# RF EXPOSURE EVALUATION REPORT

| | | |
|---|---|---|
| **APPLICANT** | : | Anker Innovations Limited |
| **PRODUCT NAME** | : | NEBULA X1 |
| **MODEL NAME** | : | D2351 |
| **BRAND NAME** | : | NEBULA |
| **FCC ID** | : | 2AOKB-D2351 |
| **STANDARD(S)** | : | 47 CFR Part 2(2.1091) |
| **RECEIPT DATE** | : | 2024-12-11 |
| **TEST DATE** | : | 2024-12-24 to 2025-01-21 |
| **ISSUE DATE** | : | 2025-01-24 |

Edited by: Su Xiaoxian

Su Xiaoxian (Rapporteur)

Approved by: Shen Junsheng

Shen Junsheng (Supervisor)

# DIRECTORY



| Change History | | |
|---|---|---|
| **Version** | **Date** | **Reason for change** |
| 1.0 | 2025-01-24 | First edition |
| | | |

# 1. Technical Information

**Note:** Provide by applicant.

## 1.1 Applicant and Manufacturer Information

| | |
|---|---|
| **Applicant:** | Anker Innovations Limited |
| **Applicant Address:** | Unit 56, 8th Floor, Tower 2, Admiralty Centre, 18 Harcourt Road, Hong Kong |
| **Manufacturer:** | Anker Innovations Limited |
| **Manufacturer Address:** | Unit 56, 8th Floor, Tower 2, Admiralty Centre, 18 Harcourt Road, Hong Kong |

## 1.2 Equipment under Test (EUT) Description

<table>
<tr><td>Product Name:</td><td colspan="5">NEBULA X1</td></tr>
<tr><td>Sample No.:</td><td colspan="5">1#, 2#, 3#</td></tr>
<tr><td>Hardware Version:</td><td colspan="5">V03</td></tr>
<tr><td>Software Version:</td><td colspan="5">V11.0.18.7</td></tr>
<tr><td rowspan="3">Frequency Bands:</td><td>WLAN 2.4GHz</td><td colspan="4">2412MHz-2462MHz</td></tr>
<tr><td>WLAN 5GHz</td><td colspan="4">5180MHz-5240MHz; 5260MHz-5320MHz;<br>5500MHz-5720MHz; 5745MHz-5825MHz</td></tr>
<tr><td>Bluetooth</td><td colspan="4">2402MHz-2480MHz</td></tr>
<tr><td rowspan="3">Modulation Mode:</td><td>WLAN 2.4GHz</td><td colspan="4">DSSS, OFDM</td></tr>
<tr><td>WLAN 5GHz</td><td colspan="4">OFDM, OFDMA</td></tr>
<tr><td>Bluetooth</td><td colspan="4">GFSK, π/4-DQPSK, 8-DPSK</td></tr>
<tr><td>Antenna Type:</td><td colspan="5">Dipole Antenna</td></tr>
<tr><td rowspan="5">Antenna Gain:</td><td rowspan="3">Wireless Mode</td><td colspan="4">Antenna Gain (dBi)</td></tr>
<tr><td colspan="3">MTK7663</td><td>RTL8711</td></tr>
<tr><td>BT</td><td>Ant 0</td><td>Ant 1</td><td>Ant 2</td></tr>
<tr><td>WLAN 2.4GHz</td><td>/</td><td>4.5</td><td>4.87</td><td>/</td></tr>
<tr><td>WLAN 5GHz</td><td>/</td><td>7.47</td><td>7.6</td><td>4.06</td></tr>
<tr><td>Bluetooth</td><td>4.7</td><td>/</td><td>/</td><td>3.2</td></tr>
</table>

## 1.3 Applied Reference Documents

**Leading reference documents for testing:**

| Identity | Document Title | Method Determination /Remark |
|---|---|---|
| 47 CFR Part 2(2.1091) | Radio Frequency Radiation Exposure Assessment: mobile devices | No deviation |
| KDB 447498 D01v06 | General RF Exposure Guidance | No deviation |
| **Note 1:** Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.<br>**Note 2:** When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% confidence intervals. | | |

# 2. Device Category and RF Exposure Limit

Per user manual, based on 47 CFR 2.1091, this device belongs to mobile device category with General Population/Uncontrolled exposure.

