Appendix B. Radiated Spurious Emission

Test Engineer :	Elvis Chen, Karl Hou, Stan Hsieh and Lewis He	Temperature :	23~25°C
		Relative Humidity :	45~47%

<For Sample 2>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 00 2402MHz		2360.58	51.59	-22.41	74	52.37	27.14	5.33	33.25	260	325	P	H
		2383.71	41.8	-12.2	54	42.46	27.19	5.39	33.24	260	325	A	H
	*	2402	95.24	-	-	95.84	27.23	5.39	33.22	260	325	P	H
	*	2402	94.53	-	-	95.13	27.23	5.39	33.22	260	325	A	H
													H
													H
		2379.66	51.3	-22.7	74	51.96	27.19	5.39	33.24	297	55	P	V
		2385.78	42.15	-11.85	54	42.77	27.23	5.39	33.24	297	55	A	V
	*	2402	95.47	-	-	96.07	27.23	5.39	33.22	297	55	P	V
	*	2402	94.77	-	-	95.37	27.23	5.39	33.22	297	55	A	V
													V
													V
BLE CH 19 2440MHz		2321.34	51.35	-22.65	74	52.29	27.05	5.27	33.26	126	281	P	H
		2382.63	41.8	-12.2	54	42.46	27.19	5.39	33.24	126	281	A	H
	*	2440	94.66	-	-	95.08	27.37	5.42	33.21	126	281	P	H
	*	2440	93.98	-	-	94.4	27.37	5.42	33.21	126	281	A	H
		2489.6	51.62	-22.38	74	51.84	27.5	5.46	33.18	126	281	P	H
		2485.32	42.11	-11.89	54	42.37	27.46	5.46	33.18	126	281	A	H
		2351.67	51.08	-22.92	74	51.86	27.14	5.33	33.25	232	322	P	V
		2360.94	41.78	-12.22	54	42.56	27.14	5.33	33.25	232	322	A	V
	*	2440	97.19	-	-	97.61	27.37	5.42	33.21	232	322	P	V
	*	2440	96.52	-	-	96.94	27.37	5.42	33.21	232	322	A	V
		2488.6	51.15	-22.85	74	51.37	27.5	5.46	33.18	232	322	P	V
		2484.08	41.95	-12.05	54	42.21	27.46	5.46	33.18	232	322	A	V

BLE CH 39 2480MHz	*	2480	94.67	-	-	94.95	27.46	5.44	33.18	145	1	P	H
	*	2480	93.96	-	-	94.24	27.46	5.44	33.18	145	1	P	H
		2484.36	51.96	-22.04	74	52.22	27.46	5.46	33.18	145	1	P	H
		2496.6	42.09	-11.91	54	42.3	27.5	5.46	33.17	145	1	A	H
													H
													H
	*	2480	99.67	-	-	99.95	27.46	5.44	33.18	319	309	P	V
	*	2480	98.98	-	-	99.26	27.46	5.44	33.18	319	309	A	V
		2497.52	52.3	-21.7	74	52.51	27.5	5.46	33.17	319	309	P	V
		2484.28	42.25	-11.75	54	42.51	27.46	5.46	33.18	319	309	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 (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 00 2402MHz		4806	36.24	-37.76	74	57.88	31.42	7.58	60.64	100	0	P	H
													H
													H
													H
		4806	36	-38	74	57.64	31.42	7.58	60.64	100	0	P	V
													V
													V
													V
BLE CH 19 2440MHz		4878	37.59	-36.41	74	58.85	31.56	7.7	60.52	100	0	P	H
		7320	44.16	-29.84	74	59.43	36.22	9.49	60.98	100	0	P	H
													H
													H
		4878	37.82	-36.18	74	59.08	31.56	7.7	60.52	100	0	P	V
		7320	42.6	-31.4	74	57.87	36.22	9.49	60.98	100	0	P	V
													V
													V
BLE CH 39 2480MHz		4962	37.96	-36.04	74	58.54	31.73	8.05	60.36	100	0	P	H
		7440	44.35	-29.65	74	59.59	36.49	9.61	61.34	100	0	P	H
													H
													H
		4962	37.92	-36.08	74	58.5	31.73	8.05	60.36	100	0	P	V
		7440	43.29	-30.71	74	58.53	36.49	9.61	61.34	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		30	29.1	-10.9	40	41.27	20	0.65	32.82			P	H
		79.68	30.63	-9.37	40	54.51	7.88	0.93	32.69	122	56	P	H
		140.7	25.99	-17.51	43.5	45.46	11.87	1.33	32.67			P	H
		309.8	22.82	-23.18	46	39.61	14.07	1.88	32.74			P	H
		433.7	18.52	-27.48	46	32.19	17.04	2.16	32.87			P	H
		630.4	21.41	-24.59	46	31.85	19.96	2.62	33.02			P	H
													H
													H
													H
													H
													H
													H
		30.27	34.84	-5.16	40	47.01	20	0.65	32.82	159	255	P	V
		79.14	34.61	-5.39	40	58.49	7.88	0.93	32.69			P	V
		140.43	24.67	-18.83	43.5	44.14	11.87	1.33	32.67			P	V
		320.3	22.46	-23.54	46	38.96	14.37	1.88	32.75			P	V
		326.6	19.23	-26.77	46	35.5	14.55	1.94	32.76			P	V
		451.2	20.18	-25.82	46	33.44	17.32	2.3	32.88			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.
!	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 1>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 39 2480MHz	*	2480	96.48	-	-	96.76	27.46	5.44	33.18	298	55	P	H
	*	2480	95.82	-	-	96.1	27.46	5.44	33.18	298	55	P	H
		2484.44	51.21	-22.79	74	51.47	27.46	5.46	33.18	298	55	P	H
		2485.08	42.53	-11.47	54	42.79	27.46	5.46	33.18	298	55	A	H
													H
													H
	*	2480	100.02	-	-	100.3	27.46	5.44	33.18	301	318	P	V
	*	2480	99.35	-	-	99.63	27.46	5.44	33.18	301	318	P	V
		2489.56	51.72	-22.28	74	51.94	27.5	5.46	33.18	301	318	P	V
		2486.36	42.4	-11.6	54	42.66	27.46	5.46	33.18	301	318	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 (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 39 2480MHz		4962	38.02	-35.98	74	58.6	31.73	8.05	60.36	100	0	P	H
		7440	41.76	-32.24	74	57	36.49	9.61	61.34	100	0	P	H
													H
													H
		4962	37.89	-36.11	74	58.47	31.73	8.05	60.36	100	0	P	V
		7440	42.71	-31.29	74	57.95	36.49	9.61	61.34	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		81.03	31.82	-8.18	40	55.46	8.12	0.93	32.69	100	114	P	H
		105.6	29.83	-13.67	43.5	50.33	11	1.14	32.64			P	H
		141.24	30.68	-12.82	43.5	50.17	11.85	1.33	32.67			P	H
		326.6	24.72	-21.28	46	40.99	14.55	1.94	32.76			P	H
		566.7	20.1	-25.9	46	31.53	18.99	2.57	32.99			P	H
		738.9	25.51	-20.49	46	34.17	21.38	2.91	32.95			P	H
													H
													H
													H
													H
													H
													H
		30	36.36	-3.64	40	48.53	20	0.65	32.82	115	320	P	V
		80.76	35.47	-4.53	40	59.23	8	0.93	32.69			P	V
		140.97	23.89	-19.61	43.5	43.36	11.87	1.33	32.67			P	V
		306.3	19.22	-26.78	46	36.09	13.99	1.88	32.74			P	V
		671.7	28.26	-17.74	46	38.21	20.38	2.67	33			P	V
		888.7	24.83	-21.17	46	30.96	23.04	3.2	32.37			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.
!	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 3>

