RF Exposure Evaluation Report

FCC 47 CFR § 2.1091

for

802.11a/b/g/n/ac 1x1 with BT 5.0 SiP Module

Model: WM-BAC-BM-25-UFL

Prepared for:

Universal Global Scientific Industrial Co., Ltd.

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Prepared by

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Issued Date: August 28, 2024

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Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	August 28, 2024	Initial Issue	ALL	Peggy Tsai

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1 Attestation of Test Results

Applicant	Universal Global Scientific Industrial Co., Ltd. No. 141, Lane 351, Sec. 1, Taiping Road, Tsaotuen, Nantou County 542007, Taiwan
Manufacturer	Universal Global Scientific Industrial Co., Ltd. No. 141, Lane 351, Sec. 1, Taiping Road, Tsaotuen, Nantou County 542007, Taiwan
Model Name	WM-BAC-BM-25-UFL
Applicable Standards	FCC 47 CFR § 2.1091 FCC 47 CFR § 1.1307 FCC 47 CFR § 1.1310 Published RF exposure KDB procedures
Receive EUT Date:	July 12, 2024
Compliance Certification Services Inc. , tested the above equipment in accordance with the requirements set forth in the above standards. Determination of compliance is based on the results of the compliance measurement,not taking into account measurement instrumentation uncertainy.All indications of Pass/Fail in this report are opinions expressed by Compliance Certification Services Inc, 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.	
Approved & Released By: 	
Sky Zhou Asst. Section Manager	

2 Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1091, the following FCC Published RF exposure KDB procedures:

- 447498 D04 Interim General RF Exposure Guidance v01
- 865664 D02 RF Exposure Reporting v01r02

3 Device Under Test (DUT) Information

3.1 DUT Description

Product	802.11a/b/g/n/ac 1x1 with BT 5.0 SiP Module
Trade Name	USI
Model No.	WM-BAC-BM-25-UFL
Model Discrepancy	N/A
EUT Serial #	88850193970119121080088
Software Version	dhd-1.363.125.25
Hardware Version	V30
Sample Stage	Identical prototype

3.2 Wireless Technologies

Frequency bands	☒ Bluetooth: 2402MHz-2480MHz ☒ 802.11b/g/n HT20: 2412MHz ~ 2462 MHz ☐ 802.11n HT40/ac VHT40/ax HE40: 2422MHz ~ 2452MHz ☒ 802.11a/n HT20: 5180MHz ~ 5240MHz / 5260MHz ~ 5320MHz / 5500MHz ~ 5720MHz / 5745MHz ~ 5825MHz ☒ 802.11ac VHT20: 5180MHz ~ 5240MHz / 5260MHz ~ 5320MHz / 5500MHz ~ 5720MHz / 5745MHz ~ 5825MHz ☐ 802.11ax HE20: 5180MHz ~ 5240MHz / 5260MHz ~ 5320MHz / 5500MHz ~ 5720MHz / 5745MHz ~ 5825MHz ☒ 802.11n HT40: 5190MHz ~ 5230MHz / 5270MHz ~ 5310MHz / 5510MHz ~ 5710MHz / 5755MHz ~ 5795MHz ☒ 802.11ac VHT40: 5190MHz ~ 5230MHz / 5270MHz ~ 5310MHz / 5510MHz ~ 5710MHz / 5755MHz ~ 5795MHz ☐ 802.11ax HE40: 5190MHz ~ 5230MHz / 5270MHz ~ 5310MHz / 5510MHz ~ 5710MHz / 5755MHz ~ 5795MHz ☒ 802.11ac VHT80: 5210MHz / 5290MHz / 5530MHz ~ 5690MHz / 5775MHz ☐ 802.11ax HE80: 5210MHz / 5290MHz / 5530MHz ~ 5690MHz / 5775MHz ☐ Others
Exposure classification	☐ Occupational/Controlled exposure ☒ General Population/Uncontrolled exposure
Antenna Specification	**Type:** FPC Antenna **Brand / Model:** Amphenol / ST0224-10-401-A BT: Gain: 2.10 dBi WIFI 2.4G: Gain: 2.10 dBi WIFI 5G: Band1: Gain: 2.58 dBi Band2: Gain: 2.51 dBi Band3: Gain: 2.28 dBi Band4: Gain: 3.10 dBi BT: Antenna Gain : 2.10 dBi (Numeric gain: 1.62) Worst 2.4GHz: Antenna Gain: 2.10 dBi (Numeric gain: 1.62) Worst 5GHz(U-NII-1): Antenna Gain: 2.58 dBi (Numeric gain: 1.81) Worst 5GHz(U-NII-2A): Antenna Gain: 2.51 dBi (Numeric gain: 1.78) Worst 5GHz(U-NII-2C) Antenna Gain: 2.28 dBi (Numeric gain: 1.69) Worst 5GHz(U-NII-3): Antenna Gain: 3.10 dBi (Numeric gain: 2.04) Worst

