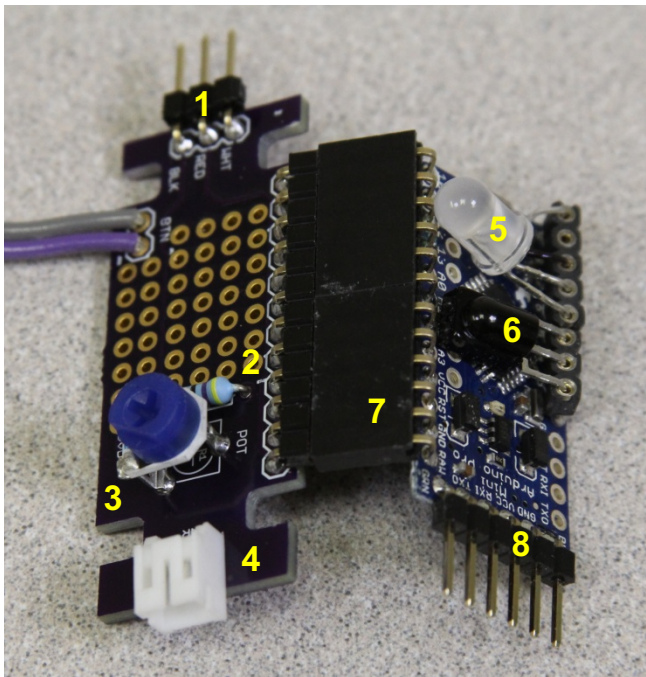


### 3. Circuit Board



The Buoyancy Engine Controller manages the servo motor on the buoyancy engine and directs it when to drawn in water and when to expel it. It consists of two main parts: The **Circuit Board** on the left and the **Arduino Pro Mini** microcontroller on the right. These are connected by sets of header pins in the middle.

The main components of the **Circuit Board** are:

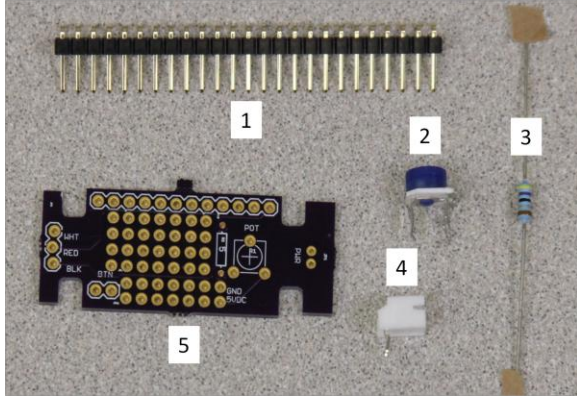
1. THREE-PIN HEADER - Connects to the buoyancy engine servo motor.
2. RESISTOR – Reduces the voltage on the servo.
3. POTENTIOMETER - Controls the pause time between buoyancy engine cycles and thus the length of the dive glide and rise glide.
4. POWER SUPPLY JACK – Is the plug-in location for the battery power supply.

The main parts of the **Arduino Pro Mini** microcontroller are:

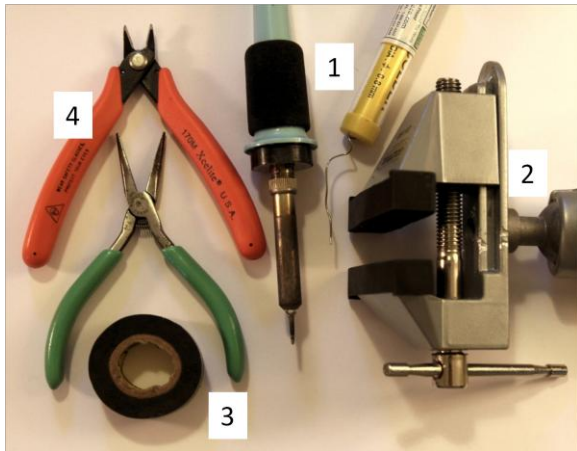
5. RGB LED – Indicates glider’s descent or ascent by color changes.
6. IR Receiver – Picks up signals from Mini IR Remote to start and stop the buoyancy engine.
7. HEADER PINS (12) along length - Connects the circuit board to the Pro Mini.
8. HEADER PINS (6) along width - Enables connection to the FTDI breakout board for programming.

To create the Buoyancy Engine Controller, follow the **Circuit Board** build and **Arduino Pro Mini** build instructions then join these two components together as illustrated in the directions.

# Circuit Board Build



1. The circuit board build includes a male right angle header 24-pin set (1), a 10k Ohm trim potentiometer (2), a 4.7-ohm resistor (3), a 2-pin JST power jack (4), and a custom printed circuit board (PCB) (5).

