RF Exposure Info / MPE Sample Calculation

Model: **ION-E System CAP-L7/80-85/17E/19 C-PE-F1**
FCC-ID: **XS5-CAPL7817E19**

CAP L 7/80-85/17E/19 – Product Specifications

Electrical

Power consumption*, W		
Fiber variant	without fans	92
	with optional fan kit	95
Copper variant	without fans	100
	with optional fan kit	103
Power consumption auxiliary port		IEEE 802.3at Class 3
Input voltage, Vdc		36 to 60
License band		USA 700
		USA 750
		SMR 800
		CEL 850
		AWS 1700
		PCS 1900
ALC Default Threshold, dBm		-45
Electrical Safety Standard		EN 60950
Electromagnetic Compatibility (EMC)		EN 301489
Flatness, inband link, dB		±2
Impedance, Ω		50

RF Performance

RF output power per band, dBm	
	18 < 1 GHz
	21 > 1 GHz
Noise figure @ max gain, dB	9
Input ICP-3, maximum, dBm	-5 dBm
DL gain**, dB	-40 to +26
UL gain***, dB	-40 to +26
Return loss, dB	12
Blocking, dBm	-30 @ 3 dB

Supported Bands

Frequency range, MHz		
700 MHz	Uplink	699 to 716
	Downlink	729 to 746
750 MHz	Uplink	777 to 787
	Downlink	746 to 756
800 MHz	Uplink	817 to 824
	Downlink	862 to 869
850 MHz	Uplink	824 to 849
	Downlink	869 to 894
1700/2100 MHz	Uplink	1710 to 1780
	Downlink	2110 to 2180
1900 MHz	Uplink	1850 to 1915
	Downlink	1930 to 1995

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Mechanical

Connectors		
Fiber variant		1x RJ45 (auxiliary port)
		2x SFP+ (options)
		1x DC power connector
		1x DC fan power connector (optional)
		2 x 4.3-10 RF connector (2 bands per RF port)
Copper power over CAT variant		2x RJ45 (auxiliary port)
		1x DC power connector
		1x DC fan power connector (optional)
		2 x 4.3-10 RF connector (2 bands per RF port)
Copper local power variant		2x RJ45 (auxiliary port)
		1x DC fan power connector (optional)
		2 x 4.3-10 RF connector (2 bands per RF port)
Height x width x depth, mm (in) (dimensions excluding connectors and mounting bracket)	without fans	424 x 388 x 110mm (16.7 x 15.3 x 4.3)
	with fan kit option	488 x 393 x 121mm (19.2 x 15.5 x 4.8)
Weight, kg (lb)	without fans	10.48 (23.10)
	with fan kit option	10.97 (24.18)

Environmental

Fiber variant operating temperature, °C (°F)		
	without fans	-33 to +40 (-27 to +104)
	with fan kit option	-33 to +55 (-27 to +131)
Copper variant operating temperature, °C (°F)		
	without fans	0 to +60 (+32 to +140)
	with fan kit option	0 to +55 (+32 to +131)
Ingress protection Fiber variant		IP67

Minimum SW Requirements for Basic Support

ION-E SW V2.1

* Without SFP+ consumption
** Downlink gain automatically adjusts to provide output power to individual RF signals defined by the user settable power table
*** Uplink gain automatically adjusts to match downlink gain

All figures are typical values unless otherwise stated.

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 **<u>one path</u>**, 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 **<u>more than one path</u>**, 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.
The max measured conducted output power see at the following table.
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]
744	18,8	9	0.098
747	18,9	9	0.099
865.5	19	9	0.093
891.5	19,2	9	0.094
1969	22,2	9	0.102
2145	21	9	0.089

The worst case would be if all bands were active:

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

$R_{all} > 0.236$ 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.