SUBS in Schools
TECHNOLOGY CHALLENGE

2017
Build Manual
Level 1: Mini ROV

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Contents

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Welcome

Congratulations on purchasing the MiniROV build 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 "NOTE", "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

A Word About Neutral 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 5.0. 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:
· If the MiniROV sinks, move the end caps closer to the ends of the tanks. Or...
· 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.

1.0 Construction of ROV Frame (Bag #1)
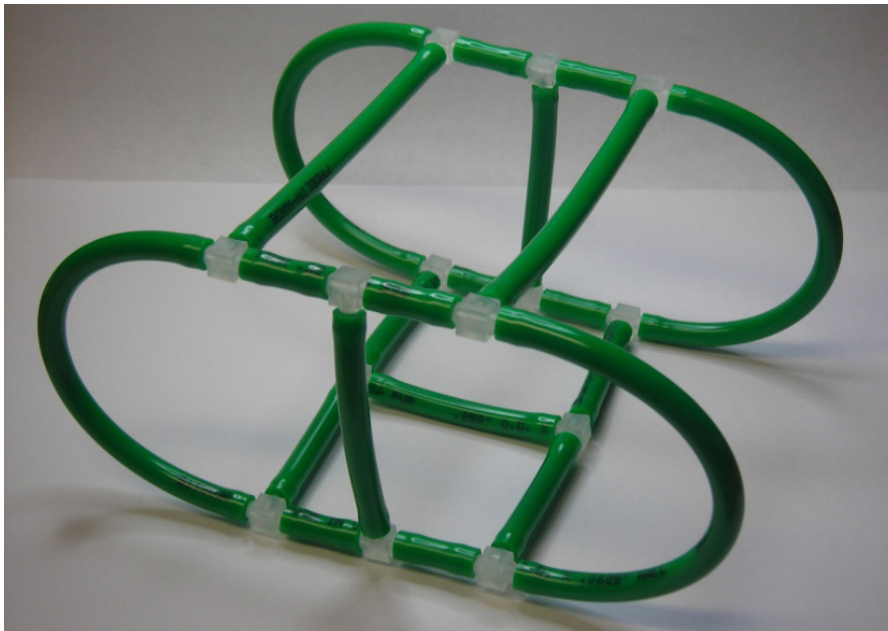
CAUTION

When connecting tubes to tee fittings a high amount of direct pressure is required. Be careful not to break a tee fitting.
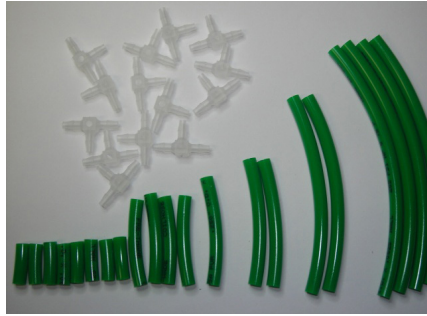
NOTE

To soften the tubes place in boiling water. This allows the tubes to slide more easily onto the tee fittings.

The frame is the skeleton of the ROV. The frame will support the thrusters and buoyancy tanks.
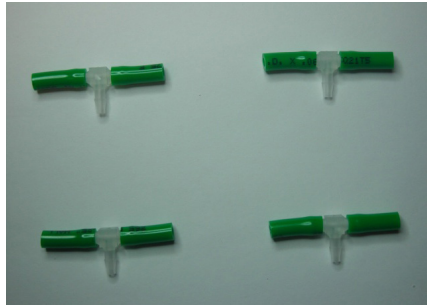
1.1 - Component Verification

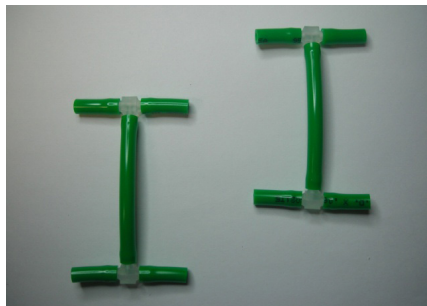| 14	- Tee Fittings
8	- 20mm Tubes
2	- 60mm Tubes
2	- 90mm Tubes
4	- 125mm Tubes
4	- 40mm Tubes
1	- 50mm Tube

1.2 - Assemble Top and Bottom Supports

Using four tee fittings and eight 20mm tubes, slide a tube on to each side of the tee connector as shown.

