Model Railroad Electronics presents

The Complete User's Guide for:

BLOCK OCCUPANCY DETECTOR

Single Channel Detector Card (BOD1)

- Current Sensing, works with DC and DCC applications.
- Powered with 6-16v DC.
- Outputs in Positive and Negative for both
  Clear and Occupied states.
- Controller override switch.
- Works with most scale models

~~$14.99~~ USD / $18.99 CAD

Introduction

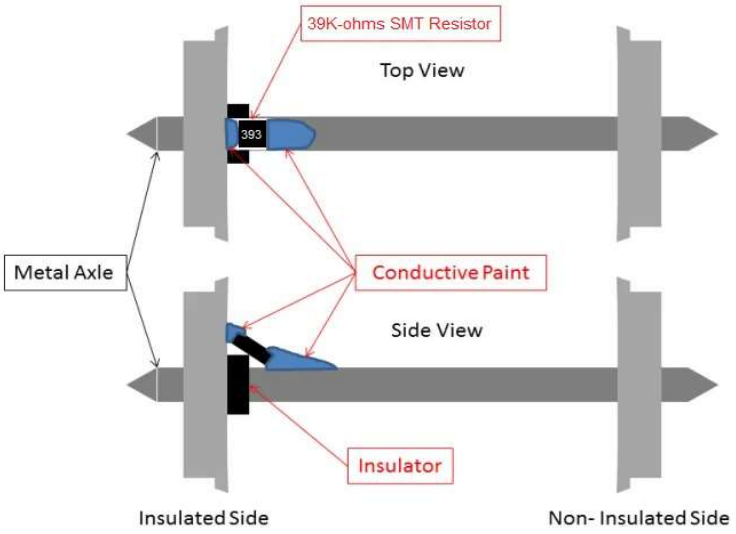
First off, I want to take this portion of the User's Guide to thank you for your purchase! All of my Model Railroad Products are designed, engineered, hand-made and tested by me. I've taken a lot of time and hard work to craft these items for you. My intention for each of them is so that you can get the satisfaction and pleasure out of them for years to come. Of course there are plenty of other producers who chose to stamp something like this out in China and sell it for less. But then they also do not support their products like I do. If you have any problems with this product, you are urged to contact me personally!

The purpose of the Block Occupancy Detector is to provide the layout with a sense of realism in the operation of signals and controls. In today's prototype railroad signaling, the presence of rail equipment on the track is detected by wayside electronics. An electric current is transmitted through the rail and shunted by the wheels and axles. The return of that current is sent back through the other rail to actuate a pickup coil on a relay at the wayside control. In modern signaling, an audible electric signal is transmitted through a rail. At the end of the block, the signal is shunted and carried over to the other rail, which is then picked up by the receiver. When a train or other rail equipment enters the designated block, the shunt is carried over into the equipment by its wheels and axles. The receiver will detect a change in phase and/or frequency of the signal using the Doppler effect. Each set of wheels are conducting that shunt from one rail to the other, making it easy to detect the presence of equipment on a track, as well as speed and direction. In most cases, these calculations are done by a device in the cabinet called a Predictor which will also tell a crossing signal when to activate or deactivate.

This Detector unit operates on a similar principle. On a model railroad layout, electric current is applied to the rails to provide power to the locomotive so that the train can move. With DCC, signals are even transmitted to the locomotive's controller unit through the same method.

