HOW DO I GO ABOUT SETTING UP SIGNALS ON MY LAYOUT?

LOOK AT ALL THE DIFFERENT TYPES OF SIGNALS!

CAN THESE SIGNALS WORK LIKE THE REAL ONES?

WOW! THE YELLOW ONES LOOK REAL!

COST?!! DO I HAVE TO TAKE OUT A SECOND MORTGAGE ON MY HOUSE?

WHERE CAN I BUY CANADIAN LOOKING SIGNALS?
Signaling Your Layout
Brian Keay (keay@ucalgary.ca)

Topics Include:

1. Prototype Signals;
2. Prototype Signal Systems;
3. How signaling systems work;
4. Signaling the WLX;
5. Signals in Action;
6. Dispatching from a computer screen;
7. Cost;
8. Questions.
Signaling Your Layout

References


c) Useful signal websites:
http://broadway.pennsyrr.com/Rail/Signal/learning_the_aspects.html
http://www.sh1.org/eisenbahn/sac.htm
http://www.alkrug.vcn.com/rrfacts/signals/signals.htm

d) Railway Signal:  http://regle105.quebectrain.com/

e) History, Signaling and engineering http://mysite.du.edu/~jcalvert/railway/railhom.htm#ssec

f) Canadian Rail Operating Rules (CROR) - Dec 26, 2013
Signaling Videos

a) 1948: https://www.youtube.com/watch?v=d2jbS0cpq8s
   https://www.youtube.com/watch?v=3Sow8O1_ZNA
   Track warrants, highballs, semaphores, interlocking towers, etc.

b) British Rail Signals and Track Warrant Methods: https://www.youtube.com/watch?v=qpYkuBvmmak

c) How to Read Canadian Railroad Signals:
   • Part 1: https://www.youtube.com/watch?v=tJpR93kp44I
   • Part 2: https://www.youtube.com/watch?v=16jXTDfEavA
   • Part 3: https://www.youtube.com/watch?v=b4IUiaWT8wE

d) How to Read CSX Signals:
   • Part 1: https://www.youtube.com/watch?v=8uC-6OFodCs
   • Part 2: https://www.youtube.com/watch?v=jqbjUBWwNHY
   • Part 3: https://www.youtube.com/watch?v=QPmFKtrARTY
   • Part 4: https://www.youtube.com/watch?v=n1sLqNumee8

e) TTC Subway Signals
   https://www.youtube.com/watch?v=i342pCPvSh0
   https://www.youtube.com/watch?v=yJlsSQBhKgE
Is Your Model Railroad Suitable for Signalling?

Maybe you are just starting to plan your dream layout or are already part way building it?

Maybe you have finished your bench work, laying track, installing switch machines, wiring your system, building, painting and weathering structures and creating your detailed scenery masterpiece........................ah, I’m done!

Now you invite some guest over to marvel at your creation and to run some trains..................

While everything ran smoothly when you are alone, things start to go awry when your guests operate a train:

• Shorts keep happening due to your guests running their trains through switches that are not lined properly or the switches are hidden by your scenery and structures;

• Cornfield meets since your guests left a siding without checking to see if the line was clear to the next siding;

• Derailments due to excess speed through turnouts;

• Guests randomly flipping fascia toggles and pushing buttons to get a switch to line for their train;

• Rear end collisions.

While thinking about all these issues and how best to solve them, you realize that the installation of a signal system might be the solution!!
Is Your Model Railroad Suitable for Signalling?

- Are you interested in having an added dimension of ‘lights’ on your layout?
- Do you plan on having operating sessions?
- Do you like the appearance of signals? If so, what type?
- Are you intrigued on how signals work?
- Do you like projects that involve learning something new and have a large learning curve?
- Are you willing to work on projects that require patience and perseverance?
- If yes, are you willing to spend the time and funds to install such a system given the size of your layout?
- Are you modeling a particular prototype or freelance? Maybe a combination?
- Did/does the prototype have sophisticated signalling? If yes, what type?
- Are you willing to do some research into prototype and model signalling?

