Appendix C. Radiated Spurious Emission

Test Engineer :	Jesse Wang, Stan Hsieh and Ken Wu	Temperature :	24~26°C
		Relative Humidity :	52~60%

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		2390	46.94	-27.06	74	42.15	32	7.74	34.95	377	280	P	H
		2390	22.15	-31.85	54							A	H
	*	2402	105.1	-	-	100.31	32	7.74	34.95	377	280	P	H
	*	2402	80.31	-	-							A	H
													H
													H
		2389.38	47.98	-26.02	74	43.18	32	7.74	34.94	127	336	P	V
		2389.38	23.19	-30.81	54							A	V
	*	2402	106.56	-	-	101.77	32	7.74	34.95	127	336	P	V
	*	2402	81.77	-	-							A	V
													V
													V
BT CH 39 2441MHz		2388.68	46.03	-27.97	74	41.23	32	7.74	34.94	325	268	P	H
		2388.68	21.24	-32.76	54							A	H
	*	2441	106.7	-	-	101.68	32.2	7.79	34.97	325	268	P	H
	*	2441	81.91	-	-							A	H
		2487.47	46.77	-27.23	74	41.7	32.2	7.84	34.97	325	268	P	H
		2487.47	21.98	-32.02	54							A	H
		2376.5	45.56	-28.44	74	40.9	31.93	7.67	34.94	130	338	P	V
		2376.5	20.77	-33.23	54							A	V
	*	2441	106.1	-	-	101.08	32.2	7.79	34.97	130	338	P	V
	*	2441	81.31	-	-							A	V
		2499.02	46.27	-27.73	74	41.21	32.2	7.84	34.98	130	338	P	V
		2499.02	21.48	-32.52	54							A	V

BT CH 78 2480MHz	*	2480	104.85	-	-	99.78	32.2	7.84	34.97	352	284	P	H
	*	2480	80.06	-	-							A	H
		2483.52	55.49	-18.51	74	50.42	32.2	7.84	34.97	352	284	P	H
		2483.52	30.7	-23.3	54							A	H
													H
													H
	*	2480	105.35	-	-	100.28	32.2	7.84	34.97	205	332	P	V
	*	2480	80.56	-	-							A	V
		2483.64	54.45	-19.55	74	49.38	32.2	7.84	34.97	205	332	P	V
		2483.64	29.66	-24.34	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	43.21	-30.79	74	56.91	34	11.36	59.06	100	0	P	H
		4804	18.42	-35.58	54							A	H
													H
													H
		4804	44.06	-29.94	74	57.76	34	11.36	59.06	100	0	P	V
		4804	19.27	-34.73	54							A	V
													V
													V
BT CH 39 2441MHz		4882	44.06	-29.94	74	57.43	34.13	11.42	58.92	100	0	P	H
		4882	19.27	-34.73	54							A	H
		7323	44.34	-29.66	74	53.05	35.63	13.97	58.31	100	0	P	H
		7323	19.55	-34.45	54							A	H
		4882	42.89	-31.11	74	56.26	34.13	11.42	58.92	100	0	P	V
		4882	18.1	-35.9	54							A	V
		7323	44.18	-29.82	74	52.89	35.63	13.97	58.31	100	0	P	V
		7323	19.39	-34.61	54							A	V
BT CH 78 2480MHz		4960	43.51	-30.49	74	56.64	34.13	11.48	58.74	100	0	P	H
		4960	18.72	-35.28	54							A	H
		7440	44.88	-29.12	74	53.67	35.5	14.09	58.38	100	0	P	H
		7440	20.09	-33.91	54							A	H
		4960	43.59	-30.41	74	56.72	34.13	11.48	58.74	100	0	P	V
		4960	18.8	-35.2	54							A	V
		7440	44.64	-29.36	74	53.43	35.5	14.09	58.38	100	0	P	V
		7440	19.85	-34.15	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		30.27	23.43	-16.57	40	27.62	24.6	1.19	29.98	-	-	P	H
		49.44	21.48	-18.52	40	35.62	14.66	1.19	29.99	-	-	P	H
		170.4	27.01	-16.49	43.5	39.32	15.51	2.07	29.89	-	-	P	H
		376.3	34.28	-11.72	46	40.32	20.88	2.86	29.78	-	-	P	H
		878.2	32.3	-13.7	46	27.77	28.91	4.63	29.01	-	-	P	H
		956.6	34.76	-11.24	46	27.85	30.69	4.74	28.52	100	0	P	H
													H
													H
													H
													H
													H
													H
		30	32.46	-7.54	40	36.65	24.6	1.19	29.98	100	0	P	V
		35.94	27.2	-12.8	40	34.48	21.51	1.19	29.98	-	-	P	V
		45.12	27.67	-12.33	40	40.17	16.3	1.19	29.99	-	-	P	V
		382.6	33.68	-12.32	46	39.34	21.05	3.07	29.78	-	-	P	V
		878.9	32.26	-13.74	46	27.72	28.91	4.63	29	-	-	P	V
		953.1	34.33	-11.67	46	27.59	30.54	4.74	28.54	-	-	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 D. Radiated Spurious Emission Plots

