

# Building HO Scale Railroad Block Signals

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The following explains in step-by-step detail how we built 3-aspect, HO scale signals for use on a modular layout for the Metrolina Model Railroaders of Belmont, NC. These signals work perfectly with the optical sensor detection system and signal control circuits offered on <http://www.modelrailroadsignals.com> as the current limiting resistors for the LEDs are incorporated into the signal control circuit boards. These boards can be configured with or without approach lighting. We chose optical detection because our layout modules are often assembled differently depending on space available at shows. Also, we wanted to keep the signaling system completely separate from the DCC track wiring, which most types of current sensing method would not allow. However, the signal control circuit boards will work with any detection system that can provide a hard ground from each block to the appropriate signal control circuit board – meaning a ground of the same potential as the –12vdc of the power source used for the signal control circuit boards. A logical ground from some detection circuits will not suffice. Grounds provided through turnout contacts, control panels switches, or other sources can also be utilized, providing complete flexibility and control.

We utilized telco type RJ-11 plugs and sockets rather than anything smaller as we wanted something that any of the club members could install during setups at train shows without any problems. We tested a smaller, easier to conceal plug but it was quickly broken by our club's most cautious member. These signals were designed to be removable but would be much easier to construct them as permanently installed devices. I will discuss both types below.

## **Material & Tools List**

1/8" Plastic hollow tubing, Evergreen # 224

.250 x .040 Plastic strips, Evergreen # 149

RJ-11 Plugs (for removable signals only.)

26 ga. Wire, Red, Green, Yellow & bare/un-insulated. Use wire that the insulation does not shrink back when soldering. Some 24 ga. wire will fit through the tubing but you may have to ream the hole a bit larger. (Use what you have but be consistent for all signals.)

Red, Green & Yellow LEDs, 3 mm T-1 Diffused. You may use a different type/size LED as most use the same electrical current.

1/8" & 3 mm. drill bits w/hand chuck or low speed Dremel tool. The 3 mm. size allows the LED body to extend through the target face but not the LED shoulder. Adjust this size if you use another size/type LED.

Wendy's black coffee stirrer (if you want hoods on the LEDs)

Screen wire with 1/8" mesh (or commercially available HO scale ladders)

Solder, fine, low temperature preferred

Soldering iron, 35 w. maximum

Fine file or sandpaper block

Hemostat or longnose pliers

Flat black, silver & concrete paint

RJ-11/RJ-14 crimping tool

Plastic liquid cement

CA cement for the ladders

Vinyl Spackling compound, premixed

### **Preparation**

Cut the tubing to length – 2” for removable signals, 3” for permanent mounting. Check to see if 4 wires will fit as the tubing inside diameters vary. If not, ream it out with the 3 mm bit.

Cut the strip material for base and platform – 2 per signal, 1/2 “ long (see note). Drill a 1/8” hole, centered but close to one end.

Cut the strip material for the target face – 5/8” long (see note). Round the corners to resemble a prototype target face. Mark for 3 holes with a center punch, awl, etc. Drill the 3 holes with a pin vice, hand drill or slow Dremel type tool. (Be careful, it is easy to drill into your fingers.)

Cut the target mounting pieces – 1/4” long (see note). Round one end to resemble D shape. Drill a hole large enough for your 4 wires. (Again, be careful.)

Cut the wires to length (4” for removable signals, long enough to reach the signal control board for permanent mounting). Strip the insulation from one wire if necessary. Ideally, you will have a red, yellow, green and bare wire. Do not twist them together as they will be harder/impossible to fit in the tubing.

Cut the screen material into individual ladders and form the top railings.

*Note: You should round one end of the small pieces and drill the necessary holes before cutting them from the long strip material. Hold them with the hemostat or pliers when finishing the other end.*

### **Assembly**

Glue the target face mounting piece to the back bottom of the target face below the bottom LED hole.

Glue the assembled target to one end of the tubing. Align the holes for the wiring.

Paint the target face and it’s edges flat black at this time.

Insert the LEDs from the rear of the target face, red on the bottom, green on top. Orient the LED leads horizontally, the same for all 3 LEDs. If they don’t fit tightly enough to stay in place, glue them from the rear with a dab of paint, nail polish, etc. It will be covered later. Try not to coat the LED leads.