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 39 2480MHz	*	2480	95.39	-	-	95.67	27.46	5.44	33.18	116	305	P	H
	*	2480	94.74	-	-	95.02	27.46	5.44	33.18	116	305	P	H
		2485.68	52.42	-21.58	74	52.68	27.46	5.46	33.18	116	305	P	H
		2485.32	42.08	-11.92	54	42.34	27.46	5.46	33.18	116	305	A	H
													H
													H
	*	2480	99.93	-	-	100.21	27.46	5.44	33.18	248	291	P	V
	*	2480	99.26	-	-	99.54	27.46	5.44	33.18	248	291	P	V
		2483.68	52.38	-21.62	74	52.64	27.46	5.46	33.18	248	291	P	V
		2483.52	42.48	-11.52	54	42.74	27.46	5.46	33.18	248	291	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 (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 39 2480MHz		4962	38.47	-35.53	74	59.05	31.73	8.05	60.36	100	0	P	H
		7440	43.08	-30.92	74	58.32	36.49	9.61	61.34	100	0	P	H
													H
													H
		4960	38.08	-35.92	74	58.78	31.73	7.93	60.36	100	0	P	V
		7440	43.3	-30.7	74	58.54	36.49	9.61	61.34	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		81.03	28.34	-11.66	40	51.98	8.12	0.93	32.69	147	199	P	H
		97.5	27.55	-15.95	43.5	48.89	10.16	1.14	32.64			P	H
		148.26	28.77	-14.73	43.5	48.47	11.65	1.33	32.68			P	H
		321	20.08	-25.92	46	36.56	14.39	1.88	32.75			P	H
		352.5	20.01	-25.99	46	35.61	15.25	1.94	32.79			P	H
		850.9	23.75	-22.25	46	30.67	22.51	3.16	32.59			P	H
													H
													H
													H
													H
													H
													H
		30.81	30.4	-9.6	40	43.11	19.46	0.65	32.82			P	V
		82.65	31.15	-8.85	40	54.66	8.24	0.93	32.68	100	21	P	V
		149.07	22.63	-20.87	43.5	42.35	11.63	1.33	32.68			P	V
		319.6	16.48	-29.52	46	32.98	14.37	1.88	32.75			P	V
		352.5	17.35	-28.65	46	32.95	15.25	1.94	32.79			P	V
		890.8	25.67	-20.33	46	31.76	23.07	3.2	32.36			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.
!	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".