



Radio Exposure Evaluation Report

FCC ID : 2A4DH-1021
Equipment : 802.11a/b/g/n/ac dual-band Wi-Fi + BT 5.1 Module
Model Name : WM-BAC-MT-53
Applicant : Amazon.com Services LLC
410 Terry Avenue North, Seattle, WA 98109, USA
Manufacturer : Amazon.com Services LLC
410 Terry Avenue North, Seattle, WA 98109, USA
Standard : 47 CFR FCC Part 2 Subpart J, section 2.1091

The product was received on May 27, 2022, and testing was started from Jun. 15, 2022 and completed on Sep. 05, 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: Michelle Tsai

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 | 2412-2472 | 802.11b: DSSS (DBPSK, DQPSK, CCK) 802.11g/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) VHT: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM) |
| 5GHz WLAN | 5150-5250 5725-5850 | 5180-5240 5745-5825 | 802.11a/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM) |
| Bluetooth | 2400-2483.5 | 2402-2480 | BR / EDR: FHSS (GFSK / $\pi/4$ -DQPSK / 8DPSK) LE: DSSS (GFSK) |

1.1.2 Antenna Information

| Ant. | Brand | Model Name | Antenna Type | Connector |
|------|-------|------------|--------------|-----------|
| 1 | USI | MT53 | PIFA | N/A |
| 2 | USI | MT53 | PIFA | N/A |

| Ant. | Port | Gain (dBi) | | |
|------|------|------------|------|------|
| | | 2.4G | 5G | BT |
| 1 | 1 | 4.27 | 6.06 | - |
| 2 | 1 | - | - | 4.35 |

Note: The antenna mentioned above will not be sold with the EUT in the market.

For 2.4GHz function:

For IEEE 802.11 b/g/n/VHT mode (1TX/1RX)

Ant. 1 (port 1) could transmit/receive.

For BT function:

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

Ant. 2 (port 1) could transmit/receive.

For 5GHz function:

For IEEE 802.11 a/n/ac mode (1TX/1RX)

Ant. 1 (port 1) could transmit/receive.



1.2 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ 47 CFR FCC Part 2 Subpart J, section 2.1091
- ♦ KDB 447498 D04 Interim General RF Exposure Guidance v01

The following reference test guidance is not within the scope of accreditation of TAF.

- ♦ 47 CFR Part 1.1307
- ♦ 47 CFR Part 1.1310

1.3 Testing Location

| | | |
|--|-----------------------------|---|
| Test Lab. : Sporton International Inc. Hsinhua Laboratory | | |
| <input checked="" type="checkbox"/> | 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. | | |
| <input type="checkbox"/> | 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: WLAN 2.4GHz + Bluetooth, WLAN 5GHz + Bluetooth

2.2 RF Exposure Exempt Measurement

| Option | Refer Std. | Exemption Exposure Thresholds (TL) |
|--------|---------------------|--|
| A | §1.1307(b)(3)(i)(A) | Available maximum time-averaged power is no more than 1 mW |
| B | §1.1307(b)(3)(i)(B) | $P_{th}(mW) = \begin{cases} ERP_{20cm} (d / 20cm)^x \rightarrow d \leq 20cm \\ ERP_{20cm} \rightarrow 20cm < d \leq 40cm \end{cases}$ $x = -\log_{10} \left(\frac{60}{ERP_{20cm} \sqrt{f}} \right) \text{ and } f \text{ is in GHz}$ $\begin{cases} ERP_{20cm} : 0.3GHz \leq f < 1.5GHz \rightarrow 2040f(mW) \\ ERP_{20cm} : 1.5GHz \leq f \leq 6GHz \rightarrow 3060(mW) \end{cases}$ |
| C | §1.1307(b)(3)(i)(C) | $\begin{cases} 0.3 \sim 1.34MHz \rightarrow ERP(W) = 1920R^2 \\ 1.34 \sim 30MHz \rightarrow ERP(W) = 3450R^2 / f^2 \\ 30 \sim 300MHz \rightarrow ERP(W) = 3.83R^2 \\ 300 \sim 1500MHz \rightarrow ERP(W) = 0.0128R^2 f \\ 1500 \sim 100000MHz \rightarrow ERP(W) = 19.2R^2 \end{cases}$ <p>f is in MHz; R is in m; $R > \lambda / 2\pi$</p> |

