

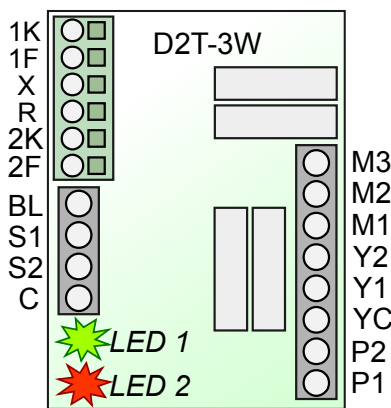
What it is: The D2T-3W is a two-channel model train detector using advanced infrared ('IR') technology. It can detect model trains at two different locations on the layout and activate a turnout (track switch) if the turnout is actuated with a 3-wire switch machine.

Three-wire (or 'twin-coil') switch machines include those made by **Atlas**, **Bachmann**, **Peco**, **Kemtron** and others.

To control a turnout equipped with a 2-wire switch machine, use a D2T-2W circuit.

Kit contents:

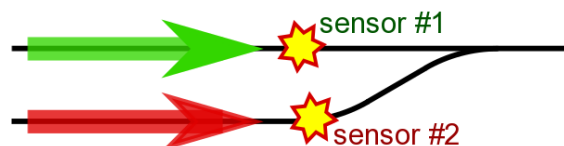
- ★ Circuit board
- ★ Two infrared light-emitting diodes (IR LEDs) with orange & white wire leads
- ★ Two IR receivers with green & yellow wire leads
- ★ Four plastic mounting tubes. The tubes are for protection of the sensor leads and to provide mounting support. They are not essential for detector operation and may be be shortened or removed entirely to best fit your situation. Use caution, do not damage the leads.
- ★ 4,700 ohm (4.7k) resistor to select alternating action or cross-over mode.



How it works: Trains are detected by infrared (IR) light, invisible to the human eye. There are two sensing elements at each track location - an IR LED light source paired with an IR receiver. The turnout can be controlled manually by connecting push buttons to the D2T. Green and red LEDs on the D2T show the status of the detectors and the position of the turnout points.

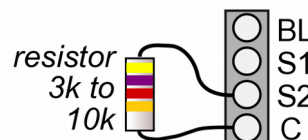
Operation Options

● **Derail prevention, single turnout control:** The two IR sensor pairs are installed to detect trains approaching the frog end of a turnout (track switch). Sensor pair #1 is placed on the 'main' track (green). When a train triggers this sensor pair, the turnout points (the movable rails at the end opposite the frog) will align for the main track. Sensor pair #2 is placed on the 'branch' track (red). Triggering sensor pair #2 will align the turnout for the branch track.

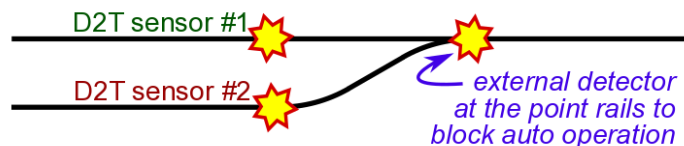


Safety lockout: If a second train approaches the turnout while the first train is still on its sensor, the D2T will keep the turnout points aligned for the first train. **The D2T waits until the first sensor has been clear for four seconds**, then it will align the points for the second train. The first train must move fast enough so its last car clears the points within four seconds after it clears its sensor.

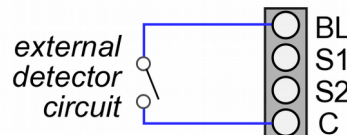
The safety lockout duration can be shortened to 1/2 second by connecting a resistor with a value between 3000 and 10,000 ohms, to terminals 'S2' and 'C.'



● **Blocking the automatic control:** To positively prevent the D2T from moving the points while a train is on the points, an external detector such as an Azatrax MRD1 can be located at the turnout points. Connect the external detector's output so it connects D2T terminal 'BL' to terminal 'C.'

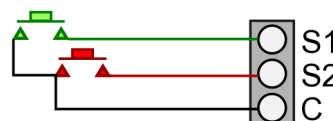


As long as 'BL' is connected to 'C', the D2T will not move the points in response to its IR sensors. The D2T will, however, move the points in response to manual push buttons.

