

Appendix A: Test Results of BLE

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Appendix A.1 Test Results of Conducted Emission on AC Mains

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

Test Mode :

Mode7

Test Voltage :

AC 120V/60Hz

L

No.	Frequency (MHz)	QuasiPeak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	QuasiPeak result (dBuV)	Average result (dBuV)	QuasiPeak limit (dBuV)	Average limit (dBuV)	QuasiPeak margin (dB)	Average margin (dB)	Remark
1P	0.1539	38.94	10.61	9.50	48.44	20.11	65.78	55.79	-17.34	-35.68	Pass
2P	0.3820	28.70	19.13	9.50	38.20	28.63	58.23	48.24	-20.03	-19.61	Pass
3P	0.5660	28.84	13.44	9.50	38.34	22.94	56.00	46.00	-17.66	-23.06	Pass
4*	0.7660	29.06	21.55	9.48	38.54	31.03	56.00	46.00	-17.46	-14.97	Pass
5P	1.1539	23.17	15.05	9.38	32.55	24.43	56.00	46.00	-23.45	-21.57	Pass
6P	1.4460	24.30	13.53	9.36	33.66	22.89	56.00	46.00	-22.34	-23.11	Pass

N

No.	Frequency (MHz)	QuasiPeak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	QuasiPeak result (dBuV)	Average result (dBuV)	QuasiPeak limit (dBuV)	Average limit (dBuV)	QuasiPeak margin (dB)	Average margin (dB)	Remark
1P	0.1539	38.61	11.24	9.40	48.01	20.64	65.78	55.79	-17.77	-35.15	Pass
2P	0.3500	26.80	9.07	9.40	36.20	18.47	58.96	48.96	-22.76	-30.49	Pass
3P	0.5780	29.02	15.64	9.40	38.42	25.04	56.00	46.00	-17.58	-20.96	Pass
4*	0.7700	29.57	20.10	9.38	38.95	29.48	56.00	46.00	-17.05	-16.52	Pass
5P	1.1500	24.01	11.85	9.28	33.29	21.13	56.00	46.00	-22.71	-24.87	Pass
6P	1.5339	22.43	12.64	9.25	31.68	21.89	56.00	46.00	-24.32	-24.11	Pass

Correction Factor = insertion loss of LISN + cable loss;

Reading = Reading Amplitude in the instrument;

Result = Correction Factor + Reading;

Margin = Result – Limit

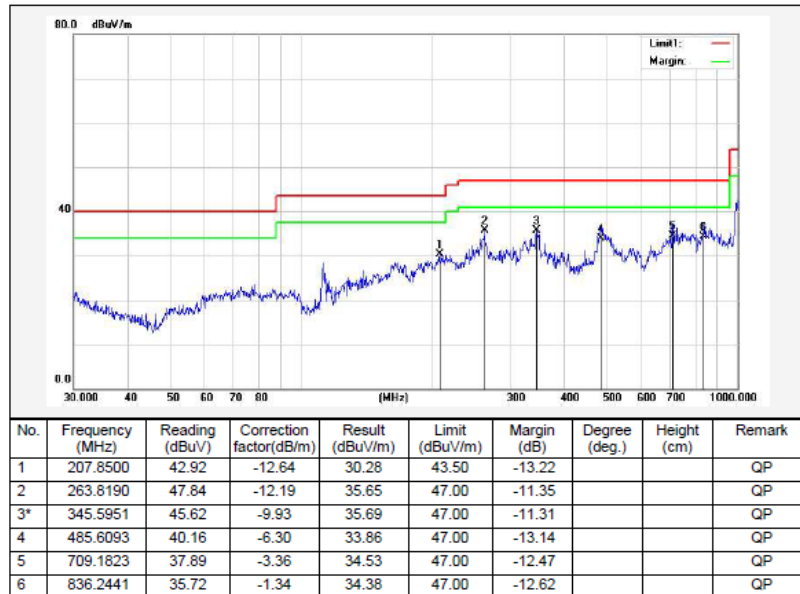
Appendix A.2 Test Results of Radiated Spurious Emission

Below 1GHz:

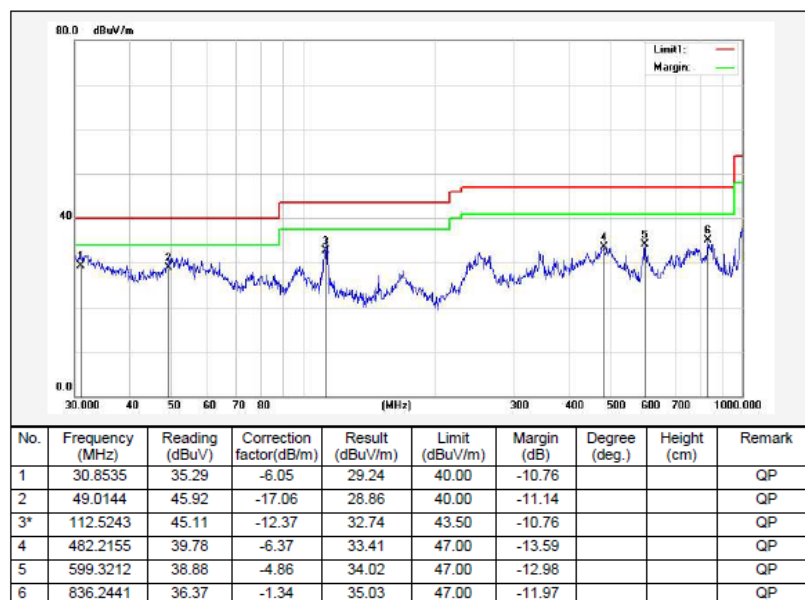
All modes have been tested, and the report only reflects the worst mode.

