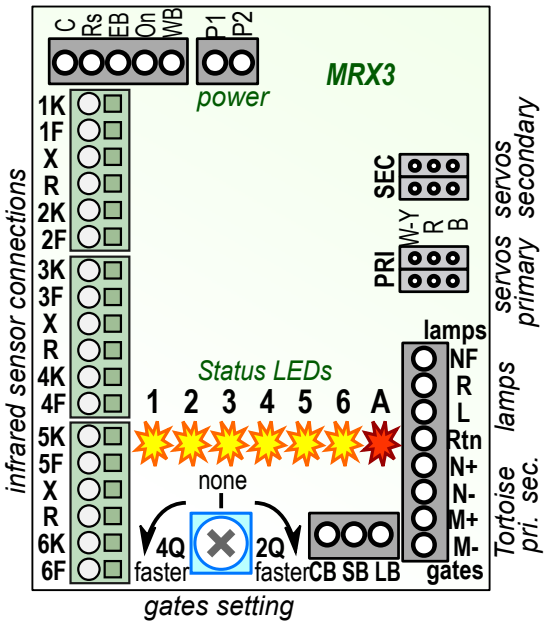


What it is: The MRX3 is a sophisticated controller that realistically operates model railroad / highway crossing signals. The MRX3 includes six infrared train detectors.

Kit contents:

★ Circuit board and mounting screws

If this controller was purchased with infrared train sensors, the kit also includes:

★ Infrared light-emitting diodes (IR LEDs) with orange & white (2 ft length) or red & white (6 ft length) wire leads

★ Infrared photo receivers with green & yellow (2 ft length) or blue & yellow (6 ft length) 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.

How it works: Trains are detected by infrared (IR) light, invisible to human eyes. There are two sensing elements at each track location - an IR LED light source paired with an IR receiver. Yellow LEDs on the MRX3 show the status of the detectors -- 'on' if the circuit is detecting an object, 'off' if no object is detected. External train detectors, such as current sensing block detectors may also be used with the MRX3. See page 6. Signals can have left/right flashing lamps and/or non-flashing lamps. Operating crossing gates are supported in either 2-quadrant or 4-quadrant configuration (see pg. 5). The MRX3 also has connections for triggering an external sound module or other accessories (see pg. 6).

Status LEDs: **At power-up** the LEDs quickly flash back-and-forth once to show that power is on and the processor is working. Then for two seconds the red 'A' LED will flicker and the yellow LEDs will show the gate speed set by the gate adjuster (below). If no yellow LEDs are lit at this time, the gate adjuster is set for 'no gates.'

During normal operation, the yellow LEDs show which of the six IR sensors are 'active' (detecting a train). The red 'A' LED will be lit continuously when the MRX3 determines that the crossing is 'hot' and the signals are active.

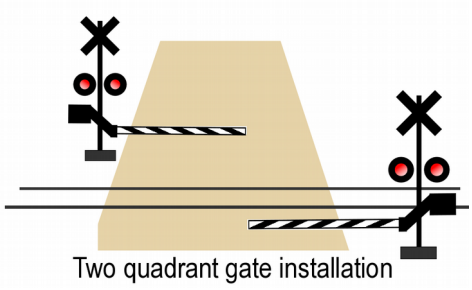
While turning the gate adjuster the red 'A' LED will flicker and the yellow LEDs show gate speed (up/down rate).

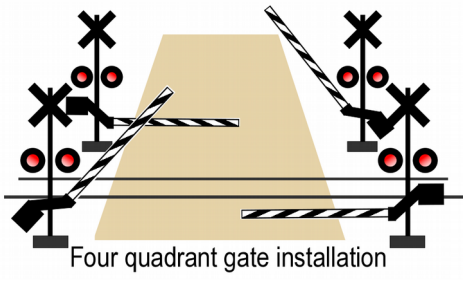
Gates setting adjustment: This is where you tell the MRX3 whether or not your signals have operating gates. If your signals do have operating gates, you also tell the MRX3 if you want 2-quadrant or 4-quadrant operation, and how fast you want the gates to move up & down.

