



# Radio Exposure Evaluation Report

**FCC ID** : C3K2028

**Equipment** : Computing Device

**Brand Name** : Microsoft Corporation

**Model Name** : 2028

**Applicant** : Microsoft Corporation  
One Microsoft Way Redmond, WA 98052-6399, U.S.A.

**Manufacturer** : Microsoft Corporation  
One Microsoft Way Redmond, WA 98052-6399, U.S.A.

**Standard** : 47 CFR FCC Part 2 Subpart J, section 2.1091

The product was received on Mar. 16, 2022, and testing was started from Apr. 08, 2022 and completed on Jul. 08, 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**



### History of this test report

| Report No. | Version | Description  | Issued Date   |
|------------|---------|--|---------------|
| FA230421   | 01      | Initial issue of report  | Aug. 09, 2022 |
| FA230421   | 02      | The Equipment Name and accessory was updated<br>This report is the latest version replacing for the report issued on Aug. 09, 2022 | Sep. 16, 2022 |
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### Summary of Test Result

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

|  |
|--|
| <b>Declaration of Conformity:</b>  |
| The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers. |
| <b>Comments and Explanations:</b>  |
| None   |

Reviewed by: Ben Tseng

Report Producer: Jenny Yang

# 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)<br>802.11g/n: OFDM (BPSK, QPSK, 16QAM, 64QAM)<br>802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)                 |
| 5GHz WLAN              | 5150-5250<br>5250-5350<br>5470-5725<br>5725-5850 | 5180-5240<br>5260-5320<br>5500-5700<br>5745-5825 | 802.11a/n: OFDM (BPSK, QPSK, 16QAM, 64QAM)<br>802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM)<br>802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM) |
| Bluetooth              | 2400-2483.5                                      | 2402-2480  | BR / EDR: FHSS (GFSK / $\pi/4$ -DQPSK / 8DPSK)<br>LE: DSSS (GFSK)  |

### 1.1.2 Antenna Information

| Ant.     | Brand | Model Name   | Antenna Type | Connector | Support  |
|----------|-------|--|--------------|-----------|----------|
| 1 (Aux)  | AWAN  | AYP8Y-100012A(1415-09AW0QS)<br>AYL00-000003A(1415-09AN0QS) | PIFA         | I-Pex     | 2.4G+5G  |
| 2 (Main) | AWAN  | AYP8Y-100011A(1415-09AM0QS)<br>AYL00-000002A(1415-09AP0QS) | PIFA         | I-Pex     | 2.4G+5G  |
| 3        | AWAN  | AYL8Y-100000A (1415-09AQ0QS)                               | PIFA         | I-Pex     | BT/BT LE |

| Ant. | Port | Gain (dBi) |         |          |          |         | BT/BT LE |
|------|------|------------|---------|----------|----------|---------|----------|
|      |      | 2.4G       | 5G      |          |          |         |          |
|      |      |            | U-NII-1 | U-NII-2A | U-NII-2C | U-NII-3 |          |
| 1    | 1    | 7.32       | 6.35    | 6.35     | 6.49     | 6.49    | -        |
| 2    | 2    | 6.07       | 6.2     | 6.35     | 6.15     | 5.03    | -        |
| 3    | 1    | -          | -       | -        | -        | -       | 2.91     |

Note 1: The EUT has three antennas.

Note 2: Transmit signals are uncorrelated.

**For 2.4GHz function:**

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

Support diversity function that each single chain was tested and recorded in this test report.

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

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



For BT/BT LE function:

For IEEE 802.15.1 Bluetooth mode (1TX/1RX)
Ant. 3 (port 1) could transmit/receive.

For 5GHz function:

For IEEE 802.11 a mode (1TX/1RX)
Support diversity function that each single chain was tested and recorded in this test report.
For IEEE 802.11 n/ac/ax mode (2TX/2RX)
Ant. 1 (port 1) and Ant. 2 (port 2) could transmit/receive simultaneously.

1.1.3 Accessories

Table with 3 columns: Item, Brand Name, and Value. Rows include Keyboard, mouse, pen, and power supply.

Reminder: Regarding to more detail and other information, please refer to user manual.

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

Table with 2 main rows for testing locations: Hsinhua and Wen 33rd.St. Each row includes address, TEL, FAX, and Test site Designation No.



