

***Railway Technology Inc.
Wheel Detector Installation Manual
MM4Z Module***

Note: Rail Switch Service LLC. is the exclusive distributor of the Railway Technology Inc. Wheel Detection System.

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Read this manual in its entirety before beginning the installation of the Wheel Detector System.

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Introduction:

The Railway Technology Inc. Wheel Detection System was developed to provide a presence detection system that is simple to install, highly reliable and easy to maintain.

The Wheel Detection System enables the user to easily configure the size of his protected zone to meet the specific needs of his application. Clearance point protection, on the trailing side of the points, and adequate facing point protection for the speed of the rail traffic is easily accomplished by proper placement of the Wheel Detection sensors.

The Wheel Detection System is easily integrated into the operation of typical DC electric Switch Machines. The Wheel Detection System is also designed to operate as a stand-alone system to allow ease of interfacing with other manufacturers' equipment.

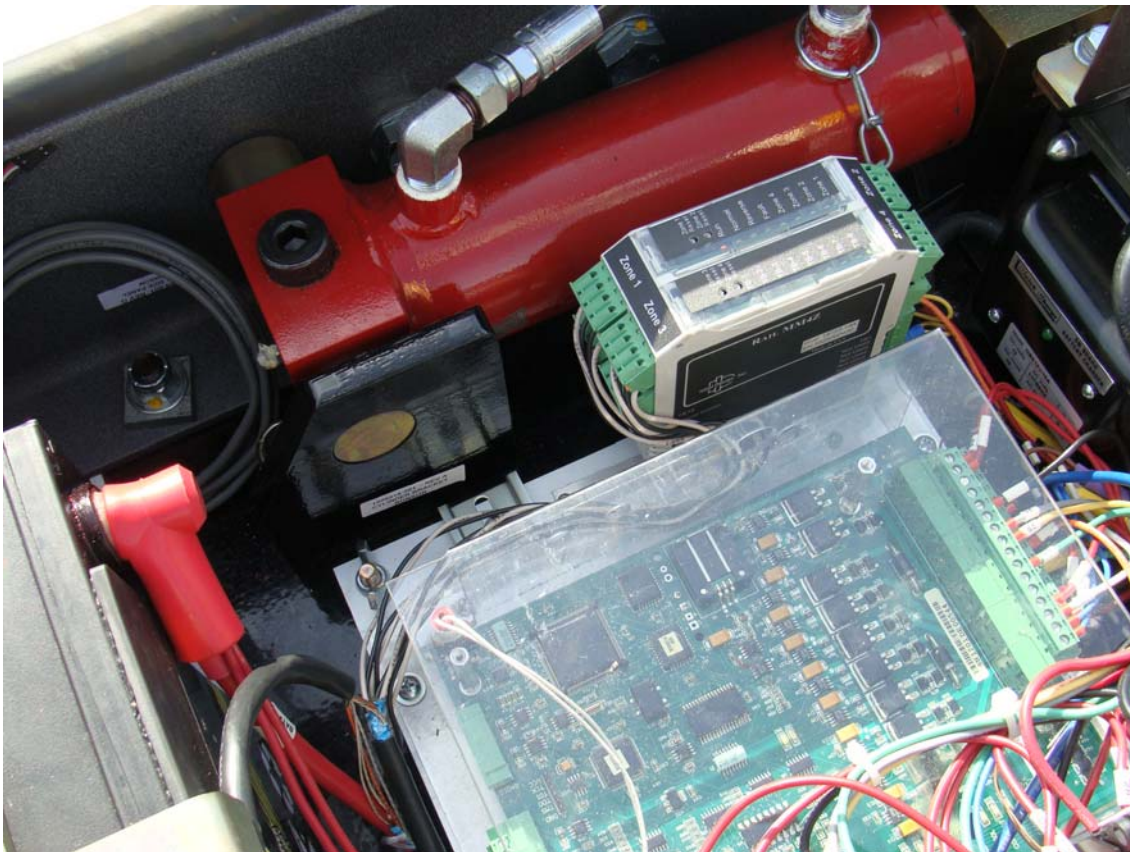
The Wheel Detection System is offered in 2-detector versions (300/2), 3-detector versions (300/3) and 4-detector versions (300/4) as standard packages. Additional sensor locations can be easily added to enable the user to have a detection system with up to 28 detectors per "main module".

The 2-detector system is normally used for the protection of Derail/Blue Flag applications. The 3-detector system is normally used in a conventional switch turnout. The 4-detector system is normally used to protect both switches in a crossover application. Variations and special track geometry are easily accommodated through the use of additional wheel sensors.

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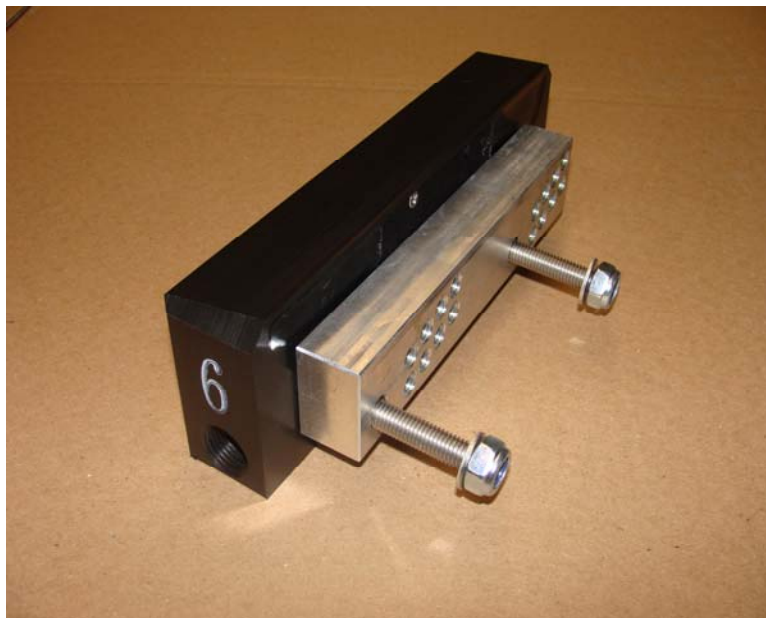
The Wheel Detection System is made up of (2) major components.

- The “main module” acts as the interface between the wheel sensors and the Switch Machine. It is also the main processing unit for the Wheel Detection System. The “main module” operates from 8 to 24 VDC with 25 mA current draw and has an “on board” event recorder that logs any activity that occurs within the system. The main module is located inside the Switch Machine enclosure when used in conjunction with most Switch Machines. No external enclosures are required for the RTI Wheel Detection System.



