# RF Exposure Evaluation Report

| | | |
|---|---|---|
| **APPLICANT** | : | **Aerohive networks Inc** |
| **EQUIPMENT** | : | **wireless access point** |
| **BRAND NAME** | : | **Aerohive** |
| **MODEL NAME** | : | **AP650X** |
| **FCC ID** | : | **WBV-AP650X** |
| **STANDARD** | : | **47 CFR Part 2.1091**<br>**FCC KDB 447498 D01 v06** |

**We, Sporton International (Kunshan) Inc., would like to declare that the device has been evaluated in accordance with 47 CFR Part 2.1091 and FCC KDB 447498 D01 v06, and pass the limit. Without written approval of Sporton International (Kunshan) Inc., the test report shall not be reproduced except in full.**

Rose Wang

**Reviewed by: Rose Wang / Supervisor**

Kat Yin

**Approved by: Kat Yin / Manager**

ACCREDITED Cert #5145.02

***Sporton International (Kunshan) Inc.***
***No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300***
***People's Republic of China***

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## Revision History

| REPORT NO. | VERSION | DESCRIPTION | ISSUED DATE |
|---|---|---|---|
| FA921502 | Rev. 01 | Initial issue of report | Aug. 08, 2019 |
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# 1. Administration Data

## 1.1. Testing Laboratory

Sporton International (Kunshan) Inc. is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

| Testing Laboratory | | |
|---|---|---|
| Test Firm | Sporton International (Kunshan) Inc. | |
| Test Site Location | No. 1098, Pengxi North Road, Kunshan Economic Development Zone<br>Jiangsu Province 215300 People's Republic of China<br>TEL : +86-512-57900158<br>FAX : +86-512-57900958 | |
| Test Site No. | FCC Designation No. | FCC Test Firm Registration No. |
| | CN1257 | 314309 |

| Applicant | |
|---|---|
| Company Name | Aerohive networks Inc |
| Address | 1011 McCarthy Boulevard Milpitas, CA 95035 United States |

## 2. Description of Equipment Under Test (EUT)

<table>
<tr><th colspan="2">Product Feature & Specification</th></tr>
<tr><td>EUT Type</td><td>wireless access point</td></tr>
<tr><td>Brand Name</td><td>Aerohive</td></tr>
<tr><td>Model Name</td><td>AP650X</td></tr>
<tr><td>FCC ID</td><td>WBV-AP650X</td></tr>
<tr><td>Wireless Technology and Frequency Range</td><td>WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz<br>WLAN 5.2GHz Band: 5150 MHz ~ 5250 MHz<br>WLAN 5.3GHz Band: 5250 MHz ~ 5350 MHz<br>WLAN 5.5GHz Band: 5470 MHz ~ 5730 MHz<br>WLAN 5.8GHz Band: 5725 MHz ~ 5850 MHz<br>Bluetooth: 2402 MHz ~ 2480 MHz</td></tr>
<tr><td>Mode</td><td>WLAN 2.4GHz 802.11b/g/n HT20<br>WLAN 2.4GHz 802.11ac VHT20<br>WLAN 2.4GHz 802.11ax HE20<br>WLAN 5GHz 802.11a/n HT20/HT40<br>WLAN 5GHz 802.11ac VHT20/VHT40/VHT80<br>WLAN 5GHz 802.11ax HE20/HE40/HE80/HE160<br>Bluetooth LE</td></tr>
<tr><td>Antenna Function for Transmitter</td><td>
<table>
<tr><th></th><th>Ant. 1</th><th>Ant. 2</th><th>Ant. 3</th><th>Ant. 4</th></tr>
<tr><td>Bluetooth</td><td>V</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>WLAN 2.4GHz 802.11 b/g/n/ac/ax SISO/MIMO</td><td>V</td><td>V</td><td>V</td><td>V</td></tr>
<tr><td>WLAN 5GHz 802.11 a/n/ac/ax SISO/MIMO</td><td>V</td><td>V</td><td>V</td><td>V</td></tr>
</table>
</td></tr>
<tr><td>HW Version</td><td>1</td></tr>
<tr><td>SW Version</td><td>10.0</td></tr>
<tr><td>EUT Stage</td><td>Production Unit</td></tr>
<tr><td colspan="2">Remark:<br>1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.<br>2. The device contains two 5GHz modules, and called ETH6 and ETH 7, ETH 6 can work separately and ETH7 can only transmit with ETH6 which at 5150~5350MHz and eth6 work at 5470~5850MHz. So ETH6 evaluate all the frequency bands and eth7 only test 5150~5350MHz.<br>3. ETH7 also supports WLAN2.4GHz.</td></tr>
</table>

