Appendix B. Radiated Spurious Emission

Test Engineer :	Jesse Wang, Stan Hsieh and Ken Wu	Temperature :	21~23°C
		Relative Humidity :	55~57%

2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Path 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)
BT CH00 2402MHz		2321.76	44.7	-29.3	74	40.16	31.87	7.86	35.19	232	0	P	H
		2321.76	19.94	-34.06	54	-	-	-	-	-	-	A	H
	*	2402	105.12	-	-	100.56	31.8	8	35.24	232	0	P	H
	*	2402	80.36	-	-	-	-	-	-	-	-	A	H
													H
													H
		2331.84	43.98	-30.02	74	39.43	31.87	7.88	35.2	262	75	P	V
		2331.84	19.22	-34.78	54	-	-	-	-	-	-	A	V
	*	2402	103.38	-	-	98.82	31.8	8	35.24	262	75	P	V
	*	2402	78.62	-	-	-	-	-	-	-	-	A	V
													V
													V
BT CH 39 2441MHz		2352.84	44.05	-29.95	74	39.47	31.87	7.92	35.21	248	0	P	H
		2352.84	19.29	-34.71	54	-	-	-	-	-	-	A	H
	*	2441	106.01	-	-	101.21	32	8.06	35.26	248	0	P	H
	*	2441	81.25	-	-	-	-	-	-	-	-		H
		2487.96	44.69	-29.31	74	39.75	32.1	8.13	35.29	248	0	P	H
		2487.96	19.93	-34.07	54	-	-	-	-	-	-		H
		2330.58	44.63	-29.37	74	40.08	31.87	7.88	35.2	228	79	P	V
		2330.58	19.87	-34.13	54	-	-	-	-	-	-		V
	*	2441	104.68	-	-	99.88	32	8.06	35.26	228	79	P	V
	*	2441	79.92	-	-	-	-	-	-	-	-		V
		2491.81	43.92	-30.08	74	38.99	32.1	8.13	35.3	228	79	P	V
		2330.58	44.63	-29.37	74	40.08	31.87	7.88	35.2	228	79	P	V

BT CH 78 2480MHz	*	2480	106.12	-	-	101.22	32.07	8.12	35.29	222	0	P	H
	*	2480	81.36	-	-	-	-	-	-	-	-	A	H
		2483.68	50.58	-23.42	74	45.68	32.07	8.12	35.29	222	0	P	H
		2483.68	25.82	-28.18	54	-	-	-	-	-	-	A	H
													H
													H
	*	2480	105.06	-	-	100.16	32.07	8.12	35.29	214	80	P	V
	*	2480	80.3	-	-	-	-	-	-	-	-	A	V
		2483.56	50.1	-23.9	74	45.2	32.07	8.12	35.29	214	80	P	V
		2483.56	25.34	-28.66	54	-	-	-	-	-	-	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

BT (Harmonic @ 3m)

BT	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BT CH 00 2402MHz		4804	40.05	-33.95	74	53.02	34	11.97	58.94	100	0	P	H
		4804	15.29	-38.71	54							A	H
													H
													H
		4804	41	-33	74	53.97	34	11.97	58.94	100	0	P	V
		4804	16.24	-37.76	54							A	V
													V
													V
BT CH 39 2441MHz		4882	39.88	-34.12	74	52.45	34.1	12.07	58.74	100	0	P	H
		4882	15.12	-38.88	54							A	H
		7323	41.32	-32.68	74	48.64	35.57	14.59	57.48	100	0	P	H
		7323	16.56	-37.44	54							A	H
		4882	39.64	-34.36	74	52.21	34.1	12.07	58.74	100	0	P	V
		4882	14.88	-39.12	54							A	V
		7323	41.58	-32.42	74	48.9	35.57	14.59	57.48	100	0	P	V
		7323	16.82	-37.18	54							A	V
BT CH 78 2480MHz		4960	40.31	-33.69	74	52.45	34.23	12.18	58.55	100	0	P	H
		4960	15.55	-38.45	54							A	H
		7440	40.11	-33.89	74	47.52	35.5	14.68	57.59	100	0	P	H
		7440	15.35	-38.65	54							A	H
		4960	40.51	-33.49	74	52.65	34.23	12.18	58.55	100	0	P	V
		4960	15.75	-38.25	54							A	V
		7440	41.56	-32.44	74	48.97	35.5	14.68	57.59	100	0	P	V
		7440	16.8	-37.2	54							A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz BT (LF)