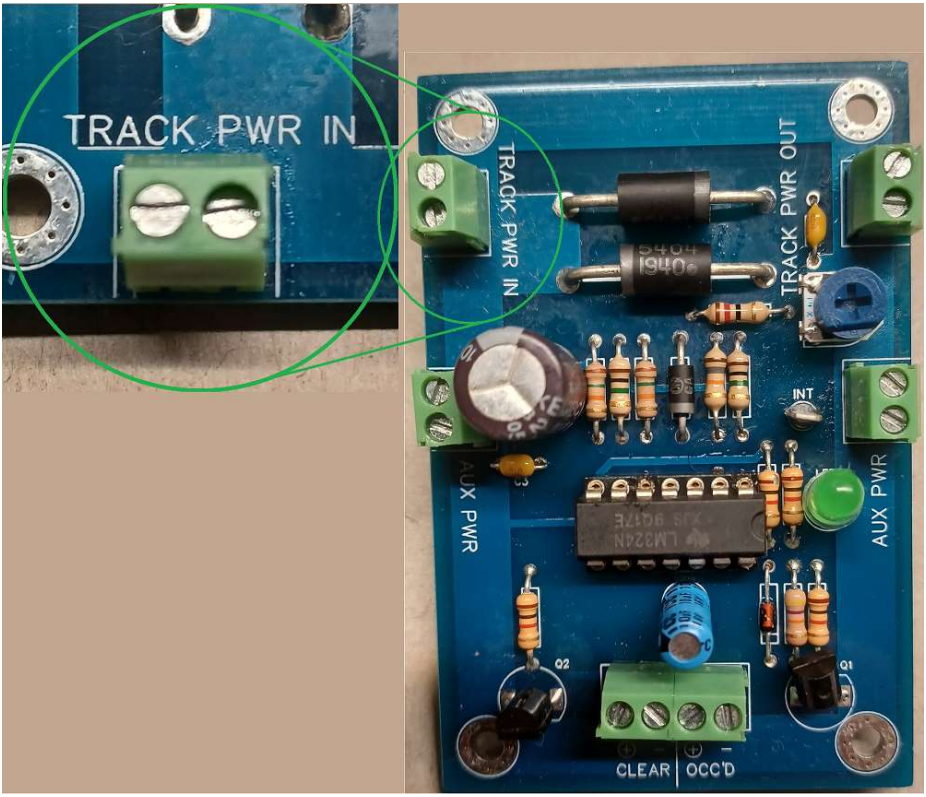
Introduction (Continued)

The detector unit is designed to precisely detect when such equipment is present within that block. The only difference is that most model train cars are manufactured with insulated wheels. So while the locomotive will trigger the Detector, the cars will not. It is advised to either install a resistor in the outer axle of each car, or replace the axles with those designed specifically to work as signaling shunts, but having resistive axles. It is recommended to use a resistance of no less than 4,000 ohms but no more than 40,000 ohms per axle.
You can install the resistors yourself if you follow this example:



Connecting your Detector Unit

The detector unit is designed to run in-line with the track power, between your power pack and the track circuit in your layout.
Near the top-left corner of the detector board is a 2-pole terminal labeled “TRACK PWR IN” and can be connected, in any polarity, to the power pack, cab selector or throttle controller.



If you are using multiple detectors, it is STRONGLY recommended that you wire them all in the same general polarity with each other. Certain issues have come up with reverse polarity in the layout, even while all trains are moving in the same direction. The problem is eliminated when all the cards are aligned in the same polarity.
Questions about this? Contact me for support.

