

### 1.1.1. RF EXPOSURE

Test Type:	Maximum Permissible Exposure
FCC Para No.:	1.1310, 2.1093
Tested By:	Paul Eberling
Date:	January 13, 2004

#### 1.1.1.1. SPECIFICATION REQUIREMENT:

As per FCC 47CFR§1.1301; FCC OET Bulletin 65, 97-01 "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" and FCC OET Bulletin 65, Supplement C, 01-01, "Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", for transmitters operating in the 824-849 MHz range, paragraph 1.1310 Table 1 limits maximum permissible exposure (MPE) to  $f/1500 \text{ mW/cm}^2$  for uncontrolled environments and  $f/300 \text{ mW/cm}^2$  for controlled environments.

The far field on-axis power flux density ( $\text{W/m}^2$ ) is calculated using the following formula:

$$S = G P_T / 4\pi R^2 \quad [6]$$

Where:

- S = Power density (in appropriate units, e.g.  $\text{mW/cm}^2$ )
- G = Power gain of the antenna in the direction of interest relative to an isotropic radiator
- $P_T$  = Power input to the antenna (in appropriate units, e.g., mW)
- R = Distance to the center of radiation of the antenna (appropriate units, e.g., cm)

It is important to note that the power gain factor, **G**, in Equation (1) is normally **numeric** gain. Therefore, when power gain is expressed in logarithmic terms, i.e., dB, a conversion is required using the relation:

$$G = 10^{(\text{dB}/10)} \quad [7]$$

For example, a logarithmic power gain of 14 dB is equal to a numeric gain of 25.12.

#### 1.1.1.2. CR100 CELLULAR SIGNAL AMPLIFIER PARTICULARS

The following table shows the maximum downlink output power of the signal amplifier combined with an antenna with 9dBi gain. This is the maximum antenna gain permissible for the downlink signal as documented in the user/installation manual. The following table also shows the maximum uplink output power of the signal amplifier combined with an antenna with 18dBi gain. This is the maximum antenna gain permissible for the uplink signal as documented in the user/installation manual. The resulting radiated power density is compared to MPE limits for both uncontrolled and controlled environments to prove compliance to both limits.

**Applicant:** Arrista Technologies Inc.

**Equipment:** CR100 Bi-Directional Cellular Signal Amplifier

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#### 1.1.1.3. UP LINK (824-849MHz)

##### Uplink MPE Calculations

<b>Output power of the amplifier:</b>	0.10 W maximum	
<b>Antenna Gain:</b> Maximum antenna gain allowed as described in user/installation manual.	Isotropic Gain = 18 dBi Numerical Gain = 63.1	
<b>Operational Frequency:</b>	824-849MHz	
<b>Minimum distance (Controlled):</b> From radiating source for personnel aware of radio frequency equipment and who are able to limit their exposure time. (Installation Technicians)	50cm Antenna mounted in building exterior	
<b>Minimum distance (Uncontrolled):</b> From radiating source for personnel unaware of radio frequency equipment and who are not able to limit their exposure time. (General Public)	50cm Antenna mounted in building exterior	
<b>Calculated RF Power Density:</b>	0.201 mW/cm <sup>2</sup>	
<b>Maximum Permissible Exposure (MPE):</b>	<b>Controlled</b> 6 min avg exposure 2.75mW/cm <sup>2</sup>	<b>Uncontrolled</b> 30 min avg exposure 0.55mW/ cm <sup>2</sup>

#### 1.1.1.4. TEST RESULTS:

**Complies**

#### 1.1.1.5. CALCULATIONS

$$S = G P_T / 4\pi R^2 \quad [8]$$

$$S = (63.1 * 0.10 * 10^3) / (4\pi * 50^2)$$

$$S = 6300 / (10000\pi)$$

$$S = 0.201 \text{ mW/cm}^2$$

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**Equipment:** CR100 Bi-Directional Cellular Signal Amplifier

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#### 1.1.1.6. DOWN LINK (869-894MHz)

##### Downlink MPE Calculations

<b>Output power of the amplifier:</b>	0.03 W maximum	
<b>Antenna Gain:</b> Maximum antenna gain allowed as described in user/installation manual.	Isotropic Gain = 9 dBi Numerical Gain = 7.94	
<b>Operational Frequency:</b>	869-894MHz	
<b>Minimum distance (Controlled):</b> From radiating source for personnel aware of radiofrequency equipment and who are able to limit their exposure time. (Installation Technicians)	20cm Antenna mounted on building interior	
<b>Minimum distance (Uncontrolled):</b> From radiating source for personnel unaware of radiofrequency equipment and who are not able to limit their exposure time. (General Public)	20cm Antenna mounted on building interior	
<b>Calculated RF Power Density:</b>	0.051 mW/cm <sup>2</sup>	
<b>Maximum Permissible Exposure (MPE):</b>	<b>Controlled</b> 6 min avg exposure 2.90mW/cm <sup>2</sup>	<b>Uncontrolled</b> 30 min avg exposure 0.58mW/ cm <sup>2</sup>

#### 1.1.1.7. TEST RESULTS:

**Complies**

#### 1.1.1.8. CALCULATIONS

$$S = G P_T / 4\pi R^2 \quad [9]$$

$$S = (7.94 * .03 * 10^3) / (4\pi * 20^2)$$

$$S = 254.1 / (1600\pi)$$

$$S = 0.051 \text{ mW/cm}^2$$

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**Equipment:** CR100 Bi-Directional Cellular Signal Amplifier

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