http://www.cubesatkit.com/

# CubeSat Kit™ Solar Panel Clips Set

Hardware Revision: A

**Means of Attaching Solar Panels to a CubeSat Kit Structure**

**Applications**

- CubeSat Kit

**Features**

- Very low mass – avoids additional fasteners
- 7 + 1 clips hold solar panels to all six sides of the CubeSat Kit
- Allows for thermal expansion and contraction of panels in all dimensions
- High-strength stainless steel construction
- For 0.062" (1.5mm) Panels and PCBs

**Compatible with**

- All CubeSat Kit structures
- All CubeSat Kit sizes (1U, 1.5U, 2U & 3U)

**ORDERING INFORMATION**

Pumpkin P/N 711-00346

| Option Code | Configuration |
|---|---|
| /00 (standard) | standard |

Contact factory for availability of optional configurations.

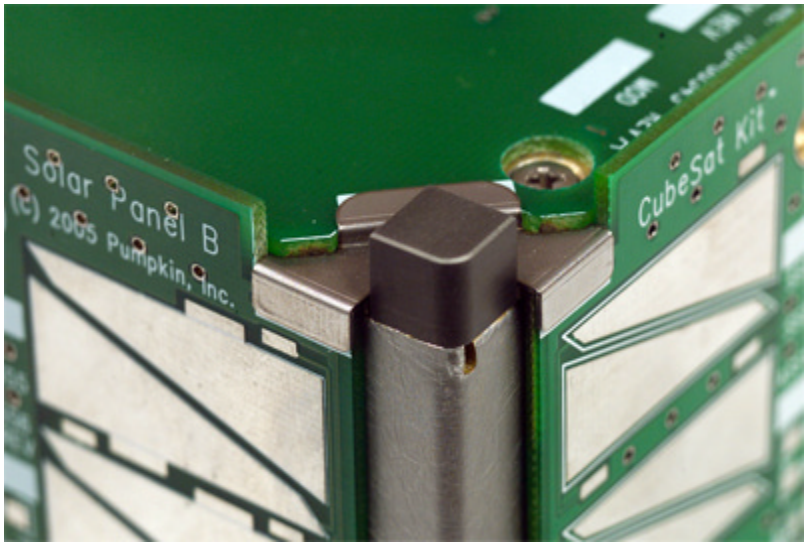
## ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | Value | Units |
|---|---|---|---|
| Operating temperature | $T_A$ | -200 to +200 | ºC |
| Maximum mass per panel [1] (safety factor = 2) | $M_{PANEL\_MAX}$ | 500 | g |

## PHYSICAL CHARACTERISTICS

| Parameter | Conditions / Notes | Symbol | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Mass | Net increase in mass of CubeSat Kit | | | +9 | | g |
| Material thickness | Stainless steel, precision bends | | | 0.5 | | mm |
| Compatible panel thickness | Panels of up to this maximum thickness can be held by the clips. | | | | 1.60 | mm |
| | | | | | 0.063 | inch |

## SAMPLE INSTALLATION




The image above shows one corner of a CubeSat Kit with its Solar Panel Clip installed, with panels (not included) made from 0.062" (1.5mm) PCB material. Each clip fits between a Cover Plate (shown) or Base Plate and the associated foot, and is held in place via the foot screw (not visible).

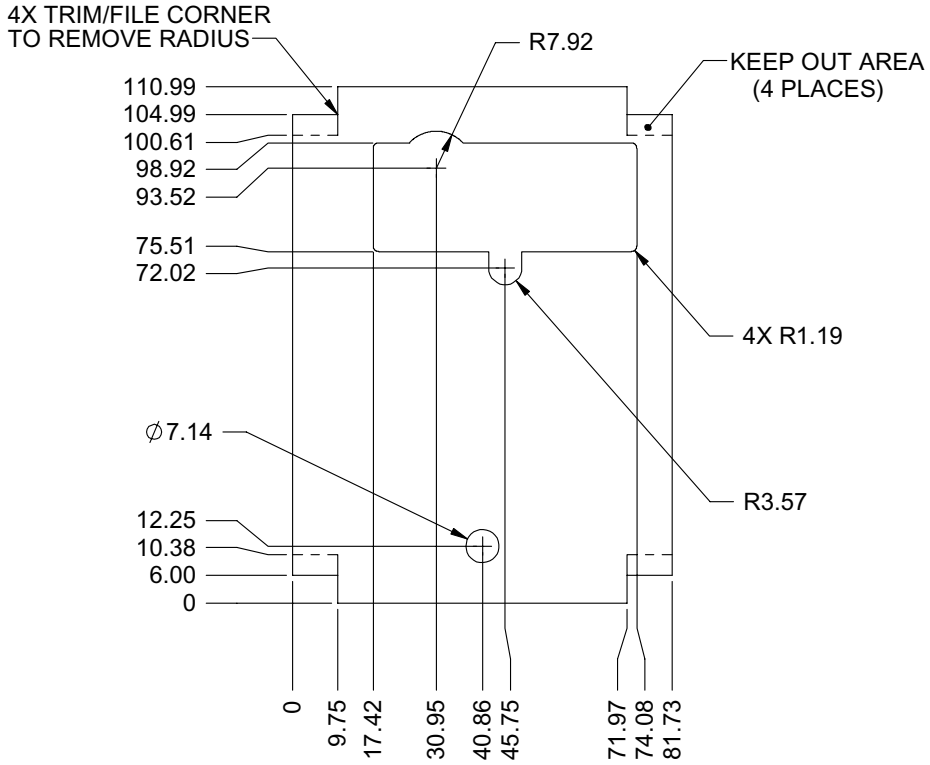
Each CubeSat is under compression when in integrated into a P-POD deployer. This compression adds beneficially to the forces that keep the Solar Panel Clips in place on each CubeSat Kit prior to deployment into space.

