

CUBESAT P-Pod Deployer Requirements

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Introduction

The CubeSat program is a joint effort between Cal Poly and Stanford Universities to develop a new class of picosatellites, which lend themselves to the educational side of space development. The Poly Picosat Orbital Deployer, or P-Pod is a standard deployment system, which will help in the effort to reduce the satellite development time for the CubeSat program. This standard deployer ensures all CubeSat developers conform to common physical requirements, which will reduce cost and development time. The P-Pod plays a critical role in as the interface between the launch vehicle and satellites.

The P-Pod is highly versatile in design with its small geometry and ability to mount in various orientations. Currently there are two designs for the P-Pod, a single tube that holds 3 CubeSats (Figure 1) and a double tube, which holds 6 (Figure 2). The tube design produces a reliable linear path for the CubeSats resulting in a low spin rate. The satellites are ejected from the tubes, using a spring plunger and travel on smooth flat rails. Release is initiated when the deployer's spring-loaded door/doors open after the line is cut.

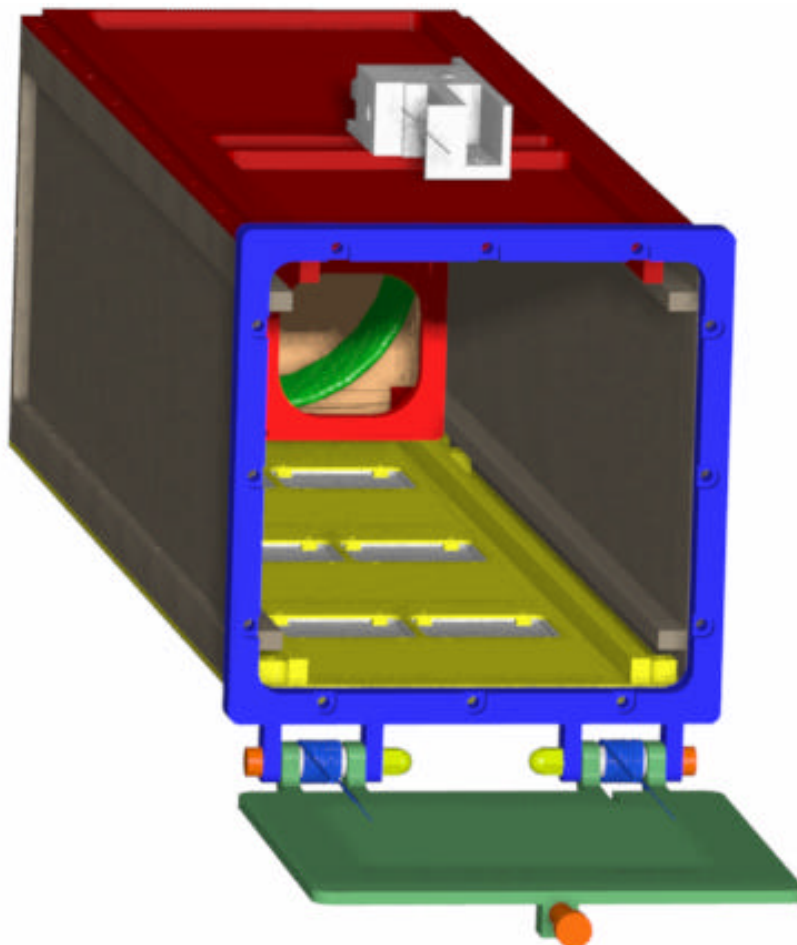


Figure 1: 3 CubeSat Capacity, Single P-Pod Design

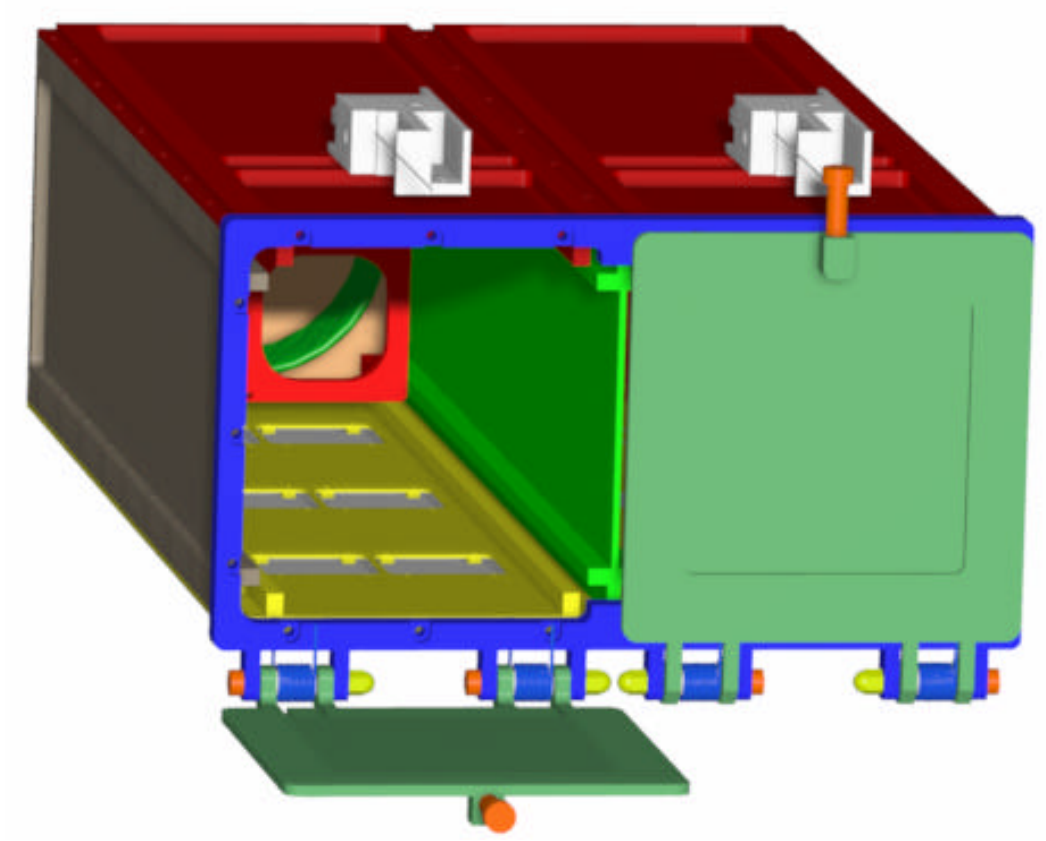


Figure 2: 6 CubeSat Capacity, Double P-Pod Design

Mechanical

- Material
 - The P-Pod material is Al 7075-T73 with Teflon impregnated hard anodize.
- Dimensions
 - Dimensions for the two P-Pod designs are shown in Figures 3 and 4.

