

UNION SWITCH & SIGNAL CO.

SEARCHLIGHT SIGNAL LED LIGHTING SYSTEM

BY



P. O. Box 91, Glendale, CA 91209

Kit No. 900: SEARCHLIGHT SIGNAL LED LIGHTING SYSTEM: \$12.95

Thank you for purchasing this *Class Five* signal lighting kit! This kit will allow you to light any of our searchlight signals. This kit uses a tri-color LED sized to fit into our searchlight signal heads. These instructions should be considered and used integrally with the instructions for the *Class Five* searchlight signal kit you are constructing.

Class Five also offers a fiber optic lighting kit that can be installed into the signal. Using a .015 inch fiber optic strand and a separate lighting module, this kit will be available as *Class Five* kit number **901**.

There are four wires on the LED, one for each of the colors (R,Y,G) and one common wire. The common wire is shorter than the others for convenient identification. *Do not attempt to light the LED without installing a current limiting resistor first*, please see below for instructions.

BASIC TOOLS AND OTHER ITEMS RECOMMENDED FOR ASSEMBLY:

(items equivalent to those listed below are also acceptable...)

- * Soldering iron, solder, soldering flux and vinegar (or isopropyl alcohol to clean solder joints)
- * Fine tweezers
- * Flat Silver acrylic colored paint
- * Current Limiting Resistor (see text below)
- * Binocular magnifier with headband

We strongly recommend the use of a binocular magnifier while assembling this kit. Because of the scale size of the components, it is almost impossible to assemble the signals without some form of visual magnification. We have found that the quality of our work is improved with magnification and the amount of eye strain is significantly reduced.

ASSEMBLY OF THE SIGNAL LIGHTING KIT

Let's get started! Locate part **B**, the tri-color LED. The four #38 magnet wires attached to the LED allow the wires to be fed from the signal head into the Flexible Conduit Opening shown on the Signal Fitting Placement Diagram and Parts Diagram in your searchlight signal kit. From the opening the wire group passes down through the signal mast (part **J1**) into the Universal Sub Base, part **A**, and then out the bottom of the signal for connection with your signal lighting and/or controls system.

PREPARING THE CONDUIT OPENING

Part of the mast preparation involves the marking of the elevations of the signal mast fittings on your signal. The elevation of the conduit opening is shown on the Signal Fitting Placement Diagram for the configuration of signal you are constructing.

To cut the hole in the 1/16 inch mast tubing mark the location of the hole with a fine Sharpie just like the marked elevations of the brackets, braces, and the other mast fittings per the Placement Diagrams. Using a fine tooth saw (Atlas Super Saw or finer) make a shallow vertical slice just breaking the surface of the tube. You must be very careful with the tubing as the thinwall tubing supplied in the kit is very fragile. Next, make another slice angled at 45 degrees from vertical also just breaking the surface of the tube. The purpose of the two cuts is to create a divit for a #63 drill held in a pin vise or similar tool. You must use a pin vise as any type of powered drill will catch the brass and fatally damage the tube. Make any additional slices in the tube to provide enough of a divit to start the drill creating the opening.

Slowly rotate a #63 (.037") drill in the divit until the drill penetrates the inside diameter of the tube. Continue to rotate the drill and start to rotate the pin vise gradually at an oblique angle to clean out the hole and prepare the tube for the LED wires. Carefully remove the sharp edge of the hole at the tube wall using a fine sandpaper (400 grit or finer), as this edge can scratch the magnet wires, removing the insulation and shorting out the LED. When completed, the tube should still have enough strength to survive normal construction and operating handling.

We suggest that you build the signal in two parts, the signal mast and signal head (part **H4** or **R1**), and keep these components separate until ready to

install the tri-color LED. We paint the signal separately and allow everything to dry for at least a couple days before beginning to install the LED.

To keep the Case Maintenance Door (part **H5** or **R2**) closed while painting we suggest using a very small amount of regular white glue. When ready to install the LED, use an Xacto knife to carefully pry the maintenance door open. Clean off any white glue residue at this time.

