RF Exposure Info / MPE Sample Calculation

Model: ION-M23 SDARS
FCC-ID: XS5-M23SDARS

INTRODUCTION

The ION-M23 SDARS 3-Sector is a Remote Unit configuration used in conjunction with a Master Unit, both forming an optical terrestrial repeater. This system transports signals in the frequency range 2324 to 2341.5 MHz, providing a cost-effective solution for coverage.
The ION system allows the distribution of RF over long distances without affecting signal quality. The combination of these units gives maximum flexibility while providing a scalable solution. The system is optimized for OFDM signals in the band 2324 - 2341.5 MHz. and an integrated 3-way divider allows the symmetrical distribution of transported signals to three antenna ports. Furthermore, it is provisioned for future modulation schemes and frequency bands.
The ION can be easily set-up and supervised from a graphical user interface (GUI). Remote units are commissioned through the use of built-in test equipment. An auto levelling function compensates for the optical link loss making installation easy and quick.
The entire system as well as complete network of systems can be managed remotely most efficiently by Commscope's A.I.M.O.S, which includes alarm monitoring, task automation, statistics, inventory management, and many more features. Should a sophisticated interface not be required, the Master Unit can be directly connected to the alarm interface of a base station via its contact relay.

The specific device generally will be <u>professionally</u> installed.
Hereby the gain of the finally installed antenna(s), cable attenuation and antenna height will be defined site specific at the time of licensing with the appropriate FCC Bureau(s).

The maximum permissible exposure limit is defined in **47 CFR 1.1310 (B).**

S = power density limit [W/m]
P = power [W]
R = distance [m]

$S_n = \frac{P_n G_n}{4\pi R_n{}^2}$ => $R_n = \sqrt{\frac{P_n G_n}{4\pi S_n}}$ (to calculate the distance at one frequency)

If we have more bands, than we have to calculated as a percentage:
The additional of the terms have to be lower than 1.

$$\frac{S_{cal1}}{S_1} + \frac{S_{cal2}}{S_2} + \frac{S_{cal3}}{S_3} + ... + \frac{S_{ca\ln}}{S_n} < 1$$

$$\frac{\frac{P_1 G_1}{4\pi R_1{}^2}}{S_1} + \frac{\frac{P_2 G_2}{4\pi R_2{}^2}}{S_2} + \frac{\frac{P_3 G_3}{4\pi R_3{}^2}}{S_3} + ... + \frac{\frac{P_n G_n}{4\pi R_n{}^2}}{S_n} < 1$$

We are looking for a distance of ensures that the formula is satisfied.
$R_1 = R_2 = R_3 = ... = R_n$

$$\frac{P_1 G_1}{4\pi R^2 S_1} + \frac{P_2 G_2}{4\pi R^2 S_2} + \frac{P_3 G_3}{4\pi R^2 S_3} + ... + \frac{P_n G_n}{4\pi R^2 S_n} < 1$$

$$\frac{P_1 G_1}{4\pi S_1} + \frac{P_2 G_2}{4\pi S_2} + \frac{P_3 G_3}{4\pi S_3} + ... + \frac{P_n G_n}{4\pi S_n} < R^2$$

$$\sqrt{\frac{P_1 G_1}{4\pi S_1} + \frac{P_2 G_2}{4\pi S_2} + \frac{P_3 G_3}{4\pi S_3} + ... + \frac{P_n G_n}{4\pi S_n}} < R$$

With $R_n = \sqrt{\frac{P_n G_n}{4\pi S_n}}$ => $R_n{}^2 = \frac{P_n G_n}{4\pi S_n}$

$$\sqrt{R_1{}^2 + R_2{}^2 + R_3{}^2 + ... + R_n{}^2} < R$$

What you have to do for calculate the minimum distance were the power density limit is met:

1) If you have **one path**, you have to put you special values in the following formula.

$$R_n = \sqrt{\frac{P_n G_n}{4\pi S_n}}$$ (Distance for one carrier)

Limits for General Population / Uncontrolled Exposures

Frequency Range (MHz)	Power Density (mW/cm^2)
300 – 1500	S = f/1500
1550 – 100000	S = 1

2) If you have **more than one path**, you must add the individual terms quadratic.

$$R_n = \sqrt{\frac{P_n G_n}{4\pi S_n}}$$ (Distance for individual carrier)

$$\sqrt{R_1^2 + R_2^2 + R_3^2 + \ldots + R_n^2} < R$$ (See previous page)

For example:

The EUT operates in the frequency band:
2324 to 2341.5 MHz.
The max measured conducted output power is 33 dBm (2W).

Calculation for every path with maximum allowed antenna gain and without cable loss:

Frequency [MHz]	Max Power out [dBm]	Max. allowed antenna gain, **without** cable loss [dBi]	Min. Distance [m]
2324	33	9	0.355 m

The worst case would be if all bands were active:

$$\sqrt{R_1^2 + R_2^2 + R_3^2 + \ldots + R_n^2} < R$$

$R_{all} > 0.355$ m (see previous page for derivation)

For more accurate calculation, the cable loss and actual antenna gain have to be included in the finally system.
The antenna(s) used with device must be fixed-mounted on permanent structures with a distance to any human body to comply with the RF Exposure limit.