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MODEL 110_{amps} Mini-BDA
Circuit Description

Uplink

The uplink RF circuit consists of two stages of gain. Each gain stage is a monolithic integrated circuit (mmic) mounted to a printed circuit board (PCB). The signal received by the inside antenna is directed to the 1st mmic stage by a frequency diplexer, which separates the uplink frequency (824-849 MHz) from the downlink frequency (869-894MHz). This signal is amplified by both mmic stages and directed to an identical diplexer at the output of the 2nd stage. Both stages are biased for linear operation. The overall gain from the inside antenna terminal to the outside antenna terminal is nominally 40 dB. Each diplexer provides 60 dB of rejection between the uplink amplifier chain and the downlink.

Downlink

The downlink circuit is similar in operation to the uplink, in that it also uses two stages of mmic amplification. The major differences are the downlink frequency (869-894 MHz), a band-pass filter and signal flow in the opposite direction.

Power Supply

All the mmic amplification stages, in both the uplink and downlink, operate from a single supply voltage of +5 Vdc. All internal dc circuits are filtered and de-coupled from the RF circuits. A 115 Vac to 5 Vdc "Wall" supply is provided as part of the unit. The overall current at 5 Vdc is less than 1.0 Amp.

Evaluation of the CSI Model 110$_{amps}$ BDA For Compliance with FCC Guidelines For Human Exposure to Radio Frequency Electromagnetic Fields

30 December 1999

General

The CSI Model 110_{amps} Bi-directional amplifier is considered to be a "mobile" device operating in the Specialized Mobile Radio 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 110_{amps} BDA, the maximum rated output power is +17dBm (50 mW). As stated in the Model 110 Manual, the maximum authorized antenna gain is 3 dBi, corresponding to a typical Omni-Directional antenna. Neglecting cable losses, the worst-case EIRP will be 0.10 watts or an ERP of 0.06 watts, (ERP=EIRP/1.64). This is well below the 1.5 watts and therefore excludes the downlink from routine evaluation. The Cautions in the Model 110_{amps} 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 BDA the maximum rated output power is +27 dBm (500 mW). With an authorized maximum antenna gain of 11 dBd, the worst-case ERP is 6.3 watts, neglecting cable losses between the antenna and BDA. 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 = 500 mW average
Cable Loss = 0 dB
Ant Gain = 11 dBd (13.2 dBi)
Frequency = 815 MHz $\pm$ 10 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,

$$S = (500)\ (20.9)/\ \pi\ (120)^2 = \boxed{0.23\ mw/cm^2}$$

From FCC rules 1.1311, Table 1B, the allowable limit for uncontrolled exposure is f(MHz) / 1500. At 815 MHz this corresponds to a level of 0.54 mw/cm^2.

The calculated value of 0.23 is below the limit of 0.54 thereby showing compliance under worst-case operating conditions.

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

$$R = \sqrt{(500)\ (20.9)/\ \pi\ (0.54)} = 78\ cm\ (2.6\ feet).$$

As in the case of the downlink, the Cautions in the Model 110 *amps* manual clearly define the antenna selection and installation criteria in order to maintain a conservative 4-foot separation.

MODEL 110amps mini-BDA POWER PER CHANNEL

Channels	UpLink dBm	DownLink dBm
1	23.0	17
2	19.0	13.0
3	16.7	10.7
4	15.0	9.0
5	13.7	7.7
6	12.7	6.7
7	11.8	5.8
8	11.0	5.0
9	10.3	4.3
10	9.7	3.7
11	9.2	3.2
12	8.7	2.7
13	8.2	2.2
14	7.8	1.8
15	7.4	1.4
16	7.0	1.0
17	6.6	0.6
18	6.3	0.3
19	6.0	0.0
20	5.7	-0.3

Power per Channel-AMPS.xls 1/3/00

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