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- The sensor & mounting bracket makes up the second part of the Wheel Detection System. The wheel sensors are located at the rail and are the devices that sense the presence of a railroad wheel over them. The optimum placement of the sensor is 1-3/4" (+0.00" – 1/16") below the top of the rail. The sensor will operate on a voltage range from 8 to 24 VDC at 32 mA current draw per sensor.
- The sensor & mounting bracket is designed to bolt directly to the rail and provide an adjustable mounting height for the sensor head. The adjustment method is through evenly spaced threaded holes in the mounting block and will be covered in detail in the installation section. The adjustment height of the wheel sensor allows the Wheel Detection System to be used on any rail size between 90 pound and 140 pound rail. Drilling the rail is required to mount the sensor-mounting bracket.



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Connection of the Wheel Detection system is accomplished using 4-conductor (2 twisted pairs) #18 gauge shielded wire (furnished by Railway Technology Inc.). This wire is of direct burial construction. It is recommended that the wire runs between the wheel sensor and the main module be buried to minimize damage to the wire from vandalism or track equipment. Burying the wire also makes track maintenance easier since the wire is not in the way of tamping or other track maintenance operations. The #18 gauge wire is adequate in size to allow wheel sensor locations as far as 4000 ft. away from the “main module”.

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Wheel Detection System Features

The Wheel Detection system is designed to “Fail-Safe”. The wheel sensors are designed so in the unlikely event they become loose on their mounting bracket or are torn away from the rail; the main module will fail to the condition that disables further Switch Machine operation. The loss of a wire or connection will result in the same Fail-Safe failure mode. A power loss to the Wheel Detection system will also result in a Fail-Safe failure mode preventing further Switch Machine operation. Each “fail condition” will be logged into the event recorder for easy diagnosis of the fault.

The event recorder can also be used to monitor six (6) separate outputs from the switch machine or device it is controlling. These outputs would log events every time they go “high” or +12vdc. These outputs would connect to terminals 1-6 on terminal block TB1.

The outputs on the main module include redundant circuitry and componentry. The operating logic and circuitry is designed so that if a failure occurs on either of the redundant outputs, the main module fails in the safe condition preventing further operation of the Switch Machine.

The operating logic used in the Wheel Detection System includes both “Auto-Line” functions and “Missed Wheel Compensation” to enhance the flexibility of the Wheel Detection System.

Sensors used on the trailing side of the points can be programmed through the software to generate a pulsed output to allow the automatic lining of the Switch Machine to correspond to the trailing side routing movement of the train or rail traffic. This function prevents run-throughs of the switch points from occurring.

The operating logic of the “main module” includes the software selectable ability to compensate for false signals as the result of dragging metal objects over the wheel sensor in such a manner as to generate a false wheel count. This feature is the “Missed Wheel Compensation” function.

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Pre-Installation Considerations

Prior to beginning the installation phase of the Wheel Detection System, it is necessary to determine the proper locations for the wheel sensors. Train speeds, track geometry, and clearance requirements all factor into the number of wheel sensors required and the location of each wheel sensor.

Three (3) Wheel sensors are usually an adequate number of sensors to protect a conventional turnout. One (1) Sensor would be located on the facing side of the points, One (1) sensor would be located on the normal routing of the trailing side of the points and One (1) sensor would be located on the reverse routing of the trailing side of the points. The wheel sensors on the trailing side of the points are also usually located at the sideswipe clearance point to eliminate a sideswipe potential.

The facing point wheel sensor location is based on the maximum expected train speed and the maximum time required for the Switch Machine to throw. For example, a train traveling 10 mph is moving at 14.66 feet per second. The maximum time required by a typical Switch Machine to throw in a worst-case scenario is 3 seconds. Therefore, 14.66 feet per second times 3 seconds results in the need to locate the facing side wheel sensor a minimum distance of 44 feet in front of the switch points.

In some instances, track geometry requires the use of several wheel sensors to provide the protection needed around a switch. The RTI “main module” will support up to (28) wheel sensors. This number of wheel sensors is more than adequate to provide a protection zone for even the most unusual and complicated track geometries.

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Installation Guidelines:

These guidelines must be strictly followed to ensure trouble free operation of the wheel counter system.

1. Do not install wheel sensors on closure rails leading into or out of rail frogs. This location has historically caused more system lock-ups than any other incorrect install location. Dragging hoses or equipment will swipe across and strike the wheel sensors installed in these locations adding unwanted counts and damaging the wheel sensors that usually results in locking the system up.
2. Do not install wheel sensors within 15 feet of rail joints, joint bars or other rail structure that will have high levels of shock/vibration. Moving the wheel sensor to increase the protection zone is usually the best choice to avoid the rail structure.
3. Do not install the wheel sensors near any moving rail structure (switch points), 3 feet should be maintained to ensure no interference with normal operation.
4. The distance between the entry and exit wheel sensors of any protected zone must be greater than the distance between the axles of the longest rail cars.
5. Always maintain a minimum of 3 feet radius between any other wheel sensors, even if the sensors are separated by a rail, to avoid interference and communication issues.
6. Always install the wheel sensors securely to the rail at the proper factory recommended height.
7. Always be sure to inspect the final wiring of the wheel sensors to ensure that the wires **are not** routed over the orange release buttons.
8. Always use the factory supplied or factory recommended wheel counter cable. Do not use a solid conductor cable with the wheel counter system, stranded cable, shielded, minimum of 18 gauge only.

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9. The inner shields of the wheel counter cable should have continuous connection from sensor to sensor when being daisy chained and connected to N12 (battery negative) inside the switch machine. The end run sensors shield wires should not be connected to anything and can be cut off at the insulation of the cable.
10. Always use factory supplied or factory recommended cable cord grips and connectors that will keep dirt, water and contaminants from entering the wheel sensors.

Installation Notes:

The wheel sensors and main module are shipped with even ID numbers programmed into them, typically #4, #6 and #8. This standard programming requires an installation of the wheel sensors on the right side of the tracks when facing the switch. This is the typical configuration of the wheel sensors.



