

Quad Optical Train Detector Module Installation and Operation

Green Steam Products presents the third generation of our optical detector. The original design has been re-engineered with several new features and improvements to enhance user operation and increase functionality. In addition, the requirements to interface the module with other devices, such as the Dual Alternating Flasher Module, have been greatly simplified.

The most important new feature is the addition of transistors on the detector outputs to drive higher-current devices. It is now possible to operate grain-of-wheat lamps, relays and other 12VDC accessories directly. LED (Light Emitting Diode) devices must be protected by current limiting resistors. Another innovation is the creation of complementary, or reverse, outputs on two of the detectors, so that when the normal output is in one state, the complementary output is in the opposite state. When one of these detectors is unoccupied the normal output is OFF and the complement is ON. When a train covers the detector the normal output switches ON and the reverse output turns OFF. This feature allows the user to connect a two-aspect signal directly to the module which could display “green” when a section of track is empty and “red” when it is occupied. The two “dual” detectors can be combined with others for detecting trains and displaying signal aspects on longer track sections.

Functional improvements include new sensitivity-adjustment controls that have been reoriented for easier access. Also, LED status indicators have been added to the circuit board to facilitate detector adjustment. No external device needs to be connected to the output for the user to properly set the sensitivity, and a glance at the module board will show the user which detectors are ON and which are OFF. Further, combining detectors to give a single output when one or more detectors is covered (such as in a grade-crossing or signal block situation) is now accomplished by merely wiring the desired detectors together - without the use of external diodes as required by the older GSP-1 (see Figure 3 outputs L2 & L3 for an example).

NOTE: You cannot connect LEDs directly to the detector outputs. YOU MUST USE CURRENT LIMITING RESISTORS. Green Steam Products recommends the use of 1,000 ohm, 1/4 watt resistors.

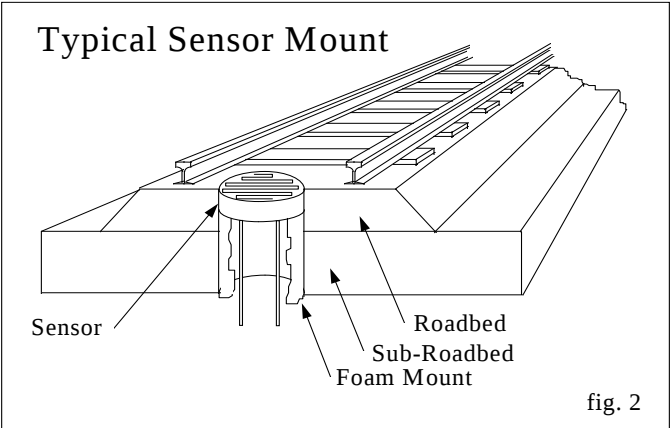
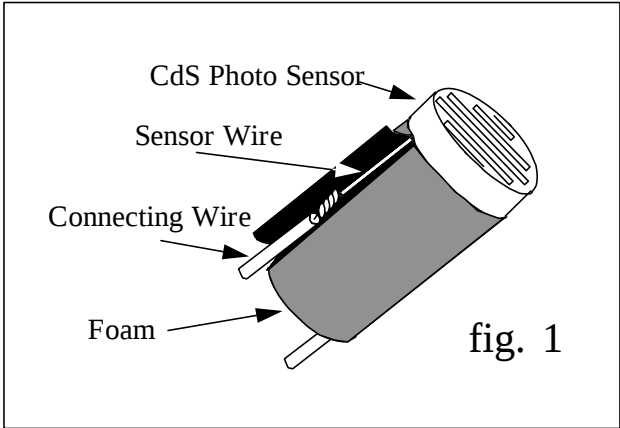
DESCRIPTION

This module contains four independent optical detector circuits. The detector system senses trains using a photo sensor that is placed in the track. When there is no train present, the sensor is lit by the surrounding room light and the detector circuit is OFF. When a train approaches and covers the sensor, shadowing it, the detector switches ON and outputs 12VDC. This system is completely separate from the track power and requires no modification to your rolling stock. Each circuit may be used to power an indication apparatus such as an LED or incandescent bulb which could be mounted on your control panel, or to trigger other devices whose operation is dependent on train position like a wayside signal or grade-crossing device. As with all optical detectors, this circuit is sensitive to ambient light conditions. In order to allow for these varying light conditions, each circuit has its own sensitivity control.

