

What it is: The MRD2 'turnout' edition is a two-channel model train detector. It can detect model trains at two different locations on the layout and activate two electrical circuits.

Kit contents:

- ★ Circuit board
- ★ Two infrared light-emitting diodes (IR LEDs) with orange & white (2 ft length) or red & white (6 ft length) wire leads
- ★ Two infrared phototransistors (light receivers) with green & yellow (2 ft length) or blue & yellow (6 ft length) 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. Just use caution not to damage the leads.
- ★ Resistor and diodes for use with 3-color LED block signals (see Block Signal Mode)
- ★ Digital output connector
- ★ Mounting screws

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 phototransistor (the receiver). The output relay contacts are electrically isolated from the detector electronics. Green and red LEDs on the MRD2 show the status of the detectors.

The action of the relays and LEDs in response to train detection depends on the operating mode selected by the user. The available operating modes are:

- ◆ Dual independent detectors
- ◆ Turnout or two-position semaphore control with twin-coil ('snap') switch machine
- ◆ Turnout or two-position semaphore control with slow-motion switch machine
- ◆ Single 3-color LED block signal control

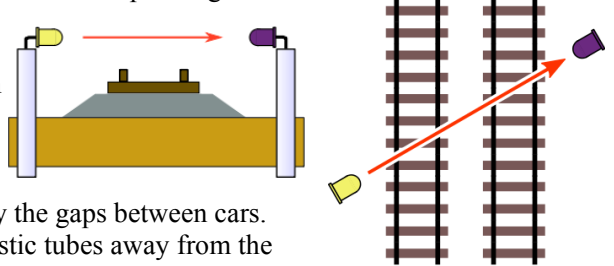
Details are covered below under 'Operating Modes.'

Installation

There are five installation steps: Sensor installation, Power connection, Sensor adjustment, Mode selection and Output connection.

First, install the sensors: Each sensor pair may be installed in one of two different ways - 'Across the Track' or 'Reflective.' Choose locations according to how you will use the detector -- see 'Operating Modes'.

Across the Track sensing: The IR LED is positioned horizontally on one side of the track(s), and the IR phototransistor is placed on the opposite side. A train is detected when it blocks the light path between the LED and phototransistor. The distance between the LED and phototransistor can be up to 18 in. (46cm), or more with careful alignment. Placing the sensors at an angle across the track(s) creates a longer detection zone and avoids possible detector flickering caused by the gaps between cars.

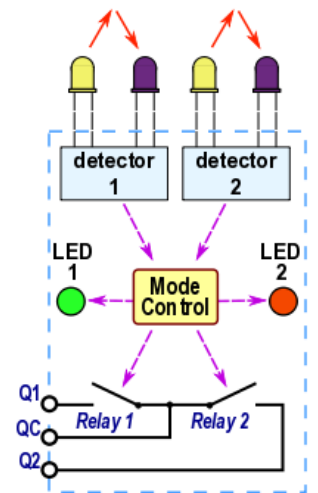
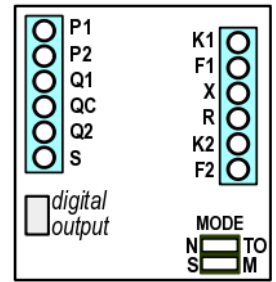
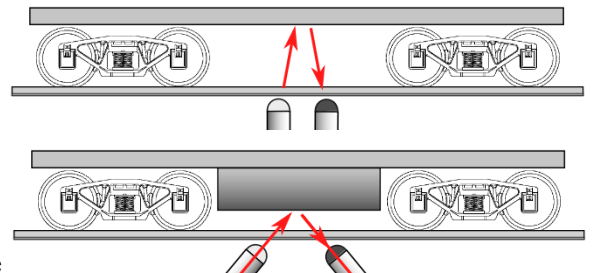


Tip #1 - If mounting the sensors vertically as shown here, slide the plastic tubes away from the sensor then carefully bend the leads to a right angle. The leads are somewhat brittle, bending them more than two or three times may cause a break.

Tip #2 - Locate the phototransistor (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.

