

# Voltage estimation of FPC conditioning for radiation consideration

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## 1. Job description and goal:

We have four FPCs. Two are *Navy FPCs*, the other two are *BNL FPCs*. The goal of the work is to conditioning the FPCs. (Two FPCs are conditioned at one time at standing wave mode)

This document is to estimate the voltage in the FPCs and connecting waveguide.

## 2. Requirement:

1MW klystron ,FPC conditioning stand, Control system.

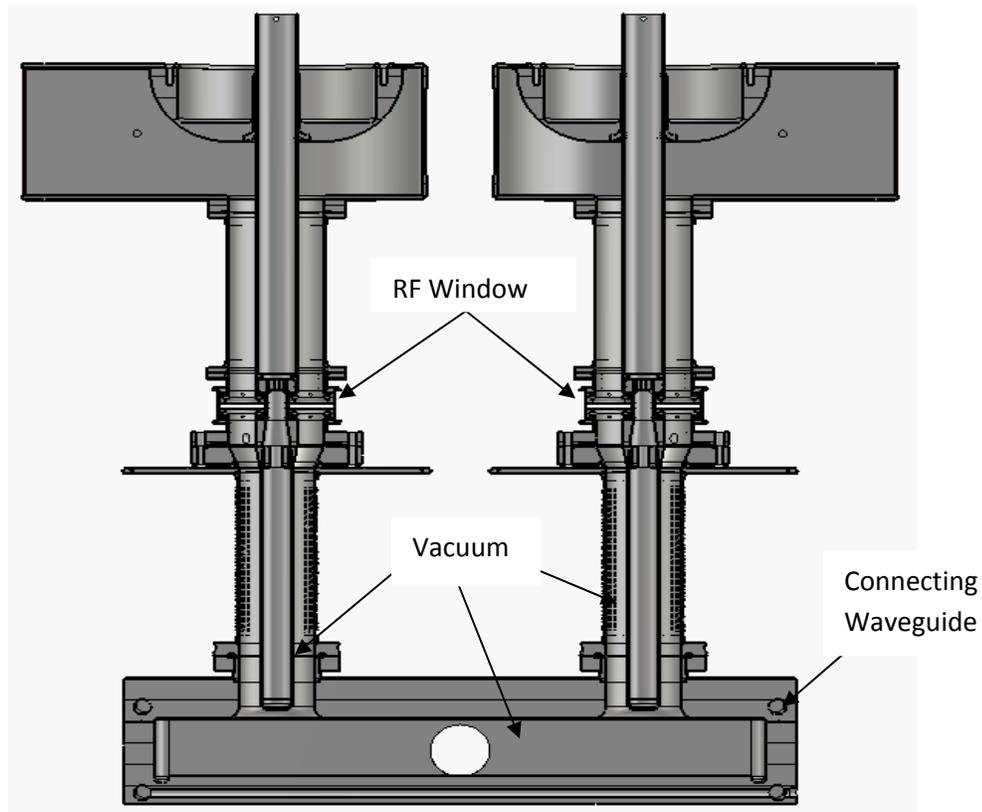


Figure1. FPC and connecting waveguide

## 3. FPC Geometry

Figure 1 shows the FPCs and connecting waveguide for conditioning. Between two windows (one at each FPC), there is ultra high vacuum (pressure less than  $5e-10$ Torr). By the way, the thickness of the box is about 2cm.

## 4. Voltage on the structure

### 4.1 Voltage on the FPCs

Both Navy and BNL FPCs were designed based on the 50 Ohm coaxial line. The distances between inner conductor and outer conductor are 0.021m for vacuum side and 0.027m for air side, which are the same for navy FPCs and BNL FPCs. In addition, the conditioning will work at standing wave mode, so the voltage on FPC is doubled. Figure 2 shows the electrical voltage in the coaxial line changing with the input power, which red line is air side and dash blue line is for vacuum side.

