



2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.	
		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )	
BT CH00 2402MHz		2340.135	48.45	-25.55	74	44.36	27.64	5.74	29.29	127	73	P	H	
		2340.135	23.69	-30.31	54	-	-	-	-	-	-	A	H	
	*	2402	99.16	-	-	95.1	27.5	5.84	29.28	127	73	P	H	
	*	2402	74.4	-	-	-	-	-	-	-	-	A	H	
													H	
													H	
			2371.53	48.23	-25.77	74	44.17	27.56	5.79	29.29	393	5	P	V
			2371.53	23.47	-30.53	54	-	-	-	-	-	-	A	V
	*	2402	95.31	-	-	91.25	27.5	5.84	29.28	393	5	P	V	
	*	2402	70.55	-	-	-	-	-	-	-	-	-	A	V
													V	
													V	
BT CH 39 2441MHz		2356.62	48.73	-25.27	74	44.66	27.59	5.77	29.29	100	70	P	H	
		2356.62	23.97	-30.03	54	-	-	-	-	-	-	A	H	
	*	2441	99.3	-	-	95.25	27.42	5.9	29.27	100	70	P	H	
	*	2441	74.54	-	-	-	-	-	-	-	-	A	H	
			2491.32	48.41	-25.59	74	44.38	27.32	5.96	29.25	100	70	P	H
			2491.32	23.65	-30.35	54	-	-	-	-	-	-	A	H
			2314.06	48.96	-25.04	74	44.82	27.74	5.7	29.3	339	28	P	V
			2314.06	24.2	-29.8	54	-	-	-	-	-	-	A	V
	*	2441	95.39	-	-	91.34	27.42	5.9	29.27	339	28	P	V	
	*	2441	70.63	-	-	-	-	-	-	-	-	-	A	V
			2486.56	48.91	-25.09	74	44.87	27.33	5.96	29.25	339	28	P	V
			2486.56	24.15	-29.85	54	-	-	-	-	-	-	A	V



<b>BT CH 78 2480MHz</b>	*	2480	97.52	-	-	93.49	27.34	5.95	29.26	100	72	P	H
	*	2480	72.76	-	-	-	-	-	-	-	-	A	H
		2483.88	49.79	-24.21	74	45.76	27.33	5.95	29.25	100	72	P	H
		2483.88	25.03	-28.97	54	-	-	-	-	-	-	A	H
													H
													H
	*	2480	94.38	-	-	90.35	27.34	5.95	29.26	366	32	P	V
	*	2480	69.62	-	-	-	-	-	-	-	-	A	V
		2485	48.96	-25.04	74	44.93	27.33	5.95	29.25	366	32	P	V
		2485	24.2	-29.8	54	-	-	-	-	-	-	A	V
													V
													V
<b>Remark</b>	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	39.85	-34.15	74	59.37	31.1	9.84	60.46	100	0	P	H	
		4804	15.09	-38.91	54	-	-	-	-	-	-	A	H	
													H	
													H	
		4804	41.51	-32.49	74	61.03	31.1	9.84	60.46	100	0	P	V	
		4804	16.75	-37.25	54	-	-	-	-	-	-	-	A	V
														V
														V
BT CH 39 2441MHz		4882	40.97	-33.03	74	60.32	31.1	9.94	60.39	100	0	P	H	
		4882	16.21	-37.79	54	-	-	-	-	-	-	A	H	
		7323	45.55	-28.45	74	55.66	36.39	12.61	59.11	100	0	P	H	
		7323	20.79	-33.21	54	-	-	-	-	-	-	-	A	H
		4882	40.58	-33.42	74	59.93	31.1	9.94	60.39	100	0	P	V	
		4882	15.82	-38.18	54	-	-	-	-	-	-	-	A	V
		7323	46.97	-27.03	74	57.08	36.39	12.61	59.11	100	0	P	V	
		7323	22.21	-31.79	54	-	-	-	-	-	-	-	A	V
BT CH 78 2480MHz		4960	40.29	-33.71	74	59.35	31.24	10.03	60.33	100	0	P	H	
		4960	15.53	-38.47	54	-	-	-	-	-	-	A	H	
		7440	46.12	-27.88	74	55.86	36.4	12.9	59.04	100	0	P	H	
		7440	21.36	-32.64	54	-	-	-	-	-	-	A	H	
		4960	41.37	-32.63	74	60.43	31.24	10.03	60.33	100	0	P	V	
		4960	16.61	-37.39	54	-	-	-	-	-	-	A	V	
		7440	46.28	-27.72	74	56.02	36.4	12.9	59.04	100	0	P	V	
		7440	21.52	-32.48	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.	
		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )	
2.4GHz BT LF		30.97	24.39	-15.61	40	29.51	24.01	0.51	29.64	-	-	P	H	
		95.96	25.59	-17.91	43.5	39.03	15.34	0.83	29.61	-	-	P	H	
		136.7	21.95	-21.55	43.5	33.06	17.34	1.16	29.61	-	-	P	H	
		763.32	34.06	-11.94	46	31.29	28.11	3.23	28.57	-	-	P	H	
		883.6	35.36	-10.64	46	30.94	29	3.68	28.26	-	-	P	H	
		955.38	35.76	-10.24	46	29.42	30.79	3.68	28.13	100	0	P	H	
													H	
													H	
													H	
													H	
													H	
													H	
			30.97	29.63	-10.37	40	34.75	24.01	0.51	29.64	-	-	P	V
			46.49	25.98	-14.02	40	39.11	15.94	0.57	29.64	-	-	P	V
			66.86	24.96	-15.04	40	42.13	11.79	0.72	29.68	-	-	P	V
			717.73	35.94	-10.06	46	34.71	26.8	3	28.57	-	-	P	V
			863.23	34.9	-11.1	46	30.62	29.05	3.57	28.34	-	-	P	V
			945.68	36.06	-9.94	46	30.11	30.42	3.67	28.14	100	0	P	V
														V
														V
													V	
													V	
													V	
													V	
Remark	1. No other spurious found. 2. All results are PASS against limit line.													