## SAMPLE PANEL DIMENSIONS

Below are sample panel dimensions for the four different panel layouts that are compatible with the Solar Panel Clips – the front panel (x1), the side panel (x3), the bottom panel (x1) and the top panel (x1).

[1] Each panel is held by four clips. Each clip holds the corners of three panels.

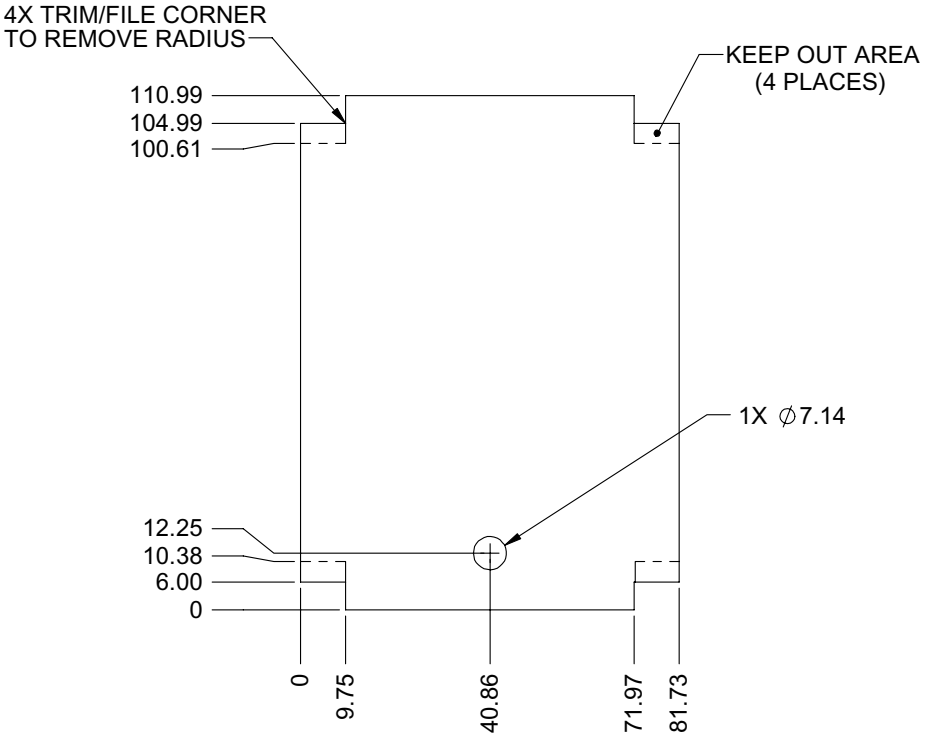
## SAMPLE PANEL DIMENSIONS [2] – FRONT [3]




[2] Dimensions in mm. Some rounding is acceptable.

