

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 :

Mode 5

Test Voltage :

AC 230V/50Hz

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	0.1580	46.45	22.12	9.62	56.07	31.74	65.56	55.57	-9.49	-23.83	Pass
2P	0.2020	41.84	19.12	9.53	51.37	28.65	63.52	53.53	-12.15	-24.88	Pass
3P	0.2220	38.09	22.01	9.53	47.62	31.54	62.74	52.74	-15.12	-21.20	Pass
4P	0.3820	33.18	16.64	9.52	42.70	26.16	58.23	48.24	-15.53	-22.08	Pass
5P	0.4780	42.35	17.50	9.52	51.87	27.02	56.37	46.37	-4.50	-19.35	Pass
6P	8.0380	42.24	17.39	9.63	51.87	27.02	60.00	50.00	-8.13	-22.98	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
1*	0.1580	46.88	29.52	9.56	56.44	39.08	65.56	55.57	-9.12	-16.49	Pass
2P	0.1780	44.46	24.84	9.59	54.05	34.43	64.57	54.58	-10.52	-20.15	Pass
3P	0.2140	39.03	17.33	9.63	48.66	26.96	63.04	53.05	-14.38	-26.09	Pass
4P	0.4580	30.39	17.00	9.62	40.01	26.62	56.73	46.73	-16.72	-20.11	Pass
5P	4.3140	29.49	16.07	9.57	39.06	25.64	56.00	46.00	-16.94	-20.36	Pass
6P	9.0300	30.47	17.92	9.83	40.30	27.75	60.00	50.00	-19.70	-22.25	Pass

Correction Factor = insertion loss of LISN + cable loss;

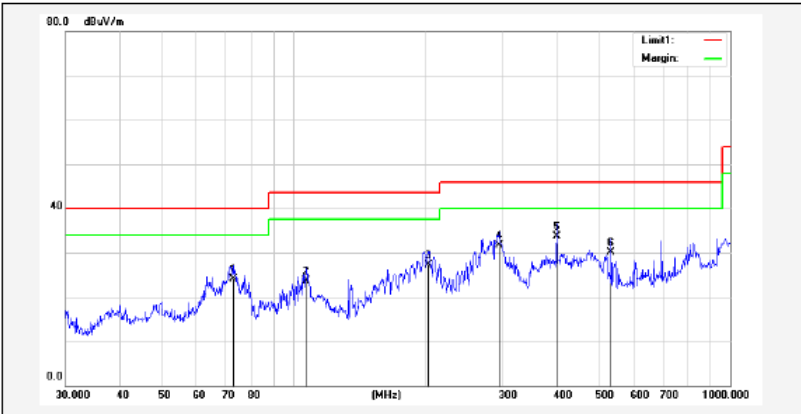
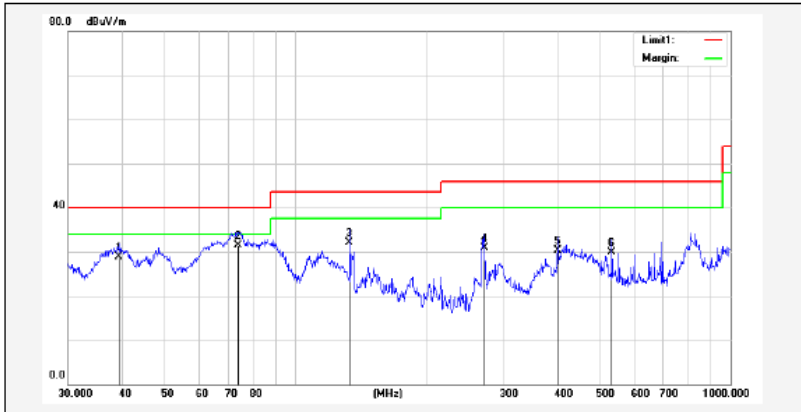
Reading = Reading Amplitude in the instrument;

Result = Correction Factor + Reading;

Margin = Result – Limit.