1.3 - Assemble Side Supports

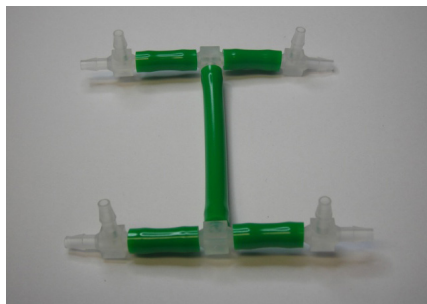Using two 60mm tubes connect the top and bottom supports as shown.

1.4 - Assemble Tee Fitting Supports

Insert eight tee fittings on to the ends of the side supports as shown.

1.5 - Verify Tee Fittings

Set each side support on a flat surface with the tee fitting pointing up as shown.
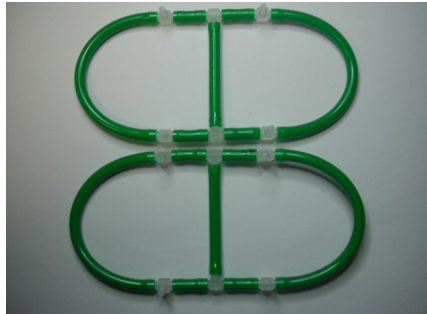

NOTE

Verify that each tee fitting is perpendicular (pointing straight up) from the flat surface.

1.6 - Assemble Ends

Attach the four 125mm tubes to each end of the side support as shown.

To avoid creasing the tube gently bend each 125mm piece prior to connecting.

1.7 - Assemble Bottom Support

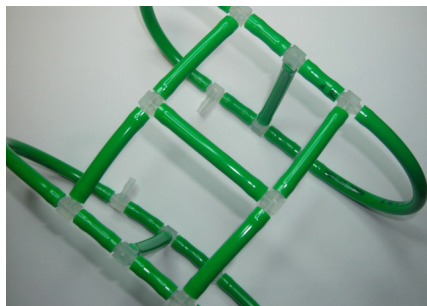Attach two tee fittings to the end of the 50mm tubes as shown. Make sure the tee fittings are in the same orientation.

1.8 - Assemble Bottom Support Cont.

Attach four 40mm tubes to each of the remaining tee fitting ends as shown.

1.9 - Assemble Bottom to Sides

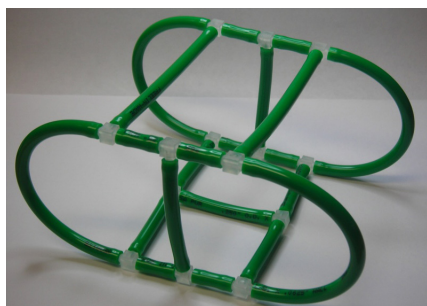Attach the bottom support from step 1.8 to the sides from step 1.6 as shown.

Be careful not to break off the tee fitting when attaching.

1.10 - Assemble Top Braces

Attach two 90mm tubes on the sides opposite the bottom supports as shown. You may have to straighten any twists in the frame tubing. DONE!

2.0   Assembly of Thrusters (Bag #2)

CAUTION — 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.

The thrusters are the sole source of propulsion for your Mini ROV.

2.1 - Thruster Kit

   3 - Motors
   3 - 19mm tubes (Prop Shafts)
   3 - Propellers
   3 - Motor Mounts
   3 - 150mm ties

2.2 - 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

The curved part of the prop should be facing away from the shaft

2.3 - 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 2mm from the motor.

IMPORTANT

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

2.4 - Assemble Motor Mount

Slide the 150mm 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 2.5.

