

**What it is:** The D2T-DS is a two-channel model train detector using advanced infrared ('IR') technology. It detects trains moving across its two IR sensors and can activate two different electrical circuits depending on which direction the train is moving.

**Kit contents:**

- ★ Circuit board
- ★ Two infrared light-emitting diodes (IR LEDs) with red & white wire leads
- ★ Two IR receivers with blue & 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 shortened or removed entirely to best fit your situation. Use caution, do not damage the leads.
- ★ One 4.7k (4700 ohms) resistor for longer output pulse (see below).

**How it works:** Trains are detected by infrared (IR) light, invisible to the human eye. There are two sensing elements at each sensor location - an IR LED light source paired with an IR receiver.

Green and red LEDs on the D2T show the status of the detectors and which of the two output circuits is active.

**Output Connections**

The D2T-DS has two single pole (SPST) relays on board. The contact of the first relay is connected to terminals 'Y2' and 'Y1.' The contact of the second relay is connected to terminals 'YC' and 'Y2.' Terminal 'YC' is common to both relays. These relay contacts act as electrical switches, they 'make' (connect) or 'break' (disconnect) a circuit. *No voltage is provided by the D2T-DS at these terminals.*

Your circuit must include a power supply appropriate for the accessory you are controlling.

**Power Connection**  
Connect an accessory power supply to terminals 'P1' & 'P2.' Voltage should be 9 to 16 volts AC or DC, +/- polarity does not matter.

**Always turn power off before making connections to the D2T-DS.**

**Operation Options**

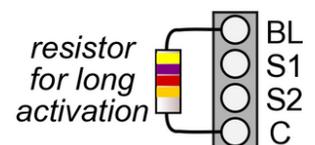
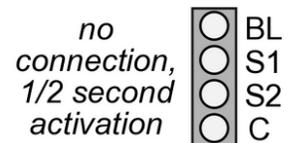
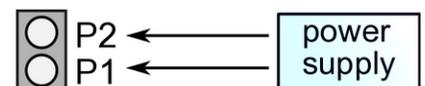
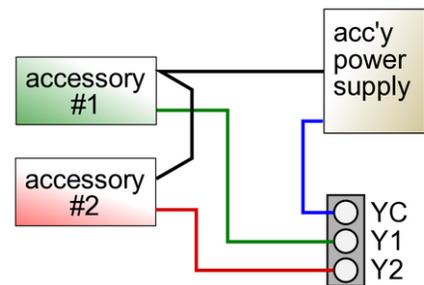
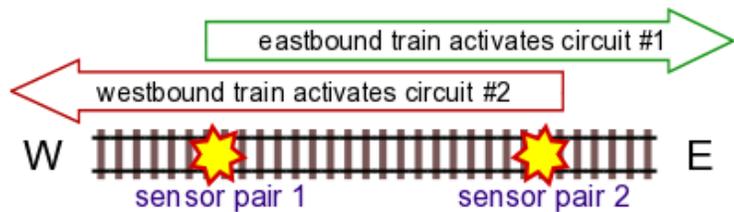
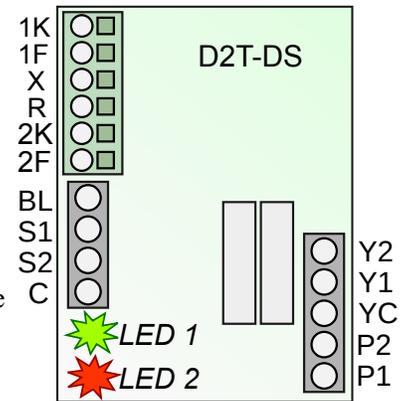
Choose one of the following operating modes.

- **Normally open momentary, single pulse, directional (default):** For activating solenoid-equipped accessories like track switches, two-solenoid semaphores, or latching relays.

**To select this operating mode, leave terminals 'S1,' 'S2' and 'BL' disconnected.**

When a train trips sensor #1 first, the Y1 relay will briefly close for 1/2 second. As the train continues past sensor #2, the D2T-DS will not activate the output relays until after the train has cleared both sensors. Similarly, if a train first trips sensor #2, the Y2 relay will briefly close for 1/2 second.

**For a longer relay "on time"** connect a resistor from terminal 'BL' to 'C' as shown. Use a resistor between 1k (1,000) and 10k (10,000) ohms to produce an output pulse of 1 to 10 seconds. The 4.7k resistor included with the D2T-DS will produce a 5 second output pulse.