**Mobile Devices:**

47 CFR 2.1091(b)

For purposes of this section, a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. In this context, the term “fixed location” means that the device is physically secured at one location and is not able to be easily moved to another location. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal computer, are considered to be mobile devices if they meet the 20 centimeter separation requirement.

**General Population/Uncontrolled Exposure:**

The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity. Warning labels placed on low-power consumer devices such as cellular telephones are not considered sufficient to allow the device to be considered under the occupational/controlled category, and the general population/uncontrolled exposure limits apply to these devices.

**Table 1Limits 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) |
|---|---|---|---|---|
| **(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 |
| 300-1500 | - | - | f/1500 | 30 |
| 1500-100,000 | - | - | 1.0 | 30 |

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

# 3. Maximum Average Power Summary

➢ **Maximum Average Power for Bluetooth**

| Wireless Mode | Channel | Frequency (MHz) | Max. Average Power (dBm) | Tune-up Limit (dBm) |
|---|---|---|---|---|
| Bluetooth (RTL8711) | CH 39 | 2480 | 9.3 | 10.00 |
| Bluetooth (MTK7663) | CH 78 | 2480 | 11.01 | 11.50 |

➢ **Maximum Average Power for WLAN Antenna 0**

| Wireless Mode | Channel | Frequency (MHz) | Max. Average Power (dBm) | Tune-up Limit (dBm) |
|---|---|---|---|---|
| WLAN 2.4GHz (MTK7663) | CH 11 | 2462 | 14.55 | 15.00 |
| WLAN 5GHz (MTK7663) | CH 149 | 5745 | 12.88 | 13.00 |

➢ **Maximum Average Power for WLAN Antenna 1**

| Wireless Mode | Channel | Frequency (MHz) | Max. Average Power (dBm) | Tune-up Limit (dBm) |
|---|---|---|---|---|
| WLAN 2.4GHz (MTK7663) | CH 6 | 2437 | 14.41 | 15.00 |
| WLAN 5GHz (MTK7663) | CH 149 | 5745 | 12.89 | 13.00 |

➢ **Maximum Average Power for WLAN Antenna 2**

| Wireless Mode | Channel | Frequency (MHz) | Max. Average Power (dBm) | Tune-up Limit (dBm) |
|---|---|---|---|---|
| WLAN 5GHz (RTL8711) | CH 100 | 5500 | 17.82 | 18.00 |

➢ **Maximum Average Power for WLAN MIMO**

| Wireless Mode | Channel | Frequency (MHz) | Max. Average Power (dBm) | Tune-up Limit (dBm) |
|---|---|---|---|---|
| WLAN 2.4GHz (MTK7663) | CH 9 | 2452 | 15.85 | 16.00 |
| WLAN 5GHz (MTK7663) | CH 151 | 5755 | 15.18 | 16.00 |

**Note 1:** According to KDB 447498, MPE assessment is based on source-based time-averaged maximum conducted output power of the RF channel requiring assessment, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions.

**Note 2:** The maximum average power refers to report (Report No.: SZ24110315W01/W02/W03/W04/05/06).

# 4. RF Exposure Assessment

➢ **Standalone Transmission Assessment**

**<Standalone Antenna Transmission Assessment>**

| Bands | Frequency (MHz) | Tune-up Power(dBm) | Antenna Gain(dBi) | E.I.R.P. (mW) | Power Density (mW/cm²) | Limit for MPE (mW/cm²) |
|---|---|---|---|---|---|---|
| WLAN 2.4GHz ANT0 (MTK7663) | 2462 | 15.00 | 4.5 | 89.13 | 0.018 | 1.0 |
| WLAN 2.4GHz ANT1 (MTK7663) | 2437 | 15.00 | 4.87 | 97.05 | 0.019 | 1.0 |
| WLAN 5GHz ANT0 (MTK7663) | 5745 | 13.00 | 7.74 | 118.58 | 0.024 | 1.0 |
| WLAN 5GHz ANT1 (MTK7663) | 5745 | 13.00 | 7.6 | 114.82 | 0.023 | 1.0 |
| WLAN 5GHz ANT2(RTL8711) | 5500 | 18.00 | 4.02 | 159.22 | 0.032 | 1.0 |
| Bluetooth (RTL8711) | 2480 | 10.00 | 3.2 | 20.89 | 0.004 | 1.0 |
| Bluetooth (MTK7663) | 2480 | 11.50 | 4.7 | 41.69 | 0.008 | 1.0 |

