PUMPKIN™
INCORPORATED
750 Naples Street • San Francisco, CA 94112 • (415) 584-6360 • http://www.pumpkininc.com

Data Sheet

From: Pumpkin
To: User
Date: Aug 11, 2014

PRM Data Sheet- Rev A

Overview

This document provides information on Pumpkin's Panel Release Mechanism (PRM) unit as well as instructions for proper installation and operation of the unit. The PRM consists of an aluminum housing that traps the burn wire against resistors that are connected in parallel. The PRM uses 8.5W of power when turned on. The PRM unit is useful for controlled release of satellite deployables, such as solar panels and antennas. The PRM enables the user to determine at what time after ejection from the P-POD they want components to deploy.

CHANGELOG

Rev.	Date	Author	Comments
A	20140811	JMM	Initial revision.

Contents

PRM Data Sheet- Rev A 1

Overview 1
List of Figures 3
List of Tables 3
1 PRM Function 4
2 PRM Components 4
3 PRM Installation Requirements 5
3.1 Exterior PCB Installation 5
3.2 Remote PRM PCB Installation 8
3.3 Required Deploying Panel Features 9
4 PRM Loading Instructions 10
Appendix I: Pumpkin Test Data 14
I Ambient Air 14

List of Figures

Figure 1: PRM Unit Exploded View. Shown with PRM Capture Clip 703-00990 5
Figure 2: Exterior PCB Installation Mounting Dimensions (shown with PRM Capture Clip 703-00990). Dimensions in brackets are in millimeters. 5
Figure 3: Required PRM Cutouts for External PCB Board. Orange outline designates resistor locations. Dimensions in brackets are in millimeters. 6
Figure 4: Chassis cutout for PRM Capture Clip and PRM Reverse Capture Clip. Dimensions in brackets are in millimeters. 7
Figure 5: Chassis cutout for PRTM Vertical Capture Clip. Dimensions in brackets are in millimeters. 8
Figure 6: Remote PRM PCB Dimensions (shown with PRM Capture Clip 703-00990). Dimensions in brackets are in millimeters. 8
Figure 7: View of deployable panel stowed over fixed panel with PRM unit with required cutout dimensions. Dimensions in brackets are in millimeters. 9
Figure 8: PRM Loading Step 3 10
Figure 9: PRM Loading Step 4 11
Figure 10: PRM Step 5 11
Figure 11: PRM Step 7 12
Figure 12: PRM Step 8 12
Figure 13: PRM Step 9 13

List of Tables

Table 1: Panel Release Mechanism Operating Values 4
Table 2: PRM Unit Components (Item number corresponds to Figure 1) 4
Table 3: PRM Capture Clip and Plate Options 7
Table 4: Pumpkin Test Equipment 14

1 PRM Function

Each PRM consists of a drive circuit, some circuitry on an external panel or PCB, a cover/body that includes a spring tensioner, and a capture clip. A command module is required to send signals to the PRM. In Pumpkin's MISC 3 architecture, triggering the PRMs is done via commands to the SIM (Solar Interface Module). Each PRM can be triggered independently, with a specified burn time. Burn time is defined as the programmed amount of time that the unit will have power. Time to deploy is defined as the duration of time between power being supplied to the unit and full deployment. A three-part Enable / Arm / Fire command sequence must be followed. End-users should refer to the MISC 3 test & validation code for an example of communications between the C&DH processor and the SIM to trigger the individual PRMs. PRM units can be implemented independent of MISC 3 architecture. See the *PRM Installation Requirements* section for more details.

Resistance (Ohms)	Peak Voltage (V)	Peak Current (A)	Burn Time (s)	Average Time to Deploy (s)
5.6	5.0	1.69	20	10
9.1	6.5	1.36	30	11.5

Table 1: Panel Release Mechanism Operating Values

2 PRM Components

Each PRM unit consists of the following components:

Item	Part Number	Description	Qty	Manufacturer
1	703-00984	PRM Housing	1	Pumpkin
2	703-00899	PRM Extension Spring	1	Pumpkin
3	97395A405	Dowel Pin, 1/16" OD, 3/8" L	1	McMaster Carr
4	703-0xxxx	PRM Clip or Plate[1]	1	Pumpkin
5	SMTSO-M2-3ET	PEM Standoff	4	Penn Engineering
6	91801A107	M2x6mm Flat Head Screw	4	McMaster Carr
7	XXXXXX	SMT Resistor[2]	2	Digikey
N/A	N/A	Power Pro Braid 20lb., 40lb., or 80lb. Test, 6lb diameter 100% Spectra fishing line	6-8in	Power Pro

Table 2: PRM Unit Components (Item number corresponds to Figure 1)

[1] There are several PRM clip and plate options that can be used. See Section 3.1 for more details.

[2] Resistance can be selected based on customer's available power.