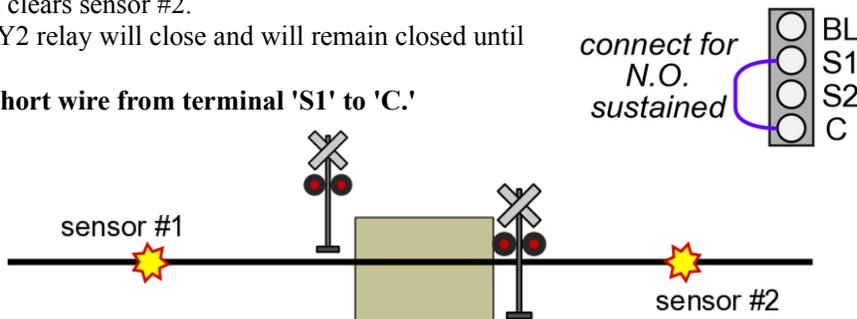
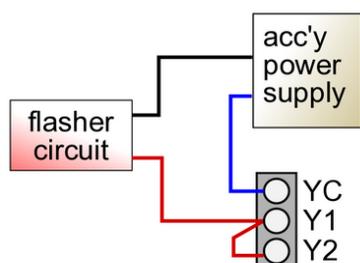
What if a train trips the first sensor, then stops and backs up? If the second sensor does not detect a train within 12 seconds after the first sensor clears, the D2T-DS will reset itself and will be ready to activate its relays when another train arrives.

**For this reason, place the two IR sensors close enough to each other so that a short, slow train will not leave the two IR sensors 'vacant' for more than 12 seconds.**

● **Normally open (N.O.), sustained:** The D2T-DS will close its Y1 relay when a train first trips sensor #1, and will keep the Y1 relay closed until the end of the train clears sensor #2.

Similarly, if a train first trips sensor #2, the Y2 relay will close and will remain closed until the end of the train clears sensor #1.

To select this operating mode, connect a short wire from terminal 'S1' to 'C.'



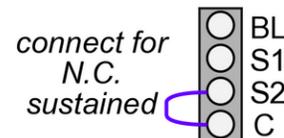
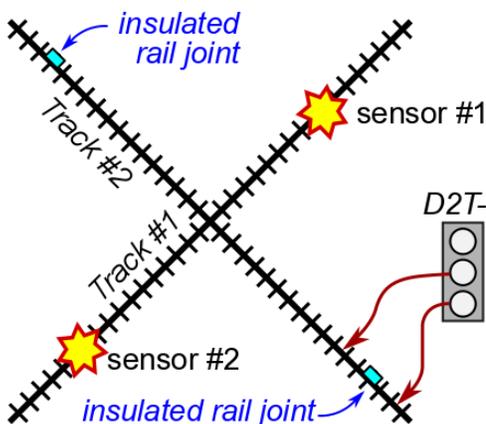
**Example:** Connecting terminals 'Y1' & 'Y2' together allows you to operate the same accessory for trains moving in either direction. This example shows a simple control of a highway crossing signal. Note that the flasher circuit is not part of the D2T-DS.

● **Normally closed (N.C.), sustained:** In this operating mode, both Y1 and Y2 relays are normally closed ('on'). When a train first trips sensor #1, the Y1 relay contact will open. Y1 stays open until the end of the train clears sensor #2.

Similarly, if a train first trips sensor #2, the Y2 relay contact will open and will remain open until the end of the train clears sensor #1.

Both relays are open when power is off.

To select this operating mode, connect a short wire from terminal 'S2' to 'C.'



What if a train trips the first sensor, then stops and backs up? If the second sensor does not detect a train within 20 seconds after the first sensor clears, the D2T-DS will close both Y1 & Y2 contacts and will reset itself. It will activate its relays again when another train arrives.

**For this reason, place the two IR sensors close enough to each other so that a short, slow train will not leave the two IR sensors 'vacant' for more than 20 seconds.**

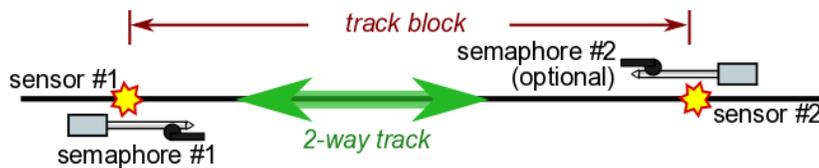
**Example:** Collision protection at a diamond crossing.