The sensors need not be located close to the circuit module or close to each other. The independent sensitivity controls allow each sensor to be adjusted for reliable operation. You also do not need to use all four circuits. If your application calls for only two detectors, leave the other two sets of inputs and outputs unconnected. If you are not going to use all of the detectors, it does not matter which one (or more) you leave unused. The detector circuits are numbered 1, 2, 3, and 4, Detectors 1 and 2 being the two “dual” detectors outlined above. The four parts of each detector you will be using are the input, the output, the sensitivity control, and the status indicator - all of which are numbered for their respective detector circuit. For example, input S3 (Sensor 3), output L3, the adjustment control marked “3” (Sensitivity Control 3), and the LED marked “3” (Status Indicator 3) all go with Detector 3.

TRAIN SENSOR MOUNTING

Enclosed with your Quad Optical Train Detector Module are four Cadmium Sulfide (CdS) photo sensors and four pieces of cylindrical foam. Determine where you want to locate each detector. A) *If your track is not yet in place*, drill a 3/8” hole on the centerline of the track at your selected location. B) *If your track has been laid*, select a point between the rails and between two ties. Drill a hole down through the roadbed and sub-roadbed. This hole should be as large as possible without damaging the ties; however, it should not exceed 3/8” diameter. Locate the hole on the underside of the benchwork. Enlarge this hole from the bottom up using a 3/8” bit. BE VERY CAREFUL NOT TO DRILL UP TOO FAR AND DAMAGE YOUR TRACK. Cut a piece of foam the same length as the depth of your 3/8” mounting



hole. With a sharp knife, cut two slits 1/16” deep on opposite sides of the foam (Figure 1). Place the sensor at one end of the foam, spread the slits apart, and then work the sensor wires into the slits. This assembly will “friction fit” into your mounting hole. When you are ready to connect the detector circuit board to this sensor, remove the sensor from the mounting hole, trim the sensor wires back so that the solder connections will fit inside the slits in the foam. Solder the wires from the detector circuit board to the sensor wires and insert the wired sensor assembly back into the mounting hole (Figure 2).

CIRCUIT BOARD MOUNTING

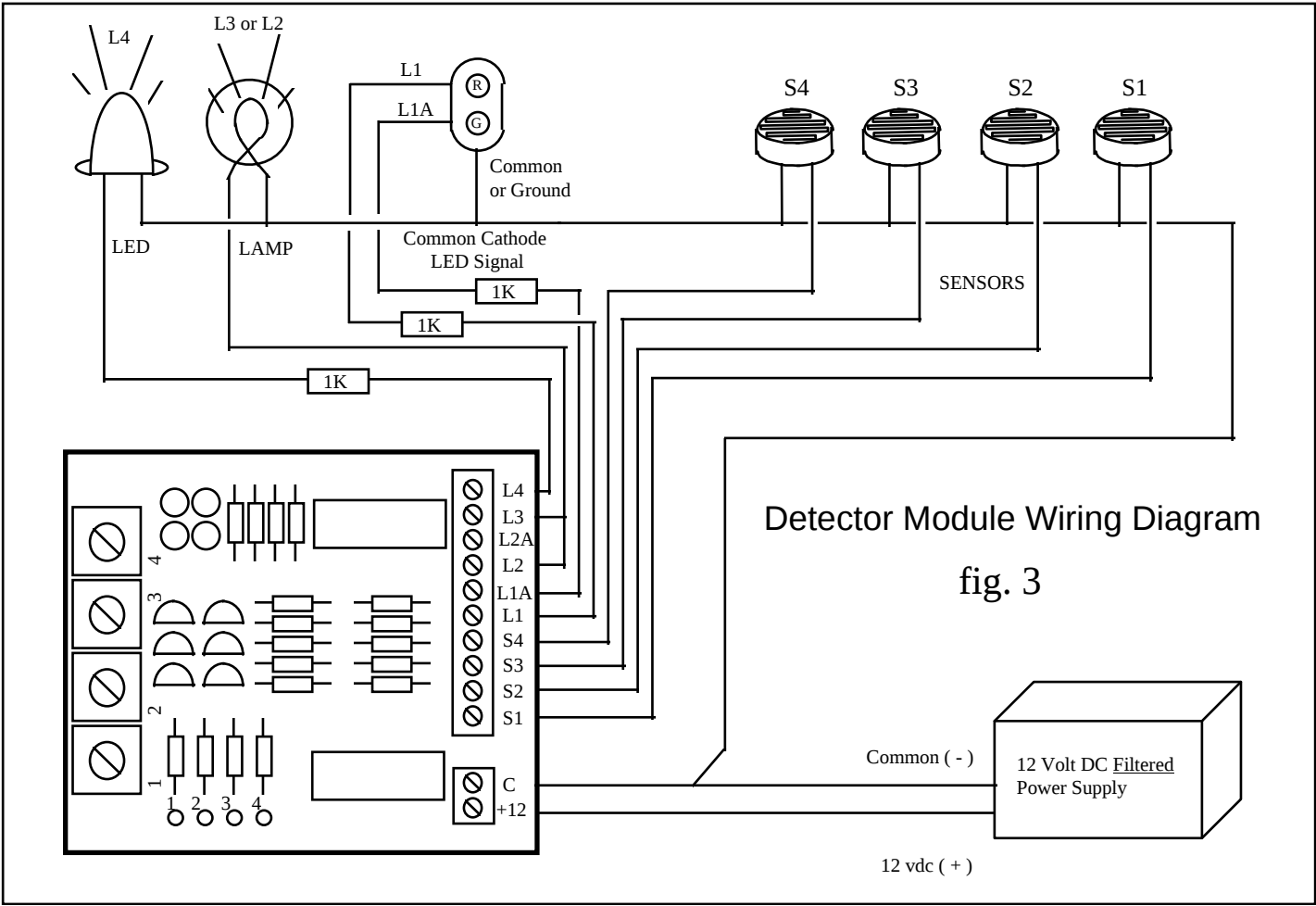
The Optical Detector Circuit board can be mounted anywhere that is convenient. It may be close to the detectors or at a central location such as a control panel. Be sure that you have easy access to the sensitivity controls on the board. The circuit board has convenient mounting holes at the corners. Using #6 hardware, the circuit board can be easily mounted to the underside of the benchwork or another location of your choosing. Be sure to mount the board squarely and do not over tighten the mounting hardware. **Improper mounting may result in circuit board damage.**

