

Att	30 de	SWT	29.7 ms 👄	<b>VBW</b> 300 kH	z Mode	Auto Sweep	)		
●1Pk View 20 dBm						1[1] 2[1]			9.12 dBm 2.48210 GHz -51.66 dBm
10 dBm	D1 9.120 d	3m						M1	2.77860 GHz
0 dBm									
-10 dBm	D2 -10	.880 dBm=				-			
-20 dBm—				· · · · · · · · · · · · · · · · · · ·					
-30 dBm		1.							
-40 dBm	-							+	
-50 dBm									M2
-60 dBm-	mailwallandlandlandlandlandlandlandlandlandla	abourserver	ingin with the	nhyeuwaheer	Kirkilmaharir	minuman	All and a second descent of the	aherburg	untertainen (
-70 dBm									

#### CSE Plot on Ch 78 between 30MHz ~ 3 GHz

Date: 17.JAN.2023 02:12:25

#### CSE Plot on Ch 78 between 2 GHz ~ 25 GHz

Att	30 dB	SWT	230 ms 🕳 🕯	<b>VBW</b> 300 kH	z Mode	Auto Sweep			
1Pk View									
20 dBm					M	1[1]			8.43 dBn 2.4830 GH
LO GDIN					M	2[1]			-44.40 dBr
10 dBm		-						1	6.5290 GH
	D1 8.430 dB	m							
dBm									-
10 dBm	D2 -11.	570 dBm-							
20 dBm									
30 dBm-									
40 dBm-						M2			
					a stable	Mr. Maria	Junets a Ar		
50 dBm	Rove Laboration	howby	howwww	America and h	had had been me		10.000 W W	a manufacture	and the start
Manual									
60 dBm									
70 dBm-									

Date: 17.JAN.2023 02:12:55



## 3.8 Radiated Band Edges and Spurious Emission Measurement

### 3.8.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency	Field Strength	Measurement Distance
(MHz)	(microvolts/meter)	(meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

#### 3.8.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.



### 3.8.3 Test Procedures

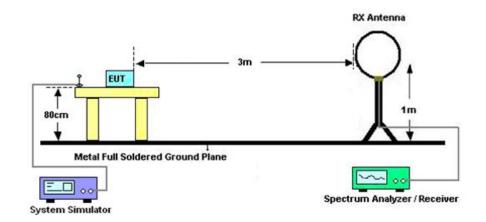
- 1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
- 2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
- 3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
- 4. Set to the maximum power setting and enable the EUT transmit continuously.
- 5. Use the following spectrum analyzer settings:
  - (1) Span shall wide enough to fully capture the emission being measured;
  - (2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
  - (3) For average measurement: use duty cycle correction factor method per 15.35(c). Duty cycle = On time/100 milliseconds On time = N<sub>1</sub>\*L<sub>1</sub>+N<sub>2</sub>\*L<sub>2</sub>+...+N<sub>n-1</sub>\*LN<sub>n-1</sub>+N<sub>n</sub>\*L<sub>n</sub> Where N<sub>1</sub> is number of type 1 pulses, L<sub>1</sub> is length of type 1 pulses, etc. Average Emission Level = Peak Emission Level + 20\*log(Duty cycle)
- 6. Corrected Reading: Antenna Factor + Cable Loss + Read Level Preamp Factor = Level
- 7. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
- 8. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than peak limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (-24.76dB) derived from 20log (dwell time/100ms). This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

