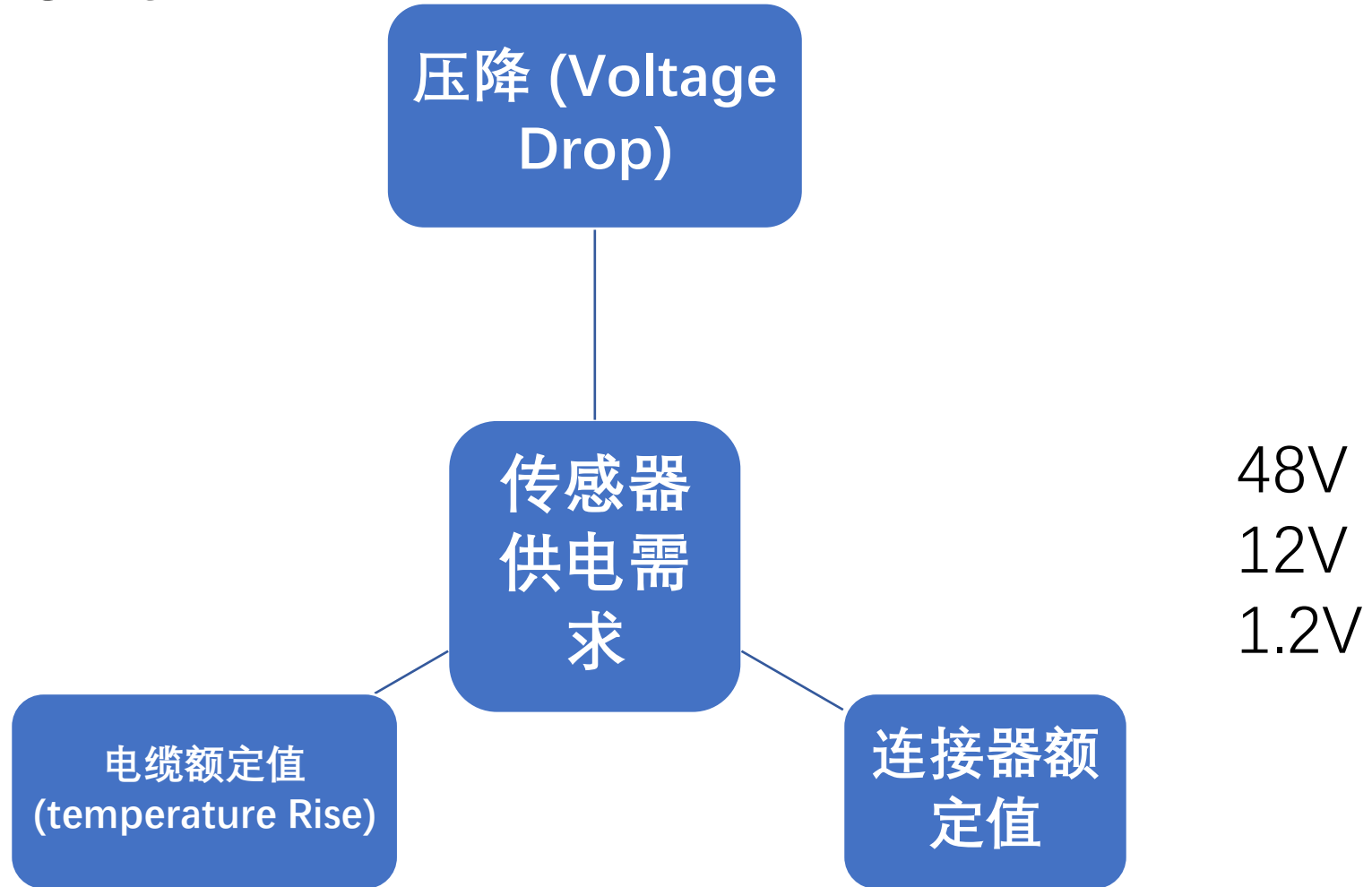


# Power Rail design

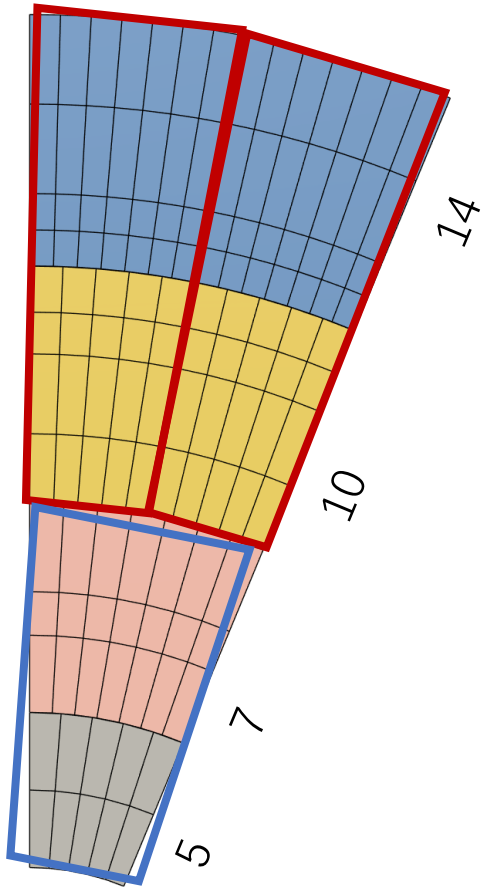
12.06.2024 Yihan Zhang



# Requirement:



# Requirement:

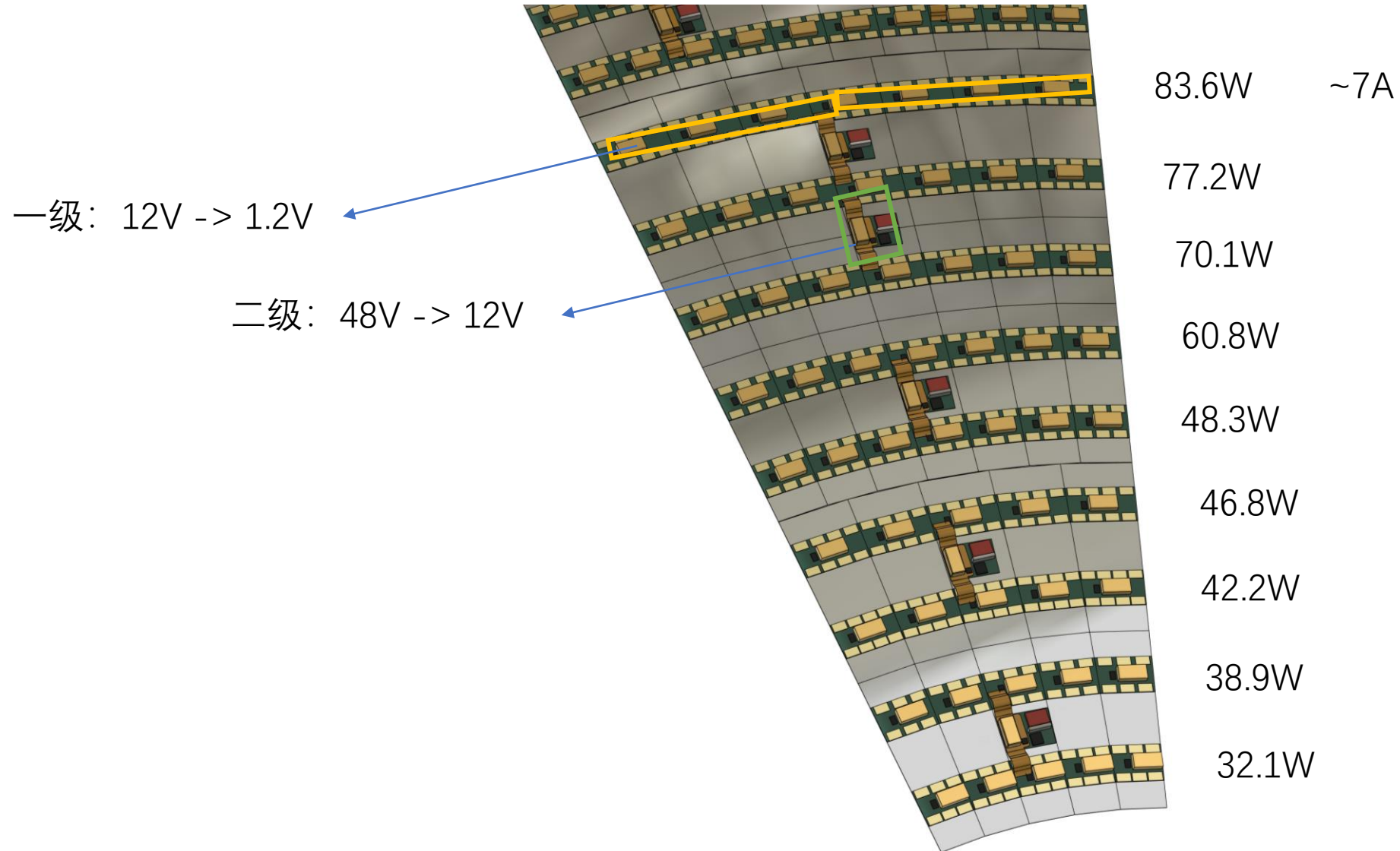


Total Power requirement:  $(300mW/cm^2)$

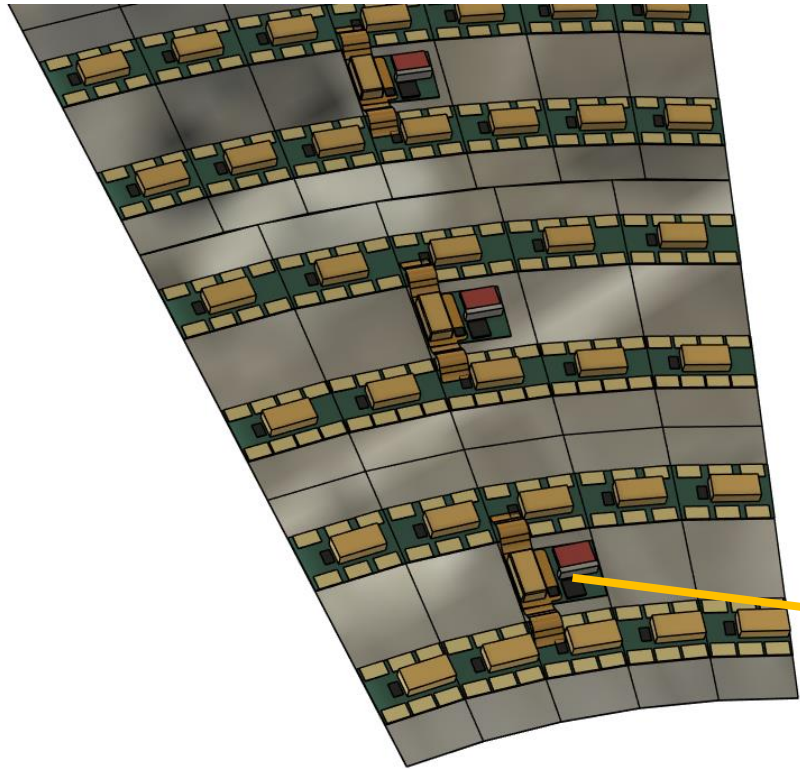
$$\frac{9.8 m^2}{16} \times \frac{300mW}{cm^2} = 1840W \text{ (one sector)}$$

Upper Area:  670W each  
Lower Area:  500W

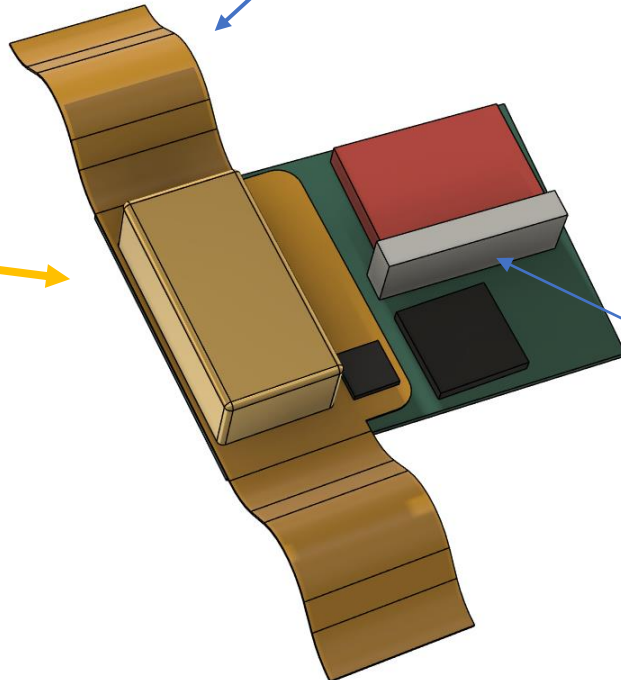
# 12V Power Rail:



# Requirement:



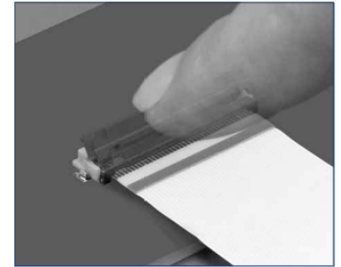
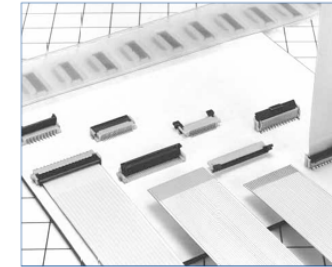
二级到一级之间的连接  
12V  
12mm 宽  
~6.9A



