

# Signals and Detection

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<http://abrams-railroad.potomac-nmra.org/>

# Occupancy Detection & Signals

- ◆ Crossbuck flashing lights, crossing gates, and trackside signals all provide visual interest to a model railroad.



- ◆ They can also inform the operators about track conditions to guide operations.
- ◆ This clinic describes installing and use of occupancy detection using current sensing and optical detectors used to control flashers, crossing gates, and trackside signals and repeaters for Automatic Block Signaling (ABS).
  - Not interacting with decoders, computers, or control systems
  - Probably not NMRA LCC compatible
  - Requires additional circuitry to send status to command station



# Operations on the ARE

- ◆ The ARE operates using
  - Switch lists generated by RailOP

PickUp	Truck Terminal	ADVX	548	Box	Blue	Advance Balistics
Roy's Place		ATSF	3124	Box	White	
SetOuts	Truck Terminal	ARE	57431	Box	Tuscan	
Roy's Place		HJH	484	Reefer	Yellow	Heinz

- “Employee instructions” detailing the route a train is to follow
  - The ARE has a single track main line with alternative branches and reversing loops
  - Trains run complex routes to give extra running time
- ◆ Time Table and Train Order (TT&TO) operation didn't work for us
- ◆ Too much variability due to switching and operator skills
  - Added too much tension
  - Want enjoyable operating experience



# Single Track Control

- ◆ Single track section must be controlled
  - Occupied by only one train
  - Some hidden track



## Track Warrant

Silver Spring District

Extending from Carnegie  
to Schenley and Squirrel  
Hill

Possession of this Track  
Warrant is required before  
a train may enter the stated  
district. Return Warrant  
when exiting district.

- ◆ Previously used physical track warrants
  - Must hold warrant to enter track block
  - People forgot to pick up or return warrant
- ◆ Automatic signals
  - More prototypical
  - Passively visible to everybody
  - Red means occupied – don't enter
  - Put signal at each end of block



# Introduction to Block Occupancy Detection

- ◆ Block occupancy current detectors measure the flow of current into block
  - ◆ Need to draw current as long as train is in block
    - Engine starts drawing current
    - Caboose or lighted car are last car to leave
  - ◆ There's a great article *Easy Block Detection and 2-Color Signals* at <http://www.gatewaymra.org/detection1.htm>
  - ◆ Older twin "T" and diode detection circuits can be used for DC & DCC
    - Detection fails when DC voltage reduced to zero
  - ◆ DCC has power on the rails at all times, enabling additional detector designs.
    - I decided to use a DCC detector
    - Computer interface possible, but I don't use it
      - Too expensive and complicated



# DCC Block Occupancy Detection

- ◆ DCC supports current sensing occupancy detection
  - Detect current through DCC decoder, even when engine stopped
  - Need resistance wheel set, or a lighted caboose or passenger car, to draw current after engine leaves block (see next slide)
- ◆ I decided to use DCC Current Sensor by Richard Napper, MMR
  - Published in *Caboose Kibitzer*, Spring 2006
  - Available from him at the time, built or as kit
- ◆ Commercial products
  - BlockWatcher™ by DCC Specialties  
<http://www.dccspecialties.com/products/bwatcher.htm>
  - TRAK-DT by Dallee Electronics  
<http://www.dallee.com/Trak-DT-Basic-Current-Detector-365>
  - RR-CirKits by Dick Bronson  
<http://www.rr-cirkits.com/description/index.html>
  - VT-5 Block Occupancy Detector For DCC by Rob Paisley  
<http://www.circuitous.ca/DccBODvt5.html>

