Appendix B. Radiated Spurious Emission

Test Engineer :	Bill Chang, Jesse Wang, and Nick Yu	Temperature :	22~23°C
		Relative Humidity :	51~55%

<For Sample 1>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 00 2402MHz		2375.16	50.96	-23.04	74	51.8	27.19	6.01	34.04	111	116	P	H
		2389.11	39.77	-14.23	54	40.57	27.23	6.01	34.04	111	116	A	H
	*	2402	83.84	-	-	84.64	27.23	6.01	34.04	111	116	P	H
	*	2402	83.01	-	-	83.81	27.23	6.01	34.04	111	116	A	H
													H
		2357.79	50.76	-23.24	74	51.72	27.14	5.95	34.05	103	225	P	V
		2385.33	39.78	-14.22	54	40.62	27.19	6.01	34.04	103	225	A	V
	*	2402	84.72	-	-	85.52	27.23	6.01	34.04	103	225	P	V
	*	2402	83.92	-	-	84.72	27.23	6.01	34.04	103	225	A	V
													V
BLE CH 19 2440MHz		2333.22	50.94	-23.06	74	52	27.05	5.95	34.06	105	100	P	H
		2383.1	39.76	-14.24	54	40.6	27.19	6.01	34.04	105	100	A	H
	*	2440	83.91	-	-	84.53	27.37	6.04	34.03	105	100	P	H
	*	2440	83.06	-	-	83.68	27.37	6.04	34.03	105	100	A	H
		2484.12	50.76	-23.24	74	51.22	27.46	6.09	34.01	105	100	P	H
		2491.72	40.15	-13.85	54	40.57	27.5	6.09	34.01	105	100	A	H
		2328.63	50.54	-23.46	74	51.6	27.05	5.95	34.06	149	223	P	V
		2385.42	39.76	-14.24	54	40.6	27.19	6.01	34.04	149	223	A	V
	*	2440	84.07	-	-	84.69	27.37	6.04	34.03	149	223	P	V
	*	2440	83.2	-	-	83.82	27.37	6.04	34.03	149	223	A	V
		2491.8	51.63	-22.37	74	52.04	27.5	6.09	34	149	223	P	V
		2490.56	40.14	-13.86	54	40.56	27.5	6.09	34.01	149	223	A	V

BLE CH 39 2480MHz	*	2480.327	81.53	-	-	82.01	27.46	6.07	34.01	100	97	P	H
	*	2480.076	80.57	-	-	81.05	27.46	6.07	34.01	100	97	A	H
		2495.44	50.95	-23.05	74	51.36	27.5	6.09	34	100	97	P	H
		2484.92	40.17	-13.83	54	40.63	27.46	6.09	34.01	100	97	A	H
													H
													H
	*	2479.742	83.52	-	-	84	27.46	6.07	34.01	375	223	P	V
	*	2480.076	82.57	-	-	83.05	27.46	6.07	34.01	375	223	A	V
		2492.4	50.98	-23.02	74	51.39	27.5	6.09	34	375	223	P	V
		2483.6	40.2	-13.8	54	40.66	27.46	6.09	34.01	375	223	A	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 00 2402MHz		4804	44.94	-29.06	74	70.08	31.3	8.65	65.09	100	0	P	H
													H
													H
													H
		4804	50.1	-23.9	74	75.24	31.3	8.65	65.09	100	0	P	V
													V
													V
													V
BLE CH 19 2440MHz		4880	44.94	-29.06	74	69.86	31.41	8.69	65.02	100	0	P	H
		7320	40.66	-33.34	74	59.02	36.32	10.39	65.07	100	0	P	H
													H
													H
		4880	46.48	-27.52	74	71.4	31.41	8.69	65.02	100	0	P	V
		7320	41.14	-32.86	74	59.5	36.32	10.39	65.07	100	0	P	V
													V
													V
BLE CH 39 2480MHz		4960	43.07	-30.93	74	67.67	31.54	8.79	64.93	100	0	P	H
		7440	40.73	-33.27	74	58.71	36.59	10.52	65.09	100	0	P	H
													H
													H
		4960	46.09	-27.91	74	70.69	31.54	8.79	64.93	100	0	P	V
		7440	41.35	-32.65	74	59.33	36.59	10.52	65.09	100	0	P	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz BLE (LF)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz BLE LF		31.62	16.09	-23.91	40	28.33	18.92	0.67	31.83			P	H
		56.73	16.29	-23.71	40	40.02	7.03	1.04	31.8			P	H
		112.08	13.83	-29.67	43.5	32.79	11.54	1.28	31.78			P	H
		750.8	21.58	-24.42	46	28.7	21.61	3.25	31.98			P	H
		839	22.98	-23.02	46	28.9	22.41	3.4	31.73			P	H
		945.4	23.48	-22.52	46	26.66	24.21	3.68	31.07	121	25	P	H
													H
													H
													H
													H
													H
													H
		30.27	25.72	-14.28	40	36.88	20	0.67	31.83	101	152	P	V
		56.46	25.14	-14.86	40	48.56	7.34	1.04	31.8			P	V
		79.95	15.85	-24.15	40	38.72	7.88	1.04	31.79			P	V
		638.1	20.42	-25.58	46	29.44	20.06	2.96	32.04			P	V
		809.6	22.26	-23.74	46	28.55	22.18	3.4	31.87			P	V
													V
													V
													V
													V
													V
													V
													V