Test Mode: Mode7

Horizontal



Vertical



Correction Factor = antenna factor + cable loss – amplifier gain;

Reading = Reading Amplitude in the instrument;

Result = Correction Factor + Reading;

Margin = Result – Limit.

Above 1GHz:
Note: 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	2394	65.18	-21.01	44.17	80.58	-36.22	peak
2	4808	61.37	-13.33	48.04	74	-25.96	peak
3	7188	59.73	-8.03	51.7	80.58	-28.69	peak
4	9602	63.87	-7.4	56.47	80.58	-23.92	peak
5	11098	53.81	-2.54	51.27	74	-22.73	peak
6	13036	53.2	-0.29	52.91	80.58	-27.48	peak

GFSK-Low Vertical

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2394	64.59	-21.01	43.58	80.58	-36.81	peak
2	3992	60.11	-15.01	45.1	74	-28.9	peak
3	4808	61.34	-13.33	48.01	74	-25.99	peak
4	7188	59	-8.03	50.97	80.58	-29.42	peak
5	9602	65.05	-7.4	57.65	80.58	-22.74	peak
6	11404	53.83	-1.87	51.96	74	-22.04	peak

GFSK- Middle Horizontal

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	3380	61.41	-17.87	43.54	80.58	-36.85	peak
2	5080	59.21	-12.5	46.71	74	-27.29	peak
3	7426	57.68	-7.09	50.59	74	-23.41	peak
4	9738	63.4	-6.35	57.05	80.58	-23.34	peak
5	10554	55.42	-2.97	52.45	80.58	-27.94	peak
6	12424	55.55	-1.81	53.74	74	-20.26	peak

GFSK-Middle Vertical

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4502	59.2	-14.82	44.38	74	-29.62	peak
2	6576	59.44	-10.31	49.13	80.58	-31.26	peak
3	7698	58.31	-7.74	50.57	74	-23.43	peak
4	9738	62.26	-6.35	55.91	80.58	-24.48	peak
5	10792	55.02	-3.21	51.81	74	-22.19	peak
6	12322	55.37	-2.2	53.17	74	-20.83	peak

GFSK-High Horizontal

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4944	61.7	-12.85	48.85	74	-25.15	peak
2	7426	61.72	-7.09	54.63	74	-19.37	peak
3	7439.97	56.92	-7.08	49.84	54	-4.16	AVG
4	9908	65.33	-5.28	60.05	80.58	-20.34	peak
5	11472	52.98	-2.21	50.77	74	-23.23	peak
6	12730	53.7	-0.78	52.92	80.58	-27.47	peak
7	13070	53.83	-0.16	53.67	80.58	-26.72	peak

GFSK-High Vertical

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	3924	60.18	-15.19	44.99	74	-29.01	peak
2	4944	59.44	-12.85	46.59	74	-27.41	peak
3	7426	58.8	-7.09	51.71	74	-22.29	peak
4	9908	67.36	-5.28	62.08	80.58	-18.31	peak
5	11914	53.53	-2.32	51.21	74	-22.79	peak
6	13070	52.95	-0.16	52.79	80.58	-27.6	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. 100.58) 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	2383.453	58.5	-21.05	37.45	54	-16.55	AVG
2	2383.53	67.23	-21.05	46.18	74	-27.82	peak
3	2390	65.34	-21.03	44.31	74	-29.69	peak
4	2390	53.42	-21.03	32.39	54	-21.61	AVG
5	2402.34	121.57	-20.99	100.58	125.2	-24.62	peak

Vertical

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2383.15	69.9	-21.05	48.85	74	-25.15	peak
2	2383.533	58.7	-21.05	37.65	54	-16.35	AVG
3	2390	66.23	-21.03	45.2	74	-28.8	peak
4	2390	52.1	-21.03	31.07	54	-22.93	AVG
5	2402.34	123.64	-20.99	102.65	125.2	-22.55	peak

