Maximum Permissible Exposure Report

Product	:	WLAN and BT Wireless Module
Model Name	:	WBU058-BGA-V11
Series Model	:	WBU058-BGA-V13, WBU058-BGA-V15
FCC ID	:	RX3-WBU058BGA
Test Regulation	:	47 CFR FCC Part 2.1091
Received Date	:	2024/8/9
Test Date	:	2024/08/13 ~ 2024/09/06
Issued Date	:	2024/10/7
Applicant	:	Hon Hai Precision Industry Co., Ltd. No.151, Sec. 1, Nankan Rd., Lujhu Dist.,Taoyuan City 33859, Taiwan
Issued By	:	Underwriters Laboratories Taiwan Co., Ltd. Building A, B and E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Testing Laboratory
3398

REVISION HISTORY

Original Test Report No.: 4791426387A-US-R6-V0

Revision	Test report No.	Date	Page revised	Contents
Original	4791426387A-US-R6-V0	2024/10/7	-	Initial issue

Table of Contents

1. Attestation of Test Results

APPLICANT:	Hon Hai Precision Industry Co., Ltd. No.151, Sec. 1, Nankan Rd., Lujhu Dist.,Taoyuan City 33859, Taiwan
MANUFACTURER:	HON HAI PRECISION IND. CO., LTD No.151, Sec. 1, Nankan Rd., Lujhu Dist.,Taoyuan City 33859, Taiwan
EUT DESCRIPTION:	WLAN and BT Wireless Module
BRAND:	FOXCONN
MODEL:	WBU058-BGA-V11
SERIES MODEL:	WBU058-BGA-V13, WBU058-BGA-V15
SAMPLE STAGE:	Engineering Verification Test Sample

APPLICABLE STANDARDS	
STANDARD	**Test Results**
47 CFR FCC Part 2.1091	PASS

Underwriters Laboratories Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Prepared By:

Cindy Hsin Date : 2024/10/7
Project Handler

Approved and Authorized By:

Eric Lee Date : 2024/10/7
Senior Laboratory Engineer

2. Test Methodology and Reference Procedures

The tests documented in this report were performed in accordance with KDB 447498 D04 Interim General RF Exposure Guidance v01.

3. Facilities and Accreditation

Test Location	Underwriters Laboratories Taiwan Co., Ltd.
Address	Building A, B and E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan
Accreditation Certificate	Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398.

4. Equipment Under Test

4.1. Description of EUT

Product	WLAN and BT Wireless Module
Brand Name	FOXCONN
Model Name	WBU058-BGA-V11
Series Model	WBU058-BGA-V13, WBU058-BGA-V15
Normal Voltage	3.3Vdc from Host

Operating Frequency	Bluetooth EDR	2402MHz ~ 2480MHz
	Bluetooth LE	2402MHz ~ 2480MHz
	WLAN	**2.4GHz:** 2412MHz ~ 2462MHz **5GHz:** 5180MHz ~ 5240MHz 5260MHz ~ 5320MHz 5500MHz ~ 5720MHz 5745MHz ~ 5825MHz **6GHz:** 5955MHz ~ 6415MHz 6435MHz ~ 6515MHz 6535MHz ~ 6855MHz 6875MHz ~ 7115MHz
Sample ID	Conducted Test: 7472206 Radiated Test: 7528177	

Note:

1. The differences between the models are shown in the table below.:

Model	Light Sensor	IR	Power Switch	Thermal Sensor	MIC
WBU058-BGA-V11	V	V	V	-	-
WBU058-BGA-V13	V	V	V	V	-
WBU058-BGA-V15	V	V	V	-	V

2. The above EUT information is declared by manufacturer and for more detailed features description, please refer the manufacturer's or user's manual, the laboratory shall not be held responsible.

