

A Switch operated, HO Scale, Single LED Searchlight Target Signal

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This project involves the construction of a simple target searchlight type signal system operated manually by a double pole switch. This same signal and others like it can also be operated automatically using a microcontroller chip and a train occupancy detection system using the same components as described here along with the controller unit. This will be the subject of an upcoming project.

The signal system constructed here is made using a single, two lead, bicolor LED. It can also be made using a three lead bicolor LED with a common cathode or separate RED and GREEN LEDs but the circuit and switching will be slightly different.

The structural components needed to construct the signal shown here include

- 1) 2.5 inches of 5/32 plastic tube (Evergreen^(TM) part #225)
- 2) a small wooden base 1/2"- 5/8" square 1/4"-3/8" deep.
- 3) a Target housing for the LED. This can be purchased online or made using a #10 zinc washer and LED housing mount.
- 4) a small top cap finial for the top of the pole. Here I used a small black screw but prototypical finials can be found.
- 5) a ladder purchased ready made or using Plastruct^(TM) part #90672

The **electrical components** will include

- 1) a bicolor Red/Green two lead 3mm LED.
- 2) 7" of 2 lead black/red stranded wire 28-30 gauge.
- 3) a 1000 ohm resistor to reduce the brightness of the LED.
- 4) a 6 pin DPDT miniature switch. (This can be a slide, toggle or rocker type)
- 5) a 9 Volt battery supply
- 6) a Battery housing with switch and wire leads.
- 7) a 20 mamp LED Driver chip.
- 8) wire connection plugs with dupont connect.
- 9) 4" heat shrink tubing

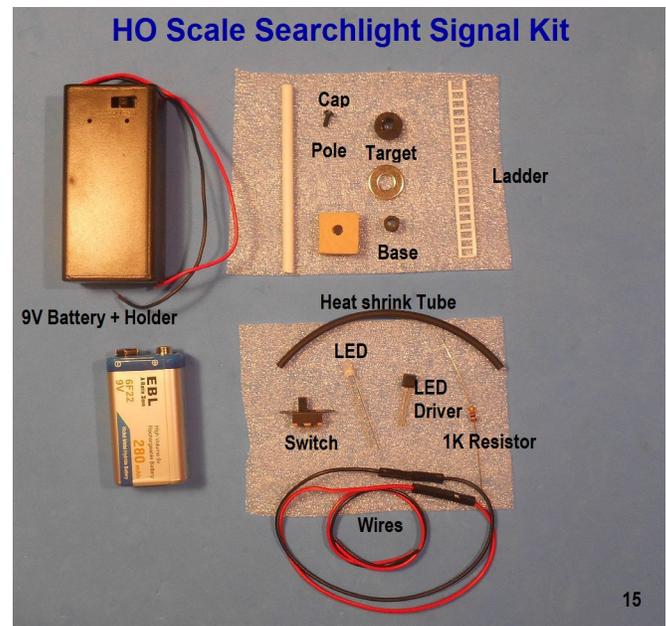
For convenience, these items have been assembled into a kit that can be purchased at the website www.modeltrainsounds.com or on eBay. In this way you can experiment with the construction before committing to buying the components in bulk.

Not included in the kit is the 9 Volt battery.

A rechargeable battery is preferred.

Also extra connection wires are not included.

If the switch is to be placed on a control panel you may wish to buy more 2 wire 28 AWG gauge stranded wire.



The tools needed will include

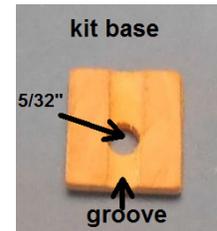
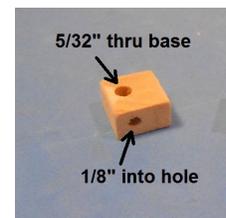
- 1) a cutting blade
- 2) a solder iron, solder, flux and soldering holder (helping hands) and heat sink.
- 3) a small slow speed drill and drill bits up to 5/32" diameter.
- 4) Wire cutter and stripper.
- 5) Small needle nosed pliers and wire Sniper.
- 6) Super Glue (the GEL type is preferred as it is slower drying and easier to manage).



Construction

It is important to proceed in the order described to avoid errors.

