# Prediction of human exposure to RF radiation during operation of SATELLAR radio modem

## Background information

FCC guidelines to evaluate the environmental impact of human exposure to radiofrequency radiation are specified in the federal rules 47 CFR §1.1307(b), except portable devices that shall be evaluated according to §2.1093.

Limits for maximum permissible exposure are set in the federal rules 47 CFR §1.1310.

Further information on evaluating compliance with these limits is found in the FCC's OST/OET Bulletin Number 65.

## Prediction methods applied

Minimum safe distances have been calculated for controlled / occupational exposures and for uncontrolled / general population exposures. The following formulas are used in calculations.

$$S = \frac{PG}{4\pi R^2}$$

where:

S = power density [mW/cm$^2$]

P = power input to the antenna [mW]

G = power gain of the antenna in direction of interest, relative to an isotropic radiator [numeric]

R = distance to the centre of radiation of the antenna [cm]

$$S = \frac{PG}{4\pi R^2} \Rightarrow R = \sqrt{\frac{PG}{4\pi S}}$$

## Applicable limits for maximum permissible exposure

The operating frequency range of SATELLAR radio modem is 406.1-520 MHz, and the transmitter output power range is 100 mW – 1W. Tx duty cycle, which is determined by the terminal device, can be up to 100 %.

Based on the above technical parameters and the Table 1 in the federal rules 47 CFR §1.1310, the following limits of power density shall apply:

a) Occupational/Controlled Exposures: **f/300 mW/cm$^2$** (averaging time 6 minutes)

b) General population/Uncontrolled Exposure: **f/1500 mW/cm$^2$** (averaging time 30 minutes)

## Calculations for the minimum safe distances

Minimum distance to the antenna in case of **General population/Uncontrolled** situation:

$$R = \sqrt{\frac{PG}{4\pi(470/1500)}} = \sqrt{\frac{PG}{3.9375}}$$

Tx power can be corrected with the 30-minute average value of the Tx duty cycle.
The antennas in the list have been defined to be used with SATELLAR radio modem.

| Tx output power [W]* | Antenna system gain [dBi / numeric] | Tx duty cycle [%], 30 min. average | Frequency [MHz] | Minimum safe distance [cm] |
|---|---|---|---|---|
| 1 | 8 / 6.310 | 100 | 407/520 | 43.0/38.1 |
| | | 50 | 407/520 | 30.4/26.9 |
| | | 20 | 407/520 | 19.2/17.0 |
| | 6 / 3.981 | 100 | 407/520 | 34.2/30.2 |
| | | 50 | 407/520 | 24.2/21.4 |
| | | 20 | 407/520 | 15.3/13.5 |
| | 2 / 1.585 | 100 | 407/520 | 21.6/19.1 |
| | | 50 | 407/520 | 15.2/13.5 |
| | | 20 | 407/520 | 9.6/8.5 |
| 0.5 | 8 / 6.310 | 100 | 407/520 | 30.4/26.9 |
| | | 50 | 407/520 | 21.5/19.0 |
| | | 20 | 407/520 | 13.6/12.0 |
| | 6 / 3.981 | 100 | 407/520 | 24.2/21.4 |
| | | 50 | 407/520 | 17.1/15.1 |
| | | 20 | 407/520 | 10.8/9.6 |
| | 2 / 1.585 | 100 | 407/520 | 15.2/13.5 |
| | | 50 | 407/520 | 10.8/9.5 |
| | | 20 | 407/520 | 6.8/6.0 |
| 0.1 | 8 / 6.310 | 100 | 407/520 | 13.6/12.0 |
| | | 50 | 407/520 | 9.6/8.5 |
| | | 20 | 407/520 | 6.1/5.4 |
| | 6 / 3.981 | 100 | 407/520 | 10.8/9.6 |
| | | 50 | 407/520 | 7.6/6.8 |
| | | 20 | 407/520 | 4.8/4.3 |
| | 2 / 1.585 | 100 | 407/520 | 6.8/6.0 |
| | | 50 | 407/520 | 4.8/4.3 |
| | | 20 | 407/520 | 3.0/2.7 |

## Conclusion

Users of SATELLAR radio modem shall be advised of the above safe distances in the appropriate documentation.