

RAILROAD SIGNAL OVERVIEW

Model and Prototype



SIGNAL TYPES

Semaphore

Lower Quadrant

First developed in 1860's

First major installation begun on PRR in 1870's

Upper Quadrant

Approved by ARA in 1904

Were majority of new installations until 1940

Common until the 1970's

Originally White was proceed indication

First change to green ~1890's

Corning research > current green/yellow/red 1906-1908

White for proceed prohibited by ICC in 1918

SIGNAL TYPES

Color Light Signals

Made feasible by optics development about 1915

Not clear when they became common

Can be vertical or “TriHead”

Note “Irish Priority”

Searchlight Signals (single light)

“Offered” first in 1920

Not clear when they became common

Now being replaced

Current New Installations

Usually color light

Vertical and “TriHead”

Vertical usually extended “Darth Vader” hood

Upgraded support framing and safety railing

SIGNAL TYPES – UNIQUE TO RR

Position Lights (PL) – PRR, + N&W, LIRR, LV

First trials on PRR in 1915

Current configuration adopted in 1922

97% conversion by late 1940's (!)

Some “stop” yellow lights replaced by red in 1950's

N&W started colorizing theirs in 1964

Being replaced on former PRR lines now

Color Position Lights (CPL) – B&O and affiliates

Only one head, unlike PRR PL's, but

May have up to 6 markers above & below head

First installation in 1921

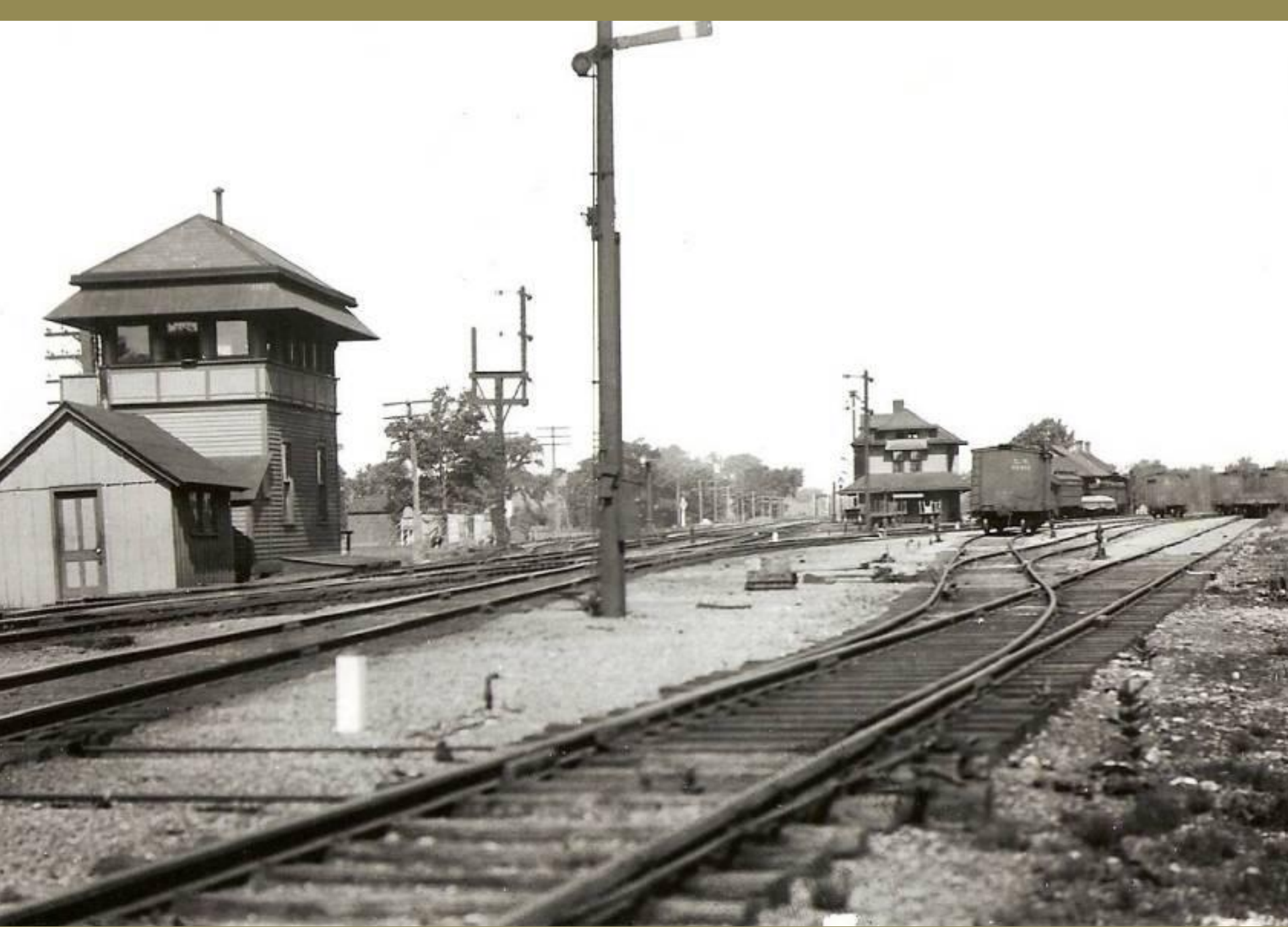
First replacement on Sand Patch in 1998

Good Reference: www.railroadsignals.us

(look at “everything else” bottom of home page)



Ball Signal – Whitfield, VT
Crossing of former B&M and MC lines
Believe several lasted into 1950's