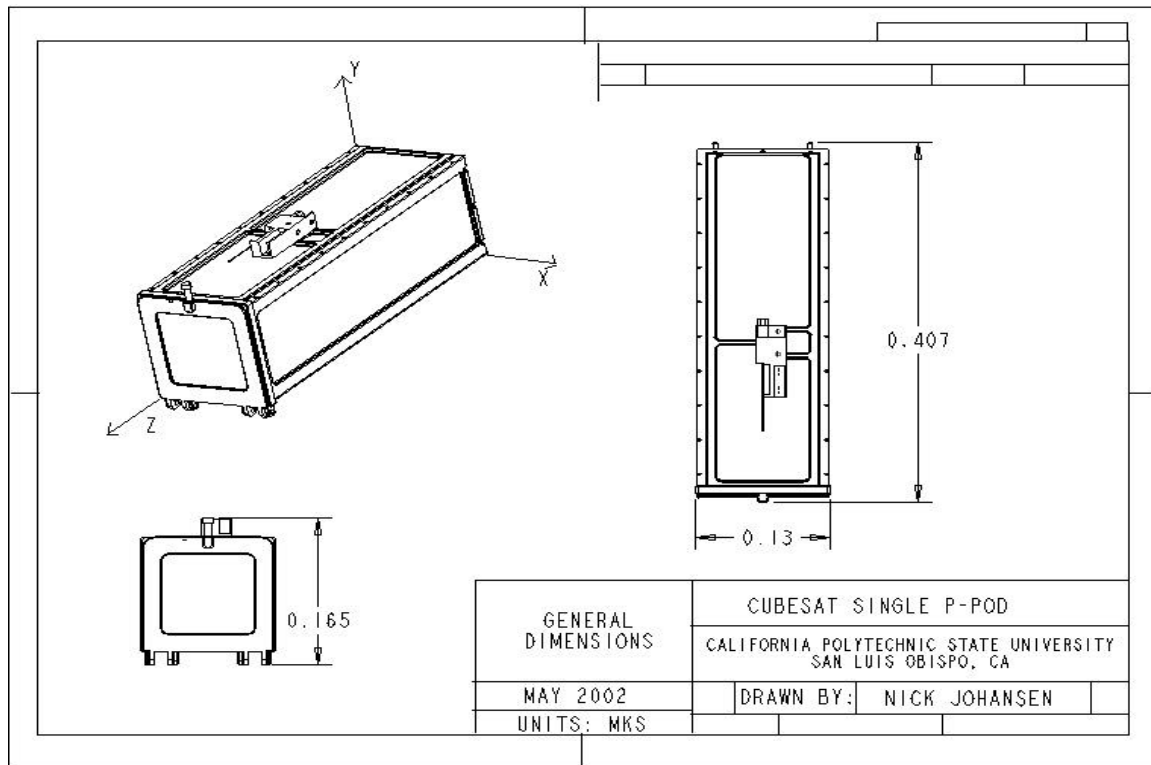


Figure 3: Single P-Pod Dimensions

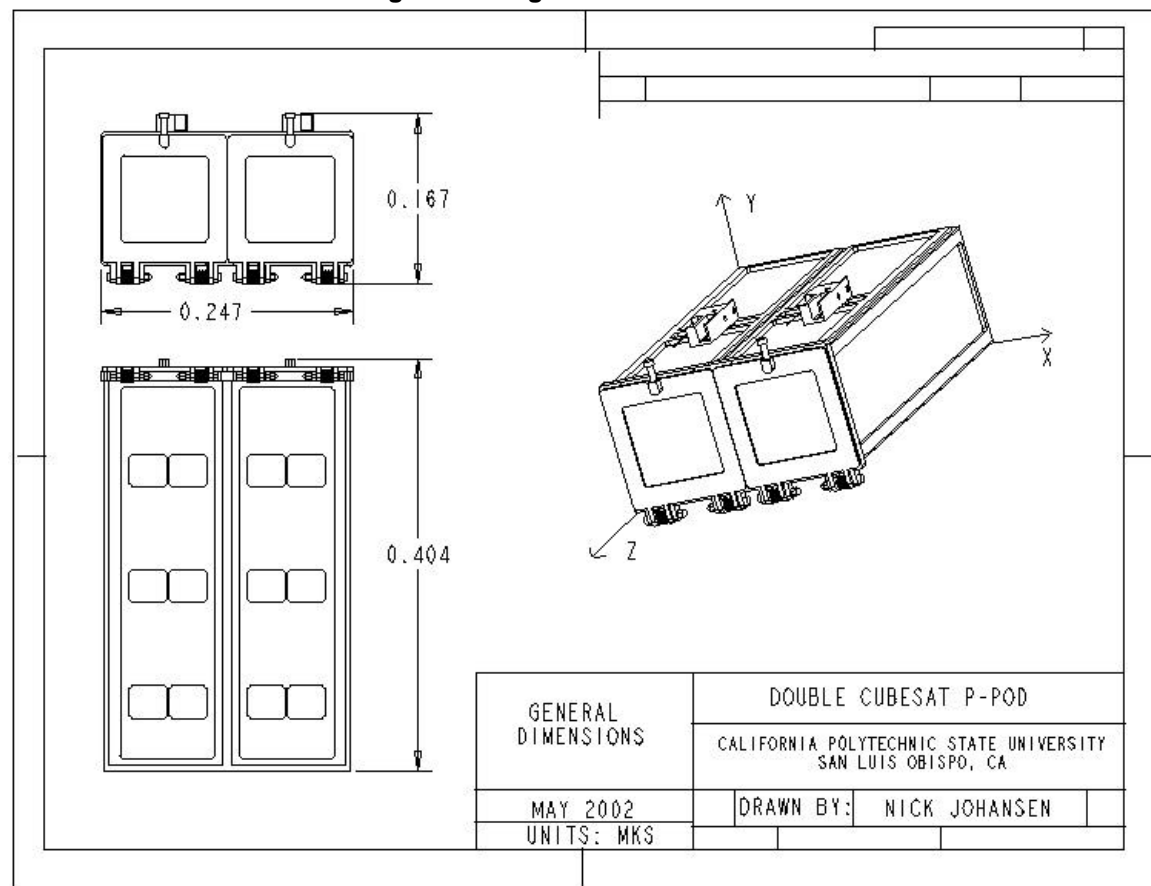


Figure 4: Double P-Pod Dimensions

Mechanical Continued

- Weights and Inertias
 - The total mass of the deployer, pre and post CubeSat deployment are shown in Table 1.
 - The moments of inertia and the center of gravity location of the payload of the single and double P-Pods prior to deployment are shown in Table 2. (See Figure 3 and 4 for coordinate system.)
 - Table 3 shows the moments of inertia and the center of gravity locations for both P-Pod designs after deployment.

Table 1: Mass Properties

Deployer	Payload Mass (Kg)	
	Pre-Deployment	Post-Deployment
Single P-Pod	5	2
Double P-Pod	9.7	3.7

Table 2: Pre-Deployment P-Pod Specifications

Deployer	Moments of Inertia (Pre-Deployment) (kg-m ²)			Payload C.G (Pre-Deployment) (m)		
	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
Single P-Pod	.073	.072	.018	.064	.065	.209
Double P-Pod	.142	.175	.069	.121	.064	.210

Table 3: Post-Deployment P-Pod Specifications

Deployer	Moments of Inertia (Post-Deployment) (kg-m ²)			Payload C.G (Post-Deployment) (m)		
	X-Axis	Y-Axis	Z-Axis	X-Axis	Y-Axis	Z-Axis
Single P-Pod	.039	.037	.010	.064	.062	.219
Double P-Pod	.073	.085	.033	.121	.061	.222

- Mounting
 - Both the single and double P-Pod are able to be mounted anywhere along the bottom panel as shown in Figure 6 and Figure 7. Figure 6b illustrates the side mounting detail of the single P-Pod.

- The single P-Pod has the additional option of side mounting on the location shown in Figure 5 and Figure 6b. A number 4 screw is advised when the single is attached along the side mounting surface.
- To attach to the launch vehicle both P-Pods can use a variety of screws ranging from number 4 up to number 6 hex head cap screws. The length can vary depending on the launch vehicle.