I’m hoping this signal clinic will answer some of these questions and alleviate your fears.................
Why are there signals on railroads?

VIA Train
https://www.youtube.com/watch?v=l1q9eBaWY3k

Subway train in Japan
https://www.youtube.com/watch?v=GjPAU4dOEQM
Why are there signals on railroads?

Signals Indicate:

1. if the line ahead is clear, occupied, or if there are track problems (e.g. broken rail, landslide, etc.);

2. If the diamond is clear for your train to proceed;

3. if the crew has permission to proceed or stop;

4. if turnouts are lined correctly for your train;

5. which way the turnouts are lined set;

5. the maximum train speed for the signal it is approaching;

6. the maximum speed the train should approach the next signal at; and

7. in some cases, the state of the signal that is 2 or 3 blocks ahead.
Train order signals were semaphore style signals operated manually by the station agent when he needed to have a train pick up orders.

The rear brakeman on this Houston Power and Light coal train is just about to snag the train orders in front of the Santa Fe depot at McGregor, TX. The train is going into the siding to meet the afternoon Amtrak train on March 22, 1980.
Types of Signals - Banjo Signals (1869) - predates semaphores by 10 yrs

Looks like the bottom of an inverted banjo.
Types of Signals - Smashboards


http://www.signalbox.org/overseas/usa/manitobajcn-s.jpg


http://www.railpictures.net/images/d1/0/1/4/6014.1267159855.jpg

http://upload.wikimedia.org/wikipedia/commons/8/8c/Smashboard_1921.jpg
Types of Signals - Tilting Targets
Types of Signals - Ball Signals

[Images of various types of ball signals and trains]
Types of Signals - Semaphore Signals
Types of Signals - Position Light Signal
Types of Signals - G-Type Signal
Types of Signals - Tall Mast Searchlight Signals

LED Searchlights

Intermediate to Bearspaw East

Intermediate signal to Sunalta looking east.

Bengal

Sunalta

Intermediate signal to Sunalta looking east.

8th St. SE & 9th Ave. SE

Mewatta
Types of Signals - Colour Light Signals
Types of Signals - Dwarf Signals
Types of Prototype Signal Systems

- Train order signals - trains slow down or stop at a telegraph station for delivery of orders from a dispatcher

- Interlocking signals - an arrangement of signal apparatus that prevents conflicting movements through an arrangement of tracks
Types of Prototype Signal Systems

• ABS (Automatic Block System) 1863 on PRR - consists of a series of signals that divide a railway line into a series of sections or “blocks”. The system controls the movement of trains between the blocks using automatic signals. Designed to allow trains operating in the same direction to follow each other in a safe manner without risk of rear end collision. Does not protect against opposing movements.

• APB (Absolute Permissive Block) 1860s - extension of ABS in that it protects against opposing movements.

• CTC (Centralized Traffic Control)
  - centralized train dispatcher’s office that controls railroad movements thru interlockings and traffic flows in portions of the rail system designated as CTC territory.

• Route indications - signal aspects
• Speed indications - signal aspects

Aspect = ‘medium to medium’

Sunalta
Signaling Methods: Track Warrant Control (TWC) (no signals needed)

- TWC is a way of operating a rail line without the need of a signaling system.
- Very simplified, a TWC is a permit for a train to occupy a given section of main track.
- A TWC is typically a permit saying "Train XXX, proceed from A to B and whether to stay on the main or take the siding at B."
Signaling Method: Automatic Block Signaling (ABS)

- ABS is a fully automated system
- There is no remote control of the signals and they only show status of the line.
- ABS does NOT provide authority to use a track. Authority must come from track warrants issued by a dispatcher
- ABS does NOT protect against opposing movements.
- Used mainly on lines in which trains travel in only one direction.