GFSK-High

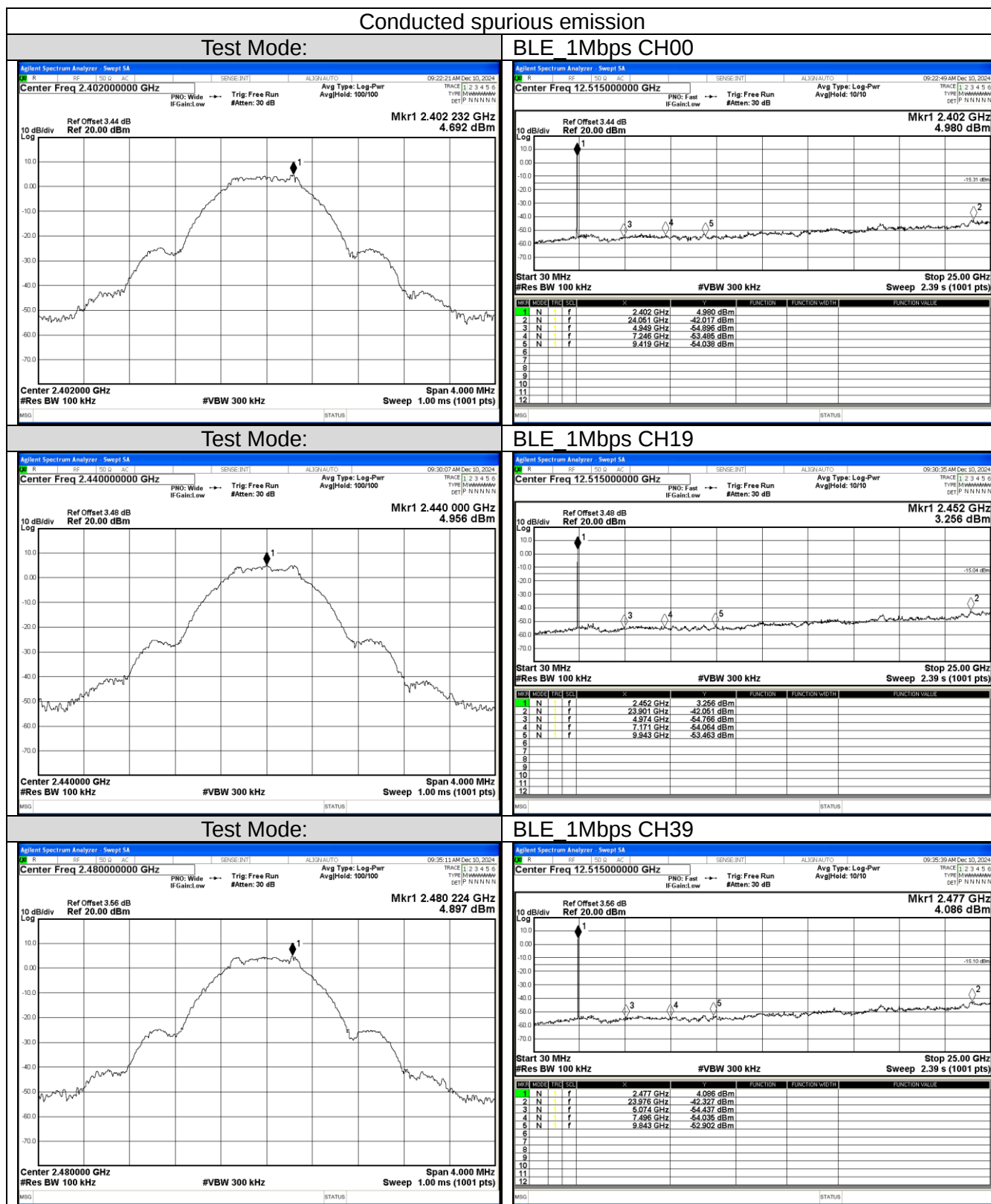
Horizontal

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2479.75	121.93	-20.91	101.02	125.2	-24.18	peak
2	2483.5	65.45	-20.91	44.54	74	-29.46	peak
3	2483.5	54.2	-20.91	33.29	54	-20.71	AVG
4	2498.96	56.97	-20.92	36.05	54	-17.95	AVG
5	2499.2	67.55	-20.92	46.63	74	-27.37	peak

Vertical

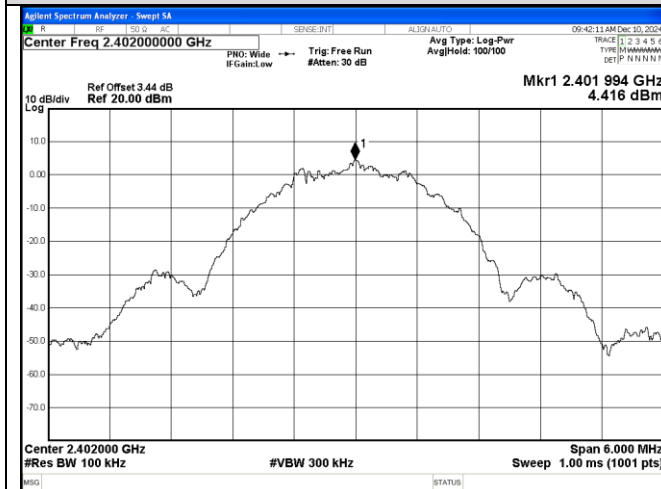
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2480.2	123.43	-20.91	102.52	125.2	-22.68	peak
2	2483.5	67.36	-20.91	46.45	74	-27.55	peak
3	2483.5	55.44	-20.91	34.53	54	-19.47	AVG
4	2498.85	68.17	-20.92	47.25	74	-26.75	peak
5	2498.97	59.6	-20.92	38.68	54	-15.32	AVG

Appendix A.3 Test Results of Conducted Spurious Emissions Measured in 100 kHz Bandwidth