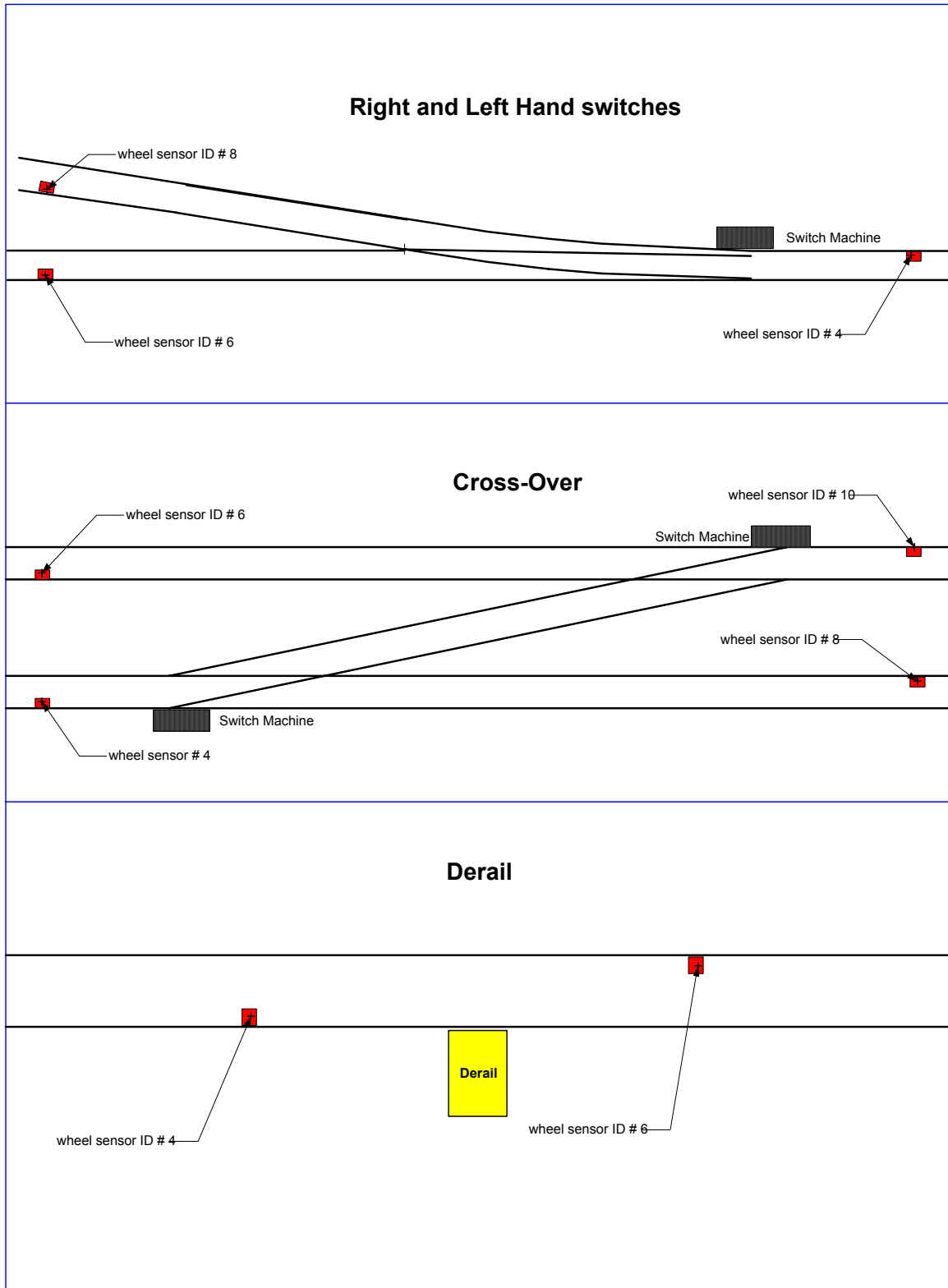
This photo shows the correct “right side” orientation of the sensor when facing the switch. **The installation of the sensor on the right side is true regardless of whether the installer is facing the switch from the facing or trailing side of the points.**

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The wheel sensors may be installed on the left side of the tracks when facing the switch to avoid rail joints or other rail structure. However, this requires re-programming the main module with an ID number that does not have a (-) negative symbol in front of the ID#. The combination of the – or + in front of the ID number in the main module and the side of the tracks the sensor is installed on is what enables the sensor to know when a train is entering or exiting a protected zone. For this reason, the location and ID number guidelines must be adhered to. The ID number can easily be changed inside the main module using the factory supplied software and programming cable. If the ID numbers in the main module are changed from the factory set (-) negative symbol in front of the ID number, the important item is that the Sensor ID numbers **MUST** match the ID numbers in the main module. ID numbers start at #4 and end at #28. Any ID number, even or odd, can be used in this range. The software used to change the ID numbers is available at our website at www.railswitchservice.com

Following are recommended locations of wheel sensors for several typical layouts. Please contact RSS for assistance in determining wheel sensor locations for your application.

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General Installation Notes

The preferred method of wheel sensor installation is to drill the web of the rail at the AXIS point and mount the aluminum adjustment block to the rail. This adjustment block allows easy height adjustment of the wheel sensor. The location of the wheel sensors would have been determined, as previously discussed, based on the track geometry.

Note: Do not make direct vertical cable runs to the Wheel Sensors. Always allow extra cable to accommodate track heaving and future Wheel Sensor replacement.

The cable should be either secured to the top of the ties or buried at a location that will allow normal track maintenance to occur without contact of the cable being possible. RSS strongly recommends that the communication cable from the wheel sensors be buried. This is the most secure and trouble free method of installing the cable for long term operation. Attaching the cable to the ties should be used in applications where the wheel sensors are being installed for test or short-term purposes.

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Direct Rail Mount Method:

The rail will need to be drilled for each wheel sensor. Two ½” holes at 4-1/2” hole-center spacing in the axis point of the rail web for each wheel sensor in the protection zone. After drilling, the rail mount adapter can be bolted to the rail. Use the two 10 mm taper head bolts, two flat washers and the two 10mm locking nuts supplied in the “bolt kit” to secure the rail mount adapter to the rail. The wrenches required to install the sensor and bracket assembly are 17 mm wrench and 6 mm hex key wrench. In addition a Combination Square with a bubble level will be needed to set the height of the wheel sensor.

Note that the rail mount adapters mounting holes are offset so the device can position the sensor mounting holes high or low to accommodate many different rail sizes.



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Select the appropriate wheel sensor and bracket assembly for installation at the location prepared to receive the assembly. This photo shows the sensor used at an end of run or for example a single facing point sensor. One end of the sensor has a cord grip to allow the installation of the communication/power cable. The other end has a plug to prevent the entrance of moisture and contaminants into the wheel sensor.

A sensor to be located in a position that will require daisy chaining the wires through the sensor will have a cord grip located on both ends of the sensor head.

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Wiring the Wheel Sensors: Attach communication cable wires to the sensor head. This should be done prior to attaching the sensor to the bracket assembly. Run the (# 18 – 4 conductor) communication cable beneath the rail in the crib space area that was previously cleaned out. Remove the black aluminum cover on the backside of the wheel sensor.

It is necessary to strip the cover from the communication cable a length of approximately (8"). Cut the shield ground wire off even with the cable jacket if the sensor has only one cable run to it. If it is a daisy chained sensor, all of the remaining shield wires need to be twisted together so as to make a continuous connection to the last sensor.



Insert the stripped wire through the cord grip on the end of the wheel sensor. Insert the wires into the spring cage connector by pushing the stripped wire ends into the appropriate terminals.