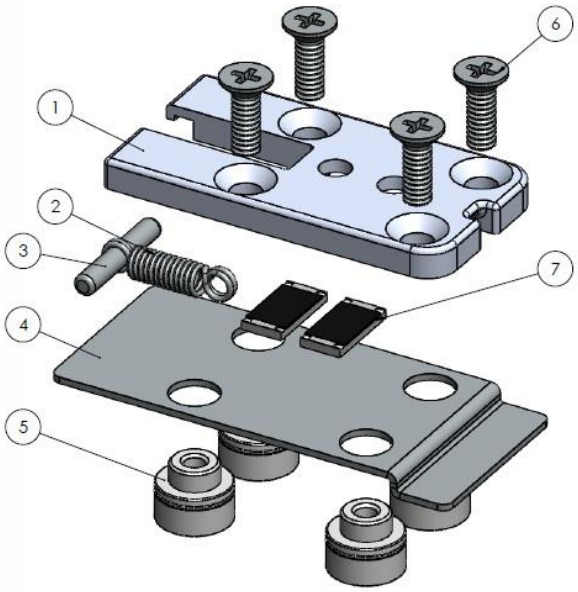


Figure 1: PRM Unit Exploded View. Shown with PRM Capture Clip 703-00990

3 PRM Installation Requirements

Each PRM unit requires a nominal volume both on the exterior and interior of the satellite for installation. PRM units must be mounted to an exterior PCB panel made by the customer or on one of Pumpkin's remote PRM PCB boards.

3.1 Exterior PCB Installation

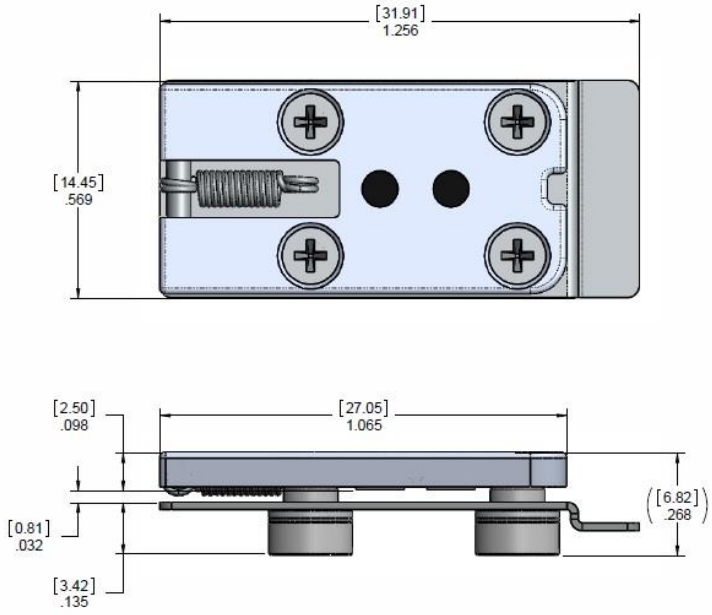


Figure 2: Exterior PCB Installation Mounting Dimensions (shown with PRM Capture Clip 703-00990). Dimensions in brackets are in millimeters.

For exterior panel installation, the PRM unit requires a .569x1.065in [27.05x14.45mm] footprint on the surface of the PCB with required cutouts for the spring and PEM standoffs (see Figure 3). About .20in [5.08mm] of additional surface clearance is recommended on the pin end of the footprint to allow room for operation of the unit. Regardless of which Capture Clip or Plate is chosen, the PRM unit will protrude into the spacecraft. The protrusion of .135in, as shown in Figure 2, is when using an exterior PCB panel with a nominal thickness of .032in.

PEM standoffs and resistors need to be soldered to the exterior panel prior to operation of the PRM unit. PEM standoffs sandwich the PRM Capture Clip/Plate to the PCB. Pads for the PEM standoffs should be grounded to avoid floating metal on the exterior of the spacecraft. The PRM Housing does not have contact with the exterior PCB surface. The PRM Capture Clip/Plate will be in contact with the interior PCB surface.