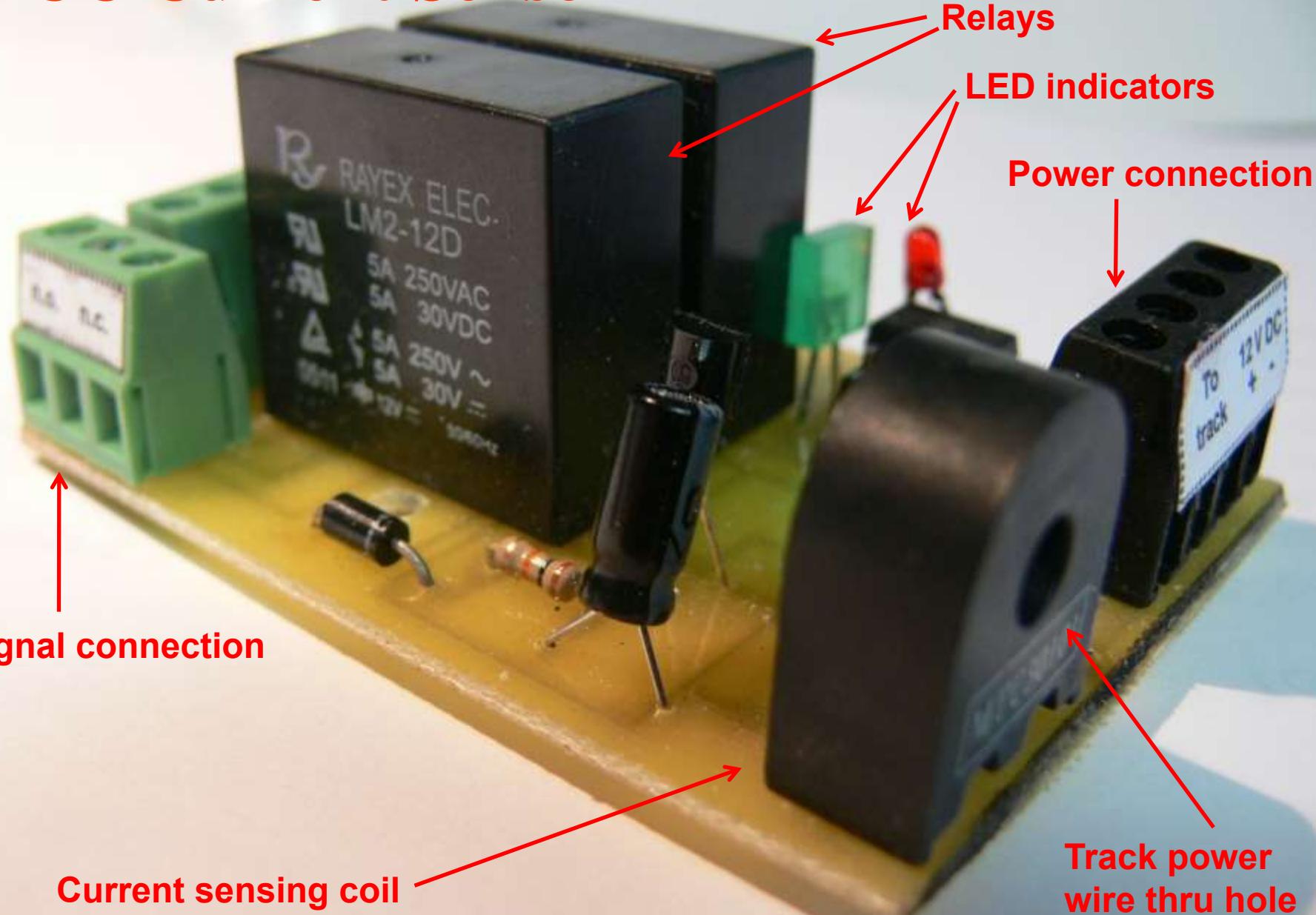


# Resistance Wheel Sets

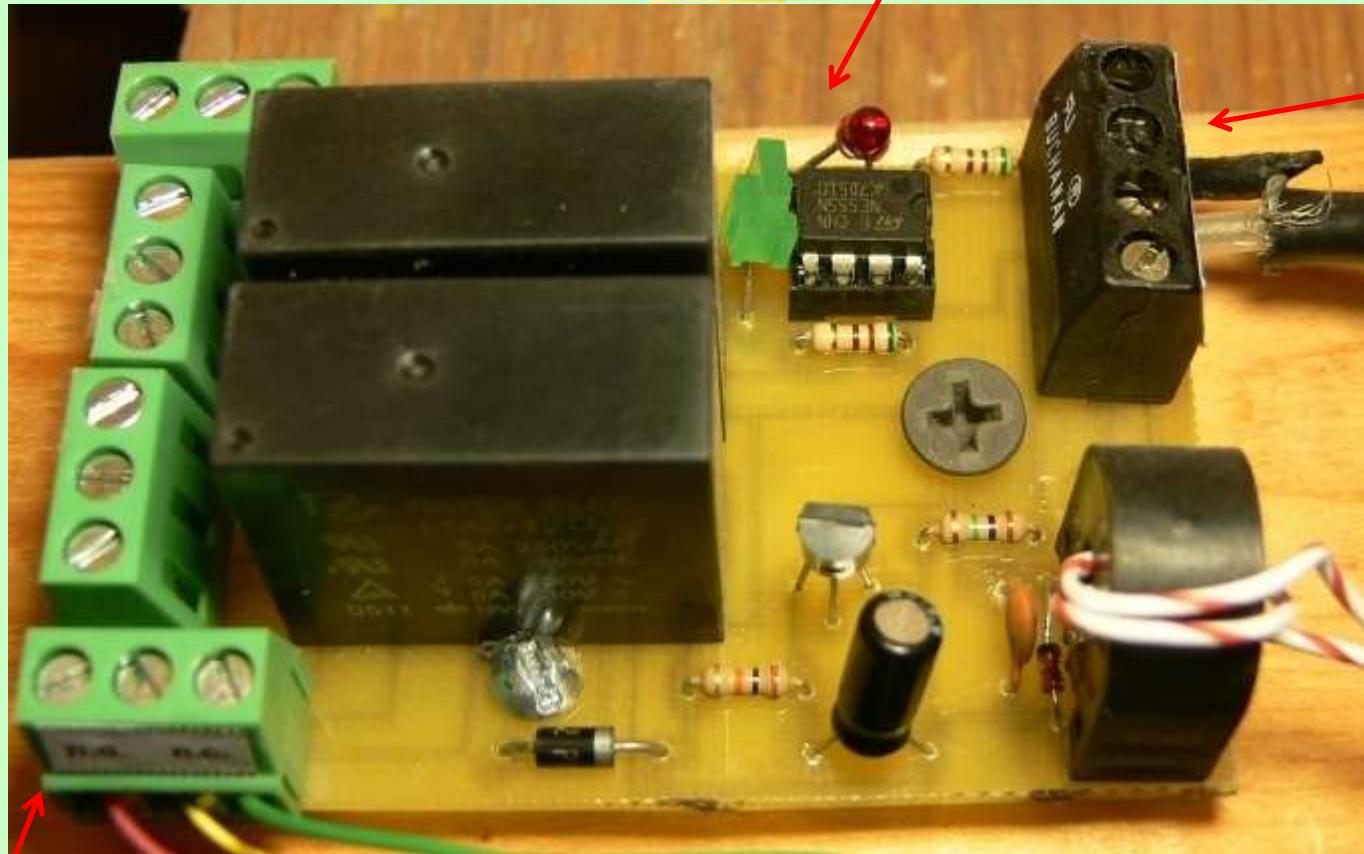
- ◆ Add resistor between wheels to allow enough current to flow to be detected
  - I used 10K ohm per axle
- ◆ Picture shows two types of resistors
  - Discrete component soldered to wheels, harder and more expensive
  - Film PC-board resistor super-glued to axle and connected to wheels with wire glue
    - Inexpensive, carbon-bearing, conductive liquid  
<http://www.wireglue.us/>
- Buy resistors from most electronic suppliers such as Digi-Key  
<http://www.digikey.com/>
- ◆ More info: Making Resistance Wheel Sets for Occupancy Detection by Dick Bronson <http://www.rr-cirkits.com/Notebook/Resistor-Wheel-Sets.pdf>
- ◆ Jaybee wheelsets available with resistors built in: Walthers #369-10620