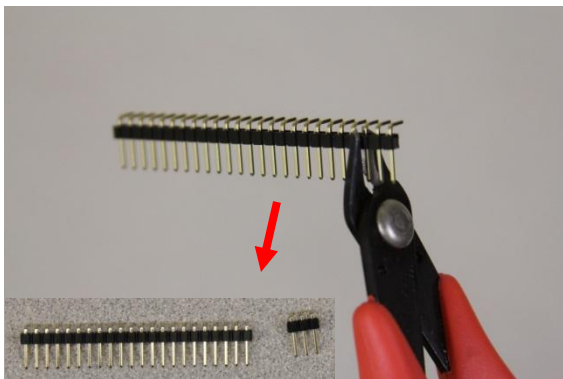


2. Tools and supplies needed are soldering iron with solder (1), small vise (2), electrical tape (3), and flush cutters and needle nose pliers (4).

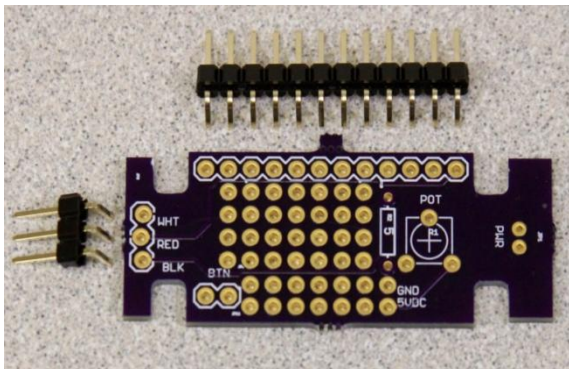
## Safety Glasses/Goggles Required

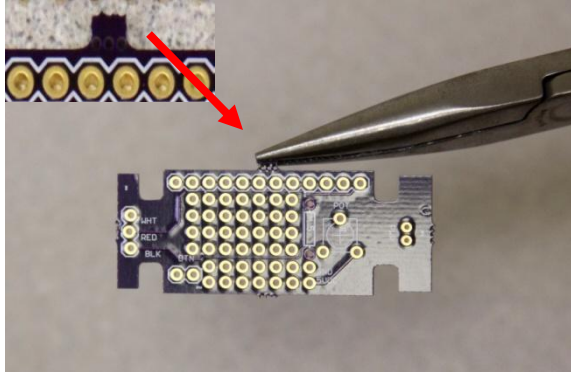


3. Use flush cutters to carefully remove a 3-pin section of male right angle header pins.

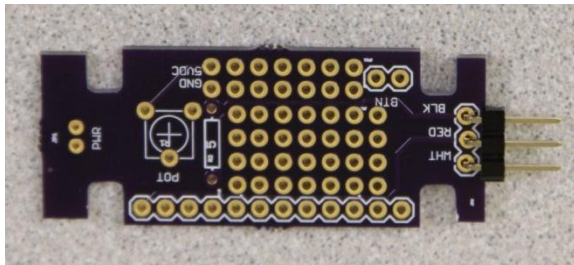


4. Also separate off a 12-pin section. **SAVE** the rest of the header pins for the Arduino Pro Mini Build in the next set of instructions.

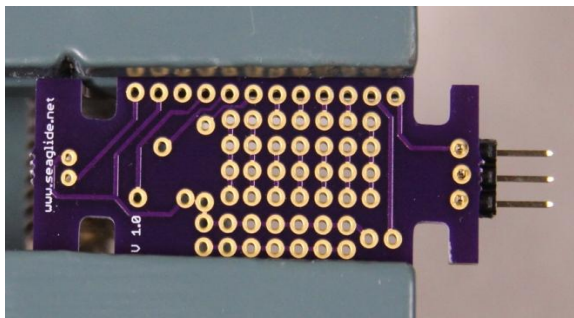
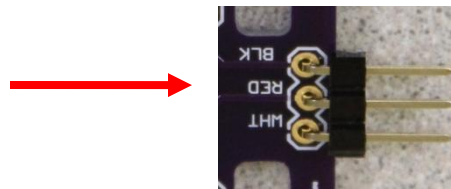




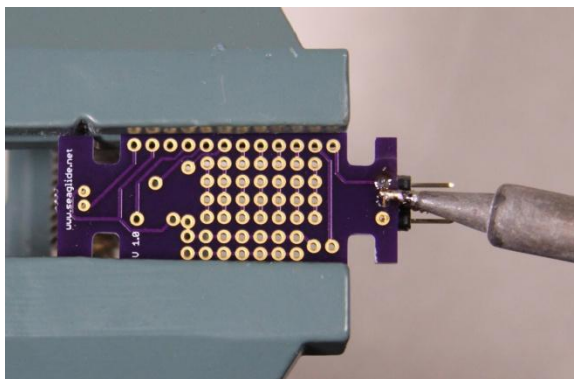
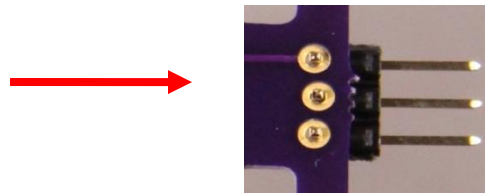
5. If remnant nubs from the PCB manufacture process remain on the board, snap these off with pliers.