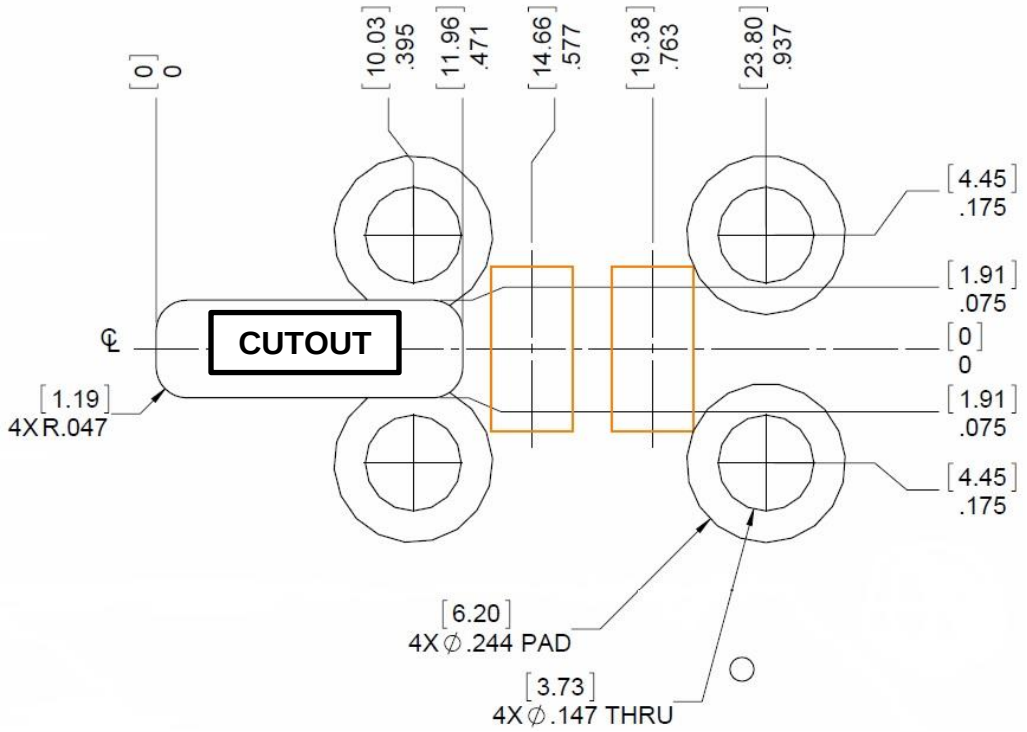


Figure 3: Required PRM Cutouts for External PCB Board. Orange outline designates resistor locations. Dimensions in brackets are in millimeters.

Note: Please consult Pumpkin if the intended panel is greater or less than .032in as it will affect the functionality of the unit.

The PRM unit comes with several options for Capture Clip/Plate, see Table 3. The purpose of the capture clip is to provide secondary mounting support for the exterior panel by bracing itself against the chassis walls of the spacecraft. The Capture Clip and Reverse Capture clip can only be mounted in one direction whereas the Vertical Capture Clip can be mounted in either an "Up" or "Down" configuration. If secondary mounting support is not needed, then the PRM Capture Plate or PRM Micro Plate should be used. The Micro Plate is smaller than Capture Plate and provides less support for the spring. All Clips and Plates are made of .02" thick material.

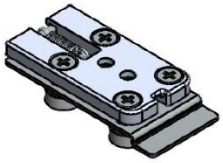
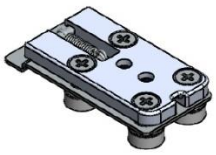
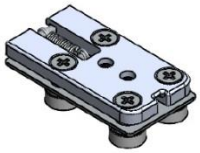
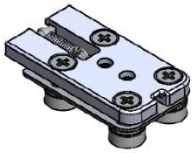
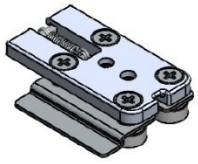
Option					
Part Name	PRM Capture Clip	PRM Reverse Capture Clip	PRM Capture Plate	PRM Micro Plate	PRM Vertical Capture Clip
Part Number	703-00990	703-01128	703-00998	703-01064	703-01073
Footprint Dimension	1.256x.569” [31.91x14.45mm]	1.256x.569” [31.91x14.45mm]	1.066x.569” [27.09x14.45mm]	.896x.569” [22.77x14.45mm]	.761x.779” [19.33x19.78mm]
Assembly View					

Table 3: PRM Capture Clip and Plate Options

Note: All PRM clips are intended for chassis walls that are .050” (1.27mm) thick.

There are different chassis cutouts that are required depending on the type of clip or plate that is chosen.

