# RapidLED Red Sea Max 130(D) Retrofit

## Contents

## Foreword

As with any type of lighting retrofit, there are many dangers, difficulties, and pitfalls that may occur. The Red Sea Max 130(D) retrofit should be attempted by people familiar with AC power and wiring, electronics, LEDs, LED Drivers, soldering LEDs, series circuits, and be comfortable with the fact that this retrofit will require complete disassembly and removal of some contents of the original hood. If you are uncomfortable with potential hazards, dangers, or pitfalls that may occur in the course of performing this retrofit, you should not attempt this retrofit.

## Outline

Here is a general outline of what steps happen in the order we think is best:

1. Complete LED work: attach LEDs to heatsink and then wire them together. If you have dimmable LED drivers, wire them up to the LEDs, turn the lights on and adjust the maximum current with a multimeter before going any further.
2. Remove hood, open it, remove the stock ballast and power compact light clip holders and sockets.
3. Drill two additional mounting holes in RSM reflector and then install heatsink.
4. Drill hole for dimming controller wiring (only if you have dimmable drivers).
5. Complete Wiring: Wire drivers to AC power, dimming wires, and LEDs
6. Test under power.

******** ENSURE THERE IS NO POWER TO THE DRIVERS UNTIL ALL WIRING IS COMPLETE ********

7. Close hood up, re-attach to RSM, and bask in the shimmer.

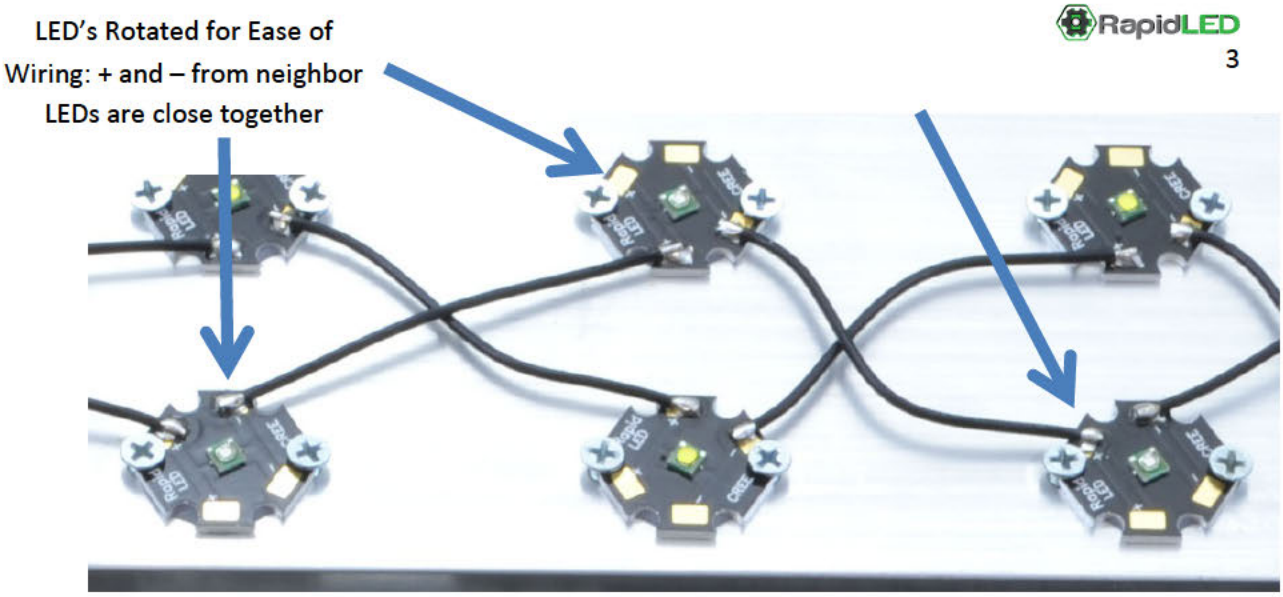
## Heatsink Preparation

Before beginning any work on this retrofit, we will prepare the heatsink by attaching the LEDs to it and then wire the LEDs together.

### Attaching LEDs to the Heatsink

The heatsink has many little holes in it. Two little holes are used to secure 1 LED to the heatsink – one at each end of each LED.

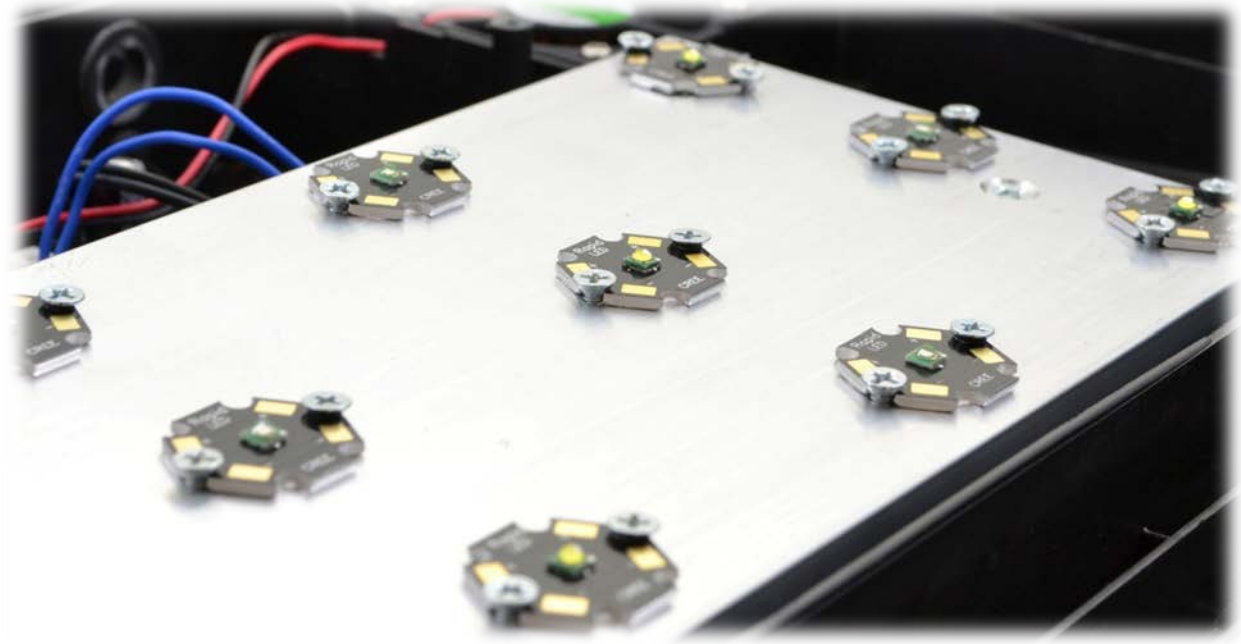
Here is a tip: when arranging the LEDs on the heatsink, lay out all of your LEDs and then rotate them such that when it comes time to solder, from + to – or – to + (depending on which end you start at) so the + from one LED will easily connect to the – of another. Please see the picture below for an example.




## Thermal Grease

We need to apply thermal grease to the back of each LED before securing it to the heatsink. Thermal grease ensures proper thermal conductivity of heat away from the LED into the heatsink. A very small dab of grease on the back of each LED is all that is necessary. More is NOT necessarily better. Too little will lower conductivity and too much will create a mess. A thin layer works best. The photo below shows about how much you should use.

