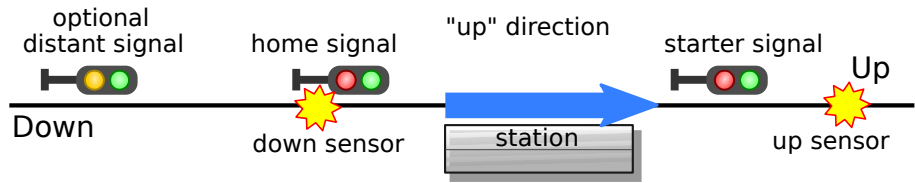


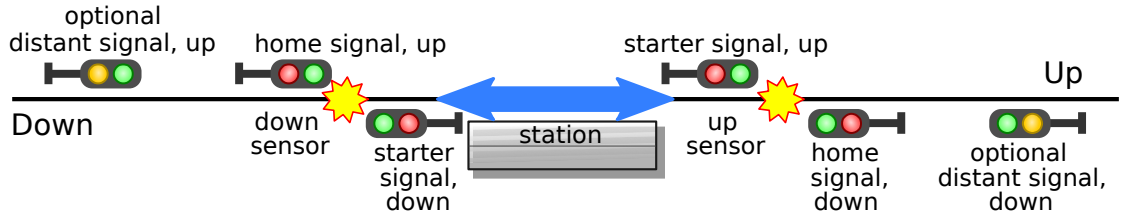
What it is: The SHS operates distant, home and starter signals on a single track at a station, generally following practice derived from British railways.

Trains are detected by infrared sensors, independent of the room lighting. The rail does not need to be cut into isolated blocks and resistor wheel sets on the train cars are not required.

LED signals must be used. Signals with incandescent bulbs need solid state relays such as Azatrax model SSR6 between the SHS and the signal.



The polarity of the signals (common anode vs. common cathode) is automatically detected by the SHS.



Train direction:

For **single direction** rail traffic, place the "down" (approach) sensor on the approach side of the station just past the home signal. Place the "up" (departure) sensor some distance beyond the departure end of the station. The starter signal will change from green to red when the head of the train trips the up sensor. The home signal will change from red to green a few seconds after the rear of the train clears the up sensor.

For **bi-directional** rail traffic, place the sensors about midway between a home signal and the opposing starter signal.

To allow the starter signal to automatically turn green, the end of the train must be clear of the approach sensor when stopped at the station. If not, manual switch T1 or T2 will change the starter signal to green (see pg 4).

Kit contents:

- ◆ Circuit board
- ◆ Infrared light-emitting diodes (IR LEDs) with orange & white wire leads
- ◆ Infrared photo receivers with green & yellow wire leads
- ◆ Plastic mounting tubes. The tubes are for protection of the sensor leads and to provide mounting support. They are not essential for detector operation and may be shortened or removed entirely to best fit your situation. Just use caution to avoid damaging the leads.

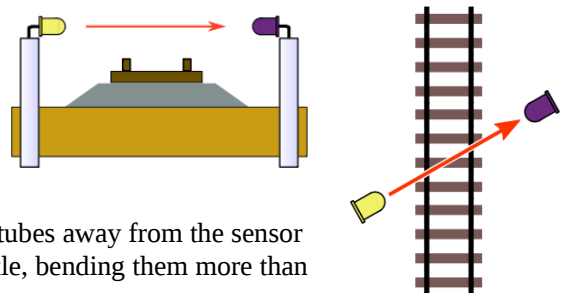
Installation

This guide assumes an up/down direction of the track. If your track directions are east/west or north/south, make appropriate substitutions -- and be consistent!

If using signals only for one-way traffic, install only signals for the "up" direction.

Install the sensors: Each sensor pair may be installed in one of two different ways - 'Across the Track' or 'Reflective.'

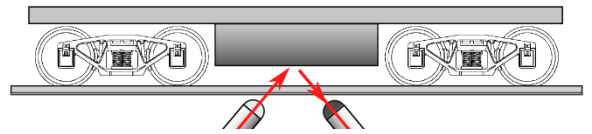
Across the Track sensing: The IR LED is positioned horizontally on one side of the track, and the IR photo receiver is placed on the opposite side. A train is detected when it blocks the light path between the LED and photo receiver. The distance between the LED and photo receiver can be up to 18 in. (46 cm), or more with careful alignment.



Tip #1 - If mounting the sensors vertically as shown here, slide the plastic tubes away from the sensor then carefully bend the leads to a right angle. The leads are somewhat brittle, bending them more than two or three times may cause a break.