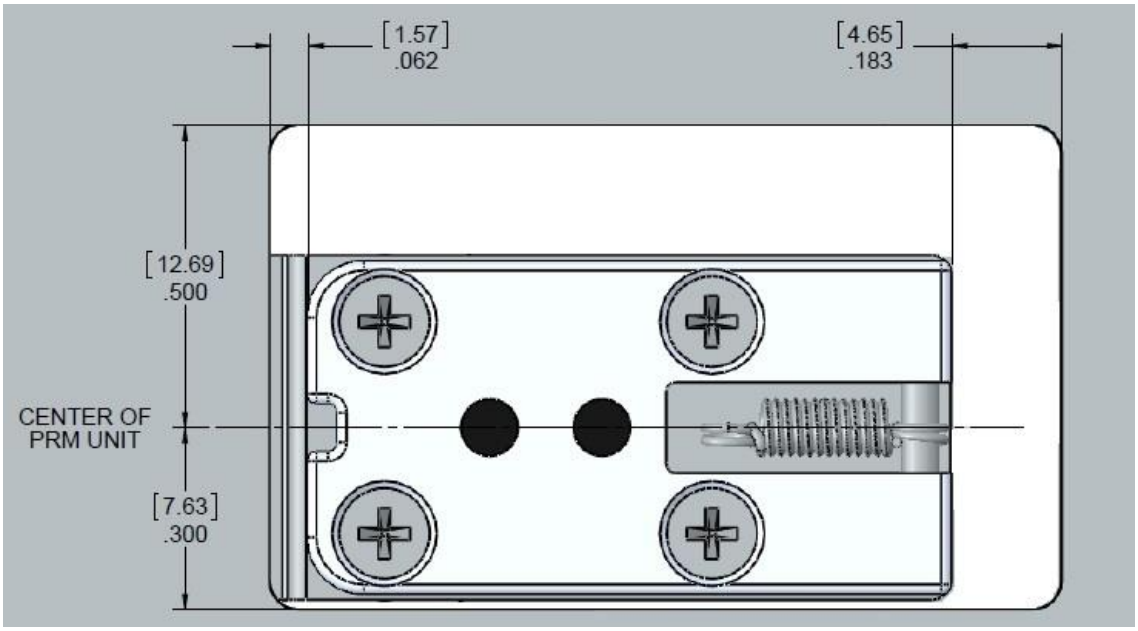


Figure 4: Chassis cutout for PRM Capture Clip and PRM Reverse Capture Clip. Dimensions in brackets are in millimeters.

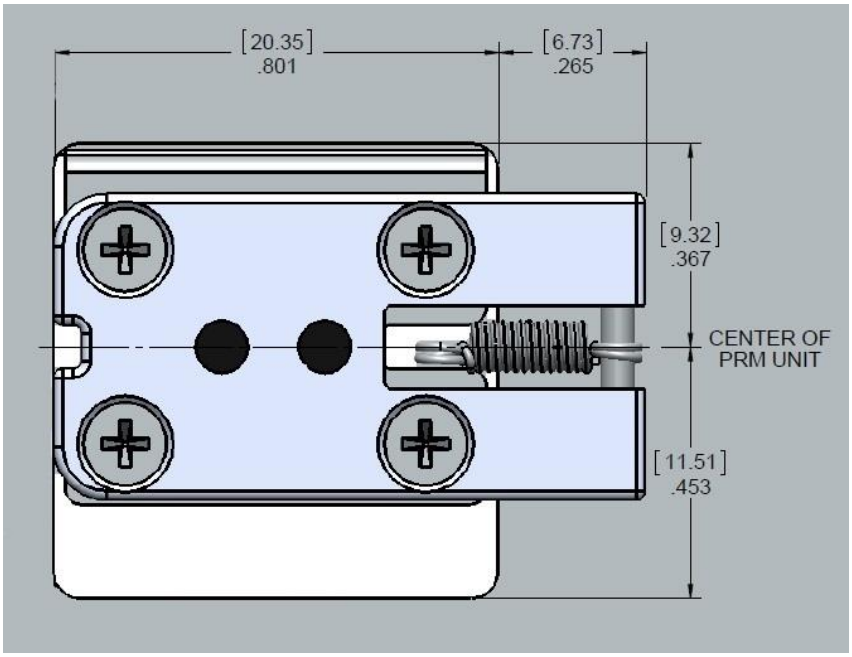


Figure 5: Chassis cutout for PRTM Vertical Capture Clip. Dimensions in brackets are in millimeters.

If using the PRM Capture Plate or PRM Micro plate, a chassis cutout offset .025in (0.64mm) from the perimeter of the plate is recommended.