4.2. Description of Available Antennas

Ant. No.	Transmitter Circuit	Frequency Range	Brand Name	Model Name	Maximum Gain (dBi)	Ant. Type	Connector Type
WLAN ANT1	Chain0	2.412~2.472GHz 5.15~5.25GHz 5.25~5.35GHz 5.47~5.725GHz 5.725~5.85GHz 5.925~6.425GHz 6.425~6.525GHz 6.525~6.875GHz 6.875~7.125GHz	FOXCONN	WBU058-BGA	2.412~2.472GHz: 3.91 5.15~5.25GHz: 4.11 5.25~5.35GHz: 5.18 5.47~5.725GHz: 4.62 5.725~5.85GHz: 4.28 5.925~6.425GHz: 3.34 6.425~6.525GHz: 3.35 6.525~6.875GHz: 4.88 6.875~7.125GHz: 4.72	Printing	N/A
WLAN ANT2	Chain1	2.412~2.472GHz 5.15~5.25GHz 5.25~5.35GHz 5.47~5.725GHz 5.725~5.85GHz 5.925~6.425GHz 6.425~6.525GHz 6.525~6.875GHz 6.875~7.125GHz	FOXCONN	WBU058-BGA	2.412~2.472GHz: 4.94 5.15~5.25GHz: 3.8 5.25~5.35GHz: 3.76 5.47~5.725GHz: 3.36 5.725~5.85GHz: 3.34 5.925~6.425GHz: 3.07 6.425~6.525GHz: 3.39 6.525~6.875GHz: 4.01 6.875~7.125GHz: 2.97	Printing	N/A
BT ANT1	Chain0	2.4~2.4835GHz	FOXCONN	WBU058-BGA	2.81	Printing	N/A
BT ANT2	Chain1	2.4~2.4835GHz	FOXCONN	WBU058-BGA	1.53	Printing	N/A

Note: The above antenna information was provided from customer and for more detailed features description, please refer the manufacturer's specification or user's manual, the laboratory shall not be held responsible.

5. Requirement

Limits for General Population/Uncontrolled Exposure

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 1: f = frequency in MHz, * means Plane-wave equivalent power density				
Note 2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.				

Power Density (S) is calculated by the following formula:

$S=(P*G)/4\pi R^2$

where: S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to the antenna (in appropriate units, e.g., mW)
G = power gain of the antenna in the direction of interest relative to an isotropic radiator R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

6. General RF Exposure Test Exemption

The corresponding Exclusion Threshold condition, listed below:

1) Blanket Exempt: Following 47 CFR 1.1307(b)(3)(i)(A), the available maximum time-averaged power is no more than 1 mW.

2) SAR Exempt: Following 47 CFR 1.1307(b)(3)(i)(B), the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^{x} & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$

d = the separation distance (cm);

3) MPE Exempt: Following 47 CFR 1.1307(b)(3)(i)(C), using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

7. Radio Frequency Radiation Exposure Evaluation

(1) General RF Exposure Test Exemption

Option	Evaluation Method	Clause
☐	Blanket Exempt	47 CFR 1.1307(b)(3)(i)(A)
☐	SAR Exempt	47 CFR 1.1307(b)(3)(i)(B)
☒	MPE Exempt	47 CFR 1.1307(b)(3)(i)(C)

Bluetooth EDR

Evaluation Frequency	λ/2π	R	Max. ERP	Max. ERP	Threshold ERP
(MHz)	(m)	(m)	(dBm)	(W)	(W)
2402 ~ 2480	0.0199	0.2	8.59	0.007	0.768

Note:
1. λ(m) = $3*10^8$ (m/s) / frequency (Hz)
2. Max. ERP (dBm) = Max. Average power (dBm) + Antenna Gain (dBi) -2.15
3. Max. ERP (W) = $10^{(\text{Max. ERP (dBm)} / 10)}$ / 1000
4. Threshold ERP (W) (RF Source Frequency 1500 – 100000 MHz) = 19.2 R^2

Bluetooth LE

Evaluation Frequency	λ/2π	R	Max. ERP	Max. ERP	Threshold ERP
(MHz)	(m)	(m)	(dBm)	(W)	(W)
2402 ~ 2480	0.0199	0.2	8.65	0.007	0.768