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	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 BT LF		213.6	30.36	-13.14	43.5	42.85	14.98	2.46	29.93	-	-	P	H
		232.5	32.75	-13.25	46	43.65	16.46	2.56	29.92	-	-	P	H
		280.56	33.2	-12.8	46	41.59	18.69	2.83	29.91	-	-	P	H
		790	31.37	-14.63	46	28.19	27.84	4.81	29.47	-	-	P	H
		848.8	33.3	-12.7	46	28.88	28.69	4.96	29.23	-	-	P	H
		955.2	34.16	-11.84	46	27.03	30.53	5.27	28.67	100	0	P	H
													H
													H
													H
													H
													H
													H
		30	29.94	-10.06	40	34.7	24.32	0.93	30.01	100	0	P	V
		63.48	25.03	-14.97	40	41.84	11.83	1.34	29.98	-	-	P	V
		280.29	31.57	-14.43	46	39.97	18.69	2.82	29.91	-	-	P	V
		804	31.18	-14.82	46	28.01	27.74	4.86	29.43	-	-	P	V
		880.3	33.09	-12.91	46	28.22	28.89	5.06	29.08	-	-	P	V
		944.7	34.59	-11.41	46	28.25	29.82	5.25	28.73	-	-	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:

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	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)
BT CH 00 2402MHz		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. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =

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

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

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Path 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) + Path 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)

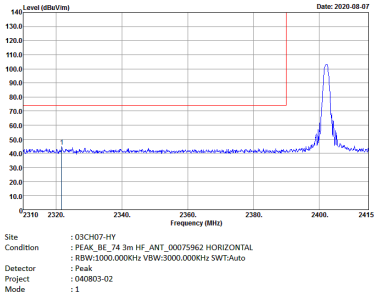
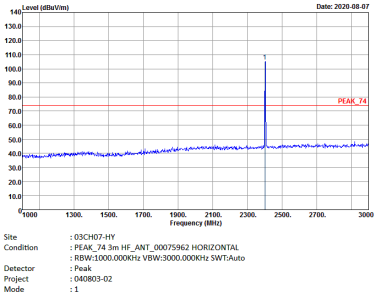
Both peak and average measured complies with the limit line, so test result is "PASS".

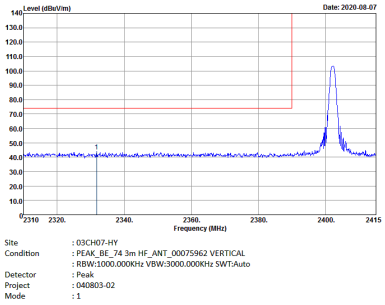
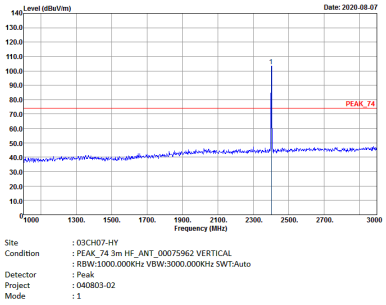
Appendix C. Radiated Spurious Emission Plots

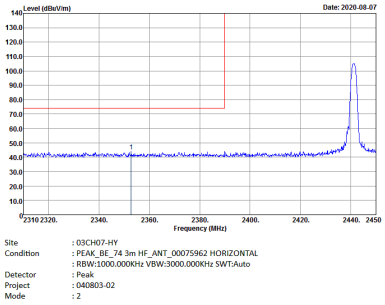
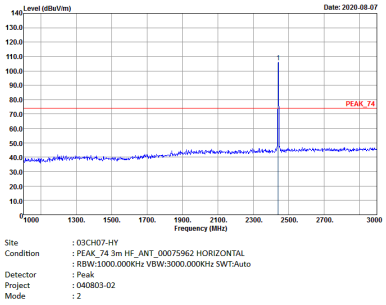
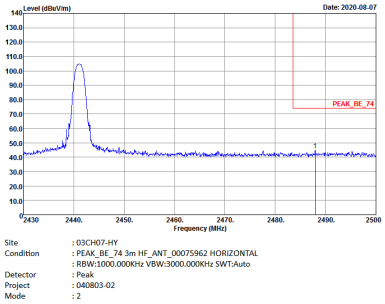
Test Engineer :	Jesse Wang, Stan Hsieh and Ken Wu	**Temperature :**	21~23°C
		Relative Humidity :	55~57%