**Note symbol**

*	<b>Fundamental Frequency</b> which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is <b>over limit</b> line.
P/A	<b>Peak</b> or <b>Average</b>
H/V	<b>Horizontal</b> or <b>Vertical</b>



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.
		( MHz )	( dBμV/m )	( dB )	Limit Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
					( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )
BT		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
CH 00		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H
2402MHz													

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

<b>Test Engineer :</b>	Jack Cheng, Lance Chiang and Chuan Chu	<b>Temperature :</b>	19.2~26.8°C
		<b>Relative Humidity :</b>	53.5~69%

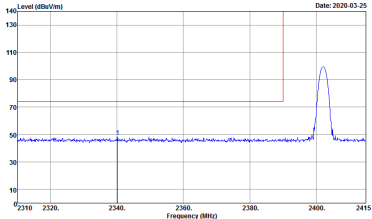
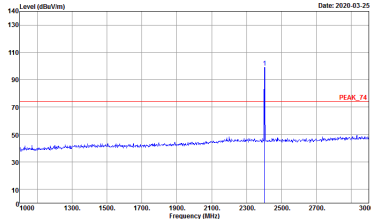
**Note symbol**

-L	Low channel location
-R	High channel location



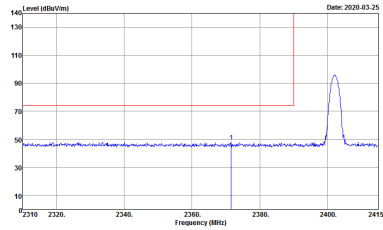
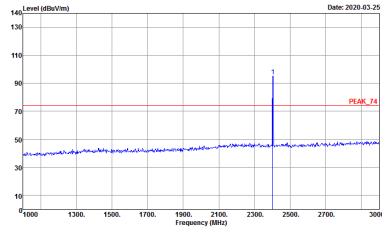
2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BT CH00 2402MHz		
Horizontal		Fundamental
Peak	 <p>Site : 03CH2-HY  Condition : PEAK_35_74 3m HORN_91200_1328 HORIZONTAL  : RBW:1000.000kHz VBW:3000.000kHz SWT:Auto  Detector : Peak  Project : 010720</p>	 <p>Site : 03CH2-HY  Condition : PEAK_74 3m HORN_91200_1328 HORIZONTAL  : RBW:1000.000kHz VBW:3000.000kHz SWT:Auto  Detector : Peak  Project : 010720</p>