The LED comes ready to install into the signal head. The magnet wires are installed on the back of the LED, the light emitting diodes are located on the other side. Install the LED into the case with the light emitting diodes pointing toward the lens barrel (part **H3** or **R3**) and clear signal lens (part **I**). The magnet wires should be pointing down to pass out the back of the signal just below the bottom of the maintenance door. There is a notch in all *Class Five* searchlight signals for this purpose.

After painting the signal, again place a very small amount of white glue on the maintenance door (part **H5** or **R2**) and attach to the back of the signal case. Check photos and the Parts Diagrams for the proper location of the door. If you have difficulty getting the door to close, carefully sand off the ribs on the inside of the maintenance door. These ribs assist in the final alignment of the door. Let the white glue dry for at least an hour. If you prefer a stronger adhesive we would then suggest a canopy glue, available at better hobby shops.

Now we are ready to route the magnet wires down the signal mast (part **J1**). Make sure that the four wires are wound together as a group, as this will help stiffen the wire group and allow passage down the mast. Carefully twist the four magnet wires at the tinned ends of the wires in the same direction as the rest of the length of the wires. It is necessary to create a pointed wire group to be able to enter the conduit opening and remain a group as the wires are pushed down the signal mast.

Using tweezers, grasp the end of the wires and start to feed the wire group into the conduit opening. The trick is to maintain rigidity of the wire group as the wires pass into the hole and down the mast. You should be able to handle the wires and signal head assembly as a group, let the signal head dangle as you feed the wire group down the mast.

We suggest feeding about a quarter of an inch of wire into the conduit opening at a time and then grabbing the wire group another quarter inch down toward the signal head. This is typically a short enough distance such that the wire group will not collapse as the wire group is being fed into the signal mast. Keep feeding one quarter inch of wire into the mast until the end of the wire group appears at the bottom of the signal mast. Once all four wires are clear of the bottom of the mast you can grab the wire group and carefully pull the wires as the signal head nears its support location.

Leave some slack in the wire group so you can maneuver the pin on the signal head (part **H4** or **R1**) into the support bracket (part **H6** or **H7**). Using a #75 drill in a pin vise carefully clean out the hole in the bracket to receive the pin. Let the drill do the work as any more force will snap the bracket off of the mast. We are considering using cyano epoxy for the bracket to mast connection in our future builds. ACC alone is not sufficient for anything other than normal handling loads.

Grab the signal head with a set of tweezers (we prefer Tamiya decal tweezers for this task) from the top, and carefully start to slowly push the pin into the hole in the bracket. If there is resistance use the #75 drill again to ream the hole out. Slowly rotate the head sideways back and forth as you insert the pin. A firm fit is preferred as we like to leave this connection dry without placing any liquid glue.

Once the head is fully seated on the bracket you can cut away the rest of the mounting pin and leave about 3 scale inches of pin protruding below the support bracket (part **H6** or **H7**). Next, pull slowly and carefully on the wire group to take up the slack in the wires. Leave enough slack in the wire group to give the characteristic "sweep" of the flexible conduit used on the full size signals. See photos in your signal kit for guidance on this aspect of construction.

To touch up your signal wire group after installation we recommend using a small brush and an acrylic paint like Polyscale Flat Aluminum, which is a very close match to Floquil lacquer Old Silver, which is the primary silver color we use for our display signals. If the lacquer is sprayed we have not found a problem with the solvent dissolving the insulating coating on the magnet wires. But for touch up the acrylic paint is better as the acrylic solvent will not attack the insulation. We have heard of situations where lacquer based

paint has damaged the insulation when brushed on magnet wires and the signals shorted out. After all of the work you have put into this signal we don't want something like this to happen to you!

