



FCC RADIO TEST REPORT

FCC ID	: ZL5S62PRO
Equipment	: Rugged Smart Phone
Brand Name	: CAT
Model Name	: S62 Pro
Applicant	: Bullitt Group
	One Valpy, Valpy Street, Reading, Berkshire, England RG1 1AR
Standard	: FCC Part 15 Subpart C §15.247

The product was received on Dec. 07, 2020 and testing was started from Dec. 14, 2020 and completed on Dec. 22, 2020. We, SPORTON INTERNATIONAL INC., EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Louis Wu

Approved by: Louis Wu SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

Page Number	: 1 of 14
Issued Date	: Jan. 26, 2021
Report Version	: 02



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History of this test report

Report No.	Version	Description	Issued Date
FR042406-07C	01	Initial issue of report	Jan. 06, 2021
FR042406-07C	02	Revising remark description.	Jan. 26, 2021



Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
-	15.247(a)(2)	6dB Bandwidth	Not Required	-
-	2.1049	99% Occupied Bandwidth	Not Required	-
3.1	15.247(b)	Power Output Measurement	Pass	-
-	15.247(e)	Power Spectral Density	Not Required	-
	15 047(d)	Conducted Band Edges	Not Required	-
-	15.247(d)	Conducted Spurious Emission	Not Required	-
3.2	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	Pass	Under limit 5.54 dB at 4924.000 MHz
-	15.207	AC Conducted Emission	Not Required	-
3.3	15.203 & 15.247(b)	Antenna Requirement	Pass	-

Note:

- 1. Not required means after assessing, test items are not necessary to carry out.
- 2. This is a variant report which can be referred change list. After spot-checking the tests, the parent test results were worse than variant test results, thus this test report was reuse parent test data, all the test cases were performed on original report which can be referred to Sporton Report Number FR042406-02C (FCC ID: ZL5S62PROE).

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Wii Chang

Report Producer: Yimin Ho



1 General Description

1.1 Product Feature of Equipment Under Test

GSM/WCDMA/LTE, Bluetooth, Wi-Fi 2.4GHz 802.11b/g/n, Wi-Fi 5GHz 802.11a/n/ac, NFC and GNSS.

Product Specification subjective to this standard			
Sample 1 Dual SIM			
Sample 2	Single SIM		
	WWAN		
	<main 1="">: PIFA Antenna</main>		
	<main 2="">: PIFA Antenna</main>		
	<diversity 1="">: PIFA Antenna</diversity>		
Antonno Tumo	<diversity 2="">: Loop Antenna</diversity>		
Antenna Type	WLAN 2.4GHz: PIFA Antenna		
	WLAN 5GHz: Mono Pole Antenna		
	Bluetooth: PIFA Antenna		
	GPS/Glonass/BDS/Galileo/SBAS: PIFA Antenna		
	NFC: Loop Antenna		

Antenna information		
2400 MHz ~ 2483.5 MHz	Peak Gain (dBi)	1.20

Remark:

- 1. The samples have same layout, circuit and components but different SIM tray. The phone software will identify the loaded sim card combinations whether with single sim card or dual sim cards.
- 2. The tests were performed with Sample 1.
- **3.** The above EUT's information was declared by manufacturer. Please refer to Comments and Explanations in report summary.

1.2 Modification of EUT

No modifications are made to the EUT during all test items.



1.3 Testing Location

Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory	
Test Site LocationNo.52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978		
Test Site No.	Sporton Site No.	
Test one No.	TH05-HY	
Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory	
Test Site Test Site Location		
	Laboratory No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-0868	

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC designation No.: TW1190 and TW0007

1.4 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02
- ANSI C63.10-2013

Remark:

- 1. All test items were verified and recorded according to the standards and without any deviation during the test.
- 2. The TAF code is not including all the FCC KDB listed without accreditation.
- 3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation emission (1 GHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Z plane) were recorded in this report.

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
	1	2412	7	2442
	2	2417	8	2447
2400 2402 5 MU-	3	2422	9	2452
2400-2483.5 MHz	4	2427	10	2457
	5	2432	11	2462
	6	2437		

2.2 Test Mode

Final test modes are considering the modulation and worse data rates as below table.