On this diagram, ABS signals only protect a train from being overtaken from behind.

There is not sufficient information to prevent approaching trains from colliding.
Signaling Method: Absolute Permissive Block (APB)

- APB is a fully automated system.
- There is no remote control of the signals and they only show status of the line.
- APB does NOT provide authority to use a track. Authority must come from track warrants issued by a dispatcher.
- ABS DOES protect against opposing movements.

When a train passes the headblock signal, the APB sets all opposing signals down to the next (opposing) headblock signal to red.

This gives protection even for the worst situation in which two trains simultaneously pass the headblock signals for the same section of line.
Signaling Method: Centralized Traffic Control (CTC)

- CTC is a fully automated system and is overseen by a dispatcher and combines interlockings with a basic ABS or APB signal system along with Traffic Locking.

- Dispatcher can only command turnout positions and a direction of traffic at interlockings.

- Traffic Locking locks the direction of travel in a track when an interlocking clears a signal to that track and prevents the interlocking at the other end of the track from sending trains onto that track. ([http://www.lundsten.dk/us_signaling/signalbasics/](http://www.lundsten.dk/us_signaling/signalbasics/))
Signaling the WLX

A few facts about Wolverine Lynx RR (WLX)

a) HO scale;

b) 35’ x 37’ walk out basement;

c) Point to point main line run: 6.7 scale miles (407 linear feet) with an optional continuous run track;

d) ~1154 cars and >130 engines;

e) 41 staging tracks;

f) 5 yards that can hold: 173, 34, 89, 29 and 82 x 50’ cars (total = 407) cars;

g) Industry spurs hold ~324 cars;

h) DCC: Digitrax using Duplex and Simplex throttles;

i) JMRI Operations for car routing;
Line Schematic of WLX

Yard Capacity - # of 50’ cars

Helix down to 35 staging tracks.

Currently signaled from Keay West to Eagle Cove West.

West Staging: 6 tracks.

Upper and Lower Spiral Tunnels

Continuous Run Track from Lynx City East to Eagle Cove West.

173 cars
34 cars
89 cars
82 cars
29 cars
Red/Green LEDs (DC), that look like dwarf signals, can be purchased from The Dispatcher and wired in series with Tortoise switch machines.

Current price is $2.20 each.
Simplest - Signals Indicating Position of Switch

Red/Green LEDs (DC), that look like dwarf signals, can be purchased from The Dispatcher and wired in series with Tortoise switch machines.
Simplest - Signals Indicating Position of Switch

Red/Green LEDs (DC), that look like dwarf signals, can be purchased from The Dispatcher and wired in series with Tortoise switch machines.
I made the following decisions:

a) Decided to follow the Canadian Railroad Operating Rules (CROR) for displaying aspects i.e. signals control route and speed;

b) Build signals seen in the Calgary area on Canadian Pacific;

c) Use tri-colour LEDs within the heads of the signals (i.e. true yellow);

d) Use current detection block detectors along with resistor mounted wheel sets;

e) Be able to dispatch my railroad using Absolute Permissive Block (APB) or CTC mode.
Types of Signals used:

- Single, double & triple headed signals
- Vertical vs. offset mounting of heads
- Single and double headed dwarf signals

Where signals are used:

- At interlocks
- Intermediate signals - between switches.
- a) Entrance into and within yards.
This summary sheet of CROR signal rules

Step 2: Determine What Aspects can be Displayed

Intermediate signals

Step 2 eventually evolves into a diagram like the following:
Steps 1 & 2: Determine what type of signals are needed

Phase 1: Keay West to Wolverine Falls West

<table>
<thead>
<tr>
<th>Details</th>
<th>Phase 1</th>
<th>Phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signals</td>
<td>30</td>
<td>16</td>
</tr>
<tr>
<td>Block Detectors</td>
<td>23</td>
<td>12</td>
</tr>
<tr>
<td>Switch machine controllers</td>
<td>12</td>
<td>4</td>
</tr>
</tbody>
</table>

