FCC Co-Location Test Report

FCC ID	:	**2ACKD-WIM1200-20**
Equipment	:	**Wireless access point module**
Model No.	:	**WIM1200-20**
Brand Name	:	**SKSPRUCE**
Applicant	:	**SKSpruce Technologies Inc.**
Address	:	**1885 Lundy Ave. Suite 270, San Jose, CA, United States, 95131**
Standard	:	**47 CFR FCC Part 15.247 47 CFR FCC Part 15.407**
Received Date	:	**Nov. 07, 2016**
Tested Date	:	**Nov. 23 ~ Nov. 24, 2016**

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by:

Along Chen / Assistant Manager

Approved by:

Gary Chang / Manager

Testing Laboratory 2732

Table of Contents

1 GENERAL DESCRIPTION 5

1.1 Information 5
1.2 The Equipment List 7
1.3 Test Standards 8
1.4 Measurement Uncertainty 8

2 TEST CONFIGURATION 9

2.1 Testing Condition 9
2.2 The Worst Test Modes and Channel Details 9

3 TRANSMITTER TEST RESULTS 10

3.1 Unwanted Emissions into Restricted Frequency Bands 10

4 TEST LABORATORY INFORMATION 21

Release Record

Report No.	Version	Description	Issued Date
FR6N2101CO	Rev. 01	Initial issue	Dec. 13, 2016

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.247(d) 15.407(b) 15.209	Radiated Emissions	[dBuV/m at 3m]: 71.67MHz 38.99 (Margin -1.01dB) – QP	Pass

1 General Description

1.1 Information

5GHz Power amplifier component has 2 sources as below

Component	Brand	Model
5GHz Power amplifier	SKYWORKS	SK85726-11
5GHz Power amplifier	SKYWORKS	SK85712-11

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information					
Frequency Range (MHz)	**IEEE Std. 802.11**	**Ch. Freq. (MHz)**	**Channel Number**	**Transmit Chains (N_{TX})**	**Data Rate / MCS**
2400-2483.5	b	2412-2462	1-11 [11]	2	1-11 Mbps
2400-2483.5	g	2412-2462	1-11 [11]	2	6-54 Mbps
2400-2483.5	n (HT20)	2412-2462	1-11 [11]	2	MCS 0-15
2400-2483.5	n (HT40)	2422-2452	3-9 [7]	2	MCS 0-15
Note 1: RF output power specifies that Maximum Peak Conducted Output Power. Note 2: 802.11b uses a combination of DSSS-DBPSK, DQPSK, CCK modulation. Note 3: 802.11g/n uses a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM modulation.					

RF General Information					
Frequency Range (MHz)	**IEEE Std. 802.11**	**Ch. Freq. (MHz)**	**Channel Number**	**Transmit Chains (N_{TX})**	**Data Rate / MCS**
5150-5250	a	5180-5240	36-48 [4]	1	6-54 Mbps
5150-5250	n (HT20)	5180-5240	36-48 [4]	1	MCS 0-23
5150-5250	n (HT40)	5190-5230	38-46 [2]	1	MCS 0-23
5150-5250	ac (VHT20)	5180-5240	36-48 [4]	1	MCS 0-9
5150-5250	ac (VHT40)	5190-5230	38-46 [2]	1	MCS 0-9
5150-5250	ac (VHT80)	5210	42 [1]	1	MCS 0-9
Note 1: RF output power specifies that Maximum Conducted Output Power. Note 2: 802.11a/n/ac uses a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM, 256QAM modulation.					

RF General Information					
Frequency Range (MHz)	**IEEE Std. 802.11**	**Ch. Freq. (MHz)**	**Channel Number**	**Transmit Chains (N_{TX})**	**Data Rate / MCS**
5725-5850	a	5745-5825	149-165 [5]	1	6-54 Mbps
5725-5850	n (HT20)	5745-5825	149-165 [5]	1	MCS 0-23
5725-5850	n (HT40)	5755-5795	151-159 [2]	1	MCS 0-23
5725-5850	ac (VHT20)	5745-5825	149-165 [5]	1	MCS 0-9
5725-5850	ac (VHT40)	5755-5795	151-159 [2]	1	MCS 0-9
5725-5850	ac (VHT80)	5775	155 [1]	1	MCS 0-9
Note 1: RF output power specifies that Maximum Conducted Output Power. Note 2: 802.11a/n/ac uses a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM, 256QAM modulation.					