## 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 <sup>2</sup> ) | Averaging Time  E  <sup>2</sup> , H  <sup>2</sup> or S (minutes) |
|-----------------------|-----------------------------------|-----------------------------------|--|--|
| 0.3-3.0               | 614                               | 1.63                              | (100)*                                   | 6  |
| 3.0-30                | 1842 / f                          | 4.89 / f                          | (900 / f <sup>2</sup> )*                 | 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 <sup>2</sup> ) | Averaging Time  E  <sup>2</sup> , H  <sup>2</sup> or S (minutes) |
|-----------------------|-----------------------------------|-----------------------------------|--|--|
| 0.3-1.34              | 614                               | 1.63                              | (100)*                                   | 30   |
| 1.34-30               | 824/f                             | 2.19/f                            | (180/f <sup>2</sup> )*                   | 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: 1. WLAN 2.4GHz Ant 1 (Aux) + WLAN 2.4GHz Ant 2 (Main)

2. WLAN 5GHz Ant 1 (Aux) + WLAN 5GHz Ant 2 (Main) + 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) | $P_{th}(mW) = \begin{cases} ERP_{20cm} (d / 20cm)^x & \rightarrow d \leq 20cm \\ ERP_{20cm} & \rightarrow 20cm < d \leq 40cm \end{cases}$ $x = -\log_{10} \left( \frac{60}{ERP_{20cm} \sqrt{f}} \right) \text{ and } f \text{ is in GHz}$ $\begin{cases} ERP_{20cm} : 0.3GHz \leq f < 1.5GHz \rightarrow 2040 f (mW) \\ ERP_{20cm} : 1.5GHz \leq f \leq 6GHz \rightarrow 3060 (mW) \end{cases}$ |
| 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; <math>R &gt; \lambda / 2\pi</math></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<sub>i</sub> = 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<sub>th,i</sub> = the exemption threshold power ( P<sub>th</sub> ) according to paragraph §1.1307(b)(3)(i)(B) of this section for fixed, mobile, or portable RF source i.</p> <p>ERP<sub>j</sub> = the ERP of fixed, mobile, or portable RF source j.</p> <p>ERP<sub>th,j</sub> = 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<sub>k</sub> = 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<sub>k</sub> = 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

Full RU

| Mode     | DG (dBi) | Power (dBm) | EIRP (dBm) | Tolerance (dB) | Tune-up ERP (dBm) | Distance (cm) | S (mW/cm <sup>2</sup> ) | S Limit (mW/cm <sup>2</sup> ) | Option | TL ERP (dBm) | TL Ratio |
|----------|----------|-------------|------------|----------------|-------------------|---------------|-------------------------|-------------------------------|--------|--------------|----------|
| 2.4G;G1D | 7.32     | 22          | 29.32      | 1.00           | 28.17             | 20.0          | 0.13054                 | 1.00000                       | B      | 34.856       | 0.2145   |
| 2.4G;D1D | 7.32     | 22          | 29.32      | 1.00           | 28.17             | 20.0          | 0.13054                 | 1.00000                       | B      | 34.856       | 0.2145   |

Partial RU

| Mode     | DG (dBi) | Power (dBm) | EIRP (dBm) | Tolerance (dB) | Tune-up ERP (dBm) | Distance (cm) | S (mW/cm <sup>2</sup> ) | S Limit (mW/cm <sup>2</sup> ) | Option | TL ERP (dBm) | TL Ratio |
|----------|----------|-------------|------------|----------------|-------------------|---------------|-------------------------|-------------------------------|--------|--------------|----------|
| 2.4G;D1D | 7.32     | 22          | 29.32      | 1.00           | 28.17             | 20.0          | 0.13054                 | 1.00000                       | B      | 34.856       | 0.2145   |

WLAN 5GHz

Full RU

| Mode     | DG (dBi) | Power (dBm) | EIRP (dBm) | Tolerance (dB) | Tune-up ERP (dBm) | Distance (cm) | S (mW/cm <sup>2</sup> ) | S Limit (mW/cm <sup>2</sup> ) | Option | TL ERP (dBm) | TL Ratio |
|----------|----------|-------------|------------|----------------|-------------------|---------------|-------------------------|-------------------------------|--------|--------------|----------|
| 5.2G;D1D | 6.35     | 21          | 27.35      | 1.00           | 26.20             | 20.0          | 0.08293                 | 1.00000                       | B      | 34.856       | 0.1363   |
| 5.3G;D1D | 6.35     | 21          | 27.35      | 1.00           | 26.20             | 20.0          | 0.08293                 | 1.00000                       | B      | 34.856       | 0.1363   |
| 5.6G;D1D | 6.49     | 21          | 27.49      | 1.00           | 26.34             | 20.0          | 0.08565                 | 1.00000                       | B      | 34.856       | 0.1407   |
| 5.8G;D1D | 6.49     | 22          | 28.49      | 1.00           | 27.34             | 20.0          | 0.10783                 | 1.00000                       | B      | 34.856       | 0.1772   |