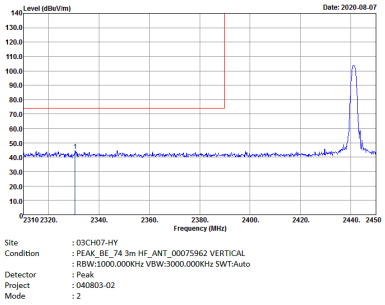
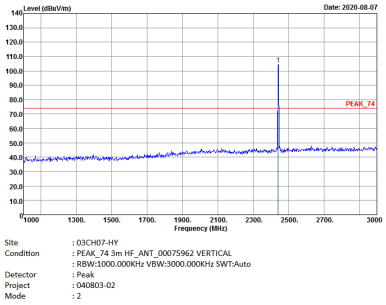
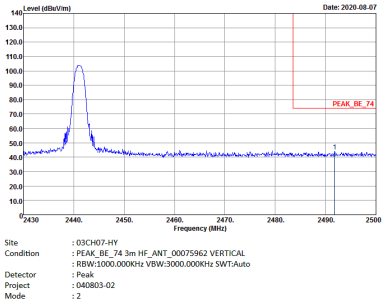
2.4GHz 2400~2483.5MHz

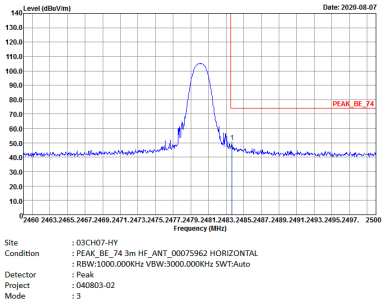
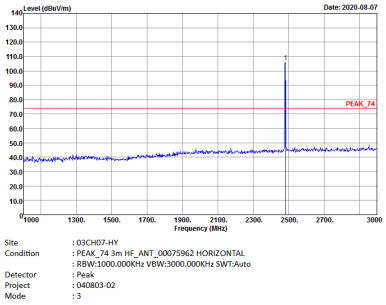
BT (Band Edge @ 3m)

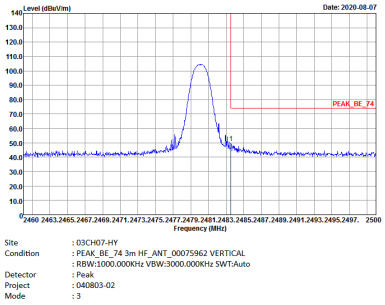
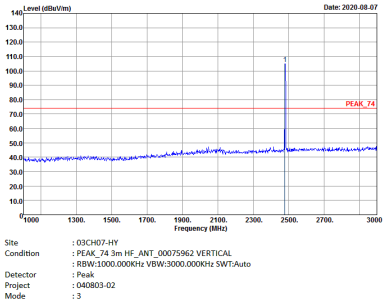
BT	**2.4GHz 2400~2483.5MHz Band Edge @ 3m**	
	BT CH00 2402MHz	
	Horizontal	**Fundamental**
Peak		

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH00 2402MHz	
	Vertical	Fundamental
Peak		

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH39 2441MHz	
	Horizontal	Fundamental
Peak		
Peak		Left blank