Lower Quadrant Semaphore
Level is stop, arm drops for less restrictive





Upper Quadrant Semaphore

Arms level for stop, raise for less restricting





**Semaphore (Train Order Board)
Thurmond, West Virginia**

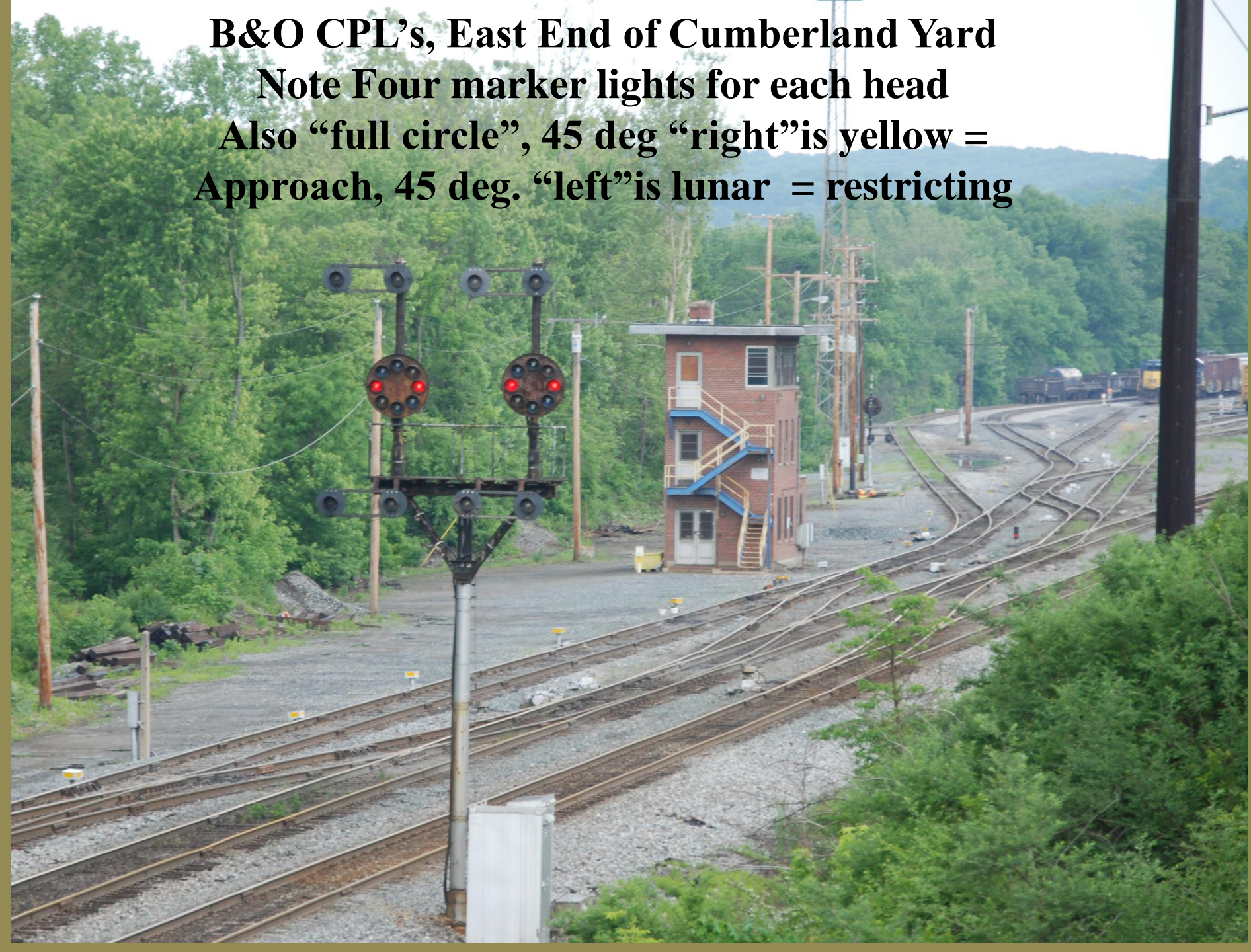


**Pennsy PL's
Summerhill, PA**



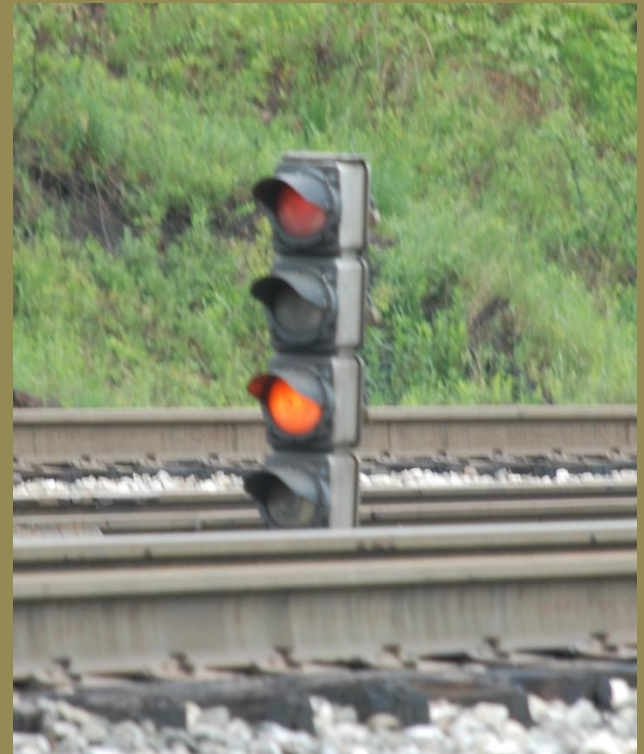
B&O CPL's East of Grafton, WV

B&O CPL's, East End of Cumberland Yard
Note Four marker lights for each head
Also "full circle", 45 deg "right" is yellow =
Approach, 45 deg. "left" is lunar = restricting

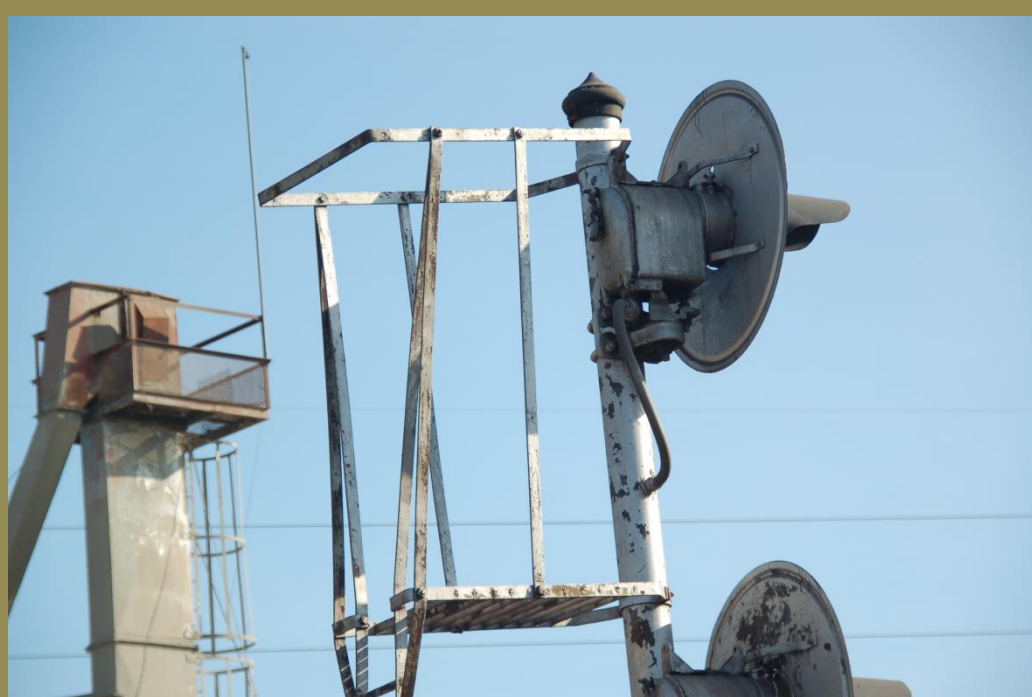




Color Lights on former C&O, Thurmond, WV
Note: Red locations > better separation



Dwarfs



**Searchlights – CSX
Cordele, GA**

**Color Light at Camp 2
Former Clinchfield
Complete with bullet holes!**





**Searchlights on bridge east end Rochester yard
Former NYC four track main**



**New searchlights on CSX east of Rochester, replaced
signal bridge, Former NYC main, now two tracks
Note 2 heads westbound (X-over), 1 eastbound**



**New “Darth Vader” color light signals new style signal “mast”
CSX, Grafton, WV - Replaced B&O CPL’s**



New CSX Color Lights South end Ora
Note: Top two G/Y/R, bottom G/Lunar/R



**New NS TriLight Signals
Cresson, PA, replaced PRR PL's**

Signal Aspects - Prototype

Most RR's did it their own way

Mergers had little immediate effect

eg, CSX today has B&O CPL's, old (SC) and new (NY) searchlights, & Old (NC) & New Color Lights (SC)

Many Aspects

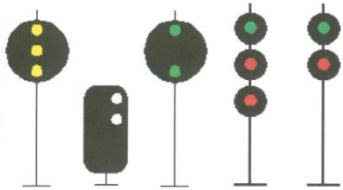
NORAC rules – 15 aspects

NYC 1941 Rulebook – 14 pages of signal aspects

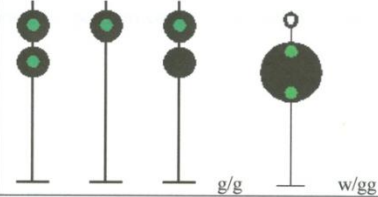
Need to simplify on a Model Railroad

Clear

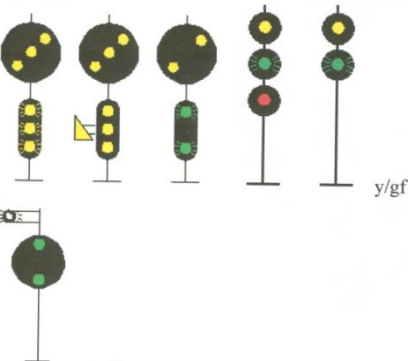
281



Clear
Proceed not exceeding Normal Speed.



g/g w/gg

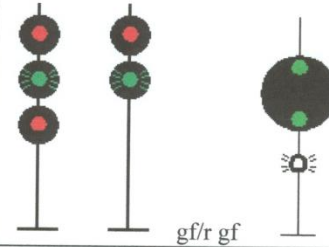
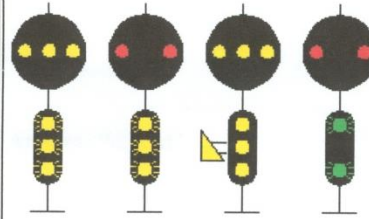


Approach Limited
Proceed approaching the next signal at Limited Speed.

<wf/gg

Approach Limited

281c



gf/r gf gg/wf

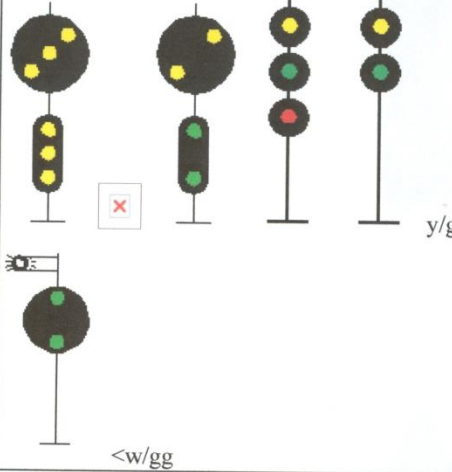
Limited Clear

Proceed at Limited Speed until entire train clears all interlocking or spring switches, then proceed at Normal Speed.

In CSS territory with fixed automatic block signals, trains not equipped with operative cab signals must approach the next signal at Limited Speed.

Limited Clear

282



<w/gg

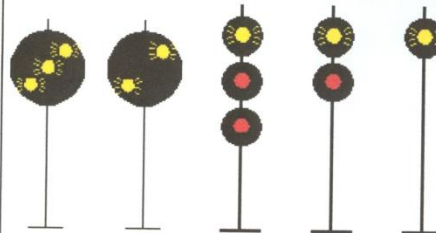
y/g

Approach Medium

Proceed approaching next signal at Medium Speed.

Approach Medium

282a

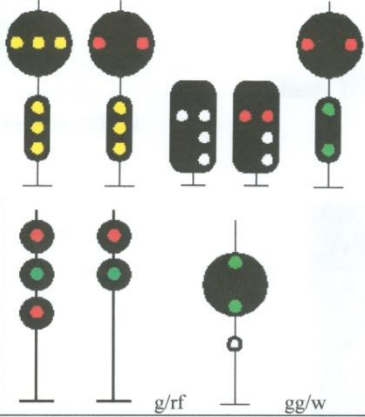


Advance Approach

Proceed prepared to stop at the second signal. Trains exceeding Limited Speed must begin reduction to Limited Speed as soon as engine passes the Advance Approach signal.

Advance Approach

283



g/rf gg/w

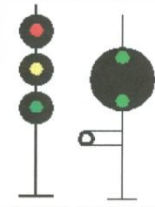
Medium Clear

Proceed at Medium Speed until entire train clears all interlocking or spring switches, then proceed at Normal Speed.

In CSS territory with fixed automatic block signals, trains not equipped with operative cab signals must approach the next signal at Medium Speed.

