Technical-information report relevant to the requirements on the electromagnetic emission and compatibility with the human health of the ERICSSON Mini-Link BAS radio equipment.

1 INTRODUCTION

The present document states the main characteristics of a terminal radio equipment of the Ericsson MINI-LINK BAS Point to Multipoint, with the purpose to evaluate the compliance with the **FCC exposure requirement 47CFR 1.1310.**

The system is composed by a node and by remote terminals. The node consists of a radio equipment that transmits/receives in the frequency band 31÷31.3 GHz through antennas installed on a mast. Each antenna radiate a 90° beam in azimuth so as to cover the surrounding area at 360°.

The terminals are installed on each remote site, composed by the same node radio equipment, but with directive antennas.

The installation has to guarantee the line-of-sight between the node antenna and each terminal antenna: such fact together with the antenna beam characteristics in elevation guarantee that in any way the building, or the node or terminals surrounding areas, cannot be exposed to electromagnetic fields of significant amount.

Notice that the terminal transmitter does not work continuously but it is switched.

2 TERMINAL STATION

2.1 INSTALLATION AREA

An antenna, with integrated transmission equipment, is installed on the roof, as seen in Section 3.3.

2.2 TECHNICAL DATA

- Operation frequency band: 31~31.3 GHz
- Channel band: 28 MHz
- Max antenna input power: 22.7 dB_m
- Max antenna gain (@0°): 35.5 dB_i
- Antenna diameter: 0.24 m
- Antenna beam width (-3dB): 3.4°
- Antenna gain @45°: 1 dB
- Antenna gain @90°: -18 dB
- EIRP on the max. radiation direction: 58.5 dB_m
- EIRP @45°: 24 dB_m
- EIRP @90°: 5 dB_m

2.3 ELECTROMAGNETIC FIELDS EVALUATION

The **47CFR 1.1301**, states the electromagnetic field exposure limit for the population, as applicable to fixed radio telecommunications and broadcasting systems.

The limit values foreseen by the above document, in the 1.5-100 GHz frequency band, where Ericsson MINI-LINK BAS operates, allows a maximum exposure equal to a power density of **1 mW/cm^2** (10 W/m^2) for an average exposure time of 30 minutes.

2.4 TYPICAL INSTALLATION OF A MINI-LINK BAS TERMINAL

In Figure 2-1 below, a typical installation of a MINI-LINK BAS radio terminal is shown, in an urban or sub-urban environment with buildings and streets. The system requires Line-Of-Sight (LOS) between the terminal and the node station where the terminal itself is to be connected; therefore the presence of obstacles along the path is incompatible with normal operation. Wherever possible, the terminal will be installed so as to ensure that the first Fresnel ellipsoid is free of obstacles. Together with the use of highly directive antennas on the terminal, this has the effect of almost null electromagnetic emission out of the antenna boresight.

