



MPE Calculations

Control4 Model: C4-EC100EXT

FCC ID: R33EC100
IC ID: 7848A-EC100

1.0	SCOPE	3
2.0	REVISION LEVEL	3
3.0	REFERENCE DOCUMENTS	3
4.0	CALCULATIONS	4
5.0	CONCLUSION	4

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 REFERENCE 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**

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

$$\text{mW} = 10^{\text{dBm}/10}$$

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/cm^2 for FCC

$$S_{\text{FCC}} = \text{EIRP}/4\pi \cdot R^2$$

EIRP = Equivalent isotropically radiated power 69.6 mW

R = Distance to the center of radiation of the antenna 20 cm

$$S_{\text{FCC}} = 0.014 \text{ mW}/\text{cm}^2$$

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

S_{IC} = Power density in W/m^2 for IC

$$S_{\text{IC}} = \text{EIRP}/4\pi \cdot R^2$$

EIRP = Equivalent isotropically radiated power in watts 0.0696 W

R = Distance to the center of radiation of the antenna 0.2 m

$$S_{\text{IC}} = 0.14 \text{ W}/\text{m}^2$$

$$S_{\text{IC}} \text{ Limit} = 10 \text{ W}/\text{m}^2 \text{ for IC}$$

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

$$\text{mW} = 10^{\text{dBm}/10}$$

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

$$S_{\text{FCC}} = \text{EIRP}/4\pi \cdot R^2$$

EIRP = Equivalent isotropically radiated power 71.9 mW

R = Distance to the center of radiation of the antenna 20 cm

$$S_{\text{FCC}} = 0.014 \text{ mW}/\text{cm}^2$$

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

S_{IC} = Power density in W/m^2 for IC

$$S_{\text{IC}} = \text{EIRP}/4\pi \cdot R^2$$

EIRP = Equivalent isotropically radiated power in watts 0.0719 W

R = Distance to the center of radiation of the antenna 0.2 m

$$S_{\text{IC}} = 0.14 \text{ W}/\text{m}^2$$

$$S_{\text{IC}} \text{ Limit} = 10 \text{ W}/\text{m}^2 \text{ for IC}$$

Zigbee #2 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

$$\text{mW} = 10^{\text{dBm}/10}$$

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/cm^2 for FCC

$$S_{\text{FCC}} = \text{EIRP}/4\pi \cdot R^2$$

EIRP = Equivalent isotropically radiated power 104.7 mW

R = Distance to the center of radiation of the antenna 20 cm

$$S_{\text{FCC}} = 0.021 \text{ mW}/\text{cm}^2$$

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

S_{IC} = Power density in W/m^2 for IC

$$S_{\text{IC}} = \text{EIRP}/4\pi \cdot R^2$$

EIRP = Equivalent isotropically radiated power in watts 0.1047 W

R = Distance to the center of radiation of the antenna 0.2 m

$$S_{\text{IC}} = 0.21 \text{ W}/\text{m}^2$$

$$S_{\text{IC}} \text{ Limit} = 10 \text{ W}/\text{m}^2 \text{ for IC}$$

5.0 CONCLUSION:

- 1. Based upon the limits for Maximum Permissible Exposure (MPE) given in Table 1 of reference document (A) as $1\text{mW}/\text{cm}^2$, this device falls under the required limits.**
- 2. Based upon the limits given in section 4.2 of the reference document (C) as $10\text{W}/\text{m}^2$, this device falls under the required limits.**