Appendix A: Test Results of BLE

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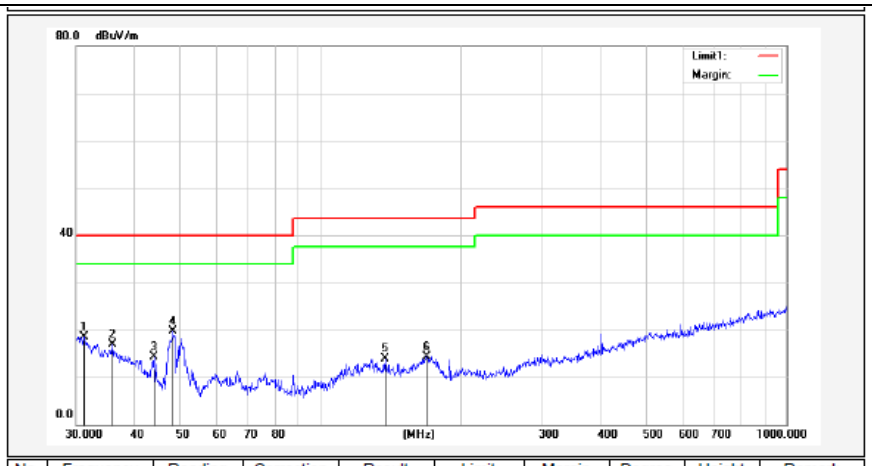
Appendix A.1 Test Results of Radiated Spurious Emission

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

Below 1GHz:

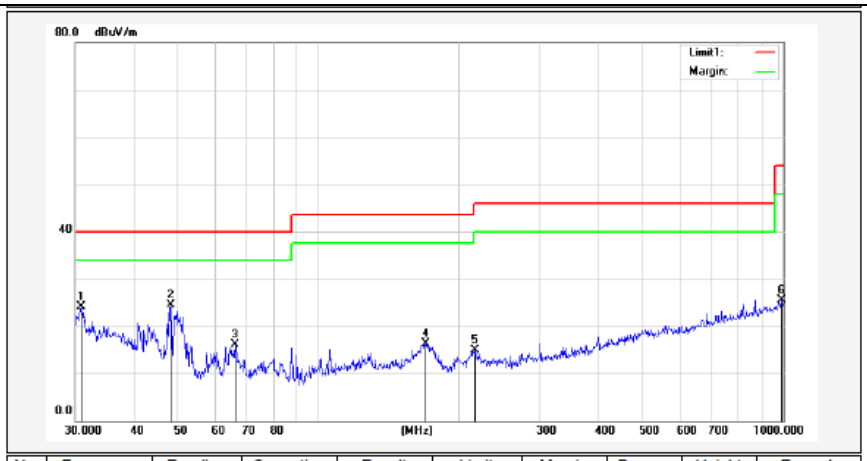
Test Mode:	Working

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correction factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (deg.)	Height (cm)	Remark
1	31.1798	25.41	-6.82	18.59	40.00	-21.41			QP
2	35.8746	26.61	-9.65	16.96	40.00	-23.04			QP
3	44.1200	29.96	-15.61	14.35	40.00	-25.65			QP
4*	48.5016	37.79	-18.04	19.75	40.00	-20.25			QP
5	137.9028	26.26	-12.44	13.82	43.50	-29.68			QP
6	169.5990	27.89	-13.56	14.33	43.50	-29.17			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	30.8535	30.68	-6.65	24.03	40.00	-15.97			QP
2*	48.1625	42.49	-17.91	24.58	40.00	-15.42			QP
3	66.2660	34.82	-18.62	16.20	40.00	-23.80			QP
4	170.1947	29.88	-13.58	16.30	43.50	-27.20			QP
5	217.5441	28.59	-13.63	14.96	46.00	-31.04			QP
6	993.0113	25.22	0.30	25.52	54.00	-28.48			QP

Correction Factor = insertion loss of LISN + cable loss;
Reading = Reading Amplitude in the instrument;
Result = Correction Factor + Reading;
Margin = Result – Limit.

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	66.71	-13.33	53.38	74	-20.62	peak
2	7188	61.05	-8.03	53.02	59.81	-6.79	peak
3	10282	53.09	-3.98	49.11	59.81	-10.70	peak
4	11098	53.22	-2.54	50.68	74	-23.32	peak
5	11438	52.58	-2.04	50.54	74	-23.46	peak
6	12424	52.64	-1.81	50.83	74	-23.17	peak

GFSK-Low Vertical

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4808	63.48	-13.33	50.15	74	-23.85	peak
2	7188	63.56	-8.03	55.53	59.81	-4.28	peak
3	7205.96	55.94	-7.94	48	54	-6.00	AVG
4	8854	54.18	-7.88	46.3	59.81	-13.51	peak
5	10452	53.31	-3.8	49.51	59.81	-10.30	peak
6	11404	53.26	-1.87	51.39	74	-22.61	peak
7	11914	53.91	-2.32	51.59	74	-22.41	peak

GFSK- Middle Horizontal

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4876	65.12	-13	52.12	74	-21.88	peak
2	7324	60.47	-7.38	53.09	74	-20.91	peak
3	10214	53.61	-3.78	49.83	59.81	-9.98	peak
4	11404	53.46	-1.87	51.59	74	-22.41	peak
5	12696	51.54	-0.74	50.8	74	-23.2	peak
6	13172	49.89	0.25	50.14	59.81	-9.67	peak