No gates: Turn the adjuster to its center 'none' position, mid way between full clockwise and full anti-clockwise. The red 'A' LED will flicker as you turn the adjuster. When all yellow LEDs go out, you are at the center position.

2-quadrant gates: Turn the adjuster fully clockwise. All yellow LEDs will light, indicating max gate speed (up/down rate). If a slower rate is desired, turn the adjuster back gradually. The yellow LEDs will successively indicate lower gate speeds. Slowest gate speed is 1. In 2-quadrant operation, gate motors connected to the 'primary' and 'secondary' connections operate at the same time.

4-quadrant gates: Turn the adjuster fully anti-clockwise. All yellow LEDs will light, indicating max gate speed (up/down rate). If a slower rate is desired, turn the adjuster back gradually. The yellow LEDs will successively indicate lower gate speeds. Slowest gate speed is 1. In 4-quadrant operation, gates connected to the 'primary' connections will close before the 'secondary' gates close. When the crossing clears, the secondary gates open before the primary gates open.

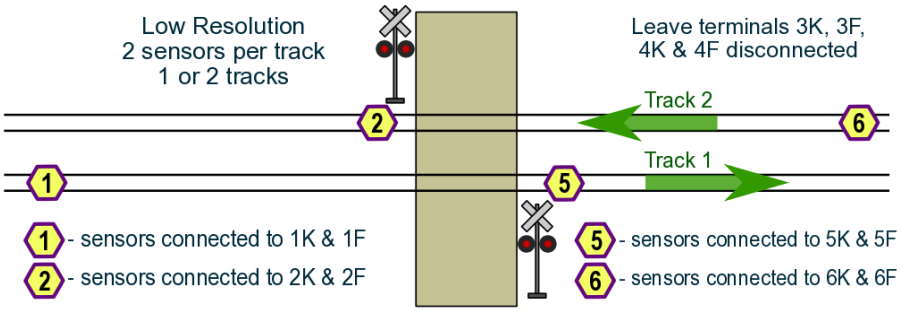

Two quadrant gate installation


Four quadrant gate installation

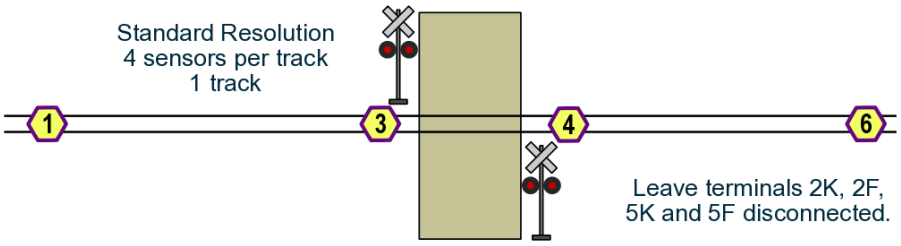
Sensor locations: Choose locations according to the number of tracks and the type of train movements that are expected at the crossing. There are three levels of train detection resolution. The higher the resolution, the more realistic the operation:

◇ **Low Resolution** -- Two detectors per track, one on each side of the crossing
◇ **Standard Resolution** -- Four detectors per track, two on each side of the crossing
◇ **High Resolution** -- Six detectors per track, three on each side of the crossing.

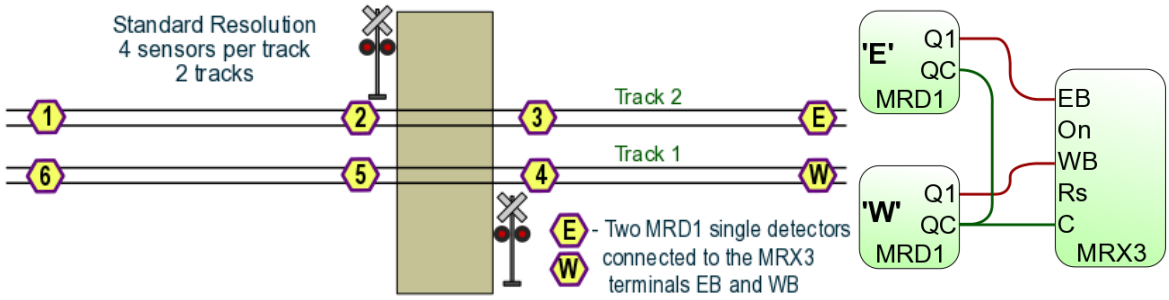
2 sensors per track, 1 or 2 tracks:
Signal turns on when a train on track 1 moves from left to right and triggers sensor 1. Signal stays on as long as the train is on either sensor 1 or sensor 5. If a short train leaves sensor 1 before reaching sensor 5, the signals will stay on for up to 30 seconds. Once the train clears sensor 5, the signals will turn off. Similar operation happens if the train on track 1 moves from right to left, encountering sensor 5 first. If trains travel in both directions on track 1, place the two sensors equal distances from the crossing. Sensors 2 and 6 on track 2 operate in the same way as the sensors on track 1.