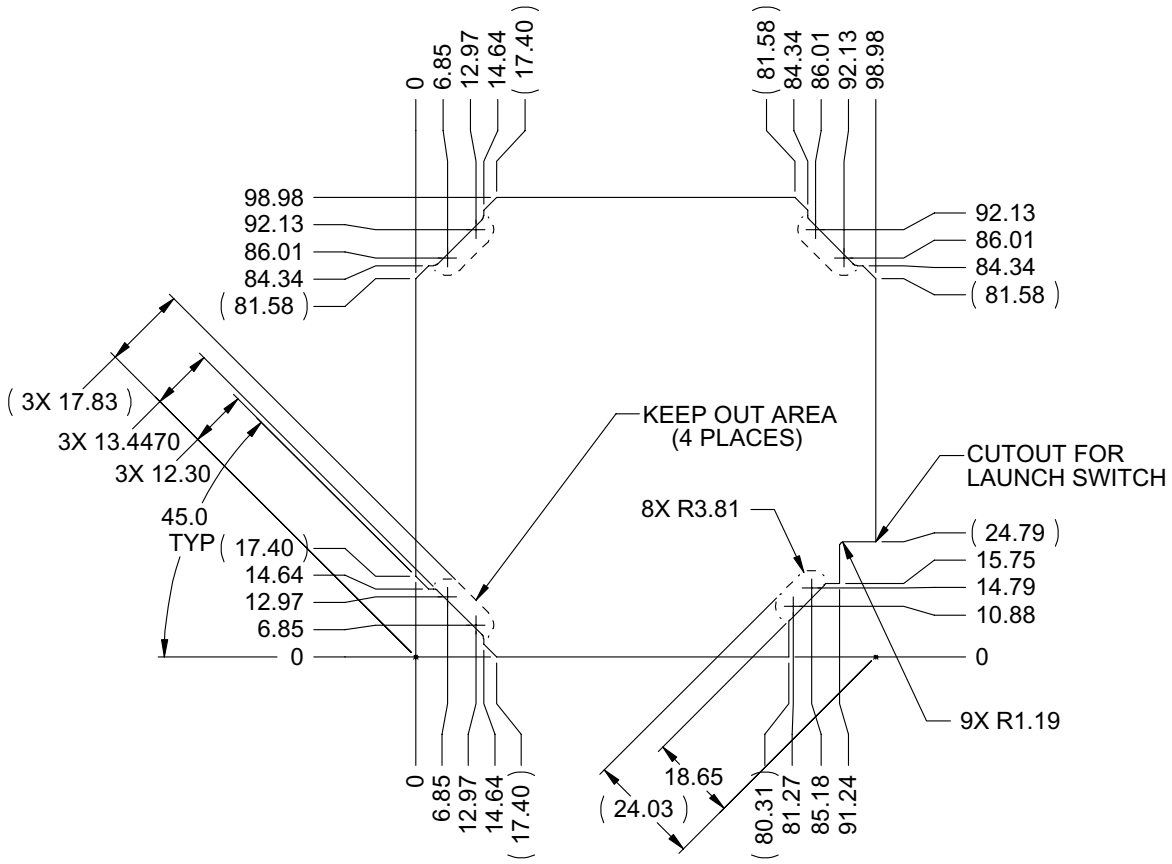
[3] Base Plate is located at top in this orientation.