Tip #2 - Locate the photo receiver so it faces away from bright lights or sunny windows. Use scenery or structures to conceal the sensors and shade them from room lighting.

Reflective sensing: Trains are detected when light from the IR LED is reflected off a train and sensed by the IR photo receiver. Typically the sensors are mounted in two 3/16-inch (4.8mm) holes drilled in the roadbed as shown here. Vertical installation works for S and larger scales as long as there is no structure above the track such as a bridge.

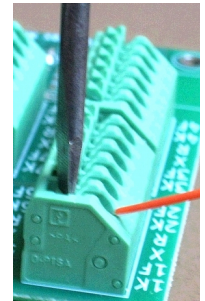


Angling the IR LED and photo receiver toward each other is best for N and HO scale where the trains are close to the rail head, and in places where an object above the track might otherwise cause false detections. Angle the IR LED and photo receiver so their centerlines intersect at the height of the bottom of your rolling stock.

Tip #3 - You can ballast your track after sensors are installed. Cover each sensor with a bit of transparent tape. Apply ballast. When the glue has dried use a dental pick or similar tool to remove ballast from the sensors. An opening of just 1 or 2 mm is required.

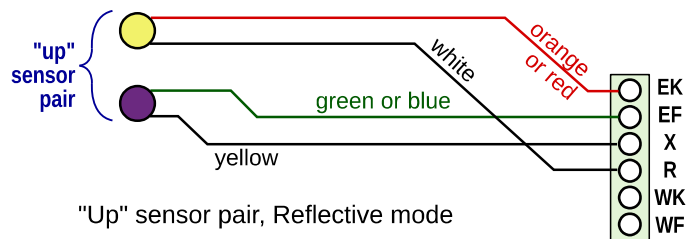
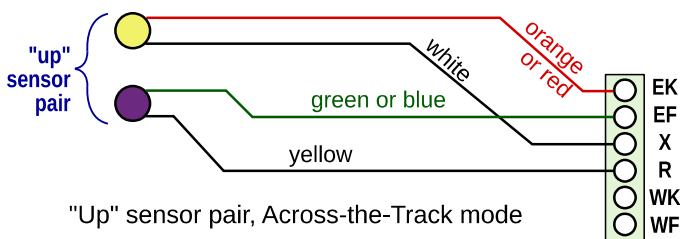
Connecting wires to the terminal blocks: The SHS has 'spring cage' quick-connect terminal blocks.

- ◆ Strip 3/8 inch (1 cm) of insulation off the end of the wire.
- ◆ Use a small screwdriver to push down (push, do not turn) the terminal's button. Push firmly.
- ◆ While the button is pushed in, hold the wire at a 45 degree angle to the terminal block and push it in. About 1 cm of wire should go into the terminal block.
- ◆ Release the button. Tug on the wire to make sure it is secure.



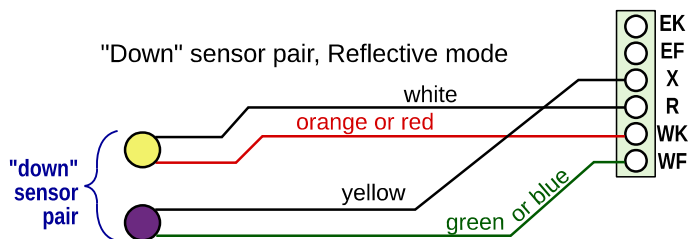
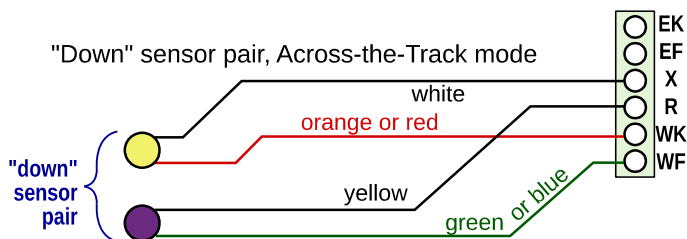
When two wires are connected to the same terminal, twist the bare ends of the wires together.

Connect "up" sensor pair: Connect the orange wire from the IR LED to terminal EK. Connect the green wire from the IR photo receiver to terminal EF. Now, how you connect the white and yellow wires to the SHS will determine whether the up detector will operate in 'Across the Track' or 'Reflective' mode. See the diagrams below:



Connect "down" sensor pair: Connect the orange wire from the IR LED to terminal WK. Connect the green wire from the IR photo receiver to terminal WF. As with the east sensor, how you connect the white and yellow wires will determine whether the down detector will operate in 'Across the Track' or 'Reflective' mode. The two detectors may operate in the same mode or in different modes.