3.2 Remote PRM PCB Installation

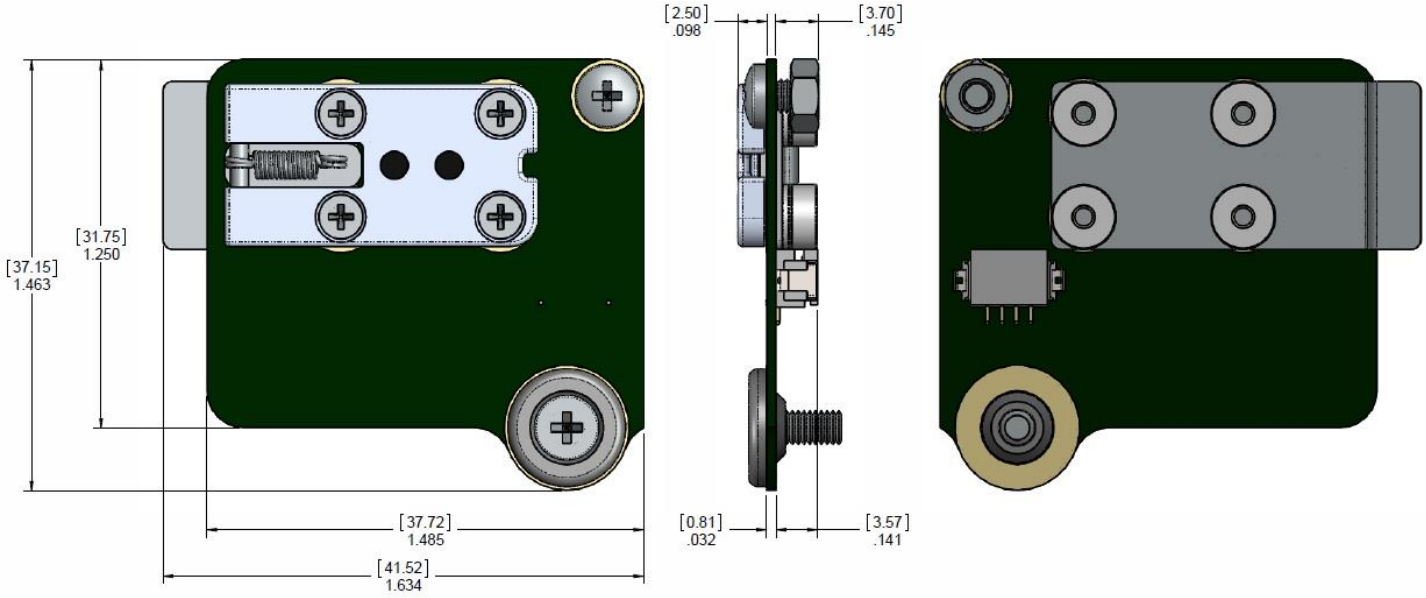


Figure 6: Remote PRM PCB Dimensions (shown with PRM Capture Clip 703-00990). Dimensions in brackets are in millimeters.

Pumpkin's Remote PRM PCB is available in cases where there isn't an external PCB panel to attach to. Currently, the Remote PRM PCB is designed to mount into one of Pumpkin's cover-

plates or endplates as well as one addition M3 mounting hole in the satellite chassis. Using one of the PRM Capture clips is recommended for additional support. The Remote PRM PCB is .032" thick FR-4. The user is able to connect to the unit through a 4-pin Hirose DF13-4P-1.25H surface-mount connector. The unit will come with the mating Hirose DF13-4S-1.25C connector and harness. Please contact Pumpkin for additional details.

3.3 Required Deploying Panel Features

All panels that stow over the PRM unit must have the window cutout for user access. Only the outermost panel requires the 5-hole burn wire tie-down feature.

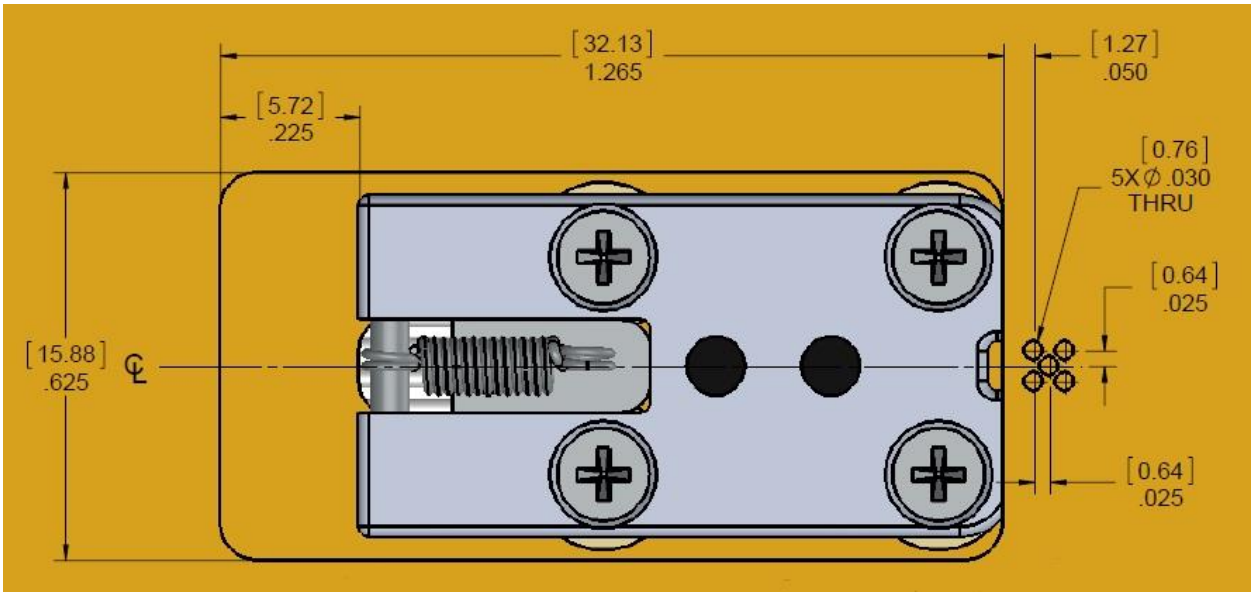


Figure 7: View of deployable panel stowed over fixed panel with PRM unit with required cutout dimensions. Dimensions in brackets are in millimeters.