| ANTENNA | BLUETOOTH | WLAN2.4GHz | WLAN5GHz |
|---|---|---|---|
| Bluetooth ANT.1 | 4.20dBi | 6.00 dBi | 5.00 dBi |
| WLAN ANT.1 | | 6.00 dBi | 5.00 dBi |
| WLAN ANT.2 | | 6.00 dBi | 5.00 dBi |
| WLAN ANT.3 | | 6.00 dBi | 5.00 dBi |
| WLAN ANT.4 | | 6.00 dBi | 5.00 dBi |

## 3. Maximum RF average output power among production units

**<WLAN 2.4GHz>**

| Model Name | Mode | Maximum Average Power (dBm) | |
|---|---|---|---|
| | | SISO | 4x4 MIMO |
| ETH7 | 802.11b | 20.5 | 26.5 |
| | 802.11g | 13.5 | 19.5 |
| | 802.11n-HT20 | 13.5 | 19.5 |
| | 802.11ac-VHT20 | 13.5 | 19.5 |
| | 802.11ax-HE20 | 13.5 | 19.5 |

Note: WLAN2.4GHz has no beamforming mode.

**<Bluetooth>**

| Mode | Maximum Average Power (dBm) |
|---|---|
| Bluetooth | 5.5 |

**<WLAN 5GHz SISO and 4x4 MIMO with CDD Mode>**

| Model Name | | Mode | Maximum Average Power (dBm) | |
|---|---|---|---|---|
| | | | SISO | 4x4 MIMO |
| ETH6 | WLAN 5.2GHz | 802.11a | 19.0 | 21.5 |
| | | 802.11n-HT20 | 19.0 | 21.0 |
| | | 802.11n-HT40 | 17.5 | 19.0 |
| | | 802.11ac-VHT20 | 19.0 | 21.0 |
| | | 802.11ac-VHT40 | 17.0 | 19.0 |
| | | 802.11ac-VHT80 | 14.5 | 17.5 |
| | | 802.11ax-HE20 | 18.5 | 21.0 |
| | | 802.11ax-HE40 | 16.5 | 19.0 |
| | | 802.11ax-HE80 | 17.5 | 17.5 |
| | | 802.11ax-HE160 | 14.5 | 17.5 |
| | WLAN 5.3GHz | 802.11a | 18.0 | 20.0 |
| | | 802.11n-HT20 | 18.0 | 20.5 |
| | | 802.11n-HT40 | 15.5 | 19.0 |
| | | 802.11ac-VHT20 | 18.0 | 20.0 |
| | | 802.11ac-VHT40 | 16.0 | 19.0 |
| | | 802.11ac-VHT80 | 16.0 | 17.5 |
| | | 802.11ax-HE20 | 17.5 | 20.5 |
| | | 802.11ax-HE40 | 15.5 | 18.5 |
| | | 802.11ax-HE80 | 16.0 | 17.0 |
| | WLAN 5.5GHz | 802.11a | 18.0 | 20.0 |
| | | 802.11n-HT20 | 18.0 | 20.5 |
| | | 802.11n-HT40 | 16.0 | 20.0 |
| | | 802.11ac-VHT20 | 18.0 | 20.0 |
| | | 802.11ac-VHT40 | 18.0 | 20.0 |
| | | 802.11ac-VHT80 | 15.0 | 17.5 |
| | | 802.11ax-HE20 | 18.0 | 20.0 |
| | | 802.11ax-HE40 | 18.0 | 20.0 |
| | | 802.11ax-HE80 | 15.0 | 17.5 |
| | | 802.11ax-HE160 | 14.5 | 17.0 |
| | WLAN 5.8GHz | 802.11a | 20.5 | 25.0 |
| | | 802.11n-HT20 | 21.0 | 24.5 |
| | | 802.11n-HT40 | 18.5 | 26.0 |
| | | 802.11ac-VHT20 | 20.5 | 24.5 |
| | | 802.11ac-VHT40 | 16.0 | 25.5 |
| | | 802.11ac-VHT80 | 20.0 | 21.0 |
| | | 802.11ax-HE20 | 21.0 | 24.5 |
| | | 802.11ax-HE40 | 21.0 | 25.5 |
| | | 802.11ax-HE80 | 19.0 | 21.0 |

