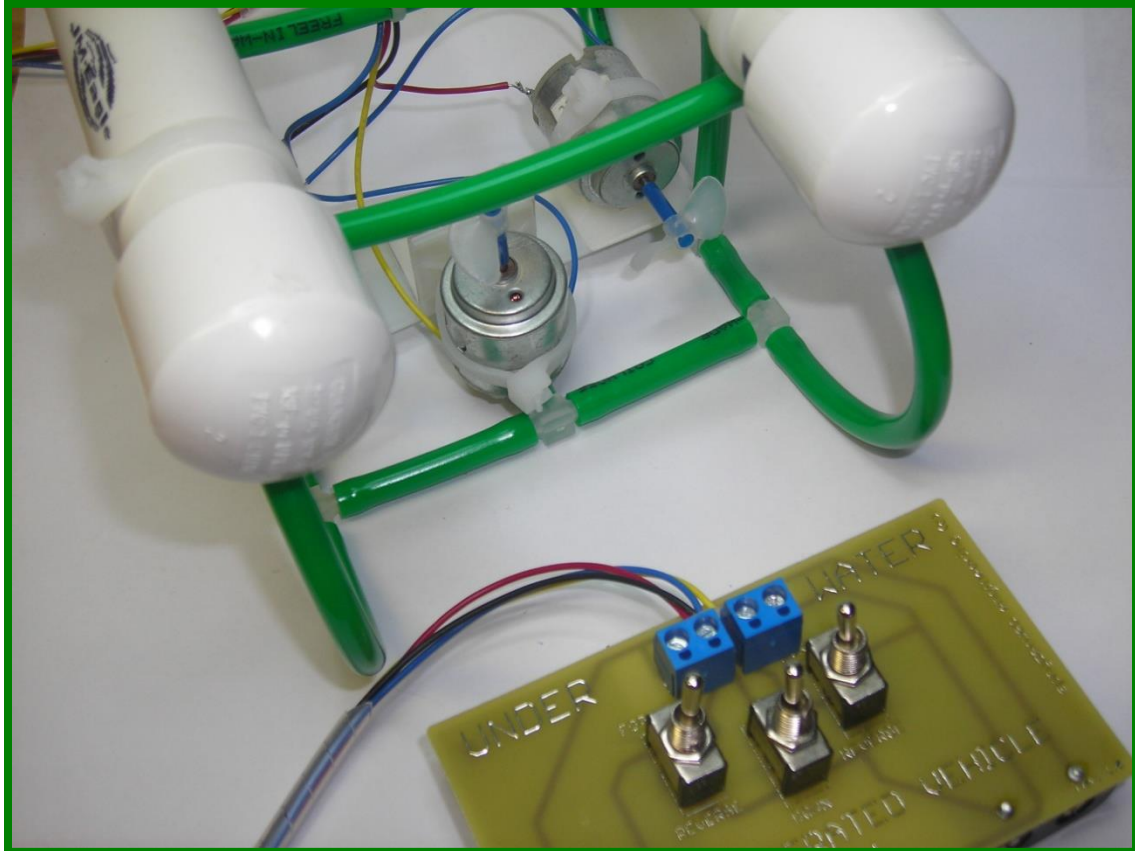


Underwater MiniROV

(Remote Operated Vehicle)

Robotic Kit



Designed by:



Welcome

Congratulations on purchasing the MiniROV Robotic Kit. You are about to embark on an adventure that will take you from the surface of the earth to underwater depths. Propulsion, electronic controls and buoyancy are only a few of the subjects you will discover as you construct your MiniROV.

This simple and illustrated manual will give you step-by-step instructions for the construction of your MiniROV. Please read the entire manual before you start. For maximum efficiency, please follow the instructions as listed. After you have mastered the construction and operation of your MiniROV feel free to make changes that take you deeper under the surface or give you the ability to take underwater photographs or video. (not included in this kit)

The manual is divided into segments. Complete each segment independently.

Note:

Pay close attention to "CAUTION" and "IMPORTANT" messages. These will point out steps that are vital to the operation and safety of your MiniROV.