After the thermal grease has been applied to the star, screw it into the heatsink with two little screws, adjusting the height of the two fastening screws to center the LED between them. Do not over tighten. The screws should be snug but not tight. When screwing down the LEDs, ensure the screw is not touching any solder or solder pads. This will ground the string at that point and cause strange behavior and possibly, damage.



## Soldering Notes

Now that the LEDs are securely attached to the heatsink with thermal grease, any heat applied to the solder pads (the little gold pads) of the LEDs will be quickly conducted away into the heatsink. When soldering, this will be a problem if your soldering iron does not have a clean, tinned tip (new is best) or does not have enough power – we recommend at least a 50 watt soldering iron. An iron that does not produce enough heat will fail to melt the solder properly. This can result in a cold solder joint which has a very high probability of creating a short. You should at most take 1-5 seconds to complete each solder joint. Leaving the iron touching a solder pad for longer than that is not advised. It also probably means your soldering iron is not hot enough or the wattage is too low.

### Tinning Wire and LEDs

Tinning is the process of pre-coating the wire, or solder pad, in the case of an LED, with solder. Tinned wire and solder pads are more easily soldered together than non-tinned components. This step is to save headache and trouble later – attempting to solder un-tinned components can cause huge problems down the line.

To tin wire, heat the wire (not the solder) with the tip of a clean soldering iron for a few seconds. After the wire is heated, apply solder to the wire (not the tip of the iron). Since solder flows towards heat sources, it should melt on to and flow through the strands of the wire, coating them evenly.

There are two photos below. The left is of un-tinned wire, the right is of the same wire tinned.

## Tinning LEDs

LEDs are tinned similarly to wire. Press the tip of the soldering iron to the LED solder pad and apply solder near the tip of the iron. You do not need too much solder. You can tin all of the solder pads or only the ones you will use. The top photo below is an un-tinned LED. The photo below it has the bottom left solder pad tinned. If the pad does not get warm, the solder will not adhere well. Ensure some heat gets into the solder pad, but not too much.


## Wiring the LED Strings

*****NEVER APPLY POWER TO THE LED DRIVER BEFORE ALL WIRING IS COMPLETE *****

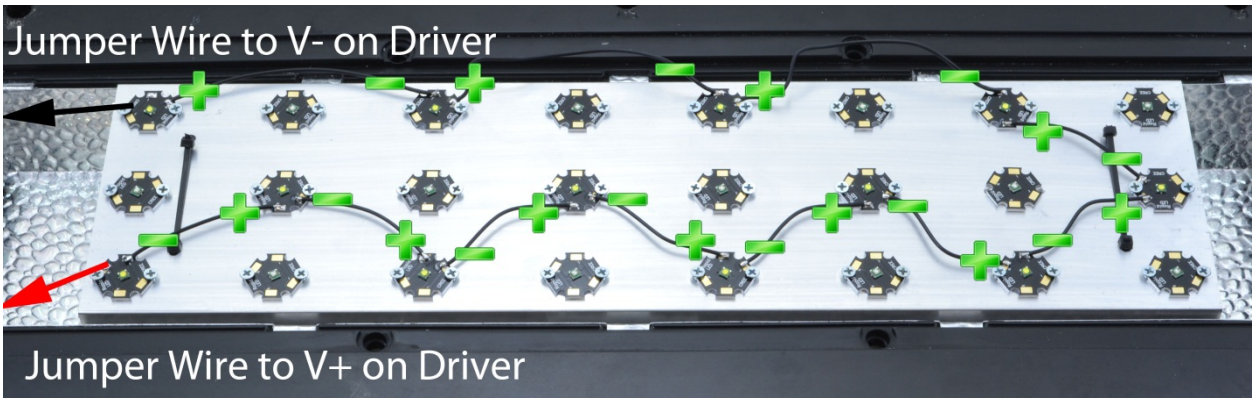
Note that all of the below photos are with the heatsink installed in the RSM hood. It is much easier to complete the LED wiring *before* the heatsink is installed in the hood.

Wiring the LEDs is done as a string in series. The string is a series circuit wired + to – (or – to +, depending on where you start) starting from one wire on the driver, from LED to LED, to the other wire on the driver.

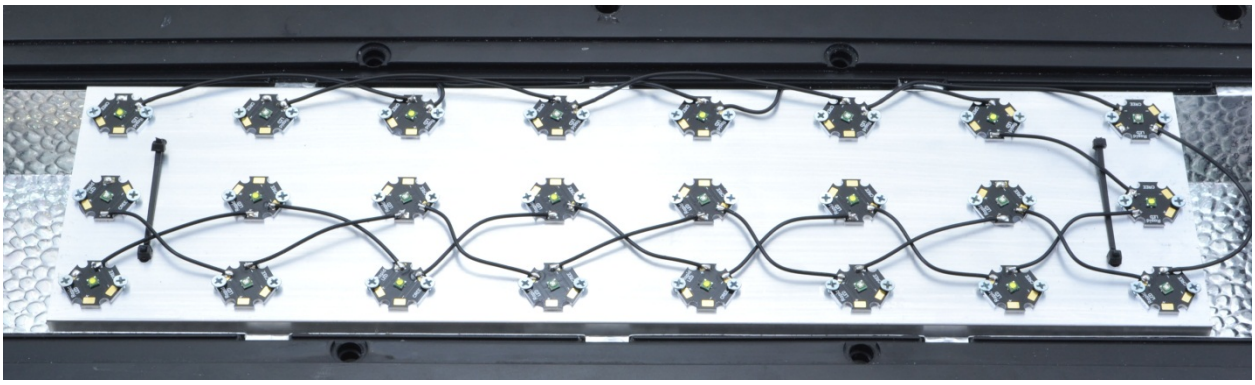
In this retrofit we will solder a red jumper wire to V+ of the first LED to a positive (+) solder pad on the first LED of the string and a black jumper wire to a negative (-) solder pad on the last LED of the same string as noted below. Since the drivers will fit in the hood, you only need enough wire to go from the driver to the LED string.

Below is a photograph of all white XP-G LEDs wired together, + to – all the way around. Wire your blue LEDs in the same manner. Again, do NOT power the driver until the wiring is complete. You risk burning out your LEDs, a very expensive mistake.

