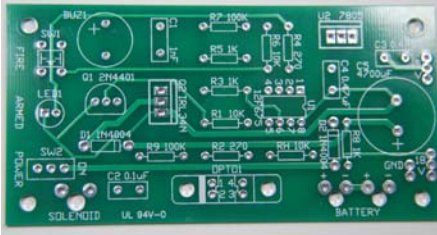




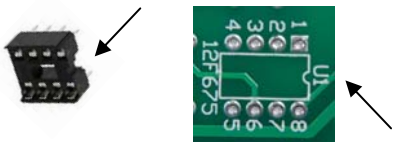
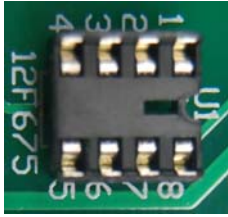


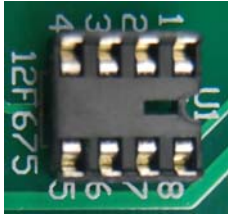



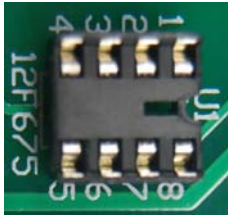




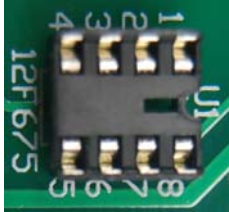



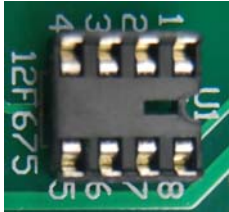

## PCB Opto Release

Step	Part Name	Photo (Pictures are not proportionate)	Part Number	Board position
1	<b>Circuit board</b> Examine the board for defects. All parts are installed on the side with text (top side) and soldered to the board on the bottom side.			
2	<b>9 Volt Battery clips</b> Route the red and black wires together from the bottom of the board through the strain relief hole above the B or the Y in BATTERY on the board. The batteries are electrically in a series; refer to the stuffing diagram, sample, or ask a staff member for the correct lead placement. Solder the two wires from each of the battery clips in place. Put the red in the + and black in the -.			
3	<b>Slide switch</b> The SW2 slide switch is not polarity sensitive. Solder slide switch in place.			SW2
4	<b>TEST</b> Attach the two nine volt batteries to the battery clips. Use a meter to check the voltage between the ground and 18V at the lower right side of the board. There should be about 18 volts present when the slide SW2 switch is on and no voltage when the switch is off. Turn off the switch and remove the batteries.			
5	<b>Voltage Regulator</b> Check to ensure that you have the right part number. This part is an integrated circuit and is polarity sensitive. Be sure that the metal tab back (without numbers and writing) faces the outer edge of the board. Solder in the regulator.		LM7805	U2
6	<b>Capacitor</b> Solder in two .47uF capacitors.		474	C3 and C4
7	<b>IC socket</b> While the socket is not polarity sensitive, the notch on the socket MUST match the notch shown in the circuit board position U1. Solder the IC socket in place.		U1	U1










PCB Opto Release

Step	Part Name	Photo (Pictures are not proportionate)	Part Number	Board position
8	<b>TEST</b> Attach the two batteries to the battery clip and turn on the SW2 switch. Use a voltage meter to monitor the voltage between the GND and 5V pads located at the upper right side of the board. There should be 5 volts present. Test the voltage between pins 1 and 8 of the IC socket. There should be 5 volts present. Turn off the switch and remove the batteries.			
9	<b>Fire switch</b> Solder fire the SW1 switch in place			SW1
10	<b>Resistor</b> (Brown, black, orange, gold) Solder the resistor in place. Not polarity sensitive.		10K Ohm	R6
11	<b>TEST</b> Attach the two nine volt batteries to the battery clips and turn the SW2 switch on. Measure between GND and pin 4 of the IC socket. With the SW1 switch pushed there should be no voltage. With SW1 released there should be about 5 volts. Turn SW2 off and remove the batteries.			
12	<b>Resistor</b> (Brown, black, orange, gold) Solder in place. Not polarity sensitive		10K Ohm	R1
13	<b>Piezo buzzer</b> The buzzer is polarity sensitive. Its + designator must face the + on the printed circuit board. Remove the paper sticker from the buzzer before soldering. Solder in place.			BUZ1
14	<b>Bipolar junction transistor</b> The transistor is polarity sensitive. Match the transistor's flat side with the straight line on the printed circuit board. Solder the part in place.		2N4401	Q1
15	<b>TEST</b> Temporarily attach the two nine volt batteries to the battery clips and turn SW2 switch on. With a small jumper wire, connect (touch) pins 1 and 7 at the same time on the IC socket. The buzzer should sound. Turn the SW2 switch off and remove the batteries.			