# DCC Current Sensor



# Sensor on Layout



Signal  
connections

LED indicators

Power  
connection

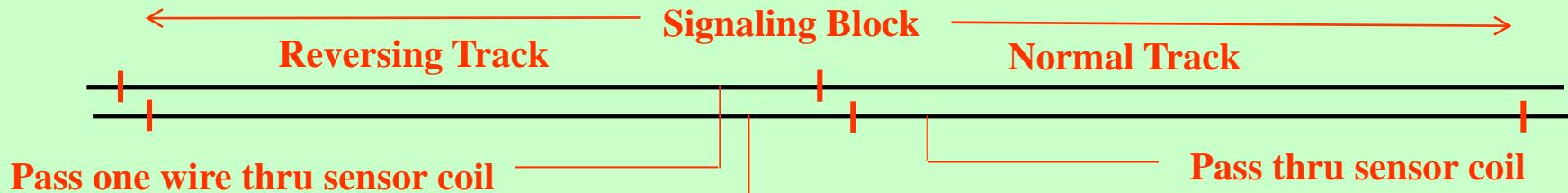
Track power  
wire thru hole

Note: more  
turns  
increases  
sensitivity

- ◆ Current flowing to track block is sensed
- ◆ Relay changes state
  - Signal lights change



# Special Case: Using Sensor for Two Blocks

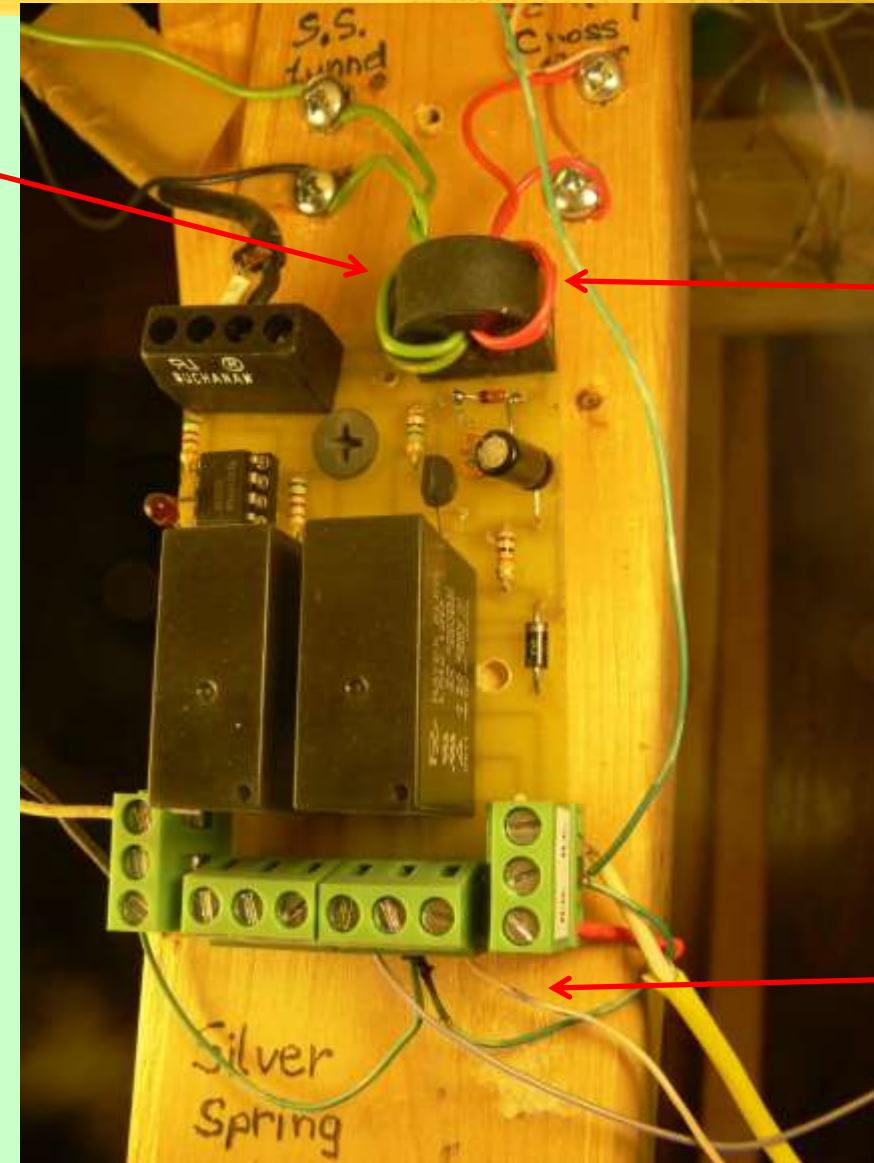


- ◆ DCC reversing track and normal track are part of signal detection block.
- ◆ Use sensor to detect current in either (or both) normal and reversing track sections
- ◆ Thread the feeder wire for the normal DCC track section & the DCC reversing track section thru the current sensing coil