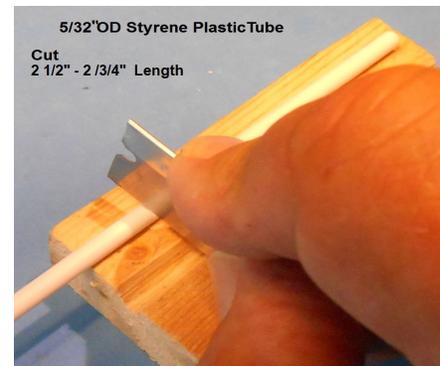
- 1) **Prepare the signal base.** First cut a small block from a 1/2" or 5/8" square strip of soft wood such as balsa. Cut to a depth of 3/8". Drill a hole slightly forward of the center line through the block. Use a pilot drill bit and expand it to a 5/32" diameter. Drill another hole 1/8" through the side perpendicular to the first hole and into it. Clean up the holes with a file and sand the block smooth. Decide which side you want the wires to exit. (generally the left). This will determine into which hole the pole will be inserted. Paint the base with a desired color (grey, black or brown) using quick drying paint such as an acrylic or latex.



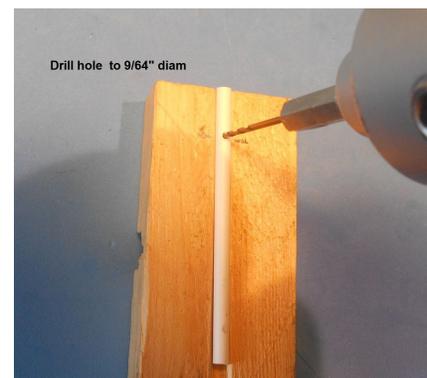
The base provided in the kit is 5/8" x 5/8" x 3/16". The hole is in the center and 2 grooves extend across the base.

2) Assemble the signal

- 1) Cut a piece of 5/32" diameter white plastic styrene tube to length of 2 1/2" - 2 3/4" using a sharp blade. Make sure the cut ends are flat or use a file to set them flat. This pole can also be painted if desired such as grey, silver, black, brown or left white.



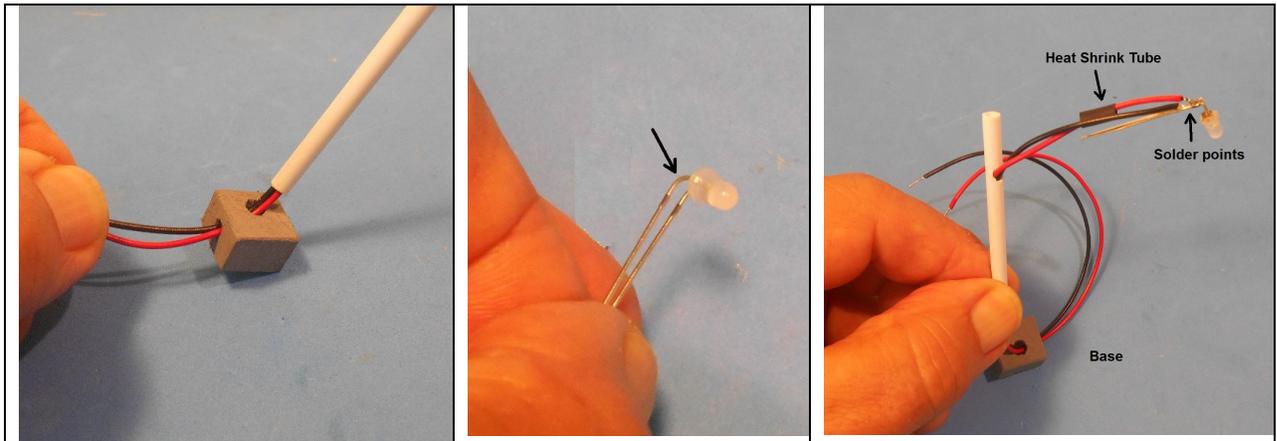
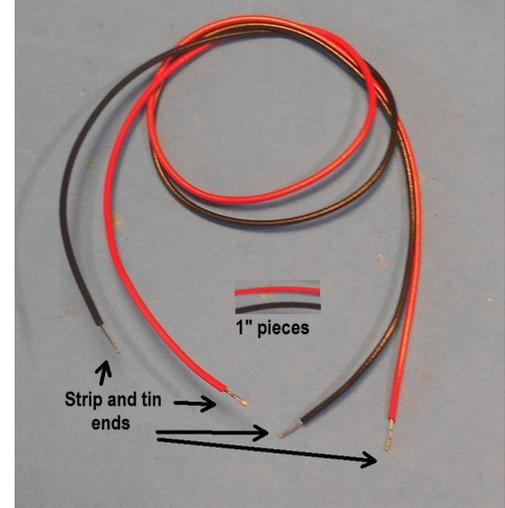
- 2) Drill a pilot hole at approximately 1/2" from one end extending into the tube cavity but NOT through it. Use a slow speed drill to avoid going through the pole. Start with a 1/16th bit and gradually increase the diameter of the hole to 9/64th width. Clean up the hole with a file or blade. A piece of wood with a groove to hold the tube in place while drilling might help secure the tube in place.