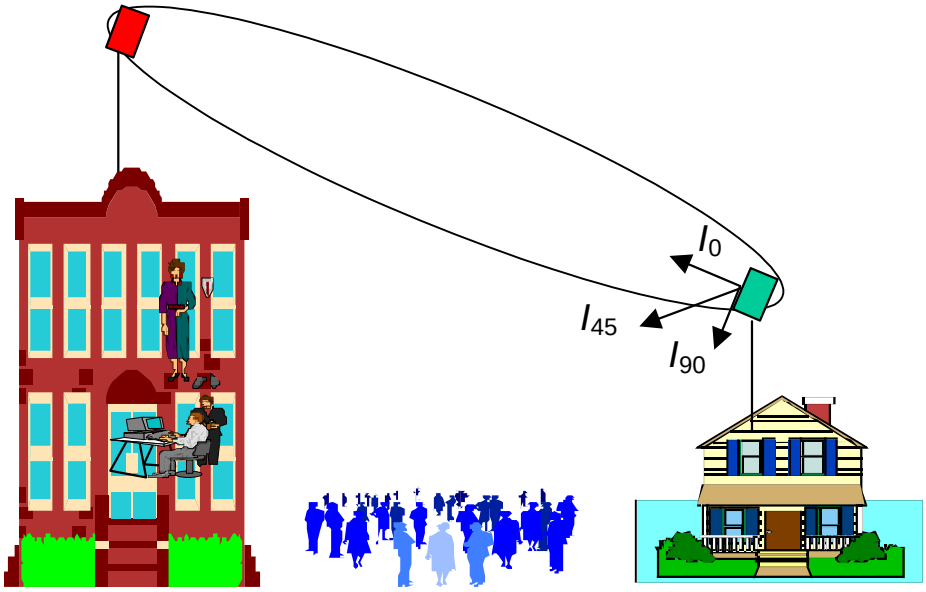

Figure 2-1. Typical scenario for MINI-LINK BAS. The node station is red, the terminal is green.

Figure 2-1 shows three possible exposure situations:

- Due to a partial interception of the beam in the direction I_0 from a nearby building;
- Due to radiation in the direction I_{45} towards streets or other buildings (when the host building is very high);
- Due to the radiation in the direction I_{90} through the host building.

In order to maximize the percentage of area in LOS, the node station will be typically higher than all terminals. Consequently, in order to ensure the best alignment to the node, the terminal antenna will be uptilted. This will also contribute to minimize the electromagnetic emission through the host building below the terminal.

2.5 MODEL TO CALCULATE THE HEALTH & SAFETY DISTANCE

By using the following formula, it is possible to calculate the required safe distance to avoid exposure to higher electromagnetic fields than the limits allow. [OET Bulletin 65 – Ed 97-01 – Section 2, “Prediction Methods”]

For the equipment and antenna considered $S_{surface}$, the maximum power density at the antenna surface can be approximated by:

$$S_{surface} = \frac{4P}{A} = \frac{4P}{\pi\left(\frac{D}{2}\right)^2} = 16.4\ \text{W/m}^2$$

The extension of the near-field region R_{nf} can be expressed as:

$$R_{nf} = \frac{D^2}{4\lambda} = 1.49\,\text{m};$$

within this region, the power density is always lower than the maximum value S_{nf}:

$$S_{nf} = \frac{16\eta P}{\pi D^2}, \text{ where}$$

$$\eta = \frac{\left(\frac{G\lambda^2}{4\pi}\right)}{\left(\frac{\pi D^2}{4}\right)} = 0.58; \text{ therefore, by substituting, } S_{nf}=9.6\ \text{W/m}^2.$$

This means that even in the near-field region, the prescribed value of 10 W/m^2 is never exceeded. The distance R_{ff} marks the beginning of the far-field region:

$$R_{ff} = \frac{0.6D^2}{\lambda} = 3.57\,\text{m},$$

and in the transition region, between R_{nf} and R_{ff}, the power density will always be below the value calculated above.

In the far-field region, beyond R_{ff}, the power density S_{ff} is given by:

$$S_{ff} = \frac{PG}{4\pi R^2},$$

which has its maximum in $R=R_{ff}$=3.57 m. By substituting, $S_{ff,\,max}$=4.1 W/m^2.

In conclusion, **even in the near-field region the radiated power density is always lower than, or equal to, 9.6 W/m^2, which is below the prescribed limit**. Considering that this value is very close to the limit, however, **we suggest as an added safety precaution to observe a minimum distance of 1.49 m** (equal to the extent of the near-field region) **from the antenna**.

2.6 LABELLING

As required a warning label will be placed on the antenna to inform about the safe allowed distance to be compliant with the maximum permitted RF exposure level.
An example of the label positioning (antenna side) is shown below.

To comply with FCC RF exposure requirement 47CFR 1.1310 a minimum safe distance of 1.49 m is required

3 RADIO EQUIPMENT MECHANICAL DATA

3.1 RADIO UNIT

The mechanical dimension of the radio are 266x321x78 mm (LxHxP), with weight of 7 kg (see Figure 3-1).