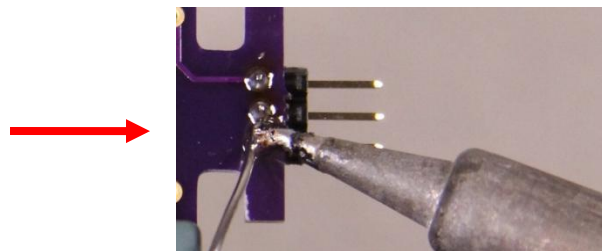
6. Place 3-pin header in PCB as shown.

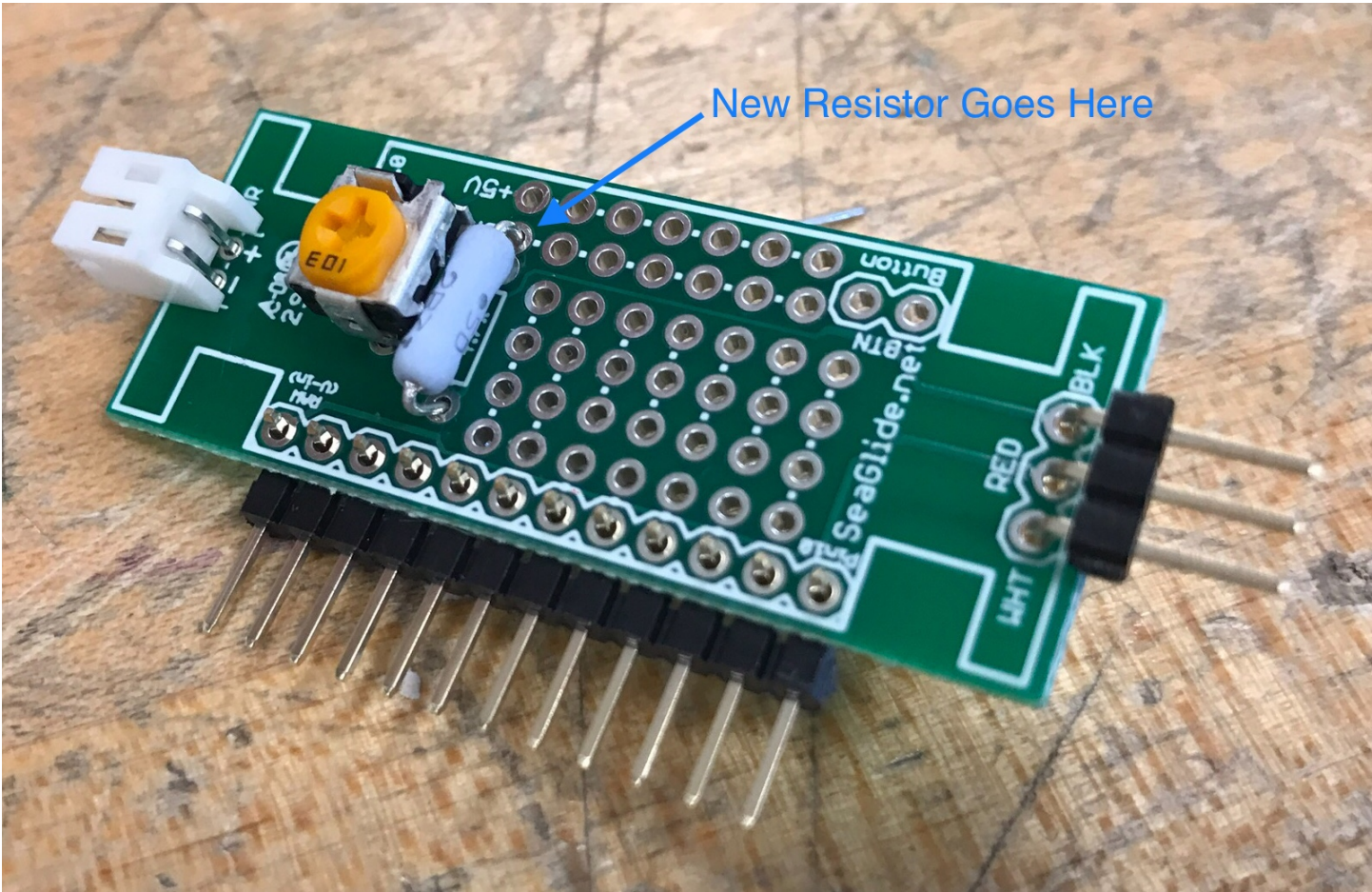


7. Flip the PCB over and secure it in a small vise.

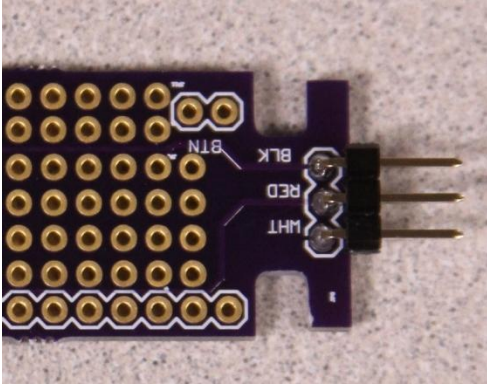


8. Solder pins in place.

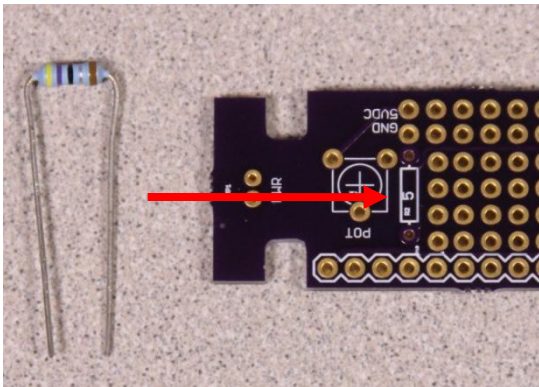




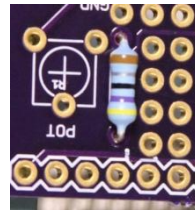
New Resistor Goes Here



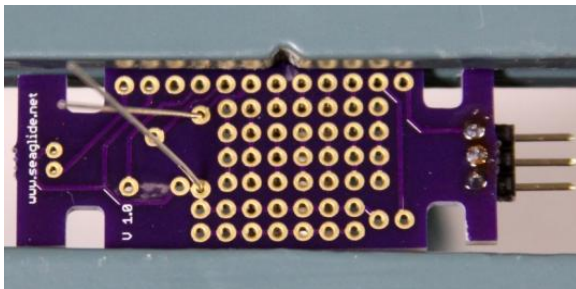
9. This 3-pin header is where the servo motor wire harness will attach. Notice the wire orientation that is labeled on the PCB: WHT for white, RED for red, and BLK for black.