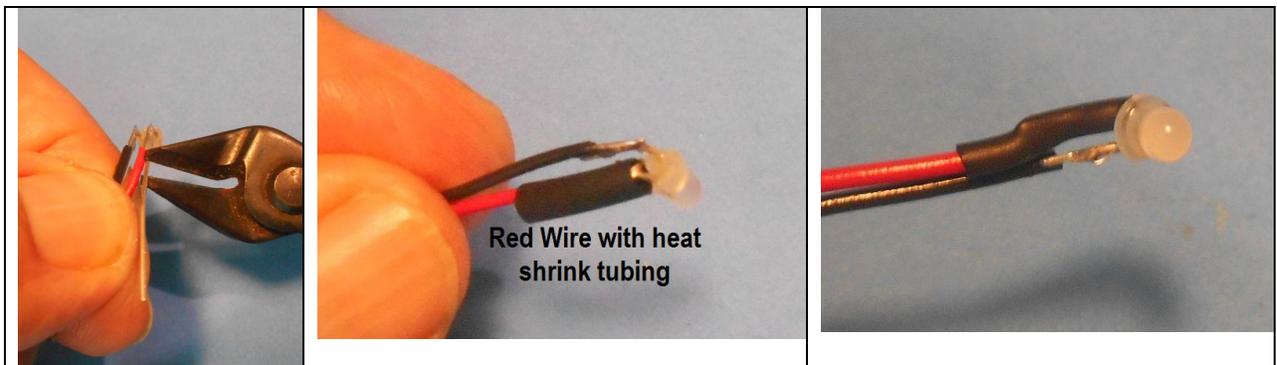
3) Cut off 1 inch of wire from the 2 wires (black and red). This will be used later in preparing the switch circuit. Strip approximately 1/4" of the insulation from both ends of the long black and red wires. Tin the exposed wire ends with solder.

4) Thread the ends of the red and black wires into the drilled hole in the side of the base exiting through the larger hole. Tweezers may assist. Now thread the wires into the tube and exit the wires through the drill hole.

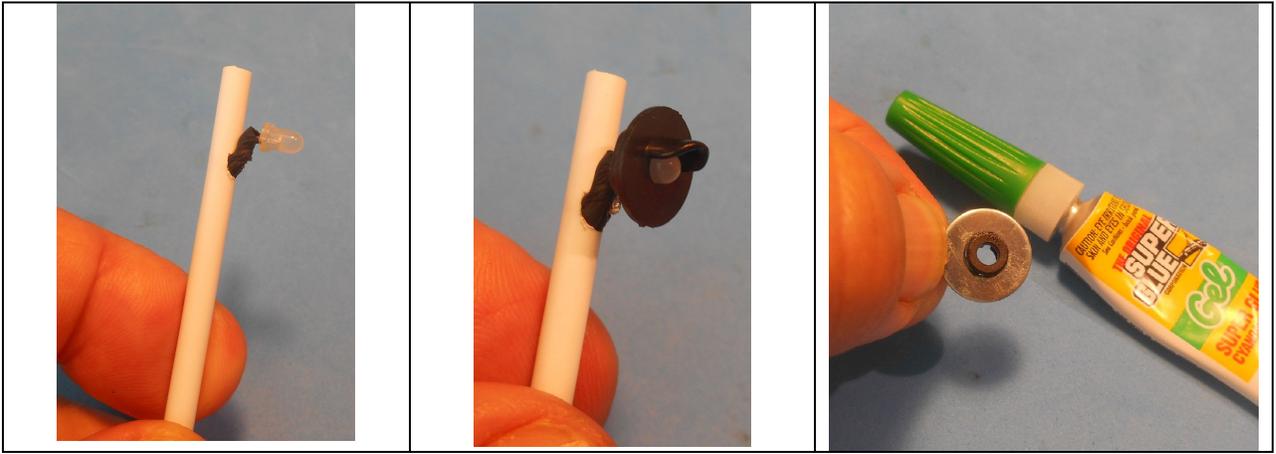
5) Bend over the leads of the LED close to the LED bulb base as shown below. Thread 1/4" of heat shrink tube on to the end of the red wire the solder the red wire to the longer lead at a point just below the bend.