Implementation using orthogonal panels is also possible. This implies that the PRM unit is mounted on a fixed panel that is orthogonal to the deploying panel. The burn wire is then strung through a cutout in the chassis or cover plate. This would be useful in situations where the deploying panel lacks the necessary real-estate for the required cutouts. The deploying panel would only require the 5-hole burn wire tie-down.

4 PRM Loading Instructions

These instructions are made in reference to MISC 3 architecture. Independent PRM units would be loaded similarly. Follow these steps to load the PRM unit:

1) It is best to pretention the burn wire (if using 20lb Spectra) to take up any stretch in the material. Hanging a 5lb weight is sufficient.
2) Slip the dowel pin through one loop of the PRM extension spring.
3) Use a variation of the Blake's Hitch knot is used to tie the burn wire to the extension spring[3]. The figure eight knot in the last step of the Blake's Hitch knot was replaced with a square knot due to difficulty in securing a figure eight knot close to the spring hook. Trim off excess tail.

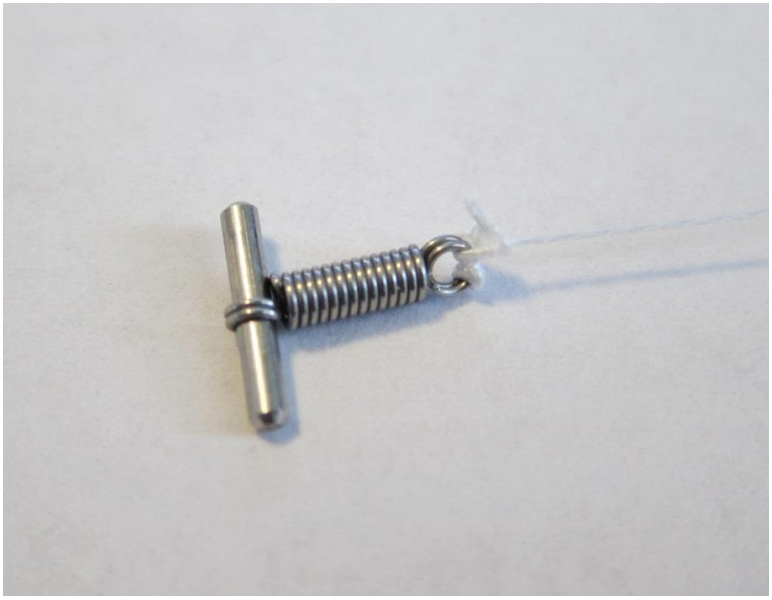


Figure 8: PRM Loading Step 3

4) Lay the burn wire horizontally across the two resistors with the spring and pin resting in the panel cutout.

[3] http://www.netknots.com/rope_knots/blakes-hitch/

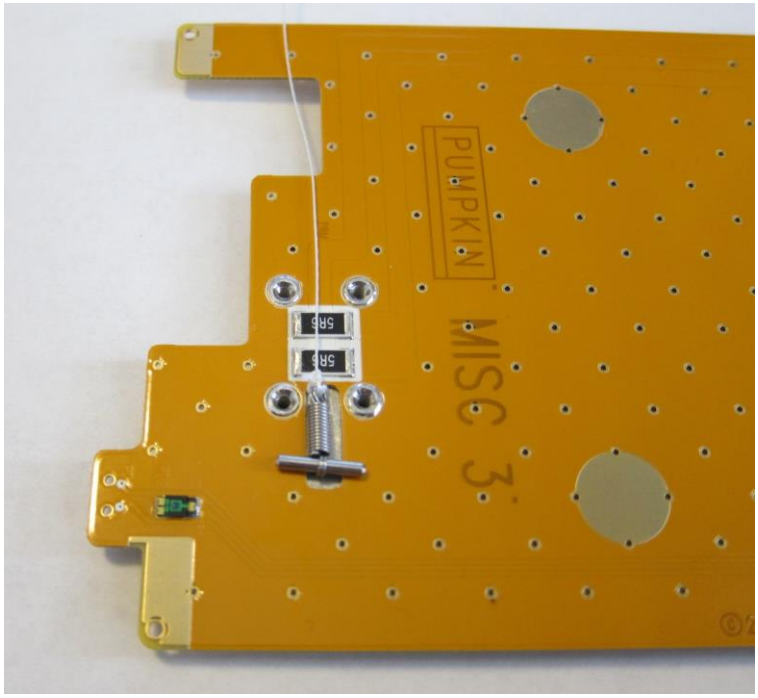


Figure 9: PRM Loading Step 4

5) Place the PRM housing on top of the resistors, orienting the mounting holes to the soldering in PEM's with the circular view ports laying over top the resistors. The user should be able to clearly see the burn wire crossing the surface of the resistors through these view ports. The spring and pin should be angled such that the pin is on top of the housing.