Appendix A.2 Test Results of Radiated Spurious Emission

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

Below 1G:																																																																															
Test Mode :		Mode 5			Test Voltage :		AC 230V/50Hz																																																																								
Horizontal																																																																															
 The graph shows the horizontal radiated emission spectrum. The y-axis represents the signal level in dBuV/m, ranging from 0.0 to 60.0. The x-axis represents the frequency in MHz, ranging from 30.000 to 1000.000. A blue line shows the measured signal, which is noisy and fluctuates between approximately 20 and 40 dBuV/m. A red line represents the Limit, and a green line represents the Margin. Both the Limit and Margin lines are step functions, starting at 40 dBuV/m and increasing in steps at various frequencies. The Margin line is consistently below the Limit line. The measured signal is generally below the Margin line, indicating compliance with the limits. <table><thead><tr><th>No.</th><th>Frequency (MHz)</th><th>Reading (dBuV)</th><th>Correction factor(dB/m)</th><th>Result (dBuV/m)</th><th>Limit (dBuV/m)</th><th>Margin (dB)</th><th>Degree (deg.)</th><th>Height (cm)</th><th>Remark</th></tr></thead><tbody><tr><td>1</td><td>72.8465</td><td>38.33</td><td>-14.26</td><td>24.07</td><td>40.00</td><td>-15.93</td><td></td><td></td><td>QP</td></tr><tr><td>2</td><td>106.7587</td><td>38.58</td><td>-14.86</td><td>23.72</td><td>43.50</td><td>-19.78</td><td></td><td></td><td>QP</td></tr><tr><td>3</td><td>203.5227</td><td>42.30</td><td>-14.92</td><td>27.38</td><td>43.50</td><td>-16.12</td><td></td><td></td><td>QP</td></tr><tr><td>4</td><td>296.1836</td><td>41.91</td><td>-10.15</td><td>31.76</td><td>46.00</td><td>-14.24</td><td></td><td></td><td>QP</td></tr><tr><td>5*</td><td>400.4318</td><td>41.08</td><td>-7.43</td><td>33.65</td><td>46.00</td><td>-12.35</td><td></td><td></td><td>QP</td></tr><tr><td>6</td><td>533.8320</td><td>34.37</td><td>-4.26</td><td>30.11</td><td>46.00</td><td>-15.89</td><td></td><td></td><td>QP</td></tr></tbody></table>										No.	Frequency (MHz)	Reading (dBuV)	Correction factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (deg.)	Height (cm)	Remark	1	72.8465	38.33	-14.26	24.07	40.00	-15.93			QP	2	106.7587	38.58	-14.86	23.72	43.50	-19.78			QP	3	203.5227	42.30	-14.92	27.38	43.50	-16.12			QP	4	296.1836	41.91	-10.15	31.76	46.00	-14.24			QP	5*	400.4318	41.08	-7.43	33.65	46.00	-12.35			QP	6	533.8320	34.37	-4.26	30.11	46.00	-15.89			QP
No.	Frequency (MHz)	Reading (dBuV)	Correction factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (deg.)	Height (cm)	Remark																																																																						
1	72.8465	38.33	-14.26	24.07	40.00	-15.93			QP																																																																						
2	106.7587	38.58	-14.86	23.72	43.50	-19.78			QP																																																																						
3	203.5227	42.30	-14.92	27.38	43.50	-16.12			QP																																																																						
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6	533.8320	34.37	-4.26	30.11	46.00	-15.89			QP																																																																						
Vertical																																																																															
 The graph shows the vertical radiated emission spectrum. The y-axis represents the signal level in dBuV/m, ranging from 0.0 to 60.0. The x-axis represents the frequency in MHz, ranging from 30.000 to 1000.000. A blue line shows the measured signal, which is noisy and fluctuates between approximately 20 and 40 dBuV/m. A red line represents the Limit, and a green line represents the Margin. Both the Limit and Margin lines are step functions, starting at 40 dBuV/m and increasing in steps at various frequencies. The Margin line is consistently below the Limit line. The measured signal is generally below the Margin line, indicating compliance with the limits. <table><thead><tr><th>No.</th><th>Frequency (MHz)</th><th>Reading (dBuV)</th><th>Correction factor(dB/m)</th><th>Result (dBuV/m)</th><th>Limit (dBuV/m)</th><th>Margin (dB)</th><th>Degree (deg.)</th><th>Height (cm)</th><th>Remark</th></tr></thead><tbody><tr><td>1</td><td>39.2991</td><td>41.55</td><td>-12.62</td><td>28.93</td><td>40.00</td><td>-11.07</td><td></td><td></td><td>QP</td></tr><tr><td>2*</td><td>73.6170</td><td>46.06</td><td>-14.46</td><td>31.60</td><td>40.00</td><td>-8.40</td><td></td><td></td><td>QP</td></tr><tr><td>3</td><td>133.1511</td><td>45.09</td><td>-12.89</td><td>32.20</td><td>43.50</td><td>-11.30</td><td></td><td></td><td>QP</td></tr><tr><td>4</td><td>271.3245</td><td>42.80</td><td>-11.88</td><td>30.92</td><td>46.00</td><td>-15.08</td><td></td><td></td><td>QP</td></tr><tr><td>5</td><td>400.4318</td><td>37.77</td><td>-7.43</td><td>30.34</td><td>46.00</td><td>-15.66</td><td></td><td></td><td>QP</td></tr><tr><td>6</td><td>533.8320</td><td>34.21</td><td>-4.26</td><td>29.95</td><td>46.00</td><td>-16.05</td><td></td><td></td><td>QP</td></tr></tbody></table>										No.	Frequency (MHz)	Reading (dBuV)	Correction factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (deg.)	Height (cm)	Remark	1	39.2991	41.55	-12.62	28.93	40.00	-11.07			QP	2*	73.6170	46.06	-14.46	31.60	40.00	-8.40			QP	3	133.1511	45.09	-12.89	32.20	43.50	-11.30			QP	4	271.3245	42.80	-11.88	30.92	46.00	-15.08			QP	5	400.4318	37.77	-7.43	30.34	46.00	-15.66			QP	6	533.8320	34.21	-4.26	29.95	46.00	-16.05			QP
No.	Frequency (MHz)	Reading (dBuV)	Correction factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (deg.)	Height (cm)	Remark																																																																						
1	39.2991	41.55	-12.62	28.93	40.00	-11.07			QP																																																																						
2*	73.6170	46.06	-14.46	31.60	40.00	-8.40			QP																																																																						
3	133.1511	45.09	-12.89	32.20	43.50	-11.30			QP																																																																						
4	271.3245	42.80	-11.88	30.92	46.00	-15.08			QP																																																																						
5	400.4318	37.77	-7.43	30.34	46.00	-15.66			QP																																																																						
6	533.8320	34.21	-4.26	29.95	46.00	-16.05			QP																																																																						