WIRING

BE VERY CAREFUL WHEN CONNECTING THE CIRCUIT BOARD TO THE POWER SUPPLY. INCORRECT CONNECTIONS WILL DAMAGE THE CIRCUIT BOARD! Leave the power supply turned “OFF” until all connections are made. Locate the 2-position and 10-position screw terminal blocks on the component side of the circuit board. Figure 3 shows a sample wiring diagram for the detector module. All terminals are clearly marked on the board. The 2-position block is for the power supply to the detector board, and must be fed with a +12 volt FILTERED dc power supply. Connect the positive (+) terminal on the supply to the +12V terminal on the detector and the negative (-) power-supply terminal to the GND terminal on the detector board. Next are the four terminals (marked S1, S2, S3, and S4) to which you connect one wire from each of the of the photo sensors. Connect only as many sensors as detector circuits you are using. For example, if you are only going to use two detector circuits, connect only one sensor to each of the two corresponding inputs.

The rest of the terminals are for the detector outputs. The terminals labeled L1, L2, L3, and L4 are “normal” outputs as described above. Normal outputs are ON when their detector circuit is sensing a train and OFF when they are vacant. The two terminals marked L1A and L2A are the “reverse” or complimentary outputs for circuits 1 and 2, respectively. They are OFF when a train is detected by circuits 1 and 2. Connect one wire from the device that is to be activated when a train is detected (i.e. a lamp or a relay) to the appropriate output terminal. If the device is polarized be sure to connect the positive (+) wire to the output terminal. Connect output devices only to circuits with sensors connected to their inputs. That is, do not connect a sensor to S3 and a light to L4 and expect your train to be detected! The other wire of all sensors and output devices is connected to the GND terminal along with the power supply (-) wire.

Figure 3 illustrates several methods of detector wiring. An LED is connected to Detector 4 through the required current limiting resistor. A 12v incandescent lamp is connected directly to both Detector 3 and Detector 2 via L3 and L2. This lamp will come on if either Detector 2 or Detector 3 is activated. Output L2A is not used. A two color common cathode LED signal is shown connected to Detector 1 via outputs L1A (Green) and L1 (Red). This signal will be RED when sensors connected to detector 1 are covered and GREEN otherwise.