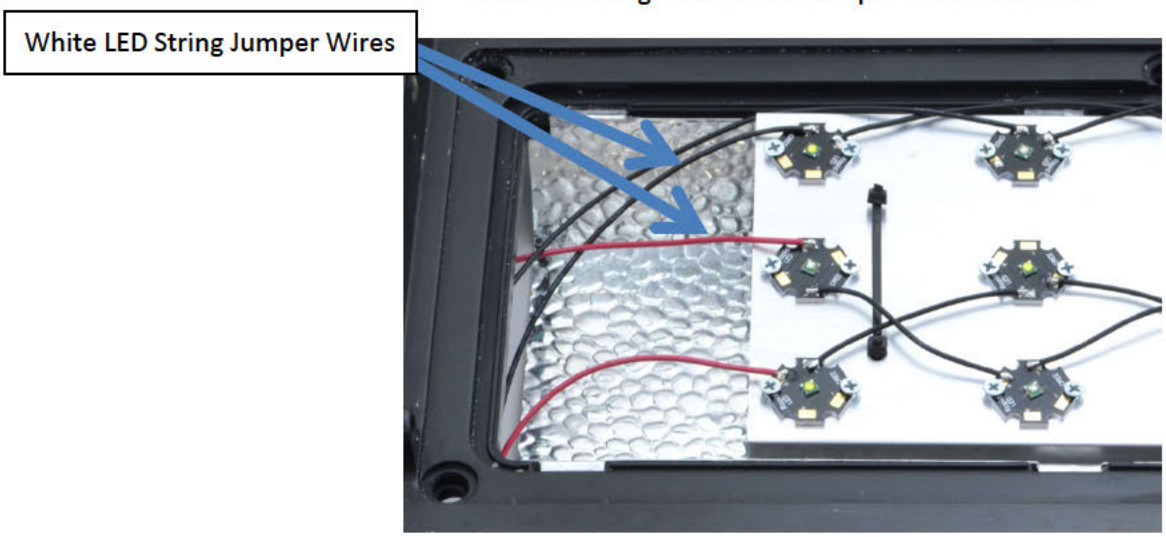
The photo below has a set of Cool White LEDs wired together. You need two jumper wires to connect to the driver.




Both LED Strings Wired:



Both LED Strings Wired with Jumper Wires Attached:



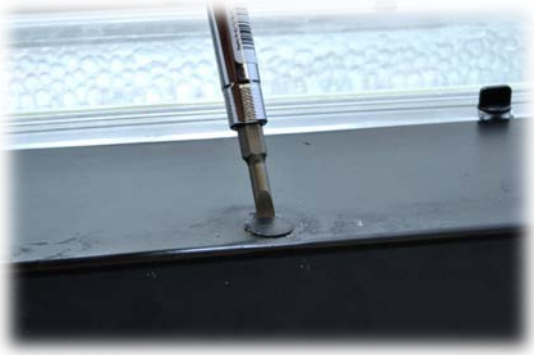

## Hood Preparation

Any and all power wires must be unplugged and disconnected before beginning. We will remove the ballast, the metal bulb clamps and the bulb sockets.

First, remove the clear plastic light cover.

Next, there are 6 screws that must be removed. Each screw is covered with a plastic plug that must be popped out. The plugs are indicated by the arrows in the photo below:

Popping the plugs out is most easily done with a **very** thinly bladed flat screwdriver; a regular flat blade screwdriver might be too thick:



After removing the plugs, with a Philips screwdriver, remove all six screws that were previously covered by the plugs:

Your hood should now look like this:

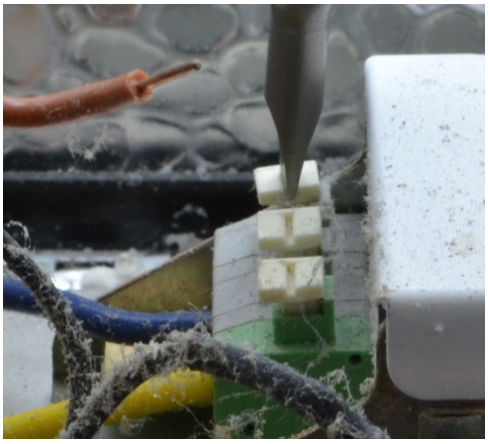
The last step is to remove the two metal power compact bulb clips:

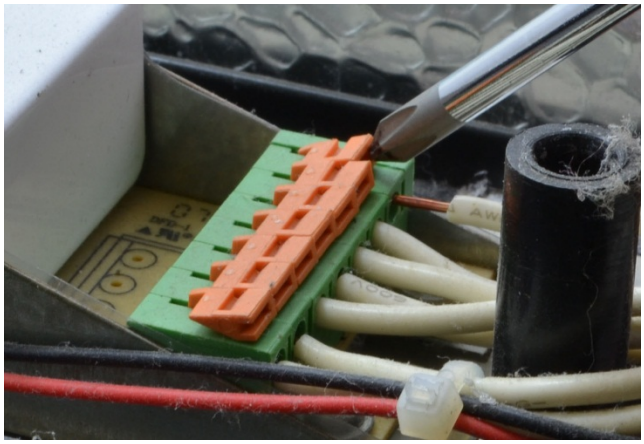
## Opening the Hood

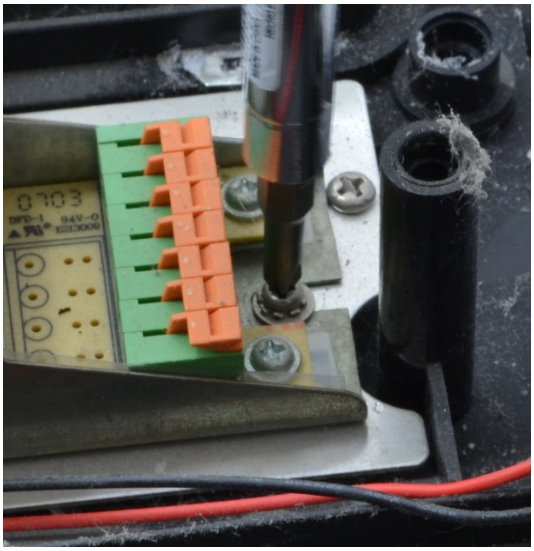
The hood is composed of two main pieces; a top and a bottom with two additional side pieces. To begin disassembly, flip the hood over so it is facing down. Since all of the screws holding the hood together have been removed, we can separate the two halves. Beginning with the outer edges, gently pull it apart until you separate the two pieces. Do not be rough and do not force it open, it just takes only a bit of coaxing to get the two main pieces to separate. Once separated, remove two additional side ventilation pieces.

## Removing the Ballast and Bulb Sockets

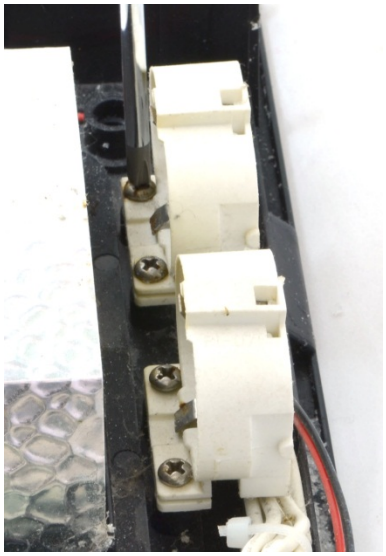
To remove the ballast, first disconnect all of the wires from it. The wire terminals on the ballast are spring loaded. Simply slide or press the terminal to unlock it and then slide the wires out. Next, remove the screws at both ends of the ballast and remove it.





After unwiring and removing the ballast, unscrew and remove the bulb sockets:



Your hood should now look like this:

## Drilling the Reflector for Heatsink Mounting Holes

As can be seen in the photograph above, there are two holes in the reflector. Two more must be drilled two more on the other side of the reflector, symmetric to the first two.