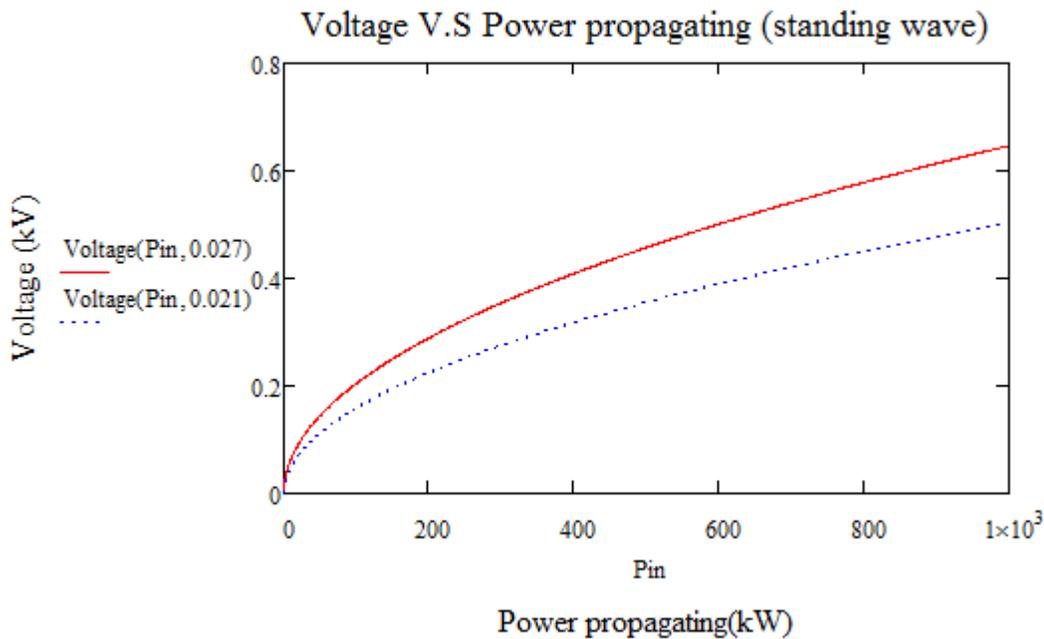


Figure 2. Voltage V.S. input power in FPCs

### 4.2 Voltage in the waveguide

The voltage estimated in the waveguide is based on TE<sub>10</sub> mode in the rectangular waveguide (The real waveguide is a little different from the rectangular waveguide because of coupling requirement for the FPCs). Figure 3 shows the voltage in rectangular waveguide changing with the input power (It is doubled by the standing wave mode).

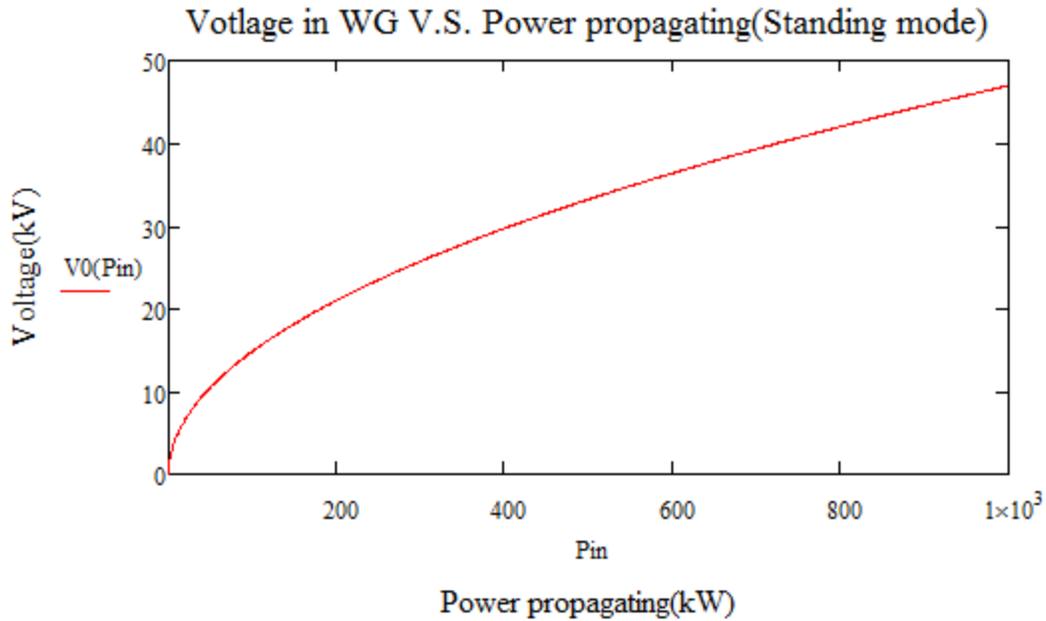


Figure2. Voltage V.S. input power in connecting waveguide

#### 5. Summary of Voltage on the structure

Because of design limitation, navy FPC will run with power smaller than 350kW and BNL FPC for 1MW termination. Since it is going to run standing wave mode for conditioning, the input power is 4 times less than the termination case, which is 87.5kW for Navy's FPC and 250kW for BNL FPC. Because we want to test the power tolerance of the window in Navy's FPC, the input power may 2 to 3 times bigger than 87.5kW.

**So, the input power for both conditioning is about 250kW, which the related voltages in coaxial line are 0.32 kV for air side and 0.25kV for vacuum side, and 23kV for waveguide.**