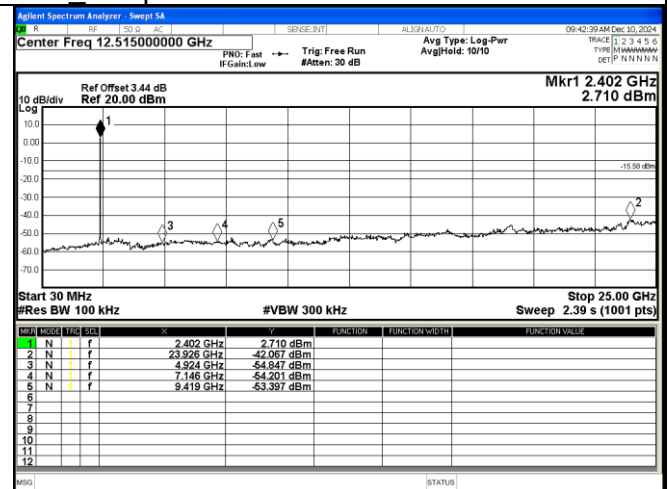


Conducted spurious emission

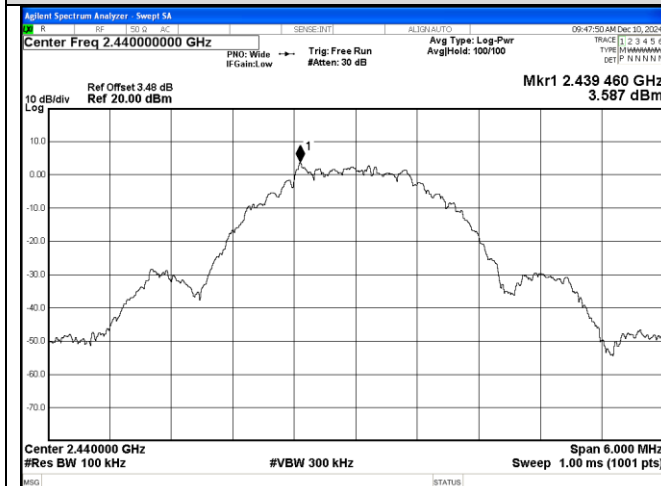
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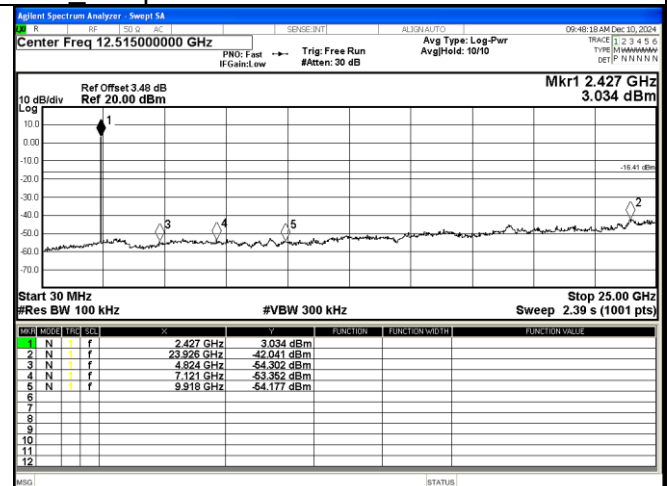
BLE 2Mbps CH00



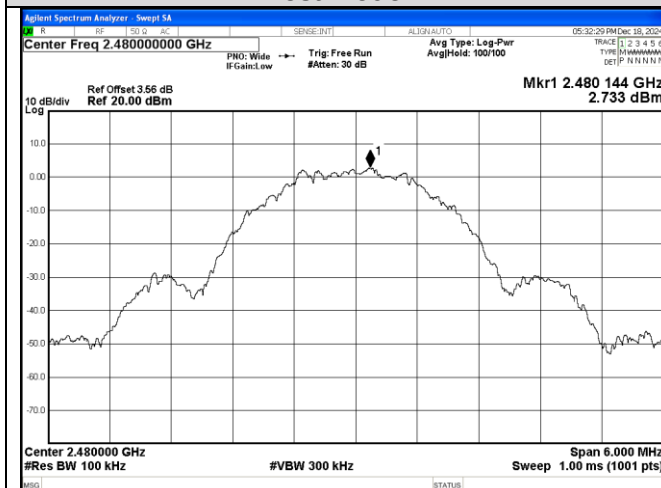
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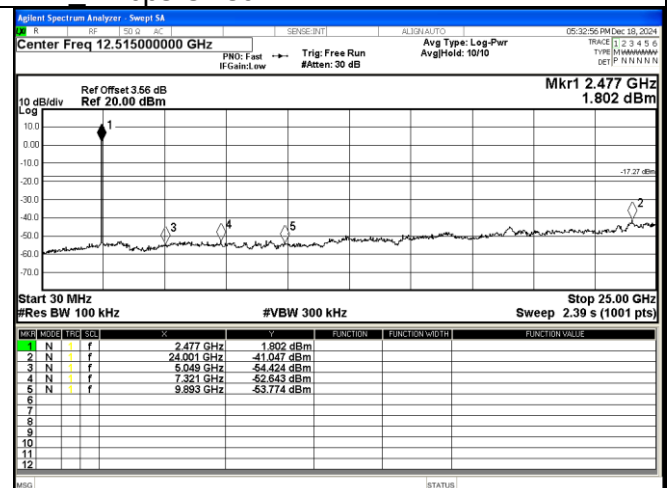
BLE 2Mbps CH19



Test Mode:



