Bang & Olufsen a/s, Peter Bangs Vej 15, P.O. box 40, DK-7600 Struer
Main phone no. [45] 96 84 11 22, Fax [45] 96 84 53 33, CVR-no.
41257911
www.bang-olufsen.dk

RF Exposure and Transmitter Power Considerations for the BeoVision 14-40

FCC ID: TTUWUSAC08V

The BeoVision 14-40 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

WIFI 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)

Bang & Olufsen a/s, Peter Bangs Vej 15, P.O. box 40, DK-7600 Struer
Main phone no. [45] 96 84 11 22, Fax [45] 96 84 53 33, CVR-no. 41257911
www.bang-olufsen.dk

WIFI 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.

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

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

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

Bang & Olufsen a/s, Peter Bangs Vej 15, P.O. box 40, DK-7600 Struer
Main phone no. [45] 96 84 11 22, Fax [45] 96 84 53 33, CVR-no. 41257911
www.bang-olufsen.dk

Calculation:

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

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

$S = 4.17/(5024)$

S_1 = 0.0008mW/ cm^2 (<1.0 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_{req2} = 1.0 mW/cm^2

Calculation:

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

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

$S = 175.8/(5024)$

S_2 = 0.035mW/ cm^2 (<1.0 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

Bang & Olufsen a/s, Peter Bangs Vej 15, P.O. box 40, DK-7600 Struer
Main phone no. [45] 96 84 11 22, Fax [45] 96 84 53 33, CVR-no. 41257911
www.bang-olufsen.dk

Power Density Requirement

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

S_{req3} = 1.0 mW/cm^2

Calculation:

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

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

$S = 215.3/(5024)$

S_3 = 0.043mW/ cm^2 (<1.0 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:

$$\Sigma MPE_{ratios} = (S_2/ S_{req2}) + (S_3/ S_{req3})$$

$$= (0.035/1.0) + (0.043/1.0)$$

$$= 0.078$$

Σ 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 14-40 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.