Phase 2: Summit East to Pusher West

<table>
<thead>
<tr>
<th>Details</th>
<th>Phase 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signals</td>
<td>17</td>
</tr>
<tr>
<td>Block Detectors</td>
<td>12</td>
</tr>
<tr>
<td>Switch machine controllers</td>
<td>12</td>
</tr>
</tbody>
</table>
### Step 3) Purchase Signals: Types - Model Manufacturers

<table>
<thead>
<tr>
<th>Type</th>
<th>Variations</th>
<th>Unique Roads</th>
<th>Prototype Mfgs</th>
<th>HO Model Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball Signals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semaphore</td>
<td>Upper, lower Quadrant</td>
<td>US&amp;S, GRS</td>
<td>Tomar, N J International, (Oregon Rail Supply #152 #155 ??)</td>
<td></td>
</tr>
<tr>
<td>Search light</td>
<td>Standard in the West</td>
<td>US&amp;S, GRS</td>
<td>Sunrise Enterprises ??, BLMA, ISS, Tomar, Oregon Rail Supply</td>
<td></td>
</tr>
<tr>
<td>Color light</td>
<td>Stacked, V (Cat face)</td>
<td>US&amp;S, GRS, Safetran</td>
<td>BLMA, ISS, Tomar, Oregon Rail Supply</td>
<td></td>
</tr>
<tr>
<td>Position Light</td>
<td>Route and Speed</td>
<td>Pennsy, N&amp;W</td>
<td>Tomar, ISS, NJI, Oregon Rail Supply</td>
<td></td>
</tr>
<tr>
<td>Dwarf</td>
<td>N&amp;W unique fan shaped CPL</td>
<td>US&amp;S, GRS</td>
<td>Tomar, Oregon Rail Supply</td>
<td></td>
</tr>
<tr>
<td>Signal Bridges and Cantilevers</td>
<td></td>
<td></td>
<td>Overland, BLMA, Oregon Rail Supply</td>
<td></td>
</tr>
<tr>
<td>Train Order Boards</td>
<td></td>
<td>US&amp;S, GRS</td>
<td>Tomar</td>
<td></td>
</tr>
</tbody>
</table>


Step 3) Purchase Signals: Types - Model Manufacturers

Custom Signal Systems - http://www.customsignalsystems.com/

Searchlight Head Mast Signals

- Single Target Searchlight
  2-Color: $20.00
  3-Color G/Y/R: $25.00
- Double Target Searchlight
  2-Color: $30.00
  3-Color G/Y/R: $35.00
- Triple Target Searchlight
  2-Color: $40.00
  3-Color G/Y/R: $45.00

G-Type Head Mast Signals

- G-Type Single Target
  $20.00
- G-Type Double Target
  $10.00
- G-Type Triple Target
  $40.00

D-Type Head Mast Signals

- Double Head 2 Over 2 Light
  $25.00
- Double Head 3 Over 2 Light
  $10.00
- Double Head 3 over 3 Light
  $35.00

HO Scale Dwarf Signals

- Dwarf Signal Single Light Searchlight
  2-Color: $10.00
  3-Color G/Y/R: $15.00
- Dwarf Signal Single Light Rectangular
  2-Color: $10.00
  3-Color G/Y/R: $15.00
- Dwarf Signal Double Light Green over Red
  $15.00