Tool List:

Soldering Iron with solder
Wire strippers and cutters
Small set of pliers
Small flathead screwdriver
Ruler
Small piece of Sandpaper

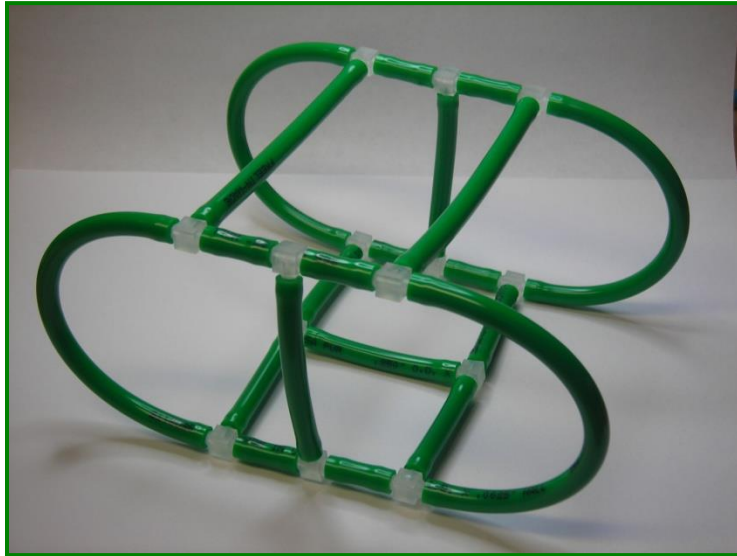
A Word About Natural Buoyancy!

Natural buoyancy is defined as "the upward force that keeps things afloat." We simply look at it as the ability for your MiniROV to stay put while in the water. In other words, your MiniROV when positioned underwater should not sink or float but stay put until you decide to move it. This is accomplished using buoyancy tanks in segment #5. We have supplied tanks that will put the MiniROV in a state of approximate natural buoyancy. To achieve a closer natural buoyancy state, try one of the following:

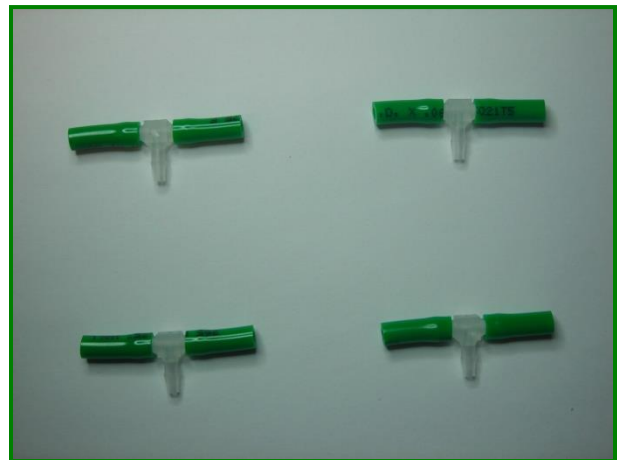
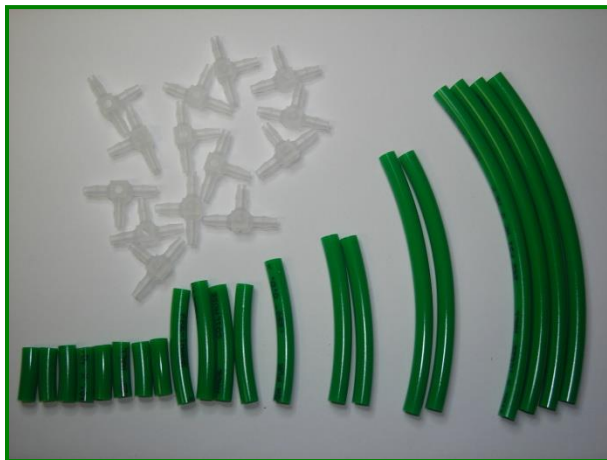
- 1) If the MiniROV sinks, move the end caps closer to the ends of the tanks.
Or...
- 2) If the MiniROV floats to the top, add small amounts of weight inside the tanks. This can be achieved by adding small washers or nuts.

Segment #1

Construction of ROV Frame



The frame is the skeleton of the ROV. The frame will support the thrusters and buoyancy tanks. **CAUTION** – When connecting tubes to tee fittings a high amount of direct pressure is required. Be careful not to break a tee fitting.



Step #1

Frame Kit (Bag #1)

Component Verification

- 14 Tee Fittings
- 8 x $\frac{3}{4}$ in. tubes
- 2 x $2\frac{3}{8}$ in. tubes
- 2 x $3\frac{3}{4}$ in. tubes
- 4 x 5 in. tubes
- 4 x $1\frac{5}{8}$ in. tubes
- 1 x 2 in. tube