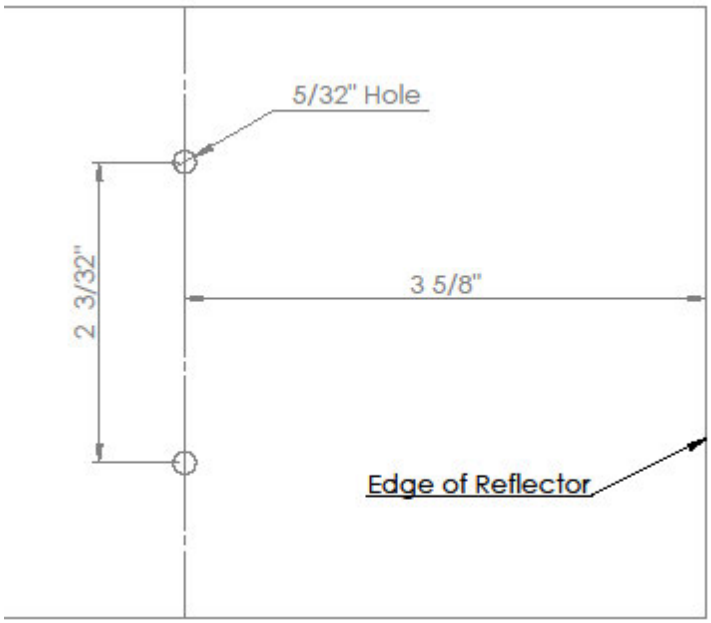
Drilling holes in sheet metal can be difficult. The tip of the drill bit will most likely wander everywhere and once the hole is made, the bit will grab and possibly tear the metal. The main goal is to make two holes approximately symmetrical to the first two. Accuracy is only approximate because we are using zip ties to fasten the heatsink to the reflector. The zip ties allow for some inaccuracy with our holes.

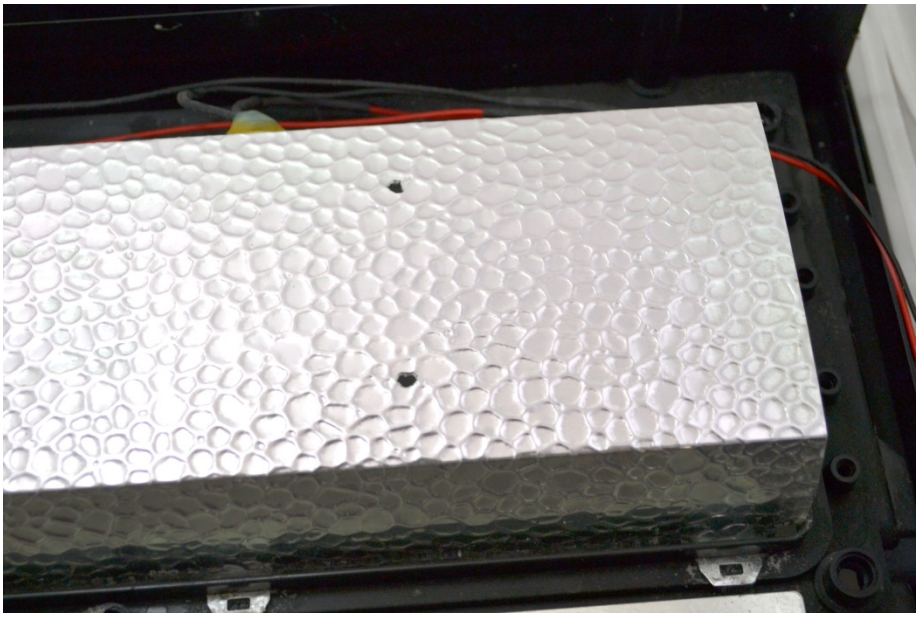
Before attempting to drill the hole, mark its location with a center punch or a sharp object (a pen may even work). This will create a depression where the drill bit tip can sit. It will prevent the bit from wandering once you start drilling.

A 5/32 drill bit was used for the holes. Drill slowly and be careful.

The holes should be 3 5/8” in from the nearest edge of the reflector.

We used a piece of string to place the hole parallel to the original hole.

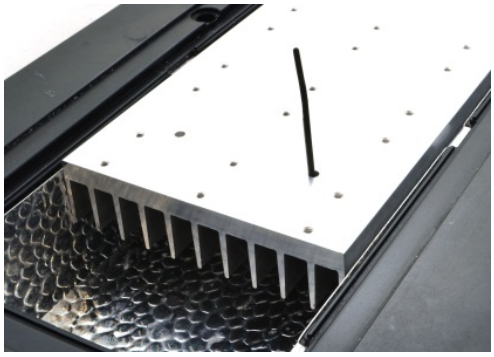


## Mounting Heatsink to Reflector

To mount the heatsink to the reflector (yours should have LEDs on it at this point), gently place it into the reflector as in the photo below. The 4 holes in the heatsink should line up with the 4 holes in the reflector.

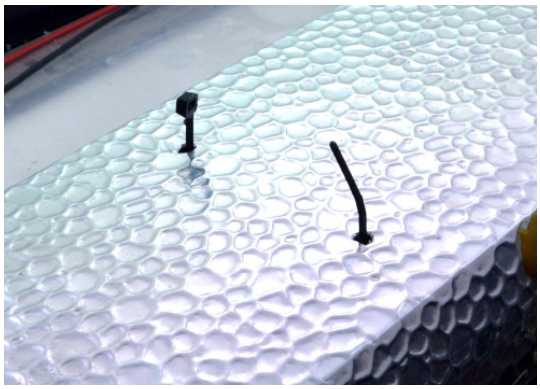
It takes 4 zip ties to attach each end of the heatsink to the reflector.



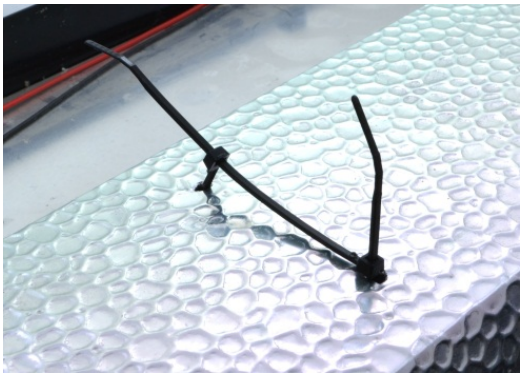
Zip Tie 1: Push it up from the bottom of the hood, through the reflector, through one hole in the heatsink.

Zip Tie 2: Slide over Zip Tie 1 just until it is secure – ONLY a FEW CLICKS! We're not pushing it all the way down at this point yet.

Zip Tie 3: Slide it over Zip Tie 2 just until it is secure – ONLY a FEW CLICKS! After this, slip the end through the other hole in the heatsink and through the reflector. Repeat for the other end of the heatsink.

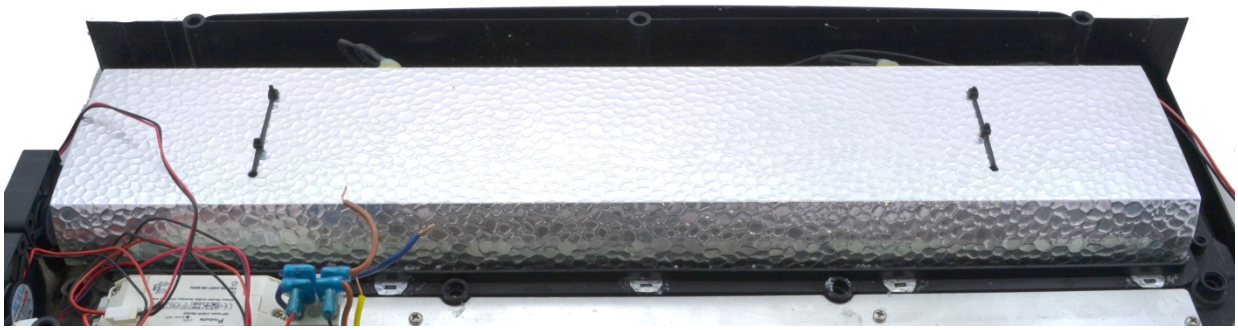


Flip the hood over. You should have two zip ties poking through the reflector holes as in the photo above.