2.3 Multiple RF Sources Exposure

| Refer Std. | Exemption Exposure Thresholds (TL) |
|----------------------|--|
| §1.1307(b)(3)(ii)(A) | <p>The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required)</p> |
| §1.1307(b)(3)(ii)(B) | $\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{ExposureLimit_k} \leq 1$ <p>a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph §1.1307(b)(3)(i)(B) of this section for P , including existing exempt transmitters and those being added.</p> <p>b = number of fixed, mobile, or portable RF sources claiming exemption using paragraph §1.1307(b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added.</p> <p>c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.</p> <p>P_i = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).</p> <p>P_{th,i} = the exemption threshold power (P_{th}) according to paragraph §1.1307(b)(3)(i)(B) of this section for fixed, mobile, or portable RF source i.</p> <p>ERP_j = the ERP of fixed, mobile, or portable RF source j.</p> <p>ERP_{th,j} = exemption threshold ERP for fixed, mobile, or portable RF source j, at a distance of at least λ/2π according to the applicable formula of paragraph §1.1307(b)(3)(i)(C) of this section.</p> <p>Evaluated_k = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation at the location of exposure.</p> <p>Evaluated Limit_k = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source k, as applicable from § 1.1310 of this chapter.</p> |



2.4 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:

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

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

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

2.5 Calculated Result and Limit

Exposure Environment: General Population / Uncontrolled Exposure

WLAN 2.4GHz

| Mode | DG (dBi) | Power (dBm) | EIRP (dBm) | Tolerance (dB) | Tune-up ERP (mW) | Distance (cm) | S (mW/cm ²) | S Limit (mW/cm ²) | Option | TL ERP (mW) | TL Ratio |
|----------|----------|-------------|------------|----------------|------------------|---------------|-------------------------|-------------------------------|--------|-------------|----------|
| 2.4G;G1D | 4.27 | 24.80 | 29.07 | 1.50 | 695.02 | 20.0 | 0.13827 | 1.00000 | B | 3060 | 0.2272 |
| 2.4G;D1D | 4.27 | 23.15 | 27.42 | 1.50 | 475.34 | 20.0 | 0.09456 | 1.00000 | B | 3060 | 0.1554 |

WLAN 5GHz

| Mode | DG (dBi) | Power (dBm) | EIRP (dBm) | Tolerance (dB) | Tune-up ERP (mW) | Distance (cm) | S (mW/cm ²) | S Limit (mW/cm ²) | Option | TL ERP (mW) | TL Ratio |
|----------|----------|-------------|------------|----------------|------------------|---------------|-------------------------|-------------------------------|--------|-------------|----------|
| 5.2G;D1D | 6.06 | 23.11 | 29.17 | 2.00 | 797.99 | 20.0 | 0.15876 | 1.00000 | B | 3060 | 0.2608 |
| 5.3G;D1D | 6.06 | 22.04 | 28.10 | 2.00 | 623.73 | 20.0 | 0.12409 | 1.00000 | B | 3060 | 0.2039 |
| 5.6G;D1D | 6.06 | 22.81 | 28.87 | 2.00 | 744.73 | 20.0 | 0.14816 | 1.00000 | B | 3060 | 0.2434 |
| 5.8G;D1D | 6.06 | 27.00 | 33.06 | 2.00 | 1954.34 | 20.0 | 0.38880 | 1.00000 | B | 3060 | 0.6388 |

