

How to Create a Mountable LED Sign



OBJECTIVE: Engrave piece of acrylic and mount it on a piece of wood.

MATERIALS:

Materials are subject to the user's preference so if you prefer using a different plastic or a different styled mount please feel free to utilize your own ideas!

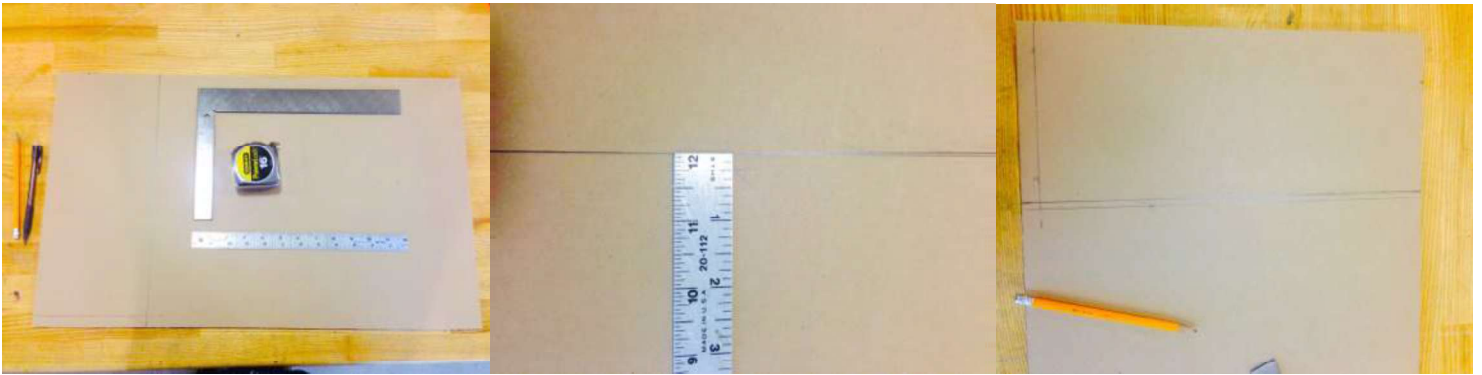
- 1/4" Acrylic Sheet
- 1/2" sanded plywood
- Rated 12V, 1A RGB strips (choose based on preference)
- Gold and Blue Spray paint
- XTC-3D **3D prints not discussed in this tutorial**
- Rulers
- Writing Utensil
- red and black 28AWG wire
- 1 roll of PLA (filament for the 3D printer) **3D prints not discussed in this tutorial**
- Power Adapter (Must match with LED rating (12V, 1A)
- Barrel Power Connectors

TOOLS:

If you are unsure as to how to use a specific tool, please ask a lab advisor or see the machining videos posted on the website.

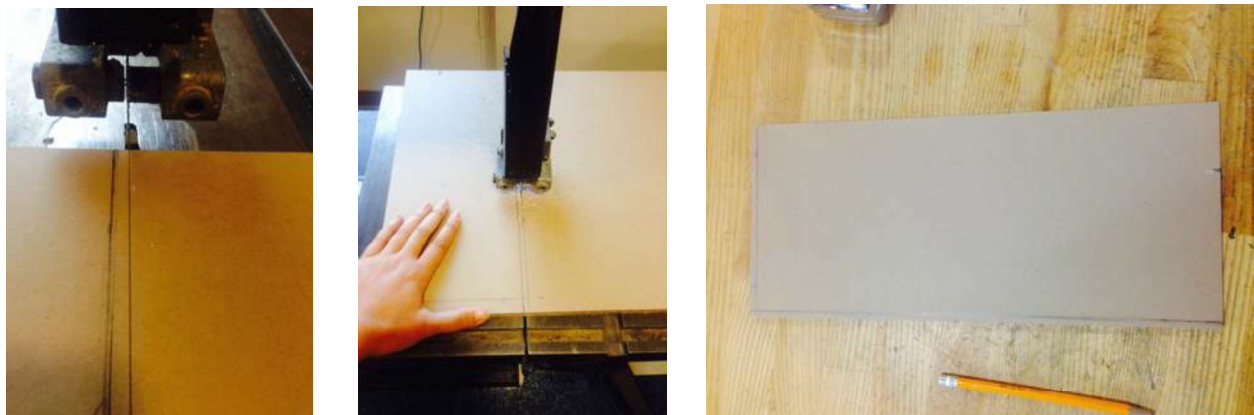
- NC Mill (assorted flat end mills and ball end mills)
- 3D Printer (Makerware Software) **3D prints not discussed in this tutorial**
- Band Saw
- Soldering Iron (Use vent when soldering)
- Wood Finish
- Sanding Paper
- Rulers