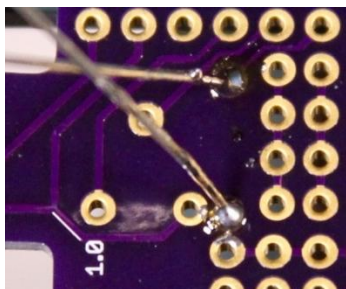
10. Locate the 4.7-ohm resistor, bend the wires as shown, and fit it in the outline labeled “R2 5 or 4.7Ω.”



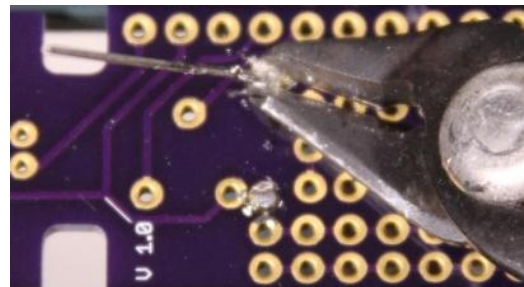
It can be installed in either direction.



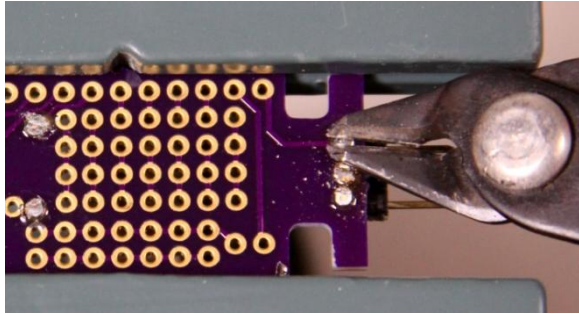
11. Flip the PCB over and bend the resistor wires to hold the resistor in a low profile position. Then secure the PCB with resistor in a small vise for soldering.