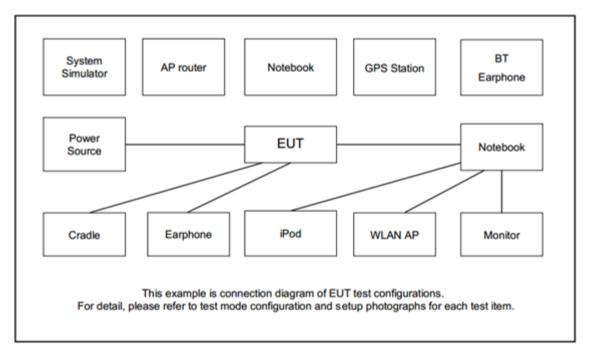
Modulation	Data Rate
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20	MCS0

Ch #	2400-2483.5 MHz
Ch. # 802.11b	
Low	-
Middle	-
High	11

Remark: For radiation spurious emission, the final modulation and the worst data rate was reference the max RF conducted power.



2.3 Connection Diagram of Test System



2.4 EUT Operation Test Setup

The RF test items, utility "QRCT v4.0.00156.0" was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.



3 Test Result

3.1 Output Power Measurement

3.1.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for output power is 30dBm. If transmitting antenna with directional gain greater than 6dBi is used, the output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

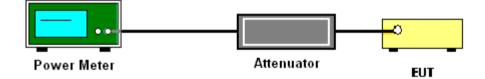
3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

3.1.3 Test Procedures

- 1. For Peak Power, the testing follows ANSI C63.10 Section 11.9.1.3 PKPM1
- 2. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G
- 3. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 4. Set to the maximum power setting and enable the EUT transmit continuously.
- 5. Measure the conducted output power and record the results in the test report.

3.1.4 Test Setup



3.1.5 Test Result of Peak Output Power

Please refer to Appendix A.

3.1.6 Test Result of Average Output Power (Reporting Only)

Please refer to Appendix A.

3.2 Radiated Band Edges and Spurious Emission Measurement

3.2.1 Limit of Radiated band edge and Spurious Emission Measurement

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. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. 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

3.2.2 Measuring Instruments

See list of measuring equipment of this test report.

3.2.3 Test Procedures

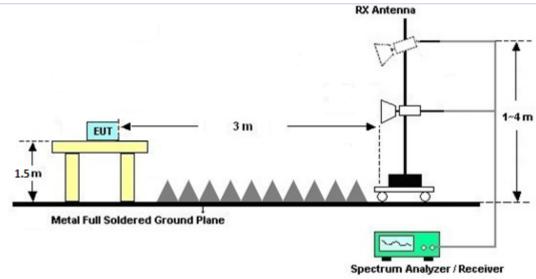
- 1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements
- 2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
- 3. The EUT was placed on a turntable with 1.5 meter for frequency above 1GHz respectively above ground.
- 4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
- 5. Corrected Reading: Antenna Factor + Cable Loss + Read Level Preamp Factor = Level
- 6. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average 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.



- 7. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW = 1 MHz, VBW= 3MHz for $f \ge 1$ GHz for peak measurement. For average measurement:
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW \geq 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.2.4 Test Setup

For radiated test above 1GHz



3.2.5 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B and C.

3.2.6 Duty Cycle

Please refer to Appendix D.

3.2.7 Test Result of Radiated Spurious Emission

Please refer to Appendix B and C.



3.3 Antenna Requirements

3.3.1 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.