1. LAYING OUT THE ACRYLIC



- Choose a 1/4" piece of acrylic from the stock pile and lay out the dimensions accordingly. **DO NOT PEEL THE PAPER OFF THE ACRYLIC.**
- If the piece is longer than that of the ruler, use this technique to draw out a perfectly straight line:
 - Measure out the width of your acrylic (I used 6") and mark the measurement on either side of the acrylic piece.
 - Using either a framing square (L shaped ruler) or a regular ruler, line up your marks and draw a straight-line.
 - Use check marks for each marked measurements.
- After laying out how long you want the acrylic to be (I used 6" x 14"), draw another line about a 1/4" away from each original mark.
 - This is the line we will use as a guide on the bandsaw.

2. CUT THE ACRYLIC



- Since the bandsaw rarely ever gives the user a straight cut unless they are a practiced carpenter/machinist, use the second line marked out as a guide.
- Make sure that the bandsaw guard is about 1/4" above the acrylic before cutting (if limitations allow). The less blade is exposed, the safer the user will be. Always set the blade guide just high enough to clear the part you are cutting.

- Acrylic is a material that will melt under high pressure/speed at low temperatures therefore do not move too quickly while cutting otherwise the bandsaw will clog or you will ruin the edge of the acrylic. Due to this type of melting, it is impractical to use a jig saw/circular saw to cut this.
- Apply a steady pressure when easing the acrylic across the blade. Ease up every once in while to give the blade a break.

3. FINISH CUT THE ACRYLIC



- In order to make either side of the acrylic parallel to one another, we will manually mill the edges off along the first line of measurements made.
- Place the aluminum table into the vice grip on the mill and clamp it in place. Make sure that the side you are milling into clears the edge of the table by at least an inch. Also make sure that the straight edges of the acrylic piece is parallel to that of the table's edges so that a straight cut will occur.
- Use a flat end mill that's diameter is larger than that of the radius being cut (the edge of the piece that was cut with the bandsaw to the first line measurement made). Also make sure that this end mill's diameter is at least larger than the acrylic's thickness. I used a 1/2" end mill.
- Line up the end mill to that of your piece using the x, y and z axes.
- Before turning on the spindle, make sure the spindle is about an inch away from the piece you will be milling.
- Turn on the end mill, adjust the speed of the acrylic between 1100-1200 rpms.
- Since you are manually moving the table to do the finishing pass, the feed rate isn't really something that can be determined. Instead move the table slow enough as to not crack the acrylic, but fast enough not to melt the acrylic. This is done through feel while the acrylic is being milled.
- When cutting along the length of the piece, only move the x axis. When cutting along the width of the piece, only move along the y axis.
- Each pass should be no more than -0.05" in depth. Therefore multiple passes must be done in order to mill down the edge. You can keep track of the coordinates by using the Mill's monitor by pressing the button DRO. Use the air hose to clear the debris off of the end mill. **DO NOT MILL THE ENTIRE EDGE OFF IN ONE PASS, THE ACRYLIC WILL SHATTER.**
- The end of the end mill should be below the bottom surface of the acrylic before performing a finishing pass.