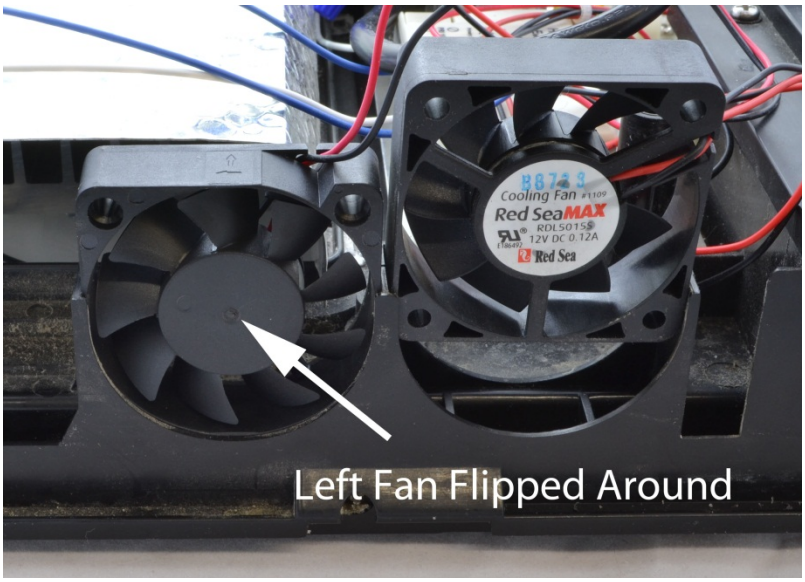
Zip Tie 4: Slide Zip Tie 4 over the other two zip ties poking through the top of the reflector.

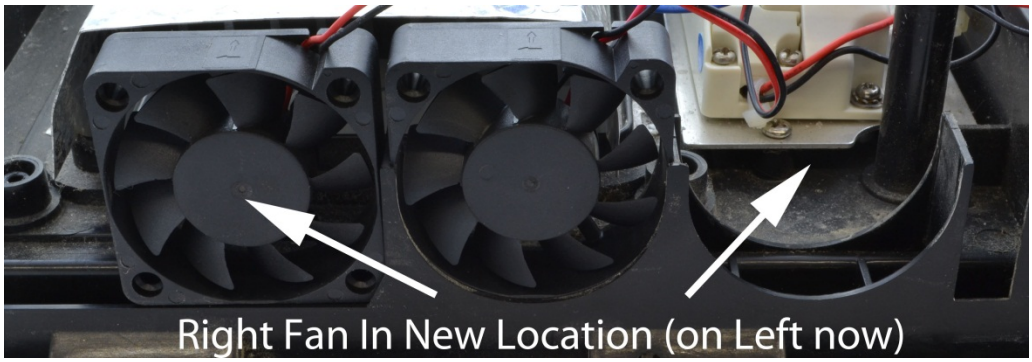
At this point, tighten down all zip ties and trim the ends off with scissors.

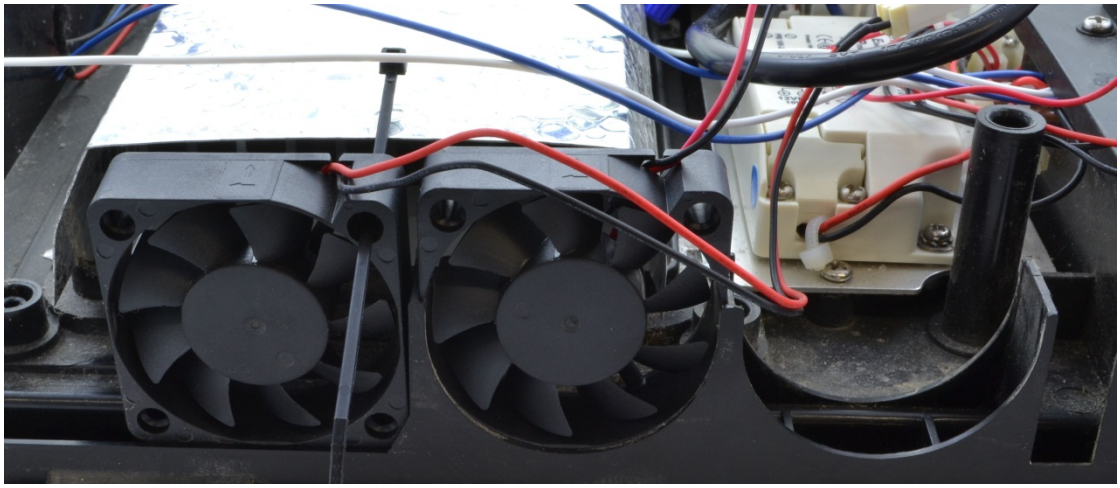


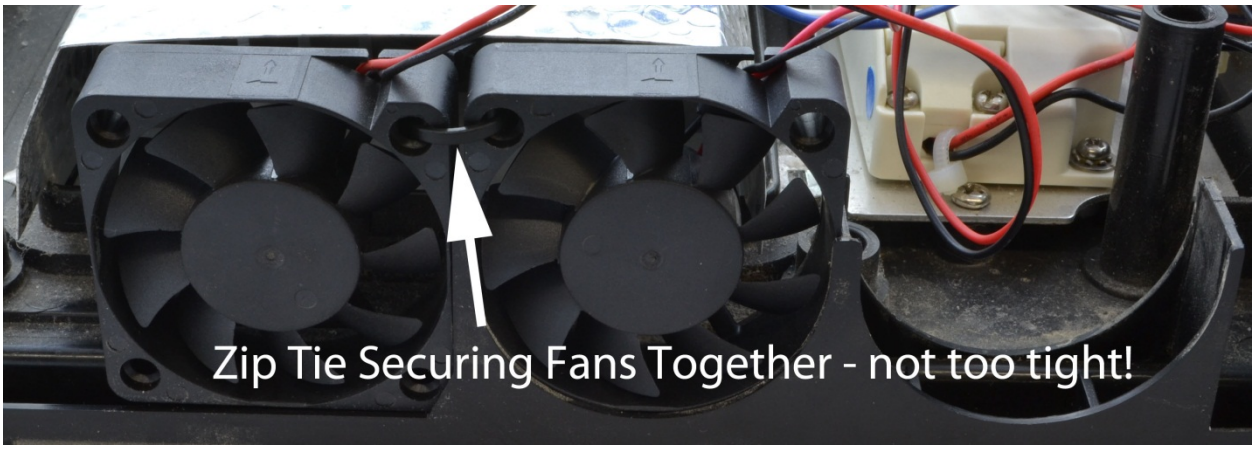
## Reversing the Fan Air Flow Direction

The Red Sea Max has two fans. The original configuration has them blowing out, but we want them blowing inwards so cool outside air flows across our heatsink fins so we will reverse their flow. To do this, gently pull them out of their mounting brackets; they might be a bit stubborn, but they do come out. We'll then flip the one on the left around 180° and put it back in and then attach the right one to it with a zip tie in a new location.