Medium Clear

283a



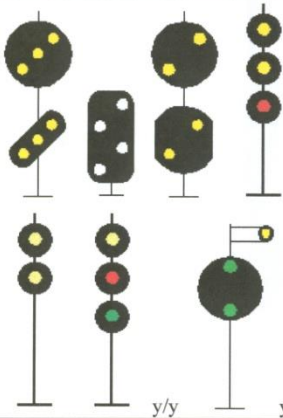
Medium Approach Medium

gg/ys

Medium Approach Medium

Proceed at Medium Speed until entire train clears all interlocking or spring switches, then approach the next signal at Medium Speed.

284



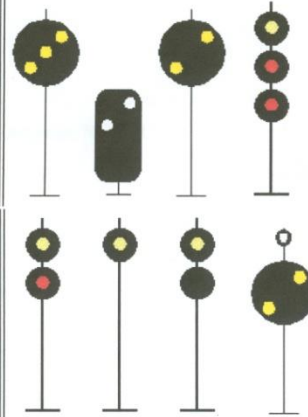
y/y y>/gg

Approach Slow

Approach Slow

Proceed approaching next signal at Slow Speed. Trains exceeding Medium Speed must begin reduction to Medium Speed as soon as engine passes the Approach Slow signal.

285



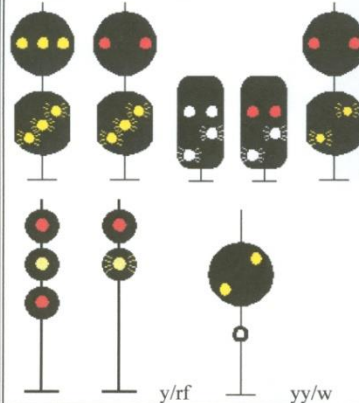
w/yy

Approach

Approach

Proceed prepared to stop at the next signal. Trains exceeding Medium Speed must begin reduction to Medium Speed as soon as the engine passes the Approach signal.

286



y/rf yy/w

Medium Approach

Medium Approach

Proceed prepared to stop at the next signal. Trains exceeding Medium Speed must begin reduction to Medium Speed as soon as the Medium Approach Signal is clearly visible.

287



g/r g gg

Slow Clear

Slow Clear

Proceed at Slow Speed until entire train clears all interlocking or spring switches, then proceed at Normal Speed.

In CSS territory with fixed automatic block signals, trains not equipped with operative cab signals must approach the next signal at Medium Speed once they have left interlocking limits.

288

Slow Approach

Proceed prepared to stop at the next signal. Slow Speed applies until entire train clears all interlocking or spring switches, then Medium Speed applies.

Slow approach

y/r y/y y/y

290

Restricting

Proceed at Restricted Speed until the entire train has:

1. Passed a more favorable fixed signal,
- or
2. Entered nonsignalled DCS territory,
- or
3. Passed a location where a more favorable cab signal was received.

Restricting

r/y y/u u/u

291

Stop and Proceed

Stop, then proceed at Restricted Speed until the entire train has:

1. Passed a more favorable fixed signal,
- or
2. Entered nonsignalled DCS territory,
- or
3. Passed a location where a more favorable cab signal was received.

When a letter G (grade marker) or letter R (restricting marker) is displayed in addition to a number plate as part of these aspects, freight trains may observe the signal as though Restricting, Rule 290, were displayed.

#/r/r w/r/r

292

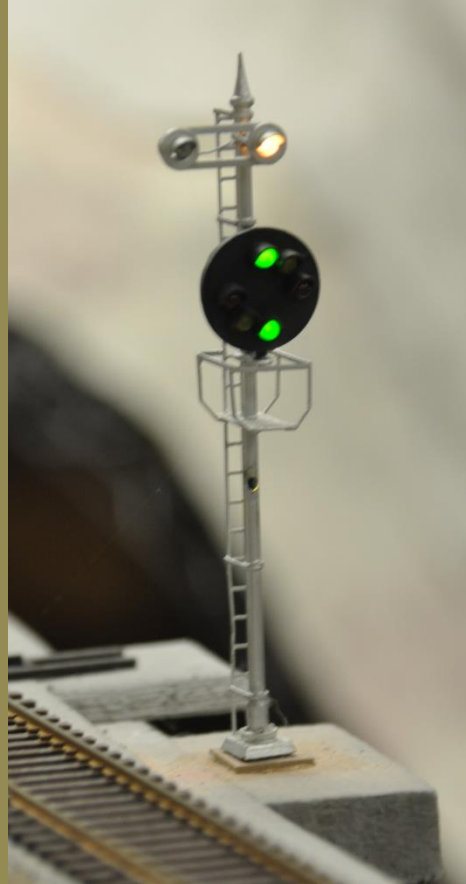
Stop

r/r/r

Stop & Proceed

Stop Signal

Stop.

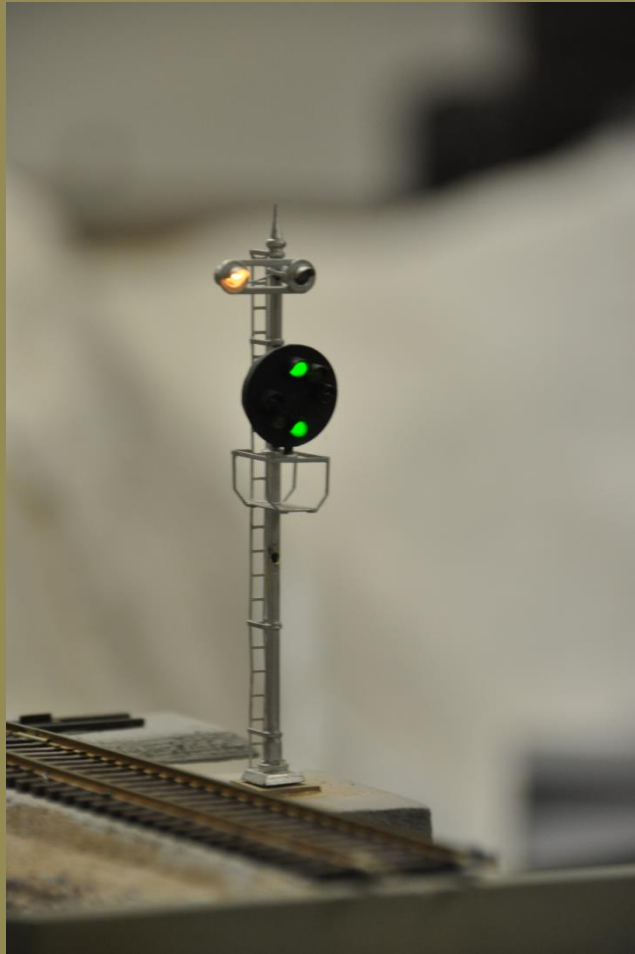


↑
Left – 2 Routes
Right - 4 Indications



← **Clear for Crossover**
(Medium Clear)

