

RF Exposure and Transmitter Power Considerations for the BeoVision Avant 55NG

FCC ID: TTUWUSAC08V

The BeoVision Avant 55NG contains a WUS-AC08V transmitter module (FCC ID: TTUWUSAC08V) which operates in the 2.4 GHz and 5 GHz frequency bands using Bluetooth BDR / EDR / LE and WLAN 802.11a/b/g/n/ac technologies. The WLAN has 802.11 g/n/ac 2x2 MIMO operation and supports antenna beam forming. The WLAN and BT transmitters can transmit simultaneously.

The FCC requires that the calculated MPE be equal to or less than a given limit dependent on frequency at a distance of 20 cm from a device to the body of a user.

The following FCC Rule Parts and procedures are applicable:

Part 1.1310 – Radiofrequency radiation exposure limits

Part 2.1091 – Radiofrequency radiation exposure evaluation: mobile devices

KDB447498 D01 v06

Mobile and Portable Devices RF Exposure Procedures and Equipment Authorisation Policies

MAXIMUM TRANSMITTER POWER CONSIDERATIONS

Conducted power values are maximum average tune up with tolerance:

Bluetooth 2.4GHz:

Power conducted = 1.58mW (2.0dBm)

Antenna Gain: 4.2dBi

EIRP = 6.2dBm = 4.17 mW

WLAN 2.4GHz:

Power conducted = 25.1mW worst case (14.0dBm)

Antenna Gain: 5.44dBi

EIRP = 19.44dBm = 87.9 mW (SISO)

EIRP = 22.45dBm = 175.8 mW (MIMO)

WLAN 5GHz:

Power conducted = 25.1mW worst case (14.0dBm)

Antenna Gain: 6.32dBi

EIRP = 20.32dBm = 107.65 mW (SISO)

EIRP = 23.3dBm = 215.3 mW (MIMO)

MPE CALCULATIONS

The MPE calculation to calculate the safe operating distance for the user is.

$$S = \text{EIRP} / 4 \pi R^2$$

Where

- S = Power density
- EIRP = Effective Isotropic Radiated Power (EIRP = P x G)
- P = Conducted Transmitter Power
- G = Antenna Gain (relative to an isotropic radiator)
- R = distance to the centre of radiation of the antenna (safe operating distance)

For Bluetooth 2.4GHz

Values:

Transmitter frequency range = 2400 MHz to 2483.5 MHz

EIRP = 4.17 mW

R = 20cm

Power Density Requirement

From table 1 (b) - Limits for General Population/ Uncontrolled Exposure of
FCC Rule Part 1.1310 for 2.4GHz

$$S_{\text{req1}} = 1.0 \text{ mW/cm}^2$$

Calculation:

$$S = 4.17/4 \pi R^2$$

$$S = 4.17/(12.56 \times 20^2)$$

$$S = 4.17/(5024)$$

$$S_1 = 0.0008 \text{mW/ cm}^2 (<1.0 \text{ mW/cm}^2)$$

For WLAN 2.4GHz (MIMO worst case)

Values:

Transmitter frequency range = 2412 MHz to 2462MHz

EIRP_{MIMO} = 22.45dBm = 175.8 mW

R = 20cm

Power Density Requirement

From table 1 (b) - Limits for General Population/ Uncontrolled Exposure of
FCC Rule Part 1.1310 for 2.4GHz

$$S_{\text{req2}} = 1.0 \text{ mW/cm}^2$$

Calculation:

$$S = \text{EIRP}/4 \pi R^2$$

$$S = 175.8/(12.56 \times 20^2)$$

$$S = 175.8/(5024)$$

$$S_2 = 0.035 \text{mW/ cm}^2 (<1.0 \text{ mW/cm}^2)$$

For WLAN 5GHz (MIMO Worst Case)

Values:

Transmitter frequency range = 5180 MHz to 5795MHz

EIRP_{MIMO} = 23.3dBm = 215.3 mW

R = 20cm

Power Density Requirement

From table 1 (b) - Limits for General Population/ Uncontrolled Exposure of
FCC Rule Part 1.1310 for 5GHz

$$S_{\text{req3}} = 1.0 \text{ mW/cm}^2$$

Calculation:

$$S = \text{EIRP}/4 \pi R^2$$

$$S = 215.3/(12.56 \times 20^2)$$

$$S = 215.3/(5024)$$

$$S_3 = 0.043 \text{ mW/cm}^2 (<1.0 \text{ mW/cm}^2)$$

KDB447498 D01 v05 Section 7.2 SIMULTANEOUS TRANSMISSION CONSIDERATIONS

The BT antenna is situated at a distance greater than 20cm away from the WLAN antennas, so can be considered as a single entity and BT operation is not considered for this simultaneous transmission calculation.

As per KDB, summation of calculated MPE ratios for WLAN 2.4GHz + 5GHz:

$$\begin{aligned} \sum \text{MPE}_{\text{ratios}} &= (S_2 / S_{\text{req2}}) + (S_3 / S_{\text{req3}}) \\ &= (0.035/1.0) + (0.043/1.0) \\ &= 0.078 \end{aligned}$$

\sum of MPE ratios < 1.0, so in accordance with KDB447498 Section 7.2, simultaneous transmission test exclusion applies for the WLAN transmitters.

Conclusion

The required 20cm RF exposure limits for General Population / Uncontrolled Exposure will not be exceeded for the BeoVision Avant 55NG using antennas having a maximum gain of 4.2 dBi for 2.4GHz BT, and 5.44 dBi for 2.4GHz WIFI, and 6.32dBi for 5GHz WIFI.