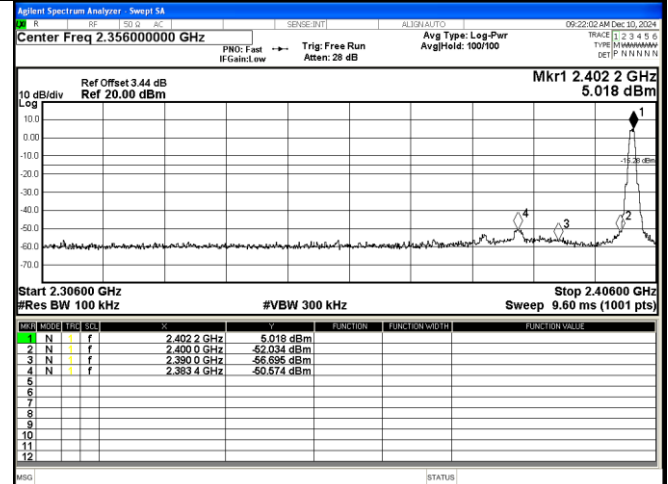
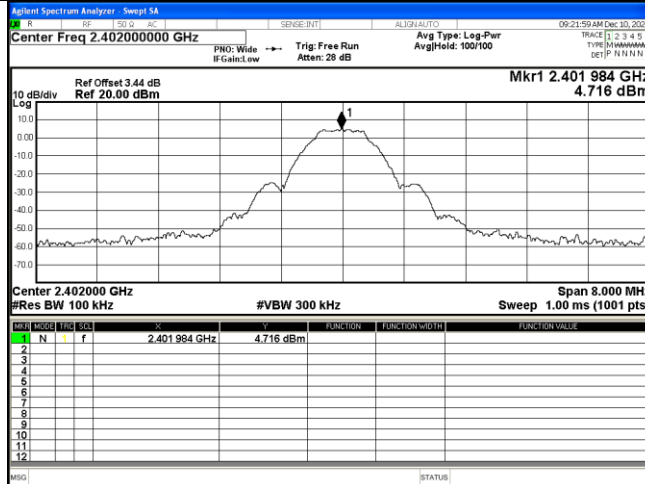
BLE 2Mbps CH39



For Band edge (it's also the reference level for conducted spurious emission)

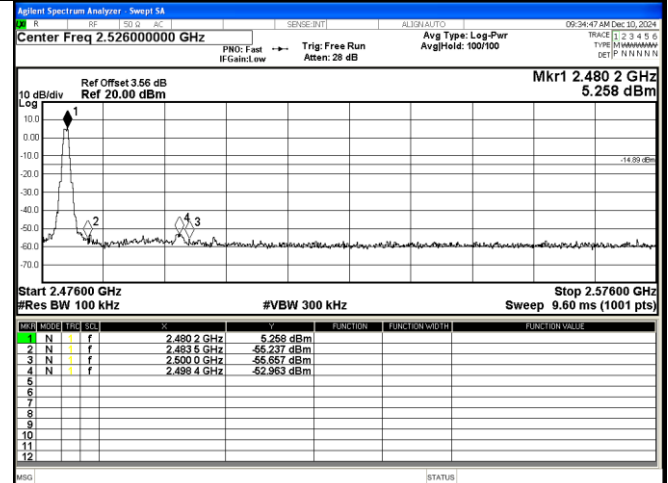
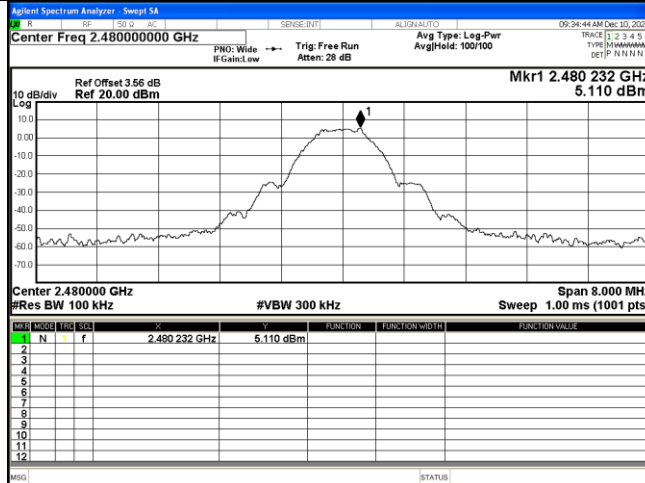
Test Mode:

BLE 1Mbps CH00



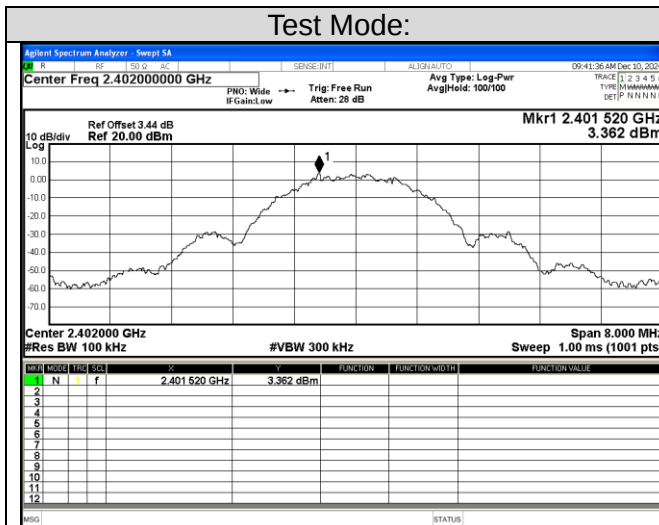
Test Mode:

BLE 1Mbps CH39

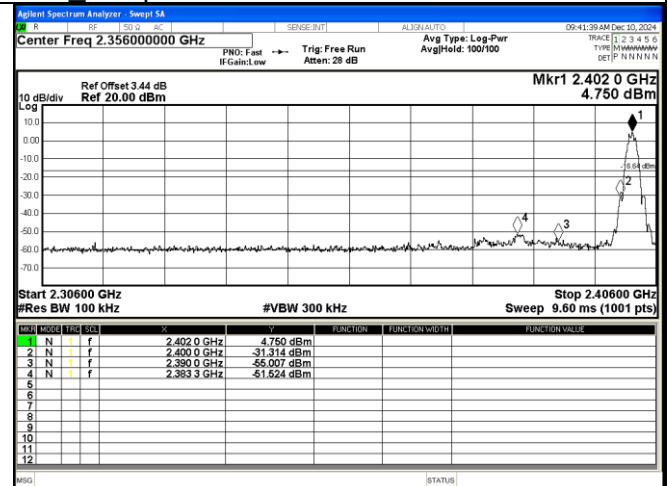




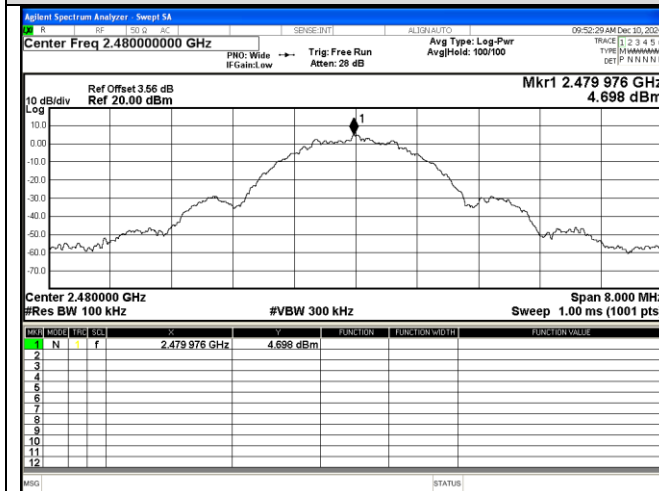
Test Mode:



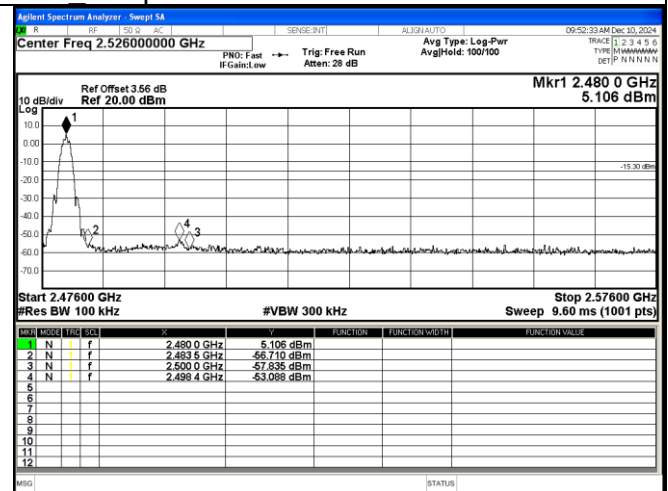
BLE 2Mbps CH00



Test Mode:



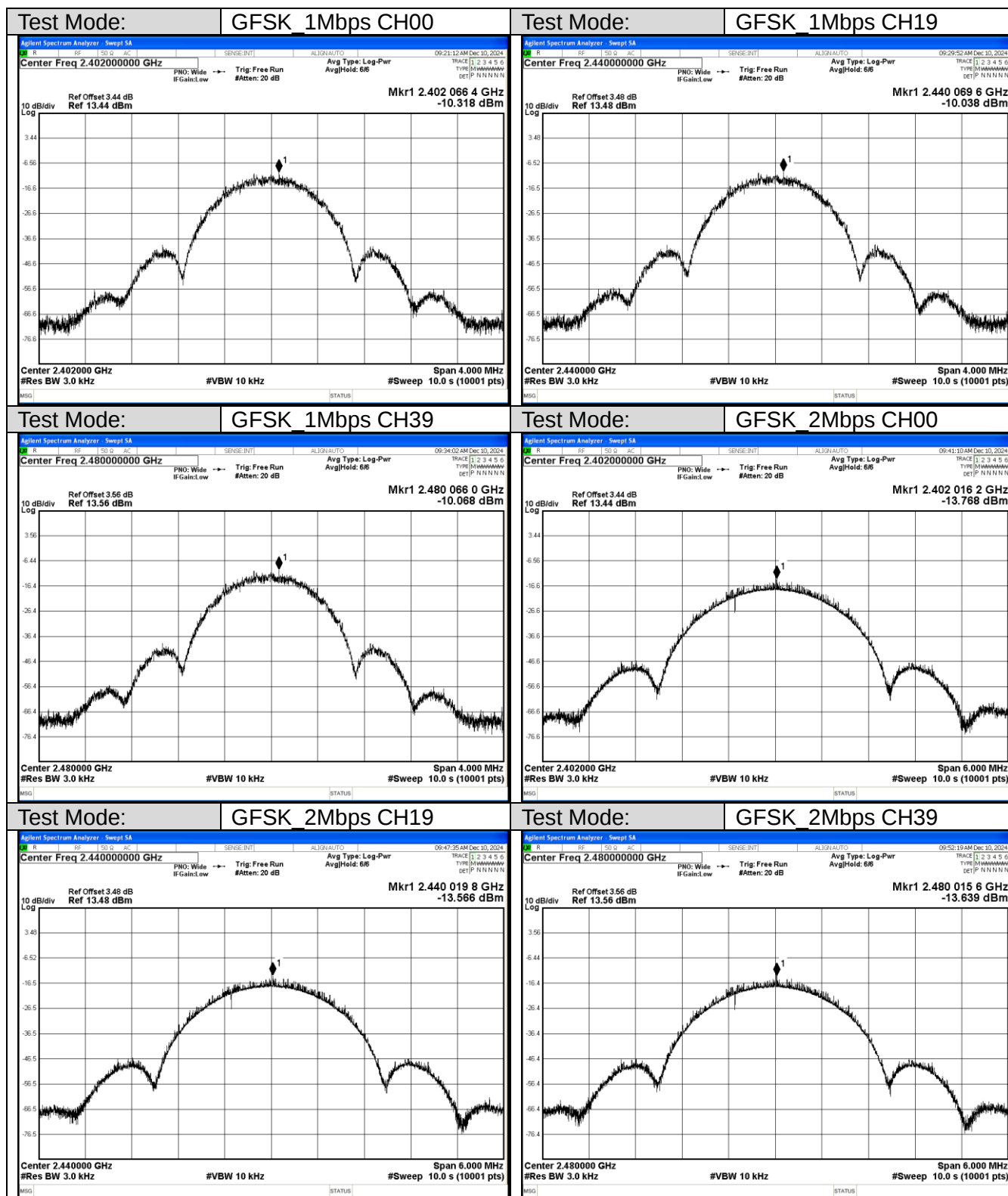
BLE 2Mbps CH39



Appendix A.4 Test Results of Conducted Power Spectral Density

GFSK_1Mbps			
Frequency	Power Density	Limit (dBm/3KHz)	Result
	(dBm/3kHz)		
CH00	-10.318	8	Pass
CH19	-10.038	8	Pass
CH39	-10.068	8	Pass

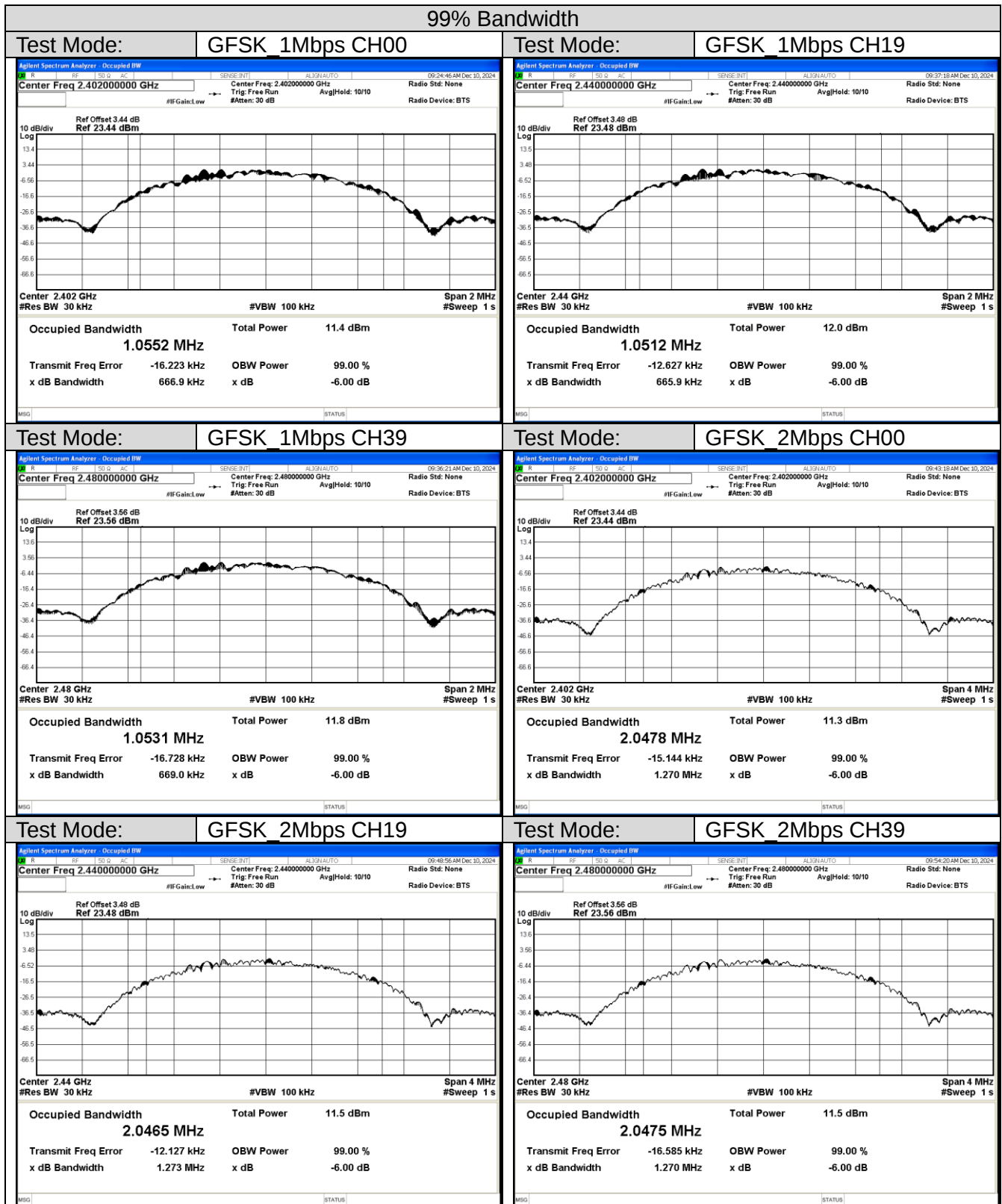
GFSK_2Mbps			
Frequency	Power Density	Limit (dBm/3KHz)	Result
	(dBm/3kHz)		
CH00	-13.768	8	Pass
CH19	-13.566	8	Pass
CH39	-13.639	8	Pass