Multiple Head Lighted Signals

The magnet wire groups are small enough to allow for multiple lighted tri-color LEDs on the same mast. Use the same approach feeding the wire groups down the mast, except always start at the highest lighted head and work your way down to the lower signal head(s). We have constructed custom signals for customers that have had as many as 16 magnet wires installed in the mast, so the typical 2 and 3 headed signals will work fine on the same mast.

Congratulations!

Your signal is complete! You now have the best lighted searchlight signal and the best replica for the prototype modeler today!

Hooking Up the Signal LED(s)

As discussed above, the shortest wire in the magnet wire group is the common wire. You **must provide and install** a current limiting resistor between the power source and the common wire. A direct connection to a power source without a current limiting resistor **will burn out the signal immediately**.

You can obtain the resistor at Radio Shack, DigiKey, Jameco or other electronics retailer. The reason we do not include a resistor in our kit is that the proper resistor is a function of two major considerations. First is the voltage of the power source that you will provide, second is the level of brightness you want to set the signal to glow at.

We use 9 volt batteries to light our portable display signals as they are readily available. If your signal is for display this is a good choice for a power supply. Many different battery holders for 9 volt batteries are available at the electronics suppliers mentioned above. We use one with a snap connector for the 9 volt terminals and a short length of red and black wires to hook up to the signal.

We have had success locating the dropping resistor on the red lead from the battery, and then connecting this lead to the common wire of the tri-color LED. For a 9 volt battery, we have used both

2200 ohm and 1500 ohm resistors successfully to light our signals. If you prefer a brighter signal, decrease the resistor value to the next available size. For less brightness, increase the value of the current limiting resistor.

If you have installed the current limiting resistor on the common wire and then connected the other battery wire to one of the color LED leads, and nothing lights up, reverse the battery terminal wires. LEDs are polarity sensitive devices. You will not damage the signal by reversing the positive and negative leads from the battery to the tri-color LED.

We suggest that you use a pencil-type soldering iron for the soldering work done in hooking up the tri-color LED. Make sure your tip is clean and tinned with an electronic silver solder such as Kester 62% Tin 36% Lead .020 inch diameter solder, which we also suggest for the other soldering on these kits.

For those with some basic electronics background here are the specifications for the tri-color LED:

Forward Voltages:

Red: 1.75 volts
Green: 2.65 volts
Yellow: 1.85 volts

The forward voltage is the minimum voltage needed to light each of the LEDs in the tri-color LED. This tri-color LED is actually three very small LEDs combined into one lens.

We like to set our green LEDs at about 3.9 milliamps (mA) of current and 2.9 volts (V) voltage on our 9 volt batteries. Using Ohm's Law we would need a current limiting resistor of about 1560 ohms, so a commonly available resistor of 1500 ohms would be fine.

Here are our recommendations for some stepped voltage supplies via batteries or a transformer:

<u>Battery or Transformer (Volts)</u>	<u>Resistor (Ohms)</u>
4	270
5	510
6	820
7	1000
8 to 9	1500
10 to 13	2200
14 to 16	3000

Remember that the limiting resistor can be decreased and increased in value to suit the individual owner's taste. For multiple LEDs each LED must have its own current limiting resistor between the battery and the common wire.

Again for those with an electronics background we recommend an operating current of about **3.9 mA** at **2.9 V** on the **green** LED.

So please experiment with your particular supply voltage to find the perfect limiting resistor for your signal system. The tri-color LED is also perfect for use in other signals in HO and in smaller scales like N scale.

In the event that one of the magnet wires breaks you can remove the insulation (stripping) from the wires by passing the end of the wire through a hot blob of solder on the tip of your soldering iron. Hold the iron steady and move the end of the wire back and forth through the solder blob. A bit of liquid flux on the wire helps with this process.

Class Five hopes that you feel that your effort was worthwhile and that you can readily see that you have the most accurately scaled and detailed operating searchlight signal on the market today! A variety of signal configurations for ATSF, UP, WP and other railroads that used US&S signals are planned for release, in addition to a full line semaphores and colorlight signals. Your continued support of *Class Five* products will ensure timely development and release of these signals!

Thank you!

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