1.1.2 Antenna Details of Specific platform

Ant. No.	Brand	Model	Type	Gain (dBi)		Connector	Remark
				2.4GHz	5GHz		
1	ALPHA	AW3509-11	Dipole	2		UFL	---

1.1.3 Accessories of Specific platform

N/A

1.2 The Equipment List

Test Item	Radiated Emission				
Test Site	966 chamber1 / (03CH01-WS)				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101498	Dec. 13, 2015	Dec. 12, 2016
Receiver	R&S	ESR3	101657	Jan. 12, 2016	Jan. 11, 2017
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Aug. 04, 2016	Aug. 03, 2017
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 16, 2015	Dec. 15, 2016
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Oct. 25, 2016	Oct. 24, 2017
Preamplifier	EMC	EMC02325	980225	Aug. 05, 2016	Aug. 04, 2017
Preamplifier	Agilent	83017A	MY39501308	Oct. 06, 2016	Oct. 05, 2017
Preamplifier	EMC	EMC184045B	980192	Aug. 24, 2016	Aug. 23, 2017
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 10, 2016	Nov. 09, 2017
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Dec. 10, 2015	Dec. 09, 2016
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16014/4	Dec. 10, 2015	Dec. 09, 2016
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Dec. 10, 2015	Dec. 09, 2016
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16139/4	Dec. 10, 2015	Dec. 09, 2016
LF cable 1M	EMC	EMCCFD400-NM-NM-1000	16052	Dec. 10, 2015	Dec. 09, 2016
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Dec. 10, 2015	Dec. 09, 2016
LF cable 10M	Woken	CFD400NL-LW	CFD400NL-002	Dec. 10, 2015	Dec. 09, 2016
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

1.3 Test Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

47 CFR FCC Part 15.247
47 CFR FCC Part 15.407
ANSI C63.10-2013
FCC KDB 558074 D01 DTS Meas Guidance v03r05
FCC KDB 662911 D01 Multiple Transmitter Output v02r01
FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r03
FCC KDB 644545 D03 Guidance for IEEE 802 11ac New Rules v01
FCC KDB 412172 D01 Determining ERP and EIRP v01r01

1.4 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Measurement Uncertainty	
Parameters	**Uncertainty**
Radiated emission ≤ 1GHz	±3.66 dB
Radiated emission > 1GHz	±5.63 dB

2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
Radiated Emissions	03CH01-WS	22-23°C / 62-63%	Vincent Yeh Kevin Lee

- FCC site registration No.: 181692
- IC site registration No.: 10807A-1

2.2 The Worst Test Modes and Channel Details

Test item	Modulation Mode	Test Channel	Data Rate	Test Configuration
Radiated Emissions	2.4GHz 11n HT40 + 5GHz 11ac VHT20 2.4GHz 11n HT40 + 5GHz 11a	CH06 + CH40 CH06 + CH48	MCS 0 + MCS 0 MCS 0 + 6Mbps	1 2

NOTE:

1. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **Z-plane** results were found as the worst case and were shown in this report.
2. The test configurations are listed as follows:

   Configuration 1: Power amplifier / SK85726-11
   Configuration 2: Power amplifier / SK85712-11

3 Transmitter Test Results

3.1 Unwanted Emissions into Restricted Frequency Bands

3.1.1 Limit of Unwanted Emissions into Restricted Frequency Bands

Restricted Band Emissions Limit			
Frequency Range (MHz)	**Field Strength (uV/m)**	**Field Strength (dBuV/m)**	**Measure Distance (m)**
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:
Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit
Note 2:
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