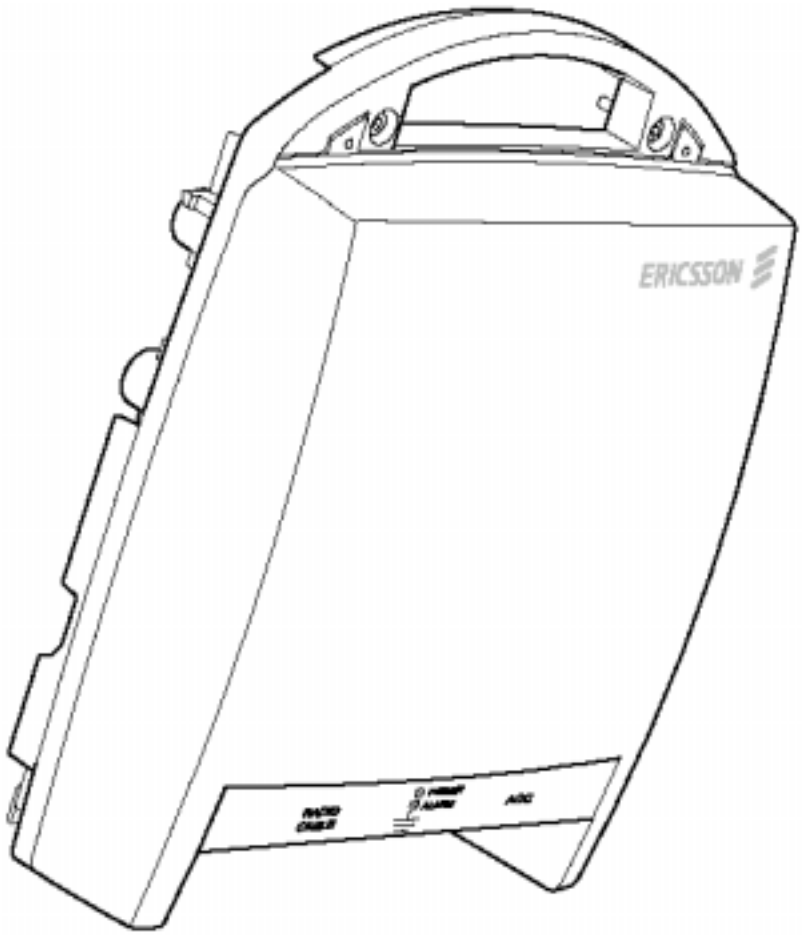

Figure 3-1. Radio Unit.

3.2 ANTENNA

The mechanical antenna dimension are: 266x296x93 mm (LxHxP), with weight of 2.5 kg (see figure 3.2).