Terminal 1 = white wire, pair 1

Terminal 2 = black wire, pair 1

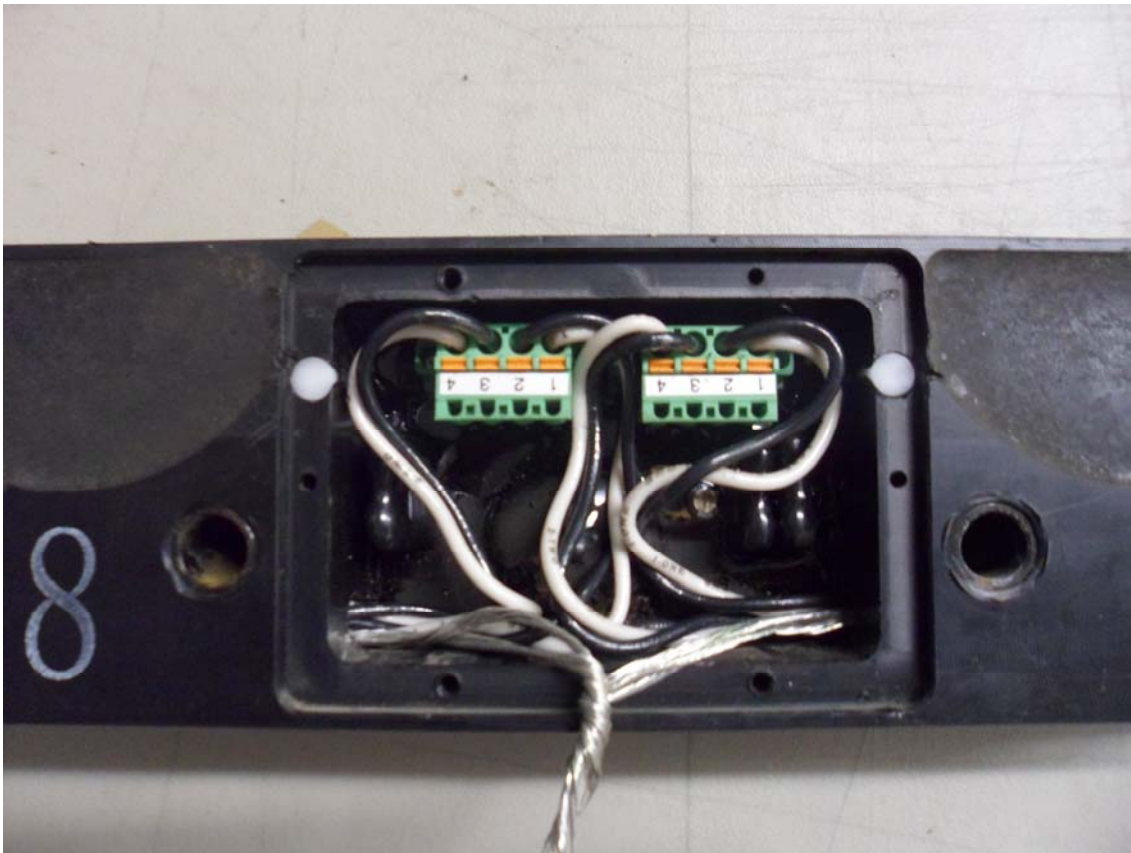
Terminal 3 = black wire, pair 2

Terminal 4 = white wire, pair 2

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NOTE: Route the wires so that they do not cross over the orange release tabs on the spring cage connector. If this step is not observed, sensor communication problems will be likely at a later date.

Tighten the cord grips to attain a secure and watertight joint where the wire goes into the wheel sensor. The cord grip should tighten around the cable jacket. A watertight seal is not possible unless the cable jacket is inserted through the cord grip.



This photo shows correctly installed wires inside a wheel sensor that is wired in a daisy chain fashion. Notice that none of the connected wires are routed over the orange release buttons on the connectors and the remaining shield wires are twisted together running to the next wheel sensor. This wire arrangement is used typically on the trailing side of the points to connect the reverse wheel sensor with the normal sensor.

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This photo shows the installer pushing the wire into the spring cage connector. Always tug on the wire, after pushing the wire into the connector, to assure a good “bite” of the spring cage on the wire.

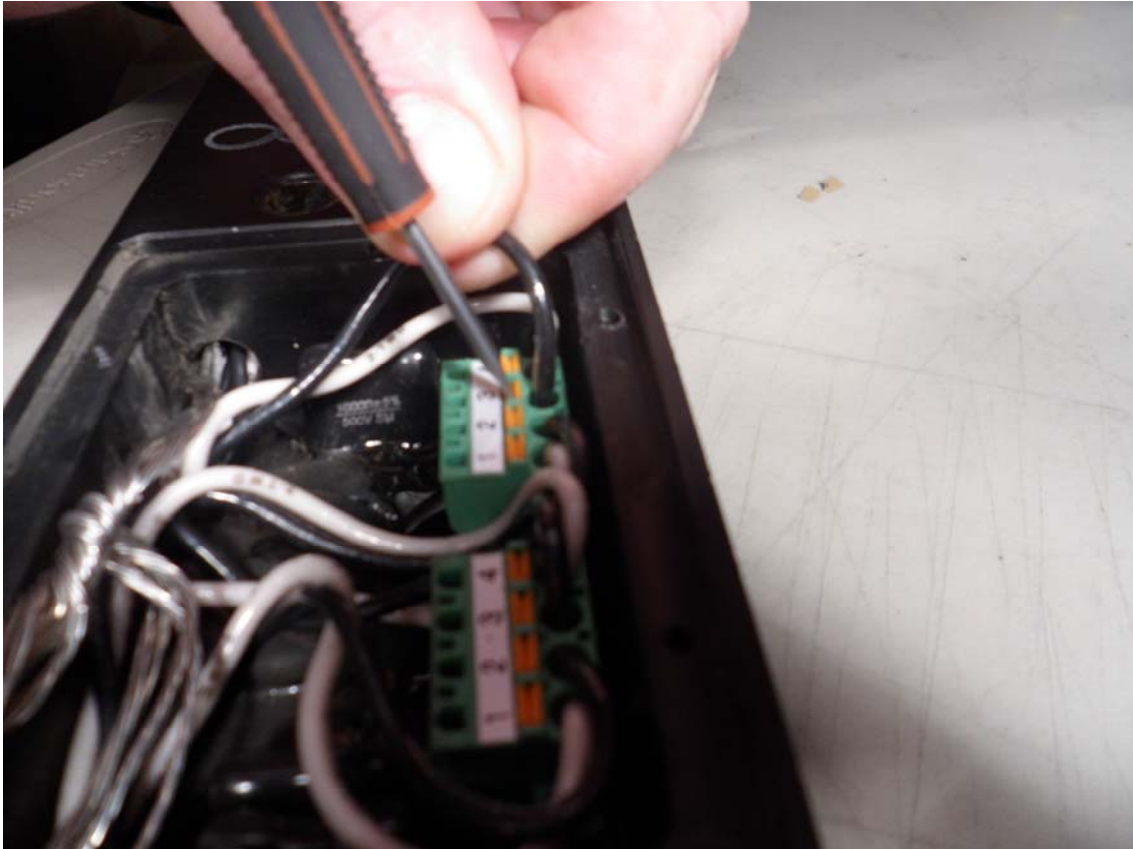


This photo shows a correctly wired wheel sensor that is an “end of run” or facing point location. Notice the oxide inhibitor grease is applied on both connectors even if wires are not in the connector to keep moisture and contaminants from entering the connector.