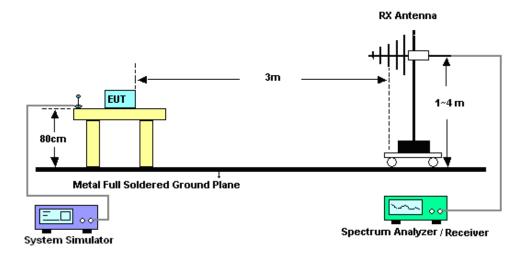


#### 3.8.4 Test Setup

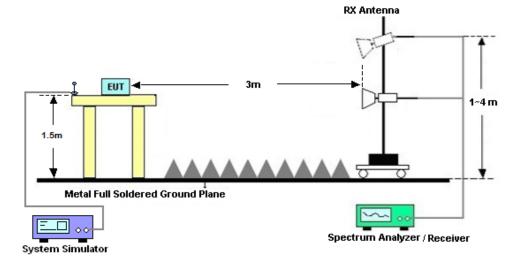
#### For radiated emissions below 30MHz



#### For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



**Sporton International Inc. (Kunshan)** TEL : +86-512-57900158 FAX : +86-512-57900958 FCC ID: XMR2022SC680AWF Page Number : 52 of 58 Report Issued Date : Feb. 15, 2023 Report Version : Rev. 01 Report Template No.: BU5-FR15CBT Version 2.0



### 3.8.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

#### 3.8.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C.

3.8.7 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic or 40GHz, whichever is lower)

Please refer to Appendix C.

#### 3.8.8 Duty cycle correction factor for average measurement

Please refer to Appendix D.



## 3.9 AC Conducted Emission Measurement

### 3.9.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBµV)			
Frequency of emission (MHZ)	Quasi-peak	Average		
0.15-0.5	66 to 56*	56 to 46*		
0.5-5	56	46		
5-30	60	50		

\*Decreases with the logarithm of the frequency.

#### 3.9.2 Measuring Instruments

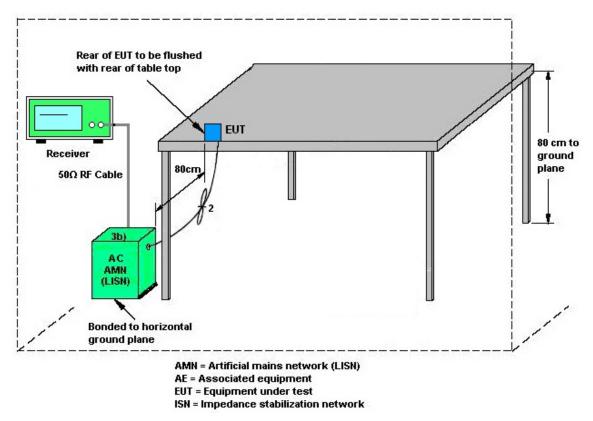
The measuring equipment is listed in the section 4 of this test report.

#### 3.9.3 Test Procedures

- 1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
- 2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
- 3. All the support units are connecting to the other LISN.
- 4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
- 5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
- 6. Both sides of AC line were checked for maximum conducted interference.
- 7. The frequency range from 150 kHz to 30 MHz was searched.
- Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.



### 3.9.4 Test Setup



## 3.9.5 Test Result of AC Conducted Emission

Please refer to Appendix B.



## 3.10 Antenna Requirements

### 3.10.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

### 3.10.2 Antenna Anti-Replacement Construction

Non-standard antenna connector is used.