Step #2

Assemble top and bottom supports

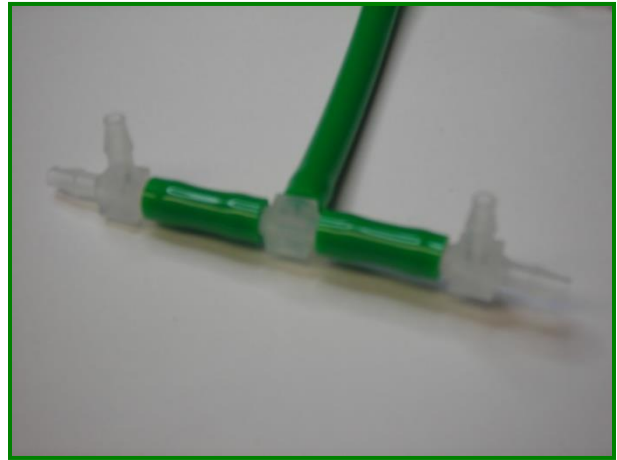
Using 4 tee fittings and the 8 x $\frac{3}{4}$ in. tubing, assemble as shown.



Step #3

Assemble Side Supports

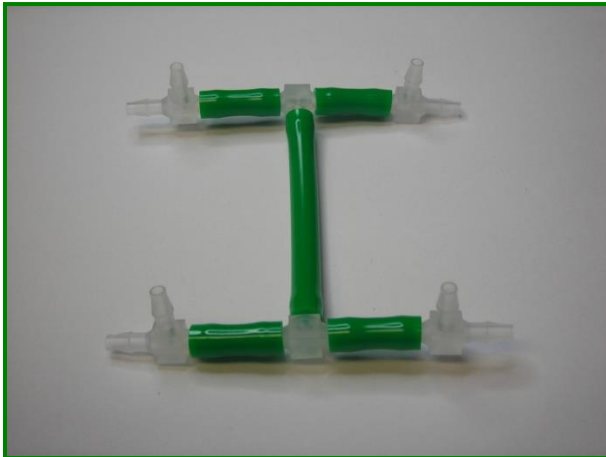
Using two 2 3/8 in. tubes connect the top and bottom supports as shown.



Step #4

Assemble Tee Fitting Supports

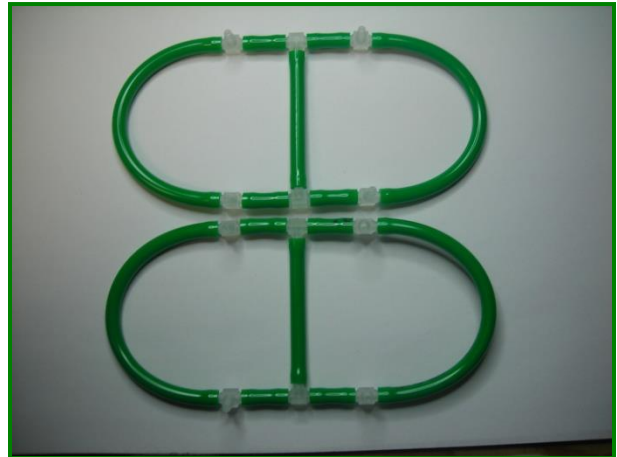
Insert 8 tee fittings into the ends of the side supports as shown.



Step #5

Verify Tee Fittings

Set each side support on a flat surface with the tee fitting pointing up as shown. Verify that each tee fitting is perpendicular (pointing straight up) from the flat surface.



Step #6

Assemble Ends

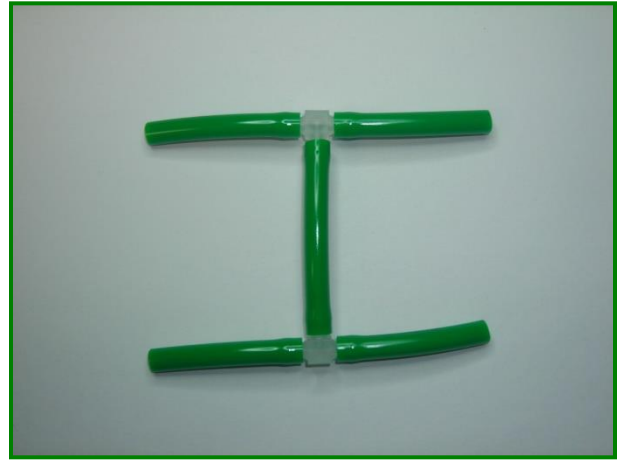
Attach the four 5 in. tubes to the ends of each side support as shown. **CAUTION** – To avoid creasing the tube gently bend each 5 in. piece prior to connecting.



