

INTERTEK TESTING SERVICES

RF Exposure

The equipment under test (EUT) is a WLAN BT Module with Bluetooth (dual-mode) function operating in 2402-2480MHz, 2.4G WIFI function operating in 2412-2462MHz, 5G WIFI function operating in 5150MHz~5250 MHz, 5250MHz~5350MHz, 5470MHz-5725MHZ, 5725MHz~5850MHz, and 6G WIFI function operating in 5925MHz~7125MHz. The EUT is powered by DC 3.3V. For more detail information pls. refer to the user manual.

EDR

Bluetooth Version: 5.4

Antenna Type: FPC antenna.

Antenna Gain: -1.01dBi.

Modulation Type: GFSK, $\pi/4$ DQPSK, 8DPSK.

The nominal conducted output power specified: 5dBm (Tolerance: +/-2dB).

The maximum conducted output power for the EUT is 6.85dBm in the frequency 2402MHz which is within the production variation.

The minimum conducted output power for the EUT is 6.13dBm in the frequency 2480MHz which is within the production variation.

According to FCC Part 2.1091, this unlicensed transmitting devices is categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use, According to the KDB 447498 V06 and OET 65, the simple calculation as below:

The source-based time averaged maximum radiated power = 7dBm -1.01dBi = 5.99dBm = 3.97mW

From above data, the exposed power density at a distance (R) of 20cm from the center of radiation of the antenna for 2.4GHz band can be calculated according to OET 65 as follow:

$$= 3.97\text{mW} / 4\pi R^2$$

$$= 0.0008\text{mW}/\text{cm}^2$$

$$< 1\text{mW}/\text{cm}^2$$

The MPE limit is 1.0 mW/cm² for general population and uncontrolled exposure in the Bluetooth frequency range according to FCC Part 1.1310. As the measured power density at 20cm from the transmitter is lower than the MPE limit, the compliance to the MPE limit can be ensured by indicating the minimum 20cm separation between the transmitter's radiating structure and body of the user or nearby persons.

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BLE

Bluetooth Version: 5.4

Antenna Type: FPC antenna.

Antenna Gain: -1.01dBi.

The nominal conducted output power specified: 2dBm (Tolerance: +/-2dB).

The maximum conducted output power for the EUT is 2.74dBm in the frequency 2402MHz which is within the production variation.

The minimum conducted output power for the EUT is 2.39dBm in the frequency 2480MHz which is within the production variation.

According to FCC Part 2.1091, this unlicensed transmitting device is categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use. According to the KDB 447498 V06 and OET 65, the simple calculation is as follows:

The source-based time averaged maximum radiated power = 4dBm -1.01dBi = 2.99dBm = 1.99mW

From above data, the exposed power density at a distance (R) of 20cm from the center of radiation of the antenna for 2.4GHz band can be calculated according to OET 65 as follows:

$$\begin{aligned} &= 1.99\text{mW} / 4\pi R^2 \\ &= 0.0004 \text{ mW/cm}^2 \\ &< 1\text{mW/cm}^2 \end{aligned}$$

The MPE limit is 1.0 mW/cm² for general population and uncontrolled exposure in the WIFI frequency range according to FCC Part 1.1310. As the measured power density at 20cm from the transmitter is lower than the MPE limit, the compliance to the MPE limit can be ensured by indicating the minimum 20cm separation between the transmitter's radiating structure and body of the user or nearby persons.

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2.4GHz WiFi:

Antenna Type: FPC Antenna.

Antenna1 Gain: 2.26dBi. Antenna2 Gain: 2.23dBi. MIMO:5.26dBi

Modulation Type: BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM, CCK, DQPSK, DBPSK and DSSS.

The nominal conducted output power specified: 14dBm (Tolerance: +/-4dB).

The maximum conducted output power for the EUT is 17.67dBm in the frequency 2422MHz(IEEE 802.11AX40) which is within the production variation.

The minimum conducted output power for the EUT is 10.3dBm in the frequency 2437MHz(IEEE 802.11N40 MIMO ANT1) which is within the production variation.

According to FCC Part 2.1091, this unlicensed transmitting devices is categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use, According to the KDB 447498 V06 and OET 65, the simple calculation as below:

The source-based time averaged maximum radiated power = 18.0dBm +5.26dBi = 23.26dBm = 211.84mW

From above data, the exposed power density at a distance (R) of 20cm from the center of radiation of the antenna for 2.4GHz band can be calculated according to OET 65 as follow:

$$= 211.84\text{mW} / 4\pi R^2$$

$$= 0.0422 \text{ mW/cm}^2$$

$$<1\text{mW/cm}^2$$

The MPE limit is 1.0 mW/cm² for general population and uncontrolled exposure in the WIFI frequency range according to FCC Part 1.1310. As the measured power density at 20cm from the transmitter is lower than the MPE limit, the compliance to the MPE limit can be ensured by indicating the minimum 20cm separation between the transmitter's radiating structure and body of the user or nearby persons.