### 3.10.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



# 4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 12, 2022	Jan. 11, 2023~ Jan. 17, 2023	Oct. 11, 2023	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GH z	Jan. 05, 2023	Jan. 11, 2023~ Jan. 17, 2023	Jan. 04, 2024	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 05, 2023	Jan. 11, 2023~ Jan. 17, 2023	Jan. 04, 2024	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY564000 04	3Hz~8.5GHz;M ax 30dBm	Oct. 13, 2022	Jan. 13, 2023~ Jan. 17, 2023	Oct. 12, 2023	Radiation (03CH05-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY551502 44	10Hz-44G,MAX 30dB	Mar. 24, 2022	Jan. 13, 2023~ Jan. 17, 2023	Mar. 23, 2023	Radiation (03CH05-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 16, 2022	Jan. 13, 2023~ Jan. 17, 2023	Oct. 15, 2023	Radiation (03CH05-KS)
Bilog Antenna	TeseQ	CBL6111D	49922	30MHz-1GHz	May. 24 ,2022	Jan. 13, 2023~ Jan. 17, 2023	May. 23, 2023	Radiation (03CH05-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00218642	1GHz~18GHz	Apr. 18, 2022	Jan. 13, 2023~ Jan. 17, 2023	Apr. 17, 2023	Radiation (03CH05-KS)
SHF-EHF Horn	Com-power	AH-840	101070	18GHz~40GHz	Jan. 04, 2023	Jan. 13, 2023~ Jan. 17, 2023	Jan. 03, 2024	Radiation (03CH05-KS)
Amplifier	SONOMA	310N	380826	9KHz-1GHz	Jul. 11, 2022	Jan. 13, 2023~ Jan. 17, 2023	Jul. 10, 2023	Radiation (03CH05-KS)
Amplifier	MITEQ	EM18G40GG A	060728	18~40GHz	Jan. 04, 2023	Jan. 13, 2023~ Jan. 17, 2023	Jan. 03, 2024	Radiation (03CH05-KS)
high gain Amplifier	EM	EM01G18GA	060839	1Ghz-18Ghz	Oct. 12, 2022	Jan. 13, 2023~ Jan. 17, 2023	Oct. 11, 2023	Radiation (03CH05-KS)
Amplifier	EM	EM01G18GA	060833	1Ghz-18Ghz	Jan. 04, 2023	Jan. 13, 2023~ Jan. 17, 2023	Jan. 03, 2024	Radiation (03CH05-KS)
AC Power Source	Chroma	61601	F1040900 04	N/A	NCR	Jan. 13, 2023~ Jan. 17, 2023	NCR	Radiation (03CH05-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Jan. 13, 2023~ Jan. 17, 2023	NCR	Radiation (03CH05-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Jan. 13, 2023~ Jan. 17, 2023	NCR	Radiation (03CH05-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	May. 24, 2022	Jan. 14, 2023	May. 23, 2023	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 13, 2022	Jan. 14, 2023	Oct. 12, 2023	Conduction (CO01-KS)
AC LISN	R&S	ENV216	100334	9kHz~30MHz	May. 24, 2022	Jan. 14, 2023	May. 23, 2023	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP00000 0811	AC 0V~300V, 45Hz~1000Hz	Oct. 12, 2022	Jan. 14, 2023	Oct. 12, 2023	Conduction (CO01-KS)

NCR: No Calibration Required



## 5 Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

#### **Uncertainty of Conducted Measurement**

Test Item	Uncertainty
Conducted Power	±0.46 dB
Conducted Emissions	±0.48 dB
Occupied Channel Bandwidth	±0.001 %

#### Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y)) 2.78 dB
--

#### Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.0 dB
--	--------

#### Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence	5.0 dB
of 95% (U = 2Uc(y))	5.0 dB

#### Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence	5.0 dB
of 95% (U = 2Uc(y))	5.0 00

----- THE END ------



# **Appendix A. Conducted Test Results**

Report Number : FR2D2303A

Test Engineer:	wei xu	Temperature:	20~26	°C
Test Date:	2023/1/11~2023/1/17	Relative Humidity:	40~51	%

Report Number : FR2D2303A

<u>Bluetooth</u>

Test Engineer:	wei xu	Temperature:	20~26	°C
Test Date:	2023/1/11~2023/1/17	Relative Humidity:	40~51	%

# BT2.0-Ant1

<u>TEST RESULTS DATA</u> 20dB and 99% Occupied Bandwidth and Hopping Channel Separation												
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	20db BW (MHz)	99% Bandwidth (MHz)	Hopping Channel Separation Measurement (KHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail			
DH	1Mbps	1	0	2402	0.947	0.854	998.550	0.6310	Pass			
DH	1Mbps	1	39	2441	0.947	0.854	998.600	0.6310	Pass			
DH	1Mbps	1	78	2480	0.944	0.854	998.600	0.6291	Pass			
2DH	2Mbps	1	0	2402	1.237	1.166	994.200	0.8249	Pass			
2DH	2Mbps	1	39	2441	1.259	1.161	998.600	0.8393	Pass			
2DH	2Mbps	1	78	2480	1.259	1.164	998.600	0.8393	Pass			
3DH	3Mbps	1	0	2402	1.229	1.149	1002.900	0.8191	Pass			
3DH	3Mbps	1	39	2441	1.229	1.146	998.600	0.8191	Pass			
3DH	3Mbps	1	78	2480	1.229	1.146	998.600	0.8191	Pass			

