

# INTERTEK TESTING SERVICES

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## Analysis Report

The Equipment under Test (EUT) is a transmitter for the Cozmo Base Kit(Cozmo Robot) model: 000-00048 can operating at 2.4GHz band. It has Wi-Fi function operating at 2412-2462MHz for 802.11b/g/n(HT20MHZ), 11 channels with 5MHz channel spacing. The EUT is powered by rechargeable battery (DC 3.7V) which can be charged by USB port (DC 5V). For more detailed features description, please refer to the user's manual.

For transmitter function operating frequency is 2402MHz-2481MHz:

Modulation Type: GFSK

Antenna Type: Integral antenna

Antenna Gain: 0dBi

The nominal conducted output power specified: -4.0dBm (Tolerance: +/- 3dB)

The nominal radiated output power (e.i.r.p) specified: -4.0dBm (Tolerance: +/- 3dB)

According to the KDB 447498:

The maximum radiated emission for the EUT is 91.2dB $\mu$ V/m at 3m in the frequency 2.442GHz

$$= [(FS \cdot D)^2 / 30] \text{ mW}$$

= -4.03 dBm which is within the production variation.

The minimum radiated emission for the EUT is 90.4dB $\mu$ V/m at 3m in the frequency 2.402GHz

$$= [(FS \cdot D)^2 / 30] \text{ mW}$$

= -4.83dBm which is within the production variation.

The maximum conducted output power specified is -1.0 dBm = 0.8mW

The source- based time-averaging conducted output power

$$= 0.8 \cdot \text{Duty cycle mW} < 0.8 \text{ mW (Duty Cycle} < 100\%)$$

The SAR Exclusion Threshold Level:

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

$$= 3.0 \cdot 5 / \text{sqrt} (2.481) \text{ mW}$$

$$= 9.52 \text{ mW}$$

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.

The duty cycle is simply the on-time divided by the period:

The duration of one cycle = 35.0725ms

Effective period of the cycle = 1.0145ms

$$\text{DC} = 1.0145\text{ms} / 35.0725\text{ms} = 0.0289 \text{ or } 2.89\%$$

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For 2.4GHz Wi-Fi function operating frequency is 2412MHz-2462MHz

Modulation Type: CCK, BPSK, QPSK, 16QAM, 64QAM

Antenna Type: Integral antenna

Antenna Gain: 0dBi

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

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

According to the KDB 447498:

The maximum radiated emission for the EUT is in the frequency 2437MHz

$$= [(FS \cdot D)^2 / 30] \text{ mW}$$

= 4.7dBm which is within the production variation.

The minimum radiated emission for the EUT is in the frequency 2412MHz

$$= [(FS \cdot D)^2 / 30] \text{ mW}$$

= 3.9dBm which is within the production variation.

The maximum conducted output power specified is 6.0dBm = 3.98mW

The source- based time-averaging conducted output power

$$= 3.98 \cdot \text{Duty cycle mW} = 3.98 \text{ mW}$$

The SAR Exclusion Threshold Level:

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

$$= 3.0 \cdot 5 / \text{sqrt}(2.462) \text{ mW}$$

$$= 9.56 \text{ mW}$$

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.

Transmitter Duty Cycle Calculation

The EUT transmit continuously during the test, the duty cycle is 1.

This requirement is according to KDB 865664 D02.

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For both WiFi and 2.4GHz transmitter are simultaneous transmissions estimated:

According to the KDB 447498:

When both Wifi and 2.4GHz transmitter are simultaneous transmissions, the maximum conducted output power for 2.4GHz transmitter is -1.0 dBm.

In the simultaneous transmissions, 2.4GHz transmitter estimated SAR values:  
= (max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm) \* [sqrt(freq. in GHz)/7.5] W/kg  
= 0.8 / 5\*[sqrt (2.481) / 7.5] W/kg  
= 0.034W/kg

When both WiFi and 2.4GHz transmitter are simultaneous transmissions, the maximum conducted output power for WiFi is 6.0dBm.

In the simultaneous transmissions, WiFi's estimated SAR values:  
= (max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm) \* [sqrt(freq. in GHz)/7.5] W/kg  
= 3.98 / 5\*[sqrt (2.462) / 7.5] W/kg  
= 0.167 W/kg

Sum of 1-g SAR of all simultaneously transmitting antennas in an operating mode:

WiFi's estimated SAR values + 2.4GHz transmitter's estimated SAR values  
= 0.167 W/kg + 0.034 W/kg  
= 0.201 W/kg

The simultaneous transmissions SAR Evaluation:  $\leq 0.4$  W/kg

This requirement is according to KDB 865664 D02.