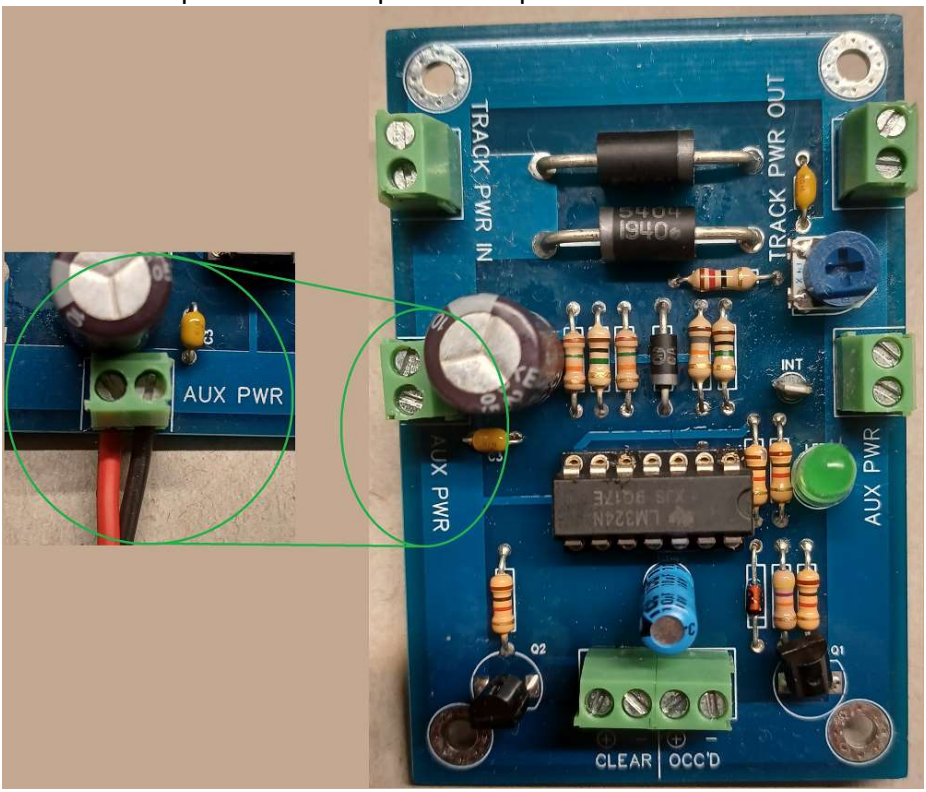
Connecting your Detector Unit (Continued)

On the board near the top-right corner is another 2-pole terminal labeled “TRACK PWR OUT” which goes directly to the isolated block of track.

Be sure to insert your wire into each terminal and gently tighten the terminal lug with a small flat head screwdriver to finger-tightness only. DO NOT OVERTIGHTEN! For best results, it is recommended that you apply a solder tin to your wire before insertion. Alternately, you may also choose to crimp on insertion lugs at the ends of your wires.

Connecting your Detector Unit (Continued)

The terminals immediately below the Track power terminals are labeled “AUX PWR.” This is where the power source shall be connected to the unit to provide it with power to operate.



This cannot be the same power source as the track power, as it will not function. The power in to AUX power must be at least 6 volts but no more than 16 volts DC. Recommended power supply is a 12-volt DC supply.

The terminal on the Aux Power closest to the Track power terminals is the Positive lead. Connecting the polarity in reverse will cause the unit to not function at all. You may connect aux power from the right side instead.

Connecting your Detector Unit (Continued)

You may wish to daisy-chain power from the unit to another unit or to other accessory devices, provided you do not exceed the power limitations of 5 amps total, including the outputs.

The outputs are located at the bottom of the board with a 4-pole terminal and are labeled “CLEAR” and “OCC'D” with a (+) and – for each.

The positive output for each is only intended to drive logic inputs such as an Arduino, or other Logic Controller device. It is not advised to use this output to drive lights or motors as it may overload the unit and cause considerable damage.
The negative output for each is designated for driving lights, motors and relays, where the device(s) are connected with a Common Anode. If you are using a DC power source, you can tap into the Positive terminal of the supply for your positive connection. If however you are using AC, you will need to install a small rectifier diode in series with your device to get your positive source. The unit is capable of switching up to 600mA on the Negative outputs, which is more than ample for small motors, relays and several lamps.

