

INTERTEK TESTING SERVICES

RF Exposure

The equipment under test (EUT) is a wireless module with Bluetooth 5.1 (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 DC 3.3V. For more detail information pls. refer to the user manual.

Bluetooth Version: 5.1 EDR mode.

Antenna Type: Integral antenna.

Antenna Gain: 2.0dBi.

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

The nominal conducted output power specified: 12.0dBm (+/-3dB)

The nominal radiated output power (e.i.r.p) specified: 14.0dBm (+/- 3dB)

According to the KDB 447498:

The maximum peak radiated emission for the EUT is 108.4dB μ V/m at 3m in the frequency 2402MHz

The EIRP = $[(FS \cdot D)^2 / 30]$ mW = 13.17dBm
which is within the production variation.

The minimum peak radiated emission for the EUT is 106.1dB μ V/m at 3m in the frequency 2441MHz

The EIRP = $[(FS \cdot D)^2 / 30]$ mW = 10.87dBm
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 and OET 65, the simple calculation as below:

The source-based time averaged maximum radiated power=14dBm+3dBi = 17dBm
= 50.12mW

From above data, the exposed power density at a distance (R) of 20cm from the center of radiation of the antenna for 5.1 EDR mode can be calculated according to OET 65 as follow:

= 50.12mW / $4\pi R^2$
= 0.010 mW/cm²
<1mW/cm²

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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Bluetooth Version: 5.1 BLE mode.

Antenna Type: Integral antenna.

Antenna Gain: 2.0dBi.

Modulation Type: GFSK.

The nominal conducted output power specified: 3.0dBm (+/-3dB)

The maximum conducted output power for the EUT is 4.53dBm in the frequency 2402MHz which is within the production variation.

The minimum conducted output power for the EUT is 3.04dBm 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 and OET 65, the simple calculation as below:

The source-based time averaged maximum radiated power = 8dBm = 6.31mW

From above data, the exposed power density at a distance (R) of 20cm from the center of radiation of the 5.1 BLE band can be calculated according to

OET 65 as follow:

$$= 6.31\text{mW} / 4\pi R^2$$

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

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

The MPE limit is 1.0 mW/cm² for general population and uncontrolled exposure in the 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.

2.4GHz WiFi:

Antenna Type: Integral Antenna.

Antenna Gain: 3.1dBi.

Directional Gain: 6.1dBi

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

The nominal conducted output power specified: 14dBm (Tolerance: +/-3dB).

The minimum conducted output power for the EUT is 12.3dBm in the frequency 2412MHz(802.11 B mode) which is within the production variation.

The maximum conducted output power for the EUT is 15.7dBm in the frequency 2422MHz(802.11 n-HT40, MIMO mode) 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 and OET 65, the simple calculation as below:

The source-based time averaged maximum radiated power = 23.1dBm = 204.2mW

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:

$$= 204.2\text{mW} / 4\pi R^2$$

$$= 0.041 \text{ mW/cm}^2$$

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

The MPE limit is 1.0 mW/cm² for general population and uncontrolled exposure in the 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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5GHz WiFi:

Antenna Type: Integral Antenna.

Antenna Gain: 2.3dBi for each antenna

Directional Gain: 5.3dBi

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

The nominal conducted output power specified: 13dBm (Tolerance: +/-3dB).

The minimum conducted output power for the EUT is 11.51dBm in the frequency 5200MHz(802.11 N-HT20, SISO mode) which is within the production variation.

The maximum conducted output power for the EUT is 15.6dBm in the frequency 5755MHz(802.11 n-HT40, MIMO mode) 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 and OET 65, the simple calculation as below:

The source-based time averaged maximum radiated power = 21.3dBm =
134.900mW

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:

$$\begin{aligned} &= 134.900\text{mW} / 4\pi R^2 \\ &= 0.027 \text{ mW/cm}^2 \\ &< 1\text{mW/cm}^2 \end{aligned}$$

The MPE limit is 1.0 mW/cm² for general population and uncontrolled exposure in the 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.

For Simultaneous transmitting of 2.4GHz WiFi and 5GHz WiFi, According to 865664D02 2.2 d) 1):

The sum of the ratios of the spatially averaged results to the applicable frequency dependent MPE limits = $0.041/1 + 0.027/1 = 0.068 < 1$

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 = $0.041/1 + 0.010/1 = 0.051 < 1$

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 = $0.027/1 + 0.010/1 = 0.037 < 1$

For Simultaneous transmitting of 2.4GHz WiFi, Bluetooth and 5GHz WiFi, According to 865664D02 2.2 d) 1):

The sum of the ratios of the spatially averaged results to the applicable frequency dependent MPE limits = $0.041/1 + 0.010/1 + 0.027/1 = 0.078 < 1$

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.”