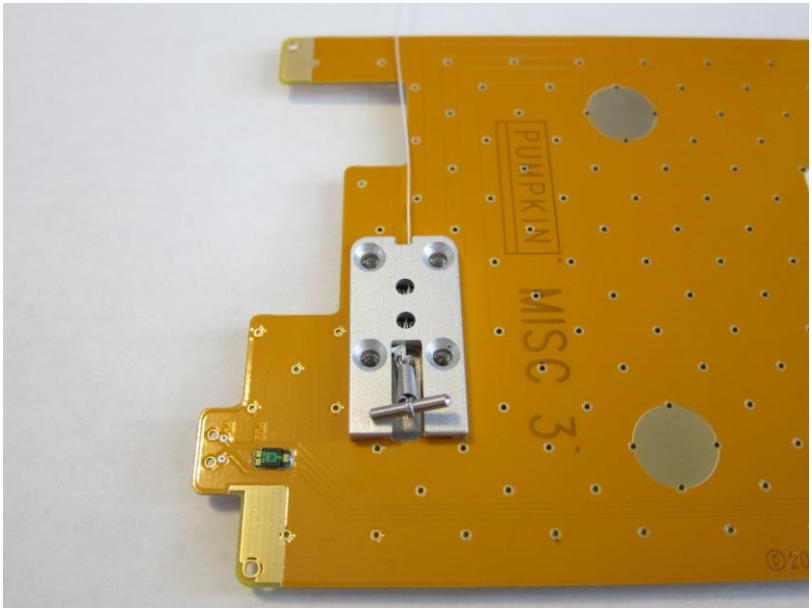


Figure 10: PRM Step 5

6) Screw in two M2x6mm flat head screws in the PEMs farthest away from the spring.
7) Fold the antenna subassembly and deployable panels and thread the burn wire through 1 of the 5 patterned holes on the deployable winglet.

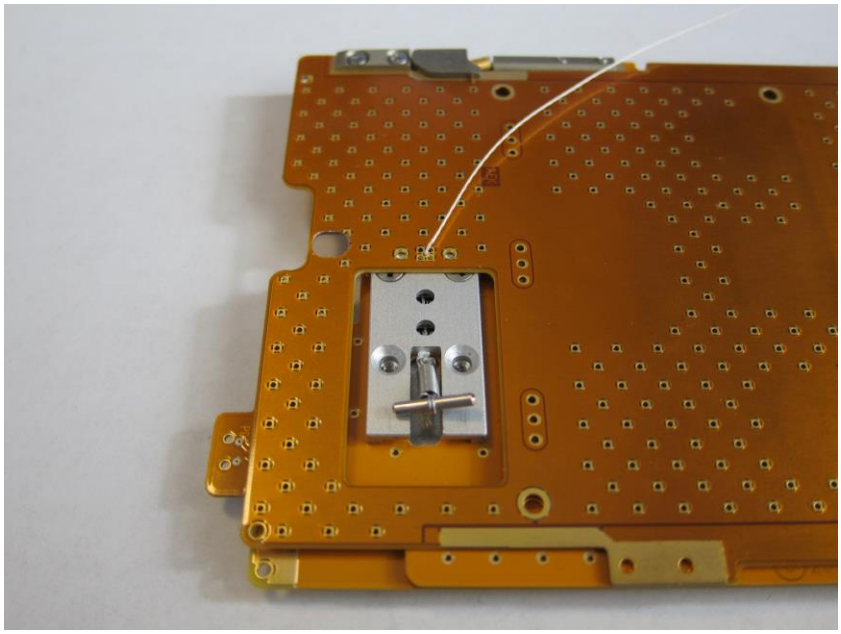


Figure 11: PRM Step 7

Pull the burn wire as tight as possible while still holding down the panes.

8) By threading the burn wire through two other holes, create a double overhand stopper knot. Tighten the burn wire with pliers. This should be as snug as possible. Trim the burn wire so only a centimeter tail is left. For the final tie down before launch, this tail should be epoxied taking care to not get epoxy anywhere near the PRM unit.