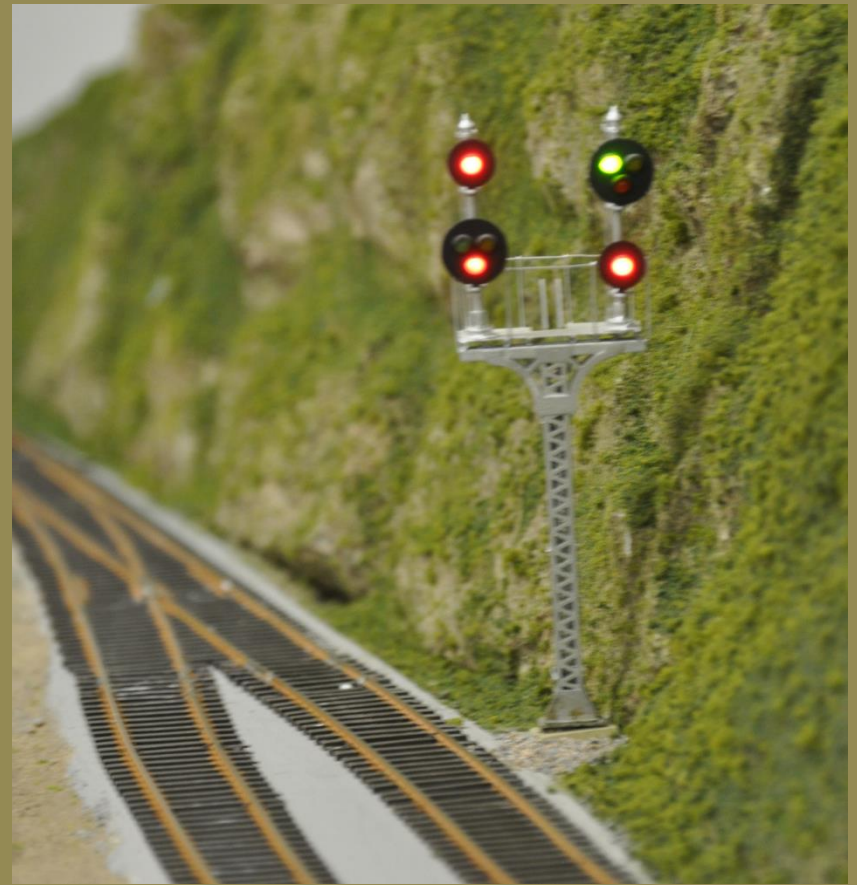
Model Signal Indications
Clear



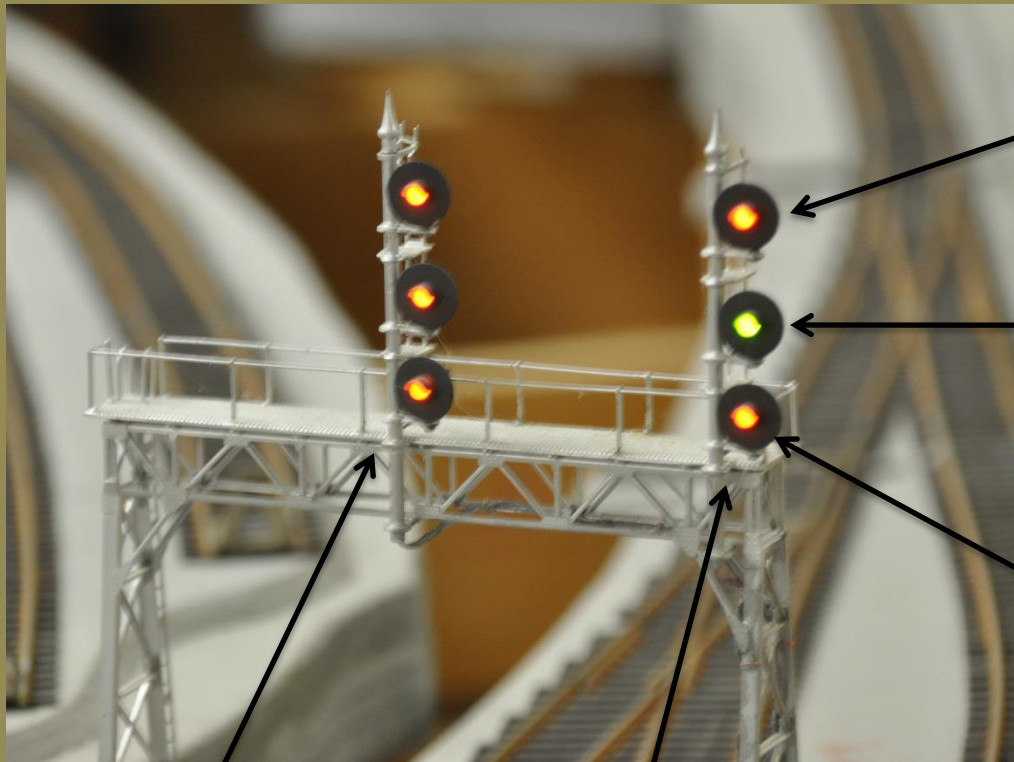
Approach Medium
Proceed, approaching next signal
at medium speed



Siding Entrance
Top Main, Bottom Siding
Bottom often Y/R only



Leaving Siding
Main G/Y/R over R
R/R = Absolute
Siding R over G/Y/R
R over G = medium clear



Main
(Clear if Green)

Siding
(Medium Clear)

Running Track
(Slow Clear if Green)

Main

Siding

Yard Exit
(separate signal)



Approach

Proceed prepared to stop at next signal

Trains exceeding medium speed must begin reduction to medium speed as engine passes signal

Model RR Signal System Components

Hardware

The signals themselves

Block Occupancy Detectors

Usually diode drop (DC) or inductive (DCC)