3.1.2 Test Procedures

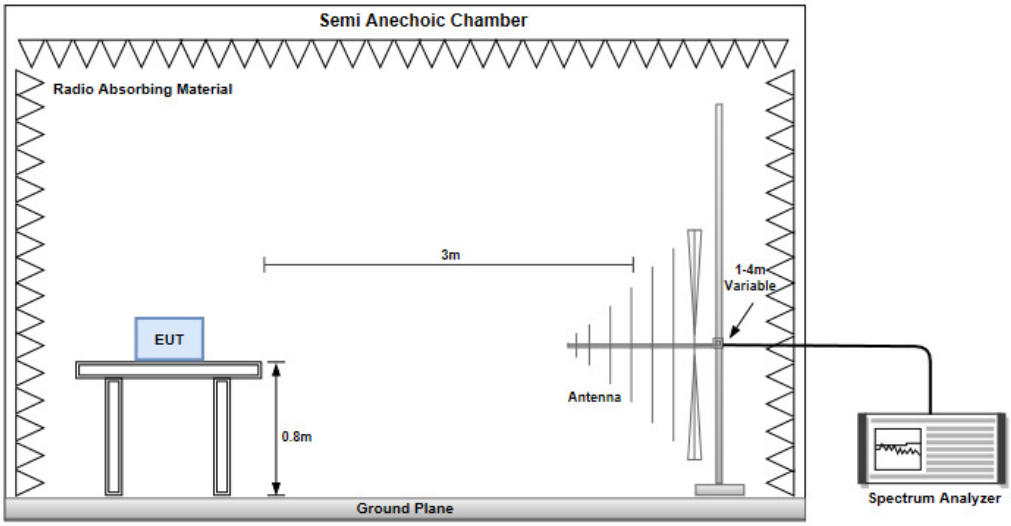
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m.
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

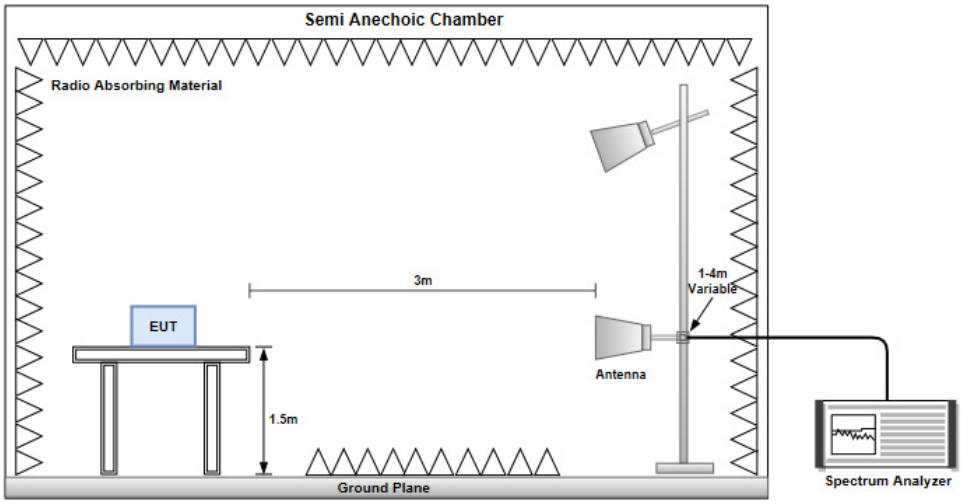
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above 1GHz.