- ◆ One end of the train can be in the DCC reversing track section and the other end in the normal DCC track section
- ◆ Detector picture on next slide



# 2-Block Sensor on Layout

Green wire = power  
to normal track  
section

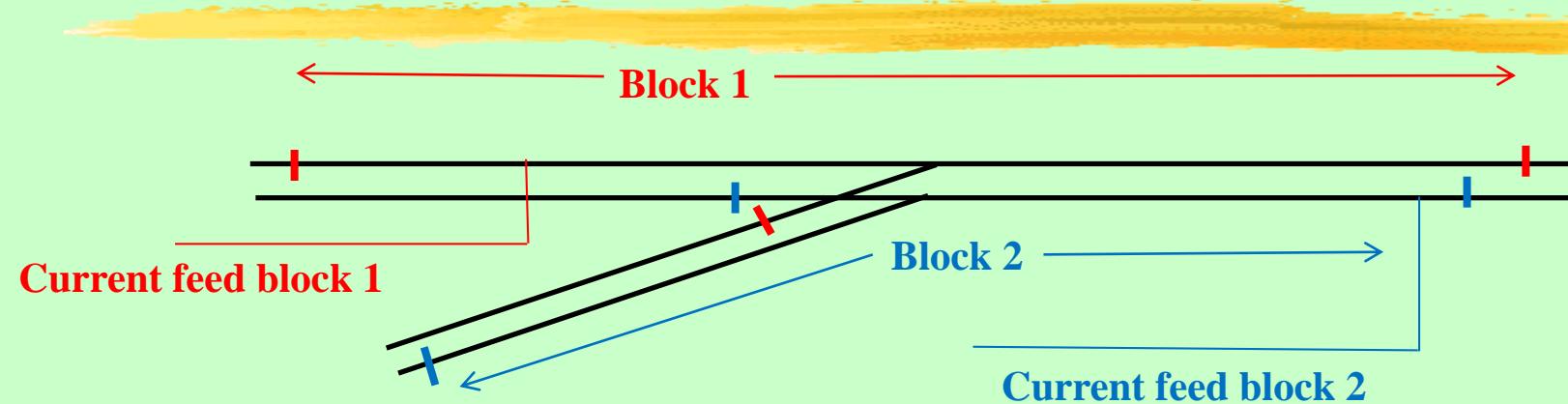


Red wire = power  
to reversing track  
section

Signal connections



# Another Special Case: Track in Two Blocks



- ◆ A different case. Blocks 1 & 2 are independent but share a common segment of track.
  - Block 1 dead ends in a town with a small yard
  - Block 2 is part of the main line
- ◆ Use each rail to define block
- ◆ Track to right of turnout is in both blocks
- ◆ Track to left of turnout is in only one block