Cooling Fan
Red SeaMAX
RDL5015
12V DC 0.12A
Red Sea
Left Fan Flipped Around


Right Fan In New Location (on Left now)





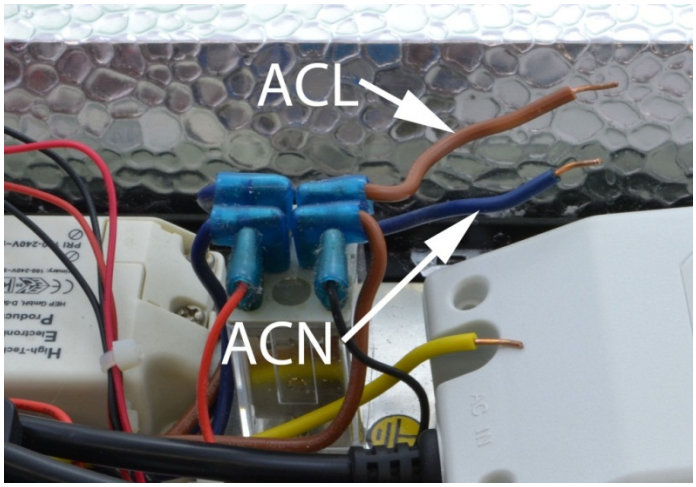

## Wiring the Driver to AC Power

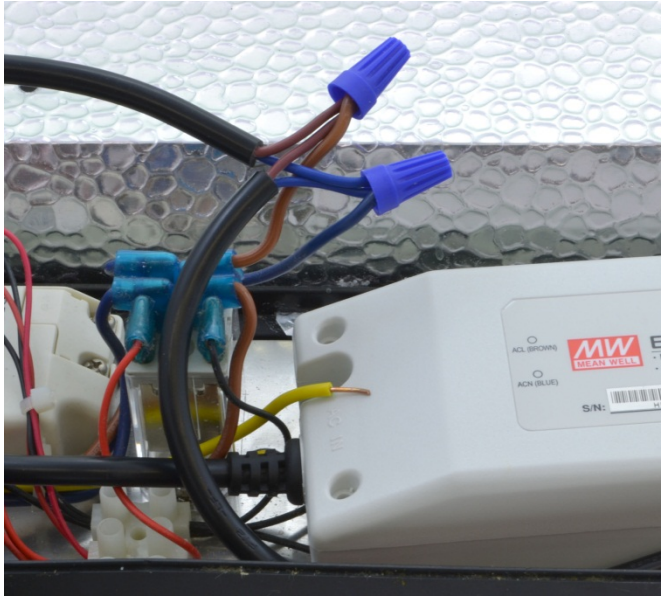
BE CAREFUL WHEN WORKING WITH 120VAC. Ensure nothing is plugged in before proceeding!

The RSM hood has a timer in it that controls a relay for AC power. To preserve functionality of this relay and get the drivers hooked up to AC power, we will wire the drivers to the relay that is controlled by the timer.

The relay inside of the RSM has AC Line (brown) and AC Neutral (blue), or ACL and ACN wires coming off of it as indicated by the photo below. These wires were attached to the original power compact ballast. Securely attach the ACL and ACN wires from both drivers to the ACL and ACN wires from the relay with wire nuts (match up the colors).

As a note, the ACL and ACN input wires for the drivers come out of the LEFT side of the driver and are also brown and blue.

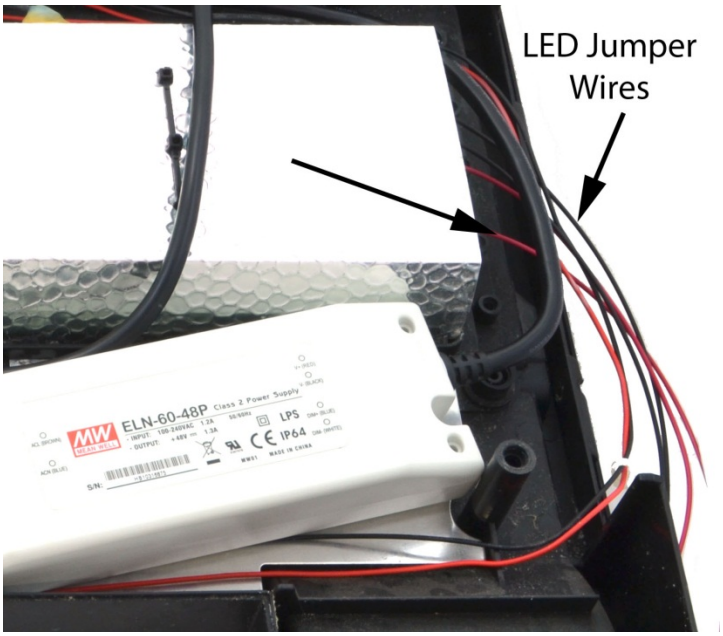


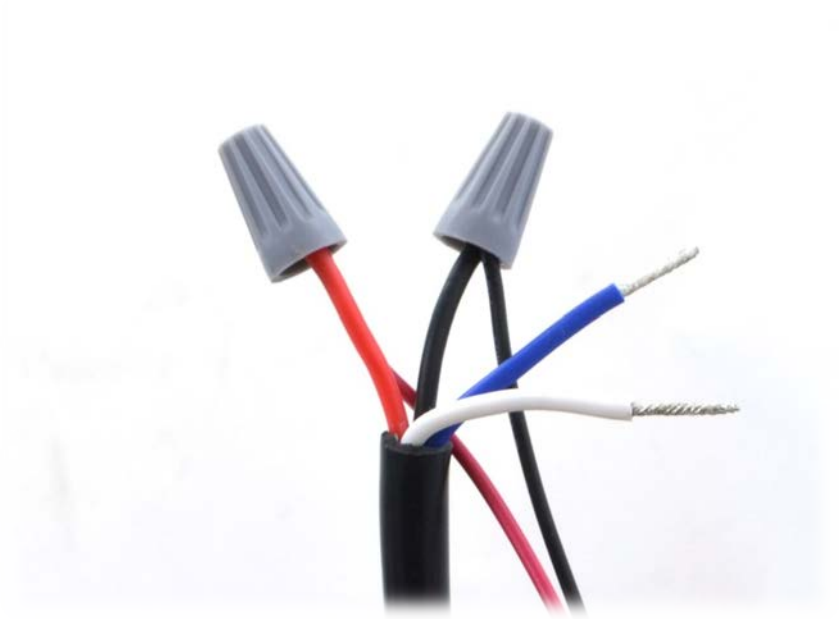



ACL and ACN wires from the drivers securely attached to the ACL and ACN wires from the relay with wire nuts.

## Wiring LEDs to Drivers

You should have previously soldered some jumper wires to the LED strings. Route them so they come out of the side of the reflector and use wire nuts to securely fasten them to V+ and V- of a driver. Each separate LED string should be connected to a separate driver. That driver should be adjusted current-wise for the particular color they are powering.



