

FCC Co-Location Test Report

FCC ID : I88WAX650S
Equipment : 802.11ax (WiFi 6) Dual-Radio Unified Pro
Access Point
Model No. : WAX650S
Brand Name : ZYXEL
Applicant : Zyxel Communications Corporation
Address : No.2 Industry East RD. IX, Hsinchu Science
Park, Hsinchu 30075, Taiwan, R.O.C
Standard : 47 CFR FCC Part 15.247
47 CFR FCC Part 15.407
Received Date : Aug. 01, 2019
Tested Date : Aug. 15 ~ Aug. 26, 2019

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



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Release Record

Report No.	Version	Description	Issued Date
FR980101CO	Rev. 01	Initial issue	Nov. 05, 2019

Summary of Test Results

NCC Rules	Test Items	Measured	Result
15.247(d) 15.407(b) 15.209	Radiated Emissions	[dBuV/m at 3m]: 42.61MHz 36.41 (Margin -3.59dB) - PK	Pass

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.

1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

WLAN	
Operating Frequency	802.11b/g/n: 2412 MHz ~ 2462 MHz 802.11a/n/ac: 5180 MHz ~ 5240 MHz; 5745 ~ 5825 MHz
Modulation Type	802.11b: DSSS (DBPSK / DQPSK / CCK) 802.11a/g/n/ac/ax: BPSK / QPSK / 16QAM / 64QAM / 256QAM / 1024 QAM
BT	
Operating Frequency	2402 MHz ~ 2480 MHz
Modulaton Type	Bluetooth 4.2 LE: GFSK

1.1.2 Radio Details

Radio	Function
1	Wi-Fi 2.4GHz, 4T4R
2	Wi-Fi 5GHz, 4T4R
3	Wi-Fi 2.4GHz & 5GHz, RX only
4	Bluetooth LE only

1.1.3 Antenna Details

For Wi-Fi, Radio 1 / 2

Ant. No.	Model	Type	Connector	Operating Frequencies (MHz) / Antenna Gain (dBi)				
				2400~2483.5	5150~5250	5250~5350	5470~5725	5725~5850
1	AD442 R1.3	PIFA	lpex	0	3.51	4.22	4.61	4.68
2	AD442 R1.3	PIFA	lpex	0	3.51	4.22	4.61	4.68
3	AD442 R1.3	PIFA	lpex	0	3.51	4.22	4.61	4.68
4	AD442 R1.3	PIFA	lpex	0	3.51	4.22	4.61	4.68

For Wi-Fi, Radio 3

Ant. No.	Model	Type	Connector	Operating Frequencies (MHz) / Antenna Gain (dBi)				
				2400~2483.5	5150~5250	5250~5350	5470~5725	5725~5850
1	AD442 R1.3	PIFA	lpex	5.7	6.9			
2	AD442 R1.3	PIFA	lpex	5.7	6.9			

For Bluetooth, Radio 4

Ant. No.	Type	Connector	Gain (dBi)	Remarks
1	Dipole	UFL	4.7	---

1.2 The Equipment List

Test Item	Radiated Emission				
Test Site	966 chamber 3 / (03CH03-WS)				
Tested Date	Aug. 15 ~ Aug. 26, 2019				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101499	Jan. 07, 2019	Jan. 06, 2020
Receiver	R&S	ESR3	101658	Dec. 11, 2018	Dec. 10, 2019
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-685	Apr. 17, 2019	Apr. 16, 2020
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1206	Jan. 07, 2019	Jan. 06, 2020
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 15, 2018	Nov. 14, 2019
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 09, 2018	Nov. 08, 2019
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 08, 2018	Oct. 07, 2019
Preamplifier	EMC	EMC02325	980187	Aug. 14, 2019	Aug. 13, 2020
Preamplifier	Agilent	83017A	MY53270014	Aug. 07, 2019	Aug. 06, 2020
Preamplifier	EMC	EMC184045B	980192	Aug. 01, 2019	Jul. 31, 2020
RF cable-3M	HUBER+SUHNER	SUCOFLEX104	MY22620/4	Oct. 01, 2018	Sep. 30, 2019
RF cable-8M	EMC	EMC104-SM-SM-80 00	181107	Oct. 01, 2018	Sep. 30, 2019
RF cable-1M	HUBER+SUHNER	SUCOFLEX104	MY22624/4	Oct. 01, 2018	Sep. 30, 2019
LF cable-0.8M	EMC	EMC8D-NM-NM-800	EMC8D-NM-NM-800 -001	Oct. 01, 2018	Sep. 30, 2019
LF cable-3M	EMC	EMC8D-NM-NM-300 0	131103	Oct. 01, 2018	Sep. 30, 2019
LF cable-13M	EMC	EMC8D-NM-NM-130 00	131104	Oct. 01, 2018	Sep. 30, 2019
Measurement Software	SENSE-15247_DTS	V5.9	--	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 15.247 Meas Guidance v05r02