3.1.3 Test Setup

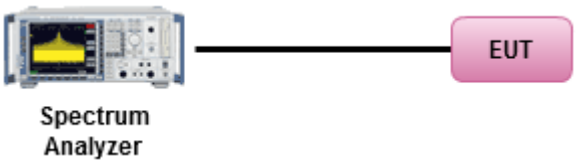
Radiated Emissions below 1 GHz



Radiated Emissions above 1 GHz



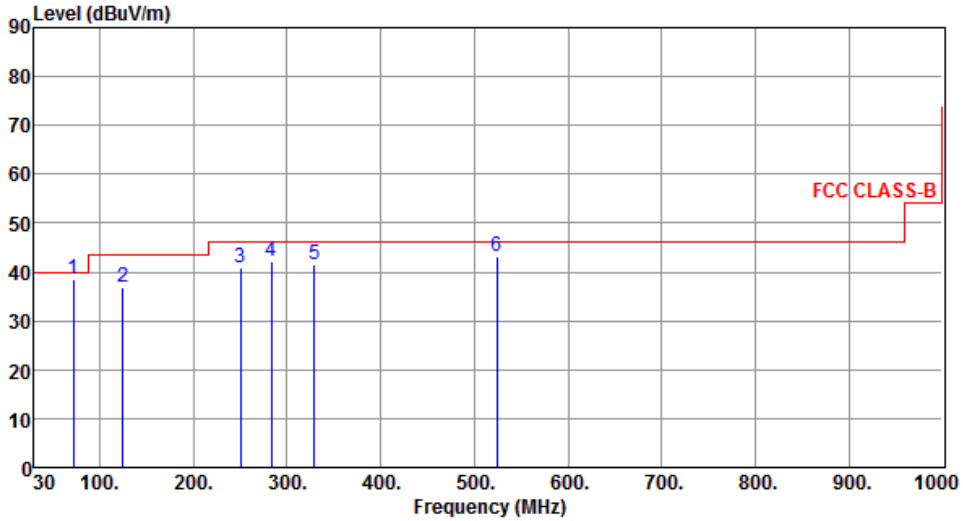
Transmitter Conducted Unwanted Emissions (30MHz~40GHz)



Configuration 1: Power amplifier / SK85726-11

3.1.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)

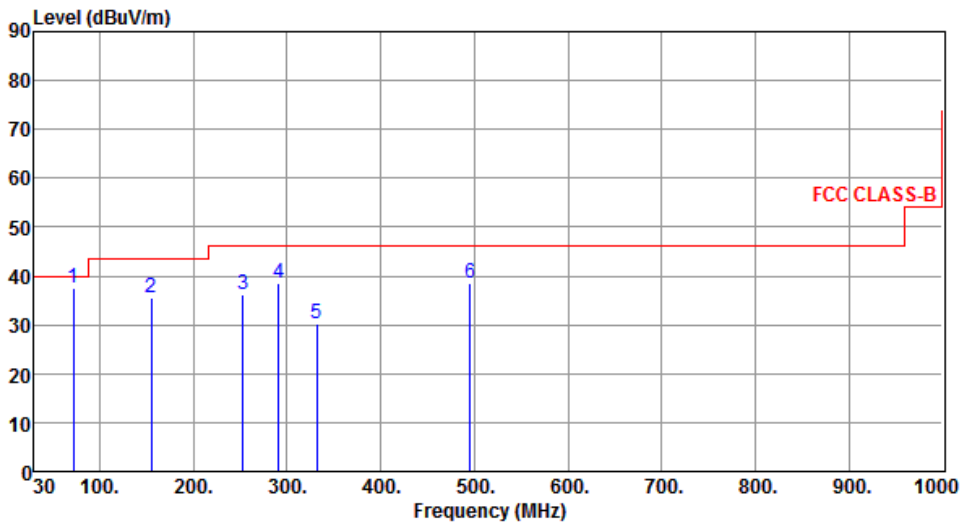
Modulation	2.4GHz 11n HT40 + 5GHz 11ac VHT20	**Test Channel**	CH06 + CH40
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	72.20	38.43	40.00	-1.57	49.48	-11.05	QP	150	306
2	125.15	36.70	43.50	-6.80	46.29	-9.59	Peak	---	---
3	250.45	40.83	46.00	-5.17	50.02	-9.19	Peak	---	---
4	283.20	42.27	46.00	-3.73	50.14	-7.87	Peak	---	---
5	329.57	41.48	46.00	-4.52	48.26	-6.78	Peak	---	---
6	524.34	43.13	46.00	-2.87	45.51	-2.38	QP	100	185

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation	2.4GHz 11n HT40 + 5GHz 11ac VHT20	Test Channel	CH06 + CH40
Polarization	Vertical		

