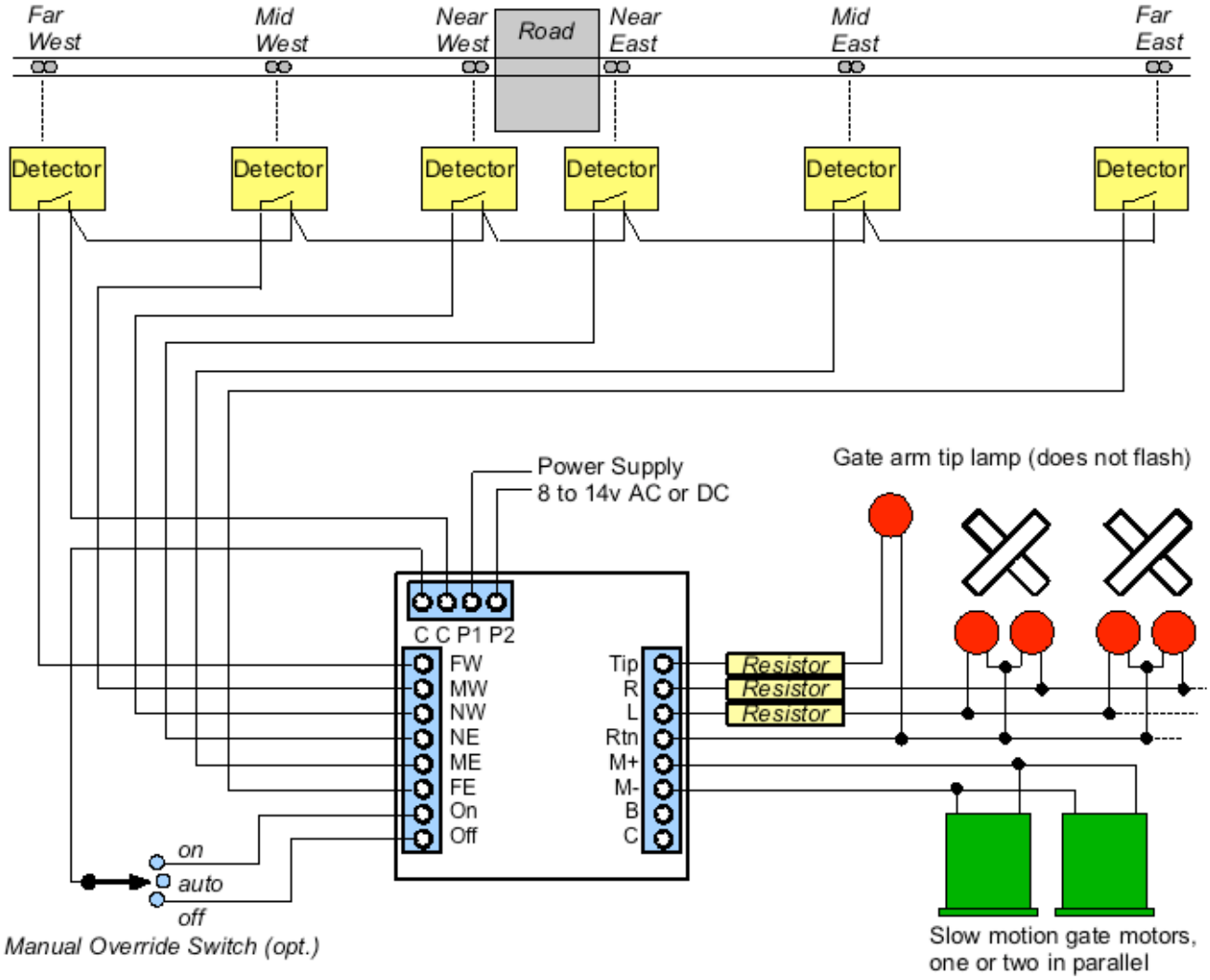
Model Railroad Grade Crossing Controller, Azatrax model MRX1 and MRXP expander

System Installation Instructions

The MRX1 controls the flashing grade crossing signals and gates of a model railroad. It will operate virtually any type of flashing signals (LED or incandescent bulbs), crossing arms with or without lights, and will drive one or two Circuitron Tortoise® motors or equivalent gate mechanism.

The MRX1 controller monitors up to six track sensors to detect train motion in the vicinity of the crossing to simulate real-world signal operation. The MRXP parallel track expander unit operates the same as the MRX1, but the MRXP has no connections to the crossing signal. See page 3.