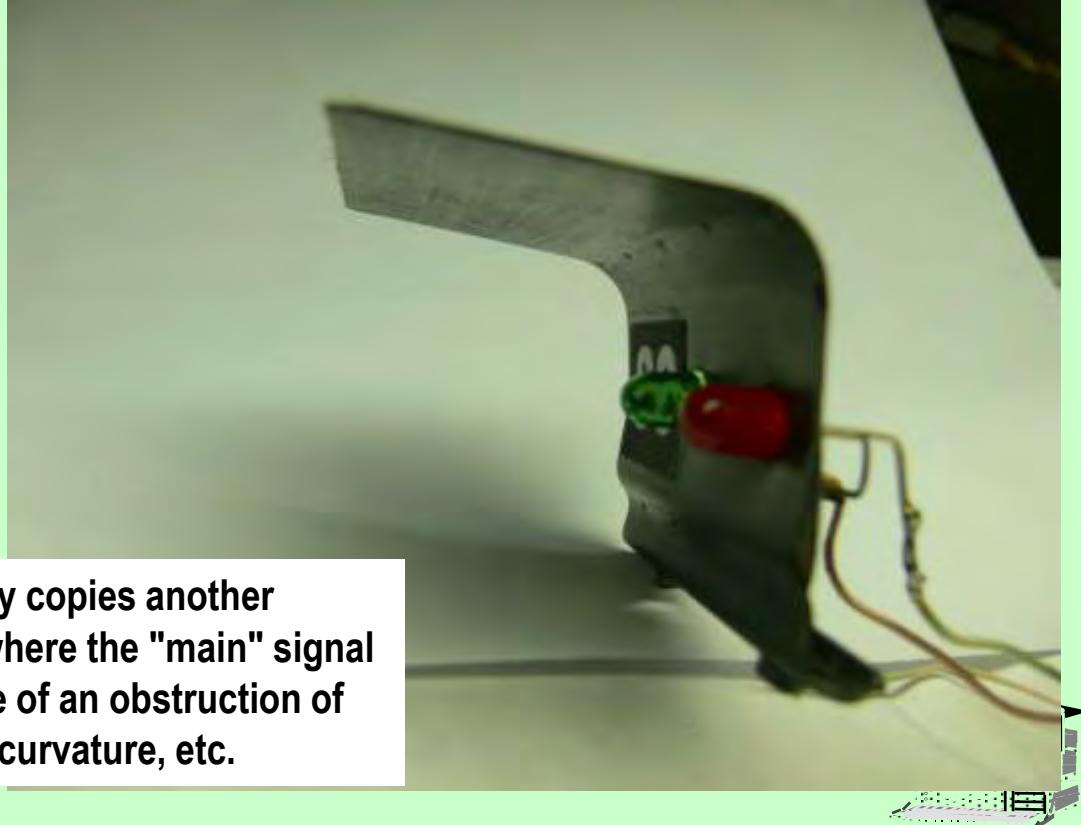


# Repeater Signal ‡

- ◆ What if you're not in position to see the track-side signal?
  - Too far away
  - Too high above the track
- ◆ Repeater signals are the answer

- ◆ Made out of Z-shaped piece of black plastic from microwave container
- ◆ Red and green LEDs inserted from rear

‡ A Repeater Signal aspect exactly copies another signal's aspect. Repeaters are used where the "main" signal cannot be seen early enough because of an obstruction of the line of sight: bridges, piers, track curvature, etc.