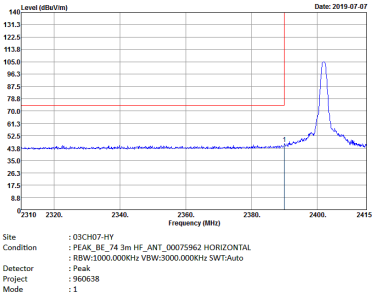
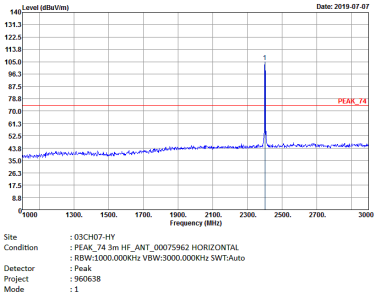
Test Engineer :	Jesse Wang, Stan Hsieh and Ken Wu	**Temperature :**	24~26°C
		Relative Humidity :	52~60%

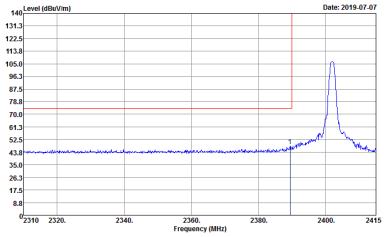
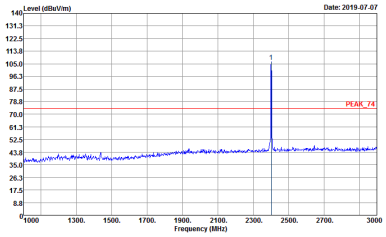
Note symbol

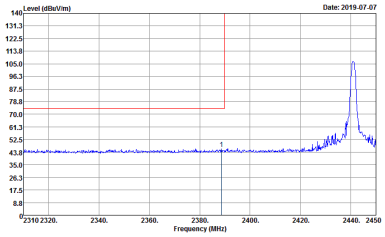
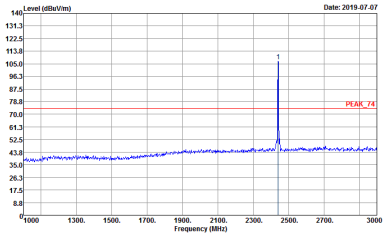
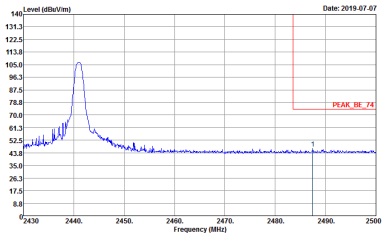
-L	**Low channel location**
-R	**High channel location**

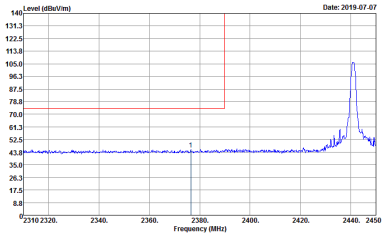
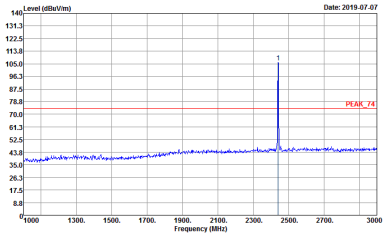
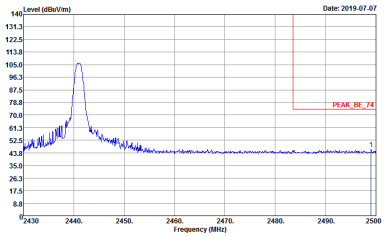
2.4GHz 2400~2483.5MHz

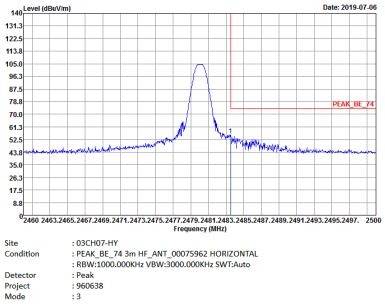
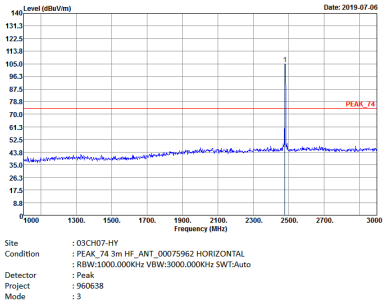
BT (Band Edge @ 3m)