GFSK-Middle Vertical

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4876	65.11	-13	52.11	74	-21.89	peak
2	7324	59.24	-7.38	51.86	74	-22.14	peak
3	10112	53.57	-4.19	49.38	59.81	-10.43	peak
4	11098	53.46	-2.54	50.92	74	-23.08	peak
5	11404	53.49	-1.87	51.62	74	-22.38	peak
6	12458	52.6	-1.59	51.01	74	-22.99	peak

GFSK-High Horizontal

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4944	64.36	-12.85	51.51	74	-22.49	peak
2	7426	60.49	-7.09	53.4	74	-20.6	peak
3	10656	52.75	-2.77	49.98	74	-24.02	peak
4	11404	52.81	-1.87	50.94	74	-23.06	peak
5	12424	54.85	-1.81	53.04	74	-20.96	peak
6	13070	49.92	-0.16	49.76	59.81	-10.05	peak

GFSK-High Vertical

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4944	64.1	-12.85	51.25	74	-22.75	peak
2	7426	61.83	-7.09	54.74	74	-19.26	peak
3	7439.97	58	-7.08	50.92	54	-3.08	AVG
4	10656	52.58	-2.77	49.81	74	-24.19	peak
5	11404	52.85	-1.87	50.98	74	-23.02	peak
6	12424	53.1	-1.81	51.29	74	-22.71	peak

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.

5、According to section part 15.247(d), frequencies other than those required by part 15.205(a) are limited to the level of the intended emission (min. 79.81) minus 20dB.

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	2385.81	70.22	-21.05	49.17	74	-24.83	peak
2	2385.81	51.22	-21.05	30.17	54	-23.83	AVG
3	2390	73.85	-21.03	52.82	74	-21.18	peak
4	2390	54.88	-21.03	33.85	54	-20.15	AVG
5	2401.96	114.66	-20.99	93.67	125.2	-31.53	peak

Vertical

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2386.76	59.15	-21.05	38.1	74	-35.9	peak
2	2386.76	42.08	-21.05	21.03	54	-32.97	AVG
3	2390	60.38	-21.03	39.35	74	-34.65	peak
4	2390	42.5	-21.03	21.47	54	-32.53	AVG
5	2402.34	101.83	-20.99	80.84	125.2	-44.84	peak

GFSK-High

Horizontal

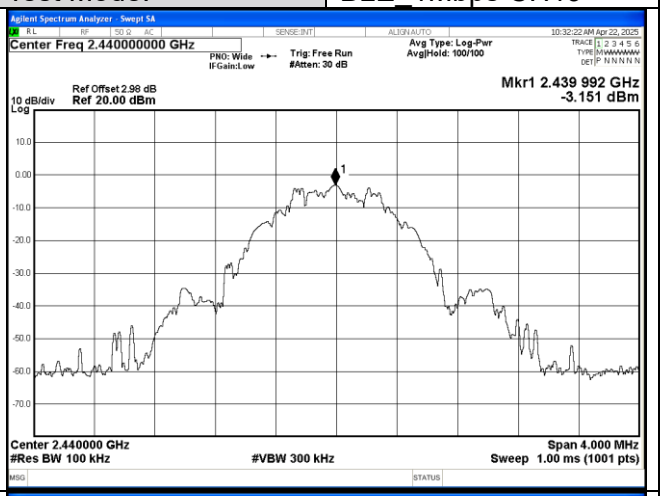
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2479.75	114.54	-20.91	93.63	125.2	-31.57	peak
2	2483.5	82.19	-20.91	61.28	74	-12.72	peak
3	2483.5	63.44	-20.91	42.53	54	-11.47	AVG
4	2484	83.38	-20.91	62.47	74	-11.53	peak
5	2484	65.89	-20.91	44.98	54	-9.02	AVG

