

INTERTEK TESTING SERVICES

RF Exposure

The Equipment Under Test (EUT) is a WIFI USB DONGLE which has Bluetooth and WiFi function, and WiFi operating at 2412-2462MHz for 802.11b/g/n-HT20, 11 channels with 5MHz channel spacing; 2422-2452MHz for 802.11n-HT20, 9 channels with 5MHz channel spacing; 5180 MHz - 5240 MHz for 802.11a/n/ac-HT20 with 4 channels, 5190 MHz ~ 5230 MHz for 802.11n/ac-HT40 with 2 channels and 5210 MHz for 802.11ac-HT80 with 1 channel. The EUT was powered USB port(DC 5V). The Device will automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signaling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. For more detailed features description, please refer to the user's manual.

Bluetooth Version: 4.0 BLE mode.

Antenna Type: Integral antenna.

Antenna Gain: 1.4dBi.

Modulation Type: GFSK.

The nominal conducted output power specified: -4.4dBm (+/-3dB)

The nominal radiated output power (e.i.r.p) specified: -3.0dBm (+/- 3dB)

According to the KDB 447498:

The maximum peak radiated emission for the EUT is 93.1dBμV/m at 3m in the frequency 2480MHz

The EIRP = $[(FS \cdot D)^2 / 30]$ mW = -2.13dBm
which is within the production variation.

The minimum peak radiated emission for the EUT is 90.2dBμV/m at 3m in the frequency 2440MHz

The EIRP = $[(FS \cdot D)^2 / 30]$ mW = -5.03dBm
which is within the production variation.

The maximum conducted output power specified is -1.4dBm = 0.72mW

The source-based time-averaging conducted output power
= 0.72 * Duty factor mW (where Duty Factor ≤ 1) = 0.72 mW

The SAR Exclusion Threshold Level:

= 3.0 * (min. test separation distance, mm) / sqrt(freq. in GHz)
= 3.0 * 5 / sqrt (2.480) mW
= 9.53 mW

Since the source-based time-averaging conducted output power is well below the SAR low threshold level, so the EUT is considered to comply with SAR requirement without testing.

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Bluetooth Version: 2.1+ EDR, 3.0.

Antenna Type: Integral antenna.

Antenna Gain: 1.4dBi.

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

The nominal conducted output power specified: 1.6dBm (+/-3dB).

The nominal radiated output power (e.i.r.p) specified: 3.0dBm (+/- 3dB)

According to the KDB 447498:

The maximum peak radiated emission for the EUT is 101.2dB μ V/m at 3m in the frequency 2480MHz

The EIRP = $[(FS \cdot D)^2 / 30]$ mW = 5.97dBm
which is within the production variation.

The minimum peak radiated emission for the EUT is 98.9dB μ V/m at 3m in the frequency 2441MHz

The EIRP = $[(FS \cdot D)^2 / 30]$ mW = 3.67dBm
which is within the production variation.

The maximum conducted output power specified is 4.6dBm = 2.88mW

The source- based time-averaging conducted output power
= 2.88 * Duty factor mW (where Duty Factor ≤ 1)
= 2.88mW

The SAR Exclusion Threshold Level:

= $3.0 \cdot (\text{min. test separation distance, mm}) / \sqrt{\text{freq. in GHz}}$
= $3.0 \cdot 5 / \sqrt{2.480}$ mW
= 9.53 mW

Since the source-based time-averaging conducted output power is well below the SAR low threshold level, so the EUT is considered to comply with SAR requirement without testing.

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2.4GHz WiFi:

Antenna Type: Integral Antenna.

Antenna Gain: 2.0dBi.

Directional Gain: 5dBi

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

The nominal conducted output power specified: 20dBm (Tolerance: +/-4dB).

5GHz WiFi:

Antenna Type: Integral Antenna.

Antenna Gain: 4.0dBi for each antenna

Directional Gain: 7dBi

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

The nominal conducted output power specified: 11dBm (Tolerance: +/-4dB).

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:

For 2.4GHz Band

The source-based time averaged maximum radiated power in MIMO mode =
 $20+4+5= 29\text{dBm} = 794.3\text{mW}$

For 5GHz Band

The source-based time averaged maximum radiated power in MIMO mode =
 $11+4+7= 22\text{dBm} = 158.5\text{mW}$

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:

$$= 794.3 / 4\pi R^2 \\ = 0.158 \text{ mW/cm}^2$$

From above data, the exposed power density at a distance (R) of 20cm from the center of radiation of the antenna for 5GHz band can be calculated according to OET 65 as follow:

$$= 158.5\text{mW} / 4\pi R^2 \\ = 0.032 \text{ mW/cm}^2$$

The MPE limit is 1.0 mW/cm^2 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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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 = $0.158/1 + 0.032/1 = 0.19 < 1$

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

For Bluetooth transmitter function:
The max. E.I.R.P.=6dBm=3.98mW

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

$$= 3.98\text{mW} / 4\pi R^2 \\ = 0.0008 \text{ mW/cm}^2$$

The sum of the ratios of the spatially averaged results to the applicable frequency dependent MPE limits = $0.158/1 + 0.0008/1 = 0.1588 < 1$

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 = $0.0008/1 + 0.032/1 = 0.0328 < 1$

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 = $0.0008/1 + 0.032/1 + 0.158/1 = 0.1908 < 1$

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.”