Connecting the Crossing Signals

All lights connected to the controller must be of the same type (LED, common cathode, common anode, etc). All signals with LED lamps must have a ***current limiting resistor*** in series with the lamps! Signals that have incandescent bulbs that are rated for less than the power supply voltage must also have a current limiting resistor.

>> Failure to include a resistor will burn out the lights very quickly! <<

Resistor Value: Most LEDs produce a realistic brightness with 5 to 8 milliamps of current. Here is a table of **suggested resistor values**, depending on power supply voltage and the total number of LEDs connected to each resistor. If your signals are pre-wired with resistors, try them first with an 8 to 10 volt AC or DC power supply.

		9 volt power supply	14 volt power supply
Total	2	680 ohms, 1/8 watt	1 K ohms, 1/8 watt
LEDs	4	330 ohms, 1/8 watt	510 ohms, 1/4 watt
per	6	240 ohms, 1/4 watt	390 ohms, 1/4 watt
resistor	10	180 ohms, 1/4 watt	270 ohms, 1/2 watt

The MRX1 can supply up to 500 milliamps of lamp current.

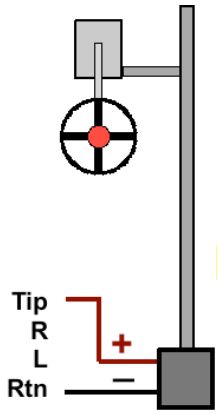
Most crossing signals will have three wires coming out the base of the mast:

* One wire goes to the **right side lamps**, connect it to the **R** terminal on the controller.
* One wire goes to the **left side lamps**, connect it to the **L** terminal.
* For lamps that should not flash (crossing arm tip, auto brake lights, etc.), connect them to the '**Tip**' terminal.
* Connect the common **return wire** to the **Rtn** terminal.

Some crossing signals have LEDs wired in a "back-to-back" arrangement. These have only two wires extending out of the base. Connect one wire to the **R** terminal on the controller. Connect the other wire, through a **series resistor**, to the **L** terminal.

All signals connected to the MRX1 must have the same wiring configuration / LED polarity.

Do NOT connect any signal wires to a layout "ground" or "common" connection!



Banjo, Wigwag or other non-flashing signals - Connect the positive (+) wire of the signal to MRX1 **Tip** terminal, and the negative (-) wire of the signal to MRX1 **Rtn**. Leave **R** and **L** unconnected.

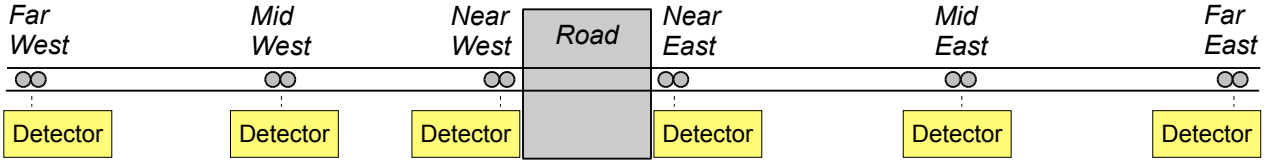
Lionel® and MTH RailKing® signals - See instructions on the Azatrax.com website.

Detectors

Detectors connect one of the MRX1 controller inputs (FW, MW, NW, etc.) to the controller's '**C**' (Common) connection to signal the presence of a train. Switching can be done by a mechanical contact or by a transistor or open-collector logic gate. If a transistor or open-collector logic gate is used, the detector's common 'ground' must be connected to the controller's '**C**' connection.

Azatrax MRD1 detectors - Wire the detector's **QC** terminal to any **C** on the MRX1 / MRXP controller. Wire the detector's **Q1** terminal to one of the controller's sensor inputs (**FE**, **ME**, **NE**, **NW**, **MW** or **FW**). **Azatrax MRD6 HexDetex™** - Wire the detector's **QC** terminal to any **C** on the controller. Wire the detector's **Q1 - Q6** terminals to the controller's sensor inputs.

How many detectors do I need? Where should I put them? It depends on what type of train operations you expect to have at your road crossing. First, a brief explanation of how the MRX1 controller sees the world:



An eastbound train (moving Left to Right in this diagram) will first trigger the **Far West (FW)** detector. The controller will turn on the crossing flashers. If the train does not trigger either the **Mid West (MW), Near West (NW)**, or **Near East (NE)** detector within 28 seconds, the controller will turn off the crossing signals. The assumption is that the train stopped, and perhaps reversed direction. This assumption is disabled in 'Very Basic' operation, explained in **A** and **B** below.