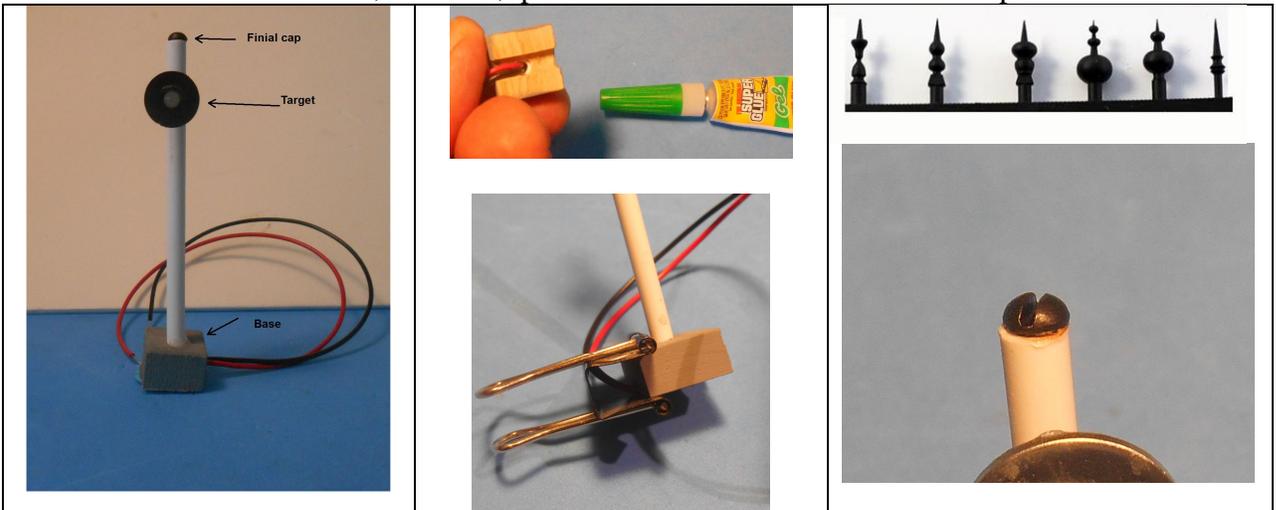
Solder the black to the shorter lead. Snip off the excess leads as close as possible to the solder joint. Extend the heat shrink tube over the red wire solder joint and heat shrink the tube. This will insulate the wire from the exposed black wire joint.



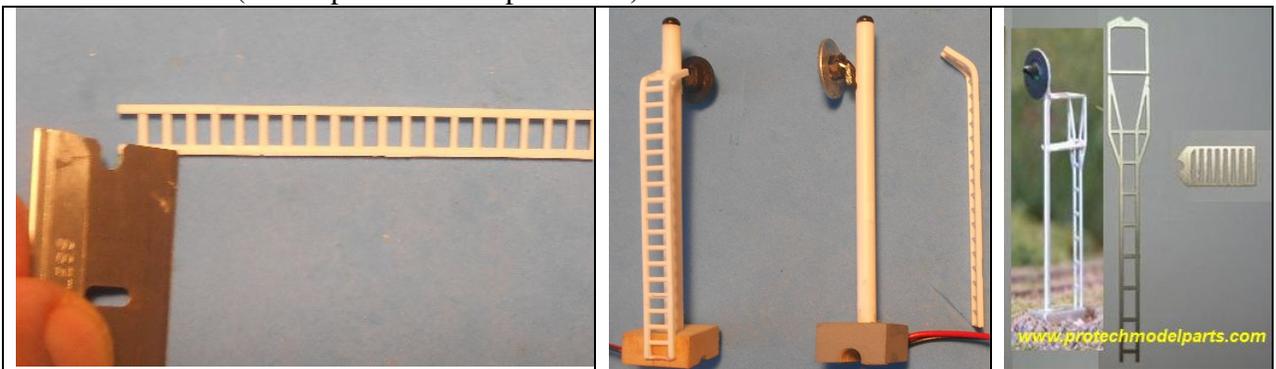
7) Pull and push the wires so that nearly all of the wires and LED leads are in the tube. Attach the black target face over the LED and glue the target to the rim of the LED base with a small amount of Superglue GEL. Avoid getting glue on the bulb. If using the zinc washer with the LED holder glue the holder to the washer first and when dry attach it to the LED. It will clip onto the LED base. Glue from the back to avoid glue on the target face.