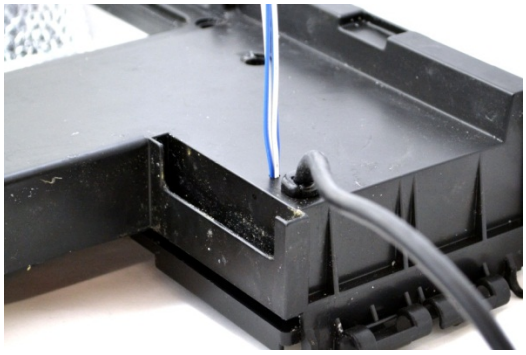


Jumper wires from LED string securely fastened to V+ and V- of a driver

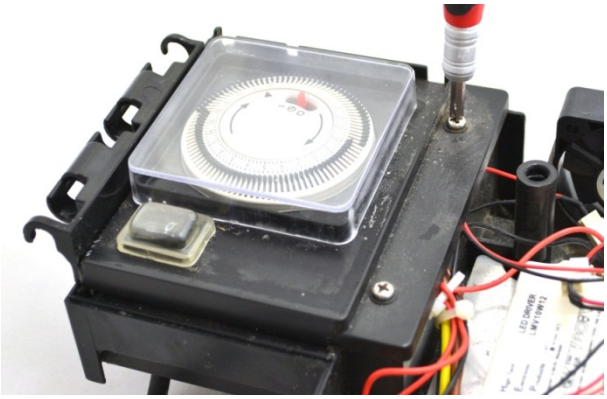
## Routing Dimming Wires (Skip to "Finishing Up" for Constant Current Drivers)

If you have dimmable drivers, you will need to route some wire from DIM+ and DIM- on the drivers to your lighting controller. Here is how we did it.

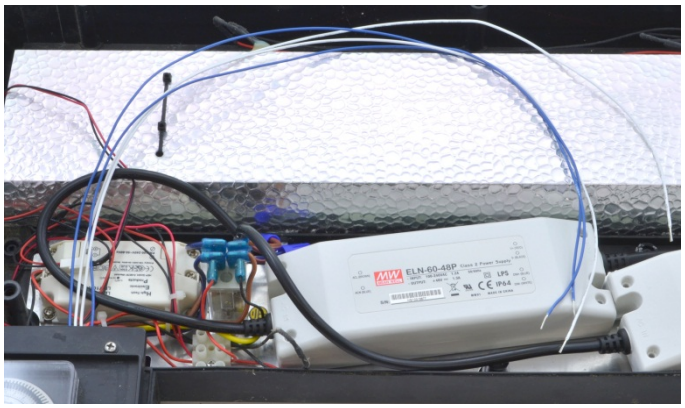
Step 1: Drill a hole near the original power cord. This will lead into the compartment under the timer.



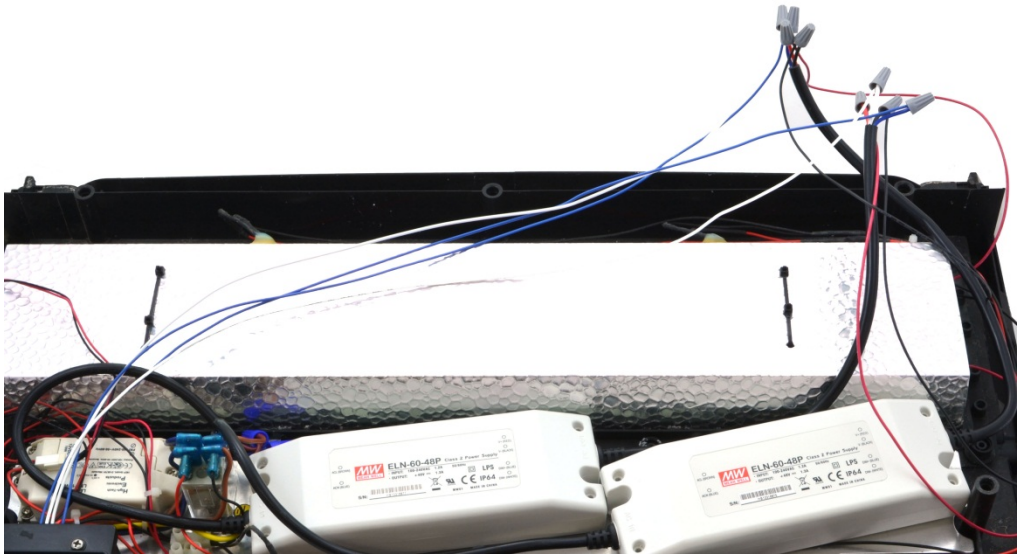
Step 2: Route some wire through the hole you drilled



Step 3: Unscrew the timer and lift it up (make sure no connections come loose, if they do re-attach them). Pull the wire through and re-attach the timer. There is a gap where the dimmer wires can exit the timer compartment.



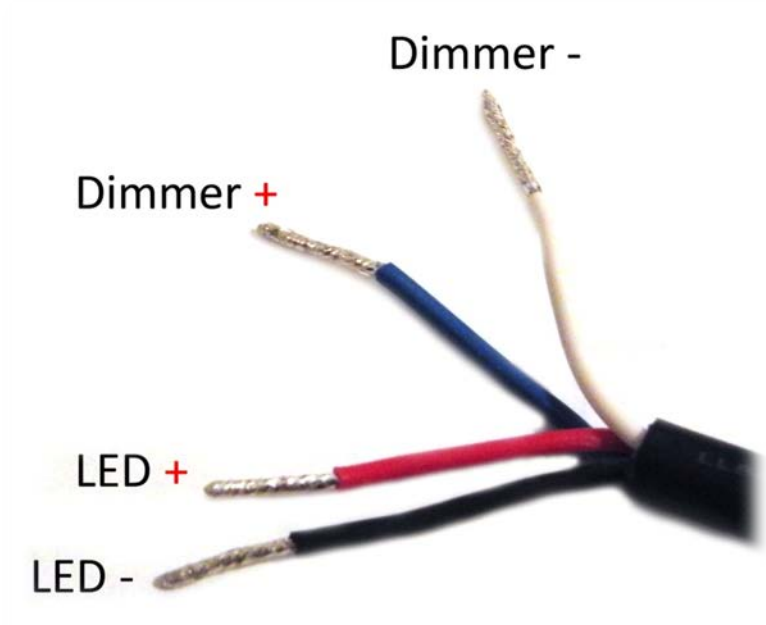
Dimmer wires fully routed



Dimmer wires attached to the drivers.  Make sure you remember which wires go to which driver!