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01

FCC KDB 412172 D01 Determining ERP and EIRP v01r01

1.4 Deviation from Test Standard and Measurement Procedure

None

1.5 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 \leq 1GHz	± 3.96 dB
Radiated emission $>$ 1GHz	± 4.51 dB

2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
Radiated Emissions	03CH03-WS	24-25°C / 63-64%	Roger Lu Brad Wu

- FCC Designation No.: TW0009
- FCC site registration No.: 207696
- ISSED#: 10807A
- CAB identifier: TW2732

2.2 The Worst Test Modes and Channel Details

Test item	Modulation Mode	Test Channel	Data Rate	Test Configuration
Radiated Emissions ≤1GHz	2.4GHz 11g + 5GHz 11a + BLE	CH6 + CH149 + CH0	6 Mbps + 6 Mbps+ 1 Mbps	1, 2
Radiated Emissions >1GHz				1

NOTE:

1. The selected channel is the maximum power channel of Wi-Fi mode + BT mode
2. 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.
3. The EUT had been tested by following test configurations.
 - 1) Configuration 1: Adapter mode
 - 2) Configuration 2: POE mode

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

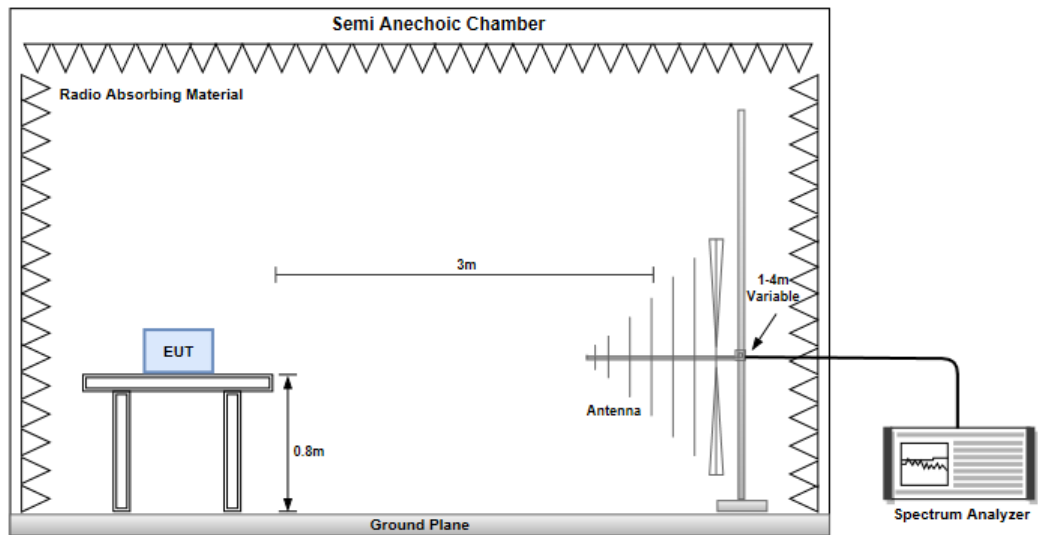
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission 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:

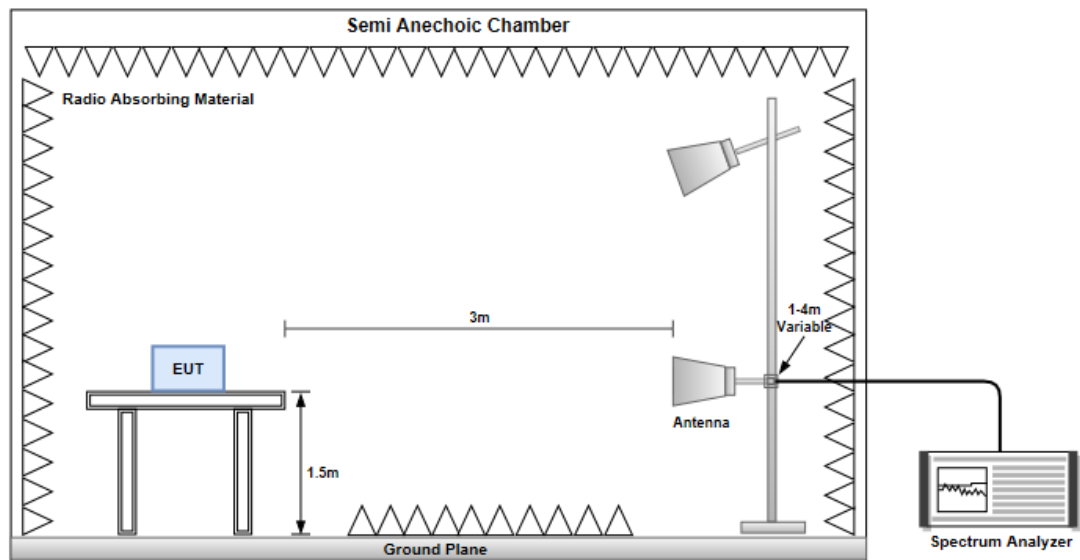
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above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

3.1.3 Test Setup

Radiated Emissions below 1 GHz

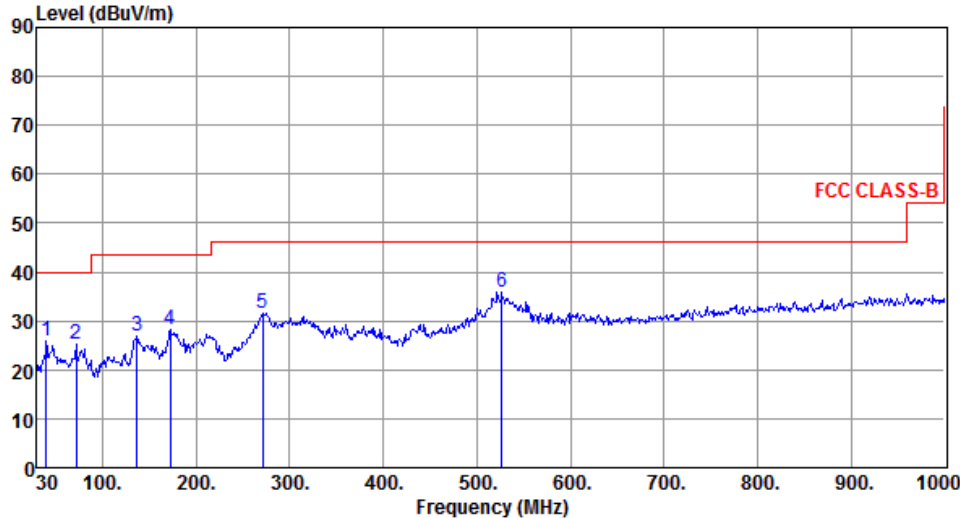


Radiated Emissions above 1 GHz



3.1.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)

