

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 and 5G WIFI function operating in 5150MHz~5250 MHz, 5250MHz~5350MHz, 5470MHz-5725MHz, 5725MHz~5850MHz. The EUT is powered by 3.3VDC (The operating voltage of the auxiliary test board is 5VDC) . For more detail information pls. refer to the user manual.

EDR

Bluetooth Version: 5.1

Antenna Type: PCB antenna.

Antenna Gain: 3.32dBi.

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

The nominal conducted output power specified: 3dBm (Tolerance: +/-2dB).

The maximum conducted output power for the EUT is 4.37dBm in the frequency 2402MHz which is within the production variation.

The minimum conducted output power for the EUT is 2.53dBm in the frequency 2440MHz 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 = 4.37dBm +3.32dBi = 7.69dBm = 5.87mW

From above data, the exposed power density at a distance (R) of 20cm from the center of radiation of the antenna for 5.0 BLE mode can be calculated according to OET 65 as follow:

$$= 5.87\text{mW} / 4\pi R^2$$

$$= 0.001\text{mW}/\text{cm}^2$$

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

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: 5.1

Antenna Type: PCB antenna.

Antenna Gain: 3.32dBi.

The nominal conducted output power specified: 3dBm (Tolerance: +/-2dB).

The maximum conducted output power for the EUT is 4.83dBm in the frequency 2402MHz which is within the production variation.

The minimum conducted output power for the EUT is 2.98dBm in the frequency 2440MHz 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 below:

The source-based time averaged maximum radiated power = 4.83dBm +3.32dBi = 8.15dBm = 6.53mW

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:

$$\begin{aligned} &= 6.53\text{mW} / 4\pi R^2 \\ &= 0.001 \text{ mW/cm}^2 \\ &< 1\text{mW/cm}^2 \end{aligned}$$

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: PCB Antenna.

Antenna0 Gain: 2.27dBi. Antenna1 Gain: 1.33dBi. MIMO:4.82dBi

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

The nominal conducted output power specified: 15dBm (Tolerance: +/-4dB).

The maximum conducted output power for the EUT is 17.2dBm in the frequency 2462MHz(IEEE 802.11G) which is within the production variation.

The minimum conducted output power for the EUT is 11.7dBm in the frequency 2412MHz(IEEE 802.11n40) 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 = 19.0dBm +4.82dBi = 23.82dBm = 240.99mW

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 follow:

$$\begin{aligned} &= 240.99\text{mW} / 4\pi R^2 \\ &= 0.0480 \text{ mW/cm}^2 \\ &<1\text{mW/cm}^2 \end{aligned}$$

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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5GHz WiFi:

Antenna Type: PCB Antenna.

Antenna0 Gain: 4.77dBi. Antenna1 Gain: 5.48dBi. MIMO: 8.14dBi.

Modulation Type: BPSK, QPSK, 16QAM, 64QAM and OFDM.

The nominal conducted output power specified: 10dBm (Tolerance: +6/-10dB).

The maximum conducted output power for the EUT is 15.53dBm in the frequency 5310MHz(IEEE 802.11 AC40 ANT0) which is within the production variation.

The minimum conducted output power for the EUT is 0.36dBm in the frequency 5200MHz(IEEE 802.11 AC20 MIMO) 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 = 16dBm +8.14dBi = 24.14dBm =259.42mW

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:

$$= 259.42\text{mW} / 4\pi R^2$$

$$= 0.0516 \text{ mW/cm}^2$$

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

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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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 = $0.0480/1 + 0.001/1 = 0.0490 < 1$

For Simultaneous transmitting of 5GHz 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 = $0.0516/1 + 0.001/1 = 0.0526 < 1$

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.”