2.5 - Attach Motor to Motor Mount

Slide motor in tie and fasten LOOSELY. Do not tighten until the next step.
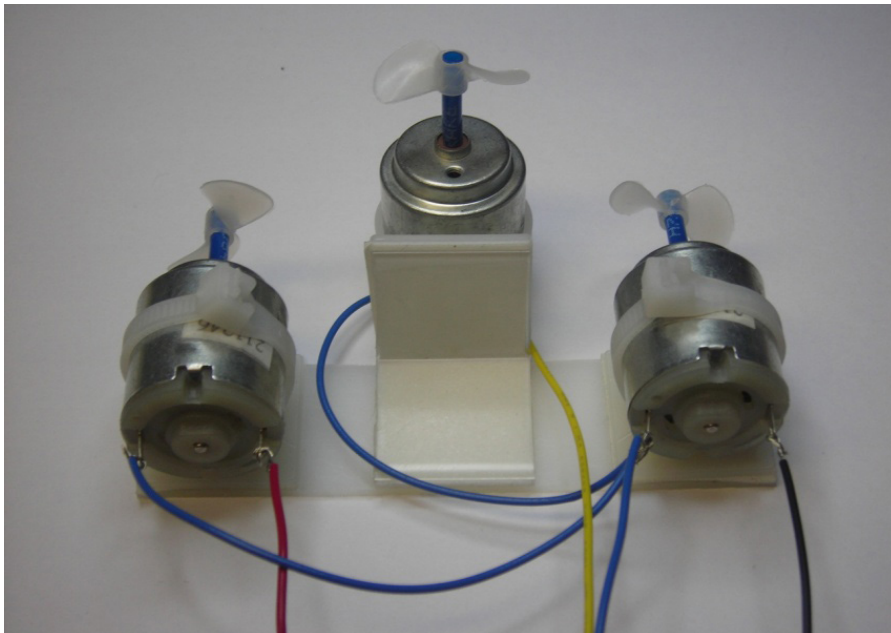
2.6 - Align Posts

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!

3.0   Assembly of Thruster Mount and Wiring (Bag #3 and #4)

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.

The thruster mount and wiring are essential parts of you ROV.
Attention to detail is important.

3.1 - Motor Mount Kit (Bag #3)

    3 - Previous Motor Assembly
1 - L shape
1 - Adhesive
1 - 100mm Mounting plate
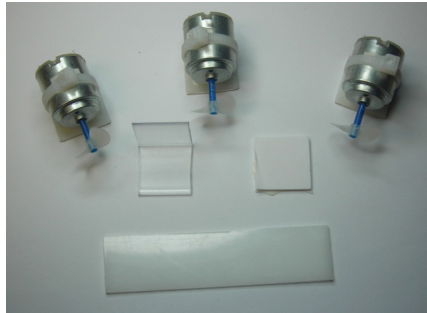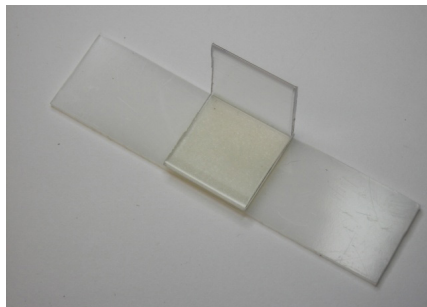

3.2 - Wiring Kit (Bag #4)

    1 - 2300mm Black Wire
1 - 2300mm Red Wire
1 - 2300mm Yellow Wire
1 - 2440mm Blue Wire

3.3 - 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.

3.4 - Thruster Assembly

Peel the backing off the adhesive and place thruster assemblies as shown.

3.5 - Connect Wiring

Cut two 75mm pieces of blue wire. Strip 6mm 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.

3.6 - Connect Wiring

Strip 6mm 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!