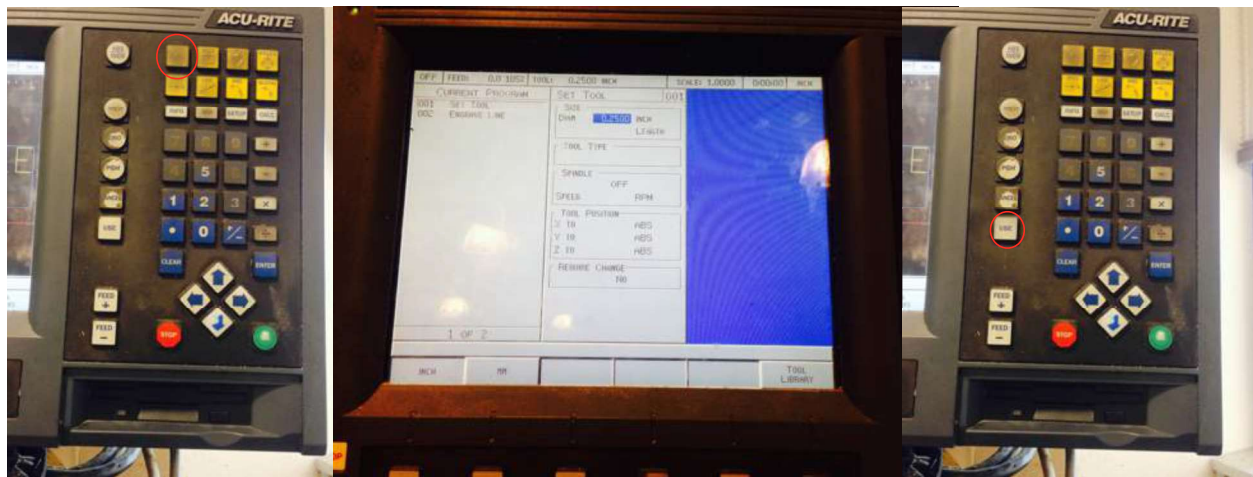
Finished Product! Now peel off one side of the acrylic sheet.



4. ENGRAVING THE ACRYLIC



- First, change the end mill to a 1/4" ball end mill and place the collet in the spindle. Please refer to the mill machining tutorials on the website in case you need help with this process.
- Next clear any existing program by pressing the Clear Program button circled above.



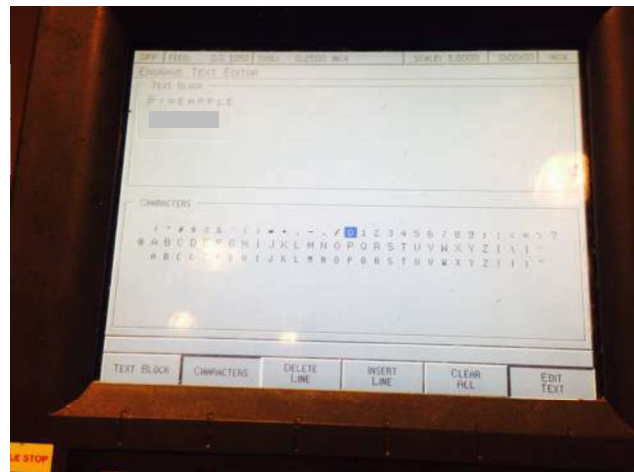
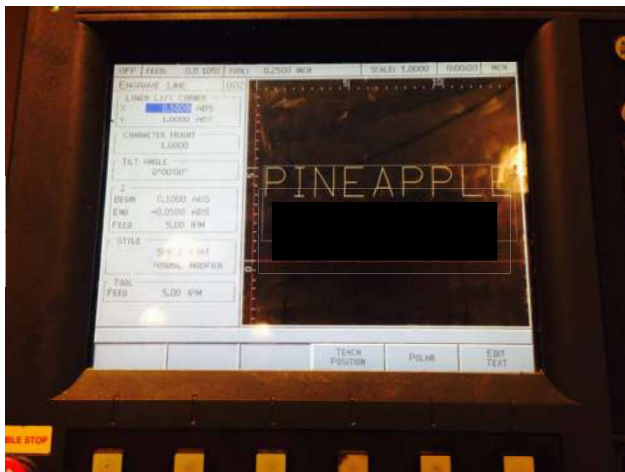
- To begin entering a program start with pressing and TOOL and then inputting your tool diameter (0.25").
- Ignore the rest of the options and then click USE.



