Control4

MPE Calculations

Control4 Model: C4-EC100EXT

FCC ID: R33EC100
IC ID: 7848A-EC100

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1.0 SCOPE:

This Report Demonstrates Evaluation and Compliance to the following standards:

1. **Code of Federal Regulations Title 47, Volume 1, Section 1.1310.**
2. **Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands) - RSS-102 Issue 3**

2.0 REVISION LEVEL:

DATE	COMMENTS	REVISION
10/10/08	Created.	1.0
08/16/10	Added RSS-102 references	2.0

3.0 REFERANCE DOCUMENTS:

(A) Limits for Maximum Permissible Exposure (MPE). Code of Federal Regulations Title 47, Volume 1, Section 1.1310.
(B) Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields. OET Bulletin 67 Edition 97-01.
(C) Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands) - RSS-102 Issue 3

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4.0 CALCULATIONS:

The C4-EC100EXT contains 3 Transceiver's (802.11 b/g, Zigbee #1 & Zigbee #2). Below are the MPE calculations for all 3 Transceiver's.

802.11 b/g Transceiver

The following worst case emissions was calculated by using Method 1 below

Method 1: Based on a PPt (Peak Power Total) measurement of the total power into the antenna and the worst case antenna gain.

Effective/Equivalent Isotropic Radiated Power [EIRP] dBm = Total power into the antenna [dBm] + antenna gain [dBi]
To convert the values from dBm to mW
mW = $10^{dBm/10}$

Total power into the antenna (dBm) = 18.1
Antenna gain (dBi) = 0.33
EIRP (dBM) = 18.43
EIRP (mW) = 69.6 worst case while in the Wi-Fi "G" mode – power level at 15

Method 2: Based on the radiated field strength measurement at 3 meters [at a calibrated OATS site, maximizing the antenna polarity and height]

After obtaining the EIRP, the Power density is calculated and compared against the FCC and IC limits.

S_{FCC} = Power density in *mW/cm²* for FCC
S_{FCC} = EIRP/4π·R²
EIRP = Equivalent isotropically radiated power 69.6 *mW*
R = Distance to the center of radiation of the antenna *20 cm*
S_{FCC} = 0.014 mW/cm²

S_{FCC} Limit = 1.0 mW/cm²

S_{IC} = Power density in *W/m²* for IC
S_{IC} = EIRP/4π·R²
EIRP = Equivalent isotropically radiated power in watts 0.0696 *W*
R = Distance to the center of radiation of the antenna *0.2 m*
S_{IC} = 0.14 W/m²

S_{IC} Limit = 10 *W/m²* for IC

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Zigbee #1 Transceiver

The following worst case emissions was calculated by using Method 1 below

Method 1: Based on a PPt (Peak Power Total) measurement of the total power into the antenna and the worst case antenna gain.

Effective/Equivalent Isotropic Radiated Power [EIRP] dBm = Total power into the antenna [dBm] + antenna gain [dBi]
To convert the values from dBm to mW
$mW = 10^{dBm/10}$

Total power into the antenna (dBm) = 17.9
Antenna gain (dBi) = 0.67
EIRP (dBM) = 18.57
EIRP (mW) = 71.9 worst case power level at 3 and amplifier gain to 10

Method 2: Based on the radiated field strength measurement at 3 meters [at a calibrated OATS site, maximizing the antenna polarity and height]

After obtaining the EIRP, the Power density is calculated and compared against the FCC and IC limits.

S_{FCC} = Power density in *mW/cm^2* for FCC
$S_{FCC} = EIRP/4\pi \cdot R^2$
EIRP = Equivalent isotropically radiated power 71.9 *mW*
R = Distance to the center of radiation of the antenna *20 cm*
S_{FCC} = 0.014 mW/cm^2

S_{FCC} Limit = 1.0 mW/cm^2

S_{IC} = Power density in *W/m^2* for IC
$S_{IC} = EIRP/4\pi \cdot R^2$
EIRP = Equivalent isotropically radiated power in watts 0.0719 *W*
R = Distance to the center of radiation of the antenna *0.2 m*
S_{IC} = 0.14 W/m^2

S_{IC} Limit = 10 *W/m^2* for IC

Zigbee #2 Transceiver

The following worst case emissions was calculated by using Method 1 below

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Method 1: Based on a PPt (Peak Power Total) measurement of the total power into the antenna and the worst case antenna gain.

Effective/Equivalent Isotropic Radiated Power [EIRP] dBm = Total power into the antenna [dBm] + antenna gain [dBi]
To convert the values from dBm to mW
$mW = 10^{dBm/10}$

Total power into the antenna (dBm) = 18.2
Antenna gain (dBi) = 2.0
EIRP (dBM) = 20.2
EIRP (mW) = 104.7 worst case power level at -3 and amplifier gain to 20

Method 2: Based on the radiated field strength measurement at 3 meters [at a calibrated OATS site, maximizing the antenna polarity and height]

After obtaining the EIRP, the Power density is calculated and compared against the FCC and IC limits.

S_{FCC} = Power density in *mW/cm²* for FCC
$S_{FCC} = EIRP/4\pi \cdot R^2$
EIRP = Equivalent isotropically radiated power 104.7 *mW*
R = Distance to the center of radiation of the antenna *20 cm*
S_{FCC} = 0.021 mW/cm²

S_{FCC} Limit = 1.0 mW/cm²

S_{IC} = Power density in *W/m²* for IC
$S_{IC} = EIRP/4\pi \cdot R^2$
EIRP = Equivalent isotropically radiated power in watts 0.1047 *W*
R = Distance to the center of radiation of the antenna *0.2 m*
S_{IC} = 0.21 W/m²

S_{IC} Limit = 10 *W/m²* for IC

5.0 CONCLUSION:

1. **Based upon the limits for Maximum Permissible Exposure (MPE) given in Table 1 of reference document (A) as 1mW/cm², this device falls under the required limits.**
2. **Based upon the limits given in section 4.2 of the reference document (C) as 10W/m², this device falls under the required limits.**

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