| Model Name | | Mode | Maximum Average Power (dBm) | |
|---|---|---|---|---|
| | | | SISO | 4x4 MIMO |
| ETH7 | WLAN 5.2GHz | 802.11a | 18.0 | 21.0 |
| | | 802.11n-HT20 | 18.0 | 21.0 |
| | | 802.11n-HT40 | 17.0 | 18.5 |
| | | 802.11ac-VHT20 | 18.0 | 20.5 |
| | | 802.11ac-VHT40 | 16.5 | 18.5 |
| | | 802.11ac-VHT80 | 15.0 | 17.0 |
| | | 802.11ax-HE20 | 18.0 | 20.0 |
| | | 802.11ax-HE40 | 16.5 | 18.0 |
| | | 802.11ax-HE80 | 15.5 | 17.5 |
| | | 802.11ax-HE160 | 14.5 | 17.5 |
| | WLAN 5.3GHz | 802.11a | 18.0 | 19.5 |
| | | 802.11n-HT20 | 18.0 | 19.5 |
| | | 802.11n-HT40 | 16.0 | 18.0 |
| | | 802.11ac-VHT20 | 18.0 | 20.0 |
| | | 802.11ac-VHT40 | 15.5 | 18.5 |
| | | 802.11ac-VHT80 | 13.0 | 17.5 |
| | | 802.11ax-HE20 | 17.5 | 19.5 |
| | | 802.11ax-HE40 | 15.0 | 18.0 |
| | | 802.11ax-HE80 | 13.0 | 17.0 |

**<<WLAN 5GHz 4x4 MIMO with Beamforming Mode>**

| Model Name | | Mode | Maximum Average Power (dBm) |
|---|---|---|---|
| ETH6 | WLAN 5.2GHz | 802.11n-HT20 | 20.5 |
| | | 802.11n-HT40 | 23.5 |
| | | 802.11ac-VHT20 | 20.0 |
| | | 802.11ac-VHT40 | 18.0 |
| | | 802.11ac-VHT80 | 17.0 |
| | | 802.11ax-HE20 | 20.5 |
| | | 802.11ax-HE40 | 18.5 |
| | | 802.11ax-HE80 | 17.0 |
| | | 802.11ax-HE160 | 14.0 |
| | WLAN 5.3GHz | 802.11n-HT20 | 14.5 |
| | | 802.11n-HT40 | 15.0 |
| | | 802.11ac-VHT20 | 14.5 |
| | | 802.11ac-VHT40 | 14.5 |
| | | 802.11ac-VHT80 | 13.5 |
| | | 802.11ax-HE20 | 15.0 |
| | | 802.11ax-HE40 | 14.5 |
| | | 802.11ax-HE80 | 13.5 |
| | WLAN 5.5GHz | 802.11n-HT20 | 14.5 |
| | | 802.11n-HT40 | 15.5 |
| | | 802.11ac-VHT20 | 14.5 |
| | | 802.11ac-VHT40 | 15.0 |
| | | 802.11ac-VHT80 | 13.5 |
| | | 802.11ax-HE20 | 15.0 |
| | | 802.11ax-HE40 | 14.0 |
| | | 802.11ax-HE80 | 14.5 |
| | | 802.11ax-HE160 | 13.5 |
| | WLAN 5.8GHz | 802.11n-HT20 | 23.0 |
| | | 802.11n-HT40 | 23.0 |
| | | 802.11ac-VHT20 | 23.0 |
| | | 802.11ac-VHT40 | 22.5 |
| | | 802.11ac-VHT80 | 20.0 |
| | | 802.11ax-HE20 | 23.5 |
| | | 802.11ax-HE40 | 23.0 |
| | | 802.11ax-HE80 | 20.0 |