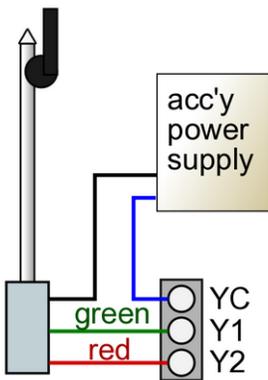
Sensors are placed on either side of the crossing on Track #1. One rail of Track #2 is isolated with an insulating rail joint (or gap) on either side of the crossing. Track power is routed to the isolated rail through terminals 'Y1' and 'Y2.' Terminal 'YC' is not used. A train approaching on Track #1 will trip one sensor which will interrupt power to the isolated section of Track #2. Power will be re-connected after the end of the train passes the second sensor.

For complete protection at the crossing, another D2T-DS circuit should be installed with its sensors on Track #2 and its 'Y1' & 'Y2' terminals controlling power to Track #1. Make sure the sensors are closer to the crossing than the insulated rail joints. A train entering a 'dead' track section should stop before it triggers the IR sensor.

● **Normally open (N.O.) momentary, dual (entrance & exit) pulses, not direction-sensitive:** For signaling a track block with twin-coil two-position semaphores. Place the two sensors on the same track. The length of track between the sensors is called a 'block.'

When a train first trips a sensor (either sensor #1 or sensor #2), the Y2 relay will briefly close for 1/2 second to indicate the



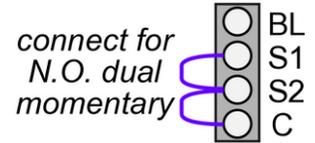


block is occupied. As the train continues to the other sensor and then clears it, the Y1 relay will briefly close for 1/2 second to indicate the block is clear.

This dual momentary mode works the same for trains moving in either direction.

Connect the semaphore(s): One or two twin-coil semaphores may be used. Typically each has three wires for the coils (solenoids); green, red and black. Connect to the D2T-DS as shown here. There may also be other wires for a lamp in the semaphore, See the manufacturer's instructions for proper connection.

**To select this operating mode, use two short wires to connect terminals 'S1' and 'S2' to 'C.'**



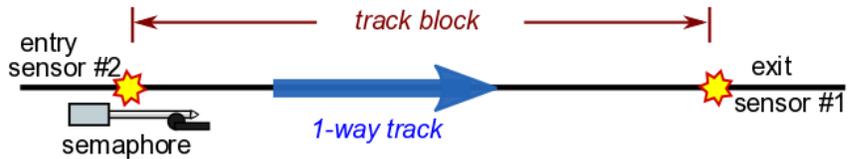
What if a train trips the first sensor, then stops and backs up? If the second sensor does not detect a train within 20 seconds after the first sensor clears, the D2T-DS will activate relay Y1, setting the semaphores to green. The D2T-DS then resets itself and will be ready to activate its relays when another train arrives.

***For this reason, place the two IR sensors close enough to each other so that a short, slow train will not leave the two IR sensors 'vacant' for more than 20 seconds.***

● **Block Occupancy Indication with Memory:** When the D2T-DS is used on a **one-way track**, you can enable its “non-volatile” memory so it will remember if a block was occupied the last time power was on.

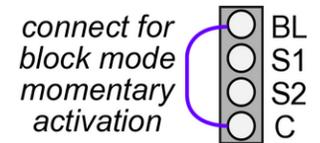
**Activating momentary accessories:**

Some accessories such as twin-coil semaphores and latching relays require momentary activation. Connect the semaphore to the D2T-DS and to the power supply as shown above. The D2T-DS will momentarily energize terminal Y2 when a train is detected by sensor #2, the entry sensor. The red LED on the D2T-DS module will light. When the rear of the train clears sensor #1, the exit sensor, terminal Y1 will be momentarily energized. The green LED on the D2T-DS module will be lit.



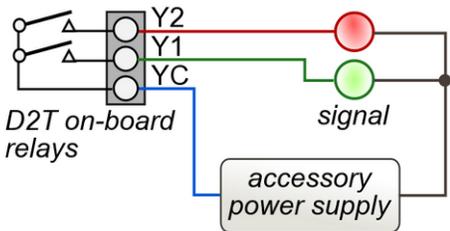
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**To select this operating mode, connect a short wire from terminal 'BL' to terminal 'C' to enable one-way block indication with memory. Leave terminals 'S1' and 'S2' unconnected to enable momentary activation.**

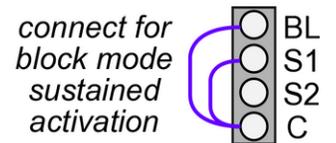


**Sustained activation of accessories:**

Other accessories such as single coil semaphores and 2-lamp (green/red) block signals require sustained (continuous) activation. Sensor placement is the same as above, sensor #2 at the block entrance and sensor #1 at the exit. When a train enters the block, terminal Y2 will be energized continuously and the red LED on the D2T-DS module will be lit. When the rear of the train clears sensor #1, the exit sensor, terminal Y2 will de-energize and terminal Y1 will be energized. The green LED on the D2T-DS module will be lit.