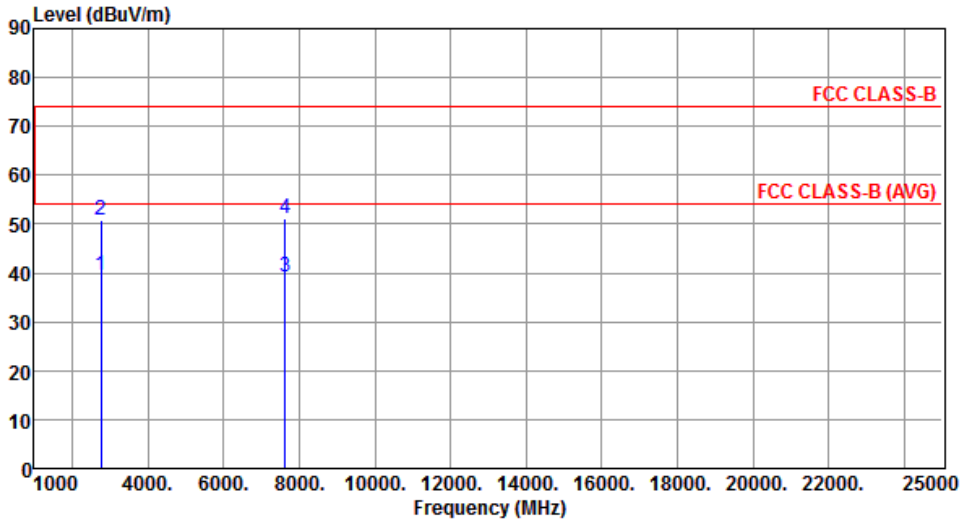


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	72.20	37.60	40.00	-2.40	48.65	-11.05	Peak	---	---
2	155.14	35.55	43.50	-7.95	43.77	-8.22	Peak	---	---
3	253.17	36.10	46.00	-9.90	45.23	-9.13	Peak	---	---
4	291.00	38.42	46.00	-7.58	46.13	-7.71	Peak	---	---
5	331.47	30.12	46.00	-15.88	36.85	-6.73	Peak	---	---
6	495.41	38.41	46.00	-7.59	41.35	-2.94	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

3.1.5 Transmitter Radiated Unwanted Emissions (Above 1GHz)

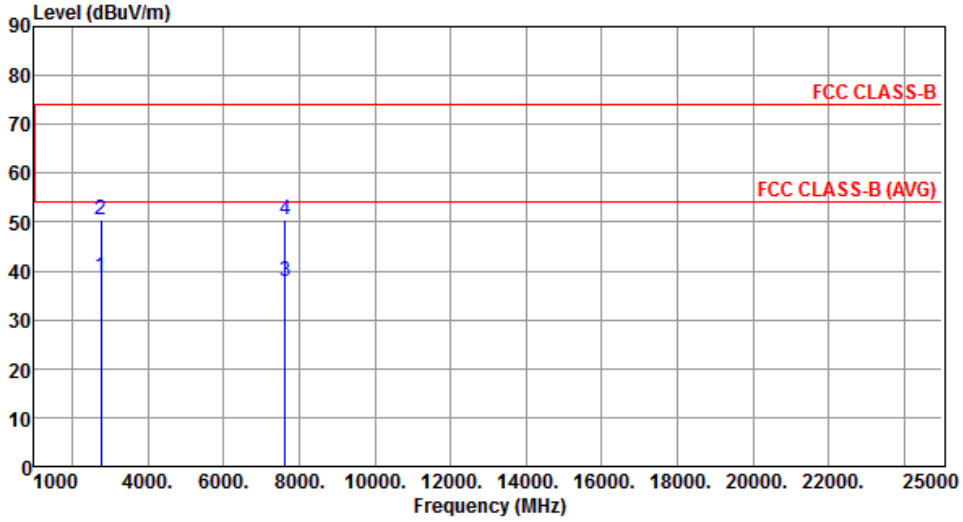
Modulation	2.4GHz 11n HT40 + 5GHz 11ac VHT20	**Test Channel**	CH06 + CH40
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2763.00	39.43	54.00	-14.57	41.35	-1.92	Average	155	221
2	2763.00	50.93	74.00	-23.07	52.85	-1.92	Peak	155	221
3	7637.00	39.06	54.00	-14.94	30.18	8.88	Average	166	195
4	7637.00	51.08	74.00	-22.92	42.20	8.88	Peak	166	195

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	2.4GHz 11n HT40 + 5GHz 11ac VHT20	Test Channel	CH06 + CH40
Polarization	Vertical		