<table>
<thead>
<tr>
<th>Bridge Brand</th>
<th>BLMA 2 Track Cantilever Bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Silver</td>
</tr>
<tr>
<td>Head Style</td>
<td>Searchlight</td>
</tr>
<tr>
<td>Head Quantity</td>
<td>2</td>
</tr>
<tr>
<td>LED Type</td>
<td>2 Color G/R</td>
</tr>
<tr>
<td>LED Quantity</td>
<td>2</td>
</tr>
<tr>
<td>Price As Shown</td>
<td>$140.00</td>
</tr>
<tr>
<td>Lighting Options</td>
<td>3 Color G/Y/R LED's add $10.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bridge Brand</th>
<th>BLMA 2 Track Cantilever Bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Black</td>
</tr>
<tr>
<td>Head Style</td>
<td>Searchlight</td>
</tr>
<tr>
<td>Head Quantity</td>
<td>6</td>
</tr>
<tr>
<td>LED Type</td>
<td>2 Color G/R</td>
</tr>
<tr>
<td>LED Quantity</td>
<td>6</td>
</tr>
<tr>
<td>Price As Shown</td>
<td>$200.00</td>
</tr>
<tr>
<td>Lighting Options</td>
<td>3 Color G/Y/R LED's add $10.00</td>
</tr>
</tbody>
</table>
3) Custom Signal Systems
(http://www.customsignalsystems.com/)
4) Choose Signal Control System:
Signalogic Systems Components (http://signalogicsystems.com/)

**System Modules**

Digital Bungalow Module (DBM)  
$64.99

DBM Expansion Module  
$24.99

**I/O Modules**

Block occupancy input module  
$9.99

Switch control interface module  
$9.99

LED Signal Driver  
$9.99
4) Signalogic Systems Components

Master Board

- DBM Expansion Modules
- LED Signal Driver
- Block occupancy input module
- Digital Bungalow Module (DBM)
- Switch control interface module

- Master Board
- Input module
- Output module
- Switch control interface module
- LED Signal Driver
- DBM Expansion Modules
- Block occupancy input module
- Digital Bungalow Module (DBM)
4) Signalogic Systems Components

Master Board

LED Signal Driver

Switch control interface module

Digital Bungalow Module (DBM)

Block occupancy input module
4) Signalogic Systems Components

Master Board

Switch Control

Tortoise Slow Motion Switch Controller (TSMSC) $19.99

Twin Coil Switch Controller (TCSC) $24.99

Block Detectors

DCC Block Detector $14.99

Dual Infrared Light Detector $19.99
4) Signalogic Systems Components
Master Board

Switch Control

Block Detectors
5) Installing Signals

Intermediate signals

Adding ferules.

Offset 2-headed signal:

Narrow channel!

Wires, wires and more wires!
5) Installing Signals - unique features

Signals mimicked on the fascia.

Signals on other side of tunnel.
5) Installing Signals - unique features
6) Purchase Resistor Mounted Wheelsets

- Purchased from Logic Rail Technologies (https://www.logicrailtech.com/)
- 33” and 36” Intermountain wheelsets with 10K resistors
- $8.95 USD per package of 4 axles = $2.24 USD each ($2.69 CDN)
- $1.00 less if you don’t want the axles painted black

- 1 out of every 3 cars on my layout has one wheelset installed

See this article by Norm Skretting on how to 'paint on' resistive materials to achieve conduction across wheelsets:
Skretting, N., Resistorized Wheel Sets, Highball, 6th Division PNR, Feb. 2015
7) Signals in Action

**Signal 386 Aspect**

- **Clear** (G/R/G/R)
- **Advanced clear to stop** (FY/Y/FY)
- **Clear to stop** (Y/Y/R)
- **Medium to stop** (R/R/Y)
- **Medium to clear** (R/G/R)
- **Medium to medium** (R/G/G)
- **Slow to stop** (R/Y/R)
- **Slow to slow** (R/FY/FY)
- **Stop** (R/R/R)

**Wolverine Falls West - Signal 386**

**Aspect at Next Signal**

- (G/R or FY/R)
- (Y/R)
- (R/R)
- (R/R/R)
- (Y/G/R)
- (R/G/R)
- (R)
- (FY)
7) Signals in Action