# Using a Dimmable Driver

## Wiring the Driver Dimmer Wires

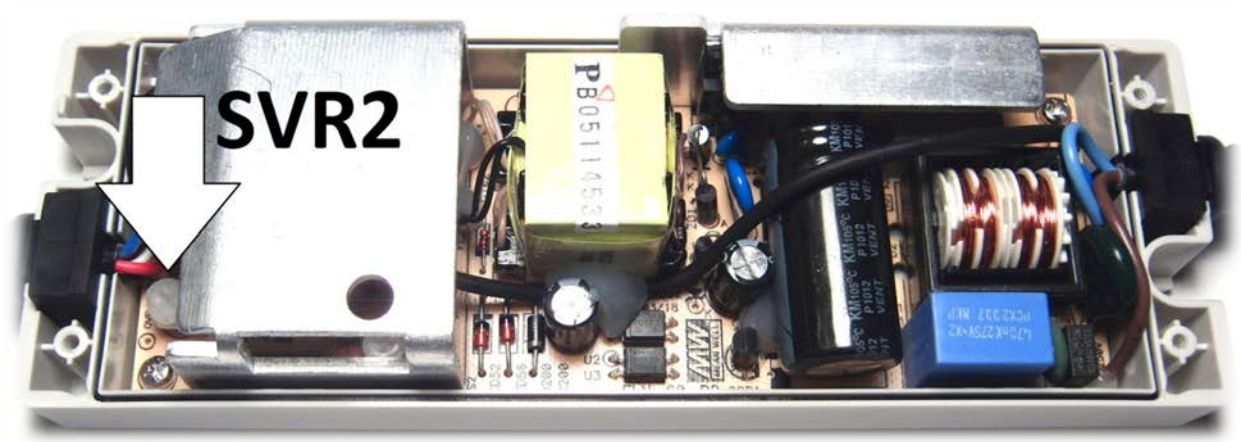



There are 4 output wires on a dimmable driver as in the above photo.  The dimming wires, DIM + (blue), and DIM – (white), simply hook up to the respective ports on your controller or dimmer. Dimmable drivers must have the dimmer wires hooked up to a controller or dimmer or the LEDs will not light up.  No dimming signal = 0% brightness.

If you do not have a dimming circuit or controller, you can test by applying a voltage to the Dimmer + and Dimmer – wires on the driver. This voltage can range from 1-10V. Do NOT exceed 10V or you risk damaging the dimming circuitry. A 1V reference voltage will light the LEDs to 10% brightness, whereas a 10V reference voltage will light the LEDs to 100% brightness. You likely have something around your house that can supply a reference voltage. A "wall wart," 9V battery, or even a AA battery can be used for testing. Be sure to test the actual output voltage of your wall wart with a multimeter before use – unregulated wall warts will output much greater than the output voltage on the label when used with small loads.

## Adjusting Driver Current – Do this before applying power to non XP-G LEDs

To adjust the driver output current, open the driver by removing the 4 screws and very gently rotate SVR2 counter-clockwise until it stops. Counter-clockwise rotation lowers output current and clockwise rotation raises output current. We have just set current to the minimum. The maximum output current of the ELN-60-48 D and P model drivers is 1.3A. **1.3A is the factory default setting and can burn out LEDs that cannot accept this much current (XR-E, XP-E, Osram, moonlight).**




## Adjusting Driver Current with a Multimeter

To adjust the driver output to a specific value, you must first wire a multimeter into your LED string and second, you must ensure the DIM+ and DIM- wires are connected to a dimmer. The dimmer should be set to full brightness.

The multimeter should be wired into your LED string exactly the same as an LED, + to -, in fact, if you just pretend it is an LED, you will have no problem measuring current. If you wire the multimeter in backwards, it will still work, but your measurements will be negative instead of positive.

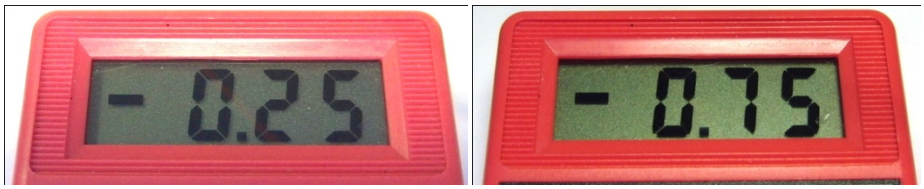
To set your multimeter up for measuring current, move the RED probe plug to the 10A socket and rotate the knob to the 10A position. Multimeters can differ in operation. Please consult your multimeter manual for model specific operating instructions.

As in the photo below on the right, have a friend firmly hold the probes in a gap in the LED string. We had to remove a wire in an existing setup for this example. If either probe loses contact with a solder pad on either LED, do NOT re-touch it to the LED until power has been removed from the driver for a few minutes, and then start over from the beginning.


The following should be complete before applying power to the driver:

- SVR2 has been gently rotated counter-clockwise until it stops (set to minimum current)
- DIM+ and DIM- wires on driver are connected to a dimmer
- Dimmer is set to 100% brightness (10VDC MAX)
- Multimeter is turned on and set up to measure current
- Multimeter is wired into LED string as if it were an LED

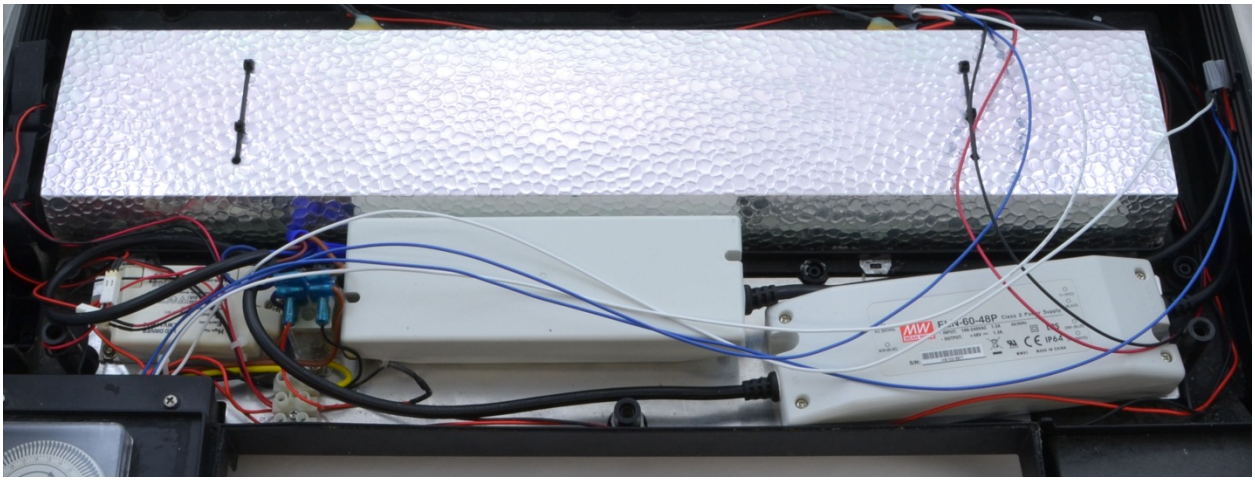
Once all of the above have been completed, power the driver and rotate SVR2 clockwise until the readout on the multimeter displays the desired output current for 100% brightness. In the below photos, the current begins at .25A, or 250mA. SVR2 was rotated clockwise until the desired maximum current, .75A, or 750mA. In our example, we wired our probes backwards, thus the – sign. When measuring current, you can ignore the – sign because we are only interested in the absolute amount of current flowing through the LED string. Switching the multimeter leads around would have would have flipped the sign around to +(no sign) in this example.




Now that you have set the current on your driver by rotating SVR2, un-plug the driver, replace the cover, and re-wire your LED string.

## Reassembling the Hood

After all of your wiring is complete, you'll need to arrange the drivers so they fit in the hood. If you don't it won't close properly.



Dimmable drivers arranged so hood will close – constant current are smaller and easier to fit in.

- For dimmable drivers, the left one must be turned upside down.
- For all types of drivers, no thick wires can run across the top of the reflector. They'll be too thick for the hood to close.

Next, put the sides of the hood back in and re-attach the two halves with the 6 screws removed during disassembly. We found that putting the two halves together and then putting the screws in from the bottom with the hood partially hanging over the edge of a table was easier than flipping it over because everything would fall out – this step is easier with two people.

## Finish