Maximum Permissible Exposure (MPE) Evaluation

according to the Electronic Code of the Federal Regulations (Edition 97-01)

Equipment evaluated:

The RAy3-24 microwave link for data transmission in the 24.050 – 24.250 GHz frequency range

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Equipment evaluated

The microwave link RAy3 is designed as a high-speed point-to-point wireless bridge for data transmission under the latest requirements of modern wireless transmission equipment. This Full Outdoor Software Defined Radio for 24 GHz band has been designed for building long range links with maximum reliability even in the most challenging conditions. The transmitted signal spectral width is limited to a single channel and never exceeds the respective channel spacing, which is 3.5, 5, 7, 10, 14, 20, 28, 40, 56, 80, 100, 112 MHz. The maximum nominal output radio-frequency (RF) power of the RAy3-24 microvawe is 10 dBm. The RAy3 microwave link main specifications for a frequency range 24.050 - 24.250 GHz are in Table 1.

Table 1 – RAy3-24 microvawe main technical parameters

Parameter	Value
Frequency range	from 24.050 GHz to 24.250 GHz
Channel spacing	3.5, 5, 7, 10, 14, 20, 28, 40, 56, 80, 100, 112 MHz
Channel setting method	software
Supply voltage (nominal)	48 V
Supply voltage range	20 V to 60 V
Operating temperature range	-30 °C to +55 °C
Power consumption:	Typical 22,5 Watt
Configurable RF antenna power range	from -30 dBm to 10 dBm

MPE Calculations

The formula according to the OET Bulletin 65 (Edition 97-01) is:

$$R=\sqrt{\frac{P*G}{4*\pi*S}}$$

S = Power density (in appropriate units, e.g. mW/cm^2)
P = Power input to the antenna (in appropriate units, e.g. mW)
G = Power gain of the antenna in the direction of interest relative to an isotropic radiator
R = Distance from the centre of radiation of the antenna (appropriate units, e.g. cm)

EIRP = P*G = 691 831 [mW]

equivalent isotropically radiated power (EIRP) is the amount of power that a theoretical isotropic antenna (which evenly distributes power in all directions) would emit to produce the peak power density observed in the direction of maximum antenna gain.

EIRP is calculated as sum of output power of transmitter (+10 dBm in case of RAy3-24 microwave link) and antenna gain (antenna gain depends on type of used antenna)

S_G = 1.0 [mW/cm$_2$]

The FCC limit for exposure of general population / uncontrolled exposure in the 1 500 - 100 000 MHz frequency range.

S_O = 5.0 [mW/cm$_2$]

The FCC limit for exposure of ccupational/Controlled Exposure in the 1 500 - 100 000 MHz frequency range.

Calculated minimum separation distance from antenna, where the limit for general population / uncontrolled exposure is met, is:

R_U = 234.6 cm

The distance, where the limit for occupational / controlled exposure is met, is:

R_C = 104.9 cm

The distance, where the limits are met for typical directional and omni directional antennas typically used with RAy3-24 microwave link. The safe distance for directional antennas is validated in the direction of the main beam centre, where it is nevertheless unreasonable to expect the presence of general public.

Table 2 – The distances where the FCC limits are met for typical antennas 10 dBm:

24.050 – 24.250 GHz – 10 dBm RF power					
Antenna code	Antenna description	Gain G (dBi)	Gain G (-)	Distance where the FCC limits is met for	
				General Population / Uncontrolled Exposure (cm)	Occupational / Controlled Exposure (cm)
ANT-LEAX-Ray-300-24	Parabolic antenna 300 mm	37.0	5011.9	63.2	28.2
ANT-LEAX-Ray-600-24	Parabolic antenna 600 mm	42.4	17378.0	117.6	52.6
ANT-LEAX-Ray-900-24	Parabolic antenna 900mm	45.8	38018.9	173.9	77.8
ANT-LEAX-Ray-1200-24	Parabolic antenna 1200mm	48.4	69183.1	234.6	104.9

Conclusion:

It is safe to assume that the general population will never be at the distance R_U (or nearer) to a fixed antenna installation of the equipment evaluated. Equally it is safe to assume that e.g. a member of staff performing mast maintenance will spend only negligible fractions of time at the distance R_C (or nearer) to the transmitting antenna. It is still important to follow the MPE calculations with respect to possible exposure when planning where to install the antennas. Consequently, in our opinion, the operation of the evaluated equipment would not make a significant environmental effect.