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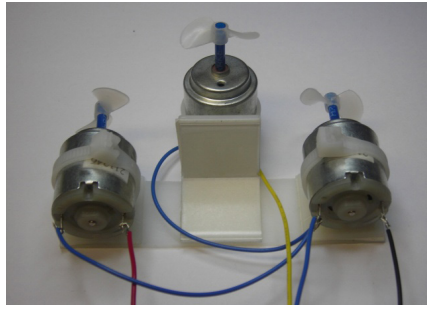
4.0 Assemble Control Board (Bag #5)

CAUTION

Improper assembly of the control board can result in direction control problems with the MiniROV.

The control board is your interface with the Mini ROV. It will supply power to the thruster motors via a set of toggle switches in which you control.
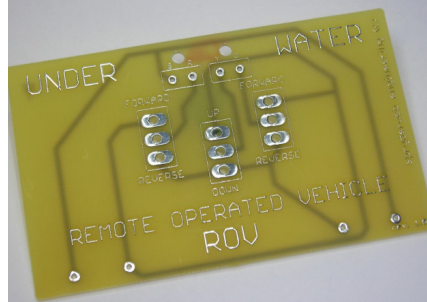
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4.1 - Control Board Kit

1 - PCB (Printed Circuit Board)
2 - AA Battery Holders
3 - Toggle Switches
2 - Terminal Blocks
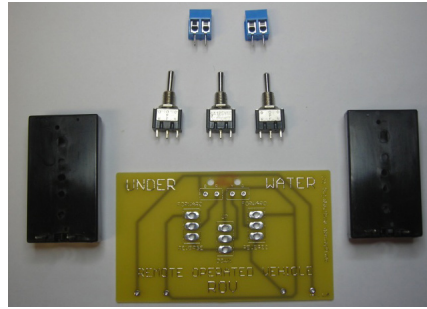
4.2 - Identify the PCB

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.

4.3 - Attach 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.

4.4 - Attach Switches

Insert the switches into the PCB as shown. Solder the switches on the bottom side of the board.
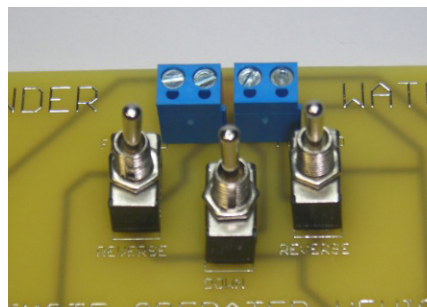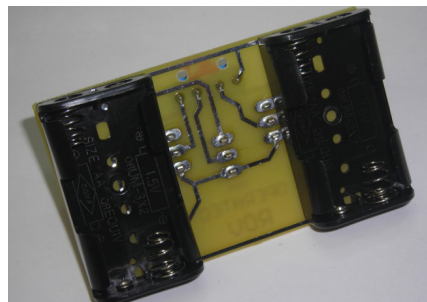

IMPORTANT All five components should be mounted flat on the PCB. Someone may need to assist while soldering.

4.5 - 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!
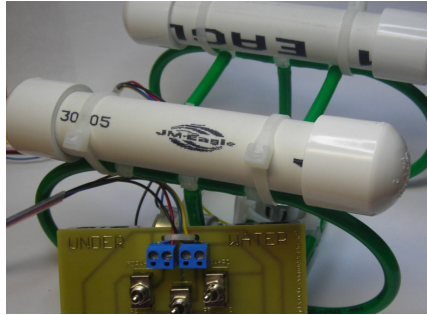
5.0 Assemble and Test ROV (Bag #6)

You are now ready to assemble the parts of your ROV. Once again, pay attention to details. Picture in your mind the completed project.
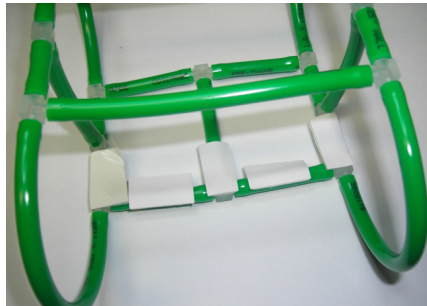
5.1 - Final Kit Assembly (Bag #6)

2 - 125 mm PVC Tubes
4 - PVC End Caps
4 - 200mm ties
3 - 100mm tie
3 - Adhesives Wire wraps

5.2 - 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.