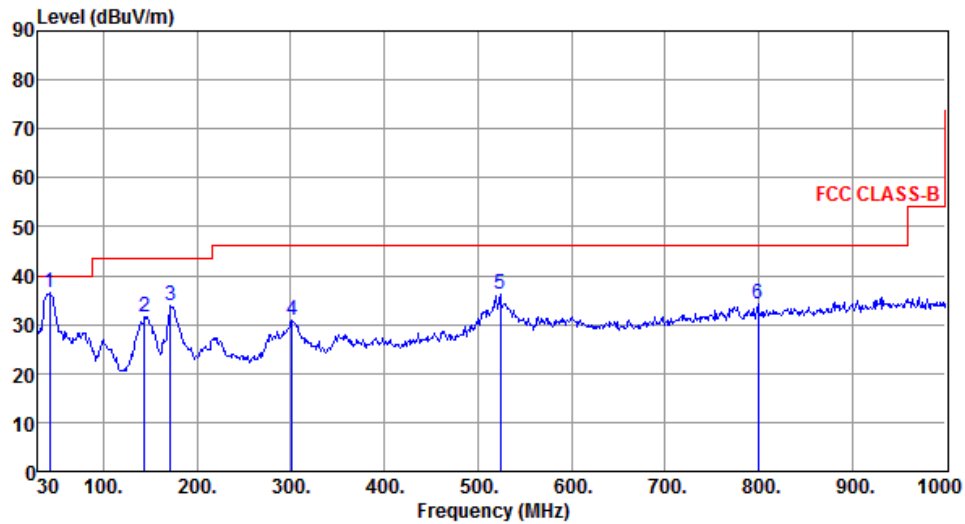
Modulation	2.4GHz 11g + 5GHz 11a + BLE	Test Channel	CH6 + CH149 + CH0
Polarization	Horizontal	Test Configuration	1



	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	39.70	25.90	40.00	-14.10	35.26	-9.36	Peak	---	---
2	71.71	25.30	40.00	-14.70	36.27	-10.97	Peak	---	---
3	136.70	26.80	43.50	-16.70	36.35	-9.55	Peak	---	---
4	172.59	28.07	43.50	-15.43	37.41	-9.34	Peak	---	---
5	271.53	31.40	46.00	-14.60	40.59	-9.19	Peak	---	---
6	526.64	35.75	46.00	-10.25	38.33	-2.58	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.

Modulation	2.4GHz 11g + 5GHz 11a + BLE	Test Channel	CH6 + CH149 + CH0
Polarization	Vertical	Test Configuration	1



	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	42.61	36.41	40.00	-3.59	45.39	-8.98	Peak	---	---
2	143.49	31.71	43.50	-11.79	40.66	-8.95	Peak	---	---
3	171.62	33.74	43.50	-9.76	42.98	-9.24	Peak	---	---
4	301.60	30.83	46.00	-15.17	39.11	-8.28	Peak	---	---
5	523.73	36.16	46.00	-9.84	38.77	-2.61	Peak	---	---
6	799.21	34.21	46.00	-11.79	31.52	2.69	Peak	---	---

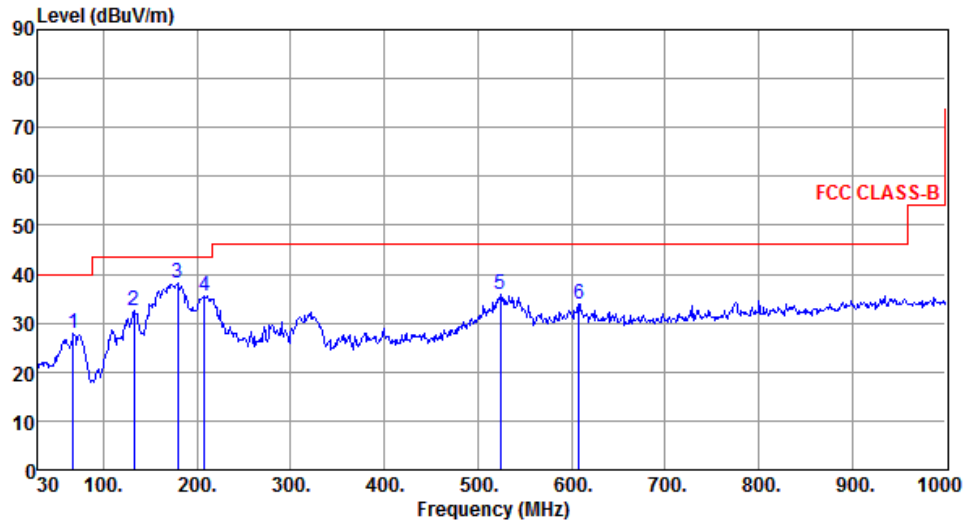
Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)

*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.