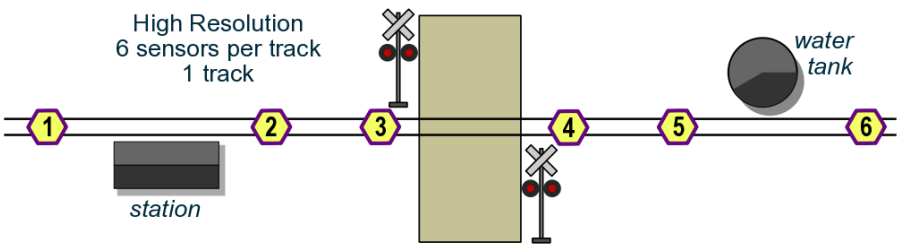
4 sensors, single track:
Signal turns on when a train moving left to right is detected by sensor 1. If the train does not reach sensor 3 within 30 seconds, whether it is still on sensor 1 or not, the signal tuns off. When the train does reach sensor 3, the signal remains on as long as the train is on either sensor 3 or 4. When the train clears both sensor 3 and sensor 4 the signal will turn off. Similar operation occurs when a train travels right to left.



4 sensors per track, 2 tracks:
Use two external detectors (Azatrax MRD1) in addition to the six detectors on the MRX3 to provide standard resolution detection for a double track crossing. Install the two single detectors according to their instructions, and connect them to MRX3 terminals 'EB' and 'WB' as shown. Each track is independently monitored in the same fashion described above for '4 sensors single track.'



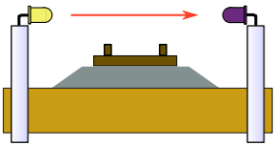
5 or 6 sensors, 1 track: Use five or six sensors per track when trains might stop or change direction within the crossing warning zone, or when trains of vastly different speeds use the same track. Signals turn on when a train moving left to right is detected by sensor 1. The train has 30 seconds to reach sensor 2 to keep the signal on. If the train stops before it reaches sensor 2, the signal will turn off even if the train remains on sensor 1. When the train starts again and resumes its motion toward the crossing, it trips sensor 2, turning the signal on again.
The train has another 30 seconds to reach sensor 3, or else the signal will turn off. While the train is on either sensor 3 or sensor 4 the signal will stay on.
Once the train clears sensors 3 and 4 the signal turns off. If the train is moving away from the crossing and it clears sensor 5, but then stops and changes direction (now moving right to left), the signal will turn on again when the train re-triggers sensor 5.



Use if switching moves occur near the crossing. To use just five sensors, leave either sensor 2 or sensor 5 disconnected.

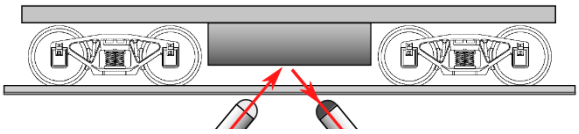
Choose mounting style: Each sensor pair may be installed in one of two different ways - 'Across the Track' or 'Reflective.'

Across the Track sensing: The IR LED is positioned horizontally on one side of the track(s), and its IR receiver is placed on the opposite side. A train is detected when it blocks the light path between the IR LED and its receiver. The distance between the IR LED and receiver 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 IR 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, 4.8mm) holes drilled in the roadbed as shown above. 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 its 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 cause false detections. Angle the IR LED and receiver so their centerlines intersect at the height of the bottom of your rolling stock.

