Parts and Other Materials

Figure 3

1. Wax Bowl Ring
2. 50' Network Cable (tether cable)
3. Electrical Tape
4. Poly Butyl Tape
5. 3x Die Cut Vinyl Tape Set
6. 3x 4-40 Self-locking Hex Nuts
7. 3x 4-40 Tee Nuts
8. 3x 4-40 Threaded Propeller Shaft Couplers
9. 3x Propellers
10. 3x 12-Volt DC Motors
11. 3x Thruster Housings and Caps (35 mm Film Canisters with Caps)

Figure 4

Figure 5

USE the SMALL drill bit to twist a hole in the centre of the canister, top and bottom.

Remove the caps and check for any plastic burrs that may be covering the hole in the bottoms of the thruster housings. It is essential to remove these burrs, as they can make it difficult to get the motor shaft to pass through the hole during the waterproofing process.

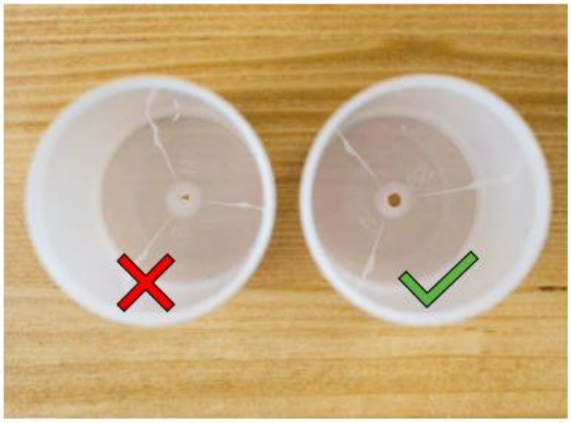


Figure 6

Figure 7

- Using the ruler, measure approximately 15” from the bare end of the tether cable (the end without the connector).
- Make a mark using the permanent marker on the cable.
- Slightly flatten the end of the cable between your fingers.
- Place the cable on a worksurface and hold the cable far enough from the end to prevent injury if the diagonal cutting pliers slip. Use the diagonal cutting pliers to carefully slit open the outer jacket of the cable and expose about 1” of colored wires. (Figure 8)

Figure 8

- Firmly grasp the bundle of colored wires in one hand and pull on the outer jacket with the other hand, tearing the outer jacket back to the 15” mark. (Figure 9)
- Use scissors or diagonal cutting pliers to trim away the outer covering ONLY, being very careful not to nick or cut any of the colored wires. (Figure 10)

Figure 9

TIP

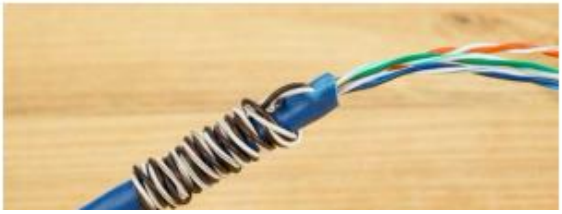
Remove only the outer covering, NOT the wires!

Four sets of colored wires should now be visible.

- **Orange** (solid and white striped)
- **Green** (solid and white striped)
- **Blue** (solid and white striped)
- **Brown** (solid and white striped)

Figure 10

The brown wires will not be used at this time. They can be cut and removed using the diagonal cutting pliers or they can be folded back and wrapped around the tether cable for later use if lights, sensors, extra motors, or other attachments are added to the ROV. (Figure 11)



- With the caps on the thruster housings, run approximately 6” of one colored wire pair through the hole in one cap, going from the outside to the inside.
- Repeat for the other two wire pairs.

Figure 12

Figure 13

Figure 17

Figure 18

These stickers are OK, but WRAPPING CLEANLY in electrical tape is BEST.

1. Find the *red dot* on the white part of each of the motors, near its electrical terminals. The red dot marks the positive (+) terminal. Mark the (+) terminal (nearest the red dot) with the marker.
2. To keep the tape on the *sides* of the motor thin enough to fit into the housing, it's best to first cover both ***ends*** of the motor, then trim the end tapes flush with the sides, and cover the sides last. Use *five, short, 1"* pieces of tape on the ends, such as in the process below. Figure 2.1-1 shows the initial taping steps.