## SAMPLE PANEL DIMENSIONS – SIDE [4]

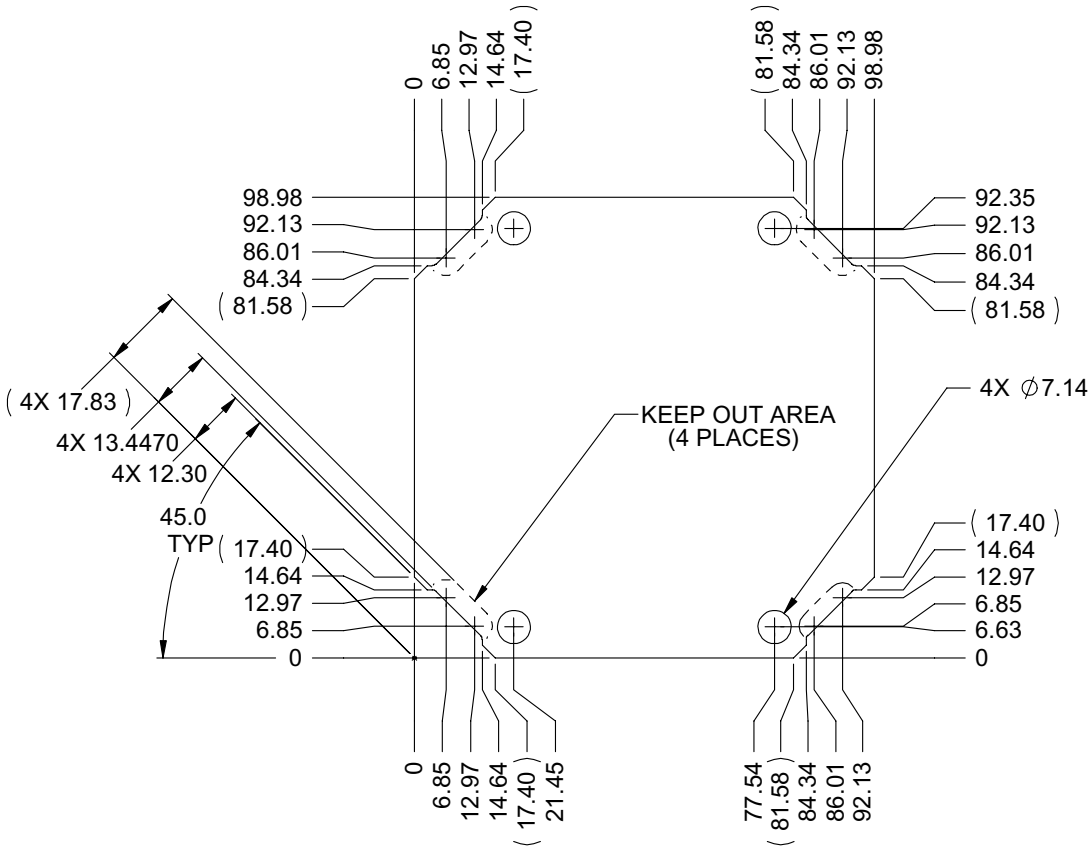



[4] Base Plate is located at top in this orientation.

## SAMPLE PANEL DIMENSIONS - BOTTOM



## SAMPLE PANEL DIMENSIONS - TOP




## PANEL LOCATION

The Solar Panel Clips hold panels flush against the outside walls of the CubeSat Kit. This maximizes the available 6.5mm[5] of allowed component height perpendicular to each wall of the CubeSat Kit, and allows the back side of each panel to be in contact with the CubeSat Kit Chassis Walls assembly to facilitate thermal transfer. When fabricated using the dimensions above, the panels will not infringe onto the "keep out" area of the CubeSat specification.

On each panel, the 4 keep-out areas where the clips hold each panel and the screw cutouts (if present) have been kept to a minimum to maximize usable panel area.

## PANEL THICKNESS

The Solar Panel Clips are designed for 0.062" (1.5mm) panels. This panel thickness represents a good compromise between mass and strength, particularly when the panels are fabricated from typical PCB material.

When using thinner panels, additional material should be added to each panel under the clip area to bring the effective thickness up to 0.062" (1.5mm).

When using thicker panels, material should be removed from each panel under the clip area to bring the effective thickness down to 0.062" (1.5mm).

## INSTALLATION

[5] The CubeSat Kit's construction allows up to 7mm of component perpendicular to the Base and Cover Plates (top and bottom). This differs from the CubeSat specification, which allows only 6.5mm. The CubeSat Kit allows a maximum component height of 6.5mm perpendicular to the Chassis Walls Assembly (sides).

The Solar Panel Clips are installed at each of the 8 corners of the CubeSat Kit, to the CubeSat Kit Base and Cover Plates. In each of the 7 corners that have feet, first remove the foot by unscrewing the fastener that holds the foot in place. Remove the stainless steel shim[6] under the foot, and replace it with the standard Solar Panel Clip. Then re-attach the foot to the plate using the original fastener. On the odd corner of the Base Plate, remove the fasteners that hold the Launch Switch in place, slip the non-standard Solar Panel Clip into place and affix it with the M3x4mm pan head stainless steel screw and lock washer.[7] Then re-install the Launch Switch.

## POSITIONING

It is helpful to carefully align each clip in its mounting plane so that the edges that hold the panels on the sides of the CubeSat Kit are parallel to the CubeSat Kit sides and out as far as possible. This is most easily done by using scrap PCBs of the correct thickness prior to tightening the clips in place.

## PANEL ATTACHMENT

To attach panels to the CubeSat Kit Base and Cover Plates, remove two adjacent Solar Panel Clips, slide the panels under the opposite-side clips, and then reattach the two adjacent clips. Panels on the Base and Cover Plates should be considered semi-permanently attached.

To attach panels to the sides of the CubeSat Kit, first attach the Base Plate to the Chassis Walls Assembly (6 M3x5 screws). Then slide each side panel into the clips of the Base Plate. Then attach the Cover Plate (6 M3x5 screws), while aligning each panel with the clips on the Cover Plate.

Disassembly is the reverse of assembly.

## ADHESIVES, ETC.

Adhesives can be used to supplement the holding power of the clips. Thermally conductive adhesives can facilitate heat transfer from each panel to the CubeSat Kit core structure. In order to facilitate disassembly and reassembly, it is recommended that adhesives be applied towards the end of the Test and Integration (T&I) phase, especially with regard to panels attached to the sides of the CubeSat Kit.

[6] When using Solar Panel clips, the shims are no longer used. However, we recommend retaining the shims for possible future use.
[7] This clip is the only clip that requires additional hardware to mount to the CubeSat Kit. The other 7 clips use the existing hardware that holds the feet in place.

## TRADEMARKS

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- CubeSat Kit™ and the CubeSat Kit logo

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