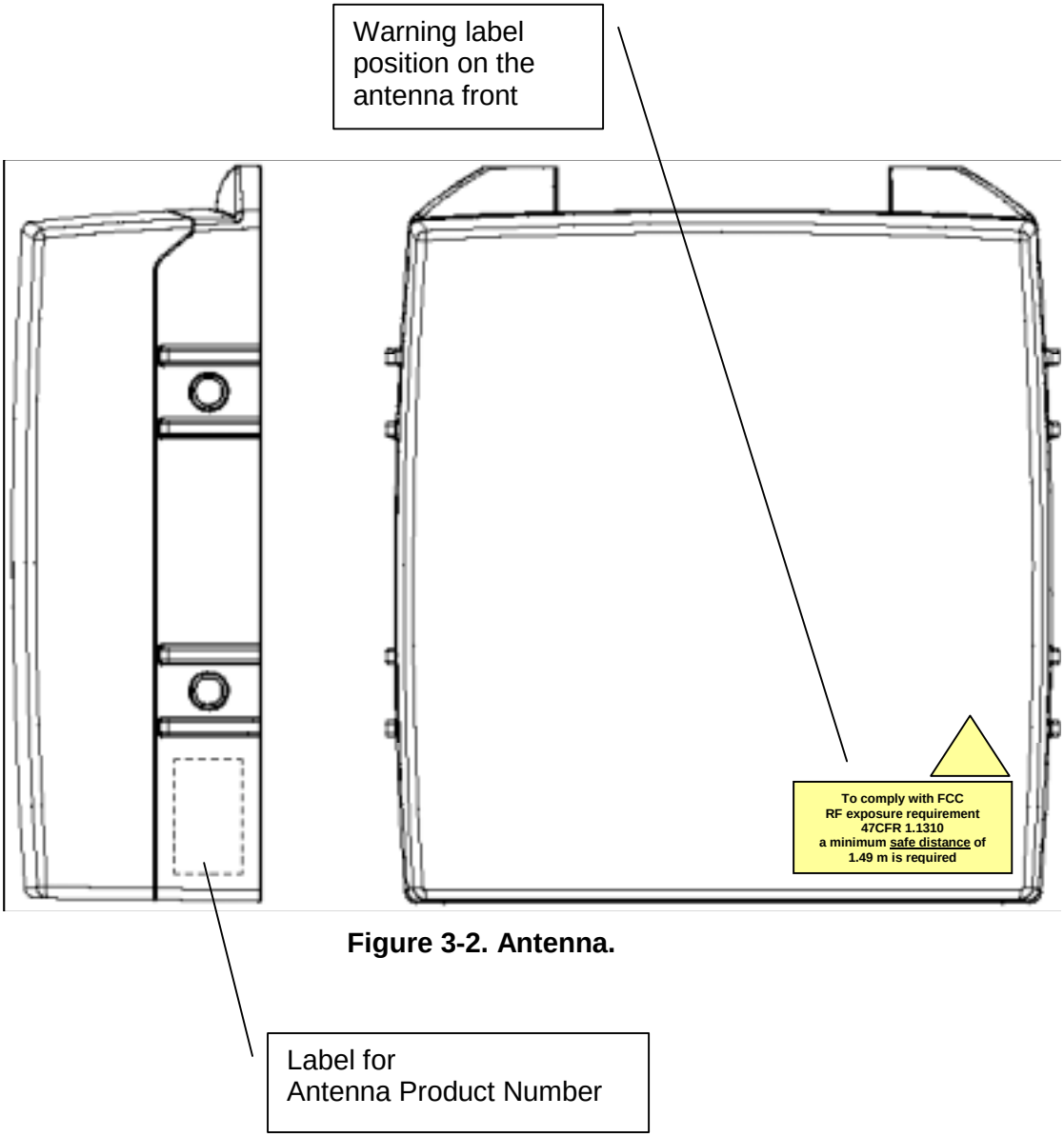

Figure 3-2. Antenna.

3.3 RADIO EQUIPMENT INSTALLATION

The radio unit and the antenna will be assembled in an unique unit (see Figure 3-3); the radio units should be mounted on a support (tripod) placed on the building roof. Such support is designed to be easily moved as it's made of small parts that can be carried on the building roof using a regular lift. (maximum length 2m).