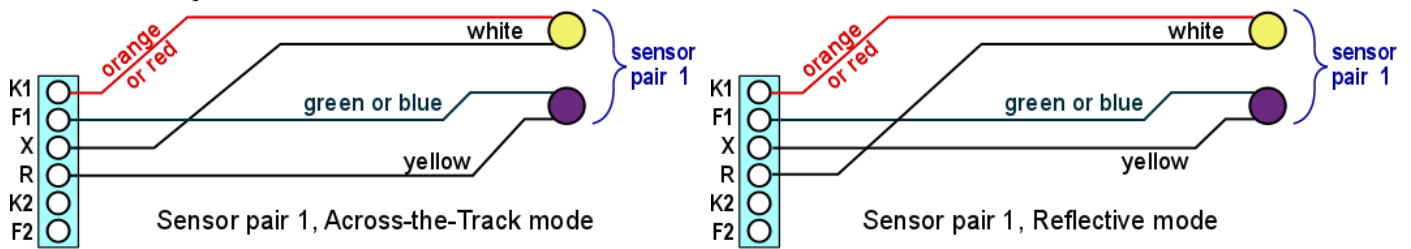
Tip #3 - The detection zone of each detector can be expanded by adding a second IR LED/phototransistor pair. Additional sensor pairs may be purchased from Azatrax, see the website www.azatrax.com for details.

Reflective sensing: Trains are detected when light from the IR LED is reflected off a train and sensed by the IR phototransistor. Typically the sensors are mounted in two 3/16-inch (4.8mm) holes drilled in the roadbed as shown here. Vertical installation works for HO and larger scales as long as there is no structure above the track such as a bridge. Angling the IR LED and phototransistor toward each other is best for N 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 phototransistor so their centerlines intersect at the height of the bottom of your rolling stock.

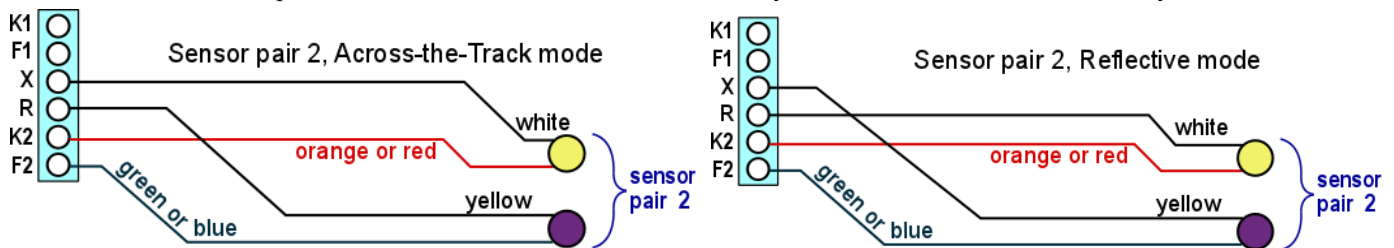


Tip #4 - You can ballast your track after sensors are installed. Cover each sensor with a bit of transparent tape. Apply ballast. When the glue has dried, use a dental pick or similar tool to remove ballast from the sensors. An opening of only 1 or 2 mm is required.

Connect sensor pair 1: How you connect the IR LED and phototransistor to the MRD2 module determines whether Detector 1 will operate in 'Across the Track' or '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: when both sensor pairs are connected, there will be two white/yellow wires in 'X' and two white/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 25 ft (7.5m).

Connect power to the MRD2 module: Connect an accessory power supply of 9 to 15 volts AC or DC to terminals P1 and P2. Do not connect the relay outputs Q1 and Q2 until after the sensors have been adjusted.

Adjust the sensors: Set the Mode switches to 'N' and 'S' and apply power to the MRD2. We use this mode because the on-board LEDs indicate detector status with no delays. But both relays could be closed at the same time, that's why we have not yet connected the relay output terminals Q1 and Q2.