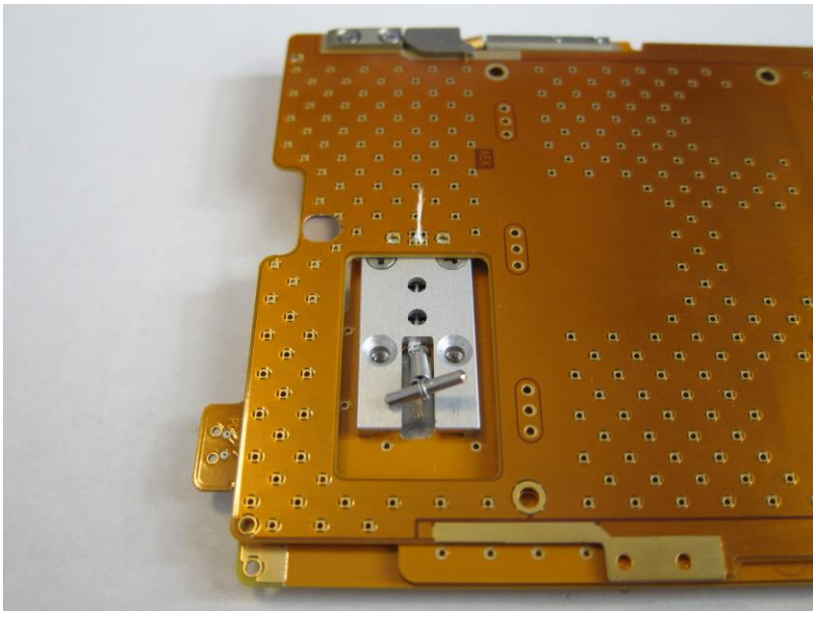


Figure 12: PRM Step 8

9) Push the dowel pin back towards the edge of the PRM housing. The dowel pin will need to be pushed into the cavity between the housing and the panel. Once in place, screw in the remaining two M2x6mm screws.

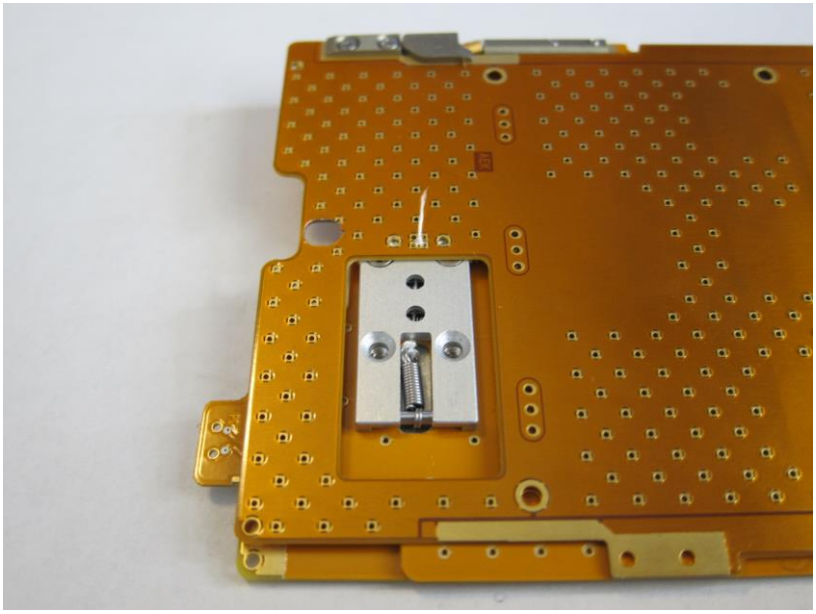


Figure 13: PRM Step 9

Appendix I: Pumpkin Test Data

Product Name	Manufacturer
6632A System DC Power Supply	Hewlett-Packard Company
3303D DC Power Supply	Topward
Trivac B Rotary Vane Vacuum Pump D16B/D25B	Leybold Vacuum
Turbo-Molecular Pump TPH 050 TPU 050	Pfeiffer Vacuum
Series 979 Atmosphere to Vacuum Transducer	Kurt J. Lesker Company
KPDR900 Series 900 Vacuum Controller RS232/485	Kurt J. Lesker Company
DVC 1 Desktop Vacuum Chamber	Pumpkin, Inc.
DVC 2 Desktop Vacuum Chamber	Pumpkin, Inc.
Model 1007C Temperature Chamber	Test Equity
3CFM	Mastercool
50 Series II Thermometer	Fluke

Table 4: Pumpkin Test Equipment

I Ambient Air

Ambient air tests were conducted at 5V. 5V is sufficient to heat the resistors to the required temperature to melt the burn wire (between 130°C-136°C). The components used for this test were previously used and the 5.6Ω resistors heavily cycled prior to testing. The PRM Housing that was used is revision B1. The following table gives the results of the ambient air tests that were conducted using 20lb and 40lb test Spectra. These tests were conducted with the panels mounted in a vertical position in a nominal room temperature. All ambient tests deployed successfully.

Spectra Weight	Voltage (V)	Current (A)	Temperature (°F)	Time to Burn (s)
20lb	5	1.6398	71.4	31.7
20lb	5	1.6398	72.8	29.0
20lb	5	1.6340	77.5	25.2
20lb	5	1.6427	78.8	23.5
20lb	5	1.6369	77.7	24.3
20lb	5	1.6383	78.9	33.4
20lb	5	1.6340	77.5	33.4
20lb	5	1.6195	69.0	31.2
20lb	5	1.6209	73.9	30.7
20lb	5	1.6122	76.6	36.2
40lb	5	1.6195	73.4	35.9
40lb	5	1.6033	78.4	42.9
40lb	5	1.6238	78.6	36.6
40lb	5	1.6035	78.8	33.9
40lb	5	1.6108	77.1	37.3
40lb	5	1.6079	74.3	29.8
40lb	5	1.5948	75.2	36.8
40lb	5	1.6253	73.7	26.0
40lb	5	1.6166	77.3	29.7
40lb	5	1.6253	75.9	25.4

This sheet was intentionally left blank