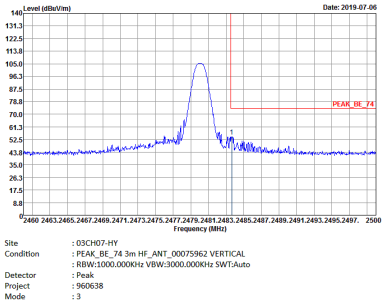
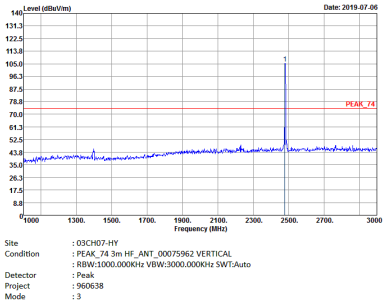
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH00 2402MHz	
	Horizontal	Fundamental
Peak		

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH00 2402MHz	
	Vertical	Fundamental
Peak	 Site : 03CH07-HY Condition : PEAK_BE_74 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 960638 Mode : 1	 Site : 03CH07-HY Condition : PEAK_74 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 960638 Mode : 1

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH39 2441MHz	
	Horizontal	Fundamental
Peak	 Site : 03CH07-HY Condition : PEAK_BE_74 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 960638 Mode : 2	 Site : 03CH07-HY Condition : PEAK_74 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 960638 Mode : 2
Peak	 Site : 03CH07-HY Condition : PEAK_BE_74 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 960638 Mode : 2	Left blank

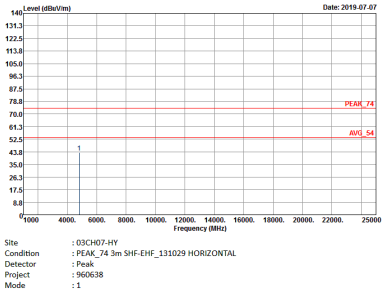
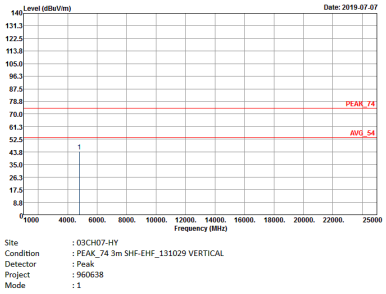
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH39 2441MHz	
	Vertical	Fundamental
Peak	 Site : 03CH07-HY Condition : PEAK_BE_74 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 960638 Mode : 2	 Site : 03CH07-HY Condition : PEAK_74 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 960638 Mode : 2
Peak	 Site : 03CH07-HY Condition : PEAK_BE_74 3m HF_ANT_00075962 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 960638 Mode : 2	Left blank

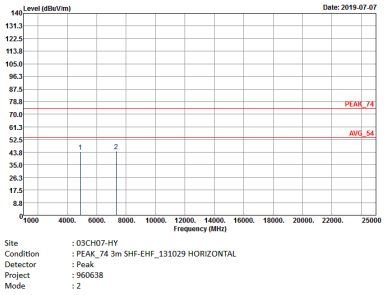
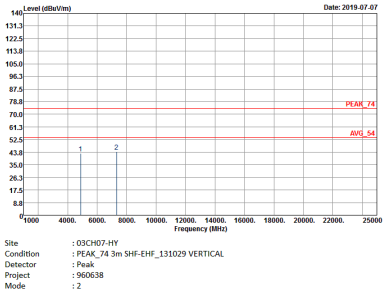
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Horizontal	Fundamental
Peak	 Site : 03CH07-HY Condition : PEAK_BE_74 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 960638 Mode : 3	 Site : 03CH07-HY Condition : PEAK_74 3m HF_ANT_00075962 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 960638 Mode : 3

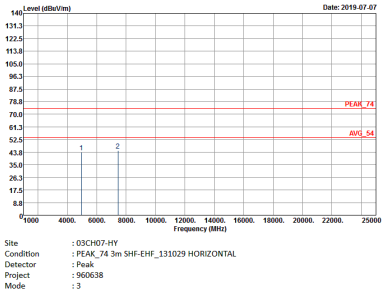
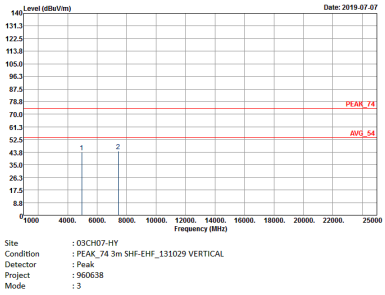
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Vertical	Fundamental
Peak		

2.4GHz 2400~2483.5MHz

BT (Harmonic @ 3m)

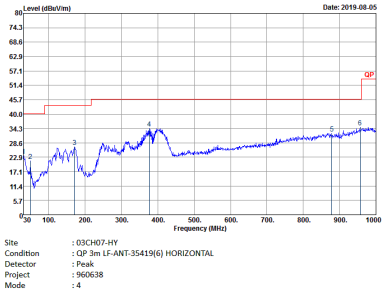
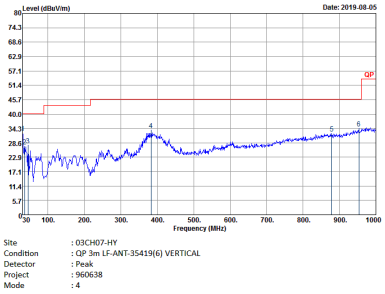
BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH00 2402MHz	
	Horizontal	Vertical
Peak Avg.		