Occasionally IR or optical

Signal Controllers

Convert block and route input to signal aspect

Route Logic

Inputting turnout position to signals

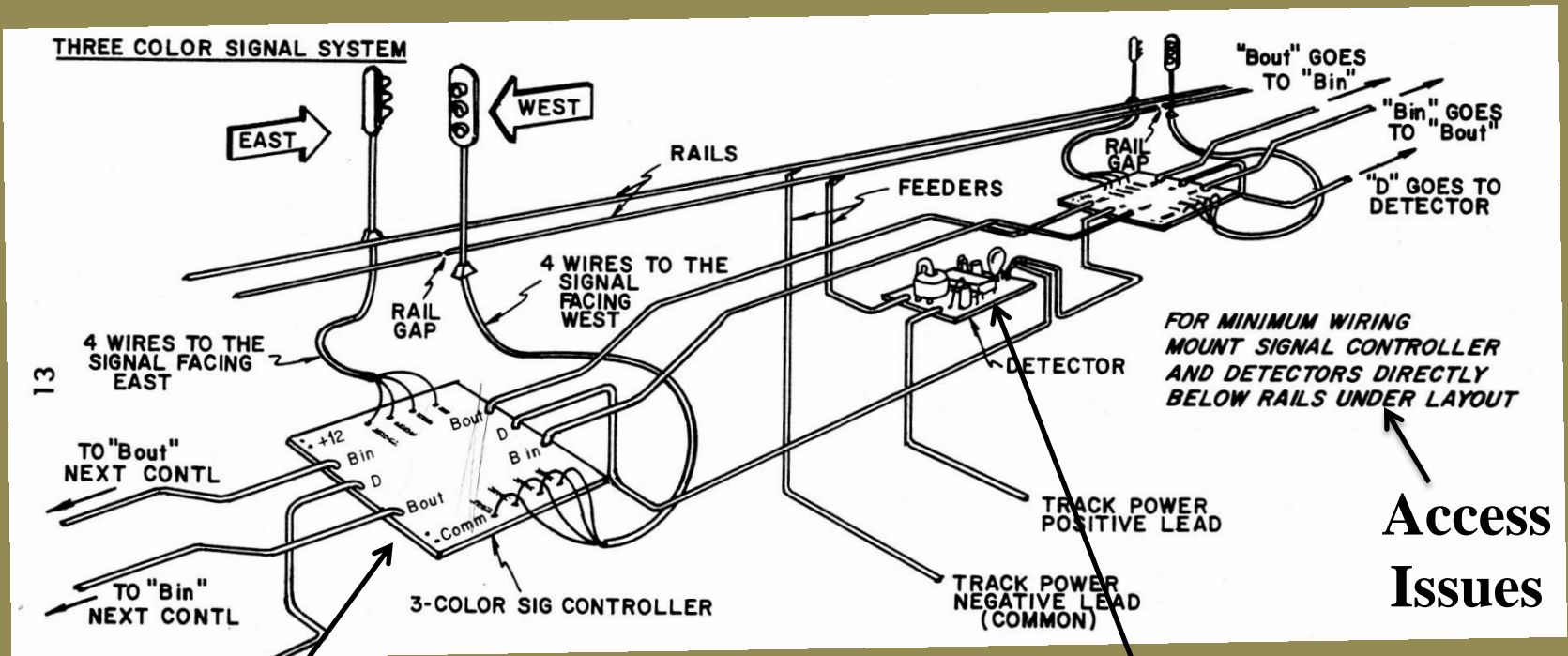
Hardwired or computer program

If computer, still need some connection hardware

Note: Most examples are based on ISS hardware

The basic principles with other suppliers should be similar

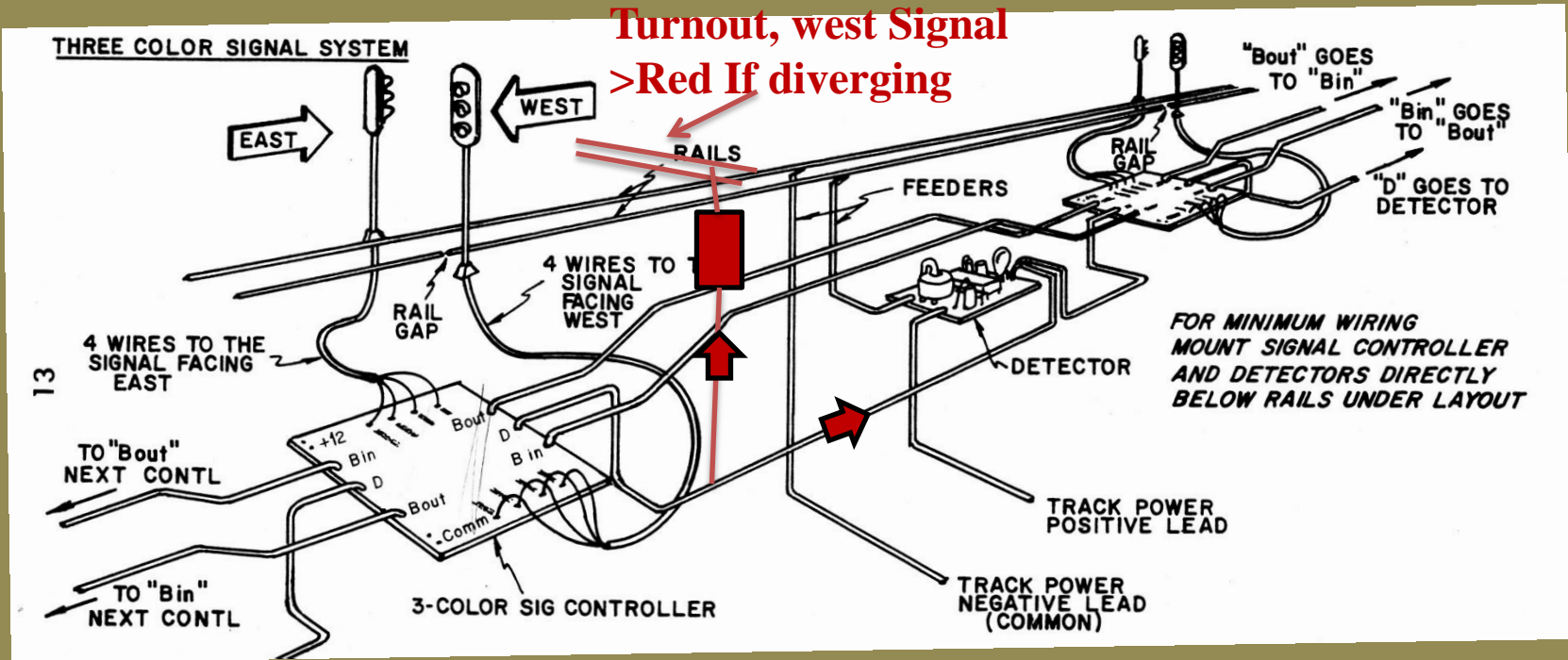
Basic MRR Signal Layout



**Signal Controller Board
1 for every 2 heads**

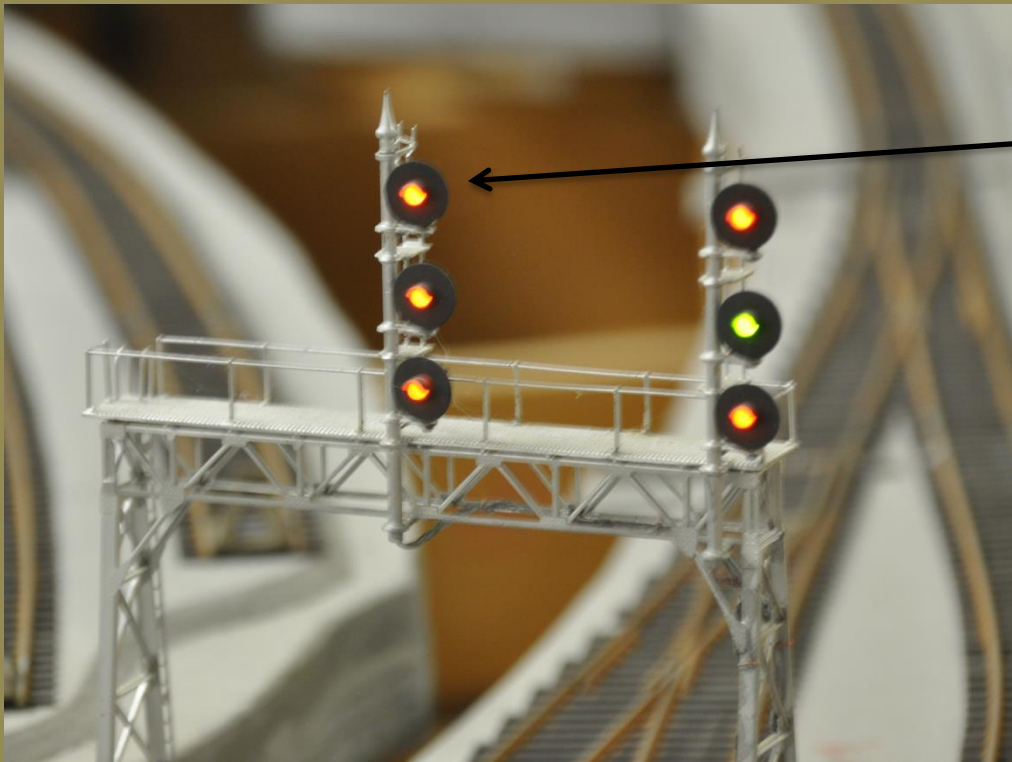
**Block Occupancy Detector
Board (1/Block)**

**Also needs one 12 volt regulated power supply
Add inputs from Turnout position > add'l heads**



If turnout interlocking added, must add diodes or east signal also goes red

3 Tracks > 1 Track > 3 Tracks



3 Heads on Main
Top: Main
Center: Siding
Bottom: Running Tk

Top Head Red if:

OS (1 tk) Oc.
Next Mn Bk Oc.
T m/s > Sid.
T m/yd > Yd
T(os) m/s > Sid.

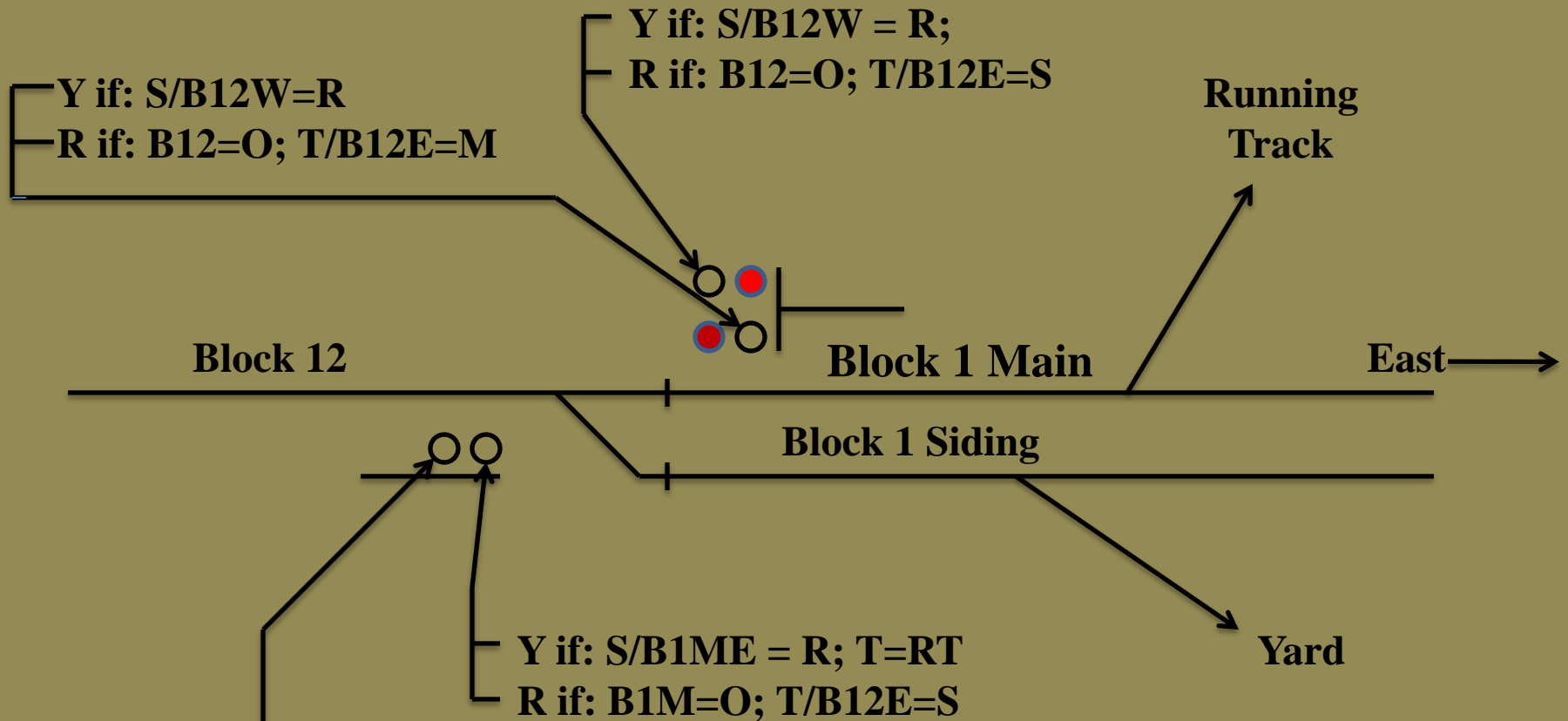
Others similar

Signals on Your Layout

Plan and Document your wiring

You Will have to trouble shoot it later

Typical Signal Logic



Abbreviations

B: Block

E: East

M: Main

S: Signal, Siding

T: Turnout

W: West

Signals on Your Layout

Plan and Document your wiring

You Will have to trouble shoot it later

Installation should be neat and allow adequate room

Test after every connection!

Check every diode after soldering

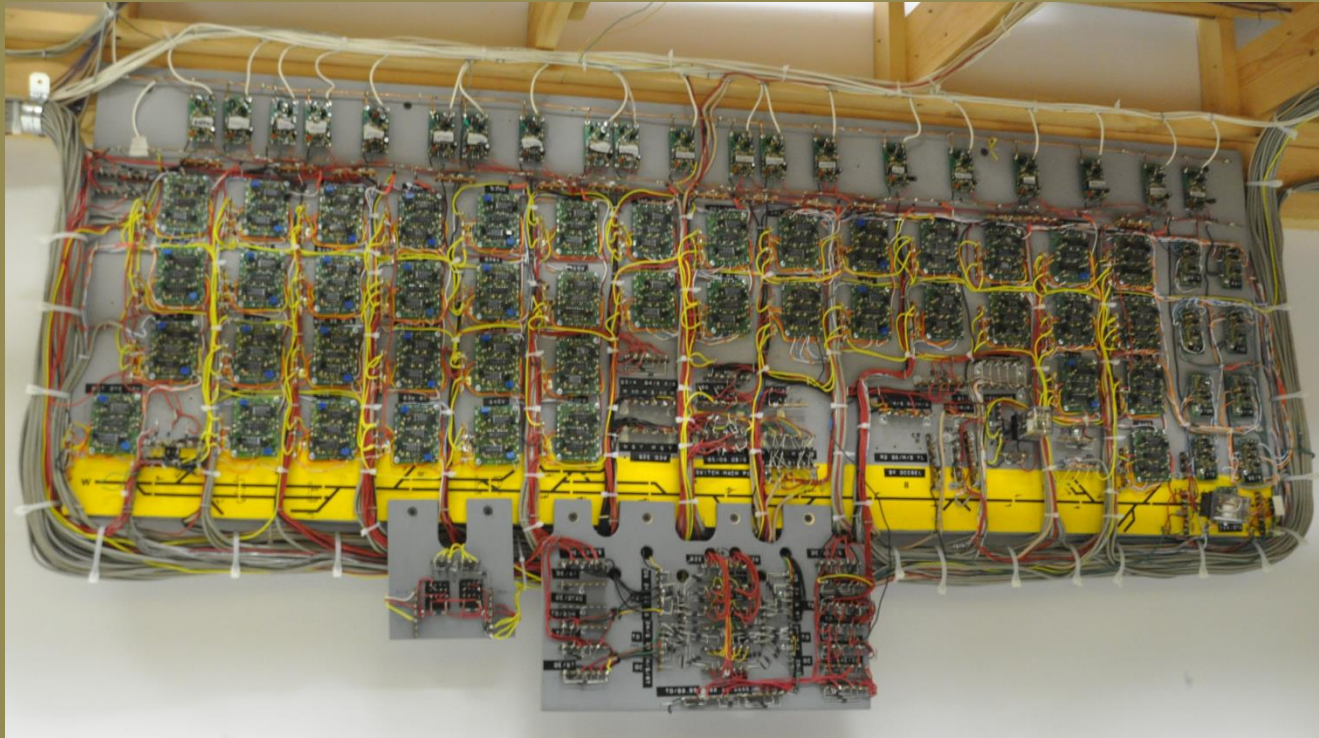
A mistake several steps back or a bad diode
can cause weird effects and be difficult to find

Use Robust Components

1N4004 diodes, 400 volts, 1 amp, 30 amp surge, 4 cents ea.