	<u>TEST RESULTS DATA</u> Dwell Time											
Mod.	Hopping Channel Number Rate	Hops Over Occupancy Time(hops)	Package Transfer Time (msec) (MHz)	Dwell Time (sec)	Limits (sec)	Pass/Fail						
Nomal	79	106.67	2.90	0.31	0.4	Pass						
AFH	20	53.33	2.90	0.15	0.4	Pass						

<u>TEST RESULTS DATA</u> <u>Peak Power Table</u>								
DH	CH.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result			
	0	1	9.06	20.97	Pass			
DH1	39	1	8.66	20.97	Pass			
	78	1	9.26	20.97	Pass			
2DH	CH.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result			
	0	1	10.59	20.97	Pass			
2DH1	39	1	10.05	20.97	Pass			
	78	1	10.73	20.97	Pass			
				-				
3DH	CH.	NTX	Peak Power	Power Limit	Test			
301	Сп.		(dBm)	(dBm)	Result			
	0	1	10.88	20.97	Pass			
3DH1	39	1	10.44	20.97	Pass			
	78	1	11.05	20.97	Pass			

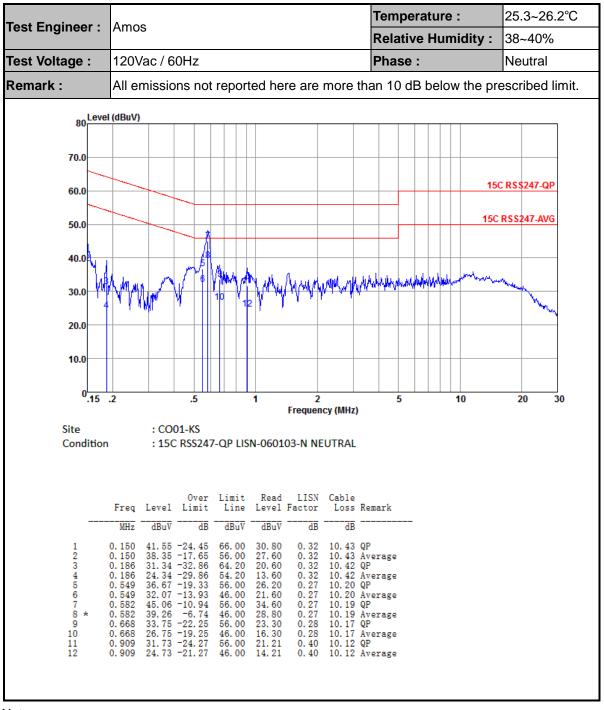
<u>TEST RESULTS DATA</u> Number of Hopping Frequency								
Number of Hopping (Channel)	Adaptive Frequency Hopping (Channel)	Limits (Channel)	Pass/Fail					
79	79	> 15	Pass					