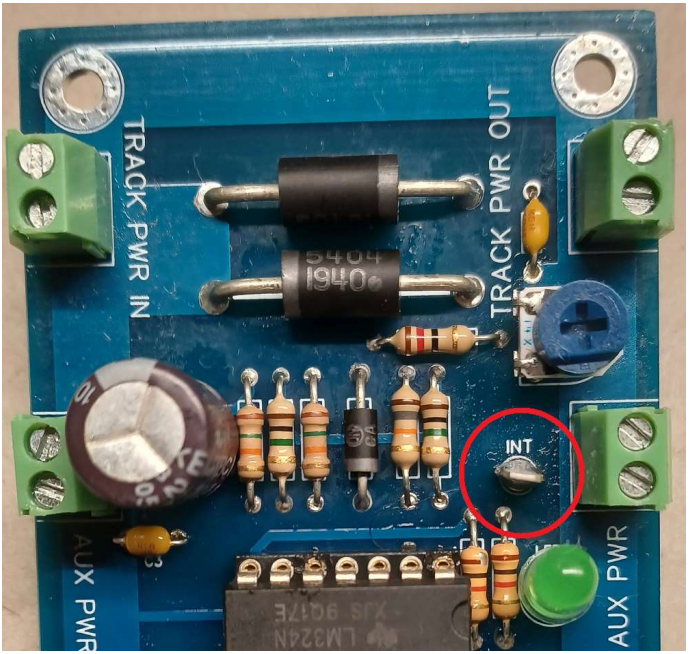
Adjusting Sensitivity

Once you have connected your unit to a Power supply and to the track power, turn on both power units, medium throttle for your track power. Then place a train car equipped with resistive axles in the designated block. Using a small phillips or flat head screwdriver, adjust the trimmer pot near the top-right corner of the board between the two terminals.

Turn the pot clockwise until the indicator on the card goes out, and then turn it back slowly just until the indicator illuminates again. You can always re-adjust the sensitivity later, but for now this should work fine. Turn off your power sources and connect your unit to the intended output devices as you desire.

Detector Override Feature

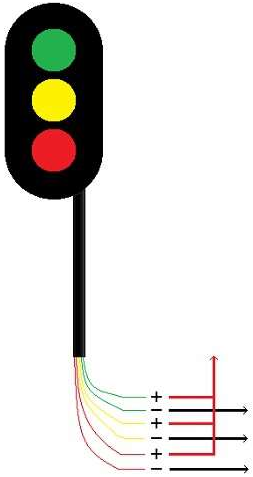
The unit is equipped with an override function. There is a single terminal located about mid-center on the right side of the board, just behind the AUX PWR terminal.



The purpose of this terminal is so that you can interrupt any latching circuits in your logic without needing to wait for a train to enter the block. It's also a means of testing the logic outputs without the sensor being activated. One example for this feature is when you have a switch or turnout inside the block that is lined against the main track, say an industrial spur or customer track. While it is lined against the main track, you can have the block continue to appear occupied without the presence of a train in the electric block. This terminal is a 0.110” male spade. You can either crimp a female spade of the same size onto a wire and snap it onto the terminal, or you can solder your wire to the terminal.

Details about Connecting your Detector Unit

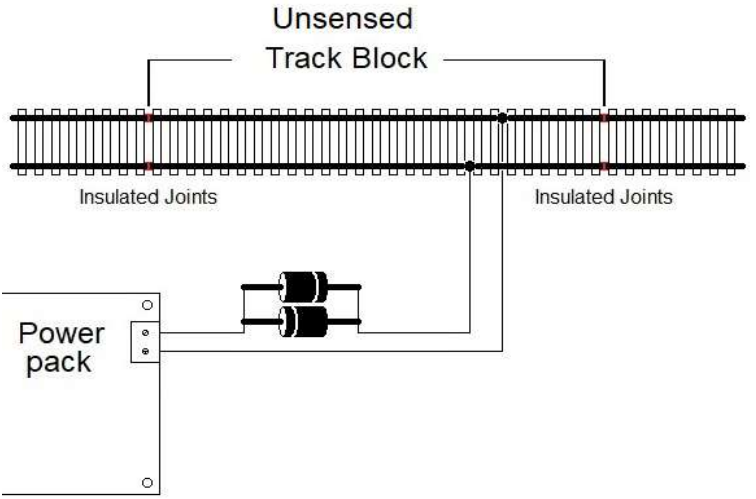
If you are connecting a signal to the unit, please check first and be sure that the signal is either separate elements or common anode. The detector unit will switch the lights from the negative side only.