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Re-install the cover plate after all wires have been checked for a good connection and the oxide inhibitor grease (supplied) has been applied.

Note: Application of the supplied oxide inhibitor grease is very important to the long term reliability of the system.



The photo above shows the correct method to remove the wires from the spring cage connector. It is necessary to use a small screwdriver to press in on the small orange tabs located next to each wire installation cavity. Pull on the wire as the tab is pressed in. This will allow the spring cage to release the bite on the wire.

Note: It is impossible to remove the wire without destroying the connector unless the orange tab is pressed in while pulling on the wire.

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The wheel sensor can now be bolted to the rail mount adapter using the remaining two 10 mm bolts, lock washers, and flat washers. Using a combination square with a bubble level, determine which threaded hole sets will place the wheel sensor at the 1-3/4" recommended height.

When the proper threaded holes have been determined the wheel sensor can be final tightened to the rail mount adapter.



As shown in the above photo, leave enough extra cable so as to allow movement of the rail and re-wiring of wheel sensors in future.

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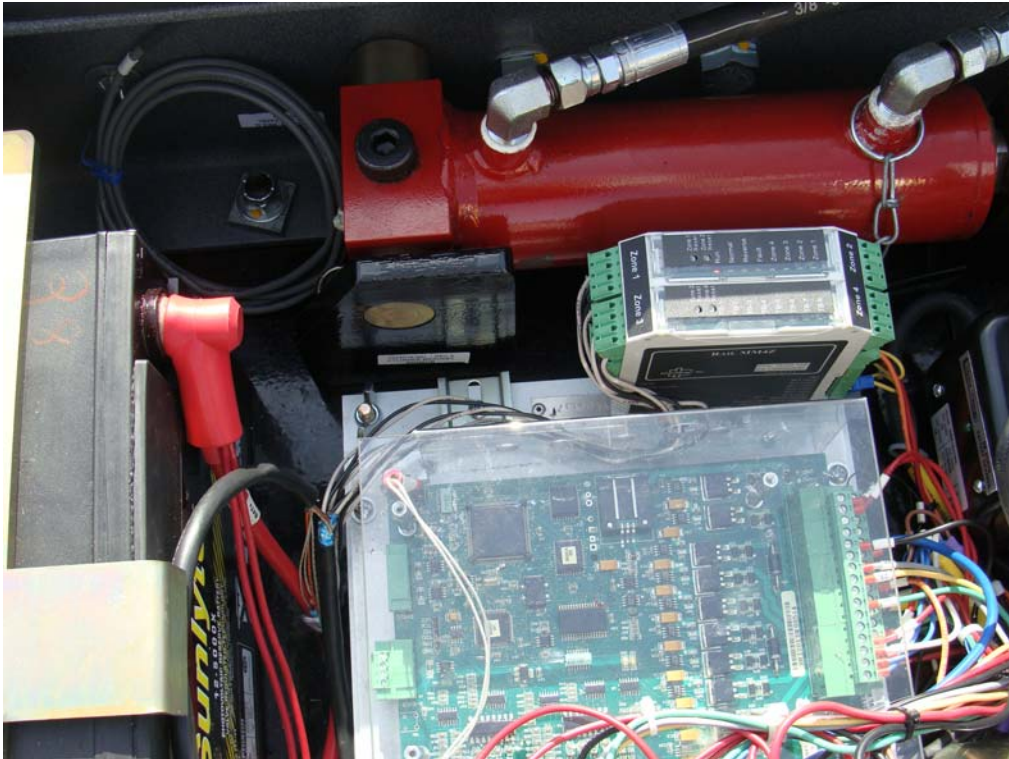
The photos above show the completed installation of wheel sensors bolted directly to the rail in both “end of run” and “daisy chain” configuration. One of the advantages of direct bolting the sensor to the rail is the ability to locate the sensor over a tie.

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Power and Communication Cable connection to the Main Module

The main module is usually installed inside the Switch Machine enclosure on a short piece of DIN rail included in the “Machine Kit”. The main module connectors are pre-wired from the factory to ease in the interface wiring of the Switch Machine. The main module connectors, wiring harness, system fuse holder, and DIN rail with adhesive back are all located in the parts bag marked “Machine Kit, PN 300/MK-MM4Z”.

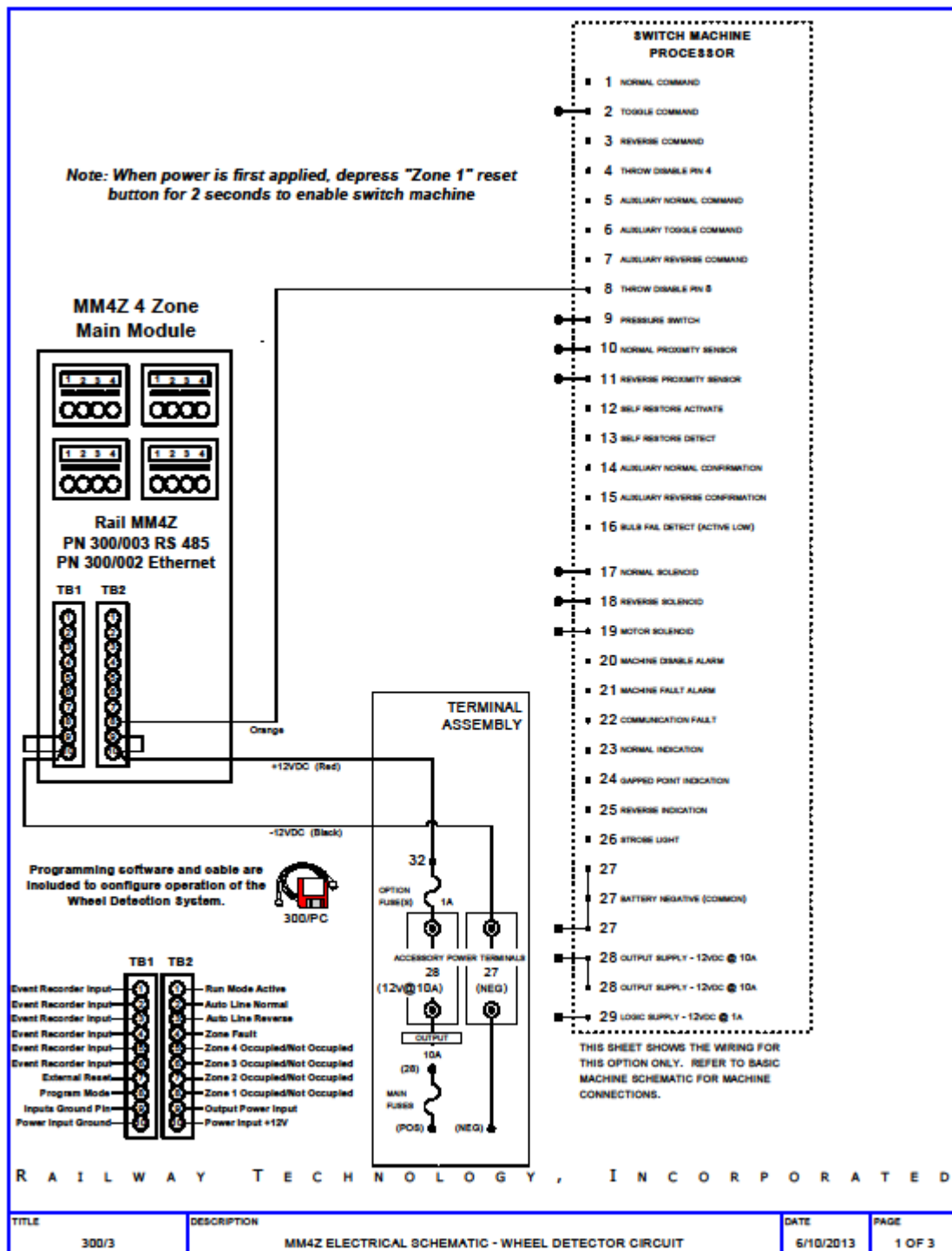
Please refer to Main Module Wiring Schematic on page 22 for specific wire terminations.