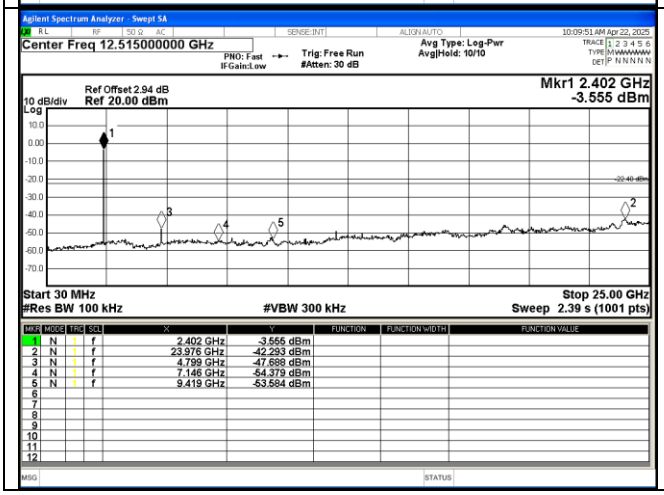
Vertical

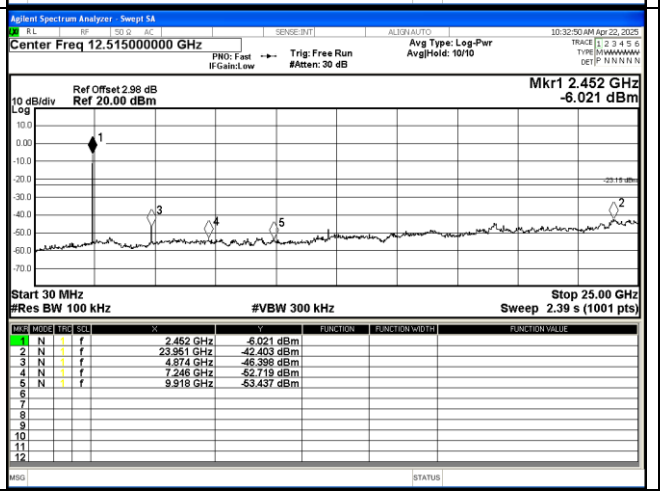
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2480.2	100.72	-20.91	79.81	125.2	-45.39	peak
2	2483.5	68.95	-20.91	48.04	74	-25.96	peak
3	2483.5	51.03	-20.91	30.12	54	-23.88	AVG
4	2483.85	69.77	-20.91	48.86	74	-25.14	peak
5	2483.85	51.75	-20.91	30.84	54	-23.16	AVG

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

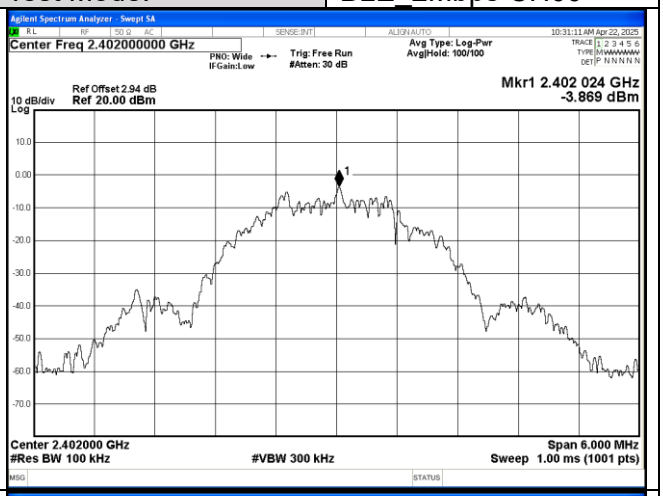
Conducted spurious emission			
Test Mode:	BLE_1Mbps CH00	Test Mode:	BLE_1Mbps CH19

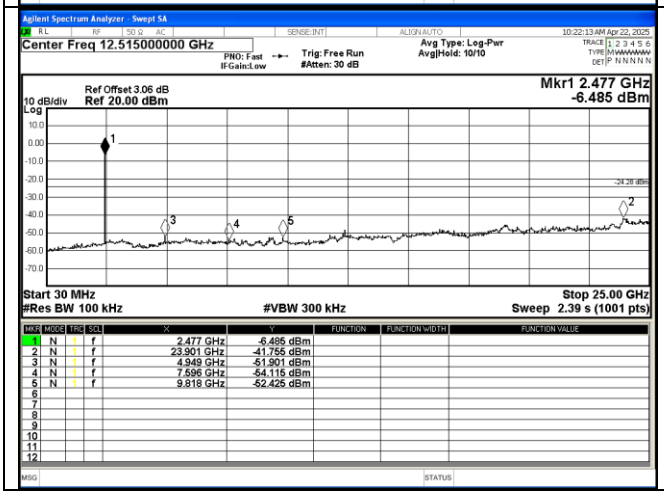


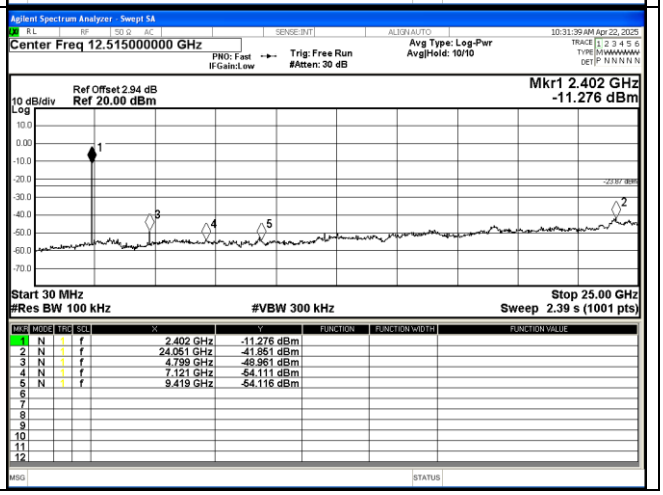




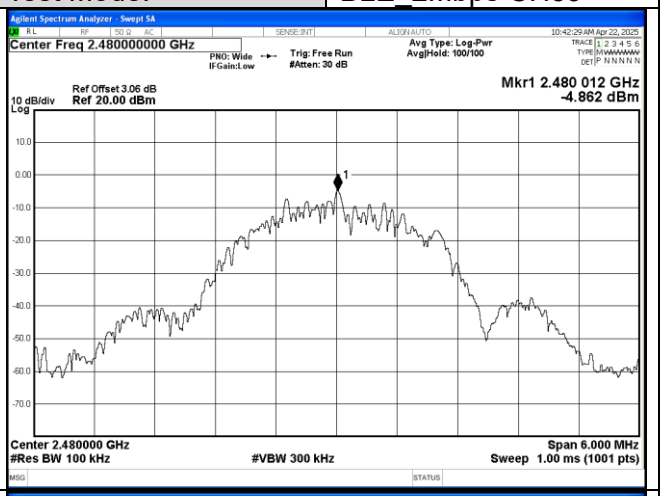
Test Mode:	BLE_1Mbps CH39	Test Mode:	BLE_2Mbps CH00