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

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	1305.319	68.89	-24.47	44.42	74	-29.58	peak
2	1305.319	48.78	-24.47	24.31	54	-29.69	AVG
3	1743.794	68.13	-23.13	45	74	-29	peak
4	1743.794	48.7	-23.13	25.57	54	-28.43	AVG
5	4917.943	61.87	-15.72	46.15	74	-27.85	peak
6	4917.943	42.15	-15.72	26.43	54	-27.57	AVG
7	7334.292	56.93	-9.32	47.61	74	-26.39	peak
8	7334.292	37.13	-9.32	27.81	54	-26.19	AVG
9	10144.5	54.88	-6.06	48.82	74	-25.18	peak
10	10144.5	34.65	-6.06	28.59	54	-25.41	AVG
11	12715.63	54.34	-2.72	51.62	74	-22.38	peak
12	12715.63	33.98	-2.72	31.26	54	-22.74	AVG

GFSK-Low Vertical

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1946.665	67.59	-22	45.59	74	-28.41	peak
2	1946.665	47.36	-22	25.36	54	-28.64	AVG
3	3240.873	62.58	-18.71	43.87	74	-30.13	peak
4	3240.873	42.18	-18.71	23.47	54	-30.53	AVG
5	4975.246	62.28	-15.6	46.68	74	-27.32	peak
6	4975.246	42.49	-15.6	26.89	54	-27.11	AVG
7	7462.854	56.64	-9.05	47.59	74	-26.41	peak
8	7462.854	36.35	-9.05	27.3	54	-26.7	AVG
9	10564.27	54.91	-5.69	49.22	74	-24.78	peak
10	10564.27	35.55	-5.69	29.86	54	-24.14	AVG
11	12715.63	54.9	-2.72	52.18	74	-21.82	peak
12	12715.63	35.13	-2.72	32.41	54	-21.59	AVG

GFSK- Middle Horizontal

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1282.832	68.52	-24.61	43.91	74	-30.09	peak
2	1282.832	48.19	-24.61	23.58	54	-30.42	AVG
3	1743.794	71.63	-23.13	48.5	74	-25.5	peak
4	1743.794	51.6	-23.13	28.47	54	-25.53	AVG
5	2050.838	66.57	-21.05	45.52	74	-28.48	peak
6	2050.838	46.6	-21.05	25.55	54	-28.45	AVG
7	5004.148	60.89	-15.59	45.3	74	-28.7	peak
8	5004.148	40.75	-15.59	25.16	54	-28.84	AVG
9	7862.219	56.13	-8.83	47.3	74	-26.7	peak
10	7862.219	36.73	-8.83	27.9	54	-26.1	AVG
11	10564.27	54.86	-5.69	49.17	74	-24.83	peak
12	10564.27	34.72	-5.69	29.03	54	-24.97	AVG

GFSK-Middle Vertical

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1391.195	67.34	-24.73	42.61	74	-31.39	peak
2	1391.195	47.05	-24.73	22.32	54	-31.68	AVG
3	1935.422	66.98	-22.08	44.9	74	-29.1	peak
4	1935.422	46.65	-22.08	24.57	54	-29.43	AVG
5	3336.106	62.09	-18.44	43.65	74	-30.35	peak
6	3336.106	42.09	-18.44	23.65	54	-30.35	AVG
7	5004.148	60.99	-15.59	45.4	74	-28.6	peak
8	5004.148	41.07	-15.59	25.48	54	-28.52	AVG
9	9797.99	55.82	-6.58	49.24	74	-24.76	peak
10	9797.99	35.59	-6.58	29.01	54	-24.99	AVG
11	12715.63	54.32	-2.72	51.6	74	-22.4	peak
12	12715.63	34.48	-2.72	31.76	54	-22.24	AVG

GFSK-High Horizontal

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1312.901	69.05	-24.51	44.54	74	-29.46	peak
2	1312.901	49.04	-24.51	24.53	54	-29.47	AVG
3	3638.928	59.53	-17.17	42.36	74	-31.64	peak
4	3638.928	39.64	-17.17	22.47	54	-31.53	AVG
5	5004.148	60.22	-15.59	44.63	74	-29.37	peak
6	5004.148	40.24	-15.59	24.65	54	-29.35	AVG
7	7334.292	56.48	-9.32	47.16	74	-26.84	peak
8	7334.292	36.51	-9.32	27.19	54	-26.81	AVG
9	9969.738	55.68	-6.07	49.61	74	-24.39	peak
10	9969.738	35.91	-6.07	29.84	54	-24.16	AVG
11	12715.63	53.64	-2.72	50.92	74	-23.08	peak
12	12715.63	32.88	-2.72	30.16	54	-23.84	AVG

GFSK-High Vertical

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1407.405	68.38	-24.73	43.65	74	-30.35	peak
2	1407.405	48.23	-24.73	23.5	54	-30.5	AVG
3	2003.868	65.95	-21.38	44.57	74	-29.43	peak
4	2003.868	45.69	-21.38	24.31	54	-29.69	AVG
5	3259.699	62.83	-18.61	44.22	74	-29.78	peak
6	3259.699	42.86	-18.61	24.25	54	-29.75	AVG
7	4975.246	60.94	-15.6	45.34	74	-28.66	peak
8	4975.246	41.21	-15.6	25.61	54	-28.39	AVG
9	7637.782	55.97	-9	46.97	74	-27.03	peak
10	7637.782	35.37	-9	26.37	54	-27.63	AVG
11	12715.63	54.33	-2.72	51.61	74	-22.39	peak
12	12715.63	34.32	-2.72	31.6	54	-22.4	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							
All modes have been tested, and the report only reflects the worst mode(1Mbps)							
GFSK - Low (worst mode)							
Horizontal							
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2347.034	49.77	2.76	52.53	74	-21.47	peak
2	2347.034	29.4	2.76	32.16	54	-21.84	AVG
3	2390	47.57	3.01	50.58	74	-23.42	peak
4	2390	27.78	3.01	30.79	54	-23.21	AVG
Vertical							
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2348.998	50.68	2.78	53.46	74	-20.54	peak
2	2348.998	30.48	2.78	33.26	54	-20.74	AVG
3	2390	48.15	3.01	51.16	74	-22.84	peak
4	2390	28.49	3.01	31.5	54	-22.5	AVG
GFSK - High (worst mode)							
Horizontal							
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.5	53.26	3.54	56.8	74	-17.2	peak
2	2483.5	32.94	3.54	36.48	54	-17.52	AVG
3	2489.579	50.18	3.59	53.77	74	-20.23	peak
4	2489.579	29.65	3.59	33.24	54	-20.76	AVG
Vertical							
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.5	52.02	3.54	55.56	74	-18.44	peak
2	2483.5	31.66	3.54	35.2	54	-18.8	AVG
3	2488.377	49.94	3.58	53.52	74	-20.48	peak
4	2488.377	29.87	3.58	33.45	54	-20.55	AVG