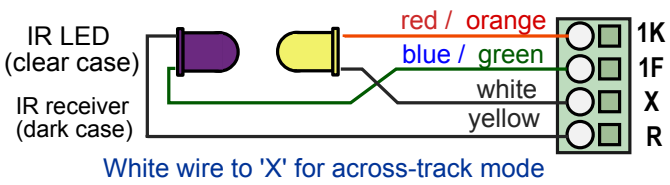
Tip #3 - Track can be ballasted after sensors are installed. Cover sensors with transparent tape. Apply ballast. When the glue has dried remove ballast from the sensors with a dental pick or similar tool. An opening of just 1 or 2 mm is required.

Connecting wires to the terminal blocks: The MRX3 has 'spring cage' terminal blocks for the IR sensors. Connections are made as follows:

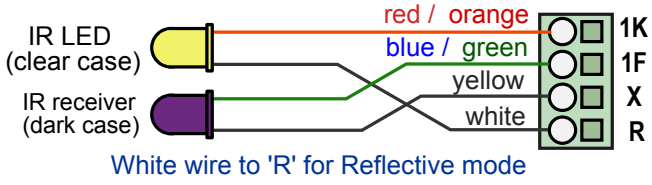
- ♣ Strip 3/8 inch (1 cm) of insulation off the end of the wire. You can measure with the strip gauge printed near the edge of the circuit board.
- ♣ Use a small screwdriver to push down (push, do not turn) the terminal's button. Push firmly.
- ♣ While the button is pushed in, hold the wire at a 45 degree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

Note that not all crossing signal systems will require installation of all six sensor pairs.

Connect sensor pair #1: Connect the orange (or red) wire from the IR LED to terminal 1K. Connect the green (or blue) wire from the IR receiver to terminal 1F. Now, how you connect the two white and yellow wires to the MRX3 will determine whether Detector 1 will operate in 'Across the Track' or 'Reflective' mode. See the diagrams below.



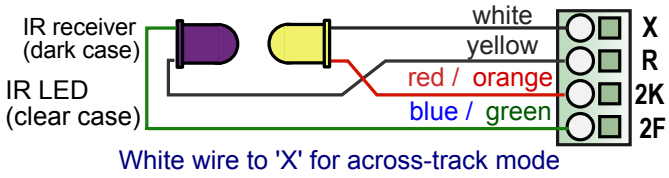
White wire to 'X' for across-track mode



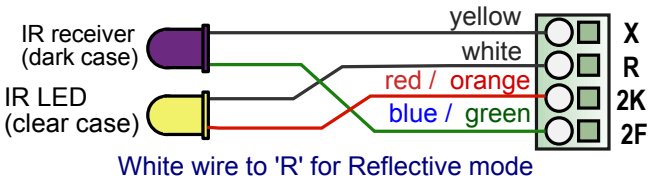
White wire to 'R' for Reflective mode

Add connections for the next sensor pair: (This example uses sensor pair #2, your installation may not use sensor pair #2). Connect the orange (or red) wire from the IR LED to terminal 2K. Connect the green (or blue) wire from the IR receiver to terminal 2F. As with sensor pair #1, how you connect the two white and yellow wires will determine whether Detector #2 will operate in 'Across the Track' or 'Reflective' mode.

Detector #2 can operate in the same mode as Detector #1, or in a different mode. When both sensor pairs are wired to the MRX3, there will be two white or yellow wires in 'X' and two white or yellow wires in 'R.' For best reliability, twist the ends of these wires together.



White wire to 'X' for across-track mode



White wire to 'R' for Reflective mode

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 1K must be paired on the layout with the IR receiver that is connected to 1F. Likewise the IR LED that is connected to 2K must be paired on the layout with the IR receiver that is connected to 2F. This is true for all sensor pairs.

Connect power to the MRX3: Connect a 9 – 15 volt AC or DC power supply to terminals P1 & P2.
The LEDs will briefly flash to show that power is on and the circuit is working.
Installations with operating gates should use a ***regulated*** 12 volt DC power supply that is rated for at least 600 milliamps (0.6 amp) output current. Tortoise® motor speed will change if the supply voltage changes.
R/C servos draw high current in short bursts, so a regulated DC supply works best.