| Model Name | | Mode | Maximum Average Power (dBm) |
|---|---|---|---|
| ETH7 | WLAN 5.2GHz | 802.11n-HT20 | 19.0 |
| | | 802.11n-HT40 | 17.5 |
| | | 802.11ac-VHT20 | 19.5 |
| | | 802.11ac-VHT40 | 17.5 |
| | | 802.11ac-VHT80 | 15.5 |
| | | 802.11ax-HE20 | 19.5 |
| | | 802.11ax-HE40 | 17.5 |
| | | 802.11ax-HE80 | 14.5 |
| | | 802.11ax-HE160 | 14.0 |
| | WLAN 5.3GHz | 802.11n-HT20 | 14.5 |
| | | 802.11n-HT40 | 14.5 |
| | | 802.11ac-VHT20 | 14.5 |
| | | 802.11ac-VHT40 | 15.0 |
| | | 802.11ac-VHT80 | 14.5 |
| | | 802.11ax-HE20 | 14.5 |
| | | 802.11ax-HE40 | 14.0 |
| | | 802.11ax-HE80 | 14.0 |

# 4. RF Exposure Limit Introduction

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

| 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 Exposures | | | | |
| 0.3-3.0 | 614 | 1.63 | *(100) | 6 |
| 3.0-30 | 1842/f | 4.89/f | *(900/f2) | 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 | | | | |
| 0.3-1.34 | 614 | 1.63 | *(100) | 30 |
| 1.34-30 | 824/f | 2.19/f | *(180/f2) | 30 |
| 30-300 | 27.5 | 0.073 | 0.2 | 30 |
| 300-1500 | | | f/1500 | 30 |
| 1500-100,000 | | | 1.0 | 30 |

The MPE was calculated at 24.5 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

$$S = \frac{PG}{4\pi R^2}$$

Where:
S = Power Density
P = Output Power at Antenna Terminals
G = Gain of Transmit Antenna (linear gain)
R = Distance from Transmitting Antenna

# 5. Radio Frequency Radiation Exposure Evaluation

## 5.1. Standalone Power Density Calculation

| Model Name | Band | Frequency (MHz) | Antenna Gain (dBi) | Maximum Power (dBm) | Maximum EIRP (dBm) | Maximum EIRP (W) | Average EIRP (mW) | Power Density at 24.5cm (mW/mW^2) | Limit (mW/mW^2) | Power Density / Limit |
|---|---|---|---|---|---|---|---|---|---|---|
| ETH6 | WLAN 5.2GHz | 5180.0 | 5.0 | 21.50 | 26.500 | 0.447 | 446.684 | 0.059 | 1.000 | 0.059 |
| | WLAN 5.3GHz | 5260.0 | 5.0 | 20.50 | 25.500 | 0.355 | 354.813 | 0.047 | 1.000 | 0.047 |
| | WLAN 5.5GHz | 5500.0 | 5.0 | 20.50 | 25.500 | 0.355 | 354.813 | 0.047 | 1.000 | 0.047 |
| | WLAN 5.8GHz | 5745.0 | 5.0 | 26.00 | 31.000 | 1.259 | 1258.925 | 0.167 | 1.000 | 0.167 |
| ETH7 | WLAN 2.4GHz | 2412.0 | 6.0 | 26.50 | 32.500 | 1.778 | 1778.279 | 0.236 | 1.000 | **0.236** |
| | WLAN 5.2GHz | 5180.0 | 5.0 | 21.00 | 26.000 | 0.398 | 398.107 | 0.053 | 1.000 | 0.053 |
| | WLAN 5.3GHz | 5260.0 | 5.0 | 20.00 | 25.000 | 0.316 | 316.228 | 0.042 | 1.000 | 0.042 |
| - | Bluetooth | 2402.0 | 4.2 | 5.50 | 9.700 | 0.009 | 9.333 | 0.001 | 1.000 | **0.001** |