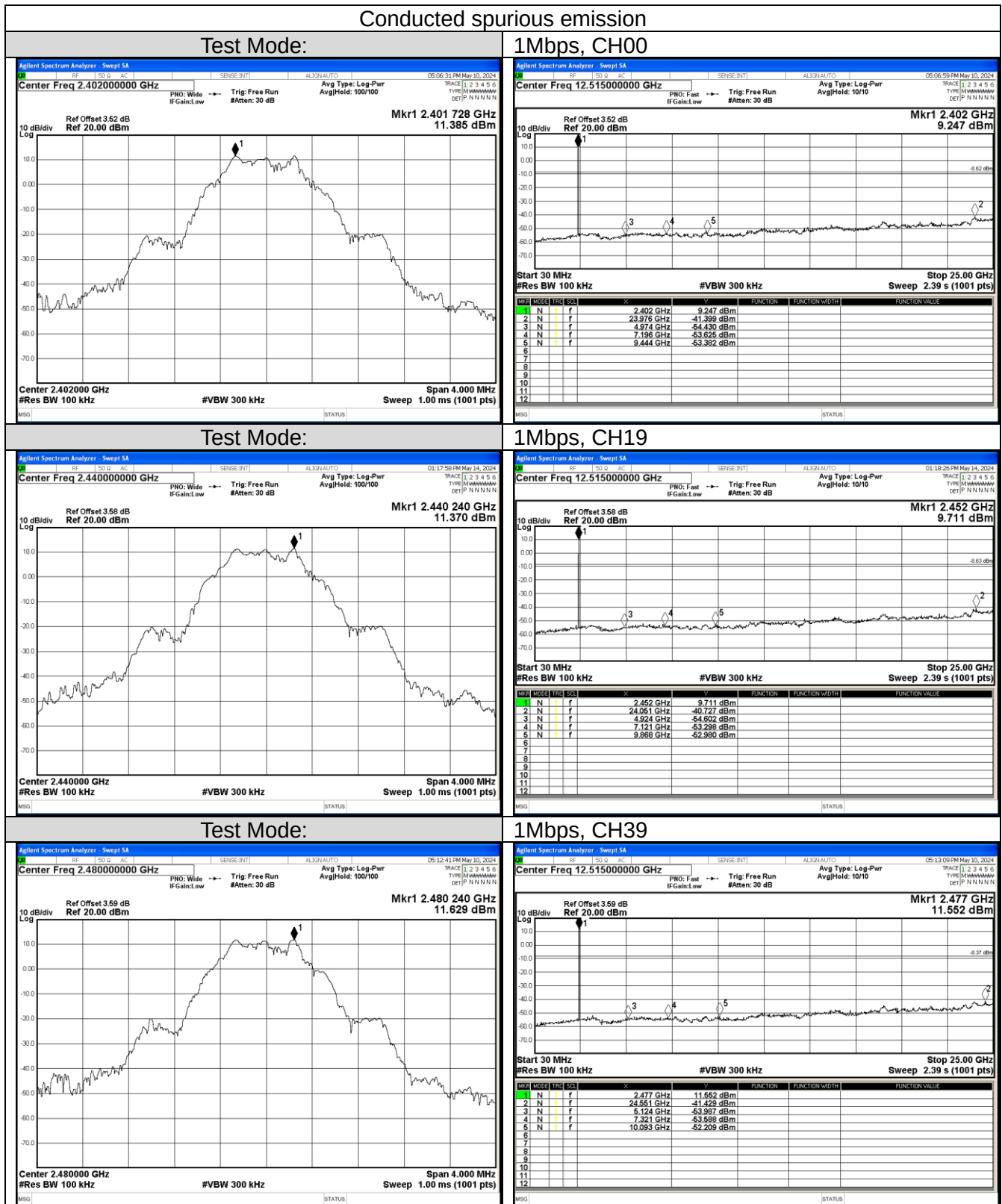
Correction Factor = antenna factor + cable loss – amplifier gain;

Reading = Reading Amplitude in the instrument;

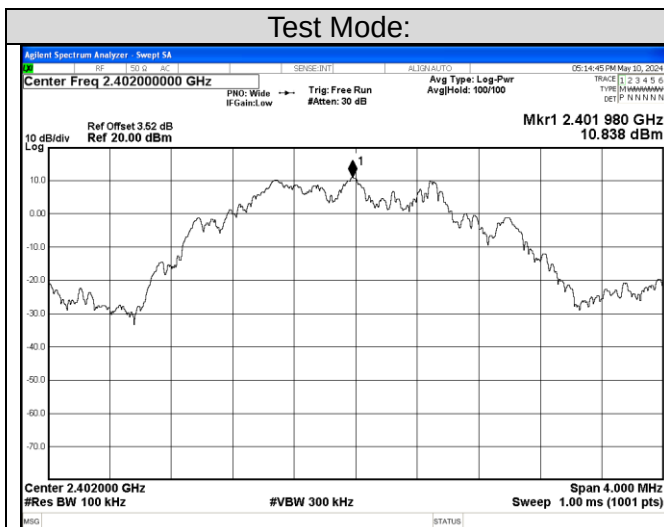
Result = Correction Factor + Reading;