   - On the terminal end, gently push a piece of tape over one terminal to poke it through the tape. Carefully place the edge of this tape up along the side of the motor-shaft boss (raised area in the center).
   - Continue doing this for all five tape pieces, overlapping them around the terminal end of the motor to fully cover it.
   - Then trim off all tape that extends past the edge of the motor shell (cut with scissors tilted toward the motor end to get a clean, flush edge).
3. Repeat this taping process on the other end of the motor. Be sure to cut the tape pieces flush at the edge of the motor as before.

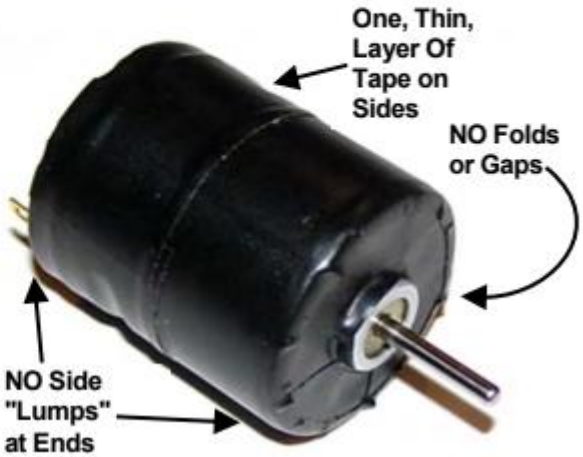


Figure 2.1-2: *Properly Sealed Motor*

Thread the wire through the motor posts, the SOLID wire connects to the post with the RED dot!!! Very Important!

Twist the wire together so the motor can not fall off!

Solder the wire on to the post.

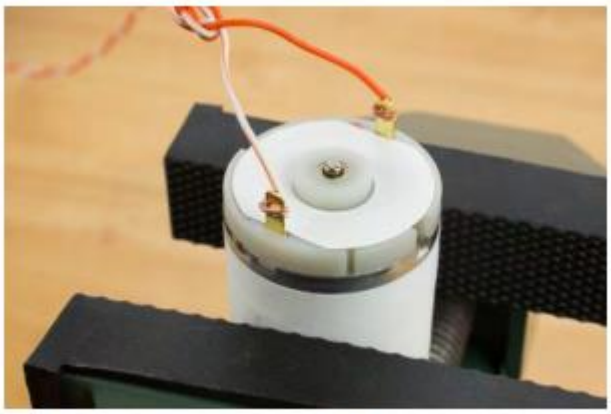


Figure 19

Propeller Making

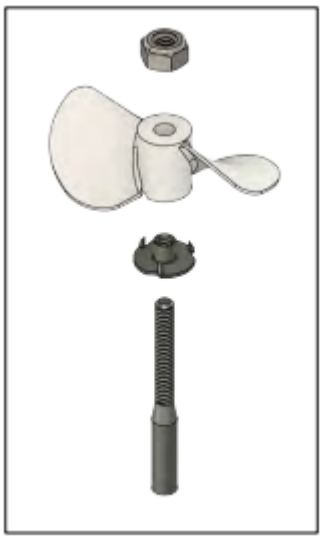


Figure 24

Figure 23

Make sure you thread the propeller the correct way! The groove marked above is face down!

Figure 25

Figure 26

Figure 27

Further water proofing of motors!

Important!!! Do not pull/push on the motor wires! Treat them very gently!

Wax is sticky! Do not get it all over the place!

Put a SMALL lump on the bottom of the canister or motor, smear a layer of wax around the inside of the canister, making sure it is evenly distributed.



Place the motor into the canister, carefully pushing the motor shaft out the bottom.

Fill the canister with wax and put the lid on.

Clean the entire motor canister with hand sanitizer.

Figure 29




Figure 32

Figure 33

Attaching the propeller to the motor shaft must be done correctly!

CLEAN with hand sanitizer. SAND the motor shaft to roughen it up. CLEAN with alcohol wipe!

TASK 2.8 -Attaching the Propeller Assemblies to the Motors

Start with clean, wax-free hands.