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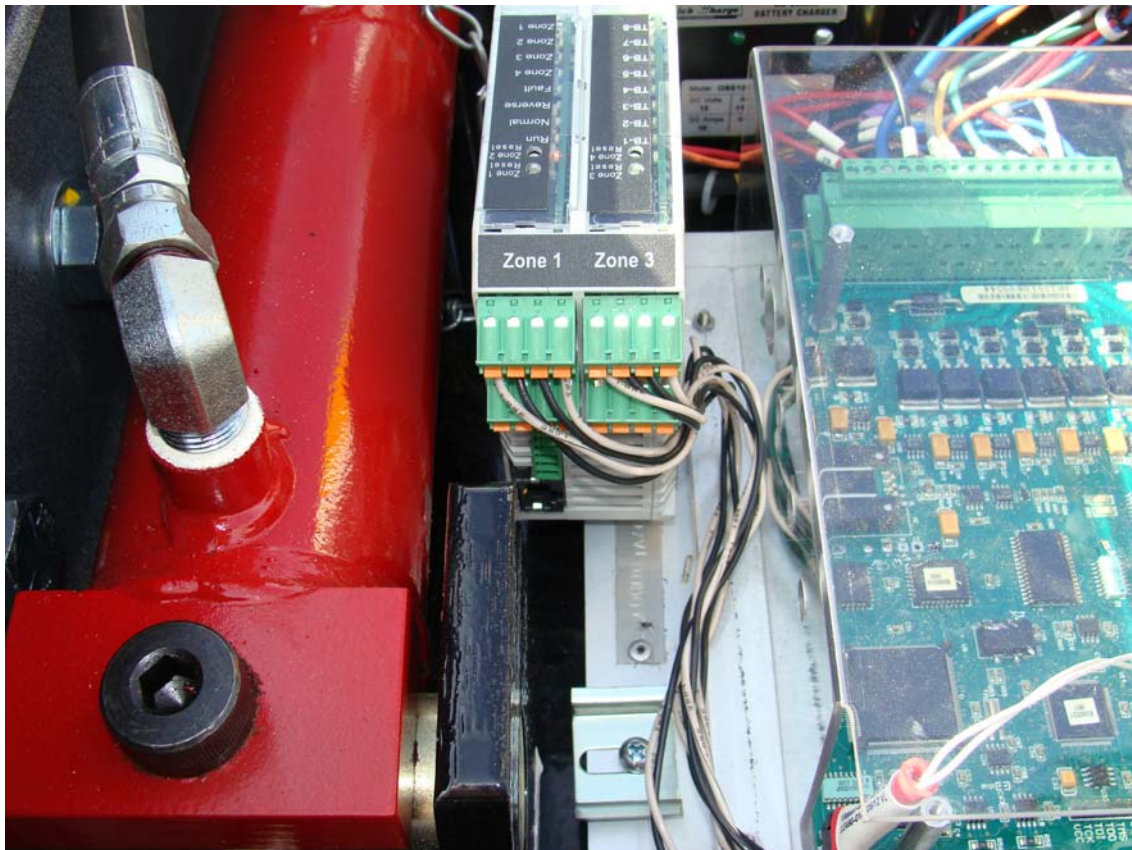
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The power and communication cables are to be routed through the cord grips located on the trackside of the Switch Machine.



Note: the power and communication wires are all located within the same tray cable. This cable is an # 18 gauge 4-conductor direct burial cable with one conductor carrying B12, one conductor carrying N12 and the other two conductors acting as the signal transmission wires.

The power and communication cable should be stripped back 36" before inserting the cable through the cord grips and into the switch machine. The cable should be pushed through the cord grips until the cable jacket is fully into the cord grip to assure a watertight entrance. Tighten the cord grips after installation of the cable.

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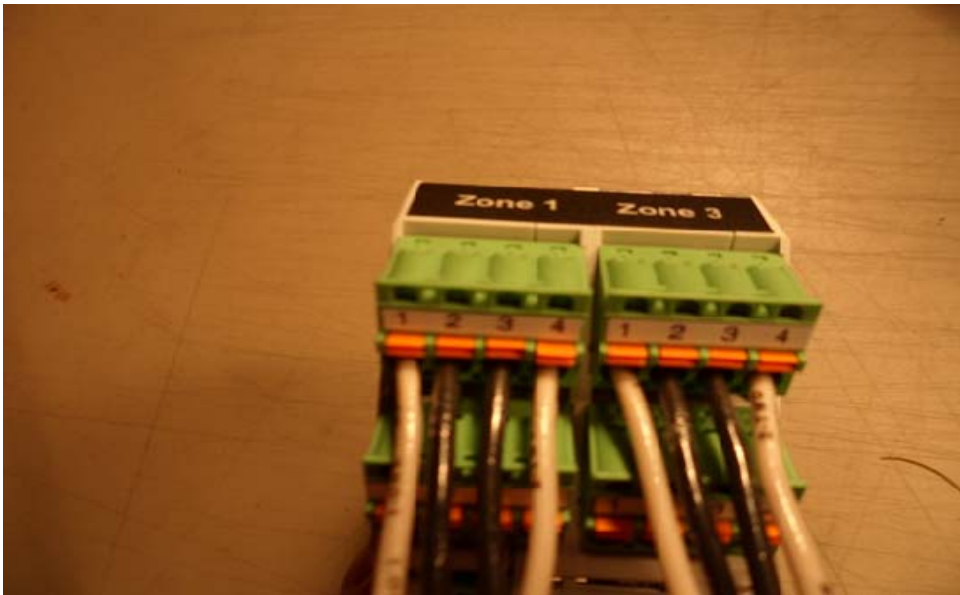


The photo above shows two separate black sensor cables entering the Switch Machine. One of the cables would be routed to the facing point wheel sensor/sensors. The other sensor cable would be routed to the trailing point wheel sensor/sensors.