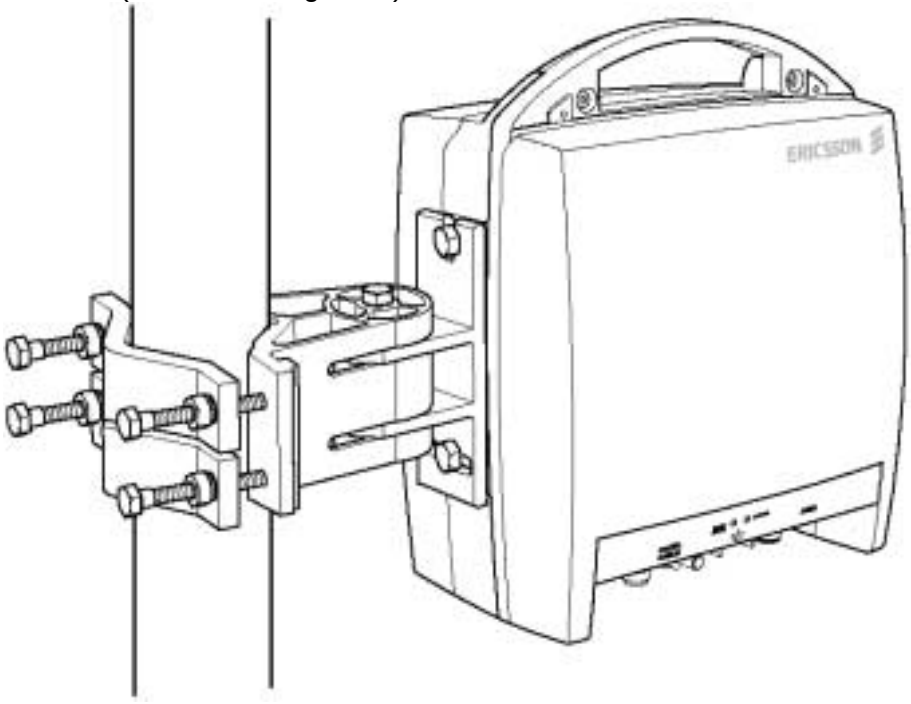

Figure 3-3. The assembled radio unit and antenna.

The support is composed by tubular elements; the lags are arranged at 120° horizontally. It's placed on the cover and held in place by concrete blocks; that means that no construction work is necessary thus avoiding any water infiltration in the floors below.

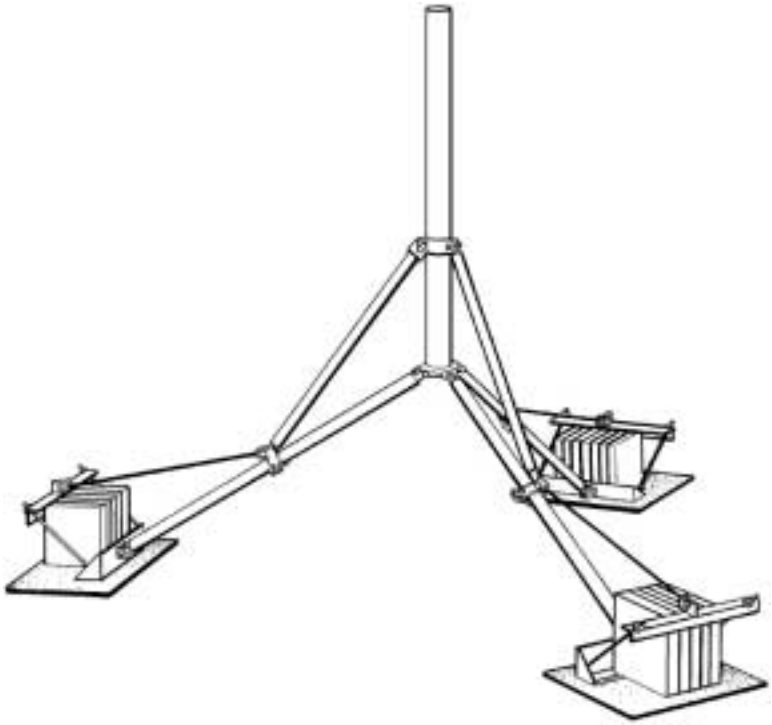

Figure 3-4. External unit support.

The total weight of the support (except for the concrete blocks) is of 65 kg; the cover must be able to sustain about 300 kg on each of the supports (700x500 mm). If the cover isn't able to sustain such weight, it's possible to reduce the block number to reach the maximum allowed load without reducing the wind resistance capability of the support; this support, actually, is designed for parabolic antennas up to 60 cm diameter and the present antennas have lower dimensions.

3.4 CABLES

The following cables are needed:

1. 1 coaxial cable 10 mm diameter for each radio equipment, from the flat to the radio

2. 1 earthing cable from each support to an earth plug on the cover; to such cable all the radio equipment will be connected so as to ensure an appropriate grounding.

3. 1 earthing cable (connected to the previous point) to connect the coaxial cable shield.

ERICSSON will control the installation of the radio equipment and will supply adequate documentation for the installation itself.