With no trains in either detection zone, the green and red LEDs on the MRD2 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 LR LED and phototransistor are pointed at each other, and nothing is between them.
3. Shade the phototransistor 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 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 phototransistor a bit deeper into the roadbed.
3. Infrared light may be 'leaking' through the roadbed material from the IR LED to the phototransistor. Push a metal shim, such as the tip of a hobby knife blade, vertically into the roadbed between the IR LED and phototransistor.
4. Is there an object above the sensor, such as a bridge, or an upper layout level? Mount the IR LED and phototransistor at a shallower angle, or paint the object flat 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 Detector 1. The MRD2's green LED should light. If the red LED also lights, re-adjust sensor pair 2 for false detection (see above). If the green LED does not light, 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 the phototransistor.

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 phototransistor. 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 Detector 1's detection zone, make sure the green LED goes out.

Place a train in Detector 2's detection zone. The MRD2's red LED should light. If the green LED also turns on, adjust sensor pair 1 for false detection (see above). If the red LED does not light, adjust sensor pair 2 for a false clear condition (same as above for sensor pair 1).

Operating Modes - Selection and Wiring

Set the Mode switches on the MRD2 module according to the desired operating mode. Do not connect relay outputs Q1 and Q2 until after setting the Mode switches.

MODE N-S Dual independent detectors. Relay 1 is closed when a train is sensed by sensor pair 1, and opens 1/2 sec after the train leaves. Relay 2 is closed when a train is sensed by sensor pair 2, and opens 1/2 sec after the train leaves. This is the only mode that allows both relays to be closed at the same time.

Tip #5 - If you want the relay *closed* when a train is *not* present, and *open* when a train *is* present, install the sensors in Reflective mode but wire them for Across-the-Track operation. Or install them across the track, but wire for Reflective mode.

MODE N-M Single 3-color LED block signal. Sensor pair 1 is placed near the signal at the entrance to the block. Sensor pair 2 is placed some distance down the track, about a train's length from the signal. Normally the block signal shows green. When a train trips sensor 1, the signal turns red. The signal stays red while a train is on sensor 1 or 2. After the train clears sensor 2, the signal shows yellow for 10 seconds, then changes back to green. If a train trips sensor 1 but then reverses back out of the block, the signal stays red for 10 seconds then resets to green.

Note that the track block does not require insulated rail joints.

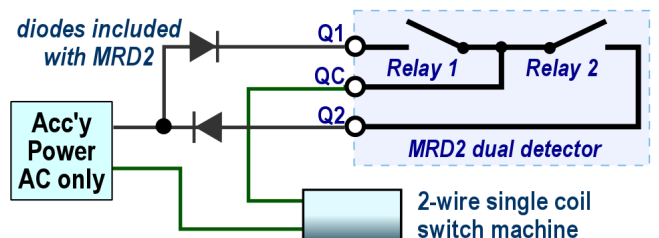
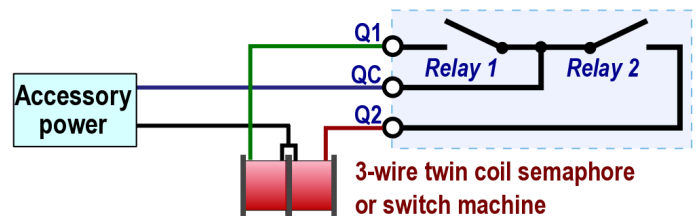
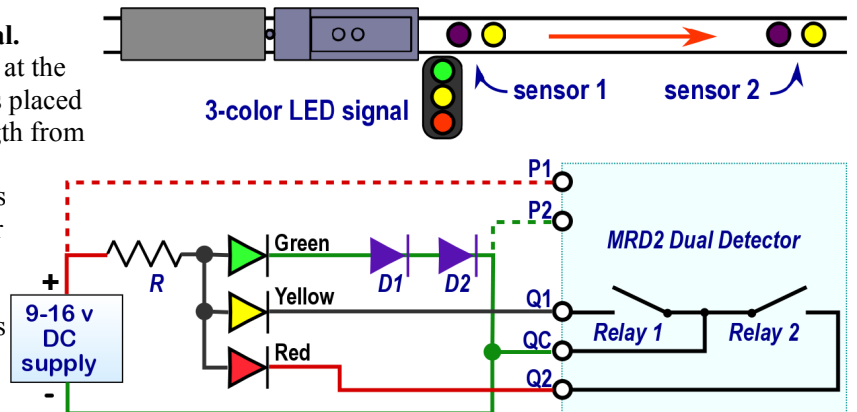
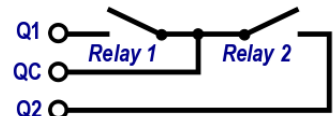
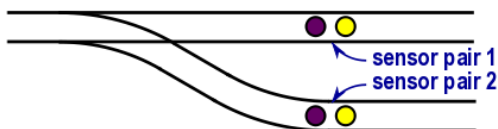
If the signal is pre-assembled with resistors, remove them and only use resistor R.