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Insert the white and black (pair 1) power wires and the white and black (pair 2) communication wires that make up the two cables into one of the 4 pin connectors. This is done by pressing the wires into the spring cage connections. Tug on the wires to assure they are properly inserted in the spring cage. **Note: Any of the eight (8) 4 pin connectors can be used for wheel sensor connection as they are all on the same channel.**

Note removal of the wires requires pressing the small orange tabs down using a small screwdriver while pulling on the wire.



The correct terminal connections for the wires are as follows:

White wires, pair 1 = Terminals 1

Black wires, pair 1 = Terminals 2

Black wires, pair 2 = Terminals 3

White wires, pair 2 = Terminals 4

Please refer to RTI Wheel Sensor Schematic on page 26 for specific wire terminations.

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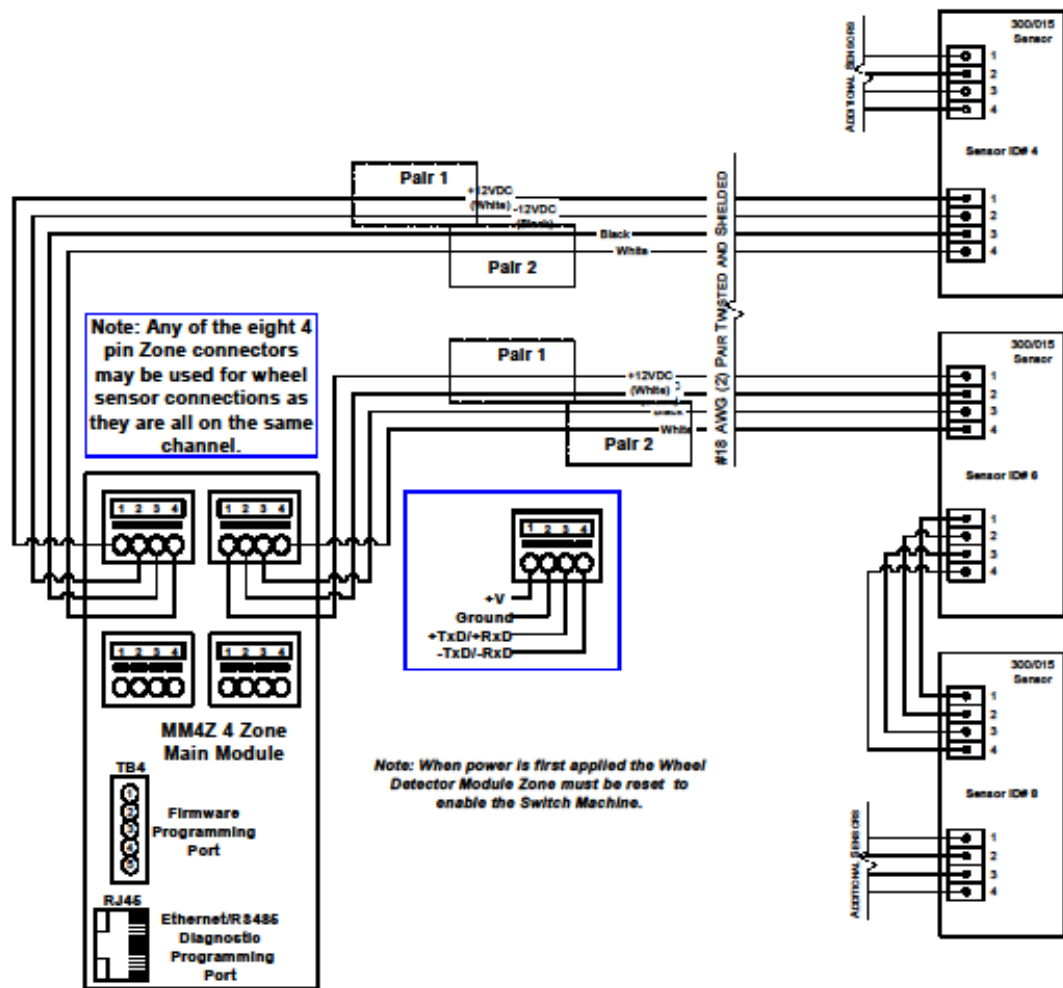
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3-Detector wiring circuit

Additional Sensors can be added by wiring them parallel to the Main Module or to other Sensors.

Important:

All shield wires or extra conductors inside the cable must be tied together inside each sensor being daisy-chained and landed on Battery Negative (-12vdc) inside the switch machine

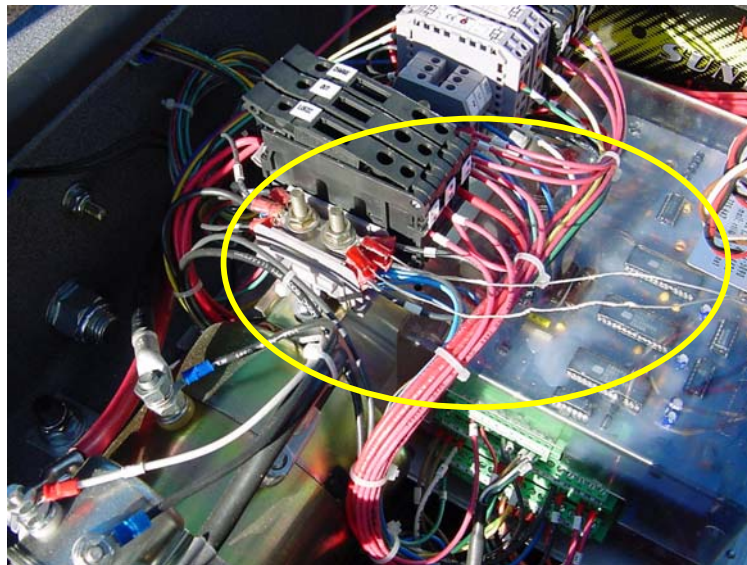


R A I L W A Y T E C H N O L O G Y I N C O R P O R A T E D

TITLE	DESCRIPTION	DATE	PAGE
300/3	MM4Z ELECTRIC SCHEMATIC - SENSOR CONNECTIONS USING OKONITE H/D CABLE	6/10/2013	2 OF 3

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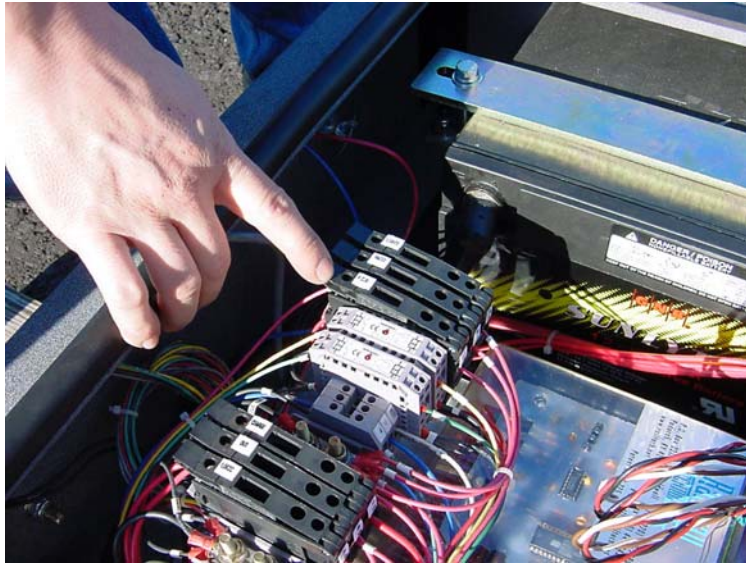
Install the ring terminals (included with the Wheel Detector System in the Machine Kit) on the shield ground wires. It is necessary to crimp the ring terminals on the shield ground wires, these are 1/4" ring terminals.