- Clamp down your acrylic to the aluminum table similar to that when manually milling. If you are only engraving a small depth into a piece, the support material underneath the acrylic is unnecessary. However, if you plan to mill slots, holes, or other geometries that will go through the whole depth of the piece, a support piece is necessary.
- We find the origin by pressing the button DRO. This will take us to the next screen, which displays the x, y, and z coordinates.
- Choose the leftmost, bottom corner to be the origin of the piece. Zero each axis by placing the end mill against the left side of the acrylic piece. Press DATUM and then press X=0. Next press USE. Since we want the origin to be there center of the end mill, lift the end mill above the piece and move the end mill overtop of the piece the length of the radius of your edge finder. ASK AN ADVISOR IF YOU ARE

INTERESTED IN LEARNING HOW TO USE AN EDGE FINDER. Press DATUM once again and zero the x-axis.

- Choose the side of the acrylic closest to you, bottom edge, and place the end mill against it. Press DATUM and then press Y=0. Next press USE. Since we want the center of the end mill to be the origin, lift the end mill above the piece and move the end mill overtop of the piece the length of the radius of your edge finder. Press DATUM again and zero the y-axis.
- For the Z-axis, place the end mill a hair length above the acrylic. One can do this using the cigarette paper trick. Instead of using cigarette paper, take a piece of computer paper, apply oil to the surface and place it on your piece. Take the end mill and lower it until it is touching the paper. You can tell that it is above the piece if you tug at the paper and it does not entirely come off or if you turn on the spindle and the paper gets caught on the end mill. I do not recommend turning on the spindle when finding the z-axis manually unless you are experienced. The piece of paper is about 0.001" and therefore once the sweet spot has been found we can set the z-axis to -.001" to find Z=0.
- Make sure that you are satisfied with the z retract and once you are done with this process, press the button PGM labeled with the blue circle.