3.3.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.3.3 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	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Horn Antenna	SCHWARZBE CK	BBHA 9120 D	9120D-152 2	1G~18GHz	Sep. 29, 2020	Dec. 18, 2020~ Dec. 22, 2020	Sep. 28, 2021	Radiation (03CH16-HY)
Preamplifier	Jet-Power	JPA0118-55-3 03	171000180 0054001	1GHz~18GHz	Sep. 04, 2020	Dec. 18, 2020~ Dec. 22, 2020	Sep. 03, 2021	Radiation (03CH16-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	BBHA9170 576	18GHz ~40GHz	May 22, 2020	Dec. 18, 2020~ Dec. 22, 2020	May 21, 2021	Radiation (03CH16-HY)
Preamplifier	Keysight	83017A	MY532702 64	1GHz~26.5GHz	Dec.		Dec. 09, 2021	Radiation (03CH16-HY)
EMI Test Receiver	Keysight	N9038A (MXE)	MY572901 11	3Hz~26.5GHz	Dec. 11, 2020	Dec. 18, 2020~ Dec. 22, 2020	Dec. 10, 2021	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11680/ 4PE	NA	Aug. 29, 2020	Dec. 18, 2020~ Dec. 22, 2020	Aug. 28, 2021	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11688/ 4PE	NA	Aug. 29, 2020	Dec. 18, 2020~ Dec. 22, 2020	Aug. 28, 2021	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	EC-A5-300 -5757	NA	Aug. 29, 2020	Dec. 18, 2020~ Dec. 22, 2020	Aug. 28, 2021	Radiation (03CH16-HY)
Hygrometer	TECPEL	DTM-303B	TP200881	QA-3-031	Oct. 22, 2020	Dec. 18, 2020~ Dec. 22, 2020	Oct. 21, 2021	Radiation (03CH16-HY)
Software	Audix	E3 6.2009-8-24	RK-001136	N/A	N/A	Dec. 18, 2020~ Dec. 22, 2020	N/A	Radiation (03CH16-HY)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	Dec. 18, 2020~ Dec. 22, 2020	N/A	Radiation (03CH16-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Dec. 18, 2020~ Dec. 22, 2020	N/A	Radiation (03CH16-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Dec. 18, 2020~ Dec. 22, 2020	N/A	Radiation (03CH16-HY)
Power Sensor	DARE	RPR3006W	17100015 SNO37	10MHz~6GHz	Dec. 02, 2020	Dec. 14, 2020	Dec. 01, 2021	Conducted (TH05-HY)
Signal Analyzer	Rohde & Schwarz	FSP7	101131	9kHz~7GHz	Aug. 12, 2020	Dec. 14, 2020	Aug. 11, 2021	Conducted (TH05-HY)
Switch Box & RF Cable	EM Electronics	EMSW18SE	SW191204	N/A	Jan. 13, 2020	Dec. 14, 2020	Jan. 12, 2021	Conducted (TH05-HY)
Hygrometer	Testo	HTC-1	2	N/A	Mar. 02, 2020	Dec. 14, 2020	Mar. 01, 2021	Conducted (TH05-HY)



5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence	6.2
of 95% (U = 2Uc(y))	6.3

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

Measuring Uncertainty for a Level of Confidence	4.7
of 95% (U = 2Uc(y))	4.7

Appendix A. Test Result of Conducted Test Items

Test Engineer:	Ching Chen	Temperature:	20.9~23.4	°C
Test Date:	2020/12/14	Relative Humidity:	54~57.7	%

TEST RESULTS DATA Peak Output Power

	2.4GHz Band Single Antenna															
Mod.			Freq. (MHz)	· Power			Po ^r Lii	Conducted Power DG Limit (dBi) (dBm)		EIRP Power (dBm)		EIRP Power Limit (dBm)		Pass /Fail		
					Ant1	Ant2	SUM	Ant1	Ant2	Ant1	Ant2	Ant1	Ant2	Ant1	Ant2	
11b	1Mbps	1	1	2412	18.06	-		30.00	-	1.20	-	19.26	-	36.00	-	Pass
11b	1Mbps	1	6	2437	17.75	-		30.00	-	1.20	-	18.95	-	36.00	-	Pass
11b	1Mbps	1	11	2462	17.56	-		30.00	-	1.20	-	18.76	-	36.00	-	Pass
11g	6Mbps	1	1	2412	22.51	-		30.00	-	1.20	-	23.71	-	36.00	-	Pass
11g	6Mbps	1	6	2437	22.63	-		30.00	-	1.20	-	23.83	-	36.00	-	Pass
11g	6Mbps	1	11	2462	22.53	-		30.00	-	1.20	-	23.73	-	36.00	-	Pass
HT20	MCS0	1	1	2412	19.14	-		30.00	-	1.20	-	20.34	-	36.00	-	Pass
HT20	MCS0	1	6	2437	19.29	-		30.00	-	1.20	-	20.49	-	36.00	-	Pass
HT20	MCS0	1	11	2462	19.12	-		30.00	-	1.20	-	20.32	-	36.00	-	Pass

TEST RESULTS DATA Average Output Power

	2.4GHz Band Single Antenna												
Mod.	Mod. Data Rate NTX		CH.	Freq. (MHz)	Conc	Average lucted Powe duty factor (dBm)	er		G Bi)	EIRP Power (dBm)			
				Ant1	Ant2	SUM	Ant1	Ant2	Ant1	Ant2			
11b	1Mbps	1	1	2412	15.88	-		1.20	-	17.08	-		
11b	1Mbps	1	6	2437	15.89	-		1.20	-	17.09	-		
11b	1Mbps	1	11	2462	15.37	-		1.20	-	16.57	-		
11g	6Mbps	1	1	2412	18.63	-		1.20	-	19.83	-		
11g	6Mbps	1	6	2437	18.79	-		1.20	-	19.99	-		
11g	6Mbps	1	11	2462	18.68	-		1.20	-	19.88	-		
HT20	MCS0	1	1	2412	14.64	-		1.20	-	15.84	-		
HT20	MCS0	1	6	2437	14.80	-		1.20	-	16.00	-		
HT20	MCS0	1	11	2462	14.66	-		1.20	-	15.86	-		