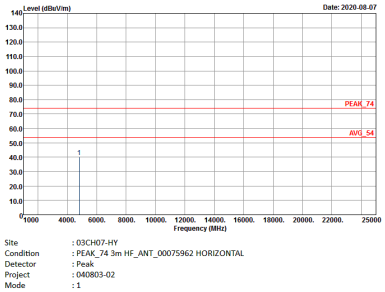
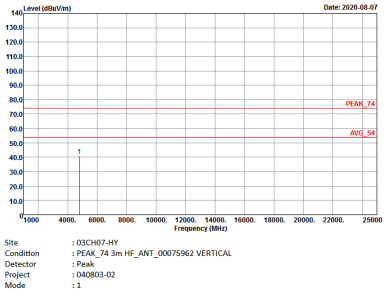
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH39 2441MHz	
	Vertical	Fundamental
Peak		
Peak		Left blank

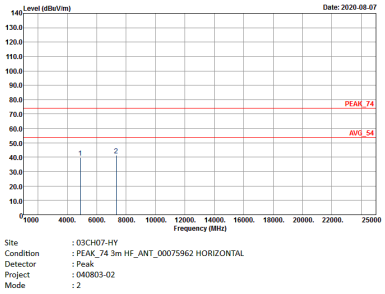
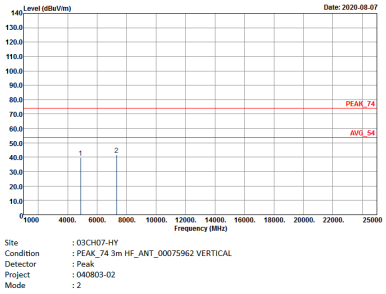
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Horizontal	Fundamental
Peak		

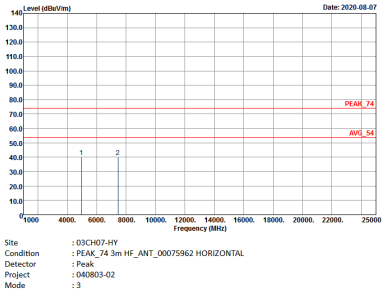
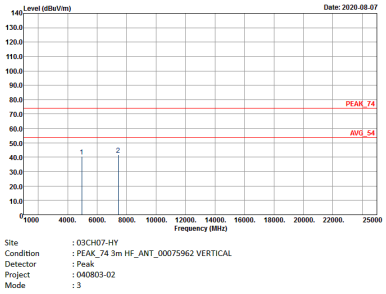
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Vertical	Fundamental
Peak		

2.4GHz 2400~2483.5MHz

BT (Harmonic @ 3m)

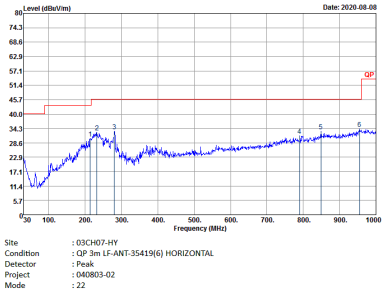
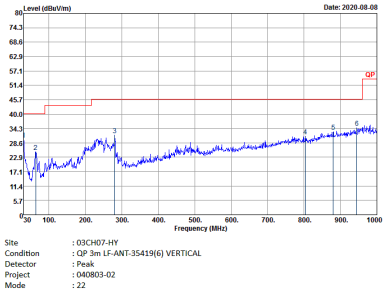
BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH00 2402MHz	
	Horizontal	Vertical
Peak Avg.		

BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH39 2441MHz	
	Horizontal	Vertical
Peak Avg.		

BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH78 2480MHz	
	Horizontal	Vertical
Peak Avg.		