This wiring diagram shows a signal with LEDs wired in common-anode configuration (positive sides of the LEDs wired together). To use a signal wired as common-cathode, reverse the direction of D1 & D2, and swap the power supply polarity. A 1000 ohm resistor R and diodes D1 and D2 are provided in the MRD2 kit. The same power supply may be used to power the signal and the MRD2 module. To do so, connect P1 and P2 as shown with the dotted lines.

MODE TO-S Turnout or semaphore control with a solenoid ('snap') switch machine. Solenoid machines have momentary action. Twin-solenoid machines have three wires, single solenoid machines have two wires.

Output relay 1 (Q1) momentarily closes for 1/2 sec when sensor pair 1 first senses a train. Output relay 2 momentarily closes when sensor pair 2 first senses a train. The relays will not close simultaneously.

If a train is on one sensor, and another train then trips the second sensor, the MRD2 will not respond to the second train until four seconds after the first train clears the first sensor.



This gives the first train time to clear the switch before moving the points.

If your switch points move opposite to what you expect, swap the wires at Q1 and Q2.

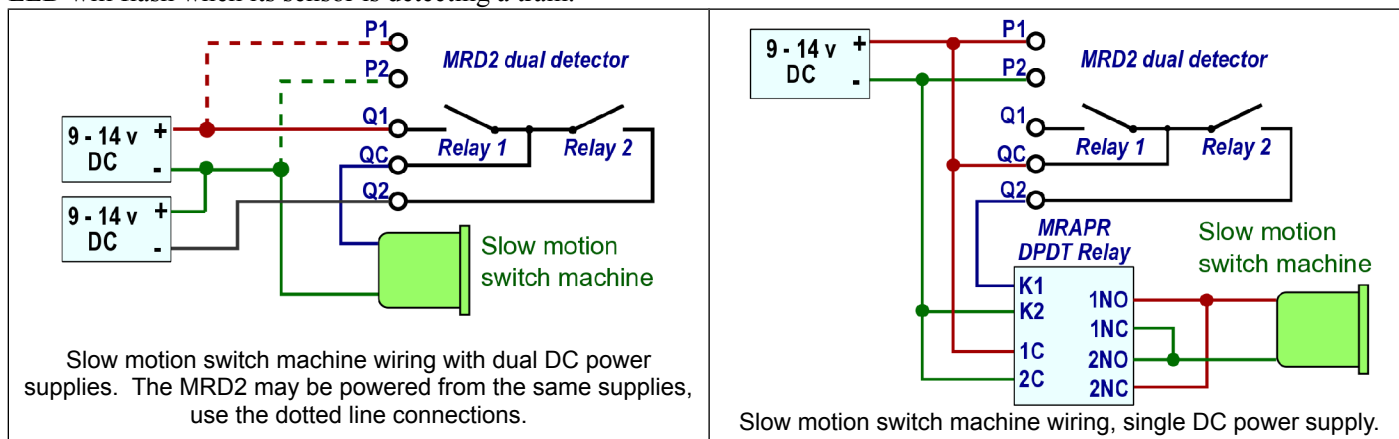
The on-board LEDs will show green when the switch is aligned with sensor 1's track, and red for sensor 2's track. Each LED will flash when its sensor is detecting a train.

Because of high current loads drawn by some twin-coil machines, the power supply for the switch machines should be separate from the supply connected to MRD2 terminals P1 and P2.