Maximum Tune up power

BT	10.00 dBm	(10.000 mW)
BLE	7.00 dBm	(5.01 mW)
2.4GHz		
IEEE 802.11b	19.00 dBm	(79.433 mW)
IEEE 802.11g	16.50 dBm	(44.668 mW)
IEEE 802.11n HT 20	16.50 dBm	(44.67 mW)
5GHz (U-NII-1)		
IEEE 802.11a	18.00 dBm	(63.096 mW)
IEEE 802.11n HT 20	18.00 dBm	(63.096 mW)
IEEE 802.11n HT 40	18.00 dBm	(63.10 mW)
IEEE 802.11ac VHT 20	18.00 dBm	(63.10 mW)
IEEE 802.11ac VHT 40	16.00 dBm	(39.81 mW)
IEEE 802.11ac VHT 80	10.50 dBm	(11.22 mW)
5GHz (U-NII-2A)		
IEEE 802.11a	18.00 dBm	(63.10 mW)
IEEE 802.11n HT 20	18.00 dBm	(63.10 mW)
IEEE 802.11n HT 40	18.00 dBm	(63.10 mW)
IEEE 802.11ac VHT 20	18.00 dBm	(63.10 mW)
IEEE 802.11ac VHT 40	16.00 dBm	(39.81 mW)
IEEE 802.11ac VHT 80	10.50 dBm	(11.22 mW)
5GHz (U-NII-2C)		
IEEE 802.11a	11.50 dBm	(14.13 mW)
IEEE 802.11n HT 20	15.00 dBm	(31.62 mW)
IEEE 802.11n HT 40	17.50 dBm	(56.23 mW)
IEEE 802.11ac VHT 20	14.50 dBm	(28.18 mW)
IEEE 802.11ac VHT 40	16.00 dBm	(39.81 mW)
IEEE 802.11ac VHT 80	16.00 dBm	(39.81 mW)
5GHz (U-NII-3)		
IEEE 802.11a	18.00 dBm	(63.10 mW)
IEEE 802.11n HT 20	18.00 dBm	(63.10 mW)
IEEE 802.11n HT 40	18.00 dBm	(63.10 mW)
IEEE 802.11ac VHT 20	18.00 dBm	(63.10 mW)
IEEE 802.11ac VHT 40	16.00 dBm	(39.81 mW)
IEEE 802.11ac VHT 80	16.00 dBm	(39.81 mW)

Notes:

1. For more details, please refer to the User's manual of the EUT.
2. Disclaimer: Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.
3. The power referred the Tune up power of the test report TMWK2407002218KR, TMWK2407002219KR, TMWK2407002220KR and TMWK2407002221KR for RF Exposure assessment purpose.

