# RF Exposure Info / MPE Sample Calculation

**Model: ION-M19P/19P/19P**
**FCC-ID: XS5-M191919P**

The ION-M19P/19P/19P is a three-sector remote unit (RU). It is used in conjunction with a master unit in the ION optical distribution system. This system transports 3 sectors simultaneously 3 x 1900 MHz, providing a cost-effective solution for distributing capacity from one or more base stations. Beside 3 – sector mode the system can be switched to single source operation. In this operation mode no frequency conversion is used, but one input signal (single source) is split to 3 output signals. Purpose of this mode is to support the possibility of quasi omni directional radiation. Together with a phase detection box the system is able to detect phase differences between the RF feeder cables to the antennas and to adjust phases such, that the phase differences are compensated, i.e. phase differences are 0° after phase adjust. This process is running automatically, when initiated by a “button to push”

The ION-M19P/19P/19P transports signals on the RF layer in a very inexpensive manner. This means that multiple operators and multiple technologies are moved simultaneously from a cluster of base stations to a remote location over the same fiber.

The ION-M (Intelligent Optical Network) optical distribution system is a cost-effective coverage solution for dense urban areas, airports, campus, high-rise buildings and other locations where physical structures increase path loss or provide limited space for installation. It has been specifically designed to reduce zoning problems and to provide homogeneous coverage. The compact, mechanical design is specifically architected to mount inside of or on poles and along side structures in such a way that it has a minimal visual impact.

It has been specifically tested and optimized for CDMA2000, EV-DO, WCDMA and LTE. Furthermore it is provisioned for future improvements to the modulation and frequency bands.

The ION-M19P/19P/19P can be easily set-up and supervised via a graphical user interface (GUI). Remote units can be commissioned through the use of built-in test equipment.

An auto-leveling function compensates for the optical link loss making installation easy and quick. The entire system may be monitored remotely via an Andrew OMC. This is a comprehensive management platform with SNMP protocol and X.733 standard implemented. Should a sophisticated interface not be re-quired, the master unit can be directly connected to the alarm interface of a base station via relay alarming.

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 with one frequency band:

**Calculation with maximum possible antenna gain and without cable loss (worst case):**

| Frequency [MHz] | Max Power out [dBm] | Max. possible Antenna gain, **without** cable loss [dBi] | Max. Distance [m] |
|---|---|---|---|
| 1990 | 43 | 19 | 3.5514 |

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.**