

**Evaluation of the CSI Model 510-AP BDA  
For  
Compliance with FCC Guidelines  
For Human Exposure to Radio Frequency  
Electromagnetic Fields**

22 June 2006

## ***General***

The CSI Model 510-AP Bi-directional amplifier is considered to be a dual-band “mobile” device operating in both the Cellular Service authorized under subpart H of part 22 and in the Personal Communication Service authorized under part 24. As such, the equipment is required to be evaluated for RF exposure if operated below 1.5 GHz with an effective radiated power (ERP) of 1.5 watts or more or if operated above 1.5 GHz with an effective radiated power (ERP) of 3.0 watts or more, as defined in 2.1091 of FCC rules.

## ***Downlink***

For the downlink portion of the Model 510-AP BDA, the maximum rated output power is +26dbm (398 mW) in the Cellular Band (<1.5 GHz) and 21 dBm (126 mW) in the PCS band (>1.5 GHz). As stated in the Model 510-AP Manual, the maximum authorized indoor antenna gain is 3 dBi, corresponding to a typical Multi-Band Omni-Directional antenna. The Table below shows the results of the calculated ERP for both cases, neglecting cable losses.

| Frequency     | Power Out | Ant Gain | EIRP   | ERP    | Limit |
|---------------|-----------|----------|--------|--------|-------|
| 869-894 MHz   | 26 dBm    | 3 dBi    | 29 dBm | 485 mW | 1.5 W |
| 1930-1990 MHz | 21 dBm    | 3 dBi    | 24 dBm | 153 mW | 3.0 W |

In both the above cases the ERP is well below the allowable limits excluding the downlink from routine evaluation.

The Cautions in the Model 510-AP manual clearly define the antenna selection and installation criteria in order to maintain a minimum 20-centimeter separation.

## ***Uplink***

For the downlink portion of the Model 510-AP BDA, the maximum rated output power is +26dbm (398 mW) in the Cellular Band (<1.5 GHz) and 21 dBm (126 mW) in the PCS band (>1.5 GHz). As stated in the Model 510-AP Manual, the maximum authorized outdoor antenna gain is 11 dBi, corresponding to a typical Multi-Element Yagi-Directional antenna. The Table below shows the results of the calculated ERP for both cases, neglecting cable losses.

| Frequency     | Power Out | Ant Gain | EIRP   | ERP     | Limit |
|---------------|-----------|----------|--------|---------|-------|
| 824-849 MHz   | 26 dBm    | 11 dBi   | 37 dBm | 3050 mW | 1.5 W |
| 1850-1910 MHz | 21 dBm    | 11 dBi   | 32 dBm | 966 mW  | 3.0 W |

As shown in the above table, only the Cellular (824-849) exceeds the allowable limit and must be evaluated for minimum separation distances in order to comply with the exposure limits of 1.1310 of the FCC rules.

Using the guidelines in FCC OET Bulletin 65 and Supplement C, the power density at a reasonable distance from the maximum gain antenna was calculated. The minimum safe distance was also determined based on the uncontrolled exposure limits defined in Table 1B of FCC rules 1.1311. The following assumptions are made concerning these calculations:

Po = 398 mw average  
Cable Loss = 0 dB  
Ant Gain = 11 dBi  
Frequency = 836.5 MHz  $\pm$  12.5 MHz  
Main Beam (worst-case)  
Rooftop 100% reflection  
Reasonable Distance = 4 feet (120 cm)

Therefore, from OET Bulletin 65,

$$S = (PG)/4\pi R^2 \quad \text{or} \quad S = EIRP/4\pi R^2$$

For 100% reflection, a doubling of the field strength can be expected. The above equation can be modified to,

$$S = (2)^2 PG/4\pi R^2 = EIRP/\pi R^2$$

Solving for S at a distance of 4 feet (120 cm) gives,

$$S = (398) (12.6) / \pi (120)^2 = \boxed{0.11 \text{ mw/cm}^2}$$

From FCC rules 1.1311, Table 1B, the allowable limit for uncontrolled exposure is  $f(\text{MHz}) / 1500$ . At 836.5 MHz this corresponds to a level of  $0.56 \text{ mw/cm}^2$ .

The calculated value of 0.11 is below the limit of 0.56 thereby showing compliance under worst-case operating conditions.

When the above equation is solved for minimum separation at the exposure limit,

$$R = \sqrt{(398) (12.6) / \pi (0.54)} = 54 \text{ cm (1.8 feet)}.$$

As in the case of the downlink, the Cautions in the Model 510-AP manual clearly define the antenna selection and installation criteria in order to maintain a conservative 4-foot separation.