二级接口: 48V  
同样是12mm,  
24pin x 0.5mm pitch  
~4.8A 230W

## 0.5 mm and 1 mm Pitch FPC/FFC Connectors

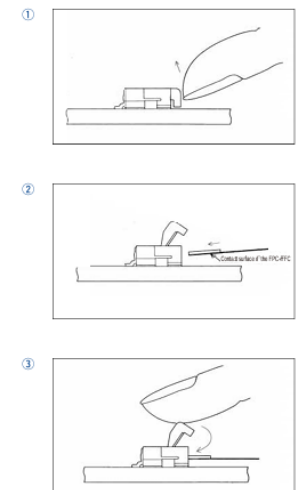
FH12 Series



### ■ Features

- 1. Rotating one-touch ZIF mechanism**  
The one-touch rotating ZIF mechanism is easier to operate and works with a light force.
- 2. Clear tactile click**  
A clear tactile click is delivered upon the successful completion of the mating process.
- 3. Supports high density mounting**  
The FH12's one-touch ZIF system requires less space than a slide locking connector and can be mounted in the center of the PCB.
- 4. Top & Bottom Contact and Vertical Mount type**  
There are three connection types available: top contact, bottom contact and a Vertical mount.
- 5. 1 mm pitch product**  
In addition to the 0.5 mm pitch connector, we also offer a 1 mm pitch connector.
- 6. Reinforced actuator**  
The FH12S version in 30, 40, 45, 50, and 53 pin counts are offered with a reinforced actuator that provides an extra measure of security against actuator breakage.
- 7. Supports 0.18 mm thick FPC**  
The FH12F version connector supports a 0.18 mm thick FPC ( $\pm 0.05$ ).  
Double-sided FPC do not require a stiffener when used on the connectors.