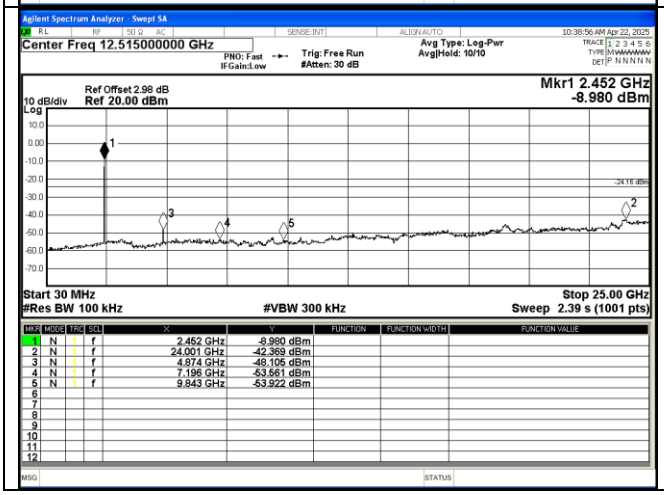


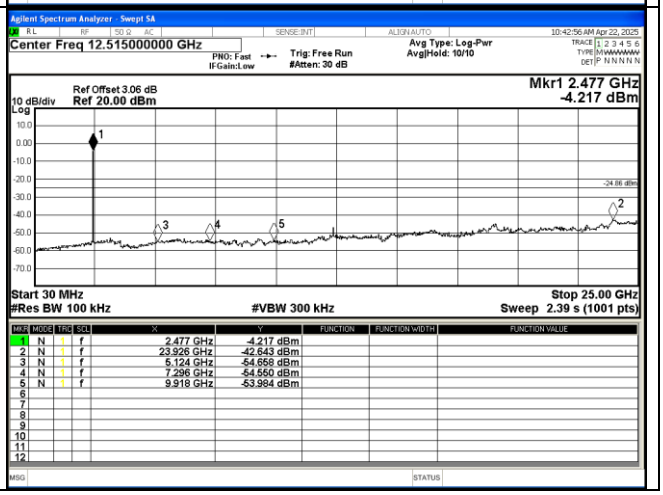




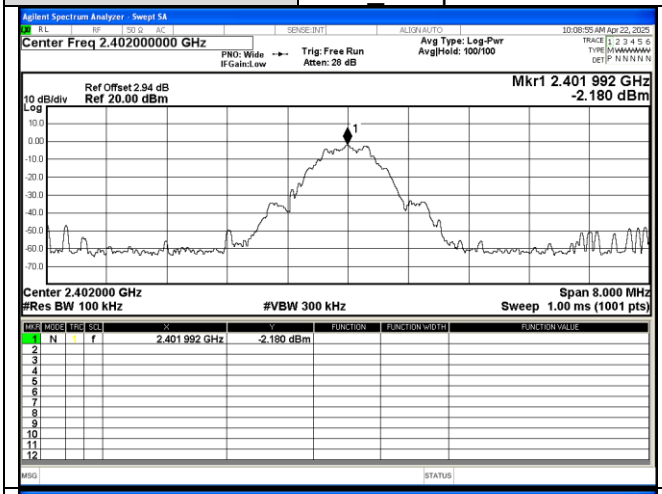
Test Mode:	BLE_2Mbps CH19	Test Mode:	BLE_2Mbps CH39