5.3 - Attach Thruster Assembly

Test fit the 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 the thruster.
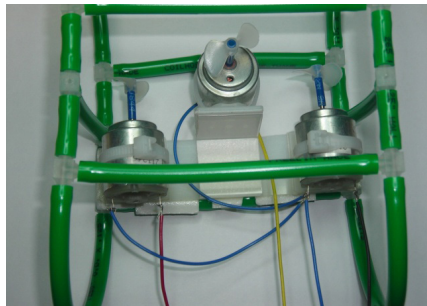
5.4 - Secure Wire Bundle on ROV

Using two 100mm zip ties, loop one around the back top tube and the other through the first to form a chain. DO NOT TIGHTEN! Feed the wire bundle through the second zip tie. Leave a little slack between the zip tie and the motors .
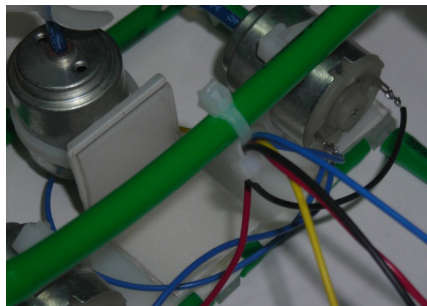
5.5 - Assemble Ballast Tanks

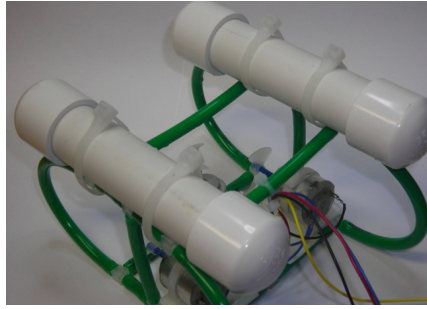Attach four 75mm PVC tube caps to the ends of two 125mm x 19mm PVC tubes. Push end caps as tight as you can.

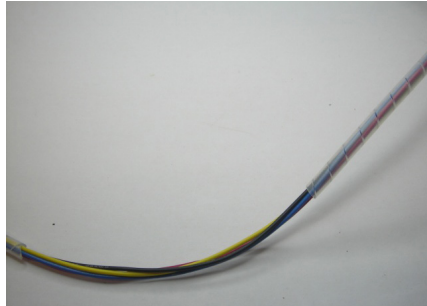
IMPORTANT

Do not glue the end caps.

5.6 - Attach Ballast Tanks to Frame

Attach ballast tanks to frame
Using four 150mm zip ties,
attach the ballast tanks to the
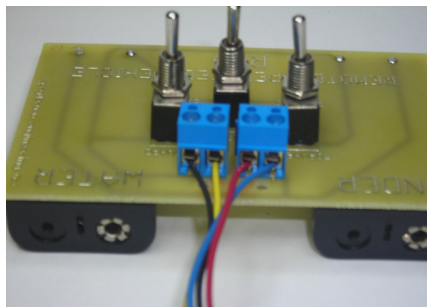top of the frame side as shown.
Secure zip ties.

5.7 - Attach Wire Wraps

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


5.8 - Attach Wire bundle to PCB

Strip 6mm 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 Black wire in the connector marked G.

5.9 - Secure Wire bundle to PCB

Insert a 75mm zip tie into the
holes on the PCB as shown.
Tighten the zip tie from the
bottom side of the PCB.
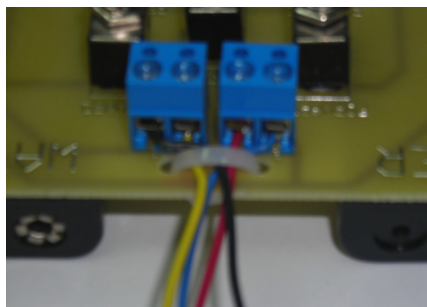
CAUTION Be careful not to pull out a wire from the terminal block while tightening the zip tie.