If the eastbound train continues east and triggers the **MW** detector, the crossing signal will be activated for another 28 seconds. If the **NW** or **NE** detectors are not triggered within 28 seconds, the crossing signal will turn off.

If either the **NW** or **NE** detector is active, the crossing signal will be on without a time limit. When the eastbound train leaves the crossing (first clearing the **NW** detector, then the **NE** detector), the crossing signal will be turned off and the controller will ignore the **Mid East (ME)** and **Far East (FE)** detectors as the train continues east. However, if the train stops after clearing the **ME** detector, then backs up (now heading west), the controller will activate the crossing signal when the train triggers the **ME** detector.

Westbound trains (moving R to L in the above diagram) will activate the crossing signal in the same way, triggering the east side detectors.

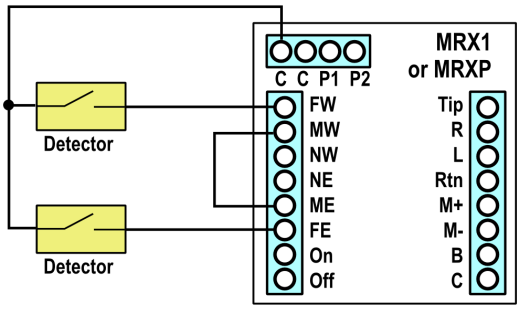
Detector Placement Guide

A. Very Basic, Single direction -1 detector

For eastbound trains, use the **FW** detector. The signals begin operating when the detector senses a train, and the signals turn off 28 seconds after the train clears the detector. For westbound trains, use the **FE** detector. The jumper wire from 'MW' to 'ME' causes the controller to operate in Very Basic mode. The controller only checks for the jumper when power is initially turned on.

B. Very Basic, Two directions - 2 detectors

Use detectors **FW** and **FE**, and connect a jumper wire from 'MW' to 'ME'. When a train triggers either detector, the signals start operating and they stay on as long as either detector is sensing a train. The signals remain on for up to 28 seconds after the first detector is cleared while the train is traveling toward the opposite detector. Once the second detector is cleared, the signals turn off.



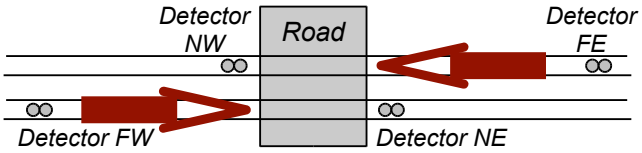
Connect a wire from MW to ME

to select Very Basic Mode

(configurations A, B or C only)

C. Very Basic, Double track, Single direction each track - 4 detectors

Detectors **FW** and **FE** sense approaching trains, and detectors **NW** and **NE** sense when the train has cleared the crossing. A jumper wire from the controller's 'MW' to 'ME' terminals selects the Very Basic double track mode. For other multi-track configurations, see part **H**.



D. Single track, Single direction, No reversing - 2 detectors

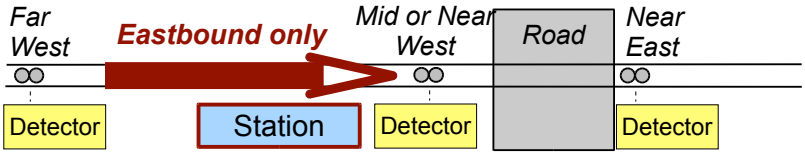
Use detector **FW** to sense an oncoming train, and detector **NE** to sense when the train has cleared the crossing. Locate the **FW** detector so that the slowest trains will reach the **NE** detector less than 28 seconds after triggering the **FW** detector. Signals stay on as long as **NE** senses a train.

E. Single track, Single direction, Wide variation of train speeds - 3 detectors

Do fast express trains use the same track as slow crawling local freights? If so, placing the **FarWest (FW)** detector far enough out to give sufficient warning for fast trains may cause the crossing signal to time out before a slow train reaches the opposite side of the road. In this case, add a **MidWest (MW)** detector between the **FW** detector and the road. Place it so that the slowest train will still reach the **NearEast (NE)** detector in less than 28 seconds.

F. Single track, Single direction, Station stop near the crossing -- 3 detectors

Is there a station or water tower on the approach to the crossing where some trains stop, and others go through?



When a train stops at the station, the crossing signal will turn off 28 seconds after the **FW** detector was first triggered. When the train resumes its eastbound travel, a **MW** or **NW** detector will activate the crossing signal again. Which to use? Here's the difference:

* When the **MW** detector is triggered, the crossing signals will turn on for up to 28 seconds, then turn off unless the **NE** detector is active. Use this if the train will always stop short of the road.

