# RADIO FREQUENCY EXPOSURE

## LIMIT

According to §15.247(i), 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 levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this chapter.

## EUT Specification

| | |
|---|---|
| **EUT** | Dual-lines VDSL2/ADSL2+ Wireless-AC 3G/4G LTE VPN Firewall Router |
| **Model** | BiPAC 8920AX |
| **Data Applies To** | BiPAC 8920AXL ; BiPAC 8921AXL ; BiPAC 8900AX ; BiPAC 8900AXL ; BEC 8920X ; BEC 8920AC ; BEC 8920ACS ; BEC 8900X ; BEC 8900AC |
| **Frequency band (Operating)** | ☒ 802.11b/g/gn HT20: 2412 MHz ~ 2462 MHz<br>802.11gn HT40: 2422 MHz ~ 2452 MHz<br>802.11a, 802.11ac VHT20 : 5180 MHz ~ 5240 MHz / 5745 MHz ~ 5825 MHz<br>802.11ac VHT40 : 5190 MHz ~ 5230 MHz / 5755 MHz ~ 5795 MHz<br>802.11ac VHT80 : 5210 MHz / 5775 MHz<br>☐ Others |
| **Device category** | ☐ Portable (<20cm separation)<br>☒ Mobile (>20cm separation)<br>☐ Others |
| **Exposure classification** | ☐ Occupational/Controlled exposure (S = 5mW/cm$^2$)<br>☒ General Population/Uncontrolled exposure (S=1mW/cm$^2$) |
| **Antenna Specification** | Dipole Antenna × 2 ,<br>2.4GHz: Antenna 0(Chain 0), Antenna Gain: 3.50 dBi (Numeric gain: 2.24)<br>2.4GHz: Antenna 1(Chain 1), Antenna Gain: 3.50 dBi (Numeric gain: 2.24)<br>Dipole Antenna × 3 ,<br>5GHz: Antenna 0(Chain 0), Antenna Gain: 5.00 dBi (Numeric gain: 3.16)<br>5GHz: Antenna 1(Chain 1), Antenna Gain: 5.70 dBi (Numeric gain: 3.72)<br>5GHz: Antenna 2(Chain 2), Antenna Gain: 5.70 dBi (Numeric gain: 3.72) |

| | |
|---|---|
| **Maximum output power** | 2.4G<br>IEEE 802.11b Mode: 18.71 dBm (74.302 mW)<br>IEEE 802.11g Mode: 28.57 dBm (719.449 mW)<br>IEEE 802.11gn HT 20 Mode: 29.31 dBm (853.100 mW)<br>IEEE 802.11gn HT 40 Mode: 26.13 dBm (410.204 mW)<br>5G UNII Band 1<br>IEEE 802.11a Mode: 18.98 dBm (79.068 mW)<br>IEEE 802.11ac VHT20 Mode: 14.56 dBm (28.576 mW)<br>IEEE 802.11ac VHT40 Mode: 19.43 dBm (87.700 mW)<br>IEEE 802.11ac VHT80 Mode: 16.51 dBm (44.771 mW)<br>5G UNII Band 3<br>IEEE 802.11a Mode: 20.04 dBm (100.925 mW)<br>IEEE 802.11ac VHT20 Mode: 21.42 dBm (138.676 mW)<br>IEEE 802.11ac VHT40 Mode: 19.34 dBm (85.901 mW)<br>IEEE 802.11ac VHT80 Mode: 16.00 dBm (39.811 mW) |
| **Evaluation applied** | ☒ MPE Evaluation*<br>☐ SAR Evaluation<br>☐ N/A |

# Revision History

| Rev. | Issue Date | Revisions | Effect Page | Revised By |
|---|---|---|---|---|
| 00 | 2015/06/08 | Initial Issue | ALL | Michelle Chiu |

## TEST RESULTS

**No non-compliance noted.**

### Calculation

Given $E = \frac{\sqrt{30 \times P \times G}}{d}$ & $S = \frac{E^2}{3770}$

*Where E = Field strength in Volts / meter*
*P = Power in Watts*
*G = Numeric antenna gain*
*d = Distance in meters*
*S = Power density in milliwatts / square centimeter*