**<For Beamforming mode>**

| Model Name | Band | Frequency (MHz) | Antenna Gain (dBi) | Maximum Power (dBm) | Maximum EIRP (dBm) | Maximum EIRP (W) | Average EIRP (mW) | Power Density at 24.5cm (mW/mW^2) | Limit (mW/mW^2) | Power Density / Limit |
|---|---|---|---|---|---|---|---|---|---|---|
| ETH6 | WLAN 5.2GHz | 5180.0 | 8.0 | 23.50 | 31.500 | 1.413 | 1412.538 | 0.187 | 1.000 | 0.187 |
| | WLAN 5.3GHz | 5260.0 | 8.0 | 15.00 | 23.000 | 0.200 | 199.526 | 0.026 | 1.000 | 0.026 |
| | WLAN 5.5GHz | 5500.0 | 8.0 | 15.50 | 23.500 | 0.224 | 223.872 | 0.030 | 1.000 | 0.030 |
| | WLAN 5.8GHz | 5745.0 | 8.0 | 23.50 | 31.500 | 1.413 | 1412.538 | 0.187 | 1.000 | **0.187** |
| ETH7 | WLAN 5.2GHz | 5180.0 | 8.0 | 19.50 | 27.500 | 0.562 | 562.341 | 0.075 | 1.000 | **0.075** |
| | WLAN 5.3GHz | 5260.0 | 8.0 | 15.00 | 23.000 | 0.200 | 199.526 | 0.026 | 1.000 | 0.026 |

**Note:**

1. For conservativeness, the lowest uplink frequency of each band is used to determine the MPE limit of that band.
2. This device support beamforming for WLAN 5GHz 802.11n/ac HT20/HT40/VHT20/VHT40/VHT80 and WLAN 5GHz 802.11ax HE20/HE40/HE80/HE160.
3. In the above table have assessed WLAN 2.4GHz and WLAN 5GHz by referring to their maximum direction gain and maximum output power.
4. WLAN2.4GHz has no beamforming mode.
5. This device supports cross-polarization Antenna for WLAN5GHz. So for 4X4 MIMO antenna the beamforming gain is per chain gain +10g2=5+3.0=8.0dBi.
6. For conservativeness, the lowest frequency of each band is used to determine the MPE limit of that band
7. Chose the maximum power to do MPE analysis.
8. The 2*2 and 3*3 power setting are same with 1*1 and 4*4, so we only test 1*1 and 4*4 for compliances.

## 5.2. Collocated Power Density Calculation

| WLAN 2.4GHz Power Density / Limit | WLAN 5GHz- ETH6 Power Density / Limit | WLAN 5GHz- ETH7 Power Density / Limit | Bluetooth Power Density / Limit | Σ(Power Density / Limit) of WLAN2.4GHz +WLAN5GHz+Bluetooth |
|---|---|---|---|---|
| 0.236 | 0.187 | 0.075 | 0.001 | 0.499 |

**Note:**

1. Σ(Power Density / Limit): This is a summation of [(power density for each transmitter/antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for WLAN 2.4GHz + WLAN 5GHz + Bluetooth.
2. The device contains two 5GHz modules, and called ETH6 and ETH 7, ETH 6 can work separately and ETH7 can only transmit with ETH6 which at 5150~5350MHz and ETH6 work at 5470~5850MHz. so WLAN 5G transmit simultaneously have evaluated for ETH6 and ETH 7.
3. Considering the WLAN 2.4GHz/5GHz module collocation with the Bluetooth transmitter of the EIRP performance listed in the table above, the aggregated (power density /limit) is smaller than 1, and MPE of 3 collocated transmitters is compliant.

## Conclusion:

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