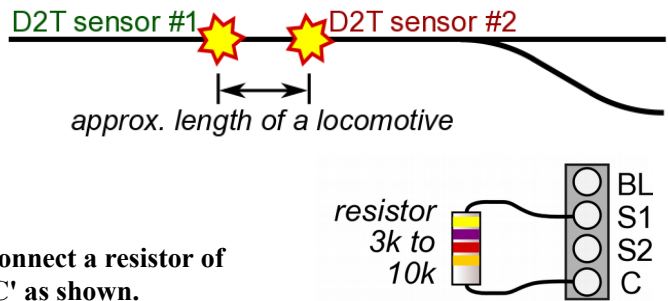


● **Manual operation (optional):** To have manual operation of the turnout, connect two push buttons as shown here. Use push buttons that are "momentary, normally open."

Pressing the button connected to 'S1' will align the turnout for the main track, pressing the button connected to 'S2' aligns the turnout to the branch track.



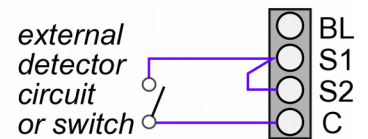
● **Alternating action with direction sensing:** Moves the points to the opposite position when a train approaches the points end of the turnout. **Trains will automatically alternate between taking the main line and the branch line.** The two IR sensor pairs are placed on the track leading to the turnout points. The D2T changes the points position only when sensor pair #1 is triggered before sensor pair #2.



To enable alternating action with direction sensing, connect a resistor of 3,000 (3k) to 10,000 (10k) ohms from 'S1' to 'C' as shown.

Push buttons for manual operation may also be connected to 'S1' and 'S2', see above.

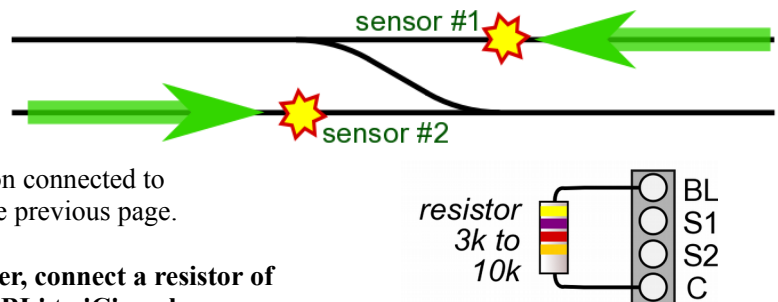
● **Alternating action, external trigger:** Moves the points to the opposite position in response to an external switch or detector circuit. Connect terminals 'S1' and 'S2' together, then connect to an external momentary switch or detector circuit (such as an Azatrax MRD1) as shown here. The switch should be “normally open.”



Closing the contact will move the turnout points to the opposite position (from main line to branch line, or from branch line to main line). The switch must be released (opened) for at least four seconds before the D2T will respond to another contact closure. This is to avoid inadvertent points movement while a train is moving through the turnout.

● **Derail prevention at a cross-over:** Two turnouts can make a 'cross-over' that allows a train on one track to cross over to the other track. If a train takes the cross-over and the operator neglects to set the turnout points back to the main lines (straight-through), then if the next train approaches from the opposite direction it is at risk of derailling on the turnout points.

Preventing this type of derailment is similar to preventing derailments at a standard single turnout, except that at a cross-over, both IR sensor pairs will set the two turnouts to the main line (straight-through) position. Setting the points to the cross-over position must be done manually with a push button connected to terminals 'S2' and 'C.' See “Manual operation” on the previous page.



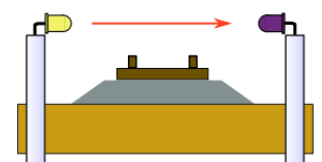
To enable derail prevention at a cross-over, connect a resistor of 3,000 (3k) to 10,000 (10k) ohms from 'BL' to 'C' as shown.

The two switch machines are connected in parallel to the D2T 'M1' and 'M2' terminals. They will operate simultaneously, therefore **the power supply must have sufficient power capacity to operate two switch machines at the same time.**

Install the sensors

Each sensor pair may be installed in one of two ways - 'Across the Track' or 'Reflective.' Choose locations according to how you will use the detector -- see 'Operation Options' on pages 1 & 2. Sensor leads may be extended up to 26 ft (8 meters) with similar twisted pair wire. Wire from telephone or 'Cat 5' computer cable works well.