Step #7

Assemble Bottom Support

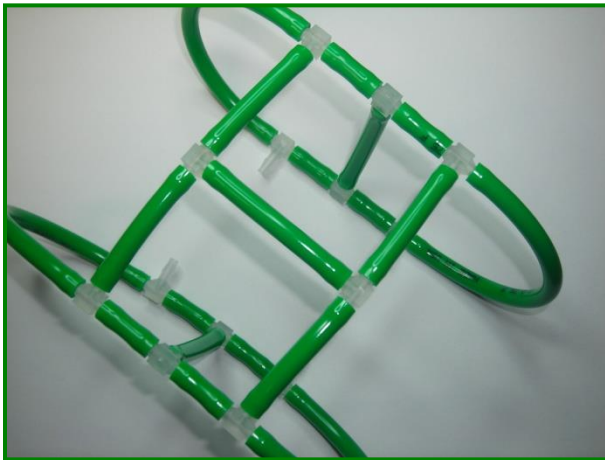
Attach two tee fittings to the end of the 2 in. tubing as shown. Make sure the tee fittings are in the same orientation.



Step #8

Assemble Bottom Support Cont.

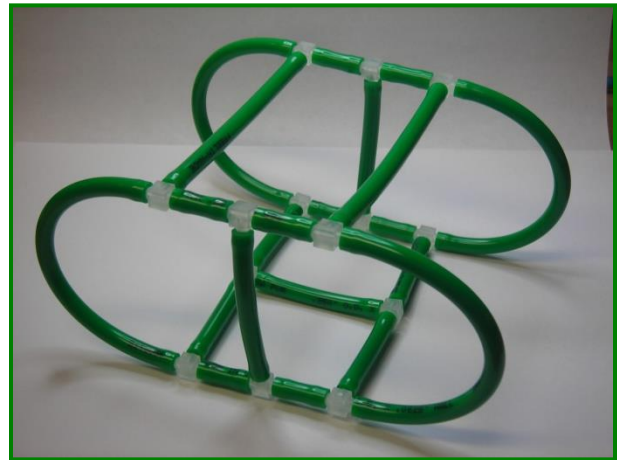
Attach four 1 5/8 in. tubing to each of the remaining tee fitting ends as shown.



Step #9

Assemble Bottom to Sides

Attach the bottom support from step #8 to the sides from step #6 as shown. **CAUTION** – be careful not to break off the tee fitting when attaching.



Step #10

Assemble Top Braces

Attach two 3 3/4 in. tubes on the sides opposite the bottom supports as shown. You may have to straighten any bends in the frame tubing. **DONE!**

Congratulation....You have completed the Frame for your ROV.

Segment #2 Assembly of Thrusters



The thrusters are the sole source of propulsion for your MiniROV. **IMPORTANT** - Attention to propeller alignment and placement on the mounting square are essential.

NOTE:

A new motor has been spec'd for the kit. It has a different appearance but better outcome due to weight reduction. Mount the motor with the longer diameter perpendicular to the mounts.



Step #1

Thruster Kit (Bag #2)

Component Verification

- 3 – Motors
- 3 x $\frac{3}{4}$ in tubes (Prop Shafts)
- 3 – Propellers
- 3 – Motor Mounts
- 3 – 6 in ties



Step #2

Attach Propellers to Shafts

Put a very small amount of hobby glue on the end of the Prop Shaft. Insert the Prop Shaft into the Prop and flush with the other side as shown. **IMPORTANT** – Notice how the props are on the shafts. The curved part of the prop should be facing away from the shaft.



Step #3

Attach Prop Assembly to Motor

Put a small amount of hobby glue on the tip of the motor shaft. Slide the prop shaft onto the motor shaft to within 1/16 in. from the motor.

IMPORTANT – Be careful not to use too much glue. Glue should not be touching the motor.



Step #4

Assemble Motor Mount

Slide the 6 in. tie through the motor mount and secure as shown. Be careful not to tighten the tie to much at this point. The tie must fit around the motor in step #5.



Step #5

Attach Motor to Motor Mount

Slide motor in tie and fasten LOOSELY. Do not tighten until the next step.



Step #6

Align Posts

Prior to tightening the zip tie, rotate motor so the small circular indentation is on the left side if looking into the motor as shown. Tighten zip tie. DONE!

