RF Exposure Info / MPE Sample Calculation

Model: **PSR 700/800 Class A**
FCC-ID: **XS5-PSR78A**

INTRODUCTION

This pick-up repeater comes in two variants, one is a digital, channelized class A repeater and the second as an analog class B repeater. Both can be used stand-alone or in combination with an Era™ system. They are designed to cover the 700 and 800 MHz public safety bands and can be used to establish a wireless connection between a BTS and a passive or active DAS. Via feature keys, this repeater can be configured as a single- or dual-band version with an output power of 0.5 W or 2 W per band. With its battery backup support, NEMA 4x housing, dry alarm contacts and its integrated oscillation detection and healing mechanism a fully NFPA 72 and IFC compliance can be guaranteed. The implemented time-slot-based muting functionality prevents desensitization of the BTS by switching off UL channels without traffic. The class A supports up to 32 channels in a range between 12.5 kHz and 10 MHz, where every channel can be muted while no traffic is active. With the class B variant, the operator can choose between 3, 10 and 18 MHz pass band bandwidths, where every pass band can be muted while no traffic is active.

This approval refers to the digital channelized class A Repeater only.

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 where 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)

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

For example:

The EUT operates in 2 frequency bands:

DL Frequency Bands are 758-775 MHz and 851-869 MHz.

The max conducted output power is 33 dBm (2W) per 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]
758	33	9	0,500
851	33	9	0,471

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} > 0,687m (see previous page for derivation)

UL Frequency Bands are 788-805 MHz and 806-824 MHz.
The max conducted output power is 27 dBm (0.5W) per 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]
788	27	9	0,246
806	27	9	0,243

The worst case would be if all bands were active:

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

R_{all} > 0,345m (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.