4 Maximum Permissible Exposure

4.1 Limits for Maximum Permissible Exposure (MPE)

Table 1 - Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
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
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
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
300-1,500			f/1500	30
1,500-100,000			1.0	30

4.2 MPE Calculation Method

Calculation

Given $E = \frac{\sqrt{30 \times P \times G}}{d}$ & $S = \frac{E^2}{377}$

Where E = Field strength in Volts / meter
P = Power in Watts
G = Numeric antenna gain
d = Distance in meters
S = Power density in milliwatts / square centimeter

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

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

Changing to units of mW and cm, using:

P (mW) = P (W) / 1000 and

d (cm) = d(m) / 100

Yields

$$S = \frac{30 \times (P/1000) \times G}{377 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2}$$ **Equation 1**

Where d = Distance in cm
P = Power in mW
G = Numeric antenna gain
S = Power density in mW / cm^2

If, Substituting the MPE safe distance using d = 20 cm into Equation 1:

$$S = 0.000199 \times P \times G$$

4.3 MPE EXEMPTION

(A) The available maximum time-averaged power is no more than 1 mW

(B) The available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold *Pth* (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). *Pth* 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);

(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 λ/2π, 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 λ/4 or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

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.
Note: R is in meters, f is in MHz.	

4.4 Multiple RF sources

In the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation),

$$\sum_{i=1}^{a} \frac{P_i}{P_{\mathrm{th},i}} + \sum_{j=1}^{b} \frac{ERP_j}{ERP_{\mathrm{th},j}} + \sum_{k=1}^{c} \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$$

5 MPE Exemption Option B

Bluetooth

Mode	Frequency (MHz)	R(m)	Max Tune-up power (dBm)	G(dBi)	Max Tune-up EIRP (dBm)	Max Tune-up ERP (dBm)	Max Tune-up ERP (mW)	ERP Threshold (mW)	MPE Exemption
BT	2480.00	0.2	10.0	2.10	12.10	9.95	9.886	3060	Complies
BLE	2480.00	0.2	7.0	2.10	9.10	6.95	4.955	3060	Complies

WIFI 2.4GHz (DTS)

Mode	Frequency (MHz)	R(m)	Max Tune-up power (dBm)	G(dBi)	Max Tune-up EIRP (dBm)	Max Tune-up ERP (dBm)	Max Tune-up ERP (mW)	ERP Threshold (mW)	MPE Exemption
IEEE 802.11b	2447.00	0.2	19.0	2.10	21.10	18.95	78.524	3060	Complies
IEEE 802.11g	2447.00	0.2	16.5	2.10	18.60	16.45	44.157	3060	Complies
IEEE 802.11n HT 20	2452.00	0.2	16.5	2.10	18.60	16.45	44.157	3060	Complies

WIFI 5.2GHz (U-NII 1)

Mode	Frequency (MHz)	R(m)	Max Tune-up power (dBm)	G(dBi)	Max Tune-up EIRP (dBm)	Max Tune-up ERP (dBm)	Max Tune-up ERP (mW)	ERP Threshold (mW)	MPE Exemption
IEEE 802.11a	5240.00	0.2	18.0	2.58	20.58	18.43	69.663	3060	Complies
IEEE 802.11n HT 20	5240.00	0.2	18.0	2.58	20.58	18.43	69.663	3060	Complies
IEEE 802.11n HT 40	5230.00	0.2	18.0	2.58	20.58	18.43	69.663	3060	Complies
IEEE 802.11ac VHT 20	5240.00	0.2	18.0	2.58	20.58	18.43	69.663	3060	Complies
IEEE 802.11ac VHT 40	5230.00	0.2	16.0	2.58	18.58	16.43	43.954	3060	Complies
IEEE 802.11ac VHT 80	5210.00	0.2	10.5	2.58	13.08	10.93	12.388	3060	Complies

WIFI 5.3GHz (U-NII 2A)

Mode	Frequency (MHz)	R(m)	Max Tune-up power (dBm)	G(dBi)	Max Tune-up EIRP (dBm)	Max Tune-up ERP (dBm)	Max Tune-up ERP (mW)	ERP Threshold (mW)	MPE Exemption
IEEE 802.11a	5300.00	0.2	18.0	2.51	20.51	18.36	68.549	3060	Complies
IEEE 802.11n HT 20	5300.00	0.2	18.0	2.51	20.51	18.36	68.549	3060	Complies
IEEE 802.11n HT 40	5270.00	0.2	18.0	2.51	20.51	18.36	68.549	3060	Complies
IEEE 802.11ac VHT 20	5300.00	0.2	18.0	2.51	20.51	18.36	68.549	3060	Complies
IEEE 802.11ac VHT 40	5310.00	0.2	16.0	2.51	18.51	16.36	43.251	3060	Complies
IEEE 802.11ac VHT 80	5290.00	0.2	10.5	2.51	13.01	10.86	12.190	3060	Complies