Congratulations...You have completed the Thrusters for your ROV

Segment #3

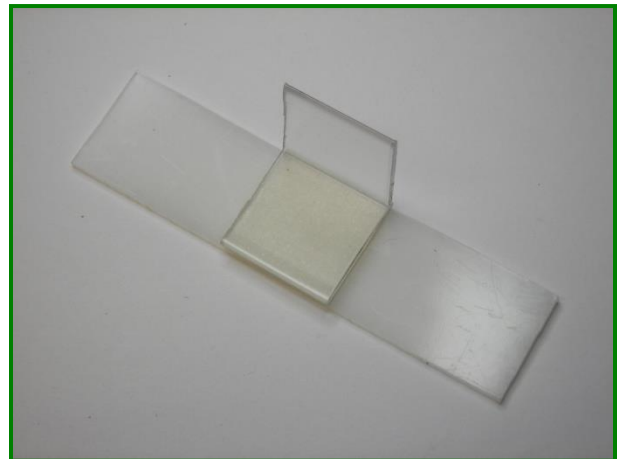
Assembly of Thruster Mount and Wiring



The Thruster Mount and Wiring are essential parts of your ROV. Attention to details is important. Alignment of the thrusters is critical. Verify all wire connections.

NOTE:

The new motors have wire leads attached. You can either use them to extend the harness or take them off and wire as in the figure.



Step #1

Motor Mount Kit (Bag #3)

- Component Verification
- 3 – Motor Assemblies (Previous)
- 1 – L shape
- 1 – Adhesive
- 1 – 1 x 4 in mounting plate

Wiring Kit (Bag #4)

- 7 ½ ft Black Wire
- 7 ½ ft Red Wire
- 7 ½ ft Yellow Wire
- 8 ft Blue Wire

Step #2

Vertical Thruster Mount

Attach the L shaped bracket to the mounting plate using the adhesive. Center the L shaped bracket on the mounting plate.

NOTE:

Using a small piece of sandpaper remove any rough edges from the L-shape and mounting plate.



Step #3

Thruster Assembly

Peel the backing on the adhesive and place Thruster Assemblies as shown.



Step #4

Connect Wiring

Cut two 3 in. pieces of blue wire. Strip $\frac{1}{4}$ in. off both ends of each piece. Twist each end with fingers. Attach wire to posts closest to the circular indentation as shown. This can be done by twisting it through the hole in the post.



Step #5

Connect Wiring (cont)

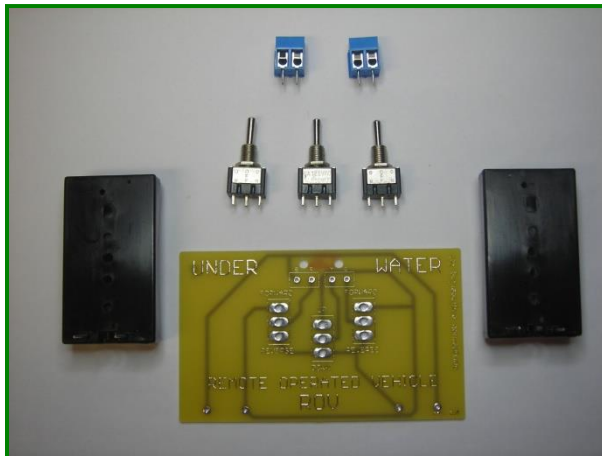
Strip $\frac{1}{4}$ in. off one end of the red, yellow, black and blue wires. Attach the red wire to the left motor, the black wire to the right motor and the yellow wire to the vertical motor. Solder all 6 connections. DONE!

Congratulations...You have completed the Thruster Mount

Segment #4 Assemble Control Board



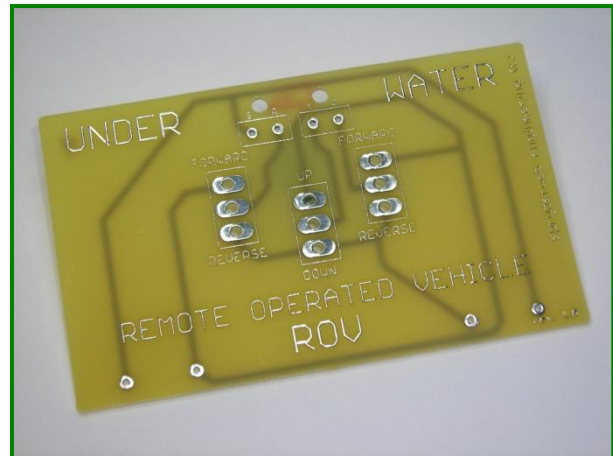
The Control Board is your interface with the MiniROV. It will supply power to the thruster motors via a set of toggle switches in which you control. **CAUTION** – Improper assembly of the Control Board can result in direction control problems with the MiniROV.



Step #1

Control Board Kit (Bag#5)

- Component Verification
- 1 – PCB (Printed Circuit Board)
 - 2 – AA Battery Holders
 - 3 – Toggle Switches
 - 2 – Terminal Blocks



Step #2

Identify the PCB (Printed Circuit Board) In the next few steps you will solder components to the PCB. The side of the PCB with writing is called the top side while the other side is called the bottom side.