Remark	1. No other spurious found. 2. All results are PASS against limit line.

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency per 15.209(c).
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Level(dBµV/m) =

Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBµV) - Preamp Factor(dB)

2. Over Limit(dB) = Level(dBµV/m) – Limit Line(dBµV/m)

For Peak Limit @ 2390MHz:

1. Level(dBµV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBµV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBµV) – 35.86 (dB)

= 55.45 (dBµV/m)

2. Over Limit(dB)

= Level(dBµV/m) – Limit Line(dBµV/m)

= 55.45(dBµV/m) – 74(dBµV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBµV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBµV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBµV) – 35.86 (dB)

= 43.54 (dBµV/m)

2. Over Limit(dB)

= Level(dBµV/m) – Limit Line(dBµV/m)

= 43.54(dBµV/m) – 54(dBµV/m)

= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is "PASS".

<For Sample 2>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 00 2402MHz		2386.59	50.74	-23.26	74	51.54	27.23	6.01	34.04	166	150	P	H
		2388.21	39.85	-14.15	54	40.65	27.23	6.01	34.04	166	150	A	H
	*	2401.837	85.08	-	-	85.88	27.23	6.01	34.04	166	150	P	H
	*	2402.087	84.25	-	-	85.05	27.23	6.01	34.04	166	150	A	H
													H
													H
		2339.97	50.7	-23.3	74	51.7	27.1	5.95	34.05	100	122	P	V
		2389.02	39.89	-14.11	54	40.69	27.23	6.01	34.04	100	122	A	V
	*	2402.338	87.9	-	-	88.7	27.23	6.01	34.04	100	122	P	V
	*	2402.087	87.12	-	-	87.92	27.23	6.01	34.04	100	122	A	V
													V
													V
BLE CH 19 2440MHz		2385.69	50.65	-23.35	74	51.45	27.23	6.01	34.04	131	149	P	H
		2389.74	39.8	-14.2	54	40.6	27.23	6.01	34.04	131	149	A	H
	*	2440.331	83.9	-	-	84.52	27.37	6.04	34.03	131	149	P	H
	*	2440.08	83.04	-	-	83.66	27.37	6.04	34.03	131	149	A	H
		2492.92	51.13	-22.87	74	51.54	27.5	6.09	34	131	149	P	H
		2493.76	40.2	-13.8	54	40.61	27.5	6.09	34	131	149	A	H
		2388.12	50.24	-23.76	74	51.04	27.23	6.01	34.04	100	112	P	V
		2385.06	39.81	-14.19	54	40.65	27.19	6.01	34.04	100	112	A	V
	*	2439.83	85.98	-	-	86.6	27.37	6.04	34.03	100	112	P	V
	*	2440.08	85.13	-	-	85.75	27.37	6.04	34.03	100	112	A	V
		2498	50.5	-23.5	74	50.91	27.5	6.09	34	100	112	P	V
		2492.96	40.2	-13.8	54	40.61	27.5	6.09	34	100	112	A	V