# Repeater Installed Above Backdrop

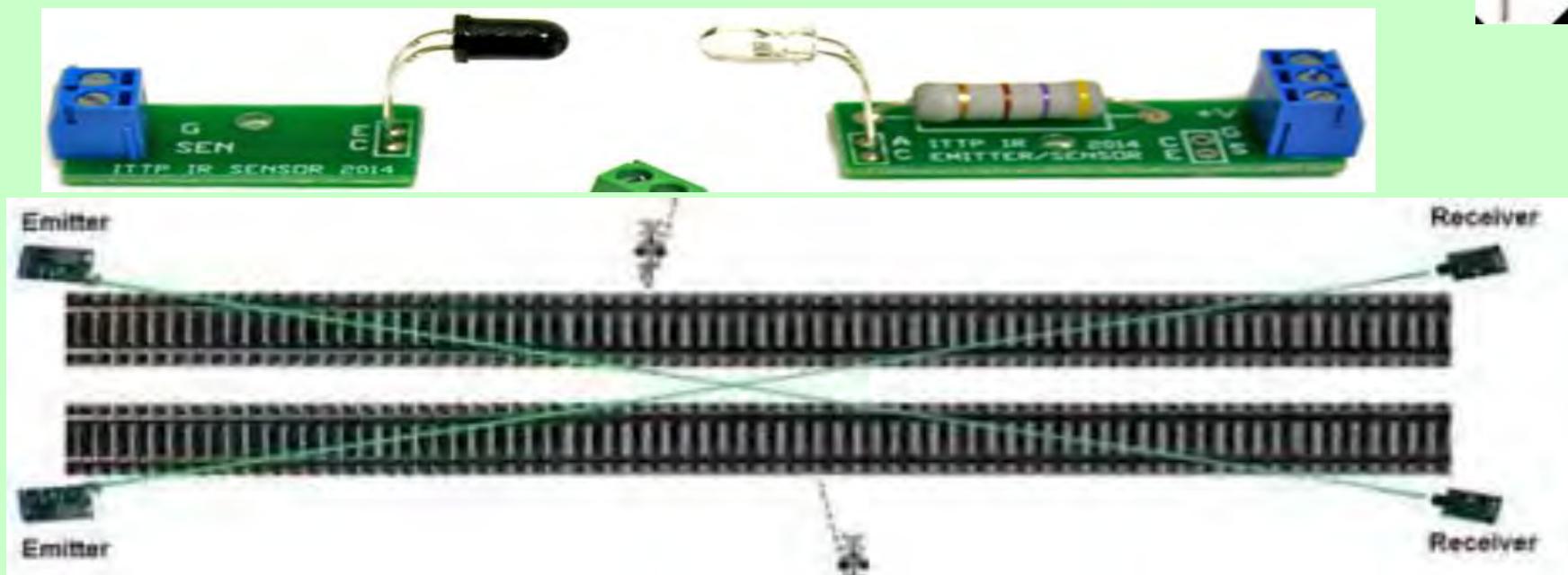
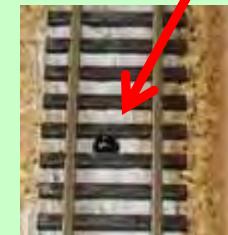
Repeater



