Section 15.247 (b) (5), RF radiation hazard

As of October 15, 1997, all products must address the issue of Human Exposure to RF electromagnetic fields. Referring to OET Bulletin 65, the limits for occupational exposure, and General Population exposure are 5 mW/cm ^{2} and 1 mW/cm ^{2}, respectively, above 1.5 GHz.

The Link CX radio transmits a maximum output power of +16 dBm (40 mW) at 5.8 GHz. The 5.8 GHz version of the Link CX can be used with three different antennas: a 21 dBi integrated panel antenna, and either a 2-ft. (28 dBi), or a 4-ft. (34.6 dBi) external parabolic antenna. Once again, to assume worst case radiation numbers, the gain numbers from the 4-ft. antenna will be used. The 34.6 dBi gain of the 4-ft. antenna has a decimal gain (G) of 2884, i.e. $10^{36.4/10}$. The duty cycle of the transmitter is 100%. A maximum EIRP of +50.6 dBm would occur at the site when the radio is operating in a fixed, point to point configuration.

RF power density can be calculated with the equation: $S = P * G / 4\pi R^2$, where S = power density in mW/cm, P = power input to the antenna in mW, G = power gain of the antenna, and R = distance to the center of radiation of the antenna in cm. By rearranging this equation, the relationship between distance (R) and Power Density (S) can be found.

Rearranging $R = \sqrt{(PG / 4\pi S)}$, and solving for the maximum limits of 5 mW/ cm ^{2}, and 1 mW/ cm ^{2} we have:

$R(5\ mW/cm^2) = \sqrt{}\ 40\ mW * 2884 / 4\pi * 5 = 43$ cm, or 17 inches.

$R(1\ mW/cm^2) = \sqrt{}\ 40\ mW * 2884 / 4\pi * 1 = 96$ cm, or 37 inches.

These results show that the general population RF exposure limits are not exceeded as long as the general population is kept 37-inches from the feed point of the antenna.

The propagation characteristics at 5.8 GHz dictate a line-of-sight type of RF path. As such, typical installation locations are up on rooftops or masts to get above ground level path obstructions. When the Link CX is installed in this manner, the general population will be further than 37-inches from the antenna, and RF exposure limits will be met.

As this application is being processed by a Telecommunications Certification Body there is a requirement that the antenna be installed in such a way that the general population is kept at least 2 meters, or 78 inches away from the main beam radiation of the antenna.

The Link CX is intended for professional installation only, and the product's manual contains appropriate warnings concerning RF exposure, and instructions to place and mount the antenna to maintain a minimum of 2 meters, or 78 inches from general population contact.

RF exposure – Installation issues

The Link CX is intended to be installed and mounted with the DC power off to avoid any RF exposure potential. Appropriate instructions are supplied in the product manual.

After the unit is mounted, the antenna must be aligned with the other end of the link. While a compass is used for rough alignment, final alignment of the antenna is done by monitoring the strength of the signal from the far end of the link. As the Link CX is a full duplex unit, there is a potential for exposure to RF energy during the antenna alignment process.

The manual cautions the installer to always remain behind the antenna during the alignment process. If the integral antenna is used, the entire Link CX enclosure is rotated in elevation and azimuth to align the antenna.

The following section will calculate the RF exposure potential to the installer during antenna alignment. The gain of each of the antennas has been modified by the specified front to back ratio as specified by the antenna manufacture.

As each of the antennas has different front-to-back ratios, the gain (loss) numbers will be examined for each of the antennas.

Antenna type	Gain (dBi)	Front to Back Ratio (dB)	Net Backwards Gain (dBi)
Integral antenna	+21.0	30	-9.0
RadioWaves SP2-5.2, 2-ft. parabolic	+28.3	36	-7.7
Gabriel SSP2-52B, 2-ft. parabolic	+28.5	38	-9.5
Gabriel SSP4-52B, 4-ft parabolic	+34.6	46	-11.4

The worst case number of –7.7 dBi (G = .169) will be used to examine the exposure potential to the installer.

Once again, using the equations from the previous section, the minimum distances that meet the RF exposure guidelines are:

$R(5\ mW/cm^2) = \sqrt{40\ mW * .169 / 4\pi * 5} = .33$-cm, or .13-inches.

$R(1\ mW/cm^2) = \sqrt{40\ mW * .169 / 4\pi * 1} = .73$-cm, or .29-inches.

These equations show that RF exposure guidelines are complied with as long as the installer remains at least 1-cm (rounded) behind the primary reflector of the antenna during the alignment process.

In the case of the external antennas, the mounting structure and pole normally preclude the installer from getting this close to the back of the antenna. The integral antenna and its reflector is mounted on one side of the Link CX enclosure. The 7-cm thickness of the

Link CX enclosure prevents the installer from getting close to the reflector of the antenna.

The manual cautions the installer to always align the antenna from the backside, and to avoid exposure from the front of the antenna. Instructions are also provided to the installer to minimize the time spent aligning antennas to further reduce the RF exposure potential.