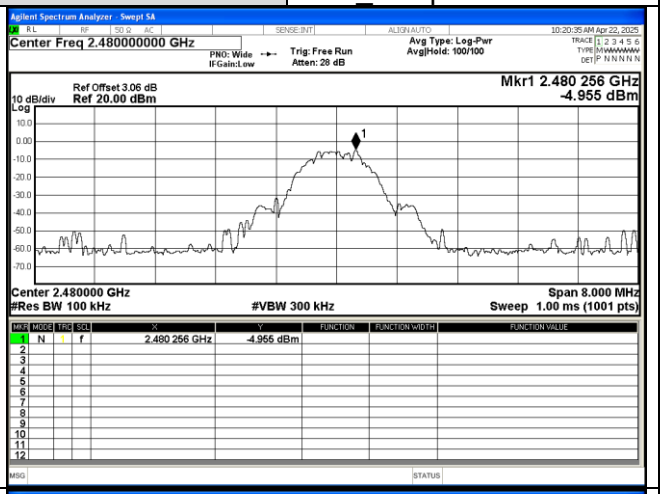


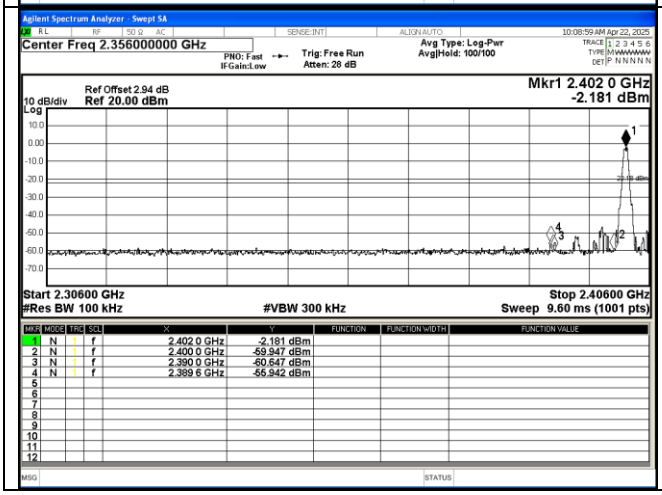


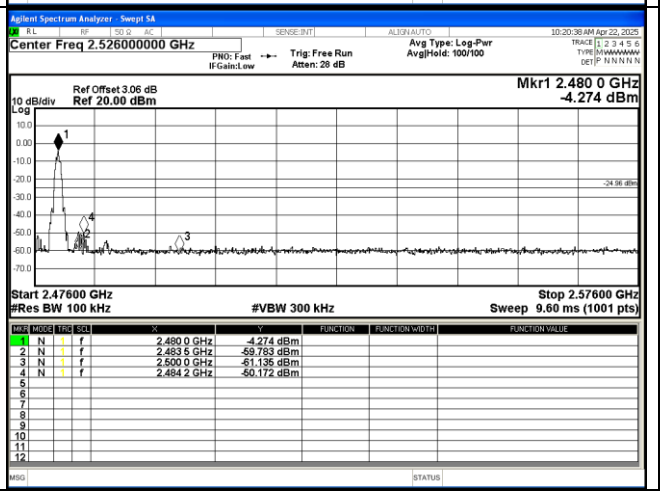


For Band edge(it's also the reference level for conducted spurious emission)			
Test Mode:	BLE_1Mbps CH00	Test Mode:	BLE_1Mbps CH39

