

Radio Exposure Evaluation Report

FCC ID : RX3-WBU058LGA
Equipment : IEEE 802.11 a/b/g/n/ac/ax 2x2+Bluetooth v5.2 Wireless Adapter
Brand Name : Foxconn
Model Name : WBU058-LGA
Applicant : Hon Hai Precision Industry Co., Ltd.
No.151, Sec. 1, Nankan Rd., Lujhu Dist., Taoyuan City 33859, Taiwan
Manufacturer : Hon Hai Precision Industry Co., Ltd.
No.151, Sec. 1, Nankan Rd., Lujhu Dist., Taoyuan City 33859, Taiwan
Standard : 47 CFR FCC Part 2 Subpart J, section 2.1091

The product was received on Sep. 24, 2021, and testing was started from Oct. 04, 2021 and completed on Mar. 16, 2022. We, SPORTON INTERNATIONAL INC. Hsinhua Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in 47 CFR FCC Part 2 Subpart J, section 2.1091 and shown compliance with the applicable technical standards.

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


Approved by: Jackson Tsai

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Photographs of EUT V01



Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
2	-	Exposure evaluation	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:

None

Reviewed by: Ben Tseng

Report Producer: Ann Hou

1 General Description

1.1 Information

1.1.1 EUT General Information

RF General Information			
Evaluation Mode	Frequency Range (MHz)	Operating Frequency (MHz)	Modulation Type
2.4GHz WLAN	2400-2483.5	2412-2462	802.11b: DSSS (DBPSK, DQPSK, CCK) 802.11g/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
5GHz WLAN	5150-5250 5250-5350 5470-5725 5725-5850	5180-5240 5260-5320 5500-5720 5745-5825	802.11a/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
Bluetooth	2400-2483.5	2402-2480	BR / EDR: FHSS (GFSK / $\pi/4$ -DQPSK / 8DPSK) LE: DSSS (GFSK)
6GHz WLAN	5925 ~ 7125	5955 ~ 7115 5965 ~ 7085 5985 ~ 7025	802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)

1.1.2 Antenna Information

Group	Ant.	Brand	Model Name	Antenna Type	Connector	Remark
A	1	Foxconn	79012F500-600-G	PIFA	I-PEX	WiFi
	2	Foxconn	79012F500-600-G	PIFA	I-PEX	
B	3	Foxconn	79012F300-600-G	PIFA	I-PEX	WiFi
	4	Foxconn	79012F300-600-G	PIFA	I-PEX	
C	5	Foxconn	79012F400-600-G	PIFA	I-PEX	WiFi
	6	Foxconn	79012F400-600-G	PIFA	I-PEX	
D	7	Foxconn	79012F200-600-G	PIFA	I-PEX	BT
	8	Foxconn	79012F200-600-G	PIFA	I-PEX	
E	9	Foxconn	79012F700-600-G	PIFA	I-PEX	BT
	10	Foxconn	79012F700-600-G	PIFA	I-PEX	
F	11	Foxconn	79012F600-600-G	PIFA	I-PEX	BT
	12	Foxconn	79012F600-600-G	PIFA	I-PEX	

Ant.	Port	Gain (dBi)					
		2.4G	UNII-1	UNII-2A	UNII-2C	UNII-3	BT
1	1	1.62	3.22	3.22	3.58	3.39	-
2	2	1.62	3.22	3.22	3.58	3.39	-
3	1	-0.73	1.83	1.83	2.56	2.45	-
4	2	-0.73	1.83	1.83	2.56	2.45	-
5	1	0.51	2.32	2.32	2.21	2.07	-
6	2	0.51	2.32	2.32	2.21	2.07	-
7	1	-	-	-	-	-	0.09
8	2	-	-	-	-	-	0.09
9	1	-	-	-	-	-	0.78
10	2	-	-	-	-	-	0.78
11	1	-	-	-	-	-	-0.02
12	2	-	-	-	-	-	-0.02

Ant.	Port	Gain (dBi)			
		5925-6425 MHz	6425-6525 MHz	6525-6875 MHz	6875-7125 MHz
1	1	4.34	3.52	4.59	4.95
2	2	4.34	3.52	4.59	4.95
3	1	2.54	2.44	3.35	2.57
4	2	2.54	2.44	3.35	2.57
5	1	3.53	3.21	3.91	4.18
6	2	3.53	3.21	3.91	4.18

Note 1: The EUT has twelve antennas.