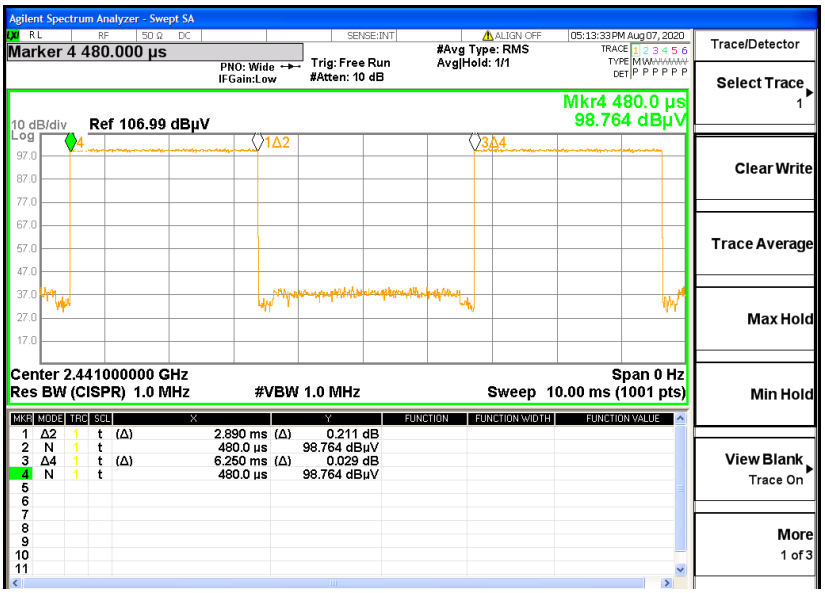
Emission below 1GHz

2.4GHz BT (LF)

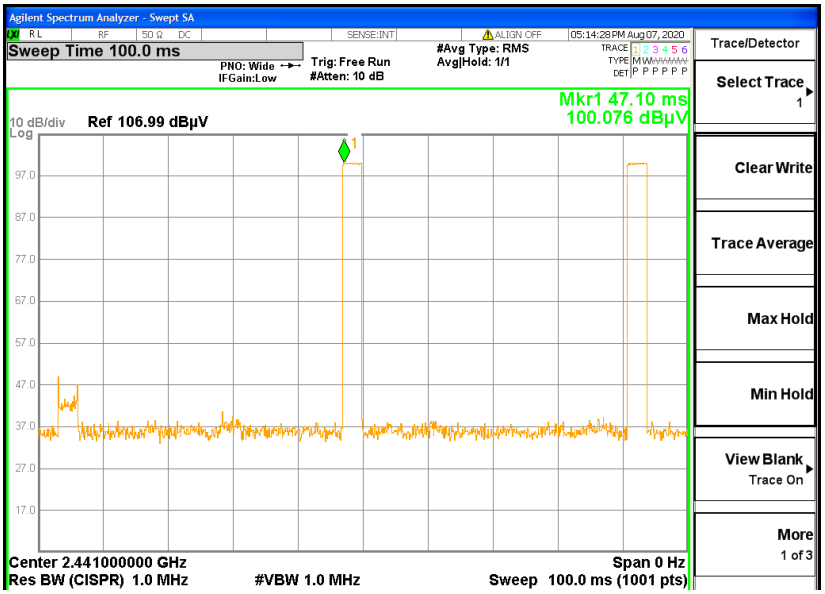
BT	2.4GHz 2400~2483.5MHz	
	BT LF	
	Horizontal	Vertical
QP / Peak		

Appendix D. Duty Cycle Plots

3DH5 on time (One Pulse) Plot on Channel 39



on time (Count Pulses) Plot on Channel 39



Note:

1. Worst case Duty cycle = on time/100 milliseconds = 2 * 2.89 / 100 = 5.78 %
2. Worst case Duty cycle correction factor = 20*log(Duty cycle) = -24.76 dB
3. **3DH5** has the highest duty cycle worst case and is reported.

Duty Cycle Correction Factor Consideration for AFH mode:

Bluetooth normal hopping rate is 1600Hz and reduced to 800Hz in AFH mode; due to the reduced number of hopping frequencies, with the same packet configuration the dwell time in each channel frequency within 100msec period is longer in AFH mode than normal mode.

In AFH mode, the minimum hopping frequencies are 20, to get the longest dwell time DH5 packet is observed; the period to have DH5 packet completing one hopping sequence is

2.89 ms x 20 channels = 57.8 ms

There cannot be 2 complete hopping sequences within 100ms period, considering the random hopping behavior, maximum 2 hops can be possibly observed within the period. [100 ms / 57.8 ms] = 2 hops

Thus, the maximum possible ON time:

2.89 ms x 2 = 5.78 ms

Worst case Duty Cycle Correction factor, which is derived from the maximum possible ON time,

20 x log(5.78 ms/100 ms) = -24.76 dB