Bluetooth

| Mode | DG (dBi) | Power (dBm) | EIRP (dBm) | Tolerance (dB) | Tune-up ERP (mW) | Distance (cm) | S (mW/cm ²) | S Limit (mW/cm ²) | Option | TL ERP (mW) | TL Ratio |
|------------|----------|-------------|------------|----------------|------------------|---------------|-------------------------|-------------------------------|--------|-------------|----------|
| 2.4G;BT-LE | 4.35 | 14.63 | 18.98 | 1.50 | 68.08 | 20.0 | 0.01354 | 1.00000 | B | 3060 | 0.0223 |
| 2.4G;BT-BR | 4.35 | 14.39 | 18.74 | 1.50 | 64.42 | 20.0 | 0.01282 | 1.00000 | B | 3060 | 0.0211 |

Note 1: Option A, B and C refer as clause 2.2

Note 2: For option B, Pth(mW) convert to TL ERP(dBm); For option C, ERP(W) convert to TL ERP(dBm)

Note 3: TL Ratio=Tune-up ERP(mW)/TL ERP(mW)



Simultaneous Transmission Analysis Mode: WLAN 2.4GHz + Bluetooth

| Mode | DG (dBi) | Power (dBm) | EIRP (dBm) | Tolerance (dB) | Tune-up ERP (mW) | Distance (cm) | S (mW/cm2) | S Limit (mW/cm2) | Option | TL ERP (mW) | TL Ratio |
|------------|----------|-------------|------------|----------------|------------------|---------------|------------|------------------|--------|-------------|----------|
| 2.4G;G1D | 4.27 | 24.80 | 29.07 | 1.50 | 695.02 | 20.0 | 0.13827 | 1.00000 | B | 3060 | 0.2272 |
| 2.4G;BT-LE | 4.35 | 14.63 | 18.98 | 1.50 | 68.08 | 20.0 | 0.01354 | 1.00000 | B | 3060 | 0.0223 |
| | | | | | | | | | | Sum Ratio | 0.2495 |
| | | | | | | | | | | Ratio Limit | 1 |

Simultaneous Transmission Analysis Mode: WLAN 5GHz + Bluetooth

| Mode | DG (dBi) | Power (dBm) | EIRP (dBm) | Tolerance (dB) | Tune-up ERP (mW) | Distance (cm) | S (mW/cm2) | S Limit (mW/cm2) | Option | TL ERP (mW) | TL Ratio |
|------------|----------|-------------|------------|----------------|------------------|---------------|------------|------------------|--------|-------------|----------|
| 5.8G;D1D | 6.06 | 27.00 | 33.06 | 2.00 | 1954.34 | 20.0 | 0.38880 | 1.00000 | B | 3060 | 0.6388 |
| 2.4G;BT-LE | 4.35 | 14.63 | 18.98 | 1.50 | 68.08 | 20.0 | 0.01354 | 1.00000 | B | 3060 | 0.0223 |
| | | | | | | | | | | Sum Ratio | 0.6611 |
| | | | | | | | | | | Ratio Limit | 1 |

Note 1: Option A, B and C refer as clause 2.2

Note 2: For option B, Pth(mW) convert to TL ERP(dBm); For option C, ERP(W) convert to TL ERP(dBm)

Note 3: TL Ratio=Tune-up ERP(mW)/TL ERP(mW)

Note 4: Refer as clause 2.3 Multiple RF Sources Exposure. Please follow below option and sum TL ration table.

| Option | Sum TL Ratio_B | Option | Sum TL Ratio_C | Option | Sum TL Ratio_E |
|--------|-------------------------------------|--------|---|--------|--|
| B | $\sum_{i=1}^a \frac{P_i}{P_{th,i}}$ | C | $\sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}}$ | E | $\sum_{k=1}^c \frac{Evaluated_k}{ExposureLimit_k}$ |

Note: The above antenna gain was declared by manufacturer.

—————THE END—————