MODE
N **TO**
S **M**
TO-M Turnout or semaphore control with slow motion switch motor. Output relay 2 (Q2) opens and relay 1 (Q1) latches closed when sensor pair 1 senses a train. Output relay 1 opens and relay 2 latches closed when sensor pair 2 senses a train. The relays will not close simultaneously.

If a train is on one sensor, and another train then trips the second sensor, the MRD2 will not respond to the second train until four seconds after the first train clears the first sensor. This gives the first train time to clear the switch before moving the points. If your switch points move opposite to what you expect, swap the wires at Q1 and Q2.

The on-board LEDs will show green when the switch is aligned with sensor 1's track, and red for sensor 2's track. Each LED will flash when its sensor is detecting a train.



Alternatively, a slow motion switch machine may be connected to the 3-pin Digital Output connector. See page 5.

Output connection

After setting the Mode switches, connect terminals Q1, Q2 and QC according to the diagrams above.

Optional manual turnout control

When the MRD2 is used in turnout control mode, manual control of the turnout can be accomplished by adding two momentary push buttons, S1 and S2. Add the buttons and wiring, shown at right, to the existing wiring.

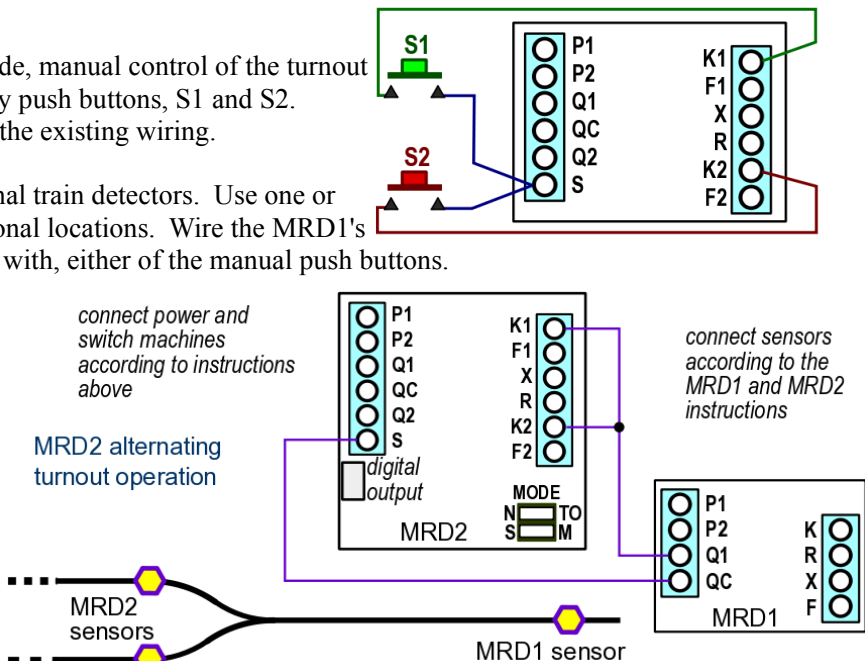
Tip #6 - The turnout can be tripped by additional train detectors. Use one or more Azatrax MRD1 single detectors at additional locations. Wire the MRD1's Q1 and QC terminals in place of, or in parallel with, either of the manual push buttons.

Alternating turnout operation

The MRD2 (rev. 6.0 and up) can be set up to change a turnout to its opposite position each time a sensor is triggered. The diagram at right shows how to wire the MRD2 to an MRD1 single detector.

Set the Mode switch according to the type of switch machine being used (see above).

When a train triggers the MRD1, the MRD2 will change the turnout to its opposite position. The turnout will only change once. The MRD1 sensor must be cleared for at least six seconds before the alternating function can be re-triggered.



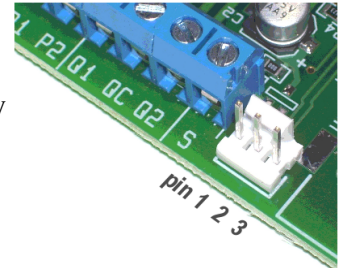
In this diagram, if trains all move from right to left, then one train will branch to the left, the next will branch to the right, and so on.