# **Appendix B. AC Conducted Emission Test Results**

Fact Fusineer .	A						Temperature :			25.3~26.2°C	
fest Engineer :	Amos	Allos						e Humi	idity :	38~40%	
est Voltage :	120Vac / 60Hz							:		Line	
Remark :	All emissi	ons not	report	ted he	re are	more that	an 10 dE	3 below	the pre	escribed limit.	
80 Level	(dBuV)										
80											
70.0											
									150	CRSS247-QP	
60.0											
50.0									15C	RSS247-AVG	
10.00											
40.0	l n	, M	n b u	1					11	milure	
30.0	Ph. a		<del>2</del> ₩₩	ludum	MuhaM	MUM	MARYNAW	NAME AND AND A	Ï	- M	
20.0 21	44 W "WW"	W. T.	8 10	Mark V	i wiki i k	r: 11. l			12	"hy	
20.0											
10.0											
0											
0 <mark>.15</mark>	.2	.5		1	2 Frequen	cy (MHz)	5	1	10	20 30	
Site Condition		01-KS C RSS247		N 0001	02.1.1.10						
Condition	: 15	C K33247	-QP LIS	N-0601	US-L LIN	IC					
	Freq Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss Re	mark				
	MHz dBuV	dB	dBuV	dBuV	dB	<u>dB</u>					
		-30.07 -35.47	65.38 55.38	24.59 9.19	0.29 0.29	10.43 QP 10.43 Av					
3 4	0.197 33.23 0.197 21.33	-30.53 -32.43	63.76 53.76	22.50 10.60	0.31 0.31	10.42 QP 10.42 Av	erage				
6 *	0.579 34.26 0.579 25.66 0.658 29.24	-20.34	46.00	15.20		10.19 QP 10.19 Av	erage				
8	0.658 23.04 0.788 31.63	-22.96	46.00	12.60	0.27 0.29	10.17 Av 10.14 QP	erage				
10 11 1	0.788 22.63 1.257 31.80	-23.37 -28.20	46.00 60.00	12.20 20.50	0.29 0.44	10.14 Av 10.86 QP	erage				
12 1	1.257 19.60	-30.40	ou. 00	8.30	0.44	10.86 Av	erage				





Note:

- 1. Level(dB $\mu$ V) = Read Level(dB $\mu$ V) + LISN Factor(dB) + Cable Loss(dB)
- 2. Over Limit(dB) = Level(dB $\mu$ V) Limit Line(dB $\mu$ V)



# Appendix C. Radiated Spurious Emission Test Data

Mode	Band (MHz)	Antenna	Modulation	Channel	Frequency	Data Rate	Remark
Mode 1	2400-2483.5	1	Bluetooth BR_GFSK	00	2402	1Mbps	-
Mode 2	2400-2483.5	1	Bluetooth BR_GFSK	39	2441	1Mbps	-
Mode 3	2400-2483.5	1	Bluetooth BR_GFSK	78	2480	1Mbps	-
Mode 4	2400-2483.5	1	Bluetooth BR_GFSK	78	2480	1Mbps	LF