Adjust the sensors:

Test and adjust sensor pairs #1 & #2 (if used) as follows before connecting the rest of the sensors:
With no trains in any of the detection zones, all of the yellow LEDs on the MRX3 module should be off. If any yellow 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 its receiver are pointed at each other, and nothing is between them.
3. Shade the IR 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.

To fix false sensing for Reflective mode:
1. Verify that the sensor pair is wired correctly.
2. Pull the IR LED and its 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 object flat black. Or use across-the-track sensing.

All detectors should be off. Now **test for train detection**. Place a locomotive or car in the detection zone of sensor #1. Yellow LED#1 should light. If yellow LED#2 also lights, re-adjust sensor pair #2 for false detection (see above). If LED#1 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 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 it 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 locomotives and cars, and adjust the sensors as needed.
Remove the train from sensor #1's detection zone, make sure LED#1 goes out.
Place a train in sensor #2's detection zone. The yellow LED#2 should light. If LED#1 also turns on, adjust sensor pair #1 for false detection (see above). If LED#2 does not light, adjust sensor pair #2 for a false clear condition (same process as above for sensor pair 1).

Connect the remaining sensor pairs: Turn off the power. Move on to the next input terminal block. Repeat the above

process, only for the sensors that will be used in your installation.

Sensor pair #3 (if used):
IR LED orange (or red) wire to 3K. IR LED white wire to X (for across-the-track) or R (for reflective mode).
IR receiver green (or blue) wire to 3F. IR receiver yellow wire to R (across-the-track) or X (reflective).

Sensor pair #4 (if used):
IR LED orange (or red) wire to 4K. IR LED white wire to X (for across-the-track) or R (for reflective mode).
IR receiver green (or blue) wire to 4F. IR receiver yellow wire to R (across-the-track) or X (reflective).

Turn on power. Test and adjust sensor pairs #3 & #4.

Sensor pair #5 (if used):
IR LED orange (or red) wire to 5K. IR LED white wire to X (for across-the-track) or R (for reflective mode).
IR receiver green (or blue) wire to 5F. IR receiver yellow wire to R (across-the-track) or X (reflective).

Sensor pair #6 (if used):
IR LED orange (or red) wire to 6K. IR LED white wire to X (for across-the-track) or R (for reflective mode).
IR receiver green (or blue) wire to 6F. IR receiver yellow wire to R (across-the-track) or X (reflective).

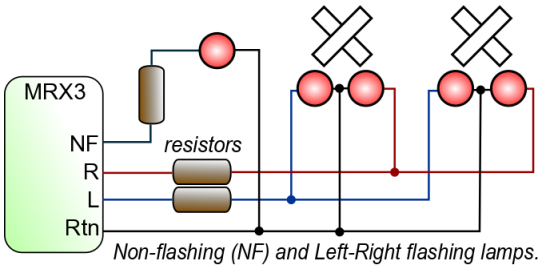
Turn on power. Test and adjust sensor pairs #5 & #6.

Connect signal lights

to these four terminals only:

NF - non-flashing lamps **R -** right side flashing lamps
L - left side flashing lamps **Rtn -** common return for all lamps

Connect signal lamps only to the above four terminals. **Do not** connect any signal to 'C' or to any other layout 'common' or 'ground' point.
Turn off power before changing connections.



Non-flashing (NF) and Left-Right flashing lamps.
Always use resistors with LED signals.

LED signals must always have resistors to limit current in the LEDs.
If signals are pre-assembled with resistors, use them. Otherwise include resistors in the signal circuits as shown above. Use 1/4 watt, 500 to 1000 ohm resistors. If the lamps seem too bright, use higher resistance (more ohms). If the lamps are too dim, try lower resistance. If the resistors get hot, use higher resistance, use higher wattage, or use a separate resistor in series with each signal.