Note 2: EUT can match with above antennas for using. Higher gain (Group A and Group E) in each group of antenna was used to perform the worst configuration and result of that was recorded as the final test result.

For 2.4GHz function:

For IEEE 802.11 b/g/n/ax mode (2TX/2RX)

Port 1 and port 2 could transmit/receive simultaneously.

For BT function:

For IEEE 802.15.1 Bluetooth mode (1TX/1RX)

Support diversity function and pre-tested on each single chain, the worst case was Ant. 9(port 1) and it was recorded in this test report.

For 5GHz function:

For IEEE 802.11 a/n/ac/ax mode (2TX/2RX)

Port 1 and port 2 could transmit/receive simultaneously.

For 6GHz function:

For IEEE 802.11 ax mode (2TX/2RX)

Port 1 and port 2 could transmit/receive simultaneously.

Note3: Directional gain information

	Maximum Output Power	Power Spectral Density
Non-BF	Directional gain = Max.gain + array gain. For power measurements on IEEE 802.11 devices Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$	$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$
BF	$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$	$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$

Ex.

Directional gain(NSS1) formula :

$$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$$

$$NSS1(g1,1) = 10^{G1/20} ; NSS1(g1,2) = 10^{G2/20} ; g_{j,k} = (NSS1(g1,1) + NSS1(g1,2))^2$$

$$DG = 10 \log[(NSS1(g1,1) + NSS1(g1,2))^2 / N_{ANT}] \Rightarrow 10 \log[(10^{G1/20} + 10^{G2/20})^2 / N_{ANT}]$$

$$5925-6425MHz DG = 10 \log[(10^{4.34/20} + 10^{4.34/20})^2 / N_{ANT}] = 7.35 \text{ dBi}$$

$$6425-6525MHz DG = 10 \log[(10^{3.52/20} + 10^{3.52/20})^2 / N_{ANT}] = 6.53 \text{ dBi}$$

$$6525-6875MHz DG = 10 \log[(10^{4.59/20} + 10^{4.59/20})^2 / N_{ANT}] = 7.60 \text{ dBi}$$

$$6875-7125MHz DG = 10 \log[(10^{4.95/20} + 10^{4.95/20})^2 / N_{ANT}] = 7.96 \text{ dBi}$$

1.1.3 Table for Permissive Change

This product is an extension of original one reported under Sporton project number: FA192341

Below is the table for the change of the product with respect to the original one.

Modifications	Performance Checking
The channel frequency 7115MHz was added.	N/A

1.2 Testing Location

Test Lab. : Sporton International Inc. Hsinhua Laboratory			
☒	Hsinhua (TAF: 3785)	ADD: No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333411, Taiwan (R.O.C.)	
		TEL: 886-3-327-3456	FAX: 886-3-327-0973
Test site Designation No. TW3785 with FCC.			
☐	Wen 33rd.St. (TAF: 3785)	ADD: No.14-1, Ln. 19, Wen 33rd St., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.)	
		TEL: 886-3-318-0787	FAX: 886-3-318-0287
Test site Designation No. TW0008 with FCC.			

2 Maximum Permissible Exposure

2.1 Limit of Maximum Permissible Exposure

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842 / f	4.89 / f	(900 / f ²)*	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	F/300	6
1500-100,000	-	-	5	6

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f ²)*	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	F/1500	30
1500-100,000	-	-	1.0	30

Note: f = frequency in MHz ; *Plane-wave equivalent power density

Multiple Transmitters Condition

Co-location as simultaneously transmitting (co-transmitting) and the evaluation shall be consider that simultaneous transmissions from co-located devices the individual transmitters are evaluated separately. After sum of the individual value (basic restriction / reference level) are measured/calculated also have to under basic restriction / reference level.