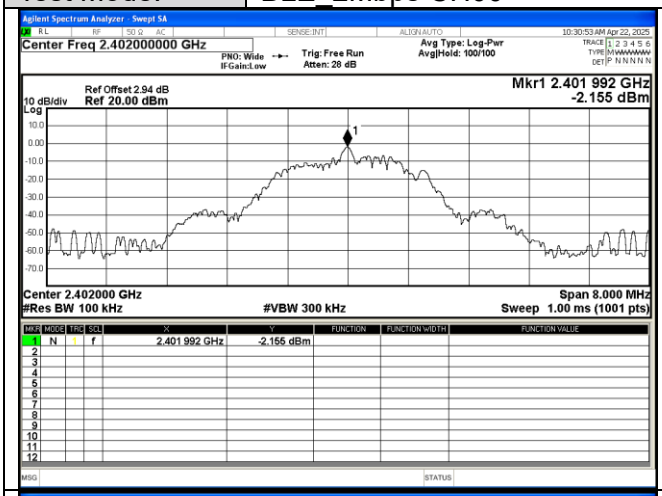


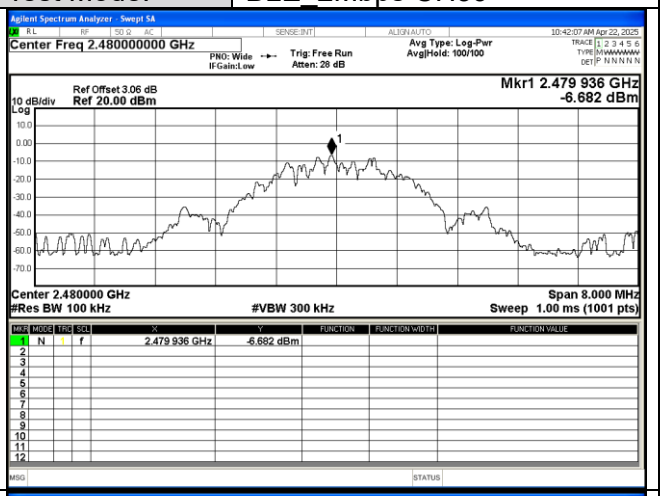


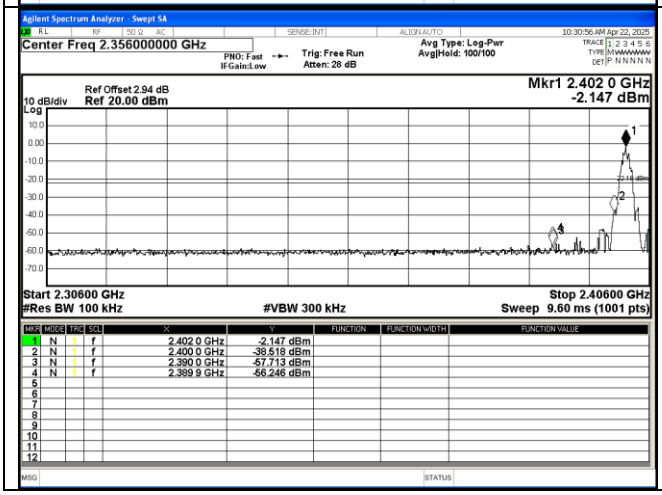


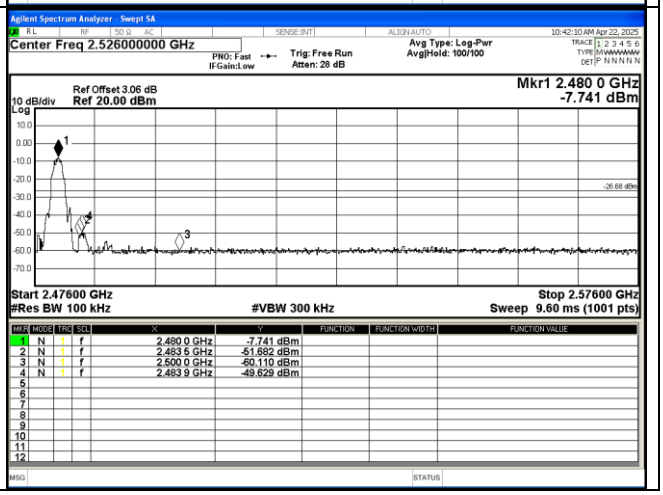


Test Mode:	BLE_2Mbps CH00	Test Mode:	BLE_2Mbps CH39







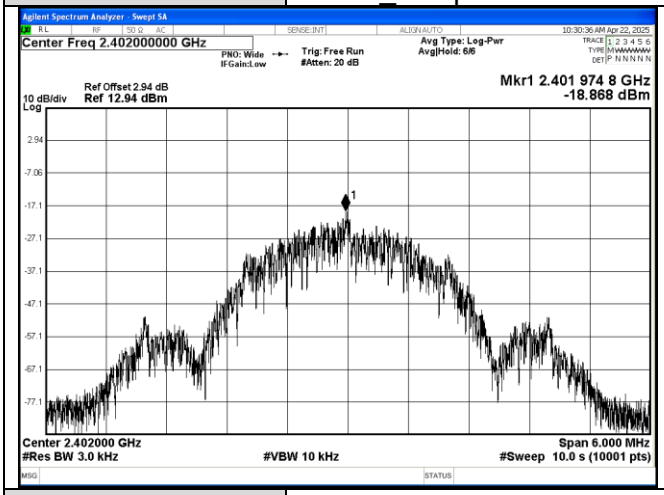


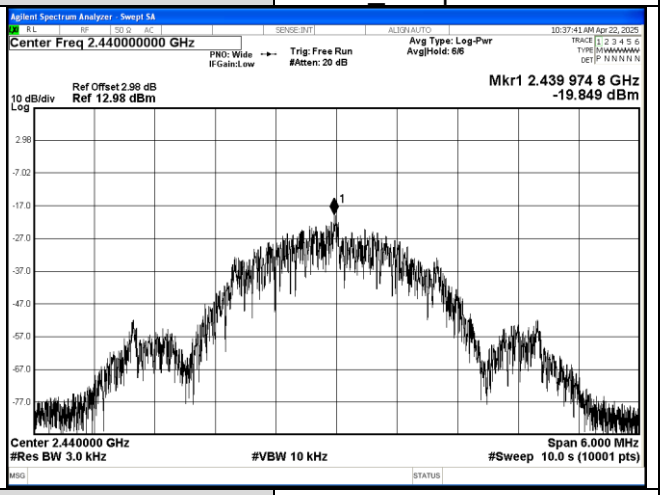
Appendix A.3 Test Results of Conducted Power Spectral Density

GFSK_1Mbps			
Frequency	Power Density (dBm/3kHz)	Limit (dBm/3KHz)	Result
CH00	-14.74	8	Pass
CH19	-15.901	8	Pass
CH39	-16.798	8	Pass

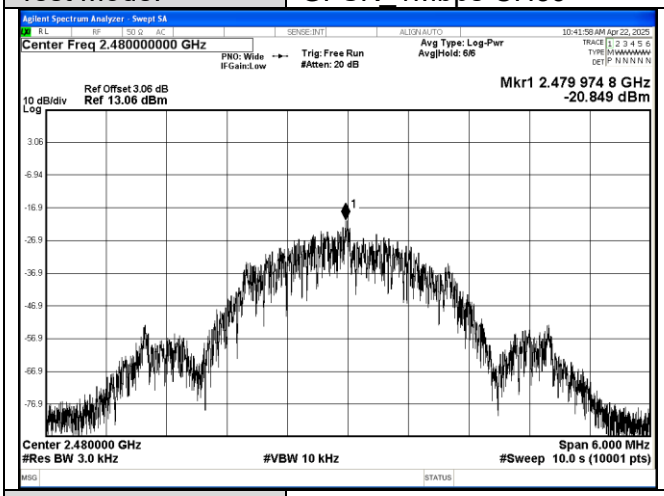
GFSK_2Mbps			
Frequency	Power Density (dBm/3kHz)	Limit (dBm/3KHz)	Result
CH00	-18.868	8	Pass
CH19	-19.849	8	Pass
CH39	-20.849	8	Pass

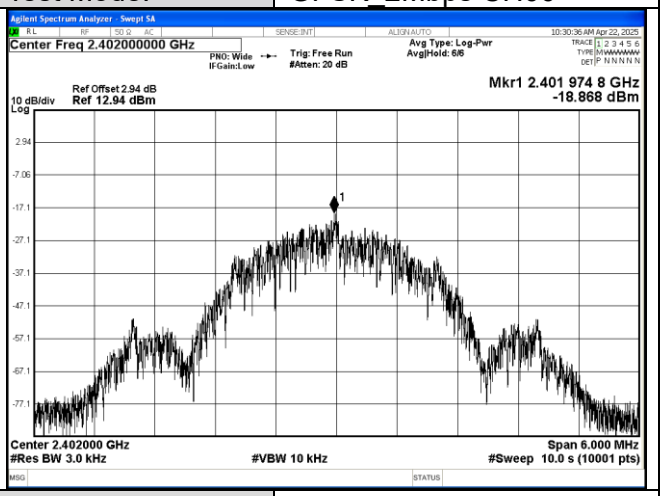
Test Mode:	GFSK_1Mbps CH00	Test Mode:	GFSK_1Mbps CH19



