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Analysis Report

The Equipment under Test (EUT) is a transmitter for the Cozmo Base Kit(Cozmo Robot) model: 300-00046 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: 1.0dBm (Tolerance: +/- 3dB)
The nominal radiated output power (e.i.r.p) specified: 1.0dBm (Tolerance: +/- 3dB)

According to the KDB 447498:

The maximum radiated emission for the EUT is 98.5dBµV/m at 3m in the frequency 2.442GHz

$= [(FS*D) \char`\^2 / 30]$ mW

= 3.27 dBm which is within the production variation.

The minimum radiated emission for the EUT is 97.2dBµV/m at 3m in the frequency 2.481GHz

$= [(FS*D) \char`\^2 / 30]$ mW

= 1.97dBm 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,

For Maximum Permissible Exposure (MPE) evaluation of the product, the maximum power density at 20 cm from this transmitter shall be less than the General Population / Uncontrolled MPE limit in FCC Part 1.1310.

The maximum EIRP= 4dBm+0dBi=2.5mW
The source-based time averaged maximum radiated power = 2.5mW x Duty Cycle = 2.5mW x 20.23% = 0.5mW

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 65 as follow:
$= PG/4\pi R\char`\^2$
$= EIRP/4\pi R\char`\^2 = 0.5/ 4\pi R\char`\^2$
$=0.0001$ mW/cm^2

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The MPE limit is 1 mW/cm^2 for general population and uncontrolled exposure in the frequency of 2.4GHz 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.

The duty cycle is simply the on-time divided by the period:
The duration of one cycle   = 5.0145ms
Effective period of the cycle = 1.0145ms
DC = 1.0145ms / 5.0145ms = 0.2023 or 20.23%

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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: 17.0dBm (Tolerance: +/- 3dB)
The nominal radiated output power (e.i.r.p) specified: 17.0dBm (Tolerance: +/- 3dB)

The maximum conducted output power for the EUT is 19.4 dBm in the frequency 2.437GHz 802.11g mode which is within the production variation.

The minimum conducted output power for the EUT is 16.1 dBm in the frequency 2.462GHz 802.11b 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:

For Maximum Permissible Exposure (MPE) evaluation of the product, the maximum power density at 20 cm from this transmitter shall be less than the General Population / Uncontrolled MPE limit in OET Bulletin 65.

The maximum E.I.R.P= 17+3+0=20dBm=100mW
The source-based time averaged maximum radiated power = 100mW x Duty Cycle = 100mW

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:
= 100mW / 4πR^2
= 0.02 mW/cm^2

The MPE limit is 1.0 mW/cm^2 for general population and uncontrolled exposure in the Wi-Fi 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.

Transmitter Duty Cycle Calculation
The EUT transmit continuously during the test, the duty cycle is 1.

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."

Simultaneous transmissions for both WiFi function and 2.4GHz transmitter function

According to the KDB 447498:

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0, according to calculated/estimated, numerically modeled, or measured field strengths or power density.

When both WiFi and 2.4GHz transmitter are simultaneous transmissions, the exposed power density at a distance (R) of 20cm from the center of radiation of the 2.4GHz transmitter antenna is 0.0001 mW/cm^2.

When both WiFi and 2.4GHz transmitter are simultaneous transmissions, the exposed power density at a distance (R) of 20cm from the center of radiation of the WiFi antenna is 0.02 mW/cm^2

MPE Ratio = (0.0001 mW/cm^2 + 0.02 mW/cm^2)/1 mW/cm^2 = 0.0201 ≤ 1.0

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