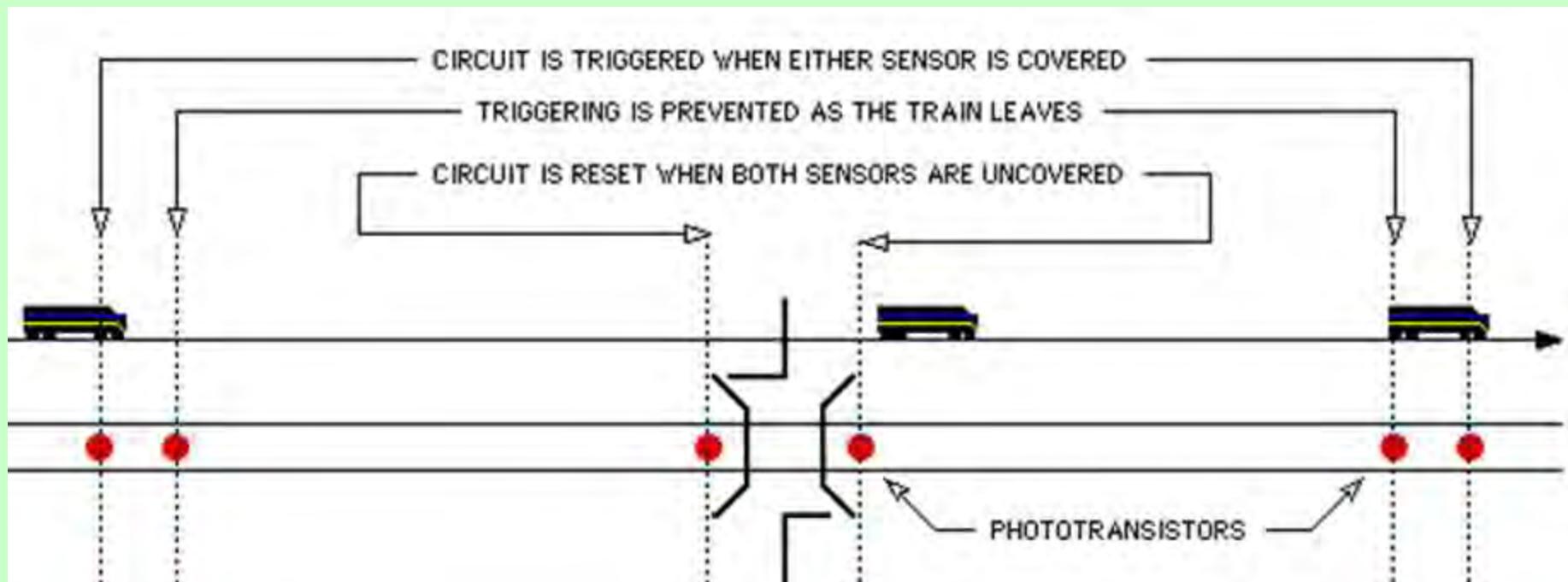
# Position Sensors



- ◆ Optical position sensors (photocells) detect a change in the visible or infrared light that activates circuit board
  - Visible light phototransistor is placed between ties
    - Depend on room light, preclude night operations
  - Infrared detectors positioned across track



# Example Crossing Gate Operation with Sensors Between Ties (1 of 2)



# Example Crossing Gate Operation with Sensors Between Ties (2 of 2)

- ◆ When a train traveling in either direction covers one outermost sensors, the crossing signals will start to flash.
- ◆ After a delay the crossing gates start to lower. (Adjustable delay)
- ◆ When the train has cleared the crossing the gates will start to lift after about 2 seconds.
- ◆ (The grade crossing is occupied until both of the last sensors are uncovered.)
- ◆ The signals will remain on for a short time after the gates are fully up. (Adjustable delay)
- ◆ As the train leaves the protected section of track, the next-to-last sensors prevent the flashers from starting again by deactivating the outermost sensors.
- ◆ The outermost sensors are reactivated approximately 5 seconds after the next-to-last sensors have been uncovered



# Signals on the ARE (1 of 2)



# Signals on the ARE (2 of 2)



# Grade Crossing on LIRR Port Jefferson Branch (1 of 2)



# Grade Crossing on LIRR Port Jefferson Branch (2 of 2)



# Links and References – Articles

- ◆ Easy Block Detection and 2-Color Signals  
<http://www.gatewaynmra.org/detection1.htm>
- ◆ DCC Current Sensor by Richard Napper, MMR  
*Caboose Kibitzer*, V.56 #2, Spring 2006:  
[www.mcior-nmra.org/Publications/Kibitzer/Volume56-2.pdf](http://www.mcior-nmra.org/Publications/Kibitzer/Volume56-2.pdf)  
email: [renapper@wildblue.net](mailto:renapper@wildblue.net)
- ◆ Block Detection [http://www.dccwiki.com/Block Detection](http://www.dccwiki.com/Block_Detection)
- ◆ Block Occupancy Detector For DCC by Rob Paisley  
<http://www.circitous.ca/DccBODvt5.html>  
email: [rpaisley4@cogeco.ca](mailto:rpaisley4@cogeco.ca)
- ◆ Where Is My Train? <http://mrhpub.com/2013-08-aug/port/#65>
- ◆ Train Signals for Your Model Railroad Layout  
<http://www.building-your-model-railroad.com/railroad-signals.html>
- ◆ Resistive wheel sets  
[http:// www.rr-cirkits.com/Notebook/Resistor-Wheel-Sets.pdf](http://www.rr-cirkits.com/Notebook/Resistor-Wheel-Sets.pdf)



# Links and References – Products

- ◆ BlockWatcher™ by DCC Specialties  
<http://www.dccspecialties.com/products/bwatcher.htm>
- ◆ TRAK-DT by Dallee Electronics  
<http://www.dallee.com/Trak-DT-Basic-Current-Detector-365>
- ◆ RR-CirKits by Dick Bronson  
<http://www.rr-cirkits.com/description/index.html>
- ◆ Wire glue <http://www.wireglue.us/>
- ◆ AZATRAX Circuits and Signals <http://www.azatrax.com/>
- ◆ Digi-Key <http://www.digikey.com/>
- ◆ Logic Rail Technologies <http://www.logicrailtech.com/>
- ◆ Atlas All Scales Signal System (a more sophisticated system)  
<http://download.atlasrr.com/pdf/SignalManual2019.pdf>