CAUTION – Although not difficult, you should understand how to solder components to a PCB.

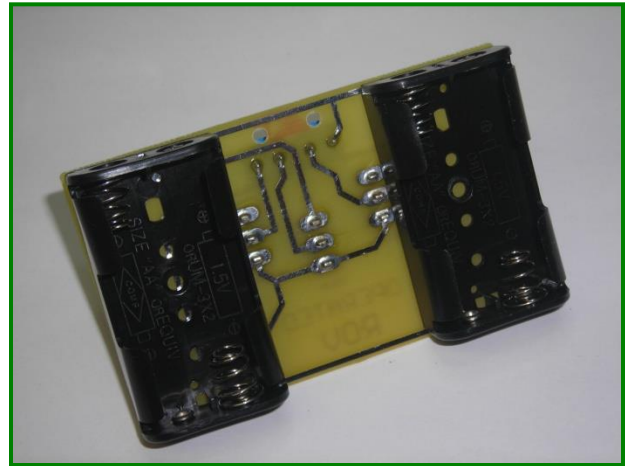


Step #3

Attach Switches and Terminals

Insert the terminal blocks into the top side of the PCB as shown. The side of the blocks with the wire connections should be facing the outside of the PCB. Solder the terminals on the bottom side of the PCB. Now insert the switches into the PCB as shown. Solder the switches on the bottom side of the board.

IMPORTANT – All five components should be mounted flat on the PCB. This may be easier if someone assists in the soldering process.



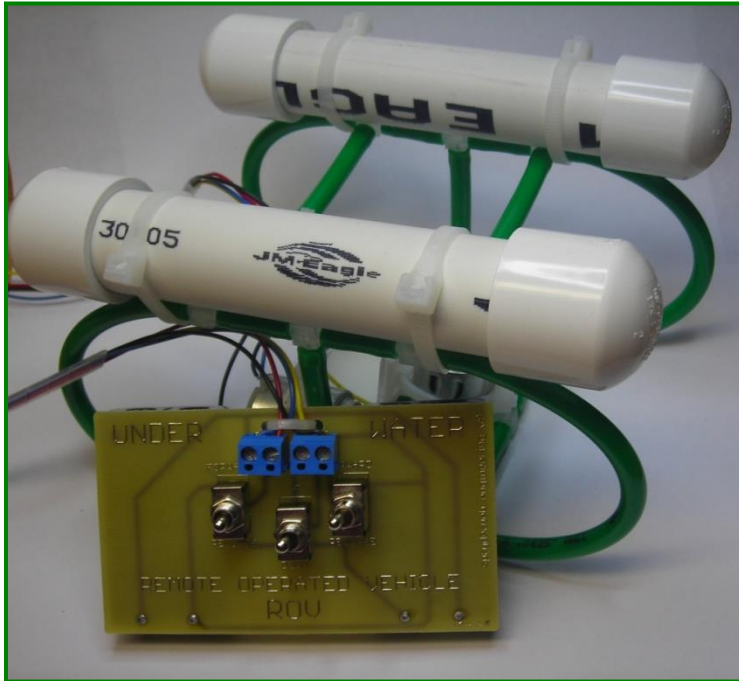
Step #4

Attach Battery Holders

The Battery Holders are mounted on the bottom side of the PCB. Insert the battery holders as shown and solder on the top side of the PCB. Clip the excess leads making sure there are no sharp edges. **DONE!**

Congratulations...You have completed the Control Board

Segment #5 Assemble and Test ROV



You are now ready to assemble the parts of your ROV. Once again, pay attention to details. Picture in your mind the completed project.

Final Assembly Kit (Bag #6)