Attach the shield ground wire ring terminals to the N12 threaded lug located on the DIN rail terminal strip or connect direct to battery negative. This completes the installation and wiring phase of the Wheel Detector System.

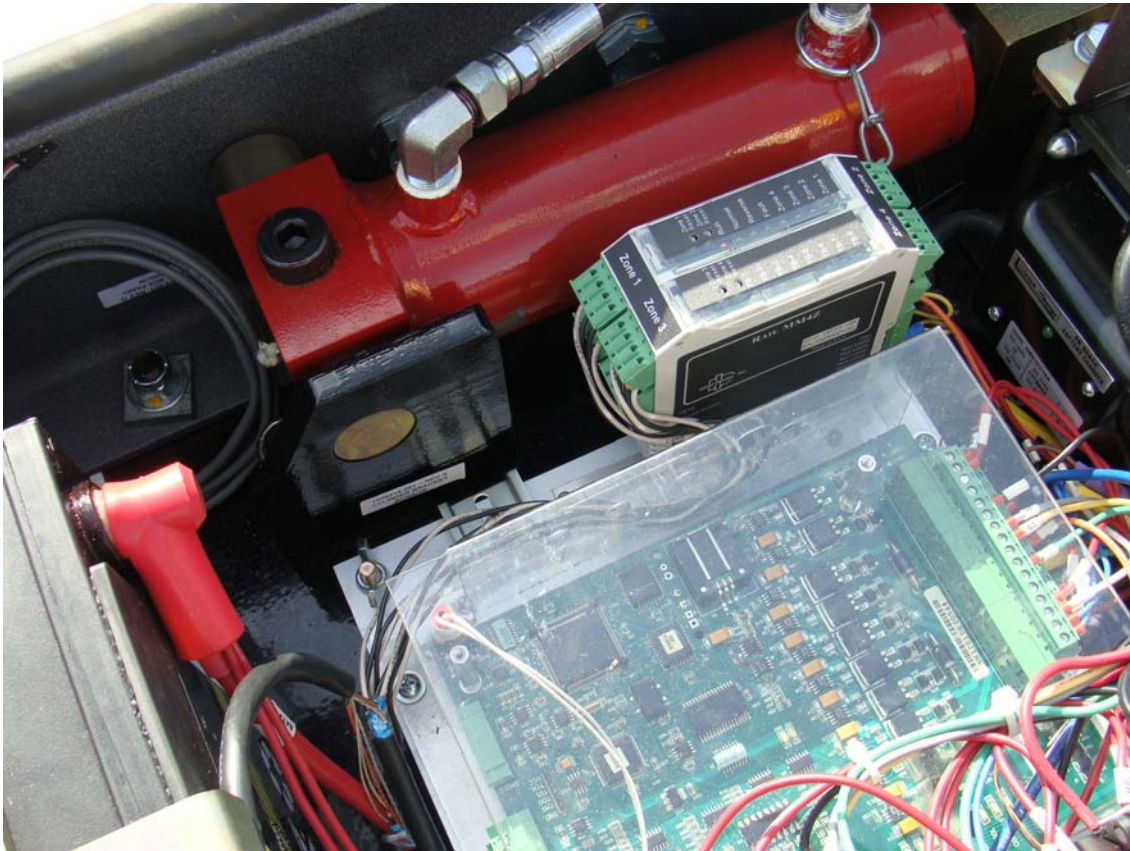
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Power Up and Testing



When the installer is ready to power up the Wheel Detector System, it is necessary to close the Wheel Detector System fuse block. This will provide B12 (+12 VDC) power to the Wheel Detector System. Be certain there is no rail traffic in the protected zone or located over any of the wheel sensors when power is applied to the system. The Wheel Detector System calibrates itself to the ambient conditions of the rail when power is first applied. The protected zone should be clear of all rail traffic in order for the system calibration to be accurate.

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After applying B12 (+12 VDC) power to the Wheel Detector System, the installer/user must press the “Zone 1” reset button on the top of the main module with a small screwdriver or pen before the system will begin operation, this will turn on the “Zone 1” output and the corresponding LED on top of the main module. **IMPORTANT: The user should wait 5 seconds after power-up before pressing the reset pushbutton to allow the system time to calibrate to the ambient conditions around the wheel sensors. The reset pushbutton should be pressed in for a minimum of (2) seconds to assure the reset function has occurred.**

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This reset button must be pressed every time power is removed and re-applied to the Wheel Detector System before the system will enable the Switch Machine to operate and begin proper operation of the Wheel Detection System. This reset button also resets the count in the zone to zero.

Note: If the “Zone 1” LED does not come on but the “Fault” LED does, power the system down and re-check the wiring connections.



The easiest way to test the Wheel Detection System is to use a railroad spike to “swipe over” the wheel sensor. The spike must be held flat and must be swiped over the entire length of the sensor in the direction a train would travel to enter the protected zone to register a valid count on the sensor. This action simulates an axle entering the protected zone and will register a valid count thereby disabling the Switch Machine. This is indicated on the main module by the extinguishing of the “Zone 1” LED.

Placing the spike over the sensor but not actually completing the swipe will disable the Switch Machine as long as the spike is located over the sensor. Removal of the spike will re-enable the Switch Machine. However, if the spike is swiped completely over the sensor, this will be recognized as an

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axle entering the zone and a count will be made disabling the Switch Machine until a swipe in the reverse direction occurs. A swipe in the reverse direction simulates the axle leaving the protected zone. When the count in the zone is zero the Switch Machine will be re-enabled. This is indicated on the main module by the illumination of the “Zone 1” LED.

Pressing the “Zone 1” reset button on the main module will reset the count to zero and re-enable the Switch Machine at any time. Care must be exercised when performing this reset. If rail traffic is present in the protected zone when the reset is pressed, an incorrect count will result when the rail traffic leaves the zone and will disable the Switch Machine requiring yet another pressing of the reset button to re-zero the count.

This completes the installation and testing of the RTI Wheel Detection System. If there are any questions not answered in the context of this manual please contact the Factory for further assistance at the address or numbers below.

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