Modulation	2.4GHz 11g + 5GHz 11a + BLE	Test Channel	CH6 + CH149 + CH0
Polarization	Horizontal	Test Configuration	2



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	67.83	27.90	40.00	-12.10	38.21	-10.31	Peak	---	---
2	132.82	32.45	43.50	-11.05	42.39	-9.94	Peak	---	---
3	179.38	38.14	43.50	-5.36	48.31	-10.17	Peak	---	---
4	207.51	35.67	43.50	-7.83	47.70	-12.03	Peak	---	---
5	523.73	35.72	46.00	-10.28	38.33	-2.61	Peak	---	---
6	608.12	34.04	46.00	-11.96	34.49	-0.45	Peak	---	---

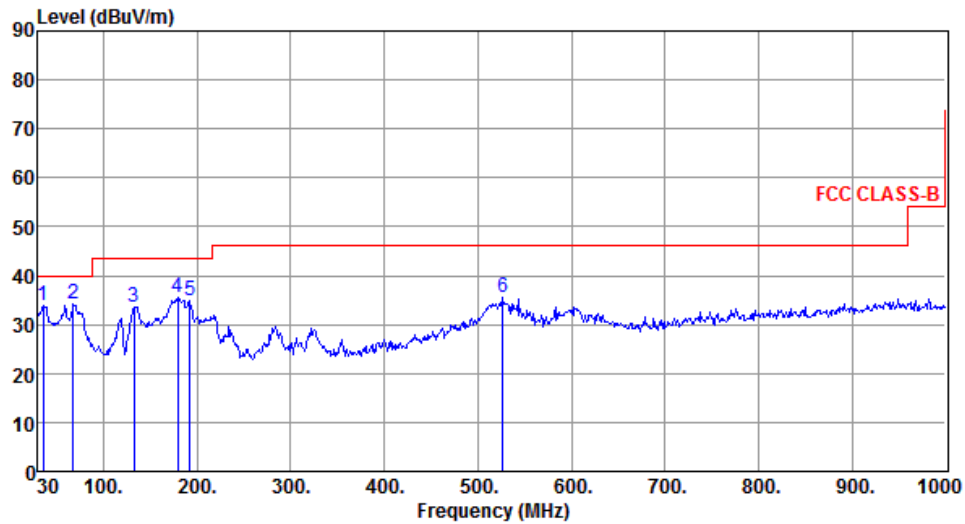
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*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.

Modulation	2.4GHz 11g + 5GHz 11a + BLE	Test Channel	CH6 + CH149 + CH0
Polarization	Vertical	Test Configuration	2



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	35.82	33.75	40.00	-6.25	43.57	-9.82	Peak	---	---
2	67.83	34.12	40.00	-5.88	44.43	-10.31	Peak	---	---
3	132.82	33.57	43.50	-9.93	43.51	-9.94	Peak	---	---
4	179.38	35.62	43.50	-7.88	45.79	-10.17	Peak	---	---
5	191.99	34.99	43.50	-8.51	46.48	-11.49	Peak	---	---
6	526.64	35.37	46.00	-10.63	37.95	-2.58	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