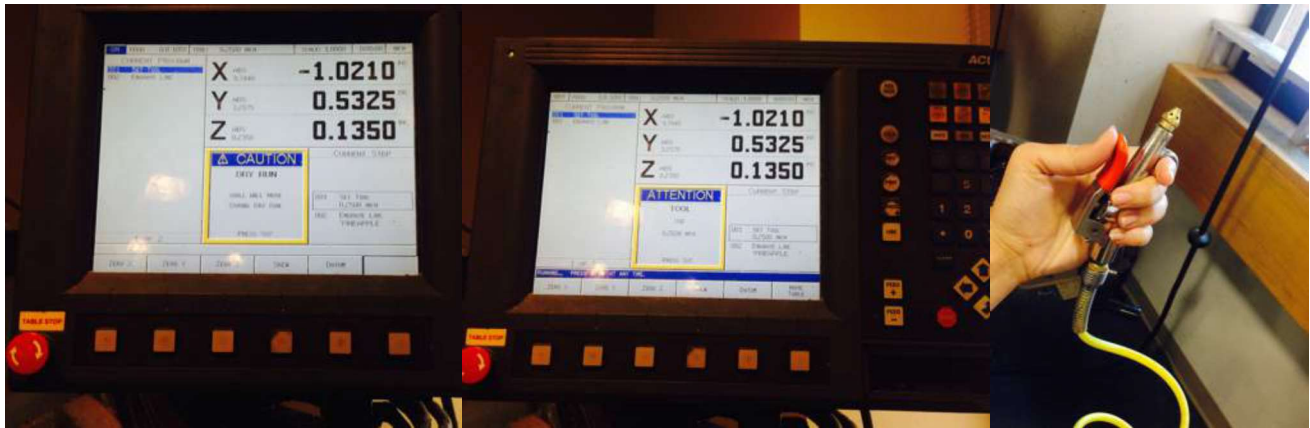


- Once your origin has been established, at the bottom of the screen press MORE OPTIONS until you find ENGRAVE LINE.
- Depending on where you position your clamps and how large your acrylic piece is, place in the necessary compensation needed to move the spindle along the x and y axes to avoid those regions. Due to the way my acrylic was set up, I used 0.5" of compensation along the x-axis and 1" of compensation along the y-axis.
- Before deciding on the character height make sure you know how large your acrylic piece is and the full length of the letters you are engraving. Character width is about 70% of character height. Meaning that the character height I chose would give me letters that were about 1 3/4" in height and about 1 1/4" in width. This changes depending on the types of letter used, letters that are thinner, such as As and Is will only be about 40% of the character height widthwise. Furthermore we must also take into account the spaces between each letter, which is measured to be about 5/16".

- Therefore if 7 of my letters are about 1 1/4" in width, 2 of my letters are 3/4" (40%) and there are 8 spaces each 5/16" apart, the total length of my longest word will be about 12 3/4"- 13". Make sure to compensate a quarter to half an inch.
- Since my acrylic piece is 14" in length, and I estimated my longest word to be 13 inches, it makes sense to have a compensation of 1/2" in the x-axis so that the letters are at least centered lengthwise.
- Since I chose 1.6" in height, there are two lines of words and about 1/2" of space between both of them, the full height would be estimated to about 4". Meaning that 1" of compensation from the upper right corner will center my phrase widthwise since my acrylic is 6" widthwise.
- Of course you should play with the option and do a few dry runs (we'll get to this) in order to fully estimate the length and width of your characters. This comes down to practice.
- Once you have chosen a height or even before you have chosen a height, enter your text by pressing EDIT TEXT. This will take you to the screen in the left picture. Choose your characters. If you need to edit a character press TEXT BLOCK to edit and then press CHARACTERS to return the keyboard. Once finished press USE. Remember to always press USE when you are finished with a program and setting an origin.
- Next, choose your begin height for the z-axis which should be zero. Your end height will be the depth the end mill plunges. Therefore I chose -0.05. DO NOT FORGET TO INPUT THIS VALUE AS A NEGATIVE.
- Since this is acrylic, change the feed rate to 5 imp (inches per minute) for both the z-axis and the tool. The feed rate value will usually be lower for metals and higher for wood and plastics. Ask an advisor for assistance if you are still unsure.
- Press USE when satisfied.



- After pressing USE, it will take you to the home screen where the programs have been set. Place the blue cursor on SET TOOL so that the machine knows where to start the commands from.
- Press RUN OPTIONS and press DRY RUN. You could also do DRY RUN and GRAPHICS ONLY, but I find using DRY RUN more helpful than GRAPHICS ONLY.
- YOU NEED TO HAVE DRY RUN SELECTED WHEN TESTING YOUR MACHINING OPERATION OTHERWISE THE TABLE WILL MOVE!!
- Now press GO.

