

Detailed Directions To Fabricate The Hobby Traffic Control Light

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Example PCB Layout

PCBfoil.pdf is a view of the foil side of the PCB (not to scale). It can be fabricated using normal PCB procedures. Dimensions are provided so that an accurate duplicate can be made from the image.

ComponentSide.pdf is of the component side of the PCB showing where the parts go. It is not necessary to print this side of the board but it certainly makes installing and troubleshooting components much easier. Notice the jumper wires.

Construction

The traffic light consists of the lamp housing and the base. The base holds the electrical wiring connections to the lamps as well as the 5 VDC power for the PCB and the 120 VAC power for the entire unit. A 1-1/2" PVC schedule 40 pipe is used to support the lamp housing as well as serve as a conduit for the AC wiring to the lamps. The pipe protrudes through the 3 levels (Red, Amber and Green) and into the top deck. All the decks are made from 23/32" plywood. Each deck is segmented into four (4) pieces with a lamp located on the deck along the long side of the triangle. Figure 1 shows a top view of a typical deck.

Assembly

After the decks have been fabricated and the dividers made, assembly can proceed. The dividers are made from hardboard or any plastic that will fit the deck saw kerf slots and can be painted. They should be painted a silver or other reflective color.

The top section has a hardwood insert mounted at its center. This will be tapped and a threaded rod inserted and epoxied to hold the top to the unit. Be sure to complete the top deck by drilling a relief hole on the bottom for the PVC pipe.

Figure 2 shows a dimensioned front view of the lamp unit. The top and dividers are also shown in this view. To start assembly, cut a length of 1-1/2" PVC pipe 22-11/16" long. Cement a coupling sleeve to the bottom end. Place another section of 1-1/2" PVC pipe in a vise so that about an inch or so protrudes above the jaws. Place the coupling with the 22-1/2" PVC pipe onto this pipe but do not cement it. Place the first or bottom deck by sliding it down the pipe until it rests on the coupling. Place the dividers into the slots then insert the next deck. The two middle decks must have saw kerfs on both sides. Proceed to assemble all the dividers and decks as well as the top. Mark the PVC pipe at the appropriate locations between each deck where the wires to the lamp will exit the pipe. Also the PVC pipe should now be cut to length so that the bottom deck rests on the coupling and the top rests on the top of the pipe. The prototype pipe was 26" long. Disassemble the unit and drill holes for the lamp wires at the various levels you previously marked so that light from one lamp will not be allowed to enter another chamber.

Mount the lamp sockets on each deck then re-assemble the unit. Hot glue the divider pieces into the slots in the bottom deck. Place the next deck (it has slots on both the bottom and top) over the pipe and insure that the dividers are securely inserted into the underside slots. After all 4 are assembled and square, hot glue the dividers to the pipe as well as the underside of the second deck. Repeat this procedure with the next two decks and the top.

Topdeck.jpg is a photograph of what the unit should look like at this point. Notice that the wires going to the lamps have been installed. Also notice that the wires from each lamp enter holes in the PVC pipe at different levels. Use red and white wire for the bottom lamps, green and white wires for the top deck lamps and yellow (if you can find that color) or black and white for the middle deck lamps (amber). The prototype wiring was done with insulated #14 stranded wire that can be purchased at Home Depot, Lowe's or most hardware or electrical supply stores. Be sure to leave enough wire to reach the interior of the base. You should decide how high the unit will be at this time to insure that enough wire is left to make connections in the base box. In the

prototype, wire was pulled through to the base and trimmed so that about 10 inches of each wire remained at the base for connections.

The next step is to make the corner strips that will be used to hold the hardboard and colored media that will produce the circular “lights”. These strips can be made up from 1/4-inch x 1-inch stock and are dimensioned as shown in Figure 3.

First the 1/4-inch strips are mounted using a small amount of wood glue. You could also use 1/2-inch nails and a finishing nail gun. The corners are built up so that the end result is a 1-inch by 1-inch wide strip with a 1/4-inch slot at each face. The hardboard with the three holes is sandwiched with a similar size acrylic or plastic that is colored so that the bottom holes are red, the center holes are amber and the top holes are green. A cardboard bat can be placed in each slot and the retainer strips and exposed edges painted a flat black. After the paint is dry, the cardboard can be removed. Holes in the hardboard are made using a circle cutter on a drill press. Be sure to clamp the piece securely and use a slow speed. They could also be made on a jig saw if reasonable care is taken to be accurate.

Hardboard Face and Colored Insert

In Figure 3, the dimensions of the hardboard and the colored inserts are shown. The colored insert can be acrylic, glass or even cellophane cemented to the hardboard. If glass or clear acrylic is used, it can be painted with a hobby paint that can be obtained at most craft shops. In the prototype, 0.093 inch thick acrylic slabs were sanded using 120 grit paper (use an orbital sander and sand both sides for good results). This will “frost” both sides of the acrylic to diffuse the light. Colored plastic material, called “gels” or colored filters can be obtained from Northern Sound & Light (www.northernsound.net) (800-796-6232). This material comes in 21-inch by 24-inch sheets and must be cut to at least 5 1/2-inches square. These squares are hot glue tacked to the back of the face board and backed up with the frosted acrylic. This “sandwich” is then inserted into the slots on each face of the lamp unit.