It does not matter if your signals are wired as common anode (common positive) LEDs, common cathode (common negative) LEDs, back-to-back LEDs, or incandescent bulbs. However, **each signal must be of the same wiring configuration as all the other signals.**

If scratch building or assembling signals from kits, consider wiring the LEDs 'back to back' (left / right LEDs in parallel, anode to cathode). This method requires running only two wires to each signal from terminals 'L' and 'R' only.

Connecting Crossing Gate Motors

Tortoise® motors: Tortoise® switch machines (low current DC stall motors) may be used to operate crossing gates. Each motor can be mounted to drive a gate directly, or Circuitron's Remote Signal Actuator and Add-on Actuator & Cable kits (Circuitron 800-8100 & 800-8101) mounted under the layout will operate two gates with one Tortoise® motor.

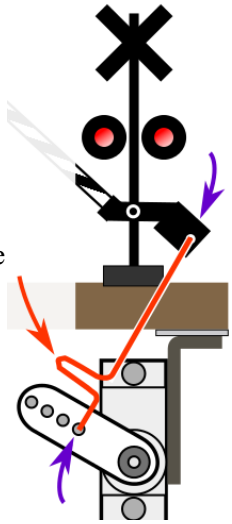
Connect one or two Tortoise® motors for the **primary** (entrance) gates to the **'M+' and 'M-'** terminals of the MRX3. Connect one or two Tortoise® motors for the **secondary** (exit) gates to the **'N+' and 'N-'** terminals. The M+ and N+ terminals will be positive to put the gates down. The M- and N- will be positive to put the gates up.
If your gates operate in the wrong direction, swap the two motor wires.

Tortoise® is a trademark of Circuitron, Inc.

R/C servo motors: Servo motors are small actuators used in radio controlled ('R/C') models. Servos can be used with the MRX3 to operate model crossing gates. Servos have three-wire cables attached, about six inches long (15cm). Extension cables are available. The MRX3 has two connectors for primary gate servos and two connectors for secondary gate servos. Connect servo cables with the **black** (or **brown**) wire aligned with **'B'** and the **white** (or **yellow**) wire aligned with **'W-Y'**. For smoothest operation use 'analog' servos. Avoid 'high speed' or 'high torque' servos. Examples of servos that work well with the MRX3 are HiTec HS-55, Futaba S3111 and HobbyKing HK-15178.

Only change connections to the MRX3 while power is off.
Servo connectors can be tight. Always support the circuit board with your fingers when removing a servo cable.

Gate Installation **Crossing gate actuating wires** are often placed too close to the pivot by the manufacturer. It looks good, but is not good for smooth operation. It's best to remove the factory wire, then drill a small hole in the gate or counterweight as far as practical from the pivot point. Drill a hole in the layout base at a 30 deg. angle and use 0.015 or 0.020 in. (0.5mm dia.) steel wire, or the factory wire. Making a hairpin bend in the wire as shown will enable small adjustments.

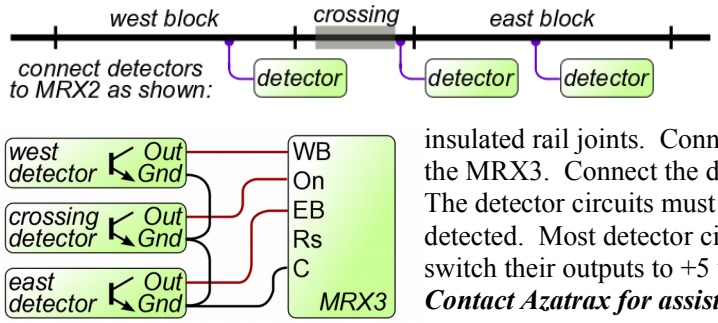


Determine which direction your servo operates. This is important because servo direction cannot be changed by swapping the wires! Temporarily install an actuator arm ('horn') on the motor shaft. Connect the servo to the MRX3, then turn on power. Connect terminal 'Rs' to 'C.' The motor will move to the gates-up position. Disconnect 'Rs' and connect terminal 'On' to 'C.' The motor will rotate about 45 degrees to the gates-down position.