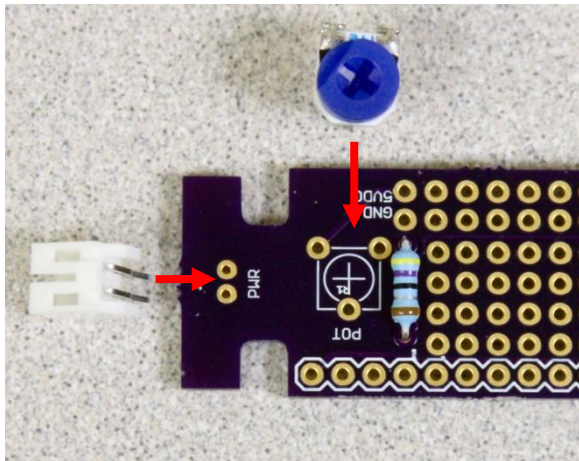
Solder Resistor Wires



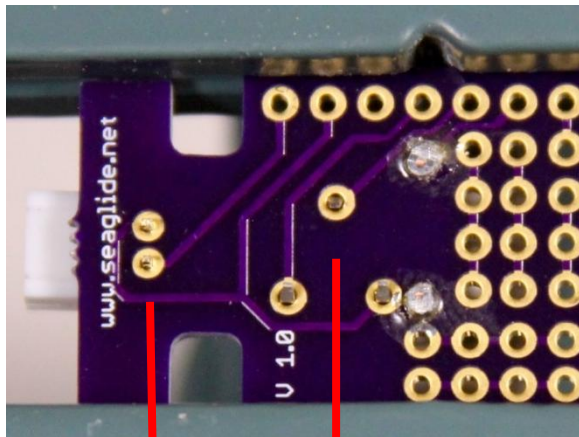
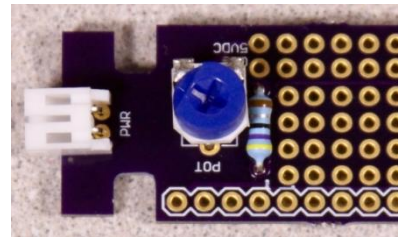
Trim Excess Wire with Flush Cutters



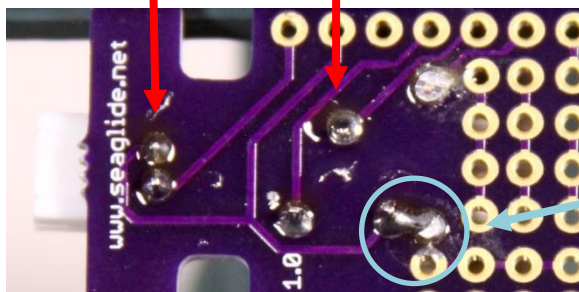
12. Also, trim the 3-pin header pins protruding from the PCB. It's okay to trim off the top of solder joints. A low-profile board will fit on the buoyancy engine later.  
**WARNING:** *Flush cutters will send clippings flying. Please wear safety glasses/goggles and clip into a trashcan.*



13. Locate the 10k Ohm potentiometer (POT) and 2-pin JST power jack (PWR). Fit these into their outlined positions as shown.



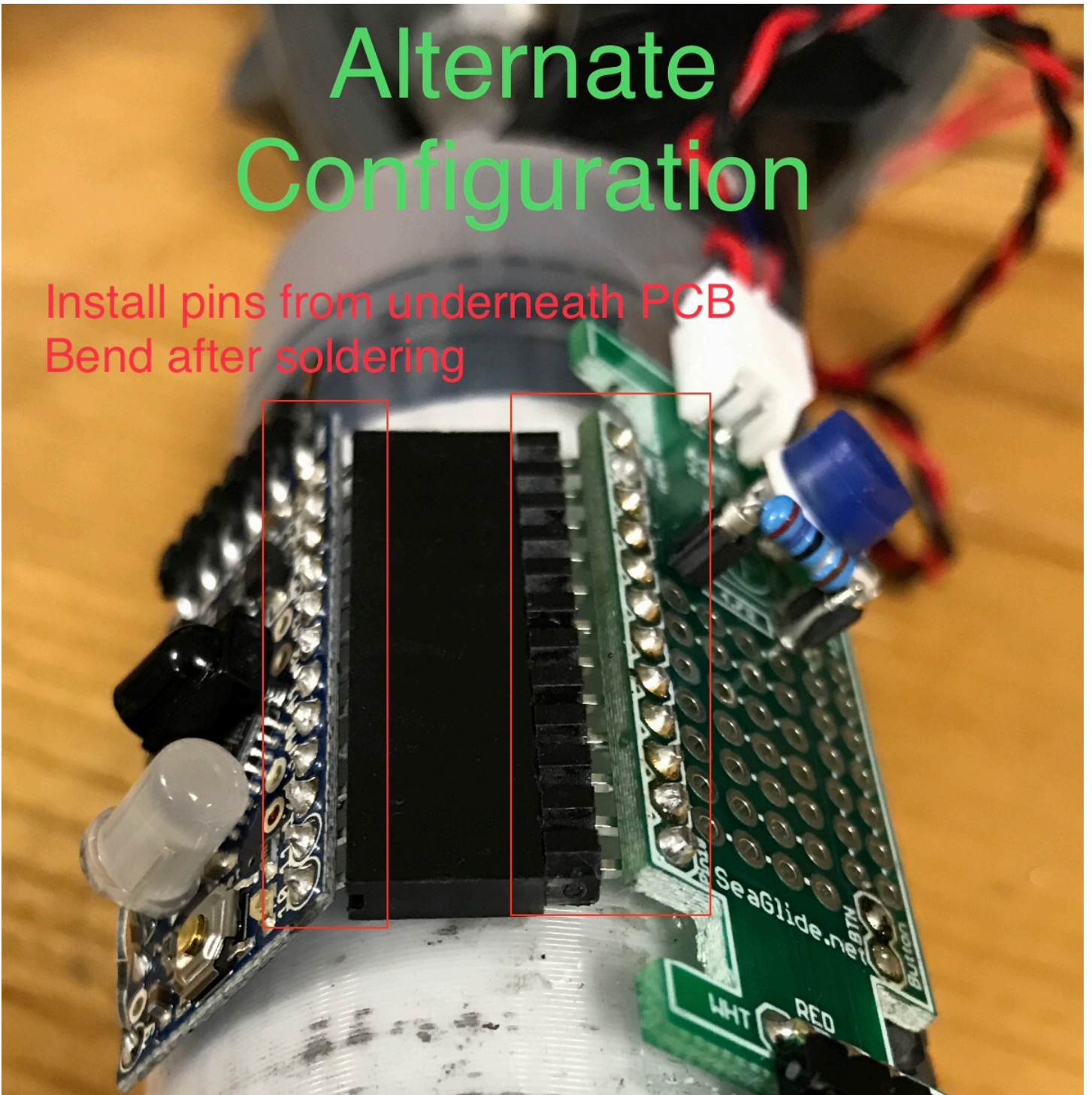
14. Flip the PCB with components over and secure the board in a vise for soldering.