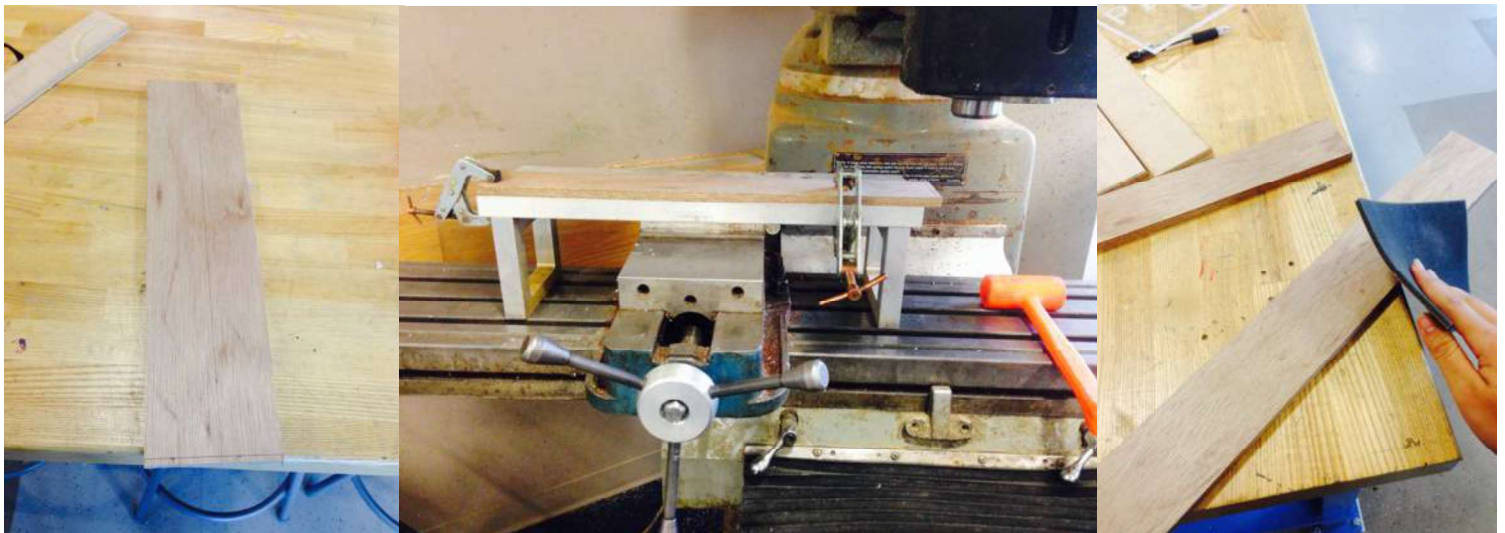


- You will see the Caution Dry Run first, press GO again and you will see the next Caution sign. Remember to keep your hand on STOP and then press GO a third time. Make sure that the Dry Run coincides with the product you desire.
- Press Run Options, press DRY RUN in order take the program off of DRY RUN and then press Go.
- Remember to use the air hose to keep the end mill free of debris.

Finished Product! Now you can peel off the paper on the back of the acrylic.



5. MILLING THE MOUNT



- When you are done laying out the measurements for your mount (I used the measurements $22\frac{3}{4} \times 2\frac{5}{8} \times \frac{3}{8}$ "), load the piece onto the mill and manually mill off the edges similar to that of the acrylic sign. We want to create straight, parallel sides. Set your spindle to about 1400 rpms and move the table slow enough to where it doesn't burn the wood; similar to that of acrylic.
- Once your part has been milled, sand the edges down for safety reasons. Use regular grit sand paper and then use fine grit sand paper for a clean finish.
- After the edges have been rounded, blow off all the debris using an air hose found in the lab.

6. MILLING THE SLOT



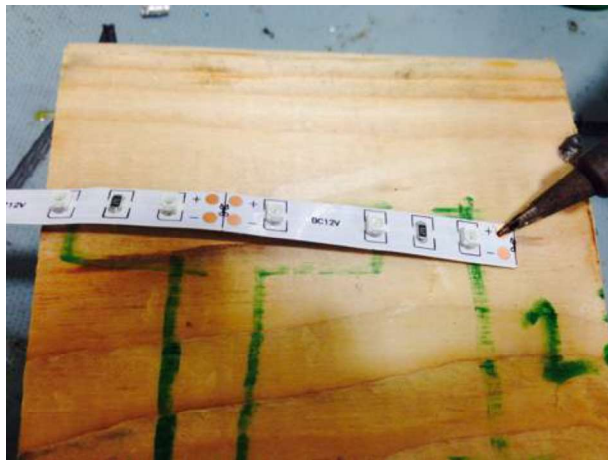
- After laying out the slot needed to hold the LED sign upright, use a $\frac{3}{8}$ " ball end mill (since the acrylic is a $\frac{1}{4}$ "") so that the sign has enough wiggle room to rest at a slight angle.
- Measure the surface of the z-axis and zero it out in the Datum. Slowly progress to -0.25" or -0.30" below the surface. Since we are using a ball end mill we can cut into the surface we are milling rather than starting a cut outside of the surface.
- Since wood is soft enough to prevent the risk of breaking the end mill, larger passing depths can be obtained. We can then use -0.1" as a depth interval for each pass.
- At one of the ends create an incision perpendicular to that of your slot. This will be the canal in which we feed the wires from the LED strip to the power supply through.
- If you are creating pockets to hold your 3D objects on either side please refer to the Pocket Tutorial to get a better understanding of using the NC mill.

