RF Exposure Info / MPE Sample Calculation

Model: **ION-M7P/80-85HP/9**
FCC-ID: **XS5-M7P8085HP9**

The ION-M7P/80-85HP/9 isi a multi-band, multi-operator Remote Unit. It is used in conjunction with a Master Unit in the ION optical distribution system.

The ION-M7P/80-85HP/9 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 optical distribution system is a cost-effective coverage solution for dense urban areas, tunnels, subway, airports, convention centers, high-rise buildings and other locations where physical structures increase path loss. It has been specifically designed to reduce zoning problems and to provide homogeneous coverage. The compact, mechanical design is specifically architected to mount along side structures in such a way that it has a minimal visual impact.

The ION-M7P/80-85HP/9 has been specifically tested and optimized for GMSK, EDGE, CDMA, WCDMA, and LTE modulation in the 700 MHz, 800/850 MHz band as well as AMPS, LMR and analogue modulations.

By means of a coupling port AWS (1700/2100) and PCS (1900) provided by a separate ION-M can be combined with 700 MHZ, 800 MHz and 850 MHz to one antenna port. The Remote Unit is equipped with an extension port to upgrade the system for supporting AWS/PCS.

The ION is 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 platform uses SNMP protocol and is compliant to X.733 standard.

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]

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

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

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

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

We are looking for a distance of ensures that the formula is satisfied.

$$R_1 = R_2 = R_3 = \dots = R_n$$

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

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

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

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

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

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)

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

For example:

The EUT operates in the 4 frequency bands: 728-757, 859-869, 869-894 and 935-961 MHz.
The max measured conducted output power is 44.5 dBm (28.2 W).

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

Frequency [MHz]	Max Power out [dBm]	Max. possible Antenna gain, **without** cable loss [dBi]	Max. Distance [m]
728	41,5	20.65	5.1865
859	44,5	17.7	4.8022
869	44,5	14.65	3.3607

The worst case would be if all bands were active:

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

<u>R_{all}</u> > 7.827 m   (see previous page for formula)

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.