Insert the 4 wires into the tubing. (4” lengths for portable signals, long enough to reach from the signal location to the controller board for permanent type). Leave 1” on each end for removable type, 1” at the target end for permanent mounting. Spread the LED leads to allow the wires to pass between them.

Slide the platform and base onto the tubing at this time. Later will be too late on portable type.

*For portable signals only:* Insert the 4 wires extending from the bottom of the tubing into a RJ-11 plug and crimp. Orient these wires to conform to the RYGB contacts of the jacks you are using before inserting into the plug. Slide the tubing down and into the top of the plug.

Important: Orient the clip on the plug so it is facing in the same direction as the LEDs – toward the oncoming trains. Insert the plug/signal assembly into a base/jack of the type you are using. Make sure that it is level. Before gluing, be sure the tubing is absolutely vertical – both front/back and sideways. Then, glue the tubing into the plug.

Slide the base down to rest on top of the plug, extending away from the clip to form a base platform for the ladder. Slide the platform up to beneath the target and level it, facing the same as the base. Glue them in place.

*For all signals:* Solder the bare wire to the 3 like LED leads on one side of the target. (With the control board we used, the long leads on the LEDs are the common leads. Your controller may be different. Verify this before proceeding, as it will be impossible to correct later). Solder close to the LEDs and trim off the excess leads and wire. I have not damaged an LED from soldering heat but less heat is better.

Solder the appropriate color wires to their respective LED. Again, solder close to the LEDs and trim off the excess leads and wire. Squeeze the connections closer together but avoid shorting any leads.

Form the back of the target with the spackling compound. Let dry and sand, or just smooth with a wet finger before it is completely dry. Get it right by adding or removing spackling compound before painting.

Trim the ladder to length and form the side railings for the platform and attaché to the base, platform and sides of the target face with CA or your preferred glue.

Mask the target face and spray or brush paint the entire assembly silver or black. Then brush paint the base and the top of the plug a concrete color. Touch-up the black target face with a fine brush if necessary.

To make the hoods, cut the black Wendy's coffee stirrers to length with one end of each piece cut at a 45 degree angle to form the "beak". Slit the bottom edge and slip onto the LEDs. Use clear nail polish to attach permanently. (Using these hoods will restrict seeing the lights from any direction except the front. We felt that the public would enjoy the signals better if they could observe them lighting up so we left off the hoods.)

### **Testing**

Test by connecting to your control circuit board that has current limiting resistors installed. DO NOT connect the 12 Volt power source directly to the signal without current limiting resistors properly in the circuit. The LEDs, once installed in the signals, are very difficult if not impossible to replace. You may find it better to test the signals before potting and painting. If you will be making many signals, constructing a tester with current limiting resistors for use with a 9 V battery would be a good idea.

### **Installing**

*For removable signals:* Install your bases/jacks 10-1/2 scale feet from the track centerline. If installed on a curve, increase the distance. Be sure all your rolling stock will clear them. The detent for the plug clip must face the oncoming trains. Be sure the tops of the bases/jacks are exactly level or the signals will not be vertical when installed. (Use a bubble level before the glue dries.) We used double-ended female/female inline connectors and fastened them in place with a hot-glue gun. Shop around as prices vary greatly. Wire them to the controller boards. After installing the bases, just plug the signals in.

*For permanent mounting:* Drill 1/8" or slightly larger holes and install the signals in them. Again, be sure to drill the holes exactly vertical. If you have foam board or other thicker material to go through, 1/8" ID plastic straws make good sockets and make it easier to push the wiring beneath the layout.

### **Finally**

This article, in an easy to print .pdf file, as well as detailed specifications for all the components we used, is available on our supplier's website – <http://www.modelrailroadsignals.com>. Our club, being on a very tight budget (as are most clubs), shopped around extensively for a system that could be purchased and installed at a reasonable price. (Buy the bare boards or the kits as they are easy to assemble and come with complete instructions.) Buying the components from one source assured us of complete compatibility throughout the entire block signaling system. The support from "Model Railroad Signals" and its' owner, John Callahan, was excellent during the system installation. John has since become an active member of our club.