* The **NW** detector will turn on the crossing signal for as long as the detector is active. But the crossing signal will turn off if both the **NW** and **NE** detectors are not active for more than a few seconds. Use this if the train is likely to stop at the station with the head end on the road.

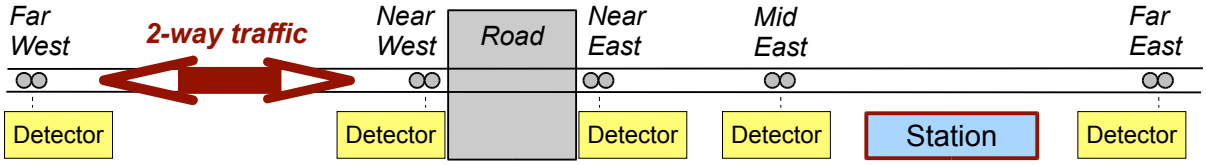
Experiment! It's easy to change the detector's connection to the controller. Just move the wire from the 'MW' terminal to the 'NW' terminal.

G. Single track, Two directions -- 4, 5 or 6 detectors

If trains operate in both directions and may stop or reverse direction near the crossing, the MRX1 will need:

* **FW** and **FE** detectors to sense approaching trains,

* **NW** and **NE** detectors at the edges of the road to sense trains in the crossing.



MW and **ME** detectors are only needed if:

* The track is shared by both very fast and very slow trains (see section E above)

* Some trains make a stop prior to entering the crossing -- place a **MW** or **ME** detector where it will be triggered as the train accelerates away from the stop and toward the crossing.

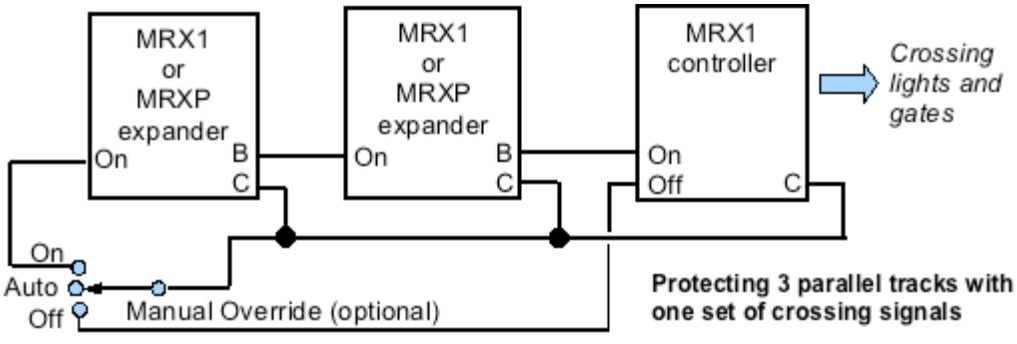
* If a train is likely to cross the road, then reverse direction before clearing the FW or FE detector -- place a **MW** or **ME** detector between the crossing and the point where the train reverses.

H. Two or more parallel tracks

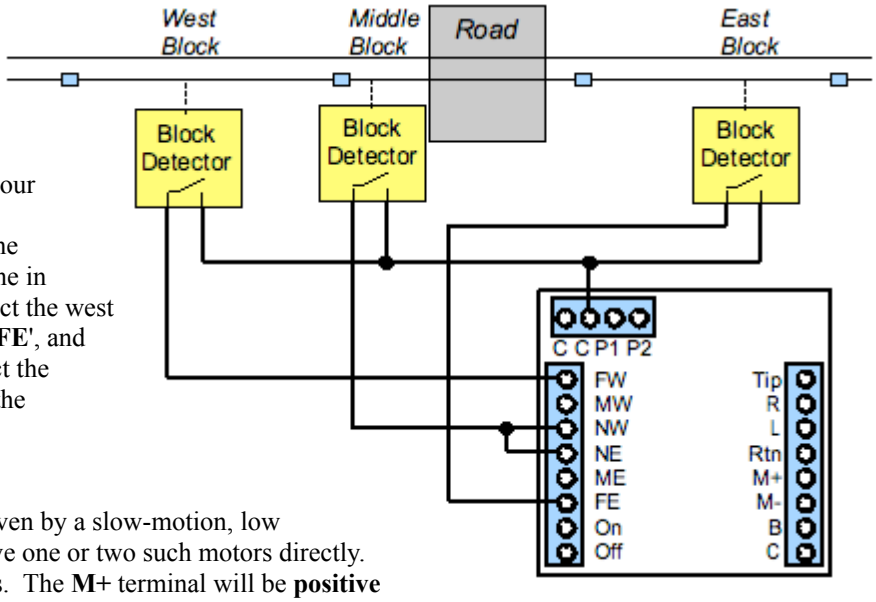
Where multiple parallel tracks cross a road and are protected by the same set of signals, multiple controllers can be cascaded together.