Possible Lightning Issues

Surge Supressors, ideally, unplug



All Electronics in one place

Neat layout

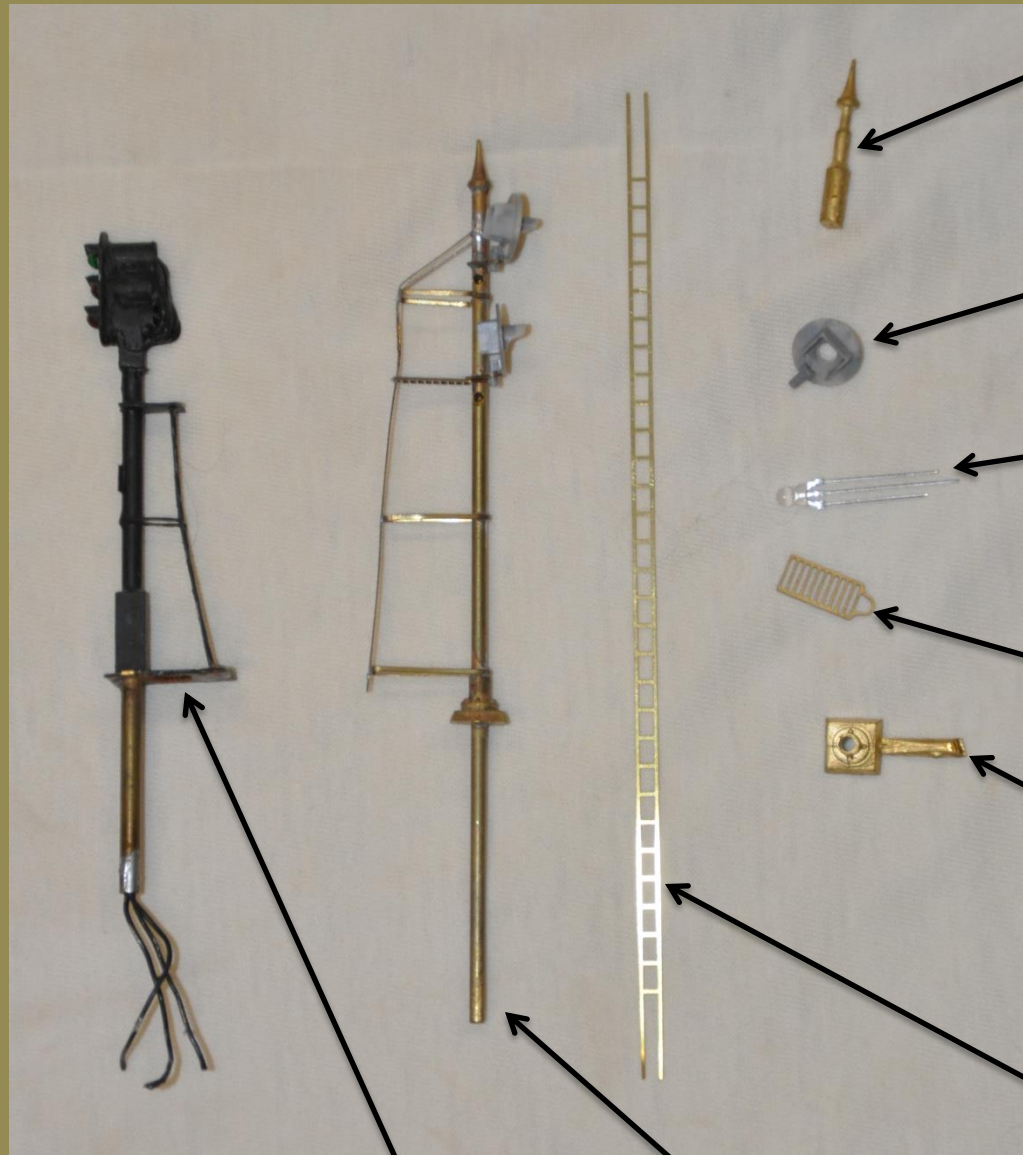
Schematic at bottom helpful

Everything labeled

Wires color coded (mostly!)

BUT should have allowed more room for wiring

Basic HO Signals



Tall Finial \$2

(or turn from styrene)

Searchlight head \$1.40

(Master & cast??)

Bipolar LED \$1.50

(AllElect. \$0.35)

Single Platform - \$1.75

(Cast ?)

Base - \$3

(Cast or styrene?)

Ladder Stock (6") - \$1.50

**Scratch – brass shapes,
GOW bulbs (~1970)**

ISS kit (1 head) ~\$25

check out **WHAT'S NEW**

Click here for the BLMA Models Blog

HO Scale Products

- Rolling Stock
- Collectable Brass
- Scenery Accessories
- Railroad Signals
- Rolling Stock Details
- Other Items

N Scale Products

- Rolling Stock
- Collectable Brass
- Scenery Accessories
- Rolling Stock Details
- Railroad Signals
- Other Items

Z Scale Products

- Scenery Accessories
- Railroad Signals
- Rolling Stock Details
- Other Items

Other Items

- Gift Certificates
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featured **PRODUCT**

HO Scale - Railroad Signals

Pages: 1 | 2 [Next 7 »](#)**Signal Heads - Non Operating (3)**

Catalog: 4000

Scale: HO Scale

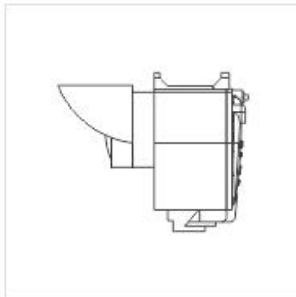
Price: \$9.95

Quantity: [PURCHASE](#)[Check out the Details](#)**Searchlight Signal Heads - Lighted & Assembled (2 per pack)**

Catalog: 4001

Scale: HO Scale

Price: \$24.95

Quantity: [PURCHASE](#)[Check out the Details](#)**PRE-ORDER
NEW ITEM****Dwarf Searchlight Signal Heads - Lighted & Assembled (2 per pack)**

Catalog: 4002

Scale: HO Scale

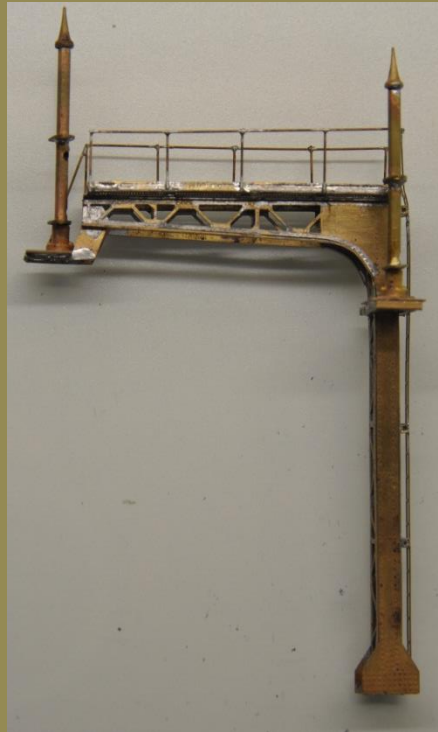
Price: \$24.95

Quantity: [PURCHASE](#)[Check out the Details](#)