Component Verification

2 – 5 in PVC Tubes

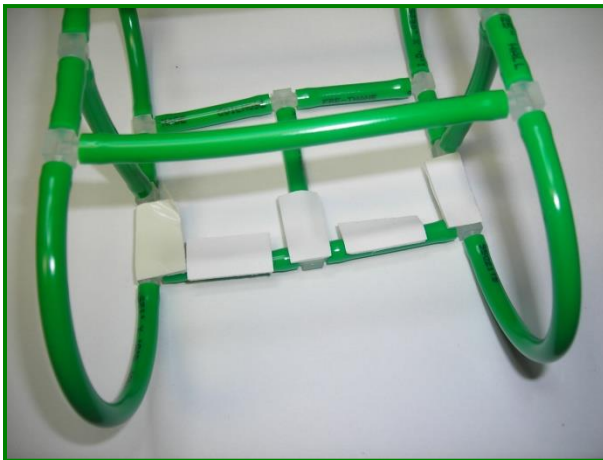
4 – PVC End Caps

4 – 8 in ties

3 – 4 in tie

3 - Adhesives

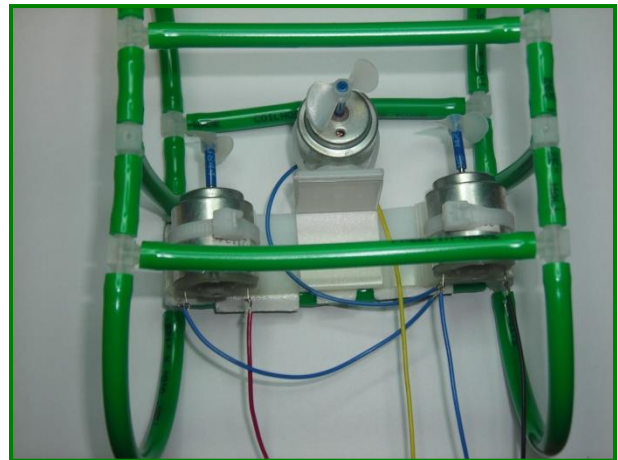
Wire wraps



Step #1

Attach Adhesives

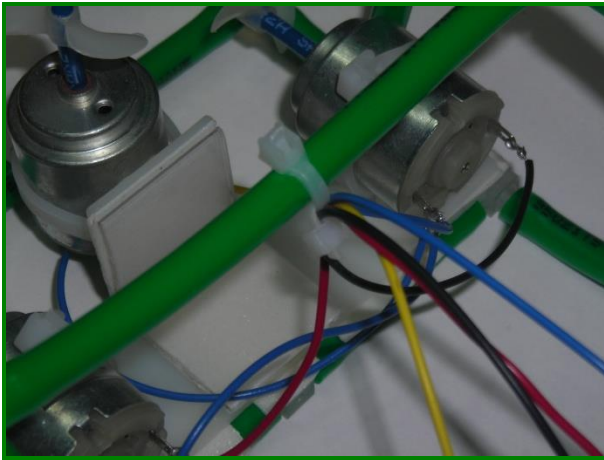
Take three adhesive pads and cut them in half. Peel the backing off one side and attach to the ROV frame as shown. This will form the attachment points for the thruster assembly.



Step #2

Attach Thruster Assembly

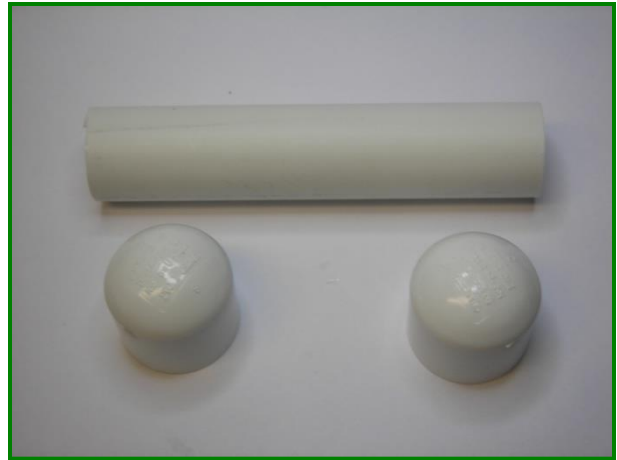
Before you remove the backing on the adhesive, place the thruster assembly on the frame as shown. The mounting plate should rest against the side supports and on the bottom support. Once this is verified remove the backing on the adhesive and secure thruster assembly.



Step #3

Secure Wire Bundle on ROV

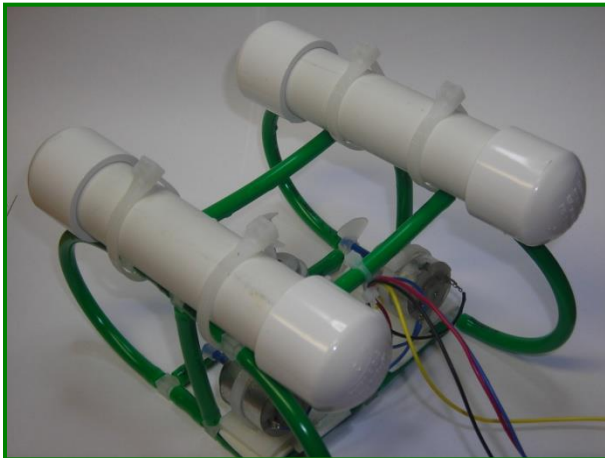
Using two 4 in. zip ties, loop one around the back top support and the other through the first to form a chain. **DO NOT TIGHTEN!** Feed the wire bundle through the second zip tie. Leaving a little slack between the zip tie and the motors tighten both zip ties.