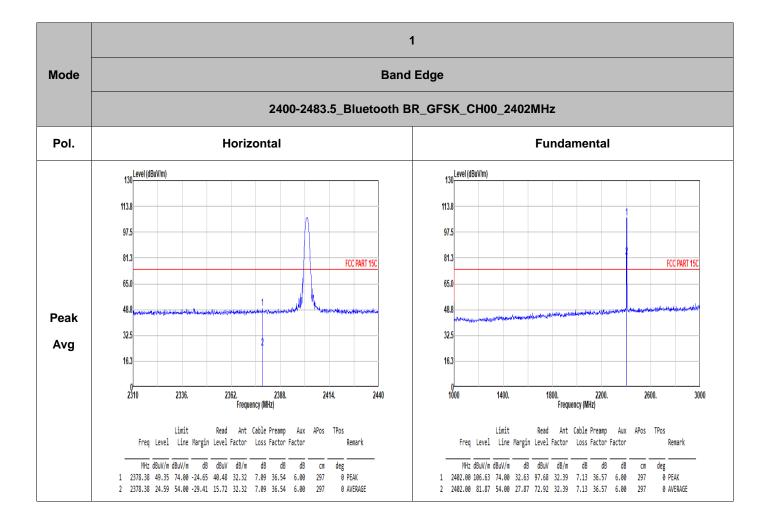


# Summary of each worse mode

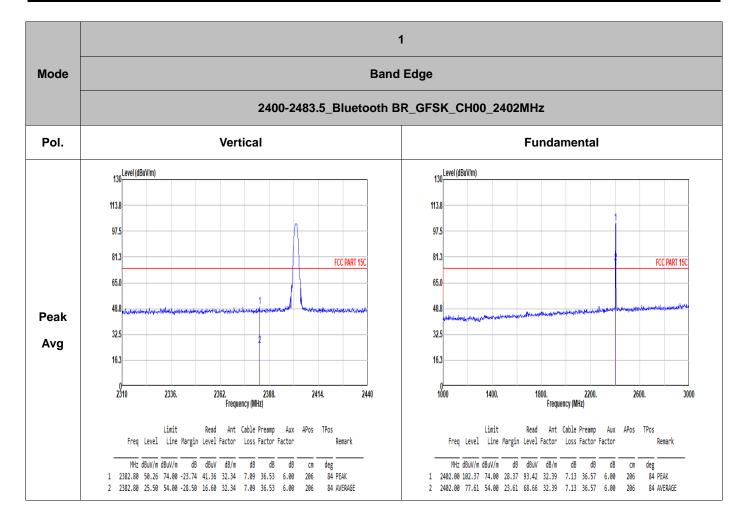
Mode	Modulation	Ch.	Freq. (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol.	Peak Avg.	Result	Remark
1	Bluetooth BR_GFSK	00	2382.80	50.26	74.00	-23.74	V	PEAK	Pass	Band Edge
,	Bluetooth BR_GFSK	00	4804.00	40.50	74.00	-33.50	V	PEAK	Pass	Harmonic
2	Bluetooth BR_GFSK	39	-	-	-	-	-	-	-	Band Edge
2	Bluetooth BR_GFSK	39	7323.00	42.49	74.00	-31.51	Н	PEAK	Pass	Harmonic
2	Bluetooth BR_GFSK	78	2483.89	53.23	74.00	-20.77	Н	PEAK	Pass	Band Edge
3	Bluetooth BR_GFSK	78	7440.00	42.23	74.00	-31.77	V	PEAK	Pass	Harmonic
4	Bluetooth BR_GFSK	78	52.31	30.79	40	-9.21	V	PEAK	Pass	LF