Hoods

Each hole or window in the hardboard has a hood attached. These can be made from thin poster board or thin plastic that can be bent into a 5-inch diameter circle. Figure 5 shows the dimensions of the hood when stretched out.

Making a template for these is advisable since 12 are needed. Once the hoods are cut out, they are bent into a circle (again, using a jig for this will make the job much easier). They are mounted into the holes in the hardboard and hot glued into place.

Once all the hoods have been installed, the hardboard and hoods are painted yellow. Be sure to paint the inside of the hoods as well as the hardboard. The file Face.jpg shows the completed face with the hoods installed and the colored insert that will be sandwiched with the face hardboard and slid into place in the slot previously created at each corner.

Top

Figure 6 is a dimensioned top view and Figure 7 is a section view showing details of the 1/4-inch threaded rod and assembly. The top is made from 1/2-inch plywood. Again, a template was used to layout the cut lines. The long side was cut at 60 degrees using a tenoning jig on the table saw. The 30 degree sides were cut on a band saw but could easily have been cut on the table saw as well. The sections are glued and nailed (again a nail gun is useful here) together to the base. A clearance hole (5/16-inch diameter) for the 1/4-20 threaded rod is drilled in the center of the base. A flat area about 1/4-inch square is filed at the peak of the unit and another 5/16-inch hole is drilled there. The top is painted flat black to match the vertical strips on the face. When finished, the top is installed and secured with a brass finial (again refer to Figure 7).

Base

The base is a box made from 23/32" plywood. Figure 8 shows the location of a 1-1/2" pipe flange mounted to the center of the top of the base box.. Figure 9 shows a dimensioned front view of the base unit. Figure 10 is a dimensioned side or profile view or sectional view of the side of the base unit.

After cutting the parts for the base to the correct size, a rabbit is made around the back of the members to accommodate a 1/8" thick hardboard panel. A 2-1/2" hole is made in the top center for the wires to pass through the pipe flange. Assemble the box with wood glue and nails. Install the pipe flange on the top then paint the unit flat black. A front panel made of 1/8" thick hardboard (1/8" x 6-9/32" x 16") is cut with 30 degree cuts at the top and

bottom to fit the sloped front opening. Layout and drill holes for a fuse holder, a single-pole toggle switch and a 10 megohm potentiometer. The photo Base.jpg shows the completed base unit as well as the front panel.

After the base box and front and back panels are completed, cut a length of 1-1/2" PVC pipe to attach to the flange. The prototype used a 26" length but you can use whatever length you desire so long as you left enough wire from the lamps to reach the base box. Figure 11 shows a profile view of the entire unit.

Final Assembly

Cement a 1-1/2" threaded male to PVC female adapter to the length of PVC pipe. Paint the pipe and adapter flat black then screw the pipe with adapter into the pipe flange. At this time direct the wires from the lamps down through the PVC pipe into the base unit and secure the lamp section to the PVC pipe. In the prototype, a 1/4-20 thumb screw was installed in the coupling at the base of the lamp unit to secure the unit and also allow for some disassembly if necessary.

Wiring and Testing

Mount a duplex outlet box inside at the right of the front panel. Wire an attachment plug to this box with wires coming out to the fuse and single pole switch. Install the switch, fuse holder and potentiometer on the front panel. Wire all the wires coming down from the lamps according to the schematic diagram. All the white (common) wires are tied together. This can be done by using wire nuts to connect groups of three or four wires together with a six inch wire tail to the next group. You should have a single white wire when finished.

In a similar fashion, wire the red-red-green-green from opposite sides together. Since there are four sides, you will have two wires at the end, one north-south and one east-west. All of the amber wires are connected together to one final wire. When completed, you should have four wires that will be connected to the control PCB: red, green, yellow (or black) and white. The image Wiring.jpg shows the wiring on the back of the front panel.

Install the PCB at a convenient location using standoffs. Connect the power supply leads to the 5 VDC input on the PCB – be sure to observe the correct polarity. The power supply is plugged into one of the duplex outlets. Wire

an attachment plug to the 120 VAC input to the PCB. The other end is plugged into one of the duplex outlets. Also connect the red, green, yellow (or black) and white wires to the terminal block along the edge of the PCB. Wire two #22 gauge wires from the PCB to the potentiometer on the front panel.

Double check all wiring and make sure all wires are accounted for. It might be helpful to “red line” the schematic diagram as wires are inserted in order to verify that they are properly installed. After inspection, plug the unit into a 120 VAC source and it should immediately begin to function. It can be turned on and off with the front panel switch and the speed can be controlled by using the potentiometer. The prototype has a maximum time of about 28 seconds for red and green and seven seconds for amber. The maximum total cycle time is 70 seconds. Timing can be changed by substituting a larger value capacitor on the PCB. Do not increase the capacitor value to more than 50 uF.

If there is any unusual electrical behavior, immediately turn the power off and check the circuit wiring. The PCB can be operated without the 120 VAC input to verify that it is counting properly. Simply observe the LED behavior. Figure 12 shows the timing sequence for the control circuit.

That's it - have fun!