RF Exposure Info / MPE Sample Calculation

Model: Prism 20 Watt 2.5 GHz TDD SISO High Band HDM
FCC-ID: F8I-PSM25TDH

FlexWave Prism Theory of Operation

The FlexWave PRISM, in its most basic configuration, serves as a transport between a FCC approved base station and a remote antenna. The system consists of two units; a “host”, that is co-located with the base station, and a “remote”, that resides at the location of the antenna. Both units perform wide band digitization, fiber optic transport, and reconstruction of the RF signal. In addition to RF transport, Flexwave PRISM also provides 10/100bT Ethernet connectivity between the host and all connected remotes. The entire system is monitored and controlled via an onboard web server that is accessible with a standard web browser.

The host unit is designed for an indoor environment with some level of climate control such as a wiring closet or a cabinet. The metal host enclosure serves as a RFI and EMI shield for the internal circuits as well as protection for those circuits. All PCBs support hot-swap serviceability. The host unit contains RF interfaces for all connected base stations, SFP fiber connectivity for all connected remotes, ENET connectivity to a user-provided PC or switch, an optional external time base port, and dry-contact I/Os for base station alarming.

The host serves as the primary time base reference for all synthesizers, however due to the nature of digitized RF transport; the intended digitized signal always has zero frequency error. The entire unit is powered by DC voltage as an external input.
The remote unit is designed for an outdoor environment and is powered by AC. The external interfaces available at the remote are the antenna connections, network ENET connection, fiber port connections, AC power connection, and dry-contact alarm connections. The remote ENET port is intended to be used for system troubleshooting, as well as network connectivity with other IP connected devices at the remote location.
The power amplifier that drives the antenna port is a feed forward linear amplifier and the output is protected with an isolator and duplexer. All servicing to the PRISM remote shall occur with the AC power to the unit disconnected.
In more complex deployments, a single host can simulcast and manage up to 8 connected remotes, as well as 8separate base station connections. In this configuration, a single base station downlink connection can be sent to 8 remotes, and the uplink from the 8 connected remotes will be summed digitally at the host and presented to the base station as a single composite uplink signal. A separate 10/100bT ENET connection is also present at each of the 8 remotes. This configuration can then be extended to allow each remote up to 3 separate base station downlinks and uplinks, since the remote unit could be configured for up to 3 separate duplexers and power amplifiers. For all deployments with more than 3 base station connections (up to a total of 8basestations), common remote elements such as wideband power amplifiers and duplexers would be shared.

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.

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

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

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)

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

For example:

The EUT operates in one frequency band: 2615 - 2690 MHz.
The max measured conducted output power is 43.5 dBm (22.4 W).

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]	Max. Distance [m]
2615	43.5	9	0.376

The worst case would be if all bands were active:

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

$R_{all} > 0.376$ 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.