ISS UP Cantilevered Signal Bridge



Kit

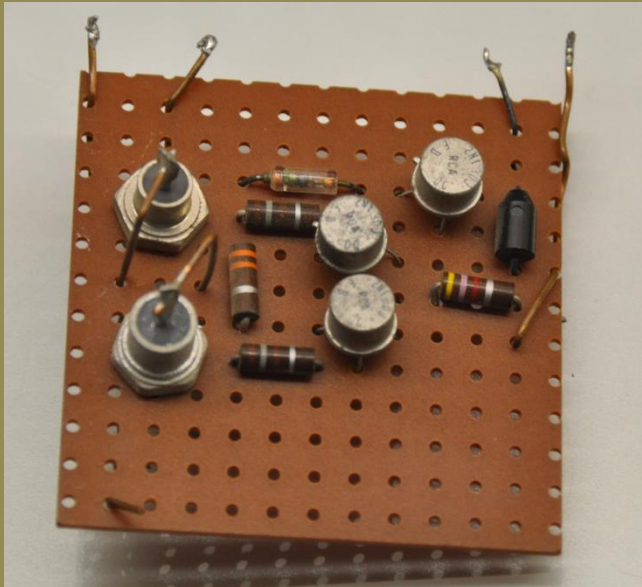


Assembled



On Layout

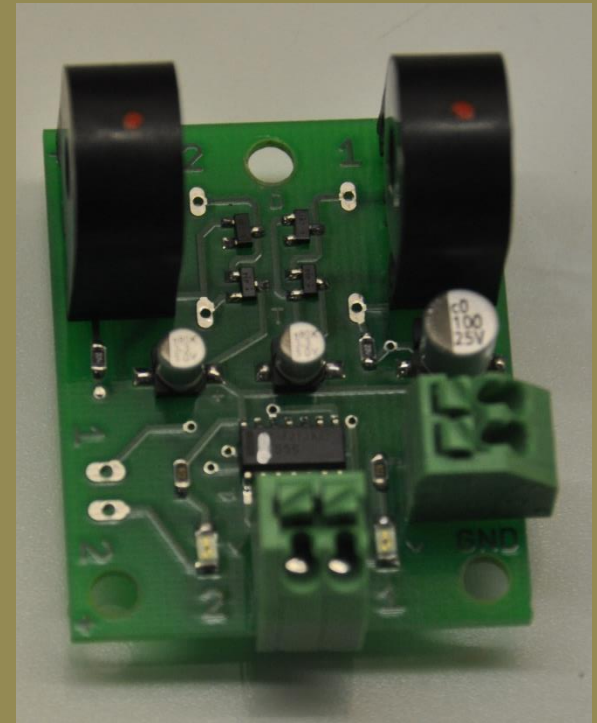
Block Occupancy Detectors



**Wescott Twin T
Circuit (1970's)**

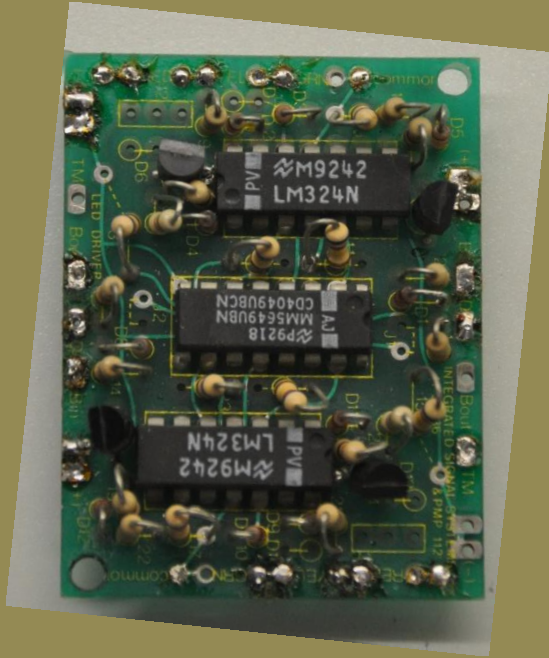


**ISS BOD
Diode drop
\$12 Kit
\$16.50 Built**

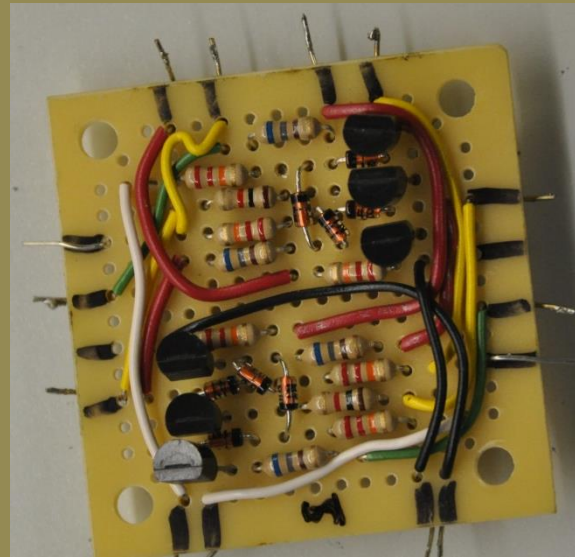


**Team Digital
inductive
\$18/2 Blocks**

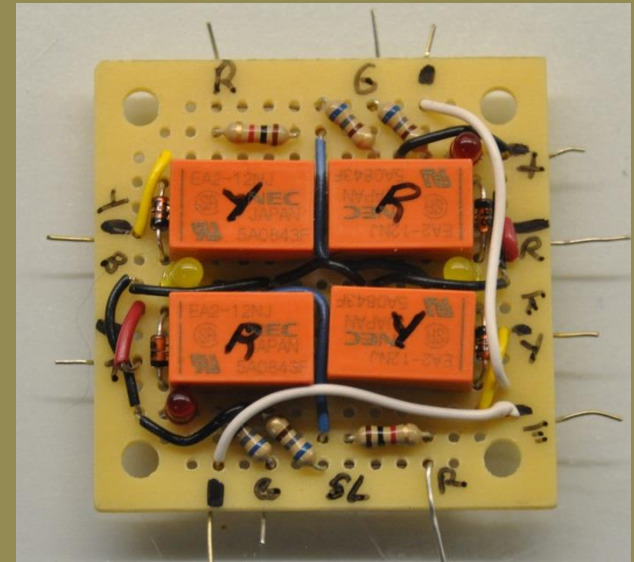
Signal Controller Boards



ISS Board
\$13 Kit
\$19 Built



Paisley Transistor
Circuit



Relay Circuit
(A-E RLY-212)
\$1 or less ea.

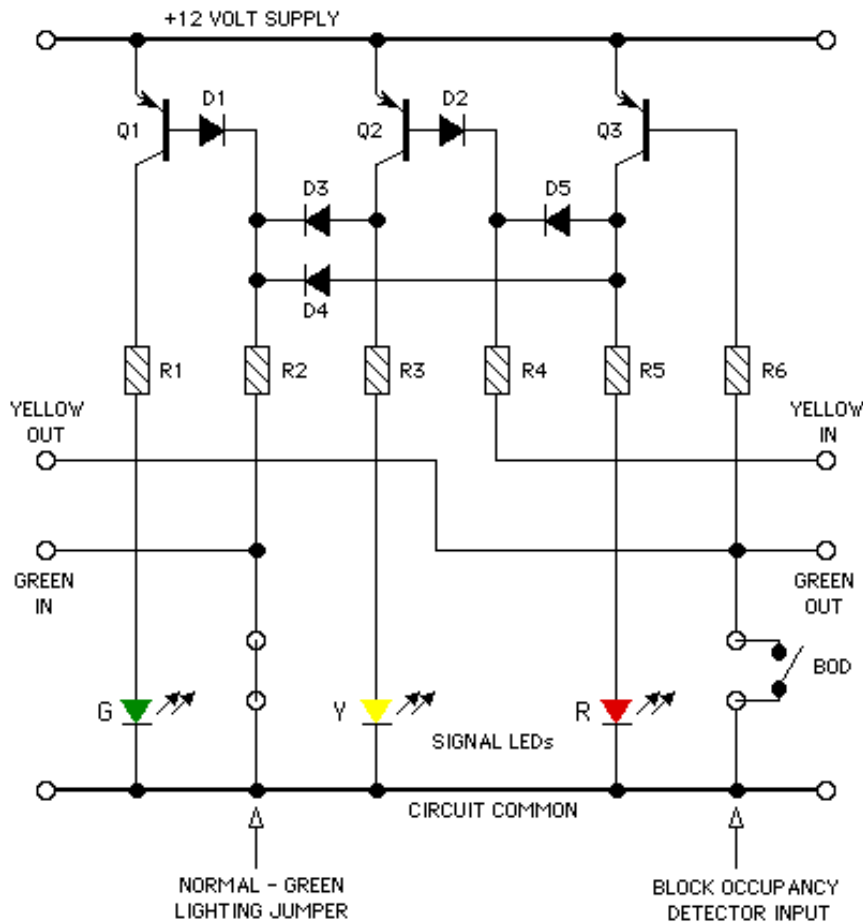
- Notes:**
- * Used conventional 12 volt relays with Twin-T
 - * Paisley and Relay boards arranged to replace ISS
 - May not be most efficient arrangement
 - * Paisley boards and assembled available

PNP - 3 LIGHT SIGNAL SCHEMATIC FOR 1 BLOCK

©ROB PAISLEY 2010

PNP 3 Light SCH 1-Block copy

10 August, 2010



- BLOCK INTERCONNECTION POINTS
- A JUMPER SELECTS NORMAL OR APPROACH LIGHTING FOR THE GREEN SIGNAL
- DETECTOR OUTPUTS CAN BE OPEN COLLECTOR OUTPUTS, OPTO ISOLATORS AND SWITCHES.
- MULTIPLE INPUTS CAN BE USED AT THE SAME TIME.
- THE YELLOW IN AND YELLOW OUT TERMINALS ARE PRECONNECTED ON THE CIRCUITBOARD BUT CAN BE SEPARATED IF NEEDED.
- THE LED CURRENT IS APPROXIMATELY 10 MILLIAMPS.