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5GHz WiFi:

Antenna Type: FPC Antenna.

Antenna1 Gain: 4.62dBi. Antenna2 Gain: 4.28dBi. MIMO: 7.46dBi.

Modulation Type: OFDM and OFDMA.

The nominal conducted output power specified: 4dBm (Tolerance: +/-13dB).

The maximum conducted output power for the EUT is 15.71dBm in the frequency 5825MHz(IEEE 802.11 N20 ANT2) which is within the production variation.

The minimum conducted output power for the EUT is -8.17dBm in the frequency 5690MHz_ UNII-3 (IEEE 802.11 AC80 MIMO ANT1) which is within the production variation.

According to FCC Part 2.1091, this unlicensed transmitting device is categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use, According to the KDB 447498 V06 and OET 65, the simple calculation as below:

The source-based time averaged maximum radiated power = 17dBm +7.46dBi = 24.46dBm =279.25mW

From above data, the exposed power density at a distance (R) of 20cm from the center of radiation of the antenna for 2.4GHz band can be calculated according to OET 65 as follow:

$$= 279.25\text{mW} / 4\pi R^2$$

$$= 0.0556\text{mW}/\text{cm}^2$$

$$<1\text{mW}/\text{cm}^2$$

The MPE limit is 1.0 mW/cm² for general population and uncontrolled exposure in the WIFI frequency range according to FCC Part 1.1310. As the measured power density at 20cm from the transmitter is lower than the MPE limit, the compliance to the MPE limit can be ensured by indicating the minimum 20cm separation between the transmitter's radiating structure and body of the user or nearby persons.

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6GHz WiFi:

Antenna Type: FPC Antenna.

Antenna1 Gain: 4.65dBi. Antenna2 Gain: 4.54dBi. MIMO: 7.46dBi.

Modulation Type: OFDMA.

The nominal conducted output power specified: 1dBm (Tolerance: +/-6dB).

The maximum conducted output power for the EUT is 6.88dBm in the frequency 6545MHz(IEEE 802.11 AX80 MIMO) which is within the production variation.

The minimum conducted output power for the EUT is -3.18dBm in the frequency 6855MHz (IEEE 802.11 AX20 MIMO ANT2) which is within the production variation.

According to FCC Part 2.1091, this unlicensed transmitting device is categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use, According to the KDB 447498 V06 and OET 65, the simple calculation as below:

The source-based time averaged maximum radiated power = 7dBm +7.46dBi = 14.46dBm =36.31mW

From above data, the exposed power density at a distance (R) of 20cm from the center of radiation of the antenna for 2.4GHz band can be calculated according to OET 65 as follow:

$$= 36.31\text{mW} / 4\pi R^2$$

$$= 0.0016\text{mW}/\text{cm}^2$$

$$<1\text{mW}/\text{cm}^2$$

The MPE limit is 1.0 mW/cm² for general population and uncontrolled exposure in the WIFI frequency range according to FCC Part 1.1310. As the measured power density at 20cm from the transmitter is lower than the MPE limit, the compliance to the MPE limit can be ensured by indicating the minimum 20cm separation between the transmitter's radiating structure and body of the user or nearby persons.

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For Simultaneous transmitting of 2.4GHz WiFi and Bluetooth, According to 865664D02 2.2 d) 1):

The sum of the ratios of the spatially averaged results to the applicable frequency dependent MPE limits = $0.0422/1 + 0.0008/1 = 0.0430 < 1$

For Simultaneous transmitting of 5GHz/6GHz WiFi and Bluetooth, According to 865664D02 2.2 d) 1):

The sum of the ratios of the spatially averaged results to the applicable frequency dependent MPE limits = $0.0556/1 + 0.0008/1 = 0.0564 < 1$

Since the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in the device is ≤ 1.0 , the EUT is considered to satisfy MPE compliance for simultaneous transmission operations.

The following RF exposure statement or similar sentence is proposed to be included in the user manual:

“FCC RF Radiation Exposure Statement Caution: This Transmitter must be installed to provide a separation distance of at least 20 cm from all persons.”