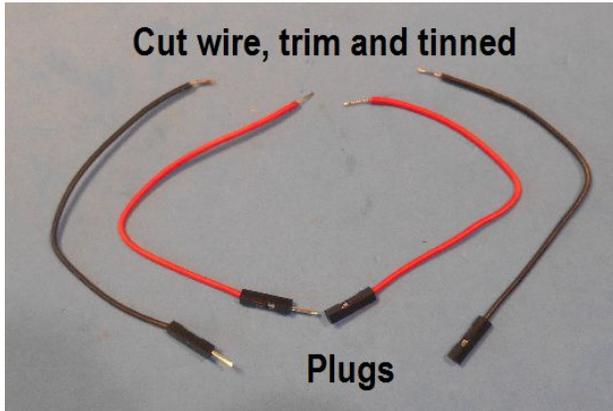
8) Insert the pole into the base and tighten the wires. The pole can be glued into the base making sure that the target is facing forward. 9) Glue the finial (black screw) into the signal pole top. Optional finials may be found on line for a more prototypical appearance or cut from the pointed end of a wooden skewer cut, trimmed, painted black, and inserted into the top.



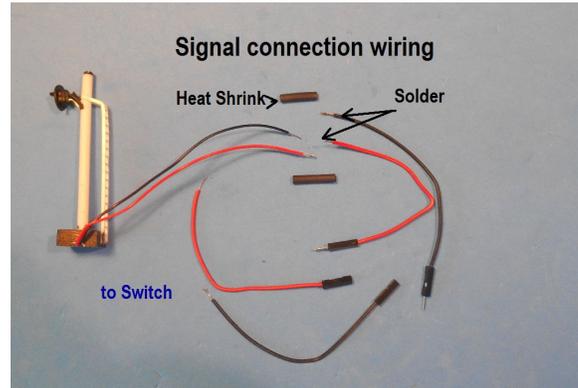
10) Attach the access ladder. This is 2 1/2" in length. Score one end with a blade about 1/4" from the end without the rung. Bend the ladder at this point and superglue to the post pole. Glue the other end to the base as shown. Painting the ladder is an option. More prototypical ladders are available on line. (www.protechmodelparts.com)



11) Two options are used for connecting the signal to the switch and power source. The kit contains red and black wires with Dupont style male/female plug connectors installed at each end. These wires are cut in the middle, trimmed, tinned and soldered to the wires coming from the signal and going to the switch as described in the following steps.

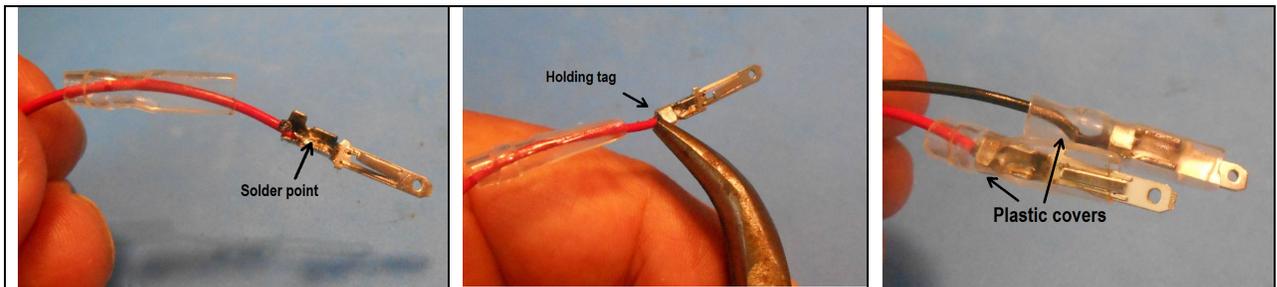


Wires cut, trimmed and tinned



Use heat shrink tube on the solder joints. Connect to wiring that will go to the switch.