Margin = Result – Limit

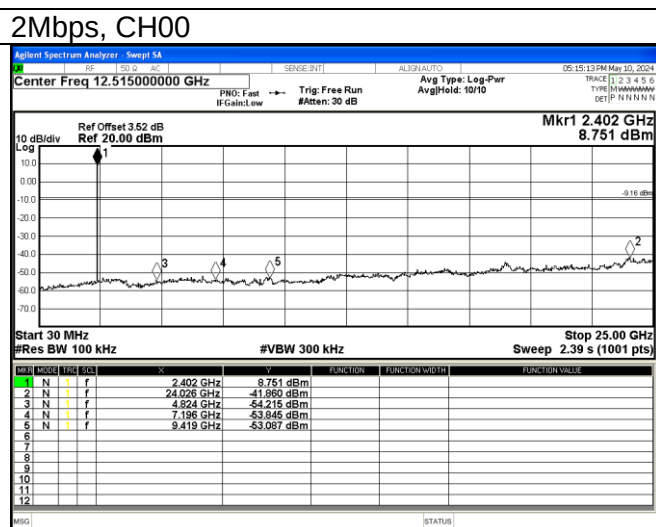
Appendix A.3 Test Results of Conducted Spurious Emissions Measured in 100 kHz Bandwidth



Test Mode:



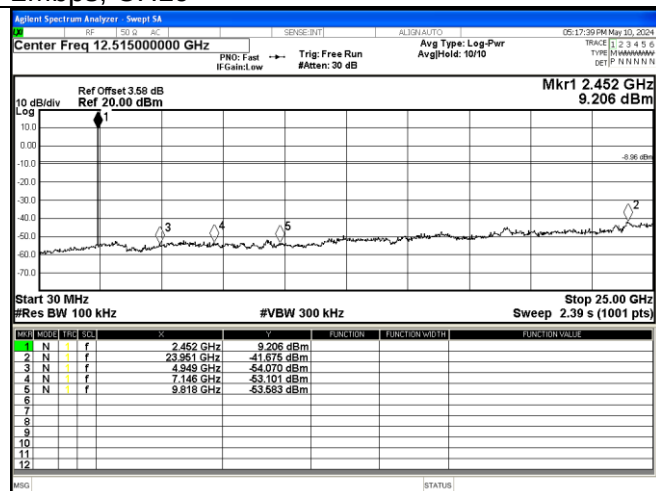
2Mbps, CH00



Test Mode:



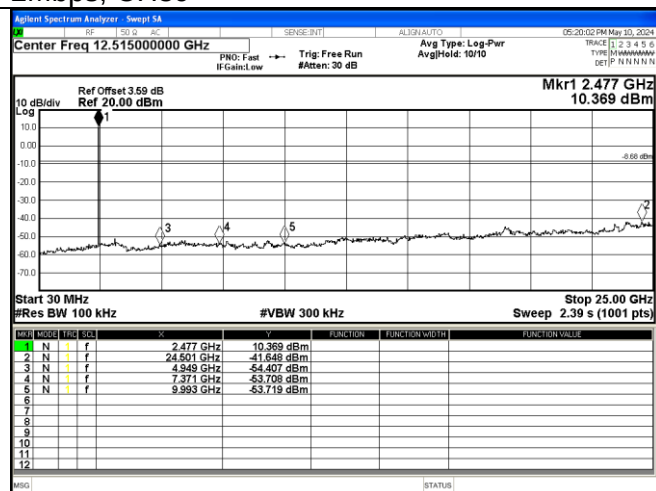
2Mbps, CH19



Test Mode:



2Mbps, CH39

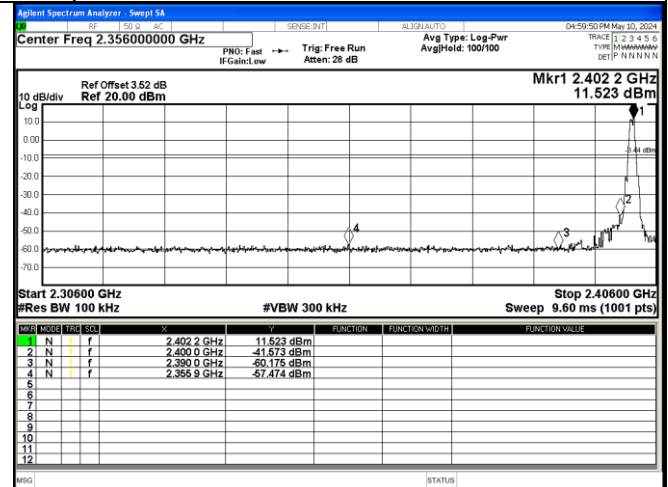
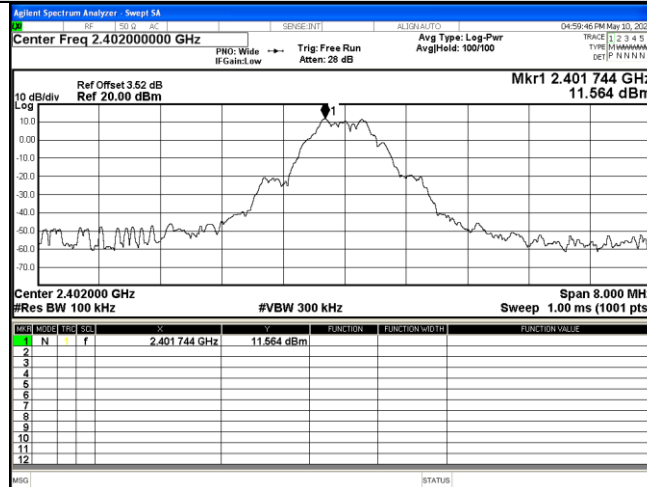