NORMAL LIGHTING
TRUTH TABLE FOR 1 BLOCK

GREEN IN	YELLOW IN	DETECT	INDICATION
LOW	HIGH	HIGH	GREEN
LOW	LOW	HIGH	YELLOW
LOW	H or L	LOW	RED

APPROACH LIGHTING
TRUTH TABLE FOR 1 BLOCK

GREEN IN	YELLOW IN	DETECT	INDICATION
HIGH	HIGH	HIGH	NONE
LOW	HIGH	HIGH	GREEN
H or L	LOW	HIGH	YELLOW
H or L	H or L	LOW	RED

Q1, 2, 3 = 2N3906 R1, 3, 5 = 1K
D1, 2, 3, 4, 5 = 1N4148 R2, 4, 6 = 22K

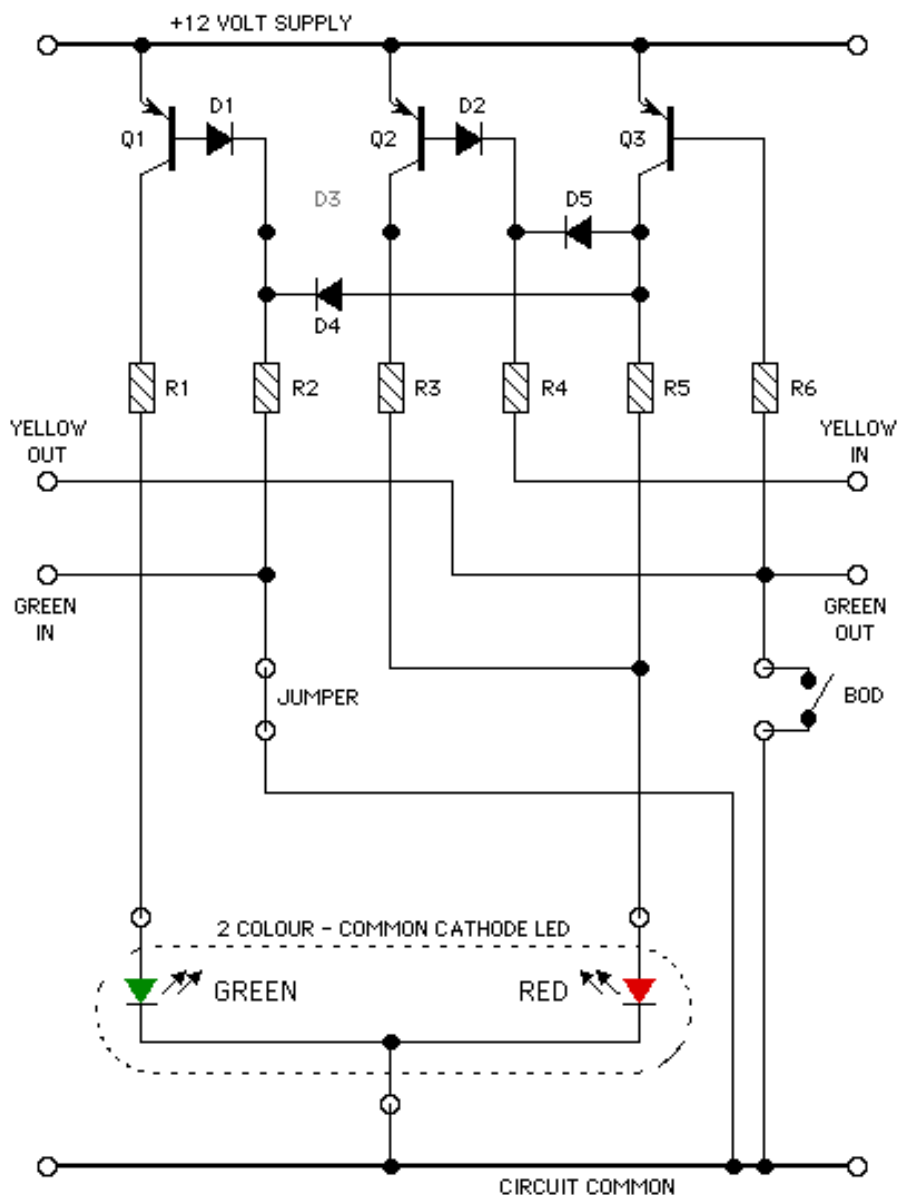
<http://home.cogeco.ca/~rpaisley4/CircuitIndex.html>

PNP - SEARCH LIGHT TYPE - SIGNAL SCHEMATIC FOR 1 BLOCK

©ROB PAISLEY 2010

- NORMAL LIGHTING -

PNP 1 Light SCH 1-Block CK Norm
21 August, 2010



- BLOCK INTERCONNECTION POINTS
- DETECTOR OUTPUTS CAN BE OPEN COLLECTOR OUTPUTS, OPTO ISOLATORS AND SWITCHES.
- MULTIPLE INPUTS CAN BE USED AT THE SAME TIME.
- THE YELLOW IN AND YELLOW OUT TERMINALS ARE PRECONNECTED ON THE CIRCUITBOARD BUT CAN BE SEPARATED IF NEEDED.
- THE MAXIMUM LED CURRENT IS APPROXIMATELY 20 MILLIAMPS.

NORMAL LIGHTING TRUTH TABLE FOR 1 BLOCK

GREEN IN	YELLOW IN	DETECT	INDICATION
LOW	HIGH	HIGH	GREEN
LOW	LOW	HIGH	GREEN + RED
LOW	H or L	LOW	RED

Q1, 2, 3 = 2N3906

R1, 3, 5 = 1K

D1, 2, 4, 5 = 1N4148

R2, 4, 6 = 22K

<http://home.cogeco.ca/~rpaisley4/CircuitIndex.html>

- THE CIRCUIT ALLOWS A 2 COLOUR - COMMON CATHODE LED TO BE CONTROLLED BY THE PNP - 3 LIGHT SIGNAL DRIVER CIRCUIT.
- D3 ON THE CIRCUIT BOARD IS REMOVED.



Approximate Cost

If all purchased, one block w/ basic equipment:

Detector Board - \$12/\$16.50 (kit/assembled)

Signal Controller Board - \$13/\$19

Signal (single head) – 2 @ ~\$25 ea.

~ \$75-85/block

Complex Signals can be much higher

UP Cantilever Signal Bridge Kit - \$30

Six heads on Bridge @ ~\$10-12 each

Additional controller boards for heads

However:

Can trade time for money (see next slide)

With switch machine contacts, interlocking inexpensive

If I were to do it over again (with DCC)

* Signals (basic)

Assemble with ISS parts and stock brass shapes

Solder #32 magnet wire to A-E LED's, assemble heads

~\$10/signal

* Signal Controller Boards

Use PC mount relays shown on Radio Shack boards

~\$5/board for two heads

* BOD's – Team Digital

~\$18/board (2 blocks)

* Turnout, etc. Logic

Hardwire with robust components

All Electronics 1N4004 diodes, 4 cents ea.

About \$35/block with basic signals

Sources (partial list)

Signals

Integrated Signal Systems

N.J. International

Oregon Rail Supply

Tomar

Block Occupancy Detectors

Diode Drop - ISS

Paisley (circuits, boards, etc)

Inductive - NCE

RR-CirKits

Team Digital

Signal Controller Boards

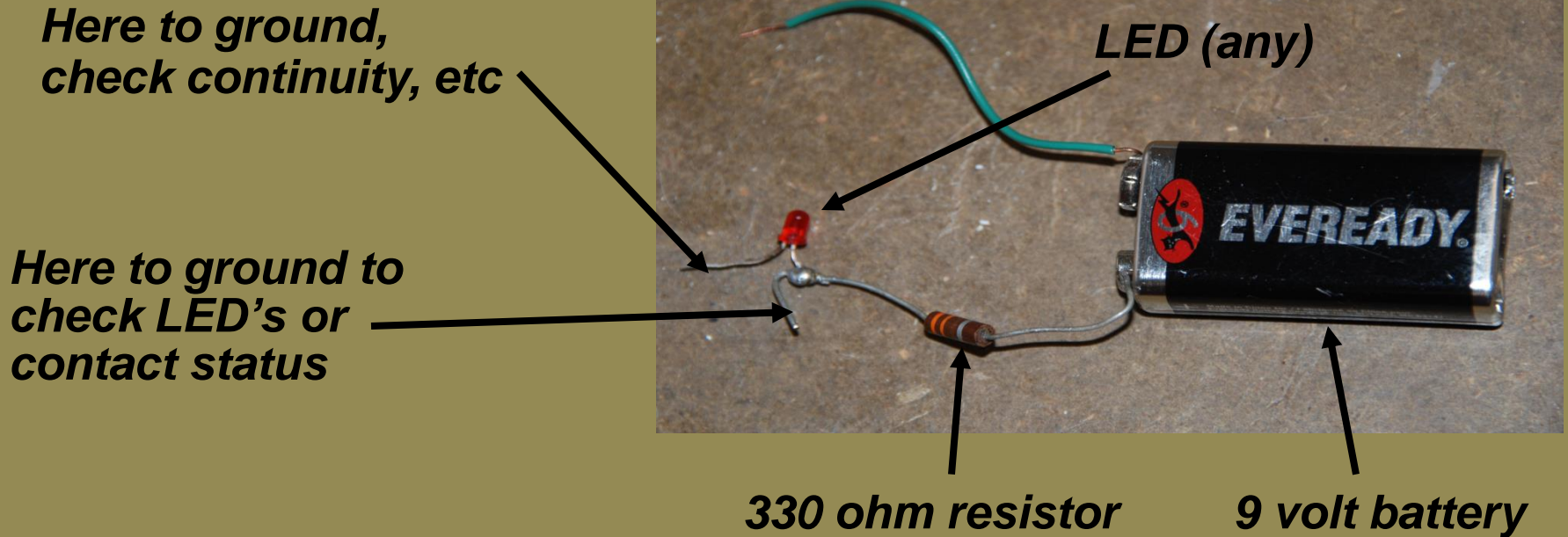
ISS

Paisley

Team Digital

Reference – <http://home.cogeco.ca/~rpaisley4/CircuitIndex.html>

Simple Electrical Tester



Check LED's (Resistor only) or Diode condition (with LED, should conduct in one direction, not the other)

Can also test transistors, on PNP, P to N (emitter and collector to base) should conduct, N to P should not.

Addenda: Use two 1.5 volt batteries in series, 120 ohm resistor. This is safer for checking LEDs. 9 Volts may exceed their allowable reverse voltage. Or check LED in series with one in test circuit.

The End



Hope you found this helpful