RF Exposure Info / MPE Sample Calculation

Model: **ION-M7P/85P/17EP/19P**
FCC-ID: **XS5-M78517E19P**

The ION-M7P/85P/17EP/19P is a multi-band, multi-operator Remote Unit configuration used in conjunction with a Master Unit in the ION optical distribution system. By supporting the entire AWS-3 spectrum, faster and more reliable wireless service is ensured and network quality can be improved.

This system transports up to four frequency bands simultaneously (700 MHz, 850 MHz, 1700/2100 MHz, 1900 MHz), providing a cost-effective solution for distributing capacity from one or more base stations.

The ION system transports signals on the RF layer in a very cost-effective manner enabling multiple operators to use multiple technologies and move their signals simultaneously from a cluster of base station to a number of remote locations over the same fiber.

The ION-M optical distribution system is a cost-effective coverage solution for dense urban areas, tunnels, subways, airports, convention centers, high-rise buildings and other locations where physical structures increase path loss.

The combination of these units gives maximum flexibility while providing a scalable solution. The system is optimized for GSM, LTE, CDMA and WCDMA signals in the 700 MHz, 850 MHz, 1900 MHz and 1700/2100 MHz bands. Furthermore it is provisioned for future modulation schemes and frequency bands.

The specific device generally will be professionally 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.

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

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

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 – 100,000	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 4 frequency bands: 728 - 757, 862 - 894, 1930 - 1995 and 2110 - 2180 MHz.

The max measured conducted output power is 43 dBm (20 W).

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

Frequency [MHz]	Max Power out [dBm]	antenna gain (f.e.), **without** cable loss [dBi]	Max. Distance [m]
728	43	9	0.510
862	43	9	0.469
1930	43	9	0.355
2110	434	9	0.355

The worst case would be if all bands were active:

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

$R_{all} > 0.855$ 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.