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

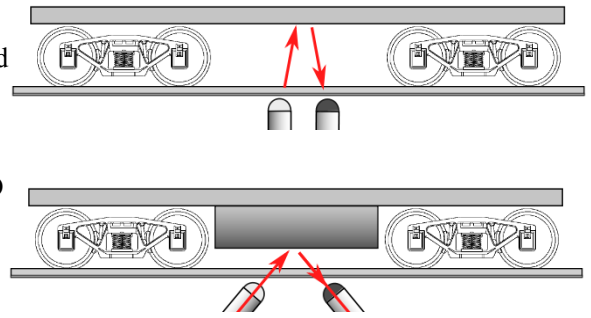


Tip #1 - If mounting the sensors vertically as shown here, slide the plastic tubes away from the sensor then carefully bend the leads to a right angle. The leads are somewhat brittle, bending them more than two or three times may cause a break.

Tip #2 - Locate the receiver so it faces away from bright lights or sunny windows. Sensors can be concealed by scenery or structures.

Always turn off power before making or changing connections !

Reflective sensing: Trains are detected when light from the IR LED is reflected off a train and sensed by the IR receiver. Typically the sensors are mounted in two #12 (3/16 inch or 4.8mm) holes drilled in the roadbed as shown here. Vertical installation works for S, O and larger scales as long as there is no structure above the track such as a bridge.

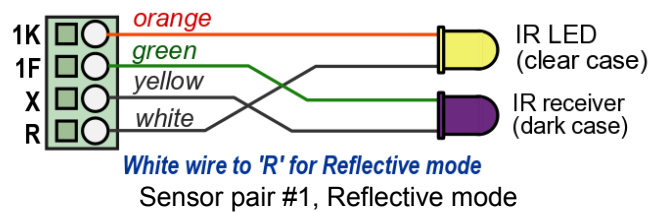
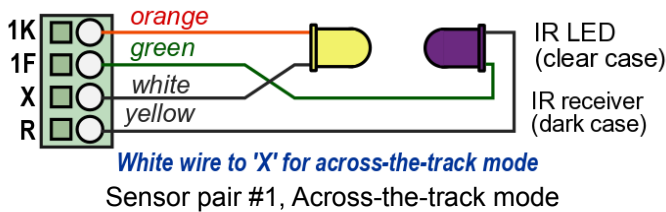


Angling the IR LED and receiver toward each other is best for N and HO scale where trains are close to the rail head, and in places where an object above the track might otherwise cause false detections. Angle the IR LED and its receiver so their centerlines intersect at the height of the bottom of your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

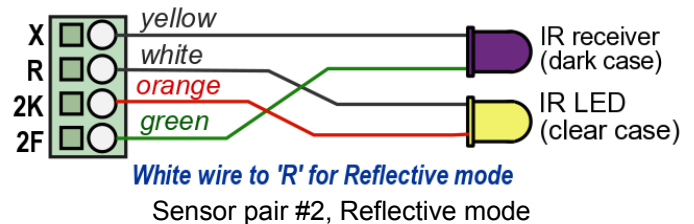
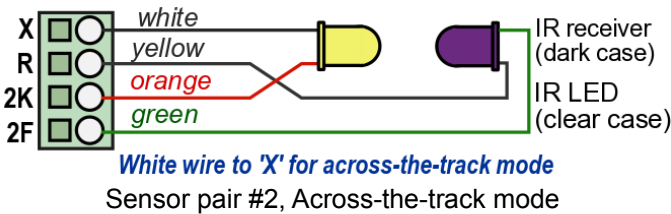
Tip #3 - You can ballast your track after sensors are installed. Cover each sensor with a bit of transparent tape. Apply ballast. When the glue has dried, use a dental pick or similar tool to remove ballast from the sensors. An opening of only 1 or 2 mm is required.

Connect the sensors to the D2T circuit board

Connect sensor pair 1: How you connect the IR LED and its receiver to the D2T module determines whether Detector #1 operates in 'Across the Track' or 'Reflective' mode. Strip the end of the sensor wire. Firmly push down the square button on the terminal block and insert the wire at a 45° angle. Release the button and tug on the wire to verify it is secure.



Add connections for sensor pair 2: Detector #2 can operate in the same mode as Detector #1, or in a different mode. Note that when both sensor pairs are wired to the D2T, there will be two white or yellow wires in terminals 'R' and 'X.' Additional wire may be spliced to the sensor leads if needed. Use similar twisted pair wire for total length up to 25 ft (7.5m).