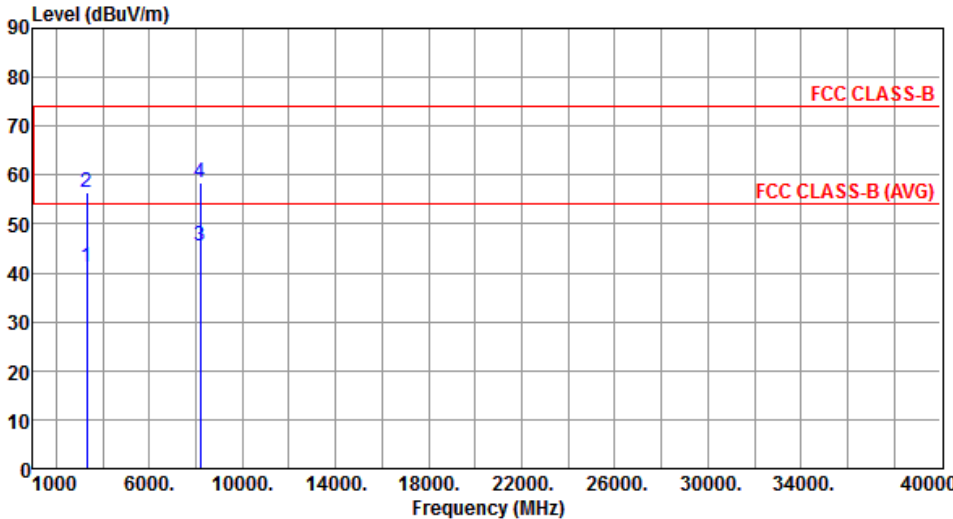
*Factor includes antenna factor , cable loss and amplifier gain

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)

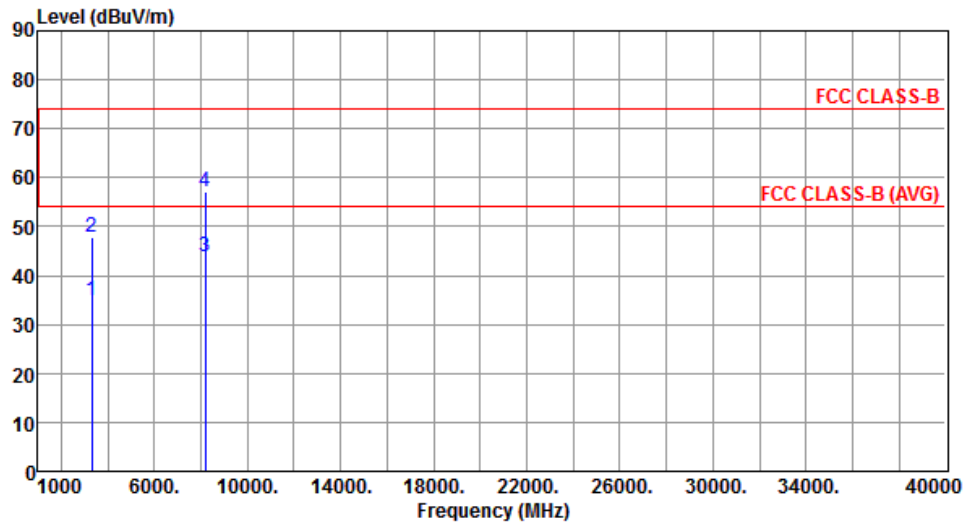
Modulation	2.4GHz 11g + 5GHz 11a + BLE	Test Channel	CH6 + CH149 + CH0
Polarization	Horizontal	Test Configuration	1



	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3308.00	41.13	54.00	-12.87	38.91	2.22	Average	203	64
2	3308.00	56.32	74.00	-17.68	54.10	2.22	Peak	203	64
3	8182.00	45.52	54.00	-8.48	32.88	12.64	Average	172	36
4	8182.00	58.38	74.00	-15.62	45.74	12.64	Peak	172	36

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 11g + 5GHz 11a + BLE	Test Channel	CH6 + CH149 + CH0
Polarization	Vertical	Test Configuration	1



	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3308.00	34.85	54.00	-19.15	32.63	2.22	Average	270	351
2	3308.00	47.89	74.00	-26.11	45.67	2.22	Peak	270	351
3	8182.00	43.74	54.00	-10.26	31.10	12.64	Average	138	14
4	8182.00	57.28	74.00	-16.72	44.64	12.64	Peak	138	14

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).

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>.

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Kou District, New Taipei City,
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Kwei Shan

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Kwei Shan District, Tao Yuan City
333, Taiwan, R.O.C.

Kwei Shan Site II

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No. 14-1, Lane 19, Wen San 3rd
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