RF Exposure Info / MPE Sample Calculation

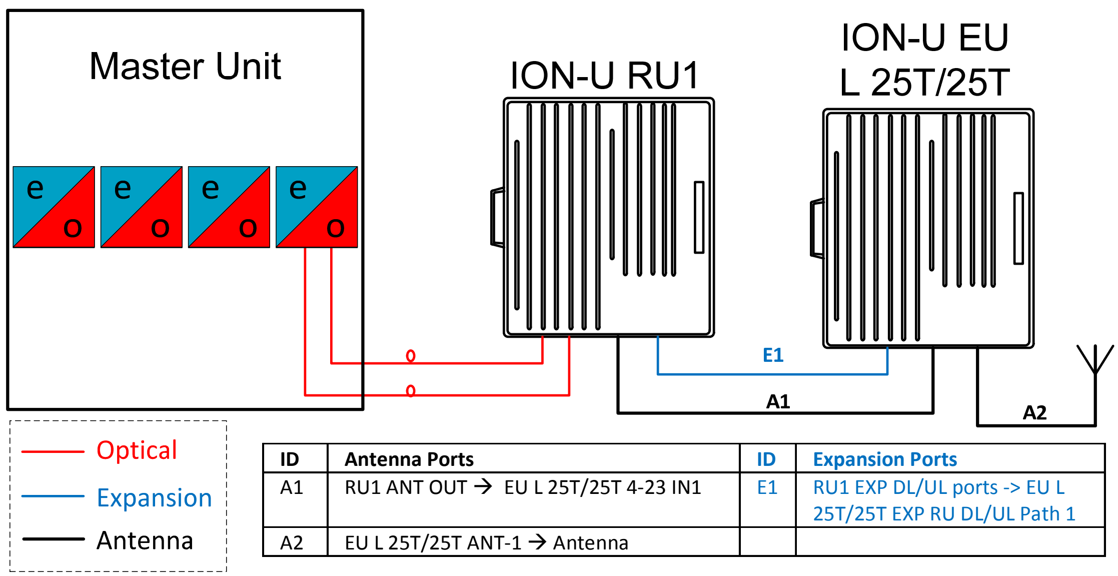
Model: **ION-U EU L 25T/25T**
FCC-ID: **XS5-UEUL2525**

INTRODUCTION

The ION-U Low Power Remote Units are scalable and integrated with up to:
5-band (Cell700, LMR800, Cell850, PCS1900, AWS-3 1700/2100) or
6-band with additional Extension Unit
7-band with two additional Extension Units

SISO capability. Two RUs can be operated as a pair for MIMO operation. These units are compatible with analog, GSM, EDGE, IS-95, CDMA2000, EVDO, W-CDMA, HSDPA, LTE, LTE TDD and iDEN modulation standards. These Remote Units feature independent downlink and uplink gain adjustments and an integrated channel power detector for in-band spectrum and PIM analysis and end-to-end auto leveling.

The ION-U EU L 25T/25T Extension unit with integrated antenna port combiner together with ION-U L 7/80-85/17(E)P/19P allows for further options.



ID	Antenna Ports	ID	Expansion Ports
A1	RU1 ANT OUT → EU L 25T/25T 4-23 IN1	E1	RU1 EXP DL/UL ports -> EU L 25T/25T EXP RU DL/UL Path 1
A2	EU L 25T/25T ANT-1 → Antenna		

In the Downlink (DL) path, the Extension Unit provides:

- RF amplification of the converted RF signal for transmission while maintaining a good signal-to-noise ratio
- RF filtering to reject spurious emissions

In the Uplink (UL) path, the Extension Unit provides:

- RF amplification to boost the signals received by the antennas to maintain a good signal-to-noise ratio
- RF filtering to reject spurious emissions
- Automatic Level Control (ALC) to adjust the RF signal level to meet blocking Requirements

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 – 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)

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

For example:

The EUT operates in the frequency band: 2496 to 2690 MHz.

The max measured conducted output power is 30 dBm (1W).

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]
2496	30	9	0.251 m

The worst case would be if all bands were active:

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

$R_{all} > 0.251$ 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.