mbps	2402	1.90	3.40	≤ 36
	2440	1.94	3.44	≤ 36
	2480	2.03	3.53	≤ 36

Note:
1) The cable loss is taken into account in results.
2) Antenna gain(G) BLE: 1.5 dBi
e.i.r.p.=P(AVG power)+ G, which is far below the 4 W