One MRX1 controller is wired to the signals and to detectors for one track as explained above.

Parallel tracks have their



own sensors connected to separate controllers. These additional controllers can be MRX1 controllers or MRXP expander units. The MRXP expanders are connected to track sensors in the same way as MRX1 controllers. Daisy-chain the controllers as shown above. The on-board LED of an MRX1 or MRXP will 'flick' when it is operating as an expander unit.

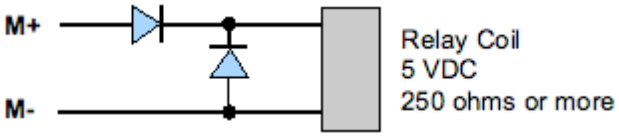


J. What about block detectors? Already have your track set up with block occupancy detectors at the grade crossing? If you have three blocks, one to the west of the road, one to the east of the road, and one in between that covers the road crossing itself, connect the west detector to the '**FW**' terminal, the east detector to '**FE**', and the center detector to both '**NW**' and '**NE**.' Connect the common side of the detectors to a '**C**' terminal on the controller.

Crossing Gates

Many operating crossing gates can be driven by a slow-motion, low current stall motor. The MRX1 controller can drive one or two such motors directly. Connect the motor(s) to the **M+** and **M--** terminals. The **M+** terminal will be **positive** when the gate is driven in the **down** direction. The polarity will be reversed to drive the motor in the up direction.

For alternative gate mechanisms, a relay can be used as shown here. Choose a 5 volt DC relay with coil resistance of 250 ohms or higher (coil current of 20 mA or less). Use diodes such as 1N4001, 1N4935 or equivalent.



When the MRX1 senses a connection to its **M+** and **M-** outputs, the crossing lights will continue to flash for 7 seconds after the train leaves the crossing while the gates are moving up.

Manual On/Off control

A switch may be connected to the controller to override the MRX1 automatic operation. Connect the MRX1 '**On**' terminal to one of the MRX1 '**C**' terminals to turn on the crossing signal. Connect the MRX1 '**Off**' terminal to one of the '**C**' terminals to turn off the crossing signal.

On-board LED and troubleshooting

The on-board LED flashes briefly when power is turned on. One flash indicates 'Very Basic' mode (see Detector Placement Guide parts A, B & C) while a double flash indicates Standard mode (Detector Placement Guide parts D - J).

The LED will be on continuously while the crossing signals are active. If the LED "flicks," the controller is acting as a parallel track expander. This is normal for an MRXP expander, and for an MRX1 when no crossing lights are connected to it.

Error codes: If the controller senses an unexpected condition with the signal lights, the lights will not operate and the on-board LED will blink an error code. Count the number of flashes between pauses to determine the error code.

Code: 1 or 2 - Defective controller, contact Azatrax for repair or replacement.
3 - R/L lights are common cathode, but Tip light is common anode. Reverse the LEDs that are connected to Tip.
4 - R/L lights are common anode, but Tip light is common cathode. Reverse the LEDs that are connected to Tip.
5 - Unrecognized lamp wiring configuration, or configuration has changed since power-up.

Turn the power source off, correct the problem, then turn power back on to reset the error condition.

If signals do not operate: If the on-board LED is not on, check power to the board and the connections to detectors. If the on-board LED is flickering, the controller does not sense connections to any signals, check for an open circuit. If the on-board LED is on steadily but the signals are not operating, there may be an overcurrent condition. Check for a short circuit in the signal wiring.

Power Supply

Connect an 8 to 14 volt, AC or DC power source to terminals P1 and P2. The voltage and current capacity of the supply should be appropriate for the number of lamps and motors in use at the crossing.

For LED signals: A supply of 8 to 10 volts is best. A higher voltage will only waste more power in the current limiting resistors.

For incandescent lamps: Incandescent lamps look better on a layout if operated at lower than rated voltage, and they will last much longer. For 12-volt lamps, try a supply of 9 or 10 volts. For 16-volt lamps, a 12 volt supply is recommended.

For further information and assistance, see the Azatrax web site, www.azatrax.com