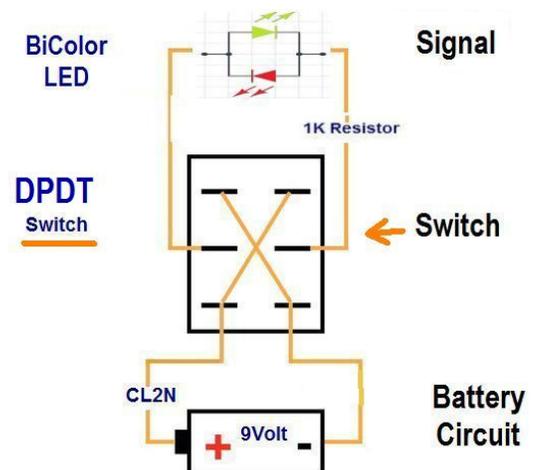
11b) An alternative method is to use small spade connectors as shown here. If the signal wires are to extend through the layout this step should be delayed until the wires are in place. Extend the plastic covers onto the wire ends and then solder the wire ends to the spade connectors. Bend the holding tags over the insulated end of the wires using pliers and then extend the covers back over the connection prongs. A crimper can also be used here..

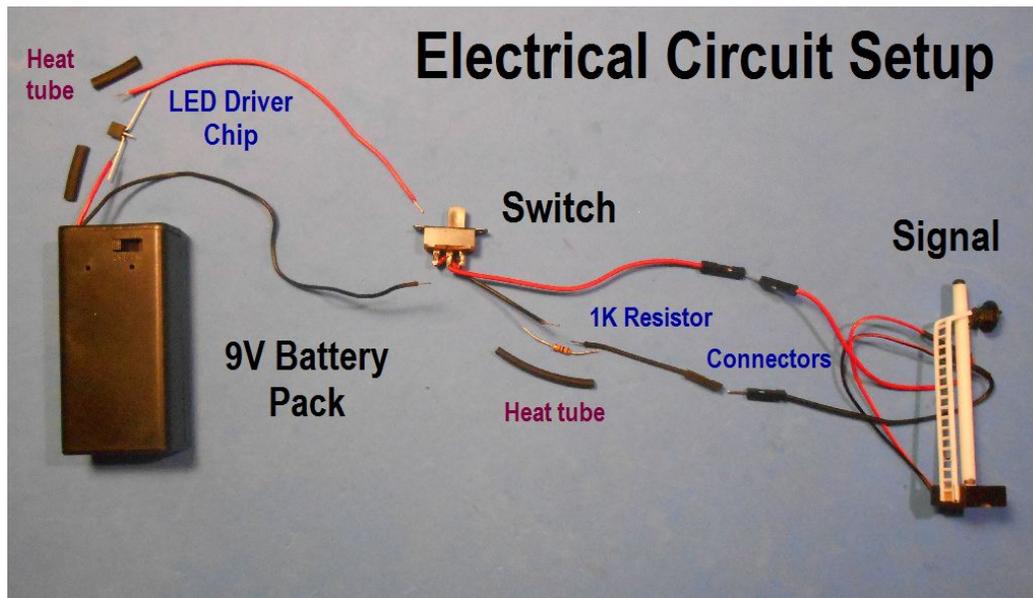


3) The Electrical Circuit setup

The electrical circuit is set up using the 9 Volt battery to power the LED using a switch that allows for current to travel in both directions. This is accomplished by using a Double Pole Double Throw (DPDT) switch with 6 pins. By crossing the connections the current flow direction can be changed when the switch is thrown.

The setup is illustrated below. In this example a slide switch is used but a toggle or rocker switch can also be used. The battery is housed in a holder with a switch to turn power to the circuit ON and OFF when not in use.