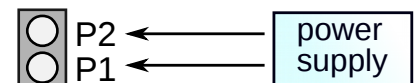
When both sensor pairs are connected, there will be two yellow (or white) wires in 'X' and two white (or yellow) wires in 'R.'



Additional wire may be spliced to the sensor leads if needed. Use similar twisted pair wire for total length up to 26 ft (8m).

◆ **Pairing is important!** The IR LED that is connected to EK must be paired on the layout with the IR receiver that is connected to EF. The IR LED that is connected to WK must be paired with the IR receiver that is connected to WF.

Connect power to the SHS: Connect an accessory power supply of 8 to 16 volts AC or DC to terminals P1 & P2. The red and yellow ('E' and 'W') LEDs will briefly flash to show that power is on and the circuit is working.



Test and adjust the sensors:

With no trains near either sensor pair, the 'E' and 'W' LEDs on the SHS module should be off. If either LED is on, correct the false sensing condition.

To fix false sensing for *Across-the-Track* mode:

1. Verify that the sensor pair is wired correctly.
2. Make sure the IR LED and photo receiver are pointed at each other, and nothing is between them.
3. Shade the photo receiver from bright lights, and point it away from windows or other strong light sources.
4. Change the nearby room light from incandescent to a fluorescent or LED bulb if possible.

To fix false sensing for *Reflective* mode:

1. Verify that the sensor pair is wired correctly.
2. Pull the IR LED and photo receiver a bit deeper into the roadbed.
3. Infrared light may be 'leaking' through the roadbed material from the IR LED to the photo receiver. Push a metal shim, such as the tip of a hobby knife blade, vertically into the roadbed between the IR LED and photo receiver.
4. Is there an object above the sensor, such as a bridge, or an upper layout level? Mount the IR LED and photo receiver at a shallower angle, or paint the object flat black. Or use across-the-track sensing.

Are all detectors now off? Now **test for train detection**. Place a locomotive or car at the **up** sensor. The 'E' (red) LED should light. If the yellow LED also lights, re-adjust the *down* sensor pair for false detection (see above).

If the 'E' LED does not light, correct the *up* sensor pair for a false clear condition.

To fix a false clear indication for *Across-the-track* mode:

1. Verify that the sensor pair is wired correctly.
2. Adjust the sensor height so the train is fully blocking the light path from the IR LED to the photo receiver.

To fix a false clear indication for *Reflective* mode:

1. Verify that the sensor pair is wired correctly.
2. Adjust the sensors higher or lower in the roadbed.
3. A bright light source above and to the side of the track may be saturating the IR photo receiver. Try pulling it deeper into the roadbed or create shade with scenery or a structure. Change the nearby light from incandescent to a fluorescent bulb.

Test with several types of rolling stock and adjust the sensors as needed.

Remove the train from the up detector, make sure the 'E' LED goes out.

Place a train at the down detector. The 'W' (yellow) LED should light.

If the 'W' LED does not light, adjust the *down* sensor pair for a false clear condition (same process as above for the up sensor pair).

Sensors must be working correctly before continuing the installation.

Signal Connections -- turn power off before changing signal connections.

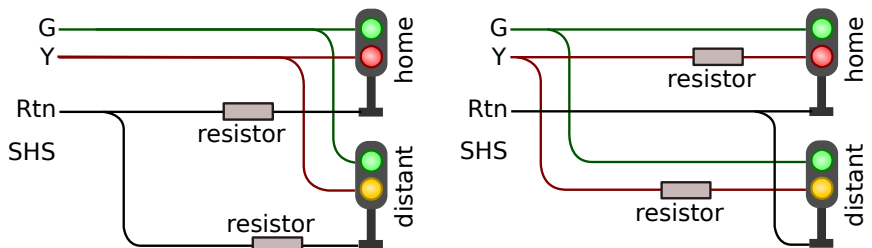
With very fine signal wires, it is best to attach larger wires (AWG #26 or #24, or 0.2 mm² such as found in telephone or LAN cable), then insert the larger wire in the terminal block.

Resistors:

If signals are pre-assembled with resistors, first try the signals with their resistors. If the signal lights are too dim, remove the resistors. The SHS has resistors on-board. This allows LED signals to be safely used without additional resistors.

◆ However ◆

When distant signals are connected, and if the home and distant signals do not already have resistors attached, then a resistor needs to be added to the home signal and to the distant signal as shown here. This balances the brightness of the red and yellow LEDs by allowing the home signal's red LED and the distant signal's yellow LED to share current more evenly. Use resistor values of 100 ohms or more. Diagrams above show two possible ways to include resistors if the home and distant signals do not already have resistors attached.



