RF Exposure Evaluation

Maximum Permissible Exposure Evaluation

for

MC906R RFID Reader

FCC ID: H9PMC906RC

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WLL PROJECT #: 8596

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1.0 Introduction

This report has been prepared on behalf of Symbol Technologies, Inc. Model: MC906R mobile computer transceiver to show compliance with the RF exposure requirements as defined in FCC §1.1307.

The Symbol MC906R mobile computer contains an 802.11b WLAN card and an RFID reader operating at 902M – 928MHz.

1.1 Requirements

Three different categories of transmitters are defined by the FCC in OET Bulletin 65. These categories are fixed installation, mobile, and portable and are defined as follows:

- **Fixed Installations:** fixed location means that the device, including its antenna, is physically secured at a permanent location and is not able to be easily moved to another location. Additionally, distance to humans from the antenna is maintained to at least 2 meters.

- **Mobile Devices:** a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to be generally used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structures and the body of the user or nearby persons. Transmitters designed to be used by consumers or workers that can be easily re-located, such as a wireless modem operating in a laptop computer, are considered mobile devices if they meet the 20 centimeter separation requirement. The FCC rules for evaluating mobile devices for RF compliance are found in 47 CFR §2.1091.

- **Portable Devices:** a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user. Portable device requirements are found in Section 2.1093 of the FCC's Rules (47 CFR§2.1093).

For this test report the Symbol MC906R mobile computer system with 6dBi antenna is classified as a “Mobile Device”. As this device is being approved as a mobile device the MPE will be evaluated at the 20cm test distance.

- The FCC also categorizes the use of the device as based upon the user's awareness and ability to exercise control over his or her exposure. The two categories defined are Occupational/ Controlled Exposure and General Population/Uncontrolled Exposure.

Since there are no warnings or training associated with this unit and it can be used by anyone, the Symbol MC906R mobile computer transceiver is evaluated to the General Population/Uncontrolled Exposure limits.

The two limits applicable for the MC906R are as follows:

RFID Device operating at 902M – 928MHz: 0.601mW/cm^2

WLAN Device operating at 2412M – 2462MHz: 1mW/cm^2

As a composite device, each transmitters Power Density is calculated and compared to its respective limit. The percentages of each level to its respective limit are then added together and the total percentage must be less than 100% to ensure compliance with the MPE limits.

1.2 Radio Frequency Radiation Exposure Evaluation

The highest RF output power of the unit was measured at 38.5mW at 2462MHz. The highest RF power measured for the RFID unit is 29.8dBm (955mW) at 927.225MHz. According to §1.1310 of the FCC rules, the power density limit for General Population/Uncontrolled Exposure at 902.75MHz is 0.601mW/cm^2. For the 802.11b card the limit is 1mW/cm^2. As this is a mobile device the MPE shall be calculated at 20cm to show compliance with the power density limit. The following formula was used to calculate the minimum safe distance:

$$S = \frac{PG}{4\pi R^2}$$

Where:
S = Power Density
P = Output Power at the Antenna Terminals
G = Gain of Transmit Antenna (linear gain)
R = Distance from Transmitting Antenna

1. For the 802.11b card device, the calculation is as follows:
   R = 20cm
   P = Output Power = 38.5mW
   G = Worst Case Gain = 1dBi = INVLOG(1/10) = 1.26

$$S = \frac{(38.5)\times(1.26)}{4\times\pi\times(20)^2} = 0.0097 \text{ mW/cm}^2 \text{ (Based on continuous transmission)}$$

This represents a 0.97% in reference to the allowable limit of 1mW/cm^2.

2. For the RFID device, the calculation is as follows:
   R = 20cm
   P = Output Power = 995mW (Continuous transmission) Per the theory of operation the transmitter is limited to a duty cycle of 73% maximum. This results in a time averaging reduction of 1.25dB or:
   $P_{75\%DC}$ = 995 x 0.73 = 726.4mW
   G = Worst Case Gain = 6dBi = INVLOG(6/10) = 4

$$S = \frac{(726.4)\times(4)}{4\times\pi\times(20)^2} = 0.578 \text{ mW/cm}^2 \text{ (Based on 75\% Operation)}$$

   This represents a 96.2% in reference to the allowable limit of 0.601mW/cm^2.

Adding the total percentages together gives a 97.2% of the total allowable MPE. Thus the MC906R complies with the MPE requirements at 20cm for a mobile unit with co-located devices.

Figure 1. Separation Distance to Antenna