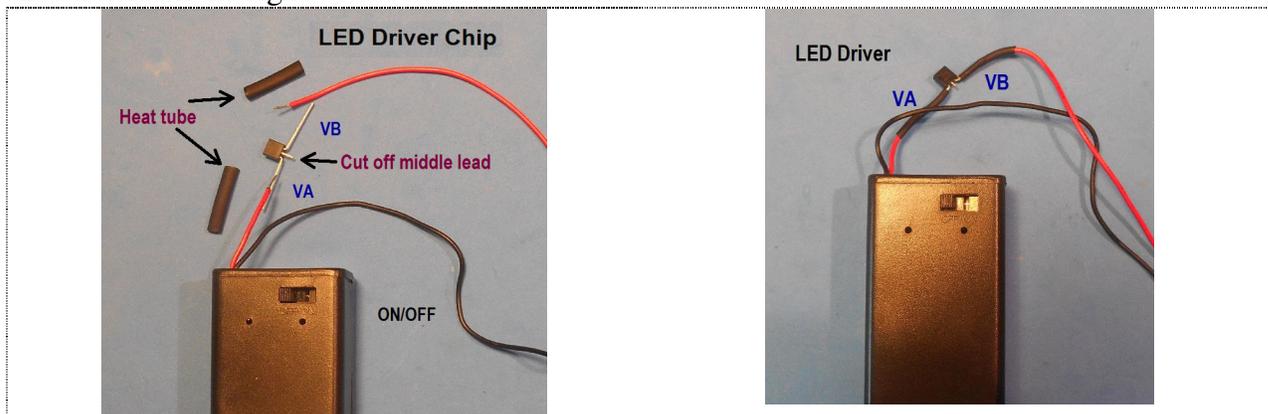




1) Prepare the Battery power supply

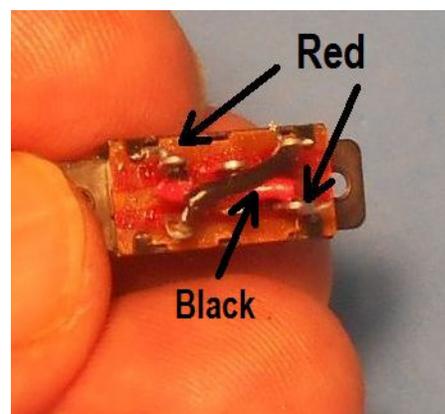
The 9Volt battery holder pack has a red and black wire extending from it. Cut the red about 1" from the battery holder. Strip and tin the wires at the ends of both the attached and unattached sides.

Cut two pieces of heat shrink: 1/2 " to cover the solder joints. Take the LED Driver chip and with the flat side facing you bend out the outer pins and snip off the middle pin. The lead on your left is the VA lead and on the right VB. Place the 1/2" heat shrink tube on the red wire closest to the battery and solder the wire to the VA lead. Solder the VB lead to the free red wire. Cover the joints with heat shrink tube and shrink the tubing over the joints. The finished job is shown here on the right.

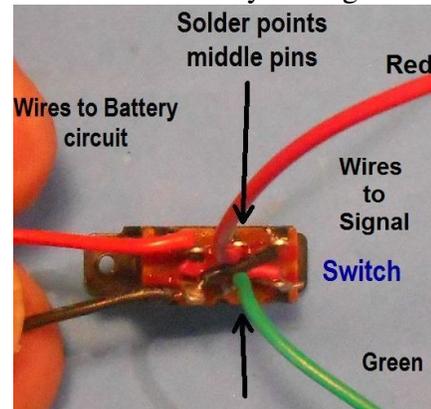
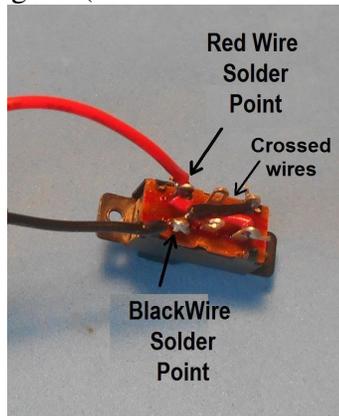


2. Prepare the switch.

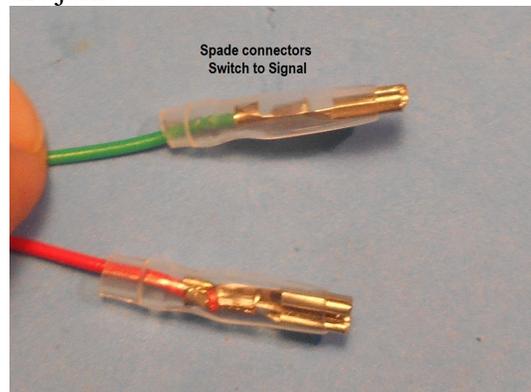
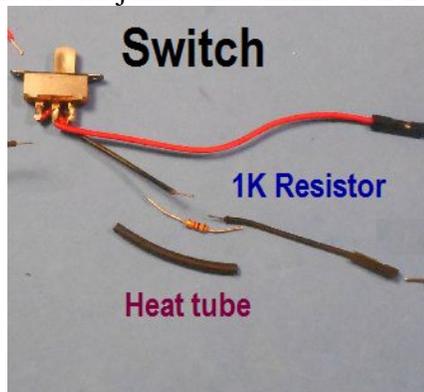
Take the two one inch sections of wire previously cut and use these to make the cross connection between the end pins of the switch. Cut a length of red and black wire that will extend between the end pins of the switch. (approx 1/2 - 3/4") . Strip and tin each of the ends . Solder the red wire on one end pin and then to the far opposite end pin. Repeat with the black wire.