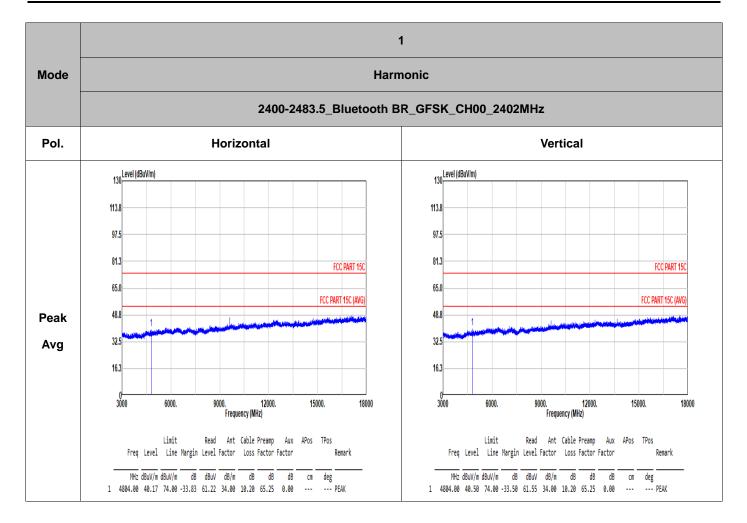




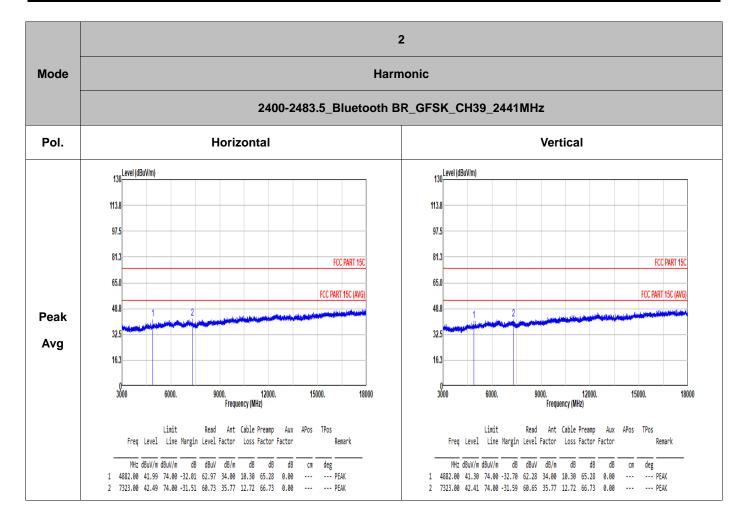




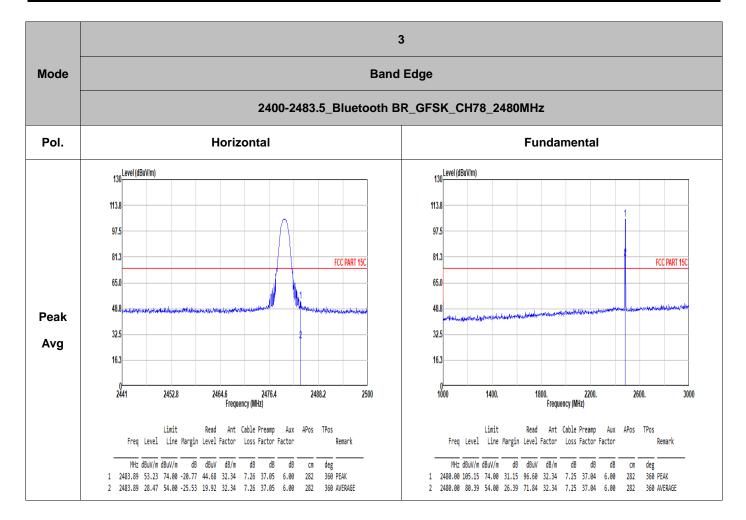




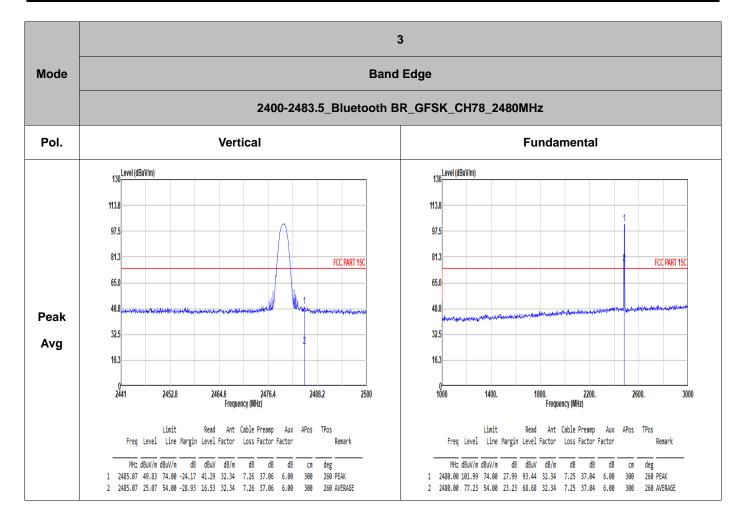




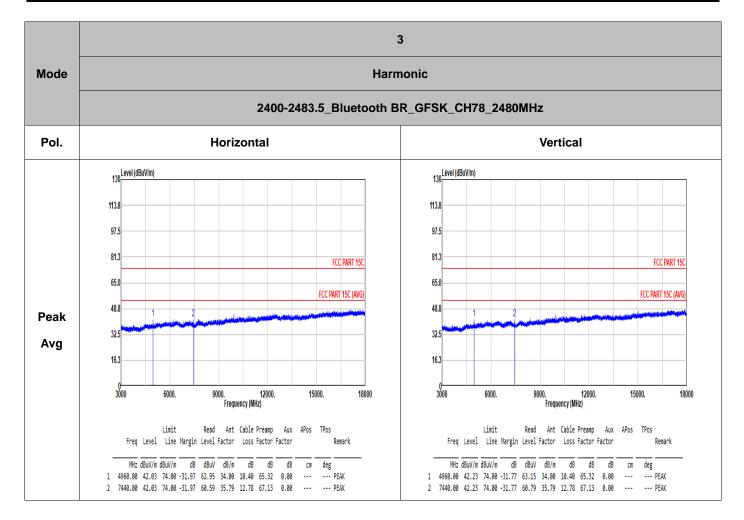




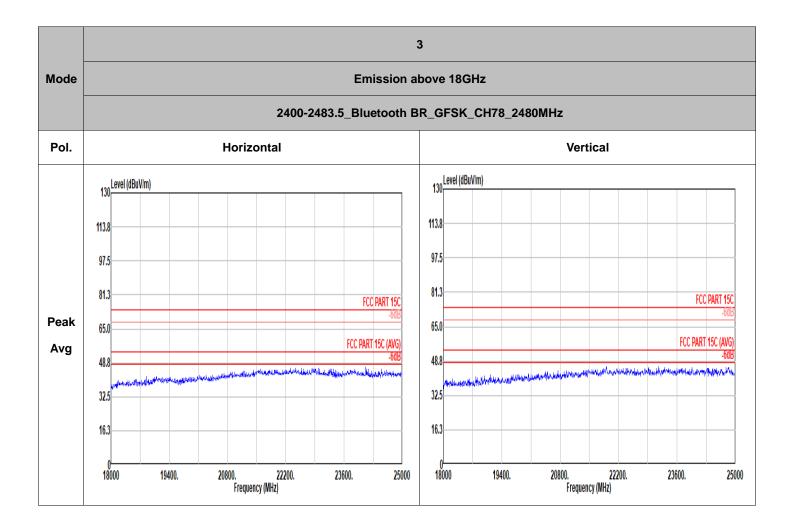




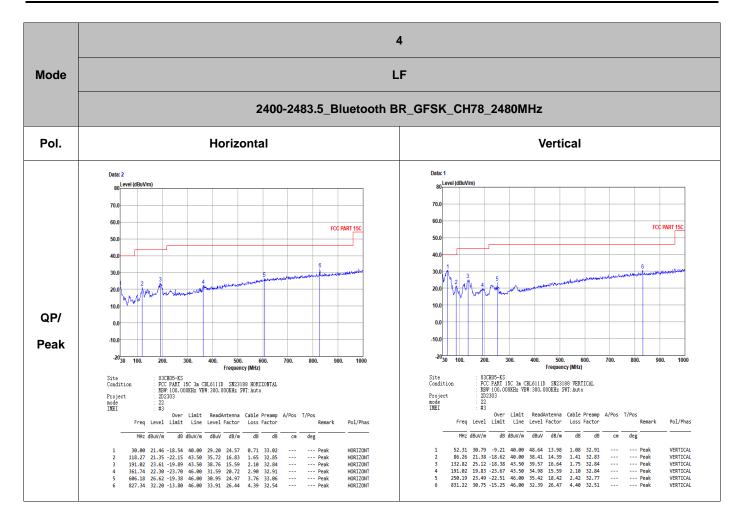














# Appendix D. Duty Cycle Plots

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



DH5 on time (Count Pulses) Plot on Channel 39



#### Note:

- 1. Worst case Duty cycle = on time/100 milliseconds = 2 \* 2.892 / 100 = 5.78 %
- 2. Worst case Duty cycle correction factor = 20\*log(Duty cycle) = -24.76 dB
- 3. DH5 has the highest duty cycle worst case and is reported.