If you are using LEDs (Common) this is referred to as the Anode. When using LEDs, it is required to have a resistor in series with each of the LEDs to bring the voltage down to the level that the LED will be able to function with.
Failure to use a current-limiting resistor in series with an LED will cause your LED to overcurrent and will destroy the LED. Most folks do not realize that unlike your favorite incandescent lamp, which is a resistive load all by itself, LEDs are just diodes, meaning they are intended to conduct current just like a wire. Yet LEDs are only able to conduct a small amount of current. Exceeding the current in your LED is like putting 20 amps through your 1 amp fuse, it will blow!

IMPORTANT NOTE

The detector will cause a remarkable difference in track power from a block that is not equipped with a detector. In other words you may observe the locomotive become slightly sluggish in the detector-sensed block compared to a block that's not equipped. It will lurch back to full speed once it returns to a non-sensed block. For continuity sake, it is recommended that you place a pair of rectifier diodes in line with your track power for each block that is not equipped with a detector, in reverse-parallel to each other. The recommended diodes are 3-amp Rectifier Diodes, such as the 1N5404.



Mounting your Detector Unit

Each unit is designed with 1/8th inch (3.175mm) mounting stud holes in all four corners. These stud holes are grounded for safety purposes, so that you can fasten them via mounting standoffs or studs to a metal panel. However the one concern is made regarding the grounding bond in that the Track power and Aux power are both bonded to ground on the Detector Unit. If for any reason this could create a short-circuit, it is imperative that you test your power connections after mounting but before energizing, to ensure that you are not connecting them to a short-circuit because you grounded the board. You can do this with a simple multimeter set on ohms or continuity. If you feel there may be an issue or you find an issue with grounding the board, it is recommended then that you fasten the detector unit to your panel using nylon standoffs or insulated wafers.

The detector unit is also capable of stacking with more detector units, sandwich-style but require a 1-inch standoff or longer between them to separate the components.

Any other form of mounting or fastening of these units is neither supported nor recommended.

Applications for the Block Detector

The applications for a Block Occupancy detector are many. In fact there is no way to explain all the available uses so I will simply give some examples where it might be used.

A Tunnel or Bridge location

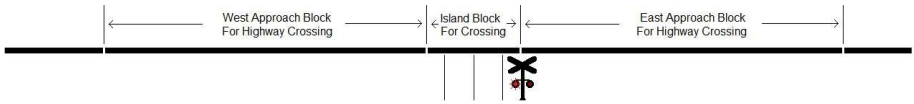
If you have a tunnel that permits bi-directional traffic, you may want to regulate it with a signal in order to keep your trains from meeting in the middle suddenly. Using the Block Occupancy Detector you can set your signals on either side of the tunnel. If the block is clear, your signals can show a Green Light. But if your train has entered the tunnel block, the signals will drop to Red, alerting any train on the other side that the tunnel is in use.

Similarly with a draw bridge or long span bridge, you can warn traffic when the span is in use or occupied. Or if you are using the draw bridge section and the bridge is open, you can connect the switch on the bridge to the “INT” terminal on the detector unit to override the block, showing a Red light regardless of the block condition.

A Highway At-Grade Crossing with flashers

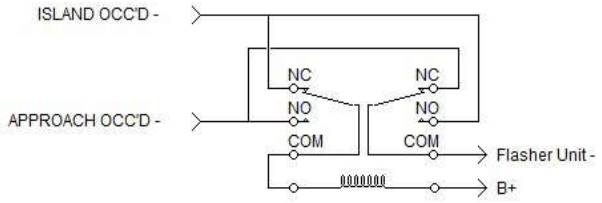
Whenever your train nears the highway you wish to offer protection to, have the “OCC'D -” connect to a relay that activates a flasher and bell at your crossing warning motorists of the present danger ahead.

If you can use two Detectors, establish an Island block for your crossing which is short and only includes a span as long as your highway is wide*. Then set up the approach circuit(s) on either side to allow for enough warning.