Caution: If trains are allowed to travel from the switch toward the MRD1 sensor (left to right in this diagram), be sure the distance from the points to the MRD1 sensor is longer than the longest train!

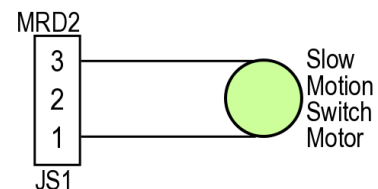
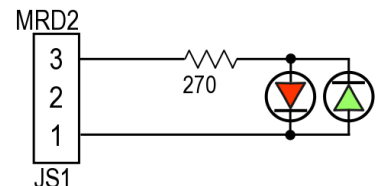
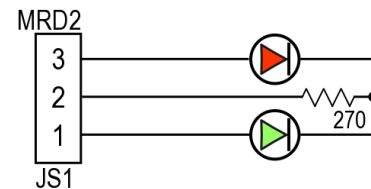
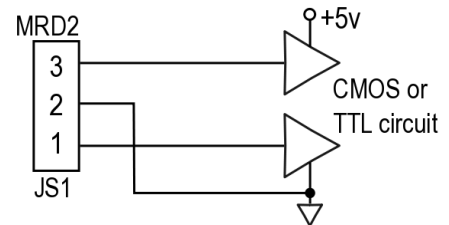
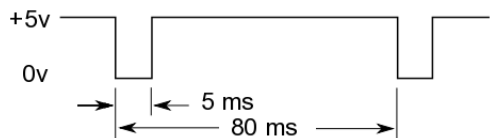
Optional external LED connection

External LEDs, such as panel indicators or a trackside signal, may be connected to the L1 and L2 solder terminals near the Mode switch. Connect the LED anode (usually the longer lead) to the '+' terminal, and the LED cathode (short lead) to the '-' terminals. The external LEDs will give the same indication as the two on-board LEDs. A current limiting resistor is on the circuit board, the external LEDs can be connected directly to L1 and L2, no other resistors are needed.

Digital Output Connector Two digital outputs are available at connector JS1. They can connect to the inputs of a 5 volt digital logic circuit or computer interface, or they can be used to operate remote LEDs or a slow-motion switch motor. An insulation-displacement connector is included for making a cable. Use AWG #24 stranded wire, press the wire firmly into the top of the connector. Or you can make a cable with any connector that mates with the AMP 640456-3 that is on the board.



Mode	Digital Outputs (Pin 2 is 'ground')
N-S	Pin 1: +5v when Detector 1 is sensing a train, otherwise 0v. Pin 3: +5v when Detector 2 is sensing a train, otherwise 0v.
N-M	Pin 1: +5v for 10 sec after a train has passed sensor 2, leaving the block (while signal is yellow). Otherwise 0v. Pin 3: +5v while a train is in the block (signal is red). Otherwise 0v.
TO-S	Pin 1: +5v when the switch points are in the 'green' position, 0v when the points are in the 'red' position. Pin 3: +5v when the switch points are in the 'red' position, 0v when the points are in the 'green' position. Pins 1 & 3 may be used to drive a slow-motion switch machine such as a Tortoise® or SwitchMaster®. This allows the MRD2's relay contacts to switch other circuits. Because the digital outputs are 5 volts, a Tortoise® will take 7 or 8 sec for full travel. For a SwitchMaster® motor, replace the 1200 ohm stock series resistor with a 300 to 390 ohm resistor to keep the 4 to 5 sec normal operating time. Connecting a Cobalt® motor to connector JS1 is not recommended. A Cobalt® will run <i>very</i> slowly. For MRD2 rev. 4.4 and later: To indicate that a detector is sensing a train, the digital output will be pulsed as shown below. A steady +5v output means the switch is set to that direction. A pulsing output means the switch is set to that direction and that detector is sensing a train.
TO-M	Same as TO-S mode above.



Tortoise® is a trademark of Circuitron, Inc., Romeoville, IL. SwitchMaster® is a trademark of Builders In Scale, Mukilteo, WA.