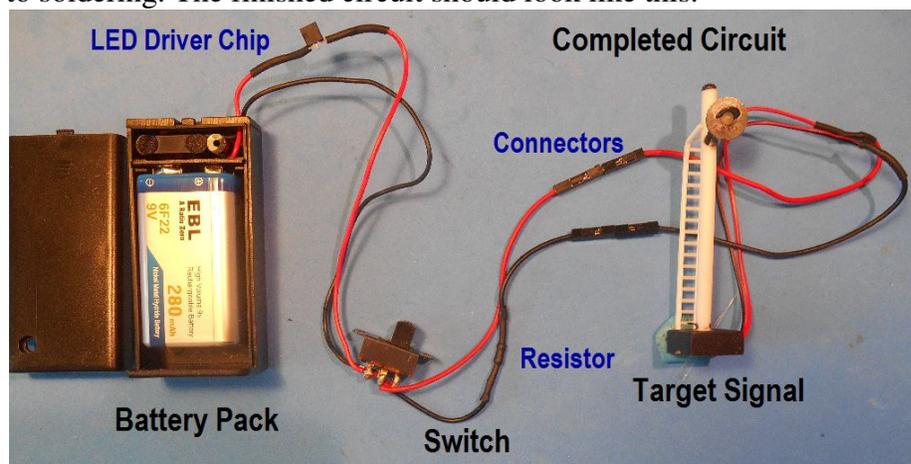
Solder the end pins from the battery circuit to the respective pins at one end of the switch. Solder the wires that lead to the signal to the middle pins. The red wire on the red battery lead side. The length of these 2 wires will vary depending on how far you wish to place the switch from the signal. (this wire is not included in the kit) and is illustrated here by a red/green wire.



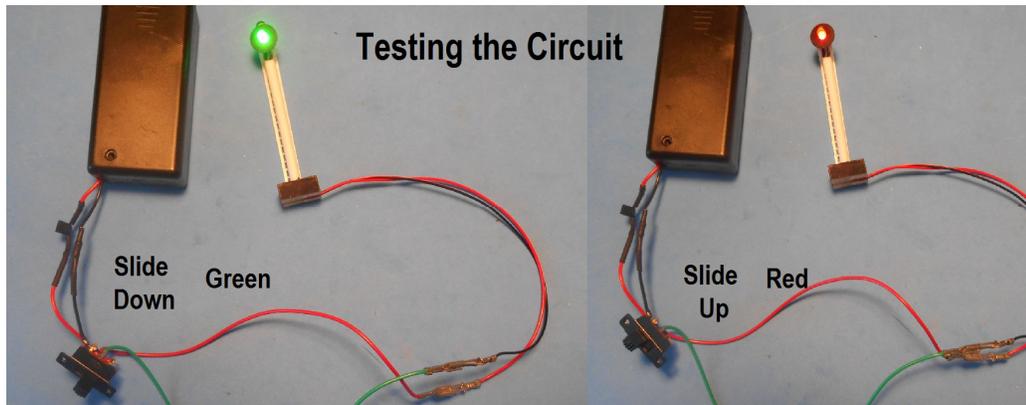
The intermediate connection wires will link to the wires containing the female plugs or spade connections as listed in 11b. A resistor is placed on the negative black wire before this connector is attached. For the 9 Volt power supply used here this resistor will be 1000 ohms (1K) . Shorten the leads of the 1 K resistor. Insert 1" of heat shrink tube over one wire and solder the cut ends of the wires to the resistor body using a heat sink. Thread the heat tubing back and over the resistor and joints and shrink with heat to protect the joint



Now solder the wires to the signal wires with the female connector plugs or if using the spade connector solder the female connectors to the ends of the red and green connecting wires using the procedure described in STEP 11b of the Signal assembly. Be sure to thread on the plastic covers prior to soldering. The finished circuit should look like this.



Testing :The circuit can now be tested. Turn on the battery power and depending on the slide switch position the red or green light should show. Slide the switch and the opposite color displays. If no lights are seen check all connections for any break in the circuit.



Operation

The signal is positioned next to the track at an appropriate spot. It can be attached using glue, adhesive putty or pin nail. If the wires are to go under the layout a hole can be added through which the wires can be inserted.

The Green light is switched on when the track is clear. When a train passes the signal is switched to Red. After the train has cleared turn back to Green.



Locomotive awaits track clearance. RED



GREEN signal Proceed

For more information on this and other projects check the website www.modeltrainsounds.com