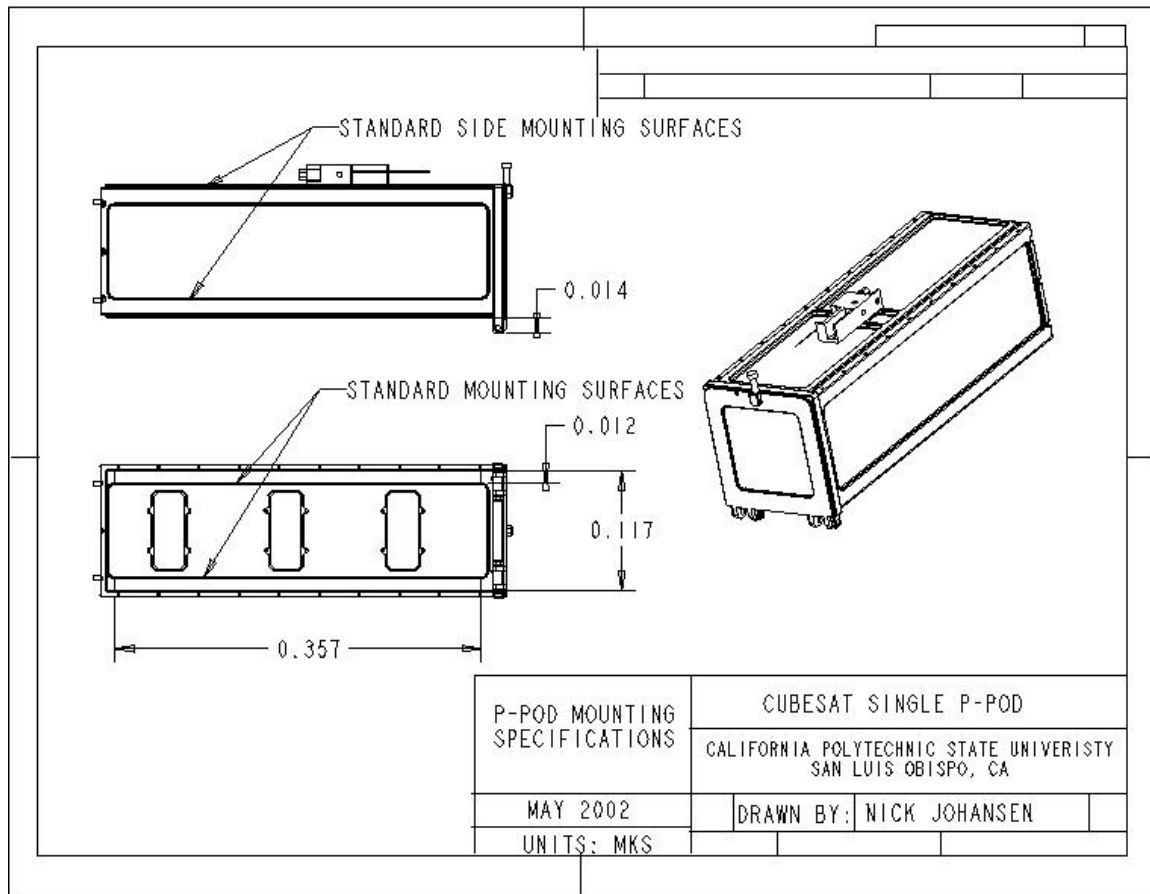


Figure 5: Single P-Pod Mounting Specifications

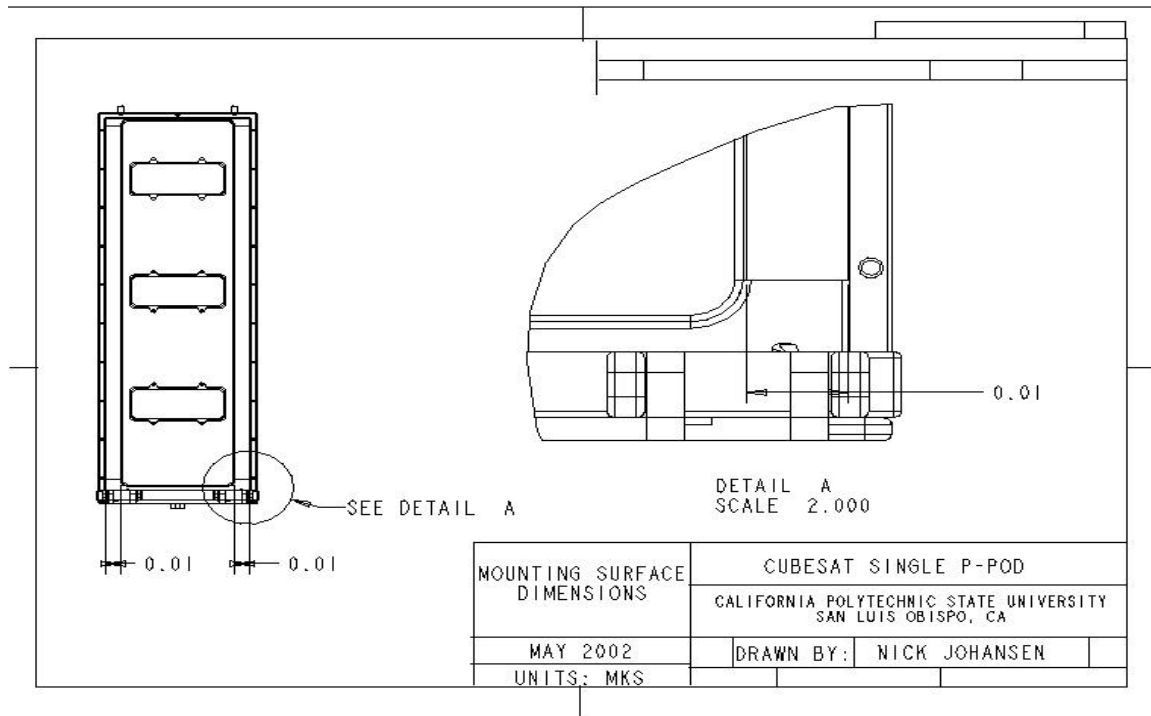


Figure 6: Detail of Single P-Pod Mounting Surface

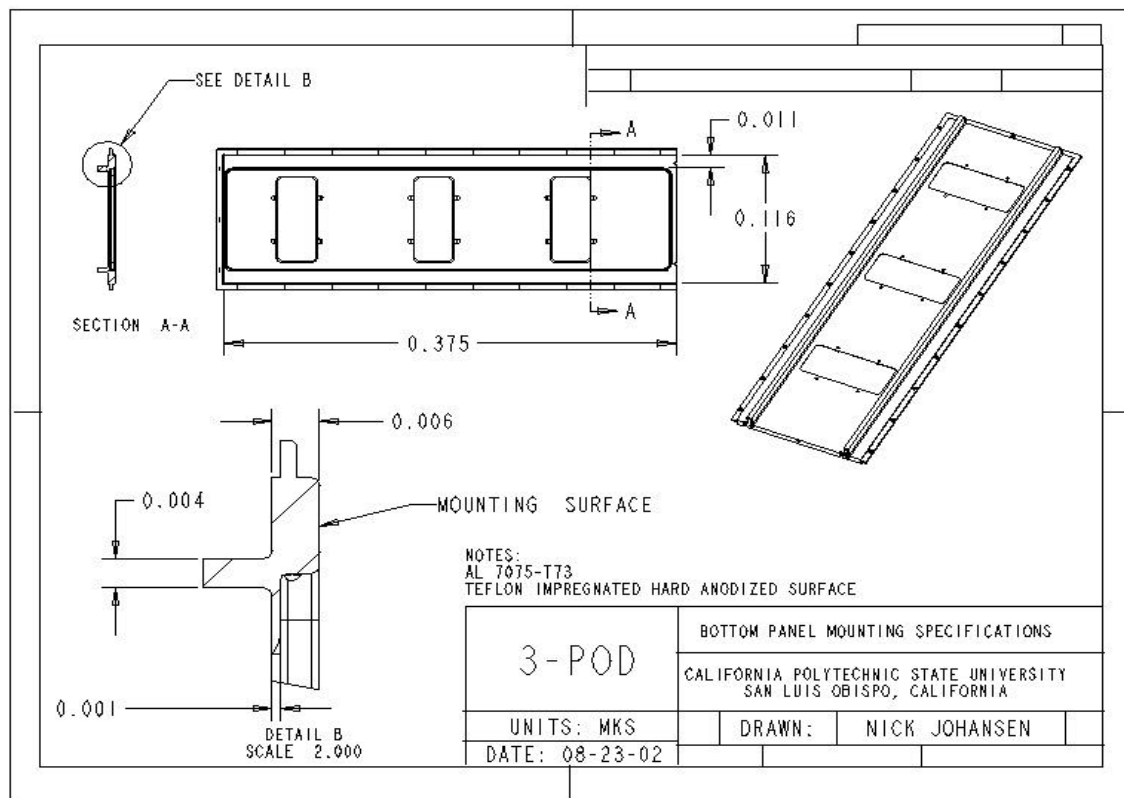


Figure 6a: Single P-Pod Bottom Panel Mounting Detail

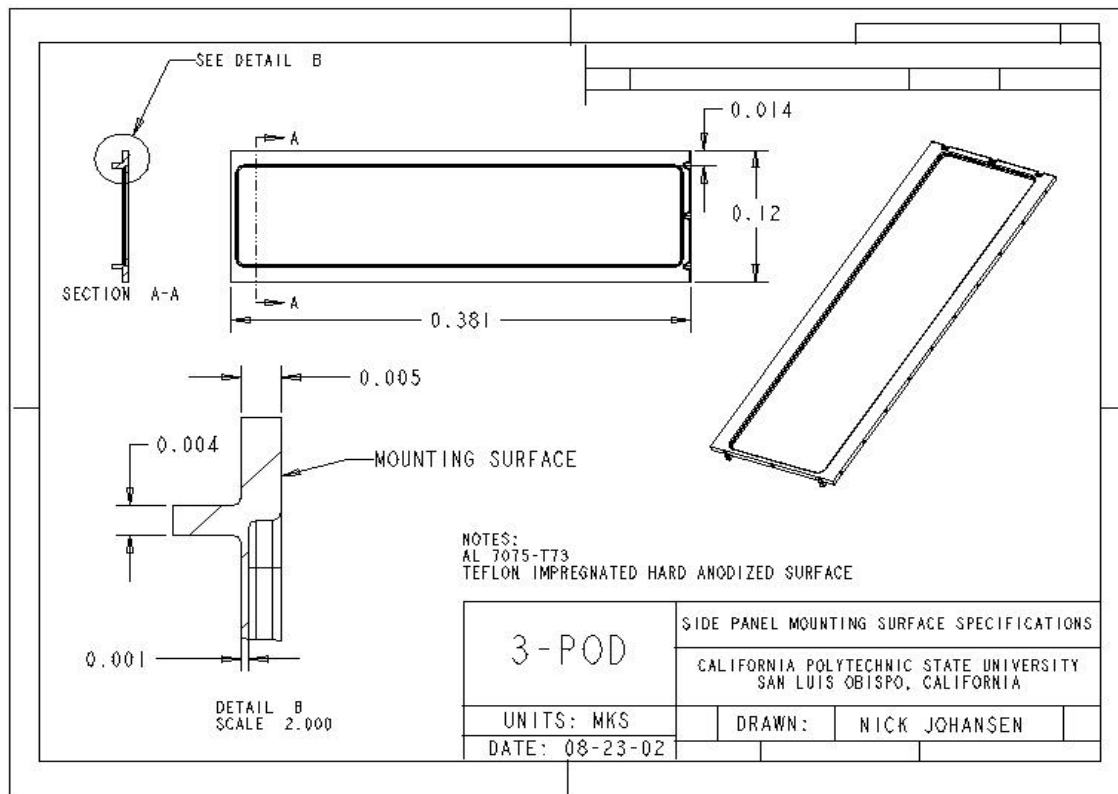


Figure 6b: Single P-Pod Side Panel Mounting Detail

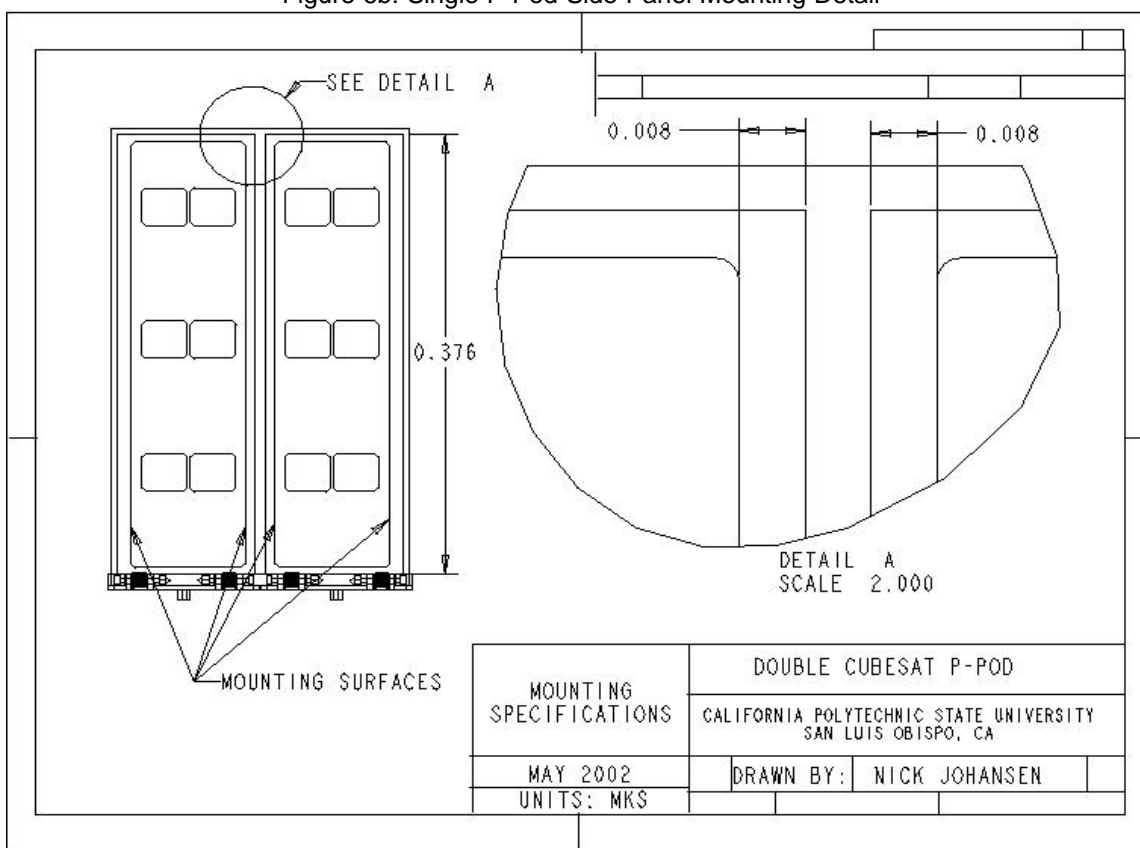


Figure 7: Detail of Double P-Pod Mounting Surface