### Rotating one-touch ZIF mechanism



# Voltage Drop for 12V:

Current (I)

6.9

A

Ambient Temperature

20

°C

Thickness (t)

25

µm

Trace Length

300

mm

Temperature Rise ( $T_{Rise}$ )

25

°C

## FORMULA

First, calculate the Area:

$$A = \left( \frac{I}{k \times T_{Rise}^b} \right)^{\frac{1}{c}}$$

Then, calculate the Width:

$$W = \frac{A}{t \times 1.378}$$

For IPC-2221 internal layers:  $k = 0.024$ ,  $b = 0.44$ ,  $c = 0.725$

For IPC-2221 external layers:  $k = 0.048$ ,  $b = 0.44$ ,  $c = 0.725$

where  $k$ ,  $b$ , and  $c$  are constants resulting from curve fitting to the IPC-2221 curves.

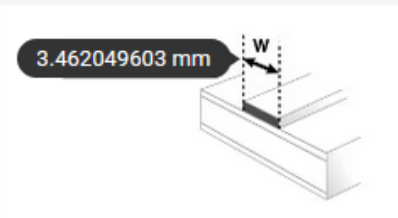
**Common values:**

Thickness: 1 oz

Ambient: 25 C

Temp rise: 10 C

Minimum Trace Width



External Layers in Air

Required Trace Width (W)