Connect power to the D2T-3W circuit: 12 to 16 volts AC or DC works well with most switch machines. If one side of the power supply is connected to a layout 'common' or 'ground,' connect it to terminal 'P2'. Connect the 'hot' side to 'P1.'

When power is turned on, the D2T checks whether the IR LEDs are connected or not.

- If IR LED #1 is connected, then the green on-board LED #1 will flash three times.
- If IR LED #2 is connected, then the red on-board LED #2 will flash three times.
- If no IR LEDs are connected, the on-board LEDs will flash four times in unison.



On-board LEDs: A green and a red LED show the status of the sensors and the turnout position.

If the turnout points are positioned for the main track, the green #1 LED will be on.

If the turnout points are positioned for the branch track, the red #2 LED will be on.

A flashing green #1 LED indicates that IR sensor pair #1 is detecting a train or other object.

A flashing red #2 LED indicates that IR sensor pair #2 is detecting a train or other object.



Adjust the sensors / troubleshooting:

With no trains in either detection zone, the green and red LEDs on the D2T should not be flashing. If either LED is flashing, 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 its receiver are pointed at each other, and nothing is between them.
3. Shade the 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 receiver a bit deeper into the roadbed.
3. Infrared light may be 'leaking' through the roadbed material from the IR LED to the receiver. Push a metal shim, such as the tip of a hobby knife blade, vertically into the roadbed between the IR LED and receiver.
4. Is there an object above the sensor, such as a bridge, or an upper layout level? Mount the IR LED and its receiver at a shallower angle, or paint the overhead object black. Or use across-the-track sensing.

Both detectors now off? Good, now **test for train detection**. Place a locomotive or car in the detection zone of IR sensor pair #1. The on-board green LED #1 should flash. If the red LED #2 also flashes, re-adjust IR sensor pair #2 for false detection (see above). If the green LED does not flash, correct sensor pair #1 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 its 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 receiver. Try pulling the receiver deeper into the roadbed or create shade with scenery or a structure. Change the nearby light to a fluorescent or LED bulb.

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

Remove the train from IR sensor #1's detection zone, make sure the green LED stops flashing.

Place a train in IR sensor #2's detection zone. The on-board red LED should flash. If the green LED also flashes, adjust IR sensor pair #1 for false detection (see above). If the red LED does not flash, adjust sensor pair #2 for a false clear condition (same as above for sensor pair #1).

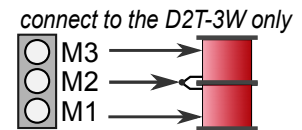
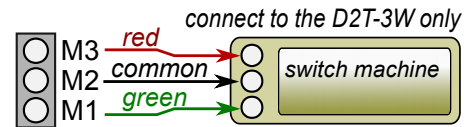
Connect the switch machine

Twin-coil machines are driven by one brief pulse of current.

The switch machine connects to D2T-3W terminals M1, M2 & M3.

If the points move in the wrong direction, swap the wires at M1 & M3.

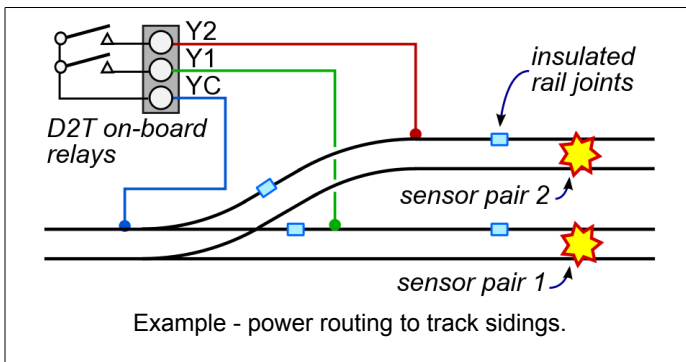
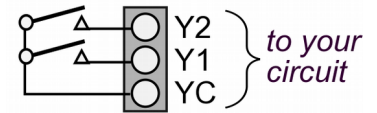
**Do not connect to other buttons or circuits.
Do not connect 'M2' to a layout 'common' or 'ground.'**



On-board relay contacts: A single pole (SPST) relay is connected to terminals Y1 and YC, and a second SPST relay is connected to terminals Y2 and YC.

Y1 connects to YC when the turnout is lined to the main track.

Y2 connects to YC when the turnout is line to the branch track. The relay contacts are rated 3 amps, 30 volts max.



Example - power routing to track sidings.