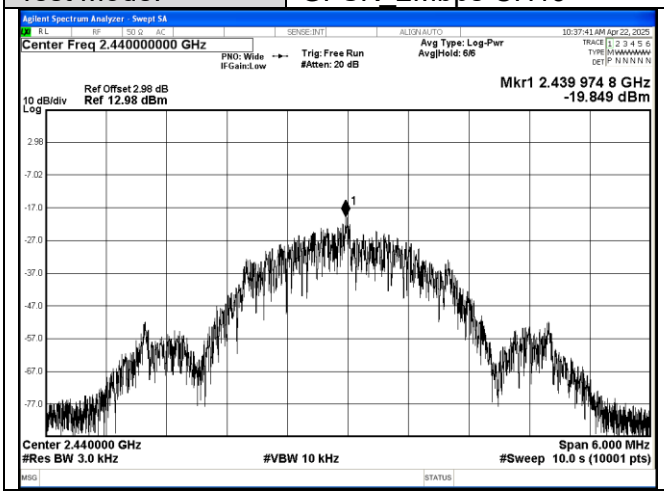


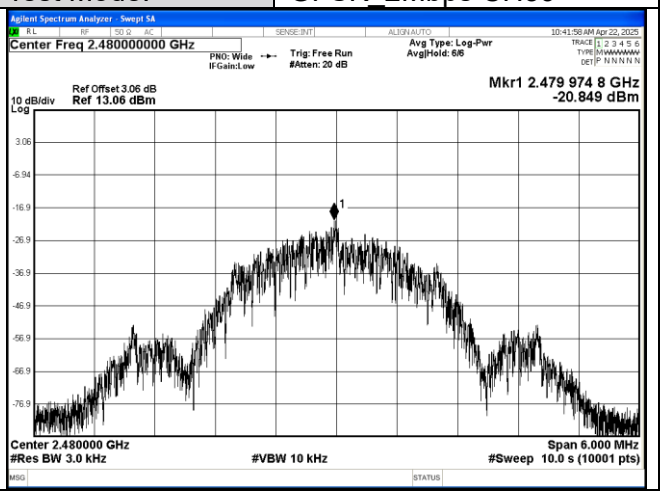
Test Mode:	GFSK_1Mbps CH39	Test Mode:	GFSK_2Mbps CH00