- Wipe a motor shaft with an alcohol wipe to completely remove excess wax or residue that may be left after the waterproofing process. (Figure 34)
- Use a small piece of sandpaper to roughen the surface of the motor shaft so the adhesive will stick better. Be sure to roughen all sides as well as the end of the motor shaft. (Figure 35)
- Thoroughly wipe the thruster shaft again with the alcohol pad to remove the sandpaper grit and residue. *Do not touch the motor shaft*; oil from your hands will prevent proper adhesion of the glue. Cleaning, roughing, and re-cleaning the motor shaft is critical for the adhesive to stick.

Figure 34

Figure 35

SAFETY

Adhesives can present hazards to skin and eyes. Wearing eye protection and gloves is recommended when working with any adhesives. Hands should always be washed after working with such materials.

- Place one small drop of Super Glue on the motor shaft near the end (Figure 36) and one small drop in the hollow end of the shaft coupler. (Figure 37)

Figure 36

Figure 37

- Push the hollow end of the shaft coupler onto the motor shaft. Leave a slight gap (about 1/16") between the shaft coupler and the thruster housing.
- Using a paper towel, wipe away any excess glue between the shaft coupler and the motor shaft. (Figure 38)
- Set the thruster aside undisturbed for at least 15 minutes until the adhesive hardens.
- Once the glue is set, turn the motors by hand to free up the newly installed assembly.
- Repeat for the other two thrusters. Three completed thruster assemblies are shown in Figure 39.

WATER PROOFING the CABLE!

Use the 'monkey putty' to seal up the exposed wires coming out of the ethernet cable. Then tape up with electrical tape-so it doesn't stick to things.

