RF Exposure Info / MPE Sample Calculation

Model: **MR1718E**
FCC-ID: **XS5-MR17E**

Simple, affordable, compact, and extremely easy to setup, the MR1718E miniRepeater is the ideal solution for extending coverage in small venues ranging from 2,300 square meters (25,000 square feet) and smaller. Its advanced functionality and intelligent features is what makes fast and easy setup possible.

Eliminating the need for bulky and expensive test equipment like spectrum analyzers, everything you need to determine proper signal levels can be viewed on the LCD display. No special software or hardware is required to set up the MR1718E miniRepeater. Autogain functionality enables automatic gain adjustment in order to maximize the unit's performance, while still allowing gain to be set manually if desired. The Ethernet port on the unit allows for easy connectivity and commissioning through a web-based browser.

Optional remote control provides equipment alarming and basic configuration settings via SMS and common Andrew OMC (A.I.M.O.S.).

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 following frequency bands: 2110 - 2180 MHz (DL) and 1710 MHz – 1780 MHz (UL).
The max measured conducted output power is 22 dBm (0.158 W).

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

Frequency [MHz]	Max Power out [dBm]	antenna gain, **without** cable loss [dBi], f.e.	Max. Distance [m]
2110	22	9	0.0317
1710	22	9	0.0317

The worst case would be if all bands were active:

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

$R_{all} > 0.0448$ 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.