Test Mode:	GFSK_2Mbps CH19	Test Mode:	GFSK_2Mbps CH39

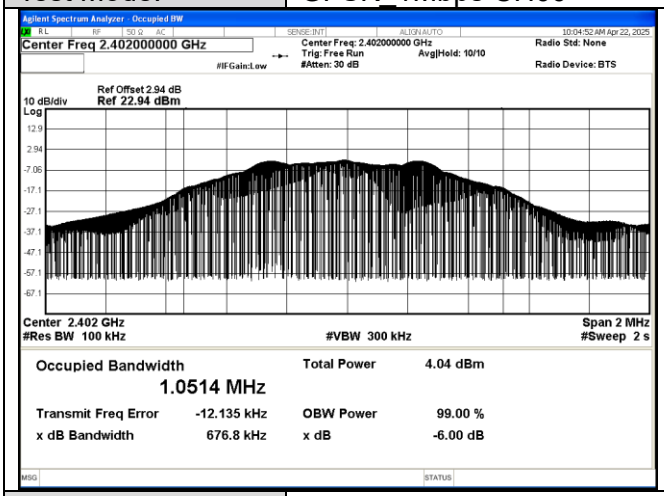
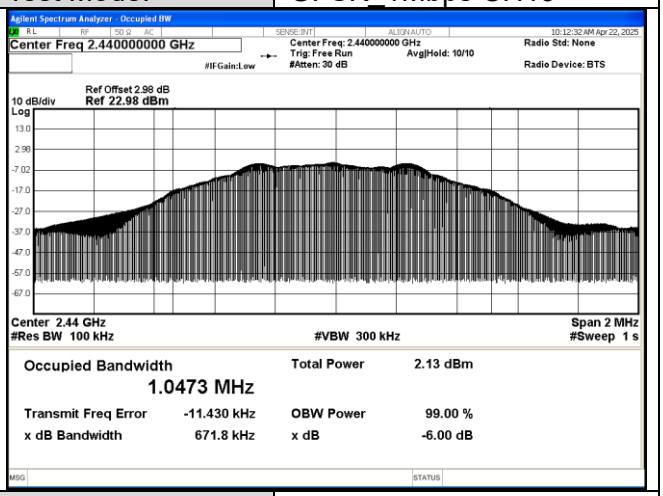
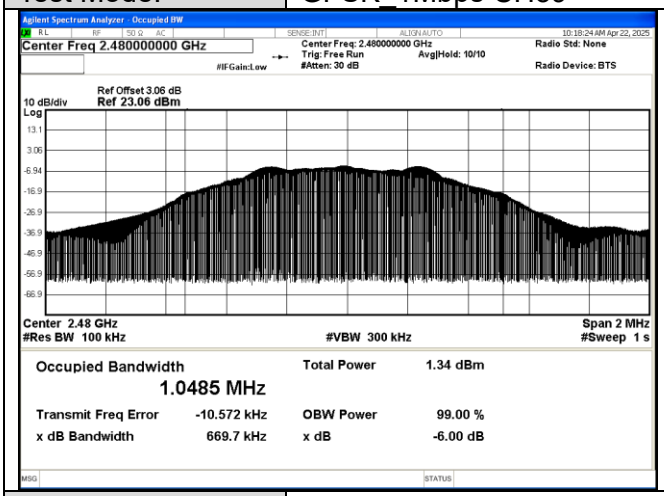
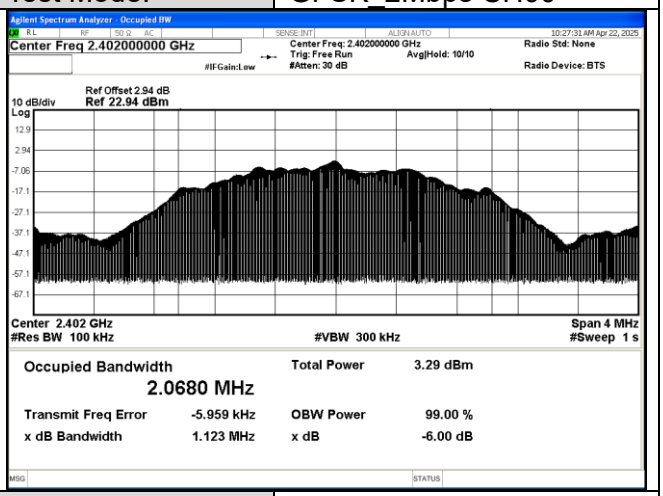
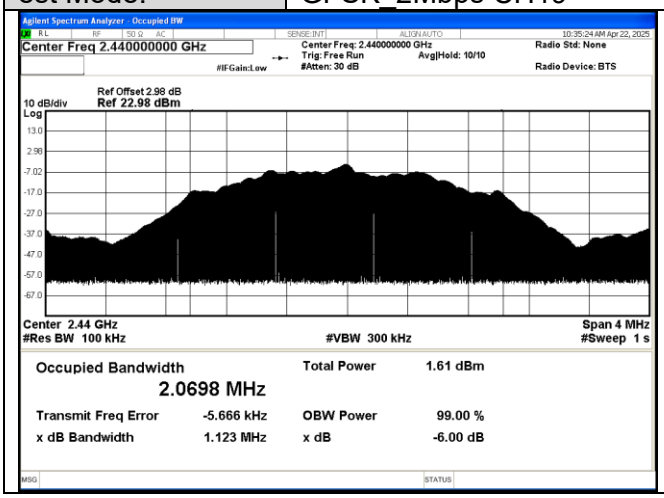
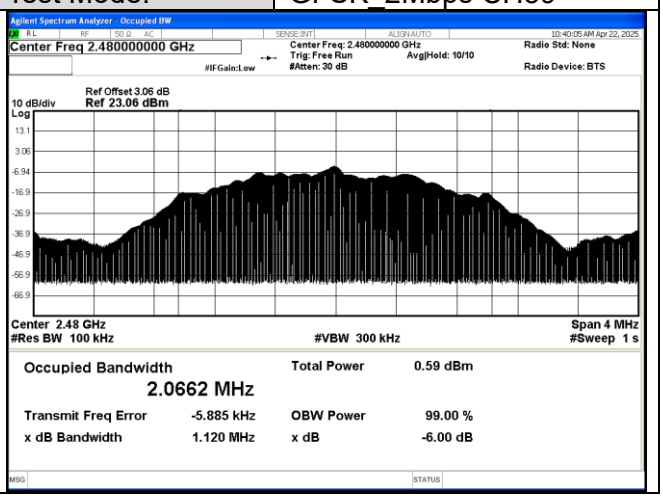




Appendix A.4 Test Results of 6dB BANDWIDTH

GFSK_1Mbps			
Frequency	Bandwidth (MHz)	6dB limit (KHz)	Result
	6dB		
CH00	0.6768	0.5	Pass
CH19	0.6718	0.5	Pass
CH39	0.6697	0.5	Pass

GFSK_2Mbps			
Frequency	Bandwidth (MHz)	6dB limit (KHz)	Result
	6dB		
CH00	1.1230	0.5	Pass
CH19	1.1230	0.5	Pass
CH39	1.1200	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
			
est Mode:	GFSK_2Mbps CH19	Test Mode:	GFSK_2Mbps CH39
			

Appendix A.5 Test Results of Maximum Conducted Power

Mode	Frequency [MHz]	Measured of peak Power		Limit [W]
		Conducted [dBm]	W	
BLE_1Mbps	2402	-1.711	0.0007	≤ 1.0
	2440	-2.886	0.0005	≤ 1.0
	2480	-3.846	0.0004	≤ 1.0
BLE_2Mbps	2402	-1.624	0.0007	≤ 1.0
	2440	-2.73	0.0005	≤ 1.0
	2480	-3.68	0.0004	≤ 1.0

Note:
1) The cable loss is taken into account in results.
2) Antenna gain(G) BLE: -1.97 dBi
e.i.r.p.=P(pk power)+ G, which is far below the 4 W