Figure 40

Figure 44

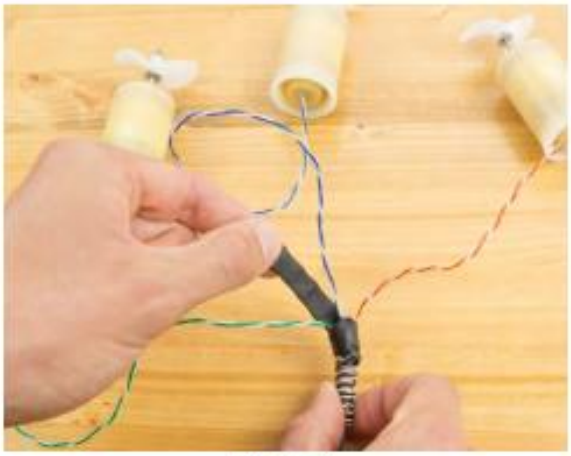


Figure 41

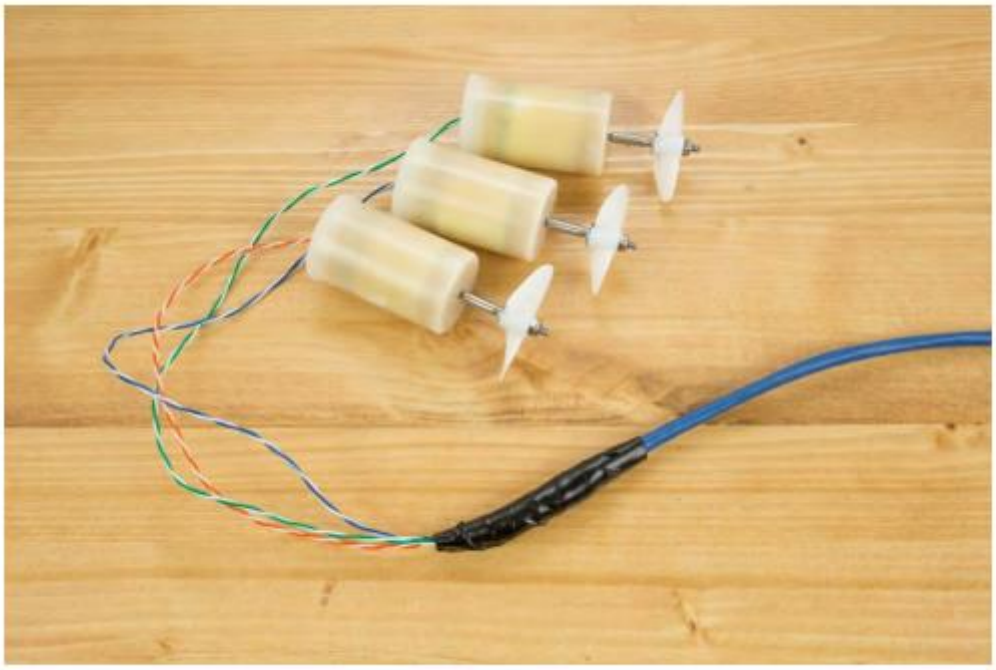


Figure 45

Before you attach the motors to the frame, TEST THEM!! Hook up a controller and figure out which motor is RIGHT, LEFT, UP/DOWN!! LABEL your motors! The labelling in the full directions is not always correct!!

Figure 8

Notice how the cable ties are attached! There are TWO, the second one is the LOCK…locking the first one tightly around the motor.

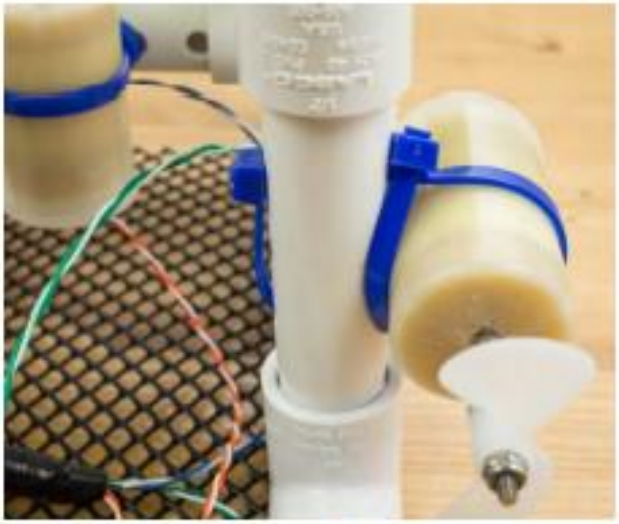


Figure 9

The components will be installed and soldered in order according to their size, smallest first. Refer to Table 1 and Figure 5 during assembly.

DO NOT INSTALL COMPONENTS UNTIL CALLED FOR IN THE INSTRUCTIONS.

Order	Component	PCB Location
1	Fuse Holder	F1
2	Pushbutton Switch	SW3
2	Pushbutton Switch	SW5
3	Toggle Switch	SW1
3	Toggle Switch	SW2
4	RJ45 Connector Jack	J1