7. FINISHING THE MOUNT

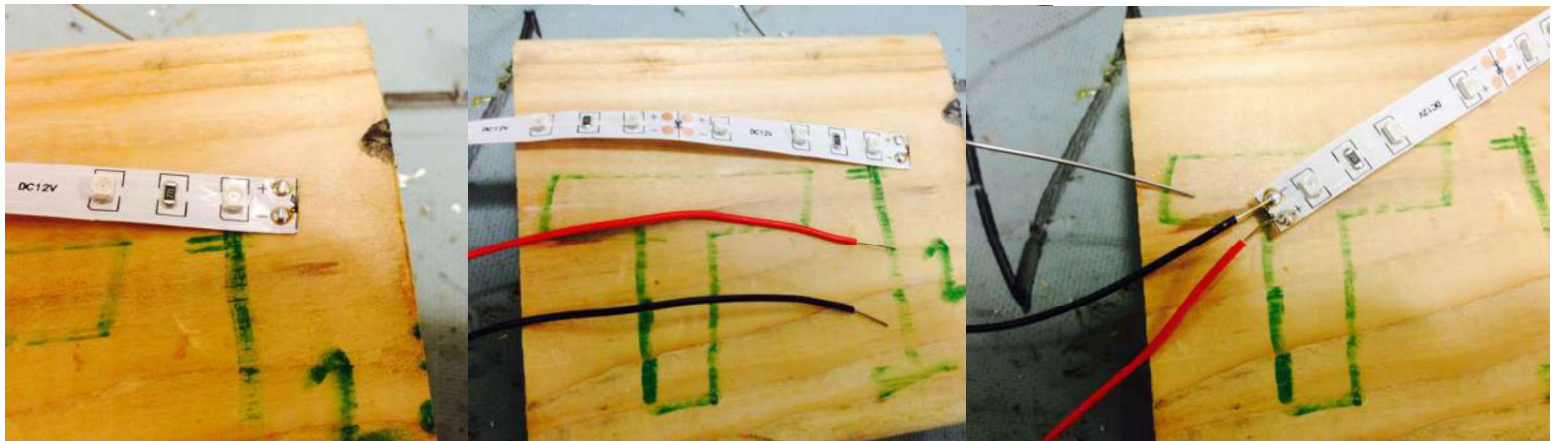


- When finishing a piece of wood, make sure to sand the entire piece down along the grain so that the finish will better catch the grains of the wood. Also make sure to sand within the pockets/slots.
- Once you have finished sanding and dusting away the debris, apply a coat of finish onto the mount.
- Remember to read the instructions before using the finish! Use a rag for even application of the finish onto the mount. Allow the finish to set for 15 minutes and then wipe it off using a clean rag. Continue to repeat this process on all sides of the mount and within the pockets/slots until you are satisfied with the color. A darker finish is achieved after applying several coats to the mount. Place the same amount of pressure and finish along the surface of the piece to allow for an even coat.
- Allow this to dry for at least 24 minutes.