- Door Opening
 - The door is designed to open 270 degrees until it reaches the bottom panel. Depending on how the P-Pod is mounted the door could open between 90 and 270 degrees.
 - The hinge mechanism protrudes from the mounting surface of the P-Pod this must be considered in the mounting configuration. The depth of the hinge assembly for the P-Pods is .01 m and is shown in Figure 5 for the single.
- Data Ports
 - The data port openings on both P-Pod designs are secured before the units are mounted to the launch vehicle.
 - Access to these openings is not required after the P-Pods are mounted on the launch vehicle. (But is desirable.)

Electrical

- Operation
 - Currently both the single and double P-Pods use radiant heaters to sever a Vectran line.
 - The line cutter release mechanism remains as a single unit after deployment to reduce space debris.
- Input Requirements
 - For a 14 V system two-amp signals are needed for a cycle of 180 seconds on, 20 seconds off, 180 seconds on for each line cutter.
 - Each line cutter has two heating elements; an electrical schematic is shown in Figure 8.
- Options
 - The development of an integration box that would accept a standard deployment signal is being considered.
 - Other devices are still being investigated.

- A deployment detection device on the P-Pod is also being considered.

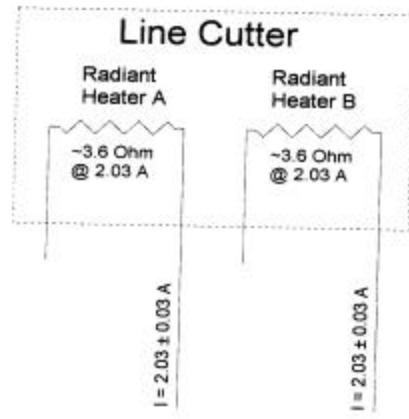


Figure 8: Electrical Schematic of line cutters