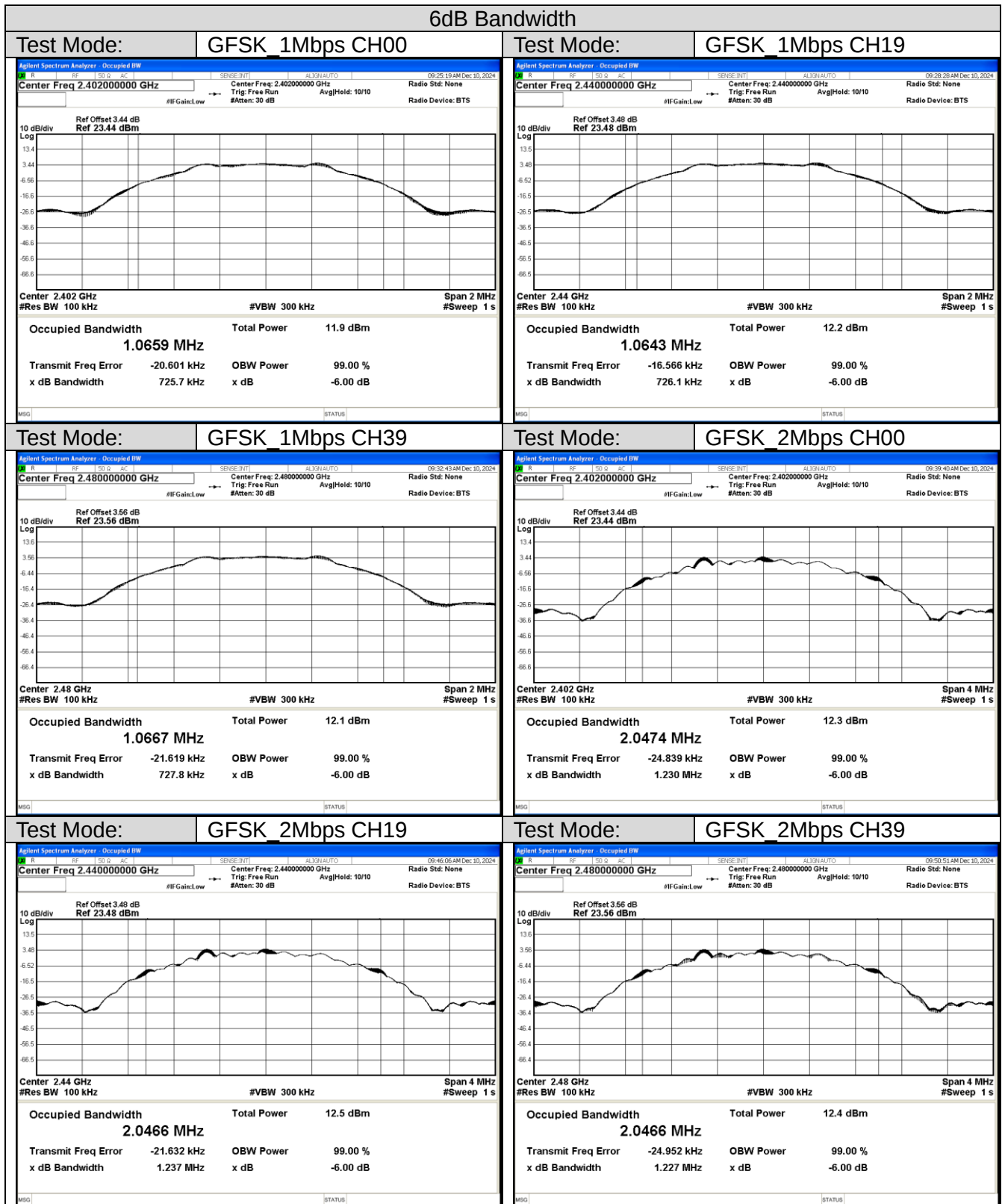


Appendix A.5 Test Results of 6dB and 99% BANDWIDTH

GFSK_1Mbps				
Frequency	99% Bandwidth (MHz)	6dB Bandwidth (MHz)	6dB limit (MHz)	Result
CH00	1.0552	0.7257	0.5	Pass
CH19	1.0512	0.7261	0.5	Pass
CH39	1.0531	0.7278	0.5	Pass

GFSK_2Mbps				
Frequency	99% Bandwidth (MHz)	6dB Bandwidth (MHz)	6dB limit (MHz)	Result
CH00	2.0478	1.23	0.5	Pass
CH19	2.0465	1.2368	0.5	Pass
CH39	2.0475	1.2267	0.5	Pass





Appendix A.6 Test Results of Maximum Conducted Power

For FCC:

Mode	Frequency [MHz]	Measured of Conducted Power	Limit [dBm]
		Conducted [dBm]	
BLE_1Mbps	2402	5.829	≤ 30
	2440	6.101	≤ 30
	2480	6.018	≤ 30
BLE_2Mbps	2402	5.715	≤ 30
	2440	5.968	≤ 30
	2480	5.909	≤ 30

Note:

- 1) The cable loss is taken into account in results.
 - 2) Antenna gain(G) BLE: 2.50 dBi
- e.i.r.p.=P(Peak power)+ G, which is far below the 4 W