For Band edge (it's also the reference level for conducted spurious emission)

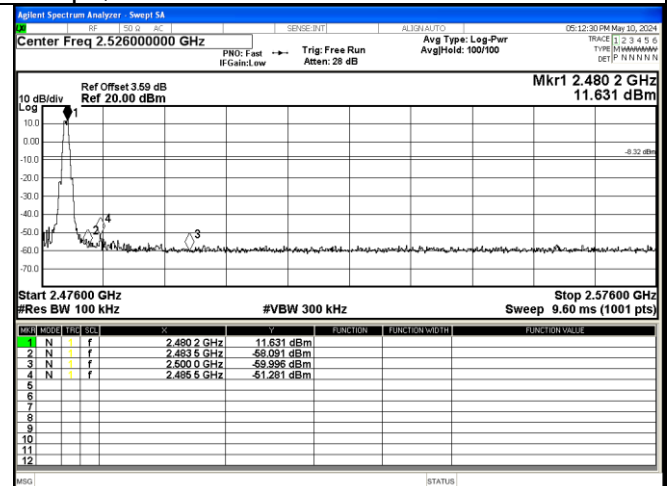
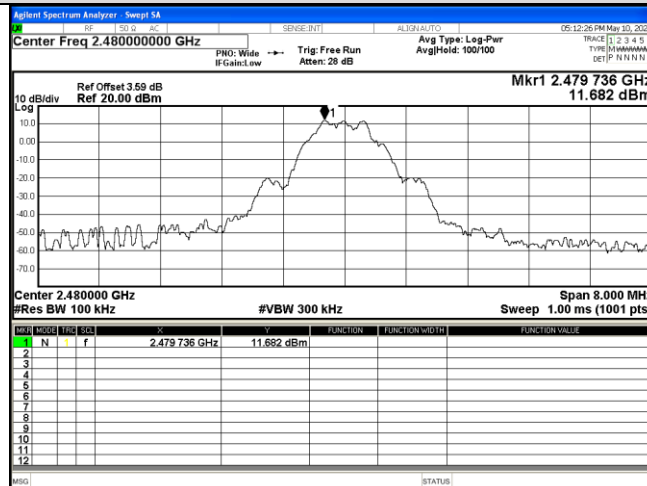
Test Mode:

1Mbps, CH00



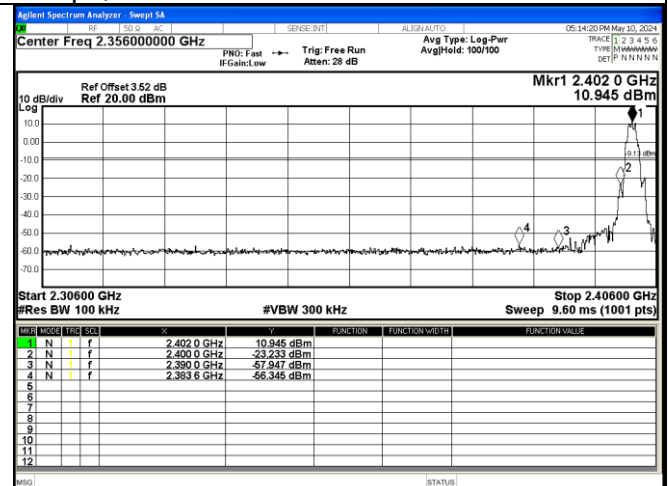
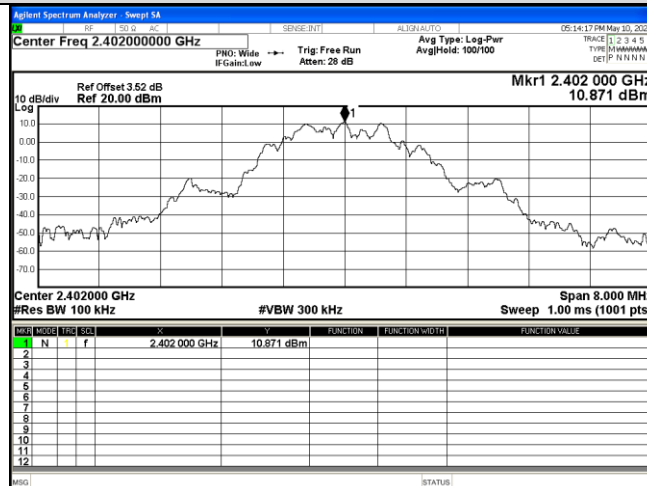
Test Mode:

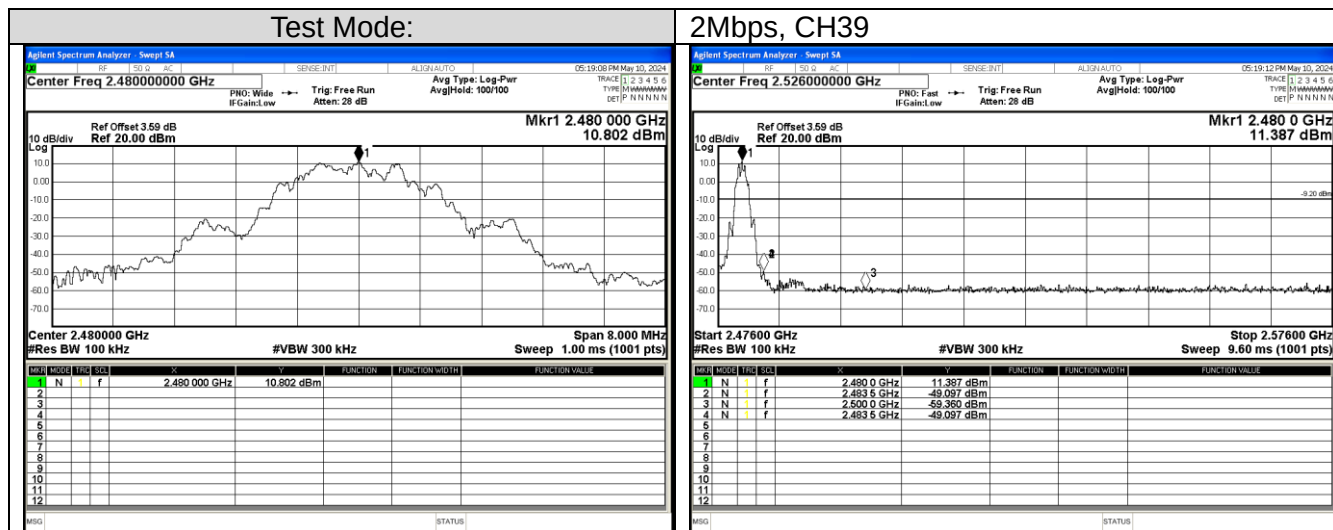
1Mbps, CH39



Test Mode:

2Mbps, CH00

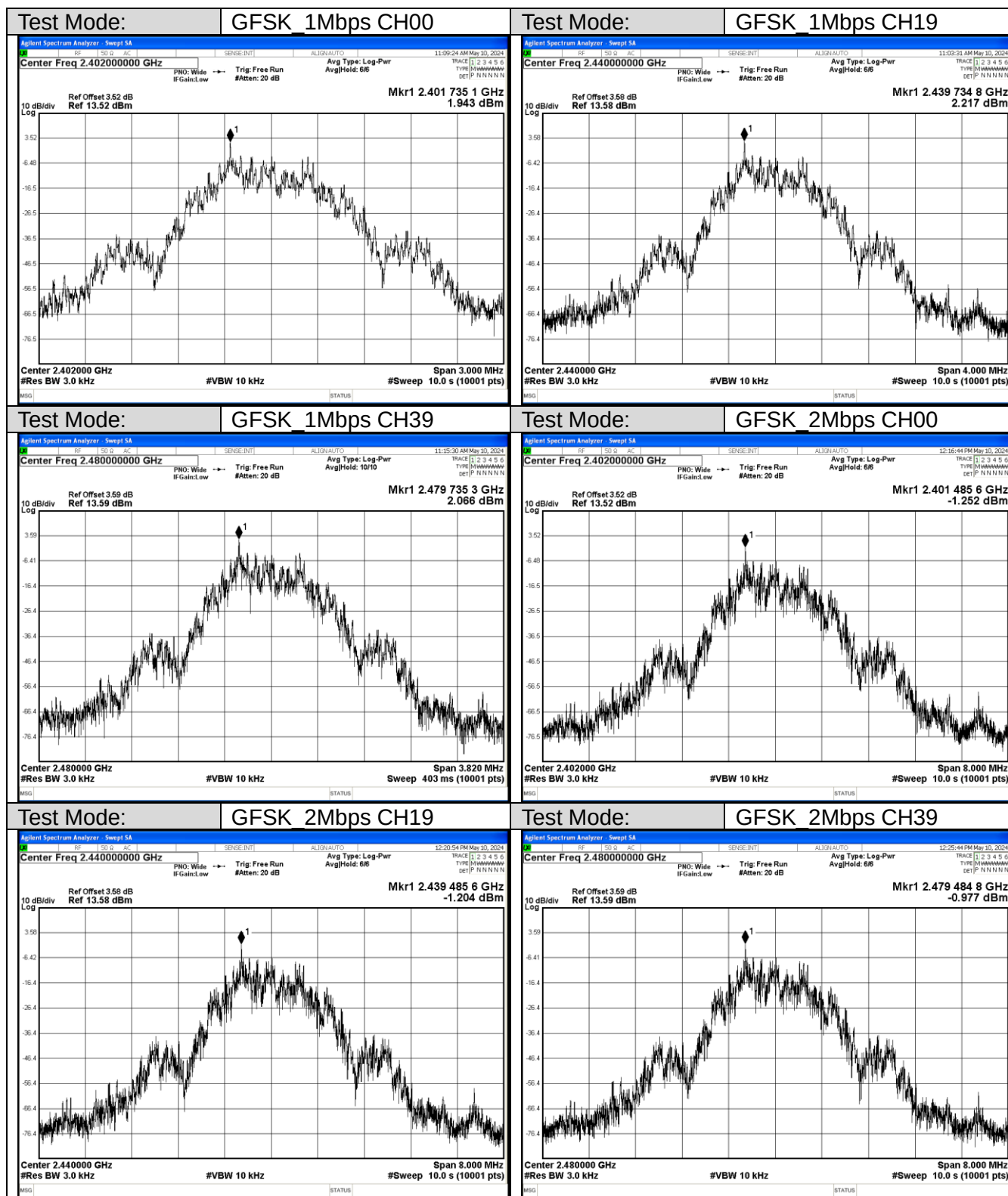




Appendix A.4 Test Results of Conducted Power Spectral Density

1Mbps			
Frequency	Power Density	Limit (dBm/3KHz)	Result
	(dBm/3kHz)		
CH00	1.943	8	Pass
CH19	2.217	8	Pass
CH39	2.066	8	Pass