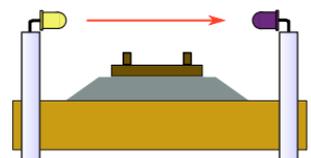
**To select this operating mode, connect a short wire from terminal 'BL' to terminal 'C' to enable one-way block indication with memory. Connect a second wire from 'S1' to 'C' to enable continuous activation.**



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.

**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

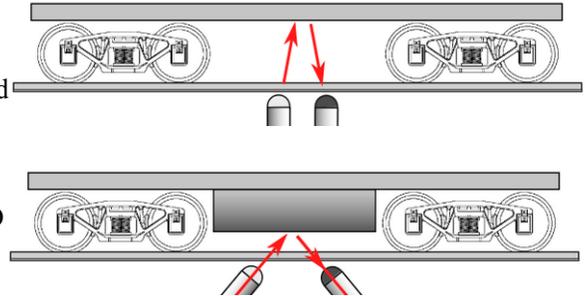


path between the LED and receiver. The distance between the LED and its receiver can be up to 18 in. (46 cm). With careful alignment longer distances can be achieved.

**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. 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 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.



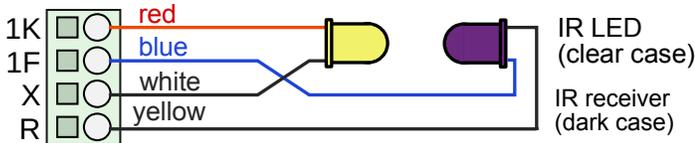
Angling the IR LED and receiver toward each other is best for N and HO scale where the trains are close to the rail head, and in places where an object above the track might otherwise cause false detections. Angle the IR LED and receiver so their centerlines intersect at the height of the bottom of your 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, pick off ballast from the sensors. An opening of only 1 or 2 mm is required.

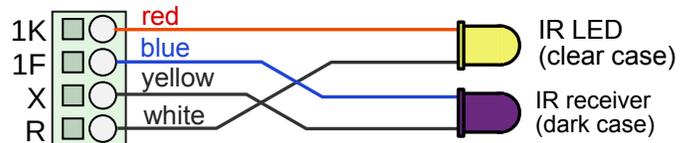
Connect the sensors to the D2T circuit board

**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.

Orange or red wires connect to 'K.' Green or blue wires connect to 'F.'

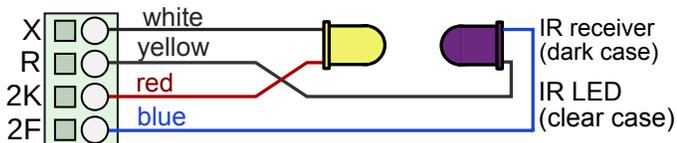


*White wire to 'X' for across-the-track mode*  
Sensor pair #1, Across-the-track mode

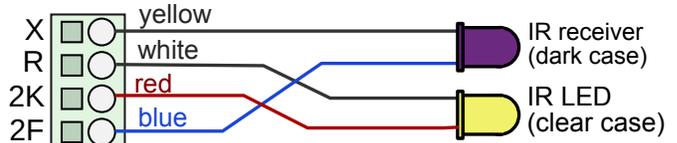


*White wire to 'R' for Reflective mode*  
Sensor pair #1, Reflective mode

**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 26 ft (8 m).



*White wire to 'X' for across-the-track mode*  
Sensor pair #2, Across-the-track mode



*White wire to 'R' for Reflective mode*  
Sensor pair #2, Reflective mode

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

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

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

A steady green LED indicates the train cleared sensor pair #1 but has not yet cleared sensor pair #2.

A steady red LED indicates the train cleared sensor pair #2 but has not yet cleared sensor pair #1.



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.

If both detectors are off, **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. Pull the receiver deeper into the roadbed or create shade with scenery or a structure. Or 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 red LED does not flash, adjust sensor pair #2 for a false clear condition (same as above for sensor pair #1).