Partial RU

| Mode     | DG (dBi) | Power (dBm) | EIRP (dBm) | Tolerance (dB) | Tune-up ERP (dBm) | Distance (cm) | S (mW/cm <sup>2</sup> ) | S Limit (mW/cm <sup>2</sup> ) | Option | TL ERP (dBm) | TL Ratio |
|----------|----------|-------------|------------|----------------|-------------------|---------------|-------------------------|-------------------------------|--------|--------------|----------|
| 5.2G;D1D | 6.35     | 21          | 27.35      | 1.00           | 26.20             | 20.0          | 0.08293                 | 1.00000                       | B      | 34.856       | 0.1363   |
| 5.3G;D1D | 6.35     | 21          | 27.35      | 1.00           | 26.20             | 20.0          | 0.08293                 | 1.00000                       | B      | 34.856       | 0.1363   |
| 5.6G;D1D | 6.49     | 21          | 27.49      | 1.00           | 26.34             | 20.0          | 0.08565                 | 1.00000                       | B      | 34.856       | 0.1407   |
| 5.8G;D1D | 6.49     | 22          | 28.49      | 1.00           | 27.34             | 20.0          | 0.10783                 | 1.00000                       | B      | 34.856       | 0.1772   |



**Bluetooth**

| Mode       | DG (dBi) | Power (dBm) | EIRP (dBm) | Tolerance (dB) | Tune-up ERP (dBm) | Distance (cm) | S (mW/cm <sup>2</sup> ) | S Limit (mW/cm <sup>2</sup> ) | Option | TL ERP (dBm) | TL Ratio |
|------------|----------|-------------|------------|----------------|-------------------|---------------|-------------------------|-------------------------------|--------|--------------|----------|
| 2.4G;BT-LE | 2.91     | 5           | 7.91       | 1.50           | 7.26              | 20.0          | 0.00106                 | 1.00000                       | B      | 34.856       | 0.0017   |
| 2.4G;BT-BR | 2.91     | 9           | 11.91      | 1.50           | 11.26             | 20.0          | 0.00266                 | 1.00000                       | B      | 34.856       | 0.0044   |

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 Ant 1 (Aux) + WLAN 2.4GHz Ant 2 (Main)**

| Mode      | DG (dBi) | Power (dBm) | EIRP (dBm) | Tolerance (dB) | Tune-up ERP (dBm) | Distance (cm) | S (mW/cm <sup>2</sup> ) | S Limit (mW/cm <sup>2</sup> ) | Option | TL ERP (dBm) | TL Ratio |
|-----------|----------|-------------|------------|----------------|-------------------|---------------|-------------------------|-------------------------------|--------|--------------|----------|
| 2.4G;Aux  | 7.32     | 19          | 26.32      | 1.00           | 25.17             | 20.0          | 0.06542                 | 1.00000                       | B      | 34.856       | 0.1075   |
| 2.4G;Main | 6.07     | 19          | 25.07      | 1.00           | 23.92             | 20.0          | 0.04906                 | 1.00000                       | B      | 34.856       | 0.0806   |
|           |          |             |            |                |                   |               |                         |                               |        | Sum Ratio    | 0.1881   |
|           |          |             |            |                |                   |               |                         |                               |        | Ratio Limit  | 1        |

**WLAN 5GHz Ant 1 (Aux) + WLAN 5GHz Ant 2 (Main) + Bluetooth**

| Mode       | DG (dBi) | Power (dBm) | EIRP (dBm) | Tolerance (dB) | Tune-up ERP (dBm) | Distance (cm) | S (mW/cm <sup>2</sup> ) | S Limit (mW/cm <sup>2</sup> ) | Option | TL ERP (dBm) | TL Ratio |
|------------|----------|-------------|------------|----------------|-------------------|---------------|-------------------------|-------------------------------|--------|--------------|----------|
| 5G;Aux     | 6.49     | 19          | 25.49      | 1.00           | 24.34             | 20.0          | 0.05404                 | 1.00000                       | B      | 34.856       | 0.0888   |
| 5G;Main    | 6.35     | 19          | 25.35      | 1.00           | 24.20             | 20.0          | 0.05233                 | 1.00000                       | B      | 34.856       | 0.0860   |
| 2.4G;BT-BR | 2.91     | 9           | 11.91      | 1.50           | 11.26             | 20.0          | 0.00266                 | 1.00000                       | B      | 34.856       | 0.0044   |
|            |          |             |            |                |                   |               |                         |                               |        | Sum Ratio    | 0.1792   |
|            |          |             |            |                |                   |               |                         |                               |        | 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—————