Table 1

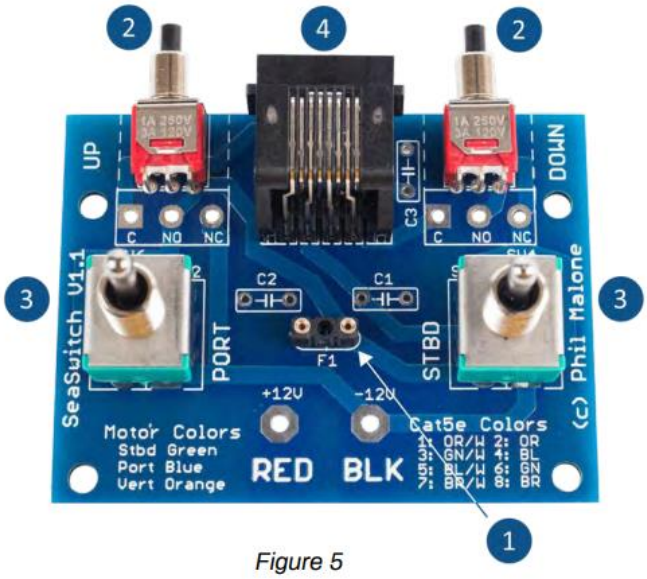


Figure 5

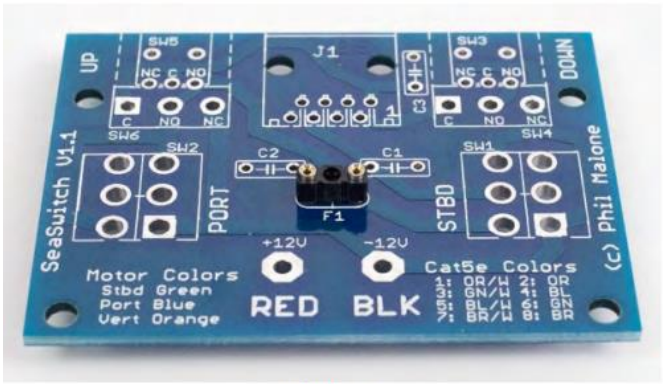


Figure 8

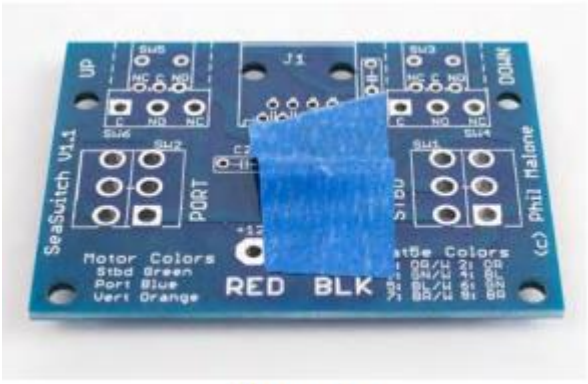


Figure 9

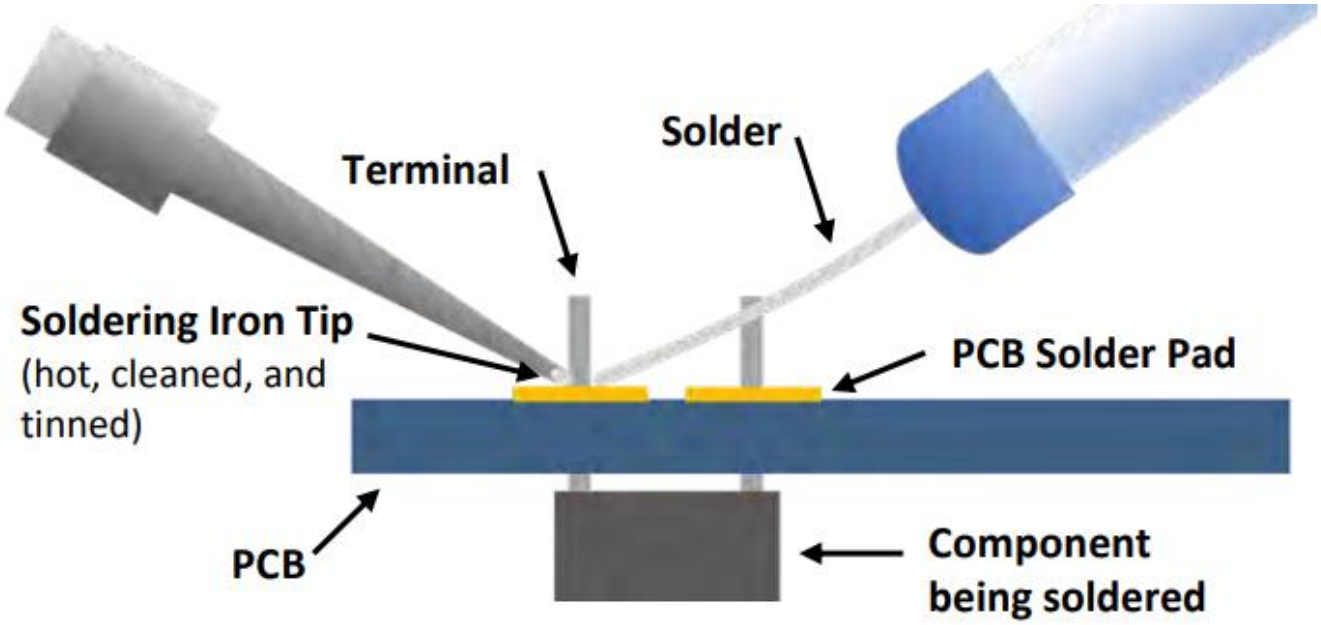


Figure 10

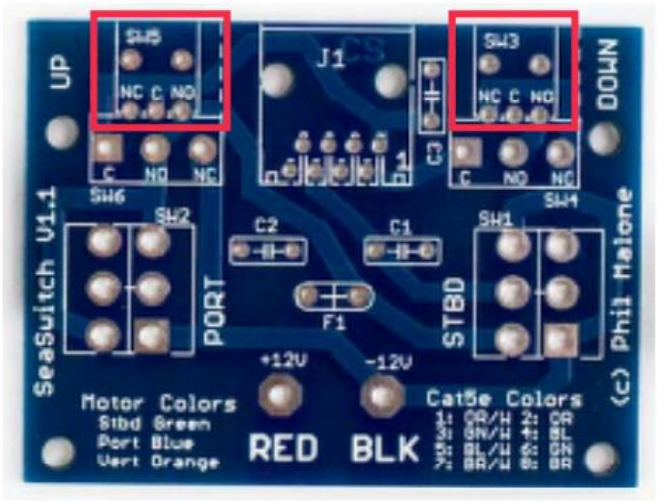


Figure 11

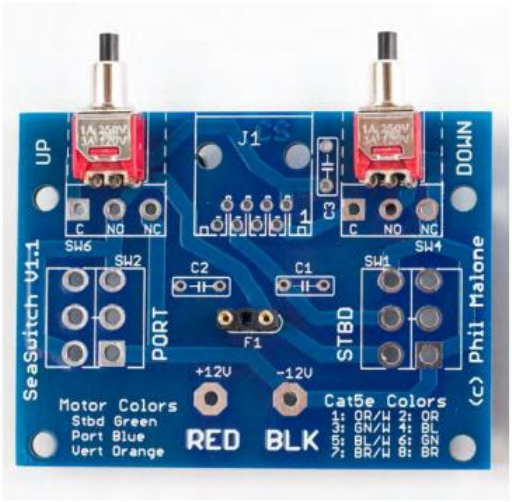


Figure 12