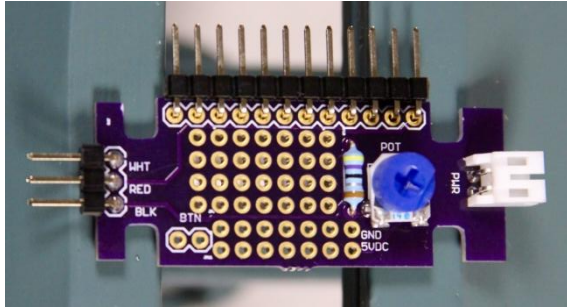


15. Solder the 10k-trim potentiometer (3-pins) and the JST power jack (2-pins) in place.  
 Solder bridges in the circled area are okay, because these paths are already connected electrically.

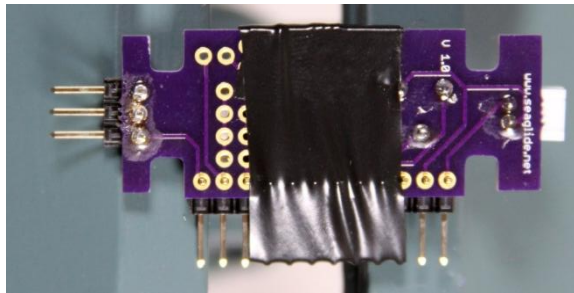
# Alternate Configuration

Install pins from underneath PCB  
Bend after soldering

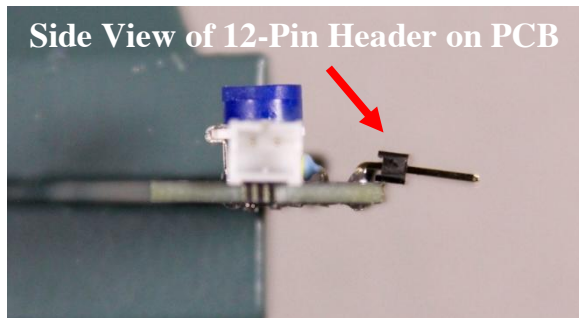




16. Locate the 12-pin section of header pins from instruction #4. Fit it onto the PCB as shown.

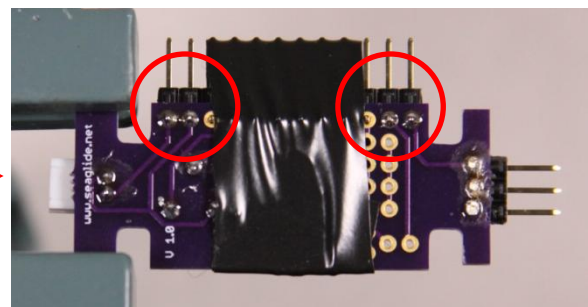
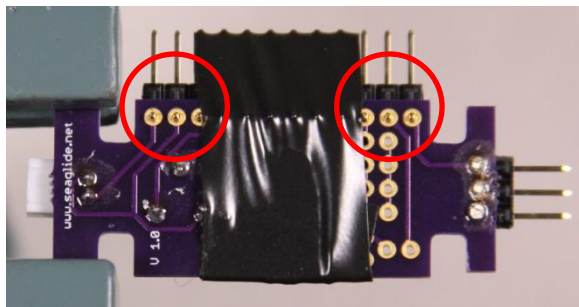


17. Flip the board over and tape the pins into position with electrical tape. Wrap the tape tightly enough to hold the pins at slight angle downward – towards the bottom of the PCB.