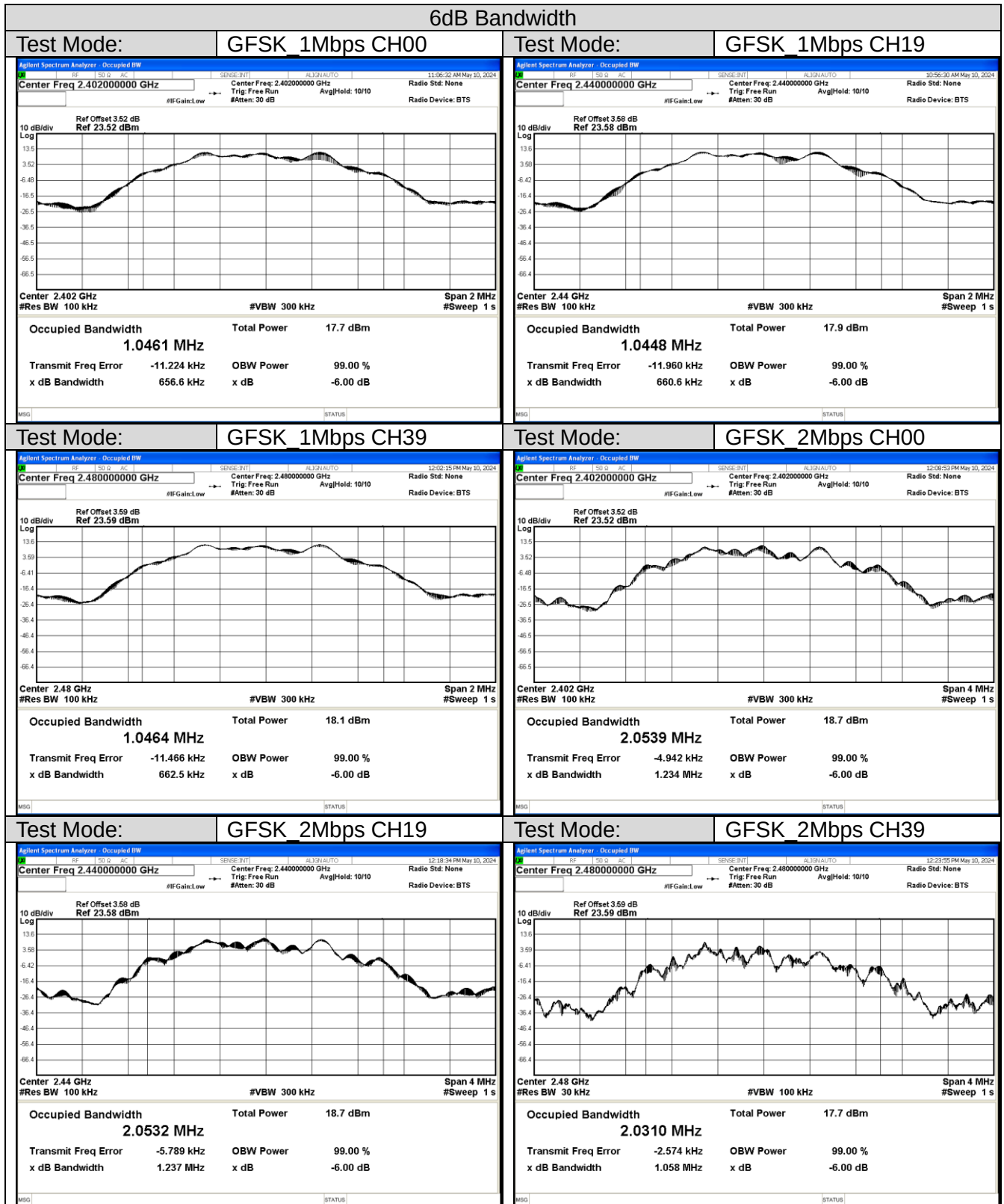
2Mbps			
Frequency	Power Density	Limit (dBm/3KHz)	Result
	(dBm/3kHz)		
CH00	-1.252	8	Pass
CH19	-1.204	8	Pass
CH39	-0.977	8	Pass



Appendix A.5 Test Results of 6dB BANDWIDTH

1Mbps			
Frequency	Bandwidth (MHz)	6dB limit (MHz)	Result
	6dB		
CH00	0.6566	0.5	Pass
CH19	0.6606	0.5	Pass
CH39	0.6625	0.5	Pass

2Mbps			
Frequency	Bandwidth (MHz)	6dB limit (MHz)	Result
	6dB		
CH00	1.2336	0.5	Pass
CH19	1.2369	0.5	Pass
CH39	1.0585	0.5	Pass



Appendix A.6 Test Results of Maximum Conducted Power

For FCC:

Mode	Frequency [MHz]	Measured of Peak Power		Limit [W]
		Conducted [dBm]	W	
BLE_1Mbps	2402	16.162	0.0413	≤ 1.0
	2440	16.142	0.0411	≤ 1.0
	2480	16.504	0.0447	≤ 1.0
BLE_2Mbps	2402	15.837	0.0383	≤ 1.0
	2440	15.886	0.0388	≤ 1.0
	2480	16.232	0.0420	≤ 1.0

Note:

1) The cable loss is taken into account in results.

2) Antenna gain(G) BLE: 2.71 dBi

e.i.r.p.=P(Peak power)+ G, which is far below the 4 W