3.462049603

mm

Resistance

0.06352075366

Ω

Voltage Drop

0.4382932003

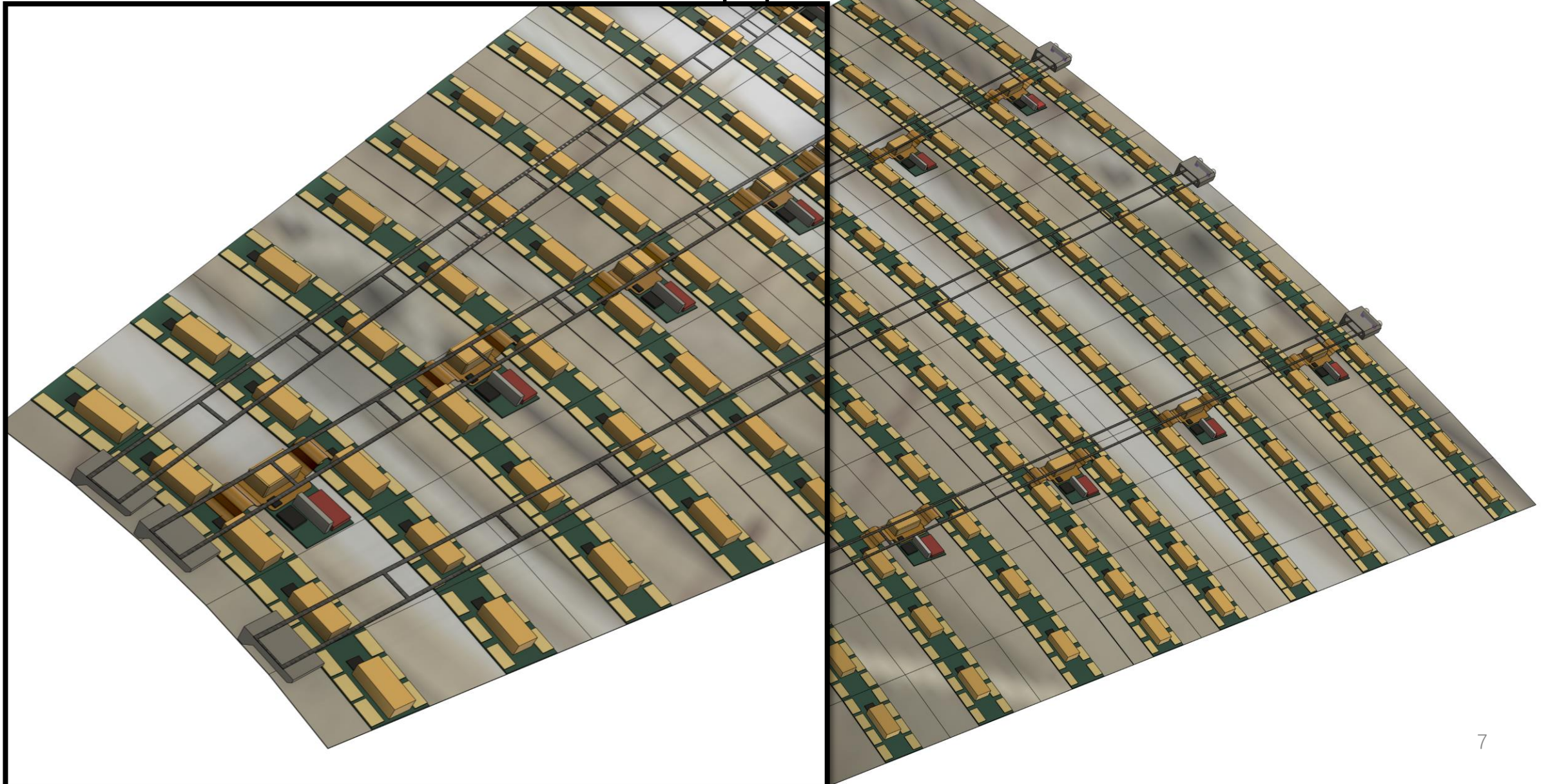
V

Power Loss