Eagle Cove East – Signals 752N and 752S

Moose River – Signal 748

<table>
<thead>
<tr>
<th>Signal 748</th>
<th>Aspects as a train moves away from 752S</th>
</tr>
</thead>
<tbody>
<tr>
<td>(G/R)</td>
<td>Medium to clear (R/G/R)</td>
</tr>
<tr>
<td>(G/R)</td>
<td>Throw switch for main line</td>
</tr>
<tr>
<td>(G/R)</td>
<td>Clear (G/R)</td>
</tr>
<tr>
<td>(G/R)</td>
<td>Train moves forward &amp; signal drops to (R/R)</td>
</tr>
<tr>
<td>(R/R)</td>
<td>Clear to stop (Y/R)</td>
</tr>
<tr>
<td>(Y/R)</td>
<td>Advanced clear to stop (FY/R)</td>
</tr>
<tr>
<td>(FY/R)</td>
<td>Clear (G/R)</td>
</tr>
</tbody>
</table>
7) Signals in Action

<------3 Signals in Sequence:
Train moving away from viewer.
Signals in Sequence

Train approaching Viewer.

APB: Protection against oncoming trains!
8) Computer Control - CTC Board

- Rail line shown in white and grey with Station Names;
- Left to right: east to west;
- Signal placement indicated with a dwarf signal;
- White line at interlocking indicates switch position;
- Switch and signal numbers indicated.
8) Computer Control - CTC Board

- Routes through an interlocking are set by two clicks of the mouse:

1) starting point and end point;

2) once chosen, the program adjusts all switches along the route, locks the switches (indicates by small red dots), and then sets the signal to indicate a proceed aspect;

3) Routes can be cancelled by the dispatcher and the cancel time set.

Setting Routes at Interlockings
8) Computer Control - CTC Board

- Track indicated by **white** lines;
- Position of a switch indicated by a **white** line;
- Alternative switch position indicated by a **grey** line;
- If a signal on the layout is displaying all **red**, signal on screen is **red**;

**Video will show the following:**

- When a route is set, track colour changes to **green**, switches lock, and signal on the screen turns **green**;
- When a block is occupied by a train, track colour changes to **red**;
- Train direction indicated by arrows within blocks set or when occupied;
9) Radios

With a dispatcher, radios will probably be required;

- Retevis H-777 Walkie Talkie;
- UHF400-470MHz;
- 16 channels;
- 3.7V, 5W, 2-Way Radio;
- Rechargeable battery;
- Recharger included;
- Ear piece included. 10 for $137.23 USD (ebay)
## 10) Cost

<table>
<thead>
<tr>
<th>Item</th>
<th>Number</th>
<th>Price/item</th>
<th>Total Cost</th>
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</thead>
<tbody>
<tr>
<td>Signals</td>
<td>63</td>
<td>varies</td>
<td></td>
</tr>
<tr>
<td>Block Detectors</td>
<td>47</td>
<td>$15</td>
<td></td>
</tr>
<tr>
<td>Switch Controllers</td>
<td>12</td>
<td>$20</td>
<td></td>
</tr>
<tr>
<td>DBMs</td>
<td>3</td>
<td>$65</td>
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<tr>
<td>Expansion Boards</td>
<td>7</td>
<td>$25</td>
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<tr>
<td>Block Boards</td>
<td>5</td>
<td>$10</td>
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</tr>
<tr>
<td>Switch Boards</td>
<td>7</td>
<td>$10</td>
<td></td>
</tr>
<tr>
<td>LED Boards</td>
<td>56</td>
<td>$10</td>
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</tr>
<tr>
<td>Radios</td>
<td>20</td>
<td>$15</td>
<td></td>
</tr>
<tr>
<td>Resistor Wheel sets</td>
<td>600</td>
<td>$1.25</td>
<td></td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td></td>
<td></td>
<td><strong>You can do the math!</strong></td>
</tr>
</tbody>
</table>
Questions?

If you would like to visit my layout, email me: keay@ucalgary.ca