Co-transmitting mode: 2.4GHz WLAN+ Bluetooth, 5GHz WLAN+Bluetooth, 6GHz WLAN+Bluetooth

2.2 MPE Calculation Method

The MPE was calculated at 20 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

$$E \text{ (V/m)} = \frac{\sqrt{30 \times P \times G}}{d} \quad \text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

E = Electric field (V/m)

P = RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$

2.3 Calculated Result and Limit

Exposure Environment: General Population / Uncontrolled Exposure

2.4GHz WLAN

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up EIRP (dBm)	Tune-up EIRP (W)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)
2.4G;G1D	1.62	21.36	22.98	0.50	23.48	0.22284	20	0.04433	1.00000
2.4G;D1D	1.62	19.04	20.66	0.50	21.16	0.13062	20	0.02599	1.00000

5GHz WLAN

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up EIRP (dBm)	Tune-up EIRP (W)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)
5.2G;D1D	3.22	16.48	19.70	0.50	20.20	0.10471	20	0.02083	1.00000
5.3G;D1D	3.22	16.40	19.62	0.50	20.12	0.10280	20	0.02045	1.00000
5.6G;D1D	3.58	16.93	20.51	0.50	21.01	0.12618	20	0.02510	1.00000
5.8G;D1D	3.39	16.48	19.87	0.50	20.37	0.10889	20	0.02166	1.00000

Bluetooth

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up EIRP (dBm)	Tune-up EIRP (W)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)
2.4G;BT-LE	0.78	5.34	6.12	0.50	6.62	0.00459	20	0.00091	1.00000
2.4G;BT-BR	0.78	5.72	6.50	0.50	7.00	0.00501	20	0.00100	1.00000
2.4G;BT-EDR	0.78	5.79	6.57	0.50	7.07	0.00509	20	0.00101	1.00000

6GHz WLAN

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up EIRP (dBm)	Tune-up EIRP (W)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)
6.2G;D1D	4.34	9.10	13.44	0.50	13.94	0.02477	20	0.00493	1.00000
6.4G;D1D	3.52	9.91	13.43	0.50	13.93	0.02472	20	0.00492	1.00000
6.7G;D1D	4.59	8.95	13.54	0.50	14.04	0.02535	20	0.00504	1.00000
7.0G;D1D	4.95	8.85	13.80	0.50	14.30	0.02692	20	0.00536	1.00000

**Co-TX 2.4GHz WLAN+Bluetooth**

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up EIRP (dBm)	Tune-up EIRP (W)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)	Ratio (S/Limit)
2.4G;G1D	1.62	21.36	22.98	0.50	23.48	0.22284	20	0.04433	1.00000	0.04433
2.4G;BT-EDR	0.78	5.79	6.57	0.50	7.07	0.00509	20	0.00101	1.00000	0.00101
									Sum Ratio	0.04534
									Ratio Limit	1

Co-TX 5GHz WLAN+Bluetooth

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up EIRP (dBm)	Tune-up EIRP (W)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)	Ratio (S/Limit)
5.6G;D1D	3.58	16.93	20.51	0.50	21.01	0.12618	20	0.02510	1.00000	0.02510
2.4G;BT-EDR	0.78	5.79	6.57	0.50	7.07	0.00509	20	0.00101	1.00000	0.00101
									Sum Ratio	0.02611
									Ratio Limit	1

Co-TX 6GHz WLAN+Bluetooth

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up EIRP (dBm)	Tune-up EIRP (W)	Distance (cm)	S (mW/cm ²)	S Limit (mW/cm ²)	Ratio (S/Limit)
7.0G;D1D	4.95	8.85	13.80	0.50	14.30	0.02692	20	0.00535	1.00000	0.00535
2.4G;BT-EDR	0.78	5.79	6.57	0.50	7.07	0.00509	20	0.00101	1.00000	0.00101
									Sum Ratio	0.00636
									Ratio Limit	1

—————THE END—————