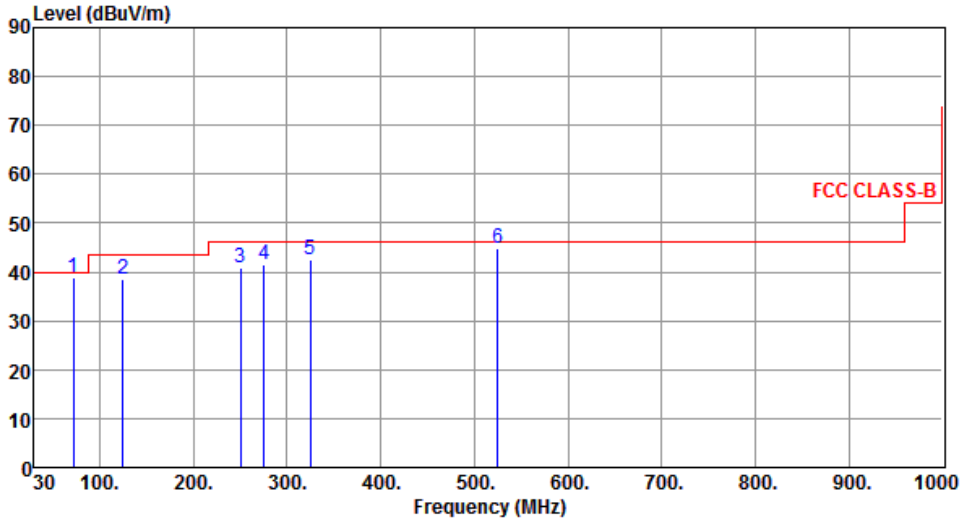
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2763.00	38.97	54.00	-15.03	40.89	-1.92	Average	166	172
2	2763.00	50.57	74.00	-23.43	52.49	-1.92	Peak	166	172
3	7637.00	37.78	54.00	-16.22	28.90	8.88	Average	129	111
4	7637.00	50.58	74.00	-23.42	41.70	8.88	Peak	129	111

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Configuration 2 : Power amplifier / SK85712-11

3.1.6 Transmitter Radiated Unwanted Emissions (Below 1GHz)

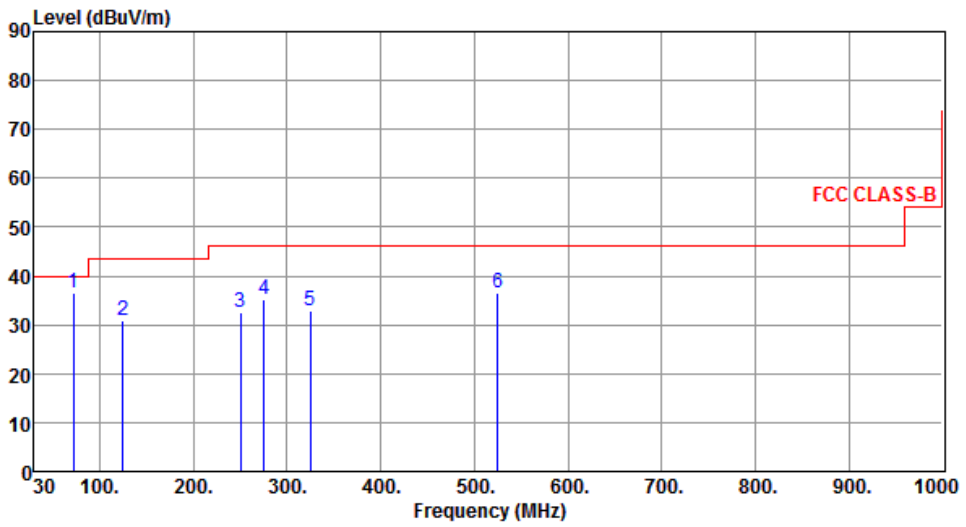
Modulation	2.4GHz 11n HT40 + 5GHz 11a	**Test Channel**	CH06 + CH48
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	71.67	38.99	40.00	-1.01	49.94	-10.95	QP	154	311
2	125.06	38.67	43.50	-4.83	48.27	-9.60	Peak	---	---
3	250.19	41.00	46.00	-5.00	50.20	-9.20	Peak	---	---
4	275.41	41.52	46.00	-4.48	49.65	-8.13	Peak	---	---
5	324.88	42.65	46.00	-3.35	49.54	-6.89	Peak	---	---
6	524.70	44.98	46.00	-1.02	47.36	-2.38	QP	106	221