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.		

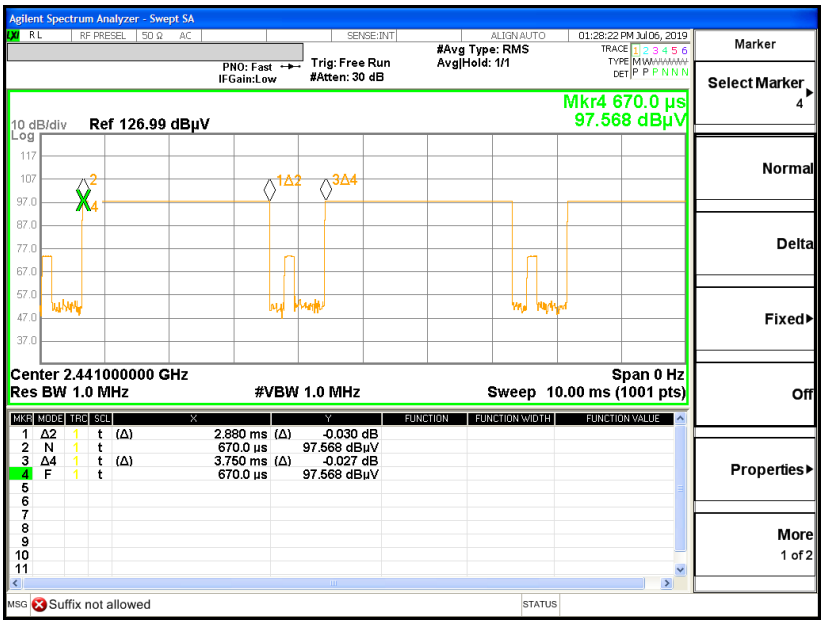
Emission below 1GHz

2.4GHz BT (LF)

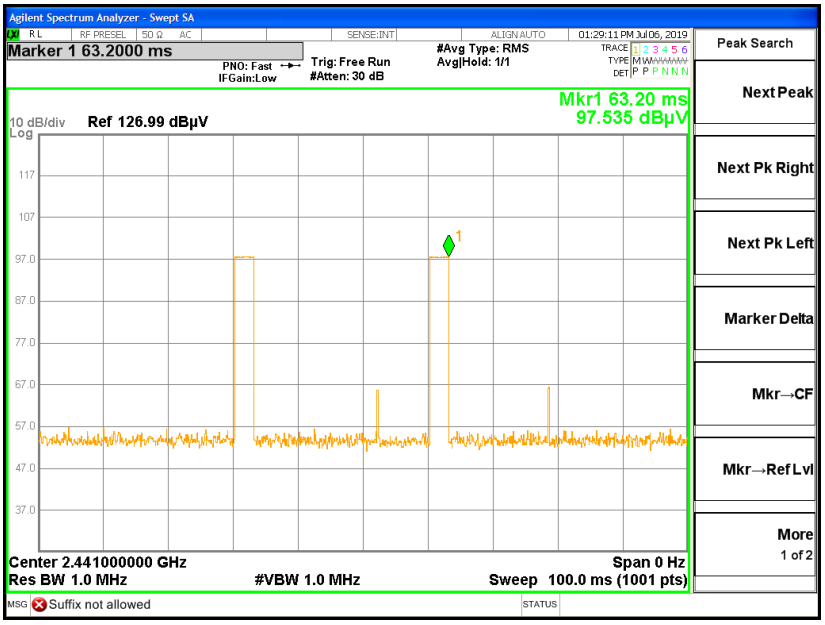
BT	2.4GHz 2400~2483.5MHz	
	BT LF	
	Horizontal	Vertical
QP / Peak		

Appendix E. Duty Cycle Plots

DH5 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 * 2.88 / 100 = 5.76 %
2. Worst case Duty cycle correction factor = 20*log(Duty cycle) = -24.79 dB
3. **DH5** 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

2.88 ms x 20 channels = 57.6 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. [100ms / 57.6ms] = 2 hops

Thus, the maximum possible ON time:

2.88 ms x 2 = 5.76 ms

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

20 x log(5.76 ms/100ms) = -24.79 dB

————THE END————