WIFI 5.5GHz (U-NII 2C)

Mode	Frequency (MHz)	R(m)	Max Tune-up power (dBm)	G(dBi)	Max Tune-up EIRP (dBm)	Max Tune-up ERP (dBm)	Max Tune-up ERP (mW)	ERP Threshold (mW)	MPE Exemption
IEEE 802.11a	5580.00	0.2	11.5	2.28	13.78	11.63	14.555	3060	Complies
IEEE 802.11n HT 20	5580.00	0.2	15.0	2.28	17.28	15.13	32.584	3060	Complies
IEEE 802.11n HT 40	5550.00	0.2	17.5	2.28	19.78	17.63	57.943	3060	Complies
IEEE 802.11ac VHT 20	5720.00	0.2	14.5	2.28	16.78	14.63	29.040	3060	Complies
IEEE 802.11ac VHT 40	5710.00	0.2	16.0	2.28	18.28	16.13	41.020	3060	Complies
IEEE 802.11ac VHT 80	5690.00	0.2	16.0	2.28	18.28	16.13	41.020	3060	Complies

WIFI 5.8GHz (U-NII 3)

Mode	Frequency (MHz)	R(m)	Max Tune-up power (dBm)	G(dBi)	Max Tune-up EIRP (dBm)	Max Tune-up ERP (dBm)	Max Tune-up ERP (mW)	ERP Threshold (mW)	MPE Exemption
IEEE 802.11a	5825.00	0.2	18.0	3.10	21.10	18.95	78.524	3060	Complies
IEEE 802.11n HT 20	5745.00	0.2	18.0	3.10	21.10	18.95	78.524	3060	Complies
IEEE 802.11n HT 40	5795.00	0.2	18.0	3.10	21.10	18.95	78.524	3060	Complies
IEEE 802.11ac VHT 20	5745.00	0.2	18.0	3.10	21.10	18.95	78.524	3060	Complies
IEEE 802.11ac VHT 40	5795.00	0.2	16.0	3.10	19.10	16.95	49.545	3060	Complies
IEEE 802.11ac VHT 80	5775.00	0.2	16.0	3.10	19.10	16.95	49.545	3060	Complies

6 Simultaneous Transmission Analysis

In the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation),

$$\sum_{i=1}^{a}\frac{P_i}{P_{\mathrm{th},i}}+\sum_{j=1}^{b}\frac{ERP_j}{ERP_{\mathrm{th},j}}+\sum_{k=1}^{c}\frac{Evaluated_k}{Exposure\ Limit_k}\leq 1$$

Simultaneous Transmission Condition

RF Exposure Condition	Item	Capable Transmit Configurations		
	1	DTS	+	BT
	2	U-NII	+	BT

6.1 Sum of the WIFI 2.4GHz + Bluetooth

Mode	Frequency (MHz)	Max Tune-up ERP(mW)	ERP Threshold(mW)	simultaneous Transmission	simultaneous Transmission Limit
WiFi 2.4GHz	2452.00	78.524	3060	0.029	≦1
Bluetooth	2480.00	9.886	3060		

6.2 Sum of the WIFI 5GHz + Bluetooth

Mode	Frequency (MHz)	Max Tune-up ERP(mW)	ERP Threshold(mW)	simultaneous Transmission	simultaneous Transmission Limit
WiFi 5GHz	5825.00	78.524	3060	0.029	≦1
Bluetooth	2480.00	9.886	3060		

7 Facilities

All measurement facilities used to collect the measurement data are located at

☒ No.11, Wugong 6th Rd., Wugu Dist., New Taipei City, Taiwan.

☐ No. 12, Ln. 116, Wugong 3rd Rd., Wugu Dist., New Taipei City, Taiwan.

--End of Test Report--