Note:
1. λ(m) = $3*10^8$ (m/s) / frequency (Hz)
2. Max. ERP (dBm) = Max. Average power (dBm) + Antenna Gain (dBi) -2.15
3. Max. ERP (W) = $10^{(\text{Max. ERP (dBm)} / 10)}$ / 1000
4. Threshold ERP (W) (RF Source Frequency 1500 – 100000 MHz) = 19.2 R^2

WLAN 2.4GHz

Evaluation Frequency	λ/2π	R	Max. ERP	Max. ERP	Threshold ERP
(MHz)	(m)	(m)	(dBm)	(W)	(W)
2412 ~ 2462	0.0198	0.2	20.24	0.106	0.768

Note:
1. λ(m) = $3*10^8$ (m/s) / frequency (Hz)
2. Max. ERP (dBm) = Max. Average power (dBm) + Antenna Gain (dBi) -2.15
3. Max. ERP (W) = $10^{(\text{Max. ERP (dBm)} / 10)}$ / 1000
4. Threshold ERP (W) (RF Source Frequency 1500 – 100000 MHz) = 19.2 R^2

WLAN 5GHz

Evaluation Frequency	λ/2π	R	Max. ERP	Max. ERP	Threshold ERP
(MHz)	(m)	(m)	(dBm)	(W)	(W)
5180 ~ 5240	0.0092	0.2	16.30	0.043	0.768
5260 ~ 5320	0.0091	0.2	16.73	0.047	0.768
5500 ~ 5720	0.0087	0.2	16.34	0.043	0.768
5745 ~ 5825	0.0083	0.2	13.65	0.023	0.768

Note:

1. $\lambda(m) = 3*10^8$ (m/s) / frequency (Hz)
2. Max. ERP (dBm) = Max. Average power (dBm) + Antenna Gain (dBi) -2.15
3. Max. ERP (W) = $10^{(\text{Max. ERP (dBm)} / 10)}$ / 1000
4. Threshold ERP (W) (RF Source Frequency 1500 – 100000 MHz) = 19.2 R^2

WLAN 6GHz

Evaluation Frequency	λ/2π	R	Max. ERP	Max. ERP	Threshold ERP
(MHz)	(m)	(m)	(dBm)	(W)	(W)
5935 ~ 6415	0.0080	0.2	12.90	0.019	0.768
6435 ~ 6515	0.0074	0.2	14.01	0.025	0.768
6535 ~ 6855	0.0072	0.2	14.17	0.026	0.768
6878 ~ 7115	0.0070	0.2	14.08	0.026	0.768

Note:

1. $\lambda(m) = 3*10^8$ (m/s) / frequency (Hz)
2. Max. ERP (dBm) = Max. Average power (dBm) + Antenna Gain (dBi) -2.15
3. Max. ERP (W) = $10^{(\text{Max. ERP (dBm)} / 10)}$ / 1000
4. Threshold ERP (W) (RF Source Frequency 1500 – 100000 MHz) = 19.2 R^2

(2) Simultaneously transmission condition:

Condition	Technology	
1	BLE	WLAN (2.4GHz)
2	BLE	WLAN (5GHz)
3	BLE	WLAN (6GHz)

Condition 1	R	Max. ERP	Threshold ERP	Transmit Simultaneously	Transmit Simultaneously Limit
	(m)	(W)	(W)		
BLE	0.2	0.007	0.768	0.147	≦1
WLAN (2.4GHz)	0.2	0.106	0.768		

Condition 2	R	Max. ERP	Threshold ERP	Transmit Simultaneously	Transmit Simultaneously Limit
	(m)	(W)	(W)		
BLE	0.2	0.007	0.768	0.070	≦1
WLAN (5GHz)	0.2	0.047	0.768		

Condition 1	R	Max. ERP	Threshold ERP	Transmit Simultaneously	Transmit Simultaneously Limit
	(m)	(W)	(W)		
BLE	0.2	0.007	0.768	0.043	≦1
WLAN (6GHz)	0.2	0.026	0.768		

Conclusion:

According to 47 CFR §2.1091, the RF exposure analysis concludes that the RF Exposure is FCC compliant.

END OF REPORT