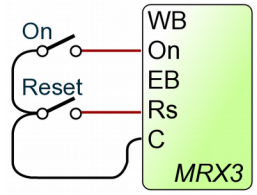
When mounting the servo under the layout, it is best to **start with the servo at the half-way position.** Turn off power to the MRX3. Connect terminal 'Rs' to 'C'. Turn on power. The servo will move to its center position until the connection to 'Rs' is removed.
With the servo in its center position, place the servo under the layout and secure the actuating arm so that the arm makes a 90º angle to the gate actuator wire. Prop the gate in the half-way position, then bend the gate actuating wire and insert in the actuator arm hole closest to the motor shaft. Remove the prop.

Put the gate in the **up** position by briefly disconnecting the 'Rs' terminal then re-connecting 'Rs' to 'C.' If the gate does not go up far enough, move the actuator wire to the next hole away from the motor shaft.

Put the gate in the **down** position by disconnecting the 'Rs' terminal then connecting 'On' to 'C.' If the gate does not go down far enough, move the actuator wire to the next hole away from the motor shaft. Repeat the process as necessary.

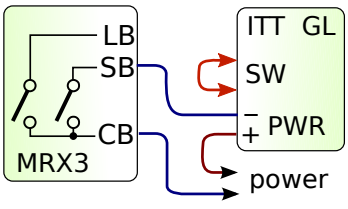


Block Detectors may be used with the MRX3 to protect one track instead of using the IR detectors. The track near the crossing is divided into three blocks by creating four insulated rail joints. Connect the 'ground' point of each detector to the 'C' terminal on the MRX3. Connect the detector outputs to terminals 'EB', 'On' and 'WB' as shown. The detector circuits must switch their output lines to 'ground' (0 volts) when a train is detected. Most detector circuits are designed this way. However, Digitrax detectors switch their outputs to +5 volts when active. This will not work with the MRX3. ***Contact Azatrax for assistance with Digitrax block detectors.***



Manual Override of the automatic operation is done with toggle switches.
Connecting terminal 'On' to 'C' will activate the signals. Connecting 'Rs' to 'C' will reset the controller and keep the signals off.
If 'Rs' is connected to 'C' while power to the MRX3 is first turned on, the servo motors will move to their center positions. This is useful for adjusting crossing gate linkages (see above).

More Parallel Tracks at the crossing can be protected by one or more Azatrax MRD6X HexDetex™ circuits. Connect the 'C' terminal each MRD6X to 'C' on the MRX3. Connect the 'B' output of each MRD6X to 'On' of the MRX3. See the MRD6X installation instructions.

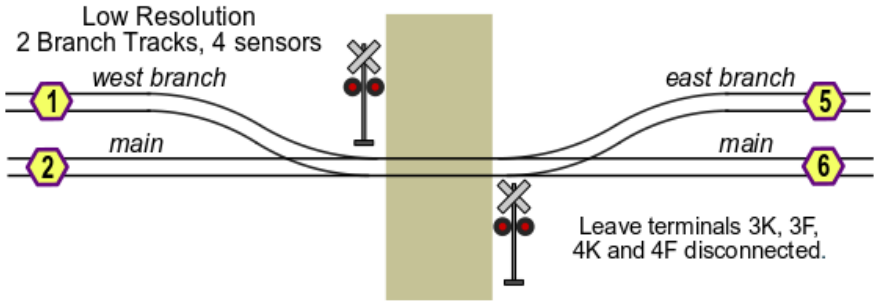


Sound Modules or other accessories can be switched by the 'Bell' outputs of the MRX3. Two relay contacts provide electrical isolation and allow the MRX3 to control circuits that require either 'high side' or 'low side' switching. 'LB' is Long Bell, 'SB' is Short Bell, 'CB' is the bell common. Relay contacts are rated for 0.35 amp max current, up to 28 volts AC or DC. The example shows a connection to an ITT Products GL sound module.
If the Gate Control is set to 'none' (no gates): SB connects to CB only until the head end of the train crosses the road. This can be used to control a locomotive bell or whistle sound. To play sound for the entire time that the signals are flashing, use terminals LB and CB.
If gate motors are enabled (gate adjustment setting 1-6): LB connects to CB until the gates start to open. SB connects to CB only until the gates are fully closed. For more info, see the Azatrax website, `www.azatrax.com`