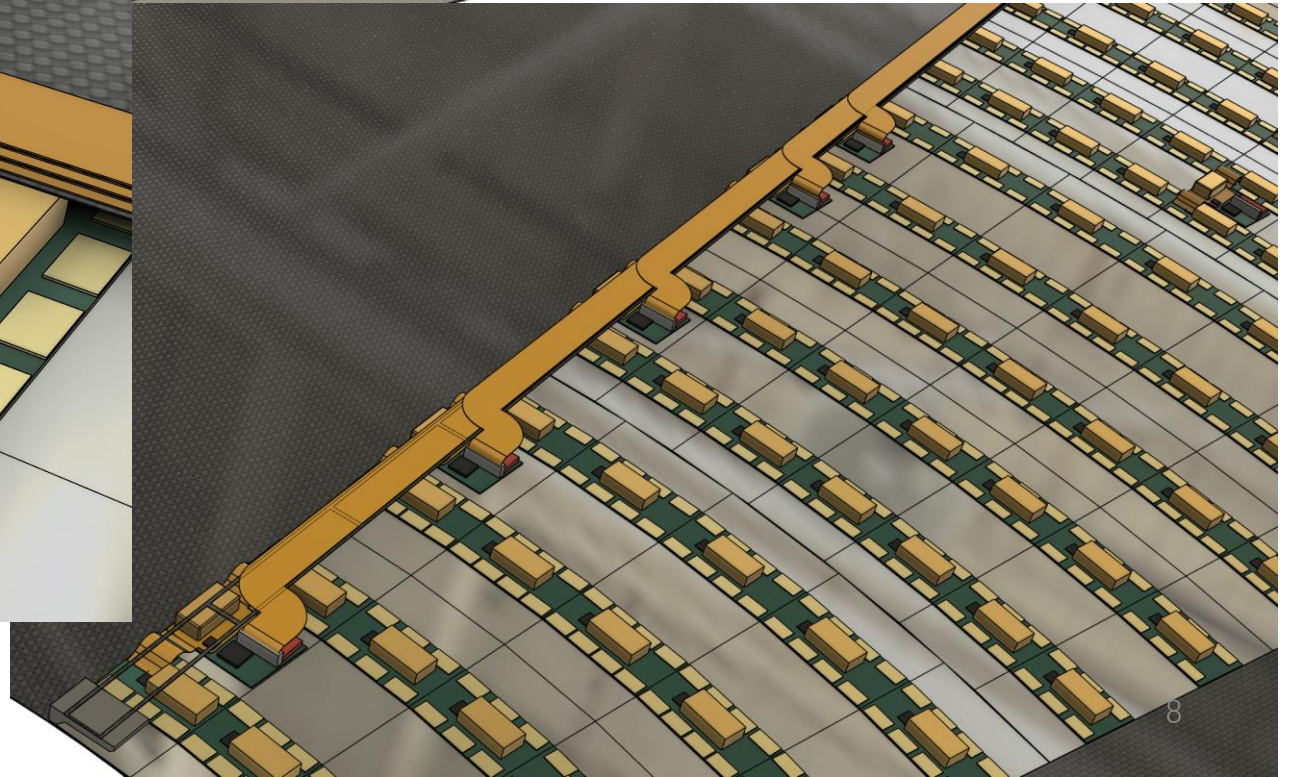
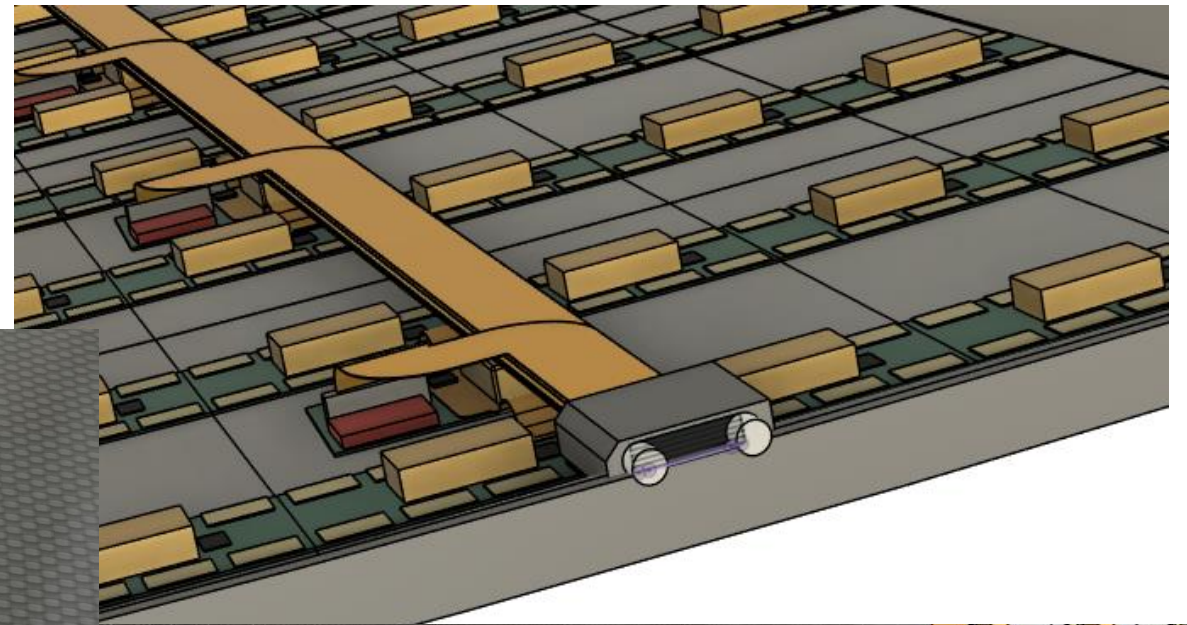
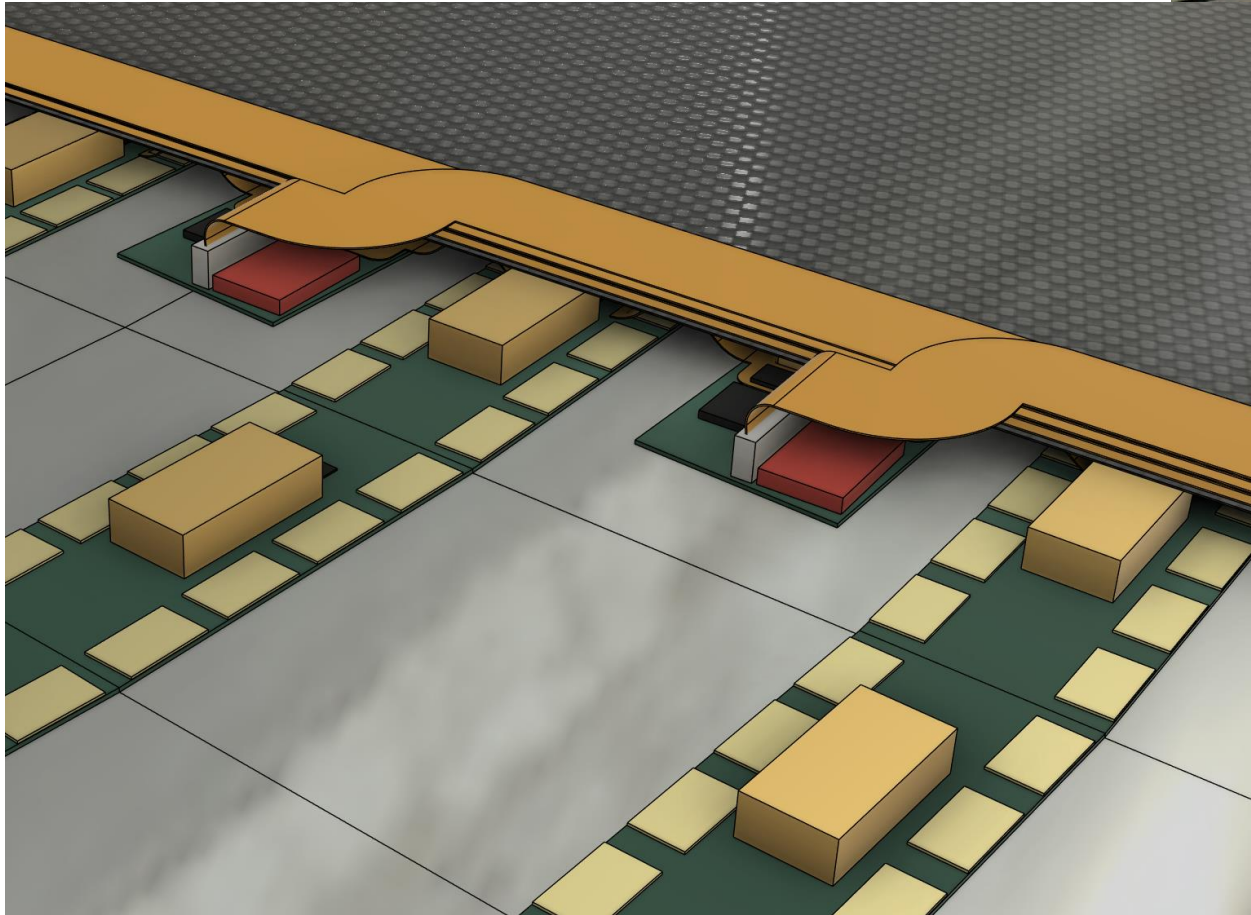
3.024223082