The directions say to do this one ABOVE first then the one BELOW. I prefer to do it the other way around.

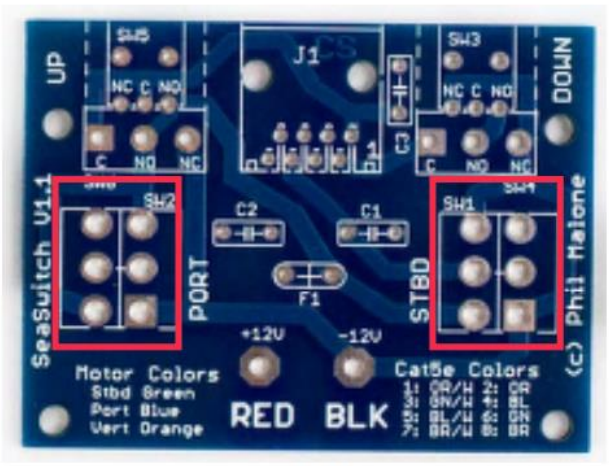


Figure 14

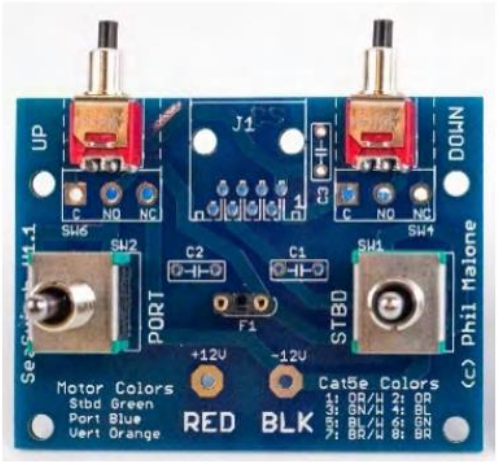


Figure 15

That way you can USE THE BOX to hold the circuit board!

Figure 17

THE HARDEST BIT!! These connections are TINY and there are 8 of them! You need to do this carefully with NO Bridges!