5.10 - Insert 4 AA batteries

Insert 4 x 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!

Congratulations! You are now ready to test your ROV!
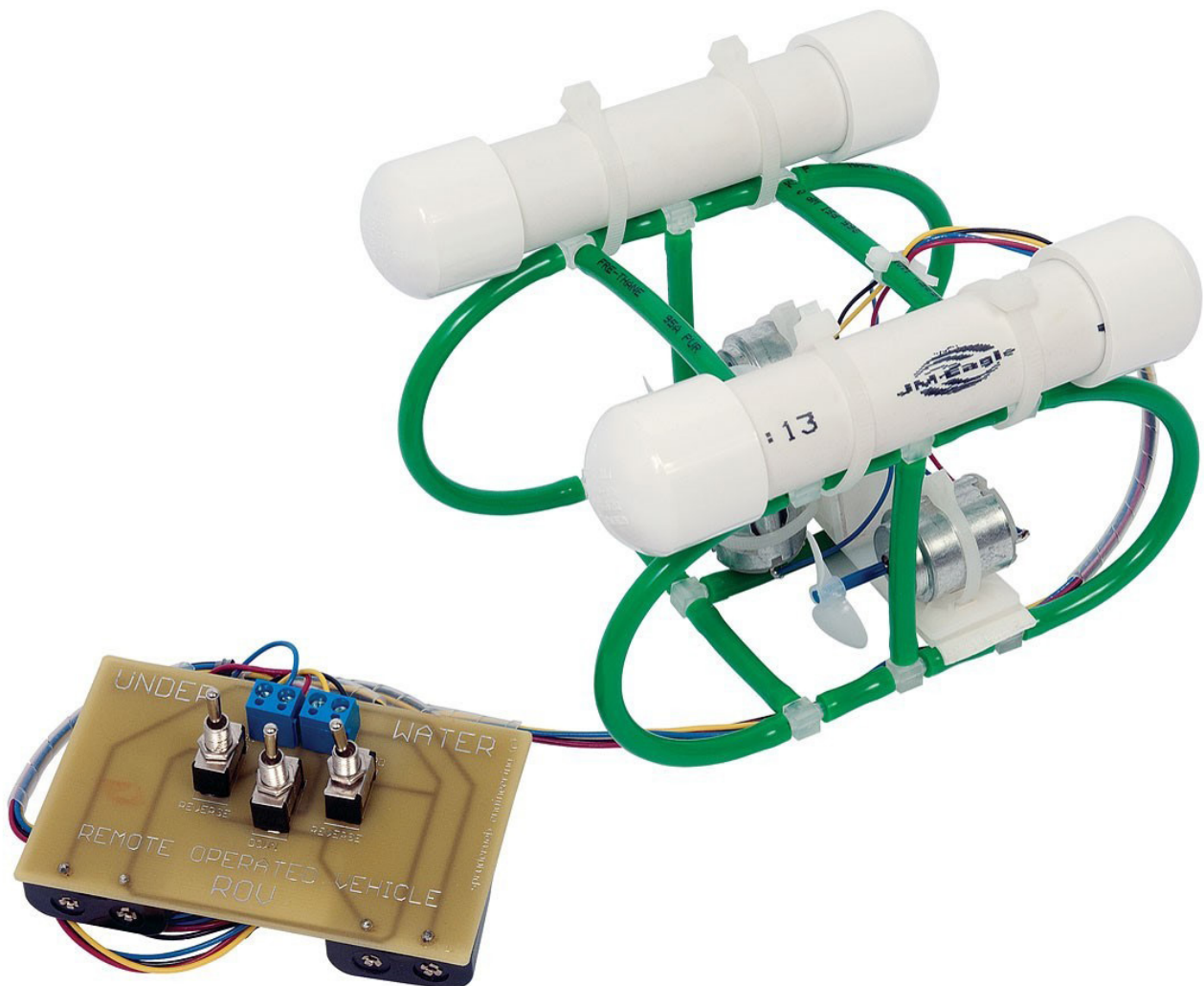
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