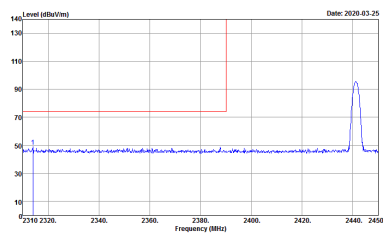
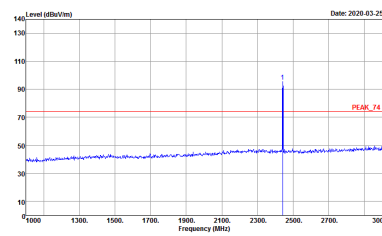
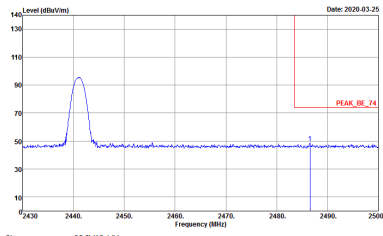


BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH00 2402MHz	
	Vertical	Fundamental
<b>Peak</b>	 <p>Site : 03CH12-HY Condition : PEAK_74 3m HORN_91200_1328 VERTICAL Detector : Peak Project : 010720</p>	 <p>Site : 03CH12-HY Condition : PEAK_74 3m HORN_91200_1328 VERTICAL Detector : Peak Project : 010720</p>

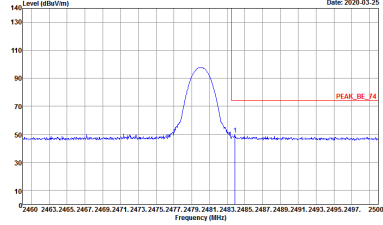
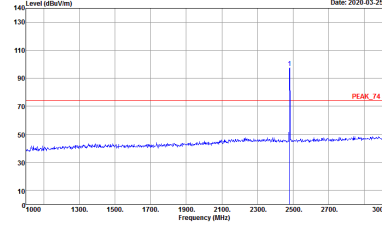


BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BT CH39 2441MHz		
Horizontal		Fundamental
<p><b>Peak</b></p>	<p>Date: 2020-03-25</p> <p>Site : 03CH12-HY            Condition : PEAK_BE_74 3m HORN_91200_1328 HORIZONTAL            RBW:1000.000kHz VBW:3000.000kHz SWT:Auto            Detector : Peak            Project : 010720</p>	<p>Date: 2020-03-25</p> <p>Site : 03CH12-HY            Condition : PEAK_BE_74 3m HORN_91200_1328 HORIZONTAL            RBW:1000.000kHz VBW:3000.000kHz SWT:Auto            Detector : Peak            Project : 010720</p>
<p><b>Peak</b></p>	<p>Date: 2020-03-25</p> <p>Site : 03CH12-HY            Condition : PEAK_BE_74 3m HORN_91200_1328 HORIZONTAL            RBW:1000.000kHz VBW:3000.000kHz SWT:Auto            Detector : Peak            Project : 010720</p>	<p><b>Left blank</b></p>



BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BT CH39 2441MHz		
Vertical		Fundamental
Peak	 <p>Date: 2020-03-25</p> <p>Site : 03CH12-HY            Condition : PEAK_BE_74 3m HORN_91200_1328 VERTICAL            RBW:1000.000kHz VBW:3000.000kHz SWT:Auto            Detector : Peak            Project : 010720</p>	 <p>Date: 2020-03-25</p> <p>Site : 03CH12-HY            Condition : PEAK_BE_74 3m HORN_91200_1328 VERTICAL            RBW:1000.000kHz VBW:3000.000kHz SWT:Auto            Detector : Peak            Project : 010720</p>
Peak	 <p>Date: 2020-03-25</p> <p>Site : 03CH12-HY            Condition : PEAK_BE_74 3m HORN_91200_1328 VERTICAL            RBW:1000.000kHz VBW:3000.000kHz SWT:Auto            Detector : Peak            Project : 010720</p>	Left blank



BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BT CH78 2480MHz		
	Horizontal	Fundamental
<b>Peak</b>	 <p>Site : 03CH2-HY Condition : PEAK_BE_74 3m HORN_91200_1328 HORIZONTAL Detector : Peak Project : 010720</p>	 <p>Site : 03CH2-HY Condition : PEAK_F4 3m HORN_91200_1328 HORIZONTAL Detector : Peak Project : 010720</p>

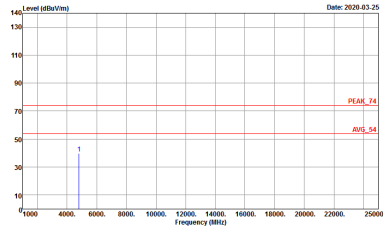
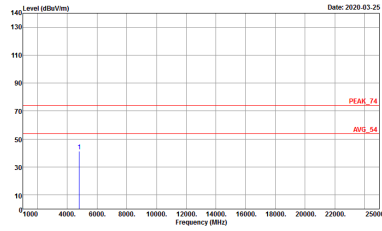


BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Vertical	Fundamental
Peak	<p>Site : 03CH2-HY          Condition : PEAK_BE_74 3m HORN_91200_1328 VERTICAL          Detector : Peak          Project : 010720</p>	<p>Site : 03CH2-HY          Condition : PEAK_74 3m HORN_91200_1328 VERTICAL          Detector : Peak          Project : 010720</p>

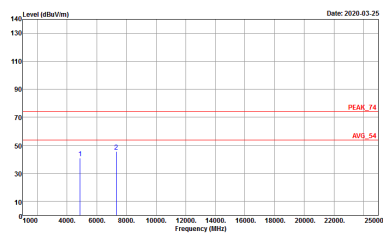
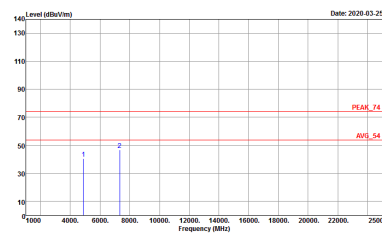


2.4GHz 2400~2483.5MHz

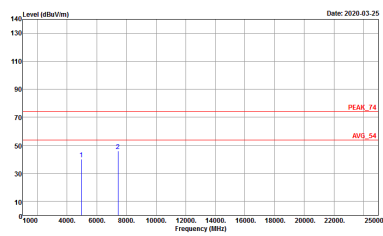
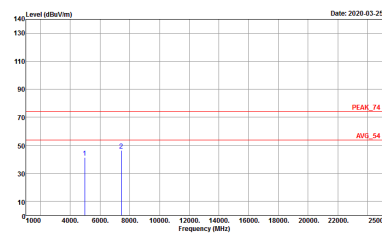
BT (Harmonic @ 3m)

BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH00 2402MHz	
	Horizontal	Vertical
<p><b>Peak</b></p> <p><b>Avg.</b></p>	 <p>Site : 03CH12-HY            Condition : PEAK_74 3m HORN_91200_1328 HORIZONTAL            Detector : Peak            Project : 010720</p>	 <p>Site : 03CH12-HY            Condition : PEAK_74 3m HORN_91200_1328 VERTICAL            Detector : Peak            Project : 010720</p>



BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH39 2441MHz	
	Horizontal	Vertical
<p><b>Peak</b> <b>Avg.</b></p>	 <p>Site : 03CH12-HY          Condition : PEAK_74 3m HORN_91200_1328 HORIZONTAL          Detector : Peak          Project : 010720</p>	 <p>Site : 03CH12-HY          Condition : PEAK_74 3m HORN_91200_1328 VERTICAL          Detector : Peak          Project : 010720</p>



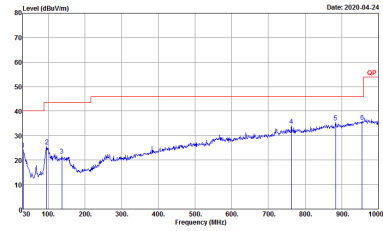
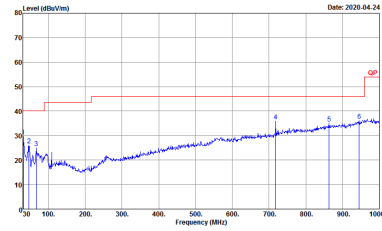
BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH78 2480MHz	
	Horizontal	Vertical
<p><b>Peak</b></p> <p><b>Avg.</b></p>	 <p>Site : 03CH12-HY            Condition : PEAK_74 3m HORN_91200_1328 HORIZONTAL            Detector : Peak            Project : 010720</p>	 <p>Site : 03CH12-HY            Condition : PEAK_74 3m HORN_91200_1328 VERTICAL            Detector : Peak            Project : 010720</p>