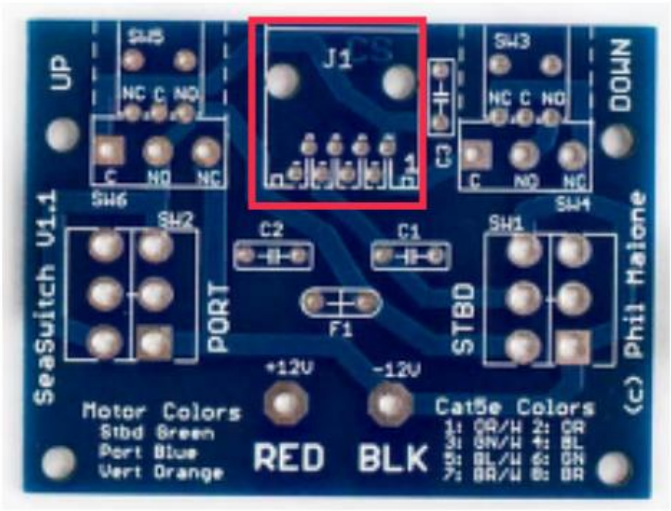


Figure 18

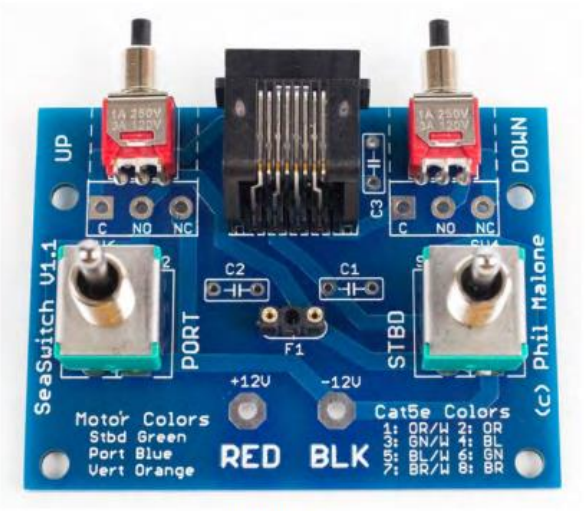


Figure 19

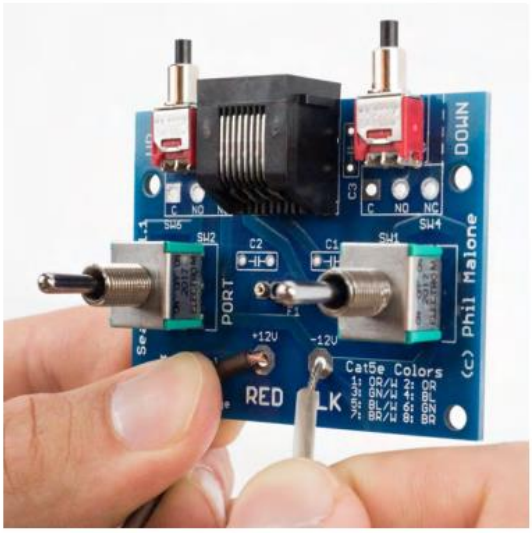


Figure 25

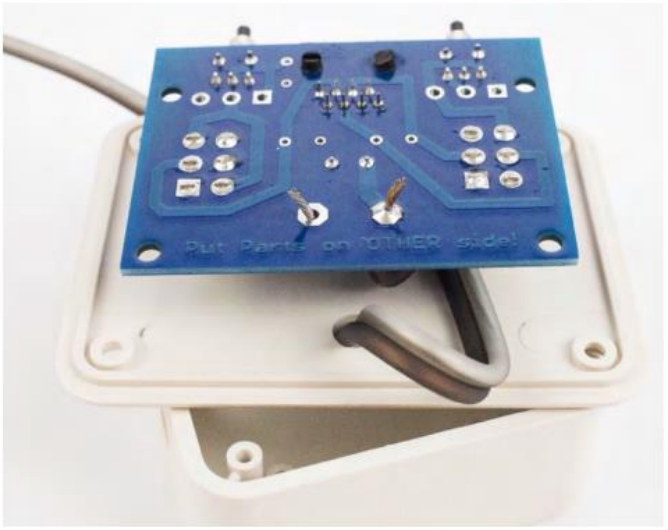


Figure 26

Figure 27

Preparing the controller power wire:

Split the wires at both ends about 15cm.

