

## RF Exposure/Environmental Evaluation

The CR1000RF (FCC ID: PII-CR1000) being submitted by Vantage Controls contains a low power frequency hopping spread spectrum transceiver. It operates in the 902-928 MHz ISM band. It has been developed by Vantage Controls to add wireless capabilities to the Vantage control system. The following calculations determine the minimum separation between the user and the antenna to meet the requirements for Maximum Permissible Exposure (MPE) outlined in CFR 47 Section 1.310.

CFR 47 Section 1.310 specifies (A) Limits for Occupational/Controlled Exposures and (B) Limits for General Population/Uncontrolled Exposure. The limits in (B) are the most stringent, so these are what we will use in our calculation.

From CFR 47 Section 1.310 Table 1 (B):

For 300-1500 MHz the limit is given in  $\text{mW}/\text{cm}^2$  and is calculated from the following equation:  $\text{Frequency}/1500$   
For our frequency range (902-928 MHz) the worst case limit comes out to  **$0.6\text{mW}/\text{cm}^2$** .

The MPE distance will be calculated for the worst case of a 100% transmitter duty cycle, transmitter power of 21.5dBm (141.3mW), and 2dBi (1.5849) antenna gain.

For an isotropic radiator, the surface area of a sphere can be used to determine the area over which the transceiver energy is radiated.

$$\text{Surface area of a sphere} = 4 * \pi * \text{radius}^2$$

In the case where there is an antenna gain, the worst-case energy density is increased by the antenna gain. In this case, the exposure level for a controlled environment can be calculated as follows:

$$\text{MPE distance} = ((\text{output power} * \text{duty cycle} * \text{antenna gain}) / (4 * \pi * \text{ExposureLimit}[\text{mw}/\text{cm}^2]))^{1/2}$$

For our device

$$\begin{aligned} \text{MPE distance} &= ((141.3 * 1 * 1.5849) / (4 * \pi * 0.6))^{1/2} \\ &= \mathbf{5.45 \text{ cm}} \end{aligned}$$

To comply with this requirement, Vantage Controls will specify a minimum distance between the user and the antenna of **20 cm**. The CR1000RF complies with this requirement when properly installed. The device is normally installed in a mechanical room or closet. Vantage products are professionally installed. Instruction is provided in the installation guide that is given to both the installer and the end user. A sample of this information is shown here:

**IMPORTANT:** *In order to comply with the FCC RF exposure requirements, this product must be installed and operated in such a way that a minimum separation distance of 20*

*cm (approximately 8 inches) is maintained from the antenna to any persons. Operations that do not meet these requirements must be avoided.*

With these restrictions, the CR1000RF is considered a “mobile device” as defined in §2.1091(b).

Therefore, the Vantage CR1000 (FCC ID: PII-CR1000) complies with the FCC RF Exposure/Environmental Evaluation requirements.

It should be noted that the above calculations are based on absolute worst-case scenarios that will rarely occur in normal use. This is a Time-Division-Duplex system, so the transmitter duty cycle will never be 100%, and the transmitter power was measured during compliance testing to be slightly less than 21.5 dBm (refer to the test report).