W

# 48V Power Rail: CF support



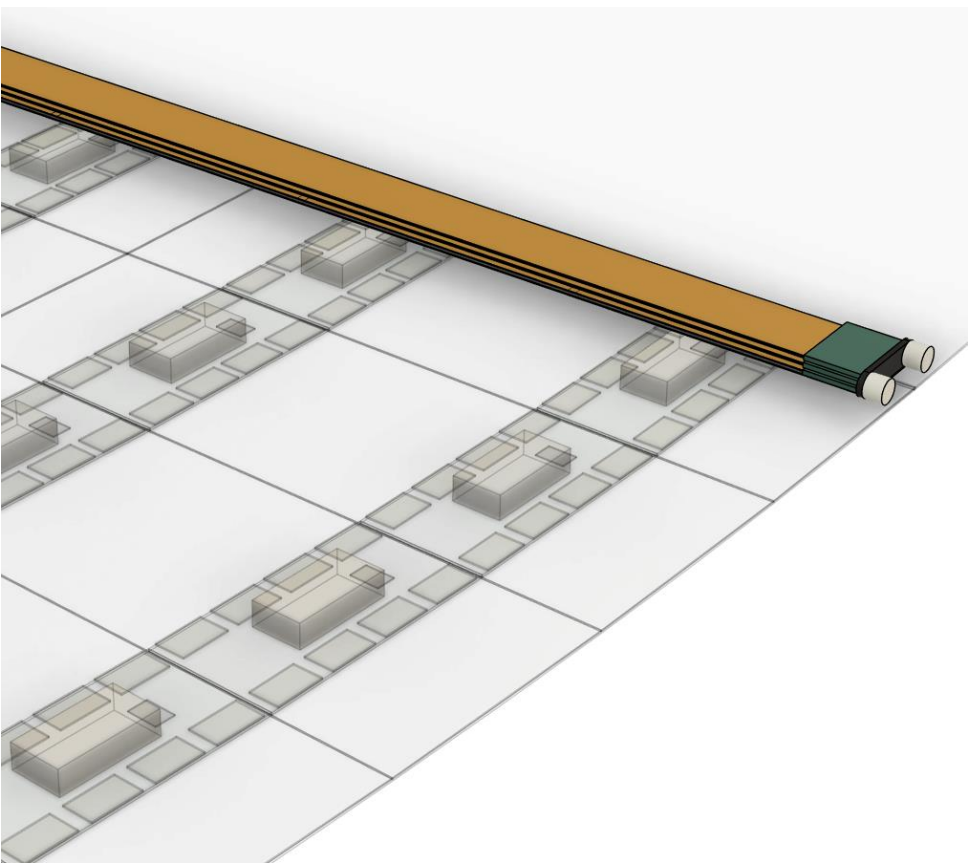
# 48V Power Rail:



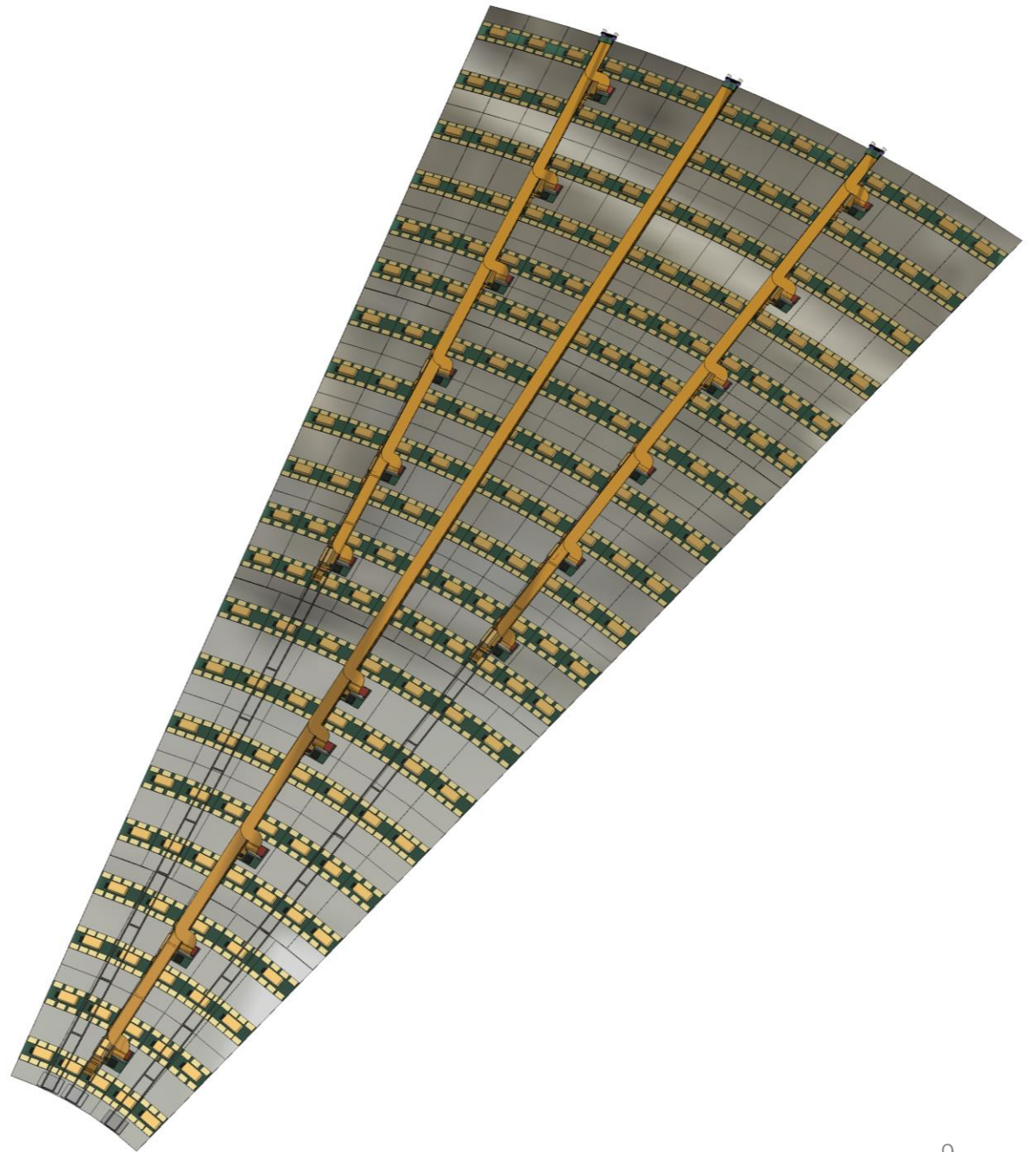
0.180 mm thick  
25um copper



# 48V Power Rail:



12mm width  
Max length: 1330mm  
4.8A 230W



# Voltage Drop for 48V:

Current (I)

4.8

A

Thickness (t)

25

μm

Temperature Rise ( $T_{Rise}$ )

20

°C

Ambient Temperature

20

°C

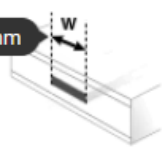
Trace Length

1330

mm

Minimum Trace Width

6.251313561 mm



Internal Layers

Required Trace Width (W)

6.251313561

mm

Resistance

0.1531369992

Ω

Voltage Drop

0.7350575964

V

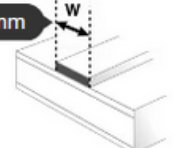
Power Loss

3.528276463

W

Minimum Trace Width

2.403020613 mm



External Layers in Air

Required Trace Width (W)

2.403020613

mm

Resistance

0.3983766909

Ω

Voltage Drop

1.912208116

V

Power Loss

9.178598959

W

## FORMULA

First, calculate the Area:

$$A = \left( \frac{I}{k \times T_{Rise}^b} \right)^{\frac{1}{c}}$$

Then, calculate the Width:

$$W = \frac{A}{t \times 1.378}$$

For IPC-2

For IPC-2

where k,

Common

Thickness

Ambient

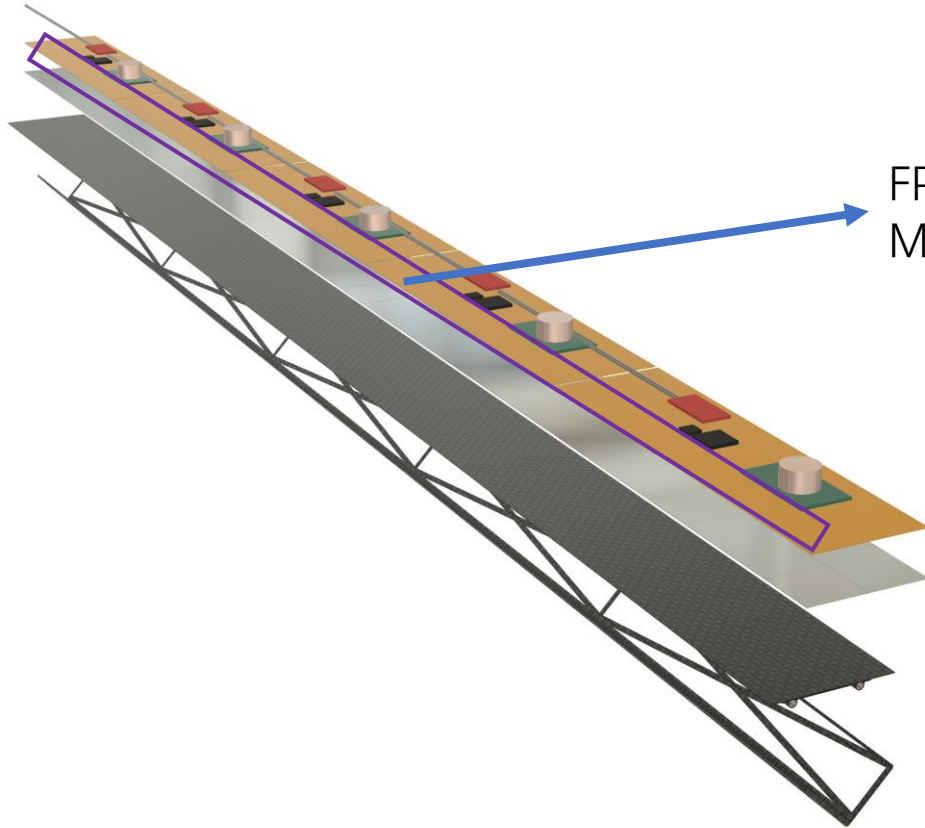
Temp rise

# Estimation for ITK:

Power requirement: 78.4W

-> 48V x 1.63A

-> 12V x 3.3A x 2 lanes



FPC for 12V rail at 490mm long:  
Min: 2.13mm

|                                 |      |
|---------------------------------|------|
| External Layers in Air          |      |
| <b>Required Trace Width (W)</b> |      |
| 2.131254647                     | mm ▾ |
| <b>Resistance</b>               |      |
| 0.1654857154                    | Ω    |
| <b>Voltage Drop</b>             |      |
| 0.7281371479                    | v    |
| <b>Power Loss</b>               |      |
| 3.203803451                     | w    |