Step #4

Assemble Ballast Tanks

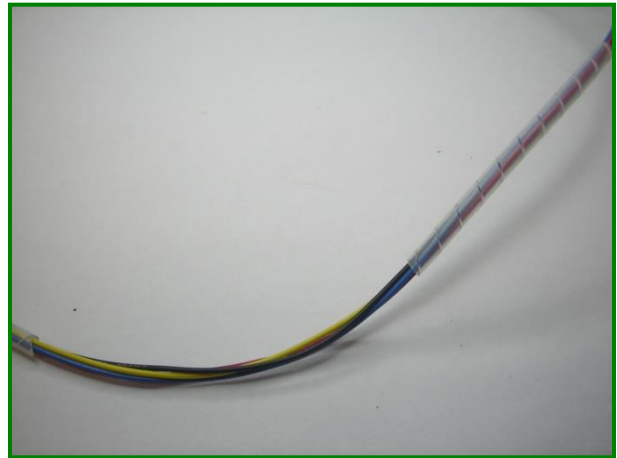
Attach four $\frac{3}{4}$ in. PVC tube caps to the ends of two 5 in. x $\frac{3}{4}$ in. PVC tubes. Push end caps as tight as you can. **Do not glue the end caps.**



Step #5

Attach Ballast Tanks to Frame

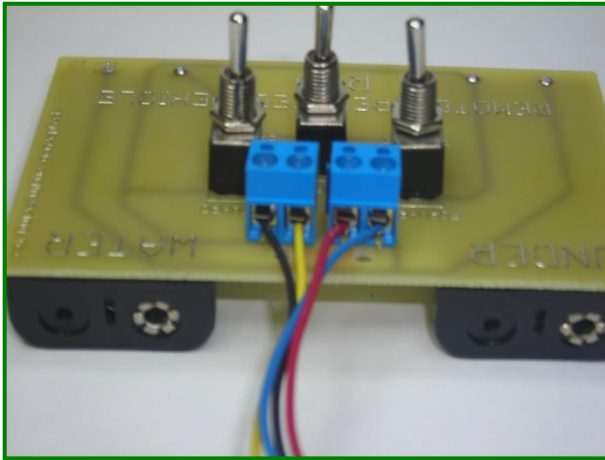
Using four 6 in. zip ties, attach the ballast tanks to the top of the frame side as shown. Secure zip ties.



Step #6

Attach Wire Wraps

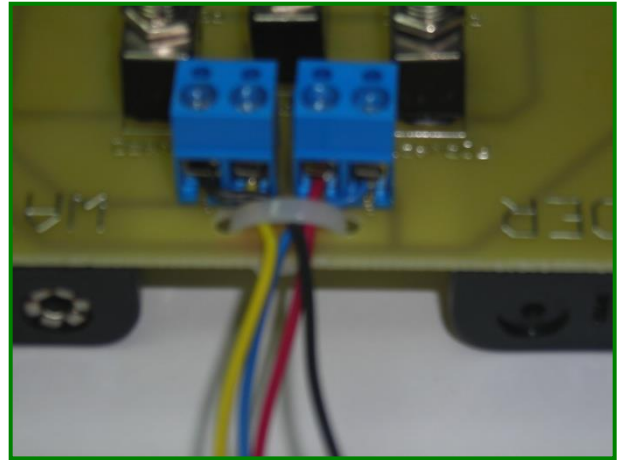
Slide wire wraps onto wire bundle. Wire wraps should be evenly spaced along the bundle.



Step #7

Attach Wire Bundle to PCB

Strip ¼ in. off the four remaining ends of the wire bundle. Insert each wire into the properly labeled connector on the PCB. Each terminal is labeled with the first letter of the color. NOTE: Substitute the black wire in the connector marked G. Tighten using the screw on top of the terminal block.



Step #8

Secure Wire Bundle to PCB

Insert a 3 in. zip tie into the holes on the PCB as shown. Tighten the zip tie from the bottom side of the PCB. **CAUTION** – Be careful not to pull out a wire from the terminal block while tightening the zip tie. DONE!

Congratulations...You are now ready to test your ROV.

Insert 4 AA batteries into the battery holders and go find a bathtub, sink, hot tub, pond, stream, puddle or any other interesting water source and go underwater exploring!