RF Exposure Info / MPE Sample Calculation

Model: ION-M17P/26EU
FCC-ID: XS5-IONM17P26EU

The ION-M17P/26 EU (Intelligent Optical Network; MMR) is a high-power dual-band Extension Unit (EU). It is used in conjunction with a Master Unit and a Main Unit containing the optical transceiver (OTRx) in the ION-M optical distribution system. This system is able to transport the whole AWS 1700 MHz band wide simultaneously, providing a cost-effective solution for distributing capacity from one or more base stations. Optionally, for 2600 MHz WiMAX in TDD * mode is available.

The ION-M17P/26 EU is connected via extension cable bridge to the Main Unit with extension port. For a frequency band extension, the additional band (for ION-M17P EU this is AWS) has just to be combined with the signal for the (Main) Remote Unit. Then, the additional band is available on the extension port of the Main Unit.

The ION-M17P/26 EU transports signals on the RF layer in a very inexpensive manner. This means that services from various operators can be transmitted simultaneously from a cluster of base stations to a remote location over the same fibre.
Any service or frequency band extension is achieved by adding an Extension Unit (EU) without any impact to the installed network.

* TDD is the abbrev. of time-division-duplex

The ION-M17P/26 EU has been specifically tested and optimized for CDMA2000, EV-DO, WCDMA, and UMTS. Furthermore, it is provisioned for future improvements to the modulation (e.g. HSDPA and OFDM) and frequency bands such as WiMAX.

The ION is easily set-up and supervised via a graphical user interface (GUI). Extension Units can be commissioned through the use of built-in test equipment with a minimum of commissioning required. 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 required, 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 in the frequency range of 2110 - 2155 MHz (path 1700) and 2640 – 2674 MHz (path 2600). **The max measured conducted output power is 1700er path: 8.9 W (39.5dBm) and 2600er path: 5.6 W (37.5dBm).**

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]
2132	39.5	22.5	3.5514
2657	37.5	27.5	5.0164

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} > 6.146 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.