Use the wire strippers to expose the copper wire about 2 cm.

The copper wire is insulated, one wire is coated in clear insulation, the other has markings on it.

The marked one will be NEGATIVE, the clear one POSITIVE.

Make sure you put the RED alligator cover on the POSITIVE wire!

Figure 31

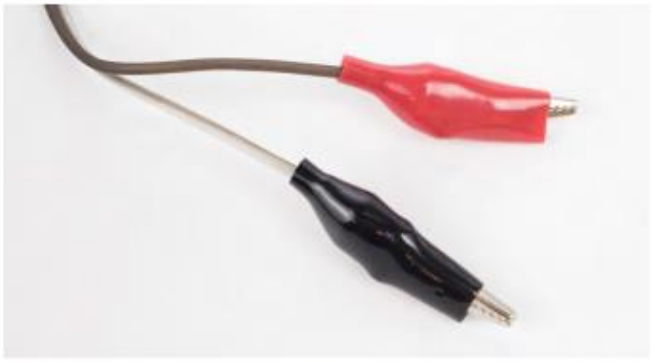
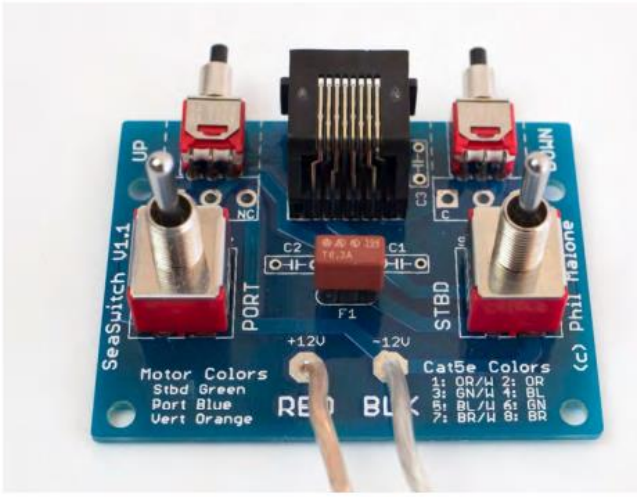


Figure 32

- Locate the **fuse**.
- Using the diagonal cutting pliers, trim both terminals on the fuse to about ¼". (Figure 33)
- Install the fuse into the fuse holder on the PCB. (Figure 34)



Task 1.10 – Finishing the Controller

Continue only after the tests have been successfully completed.

- Place the PCB into the control box enclosure, passing the pushbutton switch actuator buttons carefully through the two holes in the top of the box.
- Use the four small silver screws to secure the PCB into the box. (Figure 37)
- Install the lid onto the control box enclosure, carefully folding the power cord wires inside the box as the lid is lowered into place. Secure the lid with the four black screws. (Figure 38)
- Press the two pushbutton switch caps onto the pushbutton switch actuators.

Final assembly shown in Figure 39.

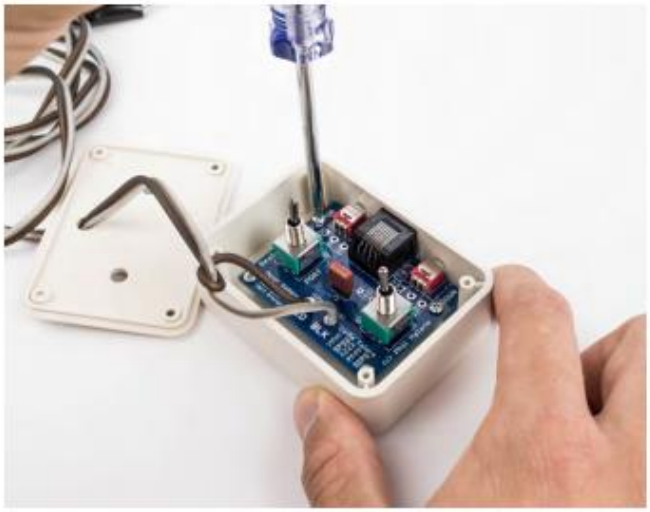


Figure 37

Figure 38

Figure 39