Evaluation of the CSI Model DSP85-1W-C Frequency Programmable Repeater For Compliance with FCC Guidelines For Human Exposure to Radio Frequency Electromagnetic Fields

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General

The CSI Model DSP85-1W-C Repeater is considered to be a "mobile" device operating in the Cellular Service authorized under subpart H of part 22. 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, as defined in 2.1091 of FCC rules.

Downlink

For the downlink portion of the Model DSP85-1W-C, the maximum rated output power is +30dBm (1000 mW). As stated in the Model DSP85-1W-C Manual, the maximum authorized antenna gain is 3 dBi, corresponding to an Omni-Directional antenna. Neglecting cable losses, the worst-case EIRP will be 2.0 watts or an ERP of 1.22 watts, (ERP=EIRP/1.64). This is well below the 3.0 watts ERP limit and therefore excludes the downlink from routine evaluation. The Cautions in the Model DSP85-1W-C manual clearly define the antenna selection and installation criteria in order to maintain a minimum 20-centimeter separation.

Uplink

For the uplink portion of the Model DSP85-1W-C, the maximum rated output power is +30dBm (1000 mW). As stated in the Model DSP85-1W-C Manual, the maximum authorized antenna gain is 14 dBi, corresponding to a Multi Element Yagi-Directional or Corner Reflector antenna. Neglecting cable losses, the worst-case EIRP will be 25.1 watts or an ERP of 15.3 watts. Under these conditions the unit 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 = 1000 mw average
                             Cable Loss = 0 dB
                             Ant Gain = 11.8 dBd (14 dBi)
                             Frequency = 824-849 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,

$$S = (1000)\,(25)/\,\pi\,(120)^2 = \boxed{0.55 \text{ mw/cm}^2}$$

From FCC rules 1.1311, Table 1B, the allowable limit for uncontrolled exposure is $f(MHz)/1500$ mw/cm^2 in the frequency range of 300 to 1500 MHz. At 850 MHz this corresponds to 0.57 mw/cm^2.

The calculated value of 0.55 is below the limit of 0.57 thereby showing compliance under worst-case operating conditions.

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

$$R = \sqrt{(1000)\,(25)/\,\pi\,(1.0)} = 89 \text{ cm (3.0 feet)}.$$

As in the case of the downlink, the Cautions in the Model DSP85-1W-C manual clearly define the antenna selection and installation criteria in order to maintain a conservative 4-foot separation.