Appendix B. Radiated Spurious Emission

Toot Engineer	Andy Yang, Karl Hou and Caster Liao	Temperature :	20~25°C
Test Engineer :	Anuy Tany, Kan nou anu Caster Liau	Relative Humidity :	50~65%

2.4GHz 2400~2483.5MHz

WIFI Limit Read Antenna Preamp Table Peak Pol. Note Frequency Level Over Path Ant Ant. Limit Line Level Factor Loss Factor Pos Pos Avg. (dB) (dBµV/m) 1 (MHz) (dBµV/m) (dBµV) (dB/m) (dB) (dB) (cm) (deg) (P/A) (H/V) * 2462 102.52 --86.76 27.4 18.62 30.26 117 58 Ρ Н * 2462 99.38 83.62 27.4 -18.62 30.26 117 58 А Н -2491.32 57.09 -16.91 74 41.26 27.4 18.68 30.25 117 58 Ρ н 2486.48 44.61 -9.39 27.4 18.67 30.25 117 58 А Н 54 28.79 Н 802.11b Н CH 11 * 2462 102.7 86.94 27.4 18.62 30.26 100 98 Р V --2462MHz * 2462 99.53 --83.77 27.4 18.62 30.26 100 98 А V ٧ 2493.64 56.61 -17.39 74 40.78 27.4 18.68 30.25 100 98 Ρ V 30.25 100 А 2483.88 44.63 -9.37 54 28.82 27.4 18.66 98 V V No other spurious found. 1. Remark 2. All results are PASS against Peak and Average limit line.

WIFI 802.11b (Band Edge @ 3m)



WIFI Ant.	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos		Avg.	
1		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
		4924	50.81	-23.19	74	65.8	31.2	13.36	59.55	100	287	Ρ	Н
802.11b		4924	48.46	-5.54	54	63.45	31.2	13.36	59.55	100	287	А	н
		7386	43.67	-30.33	74	50.14	36.43	16.36	59.26	100	0	Р	Н
													Н
CH 11 2462MHz		4924	47.1	-26.9	74	62.09	31.2	13.36	59.55	100	0	Ρ	V
240211112		7386	43.63	-30.37	74	50.1	36.43	16.36	59.26	100	0	Ρ	V
		4924	47.1	-26.9	74	62.09	31.2	13.36	59.55	100	0	Р	V
													V
Remark		o other spurious results are PA		eak and	Average lim	it line.							

2.4GHz 2400~2483.5MHz WIFI 802.11b (Harmonic @ 3m)



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	Peak or Average							
H/V	Horizontal or Vertical							



A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	Р	н
CH 01													
2412MHz		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	А	н

- 1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
- 2. Level($dB\mu V/m$) =

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

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

For Peak Limit @ 2390MHz:

- 1. Level(dBµV/m)
- = Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBµV) Preamp Factor(dB)
- $= 32.22(dB/m) + 4.58(dB) + 54.51(dB\mu V) 35.86 (dB)$
- = 55.45 (dBµV/m)
- 2. Over Limit(dB)
- = Level(dBµV/m) Limit Line(dBµV/m)
- $= 55.45(dB\mu V/m) 74(dB\mu V/m)$
- = -18.55(dB)

For Average Limit @ 2390MHz:

- 1. Level(dBµV/m)
- = Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBµV) Preamp Factor(dB)
- $= 32.22(dB/m) + 4.58(dB) + 42.6(dB\mu V) 35.86 (dB)$
- = 43.54 (dBµV/m)
- 2. Over Limit(dB)
- = Level(dB μ V/m) Limit Line(dB μ V/m)
- $= 43.54(dB\mu V/m) 54(dB\mu V/m)$
- = -10.46(dB)