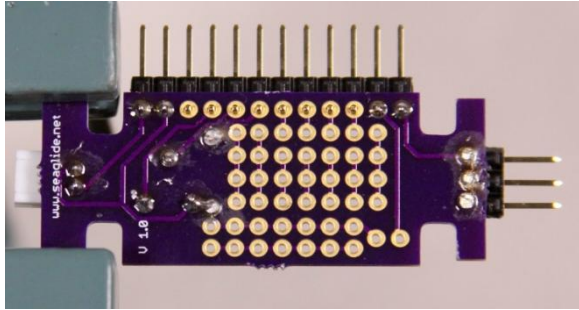


18. This slight angle will be helpful later for fitting the controller over the rounded cylinder of the buoyancy engine.

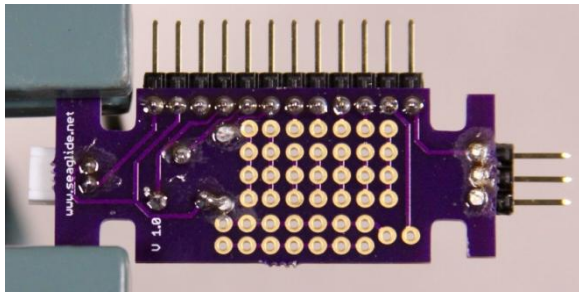
Secure PCB in vise and solder the exposed pins on either side of tape.







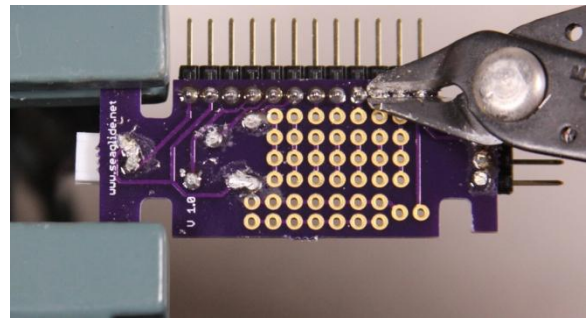
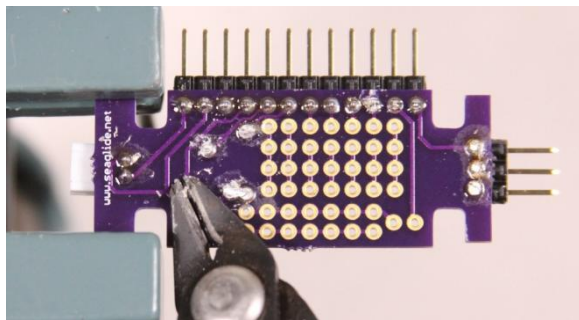
19. Remove electrical tape and finish soldering the rest of the 12-pin header.



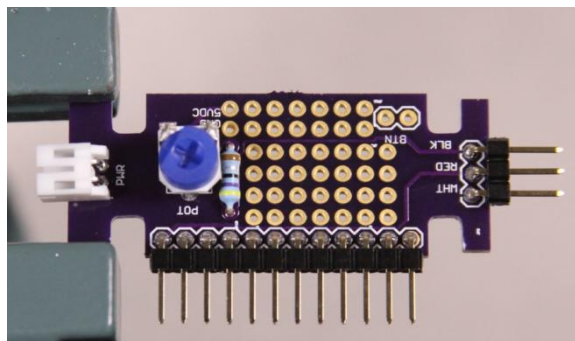
20. Check all solder joints. Use flush cutters to trim protruding pins and solder.

**WARNING:** *Flush cutters will send shavings flying. Please wear safety glasses/goggles and clip into a trashcan.*

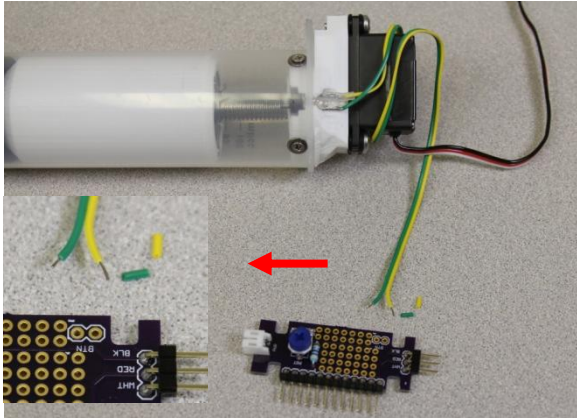
Use flush cutters to cut back pins and solder joints.