**<MIMO Transmission Assessment>**

| Bands | Frequency (MHz) | Tune-up Power(dBm) | Directional Gain(dBi) | E.I.R.P. (mW) | Power Density (mW/cm²) | Limit for MPE (mW/cm²) |
|---|---|---|---|---|---|---|
| WLAN 2.4GHz (MTK7663) | 2452 | 16.00 | 7.70 | 234.42 | 0.047 | 1.0 |
| WLAN 5GHz (MTK7663) | 5755 | 16.00 | 10.55 | 451.86 | 0.090 | 1.0 |

**Note 1:** The WLAN 2.4GHz directional gain = $10\log(10^{G1/20}+10^{G2/20})^2/2$ = 7.70dBi; WLAN 5GHz directional gain = $10\log(10^{G1/20}+10^{G2/20})^2/2$ = 10.55dBi.

**Note 2:** For 2.4G/5G WLAN, only the worst case will be used for calculating the power density.

**Note 3:** MPE calculate method

$$S = PG/4\pi R^2$$

Where: S= Power density (in appropriate units, e.g. $mW/cm^2$ )

P = Time-average maximum tune-up power (in appropriate units, e.g. dBm)

G = numeric gain of the antenna (in appropriate units, e.g. dBi)

R = Separation distance to the centre of radiation of the antenna (20cm)

➢ **Simultaneous Transmission Assessment:**

**Multi-Band Simultaneous Transmission Consideration**

| | **Position** | **Applicable Combination** |
|---|---|---|
| **Simultaneous Transmission Consideration** | Body | WLAN 2.4GHz MIMO (MTK7663) |
| | | WLAN 5GHz MIMO (MTK7663) |
| | | WLAN 2.4GHz MIMO (MTK7663) + WLAN 5GHz MIMO (MTK7663) + Bluetooth (MTK7663) + WLAN 5GHz ANT2 (RTL8711) + Bluetooth (RTL8711) |

**Note 1:** This device contains transmitters that may operate simultaneously, therefore simultaneous transmission analysis is required as below.

| **Applicable Combination** | **Transmission Bands** | **Power Density (mW/cm²)** | **Limit (mW/cm²)** | **Simultaneous Transmission Result** |
|---|---|---|---|---|
| WLAN 2.4GHz MIMO (MTK7663) + WLAN 5GHz MIMO (MTK7663) + Bluetooth (MTK7663) + WLAN 5GHz ANT2 (RTL8711) + Bluetooth (RTL8711) | WLAN 2.4GHz MIMO (MTK7663) | 0.047 | 1.0 | 0.181 |
| | WLAN 5GHz MIMO (MTK7663) | 0.090 | 1.0 | |
| | Bluetooth (MTK7663) | 0.008 | 1.0 | |
| | WLAN 5GHz ANT2 (RTL8711) | 0.032 | 1.0 | |
| | Bluetooth (RTL8711) | 0.004 | 1.0 | |
| **Note 1:** Formula for result=Power density$_1$/ limit$_1$ + Power density$_2$/ limit$_2$ ≤1.<br>**Note 2:** The highlight applicable combination is the worst condition. | | | | |

➢ **Conclusion:**

According to 47 CFR 2.1091, this device complies with human exposure basic restrictions.

# Annex A Testing Laboratory Information

### 1. Identification of the Responsible Testing Laboratory

| | |
|---|---|
| **Laboratory Name:** | Shenzhen Morlab Communications Technology Co., Ltd. |
| **Laboratory Address:** | FL.1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China |
| **Telephone:** | +86 755 36698555 |
| **Facsimile:** | +86 755 36698525 |

### 2. Identification of the Responsible Testing Location

| | |
|---|---|
| **Name:** | Shenzhen Morlab Communications Technology Co., Ltd. |
| **Address:** | FL.1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China |

### 3. Facilities and Accreditations

All measurement facilities used to collect the measurement data are located at FL.3, Building A, FeiYang Science Park, Block 67, BaoAn District, Shenzhen, 518101 P. R. China. The test site is constructed in conformance with the requirements of ANSI C63.10-2013and CISPR Publication 22; the FCC designation number is CN1192, the test firm registration number is 226174.

END OF REPORT