Operation:

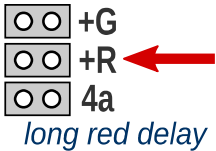
When power is turned on, the SHS does not know if the station track is occupied or not, because a train may have been added or removed from the track while power was off. The home and starter signals will show red.

Decide in which direction the train will leave the station. If departing up, momentarily close toggle switch T1. If down, momentarily close T2. The selected starter signal will change to green.

If the home signals are red but a train is not at the station, momentarily close T4 to change the home signals to green and permit a train to enter the station. If T4 is not connected, a train may pass the red home signal and enter the station by permission of the dispatcher.

Normally when the station track is clear, the home signal is green and the starter is red. As a train approaches the station and trips the approach sensor, the home signal changes to red. The train stops at the station with the starter signal ahead of the train, viewable by the driver.

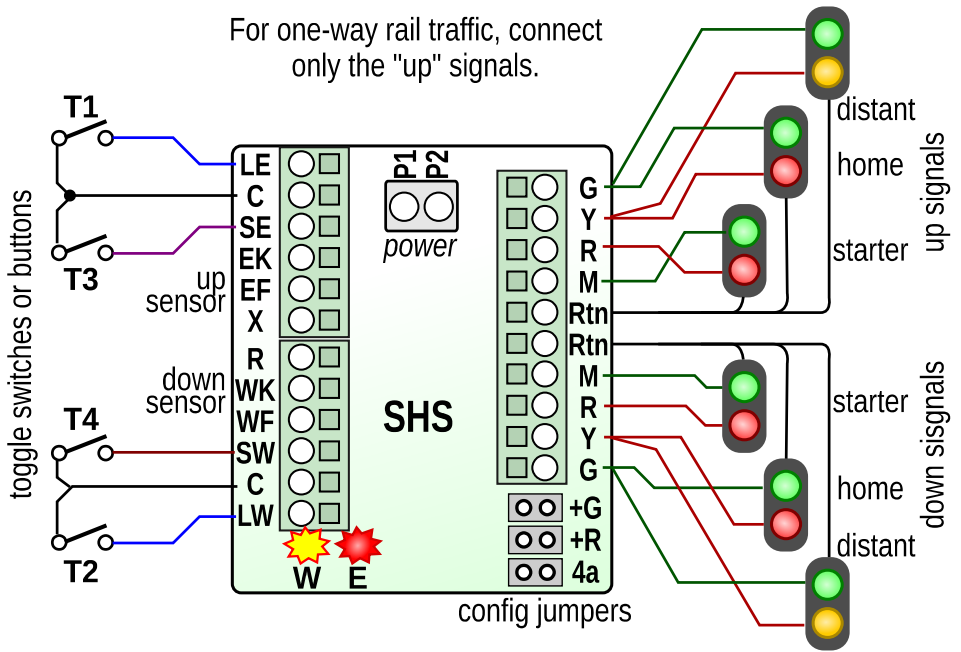
When the end of the train clears the approach sensor, a timer starts on the SHS module. If toggle switch T3 is open, the starter signal turns green when the timer runs out (normally 20 seconds). This gives the train permission to depart the station. If T3 is closed ('on') then the starter signal stays red until switch T1 or T2 is momentarily closed.



To double the time that the starter signal stays red after the train arrives, place the configuration jumper (connector block / shunt) across both pins labeled "+R." (+G and 4a jumpers do nothing).

When the locomotive reaches the departure sensor the starter signal turns red. A few seconds after the rear of the train clears the departure sensor the home signal turns green. The starter signal remains red, unless T1 or T2 is closed ('on'). Closing T1 or T2 clears the corresponding starter signal to green for the next approaching train, permitting it to pass through the station without stopping.

For further information and assistance, visit the Azatrax website, www.azatrax.com



switch	name	what it does when closed ('on')
T1	"up" clear optional for 1-way required for 2-way	Clears train for up departure by setting the up starter signal to green. Momentary activation allows the starter signal to return to red after the train departs, stopping the next train. Leave it 'on' to have a green starter signal for the next train.
T2	"down" clear not used for 1-way required for 2-way	Clears train for down departure by setting the down starter signal to green. Momentary activation allows the starter signal to return to red after the train departs, stopping the next train. Leave it 'on' to have a green starter signal for the next train.
T3	hold at station optional	Prevents the on-board timer from clearing the starter signals to green. Starters stay red until cleared by switch T1 or T2.
T4	clear home signals optional	If the station track is clear but the home signals are red, thus preventing a train from entering the station, momentarily close T4 to clear both home signals to green.