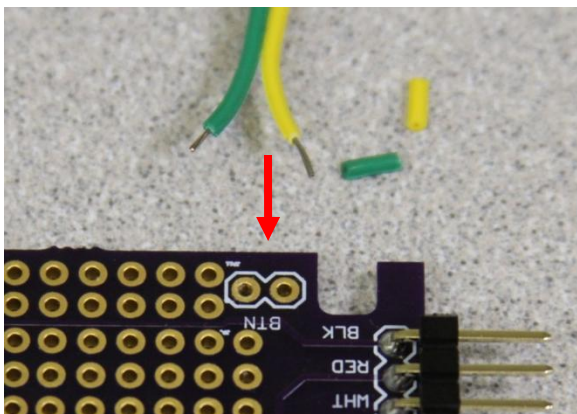
### Finished Circuit Board!



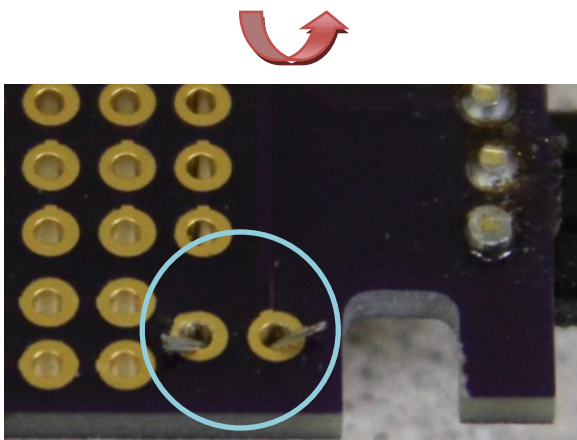
One last thing... the pushbutton switch needs to be soldered to the circuit board.



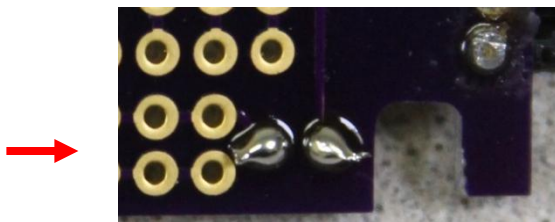
21. Locate the pushbutton switch that is attached to the buoyancy engine. Strip  $\sim \frac{1}{4}$ " of plastic insulation from ends of the two wires.

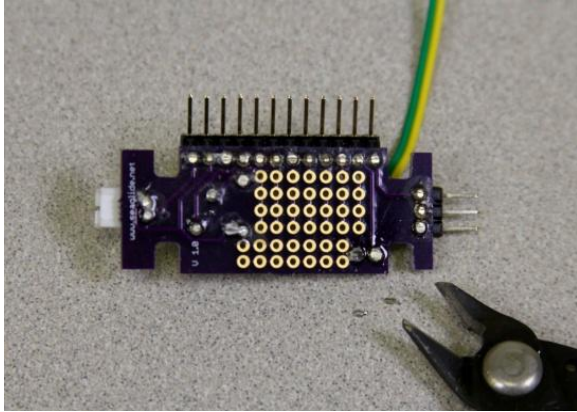


22. Fit the two wires (in any order) into outlined position marked BTN for button. Bend the wires to either side to hold them in place.



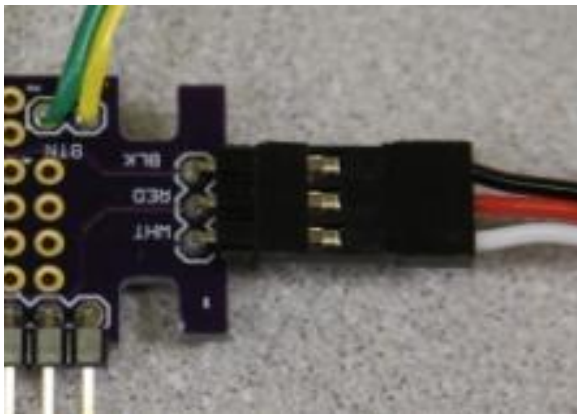
23. Flip the circuit board over and solder the two wires in place.





24. Check all solder joints. Use flush cutters to trim protruding pins and solder.

**WARNING:** *Flush cutters will send clippings flying. Please wear safety glasses/goggles and clip into a trashcan.*



25. Flip the PCB over and attach the buoyancy engine servo harness to the circuit board. The ORDER of the color coded wires is IMPORTANT. Attached the harness so that the white wire aligns with the WHT pin, the red wire with the RED pin, and the black wire with BLK pin.

### **Buoyancy Engine with attached Circuit Board**

