RF Exposure Info / MPE Sample Calculation

Model: **ION-E CAP L 7/80-85/17E/19**
FCC-ID: **XS5-CAPL7817E19**

INTRODUCTION

The CommScope ION-E Carrier Access Point, Low Power (CAP L) provides data and power through Copper, Single-Mode Fiber (SMF), or Multi-Mode Fiber (MMF). In addition to transmitting wireless data over a common cable, the CAP L also supports Gigabit Ethernet for WiFi, IP cameras.

The CAP L interfaces with the ION-E CAN/TEN via a CAT 6A cable, or via an optical link. On the downlink, the CAP L converts some or all of the data arriving at the CAP L to analog signals and sends them to the Antenna ports. On the uplink, received signals are digitized and serialized into data streams, which are sent back to the CAN. Each CAP L can provide RF coverage for up to four specific frequency bands.

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.

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

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

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

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

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 your 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)

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

For example:

The EUT operates in 4 frequency bands.
The max conducted single output power is 21dBm (0.126W) at the antenna port.

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]
729	18	9	0,091
851	18	9	0,084
1930	21	9	0,089
2110	21	9	0,089

The worst case would be if all bands were active:

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

R<u>all</u> > 0,176 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.