

## FCC 47 CFR MPE REPORT

TZUMI Electronics,LLC

ionvac UltraClean UV sanitizing robo vac (Robotic Vacuum Cleaner)

Model Number: 7688

Additional Model: 7688WM

FCC ID: 2AON7-WJ7688TZUMI

|                          |                                                                     |
|--------------------------|---------------------------------------------------------------------|
| Prepared for:            | TZUMI Electronics,LLC                                               |
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|                          |                                                                     |
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|                 |                       |
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## Maximum Permissible Exposure

### 1. Applicable Standards

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.2m normally can be maintained between the user and the device.

#### 1.1. Limits for Maximum Permissible Exposure (MPE)

##### (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 Times   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)*                                | 6                                                                      |
| 30-300                | 61.4                              | 0.163                             | 1.0                                     | 6                                                                      |
| 300-1500              |                                   |                                   | F/300                                   | 6                                                                      |
| 1500-10000            |                                   |                                   | 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 Times   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)*                                | 30                                                                     |
| 30-300                | 27.5                              | 0.073                             | 0.2                                     | 30                                                                     |
| 300-1500              |                                   |                                   | F/1500                                  | 30                                                                     |
| 1500-10000            |                                   |                                   | 1.0                                     | 30                                                                     |

Note: f=frequency in MHz; \*Plane-wave equivalent power density

## 1.2. MPE Calculation Method

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

E = Electric Field (V/m)

P = Peak 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

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

From the peak EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained

## 2. Conducted Power Result

| Mode              | Frequency (MHz) | Peak output power (dBm) | Peak output power (mW) | Target power (dBm) | Antenna gain |          |
|-------------------|-----------------|-------------------------|------------------------|--------------------|--------------|----------|
|                   |                 |                         |                        |                    | (dBi)        | (Linear) |
| IEEE 802.11b      | 2412            | 13.00                   | 19.953                 | 13±1               | 2.5          | 1.778    |
|                   | 2437            | 12.92                   | 19.588                 | 12±1               | 2.5          | 1.778    |
|                   | 2462            | 12.89                   | 19.454                 | 12±1               | 2.5          | 1.778    |
| IEEE 802.11g      | 2412            | 15.03                   | 31.842                 | 15±1               | 2.5          | 1.778    |
|                   | 2437            | 15.08                   | 32.211                 | 15±1               | 2.5          | 1.778    |
|                   | 2462            | 15.15                   | 32.734                 | 15±1               | 2.5          | 1.778    |
| IEEE 802.11n HT20 | 2412            | 15.11                   | 32.434                 | 15±1               | 2.5          | 1.778    |
|                   | 2437            | 15.25                   | 33.497                 | 15±1               | 2.5          | 1.778    |
|                   | 2462            | 15.29                   | 33.806                 | 15±1               | 2.5          | 1.778    |
| IEEE 802.11n HT40 | 2422            | 13.95                   | 24.831                 | 13±1               | 2.5          | 1.778    |
|                   | 2437            | 14.07                   | 25.527                 | 14±1               | 2.5          | 1.778    |
|                   | 2452            | 14.17                   | 26.122                 | 14±1               | 2.5          | 1.778    |

## 3. Calculated Result and Limit

| Mode              | Target power (dBm) | Antenna gain |          | Power Density (S) (mW/cm <sup>2</sup> ) | Limited of Power Density (S) (mW/cm <sup>2</sup> ) | Test Result |
|-------------------|--------------------|--------------|----------|-----------------------------------------|----------------------------------------------------|-------------|
|                   |                    | (dBi)        | (Linear) |                                         |                                                    |             |
| IEEE 802.11b      | 14                 | 2.5          | 1.778    | 0.00889                                 | 1                                                  | Compiles    |
| IEEE 802.11g      | 16                 | 2.5          | 1.778    | 0.01408                                 | 1                                                  | Compiles    |
| IEEE 802.11n HT20 | 16                 | 2.5          | 1.778    | 0.01408                                 | 1                                                  | Compiles    |
| IEEE 802.11n HT40 | 15                 | 2.5          | 1.778    | 0.01119                                 | 1                                                  | Compiles    |

**End of Test Report**