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation	2.4GHz 11n HT40 + 5GHz 11a	Test Channel	CH06 + CH48
Polarization	Vertical		

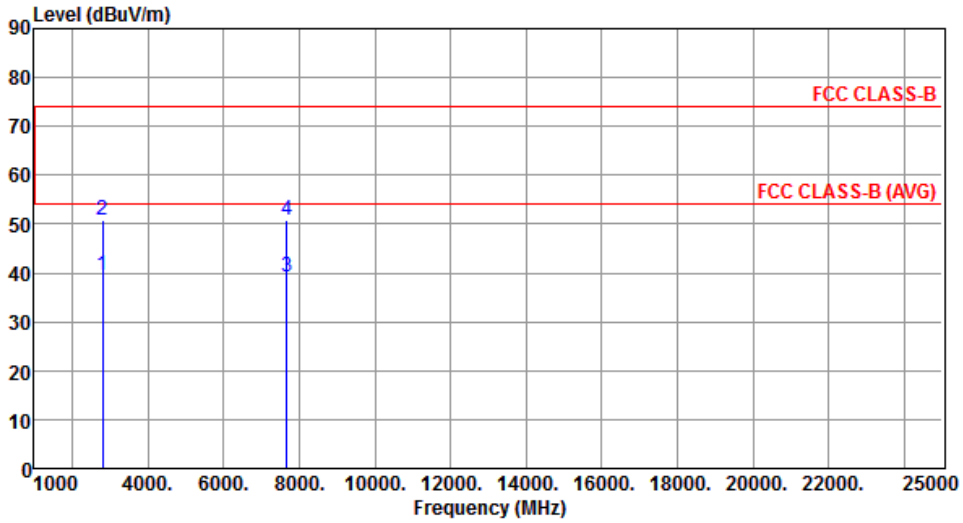


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	71.71	36.40	40.00	-3.60	47.35	-10.95	Peak	---	---
2	125.06	30.81	43.50	-12.69	40.41	-9.60	Peak	---	---
3	250.19	32.48	46.00	-13.52	41.68	-9.20	Peak	---	---
4	275.41	35.06	46.00	-10.94	43.19	-8.13	Peak	---	---
5	324.88	32.80	46.00	-13.20	39.69	-6.89	Peak	---	---
6	524.70	36.44	46.00	-9.56	38.82	-2.38	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

3.1.7 Transmitter Radiated Unwanted Emissions (Above 1GHz)

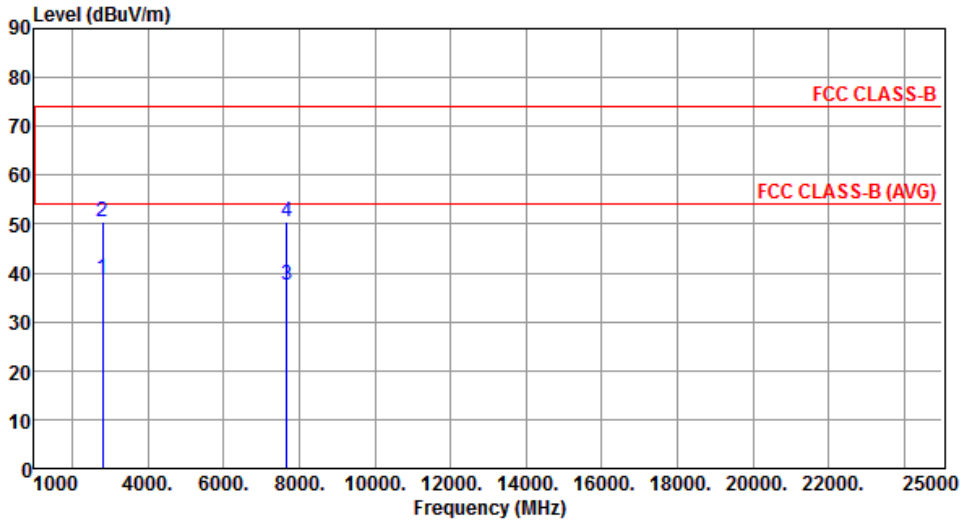
Modulation	2.4GHz 11n HT40 + 5GHz 11a	**Test Channel**	CH06 + CH48
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2803.00	39.44	54.00	-14.56	41.22	-1.78	Average	141	213
2	2803.00	50.94	74.00	-23.06	52.72	-1.78	Peak	141	213
3	7677.00	39.03	54.00	-14.97	30.18	8.85	Average	153	182
4	7677.00	50.82	74.00	-23.18	41.97	8.85	Peak	153	182