Emission below 1GHz

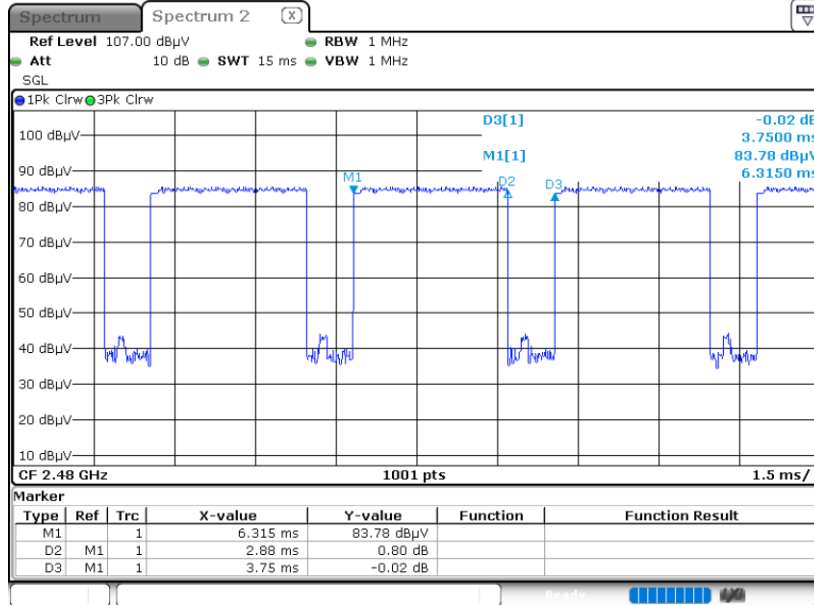
2.4GHz BT (LF)

BT	2.4GHz 2400~2483.5MHz	
	BT LF	
	Horizontal	Vertical
QP / Peak	 <p data-bbox="430 896 670 952">Site : 03CH12-HY Condition : QP 3m BILDG_6111D_37059 HORIZONTAL Detector : Peak Project : 010720</p>	 <p data-bbox="904 896 1144 952">Site : 03CH12-HY Condition : QP 3m BILDG_6111D_37059 VERTICAL Detector : Peak Project : 010720</p>



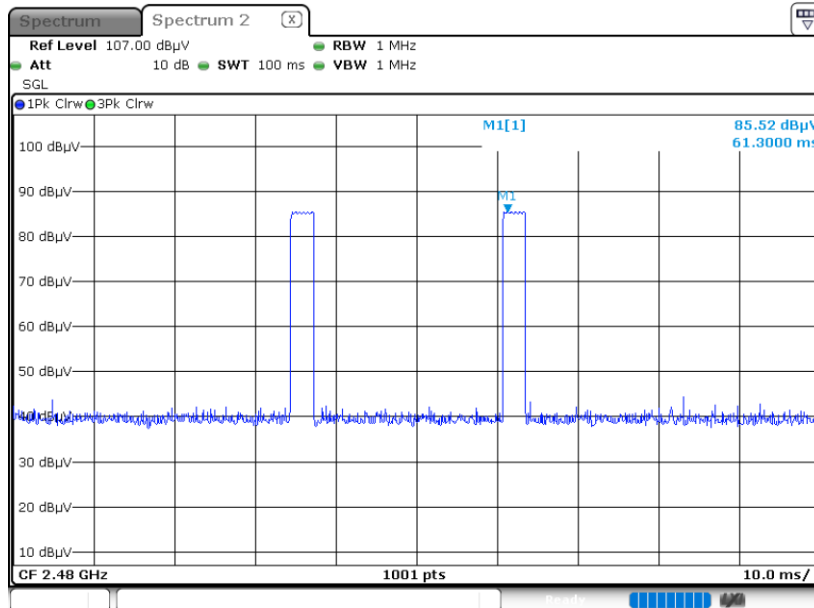
# Appendix D. Duty Cycle Plots

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



Date: 25.MAR.2020 20:47:54

### on time (Count Pulses) Plot on Channel 39



Date: 25.MAR.2020 20:49:15

#### Note:

1. Worst case Duty cycle = on time/100 milliseconds =  $2 * 2.88 / 100 = 5.76 \%$
2. Worst case Duty cycle correction factor =  $20 * \log(\text{Duty cycle}) = -24.79 \text{ dB}$
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

$$2.88 \text{ ms} \times 20 \text{ channels} = 57.6 \text{ ms}$$

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.  $[100\text{ms} / 57.8\text{ms}] = 2$  hops

Thus, the maximum possible ON time:

$$2.88 \text{ ms} \times 2 = 5.76 \text{ ms}$$

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

$$20 \times \log(5.76 \text{ ms}/100\text{ms}) = -24.79 \text{ dB}$$