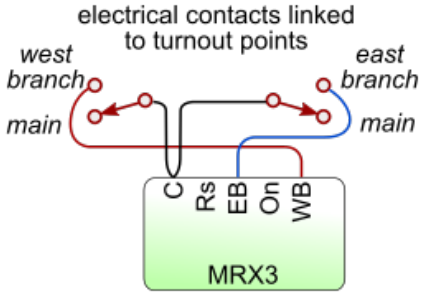
The MRX3 can be configured to correctly operate crossing signals when there is a turnout (track switch) near the grade crossing.

When a turnout is in the vicinity of a grade crossing, the signal system should respond to trains that are on the track aligned with the turnout points. The system should ignore trains that are on tracks not aligned with the turnout points.

The turnout must have an electrical contact linked to the switch machine or point rails. This contact will be connected to the MRX3 circuit. This tells the MRX3 which track is aligned with the turnout.

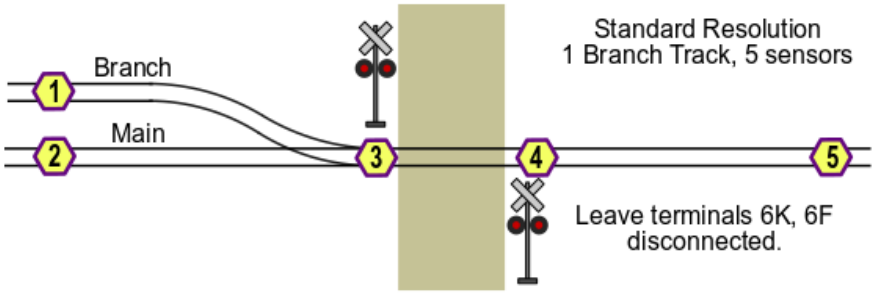


Two Turnouts - This operates in **'low resolution'** mode because two sensors are used for each possible path that a train can take through the crossing.

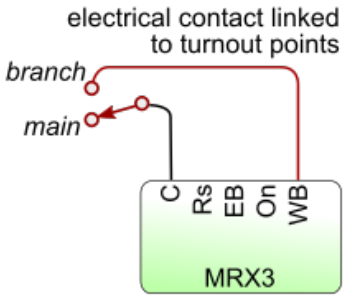


Each turnout needs an electrical contact that closes (makes contact) when the turnout is aligned with the branch track, and opens when the turnout is aligned with the main track.

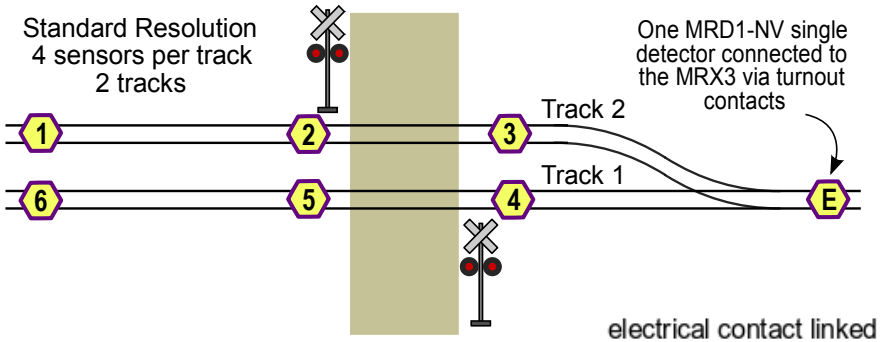
Sensors #3 and #4 are not used. Leave terminals 3K, 3F, 4K and 4F disconnected.



Single Track Crossing, One Turnout - This operates in **'standard resolution'** mode because four sensors are used for each possible path that a train can take through the crossing.



The turnout needs an electrical contact that closes (makes contact) when the turnout is aligned with the branch track (sensor #1), and opens when the turnout is aligned with the main track (sensor #2). Sensor #6 is not used.



Double Track Crossing, One Turnout This operates in **'standard resolution'** mode because four sensors are used for each possible path that a train can take through the crossing.