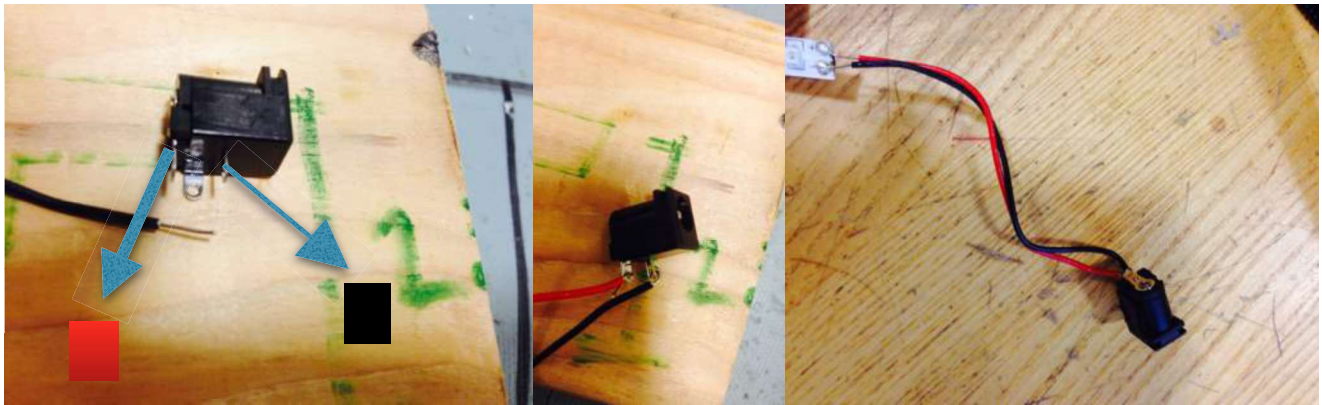
8. Soldering the RGBs to the Power Barrel Connector



- Begin by cutting a strip of RGBs to the desired length (must be shorter than the length of the slot).
- After turning the soldering iron on, apply a small amount of solder to the tip of the soldering iron. This will allow the solder to melt quicker when applying it to various parts of the circuit.
- Place the edge of the solder onto the positive terminal and press the soldering iron above it. Try to keep the solder in the copper terminals.
- Once the positive terminal cools, repeat this process for the negative side.



- Once both terminals have been soldered (make sure the solder from both terminals do not touch each other or else the RGBs will short circuit!!!!), apply solder onto the edge of the soldering iron and transfer it to the tip of each wire used for the circuit.
- After align the black wire with the negative terminal and sandwich the wire beneath the soldering iron (make sure the tip of the iron has been coated with solder).
- Heat up the solder until it melt enough over and around the end of the wire. Allow it to cool.
- Do this to both sides until you are satisfied with the end result.



- Now connect the barrel connector to the other end of the wires using a similar process used above. After coating the soldering iron tip and the tip of the wire with solder, we can easily curve the wire around the barrel connector's terminals for a clean attachment.
- The barrel connector's terminals are labeled in the picture, red is positive, black is negative.
- The middle pin between both the positive and the negative terminals is electrical insulated and is typically used to create a better attachment when soldering to circuit boards.
- Once wrapped, heat each pin and apply a small amount of solder. Again, make sure that the solder does not touch!
- Once you are finished, turn off the solder and allow the barrel connector to cool.

9. CONNECTING THE RGBS TO THE MOUNT



- Once done with the soldering, peel the paper off from the back of the RGBs and stick the adhesive side to center of the mount.

- Afterwards, loop the wires through the L slot until the barrel connector is hanging off of the side of the mount.

10. ADDING MORE AESTHETICS

- If you are interested in creating more aesthetic appeal for your sign, spray paint the back of the sign with various colors. Make sure to not over do it, we still want a transparent appeal.
- Place the 3D objects on either side of the mount. Apply adhesive material such as epoxy or super glue if you would like to keep them in place.

Now attach this to a 12V, 1A power supply and you are done! Give this to someone you think is awesome or keep it for yourself!