DETECTOR OUTPUT

The output for each detector is a voltage between its output terminal and the "GND" terminal. For the "normal" outputs, this voltage is either 0, when there is no train being detected and the detector is OFF, or 12VDC, when there is a train present at the sensor and the detector is ON. For Detectors 1 and 2, the reverse outputs (L1A & L2A) give the opposite response. A key feature of the Quad Optical Detector Module is the delay built into each detector circuit. A detector will turn ON immediately upon covering its respective sensor; but, when the sensor is uncovered, the detector will "wait" about 1½ seconds before turning "OFF". This is done to prevent the detector from "counting cars" if a train is moving slowly across a sensor. Without this feature every time the gap in the cars goes by, the light that falls in between would turn OFF the detector and the device connected to the output. Instead, the detector will "hold" ON until the next car can cover the sensor.

The circuit board includes current-amplifying transistors to allow you to connect a wide variety of devices to the output of each detector. These devices can be LEDs, 12VDC incandescent lamps, 12VDC accessories or relays with 12VDC coils to switch other electronic components. When connecting LEDs, be sure that you follow the polarity and provide an appropriate current limiting resistor as prescribed by the information packaged with the LED. Connect the anode or positive (+) wire from the LED to the appropriate output terminal (L1 - L4 in Figure 3) through the resistor. Connect the cathode or (-) wire from the LED to the GND terminal. You may also use the output from your Quad Optical Train Detector to trigger other circuits. For example, you may use the Optical Train Detector to trigger a Green Steam Products Dual Alternating Flasher Module (GSP-2A) for flashing lights at a grade crossing. BEFORE MAKING ANY EXTERNAL CONNECTIONS, BE SURE THAT THE SIGNAL LEVELS BETWEEN THE TWO CIRCUITS ARE COMPATIBLE. As the output of the detectors is either 0 or 12VDC, only accessories requiring 12VDC should be connected directly to the detector outputs. The maximum current that may be drawn from each detector is about 500mA or ½ amp. This should be more than sufficient to drive most model railroading applications, but be sure to consult the information packaged with the device you are driving.

COMBINING DETECTORS

Occasionally you may want to connect more than one detector together to activate a single device when any of the combined detectors is covered. With the GSP-1A, simply wire the outputs of the combined detectors together as illustrated for the incandescent lamp in Figure 3. When any of these combined detectors is activated, the accessory attached to that combined output will be switched on. The ability to combine detector outputs is very useful when wiring block signals or grade crossings.

ADJUSTMENT AND TEST

Each Optical Detector has its own sensitivity control. These controls are numbered 1 through 4 in Figure 3. Each control sets the sensitivity for the corresponding sensor and output terminals. For example, Control 1 sets the sensitivity for the detector connected to Sensor 1 (S1) and Output 1 (L1 & L1A). Sensitivity should always be set in normal room lighting. Since these are optical detectors, anytime you change room lighting conditions, you may have to reset the sensitivity controls for your detectors. Using a small screw driver, set the sensitivity for *each* of your detectors by following the procedure below.

1. Begin by rotating the sensitivity control fully clockwise. The detector should be OFF.
2. Under normal lighting conditions, cover the sensor with a typical train car and rotate the sensitivity control counter-clockwise until the status LED *just* comes on.
3. Move the train car away from the detector and wait two seconds. The detector should go OFF.
4. If the LED remains ON, return to Step 1, otherwise proceed to Step 5.
5. The detector is now OFF and ready for normal operation.

If the surrounding lighting conditions change, you may need to recalibrate the detector using the above procedure.

APPLICATION NOTES

If you are using your sensors in tunnels or other dark areas, illuminate the sensor by suspending a small light bulb above the track. Some possible uses for your detectors include:

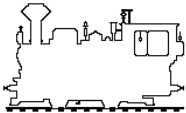
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| 1. Train position indicators | 3. Two color signal indication | 5. Horn or sound effect activation |
| 2. End of track indicators on hidden spur tracks | 4. Crossing gate/flasher activation | 6. Tunnel occupancy indicator |

And many others...

WARRANTY

Your Green Steam Products Quad Optical Detector Module was completely tested prior to packaging. Due to the electronic nature of this product and the susceptibility to damage caused by improper user operation, there is no warranty. However, if you experience problems with this product, contact Green Steam Products at the address below for troubleshooting assistance. In the event that we are unable to resolve your problem, you will be given instructions on how to return your product to Green Steam Products for repair or replacement. Do not return your product to Green Steam Products without prior factory authorization.

Thank you for purchasing the Quad Optical Train Detector Module. We hope that it gives you many years of quality service.



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