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	2.4GHz 11n HT40 + 5GHz 11a	Test Channel	CH06 + CH48
Polarization	Vertical		

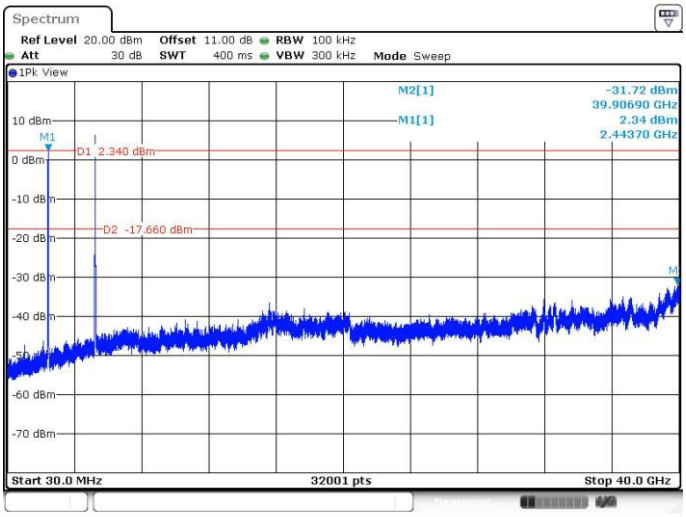


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2803.00	38.97	54.00	-15.03	40.75	-1.78	Average	147	189
2	2803.00	50.60	74.00	-23.40	52.38	-1.78	Peak	147	189
3	7677.00	37.54	54.00	-16.46	28.69	8.85	Average	126	83
4	7677.00	50.40	74.00	-23.60	41.55	8.85	Peak	126	83

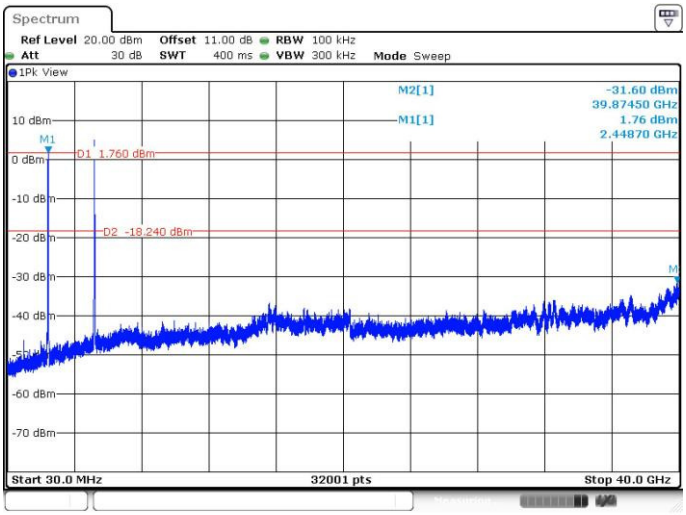
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.1.8 Conducted Emissions (30MHz~40GHz)

Configuration 1: Power amplifier / SK85726-11

Conducted Emission Plot


Configuration 2: Power amplifier / SK85712-11

Conducted Emission Plot


4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website http://www.icertifi.com.tw.

Linkou	**Kwei Shan**	**Kwei Shan Site II**
Tel: 886-2-2601-1640	Tel: 886-3-271-8666	Tel: 886-3-271-8640
No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan, R.O.C.	No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.	No. 14-1, Lane 19, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C..

If you have any suggestion, please feel free to contact us as below information

Tel: 886-3-271-8666
Fax: 886-3-318-0155
Email: ICC_Service@icertifi.com.tw

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