BLE CH 39 2480MHz	*	2479.826	83.29	-	-	83.77	27.46	6.07	34.01	100	147	P	H
	*	2480.076	82.36	-	-	82.84	27.46	6.07	34.01	100	147	A	H
		2489.4	51.24	-22.76	74	51.66	27.5	6.09	34.01	100	147	P	H
		2483.52	40.21	-13.79	54	40.67	27.46	6.09	34.01	100	147	A	H
													H
													H
	*	2479.993	85.78	-	-	86.26	27.46	6.07	34.01	113	119	P	V
	*	2480.076	85.03	-	-	85.51	27.46	6.07	34.01	113	119	A	V
		2483.68	50.87	-23.13	74	51.33	27.46	6.09	34.01	113	119	P	V
		2483.56	40.27	-13.73	54	40.73	27.46	6.09	34.01	113	119	A	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 00 2402MHz		4806	47.76	-26.24	74	72.9	31.3	8.65	65.09	100	0	P	H
													H
													H
													H
		4806	47.56	-26.44	74	72.7	31.3	8.65	65.09	100	0	P	V
													V
													V
													V
BLE CH 19 2440MHz		4878	47.53	-26.47	74	72.45	31.41	8.69	65.02	100	0	P	H
		7320	46.33	-27.67	74	64.69	36.32	10.39	65.07	100	0	P	H
													H
													H
		4878	48.84	-25.16	74	73.76	31.41	8.69	65.02	100	0	P	V
		7320	42.83	-31.17	74	61.19	36.32	10.39	65.07	100	0	P	V
													V
													V
BLE CH 39 2480MHz		4962	44.91	-29.09	74	69.47	31.54	8.83	64.93	100	0	P	H
		7440	43.42	-30.58	74	61.4	36.59	10.52	65.09	100	0	P	H
													H
													H
		4962	47.48	-26.52	74	72.04	31.54	8.83	64.93	100	0	P	V
		7440	41.4	-32.6	74	59.38	36.59	10.52	65.09	100	0	P	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz BLE (LF)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz BLE LF		57.54	17.29	-22.71	40	41.02	7.03	1.04	31.8	105	265	P	H
		111	14	-29.5	43.5	33.01	11.49	1.28	31.78			P	H
		270.84	13.78	-32.22	46	30.13	13.48	1.94	31.77				H
		425.3	18.11	-27.89	46	30.6	16.92	2.41	31.82			P	H
		551.3	20.99	-25.01	46	31.96	18.23	2.77	31.97			P	H
		864.2	22.34	-23.66	46	27.81	22.7	3.44	31.61			P	H
													H
													H
													H
													H
													H
													H
		31.62	25.75	-14.25	40	37.99	18.92	0.67	31.83			P	V
		56.46	25.89	-14.11	40	49.31	7.34	1.04	31.8	100	147	P	V
		79.95	15.65	-24.35	40	38.52	7.88	1.04	31.79			P	V
		425.3	18.29	-27.71	46	30.78	16.92	2.41	31.82			P	V
		769	21.55	-24.45	46	28.37	21.79	3.35	31.96			P	V
		967.1	24.02	-29.98	54	26.91	24.23	3.78	30.9			P	V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency per 15.209(c).
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Level(dBµV/m) =

Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBµV) - Preamp Factor(dB)

2. Over Limit(dB) = Level(dBµV/m) – Limit Line(dBµV/m)

For Peak Limit @ 2390MHz:

1. Level(dBµV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBµV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBµV) – 35.86 (dB)

= 55.45 (dBµV/m)

2. Over Limit(dB)

= Level(dBµV/m) – Limit Line(dBµV/m)

= 55.45(dBµV/m) – 74(dBµV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBµV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBµV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBµV) – 35.86 (dB)

= 43.54 (dBµV/m)

2. Over Limit(dB)

= Level(dBµV/m) – Limit Line(dBµV/m)

= 43.54(dBµV/m) – 54(dBµV/m)

= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is "PASS".