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



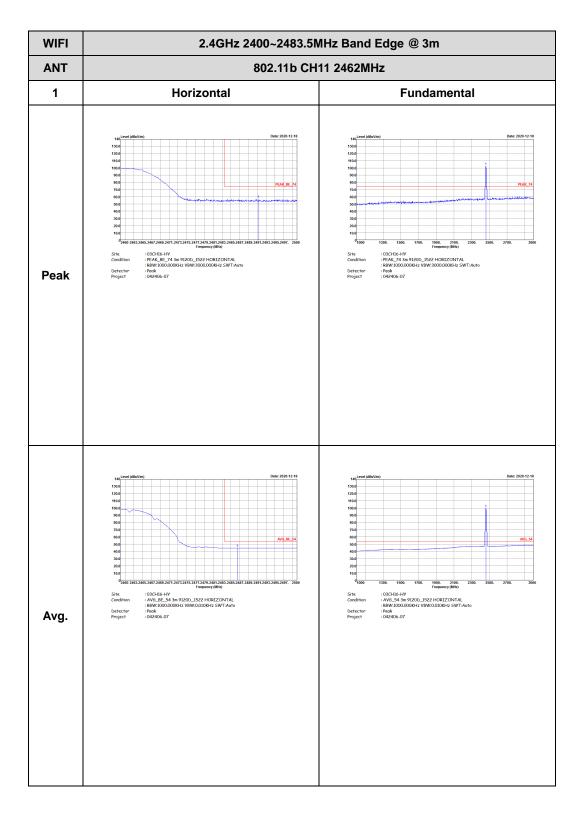
Appendix C. Radiated Spurious Emission Plots

Toot Engineer	Andy Yang, Karl Hou and Caster Liao	Temperature :	20~25°C
Test Engineer :	Andy Tang, Kan nou and Caster Liao	Relative Humidity :	50~65%

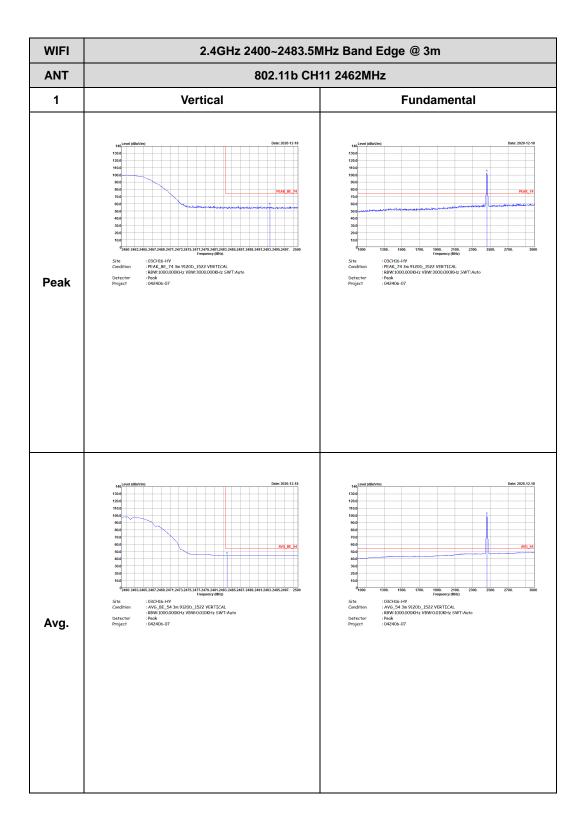


2.4GHz 2400~2483.5MHz

WIFI 802.11b (Band Edge @ 3m)



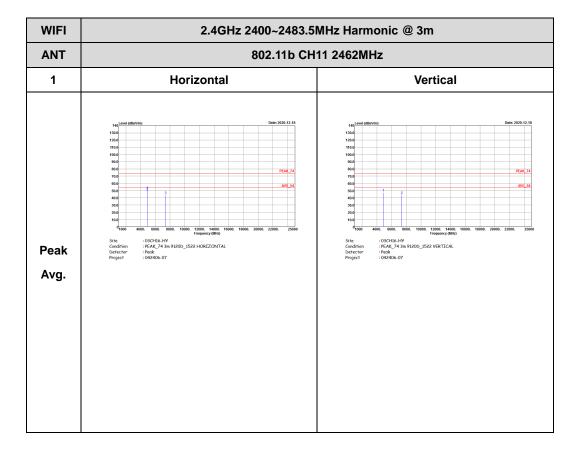






2.4GHz 2400~2483.5MHz

WIFI 802.11b (Harmonic @ 3m)





Appendix D. Duty Cycle Plots

Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting	Duty Factor(dB)	
802.11b	100.00	-	-	10Hz	0.00	

\$					Delta			
Ref 10	dBm	*Att 20 dB		10 MHz 5 ms		780.000	.12 dB 000 µs	
10						1.740	.76 dBm)00 ms	A
-10		1 ¥	-		Delta	2 [T1]	. 40 - 40 -	
-20								
-30								
a-40								308
-80								