Applications for the Block Detector (Continued)

Using a Double-Pole Double-Throw relay, you can allow your crossing warning to activate when your train enters the approach circuit but deactivate once it clears the island circuit and resets when it clears the approach.



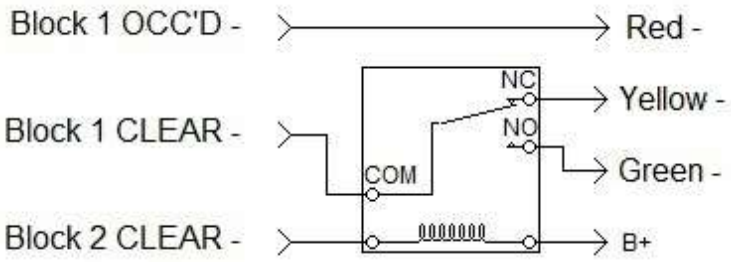
*Note – As with the prototype, you must also consider the length of your railcars in the island circuit. If you have a 40 ft. island but 80 ft. train cars, it's possible you could miss the island circuit when a train car straddles it electrically.

Applications for the Block Detector (Continued)

Automatic Block Signals

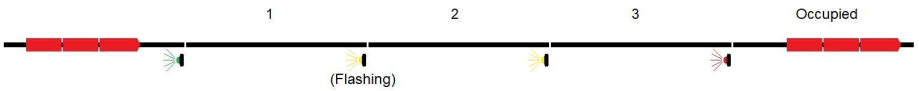
Before the technology of fiber optics and satellite communications enabled our railroads to communicate from a control office directly with every wayside controller and allow them to respond with telemetry back to the office, much of the railroad signaling was done using Automatic Blocks, meaning signals were autonomous and relied on Block detection to establish traffic speed and frequency.

Illustrated here is a 2-block system with 3 blocks in use. The first block shows a train preceding it with a Green signal. Then the next block is only showing a yellow for the preceding block. The following block is occupied so the signal is red for the block preceding it.

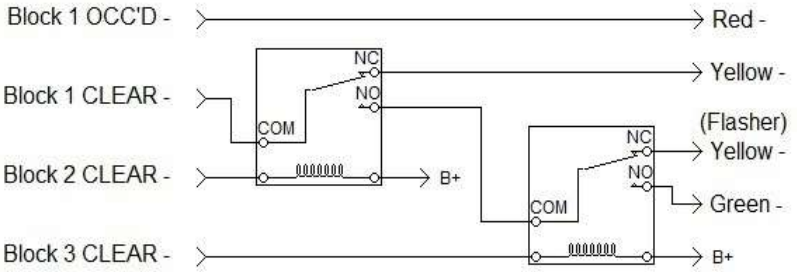


This is the diagram for using a Single Pole, Double Throw Relay to operate a 2-block system.

Applications for the Block Detector (Continued)



Illustrated here is a 3-block system with 4 blocks in use. The first block shows a train preceding it with a Green signal. Then the next block is showing a flashing yellow for the preceding block. Then the next block is only showing a yellow for the preceding block. The following block is occupied so the signal is red for the block preceding it.

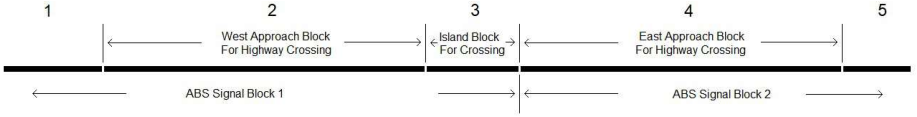


This is the diagram for using 2x SPDT relays to give the appropriate aspects for a three-block system.
These circuits are daisy-chained with each other to produce the aspects desired. I carry such a relay card for this purpose, so please contact me if you are interested in using my relay cards. Otherwise you can build your own out of relays that you have found. Of course if you have any questions, you can contact me!