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{3770 d^2}$$

Changing to units of mW and cm, using:

*P (mW) = P (W) / 1000 and*

*d (cm) = d(m) / 100*

Yields

$$S = \frac{30 \times (P/1000) \times G}{3770 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2}$$ ***Equation 1***

*Where d = Distance in cm*
*P = Power in mW*
*G = Numeric antenna gain*
*S = Power density in mW / $cm^2$*

**Maximum Permissible Exposure**

Substituting the MPE safe distance using d = 20 cm into Equation 1:

$$S = 0.000199 \times P \times G$$

*Where P = Power in mW*
*G = Numeric antenna gain*
*S = Power density in mW / cm$^2$*

**2.4G**

**IEEE 802.11b mode:**

| Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / cm$^2$ | Limit (mW/cm$^2$) |
|---|---|---|---|---|---|
| 2412 ~ 2462 | 74.302 | 2.24 | 20 | 0.0331 | 1 |

**IEEE 802.11g mode:**

| Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / cm$^2$ | Limit (mW/cm$^2$) |
|---|---|---|---|---|---|
| 2412 ~ 2462 | 719.449 | 2.24 | 20 | 0.3207 | 1 |

**IEEE 802.11gn HT20 mode:**

| Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / cm$^2$ | Limit (mW/cm$^2$) |
|---|---|---|---|---|---|
| 2412 ~ 2462 | 853.100 | 2.24 | 20 | 0.3803 | 1 |

**IEEE 802.11gn HT40 mode:**

| Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / cm$^2$ | Limit (mW/cm$^2$) |
|---|---|---|---|---|---|
| 2422 ~ 2452 | 410.204 | 2.24 | 20 | 0.1829 | 1 |

**5G UNII Band 1**

**IEEE 802.11a mode:**

| Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / $cm^2$ | Limit ($mW/cm^2$) |
|---|---|---|---|---|---|
| 5180 ~ 5240 | 79.068 | 3.72 | 20 | 0.0585 | 1 |

**IEEE 802.11ac VHT20 mode:**

| Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / $cm^2$ | Limit ($mW/cm^2$) |
|---|---|---|---|---|---|
| 5180 ~ 5240 | 28.576 | 3.72 | 20 | 0.0212 | 1 |

**IEEE 802.11ac VHT40 mode:**

| Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / $cm^2$ | Limit ($mW/cm^2$) |
|---|---|---|---|---|---|
| 5190 ~ 5230 | 87.700 | 3.72 | 20 | 0.0649 | 1 |

**IEEE 802.11ac VHT80 mode:**

| Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / $cm^2$ | Limit ($mW/cm^2$) |
|---|---|---|---|---|---|
| 5210 | 44.771 | 3.72 | 20 | 0.0331 | 1 |

**5G UNII Band 3**

**IEEE 802.11a mode:**

| Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / $cm^2$ | Limit ($mW/cm^2$) |
|---|---|---|---|---|---|
| 5475 ~ 5825 | 100.925 | 3.72 | 20 | 0.0747 | 1 |

**IEEE 802.11ac VHT20 mode:**

| Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / $cm^2$ | Limit ($mW/cm^2$) |
|---|---|---|---|---|---|
| 5475 ~ 5825 | 138.68 | 3.72 | 20 | 0.1027 | 1 |

**IEEE 802.11ac VHT40 mode:**

| Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / $cm^2$ | Limit ($mW/cm^2$) |
|---|---|---|---|---|---|
| 5755 ~ 5795 | 85.901 | 3.72 | 20 | 0.0636 | 1 |

**IEEE 802.11ac VHT80 mode:**

| Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / $cm^2$ | Limit ($mW/cm^2$) |
|---|---|---|---|---|---|
| 5775 | 39.811 | 3.72 | 20 | 0.0295 | 1 |

**Simultaneously MPE**

Simultaneously MPE = MPE1/Limit1 + MPE2/Limit2

**2.4G + 5G**

Simultaneously MPE = 0.3803 + 0.1027= 0.483 mW/cm$^2$