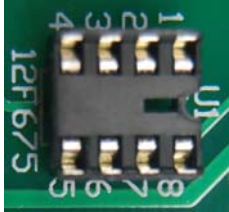

PCB Opto Release

Step	Part Name	Photo (Pictures are not proportionate)	Part Number	Board position
16	<b>Resistor</b> (red, violet, brown, gold) Solder in place		270 Ohm	R4
17	<b>Light emitting diode (LED)</b> An LED is polarity sensitive. The plastic base of the LED has a small flat or notch nearest the shorter lead. This must match the designator on the printed circuit board (the shorter lead goes into the square pad hole). Solder the LED in place.			LED 1
18	<b>TEST</b> Attach the two nine volt batteries to the battery clips and turn the SW2 switch on. With a small jumper wire, connect (touch) IC socket pins 1 and 2 at the same time. The LED should light. Turn SW2 off and remove the batteries.			
19	<b>Resistor</b> (red, violet, brown, gold) Solder in place		270 Ohm	R2
20	<b>Resistor</b> (brown, black, red, gold) Solder in place.		1K Ohm	R3
21	<b>Opto-isolator</b> Install so that the top side with the E faces C2 and the power switch, SW2. Double check and solder in place.			OPTO1
22	<b>TEST</b> Attach the batteries to the battery clips and turn on the SW2 switch. With a very small wire, touch jumper pins 1 and 5 on the IC socket. Use the voltage meter, monitor the voltage between GND and pin 6 of the IC socket. It should show near 5 volts. With a small metal scrap, block the slot in OPTO 1. The voltage on pin 6 of the IC socket should drop to near 0 volts. Turn off the switch and remove batteries.			
23	<b>Resistor</b> (brown, black, red, gold) Solder in place.		1K Ohm	R8

PCB Opto Release

Step	Part Name	Photo (Pictures are not proportionate)	Part Number	Board position
24	<b>Diode</b> The diode is polarity sensitive. The end with the white band (-) must match the printed circuit board. Install the diode and solder in place.		1N4004	D2
25	<b>Resistor</b> (brown, black, yellow)		100K Ohm	R9
26	<b>Capacitor</b> (Large) The capacitor is polarity sensitive and usually has a negative lead marked with a - stripe. The board has a positive or + lead hole marked. Put the - striped lead into the hole <u>NOT</u> marked with the + sign. You may have to straighten the small bend near the base of each lead to get the capacitor to seat down on the printed circuit board prior to installation. Solder in the large capacitor.		4700uF	C5
27	<b>TEST</b> Attach the two nine volt batteries to the battery clips and turn the SW2 switch on. With a voltmeter, monitor the voltage across the pins of the large capacitor in C5. After a few seconds, the voltage should build to over 15 volts. Turn off SW2 and remove the batteries.			
28	<b>Diode</b> The diode is polarity sensitive. The end with the white band (-) must match the printed circuit board. Install the diode and solder in place.		1N4004	D1
29	<b>Resistor</b> (brown, black, red, gold) Solder in place.		1K Ohm	R5
30	<b>Resistor</b> (brown, black, yellow, gold) Solder in place.		100K Ohm	R7
31	<b>Capacitor</b> 1nF Solder in place.		102	c1
32	<b>Capacitor</b> .1uF Solder in place.		104	C2
33	<b>Field effect transistor (FET)</b> The transistor is polarity sensitive. Face the transistor's heat sink tab side (or metal tab back without numbers and writing) toward the		IRL34N	Q2

PCB Opto Release

Step	Part Name	Photo (Pictures are not proportionate)	Part Number	Board position
	center of the printed circuit board. Solder in place.			
34	<b>Verify</b> that the resistor RH spot on the board is empty. The part is NOT used in this design. All other parts should be in place and soldered.			RH
35	<b>Hook up wire &amp; female push on connector</b>  Get two 11 inch pieces of #22 hookup wire. Strip both ends of each piece. Crimp a 3/16 (.187) female push on connector onto one end of each wire. Insert the wire from the bottom through the stress relief hole above the word SOLENOID on the board and insert the wire in one of the two holes. Solder the end of the wire to one of the solenoid holes on the printed circuit board. Repeat for the second wire.		#22  3/16 <sup>th</sup>	Solenoid
36	<b>TEST &amp; INSPECT</b> Temporarily attach the push on connectors to the solenoid. Slide the solenoid plunger part way out. Attach the batteries to the battery clips and turn on the SW2 switch. With a small jumper wire, connect (touch) the IC socket pins 1 and 3 at the same time. The solenoid should briefly pull its plunger in. Turn the switch off and remove the batteries and the solenoid.  Double check all solder joints and cut off excess leads from the bottom of the circuit board. Also check that there are no solder bridges between pads.			
37	<b>Spacers</b> Four spacers hold the printed circuit board away from the base. Do not over tighten the screws that hold the board to the base plate.			Underside of board on four corners

At this point the printed circuit board is complete except for the installation of the microcontroller.

A vane will now have to be fabricated and attached to the catapult arm matching the example uP release catapult. The board then can be mounted in place such that the vane blocks the slot in OPTO1 when the arm is in the cocked position.

**PROGRAMMING AND INSTALLING THE CONTROL INTEGRATED CIRCUIT**

The last steps are to program and install the control integrated circuit. Test the catapult when programming is complete.