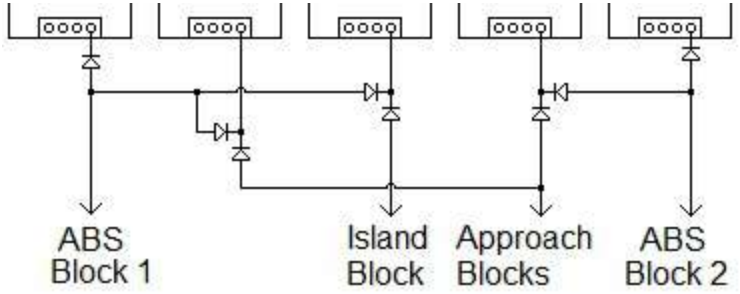
Applications for the Block Detector (Continued)

Overlapping your Blocks

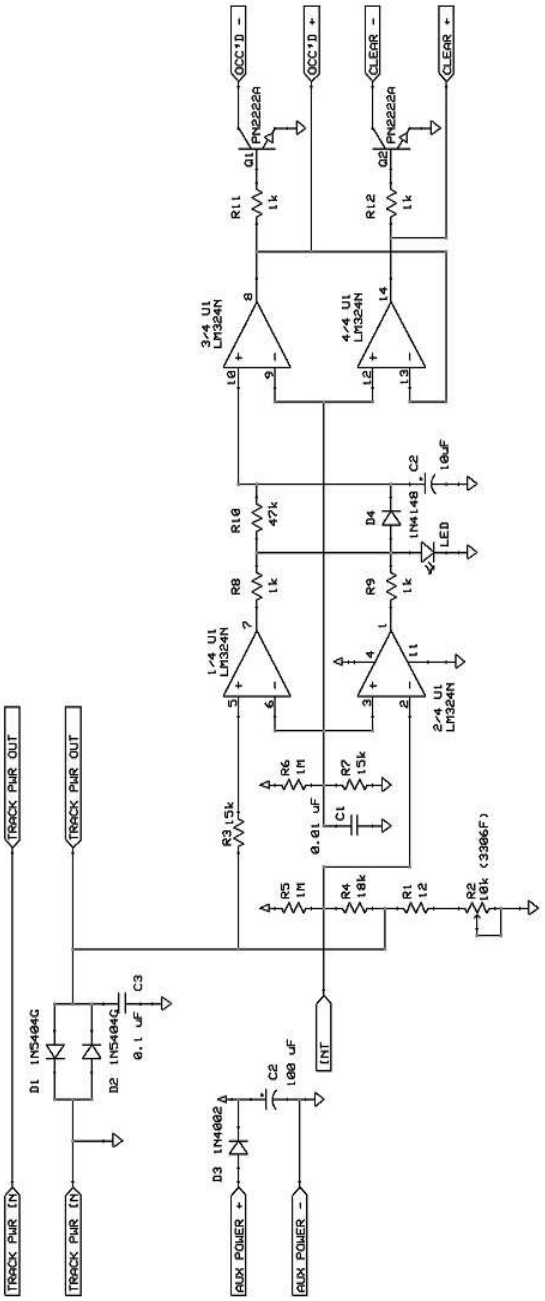
It is possible to overlap blocks, however this means using more than one block detector for the single intended block in order to accomplish your goal. The best example that I can use is the example of the grade crossing above where there is an approach circuit and an island circuit in order to operate the crossing signals. But let's assume that the crossing is also on the edge of an ABS or CTC block and you can put the East approach and Island blocks on one ABS block, but the West Approach is on the adjacent ABS block.



Using some signaling diodes such as the 1N4148, you use the detector blocks as a sub-block and produce a signal for individual combo-blocks.



Schematic Diagram



User's Notes

JASON'S BASEMENT

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Other Model Railroad Products Include:

- DC Dual Flasher Circuit
- Traffic Signal Controller
- Fused Power Distribution
- Block Signal Relay Card
- and much more...